



# THE CRYSTAL MASTER

Crystal Devices Catalogue 09



# “QMEMS” EPSON TOYOCOM

In order to meet customer needs in a rapidly advancing digital, broadband and ubiquitous society, we are committed to offering products that are one step ahead of the market and a rank above the rest in quality. To achieve our goals, we follow a “3D (three device) strategy” designed to drive both horizontal and vertical growth. We will to grow our three device categories of “Timing Devices”, “Sensing Devices” and “Optical Devices”, and expand vertical growth through a combination of products from these categories.

A Quartz MEMS is any high added value quartz device that exploits the characteristics of quartz crystal material but that is produced using MEMS (micro-electro-mechanical system) processing technology.

Market needs are advancing faster than previously imagined toward smaller, more stable crystal products, but we will stay ahead of the curve by rolling out products that exceed market speed and quality requirements. We want to further accelerate the 3D strategy by QMEMS.

Quartz devices have become crucial in the network environment where products are increasingly intended for broadband, ubiquitous applications and where various types of terminals can transfer information almost immediately via LAN and WAN on a global scale. Epson Toyocom Corporation addresses every single aspect within a network environment. The new corporation offers “Digital Convergence” solutions to problems arising with products for consumer use, such as, core network systems and automotive systems.



## PROMOTION OF ENVIRONMENTAL MANAGEMENT SYSTEM CONFORMING TO INTERNATIONAL STANDARDS

At Epson Toyocom, all environmental initiatives operate under the Plan-Do-Check-Action(PDCA) cycle designed to achieve continuous improvements. The environmental management system (EMS) operates under the ISO 14001 environmental management standard.

All of our major manufacturing and non-manufacturing sites, in Japan and overseas, completed the acquisition of ISO 14001 certification. In the future, new group companies will be expected to acquire the certification around the third year of operations.

ISO 14000 is an international standard for environmental management that was established by the International Standards Organization in 1996 against the background of growing concern regarding global warming, destruction of the ozone layer and global deforestation.

## WORKING FOR HIGH QUALITY

In order to provide high quality and reliable products and services than meet customer needs, Epson Toyocom made early efforts towards obtaining ISO9000 series certification and has acquired ISO9001 for all business establishments in Japan and abroad. We have also acquired ISO/TS 16949 certification that is requested strongly by major automotive manufacturers as standard.

QS-9000 is an enhanced standard for quality assurance systems formulated by leading U.S. automobile manufacturers based on the international ISO 9000 series.

ISO/TS 16949 is a global standard based on QS-9000, a severe standard corresponding to the requirements from the automobile industry.

### ► Explanation of the mark that are using it for the catalog

|                                                                                     |                                                                                                                                                                                                                                                            |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <ul style="list-style-type: none"><li>► Pb free.</li><li>► Complies with EU RoHS directive.</li></ul>                                                                                                                                                      |
|  | <ul style="list-style-type: none"><li>► Pb free terminal designed. Contains Pb in products exempted by RoHS directive. (Contains Pb in sealing glass, high melting temperature type solder or other.)</li><li>► Complies with EU RoHS directive.</li></ul> |
|  | <ul style="list-style-type: none"><li>► The products have been designed for high reliability applications such as Automotive.</li></ul>                                                                                                                    |

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  - / Medical instruments to sustain life / Submarine transmitters / Power stations and related / Fire work equipment and security equipment
  - / traffic control equipment / and others requiring equivalent reliability.
- In this new crystal master for Epson Toyocom, product codes and markings will remain as previously identified prior to the merger. Due to the on-going strategy of gradual unification of part numbers, please review product codes and markings, as they will change during the course of the coming months.

We apologize for the inconvenience, but we will eventually have a unified part numbering system for Epson Toyocom that will be user friendly.



## CONTENTS

## CRYSTAL UNIT / RESONATOR

|                                             |        |
|---------------------------------------------|--------|
| •kHz RANGE CRYSTAL UNIT (TUNING FORK )..... | 3 ~ 12 |
| •MHz RANGE CRYSTAL UNIT (AT).....           | 13~ 22 |
| •RESONATOR (SAW).....                       | 23~ 25 |

kHz Range  
Crystal unitMHz Range  
Crystal unitSAW  
Resonator

## OSCILLATOR

|                       |         |
|-----------------------|---------|
| •CRYSTAL OSCILLATOR   |         |
| SPXO .....            | 26 ~ 42 |
| PROGRAMMABLE.....     | 43 ~ 52 |
| SPREAD SPECTRUM.....  | 53      |
| LOW JITTER (SAW)..... | 54 ~ 58 |
| HIGH-STABILITY.....   | 59 ~ 62 |
| MULTI-OUTPUT .....    | 63      |
| •VCXO .....           | 64 ~ 74 |
| •TCXO .....           | 75 ~ 82 |
| •OCXO.....            | 83 ~ 88 |
| •RUBIDIUM .....       | 89 ~ 90 |

SPXO

Programmable

Spread Spectrum

Low-jitter  
SAW

High-Stability

Multi-Output

VCXO

TCXO

OCXO

Rubidium atomic

## REAL TIME CLOCK MODULE

|                                    |           |
|------------------------------------|-----------|
| •SERIAL INTERFACE.....             | 91 ~ 114  |
| 4-wire / 3-wire / I <sup>2</sup> C |           |
| •PARALLEL INTERFACE.....           | 115 ~ 116 |

Real Time Clock  
Module  
Serial InterfaceReal Time Clock  
Module  
Parallel Interface

## FILTER

|                                       |           |
|---------------------------------------|-----------|
| •MONOLITHIC CRYSTAL FILTER (MCF)..... | 118 ~ 127 |
| •SAW FILTER.....                      | 128 ~ 135 |

Filter  
(MCF)Filter  
(SAW)

## SENSOR

|                                   |           |
|-----------------------------------|-----------|
| •GYRO SENSOR .....                | 136 ~ 140 |
| •TEMPERATURE SENSING CRYSTAL..... | 141       |
| •PRESSURE SENSING CRYSTAL.....    | 142       |

Sensor

## OPTICAL DEVICE

|                                      |           |
|--------------------------------------|-----------|
| •1/4,1/2 WAVE PLATE .....            | 143 ~ 145 |
| •DICHROIC PRISM .....                | 146       |
| •PBS PRISM .....                     | 147       |
| •TRICHROIC PRISM.....                | 147       |
| •PS CONVERTER.....                   | 148       |
| •HEAT SINKPLATE .....                | 148       |
| •GRATING/DICHROIC FILTER.....        | 149       |
| •OPTICAL LOW PASS FILTER (OLPF)..... | 150 ~ 151 |
| •ETALON FILTER .....                 | 152       |

Optical device

## APPLICATION GUIDE

|                                                      |           |
|------------------------------------------------------|-----------|
| •WORKING FOR EU RoHS / Pb FREE.....                  | 153 ~ 155 |
| •HANDLING PRECAUTIONS.....                           | 156 ~ 160 |
| •PRECAUTIONS IN DESIGNING OSCILLATION CIRCUITS ..... | 161       |
| •OUTPUT WAVE FORM AND TEST CIRCUIT.....              | 162 ~ 163 |
| •COMPARISON TABLE FOR MODEL AND PRODUCT NUMBER ..... | 164 ~ 166 |
| •STANDARD PACKING SPECIFICATIONS.....                | 167 ~ 169 |
| •PACKAGE DIMENSIONS LIST.....                        | 170 ~ 172 |
| •GLOSSARY .....                                      | 173 ~ 175 |
| •MANUFACTURING PLANT .....                           | 176       |

Application  
Guide





## INDEX

kHz Range  
Crystal unitMHz Range  
Crystal unitSAW  
Resonator

SPXO

Programmable

Spread Spectrum

Low-jitter  
SAW

High-Stability

Multi-Output

VCXO

TCXO

OCXO

Rubidium atomic

Real Time Clock  
Module  
Serial InterfaceReal Time Clock  
Module  
Parallel InterfaceFilter  
(MCF)Filter  
(SAW)

Sensor

Optical device

Application  
Guide

## Crystal Unit

## kHz Range

|                 |    |
|-----------------|----|
| FC-12M.....     | 4  |
| FC-125.....     | 5  |
| FC-13E.....     | 6  |
| FC-13F.....     | 7  |
| FC-135.....     | 8  |
| FC-145.....     | 8  |
| FC-255.....     | 8  |
| MC-146.....     | 9  |
| MC-156.....     | 9  |
| MC-306.....     | 10 |
| MC-405/406..... | 10 |
| MC-30A.....     | 11 |
| C-TYPE.....     | 12 |
| C-2-TYPE.....   | 12 |
| C-4-TYPE.....   | 12 |

## MHz Range

|                 |    |
|-----------------|----|
| FA-128.....     | 13 |
| FA-20H.....     | 14 |
| FA-23A.....     | 15 |
| TSX-3225.....   | 16 |
| FA-238V.....    | 16 |
| FA-238.....     | 16 |
| TSX-4025.....   | 17 |
| TSX-5032.....   | 17 |
| FA-365.....     | 18 |
| MA-306.....     | 19 |
| MA-406.....     | 20 |
| MA-505/506..... | 20 |
| CA-301.....     | 21 |
| FH-33H.....     | 22 |

## SAW Resonator

|             |    |
|-------------|----|
| NS-21R..... | 23 |
| NS-32R..... | 24 |
| FS-335..... | 24 |
| FS-555..... | 24 |
| FS-585..... | 25 |

## Real Time Clock Module

## Serial Interface 4-Wire

|                   |    |
|-------------------|----|
| RX-4045SA/NB..... | 94 |
| RX-4581NB.....    | 95 |
| RA-4565SA.....    | 96 |
| RX-4801SA.....    | 97 |
| RTC-9701JE.....   | 98 |

## Serial Interface 3-Wire

|                       |     |
|-----------------------|-----|
| RTC-4701JE/NB.....    | 99  |
| RTC-4574SA/JE/NB..... | 100 |
| RX-4574LC.....        | 101 |
| RA-4574SA.....        | 102 |
| RTC-4543SA/SB.....    | 103 |
| RX-4575LC.....        | 104 |
| RX-4571LC/NB/SA.....  | 105 |

Serial Interface I<sup>2</sup>C-Bus

|                      |     |
|----------------------|-----|
| RX-8025SA/NB.....    | 106 |
| RTC-8564JE/NB.....   | 107 |
| RX-8564LC.....       | 108 |
| RA-8565SA.....       | 109 |
| RX-8571SA/NB/LC..... | 110 |
| RX-8581SA/JE/NB..... | 111 |
| RA-8581SA.....       | 112 |
| RX-8731LC.....       | 113 |
| RX-8801SA.....       | 114 |

## Parallel interface

|                    |     |
|--------------------|-----|
| RTC-7301SF/DG..... | 115 |
| RTC-62421.....     | 116 |
| RTC-62423.....     | 116 |
| RTC-72421.....     | 117 |
| RTC-72423.....     | 117 |

## Oscillator

## SPXO

|                      |          |
|----------------------|----------|
| SG-3030LC/JF/JC..... | 29       |
| SG-3040LC/JC.....    | 29       |
| SG-150S*E.....       | 30       |
| SG-211S*E.....       | 31       |
| SG-210 series.....   | 32       |
| SG-310 series.....   | 33       |
| SG-550 series.....   | 34       |
| TCO-710x series..... | 35       |
| SG-770 series.....   | 36       |
| SG-771PCD.....       | 37       |
| TCO-708x series..... | 38       |
| SG-636 series.....   | 39 to 40 |
| SG-645 series.....   | 39 to 40 |
| SG-615 series.....   | 41 to 42 |
| SG-531 series.....   | 41 to 42 |
| SG-51 series.....    | 41 to 42 |

## Programmable

|                          |          |
|--------------------------|----------|
| SG-8003 series.....      | 43 to 44 |
| SG-8002CE series.....    | 45       |
| SG-8002LB series.....    | 46       |
| SG-8002JF/CA series..... | 47       |
| SG-8002JC/JA series..... | 48       |
| SG-8002DB/DC series..... | 49       |
| SG-Writer.....           | 50       |

## Spread Spectrum

|                      |    |
|----------------------|----|
| SG-9001LB/CA/JC..... | 53 |
|----------------------|----|

## Low-jitter SAW

|                   |    |
|-------------------|----|
| XG-1000CA/CB..... | 54 |
| EG-2021CA.....    | 55 |
| EG-2001CA.....    | 55 |
| EG-2002CA.....    | 56 |
| EG-2121CA.....    | 57 |
| EG-2102CA.....    | 57 |
| EG-2101CA.....    | 58 |

## High-stability

|                       |    |
|-----------------------|----|
| HG-2150CA.....        | 59 |
| HG-8002JA series..... | 60 |
| TCO-391J.....         | 61 |
| TCO-3100 series.....  | 62 |

## Multi-Output

|                |    |
|----------------|----|
| MG-5020JE..... | 63 |
|----------------|----|

## VCXO

|                |          |
|----------------|----------|
| VG-4231CE..... | 64       |
| VG-4231CB..... | 65       |
| VG-4531CB..... | 65       |
| VG-4231CA..... | 66       |
| VG-4501CA..... | 67       |
| VG-4502CA..... | 67       |
| VG-4511CA..... | 68       |
| VG-1201CA..... | 69       |
| TCO-291J.....  | 70       |
| TCO-294J.....  | 71       |
| TCO-2152.....  | 72       |
| TCO-2000.....  | 73 to 74 |
| TCO-2100.....  | 73 to 74 |

## TCXO

|                           |    |
|---------------------------|----|
| TG-3530SA.....            | 75 |
| TG-5021BA.....            | 76 |
| TG-5005CG.....            | 77 |
| TG-5010CG.....            | 78 |
| TG-5005CE.....            | 79 |
| TG-5010LH.....            | 80 |
| TCO-5860 series.....      | 81 |
| TCO-5060/5160 series..... | 82 |

## OCXO

|                       |    |
|-----------------------|----|
| TCO-6831 series.....  | 83 |
| TCO-676 series.....   | 84 |
| TCO-679 series.....   | 85 |
| TCO-6920A.....        | 86 |
| OX-6501GG series..... | 87 |
| OX-6601DL series..... | 88 |

## Rubidium atomic OSC

|                |    |
|----------------|----|
| Rb-3310N.....  | 89 |
| Rb-2110CB..... | 90 |

## Filter

## MCF

|                      |     |
|----------------------|-----|
| HF-232A/HF-233A..... | 119 |
| HF-362A/HF-363A..... | 120 |
| HF-372A/HF-373A..... | 121 |
| HF-734A.....         | 122 |
| HF-J14A.....         | 123 |
| HF-S14A.....         | 124 |
| MF-372A/MF-373A..... | 125 |
| MF-722A/MF-723A..... | 126 |
| MF-734A.....         | 127 |

## SAW Filter

|                   |     |
|-------------------|-----|
| FF-555.....       | 128 |
| FF-585.....       | 128 |
| FF-32N.....       | 129 |
| TF-330A/C.....    | 130 |
| TQS-557A-7R.....  | 131 |
| TQS-949AD-7G..... | 132 |
| TQS-471BB-7R..... | 133 |
| TQS-477AA-7R..... | 134 |
| TQS-472BA-7R..... | 135 |

## Sensor

## Gyro Sensor

|                |     |
|----------------|-----|
| XV-8000LK..... | 137 |
| XV-8000CB..... | 138 |
| XV-8100CB..... | 139 |
| XV-3500CB..... | 140 |

## Temperature Sensing Crystal

|              |     |
|--------------|-----|
| HTS-206..... | 141 |
|--------------|-----|

## Quartz Pressure Sensor

|                 |     |
|-----------------|-----|
| TSU series..... | 142 |
|-----------------|-----|

## Optical Device

|                      |            |
|----------------------|------------|
| WAVE PLATE.....      | 144 to 145 |
| DICHROIC PRISM.....  | 146        |
| PBS PRISM.....       | 147        |
| TRICHROIC PRISM..... | 147        |
| PS Converter.....    | 148        |
| HEAT SINK PLATE..... | 148        |
| GRATING.....         | 149        |
| DICHROIC FILTER..... | 149        |
| OLPF.....            | 150 to 151 |
| ETALON FILTER.....   | 152        |





## Crystal Unit / Resonator

## ▶ kHz Range Crystal Unit (Tuning fork)

| Page | Model      | Actual size (mm) Max.                                                                 | Frequency        | 20 kHz | 32 kHz       | 100 kHz  | 200 kHz   | 300 kHz     |
|------|------------|---------------------------------------------------------------------------------------|------------------|--------|--------------|----------|-----------|-------------|
| 4    | FC-12M     |      | 2.05×1.2×0.6 t   |        | 32 kHz       | 77.5 kHz |           |             |
| 5    | FC-125     |  NEW | 2.05×1.2×0.7 t   |        | ● 32.768 kHz |          |           |             |
| 6    | FC-13E     |  NEW | 3.2×1.5×0.48 t   |        | ● 32.768 kHz |          |           |             |
| 7    | FC-13F     |      | 3.2×1.5×0.6 t    |        | ● 32.768 kHz |          |           |             |
| 8    | FC-135     |      | 3.2×1.5×0.9 t    |        | 32 kHz       | 77.5 kHz |           |             |
|      | FC-145     |      | 4.1×1.5×0.9 t    |        | ● 32.768 kHz |          |           |             |
|      | FC-255     |      | 4.9×1.8×0.9 t    |        |              |          |           |             |
| 9    | MC-146     |      | 7.0×1.5×1.4 t    |        | 32 kHz       | 100 kHz  |           |             |
|      | MC-156     |      | 7.1×3.3×1.5 t    |        |              |          |           |             |
| 10   | MC-306     |      | 8.0×3.8×2.54 t   | 20 kHz |              |          | 165 kHz   |             |
|      | MC-405/406 |      | 10.41×4.06×3.6 t | 20 kHz |              |          | 165 kHz   | ● 307.2 kHz |
| 11   | MC-30A     |      | 8.0×3.8×2.54 t   | 20 kHz |              |          | 165 kHz   |             |
| 12   | C-001R     |      | Φ3.1             |        |              |          |           |             |
|      | C-002RX    |      | Φ2.0             |        |              |          |           |             |
|      | C-004R     |      | Φ1.5             |        | ● 32.768 kHz |          |           |             |
|      | C-005R     |      | Φ1.2             |        |              |          |           |             |
|      | C-2-TYPE   |      | Φ2.0             | 20 kHz |              |          | 165 kHz   | ● 307.2 kHz |
|      | C-4-TYPE   |      | Φ1.5             |        | 32 kHz       | 120 kHz  | ● 192 kHz |             |

## ▶ MHz Range Crystal Unit (AT)

| Page | Model      | Actual size (mm) Max.                                                               | Frequency        | 1 MHz | 10 MHz             | 20 MHz                       | 64 MHz  |
|------|------------|-------------------------------------------------------------------------------------|------------------|-------|--------------------|------------------------------|---------|
| 13   | FA-128     |    | 2.0×1.6×0.5 t    |       |                    | 24 MHz                       | 54 MHz  |
| 14   | FA-20H     |   | 2.5×2.0×0.55 t   |       | 12 MHz             |                              | 48 MHz  |
| 15   | FA-23A     |  | 3.2×2.5×0.8 t    |       | 12 MHz             |                              | 54 MHz  |
| 16   | FA-238V    |  | 3.2×2.5×0.7 t    |       | 12 MHz             | 15.999 MHz                   |         |
|      | FA-238     |  | 3.2×2.5×0.7 t    |       |                    | 16 MHz                       | 60 MHz  |
|      | TSX-3225   |  | 3.2×2.5×0.6 t    |       |                    | 16 MHz                       | 48 MHz  |
| 17   | TSX-4025   |  | 4.0×2.5×0.7 t    |       | 12 MHz             |                              | 32 MHz  |
|      | TSX-5032   |  | 5.0×3.2×0.8 t    |       | 10 MHz             |                              | 32 MHz  |
| 18   | FA-365     |  | 6.0×3.5×1.4 t    |       | ● 12 MHz<br>14 MHz |                              | 41 MHz  |
| 19   | MA-306     |  | 8.0×3.8×2.54 t   |       |                    | ● 14.31818 MHz<br>17.734 MHz | 41 MHz  |
| 20   | MA-406     |  | 11.7×4.8×3.7 t   |       | 4 MHz              |                              | 64 MHz* |
|      | MA-505/506 |  | 13.46×5.08×4.6 t |       |                    |                              |         |
| 21   | CA-301     |  | Φ3.1             |       |                    |                              |         |

\* 8.0 MHz < f<sub>nom</sub> < 8.2 MHz : Unavailable.  
Available frequencies from 4 MHz to less than 5.5 MHz  
(4 MHz, 4.032 MHz, 4.096 MHz, 4.19 MHz, 4.194304 MHz, 4.433619 MHz, 4.5 MHz, 4.8 MHz, 4.9152 MHz)

| Page | Model  | Actual size (mm) Max.                                                               | Frequency     | 50 MHz | 100 MHz | 200 MHz | 500 MHz |
|------|--------|-------------------------------------------------------------------------------------|---------------|--------|---------|---------|---------|
| 22   | FH-33H |  | 3.8×3.8×1.0 t | 60 MHz |         |         | 230 MHz |

## ▶ Resonator (SAW)

| Page | Model  | Actual size (mm) Typ.                                                               | Frequency      | 200 MHz | 500 MHz | 700 MHz | 1 GHz |
|------|--------|-------------------------------------------------------------------------------------|----------------|---------|---------|---------|-------|
| 23   | NS-21R |  | 2.5×2.0×0.86 t | 300 MHz | 500 MHz |         |       |
| 24   | NS-32R |  | 3.8×3.8×0.98 t | 312 MHz |         | 870 MHz |       |
|      | FS-335 |  | 3.8×3.8×0.98 t | 300 MHz |         | 870 MHz |       |
|      | FS-555 |  | 4.8×5.2×1.5 t  | 230 MHz | 500 MHz |         |       |
| 25   | FS-585 |  | 4.8×5.2×1.5 t  | 300 MHz | 500 MHz |         |       |



## KHz RANGE CRYSTAL UNIT

### LOW PROFILE SMD

# FC - 12M

- Frequency range : 32.768 kHz (32 kHz to 77.5 kHz)
- Thickness : 0.6 mm Max.
- Overtone order : Fundamental
- Applications : Small communications devices



Product Number (please contact us)  
X1A0000x1xxxx00



Actual size

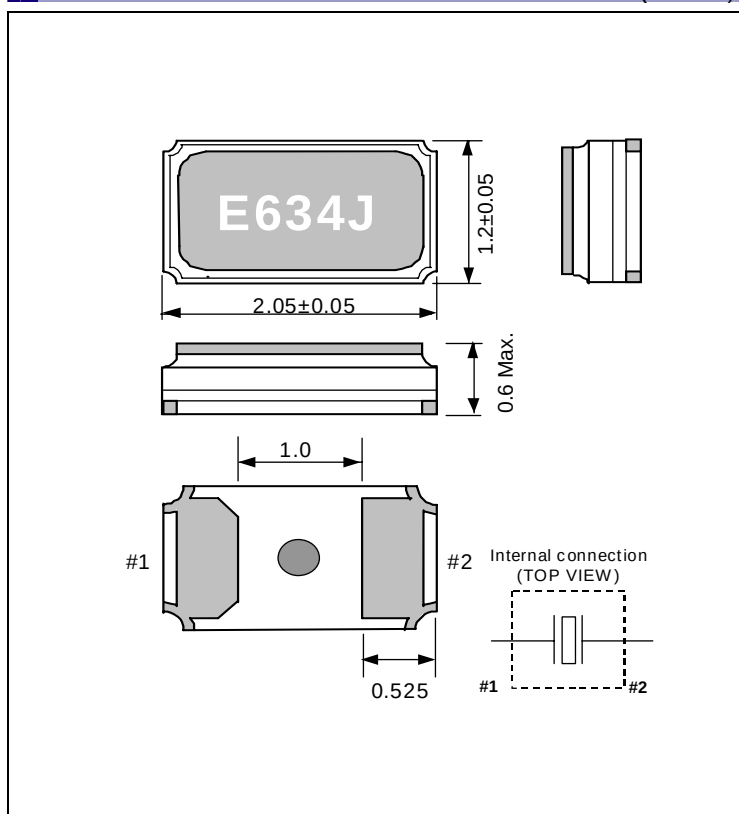


## Specifications (characteristics)

| Item                           |                       | Symbol | Specifications                                   |                    | Remarks                                                          |
|--------------------------------|-----------------------|--------|--------------------------------------------------|--------------------|------------------------------------------------------------------|
| Nominal frequency range        |                       | f_nom  | 32.768 kHz                                       | 32 kHz to 77.5 kHz | Please contact us for inquiries regarding available frequencies. |
| Temperature range              | Storage temperature   | T_stg  | -55 °C to +125 °C                                |                    | Store as bare product after unpacking                            |
|                                | Operating temperature | T_use  | -40 °C to +85 °C                                 |                    |                                                                  |
| Level of drive                 |                       | DL     | 0.5 μW Max.                                      |                    |                                                                  |
| Frequency tolerance (standard) |                       | f_tol  | ±20 × 10 <sup>-6</sup><br>±30 × 10 <sup>-6</sup> |                    | +25 °C, DL=0.1 μW<br>Please ask for tighter tolerance            |
| Turnover temperature           |                       | Ti     | +25 °C ±5 °C                                     |                    |                                                                  |
| Parabolic coefficient          |                       | B      | -0.04 × 10 <sup>-6</sup> / °C <sup>2</sup> Max.  |                    |                                                                  |
| Load capacitance               |                       | CL     | 12.5 pF                                          |                    |                                                                  |
| Motional resistance (ESR)      |                       | R1     | 90 kΩ Max.                                       | 90 kΩ to 65 kΩ     |                                                                  |
| Motional capacitance           |                       | C1     | 6.4 fF Typ.                                      | 7.0 fF to 2.7 fF   |                                                                  |
| Shunt capacitance              |                       | C0     | 1.3 pF Typ.                                      | 1.6 pF to 0.8 pF   |                                                                  |
| Frequency aging                |                       | f_age  | ±3 × 10 <sup>-6</sup> / year Max.                |                    | +25 °C, First year                                               |

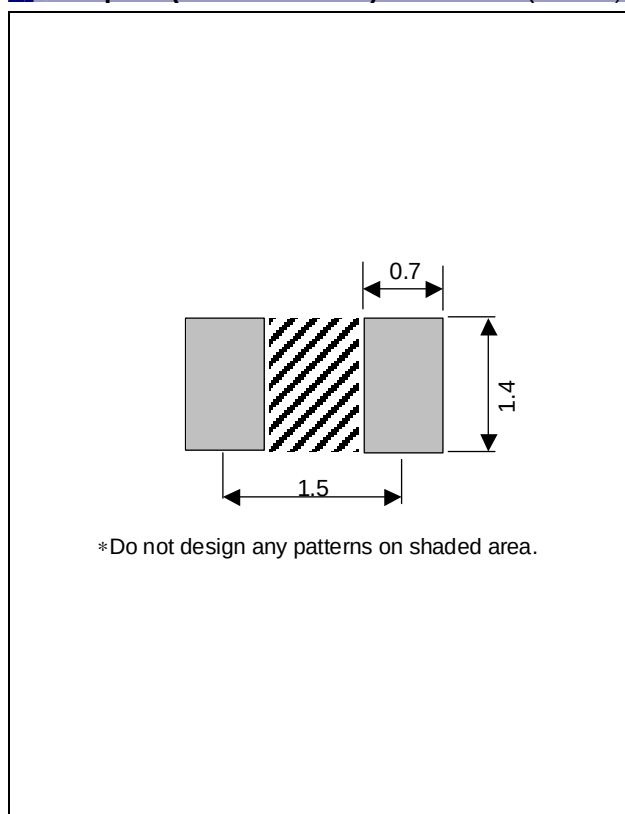
## External dimensions

(Unit:mm)



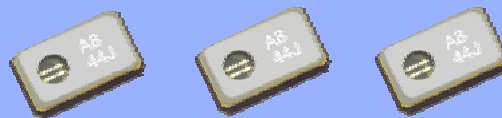
## Footprint (Recommended)

(Unit:mm)



**kHz RANGE CRYSTAL UNIT**  
**LOW PROFILE SMD****FC - 125**

- Frequency range : 32.768 kHz
- Thickness : 0.7 mm Max.
- Overtone order : Fundamental
- Applications : Small communications devices

Product Number (please contact us)  
X1A000011xxxx00

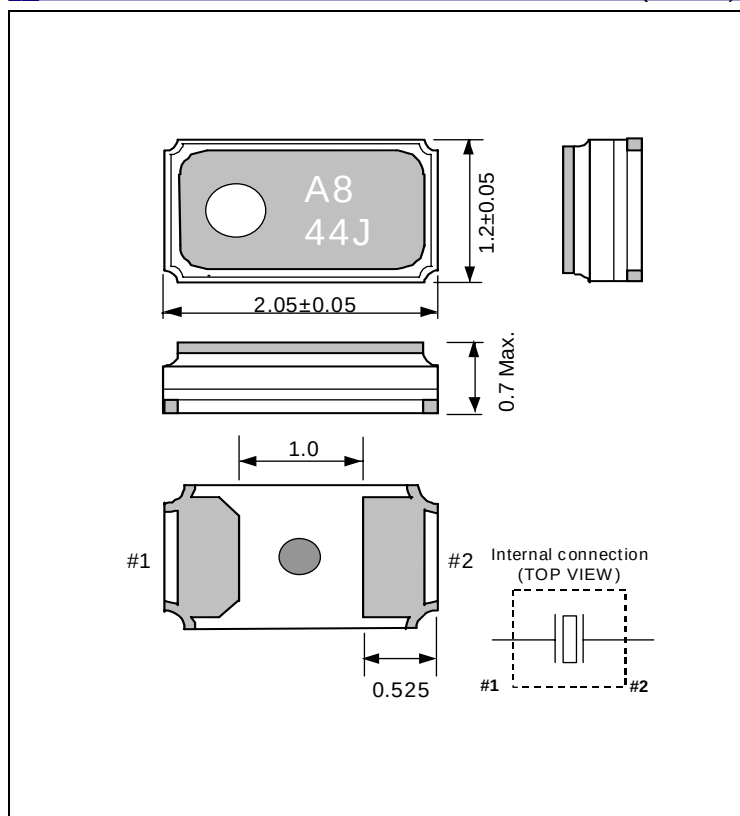
Actual size

**NEW****Specifications (characteristics)**

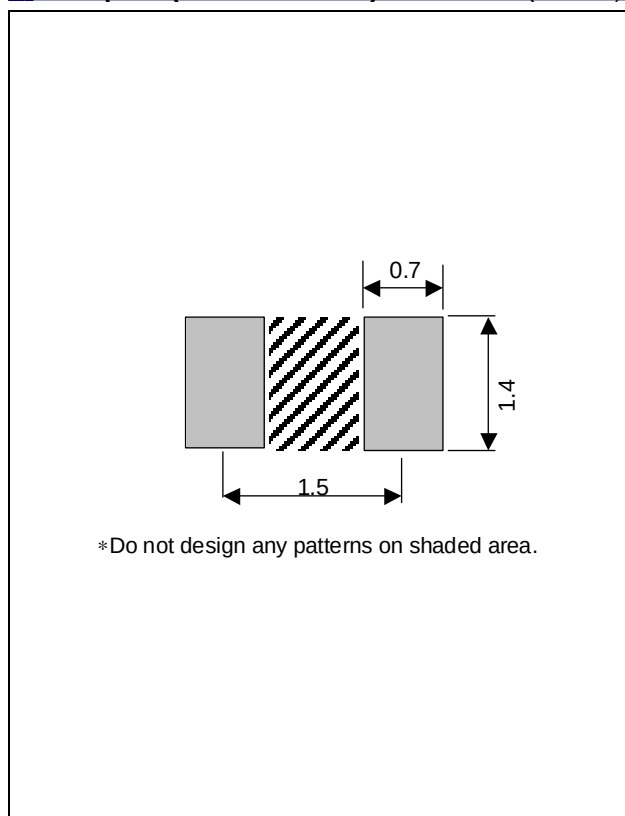
| Item                           |                       | Symbol | Specifications                                 | Remarks                               |
|--------------------------------|-----------------------|--------|------------------------------------------------|---------------------------------------|
| Nominal frequency range        |                       | f_nom  | 32.768 kHz                                     |                                       |
| Temperature range              | Storage temperature   | T_stg  | -55 °C to +125 °C                              | Store as bare product after unpacking |
|                                | Operating temperature | T_use  | -40 °C to +85 °C                               |                                       |
| Level of drive                 |                       | DL     | 0.5 µW Max.                                    |                                       |
| Frequency tolerance (standard) |                       | f_tol  | $\pm 10 \times 10^{-6}$                        | +25 °C, DL=0.1 µW                     |
| Turnover temperature           |                       | Ti     | +25 °C $\pm$ 5 °C                              |                                       |
| Parabolic coefficient          |                       | B      | $-0.04 \times 10^{-6} / ^\circ\text{C}^2$ Max. |                                       |
| Load capacitance               |                       | CL     | 12.5 pF                                        |                                       |
| Motional resistance (ESR)      |                       | R1     | 90 kΩ Max.                                     |                                       |
| Motional capacitance           |                       | C1     | 6.4 fF Typ.                                    |                                       |
| Shunt capacitance              |                       | C0     | 1.3 pF Typ.                                    |                                       |
| Frequency aging                |                       | f_age  | $\pm 3 \times 10^{-6} / \text{year}$ Max.      | +25 °C, First year                    |

**External dimensions**

(Unit:mm)

**Footprint (Recommended)**

(Unit:mm)







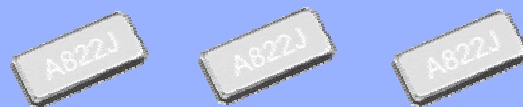
## kHz RANGE CRYSTAL UNIT LOW PROFILE SMD

### FC - 13E

- Frequency range : 32.768 kHz
- Thickness : 0.48 mm Max.
- Overtone order : Fundamental
- Applications : Small communications devices  
Smart Card



Product Number (please contact us)  
X1A000041xxxx00



Actual size



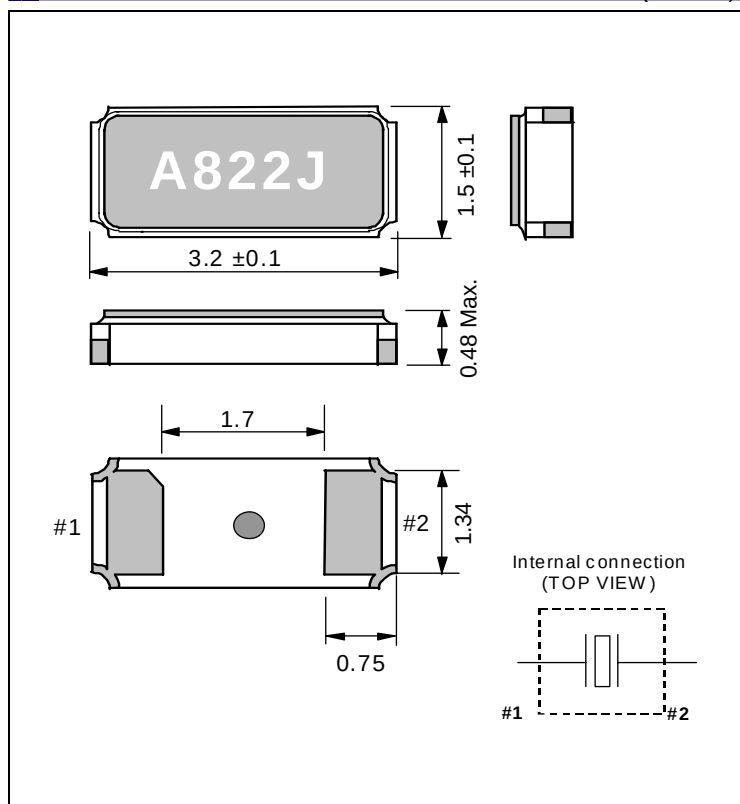
**NEW**

#### Specifications (characteristics)

| Item                           | Symbol                | Specifications                                  | Remarks                                               |
|--------------------------------|-----------------------|-------------------------------------------------|-------------------------------------------------------|
| Nominal frequency range        | f <sub>nom</sub>      | 32.768 kHz                                      |                                                       |
| Temperature range              | Storage temperature   | T <sub>stg</sub>                                | -55 °C to +125 °C                                     |
|                                | Operating temperature | T <sub>use</sub>                                | -40 °C to +85 °C                                      |
| Level of drive                 | DL                    | 0.5 μW Max.                                     |                                                       |
| Frequency tolerance (standard) | f <sub>tol</sub>      | ±100 × 10 <sup>-6</sup>                         | +25 °C, DL=0.1 μW<br>Please ask for tighter tolerance |
| Turnover temperature           | Ti                    | +25 °C ±5 °C                                    |                                                       |
| Parabolic coefficient          | B                     | -0.04 × 10 <sup>-6</sup> / °C <sup>2</sup> Max. |                                                       |
| Load capacitance               | CL                    | 9 pF, 12.5 pF                                   | Please specify                                        |
| Motional resistance (ESR)      | R1                    | 75 kΩ Max.                                      |                                                       |
| Motional capacitance           | C1                    | 3.4 fF Typ.                                     |                                                       |
| Shunt capacitance              | C0                    | 1.0 pF Typ.                                     |                                                       |
| Frequency aging                | f <sub>age</sub>      | ±3 × 10 <sup>-6</sup> / year Max.               | +25 °C, First year                                    |

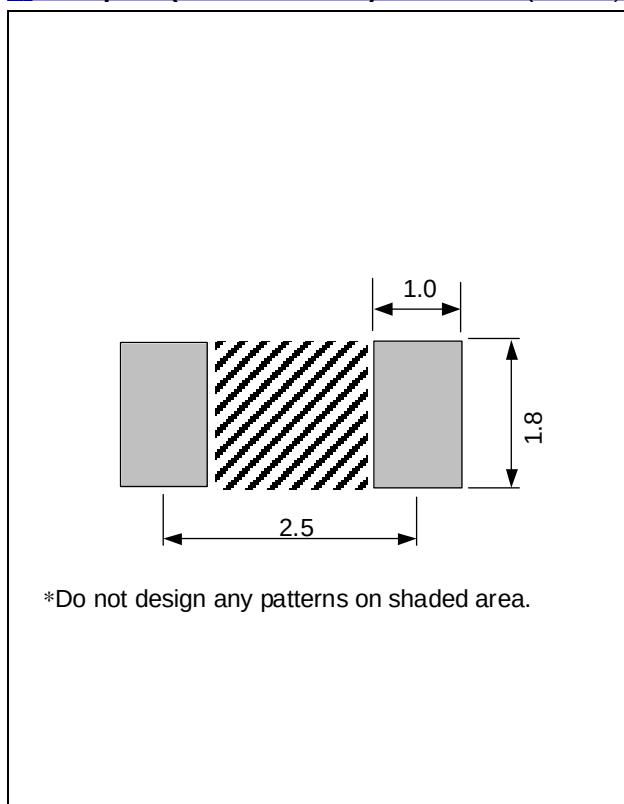
#### External dimensions

(Unit:mm)



#### Footprint (Recommended)

(Unit:mm)



**kHz RANGE CRYSTAL UNIT**  
**LOW PROFILE SMD****FC - 13F**

- Frequency range : 32.768 kHz
- Thickness : 0.6 mm Max.
- Overtone order : Fundamental
- Applications : Small communications devices

Product Number (please contact us)  
Q1xFC13F0xxxx00

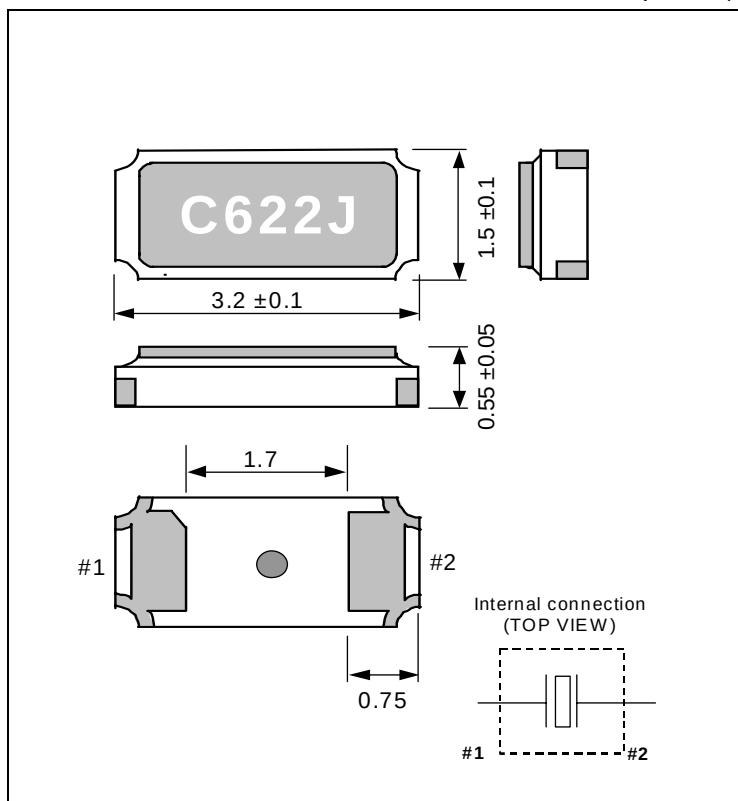
Actual size

**Specifications (characteristics)**

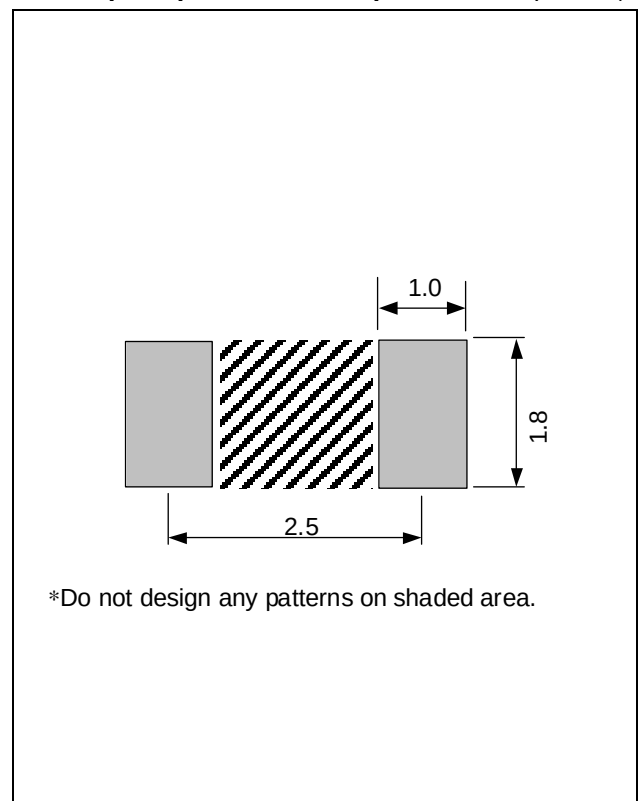
| Item                           |                       | Symbol | Specifications                                 | Remarks                                                          |
|--------------------------------|-----------------------|--------|------------------------------------------------|------------------------------------------------------------------|
| Nominal frequency range        |                       | f_nom  | 32.768 kHz                                     | Please contact us for inquiries regarding available frequencies. |
| Temperature range              | Storage temperature   | T_stg  | -55 °C to +125 °C                              | Store as bare product after unpacking                            |
|                                | Operating temperature | T_use  | -40 °C to +85 °C                               |                                                                  |
| Level of drive                 |                       | DL     | 0.5 µW Max.                                    |                                                                  |
| Frequency tolerance (standard) |                       | f_tol  | $\pm 20 \times 10^{-6}$                        | +25 °C, DL=0.1 µW<br>Please ask for tighter tolerance            |
| Turnover temperature           |                       | Ti     | +25 °C $\pm$ 5 °C                              |                                                                  |
| Parabolic coefficient          |                       | B      | $-0.04 \times 10^{-6} / ^\circ\text{C}^2$ Max. |                                                                  |
| Load capacitance               |                       | CL     | 7 pF, 9 pF, 12.5 pF                            | Please specify                                                   |
| Motional resistance (ESR)      |                       | R1     | 80 kΩ Max.                                     |                                                                  |
| Motional capacitance           |                       | C1     | 3.3 fF Typ.                                    |                                                                  |
| Shunt capacitance              |                       | C0     | 1.0 pF Typ.                                    |                                                                  |
| Frequency aging                |                       | f_age  | $\pm 3 \times 10^{-6} / \text{year}$ Max.      | +25 °C, First year                                               |

**External dimensions**

(Unit:mm)

**Footprint (Recommended)**

(Unit:mm)





## kHz RANGE CRYSTAL UNIT

### LOW PROFILE SMD

# FC-135 / FC-145

# FC-255

- Frequency range : 32.768 kHz (32 kHz to 100 kHz)
- Thickness : 0.9 mm Max.
- Overtone order : Fundamental
- Applications : Small communications devices

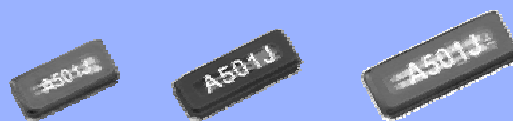


Product Number (please contact us)

FC-135 : Q13FC1350xxxx00

FC-145 : Q13FC1450xxxx00

FC-255 : Q13FC2550xxxx00



Actual size

FC-135

FC-145

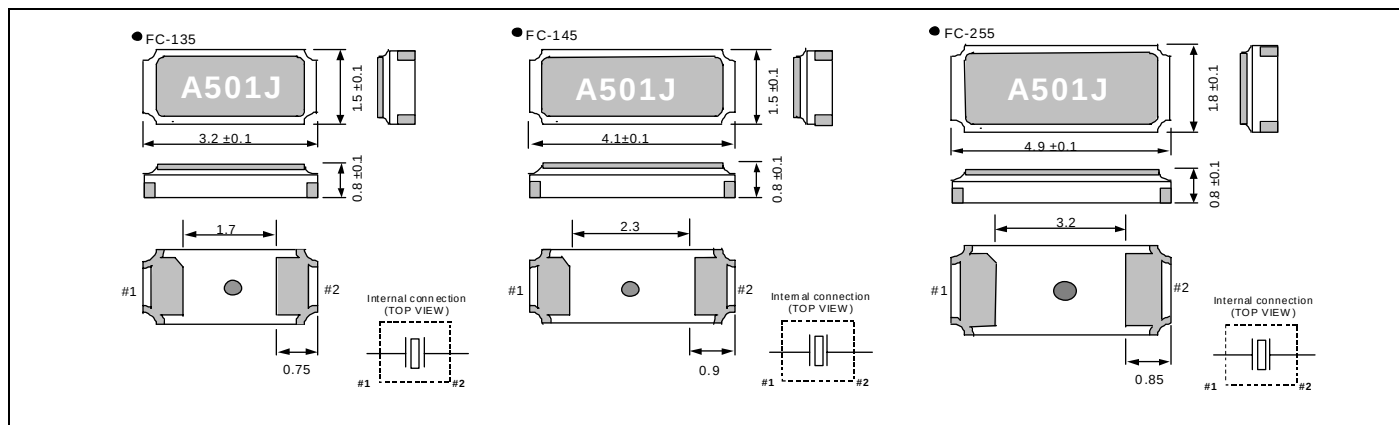
FC-255

## Specifications (characteristics)

| Item                           | Symbol                | Specifications                                  |               |                     |                   | Remarks                                                          |
|--------------------------------|-----------------------|-------------------------------------------------|---------------|---------------------|-------------------|------------------------------------------------------------------|
|                                |                       | FC-135 / 145                                    | FC-255        | FC-135              | FC-255            |                                                                  |
| Nominal frequency range        | f_nom                 | 32.768 kHz                                      |               | 32 kHz to 77.5 kHz  | 32 kHz to 100 kHz | Please contact us for inquiries regarding available frequencies. |
| Temperature range              | Storage temperature   | -55 °C to +125 °C                               |               |                     |                   | Store as bare product after unpacking                            |
|                                | Operating temperature |                                                 |               |                     |                   |                                                                  |
| Level of drive                 | DL                    | 0.5 μW Max.                                     |               |                     |                   |                                                                  |
| Frequency tolerance (standard) | f_tol                 | ±20 × 10 <sup>-6</sup>                          |               |                     |                   | +25 °C, DL=0.1 μW<br>Please ask for tighter tolerance            |
| Turnover temperature           | Ti                    | +25 °C ±5 °C                                    |               |                     |                   |                                                                  |
| Parabolic coefficient          | B                     | -0.04 × 10 <sup>-6</sup> / °C <sup>2</sup> Max. |               |                     |                   |                                                                  |
| Load capacitance               | CL                    | 7 pF, 9 pF, 12.5 pF                             | 7 pF, 12.5 pF | 7 pF, 9 pF, 12.5 pF | 7 pF, 12.5 pF     | Please specify                                                   |
| Motional resistance (ESR)      | R <sub>1</sub>        | 70 kΩ Max.                                      | 65 kΩ Max.    | 70 kΩ to 45 kΩ      | 70 kΩ to 30 kΩ    |                                                                  |
| Motional capacitance           | C <sub>1</sub>        | 3.4 fF Typ.                                     | 2.0 fF Typ.   | 3.7 fF to 1.6 fF    | 2.3 fF to 0.6 fF  |                                                                  |
| Shunt capacitance              | C <sub>0</sub>        | 1.0 pF Typ.                                     | 1.3 pF Typ.   | 1.3 pF to 0.5 pF    | 1.7 pF to 0.9 pF  |                                                                  |
| Frequency aging                | f_age                 | ±3 × 10 <sup>-6</sup> / year Max.               |               |                     |                   | +25 °C, First year                                               |

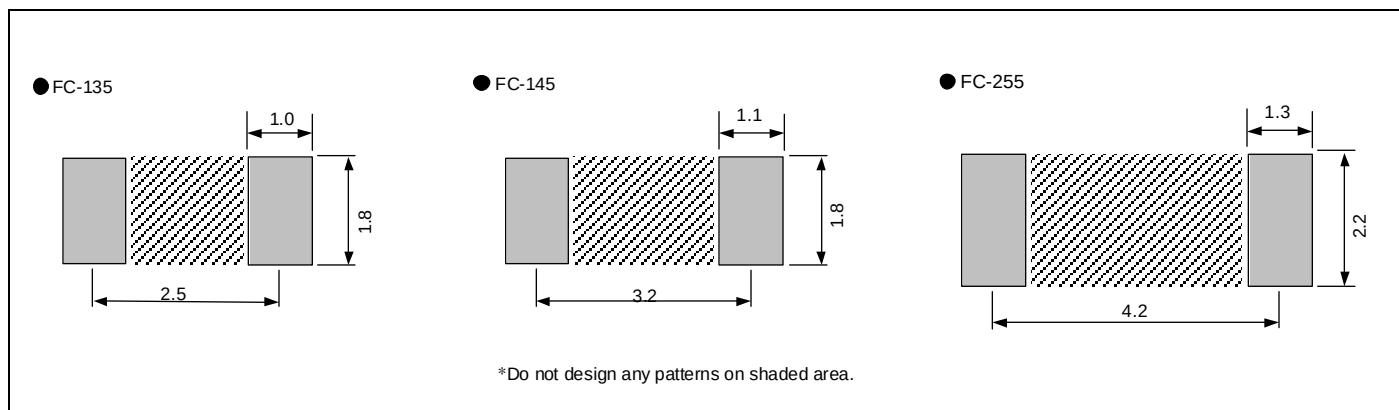
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)



**kHz RANGE CRYSTAL UNIT**  
**LOW PROFILE SMD****MC - 146 / MC - 156**

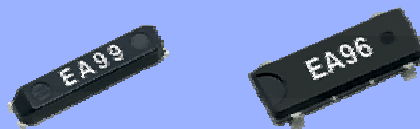
- Frequency range : 32.768 kHz (32 kHz to 100 kHz)
- Thickness : 1.4 mm Max. (MC-146)  
1.5 mm Max. (MC-156)
- Overtone order : Fundamental
- Applications : Small communications devices



Product Number (please contact us)

MC-146 : Q14MC146xxxxx00

MC-156 : Q14MC156xxxxx00



Actual size

MC-146

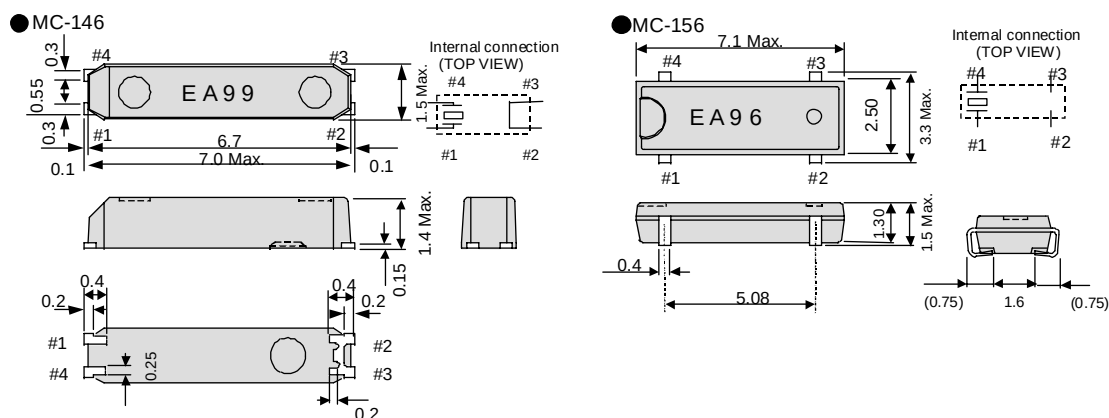
MC-156

**Specifications (characteristics)**

| Item                           |                       | Symbol         | Specifications                                    |                                                    | Remarks                                                         |
|--------------------------------|-----------------------|----------------|---------------------------------------------------|----------------------------------------------------|-----------------------------------------------------------------|
| Nominal frequency range        |                       | f_nom          | 32.768 kHz                                        | 32 kHz to 100 kHz                                  | Please contact us for inquiries regarding available frequencies |
| Temperature range              | Storage temperature   | T_stg          | -55 °C to +125 °C                                 |                                                    | Store as bare product after unpacking                           |
|                                | Operating temperature | T_use          | -40 °C to +85 °C                                  |                                                    |                                                                 |
| Level of drive                 |                       | DL             | 1.0 μW Max.                                       |                                                    | Operating Drive level 0.5 μW Max.                               |
| Frequency tolerance (standard) |                       | f_tol          | $\pm 20 \times 10^{-6}$ , $\pm 50 \times 10^{-6}$ | $\pm 50 \times 10^{-6}$ , $\pm 100 \times 10^{-6}$ | +25 °C, DL=0.1 μW                                               |
| Turnover temperature           |                       | Ti             | +25 °C $\pm$ 5 °C                                 |                                                    |                                                                 |
| Parabolic coefficient          |                       | B              | $-0.04 \times 10^{-6}$ / °C <sup>2</sup> Max.     |                                                    |                                                                 |
| Load capacitance               |                       | CL             | 7 pF, 9 pF, 12.5 pF                               |                                                    | Please specify                                                  |
| Motional resistance (ESR)      |                       | R <sub>1</sub> | 65 kΩ Max.                                        | 65 kΩ to 25 kΩ                                     |                                                                 |
| Motional capacitance           |                       | C <sub>1</sub> | 1.9 fF Typ.                                       | 2.5 fF to 0.6 fF                                   |                                                                 |
| Shunt capacitance              |                       | C <sub>0</sub> | 0.8 pF Typ.                                       | 1.2 pF to 0.5 pF                                   |                                                                 |
| Frequency aging                |                       | f_age          | $\pm 3 \times 10^{-6}$ / year Max.                | $\pm 5 \times 10^{-6}$ / year Max.                 | +25 °C, First year                                              |

**External dimensions**

(Unit:mm)

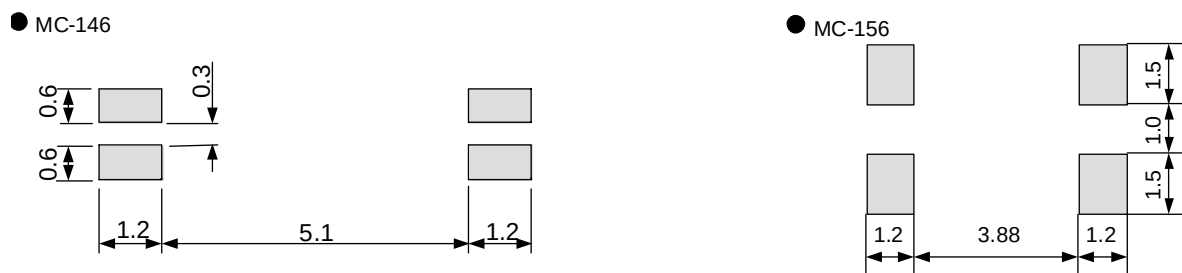


Do not connect #2 and #3 to external device.

Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

**Footprint (Recommended)**

(Unit:mm)





kHz RANGE CRYSTAL UNIT  
SMDMC - 306  
MC - 405 / MC - 406

- Frequency range : 32.768 kHz (20 kHz to 165 kHz)
- Thickness : 2.54 mm Max.(MC-306)  
3.60 mm Max.(MC-405 / 406)
- Overtone order : Fundamental / Overtone (307.2 kHz)
- Applications : Clock and Microcomputer



Product Number (please contact us)

MC-306 : Q13MC3061xxxx00

MC-405 : Q14MC4051xxxx00

MC-406 : Q14MC4061xxxx00



Actual size

MC-306



MC-405 / 406



## Specifications (characteristics)

| Item                           |                       | Symbol | Specifications                                  |                                                  | Remarks                                           |
|--------------------------------|-----------------------|--------|-------------------------------------------------|--------------------------------------------------|---------------------------------------------------|
| Nominal frequency range        |                       | f_nom  | 32.768 kHz                                      | 20 kHz to 165 kHz<br>307.2 kHz(MC-405 / 406)     | Please contact us regarding available frequencies |
| Temperature range              | Storage temperature   | T_stg  | -55 °C to +125 °C                               |                                                  | Store as bare product after unpacking             |
|                                | Operating temperature | T_use  | -40 °C to +85 °C                                |                                                  |                                                   |
| Level of drive                 |                       | DL     | 1.0 μW Max.                                     |                                                  |                                                   |
| Frequency tolerance (standard) |                       | f_tol  | ±20 × 10 <sup>-6</sup> , ±50 × 10 <sup>-6</sup> | ±50 × 10 <sup>-6</sup> , ±100 × 10 <sup>-6</sup> | +25 °C, DL=0.1 μW                                 |
| Turnover temperature           |                       | Ti     | +25 °C ±5 °C                                    |                                                  |                                                   |
| Parabolic coefficient          |                       | B      | -0.04 × 10 <sup>-6</sup> / °C <sup>2</sup> Max. |                                                  |                                                   |
| Load capacitance               |                       | CL     | 6 pF to ∞ (standard :12.5 pF)                   |                                                  | Please specify                                    |
| Motional resistance (ESR)      |                       | R1     | 50 kΩ Max.                                      | 55 kΩ to 6 kΩ                                    | As per below table                                |
| Motional capacitance           |                       | C1     | 1.8 fF Typ.                                     | 4.0 fF to 0.6 fF                                 | MC-306                                            |
|                                |                       |        | 2.0 fF Typ.                                     |                                                  | MC-405 / 406                                      |
| Shunt capacitance              |                       | C0     | 0.9 pF Typ.                                     | 2.0 pF to 0.6 pF                                 | MC-306                                            |
|                                |                       |        | 0.85 pF Typ.                                    |                                                  | MC-405 / 406                                      |
| Frequency aging                |                       | f_age  | ±3 × 10 <sup>-6</sup> / year Max.               | ±5 × 10 <sup>-6</sup> / year Max.                | +25 °C, First year                                |

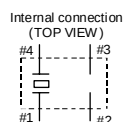
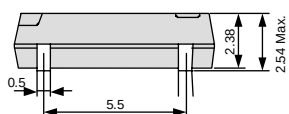
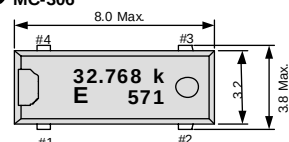
## Motional resistance (ESR)

| Frequency           | 20 kHz≤f <sub>nom</sub> <31.2 kHz | 31.2 kHz≤f <sub>nom</sub> <40 kHz | 40 kHz≤f <sub>nom</sub> <90 kHz | 90 kHz≤f <sub>nom</sub> <130 kHz | 130 kHz≤f <sub>nom</sub> ≤165 kHz | 307.2 kHz |
|---------------------|-----------------------------------|-----------------------------------|---------------------------------|----------------------------------|-----------------------------------|-----------|
| Motional resistance | 55 kΩ Max.                        | 35 kΩ Max.                        | 20 kΩ Max.                      | 12 kΩ Max.                       | 10 kΩ Max.                        | 6 kΩ Max. |

## External dimensions

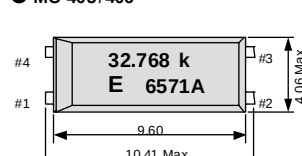
(Unit:mm)

## ● MC-306

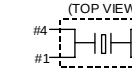


Do not connect #2 and #3 to external device.  
Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

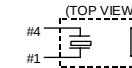
## ● MC-405 / 406



Internal connection in MC-405



Internal connection in MC-406



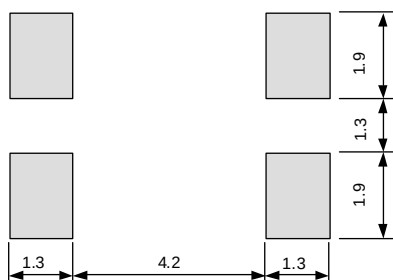
Do not connect #2 and #3 of MC-406 to external device.

The first digit of No. means: 5xxxx MC-405  
6xxxx MC-406

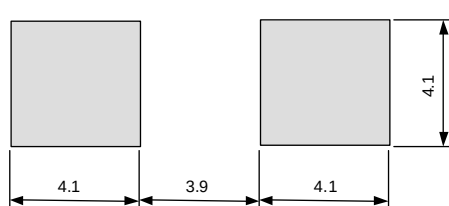
## Footprint (Recommended)

(Unit:mm)

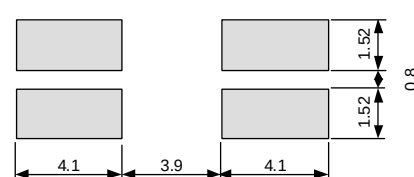
## ● MC-306



## ● MC-405



## ● MC-406





## kHz RANGE CRYSTAL UNIT FOR AUTOMOTIVE APPLICATIONS



Product Number (please contact us)  
Q13MC30A1xxx00

# MC - 30A

- Frequency range : 32.768 kHz (20 kHz to 165 kHz)
- Thickness : 2.54 mm Max.
- Overtone order : Fundamental
- Applications : Accessories and ECU sub clock
- Conforms to AEC-Q200



Actual size



### Specifications (characteristics)

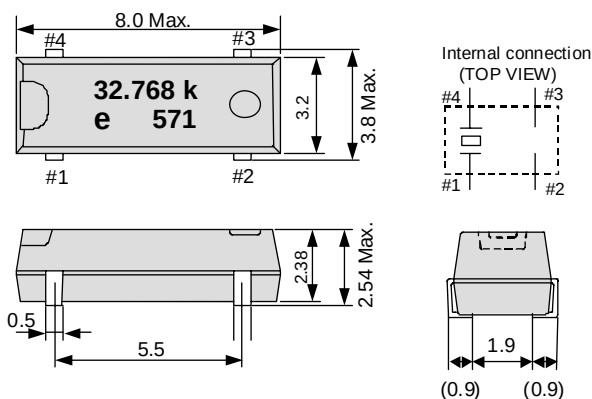
| Item                           |                       | Symbol         | Specifications                                  |                                                  | Remarks                                           |
|--------------------------------|-----------------------|----------------|-------------------------------------------------|--------------------------------------------------|---------------------------------------------------|
| Nominal frequency range        |                       | f_nom          | 32.768 kHz                                      | 20 kHz to 165 kHz                                | Please contact us regarding available frequencies |
| Temperature range              | Storage temperature   | T_stg          | -55 °C to +125 °C                               |                                                  | Store as bare product after unpacking             |
|                                | Operating temperature | T_use          | -40 °C to +85 °C                                |                                                  |                                                   |
| Level of drive                 |                       | DL             | 1.0 μW Max.                                     |                                                  |                                                   |
| Frequency tolerance (standard) |                       | f_tol          | ±20 × 10 <sup>-6</sup> , ±50 × 10 <sup>-6</sup> | ±50 × 10 <sup>-6</sup> , ±100 × 10 <sup>-6</sup> | +25 °C, DL=0.1 μW                                 |
| Turnover temperature           |                       | Ti             | +25 °C ±5 °C                                    |                                                  |                                                   |
| Parabolic coefficient          |                       | B              | -0.04 × 10 <sup>-6</sup> / °C <sup>2</sup> Max. |                                                  |                                                   |
| Load capacitance               |                       | CL             | 6 pF to ∞ (standard :12.5 pF)                   |                                                  | Please specify                                    |
| Motional resistance (ESR)      |                       | R <sub>1</sub> | 50 kΩ Max.                                      | 55 kΩ to 10 kΩ                                   | As per below table                                |
| Motional capacitance           |                       | C <sub>1</sub> | 1.8 fF Typ.                                     | 4.0 fF to 0.6 fF                                 |                                                   |
| Shunt capacitance              |                       | C <sub>0</sub> | 0.9 pF Typ.                                     | 2.0 pF to 0.6 pF                                 |                                                   |
| Frequency aging                |                       | f_age          | ±3 × 10 <sup>-6</sup> / year Max.               | ±5 × 10 <sup>-6</sup> / year Max.                | +25 °C, First year                                |

### Motional resistance (ESR)

| Frequency           | 20 kHz≤f nom<31.2 kHz | 31.2 kHz≤f nom<40 kHz | 40 kHz≤f nom<90 kHz | 90 kHz≤f nom<130 kHz | 130 kHz≤f nom≤165 kHz |
|---------------------|-----------------------|-----------------------|---------------------|----------------------|-----------------------|
| Motional resistance | 55 kΩ Max.            | 35 kΩ Max.            | 20 kΩ Max.          | 12 kΩ Max.           | 10 kΩ Max.            |

### External dimensions

(Unit:mm)

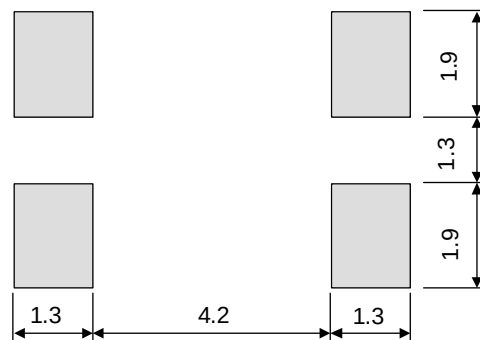


Do not connect #2 and #3 to external device.

Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

### Footprint (Recommended)

(Unit:mm)



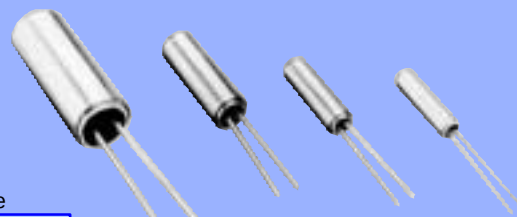
kHz RANGE CRYSTAL UNIT  
CYLINDERC - TYPE  
C - 2 - TYPE / C - 4 - TYPE

- Frequency range : 32.768 kHz (20 kHz to 307.2 kHz)
- Thickness :  $\phi 1.2$  mm to  $\phi 3.1$  mm
- Overtone order : Fundamental / Overtone (192 kHz, 307.2 kHz)
- Applications : Clock and Microcomputer



Product Number (please contact us)

C-001R : Q11C001R1xxxx00  
 C-002RX : Q11C02RX1xxxx00  
 C-004R : Q11C004R1xxxx00  
 C-005R : Q11C005R1xxxx00  
 C-2-TYPE : Q12C20001xxxx00  
 C-4-TYPE : Q12C40001xxxx00



Actual size

C-002RX

C-001R

C-002RX  
C-2-TYPEC-004R  
C-4-TYPE

C-005R

## Specifications for C-TYPE (characteristics)

| Item                           |                       | Symbol           | C-001R                                          | C-002RX                          | C-004R                     | C-005R                     | Remarks                               |
|--------------------------------|-----------------------|------------------|-------------------------------------------------|----------------------------------|----------------------------|----------------------------|---------------------------------------|
| Nominal frequency range        |                       | f <sub>nom</sub> | 32.768 kHz                                      |                                  |                            |                            |                                       |
| Temperature range              | Storage temperature   | T <sub>stg</sub> | -20 °C to +70 °C                                |                                  |                            |                            | Store as bare product after unpacking |
|                                | Operating temperature | T <sub>use</sub> | -10 °C to +60 °C                                |                                  |                            |                            |                                       |
| Level of drive                 |                       | DL               | 1.0 μW Max.                                     |                                  |                            |                            |                                       |
| Frequency tolerance (standard) |                       | f <sub>tol</sub> | ±20 ×10 <sup>-6</sup>                           |                                  |                            |                            | +25 °C, DL=0.1 μW                     |
| Turnover temperature           |                       | Ti               | +25 °C ±5 °C                                    |                                  |                            |                            |                                       |
| Parabolic coefficient          |                       | B                | -0.04 × 10 <sup>-6</sup> / °C <sup>2</sup> Max. |                                  |                            |                            |                                       |
| Load capacitance               |                       | CL               | 6 pF to ∞                                       |                                  |                            |                            | Please specify                        |
| Motional resistance (ESR)      |                       | R <sub>1</sub>   | 35 kΩ Max.<br>(18 kΩ Typ.)                      | 50 or 60 kΩ Max.<br>(30 kΩ Typ.) | 50 kΩ Max.<br>(30 kΩ Typ.) | 50 kΩ Max.<br>(37 kΩ Typ.) |                                       |
| Motional capacitance           |                       | C <sub>1</sub>   | 2.1 fF Typ.                                     | 2.0 fF                           | 2.0 fF                     | 1.9 fF Typ.                |                                       |
| Shunt capacitance              |                       | C <sub>0</sub>   | 0.9 pF Typ.                                     | 0.85 pF                          | 0.85 pF                    | 0.75 pF Typ.               |                                       |
| Frequency aging                |                       | f <sub>age</sub> | ±3 × 10 <sup>-6</sup> / year Max.               |                                  |                            |                            | +25 °C, First year                    |

## Specifications for C-2-TYPE C-4-TYPE (characteristics)

| Item                           |                       | Symbol         | Specifications                                                                                                     |                                                  | Remarks                               |
|--------------------------------|-----------------------|----------------|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|---------------------------------------|
|                                |                       |                | C-2-TYPE                                                                                                           | C-4-TYPE                                         |                                       |
| Nominal frequency range        |                       | f_nom          | 20 kHz to 165 kHz, 307.2 kHz                                                                                       | 32 kHz to 120 kHz, 192 kHz                       |                                       |
| Temperature range              | Storage temperature   | T_stg          | -20 °C to +70 °C                                                                                                   |                                                  | Store as bare product after unpacking |
|                                | Operating temperature | T_use          | -10 °C to +60 °C                                                                                                   |                                                  |                                       |
| Level of drive                 |                       | DL             | 1.0 μW Max.                                                                                                        |                                                  |                                       |
| Frequency tolerance (standard) |                       | f_tol          | ±20 × 10 <sup>-6</sup> , ±50 × 10 <sup>-6</sup> , ±100 × 10 <sup>-6</sup><br>(307.2 kHz: ±100 × 10 <sup>-6</sup> ) | ±50 × 10 <sup>-6</sup> , ±100 × 10 <sup>-6</sup> | +25 °C, DL=0.1 μW                     |
| Turnover temperature           |                       | Ti             | +25 °C ±5 °C                                                                                                       |                                                  |                                       |
| Parabolic coefficient          |                       | B              | -0.04 × 10 <sup>-6</sup> / °C <sup>2</sup> Max.                                                                    |                                                  |                                       |
| Load capacitance               |                       | CL             | 6 pF to ∞                                                                                                          |                                                  | Please specify                        |
| Motional resistance (ESR)      |                       | R <sub>1</sub> | 55 kΩ to 6 kΩ                                                                                                      | 55 kΩ to 10 kΩ                                   | As per below table                    |
| Motional capacitance           |                       | C <sub>1</sub> | 4.0 fF to 0.6 fF                                                                                                   |                                                  |                                       |
| Shunt capacitance              |                       | C <sub>0</sub> | 2.0 pF to 0.6 pF                                                                                                   |                                                  |                                       |
| Frequency aging                |                       | f_age          | ±5 × 10 <sup>-6</sup> / year Max.                                                                                  |                                                  | +25 °C, First year                    |

## Motional resistance C-2- TYPE

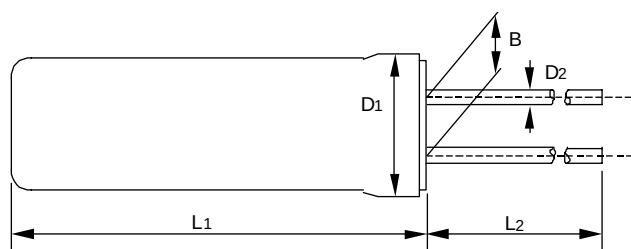
| Frequency           | 20 kHz $\leq$ f <sub>nom</sub> < 31.2 kHz | 31.2 kHz $\leq$ f <sub>nom</sub> < 40 kHz | 40 kHz $\leq$ f <sub>nom</sub> < 90 kHz | 90 kHz $\leq$ f <sub>nom</sub> < 130 kHz | 130 kHz $\leq$ f <sub>nom</sub> $\leq$ 165 kHz | 307.2 kHz         |
|---------------------|-------------------------------------------|-------------------------------------------|-----------------------------------------|------------------------------------------|------------------------------------------------|-------------------|
| Motional resistance | 55 k $\Omega$ Max.                        | 35 k $\Omega$ Max.                        | 20 k $\Omega$ Max.                      | 12 k $\Omega$ Max.                       | 10 k $\Omega$ Max.                             | 6 k $\Omega$ Max. |

## Motional resistance C-4- TYPE

| Frequency           | 32 kHz $\leq$ f <sub>nom</sub> < 38 kHz | 38 kHz $\leq$ f <sub>nom</sub> < 60 kHz | 60 kHz $\leq$ f <sub>nom</sub> < 74 kHz | 74 kHz $\leq$ f <sub>nom</sub> $\leq$ 100 kHz | 100 kHz < f <sub>nom</sub> $\leq$ 120 kHz | 192 kHz            |
|---------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------------|-------------------------------------------|--------------------|
| Motional resistance | 55 k $\Omega$ Max.                      | 30 k $\Omega$ Max.                      | 25 k $\Omega$ Max.                      | 22 k $\Omega$ Max.                            | 15 k $\Omega$ Max.                        | 10 k $\Omega$ Max. |

## External dimensions

(Unit:mm)



| Model               | L1       | L2       | D1              | D2          | B   |
|---------------------|----------|----------|-----------------|-------------|-----|
| C-001R              | 8.0 Max. | 9.0 Min. | $\phi 3.1$ Max. | $\phi 0.3$  | 1.1 |
| C-002RX<br>C-2-TYPE | 6.0 Max. | 4.0 Min. | $\phi 2.0$ Max. | $\phi 0.2$  | 0.7 |
| C-004R<br>C-4-TYPE  | 5.0 Max. | 4.0 Min. | $\phi 1.5$ Max. | $\phi 0.18$ | 0.5 |
| C-005R              | 4.6 Max. | 4.0 Min. | $\phi 1.2$ Max. | $\phi 0.15$ | 0.3 |

160 kHz to 165 kHz, 307.2 kHz: D1 =  $\phi 2.2$  Max. (C-2-TYPE)



## MHz RANGE CRYSTAL UNIT

### ULTRA MINIATURE SIZE LOW PROFILE SMD

# FA - 128

- Nominal frequency range : 24 MHz to 54 MHz
- Thickness : 0.5mm Max.
- Overtone order : Fundamental
- Applications : Mobile phone, Bluetooth, W-LAN  
ISM band radio, Clock for MPU



Product Number (please contact us)  
Q22FA1280xxx00



Actual size



## Specifications (characteristics)

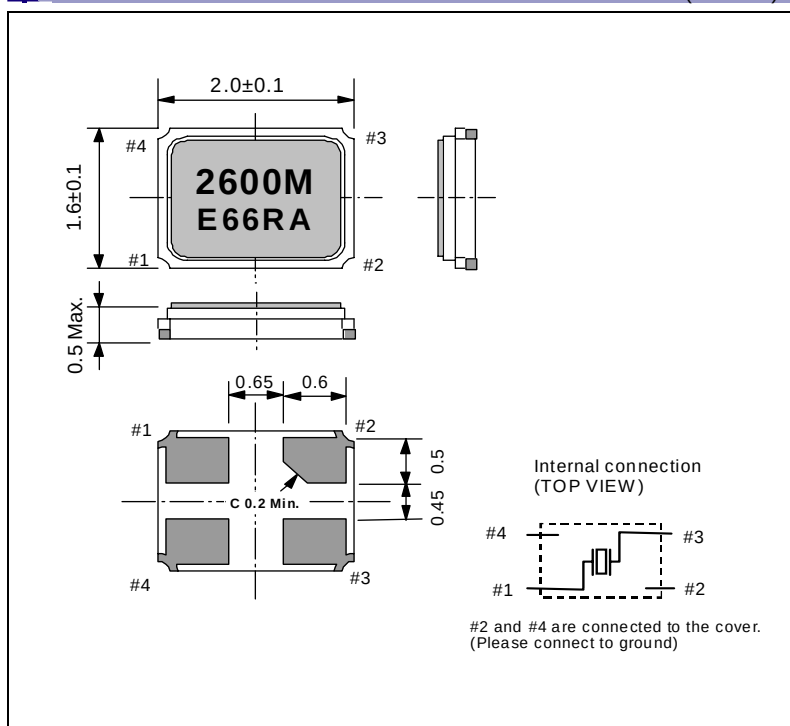
| Item                                                    | Symbol         | Specifications                     |                                    | Remarks                                                                                      |
|---------------------------------------------------------|----------------|------------------------------------|------------------------------------|----------------------------------------------------------------------------------------------|
|                                                         |                | For RF Reference                   | For Clock                          |                                                                                              |
| Nominal frequency range                                 | f_nom          | 24.000 MHz to 54.000 MHz           |                                    | Fundamental<br>Please contact us for inquiries regarding the available frequencies.          |
| Storage temperature range                               | T_stg          | -40 °C to +125 °C                  |                                    | Store as bare product after unpacking                                                        |
| Operating temperature range                             | T_use          | -40 °C to +85 °C                   |                                    |                                                                                              |
| Level of drive                                          | DL             | 100 µW Max.                        | 100 µW Max.                        |                                                                                              |
| Frequency tolerance (standard)                          | f_tol          | $\pm 10 \times 10^{-6}$            | $\pm 30 \times 10^{-6}$            | +25 °C<br>For the out of standard specifications, please contact us for inquiries.           |
| Frequency versus temperature characteristics (standard) | f_tem          | $\pm 10 \times 10^{-6}$            | $\pm 30 \times 10^{-6}$            | -20 °C to +75 °C<br>For the out of standard specifications, please contact us for inquiries. |
| Load capacitance                                        | C <sub>L</sub> | 8 pF to ∞                          |                                    | Please specify.                                                                              |
| Motional resistance (ESR)                               | R <sub>1</sub> | As per below table                 |                                    | -20 °C to +75 °C                                                                             |
| Frequency aging                                         | f_age          | $\pm 1 \times 10^{-6}$ / year Max. | $\pm 5 \times 10^{-6}$ / year Max. | +25 °C, First year                                                                           |

## Motional resistance (ESR)

| Frequency                   | Motional resistance |
|-----------------------------|---------------------|
| 24.0 MHz ≤ f_nom < 26.0 MHz | 80 Ω Max.           |
| 26.0 MHz ≤ f_nom ≤ 54.0 MHz | 60 Ω Max.           |

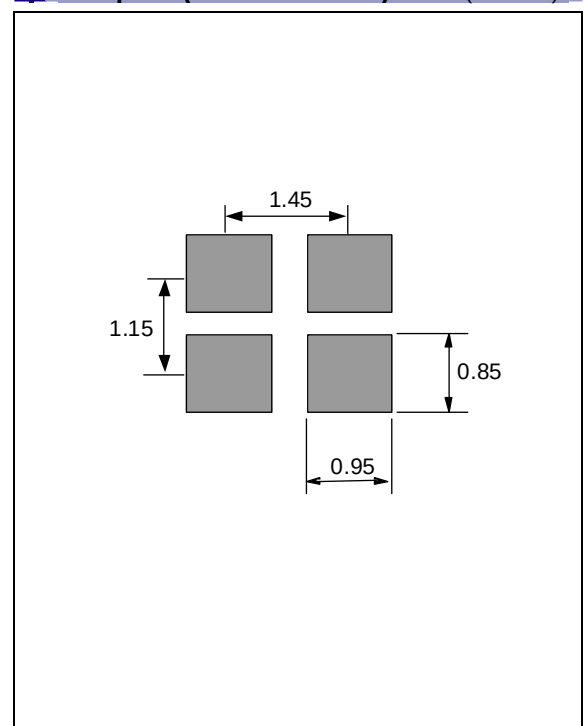
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





## MHz RANGE CRYSTAL UNIT

### ULTRA MINIATURE SIZE LOW PROFILE SMD

# FA - 20H

- Nominal frequency range : 12 MHz to 48 MHz
- Thickness : 0.55 mm Max.
- Overtone order : Fundamental
- Applications : Mobile phone, Bluetooth, W-LAN  
ISM band radio, Clock for MPU



Product Number (please contact us)  
Q24FA20H0xxx00



Actual size



## Specifications (characteristics)

| Item                                         | Symbol           | Specifications                                                |                        | Remarks                                                                             |
|----------------------------------------------|------------------|---------------------------------------------------------------|------------------------|-------------------------------------------------------------------------------------|
|                                              |                  | For RF Reference                                              | For Clock              |                                                                                     |
| Nominal frequency range                      | f <sub>nom</sub> | 12.000 MHz to 48.000 MHz                                      |                        | Fundamental<br>Please contact us for inquiries regarding the available frequencies. |
| Storage temperature range                    | T <sub>stg</sub> | -40 °C to +125 °C                                             |                        | Store as bare product after unpacking.                                              |
| Operating temperature range                  | T <sub>use</sub> | -40 °C to +85 °C                                              |                        |                                                                                     |
| Level of drive                               | DL               | 100 µW Max.                                                   |                        |                                                                                     |
| Frequency tolerance                          | f <sub>tol</sub> | ±10 × 10 <sup>-6</sup> to ±30 × 10 <sup>-6</sup> *1           | ±30 × 10 <sup>-6</sup> | +25 °C<br>Please contact us for inquiries.                                          |
| Frequency versus temperature characteristics | f <sub>tem</sub> | ±10 × 10 <sup>-6</sup> to ±30 × 10 <sup>-6</sup> *1           | ±30 × 10 <sup>-6</sup> | -20 °C to +75 °C<br>Please contact us for inquiries.                                |
| Load capacitance                             | CL               | 6 pF to ∞ (standard: 9 pF, 10 pF, 12 pF, 16 pF, ∞)            |                        | Please specify.                                                                     |
| Motional resistance (ESR)                    | R <sub>1</sub>   | As per below table                                            |                        | -20 °C to +75 °C                                                                    |
| Frequency aging                              | f <sub>age</sub> | ±1 × 10 <sup>-6</sup> to ±3 × 10 <sup>-6</sup> / year Max. *1 |                        | +25 °C, First year                                                                  |

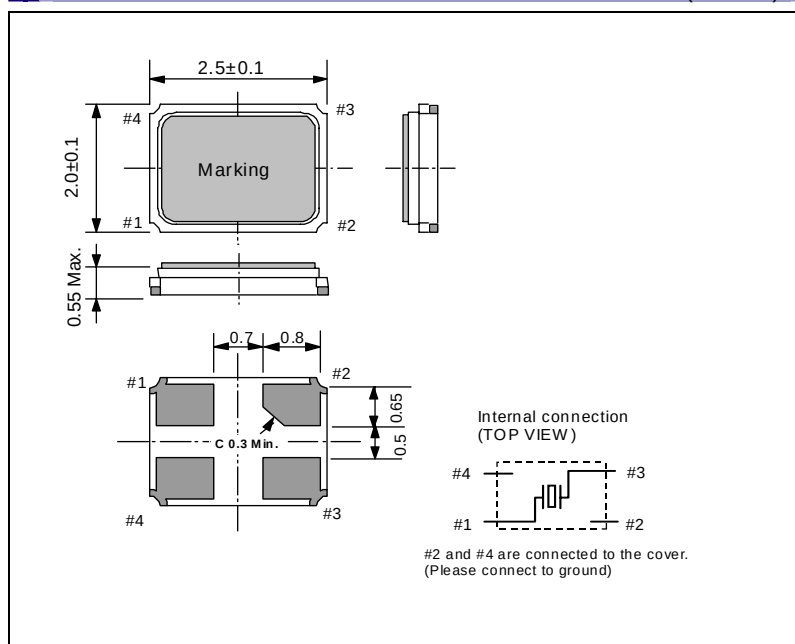
\*1 Please contact us for inquiries regarding available frequency tolerance.

## Motional resistance (ESR)

| Frequency                              | Motional resistance |
|----------------------------------------|---------------------|
| 12.0 MHz ≤ f <sub>nom</sub> < 16.0 MHz | 150 Ω Max.          |
| 16.0 MHz ≤ f <sub>nom</sub> < 25.0 MHz | 80 Ω Max.           |
| 25.0 MHz ≤ f <sub>nom</sub> < 30.0 MHz | 60 Ω Max.           |
| 30.0 MHz ≤ f <sub>nom</sub> < 35.0 MHz | 50 Ω Max.           |
| 35.0 MHz ≤ f <sub>nom</sub> ≤ 48.0 MHz | 40 Ω Max.           |

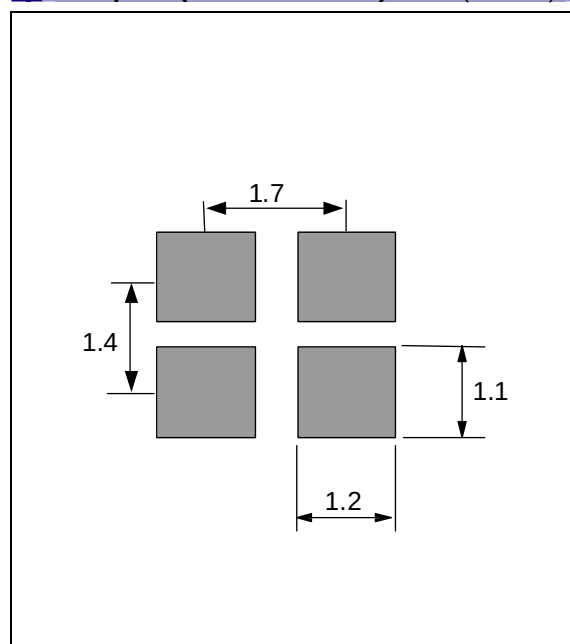
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





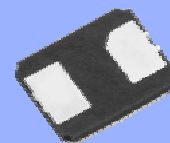
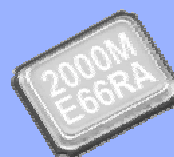


Product Number (please contact us)  
Q24FA23A0xxx00

## MHz RANGE CRYSTAL UNIT FOR AUTOMOTIVE APPLICATIONS

### FA - 23A

- Frequency range : 12 MHz to 54 MHz
- Thickness : 0.8 mm Max.
- Overtone order : Fundamental
- Applications : Accessories of car navigation, car audio.  
Receiver of communication system  
(TPMS, RKE, etc.)
- Structure of two terminals, high durability is mounted.
- Conforms to AEC-Q200



Actual size



### Specifications (characteristics)

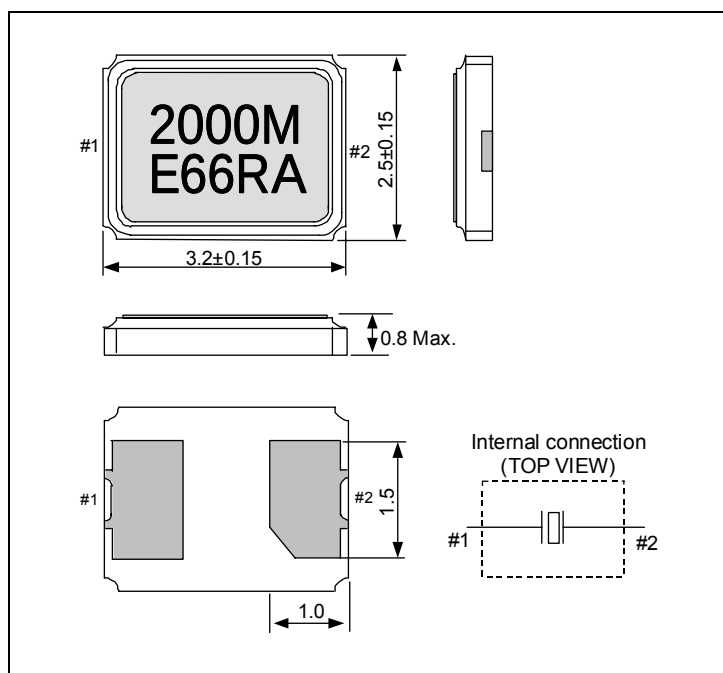
| Item                                                    |                       | Symbol           | Specifications                              | Remarks                                                                                                             |
|---------------------------------------------------------|-----------------------|------------------|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Nominal frequency range                                 |                       | f <sub>nom</sub> | 12 MHz to 54 MHz                            | Fundamental<br>Less than 16 MHz and over 48 MHz<br>Please contact us for inquiries regarding available frequencies. |
| Temperature range                                       | Storage temperature   | T <sub>stg</sub> | -40 °C to +125 °C                           | Store as bare product after unpacking                                                                               |
|                                                         | Operating temperature | T <sub>use</sub> | -40 °C to +125 °C                           |                                                                                                                     |
| Level of drive                                          |                       | DL               | 100 μW Max.                                 |                                                                                                                     |
| Frequency tolerance (standard)                          |                       | f <sub>tol</sub> | ±10 × 10 <sup>-6</sup>                      | 12 MHz ≤ f <sub>nom</sub> ≤ 48 MHz, +25 °C                                                                          |
|                                                         |                       |                  | ±20 × 10 <sup>-6</sup>                      | 48 MHz < f <sub>nom</sub> ≤ 54 MHz, +25 °C                                                                          |
| Frequency versus temperature characteristics (standard) |                       | f <sub>tem</sub> | ±20 × 10 <sup>-6</sup>                      | -40 °C to +85 °C                                                                                                    |
|                                                         |                       |                  | ±50 × 10 <sup>-6</sup>                      | -40 °C to +125 °C                                                                                                   |
| Load capacitance                                        |                       | CL               | 7 pF to ∞ (standard: 9 pF, 12 pF, 16 pF, ∞) | Please specify                                                                                                      |
| Motional resistance (ESR)                               |                       | R1               | As per below table                          |                                                                                                                     |
| Frequency aging                                         |                       | f <sub>age</sub> | ±1 × 10 <sup>-6</sup> / year Max.           | 12 MHz ≤ f <sub>nom</sub> < 40 MHz, +25 °C, First year                                                              |
|                                                         |                       |                  | ±2 × 10 <sup>-6</sup> / year Max.           | 40 MHz ≤ f <sub>nom</sub> ≤ 54 MHz, +25 °C, First year                                                              |

### Motional resistance (ESR)

| Frequency                              | Motional resistance |
|----------------------------------------|---------------------|
| 12.0 MHz ≤ f <sub>nom</sub> < 16.0 MHz | 200 Ω Max.          |
| 16.0 MHz ≤ f <sub>nom</sub> < 20.0 MHz | 80 Ω Max.           |
| 20.0 MHz ≤ f <sub>nom</sub> < 27.0 MHz | 60 Ω Max.           |
| 27.0 MHz ≤ f <sub>nom</sub> ≤ 54.0 MHz | 40 Ω Max.           |

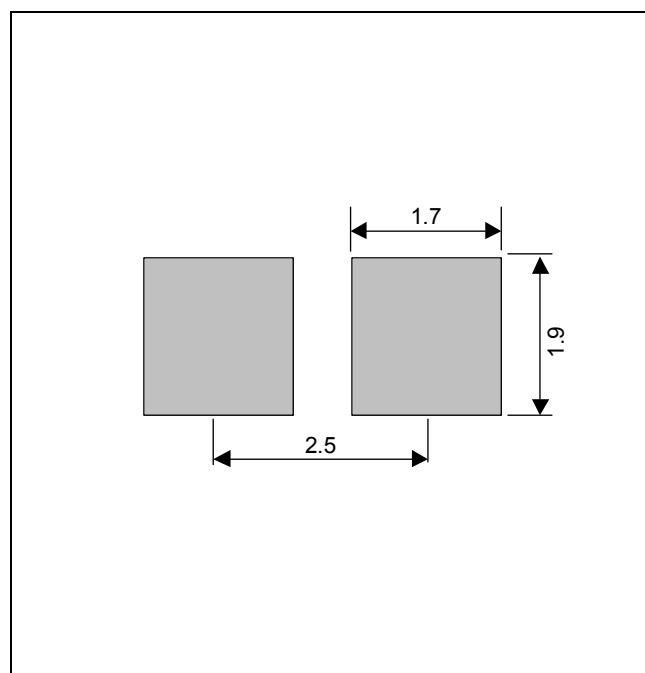
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)





## MHz RANGE CRYSTAL UNIT

### MINIATURE SIZE LOW PROFILE SMD

# FA - 238V / FA - 238

# TSX - 3225

- Frequency range : 12 MHz to 60 MHz (FA-238, FA-238V)
- Thickness : 0.6 mm Max. (TSX-3225)
- Overtone order : Fundamental
- Applications : Mobile phone, Bluetooth, W-LAN  
ISM band radio, Clock for MPU



Product Number (please contact us)

FA-238V : Q22FA23V0xxxx00

FA-238 : Q22FA2380xxxx00

TSX-3225 : X1E000021xxxx00



Actual size

FA-238V / FA-238

TSX-3225

## Specifications (characteristics)

| Item                                         | Symbol           | For Clock                                                                                             |                          | For RF Reference                               | Remarks                                                                                    |
|----------------------------------------------|------------------|-------------------------------------------------------------------------------------------------------|--------------------------|------------------------------------------------|--------------------------------------------------------------------------------------------|
|                                              |                  | FA-238V                                                                                               | FA-238                   | TSX-3225                                       |                                                                                            |
| Nominal frequency range                      | f <sub>nom</sub> | 12.000 MHz to 15.999 MHz                                                                              | 16.000 MHz to 60.000 MHz | 16.000 MHz to 48.000 MHz                       | Fundamental *1<br>For the out of standard specifications, please contact us for inquiries. |
| Temperature Range                            | T <sub>stg</sub> | -40 °C to +125 °C                                                                                     |                          | -40 °C to +125 °C                              | Store as bare product after unpacking                                                      |
| Storage temperature                          | T <sub>use</sub> | -40 °C to +85 °C                                                                                      |                          | -20 °C to +75 °C                               |                                                                                            |
| Operating temperature                        | DL               | 10 μW to 100 μW                                                                                       |                          | 100 μW Max.                                    |                                                                                            |
| Level of drive                               | f <sub>tol</sub> | ±50 × 10 <sup>-6</sup> (standard),<br>(±15 × 10 <sup>-6</sup> to ±50 × 10 <sup>-6</sup> is available) |                          | ±10 × 10 <sup>-6</sup>                         | +25 °C For the out of standard specifications, please contact us for inquiries. *1         |
| Frequency tolerance                          | f <sub>tem</sub> | ±30 × 10 <sup>-6</sup> / -20 °C to +70 °C                                                             |                          | ±10 × 10 <sup>-6</sup> / -20 °C to +75 °C      | For the out of standard specifications, please contact us for inquiries. *1                |
| Frequency versus temperature characteristics | CL               | 7 pF to ∞<br>(Standard: 10 pF)                                                                        |                          | 9 pF to ∞<br>(Standard: 9 pF, 12 pF, 16 pF, ∞) | For the out of standard specifications, please contact us for inquiries.                   |
| Load capacitance                             | R <sub>i</sub>   | As per below table                                                                                    |                          | As per below table                             | -40 °C to +85 °C, DL = 100 μW                                                              |
| Motional resistance (ESR)                    | f <sub>age</sub> | ±5 × 10 <sup>-6</sup> / year Max.                                                                     |                          | ±1 × 10 <sup>-6</sup> / year Max.*2            | +25 °C, First year                                                                         |
| Frequency aging                              |                  |                                                                                                       |                          |                                                |                                                                                            |

\*1 FA-238: For over 40 MHz, only the standard specification applies.

TSX-3225: For over 48 MHz, please contact us for inquiries.

\*2 40 MHz ≤ f<sub>nom</sub> : ±2 × 10<sup>-6</sup> / year Max.

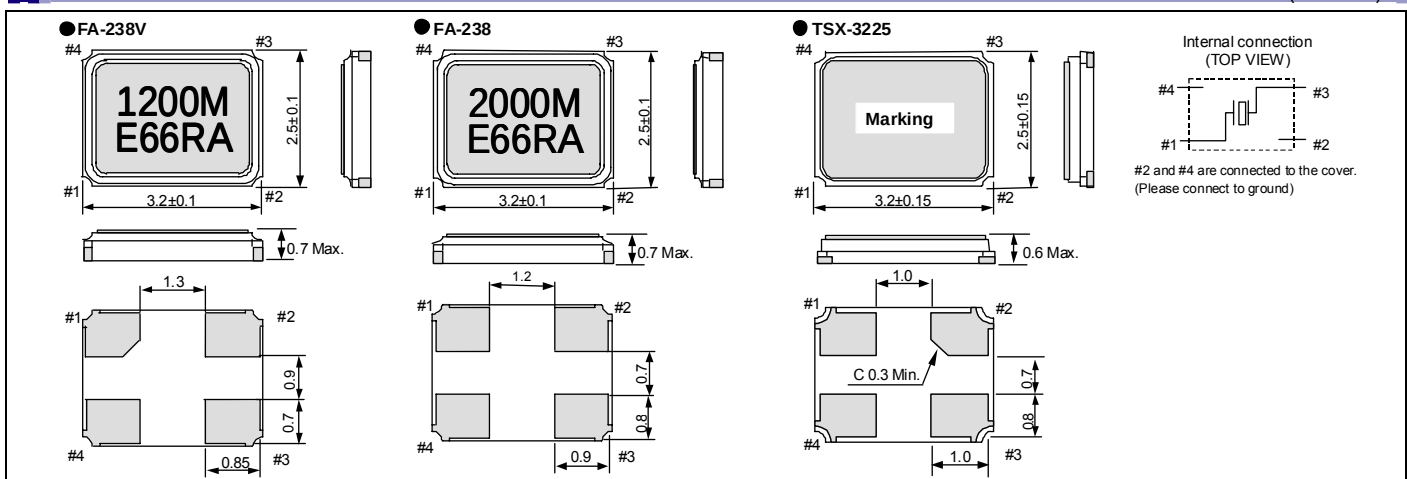
## Motional resistance (ESR)

| (FA-238V / FA-238) Frequency           | Motional resistance |
|----------------------------------------|---------------------|
| 12.0 MHz ≤ f <sub>nom</sub> ≤ 13.0 MHz | 100 Ω Max.          |
| 13.0 MHz < f <sub>nom</sub> < 20.0 MHz | 80 Ω Max.           |
| 20.0 MHz ≤ f <sub>nom</sub> < 25.0 MHz | 60 Ω Max.           |
| 25.0 MHz ≤ f <sub>nom</sub> < 30.0 MHz | 50 Ω Max.           |
| 30.0 MHz ≤ f <sub>nom</sub> ≤ 60.0 MHz | 40 Ω Max.           |

| (TSX-3225) Frequency                   | Motional resistance |
|----------------------------------------|---------------------|
| 16.0 MHz ≤ f <sub>nom</sub> < 21.0 MHz | 60 Ω Max.           |
| 21.0 MHz ≤ f <sub>nom</sub> ≤ 48.0 MHz | 40 Ω Max.           |

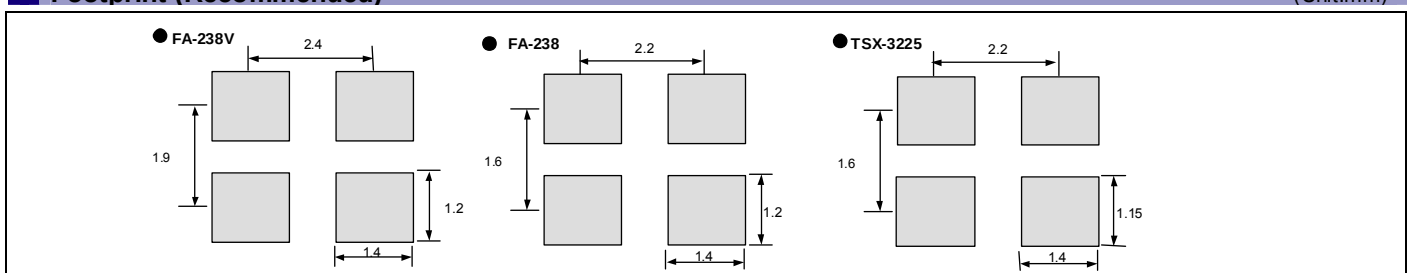
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





## MHz RANGE CRYSTAL UNIT

### LOW PROFILE SMD

# TSX-4025 / TSX-5032

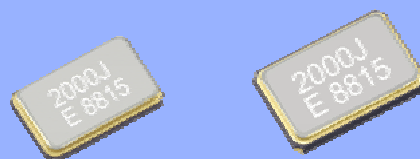
- Frequency range : 12 MHz to 32 MHz / 10 MHz to 32 MHz
- Thickness : 0.7 mm Max. (TSX-4025)  
0.8 mm Max. (TSX-5032)
- Overtone order : Fundamental
- Applications : Mobile phone, Bluetooth, W-LAN  
ISM band radio, Clock for MPU



Product Number (please contact us)

TSX-4025 : X1E000041xxxx00

TSX-5032 : X1E000061xxxx00



Actual size

TSX-4025

TSX-5032

## Specifications (characteristics)

| Item                                                    | Symbol           | Specification                               |                          | Remarks                                |
|---------------------------------------------------------|------------------|---------------------------------------------|--------------------------|----------------------------------------|
|                                                         |                  | TSX-4025                                    | TSX-5032                 |                                        |
| Nominal frequency range                                 | f <sub>nom</sub> | 12.000 MHz to 32.000 MHz                    | 10.000 MHz to 32.000 MHz | Fundamental                            |
| Storage temperature range                               | T <sub>stg</sub> | -40 °C to +125 °C                           |                          | Store as bare product after unpacking. |
| Operating temperature range                             | T <sub>use</sub> | -20 °C to +75 °C                            |                          |                                        |
| Level of drive                                          | DL               | 100 µW Max.                                 |                          |                                        |
| Frequency tolerance (standard)                          | f <sub>tol</sub> | ±10 × 10 <sup>-6</sup>                      |                          | +25 °C                                 |
| Frequency versus temperature characteristics (standard) | f <sub>tem</sub> | ±10 × 10 <sup>-6</sup>                      |                          | -20 °C to +75 °C                       |
| Load capacitance                                        | CL               | 9 pF to ∞ (standard: 9 pF, 12 pF, 16 pF, ∞) |                          | Please specify.                        |
| Motional resistance (ESR)                               | R <sub>1</sub>   | As per below table                          |                          | -20 °C to +75 °C                       |
| Frequency aging                                         | f <sub>age</sub> | ±1 × 10 <sup>-6</sup> / year Max.           |                          | +25 °C, First year                     |

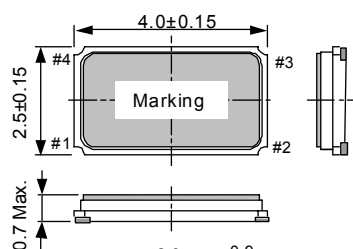
## Motional resistance (ESR)

| Frequency                              | TSX-4025  | TSX-5032  |
|----------------------------------------|-----------|-----------|
| 10.0 MHz ≤ f <sub>nom</sub> < 12.0 MHz | —         | 60 Ω Max. |
| 12.0 MHz ≤ f <sub>nom</sub> < 13.0 MHz | 60 Ω Max. |           |
| 13.0 MHz ≤ f <sub>nom</sub> < 17.0 MHz | 60 Ω Max. | 40 Ω Max. |
| 17.0 MHz ≤ f <sub>nom</sub> ≤ 32.0 MHz | 40 Ω Max. |           |

## External dimensions

(Unit:mm)

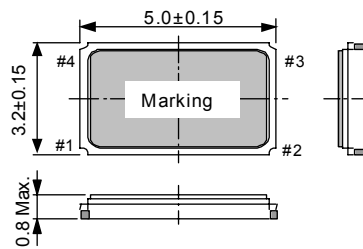
### ● TSX-4025



Internal Connection (TOP VIEW)

#2 and #4 are connected to the cover.  
(Please connect to ground)

### ● TSX-5032



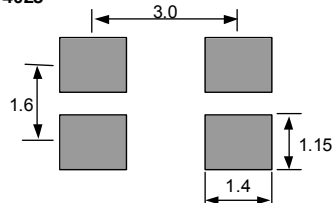
Internal Connection (TOP VIEW)

#2 and #4 are connected to the cover.  
(Please connect to ground)

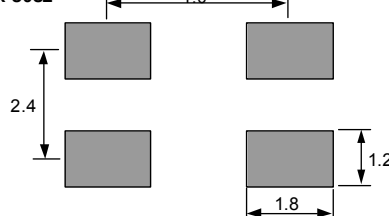
## Footprint (Recommended)

(Unit:mm)

### ● TSX-4025



### ● TSX-5032





## MHz RANGE CRYSTAL UNIT

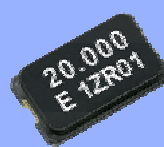
### LOW PROFILE SMD

# FA - 365

- Frequency range : 12 MHz, 14 MHz to 41 MHz
- Thickness : 1.4 mm Max.
- Overtone order : Fundamental
- Applications : For Clock of integrated circuit



Product Number (please contact us)  
Q22FA3650xxx00



Actual size



## Specifications (characteristics)

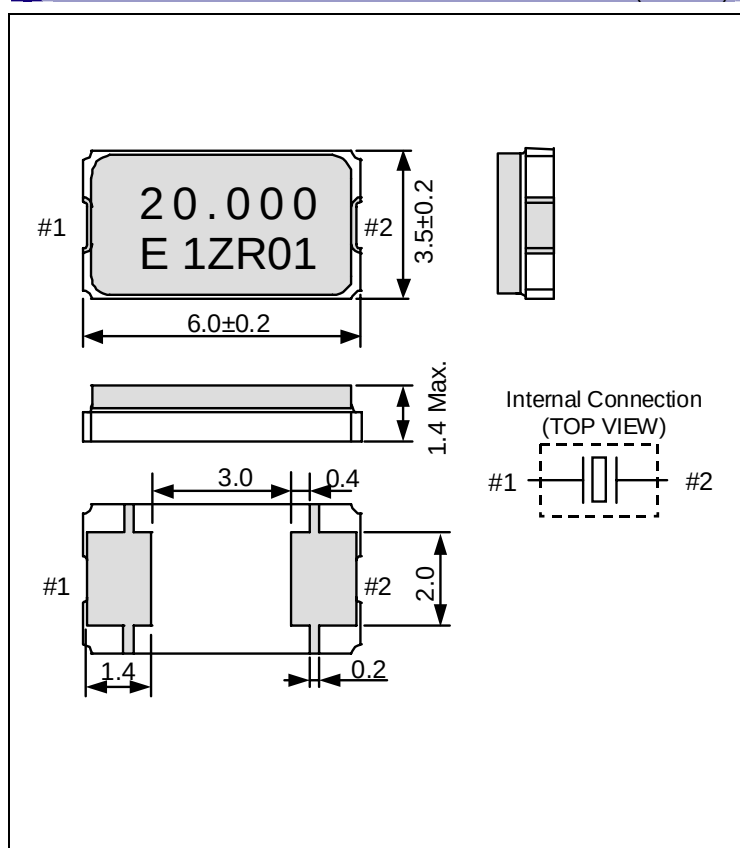
| Item                                                    | Symbol                | Specifications                                   | Remarks                                                                                    |
|---------------------------------------------------------|-----------------------|--------------------------------------------------|--------------------------------------------------------------------------------------------|
| Nominal frequency range                                 | f <sub>nom</sub>      | 12.000 MHz, 14.000 MHz to 41.000 MHz             | Fundamental                                                                                |
| Temperature range                                       | Storage temperature   | T <sub>stg</sub>                                 | -55 °C to +125 °C                                                                          |
|                                                         | Operating temperature | T <sub>use</sub>                                 | -20 °C to +70 °C                                                                           |
| Level of drive                                          | DL                    | 10 μW to 100 μW                                  |                                                                                            |
| Frequency tolerance (standard)                          | f <sub>tol</sub>      | ±50 × 10 <sup>-6</sup> , ±100 × 10 <sup>-6</sup> | +25 °C                                                                                     |
| Frequency versus temperature characteristics (standard) | f <sub>tem</sub>      | ±30 × 10 <sup>-6</sup>                           | -20 °C to +70 °C<br>For the out of standard specifications, please contact us for inquires |
| Load capacitance                                        | CL                    | 10 pF to ∞                                       | Please specify                                                                             |
| Motional resistance (ESR)                               | R <sub>1</sub>        | As per below table                               | -20 °C to +70 °C, DL=100 μW                                                                |
| Frequency aging                                         | f <sub>age</sub>      | ±5 × 10 <sup>-6</sup> / year Max.                | +25 °C, First year                                                                         |

## Motional resistance (ESR)

| Frequency                              | Motional resistance |
|----------------------------------------|---------------------|
| 12.0 MHz                               | 60 Ω Max.           |
| 14.0 MHz ≤ f <sub>nom</sub> ≤ 41.0 MHz | 50 Ω Max.           |

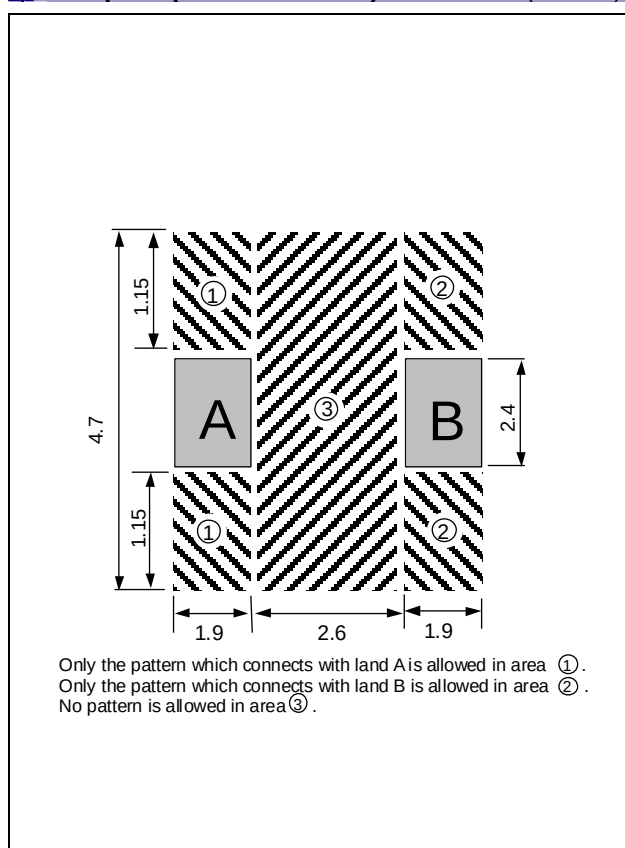
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





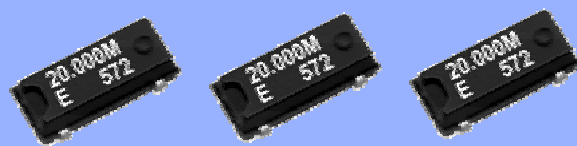
## MHz RANGE CRYSTAL UNIT LOW PROFILE SMD

### MA - 306

- Frequency range : 14.31818 MHz, 17.734 MHz to 41 MHz
- Thickness : 2.54 mm Max.
- Overtone order : Fundamental
- Applications : For Clock of integrated circuit



Product Number (please contact us)  
Q22MA3061xxxx00



Actual size

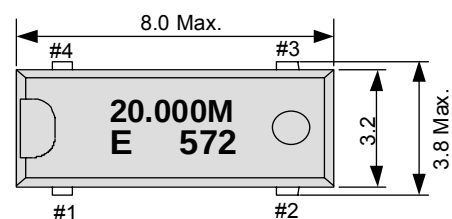


#### Specifications (characteristics)

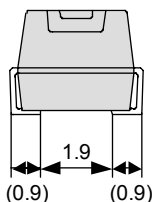
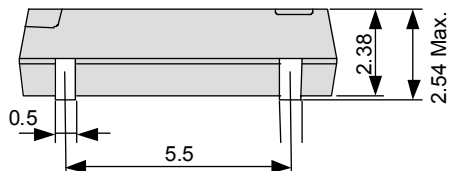
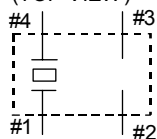
| Item                                                    |                       | Symbol         | Specifications                         | Remarks                                                                                     |
|---------------------------------------------------------|-----------------------|----------------|----------------------------------------|---------------------------------------------------------------------------------------------|
| Nominal frequency range                                 |                       | f_nom          | 14.31818 MHz, 17.734 MHz to 41.000 MHz | Fundamental                                                                                 |
| Temperature range                                       | Storage temperature   | T_stg          | -55 °C to +100 °C                      | Store as bare product after unpacking                                                       |
|                                                         | Operating temperature | T_use          | -20 °C to +70 °C                       |                                                                                             |
| Level of drive                                          |                       | DL             | 10 µW to 100 µW                        |                                                                                             |
| Frequency tolerance (standard)                          |                       | f_tol          | $\pm 50 \times 10^{-6}$                | +25 °C                                                                                      |
| Frequency versus temperature characteristics (standard) |                       | f_tem          | $\pm 30 \times 10^{-6}$                | -20 °C to +70 °C<br>For the out of standard specifications, please contact us for inquiries |
| Load capacitance                                        |                       | CL             | 10 pF to $\infty$                      | Please specify                                                                              |
| Motional resistance (ESR)                               |                       | R <sub>1</sub> | 60 Ω Max.                              | -20 °C to +70 °C, DL=100 µW                                                                 |
| Frequency aging                                         |                       | f_age          | $\pm 5 \times 10^{-6}$ / year Max.     | +25 °C, First year                                                                          |

#### External dimensions

(Unit:mm)



Internal Connection  
(TOP VIEW)

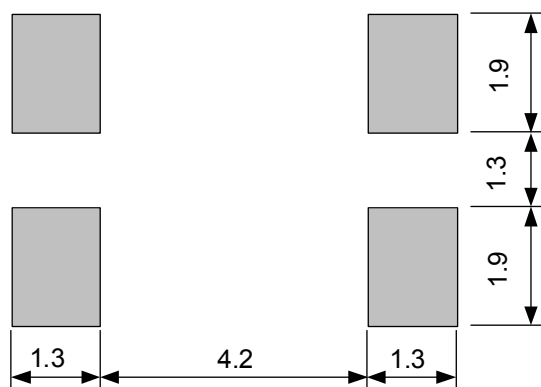


Do not connect #2 and #3 to external device.

Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

#### Footprint (Recommended)

(Unit:mm)





## MHz RANGE CRYSTAL UNIT SMD

# MA - 406 MA - 505 / MA - 506

- Frequency range : 4 MHz to 64 MHz
- Thickness : 3.7 mm Max.(MA-406)  
4.6 mm Max.(MA-505 / 506)
- Overtone order : Fundamental  
3rd overtone(30 MHz to 64 MHz)
- Applications : For Clock of integrated circuit



Product Number (please contact us)

MA-406 : Q22MA4061xxxx00

MA-505 : Q22MA5051xxxx00

MA-506 : Q22MA5061xxxx00



Actual size

MA-406

MA-505 / 506



## Specifications (characteristics)

| Item                                                    | Symbol         | Specifications                                               | Remarks                                                                 |
|---------------------------------------------------------|----------------|--------------------------------------------------------------|-------------------------------------------------------------------------|
| Nominal frequency range                                 | f_nom          | 4.000 MHz to 29.999 MHz                                      | Fundamental *1                                                          |
|                                                         |                | 30.000 MHz to 64.000 MHz                                     | 3rd overtone *2                                                         |
| Temperature range                                       | T_stg          | -55 °C to +125 °C                                            | Store as bare product after unpacking                                   |
|                                                         | T_use          | -20 °C to +70 °C                                             | Please contact us on availability of -40 °C to +85 °C                   |
| Level of drive                                          | DL             | 10 µW to 100 µW                                              |                                                                         |
| Frequency tolerance (standard)                          | f_tol          | $\pm 50 \times 10^{-6}$                                      | +25 °C                                                                  |
| Frequency versus temperature characteristics (standard) | f_tem          | Under 5.5 MHz: $\pm 50 \times 10^{-6}$                       | -20 °C to +70 °C                                                        |
|                                                         |                | Over 5.5 MHz: $\pm 30 \times 10^{-6}$                        | For the out of standard specifications, please contact us for inquiries |
| Load capacitance                                        | CL             | Fundamental: 10 pF to $\infty$<br>Overtone: 5 pF to $\infty$ | Please specify                                                          |
| Motional resistance (ESR)                               | R <sub>i</sub> | As per below table                                           | -20 °C to +70 °C, DL=100 µW                                             |
| Shunt capacitance                                       | C <sub>0</sub> | 5 pF Max.                                                    |                                                                         |
| Frequency aging                                         | f_age          | $\pm 5 \times 10^{-6}$ / year Max.                           | +25 °C, First year                                                      |

\*1 4.0 MHz  $\leq$  f\_nom < 5.5 MHz : See "Available frequencies from 4.0 MHz to less than 5.5 MHz". 8.0 MHz < f\_nom < 8.2 MHz: Unavailable.\*2 26.000 MHz  $\leq$  f\_nom < 30.000 MHz : please contact us for inquiries for 3rd overtone mode.

## Available frequencies from 4.0 MHz to less than 5.5 MHz (MHz)

|       |       |       |       |          |          |       |       |        |
|-------|-------|-------|-------|----------|----------|-------|-------|--------|
| 4.000 | 4.032 | 4.096 | 4.190 | 4.194304 | 4.433619 | 4.500 | 4.800 | 4.9152 |
|-------|-------|-------|-------|----------|----------|-------|-------|--------|

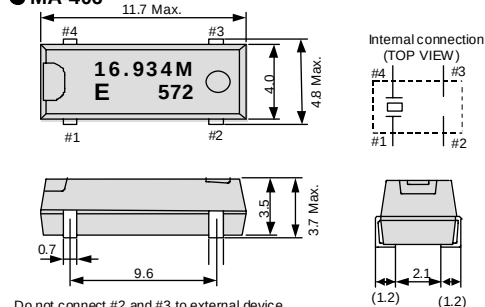
## Motional resistance (ESR)

| Frequency (MHz)     | 4 $\leq$ f_nom < 5.5 | 5.5 $\leq$ f_nom < 6 | 6 $\leq$ f_nom < 10 | 10 $\leq$ f_nom < 12 | 12 $\leq$ f_nom < 16 | 16 $\leq$ f_nom < 30 | 30 $\leq$ f_nom $\leq$ 36 | 36 < f_nom $\leq$ 64 |
|---------------------|----------------------|----------------------|---------------------|----------------------|----------------------|----------------------|---------------------------|----------------------|
| Motional resistance | 150 $\Omega$ Max.    | 100 $\Omega$ Max.    | 80 $\Omega$ Max.    | 60 $\Omega$ Max.     | 50 $\Omega$ Max.     | 40 $\Omega$ Max.     | 100 $\Omega$ Max.         | 80 $\Omega$ Max.     |
| Overtone order      | Fundamental          |                      |                     |                      |                      |                      | 3rd overtone              |                      |

## External dimensions

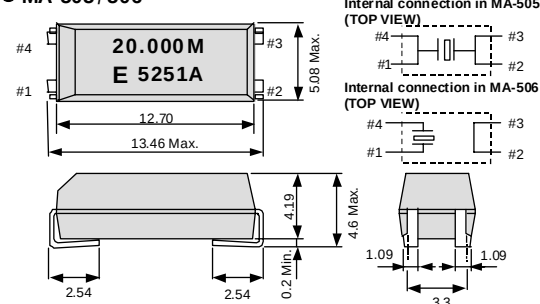
(Unit:mm)

### MA-406



Do not connect #2 and #3 to external device.  
Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

### MA-505 / 506

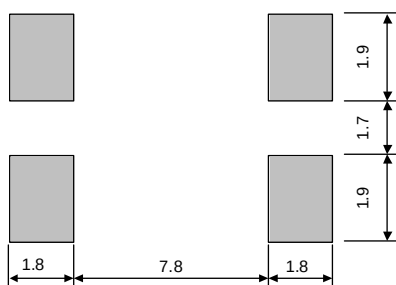


Do not connect #2 and #3 of MA-506 to external device.  
The first digit of lot No. means : 5xxxx MA-505  
6xxxx MA-506

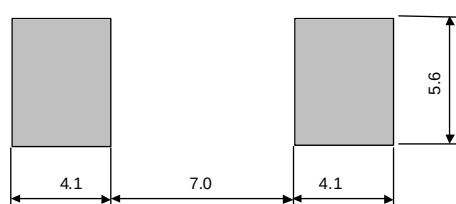
## Footprint (Recommended)

(Unit:mm)

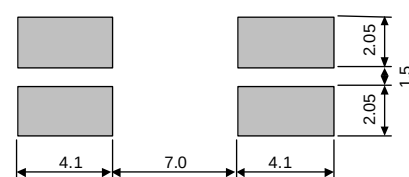
### MA-406



### MA-505



### MA-506







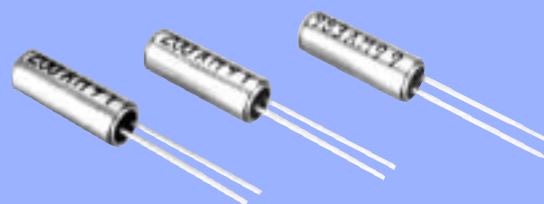
## MHz RANGE CRYSTAL UNIT CYLINDER

# CA - 301

- Frequency range : 4 MHz to 64 MHz
- Thickness :  $\phi 3.1$  mm Max.
- Overtone order : Fundamental  
3rd overtone (30 MHz to 64 MHz)
- Applications : For Clock of integrated circuit



Product Number (please contact us)  
Q21CA3011xxxx00



Actual size



### Specifications (characteristics)

| Item                                                    | Symbol                | Specification                                                                                | Remarks                          |
|---------------------------------------------------------|-----------------------|----------------------------------------------------------------------------------------------|----------------------------------|
| Nominal frequency range                                 | f <sub>nom</sub>      | 4.000 MHz to 29.999 MHz                                                                      | Fundamental *1                   |
|                                                         |                       | 30.000 MHz to 64.000 MHz                                                                     | 3rd overtone *2                  |
| Temperature range                                       | Storage temperature   | T <sub>stg</sub>                                                                             | -40 °C to +85 °C                 |
|                                                         | Operating temperature | T <sub>use</sub>                                                                             | -20 °C to +70 °C                 |
| Level of drive                                          | DL                    | 10 $\mu$ W to 100 $\mu$ W                                                                    |                                  |
| Frequency tolerance (standard)                          | f <sub>tol</sub>      | $\pm 30 \times 10^{-6}$ (Under 5.5 MHz: $\pm 50 \times 10^{-6}$ , $\pm 100 \times 10^{-6}$ ) | +25 °C                           |
| Frequency versus temperature characteristics (standard) | f <sub>tem</sub>      | Under 5.5 MHz: $\pm 50 \times 10^{-6}$                                                       | -10 °C to +60 °C                 |
|                                                         |                       | Over 5.5 MHz: $\pm 30 \times 10^{-6}$                                                        | -20 °C to +70 °C                 |
| Load capacitance                                        | CL                    | Fundamental: 10 pF to $\infty$                                                               | Please specify                   |
|                                                         |                       | Overtone: 5 pF to $\infty$                                                                   |                                  |
| Motional resistance (ESR)                               | R <sub>1</sub>        | As per below table                                                                           | -20 °C to +70 °C, DL=100 $\mu$ W |
| Frequency aging                                         | f <sub>age</sub>      | $\pm 5 \times 10^{-6}$ / year Max.                                                           | +25 °C, First year               |

\*1 4.0 MHz  $\leq$  f<sub>nom</sub> < 5.5 MHz : See "Available frequencies from 4.0 MHz to less than 5.5 MHz". 8.0 MHz < f<sub>nom</sub> < 8.2 MHz: Unavailable.

\*2 26.000 MHz  $\leq$  f<sub>nom</sub> < 30.000 MHz : please contact us for inquiries for 3rd overtone mode.

### Available frequencies from 4.0 MHz to less than 5.5 MHz (MHz)

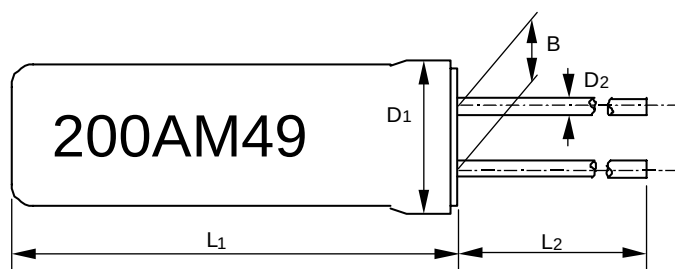
|       |       |       |       |          |          |       |       |        |
|-------|-------|-------|-------|----------|----------|-------|-------|--------|
| 4.000 | 4.032 | 4.096 | 4.190 | 4.194304 | 4.433619 | 4.500 | 4.800 | 4.9152 |
|-------|-------|-------|-------|----------|----------|-------|-------|--------|

### Motional resistance (ESR)

| Frequency (MHz)     | $4 \leq f_{nom} < 5.5$ | $5.5 \leq f_{nom} < 6$ | $6 \leq f_{nom} < 10$ | $10 \leq f_{nom} < 12$ | $12 \leq f_{nom} < 16$ | $16 \leq f_{nom} < 30$ | $30 \leq f_{nom} \leq 36$ | $36 < f_{nom} \leq 64$ |
|---------------------|------------------------|------------------------|-----------------------|------------------------|------------------------|------------------------|---------------------------|------------------------|
| Motional resistance | 150 $\Omega$ Max.      | 100 $\Omega$ Max.      | 80 $\Omega$ Max.      | 60 $\Omega$ Max.       | 50 $\Omega$ Max.       | 40 $\Omega$ Max.       | 100 $\Omega$ Max.         | 80 $\Omega$ Max.       |
| Overtone order      | Fundamental            |                        |                       |                        |                        |                        | 3rd overtone              |                        |

### External dimensions

(Unit:mm)



| Frequency     | L1       | L2       | D1              | D2         | B   |
|---------------|----------|----------|-----------------|------------|-----|
| Under 5.5 MHz | 9.3 Max. | 9.5 Min. | $\phi 3.1$ Max. | $\phi 0.3$ | 1.1 |
| Over 5.5 MHz  | 8.9 Max. | 9.5 Min. | $\phi 3.1$ Max. | $\phi 0.3$ | 1.1 |



## MHz RANGE CRYSTAL UNIT High Frequency SMD

### FH - 33H

- Frequency range : 60 MHz to 230 MHz
- Thickness : 1.0 mm Max.
- Overtone : Fundamental
- Applications : Backbone network



Product Number (please contact us)  
X1E000141xxxx00



Actual size



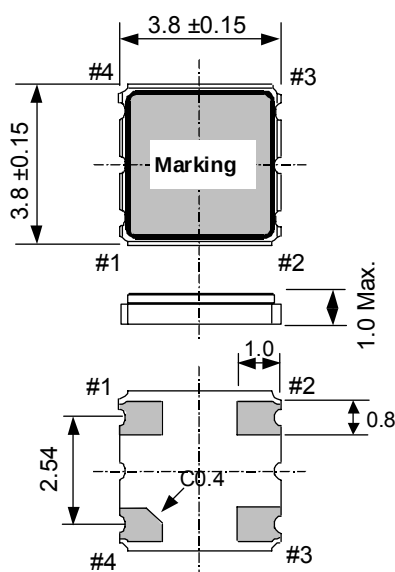
#### Specifications (characteristics)

| Item                                         | Symbol                | Specifications                         | Remarks                         |
|----------------------------------------------|-----------------------|----------------------------------------|---------------------------------|
| Nominal frequency range                      | f_nom                 | 60 MHz to 230 MHz                      | Fundamental                     |
| Temperature Range                            | Storage Temperature   | T_stg                                  | -50 °C to +95 °C                |
|                                              | Operating temperature | T_use                                  | -40 °C to +85 °C                |
| Level of drive                               | DL                    | 100 µW Max.                            |                                 |
| Frequency tolerance                          | f_tol                 | $\pm 35 \times 10^{-6}$                | +25 °C                          |
| Frequency versus Temperature characteristics | f_tem                 | $\pm 20 \times 10^{-6}$                | -40 °C to +85 °C                |
| Load capacitance                             | CL                    | 17 pF to $\infty$ (Standard $\infty$ ) | Please contact us for inquiries |
| Motional resistance                          | R <sub>1</sub>        | As per below table                     |                                 |
| Frequency aging                              | f_age                 | $\pm 10 \times 10^{-6}$ / 10years Max. | +25 °C                          |

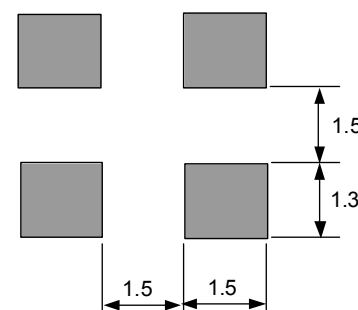
#### Motional resistance (R<sub>1</sub>)

| Frequency                              | Motional resistance |
|----------------------------------------|---------------------|
| 60.0 MHz $\leq$ f_nom < 75.0 MHz       | 40 $\Omega$ Max.    |
| 75.0 MHz $\leq$ f_nom $\leq$ 230.0 MHz | 30 $\Omega$ Max.    |

#### External dimensions



#### Footprint(Recommended) (Unit:mm)





Product Number (please contact us)  
Q25NS21Rxxxxx00

## SAW RESONATOR

### 1 port-type

# NS - 21R

- Frequency range : 300 MHz to 500 MHz
- Thickness : 0.86 mm Typ.
- Overtone order : Fundamental
- Applications : Small wireless equipment
- High reliability and excellent temperature characteristic.
- The smallest package size in the world.



Actual size



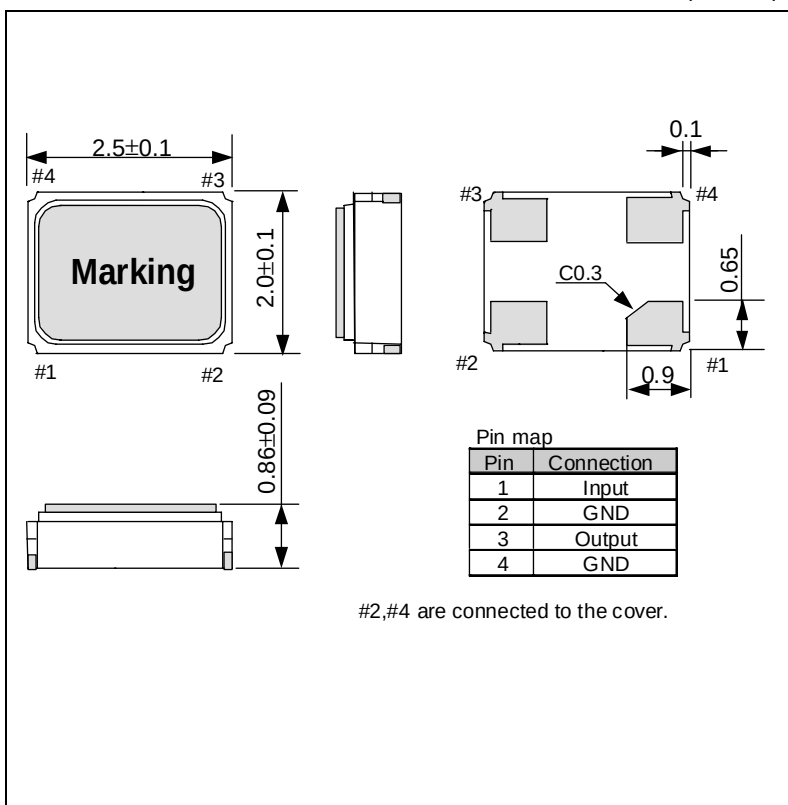
## Specifications (characteristics)

| Item                           | Symbol                | Specifications                                                             | Remarks                                                          |
|--------------------------------|-----------------------|----------------------------------------------------------------------------|------------------------------------------------------------------|
| Nominal frequency range        | f <sub>nom</sub>      | 300 MHz to 500 MHz                                                         | Please contact us for inquiries regarding available frequencies. |
| Temperature range              | Storage temperature   | T <sub>stg</sub>                                                           | -40 °C to +85 °C                                                 |
|                                | Operating temperature | T <sub>use</sub>                                                           |                                                                  |
| Level of drive                 | DL                    | 2 mW Max.                                                                  |                                                                  |
| Frequency tolerance (standard) | f <sub>tol</sub>      | ±50 × 10 <sup>-6</sup> , ±100 × 10 <sup>-6</sup> , ±150 × 10 <sup>-6</sup> | +25 °C                                                           |
| Turnover temperature           | Ti                    | +20 °C ±20 °C                                                              | Please contact us for inquiries about Peak temperature           |
| Parabolic coefficient          | B                     | -(1.6±0.4) × 10 <sup>-8</sup> / °C <sup>2</sup>                            |                                                                  |
| Harmonic ratio                 | Rs/ R <sub>1</sub>    | 2 Min.                                                                     |                                                                  |
| Motional resistance(ESR)       | R <sub>1</sub>        | 20 Ω Max.                                                                  |                                                                  |
| Frequency aging                | f <sub>age</sub>      | ±10 × 10 <sup>-6</sup> / year Max.                                         | +25 °C                                                           |
| Shock resistance               | S.R.                  | ±10 × 10 <sup>-6</sup> Max.                                                | Nine drops on a concrete surface from 1500 mm                    |

\*Please contact us for except RKE use.

