

PFC Mini™

Power Factor Corrected AC-DC Switchers

Overview

The PFC Mini is an extremely low profile switching power supply that combines the advantages of power factor correction, power density, and user selected isolated outputs. Accepting input voltages of 85Vac to 264Vac, and 100 to 380Vdc, the PFC Mini can provide up to 1500W in a package size of 1.75" x 6" x 12". The PFC Mini can provide up to 6 isolated outputs and is factory configured to meet user requirements. Its inherent flexibility comes from the use of Vicor's family of DC-DC converters. Creating a customized power supply is as easy as choosing a converter and plugging it in.

Technical Description

The PFC Mini consists of an off-line single phase, power-factor-corrected front end, EMC filter, cooling fan, customer interface, associated housekeeping circuits, and a selection of Vicor's DC-DC converters.

Input AC mains voltage is applied to a terminal block. The input current is passed through an EMC filter designed to meet conducted noise limit "B" specifications of FCC Part 15 and EN55022 level "B."

At start-up, inrush current is limited by a PTC thermistor. The PTC is shunted out shortly after initial power-up by a DC bus voltage sense circuit driving a relay. After rectification, the input voltage is put through a boost converter that keeps the AC input current sinusoidal and synchronized with the input AC voltage (in compliance with EN61000). The boost converter delivers an unregulated 370Vdc to the hold-up capacitors and a high voltage backplane. The backplane supplies power to the DC-DC converters that provide the desired low voltage, regulated outputs.

Voltage conversion is achieved by Vicor's family of Zero-Current-Switching (ZCS) DC-DC converters. These are forward converters in which the main switching element switches at zero current. This patented topology has a number of unique attributes: Low switching losses; high frequency operation, resulting in reduced size for magnetics and capacitors; excellent line and load regulation; wide adjustment range for output; low EMC emission and high efficiencies.

At initial power-up, the PFC Mini outputs are disabled to limit the inrush current and to allow the DC bus potential to settle out to the correct operating level. A low-power flyback converter operating with PWM current-mode control converts the high voltage DC bus into regulated low voltage to power the internal housekeeping circuits and DC cooling fans.

The internal housekeeping Vcc comes up within 1 sec after the application of input power. Once the high voltage bus is within operating limits, the AC Power OK signal asserts to a TTL "1," indicating the input power is OK, and allows the power outputs to come up 15-30 ms later. An auxiliary Vcc output of 5Vdc sourcing up to 0.3A is provided for peripheral use.

An output Enable/Disable function is provided by using an optocoupler to control Vicor's DC-DC converters. If the Enable/Disable control pin is pulled low, the optocoupler turns on and disables the output. The nominal delay associated for an output to come up when measured from release of the Enable/Disable pin is 5-10 ms. The General Shutdown function controls all outputs simultaneously and works in a similar manner.

Interface Connections

Chassis Input Power Terminals (J1)

Input AC power is applied to terminal block J1 using a pressure screw terminal that accepts a maximum wire size of 10 AWG. The maximum torque recommended is 10 in-lbs. J1-1 (GND) is Earth Ground for safety; J1-2 (L2) and J1-3 (L1) are the other Hot connections.

A fault clearing device, such as a fuse or circuit breaker, with a maximum 15A rating at the power supply input is required for safety agency compliance. It should be sized to handle the start-up inrush current of 30A at 115Vac and 60A at 230Vac.

Output Power Connections

There are two types of output power terminals available in the PFC Mini. Outputs from full-sized converters are terminated in two 1/4-20 plated steel bolts. The positive polarity of the output is the right bolt when viewed from the output end. Outputs from half-sized converters terminate in a Molex connector. Each power output is isolated, so outputs of positive or negative polarity can be configured through proper selection of the output reference terminal.

In order to minimize parasitic cable inductance and reduce EMC, the output power cables should be routed in close proximity to one another, and large current loops should be avoided. To avoid excessive voltage drop, do not undersize power cables, especially for high current outputs. Excessive cable inductance coupled with large capacitive loading can introduce instability in switching power supplies. This problem can be avoided with proper system design. Consult Vicor's Applications Engineering Department for assistance with applications that use long cable lengths and excessive load capacitance.

