PHASE PERFECT®

DIGITAL PHASE CONVERTERS

OPERATION & INSTALLATION MANUAL

PHASE TECHNOLOGIES, LLC

DANGER: HIGH VOLTAGE

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

DANGER – Risk of Electric Shock

Please wait 30 minutes before servicing

OVERVIEW

Congratulations on your purchase of a revolutionary Phase Perfect® Digital Phase Converter. Phase Perfect® represents the ultimate technology for converting single-phase electrical power to three-phase electrical power. The three-phase power produced by Phase Perfect is often superior in power quality to utility supplied three-phase.

All Phase Perfect® Digital Phase Converters provide balanced sinusoidal output power to any type of load, eliminating the limitations and design considerations associated with earlier phase conversion technologies. The installation and operation of Phase Perfect® is simple and straightforward compared to alternative approaches. Phase Perfect® can be operated from almost any 240 VAC power source with adequate current carrying capacity, and used to power almost any type of device, without additional external components.

KEY FEATURES AND CONSIDERATIONS

Key points to be considered when selecting a Phase Perfect for your application:

- With electronic power factor correction, Phase Perfect® operates at near unity power factor (.99)
- Phase Perfect® output is three phase, sinusoidal, with virtually no added harmonic content
- Phase Perfect® output voltages are balanced to +/- 1%
- Phase Perfect® will operate in the voltage range from 187 to 260 VAC.
- Phase Perfect® can be configured for use as either a Power Supply or a Motor Starter.
- In the Power Supply configuration Phase Perfect® can provide power to multiple loads and maintain voltage balance. In the Motor Starter configuration Phase Perfect® can start and protect a single motor load. Phase Perfect® provides the contactor and solid state motor overload protection required for a motor starter.
- For applications such as pumping, it can be switched ON and OFF automatically by a remote switch.
- Phase Perfect® should be wired by a qualified electrician into a 208 V or 240 V circuit with adequate current carrying capacity and the appropriate sized breaker.
- Phase Perfect® incorporates built-in features that protect the load from brownout, over-voltage, and fault conditions.
- The load, such as a submersible pump, can be located a large distance from Phase Perfect® without the need for additional filtering equipment.

LIMITED WARRANTY

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

Obligations of the Original Owner

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

Exclusions of the Warranty

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

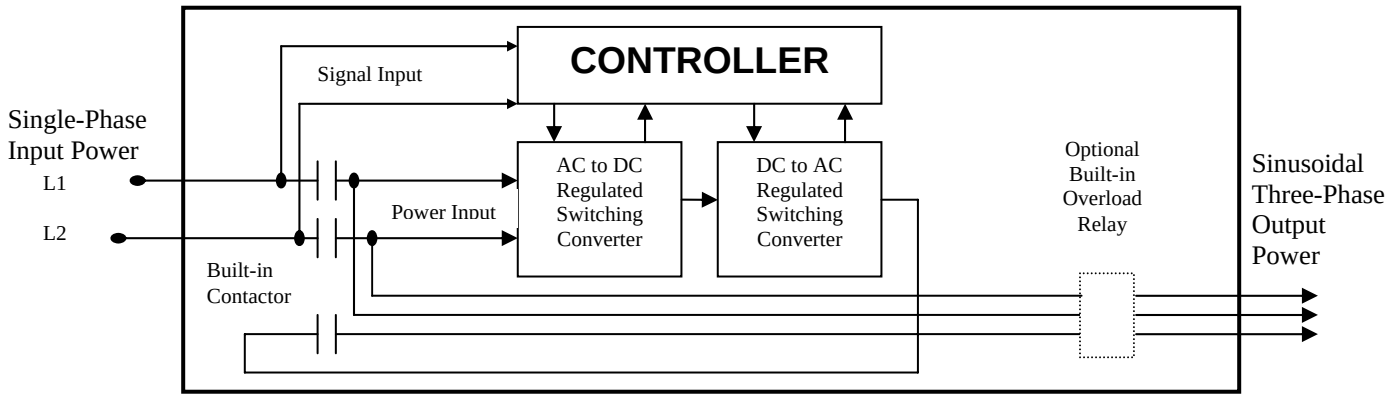
INSTALLATIONS MUST COMPLY WITH ALL NATIONAL AND LOCAL ELECTRICAL CODE REQUIREMENTS.

TABLE OF CONTENTS

1. INTRODUCTION

Phase Perfect® converts single-phase electrical power to three-phase power. The diagram below illustrates the basic design of Phase Perfect®:

PHASE PERFECT® BLOCK DIAGRAM



L1 and L2 of the single-phase input pass directly through the phase converter to provide two legs of the three-phase output. A manufactured phase is combined with the two input legs to produce three-phase output power. Hence, **the three-phase output voltage of Phase Perfect will be equal to the single-phase input voltage** (e.g. a 240 VAC single-phase input will produce 240 VAC three-phase output).

Unlike other converter technologies, Phase Perfect® actively monitors input and output currents and voltages to maintain power balance under all load conditions, near unity power factor, and sinusoidal output with virtually no harmonic distortion.

Phase Perfect® can be configured as a three-phase power supply or as a motor starter depending on the application, and is designed to eliminate the need for most additional external electrical components and controls. Phase Perfect® can also be configured to accept inputs from remote control switches, thereby automatically controlling power to a pump motor, or other load.

2. INSTALLATION

Models are available in Type 1 indoor or Type 3R rain proof enclosures. The unit should be securely mounted to a level surface and care taken to minimize the introduction of dust and other contaminants into ventilation openings.

2.1 PHYSICAL INSTALLATION

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

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

It is important that the unit be located away from excessive dirt and dust. Phase Perfect® should be set on a clean, flat horizontal surface. Elevating the unit above the ground will help to reduce the introduction of dust and contaminants into the enclosure.

