

# The MegaPAC™ Family

## AC-DC, DC-DC Switching Power Supplies



### Overview

The MegaPAC family is a line of field configurable switching power supplies that leverage Vicor’s DC-DC converters to provide maximum flexibility. Developing a custom power supply is as easy as selecting a MegaPAC chassis and sliding in the appropriate output assemblies, called ConverterPACs. With five different chassis, five different ConverterPAC styles and thousands of voltage and power combinations, there is a MegaPAC to fit almost any need.

Designing a customized power supply begins with selecting a chassis from the MegaPAC family; the PFC MegaPAC, Autoranging MegaPAC, Mini MegaPAC, Three Phase MegaPAC or DC MegaPAC. One or more can accept input voltages from 85 to 264Vac, 208/240 three phase, or 10 to 380Vdc. Maximum output power ranges up to 4000W, and all five are fan cooled. Standard features include output sequencing, general shutdown, AC OK and overcurrent protection.

Customized design continues by selecting the ConverterPACs that meet your requirements. Each ConverterPAC can be configured to provide one or two separate output voltages and up to 400W of power. Multiple ConverterPACs can be connected in parallel to achieve higher power levels. Best of all, ConverterPACs can be added or replaced with the turn of just one screw.

### MegaPAC Family Products

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## PFC MegaPAC Technical Description

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The PFC MegaPAC chassis consists of an off-line single phase, power factor corrected front end, EMC filter, cooling fan, customer interface and associated housekeeping circuits.

Input AC mains voltage (L1, L2/N and GND) is applied to a terminal block. The input current is passed through an EMC filter designed to meet conducted noise limit “B” specifications of FCC Part 15 and VDE 0871 and EN55022 level “B”. At start-up, inrush current is limited by a PTC thermistor prior to being passed to the power rectifiers. The PTC is shunted out shortly after initial power-up by a DC bus voltage sense circuit driving a relay. After rectification, the input voltage is put through a boost converter that keeps the AC input current sinusoidal and synchronized with the input AC voltage (in compliance with EN61000 at nominal line voltages). The boost converter delivers an unregulated 370Vdc to the hold-up capacitors and a high voltage backplane. The backplane supplies power to a variety of ConverterPAC assemblies that provide the desired low voltage, regulated outputs.

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 Vcc comes up within 1 sec after the application of input power. Once the high voltage bus is within its limits, the AC Power OK signal asserts to a TTL “1” indicating that the input power is OK, and allows the power outputs to come up within 15-30 ms. An auxiliary Vcc output of 5Vdc sourcing up to 0.3A is provided for peripheral use on interface connector J10-9.

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 associated for an output to come up when measured from release of the Enable/Disable pin is 5-10 ms. The General Shutdown function controls all outputs simultaneously, and works in a similar manner.

The ride-through (holdup) 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 1.2 seconds after initial power-up and may be used to indicate an impending loss of power. Approximately 3 ms of warning time is obtained. Following the loss of input power, the outputs are disabled after AC Power OK goes low.

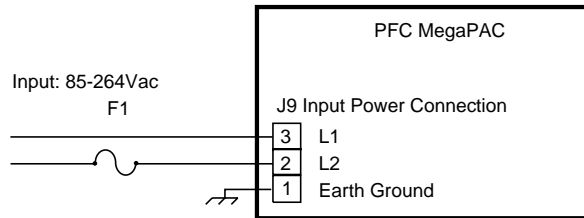
A fault-clearing device such as a fuse is required per safety agency conditions of acceptability. It should be sized to handle the specific load conditions but not to exceed 20A. 6 to 20A fast-acting ceramic body type fuses should be used, 3AB-6 to 3AB-20 respectively. For current ratings less than 6A, use a 3AB slow-blow type fuse. Fuses should be sized with sufficient voltage rating as well as current rating.

## PFC MegaPAC 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 12 AWG. The maximum torque recommended is 10 in-lbs. J9-1 (GND) is Earth Ground for safety; J9-2 (L2) is the Hot connection; J9-3 (L1/N) is the other Hot or input Neutral connection.

Figure 1.  
Input Connector J9

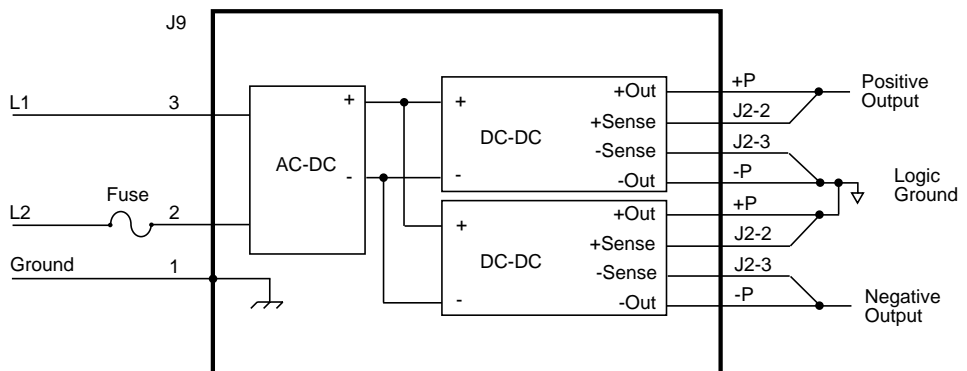


### Chassis Output Power Terminals

Depending on the ConverterPAC used, there are two types of output power terminals available in the PFC MegaPAC. For single output assemblies (ModuPAC/RamPAC/BatPAC), these terminals are two 1/4-20 plated steel bolts. The positive polarity of the output is the upper bolt. For DualPACs there is a 6-pin Molex connector for each output (J1A, J1B). For both connectors pins 1 and 4 are the +Output, and pins 2 and 5 are the -Output. Pins 3 and 6 are duplicates of the remote sense pins present on J2A and J2B. The top connector, J1B, provides the first voltage listed on the DualPAC, while the bottom connector, J1A, provides the second voltage. Each power output is isolated; thus outputs of positive or negative polarity may be configured by the user through proper selection of an output reference terminal.

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

Figure 2.  
Output Power Connections



**PFC Interface Connections (cont)**

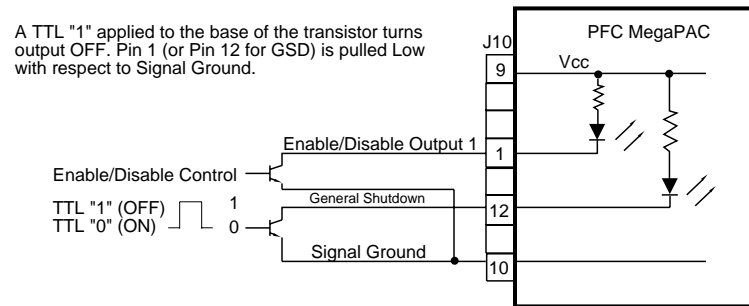
**Signal Ground (J10-10)**

Signal Ground on J10-10 is an isolated secondary ground reference for all J10 interfacing signals, and for ModuPAC output status signals such as Power Good. This is not the same as Earth Ground on input power connector J9.

**Enable/Disable (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. For DualPACs, both outputs are sequenced. In parallel arrays, only the driver ModuPAC 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 source 10mA maximum. These pins should be open circuited or allowed to exceed 4.5V when enabled. Do not apply more than 5V to these inputs at any time.

