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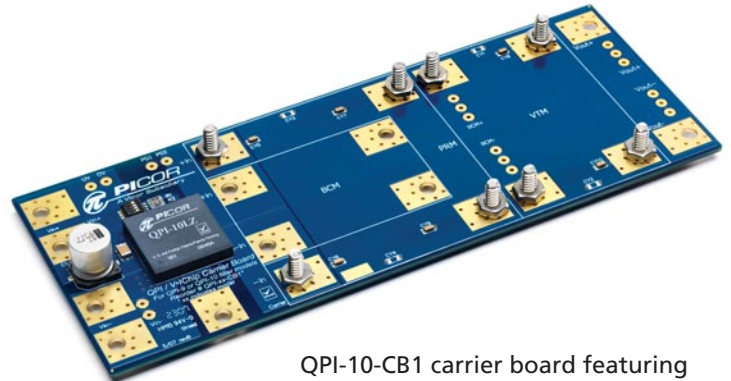
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## QPI-10LZ Filter Carrier Board for 48 V V•I Chip EMI Evaluation

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QPI-10-CB1 carrier board featuring the QPI-10LZ EMI filter with integrated Hot-Swap

### Introduction

The QPI-10-CB1 carrier board is an evaluation board platform designed to demonstrate the EMI and Hot-Swap capabilities of a QPI-10LZ filter, with any combination of 48 V input PRM / VTM and BCM evaluation boards. The QPI-10-CB1 board includes a pre-mounted filter along with some additional components necessary to demonstrate the full functionality of the filter, along with mounting areas for V•I Chip evaluation boards. This User's Guide provides basic instructions for assembly and use of the board. Further information on the functionality of the V•I Chip boards, as well as the QPI-10LZ can be found in the V•I Chip Evaluation Board User's Guide as well as the V•I Chip and QPI-10LZ data sheets.

### QPI-10LZ Product Description

The QPI-10LZ integrates a complete 48 V Hot-Swap function with an EMI filter to achieve a high performance, high density solution for V•I Chip applications, while minimizing overall design time and effort. The product aligns with the AdvancedTCA™ PICMG3.0 requirements for hot insertion and board level conducted noise limitations. The EMI filter provides conducted common-mode (CM) and differential-mode (DM) noise attenuation from 150 kHz to 30 MHz. The QPI-10LZ is designed for use on a 48 or 60 Vdc bus (36 – 76 Vdc). The inrush current limit and circuit breaker are designed to satisfy the 200 W per board PICMG3.0, limit up to 70°C PCB temperature around the QPI-10LZ.

The under and overvoltage thresholds can be trimmed separately via the UVEN and OV inputs using external series resistors. The QPI-10LZ provides two POWER GOOD signals, with one referenced to the input ground and the other to the output ground, which can be used to enable other circuits along with the V•I Chip converter.

