



# DC-DC Converter Module

VE-720331B

Micro – 300V<sub>IN</sub> / 28V<sub>OUT</sub> / 180W

## Features & Benefits

- DC input range: 180 – 375V
- Input surge withstand: 400V for 100ms
- DC output: 28V
- Programmable output: 10 – 110%
- Regulation:  $\pm 0.2\%$  no load to full load
- Efficiency: 86.2%
- Maximum operating temperature: 100°C at full load
- Height above board: 0.43in [10,9mm]
- Parallelable, with N+M fault tolerance
- Low noise ZCS/ZVS architecture
- Pin style: Long RoHS (Gold)
- Baseplate: Through-hole

## Product Overview

This DC-DC converter module uses 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.



Size:  
2.28 x 1.45 x 0.5in  
[57,9 x 36,8 x 12,7mm]

## Absolute Maximum Ratings

Parameter	Rating	Unit	Notes
+IN to –IN Voltage	-0.5 to +420	V <sub>DC</sub>	
+IN to –IN Voltage	400	V <sub>DC</sub>	< 100ms
PC to –IN Voltage	-0.5 to +7	V <sub>DC</sub>	
PR to –IN Voltage	-0.5 to 7	V <sub>DC</sub>	
+OUT to –OUT Voltage	-0.5 to +36.9	V <sub>DC</sub>	
SC to –OUT Voltage	-0.5 to +1.5	V <sub>DC</sub>	
Isolation Voltage			
IN to OUT	3000	V <sub>RMS</sub>	Test voltage
IN to Base	1550	V <sub>RMS</sub>	Test voltage
OUT to Base	500	V <sub>RMS</sub>	Test voltage
Storage Temperature	-40 to +125	°C	
Operating Temperature	-20 to +100	°C	Baseplate
Pin Soldering Temperature	500 [260]	°F [°C]	< 5s; wave solder
Pin Soldering Temperature	750 [390]	°F [°C]	< 7s; hand solder
Mounting torque	5 [0.57]	in-lbs [N·m]	6 each, # 4-40 or M3

## 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	180	300	375	V <sub>DC</sub>	
Input Surge Withstand			400	V <sub>DC</sub>	< 100ms
Output Voltage Setpoint	27.72	28	28.28	V <sub>DC</sub>	Nominal input; full load; 25°C
Output OVP Setpoint	31.5	32.7	33.9	V <sub>DC</sub>	25°C; recycle input voltage to restart (100ms off)
Output Power			180	W	At 100°C baseplate temperature
Efficiency	84.7	86.2		%	Nominal input; 75% of full load; 25°C

### Module Input Specifications

Parameter	Min	Typ	Max	Unit	Notes
Undervoltage Turn-On		174.6	178.2	V <sub>DC</sub>	
Undervoltage Turn-Off	147.4	152.8		V <sub>DC</sub>	
Overvoltage Turn-Off	378.7	393.8	412.5	V <sub>DC</sub>	
Dissipation, Standby		4.5	6	W	No load

### Module Output Specifications

Parameter	Min	Typ	Max	Unit	Notes
Line Regulation		±0.02	±0.2	%	Low line to high line; full load
Load Regulation		±0.02	±0.2	%	No load to full load; nominal input
Temperature Regulation		±0.002	±0.005	% / °C	-20 to 100°C
Ripple and Noise, p-p		135	185	mV	Nominal input; full load; 20MHz bandwidth
Load Current	0		6.43	A	
Current Limit	6.56	7.39	8.68	A	Output voltage 95% of nominal
Short Circuit Current	4.50	7.39	8.68	A	Output voltage < 250mV
Power Sharing Accuracy		±2	±5	%	10 – 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.

**Note:** The permissible load current must never be exceeded during normal, abnormal or test conditions. For additional output related application information, please refer to output connections on page 4.