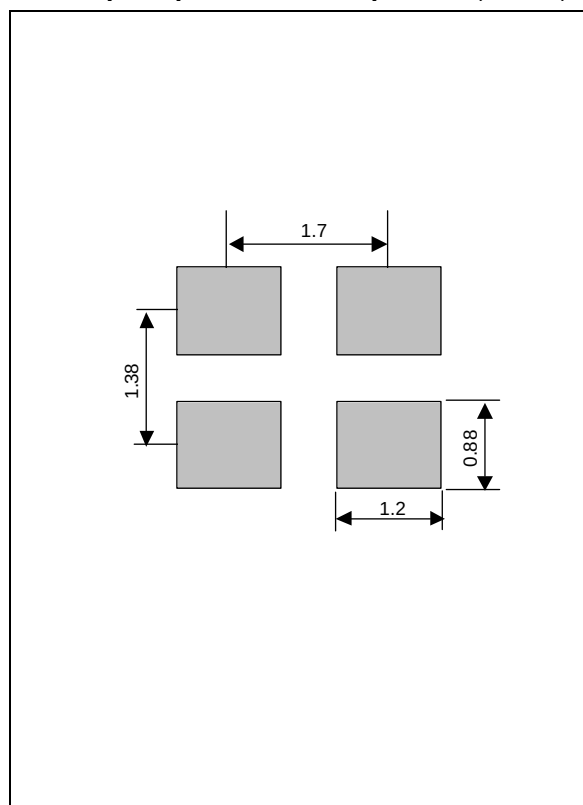
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





Product Number (please contact us)

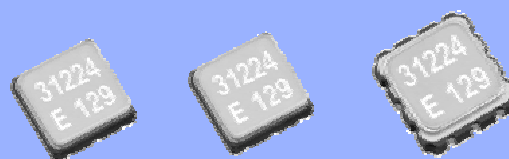
NS-32R: Q25NS32R0xxxx00

FS-335: Q25FS3350xxxx00

FS-555: Q25FS5550xxxx00

SAW RESONATOR  
HIGH-STABILITYNS - 32R  
FS - 335 / FS - 555

- Frequency range : 230 MHz to 870 MHz
- Thickness : 0.98 mm Typ.(NS-32R/FS-335)  
1.50 mm Typ.(FS-555)
- Overtone order : Fundamental
- Applications : Small wireless equipment



Actual size

NS-32R

FS-335

FS-555

## Specifications (characteristics)

| Item                           | Symbol         | Specifications                                     |                                                    |                    | Remark                                            |
|--------------------------------|----------------|----------------------------------------------------|----------------------------------------------------|--------------------|---------------------------------------------------|
|                                |                | NS-32R                                             | FS-335                                             | FS-555             |                                                   |
| Nominal frequency range        | f_nom          | 312 MHz to 870 MHz                                 | 300 MHz to 870 MHz                                 | 230 MHz to 500 MHz | Please contact us regarding available frequencies |
| Temperature range              | T_stg<br>T_use |                                                    | -40 °C to +85 °C                                   | -40 °C to +85 °C   | Store as bare product after unpacking             |
| Level of drive                 | DL             | 1 mW Typ.                                          | 2 mW Typ.                                          |                    | FS-335 : f_nom > 500 MHz 0.1 mW Typ.              |
| Frequency tolerance (standard) | f_tol          |                                                    | As per below table                                 |                    | +25 °C                                            |
| Turnover temperature           | Ti             | +25 °C ± 20 °C                                     | +25 °C ± 15 °C                                     |                    | Please specify                                    |
| Parabolic coefficient          | B              | $-(1.6 \pm 0.4) \times 10^{-8} / ^\circ\text{C}^2$ | $-(3.4 \pm 0.8) \times 10^{-8} / ^\circ\text{C}^2$ |                    |                                                   |
| Harmonic ratio                 | Rs/R1          |                                                    | 2 Min.                                             |                    |                                                   |
| Motional resistance (ESR)      | R1             |                                                    | As per below table                                 |                    |                                                   |
| Frequency aging                | f_age          |                                                    | $\pm 10 \times 10^{-6} / \text{year Max.}$         |                    | +25 °C                                            |
| Shock resistance               | S.R.           |                                                    | $\pm 10 \times 10^{-6} \text{ Max.}$               |                    | Nine drops on a concrete surface from 1500 mm     |

## Frequency tolerance / Motional resistance

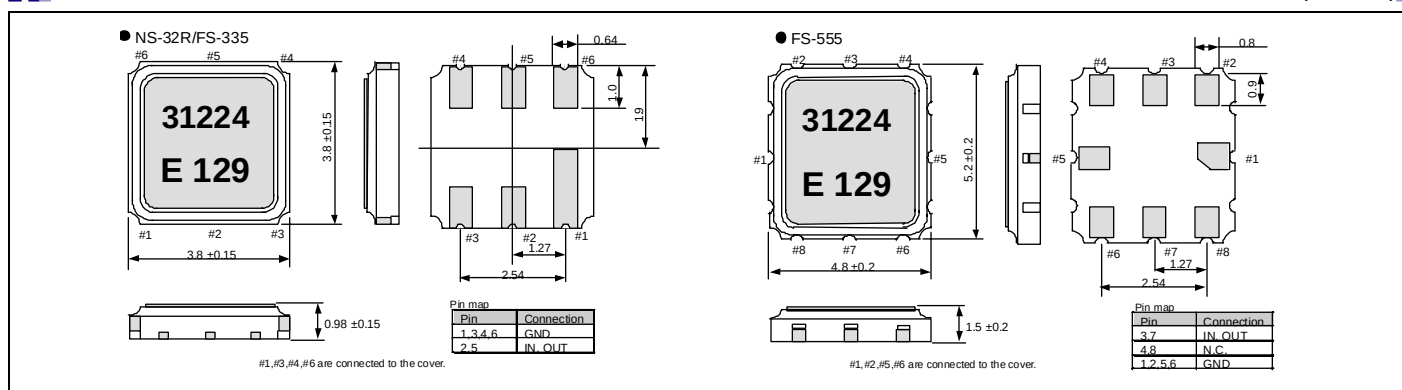
| Model  | Item                           | 312 MHz to 500 MHz                                 | 500 MHz to 870 MHz       |
|--------|--------------------------------|----------------------------------------------------|--------------------------|
| NS-32R | Frequency tolerance (standard) | $\pm 50 \times 10^{-6}, \pm 100 \times 10^{-6} *1$ | $\pm 100 \times 10^{-6}$ |
|        | Motional resistance (ESR)      | 30 Ω Max.                                          |                          |

| Model  | Item                           | 230 MHz to 250 MHz | 250 MHz to 300 MHz | 300 MHz to 500 MHz                                 | 500 MHz to 870 MHz       |
|--------|--------------------------------|--------------------|--------------------|----------------------------------------------------|--------------------------|
| FS-335 | Frequency tolerance (standard) | —                  | —                  | $\pm 50 \times 10^{-6}, \pm 100 \times 10^{-6} *1$ | $\pm 100 \times 10^{-6}$ |
|        | Motional resistance (ESR)      | —                  | —                  | 25 Ω Max.                                          | 40 Ω Max.                |
| FS-555 | Frequency tolerance (standard) | —                  | —                  | $\pm 50 \times 10^{-6}, \pm 100 \times 10^{-6} *1$ | —                        |
|        | Motional resistance (ESR)      | 40 Ω Max.          | 25 Ω Max.          | —                                                  | —                        |

\*1 Please contact us regarding frequency tolerance ( $< \pm 50 \times 10^{-6}$ )

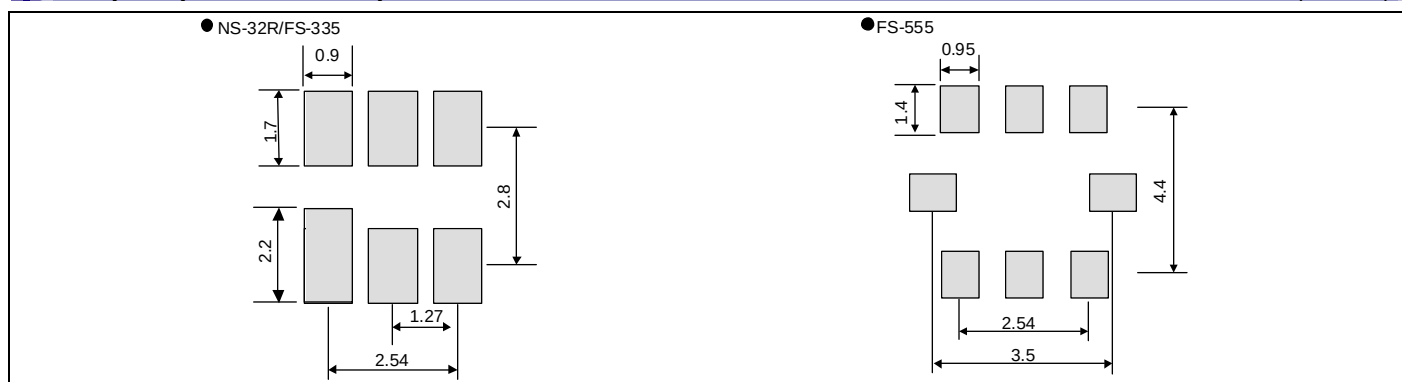
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)



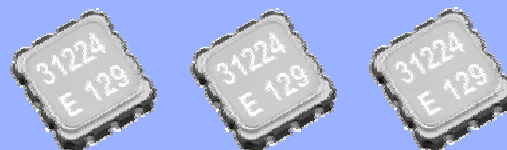


Product Number (please contact us)  
Q25FS5850xxxx00

## SAW RESONATOR FOR TPMS

### FS - 585

- Frequency range : 300 MHz to 500 MHz
- Thickness : 1.5 mm Typ.
- Overtone order : Fundamental
- Applications : TPMS, Small wireless equipment



Actual size

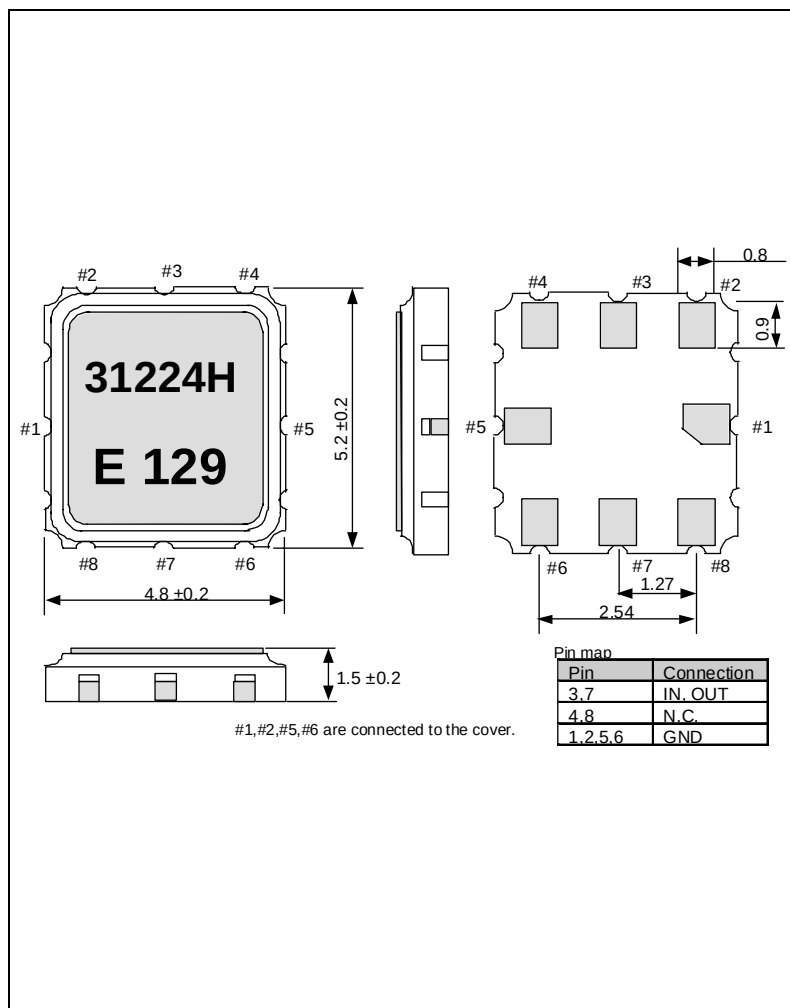


### Specifications (characteristics)

| Item                           |                       | Symbol | Specifications                                                                                | Remarks                                                          |
|--------------------------------|-----------------------|--------|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Nominal frequency range        |                       | f_nom  | 300 MHz to 500 MHz                                                                            | Please contact us for inquiries regarding available frequencies. |
| Temperature range              | Storage temperature   | T_stg  | -40 °C to +125 °C                                                                             | Store as bare product after unpacking                            |
|                                | Operating temperature | T_use  | -40 °C to +120 °C                                                                             |                                                                  |
| Level of drive                 |                       | DL     | 2 mW Typ.                                                                                     |                                                                  |
| Frequency tolerance (standard) |                       | f_tol  | $\pm 50 \times 10^{-6}$ , $\pm 100 \times 10^{-6}$                                            | +25 °C                                                           |
| Turnover temperature           |                       | Ti     | +40 °C $\pm$ 10 °C                                                                            | Please contact us for inquiries about Peak temperature           |
| Parabolic coefficient          |                       | B      | $-(3.4 \begin{smallmatrix} +0.8 \\ -0.6 \end{smallmatrix}) \times 10^{-8} / ^\circ\text{C}^2$ |                                                                  |
| Harmonic ratio                 |                       | Rs/ R1 | 2 Min.                                                                                        |                                                                  |
| Motional resistance (ESR)      |                       | R1     | 18 $\Omega$ Max.                                                                              |                                                                  |
| Frequency aging                |                       | f_age  | $\pm 10 \times 10^{-6}$ / year Max.                                                           | +25 °C                                                           |
| Shock resistance               |                       | S.R.   | $\pm 10 \times 10^{-6}$ Max.                                                                  | Nine drops on a concrete surface from 1500 mm                    |

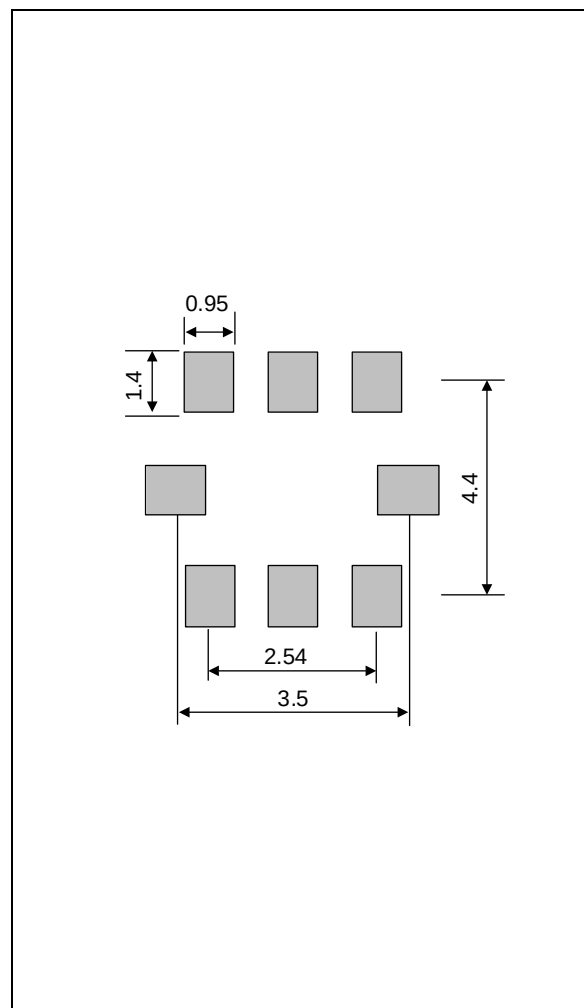
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)

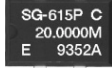




# OSCILLATOR

## CRYSTAL OSCILLATOR

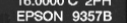
### ► SPXO

| Page  | Category                                                                                     | Actual size (mm)                                                                    |                       | Frequency    |                                                                                      |                                                                                     |         |         |         |  |
|-------|----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------|--------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|---------|---------|--|
|       |                                                                                              |                                                                                     |                       | 1 Hz         | 1 MHz                                                                                | 50 MHz                                                                              | 100 MHz | 500 MHz | 800 MHz |  |
| 29    | SG-3030JC<br>SG-3040JC                                                                       |    | 10.5×5.8×2.7 t (Max.) | ● 32.768 kHz |                                                                                      |                                                                                     |         |         |         |  |
|       | SG-3030JF                                                                                    |    | 7.1×5.1×1.5 t (Max.)  |              |                                                                                      |                                                                                     |         |         |         |  |
|       | SG-3030LC<br>SG-3040LC                                                                       |    | 3.6×2.8×1.2 t (Max.)  |              |                                                                                      |                                                                                     |         |         |         |  |
| 30    | SG-150 S*E  |    | 2.1×1.7×0.75 t (Typ.) | 3 MHz        |    | 54 MHz                                                                              |         |         |         |  |
| 31    | SG-211 S*E  |    | 2.5×2.0×0.7 t (Typ.)  | 2.375 MHz    |    | 60 MHz                                                                              |         |         |         |  |
| 32    | SG-210 series                                                                                |    | 2.5×2.0×0.8 t (Typ.)  | 2 MHz        |    | 60 MHz                                                                              |         |         |         |  |
| 33    | SG-310 series                                                                                |    | 3.2×2.5×1.05 t (Typ.) | 2 MHz        |    | 80 MHz                                                                              |         |         |         |  |
| 34    | SG-550 series                                                                                |    | 5.0×3.2×1.2 t (Max.)  | 2 MHz        |    | 48 MHz                                                                              |         |         |         |  |
| 35    | TCO-710x series                                                                              |    | 5.0×3.2×1.0 t (Typ.)  | 1.5 MHz      |    | 75 MHz                                                                              |         |         |         |  |
| 36    | SG-770 series                                                                                |    | 7.0×5.0×1.6 t (Typ.)  |              | 50 MHz                                                                               |  | 230 MHz |         |         |  |
| 37    | SG-771 PCD  |    | 7.0×5.0×1.6 t (Typ.)  |              | 50 MHz                                                                               |  | 175 MHz |         |         |  |
| 38    | TCO-708x series                                                                              |    | 7.0×5.0×1.6 t (Typ.)  | 1.5 MHz      |    | 160 MHz                                                                             |         |         |         |  |
| 39_40 | SG-645 series                                                                                |    | 7.1×5.1×1.5 t (Max.)  | 32.001 MHz   |    | 135 MHz                                                                             |         |         |         |  |
|       | SG-636 series                                                                                |   | 10.5×5.8×2.7 t (Max.) | 2.21675 MHz  |   | 135 MHz                                                                             |         |         |         |  |
| 41_42 | SG-615 series                                                                                |  | 14.0×9.8×4.7 t (Max.) | 1.025 MHz    |  | 135 MHz                                                                             |         |         |         |  |
|       | SG-531 series                                                                                |  | DIP half size         |              |                                                                                      |                                                                                     |         |         |         |  |
|       | SG-51 series                                                                                 |  | DIP full size         | 1.025 MHz    |  | 66.667 MHz                                                                          |         |         |         |  |

### ► Programmable

| Page  | Category                                                                                           | Package lineup                | Frequency |                                                                                      |        |         |         |         |
|-------|----------------------------------------------------------------------------------------------------|-------------------------------|-----------|--------------------------------------------------------------------------------------|--------|---------|---------|---------|
|       |                                                                                                    |                               | 1 Hz      | 1 MHz                                                                                | 50 MHz | 100 MHz | 500 MHz | 800 MHz |
| 43_44 | SG-8003 series  | BA,CE ,LB ,JF ,CA ,JC ,JA ,DC | 1.0 MHz   |  |        | 166 MHz |         |         |

| Page  | Category       | Package lineup                 | Frequency |                                                                                      |        |         |         |         |
|-------|----------------|--------------------------------|-----------|--------------------------------------------------------------------------------------|--------|---------|---------|---------|
|       |                |                                | 1 Hz      | 1 MHz                                                                                | 50 MHz | 100 MHz | 500 MHz | 800 MHz |
| 45_49 | SG-8002 series | CE, LB ,JF ,CA ,JC ,JA ,DC ,DB | 1.0 MHz   |  |        | 125 MHz |         |         |

| Type             | BA                                                                                  | CE                                                                                  | LB                                                                                  | JF                                                                                  | CA                                                                                  | JC                                                                                  | JA                                                                                    | DC                                                                                    | DB                                                                                    |
|------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Actual size (mm) | 2.1×1.7<br>0.75 t (Typ.)                                                            | 3.2×2.5<br>1.05 t (Typ.)                                                            | 5.0×3.2<br>1.2 t (Max.)                                                             | 7.1×5.1<br>1.5 t (Max.)                                                             | 7.0×5.0<br>1.4 t (Typ.)                                                             | 10.5×5.8<br>2.7 t (Max.)                                                            | 14.0×9.8<br>4.7 t (Max.)                                                              | DIP half size                                                                         | DIP full size                                                                         |
|                  |  |  |  |  |  |  |  |  |  |

|    |                                                                |
|----|----------------------------------------------------------------|
| 50 | SG-8002 series Outline of Specifications                       |
| 51 | SG-8002 series Jitter specifications and characteristics chart |
| 52 | SG-8000 series Programming Tool                                |





# OSCILLATOR

## CRYSTAL OSCILLATOR

### ► Spread Spectrum

| Page | Category   | Actual size (mm)                                                                  | Frequency             |        |        |         |         |         |
|------|------------|-----------------------------------------------------------------------------------|-----------------------|--------|--------|---------|---------|---------|
|      |            |                                                                                   | 1 Hz                  | 1 MHz  | 50 MHz | 100 MHz | 500 MHz | 800 MHz |
| 53   | SG-9001 LB |  | 5.0×3.2×1.2 t (Max.)  | 10 MHz |        |         | 135 MHz |         |
|      | SG-9001 CA |  | 7.0×5.0×1.4 t (Typ.)  | 10 MHz |        |         | 166 MHz |         |
|      | SG-9001 JC |  | 10.5×5.8×2.7 t (Max.) | 10 MHz |        |         | 166 MHz |         |

### ► Low-jitter SAW

| Page | Category                               | Actual size (mm)                                                                  | Frequency            |       |            |            |            |         |
|------|----------------------------------------|-----------------------------------------------------------------------------------|----------------------|-------|------------|------------|------------|---------|
|      |                                        |                                                                                   | 1 Hz                 | 1 MHz | 50 MHz     | 100 MHz    | 500 MHz    | 800 MHz |
| 54   | XG-1000CA                              |  | 7.0×5.0×1.2 t (Typ.) |       | 50 MHz     |            | 170 MHz    |         |
|      | XG-1000 CB                             |  | 5.0×3.2×1.1 t (Typ.) |       | 50 MHz     |            | 170 MHz    |         |
| 55   | EG-2021CA (2.5 V CMOS)                 |  | 7.0×5.0×1.2 t (Typ.) |       | 62.5 MHz   |            | 250 MHz    |         |
|      | EG-2001CA (3.3 V CMOS)                 |  | 7.0×5.0×1.2 t (Typ.) |       |            | 106.25 MHz | 170 MHz    |         |
| 56   | EG-2002CA (3.3 V LV-TTL)               |  | 7.0×5.0×1.2 t (Typ.) |       | 62.5 MHz   |            | 170 MHz    |         |
| 57   | EG-2121CA<br>Differential LV-PECL      |  | 7.0×5.0×1.2 t (Typ.) |       | 53.125 MHz |            | 500 MHz    |         |
|      |                                        |                                                                                   |                      |       | 53.125 MHz |            | 700 MHz    |         |
|      | EG-2102CA<br>Differential LV-PECL      |  | 7.0×5.0×1.2 t (Typ.) |       |            | 100 MHz    | 700 MHz    |         |
|      |                                        |                                                                                   |                      |       | 53.125 MHz |            | 700 MHz    |         |
| 58   | EG-2101CA (3.3 V Differential LV-PECL) |  | 7.0×5.0×1.2 t (Typ.) |       | 62.5 MHz   |            | 99.999 MHz |         |

### ► High-stability

| Page | Category        | Actual size (mm)                                                                    | Frequency             |       |        |         |         |         |
|------|-----------------|-------------------------------------------------------------------------------------|-----------------------|-------|--------|---------|---------|---------|
|      |                 |                                                                                     | 1 Hz                  | 1 MHz | 50 MHz | 100 MHz | 500 MHz | 800 MHz |
| 59   | HG-2150CA       |  | 7.0×5.0×1.5 t (Max.)  | 1 MHz |        | 60 MHz  |         |         |
| 60   | HG-8002JA       |  | 14.0×9.8×4.7 t (Max.) | 1 MHz |        | 125 MHz |         |         |
| 61   | TCO-391J        |  | 11.4×9.5×5.0 t        |       | 60 MHz |         | 230 MHz |         |
| 62   | TCO-3100 series |  | 13.9×9.8×4.7 t (Max.) |       | 60 MHz |         |         | 800 MHz |

### ► Multi-output

| Page | Category  | Actual size (mm)                                                                    | Frequency            |             |               |         |         |         |
|------|-----------|-------------------------------------------------------------------------------------|----------------------|-------------|---------------|---------|---------|---------|
|      |           |                                                                                     | 1 Hz                 | 1 MHz       | 50 MHz        | 100 MHz | 500 MHz | 800 MHz |
| 63   | MG-5020JE |  | 7.0×6.0×1.5 t (Max.) | ●32.768 kHz | ●48.00512 MHz |         |         |         |



# OSCILLATOR

## CRYSTAL OSCILLATOR / RUBIDIUM ATOMIC OSCILLATOR

### ► VCXO

| Page  | MODEL           |  | Actual size (mm)      | Frequency |        |         |         |         |         |
|-------|-----------------|--|-----------------------|-----------|--------|---------|---------|---------|---------|
|       |                 |  |                       | 1 Hz      | 1 MHz  | 50 MHz  | 100 MHz | 500 MHz | 800 MHz |
| 64    | VG-4231CE       |  | 3.2×2.5×1.05 t (Typ.) | 3 MHz     |        | 60 MHz  |         |         |         |
| 65    | VG-4231CB       |  | 5.0×3.2×1.2 t (Typ.)  | 1 MHz     |        | 60 MHz  |         |         |         |
|       | VG-4531CB       |  | 5.0×3.2×1.2 t (Typ.)  |           | 60 MHz |         | 80 MHz  |         |         |
| 66    | VG-4231CA       |  | 7.0×5.0×1.4 t (Typ.)  | 1 MHz     |        | 60 MHz  |         |         |         |
| 67    | VG-4501/4502CA  |  | 7.0×5.0×1.6 t (Typ.)  |           | 60 MHz |         | 80 MHz  |         |         |
| 68    | VG-4511CA       |  | 7.0×5.0×1.6 t (Typ.)  |           |        | 80 MHz  | 170 MHz |         |         |
| 69    | VG-1201CA       |  | 7.0×5.0×1.4 t (Typ.)  | 1 MHz     |        | 60 MHz  |         |         |         |
| 70    | TCO-291J        |  | 11.4×9.6×5.0 t (Max.) |           | 60 MHz |         | 230 MHz |         |         |
| 71    | TCO-294J        |  | 11.4×9.6×2.0 t (Max.) |           | 60 MHz |         |         |         | 690 MHz |
| 72    | TCO-2152        |  | 7.0×5.2×2.0 t (Max.)  |           |        | 77 MHz  | 230 MHz |         |         |
| 73_74 | TCO-2000 series |  | 13.9×9.8×4.7 t (Max.) | 8 MHz     |        | 125 MHz |         |         |         |
|       | TCO-2100 series |  | 13.9×9.8×4.7 t (Max.) | 1 MHz     |        |         |         |         | 800 MHz |

### ► TCXO

| Page | MODEL                |  | Actual size (mm)      | Frequency    |        |           |         |
|------|----------------------|--|-----------------------|--------------|--------|-----------|---------|
|      |                      |  |                       | 1 Hz         | 1 MHz  | 50 MHz    | 100 MHz |
| 75   | TG-3530SA            |  | 10.1×7.4×3.2 t (Typ.) | ● 32.768 kHz |        |           |         |
| 76   | TG-5021BA            |  | 2.1×1.7×0.75 t (Typ.) |              | 12 MHz | 52 MHz    |         |
| 77   | TG-5005CG            |  | 2.5×2.0×0.9 t (Typ.)  |              | 13 MHz | 40 MHz    |         |
| 78   | TG-5010CG            |  | 2.5×2.0×0.9 t (Typ.)  |              | 13 MHz | 40 MHz    |         |
| 79   | TG-5005CE            |  | 3.2×2.5×0.9 t (Typ.)  |              | 10 MHz | 40 MHz    |         |
| 80   | TG-5010LH            |  | 3.3×2.5×0.96 t (Typ.) |              | 10 MHz | 40 MHz    |         |
| 81   | TCO-5860 series      |  | 3.2×2.5×0.9 t (Typ.)  |              | 10 MHz | 40 MHz    |         |
| 82   | TCO-5060/5160 series |  | 7.0×5.0×1.9 t (Typ.)  |              | 10 MHz | 51.84 MHz |         |

### ► OCXO

| Page | MODEL            | Size (mm)               | Weight (Max.) | Frequency |          |        |         |
|------|------------------|-------------------------|---------------|-----------|----------|--------|---------|
|      |                  |                         |               | 1 Hz      | 1 MHz    | 50 MHz | 100 MHz |
| 83   | TCO-6831 series  | 70×50×12 t (Max.)       | 100 g         |           | 5 MHz    | 10 MHz |         |
| 84   | TCO-676 series   | 25.4×25.4×12.7 t (Max.) | 20 g          |           | 10 MHz   | 20 MHz |         |
| 85   | TCO-679 series   | 20.3×12.7×9.7 t (Typ.)  | 10 g          |           | 10 MHz   | 20 MHz |         |
| 86   | TCO-6920A        | 50.8×50.8×25.4 t (Max.) | 100 g         |           | ● 10 MHz |        |         |
| 87   | OX-6501GG series | 25.4×22×12.1 t (Typ.)   | 20 g          |           | 10 MHz   | 40 MHz |         |
| 88   | OX-6601DL series | 36.2×27.2×20.0 t (Max.) | 30 g          |           | 10 MHz   | 40 MHz |         |

### ► Rubidium Atomic oscillator

| Page | MODEL      | Size (mm) Typ.      | Weight (Typ.) | Frequency |                                        |        |         |
|------|------------|---------------------|---------------|-----------|----------------------------------------|--------|---------|
|      |            |                     |               | 1 Hz      | 1 MHz                                  | 50 MHz | 100 MHz |
| 89   | Rb-3310N   | 89(H)×110(W)×123(D) | 2 kg          |           | ● 10 MHz                               |        |         |
| 90   | Rb-2110 CB | 99(H)×480(W)×350(D) | 12 kg         | ●         | ● ● ● 100 kHz, 1 MHz, 3.58 MHz, 10 MHz |        |         |



## CRYSTAL OSCILLATOR

32.768 kHz

SG-3030LC / JF / JC  
SG-3040LC / JC

- Built-in 32.768 kHz crystal unit allows adjustment-free efficient operation.
- Use of C-MOS IC enables reduction of current consumption.
- VIO controls swing amplitude.



Product Number (please contact us)

SG-3030LC : Q3102LC0xxxxxx00

SG-3030JF : Q3102JF0xxxxxx00

SG-3030JC : Q3102JC0xxxxxx00

SG-3040LC : Q3103LC0xxxxxx00

SG-3040JC : Q3103JC0xxxxxx00

SG-3030LC  
SG-3040LC

Actual size

LC Type.



SG-3030JF

JF Type.

SG-3030JC  
SG-3040JC

JC Type.

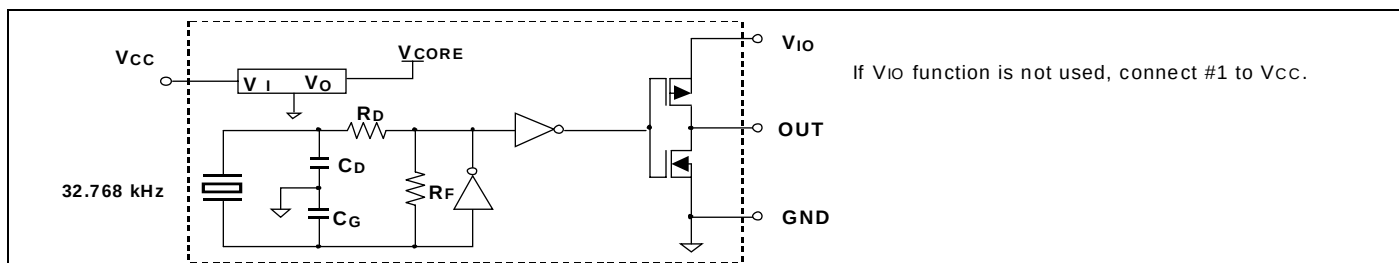


## Specifications (characteristics)

| Item                              |                       | Symbol                          | Specifications                                   |                                | Remarks                                                                                                                                       |
|-----------------------------------|-----------------------|---------------------------------|--------------------------------------------------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
|                                   |                       |                                 | SG-3030LC / JF / JC                              | SG-3040LC / JC                 |                                                                                                                                               |
| Output frequency range            |                       | f <sub>0</sub>                  | 32.768 kHz                                       |                                |                                                                                                                                               |
| Supply voltage                    |                       | V <sub>CC</sub>                 | 1.5 V to 5.5 V                                   | 0.9 V to 3.6 V                 |                                                                                                                                               |
| Interface power supply voltage    |                       | V <sub>IO</sub>                 | 1.5 V to 5.5 V                                   | 0.9 V to 3.6 V                 |                                                                                                                                               |
| Temperature range                 | Storage temperature   | T <sub>stg</sub>                | -55 °C to +125 °C                                |                                | Store as bare product after unpacking                                                                                                         |
|                                   | Operating temperature | T <sub>use</sub>                | -40 °C to +85 °C                                 |                                |                                                                                                                                               |
| Frequency tolerance               |                       | f <sub>tol</sub>                | 5 ±23 × 10 <sup>-6</sup>                         |                                | +25 °C, V <sub>CC</sub> =3.3 V (SG-3040: V <sub>CC</sub> =1.2 V)                                                                              |
| Frequency temperature coefficient |                       | f <sub>0</sub> -T <sub>C</sub>  | +10 × 10 <sup>-6</sup> / -120 × 10 <sup>-6</sup> |                                | -20 °C to +70 °C (+25 °C is reference)                                                                                                        |
| Frequency / voltage coefficient   |                       | f <sub>0</sub> -V <sub>CC</sub> | ±2 × 10 <sup>-6</sup> / V Max.                   | ±5 × 10 <sup>-6</sup> / V Max. | +25 °C                                                                                                                                        |
| Current consumption               |                       | I <sub>CC</sub>                 | 2 μA Max.                                        | 3.1 μA Max.                    | 3.3 V, No load condition                                                                                                                      |
| Symmetry                          |                       | SYM                             | 45 % to 55 %                                     |                                | 1/2 V <sub>CC</sub> (V <sub>IO</sub> )level (SG-3040: V <sub>IO</sub> =1.2 V to 3.6 V)                                                        |
| High output voltage               |                       | V <sub>OH</sub>                 | V <sub>IO</sub> -0.4 V Min.                      |                                | I <sub>OH</sub> =-0.4 mA (SG-3040: V <sub>IO</sub> =1.2 V to 3.6 V)                                                                           |
| Low output voltage                |                       | V <sub>OL</sub>                 | 0.4 V Max.                                       |                                | I <sub>OL</sub> = 0.4 mA (SG-3040: V <sub>IO</sub> =1.2 V to 3.6 V)                                                                           |
| Output load condition (CMOS)      |                       | L <sub>CMOS</sub>               | 15 pF Max.                                       |                                | CMOS load                                                                                                                                     |
| Rise time / Fall time             |                       | t <sub>r</sub> / t <sub>f</sub> | 200 ns Max.                                      | 100 ns Max.                    | CMOS load: 20 % V <sub>CC</sub> (V <sub>IO</sub> ) to 80 % V <sub>CC</sub> (V <sub>IO</sub> )level (SG-3040: V <sub>IO</sub> =1.2 V to 3.6 V) |
| Start-up time                     |                       | t <sub>str</sub>                | 1 s Max.                                         | 3 s Max.                       | Time at minimum Supply voltage to be 0 s                                                                                                      |
| Frequency aging                   |                       | f <sub>aging</sub>              | ±5 × 10 <sup>-6</sup> / year Max.                |                                | +25 °C, V <sub>CC</sub> = 3.3 V, First year                                                                                                   |

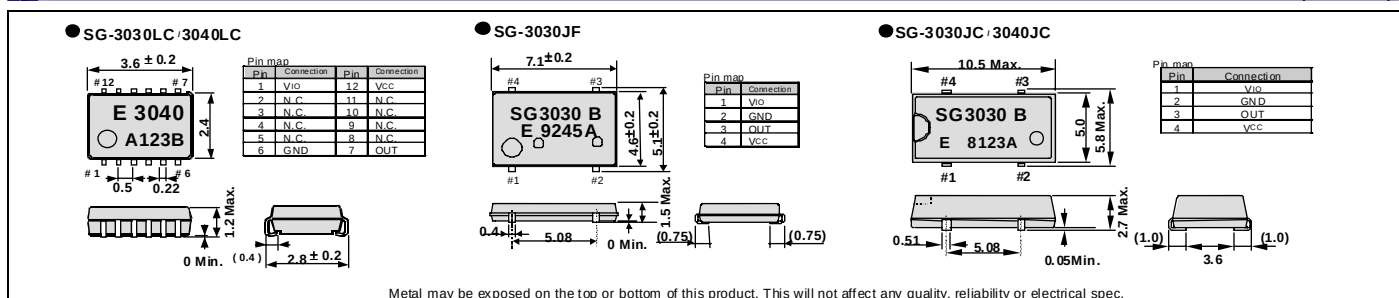
Unless otherwise stated, characteristics (specifications) shown in the above table are based on the rated operating temperature and voltage condition.

## Block diagram



## External dimension

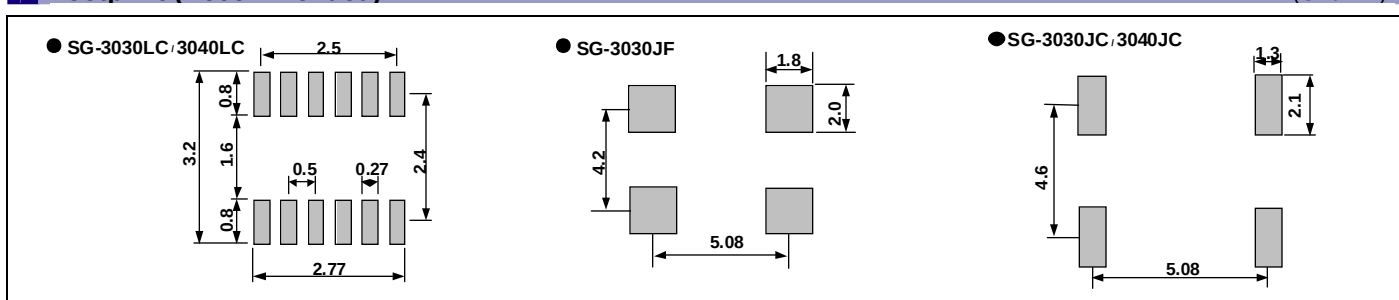
(Unit:mm)



Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

## Footprint (Recommended)

(Unit:mm)





## CRYSTAL OSCILLATOR

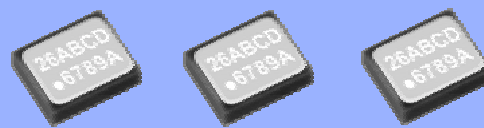
### Low Profile / High stability SPXO

# SG - 150 S\*E

- Frequency range : 3.000 MHz to 54.000 MHz
- Supply voltage : 1.8 V Typ. or 2.5 V Typ. or 3.3 V Typ.
- Current consumption : 3.3 mA Max.  
(SEE 1.8 V No load condition 40 MHz)
- Function : Standby(ST)
- Thickness : 0.75 mm Typ.



Product Number (please contact us)



Actual size

**NEW**

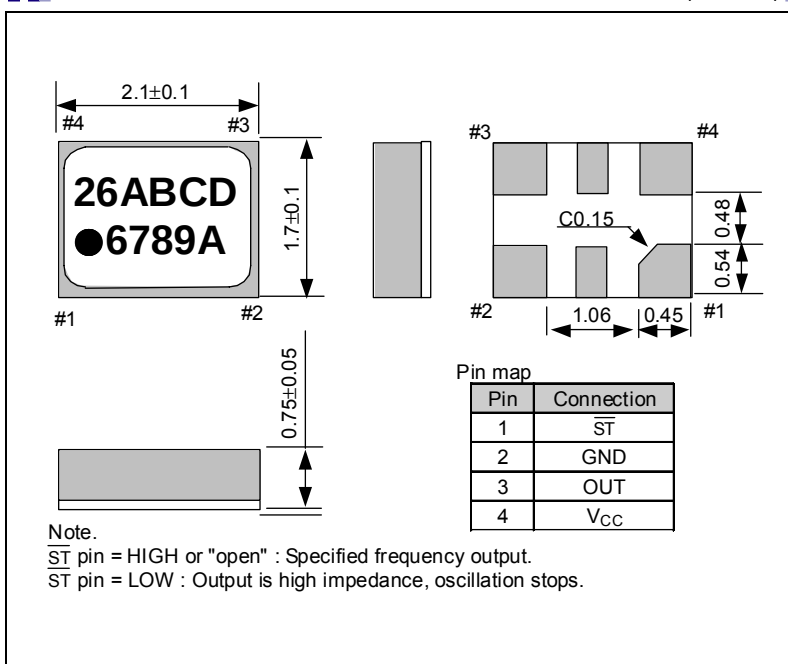
## Specifications (characteristics)

| Item                                  |                       | Symbol                          | Specifications                                         |                              |                              | Remarks                                                                      |                      |
|---------------------------------------|-----------------------|---------------------------------|--------------------------------------------------------|------------------------------|------------------------------|------------------------------------------------------------------------------|----------------------|
|                                       |                       |                                 | SG-150SEE                                              | SG-150SDE                    | SG-150SCE                    |                                                                              |                      |
| Output frequency range                |                       | f <sub>0</sub>                  | 3.000 MHz to 54.000 MHz                                |                              |                              | Please contact us for inquiries regarding the available frequencies.         |                      |
| Supply voltage                        |                       | V <sub>CC</sub>                 | 1.8 V Typ.<br>1.6 V to 2.2 V                           | 2.5 V Typ.<br>2.2 V to 2.7 V | 3.3 V Typ.<br>2.7 V to 3.6 V |                                                                              |                      |
| Temperature range                     | Storage temperature   | T <sub>stg</sub>                | -40 °C to +85 °C                                       |                              |                              | Store as bare product after unpacking                                        |                      |
|                                       | Operating temperature | T <sub>use</sub>                | -40 °C to +85 °C                                       |                              |                              |                                                                              |                      |
| Frequency tolerance *                 |                       | f <sub>tol</sub>                | D: ±20 × 10 <sup>-6</sup> , E: ±15 × 10 <sup>-6</sup>  |                              |                              | -20 °C to +70 °C                                                             | V <sub>CC</sub> ±10% |
|                                       |                       |                                 | H: ±20 × 10 <sup>-6</sup> , T: ±15 × 10 <sup>-6</sup>  |                              |                              | -40 °C to +85 °C                                                             |                      |
| Current consumption                   |                       | I <sub>CC</sub>                 | 2.3 mA Max.                                            | 2.5 mA Max.                  | 3.5 mA Max.                  | No load condition,3 MHz≤f <sub>0</sub> ≤32 MHz                               |                      |
|                                       |                       |                                 | 2.8 mA Max.                                            | 3.0 mA Max.                  | 4.0 mA Max.                  | No load condition,32 MHz<f <sub>0</sub> ≤40 MHz                              |                      |
|                                       |                       |                                 | 3.3 mA Max.                                            | 3.5 mA Max.                  | 4.5 mA Max.                  | No load condition,40 MHz<f <sub>0</sub> ≤48 MHz                              |                      |
|                                       |                       |                                 | 4.5 mA Max.                                            | 5.0 mA Max.                  | 6.0 mA Max.                  | No load condition,48 MHz<f <sub>0</sub> ≤54 MHz                              |                      |
| Stand-by current                      |                       | I <sub>std</sub>                | 5.0 μA Max.                                            |                              |                              | ST =GND                                                                      |                      |
| Symmetry                              |                       | SYM                             | 45 % to 55 %                                           |                              |                              | 50 % V <sub>CC</sub> level,L <sub>CMOS</sub> ≤ 15 pF                         |                      |
| High output voltage                   |                       | V <sub>OH</sub>                 | 90 % V <sub>CC</sub> Min.                              |                              |                              | I <sub>OH</sub> = -4 mA                                                      |                      |
| Low output voltage                    |                       | V <sub>OL</sub>                 | 10 % V <sub>CC</sub> Max.                              |                              |                              | I <sub>OL</sub> = 4 mA                                                       |                      |
| Output load condition (CMOS)          |                       | L <sub>CMOS</sub>               | 15 pF Max.                                             |                              |                              |                                                                              |                      |
| Output enable / disable input voltage |                       | V <sub>IH</sub>                 | 80 % V <sub>CC</sub> Min.                              |                              |                              | ST terminal                                                                  |                      |
|                                       |                       | V <sub>IL</sub>                 | 20 % V <sub>CC</sub> Max.                              |                              |                              |                                                                              |                      |
| Rise time / Fall time                 |                       | t <sub>r</sub> / t <sub>f</sub> | 4.5 ns Max.                                            |                              |                              | 20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> level, L <sub>CMOS</sub> =15 pF |                      |
| Start-up time                         |                       | t <sub>str</sub>                | 5 ms Max.                                              |                              |                              | t=0 at 90 % V <sub>CC</sub>                                                  |                      |
| Frequency aging                       |                       | f <sub>aging</sub>              | This is included in frequency tolerance specification. |                              |                              | +25 °C, First year, V <sub>CC</sub> = 1.8 V, 2.5 V, 3.3 V                    |                      |

\* Please contact us for inquiries regarding available frequency tolerance.

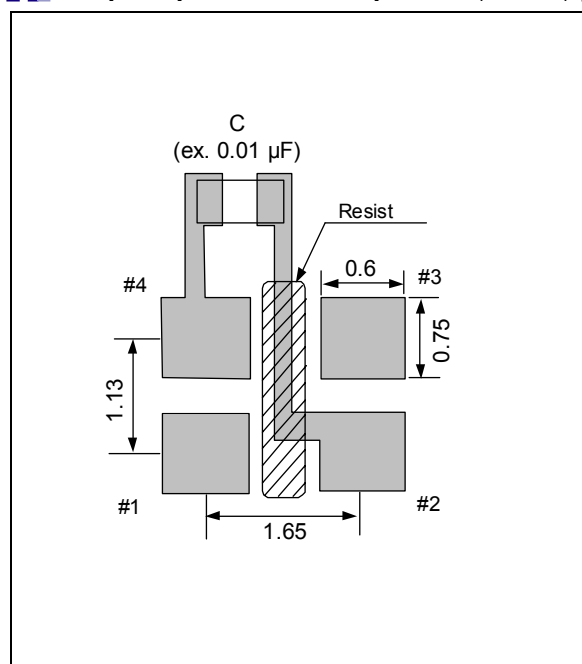
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





# CRYSTAL OSCILLATOR

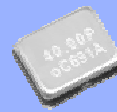
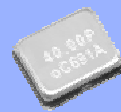
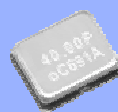
## Low Profile / High stability SPXO

# SG-211S\*E

- Frequency range : 2.375 MHz to 60.000 MHz
- Supply voltage : 1.8 V Typ. or 2.5 V Typ. or 3.3 V Typ.
- Current consumption : 3.3 mA Max.  
(SEE 1.8 V No load condition 40 MHz)
- Function : Standby( $\overline{ST}$ )
- Thickness : 0.7 mm Typ.



Product Number (please contact us)



Actual size

**NEW**

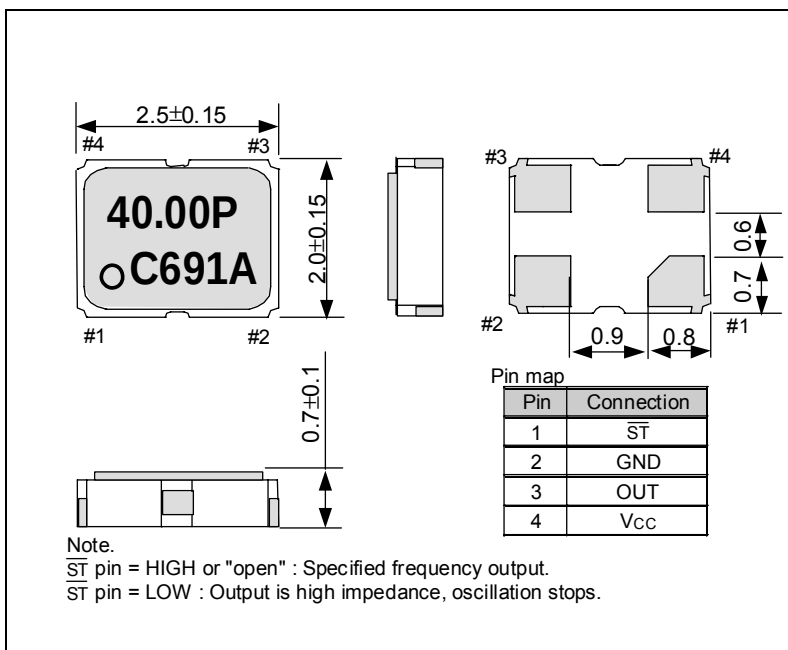
## Specifications (characteristics)

| Item                                  |                       | Symbol                          | Specifications                                         |                              |                              | Remarks                                                                      |                      |
|---------------------------------------|-----------------------|---------------------------------|--------------------------------------------------------|------------------------------|------------------------------|------------------------------------------------------------------------------|----------------------|
|                                       |                       |                                 | SG-211SEE                                              | SG-211SDE                    | SG-211SCE                    |                                                                              |                      |
| Output frequency range                |                       | f <sub>0</sub>                  | 2.375 MHz to 60.000 MHz                                |                              |                              | Please contact us for inquiries regarding the available frequencies.         |                      |
| Supply voltage                        |                       | V <sub>CC</sub>                 | 1.8 V Typ.<br>1.6 V to 2.2 V                           | 2.5 V Typ.<br>2.2 V to 2.7 V | 3.3 V Typ.<br>2.7 V to 3.6 V |                                                                              |                      |
| Temperature range                     | Storage temperature   | T <sub>stg</sub>                | -40 °C to +125 °C                                      |                              |                              | Store as bare product after unpacking                                        |                      |
|                                       | Operating temperature | T <sub>use</sub>                | -40 °C to +85 °C                                       |                              |                              |                                                                              |                      |
| Frequency tolerance *                 |                       | f <sub>tol</sub>                | D: ±20 × 10 <sup>-6</sup> , E: ±15 × 10 <sup>-6</sup>  |                              |                              | -20 °C to +70 °C                                                             | V <sub>CC</sub> ±10% |
|                                       |                       |                                 | H: ±20 × 10 <sup>-6</sup> , T: ±15 × 10 <sup>-6</sup>  |                              |                              | -40 °C to +85 °C                                                             |                      |
| Current consumption                   |                       | I <sub>CC</sub>                 | 2.3 mA Max.                                            | 2.5 mA Max.                  | 3.5 mA Max.                  | No load condition, 2.375 MHz≤f <sub>0</sub> ≤32 MHz                          |                      |
|                                       |                       |                                 | 2.8 mA Max.                                            | 3.0 mA Max.                  | 4.0 mA Max.                  | No load condition, 32 MHz<f <sub>0</sub> ≤40 MHz                             |                      |
|                                       |                       |                                 | 3.3 mA Max.                                            | 3.5 mA Max.                  | 4.5 mA Max.                  | No load condition, 40 MHz<f <sub>0</sub> ≤48 MHz                             |                      |
|                                       |                       |                                 | 4.5 mA Max.                                            | 5.0 mA Max.                  | 6.0 mA Max.                  | No load condition, 48 MHz<f <sub>0</sub> ≤60 MHz                             |                      |
| Stand-by current                      |                       | I <sub>std</sub>                | 5.0 μA Max.                                            |                              |                              | ST =GND                                                                      |                      |
| Symmetry                              |                       | SYM                             | 45 % to 55 %                                           |                              |                              | 50 % V <sub>CC</sub> level, L <sub>CMOS</sub> ≤ 15 pF                        |                      |
| High output voltage                   |                       | V <sub>OH</sub>                 | 90 % V <sub>CC</sub> Min.                              |                              |                              | I <sub>OH</sub> =4 mA                                                        |                      |
| Low output voltage                    |                       | V <sub>OL</sub>                 | 10 % V <sub>CC</sub> Max.                              |                              |                              | I <sub>OL</sub> = 4 mA                                                       |                      |
| Output load condition (CMOS)          |                       | L <sub>CMOS</sub>               | 15 pF Max.                                             |                              |                              |                                                                              |                      |
| Output enable / disable input voltage |                       | V <sub>IH</sub>                 | 80 % V <sub>CC</sub> Min.                              |                              |                              | ST terminal                                                                  |                      |
|                                       |                       | V <sub>IL</sub>                 | 20 % V <sub>CC</sub> Max.                              |                              |                              |                                                                              |                      |
| Rise time / Fall time                 |                       | t <sub>r</sub> / t <sub>f</sub> | 4.5 ns Max.                                            |                              |                              | 20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> level, L <sub>CMOS</sub> =15 pF |                      |
| Start-up time                         |                       | t <sub>str</sub>                | 5 ms Max.                                              |                              |                              | t=0 at 90 % V <sub>CC</sub>                                                  |                      |
| Frequency aging                       |                       | f <sub>aging</sub>              | This is included in frequency tolerance specification. |                              |                              | +25 °C, First year, V <sub>CC</sub> = 1.8 V, 2.5 V, 3.3 V                    |                      |

\* Please contact us for inquiries regarding available frequency tolerance.

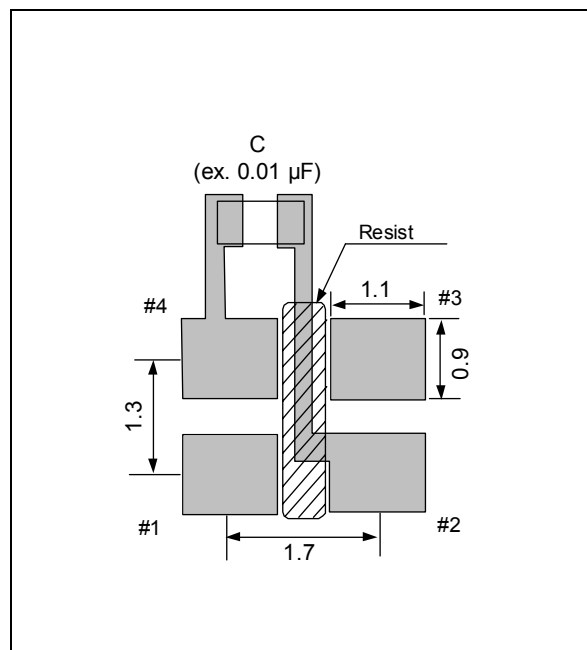
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





# CRYSTAL OSCILLATOR SPXO

## SG - 210 series

- Frequency range : 2 MHz to 60 MHz
- Supply voltage : 1.5 V Typ. / 1.8 V Typ. / 2.5 V Typ. / 3.3 V Typ.
- Current consumption : 0.9 mA Typ.  
(SEB 1.8 V No load condition 48 MHz)
- Function : Standby( $\overline{ST}$ )
- Thickness : 0.8 mm Typ.
- Operation temperature : +105 °C / +125 °C



Product Number (please contact us)  
Q33210Bx0xxxx00



Actual size

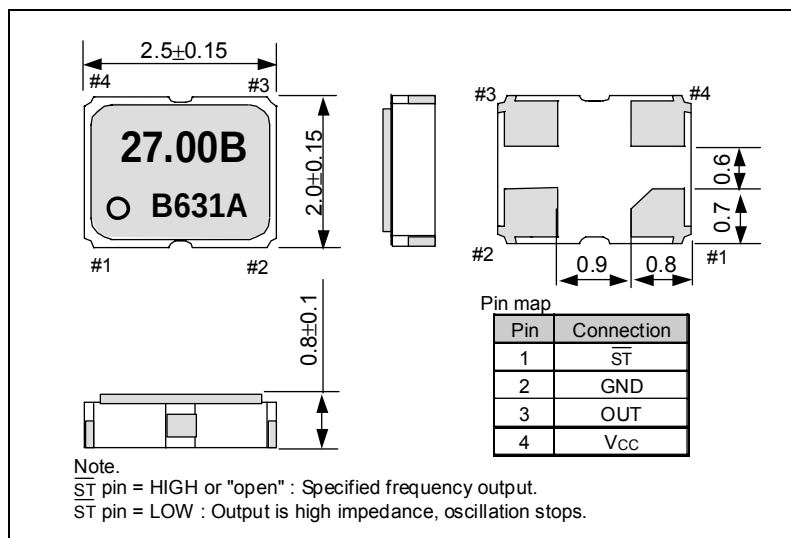


### Specifications (characteristics)

| Item                                  |                       | Symbol                          | Specifications                                           |                                                         |                              |                              | Remarks                                                                               |                                                                              |
|---------------------------------------|-----------------------|---------------------------------|----------------------------------------------------------|---------------------------------------------------------|------------------------------|------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
|                                       |                       |                                 | SG-210SGB                                                | SG-210SEB                                               | SG-210SDB                    | SG-210SCB                    |                                                                                       |                                                                              |
| Output frequency range                |                       | f <sub>0</sub>                  | 2 MHz to 32 MHz                                          | 2 MHz to 60 MHz                                         |                              |                              |                                                                                       |                                                                              |
| Supply voltage                        |                       | V <sub>CC</sub>                 | 1.5 V Typ.<br>1.3 V to 1.7 V                             | 1.8 V Typ.<br>1.6 V to 2.2 V                            | 2.5 V Typ.<br>2.2 V to 3.0 V | 3.3 V Typ.<br>2.7 V to 3.6 V |                                                                                       |                                                                              |
| Temperature range                     | Storage temperature   | T <sub>stg</sub>                | -40 °C to +125 °C                                        |                                                         |                              |                              | Store as bare product after unpacking                                                 |                                                                              |
|                                       | Operating temperature | T <sub>use</sub>                | -40 °C to +85 °C / -40 °C to +105 °C / -40 °C to +125 °C |                                                         |                              |                              |                                                                                       |                                                                              |
| Frequency tolerance                   |                       | f <sub>tol</sub>                | F: ±20 × 10 <sup>-6</sup>                                |                                                         |                              |                              | -10 °C to +60 °C, f <sub>0</sub> ≤ 32 MHz, V <sub>CC</sub> ±10%, except reflow drift. |                                                                              |
|                                       |                       |                                 | B: ±50 × 10 <sup>-6</sup> , C: ±100 × 10 <sup>-6</sup>   |                                                         |                              |                              | -20 °C to +70 °C                                                                      |                                                                              |
|                                       |                       |                                 | L: ±50 × 10 <sup>-6</sup> , M: ±100 × 10 <sup>-6</sup>   |                                                         |                              |                              | -40 °C to +85 °C                                                                      |                                                                              |
|                                       |                       |                                 | —                                                        | Y: ±50 × 10 <sup>-6</sup> , W: ±100 × 10 <sup>-6</sup>  |                              |                              | -40 °C to +105 °C                                                                     |                                                                              |
|                                       |                       |                                 | —                                                        | Z: ±100 × 10 <sup>-6</sup> , X: ±150 × 10 <sup>-6</sup> |                              |                              | -40 °C to +125 °C                                                                     |                                                                              |
| Current consumption                   |                       | I <sub>CC</sub>                 | 1.0 mA Max.                                              | 1.6 mA Max.                                             | 2.4 mA Max.                  | 3.0 mA Max.                  | No load condition                                                                     |                                                                              |
|                                       |                       |                                 | —                                                        | 2.0 mA Max                                              | 3.0 mA Max.                  | 4.0 mA Max.                  | No load condition +105 °C, +125 °C                                                    |                                                                              |
| Stand-by current                      |                       | I <sub>std</sub>                | 0.3 µA Max.                                              | 0.5 µA Max.                                             | 1.0 µA Max.                  | 1.0 µA Max.                  | ST =GND                                                                               |                                                                              |
|                                       |                       |                                 | —                                                        | 1.6 µA Max.                                             | 2.4 µA Max.                  | 3.0 µA Max.                  | ST =GND +105 °C, +125 °C                                                              |                                                                              |
| Symmetry                              |                       | SYM                             | 45 % to 55 %                                             | 45 % to 55 %                                            | 45 % to 55 %                 | 45 % to 55 %                 | 2 MHz≤f <sub>0</sub> ≤16 MHz                                                          | 50 % V <sub>CC</sub> level<br>L <sub>CMOS</sub> ≤ 15 pF                      |
|                                       |                       |                                 | 40 % to 60 %                                             |                                                         |                              |                              | 16 MHz<f <sub>0</sub> ≤32 MHz                                                         |                                                                              |
|                                       |                       |                                 | —                                                        |                                                         |                              |                              | 32 MHz<f <sub>0</sub> ≤60 MHz                                                         |                                                                              |
|                                       |                       |                                 | —                                                        |                                                         |                              |                              | +105 °C, +125 °C                                                                      |                                                                              |
| High output voltage                   |                       | V <sub>OH</sub>                 | 90 % V <sub>CC</sub> Min.                                |                                                         |                              |                              | I <sub>OH</sub> =-1 mA                                                                |                                                                              |
| Low output voltage                    |                       | V <sub>OL</sub>                 | 10 % V <sub>CC</sub> Max.                                |                                                         |                              |                              | I <sub>OL</sub> = 1 mA                                                                |                                                                              |
| Output load condition (CMOS)          |                       | L <sub>CMOS</sub>               | 15 pF Max.                                               |                                                         |                              |                              |                                                                                       |                                                                              |
| Output enable / disable input voltage |                       | V <sub>IH</sub>                 | 80 % V <sub>CC</sub> Min.                                |                                                         |                              |                              | ST terminal                                                                           |                                                                              |
|                                       |                       | V <sub>IL</sub>                 | 20 % V <sub>CC</sub> Max.                                |                                                         |                              |                              |                                                                                       |                                                                              |
| Rise time and Fall time               |                       | t <sub>r</sub> / t <sub>f</sub> | 5 ns Max.                                                | 4 ns Max.                                               | 3 ns Max.                    |                              | +85 °C                                                                                | 20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> level, L <sub>CMOS</sub> =15 pF |
|                                       |                       |                                 | —                                                        | 7 ns Max                                                |                              |                              | +105 °C, +125 °C                                                                      |                                                                              |
| Start-up time                         |                       | t <sub>str</sub>                | 3 ms Max.                                                |                                                         |                              |                              | t=0 at 90 % V <sub>CC</sub> (+105 °C, +125 °C : 5 ms Max.)                            |                                                                              |
| Frequency aging                       |                       | f <sub>aging</sub>              | ±3 × 10 <sup>-6</sup> / year Max.                        |                                                         |                              |                              | +25 °C, First year, V <sub>CC</sub> =1.5V, 1.8 V, 2.5 V, 3.3 V                        |                                                                              |

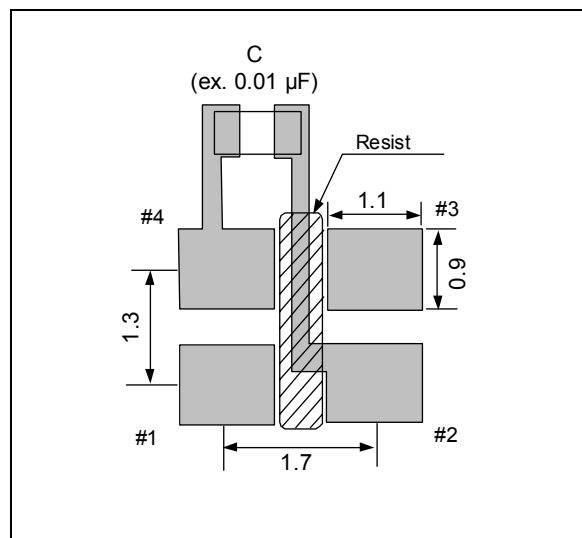
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



CRYSTAL OSCILLATOR  
SPXO

## SG - 310 series

- Frequency range : 2 MHz to 80 MHz
- Supply voltage : 1.8 V Typ. / 2.5 V Typ. / 3.3 V Typ.
- Current consumption : 1.5 mA Typ.  
(SEF 1.8 V No load condition 48 MHz)
- Function : Standby( $\overline{ST}$ )
- Thickness : 1.05 mm Typ.

Product Number (please contact us)  
Q33310xx0xxxx00

Actual size

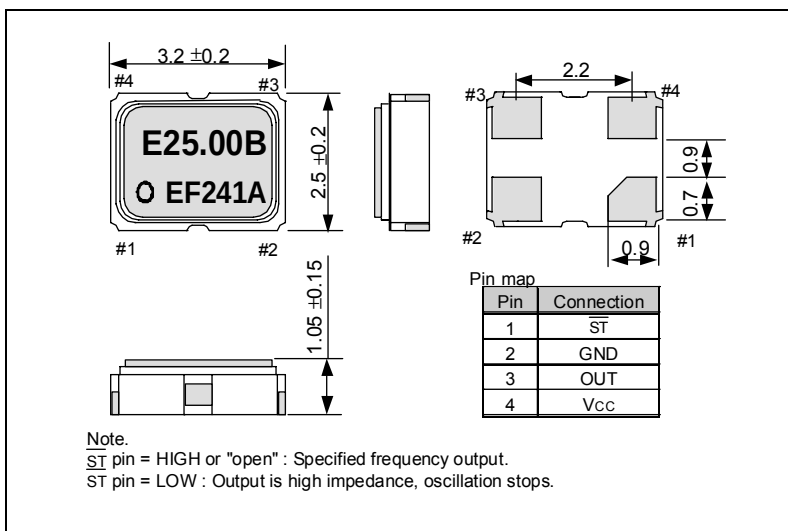


## Specifications (characteristics)

| Item                                  |                       | Symbol                             | Specifications                                         |                              |                              |                                                        |                              | Remarks                                                                      |                                                         |
|---------------------------------------|-----------------------|------------------------------------|--------------------------------------------------------|------------------------------|------------------------------|--------------------------------------------------------|------------------------------|------------------------------------------------------------------------------|---------------------------------------------------------|
|                                       |                       |                                    | SG-310 SEF                                             | SG-310 SDF                   | SG-310 SCF                   | SG-310 SDN                                             | SG-310 SCN                   |                                                                              |                                                         |
| Output frequency range                |                       | f <sub>0</sub>                     | 2.000 MHz to 48.000 MHz                                |                              |                              | 3.000 MHz to 80.000 MHz                                |                              |                                                                              |                                                         |
| Supply voltage                        |                       | V <sub>CC</sub>                    | 1.8 V Typ.<br>1.6 V to 2.2 V                           | 2.5 V Typ.<br>2.2 V to 3.0 V | 3.3 V Typ.<br>2.7 V to 3.6 V | 2.5 V Typ.<br>2.2 V to 2.7 V                           | 3.3 V Typ.<br>2.7 V to 3.6 V |                                                                              |                                                         |
| Temperature range                     | Storage temperature   | T <sub>stg</sub>                   | -40 °C to +125 °C                                      |                              |                              |                                                        |                              | Store as bare product after unpacking                                        |                                                         |
|                                       | Operating temperature | T <sub>use</sub>                   | -40 °C to +85 °C                                       |                              |                              |                                                        |                              |                                                                              |                                                         |
| Frequency tolerance                   |                       | f <sub>tol</sub>                   | B: ±50 × 10 <sup>-6</sup> , C: ±100 × 10 <sup>-6</sup> |                              |                              | B: ±50 × 10 <sup>-6</sup> , C: ±100 × 10 <sup>-6</sup> |                              | -20 °C to +70 °C                                                             |                                                         |
|                                       |                       |                                    | M: ±100 × 10 <sup>-6</sup>                             |                              |                              | M: ±100 × 10 <sup>-6</sup>                             |                              | -40 °C to +85 °C                                                             |                                                         |
|                                       |                       |                                    | —                                                      |                              |                              | D: ±20 × 10 <sup>-6</sup> , S: ±25 × 10 <sup>-6</sup>  |                              | -20 °C to +70 °C                                                             | V <sub>CC</sub> ±10 %                                   |
|                                       |                       |                                    | —                                                      |                              |                              | R: ±25 × 10 <sup>-6</sup>                              |                              | -30 °C to +85 °C                                                             | (3 MHz<f <sub>0</sub> ≤62.5 MHz)                        |
|                                       |                       |                                    | —                                                      |                              |                              | P: ±20 × 10 <sup>-6</sup>                              |                              | -30 °C to +85 °C                                                             | V <sub>CC</sub> ±5 %                                    |
| Current consumption                   |                       | I <sub>CC</sub>                    | —                                                      |                              |                              | J: ±25 × 10 <sup>-6</sup>                              |                              | -40 °C to +85 °C                                                             |                                                         |
|                                       |                       |                                    | 1.5 mA Max.                                            | 1.5 mA Max.                  | 1.5 mA Max.                  | 4.0 mA Max.                                            | 5.0 mA Max.                  | No load condition, 2 MHz<f <sub>0</sub> ≤ 4 MHz                              |                                                         |
|                                       |                       |                                    | 1.5 mA Max.                                            | 1.5 mA Max.                  | 2.0 mA Max.                  |                                                        |                              | No load condition, 4 MHz<f <sub>0</sub> ≤ 8 MHz                              |                                                         |
|                                       |                       |                                    | 1.5 mA Max.                                            | 2.0 mA Max.                  | 2.5 mA Max.                  |                                                        |                              | No load condition, 8 MHz<f <sub>0</sub> ≤16 MHz                              |                                                         |
|                                       |                       |                                    | 2.0 mA Max.                                            | 2.0 mA Max.                  | 2.5 mA Max.                  |                                                        |                              | No load condition, 16 MHz<f <sub>0</sub> ≤25 MHz                             |                                                         |
|                                       |                       |                                    | 2.0 mA Max.                                            | 2.5 mA Max.                  | 3.5 mA Max.                  |                                                        |                              | No load condition, 25 MHz<f <sub>0</sub> ≤33 MHz                             |                                                         |
|                                       |                       |                                    | 3.0 mA Max.                                            | 3.5 mA Max.                  | 4.5 mA Max.                  | No load condition, 33 MHz<f <sub>0</sub> ≤48 MHz       |                              |                                                                              |                                                         |
| Stand-by current                      |                       | I <sub>std</sub>                   | —                                                      |                              |                              | 6.0 mA Max.                                            | 7.0 mA Max.                  | No load condition, 48 MHz<f <sub>0</sub> ≤80 MHz                             |                                                         |
|                                       |                       |                                    | 0.7 μA Max.<br>(0.2 μA Typ.)                           | 1.5 μA Max.<br>(0.5 μA Typ.) | 2.0 μA Max.<br>(1.0 μA Typ.) | 10 μA Max.                                             |                              | ST =GND                                                                      |                                                         |
| Symmetry                              |                       | SYM                                | 45 % to 55 %                                           | 45 % to 55 %                 | 45 % to 55 %                 | 45 % to 55 %                                           |                              | 2 MHz<f <sub>0</sub> ≤16 MHz                                                 | 50 % V <sub>CC</sub> level<br>L <sub>CMOS</sub> ≤ 15 pF |
|                                       |                       |                                    | 40 % to 60 %                                           |                              |                              |                                                        |                              | 40 MHz<f <sub>0</sub> ≤80 MHz                                                |                                                         |
| High output voltage                   |                       | V <sub>OH</sub>                    | 90 % V <sub>CC</sub> Min.                              |                              |                              |                                                        |                              | I <sub>OH</sub> =-3 mA                                                       |                                                         |
| Low output voltage                    |                       | V <sub>OL</sub>                    | 10 % V <sub>CC</sub> Max.                              |                              |                              |                                                        |                              | I <sub>OL</sub> = 3 mA                                                       |                                                         |
| Output load condition (CMOS)          |                       | L <sub>CMOS</sub>                  | 15 pF Max.                                             |                              |                              |                                                        |                              |                                                                              |                                                         |
| Output enable / disable input voltage |                       | V <sub>IH</sub><br>V <sub>IL</sub> | 80 % V <sub>CC</sub> Min.<br>20 % V <sub>CC</sub> Max. |                              |                              | 70 % V <sub>CC</sub> Min.<br>30 % V <sub>CC</sub> Max. |                              | ST terminal                                                                  |                                                         |
| Rise time / Fall time                 |                       | t <sub>r</sub> /t <sub>f</sub>     | 4 ns Max.                                              |                              |                              |                                                        |                              | 20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> level, L <sub>CMOS</sub> =15 pF |                                                         |
| Start-up time                         |                       | t <sub>str</sub>                   | 10 ms Max.                                             |                              |                              | 2 ms Max.                                              |                              | t=0 at 90 % V <sub>CC</sub>                                                  |                                                         |
| Frequency aging                       |                       | f <sub>aging</sub>                 | ±5 × 10 <sup>-6</sup> / year Max.                      |                              |                              | ±3 × 10 <sup>-6</sup> / year Max.                      |                              | +25 °C, First year,V <sub>CC</sub> =1.8 V, 2.5 V, 3.3 V                      |                                                         |
|                                       |                       |                                    | —                                                      |                              |                              | ±10 × 10 <sup>-6</sup> Max.                            |                              | +25 °C, 10 years                                                             |                                                         |

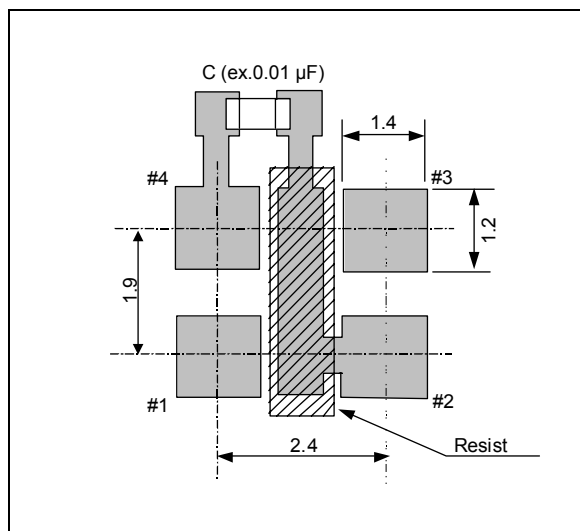
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)







# CRYSTAL OSCILLATOR SPXO

## SG - 550 series

- Frequency range : 2 MHz to 48 MHz
- Supply voltage : 1.8 V Typ. / 2.5 V Typ. / 3.3 V Typ.
- Current consumption : SEF1.8 V No load condition 48 MHz  
1.5 mA Typ.
- Function : Standby( $\overline{ST}$ )
- Thickness : 1.2 mm Max.



Product Number (please contact us)  
Q33550xx0xxxx00



Actual size

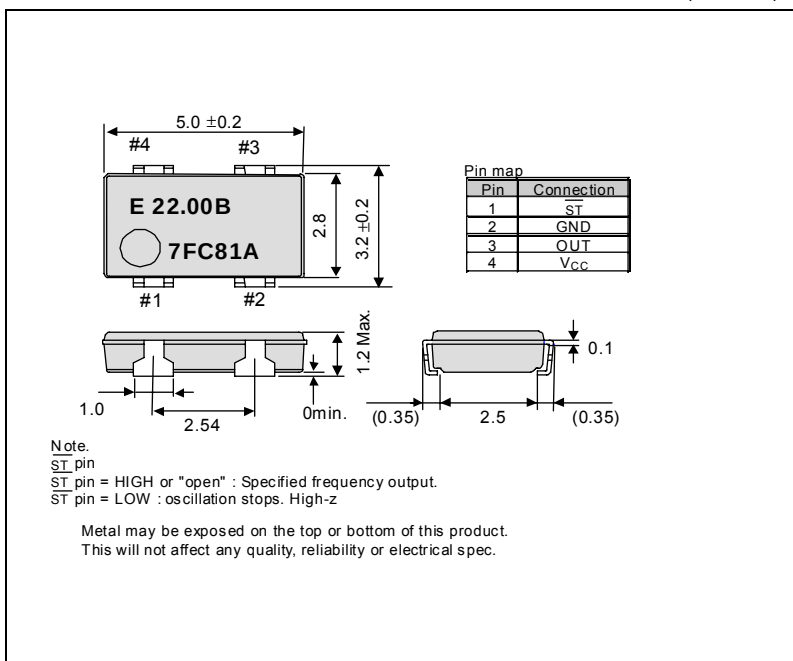


### Specifications (characteristics)

| Item                                     |                                 | Symbol                                                 | Specifications               |                              |                                                                              | Remarks                                                        |                                                          |
|------------------------------------------|---------------------------------|--------------------------------------------------------|------------------------------|------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------|
|                                          |                                 |                                                        | SG-550SEF                    | SG-550SDF                    | SG-550SCF                                                                    |                                                                |                                                          |
| Output frequency range                   |                                 | f <sub>0</sub>                                         | 2 MHz to 48 MHz              |                              |                                                                              |                                                                |                                                          |
| Supply voltage                           |                                 | V <sub>CC</sub>                                        | 1.8 V Typ.<br>1.6 V to 2.2 V | 2.5 V Typ.<br>2.2 V to 3.0 V | 3.3 V Typ.<br>2.7 V to 3.6 V                                                 |                                                                |                                                          |
| Temperature range                        | Storage temperature             | T <sub>stg</sub>                                       | -40 °C to +125 °C            |                              |                                                                              | Store as bare product after unpacking                          |                                                          |
|                                          | Operating temperature           | T <sub>use</sub>                                       | -40 °C to +85 °C             |                              |                                                                              |                                                                |                                                          |
| Frequency tolerance                      | f <sub>tol</sub>                | B: ±50 × 10 <sup>-6</sup> , C: ±100 × 10 <sup>-6</sup> |                              |                              | -20 °C to +70 °C                                                             |                                                                |                                                          |
|                                          |                                 | M: ±100 × 10 <sup>-6</sup>                             |                              |                              | -40 °C to +85 °C                                                             |                                                                |                                                          |
|                                          |                                 | L: ±50 × 10 <sup>-6</sup>                              |                              |                              | -40 °C to +85 °C                                                             | V <sub>CC</sub> ±5 %                                           |                                                          |
| Current consumption                      | I <sub>CC</sub>                 | 1.5 mA Max.                                            | 1.5 mA Max.                  | 1.5 mA Max.                  | No load condition, 2 MHz≤f <sub>0</sub> ≤ 4 MHz                              |                                                                |                                                          |
|                                          |                                 | 1.5 mA Max.                                            | 1.5 mA Max.                  | 2.0 mA Max.                  | No load condition, 4 MHz≤f <sub>0</sub> ≤ 8 MHz                              |                                                                |                                                          |
|                                          |                                 | 1.5 mA Max.                                            | 2.0 mA Max.                  | 2.5 mA Max.                  | No load condition, 8 MHz≤f <sub>0</sub> ≤16 MHz                              |                                                                |                                                          |
|                                          |                                 | 2.0 mA Max.                                            | 2.0 mA Max.                  | 2.5 mA Max.                  | No load condition, 16 MHz≤f <sub>0</sub> ≤25 MHz                             |                                                                |                                                          |
|                                          |                                 | 2.0 mA Max.                                            | 2.5 mA Max.                  | 3.5 mA Max.                  | No load condition, 25 MHz≤f <sub>0</sub> ≤33 MHz                             |                                                                |                                                          |
|                                          |                                 | 3.0 mA Max.                                            | 3.5 mA Max.                  | 4.5 mA Max.                  | No load condition, 33 MHz≤f <sub>0</sub> ≤48 MHz                             |                                                                |                                                          |
| Stand-by current                         | I <sub>std</sub>                | 0.7 μA Max.                                            | 1.5 μA Max.                  | 2.0 μA Max.                  | ST =GND                                                                      |                                                                |                                                          |
| Symmetry                                 | SYM                             | 45 % to 55 %                                           | 45 % to 55 %                 |                              |                                                                              | 2 MHz≤f <sub>0</sub> ≤16 MHz                                   | 50 % V <sub>CC</sub> level<br>L <sub>-CMOS</sub> ≤ 15 pF |
|                                          |                                 | 40 % to 60 %                                           | 40 % to 60 %                 |                              |                                                                              | 16 MHz≤f <sub>0</sub> ≤40 MHz<br>40 MHz≤f <sub>0</sub> ≤48 MHz |                                                          |
| High output voltage                      | V <sub>OH</sub>                 | 90 % V <sub>CC</sub> Min.                              |                              |                              | I <sub>OH</sub> =-3 mA                                                       |                                                                |                                                          |
| Low output voltage                       | V <sub>OL</sub>                 | 10 % V <sub>CC</sub> Max.                              |                              |                              | I <sub>OL</sub> = 3 mA                                                       |                                                                |                                                          |
| Output load condition(CMOS)              | L <sub>CMOS</sub>               | 15 pF Max.                                             |                              |                              |                                                                              |                                                                |                                                          |
| Output enable /<br>disable input voltage | V <sub>IH</sub>                 | 80 % V <sub>CC</sub> Min.                              |                              |                              | ST terminal                                                                  |                                                                |                                                          |
|                                          | V <sub>IL</sub>                 | 20 % V <sub>CC</sub> Max.                              |                              |                              |                                                                              |                                                                |                                                          |
| Rise time / Fall time                    | t <sub>r</sub> / t <sub>f</sub> | 4 ns Max.                                              |                              |                              | 20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> level, L <sub>CMOS</sub> =15 pF |                                                                |                                                          |
| Start-up time                            | t <sub>sta</sub>                | 10 ms Max.                                             |                              |                              | t=0 at 90 % V <sub>CC</sub>                                                  |                                                                |                                                          |
| Frequency aging                          | f <sub>aging</sub>              | ±5 × 10 <sup>-6</sup> / year Max.                      |                              |                              | +25 °C, First year,<br>V <sub>CC</sub> =1.8 V, 2.5 V, 3.3 V                  |                                                                |                                                          |

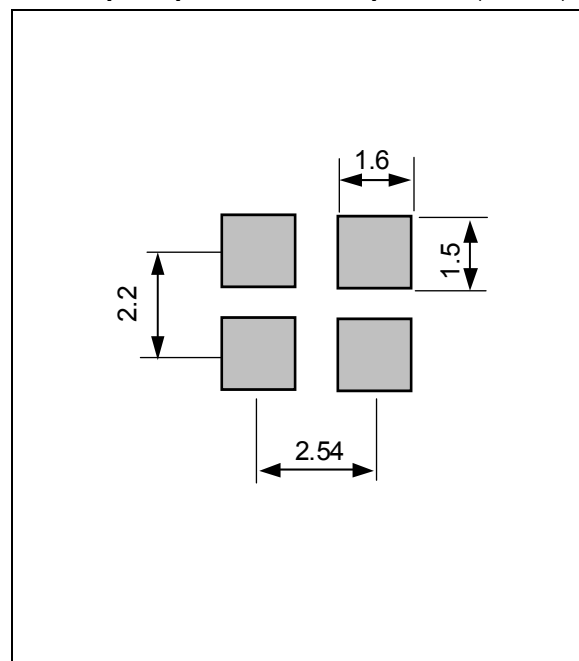
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)





# CRYSTAL OSCILLATOR

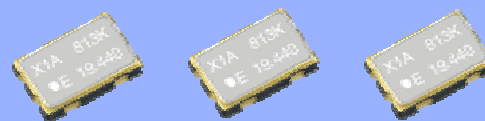
## SPXO

# TCO - 710x series

- Frequency range : 1.5 MHz to 75 MHz
- Supply voltage : 3.3 V
- Thickness : 1.0 mm Typ.
- Function : Standby ( $\overline{ST}$ )



Product Number (please contact us)  
X1G00xxx1xxxx00



Actual size



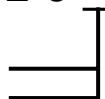
## Specifications (characteristics)

| Item                                  | Symbol      | TCO-710*X1A*                       | Remarks                                                              |
|---------------------------------------|-------------|------------------------------------|----------------------------------------------------------------------|
| Output frequency range                | $f_o$       | 1.500 MHz to 75.000 MHz            | Please contact us for inquiries regarding the available frequencies. |
| Supply voltage                        | $V_{CC}$    | 3.3 V $\pm 0.33$ V                 |                                                                      |
| Storage temperature range             | $T_{stg}$   | -40 °C to +85 °C                   | Store as bare product after unpacking.                               |
| Operating temperature range           | $T_{use}$   | As per below description           |                                                                      |
| Frequency tolerance                   | $f_{tol}$   | As per below description.          |                                                                      |
| Current consumption                   | $I_{CC}$    | 20 mA Max.                         | No load condition                                                    |
| Symmetry                              | SYM         | 40 % to 60 %                       | 50 % $V_{CC}$ level                                                  |
| High output voltage                   | $V_{OH}$    | 90 % $V_{CC}$ Min.                 | $I_{OH} = -5$ mA                                                     |
| Low output voltage                    | $V_{OL}$    | 10 % $V_{CC}$ Max.                 | $I_{OL} = 5$ mA                                                      |
| Output load condition (CMOS)          | L CMOS      | 15 pF Max.                         |                                                                      |
| Output enable / disable input voltage | $V_{IH}$    | 70 % $V_{CC}$ Min.                 | $V_{IH}$ or OPEN : Enable                                            |
|                                       | $V_{IL}$    | 30 % $V_{CC}$ Max.                 | $V_{IL}$ or GND : Disable                                            |
| Rise time / Fall time                 | $t_r / t_f$ | 6 ns Max.                          | 10 % $V_{CC}$ to 90 % $V_{CC}$ level                                 |
| Start-up time                         | $t_{str}$   | 10 ms Max.                         | Time at minimum supply voltage to be 0 s                             |
| Frequency aging                       | $f_{aging}$ | $\pm 5 \times 10^{-6}$ / year Max. | +25 °C, $V_{CC} = 3.3$ V, First year                                 |

\* Part Number

# TCO - 710 X1A

<Frequency tolerance /  $V_{CC}$  tolerance>  
 $\pm 50 \times 10^{-6}$  Max. /  $V_{CC} \pm 10$  % : 6  
 $\pm 100 \times 10^{-6}$  Max. /  $V_{CC} \pm 10$  % : 7



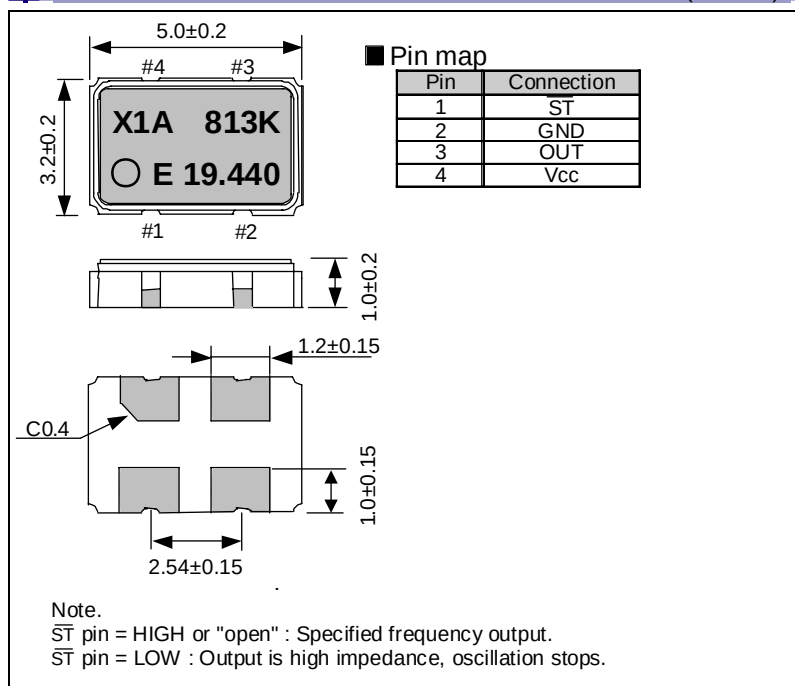
<Operating temperature range>

BLANK: 0 °C to +70 °C  
 1: -10 °C to +70 °C  
 2: -20 °C to +70 °C  
 4: -40 °C to +85 °C



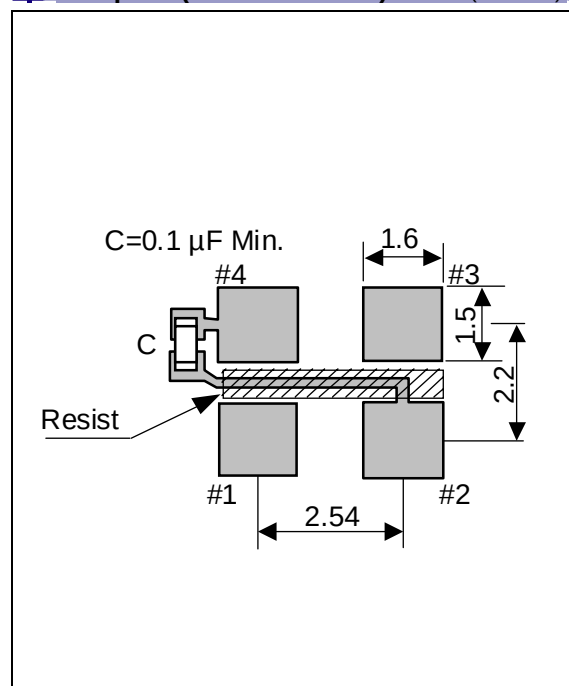
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





# CRYSTAL OSCILLATOR SPXO

## SG-770 series

- Frequency range : 50 MHz to 230 MHz
- Supply voltage : 2.5 V or 3.3 V
- Output : LV-PECL
- Thickness : 1.6 mm Typ.
- Features : Fundamental mode oscillator with HFF-XTAL
- Function : Standby ( $\overline{ST}$ )
- Old name : TCO-7116H1A



Product Number (please contact us)  
X1G0023x1xxxx00



Actual size



**NEW**

### Specifications (characteristics)

| Item                                  | Symbol                         | Specifications                    |                | Remarks                                                              |
|---------------------------------------|--------------------------------|-----------------------------------|----------------|----------------------------------------------------------------------|
|                                       |                                | SG-770SDD                         | SG-770SCD      |                                                                      |
| Output frequency range                | f <sub>o</sub>                 | 50.000 MHz to 230.000 MHz         |                | Please contact us for inquiries regarding the available frequencies. |
| Supply voltage                        | V <sub>CC</sub>                | 2.5 V ±0.125 V                    | 3.3 V ±0.165 V |                                                                      |
| Storage temperature range             | T <sub>stg</sub>               | -55 °C to +125 °C                 |                | Store as bare product after unpacking                                |
| Operating temperature range           | T <sub>use</sub>               | As per below table                |                |                                                                      |
| Frequency tolerance                   | f <sub>tol</sub>               | ±50 × 10 <sup>-6</sup> Max.       |                |                                                                      |
| Current consumption                   | I <sub>CC</sub>                | 90 mA Max.                        |                | No load condition                                                    |
| Symmetry                              | SYM                            | 45 % to 55 %                      |                | at outputs crossing point                                            |
| High output voltage                   | V <sub>OH</sub>                | V <sub>CC</sub> -1.1 V Min.       |                |                                                                      |
| Low output voltage                    | V <sub>OL</sub>                | V <sub>CC</sub> -1.5 V Max.       |                |                                                                      |
| Output load condition (ECL)           | L <sub>ECL</sub>               | LV-PECL                           |                |                                                                      |
| Output enable / disable input voltage | V <sub>IH</sub>                | 70 % V <sub>CC</sub> Min.         |                | $\overline{ST}$ terminal                                             |
|                                       | V <sub>IL</sub>                | 20 % V <sub>CC</sub> Max.         |                |                                                                      |
| Rise time / Fall time                 | t <sub>r</sub> /t <sub>f</sub> | 1 ns Max.                         |                | 20 % to 80 % (V <sub>OH</sub> -V <sub>OL</sub> )                     |
| Start-up time                         | t <sub>str</sub>               | 10 ms Max. *1                     |                | Time at minimum supply voltage to be 0 s                             |
| Frequency aging                       | f <sub>aging</sub>             | ±5 × 10 <sup>-6</sup> / year Max. |                | +25 °C, V <sub>CC</sub> =2.5 V or 3.3 V, First year.                 |

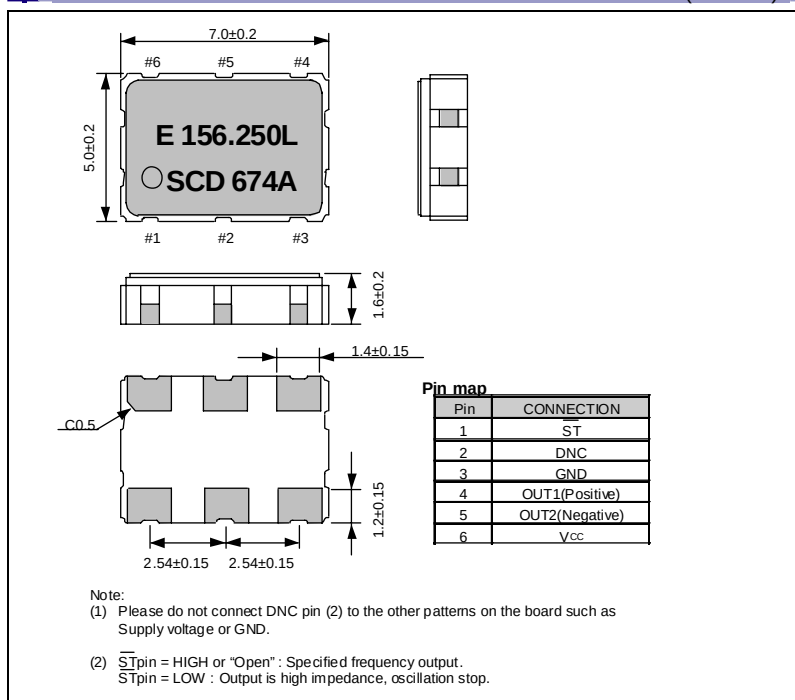
\*1 Rise time (0 V to 2.13 V or 3.15 V) of  $V_{CC} > 150 \mu s$

### Operating temperature range

| Operating temperature range |                  |
|-----------------------------|------------------|
| L                           | -40 °C to +85 °C |
| B                           | -20 °C to +70 °C |
| P                           | -10 °C to +70 °C |
| Q                           | 0 °C to +70 °C   |

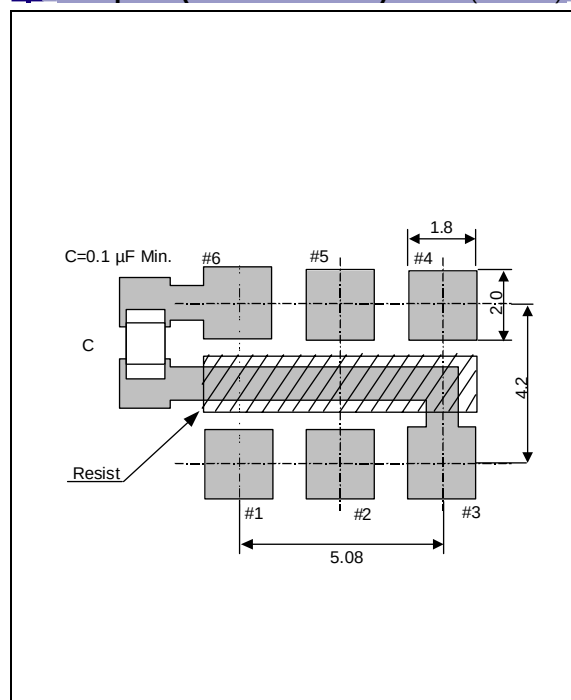
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)





# CRYSTAL OSCILLATOR SPXO

## SG-771 PCD

- Frequency range : 80 MHz to 175 MHz
- Supply voltage : 3.3 V
- Output : LV-PECL
- Thickness : 1.6 mm Typ.
- Features : Fundamental mode oscillator with HFF-XTAL
- Function : Output enable (OE)



Product Number (please contact us)  
X1G00282xxxxx00



Actual size



**NEW**

### Specifications (characteristics)

| Item                                  | Symbol      | Specifications                                         | Remarks                                                              |
|---------------------------------------|-------------|--------------------------------------------------------|----------------------------------------------------------------------|
| Output frequency range                | $f_o$       | 80.000 MHz to 175.000 MHz                              | Please contact us for inquiries regarding the available frequencies. |
| Supply voltage                        | $V_{cc}$    | 3.3 V $\pm 0.165$ V                                    |                                                                      |
| Storage temperature range             | $T_{stg}$   | -55 °C to +125 °C                                      | Store as bare product after unpacking                                |
| Operating temperature range           | $T_{use}$   | -10 °C to +70 °C                                       |                                                                      |
| Frequency tolerance                   | $f_{tol}$   | $\pm 20 \times 10^{-6}$ Max.                           |                                                                      |
| Current consumption                   | $I_{cc}$    | 70 mA Max.                                             | No load condition                                                    |
| Symmetry                              | SYM         | 40 % to 60 %                                           | $V_{cc}$ -1.3 V                                                      |
| High output voltage                   | $V_{OH}$    | $V_{cc}$ -1.1 V Min.                                   |                                                                      |
| Low output voltage                    | $V_{OL}$    | $V_{cc}$ -1.5 V Max.                                   |                                                                      |
| Output load condition (ECL)           | L_ECL       | LV-PECL                                                |                                                                      |
| Output enable / disable input voltage | $V_{IH}$    | 70 % $V_{cc}$ Min.                                     | $V_{IH}$ or OPEN : Enable                                            |
|                                       | $V_{IL}$    | 30 % $V_{cc}$ Max.                                     | $V_{IL}$ or GND : Disable                                            |
| Rise time / Fall time                 | $t_r / t_f$ | 1 ns Max.                                              | 20 % to 80 % ( $V_{OH}$ - $V_{OL}$ )                                 |
| Start-up time                         | $T_{str}$   | 10 ms Max. *1                                          | Time at minimum supply voltage to be 0 s                             |
| Frequency aging                       | $f_{aging}$ | This is included in frequency tolerance specification. | +25 °C, $V_{cc}$ =3.3 V, First year.                                 |

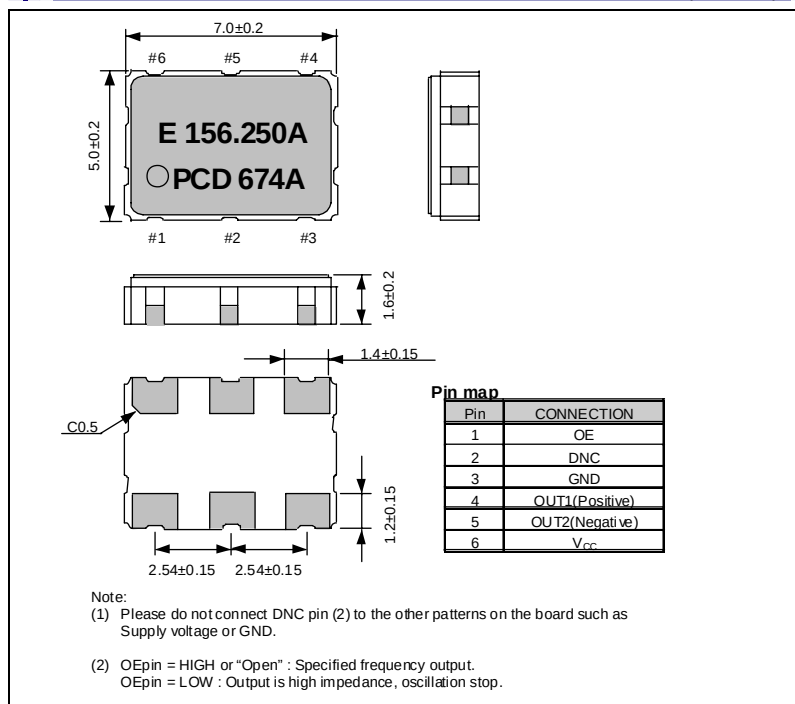
\*1 Rise time (or 3.15 V) of  $V_{cc} > 150 \mu s$ .

### Operating temperature range

|   | Frequency tolerance          | Operating temperature range | Aging    |
|---|------------------------------|-----------------------------|----------|
| A | $\pm 30 \times 10^{-6}$ Max. | -40 °C to +85 °C            | 10 years |
| B | $\pm 35 \times 10^{-6}$ Max. | -40 °C to +85 °C            | 20 years |
| C | $\pm 20 \times 10^{-6}$ Max. | -10 °C to +70 °C            | 10 years |
| D | $\pm 25 \times 10^{-6}$ Max. | -10 °C to +70 °C            | 20 years |

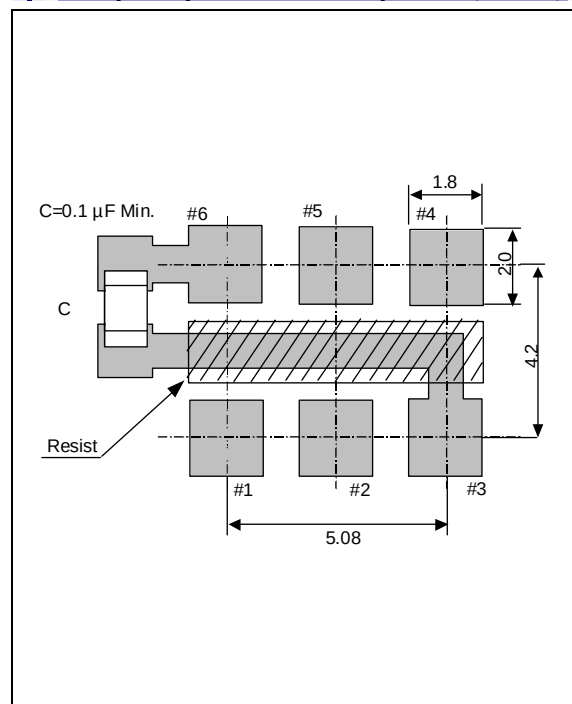
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)





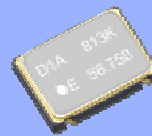
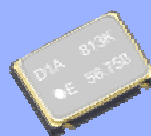
# CRYSTAL OSCILLATOR SPXO

## TCO - 708x series

- Frequency range : 1.5 MHz to 160 MHz
- Supply voltage : 3.3 V or 5.0 V
- Thickness : 1.6 mm Typ.
- Function : Standby (ST)



Product Number (please contact us)  
X1G0002x0xxxx00



Actual size



### Specifications (characteristics)

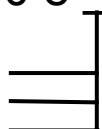
| Item                                  | Symbol                          | TCO-708*X1A*                      | TCO-708*D1A*            | Remarks                                                                      |
|---------------------------------------|---------------------------------|-----------------------------------|-------------------------|------------------------------------------------------------------------------|
| Output frequency range                | f <sub>o</sub>                  | 1.500 MHz to 160.000 MHz          | 1.500 MHz to 75.000 MHz | Please contact us for inquiries regarding the available frequencies.         |
| Supply voltage                        | V <sub>CC</sub>                 | 3.3 V                             | 5.0 V                   | As per below description                                                     |
| Storage temperature range             | T <sub>stg</sub>                | -40 °C to +85 °C                  |                         | Store as bare product after unpacking                                        |
| Operating temperature range           | T <sub>use</sub>                | As per below description          |                         |                                                                              |
| Frequency tolerance                   | f <sub>tol</sub>                | As per below description          |                         |                                                                              |
| Current consumption                   | I <sub>CC</sub>                 | 20 mA Max.                        | 20 mA Max.              | f <sub>o</sub> ≤ 30 MHz, No load condition.                                  |
|                                       |                                 |                                   | 40 mA Max.              | f <sub>o</sub> ≤ 75 MHz, No load condition.                                  |
|                                       |                                 | 50 mA Max.                        | —                       | f <sub>o</sub> ≤ 160 MHz, No load condition.                                 |
| Symmetry                              | SYM                             | 40 % to 60 %                      |                         | 50 % V <sub>CC</sub> level                                                   |
| High output voltage                   | V <sub>OH</sub>                 | 90 % V <sub>CC</sub> Min.         |                         |                                                                              |
| Low output voltage                    | V <sub>OL</sub>                 | 10 % V <sub>CC</sub> Max.         |                         |                                                                              |
| Output load condition (CMOS)          | L CMOS                          | 15 pF Max.                        |                         |                                                                              |
| Output enable / disable input voltage | V <sub>IH</sub>                 | 70 % V <sub>CC</sub> Min.         |                         | V <sub>IH</sub> or OPEN : Enable                                             |
|                                       | V <sub>IL</sub>                 | 30 % V <sub>CC</sub> Max.         |                         | V <sub>IL</sub> or GND : Disable                                             |
| Rise time / Fall time                 | t <sub>r</sub> / t <sub>f</sub> | 6 ns Max.                         | 10 ns Max.              | f <sub>o</sub> ≤ 75 MHz, 10 % V <sub>CC</sub> to 90 % V <sub>CC</sub> level  |
|                                       |                                 | 3 ns Max.                         | —                       | f <sub>o</sub> ≤ 160 MHz, 10 % V <sub>CC</sub> to 90 % V <sub>CC</sub> level |
| Start-up time                         | t <sub>str</sub>                | 10 ms Max.                        |                         | Time at minimum supply voltage to be 0 s                                     |
| Frequency aging                       | f <sub>aging</sub>              | ±5 × 10 <sup>-6</sup> / year Max. |                         | +25 °C, First year                                                           |

\* Part Number

TCO - 708 1A

<Frequency tolerance / V<sub>CC</sub> tolerance>

- ±25 × 10<sup>-6</sup> Max. / V<sub>CC</sub> ±5 % : 5
- ±50 × 10<sup>-6</sup> Max. / V<sub>CC</sub> ±10 % : 6
- ±100 × 10<sup>-6</sup> Max. / V<sub>CC</sub> ±10 % : 7



<Operating temperature range>

- BLANK: 0 °C to +70 °C
- 1: -10 °C to +70 °C
- 2: -20 °C to +70 °C
- 4: -40 °C to +85 °C (±50, ±100 × 10<sup>-6</sup> only)

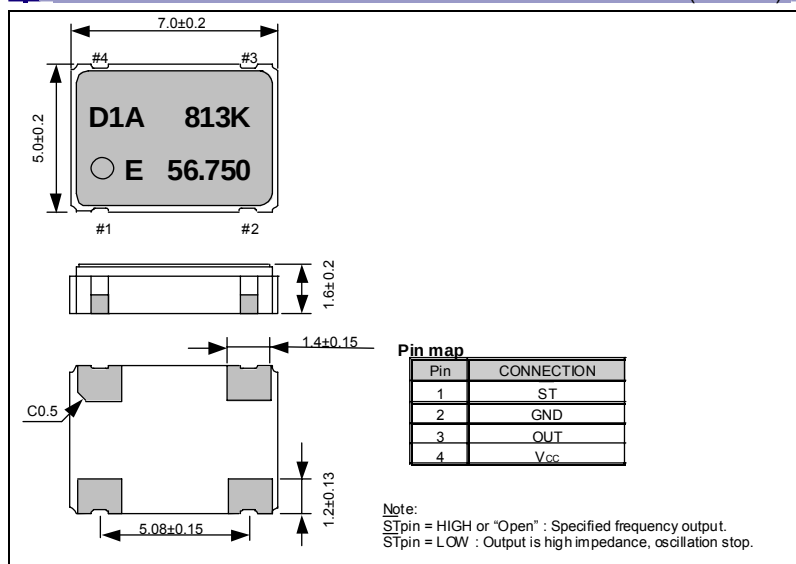
< Supply voltage / Frequency range>

- X : V<sub>CC</sub> = 3.3 V / 1.5 MHz to 160 MHz
- D : V<sub>CC</sub> = 5.0 V / 1.5 MHz to 75 MHz



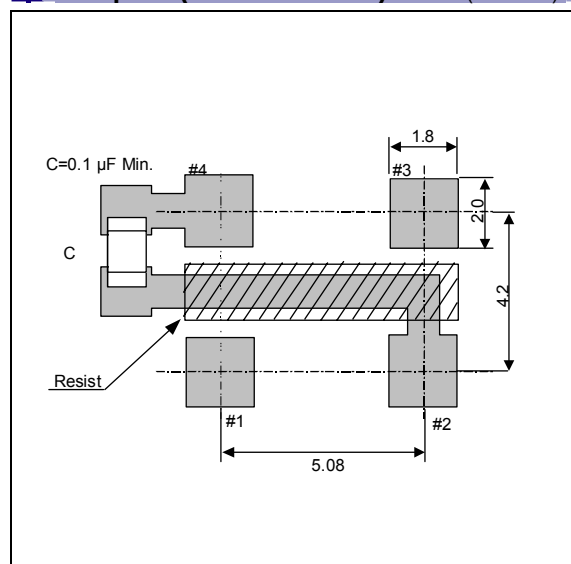
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)





# CRYSTAL OSCILLATOR SPXO

## SG - 645 / SG - 636 series

- Frequency range : 2.21675 MHz to 135 MHz
- Supply voltage : 2.5 V / 3.3 V / 5.0 V
- Function : Output enable(OE) or Standby( $\overline{ST}$ )
- Thickness : SG-645:1.5 mm Max.  
SG-636:2.7 mm Max.



Product Number (please contact us)

SG-645 : Q33645xx1xxxx00

SG-636 : Q33636xx1xxxx00



Actual size

SG-645 series



SG-636 series



### Specifications (characteristics)

| Item                                     |                          | Symbol                          | Specifications                    |                                           |                              |                              | Remarks                                                         |
|------------------------------------------|--------------------------|---------------------------------|-----------------------------------|-------------------------------------------|------------------------------|------------------------------|-----------------------------------------------------------------|
|                                          |                          |                                 | SG-636 PTF                        | SG-636 PH                                 | SG-636 PCE<br>SG-636 SCE     | SG-636 PDE                   |                                                                 |
| Output frequency range                   |                          | f <sub>0</sub>                  | 2.21675 MHz<br>to 41.000 MHz      | 41.001 MHz<br>to 70.000 MHz               | 2.21675 MHz<br>to 40.000 MHz | 2.21675 MHz<br>to 40.000 MHz |                                                                 |
| Supply voltage                           |                          | V <sub>cc</sub>                 | 5.0 V ±0.5 V                      |                                           | 3.3 V ±0.3 V                 | 2.5 V ±0.25 V                |                                                                 |
| Temperature<br>range                     | Storage<br>temperature   | T <sub>stg</sub>                | -55 °C to +100 °C                 |                                           |                              |                              | Store as bare product after unpacking                           |
|                                          | Operating<br>temperature | T <sub>use</sub>                | -20 °C to +70 °C                  |                                           |                              |                              |                                                                 |
| Frequency tolerance                      |                          | f <sub>tol</sub>                | C: ±100 × 10 <sup>-6</sup>        |                                           |                              |                              | -20 °C to +70 °C                                                |
| Current consumption                      |                          | I <sub>cc</sub>                 | 17 mA Max.                        | 35 mA Max.                                | 9 mA Max.                    | 5 mA Max.                    | No load condition                                               |
| Disable current                          |                          | I <sub>dis</sub>                | 10 mA Max.                        | 20 mA Max.                                | 5 mA Max.                    | 3 mA Max.                    | OE=GND                                                          |
| Stand-by current                         |                          | I <sub>std</sub>                | —                                 |                                           | 2 μA Max.                    | —                            | $\overline{ST}$ =GND(SCE)                                       |
| Symmetry                                 |                          | SYM                             | 40 % to 60 %                      |                                           | 45 % to 55 %                 |                              | CMOS load:50 % V <sub>cc</sub> level                            |
|                                          |                          |                                 | 45 % to 55 %                      |                                           | —                            |                              |                                                                 |
| High output voltage                      |                          | V <sub>OH</sub>                 | V <sub>cc</sub> -0.4 V Min.       |                                           |                              |                              | I <sub>OH</sub> =-8 mA(PTF)/-4 mA(PH,SCE,PCE),<br>/-3.2 mA(PDE) |
| Low output voltage                       |                          | V <sub>OL</sub>                 | 0.4 V Max.                        |                                           |                              |                              | I <sub>OL</sub> =16 mA(PTF)/4mA(PH,SCE,PCE)<br>/3.2 mA(PDE)     |
| Output load condition<br>(TTL)           |                          | L <sub>TTL</sub>                | 10 TTL Max.                       | —                                         |                              |                              | L <sub>CMOS</sub> ≤ 15 pF                                       |
| Output load condition<br>(CMOS)          |                          | L <sub>CMOS</sub>               | 50 pF Max.                        | 20 pF Max.(≤55 MHz)<br>15 pF Max(>55 MHz) | 30 pF Max.                   | 15 pF Max.                   |                                                                 |
| Output enable /<br>disable input voltage |                          | V <sub>IH</sub>                 | 2.0 V Min.                        | 80 % V <sub>cc</sub> Min.                 |                              |                              | OE Terminal or $\overline{ST}$ Terminal (SCE)                   |
|                                          |                          | V <sub>IL</sub>                 | 0.8 V Max.                        | 20 % V <sub>cc</sub> Max.                 |                              |                              |                                                                 |
| Rise time / Fall time                    |                          | t <sub>r</sub> / t <sub>f</sub> | 7 ns Max.                         | 5 ns Max.                                 |                              |                              | CMOS load:20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level    |
|                                          |                          |                                 | 5 ns Max.                         | —                                         |                              |                              | TTL load:0.4 V to 2.4 V level                                   |
| Start-up time                            |                          | t <sub>str</sub>                | 4 ms Max.                         | 10 ms Max.                                | 4 ms Max.                    |                              | Time at minimum supply voltage to be 0 s                        |
| Frequency aging                          |                          | f <sub>aging</sub>              | ±5 × 10 <sup>-6</sup> / year Max. |                                           |                              |                              | +25 °C, V <sub>cc</sub> =5.0 V/3.3 V/2.5 V, First year          |

### Specifications (characteristics)

| Item                   |                       | Symbol             | Specifications                                       |                             |                             | Remarks                                                                       |
|------------------------|-----------------------|--------------------|------------------------------------------------------|-----------------------------|-----------------------------|-------------------------------------------------------------------------------|
|                        |                       |                    | SG-636 PTG                                           | SG-636 PHG                  | SG-636 PCG<br>SG-636 SCG    |                                                                               |
| Output frequency range |                       | f <sub>0</sub>     | 2.21675 MHz to 33.000 MHz *1                         |                             |                             |                                                                               |
| Supply voltage         |                       | V <sub>cc</sub>    | 4.5 V to 5.5 V                                       |                             | 2.7 V to 3.6 V              |                                                                               |
| Temperature range      | Storage temperature   | T <sub>stg</sub>   | -55 °C to +100 °C                                    |                             |                             | Store as bare product after unpacking                                         |
|                        | Operating temperature | T <sub>use</sub>   | -20 °C to +70 °C                                     |                             |                             |                                                                               |
| Frequency tolerance    |                       | f <sub>tol</sub>   | B: ±50 × 10 <sup>-6</sup> C: ±100 × 10 <sup>-6</sup> |                             |                             | -20 °C to +70 °C                                                              |
| Current consumption    |                       | I <sub>cc</sub>    | 25 mA Max.                                           |                             | 12 mA Max.                  | No load condition                                                             |
| Disable curren         |                       | I <sub>dis</sub>   | 20 mA Max.                                           |                             | 10 mA Max.                  | OE=GND (PTG,PHG,PCG)                                                          |
| Stand-by current       |                       | I <sub>std</sub>   | —                                                    |                             | 50 μA Max.                  | ST=GND (SCG)                                                                  |
| Symmetry               |                       | SYM                | —                                                    | 45 % to 55 %                |                             | 50 % V <sub>cc</sub> level, L <sub>CMOS</sub> =25 pF                          |
|                        |                       |                    | 40 % to 60 %                                         | —                           |                             | 1.4 V level, L <sub>CMOS</sub> =25 pF                                         |
| High output voltage    |                       | V <sub>OH</sub>    | 2.4 V Min.                                           | —                           | V <sub>cc</sub> -0.4 V Min. | I <sub>OH</sub> =8 mA                                                         |
|                        |                       |                    | —                                                    | V <sub>cc</sub> -0.4 V Min. | —                           | I <sub>OH</sub> =16 mA                                                        |
| Low output voltage     |                       | V <sub>OL</sub>    | —                                                    | —                           | 0.4 V Max.                  | I <sub>OL</sub> =8 mA                                                         |
|                        |                       |                    | 0.4 V Max.                                           | —                           | —                           | I <sub>OL</sub> =16 mA                                                        |
| Output load condition  |                       | L <sub>CMOS</sub>  | 25 pF Max.                                           |                             |                             |                                                                               |
| Output enable /        |                       | V <sub>IH</sub>    | 2.0 V Min.                                           |                             | 70 % V <sub>cc</sub> Min.   | OE Terminal or ST Terminal                                                    |
| disable input voltage  |                       | V <sub>IL</sub>    | 0.8 V Max.                                           |                             | 20 % V <sub>cc</sub> Max.   |                                                                               |
| Rise time / Fall time  |                       | tr / tr            | —                                                    | 3.4 ns Max.                 | 4 ns Max.                   | 20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level, L <sub>CMOS</sub> ≤ 25 pF |
|                        |                       |                    | 2.4 ns Max.                                          | —                           |                             | TTL load:0.4 V to 2.4 V level, L <sub>CMOS</sub> ≤ 25 pF                      |
| Start-up time          |                       | t <sub>str</sub>   | 12 ms Max.                                           |                             |                             | t=0 at 90 % V <sub>cc</sub>                                                   |
| Frequency aging        |                       | f <sub>aging</sub> | ±5 × 10 <sup>-6</sup> / year Max.                    |                             |                             | +25 °C, V <sub>cc</sub> =5.0 V/ 3.3 V, First year                             |

\*1 4.1250 MHz <  $f_0$  < 4.4336 MHz, 8.2500 MHz <  $f_0$  < 8.8672 MHz, 16.500 MHz <  $f_0$  < 17.7344 MHz : Unavailable



## Specifications (characteristics)

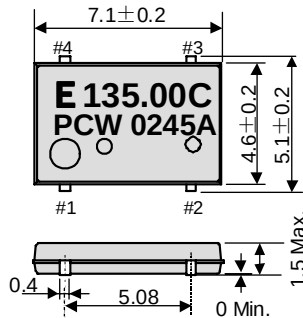
| Item                                  |                       | Symbol                          | Specifications                                            |                                      |                                      | Remarks                                                                      |
|---------------------------------------|-----------------------|---------------------------------|-----------------------------------------------------------|--------------------------------------|--------------------------------------|------------------------------------------------------------------------------|
|                                       |                       |                                 | SG-636 PTW / STW<br>SG-645 PTW / STW                      | SG-636 PHW / SHW<br>SG-645 PHW / SHW | SG-636 PCW / SCW<br>SG-645 PCW / SCW |                                                                              |
| Output frequency range                |                       | f <sub>0</sub>                  | 32.001 MHz to 135.000 MHz                                 |                                      |                                      |                                                                              |
| Supply voltage                        |                       | V <sub>cc</sub>                 | 5.0 V ±0.5 V                                              |                                      | 3.3 V ±0.3 V                         |                                                                              |
| Temperature range                     | Storage temperature   | T <sub>stg</sub>                | SG-636P**:-55 °C to +100 °C / SG-645P**:-55 °C to +125 °C |                                      |                                      | Store as bare product after unpacking                                        |
|                                       | Operating temperature | T <sub>use</sub>                | -20 °C to +70 °C                                          |                                      |                                      |                                                                              |
|                                       |                       |                                 | —                                                         |                                      | -40 °C to +85 °C                     | SG-645PCW / SCW Only                                                         |
| Frequency tolerance                   |                       | f <sub>tol</sub>                | B: ±50 × 10 <sup>-6</sup> C: ±100 × 10 <sup>-6</sup>      |                                      |                                      | -20 °C to +70 °C *1                                                          |
|                                       |                       |                                 | —                                                         |                                      | M: ±50 × 10 <sup>-6</sup>            | -40 °C to +85 °C : SG-645PCW / SCW Only                                      |
| Current consumption                   |                       | I <sub>cc</sub>                 | 45 mA Max.                                                |                                      | 28 mA Max.                           | No load condition( Max. frequency range )                                    |
| Disable current                       |                       | I <sub>dis</sub>                | 30 mA Max.                                                |                                      | 16 mA Max.                           | OE=GND (PTW,PHW,PCW)                                                         |
| Stand-by current                      |                       | I <sub>std</sub>                | 50 μA Max.                                                |                                      |                                      | ST̅=GND (STW,SHW,SCW)                                                        |
| Symmetry                              |                       | SYM                             | —                                                         | 40 % to 60 %                         |                                      | 50 % V <sub>cc</sub> level, L <sub>CMOS</sub> =Max.                          |
|                                       |                       |                                 | 40 % to 60 %                                              | —                                    |                                      | 1.4 V level, L <sub>CMOS</sub> =Max.                                         |
| High output voltage                   |                       | V <sub>OH</sub>                 | V <sub>cc</sub> -0.4 V Min.                               |                                      |                                      | I <sub>OH</sub> =-16 mA(PTW , STW , PHW , SHW)<br>/-8 mA(PCW , SCW)          |
| Low output voltage                    |                       | V <sub>OL</sub>                 | 0.4 V Max.                                                |                                      |                                      | I <sub>OL</sub> = 16 mA(PTW , STW , PHW , SHW)<br>/ 8 mA(PCW , SCW)          |
| Output load condition (TTL)           |                       | L <sub>TTL</sub>                | 5 TTL Max.                                                | —                                    | —                                    | f <sub>o</sub> ≤ 90 MHz, Max.Supply voltage.                                 |
| Output load condition (CMOS)          |                       | L <sub>CMOS</sub>               | 15 pF Max.                                                |                                      |                                      | Max.frequency, Max.Supply voltage.                                           |
| Output enable / disable input voltage |                       | V <sub>IH</sub>                 | 2.0 V Min.                                                |                                      | 70 % V <sub>cc</sub> Min.            | OE Terminal or ST̅ Terminal                                                  |
|                                       |                       | V <sub>IL</sub>                 | 0.8 V Max.                                                |                                      | 20 % V <sub>cc</sub> Max.            |                                                                              |
| Rise time / Fall time                 |                       | t <sub>r</sub> / t <sub>f</sub> | —                                                         | 4 ns Max.                            |                                      | 20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level, L <sub>CMOS</sub> ≤ Max. |
|                                       |                       |                                 | 4 ns Max.                                                 | —                                    | —                                    | 0.4 V to 2.4 V level                                                         |
| Start-up time                         |                       | t <sub>str</sub>                | 10 ms Max.                                                |                                      |                                      | Time at minimum supply voltage to be 0 s                                     |
| Frequency aging                       |                       | f <sub>aging</sub>              | ±5 × 10 <sup>-6</sup> / year Max.                         |                                      |                                      | +25 °C, V <sub>cc</sub> =5.0 V / 3.3 V, First year                           |

\*1 SG-636 series "C" tolerance : 40 MHz< $f_0$ ≤135 MHz

## External dimensions

(Unit:mm)

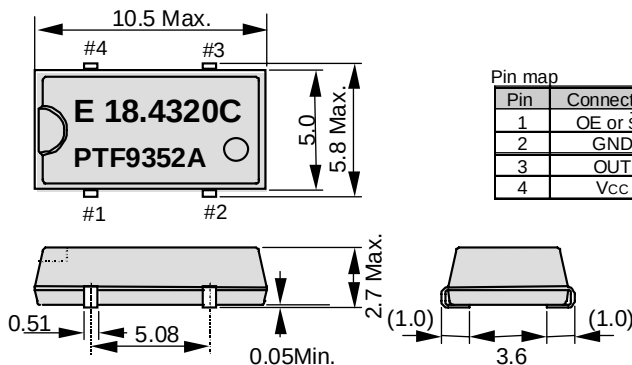
## ● SG-645 series



Pin map

| Pin | Connection |
|-----|------------|
| 1   | OE or ST   |
| 2   | GND        |
| 3   | OUT        |
| 4   | Vcc        |

## ● SG-636 series



Pin map

| Pin | Connection |
|-----|------------|
| 1   | OE or ST   |
| 2   | GND        |
| 3   | OUT        |
| 4   | Vcc        |

Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

Note.

OE pin (PTF,PH,PCE,PDE,PTW,PHW,PCW,PTG,PHG,PCG)

OE pin = "H" or "open" : Specified frequency output.

OE pin = "L" : Output is high impedance.

$\overline{ST}$  pin (STW, SHW, SCW,SCG)

$\overline{ST}$  pin = "H" or "open" : Specified frequency output.

$\overline{ST}$  pin = "L" : Output is low level (weak pull - down), oscillation stops.

$\overline{ST}$  pin (SCE)

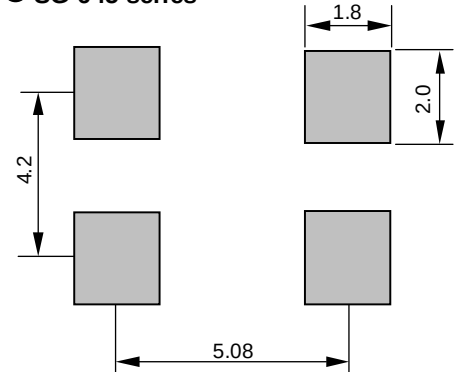
$\overline{ST}$  pin = "H" or "open" : Specified frequency output.

$\overline{ST}$  pin = "L" : Output is low level , oscillation stops.

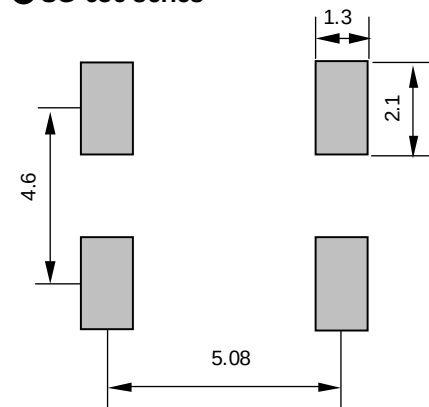
## Footprint (Recommended)

(Unit:mm)

## ● SG-645 series



## ● SG-636 series







# CRYSTAL OSCILLATOR SPXO

## SG - 615 series SG - 531 / SG - 51 series

- Frequency range : 1.025 MHz to 135 MHz
- Supply voltage : 3.3 V / 5.0 V
- Function : Output enable(OE) or Standby( $\overline{ST}$ )
- Pin compatible with full-size metal can. (SG-51 series)
- Pin compatible with half-size metal can. (SG-531 series)

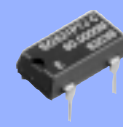


Product Number (please contact us)

SG-615 : Q33615xx1xxxx00

SG-531 : Q32531xx1xxxx00

SG-51 : Q32510xx1xxxx00



Actual size

SG-615



SG-531



SG-51



### Specifications (characteristics)

| Item                                  |                       | Symbol                          | Specifications                                         |                                    |                                 | Remarks                                                                                  |
|---------------------------------------|-----------------------|---------------------------------|--------------------------------------------------------|------------------------------------|---------------------------------|------------------------------------------------------------------------------------------|
|                                       |                       |                                 | SG-615P<br>SG-531P<br>SG-51P                           | SG-615PTJ<br>SG-531PTJ<br>SG-51PTJ | SG-615PH<br>SG-531PH<br>SG-51PH |                                                                                          |
| Output frequency range                |                       | f <sub>0</sub>                  | 1.025 MHz to 26 MHz                                    | 26.001 MHz to 66.667 MHz           |                                 | .                                                                                        |
| Supply voltage                        |                       | V <sub>cc</sub>                 | 5.0 V ±0.5 V                                           |                                    |                                 |                                                                                          |
| Temperature range                     | Storage temperature   | T <sub>stg</sub>                | -55 °C to +125 °C                                      |                                    |                                 | Store as bare product after unpacking                                                    |
|                                       | Operating temperature | T <sub>use</sub>                | -20 °C to +70 °C                                       |                                    |                                 |                                                                                          |
| Frequency tolerance                   |                       | f <sub>tol</sub>                | B: ±50 × 10 <sup>-6</sup> , C: ±100 × 10 <sup>-6</sup> |                                    |                                 | -20 °C to +70 °C *1                                                                      |
| Current consumption                   |                       | I <sub>cc</sub>                 | 23 mA Max.                                             | 35 mA Max.                         |                                 | No load condition                                                                        |
| Disable current                       |                       | I <sub>dis</sub>                | 12 mA Max.                                             | 28 mA Max.                         | 20 mA Max.                      | OE=GND                                                                                   |
| Symmetry                              |                       | SYM                             | 40 % to 60 %                                           | —                                  | 40 % to 60 %                    | CMOS load: 50 % V <sub>cc</sub> level                                                    |
|                                       |                       |                                 | 40 % to 60 %                                           | 45 % to 55 %                       | —                               | TTL load: 1.4 V level                                                                    |
| High output voltage                   |                       | V <sub>OH</sub>                 | V <sub>cc</sub> -0.4 V Min.                            | 2.4 V Min.                         | V <sub>cc</sub> -0.4 V Min.     | I <sub>OH</sub> = -400 μA(P,PTJ)/-4 mA(PH)                                               |
| Low output voltage                    |                       | V <sub>OL</sub>                 | 0.4 V Max.                                             |                                    |                                 | I <sub>OL</sub> =16 mA(P)/ 8 mA(PTJ)/ 4 mA(PH)                                           |
| Output load condition (TTL)           |                       | L <sub>TTL</sub>                | 10 TTL Max.                                            | 5 TTL Max.                         | —                               | L <sub>CMOS</sub> ≤ 15 pF                                                                |
| Output load condition (CMOS)          |                       | L <sub>CMOS</sub>               | 50 pF Max.                                             | —                                  | 50 pF Max.                      |                                                                                          |
| Output enable / disable input voltage |                       | V <sub>IH</sub>                 | 2.0 V Min.                                             | 3.5 V Min.                         | 80 % V <sub>cc</sub> Min.       | I <sub>IH</sub> = 1 μA Max. (OE=V <sub>cc</sub> )                                        |
|                                       |                       | V <sub>IL</sub>                 | 0.8 V Max.                                             | 1.5 V Max.                         | 20 % V <sub>cc</sub> Max.       | I <sub>IL</sub> = -100 μA Min. (OE=GND),<br>PTJ: I <sub>IL</sub> = -500 μA Min. (OE=GND) |
| Rise time / Fall time                 |                       | t <sub>r</sub> / t <sub>f</sub> | 8 ns Max.                                              | —                                  | 7 ns Max.                       | CMOS load: 20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level                            |
|                                       |                       |                                 | 8 ns Max.                                              | 5 ns Max.                          | —                               | TTL load: 0.4 V to 2.4 V level                                                           |
| Start-up time                         |                       | t <sub>str</sub>                | 4 ms Max.                                              | 10 ms Max.                         |                                 | Time at minimum supply voltage to be 0 s                                                 |
| Frequency aging                       |                       | f <sub>aging</sub>              | ±5 × 10 <sup>-6</sup> / year Max.                      |                                    |                                 | +25 °C, V <sub>cc</sub> =5.0 V, First year                                               |

\*1 "B" tolerance will be available up to 55 MHz.

### Specifications (characteristics)

| Item                   |                          | Symbol                          | Specifications                                                                     |                        |                             | Remarks                                                                      |
|------------------------|--------------------------|---------------------------------|------------------------------------------------------------------------------------|------------------------|-----------------------------|------------------------------------------------------------------------------|
|                        |                          |                                 | SG-615PCG<br>SG-531PCG                                                             | SG-615SCG<br>SG-531SCG | SG-615PCN                   |                                                                              |
| Output frequency range |                          | f <sub>0</sub>                  | 1.500 MHz to 26.000 MHz                                                            |                        | 26.001 MHz<br>to 66.667 MHz |                                                                              |
| Supply voltage         |                          | V <sub>cc</sub>                 | 2.7 V to 3.6 V                                                                     |                        | 3.0 V to 3.6 V              |                                                                              |
| Temperature<br>range   | Storage<br>temperature   | T <sub>stg</sub>                | -55 °C to +125 °C                                                                  |                        |                             | Store as bare product after unpacking                                        |
|                        | Operating<br>temperature | T <sub>use</sub>                | -40 °C to +85 °C                                                                   |                        |                             |                                                                              |
| Frequency tolerance    |                          | f <sub>tol</sub>                | B: ±50 × 10 <sup>-6</sup> C: ±100 × 10 <sup>-6</sup><br>M: ±100 × 10 <sup>-6</sup> |                        |                             | -20 °C to +70 °C<br>-40 °C to +85 °C                                         |
| Current consumption    |                          | I <sub>cc</sub>                 | 12 mA Max.                                                                         |                        | 20 mA Max.                  | No load condition                                                            |
| Disable current        |                          | I <sub>dis</sub>                | 10 mA Max.                                                                         | —                      | 10 mA Max.                  | OE=GND (PCG,PCN)                                                             |
| Stand-by current       |                          | I <sub>std</sub>                | —                                                                                  | 50 µA Max.             | —                           | ST =GND (SCG)                                                                |
| Symmetry               |                          | SYM                             | 45 % to 55 %                                                                       |                        |                             | 50 % V <sub>cc</sub> level, L <sub>CMOS</sub> =Max.                          |
| High output voltage    |                          | V <sub>OH</sub>                 | V <sub>cc</sub> -0.4 V Min.                                                        |                        | V <sub>cc</sub> -0.4 V Min. | I <sub>OH</sub> =-8 mA                                                       |
| Low output voltage     |                          | V <sub>OL</sub>                 | 0.4 V Max.                                                                         |                        | 0.4 V Max.                  | I <sub>OL</sub> = 8 mA                                                       |
| Output load condition  |                          | L <sub>CMOS</sub>               | 25 pF Max.                                                                         |                        | 15 pF Max.                  |                                                                              |
| Output enable /        |                          | V <sub>IH</sub>                 | 70 % V <sub>cc</sub> Min.                                                          |                        | 70 % V <sub>cc</sub> Min.   | OE Terminal or ST Terminal                                                   |
| disable input voltage  |                          | V <sub>IL</sub>                 | 20 % V <sub>cc</sub> Max.                                                          |                        | 30 % V <sub>cc</sub> Max.   |                                                                              |
| Rise time / Fall time  |                          | t <sub>r</sub> / t <sub>f</sub> | 4 ns Max.                                                                          |                        |                             | 20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level, L <sub>CMOS</sub> ≤ Max. |
| Start-up time          |                          | t <sub>str</sub>                | 12 ms Max.                                                                         |                        | 10 ms Max.                  | t=0 at 90% V <sub>cc</sub>                                                   |
| Frequency aging        |                          | f <sub>aging</sub>              | ±5 × 10 <sup>-6</sup> / year Max.                                                  |                        |                             | +25 °C, V <sub>cc</sub> =3.3 V, First year                                   |



## Specifications (characteristics)

| Item                                  | Symbol                | Specifications                                           |                                    |                                                | Remarks                                                    |
|---------------------------------------|-----------------------|----------------------------------------------------------|------------------------------------|------------------------------------------------|------------------------------------------------------------|
|                                       |                       | SG-615PTW / STW<br>SG-531PTW / STW                       | SG-615PHW / SHW<br>SG-531PHW / SHW | SG-615PCW / SCW<br>SG-531PCW / SCW             |                                                            |
| Output frequency range                | $f_0$                 | 55.001 MHz to 135.000 MHz                                |                                    | 26.001 MHz to 135.000 MHz                      |                                                            |
| Supply voltage                        | $V_{CC}$              | 5.0 V $\pm$ 0.5 V                                        |                                    | 3.3 V $\pm$ 0.3 V                              |                                                            |
| Temperature range                     | Storage temperature   | $-55^{\circ}\text{C}$ to $+125^{\circ}\text{C}$          |                                    |                                                | Store as bare product after unpacking                      |
|                                       | Operating temperature | $-20^{\circ}\text{C}$ to $+70^{\circ}\text{C}$           |                                    | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ |                                                            |
| Frequency tolerance                   | $f_{\text{tol}}$      | B: $\pm 50 \times 10^{-6}$ , C: $\pm 100 \times 10^{-6}$ |                                    |                                                | $-20^{\circ}\text{C}$ to $+70^{\circ}\text{C}$ *1          |
|                                       |                       | —                                                        |                                    | M: $\pm 100 \times 10^{-6}$                    | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$             |
| Current consumption                   | $I_{CC}$              | 45 mA Max.                                               |                                    | 28 mA Max.                                     | No load condition( Max. frequency range )                  |
| Disable current                       | $I_{\text{dis}}$      | 30 mA Max.                                               |                                    | 16 mA Max.                                     | OE=GND (PTW,PHW,PCW)                                       |
| Stand-by current                      | $I_{\text{std}}$      | 50 $\mu\text{A}$ Max.                                    |                                    |                                                | $\overline{\text{ST}}$ =GND (STW,SHW,SCW)                  |
| Symmetry                              | SYM                   | —                                                        |                                    | 40 % to 60 %                                   | 50 % $V_{CC}$ level, L CMOS=Max.                           |
|                                       |                       | 40 % to 60 %                                             |                                    | —                                              | 1.4 V level, L CMOS=Max.                                   |
| High output voltage                   | $V_{OH}$              | $V_{CC}-0.4$ V Min.                                      |                                    |                                                | $I_{OH}=-16$ mA(PTW,STW,PHW,SHW), -8 mA(PCW,SCW)           |
| Low output voltage                    | $V_{OL}$              | 0.4 V Max.                                               |                                    |                                                | $I_{OL}=16$ mA(PTW,STW,PHW,SHW), 8 mA(PCW,SCW)             |
| Output load condition (TTL)           | $L_{\text{TTL}}$      | 5 TTL Max.                                               | —                                  | —                                              | $f_0 \leq 90$ MHz, Max.supply voltage                      |
| Output load condition (CMOS)          | $L_{\text{CMOS}}$     | 15 pF Max.                                               |                                    |                                                | Max.frequency, Max.supply voltage                          |
| Output enable / disable input voltage | $V_{IH}$              | 2.0 V Min.                                               |                                    | 70 % $V_{CC}$ Min.                             | OE Terminal or $\overline{\text{ST}}$ Terminal             |
|                                       | $V_{IL}$              | 0.8 V Max.                                               |                                    | 20 % $V_{CC}$ Max.                             |                                                            |
| Rise time / Fall time                 | $t_r / t_f$           | —                                                        |                                    | 4 ns Max.                                      | 20 % $V_{CC}$ to 80 % $V_{CC}$ level, L CMOS $\leq$ Max.   |
|                                       |                       | 4 ns Max.                                                |                                    | —                                              | 0.4 V to 2.4 V level                                       |
| Start-up time                         | $t_{\text{str}}$      | 10 ms Max.                                               |                                    |                                                | Time at minimum supply voltage to be 0 s                   |
| Frequency aging                       | $f_{\text{aging}}$    | $\pm 5 \times 10^{-6}$ / year Max.                       |                                    |                                                | $+25^{\circ}\text{C}$ , $V_{CC}=5.0$ V / 3.3 V, First year |

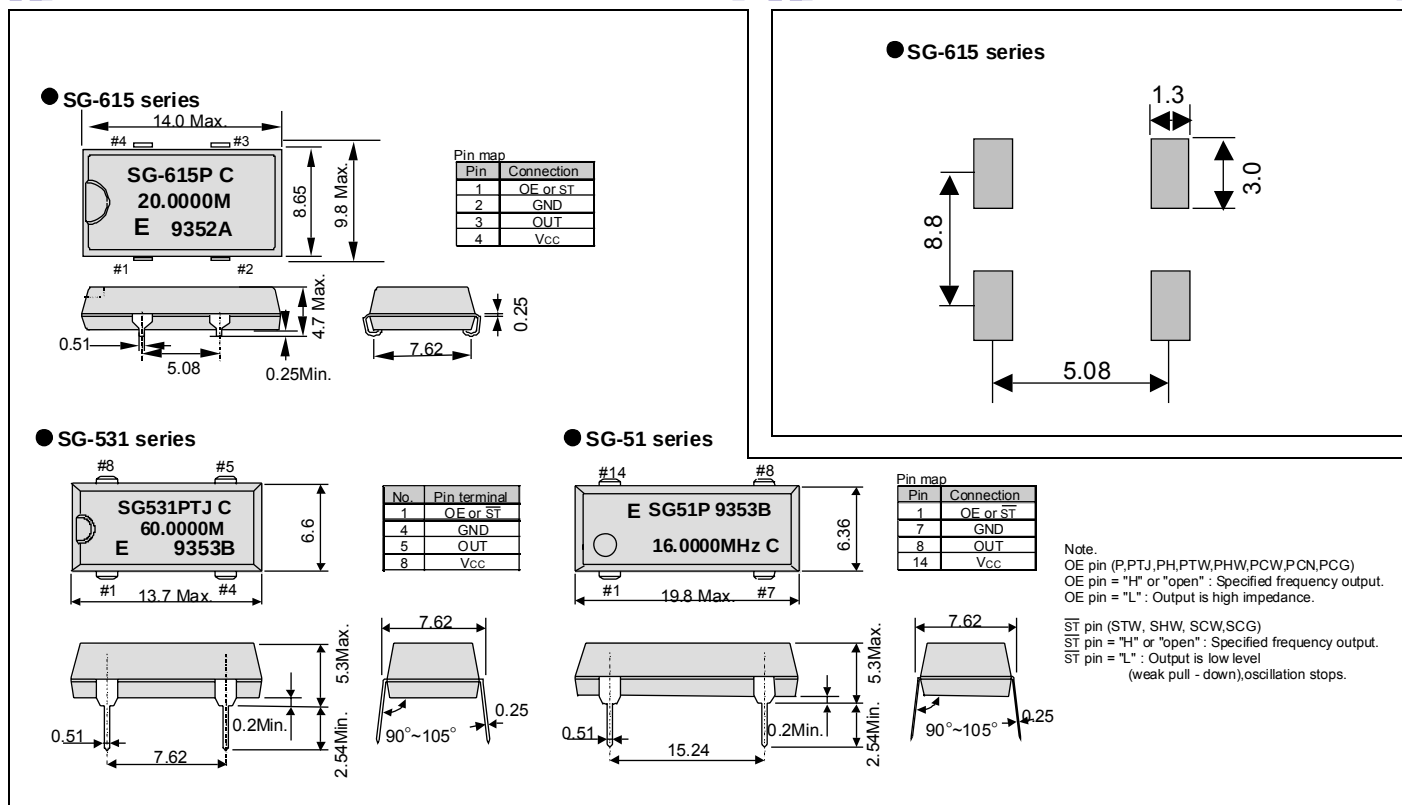
\*1 "C" tolerance :  $f_0 \geq 66.667$  MHz(PTW,STW,PHW,SHW)

## External dimensions

(Unit:mm)

## Footprint (Recommended)

(Unit:mm)





# CRYSTAL OSCILLATOR PROGRAMMABLE

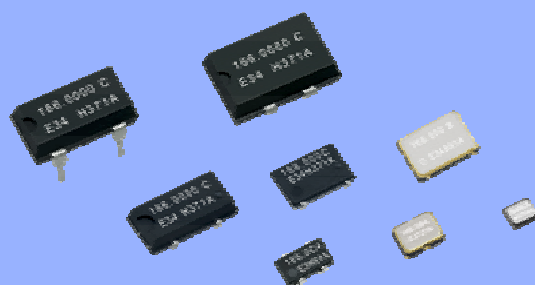
## SG - 8003 series

- Frequency range : 1 MHz to 166 MHz
- Supply voltage : 1.8 V Typ. or 2.5 V Typ. or 3.3 V Typ.
- Function : Output enable(OE) or Standby( $\overline{ST}$ )

- Short mass production lead time by PLL technology.
  - SG-Writer available to purchase.
- Please contact Epson Toyocom or local sales representative.



