PHASE TECHNOLOGIES

AMPRO ELECTRIC LTD.

ECRA / ESA LICENCE #7015465

PHASE PERFECT®

230 V & 460 V *Digital Phase Converter*

Operation & Installation Manual

- Single-Phase to Three-Phase
- Solid State Technology
- 95 - 98.7% Efficient

Product Manual

PHASE PERFECT®

Digital Phase Converter

PHASE TECHNOLOGIES

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INTRODUCTION

The 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.

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 and serviced only by trained, licensed, and qualified personnel. Follow instructions carefully and observe all warnings.

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.

WARNING: Grounding electrodes must be installed such that earth resistance is 25 Ohms or less, as specified by the NEC section 250-56. If surge protection is installed, earth resistance must be 3 Ohms or less for full effect. Failure to meet these requirements could result in serious injury or death and will void the manufacturer's warranty.

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 18 - Table 22**.

⚠ **CAUTION:** The input wire gauge must be sized for the single-phase input current, which will be significantly larger than the three-phase output current to the load. The minimum wire gauge for the input terminals is listed in **Table 17**.

⚠ **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 imbalance between the three legs to ≤ 2%. Voltage imbalance is calculated according to the NEMA MG1 standard.

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

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 Digital Phase Converter.

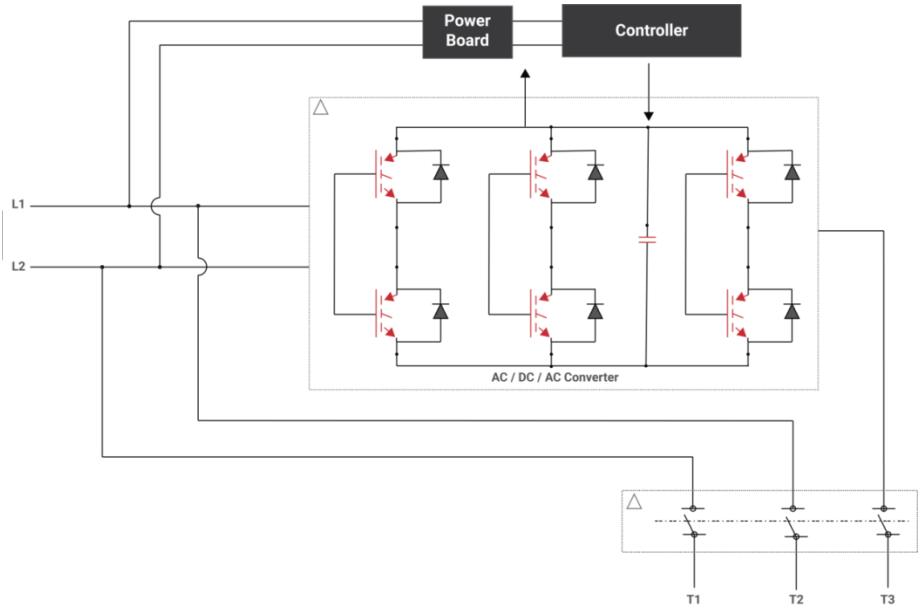


Figure 1 – Phase Perfect Digital Phase Converter Schematic

MODELS AND RATINGS

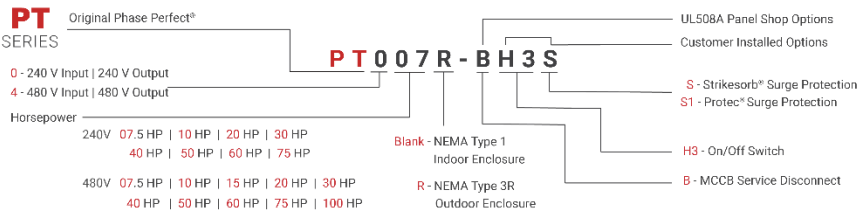


Figure 2 – Phase Perfect Nomenclature

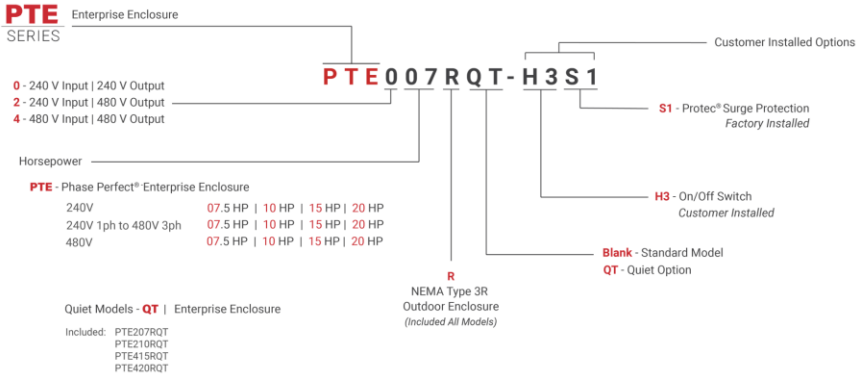


Figure 3 – Phase Perfect Enterprise Nomenclature

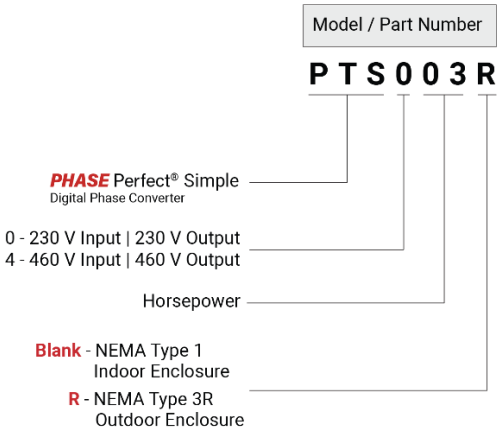


Figure 4 – Phase Perfect Simple Nomenclature

SPECIFICATIONS

General Specifications

Table 1 – General Specifications

Output Voltage – Standard Models	Approx. equal to input voltage
Output Voltage – Voltage Doubling Models	Approx. 2 x input voltage
Output Voltage Imbalance	≤2%
Operating Temperature – PT	-10°C (14°F) to 50°C (122°F)
Operating Temperature – PTE	-10°C (14°F) to 40°C (104°F)
Operating Temperature – PTS	-10°C (14°F) to 40°C (104°F)
Storage Temperature	-20°C (-4°F) to 60°C (140°F)
Efficiency – Standard Models	98.7%
Efficiency – Voltage-Doubling Models	95.0%
Short Circuit Withstand Rating	10kA
Start Delay on Power Up	2 sec

Electrical Specifications

Table 2 – 230 V PT Models and Ratings

Model	Power (HP)	Output (kVA)	Max Steady State Output Current (AAC)	Input Voltage Range (VAC)	Max AC Input Current (A)	Standby Power/Energy, (W/BTU/hr)	Full Load Energy Loss (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	1,180
PT030	30	39.4	95		165	175/597	1,752
PT040	40	54.0	130		225	190/648	2,395
PT050	50	68.5	165		286	235/802	3,043
PT060	60	78.9	190		329	260/887	3,500
PT075	75	99.7	240		416	300/1,024	4,427

Table 3 – 230 V PTE Models and Ratings

Model	Power (HP)	Output (kVA)	Max Steady State Output Current (AAC)	Input Voltage Range (VAC)	Max AC Input Current (A)	Standby Power/Energy, (W/BTU/hr)	Full Load Energy Loss (BTU/hr)
PTE007	7.5	10.8	26	187-260	45	70/239	479
PTE010	10	14.9	36		62	74/252	661
PTE015	15	21.6	52		90	77/263	958
PTE020	20	26.6	64		111	80/273	1,180

Table 4 – 230 V PTS Models and Ratings

Model	Power (HP)	Output (kVA)	Max Steady State Output Current (AAC)	Input Voltage Range (VAC)	Max AC Input Current (A)	Standby Power/Energy, (W/BTU/hr)	Full Load Energy Loss (BTU/hr)
PTS003	3	4.5	11	187-260	19	60/205	200
PTS005	5	7.4	18		31	60/205	328
PTS007	7.5	10.8	26		45	70/239	479

Table 5 – Voltage Doubling PTE Models and Ratings

Model	Power (HP)	Output (kVA)	Max Steady State Output Current (AAC)	Input Voltage Range (VAC)	Max AC Input Current (A)	Standby Power/Energy (W/BTU/hr)	Full Load Energy Loss (BTU/hr)
PTE207QT	7.5	10.8	13	187-260	45	200/682	1938
PTE210QT	10	14.9	18		62	320/1,092	2685
PTE215QT	15	22.4	27		94	435/1,484	4029
PTE220QT	20	26.6	32		111	550/1,876	4777

Table 6 – 460 V PT Models and Ratings

Model	Power (HP)	Output (kVA)	Max Steady State Output Current (AAC)	Input Voltage Range (VAC)	Max AC Input Current (A)	Standby Power/Energy, (W/BTU/hr)	Full Load Energy Loss (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	1,180
PT430	30	38.2	46		80	87/297	1,694
PT440	40	50.7	61		105	180/614	2,249

PT450	50	64	77		134	190/648	2,839
PT460	60	75.6	91		157	220/751	3,358
PT475	75	88.9	107		185	270/921	3,992
PT4100	100	118	142		246	300/1,024	5,239
PT4150	150	164.4	198		343	330/1,126	7,305
PT4175	175	183	220		381	350/1,194	8,117

Table 7 – 460 V PTE Models and Ratings

Model	Power (HP)	Output (kVA)	Max Steady State Output Current (AAC)	Input Voltage Range (VAC)	Max AC Input Current (A)	Standby Power/Energy, (W/BTU/hr)	Full Load Energy Loss (BTU/hr)
PTE407	7.5	10.8	13	440-520	22	52/177	479
PTE410	10	14.9	18		32	68/232	661
PTE415QT	15	22.4	27		48	71/242	994
PTE420QT	20	26.6	32		55	74/252	1,180

Table 8 – 460 V PTS Models and Ratings

Model	Power (HP)	Output (kVA)	Max Steady State Output Current (AAC)	Input Voltage Range (VAC)	Max AC Input Current (A)	Standby Power/Energy, (W/BTU/hr)	Full Load Energy Loss (BTU/hr)
PTS405	5	8.3	10	440-520	18	48/163	368
PTS407	7.5	10.8	13		22	52/177	479

Mechanical Specifications

Table 9 – 230 V PT Models – Enclosure Specifications

Models	PT007	PT010	PT020	PT030	PT040	PT050	PT060	PT075
Dimensions Indoor: NEMA 1 (H x W x D)*	36 15/16" x 25 3/8" x 17 1/16"			32 13/16" x 20 3/4" x 14 3/4"	36 1/4" x 27 13/16" x 15 3/4"	44 15/16" x 25 13/16" x 16 3/4"		
Dimensions Outdoor: NEMA 3R (H x W x D)*	37 7/16" x 25 3/8" x 19 5/16"			35 1/8" x 20 3/4" x 18 13/16"	38 7/8" x 27 13/16" x 19 5/16"	46 1/8" x 25 13/16" x 20 1/8"		
Weight (lbs)	102	104	129	222	233	251	255	288

Table 10 – 230 V PTE Models – Enclosure Specifications

Models	PTE007	PTE010	PTE015	PTE020
Indoor: NEMA 1 (HxWxD)*	25 7/16” x 17 1/4" x 7 3/8”		27 1/2" x 17 5/16” x 8 7/16”	
Outdoor: NEMA 3R (H x W x D)*	25 9/16” x 18 5/16” x 12”		29 1/4" x 19 3/16” x 15 9/16”	
Weight (lbs)	51	51	71	72

Table 11 – 230 V PTS Models – Enclosure Specifications

Models	PTS003	PTS005	PTS007
Indoor: NEMA 1 (H x W x D)*	17 9/16” x 12 5/16" x 5 5/8”		17 9/16” x 12 5/16” x 6 5/16”
Outdoor: NEMA 3R (H x W x D)*	17 7/8“ x 13 1/4" x 10 1/2"		18” x 13 1/4" x 11 1/4"
Weight (lbs)	20	22	24

Table 12 – Voltage Doubling PTE Models – Enclosure Specifications

Models	PTE207	PTE210	PTE215	PTE220
Indoor: NEMA 1 (H x W x D)*	33 9/16” x 18 9/16" x 8 3/8"			
Outdoor: NEMA 3R (H x W x D)*	34 3/4" x 20” x 13 7/16”			
Weight (lbs)	65	68	74	80

Table 13 – 460 V PT Models - Enclosure Specifications

Models	PT407	PT410	PT415	PT420	PT430	PT440	PT450	PT460	PT475	PT4100	PT4150	PT4175
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 16 3/4”						
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)	70	74	80	80	141	242	246	256	268	305	305	305

Table 14 – 460 V PTE Models - Enclosure Specifications

Models	PTE407	PTE410	PTE415	PTE420
Indoor: NEMA 1 (H x W x D)*	27 1/2" x 17 5/16” x 8 7/16”			
Outdoor: NEMA 3R (H x W x D)*	29 1/4" x 19 3/16” x 15 9/16”			
Weight (lbs)	69	70	70	72

Table 15 – 460 V PTS Models – Enclosure Specifications

Models	PTS405	PTS407
Indoor: NEMA 1 (H x W x D)*	18” x 14 1/8” x 6 5/16”	
Outdoor: NEMA 3R (H x W x D)*	18 11/16” x 15” x 11 3/16”	
Weight (lbs)	25	25

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

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. Model weights are found in **Table 9** – **Table 14.**

Mounting Bracket Installation

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

NEMA 3R Rain Hoods

Phase Perfect phase converters can be ordered in NEMA 1 indoor or NEMA 3R outdoor rated enclosures. Exterior openings on the top and sides of enclosure must be covered by a rain hood to be NEMA 3R outdoor rated. If the unit is being installed outdoors, install the supplied rain hood before operation. Installing products outdoors without the proper rain hood will void the manufacturer warranty.

