

3-Phase MegaPAC™ and 4kW MegaPAC™ AC-DC Switchers



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Overview

The 3-Phase MegaPAC and 4kW MegaPAC are field configurable, single- or multiple-output switchers providing up to 2,000W (3-Phase MegaPAC) to 4,000W (4kW MegaPAC) of output power. The chassis has ten slots and can provide up to 40 regulated, fully-isolated outputs. It achieves power densities of 4.4W per cubic inch (3-Phase MegaPAC) to 7.8W (4kW MegaPAC) per cubic inch. The dimensions of the 3-Phase MegaPAC are 4.9 x 7.5 x 12.3in [124,5 x 190,5 x 312,4mm] and the dimensions of the 4kW MegaPAC are 4.9 x 7.5 x 14in [124,5 x 190,5 x 355,6mm]. The 4kW MegaPAC is longer than the 3-Phase MegaPAC to accommodate a second fan.

A complete power supply is configured at the factory by selecting and inserting up to ten same-length slide-in output assemblies called ConverterPACs™. ConverterPACs incorporate one or two VI-200™ / VI-J00™ and / or Maxi Vicor DC-DC converters and are available in a wide selection of outputs 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. For detailed information about ConverterPACs, refer to the ConverterPAC information sheet. The 4kW MegaPAC uses VI-200 / VI-J00 and Maxi Vicor DC-DC converters while the 3-Phase MegaPAC uses VI-200 / VI-J00 Vicor DC-DC converters.

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 with one of the same length and has the desired voltage power rating. For additional flexibility, same-length 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, in addition to useful status indicators. Please consult our Applications Engineering Department if you have other special requirements.

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

MegaPAC Dos and Don'ts

- For units without Autosense, **do not leave ConverterPAC™ SENSE lines open. Always terminate them at their respective outputs locally or at the load. Use twisted pair 22 – 24AWG wire. If ConverterPAC has Autosense, no local-sense connection is required.** See Pages 13 and 17 for more information on Autosense.
- If needed, use Connector Kit #19-130041 for the 3-Phase / 4kW MegaPACs.
- **Always fill all output slots of the MegaPAC™. If a slot is not filled with a ConverterPAC, it should be filled with an airblock.** Airblocks are plastic assemblies whose main function is to fill up an empty slot. Any airflow escape from an empty slot, significantly degrade thermal performance can result in overheating and damage to the power supply.
- **Do not unplug ConverterPACs while input power is applied. They are not designed for hot-plug applications.**
- **Do not restrict air flow to the unit. Leave a two-inch minimum space in front and behind the supply.** The cooling fan draws air into the unit and forces it out at the output power terminals.
- For power expansion, use booster ConverterPACs. Viewing the unit from the output terminal side, always insert boosters to the right side of the driver.
- Do not use boosters as independent outputs. Disconnecting bus bars will damage booster ConverterPACs.
- Always ensure that output hex-nuts are properly torqued before applying power to supply.
- For booster arrays, **do not remove bus bars.**
- Run the output (+/-) power cables next to each other to minimize inductance.
- Wait five minutes after shutting off power before inserting or removing ConverterPACs.
- The MegaPACs does not have user-serviceable components. They must be returned to the factory for repairs. Contact Customer Service for a RMA number before returning the unit. Do not attempt to repair or modify the power supply in any manner other than the exchange of ConverterPACs as described in this user guide.
- Insert proper fault protection at power supply input terminals (i.e., a fuse).
- Use proper-size wires to avoid overheating and excessive voltage drop.
- Never loosen the inner nut on a ConverterPAC.
- Verify output nuts are tight before powering up.
- Only use the regular-length ConverterPACs in the 3-Phase / 4kW MegaPAC chassis. You cannot use any of the extended-length ConverterPACs which are only used in the EL (low-noise) products.
- Keep in mind that currently, the UniPAC™ ConverterPAC can only be used in the 4kW MegaPAC.

Technical Description

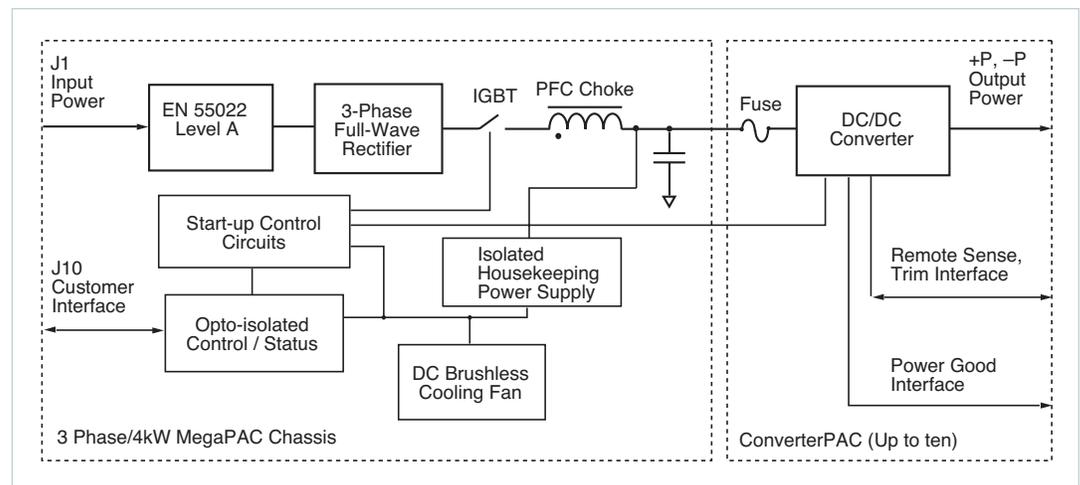
The 3-Phase MegaPAC™ and 4kW MegaPAC are configured by installing same-length ConverterPAC™ assemblies into the chassis. The chassis takes AC input power and performs filtering and rectification functions. The ConverterPACs plug into a high-voltage backplane and provide low-noise, independently-regulated and fully-isolated outputs.

Input AC mains voltage (L1, L2, L3 and GND) is applied to an agency-approved mating plug. The input current is passed through an EMI filter designed to meet EN 55022 Level A before it is passed to a three-phase, full-wave bridge rectifier. The rectifier charges storage capacitors and delivers unregulated $300V_{DC}$ to a backplane after passing through a large choke that improves input power factor. The power factor typically exceeds 0.9 depending upon load, line voltage, frequency and line balance. Inrush current is actively controlled with an IGBT and never exceeds 30A peak regardless of hot or cold starts.

A housekeeping supply, isolated from the AC input, powers the brushless DC cooling fan and other input monitoring circuits, in addition to providing an auxiliary +5V power source for the user. **The 4kW MegaPAC has a second fan for extra cooling.** Excessive input currents caused by loss of a phase or excessive output loading in single-phase operation will safely shut down the unit until input power is recycled. This occurs when the peak input current reaches 30A. An analog temperature monitor is provided, as well as overtemperature shut down. An active-high TTL compatible Enable control is included for each ConverterPAC assembly, as well as an active-low General Shut Down control; the polarities, active-high or active-low, are factory set. The 3-Phase MegaPAC and 4kW MegaPAC can be safely paralleled (with another of its own kind) with accurate current sharing for high-power systems. All interface signals are safety isolated using a common floating return.

Upon power up, all outputs are first disabled to limit the inrush current and to allow the unregulated bus to reach correct operating levels for ConverterPAC assemblies. The internal housekeeping supply comes up within 500ms after input power is applied and the AC Power OK signal asserts to a TTL "1," indicating the input power is OK. The low-voltage power outputs come up within 10 – 20ms after the AC Power OK asserts to a TTL "1." Output ramp-up time from Enable or General Shut Down is 10 – 20ms. Output-fall time from Disable is dependent on load, but is typically a few hundred microseconds.

Figure 1
3-Phase MegaPAC and
4kW MegaPAC Architectures



Configuring and Reconfiguring MegaPACs™

Most ConverterPACs™ of the same length can be easily added, replaced or moved by sliding the assemblies in or out of a MegaPAC chassis. They are driver ConverterPACs and can be inserted into any available slot. For outputs greater than 200W, a driver ConverterPAC and one or more booster ConverterPACs will be used. For outputs greater than 500W (in the 4kW MegaPAC), a driver UniPAC™ and one or more booster UniPACs 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 of the same length or an airblock.** If the slot is left empty, it will provide an airflow escape and cause failure to the power supply.