Models DPC-20 and DPC-30 are provided with lifting brackets inside the enclosure. CABLES, STRAPS OR CHAINS USED FOR LIFTING THESE UNITS MUST BE ATTACHED ONLY TO THE PROVIDED BRACKETS. Access the brackets by removing the top cover of the enclosure. Brackets with a hole for attaching lifting equipment are located on each side-wall of the enclosure.

In order to provide proper ventilation, do not obstruct the open space under and around the enclosure. Make sure air intake and exhaust openings are not obstructed. If the unit is mounted in a cabinet or shed, make certain there is adequate ventilation to provide cooling for the unit.

2.2 ELECTRICAL INSTALLATION

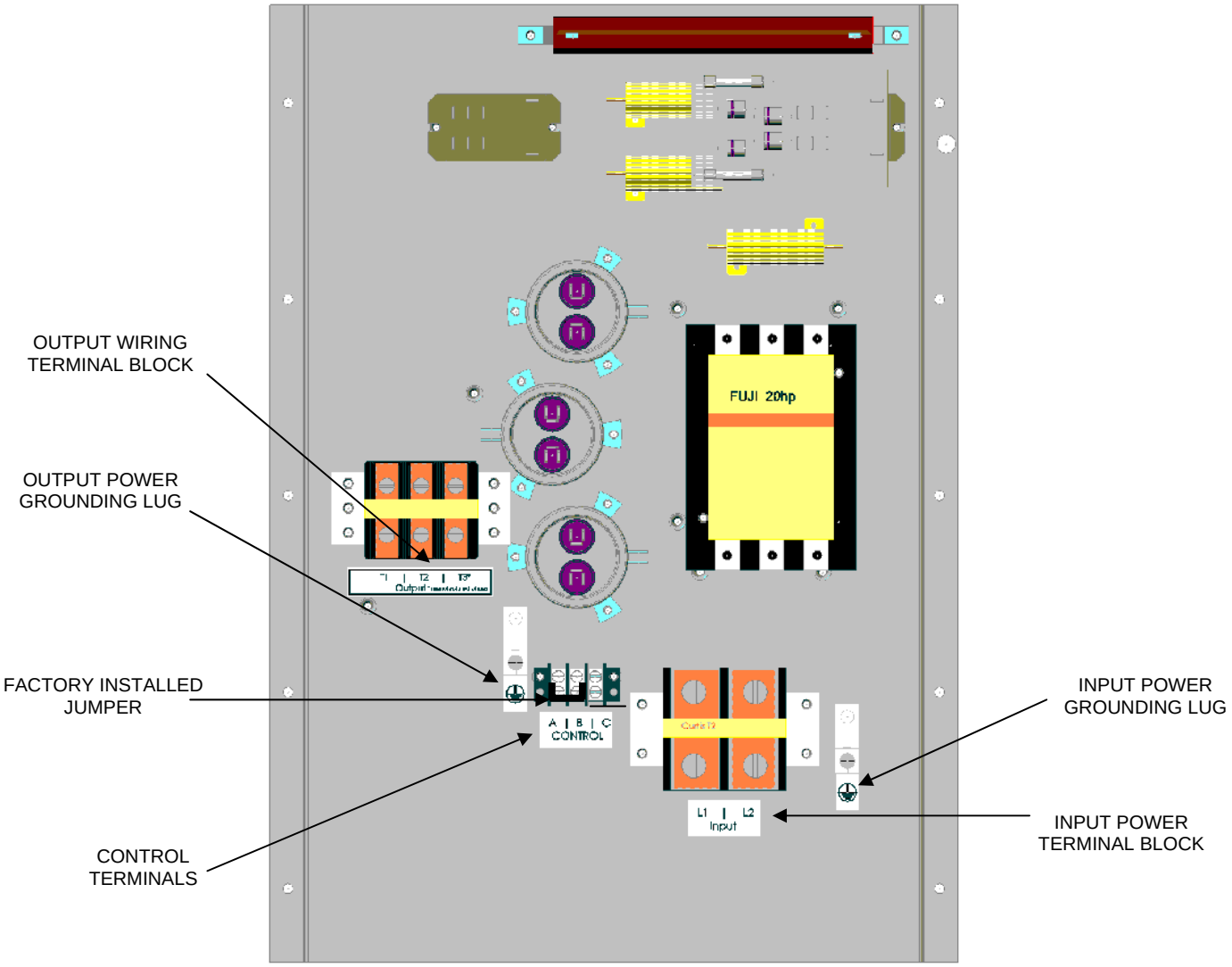
Electrical connections to the Phase Perfect® are made behind the front panel of the enclosure, as described in section 2.2.1. Phase Perfect® is available configured for use as a motor starter with single motor loads, or configured as a power supply for multiple loads. These configurations are described in section 2.2.2.

Status lights provide information about the status of the Phase Perfect® unit, and about the entire system into which the unit is wired. The status lights are very useful in troubleshooting system problems. Detailed information on the use of the status lights for troubleshooting purposes is found in section 5.2.

A panel with terminal blocks for connecting wires is found behind the front panel. Section 2.2.1 below illustrates the wiring connections and controls found on the panel. Section 2.2.1.1 provides a description of general wiring considerations. Section 2.2.1.2 provides diagrams of typical input power wiring configurations, and discusses important considerations involved in input wiring from various sources.

