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PFC MegaPAC™
Power Factor Corrected AC-DC Switchers

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Overview

The PFC MegaPAC family of supplies combine Power Factor Correction (PFC) with the inherent configurability of all Vicor MegaPAC products. This design guide covers four model variations:

1.	PFC MegaPAC	1600W max, standard chassis
2.	PFC MegaPAC MI	1600W max, rugged COTS chassis
3.	PFC MegaPAC High Power	2400W max, standard chassis
4.	PFC MegaPAC High Power MI	2400W max, rugged COTS chassis

All PFC MegaPACs have the same input and output connections, mounting points and the same dimensions:

The extended length (-EL) chassis is covered in a different design guide.

A complete power supply is configured at the factory by selecting and inserting up to eight same-length slide-in output assemblies called ConverterPACs™. ConverterPACs incorporate one (or more) VI-200 / VI-J00. Maxi Vicor DC-DC converters are available in a wide selection of output voltage and power levels. The net result is a power supply that offers the advantages of a custom supply, but is assembled from standard and modular building blocks. Currently, the standard-power chassis uses ConverterPACs with VI-200™ / VI-J00™ Vicor DC-DC converters while the high-power chassis accepts ConverterPACs with both VI-200 / VI-J00 and / or Maxi module. (Refer to Page 7 for a brief overview of the ConverterPACs used).

Note: This user guide contains references to parts and products that are no longer available for new designs. They remain included for reference only.

Manufactured at Vicor, the entire family of MegaPAC™ power supplies is completely user-configurable. If output requirements change, i.e., more power or a different output voltage is needed, upgrading is easy: simply unlock a single screw and replace the slide-in ConverterPAC™ assembly with one that is of the same length and has the desired voltage power rating. For additional flexibility, ConverterPACs can be connected in parallel to increase output power (booster ConverterPACs), or in series for higher voltages (total output voltage should not exceed 400V). The driver is to the left of the boosters when looking at the output end of the supply. A user-friendly interface provides control and output sequencing capability (see Page 30 for more information about this capability), in addition to useful status indicators. Please consult our Applications Engineering Department if you have other special requirements.

Standard Features

- Power Factor Correction; 0.99 at $115V_{AC}$, 0.95 at $230V_{AC}$ - both at full load (47 – 63Hz)
- Universal Input: 85 – $264V_{AC}$, 47 – 500Hz or 100 – $380V_{DC}$
- Power Outputs:
  Standard Chassis: 1,600W at $230V_{AC}$, 1,200W at $115V_{AC}$ **High Power Chassis:** 2,400W at $230V_{AC}$, 1,200W at $115V_{AC}$
- Outputs:
  Standard Chassis: Up to 16 outputs **High Power Chassis:** Up to 16 outputs
- Fan Cooled
- Full-power to 40°C; half power to 60°C
- Soft start for limiting inrush current
- Conducted EMI meets FCC Class A and EN 55022 Class A
  Some configurations meet Class B; Consult Factory
- Harmonic Distortion to EN61000-3-2
- RoHS compliant available
- Output sequencing and general shutdown
  (Refer to Page 30. Consult Applications Engineering for automatic-sequencing circuitry)
- Overcurrent protection on all outputs
- Overvoltage protection and overtemperature limiting on all ConverterPAC outputs
  (not applicable with VI-J00)
- Size: 3.4 x 6.0 x 12.4in [313,9 x 152,4 x 309mm]
- Safety Agency Approvals: cURus, cTÜVus, CE Mark

Optional Features

- DC OK status signal
- Current Share Boards: see Pages 26 – 28
- Output voltage adjustment range with built-in potentiometer
- Low leakage version available upon request: see Page 29
- –40°C operation
- Conformal coating (MI versions only)

Mechanical Considerations

The PFC MegaPAC™ can be mounted on any of four surfaces using standard 8-32 or 4mm screws. The chassis comes with four mounting points on each surface; maximum allowable torque is 5.5 lb·in. The maximum penetration is 0.15in [3.8mm].

When selecting a mounting location and orientation, the unit should be positioned so air flow is not restricted. Maintain a 2in minimum clearance at both ends of the PFC MegaPAC and route all cables so airflow is not obstructed. The standard unit draws air in at the fan side / AC input side and exhausts air out the load side. If airflow ducting is used, use caution, as sharp turns could present back pressure to the PFC MegaPAC. The fan moves approximately 30CFM of air.

Avoid excessive bending of output power cables after they are connected to the PFC MegaPAC. For high-current outputs, use cable ties to support heavy cables in order to minimize mechanical stress on output studs. Be careful not to short-out to neighboring output studs. The PFC MegaPAC units are supplied with serrated, flanged hex nuts on all output studs. Therefore, thread-locking compounds or lock washers are not required. The maximum torque recommended on flanged nuts is 45lb·in. Never loosen the inner nut on a ConverterPAC™. This nut supports the hardware inside the ConverterPAC and is factory torqued.

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

MegaPAC Dos and Don'ts

- Remote sense should be used:
  - to improve poor output regulation.
  - when using older ConverterPACs that do not have the autosense feature.
- **NEVER** connect the remote-sense wires in reverse. To avoid failures, **always terminate the +Sense to the +Out and the –Sense to the –Out**.
- If needed, compatible connector kits can be ordered separately. Refer to Page 25 for additional information regarding connector kits.
- To avoid overheating, **NEVER** operate the supply with an open output slot. Open slots should always be filled with a ConverterPAC or a plastic airblock designed for the PFC MegaPAC.
- Always turn the power supply **OFF** before disconnecting any input or output wires. Failure to do so may lead to an electrical shock hazard and or damage to the power supply.
- **DO NOT** insert or remove a ConverterPAC while the power supply is running. They are not designed for hot insertion or extraction.
- Wait five minutes after shutting off the power supply before inserting or removing a ConverterPAC or to clear on OVP fault condition.
- **DO NOT** restrict airflow to or from the supply as this can cause overheating damage.
- Booster ConverterPACs are available for power expansion. Refer to Page 6 for additional information.
- Do not use boosters as independent outputs. Operating boosters with disconnected bus bars will cause failures.
- Before turning on the unit, ensure all input and output wires are properly connected and all hex nuts properly tightened.
- Keep output wires as short as possible and run the output (+/–) power cables next to each other. Use twisted-pair wiring whenever possible.

- **AVOID** running input and output wiring in close proximity, as this may cause noise-related problems.
- PFC MegaPACs are **NOT** user serviceable. Please contact our customer service department at 1-800-735-6200 for repair assistance. Please be advised that attempts to repair or modify the power supply will void the warranty.
- A proper fault protection device (fuse or breaker) should be used in series with the input terminals.
- Use proper size wires to avoid overheating and excessive voltage drop.
- **NEVER** loosen the inner nut on a ConverterPAC™.
- FinPAC ConverterPACs can only be used with a high-power chassis. A high-power chassis is identified by an "MX" prefix code in the specific model number.
- Output voltages over $60V_{DC}$, whether from individual modules or series arrays, are considered as hazardous secondary outputs under UL 60950. Appropriate care must be taken in design implementation of the supply.

Technical Description

The PFC MegaPAC™ chassis consists of an off-line single phase, power-factor-corrected front end, EMI filter, cooling fan, customer interface and associated housekeeping circuits. Input AC mains voltage (L1, L2 and GND) is applied to a terminal block. The input current is passed through an EMI filter designed to meet conducted noise limit "B" specifications of FCC Part 15, VDE 0871, and EN55022 Class A. 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 AC input voltage (in compliance with EN61000). The boost converter delivers regulated high-voltage DC to the hold-up capacitors and backplane. The backplane supplies power to a variety of ConverterPAC assemblies that provide the desired regulated outputs.

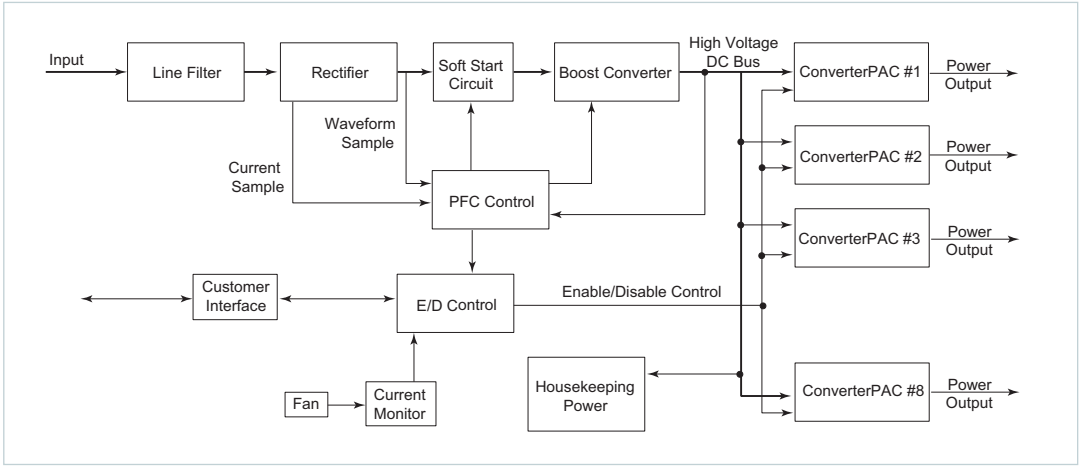
Voltage conversion in the output assemblies is achieved by Vicor's family of Zero-Current Switching (ZCS) DC-DC converters. These are forward converters in which the main switching element switches at zero current. This patented topology has a number of unique attributes: low-switching losses; high-frequency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

At initial power up the PFC MegaPAC 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 fan. The internal housekeeping V_{CC} comes up within 2s after the application of input power. Once the high-voltage bus is within its limits, the AC OK signal asserts to a TTL "1" indicating the input power is OK, and enables the power outputs. An auxiliary V_{CC} output of $5V_{DC}$ sourcing up to 0.3A is provided for peripheral use.

An output Enable / Disable function is provided by using an optocoupler to control the Gate In pins of the ConverterPAC assemblies. If the Enable / Disable control pin is pulled low, the optocoupler turns on, pulling the Gate In pin low and disabling the ConverterPAC output. The nominal delay for an output to come up when measured from release of the Enable / Disable pin is 10 – 15ms. The General Shutdown function controls all outputs simultaneously and works in a similar manner.

The ride-through (hold-up) time is the amount of time the load can be supported before loss of output regulation after the loss of input power. Detecting the loss of input power takes a finite time period after which the AC Power OK signal goes from a TTL "1" to "0." This signal is available for use within 1.2s after initial power up and can be used to indicate an impending loss of power. At least 3ms of warning time is given. Following the loss of input power, the outputs are disabled when the bus voltage drops below its operating threshold.

Figure 1
PFC MegaPAC™ and PFC MegaPAC high-power architecture



Configuring and Reconfiguring MegaPACs

Most ConverterPACs™ of the same length can be inserted into any available slot of a MegaPAC chassis. They can also be easily added, replaced or moved by sliding the assemblies in or out of a MegaPAC chassis. (Currently, two exceptions are the FinPACs™ which can only be used in the high-power chassis and the UniPACs™ which can only be used in the 4kW MegaPAC.) For outputs greater than 200W, a driver ModuPAC and one or more booster ConverterPACs will be used. For outputs greater than 600W, a driver FinPAC and one or more booster ConverterPACs will be used. Arrays of drivers and boosters should be configured so all boosters are placed in the slots to the immediate right of the driver when looking at the output end of the MegaPAC.

