PHASE TECHNOLOGIES

The NEW!
PHASE PERFECT®
240V & 480V

Digital Phase Converter

Operation & Installation Manual

Single-Phase to Three-Phase

Solid State Technology

98.7% Efficient

Product Manual

The NEW! PHASE PERFECT®

Digital Phase Converter

PHASE TECHNOLOGIES

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INTRODUCTION

The NEW! Phase Perfect® Digital Phase Converter converts single-phase AC power to three-phase AC power to operate a variety of electrical equipment. The Phase Perfect® delivers unmatched, three-phase voltage balance and operates at 98.7% efficiency.

Output voltage is sinusoidal with low harmonic content, making it safe to operate sensitive electronic equipment. The Phase Perfect was designed to comply with IEEE 519 to meet utility regulatory standards.

Phase Perfect Digital Phase Converters are available in NEMA 1 indoor enclosures and NEMA 3R outdoor enclosures with insect guards. Both enclosure types come standard with a locking cabinet to prevent tampering.

SAFETY MESSAGES AND WARNINGS

To ensure safe and reliable operation of the Phase Perfect®, it is important to carefully read this manual and to observe all warning labels attached to the unit before installing. Please follow all instructions exactly and keep this manual with the unit for quick and easy reference.

Definitions of Warning Signs and Symbols

CAUTION: Indicates a potentially hazardous situation that could result in injury or damage to the product.

WARNING: Indicates a potentially hazardous situation that could result in serious injury or death.

HIGH VOLTAGE: The voltage associated with the procedures referenced could result in serious injury or death. Use caution and follow instructions carefully.

READ THESE WARNINGS BEFORE INSTALLING OR OPERATING EQUIPMENT!

WARNING: Risk of electric shock. More than one disconnect switch may be required to de-energize the equipment before servicing.

WARNING: Risk of electric shock. De-energize the unit by disconnecting all incoming sources of power, then wait 30 minutes for internal charges to dissipate before servicing the equipment.

HIGH VOLTAGE: This equipment is connected to line voltages that can create a potentially hazardous situation. Electric shock could result in serious injury or death. This device should be installed only by trained, licensed, and qualified personnel. Follow instructions carefully and observe all warnings.

WARNING: This equipment should be installed and serviced by qualified personnel familiar with the type of equipment and experienced in working with dangerous voltages.

WARNING: Installation of this equipment must comply with the National Electrical Code (NEC) and all applicable local codes. Failure to observe and comply with these codes could result in risk of electric shock, fire, or damage to the equipment.

CAUTION: Circuit breakers, fuses, proper ground circuits, and other safety equipment and their proper installation are not provided by Phase Technologies, LLC, and are the responsibility of the end user.

⚠ **CAUTION:** Failure to maintain adequate clearance may lead to overheating of the unit and cause damage or fire.

⚠ **WARNING:** Input power connections should be made by a qualified electrician into circuit with adequate voltage and current carrying capacity for the model. Branch circuit protection to the unit should be provided by appropriately sized fuses or a 2-pole circuit breaker.

⚠ **CAUTION**: 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. Use only copper conductors.

⚠ **CAUTION:** Wires fastened to the terminal blocks shall be secured by tightening the terminal screws to a torque value listed in Table 7.

⚠ **CAUTION:** The input wire gauge must be sized to accommodate the single-phase input current, which will be significantly larger than the three-phase output current to the load.

⚠ **CAUTION:** The maximum wire gauge for the input terminals is listed in **Table 7**.

⚠ **CAUTION:** Never allow bare wire to contact metal surfaces.

⚠ **CAUTION:** Never connect AC main power to the output terminals T1, T2, and T3.

⚠ **WARNING:** Under certain conditions, the motor load may automatically restart after a trip has stopped it. Make sure power to the converter has been disconnected before approaching or servicing the equipment. Otherwise, serious injury may occur.

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THEORY OF OPERATION

L1 and L2 of the single-phase input pass directly through the phase converter to provide two legs of the three-phase output. The input module charges a DC bus from the input lines. The output module uses power from the DC bus to generate the third leg of the three phase output. The third leg is generated to limit voltage unbalance between the three legs to ≤2%. Voltage unbalance is calculated according to the NEMA MG1 standard.

$$V_{ub} = \frac{V_{\max difference}}{V_{avg}}$$

Where

$$V_{avg} = \frac{V_{T1T2} + V_{T2T3} + V_{T3T1}}{3}$$

$$V_{\max difference} = MAX\ of\ (|V_{T1T2} - Vavg|, |V_{T2T3} - Vavg|, |V_{T3T1} - Vavg|)$$

Block Diagram

The diagram in **Figure 1** illustrates the basic design schematic of the Phase Perfect.

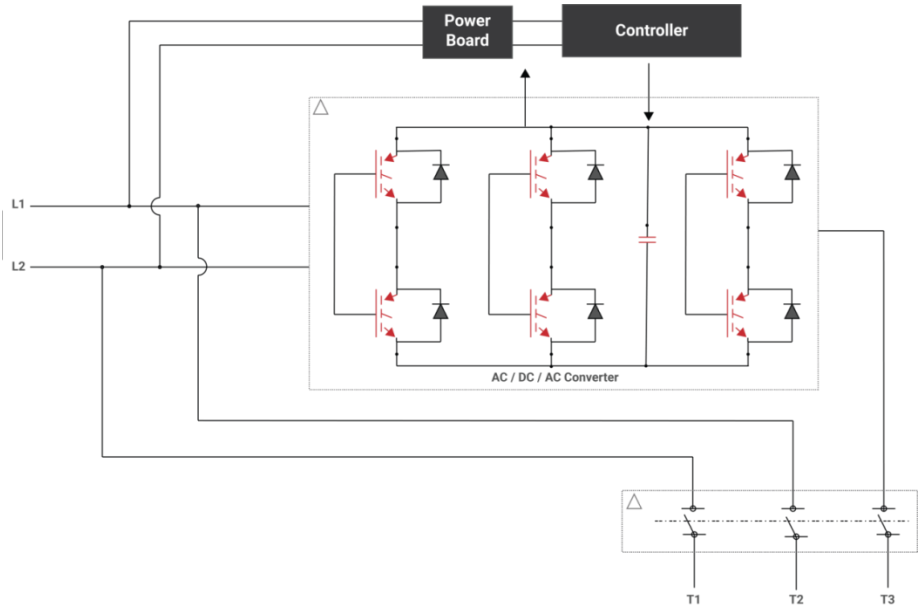


Figure 1 – Phase Perfect Design Schematic

MODELS AND RATINGS

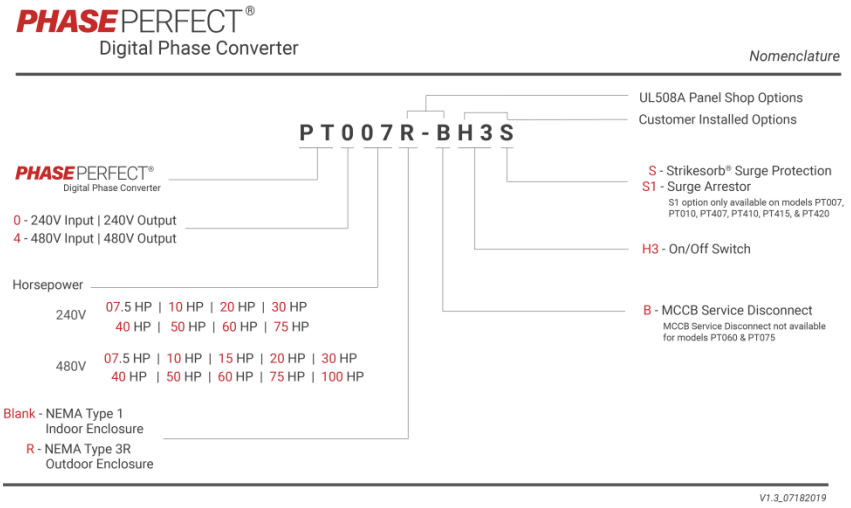


Figure 2 – Phase Perfect Nomenclature

SPECIFICATIONS

General Specifications

Table 1: Common Specifications

Output Voltage	Appx. equal to input voltage
Output Voltage Unbalance	≤2%
Operating Temperature Range	-10°C (14°F) to 50°C (122°F)
Storage Temperature	-20°C (-4°F) to 60°C (140°F)
Efficiency	98.7%
Short Circuit Withstand Rating	10kA
Noise	75 dBA w/ fan running 50 dBA w/o fan running
Start Delay on Power Up	2 sec

