Frequently Asked Questions
... and more

The following is a list, derived from the Internet FAQ, which should assist in dealing with common questions and topics from customers calls.

The links point either to the relevant apps. Note, Application manual, or specific data sheet.

Content

Pin Functions

How to use the PC pin

During normal operation, the PC pin indicates the correct function of the module by sourcing a constant 5.8V output. In case of internal failure, or alarm, the PC pin will start producing a low frequency pulse train, indicating that the module is trying to re-start.

Both cases can be easily monitored by an external circuit. If it is necessary to disable the module, the PC pin must be pulled low, below 2.7 V thresholds. In this case, it is necessary to either 'blind' the monitoring circuit, or disregard its output, as in this case the abnormal PC pin voltage is a wanted situation due to the switch off of the module.

If I am not using the Gate In, Gate Out, or Trim pins on VI-200 / VI-J00 converters and the PC, PR or SC on the Maxi, Mini and Micro converters, can I leave them floating?

This depends on how the converters are being applied; however, some applications do not require the functionality that these pins provide. Hence these pins can be left as a "no connect".
See the Vicor Applications Manual and Maxi, Mini and Micro Design Guides for more information.

- Application Manual http://cdn.vicorpower.com/documents/applications_manual/200VIJ00_Sect_2.pdf

Trimming

How to

- VI-200/VI-J00 http://cdn.vicorpower.com/documents/applications_manual/200VIJ00_Sect_5.pdf
- Maxi/Mini/Micro http://cdn.vicorpower.com/documents/applications_manual/02control_pin.pdf
- Tech Tip http://www.vicoreurope.com/support/technical_tips/output_voltage_trimming/
- Online Calculator http://www.vicorpower.com/technical_library/powerbench/design/
- Wide Trim http://cdn.vicorpower.com/documents/design_articles/pb_wide-trim.pdf

Why does the output power decrease if I trim the output voltage down?

Vicor power converters have a fixed output current limit. The output power rating divided by the rated output voltage (Po/Vo) is the rated output current (Io). Since the maximum current is fixed, a reduction in voltage reduces the output power. For example, a 5 V / 50 W module can deliver 10 A. If the converter's output voltage is trimmed down to 2.5 V, the converter can still only deliver up to a 10 A maximum; therefore, the available maximum power is now 25 W.

Y-Capacitor

What is a Y-Capacitor? Can I use another type of capacitor in my application?

To meet general EMI/RFI requirements, Vicor recommends the use of Y-capacitors with all power conversion modules. Y-capacitors meet IEC384-14, EN132400 and UL1283 standards.
All applications utilizing DC-DC converters should be properly bypassed, even if no EMC standards need to be met. Bypass power input and output pins to each module baseplate.

- Apps Manual http://cdn.vicorpower.com/documents/applications_manual/200VIJ00_Sect_3.pdf
- Apps Manual http://cdn.vicorpower.com/documents/applications_manual/200VIJ00_Sect_9.pdf

Remote and Local Sense

What is the difference between remote and local sense?

Local Sense involves using the power supply output power terminals as the sense points to provide feedback to the internal voltage regulation circuitry. Remote sense involves detection of output voltage at a point remote from the power supply, enabling the power supply to regulate output voltage and to compensate for voltage drop typically associated with long power cables. This permits greater accuracy of regulation than local sensing. The sense connections (from the sense pins) determine the regulation point, either at the converter output (local sense) or at the load (remote sense) to compensate for voltage drop. It is important to "close" the sense lines, i.e., +S to +Out, -S to –Out, as described above for proper operation of the module; and it is an absolute MUST for Maxi and Mini modules.

- Tech Tip http://www.vicoreurope.com/support/technical_tips/local_and_remote_sensing/

Thermal Management

Do the Vicor modules need a heat sink?

This depends on a variety of factors within the application such as the maximum ambient temperature specific to the module's location, availability of forced convection cooling, loading characteristics and the converter's efficiency. It is important to note that the advantage of a baseplated module versus the limitation of the open frame or bare-board converters is the flexibility of easily adding a heat sink to the baseplated module if needed.

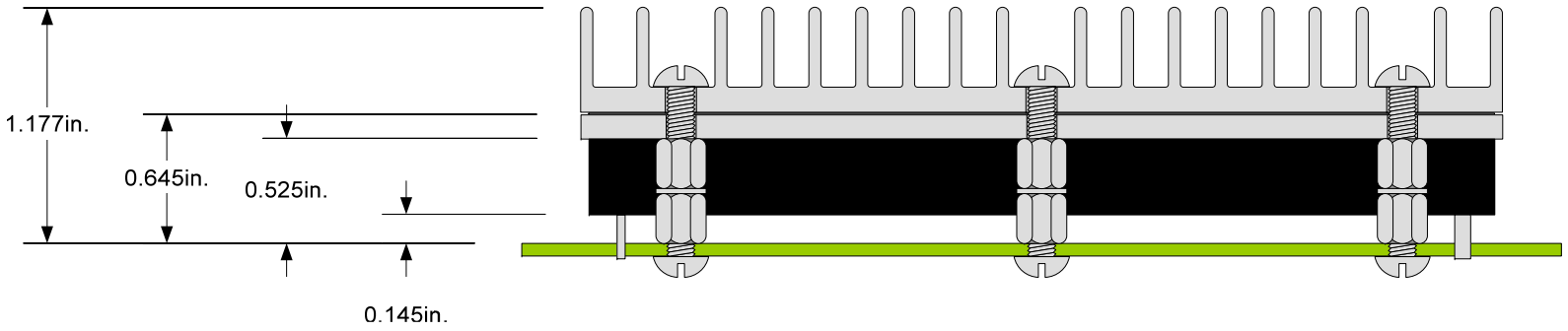
- Application manual http://cdn.vicorpower.com/documents/applications_manual/200VIJ00_Sect_20.pdf
- Tech Tip http://www.vicoreurope.com/support/technical_tips/keeping_ones_cool/
- Thermal calculator http://www.vicorpower.com/technical_library/calculators/calc_thermal.htm
- Thermal curves http://www.vicorpower.com/technical_library/calculators/calc_thermal.htm

Brick Mounting Do's and Don'ts

- Do not solder wires directly to the pins of the modules
  - If direct wire connections are required, recommend using a BusMod, Mega Module, or VIPAC Array
- Do not overheat the pins during soldering
  - Specific guidelines are for hand and wave soldering can be found in the online Module Design Guides
- Module standoffs should always be used
  - Provides mechanical support and rigidity to meet shock/vib requirements
  - Provides a means of safety grounding the baseplate
  - Provides a means of connecting the bypass capacitors to the baseplate for EMI noise suppression
- Always use a thermal interface material (pad or grease)
  - Insures proper heat transfer between the module's baseplate to a heatsink or conduction plate

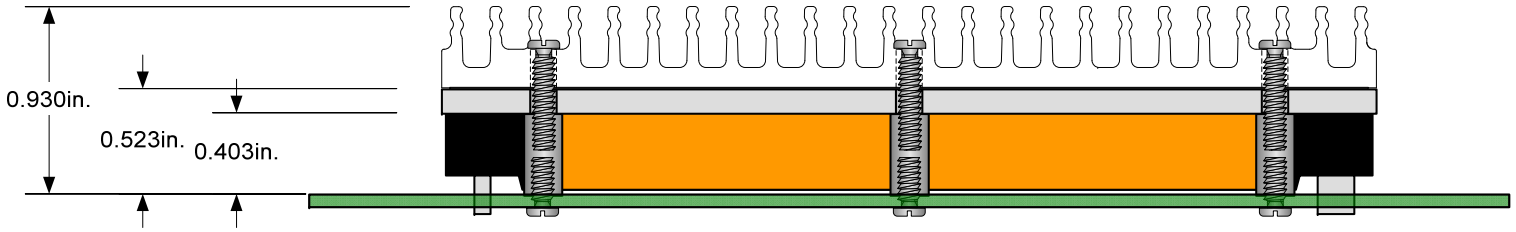
VI-200 Mounting Example

1. Printed Circuit Board
2. #32183-01: Standoffs
3. #6-32 screws (not provided by Vicor)
4. VI-200 Module
5. #20266: ThermMate Thermal Pad
6. #30194: Heatsink
7. #6-32 screws (not provided by Vicor)



