

PHASETECTM

DIGITAL POWER CONDITIONERS

PT Series Power Conditioner

OPERATION & INSTALLATION MANUAL

Version 1.5

 WARNING! HIGH VOLTAGE

Electric shock could result in death or injury. Please consult qualified personnel for installation.

 WARNING! Risk of Electric Shock

Please wait 30 minutes before servicing

OVERVIEW

Congratulations on your purchase of a PhaseTec PT Series digital power conditioner! This device features the latest advances in solid state power switching electronics to provide outstanding performance. It provides clean, regulated power for operating a wide variety of electrical equipment. The PT Series is available in a variety of configurations and sizes to fit your power needs up to 38 KVA.

The PhaseTec PT Series is designed to safely operate electrical equipment in the harshest power quality environments. With a wide input voltage range, high efficiency, electronic power factor correction and tightly regulated output, it provides high quality power for demanding applications.

PhaseTec digital power conditioners provide the ultimate power quality to protect the most sensitive electrical equipment. Employing double IGBT conversion, it converts the incoming AC power to DC, then regenerates clean, regulated AC power.

Key Features and Benefits

- Accepts a wide range of input voltage while maintaining tight output voltage regulation
- Electronic power factor correction on the input module does not require standby generators to be oversized
- IEEE 519 compliant
- Four user selected output voltages to operate a wide range of equipment
- 50 or 60 Hz input frequency and user selected output of 50 or 60 Hz allows operation anywhere in the world
- Double IGBT conversion isolates even the most sensitive equipment from dips, sags, surges, transients and harmonics
- High momentary overload capacity for demanding applications
- Optional isolation transformer provides dual voltage output and protection from common mode noise
- 94% efficiency typical
- Remote ON/OFF switching capability standard on all models
- Optional plasma display for 2 line, 32 character text display of status indicators and trouble shooting codes
- Compact, lightweight design in wall mounted enclosures
- Clean power fed back to power grid under regenerative load conditions

LIMITED WARRANTY

Phase Technologies equipment is warranted against defects in material and workmanship for a period of one year. This warranty covers both parts and labor for one year from the date of purchase by the original owner. Phase Technologies will repair or replace (at our option), at no charge, any part(s) found to be faulty during the warranty period specified. The warranty repairs must be performed by/at a Phase Technologies Authorized Service Center or at Phase Technologies LLC, Rapid City, SD 57702.

Obligations of the Original Owner

1. The original Bill of Sale must be presented in order to obtain "in-warranty" service.
2. Transportation to Phase Technologies or an Authorized Service Center is the responsibility of the original purchaser. Return transportation is provided by Phase Technologies.
3. Installations must comply with all national and local electrical codes.

Exclusions of the Warranty

This warranty does not cover any of the following: accident, misuse, fire, flood, and other acts of God, nor any contingencies beyond the control of Phase Technologies, LLC, including water damage, incorrect line voltage, improper installation, missing or altered serial numbers, and service performed by an unauthorized facility. Phase Technologies' liability for any damages caused in association with the use of Phase Technologies' equipment shall be limited to the repair or replacement only of the Phase Technologies' equipment. No person, agent, distributor, dealer, or company is authorized to modify, alter, or change the design of this merchandise without express written approval of Phase Technologies, LLC.

INSTALLATIONS MUST COMPLY WITH ALL NATIONAL AND LOCAL ELECTRICAL CODE REQUIREMENTS.

TABLE OF CONTENTS

Section 1: INTRODUCTION

- 1.1 Basic Design

Section 2: INSTALLATION

- 2.1 Mounting the Unit
- 2.2 Electrical Connections
 - 2.2.1 Connecting to Field Wiring Terminals
 - 2.2.2 Field Wiring for Parallel Units
 - 2.2.3 Procedure for Installing Parallel Systems
- 2.3 General Wiring Considerations
- 2.4 Input Power Source Considerations

Section 3: OPERATION

- 3.1 Selecting Output Voltage and Frequency
 - 3.1.1 DIP Switch Setting Procedure
- 3.2 ON/OFF Options
 - 3.2.1 Installing a Low Power Remote Switch

Section 4: STATUS INDICATORS AND TROUBLESHOOTING

- 4.1 Status Indicators
- 4.2 General Troubleshooting Tips

Section 5: SPECIFICATIONS

Specifications

TABLES

- Table 1 Field Wiring Terminal
- Table 2 Field Wiring Terminal Specifications
- Table 3 Branch Circuit Protection
- Table 4 DIP Switch Settings
- Table 5 Status Indicators
- Table 6 Specifications
- Table 7 Fuses

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Contact:

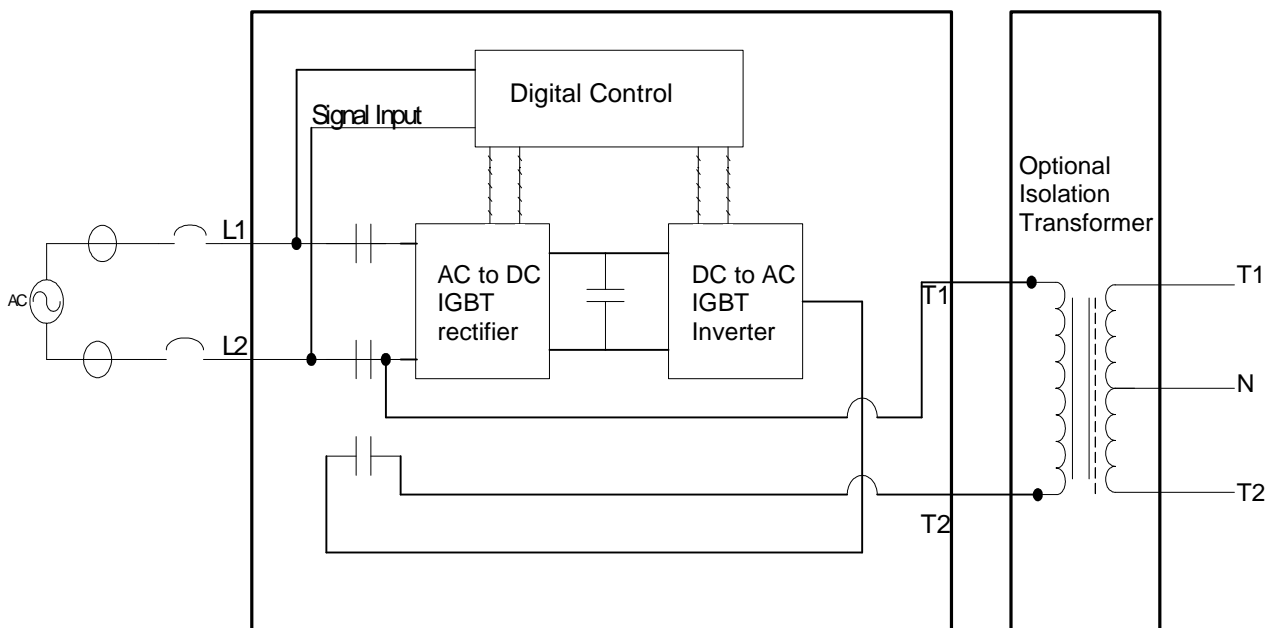
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SECTION 1: INTRODUCTION

1.1 Basic Design

The diagram in Figure 1 illustrates the basic design of a PhaseTec PT Series power supply with an optional isolation transformer on the output.

Figure 1 PT Series Block Diagram

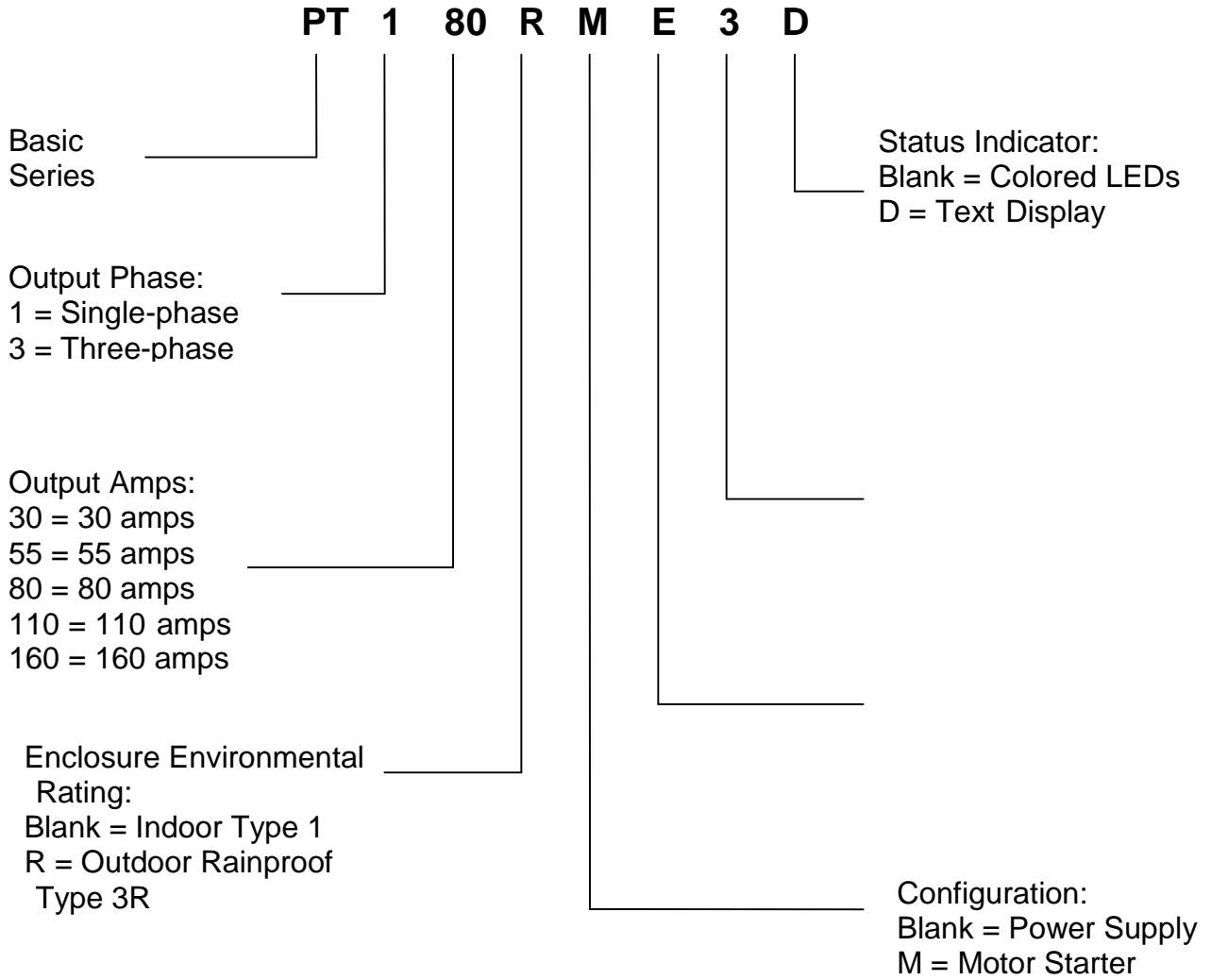


The input module takes power from the input lines and charges a DC bus. The output module then draws power from the DC bus to generate an AC voltage referenced to L2 of the input, which passes through the unit.

