DC-DC Converter Module

VI-810423B

Mini – $94V_{IN}$ / $28V_{OUT}$ / 120W

Features & Benefits

- DC input range: 69 - 144V
- Input surge withstand: 240V for 100ms
- DC output: 28V
- Programmable output: 10 to 110%
- Regulation: ±0.2% no load to full load
- Efficiency: 89.9%
- 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 Tin/Lead
- Baseplate: Slotted

Size:
2.28 x 2.2 x 0.5in
57,9 x 55,9 x 12,7mm

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.

Absolute Maximum Ratings

Parameter	Rating	Unit	Notes
+IN to –IN voltage	-0.5 to +252	V_{DC}	
+IN to –IN voltage	240	V_{DC}	< 100ms
PC to –IN voltage	-0.5 to +7	V_{DC}	
PR to –IN voltage	-0.5 to 7	V_{DC}	
+OUT to –OUT voltage	-0.5 to +36.9	V_{DC}	
+Sense to –OUT voltage	-0.5 to 36.9	V_{DC}	
–Sense to –OUT voltage	1.0	V_{DC}	
SC to –OUT voltage	-0.5 to +1.5	V_{DC}	
Isolation voltage			
IN to OUT	3000	V_{RMS}	Test voltage
IN to base	1550	V_{RMS}	Test voltage
OUT to base	500	V_{RMS}	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	69	94	144	V_{DC}	
Input surge withstand			240	V_{DC}	< 100ms
Output voltage setpoint	27.72	28	28.28	V_{DC}	Nominal input; full load; 25°C
Output OVP setpoint	31.6	32.8	34	V_{DC}	25°C; recycle input voltage to restart (100ms off)
Output power			120	W	At 100°C baseplate temperature
Efficiency	88	89.9		%	Nominal input; 75% of full load; 25°C

Module Input Specifications

Parameter	Min	Typ	Max	Unit	Notes
Undervoltage turn-on		66.9	68.4	V_{DC}	
Undervoltage turn-off	56.4	58.5		V_{DC}	
Overvoltage turn-off	145.4	151.2	158.4	V_{DC}	
Dissipation, standby		4.1	5.3	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		100	234	mV	Nominal input; full load; 20MHz bandwidth
Load current	0		4.29	A	
Current limit	4.37	4.93	5.8	A	Output voltage 95% of nominal
Short circuit current	2	4.93	6.5	A	Output voltage < 250mV
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.

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		0.16		°C/W	
Baseplate to sink; thermal pad (P/N 20264)		0.14		°C/W	
Baseplate to ambient		8.0		°C/W	
Baseplate to ambient; 1000LFM		1.9		°C/W	
Thermal capacity		83		Ws/°C	

Module Control Specifications

Parameter	Min	Typ	Max	Unit	Notes
PRIMARY SIDE (PC = Primary Control; PR = Parallel)					
PC bias voltage	5.50	5.75	6.10	V_{DC}	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_{DC}	Must be able to sink ≥ 4mA. See Fig. 2
PC module enable delay		4	7	ms	
PC module alarm			0.5	V_{AVG}	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
SECONDARY SIDE (SC = Secondary Control)					
SC bandgap voltage	1.21	1.23	1.25	V_{DC}	Referenced to –Sense
SC resistance	990	1000	1010	Ω	
SC capacitance		0.033		µF	
SC module alarm		0		V_{DC}	With open trim; referenced to –Sense. See Fig. 7

Module General Specifications

Parameter	Min	Typ	Max	Unit	Notes
Remote sense (total drop)			0.5	V_{DC}	0.25V per leg (senses must be closed)
Isolation voltage (IN to OUT)	3000			V_{RMS}	Complies with reinforced insulation requirements
Isolation voltage (IN to base)	1550			V_{RMS}	Complies with basic insulation requirements
Isolation voltage (OUT to base)	500			V_{RMS}	Complies with operational insulation requirements
Isolation resistance (IN to OUT)		10		MΩ	
Weight		3.7 (104)	4 (112)	oz (g)	
Temperature limiting	100	115		°C	See Figs. 3 and 5,
Agency approvals		cULus TÜV CE			UL60950-1, EN60950-1, CSA60950-1, IEC 60950-1; With appropriate fuse in series with the +Input