Maxi Mounting Example

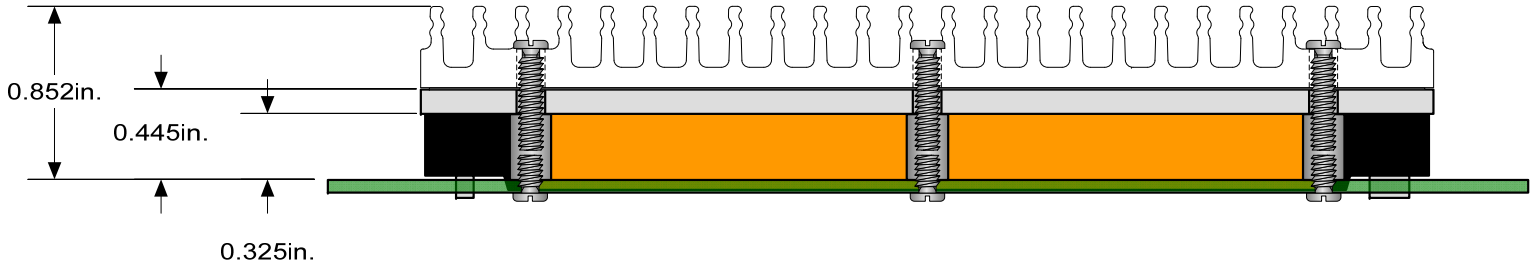
Onboard Mount



1. Standoffs
2. Module
3. ThermMate
4. Heatsink

0.062” nominal

Inboard Mount



0.062” nominal

Soldering

- RoHS http://www.vicorpower.com/documents/application_notes/rohssoldering.pdf
- Non RoHS http://www.vicorpower.com/documents/application_notes/nonrohssoldering.pdf
- VI-Chip http://cdn.vicorpower.com/documents/application_notes/vichip_appnote9.pdf

Can I solder wires directly to the pins?

Vicor does not recommend direct wire connections to the module pins of it's converters as the mechanical loading and thermal stress from bench soldering may cause potential reliability concerns. The modules are intended to be used in PCB applications with controlled soldering techniques. If chassis mounting is preferred Vicor offers packaging options for the VI-200/VI-J00 Series (MI-200/MI-J00) as BusMod, MegaMod or ComPAC products and for Maxi, Mini and Micro converters with VIPAC Arrays and VIPACs, which will facilitate discrete wire connections.

Cutting wires after soldering

The pins must be cut after the module has been soldered on the PCB. The correct word is not 'Cut' but instead 'Shear', i.e. an action which will not cause any force axial to the pin, but only perpendicular to it, to avoid any pulling stress on the solder joint. Ideally, after the cutting (or shearing) action, the pin should be re-flowed to eliminate any crack on the solder joint. If you do a search on the web for 'shearing tools' you'll find a whole lot of manufacturer such as Excelta, Excelite, Cooper-tools and so on, who offers a large choice of shear cutters, both manual or automatic, for production lines.

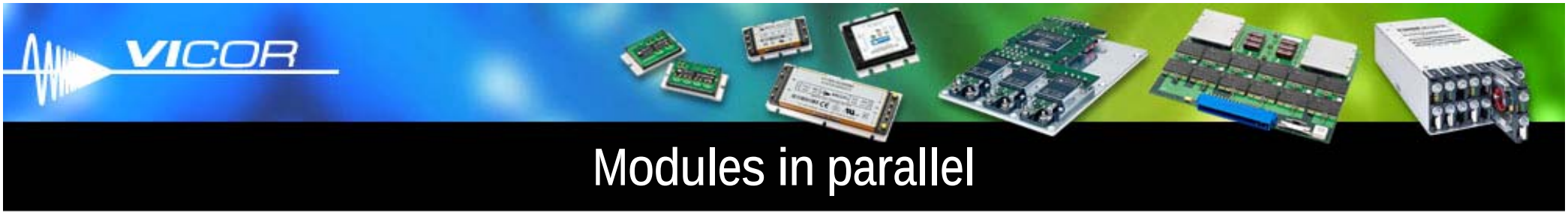
Filtering

Do I need filtering on the input and/or output side of the power converters?

All switching power supplies generate signals that could potentially interfere with other electronic circuits as a result of the switching action. Vicor's quasi-resonant, zero-current-switching topology generates far less conducted and radiated noise than other topologies in both magnitude and frequency spectrum. EMI filtering can reduce the noise by an additional 40 – 60 dB. Depending upon your application, additional filtering may be needed to meet agency and/or load requirements.
Some basic guidelines to follow for successful EMI filtering are:

- Keep current loops small. The ability of a conductor to couple energy by induction and radiation is proportional to the loop area.
- For conductor pairs, use wide (low Z) copper traces aligned above and below each other.
- Locate filters close to the source of interference; i.e., the power converter.
- Filter component values should be chosen with consideration to the desired frequency range of attenuation. For example, capacitors are self-resonant at some frequency, beyond which they look inductive.
- Keep bypass capacitor leads as short as possible.
- Bear in mind the proximity of noise sources to potentially susceptible circuits when locating components on the board.
- Contact Vicor applications engineering for assistance.

- Application Manual http://cdn.vicorpower.com/documents/applications_manual/200VIJ00_Sect_9.pdf
- Tech Tip http://www.vicoreurope.com/support/technical_tips/basic_guideline_for_EMI_filtering/



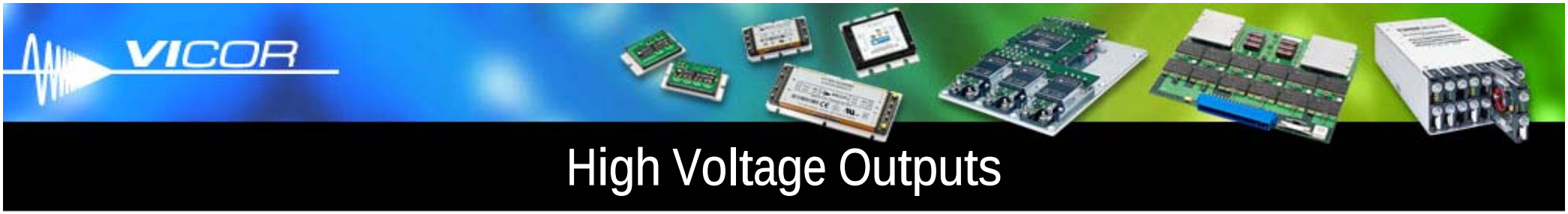
Modules in parallel

Up to 12 modules can be paralleled together, provided that you use the 'PR' transformer method for paralleling/current sharing. Information about these connection arrangements can be found on Figure 2-8 & 5-4 of the Applications Manual:

- http://cdn.vicorpower.com/documents/applications_manual/02control_pin.pdf
- http://cdn.vicorpower.com/documents/applications_manual/05current_sharing.pdf

- Datasheet PR transformer http://vdac2.vicr.com/CADPDF/7B34YB.PDF

- Application Note: High power arrays with Maxi/Mini/Micro http://cdn.vicorpower.com/documents/application_notes/AN_Designing%20High-Power%20Arrays.pdf



High Voltage Outputs

For applications that require high voltage outputs, multiple converters may be used in a series output configuration to produce a single output voltage that is the sum of all of the converter out puts in the array.

- Application Note http://cdn.vicorpower.com/documents/application_notes/an1_high-vout.pdf

Load Sharing

Do your modules load share?

An aspect of the Vicor topology is that two or more power trains driven at the same frequency will inherently load share if their outputs are tied together. The VI-200 family has associated booster modules, VI-Bxx- that may be slaved to a Driver, allowing construction of multi-kilowatt arrays.
This is documented in more detail in the Vicor Applications Manual.

