



# Data Sheet

## 48V Input Mini Family

### DC-DC Converter Module



#### Features

- RoHS Compliant (with F or G pin option)
- DC input range: 36 - 75 V
- Input surge withstand: 100 V for 100 ms
- DC output: 2 – 48 V
- Programmable output: 10 to 110%
- Regulation:  $\pm 0.5\%$  no load to full load
- Efficiency: Up to 89%
- Maximum operating temp: 100°C, full load
- Power density: up to 100 W per cubic inch
- Height above board: 0.43 in. (10,9 mm)
- Parallelable, with N+M fault tolerance
- Low noise ZCS/ZVS architecture



Shown actual size:  
2.28 x 2.2 x 0.5 in  
57,9 x 55,9 x 12,7 mm

#### Product Overview

These DC-DC converter modules use advanced power processing, control and packaging technologies to provide the performance, flexibility, reliability and cost effectiveness of a mature power component. High frequency ZCS/ZVS switching provides high power density with low noise and high efficiency.

#### Applications

Distributed power, medical, ATE, communications, defense, aerospace

#### Part Numbering

e.g. V48B12T250BL2

#### Absolute Maximum Ratings

| Parameter                 | Rating       | Unit         | Notes               |
|---------------------------|--------------|--------------|---------------------|
| +In to -In voltage        | -0.5 to +75  | Vdc          |                     |
| PC to -In voltage         | -0.5 to +7.0 | Vdc          |                     |
| PR to -In voltage         | -0.5 to +7.0 | Vdc          |                     |
| SC to -Out voltage        | -0.5 to +1.5 | Vdc          |                     |
| -Sense to -Out voltage    | 1.0          | Vdc          |                     |
| Isolation voltage         |              |              |                     |
| in to out                 | 3000         | Vrms         |                     |
| in to base                | 1550         | Vrms         |                     |
| out to base               | 500          | Vrms         |                     |
| Operating Temperature     | -55 to +100  | °C           | M-Grade             |
| Storage Temperature       | -65 to +125  | °C           | M-Grade             |
| Pin soldering temperature | 500 (260)    | °F (°C)      | <5 sec; wave solder |
|                           | 750 (390)    | °F (°C)      | <7 sec; hand solder |
| Mounting torque           | 5 (0.57)     | in-lbs (N-m) | 6 each              |

V48B    B

| Output Voltage |
|----------------|
| 2 = 2 V        |
| 3V3 = 3.3 V    |
| 5 = 5 V        |
| 12 = 12 V      |
| 15 = 15 V      |
| 24 = 24 V      |
| 28 = 28 V      |
| 36 = 36 V      |
| 48 = 48 V      |

| Product Grade Temperatures (°C) |             |             |
|---------------------------------|-------------|-------------|
| Grade                           | Operating   | Storage     |
| E                               | -10 to +100 | -20 to +125 |
| C                               | -20 to +100 | -40 to +125 |
| T                               | -40 to +100 | -40 to +125 |
| H                               | -40 to +100 | -55 to +125 |
| M                               | -55 to +100 | -65 to +125 |

| Output Power |       |
|--------------|-------|
| Vout         | Pout  |
| 2 V          | 100 W |
| 3.3 V        | 150 W |
| 5 V          | 200 W |
| 12 V         | 250 W |
| 15 V         | 250 W |
| 24 V         | 250 W |
| 28 V         | 250 W |
| 36 V         | 250 W |
| 48 V         | 250 W |

| Pin Style |                |
|-----------|----------------|
| Blank:    | Short Tin/Lead |
| L:        | Long Tin/Lead  |
| S:        | Short ModuMate |
| N:        | Long ModuMate  |
| F:        | Short RoHS     |
| G:        | Long RoHS      |

| Baseplate |              |
|-----------|--------------|
| Blank:    | Slotted      |
| 2:        | Threaded     |
| 3:        | Through-hole |

For a description of pin options, see page 8. Baseplate options include slotted flanges, threaded and thru-hole. See page 9 for dimensions. For other package sizes and power levels, see the FasTrak Micro (quarter size) and FasTrak Maxi (full size) datasheets.

## MODULE FAMILY ELECTRICAL CHARACTERISTICS

Electrical characteristics apply over the full operating range of input voltage, output load (resistive) and baseplate temperature, unless otherwise specified. All temperatures refer to the operating temperature at the center of the baseplate.

### MODULE OPERATING SPECIFICATIONS

| Parameter               | Min | Typ | Max | Unit      | Notes                          |
|-------------------------|-----|-----|-----|-----------|--------------------------------|
| Operating input voltage | 36  | 48  | 75  | Vdc       |                                |
| Input surge withstand   |     |     | 100 | Vdc       | <100 ms                        |
| Output voltage setpoint |     |     | ±1% | Vout nom. | Nominal input; full load; 25°C |

### MODULE INPUT SPECIFICATIONS

| Parameter               | Min  | Typ  | Max  | Unit | Notes |
|-------------------------|------|------|------|------|-------|
| Undervoltage turn-on    |      | 34.9 | 35.7 | Vdc  |       |
| Undervoltage turn-off   | 29.4 | 30.5 |      | Vdc  |       |
| Overvoltage turn-off/on | 75.7 | 78.8 | 82.5 | Vdc  |       |