## Electrical Characteristics (Cont.)

### Thermal Resistance and Capacity

Parameter	Min	Typ	Max	Unit	Notes
Baseplate to Sink; Flat, Greased Surface		0.24		°C/W	
Baseplate to Sink; Thermal Pad (P/N 20265)		0.21		°C/W	
Baseplate to Ambient	10.9			°C/W	
Baseplate to Ambient; 1000LFM	2.8			°C/W	
Thermal Capacity	48			Ws/°C	

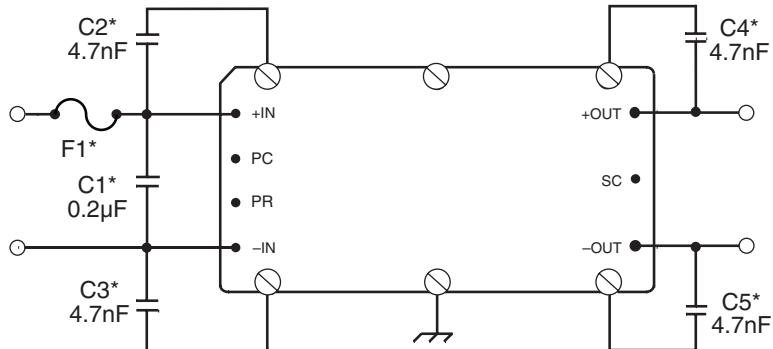
### Module Control Specifications

Parameter	Min	Typ	Max	Unit	Notes
<b>Primary Side</b> (PC = Primary Control; PR = Parallel)					
PC Bias Voltage	5.50	5.75	6.10	V <sub>DC</sub>	PC current = 1.0mA
Current Limit	1.5	2.1	3	mA	PC voltage = 5.5V
PC Module Disable	2.3	2.6	2.9	V <sub>DC</sub>	Must be able to sink ≥ 4mA. See Fig. 2
PC Module Enable Delay		4	7	ms	
PC Module Alarm			0.5	V <sub>AVG</sub>	UV, OV, OT, module fault. See Figs. 3 and 5
PC Resistance	0.9	1.0	1.1	MΩ	See Fig. 3
PR Emitter Amplitude	5.7	5.9	6.1	V	PR load > 30Ω, < 30pF
PR Emitter Current	150			mA	
PR Receiver Impedance	375	500	625	Ω	25°C
PR Receiver Threshold	2.4	2.5	2.6	V	Minimum pulse width: 20ns
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	V <sub>DC</sub>	Referenced to -OUT
SC Resistance	990	1000	1010	Ω	
SC Capacitance		0.033		μF	
SC Module Alarm		0		V <sub>DC</sub>	With open trim; referenced to -OUT. See Fig. 7

### Module General Specifications

Parameter	Min	Typ	Max	Unit	Notes
Isolation Voltage (IN to OUT)	3000			V <sub>RMS</sub>	Complies with reinforced insulation requirements
Isolation Voltage (IN to Base)	1550			V <sub>RMS</sub>	Complies with basic insulation requirements
Isolation Voltage (OUT to Base)	500			V <sub>RMS</sub>	Complies with operational insulation requirements
Isolation Resistance (IN to OUT)		10		MΩ	
Weight		2.1 [60]	2.3 [66]	oz [g]	
Temperature Limiting	100	115		°C	See Figs. 3 and 5,
Agency Approvals					

## Basic Module Operation



For C1 – C5, keep leads and connections short.

**Figure 1** — Basic module operation requires fusing, grounding, bypassing capacitors.\* See Maxi, Mini, Micro Design Guide.

### Output Connections and Considerations

The permissible load current must never be exceeded during normal, abnormal or test conditions. Converters subject to dynamic loading exceeding 25% of rated current must be reviewed by Vicor Applications Engineering to ensure that the converter will operate properly.

Under dynamic-load, light-load or no-load conditions, the converter may emit audible noise. Converters that utilize remote sense may require compensation circuitry to offset the phase lag caused by the external output leads and load impedance. If an external remote-sense circuit is used, the remote-sense

leads must be protected for conditions such as lead reversal, noise pickup, open circuit, or excessive output lead resistance between the sense point and the converters output terminals. For applications that may draw more than the rated current, a fast-acting electronic circuit breaker must be utilized to protect the converter. Under no circumstance should the rated current be exceeded. Utilizing or testing of current limit or short-circuit current will damage the converter. Ensure that the total output capacitance connected to the converter does not exceed the limits on Page 16, "Maximum Output Capacitance", of the design guide.

### Comprehensive Online Application Information



### The Design Guide and Applications Manual includes:

- Application circuits
- Design requirements
- EMC considerations
- Current sharing in power arrays
- Thermal performance information
- Recommended soldering methods
- Accessory modules – filtering, rectification, front-ends
- Mounting options
- ...and more.

