



***FH<sub>2</sub>OTON***

**FHOTON AC/DC  
Power Converter  
Installation Guide**

## **ATTENTION**

### **IMPORTANT INFORMATION FOR INSTALLERS OF THIS EQUIPMENT!**

THIS EQUIPMENT IS INTENDED FOR INSTALLATION BY TECHNICALLY QUALIFIED PERSONNEL. FAILURE TO INSTALL IT IN COMPLIANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES AND WITHIN FRANKLIN ELECTRIC RECOMMENDATIONS, MAY RESULT IN ELECTRICAL SHOCK OR FIRE HAZARD, UNSATISFACTORY PERFORMANCE, AND EQUIPMENT FAILURE. FRANKLIN INSTALLATION INFORMATION IS AVAILABLE FROM PUMP MANUFACTURERS AND DISTRIBUTORS AND DIRECTLY FROM FRANKLIN ELECTRIC.

## **⚠ WARNING**

SERIOUS OR FATAL ELECTRICAL SHOCK MAY RESULT FROM FAILURE TO CONNECT THE MOTOR, CONTROL ENCLOSURES, METAL PLUMBING, AND ALL OTHER METAL NEAR THE MOTOR OR CABLE TO A PROPER EARTH GROUND IN ACCORDANCE WITH LOCAL CODES, USING WIRE NO SMALLER THAN MOTOR CABLE WIRES. TO REDUCE RISK OF ELECTRICAL SHOCK, DISCONNECT POWER BEFORE WORKING ON OR AROUND THE WATER SYSTEM. DO NOT USE MOTOR IN SWIMMING AREAS.

## **⚠ CAUTION**

Use the Photon AC/DC Power Converter only with Photon Drive controllers up to 1.5HP (see Specifications page) and Franklin Electric motors as indicated in the Photon Drive controller installation guide. Use of this unit with any other Franklin Electric motor or with motors from other manufacturers may result in damage to both motor and electronics.

## **⚠ WARNING**

High voltages (both AC and DC) capable of causing severe injury or death by electrical shock are present in this unit. More than one disconnect switch may be required to de-energize the equipment before servicing. This unit should only be installed or serviced by technically qualified professionals.

Anytime working on or near the Photon AC/DC Power Converter, Photon Drive, or system:

- Securely cover the solar array with an opaque tarp.
- Turn OFF the external DC rated disconnect from the solar array to the Photon drive controller.
- Wait a minimum of 5 minutes after removing power from the Photon Drive before servicing.

## **⚠ WARNING**

Solar panels that have been exposed to full solar insolation for an extended period of time can achieve high temperatures and could be a potential source of burns to exposed skin if contacted. Use caution when working around solar arrays.

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## Overview

The Photon™ AC/DC Power Converter is an accessory for the Photon Drive that can convert AC power sources to DC as needed by the Photon Drive. For installation guidelines refer to this document along with the Photon Drive Installation Manual.

The Photon AC/DC Power Converter Accessory has a single-phase input power terminal block to connect either a AC or DC power source and presents (converts) at its output terminals DC power needed to power the Photon Drive.

The power source can either be an AC source, such as a generator or grid power, or a DC source, such as an array of photovoltaic (PV) panels.

For information concerning the respective input voltage ranges, please refer to the specification section located at the back of the manual.

## Description

The power source connected to the input terminal block on the left side is directed to a full-wave rectification circuit which converts AC to DC power. In the case of input AC power it is rectified to DC power, and for input DC power it too is rectified so the output DC polarity is matching to the polarity noted at the output terminal block. For this reason, the polarity of the power source at the input terminal block is not polarity sensitive, so, is not marked with any polarity designation.

Additional circuitry in the AC/DC Power Converter limits the bus capacitor in-rush current at initial power-up and protects the AC/DC Power Converter outputs from any situation where the output is shorted. If a short circuit is detected the AC/DC Power Converter protects output connections from large current spikes into a direct output attempting to protect the Photon Solar Drive from receiving these potentially damaging short circuit surges. In this case a flashing Light Emitting Diode (LED) will enunciate a Fault Code 6 fault indicating that there is a shorted condition in the output wiring.