*Figure 3.  
Enable/Disable  
and General  
Shutdown*



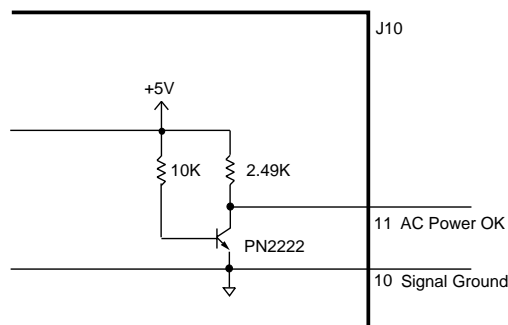
**General Shutdown GSD (J10-12)**

The GSD control pin on J10-12 allows simultaneous shutdown of all ConverterPAC outputs. This pin must be pulled down to less than 0.7V, and will source 13 mA maximum to shut down all outputs. The GSD pin should be open circuited or allowed to exceed 4.5V when not in use, or when the outputs are to be enabled. Do not apply more than 5V to this input at any time. Normal open circuit voltage is 1.5 to 3V with respect to Signal Ground.

**AC Power OK (J10-11)**

This is an active high TTL compatible signal, and provides a status indication of the AC input power. It is capable of sinking 20 mA 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" 3 ms (typical) before loss of output regulation due to the loss of input AC power. This signal may be used to warn external control circuits of an impending loss of power.

*Figure 4.  
AC Power OK*



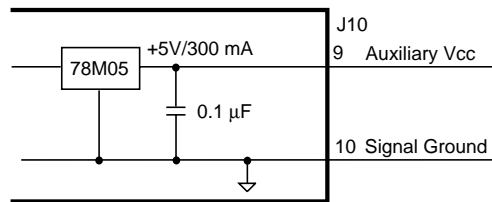
**PFC Interface Connections (cont)**

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

The Vcc on J10-9 is an auxiliary 5V regulated power source. It is +5Vdc +/-5% with respect to Signal Ground, and can supply 300 mA maximum. It is short circuit proof, but if shorted all outputs will shut down through the Enable/Disable circuitry.

The Auxiliary Vcc is typically used with the Power Good circuitry to provide a pull-up reference for the outputs of the DC Power Good circuit on a ModuPAC (Figure 5, below). If used for this purpose, then the Signal Ground on J10-10 must also be connected to the J3-4 Signal Ground pin of the ModuPAC.

Figure 5.  
Auxiliary Vcc



**PFC MegaPAC Output Power Derating**

Figure 6.  
Maximum  
Output Power vs.  
AC Input Voltage

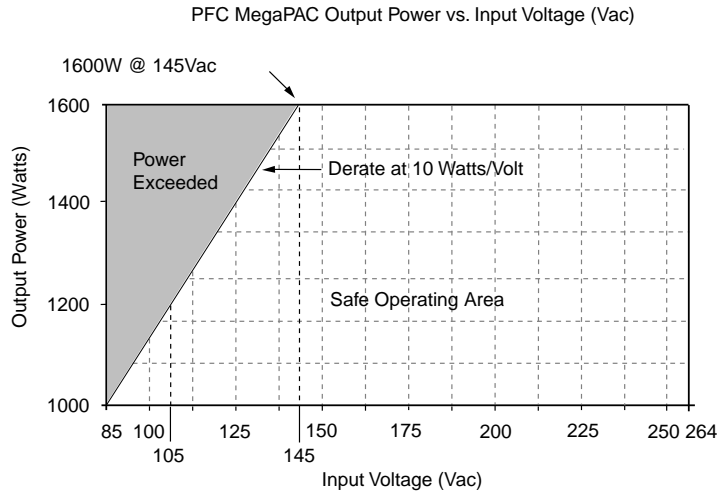
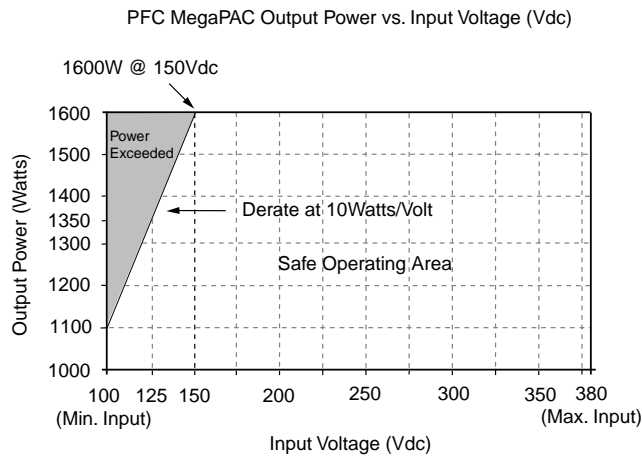


Figure 7.  
Maximum  
Output Power vs.  
DC Input Voltage

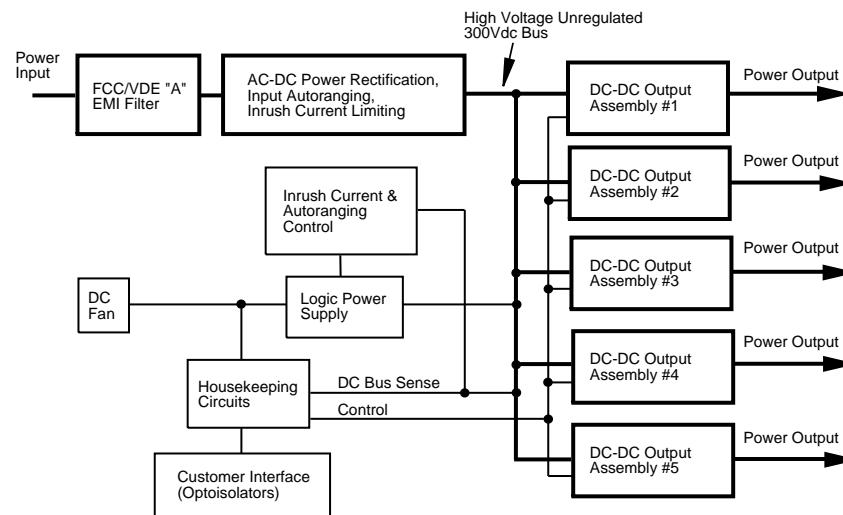


## Autoranging MegaPAC/Mini MegaPAC Technical Description

The MegaPAC and Mini MegaPAC chassis consist of an off-line single phase AC front end, EMC filter, cooling fan, customer interface and associated housekeeping circuits.

Input AC mains voltage (L1, L2/N and GND) is applied to a terminal block. The input current is passed through an EMC filter designed to meet conducted noise limit “A” specifications of FCC Part 15 and VDE 0871. At start-up, inrush current is limited by an NTC thermistor prior to being passed to the power rectifiers. The NTC is shunted out shortly after initial power-up by a relay driven by a DC bus voltage sense circuit. The sense circuit also controls the input autoranging selection relay on the autoranging MegaPAC. The power rectifiers and filter capacitors are arranged in a conventional full wave bridge rectifier/voltage doubler configuration. This operates as a full wave bridge rectifier on 230Vac, and voltage doubler on 115Vac, delivering unregulated 300Vdc to a high voltage backplane. The backplane supplies power to a variety of ConverterPAC assemblies that provide the desired low voltage, regulated outputs.

Figure 8.  
MegaPAC and  
Mini MegaPAC  
Architecture



At initial power-up, the MegaPAC outputs are disabled to limit the inrush current, reduce peak currents in the autoranging relay contacts, 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. When operating on 115Vac, the internal housekeeping Vcc comes up within 1,000 ms after the application of input power. On 230Vac, it comes up within 500 ms. The input range selection circuit in the Autoranging MegaPAC may take up to 200 ms to select the range if 115Vac is applied. When 230Vac is applied, the circuit immediately selects for operation on 230Vac. The Mini MegaPAC must be manually strapped for 115Vac or 230Vac operation. Once the input range selection has taken place, the AC Power OK signal asserts to a TTL “1” indicating that the input power is OK, and allows the power outputs to come up within 15-30 ms later. An auxiliary Vcc output of 5Vdc sourcing up to 0.3A is provided for peripheral use on interface connector J10-9.