Vicor's Maxi, Mini and Micro power converters have the capability of being configured in a fault-tolerant, power sharing "democratic" array. Load sharing for parallel connections is achieved through the PR pin, on the input side. Substantially, the principle is that both modules can apply pulses on the PR pin. The module with the highest output voltage shows a higher PR frequency (Master Module), and will synchronize the other modules. At this point, as both units operate at the same frequency, and have identical internal components, they will transfer the same energy, and therefore the same power.

For additional information regarding parallel operation of our Maxi, Mini and Micro converters, please see the Application Notes section of our web site.

- Tech Tip http://www.vicoreurope.com/support/technical_tips/paralleling_outputs/

Battery Charging

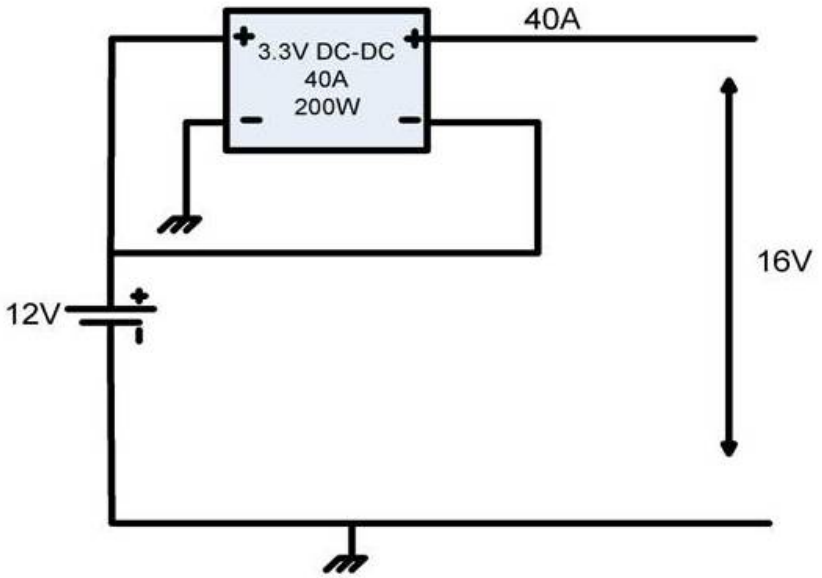
How to design a battery charger

- Technical Article http://www.vicorpower.com/documents/design_articles/pb_battery-charger.pdf
- Application Note http://www.vicorpower.com/documents/application_notes/an1_battery-charger.pdf

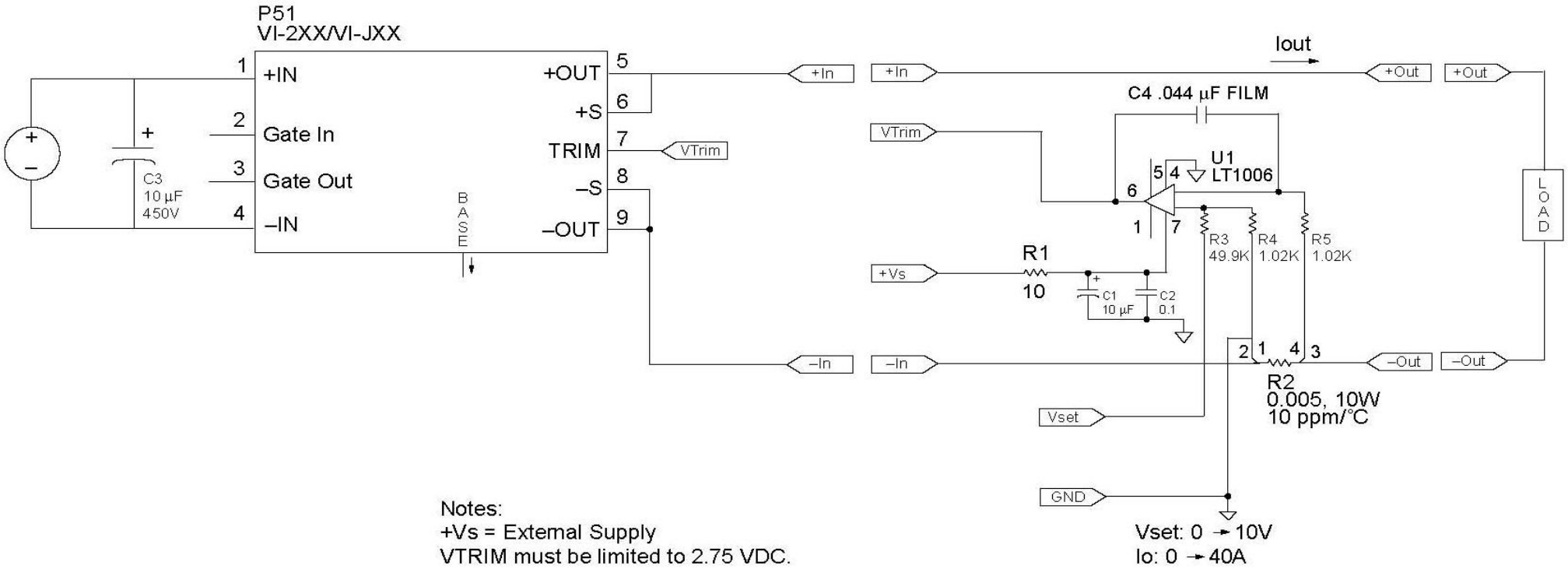
Boosting up a Battery Voltage

As the modules are insulated, placing the output voltage in series with the module supply voltage at the input is not a problem.
A couple of remarks need to be done although:

1) be aware that the total output voltage is not regulated. If the battery voltage drops to 10 V, the module will still supply 3.3 V, but the total voltage will only be 13.3 V.
2) as the module's output is in series with another voltage source, it is recommend to put a diode in parallel, to avoid that the module could be reversed biased by the battery.
3) there is no current limit. If you have an output short, the module will limit its current to 40A, but the battery can still deliver all what it can.

