

## 28 Volt Input, 7 Amp MIL COTS EMI Filter for V•I Chip™

### Description:

The MQPI-18 attenuates conducted common-mode (CM) and differential mode (DM) noise for 28 V input MIL PRMs 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<sub>A</sub>) without de-rating.



Figure 1 - MQPI-18LP (~1/2 in<sup>2</sup> area)

### Features:

- 28 V input, compatible with MIL PRM
- MIL-STD-461F compliant\* CE101, CE102, CS101, CS106, CS114, CS115, and CS116
- 100 Vdc surge, 100 ms
- 1500 Vdc hi-pot 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 3.4 mm Open-frame SiP
- Low profile LGA package
- -55° to +125°C PCB temperature (see Figure 5)
- Efficiency >99%
- Pb solder construction

\*When combined with MP028 PRMs, and MV036 VTM's.

### 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 re-flow)

### Applications

- Military mobile and fixed communications
- Radar and Targeting
- Missile and Launch systems
- Airborne flight management systems

### Typical Applications:

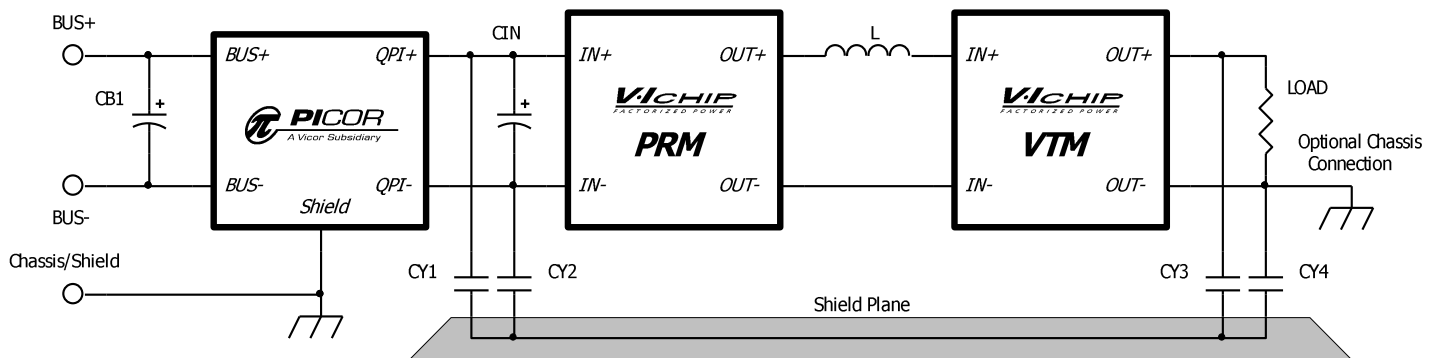


Figure 2 – Typical MQPI-18 application schematic with Vicor's MP028 PRM and MV036 VTM modules. <sup>(1)</sup>

**Note 1:** CB1 capacitor, referenced in all schematics, is a 47uF electrolytic; United Chemi-Con EMVE101ARA470MKE0S or equivalent.  
CY1 to CY4, referenced in all schematics, are 4.7nF hi-voltage safety capacitors; Vishay VY1472M63Y5UQ63V0 or equivalent.

### Absolute Maximum Ratings – Exceeding these parameters may result in permanent damage to the product.

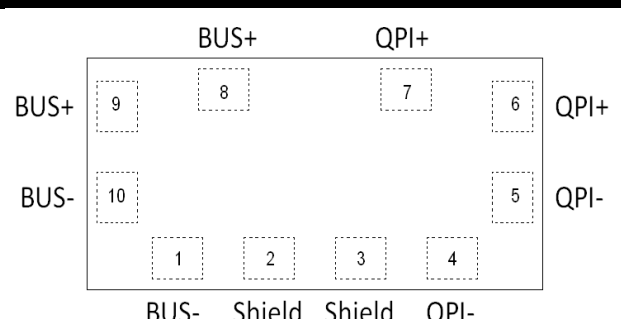
Input Voltage, BUS+ to BUS-, continuous	-50 to 50 Vdc
Input Voltage, BUS+ to BUS-, 100ms transient	-100 to 100 Vdc
BUS+/ BUS- to Shield pads, hi-pot	-1500 to 1500 Vdc
Input to output current, continuous @ 25°C T <sub>A</sub>	7 Adc
Power dissipation, @ 85°C T <sub>A</sub> , 7A <sup>(2)</sup>	1.85 W
Operating temperature - T <sub>A</sub>	-55 to 125 °C
Thermal resistance <sup>(2)</sup> - R <sub>θJA</sub> , using PCB layout in Figure 13	30 °C/W
Thermal resistance <sup>(2)</sup> - R <sub>θPCB</sub>	18 °C/W
Storage temperature, JEDEC Standard J-STD-033B	-65 to 125 °C
Reflow temperature, 20 s exposure	225 °C
ESD, Human body model (HBM)	-2000 to 2000 V