Basic Module Operation

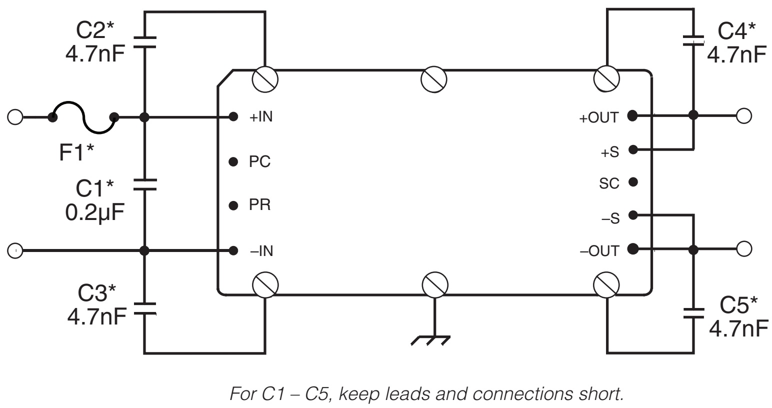


Figure 1 *— Basic module operation requires fusing, grounding, bypassing capacitors.* See Maxi, Mini, Micro Design Guide.*

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.

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

- 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.

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.

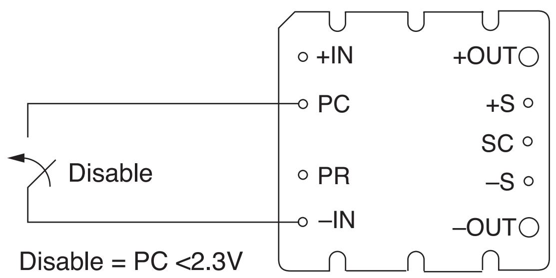


Figure 2 *— Module enable/disable*

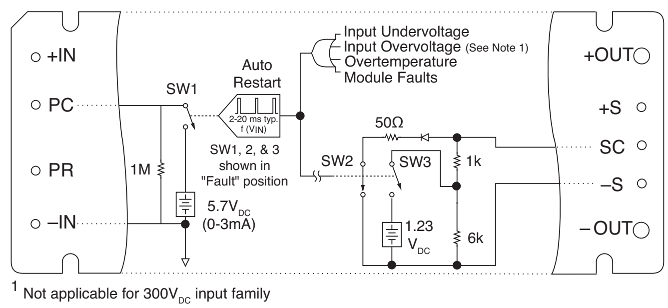


Figure 3 *— PC/SC module alarm logic*

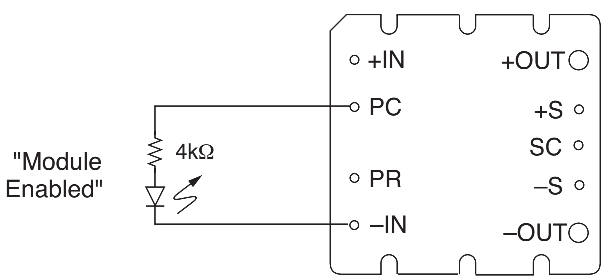


Figure 4 *— LED on-state indicator*

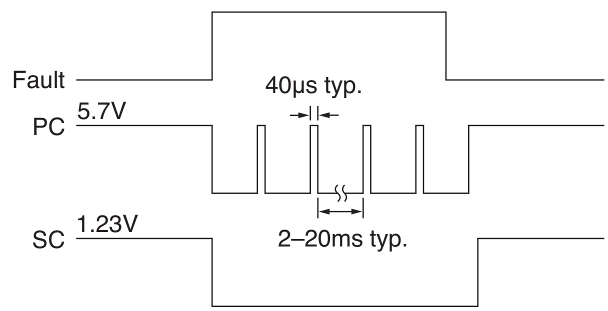


Figure 5 *— PC/SC module alarm timing*

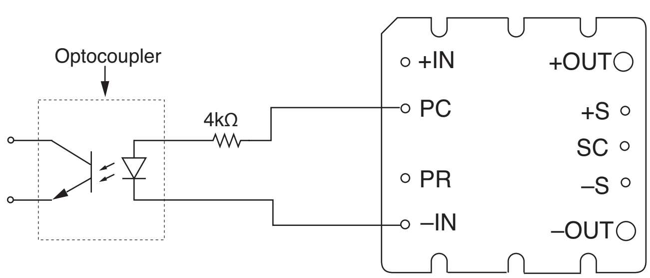


Figure 6 *— Isolated on-state indicator*