Electrical Specifications

Table 2 – 240 V Models – Base Models and Ratings

Model	Power (HP)	Output (kVA)	Max Steady State Output Current (AAC)	Input Voltage Range (VAC)	Max AC Input Current, Typical (A)	Standby Power/Energy, Typical (W/BTU/hr) Preliminary	Full Load Energy Loss-Typical (BTU/hr)
PT007	7.5	10.8	26	187-260	45	70/239	479
PT010	10	14.9	36		62	74/252	661
PT020	20	26.6	64		111	80/273	1180
PT030	30	39.5	95		165	175/597	1752
PT040	40	54.0	130		225	190/648	2395
PT050	50	68.6	165		286	235/802	3043
PT060	60	78.9	190		329	260/887	3500
PT075	75	99.8	240		416	300/1024	4427

Table 3 – 480 V Models - Base Models and Ratings

Model	Power (HP)	Output (kVA)	Max Steady State Output Current (AAC)	Input Voltage Range (VAC)	Maximum AC Input Current, Typical (A)	Standby Power/Energy, Typical (W/BTU/hr) Preliminary	Full Load Energy Loss-Typical (BTU/hr)
PT407	7.5	10.8	13	440-520	22	52/177	479
PT410	10	14.9	18		32	68/232	661
PT415	15	22.4	27		47	71/242	994
PT420	20	26.6	32		55	74/252	1180
PT430	30	38.2	46		80	87/297	1694
PT440	40	50.7	61		105	180/614	2249
PT450	50	64	77		134	190/648	2839
PT460	60	75.7	91		157	220/751	3358
PT475	75	90	107		185	270/921	3992
PT4100	100	118	142		246	300/1024	5239

Mechanical Specifications

Table 4 – 240 V Models – Enclosure Options & Specifications

Models	PT007	PT010	PT020	PT030	PT040	PT050	PT060	PT075
Options	NEMA 1 or 3R							
Dimensions Indoor: NEMA 1 (H x W x D)*	36 15/16" x 25 3/8" x 17 1/16"				44 15/16" x 25 13/16" x 19"			
Dimensions Outdoor: NEMA 3R (H x W x D)*	37 7/16" x 25 3/8" x 19 5/16"				46 1/8" x 25 13/16" x 20 1/8"			
Weight (lbs) Preliminary	102	104	134	264	284	294	285	288

**Note: Dimensions are maximum measurements including mounting hardware and optional MCCB handle. Weights include MCCB, except for PT060 and PT075*

Table 5 – 480V Models - Enclosure Options & Specifications

Models	PT407	PT410	PT415	PT420	PT430	PT440	PT450	PT460	PT475	PT4100
Options	NEMA 1 or 3R									
Indoor: NEMA 1 (HxWxD)	31 3/8" x 17 3/16" x 15 1/16"				36 15/16"x 25 3/8"x 17 1/16"	44 15/16" x 25 13/16" x 19"				
Outdoor: NEMA 3R (HxWxD)	31 3/8" x 22 7/16" x 15 1/16"				37 7/16" x 25 3/8" x 19 5/16"	46 1/8" x 25 13/16" x 20 1/8"				
Weight (lbs) Preliminary	62	64	68	74	141	286	287	298	304	334