[CLICK HERE TO VIEW  
DESIGN GUIDE](#)

Also at [vicorpower.com](http://vicorpower.com)

- PowerBench online configurators
- Over 20 Application Notes
- Online calculators – thermal, trimming, hold-up
- PDF data sheets for ALL Vicor products

## Primary Control – PC Pin

### Module Enable/Disable

The module may be disabled by pulling PC to 0V (2.3V max) with respect to the –IN. This may be done with an open collector transistor, relay, or optocoupler. Converters may be disabled with a single transistor or relay either directly or via “OR’ing” diodes for 2 or more converters. See Figure 2.

### Primary Auxiliary Supply

During normal operation only, the PC Pin can source 5.7V @ 1.5mA. In the example shown in Figure 4, PC powers a module enabled LED.

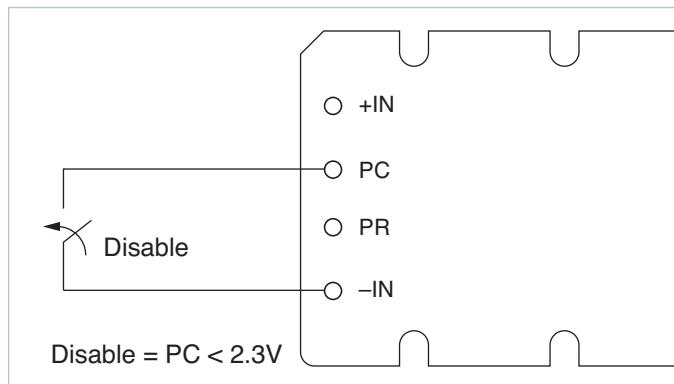


Figure 2 — Module enable/disable

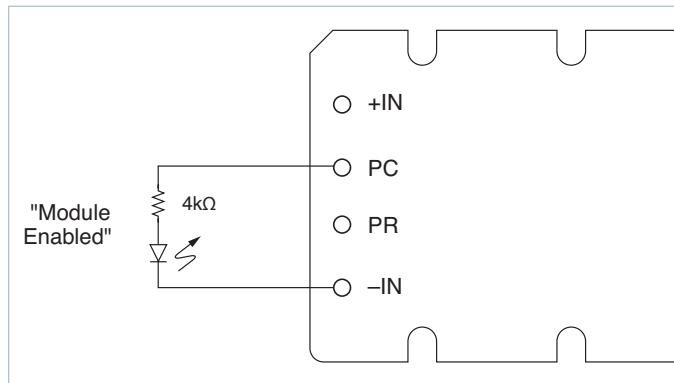


Figure 4 — LED on-state indicator

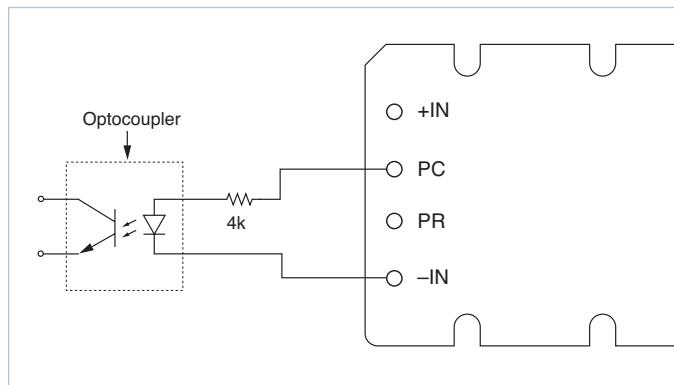


Figure 6 — Isolated on-state indicator

### 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, Input Undervoltage) 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 3 and 5.