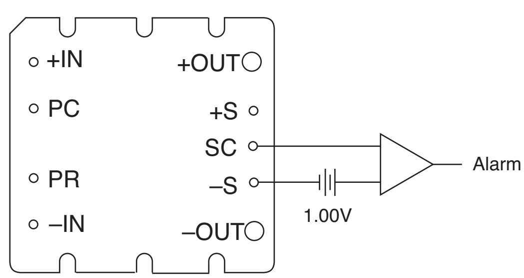
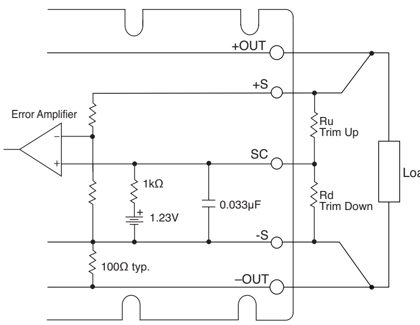


Figure 7 *— Secondary side on-state indicator*

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.



$$R_d\,(\Omega) = \frac{1{,}000\,V_{OUT}}{V_{NOM} - V_{OUT}}$$

$$R_U\,(\Omega) = \frac{1{,}000\,(V_{OUT} - 1.23)\,V_{NOM}}{1.23\,(V_{OUT} - V_{NOM})} - 1{,}000$$

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 over voltage 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.vicorpower.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 0.001µF (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.

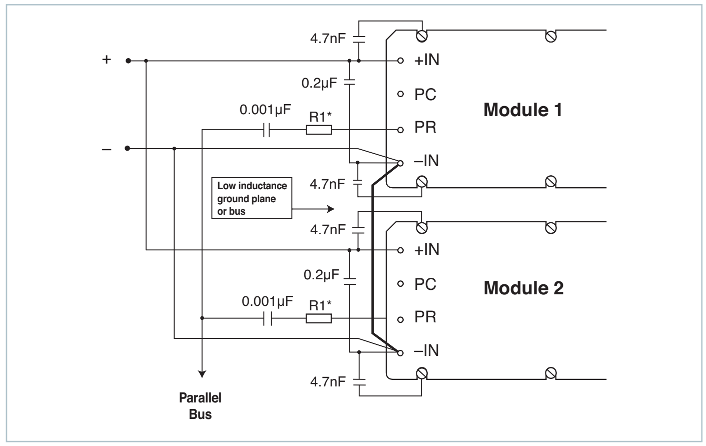


Figure 9 — *AC coupled single-wire interface*
** See Maxi, Mini, Micro Design Guide*

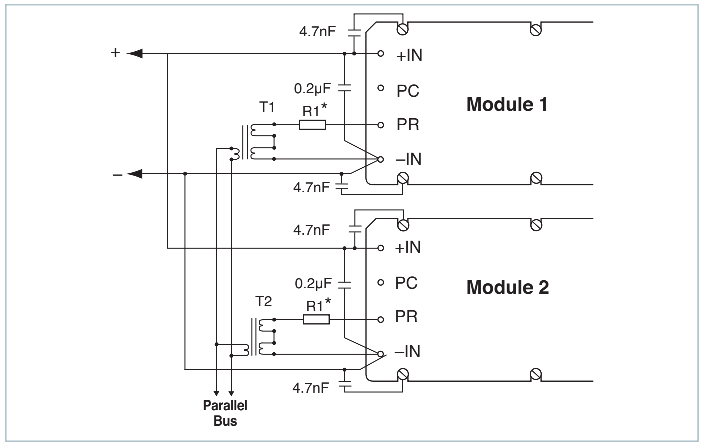
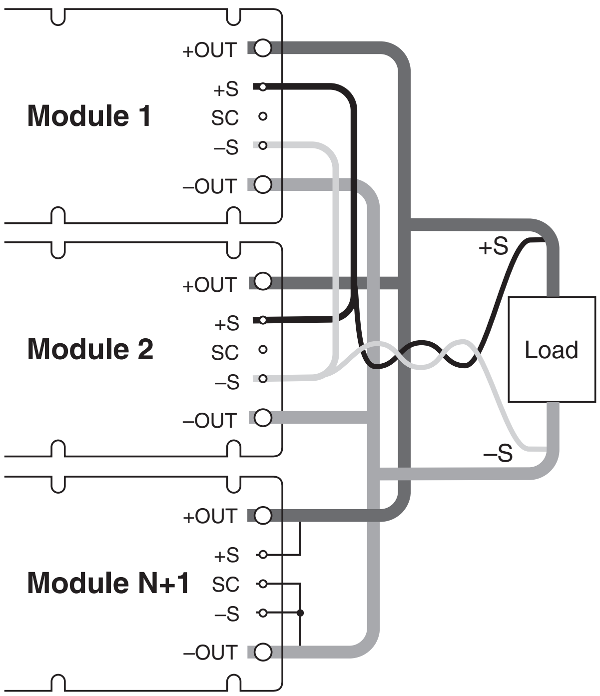


