



# Military COTS 28V<sub>IN</sub> Filter

**M-FIAM9**

Example Model Number **M-FIAM9M21**

Actual size:  
2.28 x 2.2 x 0.5in  
[57,9 x 55,9 x 12,7mm]



## Input Attenuator Module

### Features & Benefits

- EMI filtering: MIL-STD-461E<sup>[b]</sup>
- Transient protection: MIL-STD-704A/E/F, MIL-STD-1275A/B/D
- Environments: MIL-STD-810, MIL-STD-202
- Environmental stress screening
- Low-profile mounting options
- Output power up to 500W
- Output current up to 18A
- Mini-sized package
- Inrush current limiting

### Product Highlights

The M-FIAM9 is a DC front-end module that provides EMI filtering and transient protection. The M-FIAM9 enables designers using Vicor 24V or 28V DC-DC converters to meet conducted emission / conducted susceptibility per MIL-STD-461E; and input transients per MIL-STD-704A/E/F and MIL-STD-1275A/B/D. The M-FIAM9 accepts an input voltage of 10 – 36V<sub>DC</sub> and delivers output power up to 500W.

M-FIAM9 is housed in an industry-standard “half-brick” module measuring 2.28 x 2.2 x 0.5in and depending upon model selected, may be mounted onboard or inboard for height-critical applications.

### Compatible Products

- Maxi, Mini, Micro Series 24V and 28V Input DC-DC converters or VIPAC Arrays™

### Absolute Maximum Rating

Parameter	Rating	Unit	Notes
+IN to -IN	36	V <sub>DC</sub>	Continuous
	100	V <sub>DC</sub>	50ms, See Figure 1
	250	V <sub>DC</sub>	70µs
Mounting torque	5 [0.57]	in-lbs [N·m]	6 each, #4-40 or M3
Pin soldering temperature	500 [260]	°F [°C]	<5sec; wave solder
	750 [390]	°F [°C]	<7sec; hand solder

### Thermal Resistance and Capacity

Parameter	Min	Typ	Max	Unit
Baseplate to sink				
flat, greased surface		0.16		°C/Watt
with thermal pad (P/N 20264)		0.1		°C/Watt
Baseplate to ambient				
Free convection		7.9		°C/Watt
1000LFM		2.2		°C/Watt

### MTBF per MIL-HDBK-217F (M-FIAM9M21)

Temperature	Environment	MTBF	Unit
25°C	Ground Benign: G.B.	3,582	1,000Hrs
50°C	Naval Sheltered: N.S.	644	1,000Hrs
65°C	Airborne Inhabited Cargo: A.I.C.	505	1,000Hrs

### Part Numbering

<b>M-FIAM9</b>	<b>M</b>	<b>2</b>	<b>1</b>
<b>Product</b>	<b>Product Grade Temperatures (°C)</b>	<b>Pin Style</b>	<b>Baseplate</b>
	Grade Operating Storage	1 = Short Pin	1 = Slotted
	H = -40 to +100 -55 to +125	2 = Long Pin	2 = Threaded
	M = -55 to +100 -65 to +125	S = Short ModuMate <sup>[a]</sup>	3 = Thru hole
		N = Long ModuMate <sup>[a]</sup>	
		F = Short RoHS	
		G = Long RoHS	
		K = Extra Long RoHS <sup>[c]</sup>	

<sup>[a]</sup> Compatible with SurfMate and InMate socketing system.

<sup>[b]</sup> EMI performance is subject to a wide variety of external influences such as PCB construction, circuit layout etc. As such, external components in addition to those listed herein may be required in specific instances to gain full compliance to the standards specified.

<sup>[c]</sup> Not intended for socket or Surfmate mounting.

Note: Product images may not highlight current product markings.

## Specifications

Typical at  $T_{BP} = 25^{\circ}\text{C}$ , nominal line and 75% load, unless otherwise specified.