2.2.1 WIRING TO Phase Perfect® TERMINALS

Remove the front panel of the enclosure to gain access to the wiring panel. The wiring panel and key components of Model DPC-20 are illustrated below:



CONNECTION	FUNCTION	COMMENTS
GND	EARTH GROUND FOR SINGLE-PHASE INPUT POWER	
L1, L2	SINGLE-PHASE INPUT POWER TERMINALS	
JUMPER FROM A TO B	ENABLES THE OPTIONAL MOTOR OVERLOAD RELAY (WHEN INCLUDED)*	SHIPPED FROM FACTORY WITH JUMPER FROM A TO B MOTOR OVERLOAD RELAY IS DE-ACTIVATED IF CONTROL JUMPER IS CONNECTED FROM B TO C.
JUMPER FROM B TO C	CONFIGURES UNIT AS POWER SUPPLY	REPLACE JUMPER WITH THE LEADS OF AN APPROPRIATE RATED SWITCH CIRCUIT FOR REMOTE ON/OFF CONTROL UNIT WILL NOT OPERATE WITH-OUT JUMPER OR REMOTE SWITCH CIRCUIT CONNECTED
GND	EARTH GROUND FOR THREE-PHASE OUTPUT POWER	
T1, T2,T3	THREE-PHASE OUTPUT POWER TERMINALS	T3 IS THE MANUFACTURED PHASE

*The solid state overload relay is present only when the optional Motor Starter feature is ordered. The Motor Starter option allows Phase Perfect® to start and protect single motor loads. Models DPC-A10, DPC-20 and DPC-30 are equipped with a remote reset button on the front of the enclosure so that the overload relay can be reset without opening the enclosure.

2.2.1.1 GENERAL WIRING CONSIDERATIONS

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

1. **This Unit Is Suitable For Use In A Circuit Capable Of Delivering Not More Than 5 kA RMS Symmetrical Amperes, 240 V Maximum.**
2. Use 600 V vinyl-sheathed wire or equivalent. The voltage drop of the leads needs to be considered in determining wire size. Voltage drop is dependent on wire length and gauge.
3. Wire used within the motor circuit and all field wiring terminals must be rated for 60 C
4. Wires fastened to the terminal blocks shall be secured by tightening the terminal screws to a torque value listed in Table 1.
5. Use wire size suitable for Class 1 circuits.

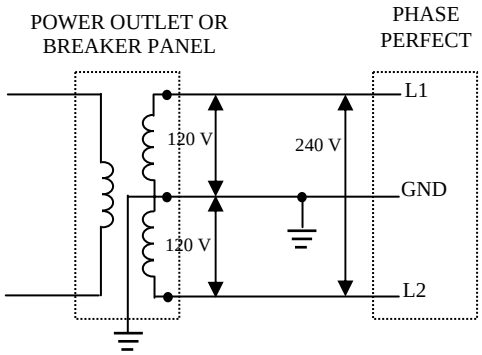
6. **The input wire gauge must be sized to accommodate the single-phase input current, which will be approximately 1.8 times the total three-phase output current to the load(s).** For example, if the output load is 20 Hp, the three-phase output current will be approximately 54 amps, and the single-phase input current will be 88 amps.
7. The maximum wire gauge for the input terminals is listed in Table 1.
8. Never allow bare wire to contact the metal surfaces.
9. Never connect AC main power to the output terminals T1, T2, and T3.
10. Input power to Phase Perfect® should be wired by a qualified electrician into a 208V or 240 V circuit with adequate current carrying capacity and the appropriate sized breaker. Branch circuit protection to the phase converter should be provided by either an appropriate size 2 pole, linked circuit breaker. Circuit breaker size for each model Phase Perfect® is listed in Table 1.

Table 1

Model:	**DPC-A10**	**DPC-20**	**DPC-30**
Input Terminals			
Tightening torque	16 in.-lb.	50 in.-lb.	275 in.-lb.
Max. wire size	14 - 6 AWG	6 - 1/0 AWG	6 AWG – 250 MCM
Output Terminals			
Tightening torque	16 in.-lb.	45 in.-lb (4-6 AWG) 40 in.-lb. (8AWG) 35 in.-lb. (10-16 AWG)	50 in.-lb.
Wire size	14 - 6 AWG	16 – 4 AWG	6 - 1/0 AWG
Optional overload relay			
Tightening torque	14 in.-lb.	35 in.-lb.	150 in.-lb.
Max. wire size	14 - 6 AWG	2 AWG	8-1/0 AWG
Circuit Breaker			
Amps	60 - 70	110 - 125	175 - 200

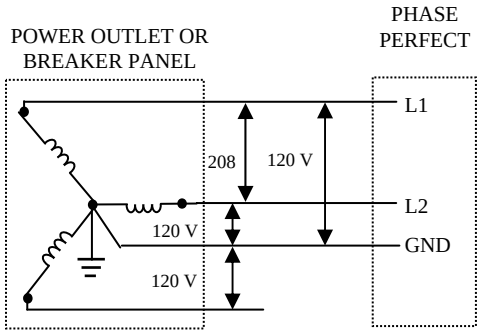
2.2.1.2 INPUT WIRING CONSIDERATIONS

Phase Perfect® can be operated from most typical input power sources ranging from 187 VAC to 260 VAC, including 120/240 VAC single-phase sources with a grounded center tap, or single-phase power derived from two legs of a three-phase source. However, specific input wiring issues must be considered when wiring to three-phase input sources. **Incorrect L1 and L2 wiring from some three-phase sources can damage the unit.** These considerations are outlined below:



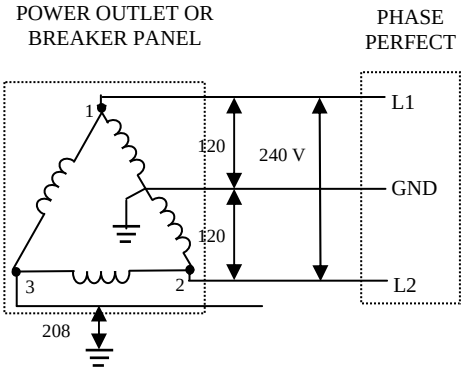
Single-phase, 120/240 V, 3 Wire

In most installations, single-phase 240 V input power will be taken from a 120/240 V center tap source. This approach is straight forward, with no additional considerations.