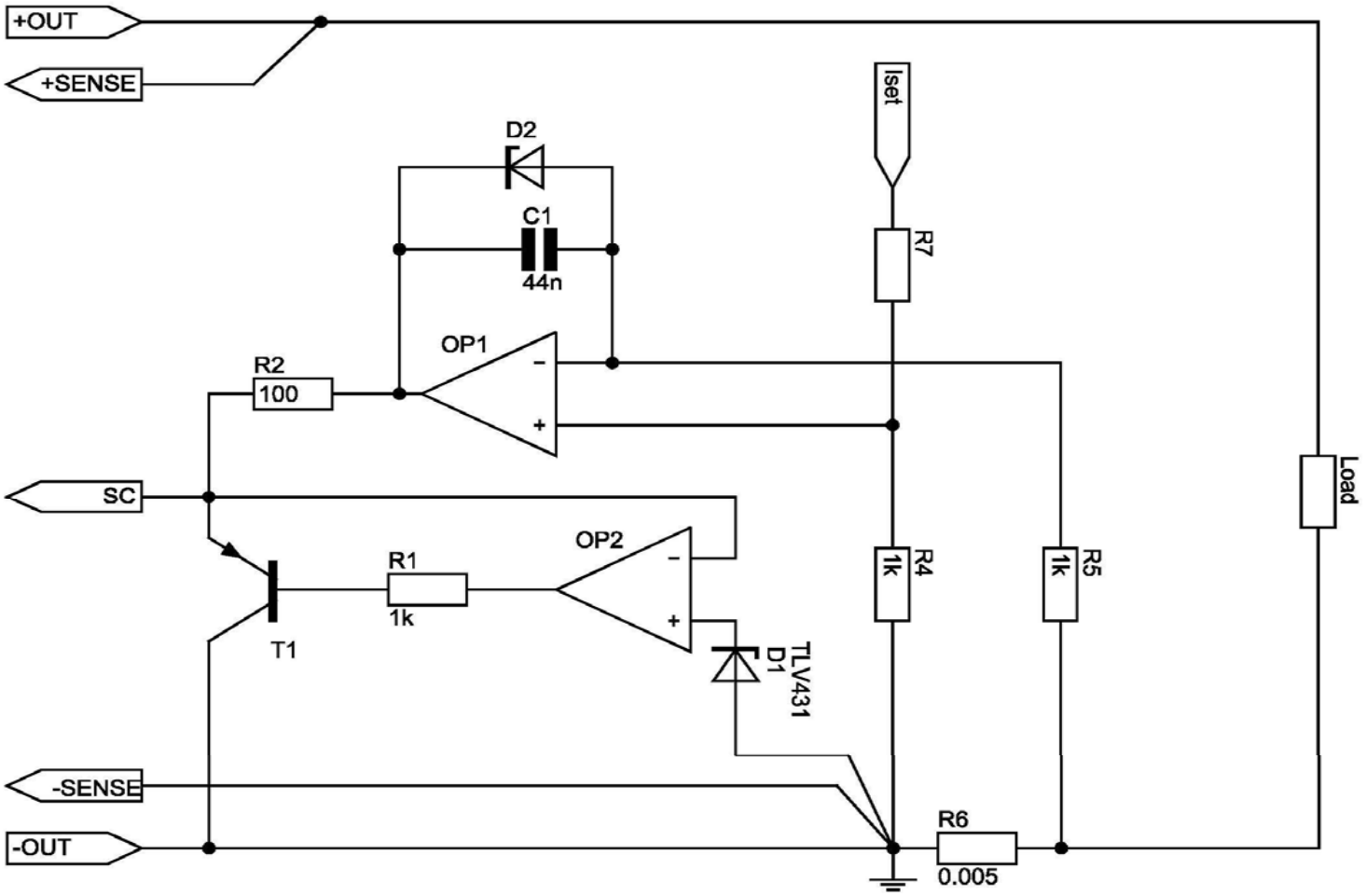


Constant Current Source 1 (see also next page)



- Application Note http://cdn.vicorpower.com/documents/application_notes/an_ConstantCurrent.pdf

Constant Current Source 2



Application recommendation, circuit not tested!

Negative Output

How do I create a negative output?

Vicor power converters have isolated outputs so they can be referenced to a common mode creating either positive or negative rails. To create a negative 5 V output for example, the +Out of the module would be connected to the common return (earth ground, chassis ground, etc). The -Out would then be treated as the "supply".

Fuse Input

Do I need to fuse the input of the converter?

Safety agency conditions of acceptability require that the module be fused to prevent fire hazard in case of catastrophic failure. The fuse must be in series with the positive (+) input lead. PR and PC terminals of the Maxi, Mini and Micro converter (Gate In and Gate Out of the VI-200 / VI-J00 converters) are referenced to the –Input. If a fuse located in the –Input lead were to open, the PR and PC terminals (Gate In and Gate Out) would rise to the potential of the +Input. This could damage any converter or circuitry connected to these pins.

- Apps Manual http://cdn.vicorpower.com/documents/applications_manual/200VIJ00_Sect_3.pdf

Switching Frequency

Switching frequency of VI-200 / VI-J00 and Maxi, Mini and Micro converters

Vicor VI-200 / VI-J00 and Maxi, Mini and Micro power converters use frequency modulated, quasi-resonant, zero-current switching in contrast to the pulse-width-modulated (PWM) switchers. As such, the operating frequency is both input line and output load dependant, and could range from under 100 kHz at light load, high line, to around 1 MHz at full load, low line. As a result, Vicor's zero-current switching has much lower conducted and radiated noise levels than conventional pulse-width-modulation (PWM) converters, typically 20 – 40 dB lower.

VI Chips are resonant converters with fixed frequency

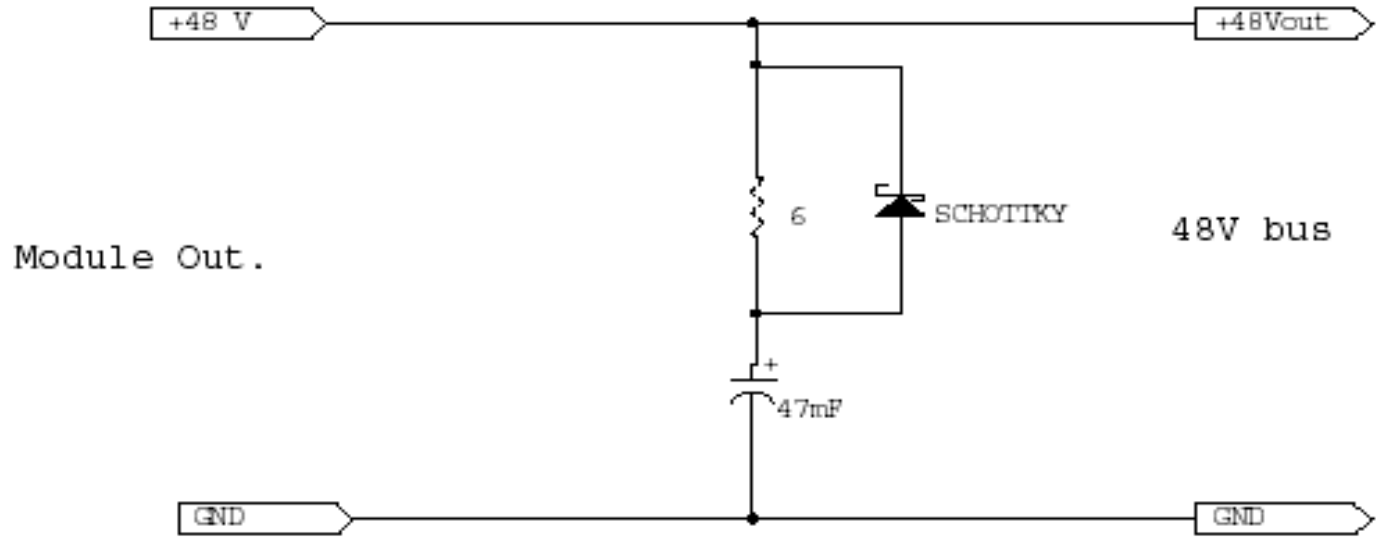
VTM/BCM	~ 3,5 MHz	
PRM	~ 1,1 - 1,5 MHz	(depending on part number)

Detailed values see datasheet.

Adding capacitors to the output of a Vicor module

The gain-phase margin of the regulation loop inside the modules limits the maximum value of capacitors connected to the output. Maximum values depend on the specific module.

Important note:
Large capacitors can also force the modules into the current limitation during start up. Due to the type of current limiting used in Micro, Mini and Maxi modules, resembling a hick-up sequence, this situation can be harmful for the module, and can lead to long term failures. Slowing down the module ramp-up time, by adding a capacitor in parallel to the trim pin, may improve the situation, however it is not easy to quantify the effect mostly at the initial start-up, when the output voltage is still very low, but still there is the possibility to have large output current pulses. To limit the charging current to the capacitor at start-up, still allowing a quick discharge in case of power failure, following circuit is recommend:



(example for a module with 48V/200W output. The 6 Ohm resistors limits the maximum current at 48V output to 8A)

HoldupBox Alternatives

Flat Caps as alternative for HoldupBox

Cornell Dubilier MLP capacitors, available through Digikey or Nippon Chemicon KLM series.
Please remind the customer that the holdup box sold by Vicor is not only two AlEl caps in series, beside the balancing resistors in parallel to each cap, there is also a built-in safety feature: there are no dangerous voltages exposed to the user. This is an IMPORTANT safety feature of our product that the customer needs to replicate in their custom solution.

Holdup Caps with -55°C Operating Temp.

Check at Cornell-Dubilier. The types 101, 125, 300, 330 are rated at -55°C.

www.cornell-dubilier.com

Enable/Disable Timing

As soon as the 'PC' pin is brought below 2.3V, power conversion is halted and the module is inhibited. If this occurs mid-cycle, then that cycle is completed, making a maximum delay of about 500ns. The time taken for the output to drop is then simply a function of the energy stored by resonant capacitors, filter capacitors and inductive components on the secondary-side of the converter and the loading on the module.