Reference the internal schematic showing the implementation of these functions located at the end of this document.

The bicolor LED (green – for the running status; red for any fault code status) shines through the lid as described further in the operational section and fault code section of the manual.

**The controller construction is ruggedized for hostile environmental conditions.**

- The case is constructed of heavy-gauge aluminum to resist rain, and animal intrusion.
- The seals are designed for Type 4 (IEC rating IP56), (withstands directed jets of water).
- For maximum protection against dust, there is no external cooling fan or other external moving parts.

## For use with specific Photon Drive Models

The Photon AC/DC Power Converter Model Number 581 114 204 is only to be used with the Franklin Electric Photon Drives having model numbers 581013000XXX-X or 581014200XXX-X, with ratings of up to, and including 1.5 hp. It is not to be used with Photon drives having ratings of 2 hp or higher, or, with products made by other manufacturers.

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## Use of External Transfer Switches

The output of the Photon AC/DC Power Converter is to be connected directly to the input power terminals of the noted Photon Drive Models. No other devices or connections should be combined with the output connections.

There may at times be benefit to switch between power sources, such as, from DC PV Panels to AC Generator or back. In this case, any properly rated power switching device (transfer switch) should be applied at the input to the AC/DC Power Converter, since the input terminals of the AC/DC Power Converter are compatible with either AC or DC sources and will provide the benefit of all AC/DC Power Converter protection features.

**If a transfer switch or disconnect is required, these devices should be connected on the input power side of the AC/DC Power Converter. Connecting a transfer switch or disconnect between the AC/DC Power Converter and Photon Solar Drive could result in nuisance trip/short circuit fault on the AC/DC Power Converter. When applying electricity, the AC/DC Power Converter and Photon Solar Drive should power on simultaneously.**

## Protection Features

Electronic monitoring gives the controller the capability to monitor the system and automatically shut down in the event of (see page 8 for fault codes):

- Overvoltage
- Undervoltage
- Overload
- Short circuit
- Overheat

In a similar way, the controller incorporates circuitry that protects against:

- In-rush current control
- Surge protection (input and output)

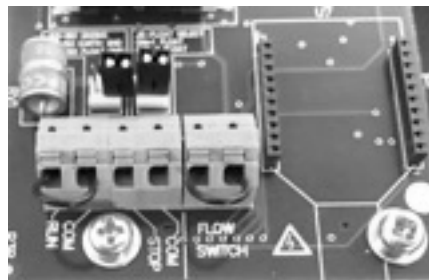
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## Features

### Flashing Green Light Run Mode and Solid Green Light Idle Mode

The Photon AC/DC Power Converter comes equipped with a bicolor LED indicator to convey operational status to the user. When operating normally, the LED will indicate solid green (IDLE condition) or flashing green (RUNNING condition). While in the RUNNING condition, the green LED will flash indicating that the power is available at the output terminals of the AC/DC Power Converter to power the Photon Drive.

There are two factory installed jumpers connected to the User Interface Board (Figure 1): Run Input and Flow Switch Input. If removed, the output of the Photon AC/DC Power Converter will switch to a high impedance state disabling the Photon Drive. In this case, the LED will be solid green indicating that it is in IDLE condition, awaiting to be enabled by reinstating the jumper. This feature is provided in support of other accessories such as an auto transfer switch which will connect to these inputs and allow for automatic switching between AC or DC sources. This can be used by the user for additional control options.



**Figure 1**  
**User Interface Board (Factory Installed Jumpers)**

The Photon AC/DC Power Converter continuously monitors system performance and can detect a variety of abnormal conditions. In many cases, the controller will compensate as needed to maintain continuous system operation; however, if a high risk of equipment damage exists, the controller will protect the system and indicate the fault condition via a flashing red LED. If possible, the controller will try to restart itself when the fault condition subsides (refer to the troubleshooting section for a list of Fault Codes and correction actions). The following sections detail the conditions in which a fault will occur.