### Electrical Characteristics – Parameter limits apply over the operating temp. range, unless otherwise noted.

Parameter	Notes	Min	Typ	Max	Units
BUS+ to BUS- input range	Measured at 7 A, 85°C ambient temperature <sup>(2)</sup>			50	Vdc
BUS+ to QPI+ voltage drop	Measured at 7 A, 85°C ambient temperature <sup>(2)</sup>			130	mVdc
BUS- to QPI- voltage drop	Measured at 7 A, 85°C ambient temperature <sup>(2)</sup>			130	mVdc
Common mode attenuation	V <sub>BUS</sub> = 28 V, Frequency = 1.0 MHz, line impedance = 50Ω		45		dB
Differential mode attenuation	V <sub>BUS</sub> = 28 V, Frequency = 1.0 MHz, line impedance = 50Ω		75		dB
Input bias current at 50 V	Input current from BUS+ to BUS-			10	uA

Note 2: See Figure 5 for the current de-rating curve.

### Pad Descriptions

Pad Number	Name	Description	LGA Pattern (Top View)
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.	

### Ordering Information

Part Number	Description
MQPI-18LP <sup>(3)</sup>	MQPI-18 LGA Package
MQPI-18LP-01	MQPI-18 LGA Package, Open Frame Package

Note 3: MQPI-18LP is a non-hermetically sealed package. Please read the "Post Solder Cleaning" section on page 8.

### MQPI-18 Evaluation Boards

Part #	Description:
MQPI-18-CB1	A MQPI-18LP mounted on a carrier board that can hold a paired MP028 PRM/ MV036 VTM evaluation boards available from Vicor.

## Applications Information

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

The MQPI-18 is not designed to be paralleled with another MQPI-18 to achieve a higher current rating.

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 (Curve 4)
CS114	Bulk Cable Injection, Radio Frequency	Passed, 78% load (Curve 5)
CS115	Damped Sinusoid Transients	Passed
CS116	Damped Sinusoid Transients	Passed

### CE101 EMI Plots: 108 Watt Load

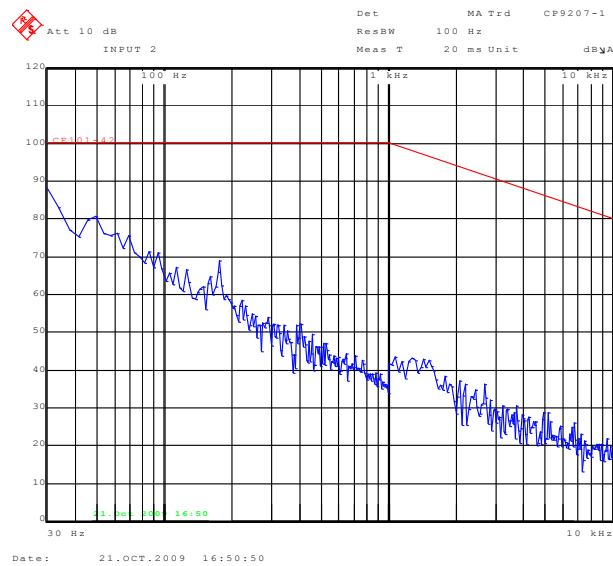
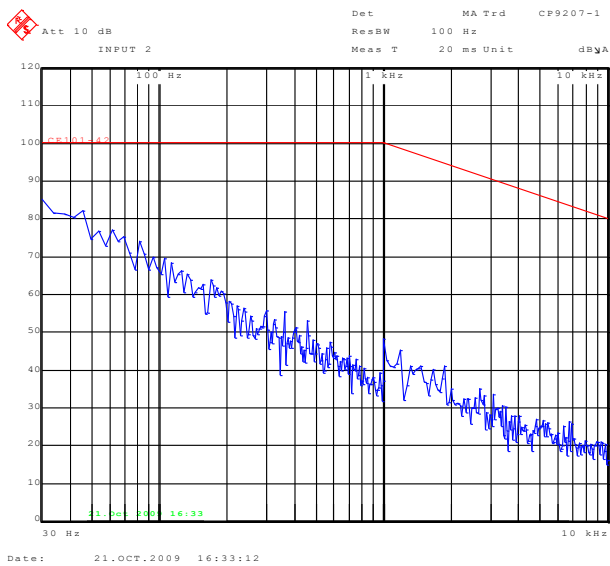


