

INTERSIL OPTICAL SENSORS

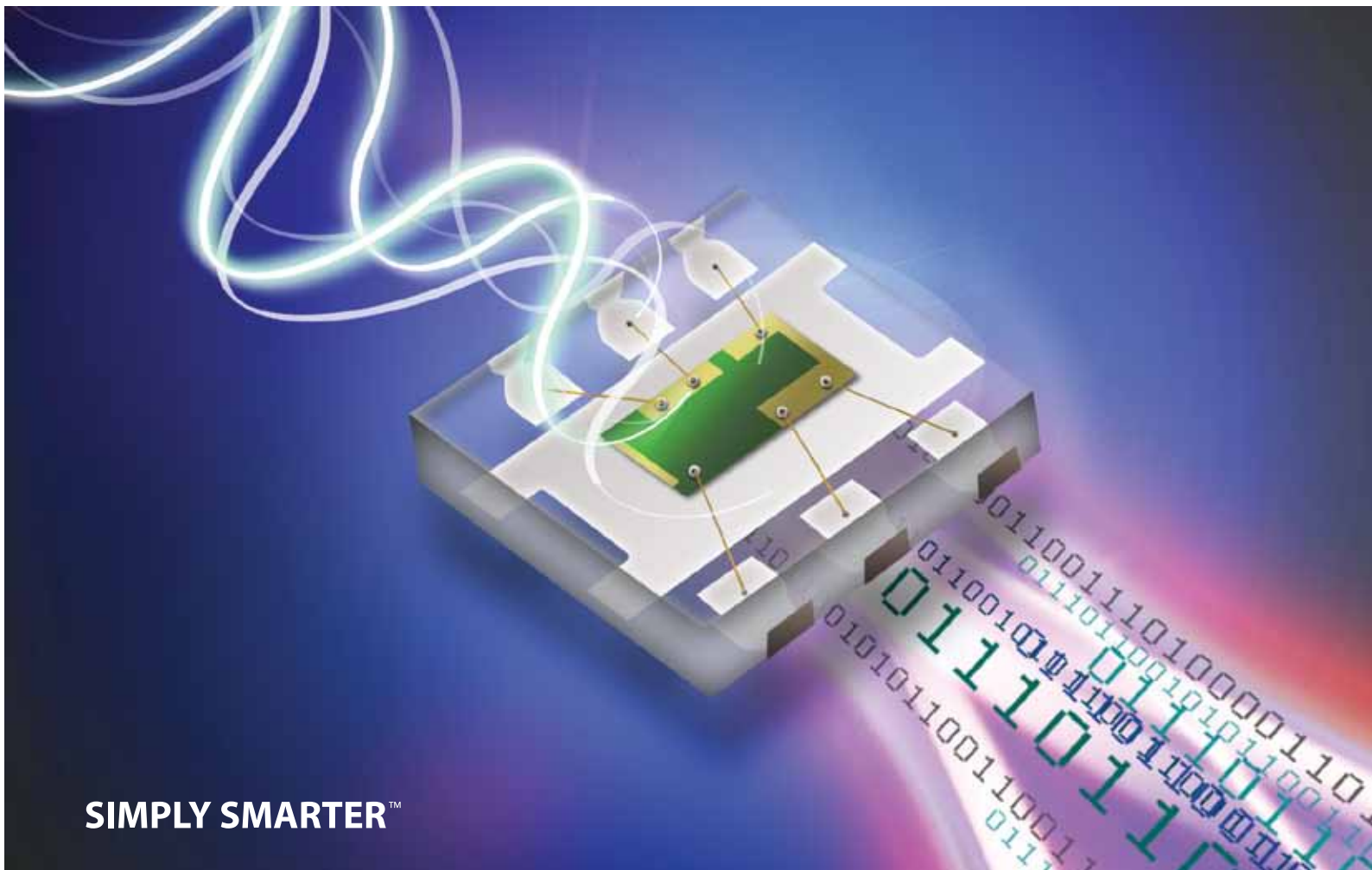
Analog ALS

Digital ALS

ALS+Proximity Sensor

Proximity Sensor

intersil[™]



SIMPLY SMARTER[™]