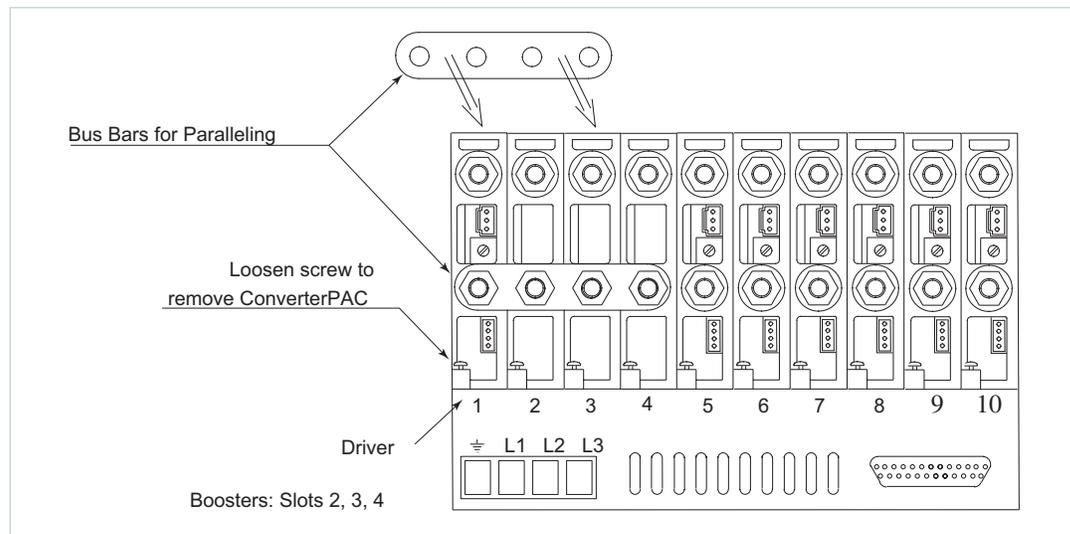
Installing ConverterPACs as Drivers

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

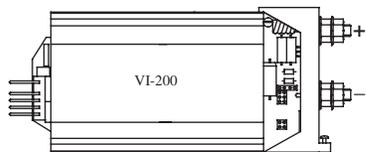
ConverterPACs can be paralleled for more power. Additional power to an output is obtained by connecting one or more boosters in parallel with a single driver. The driver can be placed in any open slot. All boosters should be inserted in the slots to the immediate right of the driver, as viewed from the output end of the MegaPAC. Figure 2 shows a driver placed in slot #1 and three 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 10. 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-Voltage Outputs](#).

Figure 2
Paralleling ConverterPACs



ConverterPAC™ Functional Description

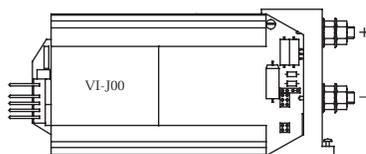
ConverterPACs are the family of slide-in output assemblies used in MegaPAC™ power supplies. Most ConverterPACs of the same length are interchangeable within a MegaPAC or between different AC input chassis. They can be added, moved or changed as necessary. The following ConverterPACs can be used in the 3-Phase and 4kW MegaPACs.



ModuPAC

ModuPAC™

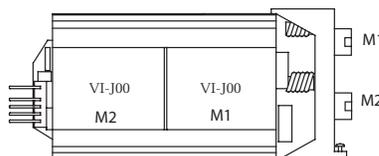
The ModuPAC output assembly consists of a VI-200™ Vicor DC-DC converter that converts the unregulated high-voltage bus to the desired regulated output voltage. Each ModuPAC can provide up to 200W of power. Multiple ModuPACs can be paralleled in a driver-boost configuration to provide more power.



JuniorPAC

JuniorPAC™

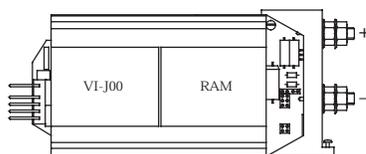
The JuniorPAC consists of a VI-J00™ Vicor DC-DC converter that converts the unregulated high-voltage bus to the desired regulated-output voltage. JuniorPACs can provide up to 100W of output power.



DualPAC

DualPAC™

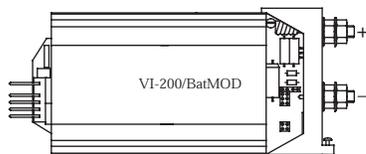
This output assembly consists of two VI-J00 Vicor DC-DC converters that convert the unregulated high-voltage bus to the desired regulated-output voltages.



RamPAC

RamPAC™

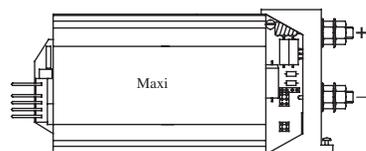
This output assembly consists of a VI-J00 Vicor DC-DC converter with a Ripple Attenuator Module (RAM) and is designed for applications requiring low-output ripple / noise.



BatPAC

BatPAC™

The BatPAC output assembly consists of a VI-200 BatMod current source that converts the unregulated high-voltage bus to the desired regulated-output voltage. The BatPAC is a 200W programmable current source that can be configured as a battery charger.



UniPAC

UniPAC™

The UniPAC output assembly consists of a Maxi Vicor DC-DC module that converts the unregulated high-voltage bus to the desired regulated-output voltage. UniPACs can provide up to 500W of power. Multiple UniPACs can be paralleled in a driver-boost configuration to provide more power. The UniPAC can only be used in the 4kW MegaPAC (not in the 3-Phase MegaPAC or any other MegaPACs).

List of ConverterPACs™ used in the 3-Phase / 4kW MegaPACs™ and their features

ConverterPAC	OVP	OCP	OTL	RS/AS ^[a]	LS/AS ^[a]	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
UniPAC™ ^[b]	Std	Std	N/A	AS ^[a]	AS ^[a]	Opt	Opt

^[a] See Pages 13 and 17 for more information on Autosense.

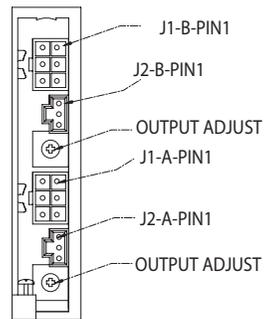
^[b] Currently, the UniPAC (XU) can only be used in the 4kW MegaPAC.

- | | | | |
|------------|-------------------------------------|------------|--|
| OVP | Overvoltage Protection (latching) | OCP | Overcurrent Protection (auto-recovery) |
| OTL | Overtemperature Limiting (latching) | RS | Remote Sense |
| PG | Power Good (DC OK TTL Signal) | LS | Local Sense |
| | | AS | Autosense |

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

ConverterPAC™ Output and Connector Pin Identification for the 3-Phase / 4kW MegaPACs™

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:

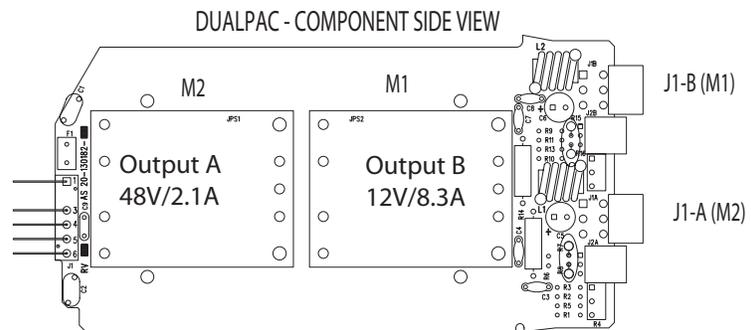
HOUSING- MOLEX P/N: 39-01-2060
 TERMINALS- MOLEX P/N: 39-00-0039
 CRIMP TOOL MOLEX P/N: 63819-0901

J2 (REMOTE SENSE)