### MODULE OUTPUT SPECIFICATIONS

| Parameter                    | Min | Typ    | Max          | Unit   | Notes   |
|------------------------------|-----|--------|--------------|--------|---|
| Line regulation              |     | ±0.02  | ±0.2         | %      | Low line to high line; full load  |
| Temperature regulation       |     | ±0.002 | ±0.005       | % / °C | Over operating temperature range  |
| Power sharing accuracy       |     | ±2     | ±5           | %      | 10 to 100% of full load   |
| Programming range            | 10  |        | 110          | %      | Of nominal output voltage. For trimming below 90% of nominal, a minimum load of 10% of maximum rated power may be required. |
| +Out to -Out, +Sense to -Out |     |        |              |        |   |
| 2 V                          |     |        | -0.5 to 3.1  | Vdc    |   |
| 3.3 V                        |     |        | -0.5 to 4.7  | Vdc    |   |
| 5 V                          |     |        | -0.5 to 7.0  | Vdc    |   |
| 12 V                         |     |        | -0.5 to 16.1 | Vdc    |   |
| 15 V                         |     |        | -0.5 to 20.0 | Vdc    |   |
| 24 V                         |     |        | -0.5 to 31.7 | Vdc    |   |
| 28 V                         |     |        | -0.5 to 36.9 | Vdc    |   |
| 36 V                         |     |        | -0.5 to 47.1 | Vdc    |   |
| 48 V                         |     |        | -0.5 to 62.9 | Vdc    |   |

**Note:** For important information relative to applications where the converter modules are subject to continuous dynamic loading, contact Vicor applications engineering at 800-927-9474.

### THERMAL RESISTANCE AND CAPACITY

| Parameter                                  | Min | Typ  | Max | Unit        |
|--|-----|------|-----|-------------|
| Baseplate to sink; flat, greased surface   |     | 0.16 |     | °C/Watt     |
| Baseplate to sink; thermal pad (P/N 20264) |     | 0.14 |     | °C/Watt     |
| Baseplate to ambient                       |     | 8.0  |     | °C/Watt     |
| Baseplate to ambient; 1000 LFM             |     | 1.9  |     | °C/Watt     |
| Thermal capacity                           |     | 83   |     | Watt-sec/°C |

## MODULE FAMILY ELECTRICAL CHARACTERISTICS (CONT.)

### ■ MODULE CONTROL SPECIFICATIONS

| Parameter   | Min  | Typ   | Max  | Unit    | Notes  |
|---|------|-------|------|---------|--|
| <b>PRIMARY SIDE</b> (PC = Primary Control; PR = Parallel) |      |       |      |         |  |
| PC bias voltage   | 5.50 | 5.75  | 6.00 | Vdc     | PC current = 1.0 mA<br>PC voltage = 5.5 V        |
| current limit   | 1.5  | 2.1   | 3.0  | mA      |  |
| PC module disable   | 2.3  | 2.6   | 2.9  | Vdc     | Must be able to sink $\geq 4$ mA. See Fig. 1     |
| PC module enable delay                                    |      | 4     | 7    | ms      |  |
| PC module alarm   |      |       | 0.5  | Vavg    | UV, OV, OT, module fault. See Figs. 2 and 4      |
| PR emitter amplitude                                      | 5.7  | 5.9   | 6.1  | Volts   | PR load $>30$ ohms, $<30$ pF                     |
| PR emitter current  | 150  |       |      | mA      |  |
| PR receiver impedance                                     | 375  | 500   | 625  | ohms    | 25°C   |
| PR receiver threshold                                     | 2.4  | 2.5   | 2.6  | Volts   | Minimum pulse width: 20 ns                       |
| PR drive capability                                       |      |       | 12   | modules | Without PR buffer amplifier                      |
| <b>SECONDARY SIDE</b> (SC = Secondary Control)            |      |       |      |         |  |
| SC bandgap voltage  | 1.21 | 1.23  | 1.25 | Vdc     | Referenced to –Sense                             |
| SC resistance   | 990  | 1000  | 1010 | ohms    |  |
| SC capacitance  |      | 0.033 |      | $\mu$ F |  |
| SC module alarm   |      | 0     |      | Vdc     | With open trim; referenced to –Sense. See Fig. 6 |

### ■ MODULE GENERAL SPECIFICATIONS

| Parameter                        | Min     | Typ            | Max            | Unit    | Notes   |
|----------------------------------|---------|----------------|----------------|---------|---|
| Remote sense (total drop)        |         |                | 0.5            | Vdc     | 0.25 V per leg (senses must be closed)  |
| Isolation voltage                |         |                |                |         |   |
| in to out                        | 3000    |                |                | Vrms    | Complies with reinforced insulation requirements                              |
| in to base                       | 1550    |                |                | Vrms    | Complies with basic insulation requirements                                   |
| out to base                      | 500     |                |                | Vrms    | Complies with operational insulation requirements                             |
| Isolation resistance (in to out) |         | 10             |                | megohms |   |
| Weight                           | (110.6) | 3.9<br>(113.4) | 4.0<br>(grams) | ounces  |   |
| Temperature limiting             | 100     | 115            |                | °C      | See Figs. 2 and 4   |
| Agency approvals                 |         | cULus, TÜV, CE |                |         | UL60950, CSA0950, EN60950, IEC60950.<br>With a fuse in series with the +Input |

**Note:**

Specifications are subject to change without notice.