Prior to removing or installing ConverterPACs, you must remove power from the MegaPAC and wait five minutes. Failure to do so can result in personal injury or damage to the supply.

Take standard ESD precautions when handling ConverterPACs.

Removing ConverterPACs

ConverterPACs can be removed by loosening the captive screw at the base. Once this screw has been loosened, the ConverterPAC will slide out of the chassis. **Once a ConverterPAC has been removed, the empty slot MUST be filled with either another ConverterPAC or an airblock.** If the slot is left empty, it will provide an airflow escape and cause failure to the power supply.

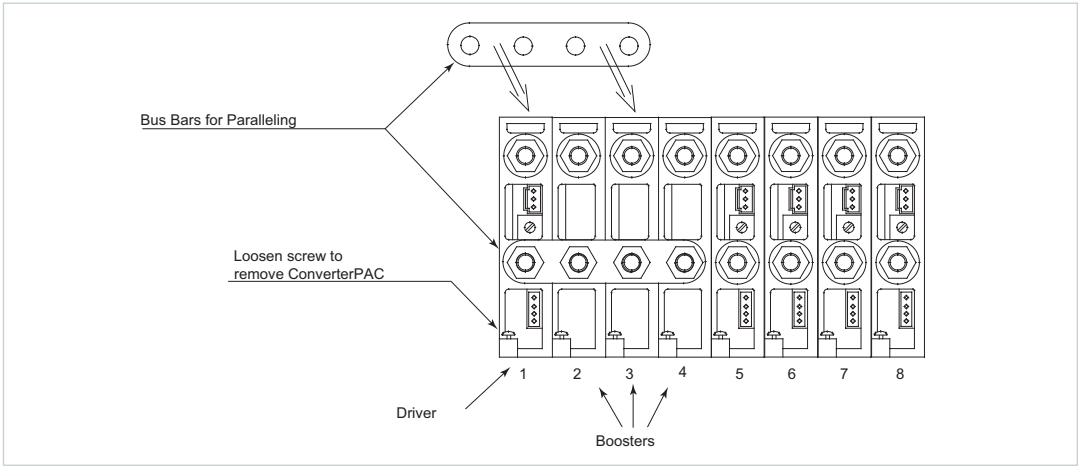
Installing ConverterPACs as Drivers

ConverterPACs can be installed in empty slots by simply sliding in the new ConverterPAC and securing the screw at the base. Torque the retaining screw to 0.23N·m (2lb·in); do not overtighten. Power and interface connections can be made after the ConverterPAC has been installed.

Installing Booster ConverterPACs to Increase Output Power

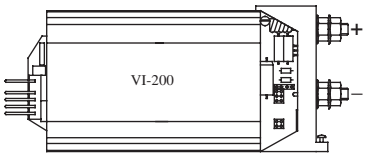
ConverterPACs™ can be paralleled for more power. Additional power to an output is obtained by connecting one or more boosters in parallel with a single driver. The driver can be placed in any open slot. All boosters should be inserted in the slots to the immediate right of the driver as viewed from the output end of the MegaPAC™. Figure 2 shows a driver placed in slots #1 and 3 boosters placed in slots #2 – 4. After inserting the driver and boosters, they are paralleled using bus bars across the positive- and negative-output studs. Drivers should not be paralleled with each other. Bus bars between a driver and booster(s) should never be disconnected. For help in identifying boosters and drivers, refer to the part numbering section on Page 8. Please note that total-output voltage should not exceed the converter baseplate-output isolation rating of 400V. For a detailed guideline on how outputs should be placed in series, please refer to: AN:204 Creating High-Voltge Outputs.

Figure 2
Paralleling ConverterPACs



ConverterPAC Functional Description

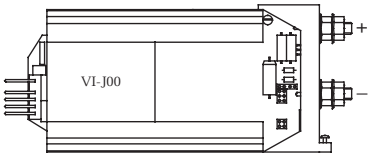
ConverterPACs are the family of slide-in output assemblies used in MegaPAC power supplies. Most ConverterPACs of the same length are interchangeable within a MegaPAC and between different AC input MegaPAC chassis (exceptions are the FinPAC™ and UniPAC™). They can be added, moved or changed as necessary. The following ConverterPACs can be used in the PFC MegaPAC and / or PFC MegaPAC-High Power. Spec sheets for ConverterPACs are available at www.vicorpower.com.



ModuPAC

ModuPAC™

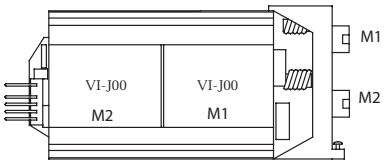
The ModuPAC output assembly consists of a VI-200™ DC-DC converter that converts the high-voltage bus to the desired regulated output voltage. Each ModuPAC can provide up to 200W of power. Multiple ModuPACs can be paralleled in a driver-booster configuration to provide more power. ModuPACs are fused with a PC-Tron, DC-rated, fast-acting fuse. A passive LC filter is used to reduce output ripple / noise down to 1% typical and 2% maximum peak-to-peak from 10% to 100% of rated load. An optional DC Power Good signal or output voltage Trim potentiometer can be specified. The ModuPAC contains overvoltage protection (OVP), overcurrent protection (OCP) and overtemperature limiting (OTL). The OCP has automatic recovery when the overcurrent condition is removed. The OVP and OTL are latching functions and require recycling of the AC input power to restart.



JuniorPAC

JuniorPAC™

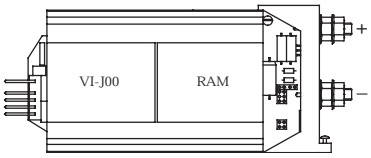
The JuniorPAC consists of a VI-J00™ DC-DC converter that converts the high-voltage bus to the desired regulated output voltage. JuniorPACs can provide up to 100W of output power and are fused with a single PC-Tron, DC-rated, fast-acting fuse. A passive LC filter is used to reduce output ripple / noise down to 1% typical and 2% maximum peak-to-peak from 10% to 100% of rated load. An optional DC Power Good signal or output voltage trim potentiometer can be specified. The JuniorPAC contains output overcurrent protection, which recovers automatically when the overcurrent condition is removed. Overvoltage protection and overtemperature limiting are not available.



DualPAC

DualPAC™

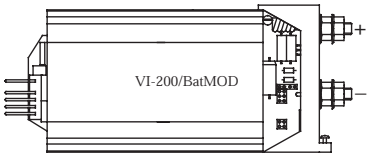
This output assembly consists of two VI-J00 DC-DC converters that convert the high-voltage bus to the desired regulated output voltages as noted above. The outputs are electrically isolated. For detailed pinout description, refer to Page 10.



RamPAC

RamPAC™

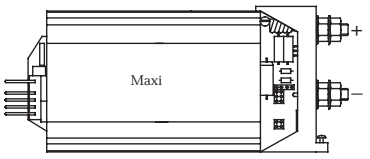
This output assembly consists of a VI-J00 DC-DC converter with a Ripple Attenuator Module (RAM) and is designed for applications requiring low-output ripple / noise. The RamPAC can attenuate the ripple / noise down to 10mV peak-to-peak over a 20MHz bandwidth from 10% to 100% of rated load of the converter. Outputs from 5V to 50V are available.



BatPAC

BatPAC™

The BatPAC output assembly consists of a VI-200 BatMod current source that converts the high-voltage bus to the desired regulated output voltage. The converter is fused with a PC-Tron, DC-rated, fast-acting fuse. The BatPAC is a 200W programmable current source that can be configured as a battery charger. Maximum current and voltage settings are controlled using potentiometers that come as a standard feature, or through Trim pin access as an option. BatPACs are available for 12, 24 and 48V battery systems.



FinPAC

FinPAC™

The FinPAC output assembly consists of a Maxi DC-DC converter that converts the unregulated high-voltage bus to the desired regulated output voltage. Each Maxi module can provide up to 600W of output power. Each FinPAC occupies two slots because it has an extra-large heatsink attached to dissipate the heat generated by this more powerful Maxi converter. Currently, the FinPAC is **ONLY** used in the high-power (MX) chassis. It cannot be used in any other member of the MegaPAC™ Family. Contact Vicor for future updates.

List of ConverterPACs™ used in the PFC MegaPAC™ and PFC MegaPAC High Power and their features							
ConverterPAC	**OVP**	**OCP**	**OTL**	**RS/AS**	**LS/AS**	**PG**	**TrimPot**
ModuPAC™	Std	Std	Std	AS[a]	AS[a]	Opt	Opt
JuniorPAC™	N/A	Std	N/A	AS[a]	AS[a]	Opt	Opt
DualPAC™	N/A	Std	N/A	AS[a]	AS[a]	N/A	Opt
RamPAC™	N/A	Std	N/A	AS[a]	AS[a]	Opt	Opt
BatPAC™	N/A	Std	N/A	N/A	N/A	N/A	Std
FinPAC™[b]	Std	Std	N/A	AS[a]	AS[a]	Opt	Opt

[a] See Pages 12 and 13 for more information on Autosense.
[b] All the above mentioned ConverterPACs can be used in both the PFC MegaPAC and PFC MegaPAC High Power except the FinPAC which currently can only be used in the PFC MegaPAC High Power.
(The UniPAC™ (not listed above) cannot be used either in the PFC MegaPAC or the PFC MegaPAC High Power. Currently, the UniPAC is only used in the 4kW MegaPAC).

Note: All ConverterPACs mentioned above can be paralleled when properly configured, EXCEPT the DualPAC, JuniorPAC and RamPAC.

Part Numbering

PFC MegaPAC **mpaa-7bcccc-v-xx**

m = M or W

p = p for standard chassis **p** = X for high power chassis

aa = number of outputs

b = number of DC-DC modules

cccc = customer specific configuration code

v = optional revision code and may be blank (Note: v = G for RoHS compatible product)

xx = additional option codes
(Note: **xx** = MI for rugged chassis, = MC for rugged chassis with conformal coating)

ConverterPAC **Xx_DV/x_EAx_F**

X = ConverterPAC type (For RoHS, add G to current prefix)

x_D = Voltage out

x_E = Current out (rounded to one decimal point)

x_F = Can be multiple options (see Page 9)

ConverterPAC™ options

B	Booster module	**S**	Trimpot removed for external BatPAC™ adjustment
D	DC OK or Power Good [c]	**T**	90 – 110% output adjustment [f]
F	Full 50 – 110% output adjustment [d]	**T1**	90 – 107.5% output adjustment
F1	50 – 107.5% output adjustment	**T2**	90 – 105% output adjustment
F2	50 – 105% output adjustment	**T3**	90 – 102.5% output adjustment
F3	50 – 102.5% output adjustment	**T4**	90 – 100% output adjustment
F4	50 – 100% output adjustment	**T5**	98 – 105% output adjustment
F5	60 – 110% output adjustment	**T6**	100 – 110% output adjustment
F6	70 – 110% output adjustment	**V1**	"VXI" low noise (150mV or less) $15V < V_{OUT} \leq 24V$ [g]
F7	80 – 110% output adjustment	**V2**	"VXI" low noise (50mV or less) $V_{OUT} \leq 15V_{DC}$
I	Industrial Grade module	**V3**	"VXI" low noise (1% ripple or less) $V_{OUT} > 24V$
K	Custom SRF module used		
P	Preload		
M	Military Grade module		
R	RAM external [e]		

Examples:

M15V/10A, M15V/10ADFI, D15V/6.7A-12V/8.3AT

M = ModuPAC™ (RoHS =GM)

R = RamPAC™ (RoHS = GR)

D = DualPAC™ (RoHS = GD)

B = BatPAC (RoHS = GB)

J = JuniorPAC™ (RoHS = GJ)

PZ = PZ - FinPAC™ (RoHS = GPZ)

[c] **D option:** Optional for all ConverterPACs EXCEPT the DualPAC, BatPAC and RamPAC.

