

August 28, 2009

Filter Box

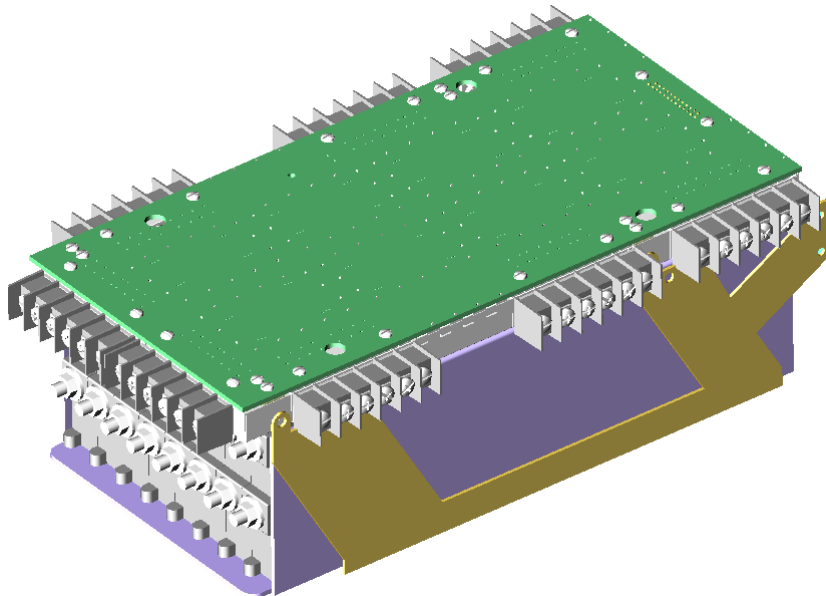
This document describes a filter box that allows using Vicor switching power supply to provide clean voltages for DES Front-End Electronics.

Description:

- Each rail voltage will be filtered to lower ripple and EMI spikes.
- Each rail voltage (currently 8) passes through its own differential/common mode filter.
- All filter components are contained inside the primary EMI shield.
- All individual filters are contained inside a secondary box approximately 12"x6"x3/4"
- The 'Filter Box' is mounted directly to the power supply.
- The power supply uses local sensing before the filter.
- The power supply outputs connect directly to the input of the Filter Box.
- The output of the Filter Box connects directly to the Analog Backplane that distributes power to the Front-End Electronics Transition cards.
- There is a 25 pin subminiature 'D' connector that monitors all rail voltages (Slow Controls). Current limiting resistors are used on these lines. Additionally there is a thermal switch mounted centrally on the filter board used for over temperature protection. The switch closes a 60°C.

PCB Details:

- The top, bottom and center layers of the circuit board will act as EMI shields and will be connected to chassis ground.
- The PC board itself will act as one side of the EMI chassis of the Filter Box.
- All electrical connections into and out of the Filter Box are made through filtered barrier strips.
- Power planes will transfer the voltages to and from the individual filters.
- Inputs (noisy) to and Outputs (quiet) from the filter box will be separated by the center ground plane.
- The PCB will require a minimum of 8 layers. Power plane layer require 2 ounce copper while all other layers can be 1 ounce.



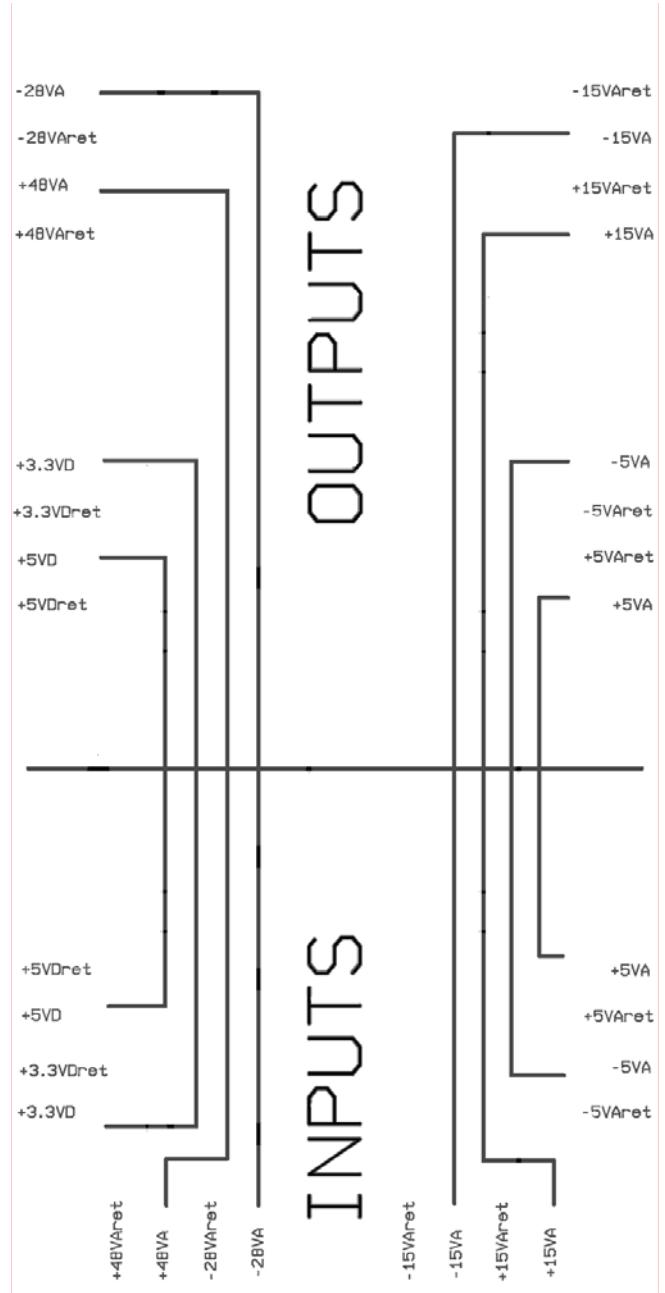
Filter Box attached to the Vicor PS.