AMBIENT LIGHT SENSING

Intersil's Light Sensor Family

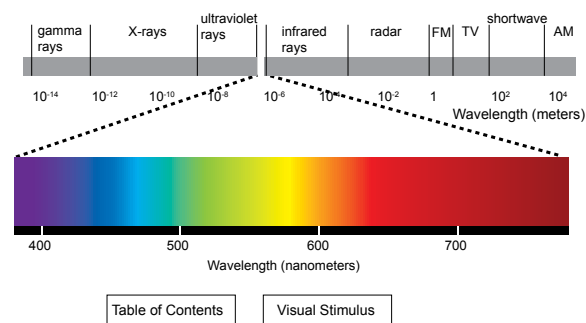
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Introduction to Ambient Light Sensing

What is Light?

Light is electromagnetic radiation with a wavelength that is visible to the eye.



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What is Ambient Light?

Ambient light is the surrounding environmental light that is everywhere - equally intense and with no directionality. Even though the light is equally intense, the brightness can vary greatly. "Lux" is the amount of visible light illuminating a point on a surface. Typical Lux values are given in Table 1.

An ambient light sensor must be sensitive over the same range of intensities. In fact, the ambient light sensor is asked to operate beyond these extremes, especially on the dimmer side. It is not unusual that a sensor be placed inside a device where it only receives a fraction of the ambient light.

Direct Sunlight	100,000 to 130,000 Lux
Full Daylight	10,000 to 20,000 Lux
Cloudy Day	1,000 Lux
Office Lights	300 to 500 Lux
Candle Light	10 Lux to 15 Lux

Table 1

What is an Ambient Light Sensor (ALS)?

Simply put, ambient light sensors are photo detectors that are designed to sense as accurately as possible to what the human eye perceives. They are used wherever a system

needs to know the ambient light conditions, as related to the human eye (see Figure 1, which shows a normalized photopic response curve), and make adjustments as needed.

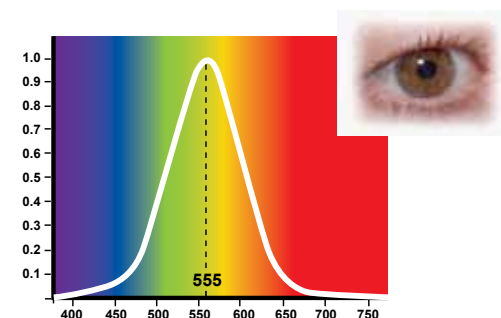


Figure 1.

ALS are used mainly in portable devices where intelligent backlight management is needed. Backlight management of a display or keyboard (keypad) not only allows for optimal battery management, but also optimal display brightness.

The typical applications where an ALS is most popular is where you can save battery life and/or improve the viewing experience of the system.

Ambient light sensors are used to:

- Automatically adjusts LCD display brightness
- Enhanced power savings
 - Longer time between charges! (Display backlight 20% total power consumption)
- Improved viewer experience
 - Max brightness outdoors
 - Min brightness indoors

Common ALS implementation:

- Mobile Devices: Smart Phones, GPS, Portable Gaming
- Computing Devices: Notebook PC, Tablets, Desktop PC
- Consumer devices: LCD-TV, Digital Picture Frame, Digital Camera
- Industrial and medical displays needing optimal backlight settings
- Ambient light sensors provide power saving solutions for hand-held electronic devices by allowing intelligent backlight management of the display and/or keyboard (keypad), as is found in smart phones, Tablets and notebook PC's.

Analog ALS

Intersil's analog light sensors convert light intensity to either voltage or current signal. An analog output signal (voltage or current) is directly proportional to the light intensity of the photodiode. Typically in a system, these signals will be inputs to other system resources such as amplifiers, ADCs, etc. to optimize system performance using the ambient light.

Voltage output Analog ALS are offered in two different output formats, linear and square root voltage signal. Current output analog ALS is also offered in both linear and square root output current signals. In addition, current ALS products have source, sink and source and sink output.

These devices are excellent for power saving control functions in cell phones, PDAs, and other handheld applications.