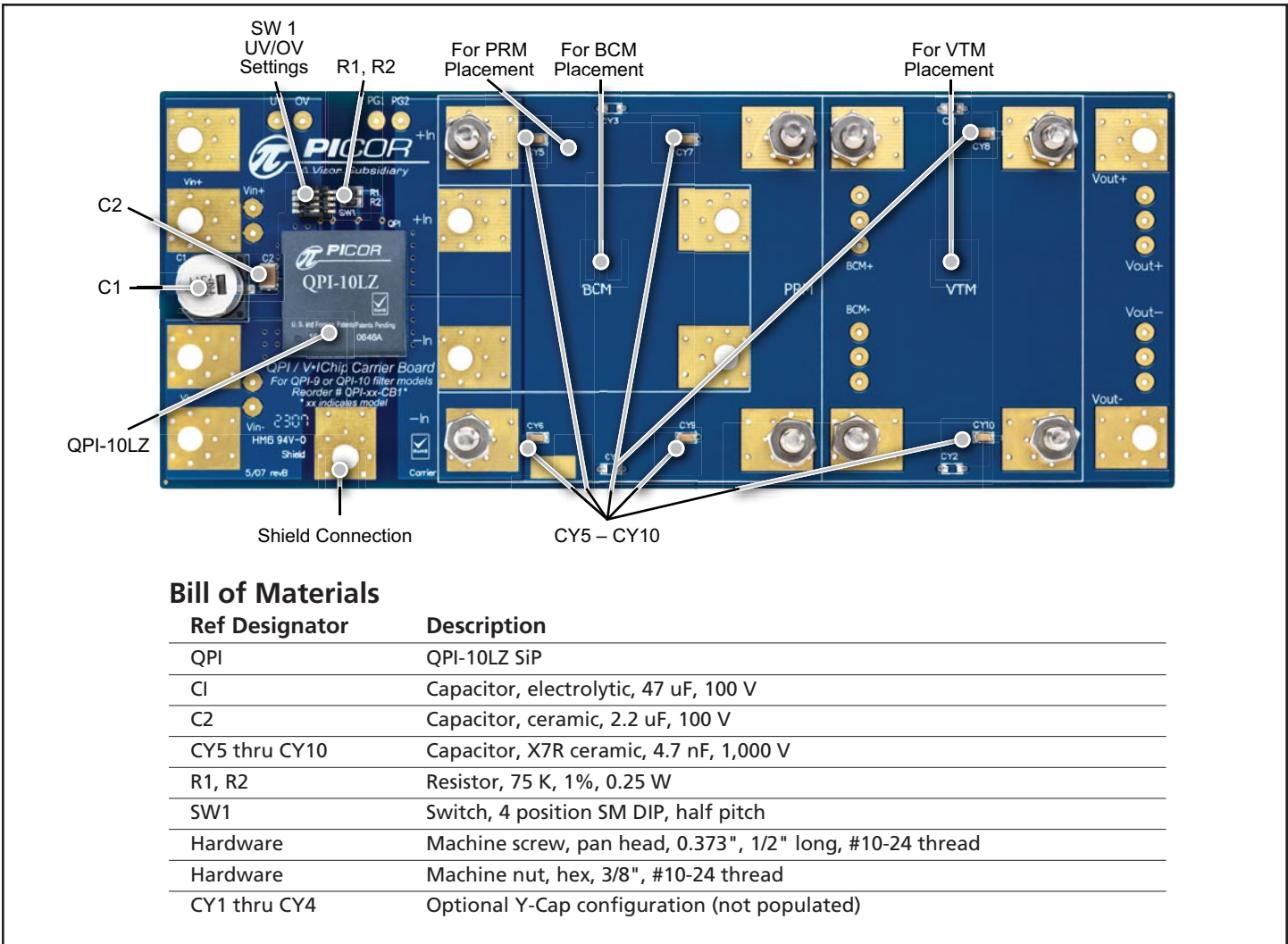


Figure 1 – QPI-10-CB1 board overview

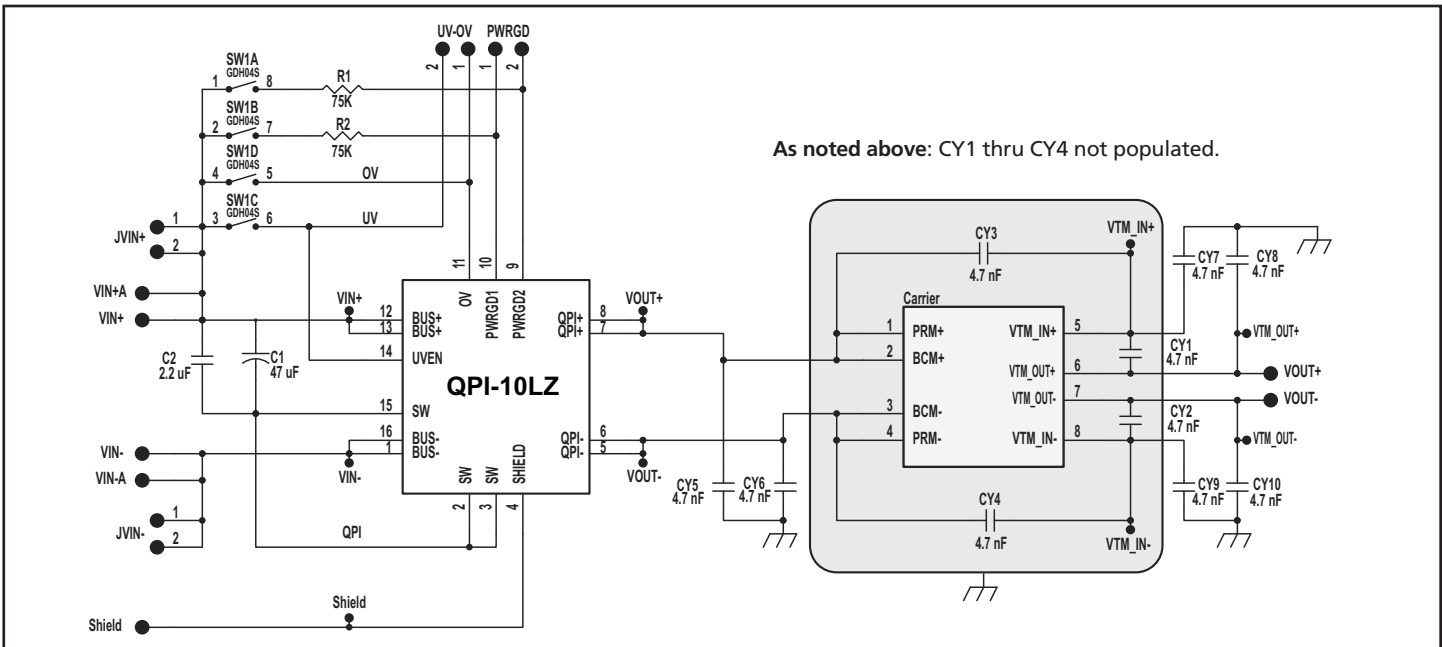


Figure 2 – QPI-10-CB1 carrier board schematic

## Board Assembly

The V•I Chip evaluation boards should be attached to the carrier board using the hardware provided. Begin by removing the top nuts from the bolts in the space provided for mounting the evaluation board. Check to see that the lower bolts are tightened. Remove rubber spacers from the V•I Chip evaluation board(s). Place the V•I Chip evaluation board on the bolts. Make sure that the evaluation board is placed in the proper input to output orientation with respect to the carrier board (the input side will have the capacitor). Replace the top nuts and tighten gently with a wrench. Attach input and output leads, be careful to confirm proper polarity before powering up.

When using the carrier board pay special attention to the wiring and grounding. Wires should be kept as short as possible and positioned to minimize radiated noise pick-up on the QPI-10LZ.