Figure 3 - CE101 EMI plots of the filtered MP028F036M12AL and MV036F120M010, shown in Figure 2, + (RED) and - (BLK) leads.

### CE102 EMI Plots: 108 Watt Load

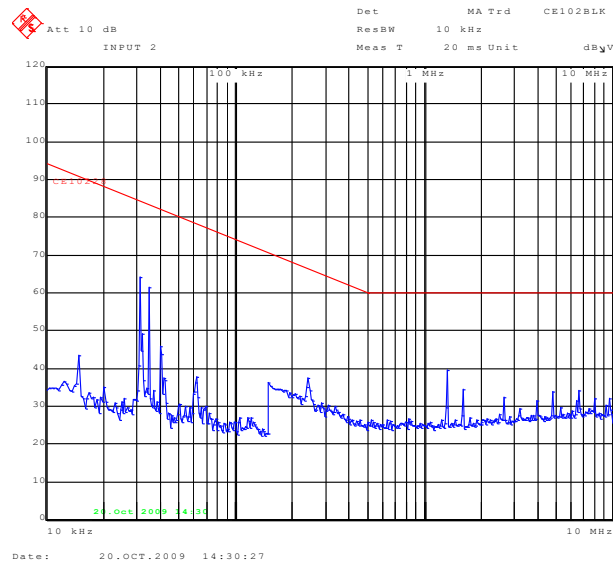
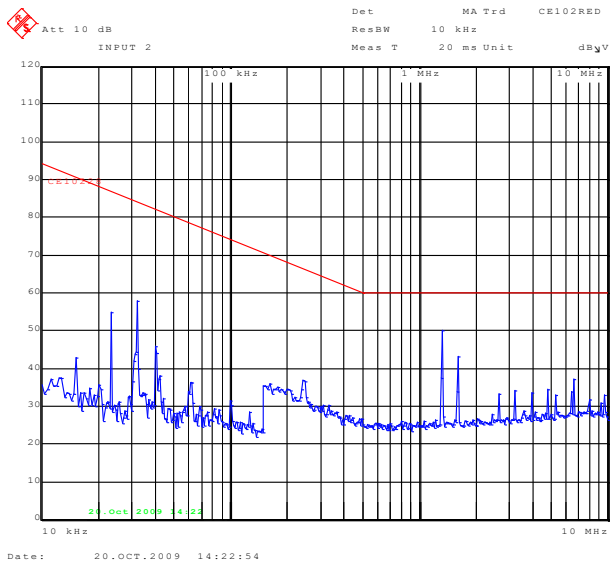
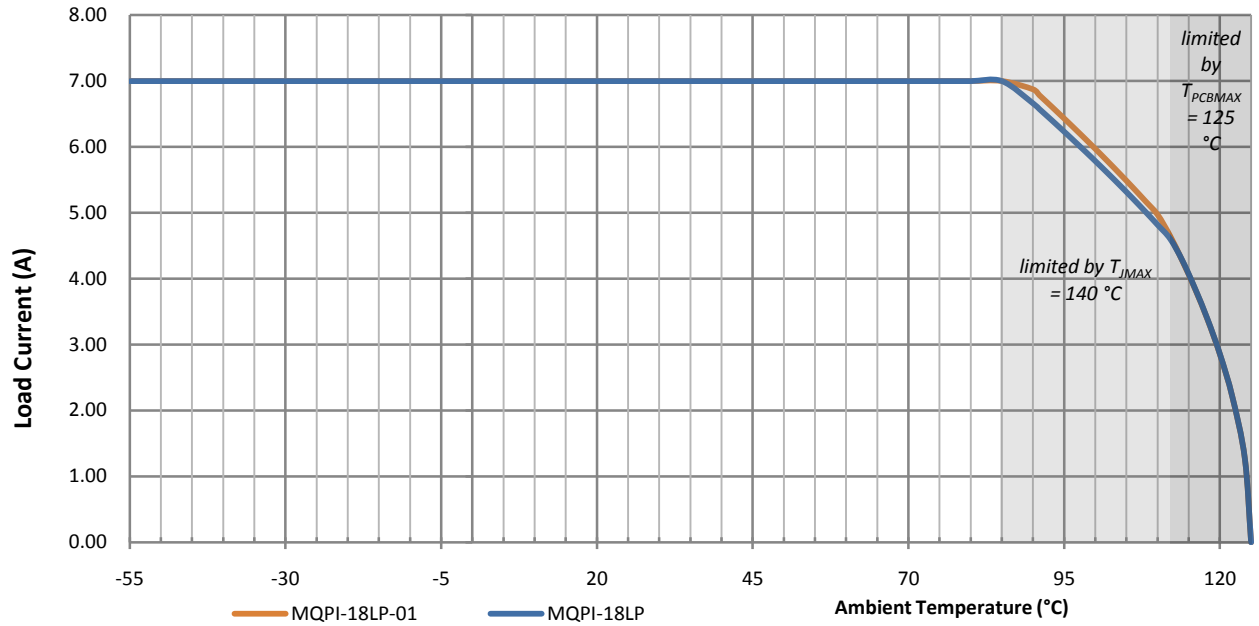