**Note: Dimensions are maximum measurements including mounting hardware and optional MCCB handle. Weights include MCCB*

Dimensional Drawings

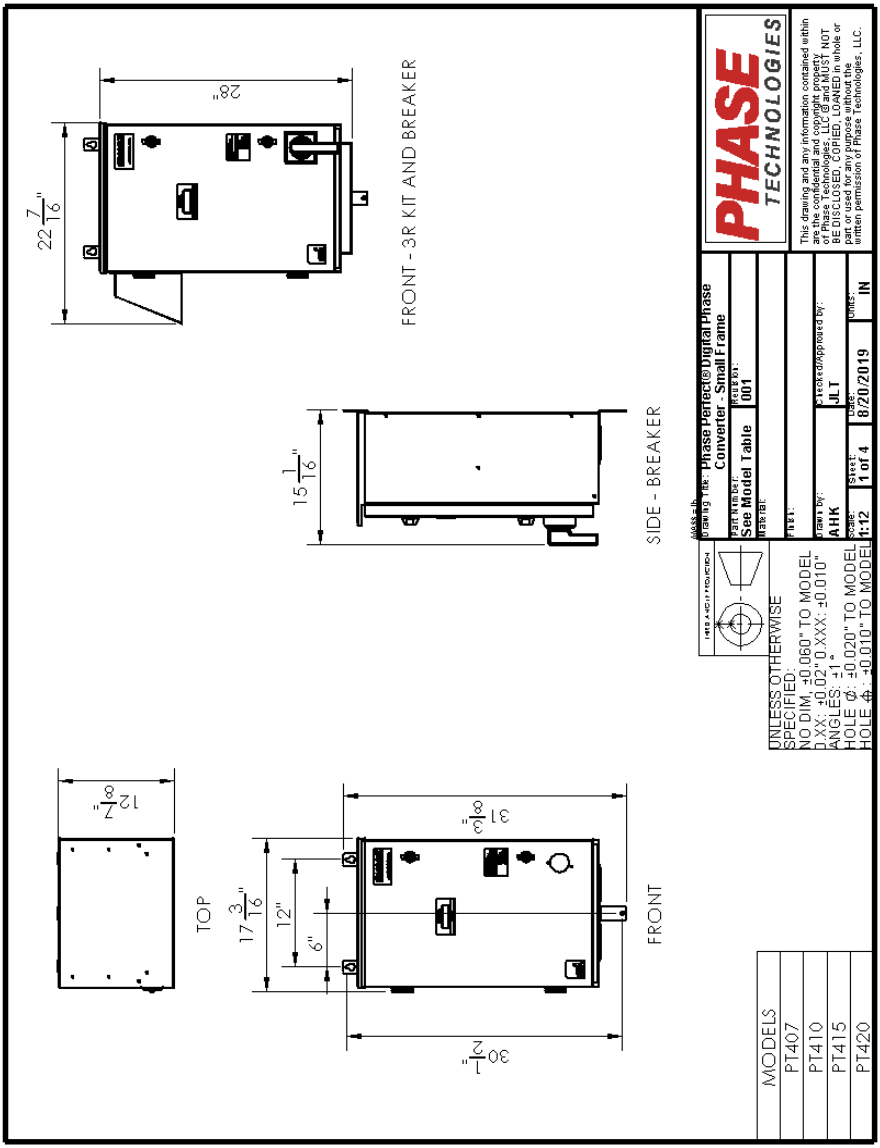


Figure 3 – PT Small Frame Dimensions

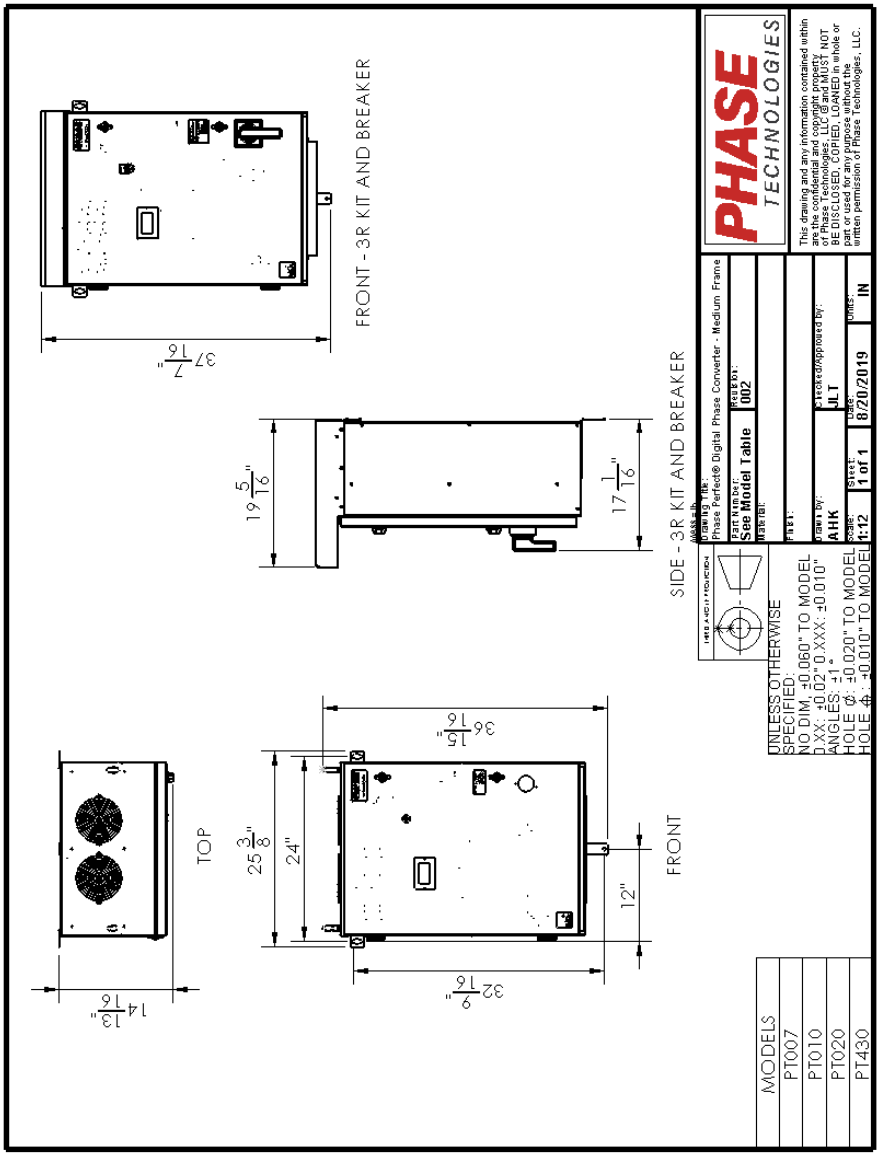


Figure 4 – PT Medium Frame Dimensions

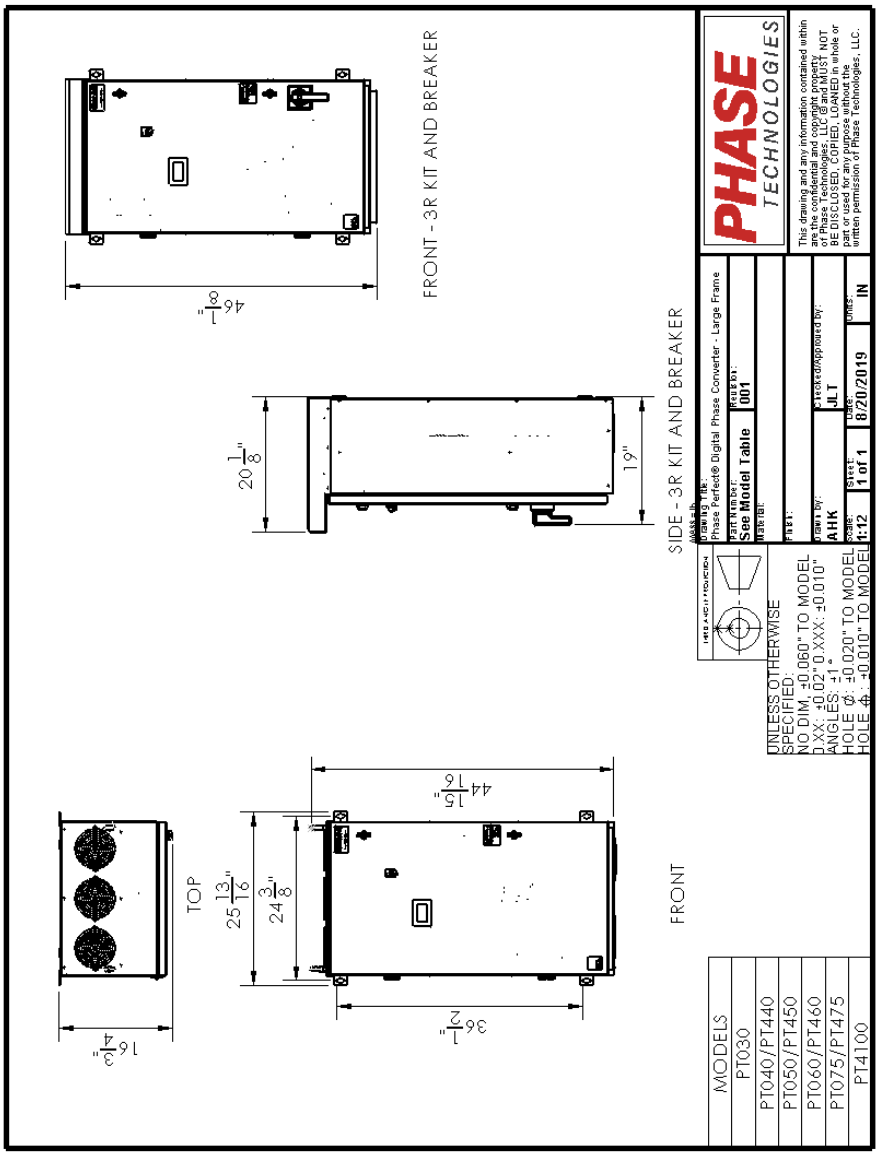


Figure 5 – PT Large Frame Dimensions

INSTALLATION

Mounting Your New Phase Perfect

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

- Corrosive gases or liquids
- Excessive vibration
- Airborne metallic particles

Mount the unit to a solid, non-flammable surface capable of bearing the weight using the mounting brackets provided with the unit. Weights for each model can be found in **Table 4** and **Table 5.**

Mounting Bracket Installation

For shipping purposes, mounting brackets may be installed upside down. If the mounting brackets are not installed in an upright position, remove the mounting screws and turn to an upright position, then fasten the screws tightly.

Proper Ventilation

In order to maintain air circulation for adequate cooling, minimum clearance around the unit must be maintained. Allow six inches on each side and top, and 18 inches below.

Ensure air intake and exhaust openings are not obstructed. If the unit is mounted in a small room, cabinet, or building, ensure there is adequate ventilation to provide sufficient cooling for the unit.

Service Entrance Equipment

The Phase Perfect phase converters are suitable for use as service equipment when the molded case circuit breaker (MCCB)/disconnect, service ground conductor terminal and grounding electrode conductor are factory installed and the converter is labeled “Suitable for use as Service Equipment.” Consult local electrical code for installation guidance.

Source Branch Circuit Protection

If a circuit breaker is not factory installed, branch circuit protection must be installed in the circuit sourcing the phase converter. See **Table 7** for recommended circuit breaker sizing. Fuses may be used for circuit protection, consult local electrical code for proper sizing. Installation of a disconnection means within sight of the phase converter is recommended.

Grounding

- Properly ground the phase converter according to local electrical code.
- Connect the ground lug to the branch circuit or service ground conductor.
- Ground the phase converter with an adequately sized conductor according to local electrical code.

Table 6 Ground Wire Specifications

Torque specifications based on solid to semi-rigid stranded copper wire. See terminal markings for additional wire size and torque information.

