PICOR
Semiconductor Power Solutions

Quiet-Power®
MQPI-18
M-Grade

28 Volt input, 7 Amp M-Grade EMI Filter Module

Product Description

The MQPI-18 attenuates conducted common-mode (CM) and differential-mode (DM) noise for DC-DC converters including the VI Chip MIL PRM to comply with MIL-STD-461F EMI requirements for conducted noise measurements. The filter operates within the full input operating range of a 28 V MIL PRM and supports 7 A loads up to 85°C (T_A) without de-rating.

Features

- 50 Vin max. input
- Compatible to most industry standard DC-DC converters including VI Chip MIL PRM
- MIL-STD-461F compliant[a] CE101, CE102, CS101, CS106, CS114, CS115, and CS116
- 100 Vdc surge, 100 ms
- 1,500 Vdc hipot hold-off to shield plane
- 7 A rating
- 12.9 x 25.3 x 5.0 mm, lidded SiP (System-in-Package)
- 12.4 x 24.9 x 4.2 mm, open-frame
- -55° to +125°C PCB temperature (see Figure 4)
- Efficiency >99%
- Pb solder construction

Applications

- Rugged Environment
- Displays
- Wireless Communications

Assembly Process Compatibility

- Designed for Pb solder SMT assembly
- Compatible with typical aqueous cleaning processes (MQPI-18LP-01, open-frame only)
- Compatible with most conformal coating compounds (MQPI-18LP-01, open-frame only, after reflow)

MQPI-18LP (~1/2 in² area)

Typical Application

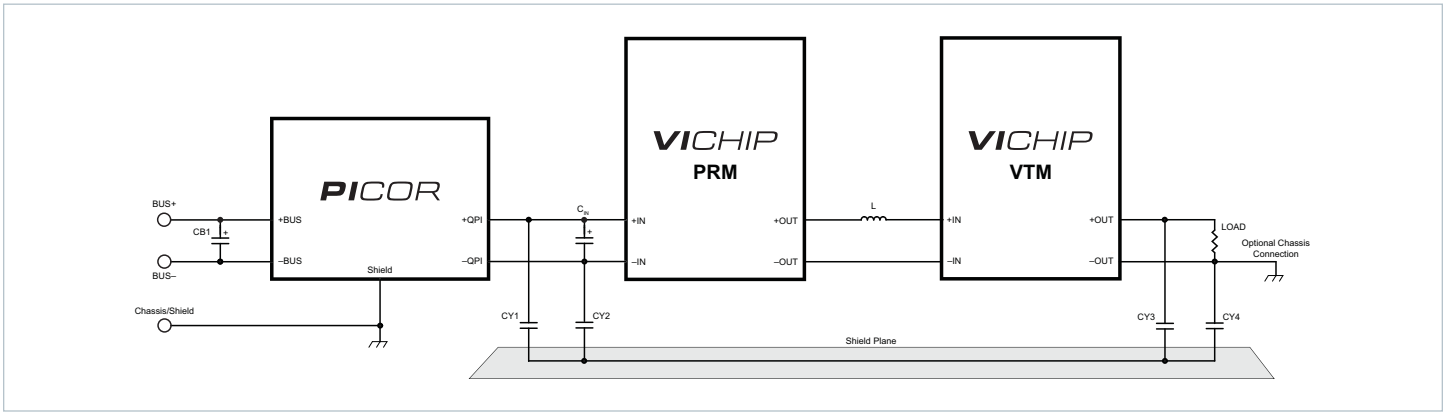


Figure 1 *— Typical MQPI-18 application schematic with Vicor's MP028 PRM and MV036 VTM modules.* [b]

[a] When combined with MP028 PRMs and MV036 VTMs.
[b] CB1 capacitor, referenced in all schematics, is a 47 uF electrolytic; United Chemi-Con EMVE101ARA470MKE0S or equivalent. CY1 to CY4, referenced in all schematics, are 4.7 nF hi-voltage safety capacitors; Vishay VY1472M63Y5UQ63V0 or equivalent.

Order Information

Part Number	Description
MQPI-18LP	MQPI-18 LGA package
MQPI-18LP-01	MQPI-18 LGA package, open-frame package
	Also Available
MQPI-18-CB1	A MQPI-18LP mounted on a carrier board that can be paired with PRM/VTM and Cool-Power® evaluation boards available from Vicor.

Absolute Maximum Ratings

Exceeding these parameters may result in permanent damage to the product.