### Input Specifications

Parameter	Min	Typ	Max	Unit	Notes
Input voltage	10	28	36	$V_{DC}$	Continuous
Inrush limiting			0.007	A/ $\mu\text{F}$	Intended for use in Military Ground Vehicles where the power available is per MIL-STD-1275D. Internal capacitance is $\sim 50\mu\text{F}$ , which precedes the inrush limit circuit. External precautions should be taken if the source cannot tolerate the capacitive charge current associated with this internal capacitance.
Transient immunity			100	$V_{DC}$	50ms per MIL-STD-1275A/B/D, continuous operation
			250	$V_{DC}$	70 $\mu\text{s}$ per MIL-STD-1275A/B/D, continuous operation
			70	$V_{DC}$	20ms per MIL-STD-704A, continuous operation
			50	$V_{DC}$	12.5ms per MIL-STD-704E/F, continuous operation

### Output Specifications

Parameter	Min	Typ	Max	Unit	Notes
Output power			500	W	See Figures 5 & 6
Output current			18	A	
Efficiency	96	97		%	
Internal voltage drop		0.85	1.5	V	500W, $25^{\circ}\text{C}$ baseplate
External capacitance	330		1000	$\mu\text{F}$	See Figure 7 on page 5 50V

### Control Pin Specifications

Parameter	Min	Typ	Max	Unit	Notes
ON/OFF control					
Enable (ON)	0.0		1.0	$V_{DC}$	Referenced to $-V_{OUT}$
Disable (OFF)	3.5		5.0	$V_{DC}$	100k $\Omega$ internal pull-up resistor

### Safety Specifications

Parameter	Min	Typ	Max	Unit	Notes
Dielectric withstand	1,500			$V_{RMS}$	Input/Output to Base
	2,121			$V_{DC}$	Input/Output to Base

### EMI

Standard	Test Procedure	Notes
MIL-STD-461E		
Conducted emissions:	CE101, CE102	When using with V28 series converters a 27 $\mu\text{H}$ inductor is needed between the filter and converter for compliance below 30% of rated power.
Conducted susceptibility:	CS101, CS114, CS115, CS116	

EMI performance is subject to a wide variety of external influences such as PCB construction, circuit layout etc. As such, external components in addition to those listed herein may be required in specific instances to gain full compliance to the standards specified.

## Specifications (Cont.)

Typical at  $T_{BP} = 25^{\circ}\text{C}$ , nominal line and 75% load, unless otherwise specified.

### General Specifications

Parameter	Min	Typ	Max	Unit	Notes
Weight			3.3 [94]	Ounces [grams]	
Warranty			2	Years	
Agency Approvals				CE UKCA	CE Marked to the Low Voltage Directive and RoHS Recast Directive, as applicable Electrical equipment (safety) regulations