### Overvoltage (Single Flash Red LED Sequence)

The Photon AC/DC Power Converter continuously monitors the incoming power source voltage for an overvoltage condition where if the voltage is greater than 420Vdc for a DC source, or greater than 264 Vrms for a AC source, the AC/DC Power Converter output state will change to a high impedance state to limit the output current. The red LED will begin a 1 flash sequence and continue this flash sequence until the input voltage range is below the noted threshold where normal operation will resume.

### Undervoltage (Two Flash Red LED Sequence)

The Photon AC/DC Power Converter continuously monitors the incoming power source voltage for an undervoltage condition where if the voltage is less than 45Vdc for a DC source, or 35Vrms for an AC source, the AC/DC Power Converter output state will change to a high impedance state to limit the output current being supplied to the Photon Solar drive. The red LED will begin a 2-flash sequence and continue this flash sequence until the input voltage range is above the noted threshold where normal operation will resume.

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## **Output Over Load (Three Flash Red LED Sequence)**

The Photon AC/DC Power Converter continuously monitors the output current. If the output current exceeds the overload trip level the output state will change to a high impedance state to limit the output current and the AC/DC Power Converter red LED will begin a 3-flash sequence and continue this flash sequence for a two and half minute interval after which time, the AC/DC Power Converter will resume normal operation. The longer off-time duration is provided to allow the system to cool down and revert to a normal operating condition if the over load condition is remedied.

## **Output Over Current, Short Circuit (Six Flash Red LED Sequence)**

The Photon AC/DC Power Converter continuously monitors the output current. If the output current exceeds the higher short circuit trip level the output state will change to a high impedance state to limit the output current and the AC/DC Power Converter red LED will begin a 6-flash sequence and continue this flash sequence for a two and half minute interval after which time, the AC/DC Power Converter will resume normal operation. The longer off-time duration is provided to allow the system to cool down and revert to a normal operating condition if the over current condition is remedied.

**NOTE: Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes.**

## **Over Temperature Shutdown (Seven Flash Red LED Sequence)**

The Photon AC/DC Power Converter is designed for full power operation from a DC or AC power source in ambient temperatures up to 122 °F (50 °C). Under extreme thermal conditions the AC/DC Power Converter output state will change to a high impedance state to limit the output current. The red LED will begin a 7-flash sequence and continue this flash until the internal temperature is reduced. The output is restored when the AC/DC Power Converter temperature cools to a safe level and a minimum of 10 minutes have passed by.

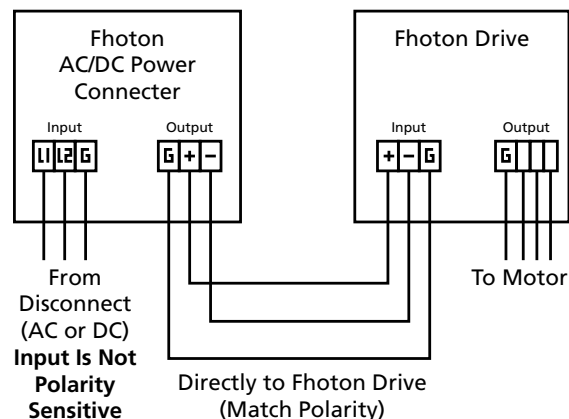
## **Internal Error (Nine Flash Red LED Sequence)**

The Photon AC/DC Power Converter continuously monitors itself for potential, internal failures. If a failure condition is detected, the Photon AC/DC Power Converter will change to a high impedance state to limit the output current. The red LED will begin a 9-flash sequence and continue this flash sequence until power is cycled.