Proper Ventilation

To maintain air circulation for adequate cooling, minimum clearance around the unit must be maintained. Allow six inches on each side and top, and at least 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.

Service Entrance Equipment

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 16** 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.
- Ground wire recommendations based on solid to semi-rigid stranded copper wire.

Table 16 – Ground Wire Specifications

Models	Recommended Circuit Breaker (A)	Wire Range (AWG)	
		Min	Max
PTS003	30	10	2
PTS005	40	10	2
PT007/PTE007/PTS007	60	10	2
PT010/PTE010	80	8	2
PTE015	125	6	2
PT020/PTE020	150	6	2
PT030	225	4	2
PT040	300	4	2
PT050	400	3	2/0
PT060	500	2	2/0
PT075	600	1	2/0
PTE207	60	8	2
PTE210	80	6	2
PTE215	125	6	2
PTE220	150	6	2
PTS405	30	10	2
PT407/PTE407/PTS407	30	10	2
PT410/PTE410	40	10	2
PT415/PTE415	60	10	2
PT420/PTE420	70	8	2
PT430	100	8	2
PT440	150	6	2
PT450	175	6	2
PT460	200	6	2
PT475	250	4	2
PT4100	400	3	2/0
PT4150	400	3	2/0
PT4175	500	3	2/0

See terminal markings for additional wire size and torque information.

Connecting Source Power

Table 17 – Input Wiring

Wire size recommendations based on 600 VAC copper wire, rated either 60°C or 75°C. Assuming 104°F (40°C) ambient and no more than 3 current carrying conductors in raceway or earth (directly buried). If phase converter will be in warmer environments, consult NEC Handbook for temperature correction factor.

Input Wiring Recommendations		
	Min. Wire Gauge (60°C)	**Min. Wire Gauge (75°C)**
PTS003	10 AWG	14 AWG
PTS005	8 AWG	10 AWG
PT007/PTE007/PTS007	4 AWG	6 AWG
PT010/PTE010	3 AWG	4 AWG
PTE015	1/0 AWG	1 AWG
PT020/PTE020	-	1/0 AWG
PT030	300 kcmil	4/0 AWG
PT040	-	350 kcmil
PT050	2 x 250 kcmil	2 x 3/0 AWG
PT060	2 x 300 kcmil	2 x 250 kcmil
PT075	2 x 500 kcmil	2 x 350 kcmil
PTE207	4 AWG	6 AWG
PTE210	3 AWG	4 AWG
PTE215	1/0 AWG	1 AWG
PTE220	-	1/0 AWG
PTS405	10 AWG	14 AWG
PT407/PTE407/PTS407	10 AWG	10 AWG
PT410/PTE410	8 AWG	8 AWG
PT415/PTE415	4 AWG	6 AWG
PT420/PTE420	4 AWG	4 AWG
PT430	1 AWG	3 AWG
PT440	-	1/0 AWG
PT450	-	2/0 AWG
PT460	250 kcmil	3/0 AWG
PT475	350 kcmil	250 kcmil
PT4100	2 x 250 kcmil	2 x 3/0 AWG
PT4150	2 x 250 kcmil	2 x 3/0 AWG
PT4175	2 x 250 kcmil	2 x 3/0 AWG

Generator Power

Phase Perfect phase converters can be powered by a generator, but it is recommended that generator be sized 150% of the phase converter rating for proper operation. If a generator will be used for backup power, a delay timer must be used to allow the phase converter to completely shut down before transferring to a new power source. This delay should be a minimum of 15 seconds.

Wire Sizing

Use **Table 17** to find minimum guidelines on properly sizing input 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.

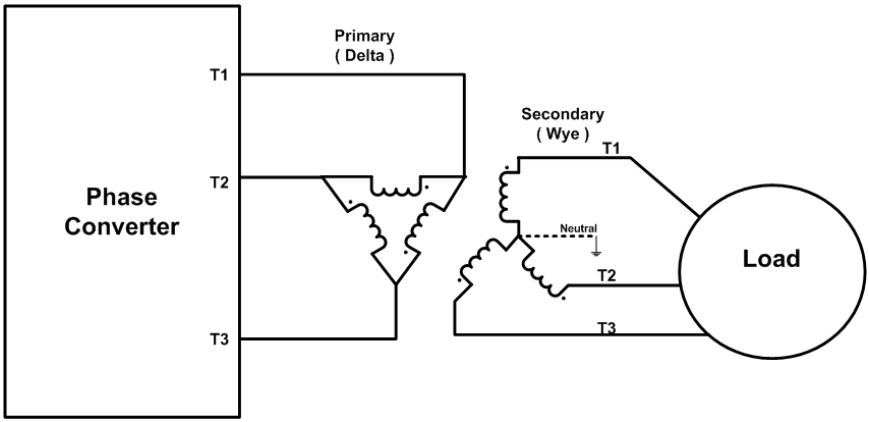


Figure 5 – Delta-Wye Wiring Diagram

Table 18 – Input Power Terminal Specifications - PT

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, PT4150, PT4175	
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 19 – Input Power Terminal Specifications - PTE

Input Power Terminals: Allowed Wire Range & Minimum Torque			
Model			
PTE007, PTE007QT, PTE010, PTE010QT, PTE207QT, PTE210QT, PTE215QT, PTE220QT, PTE407, PTE410, PTE415QT, PTE420QT		PTE015, PTE020	
Wire Size	**Torque**	**Wire Size**	**Torque**
2 – 20 AWG	17.5 in-lb	2/0 – 6 AWG 8 AWG 10 – 14 AWG	120 in-lb 40 in-lb 35 in-lb

Table 20 – Input Power Terminal Specifications - PTS

Input Power Terminals: Allowed Wire Range & Minimum Torque	
Model	
PTS003, PTS005, PTS007, PTS405, PTS407	
Wire Size	**Torque**
6 – 26 AWG	10.5 in-lb

Table 21 – 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		PT050, PT060, PT075, PT4100, PT4150, PT4175	
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 22 – Output Power Terminal Specifications - PTE

Output Power Terminals: Allowed Wire Range & Minimum Torque	
Model	
PTE007, PTE007QT, PTE010, PTE010QT, PTE015, PTE020, PTE207QT, PTE210QT, PTE215QT, PTE220QT, PTE407, PTE407QT PTE410, PTE415QT, PTE420QT	
Wire Size	**Torque**
4 – 18 AWG	16 in-lbs

Table 23 – Output Power Terminal Specifications – PTS

Output Power Terminals: Allowed Wire Range & Minimum Torque			
Model			
PTS003, PTS005, PTS007		PTS405, PTS407	
Wire Size	**Torque**	**Wire Size**	**Torque**
6 – 26 AWG	10.5 in-lbs	8 – 16 AWG	20 in-lbs

Table 24 – Field Wiring Tools

Model	Line Side	Load Side
PT007	3/16" Hex	3/16" Hex
PT010		
PT020		
PT030	5/16" Hex	
PT040		
PT050	3/8" Hex	5/16" Hex
PT060		
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		
PT4150		
PT4175		

Model	Line Side	Load Side
PTE007	Phillips Screwdriver	Flathead Screwdriver
PTE007QT		
PTE010		
PTE010QT		
PTE015	3/16" Hex	
PTE020		
PTE207QT	Phillips Screwdriver	
PTE210QT	3/16" Hex	
PTE215QT		
PTE220QT		

Model	Line Side	Load Side
PTE407	Phillips Screwdriver	Flathead Screwdriver
PTE407QT		
PTE410		
PTE410QT		
PTE415QT		
PTE420QT		

Model	Line Side	Load Side
PTS003	Flathead Screwdriver	Flathead Screwdriver
PTS005		
PTS007		
PTS405		Phillips Screwdriver
PTS407		

Table 25 – Optional Circuit Breaker Wire Size and Torque

Models	Circuit Breaker Family	Min	Max	Min Torque (in-lb)	Wire Strip
PT007 PT010 PT407 PT410 PT415 PT420 PT430	LS UTE100	14	10	31.9	0.7”
		8		39.9	
		6	3	47.8	
		2	1	55.7	
PT020 PT440	LS UTS150	14		36.2	1.01”
		12	10	47.8	
		8	2/0	133.6	
PT030 PT450 PT460 PT475	LS UTS250	1/0	2/0	254.9	1.27”
		3/0	4/0	350.5	
		250 kcmil	300 kcmil	350.5	
PT040 PT050	LS UTS400	1/0	300 kcmil	358.4	1.76”
PT4100 PT4150 PT4175		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 6 - Figure 10.**

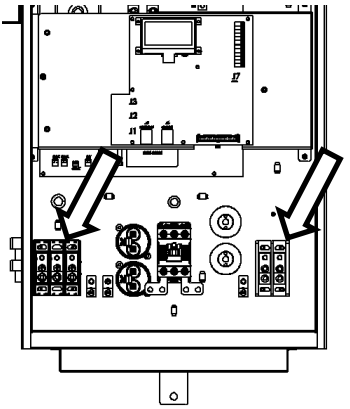


Figure 6 – PT Small Frame Field Wiring Terminals

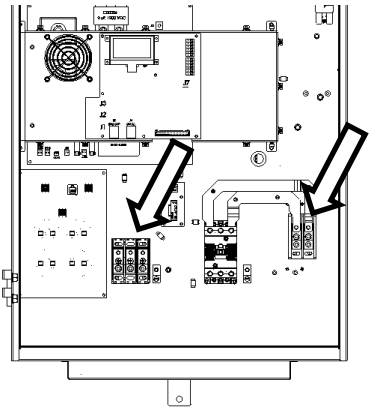


Figure 7 – PT Medium Frame Field Wiring Terminals

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, PT4150, PT4175

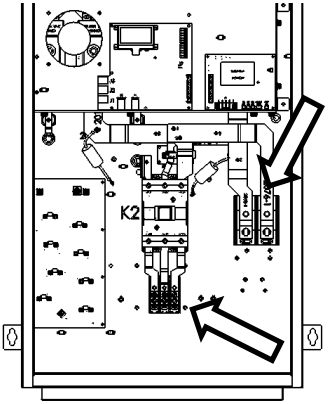


Figure 8 – PT Large Frame Field Wiring Terminals

Table 26 – 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

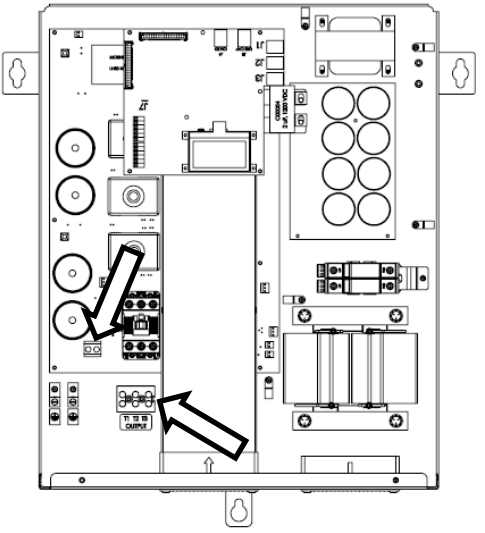


Figure 9 – PTE Field Wiring Terminals: PTE007, PTE007QT, PTE010, PTE010QT, PTE207, PTE407, PTE407QT PTE410, PTE415QT, PTE420QT