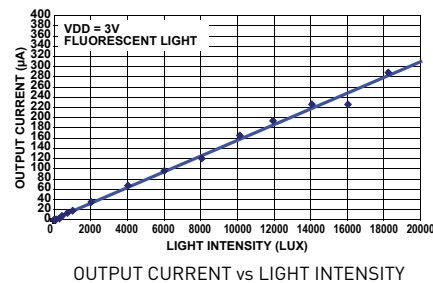
ISL29007

Low Power, Current-Output Ambient Light Photo Detect IC

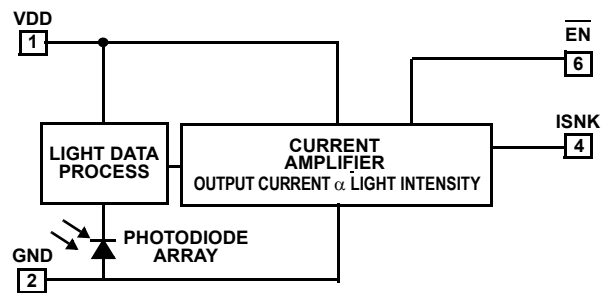
The ISL29007 is the easiest to use analog output light sensors, with the best spectral response and most desirable feature set available in the market today.

- **Ultra Low Power**
 - Only 3.5µA @ 100 lux
- **Excellent Output Linearity of Luminance**
 - Exposed to light, these light sensors give current outputs that are linearly proportional to the light intensity, enabling simple and efficient system controls
- **Dark Current and Temperature Compensation**
 - The internal compensation circuit minimizes dark current digital output noise

Excellent Output Linearity of Luminance



Simplified Block Diagram



Analog ALS

Device	Peak Spectral Sensitivity (nm)	V _s (Min) (V)	V _s (Max) (V)	Supply Current @ E _y = 100Lux (µA)	Lux Range (Max) (Lux)	Output Current @ E _y = 100Lux (µA)	Dark Current @ E _y = 0Lux (nA)	Rise Time (µs)	Fall Time (µs)	Delay Time, Rising Edge (µs)	Delay Time, Falling Edge (µs)	Pb-Free?	Enable Pin?	Package Dimensions (mm)	Package
EL7900	550	2.7	5.5	62	8000	62.5	0.01	105 @ 300Lux	170 @ 300Lux	165 @ 300Lux	65 @ 300Lux	Y	Y	2.1 x 2.0 x 0.70	5 Ld ODFN
ISL29000	550	2.5	5.5	7.4	10000	6.5	60	27 @ 1000Lux	78 @ 1000Lux	80 @ 1000Lux	35 @ 1000Lux	Y	Y	2.1 x 2.0 x 0.70	5 Ld DFN
ISL29006	550	1.8	3.6	3.5	10000	1.65	0.22	27 @ 1000Lux	233 @ 1000Lux	209 @ 1000Lux	30 @ 1000Lux	Y	Y	2.0 x 2.1 x 0.75	6 Ld ODFN
ISL29007	550	1.8	3.6	3.5	10000	1.65	0.22	27 @ 1000Lux	233 @ 1000Lux	209 @ 1000Lux	30 @ 1000Lux	Y	Y	2.0 x 2.1 x 0.75	6 Ld ODFN
ISL29008	550	1.8	3.6	3.5	10000	1.65	0.22	27 @ 1000Lux	233 @ 1000Lux	209 @ 1000Lux	30 @ 1000Lux	Y	N	2.0 x 2.1 x 0.75	6 Ld ODFN
ISL29009	550	1.8	3.6	3	10000	1.8	2	20 @ 1000Lux	1290 @ 1000Lux	280 @ 1000Lux	5 @ 1000Lux	Y	Y	2.0 x 2.1 x 0.75	6 Ld ODFN
ISL29101	550	1.8	3.6	23	10000	1.65	1	27	233	209	18	Y	N	2.0x2.1x0.70	6 Ld ODFN
ISL29102	550	1.8	3.6	10	10000	0.58	20	68	970	145	22	Y	N	2.0x2.1x0.70	6 Ld ODFN

DIGITAL ALS

Digital ALS

The digital ALS is an integrated ambient and infrared light-to-digital converter with I²C (SMBus Compatible) interface. Its advanced self-calibrated photodiode array emulates human eye response with excellent IR rejection. The part integrates a calibrated photodiode, a non-linear current amplifier and a micro-power op amp on a single monolithic IC, along with a 16 bit ADC and a serial I²C interface.