1	TRIM PIN ACCESS
2	+SENSE
3	-SENSE

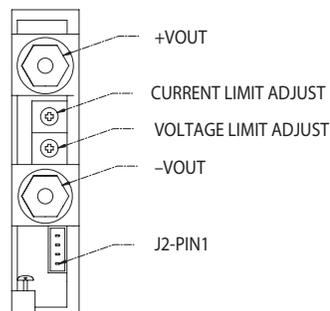
MATING HDWR:

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

BatPAC™



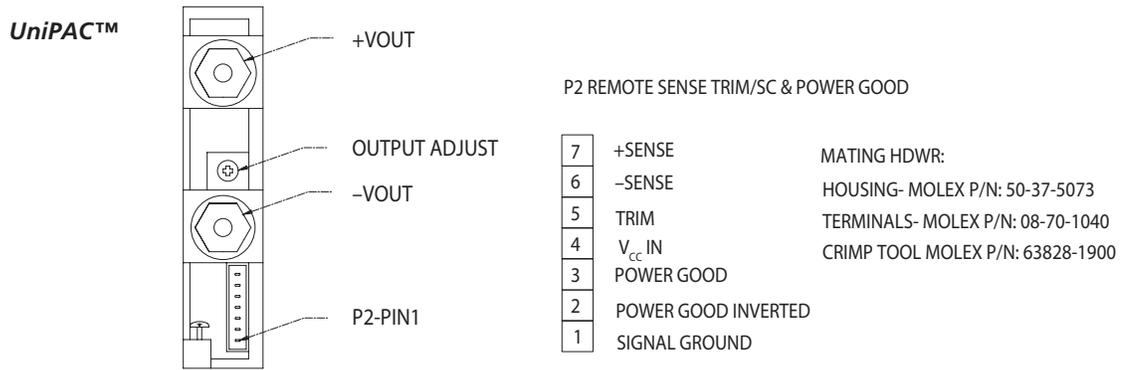
J2 (BATPAC REMOTE INTERFACE)

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

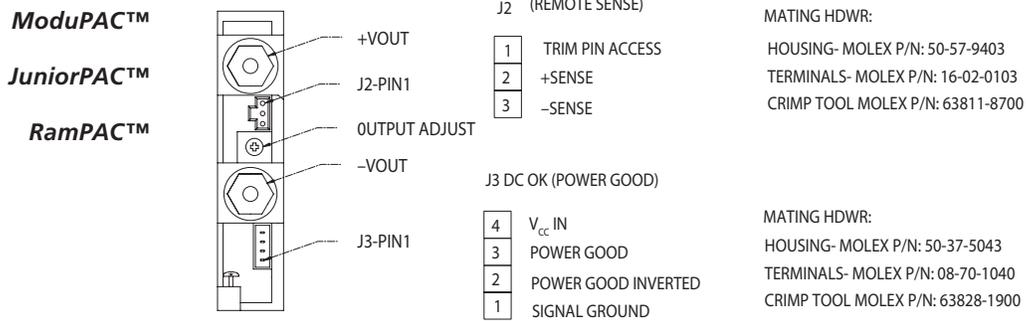
MATING HDWR:

HOUSING- MOLEX P/N: 50-37-5043
 TERMINALS- MOLEX P/N: 80-70-1040
 CRIMP TOOL MOLEX P/N: 63828-1900

ConverterPAC™ Output and Connector Pin Identification for the 3-Phase / 4kW MegaPACs™ (Cont.)



Note: The UniPAC can ONLY be used in the 4kW MegaPAC™.



Part Numbering

3-Phase MegaPAC™

mPx₁-5x₂xxxx

e.g. MP4-510108

m = M or W

P = P

x₁ = number of outputs

9 = 3-Phase MegaPAC chassis

x₂ = number of modules

xxxx = assigned by Vicor

4kW MegaPAC™

mPx₁-4x₂xxxx-x₃x₄-x₅-x₆

With VI-200™ / VI-J00™

e.g. MP10-410008-23

With Maxi

e.g. MX10-410008-23

m = M or W

P = P

x₁ = number of outputs

4 = 4kW MegaPAC chassis

x₂ = number of modules

xxxx = assigned by Vicor

x₃ = Optional Code 2 = VI-J00 or VI-200 module in slot #1; 3 = Maxi in Slot 1

x₄ = Optional Code 2 = VI-J00 or VI-200 module in slot #10; 3 = Maxi in Slot 10

x₅ = Optional Code

x₆ = Optional Code

ConverterPAC™

Xx_DV/x_EAx_F

e.g. M15V/10A

e.g. M15V/10ADF

e.g. D15V/6.7A-12V/8.3AT

X = ConverterPAC type - If RoHS precede with a "G"

M = ModuPAC™

D = DualPAC™

R = RamPAC™

J = JuniorPAC™

B = BatPAC™

XU = UniPAC™ (currently only used in the 4kW MegaPAC)

x_D = Voltage out

x_E = Current out (rounded to one decimal point)

x_F = Can be multiple options (see next page)

ConverterPAC™ options

B	Booster module (SI for FasTrak)	M	M-Grade module
D	DC OK or Power Good ^[c]	P	Preload
F	Full 50 – 110% output adjustment ^[d]	R	RAM external ^[e]
F1	50 – 107.5% output adjustment	S	Trimpot removed for external BatPAC adjustment
F2	50 – 105% output adjustment	T	90 – 110% output adjustment ^[f]
F3	50 – 102.5% output adjustment	T1	90 – 107.5% output adjustment
F4	50 – 100% output adjustment	T2	90 – 105% output adjustment
F5	60 – 110% output adjustment	T3	90 – 102.5% output adjustment
F6	70 – 110% output adjustment	T4	90 – 100% output adjustment
F7	80 – 110% output adjustment	T5	98 – 105% output adjustment
F8	90 – 110% output adjustment	T6	100 – 110% output adjustment
F9	100 – 110% output adjustment	V1	"VXI" low noise (150mV) $15V < V_{OUT} \leq 24V$ outputs ^[g]
I/H	I-/H-Grade module	V2	"VXI" low noise (50mV) $V_{OUT} \leq 15V_{DC}$
K	Custom SRF module used	V3	1% ripple for outputs > 24V

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

^[d] **F option:** Optional for all ConverterPACs EXCEPT the BatPAC™ and DualQPAC™.

^[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.

^[g] **V options:** Optional ONLY on the ModuPAC™, DualPAC and JuniorPAC™. N/A on all other ConverterPACs.

3-Phase and 4kW MegaPACs™ Quick Install Instructions

(For Mechanical Drawing, see Page 15 – 16.)

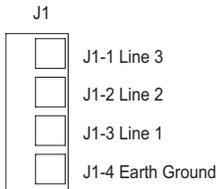
Mounting the 3-Phase MegaPAC and 4kW MegaPAC

- The 3-Phase MegaPAC and 4kW MegaPAC can be mounted on any of four sides.
- Use #8-32 or 4mm mounting screws. Maximum penetration should not exceed 0.15in [3,8mm].
- A minimum of 2in [5,1cm] clearance must be maintained at either end of the supply in order to insure proper air flow and cooling.
- Maximum allowable torque is 20lb·in.

Input Connections

Input Power J1

- Input AC power is applied to terminal block J1 using mating receptacle AMP #54483-4 with #53892-4 crimp or #54329-1 solder terminals provided.
- Use size 12AWG wire with soldered terminals.
- A fuse or circuit breaker in the input line is required for safety reasons.



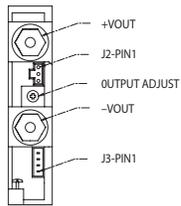
Input Panel Connectors

Output Connections

Power Connections

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

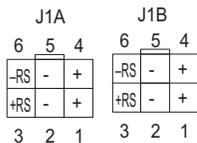
- The upper stud is Positive and the lower stud is the Return.
- Remove outer nut. **Do not remove or loosen inner nut.**
- Place ring lug over output stud.
- Replace and tighten outer nut to a maximum torque of **45lb·in. Do not over-tighten nuts.**
- Verify all output nuts are properly installed before turning on supply.



Single-Output ModuPAC™

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 #63819-0901.



PIN
 1 & 4 +VOUT
 2 & 5 -VOUT
 3 +REMOTE SENSE
 6 -REMOTE SENSE

DualPAC Output Connector

3-Phase and 4kW MegaPACs™ Quick Install Instructions (Cont.)