IMPORTANT! Because input L2 passes directly through the unit to output T1, the output has no neutral connection at the same potential as ground for source voltage that is derived from a phase-to-phase connection. Dual voltage output such as 120/240V can only be obtained by passing the output through an optional center tapped isolation transformer which reestablishes a neutral to ground connection.

CAUTION! When source voltage is derived from a phase-to-neutral voltage, always connect neutral to input terminal L2. If the neutral is not connected to input terminal L2, dangerously high voltages between the output terminals and earth may result. When input neutral is connected to input terminal L2, output neutral will be on output terminal T1.

PT Series Model Number Information



SECTION 2: INSTALLATION

Models are available in Type 1 indoor or Type 3R rain proof enclosures. The unit should be securely mounted to a solid, non-flammable vertical surface. Choose a location that minimizes the introduction of dust and other contaminants into ventilation openings.

2.1 Mounting the Unit

Properly locating the unit is important to the performance and normal operating life of the unit. The unit should be installed in a location free from:

- Excessive dirt and dust
- Corrosive gases or liquids
- Excessive vibration
- Airborne metallic particles

It is important that the unit be located away from excessive dirt and dust. It should be securely fastened to a solid, non-flammable vertical surface using the mounting brackets provided with the unit. Make sure the mounting surface is capable of bearing the weight of the unit. Weights for each model can be found in the Specification Table of this document. Elevating the unit well above the ground will help to reduce the introduction of dust and contaminants into the enclosure.

Larger models are provided with lifting eye bolts on the enclosure. **CABLES, STRAPS OR CHAINS USED FOR LIFTING THESE UNITS MUST BE ATTACHED ONLY TO THE PROVIDED BRACKETS.**

In order to provide proper ventilation, do not obstruct the open space around the enclosure. In order to maintain air circulation for cooling, minimum clearance must be 2 inches on each side, and 6 inches top and bottom. Make sure air intake and exhaust openings are not obstructed. If the unit is installed in a small room, cabinet or other enclosure, make certain there is adequate ventilation to provide cooling for the unit.

2.2 Electrical Connections

This section provides a description of general wiring considerations, as well as diagrams of typical input power wiring configurations, and discusses important considerations involved in input wiring from various sources.

Electrical connections to the unit are made behind the front door of the enclosure, as described in the section below, *Connecting to Field Wiring Terminals*. Terminal blocks for connecting wires are located on a panel inside the enclosure of the unit. Figure 2 below illustrates typical wiring connections found on the panel.

2.2.1 Connecting to Field Wiring Terminals

Open the front cover of the enclosure to gain access to the wiring panel. The field wiring terminals of a typical unit are illustrated in figure 2.