## Autoranging MegaPAC/Mini MegaPAC Interface Connections

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 associated for an output to come up when measured from release of the Enable/Disable pin is 5-10 ms. The General Shutdown function controls all outputs simultaneously, and works in a similar manner.

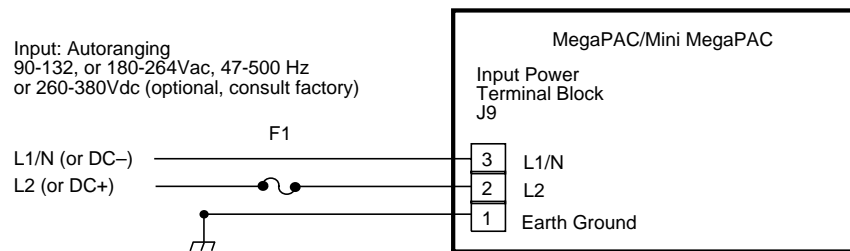
The ride-through (holdup) time is the amount of time the load can be supported before loss of output regulation after the loss of input power. Detecting the loss of input power takes a finite time period after which the AC Power OK signal goes from a TTL “1” to “0”. This signal is available for use within 1.2 seconds after initial power-up and may be used to indicate an impending loss of power. Approximately 3 ms of warning time is obtained. Following the loss of input power, the outputs are disabled after AC Power OK goes low.

### 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 10 AWG. The maximum torque recommended is 10 in-lbs. J9-1 (GND) is Earth Ground for safety; J9-2 (L2) is the Hot connection; J9-3 (L1/N) is the other Hot or input Neutral connection.

A fault clearing device such as a fuse is required per safety agency conditions of acceptability. It should be sized to handle the specific load conditions. The Autoranging MegaPAC should use a max. 30A fast-blow fuse for 1200W, 115Vac operation and a max. 25A fast-blow fuse for 1600W, 230Vac operation. The Mini MegaPAC should use a 25A max. fast blow fuse. For current ratings less than 6A, use a 3AB slow-blow type fuse. Fuses should be sized with sufficient voltage rating as well as current rating.

Figure 9.  
Input Power  
Connections



Note: An input fault clearing device, such as fuse F1 or a circuit breaker is recommended.

### Signal Ground (J10-10)

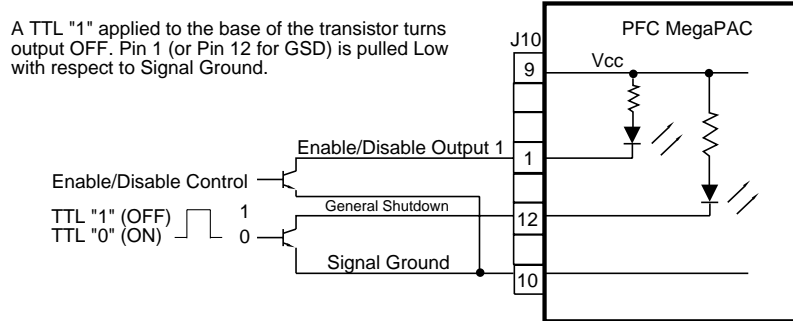
Signal Ground on J10-10 is an isolated secondary ground reference for all J10 interfacing signals, and for ModuPAC output status signals such as Power Good. This is not the same as Earth Ground on input power connector J9.

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

The Enable/Disable control pins allow ConverterPAC outputs to be sequenced either on or off. For the Autoranging MegaPAC, J10-1 through J10-8 are the control pins for output positions 1 through 8, respectively. For the Mini MegaPAC, J10-1 through J10-5 control the outputs for position 1 through 5. For DualPACs, both outputs are sequenced together. In parallel arrays, only the driver ModuPAC 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 source 10 mA maximum. These pins should be open circuited or allowed to exceed 4.5V when enabled. Do not apply more than 8V to these inputs at any time.

**Autoranging MegaPAC/Mini MegaPAC Interface Connections (cont)**

*Figure 10.  
Enable/Disable  
General Shutdown*



**General Shutdown GSD (J10-12)**

The GSD control pin on J10-12 allows simultaneous shutdown of all ConverterPAC outputs. This pin must be pulled down to less than 0.7V, and will source 13 mA maximum to shut down all outputs. The GSD pin should be open circuited or allowed to exceed 4.5V when not in use, or when the outputs are to be enabled. Do not apply more than 8V to this input at any time. Normal open circuit voltage is 1.5 to 3V with respect to Signal Ground.

**AC Power OK (J10-11)**

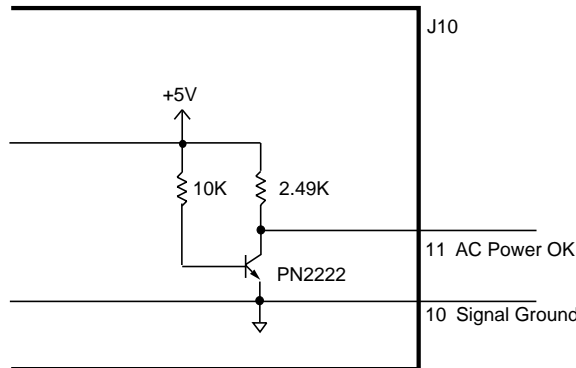
This is an active high TTL compatible signal, and provides a status indication of the AC input power. It is capable of sinking 20 mA maximum. This signal switches to a TTL "1" when the high voltage bus exceeds low-line condition during turn-on, and switches to a TTL "0" 3 ms (typical) before loss of output regulation due to the loss of input AC power. This signal may be used to warn external control circuits of an impending loss of power.

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

The Vcc on J10-9 is an auxiliary 5V regulated power source. It is +5Vdc +/-5% with respect to Signal Ground, and can supply 300 mA maximum. It is short circuit proof, but if shorted all outputs will shut down through the Enable/Disable circuitry.

The Auxiliary Vcc is typically used with the Power Good circuitry to provide a pull-up reference for the outputs of the DC Power Good circuit on a ConverterPAC (Figure 11, below). If used for this purpose, then the Signal Ground on J10-10 must also be connected to the J3-4 Signal Ground pin of the ModuPAC.

*Figure 11.  
AC Power OK*





## Autoranging MegaPAC/Mini MegaPAC Interface Connections (cont)

### Vcc (J3-1)

The Vcc on J3-1 is an input that requires +5V either from the Auxiliary Vcc on J10-9, or from another source. Input current to this pin is limited by an internal resistor to 3 mA. If the Auxiliary Vcc on J10-9 is connected to Vcc on J3-1, then Signal Ground J10-10 must also be connected to Signal Ground on J3-4.

## Three Phase MegaPAC Technical Description

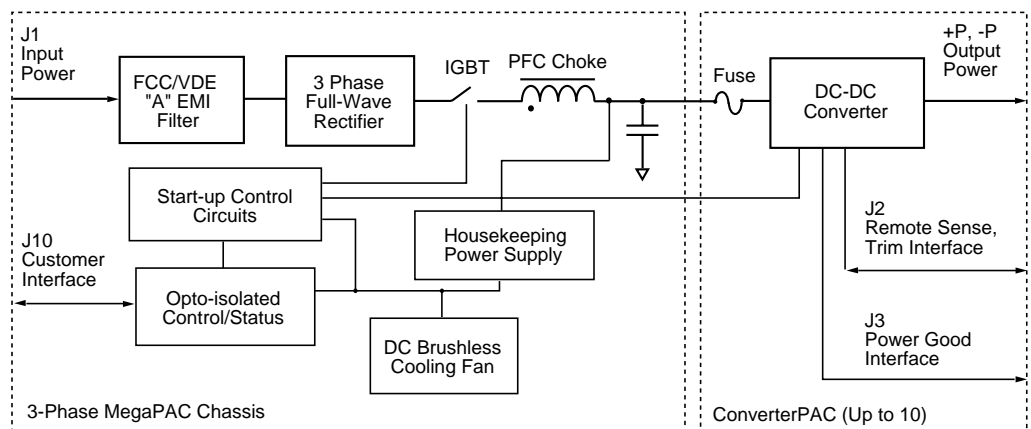
A Three Phase MegaPAC is configured by installing DC-DC ConverterPAC assemblies into a three phase front-end chassis. The chassis takes three phase AC input power and performs filtering and rectification functions. The ConverterPACs plug into a high-voltage backplane and provide low-noise, independently regulated and fully isolated outputs.