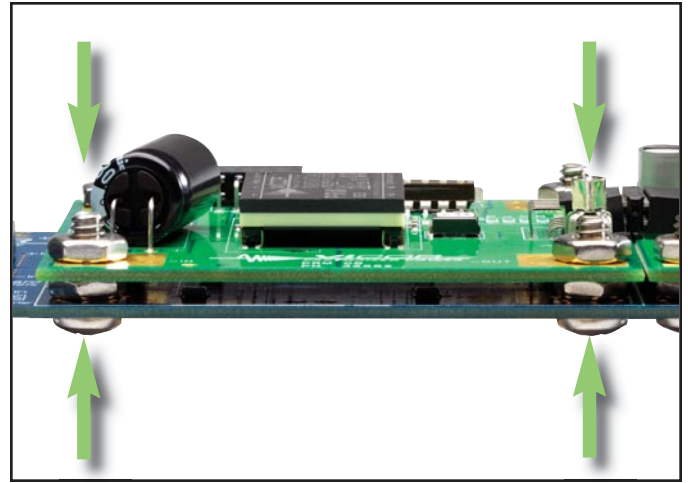


Figure 3 – Side view hardware assembly

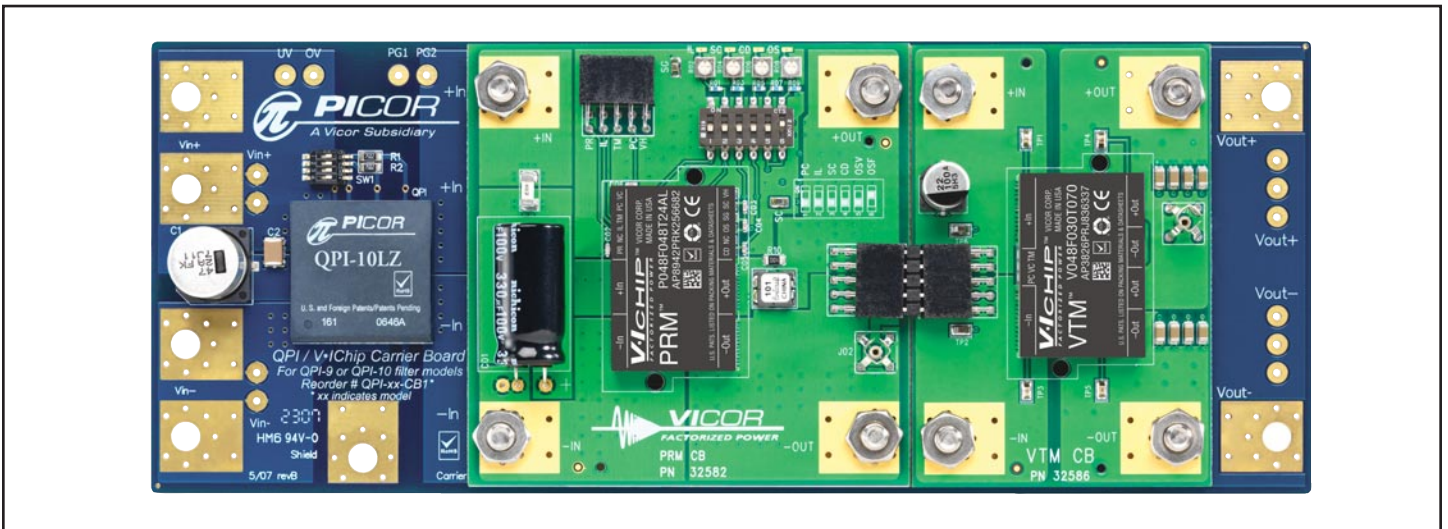


Figure 4 – QPI-10-CB1 carrier board assembled with PRM and VTM evaluation boards

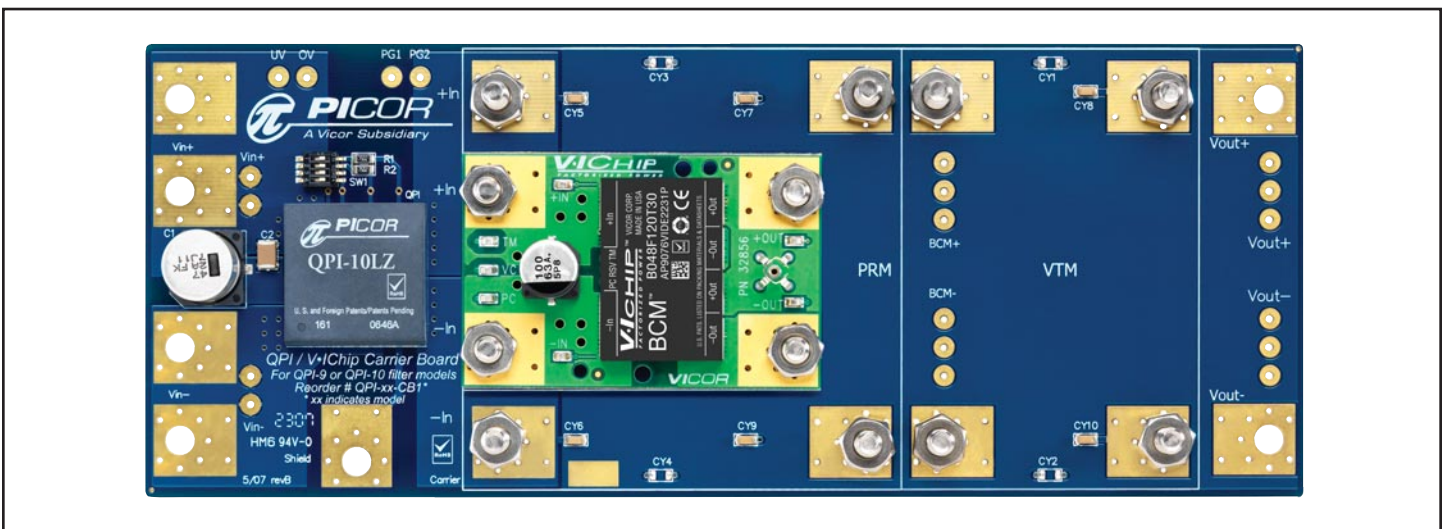


Figure 5 – QPI-10-CB1 carrier board assembled with BCM evaluation board

# EMI Bypass Configurations

EMI bypass capacitors (“Y” capacitors) are an essential element in a switch-mode DC-DC filter application as these capacitors provide a return path for common-mode noise currents to their source; so careful attention to bypass capacitor implementation is essential for a successful EMI filter design. This carrier board is preconfigured in a “base-plate” EMI topology, which uses six “Y” capacitors (only four are actually used in a BCM configuration), as illustrated in Figure 7 below. This is the preferred topology for VI Chip applications. The carrier board can be manually reconfigured to an “open frame” topology, which uses four “Y” caps in a PRM/VTM combination (two for a BCM), as shown in Figure 8. The open-frame approach may attenuate certain load dependent noise better than the base-plate method. The carrier board provides an ideal test vehicle for making a comparison between the two “Y” capacitor configurations. To reconfigure to “open frame” carefully remove capacitors CY5 through CY10 and place four of those six capacitors in the positions marked as CY1 through CY4.

## EMI Performance and Test Set Up

The EMI plots in Figures 9 through 14 are the total noise measurements, on both the positive and negative lines of the QPI-10LZ with various VI Chip configurations,

using the basic base-plate standard “Y” cap configuration. Figure 7 shows the basic EMI measurement set up that was used to achieve these results. Figure 8 shows the alternate set up method when converting to the open-frame approach.

In Figure 7 (base-plate method), capacitors CY5 through CY10 represent the recirculation capacitors that are connected to each of the four input and output terminals, then are commoned to a shield plane that has been created underneath the converter. Since the PRM/ VTM pair is similar to a conventional converter, which is split into to halves, two additional “Y” caps (CY7 and CY9) were added to the PRM’s output (the input to the VTM), referenced to the shield plane.

In Figure 8 (open-frame method), four “Y” capacitors are used (CY1 through CY4) rather than the two “Y” caps that a conventional converter would require, once again because of the topology split created by the pair.