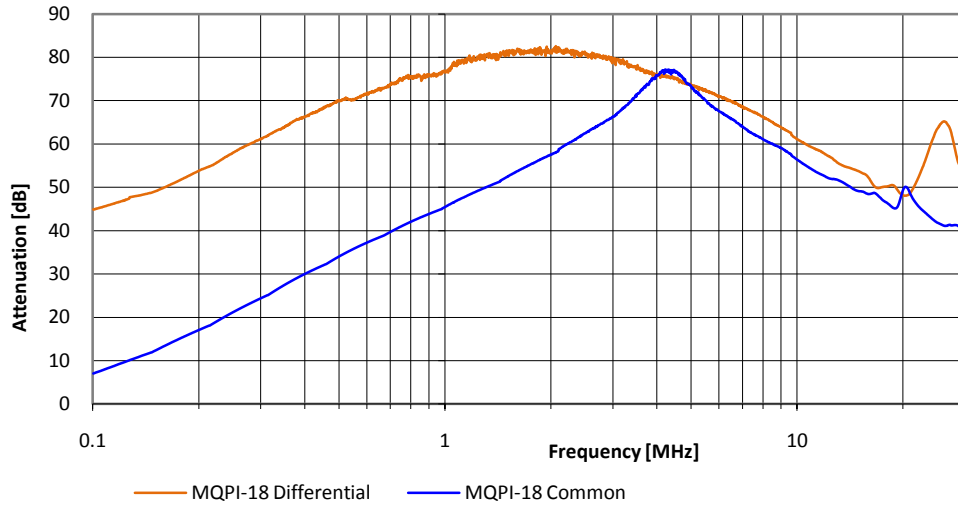
Figure 4 - CE102 EMI plots of the filtered MP028F036M12AL and MV036F120M010, shown in Figure 2, + (RED) and - (BLK) leads.