Sense Connections

Note: Newer power supplies may have a new feature installed called Autosense. For units with Autosense, 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 17 for more information on Autosense.

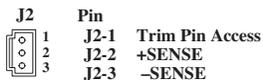
For units without Autosense, sense connections must always be made. Not connecting sense lines to their respective outputs can cause failure to the unit.

Sense Connector J2 (P2 for the UniPAC™):

- Sense connections do not have to be made if the local-sense option has been ordered. (An "L" in the ConverterPAC™ part number means the local-sense option has been installed; e.g., M5V/40AL. Only applies to units without 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 UniPAC, 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 #63828-1900.

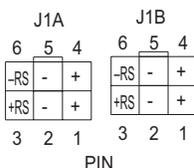
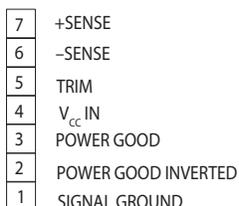
Sense Connectors on DualPACs™:

- Sense connections do not have to be made if the local-sense option has been ordered. (An "L" in the ConverterPAC part number means the local-sense option has been installed; e.g., D5V/20AL-12V/4.2AL. Only applies to units without Autosense.)
- Sense connections are available on the J2, P2 or the J1A and J1B connectors.
- If using J2 or P2 connectors, see Page 17.
- For 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 #63819-0901.
- **Verify that Sense lines are not cross-connected before applying input power.**



J2 Sense Connectors

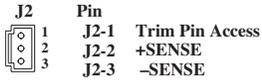
P2 REMOTE SENSE,
TRIM/SC & POWER GOOD



1 & 4 +VOUT
2 & 5 -VOUT
3 +REMOTE SENSE
6 -REMOTE SENSE

DualPAC Output Connectors

3-Phase and 4kW MegaPACs™ Quick Install Instructions (Cont.)

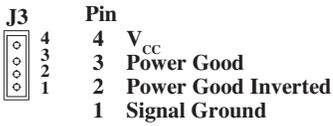


J2 Connectors

J2 Trim Connection (and P2 for UniPACs™)

- The J2 remote Trim connection should only be used if the local Trim option has not been installed. (A “T” or an “F” in the ConverterPACT™ 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 and 22 – 24AWG stranded wire using Molex tool 63811-8700.
- J2-1 provides Trim access.
- For the UniPAC, 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 #63828-1900.

DC OK (Power Good)



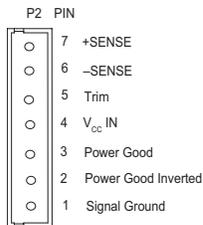
J3 Connectors

DC OK (Power Good)

- DC OK is only available as an option and is only present when requested.
- Use Molex mating receptacle #50-37-5043 with #08-70-1040 terminals provided.
- Attach terminals to 22 – 28AWG stranded wire using Molex tool #63828-1900.
- For the UniPAC, 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 #63828-1900.

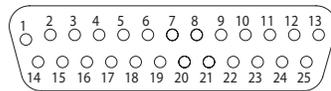
Interface Connections J10

- J10-7 to 11 and J10-20 to 24 are Enable / Disable for slots 1-10.
- J10-16, 17 are V_{CC}, J10-12 and 15 are Signal Ground, J10-18 is AC Power OK, and J10-5 is General Shut Down.



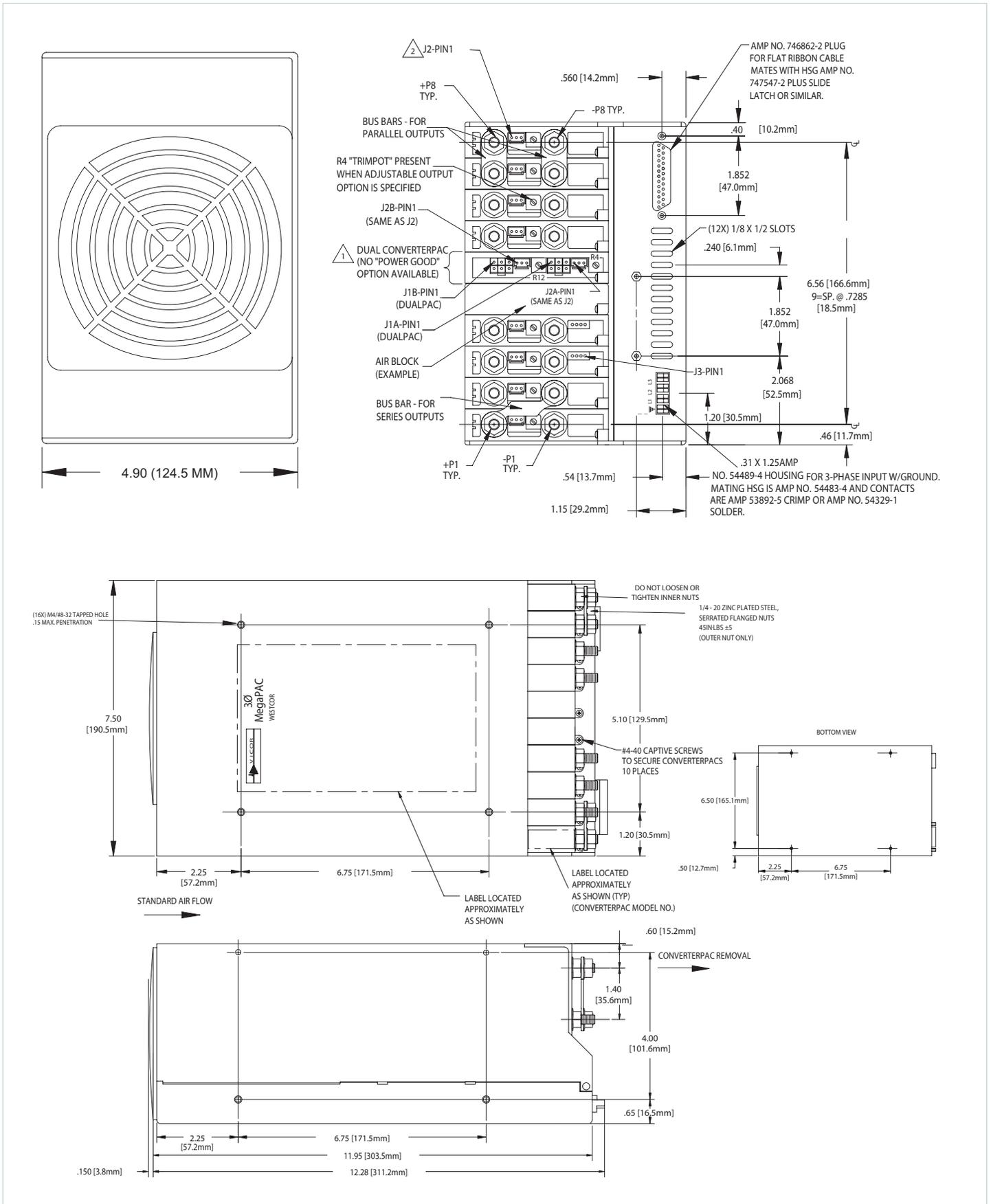
J3 Connectors

J10 INTERFACE CONNECTOR IDENTIFICATION



1	Signal Ground	14	Phase Fail
2	Signal Ground	15	Signal Ground
3	Overtemperature Warning	16	V _{CC} +5V, 300mA
4	Analog Temperature	17	V _{CC} +5V, 300mA
5	General Shutdown	18	A.C. Power OK
6	No Connection	19	A.C. Power Fail
7	Enable/Disable #10	20	Enable/Disable #9
8	Enable/Disable #8	21	Enable/Disable #7
9	Enable/Disable #6	22	Enable/Disable #5
10	Enable/Disable #4	23	Enable/Disable #3
11	Enable/Disable #2	24	Enable/Disable #1
12	Signal Ground	25	Gate #10 (Output (Isolated))
13	Gate #1 Input (isolated)		