The 'PC' pin has a self running timer, whose frequency is input supply voltage related. If the input supply is present for at least a few hundred milliseconds prior to the release of the enable, then the operation will be as follows. Every 2-20ms it checks whether the inhibit short has been removed (and that the other inhibiting signal flags are clear, such as input under-voltage, over-temperature, etc). Please see figure 2 of the module datasheet for further details. If all is clear then the 'PC' signal will go high, immediately. The output of the module will then ramp-up linearly and monotonically to the set point voltage in typically 4 milliseconds (worst case 7ms and normally not less than 3ms). Therefore depending on when you remove the 'PC' inhibit in relation to this 2-20ms retry timer, the 'PC' pin could go high immediately, or may take as long as 20ms. Therefore the enable time is not well defined and can be between 3 - 27 milliseconds and is likely to be different each time you test a particular module.

PFC

What is PFC, and what does it mean to me?

Active Power Factor Correction (PFC) is the technique of controlling the current flow into the device to track the applied voltage waveform. A specific example of a non-linear load is a line-operated switching power supply with a capacitor input filter. This type of load draws no current until the line voltage is near the peak; then draws a large pulse of current as the voltage passes through the waveform peak. Power Factor Correction (PFC) would require the power supply to force the input current to have the same wave shape as the ac voltage source.

- Application note http://cdn.vicorpower.com/documents/application_notes/an1_active-pfc.pdf

Three-Phase MegaPAC

Can the Three-Phase MegaPAC or Vicor Modules operate from an European Three-Phase main?

No, the Three-Phase MegaPac is designed to operate on an USA Three-Phase main, i.e with 208 Vac Delta (Phase to Phase). The European Three-Phase main has 380-400 Vac Phase to Phase, therefore rectified voltage is 530-620 Vdc. Damage will occur to the unit if connected to such a high voltage. Maximum input voltage of the Vicor modules is 400-425 Vdc.

Can the Three-Phase MegaPAC operate from a single-phase input?

The Three-Phase MegaPAC can be powered from a single-phase source as long as the input voltage is between 180 – 264 Vac. Although it is possible to connect the Line and Neutral wires to any of the J1 Line inputs, the most common wire scheme is listed below. For safety purposes, it is important to first verify that the input circuit is OFF, before handling any of the input wires. After confirming there is no input voltage on the wires, configure the J1 Input Power Connector as shown below.

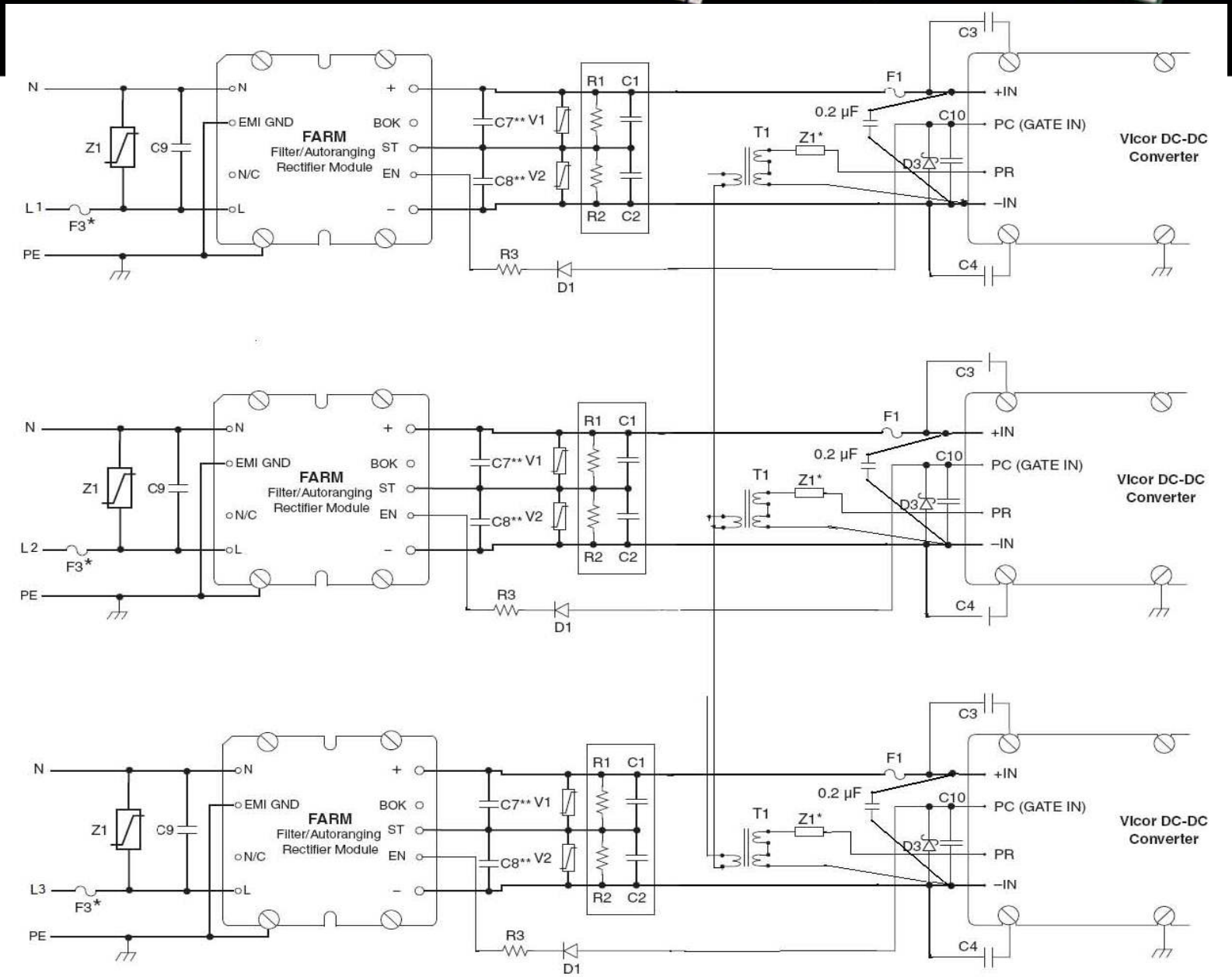
- J1-1 Line
- J1-2 Neutral
- J1-3 No Connect
- J1-4 Earth Ground

Please refer to the Three-Phase / 4 kW MegaPAC Design Guide for information regarding single-phase power deratings.

European Three-Phase Input (230 Vac)

FARMs can be used from max. 230 Vac only. In an Europan Three-phase system three FARMs can operate each between one single phase and neutral. In this case three seperate DC/DC Converters will be required, synchronized by PR Transformers. Please see the schematic next page.