## Wiring Connections

1. Make sure that the external disconnect switch is off (Verifying that the power has been shut off). Follow all safety warnings in this manual and in the Photon Drive Installation Guide.
2. Remove the Photon AC/DC Power Converter lid.
3. Use appropriate strain relief or conduit connectors. For Type 4 (IP 56), Type B liquid-tight fittings are recommended for maximum weather protection. Must be provided in accordance with all applicable national and local electrical codes.
4. Make the appropriate wiring connections in the following instructions and install per all applicable local and national codes.
  - a. Select wire gauge, temperature rating (75 °C only, for the field installed conductors) based on code recommendations for the maximum operating currents listed in the specification section. Ensure that any protection devices, such as fuses or circuit breakers, are appropriately sized and installed per local and national code.
5. Make sure that all wires are properly identified and marked.
6. Connect the cables from the external DC disconnect to the left Photon AC/DC Power Converter input terminal block labeled "AC or DC". (Torque specification: 15 in-lbs/ 1.7 N-m.) (Only use copper conductors rate 75 °C minimum.) The input wire length from the power source shall not exceed 300 ft (100 m). Note: The Photon AC/DC Power Converter input is not polarity sensitive.
7. Connect the cable from the output of the Photon AC/DC Power Converter to the input of the Photon Drive making sure to match the polarity designation as shown in the figure below. (Torque specification: 15 in-lbs/ 1.7 N-m.) (Use copper conductors only. Rated 75 °C minimum.) The output cabling to the Photon Drive shall not exceed 30 ft (10 m). Note: The Photon AC/DC Power Converter output is polarity sensitive.
8. Ground wire shall be insulated; typically green or green with yellow stripe.
9. Review the wiring that it matches the wiring diagram below for the Photon AC/DC Power Converter and Photon Drive
10. Replace the cover. Do not over-tighten the screws.
  - a. Torque screws to 6 in-lbs. (0.68 Nm).

**NOTE:** Ensure that the system is properly grounded. Improper grounding may result in the loss of voltage surge protection and interference filtering.



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## Fault Codes and Troubleshooting

The Photon AC/DC Power Converter will attempt to power the Photon Drive to deliver water even under adverse conditions. To ensure years of reliable service, it must also protect the system components from conditions that might result in equipment damage. Full operation will resume automatically whenever abnormal conditions subside.

Error conditions may suspend certain features or shut down operation of the system for varying amounts of time depending on the nature and severity of the error. Problems that reduce performance generally restore full operation when the trouble condition subsides. An error code is displayed by the flashing red LED light.

If the Photon AC/DC Power Converter has stopped to indicate a fault code, the associated time-out delay will vary depending on the nature of the fault.

Fault Code	Fault	Possible Causes	Corrective Action
1	Overvoltage	The incoming power source has a voltage greater than the specified input rating	Ensure the input power wiring is correct and powered from a source that has a nominal voltage rating within the specified input voltage range
2	Undervoltage	The incoming power source has a voltage less than the specified input range	The available power may not be sufficient to supply the minimum voltage range. Check the capability of the incoming power source.
3	Over load	The output of the AC/DC Power Converter has a load greater than the specification	Check the condition of the power cable between the AC/DC Power Converter and the Photon Drive and the cable connections
4	None	Not applicable	Not applicable
5	None	Not applicable	Not applicable
6	Short Circuit	Short in connections between the AC/DC Power Converter Output and the Photon Drive Input	Check the condition of the power cable between the AC/DC Power Converter and the Photon Drive and the cable connections
7	Overheated Controller	Unit in direct sunlight. High ambient temperature.	Shade unit. Clean any debris from heat sink fins on rear of enclosure. This fault automatically resets when temperature returns to safe level.
8	None	Not applicable	Not applicable
9	Internal Error	Controller internal processing has encountered an incorrect value.	Cycle input power. Disconnect incoming power source for at least five minutes, then re-connect power.