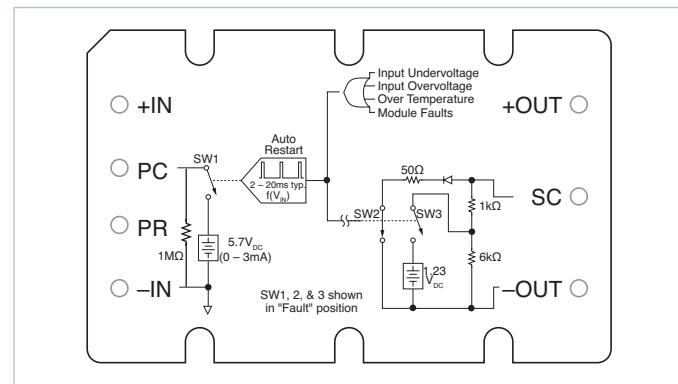


Figure 3 — PC/SC module alarm logic

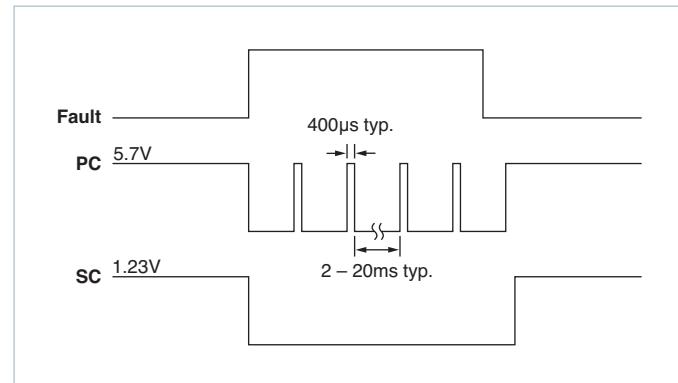


Figure 5 — PC/SC module alarm timing

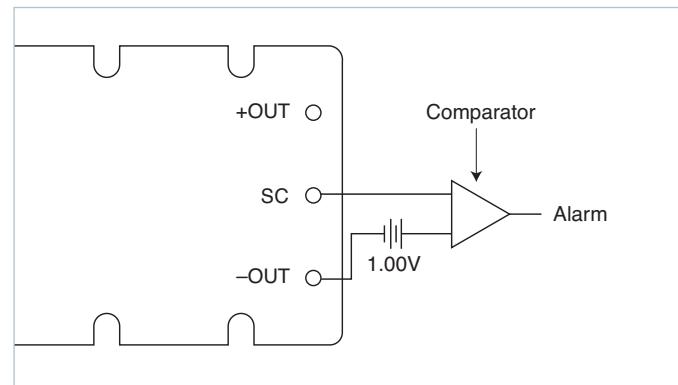


Figure 7 — Secondary side on-state indicator

## Secondary Control – SC PIN

### Output Voltage Programming

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

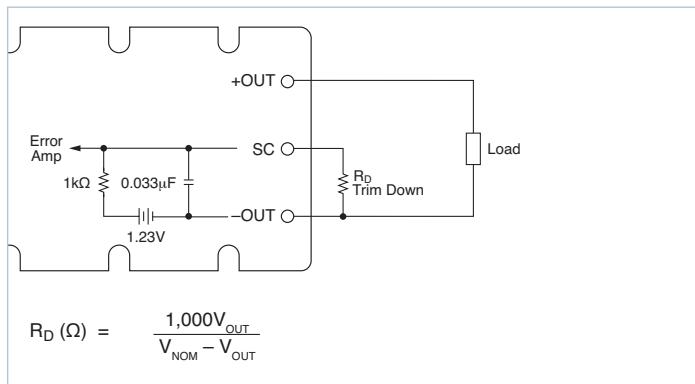


Figure 8 — Output voltage trim down and trim up circuit

### 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 between the SC and  $-S$  pins. Do not bypass the SC pin directly with a capacitor.

### 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 between the SC and  $+S$  pins. Do not bypass the SC pin directly with a capacitor.
3. Do not trim the converter above maximum trim range (typically  $+10\%$ ) or the output overvoltage protection circuitry may be activated.

#### Trim resistor values calculated automatically:

On-line calculators for trim resistor values are available on the vicor website at:  
[asp.vicorpowers.com/calculators/calculators.asp?calc=1](http://asp.vicorpowers.com/calculators/calculators.asp?calc=1)  
 Resistor values can be calculated for fixed trim up, fixed trim down and for variable trim up or down.

## Parallel Bus – PR PIN

### Parallel Operation

The PR pin supports paralleling for increased power with  $N+1$  ( $N+M$ ) redundancy. 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:

**AC-coupled single-wire interface.** All PR pins are connected to a single communication bus through  $0.001\mu F$  (500V) capacitors. This interface supports current sharing and is fault tolerant except for the communication bus. Up to three converters may be paralleled by this method. See Figure 9.

**Transformer-coupled interface.** For paralleling four or more converters a transformer coupled interface is required, and under certain conditions a PR buffer circuit.