Three-phase, 208/120 V, Grounded-Wye

Single-phase 208 V input power can be taken from two legs of a three-phase grounded-wye source. There are two possible ways to connect L1 and L2 to the unit from any two legs. If the unit is connected incorrectly the generated phase-to-ground voltage will be 240 V, causing the unit to shutdown and the yellow status light to flash. In this event reverse the L1 and L2 input connections.



Three-phase, 240/120 V, Delta--CAUTION!!!

In rare situations single-phase 240 V input power is taken from a three-phase source wired as illustrated to the left. **EXTREME CAUTION** must be exercised if using such a source for power input to the unit. Power can only be taken across points 1 and 2, with a center ground, as illustrated. Power taken across points 2 and 3, or 3 and 1, will **DAMAGE** the unit. **To avoid possible damage, always verify the voltage to ground for the L1 and L2 inputs to be approximately 120 V**

Some buildings and offices derive single-phase power from two legs of a three-phase source. **TO AVOID POSSIBLE DAMAGE TO THE UNIT, ALWAYS VERIFY THAT THE INPUT LINE VOLTAGES L1-TO-GROUND AND L2-TO GROUND ARE APPROXIMATELY 120 VOLTS PRIOR TO CONNECTING INPUT POWER TO PHASE PERFECT**.

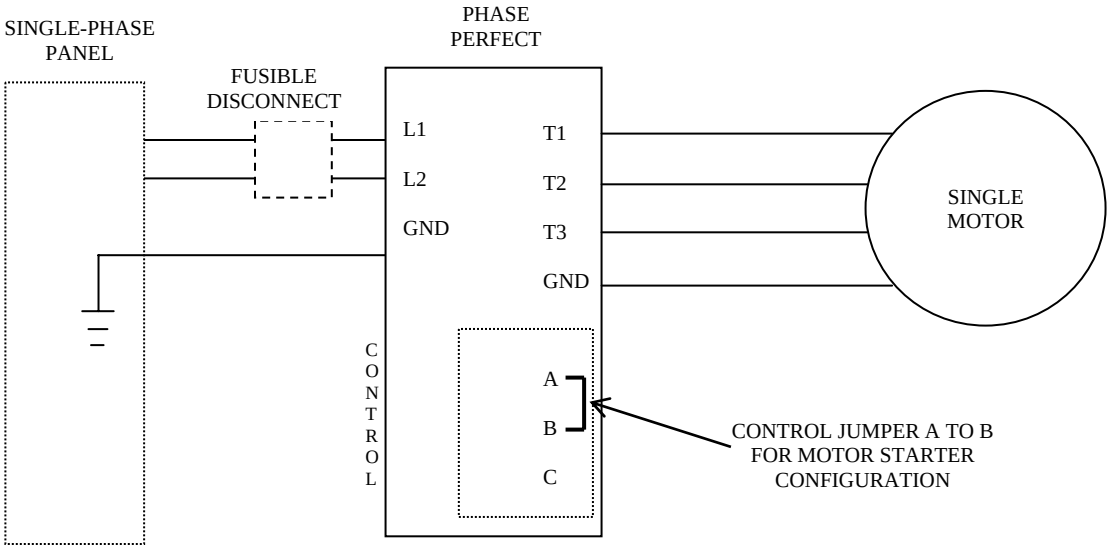
2.2.2 TYPICAL SYSTEM CONFIGURATIONS

Phase Perfect® is designed to simplify installations, to provide maximum versatility, and to eliminate or minimize the need for external electrical components and related costs. The output of Phase Perfect® is sinusoidal with virtually no harmonic components, eliminating the need for output filtering that would often be required for a variable frequency drive (VFD). With virtually no harmonics on the input, Phase Perfect® does not require input filtering. With the Motor Starter option, Phase Perfect® can start and protect a single-motor load, eliminating the need for a three-phase starter panel in many single-motor applications. A motor starter is not required at the input to Phase Perfect®, as would be required for a rotary phase converter. All types of equipment, including inductive, resistive, and capacitive loads can be safely powered by Phase Perfect®.

Three typical Phase Perfect® installations are diagrammed and explained below: (1) a motor starter configuration for use with a single-motor load, (2) a pump configuration in which a pressure or level switch automatically controls power to the pump, and (3) a power supply configuration for use in powering multiple three-phase loads.

2.2.2.1 MOTOR STARTER CONFIGURATION

With the Motor Starter option, Phase Perfect® can be used to start and protect single-motor loads, eliminating the need for a three-phase starter panel. An appropriate sized fusible disconnect must be installed on the input side of Phase Perfect®. The optional overload relay can be adjusted for motor ratings up to the rated HP capacity of the converter. The motor starter configuration used to power a single motor is illustrated below:



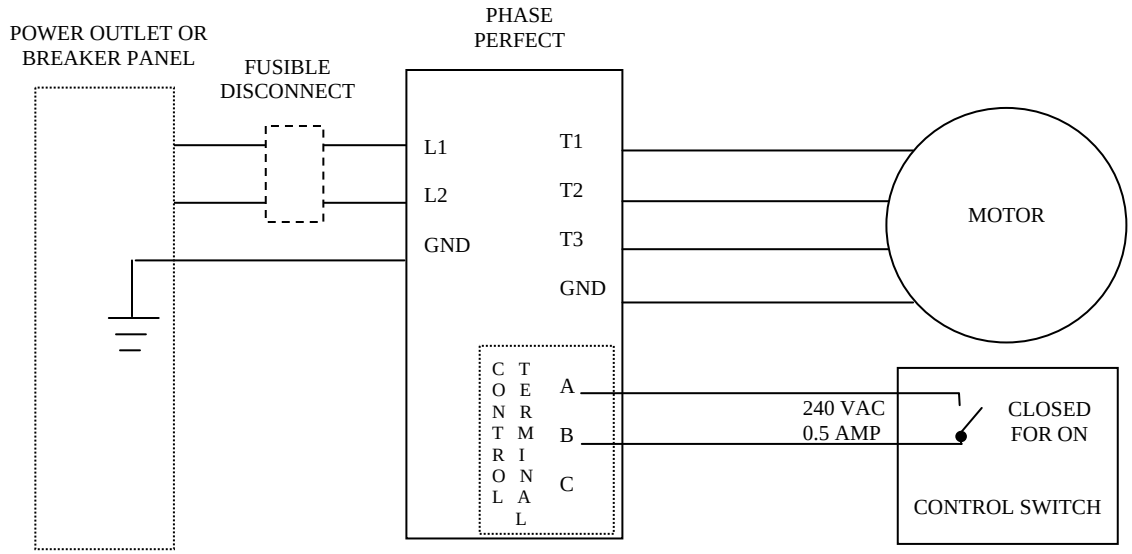
The following points should be considered when wiring Phase Perfect® as a motor starter to power a single motor:

1. Verify that no power is provided to Phase Perfect®.
2. Remove the front panel to gain access to the wiring terminals. See section 2.2.1, "Wiring to Phase Perfect® Terminals," for an illustration.
3. Verify that control terminals A and B are shorted together. Phase Perfect® is shipped from the factory in this configuration. When contacts A and B are shorted together the optional motor protection unit is enabled, and Phase Perfect is configured as a motor starter.
4. Wire Phase Perfect® to the motor as illustrated above. Three-phase output power wire connections are made to the T1, T2, and T3 output terminals, and secured with the terminal block screws.
5. Set the motor protection unit to the desired settings:
   a. Adjust the trip current to the appropriate current for the motor load being powered. The trip rating is 120% of the dial setting.
   b. Set the overload relay to auto or manual reset as desired. For auto reset, push and turn the reset button clockwise to the Auto position. The button will remain depressed. **DANGER: In this position the relay will reset automatically approximately two minutes after tripping, providing power to the load without warning.** For manual reset, push and turn the reset button to the manual position. In this position pushing the button in resets the overload relay. Additional information on the motor protection unit is provided in Section 4., "Motor Protection Unit."
6. Wire power into Phase Perfect® from an appropriate 208 V or 240 V circuit. See section 2.2.1.2, "Input Wiring Considerations," for additional information.
7. Re-attach the front panel.
8. Provide power to Phase Perfect® from the fusible disconnect. **Power will be provided to the motor after a delay of approximately five to eight seconds.** Check the motor for correct rotation. If the motor rotation is incorrect, reverse any two of the three output power leads T1, T2, and T3.
9. Note: A low power remote switch can be wired into Phase Perfect® to control the motor as described in the following section, "Control Circuit Configuration."

2.2.2.2 MOTOR STARTER WITH REMOTE ON/OFF CONTROL

Phase Perfect® can be used to power individual pumps or single-motor loads which are automatically switched ON and OFF by a remote switch such as a pressure switch or level switch with at least a 240 VAC, 0.5 amp rating. This feature can eliminate the need for an external three-phase starter panel to control the load. Phase Perfect® incorporates a contactor and adjustable overload relay, and when combined with a field installed fusible disconnect provides the necessary components of a motor starter. The built-in overload relay can be adjusted for a wide range of motor HP ratings. The installation is similar to the

motor starter configuration, with the addition of an ON/OFF control switching mechanism. The configuration used to power an individual motor with control circuit is illustrated below:



The following points should be considered when wiring Phase Perfect® to power a motor controlled by a remote switch such as a level or pressure switch:

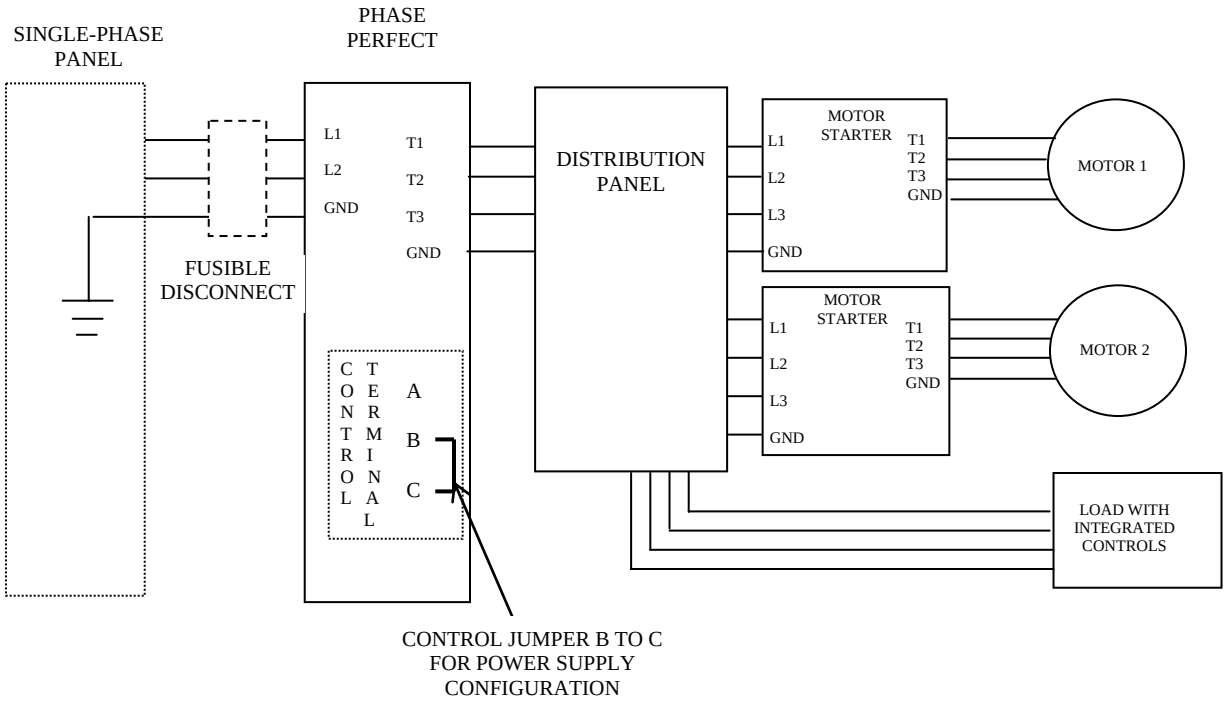
1. Verify that no power is provided to Phase Perfect®.
2. Remove the front panel to gain access to the wiring terminals. See section 2.2.1, "Wiring to Phase Perfect® Terminals," for a drawing illustrating the components found under the access panel.
3. Remove the factory installed jumper between the control terminal contacts A and B. Wire the remote pressure switch, level switch, or other control switch to control terminals A and B. **When the remote switch is closed the overload relay will be enabled and power will be provided to the motor or load after an approximately five to eight second delay.** The control switch should have a minimum rating of 240 VAC, 0.5 amp. A 3 amp fuse located just below the printed circuit board protects the remote switch circuit.
4. Wire Phase Perfect® to the motor as illustrated above. Three-phase output power wire connections are made to the T1, T2, and T3 output terminals, and secured with the terminal block screws.
5. Set the motor protection unit to the desired settings:
   c. Adjust the trip current to the appropriate current for the motor load being powered. The trip rating is 120% of the dial setting.
   d. Set the overload relay to auto or manual reset as desired. For auto reset push and turn the reset button clockwise to the Auto position. The button will remain depressed. **DANGER: In this position the relay will reset automatically approximately two minutes after tripping, providing power to the load without warning.** For manual reset push and turn the reset button to the

manual position. In this position pushing the button in resets the motor protection unit. Additional information on the motor protection unit is provided in Section 4., “Motor Protection Unit”.

6. Wire power into Phase Perfect® from an appropriate 208 V or 240 V circuit. See section 2.2.1.2, “Input Wiring Considerations,” for additional information.
7. Re-attach the front panel.
8. Provide power to Phase Perfect® from the fusible disconnect. When the remote switch is closed power will be provided to the motor after an approximately five second delay. Check the motor for correct rotation. If the rotation is incorrect reverse any two of the three output power leads T1, T2, and T3.

2.2.2.3 POWER SUPPLY CONFIGURATION

Phase Perfect® can be configured as a power supply to provide three-phase power to multiple loads of any type, including inductive, resistive, and capacitive loads. If the Phase Perfect® unit includes the optional Motor Starter feature, the jumper on the control terminals should be moved to connect B and C terminals. This will disable the motor overload relay. Separate, properly sized motor starters should be provided for each motor load to be powered. The power supply configuration used to power multiple loads is illustrated below:



The following points should be considered when wiring Phase Perfect® as a power supply to provide three-phase power to multiple loads:

1. Verify that no power is provided to Phase Perfect®.
2. Remove the front panel to gain access to the wiring terminals. See section 2.2.1, "Wiring to Phase Perfect® Terminals," for a drawing illustrating the components found under the access panel.
3. Phase Perfect® is shipped from the factory with control terminals A and B shorted together. Remove the control jumper between terminals A and B, then install the control jumper between terminals B and C.
4. **With the control terminal jumper between terminals B and C Phase Perfect® is configured as a three-phase power supply with the optional motor protection unit disabled.**
5. Wire Phase Perfect® to the motor and non-motor loads as illustrated above. Three-phase output power wire connections are made to the T1, T2, and T3 output terminals, and secured with the terminal block screws. Make certain that the total power requirement of all the loads does not exceed the rated capacity of the Model.
6. Wire power into Phase Perfect® from an appropriate 208 V or 240 V circuit. See section 2.2.1.2, "Input Wiring Considerations," for additional information.
7. Re-attach the front panel.
8. Provide power to Phase Perfect® from the fusible disconnect. **Power will be available to the load circuits after an approximately five to eight second delay.** Check each motor for correct rotation. If the motor rotation is incorrect reverse any two of the three output power leads T1, T2, and T3 at the output of the motor starter.
9. Note: A low power remote switch can be wired into Phase Perfect® to provide remote ON/OFF switching of the Phase Perfect® unit (see "Control Circuit Configuration" in the previous section).

3. OPERATION

Operation of the Phase Perfect® unit is straightforward after completion of installation and wiring.

3.1 ON/OFF FUNCTION

When Phase Perfect® is configured as a motor starter (see section 2.2.1) or a power supply (see section 2.2.3), power to the Phase Perfect® unit is controlled by a properly installed fusible disconnect. When switched on, power is provided to the load after a delay of approximately five to eight seconds.

When Phase Perfect is configured to power a motor (see section 2.2.2) or other load via a control circuit, the fusible disconnect is left on. When a control switch such as a pressure or level switch is closed, then power is applied to the load after a delay of approximately five to eight seconds. When the fusible disconnect

is on, and the control switch is open, Phase Perfect® will not draw any power and power will not be provided to the load. When either the fusible disconnect is off, or the control switch is open, the front panel green status light will be OFF.