	Wire Range (AWG)		Min Wire Size w/specified Breaker		
Models	**Min**	**Max**	**Breaker (A)**	**Wire AWG**	**Torque (in-lb)**
PT007	14	2	60	10	40
PT010	14	2	80	8	40
PT020	14	2	150	6	40
PT030	14	2	200	6	40
PT040	14	2	250	4	50
PT050	14	2/0	400	3	50
PT060	14	2/0	500	2	50
PT075	14	2/0	600	1	50
PT407	14	2	30	10	40
PT410	14	2	40	10	40
PT415	14	2	60	10	40
PT420	14	2	70	8	40
PT430	14	2	100	8	40
PT440	14	2	150	6	40
PT450	14	2	175	6	40
PT460	14	2	200	6	40
PT475	14	2	250	4	50
PT4100	14	2/0	400	3	50

Table 7 Input Wiring (75°C Wire)

Wire size recommendations based on 600VAC, 75°C rated copper wire. Assuming 86°F (30°C) ambient and no more than 3 current carrying conductors in raceway, cable or earth (directly buried).

Input Wiring Recommendations					
	Heavy Duty[1]			Light Duty[2]	
	Circuit Breaker	Wire Gauge	Torque in-lb	Circuit Breaker	Wire Gauge
PT007	60	6 AWG	120	50	8 AWG
PT010	80	4 AWG	120	60	6 AWG
PT020	150	1/0 AWG	120	125	1 AWG
PT030	200	3/0 AWG	275	200	3/0 AWG
PT040	250	250 kcmil	275	250	250 kcmil
PT050	400	2x3/0	375	300	350 kcmil
PT060	500	2x250 kcmil	375	350	500 kcmil
PT075	600	2x350 kcmil	375	500	2x4/0 AWG
PT407	30	10 AWG	120	30	10 AWG
PT410	40	8 AWG	120	40	8 AWG
PT415	60	6 AWG	120	50	8 AWG
PT420	70	4 AWG	120	60	6 AWG
PT430	100	3 AWG	120	100	3 AWG
PT440	150	1/0 AWG	120	125	1 AWG
PT450	175	2/0 AWG	120	150	1/0 AWG
PT460	200	3/0 AWG	275	200	3/0 AWG
PT475	250	250 kcmil	275	250	250 kcmil
PT4100	400	2x3/0	375	300	350 kcmil

[1] Heavy Duty: Single motor loads with heavier inertial loads that typically require class 10 overload.

[2] Light Duty: Non motor loads, system not running near full load amps, motors that start with little or no inertial load, motors started with a soft starter.

NOTE: PT060 & PT075 are not rated to start across the line motors at the full horsepower rating.

Table 8 Input Wiring (60°C Wire)

Wire size recommendations based on 600VAC, 60°C rated copper wire. Assuming 86°F (30°C) ambient and no more than 3 current carrying conductors in raceway, cable or earth (directly buried).

Input Wiring Recommendations (60°C rated wire)					
	Heavy Duty			Light Duty	
240 V	Circuit Breaker (A)	Wire Gauge	Torque in-lb	Circuit Breaker (A)	Wire Gauge
PT007	60	4 AWG	120	50	8 AWG
PT010	80	3 AWG	120	60	6 AWG
PT407	30	10 AWG	120	30	10 AWG
PT410	40	8 AWG	120	40	8 AWG
PT415	60	4 AWG	120	50	6 AWG
PT420	70	4 AWG	120	60	4 AWG
PT430	100	1 AWG	120	100	1 AWG

Wire Sizing

Use **Table 7** to find minimum guidelines in properly sizing input and output conductors according to local electrical code. The voltage drop from the supply to the converter should be limited to 3% to ensure proper starting and operation of motor loads. Increase the wire gauge to provide adequate voltage to the load. Ensure the wire gauge is suitable to the terminal block.

Use the following formula to calculate line voltage drop.

$$V_{drop} = \ wire\ resistance\left(\frac{\Omega}{ft}\right) X\ wire\ length\ (ft)\ X\ current$$

Connecting the Load

Do not connect single phase loads to the manufactured leg, T3. This places unnecessary load on the phase converter and may violate electrical code in some areas. Apply overload and short circuit protection to protect load side conductors, motors and other attached loads according to local electrical code. For some motor loads and wiring configurations load side short circuit protection may not be required. Consult local electrical code for guidance.

Important Note:
If the connected load requires a wye configured power source with a neutral connection, the load must be connected to the phase converter using a delta-wye isolation transformer.

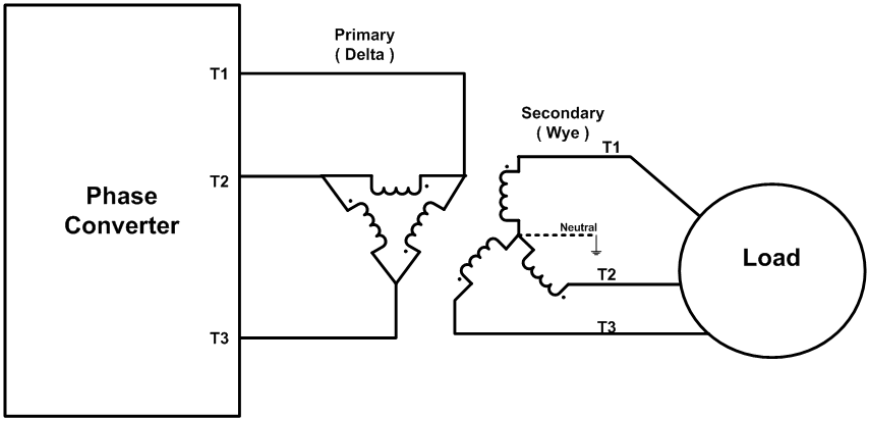


Figure 6 – Delta Wye Wiring Diagram

Table 9 Input Power Terminal Specifications

Input Power Terminals: Allowed Wire Range & Minimum Torque					
Model					
PT007, PT010, PT020, PT407, PT410, PT415, PT420, PT430, PT440, PT450		PT030, PT040, PT460, PT475		PT050, PT060, PT075, PT4100	
Wire Size	**Torque**	**Wire Size**	**Torque**	**Wire Size**	**Torque**
2/0 – 6 AWG	120 in-lb	350 kcmil-6 AWG	275 in-lb	2x500 kcmil-2x4 AWG	375 in-lb
8 AWG	40 in-lb				
10 – 14 AWG	35 in-lb				

Table 10 Output Power Terminal Specifications

Output Power Terminals: Allowed Wire Range & Minimum Torque			
Model			
PT007, PT010, PT020, PT030, PT040, PT407, PT410, PT415, PT420, PT430, PT440, PT450, PT460, PT475, PT4100		PT050, PT060, PT075	
Wire Size	**Torque**	**Wire Size**	**Torque**
2/0 – 6 AWG	120 in-lb	350 kcmil – 6 AWG	275 in-lb
8 AWG	40 in-lb		
10 – 14 AWG	35 in-lb		

Table 11 – Field Wiring Tools

Model	Line Side	Load Side
PT007	3/16" Hex	3/16" Hex
PT010		
PT020		
PT030		
PT040	5/16" Hex	
PT050		
PT060	3/8" Hex	5/16" Hex
PT075		

Model	Line Side	Load Side
PT407	3/16" Hex	3/16" Hex
PT410		
PT415		
PT420		
PT430		
PT440		
PT450		
PT460	5/16" Hex	
PT475		
PT4100		

Table 12 Optional Circuit Breaker Wire Size and Torque

Models	Circuit Breaker Family	Min	Max	Wire Strip	Min Torque (in-lb)
PT007 PT010 PT407 PT410 PT415 PT420 PT430	LS UTE100	14	10	0.7”	31.9
		8			39.9
		6	3		47.8
		2	1		55.7
PT020 PT440	LS UTS150	14		1.01”	36.2
		12	10		47.8
		8	2/0		133.6
PT030 PT460 PT475	LS UTS250	1/0	2/0	1.27”	254.9
		3/0	4/0		350.5
		250 kcmil	300 kcmil		350.5
PT040 PT050 PT4100	LS UTS400	1/0	300 kcmil	1.76”	358.4
		350 kcmil	600 kcmil		477.9

Connecting to Field Wiring Terminals

Open the front door of the enclosure to gain access to the wiring panel.
See **Figure 7 - Figure 9**.