In a BCM application there is no topology split so the set up would require two fewer capacitors for either configuration. The open-frame method would only need one pair of input an output caps, referenced to the shield plane on either side of the BCM. And for open-frame method a pair of “Y” caps across the positive input to positive output, and negative input and negative output would be sufficient.

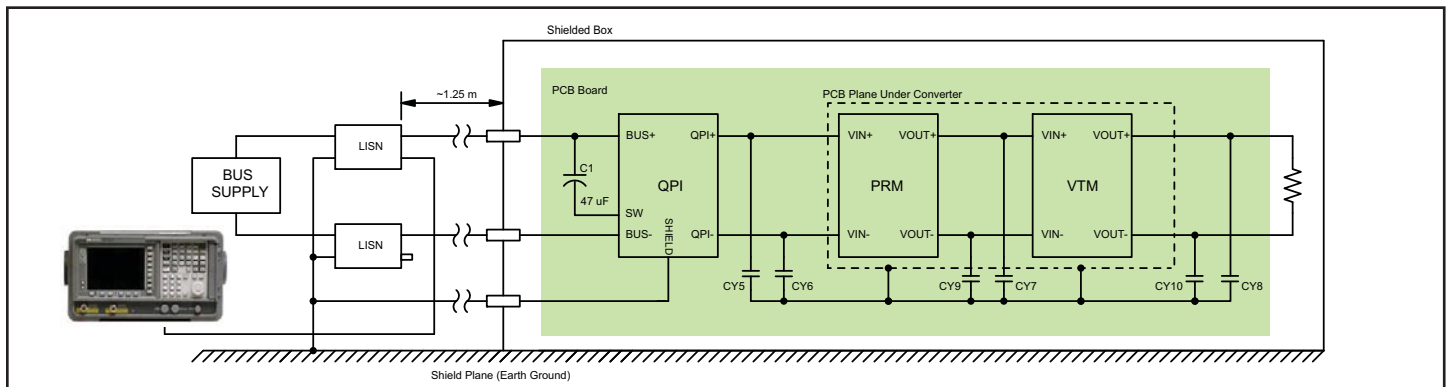


Figure 7 – Basic EMI measurement setup for “base-plate” configuration.

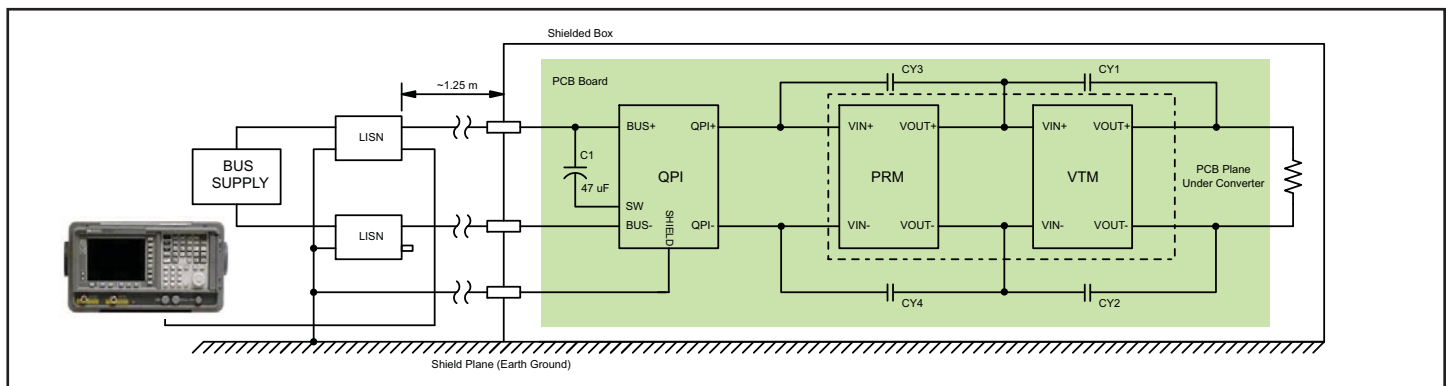
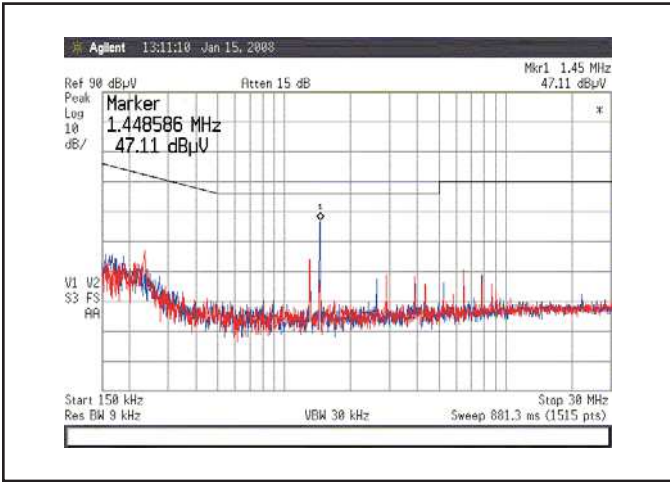
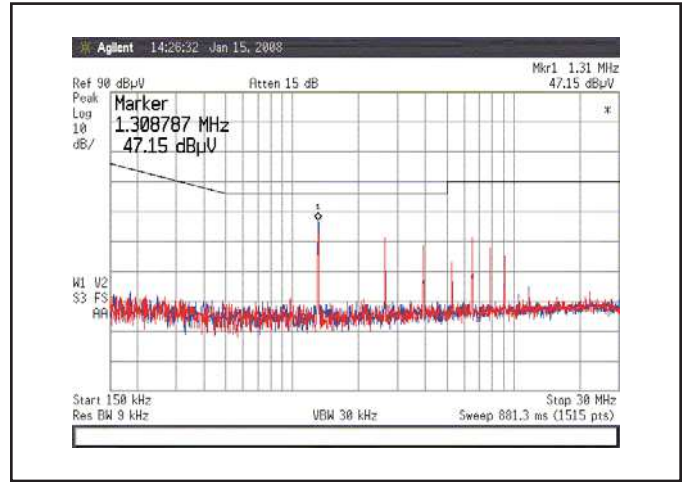