[d] **F options:** Optional for all ConverterPACs EXCEPT the BatPAC and DualQPAC. Trim range dependent on module type and voltage.

[e] **R option:** When using an external RAM, components such as autosense resistors and local-sense jumpers must be removed before turning on the supply. In addition, in order to insure proper operation, sense pins must be connected either locally or remotely after the RAM's output. For further information, contact Applications Engineering.

[f] **T options:** Optional for all ConverterPACs EXCEPT the BatPAC and DualQPAC. Trim Range dependent on module type and voltage

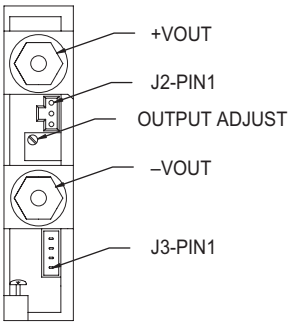
[g] **V options:** Optional ONLY on the ModuPAC, DualPAC and JuniorPAC. N/A on all other ConverterPACs. **Requires 15% minimum load.**

ConverterPAC™ Output and Connector Pin Identification for the PFC MegaPAC™

ModuPAC™

JuniorPAC™

RamPAC™



J2 (REMOTE SENSE)

1	TRIM PIN ACCESS
2	+SENSE
3	–SENSE

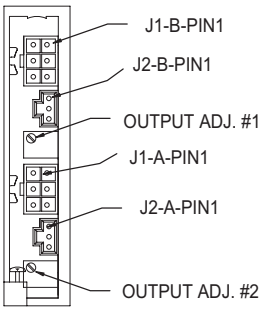
MATING HDWR:
HOUSING- MOLEX P/N: 50-57-9403
TERMINALS- MOLEX P/N: 16-02-0103
CRIMP TOOL MOLEX P/N: 63811-8700

J3 DC OK (POWER GOOD)

4	VCC IN
3	POWER GOOD
2	POWER GOOD INVERTED
1	SIGNAL GROUND

MATING HDWR:
HOUSING- MOLEX P/N: 50-37-5043
TERMINALS- MOLEX P/N: 08-70-1040
CRIMP TOOL MOLEX P/N: 63811-5200

DualPAC™



J1 (OUTPUT CONNECTORS)

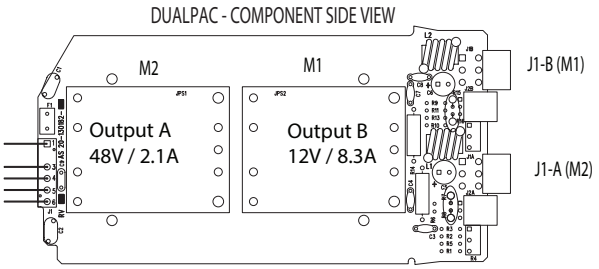
4	1	1 AND 4 +VOUT
5	2	2 AND 5 –VOUT
6	3	3 +R/SENSE 6 –R/SENSE

MATING HDWR:
HOUSING- MOLEX P/N: 39-01-2060
TERMINALS- MOLEX P/N: 39-00-0039
CRIMP TOOL MOLEX P/N: 11-01-0197

J2 (REMOTE SENSE)

1	TRIM PIN ACCESS
2	+SENSE
3	–SENSE

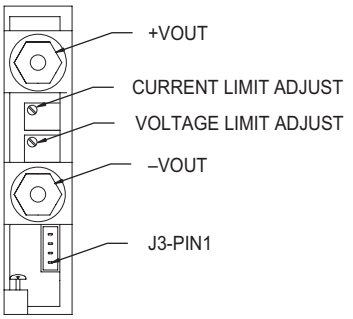
MATING HDWR:
HOUSING- MOLEX P/N: 50-57-9403
TERMINALS- MOLEX P/N: 16-02-0103
CRIMP TOOL MOLEX P/N: 63811-8700



Example: D12V / 8.3A – 48V / 2.1A

Notes:
1. All ConverterPACs except the FinPAC™ occupy one slot. The FinPAC occupies two slots.
2. New output studs were installed on the ConverterPACs and are 1/8th inch longer.
   Refer to Page 24 for more information.

BatPAC™

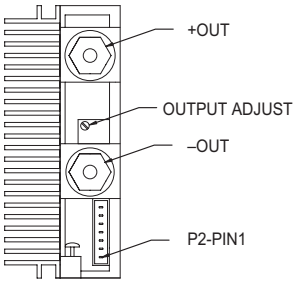


J2 (BATPAC REMOTE INTERFACE)

4	CURRENT LIMIT ADJUST
3	VOLTAGE LIMIT ADJUST
2	CURRENT MONITOR
1	–VOUT

MATING HDWR:
HOUSING- MOLEX P/N: 50-37-5043
TERMINALS- MOLEX P/N: 08-70-1040
CRIMP TOOL MOLEX P/N: 63811-5200

FinPAC™



P2 REMOTE SENSE TRIM/SC & POWER GOOD

7	+SENSE
6	–SENSE
5	TRIM
4	VCC IN
3	POWER GOOD
2	POWER GOOD INVERTED
1	SIGNAL GROUND

MATING HDWR:
HOUSING- MOLEX P/N: 50-37-5073
TERMINALS- MOLEX P/N: 08-70-1040
CRIMP TOOL MOLEX P/N: 63811-5200

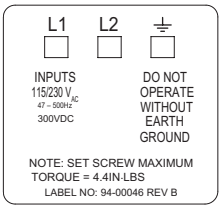
Notes:
1. All ConverterPACs™ except the FinPAC occupy one slot. The FinPAC occupies two slots.
2. New output studs were installed on the ConverterPACs and are 1/8th inch longer.
   Refer to Page 24 for more information.

PFC MegaPAC™ Quick Install Instructions

(For Mechanical Drawing, see Page 15)

Mounting the PFC MegaPAC and PFC MegaPAC High Power

- Mount the power supply on any of its four sides.
- Use #8-32 or 4mm mounting screws. Do not exceed a maximum penetration of 0.15in [3,8mm]. The maximum allowable torque is 5.5lb·in.
- Maintain 2in [5,1cm] clearance at either end for airflow.



Input Panel Connectors

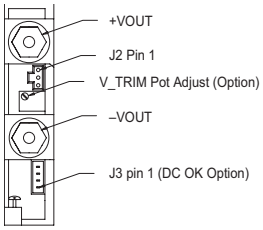
Input Connections

Input Power J9

- Apply input AC power to terminal block J9 using a pressure screw terminal.
- Strip length of AC power conductors to be 0.35in.
- Maximum torque is 4.4lb·in.
- Place a fuse or circuit breaker in the input line for safety reasons.
- Use a maximum wire size of 14AWG with soldered terminals.
- The connector manufacturer recommends the wires not be tinned. A ferrule (Phoenix P/N 32-00-58-0, purchased from other sources) can be used to prevent fraying.

Output Connections

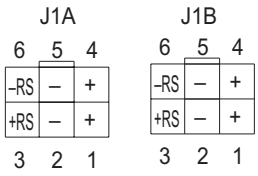
Power Connections



Single Output ModuPAC™

Installing ring lugs and / or bus bars on output studs:

- The upper stud is Positive and the lower stud is the return.
- Newer outputs studs are 1/8th inch longer. See Page 24 for more information.
- Remove nut.
- Place ring lug over output stud.
- Replace and tighten outer nut to a maximum torque of **45lb·in. Do Not Overtighten nuts.**
- Verify all output nuts are properly installed before turning on supply.



DualPAC™ Output Connector

Installing power connectors on DualPACs (J1A and J1B):

- Use Molex mating receptacle #39-01-2060 with #39-00-0039 terminals provided.
- Pins 1 and 4 are positive, while pins 2 and 5 are the return.
- Attach terminals to 18-24AWG stranded wire using Molex tool #11-01-0197.

Sense Connections

Note: Newer power supplies have the Autosense feature. For these units, if Remote Sense connections are not made or needed, no Local Sense selection is necessary - simply connect the output to the load and the unit will automatically operate in Local Sense. If Remote Sense connections are made, the unit will operate in a Remote Sense mode. Remote Sense terminals should be terminated to their respective output i.e., –RS to –Output and +RS to +Output. See Page 13 for more information on Autosense.
For units without Autosense, sense connections must ALWAYS be made. Not connecting sense lines to their respective output can cause failure to the unit.

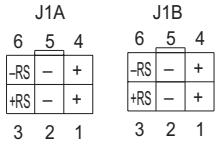
J2 Sense Connector



J2	Pin
1	J2-1 Trim Pin Access
2	J2-2 +Sense
3	J3-3 –Sense

P2 Sense Connector

7	+SENSE
6	–SENSE
5	TRIM
4	VCC IN
3	POWER GOOD
2	POWER GOOD INVERTED
1	SIGNAL GROUND



DualPAC Output Connector

Sense Connector J2 (and P2 for the FinPAC™):

- Sense connections do not have to be made if the Local Sense option was ordered or if Autosense is present (see previous note on Autosense).
- Use Molex mating receptacle #50-57-9403 with #16-02-0103 terminals provided.
- J2-2 is the +Sense and J2-3 is the –Sense.
- Attach terminals to 22-24AWG twisted pair wire using Molex tool #63811-8700.
- Attach opposite ends of Sense lines to point where regulation is desired.
- Verify that Sense lines are not cross-connected before applying input power.
- For the FinPAC, P2-7 is the +Sense and P2-6 is the –Sense.
- Use Molex mating receptacle #50-37-5073 with #08-70-1040 terminals provided.
- Attach terminals to 22-28AWG stranded wire using Molex tool #63811-5200.

Sense Connections on DualPACs™:

- Sense connections do not have to be made either if the Local Sense option has been ordered or Autosense is present (refer to previous note on Autosense).
- Sense connections are available on the J2 connector (P2 for the FinPAC) or the J1A and J1B connectors.
- If using J2 or P2 connector, see instructions on Pages 10 and 11.
- On J1A and J1B, Pin 3 is the +Sense and Pin 6 is the –Sense.
- Use Molex mating receptacle #39-01-2060 with #39-00-0039 terminals provided.
- Attach terminals to 18-24AWG twisted pair wire using Molex tool #11-01-0197.
- Verify that Sense lines are not cross-connected before applying input power.