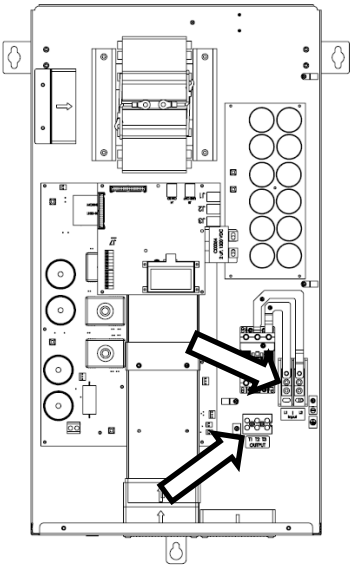


Figure 10 – PTE Field Wiring Terminals: PTE015, PTE020, PTE210, PTE215, PTE220

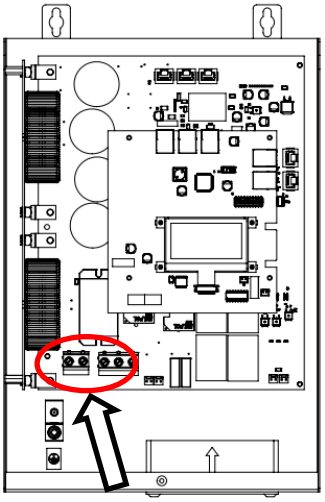


Figure 11 – PTS Field Wiring Terminals: PTS003, PTS005, PTS007

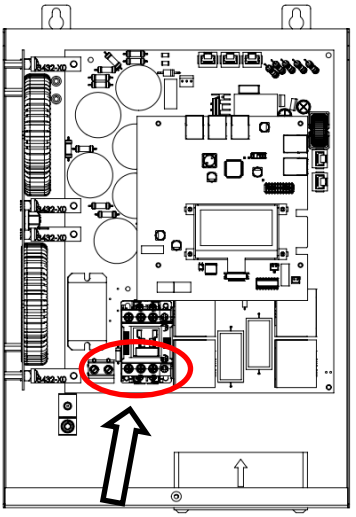


Figure 12 – PTS Field Wiring Terminals: PTS405, PTS407

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 and the motor case. Conduit hubs should be IMC or rigid steel conduit and be UL listed. Conduit hub locations can be seen in **Figure 13** - **Figure 17**.

Route power cables through the supplied openings in the bottom of the enclosure, using appropriate conduit or strain relief devices. If any conduit holes remain unused, they must be covered with a 3R hole plug to maintain the NEMA 3R rating.

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

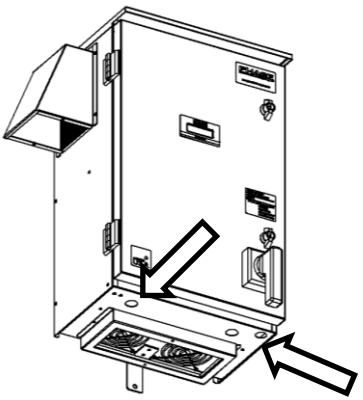


Figure 13 – PT Small Frame Conduit Locations

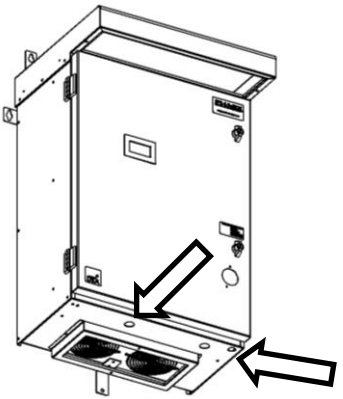


Figure 14 – PT Medium Frame Conduit Locations

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, PT4150, PT4175

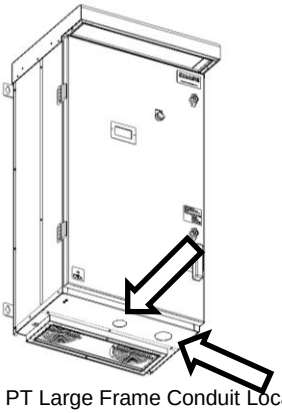


Figure 15 – PT Large Frame Conduit Locations

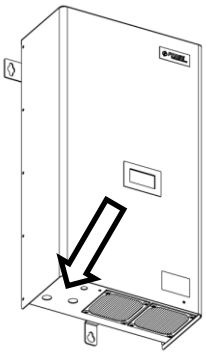


Figure 16 – PTE Conduit Locations: PTE007, PTE007QT, PTE010, PTE010QT, PTE407, PTE407QT PTE410, PTE415QT, PTE420QT

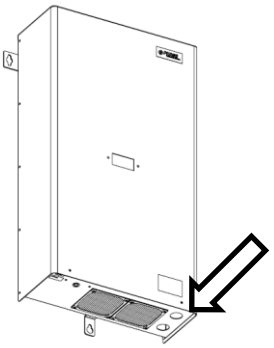


Figure 17 – PTE Conduit Locations: PTE015, PTE020, PTE207QT, PTE210QT, PTE215QT, PTE220QT

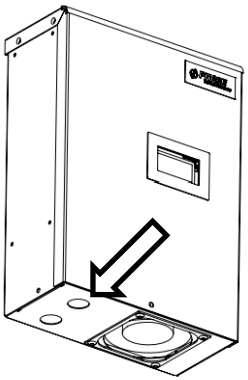


Figure 18 – PTS Conduit Locations – All Models

On/Off Control Wiring

The output of the converter can be controlled with a switch connected between the AUX1 or AUX2 and COM terminals. If installed, remove the factory installed jumper wire and replace with a switch. Jumper wire can be seen in **Figure 19** below.

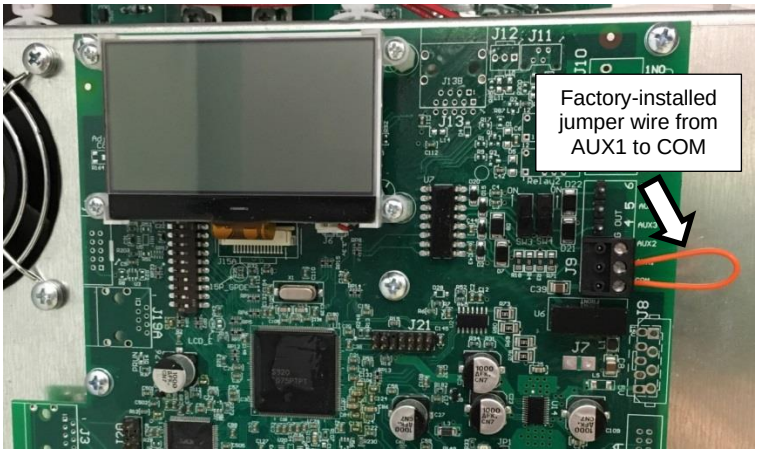


Figure 19 – Control Terminal Locations

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 20** illustrates the UL508A panel shop and customer installed options including an ON/OFF control switch. Unused conduit holes must be filled with a conduit hole plug.

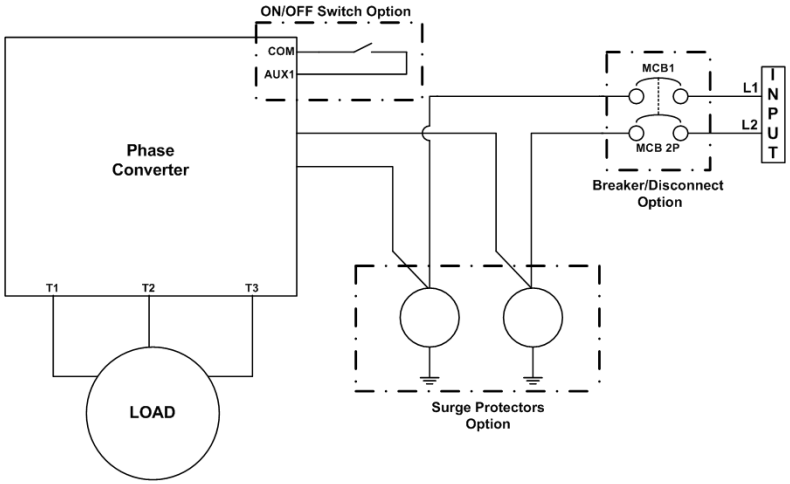


Figure 20 – Panel Shop Options

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 incoming power to the phase converter is ON, regardless of the switch setting.**

Table 27 – 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		Used for programming different modes. See next section for details.
AUX4	Auxiliary Input 4		

CAUTION! Electrostatic discharge (ESD) can damage electronic components. Discharge ESD prior to touching the board or 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 21 – Status Screen

Figure 22 – "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.

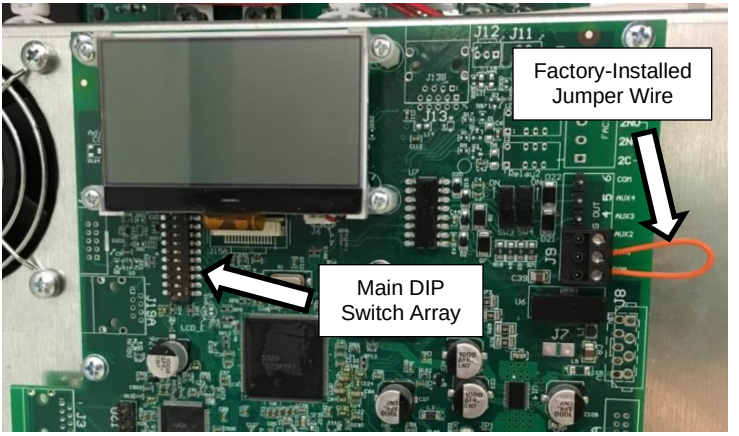


Figure 23 – Location of DIP Switches and Slide Switches

Table 28 – DIP Switch Settings

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

Bypass AUX Inputs

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.

Enable 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 to prevent overheating of the VFD due to unbalanced currents induced by the non-linear nature of the VFD inverter. Turn power to the unit off and set DIP switch 10 to the **ON** position to enable VFD mode.

Voltage Calibration

⚠ **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.

Calibrating voltage will require wiring two ON/OFF switches to the converter. Standard light switches will work. See **Figure 24** below, for wiring diagram.

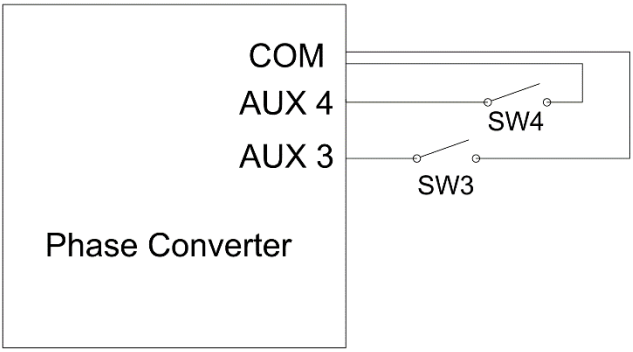


Figure 24 – Wiring Diagram for SW3 and SW4

To adjust output voltage, follow the steps below:

Step	Action
1	Turn power to PT **OFF**
2	Remove jumper wire between AUX1 and COM
3	Wire dry contact switch between AUX3 and COM (now called SW3)
4	Wire dry contact switch between AUX4 and COM (now called SW4)
5	Turn power to the PT **ON**
6	**SW4**: ON
7	**SW3**: ON

Toggle SW4 to move between ***ADJUST V23*** and ***ADJUST V31***. When the desired parameter is shown on the display, toggle SW3 **OFF** then **ON** to enter the selected menu.

Action	Effect
Toggle **SW3**	Decrease selected voltage
Toggle **SW4**	Increase selected voltage

When adjusting output voltage, make changes in small increments (5 V or less) to begin, then let the menu time out to save the change. After "**Programmed Successfully**" is shown on the display, return switches to the **OFF** position. Turn power to converter **OFF**, re-install jumper wire between **AUX1** and **COM**, then reapply power to converter and measure voltages to verify change in calibration. Repeat this procedure, using smaller increments as you get close, until desired output voltage is reached. When voltage calibration has been completed, turn power to the PT **OFF**. Remove SW3 and SW4, re-install the jumper wire connecting AUX1 and COM and re-apply power to converter.

