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.
Vicor Output Terminals

Vicor Module Arrangement

PCB Labeling
August 28, 2009

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.
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.
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 ¼” 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.

A=0.20”
B=0.50”
D=0.13”
Primary Shield is 12" x 6" x 19/32" channels.
Big Foot

Suggested Pad Layout

1.100
27.94

.600
15.24

.400
10.16

.155
3.94

.500
12.70

.006/0.15
4 SURFACES

Schematic
Wiring

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

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Color</th>
<th>Gauge</th>
<th>Alias</th>
<th>Back Plane</th>
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<tbody>
<tr>
<td>+5Vd</td>
<td>Red</td>
<td>14 Awg</td>
<td></td>
<td>+5V</td>
</tr>
<tr>
<td>+5Vd Ret</td>
<td>Black</td>
<td>14 Awg</td>
<td></td>
<td>GND</td>
</tr>
<tr>
<td>+3.3Vd</td>
<td>Orange</td>
<td>14 Awg</td>
<td></td>
<td>+3.3V</td>
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<tr>
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<td>14 Awg</td>
<td></td>
<td>GND</td>
</tr>
<tr>
<td>-15Va</td>
<td>Blue</td>
<td>16 Awg</td>
<td></td>
<td>-15V</td>
</tr>
<tr>
<td>-15Va Ret</td>
<td>Brown</td>
<td>16 Awg</td>
<td></td>
<td>GND</td>
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<tr>
<td>-5Va</td>
<td>Violet</td>
<td>16 Awg</td>
<td></td>
<td>-5V</td>
</tr>
<tr>
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<td>Brown</td>
<td>16 Awg</td>
<td></td>
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</tr>
<tr>
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<td>Gray</td>
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<td>Vdd</td>
<td>-28V</td>
</tr>
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<td>Vdd Ret</td>
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<td>16 Awg</td>
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<td>+5V</td>
</tr>
<tr>
<td>+5V Ret</td>
<td>Brown</td>
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<td>Vsub</td>
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<td>Vsub Ret</td>
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<tr>
<td>+48V Ret</td>
<td>Brown</td>
<td>16 Awg</td>
<td>Vsub Ret</td>
<td>GND</td>
</tr>
</tbody>
</table>

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
August 28, 2009

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.