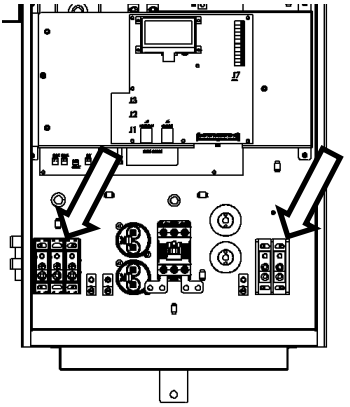


Figure 7 – PT Small Frame Field Wiring Terminals

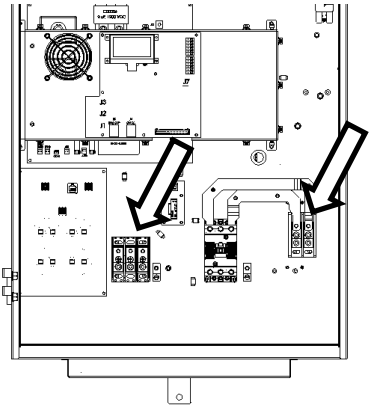


Figure 8 – PT Medium Frame Field Wiring Terminals

Small Frame Models:
PT407, PT410, PT415, PT420

Medium Frame Models:
PT007, PT010, PT020, PT430

Large Frame Models:
PT030, PT040, PT050, PT060, PT075, PT440, PT450, PT460, PT475, PT4100

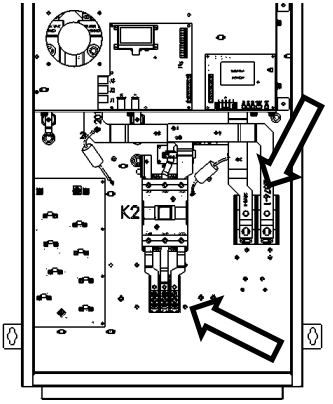


Figure 9 – PT Large Frame Field Wiring Terminals

Table 13 – Power Terminal Descriptions

Terminal Name	Description
L1, L2	Single phase input power terminals
T1, T2, T3	3 Phase output power terminals, T3 is the “manufactured” leg.
GND	Earth ground

Routing Power Cables

Note: Continuous metal conduit should be used for all power cables to reduce radiated electromagnetic interference (EMI). The conduit must be securely grounded to the converter enclosure converter and the motor case.

Route power cables through the supplied openings in the bottom of the enclosure, using appropriate conduit or strain relief devices.

Important Note: If new openings are cut, be sure to completely remove all resulting metal shavings.

Conduit hubs should be IMC or rigid steel conduit and be UL listed. Conduit hub locations can be seen in **Figure 10** and **Figure 12**.

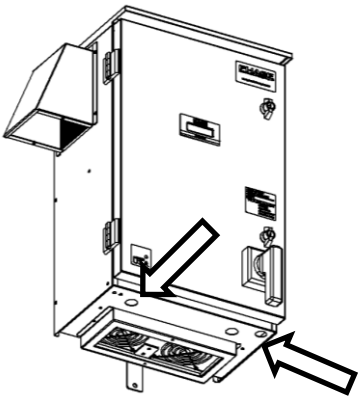


Figure 10 – PT Small Frame Conduit Locations

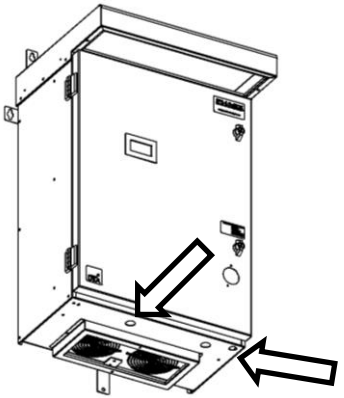


Figure 11 – PT Medium Frame Conduit Locations

Figure 12 – PT Large Frame Conduit Locations

ON/OFF Control Wiring

The output of the converter can be controlled with a low power switch connected between the AUX1 or AUX2 and COM terminals. If installed, remove the factory installed jumper wire and replace with a switch. See **Figure 17**.

When AUX1 to COM or AUX2 to COM is closed, the output is energized after a delay of approximately two seconds. When AUX1 and AUX2 to COM are open, the output of the converter will be de-energized.

The diagram in **Figure 13** illustrates the UL508A panel shop and customer installed options including an ON/OFF control switch.

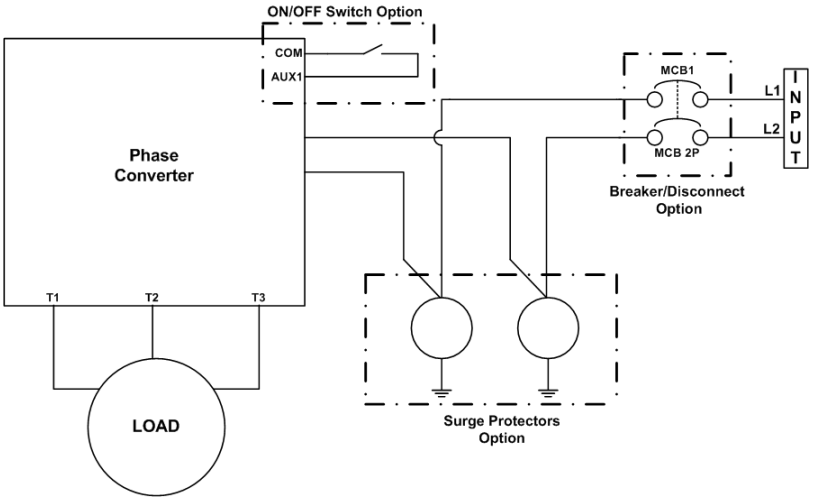


Figure 13 – Panel Shop Options

WARNING! When the converter is turned OFF using a switch on the AUX terminals, dangerous voltage may still be present on the input lines and elsewhere inside the enclosure.

Never open the enclosure or perform maintenance on the unit or connected loads when the low power remote switch is in the ON position.

Table 14 - Control Terminal Ratings and Descriptions

Terminal	Description	Rating	Comments
AUX1	Auxiliary Input 1	Dry contact type Pullup Voltage < 5 volts, galvanically isolated	Digital input. Commonly used for ON/OFF control of output.
AUX2	Auxiliary Input 2		
COM	Common		Common for AUX terminals.
AUX3	Auxiliary Input 3		RESERVED - DO NOT USE
AUX4	Auxiliary Input 4		RESERVED - DO NOT USE

⚠ **CAUTION!** Electrostatic discharge (ESD) can damage electronic components. Discharge ESD prior to touching the board or to making connections. To discharge ESD, touch your hand to unpainted metal on the enclosure.

OPERATION

LCD Status Screen

When the unit is powered up, the screen will scroll through the operating parameters.

Figure 14 – Status Screen

Figure 15 – "System Off" Status Screen

DIP SWITCH SETTINGS

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.

WARNING: Risk of electric shock. Disconnect all incoming sources of power and wait 30 minutes before opening the front cover to change the DIP switch.

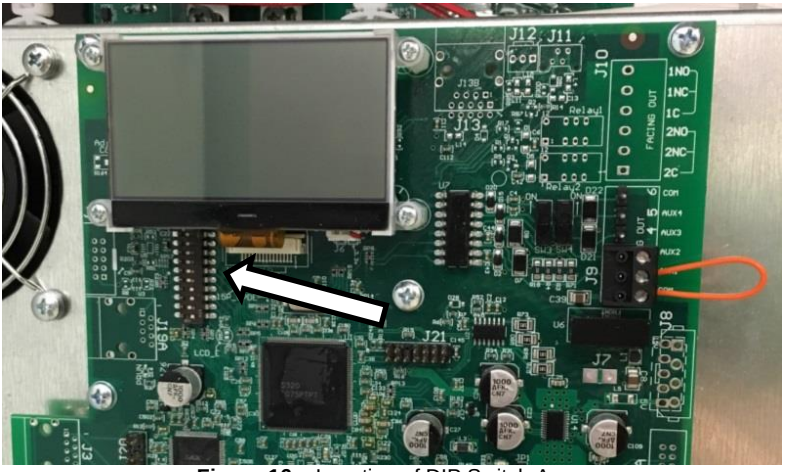


Figure 16 – Location of DIP Switch Array

DIP Switch	Function	Default
2	Disable Auto Restarts	OFF
9 & 10	Bypass AUX1 & AUX2 both **ON**	OFF/OFF
10	Enable VFD Mode note: SW9 must be **OFF**	OFF

AUX Inputs Bypass

When both DIP switches 9 and 10 are in the **ON** position, AUX1 and AUX2 inputs will be bypassed causing the output to energize regardless of the state of AUX1 and AUX2.