Figure 10 — *Transformer-coupled interface*

Number of Converters in Parallel	*R1 value Ω
2	75
3	50
4	33
5 or more	refer to application note: Designing High-Power Arrays using Maxi, Mini, Micro Family DC-DC Converters

Parallel Bus Output

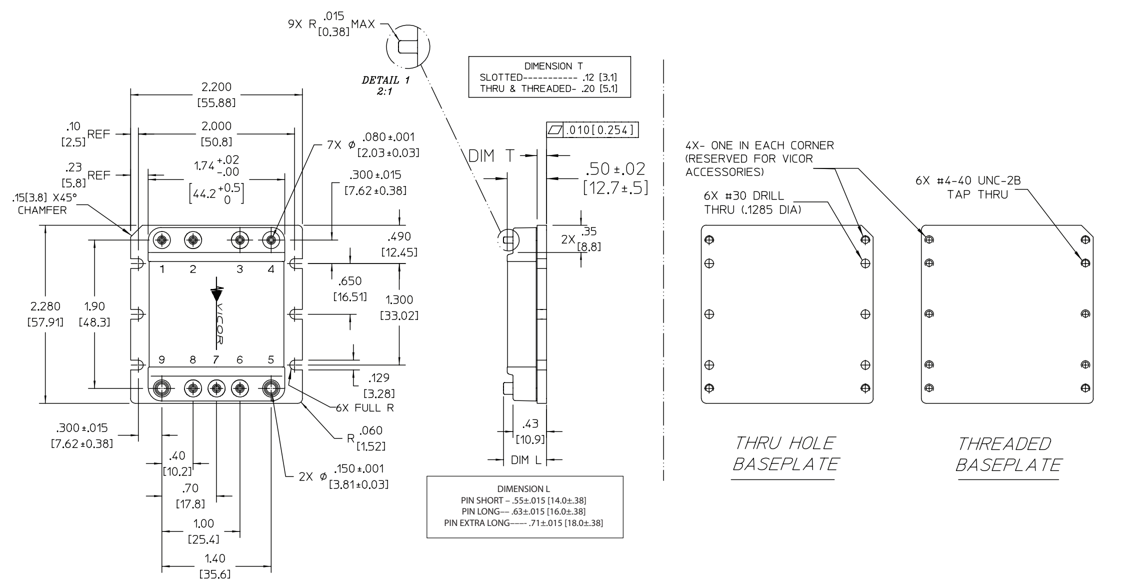


- The +OUT and –OUT power buses should be designed to minimize and balance parasitic impedance from each module output to the load.
- The +Sense pins must be tied together to form a +Sense bus. This must be Kelvin connected to +OUT at a single point. The –Sense pins should be tied together to form a –Sense bus. This must be Kelvin connected to –OUT at a single point.
- At the discretion of the power system designer, a subset of all modules within an array may be configured as slaves by connecting SC to –S.
- OR'ing diodes may be inserted in series with the +OUT pins of each module to provide module output fault tolerance.
- The +Sense and –Sense leads should be routed in close proximity to each other on the printed circuit board. If wires are used to connect the converters on a PCB to an external load, the Sense leads should be twisted together to reduce noise pickup.