For details on parallel operation please refer to the [Design Guide & Applications Manual for Maxi, Mini, Micro Family](#).

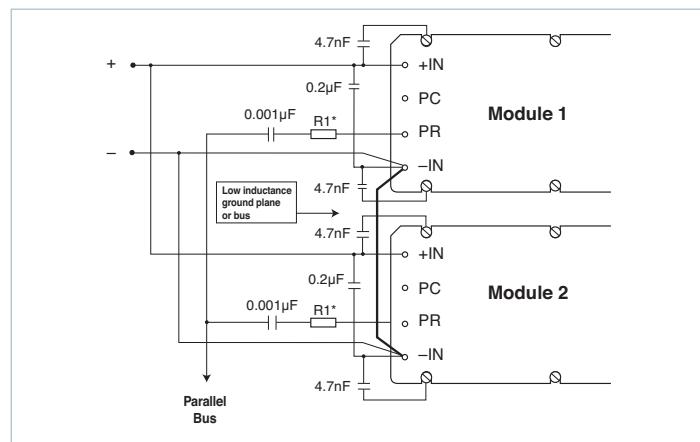


Figure 9 — AC-coupled single-wire interface

\* See Maxi, Mini, Micro Design Guide

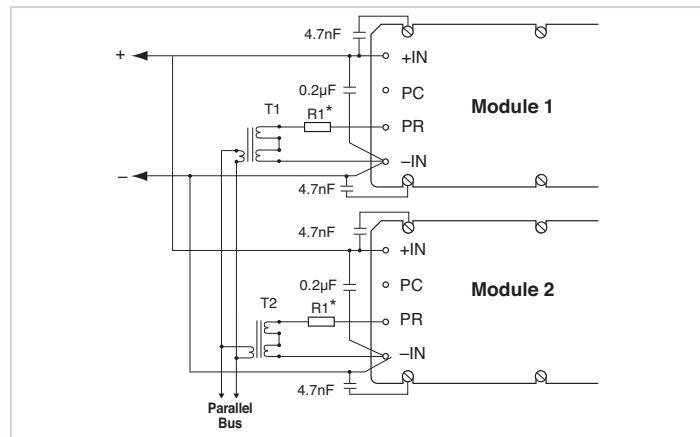


Figure 10 — Transformer-coupled interface

Number of Converters in Parallel	*R1 value $\Omega$
2	75
3	50
4	33
5 or more	refer to application note: <a href="#">Designing High-Power Arrays using Maxi, Mini, Micro Family DC-DC Converters</a>

## Parallel Bus / Voltage Drop Compensation

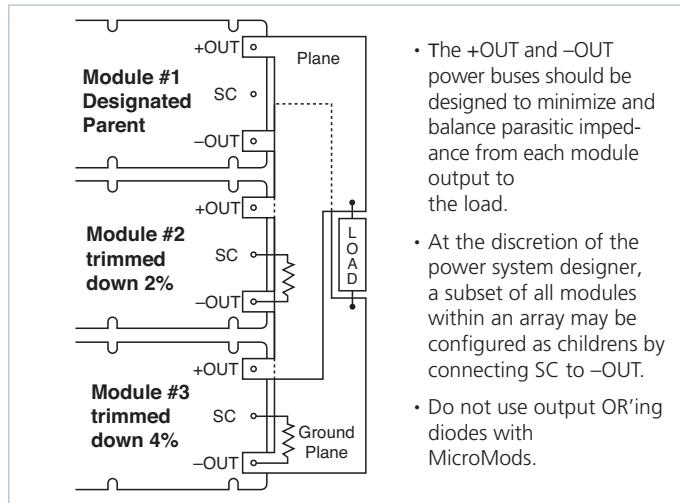


Figure 11 — N+1 module array output connections

- The +OUT and -OUT power buses should be designed to minimize and balance parasitic impedance from each module output to the load.

- At the discretion of the power system designer, a subset of all modules within an array may be configured as children by connecting SC to -OUT.
- Do not use output OR'ing diodes with MicroMods.