Transformer Mode

⚠ **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.

Transformer Mode will allow T3 to drop in voltage during heavy startups. This will require wiring two ON/OFF switches to the converter. Standard light switches will work. See **Figure 24**, for wiring diagram.

To enable **Transformer Mode**, follow the steps below:

Step	Action
1	Turn power to PT **OFF**
2	Remove jumper wire between AUX1 and COM
3	Wire dry contact switch between AUX3 and COM (now called SW3)
4	Wire dry contact switch between AUX4 and COM (now called SW4)
5	Turn power to the PT **ON**
6	Toggle **SW4** until you see **TRANSFORMER 2/5** on display
7	Toggle **SW3** to select between YES or NO

Leave Transformer select menu at desired setting, after 3 seconds of no switch toggling, the setting will be saved. **Switches must be returned to the OFF position after changes are complete.** Turn power to the PT **OFF** again. Remove SW3 and SW4, re-install the jumper wire connecting AUX1 and COM, and re-apply power to converter.

Elevator Mode

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.

WARNING! Using **Elevator Mode** on any application except an elevator will void manufacturer's warranty. **Transformer Mode** and **VFD Mode** can be used on any application without voiding warranty.

Elevator Mode forces T3 to maintain voltage during heavy startups. This setting should only be used if elevator is tripping due to a drop in input voltage. This will require wiring two ON/OFF switches to the converter. Standard light switches will work. See **Figure 24** for wiring diagram. To enable **Elevator Mode**, follow the steps below:

Step	Action
1	Turn power to PT **OFF**
2	Remove jumper wire between AUX1 and COM
3	Wire dry contact switch between AUX3 and COM (now called SW3)
4	Wire dry contact switch between AUX4 and COM (now called SW4)
5	Turn power to the PT **ON**
6	Toggle **SW4** until you see ELEVATOR on screen
7	Toggle **SW3** to select between YES or NO

Leave Elevator select menu at desired setting, after 3 seconds of no switch toggling, the setting will be saved. **Switches must be returned to the OFF position after changes are complete.** Turn power to the PT **OFF** again. Remove SW3 and SW4, re-install the jumper wire connecting AUX1 and COM and re-apply power to converter.

Startup Delay

⚠ **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.

Startup Delay will force the converter to wait for a set time period before starting up. This procedure will require wiring two ON/OFF switches to the converter. Standard light switches will work. See **Figure 24** for wiring diagram. To add a startup delay, follow the steps below:

Step	Action
1	Turn power to PT **OFF**
2	Remove jumper wire between AUX1 and COM
3	Wire dry contact switch between AUX3 and COM (now called SW3)
4	Wire dry contact switch between AUX4 and COM (now called SW4)
5	Turn power to the PT **ON**
6	Toggle **SW4** until you see **STARTUP DLY 4/5** on screen
7	Toggle **SW3** to select between YES or NO
8	Wait several seconds to allow this programming to be saved
9	Repeat steps **6** and **7**
10	**SW3** ON to access STARTUP DLY
11	**SW4** ON to access DLY TIME

Switches now act as toggle to select the **STARTUP DELAY TIME**.

Action	Effect
Toggle **SW3**	Decrease delay time
Toggle **SW4**	Increase delay time

Wait several seconds until "**Programmed Successfully**" is shown on the display, and then return switches to the **OFF** position. Turn power to converter **OFF**, re-install jumper wire between **AUX1** and **COM**, then reapply power to converter.

Infinite Restarts

⚠ **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.

Infinite Restarts will allow the converter to restart an unlimited number of times after fault conditions. This procedure will require wiring two ON/OFF switches to the converter. Standard light switches will work. See **Figure 24** for wiring diagram. To add a startup delay, follow the steps below:

Step	Action
1	Turn power to PT **OFF**
2	Remove jumper wire between AUX1 and COM
3	Wire dry contact switch between AUX3 and COM (now called SW3)
4	Wire dry contact switch between AUX4 and COM (now called SW4)
5	Turn power to the PT **ON**
6	Toggle **SW4** until you see INFINITE RESTARTS on screen
7	Toggle **SW3** to select between YES or NO

Wait several seconds until "**Programmed Successfully**" is shown on the display, and then return switches to the **OFF** position. Turn power to converter **OFF**, re-install jumper wire between **AUX1** and **COM**, then reapply power to converter.

Fault Codes

Table 29 – Fault Codes

Text	Description/Comments	Restart
BUS OVERVOLTAGE	Sudden and severe regenerative power under high line voltage may result in bus overvoltage.	Auto
CLASS 4 OVERLOAD	Output current exceeded operating limit.	Auto
CM BOARD FAULT	Connection from Control board to Hall Sensor isn't properly connected. Power down unit, reconnect, and restart.	Manual
HALL SENSE HIGH	Current exceeded the maximum rating of the Hall sensor. May indicate a fault in the motor circuit.	Auto
HIGH INPUT VOLT	Input voltage has exceeded a safe operating level. Reduce input voltage.	Auto
IGBT FAULT	Check for short circuit on input and output lines and load. Contact Phase Technologies.	Manual
INPUT OVERLOAD	Input current exceeded the operating limit.	Auto
LINE CAP FAIL	Replace line capacitors or contact Phase Technologies for replacement.	Manual
LOW INPUT VOLT	Input voltage has fallen below a safe operating level.	Auto
OUTPUT OVERLOAD	A large and sudden overcurrent event on the output module. Check motor circuit for faults.	Auto
OVER TEMPERATURE	Internal temperature of the converter exceeded safe operating limits. Check fans and ventilation openings for obstruction. Reduce ambient temperature.	Auto
PLL FAULT	Phase-Locked Loop occurs when input frequency is ± 7 Hz of 60 Hz. Check input frequency.	Auto
PRECHARGE FAIL	Pre-charge circuit has failed to charge bus capacitors.	Manual
STIR FAN FAIL	PT420 and PTE420QT only. Temperature sensor near inductor has exceed safe operating limits. Wait for temperature to drop to safe level.	Auto
TEMP SENSE FAULT	Temperature sensor on the heat sink has failed or its cable is disconnected.	Manual
UNBALANCE BUS VOL	Potential damage to a bus capacitor or degradation of the bus balancing resistor.	Auto
VOLTAGE UNBALANCE	Output voltage difference between pass-through legs and generated leg is greater than 50 V.	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.

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.

Fault Log

The Fault Log records faults with number of occurrences. To access the Fault Log, wire a dry contact switch between AUX3 and COM (now called SW3), and wire a dry contact switch between AUX4 and COM (now called SW4). Standard light switches will work. Next, set SW3 and SW4 per **Table 30**. 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.

Table 30 – 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 29** for a list of fault codes. Fault codes generally indicate that an issue exists independent of the phase converter.

Table 31 – Troubleshooting

Problem	Potential Cause	Solution
No power	Incoming circuit breaker continually trips	IGBT troubleshooting
	Blown fuses	See page 31 for information on replacing fuses. If fuses are blown, this may also require replacing filter capacitors and/or the power board if the MOV's are damaged.
Load not operating	Fault code displayed	Use **Table 29** 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 32** - **Figure 34**.
	Overcurrent fault in elevator application	Check elevator specs to ensure PT is sized correctly.
Motor is spinning backwards	Phase sequence to motor is wrong.	Swap any two of the three motor leads.
LED lights flickering or other electrical noise issues	Electromagnetic interference issues	Ensure that problem does not persist when PT is powered off. Check and improve grounding. LED lighting can be prone to noise/flickering when all LED lights are being used. Installing an incandescent light in a given circuit can often resolve these problems. Consider installing an EMI filter on the phase converter input.

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.

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. 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 18** – **Table 22**.

Capacitors: Check for leakage or deformation.

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

This section does not apply to PTS products. 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. See **Figure 25** - **Figure 27** to identify the line filter capacitors.

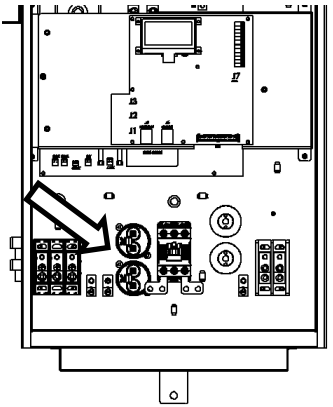


Figure 25 – PT Small Frame Line Filter Capacitors

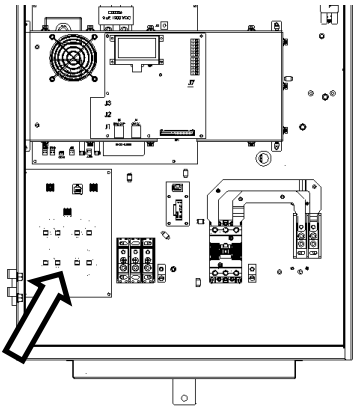


Figure 26 – PT Medium Frame Line Filter Capacitors

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, PT4150, PT4175

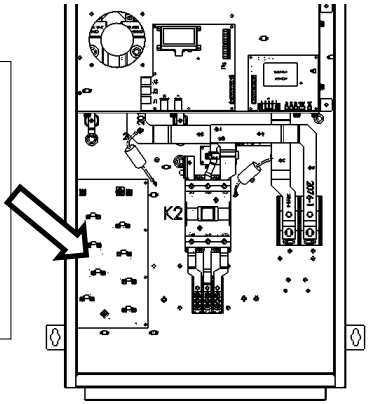
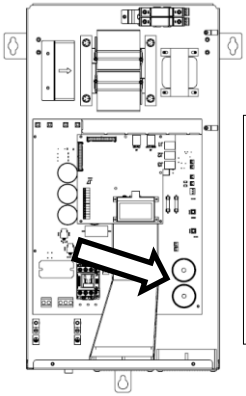


Figure 27 – PT Large Frame Line Filter Capacitors



PTE Frame 1 Models:
PTE007QT, PTE010QT, PTE015, PTE020, PTE207QT, PTE210QT, PTE215QT, PTE220QT, PTE407QT, PTE410QT, PTE415QT, PTE420QT

PTE Frame 2 Models:
PTE007, PTE010, PTE407, PTE410

Figure 28 – PTE Frame 1 Line Filter Capacitors

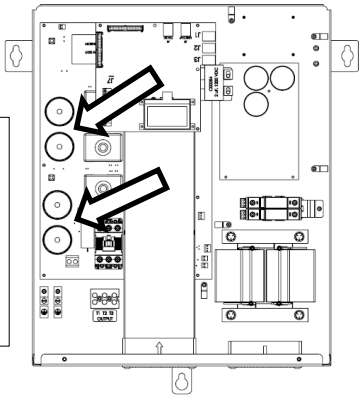


Figure 29 – PTE Frame 2 Line Filter Capacitors

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 **50% Capacitance** value in **Table 32**, contact Phase Technologies for replacement.

For **PT Medium** and **Large Frames**, disconnect wires from L2 and use a multi-meter to measure between L1 and L2, then measure between L2 and L3. If either capacitance measured is below the **50% Capacitance** value in **Table 32**, contact Phase Technologies for replacement.

Table 32 – PT Nominal Filter Capacitor Values in MicroFarads (uF)

Converter Model	Nominal Capacitance	50% Capacitance
PT407, PT410, PT415, PT420	10 uF	5 uF
PT007, PT430	10 uF	5 uF
PT010, PT020	20 uF	10 uF
PTE007, PTE007QT, PTE010, PTE010QT, PTE015, PTE020, PTE407, PTE407QT PTE410, PTE410QT, PTE415QT, PTE420QT	20 uF	10 uF
PTE207QT, PTE210QT, PTE215QT, PTE220QT	20 uF	10 uF
PT030, PT040, PT440, PT450, PT460, PT475	40 uF	20 uF
PT050, PT060, PT075, PT4100, PT4150, PT4175	80 uF	40 uF

For **230V and voltage doubling PTE models (PTE0XX and PTE2XX)**, disconnect wires from JL2 and use a multi-meter to measure between JL1 and JL2, then measure between JL2 and JL3B. If either capacitance measured is below the **50% Capacitance** value in **Table 32**, contact Phase Technologies for replacement.