## MODULE SPECIFIC OPERATING SPECIFICATIONS

### 2 Vout, 100 W (e.g. V48B2C100BL)

| Parameter             | Min  | Typ   | Max  | Unit  | Notes   |
|-----------------------|------|-------|------|-------|---|
| Efficiency            | 74.5 | 75.5  |      | %     | Nominal input; full load; 25°C                        |
| Ripple and noise      |      | 126   | 158  | mV    | p-p; Nominal input; full load; 20 MHz bandwidth       |
| Output OVP setpoint   | 2.7  | 2.8   | 2.9  | Volts | 25°C; recycle input voltage to restart (1 minute off) |
| Dissipation, standby  |      | 4.3   | 6.5  | Watts | No load   |
| Load regulation       |      | ±0.02 | ±0.2 | %     | No load to full load; nominal input                   |
| Current limit         | 51   | 57.5  | 70   | Amps  | Output voltage 95% of nominal                         |
| Short circuit current | 5    | 57.5  | 70   | Amps  | Output voltage <250 mV                                |

### 3.3 Vout, 150 W (e.g. V48B3V3C150BL)

| Parameter             | Min  | Typ   | Max  | Unit  | Notes   |
|-----------------------|------|-------|------|-------|---|
| Efficiency            | 81   | 82    |      | %     | Nominal input; full load; 25°C                        |
| Ripple and noise      |      | 80    | 100  | mV    | p-p; Nominal input; full load; 20 MHz bandwidth       |
| Output OVP setpoint   | 4.14 | 4.3   | 4.46 | Volts | 25°C; recycle input voltage to restart (1 minute off) |
| Dissipation, standby  |      | 3.5   | 5.3  | Watts | No load   |
| Load regulation       |      | ±0.02 | ±0.2 | %     | No load to full load; nominal input                   |
| Current limit         | 46.4 | 52.3  | 61.5 | Amps  | Output voltage 95% of nominal                         |
| Short circuit current | 31.8 | 52.3  | 63.7 | Amps  | Output voltage <250 mV                                |

### 5 Vout, 200 W (e.g. V48B5C200BL)

| Parameter             | Min  | Typ   | Max  | Unit  | Notes   |
|-----------------------|------|-------|------|-------|---|
| Efficiency            | 84   | 85    |      | %     | Nominal input; full load; 25°C                        |
| Ripple and noise      |      | 73    | 92   | mV    | p-p; Nominal input; full load; 20 MHz bandwidth       |
| Output OVP setpoint   | 6.03 | 6.25  | 6.47 | Volts | 25°C; recycle input voltage to restart (1 minute off) |
| Dissipation, standby  |      | 4     | 6    | Watts | No load   |
| Load regulation       |      | ±0.02 | ±0.2 | %     | No load to full load; nominal input                   |
| Current limit         | 40.8 | 46    | 52   | Amps  | Output voltage 95% of nominal                         |
| Short circuit current | 4    | 46    | 56   | Amps  | Output voltage <250 mV                                |

### 12 Vout, 250 W (e.g. V48B12C250BL)

| Parameter             | Min  | Typ   | Max  | Unit  | Notes   |
|-----------------------|------|-------|------|-------|---|
| Efficiency            | 86   | 87    |      | %     | Nominal input; full load; 25°C                        |
| Ripple and noise      |      | 378   | 473  | mV    | p-p; Nominal input; full load; 20 MHz bandwidth       |
| Output OVP setpoint   | 13.7 | 14.3  | 14.9 | Volts | 25°C; recycle input voltage to restart (1 minute off) |
| Dissipation, standby  |      | 4.4   | 6.5  | Watts | No load   |
| Load regulation       |      | ±0.02 | ±0.2 | %     | No load to full load; nominal input                   |
| Current limit         | 21.3 | 24    | 27.2 | Amps  | Output voltage 95% of nominal                         |
| Short circuit current | 14.6 | 24    | 26.2 | Amps  | Output voltage <250 mV                                |

### 15 Vout, 250 W (e.g. V48B15C250BL)

| Parameter             | Min  | Typ   | Max  | Unit  | Notes   |
|-----------------------|------|-------|------|-------|---|
| Efficiency            | 87.5 | 88.5  |      | %     | Nominal input; full load; 25°C                        |
| Ripple and noise      |      | 160   | 200  | mV    | p-p; Nominal input; full load; 20 MHz bandwidth       |
| Output OVP setpoint   | 17.1 | 17.8  | 18.5 | Volts | 25°C; recycle input voltage to restart (1 minute off) |
| Dissipation, standby  |      | 5.3   | 7.9  | Watts | No load   |
| Load regulation       |      | ±0.02 | ±0.2 | %     | No load to full load; nominal input                   |
| Current limit         | 17   | 19.2  | 21.8 | Amps  | Output voltage 95% of nominal                         |
| Short circuit current | 11.6 | 19.2  | 21.8 | Amps  | Output voltage <250 mV                                |

■ MODULE SPECIFIC OPERATING SPECIFICATIONS (CONT)

24 Vout, 250 W (e.g. V48B24C250BL)

| Parameter             | Min  | Typ   | Max  | Unit  | Notes   |
|-----------------------|------|-------|------|-------|---|
| Efficiency            | 88   | 89    |      | %     | Nominal input; full load; 25°C                        |
| Ripple and noise      |      | 220   | 275  | mV    | p-p; Nominal input; full load; 20 MHz bandwidth       |
| Output OVP setpoint   | 27.1 | 28.1  | 29.1 | Volts | 25°C; recycle input voltage to restart (1 minute off) |
| Dissipation, standby  |      | 5     | 7.5  | Watts | No load   |
| Load regulation       |      | ±0.02 | ±0.2 | %     | No load to full load; nominal input                   |
| Current limit         | 10.7 | 12.1  | 13.7 | Amps  | Output voltage 95% of nominal                         |
| Short circuit current | 7.35 | 12.1  | 13.7 | Amps  | Output voltage <250 mV                                |