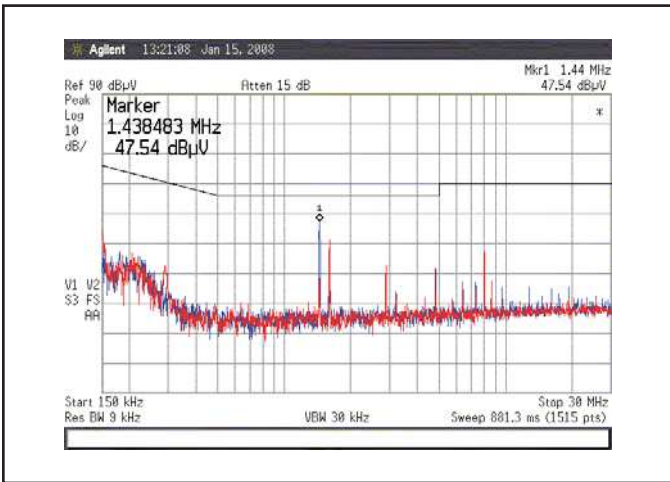
Figure 8 – Basic EMI measurement setup for “open-frame” configuration.



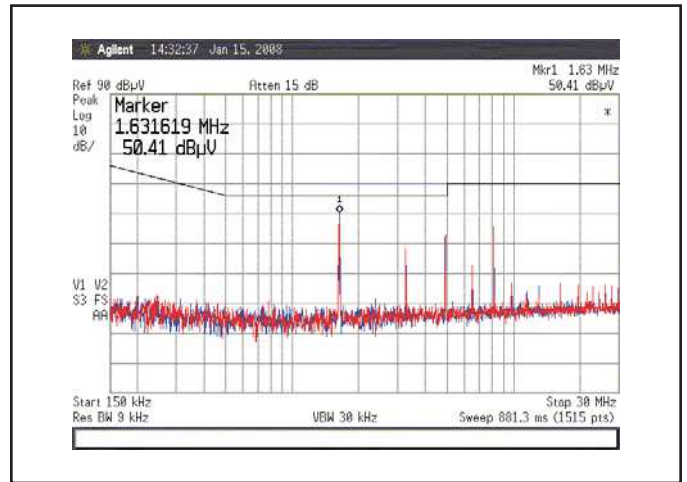
**Figure 9** – Total noise QPI-10LZ with 48 V input PRM and 3V output VTM. 3.27 A input current. 160 W output load.



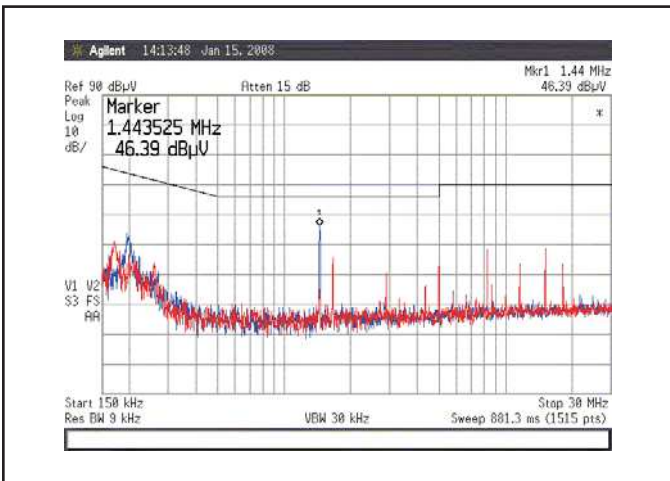
**Figure 12** – Total noise QPI-10LZ with 48 V input, 3 V output BCM. 3.18 A input current. 160 W output load.