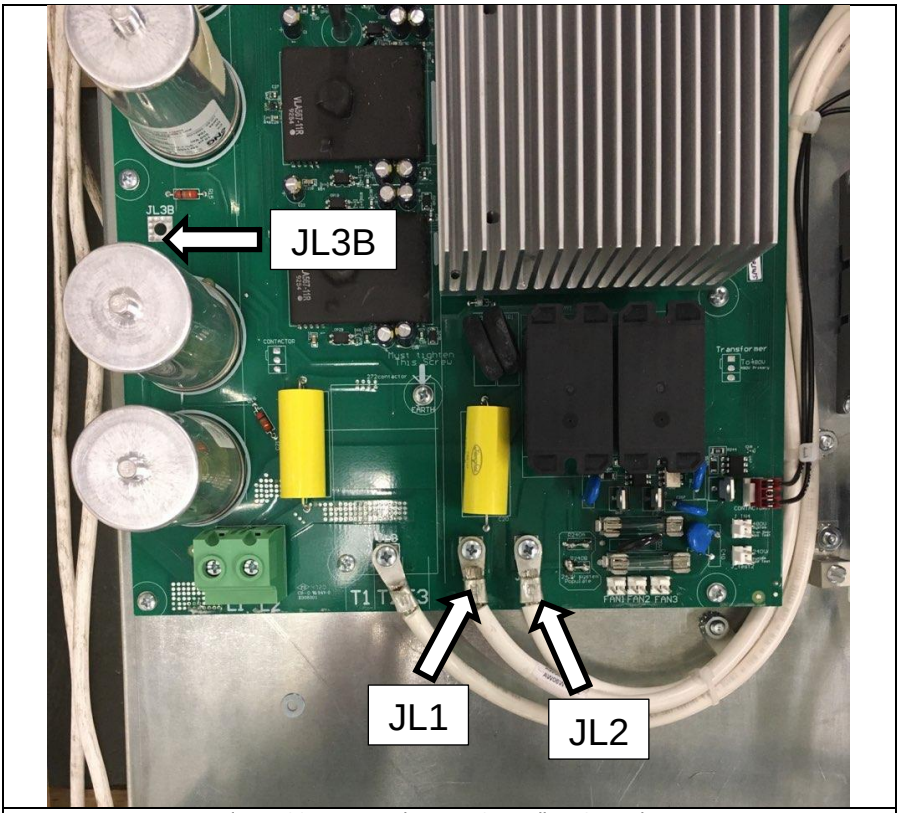


Figure 30 – Measuring PTE0XX Filter Capacitors

For **460V PTE models (PTE4XX)**, disconnect wires from JL2. You may need to remove the baffle covering the heatsink to access JL2. Next, use a multi-meter to measure between L1 and L2, then measure between L2 and JL3B. If either capacitance measured is below the **50% Capacitance** value in **Table 32**, contact Phase Technologies for replacement. Be sure to reconnect wires to JL2 before powering unit on again.

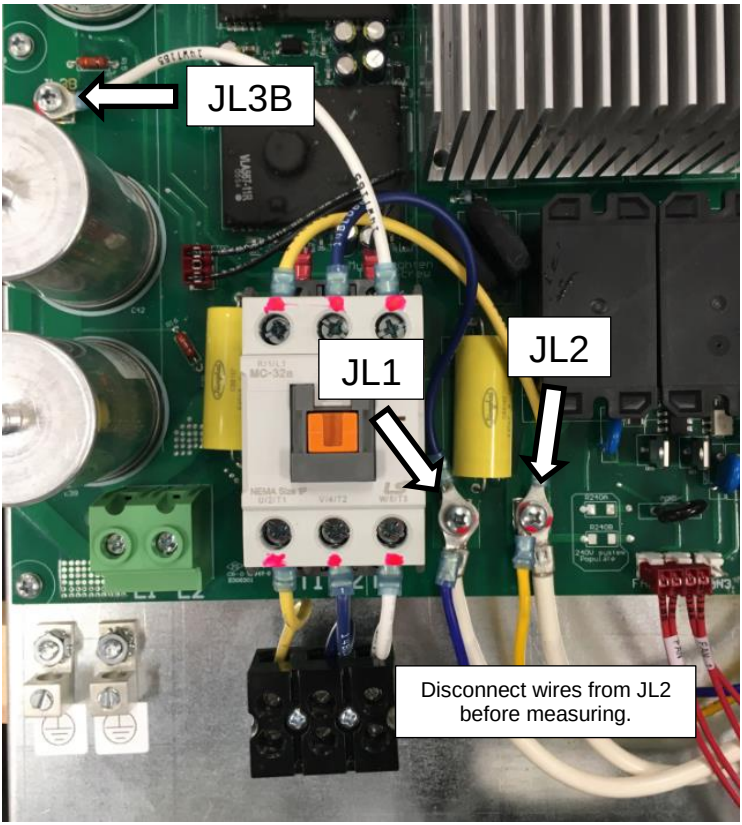


Figure 31 – Measuring PTE4XX Filter Capacitors

Fuses

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

Table 33 – Fuse Information

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

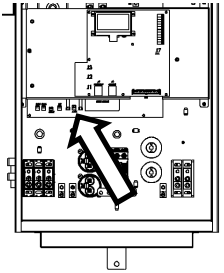


Figure 32 – PT Small Frame Fuse Location

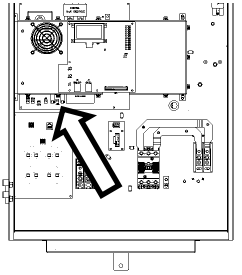


Figure 33 – PT Medium Frame Fuse Location

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, PT4150, PT4175

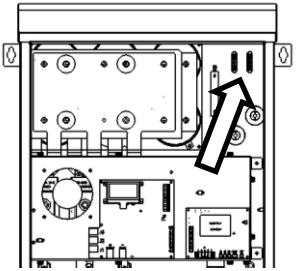


Figure 34 – PT Large Frame Fuse Locations

Some PTE models may require the heat sink baffle to be removed before accessing fuses. To do this, remove the screws fastening the baffle to the side of the heatsink.

The heat sink baffle is necessary for proper cooling and must be replaced before resuming operation. If not properly replaced, warranty may be voided.

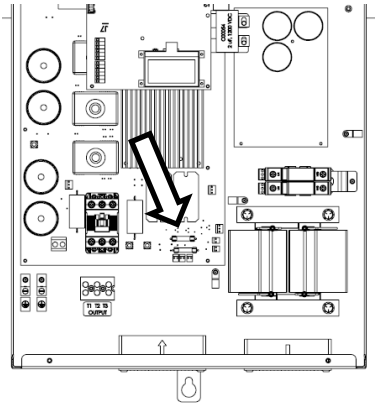
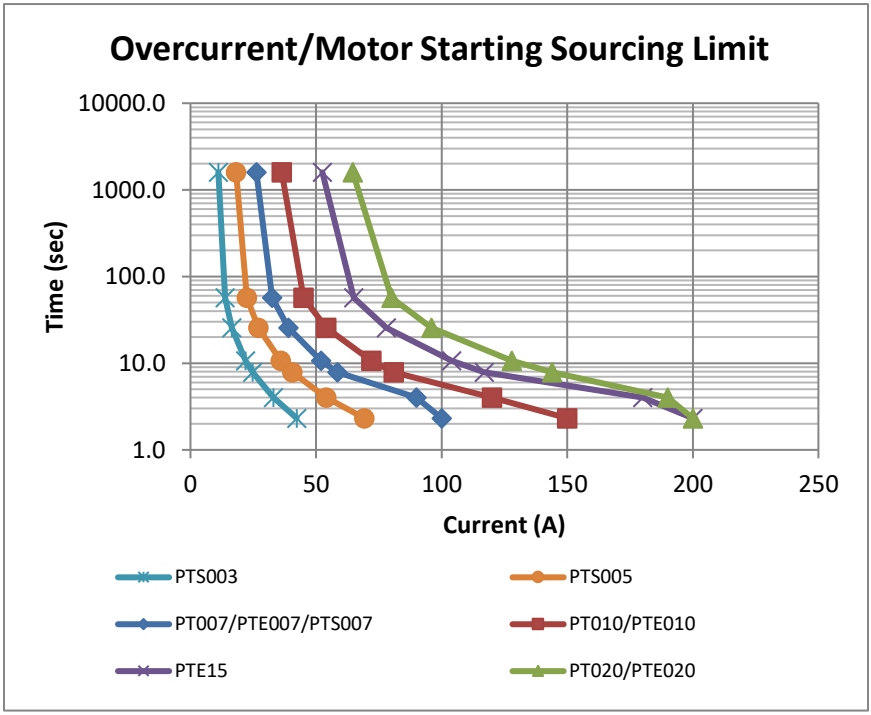
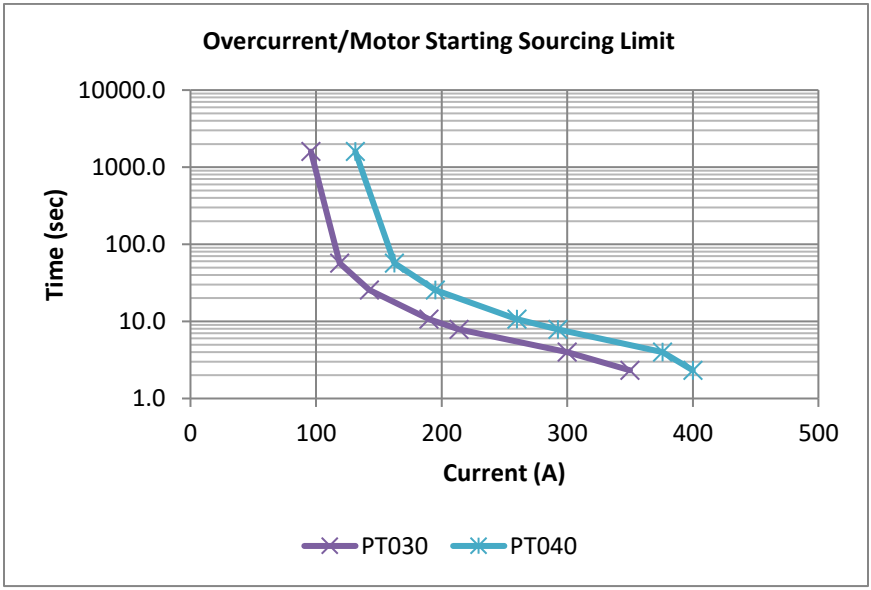


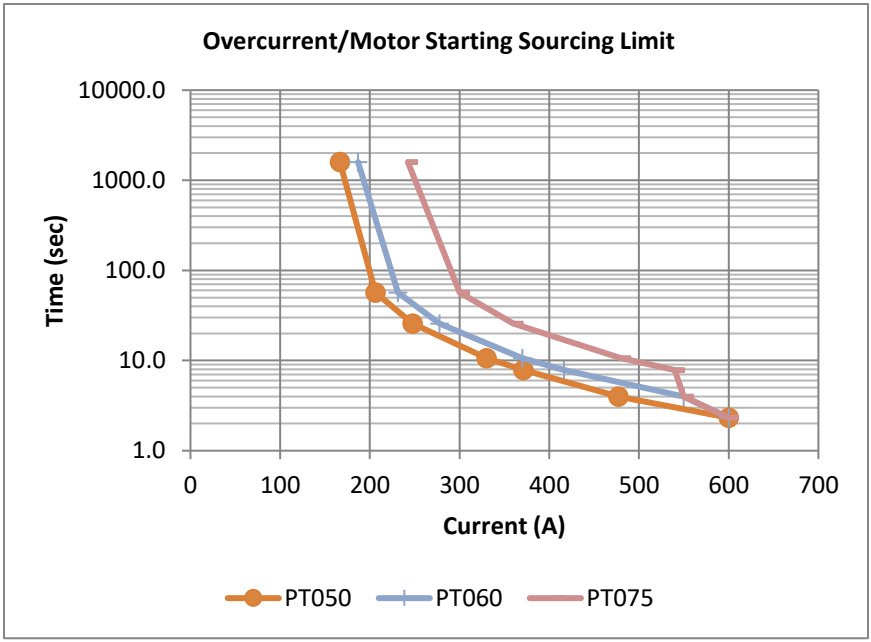
Figure 35 – PTE Frame 2 Fuse Location
(Heat Sink Baffle Must Be Removed)