The output from the photodiode is calibrated and fed through a current amplifier before entering an integrating ADC. The on-chip ADC is capable of rejecting 50Hz and 60Hz flicker caused by artificial light sources. I²C puts out an ADC count, which is proportional to the ambient light intensity, and is stored in predefined internal registers. Typically in an application they are read by an external processing unit for further processing.

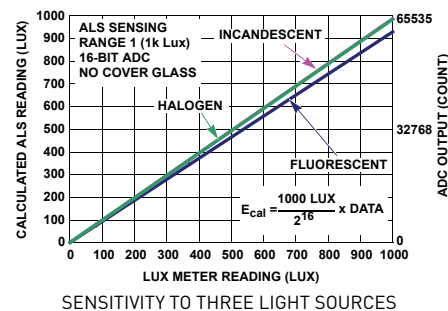
Following is the block diagram of ISL29023, which has an interrupt (INT) feature. Interrupt signal is a defined ADC count to trigger an event.

ISL29023

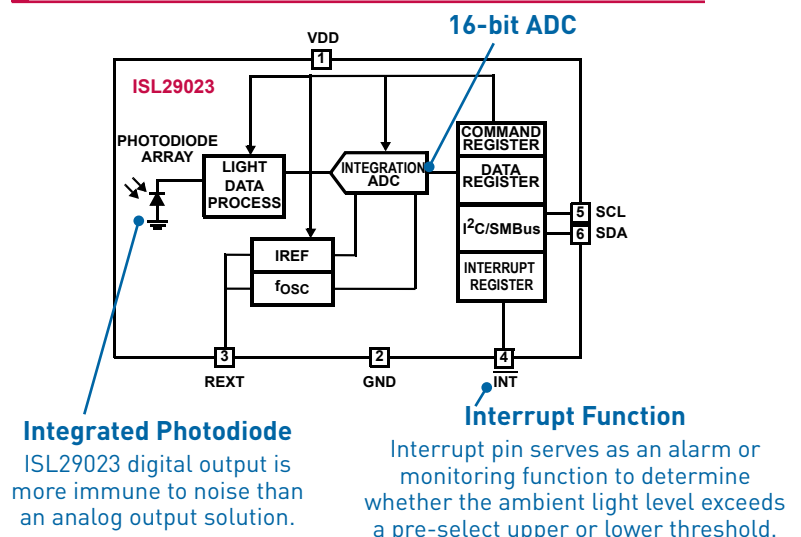
Highest Low-Light Sensitivity in The Market

- **Gain Selection and Best-in-Class Low Light Sensitivity**
 - Allows you to choose between 4 gain ranges in either wide dynamic range (up to 64,000 Lux) or excellent low light sensitivity, down to 0.015 Lux (or 65 counts per Lux).
- **50Hz/60Hz Rejection Filter and 16-bit ADC with I²C Output on a Single Monolithic Chip**
 - ISL29023 integrates ADC and filter, eliminates need for additional components required by analog output sensors.
- **Exceptional Ambient Light Sensing, Accurate Human Eye Response, and Low Power Consumption**
 - Brightness control saves battery life and improves panel visibility. Greater sensitivity, improved accuracy and battery savings.

Excellent Low-Light Sensitivity



High Integration



Digital ALS

Device	Peak Sensitivity (nm)	V _S (Min) (V)	V _S (Max) (V)	Supply Current (Typ) (μA)	Resolution (Bits)	Lux Range (Min) (Lux)	Lux Range (Max) (Lux)	Counts per Lux (Max) (Counts)	Interrupt?	Output Interface	Address Selection Pins?	Enable Pin?	Package Dimensions (mm)	Package
ISL29020	540	2.25	3.63	55	16	0.015	64,000	65	N	I ² C	Y	Software Enabled	2.0 x 2.1 x 0.70	6 Ld ODFN
ISL29023	540	2.25	3.63	70	16	0.015	64,000	65	Y	I ² C	N		2.0 x 2.1 x 0.70	6 Ld ODFN
ISL29033	540	2.25	3.63	70	16	0.002	8,000	65	Y	I ² C	N		2.0 x 2.1 x 0.70	6 Ld ODFN

Introduction to Proximity Sensing

What's Proximity Sensing?