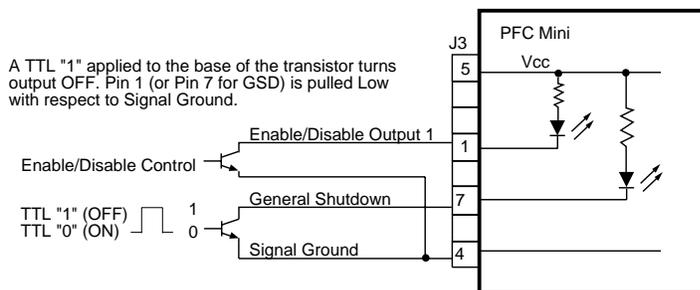
Signal Ground (J3-4)

Signal Ground on J3-4 is an isolated secondary ground reference for all J3 interfacing signals. This is **not** the same as Earth Ground on input power connector J1.

Enable/Disable (J3-1 to J3-3)

The Enable/Disable control pins allow outputs to be sequenced either on or off. J3-1 through J3-3 are the control pins for output cards 1 through 3, respectively. For 2-output cards, both outputs are enabled or disabled with a single control. The Enable/Disable pins should be pulled low to less than 0.7V with respect to Signal Ground to disable the outputs. They will source 3mA maximum. These pins should be open circuited or allowed to exceed 4.5V when enabled. Do not apply more than 5V to these inputs at any time.

Figure 1.
Enable/Disable
Control

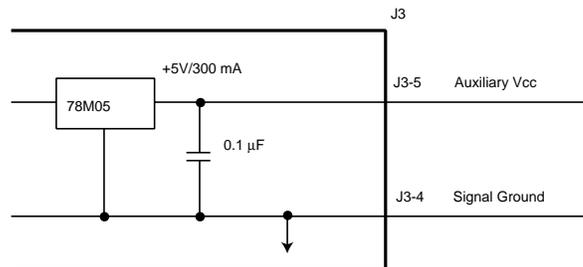


Interface Connections (cont)

General Shutdown /GSD (J3-7)

The GSD control pin on J3-7 allows simultaneous shutdown of all outputs. This pin must be pulled down to less than 0.7V, and will source 3 mA maximum to shut down all outputs. The GSD pin should be open circuited or allowed to exceed 4.5V when not in use, or when the outputs are to be enabled. Do not apply more than 5V to this input at any time. Normal open circuit voltage is 1.5 to 3V with respect to Signal Ground.

Figure 2.
AC OK



AC OK (J3-6)

AC OK is an active high TTL compatible signal, and provides a status indication of the AC input power. It is on pin J3-6 and is capable of sinking 16 mA maximum. This signal switches to a TTL "1" when the high voltage bus exceeds low-line condition during turn-on.

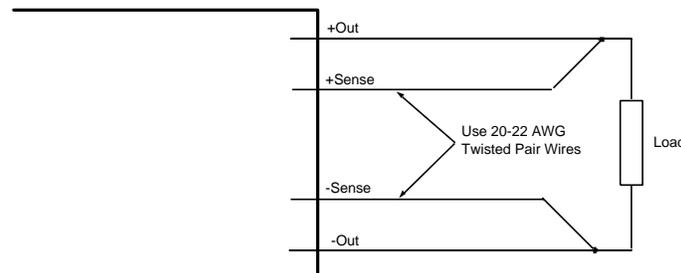
Auxiliary Vcc +5V/0.3A (J3-5)

The Vcc on J3-5 is an auxiliary 5V regulated power source. It is +5Vdc \pm 5% with respect to Signal Ground and can supply 300 mA maximum. It is short-circuit-proof, but if shorted, all outputs will shut down through the Enable/Disable circuitry.