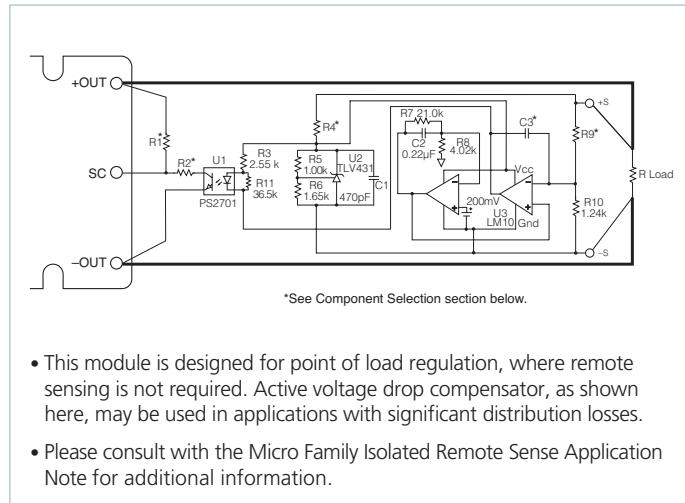


Figure 12 — Voltage drop compensation

\*See Component Selection section below.

- This module is designed for point of load regulation, where remote sensing is not required. Active voltage drop compensator, as shown here, may be used in applications with significant distribution losses.
- Please consult with the Micro Family Isolated Remote Sense Application Note for additional information.

