MIL-COTS VI BRICK™ Filter and Filter with PRM Evaluation Board P/N 37051

Contents

The Board described in this document is intended to acquaint you with the benefits and features of MIL-COTS VI BRICK™ Filter and Filter with PRM. It is not designed to be installed in end-use equipment nor is it intended to be subjected to environmental qualification testing.

Please read this document before setting up an Evaluation Board. Understand, and have the data sheet for the VI Bricks being tested in hand as this document references terms and control signals described in these documents.

During operation, the VI BRICKs and surrounding structures can be operated safely at high temperatures.

Remove power and use caution when connecting and disconnecting test probes and interface lines to avoid inadvertent short circuits and contact with hot surfaces.

When testing electronic products always use approved safety glasses.

Follow good laboratory practice and procedures.

Standard electronics laboratory equipment and tools are required to use and set up this board.

The ability, and the equipment to solder, are required to properly attach the VI BRICK to the PCB.

Introduction

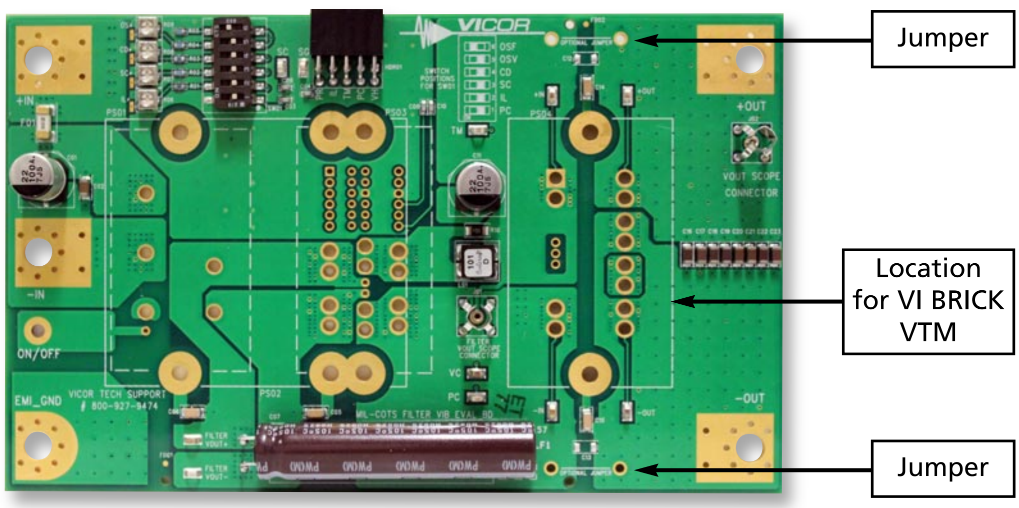
The MIL-COTS VI BRICK Filter is a compact DC front-end module, available as a standalone full-size VI BRICK (part # MF028AMFPT) or integrated with the 28 V MIL-COTS PRM in a double size VI BRICK (part # MR028B036M012FPT), that provides EMI filtering and transient protection. The MIL-COTS VI BRICK filter line of products enables designers using Vicor's MIL-COTS VI BRICKs or MIL-COTS V•I Chips to meet conducted emission / conducted susceptibility per MIL-STD-461E and input transient surges per MIL-STD-704 or MIL-STD-1275 as indicated in the data sheet. These devices are qualified and intended for use with the MIL-COTS versions of VI BRICKs and V•I Chips. The terms "filter", "PRM", and "VTM" as used in this document are intended to mean the MIL-COTS versions of these products. Additionally, it is understood these terms as related to the PCB discussion mean the VI BRICK versions of these devices. This board allows for evaluation with or without the VTM at the user's discretion.

MIL-COTS VI BRICK™ Filter and Filter with Evaluation Board Assembly

The Evaluation board comes from the factory partially assembled as shown in Figure 1. The board is clearly marked with a silkscreen that identifies the various components and measurement locations. These [references] will be used throughout this document.

This board has dual footprint locations that will accommodate either the integral Filter/PRM VI BRICK, [PS02] and optional VI BRICK VTM [PS04] or the separate Filter [PS01], PRM [PS03], VTM. In order to use the board the chosen VI BRICK (purchased separately) must be soldered into the PCB. Use an appropriate soldering iron and solder for this task.

Figure 1



For a detailed discussion of soldering VI BRICKs please review Soldering Methods and Procedures for Vicor Power Modules. If evaluation without the VI BRICK VTM is desired, install [optional jumper] in the 2 positions shown.