**Current De-Rating:** mounted to MQPI-18-CB1 evaluation board.



**Figure 5** - Current de-rating over ambient temperature range.

## MQPI-18 Insertion Loss Measurements

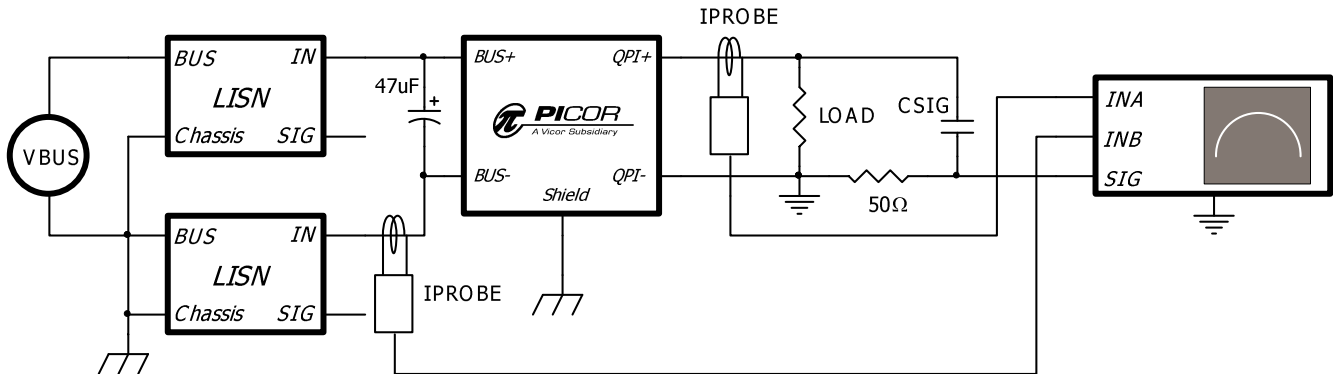


**MQPI Insertion Loss Equation:**

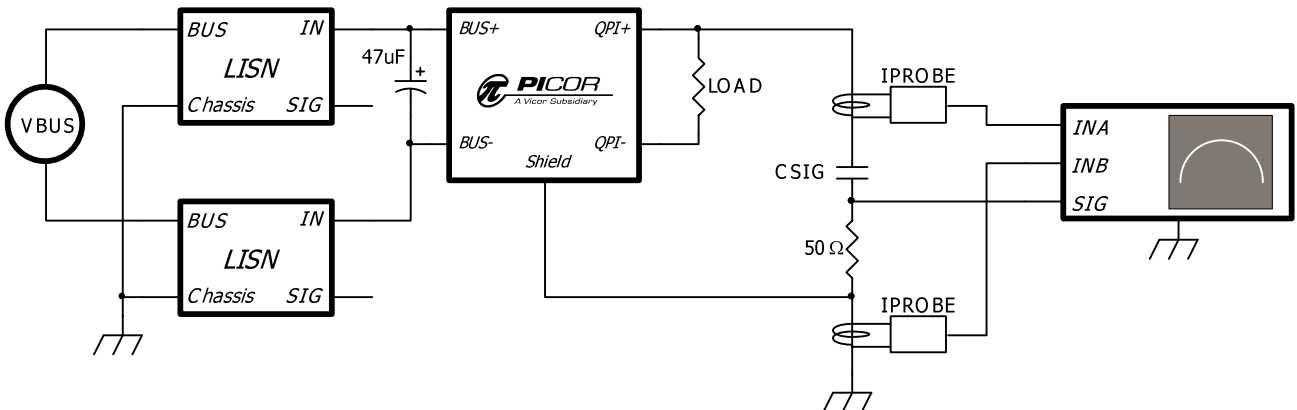
$$\text{Insertion Loss} = 20 * \log * \left[ \frac{I_{INA}}{I_{INB}} \right]$$