## Mechanical Drawings

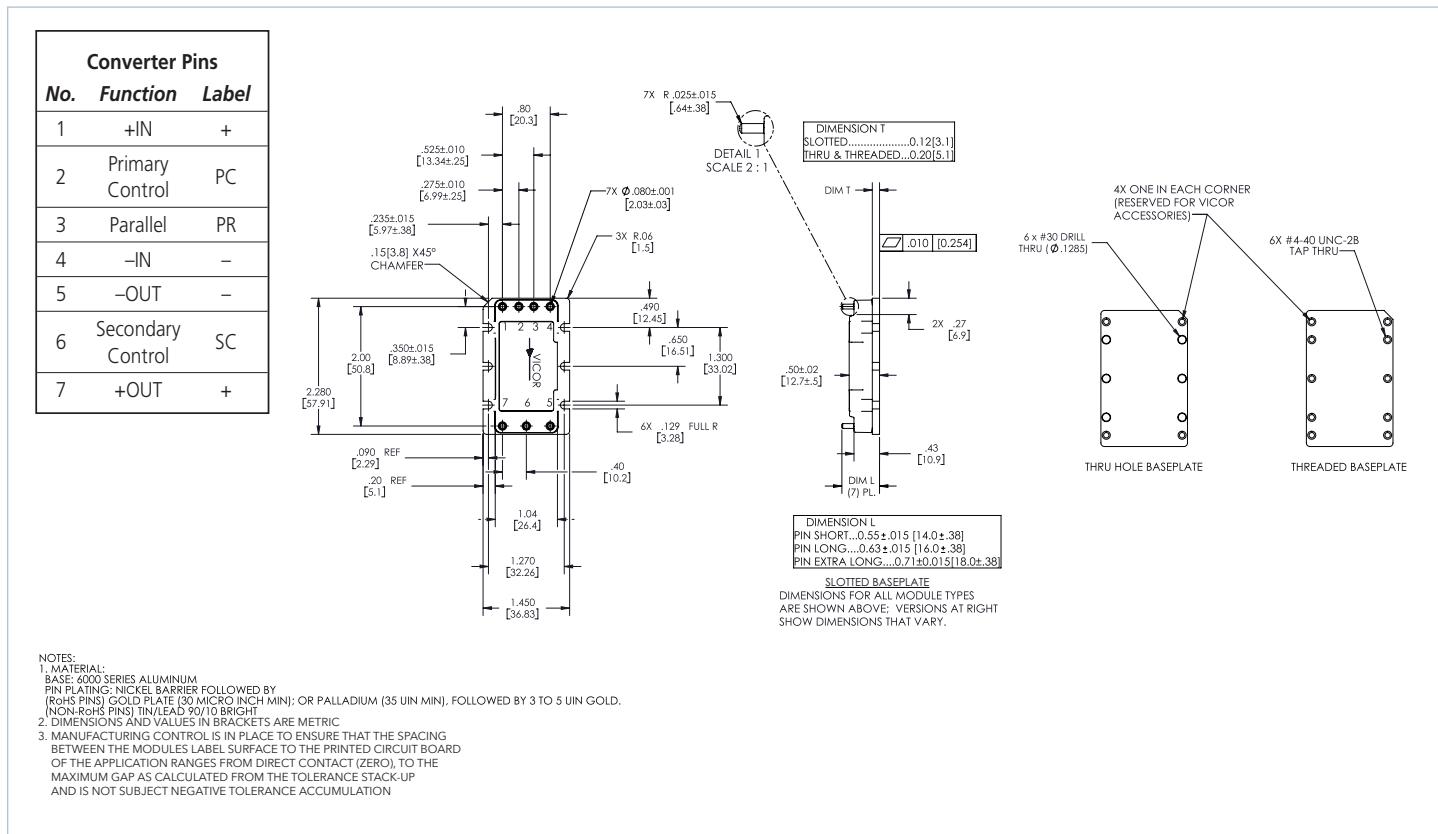


Figure 13 — Module outline

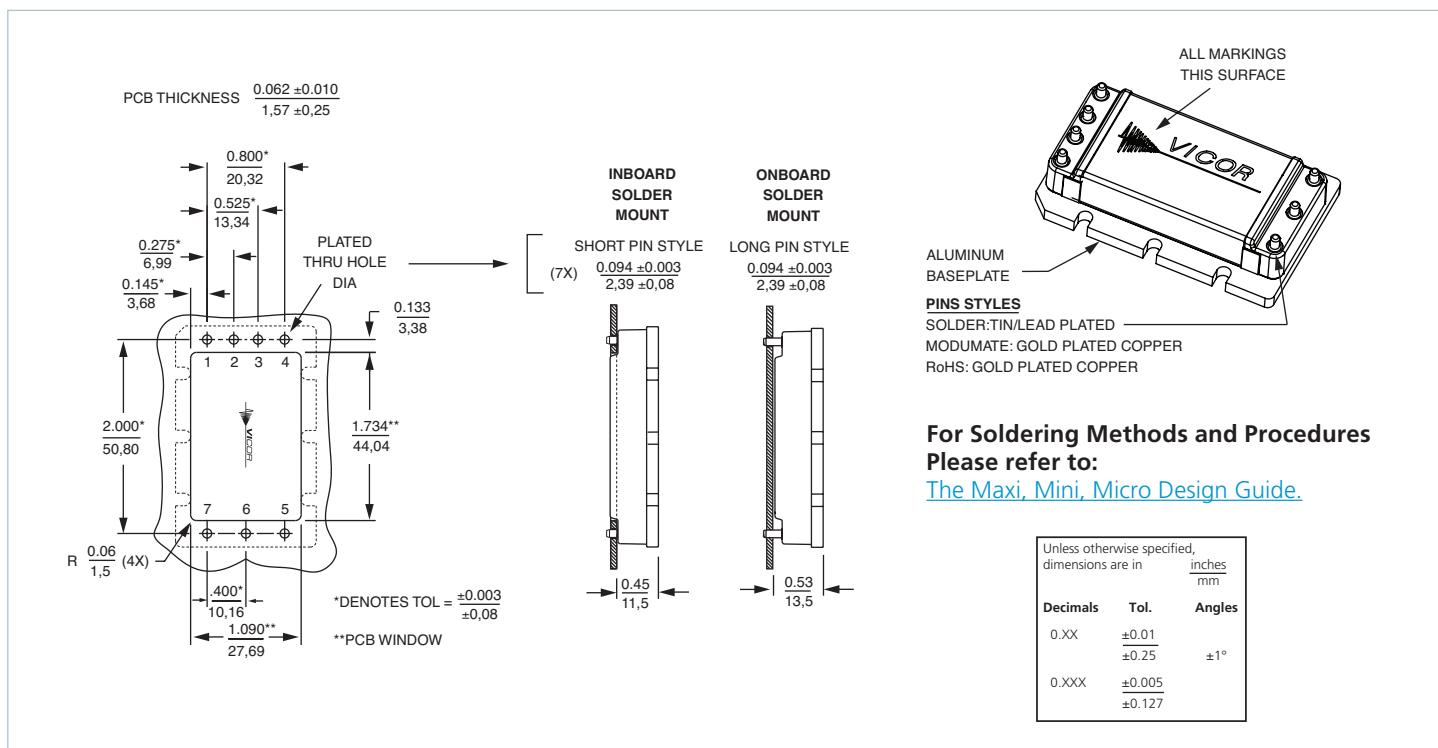


Figure 14 — PCB mounting specifications

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