3-Phase MegaPAC™ Mechanical Drawings

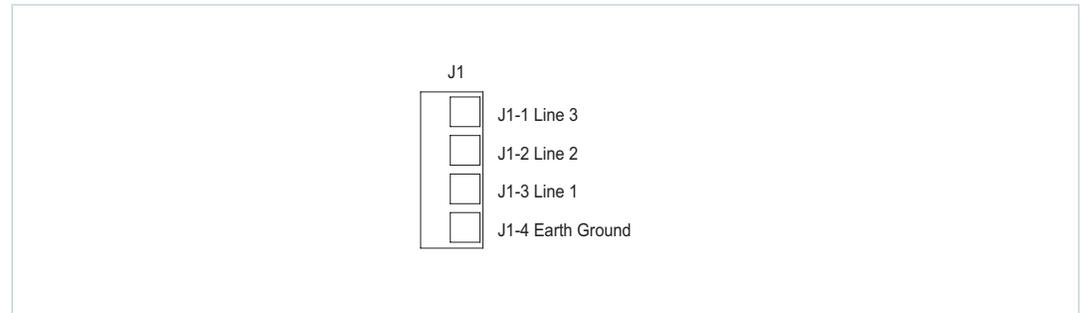


Interface Connections

Chassis Input Power Terminals (J1)

Input AC power is applied to a plug-in connector, J1, that accepts soldered terminals with a wire size of 12AWG. For operation on high-voltage DC input, input power can be connected to any two input lines. A fault-clearing device should be installed at the input of the unit. A user-accessible input fuse is not present within the unit. For an output of 2,000 – 4,000W with operation on 208V_{AC}, three-phase input, a 20A fuse in each input line is acceptable. Input power cables should be shielded to minimize radiated noise effects.

Figure 3
Input panel connector



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 six-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 J1B. 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)

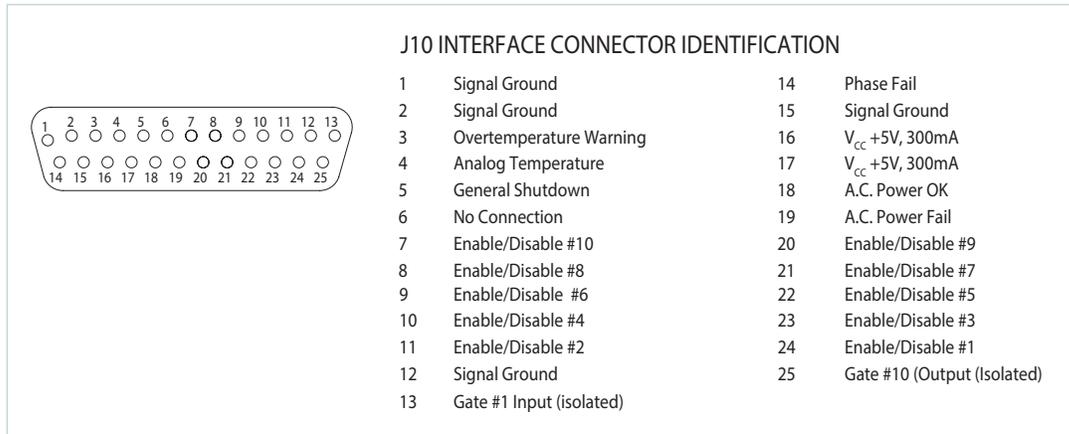
Newer power supplies may have some outputs configured with the Autosense feature that automatically locally senses the output if remote sense is not used. To check if an output has the Autosense feature, measure the impedance from the +OUT to +SENSE and –OUT to –SENSE pins. If the impedance is 5Ω, then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

For units without 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 3-Phase MegaPAC™ or 4kW MegaPAC is 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.

Signal Ground (J10-1, J10-2, J10-12, J10-15)

Signal Ground (see Figure 4) is an isolated ground reference for all J10 interface 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 J1.

Figure 4
Interface connector (J10)

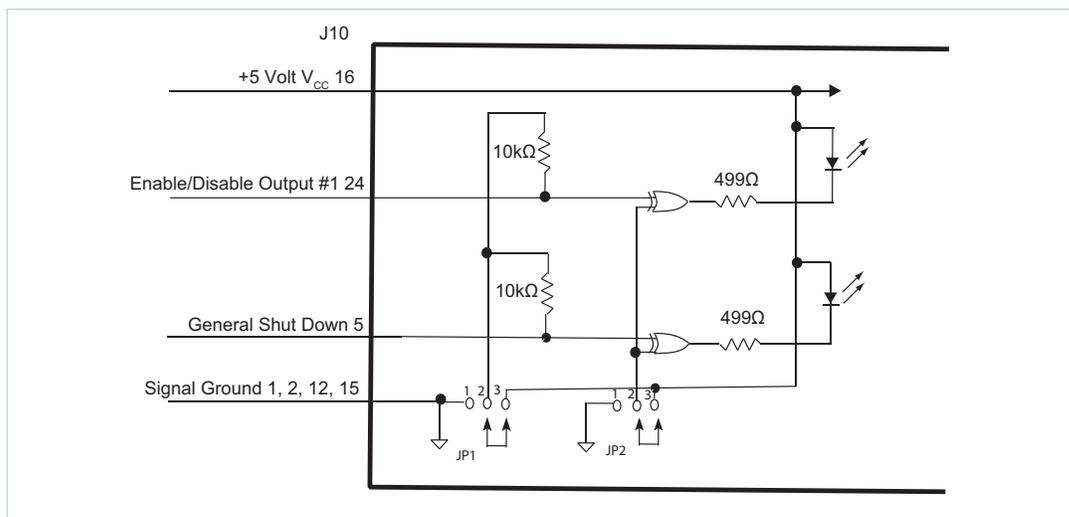


Enable/Disable and General Shut Down (GSD)

The Enable / Disable control lines allow ConverterPAC outputs to be sequenced either on or off. For DualPACs™, both outputs are sequenced. In parallel arrays, only the driver ConverterPAC needs to be sequenced. The GSD control line on J10-5 allows simultaneous shut down of all ConverterPAC outputs. An internal factory-configured jumper selects polarity, either active-high or active-low. Another jumper selects a pull-up or pull-down source for the HCMOS control inputs.

The standard Enable / Disable controls are configured as active-low with internal pull up; outputs are enabled when these pins are open-circuited or allowed to exceed 4.5V with respect to Signal Ground. Outputs are disabled when the Enable / Disable control lines are pulled low to less than 0.7V. The GSD control line is configured to be active-low with internal pull up; all outputs are simultaneously inhibited when the GSD control line is pulled low to less than 0.7V. All outputs are enabled when GSD is open circuited or allowed to exceed 4.5V. Do not apply more than 5V to these inputs at any time. The E/D and GSD circuits will sink up to 0.6mA. If driven from an electromechanical switch or relay, a small capacitor should be connected between the control line and Signal Ground to eliminate latch-up due to the effects of switch bounce (1mF, typical). As noted, active polarity and pull up / down can be altered in the factory.

Figure 5
Enable / Disable and
General Shut Down



Enable / Disable Control of Maxi 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.

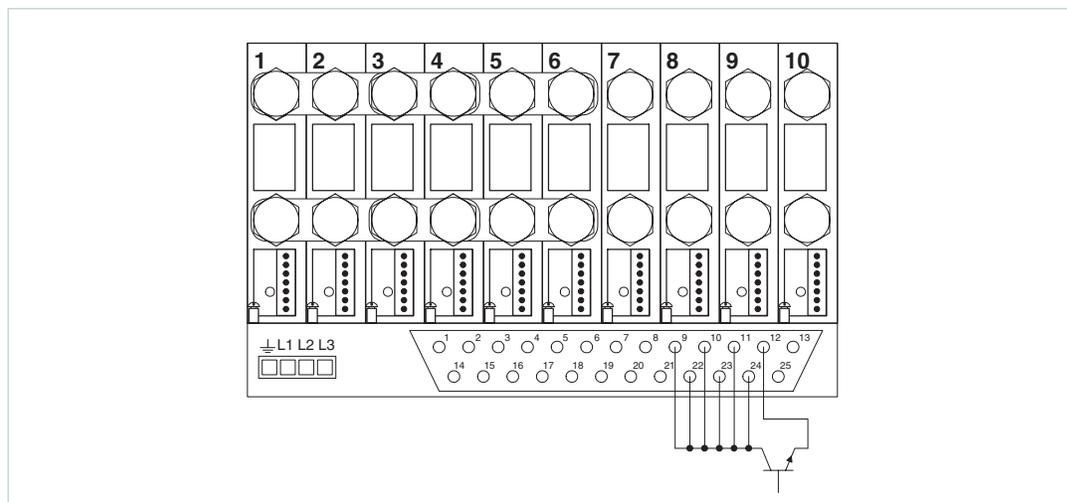
Example:

Slots 1 through 6 have been configured as a single output parallel array (see Figure 6).