MOTOR STARTING/OVERLOAD CAPABILITIES

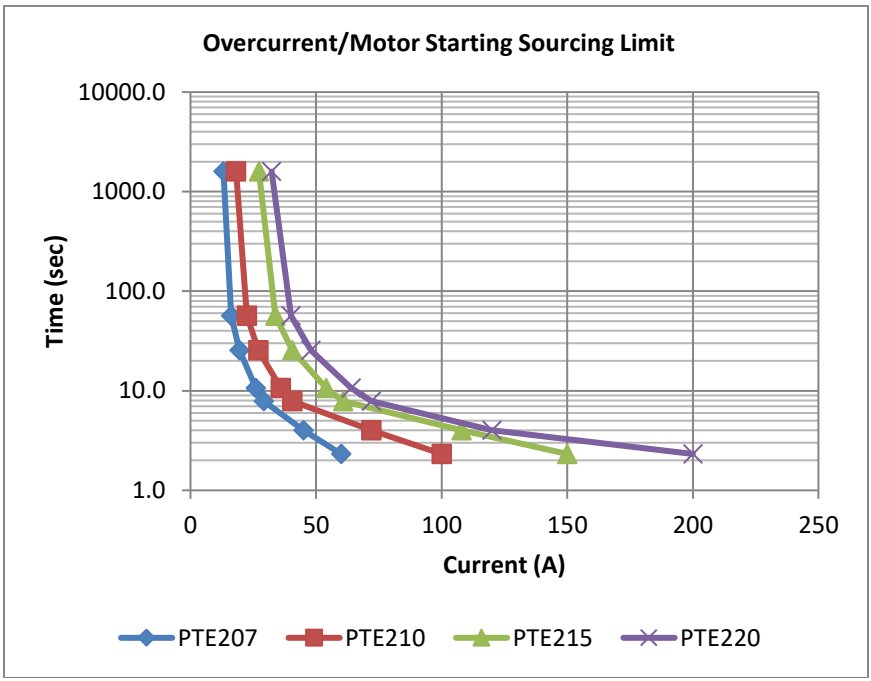
All Phase Perfect digital phase convertors are rated to across the line start motors up to the nameplate horsepower rating of the convertor except for 50 HP models and larger. Motor starting capability is approximately equivalent to an across the line starter using a Class 10 thermal overload. This capability 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 Full Load Amps (FLA) of the converter. Below 400% of FLA, a Class 4 thermal overload curve and thermal measurements, on the IGBTs, control overload tripping.

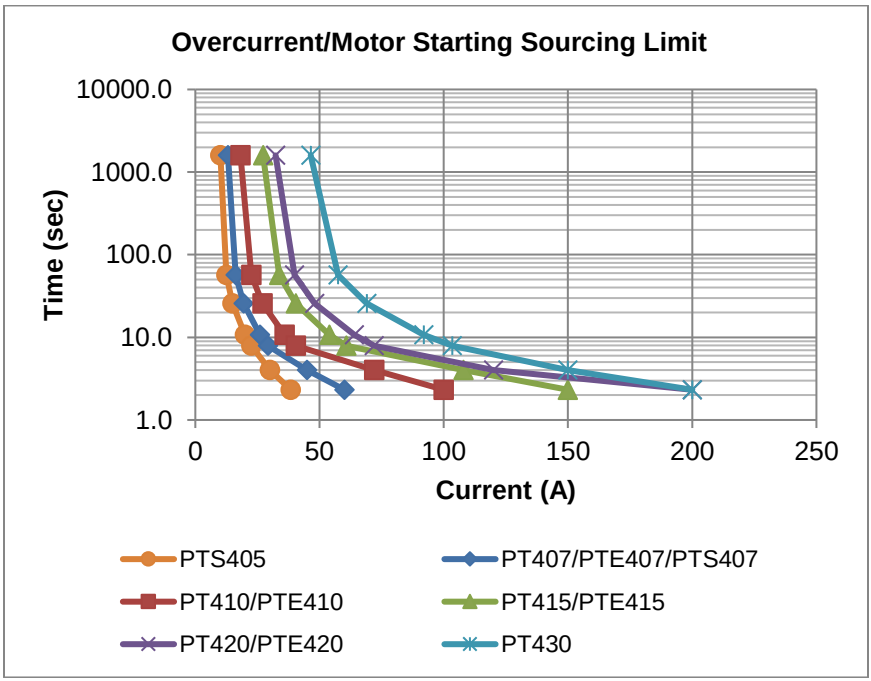


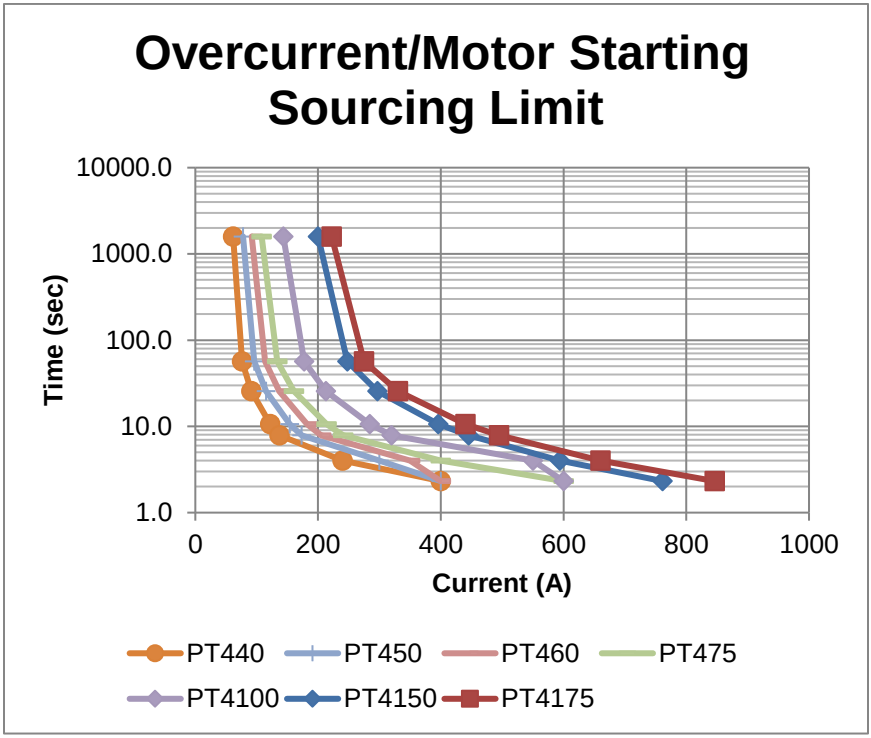




*PT050, PT060, and PT075 should not be used to cross-the-line-start motor loads.


Overcurrent/Motor Starting Sourcing Limit
10000.0
1000.0
100.0
10.0
1.0
Time (sec)
0
50
100
150
200
250
Current (A)
PTE207
PTE210
PTE215
PTE220


Overcurrent/Motor Starting Sourcing Limit
10000.0
1000.0
100.0
10.0
1.0
Time (sec)
0
50
100
150
200
250
Current (A)
PTS405
PT407/PTE407/PTS407
PT410/PTE410
PT415/PTE415
PT420/PTE420
PT430



*Phase converters 50 HP and larger should not be used to cross-the-line start motor loads.