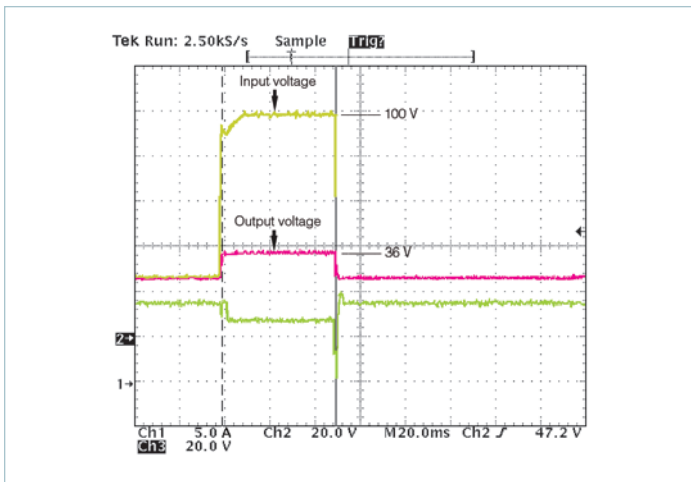
### Environmental Qualification

<b>Altitude</b> MIL-STD-810F, Method 500.4, Procedure I & II, 40,000ft. and 70,000ft. Operational.
<b>Explosive Atmosphere</b> MIL-STD-810F, Method 511.4, Procedure I, Operational.
<b>Vibration</b> MIL-STD-810F, Method 514.5, Procedure I, Category 14, Sine and Random vibration per Table 514.5C for Helicopter AH-6J Main Rotor with overall level of 5.6Grms for 4 hours per axis. MIL-STD-810F, Method 514.5C, General Minimum Integrity Curve per Figure 514.5C-17 with overall level of 7.7Grms for 1 hour per axis.
<b>Shock</b> MIL-STD-810F, Method 516.5, Procedure I, Functional Shock, 40g. MIL-S-901D, Lightweight Hammer Shock, 3 impacts / axis, 1,3,5 ft. MIL-STD-202F, Method 213B, 60g, 9ms half sine. MIL-STD-202F, Method 213B, 75g, 11ms Saw Tooth Shock.
<b>Acceleration</b> MIL-STD-810F, Method 513.5, Procedure II, table 513.5-II, Operational, 2-7g, 6 directions.
<b>Humidity</b> MIL-STD-810F, Method 507.4.
<b>Solder Test</b> MIL-STD-202G, Method 208H, 8 hour aging.

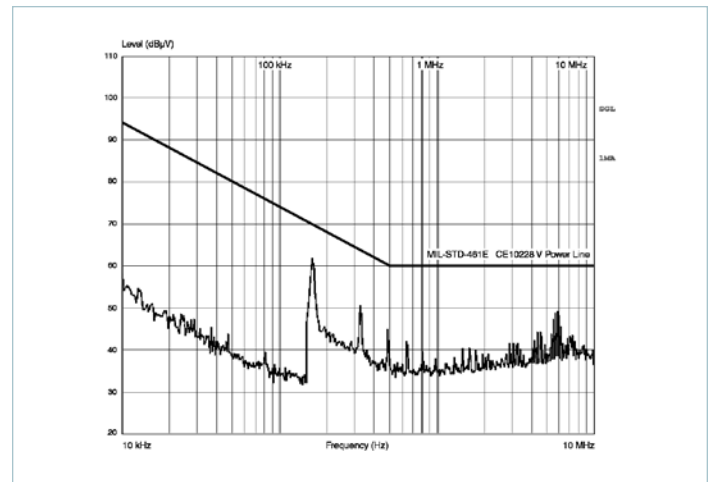
### Environmental Stress Screening

Parameter	H-Grade	M-Grade
Operating temperature	-40 to +100°C	-55 to +100°C
Storage temperature	-55 to +125°C	-65 to +125°C
Temperature cycling*	12 cycles -65 to +100°C	12 cycles -65 to +100°C
Ambient test @ 25°C	Yes	Yes
Power cycling burn-in	12 hours, 29 cycles	24 hours, 58 cycles
Functional and parametric ATE tests	-40 and +100°C	-55 and +100°C
Hi-Pot test	Yes	Yes
Visual inspection	Yes	Yes
Test data	<a href="http://vicorpower.com">vicorpower.com</a>	<a href="http://vicorpower.com">vicorpower.com</a>

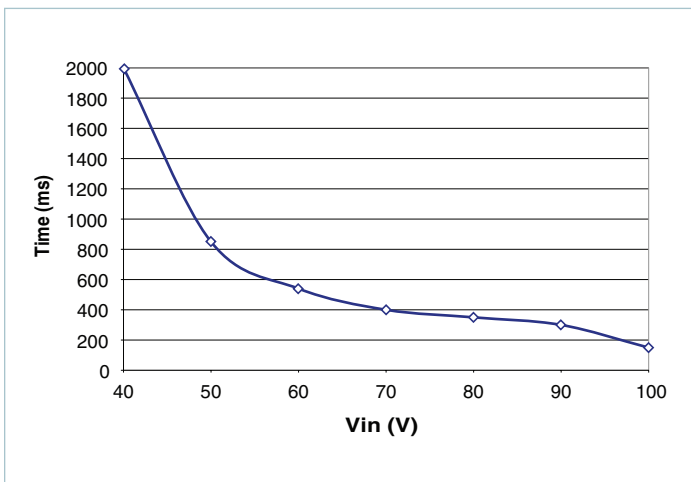
\*Temperature cycled with power off, 17°C per minute rate of change.