In order to disable this array, E/Ds 1 through 6 should be shorted together as shown in Figure 6. With the 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 Shut Down (GSD) function.

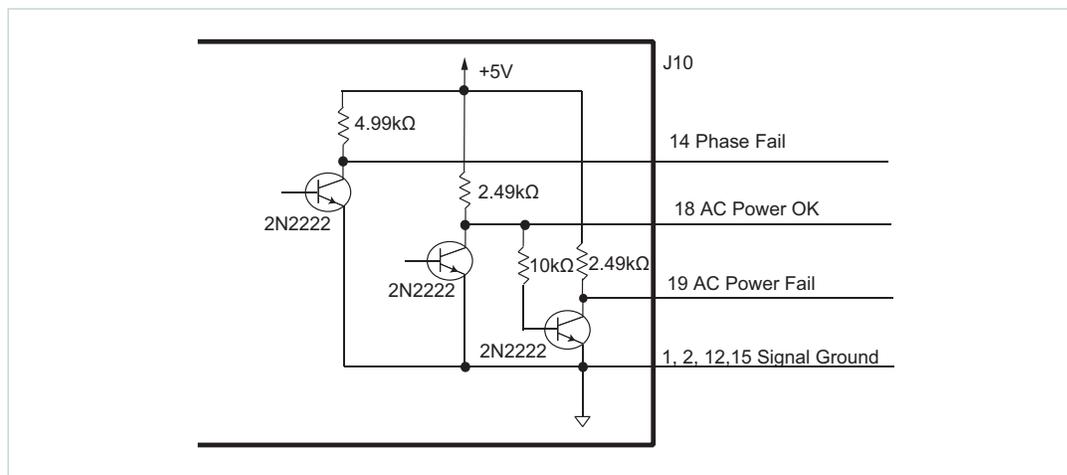
Figure 6
Enable / Disable control
of Maxi arrays



AC Power OK (J10-18)

This signal on J10-18 provides a status indication of the AC input power (see Figure 7). It is active high, TTL compatible and capable of sourcing 10mA maximum. 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



AC Power Fail (J10-19)

J10-19 is the inverse of AC Power OK, and goes to a TTL "1" when the input AC power is not OK. It is capable of sourcing 10mA maximum. The fan out is 20.

Phase Fail (Input Overcurrent) (J10-14)

J10-14 is a TTL level active-high signal that is asserted when the peak input current reaches 30A due to the loss of an input phase or severe line imbalance. This occurs when one input phase is lost with approximately 1400W output loading. Maximum current that can be sourced is 10mA.

Overtemperature Warning (J10-3)

J10-3 is a signal that asserts a TTL level "1" if the air temperature exceeds the following factory set levels. The warning trip point is 65 – 76°C, typically, and recovery point is 60 – 71°C, typically.

Overtemperature Shut Down

If the inlet ambient air temperature exceeds the following factory-set levels, the outputs are disabled. The shut-down trip point is 70 – 81°C, typically, and recovery point is 40 – 48°C, typically.

Analog Temperature Monitor (J10-4)

This signal on J10-4, referenced to Signal Ground, provides an analog DC voltage output between 0V and 10V that represents the air temperature of 0 – 100°C inside the power supply. The inlet air temperature is monitored close to the fan.

Gate IN/Gate OUT (J10-13, 25)

The 3-Phase MegaPAC™ and 4kW MegaPAC can be paralleled with other 3-Phase MegaPACs and 4kW MegaPACs respectively to increase output power. The Gate OUT (or PC) pin of the ConverterPAC™ in slot #10 is available on J10-25 and can be used to provide input to the Gate In (or PC) pin of the ConverterPAC in slot #1 of a different 3-Phase MegaPAC or 4kW MegaPAC. The ConverterPAC in slot #1 of the second chassis must be a booster and additional boosters can be connected in parallel to it. The ConverterPAC in slot #10 of the first 3-Phase MegaPAC or the 4kW MegaPAC must be either a driver or a booster in a parallel array. ConverterPACs paralleled from chassis to chassis must be of the same type, voltage and power.

The 3-Phase MegaPAC and 4kW MegaPAC are configured at the factory to allow box-to-box paralleling using the ConverterPACs originally shipped in the chassis. Since the MegaPAC is a field-configurable supply, the proper configuration must be verified before paralleling from chassis to chassis. The last two digits of the 4kW MegaPAC part number will identify whether slot #1 and slot #10 were configured for use with VI-200™ / VI-J00™ or Maxi ConverterPACs.

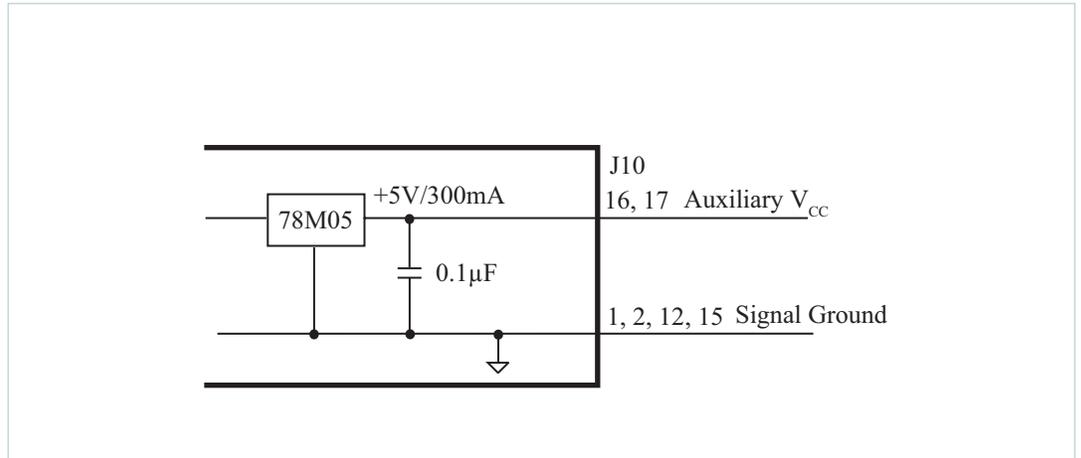
Using the example of MX7-410108-32, the last two digits, "-32," identify the type of module in slot #1 and slot #10, respectively. A "3" indicates the chassis is configured to parallel box-to-box using a Maxi converter. A "2" indicates the chassis is configured to parallel box-to-box using a VI-200 converter. The above example shows the chassis is configured for a Maxi converter in slot #1 and a VI-200 converter in slot #10.

When connecting multiple chassis in parallel, the signal ground on J10 of each chassis should be tied together. Chassis outputs should be tied together near the power supply and then cabled to the load. Using separate cables to provide power to the load will limit the supplies' ability to current share properly.

Auxiliary V_{CC} +5V/0.3A (J10-16, 17)

The V_{CC} on J10-16, 17 is an auxiliary 5V regulated power source (see Figure 8 and Connector Pin Identification on Page 18). It is $+5V_{DC} \pm 5\%$ 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 V_{CC} 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, a J10 Signal Ground must also be connected to the J3-1 Signal Ground pin of the ConverterPAC.