Name	Rating
Input voltage, BUS+ to BUS-, continuous	-50 to 50 Vdc
Input voltage, BUS+ to BUS-, 100 ms transient	-100 to 100 Vdc
BUS+/ BUS- to Shield pads, hipot	-750 to 750 Vdc
Input to output current, continuous @ 25°C T_A	7 Adc
Power dissipation, @ 85°C T_A, 7 A [c]	1.85 W
Operating temperature - T_A	-55 to 125°C
Thermal resistance[c] - $R_{\theta J\text{-}A}$, using PCB layout in Figure 12	30°C/W
Thermal resistance[c] - $R_{\theta J\text{-}PCB}$	18°C/W
Storage temperature, JEDEC Standard J-STD-033B	-55 to 125°C
Reflow temperature, 20 s exposure	245°C
ESD, Human Body Model (HBM)	-2000 to 2000 V

Electrical Characteristics

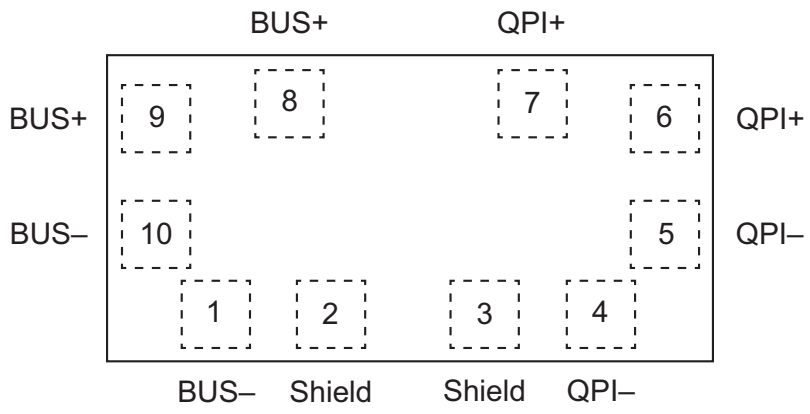
Parameter limits apply over the operating temp. range, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input range	BUS+ to BUS-	Measured at 7 A, 85°C ambient temperature [c]			50	Vdc
Voltage drop	BUS+ to QPI+	Measured at 7 A, 85°C ambient temperature [c])			130	mVdc
Voltage drop	BUS- to QPI-	Measured at 7 A, 85°C ambient temperature [c]			130	mVdc
Common-mode attenuation		V_{BUS} = 28 V, frequency = 1.0 MHz, line impedance = 50 Ω	45			dB
Differential-mode attenuation		V_{BUS} = 28 V, frequency = 1.0 MHz, line impedance = 50 Ω	75			dB
Input bias current at 50 V		Input current from BUS+ to BUS-			10	uA

[c] See Figure 4 for the current de-rating curve.

Pad Descriptions

Pin Name	Name	Description
8, 9	BUS+	Positive bus potential
1, 10	BUS-	Negative bus potential
6, 7	QPI+	Positive input to the converter
4, 5	QPI-	Negative input to the converter
2, 3	Shield	Shield connects to the system chassis or to a safety ground



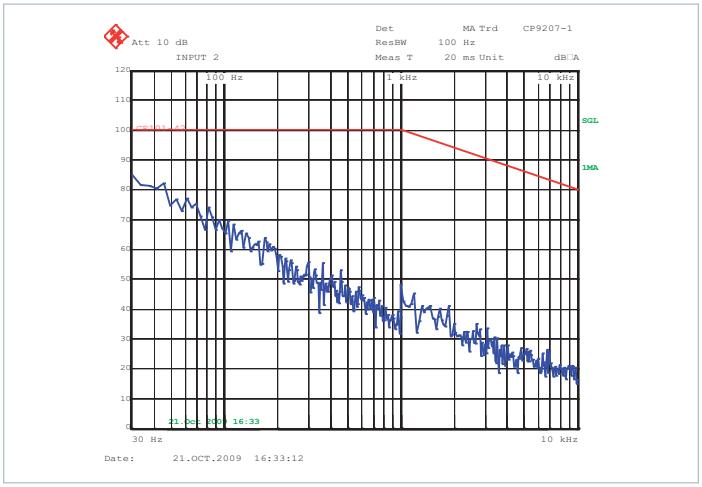
LGA Pattern (Top View)

Applications Information

The MQPI-18 was designed specifically to work with Vicor's MIL PRM (MP028) and VTM (MV036) series of VI Chip® Factorized Power Architecture™ (FPA™) converters to achieve compliance with the MIL-STD 461F standard.

MIL-STD 461F Test Results		
CS101	Conducted susceptibility, power	Leads Passed
CS106	Conducted susceptibility, transients, power leads	Passed
CS114	Bulk cable injection, radio frequency	Passed, 100% load (Figure 4)
CS114	Bulk cable injection, radio frequency	Passed, 78% load (Figure 5)
CS115	Bulk cable injection, radio frequency	Passed
CS116	Damped sinusoid transients	Passed
CS116	Damped sinusoid transients	Passed