Product Number (please contact us)

**NEW**

### Specifications (characteristics)

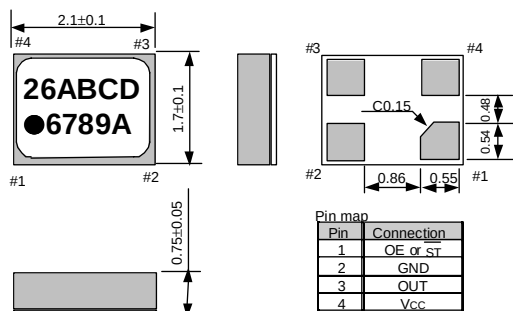
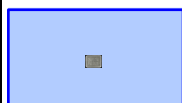
| Item                                  |                       | Symbol                          | Specifications                                         |                              |                              | Remarks                                                  |                                                                              |
|---------------------------------------|-----------------------|---------------------------------|--------------------------------------------------------|------------------------------|------------------------------|----------------------------------------------------------|------------------------------------------------------------------------------|
|                                       |                       |                                 | PE / SE                                                | PD / SD                      | PC / SC                      |                                                          |                                                                              |
| Output frequency range                |                       | f <sub>0</sub>                  | 1 MHz to 166 MHz                                       |                              |                              |                                                          |                                                                              |
| Supply voltage                        |                       | V <sub>CC</sub>                 | 1.8 V Typ.<br>1.6 V to 2.2 V                           | 2.5 V Typ.<br>2.2 V to 2.7 V | 3.3 V Typ.<br>2.7 V to 3.6 V |                                                          |                                                                              |
| Temperature range                     | Storage temperature   | T <sub>stg</sub>                | -40 °C to +85 °C                                       |                              |                              | Store as bare product after unpacking                    |                                                                              |
|                                       | Operating temperature | T <sub>use</sub>                | -20 °C to +70 °C / -40 °C to +85 °C                    |                              |                              |                                                          |                                                                              |
| Frequency tolerance                   |                       | f <sub>tol</sub>                | B: ±50 × 10 <sup>-6</sup> , C: ±100 × 10 <sup>-6</sup> |                              |                              | -20 °C to +70 °C                                         |                                                                              |
|                                       |                       |                                 | L:±50 × 10 <sup>-6</sup> , M: ±100 × 10 <sup>-6</sup>  |                              |                              | -40 °C to +85 °C                                         |                                                                              |
| Current consumption                   |                       | I <sub>CC</sub>                 | 10 mA Max.                                             | 15 mA Max.                   |                              | No load condition,f <sub>0</sub> =166 MHz                |                                                                              |
| Output disable current                |                       | I <sub>dis</sub>                | 8 mA Max.                                              |                              |                              | OE=GND (PE,PD,PC)                                        |                                                                              |
| Stand-by current                      |                       | I <sub>std</sub>                | 50 μA Max.                                             |                              |                              | ST =GND (SE,SD,SC)                                       |                                                                              |
| Symmetry                              |                       | SYM                             | 45 % to 55 %                                           |                              |                              | 50 % V <sub>CC</sub> level, L <sub>CMOS</sub> ≤ 15 pF    |                                                                              |
| High output voltage                   |                       | V <sub>OH</sub>                 | 90 % V <sub>CC</sub> Min.                              |                              | V <sub>CC</sub> -0.4 V Min.  | I <sub>OH</sub> =-4 mA(PD,SD,PE,SE), -8.0 mA(PC,SC)      |                                                                              |
| Low output voltage                    |                       | V <sub>OL</sub>                 | 10 % V <sub>CC</sub> Max.                              |                              | 0.4 V Max.                   | I <sub>OL</sub> = 4 mA(PD,SD,PE,SE), 8.0 mA(PC,SC)       |                                                                              |
| Output load condition (CMOS)          |                       | L <sub>CMOS</sub>               | 15 pF Max.                                             |                              |                              |                                                          |                                                                              |
| Output enable / disable input voltage |                       | V <sub>IH</sub>                 | 80 % V <sub>CC</sub> Min.                              |                              |                              | OE terminal or ST terminal                               |                                                                              |
|                                       |                       | V <sub>IL</sub>                 | 20 % V <sub>CC</sub> Max.                              |                              |                              |                                                          |                                                                              |
| Rise and Fall time                    |                       | t <sub>r</sub> / t <sub>f</sub> | 5.0 ns Max.                                            |                              |                              | 1 MHz≤f <sub>0</sub> <80 MHz                             | 20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> level, L <sub>CMOS</sub> =15 pF |
|                                       |                       |                                 | 2.5 ns Max.                                            |                              |                              | 80 MHz≤f <sub>0</sub> ≤166 MHz                           |                                                                              |
| Start-up time                         |                       | t <sub>str</sub>                | 5 ms Max.                                              |                              |                              | t=0 at 90 % V <sub>CC</sub>                              |                                                                              |
| Frequency aging                       |                       | f <sub>aging</sub>              | ±3 × 10 <sup>-6</sup> / year Max.                      |                              |                              | +25 °C, First year, V <sub>CC</sub> =1.8 V, 2.5 V, 3.3 V |                                                                              |

### External dimensions

(Unit:mm)

#### SG-8003BA

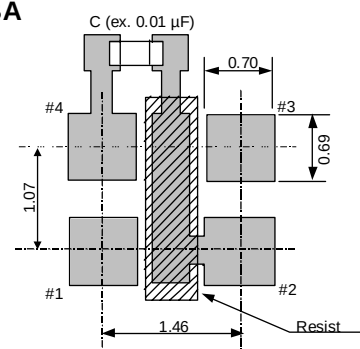
Actual size



### Footprint (Recommended)

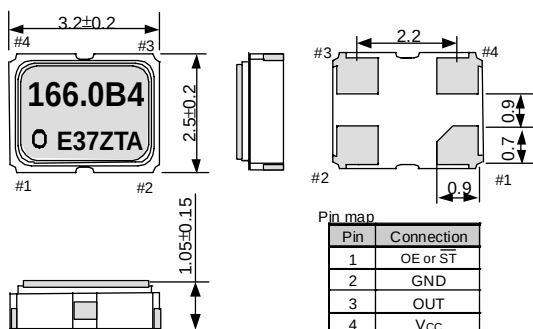
(Unit:mm)

#### SG-8003BA

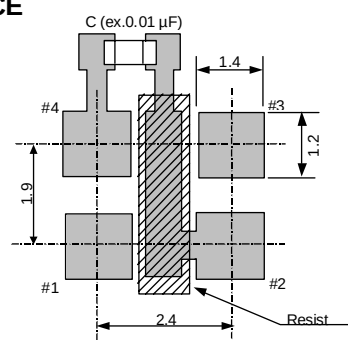


#### SG-8003CE

Actual size

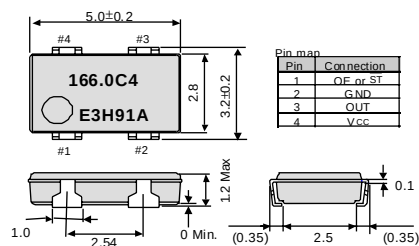


#### SG-8003CE

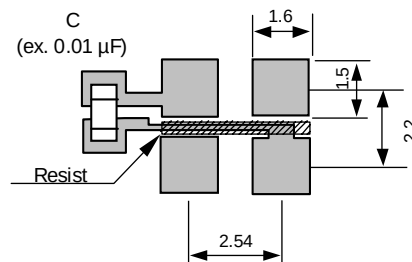


**SG-8003LB**

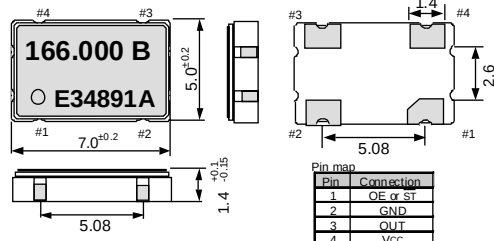
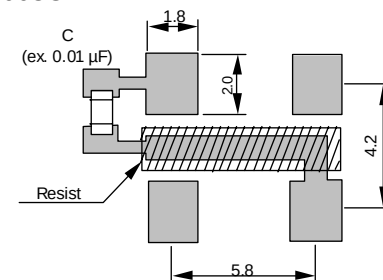
Actual size



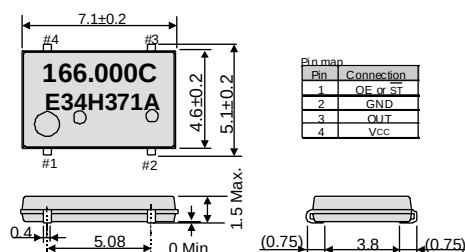
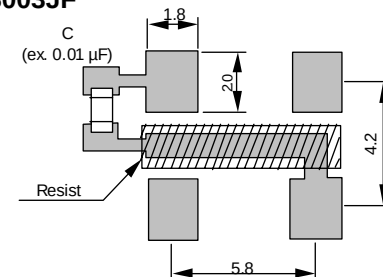
Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

**SG-8003LB****SG-8003CA**

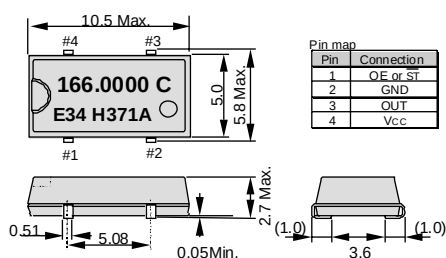
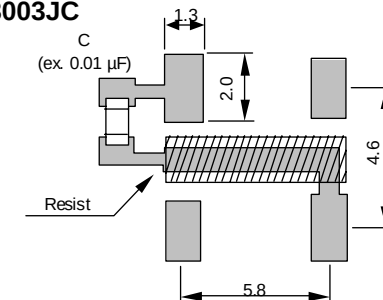
Actual size

**SG-8003CA****SG-8003JF**

Actual size

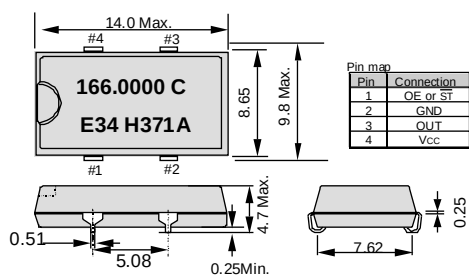
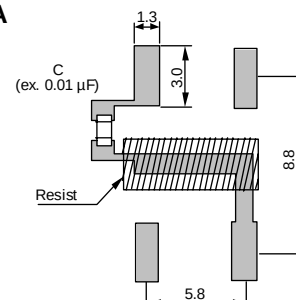
**SG-8003JF****SG-8003JC**

Actual size

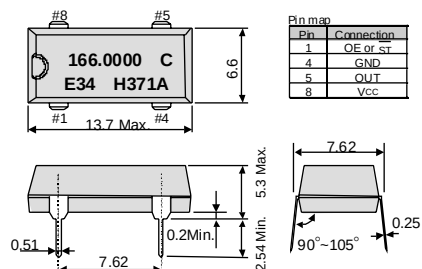
**SG-8003JC**

**SG-8003JA**

Actual size

**SG-8003JA****SG-8003DC**

Actual size



### Note

OE Pin (PE, PD, PC)

OE Pin = "H" or "open" : Specified frequency output.

OE Pin = "L" : Output is low level (weak pull - down), oscillation stops.

 $\overline{\text{ST Pin}}$  (SE SD SC)

ST Pin = "H" or "open" : Specified frequency output.

ST Pin = "L" : Output is low level (weak pull - down), oscillation stops.



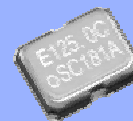
# CRYSTAL OSCILLATOR PROGRAMMABLE

## SG - 8002CE series

- Frequency range : 1 MHz to 125 MHz
  - Supply voltage : 3.3 V or 5.0 V
  - Function : Output enable(OE) or Standby( $\overline{ST}$ )
  - Thickness : 1.05 mm Typ.
  - Short mass production lead time by PLL technology.
  - SG-Writer available to purchase.
- Please contact Epson Toyocom or local sales representative.



Product Number (please contact us)  
Q3321CExxxxxx00



Actual size



### Specifications (characteristics)

| Item                                     |                       | Symbol                          | Specifications *2                                      |              |                           | Remarks                                                       |
|------------------------------------------|-----------------------|---------------------------------|--------------------------------------------------------|--------------|---------------------------|---------------------------------------------------------------|
|                                          |                       |                                 | PT / ST                                                | PH / SH      | PC / SC                   |                                                               |
| Output frequency range                   |                       | f <sub>0</sub>                  | 1 MHz to 125 MHz                                       |              | —                         | V <sub>CC</sub> =4.5 V to 5.5 V                               |
|                                          |                       |                                 | —                                                      |              | 1 MHz to 125 MHz          | V <sub>CC</sub> =3.0 V to 3.6 V                               |
|                                          |                       |                                 | —                                                      |              | 1 MHz to 66.7 MHz         | V <sub>CC</sub> =2.7 V to 3.6 V                               |
| Supply voltage                           |                       | V <sub>CC</sub>                 | 4.5 V to 5.5 V                                         |              | 2.7 V to 3.6 V            |                                                               |
| Temperature range                        | Storage temperature   | T <sub>stg</sub>                | -40 °C to +125 °C                                      |              |                           | Store as bare product after unpacking                         |
|                                          | Operating temperature | T <sub>use</sub>                | -20 °C to +70 °C (-40 °C to +85 °C)                    |              | -40 °C to +85 °C          | Refer to “Outline specifications” (Frequency range)           |
| Frequency tolerance                      |                       | f <sub>tol</sub>                | B: ±50 × 10 <sup>-6</sup> , C: ±100 × 10 <sup>-6</sup> |              |                           | -20 °C to +70 °C                                              |
|                                          |                       |                                 | M: ±100 × 10 <sup>-6</sup>                             |              |                           | -40 °C to +85 °C *3                                           |
| Current consumption                      |                       | I <sub>CC</sub>                 | 40 mA Max.                                             |              | 28 mA Max.                | No load condition, Max. frequency                             |
| Disable current                          |                       | I <sub>dis</sub>                | 30 mA Max.                                             |              | 16 mA Max.                | OE=GND                                                        |
| Standby current                          |                       | I <sub>std</sub>                | 50 μA Max.                                             |              |                           | ST =GND(ST,SH,SC)                                             |
| Symmetry *1                              |                       | SYM                             | —                                                      | 40 % to 60 % |                           | CMOS load:50 % V <sub>CC</sub> level, Max. load condition     |
|                                          |                       |                                 | 40 % to 60 %                                           | —            |                           | TTL load: 1.4 V, Max. load condition                          |
| High output voltage                      |                       | V <sub>OH</sub>                 | V <sub>CC</sub> -0.4 V Min.                            |              |                           | I <sub>OH</sub> =-16 mA(PT,ST,PH,SH), -8 mA(PC,SC)            |
| Low output voltage                       |                       | V <sub>OL</sub>                 | 0.4 V Max.                                             |              |                           | I <sub>OL</sub> =16 mA(PT,ST,PH,SH), 8 mA(PC,SC)              |
| Output load condition (TTL) *1           |                       | L <sub>TTL</sub>                | 5 TTL Max.                                             | —            |                           | Max. frequency and<br>Max. Supply voltage                     |
| Output load condition (CMOS) *1          |                       | L <sub>CMOS</sub>               | 15 pF Max.                                             |              |                           |                                                               |
| Output enable /<br>disable input voltage |                       | V <sub>IH</sub>                 | 2.0 V Min.                                             |              | 70 % V <sub>CC</sub> Min. | ST terminal or OE terminal                                    |
|                                          |                       | V <sub>IL</sub>                 | 0.8 V Max.                                             |              | 20 % V <sub>CC</sub> Max. |                                                               |
| Rise and Fall time *1                    |                       | t <sub>r</sub> / t <sub>f</sub> | —                                                      | 3 ns Max.    |                           | CMOS load: 20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> level |
|                                          |                       |                                 | 4 ns Max.                                              | —            |                           | TTL load: 0.4 V to 2.4 V level                                |
| Start-up time                            |                       | t <sub>str</sub>                | 10 ms Max.                                             |              |                           | Time at minimum supply voltage to be 0 s                      |
| Frequency aging                          |                       | f <sub>aging</sub>              | ±5 × 10 <sup>-6</sup> / year Max.                      |              |                           | +25 °C, V <sub>CC</sub> =5.0 V / 3.3 V (PC,SC) First year     |

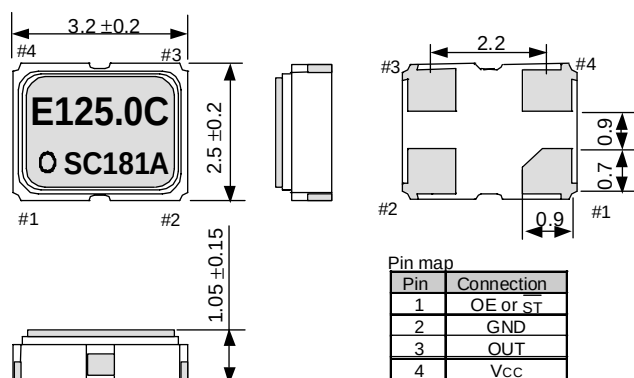
\*1 Operating temperature (-40 °C to +85 °C), the available frequency, symmetry and output load conditions, please refer to "Outline specifications" page.

\*2 PLL-PLL connection & Jitter specification, please refer to "Jitter specifications and characteristics chart" page.

\*3 PT / ST and PH / SH for "M" tolerance will be available up to 27 MHz. Checking possible by the Frequency checking program.

### External dimensions

(Unit:mm)



Note.

OE Pin (PT, PH, PC)

OE pin = "H" or "open" : Specified frequency output.

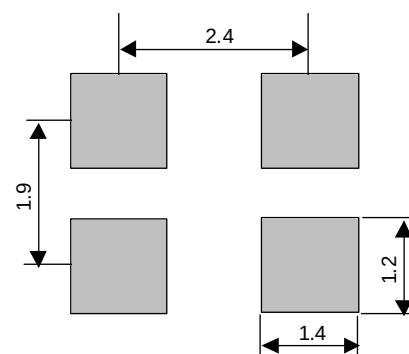
OE pin = "L" : Output is high impedance.

$\overline{ST}$  pin (ST, SH, SC)

$\overline{ST}$  pin = "H" or "open" : Specified frequency output.

$\overline{ST}$  pin = "L" : Output is low level (weak pull - down), oscillation stops.

### Footprint (Recommended) (Unit:mm)





# CRYSTAL OSCILLATOR PROGRAMMABLE

## SG - 8002 LB series

- Frequency range : 1 MHz to 125 MHz
  - Supply voltage : 3.3 V or 5.0 V
  - Function : Output enable(OE) or Standby( $\overline{ST}$ )
  - Thickness : 1.2 mm Max.
  - Short mass production lead time by PLL technology.
  - SG-Writer available to purchase.
- Please contact Epson Toyocom or local sales representative.



Product Number (please contact us)  
Q3323LBxxxxxx00



Actual size



### Specifications (characteristics)

| Item                                  | Symbol                          | Specifications *2                                        |                   | Remarks                                                     |
|---------------------------------------|---------------------------------|----------------------------------------------------------|-------------------|-------------------------------------------------------------|
|                                       |                                 | PH / SH                                                  | PC / SC           |                                                             |
| Output frequency range                | $f_o$                           | 1 MHz to 80 MHz                                          | —                 | Vcc=4.5 V to 5.5 V                                          |
|                                       |                                 | —                                                        | 1 MHz to 125 MHz  | Vcc=3.0 V to 3.6 V                                          |
|                                       |                                 | —                                                        | 1 MHz to 66.7 MHz | Vcc=2.7 V to 3.6 V                                          |
| Supply voltage                        | Vcc                             | 4.5 V to 5.5 V                                           | 2.7 V to 3.6 V    |                                                             |
| Temperature range                     | Storage temperature             | -40 °C to +125 °C                                        |                   | Store as bare product after unpacking                       |
|                                       | Operating temperature           | -20 °C to +70 °C (-40 °C to +85 °C)                      |                   | Refer to "Outline specifications" (Frequency range)         |
| Frequency tolerance                   | $f_{tol}$                       | B: $\pm 50 \times 10^{-6}$ , C: $\pm 100 \times 10^{-6}$ |                   | -20 °C to +70 °C                                            |
|                                       |                                 | M: $\pm 100 \times 10^{-6}$ *3                           |                   | -40 °C to +85 °C                                            |
|                                       |                                 | L: $\pm 50 \times 10^{-6}$                               |                   | -40 °C to +85 °C, Vcc $\pm 5\%$ *3                          |
| Current consumption                   | Icc                             | 30 mA Max.                                               | —                 | No load condition, $f_o=80$ MHz                             |
|                                       |                                 | —                                                        | 28 mA Max.        | No load condition, $f_o=125$ MHz                            |
| Disable current                       | I <sub>dis</sub>                | 25 mA Max.                                               | —                 | P Type only, $f_o=80$ MHz                                   |
|                                       |                                 | —                                                        | 16 mA Max.        | P Type only, $f_o=125$ MHz                                  |
| Stand-by current                      | I <sub>std</sub>                | 50 $\mu$ A Max.                                          |                   | S Type only, $\overline{ST}=GND$                            |
| Symmetry *1                           | SYM                             | 40 % to 60 %                                             | —                 | 50 % Vcc, L CMOS=15 pF, $\leq 80$ MHz                       |
|                                       |                                 | 45 % to 55 %                                             | —                 | 50 % Vcc, L CMOS=25 pF, $\leq 50$ MHz                       |
|                                       |                                 | —                                                        | 40 % to 60 %      | 50 % Vcc, L CMOS=15 pF, Vcc=3.0 V to 3.6 V, $\leq 125$ MHz  |
|                                       |                                 | —                                                        | 40 % to 60 %      | 50 % Vcc, L CMOS=15 pF, Vcc=2.7 V to 3.6 V, $\leq 66.7$ MHz |
|                                       |                                 | —                                                        | 45 % to 55 %      | 50 % Vcc, L CMOS=15 pF, Vcc=3.0 V to 3.6 V, $\leq 40$ MHz   |
| High output voltage                   | VOH                             | Vcc-0.4 V Min.                                           |                   | I <sub>OH</sub> =-16 mA(PH,SH), -8 mA(PC,SC)                |
| Low output voltage                    | VOL                             | 0.4 V Max.                                               |                   | I <sub>OL</sub> = 16 mA(PH,SH), 8 mA(PC,SC)                 |
| Output load condition(CMOS) *1        | L CMOS                          | 15 pF Max.                                               |                   | Max. frequency and Max. supply voltage                      |
| Output enable / disable input voltage | V <sub>IH</sub>                 | 2.0 V Min.                                               | 70 % Vcc Min.     | $\overline{ST}$ terminal or OE terminal                     |
|                                       | V <sub>IL</sub>                 | 0.8 V Max.                                               | 20 % Vcc Max.     |                                                             |
| Rise time / Fall time *1              | t <sub>r</sub> / t <sub>f</sub> | 3 ns Max.                                                |                   | 20 % Vcc to 80 % Vcc level, L CMOS=Max.                     |
| Start-up time                         | t <sub>str</sub>                | 10 ms Max.                                               |                   | Time at minimum supply voltage to be 0 s                    |
| Frequency aging                       | f <sub>aging</sub>              | $\pm 5 \times 10^{-6}$ / year Max.                       |                   | +25 °C, Vcc=5.0 V / 3.3 V (PC / SC) First year              |

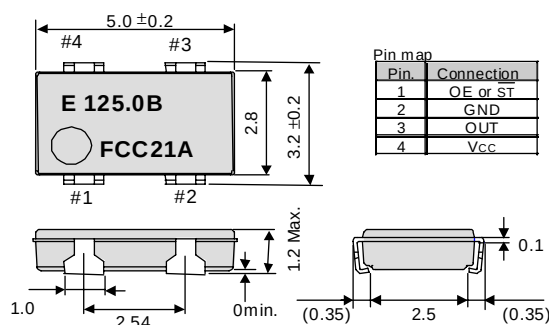
\*1 Operating temperature (-40 °C to +85 °C), the available frequency, symmetry and output load conditions, please refer to "Outline specifications" page.

\*2 PLL-PLL connection & Jitter specification, please refer to "Jitter specifications and characteristics chart" page.

\*3 PH,SH for "M" tolerance and "L" tolerance will be available up to 27 MHz. Checking possible by the Frequency checking program.

### External dimensions

(Unit:mm)



Note:

OE pin (PH, PC)

OE pin = "H" or "open" : Specified frequency output.

OE pin = "L" : Output is high impedance.

$\overline{ST}$  pin (SH, SC)

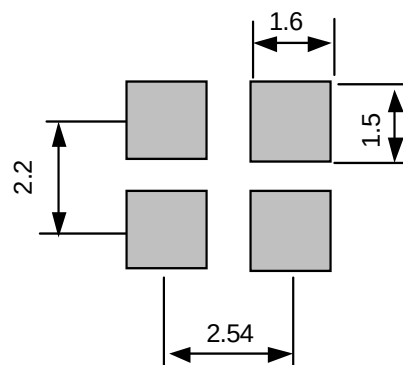
$\overline{ST}$  pin = "H" or "open" : Specified frequency output.

$\overline{ST}$  pin = "L" : Output is low level (weak pull - down), oscillation stops.

Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

### Footprint (Recommended)

(Unit:mm)





# CRYSTAL OSCILLATOR PROGRAMMABLE

## SG - 8002JF / CA series

- Frequency range : 1 MHz to 125 MHz
  - Supply voltage : 3.3 V or 5.0 V
  - Function : Output enable(OE) or Standby( $\overline{ST}$ )
  - Thickness : 1.5 mm Max.
  - Pin compatible with ceramic package crystal oscillator (7 × 5)  
: SG-8002JF
  - Short mass production lead time by PLL technology.
  - SG-Writer available to purchase.
- Please contact Epson Toyocom or local sales representative.



CA Type



JF,CA Type

Product Number (please contact us)  
SG-8002JF : Q3308JFxx1xxxx00  
SG-8002CA : Q3309CAxx0xxxx00



Actual size

SG-8002JF



SG-8002CA



### Specifications (characteristics)

| Item                                  |                       | Symbol                          | Specifications *2                                      |                               |                           | Remarks                                                                                         |
|---------------------------------------|-----------------------|---------------------------------|--------------------------------------------------------|-------------------------------|---------------------------|-------------------------------------------------------------------------------------------------|
|                                       |                       |                                 | PT / ST                                                | PH / SH                       | PC / SC                   |                                                                                                 |
| Output frequency range                |                       | f <sub>0</sub>                  | 1 MHz to 125 MHz                                       |                               | —                         | V <sub>CC</sub> =4.5 V to 5.5 V                                                                 |
|                                       |                       |                                 | —                                                      |                               | 1 MHz to 125 MHz          | V <sub>CC</sub> =3.0 V to 3.6 V                                                                 |
|                                       |                       |                                 | —                                                      |                               | 1 MHz to 66.7 MHz         | V <sub>CC</sub> =2.7 V to 3.6 V                                                                 |
| Supply voltage                        |                       | V <sub>CC</sub>                 | 4.5 V to 5.5 V                                         |                               | 2.7 V to 3.6 V            |                                                                                                 |
| Temperature range                     | Storage temperature   | T <sub>stg</sub>                | -55 °C to +125 °C                                      |                               |                           | Store as bare product after unpacking                                                           |
|                                       | Operating temperature | T <sub>use</sub>                | -20 °C to +70 °C (-40 °C to +85 °C)                    |                               | -40 °C to +85 °C          | Refer to "Outline specifications" (Frequency range)                                             |
| Frequency tolerance                   |                       | f <sub>tol</sub>                | B: ±50 × 10 <sup>-6</sup> , C: ±100 × 10 <sup>-6</sup> |                               |                           | -20 °C to +70 °C                                                                                |
|                                       |                       |                                 | M: ±100 × 10 <sup>-6</sup>                             |                               |                           | -40 °C to +85 °C *3                                                                             |
| Current consumption                   |                       | I <sub>CC</sub>                 | 45 mA Max.                                             |                               | 28 mA Max.                | No load condition, Max. frequency range                                                         |
| Disable current                       |                       | I <sub>dis</sub>                | 30 mA Max.                                             |                               | 16 mA Max.                | OE=GND(PT,PH,PC)                                                                                |
| Stand-by current                      |                       | I <sub>std</sub>                | 50 µA Max.                                             |                               |                           | ST =GND(ST,SH,SC)                                                                               |
| Symmetry*1                            | SYM                   | —                               | 40 % to 60 %                                           |                               |                           | CMOS load:50 % V <sub>CC</sub> level, Max. load condition                                       |
|                                       |                       | 40 % to 60 %                    | —                                                      |                               |                           | TTL load: 1.4 V level, Max. load condition                                                      |
| High output voltage                   |                       | V <sub>OH</sub>                 | V <sub>CC</sub> -0.4 V Min.                            |                               |                           | I <sub>OH</sub> =-16 mA(PT / ST,PH / SH), -8 mA(PC / SC)                                        |
| Low output voltage                    |                       | V <sub>OL</sub>                 | 0.4 V Max.                                             |                               |                           | I <sub>OL</sub> =16 mA(PT / ST,PH / SH), 8 mA(PC / SC)                                          |
| Output load condition (TTL) *1        |                       | L TTL                           | 5TTL Max.                                              | —                             |                           | f <sub>0</sub> ≤90 MHz, Max. supply voltage                                                     |
| Output load condition (CMOS) *1       |                       | L_CMOS                          | 15 pF Max.                                             | 15 pF Max.<br>(CA:25 pF Max.) | 15 pF Max.                | Max. frequency and Max. supply voltage                                                          |
| Output enable / disable input voltage |                       | V <sub>IH</sub>                 | 2.0 V Min.                                             |                               | 70 % V <sub>CC</sub> Min. | ST terminal or OE terminal                                                                      |
|                                       |                       | V <sub>IL</sub>                 | 0.8 V Max.                                             |                               | 20 % V <sub>CC</sub> Max. |                                                                                                 |
| Rise time / Fall time *1              |                       | t <sub>r</sub> / t <sub>f</sub> | —                                                      | 3 ns Max.                     |                           | CMOS load: 20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> level<br>TTL load: 0.4 V to 2.4 V level |
|                                       |                       |                                 | 4 ns Max.                                              | —                             |                           |                                                                                                 |
| Start-up time                         |                       | t <sub>str</sub>                | 10 ms Max.                                             |                               |                           | Time at minimum supply voltage to be 0 s                                                        |
| Frequency aging                       |                       | f <sub>aging</sub>              | ±5 × 10 <sup>-6</sup> / year Max.                      |                               |                           | +25 °C, V <sub>CC</sub> =5.0 V/ 3.3 V (PC / SC) First year                                      |

\*1 Operating temperature (-40 °C to +85 °C), the available frequency, symmetry and output load conditions, please refer to "Outline specifications" page.

\*2 PLL-PLL connection & Jitter specification, please refer to "Jitter specifications and characteristics chart" page.

\*3 PT / ST and PH / SH for "M" tolerance will be available up to 55 MHz. (JF:40 MHz)

Checking possible by the Frequency Checking Program.

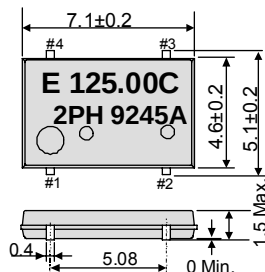
### External dimensions

(Unit:mm)

### Footprint (Recommended)

(Unit:mm)

#### SG-8002JF

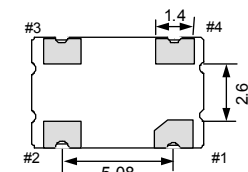
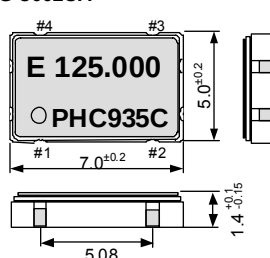


| Pin | Connection            |
|-----|-----------------------|
| 1   | OE or $\overline{ST}$ |
| 2   | GND                   |
| 3   | OUT                   |
| 4   | $V_{CC}$              |

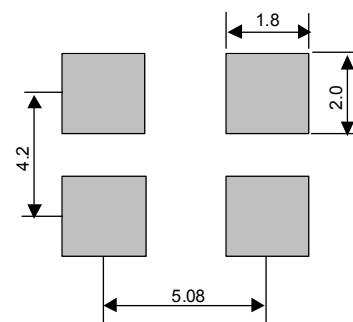
Note:  
OE Pin (PT, PH, PC)  
OE pin = "H" or "open" : Specified frequency output.  
OE pin = "L" : Output is high impedance.  
ST pin (ST, SH, SC)  
ST pin = "H" or "open" : Specified frequency output.  
ST pin = "L" : Output is low level (weak pull - down), oscillation stops.

Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

#### SG-8002CA



| Pin | Connection            |
|-----|-----------------------|
| 1   | OE or $\overline{ST}$ |
| 2   | GND                   |
| 3   | OUT                   |
| 4   | $V_{CC}$              |





CRYSTAL OSCILLATOR  
PROGRAMMABLE

## SG - 8002JC / JA series

- Frequency range : 1 MHz to 125 MHz
  - Supply voltage : 3.3 V or 5.0 V
  - Function : Output enable(OE) or Standby( $\overline{ST}$ )
  - Thickness : 2.7 mm Max.(SG-8002JC)  
4.7 mm Max.(SG-8002JA)
- Package and pin compatible with SG-636 (SG-8002JC)  
Package and pin compatible with SG-615 (SG-8002JA)  
•Short mass production lead time by PLL technology.  
•SG-Writer available to purchase.  
Please contact Epson Toyocom or local sales representative.



Product Number (please contact us)  
SG-8002JF: Q3307JCx1xxxx00  
SG-8002CA: Q3306JAx1xxxx00

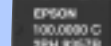


Actual size

SG-8002JC



SG-8002JA



## Specifications (characteristics)

| Item                                  |                       | Symbol                          | Specifications *2                                      |              |                           | Remarks                                                                                 |
|---------------------------------------|-----------------------|---------------------------------|--------------------------------------------------------|--------------|---------------------------|-----------------------------------------------------------------------------------------|
|                                       |                       |                                 | PT / ST                                                | PH / SH      | PC / SC                   |                                                                                         |
| Output frequency range                |                       | f <sub>0</sub>                  | 1 MHz to 125 MHz                                       |              | —                         | V <sub>CC</sub> =4.5 V to 5.5 V                                                         |
|                                       |                       |                                 | —                                                      |              | 1 MHz to 125 MHz          | V <sub>CC</sub> =3.0 V to 3.6 V                                                         |
|                                       |                       |                                 | —                                                      |              | 1 MHz to 66.7 MHz         | V <sub>CC</sub> =2.7 V to 3.6 V                                                         |
| Supply voltage                        |                       | V <sub>CC</sub>                 | 4.5 V to 5.5 V                                         |              | 2.7 V to 3.6 V            |                                                                                         |
| Temperature range                     | Storage temperature   | T <sub>stg</sub>                | -55 °C to +125 °C (JC: -55 °C to +100 °C)              |              |                           | Store as bare product after unpacking                                                   |
|                                       | Operating temperature | T <sub>use</sub>                | -20 °C to +70 °C (-40 °C to +85 °C)                    |              | -40 °C to +85 °C          | Refer to "Outline specifications" (Frequency range)<br>SG-8002JC: -20 °C to +70 °C Only |
| Frequency tolerance                   |                       | f <sub>tol</sub>                | B: ±50 × 10 <sup>-6</sup> , C: ±100 × 10 <sup>-6</sup> |              |                           | -20 °C to +70 °C                                                                        |
|                                       |                       |                                 | M: ±100 × 10 <sup>-6</sup>                             |              |                           | -40 °C to +85 °C *3 (except SG-8002JC)                                                  |
| Current consumption                   |                       | I <sub>CC</sub>                 | 45 mA Max.                                             |              | 28 mA Max.                | No load condition, Max. frequency                                                       |
| Disable current                       |                       | I <sub>dis</sub>                | 30 mA Max.                                             |              | 16 mA Max.                | OE=GND(PT,PH,PC)                                                                        |
| Stand-by current                      |                       | I <sub>std</sub>                | 50 μA Max.                                             |              |                           | ST =GND(ST,SH,SC)                                                                       |
| Symmetry *1                           |                       | SYM                             | —                                                      | 40 % to 60 % |                           | CMOS load: 50 % V <sub>CC</sub> level, Max. load condition                              |
|                                       |                       |                                 | 40% to 60%                                             | —            |                           | TTL load: 1.4 V level, Max. load condition                                              |
| High output voltage                   |                       | V <sub>OH</sub>                 | V <sub>CC</sub> -0.4 V Min.                            |              |                           | I <sub>OH</sub> = -16 mA(PT,ST,PH,SH), -8 mA(PC,SC)                                     |
| Low output voltage                    |                       | V <sub>OL</sub>                 | 0.4 V Max.                                             |              |                           | I <sub>OL</sub> =16 mA(PT,ST,PH,SH), 8 mA(PC,SC)                                        |
| Output load condition (TTL) *1        |                       | L <sub>TTL</sub>                | 5TTL Max.                                              | —            |                           | f <sub>0</sub> ≤ 90 MHz and Max. Supply voltage                                         |
| Output load condition (CMOS) *1       |                       | L <sub>CMOS</sub>               | 15pF Max.                                              |              |                           | Max. frequency and Max. Supply voltage                                                  |
| Output enable / disable input voltage |                       | V <sub>IH</sub>                 | 2.0 V Min.                                             |              | 70 % V <sub>CC</sub> Min. | ST terminal or OE terminal                                                              |
|                                       |                       | V <sub>IL</sub>                 | 0.8 V Max.                                             |              | 20 % V <sub>CC</sub> Max. |                                                                                         |
| Rise time / Fall time *1              |                       | t <sub>r</sub> / t <sub>f</sub> | —                                                      | 3 ns Max.    |                           | CMOS load: 20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> level                           |
|                                       |                       |                                 | 4 ns Max.                                              | —            |                           | TTL load: 0.4 V to 2.4 V level                                                          |
| Start-up time                         |                       | t <sub>str</sub>                | 10 ms Max.                                             |              |                           | Time at minimum supply voltage to be 0 s                                                |
| Frequency aging                       |                       | f <sub>aging</sub>              | ±5 × 10 <sup>-6</sup> / year Max.                      |              |                           | +25 °C, V <sub>CC</sub> =5.0 V/ 3.3 V (PC,SC) First year                                |

\*1 Operating temperature ( $-40\text{ }^{\circ}\text{C to }+85\text{ }^{\circ}\text{C}$ ), the available frequency, symmetry and output load conditions, please refer to "Outline specifications" page.

\*2 PLL-PLL connection & Jitter specification, please refer to "Jitter specifications and characteristics chart" page.

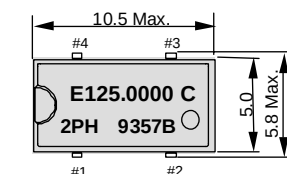
\*3 PT/ST and PH/SH for "M" tolerance will be available up to 55 MHz. (Unavailable "M" tolerance of SG-8002JC)

Checking possible by the Frequency Checking Program.

## External dimensions

(Unit:mm)

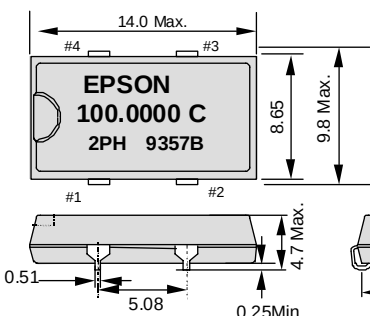
## ● SG-8002JC



Note.  
OE Pin (PT, PH, PC)  
OE pin = "H" or "open" : Specified frequency output.  
OE pin = "L" : Output is high impedance.  
ST pin (ST, SH, SC)  
ST pin = "H" or "open" : Specified frequency output.  
ST pin = "L" : Output is low level (weak pull - down), oscillation stops.

| Pin | Connection |
|-----|------------|
| 1   | OE or ST   |
| 2   | GND        |
| 3   | OUT        |
| 4   | VCC        |

## ● SG-8002JA



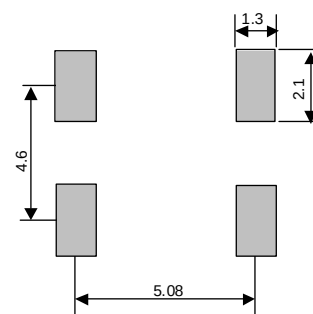
Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

| Pin | Connection |
|-----|------------|
| 1   | OE or ST   |
| 2   | GND        |
| 3   | OUT        |
| 4   | VCC        |

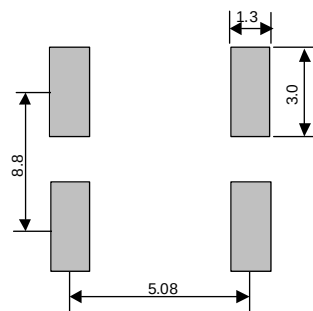
## Footprint (Recommended)

(Unit:mm)

## ● SG-8002JC



## ● SG-8002JA



CRYSTAL OSCILLATOR  
PROGRAMMABLE

## SG - 8002DC / DB series

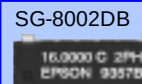
- Frequency range : 1 MHz to 125 MHz
  - Supply voltage : 3.3 V or 5.0 V
  - Function : Output enable(OE) or Standby( $\overline{ST}$ )  
Pin compatible with full size and half size.
  - Short mass production lead time by PLL technology.
  - SG-Writer available to purchase.
- Please contact EPSON TOYOCOM or local sales representative.



Product Number (please contact us)  
SG-8002DC: Q3204DCx1xxxx00  
SG-8002DB: Q3203DBx1xxxx00



Actual size



## Specifications (characteristics)

| Item                                  | Symbol                | Specifications *2                                                                       |         |                    | Remarks                                                         |
|---------------------------------------|-----------------------|-----------------------------------------------------------------------------------------|---------|--------------------|-----------------------------------------------------------------|
|                                       |                       | PT / ST                                                                                 | PH / SH | PC / SC            |                                                                 |
| Output frequency range                | $f_o$                 | 1 MHz to 125 MHz                                                                        |         | —                  | $V_{CC}=4.5\text{ V to }5.5\text{ V}$                           |
|                                       |                       | —                                                                                       |         | 1 MHz to 125 MHz   | $V_{CC}=3.0\text{ V to }3.6\text{ V}$                           |
|                                       |                       | —                                                                                       |         | 1 MHz to 66.7 MHz  | $V_{CC}=2.7\text{ V to }3.6\text{ V}$                           |
| Supply voltage                        | $V_{CC}$              | 4.5 V to 5.5 V                                                                          |         | 2.7 V to 3.6 V     |                                                                 |
| Temperature range                     | Storage temperature   | $T_{stg}$ -55 °C to +125 °C                                                             |         |                    | Store as bare product after unpacking                           |
|                                       | Operating temperature | $T_{use}$ -20 °C to +70 °C (-40 °C to +85 °C)                                           |         |                    | Refer to "Outline specifications" (Frequency range)             |
| Frequency tolerance                   | $f_{tol}$             | B: $\pm 50 \times 10^{-6}$ , C: $\pm 100 \times 10^{-6}$<br>M: $\pm 100 \times 10^{-6}$ |         |                    | -20 °C to +70 °C<br>-40 °C to +85 °C *3                         |
| Current consumption                   | $I_{CC}$              | 45 mA Max.                                                                              |         | 28 mA Max.         | No load condition, Max. frequency                               |
| Disable current                       | $I_{dis}$             | 30 mA Max.                                                                              |         | 16 mA Max.         | OE=GND(PT,PH,PC)                                                |
| Stand-by current                      | $I_{std}$             | 50 $\mu$ A Max.                                                                         |         |                    | $\overline{ST}$ =GND(ST,SH,SC)                                  |
| Symmetry *1                           | SYM                   | —                                                                                       |         | 40 % to 60 %       | CMOS load:50% $V_{CC}$ level, Max. load condition               |
| High output voltage                   | $V_{OH}$              | $V_{CC}-0.4\text{ V Min.}$                                                              |         |                    | $I_{OH}=-16\text{ mA(PT,ST,PH,SH)}, -8\text{ mA(PC,SC)}$        |
| Low output voltage                    | $V_{OL}$              | 0.4 V Max.                                                                              |         |                    | $I_{OL}=16\text{ mA(PT,ST,PH,SH)}, 8\text{ mA(PC,SC)}$          |
| Output load condition (TTL) *1        | $L_{TTL}$             | 5 TTL Max.                                                                              |         | —                  | Max. frequency and                                              |
| Output load condition (CMOS) *1       | $L_{CMOS}$            | 15 pF Max.                                                                              |         | 15 pF Max.         | Max. supply voltage                                             |
| Output enable / disable input voltage | $V_{IH}$              | 2.0 V Min.                                                                              |         | 70 % $V_{CC}$ Min. | $\overline{ST}$ terminal or OE terminal                         |
|                                       | $V_{IL}$              | 0.8 V Max.                                                                              |         | 20 % $V_{CC}$ Max. |                                                                 |
| Rise time / Fall time *1              | $t_r / t_f$           | —                                                                                       |         | 3 ns Max.          | CMOS load: 20 % $V_{CC}$ to 80 % $V_{CC}$ level                 |
|                                       | $t_r / t_f$           | 4 ns Max.                                                                               |         | —                  | TTL load: 0.4 V to 2.4 V level                                  |
| Start-up time                         | $t_{str}$             | 10 ms Max.                                                                              |         |                    | Time at minimum supply voltage to be 0 s                        |
| Frequency aging                       | $f_{aging}$           | $\pm 5 \times 10^{-6}$ / year Max.                                                      |         |                    | +25 °C, $V_{CC}=5.0\text{ V / }3.3\text{ V (PC/SC)}$ First year |

\*1 Operating temperature (-40 °C to +85 °C), the available frequency, symmetry and output load conditions, please refer to "Outline specifications" page.

\*2 PLL-PLL connection & Jitter specification, please refer to "Jitter specifications and characteristics chart" page.

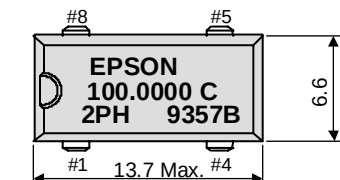
\*3 PT/ST and PH/SH for "M" tolerance will be available up to 55 MHz.

Checking possible by the Frequency Checking Program.

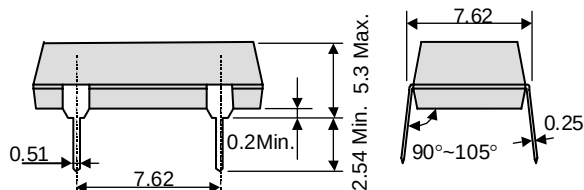
## External dimensions

(Unit:mm)

## ● SG-8002DC

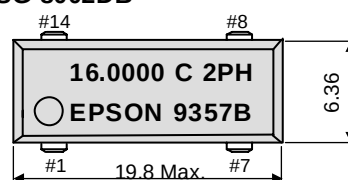


| Pin | Connection            |
|-----|-----------------------|
| 1   | OE or $\overline{ST}$ |
| 4   | GND                   |
| 5   | OUT                   |
| 8   | $V_{CC}$              |

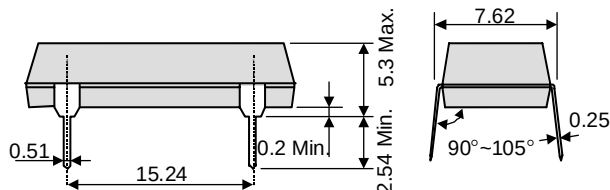


Note.  
OE Pin (PT, PH, PC)  
OE pin = "H" or "open" : Specified frequency output.  
OE pin = "L" : Output is high impedance.

## ● SG-8002DB



| Pin | Connection            |
|-----|-----------------------|
| 1   | OE or $\overline{ST}$ |
| 7   | GND                   |
| 8   | OUT                   |
| 14  | $V_{CC}$              |



$\overline{ST}$  pin (ST, SH, SC)  
 $\overline{ST}$  pin = "H" or "open" : Specified frequency output.  
 $\overline{ST}$  pin = "L" : Output is low level (weak pull - down), oscillation stops.



## SG-8002 Series Outline of specifications

| Item                      |    | Current<br>Consumption | Supply<br>Voltage                  | Output load condition                                                                                                                                                                                                       | Output rise time<br>Output fall time                                                                                                                                                     | Symmetry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Function |    |
|---------------------------|----|------------------------|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----|
| Model                     |    |                        |                                    |                                                                                                                                                                                                                             |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          |    |
| SG-8002LB<br>(SOJ 4-pin)  | PH | 30 mA<br>Max.          | 4.5 V to 5.5 V                     | 15 pF                                                                                                                                                                                                                       | 3.0 ns Max.<br>(20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L <sub>CMOS</sub> =Max.)                                                                                                  | 40 % to 60 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =15 pF, f <sub>osc</sub> 80 MHz/-40 °C to +85 °C)                                                                                                                                                                                                                                                                                                                                                                                                                                  | OE       |    |
|                           | SH |                        |                                    |                                                                                                                                                                                                                             |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ST       |    |
|                           | PC | 28 mA<br>Max.          | 3.0 V to 3.6 V<br>(2.7 V to 3.6 V) | 15 pF                                                                                                                                                                                                                       | 3.0 ns Max.<br>(20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> ,<br>L <sub>CMOS</sub> =Max.)                                                                                               | 45 % to 55 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =15 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>osc</sub> 40 MHz)<br>40 % to 60 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =15 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>osc</sub> 125 MHz)<br>↑<br>(50 % V <sub>CC</sub> , L <sub>CMOS</sub> =15 pF, V <sub>CC</sub> =2.7 V to 3.6 V, f <sub>osc</sub> 66.7 MHz)                                                                                                                                                               | OE       |    |
|                           | SC |                        |                                    |                                                                                                                                                                                                                             |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ST       |    |
| SG-8002CA<br>(SON)        | PT | 45 mA<br>Max.          | 4.5 V to 5.5 V                     | 5 TTL+15 pF (f <sub>osc</sub> 125 MHz/-20 °C to +70 °C)<br>25 pF (f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)<br>5 TTL+15 pF (f <sub>osc</sub> 40 MHz/-40 °C to +85 °C)<br>15 pF (f <sub>osc</sub> 55 MHz/-40 °C to +85 °C) | 2.0 ns Max.<br>(0.8 V to 2.0 V <sub>L</sub> , L <sub>CMOS</sub> or L <sub>TTL</sub> =Max.)<br>4.0 ns Max.<br>(0.4 V to 2.4 V <sub>L</sub> , L <sub>CMOS</sub> or L <sub>TTL</sub> =Max.) | 45 % to 55 % (1.4 V, L <sub>TTL</sub> =5 TTL+15 pF, f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)<br>↑<br>(1.4 V, L <sub>TTL</sub> =5 TTL+15 pF, f <sub>osc</sub> 40.0 MHz/-40 °C to +85 °C)<br>40 % to 60 % (1.4 V, L <sub>TTL</sub> =5 TTL+15 pF, f <sub>osc</sub> 125 MHz/-20 °C to +70 °C)<br>↑<br>(1.4 V, L <sub>CMOS</sub> =25 pF, f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)<br>↑<br>(1.4 V, L <sub>CMOS</sub> =15 pF, f <sub>osc</sub> 55.0 MHz/-40 °C to +85 °C)                                                                  | OE       |    |
| SG-8002JA<br>(SOJ 4-pin)  | ST |                        |                                    |                                                                                                                                                                                                                             |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | ST |
| SG-8002DB<br>(DIP 14-pin) | PH |                        |                                    | 25 pF (f <sub>osc</sub> 125 MHz/-20 °C to +70 °C)<br>50 pF (f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)<br>15 pF (f <sub>osc</sub> 55 MHz/-40 °C to +85 °C)<br>25 pF (f <sub>osc</sub> 40 MHz/-40 °C to +85 °C)             | 3.0 ns Max.<br>(20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L <sub>CMOS</sub> ≤25)<br>4.0 ns Max.<br>(20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L <sub>CMOS</sub> =Max.)         | 45 % to 55 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =25 pF, f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)<br>↑<br>(50 % V <sub>CC</sub> , L <sub>CMOS</sub> =25 pF, f <sub>osc</sub> 40.0 MHz/-40 °C to +85 °C)<br>40 % to 60 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =25 pF, f <sub>osc</sub> 125 MHz/-20 °C to +70 °C)<br>↑<br>(50 % V <sub>CC</sub> , L <sub>CMOS</sub> =50 pF, f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)<br>↑<br>(50 % V <sub>CC</sub> , L <sub>CMOS</sub> =15 pF, f <sub>osc</sub> 55.0 MHz/-40 °C to +85 °C) | OE       |    |
|                           | SH |                        |                                    |                                                                                                                                                                                                                             |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | ST |
| SG-8002DC<br>(DIP 8-pin)  | PC | 28 mA<br>Max.          | 3.0 V to 3.6 V<br>(2.7 V to 3.6 V) | 15 pF (f <sub>osc</sub> 66.7 MHz/2.7 to 3.6 V)<br>15 pF (f <sub>osc</sub> 125 MHz/3.0 to 3.6 V)<br>30 pF (f <sub>osc</sub> 40 MHz/3.0 to 3.6 V)                                                                             | 3.0 ns Max.<br>(20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L <sub>CMOS</sub> ≤15)<br>4.0 ns Max.<br>(20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L <sub>CMOS</sub> =Max.)         | 45 % to 55 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =30 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>osc</sub> 40 MHz)<br>40 % to 60 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =15 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>osc</sub> 125 MHz)<br>↑<br>(50 % V <sub>CC</sub> , L <sub>CMOS</sub> =15 pF, V <sub>CC</sub> =2.7 V to 3.6 V, f <sub>osc</sub> 66.7 MHz)                                                                                                                                                               | OE       |    |
|                           | SC |                        |                                    |                                                                                                                                                                                                                             |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ST       |    |
| SG-8002JC<br>(SOJ 4-pin)  | PT | 45 mA<br>Max.          | 4.5 V to 5.5 V                     | 5TTL + 15 pF (f <sub>osc</sub> 90 MHz/-20 to +70 °C)<br>15 pF (f <sub>osc</sub> 125 MHz/-20 °C to +70 °C)<br>25 pF (f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)                                                             | 2.0 ns Max.<br>(0.8 V to 2.0 V <sub>L</sub> , L <sub>CMOS</sub> or L <sub>TTL</sub> =Max.)<br>4.0 ns Max.<br>(0.4 V to 2.4 V <sub>L</sub> , L <sub>CMOS</sub> or L <sub>TTL</sub> =Max.) | 45 % to 55 % (1.4 V, L <sub>TTL</sub> =5 TTL+15 pF, f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)<br>40 % to 60 % (1.4 V, L <sub>TTL</sub> =5 TTL+15 pF, f <sub>osc</sub> 90.0 MHz/-20 °C to +70 °C)<br>↑<br>(1.4 V, L <sub>CMOS</sub> =25 pF, f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)<br>↑<br>(1.4 V, L <sub>CMOS</sub> =15 pF, f <sub>osc</sub> 125 MHz/-20 °C to +70 °C)                                                                                                                                                             | OE       |    |
|                           | ST |                        |                                    |                                                                                                                                                                                                                             |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | ST |
|                           | PH |                        |                                    | 15 pF (f <sub>osc</sub> 125 MHz/-20 °C to +70 °C)<br>25 pF (f <sub>osc</sub> 90 MHz/-20 °C to +70 °C)<br>50 pF (f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)                                                                 | 3.0 ns Max.<br>(20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L <sub>CMOS</sub> ≤25)<br>4.0 ns Max.<br>(20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L <sub>CMOS</sub> =Max.)         | 45 % to 55 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =25 pF, f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)<br>40 % to 60 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =15 pF, f <sub>osc</sub> 125 MHz/-20 °C to +70 °C)<br>↑<br>(50 % V <sub>CC</sub> , L <sub>CMOS</sub> =25 pF, f <sub>osc</sub> 90 MHz/-20 °C to +70 °C)<br>↑<br>(50 % V <sub>CC</sub> , L <sub>CMOS</sub> =50 pF, f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)                                                                                                         | OE       |    |
|                           | SH |                        |                                    |                                                                                                                                                                                                                             |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | ST |
|                           | PC | 28 mA<br>Max.          | 3.0 V to 3.6 V<br>(2.7 V to 3.6 V) | 15 pF (f <sub>osc</sub> 66.7 MHz/2.7 to 3.6 V)<br>15 pF (f <sub>osc</sub> 125 MHz/3.0 to 3.6 V)<br>30 pF (f <sub>osc</sub> 40 MHz/3.0 to 3.6 V)                                                                             | 3.0 ns Max.<br>(20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L <sub>CMOS</sub> ≤15)<br>4.0 ns Max.<br>(20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L <sub>CMOS</sub> =Max.)         | 45 % to 55 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =30 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>osc</sub> 40 MHz)<br>40 % to 60 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =15 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>osc</sub> 125 MHz)<br>↑<br>(50 % V <sub>CC</sub> , L <sub>CMOS</sub> =15 pF, V <sub>CC</sub> =2.7 V to 3.6 V, f <sub>osc</sub> 66.7 MHz)                                                                                                                                                               | OE       |    |
|                           |    | SC                     |                                    |                                                                                                                                                                                                                             |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | ST |
| SG-8002JF<br>(SOJ 4-pin)  | PT | 45 mA<br>Max.          | 4.5 V to 5.5 V                     | 15 pF (f <sub>osc</sub> 125 MHz/-20 °C to +70 °C)<br>25 pF (f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)<br>5TTL + 15 pF (f <sub>osc</sub> 90 MHz/-20 °C to +70 °C)<br>15 pF (f <sub>osc</sub> 40 MHz/-40 °C to +85 °C)      | 2.0 ns Max.<br>(0.8 V to 2.0 V <sub>L</sub> , L <sub>CMOS</sub> ≤25)<br>4.0 ns Max.<br>(0.4 V to 2.4 V <sub>L</sub> , L <sub>CMOS</sub> or L <sub>TTL</sub> =Max.)                       | 45 % to 55 % (1.4 V, L <sub>TTL</sub> =5 TTL+15 pF, f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)<br>40 % to 60 % (1.4 V, L <sub>TTL</sub> =5 TTL+15 pF, f <sub>osc</sub> 90 MHz/-20 °C to +70 °C)<br>↑<br>(1.4 V, L <sub>CMOS</sub> =25 pF, f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)<br>↑<br>(1.4 V, L <sub>CMOS</sub> =15 pF, f <sub>osc</sub> 125 MHz/-20 °C to +70 °C)<br>↑<br>(1.4 V, L <sub>CMOS</sub> =15 pF, f <sub>osc</sub> 40 MHz/-40 °C to +85 °C)                                                                           | OE       |    |
|                           | ST |                        |                                    |                                                                                                                                                                                                                             |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | ST |
|                           | PH |                        |                                    | 15 pF (f <sub>osc</sub> 125 MHz/-20 °C to +70 °C)<br>25 pF (f <sub>osc</sub> 90 MHz/-20 °C to +70 °C)<br>50 pF (f <sub>osc</sub> 50 MHz/-20 °C to +70 °C)<br>15 pF (f <sub>osc</sub> 40 MHz/-40 °C to +85 °C)               | 3.0 ns Max.<br>(20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L <sub>CMOS</sub> ≤25)<br>4.0 ns Max.<br>(20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L <sub>CMOS</sub> =Max.)         | 45 % to 55 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =25 pF, f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)<br>40 % to 60 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =25 pF, f <sub>osc</sub> 90.0 MHz/-20 °C to +70 °C)<br>↑<br>(50 % V <sub>CC</sub> , L <sub>CMOS</sub> =50 pF, f <sub>osc</sub> 50.0 MHz/-20 °C to +70 °C)<br>↑<br>(50 % V <sub>CC</sub> , L <sub>CMOS</sub> =15 pF, f <sub>osc</sub> 125 MHz/-20 °C to +70 °C)<br>↑<br>(50 % V <sub>CC</sub> , L <sub>CMOS</sub> =15 pF, f <sub>osc</sub> 40 MHz/-40 °C to +85 °C)   | OE       |    |
|                           | SH |                        |                                    |                                                                                                                                                                                                                             |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | ST |
|                           | PC | 28 mA<br>Max.          | 3.0 V to 3.6 V<br>(2.7 V to 3.6 V) | 15 pF (f <sub>osc</sub> 66.7 MHz/2.7 to 3.6 V)<br>15 pF (f <sub>osc</sub> 125 MHz/3.0 to 3.6 V)<br>30 pF (f <sub>osc</sub> 40 MHz/3.0 to 3.6 V)                                                                             | 3.0 ns Max.<br>(20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L <sub>CMOS</sub> ≤15)<br>4.0 ns Max.<br>(20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L <sub>CMOS</sub> =Max.)         | 45 % to 55 % (50 % V <sub>CC</sub> , CL=30 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>osc</sub> 40 MHz)<br>40 % to 60 % (50 % V <sub>CC</sub> , CL=15 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>osc</sub> 125 MHz)<br>↑<br>(50 % V <sub>CC</sub> , CL=15 pF, V <sub>CC</sub> =2.7 V to 3.6 V, f <sub>osc</sub> 66.7 MHz)                                                                                                                                                                                                               | OE       |    |
|                           |    | SC                     |                                    |                                                                                                                                                                                                                             |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | ST |
| SG-8002CE<br>(SON)        | PT | 40 mA<br>Max.          | 4.5 V to 5.5 V                     | 5 TTL+15 pF (f <sub>osc</sub> 125 MHz/-20 °C to +70 °C)<br>5 TTL+15 pF (f <sub>osc</sub> 27 MHz/-40 °C to +85 °C)                                                                                                           | 2.0 ns Max.<br>(0.8 V to 2.0 V <sub>L</sub> , L <sub>TTL</sub> =Max.)<br>4.0 ns Max.<br>(0.4 V to 2.4 V <sub>L</sub> , L <sub>TTL</sub> =Max.)                                           | 45 % to 55 % (1.4 V, L <sub>TTL</sub> =5 TTL+15 pF, f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)<br>↑<br>(1.4 V, L <sub>TTL</sub> =5 TTL+15 pF, f <sub>osc</sub> 27.0 MHz/-40 °C to +85 °C)<br>40 % to 60 % (1.4 V, L <sub>TTL</sub> =5 TTL+15 pF, f <sub>osc</sub> 125 MHz/-20 °C to +70 °C)                                                                                                                                                                                                                                              | OE       |    |
|                           | ST |                        |                                    |                                                                                                                                                                                                                             |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | ST |
|                           | PH |                        |                                    | 15 pF (f <sub>osc</sub> 125 MHz/-20 °C to +70 °C)<br>25 pF (f <sub>osc</sub> 100 MHz/-20 °C to +70 °C)<br>25 pF (f <sub>osc</sub> 27 MHz/-40 °C to +85 °C)                                                                  | 3.0 ns Max.<br>(20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L <sub>CMOS</sub> =Max.)                                                                                                  | 45 % to 55 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =25 pF, f <sub>osc</sub> 66.7 MHz/-20 °C to +70 °C)<br>↑<br>(50 % V <sub>CC</sub> , L <sub>CMOS</sub> =25 pF, f <sub>osc</sub> 27.0 MHz/-40 °C to +85 °C)<br>40 % to 60 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =15 pF, f <sub>osc</sub> 125 MHz/-20 °C to +70 °C)                                                                                                                                                                                                             | OE       |    |
|                           | SH |                        |                                    |                                                                                                                                                                                                                             |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | ST |
|                           | PC | 28 mA<br>Max.          | 3.0 V to 3.6 V<br>(2.7 V to 3.6 V) | 15 pF (f <sub>osc</sub> 66.7 MHz/2.7 to 3.6 V)<br>15 pF (f <sub>osc</sub> 125 MHz/3.0 to 3.6 V)                                                                                                                             | 3.0 ns Max.<br>(20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> , L <sub>CMOS</sub> =Max.)                                                                                                  | 45 % to 55 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =15 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>osc</sub> 40 MHz)<br>40 % to 60 % (50 % V <sub>CC</sub> , L <sub>CMOS</sub> =15 pF, V <sub>CC</sub> =3.0 V to 3.6 V, f <sub>osc</sub> 125 MHz)<br>↑<br>(50 % V <sub>CC</sub> , L <sub>CMOS</sub> =15 pF, V <sub>CC</sub> =2.7 V to 3.6 V, f <sub>osc</sub> 66.7 MHz)                                                                                                                                                               | OE       |    |
|                           |    | SC                     |                                    |                                                                                                                                                                                                                             |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | ST |

## ► TABLE OF FREQUENCY RANGE

| Model                                            |       | Supply voltage                     | Frequency tolerance<br>Operating Temperature | Frequency |        |         |         |
|--------------------------------------------------|-------|------------------------------------|----------------------------------------------|-----------|--------|---------|---------|
|                                                  |       |                                    |                                              | 1 MHz     | 50 MHz | 100 MHz | 125 MHz |
| SG-8002CE                                        | PT/ST | 4.5 V to 5.5 V                     | B,C                                          | 1.0 MHz   |        |         | 125 MHz |
|                                                  | PH/SH |                                    | M                                            | 1.0 MHz   | 27 MHz |         |         |
|                                                  | PC/SC | 3.0 V to 3.6 V<br>(2.7 V to 3.6 V) | B,C,M                                        | 1.0 MHz   |        |         | 125 MHz |
| SG-8002LB                                        | PH/SH | 5.0 V±0.5 V                        | B,C                                          | 1.0 MHz   |        | 80 MHz  |         |
|                                                  |       |                                    | M,L                                          | 1.0 MHz   | 27 MHz |         |         |
|                                                  | PC/SC | 3.3 V±0.3 V                        | B,C,M,L                                      | 1.0 MHz   |        |         | 125 MHz |
| SG-8002JF                                        | PT/ST | 4.5 V to 5.5 V                     | B,C                                          | 1.0 MHz   |        |         | 125 MHz |
|                                                  | PH/SH |                                    | M                                            | 1.0 MHz   | 40 MHz |         |         |
|                                                  | PC/SC | 3.0 V to 3.6 V<br>(2.7 V to 3.6 V) | B,C,M                                        | 1.0 MHz   |        |         | 125 MHz |
| SG-8002CA<br>SG-8002JA<br>SG-8002DB<br>SG-8002DC | PT/ST | 4.5 V to 5.5 V                     | B,C                                          | 1.0 MHz   |        |         | 125 MHz |
|                                                  | PH/SH |                                    | M                                            | 1.0 MHz   | 55 MHz |         |         |
|                                                  | PC/SC | 3.0 V to 3.6 V<br>(2.7 V to 3.6 V) | B,C,M                                        | 1.0 MHz   |        |         | 125 MHz |
| SG-8002JC                                        | PT/ST | 4.5 V to 5.5 V                     | B                                            | 1.0 MHz   |        |         | 125 MHz |
|                                                  | PH/SH |                                    | C                                            |           |        |         |         |
|                                                  | PC/SC | 3.0 V to 3.6 V<br>(2.7 V to 3.6 V) | B                                            | 1.0 MHz   |        |         | 125 MHz |

Frequency tolerance : B:±50×10<sup>-6</sup>(-20 °C to +70 °C), C:±100×10<sup>-6</sup>(-20 °C to +70 °C), M:±100×10<sup>-6</sup>(-40 °C to +85 °C), L:±50×10<sup>-6</sup>(-40 °C to +85 °C)



## SG / HG-8002 series\_ Jitter specifications and characteristics chart

## ■ PLL-PLL connection

Because we use a PLL technology, there are a few cases that the jitter value will increase when SG-8002 is connected to another PLL-oscillator.

In our experience, we are unable to recommend these products for the applications such as telecom carrier use or analog video clock use. Please be careful checking in advance for these application (Jitter specification is Max.250 ps/CL=15 pF)

## Jitter Specifications

| Model              | Supply Voltage    | Jitter Item    | Specifications | Remarks                                         |
|--------------------|-------------------|----------------|----------------|-------------------------------------------------|
| PT / PH<br>ST / SH | 5.0 V $\pm$ 0.5 V | Cycle to cycle | 150 ps Max.    | 33 MHz $\leq$ $f_0 \leq$ 125 MHz, L_CMOS=15 pF  |
|                    |                   |                | 200 ps Max.    | 1.0 MHz $\leq$ $f_0 <$ 33 MHz, L_CMOS=15 pF     |
|                    |                   | Peak to peak   | 200 ps Max.    | 33 MHz $\leq$ $f_0 \leq$ 125 MHz, L_CMOS=15 pF  |
|                    |                   |                | 250 ps Max.    | 1.0 MHz $\leq$ $f_0 <$ 33 MHz, L_CMOS=15 pF     |
| SC / PC            | 3.3 V $\pm$ 0.3 V | Cycle to cycle | 200 ps Max.    | 1.0 MHz $\leq$ $f_0 \leq$ 125 MHz, L_CMOS=15 pF |
|                    |                   | Peak to peak   | 250 ps Max.    | 1.0 MHz $\leq$ $f_0 \leq$ 125 MHz, L_CMOS=15 pF |

## ■ Remarks on noise management for power supply line

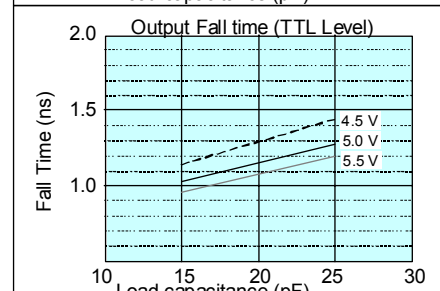
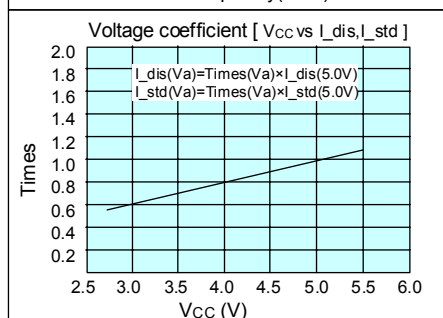
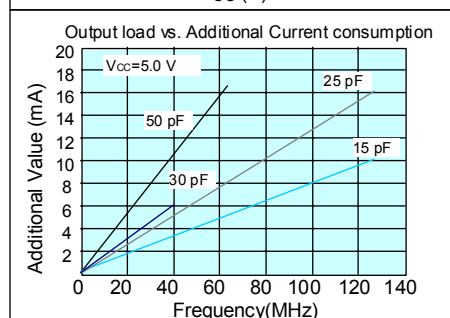
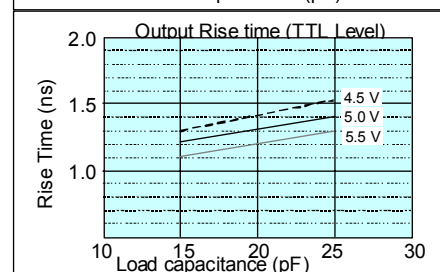
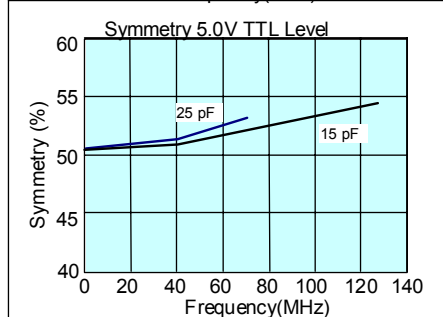
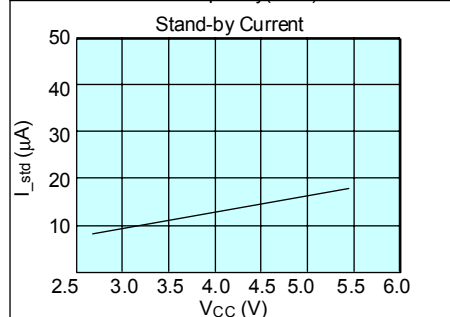
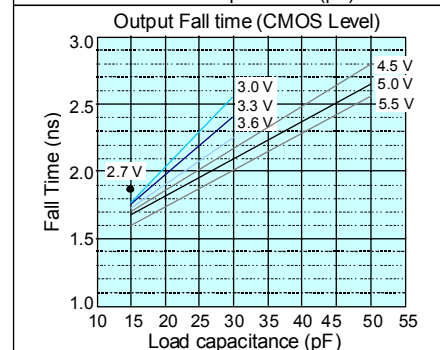
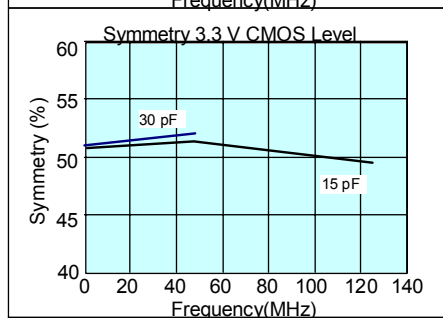
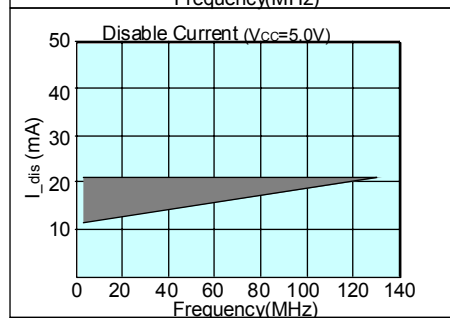
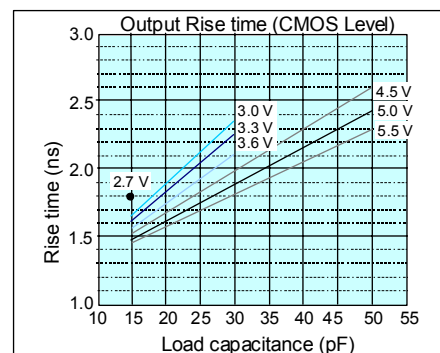
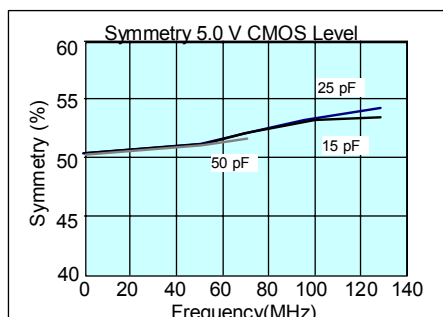
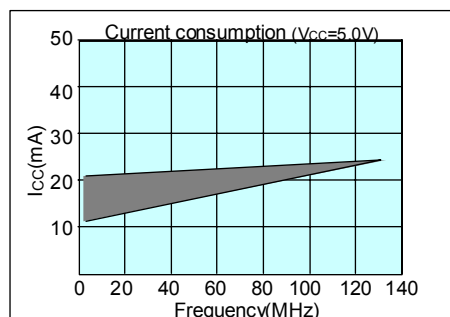
We do not recommend inserting filters or other devices in the power supply line as the counter measure of EMI noise reduction.

This device insertion might cause high-frequency impedance high in the power supply line and it affects oscillator stable drive.

When this measure is required, please evaluate circuitry and device behavior in the circuit and verify that it will not affect oscillation.

Start up time (0 % Vcc to 90 % Vcc) of power source should be more than 150  $\mu$ s.

## ■ SG-8002 series Characteristics chart





## PROGRAMMING TOOL FOR SG-8000 SERIES

### SG - Writer

- Easy frequency program for Epson Toyocom SG-8000 series oscillator (Blank oscillator).
- Free power supply for USB accommodate.
- Flexible PC accommodate.  
Windows 98SE, 2000, Me, XP (Except Windows 95, NT)
- Small body and easy carry.



Products number  
**Q91PR20W1101000**



### Main Body Specifications

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                      |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------|----------------|-----------|---------------|-----------|---------------|-----------|---------------|-----------|---------------|-----------|---------------|-----------|---------------|-----------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------|----------------|-----------|---------------|-----------|---------------|-----------|---------------|-----------|---------------|-----------|---------------|-----------|---------------|
| Name                     | SG-Writer for Epson Toyocom SG-8000 Series                                                                                                                                                                                                                                                                                                                                                                           |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
| Operating Temperature    | +10 °C to +40 °C    Writing (+25 °C ±5 °C)                                                                                                                                                                                                                                                                                                                                                                           |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
| Electric Power Supply    | Via USB                                                                                                                                                                                                                                                                                                                                                                                                              |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
| Standard Interface       | USB Type B                                                                                                                                                                                                                                                                                                                                                                                                           |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
| External Dimensions (mm) | 160 × 110 × 36 (textool top)                                                                                                                                                                                                                                                                                                                                                                                         |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
| Weight                   | 700 g                                                                                                                                                                                                                                                                                                                                                                                                                |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
| Accessories              | SG-Writer<br>CD-ROM (Software and Instruction manual : Japanese, English)<br>Documents : Japanese, English                                                                                                                                                                                                                                                                                                           |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
| Software,Driver          | SG-Writer   *1   EPSON USB Driver                                                                                                                                                                                                                                                                                                                                                                                    |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
| Option                   | SMD socket                                                                                                                                                                                                                                                                                                                                                                                                           |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
|                          | <table><tr><td>Model</td><td>Product number</td></tr><tr><td>SG-8003BA</td><td>Q91PR10W00024</td></tr><tr><td>SG-8003CE</td><td>Q91PR10W00018</td></tr><tr><td>SG-8003LB</td><td>Q91PR10W00019</td></tr><tr><td>SG-8003JF</td><td>Q91PR10W00020</td></tr><tr><td>SG-8003CA</td><td>Q91PR10W00021</td></tr><tr><td>SG-8003JC</td><td>Q91PR10W00022</td></tr><tr><td>SG-8003JA</td><td>Q91PR10W00023</td></tr></table> |                | Model | Product number | SG-8003BA | Q91PR10W00024 | SG-8003CE | Q91PR10W00018 | SG-8003LB | Q91PR10W00019 | SG-8003JF | Q91PR10W00020 | SG-8003CA | Q91PR10W00021 | SG-8003JC | Q91PR10W00022 | SG-8003JA | Q91PR10W00023 | <table><tr><td>Model</td><td>Product number</td></tr><tr><td>SG-8002LB</td><td>Q91PR10W00011</td></tr><tr><td>SG-8002CE</td><td>Q91PR10W00010</td></tr><tr><td>SG-8002JF</td><td>Q91PR10W00006</td></tr><tr><td>SG-8002CA</td><td>Q91PR10W00005</td></tr><tr><td>SG-8002JC</td><td>Q91PR10W00004</td></tr><tr><td>SG-8002JA</td><td>Q91PR10W00003</td></tr></table> |  | Model | Product number | SG-8002LB | Q91PR10W00011 | SG-8002CE | Q91PR10W00010 | SG-8002JF | Q91PR10W00006 | SG-8002CA | Q91PR10W00005 | SG-8002JC | Q91PR10W00004 | SG-8002JA | Q91PR10W00003 |
|                          | Model                                                                                                                                                                                                                                                                                                                                                                                                                | Product number |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
|                          | SG-8003BA                                                                                                                                                                                                                                                                                                                                                                                                            | Q91PR10W00024  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
|                          | SG-8003CE                                                                                                                                                                                                                                                                                                                                                                                                            | Q91PR10W00018  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
|                          | SG-8003LB                                                                                                                                                                                                                                                                                                                                                                                                            | Q91PR10W00019  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
|                          | SG-8003JF                                                                                                                                                                                                                                                                                                                                                                                                            | Q91PR10W00020  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
|                          | SG-8003CA                                                                                                                                                                                                                                                                                                                                                                                                            | Q91PR10W00021  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
|                          | SG-8003JC                                                                                                                                                                                                                                                                                                                                                                                                            | Q91PR10W00022  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
|                          | SG-8003JA                                                                                                                                                                                                                                                                                                                                                                                                            | Q91PR10W00023  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
| Model                    | Product number                                                                                                                                                                                                                                                                                                                                                                                                       |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
| SG-8002LB                | Q91PR10W00011                                                                                                                                                                                                                                                                                                                                                                                                        |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
| SG-8002CE                | Q91PR10W00010                                                                                                                                                                                                                                                                                                                                                                                                        |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
| SG-8002JF                | Q91PR10W00006                                                                                                                                                                                                                                                                                                                                                                                                        |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
| SG-8002CA                | Q91PR10W00005                                                                                                                                                                                                                                                                                                                                                                                                        |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
| SG-8002JC                | Q91PR10W00004                                                                                                                                                                                                                                                                                                                                                                                                        |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |
| SG-8002JA                | Q91PR10W00003                                                                                                                                                                                                                                                                                                                                                                                                        |                |       |                |           |               |           |               |           |               |           |               |           |               |           |               |           |               |                                                                                                                                                                                                                                                                                                                                                                     |  |       |                |           |               |           |               |           |               |           |               |           |               |           |               |

\*1 SG-Writer software is available only from Epson Toyocom website after user registration.

### Recommend PC Specifications (You need to connect the SG-Writer to a PC when you are writing.)

|                           |                                                                                                                                     |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Accommodate OS            | Windows XP, Windows Me, Windows 2000, Windows 98SE (Except Windows 95, NT)                                                          |
| Recommend CPU             | Pentium Processor 200 MHz equivalent and higher (Recommend Over 300 MHz)                                                            |
| Recommend memory Capacity | Recommend Over 64 MB                                                                                                                |
| Recommend HDD Capacity    | Need Over 40 MB                                                                                                                     |
| Other                     | CD-ROM drive, USB cable (Type A ↔ Type B)<br>Need SMD <sup>*2</sup> socket when you write SG-8000 SMD products. (Sold individually) |

\*2 Conventional SMD socket can be used with new SG-Writer.

### Precautions

- Please write SG-8003CE always with the SG-8003CE socket.
- SG-8003CE has two types of Blank sample. Please write with correct typed sample shown below.  
Vcc = 1.8 V type                      ( For PE, SE )  
Vcc = 2.5 V and 3.3 V type (For PD, SD, PC, SC)  
    \*It is able to identify Blank sample between SG-8002 series and SG-8003 series by marking.
- SG-8000 series common software still can write SG-8002 series.





## CRYSTAL OSCILLATOR SPREAD SPECTRUM

### SG-9001LB / CA / JC series

- Frequency range : 10 MHz to 166 MHz
- Supply voltage : 3.3 V
- Function : Output enable(OE)
- Thickness : 1.15 mm Typ.(SG-9001LB)  
1.40 mm Typ.(SG-9001CA)
- Range of spreading percentage is selectable by program  
(Center or Down spread, 6 Values)



CA, LB Type



CA, LB, JC Type

Product Number (please contact us)

SG-9001LB: Q3331x2x0xxxx00

SG-9001CA: Q3331x0x0xxxx00

SG-9001JC: Q3331x1x1xxxx00



Actual size

SG-9001LB

SG-9001CA

SG-9001JC

## Specifications (characteristics)

| Item                                  | Symbol                          | Specifications                     | Remarks                                                           |
|---------------------------------------|---------------------------------|------------------------------------|-------------------------------------------------------------------|
| Output frequency range                | $f_0$                           | 10.000 MHz to 166.000 MHz          | SG-9001JC, CA                                                     |
|                                       |                                 | 10.000 MHz to 135.000 MHz          | SG-9001LB                                                         |
| Supply voltage                        | V <sub>CC</sub>                 | 3.3 V $\pm$ 0.3 V                  |                                                                   |
| Temperature range                     | T <sub>stg</sub>                | -55 °C to +100 °C                  | SG-9001JC                                                         |
|                                       |                                 | -40 °C to +125 °C                  | SG-9001LB, CA                                                     |
|                                       | T <sub>use</sub>                | -20 °C to +70 °C                   |                                                                   |
| Current consumption                   | I <sub>CC</sub>                 | 30 mA Max.                         | No load condition, $f_0$ = 166 MHz                                |
| Disable current                       | I <sub>dis</sub>                | 20 mA Max.                         | OE=GND, $f_0$ = 166 MHz                                           |
| Symmetry                              | SYM                             | 45 % to 55 %                       | CMOS load: 50 % V <sub>CC</sub> level, L CMOS=15 pF               |
| High output voltage                   | V <sub>OH</sub>                 | V <sub>CC</sub> -0.4 V Min.        | I <sub>OH</sub> =-8 mA                                            |
| Low output voltage                    | V <sub>OL</sub>                 | 0.4 V Max.                         | I <sub>OL</sub> = 8 mA                                            |
| Output load condition                 | L CMOS                          | 15 pF Max.                         |                                                                   |
| Output enable / disable input voltage | V <sub>IH</sub>                 | 70 % V <sub>CC</sub> Min.          | OE terminal                                                       |
|                                       | V <sub>IL</sub>                 | 30 % V <sub>CC</sub> Max.          | OE terminal                                                       |
| Rise time / Fall time                 | t <sub>r</sub> / t <sub>f</sub> | 2.7 ns Max.                        | 20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> level, L CMOS=15 pF. |
| Start-up time                         | t <sub>str</sub>                | 10 ms Max.                         | Time at minimum supply voltage to be 0 s                          |
| Frequency aging                       | f <sub>aging</sub>              | $\pm 5 \times 10^{-6}$ / year Max. | +25 °C, First year                                                |

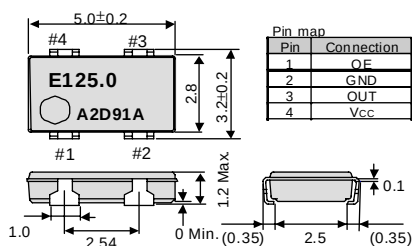
## Spread Spectrum Specifications

| Center Spread | Code       | C02P         | C05P        | C07P         | C10P        | C15P        | C20P        |
|---------------|------------|--------------|-------------|--------------|-------------|-------------|-------------|
|               | Percentage | $\pm 0.25$ % | $\pm 0.5$ % | $\pm 0.75$ % | $\pm 1.0$ % | $\pm 1.5$ % | $\pm 2.0$ % |
| Down Spread   | Code       | D05P         | D10P        | D15P         | D20P        | D30P        | D40P        |
|               | Percentage | -0.5 %       | -1.0 %      | -1.5 %       | -2.0 %      | -3.0 %      | -4.0 %      |

## External dimensions

(Unit:mm)

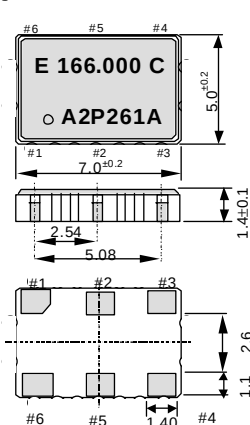
### ●SG-9001LB



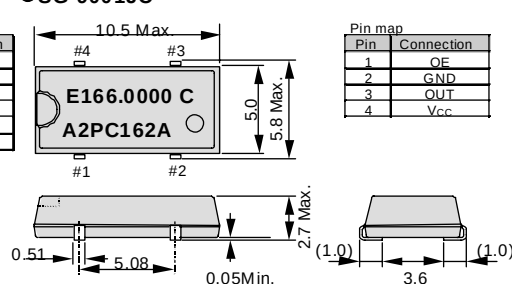
Note.  
OE pin  
OE pin = "H" or "open" : Specified frequency output.  
OE pin = "L" : Output disable output is weak pull-down.  
(130 k $\Omega$  Typ.)

SSON pin (SG-9001CA)  
SSON pin = "H" : Spread spectrum disable.  
SSON pin = "L" or "open" : Spread spectrum enable.

### ●SG-9001CA



### ●SG-9001JC

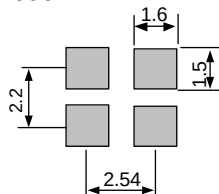


Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

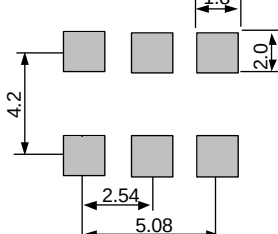
## Footprint (Recommended)

(Unit:mm)

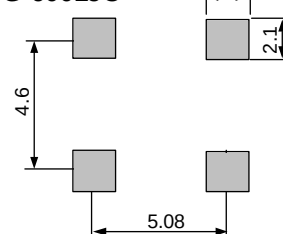
### ●SG-9001LB



### ●SG-9001CA



### ●SG-9001JC





# CRYSTAL OSCILLATOR

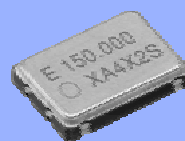
## LOW-JITTER SAW OSCILLATOR

# XG - 1000CA / CB series

- Output frequency range : 50 MHz to 170 MHz
- Supply voltage : 1.8V / 2.5V / 3.3V
- Frequency tolerance :  $\pm 50 \times 10^{-6}$ ,  $\pm 100 \times 10^{-6}$
- Output : CMOS
- Function : Output enable(OE)
- Package size : CA: 7.0×5.0×1.2 mm Typ.  
CB: 5.0×3.2×1.1 mm Typ.
- Low-jitter oscillator with SAW.



Product Number (please contact us)  
 XG-1000CA: Q3851CA00xxxx00  
 XG-1000CB: Q3851CB00xxxx00



Actual size

XG-1000CA



XG-1000CB



## Specifications (characteristics)

| Item                                    |                       | Symbol                          | Specifications                                                                |                |             | Remarks                                                        |
|-----------------------------------------|-----------------------|---------------------------------|-------------------------------------------------------------------------------|----------------|-------------|----------------------------------------------------------------|
|                                         |                       |                                 | E                                                                             | D              | C           |                                                                |
| Output frequency range *1               |                       | f <sub>0</sub>                  | 50.000 MHz to 170.000 MHz                                                     |                |             | Standard frequency                                             |
|                                         |                       |                                 | 75.000 MHz, 98.304 MHz, 100.000 MHz,<br>106.250 MHz, 125.000 MHz, 150.000 MHz |                |             |                                                                |
| Supply voltage                          |                       | V <sub>cc</sub>                 | 1.8 V ±0.1V                                                                   | 2.5 V ±0.125 V | 3.3 V ±0.3V |                                                                |
| Temperature range                       | Storage temperature   | T <sub>stg</sub>                | -40 °C to +100 °C                                                             |                |             | Store as bare product after unpacking                          |
|                                         | Operating temperature | T <sub>use</sub>                | -10°C to +70°C                                                                |                |             |                                                                |
| Frequency tolerance *2                  |                       | f <sub>tol</sub>                | B:±50 × 10 <sup>-6</sup> C:±100 × 10 <sup>-6</sup>                            |                |             | -10 °C to +70 °C                                               |
| Current consumption                     |                       | I <sub>cc</sub>                 | 20 mA Max.                                                                    | 25 mA Max.     | 35 mA Max.  | No load condition, OE=V <sub>cc</sub>                          |
| Disable current                         |                       | I <sub>dis</sub>                | 15 mA Max.                                                                    | 20 mA Max.     | 30 mA Max.  | OE=GND                                                         |
| Symmetry                                |                       | SYM                             | 40 % to 60 %                                                                  |                |             | CMOS load:50 % V <sub>cc</sub> level,Max.load condition        |
| High output voltage                     |                       | V <sub>OH</sub>                 | V <sub>cc</sub> -0.35 V Min                                                   |                |             | E:I <sub>OH</sub> = -6 mA / C,D:I <sub>OH</sub> = -8 mA        |
| Low output voltage                      |                       | V <sub>OL</sub>                 | 0.35 V Max.                                                                   |                |             | E:I <sub>OL</sub> = 6 mA / C,D:I <sub>OL</sub> = 8 mA          |
| Output load condition (CMOS)            |                       | L <sub>CMOS</sub>               | 15 pF Max.                                                                    |                |             | Max. frequency and Max. supply voltage range                   |
| Output enable/<br>Disable input voltage |                       | V <sub>IH</sub>                 | 70 % V <sub>cc</sub> Min.                                                     |                |             | OE terminal                                                    |
|                                         |                       | V <sub>IL</sub>                 | 30 % V <sub>cc</sub> Max.                                                     |                |             | OE terminal                                                    |
| Rise time / Fall time                   |                       | t <sub>r</sub> / t <sub>f</sub> | 2 ns Max.                                                                     |                |             | CMOS load : 20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level |
| Start-up time                           |                       | t <sub>str</sub>                | 10 ms Max.                                                                    |                |             | Time at minimum supply voltage to be 0 s                       |
| Jitter *3                               |                       | t <sub>RMS</sub>                | 3 ps Typ.                                                                     |                |             | σ (RMS of total distribution)                                  |
|                                         |                       | t <sub>p-p</sub>                | 25 ps Typ.                                                                    |                |             | Peak to Peak                                                   |
| Frequency aging                         |                       | f <sub>aging</sub>              | ±5 × 10 <sup>-6</sup> / year Max.                                             |                |             | +25 °C, First year, V <sub>cc</sub> =1.8 V, 2.5 V, 3.3 V       |

\*1 Please contact us for inquiries regarding non-standard frequencies.

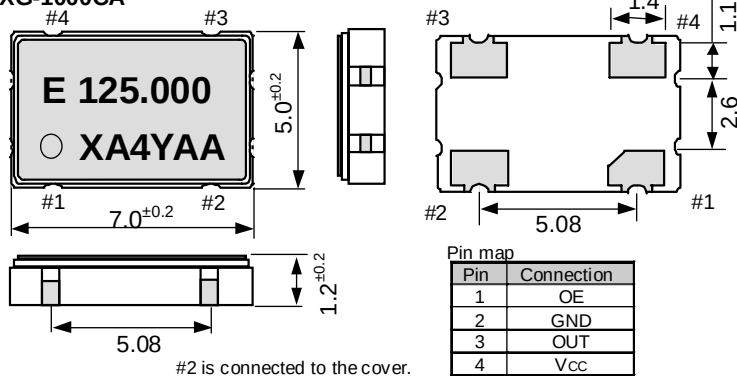
\*2 This includes initial frequency tolerance, temperature variation, supply voltage variation and frequency tolerance vs. load.

\*3 Based on DTS-2075 Digital timing system made from WAVECREST with jitter analysis software VISI6.

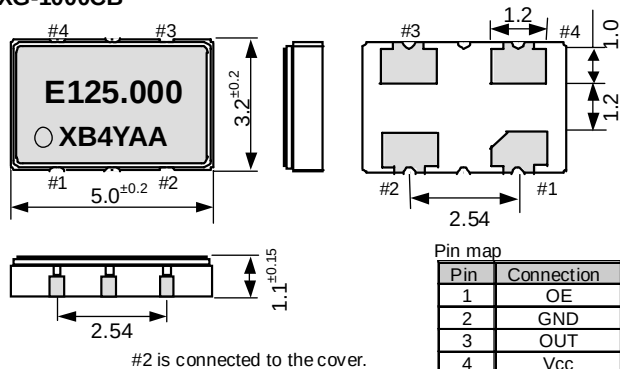
## External dimensions

(Unit:mm)

### ● XG-1000CA



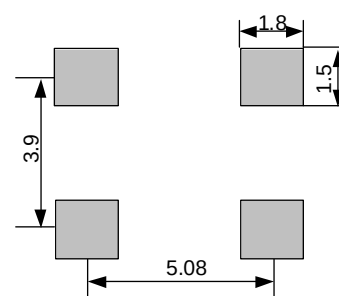
### ● XG-1000CB



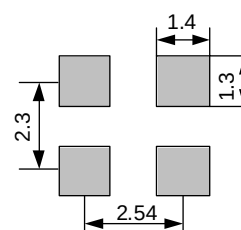
## Footprint (Recommended)

(Unit:mm)

### ● XG-1000CA



### ● XG-1000CB







# CRYSTAL OSCILLATOR

## LOW-JITTER SAW OSCILLATOR

# EG - 2021 / 2001CA series

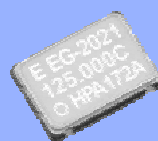
- Frequency range : 62.5 MHz to 250 MHz
- Supply voltage : 2.5V/ EG-2021CA  
3.3V/ EG-2001CA
- Output : CMOS
- Function : Output enable(OE)
- Thickness : 1.2 mm Typ.
- Very low jitter and low phase noise by SAW unit.



Product Number (please contact us)

EG-2021CA: Q3807CA00xxxx00

EG-2001CA: Q3801CA00xxxx00



Actual size

EG-2021CA

EG-2001CA

## Specifications (characteristics)

| Item                   | Symbol                          | Specifications                          |                          | Remarks                                                      |
|------------------------|---------------------------------|-----------------------------------------|--------------------------|--------------------------------------------------------------|
|                        |                                 | EG-2021CA                               | EG-2001CA                |                                                              |
| Output frequency range | $f_0$                           | 62.500 MHz to 170.000MHz                | 170.001MHz to 250.000MHz | 106.250 MHz to 170.000 MHz                                   |
| Supply voltage         | V <sub>cc</sub>                 | 2.5 V± 0.125 V                          |                          | 3.3 V± 0.3 V                                                 |
| Temperature range      | Storage temperature             | -40 °C to +100 °C                       |                          | Store as bare product after unpacking                        |
|                        | Operating temperature           |                                         |                          |                                                              |
| Frequency tolerance    | $f_{tol}$                       | P: 0 °C to +70 °C<br>R: -5 °C to +85 °C |                          | P: 0 °C to +70 °C                                            |
| Current consumption    | I <sub>cc</sub>                 | 25 mA Max.                              | 30 mA Max.               | 50 mA Max.                                                   |
| Disable current        | I <sub>dis</sub>                | 600 µA Max.                             |                          | 10 µA Max.                                                   |
| Symmetry               | SYM                             | 45 % to 55 %                            | 40 % to 60 %             | 45 % to 55 %                                                 |
| High output voltage    | V <sub>OH</sub>                 | V <sub>cc</sub> -0.35 V Min.            |                          | V <sub>cc</sub> -0.4 V Min.                                  |
| Low output voltage     | V <sub>OL</sub>                 | 0.35 V Max.                             |                          | 0.4 V Max.                                                   |
| Output load condition  | L <sub>CMOS</sub>               | 15 pF Max.                              |                          | Max. frequency and Max. supply voltage range                 |
| High input voltage     | V <sub>IH</sub>                 | 70 % V <sub>cc</sub> Min.               |                          | OE terminal                                                  |
| Low input voltage      | V <sub>IL</sub>                 | 30 % V <sub>cc</sub> Max.               |                          | OE terminal                                                  |
| Rise time / Fall time  | t <sub>r</sub> / t <sub>f</sub> | 2 ns Max.                               |                          | CMOS load:20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level |
| Start-up time          | t <sub>str</sub>                | 10 ms Max.                              |                          | Time at minimum supply voltage to be 0 s                     |
| Jitter *2              | t <sub>dj</sub>                 | 0.2 ps Typ.                             |                          | Deterministic Jitter                                         |
|                        | t <sub>rj</sub>                 | 3 ps Typ.                               |                          | Random Jitter                                                |
|                        | t <sub>rms</sub>                | 3 ps Typ.                               |                          | σ (RMS of total distribution)                                |
|                        | t <sub>p-p</sub>                | 25 ps Typ.                              |                          | Peak to Peak                                                 |
|                        | t <sub>acc</sub>                | 4 ps Typ.                               |                          | Accumulated Jitter(σ) n=2 to 50000 cycles                    |
| Phase Jitter           | t <sub>pj</sub>                 | 0.05 × 10 <sup>-3</sup> UI Typ.         |                          | Offset frequency: 12 kHz to 20 MHz                           |
| Frequency aging*3      | f <sub>aging</sub>              | ± 10 × 10 <sup>-6</sup> / year Max.     |                          | ± 5 × 10 <sup>-6</sup> / year Max.                           |

\*1 As per below table

\*2 Based on DTS-2075 Digital timing system made from WAVECREST with jitter analysis software VISI6.

\*3 Except:CHPA,CHRA,PCH

| Model               | EG-2021CA                                 |      |        |
|---------------------|-------------------------------------------|------|--------|
|                     | Details of frequency tolerance            | A*4  | N*5    |
| Frequency tolerance | HP: ±100×10 <sup>-6</sup> (0°C to +70°C)  | CHPA | CHPN   |
|                     | HR: ±100×10 <sup>-6</sup> (-5°C to +85°C) | CHRA | CHRN   |
|                     | GP: ±50×10 <sup>-6</sup> (0°C to +70°C)   | —    | CGPN   |
|                     | GR: ±50×10 <sup>-6</sup> (-5°C to +85°C)  | —    | CGRN*7 |

|                     | EG-2001CA                                  |                    |
|---------------------|--------------------------------------------|--------------------|
|                     | Output mode                                | P:Symmetry 50 ±5 % |
| Frequency tolerance | H: ±100×10 <sup>-6</sup> (0°C to +70°C) *4 | PCH                |
|                     | Y: ±100×10 <sup>-6</sup> (0°C to +70°C) *5 | PCY                |
|                     | Z: ±50×10 <sup>-6</sup> (0°C to +70°C) *6  | PCZ                |

\*4 This includes initial frequency tolerance, temperature variation, supply voltage variation, load variation, reflow drift, and aging(+25 °C,10 years).

\*5 This includes initial frequency tolerance, temperature variation, supply voltage variation, load variation, and reflow drift.(except aging)

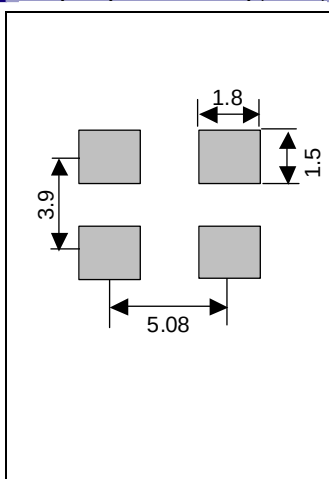
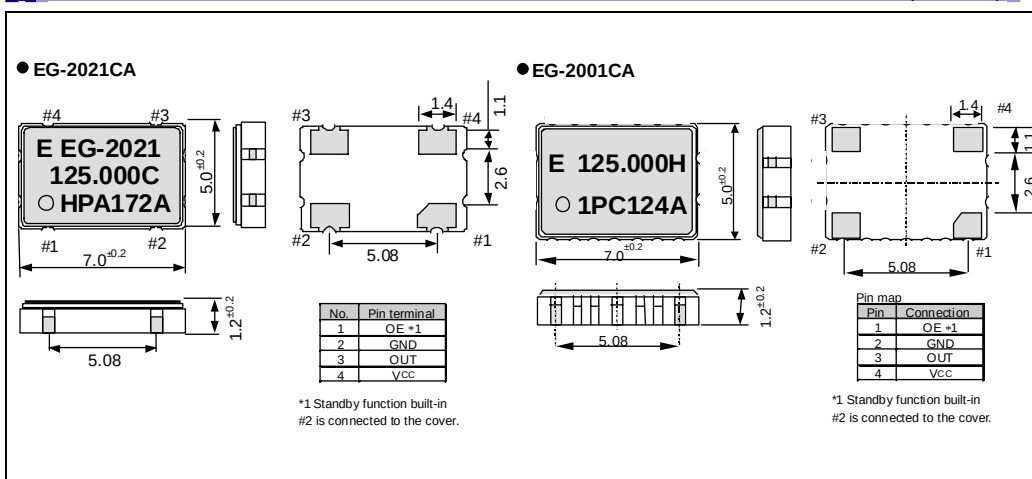
\*6 This includes initial frequency tolerance, and temperature variation.(except reflow drift, supply voltage variation, load variation and aging)

\*7 Please contact us for inquiries.

## External dimensions

(Unit:mm)

## Footprint (Recommended) (Unit:mm)





# CRYSTAL OSCILLATOR

## LOW-JITTER SAW OSCILLATOR

# EG - 2002CA

- Frequency range : 62.5 MHz to 170 MHz
- Operating voltage : 3.3 V
- Output : LV-TTL
- Function : Output enable(OE)
- Thickness : 1.2 mm Typ.
- Very low jitter and low phase noise by SAW unit.



Product Number (please contact us)  
Q3802CA00xxxx00



Actual size



## Specifications (characteristics)

| Item                   | Symbol                          | Specifications                                     | Remarks                                                          |
|------------------------|---------------------------------|----------------------------------------------------|------------------------------------------------------------------|
| Output frequency range | $f_o$                           | 62.500 MHz to 170.000 MHz                          | Please contact us for inquiries regarding available frequencies. |
| Supply voltage         | V <sub>CC</sub>                 | 3.3 V $\pm$ 0.3 V                                  |                                                                  |
| Temperature range      | T <sub>stg</sub>                | -40 °C to +100 °C                                  | Store as bare product after unpacking                            |
| Operating temperature  | T <sub>use</sub>                | 0 °C to +70 °C                                     |                                                                  |
| Frequency tolerance    | f <sub>tol</sub>                | $\pm 50 \times 10^{-6}$ , $\pm 100 \times 10^{-6}$ | 0 °C to +70 °C *1                                                |
| Current consumption    | I <sub>CC</sub>                 | 60 mA Max.                                         | OE=V <sub>CC</sub> , No load condition                           |
| Disable current        | I <sub>dis</sub>                | 25 mA Max.                                         | OE=GND                                                           |
| Symmetry               | SYM                             | 45 % to 55 %                                       | 1.4 V level, L <sub>CMOS</sub> $\leq$ Max.                       |
| High output voltage    | V <sub>OH</sub>                 | 2.4 V Min.                                         | I <sub>OH</sub> = -8 mA                                          |
| Low output voltage     | V <sub>OL</sub>                 | 0.4 V Max.                                         | I <sub>OL</sub> = 8 mA                                           |
| Output load condition  | L <sub>CMOS</sub>               | 25 pF Max.                                         | $f_o$ = 62.5 MHz                                                 |
|                        |                                 | 15 pF Max.                                         | $f_o$ > 62.5 MHz                                                 |
| High input voltage     | V <sub>IH</sub>                 | 70 % V <sub>CC</sub> Min.                          | OE terminal                                                      |
| Low input voltage      | V <sub>IL</sub>                 | 30 % V <sub>CC</sub> Max.                          | OE terminal                                                      |
| Rise time / Fall time  | t <sub>r</sub> / t <sub>f</sub> | 1.5 ns Max.                                        | 0.8 V $\rightarrow$ 2.0 V level, L <sub>CMOS</sub> $\leq$ Max.   |
| Start-up time          | t <sub>str</sub>                | 10 ms Max.                                         | Time at minimum supply voltage to be 0 s                         |
| Jitter *2              | t <sub>DJ</sub>                 | 0.2 ps Typ.                                        | Deterministic Jitter                                             |
|                        | t <sub>RJ</sub>                 | 3 ps Typ.                                          | Random Jitter                                                    |
|                        | t <sub>RMS</sub>                | 3 ps Typ.                                          | $\sigma$ (RMS of total distribution)                             |
|                        | t <sub>p-p</sub>                | 25 ps Typ.                                         | Peak to Peak                                                     |
|                        | t <sub>acc</sub>                | 4 ps Typ.                                          | Accumulated Jitter( $\sigma$ ) n=2 to 50000 cycles               |
| Phase Jitter           | t <sub>pJ</sub>                 | 0.05 $\times 10^{-3}$ UI Typ.                      | Offset frequency: 12 kHz to 20 MHz                               |
|                        |                                 | 1 ps Max.                                          |                                                                  |
| Frequency aging *3     | f <sub>aging</sub>              | $\pm 5 \times 10^{-6}$ / year Max.                 | +25 °C, First year, V <sub>CC</sub> =3.3 V                       |

\*1 As per below table

\*2 Based on DTS-2075 Digital timing system made from WAVECREST with jitter analysis software VISI6.

\*3 Except : PCH,DCH

| Frequency range (MHz)          |                                                | P: 125 to 170      | D: 62.5 to 124.999 |
|--------------------------------|------------------------------------------------|--------------------|--------------------|
| Details of frequency tolerance | H: $\pm 100 \times 10^{-6}$ (0 °C to +70 °C)*4 | PCH                | DCH                |
|                                | Y: $\pm 100 \times 10^{-6}$ (0 °C to +70 °C)*5 | PCY                | DCY                |
|                                | Z: $\pm 50 \times 10^{-6}$ (0 °C to +70 °C)*6  | PCZ                | DCZ                |
|                                | F: $\pm 50 \times 10^{-6}$ (0 °C to +70 °C)*5  | PCF (125 MHz Only) | —                  |

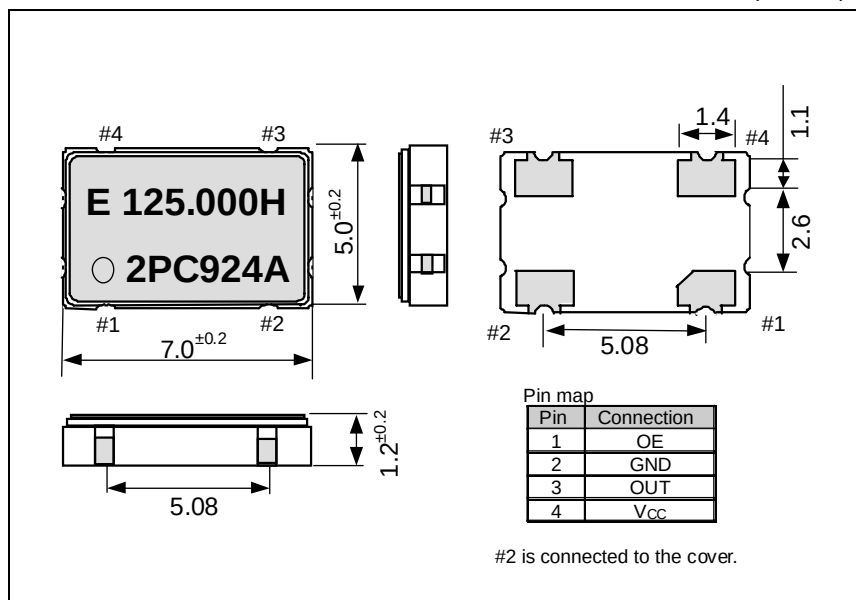
\*4 This includes initial frequency tolerance, temperature variation, supply voltage variation, load variation, reflow drift, and 10 years aging(+25 °C,10 years).

\*5 This includes initial frequency tolerance, temperature variation, supply voltage variation, load variation, and reflow drift (except 10 years aging).

\*6 This includes initial frequency tolerance and temperature variation (except supply voltage variation, load variation, reflow drift, and 10 years aging).

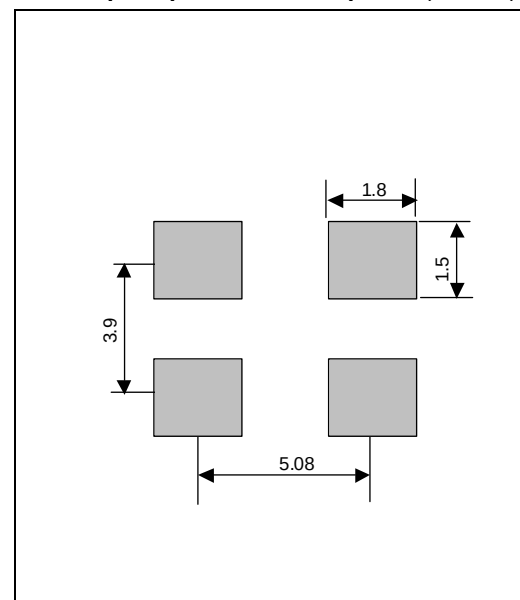
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





# CRYSTAL OSCILLATOR

## LOW-JITTER SAW OSCILLATOR

# EG-2121/2102CA series

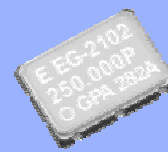
- Frequency range : 53.125 MHz to 700 MHz
- Supply voltage : 2.5 V (EG-2121CA)  
3.3 V (EG-2102CA)
- Output : Differential LV-PECL or LVDS
- Function : Output enable(OE)
- Thickness : 1.2 mm Typ.
- Very low jitter and low phase noise by SAW unit.



Product Number (please contact us)

EG-2121CA: Q3805CAx0xxxx00

EG-2102CA: Q3806CA00xxxx00



Actual size

EG-2121CA

EG-2102CA

## Specifications (characteristics)

| Item                         |                       | Symbol                                              | EG-2121CA                                               | EG-2102CA                      | EG-2121CA             | EG-2102CA                                 | Remarks                                                                                              |
|------------------------------|-----------------------|-----------------------------------------------------|---------------------------------------------------------|--------------------------------|-----------------------|-------------------------------------------|------------------------------------------------------------------------------------------------------|
|                              |                       |                                                     | Differential LV-PECL                                    |                                | LVDS                  |                                           |                                                                                                      |
| Output frequency range       |                       | f <sub>0</sub>                                      | 53.125 MHz to 500 MHz                                   | 100 MHz to 700 MHz             | 53.125 MHz to 700 MHz |                                           | Please contact us for inquiries regarding available frequencies.                                     |
| Supply voltage               |                       | V <sub>CC</sub>                                     | 2.5 V ±0.125 V                                          | 3.3 V ±0.3 V                   | 2.5 V ±0.125 V        | 3.3 V ±0.3 V                              |                                                                                                      |
| Temperature range            | Storage temperature   | T <sub>stg</sub>                                    | -40 °C to +100 °C                                       |                                |                       |                                           | Store as bare product after unpacking                                                                |
|                              | Operating temperature | T <sub>use</sub>                                    | P:0 °C to +70 °C ,R:-5 °C to +85 °C ,S:-20 °C to +70 °C |                                |                       |                                           | Please contact us for inquiries about S spec.                                                        |
| Frequency tolerance          |                       | f <sub>tol</sub>                                    | G: ± 50 × 10 <sup>-6</sup> ,H: ±100 × 10 <sup>-6</sup>  |                                |                       |                                           | P:0 °C to +70 °C,R:-5 °C to +85 °C *1                                                                |
| Current consumption          |                       | I <sub>CC</sub>                                     | 80 mA Max.                                              | 100 mA Max.                    | 30 mA Max             | 45 mA Max.                                | OE=V <sub>CC</sub> ,R <sub>L</sub> =50 Ω or 100 Ω                                                    |
| Disable current              |                       | I <sub>dis</sub>                                    | 20 mA Max.                                              | 32 mA Max                      | 20 mA Max             | 30 mA Max.                                | OE=GND                                                                                               |
| Symmetry                     |                       | SYM                                                 | P:45 % to 55 %                                          | P:45 % to 55 %                 | L:45 % to 55 %        | L:45 % to 55 %                            | f <sub>0</sub> =350 MHz (at outputs crossing point) *1                                               |
| Output voltage               | V <sub>OH</sub>       | 1.55 V Typ.                                         | 2.35 V Typ.                                             | —                              |                       | DC characteristics                        |                                                                                                      |
|                              |                       | V <sub>CC</sub> -1.025 V to V <sub>CC</sub> -0.88 V |                                                         |                                |                       |                                           |                                                                                                      |
|                              | V <sub>OL</sub>       | 0.8 V Typ.                                          | 1.6 V Typ.                                              | —                              |                       |                                           |                                                                                                      |
|                              |                       | V <sub>CC</sub> -1.81 V to V <sub>CC</sub> -1.62 V  |                                                         |                                |                       |                                           |                                                                                                      |
|                              | V <sub>OD</sub>       | —                                                   |                                                         | 350 mV Typ. 247 mV to 454 mV   |                       |                                           | Differential output, DC characteristics                                                              |
|                              | ΔV <sub>OD</sub>      | —                                                   |                                                         | 50 mV                          |                       |                                           | Output change, DC characteristics                                                                    |
|                              | V <sub>OS</sub>       | —                                                   |                                                         | 1.25 V Typ. 1.125 V to 1.375 V |                       |                                           | Offset, DC characteristics                                                                           |
|                              |                       | ΔV <sub>OS</sub>                                    | —                                                       |                                | 150 mV                |                                           | Offset change, DC characteristics                                                                    |
| Output load condition        |                       | R <sub>L</sub>                                      | 50 Ω                                                    |                                | 100 Ω                 |                                           | LV-PECL: Terminated to V <sub>CC</sub> -2.0 V<br>LVDS: Connected between OUT to OUT                  |
| Output enable input voltage  |                       | V <sub>IH</sub>                                     | 70 % V <sub>CC</sub> Min.                               |                                |                       |                                           | OE terminal                                                                                          |
| Output disable input voltage |                       | V <sub>IL</sub>                                     | 30 % V <sub>CC</sub> Max.                               |                                |                       |                                           | OE terminal                                                                                          |
| Rise time / Fall time        |                       | t <sub>r</sub> / t <sub>f</sub>                     | 400 ps Max.                                             |                                |                       |                                           | LV-PECL: 80 % to 20 % (V <sub>OH</sub> -V <sub>OL</sub> )<br>LVDS: 80 % to 20 % (V <sub>OD</sub> ×2) |
| Start-up time                |                       | t <sub>str</sub>                                    | 10 ms Max.                                              |                                |                       |                                           | Time at minimum supply voltage to be 0 s                                                             |
| Jitter *2                    | t <sub>DJ</sub>       | 0.2 ps Typ.                                         |                                                         |                                |                       | Deterministic Jitter                      |                                                                                                      |
|                              | t <sub>RJ</sub>       | 3 ps Typ.                                           |                                                         |                                |                       | Random Jitter                             |                                                                                                      |
|                              | t <sub>RMS</sub>      | 3 ps Typ.                                           |                                                         |                                |                       | σ (RMS of total distribution)             |                                                                                                      |
|                              | t <sub>p-p</sub>      | 25 ps Typ.                                          |                                                         |                                |                       | Peak to Peak                              |                                                                                                      |
|                              | t <sub>acc</sub>      | 4 ps Typ.                                           |                                                         |                                |                       | Accumulated Jitter(σ) n=2 to 50000 cycles |                                                                                                      |
| Phase Jitter                 |                       | t <sub>PJ</sub>                                     | 0.05 × 10 <sup>-3</sup> UI Typ.                         |                                |                       |                                           | Offset frequency: 12 kHz to 20 MHz                                                                   |
|                              |                       |                                                     | 1 ps Max.                                               |                                |                       |                                           |                                                                                                      |
| Frequency aging *3           |                       | f <sub>aging</sub>                                  | ± 10 × 10 <sup>-6</sup> / year Max.                     |                                |                       |                                           | +25 °C,First year,V <sub>CC</sub> =2.5 V,3.3 V                                                       |

\*1 As per below table.

\*2 Based on DTS-2075 Digital timing system made from WAVECREST with jitter analysis software VISI6.

\*3 Except: \*\*\*A

| Output mode                    |                                              | P: Differential LV-PECL                                                                |        | D: Differential LV-PECL   |        | L: LVDS                                                                                |        | V: LVDS                   |        |
|--------------------------------|----------------------------------------------|----------------------------------------------------------------------------------------|--------|---------------------------|--------|----------------------------------------------------------------------------------------|--------|---------------------------|--------|
| Frequency range                | EG-2121CA                                    | All range                                                                              |        | $f_0 \leq 175\text{ MHz}$ |        | All range                                                                              |        | $f_0 \leq 175\text{ MHz}$ |        |
|                                | $f_0 \leq 350\text{ MHz}$                    |                                                                                        |        |                           |        |                                                                                        |        |                           |        |
| Symmetry                       | EG-2121CA                                    | $50 \pm 10\%$ ( $f_0 > 350\text{ MHz}$ )<br>$50 \pm 5\%$ ( $f_0 \leq 350\text{ MHz}$ ) |        | $50 \pm 2\%$              |        | $50 \pm 10\%$ ( $f_0 > 350\text{ MHz}$ )<br>$50 \pm 5\%$ ( $f_0 \leq 350\text{ MHz}$ ) |        | $50 \pm 2\%$              |        |
|                                | EG-2102CA                                    | $50 \pm 5\%$                                                                           |        |                           |        |                                                                                        |        |                           |        |
| Details of frequency tolerance |                                              | A *4                                                                                   | N *5   | A *4                      | N *5   | A *4                                                                                   | N *5   | A *4                      | N *5   |
| Frequency tolerance            | HP: $\pm 100 \times 10^{-6}$ (0°C to +70°C)  | PHPA                                                                                   | PHPN   | DHPA                      | DHPN   | LHPA                                                                                   | LHPN   | VHPA                      | VHPN   |
|                                | HR: $\pm 100 \times 10^{-6}$ (-5°C to +85°C) | PHRA*6                                                                                 | PHRN*6 | DHRA*6                    | DHRN*6 | LHRA*6                                                                                 | LHRN*6 | VHRA*6                    | VHRN*6 |
|                                | GP: $\pm 50 \times 10^{-6}$ (0°C to +70°C)   | PGPA*6                                                                                 | PGPN*6 | DGPA*6                    | DGPN*6 | LGPA*6                                                                                 | LGPN*6 | VGPA*6                    | VGPN*6 |
|                                | GR: $\pm 50 \times 10^{-6}$ (-5°C to +85°C)  | —                                                                                      | PGRN*6 | —                         | DGRN*6 | —                                                                                      | LGRN*6 | —                         | VGRN*6 |

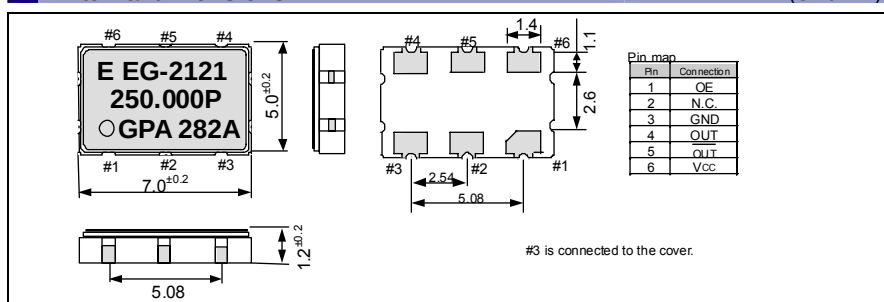
\*4 This includes initial frequency tolerance, temperature variation, supply voltage variation, reflow drift, and aging(+25  $^\circ\text{C}$ , 10 years).

\*5 This includes initial frequency tolerance, temperature variation, supply voltage variation, and reflow drift(except aging).

\*6 53.125 MHz  $\leq f_0 < 100\ \text{MHz}$ : Unavailable.

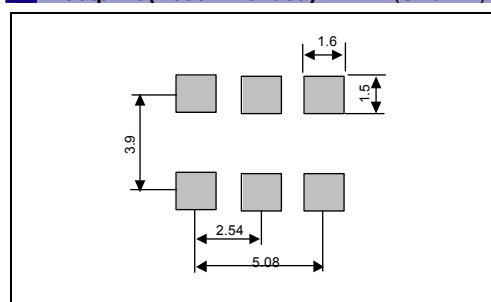
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





# CRYSTAL OSCILLATOR

## LOW-JITTER SAW OSCILLATOR

# EG - 2101CA

- Frequency range : 62.5 MHz to 99.999 MHz
- Supply voltage : 3.3 V
- Output : Differential LV-PECL
- Function : Output enable(OE)
- Thickness : 1.2 mm Typ.
- Very low jitter and low phase noise by SAW unit.



Product Number (please contact us)  
Q3803CA00xxxx00



Actual size



## Specifications (characteristics)

| Item                   | Symbol                          | Specifications                                                  | Remarks                                                         |
|------------------------|---------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|
| Output frequency range | $f_0$                           | 62.500 MHz to 99.999 MHz                                        | Please contact us for inquiries regarding available frequencies |
| Supply voltage         | V <sub>CC</sub>                 | 3.3 V $\pm 0.15$ V                                              |                                                                 |
| Temperature range      | T <sub>stg</sub>                | -40 °C to +100 °C                                               | Store as bare product after unpacking                           |
| Storage temperature    | T <sub>use</sub>                | 0 °C to +70 °C                                                  |                                                                 |
| Frequency tolerance    | f <sub>tol</sub>                | $\pm 50 \times 10^{-6}$ , $\pm 100 \times 10^{-6}$              | 0 °C to +70 °C *1                                               |
| Current consumption    | I <sub>CC</sub>                 | 60 mA Max.                                                      | OE=V <sub>CC</sub> , R <sub>L</sub> =50 $\Omega$                |
| Disable current        | I <sub>OE</sub>                 | 25 mA Max.                                                      | OE=GND                                                          |
| Symmetry *3            | SYM                             | D:47.5 % to 52.5 %                                              | DCH,DCY,DCZ at outputs crossing point                           |
| High output voltage    | V <sub>OH</sub>                 | 2.35 V Typ. V <sub>CC</sub> -1.025 V to V <sub>CC</sub> -0.88 V | DC characteristics                                              |
| Low output voltage     | V <sub>OL</sub>                 | 1.60 V Typ. V <sub>CC</sub> -1.81 V to V <sub>CC</sub> -1.62 V  |                                                                 |
| Output load condition  | R <sub>L</sub>                  | 50 $\Omega$                                                     | Terminated to V <sub>CC</sub> -2.0 V                            |
| High input voltage     | V <sub>IH</sub>                 | 70 % V <sub>CC</sub> Min.                                       | OE terminal                                                     |
| Low input voltage      | V <sub>IL</sub>                 | 30 % V <sub>CC</sub> Max.                                       | OE terminal                                                     |
| Rise time / Fall time  | t <sub>r</sub> / t <sub>f</sub> | 600 ps Max.                                                     | 20 % to 80 % (V <sub>OH</sub> -V <sub>OL</sub> )                |
| Start-up time          | t <sub>str</sub>                | 10 ms Max.                                                      | Time at minimum supply voltage to be 0 s                        |
| Jitter *2              | t <sub>dj</sub>                 | 0.2 ps Typ.                                                     | Deterministic Jitter                                            |
|                        | t <sub>rj</sub>                 | 3 ps Typ.                                                       | Random Jitter                                                   |
|                        | t <sub>RMS</sub>                | 3 ps Typ.                                                       | $\sigma$ (RMS of total distribution)                            |
|                        | t <sub>p-p</sub>                | 25 ps Typ.                                                      | Peak to Peak                                                    |
|                        | t <sub>acc</sub>                | 4 ps Typ.                                                       | Accumulated Jitter( $\sigma$ ) n=2 to 50000 cycles              |
| Phase Jitter           | t <sub>pj</sub>                 | 0.05 $\times 10^{-3}$ UI Typ.                                   | Offset frequency: 12 kHz to 20 MHz                              |
|                        |                                 | 1 ps Max.                                                       |                                                                 |
| Frequency aging *3     | f <sub>aging</sub>              | $\pm 5 \times 10^{-6}$ /year Max.                               | +25 °C, First year, V <sub>CC</sub> =3.3 V                      |

\*1 As per below table

\*2 Based on DTS-2075 Digital timing system made from WAVECREST with jitter analysis software VISI6.

\*3 Except : PCH,DCH

| Output mode (Symmetry)         |                                                | D:Symmetry 50 $\pm 2.5$ % |
|--------------------------------|------------------------------------------------|---------------------------|
| Details of frequency tolerance | H: $\pm 100 \times 10^{-6}$ (0 °C to +70 °C)*4 | DCH                       |
|                                | Y: $\pm 100 \times 10^{-6}$ (0 °C to +70 °C)*5 | DCY                       |
|                                | Z: $\pm 50 \times 10^{-6}$ (0 °C to +70 °C)*6  | DCZ                       |

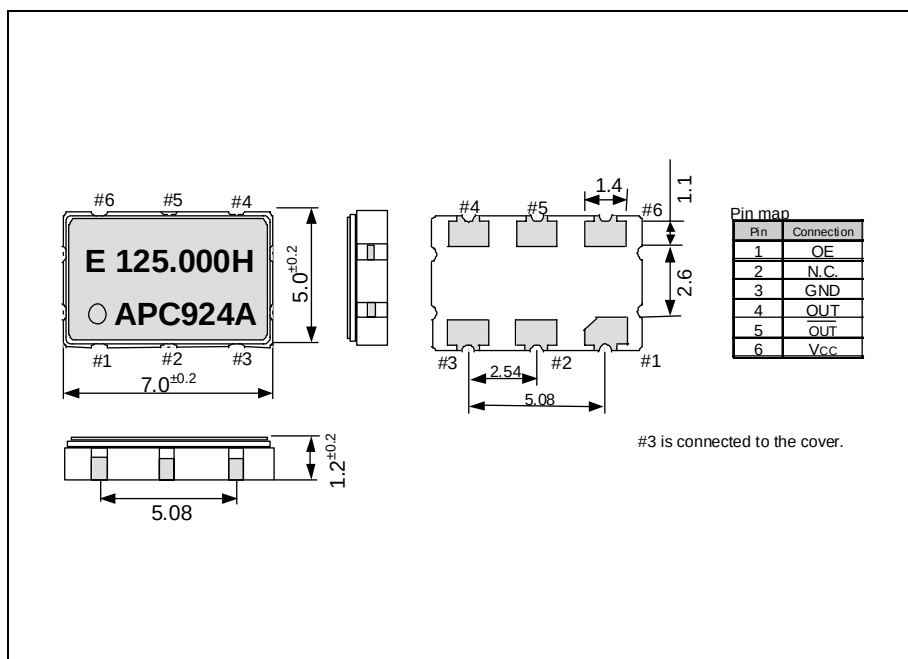
\*4 This includes initial frequency tolerance, temperature variation, supply voltage variation, reflow drift, and aging(+25 °C,10 years).

\*5 This includes initial frequency tolerance, temperature variation, supply voltage variation, and reflow drift(except aging).

\*6 This includes initial frequency tolerance and temperature variation(except supply voltage variation, reflow drift, aging).

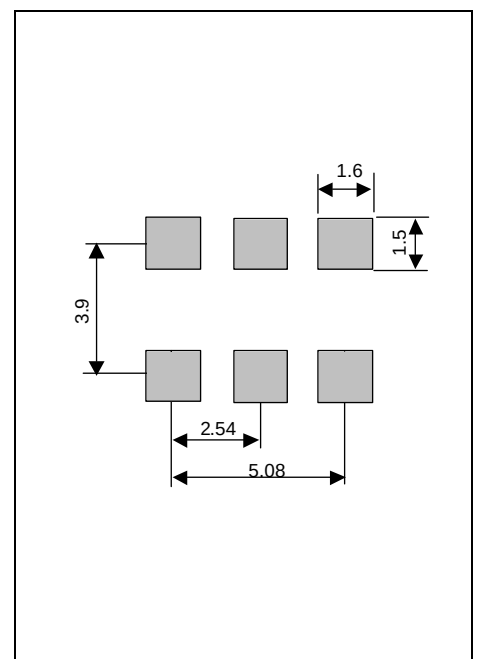
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





## CRYSTAL OSCILLATOR HIGH-STABILITY

# HG - 2150CA series

- Frequency range : 1 MHz to 60 MHz
- Supply voltage : 3.3 V or 5.0 V
- Frequency tolerance :  $\pm 15 \times 10^{-6}$  / -20 °C to +70 °C
- Function : Output enable(OE)
- Thickness : 1.5 mm Max.



Product Number (please contact us)  
Q3514CA00xxxx00



Actual size



## Specifications (characteristics)

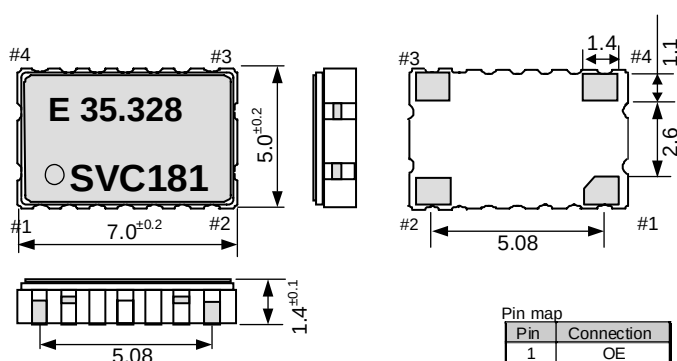
| Item                         |                       | Symbol                          | Specifications                        |                | Remarks                                            |
|------------------------------|-----------------------|---------------------------------|---------------------------------------|----------------|----------------------------------------------------|
|                              |                       |                                 | SVH / BXH                             | SVC / BXC      |                                                    |
| Output frequency range       |                       | f <sub>0</sub>                  | 1.000 MHz to 60.000 MHz               |                |                                                    |
| Supply voltage               |                       | V <sub>cc</sub>                 | H:5.0 V ±0.5 V                        | C:3.3 V ±0.3 V |                                                    |
| Temperature range            | Storage temperature   | T <sub>stg</sub>                | -40 °C to +125 °C                     |                | Store as bare product after unpacking              |
|                              | Operating temperature | T <sub>use</sub>                | V:-20 °C to +70 °C X:-40 °C to +85 °C |                |                                                    |
| Frequency tolerance          |                       | f <sub>tol</sub>                | S: ±15 × 10 <sup>-6</sup> *1          |                | -20 °C to +70 °C                                   |
|                              |                       |                                 | B: ±25 × 10 <sup>-6</sup> *1          |                | -40 °C to +85 °C                                   |
| Current consumption          |                       | I <sub>cc</sub>                 | 30 mA Max.                            | 25 mA Max.     | No load condition, OE = V <sub>cc</sub>            |
| Disable current              |                       | I <sub>dis</sub>                | 15 mA Max.                            | 12 mA Max.     | OE=GND                                             |
| Symmetry                     |                       | SYM                             | 45 % to 55 %                          |                | 50 % V <sub>cc</sub> level                         |
| High output voltage          |                       | V <sub>OH</sub>                 | V <sub>cc</sub> -0.4 V Min.           |                | I <sub>OH</sub> = -4 mA                            |
| Low output voltage           |                       | V <sub>OL</sub>                 | 0.4 V Max.                            |                | I <sub>OL</sub> = 4 mA                             |
| Output load condition        |                       | L CMOS                          | 15 pF Max.                            |                | CMOS load                                          |
| Output enable input voltage  |                       | V <sub>IH</sub>                 | 70 % V <sub>cc</sub> Min.             |                | OE terminal                                        |
| Output disable input voltage |                       | V <sub>IL</sub>                 | 30 % V <sub>cc</sub> Max.             |                | OE terminal                                        |
| Rise time / Fall time        |                       | t <sub>r</sub> / t <sub>f</sub> | 4 ns Max.                             |                | 20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level |
| Start-up time                |                       | t <sub>str</sub>                | 10 ms Max.                            |                | Time at minimum supply voltage to be 0 s.          |
| Frequency aging              |                       | f <sub>aging</sub>              | ±10 × 10 <sup>-6</sup> Max. *2        |                | +25 °C, 10 years                                   |

\*1 Frequency tolerance includes variation in reflow soldering drift, operating temperature range, supply voltage range and load change.

\*2 50 MHz <  $f_0$   $\leq$  60 MHz:  $\pm 15 \times 10^{-6}$  Max.

## External dimensions

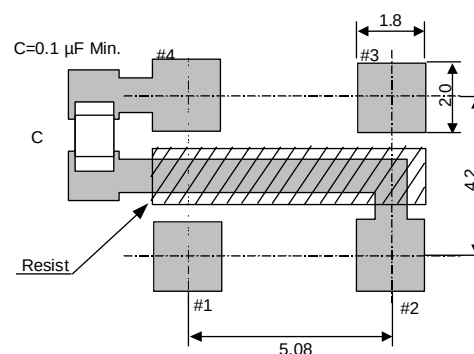
(Unit:mm)



Note.  
OE Pin  
OE pin = "H" or "open" : Specified frequency output.  
OE pin = "L" : Output is high impedance, oscillation stops.

## Footprint (Recommended)

(Unit:mm)





# CRYSTAL OSCILLATOR

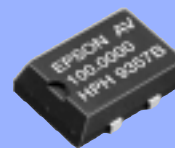
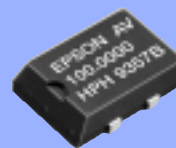
## HIGH-STABILITY

# HG - 8002JA series

- Frequency range : 1 MHz to 125 MHz
- Supply voltage : 3.3 V or 5.0 V
- Frequency tolerance :  $\pm 20 \times 10^{-6}$  / -20 °C to +70 °C
- Function : Output enable(OE) or Standby( $\overline{ST}$ )
- Thickness : 4.7 mm Max.  
Package and pin compatible with SG-615.



Product Number (please contact us)  
Q3514JAxXXXX00



Actual size



## Specifications (characteristics)

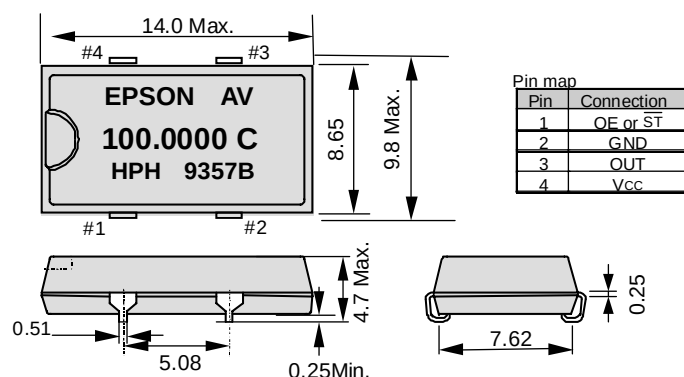
| Item                                  |                       | Symbol                          | Specifications                                         |              |                           | Remarks                                                       |
|---------------------------------------|-----------------------|---------------------------------|--------------------------------------------------------|--------------|---------------------------|---------------------------------------------------------------|
|                                       |                       |                                 | PT / ST                                                | PH / SH      | PC / SC                   |                                                               |
| Output frequency range                |                       | f <sub>0</sub>                  | 1.000 MHz to 125.000 MHz                               |              |                           |                                                               |
| Supply voltage                        |                       | V <sub>cc</sub>                 | 5.0 V±0.25 V                                           |              | 3.3 V±0.165 V             |                                                               |
| Temperature range                     | Storage temperature   | T <sub>stg</sub>                | -55 °C to +125 °C                                      |              |                           | Store as bare product after unpacking                         |
|                                       | Operating temperature | T <sub>use</sub>                | -20 °C to +70 °C<br>(-40 °C to +85 °C)                 |              | -40 °C to +85 °C          |                                                               |
| Frequency tolerance                   |                       | f <sub>tol</sub>                | AV: ±20 × 10 <sup>-6</sup> ,BV: ±25 × 10 <sup>-6</sup> |              |                           | -20 °C to +70 °C                                              |
|                                       |                       |                                 | CX: ±30 × 10 <sup>-6</sup>                             |              |                           | -40 °C to +85 °C *1                                           |
| Current consumption                   |                       | I <sub>cc</sub>                 | 45 mA Max.                                             |              | 28 mA Max.                | No load condition, Max. frequency                             |
| Disable current                       |                       | I <sub>dis</sub>                | 30 mA Max.                                             |              | 16 mA Max.                | OE=GND (PT,PH,PC)                                             |
| Stand-by current                      |                       | I <sub>std</sub>                | 50 µA Max.                                             |              |                           | ST =GND (ST,SH,SC)                                            |
| Symmetry                              |                       | SYM                             | —                                                      | 40 % to 60 % |                           | CMOS load:50%V <sub>cc</sub> level, Max. load condition       |
|                                       |                       |                                 | 40 % to 60 %                                           | —            |                           | TTL load: 1.4 V level, Max. load condition                    |
| High output voltage                   |                       | V <sub>OH</sub>                 | V <sub>cc</sub> -0.4 V Min.                            |              |                           | I <sub>OH</sub> =-16 mA(PT,ST,PH,SH),-8 mA(PC,SC)             |
| Low output voltage                    |                       | V <sub>OL</sub>                 | 0.4 V Max.                                             |              |                           | I <sub>OL</sub> = 16 mA(PT,ST,PH,SH), 8 mA(PC,SC)             |
| Output load condition (TTL)           |                       | L <sub>TTL</sub>                | 2 TTL Max.                                             | —            |                           | Max. frequency                                                |
| Output load condition (CMOS)          |                       | L <sub>CMOS</sub>               | 15 pF Max.                                             |              |                           | Max. supply voltage                                           |
| Output enable / disable input voltage |                       | V <sub>IH</sub>                 | 2.0 V Min.                                             |              | 70 % V <sub>cc</sub> Min. | ST terminal or OE terminal                                    |
|                                       |                       | V <sub>IL</sub>                 | 0.8 V Max.                                             |              | 20 % V <sub>cc</sub> Max. |                                                               |
| Rise time / Fall time                 |                       | t <sub>r</sub> / t <sub>f</sub> | —                                                      | 3 ns Max.    |                           | CMOS load: 20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level |
|                                       |                       |                                 | 4 ns Max.                                              | —            |                           | TTL load: 0.4 V to 2.4 V level                                |
| Start-up time                         |                       | t <sub>str</sub>                | 10 ms Max.                                             |              |                           | Time at minimum supply voltage to be 0 s                      |
| Frequency aging                       |                       | f <sub>aging</sub>              | ±2 × 10 <sup>-6</sup> / year Max.                      |              |                           | +25 °C, V <sub>cc</sub> =5.0 V / 3.3 V (PC / SC)              |

PLL-PLL connection & Jitter specification, please refer to "Jitter specifications and characteristics chart" page.

\*1 PT, ST and PH, SH for "CX" tolerance will be available up to 55 MHz.

## External dimensions

(Unit:mm)



Note.