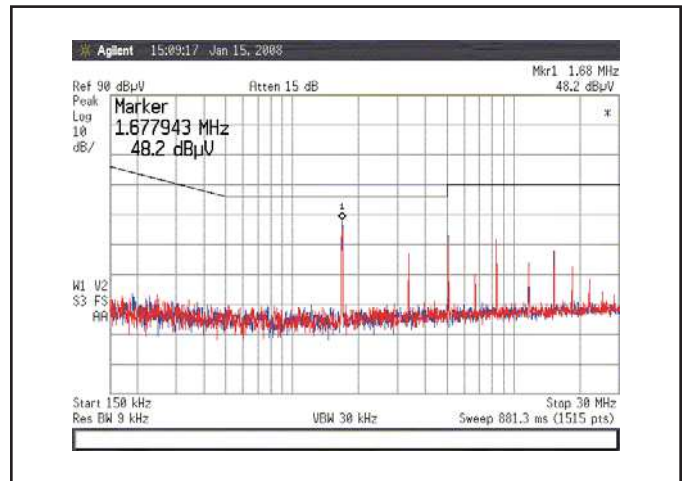
**Figure 10** – Total noise QPI-10LZ with 48 V input PRM and 12 V output VTM. 4.03 A input current. 180 W output load.



**Figure 13** – Total noise QPI-10LZ with 48 V input, 12 V output BCM. 3.75 A input current. 180 W output load.



**Figure 11** – Total noise QPI-10LZ with 48 V input PRM and 48 V output VTM. 3.45 A input current. 160 W output load.



**Figure 14** – Total noise QPI-10LZ with 48 V input, 48 V output BCM. 3.20 A input current. 153 W output load.

## Modifying OV & UV, Power Good Status

The QPI-10LZ is designed to have an undervoltage hysteretic range of 32 – 34 V when the UVEN pin is tied to the BUS+ pin with no additional series resistance. The QPI-10LZ becomes enabled when the input voltage exceeds 34 V and continues to work down to 32 V before being disabled.

The overvoltage hysteretic range is designed to be 72 – 76 V when the OV pin is tied to the BUS+ pin without a trimming resistor in series. The QPI-10LZ remains functioning until the OV surpasses 76 V, where it will shutdown until the input voltage falls below 72 V.

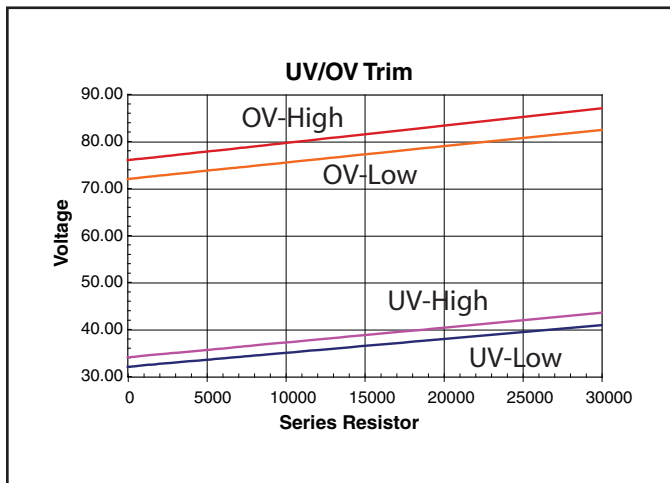


Figure 15 – Trimming UV / OV with an external series resistor

External resistors can be added to trim the UV and OV trip points higher. The graph in Figure 15 shows the trimming effect for a range of external series resistors.

This carrier board provides a means to modify the overvoltage and undervoltage trip points by utilizing the four position dip switch. (See Figure 16) The overvoltage and undervoltage setting as well as the POWER GOOD signals can be accessed through plated through holes on the board. Switches SW 1A and 1B, in the ON position, adds a 75 k pull-up resistor to the POWER GOOD pins. Refer to QPI-10LZ data sheet for more information on these functions.