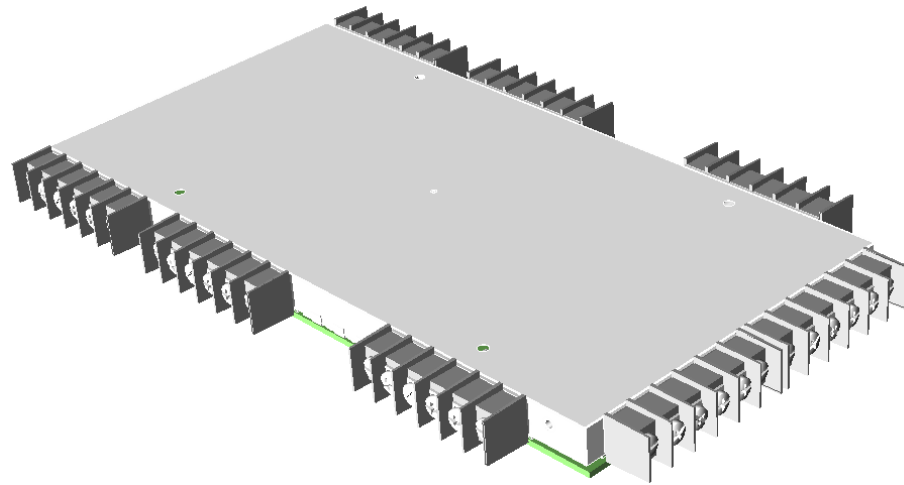
Vicor Output Terminals



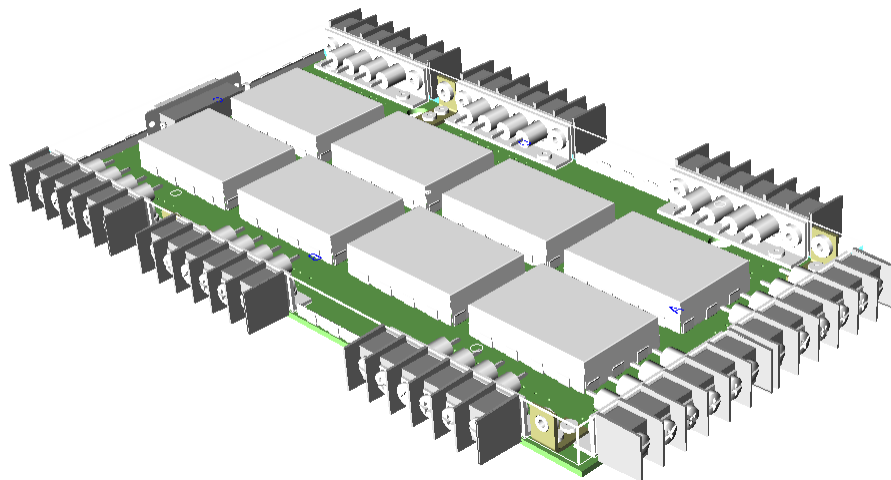
Vicor Module Arrangement



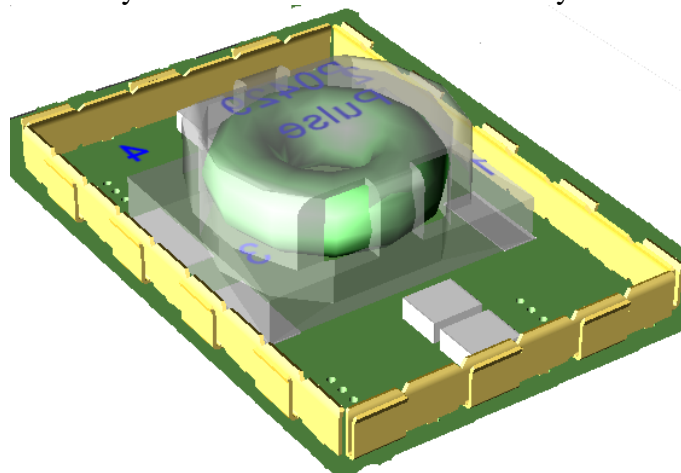
PCB Labeling