OE Pin (PT, PH, PC)

OE pin = "H" or "open" : Specified frequency output.

OE pin = "L" : Output is high impedance.

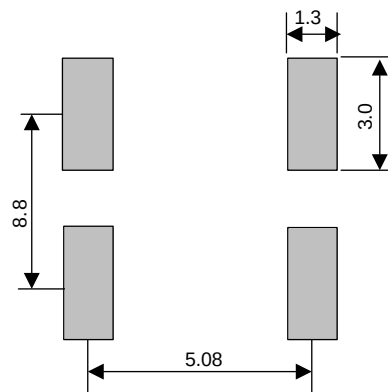
$\overline{ST}$  pin (ST, SH, SC)

$\overline{ST}$  pin = "H" or "open" : Specified frequency output.

$\overline{ST}$  pin = "L" : Output is low level (weak pull - down), oscillation stops.

## Footprint (Recommended)

(Unit:mm)





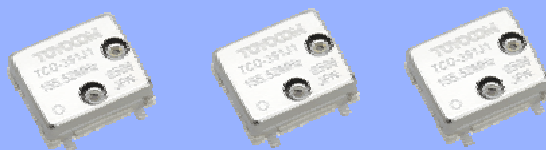
# CRYSTAL OSCILLATOR HIGH-STABILITY

## TCO - 391J

- Frequency range : 60 MHz to 230 MHz
- Supply voltage : 3.3 V
- Features : With HFF-XTAL technology  
Fundamental oscillation



Product Number (please contact us)  
X1G000481xxxx00



Actual size



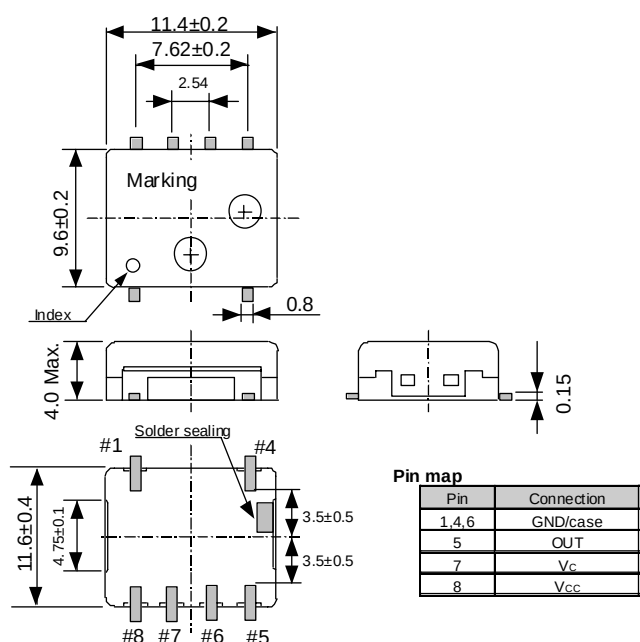
### Specifications (characteristics)

| Item                        | Symbol             | Specifications                     | Remarks                                   |
|-----------------------------|--------------------|------------------------------------|-------------------------------------------|
| Output frequency range      | $f_o$              | 60.000 MHz to 230.000 MHz          |                                           |
| Supply voltage              | Vcc                | 3.3 V $\pm 0.165$ V                |                                           |
| Storage temperature range   | T <sub>stg</sub>   | -45 °C to +90 °C                   | Store as bare product after unpacking     |
| Operating temperature range | T <sub>use</sub>   | -40 °C to +85 °C                   |                                           |
| Frequency tolerance *1      | f <sub>tol</sub>   | $\pm 35 \times 10^{-6}$ Max.       | -40 °C to +85 °C                          |
| Current consumption         | Icc                | 30 mA Max.                         |                                           |
| Output load condition       | R <sub>L</sub>     | 50 $\Omega$ (0 dBm Min.)           |                                           |
| Start-up time               | t <sub>str</sub>   | 10 ms Max.                         | Time at minimum supply voltage to be 0 s. |
| Frequency aging             | f <sub>aging</sub> | $\pm 5 \times 10^{-6}$ / year Max. | +25 °C, First year                        |

\*1 This does not include initial frequency tolerance because frequency is adjustable.

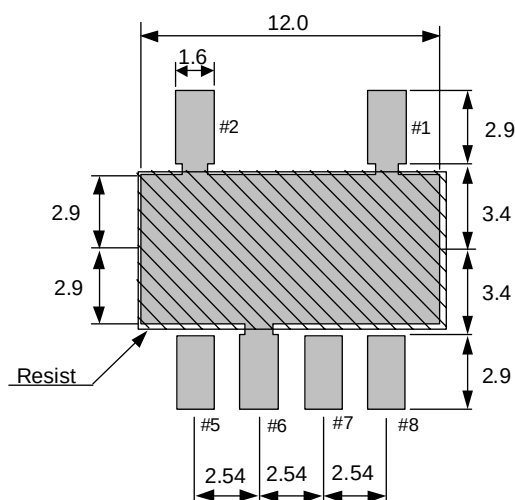
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)





CRYSTAL OSCILLATOR  
HIGH-STABILITY

## TCO - 3100 series

- Frequency range : 60 MHz to 800 MHz
- Supply voltage : 3.3 V, 5.0 V
- Features : High reliability (20 years aging)  
: Low phase noise, low jitter  
: With HFF-XTAL technology  
fundamental oscillation (60MHz to 230MHz)  
Multiplier oscillation (fo≥230MHz)



Product Number (please contact us)  
X1G0004xxxxxx00



Actual size



## Specifications (characteristics)

| Item                        | Symbol             | Specifications            |               |                | Remarks                               |
|-----------------------------|--------------------|---------------------------|---------------|----------------|---------------------------------------|
|                             |                    | TCO-3111                  | TCO-3112      | TCO-3114       |                                       |
| Output frequency range      | f <sub>o</sub>     | 60.000 MHz to 800.000 MHz |               |                |                                       |
| Supply voltage              | V <sub>cc</sub>    | 3.3 V ±0.165 V            | 5.0 V ±0.25 V | 3.3 V ±0.165 V |                                       |
| Storage temperature range   | T <sub>stg</sub>   | -45 °C to +90 °C          |               |                | Store as bare product after unpacking |
| Operating temperature range | T <sub>use</sub>   | -40 °C to +85 °C          |               |                |                                       |
| Frequency tolerance         | f <sub>tol</sub>   | As per table 1            |               |                | -40 °C to +85 °C                      |
| Current consumption         | I <sub>cc</sub>    | 65 mA Max.                |               | 40 mA Max.     |                                       |
| Output load condition       | —                  | LV-PECL                   | PECL          | LVDS           |                                       |
| Start-up time               | t <sub>str</sub>   | 10 ms Max. *1             |               |                |                                       |
| Frequency aging             | f <sub>aging</sub> | As per table 1            |               |                | +25 °C                                |

## Specifications (characteristics)

| Item                        | Symbol             | Specifications            | Remarks                               |
|-----------------------------|--------------------|---------------------------|---------------------------------------|
|                             |                    | TCO-3131                  | OE function                           |
| Output frequency range      | f <sub>o</sub>     | 60.000 MHz to 700.000 MHz |                                       |
| Supply voltage              | V <sub>cc</sub>    | 3.3 V ±0.165 V            |                                       |
| Storage temperature range   | T <sub>stg</sub>   | -45 °C to +90 °C          | Store as bare product after unpacking |
| Operating temperature range | T <sub>use</sub>   | -40 °C to +85 °C          |                                       |
| Frequency tolerance         | f <sub>tol</sub>   | As per table 1            | -40 °C to +85 °C                      |
| Current consumption         | I <sub>cc</sub>    | 75 mA Max.                |                                       |
| Output load condition       | —                  | LV-PECL                   |                                       |
| Start-up time               | t <sub>str</sub>   | 10 ms Max. *1             |                                       |
| Frequency aging             | f <sub>aging</sub> | As per table 1            | +25 °C                                |

Table 1. Frequency tolerance and aging (Ex.TCO-3111-x)

| X | Frequency tolerance            | Aging             |
|---|--------------------------------|-------------------|
| A | ±50 × 10 <sup>-6</sup> Max. *2 | 1year(First year) |
| B | ±60 × 10 <sup>-6</sup> Max. *3 | 20 years          |

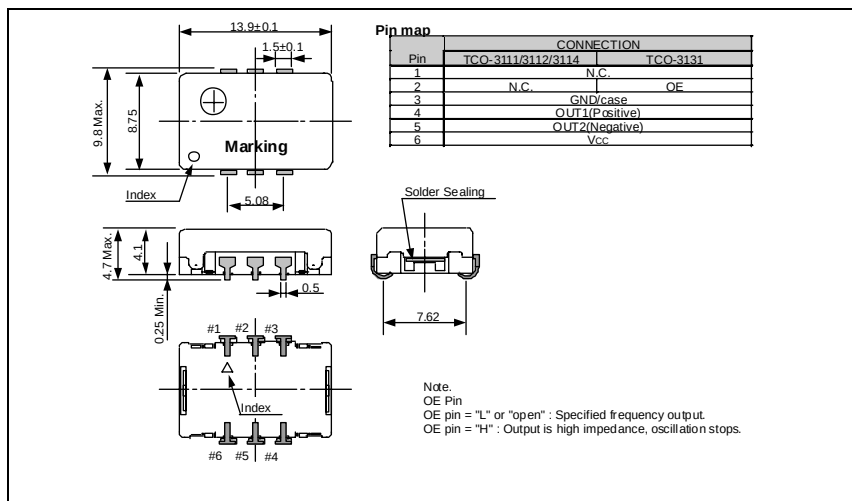
\*1 Time at minimum supply voltage to be 0 s.

\*2 This includes initial frequency tolerance, temperature variation, supply voltage variation and aging (+25 °C, 1 year).

\*3 This includes initial frequency tolerance, temperature variation, supply voltage variation and aging (+25 °C, 20 years).

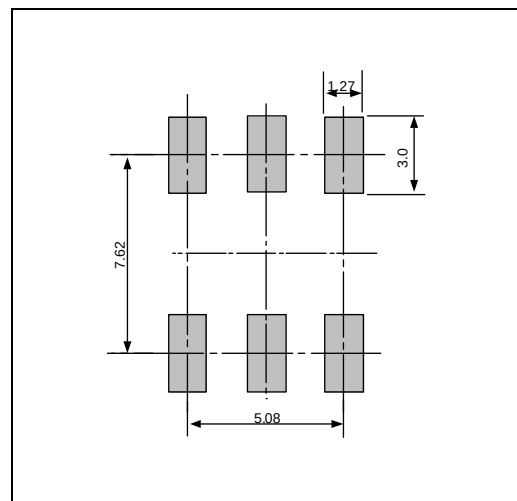
## External dimensions

(Unit:mm)



## Footprint(Recommended)

(Unit:mm)





# CRYSTAL OSCILLATOR

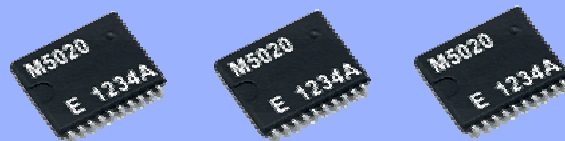
## MULTI-OUTPUT 32.768 kHz and 48 MHz

### MG - 5020JE

- Frequency range : 32.768 kHz and 48.00512 MHz
- Supply voltage : 32.768 kHz oscillation circuit 1.8 V to 3.6 V  
48 MHz oscillation circuit 2.7 V to 3.6 V.
- Built-in crystal : 32.768 kHz crystal unit
- Thickness : 1.5 mm Max.



Product Number (Please contact us)  
Q33M22JE1xxxx00



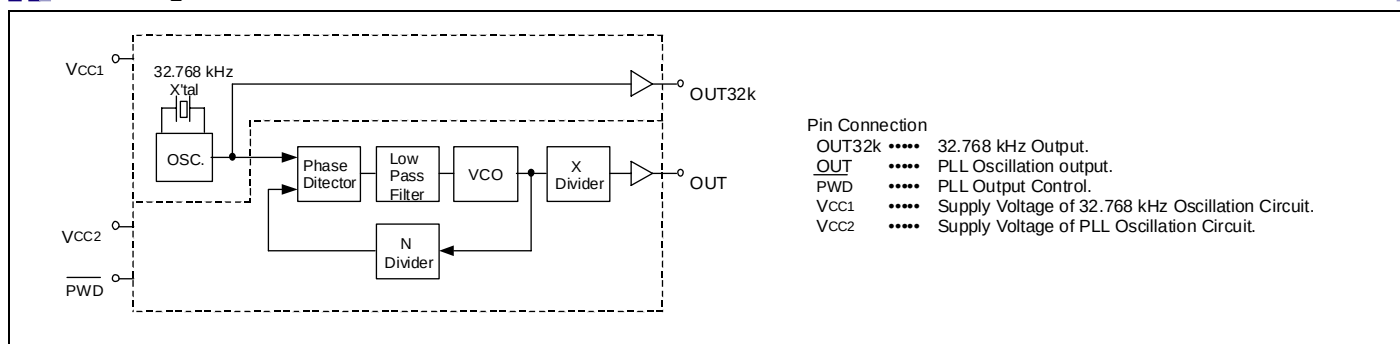
Actual size



## Specifications (characteristics)

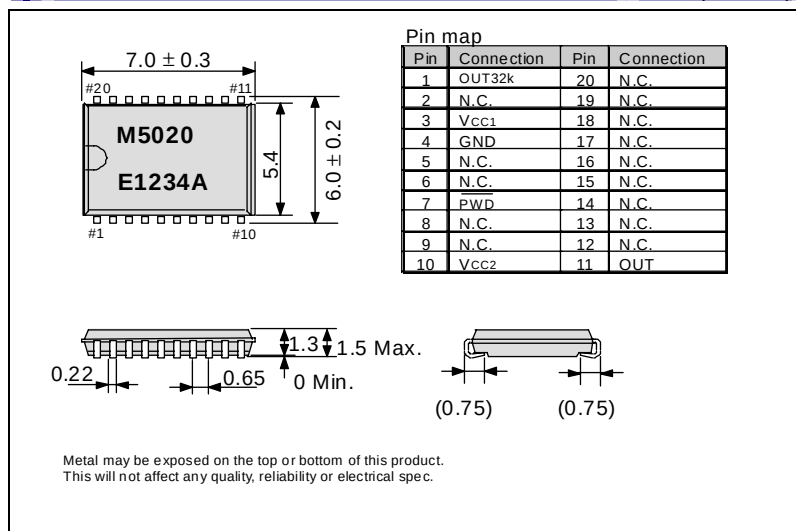
| Item                                 | Symbol      | Specifications                     | Remarks                                                    |
|--------------------------------------|-------------|------------------------------------|------------------------------------------------------------|
| Output frequency range               | $f_0$       | 32.768 kHz                         | OUT32k - pin                                               |
|                                      |             | 48.005120 MHz                      | OUT - pin                                                  |
| Supply voltage                       | $V_{CC}$    | 2.7 V to 3.6 V                     | PLL Output                                                 |
|                                      | $V_{BK}$    | 1.8 V to 3.6 V                     | 32.768 kHz Output                                          |
| Storage temperature                  | $T_{stg}$   | -55 °C to +125 °C                  | Store as bare product after unpacking                      |
| Operating temperature                | $T_{use}$   | -40 °C to +85 °C                   |                                                            |
| Frequency tolerance                  | $f_{tol}$   | $5 \pm 23 \times 10^{-6}$          | +25 °C, $V_{CC}=3.0$ V                                     |
| Current consumption 1 (PLL Stopping) | $I_{cc1}$   | 3 $\mu$ A Max.                     | $V_{CC}=1.8$ V to 3.6 V PWD =GND OUT32 k=No load condition |
| Current consumption 2 (PLL Working)  | $I_{cc2}$   | 15 mA Max.                         | $V_{CC}=2.7$ V to 3.6 V PWD =HIGH OUT= No load condition   |
| Symmetry                             | SYM         | 40 % to 60 %                       | 50 % $V_{CC}$ level                                        |
| High output voltage                  | $V_{OH}$    | $V_{CC}-0.4$ V Min.                | $I_{OH}=100 \mu$ A(OUT32k), 4.0 mA(OUT)                    |
| Low output voltage                   | $V_{OL}$    | 0.4 V Max.                         | $I_{OL}=100 \mu$ A(OUT32k), -4.0 mA(OUT)                   |
| Output load condition (CMOS)         | L CMOS      | 15 pF Max.                         | OUT32k pin, OUT pin                                        |
| Output enable input voltage          | $V_{IH}$    | 80 % $V_{CC}$ to $V_{CC}+0.2$ V    | PWD pin                                                    |
| Output disable input voltage         | $V_{IL}$    | GND-0.2 V to 0.2 $V_{CC}$          | PWD pin                                                    |
| Rise time                            | $t_r$       | 5 ns Max.                          | 20 % $V_{CC}$ →80 % $V_{CC}$ level, OUT pin                |
| Fall time                            | $t_f$       | 5 ns Max.                          | 80 % $V_{CC}$ →20 % $V_{CC}$ level, OUT pin                |
| Jitter                               | Pj          | 150 ps Max.                        | $V_{CC}=2.7$ V to 3.6 V Period jitter                      |
| Start-up time                        | $t_{str}$   | 3 s Max.                           | +25 °C, $V_{CC}=0$ V→1.8 V to 3.6 V                        |
|                                      |             | 0.1 s                              | $V_{CC}=0$ V → 2.7 V to 3.6 V, PWD=LOW→High                |
| Frequency aging                      | $f_{aging}$ | $\pm 5 \times 10^{-6}$ / year Max. | +25 °C, $V_{CC}=3.0$ V, First year                         |

## Block diagram



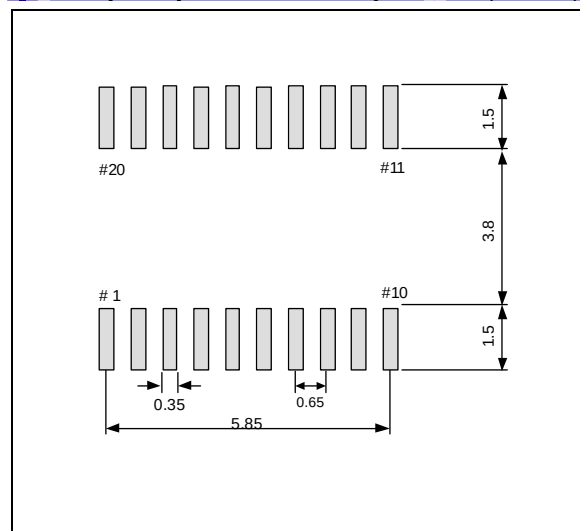
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





# VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## MINIATURE SIZE LOW PROFILE, WIDE PULL RANGE

### VG-4231CE

- Frequency range : 3 MHz to 60 MHz
- Supply voltage : 3.3 V (PSCM / CSCM)  
: 2.8 V (PSBM / CSBM)  
: 1.8 V (PQEM / CQEM)
- Frequency control range :  $\pm 140 \times 10^{-6}$  (\*SCM / \*SBM)  
:  $\pm 120 \times 10^{-6}$  (\*QEM)
- Low current consumption : 1.0 mA Typ. (27 MHz, 3.3 V)
- Thickness : 1.05 mm Typ.



Product Number (please contact us)  
Q3614CE00xxx00



Actual size



### Specifications (characteristics)

| Item                         | Symbol                | Specifications                   |                   |                                  | Remarks                                                      |
|------------------------------|-----------------------|----------------------------------|-------------------|----------------------------------|--------------------------------------------------------------|
|                              |                       | PSCM / CSCM                      | PSBM / CSBM       | PQEM / CQEM                      |                                                              |
| Output frequency range       | $f_o$                 | 3 MHz to 60 MHz                  |                   | 24 MHz to 30 MHz                 | Please contact us for inquiries regarding other frequencies. |
| Supply voltage               | $V_{cc}$              | 3.3 V $\pm 0.3$ V                | 2.8 V $\pm 0.2$ V | 1.8 V $\pm 0.2$ V                |                                                              |
| Temperature range            | Storage temperature   | -40 °C to +125 °C                |                   |                                  | Store as bare product after unpacking                        |
|                              | Operating temperature |                                  |                   |                                  |                                                              |
| Frequency tolerance          | $f_{tol}$             | As per below table               |                   |                                  |                                                              |
| Current consumption          | $I_{cc}$              | 7 mA Max.                        | 6.2 mA Max.       | 1.2 mA Max.                      | No load condition                                            |
| Frequency control range      | $f_{cont}$            | $S: \pm 140 \times 10^{-6}$ Min. |                   | $Q: \pm 120 \times 10^{-6}$ Min. | $V_c = 1/2 V_{cc} \pm 1/2 V_{cc}$                            |
| Modulation characteristics   | BW                    | 15 kHz Min.                      |                   |                                  | $\pm 3$ dB (at 1 kHz)                                        |
| Input resistance             | $R_{in}$              | $M: 1 M\Omega$ Min.              |                   |                                  | DC level                                                     |
| Frequency change polarity    | —                     | Positive polarity                |                   |                                  | $V_c = 0$ V to $V_{cc}$                                      |
| Symmetry                     | SYM                   | 40 % to 60 %                     |                   |                                  | CMOS load: 50 % $V_{cc}$ level                               |
| High output voltage          | $V_{OH}$              | $V_{cc} - 0.4$ V Min.            |                   |                                  | $I_{OH} = -3.0$ mA                                           |
| Low output voltage           | $V_{OL}$              | 0.4 V Max.                       |                   |                                  | $I_{OL} = 3.0$ mA                                            |
| Output load condition (CMOS) | $L_{CMOS}$            | 15 pF Max.                       |                   |                                  | CMOS load                                                    |
| Rise time and Fall time      | $t_r / t_f$           | 4 ns Max.                        |                   | 6 ns Max.                        | CMOS load: 20 % $V_{cc}$ to 80 % $V_{cc}$ level              |
| Start-up time                | $t_{str}$             | 5 ms Max.                        |                   |                                  | Time at 90 % $V_{cc}$ to be 0 s                              |
| Frequency aging              | $f_{aging}$           | $\pm 5 \times 10^{-6}$ Max.      |                   |                                  | +25 °C, 5 years                                              |

\* Please keep  $V_c$  pin open or ground while powering up  $V_{cc}$ .

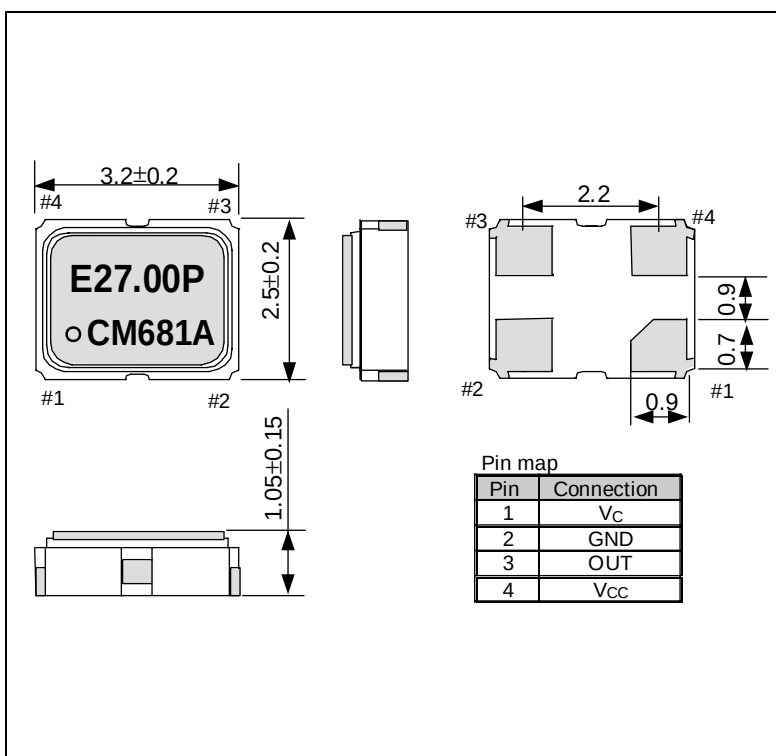
### Frequency tolerance / Temperature range / Absolute pull range

|                    | Frequency tolerance       | Temperature range | Absolute pull range                                    |
|--------------------|---------------------------|-------------------|--------------------------------------------------------|
| CSCM / CSBM / CQEM | C $\pm 30 \times 10^{-6}$ | -20 °C to +70 °C  | $S: \pm 100 \times 10^{-6} / Q: \pm 80 \times 10^{-6}$ |
| PSCM / PSBM / PQEM | P $\pm 37 \times 10^{-6}$ | -40 °C to +85 °C  | $S: \pm 95 \times 10^{-6} / Q: \pm 75 \times 10^{-6}$  |

\* Absolute pull range = Frequency control range - (Frequency tolerance + 5 years Aging + Free fall + Vibration)

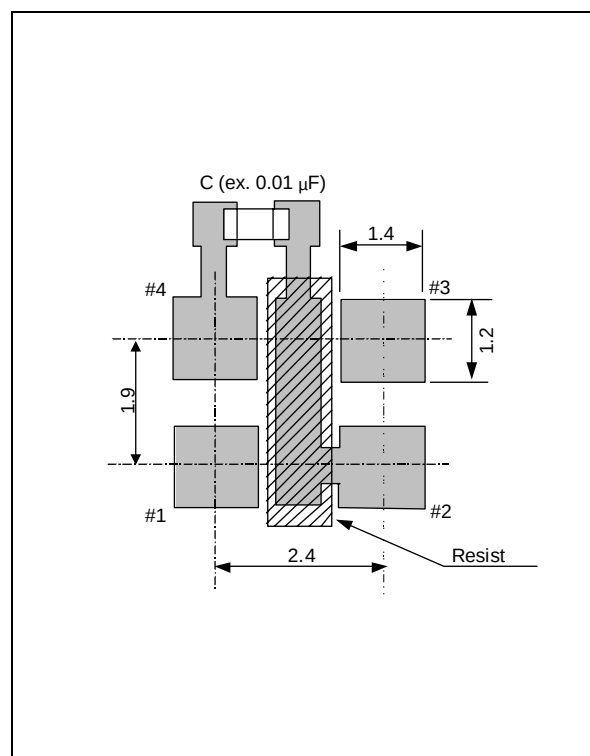
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)





## VOLTAGE -CONTROLLED CRYSTAL OSCILLATOR (VCXO)

# VG-4231CB

# VG-4531CB

- Frequency range : 1 MHz to 80 MHz
- Supply voltage : 3.3 V
- Absolute pull range :  $\pm 50 \times 10^{-6}$
- Thickness : 1.2 mm Typ.
- Function : Output enable(OE)



Product Number (please contact us)

VG-4231CB : X1G002861xxx00

VG-4531CB : X1G002881xxx00



Actual size

**NEW**

## Specifications (characteristics)

| Item                                  | Symbol                          | Specifications                       |                          | Remarks                                                          |
|---------------------------------------|---------------------------------|--------------------------------------|--------------------------|------------------------------------------------------------------|
|                                       |                                 | VG-4231CB                            | VG-4531CB                |                                                                  |
| Output frequency range                | $f_o$                           | 1.000 MHz to 60.000 MHz              | 60.001 MHz to 80.000 MHz | Please contact us for inquiries regarding available frequencies. |
| Supply voltage                        | V <sub>cc</sub>                 | 3.3 V $\pm 0.165$ V                  |                          |                                                                  |
| Storage temperature range             | T <sub>stg</sub>                | -40 °C to +85 °C                     |                          | Store as bare product after unpacking                            |
| Operating temperature range           | T <sub>use</sub>                | As per blow table.                   |                          |                                                                  |
| Frequency tolerance                   | f <sub>tol</sub>                | $\pm 50 \times 10^{-6}$ Max.         |                          | Includes frequency aging (20 years)                              |
| Current consumption                   | I <sub>cc</sub>                 | 10 mA Max.                           | 15 mA Max.               | No load condition.                                               |
| Absolute pull range                   | APR                             | $\pm 50 \times 10^{-6}$ Min.         |                          | V <sub>c</sub> = 1.65 V $\pm 1.5$ V                              |
| Input resistance                      | R <sub>in</sub>                 | 10 M $\Omega$ Min.                   |                          | DC level                                                         |
| Frequency change polarity             | —                               | Positive slope                       |                          | V <sub>c</sub> = 0.15 to 3.15 V                                  |
| Symmetry                              | SYM                             | 45 % to 55 %                         |                          | 50 % V <sub>cc</sub> level                                       |
| High output voltage                   | V <sub>OH</sub>                 | V <sub>cc</sub> -0.4 V Min.          |                          | I <sub>OH</sub> = -0.8 mA                                        |
| Low output voltage                    | V <sub>OL</sub>                 | 0.4 V Max.                           |                          | I <sub>OL</sub> = 3.2 mA                                         |
| Output load condition (CMOS)          | L <sub>CMOS</sub>               | 15 pF Max.                           |                          |                                                                  |
| Output enable / disable input voltage | V <sub>IH</sub>                 | 70 % V <sub>cc</sub> Min.            |                          | V <sub>IH</sub> or OPEN : Enable                                 |
|                                       | V <sub>IL</sub>                 | 30 % V <sub>cc</sub> Max.            |                          | V <sub>IL</sub> or GND : Disable                                 |
| Rise time / Fall time                 | t <sub>r</sub> / t <sub>f</sub> | 6 ns Max.                            |                          | 20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level               |
| Start-up time                         | t <sub>str</sub>                | 10 ms Max.                           |                          | Time at minimum supply voltage to be 0 s                         |
| Frequency aging                       | f <sub>aging</sub>              | This is included frequency tolerance |                          | +25 °C, V <sub>cc</sub> = 3.3 V, 20 years                        |

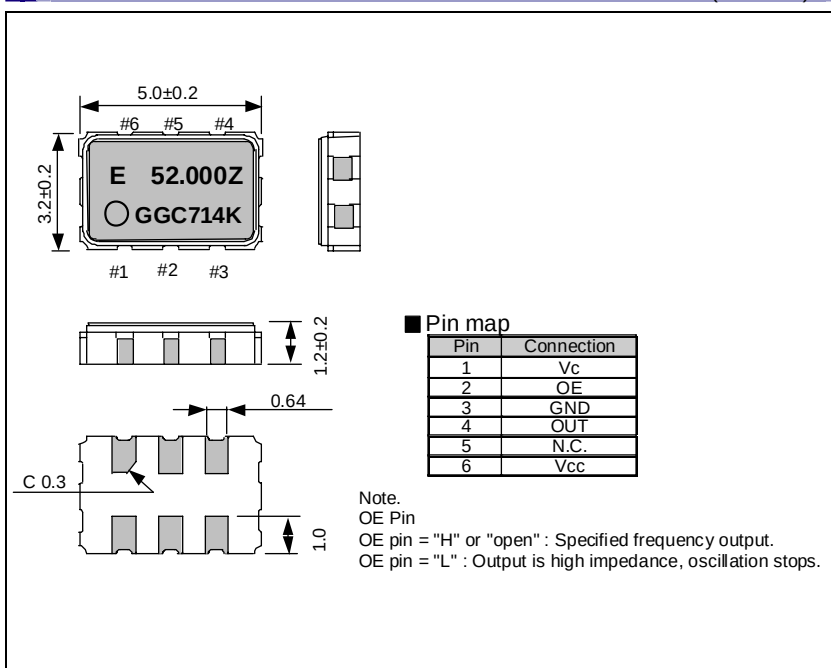
\* Please keep V<sub>c</sub> pin open or ground while powering up V<sub>cc</sub>.

## Temperature range

|      | Operating temperature range |
|------|-----------------------------|
| GGCT | -40 °C ~ +85 °C             |
| JGCT | -20 °C ~ +70 °C             |
| KGCT | 0 °C ~ +70 °C               |

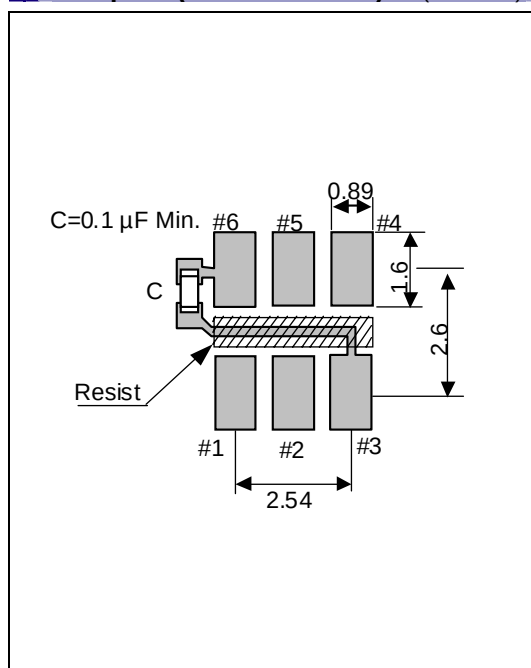
## External dimensions

(Unit : mm)



## Footprint (Recommended)

(Unit : mm)





# VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

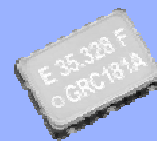
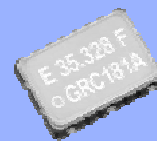
## WIDE PULL RANGE

# VG-4231CA

- Frequency range : 1 MHz to 60 MHz
- Supply voltage : 3.3 V (DRC, GRC)  
5.0 V (DRH, GRH)
- Frequency control range:  $\pm 130 \times 10^{-6}$
- Thickness : 1.4 mm Typ.



Product Number (please contact us)  
Q3614CA00xxxx00



Actual size



## Specifications (characteristics)

| Item                                  |                       | Symbol                          | Specifications                                                                                                                         |                | Remarks                                                                       |
|---------------------------------------|-----------------------|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------------|
|                                       |                       |                                 | DRH / GRH                                                                                                                              | DRC / GRC      |                                                                               |
| Output frequency range                |                       | f <sub>0</sub>                  | 1.000 MHz to 60.000 MHz                                                                                                                |                | Please contact us for inquiries regarding available frequencies.              |
| Supply voltage                        |                       | V <sub>cc</sub>                 | H:5.0 V ±0.5 V                                                                                                                         | C:3.3 V ±0.3 V |                                                                               |
| Temperature range                     | Storage temperature   | T <sub>stg</sub>                | -40 °C to +125 °C                                                                                                                      |                | Store as bare product after unpacking                                         |
|                                       | Operating temperature | T <sub>use</sub>                | As per below table                                                                                                                     |                |                                                                               |
| Frequency tolerance                   |                       | f <sub>tol</sub>                | As per below table                                                                                                                     |                | V <sub>c</sub> =2.5 V(DRH,GRH)/ V <sub>c</sub> =1.65 V(DRC,GRC)               |
| Current consumption                   |                       | I <sub>cc</sub>                 | 20 mA Max.                                                                                                                             | 10 mA Max.     | No load condition                                                             |
| Disable current                       |                       | I <sub>dis</sub>                | 15 mA Max.                                                                                                                             | 7 mA Max.      | OE=GND                                                                        |
| Frequency control range               |                       | f <sub>cont</sub>               | R:±130 × 10 <sup>-6</sup> (f <sub>0</sub> ≤42 MHz,f <sub>0</sub> ≥48 MHz)<br>Q:±120 × 10 <sup>-6</sup> (42 MHz<f <sub>0</sub> <48 MHz) |                | V <sub>c</sub> =2.5 V±2.0 V(DRH,GRH)<br>V <sub>c</sub> =1.65 V±1.5 V(DRC,GRC) |
| Absolute pull range *1                |                       | APR                             | DR:±80 × 10 <sup>-6</sup> Min., GR:±65 × 10 <sup>-6</sup> Min.                                                                         |                | Frequency control range±130 × 10 <sup>-6</sup>                                |
| Modulation characteristics            |                       | BW                              | 15 kHz Min.                                                                                                                            |                | ± 3 dB (at 1 kHz)                                                             |
| Input resistance                      |                       | R <sub>in</sub>                 | 50 kΩ Min.                                                                                                                             | 10 MΩ Min.     | DC level                                                                      |
| Frequency change polarity             |                       | —                               | Positive polarity                                                                                                                      |                | V <sub>c</sub> =0.5 V to 4.5 V(**H) , 0.15 V to 3.15 V(**C)                   |
| Symmetry                              |                       | SYM                             | 40 % to 60 %                                                                                                                           |                | CMOS load:50 % V <sub>cc</sub> level                                          |
| High output voltage                   |                       | V <sub>OH</sub>                 | V <sub>cc</sub> -0.4 V Min.                                                                                                            |                | I <sub>OH</sub> = -0.8 mA(DRC,GRC), I <sub>OH</sub> =-4 mA(DRH,GRH)           |
| Low output voltage                    |                       | V <sub>OL</sub>                 | 0.4 V Max.                                                                                                                             |                | I <sub>OL</sub> = 3.2 mA(DRC,GRC), I <sub>OL</sub> = 4 mA(DRH,GRH)            |
| Output load condition (CMOS)          |                       | L CMOS                          | 15 pF Max.                                                                                                                             |                | CMOS load                                                                     |
| Output enable / disable input voltage |                       | V <sub>IH</sub>                 | 70 % V <sub>cc</sub> Min.                                                                                                              |                | OE Terminal                                                                   |
|                                       |                       | V <sub>IL</sub>                 | 30 % V <sub>cc</sub> Max.                                                                                                              |                |                                                                               |
| Rise time and Fall time               |                       | t <sub>r</sub> / t <sub>f</sub> | 4 ns Max.                                                                                                                              |                | CMOS load: 20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level                 |
| Start-up time                         |                       | t <sub>str</sub>                | 10 ms Max.                                                                                                                             |                | Time at 90 %V <sub>cc</sub> to be 0 s                                         |
| Frequency aging                       |                       | f <sub>aging</sub>              | ±10 × 10 <sup>-6</sup> Max. *2                                                                                                         |                | +25 °C, 10 years                                                              |

\*1 Absolute pull range = Frequency control range - (Frequency tolerance + 10 years Aging + Free fall + Vibration)

\*2 50 MHz  $< f_0 \leq 60$  MHz :  $\pm 15 \times 10^{-6}$  Max.

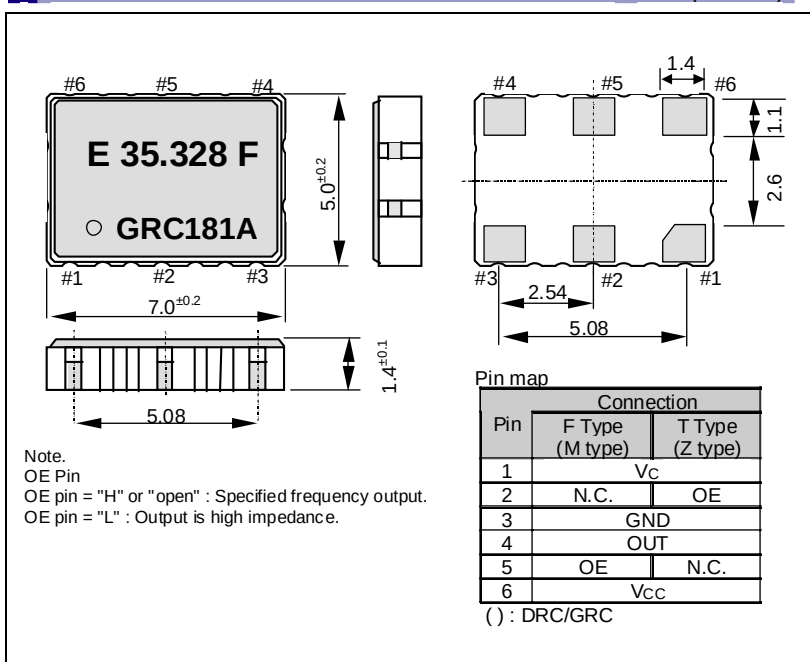
\* Please keep  $V_c$  pin open or ground while powering up  $V_{cc}$ .

## Frequency tolerance / Temperature range

|                 | Frequency tolerance     | Temperature range                          |
|-----------------|-------------------------|--------------------------------------------|
| DRC / DRH / DQC | $\pm 35 \times 10^{-6}$ | $-20^\circ\text{C}$ to $+70^\circ\text{C}$ |
| GRC / GRH / GQC | $\pm 50 \times 10^{-6}$ | $-40^\circ\text{C}$ to $+85^\circ\text{C}$ |

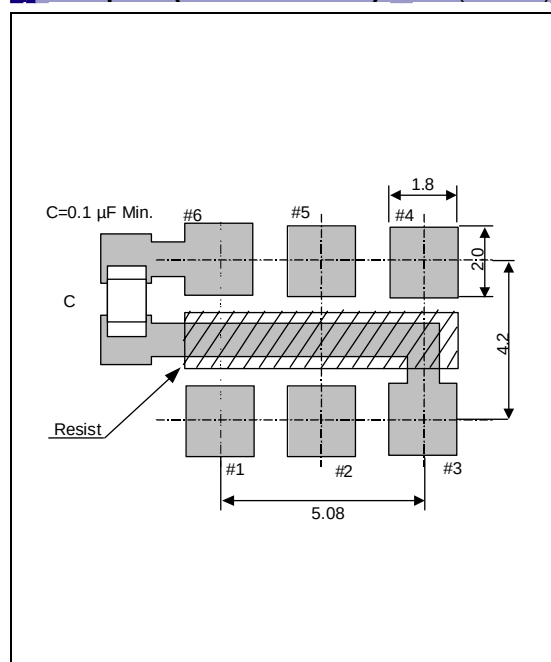
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





## VOLTAGE -CONTROLLED CRYSTAL OSCILLATOR (VCXO)

# VG - 4501CA

# VG - 4502CA

- Frequency range : 60 MHz to 80 MHz
- Supply voltage : 3.3 V
- Absolute pull range : VG-4501CA  $\pm 50 \times 10^{-6}$   
VG-4502CA  $\pm 100 \times 10^{-6}$
- Thickness : 1.6 mm Typ.
- Function : Output enable(OE)
- Old name : TCO-7116Z1Z4



Product Number (please contact us)

VG-4501CA : X1G002371xxxx00

VG-4502CA : X1G002871xxxx00



Actual size

**NEW**

## Specifications (characteristics)

| Item                                  | Symbol                          | Specifications                       |                                     | Remarks                                                          |
|---------------------------------------|---------------------------------|--------------------------------------|-------------------------------------|------------------------------------------------------------------|
|                                       |                                 | VG-4501CA                            | VG-4502CA                           |                                                                  |
| Output frequency range                | f <sub>o</sub>                  | 60.000 MHz to 80.000 MHz             |                                     | Please contact us for inquiries regarding available frequencies. |
| Supply voltage                        | V <sub>cc</sub>                 | 3.3 V $\pm 0.165$ V                  |                                     |                                                                  |
| Storage temperature range             | T <sub>stg</sub>                | -55 °C to +125 °C                    |                                     | Store as bare product after unpacking                            |
| Operating temperature range           | T <sub>use</sub>                | As per below table.                  |                                     |                                                                  |
| Frequency tolerance                   | f <sub>tol</sub>                | $\pm 50 \times 10^{-6}$ Max.         |                                     | -40 °C to +85 °C                                                 |
| Current consumption                   | I <sub>cc</sub>                 | 35 mA Max.                           |                                     | No load condition.                                               |
| Absolute pull range*1                 | APR                             | GCT : $\pm 50 \times 10^{-6}$ Min.   | HCT : $\pm 100 \times 10^{-6}$ Min. | V <sub>c</sub> = 1.65 V $\pm$ 1.65 V                             |
| Input resistance                      | R <sub>in</sub>                 | 80 k $\Omega$ Min.                   |                                     | DC level                                                         |
| Frequency change polarity             | —                               | Positive slope                       |                                     | V <sub>c</sub> = 0 to 3.3 V                                      |
| Symmetry                              | SYM                             | 45 % to 55 %                         |                                     | 50 % V <sub>cc</sub> level                                       |
| High output voltage                   | V <sub>OH</sub>                 | 90 % V <sub>cc</sub> Min.            |                                     | I <sub>OH</sub> = -0.8 mA                                        |
| Low output voltage                    | V <sub>OL</sub>                 | 10 % V <sub>cc</sub> Max.            |                                     | I <sub>OL</sub> = 3.2 mA                                         |
| Output load condition (CMOS)          | L <sub>CMOS</sub>               | 15 pF Max.                           |                                     |                                                                  |
| Output enable / disable input voltage | V <sub>IH</sub>                 | 70 % V <sub>cc</sub> Min.            |                                     | V <sub>IH</sub> or OPEN : Enable                                 |
|                                       | V <sub>IL</sub>                 | 30 % V <sub>cc</sub> Max.            |                                     | V <sub>IL</sub> or GND : Disable                                 |
| Rise time / Fall time                 | t <sub>r</sub> / t <sub>f</sub> | 5 ns Max.                            |                                     | 20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level               |
| Start-up time                         | t <sub>str</sub>                | 10 ms Max. *2                        |                                     | Time at minimum supply voltage to be 0 s                         |
| Frequency aging                       | f <sub>aging</sub>              | This is included Absolute pull range |                                     | +25 °C, V <sub>cc</sub> = 3.3 V, 20 years                        |

\*1 Absolute pull range = Frequency control range- (Frequency tolerance + 20 years Aging + Free fall + Vibration)

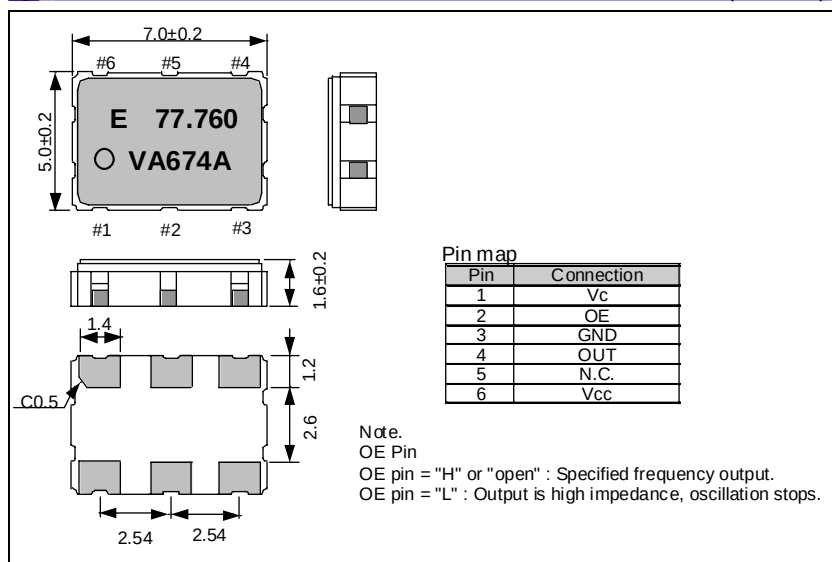
\*2 Rise time (or 3.15 V) of V<sub>cc</sub> > 150  $\mu$ s\* Please keep V<sub>c</sub> pin open or ground while powering up V<sub>cc</sub>.

## Operating temperature range

| Operating temperature range |                  | Absolute pull range                       |                                            |
|-----------------------------|------------------|-------------------------------------------|--------------------------------------------|
|                             |                  | VG-4501CA<br>$\pm 50 \times 10^{-6}$ Min. | VG-4502CA<br>$\pm 100 \times 10^{-6}$ Min. |
| G                           | -40 °C to +85 °C | GGCT                                      | GHCT                                       |
| J                           | -20 °C to +70 °C | JGCT                                      | JHCT                                       |
| K                           | 0 °C to +70 °C   | KGCT                                      | KHCT                                       |

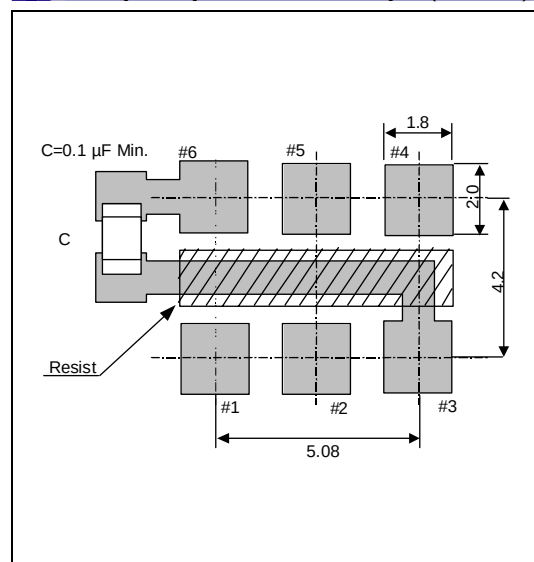
## External dimensions

(Unit : mm)



## Footprint (Recommended)

(Unit : mm)





## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## VG-4511CA

- Frequency range : 80 MHz to 170 MHz LV-PECL
- Supply voltage : 3.3 V
- Absolute pull range :  $\pm 50 \times 10^{-6}$
- Thickness : 1.6 mm Typ.
- Function : Output enable(OE)



Product Number (please contact us)  
X1G002781xxxx00



Actual size



NEW

## Specifications (characteristics)

| Item                                  | Symbol                          | Specifications                       | Remarks                                                          |
|---------------------------------------|---------------------------------|--------------------------------------|------------------------------------------------------------------|
| Output frequency range                | $f_o$                           | 80.000 MHz to 170.000 MHz            | Please contact us for inquiries regarding available frequencies. |
| Supply voltage                        | V <sub>CC</sub>                 | 3.3 V $\pm 0.165$ V                  |                                                                  |
| Storage temperature range             | T <sub>stg</sub>                | -55 °C to +125 °C                    | Store as bare product after unpacking                            |
| Operating temperature range           | T <sub>use</sub>                | As per below table.                  |                                                                  |
| Frequency tolerance                   | f <sub>tol</sub>                | $\pm 50 \times 10^{-6}$ Max.         | Includes frequency aging (20 years)                              |
| Current consumption                   | I <sub>CC</sub>                 | 70 mA Max.                           | No load condition.                                               |
| Absolute pull range                   | APR                             | GCT: $\pm 50 \times 10^{-6}$ Min.    | V <sub>C</sub> = 1.65 V $\pm$ 1.5 V                              |
| Input resistance                      | R <sub>in</sub>                 | 100 k $\Omega$ Min.                  | DC level                                                         |
| Frequency change polarity             | —                               | Positive slope                       | V <sub>C</sub> = 0 to 3.3 V                                      |
| Symmetry                              | SYM                             | 40 % to 60 %                         | —                                                                |
| High output voltage                   | V <sub>OH</sub>                 | V <sub>CC</sub> -1.1 V Min.          | —                                                                |
| Low output voltage                    | V <sub>OL</sub>                 | V <sub>CC</sub> -1.5 V Max.          | —                                                                |
| Output load condition (ECL)           | L <sub>ECL</sub>                | LV-PECL                              |                                                                  |
| Output enable / disable input voltage | V <sub>IH</sub>                 | 70 % V <sub>CC</sub> Min.            | V <sub>IH</sub> or OPEN : Enable                                 |
|                                       | V <sub>IL</sub>                 | 30 % V <sub>CC</sub> Max.            | V <sub>IL</sub> or GND : Disable                                 |
| Rise time / Fall time                 | t <sub>r</sub> / t <sub>f</sub> | 1.5 ns Max.                          | 20 % V <sub>CC</sub> to 80 % V <sub>CC</sub> level               |
| Start-up time                         | t <sub>str</sub>                | 10 ms Max.                           | Time at minimum supply voltage to be 0 s                         |
| Frequency aging                       | f <sub>aging</sub>              | This is included frequency tolerance | +25 °C, V <sub>CC</sub> =3.3 V, 20 years                         |

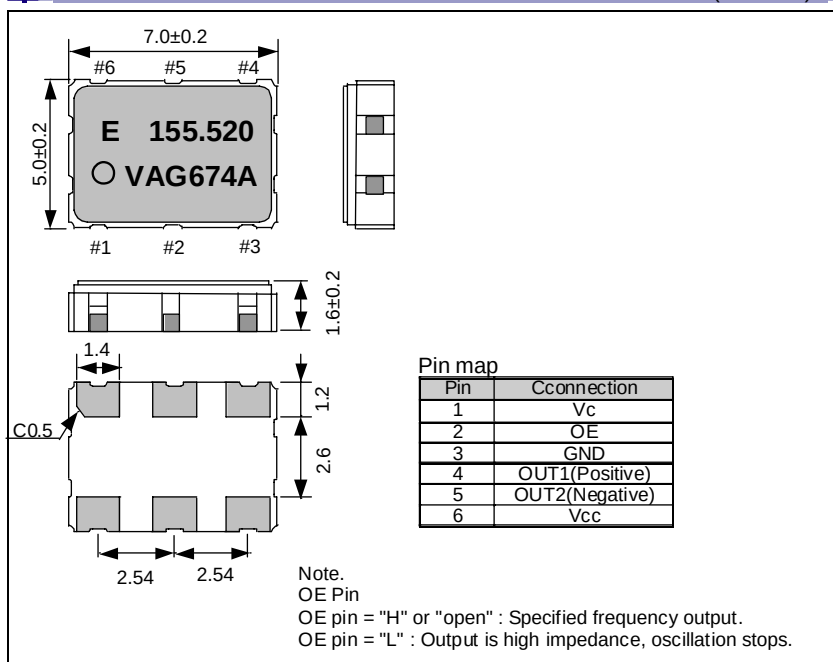
\* Please keep V<sub>C</sub> pin open or ground while powering up V<sub>CC</sub>.

## Operating temperature range

|      | Operating temperature range |
|------|-----------------------------|
| GGCT | -40 °C ~ +85 °C             |
| JGCT | -20 °C ~ +70 °C             |
| KGCT | 0 °C ~ +70 °C               |

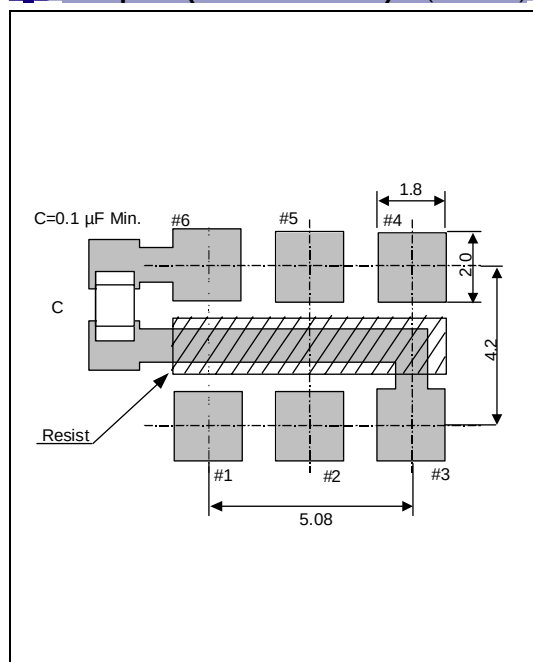
## External dimensions

(Unit : mm)



## Footprint (Recommended)

(Unit : mm)







## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## VG-1201CA

- Frequency range : 1 MHz to 60 MHz
- Supply voltage : 3.3 V(\*\*C) or 5.0 V(\*\*H)
- Function : Output enable(OE)
- Thickness : 1.4 mm Typ.



Product Number (please contact us)  
Q3603CA0xxxxx00



Actual size



## Specifications (characteristics)

| Item                                     |                       | Symbol                          | Specifications                 |                       | Remarks                                                       |
|------------------------------------------|-----------------------|---------------------------------|--------------------------------|-----------------------|---------------------------------------------------------------|
|                                          |                       |                                 | ANH / AKH / BNH / BKH          | ANC / AKC / BNC / BKC |                                                               |
| Output frequency range                   |                       | f <sub>0</sub>                  | 1.000 MHz to 60.000 MHz        |                       |                                                               |
| Supply voltage                           |                       | V <sub>cc</sub>                 | H:5.0 V ±0.5 V                 | C:3.3 V ±0.3 V        |                                                               |
| Temperature range                        | Storage temperature   | T <sub>stg</sub>                | -40 °C to +125 °C              |                       | Store as bare product after unpacking                         |
|                                          | Operating temperature | T <sub>use</sub>                | As per below table             |                       |                                                               |
| Frequency tolerance                      |                       | f <sub>tol</sub>                | As per below table             |                       |                                                               |
| Current consumption                      |                       | I <sub>cc</sub>                 | 30 mA Max.                     | 25 mA Max.            | No load condition                                             |
| Disable current                          |                       | I <sub>dis</sub>                | 15 mA Max.                     | 12 mA Max.            | OE=GND                                                        |
| Frequency control range                  |                       | f <sub>cont</sub>               | As per below table             |                       | V <sub>c</sub> =2.5 V ±2.0 V(**H) , 1.65 V ±1.50 V(**C)       |
| Modulation characteristics               |                       | BW                              | 20 kHz Min.                    |                       | ± 3 dB (at 1 kHz)                                             |
| Input resistance                         |                       | R <sub>in</sub>                 | 5 MΩ Min.                      |                       | DC level                                                      |
| Frequency change polarity                |                       | —                               | Positive polarity              |                       | V <sub>c</sub> =0.5 V to 4.5 V(**H), 0.15 V to 3.15 V(**C)    |
| Symmetry                                 |                       | SYM                             | 40 % to 60 %                   |                       | CMOS load:50 % V <sub>cc</sub> level                          |
| High output voltage                      |                       | V <sub>OH</sub>                 | V <sub>cc</sub> -0.4 V Min.    |                       | I <sub>OH</sub> = -4 mA                                       |
| Low output voltage                       |                       | V <sub>OL</sub>                 | 0.4 V Max.                     |                       | I <sub>OL</sub> = 4 mA                                        |
| Output load condition(CMOS)              |                       | L CMOS                          | 15 pF Max.                     |                       | CMOS load                                                     |
| Output enable /<br>disable input voltage | V <sub>IH</sub>       |                                 | 70 %V <sub>cc</sub> Min.       |                       | OE Terminal                                                   |
|                                          | V <sub>IL</sub>       |                                 | 30 % V <sub>cc</sub> Max.      |                       |                                                               |
| Rise time and Fall time                  |                       | t <sub>r</sub> / t <sub>f</sub> | 4 ns Max.                      |                       | CMOS load: 20 % V <sub>cc</sub> to 80 % V <sub>cc</sub> level |
| Start-up time                            |                       | t <sub>str</sub>                | 10 ms Max.                     |                       | Time at 90 % V <sub>cc</sub> to be 0 s                        |
| Frequency aging                          |                       | f <sub>aging</sub>              | ±10 × 10 <sup>-6</sup> Max. *1 |                       | +25 °C, 10 years                                              |

\*1 50 MHz <  $f_o$   $\leq$  60 MHz :  $\pm 15 \times 10^{-6}$  Max.

\* Please keep  $V_c$  pin open or ground while powering up  $V_{cc}$ .

## Frequency tolerance / Temperature range

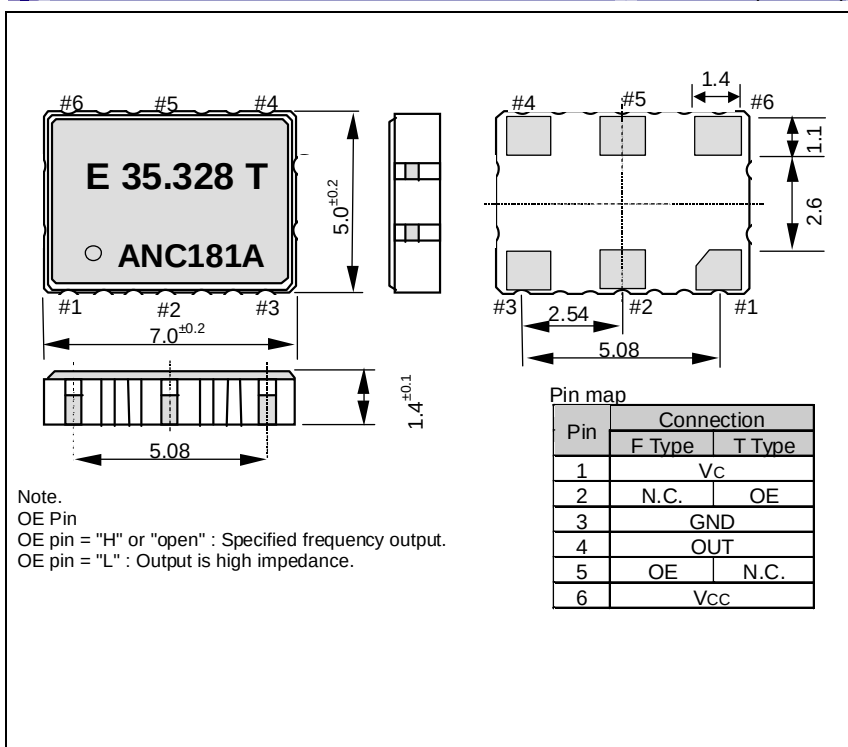
|   | Frequency tolerance     | Temperature range |
|---|-------------------------|-------------------|
| A | $\pm 20 \times 10^{-6}$ | -20 °C to +70 °C  |
| B | $\pm 25 \times 10^{-6}$ | -40 °C to +85 °C  |

## Frequency control range

|   | Frequency control range       | Output frequency range       |
|---|-------------------------------|------------------------------|
| K | $\pm 75 \times 10^{-6}$ Min.  | 41 MHz < $f_o \leq$ 60 MHz   |
| N | $\pm 100 \times 10^{-6}$ Min. | 1 MHz $\leq f_o \leq$ 41 MHz |

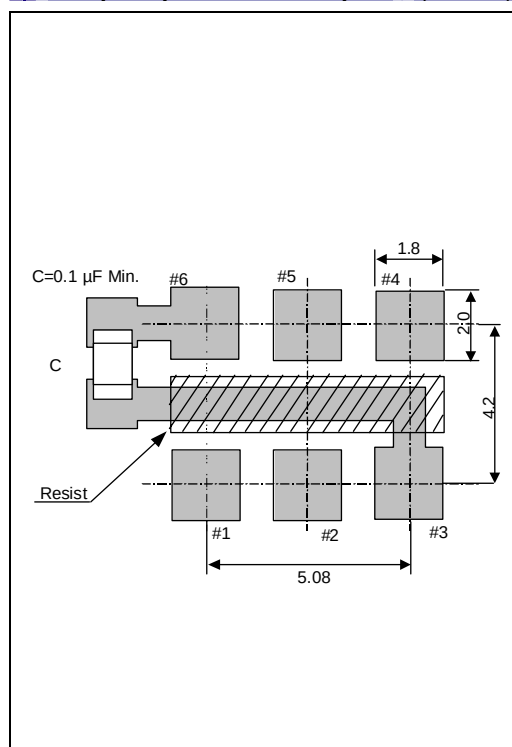
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





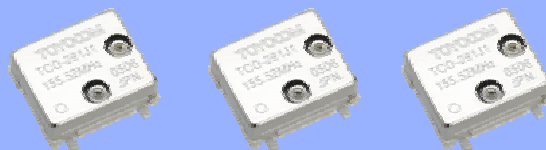
## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## TCO - 291J

- Frequency range : 60 MHz to 230 MHz
- Supply voltage : 3.3 V
- Frequency control range :  $\pm 100 \times 10^{-6}$
- Features : Wide frequency control range  
: With HFF-XTAL technology  
: Fundamental oscillation



Product Number (please contact us)  
X1G000881xxxx00



Actual size



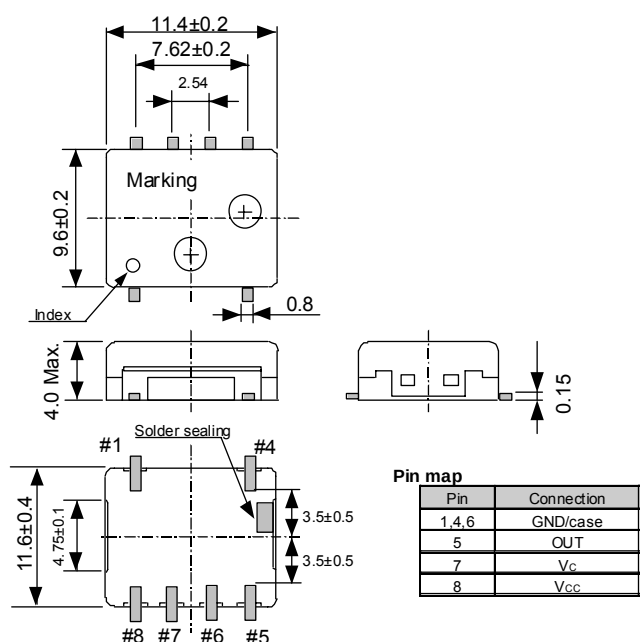
## Specifications (characteristics)

| Item                        | Symbol             | Specifications                     | Remarks                                   |
|-----------------------------|--------------------|------------------------------------|-------------------------------------------|
| Output frequency range      | $f_o$              | 60.000 MHz to 230.000 MHz          |                                           |
| Supply voltage              | V <sub>cc</sub>    | 3.3 V $\pm 0.165$ V                |                                           |
| Storage temperature range   | T <sub>stg</sub>   | -45 °C to +90 °C                   | Store as bare product after unpacking     |
| Operating temperature range | T <sub>use</sub>   | -40 °C to +85 °C                   |                                           |
| Frequency tolerance *1      | f <sub>tol</sub>   | $\pm 35 \times 10^{-6}$ Max.       | -40 °C to +85 °C                          |
| Current consumption         | I <sub>cc</sub>    | 30 mA Max.                         |                                           |
| Frequency control range     | f <sub>cont</sub>  | $\pm 100 \times 10^{-6}$ Min.      | V <sub>c</sub> = 1.65 V $\pm 1.65$ V      |
| Input resistance            | R <sub>in</sub>    | 100 k $\Omega$ Min.                | DC level                                  |
| Frequency change polarity   | —                  | Positive slope                     | V <sub>c</sub> = 0 V to 3.3 V             |
| Output load condition       | R <sub>L</sub>     | 50 $\Omega$ (0 dBm Min.)           |                                           |
| Start-up time               | t <sub>str</sub>   | 10 ms Max.                         | Time at minimum supply voltage to be 0 s. |
| Frequency aging             | f <sub>aging</sub> | $\pm 5 \times 10^{-6}$ / year Max. | +25 °C, First year                        |

\*1 This does not include initial frequency tolerance because frequency is adjustable.

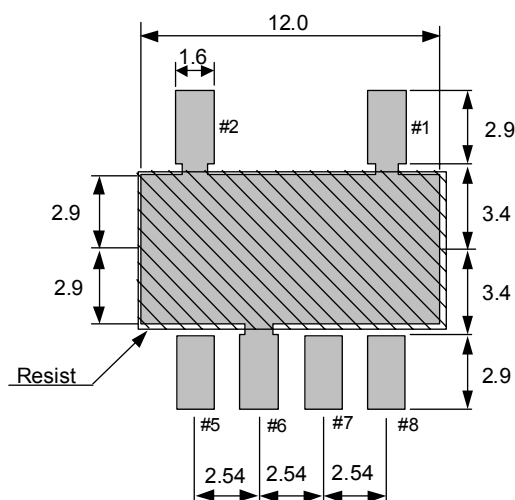
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





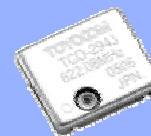
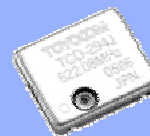
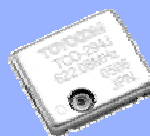
## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## TCO - 294J

- Frequency range : 60 MHz to 690 MHz
- Supply voltage : 3.3 V
- Frequency control range :  $\pm 100 \times 10^{-6}$
- Features :
  - Wide frequency control range
  - With HFF-XTAL technology
  - Fundamental oscillation (60 MHz to 230 MHz)
  - Multiplier oscillation ( $f_o \geq 230$  MHz)



Product Number (please contact us)  
X1G000901xxxx00



Actual size



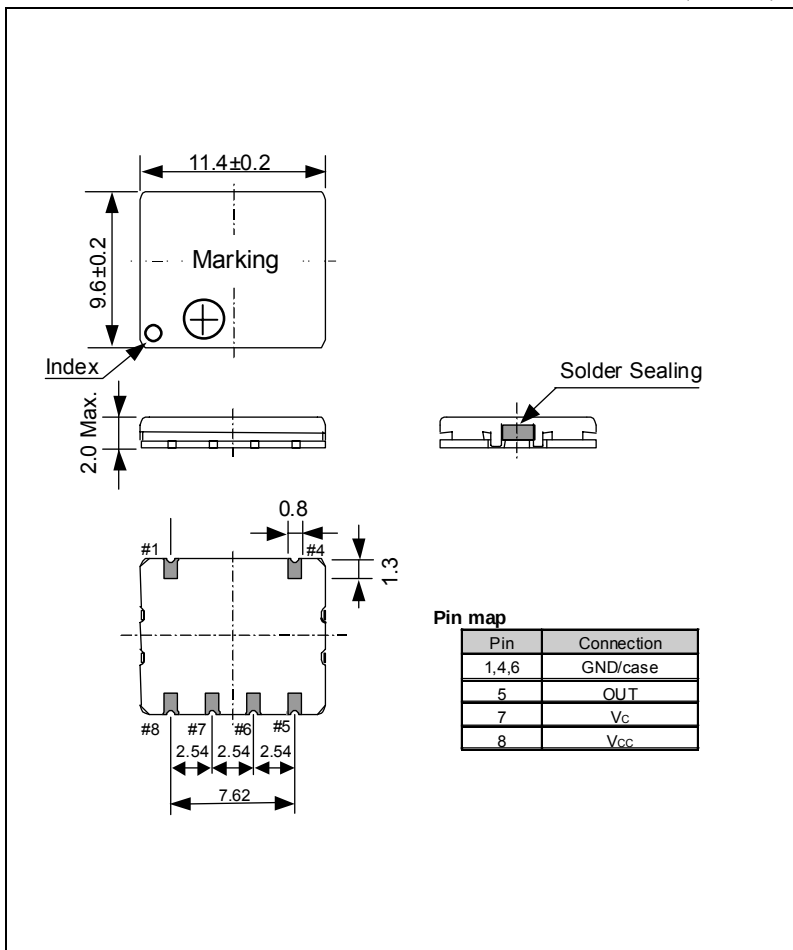
## Specifications (characteristics)

| Item                        | Symbol             | TCO-294J                           | Remarks                                   |
|-----------------------------|--------------------|------------------------------------|-------------------------------------------|
| Output frequency range      | $f_o$              | 60.000 MHz to 690.000 MHz          |                                           |
| Supply voltage              | V <sub>cc</sub>    | 3.3 V $\pm 0.165$ V                |                                           |
| Storage temperature range   | T <sub>stg</sub>   | -45 °C to +90 °C                   | Store as bare product after unpacking     |
| Operating temperature range | T <sub>use</sub>   | -40 °C to +85 °C                   |                                           |
| Frequency tolerance *1      | f <sub>tol</sub>   | $\pm 35 \times 10^{-6}$ Max.       | -40 °C to +85 °C                          |
| Current consumption         | I <sub>cc</sub>    | 40 mA Max.                         |                                           |
| Frequency control range     | f <sub>cont</sub>  | $\pm 100 \times 10^{-6}$ Min.      | V <sub>c</sub> = 1.65 V $\pm 1.65$ V      |
| Input resistance            | R <sub>in</sub>    | 100 k $\Omega$ Min.                | DC level                                  |
| Frequency change polarity   | —                  | Positive slope                     | V <sub>c</sub> = 0 V to 3.3 V             |
| Output load condition       | R <sub>L</sub>     | 50 $\Omega$ (0 dBm Min.)           |                                           |
| Start-up time               | t <sub>str</sub>   | 10 ms Max.                         | Time at minimum supply voltage to be 0 s. |
| Frequency aging             | f <sub>aging</sub> | $\pm 5 \times 10^{-6}$ / year Max. | +25 °C, First year                        |

\*1 This does not include initial frequency tolerance because frequency is adjustable.

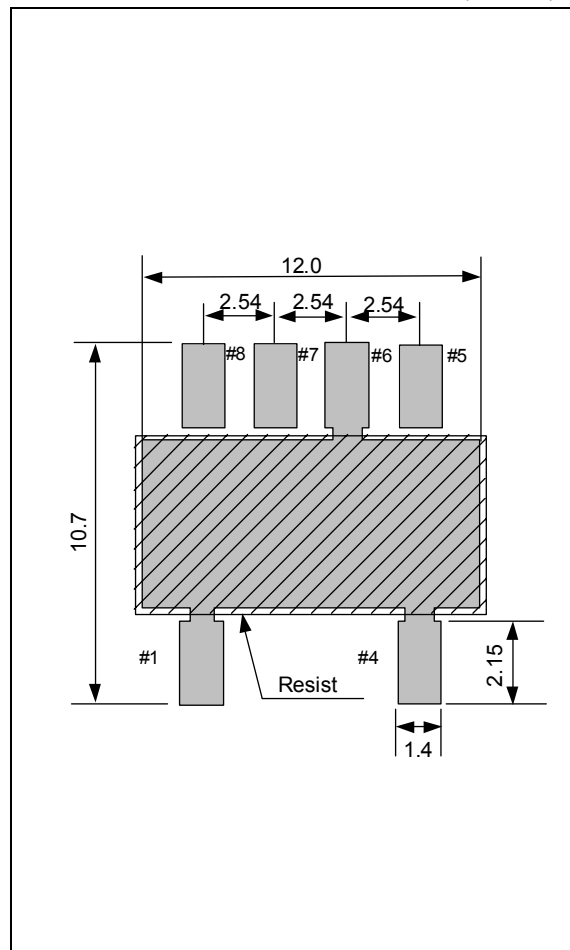
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





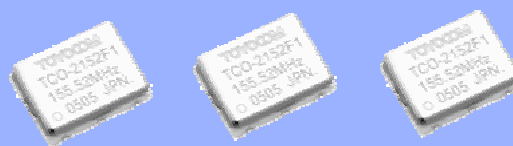
## VOLTAGE -CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## TCO - 2152

- Frequency range : 77 MHz to 230 MHz
- Supply voltage : 3.3 V
- Frequency control range :  $\pm 100 \times 10^{-6}$
- Features : Wide frequency control range
- : With HFF-XTAL technology
- : Fundamental oscillation
- Function : Output enable(OE)



Product Number (please contact us)  
X1G000531xxxx00



Actual size



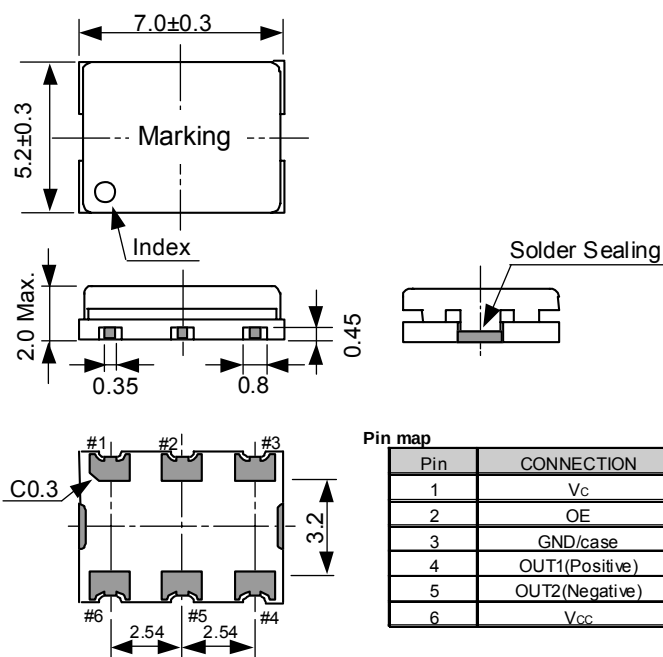
## Specifications (characteristics)

| Item                        | Symbol      | TCO-2152                           | Remarks                                   |
|-----------------------------|-------------|------------------------------------|-------------------------------------------|
| Output frequency range      | $f_o$       | 77.000 MHz to 230.000 MHz          |                                           |
| Supply voltage              | $V_{cc}$    | 3.3 V $\pm 0.165$ V                |                                           |
| Storage temperature range   | $T_{stg}$   | -45 °C to +90 °C                   | Store as bare product after unpacking     |
| Operating temperature range | $T_{use}$   | -40 °C to +85 °C                   |                                           |
| Frequency tolerance *1      | $f_{tol}$   | $\pm 35 \times 10^{-6}$ Max.       | -40 °C to +85 °C                          |
| Current consumption         | $I_{cc}$    | 70 mA Max.                         |                                           |
| Frequency control range     | $f_{cont}$  | $\pm 100 \times 10^{-6}$ Min.      | $V_c = 1.65 \text{ V} \pm 1.65 \text{ V}$ |
| Input resistance            | $R_{in}$    | 100 k $\Omega$ Min.                | DC level                                  |
| Frequency change polarity   | —           | Positive slope                     | $V_c = 0 \text{ V to } 3.3 \text{ V}$     |
| Output load condition       | —           | LV-PECL                            |                                           |
| Start-up time               | $t_{str}$   | 10 ms Max.                         | Time at minimum supply voltage to be 0 s. |
| Frequency aging             | $f_{aging}$ | $\pm 5 \times 10^{-6}$ / year Max. | +25 °C, First year                        |

\*1 This does not include initial frequency tolerance because frequency is adjustable.

## External dimensions

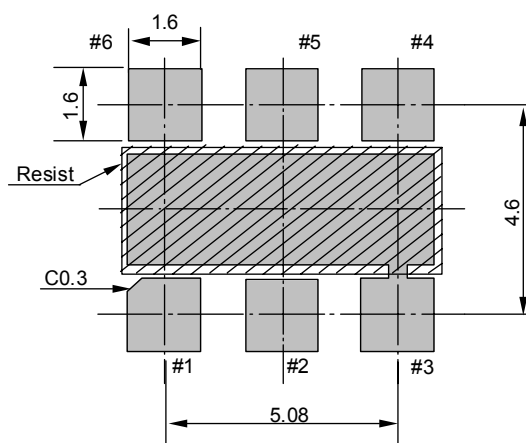
(Unit:mm)



Note.  
OE Pin  
OE pin = "L" or "open" : Specified frequency output.  
OE pin = "H" : Output is high impedance, oscillation stops.

## Footprint (Recommended)

(Unit:mm)





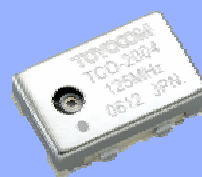
## VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO)

## TCO - 2000 / 2100 series

- Frequency range : 1 MHz to 800 MHz
- Supply voltage : 3.3 V or 5.0 V
- Frequency control range :  $\pm 100 \times 10^{-6}$  Min.
- Features : High reliability(20 years aging)  
: Wide frequency control range  
: Low phase noise, low jitter  
: With HFF-XTAL technology  
: Fundamental oscillation (60 MHz to 230 MHz)  
: Multiplier oscillation ( $f_o \geq 230$  MHz)



Product Number (please contact us)  
X1G00Xxxxxxxx00



Actual size

TCO-2000 Series

TCO-2100 Series



## Specifications (characteristics)

| Item                         | Symbol             | Specifications                                  |            |                                                     |            | Remarks                                                            |
|------------------------------|--------------------|-------------------------------------------------|------------|-----------------------------------------------------|------------|--------------------------------------------------------------------|
|                              |                    | TCO-2001                                        | TCO-2003   | TCO-2002                                            | TCO-2004   |                                                                    |
|                              |                    | TCO-2101                                        | TCO-2103   | TCO-2102                                            | TCO-2104   |                                                                    |
| Output frequency range       | f <sub>o</sub>     | 8.000 MHz to 78.000 MHz                         |            | 8.000 MHz to 125.000 MHz                            |            |                                                                    |
| Supply voltage               | V <sub>CC</sub>    | 5.0 V ±0.25 V                                   |            | 3.3 V ±0.165 V                                      |            |                                                                    |
| Storage temperature range    | T <sub>stg</sub>   | -45 °C to +90 °C                                |            |                                                     |            | Store as bare product after unpacking                              |
| Operating temperature range  | T <sub>use</sub>   | -40 °C to +85 °C                                |            |                                                     |            |                                                                    |
| Frequency tolerance          | f <sub>tol</sub>   | As per table 1                                  |            |                                                     |            | -40 °C to +85 °C                                                   |
| Current consumption          | I <sub>CC</sub>    | 50 mA Max.                                      |            |                                                     |            |                                                                    |
| Frequency control range      | f <sub>cont</sub>  | As per table 1.<br>(V <sub>C</sub> =2.5 V ±2 V) |            | As per table 1.<br>(V <sub>C</sub> =1.65 V ±1.65 V) |            |                                                                    |
| Absolute pull range          | APR                | As per table 1                                  |            |                                                     |            |                                                                    |
| Input resistance             | R <sub>in</sub>    | 100 kΩ Min.                                     |            |                                                     |            | DC level                                                           |
| Frequency change polarity    | —                  | Positive slope                                  |            |                                                     |            | V <sub>C</sub> = 0 V to 3.3 V<br>or V <sub>C</sub> =0.5 V to 4.5 V |
| Output load condition (TTL)  | L <sub>TTL</sub>   | 2 TTL Max.                                      | —          | 2 TTL Max.                                          |            |                                                                    |
| Output load condition (CMOS) | L <sub>CMOS</sub>  | —                                               | 15 pF Max. | —                                                   | 15 pF Max. |                                                                    |
| Start-up time                | t <sub>str</sub>   | 10 ms Max. *1                                   |            |                                                     |            |                                                                    |
| Frequency aging              | f <sub>aging</sub> | As per table 1                                  |            |                                                     |            | +25 °C                                                             |

## Specifications (characteristics)

| Item                         | Symbol             | Specifications          |            | Remarks                               |
|------------------------------|--------------------|-------------------------|------------|---------------------------------------|
|                              |                    | TCO-2106                | TCO-2107   |                                       |
| Output frequency range       | f <sub>o</sub>     | 1.000 MHz to 80.000 MHz |            |                                       |
| Supply voltage               | V <sub>cc</sub>    | 3.3 V ±0.165 V          |            |                                       |
| Storage temperature range    | T <sub>stg</sub>   | -45 °C to +90 °C        |            | Store as bare product after unpacking |
| Operating temperature range  | T <sub>use</sub>   | -40 °C to +85 °C        |            |                                       |
| Frequency tolerance          | f <sub>tol</sub>   | As per table 1          |            | -40 °C to +85 °C                      |
| Current consumption          | I <sub>cc</sub>    | 30 mA Max.              |            |                                       |
| Frequency control range      | f <sub>cont</sub>  | As per table 1          |            | V <sub>c</sub> = 1.65 V ±1.65 V       |
| Absolute pull range          | APR                | As per table 1          |            |                                       |
| Input resistance             | R <sub>in</sub>    | 100 kΩ Min.             |            | DC level                              |
| Frequency change polarity    | —                  | Positive slope          |            | V <sub>c</sub> = 0 V to 3.3 V         |
| Output load condition (TTL)  | L <sub>TTL</sub>   | 2 TTL Max.              | —          |                                       |
| Output load condition (CMOS) | L <sub>CMOS</sub>  | —                       | 15 pF Max. |                                       |
| Start-up time                | t <sub>str</sub>   | 10 ms Max. *1           |            |                                       |
| Frequency aging              | f <sub>aging</sub> | As per table 1          |            | +25 °C                                |

## Specifications (characteristics)

| Item                        | Symbol             | Specifications                                      |                                                 |                                                     | Remarks                                                            |
|-----------------------------|--------------------|-----------------------------------------------------|-------------------------------------------------|-----------------------------------------------------|--------------------------------------------------------------------|
|                             |                    | TCO-2111                                            | TCO-2112                                        | TCO-2114                                            |                                                                    |
| Output frequency range      | f <sub>o</sub>     | 60.000 MHz to 800.000 MHz                           |                                                 | 60.000 MHz to 230.000 MHz                           | 6 pin                                                              |
| Supply voltage              | V <sub>cc</sub>    | 3.3 V ±0.165 V                                      | 5.0 V ±0.25 V                                   | 3.3 V ±0.165 V                                      |                                                                    |
| Storage temperature range   | T <sub>stg</sub>   | -45 °C to +90 °C                                    |                                                 |                                                     | Store as bare product after unpacking                              |
| Operating temperature range | T <sub>use</sub>   | -40 °C to +85 °C                                    |                                                 |                                                     |                                                                    |
| Frequency tolerance         | f <sub>tol</sub>   | As per table 1                                      |                                                 |                                                     | -40 °C to +85 °C                                                   |
| Current consumption         | I <sub>cc</sub>    | 65 mA Max.                                          |                                                 | 40 mA Max.                                          |                                                                    |
| Frequency control range     | f <sub>cont</sub>  | As per table 1<br>(V <sub>c</sub> = 1.65 V ±1.65 V) | As per table 1<br>(V <sub>c</sub> = 2.5 V ±2 V) | As per table 1<br>(V <sub>c</sub> = 1.65 V ±1.65 V) |                                                                    |
| Absolute pull range         | APR                | As per table 1                                      |                                                 |                                                     |                                                                    |
| Input resistance            | R <sub>in</sub>    | 100 kΩ Min.                                         |                                                 |                                                     | DC level                                                           |
| Frequency change polarity   | —                  | Positive slope                                      |                                                 |                                                     | V <sub>c</sub> = 0 V to 3.3 V<br>or V <sub>c</sub> =0.5 V to 4.5 V |
| Output level                | —                  | LV-PECL                                             | PECL                                            | LVDS                                                |                                                                    |
| Start-up time               | t <sub>str</sub>   | 10 ms Max. *1                                       |                                                 |                                                     |                                                                    |
| Frequency aging             | f <sub>aging</sub> | As per table 1                                      |                                                 |                                                     | +25 °C                                                             |



## Specifications (characteristics)

| Item                        | Symbol             | Specifications            | Remarks                               |
|-----------------------------|--------------------|---------------------------|---------------------------------------|
|                             |                    | TCO-2131                  | 6pin, OE function                     |
| Output frequency range      | f <sub>o</sub>     | 60.000 MHz to 700.000 MHz |                                       |
| Supply voltage              | V <sub>cc</sub>    | 3.3 V ±0.165 V            |                                       |
| Storage temperature range   | T <sub>stg</sub>   | -45 °C to +90 °C          | Store as bare product after unpacking |
| Operating temperature range | T <sub>use</sub>   | -40 °C to +85 °C          |                                       |
| Frequency tolerance         | f <sub>tol</sub>   | As per table 1            | -40 °C to +85 °C                      |
| Current consumption         | I <sub>cc</sub>    | 75 mA Max.                |                                       |
| Frequency control range     | f <sub>cont</sub>  | As per table 1            | V <sub>c</sub> = 1.65 V ±1.65 V       |
| Absolute pull range         | APR                | As per table 1            |                                       |
| Input resistance            | R <sub>in</sub>    | 100 kΩ Min.               | DC level                              |
| Frequency change polarity   | —                  | Positive slope            | V <sub>c</sub> = 0 V to 3.3 V         |
| Output load condition       | —                  | LV-PECL                   |                                       |
| Start-up time               | t <sub>str</sub>   | 10 ms Max. *1.            |                                       |
| Frequency aging             | f <sub>aging</sub> | As per table 1            | +25 °C                                |

Table 1. Frequency tolerance, Absolute pull range and aging (TCO-2100-xx)

| xx | Frequency tolerance            | Absolute pull range *4       | (Frequency control range)    | Aging                  |
|----|--------------------------------|------------------------------|------------------------------|------------------------|
| AA | ±50 × 10 <sup>-6</sup> Max. *2 | ±50 × 10 <sup>-6</sup> Min.  | ±100 × 10 <sup>-6</sup> Min. | 1 year<br>(First year) |
| AB |                                | ±100 × 10 <sup>-6</sup> Min. | ±150 × 10 <sup>-6</sup> Min. |                        |
| BA | ±60 × 10 <sup>-6</sup> Max. *3 | ±50 × 10 <sup>-6</sup> Min.  | ±110 × 10 <sup>-6</sup> Min. | 20 years               |
| BB |                                | ±100 × 10 <sup>-6</sup> Min. | ±160 × 10 <sup>-6</sup> Min. |                        |

\*1 Time at minimum supply voltage to be 0 s.

\*2 This includes initial frequency tolerance, temperature variation, supply voltage variation and aging (+25°C, 1 year).

\*3 This includes initial frequency tolerance, temperature variation, supply voltage variation and aging (+25°C, 20 years).

\*4 Absolute pull range = Frequency control range - Frequency tolerance

## External dimensions

(Unit:mm)

| ● TCO-2000 series | ● TCO-2101/2102/2103/2104 | ● TCO-2106/2107/2111/2112/2113/2114/2131 |
|-------------------|---------------------------|------------------------------------------|
| <br><br>          | <br><br>                  | <br><br>                                 |

## External dimensions

(Unit:mm)

| ● TCO-2000 series | ● TCO-2100 series |
|-------------------|-------------------|
|                   |                   |

## OE terminal

## ● TCO-2106 / 2107

OE pin = "H" or "open" : Specified frequency output.  
 OE pin = "L" : Output is high impedance, oscillation stops.

## ● TCO-2131

OE pin = "L" or "open" : Specified frequency output.  
 OE pin = "H" : Output is high impedance, oscillation stops.



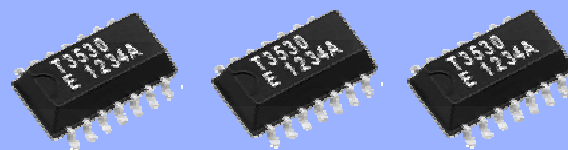
**TCXO**  
**32.768 kHz**

## TG - 3530 SA

- Built-in 32.768 kHz crystal oscillator with high accuracy.  
(adjustment-free efficient operation)
- Temperature compensated circuit : Stabilized frequency tolerance at any operating temperature.
- Oscillation output voltage : 1.5 V to 5.5 V
- Temperature Compensated Voltage : 2.2 V to 5.5 V
- 32.768 kHz output : C-MOS output, output load : 15 pF



Product Number (Please contact us)  
**Q3721SA01xxxx00**



Actual size



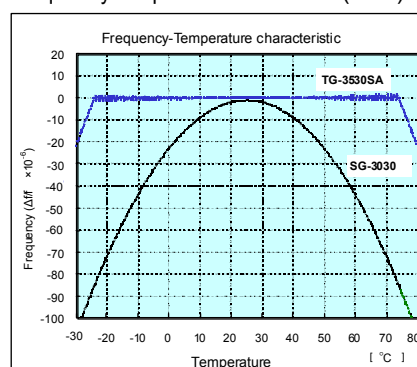
### Specifications (characteristics)

| Item                                 | Symbol             | Specifications                                                              | Condition                                                       |
|--------------------------------------|--------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------|
| Output frequency                     | $f_o$              | 32.768 kHz                                                                  |                                                                 |
| Oscillation output voltage           | V <sub>CC</sub>    | 1.5 V to 5.5 V                                                              |                                                                 |
| Temperature compensated voltage      | V <sub>CC</sub>    | 2.2 V to 5.5 V                                                              |                                                                 |
| Storage temperature                  | T <sub>stg</sub>   | -55 °C to +125 °C                                                           | Store as bare product after unpacking                           |
| Operating temperature                | T <sub>use</sub>   | -40 °C to +85 °C                                                            |                                                                 |
| Frequency temperature characteristic | fo-Tc              | $\pm 3.8 \times 10^{-6}$<br>* Equivalent to 10 seconds of monthly deviation | -10 °C to +60 °C<br>V <sub>CC</sub> = 3.0 V                     |
|                                      |                    | $\pm 5.0 \times 10^{-6}$<br>* Equivalent to 13 seconds of monthly deviation | -20 °C to +70 °C<br>V <sub>CC</sub> = 3.0 V                     |
| Frequency voltage coefficient        | fo-V <sub>CC</sub> | $\pm 1.0 \times 10^{-6}$ / V Max.                                           | +25 °C<br>V <sub>CC</sub> = 2.2 V to 5.5 V                      |
| Current consumption                  | I <sub>CC</sub>    | 6.0 $\mu$ A (Max.)<br>3.0 $\mu$ A (Typ.)                                    | V <sub>CC</sub> = 5.0 V, No load condition                      |
|                                      |                    | 4.0 $\mu$ A (Max.)<br>1.7 $\mu$ A (Typ.)                                    | V <sub>CC</sub> = 3.0 V, No load condition                      |
| Output voltage ("H" level)           | V <sub>OH</sub>    | V <sub>CC</sub> - 0.4 V Min.                                                | I <sub>OH</sub> = -0.1 mA<br>V <sub>CC</sub> = 3.0 V            |
| Output voltage ("L" level)           | V <sub>OL</sub>    | 0.4 V Max.                                                                  | I <sub>OL</sub> = 0.1 mA<br>V <sub>CC</sub> = 3.0 V             |
| Output load condition                | L <sub>CMOS</sub>  | 15 pF Max.                                                                  | CMOS load                                                       |
| Symmetry                             | SYM                | 40 % to 60 %                                                                | V <sub>CC</sub> = 1.5 V to 5.5 V<br>1 / 2 V <sub>CC</sub> level |
| Rise time                            | t <sub>r</sub>     | 200 ns Max.                                                                 | CMOS load<br>20 % V <sub>CC</sub> → 80 % V <sub>CC</sub>        |
| Fall time                            | t <sub>f</sub>     | 200 ns Max.                                                                 | CMOS load<br>80 % V <sub>CC</sub> → 20 % V <sub>CC</sub>        |
| Start-up time                        | t <sub>str</sub>   | 1.0 s Max. *1)                                                              | +25 °C<br>V <sub>CC</sub> = 3.0 V                               |
|                                      |                    | 3.0 s Max. *1)                                                              | -40 °C to +85 °C<br>V <sub>CC</sub> = 3.0 V                     |
| Frequency aging                      | f <sub>age</sub>   | $\pm 3.0 \times 10^{-6}$ / year                                             | +25 °C<br>V <sub>CC</sub> = 3.0 V, first year                   |

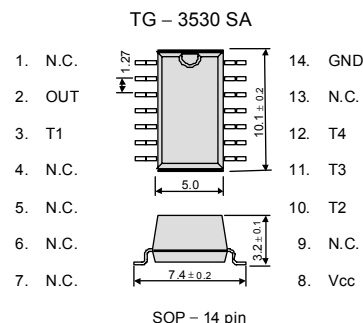
\*1) V<sub>CC</sub> rise time < 10ms (10 % V<sub>CC</sub> - 90 % V<sub>CC</sub>)

\*2) If not specifically indicated, -40 °C to +85 °C.

### Frequency temperature coefficient ( Ex. )



### Terminal connection



| Signal Name    | Input / Output | Function                                                            |
|----------------|----------------|---------------------------------------------------------------------|
| VCC            | —              | Connected to a positive power supply.                               |
| OUT            | OUTPUT         | 32.768 kHz clock output pin (C-MOS).                                |
| GND            | —              | Connected to a ground.                                              |
| T1, T2, T3, T4 | —              | * Used by the manufacture for testing. (Do not connect externally.) |

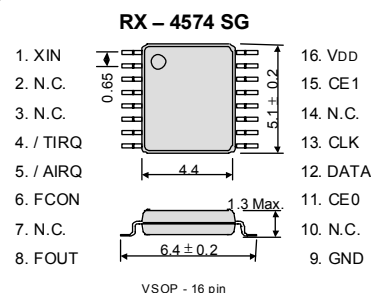
### REAL TIME CLOCK IC. For TG-3530SA

## RX - 4574 SG

- By combining TG-3530SA with RX-4574SG (real-time clock IC), it is possible to achieve a very high accuracy clock system.
- Functions are compatible with RX-4574 LC and RTC-4574 series (except 32 kHz oscillation function).
- Complies with EU RoHS directive

Note) RX-4574SG does not include the crystal unit.  
The external clock resources (CMOS) of 32.768 kHz are necessary.  
Please input it from the XIN terminal.

### Pin map







# TCXO

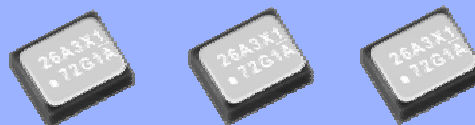
## ULTRA MINIATURE SIZE LOW PROFILE

# TG - 5021BA

- Frequency range : 13 MHz to 52 MHz
- Supply voltage : 2.8 V Typ.
- External dimensions : 2.1 × 1.7 × 0.75 t mm Typ.
- Applications : Cellular phone(GSM,CDMA,WCDMA)
- Features : World's smallest size,Low Noise



Product Number (Please contact us)  
X1G003571xxxx00



Actual size



**NEW**

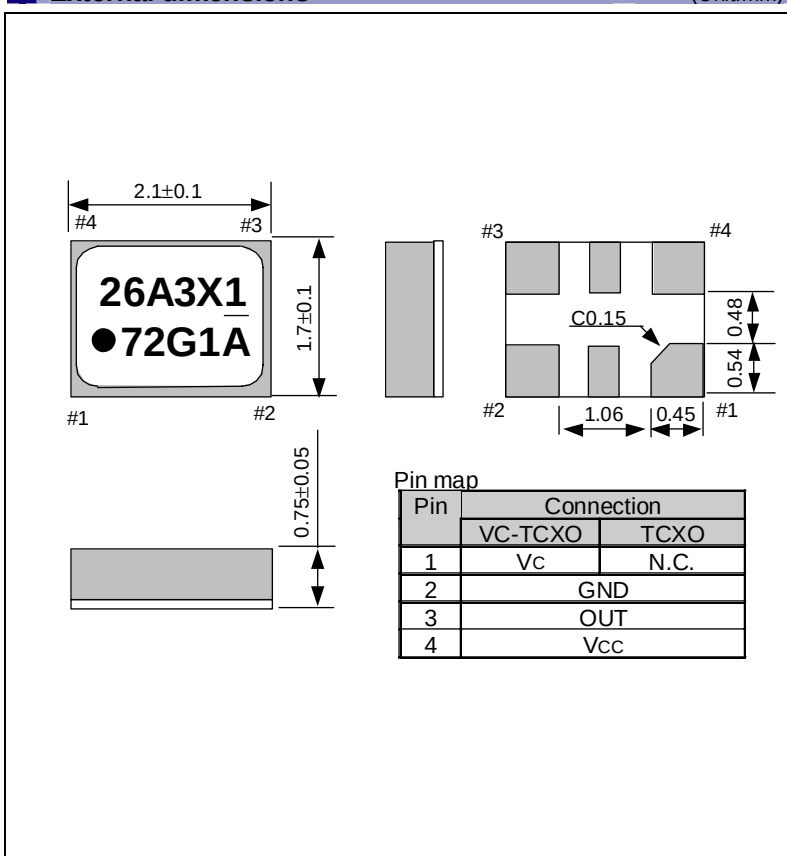
## Specifications (characteristics)

| Item                                    |                       | Symbol             | Specifications                                     |      | Remarks                                        |
|-----------------------------------------|-----------------------|--------------------|----------------------------------------------------|------|------------------------------------------------|
|                                         |                       |                    | VC-TCXO                                            | TCXO |                                                |
| Output frequency range                  |                       | f <sub>0</sub>     | 13.000 MHz to 52.000 MHz                           |      | Standard frequency                             |
|                                         |                       |                    | 13 MHz, 19.2 MHz, 26 MHz, 27.456 MHz,38.4 MHz      |      |                                                |
| Supply voltage                          |                       | V <sub>cc</sub>    | 2.8 V±0.14 V                                       |      | 2.3 V to 3.6 V                                 |
| Temperature range                       | Storage temperature   | T <sub>stg</sub>   | -40 °C to +85 °C                                   |      | Store as bare product after unpacking          |
|                                         | Operating temperature | T <sub>use</sub>   | -30 °C to +85 °C                                   |      |                                                |
| Frequency tolerance                     |                       | f <sub>tol</sub>   | ±2.0 ×10 <sup>-6</sup> Max.                        |      | After reflow,<br>V <sub>C</sub> =1.4 V, +25 °C |
| Frequency / temperature characteristics |                       | fo-Tc              | ±2.0 × 10 <sup>-6</sup> Max.                       |      | -30 °C to +85 °C                               |
| Frequency / load coefficient            |                       | fo-Load            | ±0.2 × 10 <sup>-6</sup> Max.                       |      | 10 kΩ // 10 pF ±10 %                           |
| Frequency / voltage coefficient         |                       | fo-V <sub>cc</sub> | ±0.2 ×10 <sup>-6</sup> Max.                        |      | 2.8 V ± 0.14 V                                 |
| Frequency aging                         |                       | f <sub>age</sub>   | ±1.0 ×10 <sup>-6</sup> Max.                        |      | +25 °C, First year                             |
| Current consumption                     |                       | I <sub>cc</sub>    | 2.0 mA Max.                                        |      | 13 MHz to 40 MHz                               |
|                                         |                       |                    | 2.5 mA Max.                                        |      | 40 MHz to 52 MHz                               |
| Input resistance                        |                       | R <sub>in</sub>    | 500 kΩ Min.                                        | —    | V <sub>C</sub> -GND(DC)                        |
| Frequency control range                 |                       | f <sub>cont</sub>  | ±5.0 × 10 <sup>-6</sup> to ±12.0 ×10 <sup>-6</sup> | —    | V <sub>C</sub> =1.4 V ±1.0 V                   |
| Frequency change polarity               |                       | —                  | Positive polarity                                  | —    |                                                |
| Symmetry                                |                       | SYM                | 40 % to 60 %                                       |      | GND level (DC cut)                             |
| Output voltage                          |                       | V <sub>PP</sub>    | 0.8 V Min.                                         |      | Peak to peak                                   |
| Load resistance                         |                       | Load <sub>R</sub>  | 10 kΩ                                              |      | DC cut capacitor = 0.01 μF                     |
| Load capacitance                        |                       | Load <sub>C</sub>  | 10 pF                                              |      |                                                |

Note: Please contact us for inquiries about specifications other than the above.

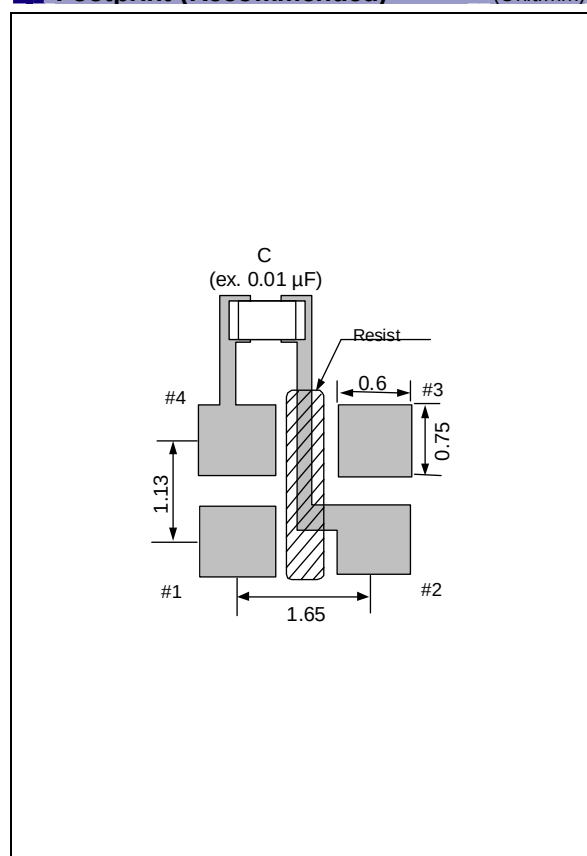
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





# TCXO

## MINIATURE SIZE LOW PROFILE

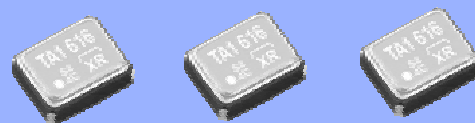
## HIGH STABILITY

# TG - 5005CG

- Frequency range : 13 MHz to 40 MHz
- Supply voltage : 2.8 V Typ.
- Frequency / temperature characteristics :  $\pm 0.5 \times 10^{-6}$  Max.
- External dimensions :  $2.5 \times 2.0 \times 0.9$  mm Typ.
- Applications : Cellular phone (GPS)
- Features : High frequency stability
- : Low current consumption



Product Number (Please contact us)  
X1G001571xxxx00



Actual size



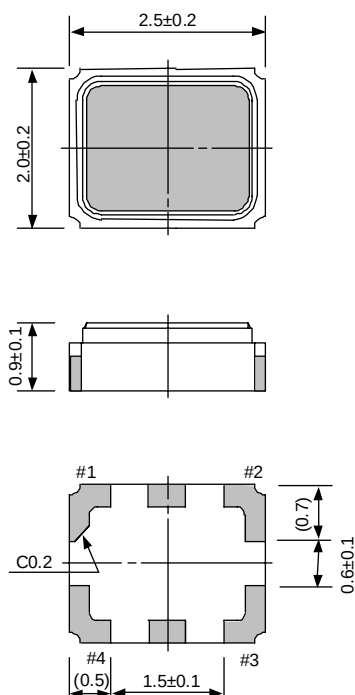
### Specifications (characteristics)

| Item                                    |                       | Symbol                          | Specifications                                             |      | Remarks                                     |
|-----------------------------------------|-----------------------|---------------------------------|------------------------------------------------------------|------|---------------------------------------------|
|                                         |                       |                                 | VC-TCXO                                                    | TCXO |                                             |
| Output frequency                        |                       | f <sub>0</sub>                  | 13.000 MHz to 40.000 MHz                                   |      | Standard frequency                          |
|                                         |                       |                                 | 13 MHz, 16.368 MHz, 19.2 MHz, 26 MHz, 27.456 MHz, 38.4 MHz |      |                                             |
| Supply voltage                          |                       | V <sub>cc</sub>                 | 2.8 V±0.14 V                                               |      | 2.3 V to 3.6 V                              |
| Temperature range                       | Storage temperature   | T <sub>stg</sub>                | -40 °C to +85 °C                                           |      | Store as bare product after unpacking       |
|                                         | Operating temperature | T <sub>use</sub>                | -30 °C to +85 °C                                           |      |                                             |
| Frequency tolerance                     |                       | f <sub>tol</sub>                | ±2.0 ×10 <sup>-6</sup> Max.                                |      | After reflow, V <sub>C</sub> =1.4 V, +25 °C |
| Frequency / temperature characteristics |                       | f <sub>0</sub> -T <sub>C</sub>  | ±0.5 × 10 <sup>-6</sup> Max.                               |      | -30 °C to +85 °C                            |
| Frequency / load coefficient            |                       | f <sub>0</sub> -Load            | ±0.2 × 10 <sup>-6</sup> Max.                               |      | 10 kΩ // 10 pF ±10 %                        |
| Frequency / voltage coefficient         |                       | f <sub>0</sub> -V <sub>cc</sub> | ±0.2 × 10 <sup>-6</sup> Max.                               |      | 2.8 V ± 0.14 V                              |
| Frequency aging                         |                       | f <sub>age</sub>                | ±1.0 × 10 <sup>-6</sup> Max.                               |      | +25 °C, First year                          |
| Current consumption                     |                       | I <sub>cc</sub>                 | 2.0 mA Max.                                                |      | V <sub>cc</sub> =2.8 V, 10 kΩ // 10 pF      |
| Input resistance                        |                       | R <sub>in</sub>                 | 500 kΩ Min.                                                | —    | V <sub>C</sub> - GND (DC)                   |
| Frequency control range                 |                       | f <sub>cont</sub>               | ±5.0 × 10 <sup>-6</sup> to ±12.0 × 10 <sup>-6</sup>        | —    | V <sub>C</sub> =1.4 V ±1.0 V                |
| Frequency change polarity               |                       | —                               | Positive polarity                                          | —    |                                             |
| Symmetry                                |                       | SYM                             | 40 % to 60 %                                               |      | GND level (DC cut)                          |
| Output voltage                          |                       | V <sub>PP</sub>                 | 0.8 V Min.                                                 |      | Peak to peak                                |
| Load resistance                         |                       | Load <sub>_R</sub>              | 10 kΩ                                                      |      | DC cut capacitor = 0.01 μF                  |
| Load capacitance                        |                       | Load <sub>_C</sub>              | 10 pF                                                      |      |                                             |

Note: Please contact us for inquiries about specifications other than the above.

### External dimensions

(Unit:mm)

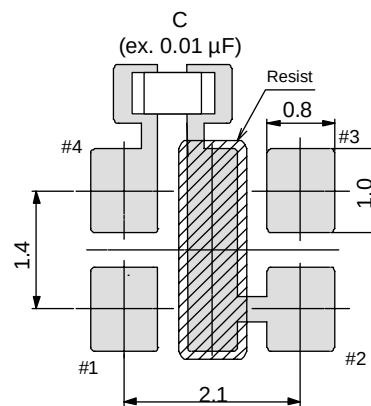


Pin map

| Pin | Connection      |
|-----|-----------------|
| 1   | VC-TCXO         |
| 2   | V <sub>C</sub>  |
| 3   | GND             |
| 4   | OUT             |
|     | V <sub>CC</sub> |

### Footprint (Recommended)

(Unit:mm)





# TCXO

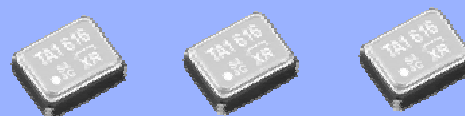
## ULTRA MINIATURE SIZE LOW PROFILE

# TG - 5010CG

- Frequency range : 13 MHz to 40 MHz
- Supply voltage : 2.8 V Typ.
- Frequency / temperature characteristics :  $\pm 2 \times 10^{-6}$  Max.
- External dimensions :  $2.5 \times 2.0 \times 0.9$  mm Typ.
- Applications : Cellular phone (CDMA, WCDMA, GSM)
- Features : Low current consumption



Product Number (Please contact us)  
X1G002771xxxx00



Actual size



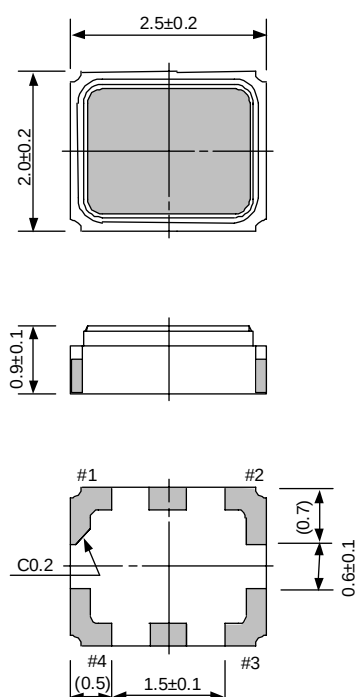
## Specifications (characteristics)

| Item                                  | Symbol                          | Specifications                                                    |      | Remarks                                         |
|---------------------------------------|---------------------------------|-------------------------------------------------------------------|------|-------------------------------------------------|
|                                       |                                 | VC-TCXO                                                           | TCXO |                                                 |
| Output frequency range                | f <sub>o</sub>                  | 13 MHz to 40 MHz<br>13 MHz, 19.2 MHz, 26 MHz,27.456 MHz, 38.4 MHz |      | Standard frequency                              |
| Supply voltage                        | V <sub>cc</sub>                 | 2.8 V ±0.14 V                                                     |      | Supply voltage range : 2.3 V to 3.6 V           |
| Storage temperature range             | T <sub>stg</sub>                | -40 °C to +85 °C                                                  |      | Store as bare product after unpacking           |
| Operating temperature range           | T <sub>use</sub>                | -30 °C to +85 °C                                                  |      |                                                 |
| Frequency tolerance                   | f <sub>tol</sub>                | ±2.0 × 10 <sup>-6</sup> Max.                                      |      | After reflow<br>(V <sub>c</sub> =1.4 V, +25 °C) |
| Frequency/temperature characteristics | f <sub>o</sub> -T <sub>c</sub>  | ±2.0 × 10 <sup>-6</sup> Max.                                      |      | -30 °C to +85 °C                                |
| Frequency/load coefficient            | f <sub>o</sub> -Load            | ±0.2 × 10 <sup>-6</sup> Max.                                      |      | 10 kΩ // 10 pF ±10 %                            |
| Frequency/voltage coefficient         | f <sub>o</sub> -V <sub>cc</sub> | ±0.2 × 10 <sup>-6</sup> Max.                                      |      | V <sub>cc</sub> =2.8 V ±0.14 V                  |
| Frequency aging                       | f <sub>age</sub>                | ±1.0 ×10 <sup>-6</sup> Max.                                       |      | +25 °C, First year                              |
| Current consumption                   | I <sub>cc</sub>                 | 2.0 mA Max.                                                       |      |                                                 |
| Input resistance                      | R <sub>in</sub>                 | 500 kΩ Min.                                                       | —    |                                                 |
| Frequency control range               | f <sub>cont</sub>               | ±5.0 × 10 <sup>-6</sup> to ±12.0 × 10 <sup>-6</sup>               | —    | V <sub>c</sub> =1.4 V ±1.0 V                    |
| Frequency change polarity             | —                               | Positive polarity                                                 | —    |                                                 |
| Symmetry                              | SYM                             | 40 % to 60 %                                                      |      | GND level (DC cut)                              |
| Output voltage                        | V <sub>pp</sub>                 | 0.8 V Min.                                                        |      | Peak to peak                                    |
| Output load condition                 | Load <sub>R</sub>               | 10 kΩ                                                             |      | DC cut capacitor = 0.01 μF                      |
|                                       | Load <sub>C</sub>               | 10 pF                                                             |      |                                                 |

\* Note : Please contact us for inquiries about specifications other than the above.

## External dimensions

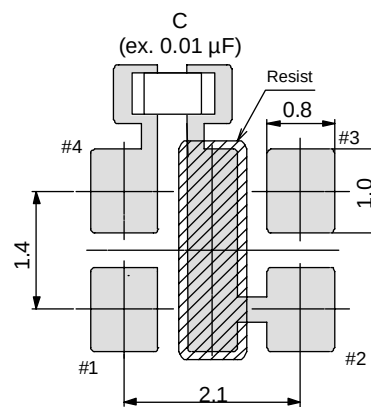
(Unit:mm)



| Pin | Connection |      |
|-----|------------|------|
|     | VC-TCXO    | TCXO |
| 1   | $V_c$      | N.C. |
| 2   | GND        |      |
| 3   | OUT        |      |
| 4   | $V_{cc}$   |      |

## Footprint (Recommended)

(Unit:mm)





# TCXO

## MINIATURE SIZE LOW PROFILE

## HIGH STABILITY

# TG - 5005CE

- Frequency range : 10 MHz to 40 MHz
- Supply voltage : 2.8 V Typ.
- Frequency / temperature characteristics :  $\pm 0.5 \times 10^{-6}$  Max.
- External dimensions :  $3.2 \times 2.5 \times 0.9$  mm Typ.
- Applications : Cellular phone(GPS)
- Features : High frequency stability  
Low current consumption



Product Number (Please contact us)  
X1G001521xxxx00



Actual size



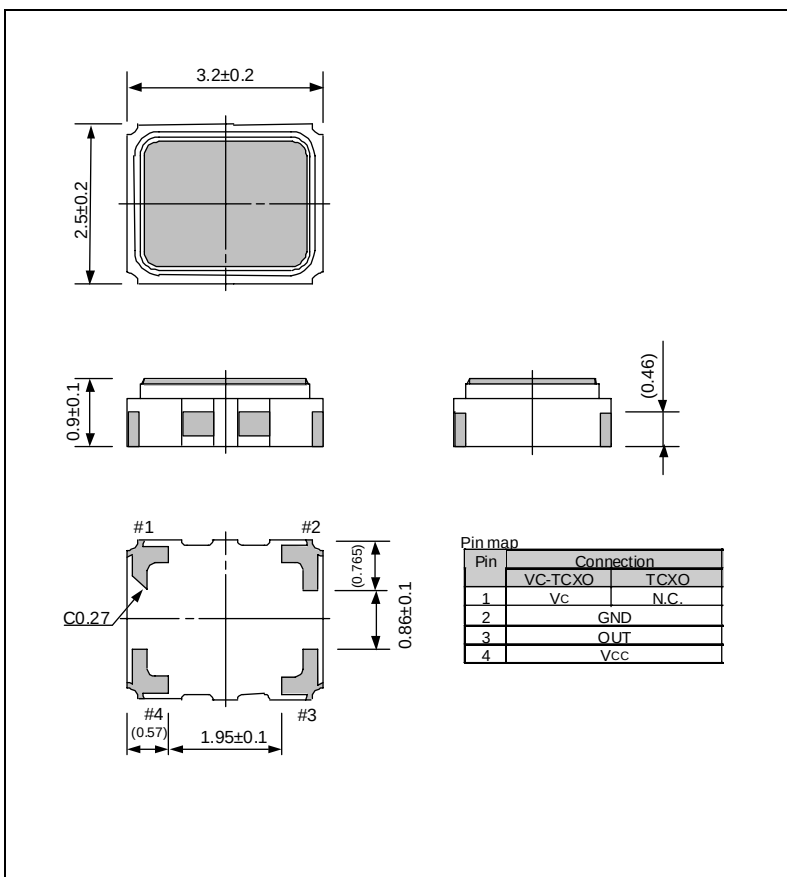
### Specifications (characteristics)

| Item                                    |                       | Symbol                          | Specifications                                     |      | Remarks                                     |
|-----------------------------------------|-----------------------|---------------------------------|----------------------------------------------------|------|---------------------------------------------|
|                                         |                       |                                 | VC-TCXO                                            | TCXO |                                             |
| Output frequency range                  |                       | f <sub>o</sub>                  | 10.000 MHz to 40.000 MHz                           |      | Standard frequency                          |
|                                         |                       |                                 | 16.369 MHz, 24.5535 MHz, 26 MHz, 27.456 MHz        |      |                                             |
| Supply voltage                          |                       | V <sub>cc</sub>                 | 2.8 V±0.14 V                                       |      | Supply voltage range : 2.3 V to 3.6 V       |
| Temperature range                       | Storage temperature   | T <sub>stg</sub>                | -40 °C to +85 °C                                   |      | Store as bare product after unpacking       |
|                                         | Operating temperature | T <sub>use</sub>                | -30 °C to +85 °C                                   |      |                                             |
| Frequency tolerance                     |                       | f <sub>tol</sub>                | ±2.0 ×10 <sup>-6</sup> Max.                        |      | After reflow, V <sub>c</sub> =1.4 V, +25 °C |
| Frequency / temperature characteristics |                       | f <sub>o</sub> -T <sub>c</sub>  | ±0.5 × 10 <sup>-6</sup> Max.                       |      | -30 °C to +85 °C                            |
| Frequency / load coefficient            |                       | f <sub>o</sub> -Load            | ±0.2 × 10 <sup>-6</sup> Max.                       |      | 10 kΩ // 10 pF ±10 %                        |
| Frequency / voltage coefficient         |                       | f <sub>o</sub> -V <sub>cc</sub> | ±0.2 ×10 <sup>-6</sup> Max.                        |      | 2.8 V ± 0.14 V                              |
| Frequency aging                         |                       | f <sub>age</sub>                | ±1.0 ×10 <sup>-6</sup> Max.                        |      | +25 °C, First year                          |
| Current consumption                     |                       | I <sub>cc</sub>                 | 2.0 mA Max.                                        |      | V <sub>cc</sub> =2.8 V, 10 kΩ// 10 pF       |
| Input resistance                        |                       | R <sub>in</sub>                 | 500 kΩ Min.                                        | —    | V <sub>c</sub> - GND (DC)                   |
| Frequency control range                 |                       | f <sub>cont</sub>               | ±5.0 × 10 <sup>-6</sup> to ±12.0 ×10 <sup>-6</sup> | —    | V <sub>c</sub> =1.4 V ±1.0 V                |
| Frequency change polarity               |                       | —                               | Positive polarity                                  | —    |                                             |
| Symmetry                                |                       | SYM                             | 40 % to 60 %                                       |      | GND level (DC cut)                          |
| Output voltage                          |                       | V <sub>PP</sub>                 | 0.8 V Min.                                         |      | Peak to peak                                |
| Load resistance                         |                       | Load_R                          | 10 kΩ                                              |      | DC cut capacitor = 0.01 μF                  |
| Load capacitance                        |                       | Load_C                          | 10 pF                                              |      |                                             |

Note: Please contact us for inquiries about specifications other than the above.

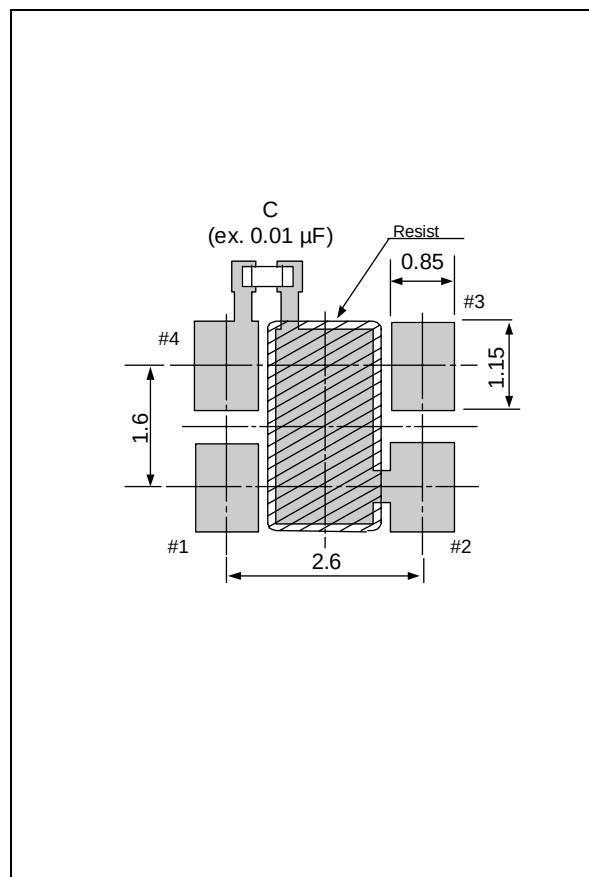
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)





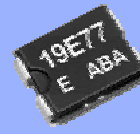
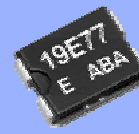
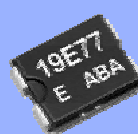
# TCXO MINIATURE SIZE LOW PROFILE

## TG - 5010LH

- Frequency range : 10 MHz to 40 MHz
- Supply voltage : 2.8 V Typ.
- Frequency / temperature characteristics :  $\pm 2 \times 10^{-6}$  Max.
- External dimensions :  $3.3 \times 2.5 \times 0.96$  mm Typ.
- Applications : Cellular phone(GSM,CDMA,WCDMA)
- Features : Miniature size (J-Lead type)  
: Low current consumption



Product Number (Please contact us)  
Q3716LH01xxxx00



Actual size



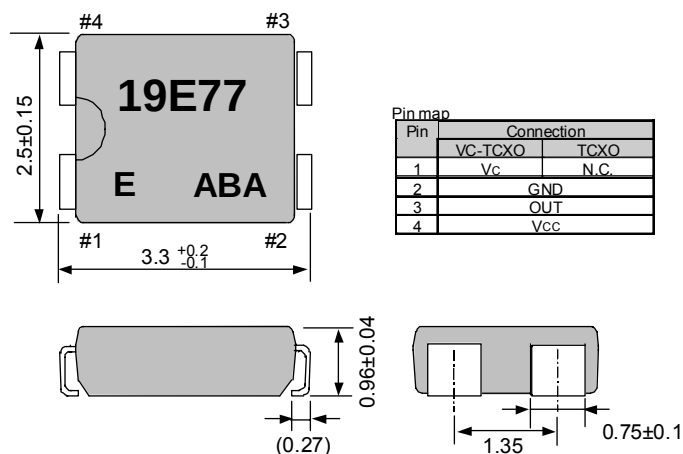
### Specifications (characteristics)

| Item                                    |                       | Symbol                          | Specifications                                     |      | Remarks                                        |
|-----------------------------------------|-----------------------|---------------------------------|----------------------------------------------------|------|------------------------------------------------|
|                                         |                       |                                 | VC-TCXO                                            | TCXO |                                                |
| Output frequency                        |                       | f <sub>0</sub>                  | 10.000 MHz to 40.000 MHz                           |      | Standard frequency                             |
|                                         |                       |                                 | 13 MHz, 19.2 MHz, 26 MHz, 27.456 MHz               |      |                                                |
| Supply voltage                          |                       | V <sub>cc</sub>                 | 2.8 V±0.14 V                                       |      | 2.3 V to 3.6 V                                 |
| Temperature range                       | Storage temperature   | T <sub>stg</sub>                | -40 °C to +85 °C                                   |      | Store as bare product after unpacking          |
|                                         | Operating temperature | T <sub>use</sub>                | -30 °C to +85 °C                                   |      |                                                |
| Frequency tolerance                     |                       | f <sub>tol</sub>                | ±2.0 ×10 <sup>-6</sup> Max.                        |      | After reflow,<br>V <sub>c</sub> =1.4 V, +25 °C |
| Frequency / temperature characteristics |                       | f <sub>0</sub> -T <sub>c</sub>  | ±2.0 × 10 <sup>-6</sup> Max.                       |      | -30 °C to +85 °C                               |
| Frequency / load coefficient            |                       | f <sub>0</sub> -Load            | ±0.2 × 10 <sup>-6</sup> Max.                       |      | 10 kΩ // 10 pF ±10 %                           |
| Frequency / voltage coefficient         |                       | f <sub>0</sub> -V <sub>cc</sub> | ±0.2 ×10 <sup>-6</sup> Max.                        |      | 2.8 V ± 0.14 V                                 |
| Frequency aging                         |                       | f <sub>age</sub>                | ±1.0 ×10 <sup>-6</sup> Max.                        |      | +25 °C, First year                             |
| Current consumption                     |                       | I <sub>cc</sub>                 | 2.0 mA Max.                                        |      | V <sub>cc</sub> =2.8 V, 10 kΩ// 10 pF          |
| Input resistance                        |                       | R <sub>in</sub>                 | 500 kΩ Min.                                        | —    | V <sub>c</sub> -GND (DC)                       |
| Frequency control range                 |                       | f <sub>cont</sub>               | ±5.0 × 10 <sup>-6</sup> to ±12.0 ×10 <sup>-6</sup> | —    | V <sub>c</sub> =1.4 V ±1.0 V                   |
| Frequency change polarity               |                       | —                               | Positive polarity                                  | —    |                                                |
| Symmetry                                |                       | SYM                             | 40 % to 60 %                                       |      | GND level (DC cut)                             |
| Output voltage                          |                       | V <sub>pp</sub>                 | 0.8 V Min.                                         |      | Peak to peak                                   |
| Load resistance                         |                       | Load_R                          | 10 kΩ                                              |      | DC cut capacitor = 0.01 μF                     |
| Load capacitance                        |                       | Load_C                          | 10 pF                                              |      |                                                |

Note: Please contact us for inquiries about specifications other than the above.

### External dimensions

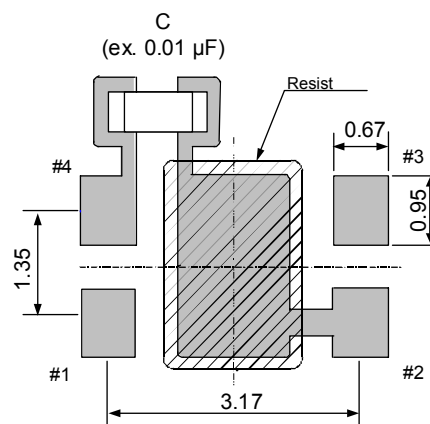
(Unit:mm)



\*Metal may be exposed on bottom of this product.  
This will not affect any quality, reliability or electrical spec.

### Footprint (Recommended)

(Unit:mm)





## TCXO MINIATURE SIZE LOW PROFILE

### TCO - 5860 series

- Frequency range : 10 MHz to 40 MHz
- Supply voltage : 2.8 V Typ.
- Frequency / temperature coefficient :  $\pm 2 \times 10^{-6}$  Max.
- External dimensions :  $3.2 \times 2.5 \times 0.9$  mm Typ.
- Applications : Cellular phone (WiMAX, CDMA, WCDMA)
- Features : Low current consumption



Product Number (Please contact us)  
X1G0014xxxxxx00



Actual size



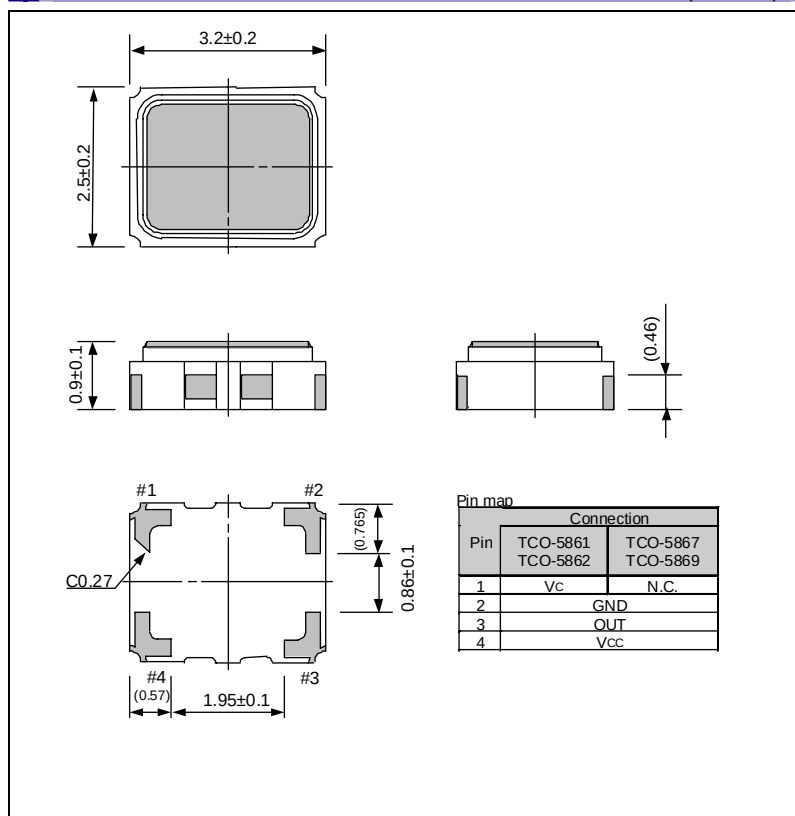
#### Specifications (characteristics)

| Item                                  | Symbol  | VC-TCXO                                             |                  | TCXO             |          | Remarks                               |
|---------------------------------------|---------|-----------------------------------------------------|------------------|------------------|----------|---------------------------------------|
|                                       |         | TCO-5861                                            | TCO-5862         | TCO-5867         | TCO-5869 |                                       |
| Output frequency range                | fo      | 16 MHz to 40 MHz                                    | 10 MHz to 20 MHz | 16 MHz to 40 MHz |          |                                       |
|                                       |         | 16 MHz, 20 MHz , 38.4 MHz , 40 MHz                  |                  |                  |          | Standard frequency                    |
| Supply voltage                        | Vcc     | 2.8 V ±0.14 V                                       |                  |                  |          | Supply voltage range : 2.3 V to 3.6 V |
| Storage temperature range             | T_stg   | -40 °C to +85 °C                                    |                  |                  |          | Store as bare product after unpacking |
| Operating temperature range           | T_use   | -30 °C to +85 °C                                    |                  |                  |          |                                       |
| Frequency tolerance                   | f_tol   | ±2.0 × 10 <sup>-6</sup> Max.                        |                  |                  |          | After reflow<br>(Vc=1.4 V, +25 °C)    |
| Frequency/temperature characteristics | fo-Tc   | ±2.0 × 10 <sup>-6</sup> Max.                        |                  |                  |          | -30 °C to +85 °C                      |
| Frequency/load coefficient            | fo-Load | ±0.2 × 10 <sup>-6</sup> Max.                        |                  |                  |          | 10 kΩ // 10 pF ± 10 %                 |
| Frequency/voltage coefficient         | fo-Vcc  | ±0.2 × 10 <sup>-6</sup> Max.                        |                  |                  |          | Vcc=2.8 V ±0.14 V                     |
| Frequency aging                       | f_age   | ±1.0 ×10 <sup>-6</sup> Max.                         |                  |                  |          | +25 °C, First year                    |
| Current consumption                   | Icc     | 2.0 mA Max.                                         |                  |                  |          |                                       |
| Input resistance                      | Rin     | 500 kΩ Min.                                         |                  | —                |          |                                       |
| Frequency control range               | f_cont  | ±5.0 × 10 <sup>-6</sup> to ±12.0 × 10 <sup>-6</sup> |                  | —                |          | Vc=1.4 V ±1.0 V                       |
| Frequency change polarity             | —       | Positive polarity                                   |                  | —                |          |                                       |
| Symmetry                              | SYM     | 40 % to 60 %                                        |                  |                  |          | GND level (DC cut)                    |
| Output voltage                        | Vpp     | 0.8 V Min.                                          |                  |                  |          | Peak to peak                          |
| Output load condition                 | Load_R  | 10 kΩ                                               |                  |                  |          | DC cut capacitor = 0.01 μF            |
|                                       | Load_C  | 10 pF                                               |                  |                  |          |                                       |

\* Note : Please contact us for inquiries about specifications other than the above.

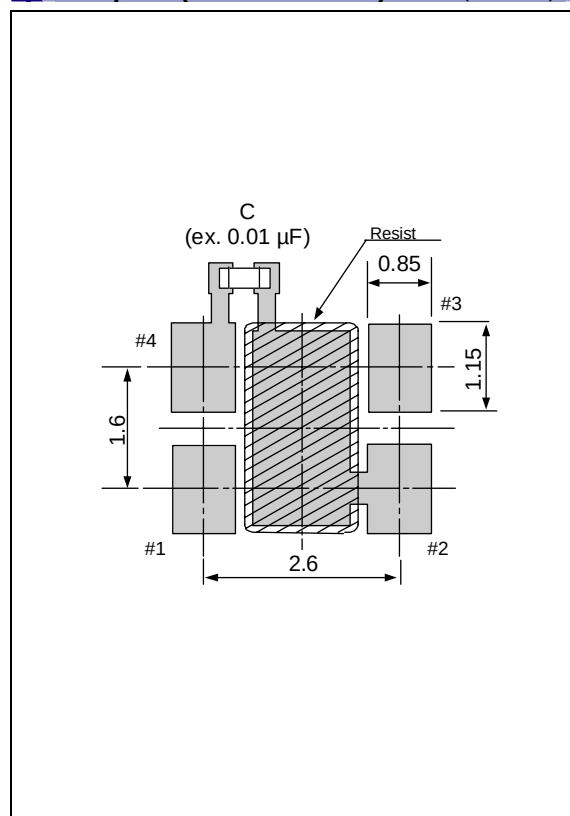
#### External dimensions

(Unit:mm)



#### Footprint (Recommended)

(Unit:mm)





# TCXO HIGH-STABILITY

## TCO - 5060 / 5160 series

- Frequency range : 10MHz to 51.84 MHz
- Supply voltage : 3.3 V Typ.
- Applications : Basestation, Transmission Measurement Equipment
- Function : Output enable(OE)
- Features : High frequency stability  
CMOS Output



Product Number (Please contact us)  
X1G00xxxxxxx00



Actual size



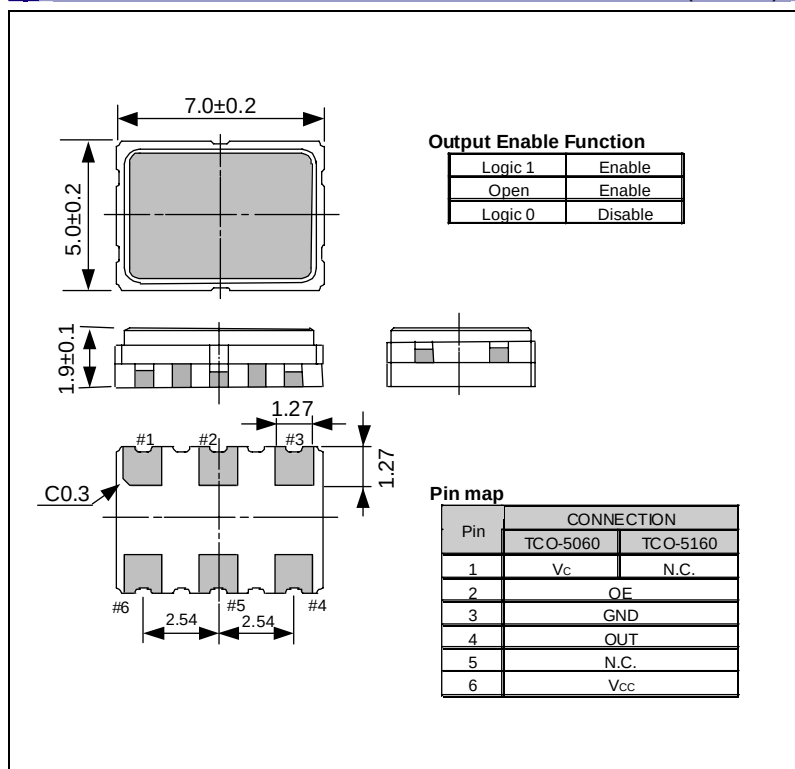
### Specifications (characteristics)

| Item                                  | Symbol                          | VC-TCXO                                                                                                        | TCXO     | Remarks                                          |
|---------------------------------------|---------------------------------|----------------------------------------------------------------------------------------------------------------|----------|--------------------------------------------------|
|                                       |                                 | TCO-5060                                                                                                       | TCO-5160 |                                                  |
| Output frequency range                | f <sub>o</sub>                  | 10.000 MHz to 51.840 MHz<br>10 MHz, 19.44 MHz, 20 MHz, 24.576 MHz,<br>38.88 MHz, 40 MHz, 49.152 MHz, 51.84 MHz |          | Standard frequency                               |
| Supply voltage                        | V <sub>cc</sub>                 | 3.3 V ±0.165 V                                                                                                 |          | Supply voltage range :<br>2.8 V to 5.5 V         |
| Storage temperature range             | T <sub>stg</sub>                | -40 °C to +85 °C                                                                                               |          | Store as bare product after unpacking            |
| Operating temperature range           | T <sub>use</sub>                | -40 °C to +85 °C                                                                                               |          |                                                  |
| Frequency tolerance                   | f <sub>tol</sub>                | ±2.0 × 10 <sup>-6</sup> Max.                                                                                   |          | After reflow<br>(V <sub>c</sub> =1.65 V, +25 °C) |
| Frequency/temperature characteristics | f <sub>o</sub> -T <sub>c</sub>  | ±1.0 × 10 <sup>-6</sup> Max.                                                                                   |          | -40 °C to +85 °C                                 |
| Frequency/voltage coefficient         | f <sub>o</sub> -V <sub>cc</sub> | ±0.5 × 10 <sup>-6</sup> Max.                                                                                   |          | V <sub>cc</sub> =3.3 V ±0.165 V                  |
| Frequency aging                       | f <sub>age</sub>                | ±1.0 × 10 <sup>-6</sup> Max. / year (First year)                                                               |          | +25 °C, 10 MHz to 30 MHz                         |
|                                       |                                 | ±5.0 × 10 <sup>-6</sup> Max. / 10 years                                                                        |          |                                                  |
|                                       |                                 | ±2.0 × 10 <sup>-6</sup> Max. / year (First year)                                                               |          | +25 °C, 30.1 MHz to 51.84 MHz                    |
|                                       |                                 | ±10.0 × 10 <sup>-6</sup> Max. / 10 years                                                                       |          |                                                  |
| Current consumption                   | I <sub>cc</sub>                 | 10.0 mA Max.                                                                                                   |          |                                                  |
| Input resistance                      | R <sub>in</sub>                 | 100 kΩ Min.                                                                                                    |          |                                                  |
| Frequency control range               | f <sub>cont</sub>               | ±5.0 × 10 <sup>-6</sup> to ±25.0 × 10 <sup>-6</sup>                                                            |          | V <sub>c</sub> =1.65 V ±1.65 V                   |
| Frequency change polarity             | —                               | Positive polarity                                                                                              |          |                                                  |
| Output voltage                        | V <sub>pp</sub>                 | CMOS V <sub>OL</sub> = 10 % V <sub>cc</sub> Max. V <sub>OH</sub> = 90 % V <sub>cc</sub> Min.                   |          |                                                  |
| Symmetry                              | SYM                             | 40 % to 60 %                                                                                                   |          | 50 % V <sub>cc</sub> level                       |
| Output load condition (CMOS)          | L <sub>CMOS</sub>               | 15 pF                                                                                                          |          |                                                  |

\* Note : Please contact us for inquiries about specifications other than the above.