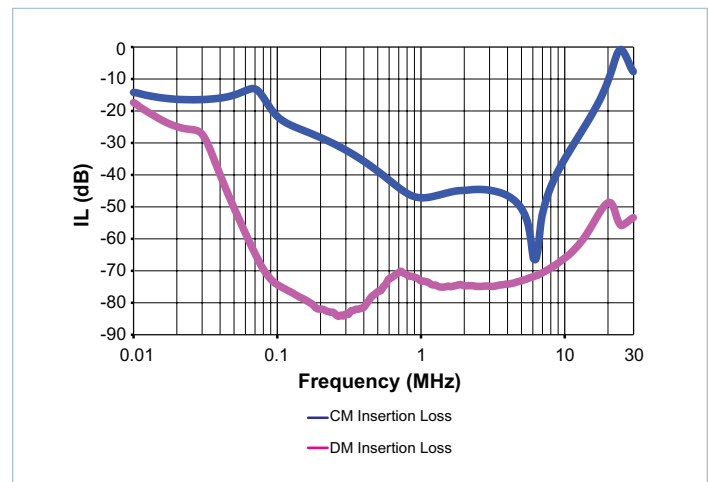
**Figure 1** — Transient immunity: M-FIAM9 output response to an input transient



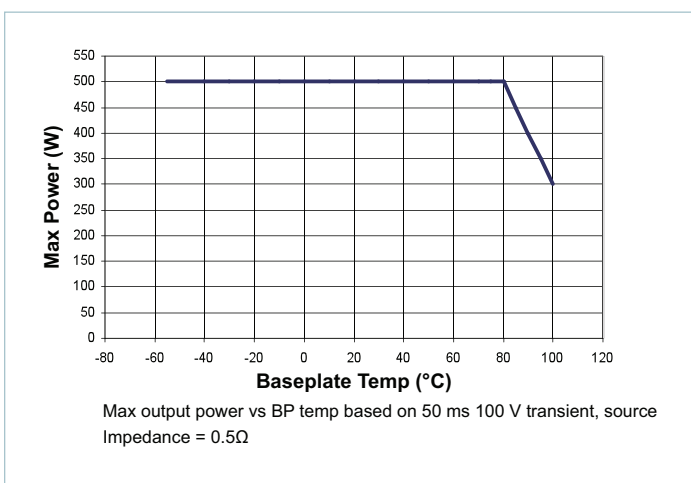
**Figure 2** — Conducted noise: M-FIAM9 and model V28A12M200B DC-DC converter operating at 28V<sub>DC</sub>, 200W