- Datasheet: http://cdn.vicorpower.com/documents/datasheets/ds_farm.pdf
- Apps Note: http://cdn.vicorpower.com/documents/application_notes/an2_pr-pin.pdf
- Module output connections should follow the recommendation on page 8 of 87 of the Application Manual: http://cdn.vicorpower.com/documents/applications_manual/02control_pin.pdf

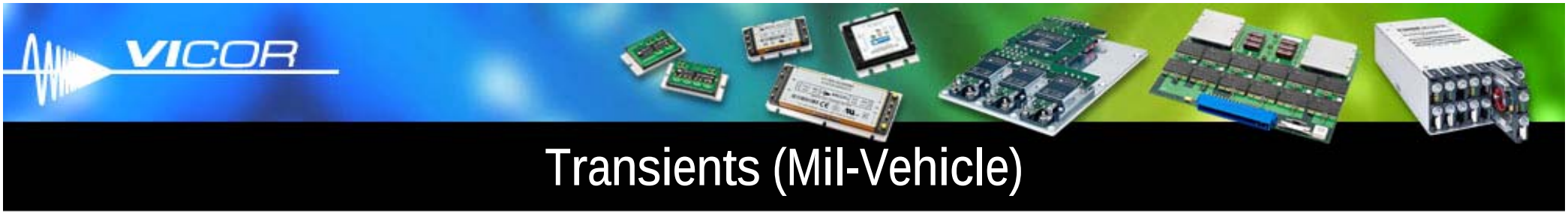

N
L1
PE
Z1
C9
F3*
EMI GND
N/C
FARM
Filter/Autoranging
Rectifier Module
BOK
ST
EN
C7** V1
C8** V2
R1
C1
R2
C2
R3
D1
T1
Z1*
F1
0.2 µF
C10
D3
C3
C4
+IN
PC (GATE IN)
PR
–IN
Vicor DC-DC
Converter
L2
L3

Railway

Using Modular DC/DC Converters to Meet European Standards for Railway Applications

In Europe, the performance of electrical and electronic equipment in railway applications is governed by two international standards.
The one most frequently cited in design specifications is the document IEC571, “Electronic Equipment on Rail Vehicles,” also known as European Norm EN50155, “Electronic Equipment Used on Rolling Stock Equipment.” In the U.K. the standard that applies is RIA12, “General Specification for Protection of Traction and Rolling Stock Equipment from Transients and Surges in DC Control Systems,” developed by the Railway Industries Association (RIA).

- Application Note http://www.vicorpower.com/documents/application_notes/an1_euro-railway.pdf



Transients (Mil-Vehicle)

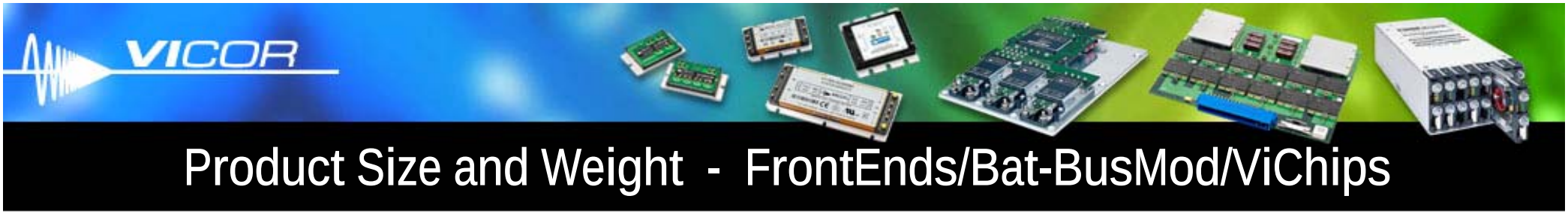
Meeting transient specifications for electrical systems in military vehicles

Electrical systems in military vehicles are normally required to meet stringent transient requirements. Typical of these specifications are MIL-STD-1275B in the U.S.A. and DEF-STAN 61-5 (Part 6)/Issue 5 in the UK. Although the specified levels of these surges and spikes are outside the capability of Vicor 2nd Generation modules, it is quite possible, with simple circuitry, to make the 24 V input (18-36 V input range) DC-DC converter modules compliant to these specifications for the 28 V vehicle voltage system.

- Application Note http://www.vicorpower.com/documents/application_notes/milvehicle_appnote.pdf
- Datasheet http://cdn.vicorpower.com/documents/datasheets/ds_M-FIAM9.pdf

Product Size and Weight - Modules

PRODUCT TYPE	*L"*	*W "*	*H "*	*WEIGHT PER UNIT (KG)*	*-CC (KG)*	*-H1 (KG)*
VI-/MI-200 "E,C,I,M" grade including SlimMod	4,6	2,4	0,5	0.178kg		
VI-/MI-J00 "E,C,I,M" grade	2,28	2,4	0,5	0.107kg		
FLATPAC 1UP "E,C,I" grade	9,25	2,5	1,37	0.635kg	0.816kg	
FLATPAC 2UP "E,C,I" grade	9,25	4,9	1,37	1.248kg	1.59kg	
FLATPAC 3UP "E,C,I" grade	9.25	7,3	1,37	1.843kg	2.32kg	
PFC FLATPAC(VE-CMU) "E,C,I" grade	1,37	4,9	9,25	1,304kg		
COMPAC 1UP "E,C,I" grade	9,25	2,5	0,99	0.544kg	0.636kg	0.590kg
COMPAC 2UP "E,C,I" grade	9,25	4,9	0,99	1.248kg	1.27kg	1.23kg
COMPAC 3UP "E,C,I" grade	9,25	7,3	0,99	1.633kg	1.91kg	1.82kg
MEGAMOD 1UP "E" grade	4,9	2,5	0,62	0.255kg		
MEGAMOD 2UP "C,I,M" grade	4,9	4,9	0,62	0.544kg		
MEGAMOD 3UP "C,I,M" grade	4,9	7,3	0,62	0.771kg		
MEGAMOD JR 1UP "E" grade	2,58	2,5	0,62	0.128kg		
MEGAMOD JR 2UP "C,I,M" grade	2,58	4,9	0,62	0.250kg		
MEGAMOD JR 3UP "C,I,M" grade	2,58	7,3	0,62	0.377kg		
MAXI (FULL-BRICK) "E,C,T,H,M" grade	4,6	2,2	0,5	0.233kg -0.235kg		
MINI (HALF-BRICK) "E,C,T,H,M" grade	2,28	2,2	0,5	0.111kg - 0.113kg		
MICRO (QUARTER-BRICK) "E,C,T,H,M" grade	2.28	1.45	0.5	0.652kg - .0680kg		



Product Size and Weight - FrontEnds/Bat-BusMod/ViChips

PRODUCT TYPE	*L"*	*W "*	*H "*	*WEIGHT PER UNIT (KG)*
FRONTENDS				
VI-FPE6-CUX				**0.184kg**
VI-FKE6-CUX				**0.340kg**
VI-FPE6-CQX				**0.391kg**
VI-FKE6-CQX				**0.610kg**
VI-FPE6-CMX				**0.496kg**
VI-FKE6-CMX				**0.737kg**
VI-TKY6-CHX				**0.862kg**
VI-TKY6-CEX				**0.150kg**
VI-TRY6-CCX				**0.286kg**
BATMOD				**0.170kg**
BUSMOD				
VI-2XX-XX-B1				**0.357kg**
MI-2XX-XX-B1				**0.357kg**
VI-JXX-XX-B1				**0.181kg**
MI-JXX-XX-B1				**0.181kg**
VICHIPS				
BCM	1.28/32.5mm	0.87/22.0mm	0.26/6.6mm	0.015kg
PRM	1.28/32.5mm	0.87/22.0mm	0.26/6.6mm	0.015kg
VTM	1.28/32.5mm	0.87/22.0mm	0.26/6.6mm	0.015kg

Product Size and Weight - Picor

PRODUCT TYPE	*L"*	*W "*	*H "*	*WEIGHT PER UNIT (KG)*
QPO-1L	25	25	4.5mm	.0031kg
QPO-2L	25	25	4.5mm	.0025kg
QPI-3L	25	25	4.5mm	.0043kg
QPI-4L	25	25	4.5mm	.0043kg
QPI-5L	25	25	4.5mm	.0053kg
QPI-6L	25	25	4.5mm	.0054kg
QPI-7L	25	25	4.5mm	.0047kg
QPI-8L	25	25	4.5mm	.0046kg
QPI-9L	25	25	4.5mm	.0035kg
QPI-10L	25	25	4.5mm	.0037kg
QPI-11L	25	25	4.5mm	.0025kg
QPI-12L	25	25	4.5mm	.0024kg
QPO-1LZ	25	25	4.5mm	.0058kg
QPO-2LZ	25	25	4.5mm	.0058kg
QPI-3LZ	25	25	4.5mm	.0068kg
QPI-4LZ	25	25	4.5mm	.0068kg
QPI-5LZ	25	25	4.5mm	.0076kg
QPI-6LZ	25	25	4.5mm	.0076kg
QPI-7LZ	25	25	4.5mm	.0069kg
QPI-8LZ	25	25	4.5mm	.0067kg
QPI-9LZ -10LZ - DESIGNED FOR VI CHIP PRODUCTS	25	25	4.5mm	.0064kg
QPI-11LZ -12LZ - DESIGNED FOR VI CHIP PRODUCTS	12.5	25	4.5mm	.0034kg

