

# 10 HP – 30 HP Single-Phase to Three-Phase Digital Phase Converter DPC- Series

## 1.0 General

This specification describes the features and design of a single-phase to three-phase digital phase converter for operating three-phase electrical equipment from a single-phase source. The converter shall deliver balanced, sine-wave voltages with high efficiency, electronic power factor correction and high momentary overload currents for starting motors. Protection from under-voltage and over-voltage of utility mains as well as protection from fault and overload must be provided. The converter shall be able to feed clean, regulated regenerative currents back into the power grid. Optional motor starter capability shall be provided which allows the converter to function as an approved motor starter, able to start and protect a three-phase motor load. Both indoor Type 1 and outdoor Type 3R rain-proof enclosures shall be available.

### 1.1 Standards

The converter shall be designed in accordance with:  
National Electrical Code (NEC)  
Underwriters Laboratories (UL) 508C  
FCC Article 15, Section J

#### 1.1.1 Listings

The converter shall be listed to UL standard UL508C

### 1.2 Submittals

1.2.1 The manufacturer shall supply documentation for the installation of the converter, including wiring diagrams and cabinet outlines showing dimensions, weights, input/output connection locations and required clearances. Product certificates, signed by the manufacturer of the converter, certifying that the product furnished complies with the requirement shall be provided.

1.2.2 Factory test results shall be provided to show compliance with the requirements.

## 2.0 Manufacturers

The equipment specified shall be the DPC series digital phase converter, model DPC\_ (choose one) A10,20 or 30, manufactured by Phase Technologies, LLC, or those manufacturers that can clearly demonstrate compliance with all the requirements. Exceptions will be classified as non-compliant and subject to a no bid status.

## 3.0 Converter Design and Function

3.1 The converter shall be based on a double-IGBT conversion design, rectifying the incoming AC power to DC, then generating a third AC voltage which is added to the two legs of the single-phase service, producing balanced three-phase power in a closed delta configuration with a center-tap ground between two of the legs.

The input module shall draw input current in a sinusoidal fashion with a power factor at or near unity. The output module shall generate a sine-wave voltage with less than 3% total harmonic distortion (THD), balanced within 1% of the other voltages and in proper phase alignment.

3.2 Automatic converter operating functions shall include:

3.2.1 Normal Operation: The load shall be supplied with clean, balanced three-phase power from no-load to full-load conditions. A status light indicating normal operation shall be visible.

3.2.2 Protective Functions: The converter shall have the ability to automatically shut down to protect both the converter and the load from damage. System status lights or other appropriate readout shall allow the operator to identify the reason for shutdown under the following conditions:

- A. Internal short in the converter
- B. Over heating of the converter (thermal overload)
- C. Low utility line voltage
- D. Noisy line voltage
- E. Short between the output lines
- F. Excessive load demand
- G. High utility line voltage
- H. Line to ground fault

3.2.3 Automatic Restart: In the event of thermal overload, the unit will automatically restart when internal temperature has reached an acceptable level. In the event of automatic shut down due to utility under-voltage or over-voltage, the converter shall restart automatically when voltage returns to an acceptable level. If equipped with a motor overload relay, the converter shall have the option of restarting automatically after the relay trips.

3.3 Motor Starter (Optional)

3.3.1 The converter shall operate as a rated motor starter to start and protect a single motor load. The required elements of a motor starter shall be included in the converter and consist of:

- A. Appropriate sized AC rated 3-pole magnetic contactor
- B. Fusible disconnect (installed on the line side of the converter)
- C. Trip class 10 motor protection
- D. Remote ON/OFF switching capability

3.3.2 Motor protection shall be provided by an adjustable solid state trip class 10 motor overload relay. The relay shall be adjustable for a wide range of trip current settings within the load range of the converter. The relay shall have the option of automatic or manual restart and a button or other means shall be provided to reset the relay from the outside of the converter.

3.3.3 The converter shall have means to accept input from an external switch for controlling both the converter and the load. Control terminals shall be provided to connect the leads of switch circuit rated at 240V, 0.5A. When the switch circuit is open, the converter and the load shall be OFF. When the switch circuit is closed, the converter shall energize the output and close the contactor, supplying power to the load.

#### 4.0 Specifications

- 4.1 The system shall operate continuously at full output without derating while subjected to ambient temperatures of 0° to 40° C.
- 4.2 The system shall emit a maximum of 65dB acoustical noise measured at 1 meter.
- 4.3 Input Current Characteristics:
  - 4.3.1 The system shall be capable of operating at a power factor of .99 or better under all load conditions.
  - 4.3.2 Input current shall be true sinusoidal and contain less than 3% total harmonic distortion (THD).
  - 4.3.3 Input Voltage Range: The unit shall operate from 1 $\Phi$ , 60 Hz, 2 wire plus ground. The system shall accept voltage within a range of 187 to 255VAC.
- 4.4 Output Power Characteristics:
  - 4.4.1 The 3 $\Phi$  output voltage shall be equal to the 1 $\Phi$  input voltage.
  - 4.4.2 Phase to Phase Voltage Balance: The converter shall produce three-phase voltages balanced within 1%\* under all load conditions. \*NEMA MG1 standard for voltage unbalance.
  - 4.4.3 Output Harmonic Distortion: The output voltages shall be true sinusoidal, with less than 3% total harmonic distortion (THD).
  - 4.4.4 Rated Steady State Output Current: The converter shall be capable of supplying (choose one) 29, 54 or 80 amps of current under continuous operation.
  - 4.4.5 Overload Output Current Rating:
    - A. 120% of the rated steady state output current continuous
    - B. 500% of the rated steady state current for 4 seconds
- 4.5 Automatic Protection:
  - 4.5.1 Undervoltage: The converter shall automatically shut down when input voltage falls below 187V, then automatically return to normal operation when input voltage reaches 199V.
  - 4.5.2 Overvoltage: The converter shall automatically shut down when input voltage exceeds 255V, then automatically return to normal operation when input voltage falls below 255V.
  - 4.5.3 Thermal Protection: The converter shall have redundant internal temperature sensors that automatically shut down the converter when internal temperature reaches unsafe levels. The converter shall automatically return to normal operation when internal temperature returns to safe levels.

4.5.4 Motor Overload Protection (Optional): The converter shall have an adjustable, trip class 10, solid state motor overload relay to protect an operated motor load. The motor overload relay shall have both manual restart and automatic restart capability after tripping.

4.6 Efficiency: The converter shall operate the rated load at 95% to 98% efficiency.

4.7 Regenerative Power Capability: The converter shall have the ability to operate without braking resistors and be able to distribute clean, regulated power back to the utility during regenerative load conditions such as motor braking.

## 5.0 Physical Requirements

5.1 Cabinet Construction: The enclosure shall be constructed with painted steel, 5/64 in. (2.0 mm) minimum thickness.

5.2 Corrosion Protection: All parts shall be of corrosion resistant material or plated or painted as corrosion protection.

5.3 The converter shall be supplied in a (choose one) indoor Type 1, or outdoor rainproof Type 3R enclosure.

5.4 Electrical Connections: The converter shall include input and output terminals for hard wired connections. The enclosure shall provide input and output conduit openings.

## 6.0 Warranty

6.1 The manufacturer shall guarantee the converter to be free from material defects and workmanship for a period of one year from purchase.