**Figure 3** — Shut-down time of M-FIAM9 vs. overvoltage



**Figure 4** — M-FIAM9 insertion loss



**Figure 5** — Temperature de-rating

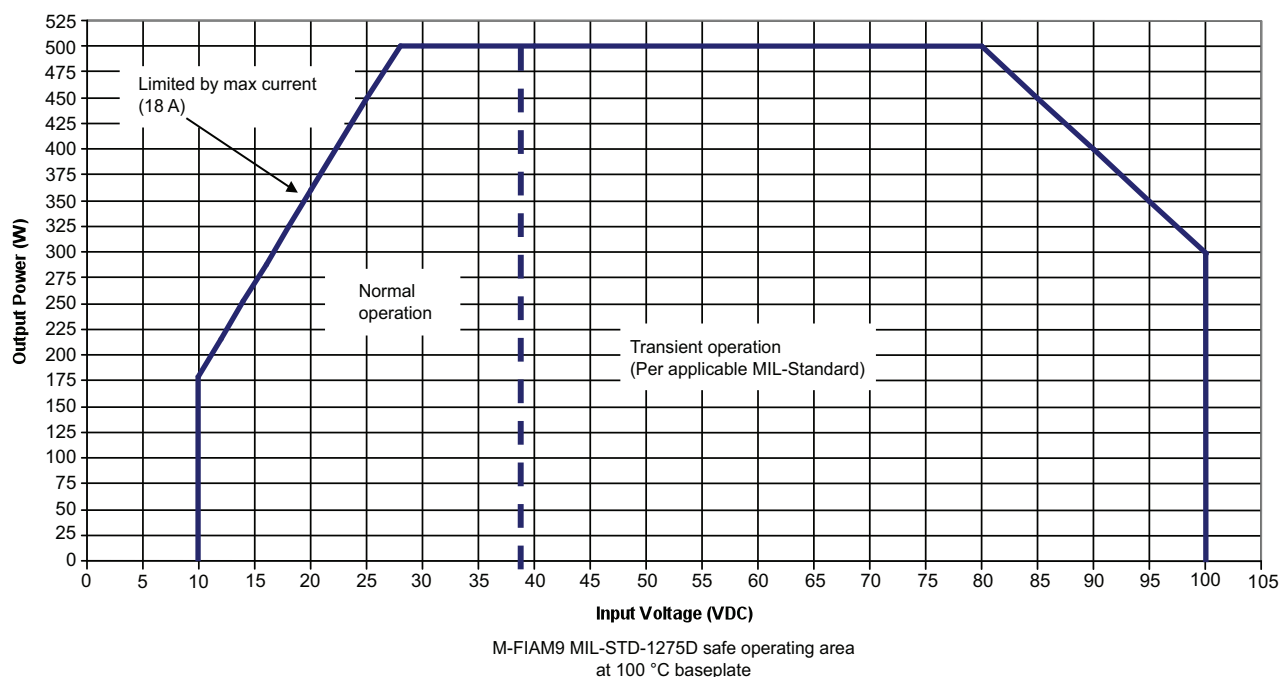


Figure 6 — M-FIAM 9 transient safe operating area at 100°C baseplate

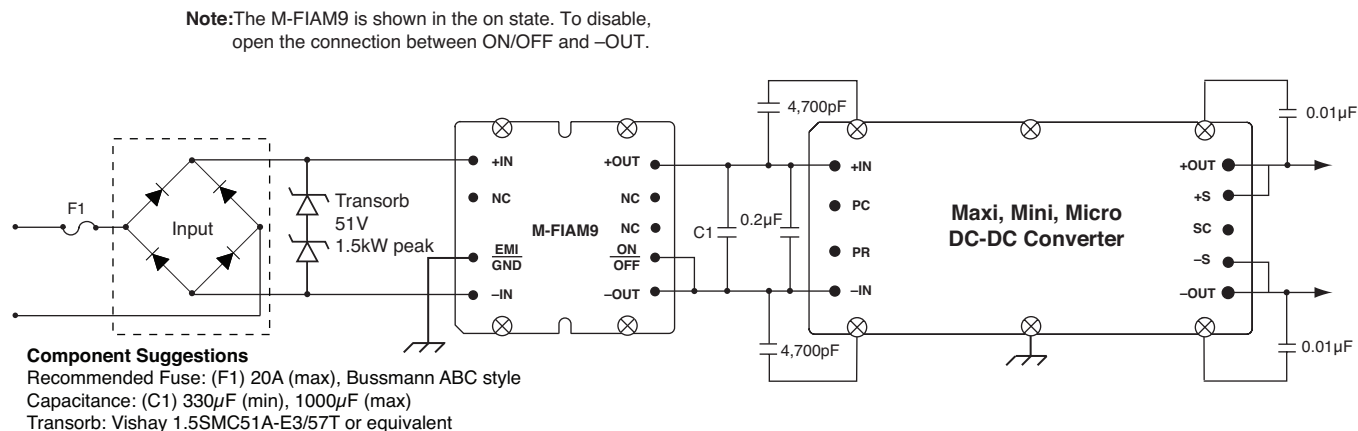


Figure 7 — Transient, surge protection and recommended reverse-polarity protection