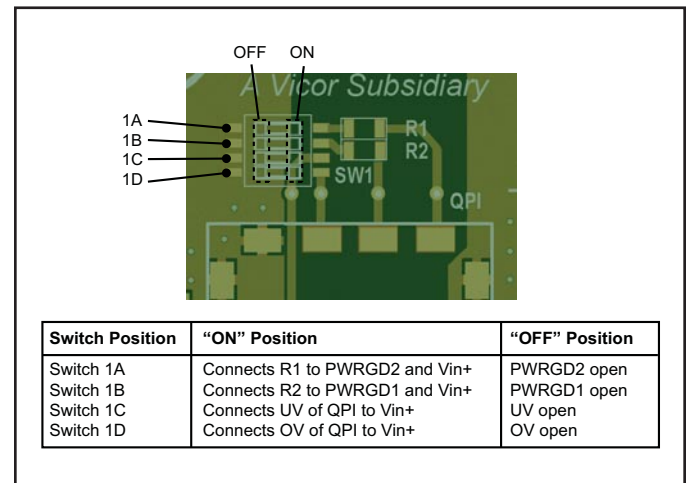


Figure 16 – QPI-10-CB1 switches

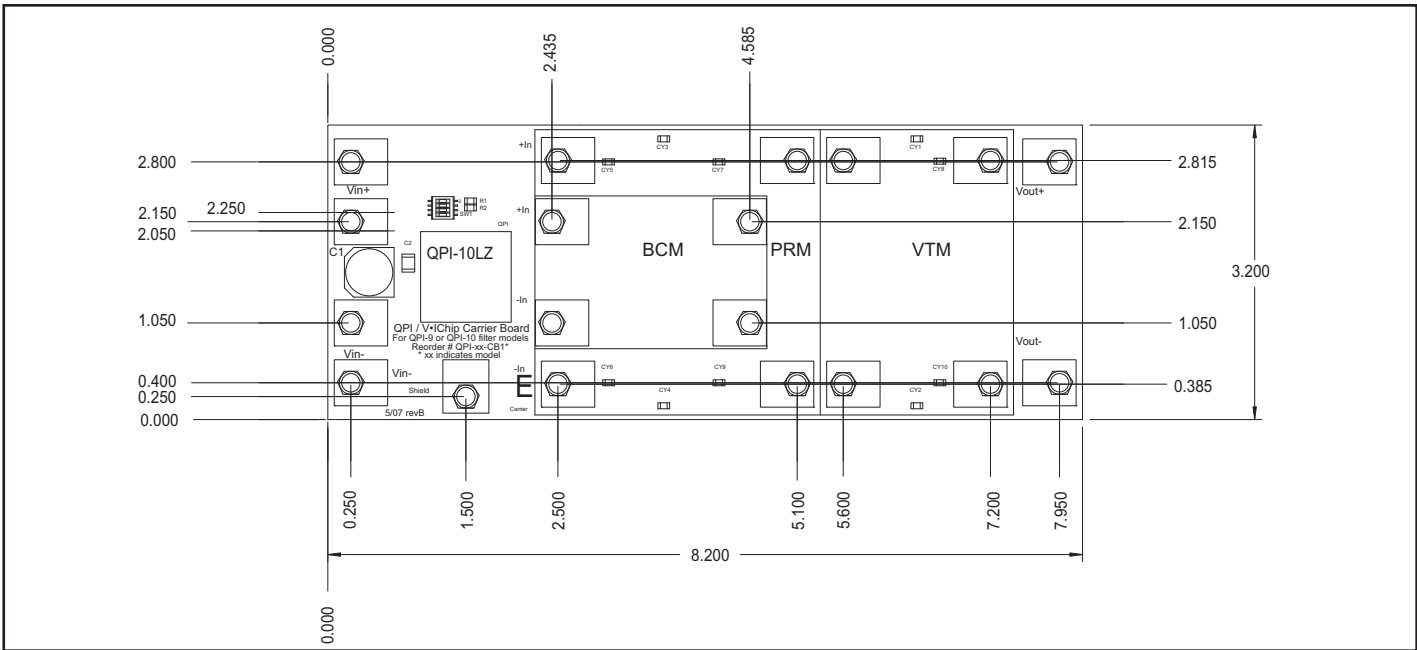


Figure 17 – Mechanical drawing for QPI-10-CB1

## Ordering Information

Carrier Board Part Number	Compatible V-I Chip Evaluation Boards (sold separately)*
QPI-10-CB1	<b>PRMs:</b> P048F048T12AL-CB, P048F048T24AL-CB, P048F048T17AL-CB, P048F048T32AL-CB,  <b>VTMs:</b> All 48 V input models  <b>BCMs:</b> All 48 V input models

\* Some V-I Chip products exceed the current rating and therefore may not be compatible when operating at full load

## Additional Resources Online

QPI-10LZ Data Sheet  
[http://vicorpower.com/picorpower/data\\_sheets/#input\\_filters](http://vicorpower.com/picorpower/data_sheets/#input_filters)

V-I Chip Data Sheets and User Guides  
<http://vicorpower.com/products/vichip/>