**Figure 6** – Typical Attenuation curves into a 50Ω line impedance at VBUS = 28V.

## MQPI Insertion Loss Test Circuits



**Figure 7** – Test Set-up to measure Differential Mode EMI currents in Figure 6.



**Figure 8** - Test Set-up to measure Common Mode EMI currents in Figure 6.

### Mechanicals

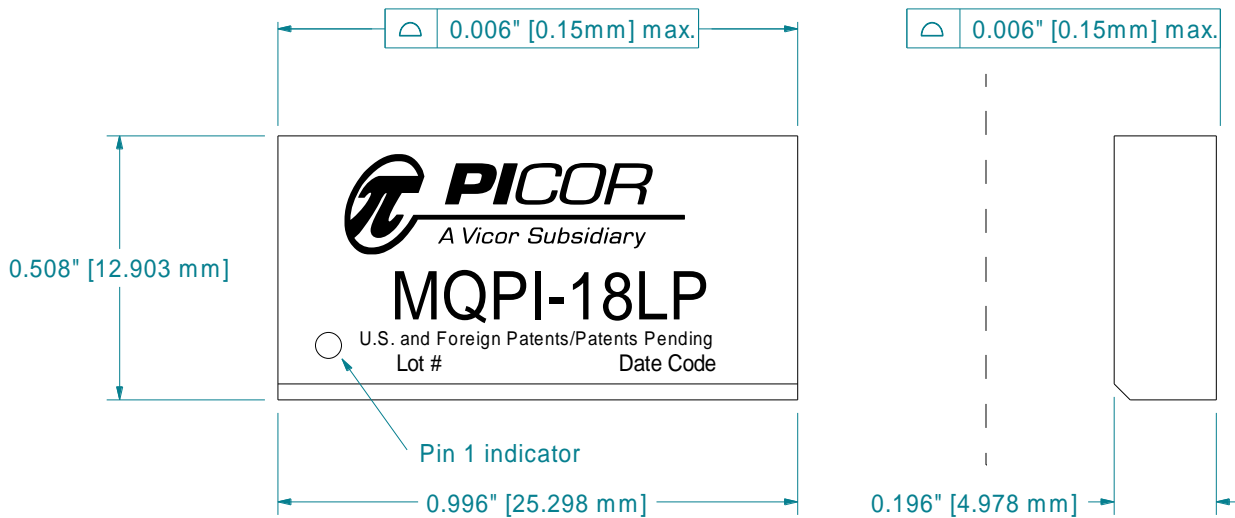


Figure 9 - Lidded Package Dimensions, tolerance of  $\pm 0.004$ "