Product Size and Weight - Westcor

PRODUCT TYPE		*L"*	*W "*	*H "*	*WEIGHT PER UNIT (KG) FULLY CONFIGURED*	*WEIGHT PER UNIT (KG) CHASSIS ONLY*
PFC MICRO	SINGLE PACK	14	8	6	2,36	
	2 PACK	13 5/8	8,5	14,5		
	4 PACK	27 1/8	8,5	14,5		
PFC MICRO S					1,41	
FLATPAC-EN					1,5	
QPAC		14	8	6		
REGULAR CONVERTERPAC						
FINPAC						
MODUPAC						
PFC MINI (1 IN BOX)		17	10	6	2,49	
PFC MINI (2 IN BOX)						
PFC MEGAPAC	SINGLE PACK	17	10	6	4,42	2
	2 PACK	14	10,5	17,5		
	4 PACK	28	10,5	17,5		
PFC MEGAPAC HIGH POWER					4,54	
AUTO-RANGING MEGAPAC					4,08	
MINI MEGAPAC	SINGLE PACK	14	10	6	2,84	
	2 PACK	13 5/8	10 5/8	14 1/4		
	4 PACK	21 1/8	13 5/8	14 1/4		
PFC MEGAPAC-EL		20	10	8	5,81	2,19
3 PHASE STANDARD		14	12	9	8,21	5,03
3 PHASE-EL		22	13	10	9,82	5,29
4KW STANDARD		13,9	7,5	4,9	8,47	5,3
4KW-EL		24	13	10	10,09	5,56

VI-200/J00, MI-200/J00 Mechanical Accessories Guide

MODULE	VI-200, VE-200, MI-200	VI-J00, VE-J00, MI-J00
STANDOFFS	Standoffs 32183-01 (Sold individually) (minimum 6 per module)	Standoffs 32183-01 (Sold individually) (minimum 4 per module)
THERMAL PAD	Thermal Pad ThermMate: 20266 (Packets of 10)	Thermal Pad ThermMate: 20267 (Packets of 10)
HEATSINKS	Longitudinal Heatsinks 1.45" Fin: 30780 0.9" Fin: 30089 0.7" Fin: 30775 Transverse Heatsinks 0.9" Fin: 30090 0.7" Fin: 30193 0.4" Fin: 30194	Longitudinal Heatsinks 0.9" Fin: 30191 Transverse Heatsinks 0.9" Fin: 30771 0.4" Fin: 30140
SOCKETS	Sockets 0.04" Pin (require 7 per module): 30074 0.08" Pin (require 2 per module): 30075 (All Sockets sold individually)	Sockets 0.04" Pin (require 7 per module): 30074 0.08" Pin (require 2 per module): 30075 (All Sockets sold individually)
GROUND CLIPS	Ground Clips -F1 and -F2: 32185 -F3 and -F4: 32184 -S: 09674 (Shipped free with module)	Ground Clips -F1 and -F2: 32185 -F3 and -F4: 32184 -S: 09674 (Shipped free with module)
BELLY SHIELDS	Belly Shields with Pem Nuts: 30139 without Pem Nuts: 32175	Belly Shields with Pem Nuts: 32184

Solder Mounting Accessories Guide for Maxi/Mini/Micro Modules

BASEPLATE STYLE

- Slotted (standard)
- Threaded (Style 2)
- Thru-Hole (Style 3)

STANDOFFS

Standoffs

PCB Thickness	Pin Style	Mounting Style	Thru-Hole Heatsink	Threaded Heatsink
0.062" nominal	Non-RoHS: blank	In-Board	Kit: 18150	Kit: 18151
	RoHS: F		Bag: 19126	Bag: 19127
	Non-RoHS: L	On-Board	Kit: 18156	Kit: 18157
	RoHS: G		Bag: 19132	Bag: 19133
0.093" nominal	Non-RoHS: L	In-Board	Kit: 18150	Kit: 18151
	RoHS: G		Bag: 19126	Bag: 19127

*Kit Include: 6 standoffs and #4-40 stainless steel screws
**Bag Include: 100 standoffs (screws not included)


Standoffs

PCB Thickness	Pin Style	Mounting Style	Thru-Hole Heatsink
0.062" nominal	Non-RoHS: blank	In-Board	Kit: 18146
	RoHS: F		Bag: 19122
	Non-RoHS: L	On-Board	Kit: 18150
	RoHS: G		Bag: 19126
0.093" nominal	Non-RoHS: L	In-Board	Kit: 18146
	RoHS: G		Bag: 19122

*Kit Include: 6 standoffs and #4-40 stainless steel screws
**Bag Include: 100 standoffs (screws not included)

Standoffs

PCB Thickness	Pin Style	Mounting Style	Thru-Hole Heatsink	Threaded Heatsink
0.062" nominal	Non-RoHS: blank	In-Board	Kit: 18146	Kit: 18147
	RoHS: F		Bag: 19122	Bag: 19123
	Non-RoHS: L	On-Board	Kit: 18150	Kit: 18152
	RoHS: G		Bag: 19126	Bag: 19128
0.093" nominal	Non-RoHS: L	In-Board	Kit: 18146	Kit: 18147
	RoHS: G		Bag: 19122	Bag: 19123

*Kit Include: 6 standoffs and #4-40 stainless steel screws
**Bag Include: 100 standoffs (screws not included)


THERMAL PADS

ThermMate Thermal Pads

Maxi: 20263
Mini: 20264
Micro: 20265

*ThermMates sold in packages of 10

HEATSINKS

Heatsinks

	Maxi Heatsinks		Mini Heatsinks		Micro Heatsinks	
	Threaded	Thru-Hole	Threaded	Thru-Hole	Threaded	Thru-Hole
Longitudinal Fins	0.4" Fin: 30482	0.4" Fin: 30718	0.4" Fin: 32188	0.4" Fin: 30195	0.4" Fin: 32174	0.4" Fin: 30719
	0.9" Fin: 30188	0.9" Fin: 30181	0.9" Fin: 30189	0.9" Fin: 30182	0.9" Fin: 30190	0.9" Fin: 30183
Transverse Fins	0.4" Fin: 30778	0.4" Fin: 30720	0.4" Fin: 30184	0.4" Fin: 30721	0.4" Fin: 32173	0.4" Fin: 30722
	0.9" Fin: 30196	0.9" Fin: 30723	0.9" Fin: 30269	0.9" Fin: 30724	0.9" Fin: 30270	0.9" Fin: 30725
Low Profile	0.55" Side Fin: 30096		0.55" Side Fin: 32190		0.55" Side Fin: 30095	



BELLY SHIELDS

Belly Shields

Maxi: 30141
Mini: 30198
Micro: 30199

InMate Socket Mechanical Accessories Guide for Maxi/Mini/Micro Modules

BASEPLATE STYLE

Slotted (standard) | Threaded (Style 2) | Thru-Hole (Style 3)

STANDOFFS

Standoffs

PCB Thickness	Pin Style	Mounting Style	Thru-Hole Heatsink	Threaded Heatsink
0.062" nominal	Non-RoHS: S	In-Board	Kit: 18153	Kit: 18154
	RoHS: F		Bag: 19129	Bag: 19130
	Non-RoHS: N	On-Board	Kit: 18158	Kit: 18159
	RoHS: G		Bag: 19134	Bag: 19135
0.093" nominal	Non-RoHS: S	In-Board	Kit: 18153	Kit: 18154
	RoHS: F		Bag: 19129	Bag: 19130
	Non-RoHS: N	On-Board	Kit: 18156	Kit: 18157
	RoHS: G		Bag: 19132	Bag: 19133
0.125" nominal	Non-RoHS: N	On-Board	Kit: 24054	Kit: 18157
	RoHS: G		Bag: 19132	Bag: 19133