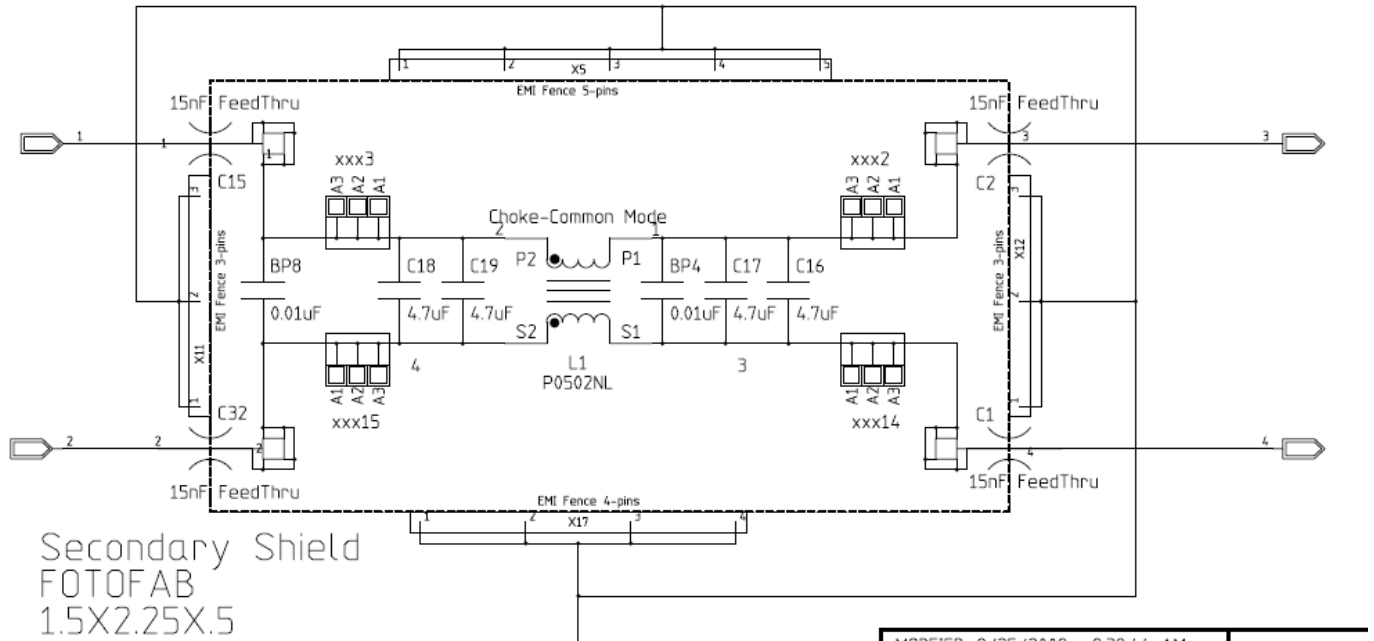
Bottom view with primary shield in place.



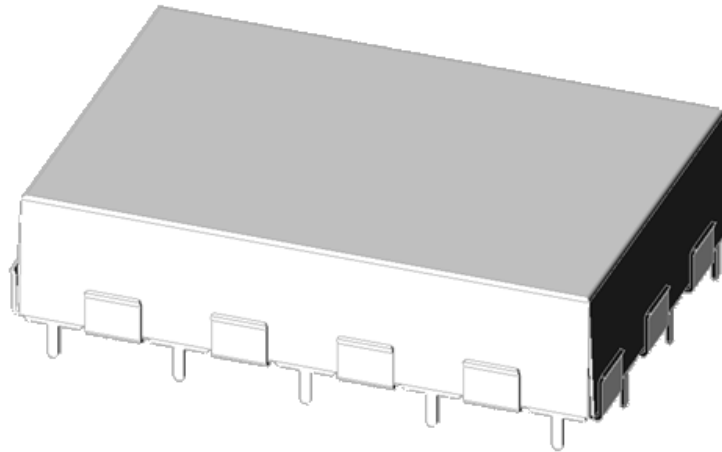
Primary shield remove to show secondary shields.