Figure 2 Field Wiring Terminals

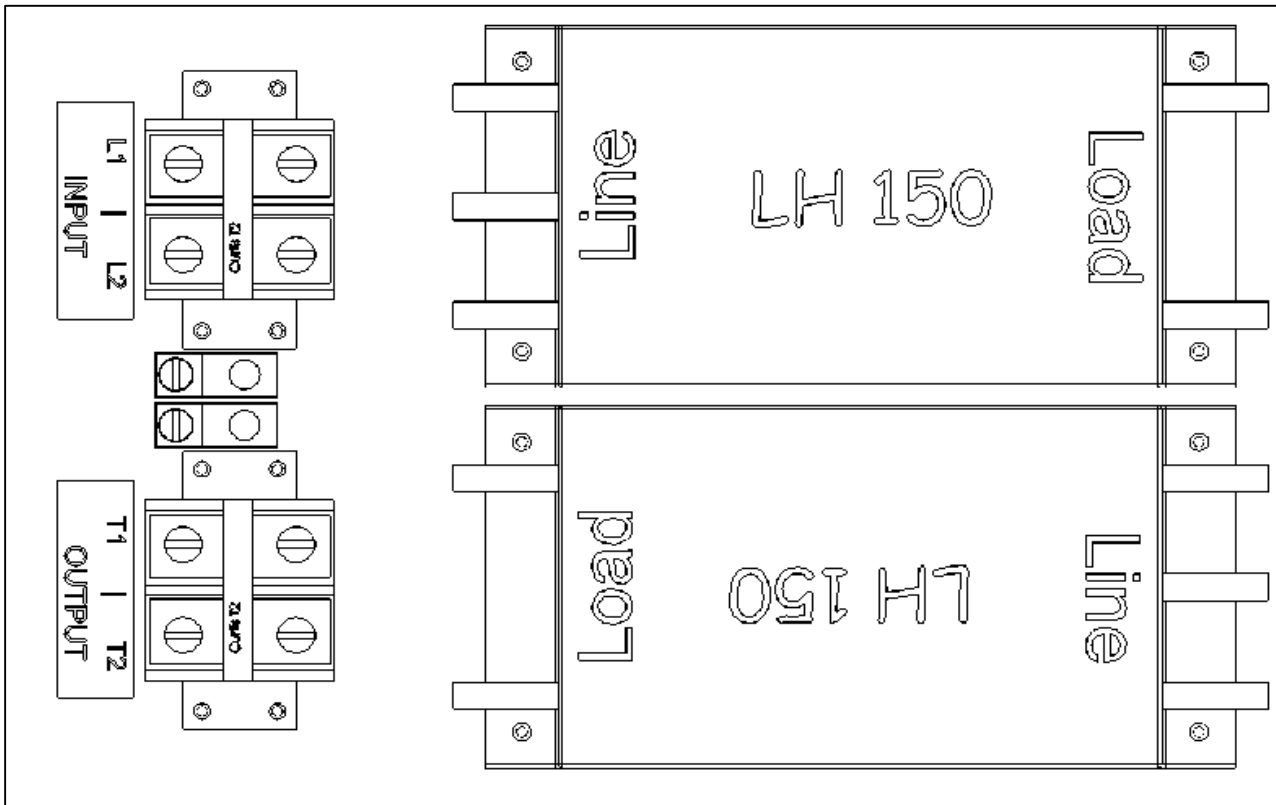


Table 1 Field Wiring Terminals

TERMINAL	FUNCTION	COMMENTS
GND	Earth Ground	
L1, L2	Single-Phase Input Power Terminals	For connection to single-phase power derived from a phase-to-neutral voltage, such as 230V in Europe, always connect neutral to L2
AMP Control Terminal	Remote switching circuit	Connect switch leads to AB & CD for remote control ON/OFF.
T1, T2	Output Power Terminals	T2 is the generated output terminal. When source power is derived phase-to-neutral, input neutral should be connected to input terminal L2. Output T1 will then be at same potential as input neutral.

2.3 General Wiring Considerations

Installations must comply with all national and local electrical code requirements. General Wiring Considerations Include:

1. **This Unit Is Suitable For Use In A Circuit Capable Of Delivering Not More Than 5 kA RMS Symmetrical Amperes, 240 V Maximum.**
2. Use 600 V vinyl-sheathed wire or equivalent. The voltage drop of the leads needs to be considered in determining wire size. Voltage drop is dependent on wire length and gauge.
3. Wire used within the motor circuit and all field wiring terminals must be rated for 60 C
4. Wires fastened to the terminal blocks shall be secured by tightening the terminal screws to a torque value listed in Table 2.
5. Use wire size suitable for Class 1 circuits.
6. The maximum wire gauge for the input terminals is listed in Table 2.
7. Never allow bare wire to contact the metal surfaces.
8. Never connect AC main power to the output terminals T1 and T2.
9. Input power connections should be made by a qualified electrician into a 208V or 240 V circuit with adequate current carrying capacity and the appropriate sized breaker. Branch circuit protection to the phase converter should be provided by an appropriate size, 2 pole, linked circuit breaker or fuse. Branch circuit protection specifications are listed in Table 3.

Table 2 Field Wiring Terminal Specifications

Model:	PT1160		PT1110	
Input Terminals	Source Line Side	PT Unit Side	Source Line Side	PT Unit Side
Tightening torque	275 in. lbs	192 in. lbs	275 in. lbs	192 in. lbs
Max. wire size	350kcmil – 6 AWG	3/8 – 16 Stud	350kcmil – 6 AWG	3/8 – 16 Stud
Output Terminals	Load Side	PT Unit Side	Load Side	PT Unit Side
Tightening torque	120 in. lbs (2/0-6 AWG) 40 in. lbs (8AWG) 35 in. lbs (10-14 AWG)	61 in. lbs	120 in. lbs (2/0-6 AWG) 40 in. lbs (8AWG) 35 in. lbs (10-14 AWG)	61 in. lbs
Max. Wire size	2/0 – 14 AWG	¼ - 20 Stud	2/0 – 14 AWG	¼ - 20 Stud

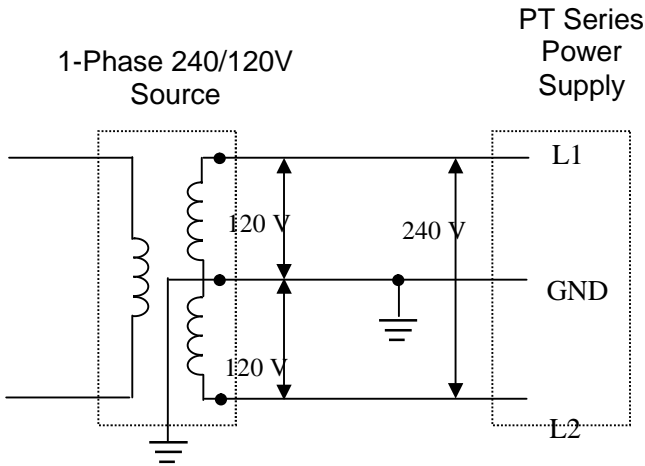
Field Wiring Terminal Specifications, continued...