In proximity sensing, an IR LED emits photons, which bounce off an object, and the reflected IR light is detected by an IR sensor. The proximity of a nearby object is proportional to magnitude of the detected IR light from its reflection (Figure 2). This is digitized through on-chip signal conditioning and analog-to-digital conversion, and the digitized output is made available to a microcontroller.

A typical system comprises an optical front end, analog mixed-signal processing circuits and packaging, including optics.

When there is no sensing object in the proximity detection path, no reflected infrared signal is reflected back to be captured by the proximity sensor, and the sensor output consists of default baseline counts, as seen in Figure 1.

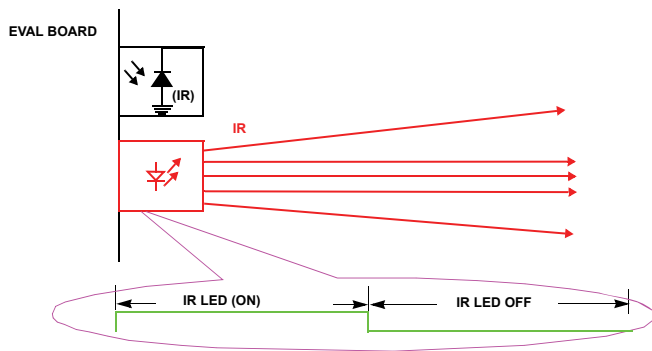


Figure 1. No Sensing Object in Proximity Detection Area

When the sensing object is within a detectable distance from the center point between the IR LED and the infrared sensor, the sensor captures the reflected signal and the proximity readout is linearly proportional to the captured infrared light signal intensity, which is inversely proportional to the square of the distance.

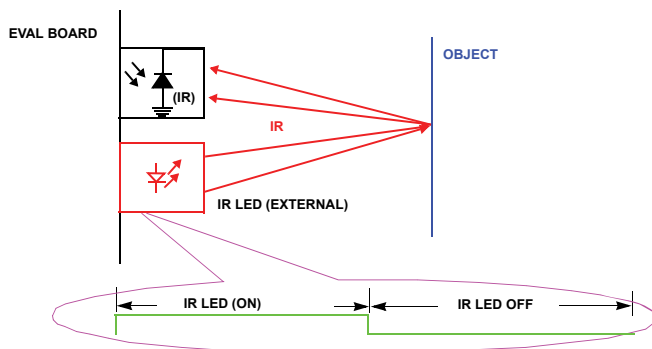


Figure 2. Sensing Object Within 10cm For Proximity Detection

Sometimes the proximity subsystem is designed to simply respond to the presence of nearby objects. The classic example is a cell phone that turns off its screen when the user holds the phone next to his or her ear.

It is possible to do more than that, however. An integrated ambient light sensing and proximity sensing system can also detect approaching or departing objects. This allows the microprocessor to make much more complicated control or adjustment decisions.

In summary, proximity sensors

- Make a decision based on the proximity of an object to the sensor
- Increase power efficiency and improve user experience
- Are must for today's smartphone applications!

What's new with ALS and Proximity Sensing?

The latest generation provides a range of new features. One such feature is ambient-IR cancellation during proximity sensing, which allows the sensor to properly function under direct sunlight. Another feature accommodates four different ambient light sensitivity ranges, sensing light conditions from as low as 0.015 Lux to as high as 64,000 Lux. An interrupt function serves as an alarm/monitoring function to determine whether the ambient light level or the proximity detection level has exceeded the upper threshold or gone below the lower threshold. These devices also allow the user to configure the persistency of the interrupt through a digital interface. There are novel applications as well. A recently announced product is an optical tactile sensor, a 'touch button' solution that eliminates as many as eight mechanical or capacitive buttons, and can be used for various up/down scrolling for dimming or volume control.