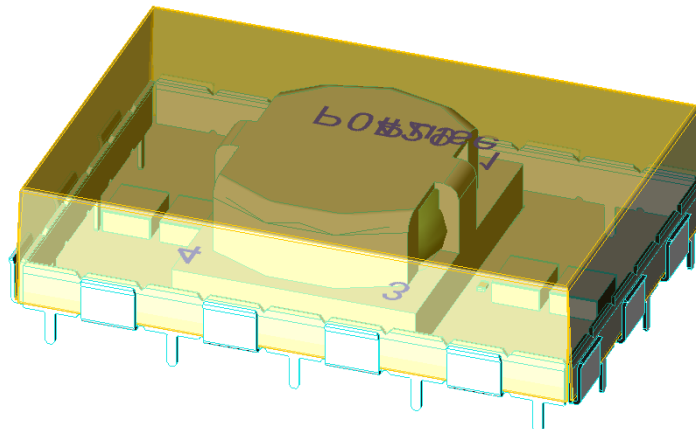
Filter Components



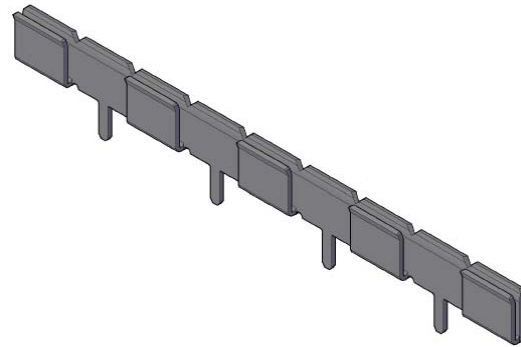
This is the schematic for one of the 8 filter RF Shielding Fence



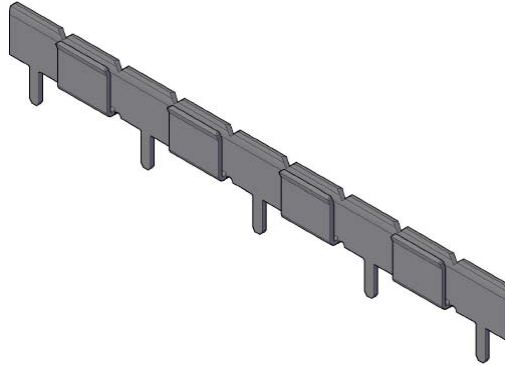
Single filter with secondary shield in place.



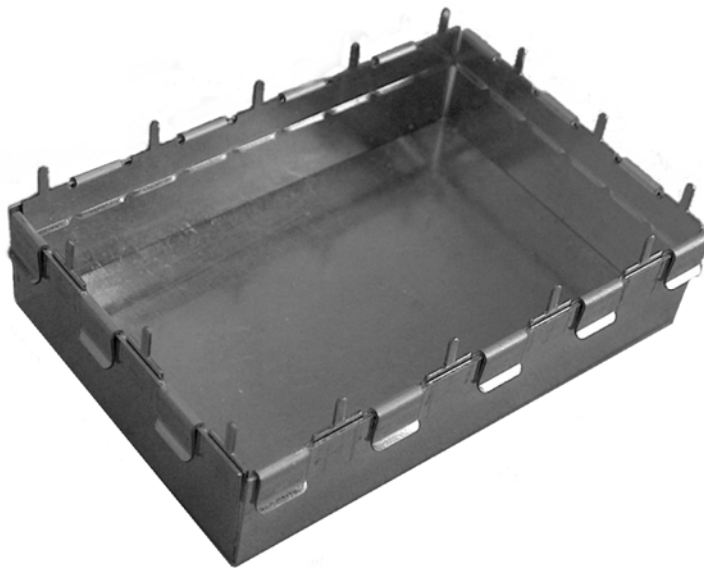
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Filter components shown with shield removed.

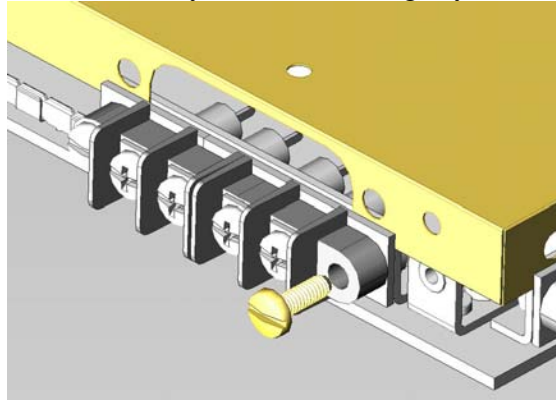


There are two several ways to cut a 2 ¼" EMI fence. The fence is segmented at ¼" intervals so a fence can have 4 or 5 pins associated with it. The ends can also have the pins or the folded clamp. This will allow the shield to have evenly spaced pins as it goes around the box perimeter.