J2 Trim Pin Connector



J2	Pin
1	J2-1 Trim Pin Access
2	J2-2 +Sense
3	J3-3 –Sense

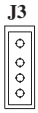
P2 Trim Pin Connector

7	+SENSE
6	–SENSE
5	TRIM
4	VCC IN
3	POWER GOOD
2	POWER GOOD INVERTED
1	SIGNAL GROUND

Trim Pin Connection J2 (and P2 for FinPAC)

- The Trim J2 connection should only be made if the Trim option has not been installed. (A "T" or an "F" in the ConverterPAC™ part number means the Trim option is installed; e.g., M5V/40AT.)
- Use Molex mating receptacle #50-57-9403 with #16-02-0103 terminals provided.
- Attach terminals to 22-24AWG stranded wire using Molex tool #63811-8700.
- J2-1 provides Trim access.
- For the FinPAC, refer to P2 Connector. P2-5 provides trim access.
- Use Molex mating receptacle #50-37-5073 with #08-70-1040 terminals provided.
- Attach terminals to 22-28AWG stranded wire using Molex tool #63811-5200.

DC OK (Power Good)



J3	Pin	
4	J3-4	VCC
3	J3-3	Power Good
2	J3-2	Power Good Inverted
1	J3-1	Signal Ground

P2 DC OK Connector

7	+SENSE
6	–SENSE
5	TRIM
4	VCC IN
3	POWER GOOD
2	POWER GOOD INVERTED
1	SIGNAL GROUND

J10



J10 INTERFACE

J10-1	E/D-1	J10-7	E/D-7
J10-2	E/D-2	J10-8	E/D-8
J10-3	E/D-3	J10-9	VCC + 5V, 0.3A
J10-4	E/D-4	J10-10	SIGNAL GROUND
J10-5	E/D-5	J10-11	AC POWER OK
J10-6	E/D-6	J10-12	GEN SHUTDOWN

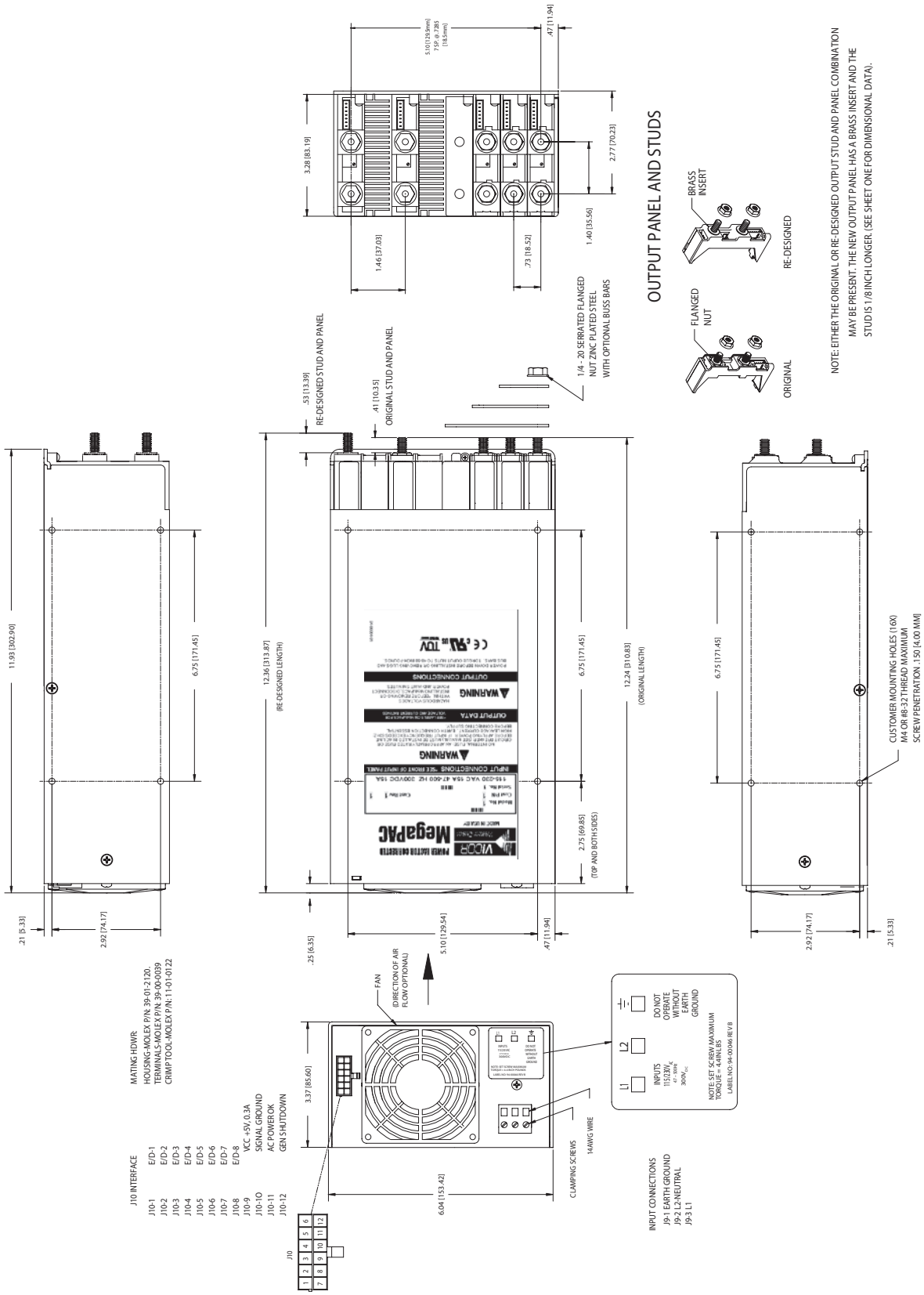
DC OK (Power Good) Connection J3 (and P2 for FinPAC™)

- DC OK is only available as an option and is not always present.
- J3-4 is VCC IN, J3-3 is Power Good, J3-2 is Power Good inverted, and J3-1 is Signal Ground.
- Use Molex mating receptacle #50-37-5043 with #08-70-1040 terminals provided.
- Attach terminals to 22-28AWG stranded wire using Molex tool #63811-5200.
- For the FinPAC, refer to the P2 Connector. P2-3 is Power Good.
- Use Molex mating receptacle #50-37-5073 with #08-70-1040 terminals provided.
- Attach terminals to 22-28AWG stranded wire using Molex tool #63811-5200.

Interface Connections J10

- Use Molex mating receptacle #39-01-2120 with #39-00-0039 terminals provided.
- J10-1 to 8 are Enable/Disable for slots 1 – 8.
- J10-9 is VCC, J10-10 is Signal Ground, J10-11 is AC Power OK, and J10-12 is General Shutdown.
- Attach terminals to 18-24AWG stranded wire using Molex tool #11-01-0197.

PFC MegaPAC™ Mechanical Drawing



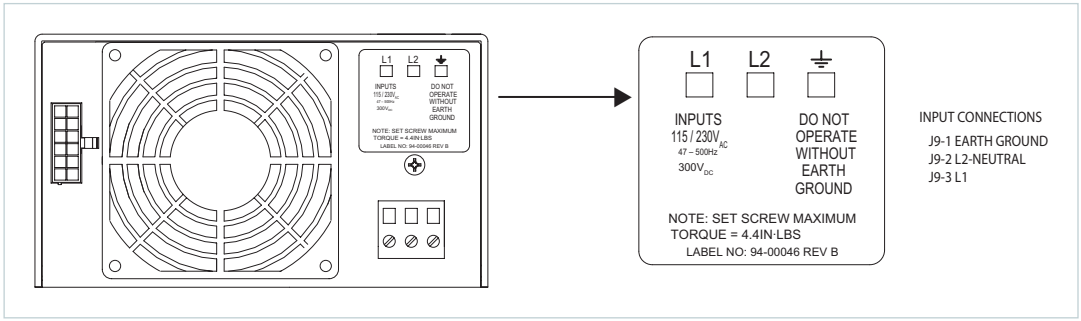
Interface Connections

Chassis Input Power Terminals (J9)

Input AC power is applied to terminal block J9 using a pressure screw terminal that accepts a maximum wire size of 14AWG. The insulation should be stripped 0.35in and the maximum torque applied to the screws should not exceed 4.4lb·in. The connector manufacturer recommends the wires not be tinned. A ferrule (Phoenix P/N 32-00-58-0, purchased from other sources) can be used to prevent fraying. J9-1 (GND) is Earth Ground for safety; J9-2 (L2) and J9-3 (L1) are the other hot connections. For Input DC power, L2 is (+) and L1 is (–).

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 $25A_{PK}$ at $115V_{RMS}$ and $230V_{RMS}$.

Figure 3
Input panel connectors



Output Power Connections (+P, –P for Single Output, or J1A / J1B for Dual Outputs)

For single output ConverterPACs™, these terminals are two 1/4-20 plated steel studs. The upper stud is positive with respect to the lower stud. For dual output ConverterPACs, there is a 6-pin Molex connector for each output. J1A pins 1 and 4 are the +Output, and J1A pins 2 and 5 are the –Output. Pins 3 and 6 are duplicates of the Remote Sense terminals present on J2A and J2B. Use appropriate wire size rated to handle the full output current, including short-circuit levels. Avoid large current loops in output cables; run power and return cables next to one another to minimize inductive effects. All outputs are isolated and can provide positive or negative outputs.

Output +/–Sense Connections –J2 for Single Output, or J1A / J1B for Dual Outputs

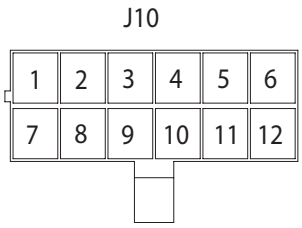
Newer power supplies may have some outputs configured with the Autosense feature that automatically locally senses the output if Remote Sense is not used. To check if an output has the Autosense feature, measure the impedance from the +Out to +Sense and –Out to –Sense pins. If the impedance is 5Ω, then the output has Autosense and does not require local-sense jumpers.

If units do not have Autosense, sense connections must be made. When making sense connections, keep in mind that although all outputs are open-sense protected, the +/–Sense terminals must be connected to their respective outputs before the PFC MegaPAC™ and PFC MegaPAC High Power are powered up. Regardless of the output polarity configured, the +Sense should always connect to the +Power output. The –Sense connects to the –Power output. Sense connections are not required on booster ConverterPACs, BatPACs™, or if the Local Sense option is specified. Local Sense mode means that the Remote Sense lines are not connected. Sense pins can be accessed on J1A / J1B or J2A / J2B on dual output units.

Signal Ground (J10-10)

Signal Ground (see Figure 4 and Connector Pin Identification below) is an isolated ground reference for all J10 interfacing signals and can be used for ConverterPAC™ output status signals such as Power Good. This is not the same as Earth Ground on input power connector J9.