VFD Mode

In VFD mode the phase converter will automatically adjust the current on the generated leg to balance the three phase currents by adjusting the voltage of the generated leg. In this mode the output voltage may not be balanced. This function is typically used with some VFDs to prevent overheating of the VFD due to imbalanced currents induced by the non-linear nature of the VFD inverter. Set DIP switch 10 to the **ON** position to enable VFD mode.

Faults with Auto-Restart

⚠ **WARNING:** Load may restart automatically without warning when operating conditions permit. Disconnect power before servicing the convertor or connected loads.

The factory default allows auto restarts for noncritical faults. Disable restarts by setting DIP switch 2, see Figure 16, to the **ON** position.

After non-critical faults clear, the converter will automatically restart after a minimum 60 second delay. The LCD screen displays the auto restart count down. Cycle input power to abort the restart delay and manually restart the converter. If an Auto Restart Fault repeats 10 times, the 11th occurrence becomes a manual restart event.

Table 15 – Fault Codes

Text	Description/Comments	Restart
OUTPUT FAULT	Check for short circuit on output lines and load. Contact Phase Technologies.	Manual
INPUT FAULT	Check for short circuit on input lines. Contact Phase Technologies.	Manual
OVER TEMPERATURE	Internal temperature of the converter exceeded safe operating limits. Check fans and ventilation openings for obstruction. Reduce ambient temperature.	Auto
BUS OVERVOLTAGE	Sudden and severe regenerative power under high line voltage may result in bus overvoltage.	Auto
HALL SENSE HIGH	Current exceeded the maximum rating of the Hall sensor. May indicate a fault in the motor circuit.	Auto
LOW INPUT VOLT	Input voltage has fallen below a safe operating level.	Auto
CLASS 4 OVERLOAD	Output current exceeded operating limit.	Auto
PLL FAULT	Phase-Locked Loop. Check input frequency.	Auto
INPUT OVERLOAD	Input current exceeded the operating limit.	Auto
TEMP SENSE FAULT	Temperature sensor on the heat sink has failed or its cable is disconnected.	Manual
HIGH INPUT VOLT	Input voltage has exceeded a safe operating level. Reduce input voltage.	Auto
OUTPUT OVERLOAD	A large and sudden overcurrent event on the output module. Check motor circuit for faults.	Auto
PRECHARGE FAIL	Pre-charge circuit has failed to charge bus capacitors.	Manual
LINE CAP FAIL	Replace line capacitors or contact Phase Technologies for replacement.	Manual
UNBALANCE BUS VOL	Potential damage to a bus capacitor or degradation of the bus balancing resistor.	Auto
CM BOARD FAULT	Connection from Control board to Hall Sensor isn't properly connected. Power down unit, reconnect, and restart.	Manual

Faults: Manual Restart

These faults generally indicate damage to the converter and/or the load. They may also indicate a potentially dangerous condition. When this type of fault occurs, the display will indicate the fault message and the converter output will remain off.

⚠ **CAUTION!** Contact Phase Technologies for assistance before restarting or troubleshoot the system thoroughly before power cycling the converter. See additional descriptions of the faults in **Table 15**.

Fault Log

The Fault Log records faults with number of occurrences. To access the Fault Log, set SW3 and SW4 per **Table 16**. There are two fault logs – Master and User Fault Log.

Master Fault Log:
A non-resettable count of all faults over the life of the main circuit board

User Fault Log:
A resettable count of faults. Each fault type is limited to a count of 10. On the 11th fault, the unit will display the appropriate fault and the LCD screen will display "RESET? PWR CYCLE".

Power cycling the unit will reset the fault back to zero.

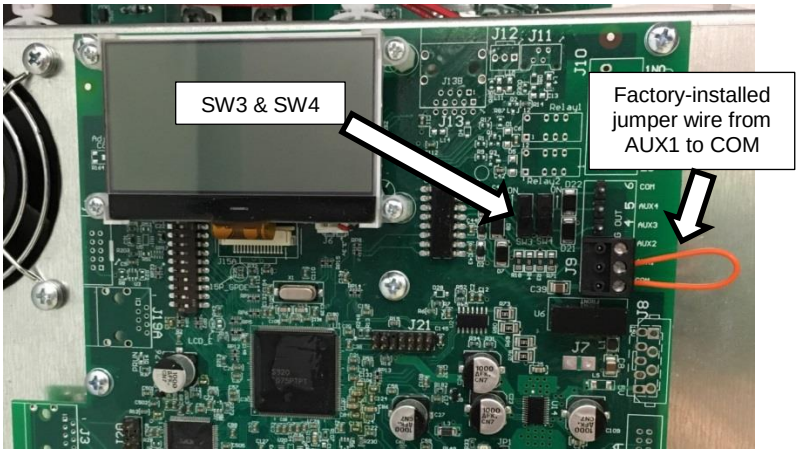


Figure 17 – Control Terminal Locations

Table 16 – Modes for SW3 and SW4 (ON = up, OFF = down)

SW3	SW4	Result
OFF	OFF	Factory default: LCD screen will scroll various operating parameters – UNIT WILL OPERATE WHILE IN THIS MODE
ON	OFF	LCD screen will show Master Fault Log (non-resettable count of all faults) UNIT **WILL NOT** OPERATE WHILE IN THIS MODE
ON	ON	LCD screen will show User Fault Log (resettable count of all faults) UNIT **WILL NOT** OPERATE WHILE IN THIS MODE
OFF	ON	Reserved

TROUBLESHOOTING TIPS

If a fault occurs, a fault code will be displayed on the LCD screen. See **Table 15** for a list of fault codes.

Table 17 – Troubleshooting

Problem	Potential Cause	Solution
Load not operating	Fault code displayed	Use **Table 15 – Fault Codes** for more information and guidance on fault codes. Clear the fault by power cycling the converter. Remove the load to determine if the issue is internal or external to the unit.
	AUX1 and AUX2 open	Check the jumper or switches connected to the AUX1 and/or AUX2 inputs
	Signals to the Control Terminals corrupted	Shielded cable is required for AUX terminal leads longer than 20 ft.
	Input terminals L1 and L2 not energized	Check the main input fuses or breaker. Check the secondary circuit fuses. See **Figure 21 – PT Small Frame Fuse Location – Figure 23.**
Motor is spinning backwards	Phase sequence to motor is wrong.	Swap any two of the three motor leads.

ROUTINE INSPECTION AND MAINTENANCE

HIGH VOLTAGE: This equipment is connected to line voltages that can create a potentially hazardous situation. Electric shock could result in serious injury or death. This device should only be installed and serviced by trained and licensed personnel. Follow instructions carefully and observe all warnings.

WARNING! Under certain operating conditions, the converter will shut down and automatically restart. Always disconnect input power from the unit and wait 30 minutes for charge to dissipate before performing service on the converter or connected loads.

The converter should be inspected and cleaned annually or more frequently if located in a hot or dirty environment. Special attention should be given to the following:

Power terminals: Periodically, inspect for loose connections and tighten to specifications in **Table 6, Table 7, Table 8, Table 9** and **Table 10**.

Capacitors: Check for leakage or deformation.

Overall: Perform visual inspection, checking for things such as discolored wires or terminals, evidence of arcing, loose mounting screws, physical damage to the enclosure, etc.

Fans and heatsinks: Excessive dust buildup on heatsink or fan impellers may lead to overheating. Lightly brush and vacuum.

Contact Customer Service for assistance in replacing cooling fans. Use only fans approved by Phase Technologies. Unapproved fans may lead to component damage.