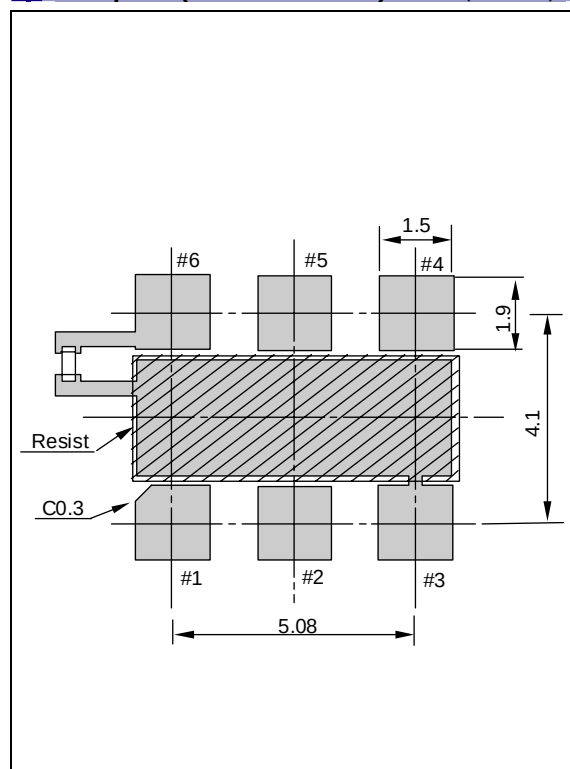
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)







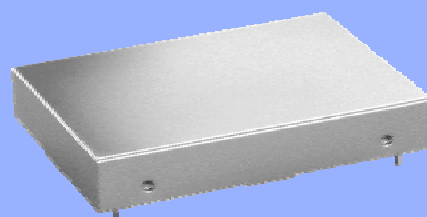
## Oven Controlled Crystal Oscillator (OCXO)

## TCO - 6831 series

- Features
  - : Very fast warm-up and accurate stability
  - : Guarantee long term stability
  - : SC-Cut Crystal unit



Product number (please contact us)  
X1G002331xxxx00

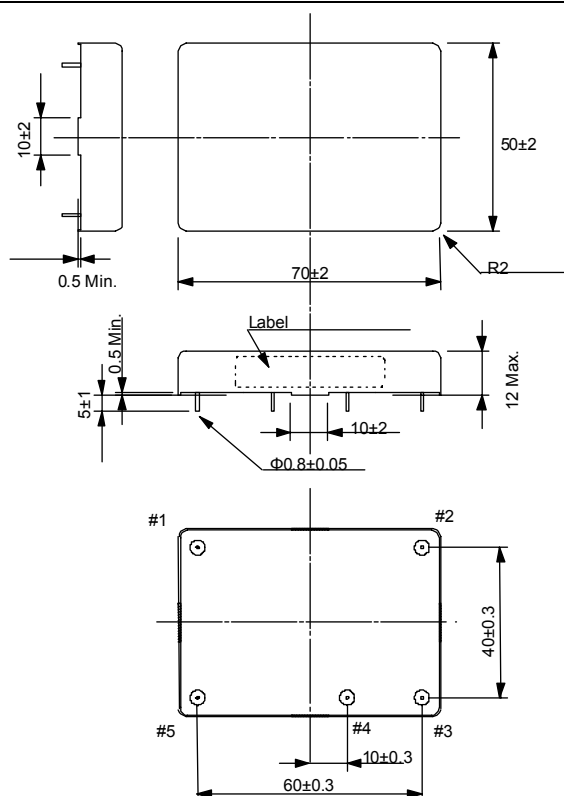


## Specifications (characteristics)

| Item                                  |              | Symbol | Specifications                                                          | Remarks                              |
|---------------------------------------|--------------|--------|-------------------------------------------------------------------------|--------------------------------------|
| Output frequency range                |              | fo     | 5 MHz to 10 MHz                                                         |                                      |
|                                       |              |        | 5 MHz, 10 MHz                                                           | Standard frequency                   |
| Supply voltage                        |              | Vcc    | 5 V $\pm$ 0.25 V                                                        |                                      |
| Storage temperature range             |              | T_stg  | -20 °C to +80 °C                                                        | During transport only.               |
| Operating temperature range           |              | T_use  | 0 °C to +70 °C                                                          | Long term storage: Room temperature. |
| Frequency/temperature characteristics |              | fo-Tc  | $\pm 8 \times 10^{-9}$ Max.                                             | 0 °C to +70 °C                       |
| Frequency/voltage coefficient         |              | fo-Vcc | $\pm 2 \times 10^{-9}$ Max.                                             | Vcc=5 V $\pm$ 0.25 V                 |
| Frequency aging                       |              | f_age  | $\pm 2 \times 10^{-9}$ / day Max.<br>$\pm 2 \times 10^{-8}$ / year Max. | 5 MHz                                |
| Warm-up                               |              | —      | $\pm 1 \times 10^{-7}$ Max. / 5 min                                     | +25 °C                               |
| Current consumption                   | Warm-up      | Icc    | 1600 mA Max.                                                            |                                      |
|                                       | Steady state |        | 850 mA Max.                                                             | at +25 °C                            |
| Frequency control range               |              | f_cont | $\pm 1 \times 10^{-7}$ Min. to $\pm 3 \times 10^{-7}$ Max.              | Vc=2.5 V $\pm$ 2.0 V                 |
| Symmetry                              |              | SYM    | 45 % to 55 %                                                            | (VOH-VOL)/2                          |
| High output voltage                   |              | VOH    | 2.4 V Min.                                                              | 3.3 V Level CMOS                     |
| Low output voltage                    |              | VOL    | 0.4 V Max.                                                              |                                      |
| Load resistance                       |              | Load_R | 10 k $\Omega$                                                           |                                      |
| Load capacitance                      |              | Load_C | 15 pF                                                                   |                                      |
| Weight                                |              | —      | 100 g Max.                                                              |                                      |

## External dimensions

(Unit:mm)



Pin map

| Pin | CONNECTION |
|-----|------------|
| 1   | Vc         |
| 2   | GND        |
| 3   | OUT        |
| 4   | N.C.       |
| 5   | Vcc        |



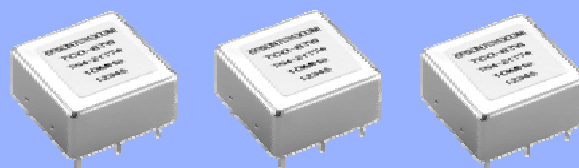
## Oven Controlled Crystal Oscillator (OCXO)

## TCO - 676 series

- Features : Compact and low profile
- : Very fast warm-up
- : SC-Cut Crystal unit



Product number (please contact us)  
X1G002291xxxx00

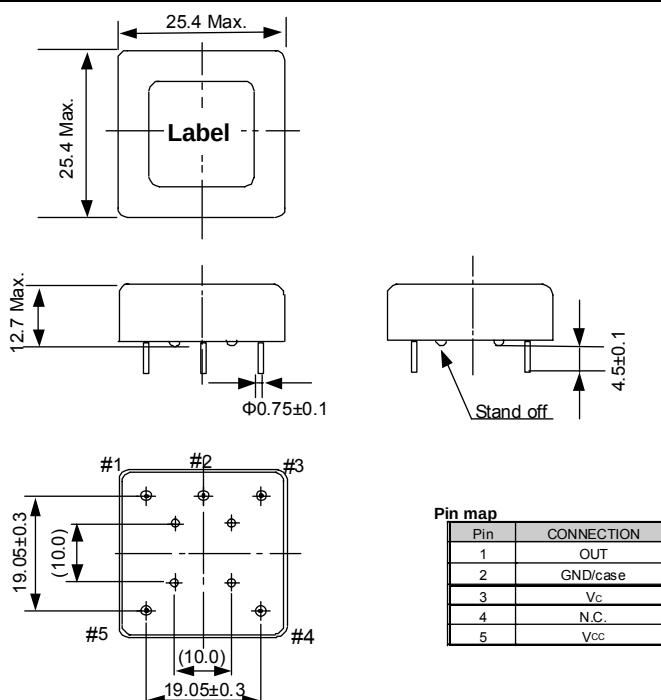


## Specifications (characteristics)

| Item                                  |              | Symbol                          | Specifications                                                        |                                                            |                                                            | Remarks                                                       |
|---------------------------------------|--------------|---------------------------------|-----------------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------------------|
|                                       |              |                                 | TCO-676R3                                                             | TCO-676R2                                                  | TCO-676R                                                   |                                                               |
| Output frequency range                |              | f <sub>o</sub>                  | 10 MHz to 20 MHz                                                      |                                                            |                                                            | Standard frequency                                            |
|                                       |              |                                 | 17 MHz                                                                | 10 MHz                                                     |                                                            |                                                               |
| Supply voltage                        |              | V <sub>cc</sub>                 | 3.3 V ±0.165 V                                                        | 5 V ±0.25 V                                                | 12 V ±0.6 V                                                |                                                               |
| Storage temperature range             |              | T <sub>stg</sub>                | -20 °C to +80 °C                                                      |                                                            |                                                            | During transport only.<br>Long term storage:Room Temperature. |
| Operating temperature range           |              | T <sub>use</sub>                | -10 °C to +70 °C                                                      |                                                            |                                                            |                                                               |
| Frequency/temperature characteristics |              | f <sub>o</sub> -T <sub>c</sub>  | ±2 × 10 <sup>-8</sup> Max.                                            |                                                            |                                                            | -10 °C to +70 °C                                              |
| Frequency/voltage coefficient         |              | f <sub>o</sub> -V <sub>cc</sub> | ±5 × 10 <sup>-9</sup> Max.<br>V <sub>cc</sub> =3.3 V ±0.165 V         | ±5 × 10 <sup>-9</sup> Max.<br>V <sub>cc</sub> =5 V ±0.25 V | ±5 × 10 <sup>-9</sup> Max.<br>V <sub>cc</sub> =12 V ±0.6 V |                                                               |
| Frequency aging                       |              | f <sub>age</sub>                | ±1 × 10 <sup>-8</sup> / day Max.<br>±1 × 10 <sup>-7</sup> / year Max. |                                                            |                                                            |                                                               |
| Warm-up                               |              | —                               | ±5 × 10 <sup>-8</sup> / 5 min Max.                                    |                                                            |                                                            | +25 °C                                                        |
| Current consumption                   | Warm-up      | I <sub>cc</sub>                 | 1150 mA Max.                                                          | 700 mA Max.                                                | 300 mA Max.                                                | at +25 °C                                                     |
|                                       | Steady state |                                 | 650 mA Max.                                                           | 300 mA Max.                                                | 130 mA Max.                                                |                                                               |
| Frequency control range               |              | f <sub>cont</sub>               | ±1 × 10 <sup>-6</sup> Min.<br>V <sub>c</sub> =1.65 V ±1.65 V          | ±1 × 10 <sup>-6</sup> Min.<br>V <sub>c</sub> =2.5 V ±2.5 V |                                                            |                                                               |
| Symmetry                              |              | SYM                             | 45 % to 55 %                                                          |                                                            |                                                            | (V <sub>OH</sub> -V <sub>OL</sub> )/2                         |
| High output voltage                   |              | V <sub>OH</sub>                 | 2.4 V Min.                                                            | 4.0 V Min.                                                 | 4.0 V Min.                                                 | V <sub>cc</sub> =3.3 V:3.3 V Level CMOS                       |
| Low output voltage                    |              | V <sub>OL</sub>                 | 0.4 V Max.                                                            | 0.5 V Max.                                                 | 0.5 V Max.                                                 | V <sub>cc</sub> =5 V,12 V:5 V Level CMOS                      |
| Load resistance                       |              | Load_R                          | 10 kΩ                                                                 |                                                            |                                                            |                                                               |
| Load capacitance                      |              | Load_C                          | 10 pF                                                                 |                                                            |                                                            |                                                               |
| Weight                                |              | —                               | 20 g Max.                                                             |                                                            |                                                            |                                                               |

## External dimensions

(Unit:mm)





## Oven Controlled Crystal Oscillator (OCXO)

## TCO - 679 series

- Features : DIP-14pin package
- : Very fast warm-up
- : SC-Cut Crystal unit



Product number (please contact us)  
X1G002311xxxx00

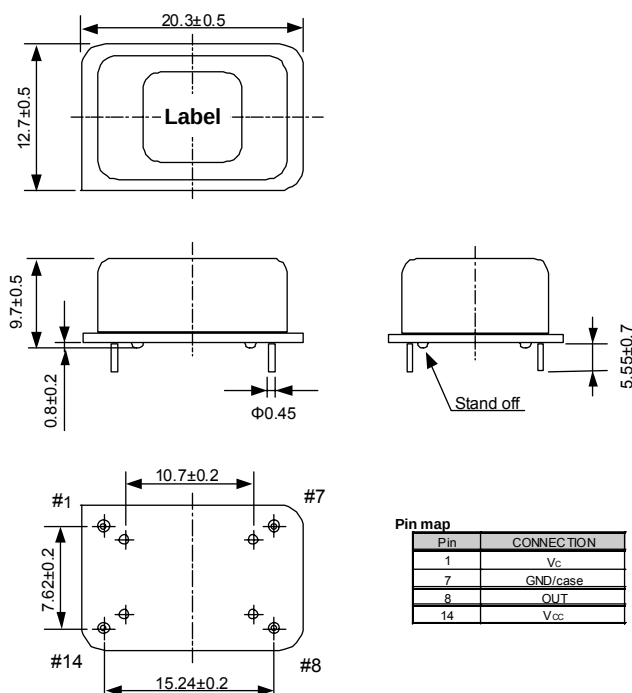


## Specifications (characteristics)

| Item                                  |              | Symbol | Specifications                                                        |                                               | Remarks                              |
|---------------------------------------|--------------|--------|-----------------------------------------------------------------------|-----------------------------------------------|--------------------------------------|
|                                       |              |        | TCO-679S1                                                             | TCO-679S2                                     |                                      |
| Output frequency range                |              | fo     | 10 MHz to 20 MHz                                                      |                                               | Standard frequency                   |
|                                       |              |        | 10 MHz                                                                |                                               |                                      |
| Supply voltage                        |              | Vcc    | 5 V ±0.25 V                                                           | 12 V ±0.6 V                                   |                                      |
| Storage temperature range             |              | T_stg  | -20 °C to +80 °C                                                      |                                               | During transport only.               |
| Operating temperature range           |              | T_use  | 0 °C to +70 °C                                                        |                                               | Long term storage: Room Temperature. |
| Frequency/temperature characteristics |              | fo-Tc  | ±1 × 10 <sup>-7</sup> Max.                                            |                                               | 0 °C to +70 °C                       |
| Frequency/voltage coefficient         |              | fo-Vcc | ±1 × 10 <sup>-7</sup> Max.<br>Vcc=5 V ±0.25 V                         | ±1 × 10 <sup>-7</sup> Max.<br>Vcc=12 V ±0.6 V |                                      |
| Frequency aging                       |              | f_age  | ±5 × 10 <sup>-8</sup> / day Max.<br>±5 × 10 <sup>-7</sup> / year Max. |                                               |                                      |
| Warm-up                               |              | —      | ±5 × 10 <sup>-7</sup> / 5 min Max.                                    |                                               | at +25 °C                            |
| Current consumption                   | Warm-up      | Icc    | 380 mA Max.                                                           | 160 mA Max.                                   | at +25 °C                            |
|                                       | Steady state |        | 160 mA Max.                                                           | 70 mA Max.                                    |                                      |
| Frequency control range               |              | f_cont | ±5 × 10 <sup>-6</sup> Min.<br>Vc=2.5 V ±2.5 V                         | ±5 × 10 <sup>-6</sup> Min.<br>Vc=4.5 V ±4.5 V |                                      |
| Symmetry                              |              | SYM    | 45 % to 55 %                                                          |                                               | (VOH-VOL)/2                          |
| High output voltage                   |              | VOH    | 4.0 V Min.                                                            |                                               | 5 V Level CMOS                       |
| Low output voltage                    |              | VOL    | 0.5 V Max.                                                            |                                               |                                      |
| Load resistance                       |              | Load_R | 10 kΩ                                                                 |                                               |                                      |
| Load capacitance                      |              | Load_C | 15 pF                                                                 |                                               |                                      |
| Weight                                |              | —      | 10 g Max.                                                             |                                               |                                      |

## External dimensions

(Unit:mm)





## Oven Controlled Crystal Oscillator (OCXO) DOUBLE OVEN

# TCO - 6920A

- Features : Ultra-High Stability
- : Low Phase Noise
- : SC-Cut Crystal unit
- : Double Oven



Product number (please contact us)  
X1G002341xxxx00

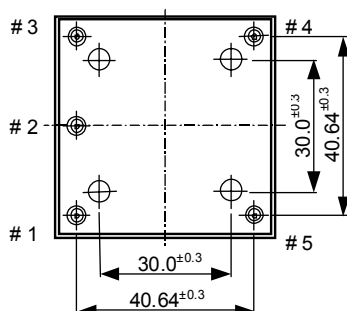
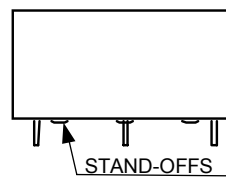
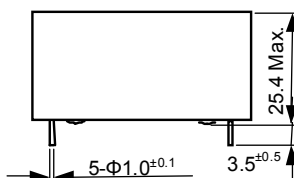
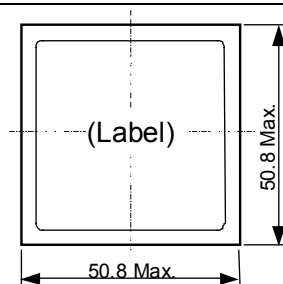


### Specifications (characteristics)

| Item                                  | Symbol                 | Specifications                       | Remarks                                                        |
|---------------------------------------|------------------------|--------------------------------------|----------------------------------------------------------------|
|                                       |                        | TCO-6920A                            |                                                                |
| Output frequency                      | $f_o$                  | 10 MHz                               |                                                                |
| Supply voltage                        | $V_{CC}$               | 12 V $\pm$ 0.6 V                     |                                                                |
| Storage temperature range             | $T_{stg}$              | -40 °C to +80 °C                     | During transport only.<br>Long term storage: Room Temperature. |
| Operating temperature range           | $T_{use}$              | -30 °C to +70 °C                     |                                                                |
| Frequency/temperature characteristics | $f_o-T_c$              | $\pm 5 \times 10^{-10}$ Max.         | -30 °C to +70 °C                                               |
| Frequency/voltage coefficient         | $f_o-V_{CC}$           | $\pm 2 \times 10^{-10}$ Max.         | $V_{CC}=12 \text{ V} \pm 0.6 \text{ V}$                        |
| Frequency aging                       | $f_{age}$              | $\pm 5 \times 10^{-11}$ / day Max.   | After 30 days of operation                                     |
| Warm-up                               | —                      | $\pm 2 \times 10^{-8}$ / 10 min Max. | +25 °C                                                         |
| Output Waveform                       | —                      | Sine wave                            |                                                                |
| Load resistance                       | $Load\_R$              | 50 $\Omega$ (5 dBm Min.)             |                                                                |
| Current consumption                   | Warm-up                | 1050 mA Max.                         |                                                                |
|                                       | Steady state at +25 °C | 300 mA Max.                          |                                                                |
| Frequency control range               | $f_{cont}$             | $\pm 3 \times 10^{-7}$ Min.          | $V_c=5 \text{ V} \pm 5 \text{ V}$                              |
| Weight                                | —                      | 100 g Max.                           |                                                                |

### External dimensions

(Unit:mm)



Pin map

| Pin | Connection |
|-----|------------|
| 1   | $V_c$      |
| 2   | N.C.       |
| 3   | OUT        |
| 4   | GND / case |
| 5   | $V_{CC}$   |



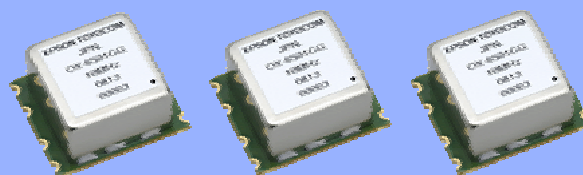
## Oven Controlled Crystal Oscillator (OCXO)

## OX - 6501GG series

- Features : Low profile full SMD package
- : Very fast warm-up and accurate stability
- : IPC/JEDEC J-STD-020C reflowable
- : SC-Cut Crystal unit



Product number (please contact us)

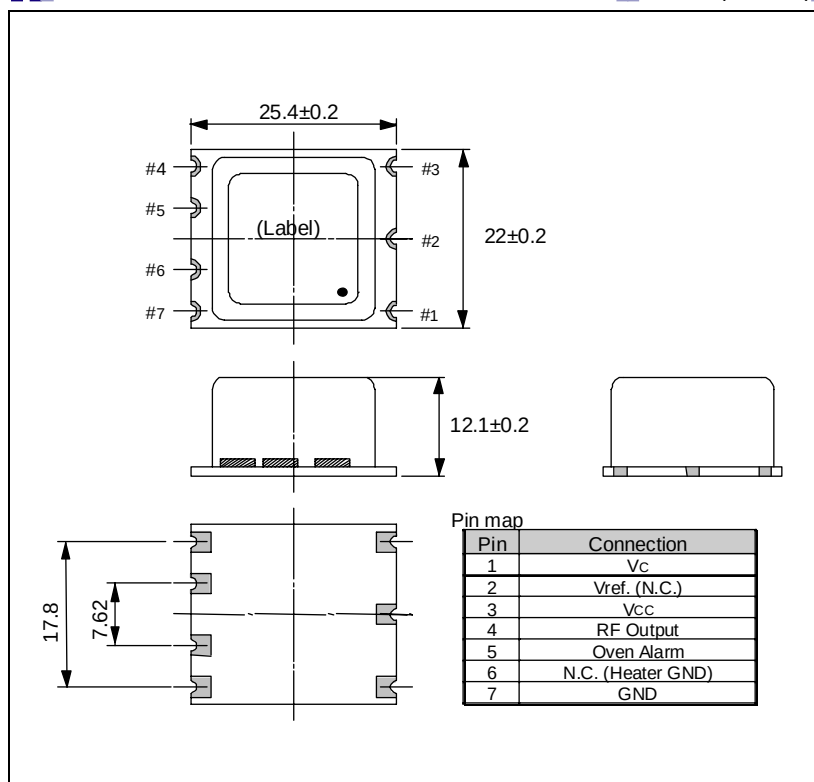
**NEW**

## Specifications (characteristics)

| Item                                  | Symbol          | Specifications                                                                                                                                       |                    |                                                                         |
|---------------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------------------------------------------------------------|
| Output frequency range                | $f_o$           | 10.000 MHz to 40.000 MHz                                                                                                                             |                    |                                                                         |
|                                       |                 | 10 MHz, 30.72 MHz                                                                                                                                    |                    | Standard frequency                                                      |
| Supply voltage                        | Vcc             | 3.3 V $\pm 0.165$ V                                                                                                                                  | 5.0 V $\pm 0.25$ V |                                                                         |
| Storage temperature range             | T_stg           | -40 °C to +85 °C                                                                                                                                     |                    | During transportation only.<br>Long term storage :<br>Room temperature. |
| Operating temperature range           | T_use           | -10 °C to +70 °C                                                                                                                                     |                    |                                                                         |
| Frequency/temperature characteristics | fo-Tc           | $\pm 2.5 \times 10^{-8}$ Max.                                                                                                                        |                    | -10 °C to +70 °C                                                        |
| Frequency/voltage coefficient         | fo-Vcc          | $\pm 5 \times 10^{-9}$ Max. OP.: $\pm 2 \times 10^{-9}$ Max.                                                                                         |                    | Vcc=3.3 V $\pm 0.165$ V<br>Vcc=5.0 V $\pm 0.25$ V                       |
| Frequency aging                       | f_age           | $\pm 1 \times 10^{-8}$ / dayMax. OP.: $\pm 1 \times 10^{-9}$ / dayMax.<br>$\pm 1 \times 10^{-7}$ / year Max. OP.: $\pm 3 \times 10^{-8}$ / year Max. |                    |                                                                         |
| Warm-up                               | —               | $\pm 5 \times 10^{-8}$ / 5 min Max.                                                                                                                  |                    | +25 °C                                                                  |
| Current consumption                   | Warm-up         | Icc                                                                                                                                                  | 750 mA Max.        | 600 mA Max.                                                             |
|                                       | Steady state    |                                                                                                                                                      | 300 mA Max.        | 200 mA Max.                                                             |
| Frequency control range               | f_cont          | $\pm 1 \times 10^{-6}$ Min.                                                                                                                          |                    | Vc=1.4 V $\pm 1.4$ V, Vc=2.0 V $\pm 2.0$ V                              |
| Symmetry                              | SYM             | 45 % to 55 %                                                                                                                                         |                    | (V <sub>OH</sub> - V <sub>OL</sub> )/2                                  |
| High output voltage                   | V <sub>OH</sub> | 2.4 V Min.                                                                                                                                           | 2.8 V Min.         | CMOS                                                                    |
| Low output voltage                    | V <sub>OL</sub> | 0.4 V Max.                                                                                                                                           | 0.4 V Max.         |                                                                         |
| Load resistance                       | Load_R          | 10 k $\Omega$                                                                                                                                        |                    |                                                                         |
| Load capacitance                      | Load_C          | 15 pF                                                                                                                                                |                    |                                                                         |
| Weight                                | —               | 10 g Max.                                                                                                                                            |                    |                                                                         |

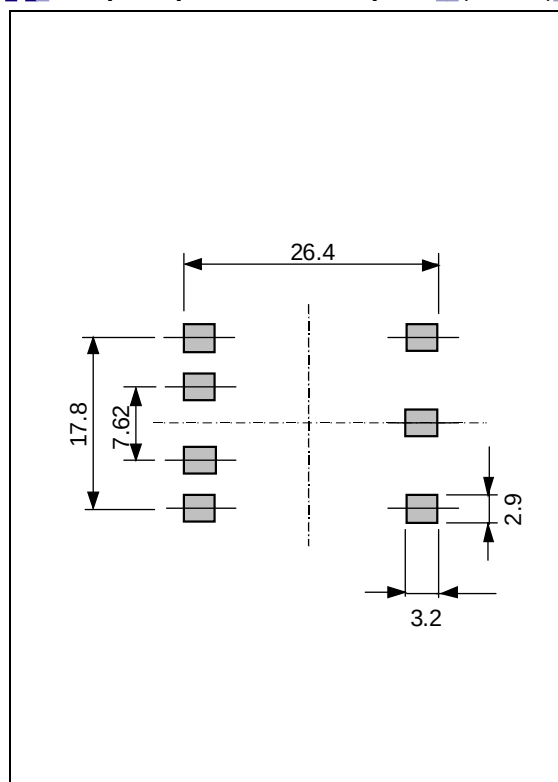
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





## Oven Controlled Crystal Oscillator (OCXO)

## OX - 6601DL series

- Features : Small size and low power
- : Fast warm-up and high stability
- : SC-Cut Crystal unit



Product number (please contact us)

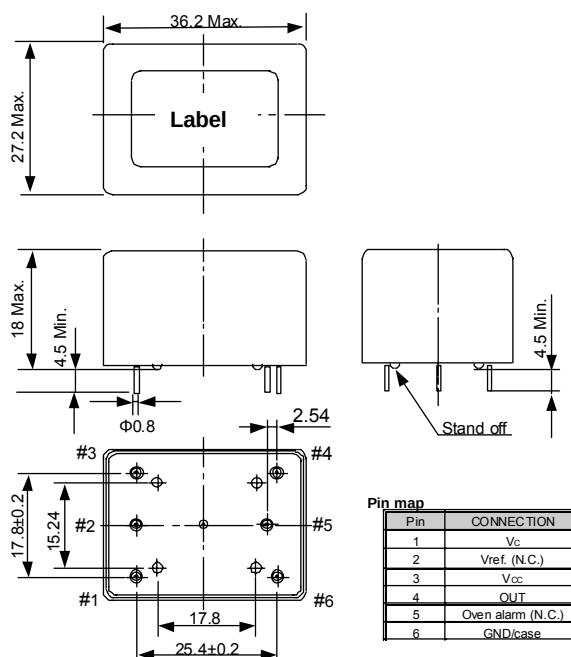
**NEW**

## Specifications (characteristics)

| Item                                  |              | Symbol                          | Specifications                                                        |               | Remarks                                                                                                          |
|---------------------------------------|--------------|---------------------------------|-----------------------------------------------------------------------|---------------|------------------------------------------------------------------------------------------------------------------|
| Output frequency range                |              | f <sub>o</sub>                  | 10 MHz to 40 MHz                                                      |               | Standard frequency                                                                                               |
|                                       |              |                                 | 10 MHz                                                                |               |                                                                                                                  |
| Supply voltage                        |              | V <sub>CC</sub>                 | 3.3 V ±0.165 V                                                        | 5.0 V ±0.25 V |                                                                                                                  |
| Storage temperature range             |              | T <sub>stg</sub>                | -40 °C to +85 °C                                                      |               | During transport only.<br>Long term storage: Room Temperature.                                                   |
| Operating temperature range           |              | T <sub>use</sub>                | -10 °C to +70 °C                                                      |               |                                                                                                                  |
| Frequency/temperature characteristics |              | f <sub>o</sub> -T <sub>c</sub>  | ±8 × 10 <sup>-9</sup> Max.                                            |               | -10 °C to +70 °C                                                                                                 |
| Frequency/voltage coefficient         |              | f <sub>o</sub> -V <sub>CC</sub> | ±2 × 10 <sup>-9</sup> Max.                                            |               | V <sub>CC</sub> =3.3 V ±0.165 V<br>V <sub>CC</sub> =5 V ±0.25 V                                                  |
| Frequency aging                       |              | f <sub>age</sub>                | ±1 × 10 <sup>-9</sup> / day Max.<br>±3 × 10 <sup>-8</sup> / year Max. |               |                                                                                                                  |
| Warm-up                               |              | —                               | ±5 × 10 <sup>-8</sup> / 5 min Max.                                    |               | +25 °C                                                                                                           |
| Current consumption                   | Warm-up      | I <sub>CC</sub>                 | 750 mA Max.                                                           | 600 mA Max.   | at +25 °C                                                                                                        |
|                                       | Steady state |                                 | 300 mA Max.                                                           | 200 mA Max.   |                                                                                                                  |
| Frequency control range               |              | f <sub>cont</sub>               | ±1 × 10 <sup>-6</sup> Min.                                            |               | V <sub>C</sub> = 1.4 V ±1.4 V (V <sub>CC</sub> =3.3 V)<br>V <sub>C</sub> = 2.0 V ±2.0 V (V <sub>CC</sub> =5.0 V) |
| Symmetry                              |              | SYM                             | 45 % to 55 %                                                          |               | (V <sub>OH</sub> - V <sub>OL</sub> )/2                                                                           |
| High output voltage                   |              | V <sub>OH</sub>                 | 2.4 V Min.                                                            | 2.8 V Min.    | CMOS                                                                                                             |
| Low output voltage                    |              | V <sub>OL</sub>                 | 0.4 V Max.                                                            | 0.4 V Max.    |                                                                                                                  |
| Load resistance                       |              | Load_R                          | 10 kΩ                                                                 |               |                                                                                                                  |
| Load capacitance                      |              | Load_C                          | 15 pF                                                                 |               |                                                                                                                  |
| Weight                                |              | —                               | 30 g Max.                                                             |               |                                                                                                                  |

## External dimensions

(Unit:mm)





## RUBIDIUM ATOMIC OSCILLATOR

## Rb - 3310N

- Features : Excellent high stability
- : EU RoHS compliant



Product number (please contact us)  
X1G002401xxxx00

**NEW**

## Specifications (characteristics)

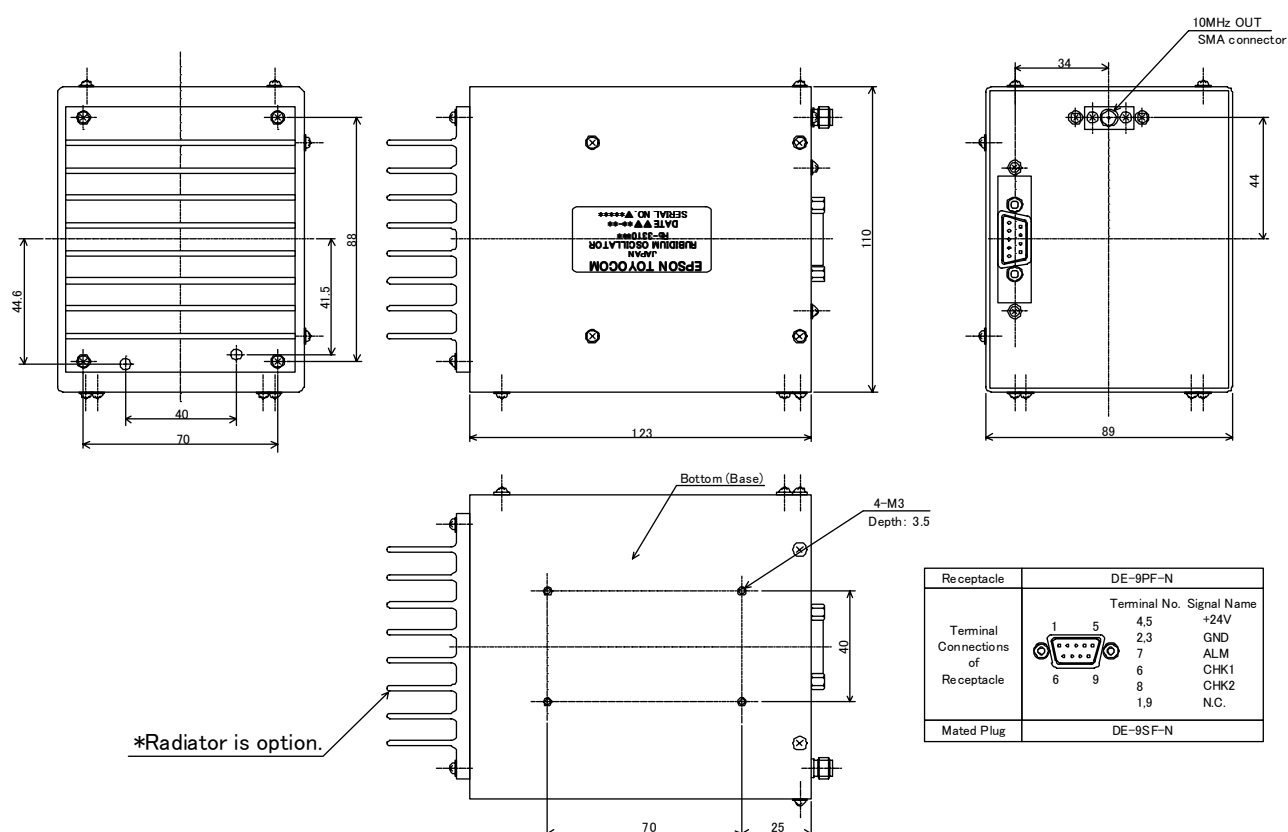
| Parameter            |                            | Standard                                     | Condition                                            |
|----------------------|----------------------------|----------------------------------------------|------------------------------------------------------|
| Frequency stability  | Long term                  | $< 2 \times 10^{-11}$ / month                | —                                                    |
|                      | Short term                 | $< 1 \times 10^{-11}$ / s                    | —                                                    |
|                      | vs Temperature             | $< \pm 1.5 \times 10^{-10}$ / 0 °C to +50 °C | Referred to +25 °C                                   |
|                      | Voltage sensitivity        | $< \pm 1 \times 10^{-11}$ / V                | DC24 V $\pm$ 2 V                                     |
|                      | Warm-up (locked frequency) | $< 2 \times 10^{-10}$                        | Within 20 minutes at +25 °C after power on (Typical) |
| Frequency adjustment |                            | $> 2 \times 10^{-9}$                         | Internal volume                                      |
| Output               | Frequency                  | 10 MHz                                       | SMA connector                                        |
|                      | Level                      | $> 0.5$ Vrms / 50 $\Omega$                   | Sine wave (Harmonics $< -20$ dB)                     |
|                      | Alarm                      | Open collector                               | —                                                    |
| Supply voltage       |                            | DC 24 V $\pm$ 2 V                            | Noise 100 mV <sub>pp</sub> Max.                      |
| Supply power         |                            | $< 17$ W                                     | +25 °C (steady state)                                |
|                      |                            | $< 30$ W                                     | Warm up                                              |
| Condition            | Storage temperature        | -10 °C to +50 °C                             |                                                      |
|                      | Operating temperature      | 0 °C to +50 °C                               |                                                      |
|                      | Operating humidity         | Less than 90 %Rh                             | at less than +40 °C                                  |
| Dimensions (mm)      |                            | 89(H) $\times$ 110(W) $\times$ 123(D)        | —                                                    |
| Weight               |                            | 2 kg Typ.                                    | —                                                    |

1) Specifications are subject to change without notice.

2) Option : Frequency control  $> 2 \times 10^{-9}$  / 2.5 V (2.5 V (by external voltage input)

## External dimensions

(Unit:mm)





Product number (please contact us)  
X1G0025400xxx

# RUBIDIUM ATOMIC OSCILLATOR

(1PPS Synchronization Rubidium Frequency Standard)

## Rb-2110CB

- Features : 19 inches rack type
- : Excellent frequency stability
- : 1PPS synchronization type



**NEW**

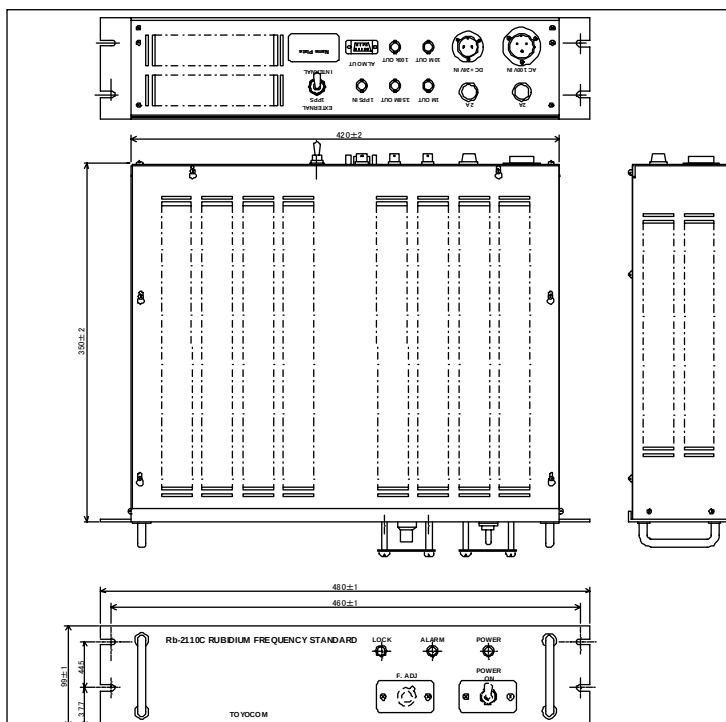
### Specifications (characteristics)

| Parameter                          | Standard                                                | Condition                                                                                                    |
|------------------------------------|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Frequency stability                | Long term                                               | $< 2 \times 10^{-11}$ / month                                                                                |
|                                    | Short term                                              | $< 1 \times 10^{-11}$ / s                                                                                    |
|                                    | vs Temperature (1)                                      | $< \pm 1.5 \times 10^{-10}$ / 0 °C to +50 °C                                                                 |
|                                    | vs Temperature (2)                                      | $< 1 \times 10^{-10}$ / -10 °C to 0 °C                                                                       |
|                                    | Voltage sensitivity                                     | $< \pm 1 \times 10^{-11}$                                                                                    |
|                                    | Warm-up (locked frequency)                              | $< 2 \times 10^{-10}$                                                                                        |
| Output                             | Frequency                                               | 10 MHz, 3.58 MHz, 1 MHz, 100 kHz                                                                             |
|                                    | Level                                                   | $> 1 \text{ Vrms} / 50 \Omega$ (10 MHz, 1 MHz, 100 kHz)<br>$2 \text{ V pp} \pm 20 \% / 75 \Omega$ (3.58 MHz) |
|                                    | Alarm                                                   | Relay contact on back panel connector                                                                        |
| Frequency adjustment               | $> 2 \times 10^{-9}$                                    | Front panel dial                                                                                             |
| Supply voltage                     | AC                                                      | AC 100 V $\pm 10 \%$ (50 or 60 Hz)                                                                           |
|                                    | DC                                                      | DC +24 V $\pm 1 \text{ V}$                                                                                   |
| Battery operation                  | $> 20 \text{ min}$                                      | +25 °C after AC power off                                                                                    |
| Dimensions (mm)                    | 99(H) $\times$ 480(W) $\times$ 350(D)(mm)               | —                                                                                                            |
| Weight                             | 12 kg Typ.                                              | —                                                                                                            |
| 1PPS Input                         | 50 $\mu\text{s}$ Positive Pulse / 50 $\Omega$ TTL Level | External Synchronization Option                                                                              |
| Frequency Synchronization Accuracy | $< \pm 1 \times 10^{-12}$ (24 h Average)                | External Synchronization Option                                                                              |

1) The specification is subject to change without notice.

2) When alarm is generated, output frequency is swept about  $\pm 10 \times 10^{-6}$ .

### External dimensions



#### Pin map of each connector

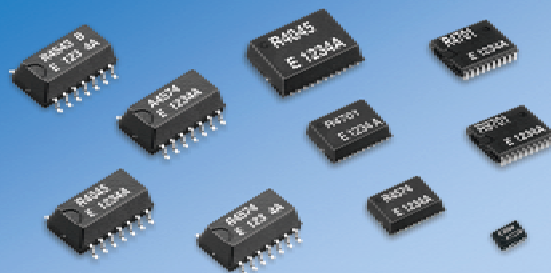
|                             |            |            |
|-----------------------------|------------|------------|
|                             | AC 100V IN | DC +24V IN |
| Connector code (Receptacle) | CN-2103RJ  | CN-1602RJ  |
| Connection                  |            |            |
| Connector code (Plug)       | CN-2103RP  | CN-1602RP  |
|                             | ALARM OUT  |            |
| Connector code (Receptacle) | HDEB-9S    |            |
| Connection                  |            |            |
| Connector code (Plug)       | HDEB-9P    |            |

# REAL TIME CLOCK MODULE

## Serial 4-Wire / Serial 3-Wire

### ●Features

- ▶ Serial interface which can be controlled 4 or 3 signal lines.
- ▶ Built in frequency adjusted 32.768 kHz crystal unit.



### ■Serial 4-Wire / Serial 3-Wire

| Category      |                                                                                                                                                                         | Model                |                                                                                     | Actual size (mm)      | Features                           | Page |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------------------------------------------------------------------------------|-----------------------|------------------------------------|------|
| Serial 4-Wire |                                                                                        | RX-4045SA            |    | 10.1×7.4×3.2 t (Typ.) | High-Stability                     | 94   |
|               |                                                                                                                                                                         | RX-4045NB            |    | 6.3×5.2×1.4 t (Max.)  |                                    |      |
|               |                                                                                                                                                                         | RX-4581NB            |    | 6.3×5.2×1.4 t (Max.)  | Built-in SRAM                      | 95   |
|               |       | RA-4565SA <b>NEW</b> |    | 10.1×7.4×3.2 t (Typ.) | For Automotive                     | 96   |
|               |                                                                                        | RX-4801SA <b>NEW</b> |    | 10.1×7.4×3.2 t (Typ.) | Built-in DTCXO High-Stability      | 97   |
|               |                                                                                                                                                                         | RTC-9701JE           |    | 7.3×6.2×1.5 t (Max.)  | Built-in EEPROM                    | 98   |
| Serial 3-Wire |                                                                                      | RTC-4701JE           |    | 7.3×6.2×1.5 t (Max.)  | Built-in Temperature Sensor        | 99   |
|               |                                                                                                                                                                         | RTC-4701NB           |   | 6.3×5.2×1.4 t (Max.)  |                                    |      |
|               |                                                                                                                                                                         | RTC-4574SA           |  | 10.1×7.4×3.2 t (Typ.) | Simple Function                    | 100  |
|               |                                                                                                                                                                         | RTC-4574JE           |  | 7.3×6.2×1.5 t (Max.)  |                                    |      |
|               |                                                                                                                                                                         | RTC-4574NB           |  | 6.3×5.2×1.4 t (Max.)  |                                    |      |
|               |                                                                                                                                                                         | RX-4574LC            |  | 3.6×2.8×1.2 t (Max.)  |                                    | 101  |
|               |   | RA-4574SA            |  | 10.1×7.4×3.2 t (Typ.) | For Automotive                     | 102  |
|               |                                                                                      | RTC-4543SA           |  | 10.1×7.4×3.2 t (Typ.) | Simple Function                    | 103  |
|               |                                                                                                                                                                         | RTC-4543SB           |  | 11.6×8.0×2.0 t (Max.) |                                    |      |
|               |                                                                                                                                                                         | RX-4575LC            |  | 3.6×2.8×1.2 t (Max.)  | Built-in external event detection. | 104  |
|               |                                                                                                                                                                         | RX-4571LC            |  | 3.6×2.8×1.2 t (Max.)  | Low Backup Voltage                 | 105  |
|               |                                                                                                                                                                         | RX-4571NB            |  | 6.3×5.2×1.4 t (Max.)  |                                    |      |
|               |                                                                                                                                                                         | RX-4571SA            |  | 10.1×7.4×3.2 t (Typ.) |                                    |      |

### ► Specifications

| Item              | Interface     | Frequency tolerance (Standard)                   | Interface voltage | Clock voltage   | Current consumption (Backup) | Memory           | Alarm                             | Time interval of standard pulse | Other features                     |
|-------------------|---------------|--------------------------------------------------|-------------------|-----------------|------------------------------|------------------|-----------------------------------|---------------------------------|------------------------------------|
| Model             |               |                                                  |                   |                 |                              |                  |                                   |                                 |                                    |
| RX-4045 SA / NB   | 4-Wire Serial | 5±5 × 10 <sup>-6</sup><br>0±5 × 10 <sup>-6</sup> | 1.7 V to 5.5 V    | 1.15 V to 5.5 V | 0.48 μA Typ.(3 V)            | —                | —                                 | 32.768 kHz                      | High-Stability                     |
| RX-4581 NB        |               | 5±23 × 10 <sup>-6</sup>                          | 1.6 V to 5.5 V    | 1.6 V to 5.5 V  | 0.4 μA Typ.(3 V)             | 128 bit (SRAM)   | Minute to Day and day of the week | 32.768 kHz to 1/60 Hz           | Built-in SRAM                      |
| RA-4565SA         |               |                                                  | 1.5 V to 5.5 V    | 1.5 V to 5.5 V  | 0.5 μA Typ.(3 V)             | —                | Minute to Day                     | 32.768 kHz to 1 Hz              | For automotive                     |
| RX-4801SA         |               | ±5 × 10 <sup>-6</sup>                            | 1.8 V to 5.5 V    | 1.6 V to 5.5 V  | 0.8 μA Typ.(3 V)             | —                | Minute to Day                     | 32.768 kHz to 1 Hz              | Built-in DTCXO                     |
| RTC-9701 JE       | 3-Wire Serial | 5±23 × 10 <sup>-6</sup>                          | 2.7 V to 3.6 V    | 1.8 V to 5.5 V  | 0.8 μA Typ.(3 V)             | 4 k bit (EEPROM) | Minute to Day and day of the week | 32.768 kHz                      | Built-in EEPROM                    |
| RTC-4701 JE/NB    |               | 5±23 × 10 <sup>-6</sup>                          | 1.6 V to 5.5 V    | 1.6 V to 5.5 V  | 0.5 μA Typ.(3 V)             | —                | Minute to Day and day of the week | 32.768 kHz to 1/30 Hz           | Built in temperature sensor        |
| RX-4574 LC        |               |                                                  | 1.6 V to 5.5 V    | 1.3 V to 5.5 V  | 0.35 μA Typ.(3 V)            | —                |                                   |                                 | For automotive                     |
| RA-4574 SA        |               |                                                  | 1.6 V to 5.5 V    | 1.6 V to 5.5 V  | 0.5 μA Typ.(3 V)             | —                |                                   |                                 |                                    |
| RTC-4574 SA/JE/NB |               |                                                  | 2.5 V to 5.5 V    | 1.4 V to 5.5 V  | 0.5 μA Typ.(2 V)             | —                | —                                 | 32.768 kHz, 1 Hz                | —                                  |
| RTC-4543 SA/SB    |               |                                                  | 1.6 V to 5.5 V    | 1.3 V to 5.5 V  | 0.35 μA Typ.(3 V)            | —                | Minute to Day                     | 32.768 kHz                      | Built-in external event detection. |
| RX-4575LC         |               |                                                  | 1.6 V to 5.5 V    | 1.1 V to 5.5 V  | 0.32 μA Typ.(3 V)            | —                | Minute to Day and day of the week | 32.768 kHz to 1 Hz              | LOW BACKUP VOLTAGE                 |
| RX-4571LC/NB/SA   |               |                                                  | 1.6 V to 5.5 V    | 1.1 V to 5.5 V  | 0.32 μA Typ.(3 V)            | —                | Minute to Day and day of the week | 32.768 kHz to 1 Hz              | —                                  |

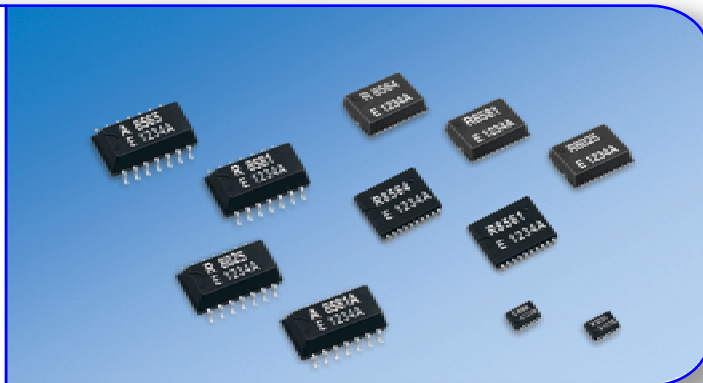
# REAL TIME CLOCK MODULE

## I<sup>2</sup>C-Bus

### ●Features

- ▶ Compliant with I<sup>2</sup>C high-speed bus specifications.
- ▶ Built in frequency adjusted 32.768 kHz crystal unit.

\* The I<sup>2</sup>C-Bus is a trademark of NXP Semiconductors.



### I<sup>2</sup>C-Bus

| Category             | Model                                                                               |            | Actual size (mm)                                                                    |                       | Features                                                                         | Page |
|----------------------|-------------------------------------------------------------------------------------|------------|-------------------------------------------------------------------------------------|-----------------------|----------------------------------------------------------------------------------|------|
| I <sup>2</sup> C Bus |    | RX-8025SA  |    | 10.1×7.4×3.2 t (Typ.) | High-Stability                                                                   | 106  |
|                      |                                                                                     | RX-8025NB  |    | 6.3×5.2×1.4 t (Max.)  |                                                                                  |      |
|                      |                                                                                     | RTC-8564JE |    | 7.3×6.2×1.5 t (Max.)  | Low power consumption                                                            | 107  |
|                      |                                                                                     | RTC-8564NB |    | 6.3×5.2×1.4 t (Max.)  |                                                                                  |      |
|                      |                                                                                     | RX-8564LC  |    | 3.6×2.8×1.2 t (Max.)  |                                                                                  |      |
|                      |    | RA-8565SA  |    | 10.1×7.4×3.2 t (Typ.) | For Automotive                                                                   | 109  |
|                      |   | RX-8571SA  |   | 10.1×7.4×3.2 t (Typ.) | Low power consumption<br>128 bit User RAM<br>Long-running timer<br>(65000 hours) | 110  |
|                      |                                                                                     | RX-8571NB  |  | 6.3×5.2×1.4 t (Max.)  |                                                                                  |      |
|                      |                                                                                     | RX-8571LC  |  | 3.6×2.8×1.2 t (Max.)  |                                                                                  |      |
|                      |                                                                                     | RX-8581SA  |  | 10.1×7.4×3.2 t (Typ.) | Simple Function                                                                  | 111  |
|                      |                                                                                     | RX-8581JE  |  | 7.3×6.2×1.5 t (Max.)  |                                                                                  |      |
|                      |                                                                                     | RX-8581NB  |  | 6.3×5.2×1.4 t (Max.)  |                                                                                  |      |
|                      |  | RA-8581SA  |  | 10.1×7.4×3.2 t (Typ.) | For Automotive                                                                   | 112  |
|                      |  | RX-8731LC  |  | 3.6×2.8×1.2 t (Max.)  | Built-in EEPROM and Unique ID-ROM                                                | 113  |
|                      |                                                                                     | RX-8801SA  |  | 10.1×7.4×3.2 t (Typ.) | Built-in DTCXO                                                                   | 114  |

### ▶ Specifications

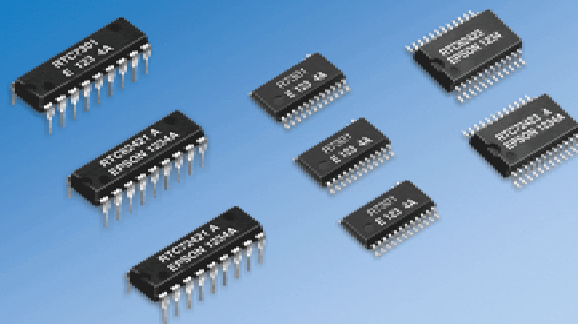
| Item            | Interface            | Frequency tolerance (Standard)                   | Interface voltage | Clock voltage   | Current consumption (Backup) | Memory                             | Alarm                             | Time interval of standard pulse | Other features                              |
|-----------------|----------------------|--------------------------------------------------|-------------------|-----------------|------------------------------|------------------------------------|-----------------------------------|---------------------------------|---------------------------------------------|
| RX-8025 SA/NB   | I <sup>2</sup> C Bus | 5±5 × 10 <sup>-6</sup><br>0±5 × 10 <sup>-6</sup> | 1.7 V to 5.5 V    | 1.15 V to 5.5 V | 0.48 μA Typ.(3 V)            | —                                  | Minute to Hour                    | 32.768 kHz                      | High-Stability                              |
| RX-8564 LC      |                      | 5±23 × 10 <sup>-6</sup>                          | 1.8 V to 5.5 V    | 1.0 V to 5.5 V  | 0.28 μA Typ.(3 V)            | —                                  | Minute to Day and day of the week | 32.768 kHz to 1 Hz              | Low power consumption                       |
| RTC-8564 JE/NB  |                      |                                                  | 1.8 V to 5.5 V    | 1.7 V to 5.5 V  | 0.55 μA Typ.(3 V)            | —                                  | Minute to Day and day of the week |                                 | Low power consumption                       |
| RA-8565SA       |                      |                                                  | 1.8 V to 5.5 V    | 1.7 V to 5.5 V  | 0.55 μA Typ.(3 V)            | —                                  | Minute to Day and day of the week | 32.768 kHz to 1 Hz              | For automotive                              |
| RX-8571SA/NB/LC |                      |                                                  | 1.6 V to 5.5 V    | 1.3 V to 5.5 V  | 220 nA Typ.(3 V)             | 128 bit                            | Minute to Day and day of the week | 32.768 kHz to 1 Hz              | Low power consumption<br>Long-running timer |
| RA-8581 SA      |                      |                                                  | 1.8 V to 5.5 V    | 1.6 V to 5.5 V  | 0.45 μA Typ.(3 V)            | —                                  | Minute to Day and day of the week | 32.768 kHz                      | For automotive                              |
| RX-8581 SA/JE   |                      |                                                  | 1.8 V to 5.5 V    | 1.6 V to 5.5 V  | 0.45 μA Typ.(3 V)            | —                                  | Minute to Day and day of the week | 32.768 kHz                      | Simple Function                             |
| RX-8731LC       |                      |                                                  | 1.7 V to 5.5 V    | 1.3 V to 5.5 V  | 0.35 μA Typ.(3 V)            | 80 bit (EEPROM)<br>48 bit (ID-ROM) | Minute to Day and day of the week | 32.768 kHz to 1 Hz              | Built-in EEPROM and Unique ID-ROM           |
| RX-8801SA       |                      | ±5 × 10 <sup>-6</sup>                            | 1.8 V to 5.5 V    | 1.6 V to 5.5 V  | 0.8 μA Typ.(3 V)             | —                                  | Minute to Day and day of the week | 32.768 kHz to 1 Hz              | Built-in DTCXO                              |

# REAL TIME CLOCK MODULE

## Parallel 4-bit

### ●Features

- ▶ Parallel interface.
- ▶ Built in frequency adjusted 32.768 kHz crystal unit.



### ■Parallel 4-bit

| Category       | Model      | Actual size (mm)                                                                                         | Features                    | Page |
|----------------|------------|----------------------------------------------------------------------------------------------------------|-----------------------------|------|
| Parallel 4-bit | RTC-7301SF |  10.5×8.1×2.0 t (Max.)  | Built-in Temperature Sensor | 115  |
|                | RTC-7301DG |  DIP 18 pin             | Available Alarm and Timer   |      |
|                | RTC-62421  |  DIP 18 pin             | 4-bit Simple Function       | 116  |
|                | RTC-62423  |  16.3×12.2×2.8 t (Max.) |                             |      |
|                | RTC-72421  |  DIP 18 pin             |                             | 117  |
|                | RTC-72423  |  16.3×12.2×2.8 t (Max.) |                             |      |

### ► Specifications

| Item           | Interface      | Frequency tolerance (Standard)                     | Interface voltage | Clock voltage  | Current consumption (Backup) | Memory | Alarm                             | Time interval of standard pulse | Other features                 |
|----------------|----------------|----------------------------------------------------|-------------------|----------------|------------------------------|--------|-----------------------------------|---------------------------------|--------------------------------|
| Model          |                |                                                    |                   |                |                              |        |                                   |                                 |                                |
| RTC-7301 SF/DG | 4-bit Parallel | $5 \pm 23 \times 10^{-6}$                          | 2.4 V to 5.5 V    | 1.6 V to 5.5 V | 0.6 $\mu$ A Typ.(3 V)        | —      | Second to Day and day of the week | 32.768 kHz to 1/30 Hz           | High speed access 3V operation |
| RTC-62421      |                | $\pm 10 \times 10^{-6}$<br>$\pm 50 \times 10^{-6}$ | 4.5 V to 5.5 V    | 2.0 V to 5.5 V | 1.0 $\mu$ A Typ.(2 V)        | —      | —                                 | 64 Hz, 1 s, 1 min, 1 h          | Intel bus                      |
| RTC-62423      |                | $\pm 20 \times 10^{-6}$<br>$\pm 50 \times 10^{-6}$ |                   |                |                              | —      | —                                 |                                 |                                |
| RTC-72421      |                | $\pm 10 \times 10^{-6}$<br>$\pm 50 \times 10^{-6}$ |                   |                | 0.9 $\mu$ A Typ.(2 V)        | —      | —                                 |                                 |                                |
| RTC-72423      |                | $\pm 20 \times 10^{-6}$<br>$\pm 50 \times 10^{-6}$ |                   |                |                              | —      | —                                 |                                 |                                |
| RTC-72423      |                | $\pm 20 \times 10^{-6}$<br>$\pm 50 \times 10^{-6}$ |                   |                |                              | —      | —                                 |                                 |                                |

### Bits of knowledge

Frequency accuracy and clock accuracy

The expression of accuracy in time measurement has a monthly deviation that shows how many seconds in a month.

Our real time clock module has a built-in oscillation circuit with a tuning fork crystal unit and is shown in the chart below as frequency tolerance.

The calculation for conversion is simple. Multiply the seconds in a month by the frequency tolerance.

For example

$$\text{Frequency tolerance } \pm 10 \times 10^{-6} : 30 \text{ days} \times 24 \text{ hours} \times 60 \text{ minutes} \times 60 \text{ seconds} \times 10 \times 10^{-6} \\ = \text{Equivalent to 30 seconds of monthly deviation}$$

| Frequency tolerance           | Monthly deviation (+25°C)                                    | Model                                        |
|-------------------------------|--------------------------------------------------------------|----------------------------------------------|
| $\pm 5 \times 10^{-6}$        | Equivalent to 13 seconds<br>(+30seconds/-0 seconds)          | RX-4045series, RX-8025series, RTC-7301series |
| $\pm 5 \pm 23 \times 10^{-6}$ | Equivalent to 1 minute<br>(+1 minute 15 seconds/-45 seconds) | RX-4574series, RX-8564series, etc.           |
| $0 \pm 5 \times 10^{-6}$      | Equivalent to 13 seconds                                     | RX-4045series, RX-8025series, RTC-7301series |
| $\pm 10 \times 10^{-6}$       | Equivalent to 30 seconds                                     | RTC-62421, RTC-72421                         |
| $\pm 20 \times 10^{-6}$       | Equivalent to 1 minute                                       | RTC-62423, RTC-72423                         |
| $\pm 50 \times 10^{-6}$       | Equivalent to 2 minutes 15 seconds                           | RTC-62421, RTC-72421, RTC-62423, RTC-72423   |

Attention: Temperature variation and power supply voltage variation are not considered.

The frequency of the temperature variation among the tuning fork crystal units is set off by a value of +5 because of negative shifts.



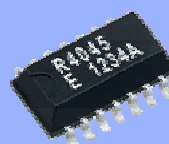
# High-Stability Frequency SERIAL-INTERFACE REAL TIME CLOCK MODULE

## RX-4045 SA / NB

- Built-in 32.768 kHz crystal unit: Frequency adjusted for high accuracy.  
( $\pm 5 \times 10^{-6}$  /  $T_a = +25^\circ\text{C}$ )
- Interface Type : 4-wire serial interface
- Operating voltage range : 1.7 V to 5.5 V
- Wide Timekeeper voltage range : 1.15 V to 5.5 V
- Various detection Functions : Oscillation stop detection function etc.
- Low backup current : 0.48  $\mu\text{A}$  / 3 V (Typ.)
- 32.768 kHz clock frequency output : N-ch open drain output
- Function of time and calendar, the various detection function, and interrupt function etc.



Product Number (Please contact us)  
RX-4045SA : Q41404551xxxx00  
RX-4045NB : Q41404591xxxx00

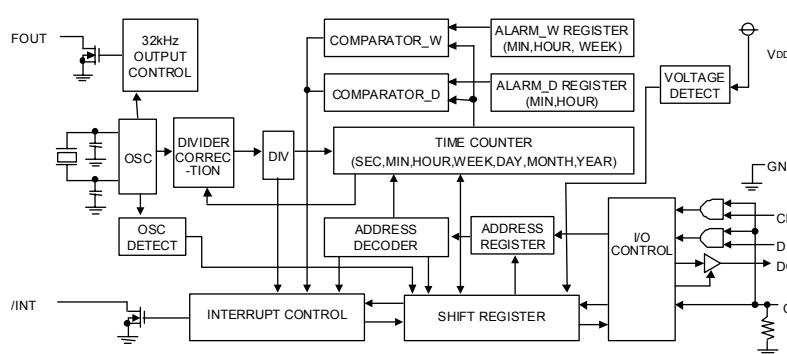


Actual size

RX-4045SA

RX-4045NB

### Block diagram



### Features built-in 32.768 kHz crystal unit

- Frequency adjusted for high accuracy  
( $\pm 5 \times 10^{-6}$  /  $T_a = +25^\circ\text{C}$ )  
(Equivalent to 13 seconds of monthly deviation)

### The various detection Function

- Power supply voltage monitoring function  
(with selectable detection threshold)
- Stop detection function
- Power-on reset detection function

### Equipped with alarm and timer

- Timer function produces a periodic interruption signal.  
As for the Alarm function an optional combination is produced. (Date of the week, time, minute)

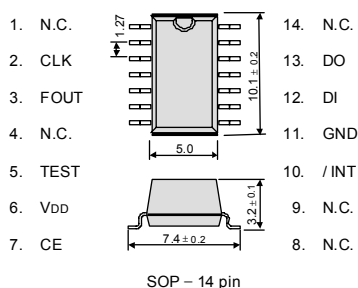
### Pin function

| Signal Name | Input / Output | Function                                                                                                                      |
|-------------|----------------|-------------------------------------------------------------------------------------------------------------------------------|
| CE          | Input          | The chip enabled input pin.<br>( built-in pull-down resistance )<br>At the "H" level, access becomes possible.                |
| CLK         | Input          | The shift clock input pin for serial data transfer.                                                                           |
| DI          | Input          | The data input pin for serial data transfer.                                                                                  |
| DO          | Output         | The data output pin for serial data transfer.                                                                                 |
| FOUT        | Output         | 32.768 kHz clock output pin with the output control function ( N-ch open drain )<br>High impedance at the time of output off. |
| /INT        | Output         | Interrupt output ( N-ch open drain )                                                                                          |
| TEST        | —              | * Used by the manufacturer for testing.<br>(Do not connect externally.)                                                       |
| VDD         | —              | Connected to a positive power supply.                                                                                         |
| GND         | —              | Connected to a ground.                                                                                                        |

### Terminal connection / External dimensions

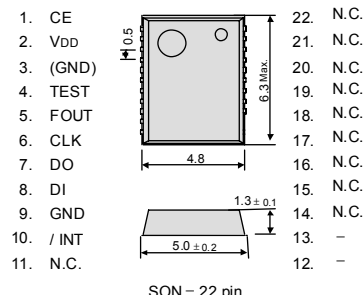
(Unit:mm)

#### RX-4045 SA



SOP - 14 pin

#### RX-4045 NB



SON - 22 pin

Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

### Specifications (characteristics)

\* Refer to application manual for details.

#### Recommended Operating Conditions

| Item                  | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------|--------|-----------|------|------|------|------|
| Power voltage         | VDD    | —         | 1.7  | 3.0  | 5.5  | V    |
| Clock voltage         | VCLK   | —         | 1.15 | 3.0  | 5.5  | V    |
| Operating temperature | TOPR   | —         | -40  | +25  | +85  | °C   |

#### Frequency characteristics

| Item                                | Symbol         | Condition                                                               | Rating                                                       | Unit             |
|-------------------------------------|----------------|-------------------------------------------------------------------------|--------------------------------------------------------------|------------------|
| Frequency tolerance                 | $\Delta f / f$ | $T_a = +25^\circ\text{C}$<br>$V_{DD} = 3.0 \text{ V}$                   | AA: $5 \pm 5$ <sup>*1)</sup><br>AC: $0 \pm 5$ <sup>*2)</sup> | $\times 10^{-6}$ |
| Oscillation start-up time           | $t_{STA}$      | $T_a = +25^\circ\text{C}$<br>$V_{DD} = 2.0 \text{ V}$                   | 1 Max.                                                       | s                |
| Frequency / voltage characteristics | $f / V$        | $T_a = +25^\circ\text{C}$<br>$V_{DD} = 2.0 \text{ V to } 5.5 \text{ V}$ | $\pm 1$ Max.                                                 | $\times 10^{-6}$ |

\*1) \*2) Equivalent to 13 seconds of monthly deviation (excluding offset.)

#### Current consumption characteristics

 $T_a = -40^\circ\text{C to } +85^\circ\text{C}$ 

| Item                | Symbol           | Condition                               | Min.                   | Typ. | Max. | Unit          |
|---------------------|------------------|-----------------------------------------|------------------------|------|------|---------------|
| Current Consumption | I <sub>bk</sub>  | CE = GND<br>FOUT ; output OFF (Hi-z)    | $V_{DD} = 5 \text{ V}$ | 0.60 | 1.80 | $\mu\text{A}$ |
|                     |                  |                                         | $V_{DD} = 3 \text{ V}$ | 0.48 | 1.20 |               |
|                     | I <sub>32k</sub> | CE = GND<br>FOUT ; 32.768 kHz output ON | $V_{DD} = 3 \text{ V}$ | 0.65 | 2.00 | $\mu\text{A}$ |

#### Power supply detection voltage

 $T_a = -30^\circ\text{C to } +70^\circ\text{C}$ 

| Item              | Symbol            | Condition | Min. | Typ. | Max. | Unit |
|-------------------|-------------------|-----------|------|------|------|------|
| High-voltage mode | V <sub>DETH</sub> | VDD pin   | 1.90 | 2.10 | 2.30 | V    |
| Low-voltage mode  | V <sub>DETL</sub> | VDD pin   | 1.15 | 1.30 | 1.45 | V    |



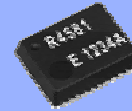
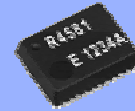
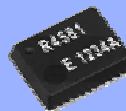
## Built-in SRAM SERIAL-INTERFACE REAL TIME CLOCK MODULE

# RX - 4581 NB

- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : 4-wire serial interface
- Operating voltage range : 1.6 V to 5.5 V
- Wide Timekeeper voltage range : 1.6 V to 5.5 V
- Low backup current : 0.4  $\mu$ A / 3 V (Typ.)
- Built-in SRAM : Built-in 128 bit (8 bit  $\times$  16) RAM.
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer.



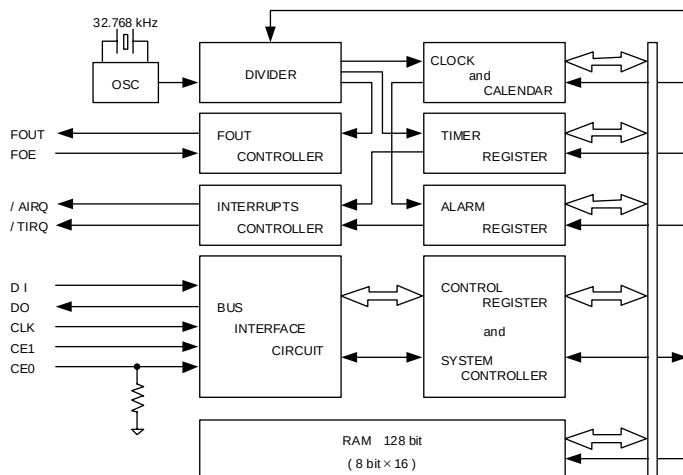
Product Number (Please contact us)  
RX-4581NB : Q41458191000200



Actual size



### Block diagram



### Overview

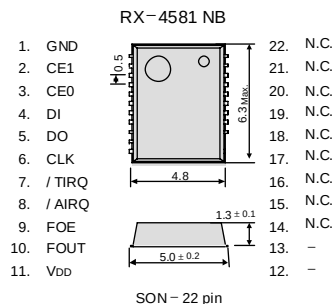
- Built-in SRAM
  - Include 128 bit (8 bit  $\times$  16) RAM.
- Interface Type
  - Serial interface in 4 lines form.
  - \* It is possible to make it to 3 lines by wired-OR connecting DI and DO pins.
- 32.768 kHz frequency output function
  - FOUT pin output (C-MOS output), CL=30 pF
  - FOE pin enables output on/off control.
- Timer function
  - Timer function can be set up between 1/4096 second and 4095 minutes.
  - It is recorded automatic to TF-bit at the time of event occurrence, and possible to output with /TIRQ pin output (open-drain output).
- Interrupt function
  - Alarm interrupt function, and timer interrupt function.

### Pin Function

| Signal Name | Input/Output | Function                                                                                                           |
|-------------|--------------|--------------------------------------------------------------------------------------------------------------------|
| CE0         | Input        | The chip enabled input pin 0. (It has a built-in pull-down resistance)                                             |
| CE1         | Input        | The chip enabled input pin 1. (It does not have a built-in pull-down resistance)                                   |
| CLK         | Input        | The shift clock input pin for serial data transfer.                                                                |
| DI          | Input        | The data input pin for serial data transfer.                                                                       |
| DO          | Output       | The data output pin for serial data transfer.                                                                      |
| FOUT        | Output       | This pin outputs the reference clock signal at 32.768 kHz (CMOS output). High impedance at the time of output off. |
| FOE         | Input        | The input pin for the FOUT output control.                                                                         |
| /AIRQ       | Output       | The open drain output pin for alarm and time update interrupts.                                                    |
| /TIRQ       | Output       | The open drain output pin for timer interrupt.                                                                     |
| VDD         | —            | Connected to a positive power supply.                                                                              |
| GND         | —            | Connected to a ground.                                                                                             |

### Terminal connection / External dimensions

(Unit:mm)



Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

### Specifications (characteristics)

\* Refer to application manual for details.

#### Recommended Operating Conditions

| Item                  | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------|--------|-----------|------|------|------|------|
| Power voltage         | VDD    | —         | 1.6  | 3.0  | 5.5  | V    |
| Clock voltage         | VCLK   | —         | 1.6  | 3.0  | 5.5  | V    |
| Operating temperature | TOPR   | —         | -40  | +25  | +85  | °C   |

#### Frequency characteristics

| Item                      | Symbol       | Condition                  | Rating       | Unit             |
|---------------------------|--------------|----------------------------|--------------|------------------|
| Frequency tolerance       | $\Delta f/f$ | Ta = +25 °C<br>VDD = 3.0 V | 5 $\pm$ 23 * | $\times 10^{-6}$ |
| Oscillation start-up time | tSTA         | Ta = +25 °C<br>VDD = 3.0 V | 3 Max.       | s                |

\* Please ask for tighter tolerance. (Equivalent to 1 minute of monthly deviation)

#### Current consumption characteristics

Ta = -40 °C to +85 °C

| Item                | Symbol | Condition                                   | Min.      | Typ. | Max. | Unit    |
|---------------------|--------|---------------------------------------------|-----------|------|------|---------|
| Current Consumption | IBK    | CE0, CE1 = GND<br>FOE = GND                 | VDD = 5 V | 0.6  | 1.2  | $\mu$ A |
|                     |        | FOUT; output OFF (Hi-Z)                     | VDD = 3 V | 0.4  | 0.8  |         |
|                     | I32k   | CE0, CE1 = GND<br>FOE = VDD                 | VDD = 5 V | 8.0  | 20.0 | $\mu$ A |
|                     |        | FOUT;<br>32.768 kHz output ON<br>CL = 30 pF | VDD = 3 V | 5.0  | 12.0 |         |



**LOW BACKUP VOLTAGE  
SERIAL-INTERFACE REAL TIME CLOCK MODULE**

# RX - 4571 LC / NB / SA

- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : 3-wire serial interface
- Operating voltage range : 1.6 V to 5.5 V
- Wide Timekeeper voltage range : 1.0 V to 5.5 V / Ta = +25 °C
- Low backup current : 0.32 μA (Typ.) / 3 V
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- Real-time clock function  
Clock/calendar function, auto leap year correction function,  
alarm interrupt function, etc.



Product Number (Please contact us)

**RX-4571LC : Q414571C1000100**

**RX-4571NB : Q41457191000100**

RX-4571SA : 041457151000100



Actual size

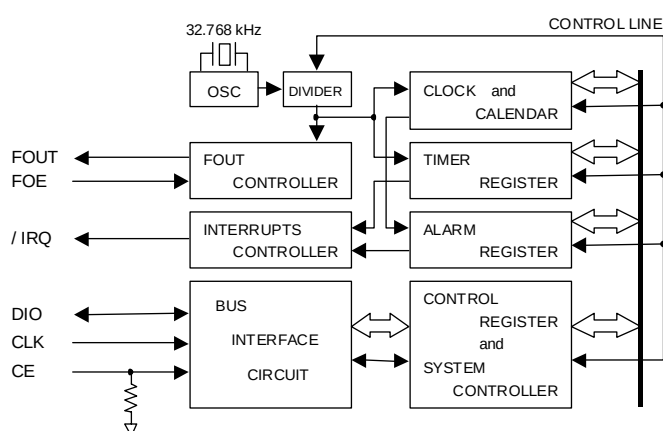
RX-4571LC

RX-4571NB

RX-4571SA



## Block diagram



## Overview

- **32.768 kHz frequency output function**
  - FOUT pin output ( C-MOS output ) , CL=30 pF
- **Timer function**
  - Timer function which can be set up between 1/4096 second and 4095 minutes.
- **Alarm function**
  - Alarm function can be set to any combination of day, day of week, hour, or minute.
- **Pin Function**

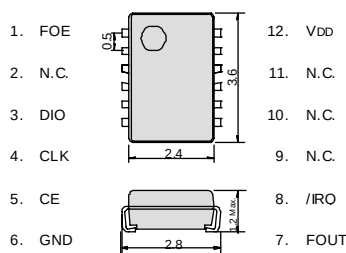
- **Pin Function**

| Signal Name     | Input / Output | Function                                                                     |
|-----------------|----------------|------------------------------------------------------------------------------|
| CE              | Input          | The chip enabled input pin 0.<br>( It has a built -in pull-down resistance ) |
| CLK             | Input          | The shift clock input pin for serial data transfer.                          |
| DIO             | Bi-directional | The data input / output pin for serial data transfer.                        |
| FOUT            | Output         | 32.768 kHz clock output pin with the output control function. ( C-MOS )      |
| FOE             | Input          | FOE pin control the condition of FOUT with FSEL1-bit, FSEL0-bit, etc.        |
| / IRQ           | Output         | Interrupt output ( N-ch open drain )                                         |
| V <sub>DD</sub> | —              | Connected to a positive power supply.                                        |
| GND             | —              | Connected to a ground.                                                       |

## Terminal connection / External dimensions

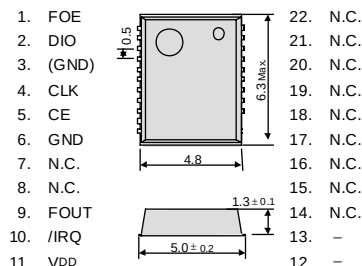
(Unit:mm)

RX-4571 LC



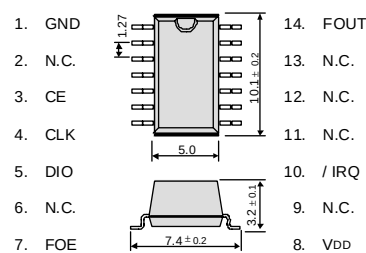
VSOJ – 12pin

RX - 4571 NB



SON - 22 pin

RX - 4571 SA



SOP - 14 pin

Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

### Specifications (characteristics)

\* Refer to application manual for details.

### ■ Recommended Operating Conditions

| Item                  | Symbol           | Condition                      | Min. | Typ. | Max. | Unit |
|-----------------------|------------------|--------------------------------|------|------|------|------|
| Power voltage         | V <sub>DD</sub>  | —                              | 1.6  | 3.0  | 5.5  | V    |
| Clock voltage         | V <sub>CLK</sub> | T <sub>a</sub> = +25 °C        | 1.0  | 3.0  | 5.5  | V    |
|                       |                  | T <sub>a</sub> = -40 to +85 °C | 1.1  | 3.0  | 5.5  | V    |
| Operating temperature | T <sub>OPR</sub> | —                              | -40  | +25  | +85  | °C   |

### ■ Frequency characteristics

| Item                      | Symbol         | Condition                  | Rating   | Unit               |
|---------------------------|----------------|----------------------------|----------|--------------------|
| Frequency tolerance       | $\Delta f / f$ | Ta = +25 °C<br>VDD = 3.0 V | 5 ± 23 * | × 10 <sup>-6</sup> |
| Oscillation start-up time | tSTA           | Ta = +25 °C<br>VDD = 1.6 V | 1 Max.   | s                  |

\* Please ask for tighter tolerance. (Equivalent to 1 minute of monthly deviation)

### ■ Current consumption characteristics

$T_a = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$

| Symbol           | Condition                                                   | Min.                     | Typ. | Max. | Unit |
|------------------|-------------------------------------------------------------|--------------------------|------|------|------|
| I <sub>BK</sub>  | CE = GND<br>/IRQ = OFF                                      | V <sub>DD</sub><br>= 5 V | 0.40 | 1.00 | μA   |
|                  | FOUT ;<br>output OFF ( Hi - z )                             | V <sub>DD</sub><br>= 3 V | 0.32 | 0.95 |      |
| I <sub>32k</sub> | CE = GND<br>/IRQ = OFF                                      | V <sub>DD</sub><br>= 5 V | 8.0  | 14.0 | μA   |
|                  | FOUT ;<br>32.768 kHz output<br>ON<br>C <sub>I</sub> = 30 pF | V <sub>DD</sub><br>= 3 V | 5.0  | 8.5  |      |





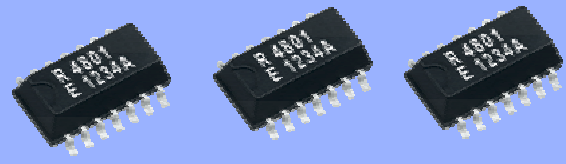
## Built-in 32.768 kHz-DTCXO, High Stability SERIAL-INTERFACE REAL TIME CLOCK MODULE

### RX - 4801 SA

- Built in frequency adjusted 32.768 kHz crystal unit and DTCXO.
- Interface Type : 4-wire serial interface
- Interface voltage range : 1.8 V to 5.5 V
- Temp.compensated voltage range: 2.2 V to 5.5 V
- Wide Timekeeper voltage range : 1.6 V to 5.5 V
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer.



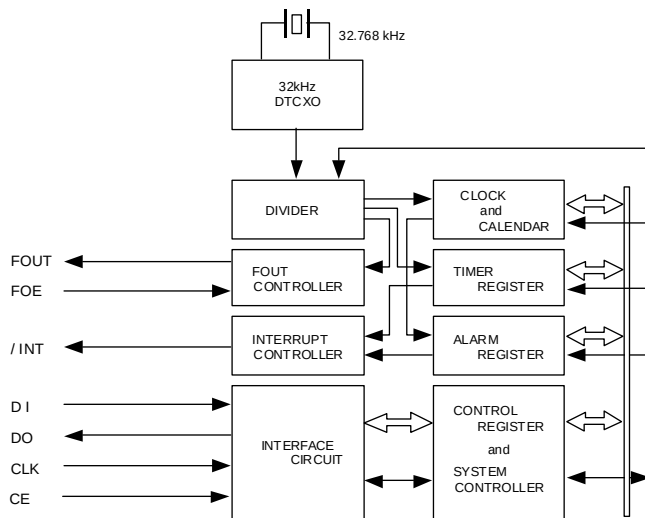
Product Number (Please contact us)  
RX-4801SA : X1B000021xxxx00



Actual size

**NEW**

#### Block diagram



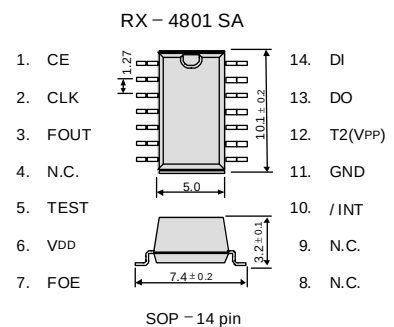
#### Overview

- High Stability
  - UA
    - $\pm 1.9 \times 10^{-6}$  /  $0^\circ\text{C}$  to  $+40^\circ\text{C}$   
(Equivalent to 5 seconds of month deviation)
    - $\pm 3.4 \times 10^{-6}$  /  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$   
(Equivalent to 9 seconds of month deviation)
  - UB
    - $\pm 3.8 \times 10^{-6}$  /  $0^\circ\text{C}$  to  $+50^\circ\text{C}$   
(Equivalent to 10 seconds of month deviation)
    - $\pm 5.0 \times 10^{-6}$  /  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$   
(Equivalent to 13 seconds of month deviation)
- 32.768 kHz frequency output function
  - FOUT pin output (C-MOS output),  $\text{CL}=30\text{ pF}$
  - Output selectable  
< 32.768 kHz, 1024 Hz, 1 Hz >
- The various interrupt
  - Timer Function can be set up between  
1/ 4096 second and 255 minutes.
  - Alarm Function can be set to day of week,  
day, hour, or minute.

#### Pin Function

| Signal Name | Pin No. | I / O  | Function                                                              |
|-------------|---------|--------|-----------------------------------------------------------------------|
| CE          | 1       | input  | The chip enable input pin.                                            |
| CLK         | 2       | input  | The shift clock input pin for serial data transfer.                   |
| FOUT        | 3       | Output | The pin outputs the reference clock signal.<br>(CMOS output)          |
| TEST        | 5       | input  | * Use by the manufacture for testing.<br>(Do not connect externally.) |
| VDD         | 6       | -      | Connected to a positive power supply                                  |
| FOE         | 7       | input  | The input pin for the FOUT output control.                            |
| /INT        | 10      | Output | The open drain output for interrupt.                                  |
| GND         | 11      | -      | Connected to a ground                                                 |
| T2(VPP)     | 12      | -      | * Use by the manufacture for testing.<br>(Do not connect externally.) |
| DO          | 13      | Output | The data output pin for serial data transfer.                         |
| DI          | 14      | input  | The data input pin for serial data transfer.                          |

#### Terminal connection / External dimensions (Unit:mm)



Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

#### Specifications (characteristics)

\* Refer to application manual for details.

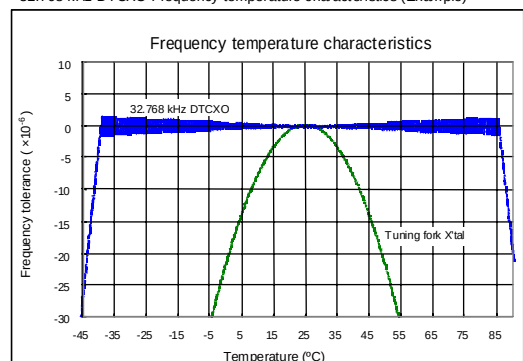
##### Electrical Characteristics

| Item                      | Symbol         | Condition                                                    | Min.                                             | Typ. | Max.           | Unit             |
|---------------------------|----------------|--------------------------------------------------------------|--------------------------------------------------|------|----------------|------------------|
| Interface voltage         | VDD            | Interface voltage                                            | 1.8                                              | 3.0  | 5.5            | V                |
| Temp. compensated voltage | VTEM           | Temp. compensated voltage                                    | 2.2                                              | 3.0  | 5.5            | V                |
| Clock voltage             | VCLK           | -                                                            | 1.6                                              | 3.0  | 5.5            | V                |
| Operating temperature     | TOPR           | -                                                            | -40                                              | +25  | +85            | °C               |
| Stability                 | $\Delta f / f$ | UA                                                           | $T_a = 0^\circ\text{C}$ to $+40^\circ\text{C}$   |      | $\pm 1.9^{*1}$ | $\times 10^{-6}$ |
|                           |                | UB                                                           | $T_a = -40^\circ\text{C}$ to $+85^\circ\text{C}$ |      | $\pm 3.4^{*2}$ |                  |
|                           |                | UB                                                           | $T_a = 0^\circ\text{C}$ to $+50^\circ\text{C}$   |      | $\pm 3.8^{*3}$ |                  |
|                           |                | UB                                                           | $T_a = -40^\circ\text{C}$ to $+85^\circ\text{C}$ |      | $\pm 5.0^{*4}$ |                  |
| Current consumption (1)   | IBK1           | Backup Mode<br>FOE = GND,<br>/INT = VDD<br>FOUT output : OFF | VDD = 5V                                         |      | -              | $\mu\text{A}$    |
| Current consumption (2)   | IBK2           |                                                              | VDD = 3V                                         |      | -              |                  |

\*1) Equivalent to 5 seconds of month deviation. \*2) Equivalent to 9 seconds of month deviation.

\*3) Equivalent to 10 seconds of month deviation. \*4) Equivalent to 13 seconds of month deviation.

##### 32.768 kHz-DTCXO Frequency temperature characteristics (Example)



**Built-in EEPROM**  
**SERIAL-INTERFACE REAL TIME CLOCK MODULE**

# RTC - 9701 JE

- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : 4-wire serial interface
- Operating voltage range : 2.7 V to 3.6 V
- Wide Timekeeper voltage range : 1.8 V to 5.5 V
- Include EEPROM : 4 kbit ( 256 × 16 bit )
- Various detection Functions : Ex.Power supply voltage monitoring function
- 32.768 kHz frequency output function : C-MOS output/With Control Pin
- The various functions include full calendar, alarm, timer.



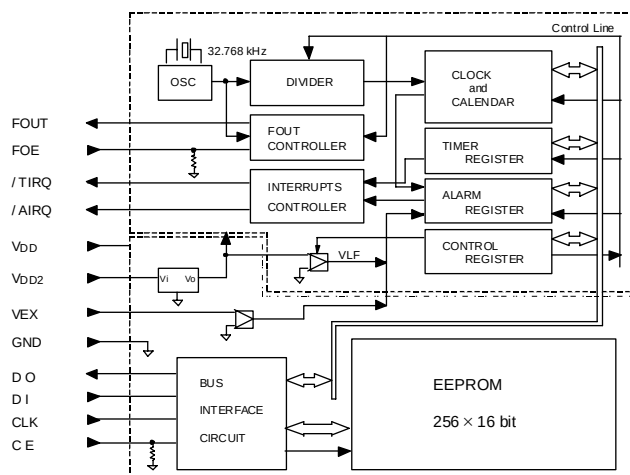
Product Number (Please contact us)  
**RTC-9701JE : O41970171000100**



Actual size



## Block diagram



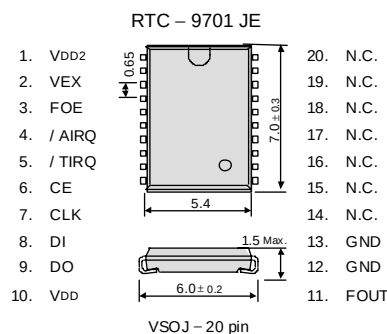
## Overview

- **Include EEPROM**
  - 4 kbit ( 256 × 16 bit ) User Memory.
- **The various Power supply voltage monitoring function**
  - VEX input pin : Power supply voltage monitoring function
  - VDD2 pin : Low voltage detection function
  - Oscillation circuit : Low voltage detection function
- **Interface Type**
  - Serial interface in 4 lines form.
    - \* It is possible to make it to 3 lines by wired-OR connecting DI and DO pins.
- **32.768 kHz frequency output function**
  - FOUT pin output (C-MOS output)
  - FOE pin enables output on/off control.
- **The various interrupt function**
  - Alarm interrupt function,  
Time-update interrupt function, timer function.

### Pin Function

| Signal Name | Input / Output | Function                                                                                                            |
|-------------|----------------|---------------------------------------------------------------------------------------------------------------------|
| VDD         | —              | Connected to a positive power supply.                                                                               |
| VDD2        | —              | Real time clock module power.<br>* Always supply the power irrespective of action situation to this terminal.       |
| VEX         | —              | External voltage detection input pin                                                                                |
| CE          | Input          | The chip enabled input pin. ( built -in pull-down resistance )                                                      |
| CLK         | Input          | The shift clock input pin for serial data transfer.                                                                 |
| DI          | Input          | The data input pin for serial data transfer.                                                                        |
| DO          | Output         | The data output pin for serial data transfer.                                                                       |
| FOUT        | Output         | This pin outputs the reference clock signal at 32.768 kHz ( C-MOS output ).<br>Low level at the time of output off. |
| FOE         | Input          | The input pin for the FOUT output control.                                                                          |
| / AIRQ      | Output         | Open drain output pin for alarm and time update interrupts.                                                         |
| / TIRQ      | Output         | Open drain output pin for timer interpt.                                                                            |
| GND         | —              | Connected to a ground.                                                                                              |

## Terminal connection / External dimensions (Unit:mm)



Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

### Specifications (characteristics)

\* Refer to application manual for details.

### ■ Recommended Operating Conditions

| Item                  | Symbol           | Condition            | Min. | Typ. | Max. | Unit |
|-----------------------|------------------|----------------------|------|------|------|------|
| Power voltage         | V <sub>DD</sub>  | V <sub>DD pin</sub>  | 2.7  | 3.0  | 3.6  | V    |
| Clock voltage         | V <sub>DD2</sub> | V <sub>DD2 pin</sub> | 1.8  | 3.0  | 5.5  | V    |
| Analog voltage        | V <sub>EX</sub>  | V <sub>EX pin</sub>  | 1.4  |      | 5.5  | V    |
| Operating temperature | T <sub>OPR</sub> | —                    | -40  | +25  | +85  | °C   |

### ■ Frequency characteristics

| Item                | Symbol         | Condition                  | Rating   | Unit               |
|---------------------|----------------|----------------------------|----------|--------------------|
| Frequency tolerance | $\Delta f / f$ | Ta = +25 °C<br>VDD = 3.0 V | 5 ± 23 * | × 10 <sup>-6</sup> |

\* Please ask for tighter tolerance. (Equivalent to 1 minute of monthly deviation)

\* If not specifically indicated,  $V_{DD} = 2.7 \text{ V}$  to  $3.6 \text{ V}$ ,  $V_{DD2} = 1.8 \text{ V}$  to  $5.5 \text{ V}$ ,  $T_a = -40^\circ\text{C}$  to  $+85^\circ\text{C}$

### ■ EEPROM Memory characteristics

| Item                                            | Min.                  | Typ. | Max. | Unit  |
|-------------------------------------------------|-----------------------|------|------|-------|
| Memory contents                                 | 4 kbit (256 × 16 bit) |      |      | —     |
| Program/Erase cycle                             | 10 <sup>5</sup>       |      |      | times |
| Current consumption (write to EEPROM)           |                       | 1    | 3    | mA    |
| Access time                                     |                       | 5    | 10   | ms    |
| CLK clock cycle V <sub>DD</sub> = 3.0 V ± 0.3 V | 1000                  |      |      | ns    |
| CLK clock cycle V <sub>DD</sub> = 3.3 V ± 0.3 V | 900                   |      |      | ns    |

### ■ Access characteristics

| Item            | Min. | Typ. | Max. | Unit |
|-----------------|------|------|------|------|
| CLK clock cycle | 500  |      |      | ns   |



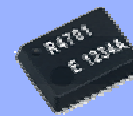
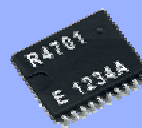
## Built-in Temperature Sensor SERIAL-INTERFACE REAL TIME CLOCK MODULE

# RTC - 4701 JE / NB

- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : 3-wire serial interface
- Operating voltage range : 1.6 V to 5.5 V
- Wide Timekeeper voltage range : 1.6 V to 5.5 V
- Built-in temperature sensor : Detects temperature.  
Converts output to analog voltage
- 32.768 kHz frequency output function: C-MOS output With Control Pin
- Function of time and calendar, the various interrupt function etc.



Product Number (Please contact us)  
 RTC-4701JE : Q41470171000200  
 RTC-4701NB : Q41470191000200



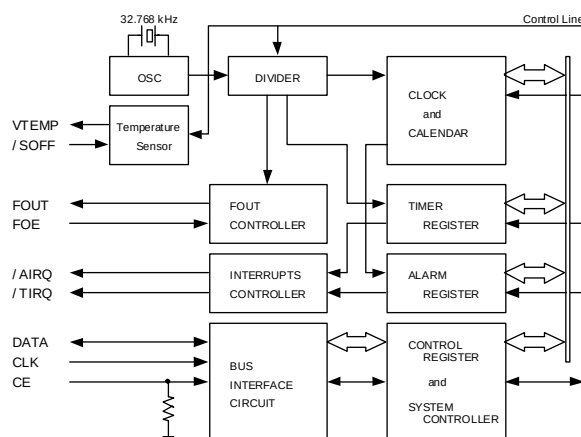
Actual size

RTC-4701JE

RTC-4701NB



### Block diagram



### Overview

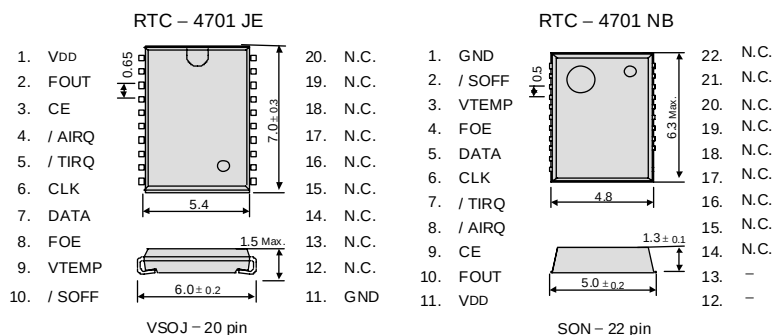
- **Built-in temperature sensor**
  - Diode temperature sensor (analog voltage output)
    - \* temperature sensor operating voltage : 2.7 V to 5.5 V
    - \* temperature sensor tolerance :  $\pm 5^\circ\text{C}$  ( $T_a = +25^\circ\text{C}$ )
    - \* voltage output (analog):  $-7.6\text{ mV}/^\circ\text{C}$  Typ.
- **32.768 kHz frequency output function**
  - FOUT pin output (C-MOS output), CL=30 pF
  - FOE pin enables output on/off control.
- **The various interrupt function**
  - 12 bit additional counter. (to 4095 count)
  - Timer function can be set up between 1/4096 second and 255 minutes.
  - Alarm function can be set to day of week, hour, or minute.

### Pin Function

| Signal Name | Input / Output    | Function                                                                                                                                                                                                   |  |  |           |             |  |      |                   |                |     |            |          |
|-------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|-----------|-------------|--|------|-------------------|----------------|-----|------------|----------|
| CE          | Input             | The chip enabled input pin.<br>(Built-in pull-down resistance)                                                                                                                                             |  |  |           |             |  |      |                   |                |     |            |          |
| CLK         | Input             | The shift clock input pin for serial data transfer.                                                                                                                                                        |  |  |           |             |  |      |                   |                |     |            |          |
| DATA        | Bi-directional    | The data input / output pin for serial data transfer.                                                                                                                                                      |  |  |           |             |  |      |                   |                |     |            |          |
| FOUT        | Output            | <table><tr><th>FOE input</th><th colspan="2">FOUT output</th></tr><tr><td>HIGH</td><td>32.768 kHz output</td><td>* C-MOS output</td></tr><tr><td>LOW</td><td>output OFF</td><td>* Hi - z</td></tr></table> |  |  | FOE input | FOUT output |  | HIGH | 32.768 kHz output | * C-MOS output | LOW | output OFF | * Hi - z |
| FOE input   | FOUT output       |                                                                                                                                                                                                            |  |  |           |             |  |      |                   |                |     |            |          |
| HIGH        | 32.768 kHz output | * C-MOS output                                                                                                                                                                                             |  |  |           |             |  |      |                   |                |     |            |          |
| LOW         | output OFF        | * Hi - z                                                                                                                                                                                                   |  |  |           |             |  |      |                   |                |     |            |          |
| FOE         | Input             |                                                                                                                                                                                                            |  |  |           |             |  |      |                   |                |     |            |          |
| VTEMP       | Output            | The voltage output pin for the temperature sensor (analog).                                                                                                                                                |  |  |           |             |  |      |                   |                |     |            |          |
| /SOFF       | Input             | The input pin for the temperature sensor control.                                                                                                                                                          |  |  |           |             |  |      |                   |                |     |            |          |
| /AIRO       | Output            | Output 1 pin (N-ch open drain)                                                                                                                                                                             |  |  |           |             |  |      |                   |                |     |            |          |
| /TIRO       | Output            | Output 2 pin (N-ch open drain)                                                                                                                                                                             |  |  |           |             |  |      |                   |                |     |            |          |
| VDD         | —                 | Connected to a positive power supply.                                                                                                                                                                      |  |  |           |             |  |      |                   |                |     |            |          |
| GND         | —                 | Connected to a ground.                                                                                                                                                                                     |  |  |           |             |  |      |                   |                |     |            |          |

### Terminal connection / External dimensions

(Unit:mm)



Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

### Temperature sensor characteristics

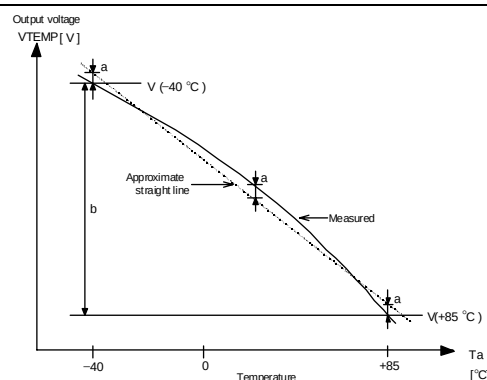
\* Refer to application manual for details.

| Item                        | Symbol            | Condition                                                             | Min. | Typ.  | Max.      | Unit                       |
|-----------------------------|-------------------|-----------------------------------------------------------------------|------|-------|-----------|----------------------------|
| Temperature output voltage  | VTEMP             | VTEMP pin, $T_a = +25^\circ\text{C}$<br>GND based output voltage      |      | 1.480 |           | V                          |
| Output tolerance            | TACR              | $T_a = +25^\circ\text{C}$                                             |      |       | $\pm 5.0$ | $^\circ\text{C}$           |
| Temperature sensitivity     | VSE               | $-40^\circ\text{C} \leq T_a \leq +85^\circ\text{C}$                   | -7.1 | -7.6  | -8.1      | $\text{mV}/^\circ\text{C}$ |
| Linearity                   | $\Delta\text{NL}$ | $-40^\circ\text{C} \leq T_a \leq +85^\circ\text{C}$                   |      |       | $\pm 2.0$ | %                          |
| Temperature detection range | TSOP              | $\Delta\text{NL} \leq \pm 2.0\%$                                      | -40  |       | +85       | $^\circ\text{C}$           |
| Output resistance           | RO                | VTEMP pin, $T_a = +25^\circ\text{C}$<br>GND standard and VDD standard |      | 1.0   | 3.0       | k $\Omega$                 |

\* Temperature sensitivity  $VSE = (V(+85^\circ\text{C}) - V(-40^\circ\text{C})) / 125 [\text{mV}/^\circ\text{C}]$ 

\* Linearity  $\Delta\text{NL} = \frac{a}{b} \times 100 [\%]$

a : Maximum deviation between the measured value of VTEMP and approximate straight line.  
 b : Difference between the measured values at  $-40^\circ\text{C}$  and  $+85^\circ\text{C}$ .

\* Output resistance (Ro)  $Ro = \frac{\Delta V}{\Delta I} [\Omega]$ 



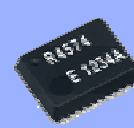
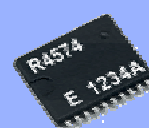
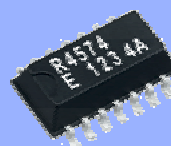
## SERIAL-INTERFACE REAL TIME CLOCK MODULE

## RTC - 4574 SA / JE / NB

- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : 3-wire serial interface
- Operating voltage range : 1.6 V to 5.5 V
- Wide Timekeeper voltage range : 1.6 V to 5.5 V
- Low backup current : 0.5  $\mu$ A / 3 V (Typ.)
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer.



Product Number (Please contact us)  
 RTC-4574SA : Q41457451000200  
 RTC-4574JE : Q41457471000100  
 RTC-4574NB : Q41457491000100



Actual size

RTC-4574SA



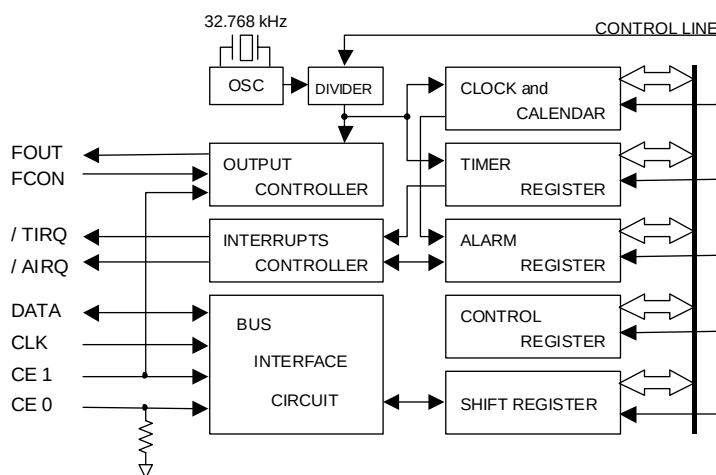
RTC-4574JE



RTC-4574NB



## Block diagram



## Overview

## • 32.768 kHz frequency output function

- FOUT pin output (C-MOS output), CL=30 pF
- Output frequency selectable from 1/30 Hz to 32.768 kHz (32 Values)

## • Timer function

- Timer function can be set up between 1/4096 second and 255 minutes.
- It is recorded automatically to TF-bit at the time of event occurrence, and it's possible to output with /TIRQ pin output (open-drain output).
- Selectable one time mode or repeat mode.

## • Alarm function

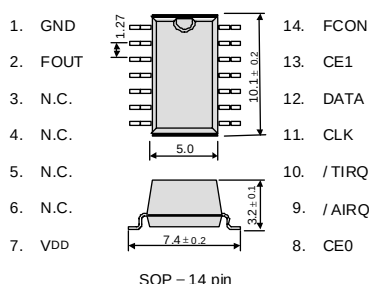
- Alarm function can be set to any combination of day of week, hour, or minute.
- It is recorded automatically to AF-bit at the time of event occurrence, and it's possible to output with /AIRQ pin output (open-drain output).

\* Functions are compatible with RX - 4574 LC.

## Terminal connection / External dimensions

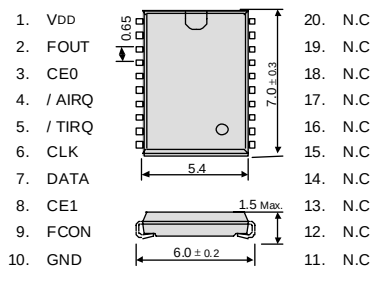
(Unit:mm)

RTC - 4574 SA



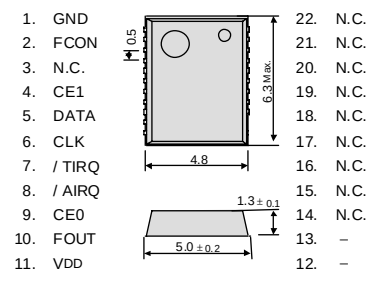
SOP - 14 pin

RTC - 4574 JE



VSOJ - 20 pin

RTC - 4574 NB



SON - 22 pin

Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

## Specifications (characteristics)

\* Refer to application manual for details.

## ■ Recommended Operating Conditions

| Item                  | Symbol           | Condition | Min. | Typ. | Max. | Unit |
|-----------------------|------------------|-----------|------|------|------|------|
| Power voltage         | V <sub>DD</sub>  | —         | 1.6  | 3.0  | 5.5  | V    |
| Clock voltage         | V <sub>CLK</sub> | —         | 1.6  | 3.0  | 5.5  | V    |
| Operating temperature | T <sub>OPR</sub> | —         | -40  | +25  | +85  | °C   |

## ■ Frequency characteristics

| Item                      | Symbol           | Condition                                          | Rating   | Unit               |
|---------------------------|------------------|----------------------------------------------------|----------|--------------------|
| Frequency tolerance       | $\Delta f / f$   | T <sub>a</sub> = +25 °C<br>V <sub>DD</sub> = 3.0 V | 5 ± 23 * | × 10 <sup>-6</sup> |
| Oscillation start-up time | t <sub>STA</sub> | T <sub>a</sub> = +25 °C<br>V <sub>DD</sub> = 1.6 V | 3 Max.   | s                  |

\* Please ask for tighter tolerance. (Equivalent to 1 minute of monthly deviation)

## ■ Current consumption characteristics

T<sub>a</sub> = -40 °C to +85 °C

| Item                | Symbol           | Condition                                                                          | Min.                  | Typ. | Max. | Unit    |
|---------------------|------------------|------------------------------------------------------------------------------------|-----------------------|------|------|---------|
| Current Consumption | I <sub>BK</sub>  | CE0, CE1 = GND<br>FOUT ; output OFF<br>(Hi - z)                                    | V <sub>DD</sub> = 5 V | 1.0  | 2.0  | $\mu$ A |
|                     |                  |                                                                                    | V <sub>DD</sub> = 3 V | 0.5  | 1.0  |         |
|                     | I <sub>32k</sub> | CE0 = GND<br>CE1 = V <sub>DD</sub><br>FOUT ;<br>32.768 kHz output ON<br>CL = 30 pF | V <sub>DD</sub> = 5 V | 8.0  | 20.0 | $\mu$ A |
|                     |                  |                                                                                    | V <sub>DD</sub> = 3 V | 5.0  | 12.0 |         |



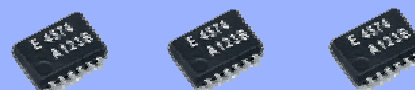
## Small size, low profile model package SERIAL-INTERFACE REAL TIME CLOCK MODULE

# RX - 4574 LC

- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : 3-wire serial interface
- Operating voltage range : 1.6 V to 5.5 V
- Wide Timekeeper voltage range : 1.3 V to 5.5 V
- Low backup current : 0.35  $\mu$ A / 3 V (Typ.)
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer.



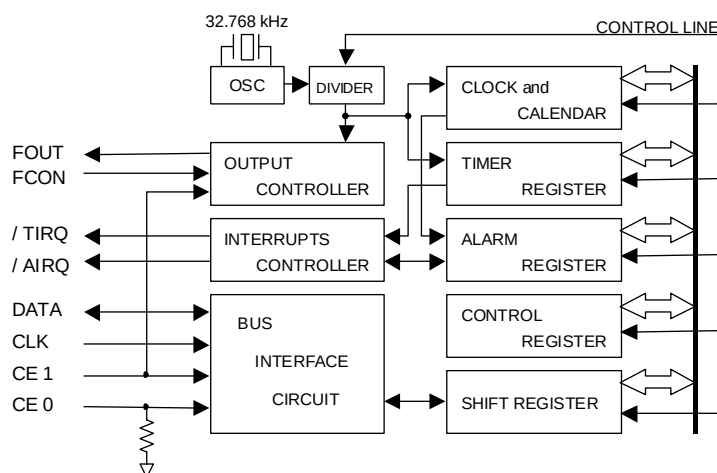
Product Number (Please contact us)  
RX-4574LC : Q414574C2000300



Actual size



## Block diagram



## Overview

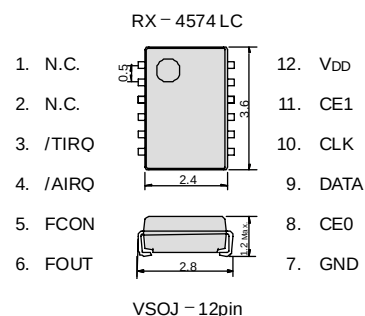
- **32.768 kHz frequency output function**
  - FOUT pin output (C-MOS output), CL=30 pF
  - Output frequency is selectable from 1/30 Hz to 32.768 kHz (32 Values)
- **Timer function**
  - Timer function which can be set up between 1/4096 second and 255 minutes.
  - It is recorded automatically to TF-bit at the time of event occurrence, and it's possible to output with /TIRQ pin output (open-drain output).
  - Selectable one time mode or repeat mode.
- **Alarm function**
  - Alarm function can be set to any combination of day of week, hour, or minute.
  - It is recorded automatically to AF-bit at the time of event occurrence, and it's possible to output with /AIRQ pin output (open-drain output).

\* Functions are compatible with RTC-4574 SA / JE / NB.

## Pin Function

| Signal Name | Input / Output | Function                                                                                                                                                               |
|-------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CE0         | Input          | The chip enabled input pin 0. (Built-in pull-down resistance) When both CE0 and CE1 pins are at the "H" level, access to this Real time clock module becomes possible. |
| CE1         | Input          | The chip enabled input pin 1. When the CE1 pin is at the HIGH level, the FOUT pin is in the output state.                                                              |
| CLK         | Input          | The shift clock input pin for serial data transfer.                                                                                                                    |
| DATA        | Bi-directional | The data input / output pin for serial data transfer.                                                                                                                  |
| FOUT        | Output         | This pin outputs the reference clock signal at 32.768 kHz ( C-MOS output ). High impedance at the time of output off.                                                  |
| FCON        | Input          | The input pin for the FOUT output control.                                                                                                                             |
| / AIRQ      | Output         | The open drain output pin for alarm and time update interrupts.                                                                                                        |
| / TIRQ      | Output         | The open drain output pin for timer interrupt.                                                                                                                         |
| VDD         | —              | Connected to a positive power supply.                                                                                                                                  |
| GND         | —              | Connected to a ground.                                                                                                                                                 |

## Terminal connection / External dimensions (Unit: mm)



## Specifications (characteristics)

\* Refer to application manual for details.

### Recommended Operating Conditions

| Item                  | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------|--------|-----------|------|------|------|------|
| Power voltage         | VDD    | —         | 1.6  | 3.0  | 5.5  | V    |
| Clock voltage         | VCLK   | —         | 1.3  | 3.0  | 5.5  | V    |
| Operating temperature | TOPR   | —         | -40  | +25  | +85  | °C   |

### Frequency characteristics

| Item                      | Symbol       | Condition                                                          | Rating           | Unit             |
|---------------------------|--------------|--------------------------------------------------------------------|------------------|------------------|
| Frequency tolerance       | $\Delta f/f$ | Ta = +25 °C<br>VDD = 3.0 V                                         | 5 ± 23 *         | $\times 10^{-6}$ |
| Oscillation Start-up time | tSTA         | Ta = +25 °C<br>VDD = 1.6 V<br>Ta = -40 °C to +85 °C<br>VDD = 1.6 V | 1 Max.<br>3 Max. | s                |

\*Equivalent to 1 minute of monthly deviation

### Current consumption characteristics

Ta = -40 °C to +85 °C

| Item                | Symbol | Condition                                                              | Min.      | Typ. | Max. | Unit    |
|---------------------|--------|------------------------------------------------------------------------|-----------|------|------|---------|
| Current Consumption | IBK    | CE0, CE1 = GND<br>FOUT ; output OFF<br>( Hi - z )                      | VDD = 5 V | 0.45 | 0.9  | $\mu$ A |
|                     |        |                                                                        | VDD = 3 V | 0.35 | 0.7  |         |
|                     | I32k   | CE0 = GND<br>CE1 = VDD<br>FOUT ;<br>32.768 kHz output ON<br>CL = 30 pF | VDD = 5 V | 8.0  | 20.0 | $\mu$ A |
|                     |        |                                                                        | VDD = 3 V | 5.0  | 12.0 |         |

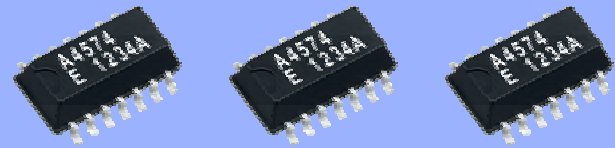


Product Number (Please contact us)  
RA-4574SA : Q41A47451xxxx00

## For Automotive SERIAL-INTERFACE REAL TIME CLOCK MODULE

# RA - 4574 SA

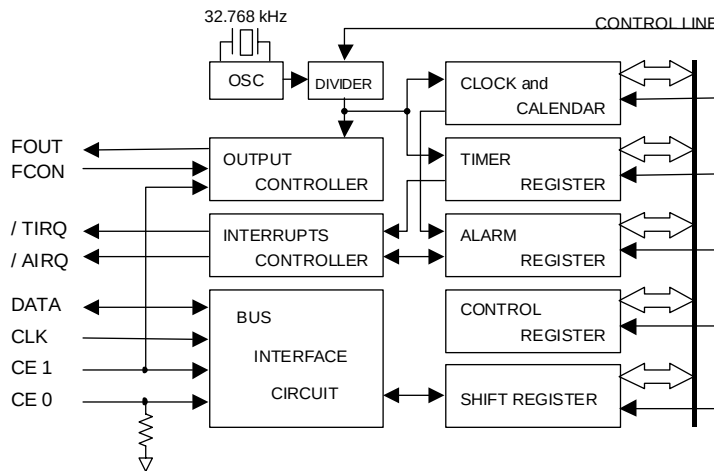
- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : 3-wire serial interface
- Operating voltage range : 1.6 V to 5.5 V
- Wide Timekeeper voltage range : 1.6 V to 5.5 V
- Low backup current : 0.5  $\mu$ A / 3 V (Typ.)
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer.
- Conforms to AEC-Q200



Actual size



### Block diagram



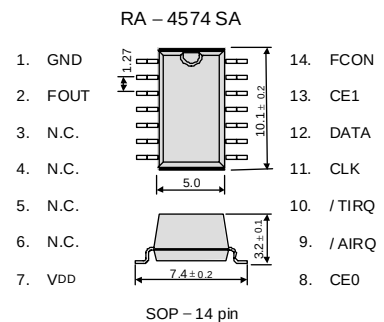
### Overview

- **32.768 kHz frequency output function**
  - FOUT pin output (C-MOS output), CL=30 pF
  - Output frequency selectable from 1/30 Hz to 32.768 kHz (32 Values)
- **Timer function**
  - Timer function can be set between 1/4096 second and 255 minutes.
  - It is recorded automatically to TF-bit at the time of event occurrence, and it's possible to output with /TIRQ pin output (open-drain output).
  - Selectable one time mode or repeat mode.
- **Alarm function**
  - Alarm function can be set to any combination of day of week, hour, or minute.
  - It is recorded automatically to AF-bit at the time of event occurrence, and it's possible to output with /AIRQ pin output (open-drain output).

### Pin Function

| Signal Name | Input / Output | Function                                                                                                                                                                  |
|-------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CE0         | Input          | The chip enabled input pin 0. (Built-in pull-down resistance)<br>When both CE0 and CE1 pins are at the "H" level, access to this Real time clock module becomes possible. |
| CE1         | Input          | The chip enabled input pin 1.<br>When the CE1 pin is at the HIGH level, the FOUT pin is in the output state.                                                              |
| CLK         | Input          | The shift clock input pin for serial data transfer.                                                                                                                       |
| DATA        | Bi-directional | The data input / output pin for serial data transfer.                                                                                                                     |
| FOUT        | Output         | This pin outputs the reference clock signal at 32.768 kHz (C-MOS output).<br>High impedance at the time of output off.                                                    |
| FCON        | Input          | The input pin for the FOUT output control.                                                                                                                                |
| /AIRQ       | Output         | The open drain output pin for alarm and time update interrupts.                                                                                                           |
| /TIRQ       | Output         | The open drain output pin for timer interrupt.                                                                                                                            |
| VDD         | —              | Connected to a positive power supply.                                                                                                                                     |
| GND         | —              | Connected to a ground.                                                                                                                                                    |

### Terminal connection / External dimensions (Unit:mm)



Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

### Specifications (characteristics)

\* Refer to application manual for details.

#### Recommended Operating Conditions

| Item                  | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------|--------|-----------|------|------|------|------|
| Power voltage         | VDD    | —         | 1.6  | 3.0  | 5.5  | V    |
| Clock voltage         | VCLK   | —         | 1.6  | 3.0  | 5.5  | V    |
| Operating temperature | TOPR   | —         | -40  | +25  | +85  | °C   |

#### Frequency characteristics

| Item                      | Symbol         | Condition                  | Rating   | Unit               |
|---------------------------|----------------|----------------------------|----------|--------------------|
| Frequency tolerance       | $\Delta f / f$ | Ta = +25 °C<br>VDD = 3.0 V | 5 ± 23 * | × 10 <sup>-6</sup> |
| Oscillation start-up time | tSTA           | Ta = +25 °C<br>VDD = 1.6 V | 3 Max.   | s                  |

\* Equivalent to 1 minute of monthly deviation

#### Current consumption characteristics

Ta = -40 °C to +85 °C

| Item                | Symbol | Condition                                    | Min.      | Typ. | Max. | Unit    |
|---------------------|--------|----------------------------------------------|-----------|------|------|---------|
| Current Consumption | IBK    | CE0, CE1 = GND                               | VDD = 5 V | 1.0  | 2.0  | $\mu$ A |
|                     |        | FOUT ; Output OFF (Hi-Z)                     | VDD = 3 V | 0.5  | 1.0  |         |
|                     | I32k   | CE0 = GND<br>CE1 = VDD                       | VDD = 5 V | 8.0  | 20.0 | $\mu$ A |
|                     |        | FOUT ;<br>32.768 kHz output ON<br>CL = 30 pF | VDD = 3 V | 5.0  | 12.0 |         |





## Simple Function SERIAL-INTERFACE REAL TIME CLOCK MODULE

# RTC - 4543 SA / SB

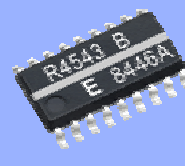
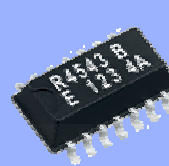
- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface type : 3-wire serial interface
- Operating voltage range : 2.5 V to 5.5 V
- Wide Timekeeper voltage range: 1.4 V to 5.5 V
- 32.768 kHz frequency output function: C-MOS output With Control Pin
- The various functions include full calendar, timer, and low voltage detection.



Product Number (Please contact us)

RTC-4543SA : Q41454351000200

RTC-4543SB : Q41454361000200



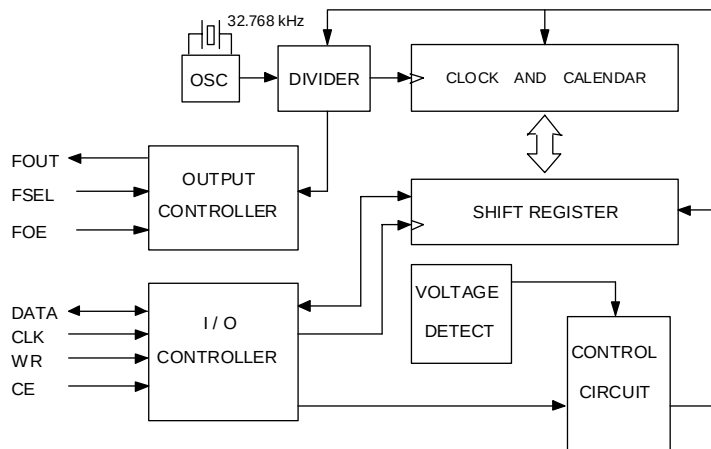
Actual size

RTC-4543SA

RTC-4543SB



## Block diagram



## Overview

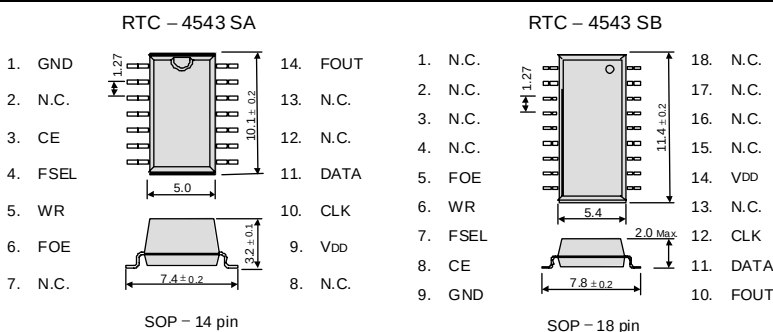
- **32.768 kHz frequency output function**
  - FOUT pin output (C-MOS output), CL=30 pF
  - FOE pin enables output on/off control.
  - FSEL pin enables output selectable 32.768 kHz or 1 Hz.
- **Power supply voltage monitoring function**
  - Detection that power supply voltage descended to 1.7 V or less.
  - Automatic record to FDT-bit at the time of power supply decline detection.

## Pin Function

| Signal Name | Input / Output | Function                                                                          |
|-------------|----------------|-----------------------------------------------------------------------------------|
| CE          | Input          | The chip enabled input pin. At the HIGH level, access becomes possible.           |
| CLK         | Input          | The shift clock input pin for serial data transfer.                               |
| WR          | Input          | DATA pin input / output switching pin.                                            |
| DATA        | Bi-directional | The data input / output pin for serial data transfer.                             |
| FOUT        | Output         | 32.768 kHz or 1 Hz clock output pin (C-MOS output). High impedance at output off. |
| FOE         | Input          | The input pin for the FOUT output control.                                        |
| FSEL        | Input          | Select the frequency that is output from the FOUT pin.                            |
| VDD         | —              | Connected to a positive power supply.                                             |
| GND         | —              | Connected to a ground.                                                            |

## Terminal connection / External dimensions

(Unit:mm)



Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

## Specifications (characteristics)

\* Refer to application Manual for details.

### Recommended Operating Conditions

| Item                  | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------|--------|-----------|------|------|------|------|
| Power voltage         | VDD    | —         | 2.5  | 5.0  | 5.5  | V    |
| Clock voltage         | VCLK   | —         | 1.4  | 5.0  | 5.5  | V    |
| Operating temperature | TOPR   | —         | -40  | +25  | +85  | °C   |

### Frequency characteristics

| Item                      | Symbol       | Condition                  | Rating   | Unit               |
|---------------------------|--------------|----------------------------|----------|--------------------|
| Frequency tolerance       | $\Delta f/f$ | Ta = +25 °C<br>VDD = 5.0 V | 5 ± 23 * | × 10 <sup>-6</sup> |
| Oscillation start-up time | tSTA         | Ta = +25 °C<br>VDD = 2.5 V | 3 Max.   | s                  |

\* Please ask for tighter tolerance.(Equivalent to 1 minute of monthly deviation)

### Current consumption characteristics

Ta = -40 °C to +85 °C

| Item                | Symbol | Condition                                         | Min.      | Typ. | Max. | Unit |
|---------------------|--------|---------------------------------------------------|-----------|------|------|------|
| Current Consumption | IBK    | CE = GND<br>FOE = GND<br>FOUT ; output OFF (Hi-Z) | VDD = 5 V | 1.5  | 3.0  | μA   |
|                     |        |                                                   | VDD = 3 V | 1.0  | 2.0  |      |
|                     |        |                                                   | VDD = 2 V | 0.5  | 1.0  |      |

### Supply Voltage Detection Characteristic

Ta = -40 °C to +85 °C

| Item                           | Symbol | Condition | Min. | Typ. | Max. | Unit |
|--------------------------------|--------|-----------|------|------|------|------|
| Power supply detection voltage | VDT    | VDD pin   | 1.4  | 1.7  | 2.0  | V    |





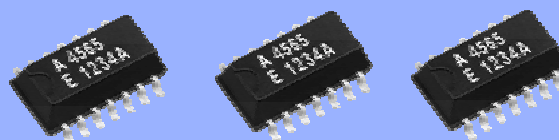
Product Number (Please contact us)  
RA-4565SA : O41A46550xxxx00

## For Automotive

## SERIAL INTERFACE REAL TIME CLOCK MODULE

**RA - 4565 SA**

- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : 4-wire serial interface
- Wide operating voltage range : 1.6 V to 5.5 V
- Wide Timekeeper voltage range : 1.5 V to 5.5 V  
 $T_a = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- Extended operating temperature range:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- 32.768 kHz frequency output function : Open drain output  
with Control Pin
- 32.768 kHz Clock/calendar function, auto leap year correction function,  
alarm interrupt function, etc.
- Conforms to AEC-Q200

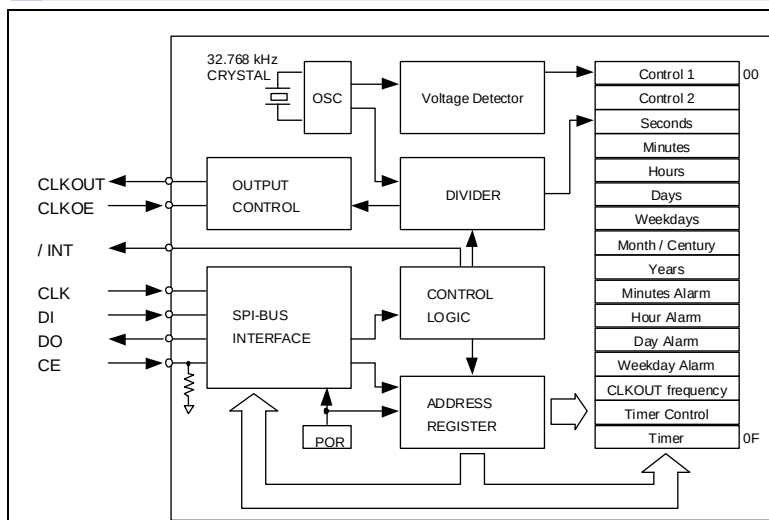


Actual size



NEW

### Block diagram



## Overview

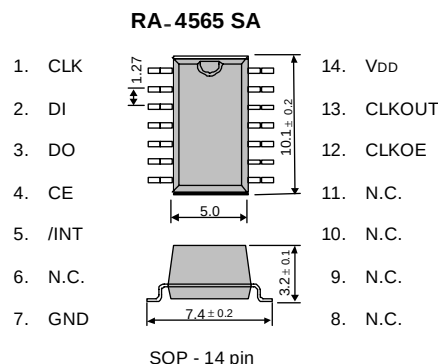
- **Wide operating temperature range**
  - $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- **Clocking-status detection function**
  - It can judge the validity of data after backup operation return by a status of VL-bit.
- **32.768 kHz frequency output function**
  - CLKOUT pin output (Open Drain output )
  - Output frequency can be selected as 32.768 kHz, 1024 Hz, 32 Hz, or 1 Hz.
- **The various interrupt function**
  - Timer function can be set up between  $1/4096$  second and 255 minutes.
  - Alarm function can be set to day of week, day, hour, or minute.

### Pin Function

| Terminal | Directions | Functions                                                                                                                                                                                                                                                                       |
|----------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CE       | Input      | Chip enabled input.                                                                                                                                                                                                                                                             |
| CLK      | Input      | Serial clock input.                                                                                                                                                                                                                                                             |
| DI       | Input      | Data input.                                                                                                                                                                                                                                                                     |
| DO       | Output     | Data output.                                                                                                                                                                                                                                                                    |
| CLKOUT   | Output     | The CLKOUT pin is a clock output ( open drain output ) pin with control output. (Output frequency can be selected as 32.768 kHz, 1024 Hz, 32 Hz, or 1 Hz. )                                                                                                                     |
| CLKOE    | Input      | The CLKOE pin is an input pin used to control the output mode of the CLKOUT output pin.<br><br>During the initial power-on (when power is applied from 0 V ), if the CLKOE input pin is at high level ( = H ), the power-on reset function selects 32.768 kHz as the frequency. |
| /INT     | Output     | Interrupts output by Alarm and Timer events. ( Open drain output )                                                                                                                                                                                                              |
| VDD      | —          | VDD                                                                                                                                                                                                                                                                             |
| GND      | —          | GND                                                                                                                                                                                                                                                                             |

### Terminal connection / External dimensions

(Unit:mm)



Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

### Specifications (characteristics)

\* Refer to application manual for details.

### ■ Recommended Operating Conditions

| Item                  | Symbol           | Conditions | Min. | Typ. | Max. | unit |
|-----------------------|------------------|------------|------|------|------|------|
| Operating voltage     | V <sub>DD</sub>  | –          | 1.6  | 3.0  | 5.5  | V    |
| Timekeeper voltage    | V <sub>CLK</sub> | –          | 1.5  | 3.0  | 5.5  | V    |
| Operating temperature | T <sub>OPR</sub> | –          | –40  | +25  | +125 | °C   |

### ■ Frequency characteristics

| Item                      | Symbol         | Conditions                            | Rating                   | unit             |
|---------------------------|----------------|---------------------------------------|--------------------------|------------------|
| Frequency stability       | $\Delta f / f$ | Ta = +25 °C<br>VDD = 3.0 V            | $5 \pm 23$ <sup>+1</sup> | $\times 10^{-6}$ |
| Oscillation start up time | tSTA           | Ta = +25 °C<br>VDD = 1.6 V            | 1.5 Max.                 | s                |
|                           |                | Ta = -40 °C to +125 °C<br>VDD = 3.0 V | 3.0 Max.                 | s                |

\*<sup>1)</sup> Equivalent to 1 minutes of monthly deviation.

■ Current consumption under backup mode.

| ■ Current consumption under backup mode: |        |                                         |         |      |      |      |      |
|------------------------------------------|--------|-----------------------------------------|---------|------|------|------|------|
| Item                                     | Symbol | Conditions                              |         | Min. | Tvp. | Max. | unit |
| Standby current.                         | IBK    | fSCL = 0 Hz<br>CLKOE = "L"<br>VDD = 5 V | +125 °C |      | 1.0  | 2.0  | μA   |
|                                          |        | -40 to +85 °C                           |         | 0.6  | 1.2  |      |      |
|                                          |        | fSCL = 0 Hz<br>CLKOE = "L"<br>VDD = 3 V | +125 °C |      | 0.8  | 1.6  | μA   |
|                                          |        | -40 to +85 °C                           |         | 0.5  | 1.0  |      |      |



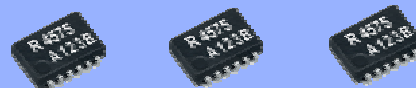
## Built-in external event detection. SERIAL INTERFACE REAL TIME CLOCK MODULE

# RX-4575LC

- Built in frequency adjusted 32.768 kHz crystal unit.
  - Interface Type : 3-wire serial interface
  - Operating voltage range : 1.6 V ~ 5.5 V
  - Wide timekeeper voltage range : 1.3 V ~ 5.5 V
  - Low backup current : 0.35  $\mu$ A / 3 V (Typ.)
  - External event detection : Chattering free input port \* 2.
- (The various functions include full calendar, alarm, timer.)



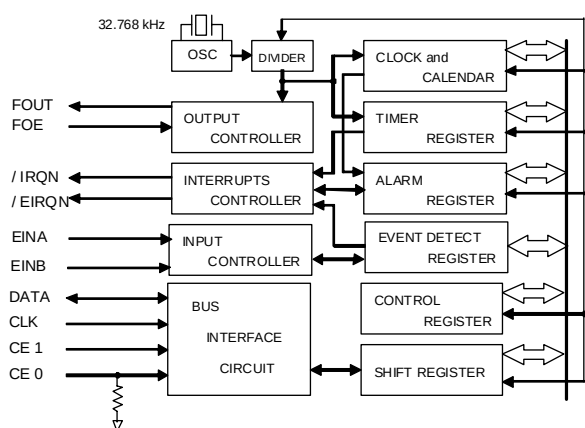
Product Number (Please contact us)  
RX-4575LC : Q414575C1000100



Actual size



### Block diagram



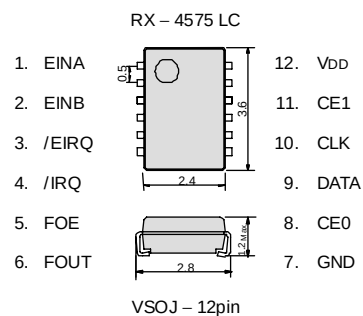
### Overview

- **Event detection.**
  - Selectable Hi detection or Lo detection.
  - Recognition of detection is available both the hardware interrupt and the monitor via software.
  - Automatic interrupt release mode is available.
  - The all 'OR' interrupt output is possible via alarm, timer and event detection.
- **Performance of event input terminal.**
  - As for the chattering filter, following are prepared for. ( 8 ms, 31 ms, 62 ms, 125 ms )
  - Built-in resistor connect and release is possible via software. Selectable pull-up or pull-down.
- **Timer function**
  - Built in 12 bit counter.
  - Timing period are 1 min, 1 s, 64 Hz, 4096 Hz.
- **Alarm function**
  - Alarm setting is possible by combination of a day, hours, and minutes.

### Pin Function

| Signal Name  | Input / Output | Functions                                                           |
|--------------|----------------|---------------------------------------------------------------------|
| EINA<br>EINB | Input          | External event input pin.                                           |
| CE 0<br>CE 1 | Input          | Interface is possible when both CE0 and CE1 is high level.          |
| CLK          | Input          | Serial Clock input pin.                                             |
| DATA         | Bidirectional  | Data input and output pin.                                          |
| FOUT         | Output         | 32.768 kHz clock output pin ( C-MOS ) .<br>Output is Hi-Z when OFF. |
| FOE          | Input          | 32kHz is output when input is Hi, 32 kHz is OFF when input is Lo.   |
| / EIRQ       | Output         | Interrupt output pin. ( N-ch open drain )                           |
| / IRQ        | Output         | Interrupt output pin. ( N-ch open drain )                           |
| VDD          | —              | Connected to a positive power supply.                               |
| GND          | —              | Connected to a ground.                                              |

### Terminal connection / External dimensions (Unit:mm)



### Specifications (characteristics)

\* Refer to application

#### Recommended Operating conditions

| Item                  | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------|--------|-----------|------|------|------|------|
| Power voltage         | VDD    | —         | 1.6  | 3.0  | 5.5  | V    |
| Clock voltage         | VCLK   | —         | 1.3  | 3.0  | 5.5  | V    |
| Operating Temperature | TOPR   | —         | -40  | +25  | +85  | °C   |

#### Frequency characteristics

| Item                      | Symbol         | Condition                           | Rating       | Unit             |
|---------------------------|----------------|-------------------------------------|--------------|------------------|
| Frequency tolerance       | $\Delta f / f$ | Ta = +25 °C<br>VDD = 3.0 V          | 5 $\pm$ 23 * | $\times 10^{-6}$ |
| Oscillation Start-up time | tSTA           | Ta = +25 °C<br>VDD = 1.6 V          | 1 Max.       | s                |
|                           |                | Ta = -40 °C ~ +85 °C<br>VDD = 1.6 V | 3 Max.       | s                |

\*Equivalent to 1 minute of monthly deviation

#### Current consumption characteristics

Ta = -40 °C ~ +85 °C

| Item                | Symbol | Condition                                                                          | Min.      | Typ. | Max. | Unit    |
|---------------------|--------|------------------------------------------------------------------------------------|-----------|------|------|---------|
| Current Consumption | IBK    | CE0, CE1 = GND<br>/ IRQ, / EIRQ = OFF<br>FOUT : output OFF<br>Event detection OFF  | VDD = 5 V | 0.45 | 0.9  | $\mu$ A |
|                     |        |                                                                                    | VDD = 3 V | 0.35 | 0.7  |         |
|                     | I32k   | CE0, CE1 = GND<br>/ IRQ, / EIRQ = OFF<br>FOUT ; CL = 30 pF<br>32.768 kHz output ON | VDD = 5 V | 8.0  | 20.0 | $\mu$ A |
|                     |        |                                                                                    | VDD = 3 V | 5.0  | 12.0 |         |



# High-Stability I<sup>2</sup>C-Bus INTERFACE REAL TIME CLOCK MODULE

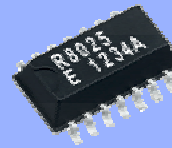
## RX - 8025 SA / NB

- Built-in 32.768 kHz crystal unit : Frequency adjusted for high accuracy ( $\pm 5 \times 10^{-6}$  /  $T_a = +25^\circ\text{C}$ )
- Interface Type : I<sup>2</sup>C-Bus Interface (400 kHz)
- Operating voltage range: 1.70 V to 5.5 V
- Wide Timekeeper voltage range : 1.15 V to 5.5 V
- Various detection Functions : Ex. Oscillation stop detection function
- Low backup current : 0.48  $\mu\text{A}$  / 3 V (Typ.)
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer.