Figure 8
Auxiliary V_{CC}

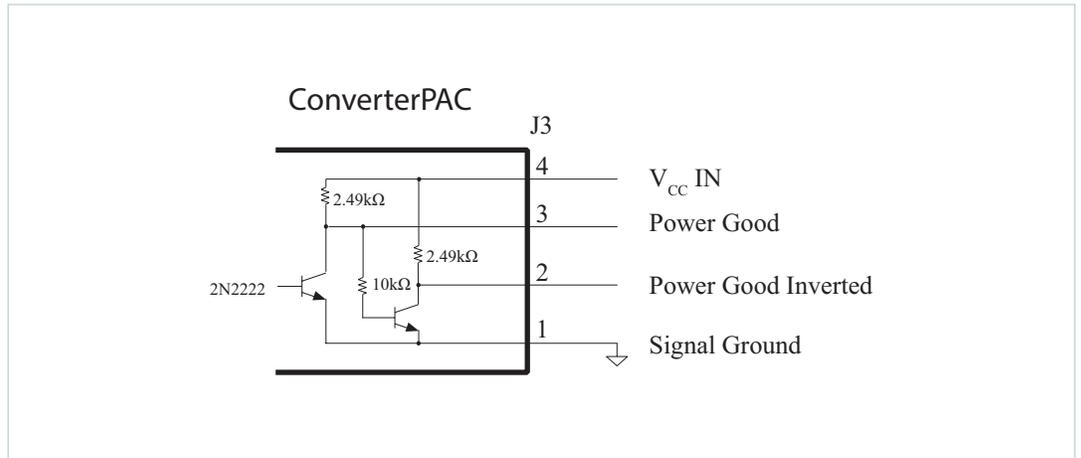


Power Good (J3-3)

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 V_{CC}



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 J1.

V_{CC} IN (J3-4)

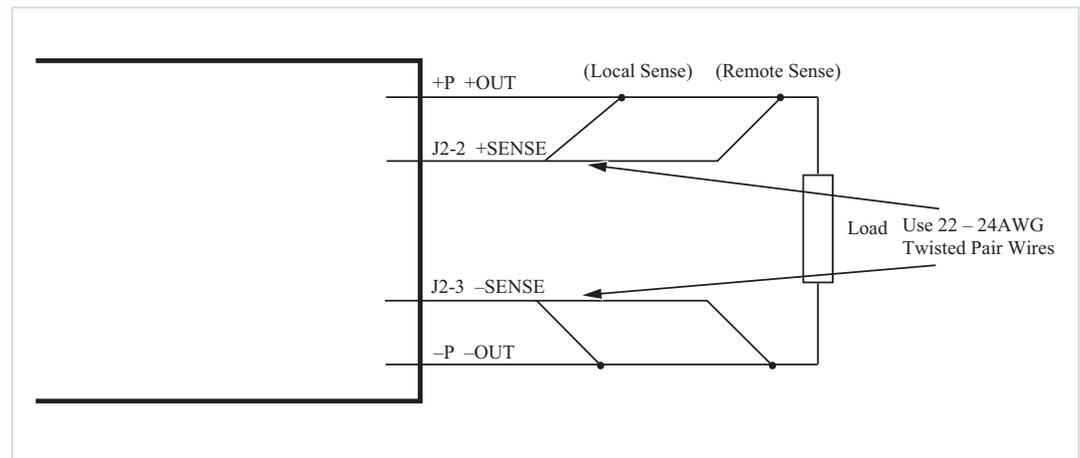
The V_{CC} IN on J3-4 is an input that requires +5V either from the J10 Auxiliary V_{CC}, or from another source. Input current to this pin is limited by an internal resistor to 3mA. If the J10 Auxiliary V_{CC} is connected to V_{CC} IN on J3-4, then at least one J10 Signal Ground must be connected to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

+SENSE / -SENSE (J2-2 and J2-3)

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.

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. Recovering from OVP will require cycling input power to the MegaPAC.

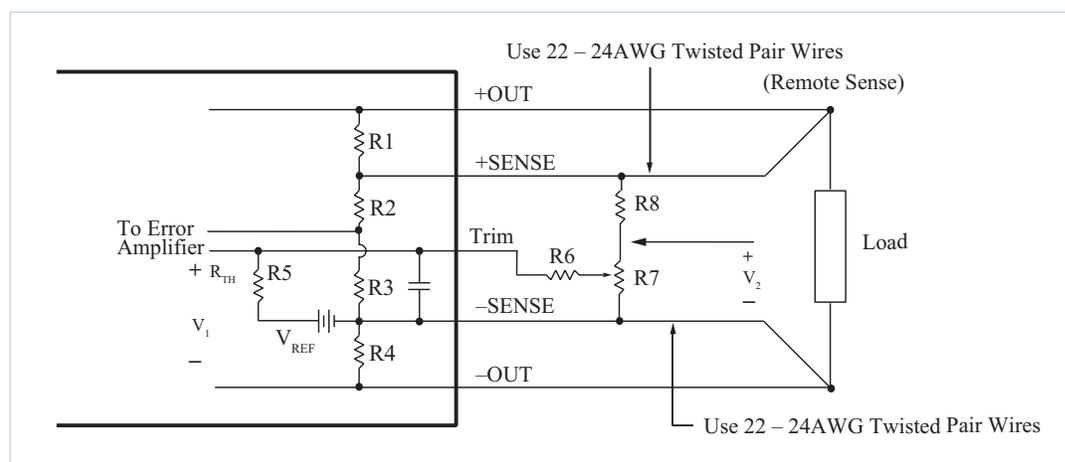
The Trim pin on J2 can be used to control the output voltage. It is referenced to the –SENSE pin on J2 and can be controlled by either a resistor network or an external voltage source. To increase an output voltage above its nominal, it is necessary to increase the voltage at the Trim pin above the internal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

Note: Converters are sometimes pretrimmed 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 below. Please consult the factory for assistance.

Table 1
Module internal reference
voltages and Thevenin
resistances

Output Module	V_{REF}	R_{TH}
VE-200 / VE-J00 \geq 3.3V	2.5V	10.0k Ω
VE-200 / VE-J00 $<$ 3.3V	0.97V	3.88k Ω
Maxi (Pre-Defined)	1.23V	1.0k Ω
Maxi (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:

$$V_1 = V_{REF} + 10\% = 2.75V$$

Given: $V_{REF} = 2.5V$ (see Table 1)

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

Setting the bottom limit:

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

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

$$R6 = V_{R6}/I_{R6} = 2.25V/25mA = 90k\Omega$$

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

$$I_{R7} = V_2/R7 = 5V/10k\Omega = 500\mu A$$

$$I_{R8} = I_{R7} + I_{R6} = 525\mu A$$

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

Given: $V_{NOM} = 12V$

$$R8 = V_{R8}/I_{R8} = 8.2V/525\mu A = 15.62k\Omega$$

Using the previous 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 Manual or consult the factory for assistance.

CONSULT APPLICATIONS ENGINEERING WHEN TRIMMING OUTPUTS BELOW 5V.]

Specifications

Input Characteristics	
Input Voltage	3-phase 208/240V _{AC} , 1-phase 180 – 264V _{AC} , (47 – 500Hz) 260 – 352V _{DC}
Power Factor (Passive)	0.92 (3-phase operation)
Inrush Current	30A _{RMS} at 230V _{AC}
Ride-Through Time	>20ms at nominal line, full load
Power Fail	>3ms warning
Conducted EMI (47 – 63Hz)	EN55022 Level A
Surge Immunity (Common Mode and Normal Mode)	EN 61000-4-5 Class 3 (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}
Output Characteristics	
VI-200™ / VI-J00™ Line/Load Regulation	0.2% max from 10 to 100% load; 0.5% max from 0 to 10% load
Maxi Line Regulation ^[h]	0.20% max to 0.30% max
Maxi Load Regulation ^[h]	0.20% max to 0.70% max
VI-200 / VI-J00 Setpoint 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} max, whichever is greater, 10% min load VXI options: 50mV _{p-p} < 15V _{DC} ; 150mV _{p-p} max for > 15V < 24V 1% ripple for > 24V; RamPAC™: 10mV _{p-p} max or 0.15% whichever is greater UniPAC™: see Vicor module specifications
Output Trim Range	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	ModuPACs™: 115 – 135%
Efficiency	82% typical
Output Power 4kW MegaPAC™ 3-Phase MegaPAC	4,000W at 45°C (3-phase); 1,500W at 45°C (1-phase) 2,000W at 45°C (3-phase); 1,200W at 45°C (1-phase)
Environmental Characteristics	
Storage Temperature	–40 to 85°C
Operating Temperature ^[h]	–20 to +45°C full power, –20 to +65°C half power
Humidity	0 – 95% non-condensing
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 40k.
Safety Approvals	cURus – UL 60950-1, CSA 60950-1 cTUVus – EN 60950-1, UL 60950-1, CSA 60950-1 CE Mark – Low Voltage Directive, 73/23/EEC amended by 93/68/EEC
Product Weights	3-Phase MegaPAC: 18.1lbs [8.21kgs] fully configured 4kW MegaPAC: 21.5lbs [9.77kgs] fully configured
Warranty	2 years limited warranty. See vicorpower.com for complete warranty statement.