Figure 4
Interface connector

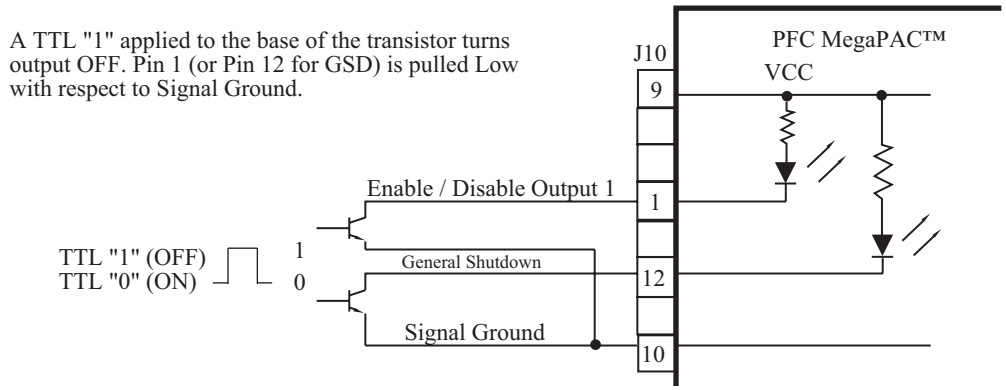


J10-1	E/D-1	J10-7	E/D-7
J10-2	E/D-2	J10-8	E/D-8
J10-3	E/D-3	J10-9	VCC + 5V, 0.3A
J10-4	E/D-4	J10-10	SIGNAL GROUND
J10-5	E/D-5	J10-11	AC POWER OK
J10-6	E/D-6	J10-12	GEN SHUTDOWN

Enable / Disable (J10-1 to J10-8)

The Enable / Disable control pins allow ConverterPAC outputs to be sequenced either on or off. J10-1 through J10-8 are the control pins for output positions 1 through 8, respectively (see Figure 4 and Connector Pin Identification above). For DualPACs™, all outputs are sequenced. In parallel array using VI / VE modules only the driver ConverterPAC need be controlled. The Enable / Disable pins should be pulled low to less than 0.7V with respect to Signal Ground to disable the outputs. They will sink 10mA maximum. These pins should be open circuited or allowed to exceed 4.5V when enabled. Do not apply more than 6V to these inputs at any time. If driven from an electromechanical switch or relay, a capacitor should be connected to eliminate the effects of switch bounce.

Figure 5
Enable / disable and general shutdown



Enable / Disable Control of Maxi, Mini, Micro Module Arrays

When using the Enable / Disable function on an output that consists of two or more Maxi modules, it is necessary to connect the E/D pins of the corresponding module locations together such that both modules are commanded to turn ON or OFF simultaneously.

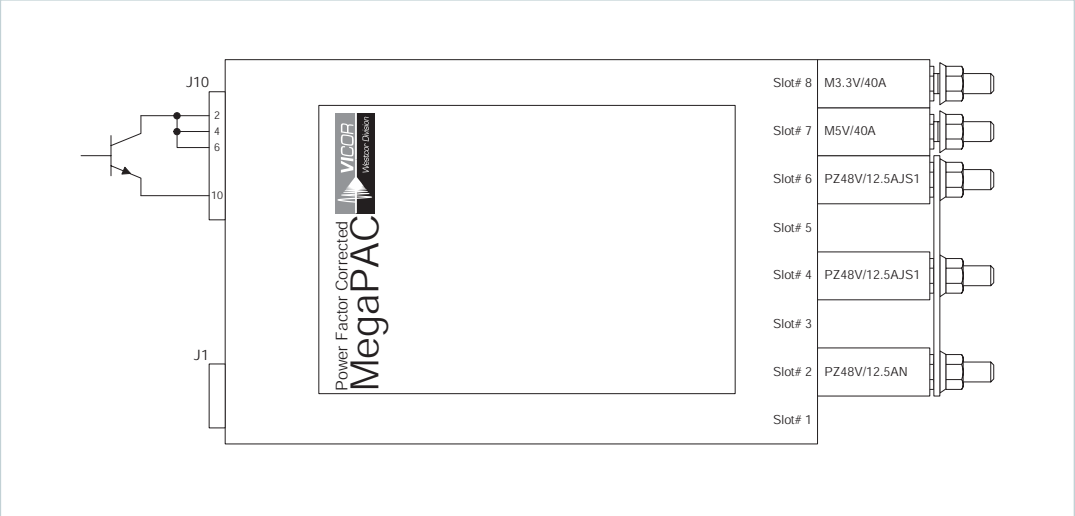
Example:

Slots 2, 4 and 6 have been configured as a single-output parallel array (see Figure 6).

In order to disable the 48V output, E/D 2, E/D 4 and E/D 6 should be shorted together as shown in Figure 6. With E/Ds connected together, a single switch can then be used to remotely enable and disable the output.

Note: For single output power supply configurations, the simplest method of remotely enabling and disabling the output is to use the General Shutdown (GSD) function.

Figure 6
Enable / disable control of Maxi Arrays



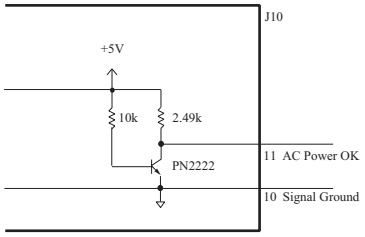
General Shutdown / GSD (J10-12)

The GSD control pin on J10-12 allows simultaneous shutdown of all ConverterPAC™ outputs (see Connector Pin Identification on Page 17). This pin must be pulled down to less than 0.7V and will sink 13mA 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 6V to this input at any time. Normal open circuit voltage is 1.5 – 3V with respect to Signal Ground. If driven from an electromechanical switch or relay, a capacitor should be connected to eliminate the effects of switch bounce.

AC OK / Power Fail (J10-11)

This is an active high TTL compatible signal and provides a status indication of the AC input power (see Figure 7 and Connector Pin Identification on Page 17). It is capable of sourcing 0.5mA at >3.2V and sink 16mA at <0.5V. This signal switches to a TTL "1" when the high-voltage bus exceeds low-line condition during turn-on, and switches to a TTL "0" 3ms (minimum) before loss of output regulation due to the loss of input AC power. This signal can be used to warn external control circuits of an impending loss of power.

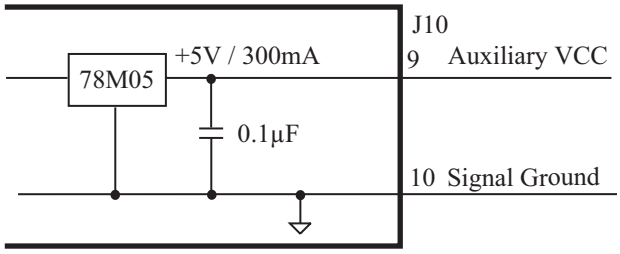
Figure 7
AC OK power fail



Auxiliary VCC +5V/0.3A (J10-9)

The VCC on J10-9 is an auxiliary 5V regulated power source (see Figure 8 and Connector Pin Identification on Page 17). It is +5V_{DC} ±5% with respect to Signal Ground and can supply 300mA maximum. It is short-circuit-proof, but if shorted all outputs will shut down through the Enable / Disable circuitry. The Auxiliary VCC typically powers user circuitry or is used with the Power Good circuitry to provide a pull-up reference for the outputs of the DC Power Good circuit on a ConverterPAC™. If used for this purpose, the Signal Ground on J10-10 must also be connected to the J3-1 Signal Ground pin of the ConverterPAC.

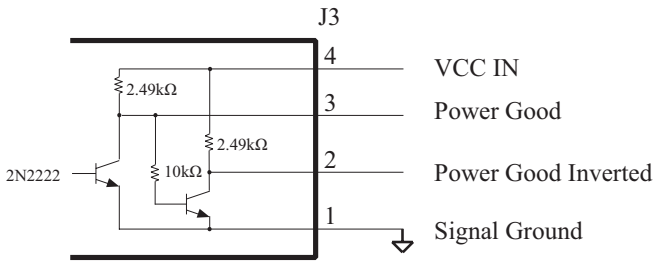
Figure 8
Auxiliary VCC



Power Good (J3-3)

The optional Power Good signal on J3-3 is referenced to Signal Ground on J3-1 and indicates the status of the output voltage. This signal is asserted a TTL "1" when the output voltage is above 95% of nominal. It is a TTL "0" when the output voltage is below 85% of nominal. If the Trim option is also used, the Power Good trip points DO NOT track with the trimmed voltage. It is possible to trim the output below the fixed setpoints of the Power Good circuit and cause a negative Power Good signal.

Figure 9
Power Good and VCC



Power Good Inverted (J3-2)

This is the inverse of the Power Good signal and is referenced to Signal Ground on J3-1.

Signal Ground (J3-1)

Signal Ground on J3-1 is an isolated secondary ground reference for J3 status signals. It is used to provide a reference point for the Power Good circuitry and is not the same as Earth Ground on input power connector J9.

VCC IN (J3-4)

The VCC In on J3-4 is an input that requires +5V either from the J10 Auxiliary VCC, or from another source. Input current to this pin is limited by an internal resistor to 3mA. If the J10 Auxiliary VCC is connected to VCC IN on J3-4, then the J10 Signal Ground must be connected to Signal Ground on J3-1.

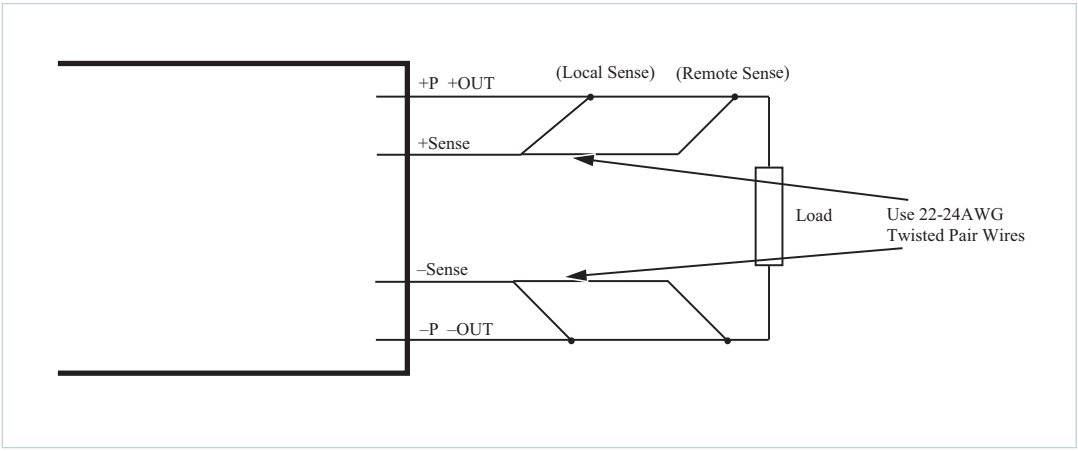
+Sense / –Sense - J2-2 and J2-3 (See Pages 12 and 13 for information on Autosense)

The +Sense on J2-2 should be connected to the +Power Out, and the –Sense on J2-3 to the –Power Out terminal. Do not reverse or leave the Sense pins open. Sense pins can be terminated locally at the output of the power supply, in which case the power supply will provide regulation 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, this termination should be made close to the output load. Compensation of up to 0.5V (0.25V per lead) can be obtained. Use twisted pair 22-24AWG wire for this purpose.