ALS + PROXIMITY SENSOR

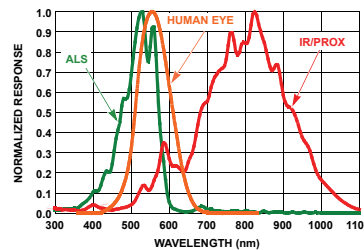
ISL29028A

Low Power ALS & Proximity Sensor with Intelligent Interrupt and Sleep Modes

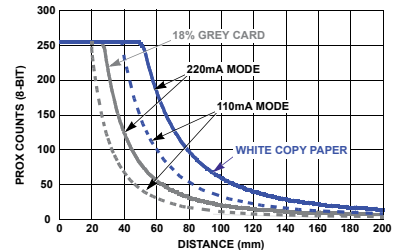
The ISL29028A is an integrated ambient and infrared light-to-digital converter with a built-in IR LED driver and I²C Interface (SMBus Compatible). This device uses two independent ADCs for concurrently measuring ambient light and proximity in parallel. The flexible interrupt scheme is designed for minimal microcontroller utilization.

- **Works Under All Light Sources, Including Sunlight**
- **Low Power**
- **Intelligent ALS and Proximity Interrupt Scheme Simplifies μ C Code**
- **Dual ADC Architecture**
- **Ambient Light Sensing**
 - Ideal light sensor response
- **Proximity Sensing**
 - 850nm and 940nm LED compatible
 - Ambient IR noise cancellation
- **Intelligent and Flexible Interrupts**
 - Independent ALS/Prox interrupt thresholds
 - Selectable persist control
- **Ultra Low Power**
 - 138 μ A (Typ) including IR LED current
- **Easy to Use**
 - Set Registers; wait for interrupt
 - I²C (SMBus compatible) output
 - Small package - 2.0x2.1x0.7

Ideal Proximity Performance Under All Lighting Conditions



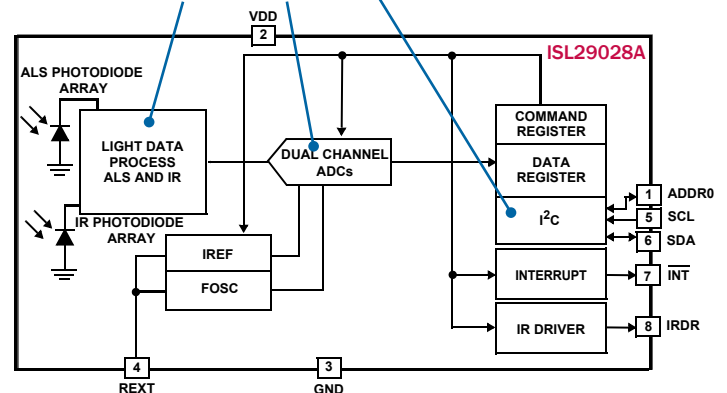
Sensitivity to Different Wavelengths



Prox Counts vs Distance with 10cm X 10cm Reflector (Using ISL29028 Evaluation Board)

Advanced Features, But Also Very Easy to Use

Independent Proximity and Ambient Light Sensing and Control



Tiny Combined ALS / Proximity Sensor in One Space-Saving Package

8 Ld ODFN 2.0 x 2.1 x 0.7 (mm)



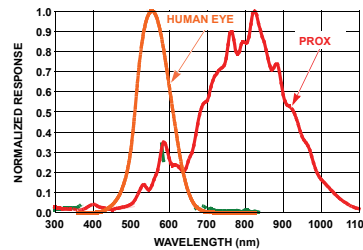
ALS + Proximity Sensor

Device	Peak Sensitivity (nm)	V _S (Min) (V)	V _S (Max) (V)	Supply Current (Max) (μ A)	Resolution (Bits)	Lux Range (Min) (Lux)	Lux Range (Max) (Lux)	Counts per Lux (Max) (Counts)	Dark ADC Code @ E _v = 0Lux (Max) (Count)	Gain Selection?	Output Interface	Address Selection Pins?	Interrupt Pin?	Package Dimensions (mm)	Package
ISL29011	540	2.25	3.63	90 μ A	16	0.015	64,000	65	5	Y	I ² C	N	Y	2.0x2.1x0.70	8 Ld ODFN
ISL29018	540	2.25	3.63	(without IR LED current)	16	0.015	64,000	65	5	Y	I ² C	N	Y	3.0x3.0x0.70	8 Ld ODFN
ISL29028A	540	2.25	3.63	125 μ A	12	0.03	2,000	30	3	Y	I ² C	Y	Y	2.0x2.1x0.7	8 Ld ODFN
ISL29029	540	2.25	3.63	(with LED current)	12	0.03	2,000	30	3	Y	I ² C	Y	Y	2.0x2.1x0.7	8 Ld ODFN
ISL29030A	540	2.25	3.63		12	0.03	2,000	30	3	Y	I ² C	N	Y	2.0x2.1x0.7	8 Ld ODFN