28 Vout, 250 W (e.g. V48B28C250BL)

| Parameter             | Min  | Typ   | Max  | Unit  | Notes   |
|-----------------------|------|-------|------|-------|---|
| Efficiency            | 88.5 | 89.5  |      | %     | Nominal input; full load; 25°C                        |
| Ripple and noise      |      | 178   | 223  | mV    | p-p; Nominal input; full load; 20 MHz bandwidth       |
| Output OVP setpoint   | 31.5 | 32.7  | 33.9 | Volts | 25°C; recycle input voltage to restart (1 minute off) |
| Dissipation, standby  |      | 5.8   | 8.7  | Watts | No load   |
| Load regulation       |      | ±0.02 | ±0.2 | %     | No load to full load; nominal input                   |
| Current limit         | 9.1  | 10.3  | 12.1 | Amps  | Output voltage 95% of nominal                         |
| Short circuit current | 5    | 10.3  | 12.1 | Amps  | Output voltage <250 mV                                |

36 Vout, 250 W (e.g. V48B36C250BL)

| Parameter             | Min  | Typ   | Max  | Unit  | Notes   |
|-----------------------|------|-------|------|-------|---|
| Efficiency            | 88.5 | 89.3  |      | %     | Nominal input; full load; 25°C                        |
| Ripple and noise      |      | 250   | 313  | mV    | p-p; Nominal input; full load; 20 MHz bandwidth       |
| Output OVP setpoint   | 40.4 | 41.9  | 43.4 | Volts | 25°C; recycle input voltage to restart (1 minute off) |
| Dissipation, standby  |      | 6.9   | 11.1 | Watts | No load   |
| Load regulation       |      | ±0.02 | ±0.2 | %     | No load to full load; nominal input                   |
| Current limit         | 7.07 | 7.98  | 9.37 | Amps  | Output voltage 95% of nominal                         |
| Short circuit current | 4.85 | 7.98  | 9.37 | Amps  | Output voltage <250 mV                                |

48 Vout, 250 W (e.g. V48B48C250BL)

| Parameter             | Min  | Typ   | Max  | Unit  | Notes   |
|-----------------------|------|-------|------|-------|---|
| Efficiency            | 88.5 | 89.5  |      | %     | Nominal input; full load; 25°C                        |
| Ripple and noise      |      | 150   | 188  | mV    | p-p; Nominal input; full load; 20 MHz bandwidth       |
| Output OVP setpoint   | 53.7 | 55.7  | 57.7 | Volts | 25°C; recycle input voltage to restart (1 minute off) |
| Dissipation, standby  |      | 3.9   | 5.8  | Watts | No load   |
| Load regulation       |      | ±0.02 | ±0.2 | %     | No load to full load; nominal input                   |
| Current limit         | 5.31 | 5.99  | 7.29 | Amps  | Output voltage 95% of nominal                         |
| Short circuit current | 2.08 | 5.99  | 7.29 | Amps  | Output voltage <250 mV                                |

# CONTROL FUNCTIONS - PC PIN

## Module Enable/Disable

The module may be disabled by pulling PC below 2.3 V with respect to the -Input. This may be done with an open collector transistor, relay, or optocoupler. Multiple converters may be disabled with a single transistor or relay either directly or via "OR'ing" diodes. See Figure 1.

## Primary Auxiliary Supply

At 5.7 V, PC can source up to 1.5 mA. In the example shown in Figure 3, PC powers a module enabled LED.

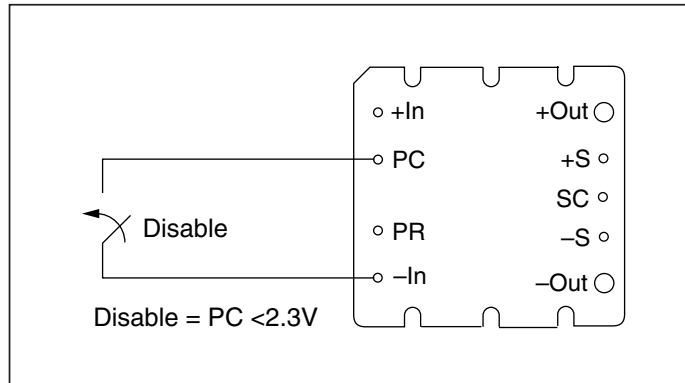


Figure 1 — Module enable/disable.

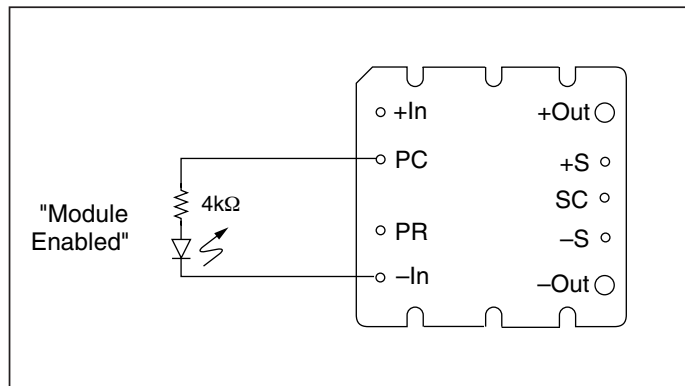


Figure 3 — LED on-state indicator.