DIMENSIONAL DRAWINGS

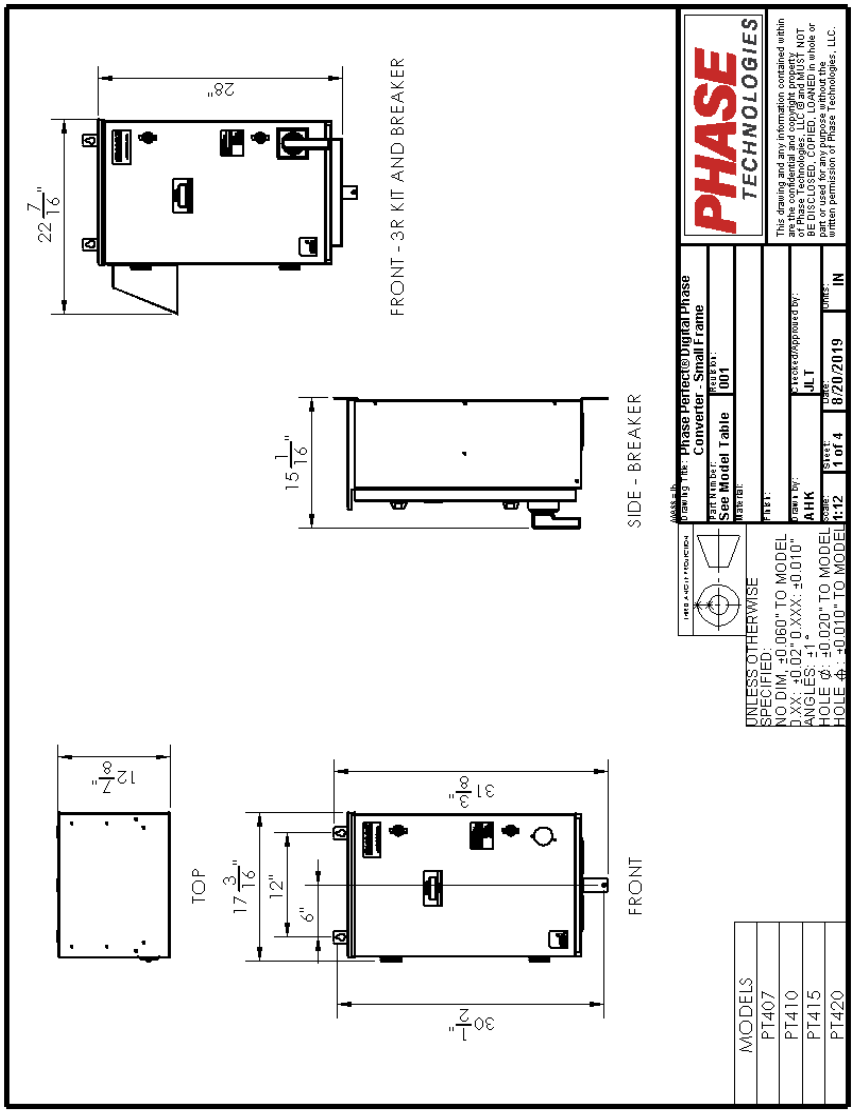


Figure 36 – PT Small Frame Dimensions

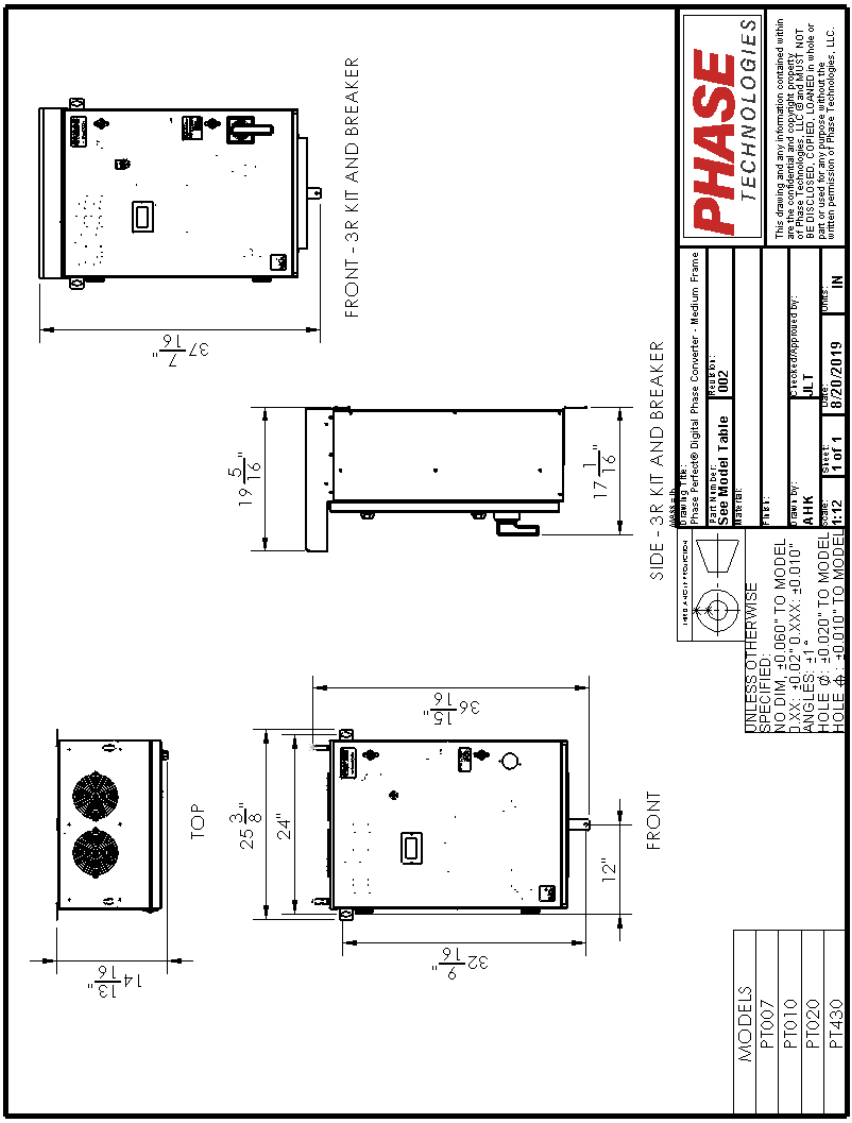


Figure 37 – PT Medium Frame Dimensions

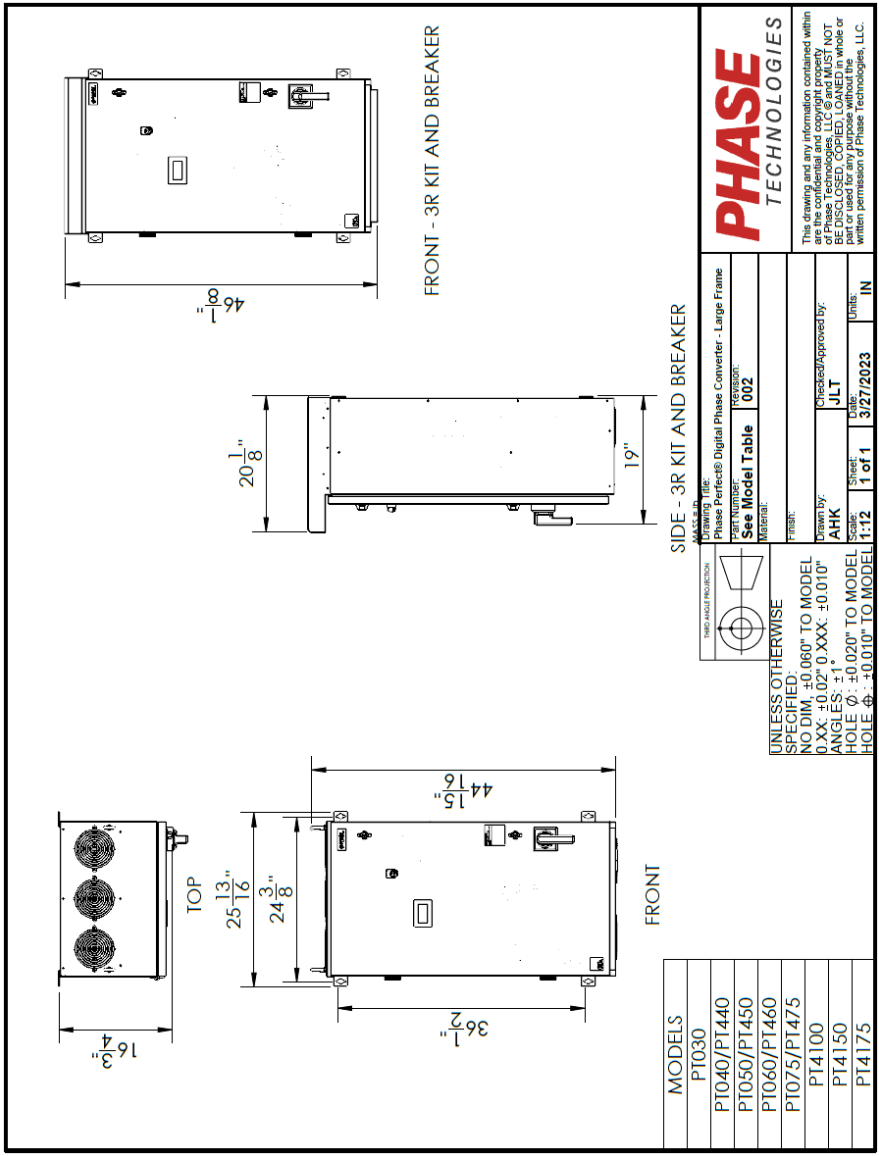


Figure 38 – PT Large Frame Dimensions

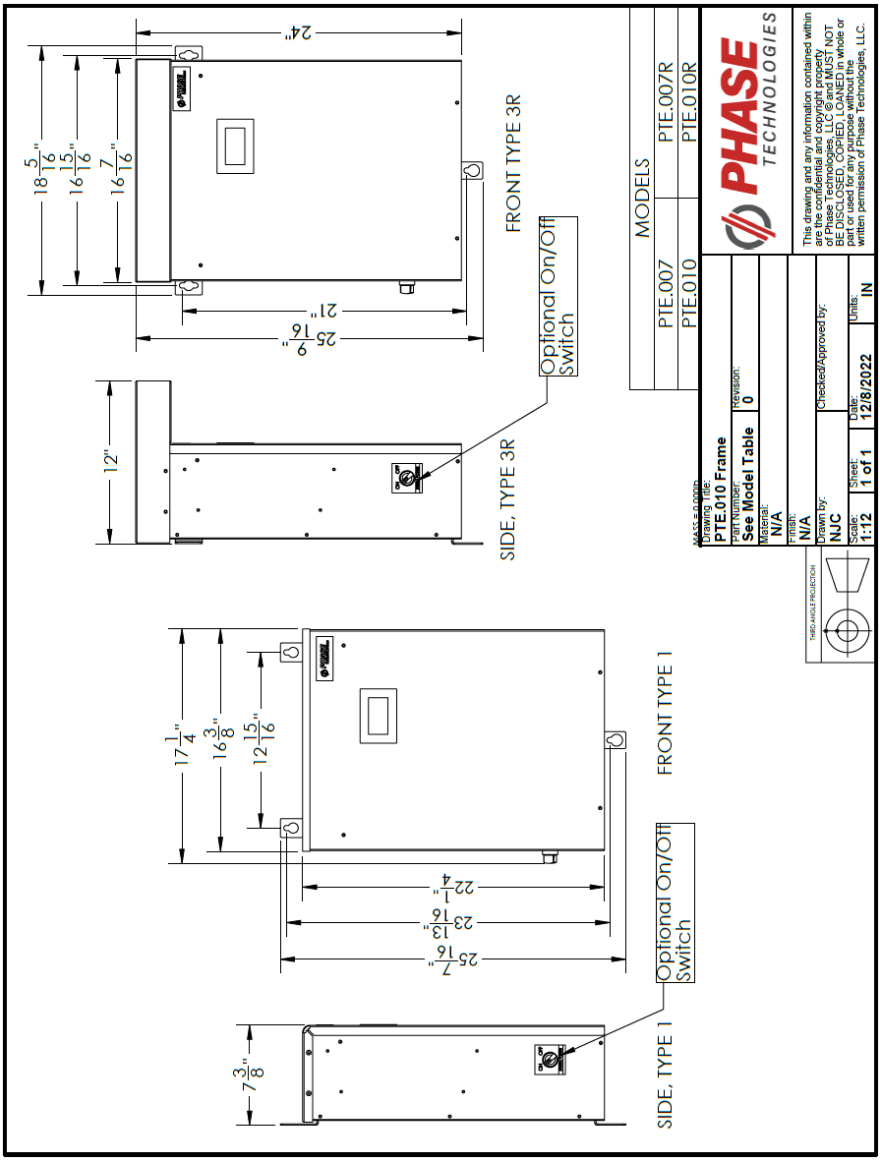


Figure 39 – PTE Small Frame Dimensions

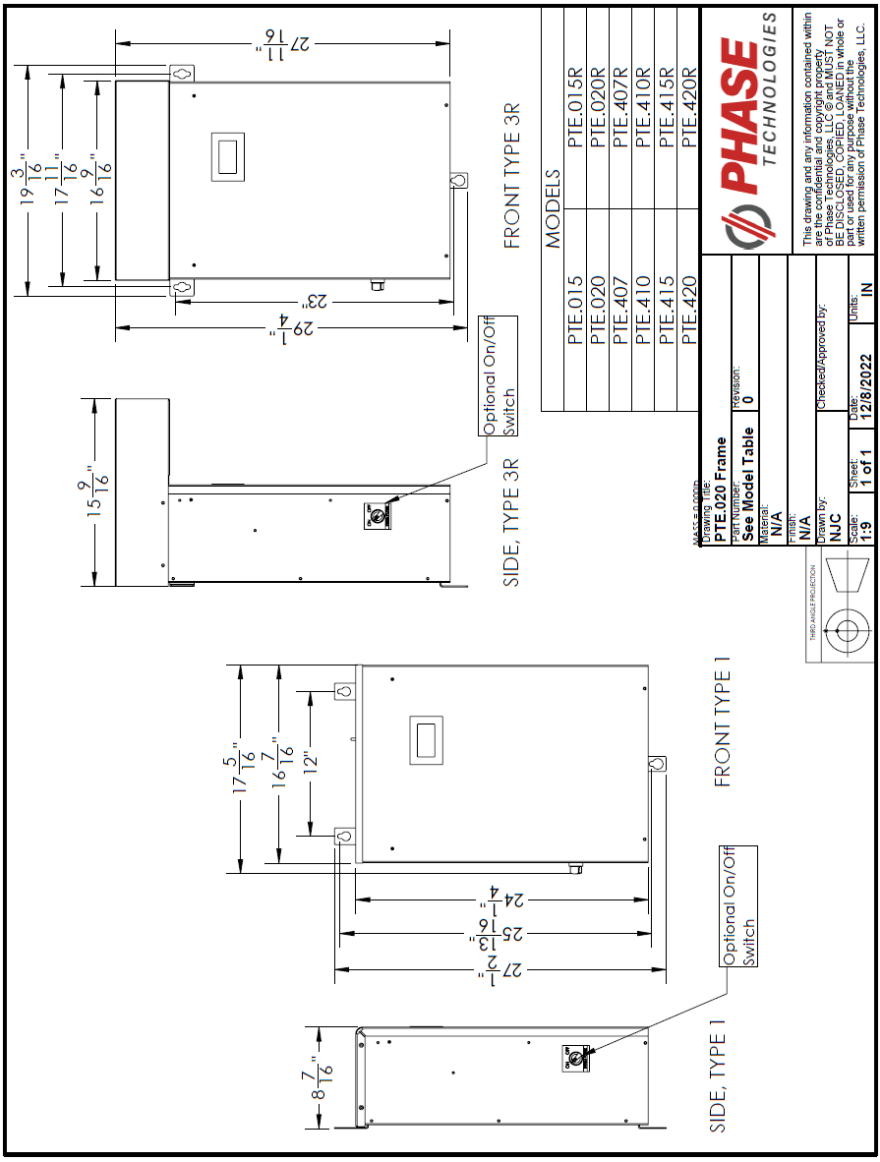


Figure 40 – PTE Medium Frame Dimensions

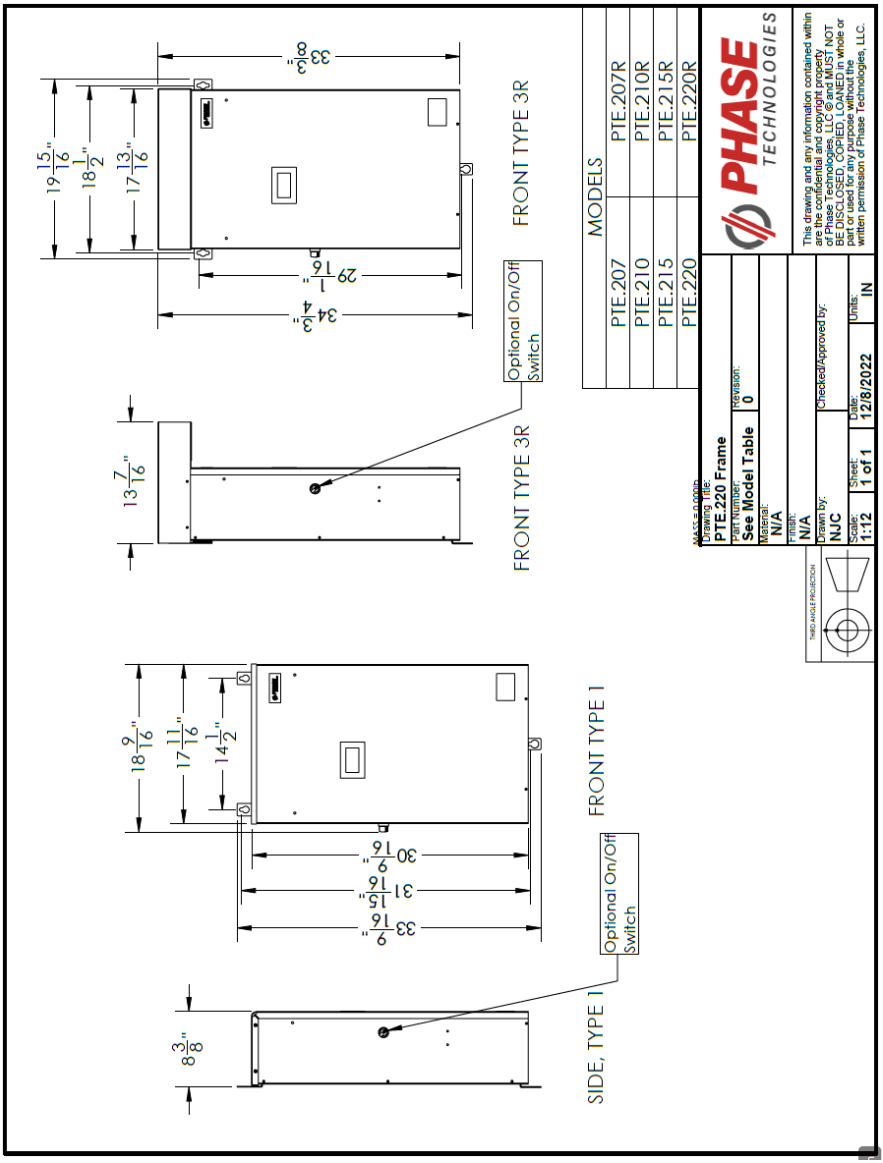


Figure 41 – PTE Large Frame Dimensions