For DualPACs, the +Sense pins are available on connectors designated as J2A-2 and J2B-2 for outputs A and B, respectively. –Sense pins are on J2A-3 and J2B-3, respectively. These pins are also duplicated on the power connectors J1A and J1B.

Reminder: Only units with Autosense will automatically operate in Local Sense mode if no sense connections are made. It will operate in Remote Sense mode if Remote Sense connections are made. Units without Autosense MUST have sense connections (local or remote) terminated to their respective output for the unit to operate properly.

Figure 10
Sense leads



External Trim (J2-1)

Output voltage can be trimmed using an optional factory-installed Trim potentiometer or with the Trim pin (see Figure 11). The Trim potentiometer is located on the ConverterPAC™. If the Trim potentiometer has not been ordered, the Trim pin must be used. When using the Trim pin, the Trim limits are determined by the DC-DC converter used on the ConverterPAC. Maximum Trim ranges are 10% above the nominal converter voltage and 50% below the nominal converter voltage (except 10, 12 and 15V outputs which are 10% below nominal) as measured from the output studs or output connector of the power supply.

Note: The combined effects of module trim up, Remote Sense and dynamic load step may cause the module to trip OVP. (See Page 3 for information on restart).

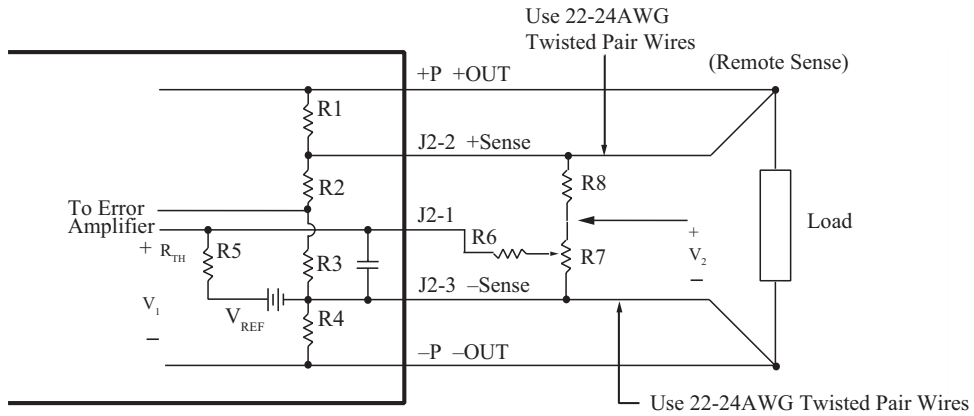
The Trim pin on J2 can be used to control the output voltage. It is referenced to the –Sense pin on J2 and can be controlled by either a resistor network or an external voltage source. To increase an output voltage above its nominal, it is necessary to increase the voltage at the Trim pin above the internal reference voltage (V_{REF}). The reverse is true to decrease an output voltage.

Note: Converters are sometimes pre-trimmed at the factory if a nonstandard output voltage is requested. Standard voltages include 2, 3.3, 5, 10, 12, 15, 24, 28 and 48V. If using a nonstandard voltage, or if a ConverterPAC is ordered with a Trim option, the resistor calculations will differ from those on Page 22. Please consult the factory for assistance.

Table 1
Module internal reference voltages and Thevenin resistances

Output Module	V_{REF}	R_{TH}
VI-200™ / VI-J00™ ≥3.3V	2.50V	10.0kW
VI-200 VI-J00 <3.3V	0.97V	3.88kW
Maxi / Mini / Micro (Pre-Defined)	1.23V	1.0kW
Maxi / Mini / Micro (User-Defined)	1.23V	Consult Factory

Figure 11
External trim



Example:

±10% Trim adjust on a 12V nominal output.

Figure 11 shows a typical variable Trim circuit. Using a 10kΩ trimpot (R7), the resistor values for R6 and R8 can be calculated as follows:

$\mathbf{V_1} = V_{REF} + 10\% = 2.75V$ Given: $V_{REF} = 2.5V$ (see Table 1)

$\mathbf{I_{R5}} = (2.75V - V_{REF})/R_{TH} = (2.75V - 2.5V) / 10kW = 25mA$

Setting the bottom limit:

$\mathbf{V_{R6}} = 2.5V - 10\% = 2.25V$

And since $I_{R5} = I_{R6} = 25mA$,

$\mathbf{R6} = V_{R6} / I_{R6} = 2.25V / 25mA = 90kW$

$\mathbf{V_2} = V_1 + V_{R6} = 2.75V + 2.25V = 5V$

$\mathbf{I_{R7}} = V_2 / R_7 = 5V / 10kW = 500mA$

$\mathbf{I_{R8}} = I_{R7} + I_{R6} = 525mA$

$\mathbf{V_{R8}} = (V_{NOM} + 10\%) - V_2 = 13.2V - 5V = 8.2V$ Given: $V_{NOM} = 12V$

$\mathbf{R8} = V_{R8} / I_{R8} = 8.2V / 525mA = 15.62kW$

Using the above resistor combination, a 12V output can be trimmed externally up to 13.2V and down to 10.8V. For further information on external trimming, refer to Chapter 5 of the Applications Design Guide or consult the factory for assistance.

CONSULT APPLICATIONS ENGINEERING WHEN TRIMMING OUTPUTS BELOW 5V.

Specifications

Input Characterisitcs		
Input Voltage	85 – 264V_{AC}, 47 – 500Hz 100 – 380V_{DC}	
Power Factor	0.99 at 115V_{AC} ; 0.95 at 230V_{AC} - both at full load (47 – 63Hz)	
Inrush Current	25A_{PK} at 115V_{RMS} and 230V_{RMS}	
Ride-Through Time	>20ms at nominal line, full load	
Power Fail	>3ms warning	
Conducted EMI	FCC Class A; EN55022 Class A (Certain configurations meet B. Contact Factory) Mil-STD 461 CE 101 and 102 require external filtering	
Surge Immunity	EN 61000-4-5 Installation Class 3, Performance Criteria B (Temporary loss of output power may occur which is self recoverable)	
Dielectric Withstand	Primary to Chassis GND = 2,121V_{DC} Primary to Secondary = 4,242V_{DC} Secondary to Chassis GND = 750V_{DC}	
Overvoltage and Transients	Per Mil-STD 704 and 1399 (MI rugged chassis only)	
Ouput Characterisitcs		
Line/Load Regulation	Ist Gen: ±0.2% max.10% to full load ±0.5% max. No load to 10% load	
Line Regulation[h]	Maxi: ± 0.20% max. to 0.3% max LL to HL, Full Load	
Load Regulation[h]	Maxi: ± 0.1% No load to full load	
VI-200™ / VI-J00™ Set Point Accuracy[h]	1% for standard voltages; 2% for special or adjustable voltages	
Maxi Set Point Accuracy	1% for standard voltages; 2% for special, adjustable voltages and 48V_{DC} outputs	
Ripple and Noise	Std. outputs: 2% or 100mV_{P-P}, whichever is greater, 75% min. load; VXI options: V1 = (150mV_{P-P} or less) 15V < V_{OUT} < 24V outputs V2 = (50mV_{P-P} or less) V_{OUT} < 15V_{DC} V3 = (1% ripple or less) V_{OUT} > 24V (VXI options require 15% minimum load) RamPAC™: 10mV_{P-P} or 0.15% whichever is greater	
External Output Trim Range (Using Trim/Sc pin)	10 – 110% of nominal voltage Maxi modules 50 – 110% of nominal voltage VI-200 / VI-J00 modules 90 – 110% of nominal voltage VI-200 / VI-J00 modules 10 – 15V	
Overcurrent Trip Point	105 – 125% of full load capability of VI-200 / VI-J00 modules 115% typical of full load capability of Maxi modules	
Overvoltage Protection	115 – 135% on VI-200 and Maxi modules only	
Efficiency	80% typical	
Output Power	**MP Prefix**	**MX Prefix**
	1,600W at 230V_{AC}	2,400W at 230V_{AC}
	1,200W at 115V_{AC+}	1,200W at 115V_{AC+}

[h] Not to exceed an input current of 15A.

Environmental Characteristics		
Storage Temperature	–40 to 85°C	
Altitude	De-rate 2.6% total output power for each 1,000ft to a maximum operating altitude of 15,000ft. Non-operating storage maximum altitude is 40,000ft.	
Operating Temperature[i]	–20 to 40°C full power; –20 to 60°C half power –40°C optional with rugged chassis (–MI or –MC suffix)	
Shock and Vibration	Mil-STD 810 (MI rugged chassis ONLY)	
Humidity	0 – 95% non-condensing	
Safety Agency Approvals	cURus – UL 60950-1, CSA 60950-1 cTÜVus – EN 60950-1, UL 60950-1, CSA 60950-1 CE Mark – Low Voltage Directive, 73/23/EEC amended by 93/68/EEC Note: Some MI chassis will not carry all safety approvals	
Product Weights (fully configured)	**MP or WP Chassis**	**MX or WX Chassis**
	9.75lbs [4,42kgs]	10lbs [4,54kgs]
Warranty	2 year limited warranty See www.vicorpower.com for complete warranty statement.	

See Vicor module specifications. A preload may be necessary for modules trimmed down below 90% of normal output voltage.

[i] The maximum operating temperature is 40°C. If using a VI-200™ with output voltage less than 12V and more than 150W, the operating temperature decreases to 35°C. This also applies when using a FinPAC™ with output voltage less than 24V and more than 500W.

Output Studs

New, more robust output studs (with a 3 to 1 safety margin at 45in·lbs) were installed in ConverterPACs™, the slide-in assemblies used in the MegaPAC™ Family. These new outputs studs are 1/8" longer to allow for multiple lugs. They are fully compatible with the original flanged nut ConverterPACs for use in parallel arrays.