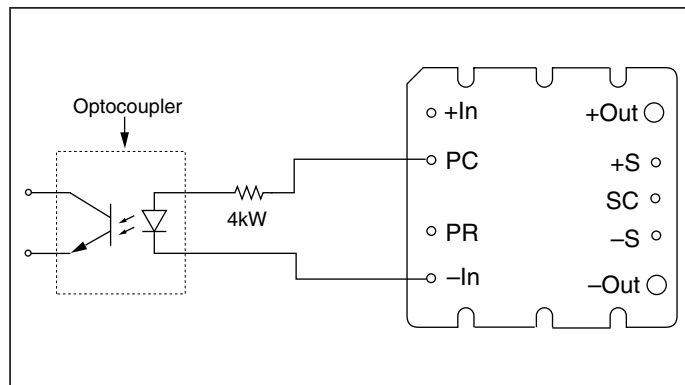


Figure 5 — Isolated on-state indicator.

## Module Alarm

The module contains "watchdog" circuitry which monitors input voltage, operating temperature and internal operating parameters. In the event that any of these parameters are outside of their allowable operating range, the module will shut down and PC will go low. PC will periodically go high and the module will check to see if the fault (as an example, overtemperature) has cleared. If the fault has not been cleared, PC will go low again and the cycle will restart. The SC pin will go low in the event of a fault and return to its normal state after the fault has been cleared. See Figures 2 and 4.

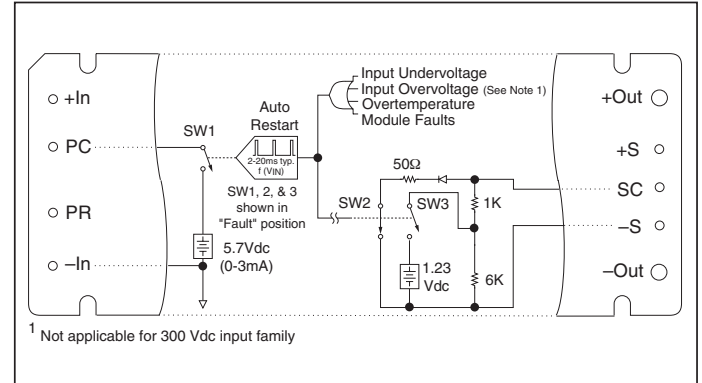


Figure 2 — PC/SC module alarm logic.

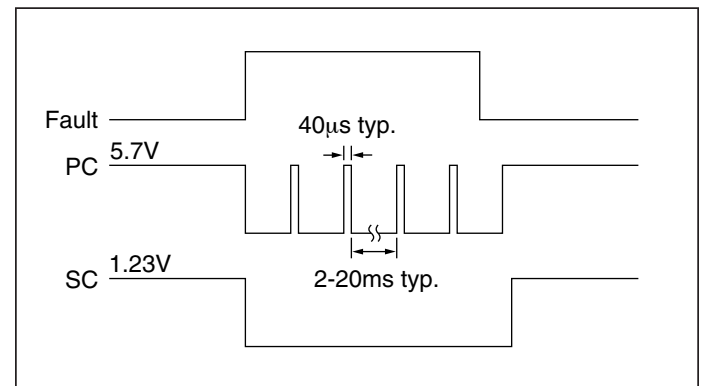


Figure 4 — PC/SC module alarm timing.

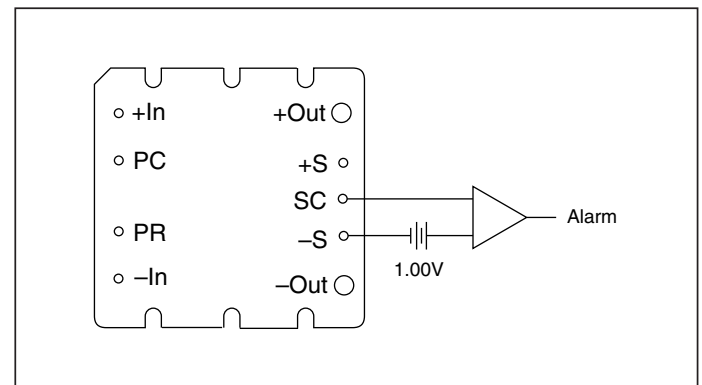


Figure 6 — Secondary side on-state indicator.

# CONTROL FUNCTIONS - SC PIN

## Output Voltage Programming

The output voltage of the converter can be adjusted or programmed via fixed resistors, potentiometers or voltage DACs. See Figures 7 and 8.

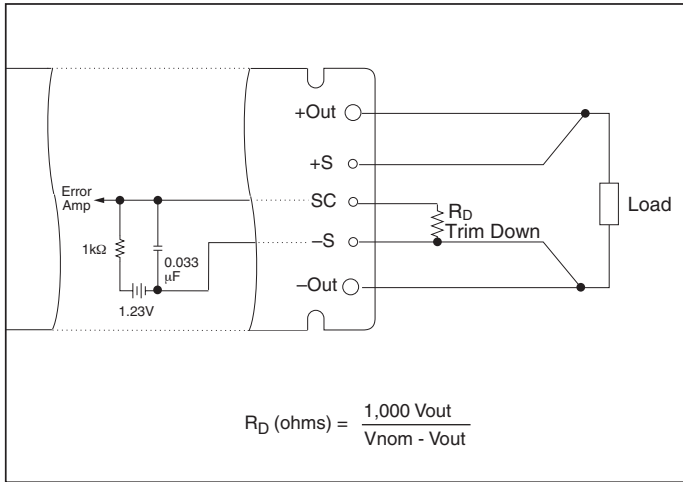


Figure 7 — Output voltage trim down circuit.