\* The I<sup>2</sup>C-Bus is a trademark of NXP Semiconductors



Product Number (Please contact us)  
RX-8025SA : Q41802551xxxx00  
RX-8025NB : Q41802591xxxx00



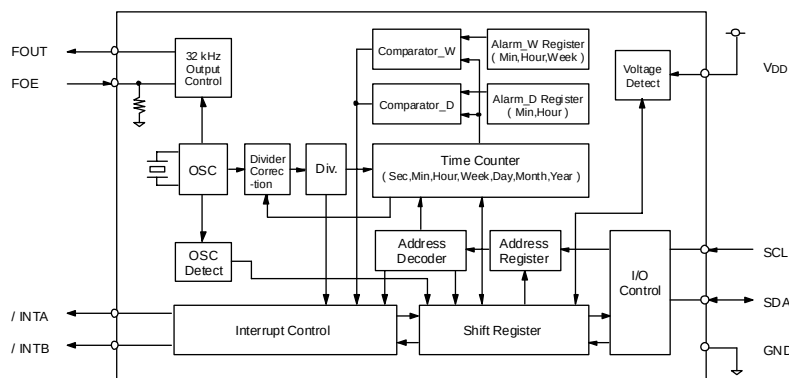
Actual size

RX-8025SA

RX-8025NB



### Block diagram



### Overview

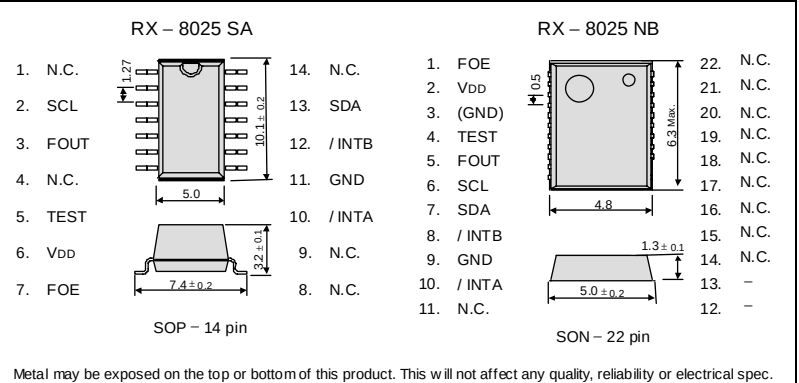
- **Features built-in 32.768 kHz crystal unit**
  - Frequency adjusted for high accuracy ( $\pm 5 \times 10^{-6}$  /  $T_a = +25^\circ\text{C}$ ) (Equivalent to 13 seconds of monthly deviation)
- **The various detection function**
  - Power supply voltage monitoring function (with selectable detection threshold)
  - Stop detection function
  - Power-on reset detection function
- **Alarm function and Timer function**
  - Timer function produces a periodic interruption signal. As for the Alarm function an optional combination is produced. (Date of the week, time, minute)

### Pin Function

| Signal Name     | Input / output | Function                                                                                                                                                                                                                                                                                                                                                                          |             |            |            |             |   |   |   |           |   |   |   |            |   |   |            |   |   |            |   |   |          |
|-----------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------|------------|-------------|---|---|---|-----------|---|---|---|------------|---|---|------------|---|---|------------|---|---|----------|
| SCL             | Input          | Serial clock input pin                                                                                                                                                                                                                                                                                                                                                            |             |            |            |             |   |   |   |           |   |   |   |            |   |   |            |   |   |            |   |   |          |
| SDA             | Bi-directional | Data input and output pin                                                                                                                                                                                                                                                                                                                                                         |             |            |            |             |   |   |   |           |   |   |   |            |   |   |            |   |   |            |   |   |          |
| FOUT            | Output         | 32.768 kHz clock output pin with the output control function. (C-MOS)                                                                                                                                                                                                                                                                                                             |             |            |            |             |   |   |   |           |   |   |   |            |   |   |            |   |   |            |   |   |          |
| FOE             | Input          | <table><tr><th>FOE input</th><th>/CLEN1 bit</th><th>/CLEN2 bit</th><th>FOUT output</th></tr><tr><td>L</td><td>X</td><td>X</td><td>OFF (LOW)</td></tr><tr><td rowspan="4">H</td><td>0</td><td>0</td><td>32.768 kHz</td></tr><tr><td>0</td><td>1</td><td>32.768 kHz</td></tr><tr><td>1</td><td>0</td><td>32.768 kHz</td></tr><tr><td>1</td><td>1</td><td>OFF(LOW)</td></tr></table> | FOE input   | /CLEN1 bit | /CLEN2 bit | FOUT output | L | X | X | OFF (LOW) | H | 0 | 0 | 32.768 kHz | 0 | 1 | 32.768 kHz | 1 | 0 | 32.768 kHz | 1 | 1 | OFF(LOW) |
| FOE input       | /CLEN1 bit     | /CLEN2 bit                                                                                                                                                                                                                                                                                                                                                                        | FOUT output |            |            |             |   |   |   |           |   |   |   |            |   |   |            |   |   |            |   |   |          |
| L               | X              | X                                                                                                                                                                                                                                                                                                                                                                                 | OFF (LOW)   |            |            |             |   |   |   |           |   |   |   |            |   |   |            |   |   |            |   |   |          |
| H               | 0              | 0                                                                                                                                                                                                                                                                                                                                                                                 | 32.768 kHz  |            |            |             |   |   |   |           |   |   |   |            |   |   |            |   |   |            |   |   |          |
|                 | 0              | 1                                                                                                                                                                                                                                                                                                                                                                                 | 32.768 kHz  |            |            |             |   |   |   |           |   |   |   |            |   |   |            |   |   |            |   |   |          |
|                 | 1              | 0                                                                                                                                                                                                                                                                                                                                                                                 | 32.768 kHz  |            |            |             |   |   |   |           |   |   |   |            |   |   |            |   |   |            |   |   |          |
|                 | 1              | 1                                                                                                                                                                                                                                                                                                                                                                                 | OFF(LOW)    |            |            |             |   |   |   |           |   |   |   |            |   |   |            |   |   |            |   |   |          |
| / INTA          | Output         | Interrupt output A pin ( N-ch open drain )                                                                                                                                                                                                                                                                                                                                        |             |            |            |             |   |   |   |           |   |   |   |            |   |   |            |   |   |            |   |   |          |
| / INTB          | Output         | Interrupt output B pin ( N-ch open drain )                                                                                                                                                                                                                                                                                                                                        |             |            |            |             |   |   |   |           |   |   |   |            |   |   |            |   |   |            |   |   |          |
| TEST            | —              | * Used by the manufacture for testing.<br>( Do not connect externally.)                                                                                                                                                                                                                                                                                                           |             |            |            |             |   |   |   |           |   |   |   |            |   |   |            |   |   |            |   |   |          |
| V <sub>DD</sub> | —              | Connected to a positive power supply.                                                                                                                                                                                                                                                                                                                                             |             |            |            |             |   |   |   |           |   |   |   |            |   |   |            |   |   |            |   |   |          |
| GND             | —              | Connected to a ground.                                                                                                                                                                                                                                                                                                                                                            |             |            |            |             |   |   |   |           |   |   |   |            |   |   |            |   |   |            |   |   |          |

### Terminal connection / External dimensions

(Unit:mm)



### Specifications (characteristics)

\* Refer to application manual for details.

#### Recommended Operating Conditions

| Item                  | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------|--------|-----------|------|------|------|------|
| Power voltage         | VDD    | —         | 1.7  | 3.0  | 5.5  | V    |
| Clock voltage         | VCLK   | —         | 1.15 | 3.0  | 5.5  | V    |
| Operating temperature | TOPR   | —         | -40  | +25  | +85  | °C   |

#### Frequency characteristics

| Item                              | Symbol           | Condition                                                             | Range                                  | Unit             |
|-----------------------------------|------------------|-----------------------------------------------------------------------|----------------------------------------|------------------|
| Frequency tolerance               | $\Delta f / f$   | $T_a = +25^\circ\text{C}$<br>$V_{DD} = 3.0\text{ V}$                  | AA: $5 \pm 5$ *1)<br>AC: $0 \pm 5$ *2) | $\times 10^{-6}$ |
| Oscillation start-up time         | t <sub>STA</sub> | $T_a = +25^\circ\text{C}$<br>$V_{DD} = 2.0\text{ V}$                  | 1 Max.                                 | s                |
| Frequency voltage characteristics | f / V            | $T_a = +25^\circ\text{C}$<br>$V_{DD} = 2.0\text{ V to } 5.5\text{ V}$ | $\pm 1$ Max.                           | $\times 10^{-6}$ |

\*1) \*2) Equivalent to 13 seconds of monthly deviation (excluding offset).

#### Current consumption characteristics

 $T_a = -40^\circ\text{C to } +85^\circ\text{C}$ 

| Item                | Symbol           | Condition                                                                               | Min.        | Typ. | Max. | Unit |
|---------------------|------------------|-----------------------------------------------------------------------------------------|-------------|------|------|------|
| Current Consumption | I <sub>BK</sub>  | f <sub>SCL</sub> = 0Hz<br>FOE = GND<br>FOUT ; output OFF(LOW)                           | VDD = 5 V   | 0.60 | 1.80 | μA   |
|                     | I <sub>32k</sub> | f <sub>SCL</sub> = 0Hz<br>VDD, FOE = 5.5 V<br>FOUT ; output ON (Output=OPEN; CL = 0 pF) | VDD = 5.5 V | 3.0  | 6.5  | μA   |

#### Power supply detection voltage

 $T_a = -30^\circ\text{C to } +70^\circ\text{C}$ 

| Item              | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-------------------|--------|-----------|------|------|------|------|
| High-voltage mode | VDETH  | VDD pin   | 1.90 | 2.10 | 2.30 | V    |
| Low-voltage mode  | VDETL  | VDD pin   | 1.15 | 1.30 | 1.45 | V    |

## Low current consumption

# RTC - 8564 JE / NB

- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : I<sup>2</sup>C-Bus Interface (400 kHz)
- Operating voltage range : 1.8 V to 5.5 V
- Timekeeper voltage range : 1.0 V to 5.5 V / -20 °C to +70 °C
- Low backup current : 275 nA / 3.0 V(Typ.)
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer, and power supply voltage monitoring function

\* The I<sup>2</sup>C-Bus is a trademark of NXP Semiconductors



Product Number (Please contact us)

Product Number (Please contact us)  
**RTC-8564JE : Q41856471000100**

RTC-8564NB : Q41856491000200



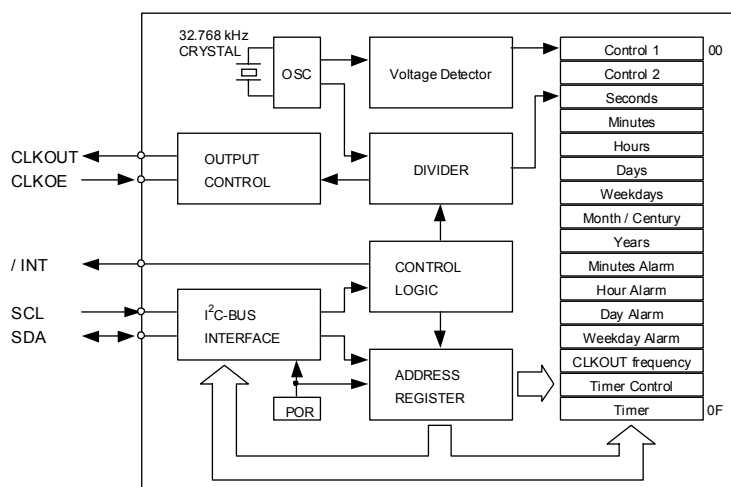
Actual size

RTC-8564JE

RTC-8564NB



### Block diagram



## Overview

- **Interface Type**

- I<sup>2</sup>C-Bus Interface. ( Hi-speed bus specifications 400 kHz )
- \* I<sup>2</sup>C-Bus slave address : read A3h and write A2h

- **Low Timekeeper voltage range**

- 1.0 V to 5.5 V /  $T_a = -20\text{ }^{\circ}\text{C}$  to  $+70\text{ }^{\circ}\text{C}$
- 1.1 V to 5.5 V /  $T_a = -40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$

- 32.768 kHz frequency output function

- CLKOUT pin output (C-MOS output ), CL=30 pF
- CLKOE pin enables output on/off control.
- Output selectable  
 $<32\ 768\ \text{kHz}\ 1024\ \text{Hz}\ 32\ \text{Hz}\ 1\ \text{Hz}>$

- The various interrupt function

- Timer function can be set up between 1/4096 second and 255 minutes.
- Alarm function can be set to any combination of day of week, hour, or minute.

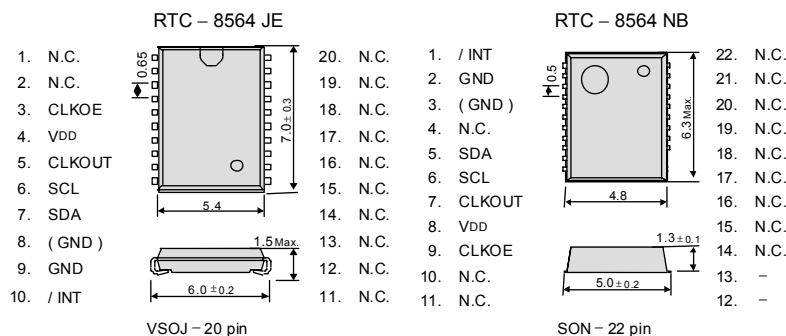
\* Functions are compatible with RX-8564 LC series.

## Pin Function

| Signal Name     | Input/Output   | Function                                                                                                                                                                                                                                                                                                                                                    |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
|-----------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------|-------------------|------|---|----------------|---|-----------|-----|---|-----------|---|-----------|
| SCL             | Input          | Serial clock input pin.                                                                                                                                                                                                                                                                                                                                     |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
| SDA             | Bi-directional | Data input and output pin.                                                                                                                                                                                                                                                                                                                                  |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
| CLKOUT          | Output         | 32.768 kHz dock output pin with the output control function. (C-MOS)<br>CLKOE pin control the condition of CLKOUT with FE-bit, etc.                                                                                                                                                                                                                         |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
| CLKOE           | Input          | <table border="1"> <thead> <tr> <th>CLKOE pin input</th><th>FE bit</th><th>CLKOUT pin output</th></tr> </thead> <tbody> <tr> <td rowspan="2">HIGH</td><td>1</td><td>Output (C-MOS)</td></tr> <tr> <td>0</td><td>OFF (LOW)</td></tr> <tr> <td rowspan="2">LOW</td><td>1</td><td>OFF (LOW)</td></tr> <tr> <td>0</td><td>OFF (LOW)</td></tr> </tbody> </table> | CLKOE pin input | FE bit | CLKOUT pin output | HIGH | 1 | Output (C-MOS) | 0 | OFF (LOW) | LOW | 1 | OFF (LOW) | 0 | OFF (LOW) |
| CLKOE pin input | FE bit         | CLKOUT pin output                                                                                                                                                                                                                                                                                                                                           |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
| HIGH            | 1              | Output (C-MOS)                                                                                                                                                                                                                                                                                                                                              |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
|                 | 0              | OFF (LOW)                                                                                                                                                                                                                                                                                                                                                   |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
| LOW             | 1              | OFF (LOW)                                                                                                                                                                                                                                                                                                                                                   |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
|                 | 0              | OFF (LOW)                                                                                                                                                                                                                                                                                                                                                   |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
| /INT            | Output         | Interrupt output (N-ch open drain)                                                                                                                                                                                                                                                                                                                          |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
| VDD             | —              | Connected to a positive power supply.                                                                                                                                                                                                                                                                                                                       |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
| GND             | —              | Connected to a ground.                                                                                                                                                                                                                                                                                                                                      |                 |        |                   |      |   |                |   |           |     |   |           |   |           |

## Terminal connection / External dimensions

(Unit:mm)



Metal may be exposed on the top or bottom of this product. This will not affect any quality , reliability or electrical spec.

### Specifications (characteristics)

\* Refer to application manual for details.

### ■ Recommended Operating Conditions

| Item                  | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------|--------|-----------|------|------|------|------|
| Power voltage         | VDD    | —         | 1.8  | 3.0  | 5.5  | V    |
| Clock voltage         | VCLK   | —         | VLOW | 3.0  | 5.5  | V    |
| Operating temperature | TOPR   | —         | -40  | +25  | +85  | °C   |

- Low voltage detection

| Item                  | Symbol           | Condition                        | Typ. | Max. | Unit |
|-----------------------|------------------|----------------------------------|------|------|------|
| Low voltage detection | V <sub>LOW</sub> | T <sub>a</sub> = -20 °C ~ +70 °C | 0.9  | 1.0  | V    |
|                       |                  | T <sub>a</sub> = -40 °C ~ +85 °C | 0.9  | 1.1  | V    |

### ■ Frequency characteristics

| Item                | Symbol       | Condition                  | Rating   | Unit               |
|---------------------|--------------|----------------------------|----------|--------------------|
| Frequency tolerance | $\Delta f/f$ | Ta = +25 °C<br>VDD = 3.0 V | 5 ± 23 * | × 10 <sup>-6</sup> |

\* Please ask for tighter tolerance. (Equivalent to 1 minute of monthly deviation)

- Current consumption characteristics

$T_a = -40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$

| Current consumption characteristics |                  |                                                                  |                       |      |      |      | T <sub>a</sub> = -40 °C to +65 °C |
|-------------------------------------|------------------|------------------------------------------------------------------|-----------------------|------|------|------|-----------------------------------|
| Item                                | Symbol           | Condition                                                        |                       | Min. | Typ. | Max. | Unit                              |
| Current Consumption                 | I <sub>BK</sub>  | f <sub>SCL</sub> = 0 Hz<br>CLKOE = GND                           | V <sub>DD</sub> = 5 V |      | 330  | 800  | nA                                |
|                                     |                  | CLKOUT ;<br>output OFF ( LOW )                                   | V <sub>DD</sub> = 3 V |      | 275  | 700  |                                   |
|                                     | I <sub>32k</sub> | f <sub>SCL</sub> = 0 Hz<br>CLKOE = V <sub>DD</sub>               | V <sub>DD</sub> = 5 V |      | 2.5  | 3.4  | μA                                |
|                                     |                  | CLKOUT ;<br>32.768 kHz output ON<br>(Output=OPEN ;<br>CL = 0 pF) | V <sub>DD</sub> = 3 V |      | 1.5  | 2.2  |                                   |

**Low current consumption /  
Small size, low profile model package**

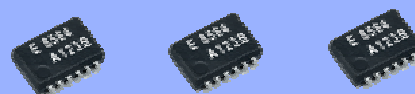
# RX - 8564 LC

- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : I<sup>2</sup>C-Bus Interface (400 kHz)
- Operating voltage range : 1.8 V to 5.5 V
- Wide Timekeeper voltage range : 1.0 V to 5.5 V / T<sub>A</sub> = +25 °C
- Low backup current : 275 nA / 3.0 V(Typ.)
- 32.768 kHz frequency output function: C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer, and power supply voltage monitoring function.

\* The I<sup>2</sup>C-Bus is a trademark of NXP Semiconductors



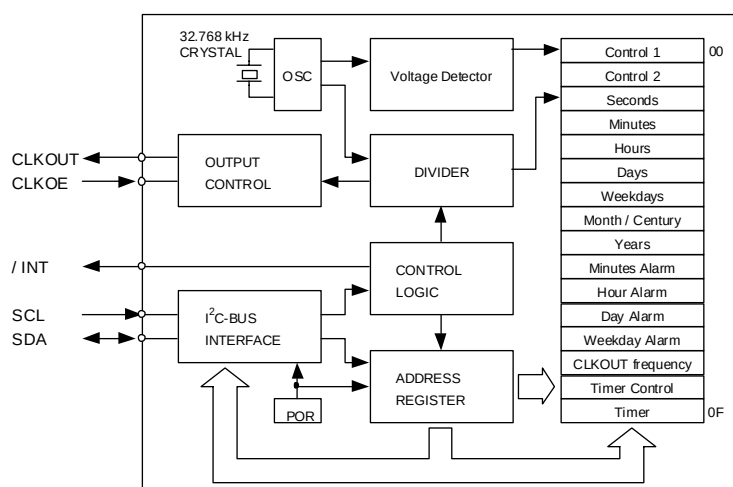
Product Number (Please contact us)  
**RX-8564LC : O418564C0xxxx00**



Actual size



### Block diagram



## Overview

- **Interface Type**

- I<sup>2</sup>C hi-speed bus specifications. ( 400 kHz )
- \* I<sup>2</sup>C-Bus slave address : read A3h and write A2h

- Low Timekeeper voltage

- 1.0 V to 5.5 V /  $T_a = +25\text{ }^{\circ}\text{C}$
- 1.3 V to 5.5 V /  $T_a = -40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$

- 32.768 kHz frequency output function

- CLKOUT pin output (C-MOS output ), CL=30 pF
- CLKOE pin enables output on/off control.
- Output selectable <32.768 kHz, 1024 Hz, 32 Hz, 1 Hz>

- The various interrupt function

- Timer function can be set up between 1/4096 second and 255 minutes.
- Alarm function can be set to any combination of day of week, hour, or minute.

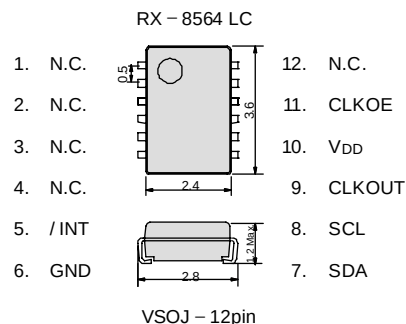
\* Functions are compatible with RTC-8564 JE / NB series

### Pin Function

| Signal Name     | Input / Output | Function                                                                                                                                                                                                                                                                                                                                                    |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
|-----------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------|-------------------|------|---|----------------|---|-----------|-----|---|-----------|---|-----------|
| SCL             | Input          | Serial clock input pin                                                                                                                                                                                                                                                                                                                                      |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
| SDA             | Bi-directional | Data input and output pin                                                                                                                                                                                                                                                                                                                                   |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
| CLKOUT          | Output         | 32.768 kHz clock output pin with the output control function. (C-MOS)<br>CLKOE pin control the condition of CLKOUT pin with FE-bit, FD1-bit, FD0-bit.                                                                                                                                                                                                       |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
| CLKOE           | Input          | <table border="1"> <thead> <tr> <th>CLKOE pin input</th><th>FE bit</th><th>CLKOUT pin output</th></tr> </thead> <tbody> <tr> <td rowspan="2">HIGH</td><td>1</td><td>Output (C-MOS)</td></tr> <tr> <td>0</td><td>OFF (LOW)</td></tr> <tr> <td rowspan="2">LOW</td><td>1</td><td>OFF (LOW)</td></tr> <tr> <td>0</td><td>OFF (LOW)</td></tr> </tbody> </table> | CLKOE pin input | FE bit | CLKOUT pin output | HIGH | 1 | Output (C-MOS) | 0 | OFF (LOW) | LOW | 1 | OFF (LOW) | 0 | OFF (LOW) |
| CLKOE pin input | FE bit         | CLKOUT pin output                                                                                                                                                                                                                                                                                                                                           |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
| HIGH            | 1              | Output (C-MOS)                                                                                                                                                                                                                                                                                                                                              |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
|                 | 0              | OFF (LOW)                                                                                                                                                                                                                                                                                                                                                   |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
| LOW             | 1              | OFF (LOW)                                                                                                                                                                                                                                                                                                                                                   |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
|                 | 0              | OFF (LOW)                                                                                                                                                                                                                                                                                                                                                   |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
| /INT            | Output         | Interrupt output (N-ch open drain)                                                                                                                                                                                                                                                                                                                          |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
| VDD             | —              | Connected to a positive power supply.                                                                                                                                                                                                                                                                                                                       |                 |        |                   |      |   |                |   |           |     |   |           |   |           |
| GND             | —              | Connected to a ground.                                                                                                                                                                                                                                                                                                                                      |                 |        |                   |      |   |                |   |           |     |   |           |   |           |

### Terminal connection / External dimensions

(1 Unit=mm)



### Specifications (characteristics)

\* Refer to application manual for details.

### ■ Recommended Operating Conditions

| Item                  | Symbol           | Condition | Min.             | Typ. | Max. | Unit |
|-----------------------|------------------|-----------|------------------|------|------|------|
| Power voltage         | V <sub>DD</sub>  | —         | 1.8              | 3.0  | 5.5  | V    |
| Clock voltage         | V <sub>CLK</sub> | —         | V <sub>low</sub> | 3.0  | 5.5  | V    |
| Operating temperature | T <sub>OPR</sub> | —         | -40              | +25  | +85  | °C   |

- Low voltage detection

| Item                  | Symbol           | Condition                         | Min. | Typ. | Max. | Unit |
|-----------------------|------------------|-----------------------------------|------|------|------|------|
| Low voltage detection | V <sub>LOW</sub> | T <sub>a</sub> = +25°C            |      | 0.9  | 1.0  | V    |
|                       |                  | T <sub>a</sub> = -20 °C to +70 °C |      | 0.9  | 1.2  | V    |
|                       |                  | T <sub>a</sub> = -40 °C to +85 °C |      | 0.9  | 1.3  | V    |

### ■ Frequency characteristics

| Item                | Symbol         | Condition                  | Rating   | Unit               |
|---------------------|----------------|----------------------------|----------|--------------------|
| Frequency tolerance | $\Delta f / f$ | Ta = +25 °C<br>VDD = 3.0 V | 5 ± 23 * | × 10 <sup>-6</sup> |

\* Please ask for tighter tolerance. (Equivalent to 1 minute of monthly deviation)

- Current consumption characteristics

 $T_a = -40\text{ }^{\circ}\text{C to }+85\text{ }^{\circ}\text{C}$ 

| Item                | Symbol           | Condition                                                      | Min.                  | Typ. | Max. | Unit |    |
|---------------------|------------------|----------------------------------------------------------------|-----------------------|------|------|------|----|
| Current Consumption | I <sub>BK</sub>  | f <sub>SCL</sub> = 0 Hz<br>CLKOE = GND                         | V <sub>DD</sub> = 5 V |      | 330  | 800  | nA |
|                     |                  | CLKOUT;<br>output OFF ( LOW )                                  | V <sub>DD</sub> = 3 V |      | 275  | 700  |    |
|                     | I <sub>32k</sub> | f <sub>SCL</sub> = 0 Hz<br>CLKOE = V <sub>DD</sub>             | V <sub>DD</sub> = 5 V |      | 2.5  | 3.4  | μA |
|                     |                  | CLKOUT;<br>32.768 kHz Output ON<br>(Output=OPEN;<br>CL = 0 pF) | V <sub>DD</sub> = 3 V |      | 1.5  | 2.2  |    |



## For Automotive

I<sup>2</sup>C-Bus INTERFACE REAL TIME CLOCK MODULE

## RA - 8565 SA

- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : I<sup>2</sup>C-Bus Interface (400 kHz)
- Wide operating voltage range : 1.8 V to 5.5 V
- Wide Timekeeper voltage range : 1.7 V to 5.5 V  
T<sub>a</sub> = -40 °C to +125 °C
- Extended operating temperature range: -40 °C to +125 °C
- 32.768 kHz frequency output function: N-ch Open drain output  
With Control Pin
- The various functions include full calendar, alarm, timer, etc.
- Conforms to AEC-Q200
- \* The I<sup>2</sup>C-Bus is a trademark of NXP Semiconductors



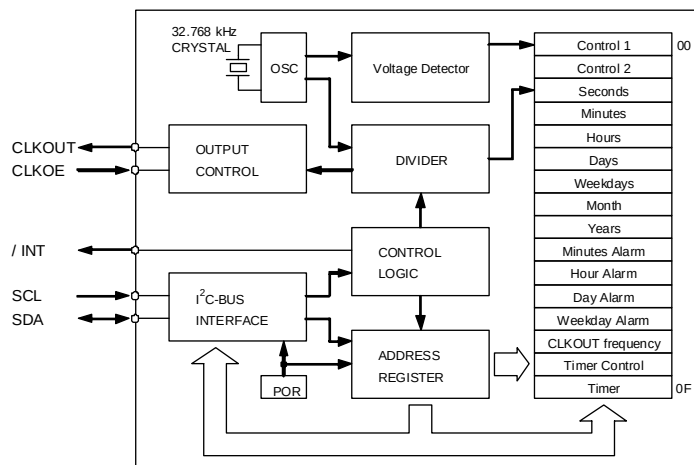
Product Number (Please contact us)  
RA-8565SA : Q41A86551xxxx00



Actual size



## Block diagram



## Overview

- Wide operating temperature range for automotive
  - -40 °C to +125 °C
- Clocking-status detection function
  - It can judge the validity of data after backup operation return by a status of VL-bit.
- 32.768 kHz frequency output function
  - CLKOUT pin output (N-ch Open Drain output)
  - Output frequency can be selected as 32.768 kHz, 1024 Hz, 32 Hz, or 1 Hz.
- The various interrupt function
  - Timer function can be set up between 1/4096 second and 255 minutes.
  - Alarm function can be set to day of week, day, hour, or minute.

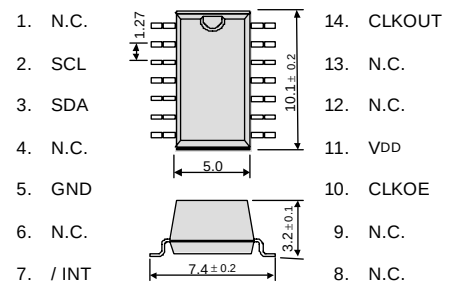
## Pin Function

| Terminal | Directions     | Functions                                                                                                                                                                                                                                                                      |
|----------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SCL      | Input          | Serial clock input.                                                                                                                                                                                                                                                            |
| SDA      | Bi-directional | Data input and output.                                                                                                                                                                                                                                                         |
| CLKOUT   | Output         | The CLKOUT pin is a clock output ( open drain output ) pin with control output. ( Output frequency can be selected as 32.768 kHz, 1024 Hz, 32 Hz, or 1 Hz. )                                                                                                                   |
| CLKOE    | Input          | The CLKOE pin is an input pin used to control the output mode of the CLKOUT output pin.<br>During the initial power-on ( when power is applied from 0 V ) , if the CLKOE input pin is at high level ( = H ) , the power-on reset function selects 32.768 kHz as the frequency. |
| /INT     | Output         | Interrupts output by Alarm and Timer events. ( Open drain output )                                                                                                                                                                                                             |
| VDD      | -              | Connected to a positive power supply.                                                                                                                                                                                                                                          |
| GND      | -              | Connected to a ground.                                                                                                                                                                                                                                                         |

## Terminal connection / External dimensions

(Unit:mm)

## RA - 8565 SA



SOP - 14 pin

Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

## Specifications (characteristics)

\* Refer to application manual for details.

## ■ Recommended Operating Conditions

| Item                  | Symbol | Conditions | Min. | Typ. | Max. | unit |
|-----------------------|--------|------------|------|------|------|------|
| Operating voltage     | VDD    | -          | 1.8  | 3.0  | 5.5  | V    |
| Timekeeper voltage    | VCLK   | -          | 1.7  | 3.0  | 5.5  | V    |
| Operating temperature | TOPR   | -          | -40  | +25  | +125 | °C   |

## ■ Frequency characteristics

| Item                      | Symbol           | Conditions                                        | Rating    | unit               |
|---------------------------|------------------|---------------------------------------------------|-----------|--------------------|
| Frequency stability       | $\Delta f/f$     | T <sub>a</sub> = +25 °C<br>VDD = 3.0 V            | 5 ± 23 *1 | × 10 <sup>-6</sup> |
| Oscillation start up time | t <sub>STA</sub> | T <sub>a</sub> = +25 °C<br>VDD = 1.8 V            | 1.5 Max.  | s                  |
|                           |                  | T <sub>a</sub> = -40 °C to +125 °C<br>VDD = 3.0 V | 3 Max.    | s                  |

\*1) Equivalent to 1 minutes of monthly deviation.

## ■ Current consumption under backup mode.

| Item             | Symbol          | Conditions                             | Min. | Typ. | Max. | unit |
|------------------|-----------------|----------------------------------------|------|------|------|------|
| Standby current. | I <sub>BK</sub> | f <sub>SCL</sub> = 0 Hz<br>CLKOE = LOW |      | 1.10 | 1.80 | μA   |
|                  |                 | VDD = 5 V                              |      | 0.60 | 1.2  |      |
|                  |                 | -40 °C to +85 °C                       |      |      |      |      |
|                  |                 | f <sub>SCL</sub> = 0 Hz<br>CLKOE = LOW |      | 1.00 | 1.6  | μA   |
|                  |                 | VDD = 3 V                              |      | 0.55 | 1.0  |      |
|                  |                 | -40 °C to +85 °C                       |      |      |      |      |



I<sup>2</sup>C-Bus INTERFACE REAL TIME CLOCK MODULE

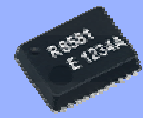
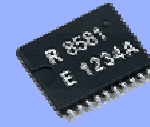
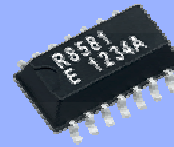
## RX - 8581 SA / JE / NB

- Built-in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : I<sup>2</sup>C-Bus Interface (400 kHz)
- Operating voltage range : 1.8 V to 5.5 V
- Wide Timekeeper voltage range : 1.6 V to 5.5 V
- Low backup current : 0.45  $\mu$ A / 3 V (Typ.)
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer.

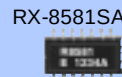
\* The I<sup>2</sup>C-Bus is a trademark of NXP Semiconductors



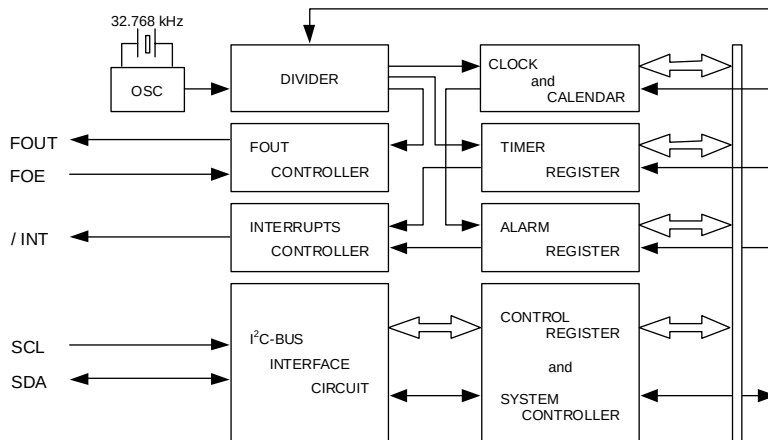
Product Number (Please contact us)  
 RX-8581SA : Q41858151xxxx00  
 RX-8581JE : Q41858171xxxx00  
 RX-8581NB : Q41858191000200



Actual size



## Block diagram



## Overview

## • Interface Type

- I<sup>2</sup>C-Bus interface. (Hi-speed bus specifications 400 kHz)
- \* I<sup>2</sup>C-Bus slave address : read A3h and write A2h

## • 32.768 kHz frequency output function

- FOUT pin output (C-MOS output), CL=30 pF
- 32.768 kHz clock frequency output. (Duty 50  $\pm$  5 %)

## • Timer function

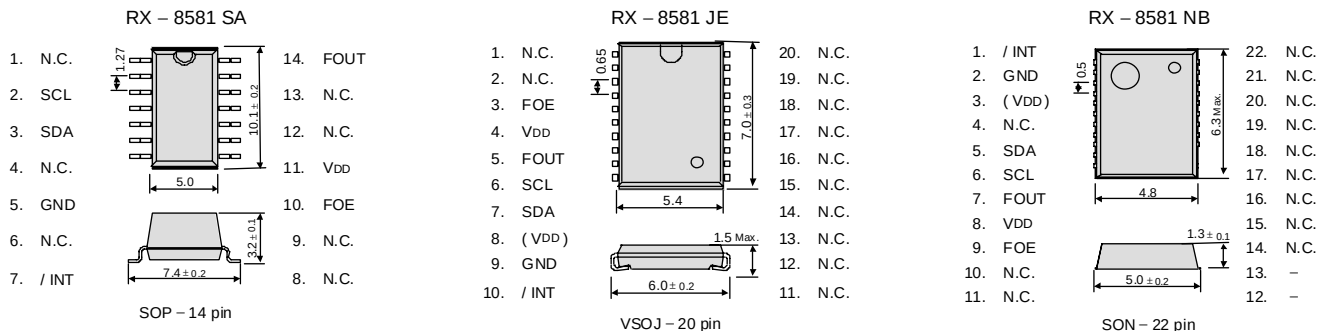
- Timer interrupt function can be set up between 1/4096 second and 4095 minutes.
- It is recorded automatic to TF-bit at the time of event occurrence, and possible to output with /TIRQ pin output (N-ch open-drain output).

## • Interrupt function

- Alarm interrupt function, Time update interrupt function.

## Terminal connection / External dimensions

(Unit:mm)



Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

## Specifications (characteristics)

\* Refer to application manual for details.

## ■ Recommended Operating Conditions

| Item                  | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------|--------|-----------|------|------|------|------|
| Power voltage         | VDD    | —         | 1.8  | 3.0  | 5.5  | V    |
| Clock voltage         | VCLK   | —         | 1.6  | 3.0  | 5.5  | V    |
| Operating temperature | TOPR   | —         | -40  | +25  | +85  | °C   |

## ■ Frequency characteristics

| Item                | Symbol         | Condition                                     | Rating       | Unit             |
|---------------------|----------------|-----------------------------------------------|--------------|------------------|
| Frequency tolerance | $\Delta f / f$ | Ta = +25 °C<br>VDD = 3.0 V                    | 5 $\pm$ 23 * | $\times 10^{-6}$ |
| FOUT output Duty    | tw / t         | Ta = -40 °C to +85 °C<br>VDD = 2.4 V to 5.5 V | 50 $\pm$ 5   | %                |

\* Please ask for tighter tolerance. (Equivalent to 1 minute of monthly deviation)

## ■ Current consumption characteristics

Ta = -40 °C to +85 °C

| Item                | Symbol | Condition                                    | Min.      | Typ. | Max. | Unit    |
|---------------------|--------|----------------------------------------------|-----------|------|------|---------|
| Current Consumption | IBK    | f <sub>SCL</sub> = 0 Hz<br>FOE = GND         | VDD = 5 V | 0.65 | 1.2  | $\mu$ A |
|                     |        | FOUT ;<br>output OFF ( LOW )                 | VDD = 3 V | 0.45 | 0.8  |         |
|                     | I32k   | f <sub>SCL</sub> = 0 Hz<br>FOE = VDD         | VDD = 5 V | 8.0  | 20.0 | $\mu$ A |
|                     |        | FOUT ;<br>32.768 kHz output ON<br>CL = 30 pF | VDD = 3 V | 5.0  | 12.0 |         |





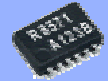
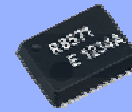
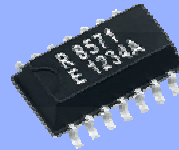
## Low current consumption I<sup>2</sup>C-Bus INTERFACE REAL TIME CLOCK MODULE

# RX - 8571 SA / NB / LC

- Built-in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : I<sup>2</sup>C-Bus Interface (400 kHz)
- Operating voltage range : 1.6 V to 5.5 V
- Wide Timekeeper voltage range : 1.3 V to 5.5 V
- Low backup current : 220 nA (Typ.) / 3 V
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- User RAM : 128 bit
- The various functions include full calendar, alarm, timer, etc.  
(Long-running timer : 65535 hours)
- \* The I<sup>2</sup>C-Bus is a trademark of NXP Semiconductors



Product Number (Please contact us)  
 RX-8571SA : X1B000071xxxx00  
 RX-8571NB : X1B000061xxxx00  
 RX-8571LC : X1B000051xxxx00



Actual size

RX-8571SA



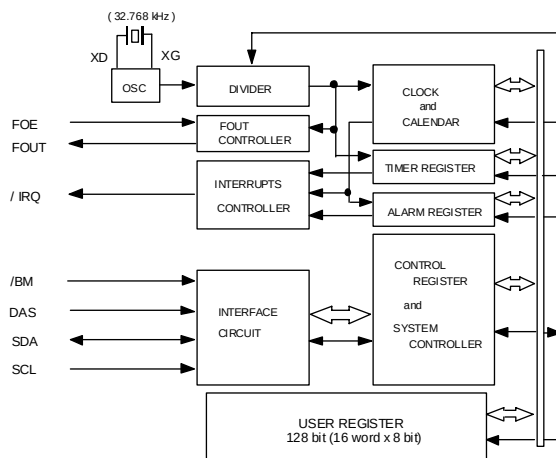
RX-8571NB



RX-8571LC

**NEW**

### Block diagram

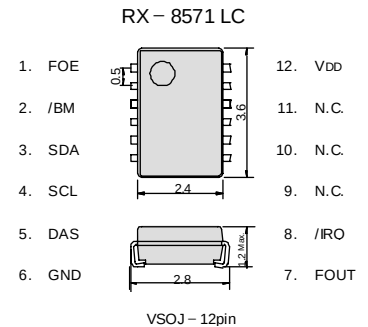
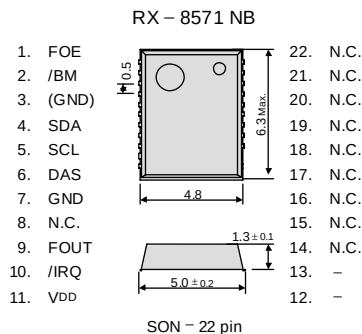
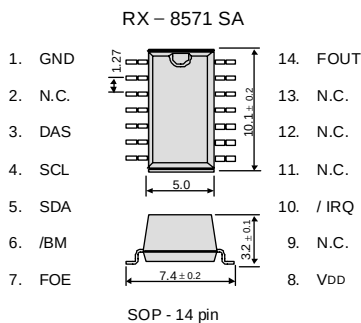


### Overview

- 32.768 kHz frequency output function
  - FOE pin enable output on/off control.
  - Output frequency can be selected as 32.768 kHz, 1024 Hz, 1 Hz.
- Timer Function
  - Timer function can be set up between 1/4096 second and 65535 hours.
  - Timing period are 1 h, 1 min, 64 Hz, 4096 Hz.
  - It is recorded automatically to TF-bit at the time of event occurs, and possible to output with /IRQ pin output.
- Alarm function
  - Alarm function can be set to day of week, day, hour, or minute.
  - It is recorded automatically to AF-bit at the time of event occurs, and possible to output with /IRQ pin output.
- Built-in RAM
  - 128 bit (16 word x 8 bit)

### Terminal connection / External dimensions

(Unit:mm)



Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

### Specifications (characteristics)

\* Refer to application manual for details.

#### Recommended Operating Conditions

| Item                  | Symbol           | Condition | Min. | Typ. | Max. | Unit |
|-----------------------|------------------|-----------|------|------|------|------|
| Power voltage         | V <sub>DD</sub>  | —         | 1.6  | 3.0  | 5.5  | V    |
| Clock voltage         | V <sub>CLK</sub> | —         | 1.3  | 3.0  | 5.5  | V    |
| Operating temperature | T <sub>OPR</sub> | —         | -40  | +25  | +85  | °C   |

#### Frequency characteristics

| Item                      | Symbol           | Condition                                          | Rating   | Unit               |
|---------------------------|------------------|----------------------------------------------------|----------|--------------------|
| Frequency tolerance       | $\Delta f / f$   | T <sub>a</sub> = +25 °C<br>V <sub>DD</sub> = 3.0 V | 5 ± 23 * | × 10 <sup>-6</sup> |
| Oscillation start up time | t <sub>STA</sub> | T <sub>a</sub> = +25 °C<br>V <sub>DD</sub> = 1.6 V | 1 Max.   | s                  |

\* Please ask for tighter tolerance. (Equivalent to 1 minute of monthly deviation)

#### Current consumption characteristics

| Item                | Symbol          | Condition                                                                                        | Min. | Typ. | Max. | Unit |
|---------------------|-----------------|--------------------------------------------------------------------------------------------------|------|------|------|------|
| Current Consumption | I <sub>DD</sub> | FOE=/BM="L"<br>FOUT=OFF<br>/IRQ=OFF<br>V <sub>DD</sub> =3.0V<br>T <sub>a</sub> =+25 °C           |      | 220  | 400  | nA   |
|                     |                 | LC type                                                                                          |      |      |      |      |
|                     |                 | SA/NB type                                                                                       |      | 200  | 400  |      |
|                     |                 | FOE=/BM="L"<br>FOUT=OFF<br>/IRQ=OFF<br>V <sub>DD</sub> =3.0V<br>T <sub>a</sub> =-40 °C to +85 °C |      |      | 550  | nA   |



## For Automotive I<sup>2</sup>C-Bus INTERFACE REAL TIME CLOCK MODULE

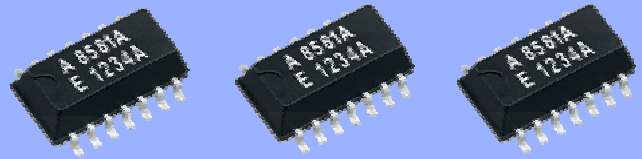
# RA - 8581 SA

- Built-in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : I<sup>2</sup>C-Bus Interface (400 kHz)
- Operating voltage range : 1.8 V to 5.5 V
- Wide Timekeeper voltage range : 1.6 V to 5.5 V
- Low backup current : 0.45  $\mu$ A / 3 V (Typ.)
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer.
- Conforms to AEC-Q200

\* The I<sup>2</sup>C-Bus is a trademark of NXP Semiconductors



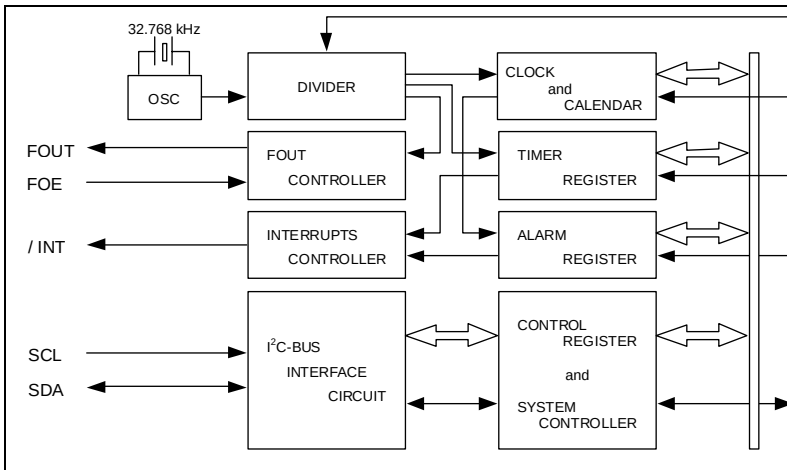
Product Number (Please contact us)  
RA-8581SA : Q41A88151xxxx00



Actual size



## Block diagram



## Overview

### Interface Type

- I<sup>2</sup>C-Bus interface. (Hi-speed bus specifications 400 kHz)
- \* I<sup>2</sup>C-Bus slave address : read A3h and write A2h

### 32.768 kHz frequency output function

- FOUT pin output (C-MOS output), CL=30 pF
- 32.768 kHz clock frequency output. (Duty 50  $\pm$  5%)

### Timer function

- Timer interrupt function can be set up between 1/4096 second and 4095 minutes.
- It is recorded automatic to TF-bit at the time of event occurrence, and possible to output with /TIRQ pin output (N-ch open-drain output).

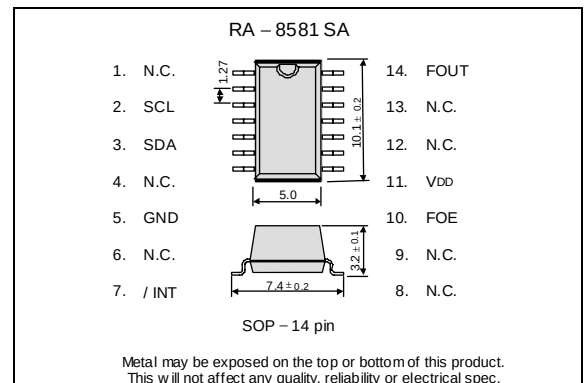
### Interrupt function

- Alarm interrupt function, Time update interrupt function.

## Pin Function

| Signal Name   | Input / Output       | Function                                                                                                                                                           |               |                 |      |                      |     |             |
|---------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------|------|----------------------|-----|-------------|
| SCL           | Input                | Serial clock input pin                                                                                                                                             |               |                 |      |                      |     |             |
| SDA           | Bi-directional       | Data input and output pin                                                                                                                                          |               |                 |      |                      |     |             |
| FOUT          | Output               | FOUT pin outputs the reference clock signal at 32.768 kHz.<br>FOE pin inputs the FOUT output control.                                                              |               |                 |      |                      |     |             |
| FOE           | Input                | <table><tr><th>FOE pin input</th><th>FOUT pin output</th></tr><tr><td>HIGH</td><td>Output ( C - M O S )</td></tr><tr><td>LOW</td><td>OFF ( LOW )</td></tr></table> | FOE pin input | FOUT pin output | HIGH | Output ( C - M O S ) | LOW | OFF ( LOW ) |
| FOE pin input | FOUT pin output      |                                                                                                                                                                    |               |                 |      |                      |     |             |
| HIGH          | Output ( C - M O S ) |                                                                                                                                                                    |               |                 |      |                      |     |             |
| LOW           | OFF ( LOW )          |                                                                                                                                                                    |               |                 |      |                      |     |             |
| /INT          | Output               | Interrupt output ( N-ch open drain )                                                                                                                               |               |                 |      |                      |     |             |
| VDD           | —                    | Connected to a positive power supply.                                                                                                                              |               |                 |      |                      |     |             |
| GND           | —                    | Connected to a ground.                                                                                                                                             |               |                 |      |                      |     |             |

## Terminal connection / External dimensions (Unit:mm)



## Specifications (characteristics)

\* Refer to application manual for details.

### Recommended Operating Conditions

| Item                  | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------|--------|-----------|------|------|------|------|
| Power voltage         | VDD    | —         | 1.8  | 3.0  | 5.5  | V    |
| Clock voltage         | VCLK   | —         | 1.6  | 3.0  | 5.5  | V    |
| Operating temperature | TOPR   | —         | -40  | +25  | +85  | °C   |

### Frequency characteristics

| Item                | Symbol         | Condition                                     | Rating       | Unit             |
|---------------------|----------------|-----------------------------------------------|--------------|------------------|
| Frequency tolerance | $\Delta f / f$ | Ta = +25 °C<br>VDD = 3.0 V                    | 5 $\pm$ 23 * | $\times 10^{-6}$ |
| FOUT output Duty    | tw / t         | Ta = -40 °C to +85 °C<br>VDD = 2.4 V to 5.5 V | 50 $\pm$ 5   | %                |

\* Equivalent to 1 minute of monthly deviation

### Current consumption characteristics

Ta = -40 °C to +85 °C

| Item                | Symbol | Condition                                                             | Min.      | Typ. | Max. | Unit    |
|---------------------|--------|-----------------------------------------------------------------------|-----------|------|------|---------|
| Current Consumption | IBK    | fSCL = 0 Hz<br>FOE = GND<br>FOUT ; Output OFF (LOW)                   | VDD = 5 V | 0.65 | 1.2  | $\mu$ A |
|                     |        |                                                                       | VDD = 3 V | 0.45 | 0.8  |         |
|                     | I32k   | fSCL = 0 Hz<br>FOE = VDD<br>FOUT ; 32.768 kHz Output ON<br>CL = 30 pF | VDD = 5 V | 8.0  | 20.0 | $\mu$ A |
|                     |        |                                                                       | VDD = 3 V | 5.0  | 12.0 |         |

**Built-in EEPROM and Unique ID-ROM**  
**I<sup>2</sup>C-Bus INTERFACE REAL TIME CLOCK MODULE**

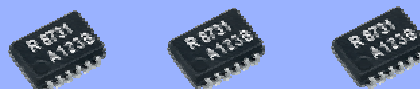
# RX - 8731 LC

- Built in frequency adjusted 32.768 kHz crystal unit.
- Interface Type : I<sup>2</sup>C-Bus interface (400 kHz)
- Operating voltage range : 1.7 V to 5.5 V
- Wide Timekeeper voltage range : 1.3 V to 5.5 V
- Low backup current : 0.35  $\mu$ A / 3 V (Typ.)
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer.

\* The I<sup>2</sup>C-Bus is a trademark of NXP Semiconductors



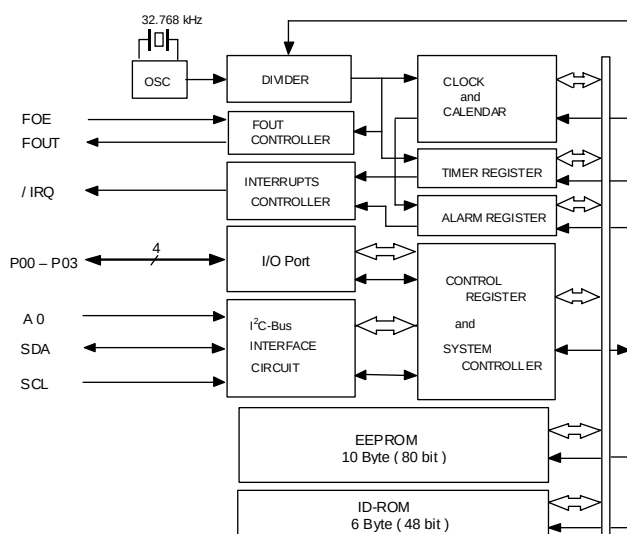
Product Number (Please contact us)  
**RX-8731LC : O418731C1000100**



Actual size



## Block diagram



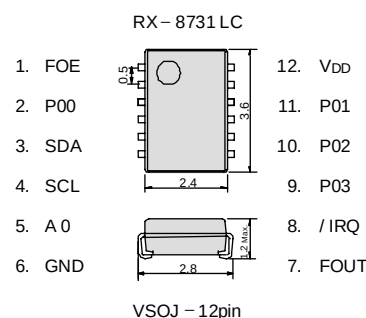
## Overview

- **Built in EEPROM and ID-ROM**
  - Built in 10 Byte ( 80 bit) EEPROM
  - Built in 6 Byte ( 48 bit) ID-ROM
- **Programmable I/O ports**
  - 4 Programmable I/O ports
- **Interface Type**
  - I<sup>2</sup>C-Bus high-speed bus specifications . (400 kHz)
- **32.768 kHz frequency output function**
  - FOUT pin output (C-MOS output), CL=30 pF
  - FOE pin enables output on/off control.
  - Output frequency is selectable.  
< 32.768 kHz, 1024 Hz, 1 Hz >
- **The various interrupt function**
  - Alarm interrupt function
  - Timer interrupt function
  - Update interrupt function

### Pin Function

| Signal Name              | Input / Output | Function                                                                           |
|--------------------------|----------------|------------------------------------------------------------------------------------|
| SCL                      | Input          | Serial Clock input pin.                                                            |
| SDA                      | Bi-directional | Data input and output pin.                                                         |
| A 0                      | Input          | Device address A0 input pin.                                                       |
| FOUT                     | Output         | FOUT pin is 32.768 kHz clock output pin ( C-MOS ) that output control is possible. |
| FOE                      | Input          | FOE pin control the frequency output from FOUT pin with FSEL1-bit and FSEL0-bit.   |
| /IRQ                     | Output         | Interrupt output pin. ( N-ch open drain )                                          |
| P00<br>P01<br>P02<br>P03 | Bi-directional | Programmable I/O ports.                                                            |
| VDD                      | —              | Connected to a positive power supply.                                              |
| GND                      | —              | Connected to a ground.                                                             |

## Terminal connection / External dimensions (Unit:mm)



### Specifications (characteristics)

\* Refer to application manual for details.

### ■ Recommended Operating Conditions

| Item                  | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------|--------|-----------|------|------|------|------|
| Power voltage         | VDD    | —         | 1.7  | 3.0  | 5.5  | V    |
| Clock voltage         | VCLK   | —         | 1.3  | 3.0  | 5.5  | V    |
| Operating temperature | TOPR   | —         | -40  | +25  | +85  | °C   |

### ■ Frequency characteristics

| Item                      | Symbol           | Condition                            | Rating   | Unit               |
|---------------------------|------------------|--------------------------------------|----------|--------------------|
| Frequency tolerance       | $\Delta f / f$   | Ta = +25 °C<br>VDD = 3.0 V           | 5 ± 23 * | × 10 <sup>-6</sup> |
| Oscillation Start-up time | t <sub>STA</sub> | Ta = +25 °C<br>VDD = 1.6 V           | 1 Max.   | s                  |
|                           |                  | Ta = -40 °C to +85 °C<br>VDD = 1.6 V | 3 Max.   | s                  |

\*Equivalent to 1 minute of monthly deviation

### ■ Current consumption characteristics

 $T_a = -40\text{ }^{\circ}\text{C to } +70\text{ }^{\circ}\text{C}$ 

| Current consumption characteristics |                  |                                           |                       | T <sub>a</sub> = -40 °C to +70 °C |      |      |  |
|-------------------------------------|------------------|-------------------------------------------|-----------------------|-----------------------------------|------|------|--|
| Item                                | Symbol           | Condition                                 | Min.                  | Typ.                              | Max. | Unit |  |
| Current Consumption                 | I <sub>BK</sub>  | f <sub>SCL</sub> = 0 Hz<br>/ IRQ = OFF    | V <sub>DD</sub> = 5 V | 0.45                              | 0.9  | μA   |  |
|                                     |                  | FOUT : output OFF<br>(Hi - z)             | V <sub>DD</sub> = 3 V | 0.35                              | 0.7  |      |  |
|                                     | I <sub>32k</sub> | f <sub>SCL</sub> = 0 Hz<br>/ IRQ = OFF    | V <sub>DD</sub> = 5 V | 8.0                               | 16.0 | μA   |  |
|                                     |                  | FOUT :<br>32.768 kHz output<br>CL = 30 pF | V <sub>DD</sub> = 3 V | 5.0                               | 10.0 |      |  |



## Built-in 32.768 kHz-DTCXO, High Stability I<sup>2</sup>C-Bus INTERFACE REAL TIME CLOCK MODULE

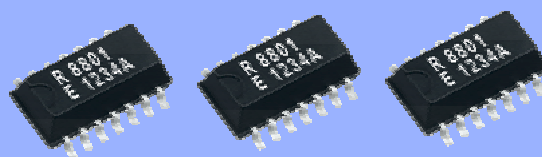
# RX - 8801 SA

- Built in frequency adjusted 32.768 kHz crystal unit and DTCXO.
- Interface Type : I<sup>2</sup>C-Bus Interface (400 kHz)
- Interface voltage range : 1.8 V to 5.5 V
- Temp.compensated voltage range: 2.2 V to 5.5 V
- Wide Timekeeper voltage range : 1.6 V to 5.5 V
- 32.768 kHz frequency output function : C-MOS output With Control Pin
- The various functions include full calendar, alarm, timer.

\* The I<sup>2</sup>C-Bus is a trademark of NXP Semiconductors



Product Number (Please contact us)  
RX-8801SA : X1B000011xxxx00

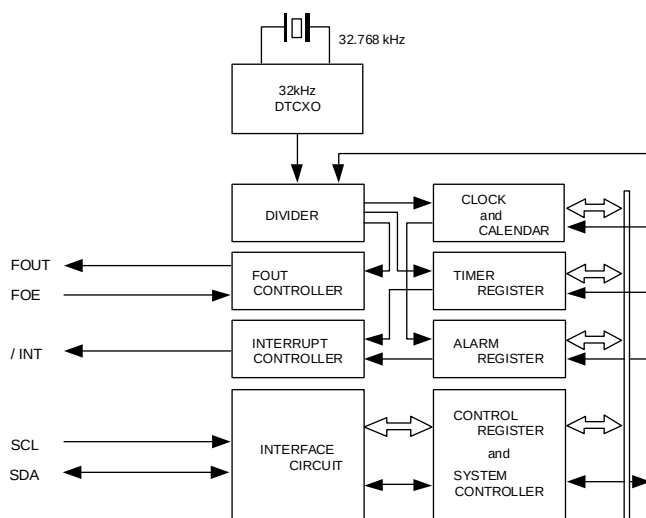


Actual size



**NEW**

## Block diagram



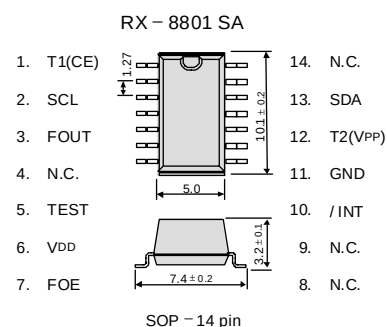
## Overview

- High Stability
  - UA
    - $\pm 1.9 \times 10^{-6}$  / 0 °C to +40 °C  
(Equivalent to 5 seconds of month deviation)
    - $\pm 3.4 \times 10^{-6}$  / -40 °C to +85 °C  
(Equivalent to 9 seconds of month deviation)
  - UB
    - $\pm 3.8 \times 10^{-6}$  / 0 °C to +50 °C  
(Equivalent to 10 seconds of month deviation)
    - $\pm 5.0 \times 10^{-6}$  / -40 °C to +85 °C  
(Equivalent to 13 seconds of month deviation)
- 32.768 kHz frequency output function
  - FOUT pin output (C-MOS output), CL=30 pF
  - Output selectable  
< 32.768 kHz, 1024 Hz, 1 Hz >
- The various interrupt
  - Timer Function can be set up between 1/4096 second and 255 minutes.
  - Alarm Function can be set to day of week, day, hour, or minute.

## Pin Function

| Signal Name | Pin No. | I / O  | Function                                                               |
|-------------|---------|--------|------------------------------------------------------------------------|
| T1(CE)      | 1       | input  | * Use by the manufacture for testing.<br>( Do not connect externally.) |
| SCL         | 2       | input  | Serial clock input pin                                                 |
| FOUT        | 3       | Output | The pin outputs the reference clock signal.<br>( CMOS output )         |
| TEST        | 5       | input  | * Use by the manufacture for testing.<br>( Do not connect externally.) |
| VDD         | 6       | -      | Connected to a positive power supply                                   |
| FOE         | 7       | input  | The input pin for the FOUT output control.                             |
| /INT        | 10      | Output | Interrupt output ( N-ch open drain )                                   |
| GND         | 11      | -      | Connected to a ground                                                  |
| T2(VPP)     | 12      | -      | * Use by the manufacture for testing.<br>( Do not connect externally.) |
| SDA         | 13      | I / O  | Data input and output pin                                              |

## Terminal connection / External dimensions (Unit:mm)



Metal may be exposed on the top or bottom of this product.  
This will not affect any quality, reliability or electrical spec.

## Specifications (characteristics)

\* Refer to application manual for details.

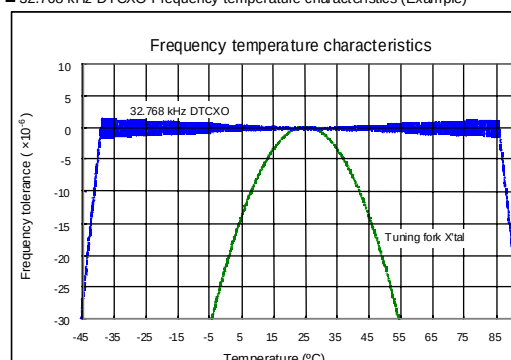
### Electrical Characteristics

| Electrical Characteristics |         |                                                              |                       |                    |      |      |                    |
|----------------------------|---------|--------------------------------------------------------------|-----------------------|--------------------|------|------|--------------------|
| Item                       | Symbol  | Condition                                                    |                       | Min.               | Typ. | Max. | Unit               |
| Interface voltage          | VDD     | Interface voltage                                            |                       | 1.8                | 3.0  | 5.5  | V                  |
| Temp. compensated voltage  | VTEM    | Temp. compensated voltage                                    |                       | 2.2                | 3.0  | 5.5  | V                  |
| Clock voltage              | VCLK    | -                                                            |                       | 1.6                | 3.0  | 5.5  | V                  |
| Operating temperature      | TOPR    | -                                                            |                       | -40                | +25  | +85  | °C                 |
| Stability                  | Δ f / f | UA                                                           | Ta = 0 °C to +40 °C   | ±1.9 <sup>*1</sup> |      |      | × 10 <sup>-6</sup> |
|                            |         |                                                              | Ta = -40 °C to +85 °C | ±3.4 <sup>*2</sup> |      |      |                    |
|                            |         | UB                                                           | Ta = 0 °C to +50 °C   | ±3.8 <sup>*3</sup> |      |      |                    |
|                            |         |                                                              | Ta = -40 °C to +85 °C | ±5.0 <sup>*4</sup> |      |      |                    |
| Current consumption (1)    | IBK1    | Backup Mode<br>FOE = GND,<br>/INT = VDD<br>FOUT output : OFF | VDD = 5 V             | -                  | 1.2  | 3.4  | μA                 |
| Current consumption (2)    | IBK2    |                                                              | VDD = 3 V             | -                  | 0.8  | 2.8  |                    |

\*<sup>1</sup>) Equivalent to 5 seconds of month deviation. \*<sup>2</sup>) Equivalent to 9 seconds of month deviation.

\*<sup>3</sup>) Equivalent to 10 seconds of month deviation. \*<sup>4</sup>) Equivalent to 13 seconds of month deviation.

### 32.768 kHz-DTCXO Frequency temperature characteristics (Example)





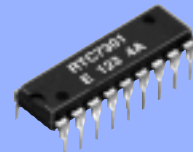
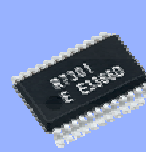
## 4-bit REAL TIME CLOCK MODULE

## RTC-7301SF / DG

- Built-in crystal unit 32.768 kHz with frequency adjusted
- Frequency selectable clock output (32.768 kHz to 1/30 Hz)
- Built-in 30 second adjustment function, digital pace adjustment function (Max. adjustment:  $\pm 192 \times 10^{-6}$ )
- Built-in alarm and timer interrupt functions.
- Built-in semiconductor temperature sensor (Voltage output:  $-7.8 \text{ mV} / ^\circ\text{C}$ , RTC-7301SF)
- Operating voltage range: 2.4 V to 5.5 V, time keeping voltage range: 1.6 V to 5.5 V
- Low current consumption (0.6  $\mu\text{A}$  / 3 V Typ.)
- High speed parallel interface compatible with SRAM



Product Number (Please contact us)  
 RTC-7301SF : Q42730181000200  
 RTC-7301DG : Q42730111000200

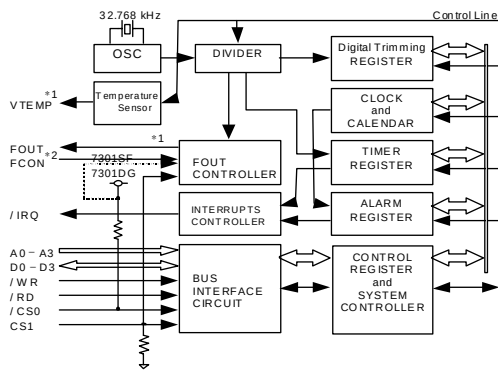


RTC-7301SF

RTC-7301DG



## Block diagram



This is a block diagram for RTC-7301SF.

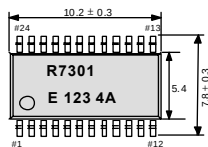
Be aware that RTC-7301DG differs according to the following 2 points.

- \*1) The VTEMP output is not connected to an external pin.
- \*2) The FCON input pin is not connected to an external pin, but is fixed at "H" internally.

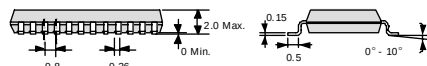
## External dimensions/Terminal connection

(Unit:mm)

## ● RTC-7301SF (SSOP 24-pin)

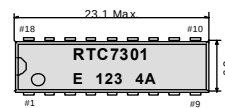


| No. | Pin terminal | No. | Pin terminal |
|-----|--------------|-----|--------------|
| 1   | /CS0         | 24  | VDD          |
| 2   | FCON         | 23  | (VDD)        |
| 3   | FOUT         | 22  | (VDD)        |
| 4   | VTEMP        | 21  | (VDD)        |
| 5   | (VDD)        | 20  | (VDD)        |
| 6   | /IRQ         | 19  | (VDD)        |
| 7   | A0           | 18  | CS1          |
| 8   | A1           | 17  | D0           |
| 9   | A2           | 16  | D1           |
| 10  | A3           | 15  | D2           |
| 11  | /RD          | 14  | D3           |
| 12  | GND          | 13  | /WR          |

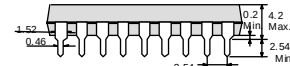


Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

## ● RTC-7301DG (DIP 18-pin)



| No. | Pin terminal | No. | Pin terminal |
|-----|--------------|-----|--------------|
| 1   | /CS0         | 18  | VDD          |
| 2   | FOUT         | 17  | (VDD)        |
| 3   | /IRQ         | 16  | (VDD)        |
| 4   | A0           | 15  | CS1          |
| 5   | A1           | 14  | D0           |
| 6   | A2           | 13  | D1           |
| 7   | A3           | 12  | D2           |
| 8   | /RD          | 11  | D3           |
| 9   | GND          | 10  | /WR          |



## Specifications (characteristics)

\*Refer to application manual for details.

## ■ Absolute Max. rating

GND=0 V

| Item                | Symbol | Condition                              | Min.    | Max.    | Unit |
|---------------------|--------|----------------------------------------|---------|---------|------|
| Supply voltage      | VDD    | VDD to GND                             | -0.3    | +7.0    |      |
| Input voltage       | VIN    | Input terminal, Do to D3 pins          | GND-0.3 | VDD+0.3 | V    |
| Output voltage(1)   | VOUT1  | /IRQ pin                               |         | +8.0    |      |
| Output voltage(2)   | VOUT2  | FOUT, D0-D3, VTEMP pin                 |         | VDD+0.3 |      |
| Storage temperature | TSTG   | Stored as bare product after unpacking | -55     | +125    | °C   |

## ■ Operating range

GND = 0 V

| Item                  | Symbol | Condition       | Min. | Max. | Unit |
|-----------------------|--------|-----------------|------|------|------|
| Power voltage         | VDD    | —               | 2.4  | 5.5  | V    |
| Clock voltage         | VCLK   | —               | 1.6  |      | V    |
| Operating temperature | TOPR   | No condensation | -40  | +85  | °C   |

## ■ Frequency characteristics

| Item                                  | Symbol       | Condition                                | Range                            | Unit                         |
|---------------------------------------|--------------|------------------------------------------|----------------------------------|------------------------------|
| Frequency precision                   | $\Delta f/f$ | Ta=+25 °C, VDD=3.0 V                     | B: $5 \pm 23$ ( <sup>(*)</sup> ) | $\times 10^{-6}$             |
| Oscillation Start up time             | tSTA         | Ta=+25 °C, VDD=2.4 V                     | 3.0 Max.                         | s                            |
| Frequency temperature characteristics | TOP          | Ta=-10 °C to +70 °C<br>VDD=3.0 V, +25 °C | +10 / -120                       | $\times 10^{-6}$             |
| Frequency voltage characteristics     | f/V          | Ta=+25 °C,<br>VDD=1.6 V to 5.5 V         | $\pm 2.0$ Max.                   | $\times 10^{-6}/V$           |
| Aging                                 | fa           | Ta=+25 °C,<br>VDD=3.0 V First year       | $\pm 5.0$ Max.                   | $\times 10^{-6}/\text{year}$ |

(\*) Please ask tighter tolerance

## ■ DC characteristics

(GND=0 V, VDD=1.6 V to 5.5 V, Ta=-40 °C to +85 °C)

| Item                                                                               | Symbol | Condition                                                                                                 | Min.    | Typ. | Max. | Unit          |
|------------------------------------------------------------------------------------|--------|-----------------------------------------------------------------------------------------------------------|---------|------|------|---------------|
| Current consumption (When non-accessed)<br>FOUT = Output OFF<br>VTEMP = Output OFF | IbD1   | /CS0, /RD, /WR = VDD<br>A0-A3, CS1 = GND<br>D0-D3, /IRQ = Hi-Z<br>FOUT = Hi-Z (OFF)<br>VTEMP = Hi-Z (OFF) | VDD=5 V | 1.0  | 2.0  | $\mu\text{A}$ |
|                                                                                    | IbD2   | VDD=3 V                                                                                                   |         |      |      |               |

Note) There is no VTEMP pin on the RTC-7301DG so standards for the VTEMP pin within the conditions described above do not apply.

## ■ Temperature sensor characteristics

GND=0 V, Ta=-40 °C to +85 °C

| Item                        | Symbol            | Condition                                                                 | Min. | Typ.  | Max.      | Unit          |
|-----------------------------|-------------------|---------------------------------------------------------------------------|------|-------|-----------|---------------|
| Temperature output voltage  | VTEMP             | Ta=+25 °C, GND based output voltage<br>VTEMP pins, VDD=2.7 V to 5.5 V     |      | 1.470 |           | V             |
| Output precision            | TACR              | Ta=+25 °C, VDD=2.7 V to 5.5 V                                             |      |       | $\pm 5.0$ | °C            |
| Temperature sensitivity     | VSE               | -40 °C $\leq$ Ta $\leq$ +85 °C, VDD=2.7 V to 5.5 V                        | -7.3 | -7.8  | -8.3      | mV/°C         |
| Linearity                   | $\Delta\text{NL}$ | -40 °C $\leq$ Ta $\leq$ +85 °C, VDD=2.7 V to 5.5 V                        |      |       | $\pm 2.0$ | %             |
| Temperature detection range | TSOP              | $\Delta\text{NL} \leq \pm 2.0\%$ , VDD=2.7 V to 5.5 V                     | -40  |       | +85       | °C            |
| Output resistance           | Ro                | Ta=25 °C, VTEMP pins, VDD=2.7 V to 5.5 V<br>GND standard and VDD standard |      | 1.0   | 3.0       | k $\Omega$    |
| Load condition              | CL                | VDD=2.7 V to 5.5 V                                                        |      |       | 100       | pF            |
|                             | RL                | VDD=2.7 V to 5.5 V                                                        | 500  |       |           | k $\Omega$    |
| Response time               | tRSP              | VDD=3.3 V<br>CL=50 pF, RL=500 k $\Omega$ , Max. $\pm 1$ °C                |      |       | 200       | $\mu\text{s}$ |

Note) There is no temperature sensor function on the RTC-7301DG.



## 4-bit REAL TIME CLOCK MODULE

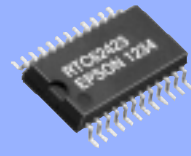
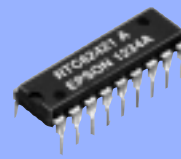
# RTC - 62421

# RTC - 62423

- Built-in crystal unit allows adjustment-free efficient operation.
- 24 h / 12 h changeable and leap year automatically adjustable (Gregorian calendar).
- Pins and functions are compatible with the MSM6242 series.



Product Number (Please contact us)  
 RTC-62421 : Q42624211xxxx00  
 RTC-62423 : Q42624231xxxx00

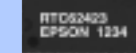


Actual size

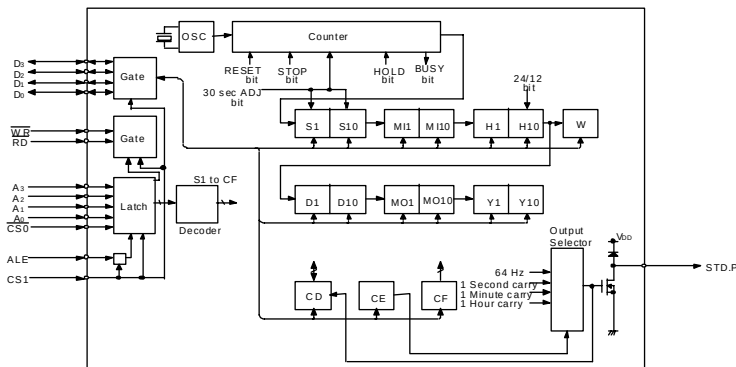
RTC-62421



RTC-62423



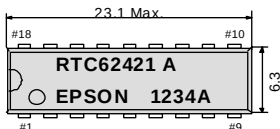
## Block diagram



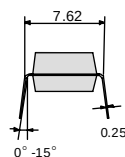
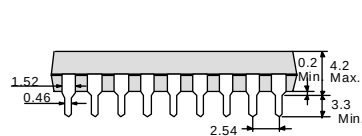
## Terminal connection/External dimensions

(Unit:mm)

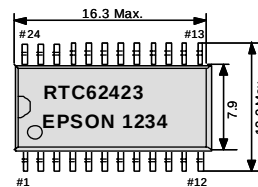
## ● RTC-62421 (DIP 18-pin)



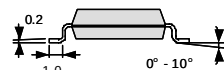
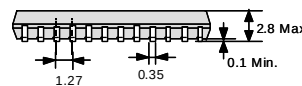
| No. | Pin terminal | No. | Pin terminal |
|-----|--------------|-----|--------------|
| 1   | STD.P        | 18  | VDD          |
| 2   | /CS0         | 17  | (VDD)        |
| 3   | ALE          | 16  | (VDD)        |
| 4   | A0           | 15  | CS1          |
| 5   | A1           | 14  | C0           |
| 6   | A2           | 13  | D1           |
| 7   | A3           | 12  | D2           |
| 8   | /RD          | 11  | D3           |
| 9   | GND          | 10  | /WR          |



## ● RTC-62423 (SOP 24-pin)



| No. | Pin terminal | No. | Pin terminal |
|-----|--------------|-----|--------------|
| 1   | STD.P        | 24  | VDD          |
| 2   | /CS0         | 23  | (VDD)        |
| 3   | N.C.         | 22  | (VDD)        |
| 4   | ALE          | 21  | N.C.         |
| 5   | A0           | 20  | CS1          |
| 6   | N.C.         | 19  | D0           |
| 7   | A1           | 18  | N.C.         |
| 8   | N.C.         | 17  | N.C.         |
| 9   | A2           | 16  | D1           |
| 10  | A3           | 15  | D2           |
| 11  | /RD          | 14  | D3           |
| 12  | GND          | 13  | /WR          |



Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

## Specifications (characteristics)

\*Refer to application manual for details.

## Absolute Max. rating

| Item                  | Symbol | Condition | Min.    | Max.    | Unit |
|-----------------------|--------|-----------|---------|---------|------|
| Supply voltage        | VDD    | Ta=+25 °C | -0.3    | +7.0    | V    |
| Input voltage         | VIO    | Ta=+25 °C | GND-0.3 | VDD+0.3 | V    |
| Storage temperature * | TSTG   | RTC-62421 | -55     | +85     | °C   |
|                       |        | RTC-62423 | -55     | +125    | °C   |

\*Stored as bare product after unpacking

## Operating range

| Item                  | Symbol | Condition                              | Min. | Max. | Unit |
|-----------------------|--------|----------------------------------------|------|------|------|
| Power voltage         | VDD    | —                                      | 4.5  | 5.5  | V    |
| Clock voltage         | VCLK   | —                                      | 2.0  | 5.5  | V    |
| Operating temperature | TOPR   | Stored as bare product after unpacking | -40  | +85  | °C   |

## Frequency characteristics

| Item                                  | Symbol       | Condition                        | Range                                               | Unit                    |
|---------------------------------------|--------------|----------------------------------|-----------------------------------------------------|-------------------------|
| Frequency precision                   | $\Delta f/f$ | Ta=+25 °C<br>VDD=5.0 V           | 62421A ±10<br>62421B ±50<br>62423A ±20<br>62423 ±50 | ×10 <sup>-6</sup>       |
| Frequency temperature characteristics | TOP          | -10 °C to +70 °C (+25 °C)        | +10 / -120                                          |                         |
|                                       |              | -40 °C to +85 °C (+25 °C)        | +10 / -220                                          |                         |
| Frequency voltage characteristics     | f/V          | Ta=+25 °C, VDD=4.5 V to 5.5 V    | ±5.0 Max.                                           | ×10 <sup>-6</sup> /V    |
| Aging                                 | fa           | Ta=+25 °C, VDD=5.0 V, First year | ±5.0 Max.                                           | ×10 <sup>-6</sup> /year |

## DC characteristics

| Item                   | Symbol                               | Condition                      | Min.    | Typ.    | Max.      | Unit | Applicable terminal       |
|------------------------|--------------------------------------|--------------------------------|---------|---------|-----------|------|---------------------------|
| Current consumption    | I <sub>DD1</sub><br>I <sub>DD2</sub> | CS1= 0 V<br>VDD=5 V<br>VDD=2 V | —       | 15<br>1 | 30<br>1.8 | μA   | —                         |
| HIGH input voltage (1) | V <sub>IH1</sub>                     | —                              | 2.2     | —       | —         | V    | All inputs other than CS1 |
| LOW input voltage (1)  | V <sub>IL1</sub>                     | —                              | —       | —       | 0.8       | V    |                           |
| LOW output voltage (1) | V <sub>OL1</sub>                     | I <sub>OL</sub> =2.5 mA        | —       | —       | 0.4       | V    | D0 to D3                  |
| HIGH output voltage    | V <sub>OH</sub>                      | I <sub>OH</sub> =-400 μA       | 2.4     | —       | —         | V    |                           |
| LOW output voltage (2) | V <sub>OL2</sub>                     | I <sub>OL</sub> =2.5 mA        | —       | —       | 0.4       | V    | STD.P                     |
| OFF leak current       | I <sub>OFFLK</sub>                   | V <sub>I</sub> =VDD/0 V        | —       | —       | 10/-10    | μA   |                           |
| Input capacity         | C <sub>I</sub>                       | Input frequency 1 MHz          | —       | 5       | —         | pF   | Input Pins                |
| HIGH input voltage (2) | V <sub>IH2</sub>                     | VDD=2.0 V to 5.5 V             | 4/5 VDD | —       | —         | V    | CS1                       |
| LOW input voltage (2)  | V <sub>IL2</sub>                     | —                              | —       | —       | 1/5 VDD   | V    |                           |
| Input leak current (1) | I <sub>LK1</sub>                     | V <sub>I</sub> =VDD/0 V        | —       | —       | 1/-1      | μA   | Input other than D0 to D3 |
| Input leak current (2) | I <sub>LK2</sub>                     | —                              | —       | —       | 10/-10    | μA   | D0 to D3                  |





## 4-bit REAL TIME CLOCK MODULE

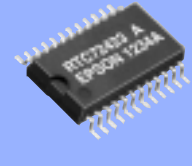
# RTC - 72421

# RTC - 72423

- Built-in crystal unit allows adjustment-free efficient operation.
- 24 h / 12 h changeable and leap year automatically adjustable (Gregorian calendar).



Product Number (Please contact us)  
 RTC-72421 : Q42724211xxxx00  
 RTC-72423 : Q42724231xxxx00



Actual size

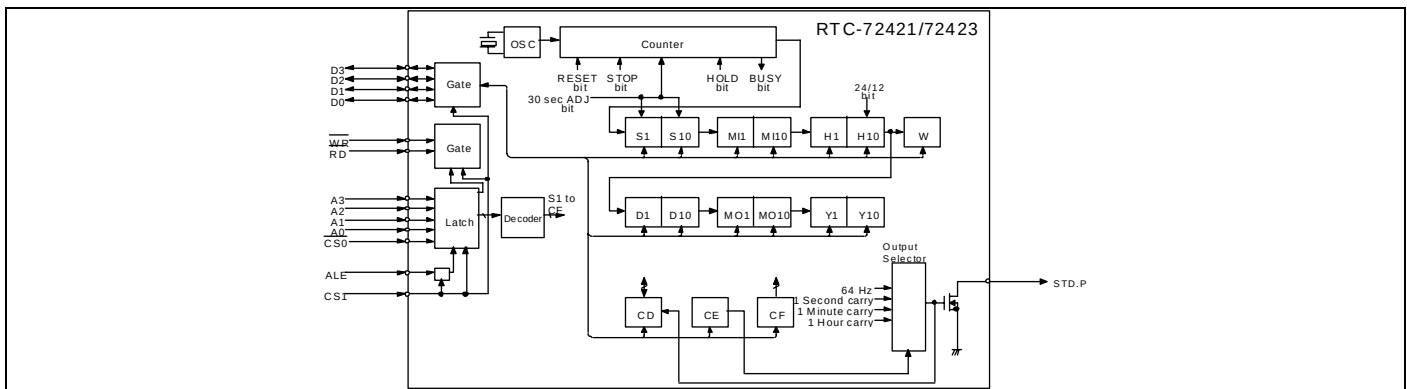
RTC-72421



RTC-72423



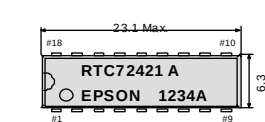
## Block diagram



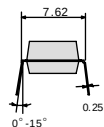
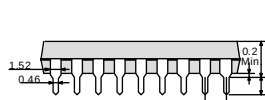
## Terminal connection/External dimensions

(Unit:mm)

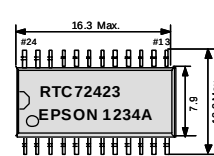
## ● RTC-72421 (DIP 18-pin)



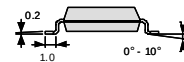
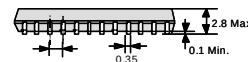
| No. | Pin terminal | No. | Pin terminal |
|-----|--------------|-----|--------------|
| 1   | STD.P        | 18  | VDD          |
| 2   | /CS0         | 17  | (VDD)        |
| 3   | ALE          | 16  | (VDD)        |
| 4   | A0           | 15  | CS1          |
| 5   | A1           | 14  | C0           |
| 6   | A2           | 13  | D1           |
| 7   | A3           | 12  | D2           |
| 8   | /RD          | 11  | D3           |
| 9   | GND          | 10  | /WR          |



## ● RTC-72423 (SOP 24-pin)



| No. | Pin terminal | No. | Pin terminal |
|-----|--------------|-----|--------------|
| 1   | STD.P        | 24  | VDD          |
| 2   | /CS0         | 23  | (VDD)        |
| 3   | N.C.         | 22  | (VDD)        |
| 4   | ALE          | 21  | N.C.         |
| 5   | A0           | 20  | CS1          |
| 6   | N.C.         | 19  | D0           |
| 7   | A1           | 18  | N.C.         |
| 8   | N.C.         | 17  | N.C.         |
| 9   | A2           | 16  | D1           |
| 10  | A3           | 15  | D2           |
| 11  | /RD          | 14  | D3           |
| 12  | GND          | 13  | /WR          |



Metal may be exposed on the top or bottom of this product. This will not affect any quality, reliability or electrical spec.

## Specifications (characteristics)

\*Refer to application manual for details.

## Absolute Max. rating

| Item                  | Symbol | Condition | Min.    | Max.    | Unit |
|-----------------------|--------|-----------|---------|---------|------|
| Supply voltage        | VDD    | Ta=+25 °C | -0.3    | +7.0    | V    |
| Input voltage         | VIO    | Ta=+25 °C | GND-0.3 | VDD+0.3 | V    |
| Storage temperature * | TSTG   | RTC-72421 | -55     | +85     | °C   |
|                       |        | RTC-72423 | -55     | +125    | °C   |

\*Stored as bare product after unpacking

## Operating range

| Item                  | Symbol | Condition | Min. | Max. | Unit |
|-----------------------|--------|-----------|------|------|------|
| Power voltage         | VDD    | —         | 4.5  | 5.5  | V    |
| Clock voltage         | VCLK   | —         | 2.0  | 5.5  | V    |
| Operating temperature | TOPR   | RTC-72421 | -10  | +70  | °C   |
|                       |        | RTC-72423 | -40  | +85  | °C   |

Stored as bare product after unpacking

## Frequency characteristics

| Item                                  | Symbol         | Condition                                              | Range                               | Unit                                                             |
|---------------------------------------|----------------|--------------------------------------------------------|-------------------------------------|------------------------------------------------------------------|
| Frequency precision                   | $\Delta f / f$ | Ta=+25 °C<br>VDD=5.0 V                                 | 72421A<br>72421B<br>72423A<br>72423 | $\pm 10$<br>$\pm 50$<br>$\pm 20$<br>$\pm 50$<br>$\times 10^{-6}$ |
| Frequency temperature characteristics | TOP            | -10 °C to +70 °C (+25 °C)<br>-40 °C to +85 °C (+25 °C) |                                     | +10 / -120<br>+10 / -220                                         |
| Frequency voltage characteristics     | f/V            | Ta=+25 °C, VDD=2.0 V to 5.5 V                          |                                     | $\pm 5.0$ Max.<br>$\times 10^{-6}/V$                             |
| Aging                                 | fa             | Ta=+25 °C, VDD=5.0 V, First year                       |                                     | $\pm 5.0$ Max.<br>$\times 10^{-6}/\text{year}$                   |

## DC characteristics

| Item                   | Symbol | Condition                               | Min.    | Typ. | Max.    | Unit | Applicable terminal       |
|------------------------|--------|-----------------------------------------|---------|------|---------|------|---------------------------|
| Current consumption    | IDD1   | CS1=0 V<br>Exclude input/output current | —       | 1    | 10      | μA   | —                         |
|                        | IDD2   | VDD=5 V<br>VDD=2 V                      | —       | 0.9  | 5       | μA   | —                         |
| HIGH input voltage (1) | VIH1   | —                                       | 2.2     | —    | —       | V    | All inputs other than CS1 |
| LOW input voltage (1)  | VL1    | —                                       | —       | —    | 0.8     | V    | D0 to D3                  |
| LOW output voltage (1) | VO1    | IOL=2.5 mA                              | —       | —    | 0.4     | V    | STD.P                     |
| HIGH output voltage    | VOH    | IOH=-400 μA                             | 2.4     | —    | —       | V    | —                         |
| LOW output voltage (2) | VO2    | IOL=2.5 mA                              | —       | —    | 0.4     | V    | —                         |
| OFF leak current       | IOFLK  | V1=VDD/0 V                              | —       | —    | 10/-10  | μA   | —                         |
| Input capacity         | C1     | Input frequency<br>1 MHz                | —       | 10   | —       | pF   | Input other than D0 to D3 |
| HIGH input voltage (2) | VIH2   | VDD=2.0 V to 5.5 V                      | 4/5 VDD | —    | —       | V    | D0 to D3, STD.P           |
| LOW input voltage (2)  | VL2    | —                                       | —       | —    | 1/5 VDD | V    | —                         |
| Input leak current (1) | ILK1   | V1=VDD/0 V                              | —       | —    | 1/-1    | μA   | Input other than D0 to D3 |
| Input leak current (2) | ILK2   | —                                       | —       | —    | 10/-10  | μA   | D0 to D3                  |



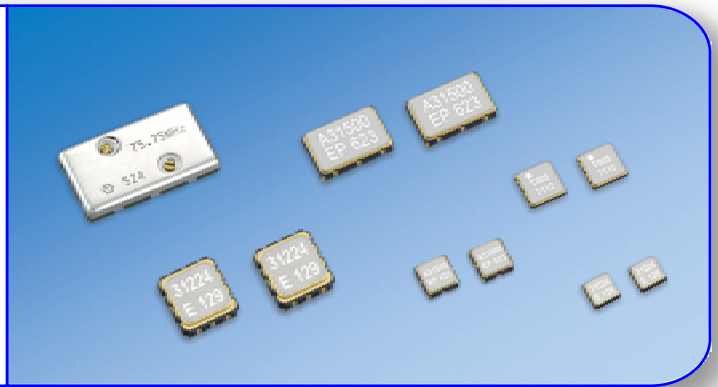


# FILTER

## Monolithic Crystal Filter (MCF) SAW Filter

### •Features

- ▶ Wide selection of types according to application.
- ▶ Custom designs available upon request.  
Please inquire it.



### ■Monolithic Crystal Filter (MCF)

#### ▶ HF series

| Applications                                               | Frequency<br>MHz | Pole<br>(Filter order) | Passband |    | Model   | External dimension (mm) |                     |  | Page |
|------------------------------------------------------------|------------------|------------------------|----------|----|---------|-------------------------|---------------------|--|------|
|                                                            |                  |                        | kHz      | dB |         |                         |                     |  |      |
| Radio Equipment / IF<br>(For miniature size<br>Equipments) | 130.05           | 2                      | ±15      | 3  | HF-232A |                         | 2.5×2.0×0.9 t       |  | 119  |
|                                                            | 130.05           | 3                      | ±15      | 3  | HF-233A |                         | 3.0×3.0×0.9 t       |  | 120  |
|                                                            | 122.88           | 2                      | ±6       | 3  | HF-362A |                         | 3.0×3.0×0.9 t       |  | 121  |
|                                                            | 243              | 3                      | ±10      | 3  | HF-363A |                         | 3.8×3.8×1.0 t       |  | 122  |
|                                                            | 61.44            | 2                      | ±6       | 3  | HF-372A |                         | 7.0×5.0×1.1 t       |  | 123  |
|                                                            | 73.35            | 3                      | ±6       | 3  | HF-373A |                         | 18.3 x 10.3 x 2.8 t |  | 124  |
| Radio Equipment / IF                                       | 73.35            | 4                      | ±7.5     | 3  | HF-734A |                         | 26.0×16.0×5.0 t     |  |      |
| Base Stations / IF<br>(GSM)                                | 71               | 4                      | ±10      | 3  | HF-J14A |                         | 18.3 x 10.3 x 2.8 t |  | 123  |
|                                                            |                  | 4                      | ±80      | 3  | HF-S14A |                         | 26.0×16.0×5.0 t     |  | 124  |

\*Models for other frequencies are available upon request.

#### ▶ MF series

| Applications                                               | Frequency<br>MHz | Pole<br>(Filter order) | Passband |    | Model   | External dimension (mm) |               |  | Page |
|------------------------------------------------------------|------------------|------------------------|----------|----|---------|-------------------------|---------------|--|------|
|                                                            |                  |                        | kHz      | dB |         |                         |               |  |      |
| Radio Equipment / IF<br>(For miniature size<br>Equipments) | 45               | 2                      | ±7.5     | 3  | MF-372A |                         | 3.8×3.8×1.0 t |  | 125  |
|                                                            | 130.05           | 3                      | ±14      | 3  | MF-373A |                         | 7.0×5.0×1.0 t |  | 126  |
| Radio Equipment / IF                                       | 21.4             | 2                      | ±7.5     | 3  | MF-722A |                         | 7.0×5.0×1.0 t |  | 127  |
|                                                            | 21.7             | 2                      | ±7.5     | 3  | MF-722A |                         | 7.0×5.0×1.0 t |  |      |
|                                                            | 45               | 2                      | ±15      | 3  | MF-723A |                         | 7.0×5.0×1.1 t |  |      |
|                                                            | 45               | 3                      | ±15      | 3  | MF-723A |                         | 7.0×5.0×1.1 t |  |      |
|                                                            | 45               | 4                      | ±7.5     | 3  | MF-734A |                         | 7.0×5.0×1.1 t |  |      |

\*Models for other frequencies are available upon request.

### ■SAW Filter

| Application                                    |                             | Nominal<br>frequency<br>(MHz) | Passband<br>(MHz) | Model        | External dimension |                    |  | Page |
|------------------------------------------------|-----------------------------|-------------------------------|-------------------|--------------|--------------------|--------------------|--|------|
|                                                |                             |                               |                   |              | Actual<br>size     | Typ. (mm)          |  |      |
| TPMS, RKE/RF<br>ARIB std. T67<br>in Japan / RF | RKE<br>TPMS<br>ARIB T67<br> | 300 to 500                    | 0.2               | FF-555       |                    | 5.2 x 4.8 x 1.5 t  |  | 128  |
|                                                |                             | 300 to 500                    | 0.4               | FF-585       |                    | 3.8 x 3.8 x 0.98 t |  | 129  |
|                                                |                             | 300 to 500                    | 0.4(0.6)          | FF-32N       |                    | 3.0 x 3.0 x 1.11 t |  | 130  |
|                                                |                             | 300 to 450                    | 0.6 to 4          | TF-330A / C  |                    | 3.0 x 3.0 x 1.11 t |  | 131  |
| ISM/RF                                         | Europe                      | 869                           | 2                 | TQS-557AA-7R |                    | 3.0 x 3.0 x 1.11 t |  | 132  |
| GPS,<br>Car navigation / RF                    |                             | 1575.42                       | 2.4               | TQS-949AD-7G |                    | 2.5 x 2.0 x 0.8 t  |  | 133  |
| W-LAN/IF                                       |                             | 374                           | 17                | TQS-471BB-7R |                    | 3.0 x 3.0 x 1.11 t |  | 134  |
| Cellular phone / IF                            | W-CDMA/UMTS                 | 190                           | 4.6               | TQS-477AA-7R |                    | 3.0 x 3.0 x 1.11 t |  | 135  |
| Base station / IF                              | W-CDMA Base Station         | 380                           | 4.4               | TQS-472BA-7R |                    | 7.0 x 5.0 x 1.5 t  |  |      |

RKE : Remote Keyless Entry  
TPMS : Tire Pressure Monitoring System

## CRYSTAL FILTER FOR MINIATURE SIZE RADIO EQUIPMENT/ IF

# HF - 232A

- Number of poles : 2 pole
- Available frequency range : 70 MHz to 180 MHz
- Old name : TF2-D0AD6

**HF - 233A**

- Number of poles : 3 pole
- Available frequency range : 100 MHz to 150 MHz
- Old name : TF3-D0AC7

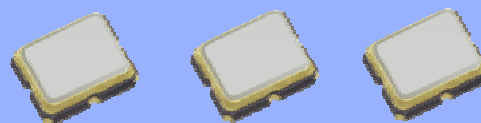
- High frequency and outstanding mechanical strength with original inverted-mesa structure.
- High frequency 3 pole filters with original process technology.
- Applications : Various kinds of miniature size radio equipment



Product number (please contact us)

Product Number (please contact  
HF-232A : X1F000011xxxx00

HF-233A: X1F000021xxxx00



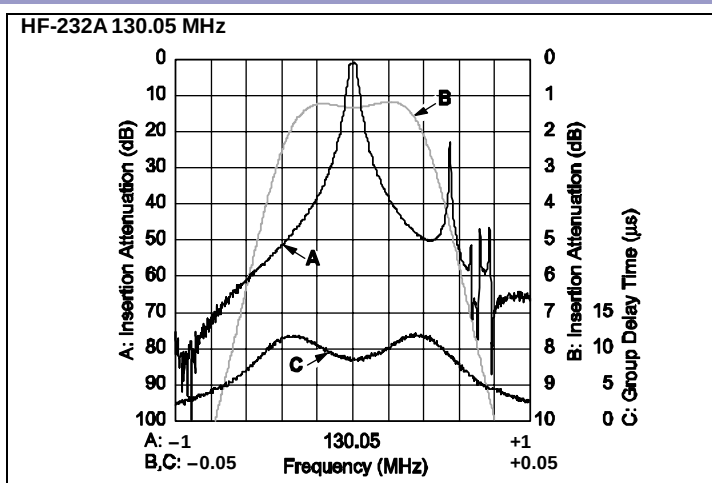
Actual size



### Specifications (characteristics)

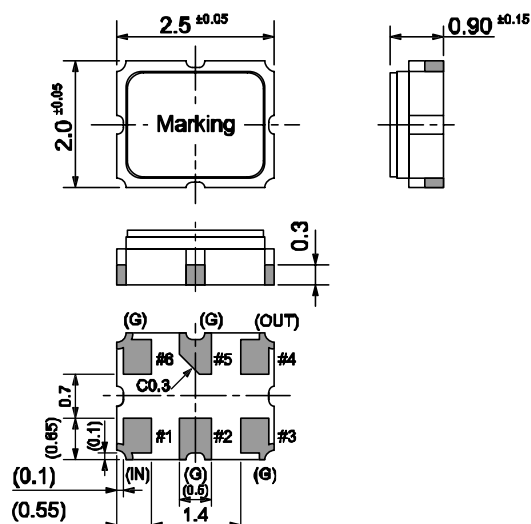
| Item                        | Symbol | HF-232A                   | HF-233A                   | Remarks                                                        |
|-----------------------------|--------|---------------------------|---------------------------|----------------------------------------------------------------|
| Nominal frequency           | f_nom  | 130.05 MHz                | 130.05 MHz                | Other frequency and pass bandwidth are available upon request. |
| Storage temperature range   | T_stg  | -40 °C to +85 °C          | -40 °C to +85 °C          |                                                                |
| Operating temperature range | T_use  | -30 °C to +85 °C          | -30 °C to +85 °C          |                                                                |
| Number of poles             | —      | 2                         | 3                         |                                                                |
| Pass bandwidth              | P_Bw   | f_nom ±15 kHz Min.        | f_nom ±15 kHz Min.        |                                                                |
| Insertion loss              | IL     | 3 dB Max.                 | 4 dB Max.                 |                                                                |
| Ripple                      | Ripple | 1 dB Max.                 | 1 dB Max.                 |                                                                |
| Stop bandwidth              | S_Bw   | f_nom ±50 kHz:10 dB Min.  | f_nom ±50 kHz:20 dB Min.  |                                                                |
| Guaranteed attenuation      | G_Att  | f_nom -900 kHz:70 dB Min. | f_nom -900 kHz:70 dB Min. |                                                                |
| Terminating impedance       | Zt     | 200 Ω // 1.7 pF           | 250 Ω // -1.0 pF          |                                                                |
| Package                     | —      | TS-2520                   | TS-2520                   |                                                                |

## Electrical DATA



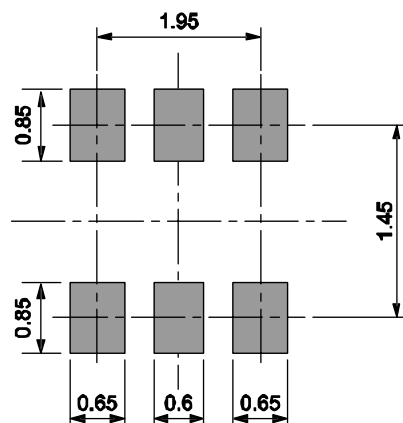
## External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)





## CRYSTAL FILTER FOR MINIATURE SIZE RADIO EQUIPMENT/ IF

### HF-362A

- Number of poles : 2 pole
- Available frequency range : 40 MHz to 325 MHz
- Old name : TF2-D0AC5

### HF-363A

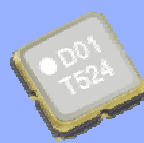
- Number of poles : 3 pole
- Available frequency range : 60 MHz to 250 MHz
- Old name : TF3-J3DC5
- High frequency and outstanding mechanical strength with original inverted-mesa structure.
- High frequency 3 pole filters with original process technology.
- Applications : Various kinds of miniature size radio equipment



Product number (please contact us)

HF-362A : X1F000031xxxx00

HF-363A : X1F000041xxxx00



Actual size

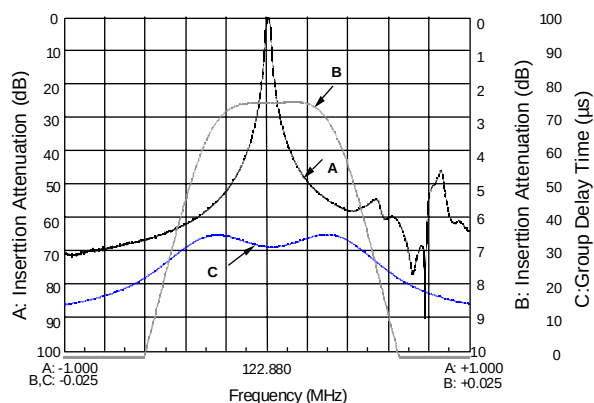


## Specifications (characteristics)

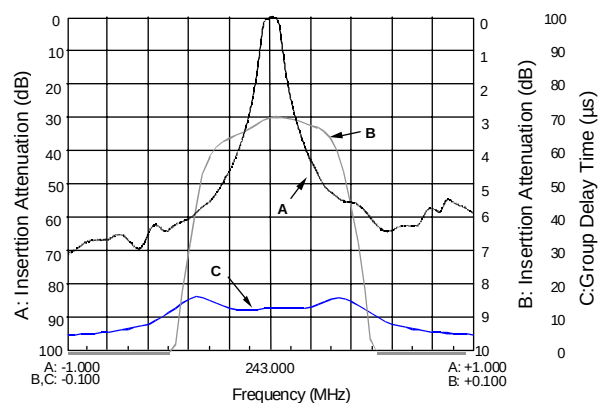
| Item                        | Symbol | HF-362A                       | HF-363A                       |                               | Remarks                                                        |
|-----------------------------|--------|-------------------------------|-------------------------------|-------------------------------|----------------------------------------------------------------|
| Nominal frequency           | f_nom  | 122.88 MHz                    | 156.525 MHz                   | 243 MHz                       | Other frequency and pass bandwidth are available upon request. |
| Storage temperature range   | T_stg  | -40 °C to +85 °C              | -40 °C to +85 °C              | -40 °C to +85 °C              |                                                                |
| Operating temperature range | T_use  | -30 °C to +85 °C              | -30 °C to +85 °C              | -30 °C to +85 °C              |                                                                |
| Number of poles             | —      | 2                             | 3                             | 3                             |                                                                |
| Pass bandwidth              | P_Bw   | f_nom±6 kHz Min.              | f_nom±10 kHz Min.             | f_nom±10 kHz Min.             |                                                                |
| Insertion loss              | IL     | 4 dB Max.                     | 5 dB Max.                     | 5 dB Max.                     |                                                                |
| Ripple                      | Ripple | 1 dB Max.                     | 1 dB Max.                     | 1 dB Max.                     |                                                                |
| Stop bandwidth              | S_Bw   | f_nom ±60 kHz:<br>28 dB Min.  | f_nom ±50 kHz:<br>20 dB Min.  | f_nom ±100 kHz:<br>20 dB Min. |                                                                |
| Guaranteed attenuation      | G_Att  | f_nom -900 kHz:<br>70 dB Min. | f_nom -900 kHz:<br>70 dB Min. | f_nom -900 kHz:<br>65 dB Min. |                                                                |
| Terminating impedance       | Zt     | 150 Ω // 3.0 pF               | 120 Ω // -0.8 pF              | 150 Ω // -1.0 pF              |                                                                |
| Package                     | —      | TS-30                         | TS-30                         | TS-30                         |                                                                |

## Electrical DATA

HF-362A 122.88 MHz

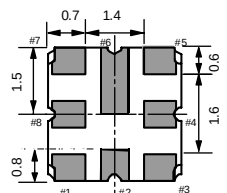
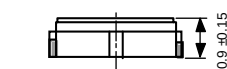
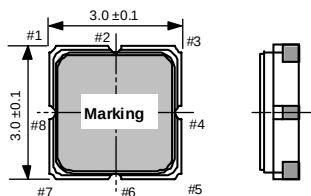


HF-363A 243 MHz



## External dimensions

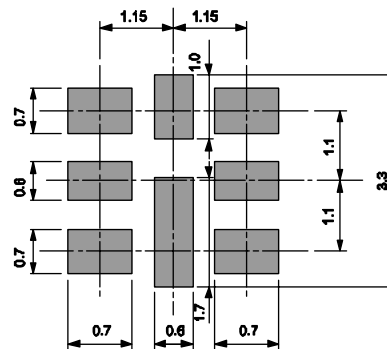
(Unit:mm)



| Pin         | Connection |
|-------------|------------|
| 1           | INPUT      |
| 5           | OUTPUT     |
| 2,3,4,6,7,8 | GND        |

## Footprint (Recommended)

(Unit:mm)





## CRYSTAL FILTER FOR MINIATURE SIZE RADIO EQUIPMENT/ IF

### HF-372A

- Number of poles : 2 pole
- Available frequency range : 40 MHz to 250 MHz
- Old name : TF2-45BB1

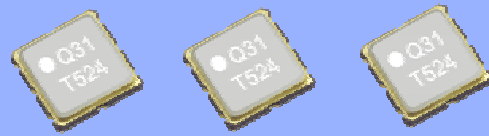
### HF-373A

- Number of poles : 3 pole
- Available frequency range : 60 MHz to 250 MHz
- Old name : TF3-A9AB1

- High frequency and outstanding mechanical strength with original inverted-mesa structure.
- High frequency 3 pole filters with original process technology.
- Applications : Various kinds of miniature size radio equipment



Product number (please contact us)  
HF-372A : X1F000051xxxx00  
HF-373A : X1F000201xxxx00



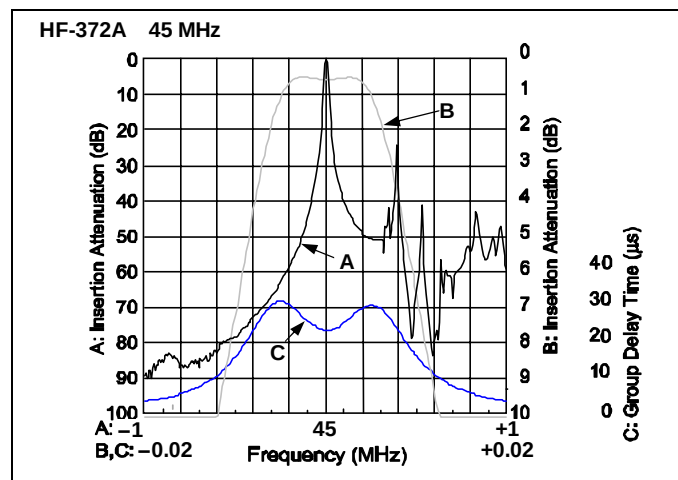
Actual size



## Specifications (characteristics)

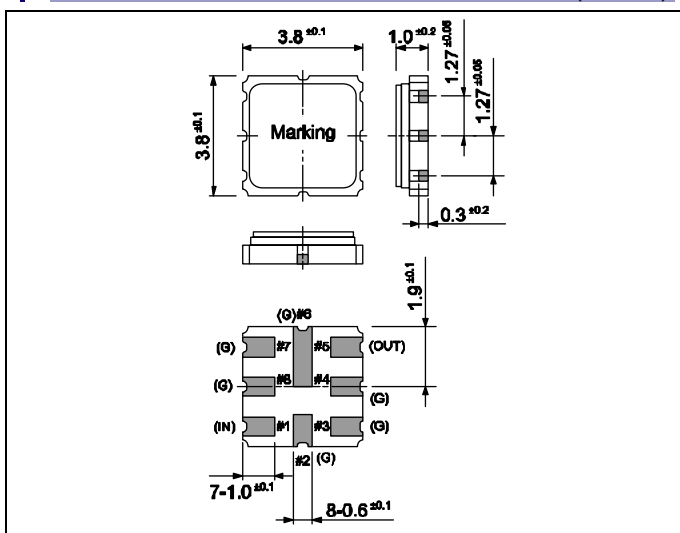
| Item                        | Symbol           | HF-372A                                           |                                     | HF-373A                              | Remarks                                                        |
|-----------------------------|------------------|---------------------------------------------------|-------------------------------------|--------------------------------------|----------------------------------------------------------------|
| Nominal frequency           | f <sub>nom</sub> | 45 MHz                                            | 61.44 MHz                           | 73.35 MHz                            | Other frequency and pass bandwidth are available upon request. |
| Storage temperature range   | T <sub>stg</sub> | -40 °C to +85 °C                                  | -40 °C to +85 °C                    | -40 °C to +85 °C                     |                                                                |
| Operating temperature range | T <sub>use</sub> | -30 °C to +85 °C                                  | -30 °C to +85 °C                    | -30 °C to +85 °C                     |                                                                |
| Number of poles             | —                | 2                                                 | 2                                   | 3                                    |                                                                |
| Pass bandwidth              | P <sub>Bw</sub>  | f <sub>nom</sub> ±7.5 kHz Min.                    | f <sub>nom</sub> ±6 kHz Min.        | f <sub>nom</sub> ±6 kHz Min.         |                                                                |
| Insertion loss              | IL               | 3.5 dB Max.                                       | 3 dB Max.                           | 4.5 dB Max.                          |                                                                |
| Ripple                      | Ripple           | 1 dB Max.                                         | 1 dB Max.                           | 1 dB Max.                            |                                                                |
| Stop bandwidth              | S <sub>Bw</sub>  | f <sub>nom</sub> ±25 kHz:15 dB Min.               | f <sub>nom</sub> ±60 kHz:30 dB Min. | f <sub>nom</sub> ±25 kHz:20 dB Min.  |                                                                |
| Guaranteed attenuation      | G <sub>Att</sub> | f <sub>nom</sub> -800 kHz to -1000 kHz:70 dB Min. | —                                   | f <sub>nom</sub> -900 kHz:70 dB Min. |                                                                |
| Terminating impedance       | Z <sub>t</sub>   | 650 Ω // 1.5 pF                                   | 650 Ω // 1.5 pF                     | 400 Ω // -1.0 pF                     |                                                                |
| Package                     | —                | TS-38                                             | TS-38                               | TS-38                                |                                                                |

## Electrical DATA



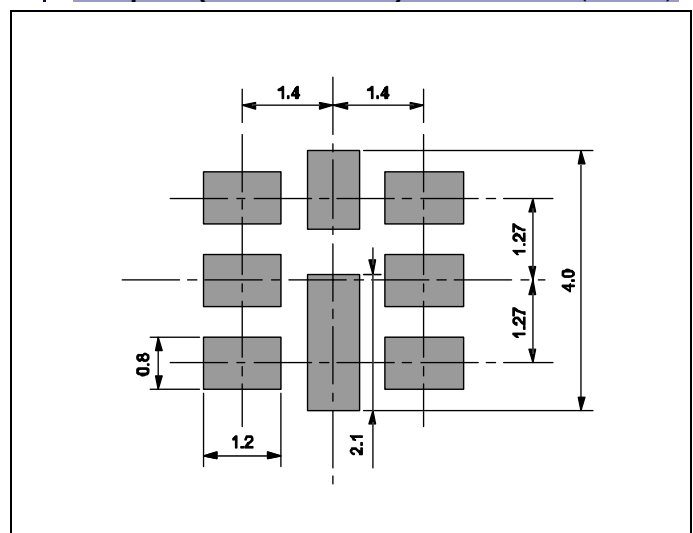
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





# CRYSTAL FILTER FOR MINIATURE SIZE RADIO EQUIPMENT/ IF HF-734A

- Number of poles : 4 pole
- Available frequency range : 40 MHz to 180 MHz
- Old name : TF4-73BA2
- Superb attenuation with 4 pole filters.
- Applications : Various kinds of radio equipment



Product number (please contact us)  
HF-734A : X1F000081xxxx00



Actual size

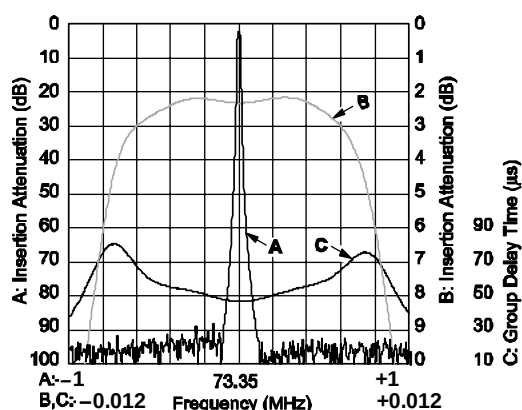


## Specifications (characteristics)

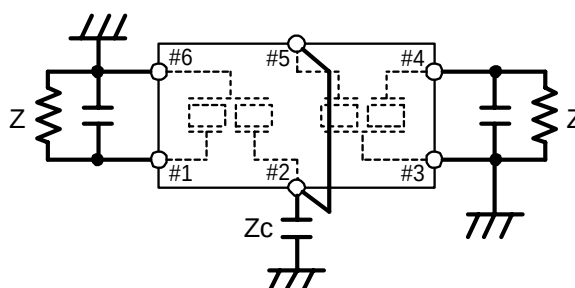
| Item                        | Symbol | HF-734A                                | Remarks                                                        |
|-----------------------------|--------|----------------------------------------|----------------------------------------------------------------|
| Nominal frequency           | f_nom  | 73.35 MHz                              | Other frequency and pass bandwidth are available upon request. |
| Storage temperature range   | T_stg  | -40 °C to +85 °C                       |                                                                |
| Operating temperature range | T_use  | -30 °C to +85 °C                       |                                                                |
| Number of poles             | —      | 4                                      |                                                                |
| Pass bandwidth              | S_Bw   | f_nom ±7.5 kHz Min.                    |                                                                |
| Insertion loss              | IL     | 5 dB Max.                              |                                                                |
| Ripple                      | Ripple | 1 dB Max.                              |                                                                |
| Stop bandwidth              | P_Bw   | f_nom ±25 kHz                          | 30 dB Min.                                                     |
| Guaranteed attenuation      | G_Att  | f_nom -800 kHz to -1000 kHz:70 dB Min. |                                                                |
| Terminating impedance       | Zt     | 500 Ω // +3.5 pF                       | Zc : 7.0 pF *1                                                 |
| Package                     | —      | TS-75B                                 |                                                                |

\*1 Zc is connected from pin 2 and 5 to ground. (As per pin connection of 4pole)

## Electrical DATA

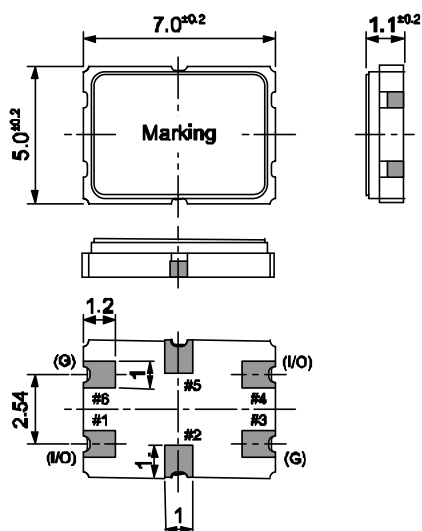


## Pin connection



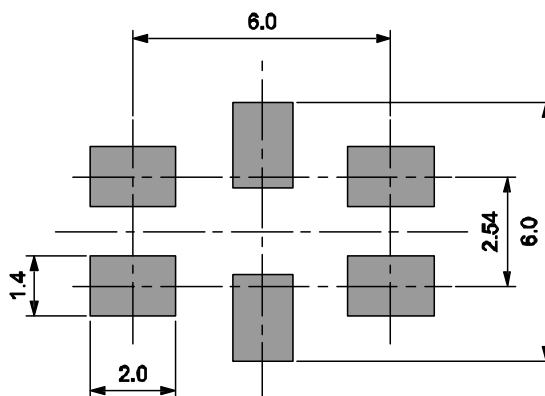
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)



CRYSTAL FILTER  
FOR BASE STATION / IF

## HF-J14A

- Number of poles : 4 pole
- Available frequency range : 40 MHz to 200 MHz
- Old name : TF4-71DY1

- High stability for external impedance with matching circuit.
- Applications : Base station for mobile phones



Product number (please contact us)  
HF-J14A : X1F000091xxxx00



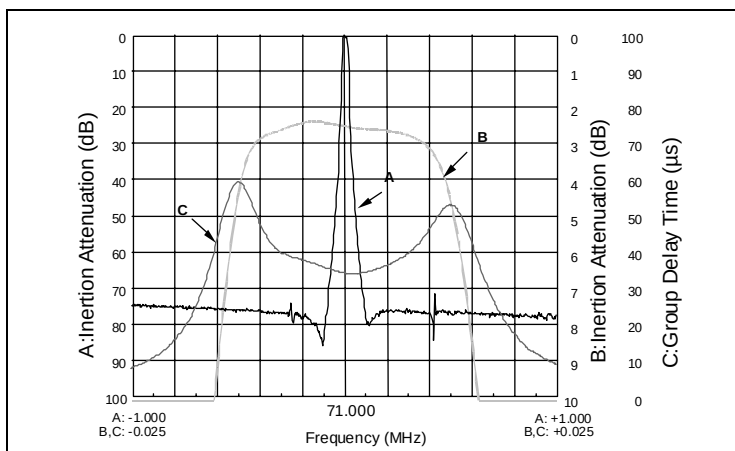
Actual size



## Specifications (characteristics)

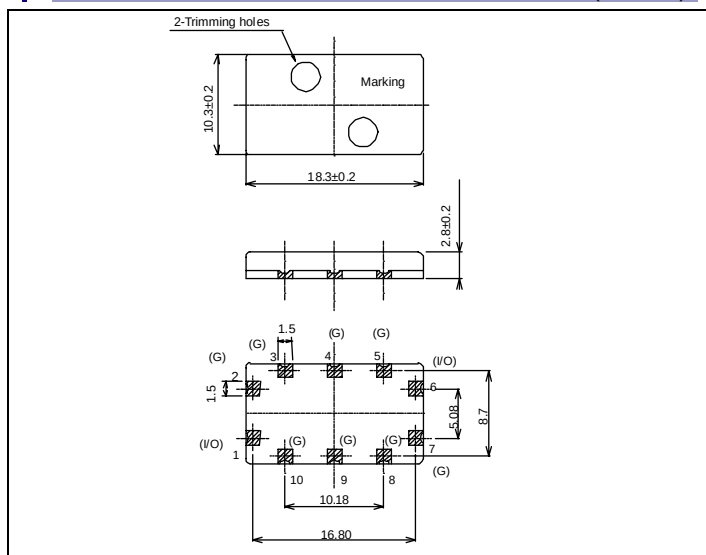
| Item                        | Symbol           | Specifications                                                      | Remarks                                                        |
|-----------------------------|------------------|---------------------------------------------------------------------|----------------------------------------------------------------|
| Nominal frequency           | f <sub>nom</sub> | 71 MHz                                                              | Other frequency and pass bandwidth are available upon request. |
| Storage temperature range   | T <sub>stg</sub> | -40 °C to +85 °C                                                    |                                                                |
| Operating temperature range | T <sub>use</sub> | -20 °C to +70 °C                                                    |                                                                |
| Number of poles             | —                | 4                                                                   |                                                                |
| Pass bandwidth (3 dB down)  | P <sub>Bw</sub>  | f <sub>nom</sub> ±10 kHz Min.                                       |                                                                |
| Insertion loss              | IL               | 4 dB Max.                                                           |                                                                |
| Ripple                      | Ripple           | 1 dB Max.                                                           |                                                                |
| Stop bandwidth              | S <sub>Bw</sub>  | f <sub>nom</sub> ±25 kHz Max.:30 dB Min.                            |                                                                |
| Guaranteed attenuation      | G <sub>Att</sub> | f <sub>nom</sub> ±800 kHz to f <sub>nom</sub> ±1000 kHz :70 dB Min. |                                                                |
| Terminating impedance       | Z <sub>t</sub>   | 50 Ω // 0 pF                                                        |                                                                |
| Package                     | —                | S-428                                                               |                                                                |

## Electrical DATA



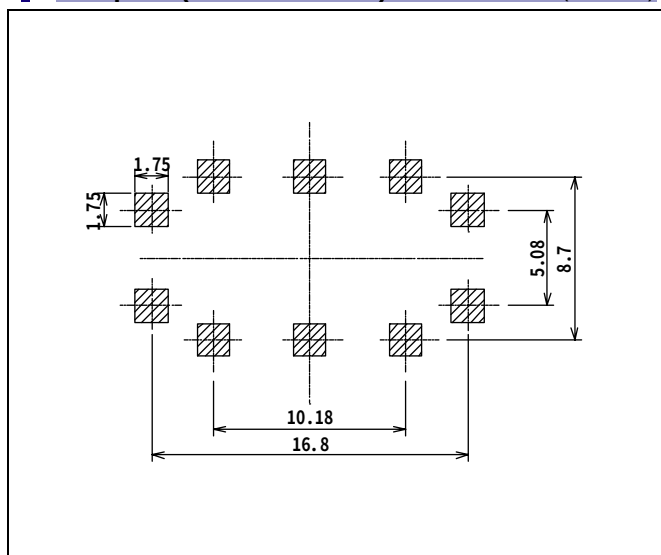
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





# CRYSTAL FILTER FOR BASE STATION / IF

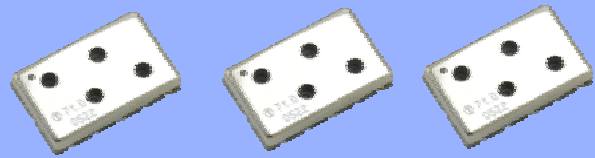
## HF-S14A

- Number of poles : 4 pole
- Available frequency range : 40 MHz to 200 MHz
- Old name : TF4-71GX2

- High stability for external impedance with matching circuit.
- Applications : Base station for mobile phones



Product number (please contact us)  
HF-S14A : X1F000101xxxx00



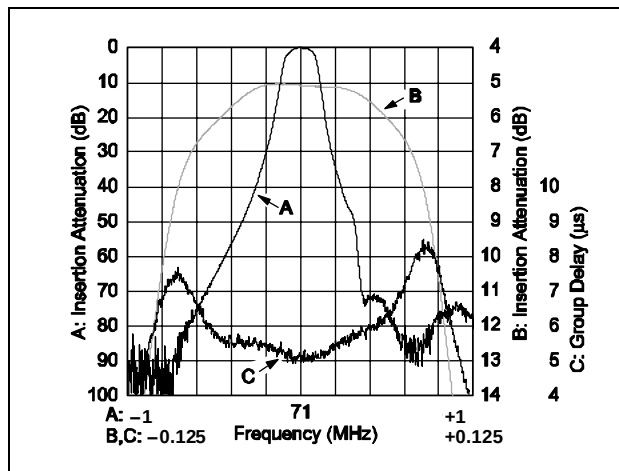
Actual size



### Specifications (characteristics)

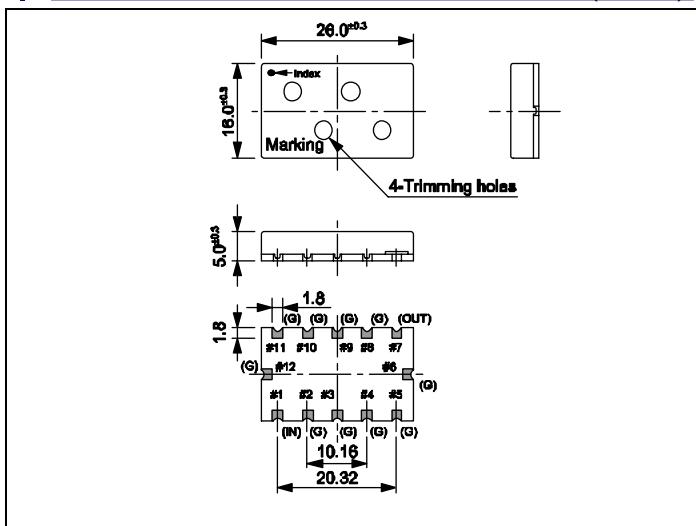
| Item                        | Symbol | Specifications            | Remarks                                                        |
|-----------------------------|--------|---------------------------|----------------------------------------------------------------|
| Nominal frequency           | f_nom  | 71 MHz                    | Other frequency and pass bandwidth are available upon request. |
| Storage temperature range   | T_stg  | -40 °C to +85 °C          |                                                                |
| Operating temperature range | T_use  | 0 °C to +70 °C            |                                                                |
| Number of poles             | —      | 4                         |                                                                |
| Pass bandwidth (3 dB down)  | P_Bw   | f_nom ±80 kHz Min.        |                                                                |
| Insertion loss              | IL     | 6 dB Max.                 |                                                                |
| Ripple                      | Ripple | 1 dB Max.                 |                                                                |
| Stop bandwidth              | S_Bw   | f_nom ±200 kHz Max.       | 28 dB Min.                                                     |
| Guaranteed attenuation      | G_Att  | f_nom ±800 kHz:70 dB Min. |                                                                |
| Terminating impedance       | Zt     | 50 Ω // 0 pF              |                                                                |
| Package                     | —      | S-436                     |                                                                |

### Electrical DATA



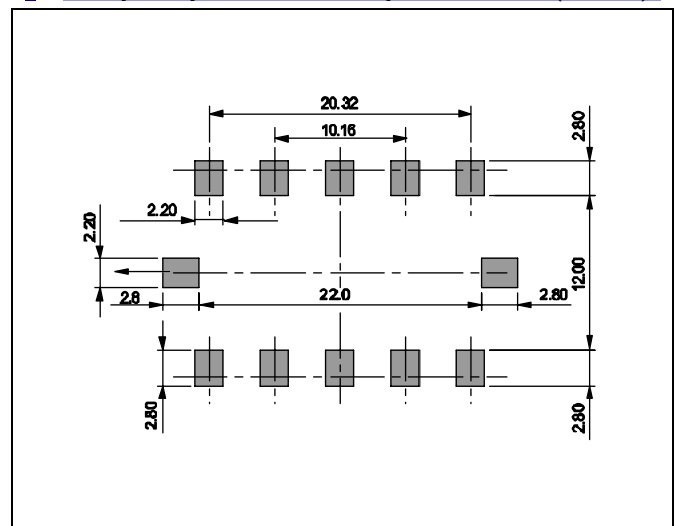
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)







## CRYSTAL FILTER FOR MINIATURE SIZE RADIO EQUIPMENT/ IF

### MF-372A

- Number of poles : 2 pole
- Available frequency range : 19 MHz to 150 MHz
- Old name : TS2-45B31

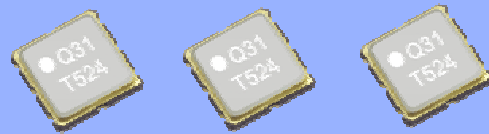
### MF-373A

- Number of poles : 3 pole
- Available frequency range : 40 MHz to 150 MHz
- Old name : TS3-D0A31

- High frequency 3 pole filters with original process technology.
- Applications : Various kinds of miniature size radio equipment.



Product number (please contact us)  
MF-372A : X1F000111xxxx00  
MF-373A : X1F000121xxxx00



Actual size

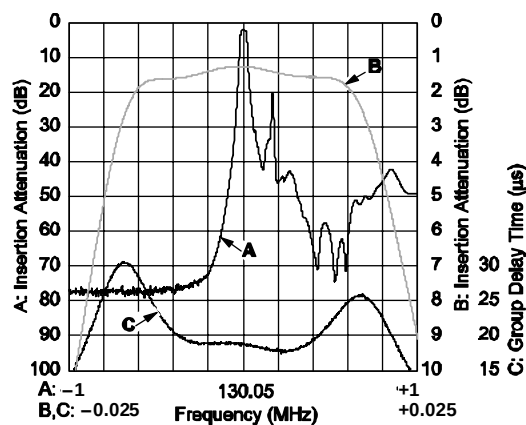


## Specifications (characteristics)

| Item                        | Symbol | MF-372A                                      | MF-373A                                      | Remarks                                                        |
|-----------------------------|--------|----------------------------------------------|----------------------------------------------|----------------------------------------------------------------|
| Nominal frequency           | f_nom  | 45 MHz                                       | 130.05 MHz                                   | Other frequency and pass bandwidth are available upon request. |
| Storage temperature range   | T_stg  | -40 °C to +85 °C                             | -40 °C to +85 °C                             |                                                                |
| Operating temperature range | T_use  | -30 °C to +85 °C                             | -30 °C to +85 °C                             |                                                                |
| Number of poles             | —      | 2                                            | 3                                            |                                                                |
| Pass bandwidth              | P_Bw   | f_nom ± 7.5 kHz Min.                         | f_nom ± 14 kHz Min.                          |                                                                |
| Insertion loss              | IL     | 3.5 dB Max.                                  | 3 dB Max.                                    |                                                                |
| Ripple                      | Ripple | 1 dB Max.                                    | 1 dB Max.                                    |                                                                |
| Stop bandwidth              | S_Bw   | f_nom ± 25 kHz: 15 dB Min.                   | f_nom ± 50 kHz: 20 dB Min.                   |                                                                |
| Guaranteed attenuation      | G_Att  | f_nom - 800 kHz to -1000 kHz<br>: 70 dB Min. | f_nom - 800 kHz to -1000 kHz<br>: 70 dB Min. |                                                                |
| Terminating impedance       | Zt     | 650 Ω // 1.5 pF                              | 950 Ω // -1.2 pF                             |                                                                |
| Package                     | —      | TS-38                                        | TS-38                                        |                                                                |

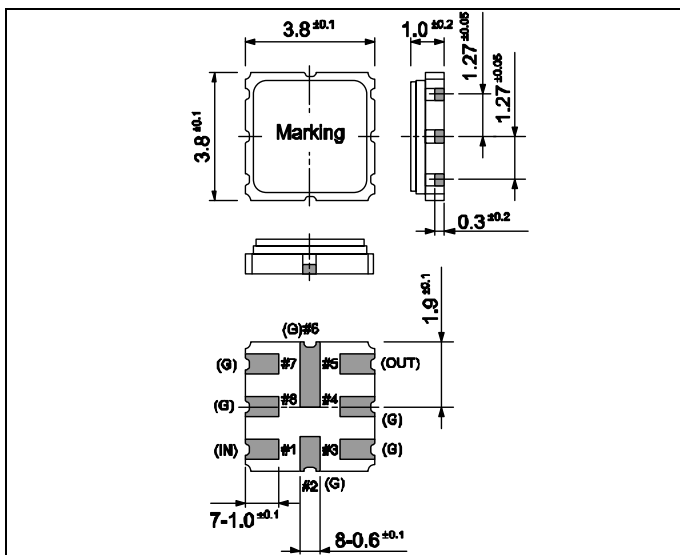
## Electrical DATA

MF-373A 130.05 MHz



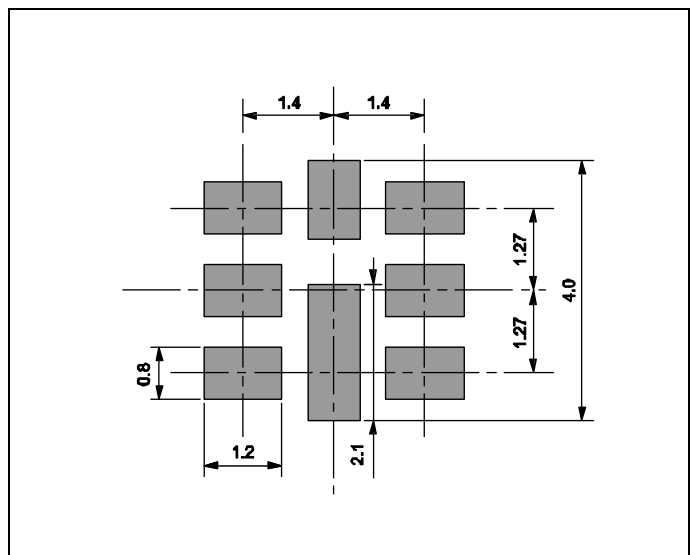
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





# CRYSTAL FILTER FOR MINIATURE SIZE RADIO EQUIPMENT/ IF

## MF-722A

- Number of poles : 2 pole
- Available frequency range : 19 MHz to 150 MHz
- Old name : TF2-21B14

## MF-723A

- Number of poles : 3 pole
- Available frequency range : 19 MHz to 150 MHz
- Old name : TS3-45A01

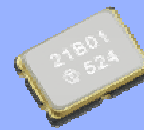
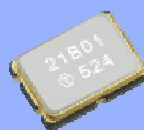
- High frequency 3 pole filters with original process technology.
- Applications : Various kinds of miniature size radio equipment



Product number (please contact us)

MF-722A : X1F000131xxxx00

MF-723A : X1F000141xxxx00



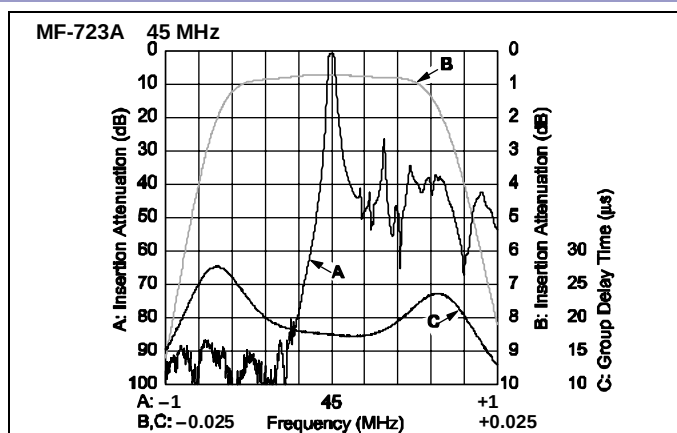
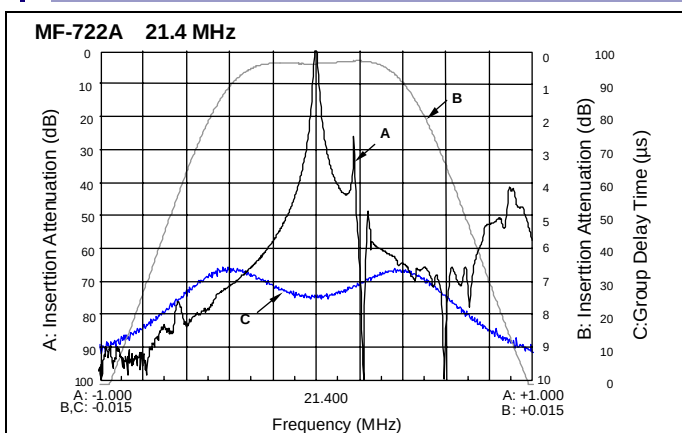
Actual size



## Specifications (characteristics)

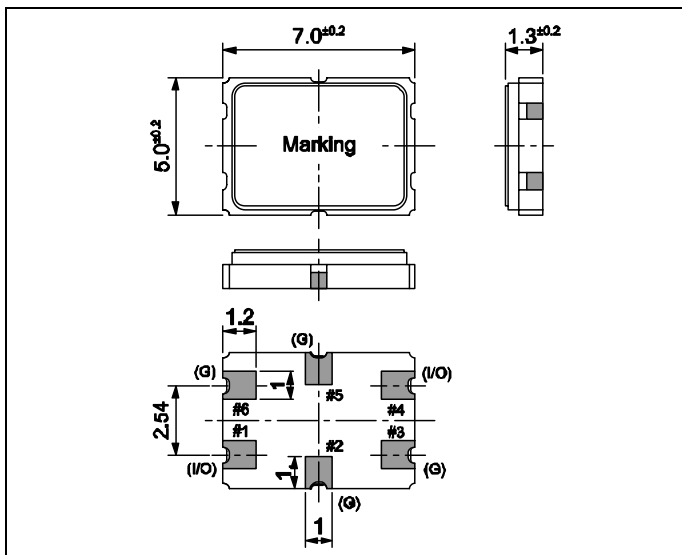
| Item                        | Symbol | MF-722A                   |                                           | MF-723A                                   | Remarks                                                        |
|-----------------------------|--------|---------------------------|-------------------------------------------|-------------------------------------------|----------------------------------------------------------------|
| Nominal frequency           | f_nom  | 21.4 MHz , 21.7 MHz       | 45 MHz                                    | 45 MHz                                    | Other frequency and pass bandwidth are available upon request. |
| Storage temperature range   | T_stg  | -40 °C to +85 °C          | -40 °C to +85 °C                          | -40 °C to +85 °C                          |                                                                |
| Operating temperature range | T_use  | -30 °C to +85 °C          | -30 °C to +85 °C                          | -30 °C to +85 °C                          |                                                                |
| Number of poles             | —      | 2                         | 2                                         | 3                                         |                                                                |
| Pass bandwidth              | P_Bw   | f_nom ±7.5 kHz Min.       | f_nom ±15 kHz Min.                        | f_nom ±15 kHz Min.                        |                                                                |
| Insertion loss              | IL     | 1.5 dB Max.               | 3 dB Max.                                 | 3 dB Max.                                 |                                                                |
| Ripple                      | Ripple | 1 dB Max.                 | 1 dB Max.                                 | 1 dB Max.                                 |                                                                |
| Stop bandwidth              | S_Bw   | f_nom±25 kHz:15 dB Min.   | f_nom±50 kHz:15 dB Min.                   | f_nom±50 kHz:20 dB Min.                   |                                                                |
| Guaranteed attenuation      | G_Att  | f_nom -910 kHz:70 dB Min. | f_nom -800 kHz to<br>-1000 kHz:70 dB Min. | f_nom -800 kHz to<br>-1000 kHz:70 dB Min. |                                                                |
| Terminating impedance       | Zt     | 1500 Ω // 1.0 pF          | 1100 Ω // 0 pF                            | 1200 Ω // -1.0 pF                         |                                                                |
| Package                     | —      | TS-75A                    | TS-75A                                    | TS-75A                                    |                                                                |

## Electrical DATA



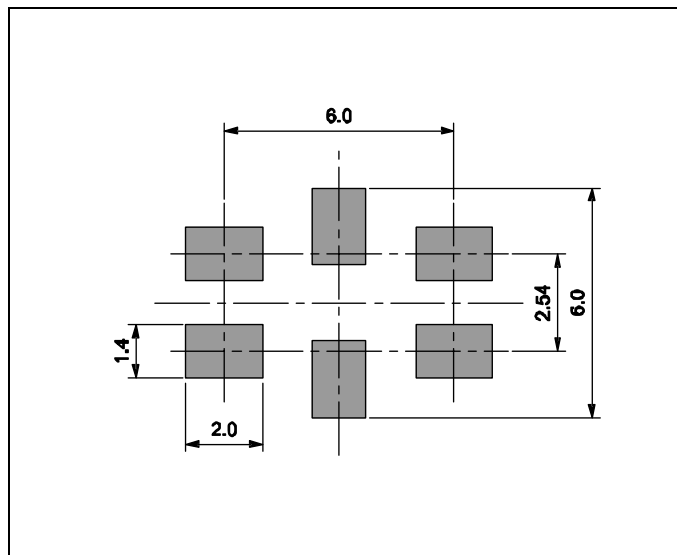
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





# CRYSTAL FILTER FOR MINIATURE SIZE RADIO EQUIPMENT/ IF

## MF-734A

- Number of poles : 4 pole
- Available frequency range : 19 MHz to 150 MHz
- Old name : TS4-45B01
- Superb attenuation with 4 pole filters.
- Applications : Various kinds of radio equipment.