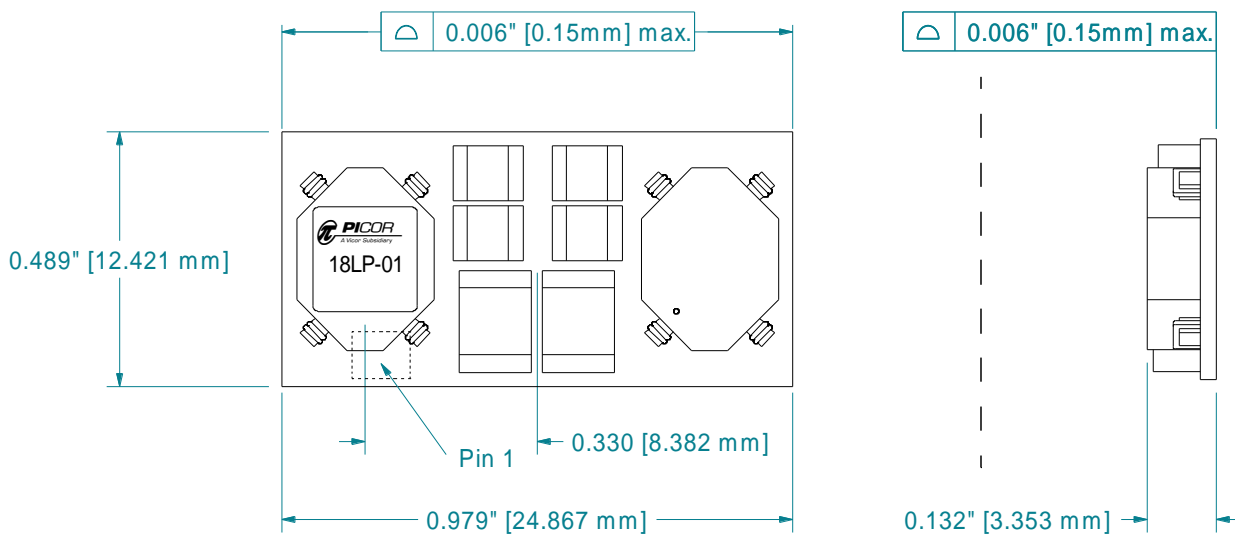
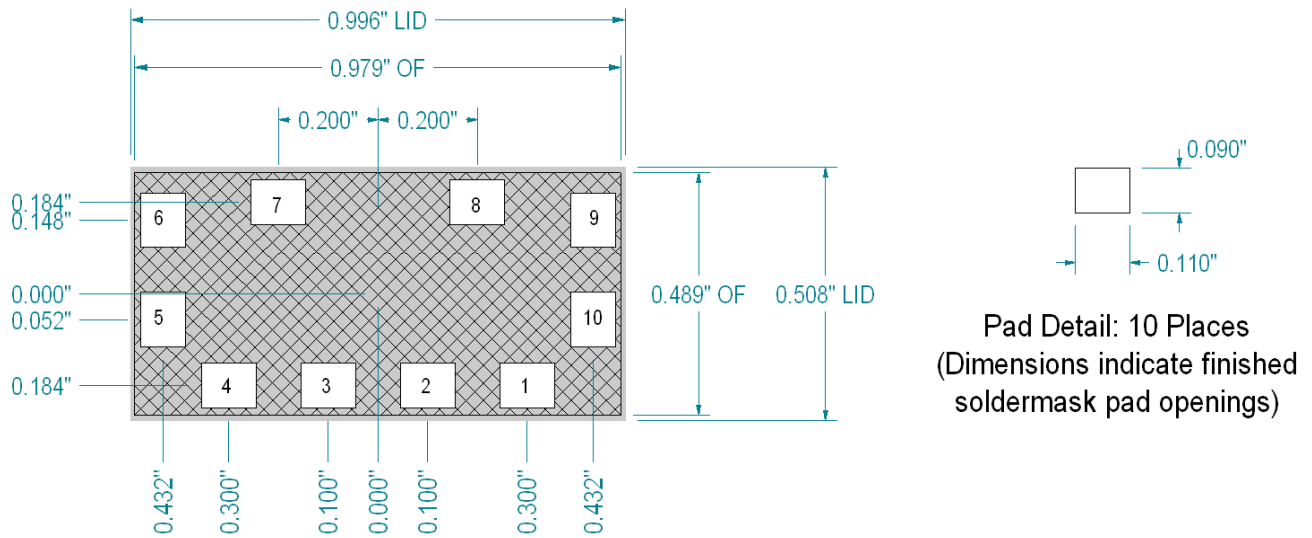


Figure 10 - Open-frame Package dimensions, tolerance of  $\pm 0.004$ ". Pick and Place from label center.

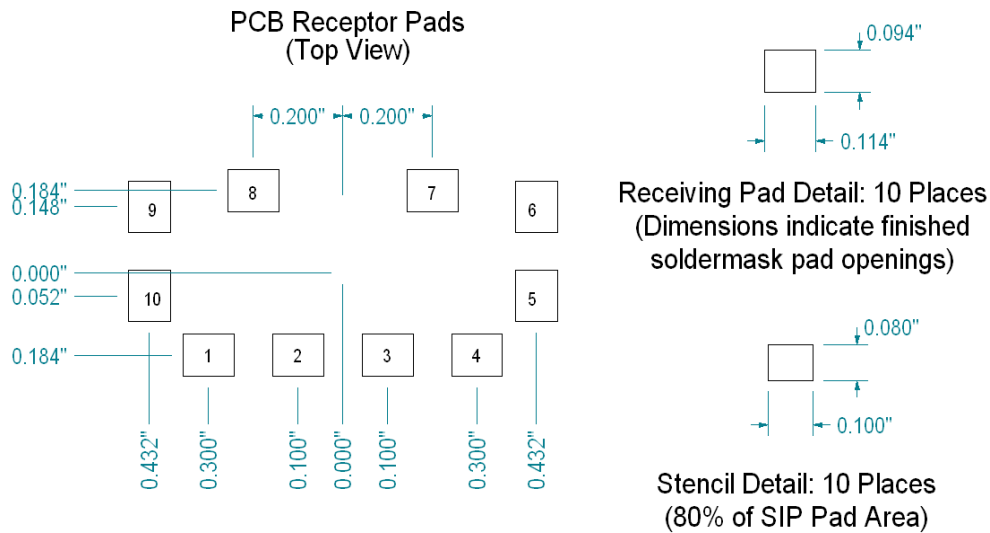
### MQPI-18 Mechanical Data

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	225	225	IPC/JEDEC J-STD-020D