CE101 EMI Plots: 108 Watt Load



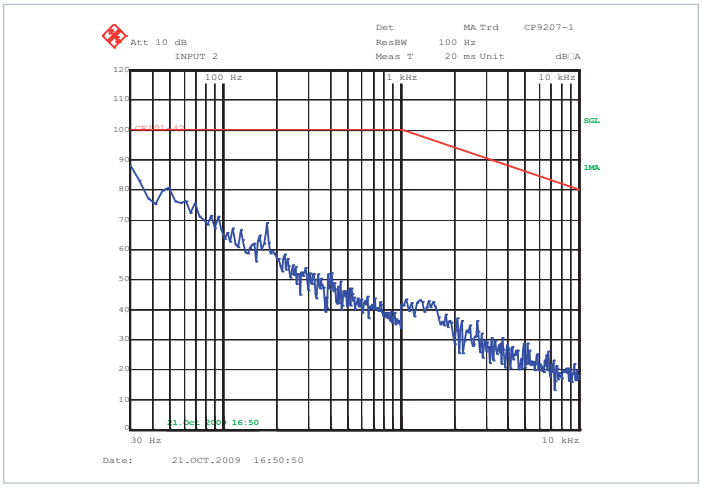
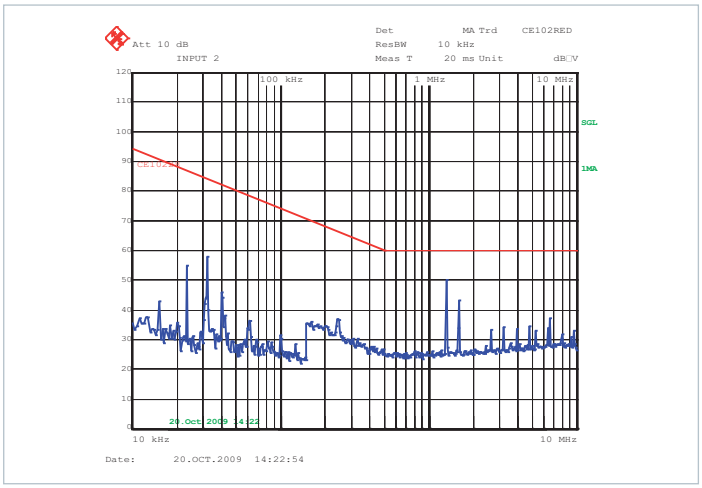


Figure 2 *— CE101 EMI plots of the MP028F036M12AL and MV036F120M010, filtered with the MQPI-18LP, + (RED) and –(BLK) leads*

CE102 EMI Plots: 108 Watt Load



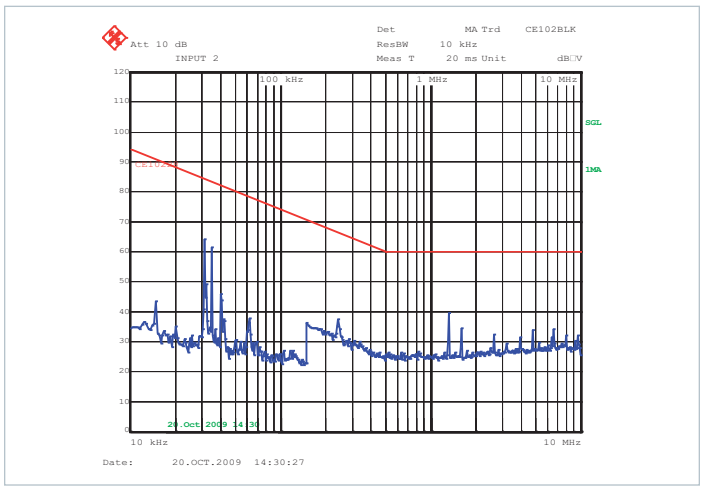


Figure 3 *— CE102 EMI plots of the MP028F036M12AL and MV036F120M010, filtered with the MQPI-18LP, + (RED) and –(BLK) leads*