The order of assembly is:

Install standoffs in the locations for the VI BRICKs being installed using the screw and standoffs supplied. (Figures 2 and 3)

Examine the pins of the VI BRICKs being installed; straighten as needed.

Carefully align the VI BRICK pins over the plated through holes in the PCB for the respective location

Carefully press the VI BRICKs straight into the PCB taking care not to cock or misalign the control pins until the baseplate flange seats on the standoffs. Do not force as the pins can be damaged. If the VI BRICKs do not go into the PCB easily, remove and examine the control pins, as they can be easily misaligned.

Secure the VI BRICKs to the standoffs using the screws supplied. (Figures 4 and 5)

Solder the VI BRICK pins to the Evaluation PCB from the bottom side. The large pins will require considerably more time to solder than the small control pins. Use only enough heat and time to flow the solder and fill the hole while ending up with a good solder fillet. Take care to not create solder shorts between the control pins or other components.

Clean and examine the solder joints for suitability.

Rework any joint as needed and remove any observed solder shorts.

Affix the supplied rubber pads to the bottom side of the PCB in the locations shown on the PCB silkscreen.

Figure 2
Components removed for clarity

Figure 3
Components removed for clarity

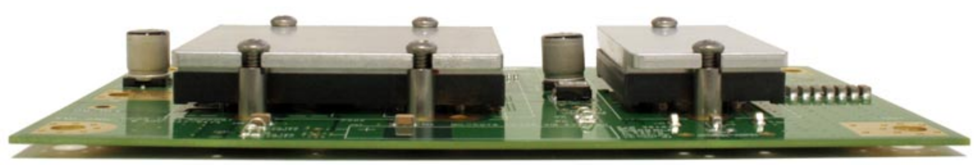


Figure 4
MR028B036M012FPT with VTM
Components removed for clarity

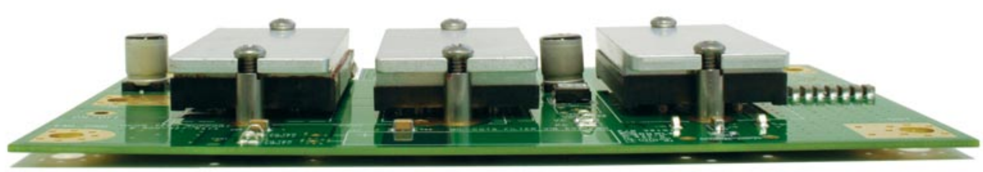


Figure 5
MF028AMFPT/ PRM/ VTM
Components removed for clarity

This board has several features that enable the user to fully explore the capabilities of MF028AMFPT or MR028B036M012FPT:

Source voltage input points [+IN], [-IN] are designed to accommodate #10 hardware and Panduit ring lugs.

BE CERTAIN THAT THE POLARITY IS CORRECT BEFORE APPLYING POWER.

Auxiliary control [HDR01] - access points for IL, TM, PC, and VH, (header shown installed).

Reference for measurements - Signal Ground [SG].

Adjustment potentiometers for indicated function [OS], [CD], [SC], [IL] are used in conjunction with actuation of corresponding switch in [SW01].

PRM PORT CONTROL (switch bank [SW01] and silk screen reference).

Toggling the switch indicated [PC] (#1) to the ON position inhibits the PRM output.

Toggling the switch indicated [IL] (#2) to the ON position enables an adjustable current limit effected by varying the corresponding IL trim pot [R06].

Toggling the switch indicated [SC] (#3) to the ON position enables adjustment of the output voltage down from the set point determined by the OS resistor by varying the corresponding [SC] trim pot. CAUTION: Depending upon the initial output voltage set point determined by the [OS] resistor it is possible to trim the SC so low that the output shuts off. The minimum output voltage per the data sheet is 26 Vdc.

Toggling the switch indicated [CD] (#4) to the ON position places the PRM in Adaptive Loop regulation mode (for use with the VTM) from the Local Loop regulation mode. (In Local Loop mode the set point voltage is regulated at the output terminals of the PRM.) Adjusting the corresponding [CD] trim pot changes the gain of the loop to compensate for different OS settings and / or interconnect resistive losses.

Toggling the switch indicated [OSV] (OS Variable) (#5) to the ON position requires the switch indicated [OSF] (OS Fixed) (#6) be placed in the OFF position and allows the PRM output set point to be varied within the range specified on the data sheet.