**Pad and Stencil Definitions:**

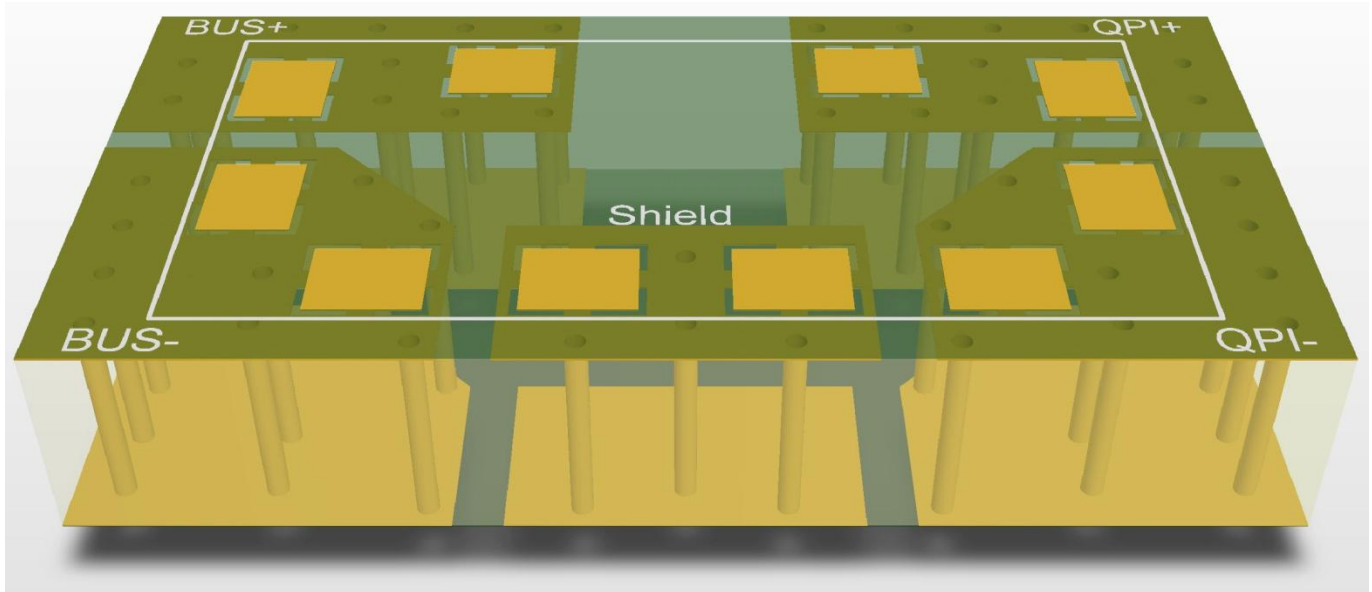


**Figure 11** - Bottom view of open-frame (OF) and lidded (LID) products. (All dimensions are in inches.)



**Figure 12** - Recommended receptor and stencil patterns. (All dimensions are in inches.)

Stencil definition is based on a 6mil 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 13** - 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 1 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 13

shows the recommended pcb layout on a 2 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.



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Vicor Corporation  
25 Frontage Road  
Andover, MA 01810  
USA

Picor Corporation  
51 Industrial Drive  
North Smithfield, RI 02896  
USA

Customer Service: [custserv@vicorpower.com](mailto:custserv@vicorpower.com)  
Technical Support: [apps@vicorpower.com](mailto:apps@vicorpower.com)  
Tel: 800-735-6200  
Fax: 978-475-6715

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Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: [ocean@oceanchips.ru](mailto:ocean@oceanchips.ru)

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А