

## FILTERING AND TRANSIENT PROTECTION

All switching power supplies generate potentially interfering signals as a result of high-frequency, high-power switching. The Vicor power converter topology, to a large extent, addresses the problem at the source by the use of a quasi-resonant, zero-current switching (ZCS) and zero-voltage switching (ZVS) topology. The switching current waveform is a half sine wave that generates far less conducted and radiated noise in both frequency spectrum and magnitude. EMI filtering, if properly designed and implemented, reduce the magnitude of conducted noise an additional 40 – 60 dB, and as a result, the noise radiated by the power conductors is reduced proportionally.

Conducted noise on the input power lines can occur as either differential-mode or common-mode noise currents. Differential-mode noise, largely at low frequencies, appears across the input conductors at the fundamental switching frequency and its harmonics. Common-mode noise, which has mostly high-frequency content, is measured between the converter's input conductors and ground.

The Vicor power converter being an electronic device may be susceptible to high levels of conducted or radiated emissions. It is the responsibility of the user to assess testing protocols in order to determine applicability of the converter in the intended application.

## BASIC GUIDELINES FOR SUCCESSFUL EMI FILTERING

1. Keep current loops small. The ability of a conductor to couple energy by induction and radiation is reduced accordingly.
2. For conductor pairs, use wide (low Z) copper traces aligned above and below each other.
3. Locate filters at the source of interference; i.e., close to the power converter(s).
4. Filter component values should be chosen with consideration given to the desired frequency range of attenuation. For example, capacitors are self-resonant at a certain frequency, beyond which they look inductive. Keep bypass capacitor leads as short as possible.
5. Locate components on the PCB with consideration given to proximity of noise sources to potentially susceptible circuits. For example, the FIAM is an input line filter module that has been optimized for use with Maxi, Mini, and Micro DC-DC converters. When used in conjunction with the recommended external components and layout, it will significantly reduce the differential and common-mode noise returned to the power source. The FIAM meets the requirements of EN55022 "B", FCC "B", and Bellcore GR-001089-CORE, Issue 2 when used with any combination of Maxi, Mini, and Micro converters up to the FIAM's maximum rated current.

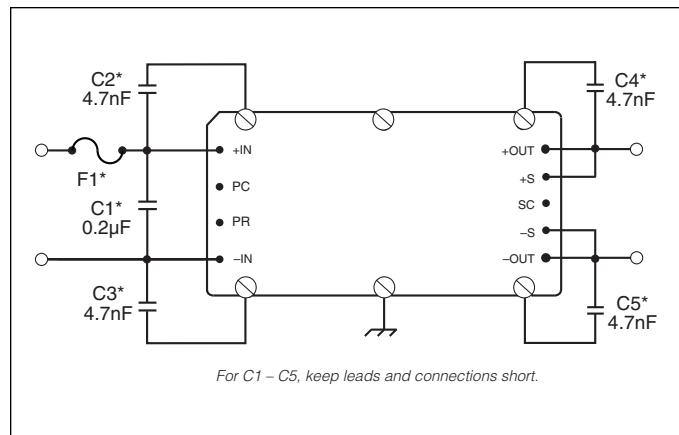
DC-DC converter inputs and outputs must be properly bypassed, to system chassis or earth. Bypass Vin and Vout pins to each DC-DC module baseplate. Capacitor lead length must be as short as possible. (Figure 4-1)

EMI filtering can be application dependent. A packaged filter module may not always be the appropriate solution, and the general practice of bypassing Vin and Vout may not produce optimal results. You may have to adjust the values depending on the severity of common-mode and differential-mode noise. (Figures 4-2 and 4-3)

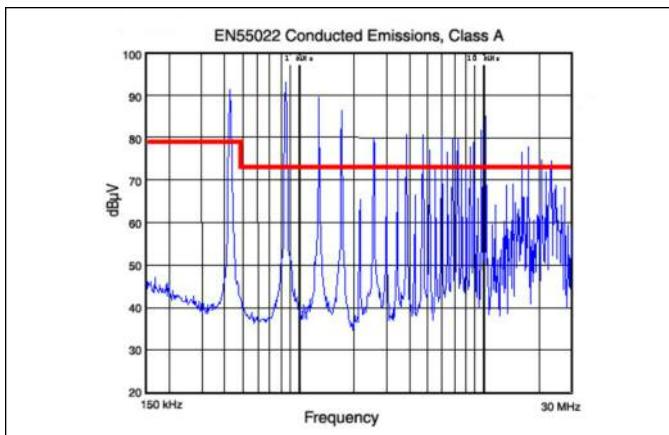
Input transient suppression should be used in applications where source transients may be induced by load changes, blown fuses, etc. The level of transient suppression required will depend on the expected severity of the transients. A Zener diode, TRANSORB™, or MOV will provide transient suppression, act as a voltage clamp for DC input spikes, and provide reverse input voltage protection. The device voltage rating should be chosen above high-line voltage limits to avoid conducting during normal operation which would result in overheating.

Module shields that provide shielding around the belly (label side) of the Maxi, Mini, Micro are also available for applications that are highly noise sensitive. Module shield information is available on the Vicor website, see links provided, on the following page.

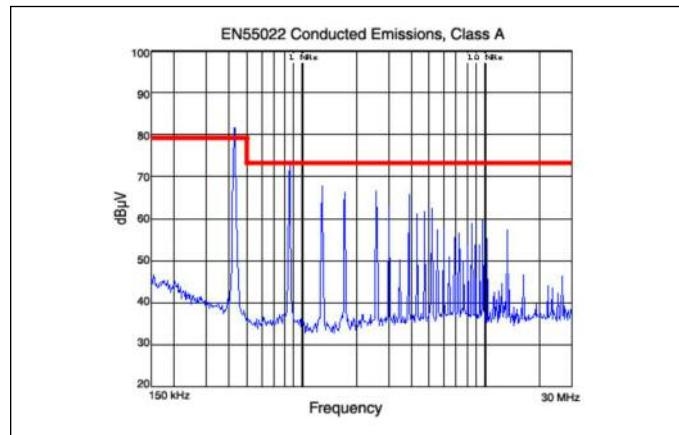
**NOTE: Acoustic Noise.** Audible noise may be emitted from the module under no load, light load, or dynamic loading conditions. This is considered normal operation of the module.



**Figure 4-1** — Recommended bypassing capacitors must be in close proximity, i.e., have short lead length to be effective.



**Figure 4-2** — V48B28H250BN without bypass caps (330 μF across input)



**Figure 4-3** — V48B28H250BN with recommended bypass caps (330 μF across input)

### Module Shield Information

Module shield for Maxi with threaded or through-hole baseplate P/N 30142

<http://asp.vicorpower.com/CADPDF/H7CEX3.PDF>

Module shield for Maxi with slotted baseplate P/N 30199

<http://asp.vicorpower.com/CADPDF/HXE113.PDF>

Module shield for Mini with threaded or through-hole baseplate P/N 30180

<http://asp.vicorpower.com/CADPDF/UT55TT.PDF>

Module shield for Mini with slotted baseplate P/N 30198

<http://asp.vicorpower.com/CADPDF/HXE112.PDF>

Module shield for Micro with threaded or through-hole baseplate P/N 30143

<http://asp.vicorpower.com/CADPDF/9YRD8X.PDF>

Module shield for Micro with slotted baseplate P/N 30141

<http://asp.vicorpower.com/CADPDF/NG6SIS.PDF>