### Trim Down

1. This converter is not a constant power device – it has a constant current limit. Hence, available output power is reduced by the same percentage that output voltage is trimmed down. Do not exceed maximum rated output current.
2. The trim down resistor must be connected to the –Sense pin.

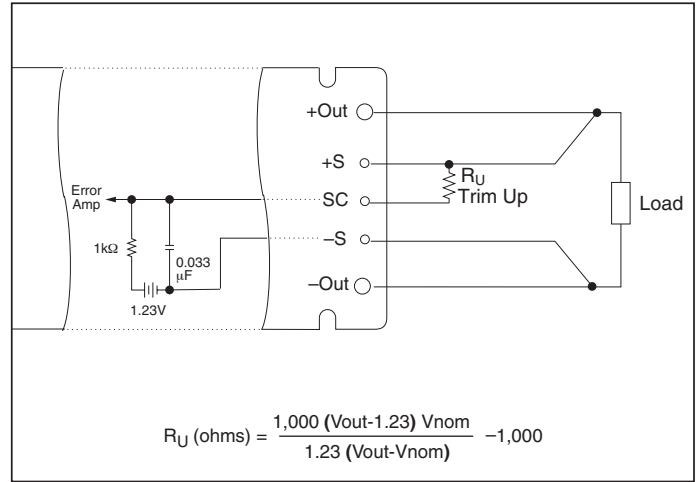


Figure 8 — Output voltage trim up circuit.

### Trim Up

1. The converter is rated for a maximum delivered power. To ensure that maximum rated power is not exceeded, reduce maximum output current by the same percentage increase in output voltage.
2. The trim up resistor must be connected to the +Sense pin.
3. Do not trim the converter above maximum trim range (typically +10%) or the output over voltage protection circuitry may be activated.

**Resistor Values for Fixed Output Voltage Trimming** back to main window

Vicor product:  VI-200  VI-J00  Maxi, Mini, and Micro

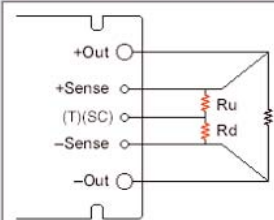
Notes: VI-200 and VI-J00 — Minimum preload of 1% should be maintained  
Maxi, Mini, and Micro — Consult factory when trimming below –10%

Nominal output voltage:

Trim range:  V or Vnom  %

Desired output voltage:  V or Vnom  %

Trim resistor value:  K ohm



R<sub>u</sub> = Trim up resistor  
 K ohm

R<sub>d</sub> = Trim down resistor  
 K ohm

### Trim resistor values calculated automatically:

On-line calculators for trim resistor values are available on the vicor website at: [vicorpower.com/tools.html](http://vicorpower.com/tools.html).

Resistor values can be calculated for fixed trim up, fixed trim down and for variable trim up or down.

In addition to trimming information, the web site and the Applications Manual also include design tips, applications circuits, EMC suggestions, thermal design guidelines and PDF data sheets for all available Vicor products.



# CONTROL FUNCTIONS - PR PIN

## Parallel Operation

The PR pin supports paralleling for increased power with N+1 (N+M) redundancy and phased array capability. Modules of the same input voltage, output voltage, and power level will current share if all PR pins are suitably interfaced.

Compatible interface architectures include the following:

*DC coupled single-wire interface.* All PR pins are directly connected to one another. This interface supports current

sharing but is not fault tolerant. Minus In pins must be tied to the same electric potential. See Figure 9.

*AC coupled single-wire interface.* All PR pins are connected to a single communication bus through 0.001  $\mu\text{F}$  (500 V) capacitors. This interface supports current sharing and is fault tolerant except for the communication bus. See Figure 10.

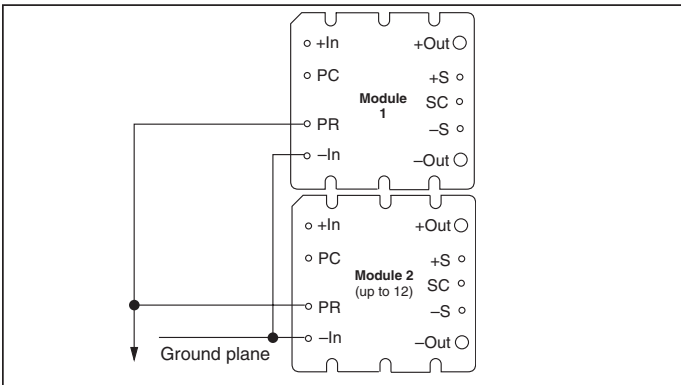


Figure 9 — DC coupled single-wire interface.

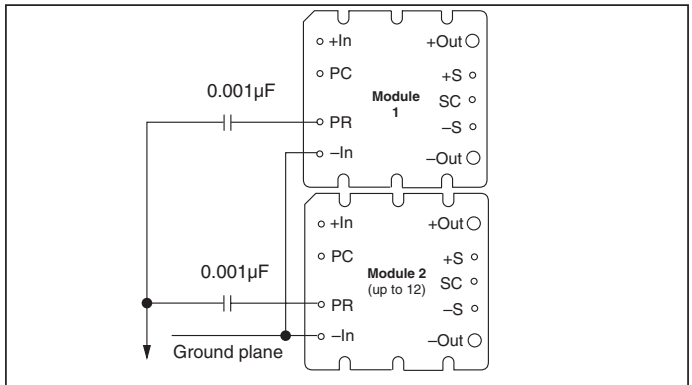


Figure 10 — AC coupled single-wire interface.