Current De-Rating

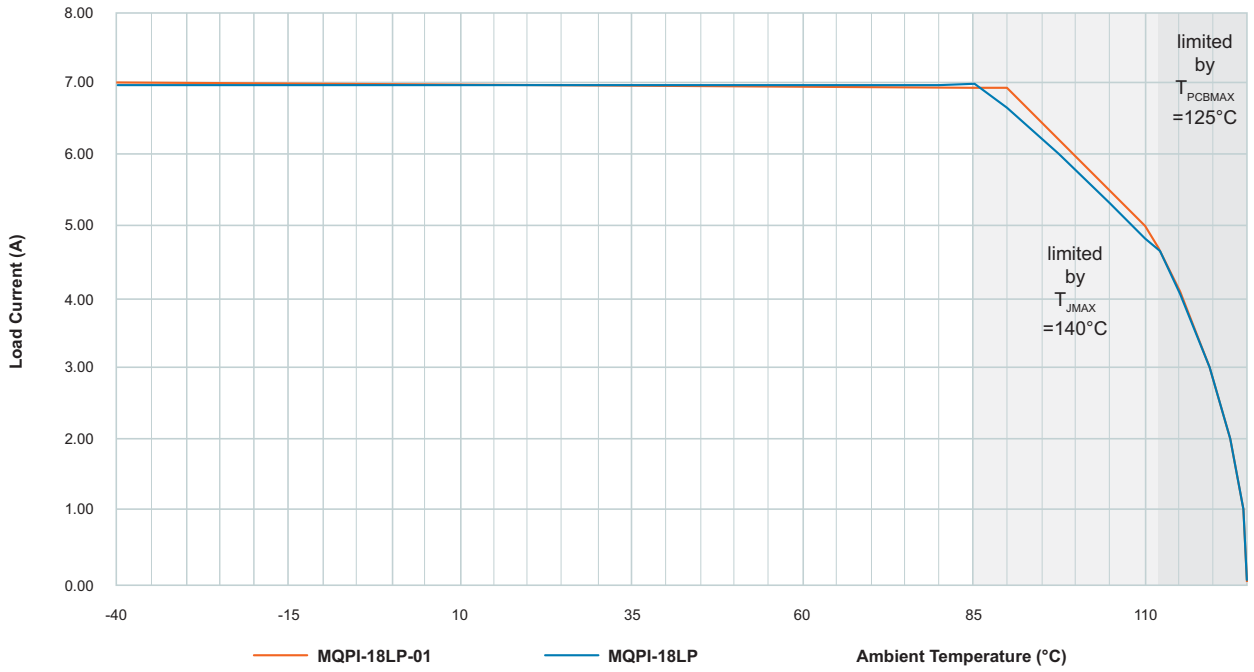


Figure 4 — *Current de-rating over ambient temperature range*

MQPI-18 Insertion Loss Measurements

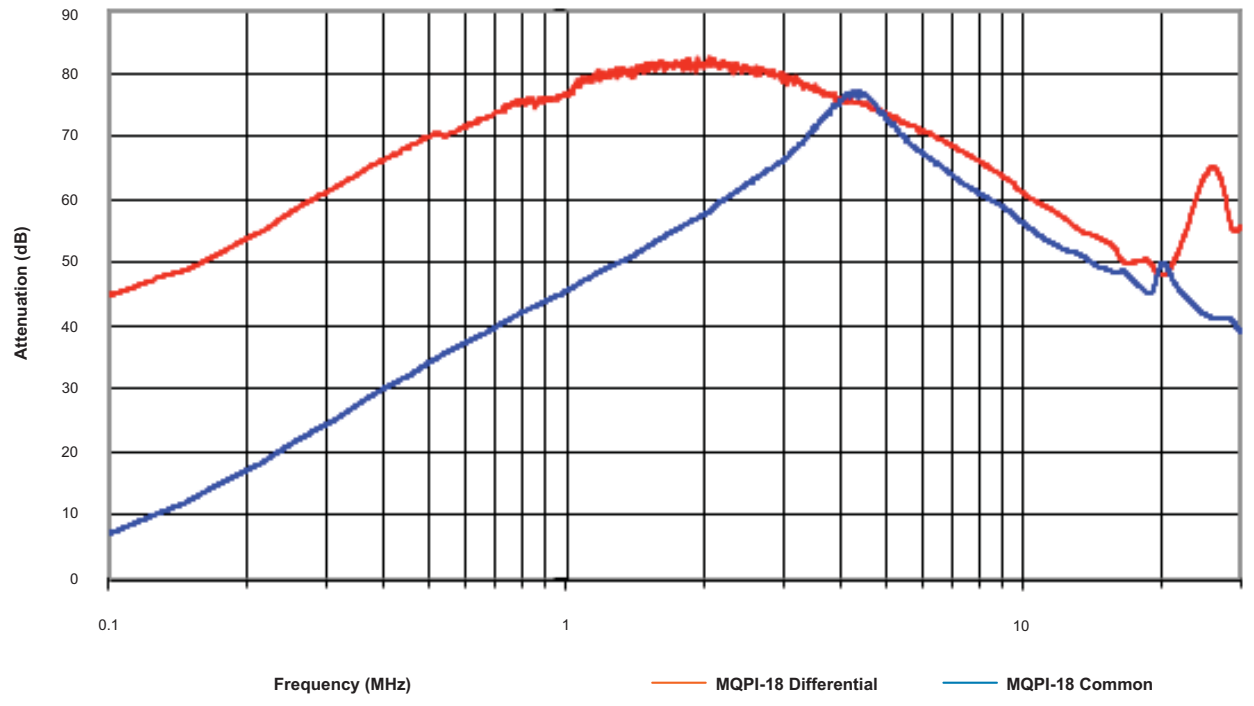


Figure 5 — *Attenuation curves into a 50 Ω line impedance, bias from a 48 V bus*

MQPI Insertion Loss Test Circuits

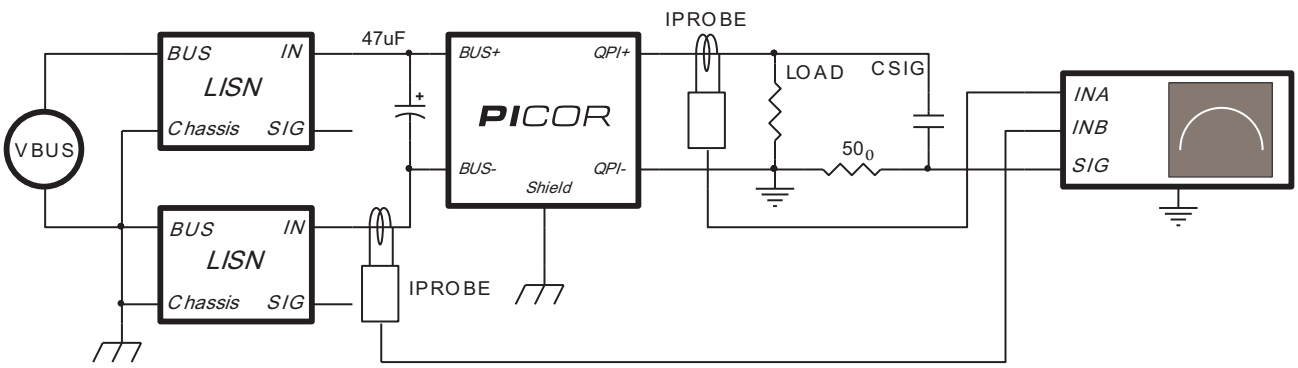