### Three Phase MegaPAC Chassis

Input AC mains voltage (L1, L2, L3 and GND) is applied to an agency-approved mating plug. The input current is passed through an EMC filter designed to meet conducted noise limit "A" specifications of FCC Part 15 and VDE 0871, before it is passed to a three-phase full-wave bridge rectifier. The rectifier charges-up storage capacitors and delivers unregulated 300Vdc 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. The backplane supplies power to a variety of ConverterPAC assemblies that provide the desired low-voltage, regulated outputs.

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. Excessive input currents caused by loss of a phase, or excessive output loading in single phase operation, will safely shut down the unit and provide a phase fail indication until input power is recycled. This occurs when the peak input current reaches 30A. Analog and digital temperature monitors are provided, as well as overtemperature shutdown. An active-high TTL compatible, Enable control is included for each ConverterPAC assembly, as well as an active-low General Shutdown control; the polarities, active-high or active-low, are factory set. Three Phase MegaPACs can be safely paralleled with accurate current sharing for high power systems. All interface signals are safety-isolated using a common floating return.

Figure 12.  
Three-Phase MegaPAC  
Architecture



### Three Phase MegaPAC Technical Description (cont)

Upon power-up, all outputs are first disabled to limit the inrush current, and to allow the unregulated 300Vdc to reach correct operating levels for ConverterPAC assemblies. The internal housekeeping supply comes up within 500 ms after input power is applied, at which time the AC Power OK signal asserts to a TTL “1,” indicating that the input power is OK. The low-voltage power outputs come up within 10-20 ms after the AC Power OK asserts to a TTL “1.” Output ramp-up time from Enable or General Shutdown is 10-20 ms. Output fall time from Disable is dependent on load, but typically a few hundred microseconds.

### Three Phase MegaPAC Interface Connections

#### Input Power Connections (J1)

Input AC power is applied to a plug-in connector, J1, that accepts soldered terminals with a maximum wire size of 12 AWG. For operation on high voltage DC input, input power may be connected to any two input lines. A fault-clearing device, such as a fuse, at the power supply input is required per safety agency conditions of acceptability. A user-accessible input fuse is not present within the unit. For an output of 2000W with operation on 208Vac, 3Ø input, a 20A slow-blow fuse in each input line is acceptable. Input power cables should be shielded to minimize radiated noise effects.

The Three Phase MegaPAC can also operate from a single phase 230Vac input; however, the output power must be limited to 1200W.

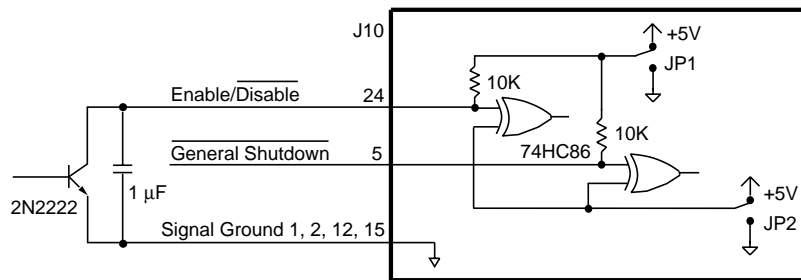
#### Signal Ground (J10)

Signal Ground on J10 pins 1, 2, 12, and 15 is an isolated secondary ground reference for all J10 interface signals. This is not the same as Earth Ground on input power connector J1.

#### Enable/Disable and General Shutdown (GSD) (J10)

The Enable/Disable control lines allow individual ConverterPAC outputs to be sequenced either on or off via TTL compatible HCMOS control inputs. For DualPACs, both outputs are sequenced together. In parallel arrays, only the driver ModuPAC needs to be sequenced. The GSD control line on J10-5 allows simultaneous shutdown of all ConverterPAC outputs. An internal jumper, JP2, selects polarity, either active-high or active-low. A jumper, JP1, selects a pull-up or pull-down source for the HCMOS control inputs.

Figure 13.  
Enable/Disable and  
General Shutdown



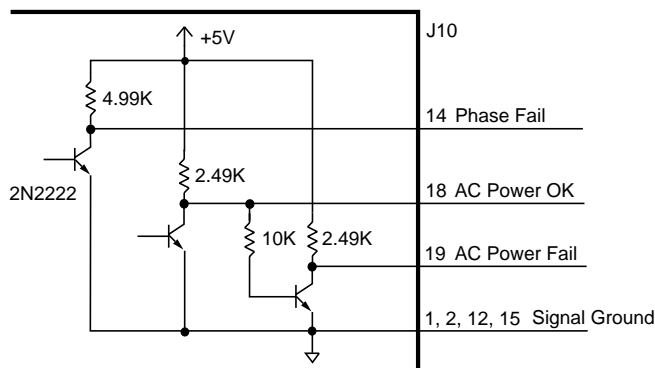
## Three Phase MegaPAC Interface Connections (cont)

For standard Three Phase MegaPACs, the Enable/Disable controls are configured as active-high 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. 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 (1  $\mu$ F, typical).

### AC Power OK (J10-18)

This signal on J10-18 provides a status of the AC input power. It is active high, TTL compatible and capable of sinking 10 mA 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” 3 ms (typical) before loss of output regulation due to the loss of input AC power. This signal may be used to warn external control circuits of an impending loss of power.

Figure 14.  
AC Power OK,  
AC Power Fail and  
Phase 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 sinking 10 mA 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 10 mA.

### Analog Temperature (J10-4)

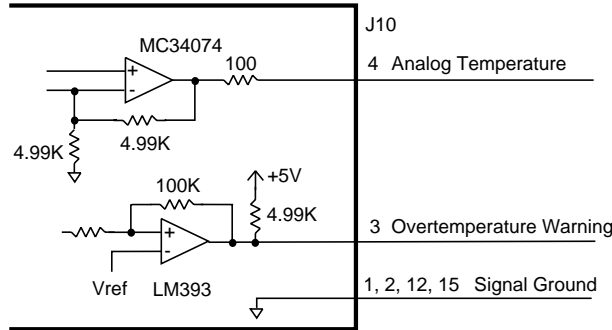
J10-4 provides an analog DC voltage between 0V and 10V, representing an inlet air temperature of 0°C to 100°C, respectively. The temperature is monitored close to the fan.

### Overtemperature Warning (J10-3)

J10-3 asserts a TTL level “1” if the inlet air temperature exceeds the following factory set levels. For standard units, the warning trip point is between 65°C to 76°C. The recovery point is 1°C lower than the actual trip point.