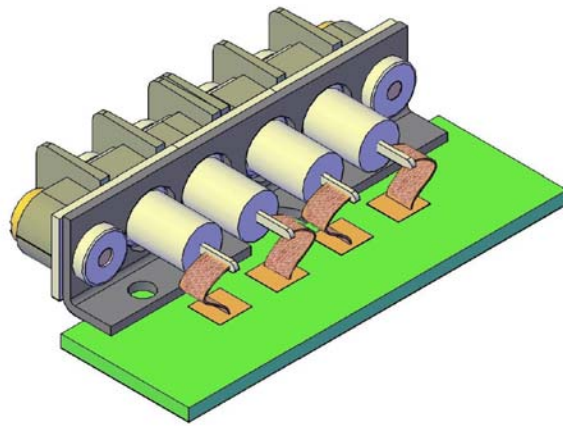


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Primary shield lifted slightly



Shield is sandwiched between the barrier strip and the mounting bracket

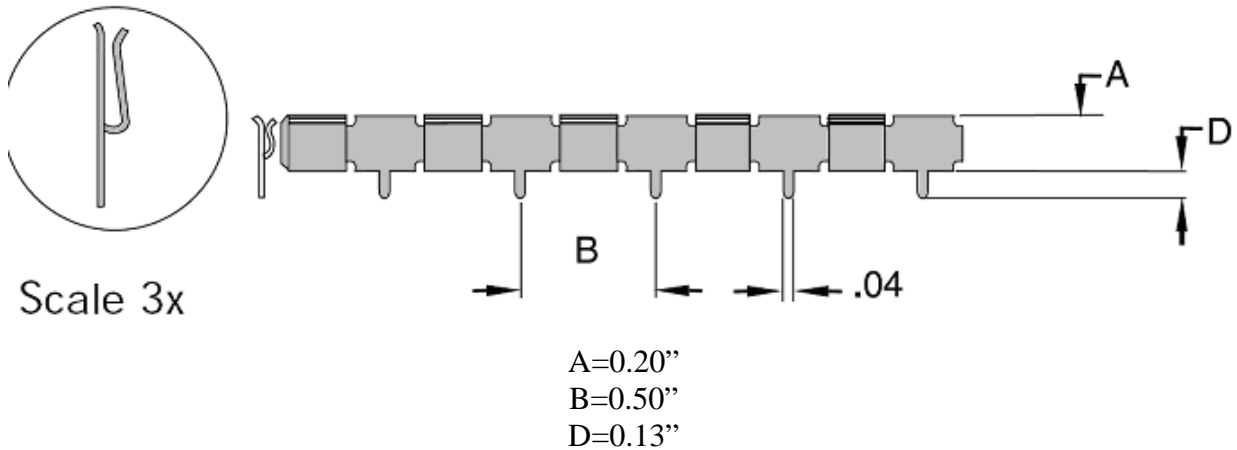


Barrier strip feed-through capacitors are connected to the PCB with 1/4" tinned-copper braid

Manufactured by Leader Tech

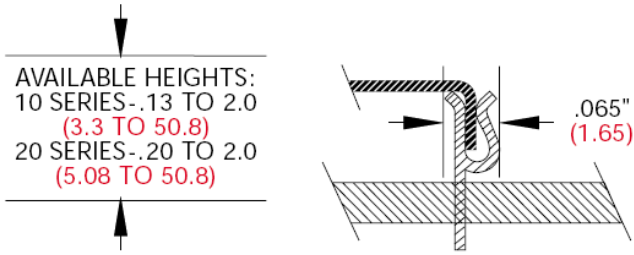
Part Number 29-CBSU-24 cut to length.

Shield boxes are used to separate each power supply voltage.