## Storage

Vicor products, when not installed in customer units, should be stored in ESD safe packaging in accordance with ANSI/ESD S20.20, "Protection of Electrical and Electronic Parts, Assemblies and Equipment" and should be maintained in a temperature controlled factory/warehouse environment not exposed to outside elements controlled between the temperature ranges of 15°C and 38°C. Humidity shall not be condensing, no minimum humidity when stored in an ESD compliant package.

## Mechanical Drawings

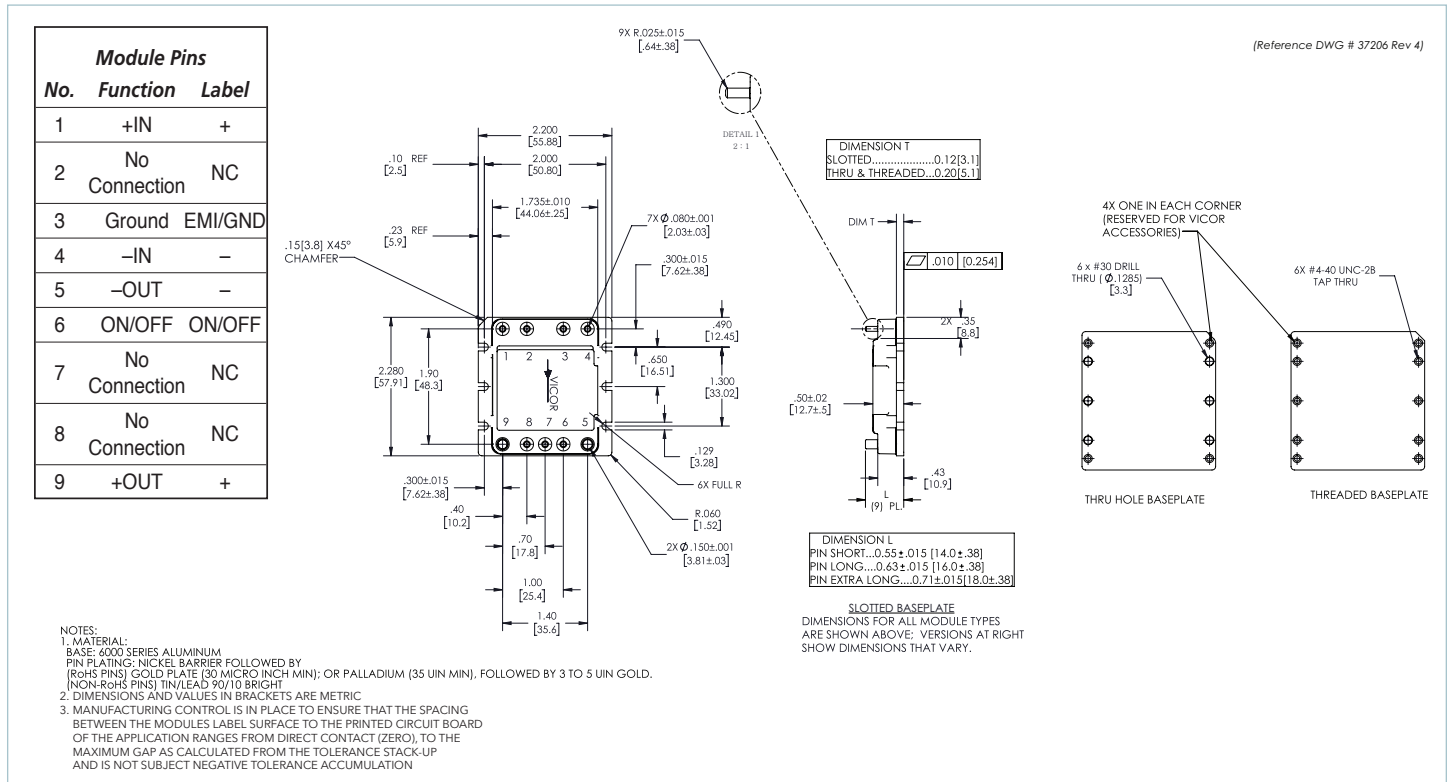


Figure 8 — Mechanical diagram

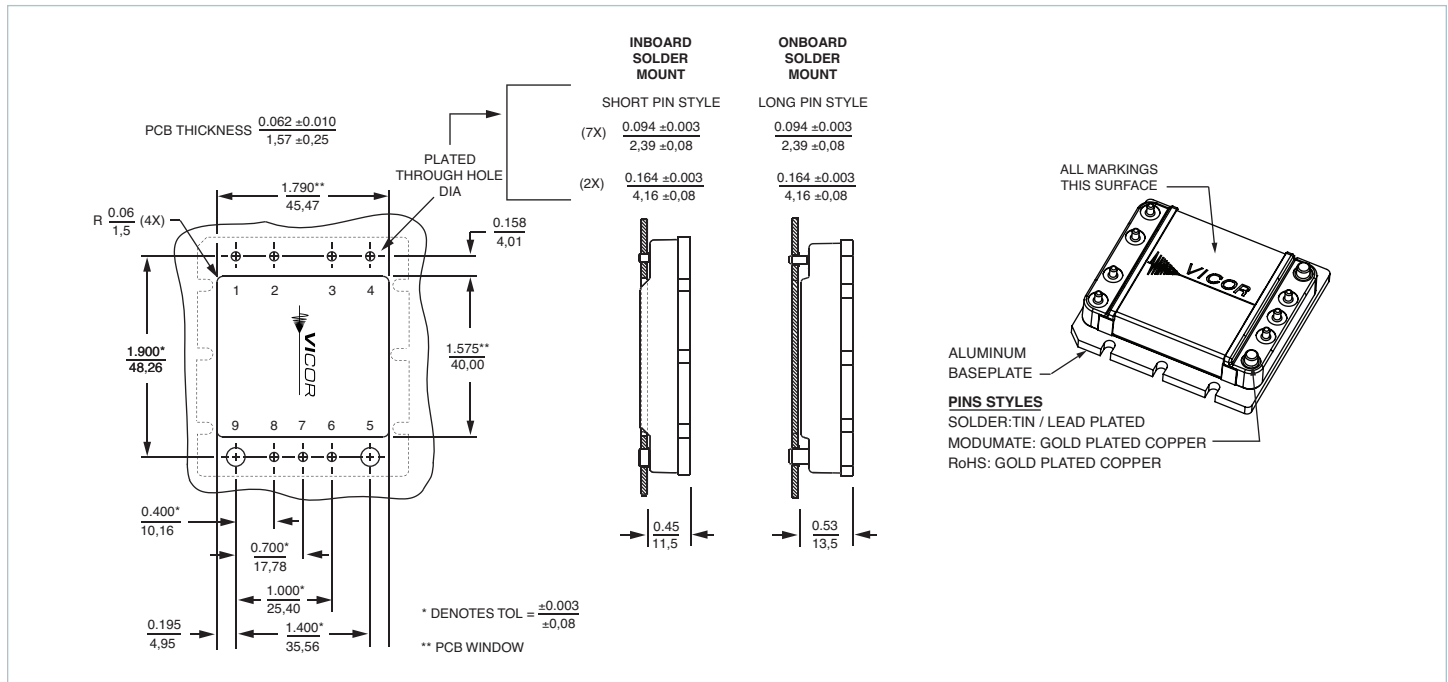


Figure 9 — PCB mounting specifications

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