### Three Phase MegaPAC Interface Connections (cont)

Figure 15.  
Analog Temperature  
and Overtemperature  
Warning



#### Overtemperature Shutdown

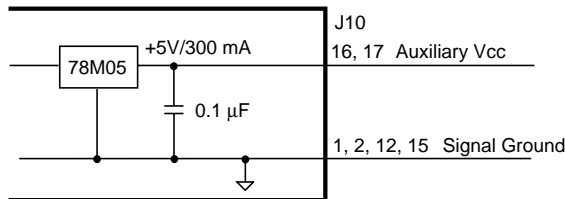
If the inlet ambient air temperature exceeds the following factory set levels, then all outputs are disabled. For standard units the shutdown trip point is between 70°C to 81°C. The recovery point is 10°C lower than the actual trip point.

#### Auxiliary Vcc (J10-16,17)

J10 pins 16 and 17 provide an auxiliary regulated power source. It is +5Vdc +/-5% with respect to Signal Ground, and can supply 300 mA maximum. It is short circuit proof, but if shorted, all outputs will shut down.

The Auxiliary Vcc can be used to provide a pull-up reference for the Power Good circuit on ConverterPACs. In this case, Signal Ground on J10 must also be connected to Signal Ground on J3-4 of the ConverterPAC Power Good connector.

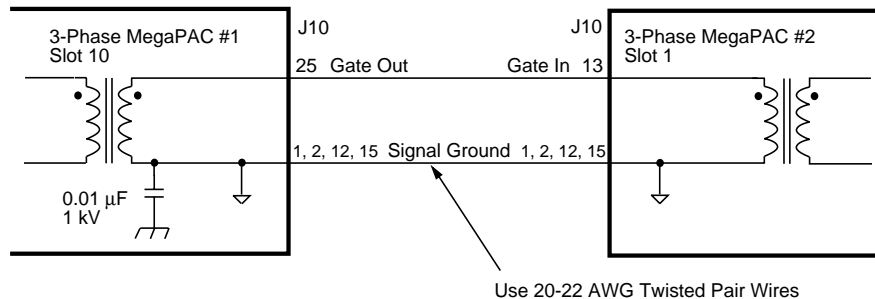
Figure 16.  
Auxiliary Vcc



#### Gate-In, Gate-Out (J10-13,25)

Gate-In and Gate-Out signals are used for paralleling Three Phase MegaPACs for high power systems using a proprietary driver/booster technique that provides accurate current sharing between units. One channel may be paralleled, i.e., one output voltage from unit #1 may be connected to unit #2. The Three Phase MegaPAC #1 provides a signal from output slot #10 at J10-25, to slot #1 in the Three-Phase MegaPAC #2 at J10-13. These signals are referenced to Signal Ground on J10. Use twisted pair 20-22 AWG wires. Do not separate the units by more than six feet.

Figure 17.  
Gate-In and Gate-Out

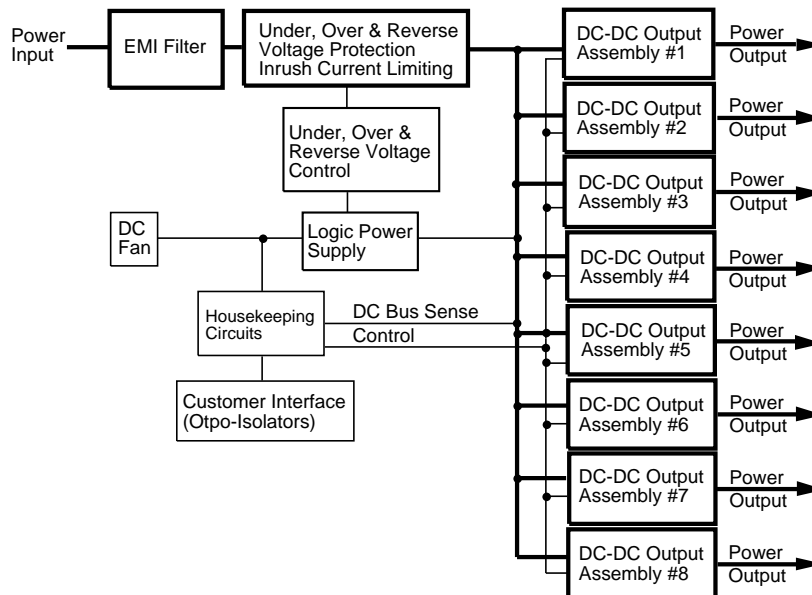


## DC MegaPAC Technical Description

The DC MegaPAC chassis consists of an EMC filter, cooling fan, customer interface and associated housekeeping circuits.

Input DC voltage (+Vin, -Vin and GND) is applied to the input connectors. The input current is passed through an EMC filter designed to meet British Telecom specifications. At start-up, inrush current is limited by a thermistor. The thermistor is shunted out shortly after initial power-up by a relay driven by a DC bus voltage sense circuit. The DC voltage is then fed to the backplane. The backplane supplies power to a variety of ConverterPAC assemblies that provide the desired voltage, regulated outputs.

Figure 18.  
DC MegaPAC  
Architecture



At initial power-up, the DC MegaPAC outputs are disabled to limit the inrush current and to allow the DC bus potential to charge to the operating level. A low-power flyback converter operating with PWM current-mode control converts the voltage DC bus into regulated low voltage to power the internal housekeeping circuits and DC cooling fan. The internal housekeeping Vcc comes up within three seconds after the application of input power. Once the input range is within specification, the Vin OK signal asserts to a TTL "1" indicating that the input voltage is OK, and allows the power outputs to be enabled. The power outputs will be in regulation 500 ms after the Vin OK signal asserts to a TTL "1". An auxiliary Vcc output of 5Vdc sourcing up to 0.3A is provided for peripheral use on interface connector J10-16 and J10-17.

## DC MegaPAC Interface Connections

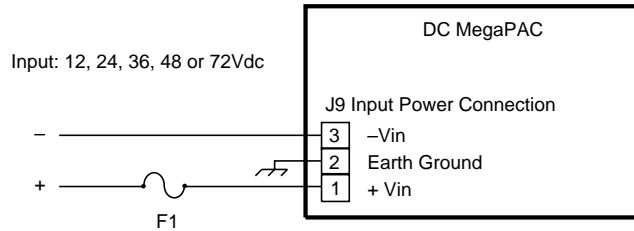
### Chassis Input Power Terminals (J9)

Input DC power is applied to solderless lugs J9, using a wire size of 2 AWG. J9-1 is the +DC Voltage IN connection and J9-3 is the -DC Voltage IN connection. The Earth Ground is accessed via J9-2, a size 10-32 self-locking PEM nut. Max. torque recommended is 25 in-lbs. A fault clearing device such as a fuse or circuit breaker at the power supply input is strongly recommended. For an output of 1600W with operation on 48Vdc (and low line operation

## DC MegaPAC Interface Connections (cont)

of 42V), a fast-blow fuse of 50 Amps is recommended. Start-up inrush current is limited by a 10Ω thermistor and in most cases will be less than nominal line current during operation. Start-up inrush current can be calculated by  $I = \text{MaxVin}/10$  (where MaxVin is the maximum operating voltage, see Table 1, page 20-16). Example: for a nominal 48V input, the maximum operating voltage is 60V, therefore,  $I = 60\text{V}/10 = 6$  Amps.

Figure 19.  
Input Connector J9



**NOTE:** An input fault clearing device such as fuse F1, or a circuit breaker is required per safety agency conditions of acceptability.

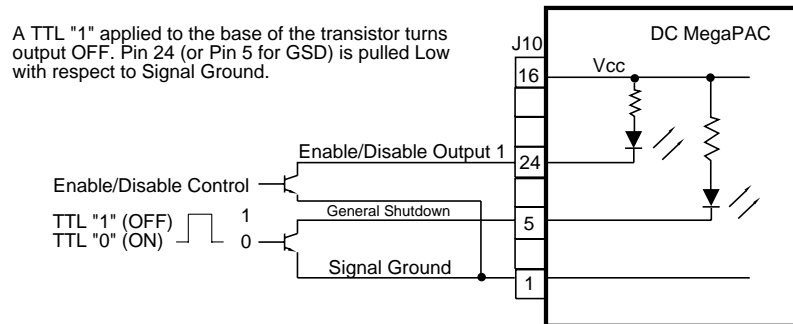
### Signal Ground (J10-1,2,12,15)

Signal Ground on J10-1, 2, 12 and 15 are isolated secondary ground references for all J10 interfacing signals. This is not the same as Earth Ground on input power connector J9.