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

^[i] Operating temperature is 45°C using any combination of modules and output voltages as long as the front-end rating is not exceeded. Normal de-rating applies to half power if the ambient temperature is 20°C hotter.

Current Share Boards – Optional Feature

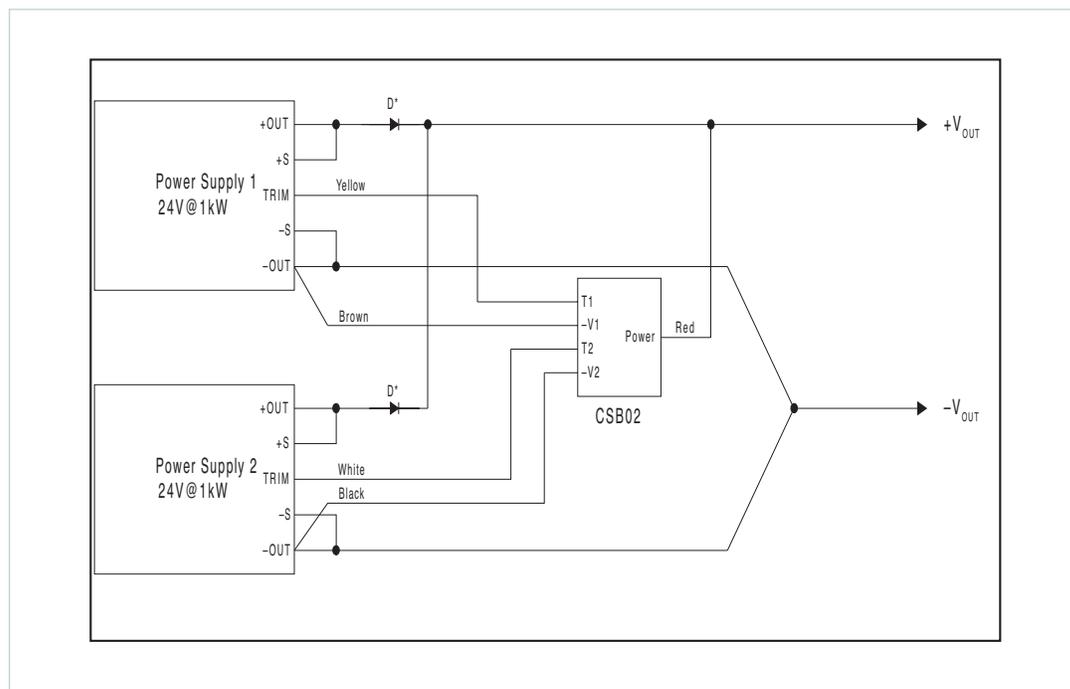
"Current sharing" also known as Load Sharing, is the ability to divide the output current evenly across all active power supplies. This greatly reduces stresses on each power supply and allows them to run cooler, resulting in higher reliability. Standard "current sharing" techniques typically utilize 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 >100Amps. 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 MegaPAC 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 $\pm 1\text{mV}$ accuracy between the Negative Output power rails. This accuracy translates to a 1% current sharing if there is a total of 100mV conduction 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



Current Share Boards – Optional Feature (Cont.)

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 1. 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 previously.
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

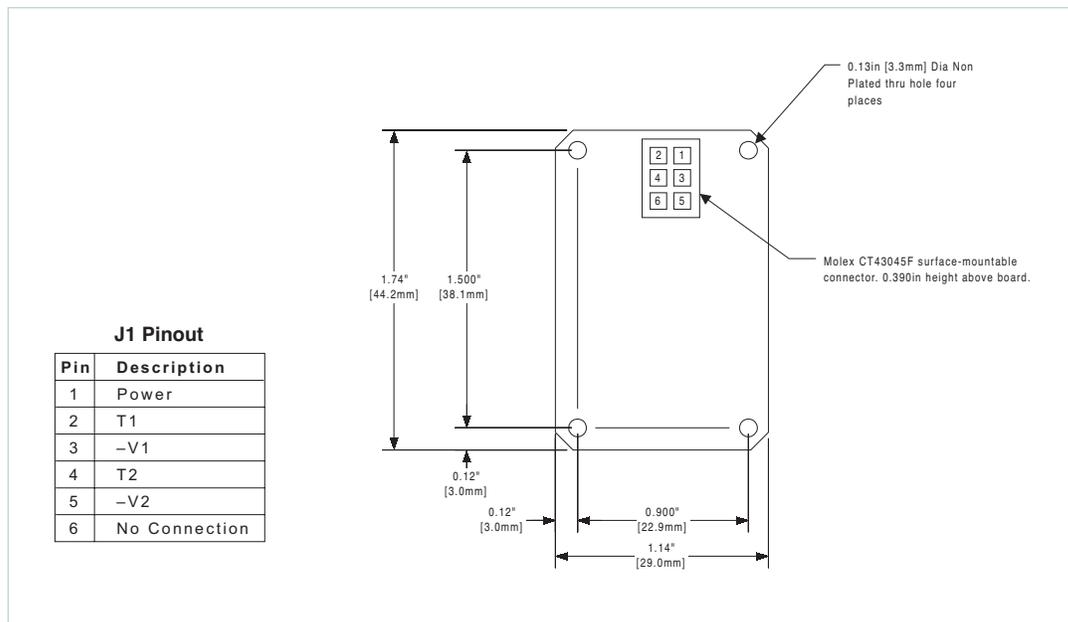
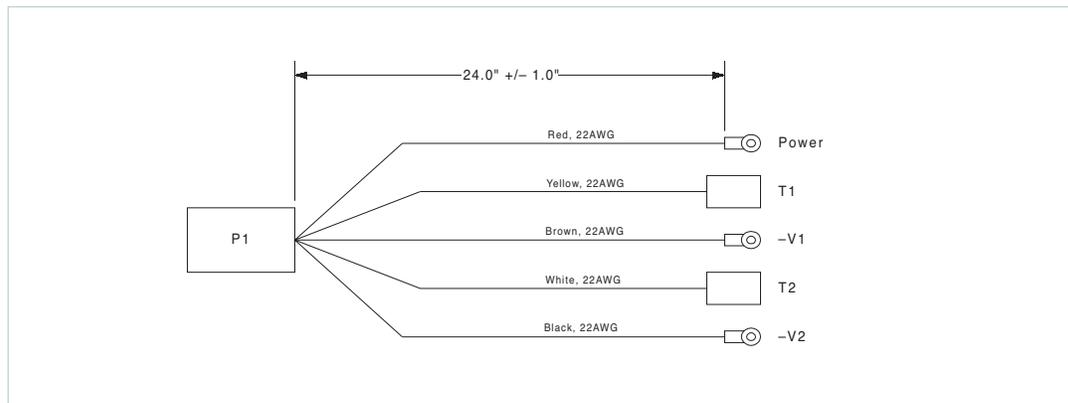


Figure 14
Cable drawing



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).
4. Use four, non-plated through holes with standoffs for mounting.
5. CSB01 MUST be used for current sharing VI-200™ / VI-J00™ converters.
6. CSB02 MUST be used for current sharing Maxi converters .

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

Contact your Regional Applications Engineer at 1-800-927-9474 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 500mA 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 500mA. 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 will 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 may be 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
ModuPAC™ (M)	FinPAC™ (PZ)
JuniorPAC™ (J)	UniPAC™ (XU)
DualPAC™ (D)	QPAC™ (XQ)
RamPAC™ (R)	375V UniPAC (XT)
BatPAC™ (B)	
QPAC™ (L)	
DualQPAC™ (LD)	
Junior QPAC™ (LJ)	

For RoHS-compliant versions a preceeding G is added to the part number.

Please note: The MegaPACs (including the Low Leakage versions) are not UL 2601/60601 compliant or EN60601 compliant.

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-ENT™

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

Limitation of Warranties

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