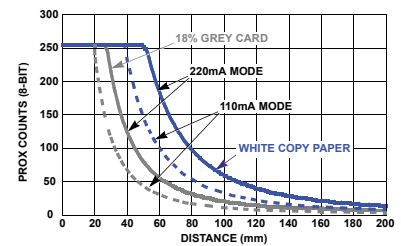
Proximity Sensor with Intelligent Interrupt and Sleep Modes

- **Works Under All Light Sources, Including Sunlight**
- **Low Power**
- **Intelligent Proximity Interrupt Scheme Simplifies μ C Code**
- **Proximity Sensing**
 - Proximity sensor with broad IR spectrum
 - IR LED driver with I²C programmable sink currents
 - Ambient IR noise cancellation (Including sunlight)
- **Intelligent and Flexible Interrupts**
 - Proximity interrupt thresholds
 - Adjustable interrupt persistency
- **Ultra Low Power**
 - 138 μ A DC typical supply current for prox sensing
 - <1.0 μ A supply current when powered down
- **Easy to Use**
 - Set registers; wait for interrupt
 - I²C (SMBus compatible) output
 - Temperature compensated
 - Tiny ODFN8 2.0x2.1x0.7 (mm) package

Ideal Proximity Performance Under All Lighting Conditions



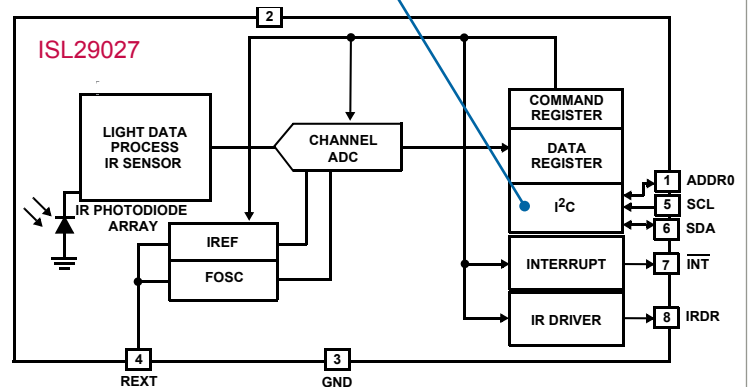
Sensitivity to Different Wavelengths



Prox Counts vs Distance with 10cm X 10cm Reflector

Advanced Features, But Also Very Easy to Use

Intelligent and Flexible Interrupts



Proximity Sensor

Device	Peak Sensitivity (nm)	V _S (Min) (V)	V _S (Max) (V)	Supply Current (Max) (μ A)	Resolution (Bits)	Gain Selection?	Output Interface	Address Selection Pins?	Interrupt Pin?	Package Dimensions (mm)	Package
ISL29021	840	2.25	3.63	90 μ A (without IR LED current)	16	Y	I ² C	N	Y	2.0x2.1x0.70	8 Ld ODFN
ISL29027	840	2.25	3.63	125 μ A (with LED current)	8	N	I ² C	Y	Y	2.0x2.1x0.7	8 Ld ODFN

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ISL29007
Small, Low Power, Current-Output Ambient Light Photo Detect IC

Printer Friendly

- Features Description
- Technical Documentation
- Pricing / Samples
- iSim Design Simulation
- Tools And Support
- Related Devices

Datasheet

 **ISL29007**
Small, Low Power, Current-Output Ambient Light Photo Detect IC

Peak Spectral Sensitivity (nm)	550
V _s (Min) (V)	1.8
V _s (Max) (V)	2.6

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