Figure 6 — *Test set-up to measure differential-mode EMI currents in Figure 4*

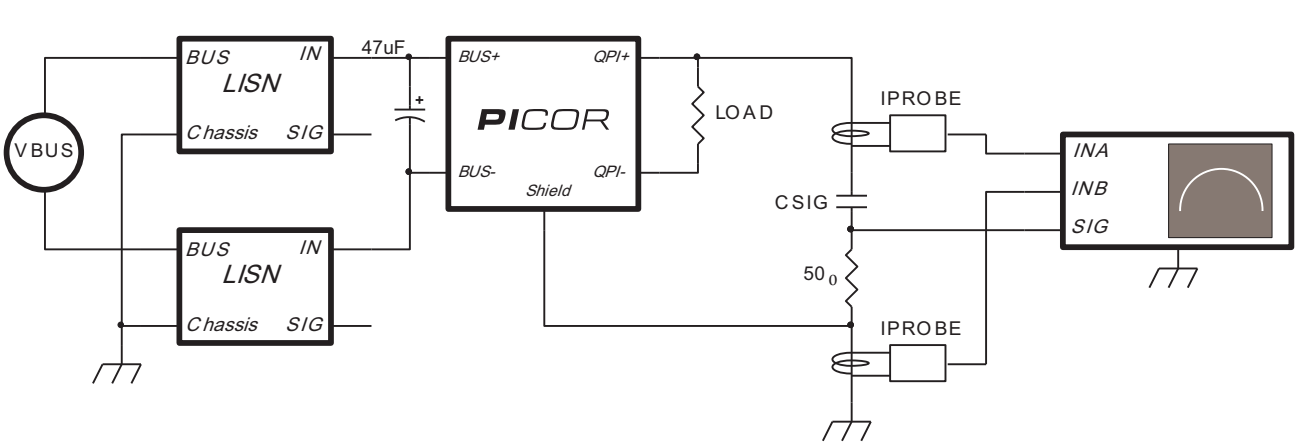


Figure 7 — *Test set-up to measure common-mode EMI currents in Figure 4*

Mechanical Package Drawings

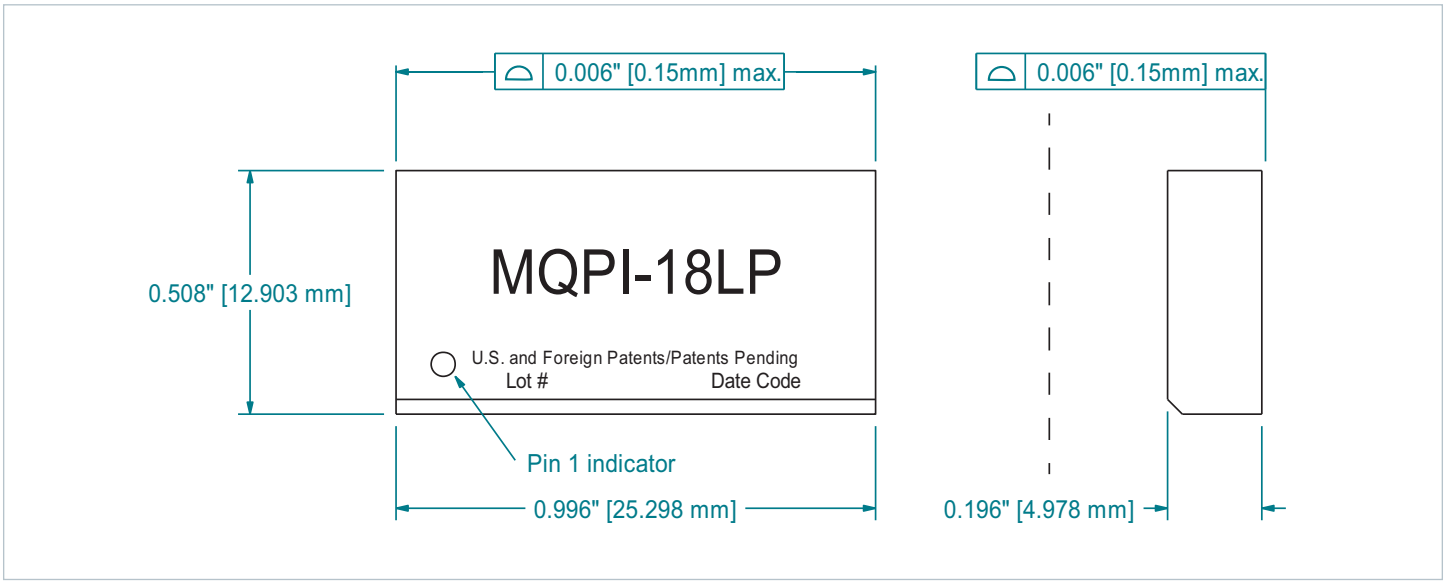


Figure 8 *— Bottom view of open-frame (OF) and lidded (LID) products.*

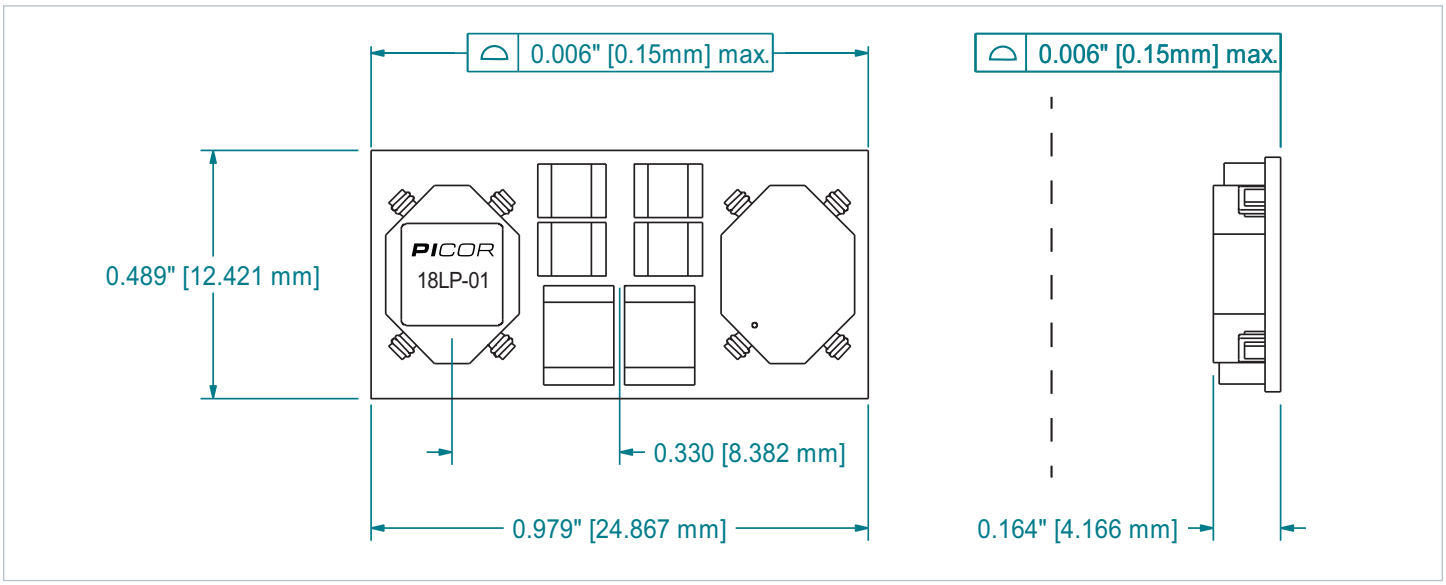


Figure 9 *— Recommended receptor and stencil patterns.*

Datum	Units	MQPI-18LP	MQPI-18LP-01	Notes
FITS	failure/billion hrs.	16	16	FITS based on the BellCore Standard TR-332
MTBF	million hrs.	62.5	62.5	MTBFs based on the BellCore Standard TR-332
Weight	grams	2.4	2.075	
MSL		3	3	
Peak Reflow Temperature	°C/20 seconds	245	245	IPC/JEDEC J-STD-020D