Product number (please contact us)  
MF-734A : X1F000171xxxx00



Actual size

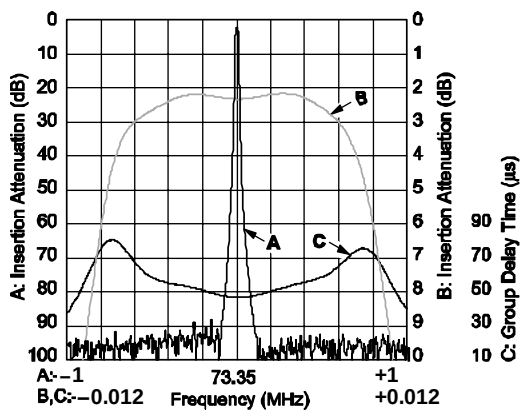


### Specifications (characteristics)

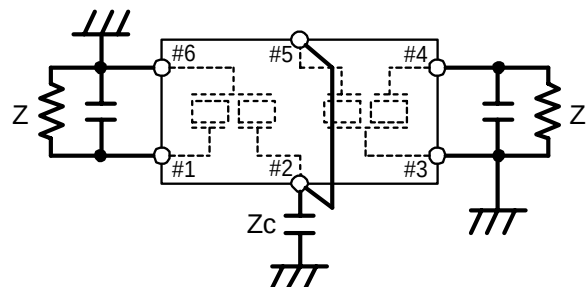
| Item                        | Symbol           | MF-734A                                           | Remarks                                                  |
|-----------------------------|------------------|---------------------------------------------------|----------------------------------------------------------|
| Nominal frequency           | f <sub>nom</sub> | 45 MHz                                            | Other frequency and bandwidth are available upon request |
| Storage temperature range   | T <sub>stg</sub> | -40 °C to +85 °C                                  |                                                          |
| Operating temperature range | T <sub>use</sub> | -30 °C to +85 °C                                  |                                                          |
| Number of poles             | —                | 4                                                 |                                                          |
| Pass bandwidth              | P <sub>Bw</sub>  | f <sub>nom</sub> ±7.5 kHz Min.                    |                                                          |
| Insertion loss              | IL               | 3 dB Max.                                         |                                                          |
| Ripple                      | Ripple           | 1 dB Max.                                         |                                                          |
| Stop bandwidth              | S <sub>Bw</sub>  | f <sub>nom</sub> ±25 kHz                          | 30 dB Min.                                               |
| Guaranteed attenuation      | G <sub>Att</sub> | f <sub>nom</sub> -800 kHz to -1000 kHz:70 dB Min. |                                                          |
| Terminating impedance       | Z <sub>t</sub>   | 650 Ω // +3.0 pF                                  | Z <sub>c</sub> : 7.0 pF *1                               |
| Package                     | —                | TS-75B                                            |                                                          |

\*1 Z<sub>c</sub> is connected from pin 2 and 5 to ground. (As per pin connection of 4pole)

### Electrical DATA

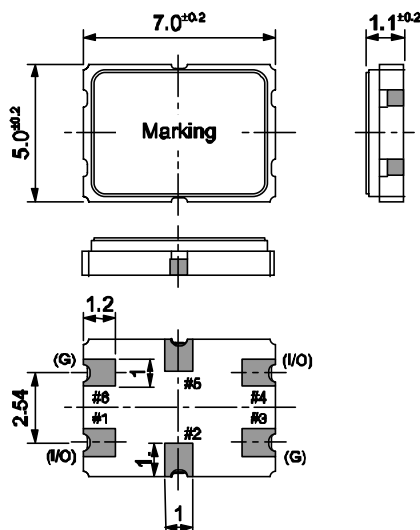


### Pin connection



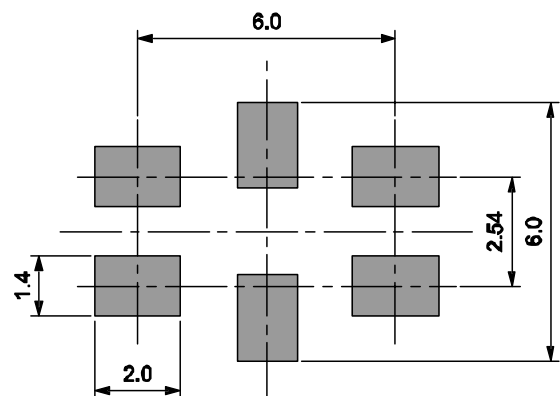
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)





Product number (please contact us)

FF-555 : Q51FF5550xxxx00

FF-585 : Q51FF5850xxxx00

## SAW FILTER

## FF - 555 / FF - 585

- Frequency range : 300 MHz to 500 MHz
- Thickness : 1.5 mm Typ.
- Applications : Wireless remote-control, Security (Automotive keyless entry)
- Excellent shock resistance and environmental capability (prevention for contamination)
- Low-loss, Narrow Pass bandwidth, High stability by using crystal substrate.



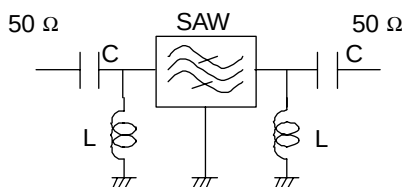
Actual size



## Specifications (characteristics)

| Item                        | Symbol           | Specifications                                                                   |                                                                                 | Remarks                               |
|-----------------------------|------------------|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------------|
|                             |                  | FF-555                                                                           | FF-585                                                                          |                                       |
| Nominal frequency range     | f <sub>nom</sub> | 300 MHz to 500 MHz                                                               |                                                                                 |                                       |
| Storage temperature range   | T <sub>stg</sub> | -55 °C to +125 °C                                                                |                                                                                 | Store as bare product after unpacking |
| Operating temperature range | T <sub>use</sub> | -40 °C to +85 °C                                                                 |                                                                                 |                                       |
| Insertion Loss              | IL               | 3.5 dB Max.                                                                      |                                                                                 | Minimum Loss                          |
| Pass bandwidth              | P <sub>Bw</sub>  | f <sub>nom</sub> ± 100 kHz Min.<br>/ Reference to Through level<br>(3.5 dB down) | f <sub>nom</sub> ± 200 kHz Min.<br>/ Reference to minimum loss<br>(3.5 dB down) |                                       |
| Attenuation                 | G <sub>Att</sub> | f <sub>nom</sub> -21.4 MHz 40 dB Min.<br>f <sub>nom</sub> -10.7 MHz 40 dB Min.   | f <sub>nom</sub> +21.4 MHz 40 dB Min.<br>f <sub>nom</sub> -21.4 MHz 40 dB Min.  | Reference to Through level            |
| Turnover temperature        | T <sub>i</sub>   | +25 °C ±15 °C                                                                    |                                                                                 |                                       |
| Temperature coefficient     | B                | -(3.4± 0.8) × 10 <sup>-8</sup> / °C <sup>2</sup>                                 |                                                                                 |                                       |
| Terminal impedance          | Z <sub>t</sub>   | 370 Ω Typ.                                                                       |                                                                                 | Ex : 315 MHz                          |
|                             |                  | 160 Ω Typ.                                                                       |                                                                                 | Ex : 433.92 MHz                       |

## Test fixture



## Remarks

Ex: f<sub>nom</sub> =315 MHz

C=4 pF

L=33 nH

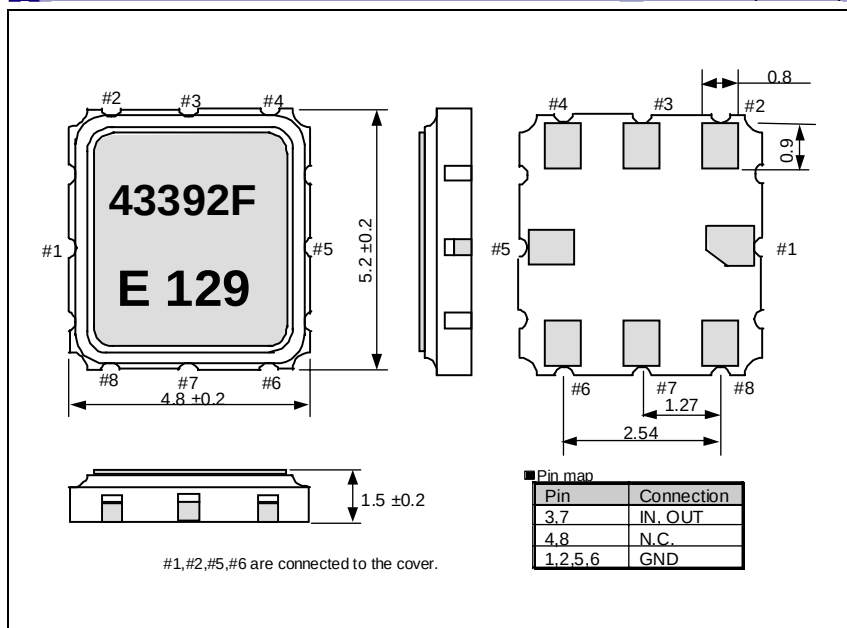
Ex: f<sub>nom</sub> =433.92 MHz

C=5 pF

L=18 nH

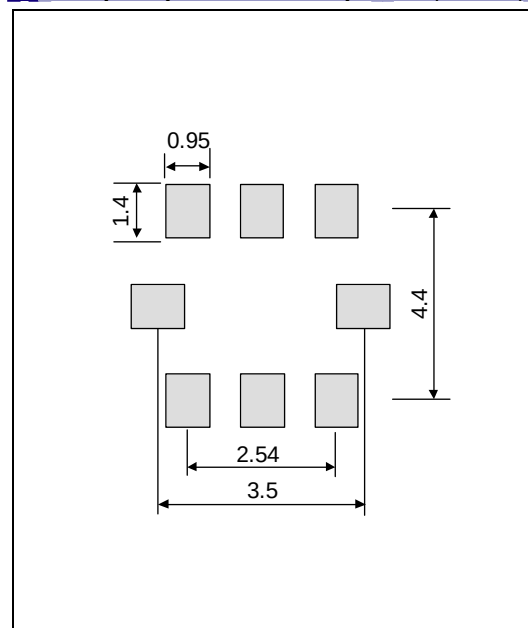
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)



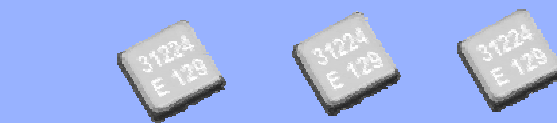


Product number (please contact us)  
FF-32N : Q51FF32N0xxxx00

## SAW FILTER

## FF-32N

- Frequency range : 300 MHz to 500 MHz
- Thickness : 0.98 mm Typ.
- Applications : Wireless remote-control, Security (Automotive keyless entry, ARIB std. T67 in Japan)
- Filter of low impedance by an original design.
- Low-loss, Narrow Pass bandwidth, High stability by using crystal substrate.



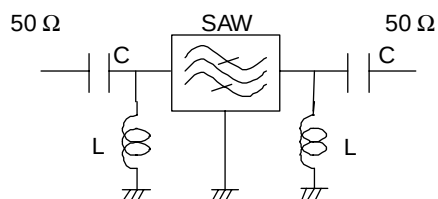
Actual size



## Specifications (characteristics)

| Item                        | Symbol           | Specifications                                                                   |                                                                                    | Remarks                               |
|-----------------------------|------------------|----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|---------------------------------------|
| Nominal frequency range     | f <sub>nom</sub> | 300 MHz to 500 MHz                                                               | 426 MHz, 429 MHz band*                                                             | *ARIB std. T67 in Japan               |
| Storage temperature range   | T <sub>stg</sub> | -55 °C to +125 °C                                                                | -55 °C to +125 °C                                                                  | Store as bare product after unpacking |
| Operating temperature range | T <sub>use</sub> | -40 °C to +85 °C                                                                 | -10 °C to +60 °C                                                                   |                                       |
| Insertion Loss              | IL               | 3.5 dB Max.                                                                      | 3.5 dB Max.                                                                        | Minimum Loss                          |
| Pass bandwidth              | P <sub>Bw</sub>  | f <sub>nom</sub> ±200 kHz Min.                                                   | f <sub>nom</sub> ±300 kHz Min.                                                     | Reference to minimum loss (3 dB down) |
| Guaranteed attenuation      | G <sub>Att</sub> | f <sub>nom</sub> -21.4 MHz : 40 dBMin.<br>f <sub>nom</sub> -10.7 MHz : 35 dBMin. | f <sub>nom</sub> -21.4 MHz : 40 dB Min.<br>f <sub>nom</sub> -10.7 MHz : 35 dB Min. | Reference to minimum loss             |
| Turnover temperature        | T <sub>i</sub>   | +25 °C ±15 °C                                                                    | +25 °C ±15 °C                                                                      |                                       |
| Temperature coefficient     | B                | -(3.4±0.8) × 10 <sup>-8</sup> / °C <sup>2</sup>                                  | -(3.4±0.8) × 10 <sup>-8</sup> / °C <sup>2</sup>                                    |                                       |
| Terminal impedance          | Z <sub>t</sub>   | 370 Ω Typ.                                                                       |                                                                                    | Ex: 315 MHz                           |
|                             |                  | 160 Ω Typ.                                                                       |                                                                                    | Ex: 433.92 MHz                        |
|                             |                  |                                                                                  | 220 Ω Typ.                                                                         | Ex: 429.45 MHz                        |

## Test fixture



## Remarks

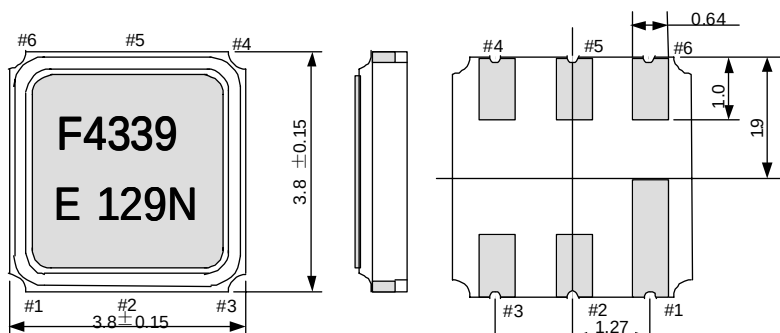
Ex: f<sub>nom</sub> =315 MHz  
Series Capacitance = 4 pF  
Parallel Inductance =33 nH

Ex: f<sub>nom</sub> =429.45 MHz  
Series Capacitance =4 pF  
Parallel Inductance =18 nH

Ex: f<sub>nom</sub> =433.92 MHz  
Series Capacitance =5 pF  
Parallel Inductance =18 nH

## External dimension

(Unit:mm)



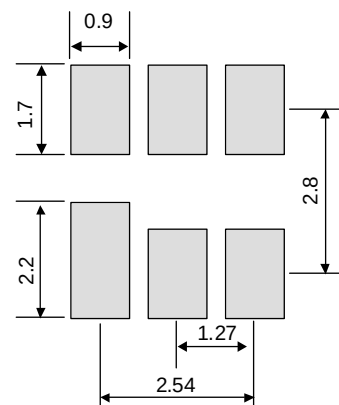
Pin map

| Pin     | Connection |
|---------|------------|
| 1,3,4,6 | GND        |
| 2,5     | IN,OUT     |

#1,#3,#4,#6 are connected to the cover.

## Footprint (Recommended)

(Unit:mm)





Product number (please contact us)

TF-330A : X1L000371xxxx00

TF-330C : X1L000381xxxx00

## SAW FILTER

FOR TPMS, RKE, Japan ARIB std. T67 / RF

## TF - 330A / C

- Lowest insertion loss.
- Excellent shock resistance and environmental capability (Prevention for contamination)



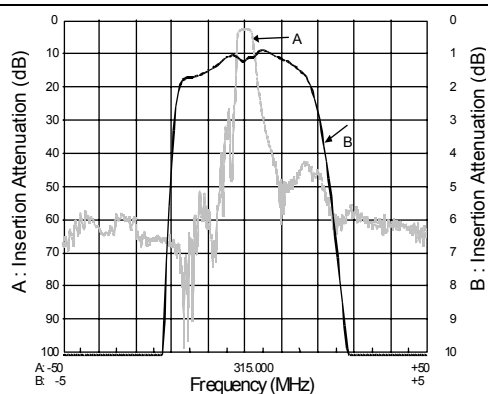
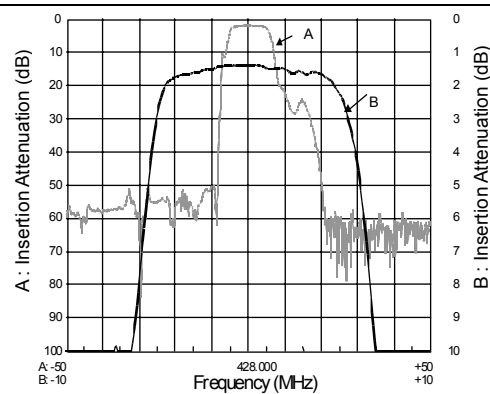
Actual size



## Specifications (characteristics)

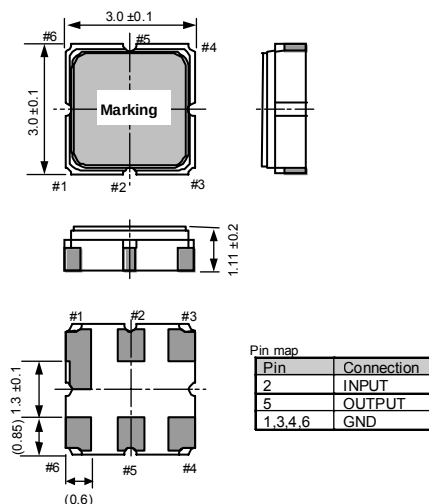
| Item                        | Symbol | TF-330A                                                                                                                      |             |                   |                                                                                                                                                                                                                                                                          |             |                                                                                                                                                                                                                                                                          | TF-330C     |                                                                                                                                          |
|-----------------------------|--------|------------------------------------------------------------------------------------------------------------------------------|-------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Nominal frequency           | f_nom  | 315 MHz                                                                                                                      |             |                   | 433.92 MHz                                                                                                                                                                                                                                                               |             | 426.425 MHz                                                                                                                                                                                                                                                              | 429.550 MHz | 428 MHz                                                                                                                                  |
| Storage temperature range   | T_stg  | -40 °C to +110 °C                                                                                                            |             |                   | -40 °C to +110 °C                                                                                                                                                                                                                                                        |             | -40 °C to +110 °C                                                                                                                                                                                                                                                        |             | -40 °C to +110 °C                                                                                                                        |
| Operating temperature range | T_use  | -40 °C to +85 °C                                                                                                             |             | -40 °C to +110 °C | -40 °C to +85 °C                                                                                                                                                                                                                                                         |             | -40 °C to +85 °C                                                                                                                                                                                                                                                         |             | -40 °C to +85 °C                                                                                                                         |
| Pass bandwidth              | P_Bw   | ±300 kHz                                                                                                                     | ±600 kHz    | ±300 kHz          | ±300 kHz                                                                                                                                                                                                                                                                 | ±870 kHz    | ±425 kHz                                                                                                                                                                                                                                                                 | ±400 kHz    | ±2 MHz                                                                                                                                   |
| Insertion loss              | IL     | 2.0 dB Max.                                                                                                                  | 2.5 dB Max. | 2.5 dB Max.       | 2.0 dB Max.                                                                                                                                                                                                                                                              | 2.5 dB Max. | 2.1 dB Max.                                                                                                                                                                                                                                                              | 2.1 dB Max. | 2.3 dB Max.                                                                                                                              |
| Deviation in PB             | Dev    | 1.0 dB Max.                                                                                                                  | 1.5 dB Max. | 1.5 dB Max.       | 1.0 dB Max.                                                                                                                                                                                                                                                              | 1.5 dB Max. | 1.2 dB Max.                                                                                                                                                                                                                                                              | 1.2 dB Max. | 1.0 dB Max.                                                                                                                              |
| VSWR                        | —      | 2.2 Max.                                                                                                                     | 2.3 Max.    | 2.3 Max.          | 2.2 Max.                                                                                                                                                                                                                                                                 | 2.4 Max.    | 2.2 Max.                                                                                                                                                                                                                                                                 | 2.2 Max.    | 2.0 Max.                                                                                                                                 |
| Guaranteed attenuation      | G_Att  | f_nom -21.4 MHz : 50 dB Min.<br>f_nom -10.7 MHz : 35 dB Min.<br>f_nom +10.7 MHz : 35 dB Min.<br>f_nom +21.4 MHz : 40 dB Min. |             |                   | f_nom -43.4 MHz to f_nom -42.8 MHz : 50 dB Min.<br>f_nom -21.7 MHz to f_nom -21.4 MHz : 50 dB Min.<br>f_nom -10.7 MHz : 32 dB Min.<br>f_nom +10.7 MHz : 30 dB Min.<br>f_nom +21.4 MHz to f_nom +21.7 MHz : 40 dB Min.<br>f_nom +42.8 MHz to f_nom +43.4 MHz : 50 dB Min. |             | f_nom -43.4 MHz to f_nom -42.8 MHz : 50 dB Min.<br>f_nom -21.7 MHz to f_nom -21.4 MHz : 50 dB Min.<br>f_nom -10.7 MHz : 35 dB Min.<br>f_nom +10.7 MHz : 33 dB Min.<br>f_nom +21.4 MHz to f_nom +21.7 MHz : 40 dB Min.<br>f_nom +42.8 MHz to f_nom +43.4 MHz : 50 dB Min. |             | 383 MHz to 388 MHz : 50 dB Min.<br>404 MHz to 409 MHz : 45 dB Min.<br>447 MHz to 452 MHz : 22 dB Min.<br>468 MHz to 473 MHz : 50 dB Min. |
| Terminating impedance       | Zt     | 50 Ω (Unbalance)                                                                                                             |             |                   | 50 Ω (Unbalance)                                                                                                                                                                                                                                                         |             | 50 Ω (Unbalance)                                                                                                                                                                                                                                                         |             | 50 Ω (Unbalance)                                                                                                                         |
| Package                     | —      | SS-30S1(GH)                                                                                                                  |             |                   | SS-30S1(GH)                                                                                                                                                                                                                                                              |             | SS-30S1(GH)                                                                                                                                                                                                                                                              |             | SS-30S1(GH)                                                                                                                              |

## Electrical DATA

TF-330A  
315 MHzTF-330C  
428 MHz

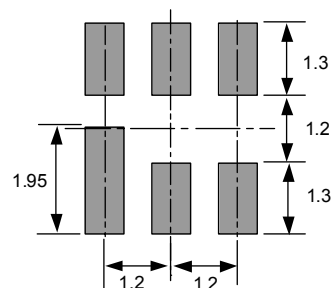
## External dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





## SAW FILTER FOR W-LAN / IF

### TQS-471BB-7R

- Excellent performance in small size with original design algorithm.



Product number (please contact us)  
TQS-471BB-7R : X1L000011xxxx00



Actual size

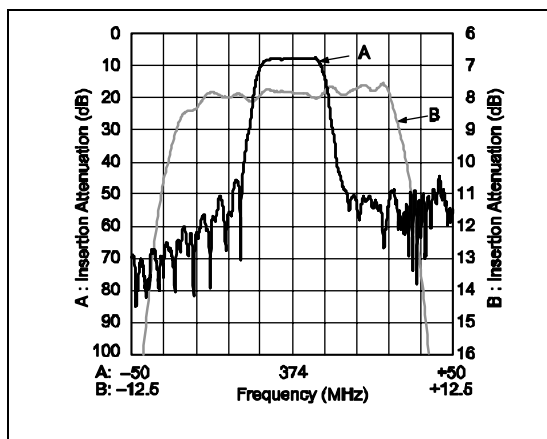


#### Specifications (characteristics)

| Item                        | Symbol           | TQS-471BB-7R                                                                                                                                                                                                                                                                                                                                                                                                                       | Remarks                                 |
|-----------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| Nominal frequency           | f <sub>nom</sub> | 374 MHz                                                                                                                                                                                                                                                                                                                                                                                                                            |                                         |
| Storage temperature range   | T <sub>stg</sub> | -40 °C to +85 °C                                                                                                                                                                                                                                                                                                                                                                                                                   |                                         |
| Operating temperature range | T <sub>use</sub> | -30 °C to +70 °C                                                                                                                                                                                                                                                                                                                                                                                                                   |                                         |
| Pass bandwidth              | P <sub>Bw</sub>  | f <sub>nom</sub> ±8.5 MHz Min.                                                                                                                                                                                                                                                                                                                                                                                                     | 3 dB relative to IL at f <sub>nom</sub> |
| Insertion loss              | IL               | 9 dB Max.(-30 °C to +30 °C) *<br>10 dB Max.(-30 °C to +70 °C) *                                                                                                                                                                                                                                                                                                                                                                    | at f <sub>nom</sub>                     |
| Deviation in PB             | DEV              | 1.5 dB Max.                                                                                                                                                                                                                                                                                                                                                                                                                        |                                         |
| Ripple                      | Ripple           | 1.5 dB Max.                                                                                                                                                                                                                                                                                                                                                                                                                        |                                         |
| Group delay distortion      | GDD              | 100 ns Max.                                                                                                                                                                                                                                                                                                                                                                                                                        |                                         |
| Stop bandwidth              | S <sub>Bw</sub>  | f <sub>nom</sub> -41.5 MHz to f <sub>nom</sub> -22 MHz : 40 dB Min.<br>f <sub>nom</sub> -22 MHz to f <sub>nom</sub> -18 MHz : 35 dB Min.<br>f <sub>nom</sub> -18 MHz to f <sub>nom</sub> -16.5 MHz : 35 dB Min.<br>f <sub>nom</sub> +16.5 MHz to f <sub>nom</sub> +18 MHz : 35 dB Min.<br>f <sub>nom</sub> +18 MHz to f <sub>nom</sub> +22 MHz : 35 dB Min.<br>f <sub>nom</sub> +22 MHz to f <sub>nom</sub> +41.5 MHz : 35 dB Min. |                                         |
| Terminating impedance       | Z <sub>t</sub>   | Input : 680 Ω // 88 nH<br>Output : 780 Ω // 120 nH                                                                                                                                                                                                                                                                                                                                                                                 | Balanced or Unbalanced                  |
| Package                     | —                | SS-30S1(D)                                                                                                                                                                                                                                                                                                                                                                                                                         |                                         |

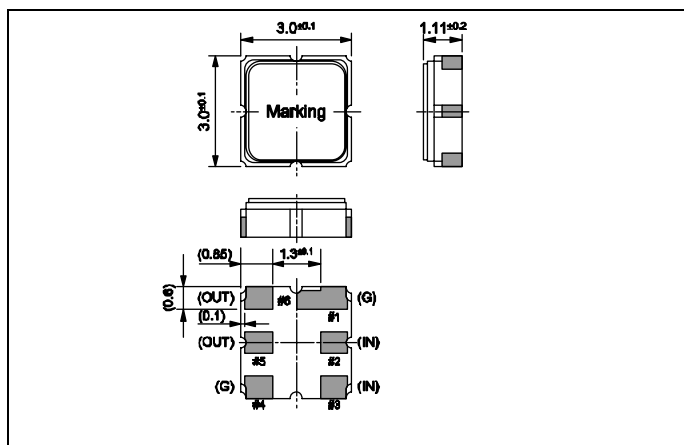
\* Includes losses in matching circuit (Matching inductor size : 1.6 × 0.8 mm)

#### Electrical DATA



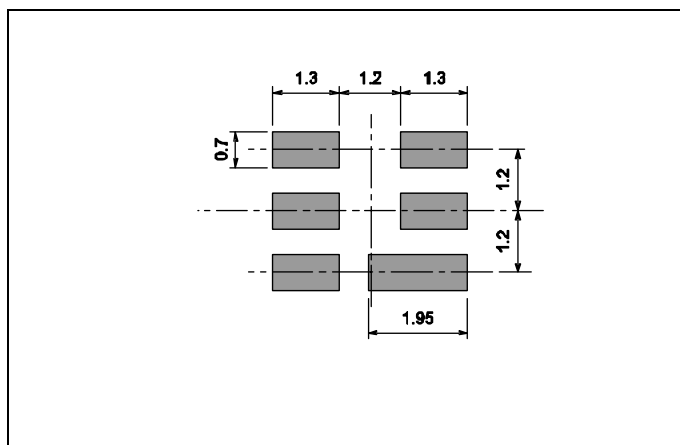
#### External dimensions

(Unit:mm)



#### Footprint (Recommended)

(Unit:mm)







# SAW FILTER FOR CELLULAR BASE STATION / IF

## TQS-472BA-7R

- Excellent performance in small size with original design algorithm



Product number (please contact us)  
TQS-472BA-7R : X1Lxxxxxxxxxx00



Actual size

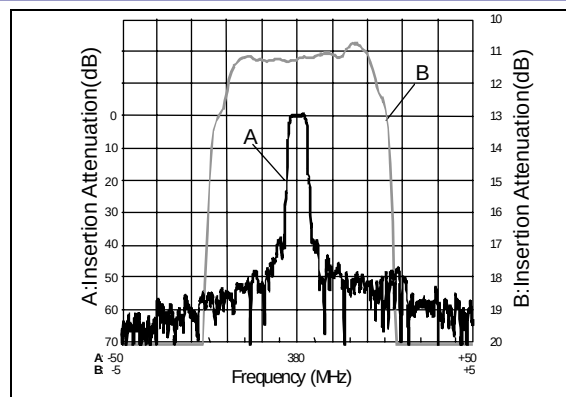


### Specifications (characteristics)

| Item                        | Symbol           | TQS-472BA-7R                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Remarks                                 |
|-----------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| Nominal frequency           | f <sub>nom</sub> | 380 MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                         |
| Storage temperature range   | T <sub>stg</sub> | -40 °C to +85 °C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                         |
| Operating temperature range | T <sub>use</sub> | -30 °C to +85 °C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                         |
| Pass bandwidth              | P <sub>Bw</sub>  | f <sub>nom</sub> ±2.2 MHz Min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3 dB relative to IL at f <sub>nom</sub> |
| Insertion loss              | IL               | 12.5 dB Max. *                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                         |
| Ripple                      | Ripple           | 1.2 dB Max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | f <sub>nom</sub> ±1.92 MHz              |
| Group delay distortion      | GDD              | 180 ns Max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | f <sub>nom</sub> ±1.92 MHz              |
| Phase linearity             | PHL              | 4 deg rms Max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | f <sub>nom</sub> ±1.92 MHz              |
| Stop band attenuation       | S <sub>Bw</sub>  | 10 dB BW: f <sub>nom</sub> ±3.25 MHz Max.<br>20 dB BW: f <sub>nom</sub> ±3.65 MHz Max.<br>30 dB BW: f <sub>nom</sub> ±4.00 MHz Max.                                                                                                                                                                                                                                                                                                                                                                                                           | Relative to IL at f <sub>nom</sub>      |
| Guaranteed attenuation      | G <sub>Att</sub> | DC to f <sub>nom</sub> -25 MHz : 45 dB Min.<br>f <sub>nom</sub> -25 MHz to f <sub>nom</sub> -10 MHz : 42 dB Min.<br>f <sub>nom</sub> -10 MHz to f <sub>nom</sub> -5.0 MHz : 35 dB Min.<br>f <sub>nom</sub> -5 MHz to f <sub>nom</sub> -4 MHz : 30 dB Min.<br>f <sub>nom</sub> +4 MHz to f <sub>nom</sub> +5 MHz : 30 dB Min.<br>f <sub>nom</sub> +5.0 MHz to f <sub>nom</sub> +10 MHz : 35 dB Min.<br>f <sub>nom</sub> +10 MHz to f <sub>nom</sub> +40 MHz : 40 dB Min.<br>f <sub>nom</sub> +40 MHz to f <sub>nom</sub> +100 MHz : 45 dB Min. | Relative to IL at f <sub>nom</sub>      |
| Terminating impedance       | Z <sub>t</sub>   | Input : 365 Ω // -8.0 pF<br>Output : 525 Ω // -5.0 pF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Unbalanced                              |
| Package                     | —                | SS-752(H)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                         |

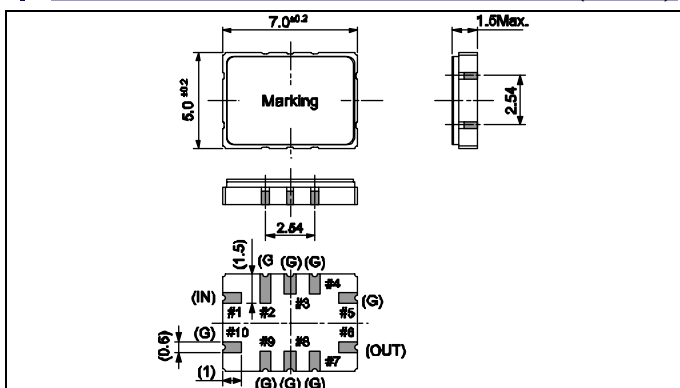
\* Includes losses in matching circuit (Matching inductor size : 1.6 × 0.8 mm)

### Electrical DATA



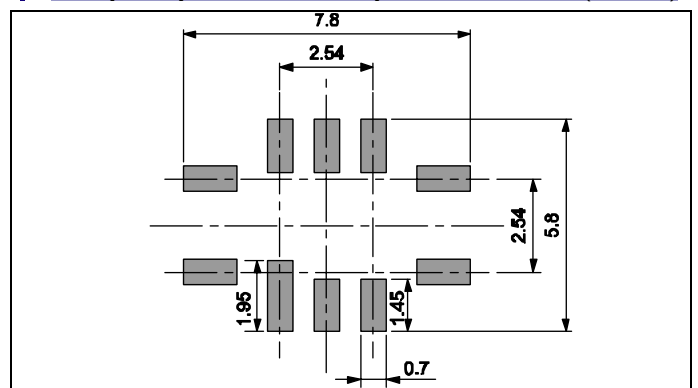
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)





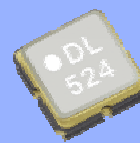
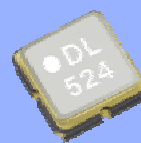
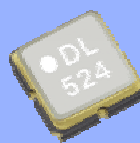
# SAW FILTER FOR CELLULAR / IF

## TQS-477AA-7R

- Excellent performance in small size with original design algorithm.



Product number (please contact us)  
TQS-477AA-7R : X1L000301000100



Actual size

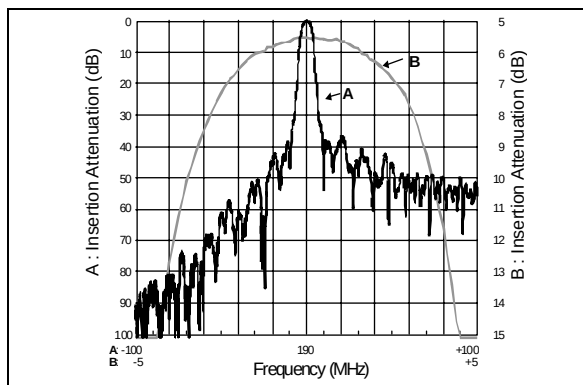


### Specifications (characteristics)

| Item                        | Symbol           | TQS-477AA-7R                                                                                                                                                                                                                                                                                                                                                                                                                           | Remarks                                            |
|-----------------------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| Nominal frequency           | f <sub>nom</sub> | 190 MHz                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                    |
| Storage temperature range   | T <sub>stg</sub> | -40 °C to +85 °C                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                    |
| Operating temperature range | T <sub>use</sub> | -30 °C to +85 °C                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                    |
| Pass bandwidth              | P <sub>Bw</sub>  | f <sub>nom</sub> ±2.3 MHz Min.                                                                                                                                                                                                                                                                                                                                                                                                         | 3 dB relative to IL at f <sub>nom</sub>            |
| Insertion loss              | IL               | 7 dB Max.                                                                                                                                                                                                                                                                                                                                                                                                                              | at f <sub>nom</sub>                                |
| Ripple                      | Ripple           | 2 dB Max.                                                                                                                                                                                                                                                                                                                                                                                                                              | f <sub>nom</sub> -2 MHz to f <sub>nom</sub> +2 MHz |
| Group delay distortion      | GDD              | 100 ns Max.                                                                                                                                                                                                                                                                                                                                                                                                                            | f <sub>nom</sub> -2 MHz to f <sub>nom</sub> +2 MHz |
| Guaranteed attenuation      | G <sub>Att</sub> | f <sub>nom</sub> -100 MHz to f <sub>nom</sub> -12.5 MHz : 40 dB Min.<br>f <sub>nom</sub> -12.5 MHz to f <sub>nom</sub> -7.5 MHz : 25 dB Min.<br>f <sub>nom</sub> -7.5 MHz to f <sub>nom</sub> -5 MHz : 10 dB Min.<br>f <sub>nom</sub> +5 MHz to f <sub>nom</sub> +7.5 MHz : 10 dB Min.<br>f <sub>nom</sub> +7.5 MHz to f <sub>nom</sub> +12.5 MHz : 25 dB Min.<br>f <sub>nom</sub> +12.5 MHz to f <sub>nom</sub> +100 MHz : 40 dB Min. | relative to IL at f <sub>nom</sub>                 |
| Terminating impedance       | Z <sub>t</sub>   | Input : 1000 Ω // -5.0 pF<br>Output : 1000 Ω // -4.0 pF                                                                                                                                                                                                                                                                                                                                                                                | Balanced or Unbalanced                             |
| Package                     | —                | SS-30S1(DE)                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                    |

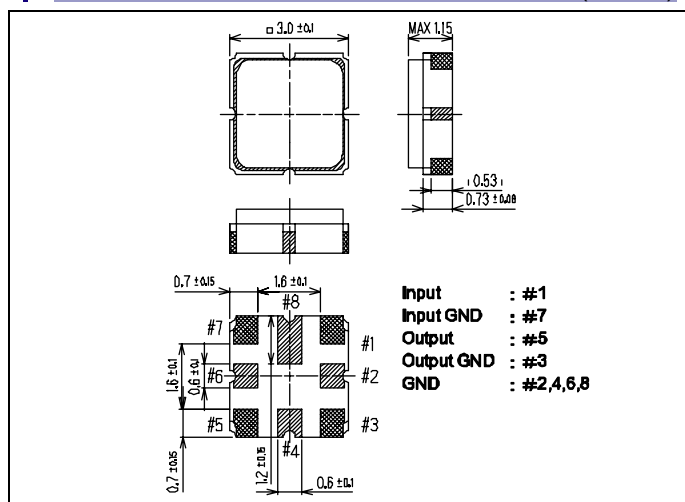
\* Includes losses in matching circuit (Matching inductor size : 1.6 × 0.8 mm)

### Electrical DATA



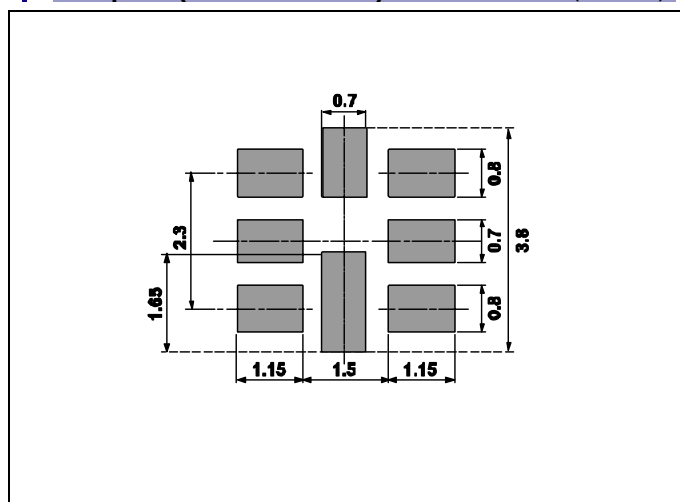
### External dimensions

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)



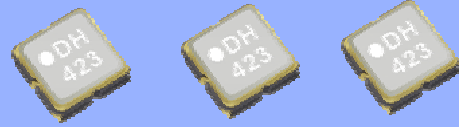


# SAW FILTER FOR ISM BAND / RF

## TQS-557AA-7R



Product number (please contact us)  
TQS-557AA-7R : X1L000201000200



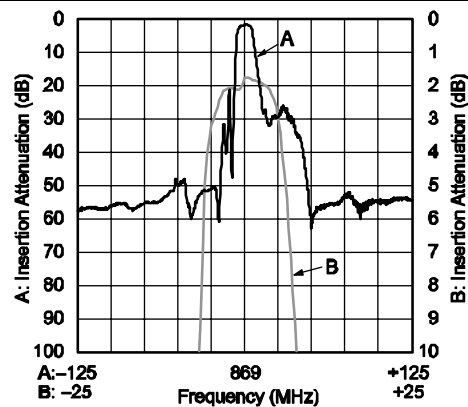
Actual size



### Specifications (characteristics)

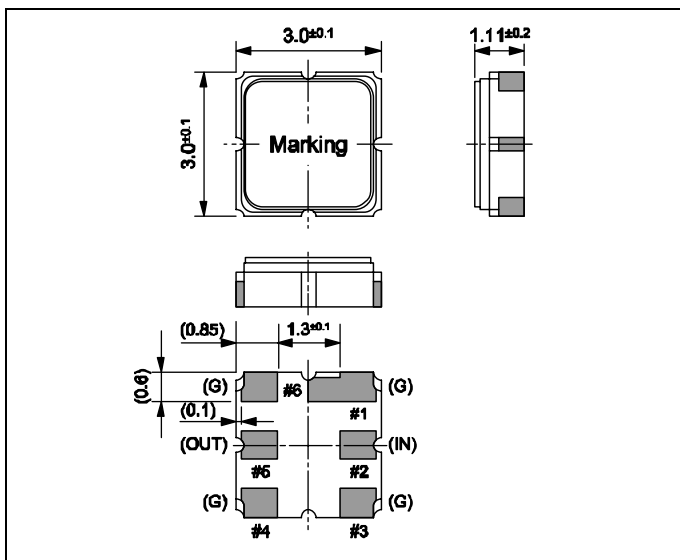
| Item                        | Symbol           | TQS-557AA-7R                                                                                                                                            | Remarks                   |
|-----------------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Nominal frequency           | f <sub>nom</sub> | 869 MHz                                                                                                                                                 |                           |
| Storage temperature range   | T <sub>stg</sub> | -40 °C to +85 °C                                                                                                                                        |                           |
| Operating temperature range | T <sub>use</sub> | -10 °C to +60 °C                                                                                                                                        |                           |
| Pass bandwidth              | P Bw             | 868 to 870 MHz                                                                                                                                          |                           |
| Insertion loss              | IL               | 3 dB Max.                                                                                                                                               | IL in Pass bandwidth      |
| Ripple                      | Ripple           | 1.5 dB p-p Max.                                                                                                                                         |                           |
| VSWR                        | —                | 2.5 Max.                                                                                                                                                |                           |
| Guaranteed attenuation      | G <sub>Att</sub> | DC to 828 MHz : 45 dB Min.<br>828 to 849 MHz : 30 dB Min.<br>880 to 890 MHz : 10 dB Min.<br>890 to 925 MHz : 22 dB Min.<br>925 to 1740 MHz : 40 dB Min. | Relative to through level |
| Terminating impedance       | Z <sub>t</sub>   | 50 Ω                                                                                                                                                    | Unbalanced                |
| Package                     | —                | SS-30S1(G)                                                                                                                                              |                           |

### Electrical DATA



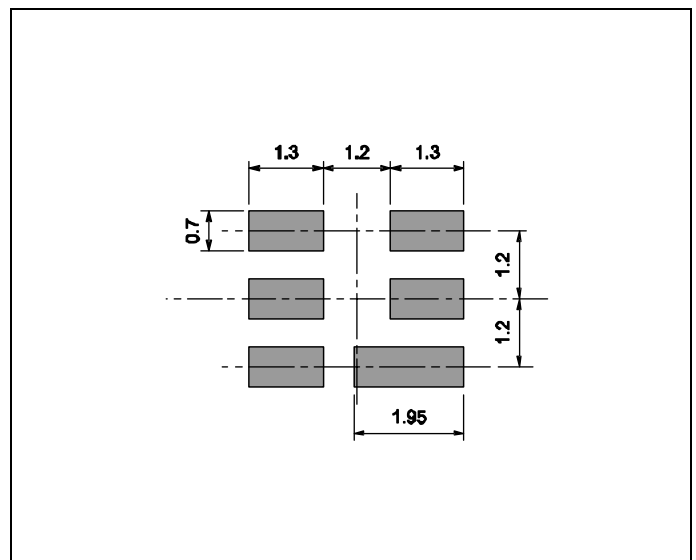
### External dimension

(Unit:mm)



### Footprint (Recommended)

(Unit:mm)





## SAW FILTER FOR GPS / RF

### TQS-949AD-7G

- FCB technology achieves miniature size and low profile.



Product number (please contact us)  
TQS-949AD-7G : X1L000171000300



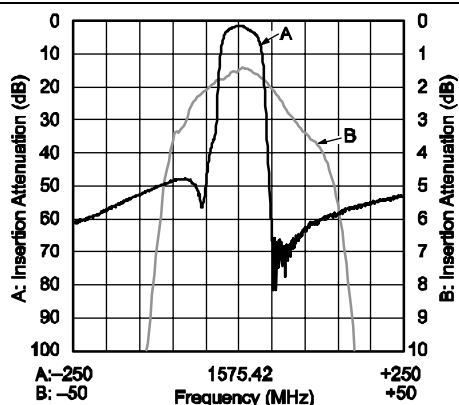
Actual size



#### Specifications (characteristics)

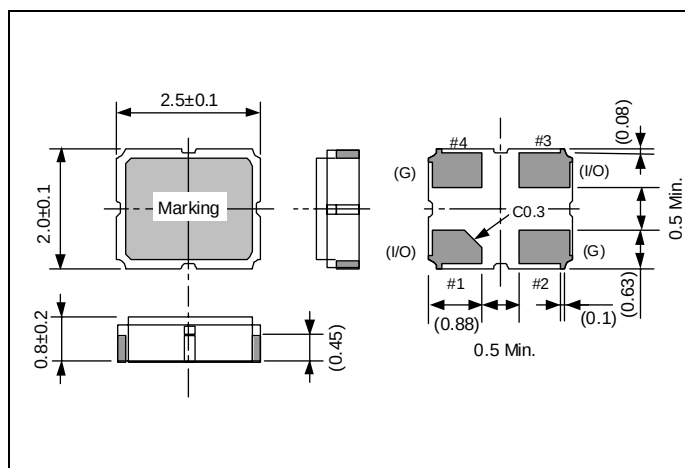
| Item                        | Symbol           | TQS-949AD-7G                                                                                                                                                                                                                                   | Remarks                   |
|-----------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Nominal frequency           | f <sub>nom</sub> | 1575.42 MHz                                                                                                                                                                                                                                    |                           |
| Storage temperature range   | T <sub>stg</sub> | -40 °C to +85 °C                                                                                                                                                                                                                               |                           |
| Operating temperature range | T <sub>use</sub> | -40 °C to +85 °C                                                                                                                                                                                                                               |                           |
| Pass bandwidth              | P <sub>Bw</sub>  | 1574.22 to 1576.62 MHz                                                                                                                                                                                                                         |                           |
| Insertion loss              | IL               | 2.3 dB Max.                                                                                                                                                                                                                                    | IL in Pass bandwidth      |
| Ripple                      | Ripple           | 0.6 dB p-p Max.                                                                                                                                                                                                                                |                           |
| VSWR                        | —                | 2.0 Max.                                                                                                                                                                                                                                       |                           |
| Guaranteed attenuation      | G <sub>Att</sub> | 824 to 960 MHz : 45 dB Min.<br>1475.42 MHz : 40 dB Min.<br>1525.42 MHz : 35 dB Min.<br>1625.42 MHz : 35 dB Min.<br>1675.42 MHz : 50 dB Min.<br>1710 to 1880 MHz : 45 dB Min.<br>1850 to 1990 MHz : 40 dB Min.<br>1920 to 2170 MHz : 40 dB Min. | Relative to through level |
| Terminating impedance       | Z <sub>t</sub>   | 50 Ω (Unbalanced)                                                                                                                                                                                                                              |                           |
| Package                     | —                | SS-2520(E)                                                                                                                                                                                                                                     |                           |

#### Electrical DATA



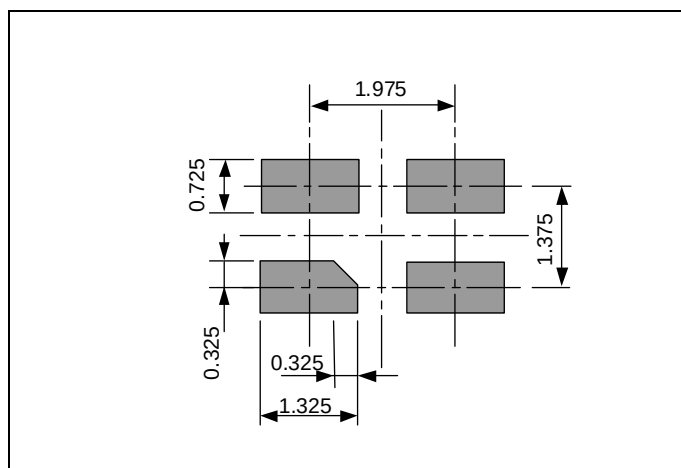
#### External dimension

(Unit:mm)



#### Footprint (Recommended)

(Unit:mm)

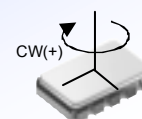
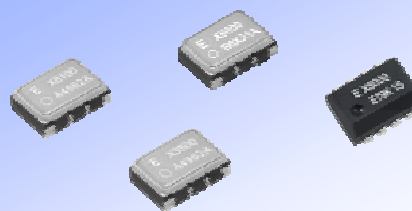




## GYRO SENSOR

### XV series

- Ultra Small Package size SMD ( $5 \times 3.2 \times 1.3$  mm)
- Hermetic sealing provides excellent sustainable environmental capability.
- High stability using vibration crystal.



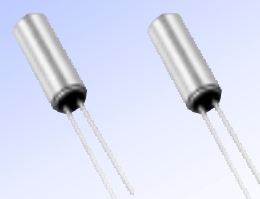
#### ► Gyro sensor

| Model     | Operating Voltage | Reference Voltage | Detection Range | Scale Factor                             | Non Linearity | Recommended Application         | Page |
|-----------|-------------------|-------------------|-----------------|------------------------------------------|---------------|---------------------------------|------|
| XV-8000LK | 4.75 to 5.25 V    | 50 % $V_{DD}$     | $\pm 60$ deg/s  | 25 mV/( $^{\circ}\text{s}^{-1}$ ) Typ.   | $\pm 0.5$ %FS | Car navigation system           | 137  |
| XV-8000CB | 4.75 to 5.25 V    | 50 % $V_{DD}$     | $\pm 60$ deg/s  | 25 mV/( $^{\circ}\text{s}^{-1}$ ) Typ.   | $\pm 0.5$ %FS | Car navigation system           | 138  |
| XV-8100CB | 2.85 to 3.15 V    | 1350 mV           | $\pm 100$ deg/s | 2.50 mV/( $^{\circ}\text{s}^{-1}$ ) Typ. | $\pm 0.5$ %FS | Portable type GPS,PND           | 139  |
| XV-3500CB | 2.7 to 3.3 V      | 1350 mV           | $\pm 100$ deg/s | 0.67 mV/( $^{\circ}\text{s}^{-1}$ ) Typ. | $\pm 5$ %FS   | Detection picture stabilization | 140  |

## TEMPERATURE SENSING CRYSTAL

### HTS-206

- 2 mm in diameter and 6 mm in length.
- Good linearity frequency and temperature.
- Low frequency (40 kHz) enables low current consumption.
- Wide temperature range ( $-40$   $^{\circ}\text{C}$  to  $+85$   $^{\circ}\text{C}$ ).
- Suitable for DTCXO and temperature equipment.



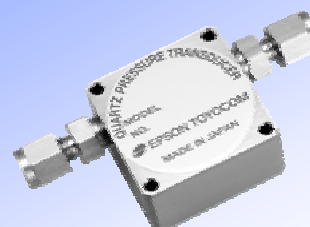
#### ► Temperature Sensing Crystal

| Model   | Frequency Tolerance | Temperature coefficient                   |                                            |                                                  | Motional resistance | Page |
|---------|---------------------|-------------------------------------------|--------------------------------------------|--------------------------------------------------|---------------------|------|
|         |                     | 1st.                                      | 2ed.                                       | 3rd.                                             |                     |      |
| HTS-206 | $\pm 2$ %           | $-26.0 \times 10^{-6} / ^{\circ}\text{C}$ | $-5.8 \times 10^{-8} / ^{\circ}\text{C}^2$ | $-1.5 \times 10^{-10} / ^{\circ}\text{C}^3$ Max. | 30 k $\Omega$ Max.  | 141  |

## QUARTZ PRESSURE SENSOR

### TSU series

- High precision and high resolution and accuracy
- Excellent repeatability with minimal hysteresis
- High stability against temperature variation
- Output frequency is unaffected by IN/OUT cable length.
- Applications : Various kinds of pressure measurement for industrial use  
Water level measurement of dam, river, reservoir.



#### ► Quartz Pressure Sensor

| Model    | Pressure measurement range | Linearity after linearization | Accuracy (Linearity, Repeatability, Hysteresis) | Operating Temperature                                | Page |
|----------|----------------------------|-------------------------------|-------------------------------------------------|------------------------------------------------------|------|
| TSU-20G  | 0 to 200 kPa               | 0.01 % FS Max.                | 0.023 % FS Max.                                 | $-10$ $^{\circ}\text{C}$ to $+70$ $^{\circ}\text{C}$ | 142  |
| TSU-70G  | 0 to 700 kPa               |                               |                                                 |                                                      |      |
| TSU-100G | 0 to 1 MPa                 |                               |                                                 |                                                      |      |



# SENSOR

## ULTRA MINIATURE SIZE GYRO SENSOR

(For portable GPS, PND applications)

# XV - 8100CB

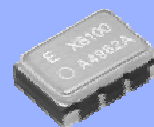
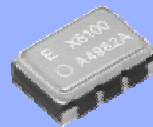
- Ultra Small Package size SMD(5 × 3.2 × 1.3 mm)
- Hermetic sealing provides excellent sustainable environmental capability
- 3.0 V operable device, Low current consumption
- High stability using vibration crystal
- Low Noise

### Recommended Application

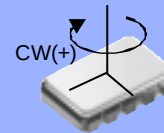
- Portable type GPS, PND (Personal Navigation Device)



Product number (please contact us)  
Q71810020xxxx00



Actual size

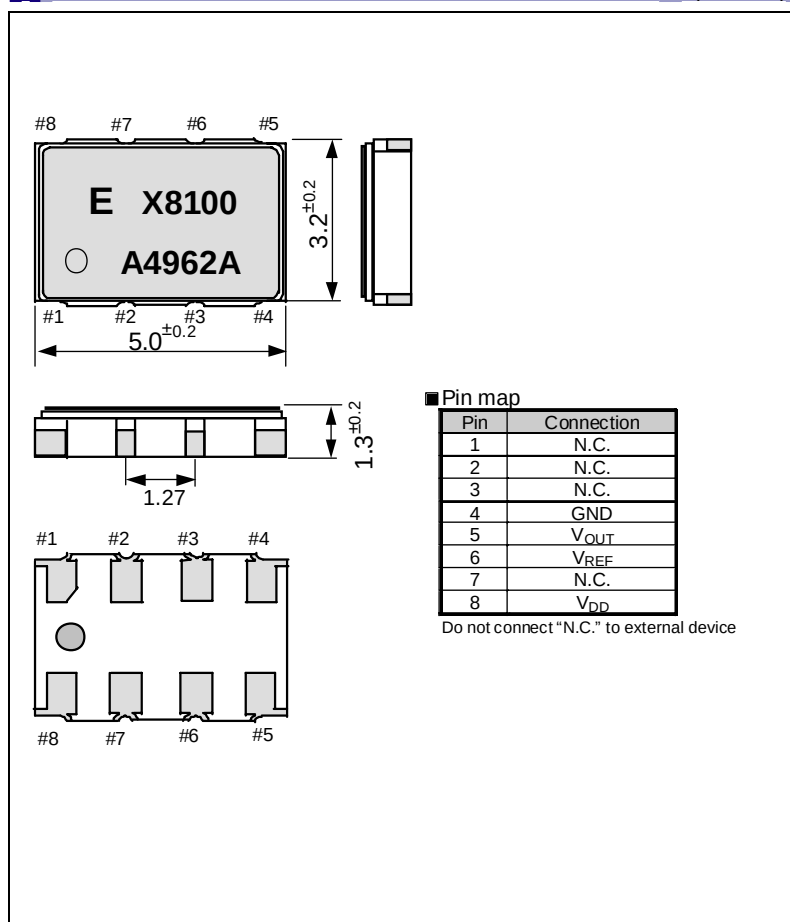


## Specifications (characteristics)

| Item                 | Symbol                | Specifications                   | Remarks                                                      |
|----------------------|-----------------------|----------------------------------|--------------------------------------------------------------|
| Power source Voltage | Operating Voltage     | V <sub>DD</sub>                  | 3.0 V ±0.15 V                                                |
| Temperature range    | Storage Temperature   | T <sub>STG</sub>                 | -40 °C to +85 °C                                             |
|                      | Operating Temperature | T <sub>OPR</sub>                 | -40 °C to +85 °C                                             |
| Scale factor         | S <sub>0</sub>        | 2.5 mV/(°·s <sup>-1</sup> ) Typ. |                                                              |
| Bias                 | V <sub>0</sub>        | 1350 mV Typ.                     | T <sub>a</sub> =+25 °C                                       |
| Reference voltage    | V <sub>r</sub>        | 1350 mV Typ.                     | T <sub>a</sub> =+25 °C                                       |
| Rate range           | I                     | ±100 deg/s                       |                                                              |
| Non linearity        | NI                    | ±0.5 % FS Max.                   | T <sub>a</sub> =+25 °C                                       |
| Cross axes           | OS                    | ±5 % Max.                        | T <sub>a</sub> =+25 °C                                       |
| Current consumption  | I <sub>op</sub>       | 1.7 mA Typ.                      | V <sub>0</sub> , V <sub>REF</sub> : Output No load condition |
| Noise                | r <sub>N</sub>        | 0.004 deg/s/√Hz                  | at 10 Hz                                                     |

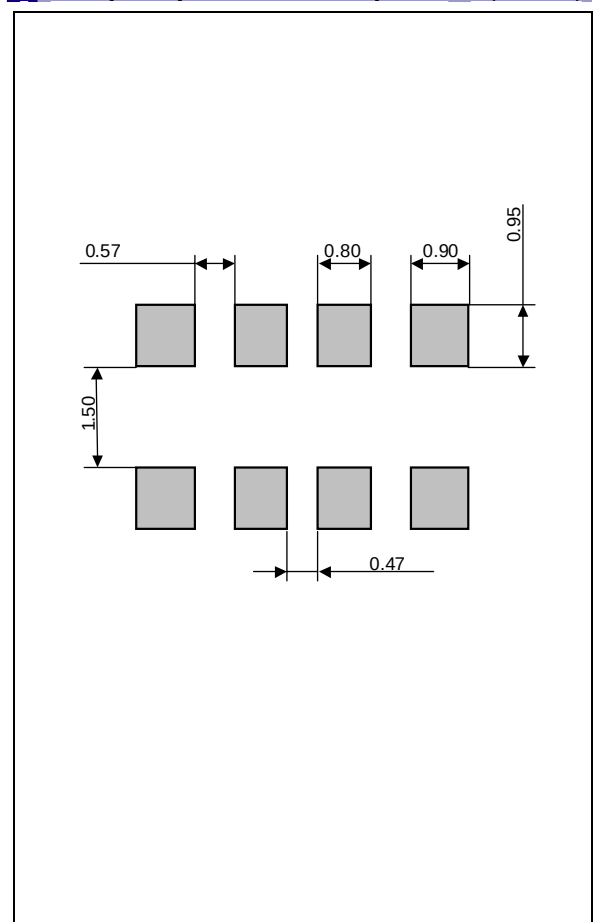
## External Dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





# SENSOR

## ULTRA MINIATURE SIZE GYRO SENSOR

### (FOR CAR NAVIGATION SYSTEM)

# XV - 8000CB

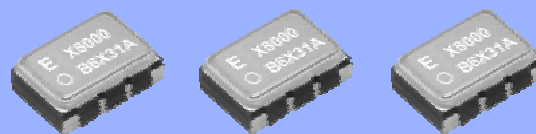
- Ultra Small Package size SMD ( $5 \times 3.2 \times 1.3$  mm)
- 5.0V operable device (Ratio metric output)
- High stability using vibration crystal
- With output terminal of temperature sensor

#### Recommended Application

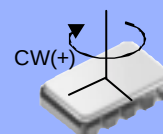
- Car navigation system



Product number (please contact us)  
Q71800020xxxx00



Actual size

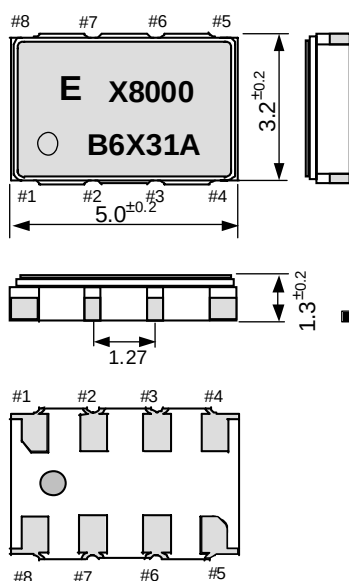


## Specifications (characteristics)

| Item                 |                       | Symbol           | Specifications                  | Remarks                                   |
|----------------------|-----------------------|------------------|---------------------------------|-------------------------------------------|
| Power source Voltage | Operating Voltage     | V <sub>DD</sub>  | 5.0 V ±0.25 V                   | V <sub>SS</sub> =0 V                      |
| Temperature range    | Storage Temperature   | T <sub>STG</sub> | -40 °C to +85 °C                |                                           |
|                      | Operating Temperature | T <sub>OPR</sub> | -40 °C to +85 °C                |                                           |
| Scale factor         |                       | S <sub>0</sub>   | 25 mV/(°·s <sup>-1</sup> ) Typ. |                                           |
| Bias                 |                       | V <sub>0</sub>   | 50 % V <sub>DD</sub>            | T <sub>a</sub> =+25 °C                    |
| Rate range           |                       | I                | ±60 deg/s                       |                                           |
| Non linearity        |                       | NI               | ±0.5 % FS Max.                  | T <sub>a</sub> =+25 °C                    |
| Frequency response   |                       | BW               | 10 Hz Typ.                      | Phase delay angle 90°                     |
| Cross axes           |                       | OS               | ±5 % Max.                       | T <sub>a</sub> =+25 °C                    |
| Current consumption  |                       | I <sub>op</sub>  | 4 mA Typ.                       | V <sub>o</sub> : Output No load condition |
| Quiescent noise      |                       | r <sub>N</sub>   | 3 mV <sub>p-p</sub> Typ         |                                           |

## External Dimensions

(Unit:mm)



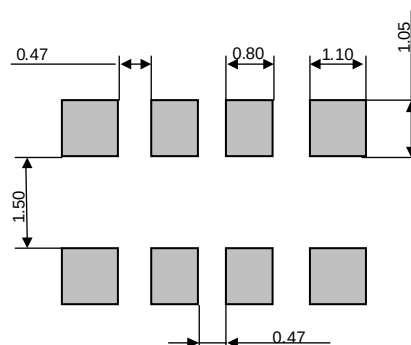
Pin map

| Pin | Connection        |
|-----|-------------------|
| 1   | N.C.              |
| 2   | GND               |
| 3   | V <sub>DD</sub>   |
| 4   | N.C.              |
| 5   | N.C.              |
| 6   | V <sub>OUT</sub>  |
| 7   | V <sub>TEMP</sub> |
| 8   | N.C.              |

Do not connect "N.C." to external device

## Footprint (Recommended)

(Unit:mm)







# SENSOR

## ULTRA MINIATURE SIZE VIBRATION GYRO SENSOR (angular rate sensor)

# XV - 3500CB

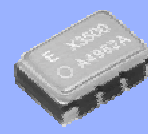
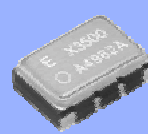
- Ultra Small Package size SMD(5 × 3.2 × 1.3 mm)
- Hermetic sealing provides excellent sustainable environmental capability
- High stability using vibration crystal
- Clipped startup time and low power consumption with sleep mode

### Recommended Application

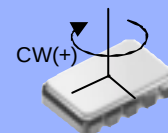
- Detection picture stabilization of DVC and DSC
- Detection of moving with man machine interface



Product number (please contact us)  
Q71350020xxxx00



Actual size

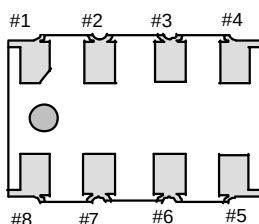
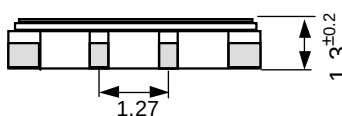
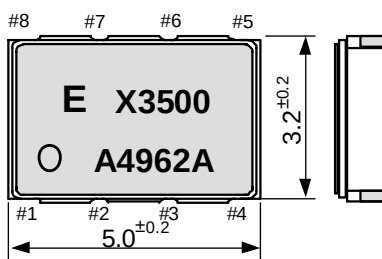


## Specifications (characteristics)

| Item                 |                       | Symbol             | Specifications                    | Remarks                                                                  |
|----------------------|-----------------------|--------------------|-----------------------------------|--------------------------------------------------------------------------|
| Power source Voltage | Operating Voltage     | V <sub>DD</sub>    | 3.0 V ±0.3 V                      | V <sub>SS</sub> =0 V                                                     |
|                      | Storage Temperature   | T <sub>STG</sub>   | -40 °C to +85 °C                  |                                                                          |
| Temperature range    | Operating Temperature | T <sub>OPR</sub>   | -20 °C to +80 °C                  |                                                                          |
|                      | Scale Factor          | S <sub>o</sub>     | 0.67 mV/(°·s <sup>-1</sup> ) Typ. |                                                                          |
| Bias                 |                       | V <sub>o</sub>     | V <sub>r</sub>                    | T <sub>a</sub> =+25 °C                                                   |
| Reference Voltage    |                       | V <sub>r</sub>     | 1350 mV Typ.                      | T <sub>a</sub> =+25 °C                                                   |
| Rate Range           |                       | I                  | ±100 deg/s                        | For the out of standard specifications, please contact us for inquiries. |
| Phase Delay          |                       | φ <sub>20</sub>    | 4 (Degree)                        | at 20Hz phase delay angle                                                |
| Power Consumption    | In Operating          | I <sub>op</sub>    | 1.7 mA Typ.                       | V <sub>o</sub> , V <sub>r</sub> : Output No load condition               |
|                      | Sleep Mode            | I <sub>sleep</sub> | 1 mA Typ.                         | V <sub>o</sub> , V <sub>r</sub> : Output No load condition               |

## External Dimensions

(Unit:mm)



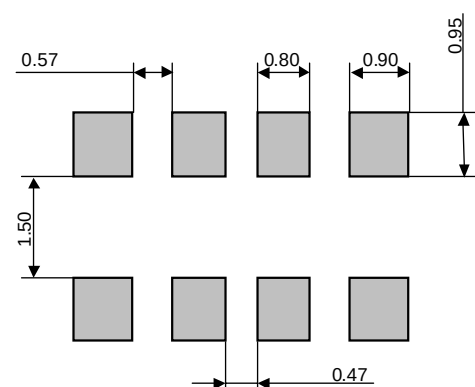
### Pin map

| Pin | Connection       |
|-----|------------------|
| 1   | N.C.             |
| 2   | N.C.             |
| 3   | N.C.             |
| 4   | GND              |
| 5   | V <sub>OUT</sub> |
| 6   | V <sub>REF</sub> |
| 7   | Sleep            |
| 8   | V <sub>DD</sub>  |

Do not connect "N.C." to external device

## Footprint (Recommended)

(Unit:mm)





# SENSOR

## MINIATURE SIZE INCLINED GYRO SENSOR (FOR CAR NAVIGATION SYSTEM)

# XV - 8000LK

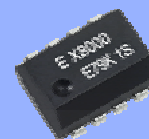
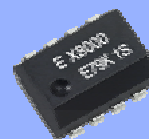
- Small Package size SMD ( $6.0 \times 4.8 \times 3.3$  mm)
- Inclined angles: 20 degrees
- 5.0V operable device (Ratio metric output)
- High stability using vibration crystal
- With output terminal of temperature sensor

### Recommended Application

- Car navigation system



Product number (please contact us)  
X2A000011xxxx00



Actual size



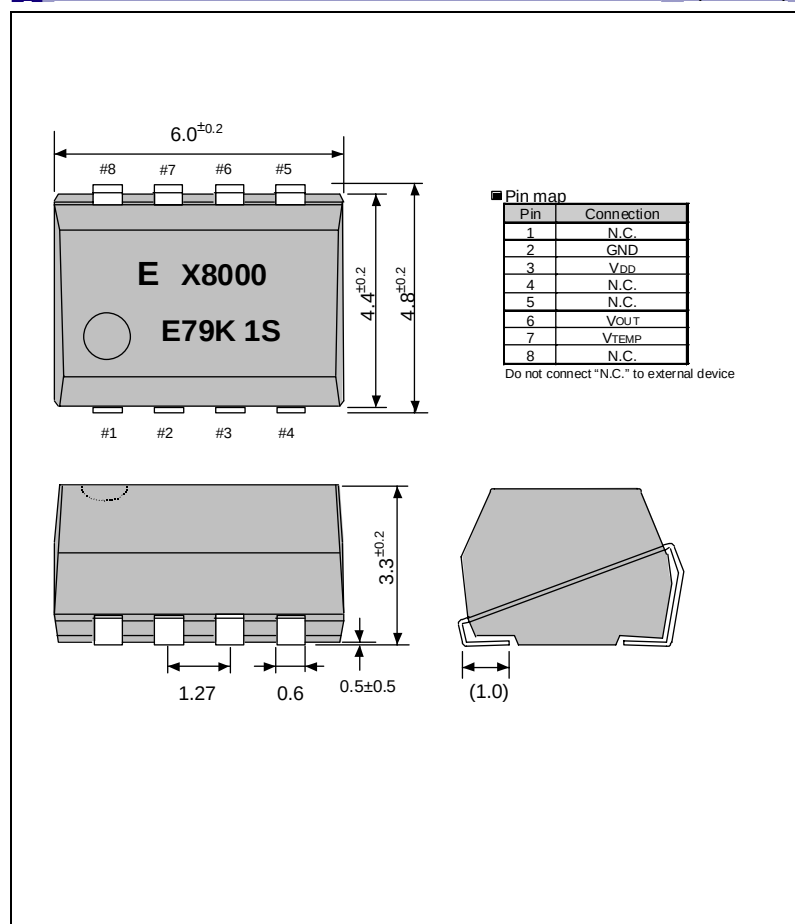
**NEW**

## Specifications (characteristics)

| Item                 | Symbol                | Specifications                  | Remarks                                   |
|----------------------|-----------------------|---------------------------------|-------------------------------------------|
| Power source Voltage | Operating Voltage     | V <sub>DD</sub>                 | 5.0 V $\pm 0.25$ V                        |
| Temperature range    | Storage Temperature   | T <sub>STG</sub>                | -40 °C to +85 °C                          |
|                      | Operating Temperature | T <sub>OPR</sub>                | -40 °C to +85 °C                          |
| Scale factor         | S <sub>0</sub>        | 25 mV/(°·s <sup>-1</sup> ) Typ. |                                           |
| Bias                 | V <sub>0</sub>        | 50 % V <sub>DD</sub>            | T <sub>a</sub> =+25 °C                    |
| Rate range           | I                     | $\pm 60$ deg/s                  |                                           |
| Non linearity        | NI                    | $\pm 0.5$ % FS Max.             | T <sub>a</sub> =+25 °C                    |
| Frequency response   | BW                    | 10 Hz Typ.                      | Phase delay angle 90°                     |
| Cross axes           | OS                    | $\pm 5$ % Max.                  | T <sub>a</sub> =+25 °C                    |
| Current consumption  | I <sub>op</sub>       | 4 mA Typ.                       | V <sub>0</sub> : Output No load condition |
| Quiescent noise      | r <sub>N</sub>        | 3 mVp-p Typ                     |                                           |

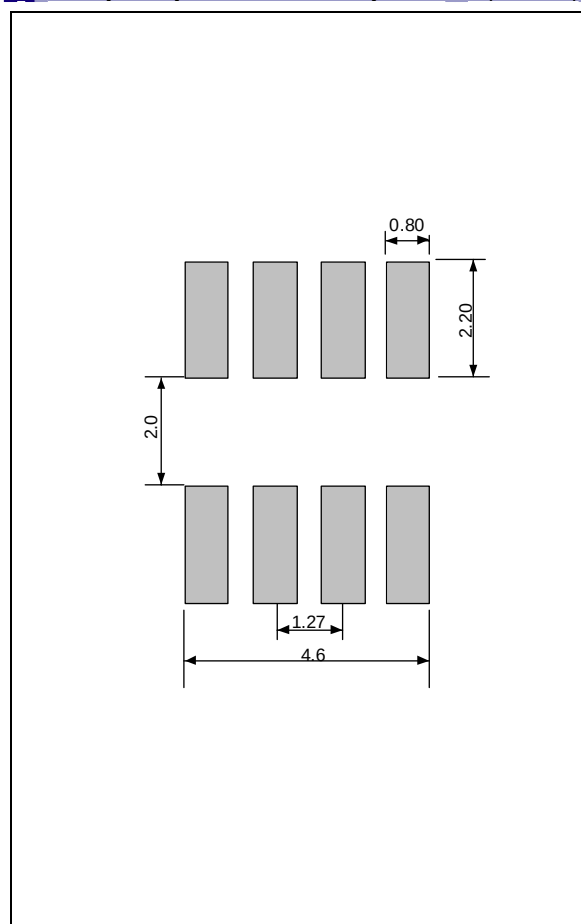
## External Dimensions

(Unit:mm)



## Footprint (Recommended)

(Unit:mm)





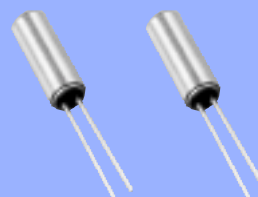
## SENSOR TEMPERATURE SENSING CRYSTAL

# HTS - 206

- Crystal used to sense the change in temperature.
- 2 mm in diameter and 6 mm in length.
- Good linearity frequency and temperature.
- Low frequency (40 kHz) enables low current consumption.
- Wide temperature range (-40 °C to +85 °C).
- Suitable for DTCXO and temperature equipment.



Product number (please contact us)  
Q19HT2060xxxx00



Actual size

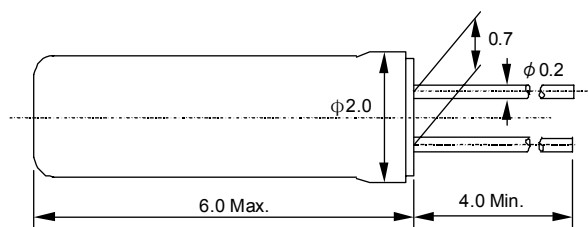


### Specifications (characteristics)

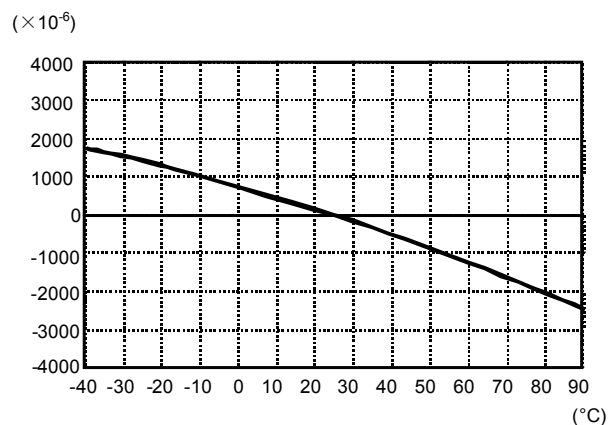
| Item                        |                       | Symbol | Specifications                                   | Remarks                               |
|-----------------------------|-----------------------|--------|--------------------------------------------------|---------------------------------------|
| Nominal frequency range     |                       | f_nom  | 40 kHz                                           |                                       |
| Temperature range           | Storage temperature   | T_stg  | -55 °C to +125 °C                                | Store as bare product after unpacking |
|                             | Operating temperature | T_use  | -40 °C to +85 °C                                 |                                       |
| Level of drive              |                       | DL     | 0.1 μW Typ.                                      | GL:1.0 μW Max.                        |
| Frequency tolerance         |                       | f_tol  | ±2 %                                             | +25 °C ,DL=0.1 μW                     |
| 1st.Temperature coefficient |                       | α      | $-26.0 \times 10^{-6} / ^\circ\text{C}$ ( ±2 %)  |                                       |
| 2nd.Temperature coefficient |                       | β      | $-5.8 \times 10^{-8} / ^\circ\text{C}^2$ ( ±8 %) |                                       |
| 3rd.Temperature coefficient |                       | γ      | $-1.5 \times 10^{-10} / ^\circ\text{C}^3$ Max.   |                                       |
| Motional resistance (ESR)   |                       | R1     | 30 kΩ Max.                                       | +25 °C,DL=0.1 μW                      |
| Motional capacitance        |                       | C1     | 2.0 fF Typ.                                      |                                       |
| Shunt capacitance           |                       | C0     | 0.9 pF Typ.                                      |                                       |
| Frequency aging             |                       | f_age  | $\pm 3 \times 10^{-6} / \text{year}$ Max.        | +25 °C                                |

### External dimensions

(Unit:mm)



### Frequency Temperature coefficient





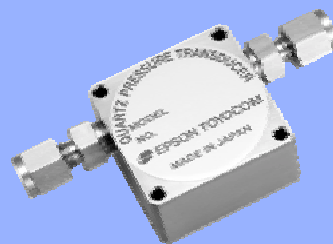
## SENSOR QUARTZ PRESSURE SENSOR

### TSU series

- High resolution and accuracy
- Excellent repeatability with minimal hysteresis
- High stability against temperature variation
- Output frequency is unaffected by IN/OUT cable length.
- Applications : Various kinds of pressure measurement for industrial use



Product number (please contact us)  
X2C0000xxxxxx00

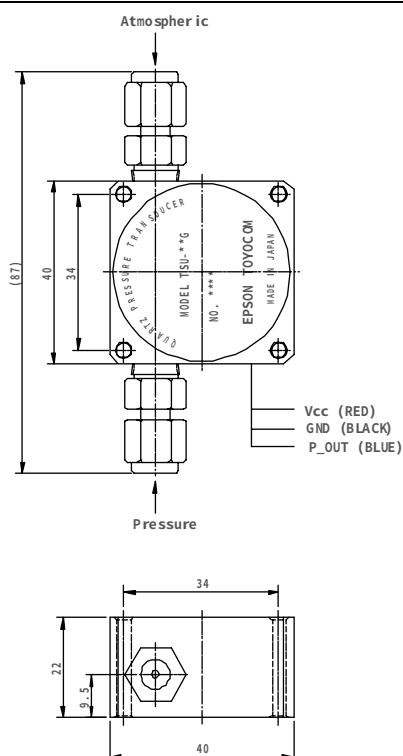


#### Specifications (characteristics)

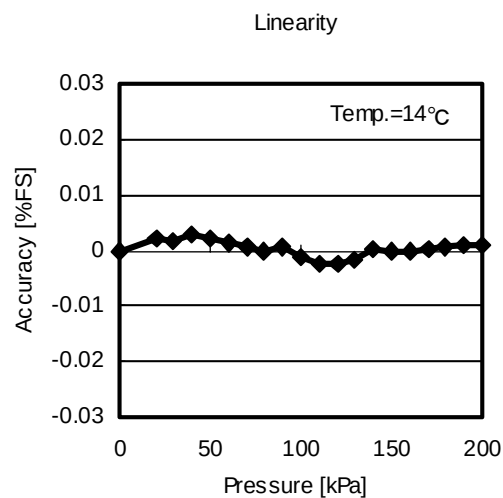
| Item                                               | Symbol           | TSU-20G                                              | TSU-70G      | TSU-100G   |
|----------------------------------------------------|------------------|------------------------------------------------------|--------------|------------|
| Pressure measurement range                         | —                | 0 to 200 kPa                                         | 0 to 700 kPa | 0 to 1 MPa |
| Linearity after linearization                      | —                | 0.01 %FS Max.                                        |              |            |
| Accuracy<br>(Linearity, Repeatability, Hysteresis) | —                | 0.023 %FS Max.                                       |              |            |
| Operating temperature range                        | T <sub>use</sub> | -10 °C to +70 °C                                     |              |            |
| Storage temperature range                          | T <sub>stg</sub> | -20 °C to +80 °C                                     |              |            |
| Operating humidity range                           | —                | 0 % to 95 %                                          |              |            |
| Tilt correction                                    | —                | Equipped                                             |              |            |
| Built-in temperature sensor                        | —                | Option                                               | Option       | Option     |
| Output frequency without pressure                  | —                | 39 kHz Typ.                                          |              |            |
| Maximum frequency change                           | —                | 4 kHz Typ.                                           |              |            |
| Output voltage                                     | V <sub>pp</sub>  | 3.2 Vpp Min. (output load 600 Ω) Clipped sine DC cut |              |            |
| Supply voltage                                     | V <sub>cc</sub>  | 12 V (Standard)                                      |              |            |
| Current consumption                                | I <sub>cc</sub>  | 2 mA Typ. ( 4 mA Typ. : Built-in temperature sensor) |              |            |
| Pressure input/output port                         | —                | 1/8" Fitting                                         |              |            |
| Weight                                             | —                | 200 g                                                |              |            |
| Material                                           | —                | SUS304                                               |              |            |

#### External dimensions

(Unit:mm)



#### Typical Data

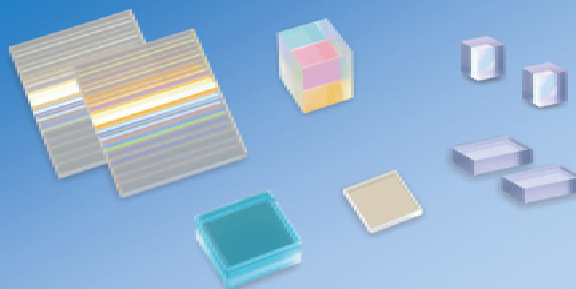




# OPTICAL DEVICE

## ●Features

- ▶ Wide selection of types according to application.
- ▶ Custom designs available upon request.  
Please inquire it.



## ▶ Optical Device

| Applications    |                  | Model                                | Wavelength (nm)                                                                     | Optical Specification                                                              | Incident Angle (°) | Dimension (Ex.) (mm)  | Page |
|-----------------|------------------|--------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|--------------------|-----------------------|------|
| Optical Pickup  | DVD CD           | 1/4 Wave plate C type (Single plate) | 660 or 785                                                                          | Phase retardation:90° ±5 (0° Incident angle)                                       | 0° ±0.5°           | □4 t:DVD:0.35 CD:0.45 | 144  |
|                 |                  | 1/4 Wave plate D type (Double plate) |                                                                                     |                                                                                    | 0° ±5°             | □4 t:DVD:1.1 CD:1.1   |      |
|                 |                  | 1/4 Wave plate G type (Double plate) |                                                                                     |                                                                                    | 0° ±5°             | □4 t:DVD:0.55 CD:0.7  |      |
|                 |                  | 1/2 Wave plate C type (Single plate) |                                                                                     | Phase retardation:180° ±5° (0° Incident angle)                                     | 0° ±0.5°           | □4 t:DVD:0.7 CD:0.85  |      |
|                 |                  | 1/2 Wave plate D type (Double plate) |                                                                                     |                                                                                    | 0° ±5°             | □4 t:DVD:1.1 CD:1.1   |      |
|                 |                  | 1/2Wave plate G type (Double plate)  |                                                                                     |                                                                                    | 0° ±5°             | □4 t:DVD:0.7 CD:0.7   |      |
|                 | Blue             | 1/4 Wave plate C type (Single plate) | 405                                                                                 | Phase retardation:90° ±5° (0° Incident angle)                                      | 0° ±0.5°           | □4 × 0.3              | 145  |
|                 |                  | 1/4 Wave plate D type (Double plate) |                                                                                     |                                                                                    | 0° ±5°             | □4 × 0.6              |      |
|                 |                  | 1/2 Wave plate D type (Double plate) |                                                                                     | Phase retardation:180° ±5° (0° Incident angle)                                     | 0° ±5°             | □4 × 0.6              |      |
|                 | DVD CD           | Dichroic Prism DVD penetrate type    | 660                                                                                 | Tp ≥ 90 % Ts ≥ 90 % (0° Incident angle)<br>Rp ≥ 88 % Rs ≥ 92 % (0° Incident angle) | 0° ±5°             | 3 × 3 × 3             | 146  |
|                 |                  |                                      | 785                                                                                 |                                                                                    |                    |                       |      |
|                 |                  | Dichroic Prism DVD reflection type   | 660                                                                                 | Rp ≥ 80 % Rs ≥ 97 % (0° Incident angle)                                            | 0° ±5°             | 3 × 3 × 3             |      |
|                 |                  |                                      | 785                                                                                 | Tp ≥ 94 % Ts ≥ 94 % (0° Incident angle)                                            |                    |                       |      |
|                 | Blue             | PBS Prism                            | 405                                                                                 | Tp ≥ 93 % Rs ≥ 90 % (0° Incident angle)                                            | 0° ±6°             | 3 × 3 × 3             | 147  |
|                 | Blue DVD CD      | Trichroic Prism                      | 405                                                                                 | Rp ≥ 84 % Rs ≥ 93 % (0° Incident angle)                                            | 0° ±6°             | 4 × 4 × 4             | 147  |
|                 |                  |                                      | 660                                                                                 | Tp ≥ 93 % Ts ≥ 93 % (0° Incident angle)                                            |                    |                       |      |
| 785             |                  |                                      | Tp ≥ 94 % Ts ≥ 94 % (0° Incident angle)                                             |                                                                                    |                    |                       |      |
| Blue DVD CD     | Grating          | 405 or 660 or 785                    | Grating ratio=1:10:1 Grating pitch 20 μm                                            | 0°                                                                                 | 3 × 2 × 0.5        | 149                   |      |
| DVD CD          | Dichroic Filter  | 660,785                              | Peripheral 660 nm T ≥ 95 % 785 nm T ≤ 5 %<br>Center 660 nm T ≥ 95 % 785 nm T ≥ 95 % | 0°                                                                                 | 4 × 4 × 0.5        | 149                   |      |
| Camera          | DSC DVC          | OLPF IR-cut Filter                   | 400 to 1200                                                                         | 50 % Wavelength 650 nm ±10 nm                                                      | 0°                 | 8 × 7                 | 150  |
|                 |                  | OLPF UV-IRcut-Filter                 | 410 to 1200                                                                         | 50 % Wavelength UV: 410 nm ±10 nm<br>50 % Wavelength IR: 650 nm ±10 nm             |                    |                       |      |
|                 | DSLR             | OLPF 4 points separation             | 400 to 1200                                                                         | 50 % Wavelength UV: 410 nm ±10 nm<br>50 % Wavelength IR: 650 nm ±10 nm             | 0°                 | 22 × 28               | 151  |
| Projector       | 3LCD             | PS Converter                         | 420 to 680                                                                          | Tp ≥ 94% Rs ≥ 95 % (0°Insident angle)                                              | 0°                 | 34.6 × 35 × 4.2       | 148  |
|                 |                  | Heat Sink Plate                      | 420 to 680                                                                          | 1 % Max. (0° Incident angle)                                                       | 0°                 | 23.5 × 20             | 148  |
| Optical Network | Infra-str ucture | Etalon Filter                        | 1520 to 1610                                                                        | FSR 50 GHz                                                                         | 0°                 |                       | 152  |



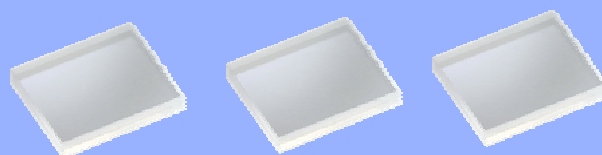
Product number (please contact us)  
X3Gxxxxxxxxx00

## OPTICAL DEVICE

# 1/4 Wave Plate

# 1/2 Wave Plate

- Corresponds to DVD.
- Corresponds to CD.

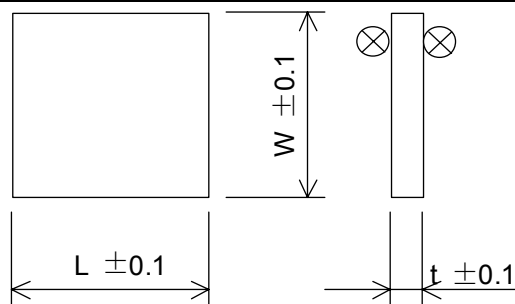


## Specifications

| Type                                       | 1/4 Wave plate                                       |      |                          |     |                          |      | 1/2 Wave plate           |      |                          |     |                          |     |
|--------------------------------------------|------------------------------------------------------|------|--------------------------|-----|--------------------------|------|--------------------------|------|--------------------------|-----|--------------------------|-----|
|                                            | C type<br>(Single plate)                             |      | D type<br>(Double plate) |     | G type<br>(Double plate) |      | C type<br>(Single plate) |      | D type<br>(Double plate) |     | G type<br>(Double plate) |     |
| Material                                   | Synthetic quartz                                     |      |                          |     |                          |      |                          |      |                          |     |                          |     |
| Wavelength (nm)                            | 660                                                  | 785  | 660                      | 785 | 660                      | 785  | 660                      | 785  | 660                      | 785 | 660                      | 785 |
| Incident Angle                             | 0 ° ±0.5 °                                           |      | 0 ° ±5 °                 |     |                          |      | 0 ° ±0.5 °               |      | 0 ° ±5 °                 |     |                          |     |
| Dimensions(Ex.)<br>L × W (mm)              | Standard: 4.0 × 4.0<br>Other dimensions upon request |      |                          |     |                          |      |                          |      |                          |     |                          |     |
| Thickness t (mm)                           | 0.35                                                 | 0.45 | 1.10                     |     | 0.55                     | 0.70 | 0.70                     | 0.85 | 1.10                     |     | 0.70                     |     |
| Phase retardation<br>(Incident angle: 0 °) | 90 ° ±5 °                                            |      |                          |     |                          |      | 180 ° ±5 °               |      |                          |     |                          |     |
| Reflectance of<br>AR coating               | 0.5 % Max. (Incident angle: 0 °)                     |      |                          |     |                          |      |                          |      |                          |     |                          |     |
| Wavefront aberration                       | 0.020 λ rms<br>(φ3 mm)                               |      | 0.025 λ rms (φ3 mm)      |     |                          |      | 0.020 λ rms<br>(φ3 mm)   |      | 0.025 λ rms (φ3 mm)      |     |                          |     |

## Outline Drawing

(Unit :mm)



⊗ :AR coating

## Optical Axis Direction

| 90° type                            | 45° type                            | 22.5° type                            |
|-------------------------------------|-------------------------------------|---------------------------------------|
| <br>$\theta = 90^\circ \pm 1^\circ$ | <br>$\theta = 45^\circ \pm 1^\circ$ | <br>$\theta = 22.5^\circ \pm 1^\circ$ |

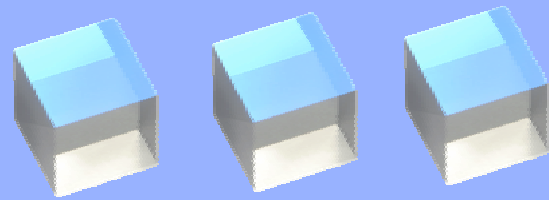


## OPTICAL DEVICE

## Dichroic Prism

- Corresponds to DVD,CD.

Product number (please contact us)  
X3Axxxxxxxxx00

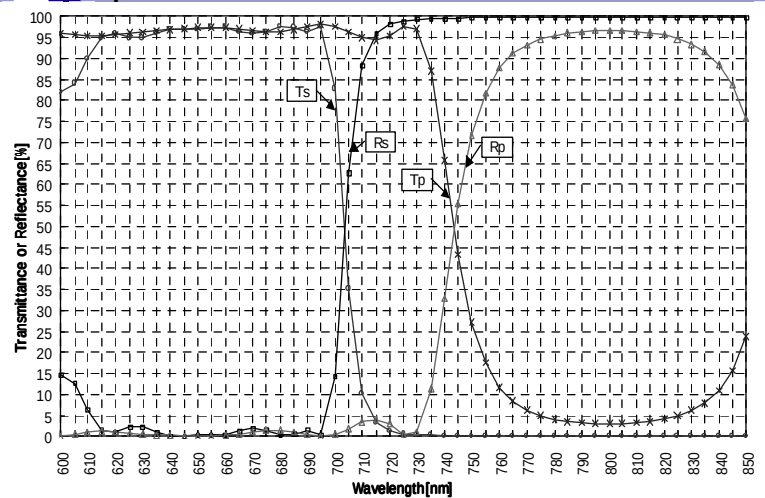


## DVD penetrate type

## Specifications

|                                  |                                                                                       |                |                                  |
|----------------------------------|---------------------------------------------------------------------------------------|----------------|----------------------------------|
| Material                         | BK7 or equivalent                                                                     |                |                                  |
| Wavelength                       | 660 nm $\pm$ 10 nm, 785 nm $\pm$ 10 nm                                                |                |                                  |
| Incident angle                   | 0 ° $\pm$ 5 °                                                                         |                |                                  |
| Dimensions (Ex.)                 | 3.0 $^{+0.1}_{-0.1}$ $\times$ 3.0 $^{+0.1}_{-0.1}$ $\times$ 3.0 $^{+0.1}_{-0.1}$ (mm) |                |                                  |
| Clear aperture                   | $\phi$ 2 mm                                                                           |                |                                  |
| Wavefront aberration             | 0.02 $\lambda$ rms Max.<br>(Transmission, $\lambda$ = 660 nm)                         |                |                                  |
| Dichroic coating characteristics | Wavelength                                                                            | Incident angle | Characteristics                  |
|                                  | 660 nm                                                                                | 0 °            | Tp $\geq$ 90 %<br>Ts $\geq$ 90 % |
|                                  | 785 nm                                                                                | 0 °            | Rp $\geq$ 88 %<br>Rs $\geq$ 92 % |
| Reflectance of AR coating        | 0.5 % Max. (Incident angle: 0 °)                                                      |                |                                  |

## Spectral Characteristics



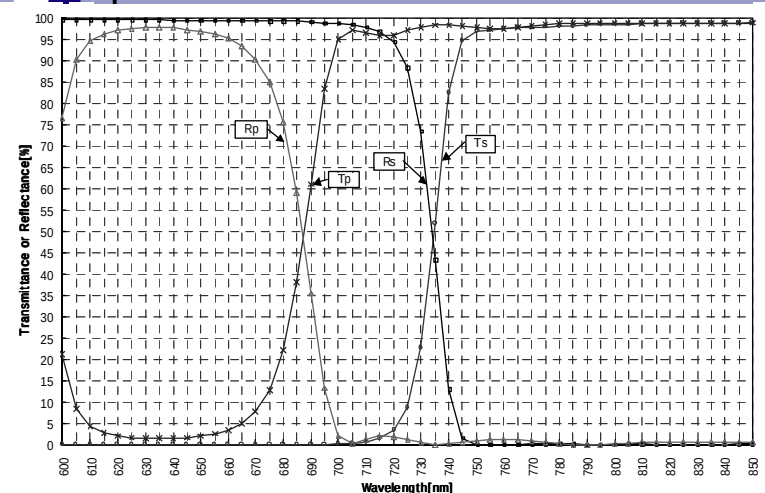
TP: Transmittance P polarization Rp: Reflectance P polarization  
TS: Transmittance S polarization RS: Reflectance S polarization

## DVD reflection type

## Specifications

|                                  |                                                                                       |                |                                  |
|----------------------------------|---------------------------------------------------------------------------------------|----------------|----------------------------------|
| Material                         | BK7 or equivalent                                                                     |                |                                  |
| Wavelength                       | 660 nm $\pm$ 10 nm, 785 nm $\pm$ 10 nm                                                |                |                                  |
| Incident angle                   | 0 ° $\pm$ 5 °                                                                         |                |                                  |
| Dimensions (Ex.)                 | 3.0 $^{+0.1}_{-0.1}$ $\times$ 3.0 $^{+0.1}_{-0.1}$ $\times$ 3.0 $^{+0.1}_{-0.1}$ (mm) |                |                                  |
| Clear aperture                   | $\phi$ 2 mm                                                                           |                |                                  |
| Wavefront aberration             | 0.02 $\lambda$ rms max (Reflection, $\lambda$ = 660 nm)                               |                |                                  |
| Dichroic coating characteristics | Wavelength                                                                            | Incident angle | Characteristics                  |
|                                  | 660 nm                                                                                | 0 °            | Rp $\geq$ 80 %<br>Rs $\geq$ 97 % |
|                                  | 785 nm                                                                                | 0 °            | Tp $\geq$ 94 %<br>Ts $\geq$ 94 % |
| Reflectance of AR coating        | 0.5 % Max. (Incident angle: 0 °)                                                      |                |                                  |

## Spectral Characteristics

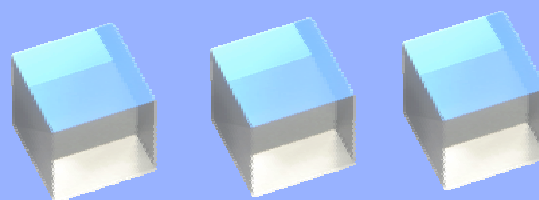


TP: Transmittance P polarization Rp: Reflectance P polarization  
TS: Transmittance S polarization RS: Reflectance S polarization





Product number (please contact us)  
X3Axxxxxxxxx00



## OPTICAL DEVICE

## PBS-Prism for Blue

- Corresponds to Blue Laser.

## Trichroic Prism

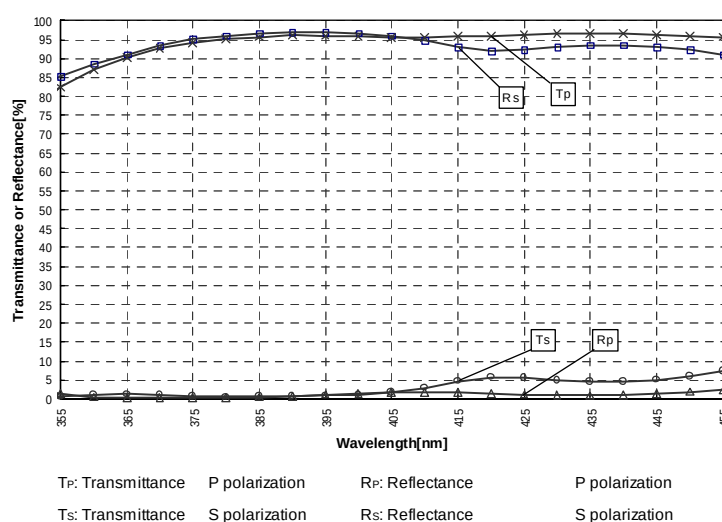
- Corresponds to three wavelength.(Blue,DVD,CD)

## PBS-Prism for Blue

## Specifications

|                                  |                                                                      |                |                                  |
|----------------------------------|----------------------------------------------------------------------|----------------|----------------------------------|
| Material                         | BK7 or equivalent                                                    |                |                                  |
| Wavelength                       | 405 nm $\pm$ 10 nm                                                   |                |                                  |
| Incident angle                   | 0° $\pm$ 6°                                                          |                |                                  |
| Dimensions (Ex.)                 | 3.0 <sup>+0.1</sup> × 3.0 <sup>+0.1</sup> × 3.0 <sup>+0.1</sup> (mm) |                |                                  |
| Clear aperture                   | Φ2.0 mm                                                              |                |                                  |
| Wavefront aberration             | 0.030 λ rms Max. (λ = 405 nm)                                        |                |                                  |
| Dichroic coating characteristics | Wavelength                                                           | Incident angle | Characteristics                  |
|                                  | 405 $\pm$ 10 nm                                                      | 0°             | Tp $\geq$ 93 %<br>Rs $\geq$ 90 % |
|                                  |                                                                      | 0° $\pm$ 6°    | Tp $\geq$ 89 %<br>Rs $\geq$ 90 % |
| Reflectance of AR coating        | 0.5 % Max. (Incident angle: 0°)                                      |                |                                  |

## Spectral Characteristics (Ex.)

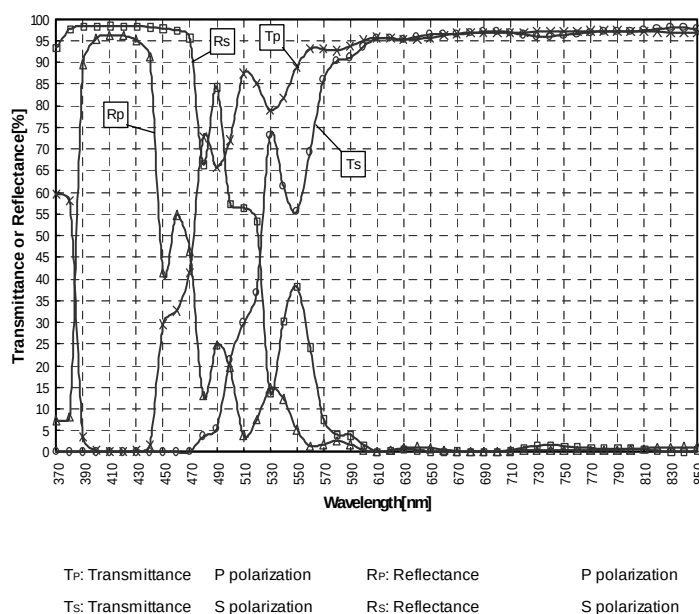


## Trichroic Prism

## Specifications

|                                   |                                                                        |                |                                  |
|-----------------------------------|------------------------------------------------------------------------|----------------|----------------------------------|
| Material                          | BK7 or equivalent                                                      |                |                                  |
| Wavelength                        | 405 nm $\pm$ 5 nm<br>660 nm $\pm$ 15 nm, 785 nm $\pm$ 15 nm            |                |                                  |
| Incident angle                    | 0° $\pm$ 6°                                                            |                |                                  |
| Dimensions (Ex.)                  | 4.0 <sup>+0.1</sup> × 4.0 <sup>+0.1</sup> × 4.0 <sup>+0.1</sup> (mm)   |                |                                  |
| Clear aperture                    | Φ3.0 mm                                                                |                |                                  |
| Wavefront aberration              | 0.030 λ rms Max.(Ref. λ = 405 nm)<br>0.025 λ rms Max.(Tra. λ = 660 nm) |                |                                  |
| Trichroic coating characteristics | Wavelength                                                             | Incident angle | Characteristics                  |
|                                   | 405 $\pm$ 5 nm                                                         | 0° $\pm$ 6°    | Rp $\geq$ 84 %<br>Rs $\geq$ 93 % |
|                                   | 660 $\pm$ 10 nm                                                        | 0° $\pm$ 6°    | Tp $\geq$ 93 %<br>Ts $\geq$ 93 % |
|                                   | 785 $\pm$ 15 nm                                                        | 0° $\pm$ 6°    | Tp $\geq$ 94 %<br>Ts $\geq$ 94 % |
| Reflectance of AR coating         | 1.0 % Max. (Incident angle: 0°)                                        |                |                                  |

## Spectral Characteristics (Ex.)





## OPTICAL DEVICE

## PS Converter

- Polarization beam splitter

## Heat Sink Plate

- For projector

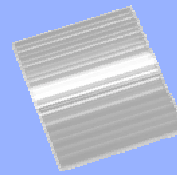
Product number (please contact us)

PS Converter

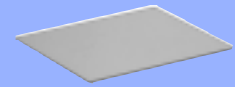
X3Kxxxxxxxxxx00

Heat sink Plate

X3Hxxxxxxxxxx00



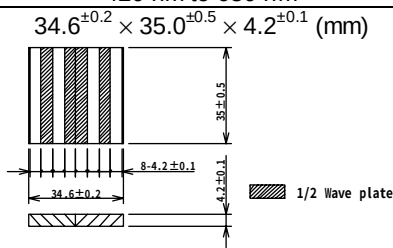
PS Converter



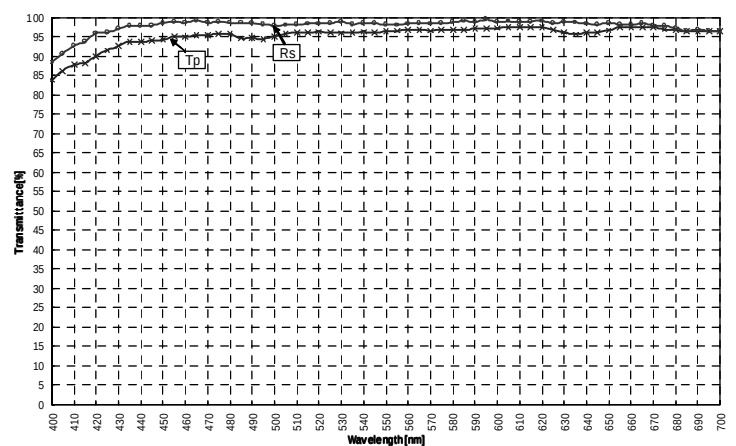
Heat Sink Plate

## PS Converter

## Specification

|                                |                                                                                                                                            |                   |                                    |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------------------------------------|
| Material                       | B270 or equivalent                                                                                                                         |                   |                                    |
| Wavelength                     | 420 nm to 680 nm                                                                                                                           |                   |                                    |
| Dimensions<br>(Ex.)            | $34.6^{+0.2} \times 35.0^{+0.5} \times 4.2^{+0.1}$ (mm)  |                   |                                    |
| PBS coating<br>Characteristics | Wavelength                                                                                                                                 | Incident<br>angle | Characteristics                    |
|                                | 420 nm<br>to 680 nm                                                                                                                        | 0 °               | Tp(Ave.) ≥ 94 %<br>Rs(Ave.) ≥ 95 % |
| Reflectance of<br>AR coating   | Average 0.5 % Max.                                                                                                                         |                   |                                    |

## Spectral Characteristics (Ex.)



Tp: Transmittance P polarization Rs: Reflectance S Polarization

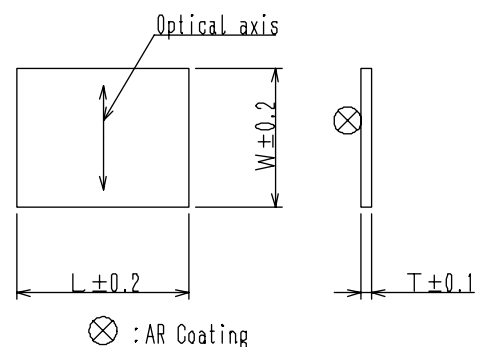
## Heat Sink Plate

## Specifications

|                                  |                                                 |
|----------------------------------|-------------------------------------------------|
| Material                         | Synthetic Quartz                                |
| Wavelength                       | 420 nm to 680 nm                                |
| Accuracy against<br>optical axis | Angle between optical axis and L<br>90 ° ±0.5 ° |
|                                  | Angle between optical axis and W<br>0 ° ±0.5 °  |
| Reflectance of<br>AR coating     | 1.0 % Max. (Incident Angle: 0 °)                |

## Outline Drawing

(Unit:mm)



| L    | W    | T             |
|------|------|---------------|
| 20.0 | 18.0 | on discussion |
| 23.5 | 16.0 |               |
| 23.5 | 20.0 |               |
| 26.0 | 21.0 |               |
| 28.0 | 22.0 |               |



## OPTICAL DEVICE

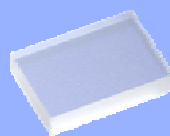
## Grating

- Corresponds to three wavelength.(Blue,DVD,CD)

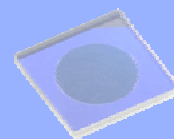
## Dichroic Filter

- Allows the DVD and CD wavelength to transmit selectively

Product number (please contact us)  
X3Dxxxxxxxxxx00



Grating



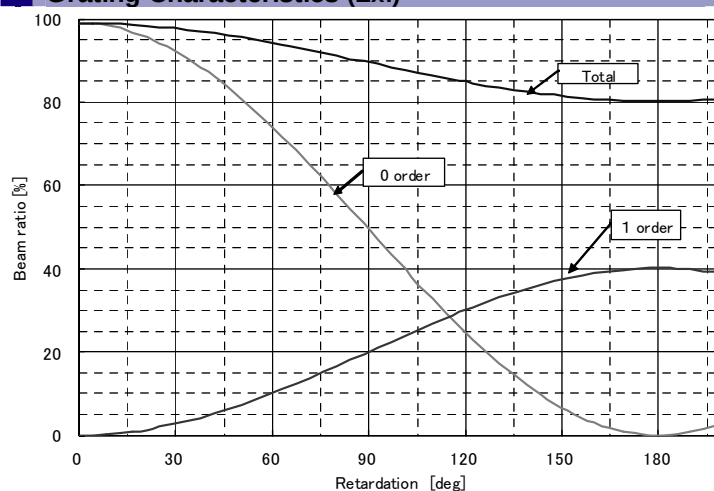
Dichroic Filter

## Grating

## Specifications

|                           |                                                              |         |         |
|---------------------------|--------------------------------------------------------------|---------|---------|
| Material                  | Non-alkaline glass                                           |         |         |
| Wavelength (nm)           | 405 ±10                                                      | 660 ±10 | 785 ±10 |
| Dimensions (Ex.)          | 3.0 <sup>±0.1</sup> × 2.0 <sup>±0.1</sup> (mm)               |         |         |
| Thickness                 | 0.3 <sup>±0.05</sup> , 0.5 <sup>±0.05</sup> (mm)             |         |         |
| Grating pitch             | 20 μm (Duty 1:1)<br>Other pitches upon request               |         |         |
| Wavefront aberration      | 0.02 λrms Max.<br>(λ = 660 nm, φ1.4 mm)                      |         |         |
| Grating ratio             | -1 order:0 order:+1 order=1:10:1<br>Other ratio upon request |         |         |
| Reflectance of AR coating | 0.5 % Max. (Incident angle: 0 °)                             |         |         |

## Grating Characteristics (Ex.)

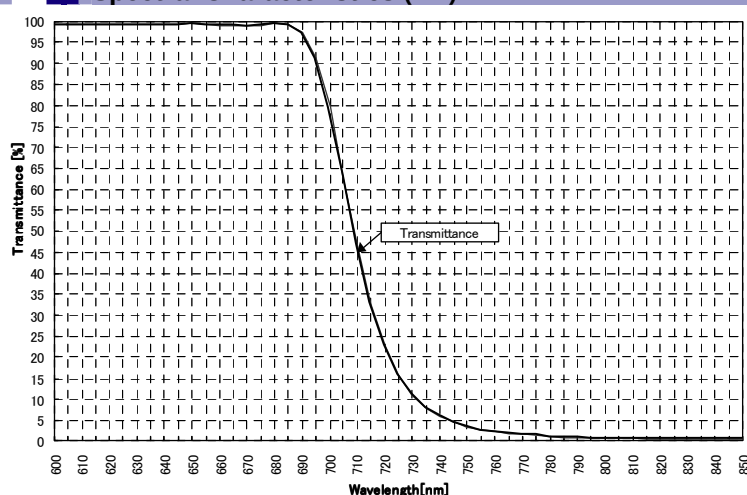


## Dichroic Filter

## Specifications

|                           |                                                  |            |                 |
|---------------------------|--------------------------------------------------|------------|-----------------|
| Material                  | Non-alkaline glass                               |            |                 |
| Wavelength                | 660 nm ±10 nm, 785 nm ±10 nm                     |            |                 |
| Dimensions (Ex.)          | 4.0 <sup>±0.1</sup> × 4.0 <sup>±0.1</sup> (mm)   |            |                 |
| Thickness                 | 0.3 <sup>±0.05</sup> , 0.5 <sup>±0.05</sup> (mm) |            |                 |
| Wavefront aberration      | 0.025 λrms Max.<br>(λ = 660 nm, φ2.0 mm)         |            |                 |
| Transmittance             | Peripheral area                                  | Wavelength | Characteristics |
|                           |                                                  | 660 nm     | ≥ 95 %          |
|                           | Center                                           | 785 nm     | ≤ 5 %           |
|                           |                                                  | 660 nm     | ≥ 95 %          |
| Reflectance of AR coating | 0.5 % Max. (Incident angle: 0 °)                 |            |                 |

## Spectral Characteristics (Ex.)





## OPTICAL DEVICE

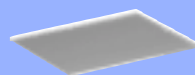
# OLPF

## IR-cut Filter

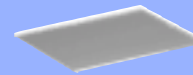
## UV•IR-cut

- Sharply cut infrared ray

Product number (please contact us)  
X3Fxxxxxxxxx00



OLPF  
IR-cut Filter



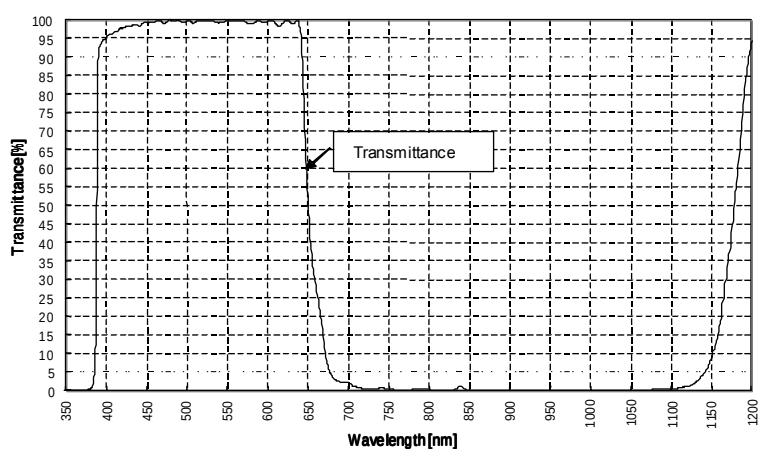
OLPF  
UV•IR-cut Filter

### IR-cut Filter

#### Specifications

|                                  |                                                                          |
|----------------------------------|--------------------------------------------------------------------------|
| Material                         | Synthetic Quartz ,glass                                                  |
| Wavelength                       | 400 nm to 1200 nm                                                        |
| Dimensions<br>(Ex.)              | $8.0 \pm 0.05 \times 7.0 \pm 0.05$ (mm)                                  |
| Accuracy against<br>optical axis | Angle of optical axis (from cutting)<br>$45^\circ \pm 1^\circ$           |
|                                  | Separation angle $\pm 1^\circ$                                           |
| IR-cut filter<br>characteristics | 50 % wavelength of IR : 650 nm $\pm 10$ nm                               |
| Reflectance of<br>AR coating     | 1.0 % Max.<br>(Incident angle: $0^\circ$ , $\lambda = 420$ nm to 680 nm) |

#### Spectral Characteristics (Ex.)

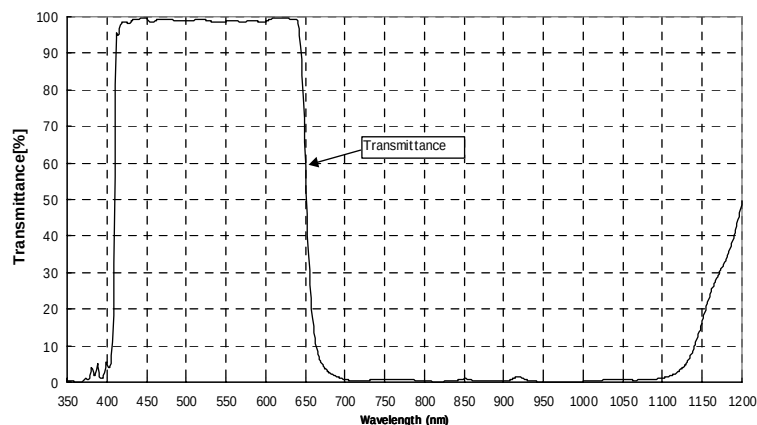


### UV•IR-cut Filter

#### Specifications

|                                     |                                                                                     |
|-------------------------------------|-------------------------------------------------------------------------------------|
| Material                            | Synthetic Quartz ,glass                                                             |
| Wavelength                          | 400 nm to 1200 nm                                                                   |
| Dimensions<br>(Ex.)                 | $8.0 \pm 0.05 \times 7.0 \pm 0.05$ (mm)                                             |
| Accuracy against<br>optical axis    | Angle of optical axis (from cutting)<br>$45^\circ \pm 1^\circ$                      |
|                                     | Separation angle $\pm 1^\circ$                                                      |
| UV•IR-cut filter<br>characteristics | UV:50 % Wavelength : 410 nm $\pm 10$ nm<br>IR :50 % Wavelength : 650 nm $\pm 10$ nm |
| Reflectance of<br>AR coating        | 1.0% Max.<br>(Incident angle: $0^\circ$ , $\lambda = 420$ nm to 680 nm)             |

#### Spectral Characteristics (Ex.)





## OPTICAL DEVICE

## OLPF

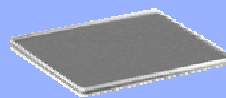
## 4 points separation / Film type

- For digital single lens reflex camera (DSLR)
- Good separation performance, lighter and thinner

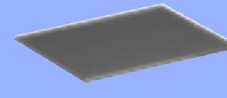
## Anti-Dust coat

- Reduce dust adhesion, improve dust removal

Product number (please contact us)  
X3Fxxxxxxxxx00



OLPF  
4 points separation/Film type



OLPF  
Anti-Dust coat

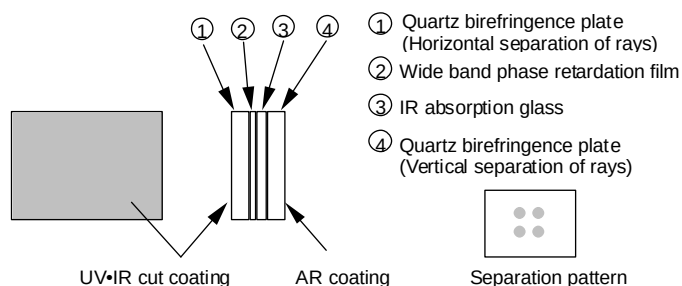
NEW

## 4 points separation / Film type OLPF

## Specifications

|                                       |                                                                                      |
|---------------------------------------|--------------------------------------------------------------------------------------|
| Material                              | Synthetic Quartz, IR glass,<br>Wide band phase retardation film                      |
| Wavelength                            | 400 nm ~ 1200 nm                                                                     |
| Dimensions(Ex.)                       | $22.0^{+0.1} \times 28.0^{+0.1}$ (mm)                                                |
| Accuracy against<br>optical axis(Ex.) | Angle of optical axis (from cutting)<br>( $\theta$ ) $45^\circ \pm 1^\circ$          |
|                                       | Separation angle<br>( $\phi$ ) $0^\circ \pm 1^\circ$                                 |
| UV•IR-cut coat<br>characteristics     | UV: 50 % Wavelength : 415 nm $\pm 10$ nm<br>IR: 50 % Wavelength : 680 nm $\pm 10$ nm |
| Reflectance of<br>AR coating          | 1.0 % Max.<br>(Incident Angle $0^\circ$ , $\lambda = 450$ nm~650 nm)                 |

## Structure

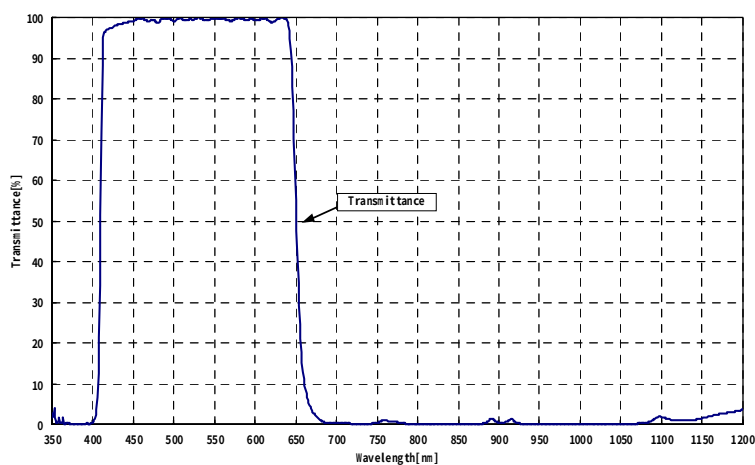


## Anti-Dust coat OLPF

## Specifications

|                                   |                                                                                      |
|-----------------------------------|--------------------------------------------------------------------------------------|
| Material                          | Synthetic Quartz (Glass)                                                             |
| Wavelength                        | 400 nm~1200 nm                                                                       |
| Dimensions(Ex.)                   | $22.0^{+0.05} \times 28.0^{+0.05}$ (mm)                                              |
| Accuracy against<br>optical axis  | Angle of optical axis (from cutting)<br>( $\theta$ ) $45^\circ \pm 1^\circ$          |
|                                   | Separation angle<br>( $\phi$ ) $0^\circ \pm 1^\circ$                                 |
| UV•IR-cut coat<br>characteristics | UV: 50 % Wavelength : 410 nm $\pm 10$ nm<br>IR: 50 % Wavelength : 650 nm $\pm 10$ nm |
| Reflectance of AR<br>coating      | 1.0 % max.<br>(Incident Angle $0^\circ$ , $\lambda = 450$ nm~650 nm)                 |
| Anti-Dust<br>coating side         | AR coat side or UVIR coat side                                                       |
| Anti-Dust<br>characteristics      | Please inquire                                                                       |

## Spectral Characteristics



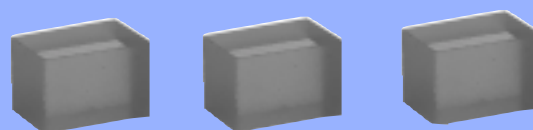


Product number (please contact us)  
X3Exxxxxxxxx00

## OPTICAL DEVICE

# Etalon Filter

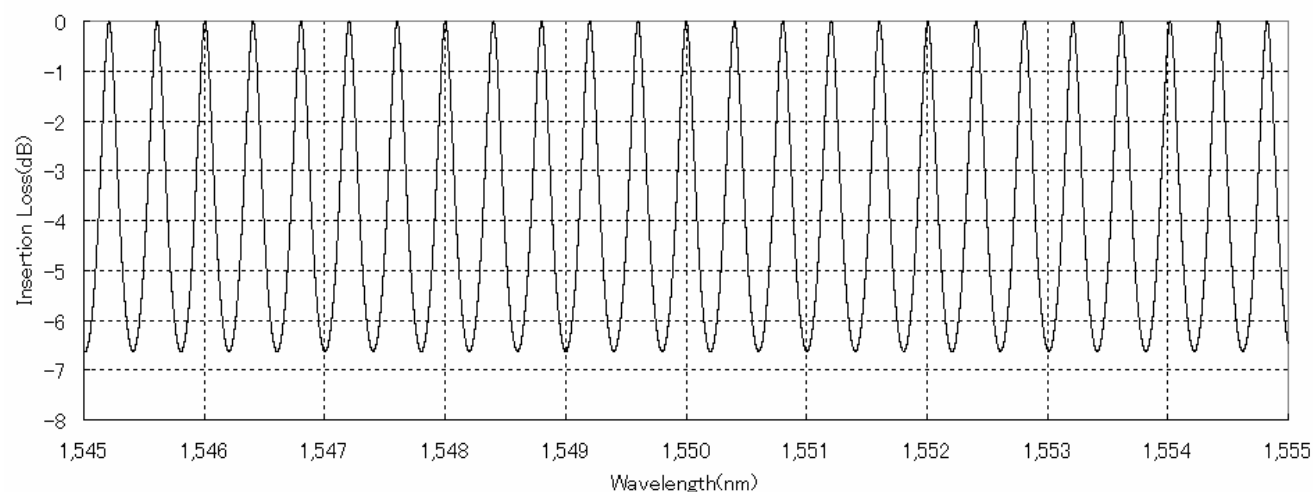
- Keep the loss low
- Stable against temperature



## Specification

|                |                    |
|----------------|--------------------|
| Material       | Synthetic Quartz   |
| Wavelength     | 1520 nm to 1610 nm |
| Dimensions     | Upon request       |
| FSR            | 50 GHz             |
| Insertion loss | $\leq 1.0$ dB      |

## Etalon Characteristics (50GHz)





# WORKING FOR EU RoHS / Pb FREE

## ■EU RoHS / Pb Free Products of Epson Toyocom

Epson Toyocom's standard product offering is compliant with EU RoHS directives.

We provide the following two EU RoHS directive compliances.

The appropriate symbol is displayed on individual product pages as applicable.

|                                                                                   |                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <ul style="list-style-type: none"> <li>●Pb free.</li> <li>●Complies with EU RoHS directive.</li> </ul>                                                                                                                                                                      |
|  | <ul style="list-style-type: none"> <li>●Pb free terminal designed.</li> <li>Contains Pb in products exempted by EU RoHS directive.<br/>(Contains Pb in sealing glass, high melting temperature type solder or other.)</li> <li>●Complies with EU RoHS directive.</li> </ul> |

## ■DISTINCTIONS

Distinctions between the products with Pb plating terminals and the products that comply with EU RoHS directives.

- Plastic packaged type products.

Marking (year part lot No.) will be changed as follows.

|                                                                                 |          |   |   |   |   |   |   |   |   |   |   |
|---------------------------------------------------------------------------------|----------|---|---|---|---|---|---|---|---|---|---|
| Products with Pb plating terminals<br>(Terminal Plating : Sn-Pb)                | Numeric  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 |
| Products Complied with EU RoHS directive<br>(Terminal Plating : Sn-Bi or Sn-Ag) | Alphabet | A | B | C | D | E | F | G | H | J | K |
| Products Complied with EU RoHS directive<br>(Terminal Plating : Sn)             | Alphabet | M | N | R | S | T | U | V | W | X | Z |

- Cylinder type products

The color of glass plug will be changed as follows.

|                                          |                   |
|------------------------------------------|-------------------|
| Terminal Pb Plating products             | Blue or Green etc |
| Complies with EU RoHS directive products | Gray or White     |

## ■Temrinal materials of Epson Toyocom products that comply with EU RoHS directive

We will deliver products that comply with EU RoHS directives for new orders.

Sn plating of terminals is our standard for the products that offer two types of plating.

|                            | Model              | Terminal Material | Terminal Plating | Complies With EU RoHS directive | Pb Free | Remarks<br>(Contains Pb in products exempted by RoHS directive.) | Reference weight (Typ.) |
|----------------------------|--------------------|-------------------|------------------|---------------------------------|---------|------------------------------------------------------------------|-------------------------|
| kHz range<br>Crystal units | C-001R             | Fe-Ni-Co          | Sn-Cu            | ○                               | ○       |                                                                  | 148 mg                  |
|                            | C-002RX / C-2-TYPE | Fe-Ni-Co          | Sn-Cu            | ○                               | ○       |                                                                  | 52 mg                   |
|                            | C-004R/C-4-TYPE    | Fe-Ni-Co          | Sn-Cu            | ○                               | ○       |                                                                  | 30 mg                   |
|                            | C-005R             | Fe-Ni-Co          | Sn-Cu            | ○                               | ○       |                                                                  | 17 mg                   |
|                            | FC-12M             | W or Mo           | Au               | ○                               | ○       |                                                                  | 5 mg                    |
|                            | FC-125             | W or Mo           | Au               | ○                               | ○       |                                                                  | 6 mg                    |
|                            | FC-13E             | W                 | Au               | ○                               | ○       |                                                                  | 8 mg                    |
|                            | FC-13F             | W                 | Au               | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 8 mg                    |
|                            | FC-135             | W                 | Au               | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 11 mg                   |
|                            | FC-145             | W                 | Au               | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 15 mg                   |
|                            | FC-255             | W                 | Au               | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 22 mg                   |
|                            | MC-146             | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 29 mg                   |
|                            | MC-156             | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 50 mg                   |
| MHz range<br>Crystal units | CA-301             | Fe-Ni-Co          | Sn-Cu            | ○                               | ○       |                                                                  | 172 mg                  |
|                            | FA-128             | W                 | Au               | ○                               | ○       |                                                                  | 7 mg                    |
|                            | FA-20H             | W                 | Au               | ○                               | ○       |                                                                  | 11 mg                   |
|                            | FA-23A             | W                 | Au               | ○                               | ○       |                                                                  | 23 mg                   |
|                            | FA-238V            | W                 | Au               | ○                               | ○       |                                                                  | 18 mg                   |
|                            | FA-238             | W                 | Au               | ○                               | ○       |                                                                  | 16 mg                   |
|                            | TSX-3225           | W                 | Au               | ○                               | ○       |                                                                  | 17 mg                   |
|                            | TSX-4025           | W                 | Au               | ○                               | ○       |                                                                  | 24 mg                   |
|                            | TSX-5032           | W                 | Au               | ○                               | ○       |                                                                  | 40 mg                   |
|                            | FA-365             | W                 | Au               | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 84 mg                   |
|                            | MA-306             | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 124 mg                  |
|                            | MA-406             | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 330 mg                  |
|                            | MA-505/MA-506      | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 505 mg                  |
| Resonator                  | FH-33H             | W                 | Au               | ○                               | ○       |                                                                  | 38 mg                   |
|                            | NS-21R             | W                 | Au               | ○                               | ○       |                                                                  | 13 mg                   |
|                            | NS-32R             | W                 | Au               | ○                               | ○       |                                                                  | 49 mg                   |
|                            | FS-335             | W                 | Au               | ○                               | ○       |                                                                  | 56 mg                   |
|                            | FS-555             | W                 | Au               | ○                               | ○       |                                                                  | 112 mg                  |
|                            | FS-585             | W                 | Au               | ○                               | ○       |                                                                  | 112 mg                  |





|      | Model                  | Terminal Material | Terminal Plating | Complies With EU RoHS directive | Pb Free | Remarks<br>(Contains Pb in products exempted by RoHS directive.) | Reference weight (Typ.) |
|------|------------------------|-------------------|------------------|---------------------------------|---------|------------------------------------------------------------------|-------------------------|
| SPXO | SG-150 series          | Cu                | Au               | ○                               | ○       |                                                                  | 9 mg                    |
|      | SG-211 series          | W                 | Au               | ○                               | ○       |                                                                  | 13 mg                   |
|      | SG-210 series          | W                 | Au               | ○                               | ○       |                                                                  | 15 mg                   |
|      | SG-310 series          | W                 | Au               | ○                               | ○       |                                                                  | 26 mg                   |
|      | SG-550 series          | 42 Alloy          | Sn-Bi            | ○                               | ○       |                                                                  | 41 mg                   |
|      | TCO-710x series        | W                 | Au               | ○                               | ○       |                                                                  | 53 mg                   |
|      | SG-770 series          | W                 | Au               | ○                               | ○       |                                                                  | 166 mg                  |
|      | TCO-708x series        | W                 | Au               | ○                               | ○       |                                                                  | 158 mg                  |
|      | SG-645 series          | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 98 mg                   |
|      | SG-636 series          | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 241 mg                  |
|      | SG-615 series          | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 917 mg                  |
|      | SG-531 series          | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 698 mg                  |
|      | SG-51 series           | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 952 mg                  |
|      | SG-8003BA              | Cu                | Au               | ○                               | ○       |                                                                  | 9 mg                    |
|      | SG-8002CE/SG-8003CE    | W                 | Au               | ○                               | ○       |                                                                  | 27 mg                   |
|      | SG-8002LB/SG-8003LB    | 42 Alloy          | Sn-Bi            | ○                               | ○       |                                                                  | 41 mg                   |
|      | SG-8002JF              | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 98 mg                   |
|      | SG-8002CA/SG-8003CA    | W                 | Au               | ○                               | ○       |                                                                  | 148 mg                  |
|      | SG-8002JC              | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 234 mg                  |
|      | SG-8002JA              | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 894 mg                  |
|      | SG-8002DC              | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 699 mg                  |
|      | SG-8002DB              | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 942 mg                  |
|      | SG-8003JF              | 42 Alloy          | Sn or Sn-Bi      | ○                               | ○       |                                                                  | 98 mg                   |
|      | SG-8003JC              | 42 Alloy          | Sn or Sn-Bi      | ○                               | ○       |                                                                  | 234 mg                  |
|      | SG-8003JA              | 42 Alloy          | Sn or Sn-Bi      | ○                               | ○       |                                                                  | 894 mg                  |
|      | SG-8003DC              | 42 Alloy          | Sn or Sn-Bi      | ○                               | ○       |                                                                  | 699 mg                  |
|      | SG-9001LB              | 42 Alloy          | Sn-Bi            | ○                               | ○       |                                                                  | 41 mg                   |
|      | SG-9001CA              | W                 | Au               | ○                               | ○       |                                                                  | 155 mg                  |
|      | SG-9001JC              | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 239 mg                  |
|      | XG-1000CA              | W                 | Au               | ○                               | ○       |                                                                  | 126 mg                  |
|      | XG-1000CB              | W                 | Au               | ○                               | ○       |                                                                  | 56 mg                   |
|      | EG-2021CA series       | W                 | Au               | ○                               | ○       |                                                                  | 135 mg                  |
|      | EG-2001CA series       | W                 | Au               | ○                               | ○       |                                                                  | 130 mg                  |
|      | EG-2002CA series       | W                 | Au               | ○                               | ○       |                                                                  | 135 mg                  |
|      | EG-2121CA series       | W                 | Au               | ○                               | ○       |                                                                  | 133 mg                  |
|      | EG-2102CA series       | W                 | Au               | ○                               | ○       |                                                                  | 129 mg                  |
|      | EG-2101CA series       | W                 | Au               | ○                               | ○       |                                                                  | 134 mg                  |
|      | HG-2150CA series       | W                 | Au               | ○                               | ○       |                                                                  | 153 mg                  |
|      | HG-8002JA series       | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 896 mg                  |
|      | TCO-391J               | Sn-P-Cu           | Sn or Sn-Cu      | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 742 mg                  |
|      | TCO-3100 series        | Sn-P-Cu           | Sn-Cu            | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 1018 mg                 |
|      | MG-5020JE              | 42 Alloy          | Sn-Ag            | ○                               |         | High melting temperature type solder. (Pb85%)                    | 120 mg                  |
|      | SG-3030LC/3040LC       | 42 Alloy          | Sn or Sn-Ag      | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 25 mg                   |
|      | SG-3030JF              | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 90 mg                   |
|      | SG-3030JC/3040JC       | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 239 mg                  |
| VCXO | VG-4231CE              | W                 | Au               | ○                               | ○       |                                                                  | 26 mg                   |
|      | VG-4231CB              | W                 | Au               | ○                               | ○       |                                                                  | 54 mg                   |
|      | VG-4531CB              | W                 | Au               | ○                               | ○       |                                                                  | 53 mg                   |
|      | VG-4231CA              | W                 | Au               | ○                               | ○       |                                                                  | 153 mg                  |
|      | VG-4501CA              | W                 | Au               | ○                               | ○       |                                                                  | 169 mg                  |
|      | VG-4502CA              | W                 | Au               | ○                               | ○       |                                                                  | 164 mg                  |
|      | VG-4511CA              | W                 | Au               | ○                               | ○       |                                                                  | 169 mg                  |
|      | VG-1201CA              | W                 | Au               | ○                               | ○       |                                                                  | 158 mg                  |
|      | TCO-291J               | Sn-P-Cu           | Sn               | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 742 mg                  |
|      | TCO-294J               | Cu                | Au               | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 358 mg                  |
|      | TCO-2152               | Ag-Pd             | Au               | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 152 mg                  |
|      | TCO-2000 series        | Sn-P-Cu           | Sn or Sn-Cu      | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 971 mg                  |
|      | TCO-2100 series        | Sn-P-Cu           | Sn or Sn-Cu      | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 1018 mg                 |
| TCXO | TG-3530SA              | 42 Alloy          | Sn-Ag            | ○                               |         | High melting temperature type solder. (Pb85%)                    | 290 mg                  |
|      | TG-5021BA              | Cu                | Au               | ○                               | ○       |                                                                  | 9 mg                    |
|      | TG-5005CG              | W                 | Au               | ○                               | ○       |                                                                  | 16 mg                   |
|      | TG-5010CG              | W                 | Au               | ○                               | ○       |                                                                  | 16 mg                   |
|      | TG-5005CE              | W                 | Au               | ○                               | ○       |                                                                  | 29 mg                   |
|      | TG-5010LH              | 42 Alloy          | Sn-Bi            | ○                               | ○       |                                                                  | 22 mg                   |
|      | TCO-5860 series        | W                 | Au               | ○                               | ○       |                                                                  | 29 mg                   |
| OCXO | TCO-5060 / 5160 series | W                 | Au               | ○                               | ○       |                                                                  | 214 mg                  |
|      | TCO-6831               | Fe-Ni(50 %)       | Sn-Cu            | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 55.5 g                  |
|      | OX-6501GG              | Cu                | Au               | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 7.0 g                   |
|      | TCO-6600 series        | Fe-Ni(50 %)       | Sn-Cu            | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 27.5 g                  |
|      | TCO-6730               | Fe-Ni(50 %)       | Sn-Cu            | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 82.5 g                  |
|      | TCO-676 series         | Fe-Ni(50 %)       | Sn-Cu            | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 10.0 g                  |
|      | TCO-679 series         | Fe-Ni-Co          | Sn-Ag-Cu         | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 4.5 g                   |
|      | TCO-6920A              | Fe-Ni(50 %)       | Sn-Cu            | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 91.0 g                  |



|                        | Model             | Terminal Material | Terminal Plating | Complies With EU RoHS directive | Pb Free | Remarks<br>(Contains Pb in products exempted by RoHS directive.) | Reference weight (Typ.) |
|------------------------|-------------------|-------------------|------------------|---------------------------------|---------|------------------------------------------------------------------|-------------------------|
| Real Time Clock Module | RX-4045SA         | 42Alloy           | Sn or Sn-Ag      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 290 mg                  |
|                        | RX-4045NB         | Cu Alloy          | Sn or Sn-Ag      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 84 mg                   |
|                        | RX-4581NB         | Cu Alloy          | Sn or Sn-Ag      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 84 mg                   |
|                        | RTC-9701JE        | 42 Alloy          | Sn-Ag            | ○                               |         | High melting temperature type solder. (Pb85%)                    | 123 mg                  |
|                        | RTC4701JE         | 42 Alloy          | Sn-Ag            | ○                               |         | High melting temperature type solder. (Pb85%)                    | 120 mg                  |
|                        | RTC-4701NB        | Cu Alloy          | Sn or Sn-Ag      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 83 mg                   |
|                        | RTC-4574SA        | 42Alloy           | Sn or Sn-Ag      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 289 mg                  |
|                        | RTC-4574JE        | 42 Alloy          | Sn-Ag            | ○                               |         | High melting temperature type solder. (Pb85%)                    | 118 mg                  |
|                        | RTC-4574NB        | Cu Alloy          | Sn or Sn-Ag      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 83 mg                   |
|                        | RX-4574LC         | 42 Alloy          | Sn or Sn-Ag      | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 25 mg                   |
|                        | RA-4574SA         | 42Alloy           | Sn-Ag            | ○                               |         | High melting temperature type solder. (Pb85%)                    | 289 mg                  |
|                        | RTC-4543SA        | 42 Alloy          | Sn-Ag            | ○                               |         | High melting temperature type solder. (Pb85%)                    | 291 mg                  |
|                        | RTC-4543SB        | 42 Alloy          | Sn-Ag            | ○                               |         | High melting temperature type solder. (Pb85%)                    | 238 mg                  |
|                        | RX-4575LC         | 42 Alloy          | Sn or Sn-Ag      | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 25 mg                   |
|                        | RX-4571LC         | 42 Alloy          | Sn or Sn-Ag      | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 25 mg                   |
|                        | RX-4571NB         | Cu Alloy          | Sn or Sn-Ag      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 83 mg                   |
|                        | RX-4571SA         | 42Alloy           | Sn or Sn-Ag      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 309 mg                  |
|                        | RA-4565SA         | 42Alloy           | Sn-Ag            | ○                               |         | High melting temperature type solder. (Pb85%)                    | 309 mg                  |
|                        | RX-4801SA         | 42Alloy           | Sn               | ○                               |         | High melting temperature type solder. (Pb85%)                    | 313 mg                  |
|                        | RX-8025SA         | 42Alloy           | Sn or Sn-Ag      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 292 mg                  |
|                        | RX-8025NB         | Cu Alloy          | Sn or Sn-Ag      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 84 mg                   |
|                        | RTC-8564JE        | 42 Alloy          | Sn-Ag            | ○                               |         | High melting temperature type solder. (Pb85%)                    | 119 mg                  |
|                        | RTC-8564NB        | Cu Alloy          | Sn or Sn-Ag      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 83 mg                   |
|                        | RX-8564LC         | 42 Alloy          | Sn or Sn-Ag      | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 25 mg                   |
|                        | RA-8565SA         | 42Alloy           | Sn-Ag            | ○                               |         | High melting temperature type solder. (Pb85%)                    | 309 mg                  |
|                        | RX-8571LC         | 42 Alloy          | Sn               | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 25 mg                   |
|                        | RX-8571NB         | Cu Alloy          | Sn               | ○                               |         | High melting temperature type solder. (Pb85%)                    | 84 mg                   |
|                        | RX-8571SA         | 42Alloy           | Sn               | ○                               |         | High melting temperature type solder. (Pb85%)                    | 311 mg                  |
|                        | RX-8581SA         | 42Alloy           | Sn or Sn-Ag      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 289 mg                  |
|                        | RX-8581JE         | 42 Alloy          | Sn-Ag            | ○                               |         | High melting temperature type solder. (Pb85%)                    | 111 mg                  |
|                        | RX-8581NB         | Cu Alloy          | Sn or Sn-Ag      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 84 mg                   |
|                        | RA-8581SA         | 42Alloy           | Sn-Ag            | ○                               |         | High melting temperature type solder. (Pb85%)                    | 289 mg                  |
|                        | RX-8731LC         | 42 Alloy          | Sn or Sn-Ag      | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 25 mg                   |
|                        | RX-8801SA         | 42Alloy           | Sn               | ○                               |         | High melting temperature type solder. (Pb85%)                    | 313 mg                  |
|                        | RTC-7301SF        | Cu Alloy          | Sn or Sn-Ag      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 233 mg                  |
|                        | RTC-7301DG        | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 1082 mg                 |
|                        | RTC-62423         | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 656 mg                  |
|                        | RTC-72423         | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 661 mg                  |
|                        | RTC-62421 / 72421 | 42 Alloy          | Sn or Sn-Bi      | ○                               |         | High melting temperature type solder. (Pb85%)                    | 1090 mg                 |
| Crystal Filter (MCF)   | HF-232A/233A      | W                 | Au               | ○                               | ○       |                                                                  | 16 mg                   |
|                        | HF-362A/363A      | W                 | Au               | ○                               | ○       |                                                                  | 25 mg                   |
|                        | HF-372A/373A      | W                 | Au               | ○                               | ○       |                                                                  | 42 mg                   |
|                        | HF-734            | W                 | Au               | ○                               | ○       |                                                                  | 129 mg                  |
|                        | HF-J14A           | W                 | Au               | ○                               |         |                                                                  | 1025 mg                 |
|                        | HF-S14A           | W                 | Au               | ○                               |         |                                                                  | 3690 mg                 |
|                        | MF-372A/373A      | W                 | Au               | ○                               | ○       |                                                                  | 42 mg                   |
|                        | MF-722A/723A      | W                 | Au               | ○                               | ○       |                                                                  | 150 mg                  |
| SAW Filter             | MF-734A           | W                 | Au               | ○                               | ○       |                                                                  | 124 mg                  |
|                        | TF-330A/C         | W                 | Au               | ○                               | ○       |                                                                  | 33 mg                   |
|                        | FF-32N            | W                 | Au               | ○                               | ○       |                                                                  | 49 mg                   |
|                        | FF-555/FF-585     | W                 | Au               | ○                               | ○       |                                                                  | 112 mg                  |
|                        | TQS-570AA-7R      | W                 | Au               | ○                               |         |                                                                  | 33 mg                   |
|                        | TQS-566AA-7R      | W                 | Au               | ○                               | ○       |                                                                  | 33 mg                   |
|                        | TQS-557AA-7R      | W                 | Au               | ○                               | ○       |                                                                  | 34 mg                   |
|                        | TQS-949AD-7G      | W                 | Au               | ○                               | ○       |                                                                  | 18 mg                   |
| Sensor                 | TQS-471BB-7R      | W                 | Au               | ○                               | ○       |                                                                  | 30 mg                   |
|                        | TQS-477AA-7R      | W                 | Au               | ○                               | ○       |                                                                  | 35 mg                   |
|                        | TQS-472BA-7R      | W                 | Au               | ○                               |         |                                                                  | 170 mg                  |
|                        | XV-8000LK         | 42 Alloy          | Sn-Ag            | ○                               | ○       |                                                                  | 191 mg                  |
|                        | XV-3500CB         | W                 | Au               | ○                               | ○       |                                                                  | 65 mg                   |
|                        | XV-8000CB         | W                 | Au               | ○                               | ○       |                                                                  | 65 mg                   |
|                        | XV-8100CB         | W                 | Au               | ○                               | ○       |                                                                  | 65 mg                   |
|                        | HTS-206           | Fe-Ni-Co          | Sn-Pb            | ○                               |         | High melting temperature type solder. (Pb85%)                    | 54 mg                   |
|                        | TSU-20G           | Cu                | Sn               | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 200 g                   |
|                        | TSU-70G           | Cu                | Sn               | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 200 g                   |
|                        | TSU-100G          | Cu                | Sn               | ○                               |         | Contains Pb in sealing glass exempted by RoHS directive.         | 200 g                   |



## HANDLING PRECAUTIONS

When using Epson Toyocom products, it is essential to observe the operating conditions specified in their respective specifications or catalogs.