Toggling the switch indicated [OSF] to the ON position sets the output of the PRM to the nominal value indicated on the data sheet. CAUTION: If this switch is in the OFF position and the [OSV] switch is also OFF, the unit will not function.

IT IS BEST TO SET THE SWITCH POSITION AND CORRESPONDING TRIM POT SETTINGS BEFORE APPLYING POWER TO THE BOARD.

Test point for Secondary Control [SC] is located between [HRD01] and [SW01]

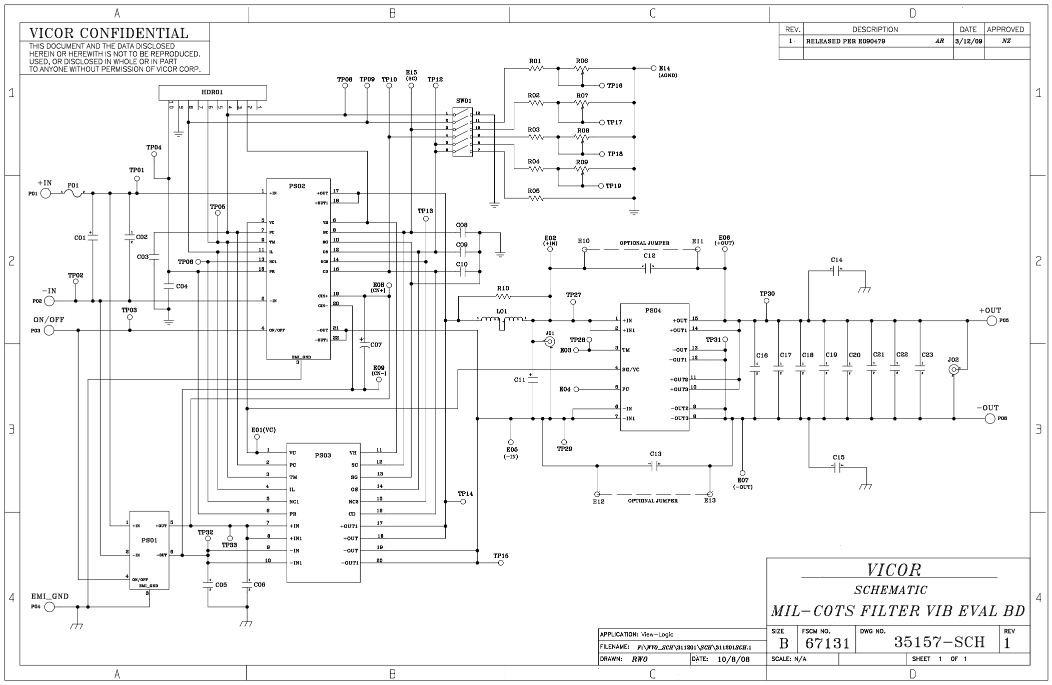
Output voltage points [+OUT] and [-OUT] are designed to accommodate #10 hardware and Panduit ring lugs.

PRM Output scope jack [J01]. VTM Output scope jack [J02].

NOTE: Header [HDR01] is 0.100" spacing, 10 position female, manufactured by Sullins Electronics and available from Digi-Key as part # S5519-ND.

Below is the schematic for this PCB. *Double click image to enlarge for better viewing.*

Figure 6



Hardware

The hardware kit contains:

- (5) #10-32 screws
- (5) #10 flat washers
- (5) #10 lock washers
- (5) #10 hex nuts
- (6) F-F Standoffs
- (12) #4-40 with threadlock mm screws
- (6) Rubber feet

Hardware kit is included with the Evaluation Board. All hardware is stainless steel except the ring lug.

Suggested hardware *(not supplied)*
- (4) ring lugs from Panduit, P/N LCAS6-10-L

Initial Set Up

To test the VI BRICK PRM mounted to the board it is necessary to configure the switch bank [SW01] as shown on the silk screen. Placing the switch bank in this state connects a fixed resistor between OS and SG of the PRM that sets the output voltage of the PRM to the nominal value indicated on its respective data sheet. The Filter stage has an on/off control. To enable the Filter the [ON/OFF] connection must be electrically tied to [Filter VOUT-] either via a switch or direct wire connection.

CAUTION: FAILURE TO CONFIGURE THE SWITCH BANK IN THIS STATE PRIOR TO TESTING MAY RESULT IN IMPROPER OUTPUT OR NO OUTPUT.