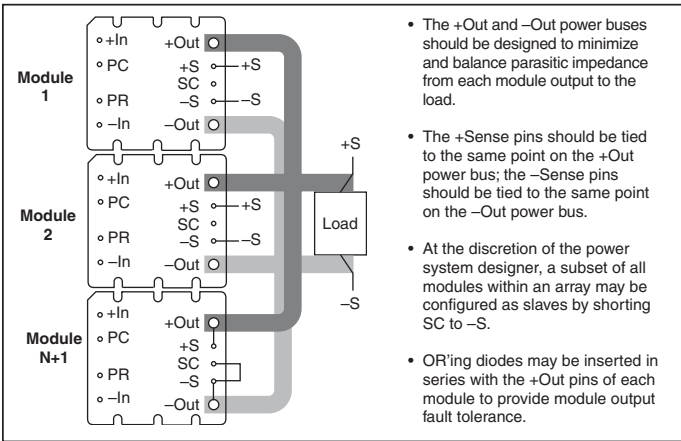


Figure 11 — N+1 module array output connections.

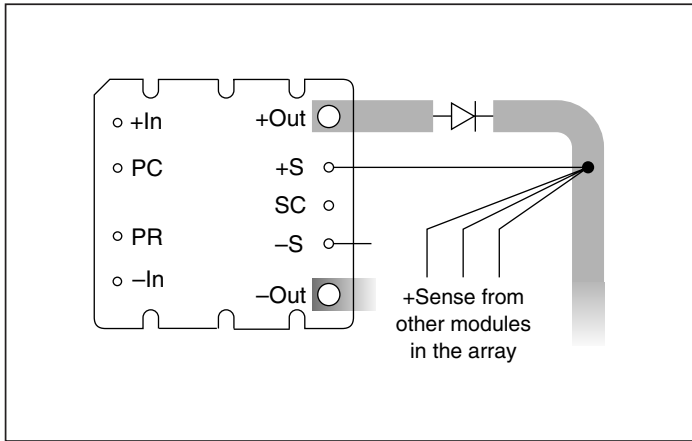


Figure 12 — OR'ing diodes connections.

## Pin Styles \*

| Designator | Description    | Notes   |
|------------|----------------|---|
| (None)     | Short solder   | Requires in-board, mounting   |
| L          | Long solder    | On-board mounting for 0.065" boards                                     |
| S          | Short ModuMate | SurfMate or in-board socket mounting                                    |
| N          | Long ModuMate  | On-board socket mounting  |
| F          | Short RoHS     | Select for RoHS compliant in-board solder, socket, or SurfMate mounting |
| G          | Long RoHS      | Select for RoHS compliant on-board solder or socket mounting            |

\* Pin style designator follows the "B" after the output power and precedes the baseplate designator.