Other advantages include:

- Inner nut (that might become loose) replaced by a brass insert
- Stronger connection to the PCB
- Improved conductivity (less voltage drop and heating)
- Both the stud and panel are less likely to break due to over torqueing

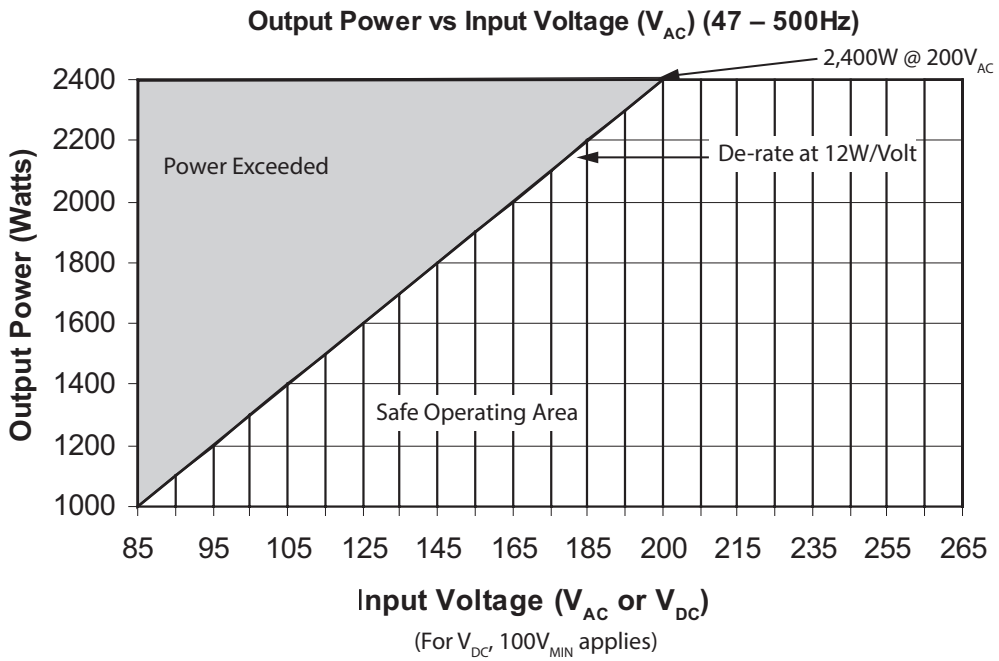
Shown below are the original and redesigned studs.



Original Redesigned

Refer to Page 15 for dimensional data.

PFC MegaPAC™ Output Power De-Rating



PFC MegaPAC Connector Kit (43075) Listing

Item	Qty	Description	Vendor #1	Part #
1	1	HOUSING 12 POS.165 CTR W/LATCH	MOLEX	39-01-2120
2	12	TERMINAL FEM CRIMP 18 – 24AWG TIN	MOLEX	39-00-0039
**		CRIMP TOOL FOR ITEM 2	MOLEX	11-01-0197
3	8	HOUSING 7 POS.098 CTR L/PROFILE	MOLEX	50-37-5073
4	8	HOUSING 4 POS.098 CTR L/PROFILE	MOLEX	50-37-5043
5	94	TERMINAL FEM CRIMP 22 – 18AWG PH/BRNZ	MOLEX	08-70-1040
**		CRIMP TOOL FOR ITEMS 3 & 4	MOLEX	63811-5200
6	8	HOUSING 3 POS.1 CTRS W/LATCH	MOLEX	50-57-9403
7	27	TERMINAL FEM CRIMP 22 – 24AWG SEL/GLD	MOLEX	16-02-0103
**		CRIMP TOOL FOR ITEM 7	MOLEX	63811-8700

** ITEMS FOR REFERENCE ONLY (NOT INCLUDED IN KIT)

Current Share Boards - Optional Feature

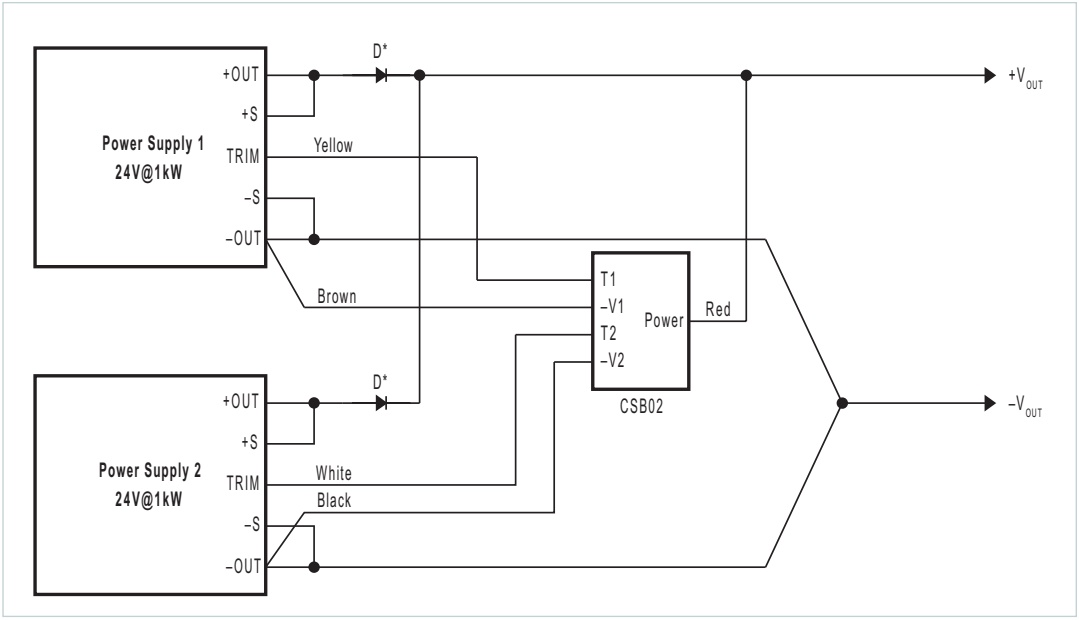
"Current sharing" also known as Load Sharing, is the ability to divide the output current evenly across all active power supplies. This greatly reduces stresses on each power supply and allows them to run cooler, resulting in higher reliability. Standard "current sharing" techniques typically utilize shunt resistors or Hall-Effect devices to measure the current from each power supply. Power shunt resistors continually dissipate power and require cooling especially when dealing with high-output currents of >100A. Hall-Effect devices measure magnetic fields generated by current flowing through a conductor and, although they dissipate no power, they tend to be large and expensive.

First developed by Vicor Engineering for paralleling MegaPAC™ supplies, the box-to-box Current Share Board or CSB allows two or more Vicor power supplies to current share by utilizing the inherent voltage drop produced in the negative output return cable. This eliminates the need for additional shunt resistors or expensive Hall-Effect devices and provides a simple five-wire connection method to achieve a ±1mV accuracy between the Negative Output power rails. This accuracy translates to a 1% current sharing if there is a total of 100mV conductional voltage drop in the negative return path.

Constructed as a current source to drive the Trim pin of a Vicor module, the design uses an accurate comparator circuit to monitor the power returns. In addition, the circuit is unidirectional and can only trim an output voltage up. The benefit is that only the supply that is supporting less current is adjusted up. This action balances the currents to the load by matching the output voltages of the supplies. In the case of one supply failing, the circuit will attempt to trim the failed supply only. This will leave the remaining functional supply alone to provide power to the load at its nominal voltage. Thus the circuit also offers simple redundancy. In addition, because CSB functions as a current source, the Trim outputs (T1 and T2) of the CSB can be placed in parallel to create a summing node. This allows current sharing between more than two supplies by paralleling the T2 output of one CSB circuit with the T1 output of the next CSB.

Please note: The CSB is not intended for use in Hot-Swap Applications.

Figure 12
CSB interconnect example



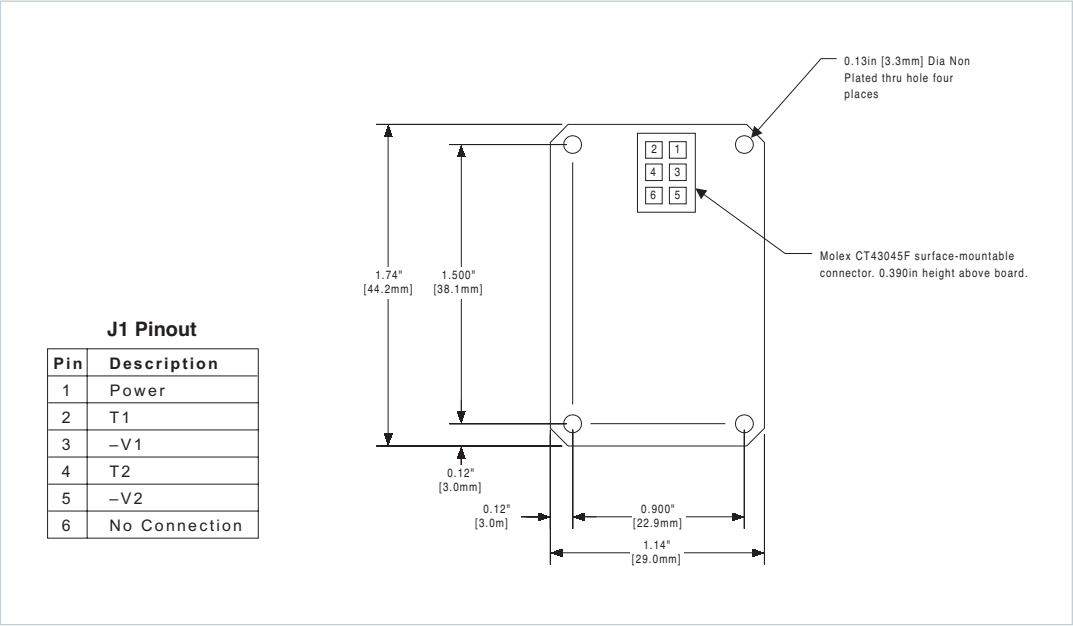
(Requirements on Page 27).

Requirements:

1. For proper operation, the power supplies being paralleled should be enabled at the same time.
2. –Out conductors must be of equal length and wire gauge.
   Separate –Out conductors must be used from each supply to the load or the use of a "Y" connection to a common point must be used as shown in Figure 12. Each leg of the "Y" must have a minimum of a few millivolts of drop in order for proper operation. 50 – 100mV of drop will provide from 5 to 1% accuracy.
3. –V1 and –V2 for all box-to-box circuits must be connected directly at the negative output power studs or terminals to achieve accurate current sharing.
4. D* can be added if redundancy is needed. If redundancy is not required, D* can be replaced with direct wire connections.
5. When using D*, the Power input should be connected on the cathode side of the paralleling diodes as shown in Figure 12.
6. Terminate Sense Leads either locally or remotely as shown in Figure 12.
7. For paralleling more than two supplies consult factory for assistance.

Current Share Boards - Optional Feature Diagram

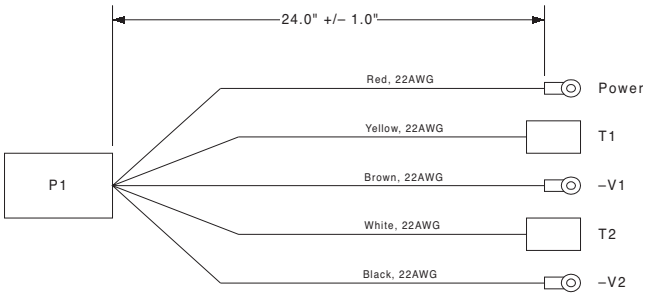
Figure 13
Mechanical drawing



J1 Pinout

Pin	Description
1	Power
2	T1
3	–V1
4	T2
5	–V2
6	No Connection

Figure 14
Cable drawing



Specifications:

1. Power: 2 – 50V_{DC} at 5mA maximum.
2. Accuracy: ±1mV between –VOUT connections.
3. Output current when not trimming up: ±1µA (VI-200 / J00), ±5µA (Maxi / Mini / Micro).
4. Use four, non-plated through holes with standoffs for mounting.
5. CSB01 MUST be used for current sharing VI-200™ / VI-J00™ converters (VI-200 / J00).
6. CSB02 MUST be used for current sharing Maxi / Mini / Micro converters (Maxi, Mini and Micros).