### Enable/Disable (J10)

The Enable/Disable control pins allow ConverterPAC outputs to be sequenced either on or off; see outline drawing for locations. For DualPACs, both outputs are sequenced together. In parallel arrays, 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 source 8 mA maximum. These pins should be open circuited or allowed to exceed 4.5V when enabled. Do not apply more than 8V 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 20.  
Enable/Disable  
and General  
Shutdown



### General Shutdown (GSD) (J10-5)

The GSD control pin on J10-5 allows simultaneous shutdown of all ConverterPAC outputs. This pin must be pulled low to less than 0.7V, and will source 8 mA maximum to shut down all outputs. The GSD pin should be open circuited or allowed to exceed 4.5V when not in use, or when the outputs are to be enabled. Do not apply more than 8V to this input at any time. Normal open circuit voltage is 1.5 to 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.

## DC MegaPAC Interface Connections (cont)

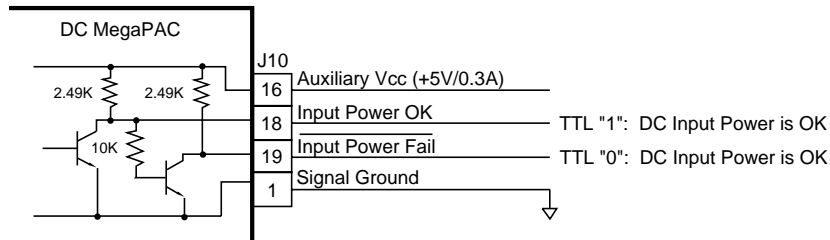
### Input Power OK (J10-18)

This is an active high TTL compatible signal on pin J10-18, and provides a status indication of the DC input power. It is capable of sinking 20 mA maximum. This signal switches to a TTL “1” when  $V_{in}$  voltage is within specification. See Table 1, page 20-16 for specifications.

### Input Power Fail (J10-19)

The Input Power Fail signal on pin J10-19 is the inverse of the Input Power OK signal on J10-18, and goes to a TTL “0” when the input DC power is OK. It is capable of sinking 20 mA maximum.

Figure 21.  
Input Power OK,  
Input Power Fail



### Analog Temperature (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°C to 100°C, respectively, inside the power supply. The inlet air temperature is monitored close to the fan.

### 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°C to 76°C typically and the recovery point is 1°C lower than the actual trip point.

### Overtemperature Shutdown

If the inlet ambient air temperature exceeds the following factory set levels, then the outputs are disabled. The shutdown trip point is 70°C to 81°C typically and the recovery point is 10°C lower than the actual trip point.

### Gate In/Gate Out (J10-13,25)

The Gate In and Gate Out signals are used for paralleling DC MegaPACs for power expansion. The Gate Out signal, J10-25, of the driver DC MegaPAC should be connected to the Gate In, J10-13, of the Booster DC MegaPAC; J10 signal ground of the driver DC MegaPAC also needs to be connected to J10 signal ground of the booster DC MegaPAC.

The driver DC MegaPAC (ModuPAC, slot #8) generates the Gate Out signal and sends it to the booster DC MegaPAC (ModuPAC, slot #1). Vicor’s zero-current-switching Booster technology provides for accurate, dynamic power sharing within arrays, without the need for trimming, module “matching” or external components.

### Auxiliary Vcc +5V/0.3A (J10-16,17)

The Vcc on J10-16, 17 is an auxiliary 5V regulated power source. It is +5Vdc +/-5% with respect to Signal Ground, and can supply 300 mA maximum. It is short circuit protected, but if shorted all outputs will shut down through the Enable/Disable circuitry.

The Auxiliary Vcc can be 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, then the Signal Ground on J10-1, 2, 12 or 15 must also be connected to the J3-4 Signal Ground pin of the ConverterPAC.

## DC MegaPAC Input Voltage Range and Vin OK Limits

Table 1.

| Code | Operating Range |          |           | Vin OK Trigger   |                   |
|------|-----------------|----------|-----------|------------------|-------------------|
|      | Nominal Vdc     | Low Line | High Line | Low Line Cut off | High Line Cut off |
| 0    | 12V             | 10V      | 20V       | 6V to 10V        | 20V to 23V        |
| 1    | 24V             | 21V      | 32V       | 16V to 21V       | 32V to 36V        |
| W    | 24V Wide        | 18V      | 36V       | 12V to 18V       | 36V to 41V        |
| 2    | 36V             | 21V      | 56V       | 11V to 21V       | 56V to 63V        |
| 3    | 48V             | 42V      | 60V       | 34V to 42V       | 60V to 68V        |
| N    | 48V Wide        | 36V      | 76V       | 23V to 36V       | 76V to 86V        |
| 4    | 72V             | 55V      | 100V      | 40V to 55V       | 100V to 112V*     |

\*Do not apply greater than 100V to the input of the DC MegaPAC.

## ConverterPAC Functional Descriptions

A brief description of the standard output assemblies and the power and interface connections is provided. Please refer to the MegaPAC Family data sheet for technical specifications and mechanical details.

### ModuPAC

The ModuPAC output assembly consists of a VI-200 DC-DC converter that converts the unregulated high voltage bus to the desired regulated output voltage. The converter is fused with a PC-Tron 3A fast-acting fuse in the positive input terminal. The output of the converter contains a passive LC filter to reduce output ripple/noise down to 1% (typ.), and 2% (max.) when measured peak to peak up to a 20 MHz bandwidth from 10% to 100% of rated load of the converter. To meet VXI noise level standards the “V2” option can be selected for outputs up to 15Vdc, and the “V1” option can be selected for 24Vdc outputs. Option “V2” limits output ripple/noise to 50 mV peak to peak, and option “V1” limits output ripple/noise to 150 mV peak to peak. An optional DC Power Good signal and/or output voltage adjustment potentiometer may be specified.

The ModuPAC contains output overvoltage protection (OVP), overcurrent protection (OCP), and overtemperature protection (OTP). The OCP has automatic recovery when the overcurrent condition is removed. The OVP and OTP are latching functions, and require recycling of the AC input power to restart.

### JuniorPAC

The JuniorPAC consists of one VI-J00 DC-DC converter that converts the unregulated input voltage to the desired regulated output voltage. The assembly is fused with a single PC-Tron fast-acting fuse. The output contains a passive LC filter to reduce output ripple/noise to 1% (typ.), and 2% (max.) when measured peak to peak up to a 20 MHz bandwidth from 10% to 100% of rated load of the converters. To meet VXI noise level standards the “V2” option can be selected for outputs up to 15Vdc, and the “V1” option can be selected for 24Vdc outputs.

Option “V2” limits output ripple/noise to 50 mV peak to peak and option “V1” limits output ripple/noise to 150 mV peak to peak. An optional DC Power Good signal and/or output voltage adjustment potentiometer may be specified.



## ConverterPAC Functional Descriptions (cont)

The JuniorPAC contains output overcurrent protection which recovers automatically when the overcurrent condition is removed. Overvoltage and overtemperature protection are not available.