Ex. V48B12T250BN2 — Long ModuMate Pins



# MECHANICAL DRAWINGS

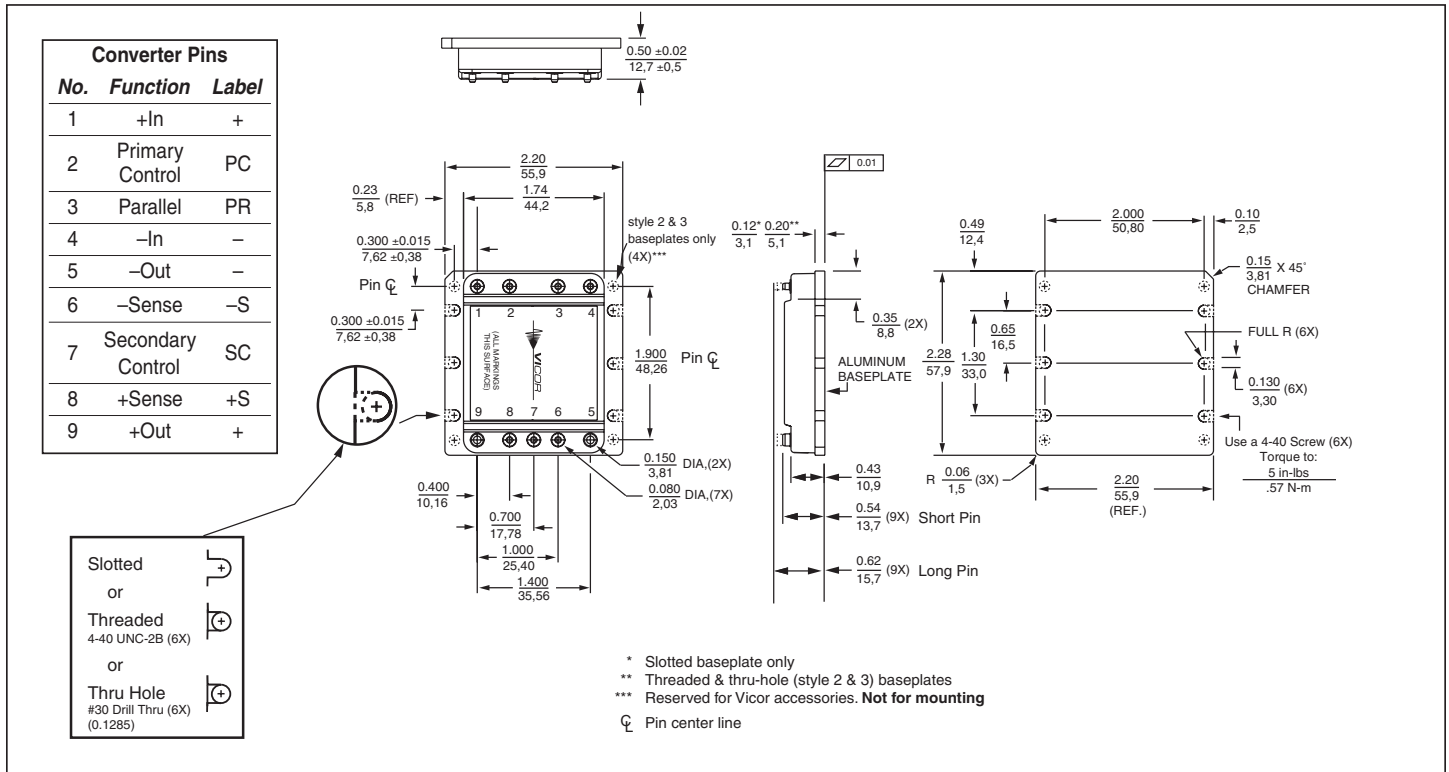


Figure 13 – Module outline

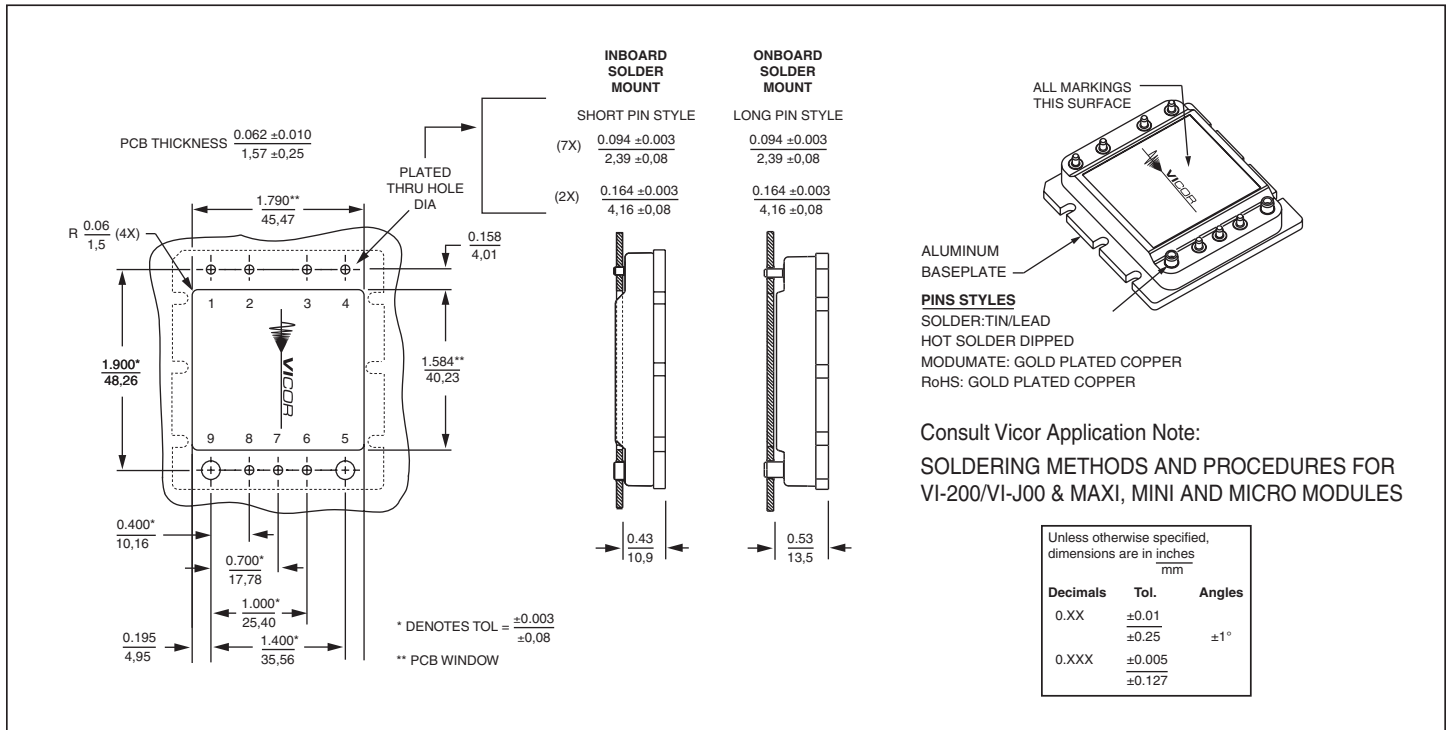


Figure 14 – PCB mounting specifications

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**Vicor Corporation**  
25 Frontage Road  
Andover, MA, USA 01810  
Tel: 800-735-6200  
Fax: 978-475-6715

### **email**

Customer Service: [custserv@vicorpower.com](mailto:custserv@vicorpower.com)  
Technical Support: [apps@vicorpower.com](mailto:apps@vicorpower.com)