Model:	PT180	PT155	PT130
Input Terminals			
Tightening torque	50 in.-lb.	45 in.-lb (4-6 AWG) 40 in.-lb. (8AWG) 35 in.-lb. (10-16 AWG)	16 in.-lb.
Max. wire size	6 - 1/0 AWG	16 – 4 AWG	14 - 6 AWG
Output Terminals			
Tightening torque	50 in.-lb.	45 in.-lb (4-6 AWG) 40 in.-lb. (8AWG) 35 in.-lb. (10-16 AWG)	16 in.-lb.
Max. Wire size	6 - 1/0 AWG	16 – 4 AWG	14 - 6 AWG

Table 3 Branch Circuit Protection Rating in Amps

APPROVED BRANCH CIRCUIT PROTECTION	PT1160	PT1110	PT180	PT155	PT130
Inverse time circuit breaker	200	150	100	75	40
Class 200 fuse	200	150	100	75	40
Class RK5 fuse	200	150	100	75	40

Figure 5 Power Source Configurations



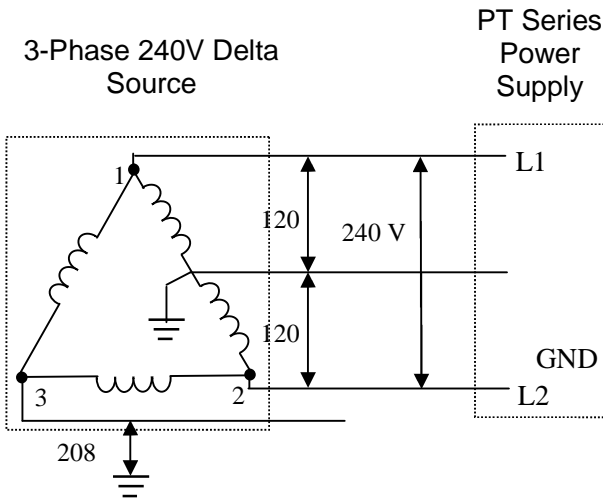
Single-phase, 120/240V, 3 Wire

In most installations, single-phase 240V input power will be taken from a 240/120V center tap source. Connect L1 and L2 to the input terminals.

⚠ WARNING!

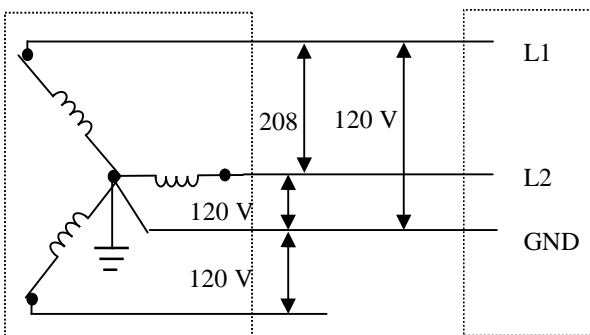
Three-phase, 240/120V, Delta

In some situations, single-phase 240V input power may be derived from a three-phase source as illustrated to the left. Caution must be exercised if using such a source for power input to the unit. Power should only be derived from legs 1 & 2, with a center ground, as illustrated. Power derived from legs 2 & 3, or 3 & 1, may result in output phase-to-ground voltage well above 200V. To avoid potentially hazardous voltage, always verify the phase-to-ground voltage for the L1 and L2 inputs is approximately 120V.



3-Phase 208Y120V Source

PT Series Power Supply



⚠ WARNING!

Three-phase, 208Y/120V

Single-phase 208V input power can be taken from two legs of a three-phase grounded-wye source. There are two possible ways to connect L1 and L2 to the unit from any two legs. If the unit is connected incorrectly, the voltage from output line T2 to ground will be over 240V. Reversing L1 and L2 on the input should lower the T2 to ground voltage nearer to 120V.

CAUTION! When operating from generator power, never start the generator while directly connected to the power conditioner. A power source ramping up from zero voltage and zero frequency may damage the power conditioner. Connect the power conditioner to the generator source only after the generator output is stable.

Section 3: OPERATION

Operation of a PT Series power supply is simple and straightforward after completion of installation and wiring.