### DualPAC

This output assembly consists of two VI-J00 DC-DC converters that convert the unregulated high voltage bus to the desired regulated output voltages. The assembly is fused with a single PC-Tron 3A fast-acting fuse. The output of each converter contains a passive LC filter to reduce output ripple/noise to 1% (typ.), and 2% (max.) when measured peak to peak up to a 20 MHz bandwidth from 10% to 100% of rated load of the ConverterPACs. To meet VXI noise level standards the “V2” option can be selected for outputs up to 15Vdc, and the “V1” option can be selected for 24Vdc outputs. Option “V2” limits output ripple/noise to 50 mV peak to peak and option “V1” limits output ripple/noise to 150 mV peak to peak. An optional output voltage adjustment potentiometer may be specified for each output. DC Power Good signal is not available. When using the Enable/Disable feature on any MegaPAC, both outputs on a DualPAC are controlled simultaneously.

The DualPAC contains output overcurrent protection which recovers automatically when the overcurrent condition is removed. Overvoltage and overtemperature protection are not available.

### RAMPAC

This output assembly consists of a VI-J00 DC-DC converter with a Ripple Attenuator Module (VI-RAM) and is often used in applications requiring low output ripple/noise. The RAMPAC attenuates the ripple/noise down to 10 mV when measured peak to peak over a 20 MHz bandwidth from 10% to 100% of rated load of the converter. The converter is also fused at the input with a PC-Tron 3A fast-acting fuse. An optional DC Power Good signal, or output voltage adjustment potentiometer may be specified.

The RAMPAC contains output overcurrent protection which recovers automatically when the overcurrent condition is removed. Overvoltage and overtemperature protection are not available.

### BatPAC

The BatPAC output assembly consists of a VI-200 BatMod current source that converts the unregulated input voltage to the desired regulated output current or voltage. The converter is fused with a PC-Tron fast-acting fuse in the positive input terminal. This is a programmable current source that may be configured as a battery charger. Overvoltage and overtemperature protection are not available. Maximum current and voltage settings are made using potentiometers that come as a standard feature. An option to control these maximum settings externally is also available.

|  | ConverterPAC | OVP  | OCP  | OTP  | RS   | LS   | PG   | TrimPot |
|--|--------------|------|------|------|------|------|------|---------|
| <i>Table 2.<br/>Summary of<br/>ConverterPAC<br/>Features</i> | ModuPAC      | Std. | Std. | Std. | Std. | Opt. | Opt. | Opt.    |
|  | DualPAC      | N/A  | Std. | N/A  | Std. | Opt. | N/A  | Opt.    |
|  | JuniorPAC    | N/A  | Std. | N/A  | Std. | Opt. | Opt. | Opt.    |
|  | RAMPAC       | N/A  | Std. | N/A  | Std. | Opt. | Opt. | Opt.    |
|  | BatPAC       | N/A  | Std. | N/A  | N/A  | Std. | N/A  | Std.    |

OVP: Overvoltage Protection

OCP: Overcurrent Protection

OTP: Overtemperature Protection

RS: Remote Sense

LS: Local Sense

PG: Power Good

**ConverterPAC Functional Descriptions (cont)**

**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. It is capable of sinking 20 mA maximum when 5V is used as Vcc. 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.

**Power Good Inverted (J3-2)**

This is the inverse of the Power Good signal on J3-3, referenced to Signal Ground on J3-1.

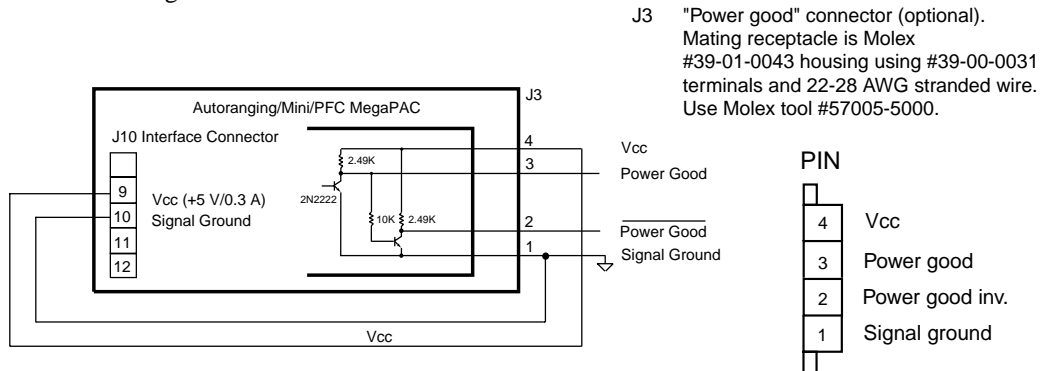
**Signal Ground (J3-1)**

Signal Ground on J3-1 is an isolated secondary ground reference for all 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 (J3-4)**

The Vcc on J3-1 is an input that requires +5V either from the Auxiliary Vcc on J10-9, or from another source. Input current to this pin is limited by an internal resistor to 3 mA. If the Auxiliary Vcc on J10-9 is connected to Vcc on J3-4, then Signal Ground J10-10 must also be connected to Signal Ground on J3-1.

Figure 22.  
Power Good and  
Vcc



**ConverterPAC Remote Sense and Trim Interface**

(J2 for Single Outputs or J2A and J2B for Dual Outputs)

**+Sense/–Sense (J2)**

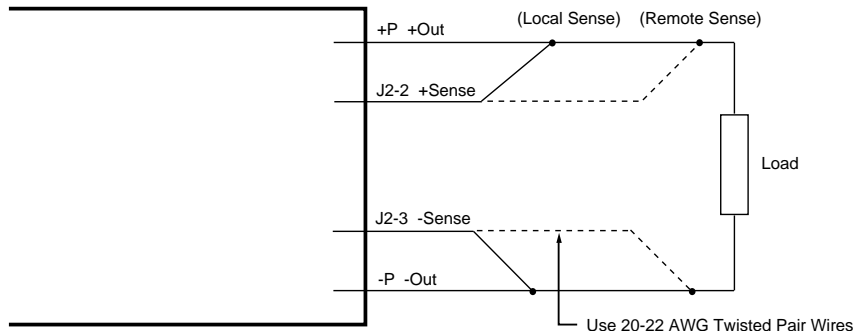
The +Sense on J2-2 should be connected to the +Power Out, and the –Sense on J2-3 to the –Power Out terminal. Do not leave the Sense pins open.

These pins may 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 can be obtained. Use twisted pair 20-22 AWG 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 power connectors J1A and J1B.

ConverterPAC Functional Descriptions (cont)

Figure 23.  
Sense Leads

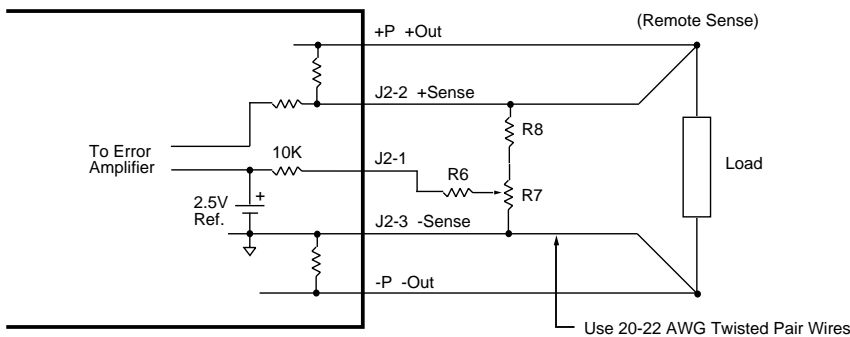


Trim (J2)

The Trim pin on J2-1 may be used to control the output voltage. It is referenced to the -Sense pin on J2-3. For DualPACs, the Trim pins are available on connectors designated as J2A-1 and J2B-1 for outputs A and B, respectively.