Line Filter Capacitors

Line filter capacitors are part of the inductor/capacitor (L/C) filters and should be routinely monitored and replaced if degraded. Failure of the L/C filter can lead to increased harmonic levels, which may damage equipment connected to converter.

The capacitors can be observed by opening the front door of the converter. See **Figure 18 - Figure 20** to identify the line filter capacitors.

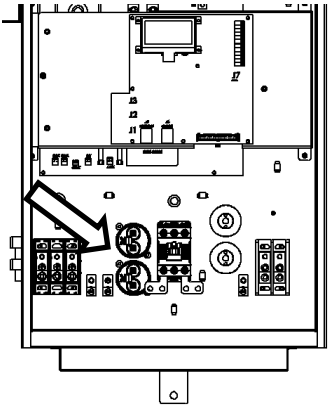


Figure 18 – PT Small Frame Line Filter Capacitors

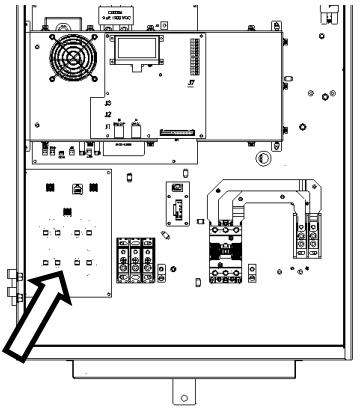


Figure 19 – PT Medium Frame Line Filter Capacitors

Small Frame Models:
PT407, PT410, PT415, PT420

Medium Frame Models:
PT007, PT010, PT020, PT430

Large Frame Models:
PT030, PT040, PT050, PT060, PT075, PT440, PT450, PT460, PT475, PT4100

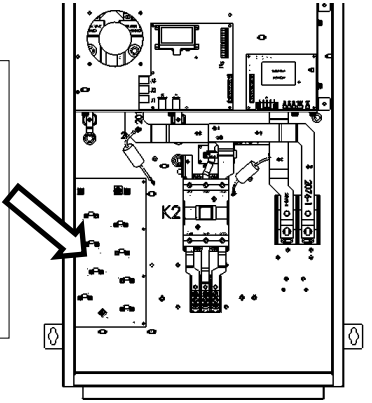


Figure 20 – PT Large Frame Line Filter Capacitors

Visually inspect the line filter capacitors and connecting wires for any discoloration or bulges in the canisters.

For **PT Small Frames**, disconnect the wires from the capacitor being measured, noting where they were connected. Use a multi-meter to measure capacitance between the terminals of one capacitor at a time. If the capacitance of either is below the **70% Capacitance** value in **Table 18**, contact Phase Technologies for replacement.

For **PT Medium** and **Large Frames**, use a multi-meter to measure between L1 and L2, then measure between L2 and L3. If either capacitance measured is below the **70% Capacitance** value in **Table 18**, contact Phase Technologies for replacement.

Table 18 – Nominal Filter Capacitor Values in MicroFarads (uF)

Converter Model	# Caps	70% Capacitance
PT007, PT407, PT410, PT415, PT420, PT430	2	7 uF
PT010, PT020	4	14 uF
PT030, PT040, PT440, PT450, PT460, PT475	8	28 uF
PT050, PT060, PT075, PT4100	8	56 uF

Fuses

There are several replaceable fuses in the converter. Each fuse is assigned a designator, indicated by its label. Contact the Service Department for replacement fuses.

Table 19 – Fuse Information

Fuse Designator	Locations	250 V Fuse Rating
F1	Inverter Board	3 A Fast Blow
F3	Inverter Board	3 A Fast Blow

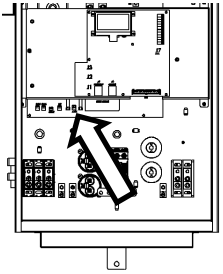


Figure 21 – PT Small Frame Fuse Location

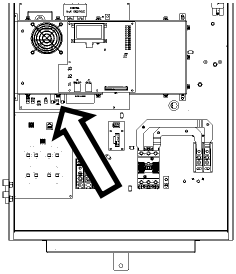


Figure 22 – PT Medium Frame Fuse Location

Small Frame Models:
PT407, PT410, PT415, PT420

Medium Frame Models:
PT007, PT010, PT020, PT430

Large Frame Models:
PT030, PT040, PT050, PT060, PT075, PT440, PT450, PT460, PT475, PT4100

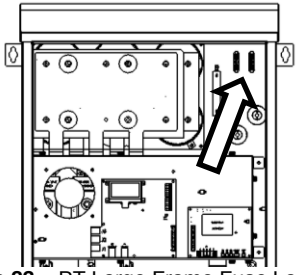
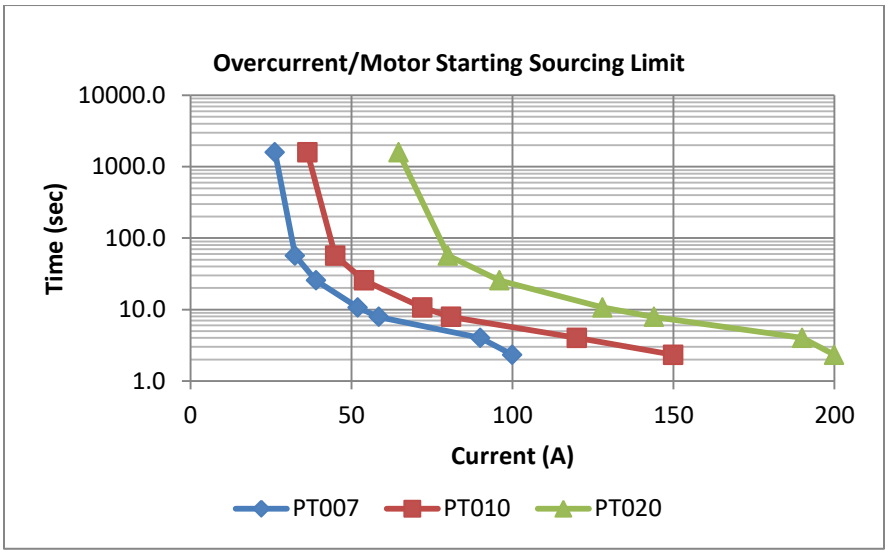
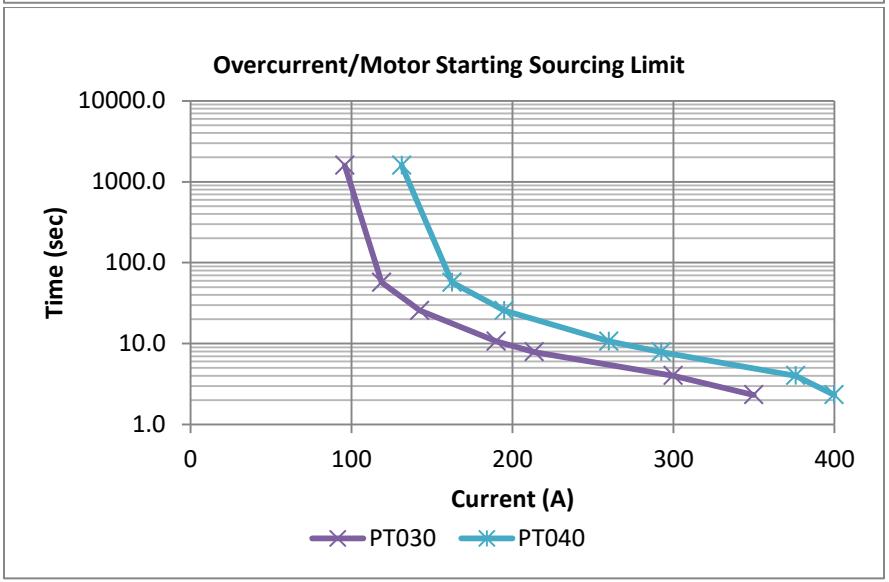