3.2 STATUS LIGHTS

The GREEN, YELLOW, and RED status lights are found on the front panel of Phase Perfect®. The status lights cannot be viewed in direct sunlight, but should be shaded for clear viewing. The status lights provide information about the status of the Phase Perfect® unit, and provide useful troubleshooting information about the entire system into which Phase Perfect® is wired.
Three basic status light indications are:

GREEN STATUS LIGHT ON Steady: Power ON, Control Switch Closed (if present)

YELLOW STATUS LIGHT ON Steady: Internal Unit Temperature Too High

RED STATUS LIGHT Flashing: Internal Short in Unit, Consult Factory

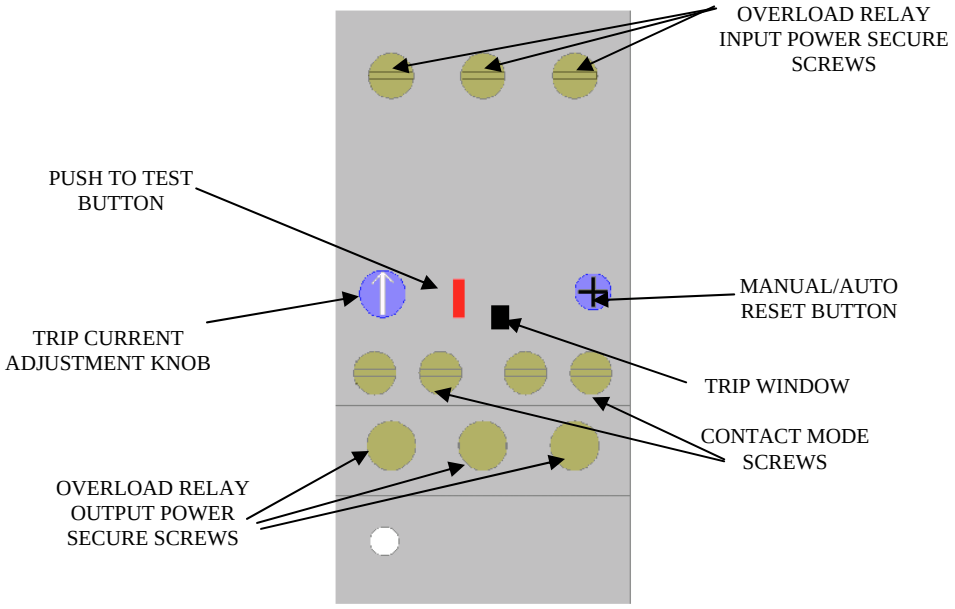
Note: The red and yellow status lights may flash briefly when starting heavy loads. This is normal and can be ignored.

In addition to the basic status light functions indicated above, **flashing status lights and combinations of status lights are designed to indicate and help troubleshoot a wide range of potential problems.** A complete listing of status light indications is provided in Section 5.2, “Troubleshooting with Status Lights.”

4. SOLID STATE OVERLOAD RELAY INFORMATION

Phase Perfect® is available with an optional solid overload relay for single-motor applications. The solid state solid overload relay replaces earlier style thermal relays in motor starter applications, and provides significant advantages over older thermal relay technologies. For example, the solid overload relay provides an expanded current adjustment range suitable for a wide motor horsepower range up to the capacity of the converter. The overload relay unit is enabled when Phase Perfect® is used in the motor starter configuration by shorting control terminals A and B together in the wiring cavity. The overload relay is disabled when Phase Perfect® is used in the power supply configuration by shorting terminals B and C together in the wiring cavity. This section provides detailed information on the overload relay, as illustrated below:

OVERLOAD RELAY



The following points describe adjustment and features of the motor protection unit. **Remember, the motor protection unit is bypassed in the power supply mode by shorting control terminals B and C together in the wiring cavity.**

1. **TRIP CURRENT ADJUSTMENT BUTTON**—Used to adjust the current trip limit when Phase Perfect® is used as a motor starter in the motor starter configuration. To adjust the trip current, turn the dial until the desired current is aligned with the pointer. The trip rating is 120% of the dial setting.
2. **MANUAL/AUTO RESET BUTTON**—Used to control automatic and manual reset features of the overload relay, and to reset the motor protection unit if it trips out. The unit is shipped from the factory in the manual mode. Automatic reset of the overload relay is often desirable when Phase Perfect is located at remote locations such as a pumping shed. Manual reset is typically used when the Phase Perfect unit is readily accessible, such as in a machine shop.
   a. For auto reset, push and turn the reset button clockwise to the Auto position. The button will remain in the IN position. The unit will reset automatically approximately two minutes after tripping. **ATTENTION: Do not use the automatic reset mode in applications where unexpected automatic restart of the motor can cause injury to persons or damage to equipment.**
   b. For manual reset push and turn the reset button to the Manual position. In this position pushing the button in resets the overload relay.
   c. To manually trip the overload relay, push and turn the button counterclockwise to the trip position. Releasing the button reverts the unit to the manual position.
   d. To reset the overload relay push the button.

3. **TEST BUTTON**—Will shut OFF Phase Perfect and power to the load when pushed.
4. **TRIP INDICATOR WINDOW**—A yellow indicator will be visible on the relay if it has tripped due to an overload condition. The overload relay can be reset by pushing the manual/auto reset button IN when the button is in the manual position.
5. **OUTPUT POWER SECURE SCREWS**—Used to secure power wires in place between the motor protection unit and the load.
6. **INPUT POWER SECURE SCREWS**—Used to secure input power wires from Phase Perfect® electronics to the overload relay in place. Factory pre-installed wires at this location should not be removed or altered.
7. **CONTACT MODE SCREWS**—Used to secure wires to configure the contact mode of the overload relays. **Wires connected to the NC contacts are pre-wired at the factory, and should not be removed.**

Note: If problems develop with the overload relay, contact the Field Support Manager at Phase Technologies, (605) 343-7934.