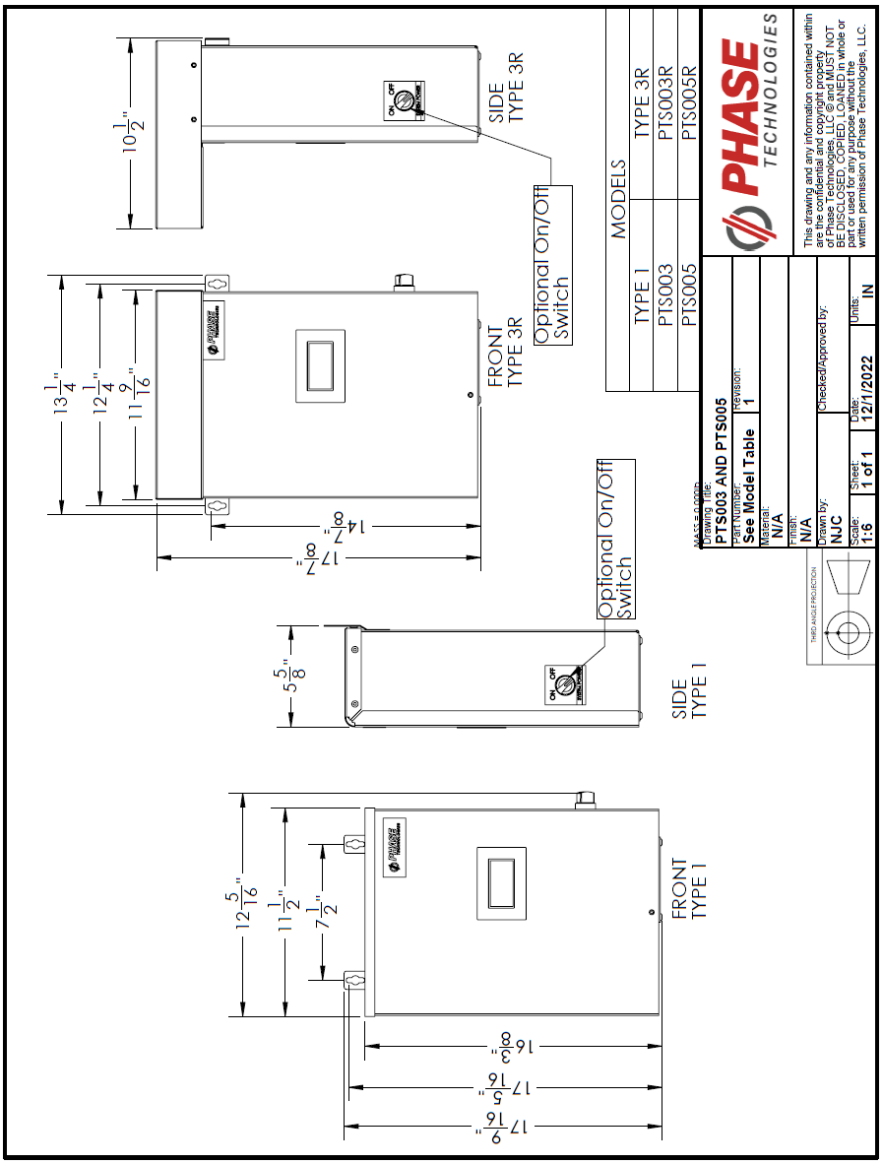


Figure 42 – PTS003 and PTS005 Dimensions

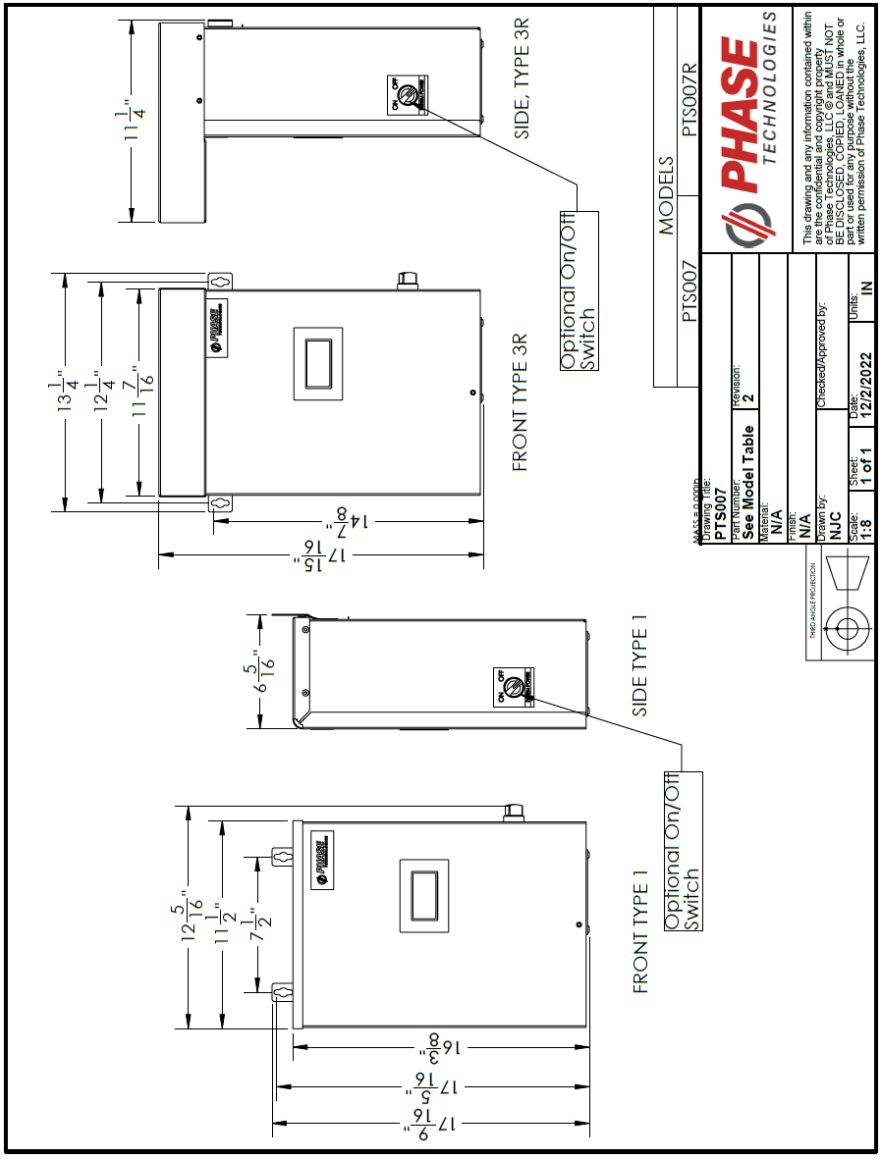


Figure 43 – PTS007 Dimensions

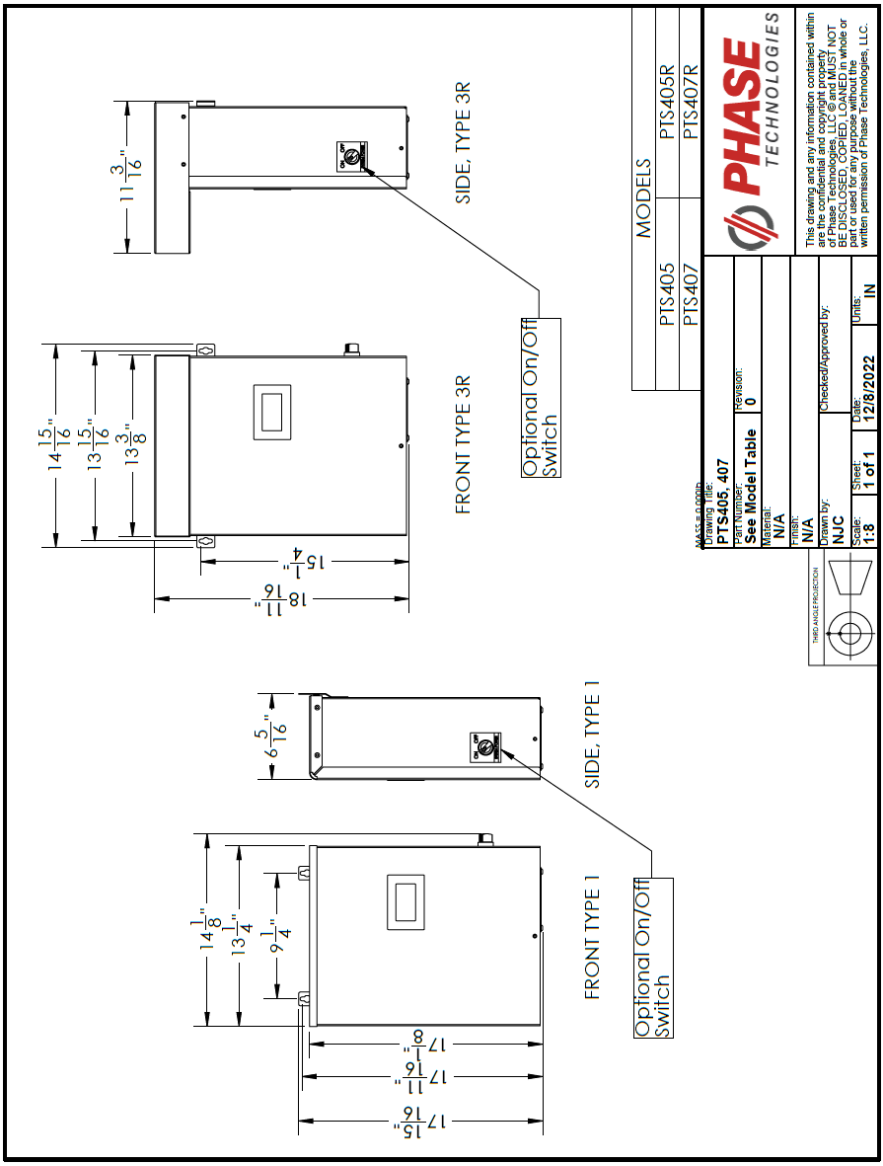


Figure 44 – PTS405 and PTS407 Dimensions

NOTES

LIMITED WARRANTY

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

Phase Perfect® Digital Phase Converters
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 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.

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