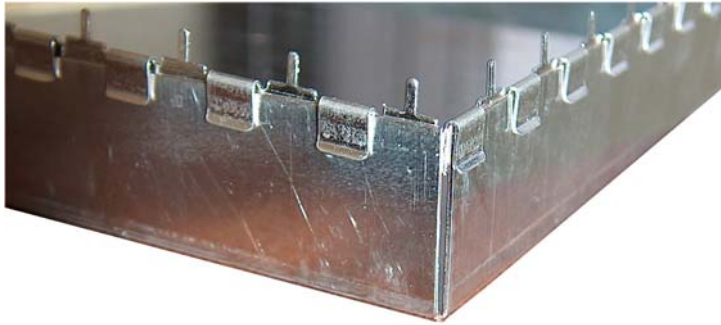


CBS

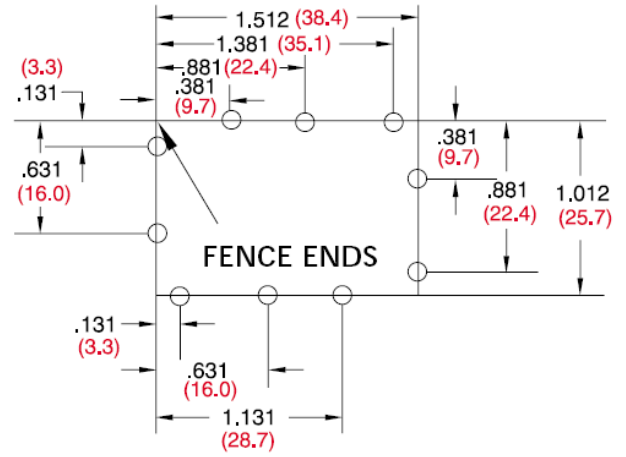
10 & 20 Series Configuration



Recommended hole size: .050" (1.27)