PLEASE NOTE, THE CSB IS NOT INTENDED FOR HOT-SWAP APPLICATIONS

Contact your Regional Applications Engineer at: apps@vicorpower.com for additional information.

Low-Leakage Version

If Low Leakage is required, the MegaPAC™ Family of Power Supplies has a model variant (must be requested). This model enables the user to meet various additional specifications. Presently, the PFC MegaPAC, Mini MegaPAC and Autoranging MegaPAC are available in Low Leakage versions. Other models can be made available. The MegaPAC Family of Power Supplies consist of:

- PFC MegaPAC™
- PFC MegaPAC High Power
- PFC MegaPAC-EL™ (Low Noise)
- Mini MegaPAC
- 4kW MegaPAC

The advantage of the Low Leakage MegaPAC power supply is in multiple power supply systems that have one AC input. This option will lower the input leakage current for these products to 500µA or less. An additional external EMI filter may be required.

How Low Leakage is obtained

Low Leakage for the MegaPAC Family of power supplies is obtained with the removal of the "Y" capacitors from within the EMI filter of the MegaPAC as well as the "Y" capacitors on the input of the ConverterPACs™. This reduces the leakage current from the AC input to AC ground (chassis) to below 500µA. At the same time, since the "Y" capacitors are a vital component of the EMI filter, without them, the EMI will go up. When this happens, the unit may no longer meet the Vicor published specifications for conducted EMI. In order to reduce the EMI to within an acceptable limit, an additional external EMI filter maybe required. All safety agency certifications for the MegaPAC Power Supplies remain intact. Contact Applications Engineering for more information.

Vicor currently has the following ConverterPACs (See ConverterPAC information sheet and/or Design Guide for more information):

VI-200™ / VI-J00™	**Maxi / Mini / Micro**
ModuPAC™ (M)	FinPAC™ (PZ)
JuniorPAC™ (J)	UniPAC™ (XU)
DualPAC™ (D)	QPAC (XQ)
RamPAC™ (R)	FinQPAC™ (PZL)
BatPAC™ (B)	
QPAC™ (L)	
DualQPAC™ (LD)	
Junior QPAC™ (LJ)	

Please note: The MegaPACs (including Low Leakage versions) are not UL 2601 or EN60601 compliant.

Output Sequencing

Using the MegaPAC's™ standard Input Interface Connector (J10) along with the ConverterPAC's™ optional DC OK Option[j], it is possible to implement unique output voltage power-up and power-down sequences. Below is an example showing how this may be done.

Requirement: 5V must start before the 3.3V output. If the 5V output is lost, the 3.3V output must turn off.

The first step in meeting this requirement is to configure the 5V ModuPAC™ with the DC OK Option, which is indicated by a "D" designator in the ModuPAC's part number, located on the top surface of each ModuPAC above the $+V_{OUT}$. Any ModuPAC that has the DC OK option will also have the four-pin J3 DC OK connector installed. To order a ModuPAC with the DC OK option, please contact the Vicor customer service department for assistance. The DC OK option monitors the output voltage of a given ConverterPAC and provides a TTL logic signal depending on its output voltage.

Figure 15
ModuPAC pinout

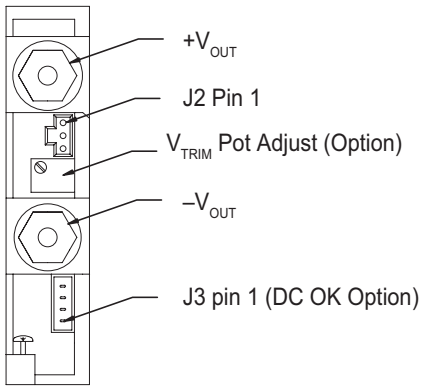
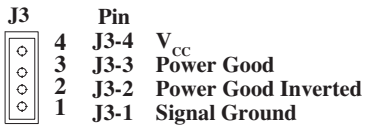


Figure 16
J3 DC OK connector



[j] DC OK Option is not available for VI-J00™ dual output DualPACs™.

Figure 17
Output sequencing wire interconnect

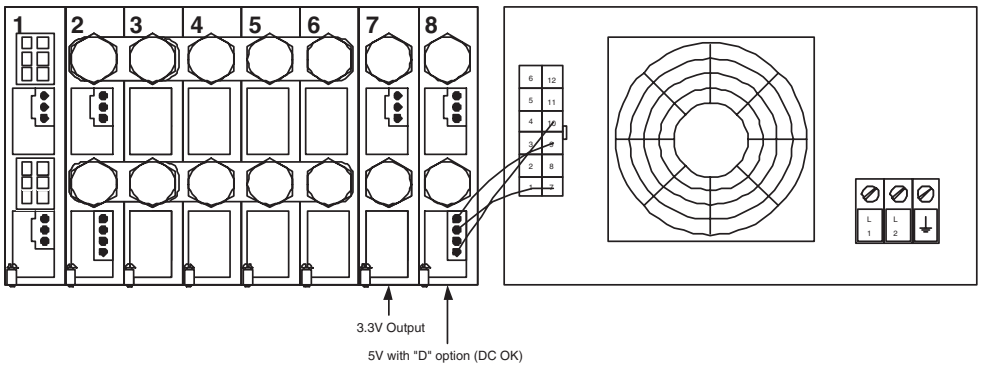


Figure 17 shows the correct wiring connections between the Power Good Connector (J3) of a 5V ModuPAC™ and the Input Interface Connector (J10) of a typical PFC MegaPAC™ configuration. In this example, the 3.3V ModuPAC is located in the slot #7 and the 5V ModuPAC (with the DC OK option) is located in slot #8. In order for the Power Good option to properly function, it requires a 5V source to provide the necessary V_{CC} pull up. This 5V source is conveniently available using the +5V aux source from the Input Interface Connector (J10-9 and J10-10). With a V_{CC} voltage properly applied to the 5V ModuPAC's Power Good Connector (J3-1 and J3-4), the Power Good signal (J3-3) can now be connected to the Enable / Disable control pin for slot #7 (J10-7). The 5V ModuPAC's Power Good signal will remain low until its output has reached approximately 95% of its nominal output voltage. This will keep the 3.3V output in disabled mode, allowing the 5V output to reach regulation first. In addition, should the 5V output drop below 85%, the Power Good signal will drop low and disable the 3.3V output. Figures 18 and 19 show the start up and shut down waveforms for the circuit shown in Figure 17.

Channel #1: 5V Output

Channel #2: 3.3V Output

Channel #3: 5V DC OK signal

Figure 18
Start-up waveforms

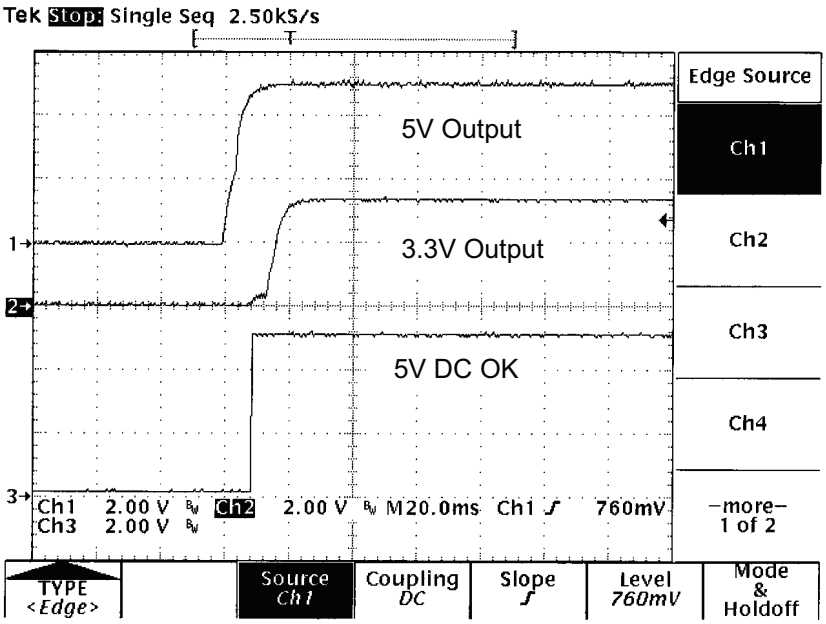
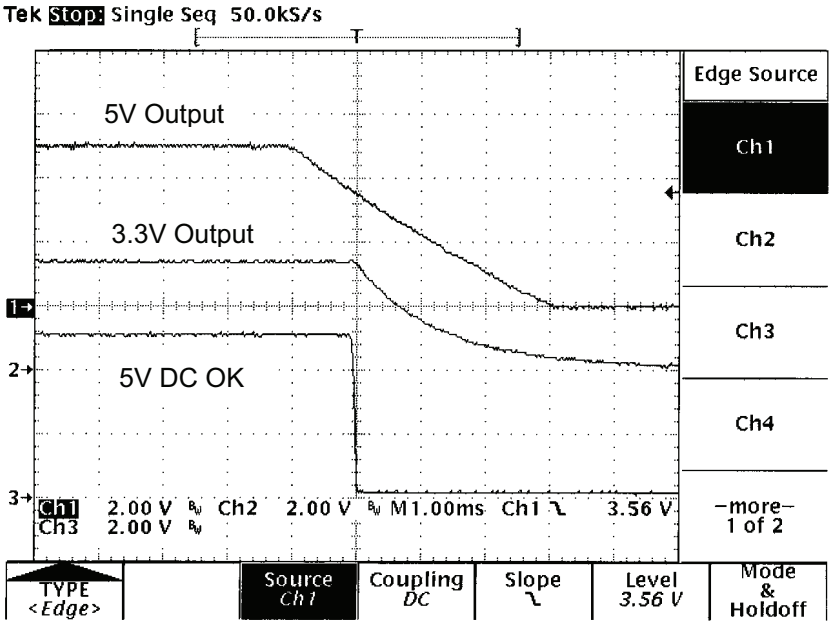


Figure 19
Shut-down waveforms



For more information about this or other Vicor products, or for assistance with component-based power system design, contact the Vicor office nearest you. The Vicor comprehensive line of power solutions includes modular, high-density DC-DC converters and accessory components, configurable power supplies and custom power systems. Vicor designs and builds configurable power supplies incorporating its high-density DC-DC converters and accessory components.

This product line includes:

LoPAC™ FAMILY:

- PFC MicroS
- PFC Micro
- PFC Mini

MegaPAC™ FAMILY:

- PFC MegaPAC™
- 4kW MegaPAC
- PFC MegaPAC (High Power)
- PFC MegaPAC (Low Noise/High Power)
- PFC MegaPAC-EL™ (Low Noise)
- Mini MegaPAC™
- ConverterPACs™

OTHERS:

- FlatPAC-EN™

Rugged COTS versions (MI) are available for the PFC Micro, PFC MicroS, PFC Mini and PFC MegaPAC.

Limitation of Warranties

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