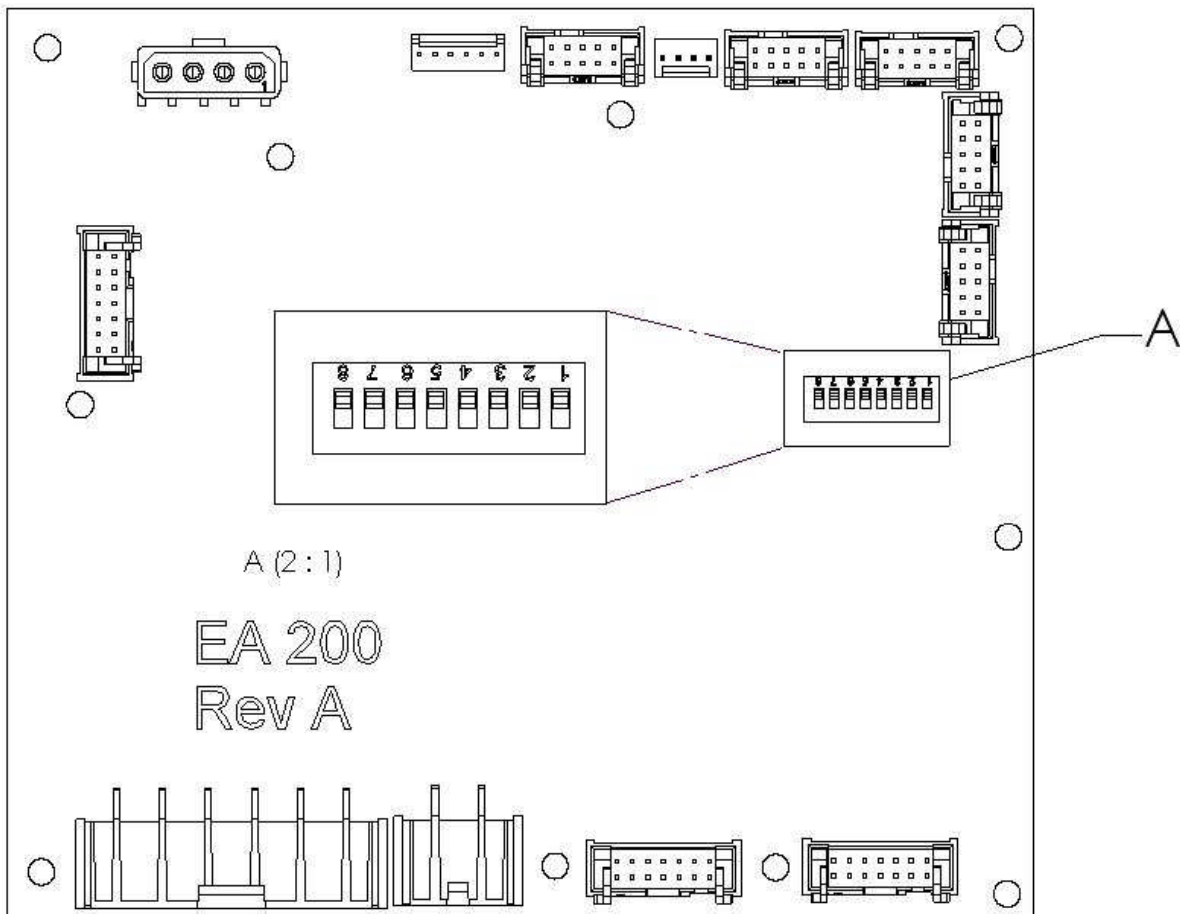
3.1 Selecting Output Voltage and Frequency

Users can select the desired frequency (50 or 60 Hz) and one of four possible voltage outputs (208V, 220V, 230V or 240V) of PHASETEC™ digital power conditioners by setting a series of DIP switches located on the control circuit board inside the enclosure.

CAUTION! When equipped with an optional output isolation transformer, the transformer must be rated 50/60 Hz for 50 Hz output.

Refer to Table 4 for the desired settings. The DIP switch component is a row of switches that can be set in either an ON or OFF position. Refer to Figure 6 to locate the dip switch array on the main printed circuit board.

Figure 6 DIP Switch Array



DIP Switch Setting Procedure:

1. **CAUTION!** Never change the DIP switch settings when the unit is energized.
2. Verify that no input power is connected to the unit by turning the input disconnect to OFF, then lock and tag it.
3. Open the front panel to gain access to the circuit board.
4. **CAUTION!** Before touching the circuit board, make sure that you place your hand on an unpainted surface of the enclosure to avoid a static discharge to the circuit board.
5. Locate the DIP switches on the control circuit board.
6. Select the proper combination of settings for switches 6, 7 and 8 as indicated in Table 4 below.
7. **CAUTION!** Only switches 6-8 should be used to select frequency and voltage output. Switches 1-5 must not be altered.
8. Secure the front panel.
9. Restore input power to the power conditioner.

Table 4 DIP Switch Settings

Desired Output	Switch No. 6 position	Switch No. 7 position	Switch No. 8 position
50 Hz*	ON		
60 Hz**	OFF		
208 VAC		OFF	OFF
220 VAC		ON	OFF
230 VAC		OFF	ON
240 VAC		ON	ON

* For 50 Hz output with an optional output isolation transformer, the transformer must be specified for 50Hz. If the transformer is rated for 60 Hz only, the 50 Hz output feature should not be used.

**PhaseTec PT Series digital power conditioners are shipped from the factory with a default setting of 60 Hz, 240 VAC.

3.2 ON/OFF Options

There are two ways to turn a PT Series unit ON and OFF:

ON/OFF With Input Power Disconnect Switch

In most cases, the unit should be installed with a disconnect switch on the line side of the unit. When in the OFF position, this disconnect switch will break the connection between the unit and the input power source.


⚠ WARNING! Make sure the input power disconnect switch is in the OFF position before opening the front cover to the unit. Opening the front cover with the switch in the ON position exposes the user to the risk of electric shock.

When the input terminals are energized, power is provided to the output load terminals after a delay of approximately five to eight seconds.

ON/OFF With a Low Power Remote Switch

The PhaseTec PT Series is equipped with a remote switch circuit that allows the unit to be turned on and off with a simple low power, 240 volt rated switch circuit. A Control Terminal block for connecting a remote switch is located in the enclosure near the main field terminals. The EMI rated remote circuit is designed to reduce conducted noise that may be transmitted on the control circuit lines.

When the PT Series unit is configured with a remote ON/OFF switch on the Control Terminals, the input power disconnect switch is left in the ON position. When the remote switch is closed, the unit energizes, and output power is provided to the load after a delay of approximately five to eight seconds. When the input power is ON, and the remote control switch is open, the unit is not energized and will not consume any power. No voltage will be present on the output terminals, however, the input terminals and some circuits within the unit will be energized.

 **WARNING!** When the converter is turned OFF using a remote switch on the Control Terminals, dangerous voltage is still present on the input terminals and inside the enclosure. Never open the enclosure or perform maintenance on the unit when the input disconnect switch is in the ON position.