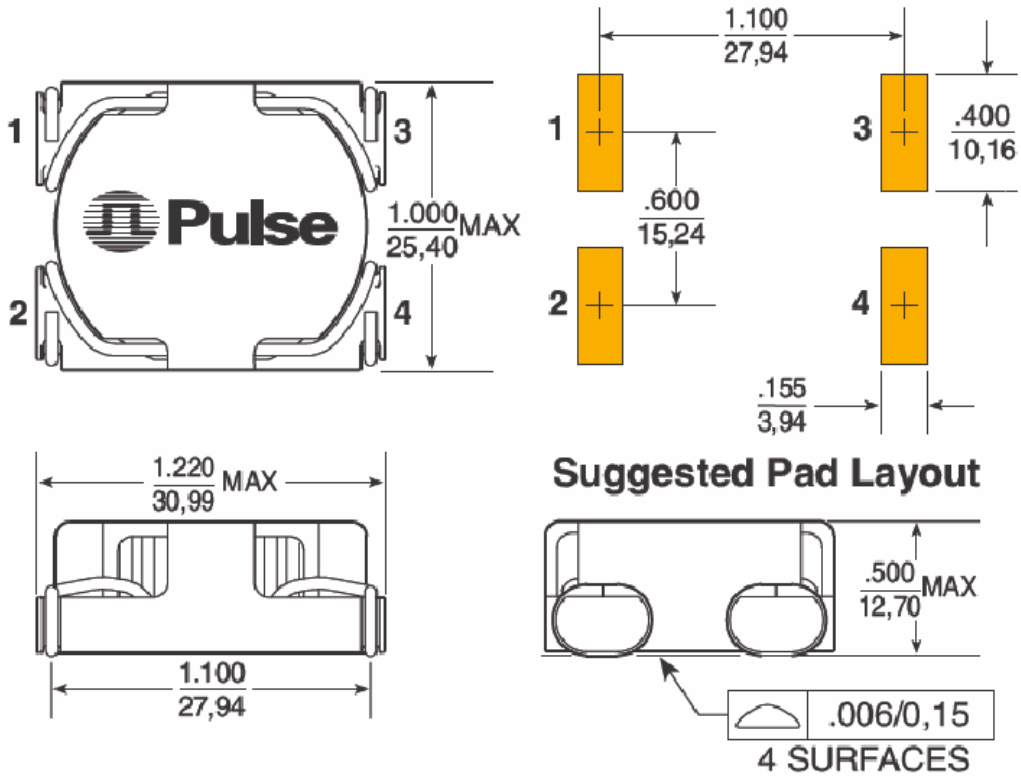


Example: Mounting Hole Pattern For 10 & 20 Series

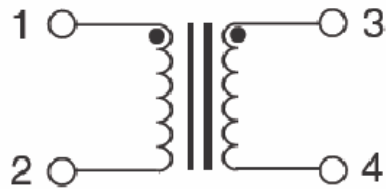


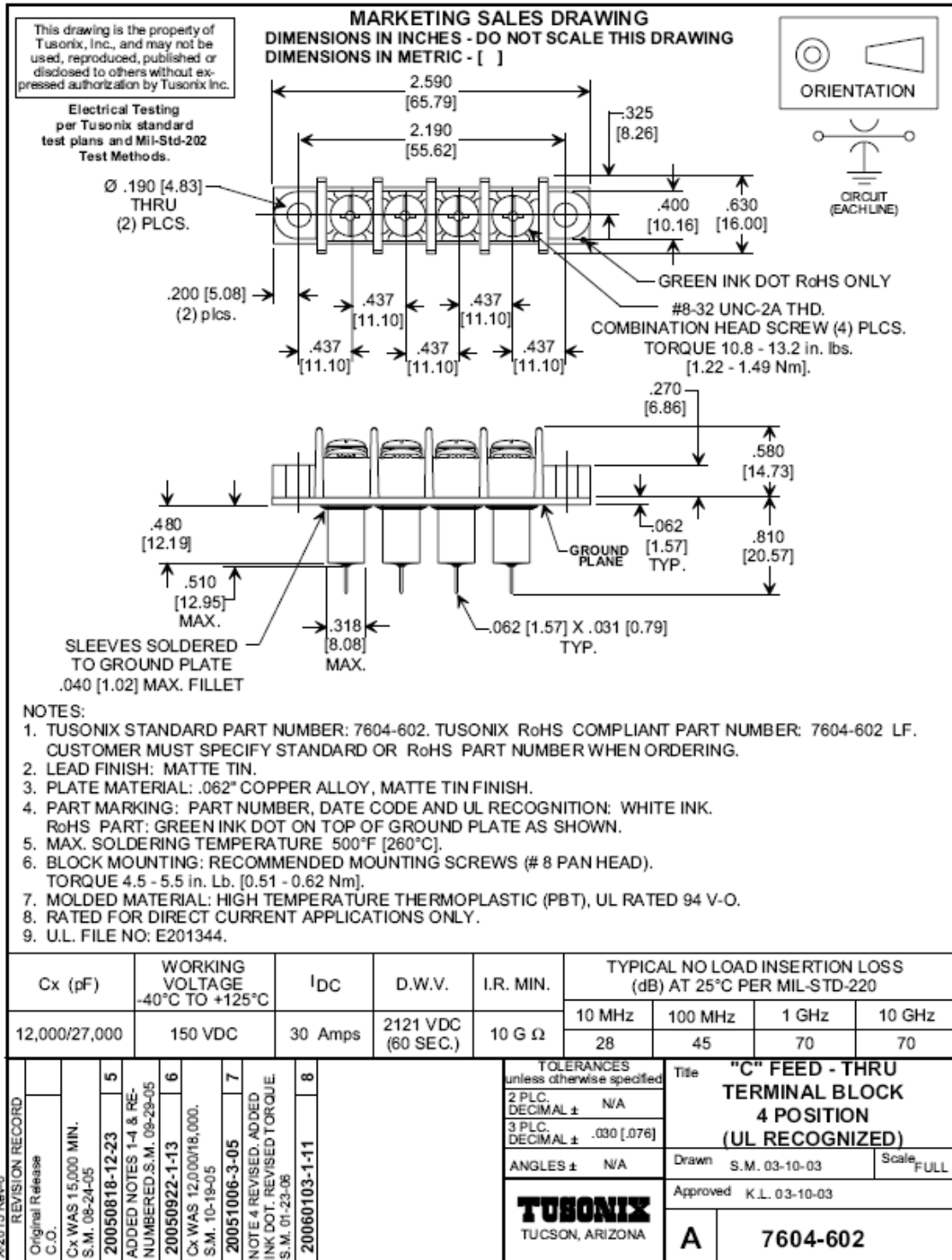
Primary Shield is 12" x 6" x 19/32" channels.

Big Foot

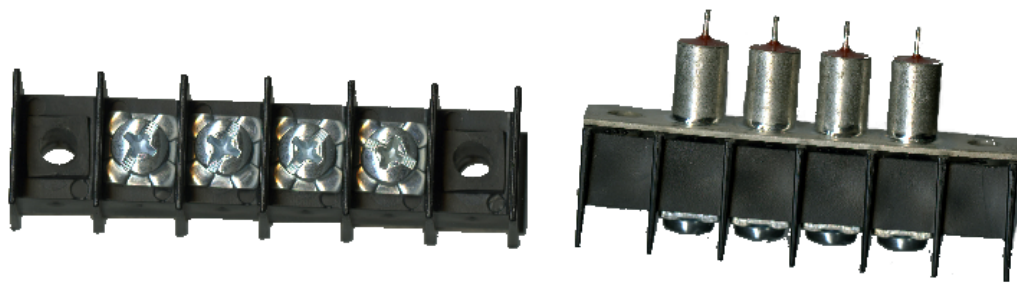


Schematic





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Wiring

This is the recommended wiring scheme for Vicor to Filter to Analog Backplane.