### Common points for all products

#### 1. Shock resistance

Epson Toyocom's crystal products are designed to resist physical shocks, but crystal products may be damaged under some conditions, such as dropping from desks or receiving shocks during mounting. Please be sure to re-check the characteristics if product has received any shocks.

#### 2. Soldering heat resistance

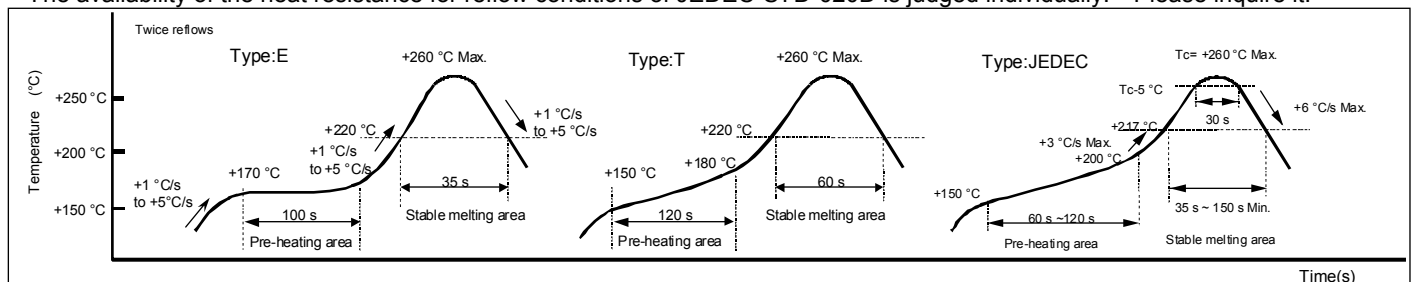
Epson Toyocom's crystal products except SMD products use solder having a +180°C to +200°C melting point. Heating up the package more than +150°C may deteriorate the characteristics or damage the products. If the crystal products need to be soldered at temperature of more than +150°C, SMD products are recommended. Using higher temperatures over the following reflow conditions to crystal products, even SMD products, may cause the characteristics to deteriorate. The reflow conditions within following profile is recommended. Always check the soldering temperature and time before mounting these products. Also, please check them again when the mounting conditions are changed. Please contact us for inquiries about heat-resistance if crystal products need to be soldered over the following profile.

(1) Cylinder products and DIP products

| Model                                                                                               | Soldering conditions                                                                                                                    |
|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| [ Cylinder ] C-TYPE, C-2-TYPE, C-4-TYPE, HTS-206                                                    | +280 °C or under @ Max. 5 s.<br>Do not heat the package at more than +150 °C.                                                           |
| [ Cylinder ] CA-301<br>[ DIP ] SG-51 / 531, SG-8002DB / DC, SG-8003DC<br>RTC-62421 / 72421 / 7301DG | +260 °C or under @ Max. 10 s.<br>Do not heat the package at more than +150 °C.                                                          |
| [ DIP ] TCO-6831 / TCO-676 / TCO-679<br>TCO-6920A / OX-6601DL                                       | Temperature in point of soldering iron<br>+370 °C or under @ Max. 5 s. (Each terminal)<br>Do not heat the package at more than +150 °C. |

(2) SMD products Reflow profile (example)

The availability of the heat resistance for reflow conditions of JEDEC-STD-020D is judged individually. Please inquire it.



Please make temperature rate as gentle a curve as possible. Also, if the package is cellular, the possibility of cracking is inevitable, so please store it for a short duration and take measures to protect product from dampness when you store it in high humidity.

|                           | Model      | Type:E | Type:T | Type:JEDEC        | Remarks    |
|---------------------------|------------|--------|--------|-------------------|------------|
| kHz Range<br>Crystal unit | FC-12M     | ○      | —      | Please contact us |            |
|                           | FC-125     | ○      | —      | —                 |            |
|                           | FC-13E     | ○      | —      | —                 |            |
|                           | FC-13F     | ○      | —      | Please contact us |            |
|                           | FC-135     | ○      | —      | Please contact us |            |
|                           | FC-145     | ○      | —      | Please contact us |            |
|                           | FC-255     | ○      | —      | Please contact us |            |
|                           | MC-146     | ○      | —      | Please contact us |            |
|                           | MC-156     | ○      | —      | Please contact us |            |
|                           | MC-306     | ○      | —      | ○                 |            |
|                           | MC-30A     | ○      | —      | ○                 |            |
|                           | MC-405/406 | ○      | —      | ○                 |            |
| MHz Range<br>Crystal unit | FA-128     | ○      | ○      | ○                 |            |
|                           | FA-20H     | ○      | ○      | ○                 |            |
|                           | FA-23A     | ○      | —      | ○                 |            |
|                           | FA-238V    | ○      | —      | ○                 |            |
|                           | FA-238     | ○      | —      | ○                 |            |
|                           | TSX-3225   | —      | ○      | ○                 |            |
|                           | TSX-4025   | —      | ○      | ○                 |            |
|                           | TSX-5032   | —      | ○      | ○                 |            |
|                           | FA-365     | ○      | —      | ○                 |            |
|                           | MA-306     | ○      | —      | Please contact us |            |
|                           | MA-406     | ○      | —      | ○                 | Tc=+250 °C |
|                           | MA-505/506 | ○      | —      | ○                 | Tc=+250 °C |
|                           | FH-33H     | —      | ○      | ○                 |            |
|                           | NS-21R     | —      | —      | ○                 |            |
|                           | NS-32R     | ○      | —      | ○                 |            |
|                           | FS-335     | ○      | —      | ○                 |            |
| SAW<br>Resonator          | FS-555     | ○      | —      | Please contact us |            |
|                           | FS-585     | ○      | —      | Please contact us |            |



|                 | Model                | Type:E | Type:T | Type:JEDEC        | Remarks    |
|-----------------|----------------------|--------|--------|-------------------|------------|
| SPXO            | SG-3030 series       | ○      | —      | Please contact us |            |
|                 | SG-3040 series       | ○      | —      | Please contact us |            |
|                 | SG-150S*E            | —      | —      | ○                 |            |
|                 | SG-211S*E            | —      | —      | ○                 |            |
|                 | SG-210 series        | ○      | —      | ○                 |            |
|                 | SG-310 series        | ○      | —      | ○                 |            |
|                 | SG-550 series        | ○      | —      | ○                 |            |
|                 | TCO-710x series      | —      | ○      | ○                 |            |
|                 | SG-710 series        | ○      | —      | ○                 |            |
|                 | SG-770 series        | —      | —      | ○                 |            |
|                 | TCO-708x series      | —      | ○      | ○                 |            |
|                 | SG-645 series        | ○      | —      | —                 |            |
|                 | SG-636 series        | ○      | —      | Please contact us | Tc=+250 °C |
|                 | SG-615 series        | ○      | —      | ○                 | Tc=+245 °C |
| Programmable    | SG-8003BA            | —      | —      | ○                 |            |
|                 | SG-8003CE            | —      | —      | ○                 |            |
|                 | SG-8003LB            | —      | —      | ○                 |            |
|                 | SG-8003CA            | —      | —      | ○                 |            |
|                 | SG-8003JF            | —      | —      | ○                 |            |
|                 | SG-8003JC            | —      | —      | ○                 | Tc=+250 °C |
|                 | SG-8003JA            | —      | —      | ○                 | Tc=+245 °C |
|                 | SG-8002CE            | ○      | —      | ○                 |            |
|                 | SG-8002LB            | ○      | —      | ○                 |            |
|                 | SG-8002JF            | ○      | —      | —                 |            |
|                 | SG-8002CA            | ○      | —      | ○                 |            |
|                 | SG-8002JC            | ○      | —      | Please contact us | Tc=+250 °C |
|                 | SG-8002JA            | ○      | —      | ○                 | Tc=+245 °C |
| Spread Spectrum | SG-9001LB            | ○      | —      | ○                 |            |
|                 | SG-9001CA            | ○      | —      | ○                 |            |
|                 | SG-9001JC            | ○      | —      | Please contact us | Tc=+250 °C |
| SAW             | XG-1000CA            | ○      | —      | ○                 |            |
|                 | XG-1000CB            | ○      | —      | ○                 |            |
|                 | EG-2021CA series     | ○      | —      | ○                 |            |
|                 | EG-2001CA series     | ○      | —      | ○                 |            |
|                 | EG-2002CA series     | ○      | —      | ○                 |            |
|                 | EG-2121CA series     | ○      | —      | ○                 |            |
|                 | EG-2102CA series     | ○      | —      | ○                 |            |
|                 | EG-2101CA series     | ○      | —      | ○                 |            |
| High-Stability  | HG-2150CA series     | ○      | —      | ○                 |            |
|                 | HG-8002JA series     | ○      | —      | ○                 | Tc=+245 °C |
|                 | TCO-391J             | —      | ○      | ○                 | Tc=+245 °C |
|                 | TCO-3100 series      | —      | ○      | ○                 | Tc=+245 °C |
| Multi-Output    | MG-5020JE            | ○      | —      | Please contact us |            |
| VCXO            | VG-4231CE            | ○      | —      | ○                 |            |
|                 | VG-4231CB            | —      | —      | ○                 |            |
|                 | VG-4531CB            | —      | —      | ○                 |            |
|                 | VG-4231CA            | ○      | —      | ○                 |            |
|                 | VG-4501CA            | —      | —      | ○                 |            |
|                 | VG-4502CA            | —      | —      | ○                 |            |
|                 | VG-4511CA            | —      | —      | ○                 |            |
|                 | VG-1201CA            | ○      | —      | ○                 |            |
|                 | TCO-291J             | —      | ○      | ○                 | Tc=+245 °C |
|                 | TCO-294J             | —      | ○      | ○                 |            |
|                 | TCO-2152             | —      | ○      | ○                 |            |
|                 | TCO-2000 series      | —      | ○      | ○                 | Tc=+245 °C |
|                 | TCO-2100 series      | —      | ○      | ○                 | Tc=+245 °C |
| TCXO            | TG-3530SA            | ○      | —      | Please contact us | Tc=+250 °C |
|                 | TG-5021BA            | ○      | ○      | Please contact us |            |
|                 | TG-5005CG            | —      | ○      | Please contact us |            |
|                 | TG-5010CG            | —      | ○      | Please contact us |            |
|                 | TG-5005CE            | —      | ○      | Please contact us |            |
|                 | TG-5010LH            | ○      | —      | Please contact us |            |
|                 | TCO-5860 series      | —      | ○      | Please contact us |            |
| OCXO            | TCO-5060/5160 series | —      | ○      | Please contact us |            |
|                 | OX-6501GG series     | —      | —      | ○                 | Tc=+245 °C |
| Sensor          | XV-8000LK            | ○      | —      | ○                 | Tc=+250 °C |
|                 | XV-3500CB            | ○      | —      | ○                 |            |
|                 | XV-8000CB            | ○      | —      | ○                 |            |
|                 | XV-8100CB            | ○      | —      | ○                 |            |



|                        | Model         | Type:E | Type:T | Type:JEDEC        | Remarks    |
|------------------------|---------------|--------|--------|-------------------|------------|
| Real Time Clock Module | RX-4045SA     | ○      | —      | Please contact us | Tc=+250 °C |
|                        | RX-4045NB     | ○      | —      | Please contact us |            |
|                        | RX-4581NB     | ○      | —      | Please contact us |            |
|                        | RTC-9701JE    | ○      | —      | Please contact us |            |
|                        | RTC-4701JE    | ○      | —      | Please contact us |            |
|                        | RTC-4574SA    | ○      | —      | Please contact us | Tc=+250 °C |
|                        | RTC-4574JE    | ○      | —      | Please contact us |            |
|                        | RTC-4574NB    | ○      | —      | Please contact us |            |
|                        | RX-4574LC     | ○      | —      | Please contact us |            |
|                        | RA-4574SA     | ○      | —      | Please contact us | Tc=+250 °C |
|                        | RTC-4543SA    | ○      | —      | Please contact us | Tc=+250 °C |
|                        | RTC-4543SB    | ○      | —      | Please contact us |            |
|                        | RX-4575LC     | ○      | —      | ○                 |            |
|                        | RX-4571LC     | ○      | —      | ○                 |            |
|                        | RX-4571NB     | ○      | —      | ○                 |            |
|                        | RX-4571SA     | ○      | —      | ○                 | Tc=+250 °C |
|                        | RA-4565SA     | ○      | —      | ○                 | Tc=+250 °C |
|                        | RX-4801SA     | ○      | —      | ○                 | Tc=+250 °C |
|                        | RX-8025SA     | ○      | —      | Please contact us | Tc=+250 °C |
|                        | RX-8025NB     | ○      | —      | Please contact us |            |
|                        | RTC-8564JE    | ○      | —      | Please contact us |            |
|                        | RTC-8564NB    | ○      | —      | Please contact us |            |
|                        | RX-8564LC     | ○      | —      | Please contact us |            |
|                        | RA-8565SA     | ○      | —      | ○                 | Tc=+250 °C |
|                        | RX-8571LC     | ○      | —      | ○                 |            |
|                        | RX-8571NB     | ○      | —      | ○                 |            |
|                        | RX-8571SA     | ○      | —      | ○                 | Tc=+250 °C |
|                        | RX-8581SA     | ○      | —      | Please contact us | Tc=+250 °C |
|                        | RX-8581JE     | ○      | —      | Please contact us |            |
|                        | RA-8581SA     | ○      | —      | Please contact us | Tc=+250 °C |
|                        | RX-8731LC     | ○      | —      | ○                 |            |
|                        | RX-8801SA     | ○      | —      | ○                 | Tc=+250 °C |
|                        | RTC-7301SF    | ○      | —      | Please contact us |            |
|                        | RTC-62423     | ○      | —      | Please contact us | Tc=+245 °C |
|                        | RTC-72423     | ○      | —      | Please contact us | Tc=+245 °C |
| Filter                 | HF-232A/233A  | —      | ○      | ○                 |            |
|                        | HF-362A/363A  | —      | ○      | ○                 |            |
|                        | HF-372A/373A  | —      | ○      | ○                 |            |
|                        | HF-734        | —      | ○      | ○                 |            |
|                        | HF-J14A       | —      | ○      | ○                 | Tc=+245 °C |
|                        | HF-S14A       | —      | ○      | ○                 | Tc=+245 °C |
|                        | MF-372A/373A  | —      | ○      | ○                 |            |
|                        | MF-722A/723A  | —      | ○      | ○                 |            |
|                        | MF-734A       | —      | ○      | ○                 |            |
|                        | TF-330A/C     | —      | —      | ○                 |            |
|                        | FF-32N        | ○      | —      | Please contact us |            |
|                        | FF-555/FF-585 | ○      | —      | Please contact us |            |
|                        | TQS-557AA-7R  | —      | ○      | ○                 |            |
|                        | TQS-949AD-7G  | —      | ○      | ○                 |            |
|                        | TQS-471BB-7R  | —      | ○      | ○                 |            |
|                        | TQS-477AA-7R  | —      | ○      | ○                 |            |
|                        | TQS-472BA-7R  | —      | ○      | ○                 |            |

### 3. Mounting precautions

#### Shocks by auto mounting

Shocks caused by auto mounting and vacuuming may deteriorate the characteristics and affect the products. Please set the mounting conditions to minimize the shocks as much as possible, and be sure that there is no affect on the characteristics before mounting. Please review the conditions after the conditions are changed. Also please be sure that crystal products don't hit machines or other electric boards, etc. before or after mounting.

#### (1) a) Ceramic package products and SON products

Bending the board after soldering ceramic package products and SON products (MC-146,RTC-\*\*\*\*NB,RX-\*\*\*\*NB) may cause peeling off portions of soldering or package cracks by mechanical stress. Particularly, in the case of cutting boards after soldering these products, please be sure to layout the crystal on a less stressed location and use less stressed cutting method.

#### b) Ceramic package products

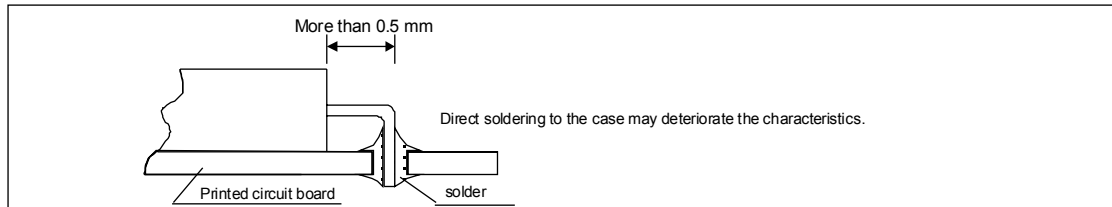
In the case of soldering ceramic package products on a different expansion-coefficient board (ex. Epoxy Glass),soldering crack at the foot pattern would be expected under repeated temperature changes for a long period. Under these conditions, be sure to check the solderability in advance.



## (2) Cylinder products

Bending the lead on the glass or pulling the lead strongly may cause cracking of the hermetic seal glass at the root of the lead and may cause the airtightness and the characteristics to deteriorate. When the lead of crystal products need to be bent as in the figure below, leave more than 0.5 mm of lead from the case and hold the lead to prevent the lead from cracks. When the lead needs to be repaired, do not pull it, and hold the bent part to correct it. Giving undue pressure on this portion of hermetic seal may cause the airtightness to deteriorate. Please avoid applying pressure. Gluing the case of products on the electric board is recommended to prevent the airtightness from deteriorating.

### ● Installation example



## (3) DIP products

Deformed leads cannot be inserted into board holes. Avoid applying stress sufficient to deform leads.

## (4) SOJ Products and SOP products

Please avoid applying stress sufficient to deform the leads.

Deformed leads may cause incorrect soldering.

Particularly SOP products need to be handled with the greatest care.

## 4. Ultrasonic cleaning

- Products using AT-cut crystal and SAW resonator/filter can be cleaned by ultrasonic methods. But under some conditions, the crystal characteristics may be affected and internal wiring may be damaged. Please be sure to check the suitability of your system in advance.
- Products using tuning-fork crystals and gyro sensors cannot be guaranteed if cleaned using ultrasonic methods, because crystal may be destroyed.
- Do not wash open-type products.
- With washable products, avoid the use of cleaners or solvents that may negatively affect the product.

## 5. The affect of mechanical vibration

While there is any given shock or mechanical vibration periodically to crystal products, such as, a piezo sounder, a piezo buzzer, and speaker, to crystal products, output frequency and amplitude can be changed. Especially the quality of telecommunication equipment could be affected by this phenomenon. Although Epson Toyocom's crystal products are designed to minimize the effect of mechanical vibration, Epson Toyocom recommends to check them in advance and then follow the Mounting guidelines as below.

### ● Mounting guidelines

- (1) Ideally, the mechanical buzzer source should be mounted on a separate PCB from the crystal device.
- (2) It is advisable to use cushion or cutting PCB, if you mount on same PCB.
- (3) Traveling mechanical vibration differs when applied to the PCB only vs. inside the body. Last of all, it is advisable to conform to inside body characteristics.

## 6. Storage

- (1) Storing the crystal products under higher or lower temperature or high humidity for a long period may affect frequency stability or solderability. Please store the crystal products at the normal temperature and humidity, avoid storing them for a long period and mount them as soon as possible after unpacking.

### Normal temperature and humidity:

Temp, +15 °C to +35 °C, humidity 25 % RH to 85 % RH (refer to the standard conditions of test site JIS Z-8703)

- (2) Please carefully handle the inner and outer boxes and reel. External pressure may cause deformation of reel and tape.

## 7. Radiation

Exposure to radiation can cause deterioration in performance, so avoid irradiation.

## 8. Chemicals / pH

Do not use or store the product in a pH range that may cause corrosion or dissolution of the materials or packaging.

## 9. Adhesive

Do not use an adhesive that may cause corrosion of the packing materials, terminals, components, glass materials, and vapor deposited materials used in the products.

(For example, a chlorine-based adhesive may corrode the metal parts "lid" of a crystal unit to diminish the hermetic qualities, lowering the performance.)

## 10. Halogen Compound

Do not use products in halogen gas. Even a slight amount of halogen gas, such as that found in chlorine gas in the air or in metal parts used in the package, may corrode. Also, do not use any resin that emits halogen gas.





## ■Crystal unit / Resonator

### 1. Drive level

Applying excessive drive level to the crystal units may cause deterioration of characteristics or damage. Circuit design must be such as to maintain a proper drive level.(refer to page “Drive level”)

### 2. Negative resistance

Unless adequate negative resistance is allocated in the oscillation circuit, oscillation or oscillation start up time may increase (refer to page “Allowance for Oscillation”).

### 3. Load capacitance

Differences in the load capacitance in the oscillation circuit may result in deviations in the oscillation frequency from the desired frequency. Attempting to tune by force may merely cause abnormal oscillation. Before use, please specify the load capacitance of the oscillation circuit.(refer to page “Load capacitance” )

## ■Crystal Oscillator and real time clock module

All crystal oscillators and real time clock modules are provided with a CMOS IC. Please pay attention to the following points.

### 1. Static electricity

Although an anti-static-electricity protection circuit is provided in the circuit, excessive levels of static electricity may damage the IC. Choose conductive materials for containers and packing material. Use a soldering gun and a measuring circuit free from high-voltage leakage and provide grounding connection when working with them.

### 2. Noise

Applying excessive level of extraneous noise to power source or input terminal may cause latch up or spurious phenomenon, which results in malfunction and breakdown.  
To maintain stable operation, provide by-pass capacitor with more than 0.1  $\mu$ F at a location as near as possible to the power source terminal of the crystal products (between Vcc - GND). Do not permit any objects which emit a high level of noise in a location near the crystal oscillator.

### 3. Power supply line

Line impedance of a power supply should be as low as possible.

### 4. Output Load

It is recommended that output load is installed as close as possible to an oscillator (within 20 mm).

### 5. Treatment of unused input terminals

Unused pins that are left open may collect noise, thereby resulting in malfunction. Also, power consumption may increase when both P-channel and N-channel are turned on, therefore connect unused input terminals to Vcc or GND.

### 6. Heat impact

Repeated large changes in temperature may degrade the characteristics of a deteriorated crystal unit and cause breakage of wires inside the plastic mold. This must be avoided.

### 7. Mounting direction

Incorrect mounting of the oscillator may cause malfunction and breakdown, so please check the mounting direction when installing.

### 8. Power on

It is not recommended to power on from intermediate electric potential and / or extreme fast power on. Powering on under such conditions may cause no oscillation and / or malfunction.

## ■Optical device

### 1.Chemicals

Do not use chemicals that may negatively affect the glass materials,vapor deposited materials,or adhesives used in the product.





# ■ PRECAUTIONS IN DESIGNING OSCILLATION CIRCUITS

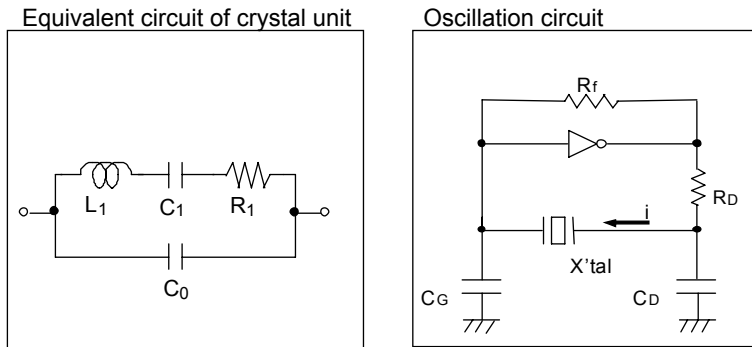
## 1. Drive level

Drive level denotes electric power required to oscillate a crystal unit, which can be calculated using the following formula.

$$\text{Drive level (P)} = i^2 \cdot R_e$$

Where  $i$  stands for current to pass in the crystal unit,  $R_e$  for effective resistance of crystal unit, and  $R_e = R_1(1 + C_0/C_L)^2$ .

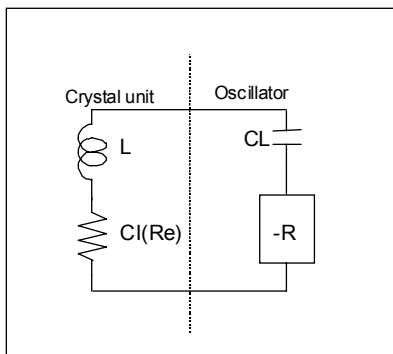
If the Drive level (P) exceeds the specified level, oscillation frequency will shift. This occurs because an excessive level of power causes stress for the crystal and, consequently, temperature rises. If excessive drive level of power is applied to the crystal unit, this may deteriorate or damage the characteristics.



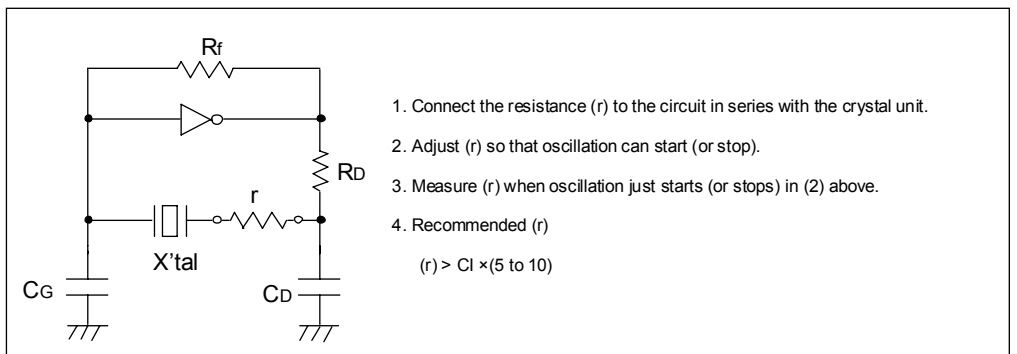
## 2. Allowance for oscillation

Unless adequate negative resistance is allocated in the oscillation circuit, oscillation start-up time may be increased, or No oscillation may occur. In order to avoid this, provide enough negative resistance in the circuitry design.

### ● Crystal unit and Oscillator



### ● Check of Negative resistance

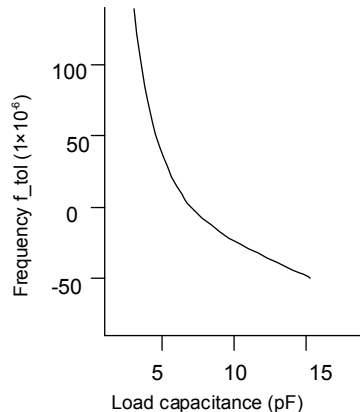


## 3. Load capacitance

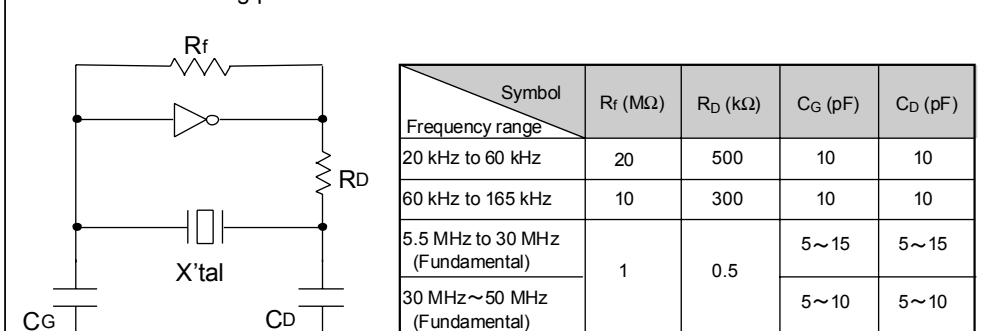
Differences in the load capacitance of the oscillation circuit may result in a different oscillation frequency from the desired one, as shown in the figure below. Approximate expression of the load capacitance of the circuit  $CL \cong C_G \times C_D / (C_G + C_D) + C_s$ .

Where  $C_s$  Stands for stray Capacity of the circuit.

### ● Frequency and load capacitance characteristics



### ● Reference for setting parameters of oscillation circuit



IC: equivalent to TC74HCU04 (Unbuffer)

IC: equivalent to TC74VHCU04 (Unbuffer) (30 MHz to 50 MHz)

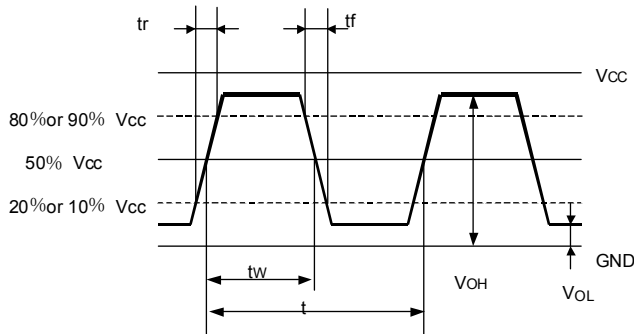
(TC74HCU04 and TC74VHCU04 are product number of Toshiba Corp.)



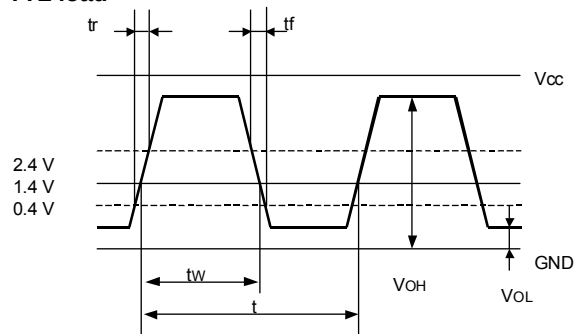
# OUTPUT WAVEFORM AND TEST CIRCUIT

## 1. Timing chart

### (1) CMOS load



### (2) TTL load



NOTE : SYM= $t_w/t \times 100\%$

## 2. Test conditions

### (1) Supply voltage

- More than 150  $\mu s$  until voltage level reaches 90 % from 0 %.
- Supply voltage impedance is less than 2  $\Omega$  of resistance.

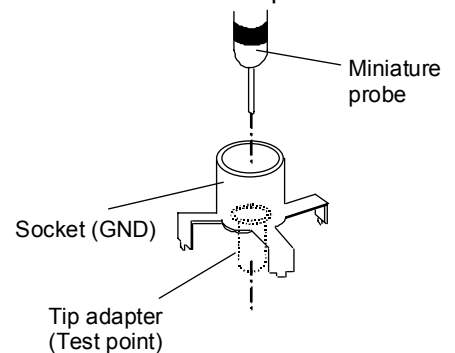
### (2) Oscilloscope

- Input capacitance of less than 15 pF
- Frequency range of 5 times or more of measurements frequency.
- Earth lead of the probe should be as short as possible.
- Probe impedance when measuring frequency is to be more than 1 M $\Omega$ . Simultaneous measurement is possible as the wave form passes from the amplifier stage of an oscilloscope.

### (3) MISCELLANEOUS

- CL includes the probe capacitance.
- Ammeter with small internal impedance should be used.
- To observe wave form, please use a miniature socket.
- (do not use a long ground wire of the probe.)

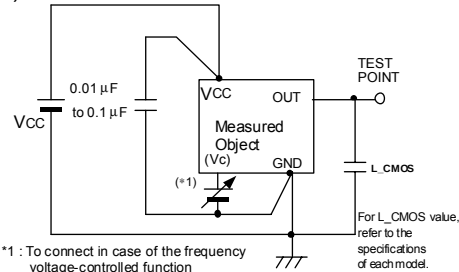
### Miniature socket parts



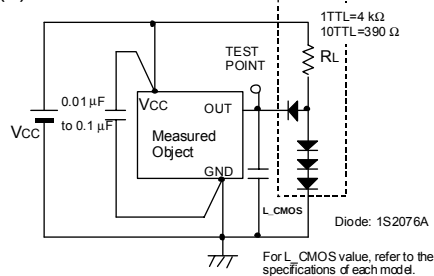
## 3. Test circuit

### SG/EG/MG/HG/VG series

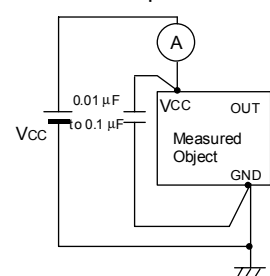
#### (1) CMOS load



#### (2) TTL load



#### (3) Current consumption



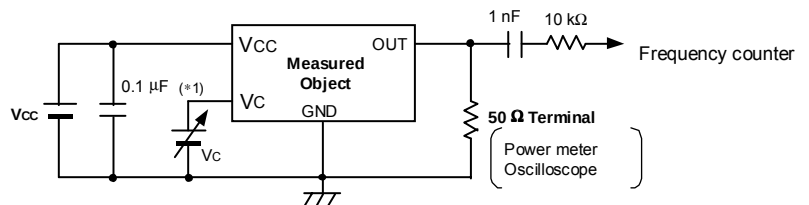
### TCO-\*\*\*\*series

\*1 : To connect in case of the frequency voltage-controlled function

#### (1) 50 $\Omega$ load

##### Model:

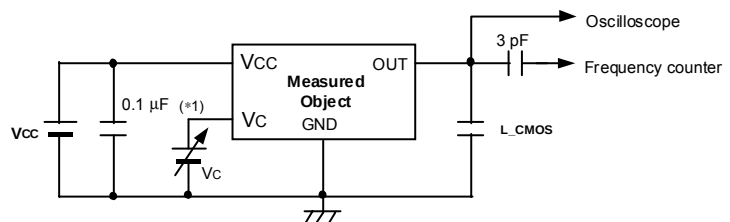
TCO-294J  
TCO-6920A  
TCO-291J  
TCO-391J



#### (2) CMOS load-1

##### Model:

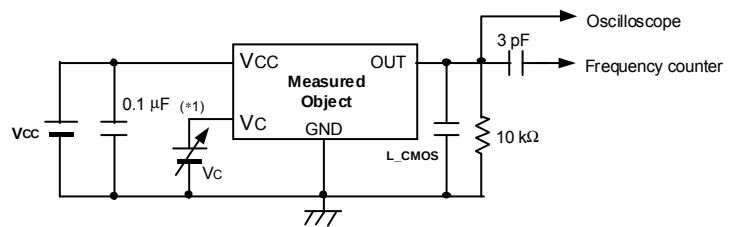
TCO-2003A      TCO-7116X1Z4  
TCO-2004A      VG-4501CA  
TCO-2103A      TCO-710x series  
TCO-2104A      TCO-5060/5160 series  
TCO-2107      TCO-708\*X1A series





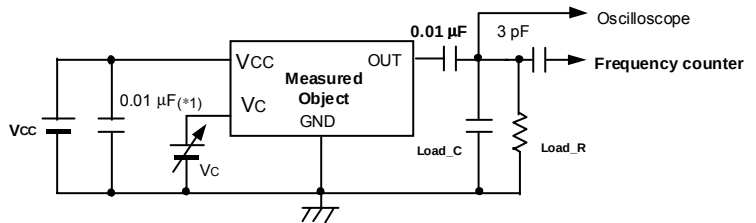
## (3) CMOS load-2

Model:  
TCO-6602  
TCO-676  
TCO-679



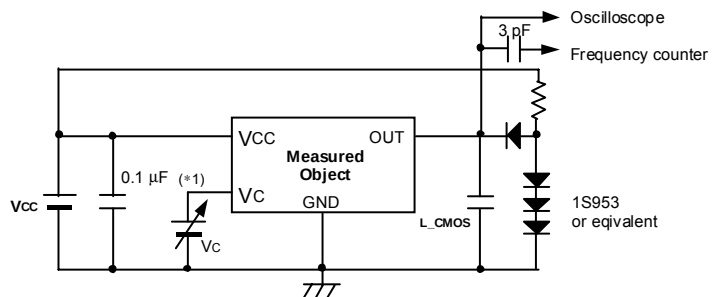
## (4) Resistance, Capacity load

Model:  
TCO-5860 series  
TG-5010CG  
TG-5010LH  
TG-5005CE  
TG-5005CG  
TG-5021BA



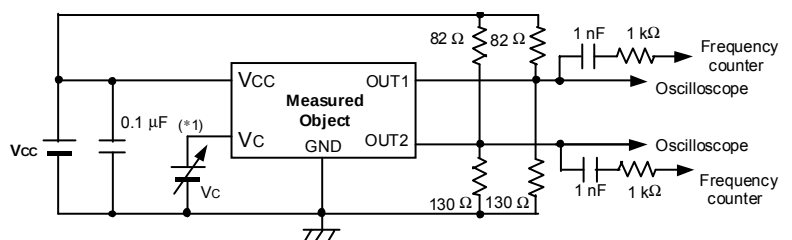
## (5) TTL load

Model:  
TCO-2001A  
TCO-2002A  
TCO-2101A  
TCO-2102A  
TCO-2106  
TCO-6730  
TCO-708\*A1A series



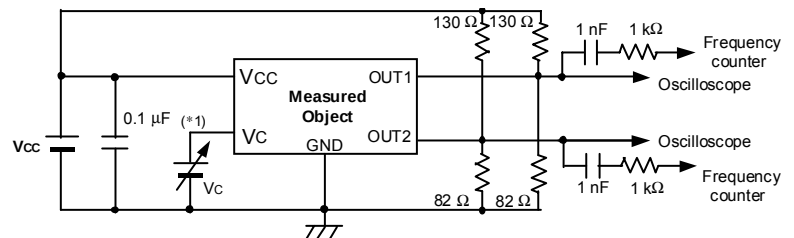
## (6) PECL load

Model:  
TCO-2112  
TCO-3112



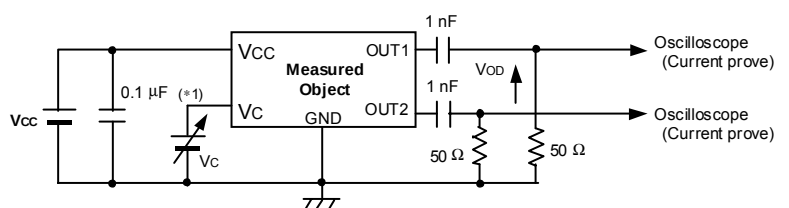
## (7) LV-PECL load

Model:  
TCO-2111  
TCO-2131  
TCO-2152  
TCO-3111  
TCO-3131



## (8) LVDS load

Model:  
TCO-2114  
TCO-3114





## STANDARD PACKING SPECIFICATIONS

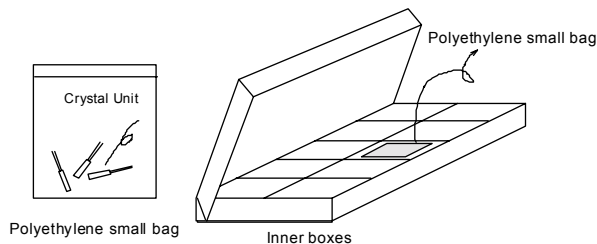
For SMD products, standard packing quantity is specified as below table. Please order in accordance with packing quantity.

## 1. Cylinder

Cylinder products are packed in vinyl bags per lot of 250 to 1000pcs.

From 1 to 20 bags are then placed in inner boxes to make a lot.

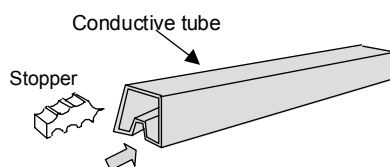
Inner boxes are then placed in cartons for shipment. ( the quantity varies with the model.)



| Model                                                         | Quantity             |
|---------------------------------------------------------------|----------------------|
| C-001R                                                        | 250 pcs / vinyl bags |
| C-2-TYPE<br>C-4-TYPE<br>C-002RX<br>C-004R<br>C-005R<br>CA-301 | 500 pcs / vinyl bags |

## 2. DIP

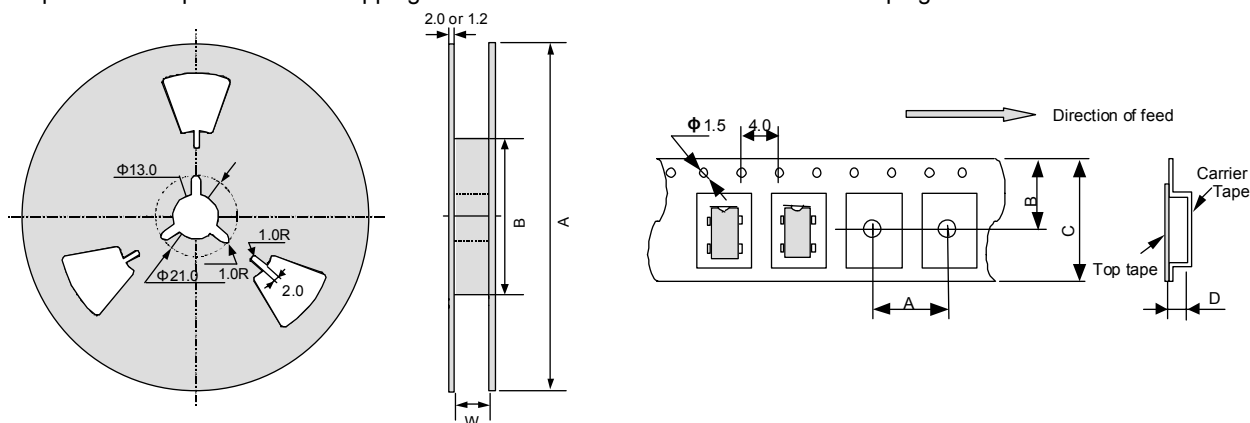
DIP products are placed into antistatic IC tubes and packed into boxes for shipment.



| Model                                                      | Quantity      |
|------------------------------------------------------------|---------------|
| SG-531<br>SG-8002/8003DC                                   | 35 pcs / tube |
| SG-51<br>SG-8002DB<br>RTC-62421<br>RTC-72421<br>RTC-7301DG | 25 pcs / tube |

## 3. SMD

SMD products are packed in the shipping carton as below table in accordance with taping standards EIA-481 and IEC-60286 .



## STANDARD PACKING QUANTITY and dimension (Unit:mm)

## ●Crystal Unit / Resonator

| Model               | Quantity<br>(pcs/Reel) | Reel dimension |             |      | Career Tape dimension |       |      |      | Direction of feed<br>(L=left direction) |
|---------------------|------------------------|----------------|-------------|------|-----------------------|-------|------|------|-----------------------------------------|
|                     |                        | A              | B           | W    | A                     | B     | C    | D    |                                         |
| FC-12M              | 3000                   | Φ180           | Φ60         | 9.0  | 4.0                   | 5.25  | 8.0  | 0.75 | L                                       |
| FC-125              | 3000                   | Φ180           | Φ60         | 9.0  | 4.0                   | 5.25  | 8.0  | 0.75 | L                                       |
| FC-13E              | 3000                   | Φ180           | Φ60         | 13.0 | 4.0                   | 7.25  | 12.0 | 0.7  | L                                       |
| FC-13F              | 3000                   | Φ180           | Φ60         | 13.0 | 4.0                   | 7.25  | 12.0 | 0.7  | L                                       |
| FC-135              | 3000                   | Φ180           | Φ60         | 13.0 | 4.0                   | 7.25  | 12.0 | 1.0  | L                                       |
| FC-145              | 3000                   | Φ180           | Φ60         | 13.0 | 4.0                   | 7.25  | 12.0 | 1.0  | L                                       |
| FC-255              | 3000                   | Φ330           | Φ80 or Φ100 | 13.5 | 8.0                   | 7.25  | 12.0 | 1.1  | L                                       |
| MC-146              | 3000                   | Φ330           | Φ80 or Φ100 | 17.5 | 8.0                   | 9.25  | 16.0 | 1.7  | L                                       |
| MC-156              | 3000                   | Φ330           | Φ80 or Φ100 | 17.5 | 8.0                   | 9.25  | 16.0 | 1.65 | L                                       |
| FA-128              | 3000                   | Φ180           | Φ60         | 9.0  | 4.0                   | 5.25  | 8.0  | 0.7  | L                                       |
| FA-20H              | 3000                   | Φ180           | Φ60         | 9.0  | 4.0                   | 5.25  | 8.0  | 0.75 | L                                       |
| TSX-3225            | 2000                   | Φ180           | Φ60         | 9.0  | 4.0                   | 5.25  | 8.0  | 1.0  | L                                       |
| FA-238V / 238 / 23A | 3000                   | Φ180           | Φ60         | 9.0  | 4.0                   | 5.25  | 8.0  | 1.05 | L                                       |
| TSX-4025            | 2000                   | Φ180           | Φ60         | 13.0 | 4.0                   | 7.25  | 12.0 | 0.9  | L                                       |
| TSX-5032            | 2000                   | Φ180           | Φ60         | 13.0 | 8.0                   | 7.25  | 12.0 | 1.0  | L                                       |
| FA-365              | 1000                   | Φ180           | Φ60         | 13.0 | 8.0                   | 7.25  | 12.0 | 1.6  | L                                       |
| MC-306/30A          | 3000                   | Φ330           | Φ80 or Φ100 | 17.5 | 8.0                   | 9.25  | 16.0 | 2.7  | L                                       |
| MC-405/406          | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 8.0                   | 9.25  | 16.0 | 3.8  | L                                       |
| MA-306              | 3000                   | Φ330           | Φ80 or Φ100 | 17.5 | 8.0                   | 9.25  | 16.0 | 2.7  | L                                       |
| MA-406              | 1000                   | Φ330           | Φ80 or Φ100 | 25.5 | 12.0                  | 13.25 | 24.0 | 4.0  | L                                       |
| MA-505/506          | 1000                   | Φ330           | Φ80 or Φ100 | 25.5 | 12.0                  | 13.25 | 24.0 | 4.8  | L                                       |
| FH-33H              | 1000                   | Φ180           | Φ60         | 13.0 | 8.0                   | 7.25  | 12.0 | 1.35 | L                                       |
| NS-21R              | 3000                   | Φ180           | Φ60         | 9.0  | 4.0                   | 5.25  | 8.0  | 1.15 | Individual regulations                  |
| NS-32R              | 4000                   | Φ330           | Φ80 or Φ100 | 13.5 | 8.0                   | 7.25  | 12.0 | 1.52 | R                                       |
| FS-335              | 4000                   | Φ330           | Φ80 or Φ100 | 13.5 | 8.0                   | 7.25  | 12.0 | 1.52 | R                                       |
| FS-555              | 4000                   | Φ330           | Φ80 or Φ100 | 13.5 | 8.0                   | 7.25  | 12.0 | 2.0  | R                                       |
| FS-585              | 4000                   | Φ330           | Φ80 or Φ100 | 13.5 | 8.0                   | 7.25  | 12.0 | 2.0  | R                                       |



## ●Crystal Oscillator

| Model               | Quantity<br>(pcs/reel) | Reel dimension |             |      | Career Tape dimension |       |      |      | Direction of feed<br>(L=left direction) |
|---------------------|------------------------|----------------|-------------|------|-----------------------|-------|------|------|-----------------------------------------|
|                     |                        | A              | B           | W    | A                     | B     | C    | D    |                                         |
| SG-3030/3040JC      | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 8.0                   | 9.25  | 16.0 | 3.3  | L                                       |
| SG-3030JF           | 1000                   | Φ254           | Φ100        | 17.5 | 8.0                   | 9.25  | 16.0 | 2.3  | L                                       |
| SG-3030/3040LC      | 2000                   | Φ180           | Φ60         | 13.0 | 4.0                   | 7.25  | 12.0 | 1.45 | L                                       |
| SG-150 series       | 3000                   | Φ180           | Φ60         | 9.0  | 4.0                   | 5.25  | 8.0  | 0.95 | L                                       |
| SG-645 series       | 1000                   | Φ254           | Φ100        | 17.5 | 8.0                   | 9.25  | 16.0 | 2.3  | L                                       |
| SG-636 series       | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 8.0                   | 9.25  | 16.0 | 3.0  | L                                       |
| SG-615 series       | 1000                   | Φ330           | Φ80 or Φ100 | 25.5 | 12.0                  | 13.25 | 24.0 | 4.8  | L                                       |
| SG-210 series       | 3000                   | Φ180           | Φ60         | 9.0  | 4.0                   | 5.25  | 8.0  | 1.15 | L                                       |
| SG-211 series       | 3000                   | Φ180           | Φ60         | 9.0  | 4.0                   | 5.25  | 8.0  | 1.15 | L                                       |
| SG-310 series       | 2000                   | Φ180           | Φ60         | 9.0  | 4.0                   | 5.25  | 8.0  | 1.4  | L                                       |
| TCO-710x series     | 1000                   | Φ180           | Φ60         | 13.0 | 8.0                   | 7.25  | 12.0 | 1.4  | L                                       |
| SG-770 SCD          | 1000                   | Φ180           | Φ60         | 17.0 | 8.0                   | 9.25  | 16.0 | 2.1  | L                                       |
| TCO-708x series     | 1000                   | Φ254           | Φ100        | 17.5 | 8.0                   | 9.25  | 16.0 | 2.1  | L                                       |
| SG-8003BA           | 3000                   | Φ180           | Φ60         | 9.0  | 4.0                   | 5.25  | 8.0  | 0.95 | L                                       |
| SG-8002CE/SG-8003CE | 2000                   | Φ180           | Φ60         | 9.0  | 4.0                   | 5.25  | 8.0  | 1.4  | L                                       |
| SG-8002LB/SG-8003LB | 2000                   | Φ254           | Φ100        | 13.4 | 8.0                   | 7.50  | 12.0 | 1.4  | L                                       |
| SG-8002JF/SG-8003JF | 1000                   | Φ254           | Φ100        | 17.5 | 8.0                   | 9.25  | 16.0 | 2.3  | L                                       |
| SG-8002CA/SG-8003CA | 1000                   | Φ254           | Φ100        | 17.5 | 8.0                   | 9.25  | 16.0 | 2.3  | L                                       |
| SG-8002JC/SG-8003JC | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 8.0                   | 9.25  | 16.0 | 3.3  | L                                       |
| SG-8002JA/SG-8003JA | 1000                   | Φ330           | Φ80 or Φ100 | 25.5 | 12.0                  | 13.25 | 24.0 | 4.8  | L                                       |
| SG-9001LB           | 2000                   | Φ254           | Φ100        | 13.4 | 8.0                   | 7.50  | 12.0 | 1.4  | L                                       |
| SG-9001CA           | 1000                   | Φ254           | Φ100        | 17.5 | 8.0                   | 9.25  | 16.0 | 2.3  | L                                       |
| SG-9001JC           | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 8.0                   | 9.25  | 16.0 | 3.3  | L                                       |
| XG-1000CA           | 1000                   | Φ254           | Φ100        | 17.5 | 8.0                   | 9.25  | 16.0 | 2.3  | L                                       |
| XG-1000CB           | 2000                   | Φ254           | Φ100        | 13.4 | 8.0                   | 7.25  | 12.0 | 1.95 | L                                       |
| EG-2000 series      | 1000                   | Φ254           | Φ100        | 17.5 | 8.0                   | 9.25  | 16.0 | 2.3  | L                                       |
| HG-2150CA           | 1000                   | Φ254           | Φ100        | 17.5 | 8.0                   | 9.25  | 16.0 | 2.3  | L                                       |
| HG-8002JA           | 1000                   | Φ330           | Φ80 or Φ100 | 25.5 | 12.0                  | 13.25 | 24.0 | 4.8  | L                                       |
| TCO-391J            | 1000                   | Φ330           | Φ80         | 25.5 | 16.0                  | 13.25 | 24.0 | 4.2  | L                                       |
| TCO-3100 series     | 700                    | Φ330           | Φ80         | 25.5 | 16.0                  | 13.25 | 24.0 | 5.4  | L                                       |
| MG-5020JE           | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 2.0  | L                                       |

## ●VCXO

|                      |      |      |      |      |      |       |      |     |   |
|----------------------|------|------|------|------|------|-------|------|-----|---|
| VG-4231CE            | 2000 | Φ180 | Φ60  | 9.0  | 4.0  | 5.25  | 8.0  | 1.4 | L |
| VG-4231CB            | 1000 | Φ180 | Φ60  | 13.0 | 8.0  | 7.25  | 12.0 | 1.4 | L |
| VG-4531CB            | 1000 | Φ180 | Φ60  | 13.0 | 8.0  | 7.25  | 12.0 | 1.4 | L |
| TCO-7106X1Z4         | 1000 | Φ180 | Φ60  | 13.0 | 8.0  | 7.25  | 12.0 | 1.4 | L |
| VG-4231CA            | 1000 | Φ254 | Φ100 | 17.5 | 8.0  | 9.25  | 16.0 | 2.3 | L |
| VG-4501CA            | 1000 | Φ180 | Φ60  | 17.0 | 8.0  | 9.25  | 16.0 | 2.1 | L |
| VG-4502CA            | 1000 | Φ180 | Φ60  | 17.0 | 8.0  | 9.25  | 16.0 | 2.1 | L |
| VG-4511CA            | 1000 | Φ180 | Φ60  | 17.0 | 8.0  | 9.25  | 16.0 | 2.1 | L |
| VG-1201CA            | 1000 | Φ254 | Φ100 | 17.5 | 8.0  | 9.25  | 16.0 | 2.3 | L |
| TCO-291J             | 1000 | Φ330 | Φ80  | 25.5 | 16.0 | 13.25 | 24.0 | 4.2 | L |
| TCO-294J             | 500  | Φ330 | Φ80  | 25.5 | 12.0 | 13.25 | 24.0 | 2.8 | L |
| TCO-2152             | 1000 | Φ180 | Φ60  | 19.4 | 8.0  | 9.25  | 16.0 | 2.2 | L |
| TCO-2000/2100 series | 700  | Φ330 | Φ80  | 25.5 | 16.0 | 13.25 | 24.0 | 5.4 | L |

## ●TCXO

|                      |      |      |             |      |      |      |      |      |   |
|----------------------|------|------|-------------|------|------|------|------|------|---|
| TG-3530SA            | 1000 | Φ330 | Φ80 or Φ100 | 17.5 | 12.0 | 9.25 | 16.0 | 3.65 | L |
| TG-5021BA            | 3000 | Φ180 | Φ60         | 9.0  | 4.0  | 5.25 | 8.0  | 0.95 | L |
| TG-5005CG            | 2000 | Φ180 | Φ60         | 9.0  | 4.0  | 5.25 | 8.0  | 1.15 | L |
| TG-5010CG            | 2000 | Φ180 | Φ60         | 9.0  | 4.0  | 5.25 | 8.0  | 1.15 | L |
| TG-5005CE            | 2000 | Φ180 | Φ60         | 9.0  | 4.0  | 5.25 | 8.0  | 1.4  | L |
| TG-5010LH            | 3000 | Φ180 | Φ60         | 9.0  | 4.0  | 5.25 | 8.0  | 1.4  | L |
| TCO-5860 series      | 2000 | Φ180 | Φ60         | 9.0  | 4.0  | 5.25 | 8.0  | 1.4  | L |
| TCO-5060/5160 series | 1000 | Φ180 | Φ60         | 17.5 | 8.0  | 9.25 | 16.0 | 2.2  | L |



## ● Real time clock module

| Model      | Quantity<br>(pcs/reel) | Reel dimension |             |      | Career Tape dimension |       |      |      | Direction of feed<br>(L=left direction) |
|------------|------------------------|----------------|-------------|------|-----------------------|-------|------|------|-----------------------------------------|
|            |                        | A              | B           | W    | A                     | B     | C    | D    |                                         |
| RX-4045SA  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 3.65 | L                                       |
| RX-4045NB  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 1.8  | L                                       |
| RX-4581NB  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 1.8  | L                                       |
| RA-4565SA  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 3.65 | L                                       |
| RX-4801SA  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 3.65 | L                                       |
| RTC-9701JE | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 2.0  | L                                       |
| RTC-4701JE | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 2.0  | L                                       |
| RTC-4701NB | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 1.8  | L                                       |
| RTC-4574SA | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 3.65 | L                                       |
| RTC-4574JE | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 2.0  | L                                       |
| RTC-4574NB | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 1.8  | L                                       |
| RX-4574LC  | 2000                   | Φ180           | Φ60         | 13.0 | 4.0                   | 7.25  | 12.0 | 1.45 | L                                       |
| RA-4574SA  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 3.65 | L                                       |
| RTC-4543SA | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 3.65 | L                                       |
| RTC-4543SB | 1000                   | Φ330           | Φ80 or Φ100 | 24.4 | 12.0                  | 11.50 | 24.0 | 2.5  | L                                       |
| RX-4575LC  | 2000                   | Φ180           | Φ60         | 13.0 | 4.0                   | 7.25  | 12.0 | 1.45 | L                                       |
| RX-4571LC  | 2000                   | Φ180           | Φ60         | 13.0 | 4.0                   | 7.25  | 12.0 | 1.45 | L                                       |
| RX-4571NB  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 1.8  | L                                       |
| RX-4571SA  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 3.65 | L                                       |
| RX-8025SA  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 3.65 | L                                       |
| RX-8025NB  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 1.8  | L                                       |
| RTC-8564JE | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 2.0  | L                                       |
| RTC-8564NB | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 1.8  | L                                       |
| RX-8564LC  | 2000                   | Φ180           | Φ60         | 13.0 | 4.0                   | 7.25  | 12.0 | 1.45 | L                                       |
| RA-8565SA  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 3.65 | L                                       |
| RX-8571LC  | 2000                   | Φ180           | Φ60         | 13.0 | 4.0                   | 7.25  | 12.0 | 1.45 | L                                       |
| RX-8571NB  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 1.8  | L                                       |
| RX-8571SA  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 3.65 | L                                       |
| RX-8581SA  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 3.65 | L                                       |
| RX-8581JE  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 2.0  | L                                       |
| RX-8581NB  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 1.8  | L                                       |
| RA-8581SA  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 3.65 | L                                       |
| RX-8731LC  | 2000                   | Φ180           | Φ60         | 13.0 | 4.0                   | 7.25  | 12.0 | 1.45 | L                                       |
| RX-8801SA  | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 3.65 | L                                       |
| RTC-7301SF | 1000                   | Φ330           | Φ80 or Φ100 | 17.5 | 12.0                  | 9.25  | 16.0 | 2.4  | L                                       |
| RTC-62423  | 1000                   | Φ330           | Φ80 or Φ100 | 25.5 | 16.0                  | 13.25 | 24.0 | 2.95 | L                                       |
| RTC-72423  | 1000                   | Φ330           | Φ80 or Φ100 | 25.5 | 16.0                  | 13.25 | 24.0 | 2.95 | L                                       |

## ● Monolithic Crystal Filter

|                  |      |      |      |      |      |       |      |      |   |
|------------------|------|------|------|------|------|-------|------|------|---|
| HF-232A/ HF-233A | 3000 | Φ180 | Φ60  | 9.0  | 4.0  | 5.25  | 8.0  | 1.15 | L |
| HF-362A/ HF-363A | 2000 | Φ180 | Φ60  | 9.0  | 4.0  | 5.25  | 8.0  | 1.5  | L |
| HF-372A/ HF-373A | 1000 | Φ180 | Φ60  | 13.0 | 8.0  | 7.25  | 12.0 | 1.35 | L |
| HF-734A          | 1000 | Φ180 | Φ60  | 17.0 | 8.0  | 9.25  | 16.0 | 1.8  | L |
| HF-J14A          | 1000 | Φ330 | Φ80  | 25.5 | 16.0 | 13.25 | 24.0 | 4.0  | L |
| HF-S14A          | 400  | Φ330 | Φ100 | 45.5 | 24.0 | 21.95 | 44.0 | 5.4  | L |
| MF-372A/ MF-373A | 1000 | Φ180 | Φ60  | 13.0 | 8.0  | 7.25  | 12.0 | 1.35 | L |
| MF-722A/ MF-723A | 1000 | Φ180 | Φ60  | 17.0 | 8.0  | 9.25  | 16.0 | 1.8  | L |
| MF-734A          | 1000 | Φ180 | Φ60  | 17.0 | 8.0  | 9.25  | 16.0 | 1.8  | L |

## ● SAW Filter

|              |      |      |             |      |      |      |      |      |                        |
|--------------|------|------|-------------|------|------|------|------|------|------------------------|
| FF-555       | 4000 | Φ330 | Φ80 or Φ100 | 13.5 | 8.0  | 7.25 | 12.0 | 2.0  | R                      |
| FF-585       | 4000 | Φ330 | Φ80 or Φ100 | 13.5 | 8.0  | 7.25 | 12.0 | 2.0  | R                      |
| FF-32N       | 4000 | Φ330 | Φ80 or Φ100 | 13.5 | 8.0  | 7.25 | 12.0 | 1.52 | R                      |
| TF-330A/C    | 2000 | Φ180 | Φ60         | 9.0  | 4.0  | 5.25 | 8.0  | 1.5  | Individual regulations |
| TQS-570AA-7R | 2000 | Φ180 | Φ60         | 9.0  | 4.0  | 5.25 | 8.0  | 1.5  | Individual regulations |
| TQS-566AA-7R | 2000 | Φ180 | Φ60         | 9.0  | 4.0  | 5.25 | 8.0  | 1.5  | Individual regulations |
| TQS-557AA-7R | 2000 | Φ180 | Φ60         | 9.0  | 4.0  | 5.25 | 8.0  | 1.5  | Individual regulations |
| TQS-949AD-7G | 3000 | Φ180 | Φ60         | 9.0  | 4.0  | 5.25 | 8.0  | 1.5  | Individual regulations |
| TQS-471BB-7R | 2000 | Φ180 | Φ60         | 9.0  | 4.0  | 5.25 | 8.0  | 1.5  | Individual regulations |
| TQS-477AA-7R | 2000 | Φ180 | Φ60         | 9.0  | 4.0  | 5.25 | 8.0  | 1.5  | Individual regulations |
| TQS-472BA-7R | 1000 | Φ180 | Φ60         | 17.0 | 12.0 | 9.25 | 16.0 | 1.9  | L                      |
| BF-531A      | 1000 | Φ180 | Φ60         | 13.0 | 8.0  | 7.25 | 12.0 | 1.4  | Individual regulations |

## ● Gyro Sensor

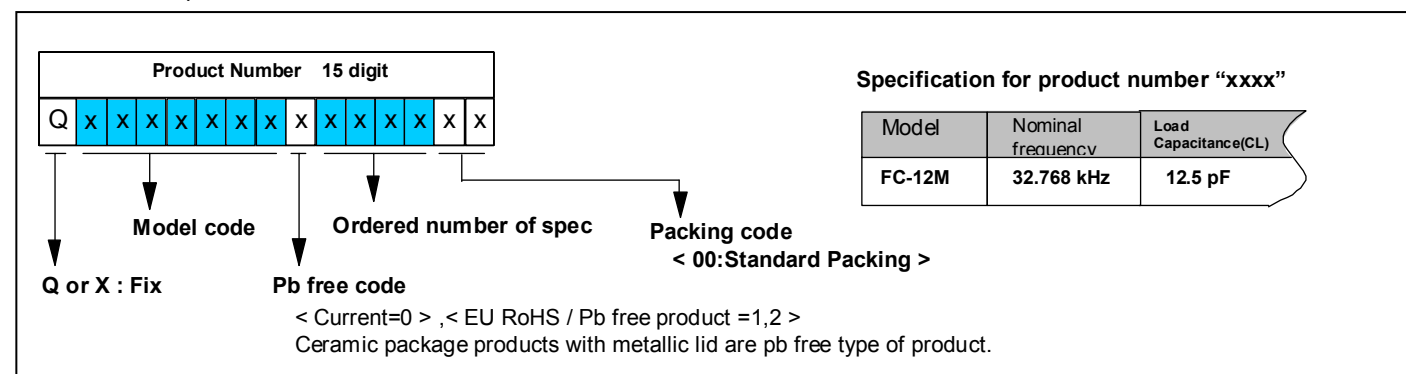
|           |      |      |      |      |     |      |      |     |   |
|-----------|------|------|------|------|-----|------|------|-----|---|
| XV-3500CB | 2000 | Φ254 | Φ100 | 13.4 | 8.0 | 7.25 | 12.0 | 2.1 | L |
| XV-8000CB | 2000 | Φ254 | Φ100 | 13.4 | 8.0 | 7.25 | 12.0 | 2.1 | L |
| XV-8100CB | 2000 | Φ254 | Φ100 | 13.4 | 8.0 | 7.25 | 12.0 | 2.1 | L |
| XV-8000LK | 1000 | Φ254 | Φ100 | 13.4 | 8.0 | 7.25 | 12.0 | 3.7 | L |



## COMPARISON TABLE FOR MODEL AND PRODUCT NUMBER

The Product Number expresses the specification of the product with the codes of 15 columns.

As for the order, please use the Product Number.



When ordering, please specify Product Number. Please confirm your specifications and consult our standard packing specifications before contacting us for Product Number specifications and standard packing specifications.

See below for examples of our standard frequency specifications.

## ■CRYSTAL UNIT

### ●kHz range Crystal Units

| Product number    | Model    | Nominal frequency | Load capacitance (CL) | Frequency tolerance ( $\times 10^{-6}$ ) | Standard packing     |
|-------------------|----------|-------------------|-----------------------|------------------------------------------|----------------------|
| X1A00006 10001 00 | FC-12M   | 32.768 kHz        | 12.5 pF               | $\pm 30$                                 | 3000 pcs / Reel "L"  |
| Q13FC13F 00001 00 | FC-13F   | 32.768 kHz        | 12.5 pF               | $\pm 30$                                 | 3000 pcs / Reel "L"  |
| Q13FC135 00004 00 | FC-135   | 32.768 kHz        | 12.5 pF               | $\pm 20$                                 | 3000 pcs / Reel "L"  |
| Q13FC145 00006 00 | FC-145   | 32.768 kHz        | 12.5 pF               | $\pm 20$                                 | 3000 pcs / Reel "L"  |
| Q13FC255 00004 00 | FC-255   | 32.768 kHz        | 12.5 pF               | $\pm 20$                                 | 3000 pcs / Reel "L"  |
| Q13MC146 10002 00 | MC-146   | 32.768 kHz        | 12.5 pF               | $\pm 20$                                 | 3000 pcs / Reel "L"  |
| Q13MC156 10004 00 | MC-156   | 32.768 kHz        | 12.5 pF               | $\pm 20$                                 | 3000 pcs / Reel "L"  |
| Q13MC306 10003 00 | MC-306   | 32.768 kHz        | 12.5 pF               | $\pm 20$                                 | 3000 pcs / Reel "L"  |
| Q13MC405 10002 00 | MC-405   | 32.768 kHz        | 12.5 pF               | $\pm 20$                                 | 1000 pcs / Reel "L"  |
| Q13MC406 10001 00 | MC-406   | 32.768 kHz        | 12.5 pF               | $\pm 20$                                 | 1000 pcs / Reel "L"  |
| Q11C001R 10021 00 | C-001R   | 32.768 kHz        | 12.5 pF               | $\pm 20$                                 | 250 pcs / Vinyl bags |
| Q11C02RX 10022 00 | C-002RX  | 32.768 kHz        | 12.5 pF               | $\pm 20$                                 | 500 pcs / Vinyl bags |
| Q11C004R 10020 00 | C-004R   | 32.768 kHz        | 8.7 pF                | $\pm 20$                                 | 500 pcs / Vinyl bags |
| Q11C005R 10023 00 | C-005R   | 32.768 kHz        | 8.2 pF                | $\pm 20$                                 | 500 pcs / Vinyl bags |
| Q12C2000 10254 00 | C-2-TYPE | 40.000 kHz        | 12.5 pF               | $\pm 50$                                 | 500 pcs / Vinyl bags |
| Q12C4000 10010 00 | C-4-TYPE | 40.000 kHz        | 12.5 pF               | $\pm 50$                                 | 500 pcs / Vinyl bags |

### ●MHz range Crystal units

| Product Number    | Model    | Nominal Frequency | Load capacitance (CL) | Frequency tolerance ( $\times 10^{-6}$ ) | Frequency temperature characteristics ( $\times 10^{-6}$ ) | Overtone order | Standard packing     |
|-------------------|----------|-------------------|-----------------------|------------------------------------------|------------------------------------------------------------|----------------|----------------------|
| Q22FA128 00022 00 | FA-128   | 24.000 MHz        | 10.0 pF               | $\pm 10$                                 | $\pm 10 / -20^{\circ}\text{C to } +75^{\circ}\text{C}$     | Fundamental    | 3000 pcs / Reel "L"  |
| Q24FA29H 00037 00 | FA-20H   | 40.000 MHz        | 12.0 pF               | $\pm 15$                                 | $\pm 10 / -20^{\circ}\text{C to } +75^{\circ}\text{C}$     | Fundamental    | 3000 pcs / Reel "L"  |
| Q22FA23V 00019 00 | FA-238V  | 12.000 MHz        | 10.0 pF               | $\pm 50$                                 | $\pm 50 / -20^{\circ}\text{C to } +70^{\circ}\text{C}$     | Fundamental    | 3000 pcs / Reel "L"  |
| Q22FA238 00264 00 | FA-238   | 20.000 MHz        | 10.0 pF               | $\pm 50$                                 | $\pm 30 / -20^{\circ}\text{C to } +70^{\circ}\text{C}$     | Fundamental    | 3000 pcs / Reel "L"  |
| X1E00002 10172 00 | TSX-3225 | 40.000 MHz        | 9.0 pF                | $\pm 10$                                 | $\pm 10 / -20^{\circ}\text{C to } +75^{\circ}\text{C}$     | Fundamental    | 2000 pcs / Reel "L"  |
| X1E00006 10045 00 | TSX-5032 | 10.000 MHz        | 18.0 pF               | $\pm 10$                                 | $\pm 10 / -20^{\circ}\text{C to } +75^{\circ}\text{C}$     | Fundamental    | 2000 pcs / Reel "L"  |
| Q22FA365 00065 00 | FA-365   | 20.000 MHz        | 10.0 pF               | $\pm 50$                                 | $\pm 30 / -20^{\circ}\text{C to } +70^{\circ}\text{C}$     | Fundamental    | 1000 pcs / Reel "L"  |
| Q22MA306 10022 00 | MA-306   | 20.000 MHz        | 10.0 pF               | $\pm 50$                                 | $\pm 30 / -20^{\circ}\text{C to } +70^{\circ}\text{C}$     | Fundamental    | 3000 pcs / Reel "L"  |
| Q22MA406 10563 00 | MA-406   | 20.000 MHz        | 10.0 pF               | $\pm 50$                                 | $\pm 30 / -20^{\circ}\text{C to } +70^{\circ}\text{C}$     | Fundamental    | 1000 pcs / Reel "L"  |
| Q22MA505 10208 00 | MA-505   | 20.000 MHz        | 16.0 pF               | $\pm 50$                                 | $\pm 30 / -20^{\circ}\text{C to } +70^{\circ}\text{C}$     | Fundamental    | 1000 pcs / Reel "L"  |
| Q22MA506 10426 00 | MA-506   | 20.000 MHz        | 16.0 pF               | $\pm 50$                                 | $\pm 30 / -20^{\circ}\text{C to } +70^{\circ}\text{C}$     | Fundamental    | 1000 pcs / Reel "L"  |
| Q21CA301 10529 00 | CA-301   | 20.000 MHz        | 16.0 pF               | $\pm 30$                                 | $\pm 30 / -20^{\circ}\text{C to } +70^{\circ}\text{C}$     | Fundamental    | 500 pcs / Vinyl bags |

### ●SAW Resonator

| Product Number    | Model  | Nominal frequency | Frequency tolerance ( $\times 10^{-6}$ ) | Operating temperature range                    | Standard packing    |
|-------------------|--------|-------------------|------------------------------------------|------------------------------------------------|---------------------|
| Q25NS32R 00001 00 | NS-32R | 314.890 MHz       | $\pm 50$                                 | $-40^{\circ}\text{C to } +85^{\circ}\text{C}$  | 4000 pcs / Reel "R" |
| Q25FS335 00052 00 | FS-335 | 315.000 MHz       | $\pm 100$                                | $-40^{\circ}\text{C to } +85^{\circ}\text{C}$  | 4000 pcs / Reel "R" |
| Q25FS555 00016 00 | FS-555 | 315.000 MHz       | $\pm 100$                                | $-40^{\circ}\text{C to } +85^{\circ}\text{C}$  | 4000 pcs / Reel "R" |
| Q25FS585 00015 00 | FS-585 | 434.000 MHz       | $\pm 50$                                 | $-40^{\circ}\text{C to } +120^{\circ}\text{C}$ | 4000 pcs / Reel "R" |





## ■ CRYSTAL OSCILLATOR

### ● SPXO ( 32.768 kHz )

| Product Number |       |    | Model     | Output frequency | Frequency tolerance<br>(×10 <sup>-6</sup> ) | Frequency<br>temperature characteristics | Standard packing    |
|----------------|-------|----|-----------|------------------|---------------------------------------------|------------------------------------------|---------------------|
| Q3102LC0       | 20001 | 00 | SG-3030LC | 32.768 kHz       | 5 ±23                                       | +5 to -20 / -20 °C to +70 °C             | 1000 pcs / Reel "L" |
| Q3102JF0       | 20001 | 00 | SG-3030JF | 32.768 kHz       | 5 ±23                                       | +5 to -20 / -20 °C to +70 °C             | 1000 pcs / Reel "L" |
| Q3102JC0       | 20001 | 00 | SG-3030JC | 32.768 kHz       | 5 ±23                                       | +5 to -20 / -20 °C to +70 °C             | 1000 pcs / Reel "L" |
| Q3103LC0       | 10001 | 00 | SG-3040LC | 32.768 kHz       | 5 ±23                                       | +5 to -20 / -20 °C to +70 °C             | 1000 pcs / Reel "L" |
| Q3103JC0       | 10001 | 00 | SG-3040JC | 32.768 kHz       | 5 ±23                                       | +5 to -20 / -20 °C to +70 °C             | 1000 pcs / Reel "L" |

### ● SPXO

| Product Number |       |    | Model        | Output frequency | Function  | Operating Voltage | Frequency tolerance /<br>Operating temperature range<br>(×10 <sup>-6</sup> ) | Standard packing    |
|----------------|-------|----|--------------|------------------|-----------|-------------------|------------------------------------------------------------------------------|---------------------|
| Q33550FE       | 10008 | 00 | SG-550SEF    | 20.000 MHz       | S:Standby | 1.8 V             | B: ±50 / -20 °C to +70 °C                                                    | 1000 pcs / Reel “L” |
| Q33645W7       | 10043 | 00 | SG-645SCW    | 40.000 MHz       | S:Standby | C:3.3 V           | M: ±100 / -40 °C to +85 °C                                                   | 1000 pcs / Reel “L” |
| Q33636E4       | 10009 | 00 | SG-636PCE    | 20.000 MHz       | P: OE     | C:3.3 V           | C: ±100 / -20 °C to +70 °C                                                   | 1000 pcs / Reel “L” |
| Q3361501       | 10772 | 00 | SG-615P      | 20.000 MHz       | P:OE      | 5.0 V             | C: ±100 / -20 °C to +70 °C                                                   | 1000 pcs / Reel “L” |
| Q3253101       | 10355 | 00 | SG-531P      | 20.000 MHz       | P:OE      | 5.0 V             | C: ±100 / -20 °C to +70 °C                                                   | 35 pcs / Tube       |
| Q3251001       | 10002 | 00 | SG-51P       | 20.000 MHz       | P:OE      | 5.0 V             | C: ±100 / -20°C to +70 °C                                                    | 25 pcs / Tube       |
| Q33211C7       | 00009 | 00 | SG-211SCC    | 25.000 MHz       | Standby   | 3.3 V             | H: ±20 / -40 °C to +85 °C                                                    | 3000 pcs / Reel “L” |
| Q33210B6       | 00004 | 00 | SG-210SGB    | 24.000 MHz       | Standby   | 1.5 V             | C: ±100 / -20 °C to +70 °C                                                   | 3000 pcs / Reel “L” |
| Q33310F7       | 00017 | 00 | SG-310SCF    | 20.000 MHz       | S:Standby | 3.3 V             | C: ±100 / -20 °C to +70 °C                                                   | 2000 pcs / Reel “L” |
| X1G00036       | 10008 | 00 | TCO-7106X1A4 | 25.000 MHz       | Standby   | 3.3 V             | ±50 / -40 °C to +85 °C                                                       | 1000 pcs / Reel “L” |
| X1G00037       | 10003 | 00 | TCO-7107X1A4 | 25.000 MHz       | Standby   | 3.3 V             | ±100 / -40 °C to +85 °C                                                      | 1000 pcs / Reel “L” |
| X1G00235       | 10028 | 00 | SG-770SCD    | 106.250 MHz      | Standby   | 3.3 V             | L:±50 / -40 °C to +85 °C                                                     | 1000 pcs / Reel “L” |
| X1G00021       | 10031 | 00 | TCO-7085X1A1 | 25.000 MHz       | Standby   | 3.3 V             | ±25 / -10 °C to +70 °C                                                       | 1000 pcs / Reel “L” |
| X1G00022       | 10065 | 00 | TCO-7086X1A4 | 25.000 MHz       | Standby   | 3.3 V             | ±50 / -40 °C to +85 °C                                                       | 1000 pcs / Reel “L” |
| X1G00023       | 10013 | 00 | TCO-7087D1A1 | 25.000 MHz       | Standbv   | 5.0 V             | ±100 / -10 °C to +70 °C                                                      | 1000 pcs / Reel “L” |

### ● Programmable

| Product Number |         |  | Model        | Output frequency | Function  | Operating Voltage | Frequency tolerance / Operating temperature range (×10 <sup>6</sup> ) | Standard packing    |
|----------------|---------|--|--------------|------------------|-----------|-------------------|-----------------------------------------------------------------------|---------------------|
| Q33519E7       | 0002600 |  | SG-8003CE SC | 20.000 MHz       | S:Standby | C:3.3 V           | C: ±100 / -20 °C to +70 °C                                            | 2000 pcs / Reel “L” |
| Q3321CE7       | 0004100 |  | SG-8002CE SC | 20.000 MHz       | S:Standby | C:3.3 V           | C: ±100 / -20 °C to +70 °C                                            | 2000 pcs / Reel “L” |
| Q3323LB2       | 1000400 |  | SG-8002LB PH | 20.000 MHz       | P:OE      | H:5.0 V           | C: ±100 / -20 °C to +70 °C                                            | 1000 pcs / Reel “L” |
| Q3308JF7       | 1004700 |  | SG-8002JF SC | 20.000 MHz       | S:Standby | C:3.3 V           | C: ±100 / -20 °C to +70 °C                                            | 1000 pcs / Reel “L” |
| Q3309CA7       | 0006200 |  | SG-8002CA SC | 20.000 MHz       | S:Standby | C:3.3 V           | C: ±100 / -20 °C to +70 °C                                            | 1000 pcs / Reel “L” |
| Q3307JC7       | 1000300 |  | SG-8002JC SC | 20.000 MHz       | S:Standby | C:3.3 V           | C: ±100 / -20 °C to +70 °C                                            | 1000 pcs / Reel “L” |
| Q3306JA7       | 0101300 |  | SG-8002JA SC | 20.000 MHz       | S:Standby | C:3.3 V           | C: ±100 / -20 °C to +70 °C                                            | 1000 pcs / Reel “L” |
| Q3204DC7       | 1000300 |  | SG-8002DC SC | 20.000 MHz       | S:Standby | C:3.3 V           | C: ±100 / -20 °C to +70 °C                                            | 35 pcs / Tube       |
| Q3203DB7       | 1000100 |  | SG-8002DB SC | 20.000 MHz       | S:Standby | C:3.3 V           | C: ±100 / -20 °C to +70 °C                                            | 25 pcs / Tube       |

### ● Spread spectrum

| Product Number |         |         | Model     | Output frequency | Modulation type | Spread percentage | Function | Standard packing    | Suffix |
|----------------|---------|---------|-----------|------------------|-----------------|-------------------|----------|---------------------|--------|
| Q              | 3331521 | 1000700 | SG-9001LB | 100.000 MHz      | C:Centre        | 10:±1.0 %         | P:OE     | 2000 pcs / Reel “L” | C10P   |
| Q              | 3331701 | 0001600 | SG-9001CA | 100.000 MHz      | C:Centre        | 15:±1.5 %         | P:OE     | 1000 pcs / Reel “L” | C15P   |
| Q              | 3331E11 | 1000700 | SG-9001JC | 100.000 MHz      | D:Down          | 20:±2.0 %         | P:OE     | 1000 pcs / Reel “L” | D20P   |

### ● Low-jitter SAW

| Product Number |       |    | Model     | Output frequency | Output condition Symmetry | Operating voltage | Frequency tolerance      |   | Standard packing    | Suffix |
|----------------|-------|----|-----------|------------------|---------------------------|-------------------|--------------------------|---|---------------------|--------|
|                |       |    |           |                  |                           |                   | (×10 <sup>-6</sup> )     |   |                     |        |
| Q3851CA0       | 00027 | 00 | XG-1000CA | 125 MHz          | CMOS                      | D:2.5 V           | B:±50 /-10 °C to +70°C   | - | 1000 pcs / Reel "L" | DB     |
| Q3851CB0       | 00028 | 00 | XG-1000CB | 125 MHz          | CMOS                      | E:1.8 V           | B:±50 /-10 °C to +70°C   | - | 2000 pcs / Reel "L" | EB     |
| Q3807CA0       | 00001 | 00 | EG-2021CA | 125 MHz          | C:CMOS SYM ±5 %           | 2.5 V             | GP:±50 / 0 °C to +70°C   | N | 1000 pcs / Reel "L" | CGPN   |
| Q3801CA0       | 00002 | 00 | EG-2001CA | 125 MHz          | P:CMOS SYM ±5 %           | C:3.3 V           | H:±100 / 0 °C to +70 °C  | - | 1000 pcs / Reel "L" | PCH    |
| Q3802CA0       | 00020 | 00 | EG-2002CA | 125 MHz          | P:LV-TTL SYM ±5 %         | C:3.3 V           | Z:±50 / 0 °C to +70 °C   | - | 1000 pcs / Reel "L" | PCZ    |
| Q3805CA0       | 00002 | 00 | EG-2121CA | 125 MHz          | P:LV-PECL SYM ± 5 %       | 2.5 V             | HP:±100 / 0 °C to +70 °C | A | 1000 pcs / Reel "L" | PHPA   |
| Q3805CA1       | 00003 | 00 | EG-2121CA | 125 MHz          | L:LVDS SYM ±5 %           | 2.5 V             | HP:±100 / 0 °C to +70 °C | A | 1000 pcs / Reel "L" | LHPA   |
| Q3806CA0       | 00029 | 00 | EG-2102CA | 125 MHz          | P:LV-PECL SYM±5 %         | 3.3 V             | HP:±100 / 0 °C to +70 °C | A | 1000 pcs / Reel "L" | PHPA   |
| Q3806CA1       | 00039 | 00 | EG-2102CA | 125 MHz          | L:LVDS SYM ±5 %           | 3.3 V             | HP:±100 / 0 °C to +70 °C | A | 1000 pcs / Reel "L" | LHPA   |
| Q3803CA0       | 00023 | 00 | EG-2101CA | 125 MHz          | D:LV-PECL SYM ±2.5 %      | C:3.3 V           | H:±100 / 0 °C to +70 °C  | - | 1000 pcs / Reel "L" | DCH    |

### ● High-stability

| Product Number |       |    | Model     | Output frequency | Frequency tolerance<br>(×10 <sup>-6</sup> ) | Function  | Operating voltage | Standard packing    | Suffix |
|----------------|-------|----|-----------|------------------|---------------------------------------------|-----------|-------------------|---------------------|--------|
| Q3514CA0       | 00019 | 00 | HG-2150CA | 20.000 MHz       | BX: ±25 / -40 °C to +85 °C                  | OE        | C:3.3 V           | 1000 pcs / Reel "L" | BXC    |
| Q3502JA7       | 10054 | 00 | HG-8002JA | 20.000 MHz       | BV: ±25 / -20 °C to +70 °C                  | S:Standby | C:3.3 V           | 1000 pcs / Reel "L" | SC BV  |



## ● Voltage Control (VCXO)

| Product Number   | Model     | Output frequency | Frequency tolerance ( $\times 10^{-6}$ ) | Pull range   | Operating voltage | Standard packing    | Suffix |
|------------------|-----------|------------------|------------------------------------------|--------------|-------------------|---------------------|--------|
| Q3614CE00001200  | VG-4231CE | 27.000 MHz       | C: $\pm 30$ / -20 °C to +70 °C           | S: $\pm 140$ | C: 3.3 V          | 2000 pcs / Reel "L" | CSC-M  |
| Q3603CA00004300  | VG-1201CA | 27.000 MHz       | B: $\pm 25$ / -40 °C to +85 °C           | N: $\pm 100$ | C: 3.3 V          | 1000 pcs / Reel "L" | BNC-F  |
| Q3614CA00101800  | VG-4231CA | 27.000 MHz       | G: $\pm 50$ / -40 °C to +85 °C           | R: $\pm 130$ | C: 3.3 V          | 1000 pcs / Reel "L" | GRC-F  |
| X1G0006210005100 | TCO-2111  | 500 MHz          | $\pm 50$ / -40 °C to +85 °C              | $\pm 100$    | 3.3 V             | 700 pcs / Reel "L"  | AA     |

## ■ TEMPERATURE SENSING CRYSTAL

| Product Number   | Model   | Nominal frequency | Frequency tolerance | Operating temperature range | Standard packing     |
|------------------|---------|-------------------|---------------------|-----------------------------|----------------------|
| Q19HT20600000100 | HTS-206 | 40.000 kHz        | $\pm 2$ %           | -10 °C to +60 °C            | 500 pcs / Vinyl bags |

## ■ SAW FILTER

| Product Number    | Model        | Nominal frequency | Pass bandwidth                      | Insertion loss | Operating temperature | Standard packing    |
|-------------------|--------------|-------------------|-------------------------------------|----------------|-----------------------|---------------------|
| Q51FF32N00000100  | FF-32N       | 429.450 MHz       | f <sub>nom</sub> $\pm 300$ kHz Min. | 3.5 dB Max.    | -10 °C to +60 °C      | 4000 pcs / Reel "R" |
| Q51FF55500000700  | FF-555       | 315.000 MHz       | f <sub>nom</sub> $\pm 100$ kHz Min. | 3.5 dB Max.    | -40 °C to +85 °C      | 4000 pcs / Reel "R" |
| Q51FF58500000300  | FF-585       | 315.000 MHz       | f <sub>nom</sub> $\pm 200$ kHz Min. | 3.5 dB Max.    | -40 °C to +85 °C      | 4000 pcs / Reel "R" |
| X1L00000110000200 | TQS-471BB-7R | 374.000 MHz       | f <sub>nom</sub> $\pm 8.5$ MHz Min. | 10 dB Max.     | -30 °C to +70 °C      | 2000 pcs / Reel     |
| X1L00001710000300 | TQS-949AD-7G | 1575.420 MHz      | f <sub>nom</sub> $\pm 200$ kHz Min. | 2.3 dB Max.    | -40 °C to +85 °C      | 3000 pcs / Reel     |

## ■ REAL TIME CLOCK MODULE

| Product Number   | Model      | Frequency tolerance ( $\times 10^{-6}$ ) | Standard packing    |
|------------------|------------|------------------------------------------|---------------------|
| Q414045510000100 | RX-4045SA  | AA: $5 \pm 5$                            | 1000 pcs / Reel "L" |
| Q414045910000100 | RX-4045NB  | AA: $5 \pm 5$                            | 1000 pcs / Reel "L" |
| Q414581910000200 | RX-4581NB  | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q419701710000100 | RTC-9701JE | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q414701910000200 | RTC-4701NB | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q414574510000200 | RTC-4574SA | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q414574710000100 | RTC-4574JE | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q414574910000100 | RTC-4574NB | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q414574C20000300 | RX-4574LC  | B: $5 \pm 23$                            | 2000 pcs / Reel "L" |
| Q414543510000200 | RTC-4543SA | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q414543610000200 | RTC-4543SB | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q414575C10000100 | RX-4575LC  | B: $5 \pm 23$                            | 2000 pcs / Reel "L" |
| Q414571C10000100 | RX-4571LC  | B: $5 \pm 23$                            | 2000 pcs / Reel "L" |
| Q414571910000100 | RX-4571NB  | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q414571510000100 | RX-4571SA  | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q418025510000100 | RX-8025SA  | AA: $5 \pm 5$                            | 1000 pcs / Reel "L" |
| Q418025910000100 | RX-8025NB  | AA: $5 \pm 5$                            | 1000 pcs / Reel "L" |
| Q418564710000100 | RTC-8564JE | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q418564910000200 | RTC-8564NB | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q418564C20000100 | RX-8564LC  | B: $5 \pm 23$                            | 2000 pcs / Reel "L" |
| Q418581510000200 | RX-8581SA  | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q418581710000200 | RX-8581JE  | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q418581910000200 | RX-8581NB  | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q418731C10000100 | RX-8731LC  | B: $5 \pm 23$                            | 2000 pcs / Reel "L" |
| Q427301810000200 | RTC-7301SF | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q427301110000200 | RTC-7301DG | B: $5 \pm 23$                            | 1000 pcs / Reel "L" |
| Q426242110000200 | RTC-62421  | A: $\pm 10$                              | 25 pcs / Tube       |
| Q426242310000200 | RTC-62423  | A: $\pm 20$                              | 1000 pcs / Reel "L" |
| Q427242110000100 | RTC-72421  | A: $\pm 10$                              | 25 pcs / Tube       |
| Q427242310000600 | RTC-72423  | A: $\pm 20$                              | 1000 pcs / Reel "L" |

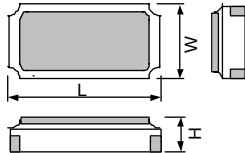


## TABLE OF DIMENSIONS

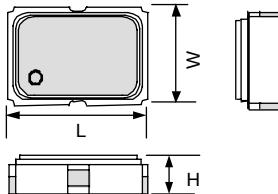
## ■ SMD Type

## ● SON

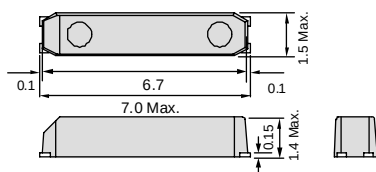
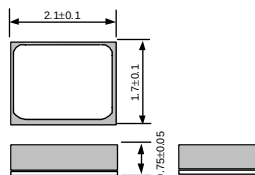
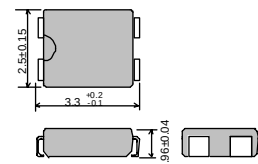
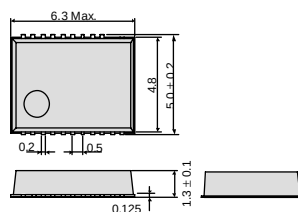
## Glass Lid type



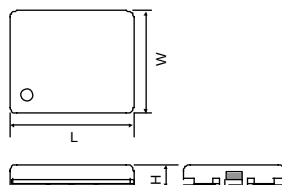
## Metal Lid type



| Category           | Model                             | Dimension (mm) |          |           | Pin |
|--------------------|-----------------------------------|----------------|----------|-----------|-----|
|                    |                                   | L              | W        | H         |     |
| Crystal Unit       | FC-12M                            | 2.05±0.05      | 1.2±0.05 | 0.6 Max.  | 2   |
|                    | FC-125                            | 2.05±0.05      | 1.2±0.05 | 0.7 Max.  | 2   |
|                    | FC-13F                            | 3.2±0.1        | 1.5±0.1  | 0.5 Max.  | 2   |
|                    | FC-13F                            | 3.2±0.1        | 1.5±0.1  | 0.6 Max.  | 2   |
|                    | FC-135                            | 3.2±0.1        | 1.5±0.1  | 0.8±0.1   | 2   |
|                    | FC-145                            | 4.1±0.1        | 1.5±0.1  | 0.8±0.1   | 2   |
|                    | FC-255                            | 4.9±0.1        | 1.8±0.1  | 0.8±0.1   | 2   |
|                    | FA-128                            | 2.0±0.1        | 1.6±0.1  | 0.5 Max.  | 4   |
|                    | FA-20H                            | 2.5±0.1        | 2.0±0.1  | 0.55 Max. | 4   |
|                    | FA-23A                            | 3.2±0.15       | 2.5±0.15 | 0.8 Max.  | 2   |
|                    | TSX-3225                          | 3.2±0.15       | 2.5±0.15 | 0.6 Max.  | 4   |
|                    | FA-238 / 238V                     | 3.2±0.1        | 2.5±0.1  | 0.6±0.1   | 4   |
|                    | TSX-4025                          | 4.0±0.15       | 2.5±0.15 | 0.7 Max.  | 4   |
|                    | TSX-5032                          | 5.0±0.15       | 3.2±0.15 | 0.8 Max.  | 4   |
|                    | FA-365                            | 6.0±0.2        | 3.5±0.2  | 1.4 Max.  | 2   |
| SAW Resonator      | NS-21R                            | 2.5±0.1        | 2.0±0.1  | 0.86±0.9  | 4   |
|                    | FS-335 / NS-32R                   | 3.8±0.15       | 3.8±0.15 | 0.98±0.15 | 6   |
|                    | FS-555 / 585                      | 4.8±0.2        | 5.2±0.2  | 1.5±0.2   | 8   |
| Crystal Oscillator | SG-211                            | 2.5±0.15       | 2.0±0.15 | 0.7±0.1   | 4   |
|                    | SG-210                            | 2.5±0.15       | 2.0±0.15 | 0.8±0.1   | 4   |
|                    | SG-310 / SG-8002CE / SG-8003CE    | 3.2±0.2        | 2.5±0.2  | 1.05±0.15 | 4   |
|                    | TCO-710x series                   | 5.0±0.2        | 3.2±0.2  | 1.0±0.2   | 4   |
|                    | SG-770SCD                         | 7.0±0.2        | 5.0±0.2  | 1.6±0.2   | 6   |
|                    | TCO-708x series                   | 7.0±0.2        | 5.0±0.2  | 1.6±0.2   | 4   |
|                    | SG-8002CA / SG-8003CA             | 7.0±0.2        | 5.0±0.2  | 1.5 Max.  | 4   |
|                    | HG-2150CA                         | 7.0±0.2        | 5.0±0.2  | 1.5 Max.  | 4   |
|                    | SG-9001CA                         | 7.0±0.2        | 5.0±0.2  | 1.4±0.1   | 6   |
|                    | XG-1000CA                         | 7.0±0.2        | 5.0±0.2  | 1.2±0.2   | 4   |
|                    | XG-1000CB                         | 5.0±0.2        | 3.2±0.2  | 1.1±0.15  | 4   |
|                    | EG-20**CA                         | 7.0±0.2        | 5.0±0.2  | 1.2±0.2   | 4   |
|                    | EG-21**CA                         | 7.0±0.2        | 5.0±0.2  | 1.2±0.2   | 6   |
|                    | VG-4231CE                         | 3.2±0.2        | 2.5±0.2  | 1.05±0.15 | 4   |
|                    | VG-4231CB / VG-4531CB             | 5.0±0.2        | 3.2±0.2  | 1.2±0.2   | 6   |
| VCXO               | VG-4231CA / VG-1201CA             | 7.0±0.2        | 5.0±0.2  | 1.4±0.1   | 6   |
|                    | VG-4501CA / VG-4502CA / VG-4511CA | 7.0±0.2        | 5.0±0.2  | 1.6±0.2   | 6   |
|                    | TG-5010CG / TG-5005CG             | 2.5±0.2        | 2.0±0.2  | 1.0 Max.  | 4   |
| TCXO               | TCO-5860 series / TG-5005CE       | 3.2±0.2        | 2.5±0.2  | 1.0 Max.  | 4   |
|                    | TCO-5060/5160 series              | 7.0±0.2        | 5.0±0.2  | 1.9±0.1   | 6   |
|                    | TQS-949AD-7G                      | 2.5±0.1        | 2.0±0.1  | 0.8±0.2   | 4   |
| SAW Filter         | TQS-570AA-7R                      | 3.0±0.1        | 3.0±0.1  | 1.11±0.2  | 6   |
|                    | TQS-557AA-7R/TQS-566AA-7R         | 3.0±0.1        | 3.0±0.1  | 1.11±0.2  | 6   |
|                    | TQS-471BA-7R                      | 3.0±0.1        | 3.0±0.1  | 1.15 Max. | 8   |
|                    | TQS-477AA-7R                      | 3.0±0.1        | 3.0±0.1  | 1.15 Max. | 8   |
|                    | FF-32N                            | 3.8±0.15       | 3.8±0.15 | 0.98±0.15 | 6   |
|                    | FF-555 / 585                      | 4.8±0.2        | 5.2±0.2  | 1.5±0.2   | 8   |
|                    | TF-330A / C                       | 3.0±0.1        | 3.0±0.1  | 1.11±0.2  | 6   |
|                    | BF-531A                           | 5.0±0.2        | 3.2±0.2  | 1.05±0.15 | 6   |
|                    | TQS-472BA-7R                      | 7.0±0.2        | 5.0±0.2  | 1.5 Max.  | 10  |
|                    | HF-232A/HF-233A                   | 2.5±0.05       | 2.0±0.05 | 0.9±0.15  | 6   |
| MCF                | HF-362A/HF-363A                   | 3.0±0.1        | 3.0±0.1  | 0.9±0.15  | 8   |
|                    | HF-372A/HF-373A/MF-372A/MF-373A   | 3.8±0.1        | 3.8±0.1  | 1.0±0.2   | 8   |
|                    | HF-722A/HF-723A                   | 7.0±0.2        | 5.0±0.2  | 1.3±0.2   | 6   |
|                    | HF-734A/MF-734A                   | 7.0±0.2        | 5.0±0.2  | 1.1±0.2   | 6   |
|                    | XV-3500CB/XV-8100CB/XV-8000CB     | 5.0±0.2        | 3.2±0.2  | 1.3±0.2   | 8   |

● SON (Crystal Unit)  
MC-146● SON (Crystal Oscillator)  
SG-150 / SG-8003BA / TG-5021BA● SON (TCXO)  
TG-5010LH● SON (Real time clock module:NB Package)  
RX-\*\*\*NB / RTC-\*\*\*NB

## ● SON (Metal Cap Type)

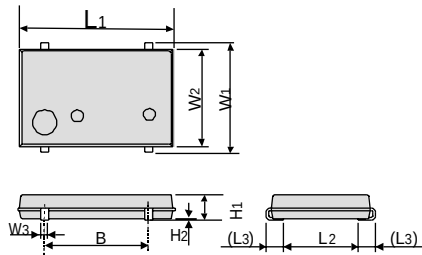


| Category | Model    | L        | W        | H        | Pin  |
|----------|----------|----------|----------|----------|------|
| VCXO     | TCO-294J | 11.4±0.2 | 9.6±0.2  | 2.0 Max. | 6(8) |
|          | TCO-2152 | 7.0±0.3  | 5.2±0.3  | 2.0 Max. | 6    |
| MCF      | HF-J14A  | 16.3±0.2 | 10.3±0.2 | 3.0 Max. | 10   |
|          | HF-S14A  | 26.0±0.3 | 16.0±0.3 | 5.0±0.3  | 12   |



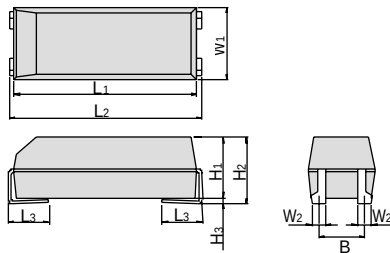
## ■ SMD Type

## ● SOJ / VSOJ



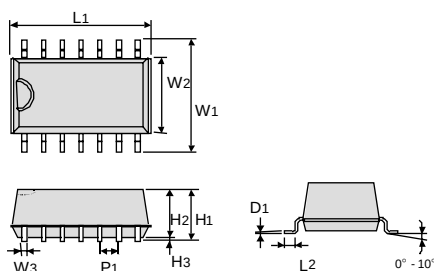
| Category                  | Model                                                             | L1           | L2   | (L3)   | W1          | W2   | W3   | H1           | H2           | B    | Pin |
|---------------------------|-------------------------------------------------------------------|--------------|------|--------|-------------|------|------|--------------|--------------|------|-----|
| Crystal Unit              | MC-156                                                            | 7.1<br>Max.  | 1.6  | (0.75) | 3.3<br>Max. | 2.5  | 0.4  | 1.5<br>Max.  | —            | 5.08 | 4   |
|                           | MC-306/30A<br>MA-306                                              | 8.0<br>Max.  | 1.9  | (0.9)  | 3.8<br>Max. | 3.2  | 0.5  | 2.54<br>Max. | —            | 5.5  | 4   |
|                           | MA-406                                                            | 11.7<br>Max. | 2.1  | (1.2)  | 4.8<br>Max. | 4.0  | 0.7  | 3.7<br>Max.  | —            | 9.6  | 4   |
|                           | SG-**LB                                                           | 5.0<br>±0.2  | 2.5  | (0.35) | 3.2<br>±0.2 | 2.8  | 1.0  | 1.2<br>Max.  | 0.0<br>Min.  | 2.54 | 4   |
| Crystal Oscillator        | SG-645                                                            | 7.1<br>±0.2  | 3.8  | (0.75) | 5.1<br>±0.2 | 4.6  | 0.4  | 1.5<br>Max.  | 0.0<br>Min.  | 5.08 | 4   |
|                           | SG-**JF                                                           | 7.1<br>±0.2  | 3.8  | (0.75) | 5.1<br>±0.2 | 4.6  | 0.4  | 1.5<br>Max.  | 0.0<br>Min.  | 5.08 | 4   |
|                           | SG-636                                                            | 10.5<br>Max. | 3.6  | (1.0)  | 5.8<br>Max. | 5.0  | 0.51 | 2.7<br>Max.  | 0.05<br>Min. | 5.08 | 4   |
|                           | SG-**JC                                                           | 10.5<br>Max. | 3.6  | (1.0)  | 5.8<br>Max. | 5.0  | 0.51 | 2.7<br>Max.  | 0.05<br>Min. | 5.08 | 4   |
|                           | SG-615                                                            | 14.0<br>Max. | 7.62 | —      | 9.8<br>Max. | 8.65 | 0.51 | 4.7<br>Max.  | 0.25<br>Min. | 5.08 | 4   |
|                           | SG-**JA<br>HG-**JA                                                | 14.0<br>Max. | 7.62 | —      | 9.8<br>Max. | 8.65 | 0.51 | 4.7<br>Max.  | 0.25<br>Min. | 5.08 | 4   |
|                           | MG-5020JE                                                         | 7.0<br>±0.3  | 4.5  | (0.75) | 6.0<br>±0.2 | 5.4  | 0.22 | 1.5<br>Max.  | 0.0<br>Min.  | 0.65 | 20  |
| VC XO                     | TCO-3110 series<br>TCO-3131                                       | 13.9<br>±0.1 | 7.62 | —      | 9.8<br>Max. | 8.75 | 0.5  | 4.7<br>Max.  | 0.25<br>Min. | 2.54 | 6   |
|                           | VG-**JA                                                           | 14.0<br>Max. | 7.62 | —      | 9.8<br>Max. | 8.65 | 0.51 | 4.7<br>Max.  | 0.25<br>Min. | 5.08 | 4   |
|                           | TCO-2000 series<br>TCO-2100 series<br>TCO-2110 series<br>TCO-2131 | 13.9<br>±0.1 | 7.62 | —      | 9.8<br>Max. | 8.75 | 0.5  | 4.7<br>Max.  | 0.25<br>Min. | 2.54 | 6   |
|                           | SG-**LC<br>RX-**LC                                                | 3.6<br>±0.2  | 2.0  | (0.4)  | 2.8<br>±0.2 | 2.4  | 0.22 | 1.2<br>Max.  | 0.0<br>Min.  | 0.5  | 12  |
| Real time Clock<br>Module | RX-**JE<br>RTC-**JE                                               | 7.0<br>±0.3  | 4.5  | (0.75) | 6.0<br>±0.2 | 5.4  | 0.22 | 1.5<br>Max.  | 0.0<br>Min.  | 0.65 | 20  |

## ● SOJ (Crystal Unit)

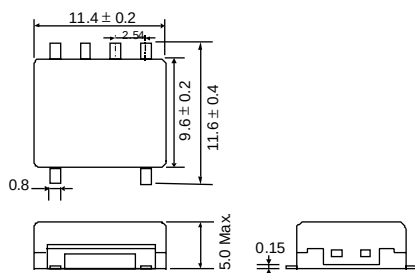
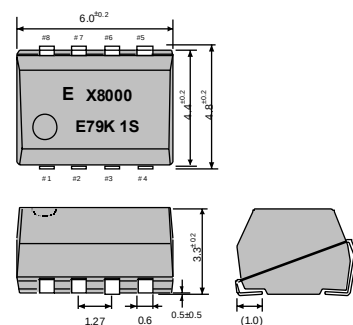


| Category     | Model      | L1   | L2            | L3   | W1           | W2   | B    | H1   | H2          | H3          |
|--------------|------------|------|---------------|------|--------------|------|------|------|-------------|-------------|
| Crystal Unit | MC-405/406 | 9.6  | 10.41<br>Max. | 2.54 | 4.06<br>Max. | 0.51 | 2.29 | 3.15 | 3.6<br>Max. | 0.2<br>Min. |
|              | MA-505/506 | 12.7 | 13.46<br>Max. | 2.54 | 5.08<br>Max. | 1.09 | 3.3  | 4.19 | 4.6<br>Max. | 0.2<br>Min. |

## ● SOP / VSOP



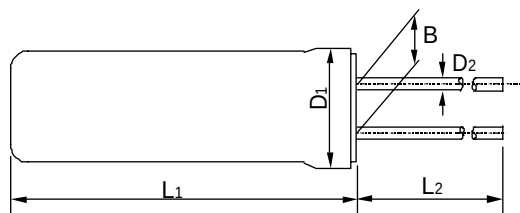
| Category                  | Model                                | L1           | L2  | W1           | W2  | W3   | H1          | H2  | H3           | D1   | P1   | Pin |
|---------------------------|--------------------------------------|--------------|-----|--------------|-----|------|-------------|-----|--------------|------|------|-----|
| Real time Clock<br>Module | RTC-****SA<br>RX-****SA<br>RA-****SA | 10.1<br>±0.2 | 0.6 | 7.4<br>±0.2  | 5.0 | 0.35 | 3.2<br>±0.1 | 3.1 | 0.05<br>Min. | 0.15 | 1.27 | 14  |
|                           | RTC-4543SB                           | 11.4<br>±0.2 | 0.6 | 7.8<br>±0.2  | 5.4 | 0.4  | 2.0<br>Max. | 1.8 | 0<br>Min.    | 0.15 | 1.27 | 18  |
|                           | RTC-62423                            | 16.3<br>Max. | 1.0 | 12.2<br>Max. | 7.9 | 0.35 | 2.8<br>Max. | —   | 0.1<br>Min.  | 0.2  | 1.27 | 24  |
|                           | RTC-72423                            | 10.2<br>±0.3 | 0.5 | 7.8<br>±0.3  | 5.4 | 0.36 | 2.0<br>Max. | —   | 0<br>Min.    | 0.15 | 0.8  | 24  |
|                           | RTC-7301SF                           | 10.2<br>±0.3 | 0.5 | 7.8<br>±0.3  | 5.4 | 0.36 | 2.0<br>Max. | —   | 0<br>Min.    | 0.15 | 0.8  | 24  |

● SOP (Crystal Oscillator)  
TCO-391J, TCO-291J● SOJ (Gyro sensor)  
XV-8000LK



## Dip Type

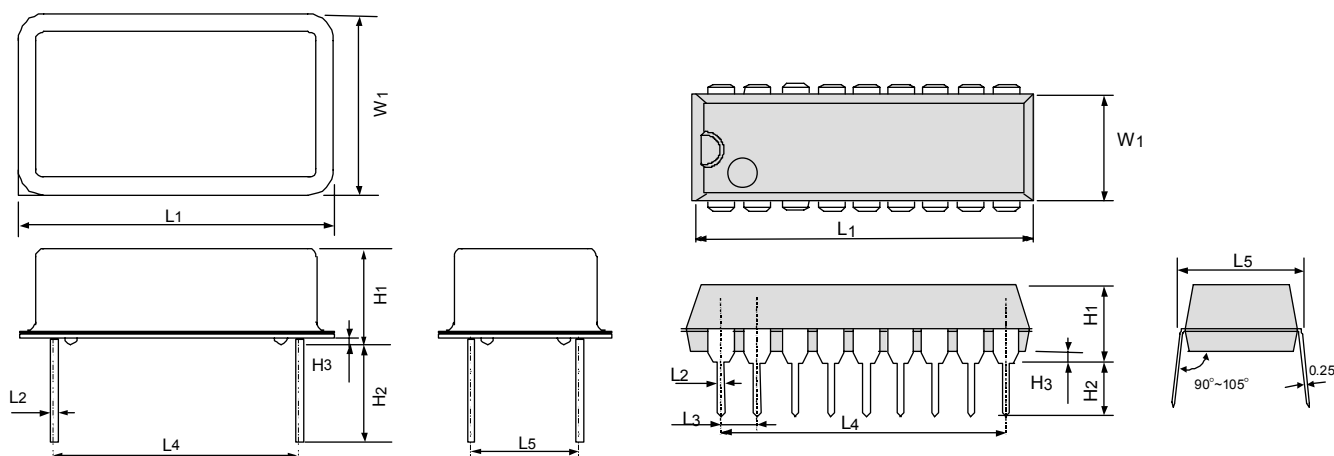
## ●Cylinder



| Category     | Model            | L <sub>1</sub> | L <sub>2</sub> | D <sub>1</sub> | D <sub>2</sub> | B    |
|--------------|------------------|----------------|----------------|----------------|----------------|------|
| Crystal Unit | C-001R           | 8.0 Max.       | 9.0 Min.       | Φ3.1 Max.      | Φ0.3           | 1.1  |
|              | C-002RX/C-2-TYPE | 6.0 Max.       | 4.0 Min.       | Φ2.0 Max.      | Φ0.2           | 0.7  |
|              | C-004R/C-4-TYPE  | 5.0 Max.       | 4.0 Min.       | Φ1.5 Max.      | Φ0.18          | 0.5  |
|              | C-005R           | 4.6 Max.       | 4.0 Min.       | Φ1.2 Max.      | Φ0.15          | 0.3  |
|              | CA-301           | Over 5.5 MHz   | 8.9 Max.       | 9.5 Min.       | Φ3.1 Max.      | Φ0.3 |
|              |                  | Under 5.5 MHz  | 9.3 Max.       | 9.5 Min.       | Φ3.1 Max.      | Φ0.3 |

160 kHz to 165 kHz 307.2 kHz D1= ø 2.2 Max.(C-2-TYPE)

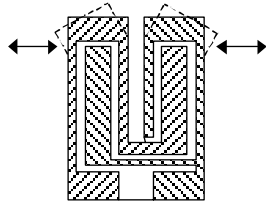
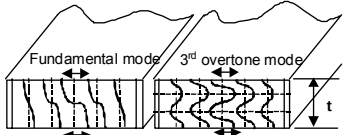
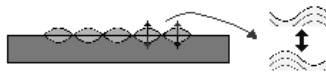
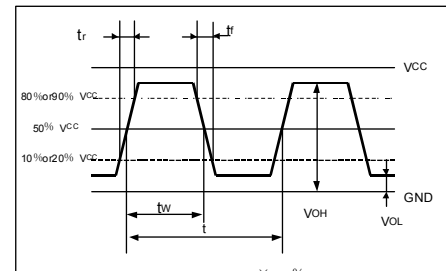
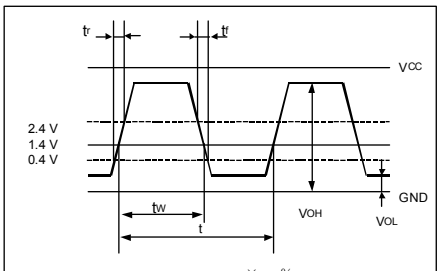
## ●DIP



| Category               | Model               | L <sub>1</sub> | L <sub>2</sub> | L <sub>3</sub> | L <sub>4</sub> | L <sub>5</sub> | H <sub>1</sub> | H <sub>2</sub> | H <sub>3</sub> | W <sub>1</sub> | Pin    |
|------------------------|---------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------|
| Crystal Oscillator     | SG-51               | 19.8           | 0.51           | —              | 15.24          | 7.62           | 5.3            | 2.54           | 0.2            | 6.36           | 4 Pin  |
|                        | SG-8002DB           | Max.           |                |                |                |                | Max.           | Min.           | Min.           |                |        |
|                        | SG-531              | 13.7           | 0.51           | —              | 7.62           | 7.62           | 5.3            | 2.54           | 0.2            | 6.6            | 4 Pin  |
| OCXO                   | SG-8002DC/SG-8003DC | Max.           |                |                |                |                | Max.           | Min.           | Min.           |                |        |
|                        | OX-6601DL series    | 36.2           | Φ0.8           | —              | 25.4           | 17.8           | 18.0           | 4.5            |                | 27.2           | 6 Pin  |
|                        | TCO-6831 series     | Max.           |                |                | ±0.2           |                | Max.           | Min.           |                | Max.           |        |
|                        |                     | 72.0           | Φ0.8           | —              | 60.0           | 40.0           | 12.0           | 5.0            | 0.5 Min.       | 52.0           | 5 Pin  |
|                        | TCO-676 series      | Max.           |                |                | ±0.3           |                | Max.           |                |                | Max.           |        |
|                        |                     | 25.4           | Φ0.75          | —              | 19.05          | 19.05          | 12.7           | 4.5            | Inside H1      | 25.4           | 5 Pin  |
| Real time clock Module | TCO-679 series      | Max.           |                |                | ±0.3           |                | Max.           | ±0.1           |                | Max.           |        |
|                        |                     | 20.3           | Φ0.45          | —              | 15.24          | 7.62           | 9.7            | 5.55           | 0.8            | 12.7           | 4 Pin  |
|                        | TCO-6920A           | ±0.5           |                |                | ±0.2           |                | ±0.5           | ±0.7           | ±0.2           | ±0.5           |        |
|                        |                     | 50.8           | Φ1.0           | —              | 40.64          | 40.64          | 25.4           | 3.5            | Inside H1      | 50.8           | 5 Pin  |
| Real time clock Module | RTC-7301DG          | Max.           |                |                | ±0.3           |                | Max.           | ±0.5           |                | Max.           |        |
|                        |                     | 23.1           | 0.46           | 2.54           | 20.32          | 7.62           | 4.2            | 2.54           | 0.2            | 6.3            | 18 Pin |
|                        | RTC-62421           | 23.1           | 0.65           | 2.54           | 20.32          | 7.62           | 4.2            | 3.3            | 0.2            | 6.3            | 18 Pin |
| Real time clock Module | RTC-72421           | Max.           |                |                |                |                | Max.           | Min.           | Min.           |                |        |
|                        |                     | 23.1           | 0.65           | 2.54           | 20.32          | 7.62           | 4.2            | 3.3            | 0.2            | 6.3            | 18 Pin |



# Glossary

| Item                                                                       | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Object     |
|----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Fundamental mode                                                           | <p>First harmonic crystal vibration mode.<br/>The AT resonance frequency is determined by the thickness of the crystal, but even with the same thickness the third overtone will be about three times the frequency of the fundamental. With tuning fork crystal unit, the second overtone is about six times the fundamental.</p> <div>  <p>Tuning fork crystal unit<br/>Fundamental mode</p>  <p>AT-cut crystal unit<br/><math display="block">F(\text{MHz}) = \frac{1670}{t(\mu\text{m})} \quad (t: \text{Thickness})</math><br/>Fundamental mode 3<sup>rd</sup> overtone mode</p>  <p>SAW Resonator</p>  <p>Vibration mode</p> <p>SAW Structure figure<br/>Output Frequency <math>f = k/\lambda</math> (<math>\lambda</math>=Interval of an/the electrode, <math>k</math>= Fixed number )</p> </div> | X'tal ,OSC |
| Divided frequency                                                          | The output frequency that is divided by the internal IC.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | OSC        |
| Symmetry (tw/t)<br>(SYM)                                                   | <p>Ratio of full and half cycles. For CMOS loading duty is rated at 1/2 V<sub>CC</sub>, and for TTL loading at 1.4V.</p> <div>  <p>● CMOS loading</p>  <p>● TTL loading</p> <p>NOTE : SYM=tw/t × 100%</p> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | OSC        |
| (Equivalent)series capacitance (C <sub>1</sub> )<br>(motional capacitance) | Energy distortion to the (equivalent) internal charge capacitance component of the crystal unit, at the series resonant frequency.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | X'tal      |
| (Equivalent)series resonant resistance (R <sub>1</sub> )                   | Vibration loss to the (equivalent) internal charge capacitance component of the crystal unit, at the series resonant frequency. A measure of the easiness of oscillation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | X'tal      |
| Drive level (DL)                                                           | Current or voltage level in the oscillating (operating)state.(Drive power= power required to oscillate crystal unit.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | X'tal      |
| Deviation in PB                                                            | The difference between the max. and min. attenuations within a pass band.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Filter     |
| Frequency ( f )                                                            | Number of waves (cycles)per second. The relation between frequency and cycle is $f(\text{Hz})=1/t(\text{s})$ .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ALL        |
| (Frequency )aging (f <sub>age</sub> , f <sub>aging</sub> )                 | Amount of frequency drift when operated under the specified conditions for a specified term.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ALL        |
| Frequency tolerance precision (f <sub>tol</sub> )                          | Under specified conditions at an ambient temperature of +25 °C,the difference in actual (measured) frequency from the nominal frequency.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | X'tal      |
| Frequency voltage Coefficient                                              | Taking the output frequency at the central voltage in the operating voltage range as the reference, the change in output frequency to voltage. Causes of this change are changes in crystal deformation, and changes in IC internal constants for chips mounted in the oscillator and Real time clock module. The effects of the ICs are larger.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | OSC        |
| Frequency tolerance (f <sub>tol</sub> )                                    | Within standard temperature and operational voltage ranges, the drift in the output frequency. The output frequency drift including frequency temperature characteristics and frequency voltage characteristics.<br>When there is an annotation in the margin, It is given to priority.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | OSC        |
| HFF-XTAL                                                                   | HFF-XTAL is a high frequency fundamental mode crystal unit using inverted-mesa shape AT-cut blank fabricated with photolithographic technology. Therefore it has an excellent stability for temperature, aging and shock.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | OSC        |

X'tal:Crystal unit, OSC:Crystal oscillator

More details available on Epson Toyocom website.



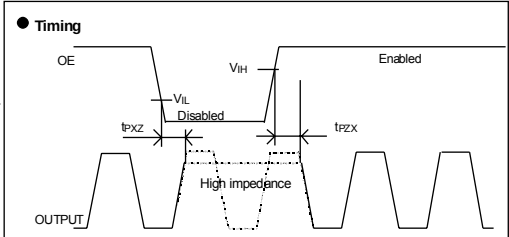
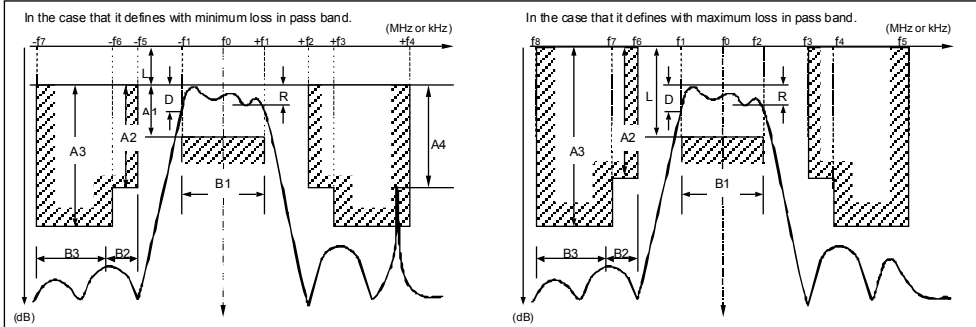
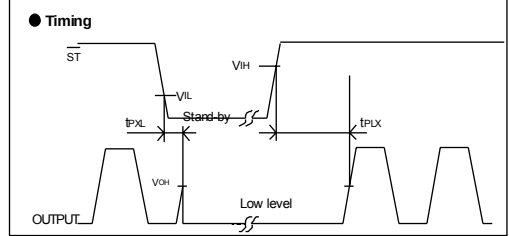
| Item                                           | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Object          |
|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Frequency temperature characteristics          | <p>Taking the frequency at 25 degrees Centigrade as the reference, the change in frequency in response to ambient temperature.</p> <ul style="list-style-type: none"> <li>● Tuning fork crystal unit. SAW Resonator.<br/> <math display="block">\Delta f/f = B(T_i - \theta X)^2</math> <math display="block">\theta X: \text{specified temperature}</math> </li> <li>● AT crystal unit.<br/> <math display="block">\Delta f/f = \alpha(\theta X - 25) + \beta(\theta X - 25)^2 + \chi(\theta X - 25)^3</math> </li> </ul> <p>Examples of frequency temperature characteristics</p> <div> </div> | ALL             |
| Group delay distortion ( $\Delta t$ )          | The difference between the max. and min. group delay within a pass band B1 unless otherwise specified.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Filter          |
| Insulation resistance (IR)                     | Resistance between lead and lead, or between lead and case package.(conductive package)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ALL             |
| Insertion loss (L)                             | The logarithmic ratio of the power delivered to the load impedance before insertion of the filter to the power delivered to the load impedance after insertion of the filter.                                                                                                                                                                                                                                                                                                                                                                                                                    | Filter          |
| Load capacitance (CL)                          | Effective capacitance (series equivalent charge capacitance) of the oscillation circuit as seen from the pins of the crystal unit. This capacitance is determined as a condition when the crystal unit is connected to the oscillation circuit and will determine the output frequency. Load capacitance approximation:CL                                                                                                                                                                                                                                                                        | X'tal           |
| Max.drive level (GL)                           | Rating for the drive level. Current or power input over this level may result in characteristic degradation or destruction.                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | X'tal           |
| Max. supply voltage (Vcc-GND)                  | Maximum rated value for power input to the power supply pin. Input over this value may result in characteristic degradation or destruction.                                                                                                                                                                                                                                                                                                                                                                                                                                                      | OSC             |
| Max. input level (R)                           | The max. power that can be delivered to the filter without destructing the filter.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Filter          |
| Nominal frequency (f <sub>nom</sub> )          | Nominal value of frequency of crystal unit.<br>A frequency given in specification, to which other frequencies may be referred.                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | X'tal<br>Filter |
| Operating temperature Range(T <sub>use</sub> ) | Temperature range where specification characteristics are fulfilled,unless otherwise specified.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ALL             |
| Origin frequency (f <sub>o</sub> )             | Oscillation source frequency of oscillator inside oscillation system.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | OSC             |
| Fall time(t <sub>f</sub> )                     | The time it takes for the output wave form to change from the high voltage(high level) to the low voltage(low level). Also called wave form fall time. See waveform diagram under Symmetry.                                                                                                                                                                                                                                                                                                                                                                                                      | OSC             |
| Rise time(t <sub>r</sub> )                     | The time it takes for the output wave form to change from the low voltage (low level) to the high voltage (high level). Also called wave form fall time. See wave from diagram under Symmetry.                                                                                                                                                                                                                                                                                                                                                                                                   | OSC             |
| Oscillation circuit                            | <p>Circuit needed to oscillate crystal unit. Circuit Constants will differ with type of crystal unit and frequency.</p> <p><b>Basic oscillation circuit using CMOS IC</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                    | X'tal           |

X'tal:Crystal Unit, OSC:Crystal Oscillator

More details available on Epson Toyocom website.





| Item                                          | Content                                                                                                                                                                                                                                                                                                                                                                                                                        | Object    |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Start-up time (t <sub>str</sub> )             | The time from power on until the wave form stabilizes.<br>However, voltage rise times depend on the power supply.<br>Therefore, the time depends on the power supply, and the time is measured from a specific set of initial conditions.                                                                                                                                                                                      | OSC       |
| Output enable(OE)                             | Output is switched to high impedance, and wired OR connection can be used to select multiple outputs(frequency).<br><br>OE pin: High or open.<br>Specified frequency output = enabled.<br>OE pin: Low. Output is high impedance=disabled.<br>Oscillation is not stopped, so after the clock is disabled, it is not synchronized with OE (clock is continuous).                                                                 | OSC       |
|                                               | <b>● Timing</b><br>                                                                                                                                                                                                                                                                                                                          |           |
| Output frequency (f <sub>o</sub> )            | The frequency output from the oscillator circuit or the crystal oscillator system.                                                                                                                                                                                                                                                                                                                                             | OSC       |
| Output load conditions                        | The types and quantities (power) of the loads that can be connected to the oscillator.<br>Calculated for 1 TTL as I <sub>OH</sub> = -40 μA, I <sub>OL</sub> = 1.6 mA and for LS-TTL as I <sub>OH</sub> = -20 μA, I <sub>OL</sub> = 0.4 mA.                                                                                                                                                                                     | OSC       |
| Overtone                                      | Vibration state when crystal is vibrating as a high harmonic(see base wavelength). It is harder to match the overtone oscillation circuit with the crystal unit than the fundamental oscillation circuit.                                                                                                                                                                                                                      | X'tal,OSC |
| Pass band (BW)                                | Pass band (BW)<br>A band of frequencies B1 in which the attenuation is equal to or less than a specified value A1<br>A band of frequencies B1 in which the attenuation is equal to or less than the insertion loss L.<br><br>Stop band attenuation<br>Bands of frequencies B2 and B3 in which the attenuations are equal to or greater than specified values A2 and A3 respectively.                                           | Filter    |
|                                               |                                                                                                                                                                                                                                                                                                                                             |           |
| Ripple (R)                                    | The difference between the max. and min. peak attenuation within a pass band.                                                                                                                                                                                                                                                                                                                                                  | Filter    |
| Recommended drive level (DL)                  | Excitation level for optimum oscillation characteristics.                                                                                                                                                                                                                                                                                                                                                                      | X'tal     |
| Shunt capacitance(Co)                         | Charge capacitance between the two electrodes in the crystal unit.                                                                                                                                                                                                                                                                                                                                                             | X'tal     |
| Soldering conditions (T <sub>SOL</sub> )      | Temperatures or times over these limits may result in characteristic degradation or destruction.                                                                                                                                                                                                                                                                                                                               | ALL       |
| Stand-by (ST)                                 | Function that halts crystal unit oscillation and frequency Division. Cuts the current consumed by the oscillators circuit and the frequency division stage.<br><br>ST pin-high or open: Specified frequency output.<br>ST pin-low: Output is low level, oscillation stops.<br>: Output is low level (weak pull-down), oscillation stops.<br>: Output is high impedance, oscillation stops.<br>Please refer to each data sheet. | OSC       |
|                                               | <b>● Timing</b><br>                                                                                                                                                                                                                                                                                                                        |           |
| Shortage temperature Range(T <sub>stg</sub> ) | Maximum absolute rating for the discharged state (no input of voltage, current or power).<br>Exposure to temperatures over this level may result in characteristic degradation or destruction.<br>To assure precision, store at room temperature whenever possible.                                                                                                                                                            | ALL       |
| Spurious response A4 (dB)                     | Min. attenuation caused by extraordinary response in the stop band. Spurious response usually appears at a higher frequency than the center frequency.                                                                                                                                                                                                                                                                         | Filter    |
| Supply voltage (V <sub>CC</sub> )             | Voltage input to V <sub>CC</sub> pin which will support continuous operation with specification characteristics.                                                                                                                                                                                                                                                                                                               | OSC       |
| Terminating impedance (Z <sub>t</sub> )       | Either of the impedances presented to the filter by the source or by the load.<br>(R <sub>t</sub> : Resistive portion, C <sub>t</sub> : Parallel capacitive portion including stray capacitance)                                                                                                                                                                                                                               | Filter    |
| VSWR                                          | Voltage Standing Wave Ratio                                                                                                                                                                                                                                                                                                                                                                                                    | Filter    |

X'tal:Crystal Unit, OSC:Crystal Oscillator

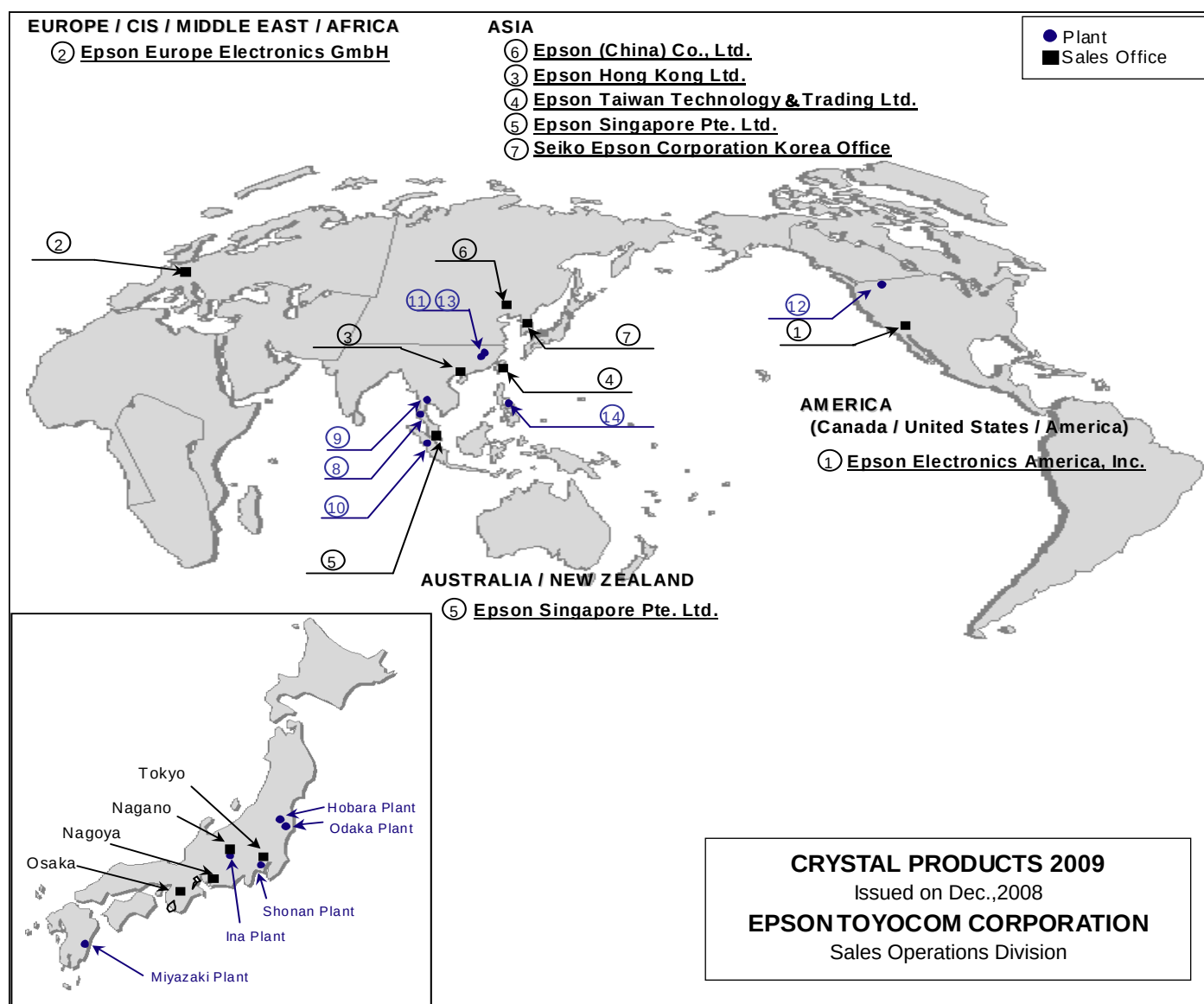
More details available on Epson Toyocom website.

## Manufacturing Plant

| Plant          | Date Operations Commenced | Products                                                                                                                         |
|----------------|---------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Ina Plant      | Jun.1959                  | Crystal unit<br>Crystal oscillator<br>Real time clock module<br>Surface acoustic wave device<br>Sensing device<br>Optical device |
| Shonan Plant   | Jun.1963                  | —                                                                                                                                |
| Hobara Plant   | Nov.1972                  | Crystal unit<br>Crystal oscillator<br>Module                                                                                     |
| Odaka Plant    | Jan.1977                  | Crystal unit<br>Surface acoustic wave device<br>Monolithic crystal filter                                                        |
| Miyazaki Plant | Jun.1984                  | Synthetic quartz<br>Crystal oscillator<br>Optical device                                                                         |

| Plant                                                 | Date Operations Commenced | Products                                                     |
|-------------------------------------------------------|---------------------------|--------------------------------------------------------------|
| ⑧: <a href="#">Epson Toyocom Malaysia Sdn.Bhd.</a>    | Dec.1974                  | Crystal unit<br>Crystal oscillator<br>Real time clock module |
| ⑨: <a href="#">Epson Toyocom (Thailand) LTD.</a>      | May.1988                  | Optical device                                               |
| ⑩: <a href="#">PT.Epson Toyocom Indonesia</a>         | Apr.1996                  | Crystal unit<br>Crystal oscillator                           |
| ⑪: <a href="#">Epson Toyocom Suzhou CO.,LTD.</a>      | Mar.1997                  | Crystal unit<br>Crystal oscillator<br>Real time clock module |
| ⑫: <a href="#">Epson Toyocom Seattle, Inc.</a>        | Jun.2000                  | Synthetic quartz                                             |
| ⑬: <a href="#">Epson Toyocom (Wuxi)CO.,LTD.</a>       | Jul.2001                  | Crystal unit<br>Optical device                               |
| ⑭: <a href="#">Epson Precision (Philippines) Inc.</a> | Feb.2002                  | Crystal unit                                                 |

## Business area



## AMERICA

### EPSON ELECTRONICS AMERICA, INC.

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