+Sense/–Sense (J2)

The Sense lines for the outputs are shipped from the factory with Local Sense installed. If Remote Sense is desired the Local Sense jumpers can be removed for individual outputs. If the Local Sense jumpers are removed, the Sense lines must be connected for Remote Sense. Leaving the Sense lines open will prevent proper output regulation and can damage the unit.

Figure 3.



When Local Sense is used, the power supply will regulate the output at the output terminals. The voltage appearing at the load may drop slightly due to voltage drop in the power cables. If it is necessary to compensate for voltage drop along the output power cables, the output can be trimmed up or configured for Remote Sense. Use twisted pair 20-22 AWG wire for the Remote Sense lines. Remote Sense can compensate for a voltage drop of up to 0.5V, or 0.25V on each leg.

Interface Connections (cont)

Installing Remote Sense requires the Local Sense jumpers to be removed. On single output cards, the Local Sense jumpers are located behind the Sense connector at J1. To remove the jumpers, pull them off the four pins at J1. On dual output cards, the Local Sense jumpers are on either side of the output connector at J1 and J3. The jumpers at J1 are for output #1, and the jumpers at J3 are for output #2.

Note: PFC Mini units built after 12/2000 have been equipped with a new feature called Autosense. With Autosense, the PFC Mini will automatically operate in a Remote Sense mode when Remote Sense connections are made. In the event that the Remote Sense is not connected or needed, no Local Sense selection is necessary – simply hook up the output and the PFC Mini will automatically operate in the Local Sense.

The Sense connector for a single output board is a 3 pin connector providing the +Sense connection on J2-2 and the –Sense connection on J2-3. The Sense connector for a dual output board is a 14 pin connector that also provides the output and trim connections. +Sense and –Sense for the first output are located on J2-1 and J2-8, respectively. +Sense and –Sense for the second output are located on J2-7 and J2-14, respectively.

External Trim (J2)

The Trim pin on J2 can be used to control the output voltage. It is referenced to the –Sense pin. For dual output cards, the Trim pins are available on J2-4 and J2-11 for outputs 1 and 2, respectively. To trim the output up, it is necessary for the voltage at the Trim pin to be greater than the 2.5V bandgap. A 10% increase to 2.75V results in a 10% increase in output voltage. Bringing the voltage at the trim pin below 2.5V trims the output down. A 50% reduction to 1.25V causes the output to decrease by 50%.

Refer to Section 5 for further information on trimming Vicor's DC-DC converters.

CONSULT APPLICATIONS ENGINEERING WHEN TRIMMING OUTPUTS BELOW 5V.

Mechanical Considerations

The PFC Mini can be mounted on either of two surfaces using standard 6-32 size screws. The chassis comes with four mounting points on two surfaces; maximum allowable torque is 20 in.-lbs. The maximum penetration is 0.19 in. (4.8 mm).

When selecting a mounting location and orientation, the unit should be positioned so air flow is not restricted. Maintain a 2" (50,8 mm) minimum clearance at both ends of the PFC Mini, and route all cables so airflow is not obstructed. The power supply draws air in at the fan side/AC input side and exhausts air out the load side. If airflow ducting is used, avoid sharp turns that could create back pressure. The fans move approximately 30 CFM of air.

Avoid excessive bending of output power cables after they are connected to the output terminals. For high-current outputs, use cable-ties to support heavy cables and minimize mechanical stress on connectors. Be careful not to short-out to neighboring outputs. The maximum torque recommended on output nuts is 18 in.-lbs.

Avoid applications in which the unit is exposed to excessive shock or vibration levels. In such applications, a shock absorbing mount design is required.

PFC Mini Do's and Don'ts

- **If Sense jumpers are removed, do not leave Sense lines open. Use twisted pair 20-22 AWG wire when installing Remote Sense.**
- Do not restrict airflow to the unit. The cooling fan draws air into the unit and forces it out at the output power terminals.
- Run the output (+/-) power cables next to each other to minimize inductance.
- Do not attempt to repair or modify the power supply in any manner.
- Insert proper fault protection at power supply input terminals (i.e., a fuse).
- Use proper size wires to avoid overheating and excessive voltage drop.