Pad and Stencil Definitions

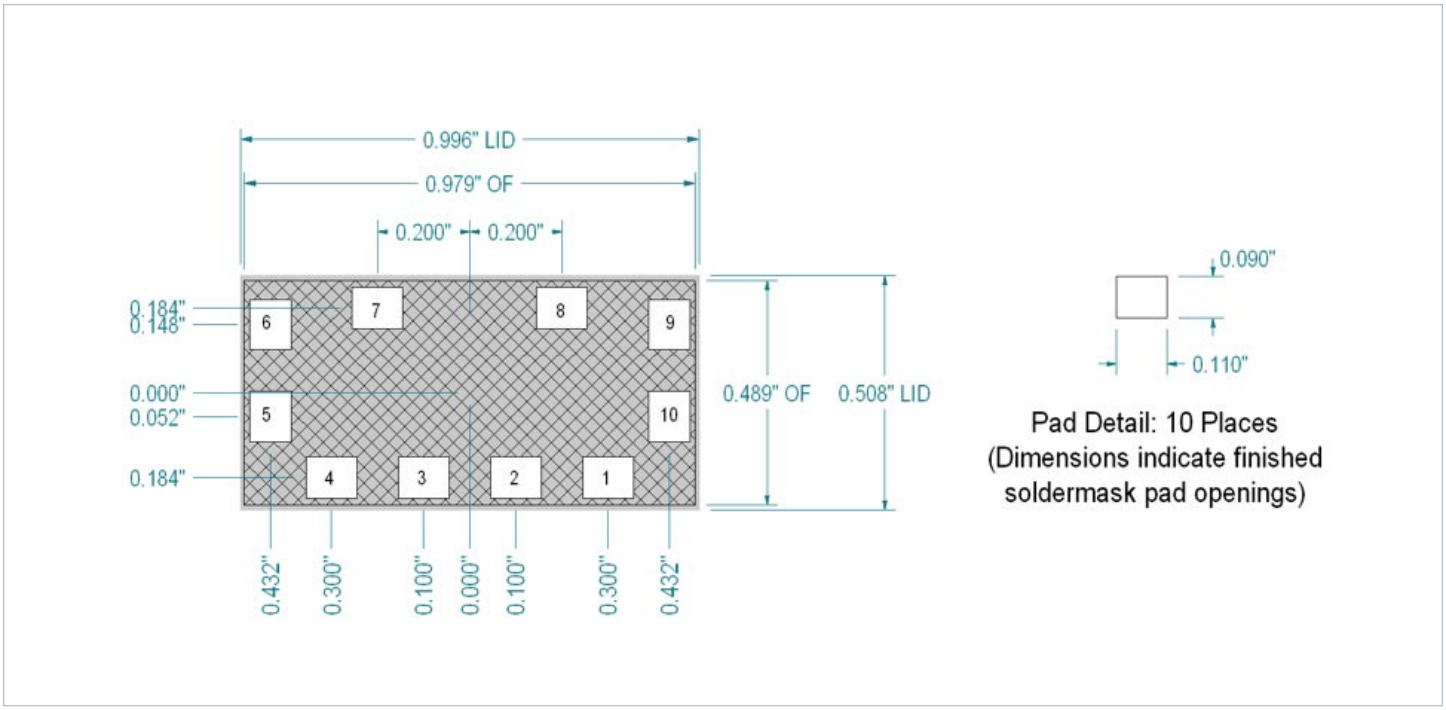


Figure 10 *— Bottom view of open-frame (OF) and lidded (LID) products. (All dimensions are in inches)*

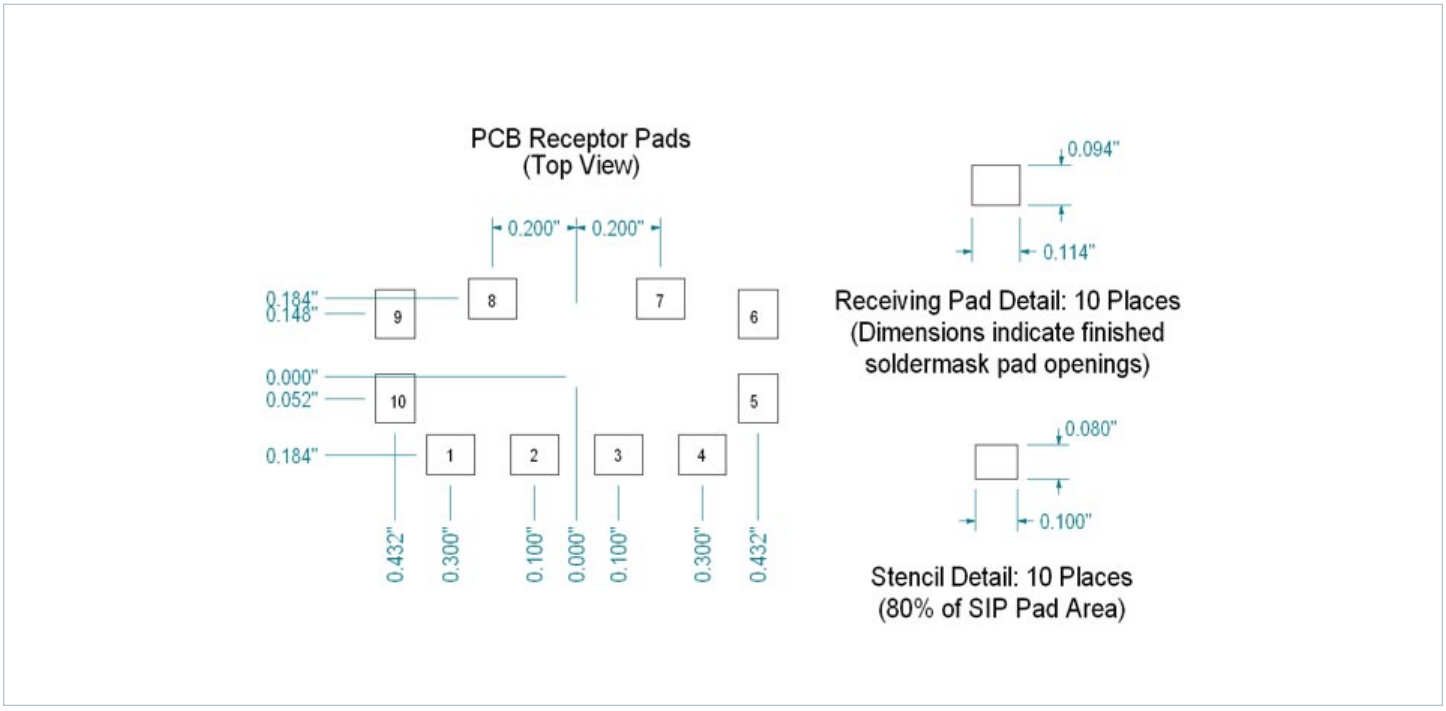


Figure 11 *— Recommended receptor and stencil patterns. (All dimensions are in inches)*

Stencil definition is based on a 6 mil stencil thickness, 80% of LGA pad area coverage. LGA package dimensions are for both the open-frame and lidded versions of the MQPI-18.