Trimming is accomplished by using the techniques shown earlier in Section 5, *Output Voltage Trimming*. These techniques show how a potentiometer placed external to the power supply may be used to adjust the output voltage (Figure 24, below). Alternatively, a digital-to-analog converter (DAC) may be used to program the output voltage from 50% to 110% of nominal as the DAC output is controlled from 1.25 to 2.75Vdc.

Figure 24.  
External Trim



MegaPAC Mechanical Considerations

The MegaPAC Family may be mounted on any of four surfaces using standard 8-32/M4 size screws. The chassis comes with four mounting points on each surface; maximum allowable torque is 20 in.-lbs. The maximum penetration is 0.15 in (3.7 mm).

When selecting a mounting location and orientation, the unit should be positioned so that air flow is not restricted. Maintain a 2" minimum clearance at both ends of the MegaPAC and route all cables so that airflow is not obstructed. The standard unit draws air in at the fan side and exhausts air out the load side. If airflow ducting is used, pay attention as sharp turns could present back pressure to the MegaPAC. The fan moves approximately 30 CFM of air (38 CFM for Three-Phase MegaPAC).

## MegaPAC Mechanical Considerations (cont)

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Avoid excessive bending of output power cables after they are connected to the MegaPAC. For high-current outputs, use cable-ties to support heavy cables to minimize mechanical stress on output studs. Be careful to not short-out to neighboring output studs. The MegaPAC is supplied with serrated, flanged hex-nuts on all output studs, therefore, Loc-tite® or lock washers are not required. The maximum torque recommended on flanged nuts is 45 in.-lbs.

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 Do's and Don'ts

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- **Do not leave ConverterPAC sense line open. Always terminate them locally or at the load. Use twisted pair 20-22 AWG wire.**
- **Insert proper fault protection at power supply input terminals (i.e., a fuse).**
- **Use proper size wires to minimize voltage drop.**
- **Always fill all output slots of the MegaPAC. If a slot is not filled with a ConverterPAC it should be filled with an Airblock. Failure to do so may result in overheating and damage to the power supply.**
- **Never loosen the inner nut on a ConverterPAC.**
- Do not unplug ConverterPAC while input power is applied. They are not designed for hot plug applications.
- Do not restrict airflow to the unit. The cooling fan draws air into the unit and forces it out of the output power terminals.
- For power expansion use booster ModuPACs. Viewing the unit from the output terminal side, always insert boosters to the right of the driver.
- Run the output power cables next to each other to minimize inductance.
- Wait 5 minutes after shutting off power to insert or remove ConverterPACs.
- Do not attempt to repair or modify the power supply in any manner other than the exchange of ConverterPACs as described.

ConverterPAC Derating Curves

Figure 25.

Autoranging/Mini/DC/3-Phase MegaPAC Thermal Derating Curve  
(5V ConverterPACs)

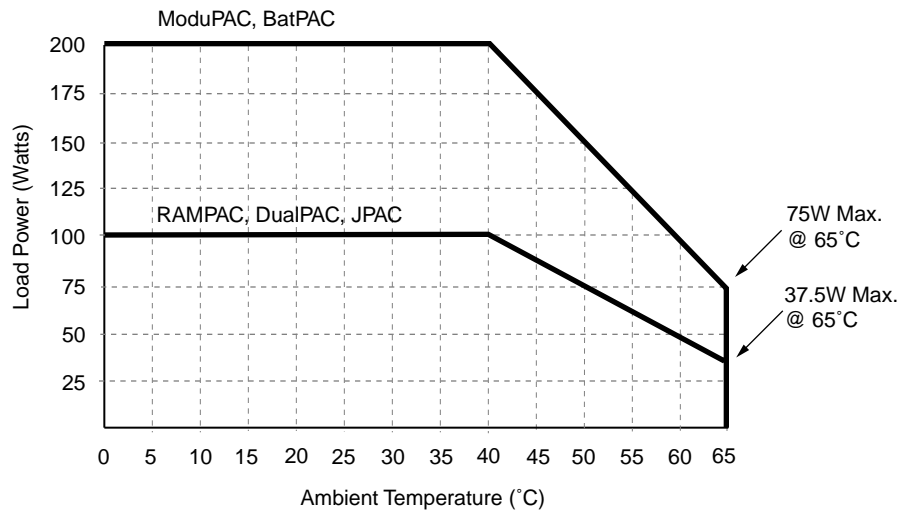
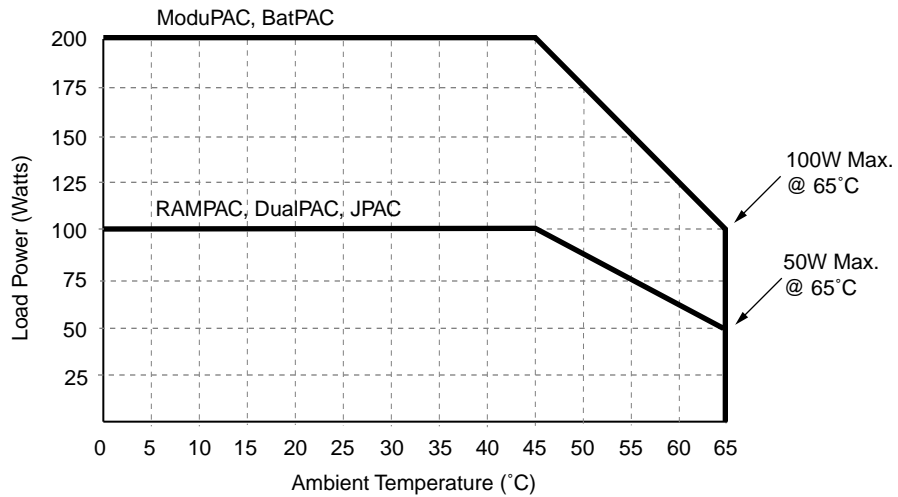


Figure 26.

Autoranging/Mini/DC/3-Phase MegaPAC Thermal Derating Curve  
(12-95V ConverterPACs)



ConverterPAC Derating Curves (cont)

Figure 27.

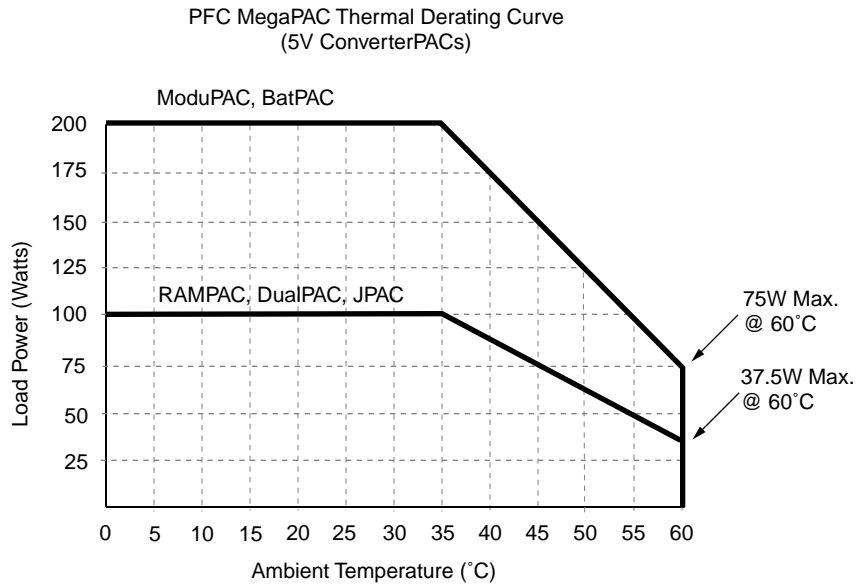


Figure 28.