5. TROUBLESHOOTING

This section provides troubleshooting information for potential system problems.

5.1 GENERAL TROUBLESHOOTING TIPS

After the system is fully wired, turn the Phase Perfect® unit ON with the fusible disconnect.

If the unit fails to turn ON, and all status lights are OFF, check the following:

1. Verify that the appropriate circuit breaker in the building's electrical distribution box is set ON and is properly sized.
2. Check the control circuit fuse located on the panel just below the printed circuit board. If necessary, replace with appropriate 3 A fuse.
3. Verify that the jumper on the control terminal is connected either A to B for motor starter configuration, or B to C for power supply configuration. The unit will not operate unless the jumper wire or control circuit wires are connected to the appropriate control terminals.

For single-motor applications, if the unit turns ON but power is not provided to the load:

1. Check the TRIP INDICATOR WINDOW on the motor protection unit to see if it has tripped. If tripped, push the AUTO/MANUAL RESET button on the motor protection unit.
2. Verify that the overload relay current limit is appropriately set for the load.

After turning the motor ON always check for correct rotation. If the motor rotation is incorrect, reverse any two of the three output power leads T1, T2, and T3.

Refer to the following status light information for additional troubleshooting tips.

5.2 STATUS LIGHTS

The status lights provide a very useful tool for detecting and diagnosing system problems. The table on the following page provides a list of status light modes, the indicated problem, and potential causes of the problem.

STATUS LIGHT TROUBLESHOOTING TABLE

STATUS LIGHT MODE	INDICATED PROBLEM	POTENTIAL CAUSES	SUGGESTED FIXES	NOTES
Steady Green	System normal			
Steady Yellow	**Phase Perfect®** overheated	Blockage of air intake and exhaust Ambient temperature too high. (ambient temp. should not exceed 40 C) Internal dirt buildup Failed internal fan	Make certain vents are clear. Verify adequate clearance between unit and surroundings. Ensure that building is adequately vented. Avoid direct sunlight. Contact factory. Note: fan is temp. controlled, and does not operate continuously.	**1**
Flashing Red	Fault	Internal short in unit	Contact manufacturer	**2**
Steady Red and Steady Green	Input voltage too low	Low utility line voltage	Ensure the input line voltage between L1 and L2 is above 187 VAC	**3**
Steady Red and Steady Yellow	PLL not in sync	Noisy line voltage	Contact utility	**3**
Flashing Green and Flashing Yellow	Output current too high	Short between T3 & T1 or T2 Excessive load	Eliminate short Ensure steady state current is within ratings. Higher current is OK for momentary load startup	**2**
Steady Green and Yellow Or Steady Red	High DC bus voltage	High utility line voltage Short between T1 & T2 or T3	Ensure input line voltage between L1 and L2 is below 255 VAC Eliminate short	**3**
Flashing Yellow	Output GND voltage (T3 to GND) too high	Grounded-wye three-phase input used with L1 and L2 reversed	Reverse L1 and L2	**2**
Flashing Red, Green and Yellow	Abnormal DC bus voltage	T3 to ground fault	Eliminate short Ensure steady state current is within ratings. Higher current is OK for momentary load startup	**2**
Steady Red and Steady Yellow	Input voltage too high	High utility line voltage	Ensure input line voltage between L1 and L2 is below 255 VAC	**3**

Notes:

1. **WARNING: The unit will automatically turn back ON after internal temperature reaches acceptable levels.**
2. The output will remain de-energized until the fusible disconnect is cycled OFF/ON, or the control signal is cycled OFF/ON.
3. The unit will automatically turn back ON 15 seconds after the problem is corrected.

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

6. FEATURES AND SPECIFICATIONS

6.1 FEATURES

Electronic power factor correction
High efficiency
Balanced output voltages
Automatic brownout and over-voltage protection
Fault protection and overload protection
Optional built-in motor starter capability
Clean power fed back to power grid during load braking situations

6.2 SPECIFICATIONS

Model:	DPC-A10	DPC-20	DPC-30
Input current characteristics:	True sinusoidal, (2.3% THD)		
Power factor:	.99 all load conditions		
Rated steady state single-phase input current:	50 amps	88 amps	136 amps
Input voltage:	187 V to 260 V		
Output Power Characteristics:	Three-phase, sinusoidal (3.4% THD)		
Phase to phase voltage balance:*	better than 1%		
Rated steady state output current:	29 amps	54 amps	80 amps
Service factor output current:	36 amps	64 amps	96 amps
Momentary overload current, 4 seconds	150 amps	280 amps	400 amps
Rated HP:	10	20	30
Output voltage:	Equal to input voltage		
Service factor:	1.2	1.2	1.2
Enclosure:	Type 1 indoor or 3R rain proof	Type 1 indoor or 3R rain proof	Type 1 indoor or 3R rain proof
Weight:	123 lb.	230 lb.	330 lb.
Dimensions (H x W x D in.):			
Type 1 indoor	22 x 21 x 12	30 x 27 x 15	32 x 36 x 15
Type 3R rainproof	27 x 21 x 12	34 x 27 x 15	37 x 36 x 15

*NEMA MG1 standard for voltage unbalance

PROTECTIVE FUNCTIONS

Undervoltage: Automatic shutdown below 187 V, then resets ON when voltage >199 V
Overvoltage: Automatic shutdown above 260 V, then resets ON when voltage < 260 V
Motor overload protection: Solid state, trip class 10, motor overload relay (only included on models with Motor Starter option)
Internal overheat: Heatsink temperature sensor

GENERAL

Efficiency: >95%
Operating temperature range: -10 C to 40 C
Storage temperature range: -20 C to 60 C