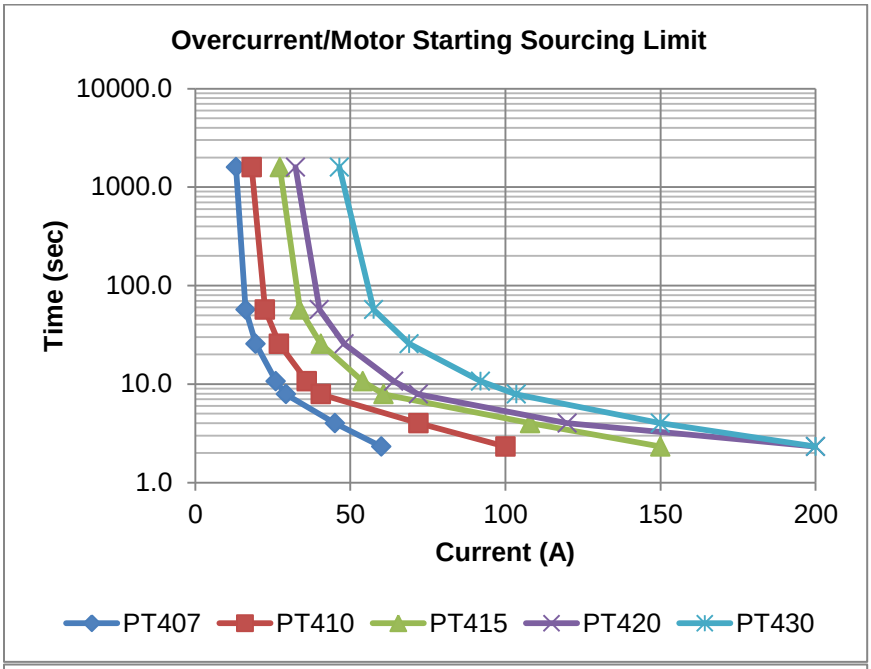
Figure 23 – PT Large Frame Fuse Locations

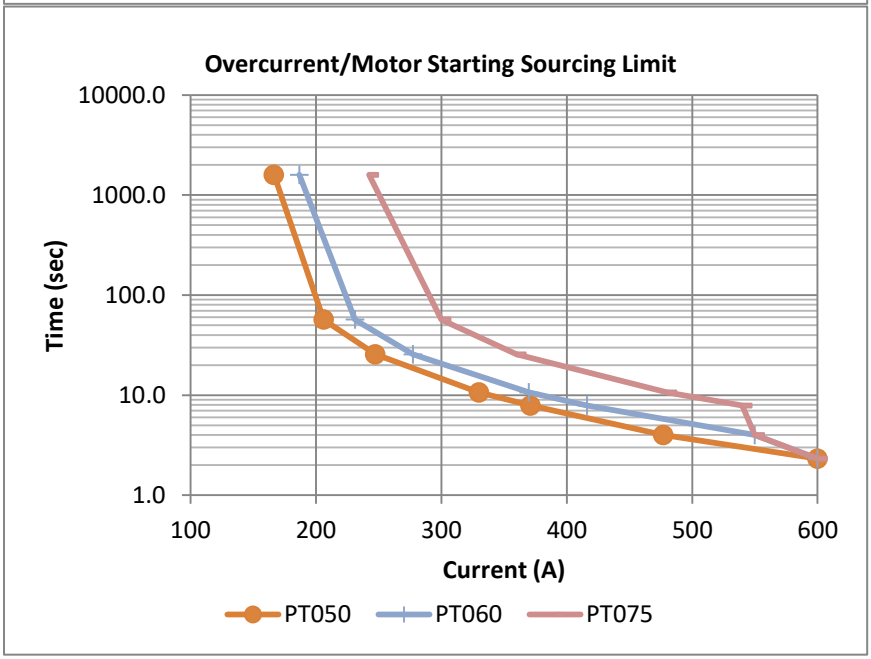
MOTOR STARTING/OVERLOAD CAPABILITIES

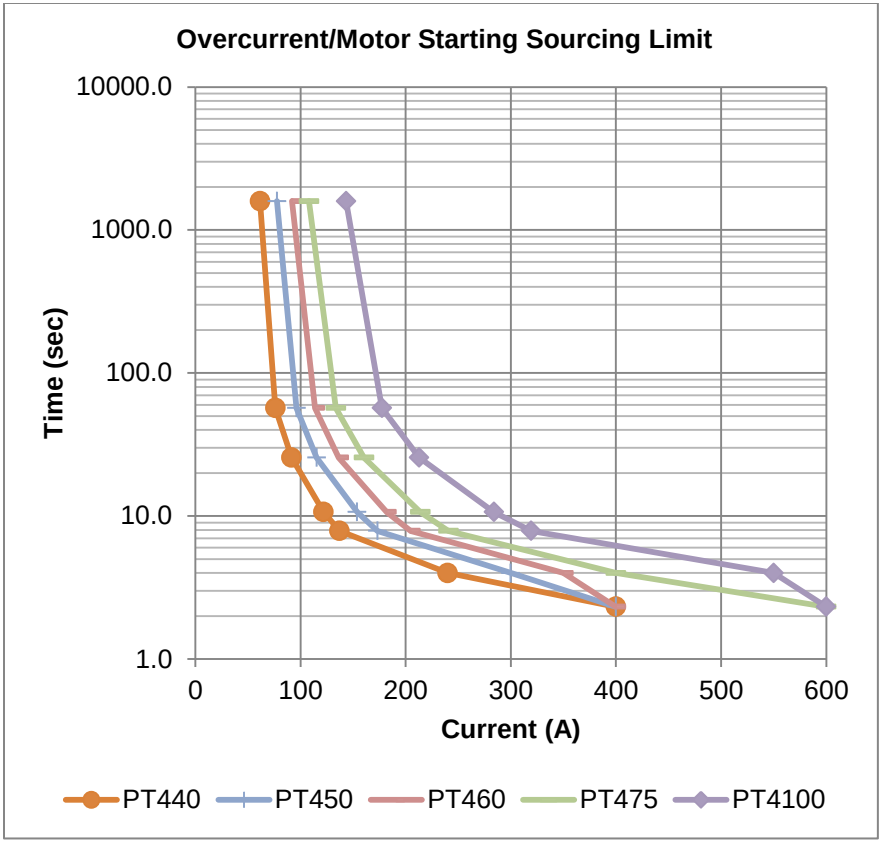
All Phase Perfect digital phase convertors are rated to across the line start motors up to the nameplate horsepower rating of the convertor except for PT060 and PT075. Motor starting capability is approximately equivalent to an across the line starter using a Class 10 thermal overload. This capability is accomplished using a Class 4 thermal overload characteristic with a proprietary algorithm that limits inrush current on the manufactured leg during startup to prevent nuisance tripping. During startup voltage is folded back when current exceeds 400% of FLA of the converter. Below 400% of FLA a Class 4 thermal overload characteristic and thermal measurements on the IGBTs controls overload tripout.






Overcurrent/Motor Starting Sourcing Limit
10000.0
1000.0
100.0
10.0
1.0
Time (sec)
0
50
100
150
200
Current (A)
PT407
PT410
PT415
PT420
PT430


Overcurrent/Motor Starting Sourcing Limit
10000.0
1000.0
100.0
10.0
1.0
Time (sec)
100
200
300
400
500
600
Current (A)
PT050
PT060
PT075



DEFINITIONS & ABBREVIATIONS

FLA	Full Load Amps
MCCB	Molded Case Circuit Breaker

NOTES

PHASE TECHNOLOGIES

LIMITED WARRANTY

This Limited Warranty applies to the following
Phase Technologies' product lines:

The NEW! Phase Perfect® Digital Phase Converters: 240V and 480V
One Year Warranty

Phase Perfect Digital Phase Converters are warranted against defects in material and workmanship. This warranty covers both parts and labor from the date of purchase from Phase Technologies. 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.

Obligations of Customer

1. The original Bill of Sale must be presented in order to obtain "in-warranty" service. Transportation to Phase Technologies or an Authorized Service Center is the responsibility of the purchaser. Return transportation is provided by Phase Technologies.

2. 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 does this warranty cover 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.

PHASE
TECHNOLOGIES

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