Baseline Test Procedure

1.0 Recommended Equipment

1.1 DC power supply: 0 – 100 V; 500 W
1.2 DC electronic load: pulse capable; 0 –100 V; 100 A minimum
1.3 DMM
1.4 Oscilloscope
1.5 Appropriately sized interconnect cables
1.6 Fastening hardware
1.7 Fan
1.8 Safety glasses
1.9 Data sheet for the requisite VI BRICK

2.0 Hook Up

2.1 Connect the power supply +Out lead to the [+In] terminal.
2.2 Connect the power supply –Out lead to the [–In].
2.3 A high quality, low-noise power supply should be connected to these locations.
2.4 Connect a lead between the [+Out] on the Customer Evaluation Board and +In of the load.
2.5 Connect a lead between the [–Out] on the Customer Evaluation Board and –In of the load.
2.6 Connections to these locations should be with short heavy gauge leads.
2.7 Connect [ON/OFF] via switch or direct wire to [FILTER VOUT-].

3.0 Verify Connections

4.0 Test Sequence (without VTM installed - [Optional Jumper]s installed)

4.1 Have the latest version of the MR028B036M012FPT or MR028A036M012FP data sheet in hand.
4.2 Assure that the DC supply is set to 0 Vdc prior to turning the unit on.
4.3 Confirm that the switch bank is configured as shown in the silk screen on the board.
4.4 Turn on the DC supply.
4.5 Make sure the DC load is set to constant current and at 0 A prior to turning on the load.
4.6 Turn on the DC load.
4.7 Connect an oscilloscope to the test point provided, [J01], to monitor output voltage. Many types of scope probes may be directly connected to these points if the probe is equipped with a removable plastic sheath. Be careful to avoid creating ground loops when making measurements of this voltage and the input voltage. It is recommended that the measurements be made separately. Shorting the –input and –output of the PRM will defeat the PRM current limit feature as the current shunt is in this path.
4.8 Turn on a fan if desired.
4.9 Raise the DC input voltage to the nominal value indicated on the data sheet.
4.10 Verify no load operation by raising and lowering the input voltage through the entire input voltage range. The output voltage should remain constant within the tolerance indicated in the data sheet.
4.11 Re-establish the nominal input voltage.

4.12 Slowly increase the load current to full load while monitoring the output voltage. The output voltage should remain within the limits specified in the appropriate PRM data sheet.
4.13 Return the load current to 0A and decrease the input voltage to low line.
4.14 Repeat step 4.12. Depending upon the supply used and the source impedance it may be necessary to adjust the input voltage to keep the input to the PRM at low line.
4.15 Return the load current to 0A and increase the input voltage to high line.
4.16 Repeat step 4.12.

5.0 You have now verified the functionality of the VI BRICK PRM over the entire line and load operating range.

6.0 Deviating from Nominal Settings

This board has provisions to adjust the configuration of the PRM about the nominal values. The data sheet for the PRM has equations and curves for determining the required resistor values needed for specific conditions.

Applications requiring output voltages other than the nominal setting will need to have the new value set via the trim pots and respective switches. Reference the silkscreen and the schematic shown in Figure 6.

6.1 Adjust the VI BRICK PRM Output Voltage Set Point.

6.1.1 Make sure that the power is removed from the unit prior to making adjustment.
6.1.2 Using a DMM (set to measure resistance), probe between [SG] and the pad labeled [OS] located next to the 5 kΩ trim pot [R09].
6.1.3 Adjust [R09] such that the meter reads ~ 200 Ω. This value added to the fixed resistor [R04] should total ~ 2.3 kΩ. NOTE: R04 is 1.7 kΩ on the board.
6.1.4 One could also probe between SG and the ON side of switch OSV (#5) and set the total resistance to ~ 2.3 kΩ.
6.1.5 Move switch OSF (#6) to the OFF position.
6.1.6 Move switch OSV to the ON position.
6.1.7 The unit is now ready to provide the desired output voltage set point.
6.1.8 Powering the device on should yield an approximate no-load output voltage of the nominal specified value.
6.1.9 The output voltage can now be set to the desired value by varying trim pot OS [R09].
6.1.10 IT MAY BE POSSIBLE TO INADVERTENTLY TRIM THE OUTPUT TOO HIGH ENABLING THE OVERVOLTAGE PROTECTION CIRCUIT. If this happens, reduce the impedance of [R09]. The initial conditions of steps 6.1.2 and 6.1.3 can be used to recover.
6.1.11 The desired output voltage set point can also be achieved by using the equations in the data sheet and setting the total OS resistance ([R04]+[R09]) to that value and then configuring the switches as above.
6.1.12 CAUTION: Be certain to adhere to the power vs. output voltage curve in the data sheet to avoid over powering the device!