*Kit Include: 6 standoffs and #4-40 stainless steel screws
**Bag Include: 100 standoffs (screws not included)

Standoffs

PCB Thickness	Pin Style	Mounting Style	Threaded Heatsink
0.062" nominal	Non-RoHS: S	In-Board	Kit: 18148
	RoHS: F		Bag: 19124
	Non-RoHS: N	On-Board	Kit: 18153
	RoHS: G		Bag: 19129
0.093" nominal	Non-RoHS: S	In-Board	Kit: 18148
	RoHS: F		Bag: 19124
	Non-RoHS: N	On-Board	Kit: 18150
	RoHS: G		Bag: 19126
0.125" nominal	Non-RoHS: N	On-Board	Kit: 24056
	RoHS: G		Bag: 19126

*Kit Include: 6 standoffs and #4-40 stainless steel screws
**Bag Include: 100 standoffs (screws not included)

Standoffs

PCB Thickness	Pin Style	Mounting Style	Thru-Hole Heatsink	Threaded Heatsink
0.062" nominal	Non-RoHS: S	In-Board	Kit: 18148	Kit: 18149
	RoHS: F		Bag: 19124	Bag: 19125
	Non-RoHS: N	On-Board	Kit: 18153	Kit: 18155
	RoHS: G		Bag: 19129	Bag: 19131
0.093" nominal	Non-RoHS: S	In-Board	Kit: 18148	Kit: 18149
	RoHS: F		Bag: 19124	Bag: 19125
	Non-RoHS: N	On-Board	Kit: 18150	Kit: 18152
	RoHS: G		Bag: 19126	Bag: 19128
0.125" nominal	Non-RoHS: N	On-Board	Kit: 24056	Kit: 18152
	RoHS: G		Bag: 19126	Bag: 19128

*Kit Include: 6 standoffs and #4-40 stainless steel screws
**Bag Include: 100 standoffs (screws not included)

SOCKETS & MODULE EXCHANGE TOOLS

InMate Sockets

PCB Thickness	Pin Style	Mounting Style	Maxi Input	Maxi Output	Maxi 5 Sets	Mini Input	Mini Output	Mini 5 Sets	Micro Input	Micro Output	Micro 5 Sets
0.062" nominal	S, F	In-Board	18374	18382	18362	18374	18384	18366	18376	18386	18370
	N, G	On-Board	18378	18388	18364	18378	18390	18368	18380	18392	18372
0.093" nominal	S, F	In-Board	18375	18383	18363	18375	18385	18367	18377	18387	18371
	N, G	On-Board	18379	18389	18365	18379	18391	18369	18381	18393	18373
0.125" nominal	N, G	On-Board	21539	21543	21510	21539	21544	21511	21540	21545	21512

*For individual Input and Output InMate Socket PN#s, there is a minimum quantity order of 35 pieces for the Maxis and Minis and 40 pieces for the Micros.

Module Exchange Tool

Maxi: 22827
Mini: 22828
Micro: 22829

*Exchange Tool prevents damage to sockets during module removal.

THERMAL PADS

ThermMate Thermal Pads

Maxi: 20263
Mini: 20264
Micro: 20265

*ThermMates sold in packages of 10

HEATSINKS

Heatsinks

	Maxi Heatsinks Threaded	Maxi Heatsinks Thru-Hole	Mini Heatsinks Threaded	Mini Heatsinks Thru-Hole	Micro Heatsinks Threaded	Micro Heatsinks Thru-Hole
Longitudinal Fins	0.4" Fin: 30482	0.4" Fin: 30718	0.4" Fin: 32188	0.4" Fin: 30195	0.4" Fin: 32174	0.4" Fin: 30719
	0.9" Fin: 30188	0.9" Fin: 30181	0.9" Fin: 30189	0.9" Fin: 30182	0.9" Fin: 30190	0.9" Fin: 30183
Transverse Fins	0.4" Fin: 30778	0.4" Fin: 30720	0.4" Fin: 30184	0.4" Fin: 30721	0.4" Fin: 32173	0.4" Fin: 30722
	0.9" Fin: 30196	0.9" Fin: 30723	0.9" Fin: 30269	0.9" Fin: 30724	0.9" Fin: 30270	0.9" Fin: 30725
Low Profile	0.55" Side Fin: 30096		0.55" Side Fin: 32190		0.55" Side Fin: 30095	

BELLY SHIELDS

Belly Shields

Maxi: 30141
Mini: 30198
Micro: 30199

SurfMate Socket Mechanical Accessories Guide for Maxi/Mini/Micro Modules

BASEPLATE STYLE

Slotted (standard) | Threaded (Style 2) | Thru-Hole (Style 3)

STANDOFFS

Standoffs

PCB Thickness	Pin Style	Mounting Style	Thru-Hole Heatsink	Threaded Heatsink
ALL	Non-RoHS: S	Surface Mount	Kit: 20178	Kit: 20179
	RoHS: F		Bag: 20188	Bag: 20189

*Kit Include: 6 standoffs and #4-40 stainless steel screws
**Bag Include: 100 standoffs (screws not included)


Standoffs

PCB Thickness	Pin Style	Mounting Style	Thru-Hole Heatsink
ALL	Non-RoHS: S	Surface Mount	Kit: 20176
	RoHS: F		Bag: 20186

*Kit Include: 6 standoffs and #4-40 stainless steel screws
**Bag Include: 100 standoffs (screws not included)

Standoffs

PCB Thickness	Pin Style	Mounting Style	Thru-Hole Heatsink	Threaded Heatsink
ALL	Non-RoHS: S	Surface Mount	Kit: 20176	Kit: 20177
	RoHS: F		Bag: 20186	Bag: 20187

*Kit Include: 6 standoffs and #4-40 stainless steel screws
**Bag Include: 100 standoffs (screws not included)


SOCKETS & MODULE EXCHANGE TOOLS

SurfMate Sockets

PCB Thickness	Pin Style	Mounting Style	Maxi Input	Maxi Output	Maxi 5 Sets	Mini Input	Mini Output	Mini 5 Sets	Micro Input	Micro Output	Micro 5 Sets
ALL	Non-RoHS: S	Surface Mount	22100	22101	16017	22100	22102	16021	22103	22104	16025
	RoHS: F										

*For individual Input and Output InMate Socket PNs, there is a minimum quantity order of 35 pieces for the Maxis and Minis and 40 pieces for the Micros.






Module Exchange Tool

Maxi: 22827
Mini: 22828
Micro: 22829

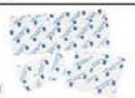
*Exchange Tool prevents damage to sockets during module removal.

THERMAL PADS

ThermMate Thermal Pads

Maxi: 20263
Mini: 20264
Micro: 20265

*ThermMates sold in packages of 10



HEATSINKS

Heatsinks

	Maxi Heatsinks		Mini Heatsinks		Micro Heatsinks	
	Threaded	Thru-Hole	Threaded	Thru-Hole	Threaded	Thru-Hole
Longitudinal Fins	0.4" Fin: 30482	0.4" Fin: 30718	0.4" Fin: 32188	0.4" Fin: 30195	0.4" Fin: 32174	0.4" Fin: 30719
	0.9" Fin: 30188	0.9" Fin: 30181	0.9" Fin: 30189	0.9" Fin: 30182	0.9" Fin: 30190	0.9" Fin: 30183
Transverse Fins	0.4" Fin: 30778	0.4" Fin: 30720	0.4" Fin: 30184	0.4" Fin: 30721	0.4" Fin: 32173	0.4" Fin: 30722
	0.9" Fin: 30196	0.9" Fin: 30723	0.9" Fin: 30269	0.9" Fin: 30724	0.9" Fin: 30270	0.9" Fin: 30725
Low Profile	0.55" Side Fin: 30096		0.55" Side Fin: 32190		0.55" Side Fin: 30096	

BELLY SHIELDS

Belly Shields

Maxi: 30141
Mini: 30198
Micro: 30199