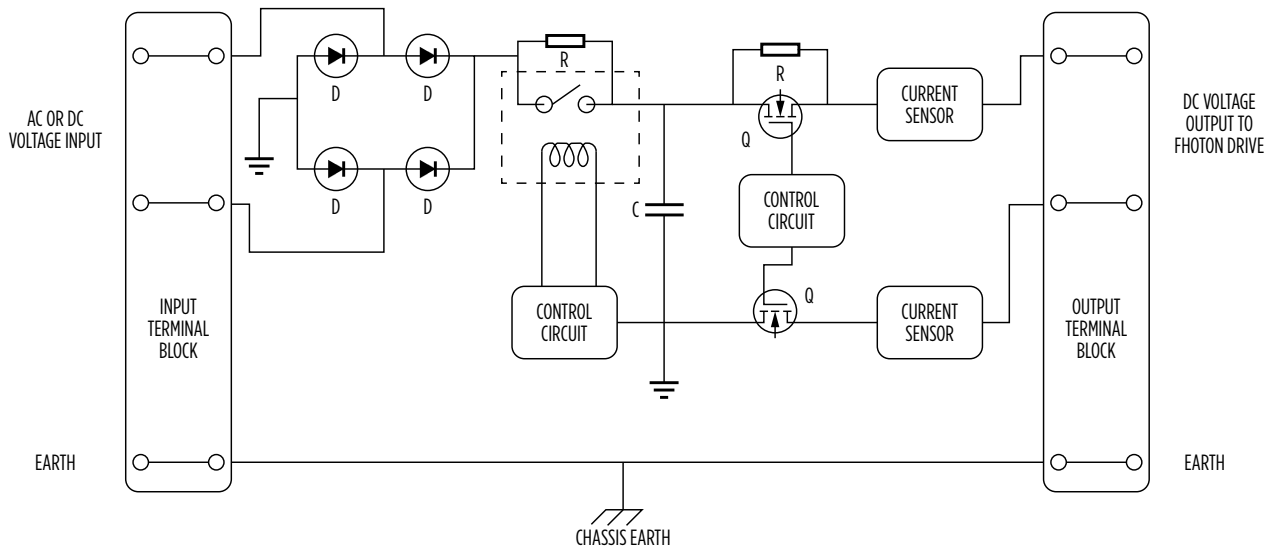


## AC/DC Power Converter Specifications

The AC/DC Power Converter can accept either AC or DC input power (Polarity Independent), and the output is DC, where the polarity is denoted by a "+" and a "-" symbol.

<b>AC/DC Power Converter Model No.</b>	<b>581114204</b>
<b>Input</b>	<b>AC or DC</b>
Phase	Single (Polarity Independent)
Voltage (AC Power Source)	90Vrms to 264Vrms, 50Hz or 60Hz • Use 120Vac when 3/4Hp System • Use 240Vac when 1.5Hp System
Voltage (DC Power Source)	45Vdc to 420Vdc
Current (AC Power Source)	14.9Arms, Max (Suitable for use on a circuit capable of delivering not more than 5,000rms symmetrical amperes, 420VDC or 264VAC Maximum)
Current (DC Power Source)	10Adc, Max
Power Factor From AC Power Source	0.65 (Approx. - Rectifier Input)
<b>Output</b>	<b>DC</b>
Phase	Single (Polarity is noted)
Voltage (Rectified Output)	45Vdc to 420 Vdc
Current	7.5Adc, Max
Overload Trip Level	10Adc
Short Circuit Trip Level	40A
Efficiency at Max Power	98%
Use with these Franklin Electric Photon Drive Models, only	Models 58101300 or 58101420 followed by any sequence of numbers or characters up to and including 1.5 hp
<b>Controller Size L x W x D</b>	
Millimeters	159.5 x 159.5 x 102.1
Inches	6.28 x 6.28 x 4.02
<b>Operating Conditions</b>	
Temperature Range	-25 °C to 50 °C Max. -13 °F to 122 °F Max.
Relative Humidity Range	0 to 100% Condensing
Enclosure Type	UL Type 4 rating (IEC IP56 rating)