MQPI-18 PCB Layout Recommendations

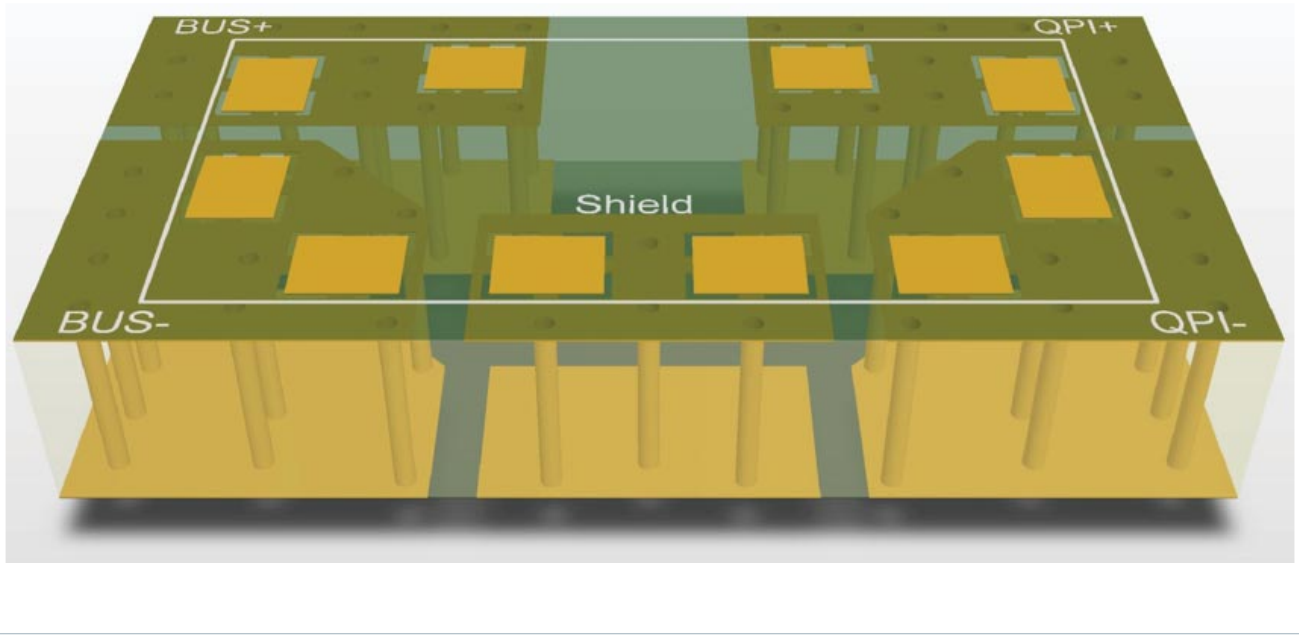


Figure 12 *— 3D view of paralleling planes underneath the MQPI-18*

The filtering performance of the MQPI-18 is sensitive to capacitive coupling between its input and output pins. Parasitic plane capacitance must be kept below one pico-Farad between inputs and outputs using the layout shown above and the recommendations described below to achieve maximum conducted EMI performance.

To avoid capacitive coupling between input and output pins, there should not be any planes or large traces that run under both input and output pins, such as a ground plane or power plane. For example, if there are two signal planes or large traces where one trace runs under the input pins, and the other under the output pins, and both planes overlap in another area, they will cause capacitive coupling between input and output pins. Also, planes that run under both input and outputs pins, but do not cross, can cause capacitive coupling if they are capacitively by-passed together. Figure 11 shows the recommended PCB layout on a two-layer board. Here, the top layer planes are duplicated on the bottom layer so that there can be no overlapping of input and output planes. This method can be used for boards of greater layer count.

Post Solder Cleaning

Picor's MQPI-18LP SiPs are not hermetically sealed and must not be exposed to liquid, including but not limited to cleaning solvents, aqueous washing solutions or pressurized sprays. When soldering, it is recommended that no-clean flux solder be used, as this will ensure that potentially corrosive mobile ions will not remain on, around, or under the module following the soldering process. For applications where the end product must be cleaned in a liquid solvent, Picor recommends using the MQPI-18LP-01, open-frame version of the EMI filter.

Vicor's comprehensive line of power solutions includes high density AC-DC and DC-DC modules and accessory components, fully configurable AC-DC and DC-DC power supplies, and complete custom power systems.

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