Figure 11 *— N+1 module array output connections*

Mechanical Drawings

Converter Pins		
No.	**Function**	**Label**
1	+IN	+
2	Primary Control	PC
3	Parallel	PR
4	–IN	–
5	–OUT	–
6	–Sense	–S
7	Secondary Control	SC
8	+Sense	+S
9	+OUT	+

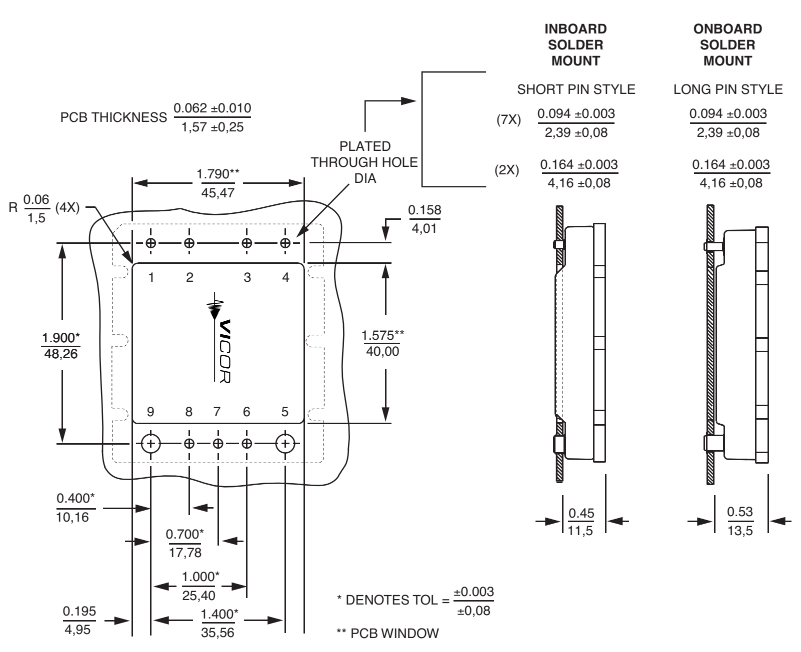


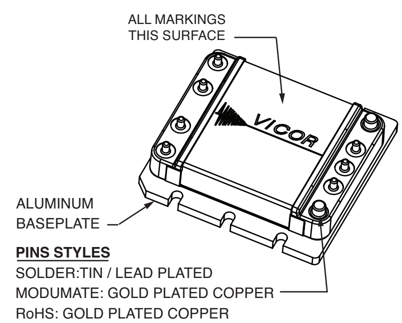
SLOTTED BASEPLATE

DIMENSIONS FOR ALL MODULE TYPES ARE SHOWN ABOVE, VERSIONS AT RIGHT SHOW DIMENSIONS THAT VARY

NOTES:
1. MATERIAL:
   BASE: 6000 SERIES ALUMINUM
   COVER: LCP, ALUMINUM 3003 H14
   PINS: RoHS PINS GOLD PLATE 30 MICRO INCH MIN; NON-RoHS
   PINS: TIN/LEAD 90/10 BRIGHT
2. DIMENSIONS AND VALUES IN BRACKETS ARE METRIC
3. MANUFACTURING CONTROL IS IN PLACE TO ENSURE THAT THE SPACING BETWEEN THE MODULES LABEL SURFACE TO THE PRINTED CIRCUIT BOARD OF THE APPLICATION RANGES FROM DIRECT CONTACT (ZERO), TO THE MAXIMUM GAP AS CALCULATED FROM THE TOLERANCE STACK-UP AND IS NOT SUBJECT NEGATIVE TOLERANCE ACCUMULATION

Figure 12 — *Module outline*





For Soldering Methods and Procedures Please refer to:
The MAXI, MINI, MICRO Design Guide.

Unless otherwise specified, dimensions are in inches / mm

Decimals	Tol.	Angles
0.XX	±0.01 / ±0.25	±1°
0.XXX	±0.005 / ±0.127	

Figure 13 — *PCB mounting specifications*

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