## AC/DC Power Converter Schematic

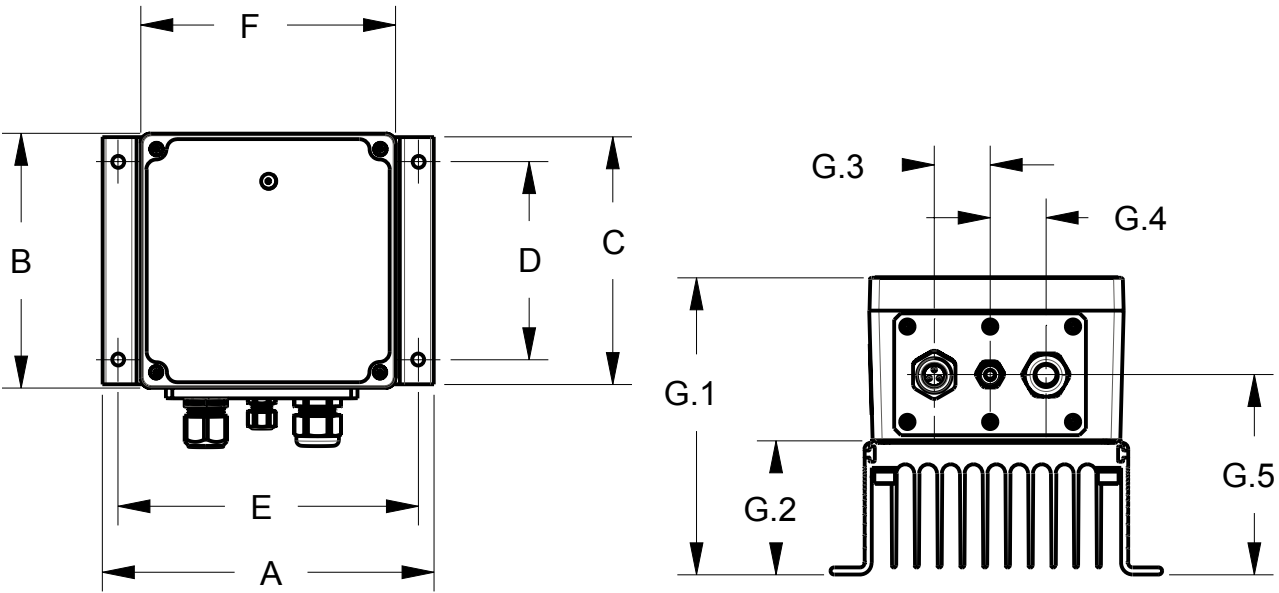


### Circuit Operation

The power source connected to the input terminal block on the left side is directed to a full-wave rectification circuit which converts AC to DC power. In the case of input AC power it is rectified to DC power, and for input DC power it too is rectified so the output DC polarity is matching to the polarity noted at the output terminal block. For this reason, the polarity of the power source at the input terminal block is not polarity sensitive, so, is not marked with any polarity designation.

There is additional circuitry in the AC/DC Power Converter that limits the bus capacitor in-rush current at initial power-up and protects the AC/DC Power Converter outputs from any situation where the output is shorted. If a short circuit is detected the AC/DC Power Converter output connections will go to a high impedance state to avoid sourcing large currents into a direct output short-circuit. In this case a flashing Light Emitting Diode (LED) will enunciate a Fault Code 6 fault indicating that there is a shorted condition in the output wiring.

**AC/DC Power Converter Outline Dimensions**



Photon Drive Dimension	A	B	C	D	E	F	G.1*	G.2	G.3	G.4	G.5
Inches	8.17	6.28	6.10	4.88	7.40	6.28	7.32	3.30	1.38	1.38	4.94
Millimeters	207.55	159.4	155	124	188	159.4	185.82	83.82	35	35	125.47