6.2 Adjusting the Current Limit

6.2.1 Increasing the load beyond the rated maximum may activate the VI BRICK PRM's internal current limit (see data sheet for values) feature. Certain applications may require a lower limit and for those situations we offer the adjustment feature.

6.2.2 Refer to the data sheet for the resistance vs. limit curve for the desired limit value.

NOTE: The IL values of resistors installed on this board ([R01] + [R06]: 2 kΩ + 100 kΩ) may not cover the entire range of the curve.

6.2.3 The adjustable IL mode is engaged by repositioning the IL switch (#2) from OFF to ON. (This may be done while the unit is powered.)

6.2.4 Adjusting the IL trim pot [R06] will reduce the current limit from the factory preset limits specified in the data sheet. It is not possible to increase this limit beyond the factory settings.

6.2.5 To reinstate the factory limit return the IL switch (#2) to the OFF position.

6.3 Trimming the Output Voltage using SC.

6.3.1 Once the output voltage has been determined and set using the OS resistors, it is still possible to trim the output down to 26 V using the SC control. Adjusting the output in this manner rather than merely adjusting the output via the OS values provides improved regulation.

6.3.2 Depending upon the chosen initial output voltage determined by the OS resistors, the amount of available adjustment might be very limited. Enabling SC adjustment by toggling the SC switch (#3) to the ON position may result in shut down.

6.3.3 To avoid the situation described in 6.3.2, set the SC trim pot [R07] (100 kΩ) to its maximum value prior to enabling the switch.

6.3.4 The data sheet has an equation for calculating the appropriate resistor value for a trimmed output voltage. This value would be the sum of fixed resistor [R02] (5.11 kΩ) and the trim pot [R07]. [R07] can be set using the test points provided locally, or the sum set using the [SC] and [SG] test points when the SC switch (#3) is ON.

6.4 Activating Adaptive Loop Regulation and Interconnect Compensation CD.

6.4.1 The CD switch (#4) and the associated fixed resistor [R03] (20Ω) and trim pot [R08] (20Ω) enable the PRM Adaptive Loop regulation feature, which compensates for the VTM output resistance induced voltage drop as the load current from the VTM is increased.

6.4.2 This feature is intended to be used with an installed VI BRICK VTM discussed in detail in the next section.

The VI BRICK VTM module provides the isolation stage and the output voltage step down. When paired with the VI BRICK PRM the two form a traditional DC-DC converter.

For example, if a MR028B036M012FPT and a MT036A120M010FP are mated, the input range to the pair is 16-50 Vdc and the output would be 12 Vdc at no load decreasing by Iout x Rout of the VTM as the load current increases. This Vout decrease is due to the switch bank being configured as shown in the silk screen. In this configuration, the PRM is set for Local Loop mode.

To provide for load regulation at the output of the VTM, the Adaptive Loop regulation mode should be engaged. To activate this feature of the PRM, the switch indicated CD (switch #4) should be set to the ON position. The corresponding trim pot [R08] should be set to 19.2 Ω which will result in a total CD to SG resistance of 39.2 Ω. This is the optimal value for the nominal PRM output voltage as set by the fixed OS resistor installed on the board and activated by the OSF (switch #6) in the ON position.

Be certain to refer to the data sheets for the appropriate resistor values for your requirements.

To validate the functionality of the Adaptive Loop regulation, repeat the steps in Sections 2.0 to 5.0 under the Baseline Test Procedure except in this instance the VTM is installed and the [optional jumper]s removed. Both the VI BRICK PRM and VTM data sheets should be in hand.

The PRM Adaptive Loop regulates the output of the VTM without sense lines. The Factorized Bus voltage (Vf) may be monitored by using J01 on the board while increasing the load current. Observe the Vf voltage increases with the load current, compensating for the insertion loss due to the VTM output resistance.

VTM output voltages, which deviate from the nominal configuration, are available by changing the output set point of the PRM as described in Section 6 of this document and using the formula described in the data sheet.