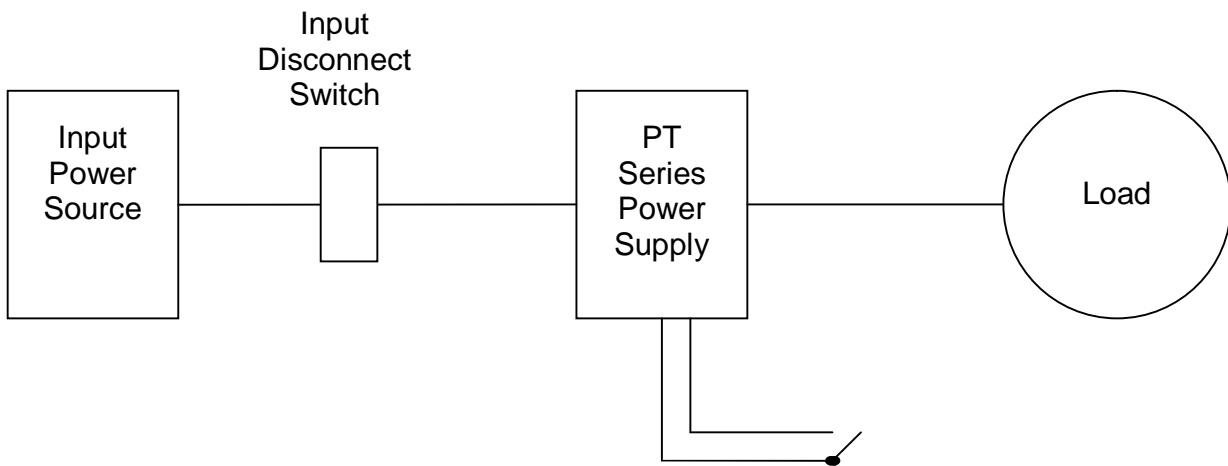
When either the input power disconnect switch is OFF, or the remote switch on the Control Terminals is open, the status indicator LEDs will be off. If the unit is equipped with the optional text display, the status screen will be blank.

3.2.1 Installing a Low Power Remote Switch

When a low power remote switch is connected to the Control Terminals, the unit and any connected loads can be switched ON/OFF by a remote switch. **The remote switch must be rated at a minimum of 240 VAC, 0.5 amp.** Below are instructions for configuration of the remote switch.

1. Verify that no input power is connected to the unit by turning the input disconnect to OFF, then lock and tag it.
2. Open the front cover and locate the Control Terminal block.
3. Connect the remote switch leads to control terminals AB or BC. When the remote switch is closed, the unit will energize and power will be provided to the load after an approximately five second delay.
4. The control switch should have a minimum rating of 240 VAC, 3 amp. The fuse labeled F501 in the wiring panel provides protection to the control circuit in the event of a short or fault.
5. Provide power to unit. When the remote switch is closed, the unit will energize and power will be provided to the load after an approximately five second delay.
6. When replacing fuse F501 in the control circuit, use only a 240 V, 3 A rated fuse.
7. When the unit is not equipped with a remote switch, the jumper supplied from the factory must be connected between the AB or BC terminals for the power conditioner to operate.

Figure 7 Remote Switch Configuration



Remote switch rated 240V, 3A. Closed switch will energize the power supply and start the load after a 5-8 second delay.

Section 4: STATUS INDICATORS AND TROUBLESHOOTING

4.1 Status Indicators

The GREEN, YELLOW, and RED status LEDs are found on the control printed circuit board inside the enclosure, or are mounted on the front cover when the unit is equipped with optional EMI enclosure. The status lights provide information about the operating status of the unit, and provide useful troubleshooting information. An optional text display status screen that provides 16 character, 2 row text messages for status indicators is also available on some models.

⚠ WARNING! In some instances, such as overheating, the unit will shut down, then automatically restart when conditions allow. Always disconnect input power from the unit and wait for internal electrical charges to dissipate before performing service on the unit or its connected loads.

4.2 General Troubleshooting Tips

After the system is properly connected to input power, turn the unit ON with the disconnect switch and/or input circuit breaker. It is always advisable to check the operating status of the converter before connecting any loads to the output.

If the unit fails to energize, and all status indicators are off, check the following:

1. Verify that the appropriate circuit breaker in the building's electrical distribution box is set ON and is properly sized.
2. Check the control circuit fuse, labeled F501, located on the panel inside the unit enclosure. If necessary, replace with appropriate 3A fuse.
3. Verify that any remote switch connected to the Control Terminals is closed and properly connected to the terminal. The unit will not operate unless the jumper or control circuit wires are connected to the appropriate Control Terminals.

Refer to the Status Indicators in Table 5 for additional troubleshooting tips.