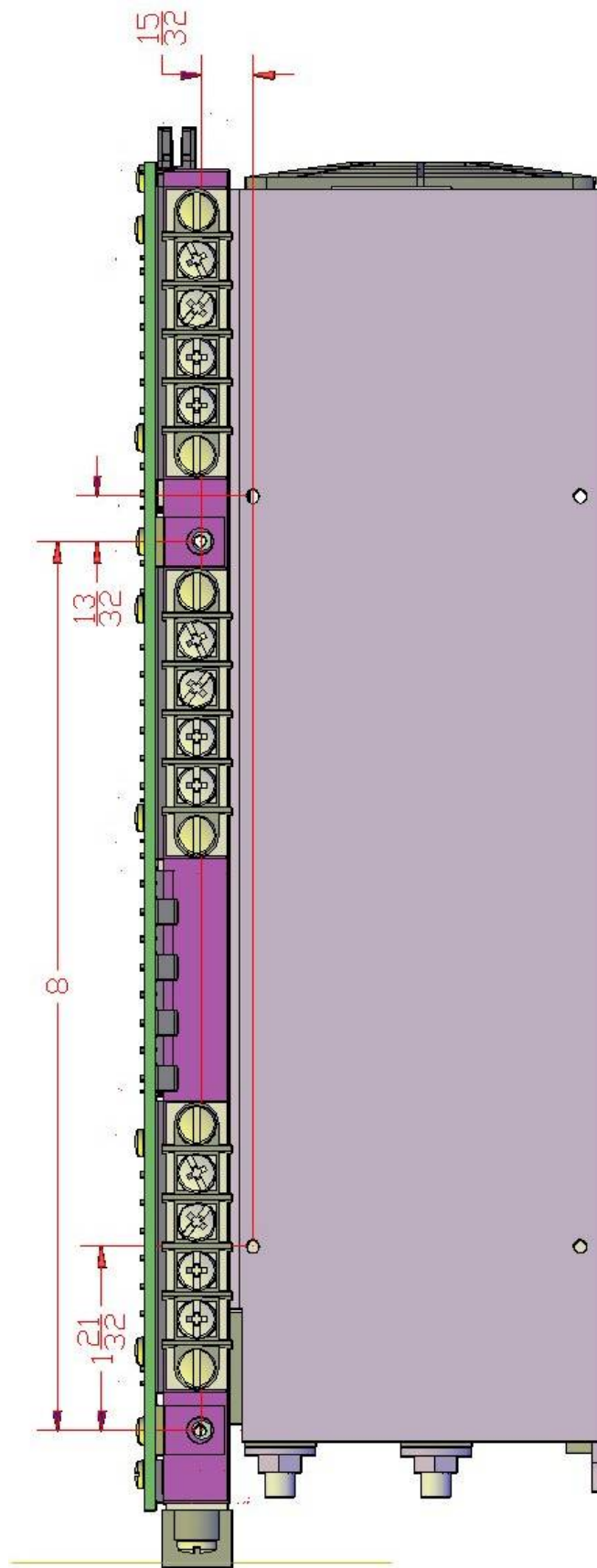
Voltage	Color	Gauge	Alias	Back Plane	
+5Vd	Red	14 Awg		+5V	Digital
+5Vd Ret	Black	14 Awg		GND	
+3.3Vd	Orange	14 Awg		+3.3V	
+3.3Vd Ret	Black	14 Awg		GND	
-15Va	Blue	16 Awg		-15V	Analog
-15Va Ret	Brown	16 Awg		GND	
-5Va	Violet	16 Awg		-5V	
-5Va Ret	Brown	16 Awg		GND	
-28Va	Gray	16 Awg	Vdd	-28V	
-28Va Ret	Brown	16 Awg	Vdd Ret	GND	
+15Va	Yellow	16 Awg		+15V	
+15Va Ret	Brown	16 Awg		GND	
+5VA	Red	16 Awg		+5V	
+5VA Ret	Brown	16 Awg		GND	
+48Va	White	16 Awg	Vsub	+48V	
+48Va Ret	Brown	16 Awg	Vsub Ret	GND	

Each rail voltage will be twisted with its return wire. The Analog Backplanes are separate, one is a 4-slot the other a 6-slot. The analog power is run to each backplane separately from the Filter box.

We may however daisy-chain the digital power from one backplane to the other. We could do this with 14AWG wire from the Filter box to the first backplane then 16AWG wire from that backplane to the next.

The resistance reading between rail and return will be 10x the voltage for rails above 5V

i.e. 15V filters read 150Ohms, 28V filter measures 280Ohms and 48V filter reads 480Ohms.



Filter Box with respect to Vicor mounting

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Corrections for Version 2

1. Bottom side silkscreen.
2. Correct capacitors on schematic and BOM.
3. PCB layout needs footprint changed for larger capacitors.
4. Changed mechanical pieces to use 4-position barrier feed-through parts.
5. Found the +/-15VA circuits mislabeled. The output labels are reversed. We need to be careful when wiring the output of the Filter box to the crate.
6. Changed the Monitoring connector to a 25 pin subminiature 'D' type. This accommodates both Front End Electronics and Heater crates.