TABLE 5 STATUS INDICATORS

LED INDICATOR	TEXT INDICATOR	COMMENTS AND TROUBLESHOOTING TIPS	
STEADY GREEN	SYSTEM ON NORMAL		
FLASHING GREEN	STARTING		
STEADY YELLOW	STOPPED OVERTEMP WAIT FOR RESTART	Check for faulty fan, or ventilation opening obstructions. Reduce ambient temperature.	2
FLASHING GREEN STEADY YELLOW	DEFECTIVE TEMP SENSOR	Failed temp sensor (TM circuit board) or loose connection to TM circuit board	
STEADY RED	C1 VOLTAGE LOW	Check charging circuit fuse (F701), relay and diode Possible failed bus capacitor on VPOS	
STEADY GREEN STEADY YELLOW	C2 VOLTAGE LOW	Check charging circuit fuse (F701), relay and diode Possible failed bus capacitor on VNEG	
STEADY YELLOW FLASHING RED	C1 OVER VOLTAGE	Possible heavy power regeneration from load Possible voltage sensing problem on EA200 circuit board	3
FLASHING YELLOW	C2 OVER VOLTAGE	Possible heavy power regeneration from load Possible voltage sensing problem on EA200 circuit board	3
STEADY GREEN FLASHING RED	POSSIBLE SHORT C1	Internal fault possible, contact factory	3
FLASHING GREEN STEADY RED	POSSIBLE SHORT C2	Internal fault possible, contact factory	3
FLASHING RED	IGBT FAULT INPUT MODULE	Possible failed IGBT or PDR500 circuit board on input module	3
FLASHING GREEN FLASHING RED	IGBT FAULT OUTPUT MODULE	Possible failed IGBT or PDR500 circuit board on output module	3
STEADY YELLOW STEADY RED	INPUT FREQUENCY OUT OF RANGE	Input frequency must be 46-64 Hz. Generator source must be stable. Possible voltage distortion in source power.	2
STEADY YELLOW FLASHING RED	LOW INPUT V AUTO RESTART	Increase input voltage to specified input range if possible. See Note 1.	1
FLASHING YELLOW STEADY RED	LOW INPUT V AUTO RESTART 1H	Increase input voltage to specified input range if possible. See Note 1.	1
STEADY GREEN STEADY RED	LOW INPUT V AUTO RESTART 10S	Increase input voltage to specified input range if possible. See Note 1.	1
STEADY GREEN STEADY YELLOW STEADY RED	HIGH INPUT V AUTO RESTART	Decrease input voltage to specified input range if possible. See Note 1.	1

STEADY GREEN STEADY YELLOW FLASHING RED	HIGH INPUT V AUTO RESTART 1H	Decrease input voltage to specified input range if possible. See Note 1.	1
STEADY GREEN FLASHING YELLOW	HIGH INPUT V AUTO RESTART 10S	Decrease input voltage to specified input range if possible. See Note 1.	1
FLASHING GREEN STEADY YELLOW STEADY RED	OVERCURRENT INPUT 10S	Input current exceeded steady state maximum. Reduce load or increase input voltage if possible.	3
FLASHING GREEN FLASHING YELLOW STEADY RED	OVERCURRENT OUTPUT 4S	Output current exceeded momentary maximum. Reduce load or increase input voltage if possible.	3
FLASHING GREEN FLASHING YELLOW FLASHING RED	OVERCURRENT OUTPUT 10S	Output current exceeded steady state maximum. Reduce load or increase input voltage if possible.	3
FLASHING GREEN FLASHING YELLOW	V OUT SENSE WIRE IS LOOSE	Voltage sense wire is not providing a voltage signal to the controls	2
FLASHING GREEN STEADY YELLOW FLASHING RED	SYSTEM INTERRUPT CYCLE PWR OFF ON	Possible software code hangup. Reboot by cycling input power OFF ON.	3

Notes:

Note 1: For high and low input voltage trip, the unit will attempt to restart after a 10 sec. delay, followed by another 10 sec. restart delay. If the unit does not successfully start on the second try, the cycle will be repeated after a 1 hr. delay. The restart cycle can be cancelled by cycling input power OFF ON.

Note 2:  **WARNING! Unit will restart automatically when condition returns to normal.**

Note 3: Unit will not automatically restart. Cycle input power OFF ON to restart.

If problems cannot be corrected, contact the Field Support Manager at Phase Technologies, (605) 343-7934.

Table 6 SPECIFICATIONS

MODEL:	PT130	PT155	PT180
INPUT POWER			
Input frequency	50 or 60 Hz		
Power factor	Near unity		
Input voltage	Single-phase, 170* – 277 V AC		
OUTPUT POWER			
Output power characteristics	Sinusoidal, <2% total harmonic distortion		
Voltage regulation	+/- 2% for entire input voltage range		
Output voltage	User selected: Single-phase, 208, 220, 230, 240 VAC		
Output frequency**	User selected: 50 or 60 Hz		
Rated current, steady state	30A	55A	80A
GENERAL			
Efficiency	94% typical		
Ambient temperature range	-29 – 40 C		
Storage temperature range	-29 – 60 C		
Audible noise***	<70 dB, A-scale @ 1 meter		
Enclosure	Powder coated aluminum, indoor Type 1		
Connections	Hard wired, terminal blocks		
Weight	70 lb.	113 lb.	230 lb.
Nominal Dimensions (H x W x D)	18 x 16 x 13	26 x 19 x 14	30 x 24 x 12 in.

* Input voltage must be >190V to start

** For 50 Hz output with an optional isolation transformer, the transformer must be specified for 50/60 Hz. If the transformer is rated for 60 Hz only, the 50 Hz output feature should not be used.

*** Measured at rated output current, no frequency conversion

Table 7 Fuses

FUSE ID	FUSE RATING	COMMENTS
F1	2 A, slow blow	Located on PCB PWR600
F2	2 A, slow blow	Located on PCB PWR600
F3	3 A, fast blow	Located on PCB PWR600
F501	3 A, fast blow	Panel mounted, protects remote switch circuit
F701	12 A, slow blow	Panel mounted, protects DC bus charging circuit

NOTES