



FHOTON

FHOTON™ Drive

Installation Guide



Franklin Electric

PHOTON™ DRIVE INSTALLATION MANUAL TABLE OF CONTENTS

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EU Declaration of Conformity

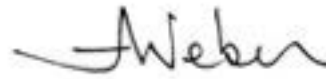
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Herewith, we declare under our sole responsibility that the Photon Solar Power Converters, models 58101300, 58101420, and 58103850 (followed by any combination of additional characters or numbers,) when bearing the CE mark, are in conformity with the provisions of the Low Voltage Directive (LVD) 2014/35/EU and the Electromagnetic Compatibility Directive (EMC) 2014/30/EU.

The following harmonized standards and technical specifications have been applied:

LVD: EN61800-5-1: 2007
EMC: EN61800-3: 2004



J.A. Weber
Manager, Product Certification Engineering

11 May 2018

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 Foton™ Drive controller only with Franklin Electric motors as specified in this manual (see Table 4, page 19). 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 Foton™ Drive, or system:

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

This equipment must not be used by children or persons with reduced physical, sensory or mental abilities, or lacking in experience and expertise, unless supervised or instructed. Children may not use the equipment, nor may they play with the unit or in the immediate vicinity.

⚠ 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.

Overview

The Photon™ Drive is a variable speed motor drive designed to run a Franklin Electric three-phase submersible induction motor. The Photon™ Drive provides water to remote locations by converting high voltage, direct current from a solar array into alternating current to run a standard AC submersible motor. The controller provides fault detection, motor soft start, and speed control. The Photon™ Drive is designed to provide these features with the plug and play ease of installation similar to a single-phase control box.

The Photon™ Drive is designed with the high standard of reliability expected of Franklin Electric products. The controller drives the pump and motor to deliver water even under adverse conditions, reducing output as necessary to protect the system components from damage, and only shutting down in extreme cases. Full operation is restored automatically whenever abnormal conditions subside.

Inspection

Before you begin, receive and inspect the Photon™ Drive unit. Verify that the part number matches what was ordered and that no damage has occurred during transit.

Descriptions and Features

The Photon™ Drive system controller controls a Franklin Electric 4- or 6-inch three-phase motor driving a 4- or 6-inch submersible centrifugal pump powered by a DC solar array.

The Photon™ Drive continuously monitors system performance and incorporates a number of features for pump system protection. In the event of a fault, the Photon™ Drive will indicate the type of fault by a flashing red LED. (See Fault Codes and Troubleshooting on pages 20 & 21.)

The Photon™ Drive system is optimized for pumping under adverse input power conditions unique to solar arrays.

- Internal diagnostics will tolerate a lower input voltage.
- Whenever possible, the controller attempts to regulate the pump load in an optimized manner for maximum power transfer from the solar array.

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), (protected against dust; withstands directed jets of water).

Protection Features

Electronic monitoring gives the controller the capability to monitor the system and automatically shut down in the event of:

- Dry well conditions – with smart pump monitoring
- Bound pump – with auto retry
- High voltage surge
- Low input voltage
- Open motor circuit
- Short circuit
- Overheat
- Deadhead/no flow conditions (when using a flow switch)

NOTE: This drive provides motor overload protection by preventing motor current from exceeding service factor amps (115% of full-load). This drive does not provide over-temperature sensing of the motor, therefore requiring motor over-temperature sensing.

How it Works

The Photon™ Drive system serves to provide water in remote applications where electrical grid power is either unreliable or unavailable. The system pumps water using a DC power source such as an array of solar panels. Since the sun is only available during certain hours of the day and only in good weather conditions, the water is generally pumped into a storage tank. Up to two level switches can be installed inside the tank to regulate the water level. A flow switch detects if flow is below critical levels while the pump is still running. This serves as an indication that the well has run dry, or that insufficient power is available to continue pumping. The system will shut down to protect the pump and motor until the well, or adequate electric power, has recovered.

The Photon™ Drive runs at variable speed to match the changing power available from the PV solar array. Variable speed operation means there is no in-rush or surge of energy during the pump/motor start-up, thus reducing wear on the motor and pumping system. A leading cause of pump motor failure is the stress applied to the motor during a full voltage start-up. The Photon™ Drive variable speed operation ramps up the speed smoothly, which reduces starting stress. This feature enhances long-term motor reliability (see Motor Soft-Start on page 7).

The Franklin Electric Photon™ Drive is designed to be part of a system that consists of:

- A. Solar Array (not included)
- B. DC Rated Disconnect - per applicable codes (not included)
- C. Photon™ Solar Drive
- D. Standard Pump and Motor
- E. Flow Switch (with sensor cable)
- F. Control Switches (optional, not included)

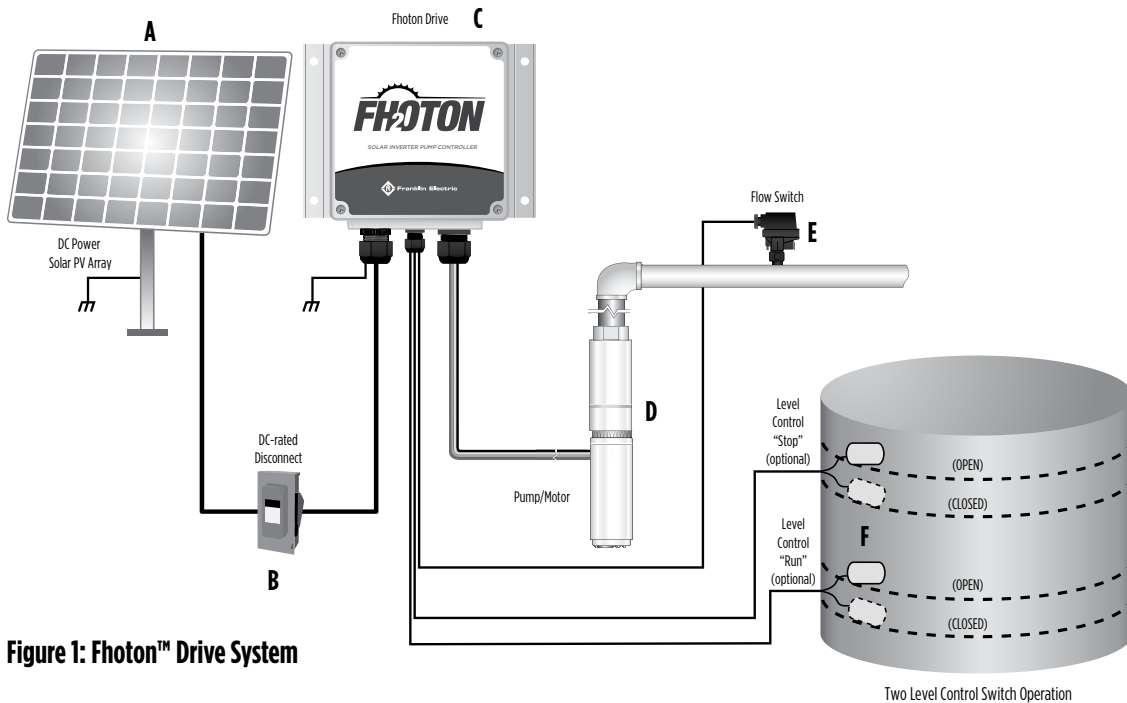


Figure 1: Photon™ Drive System

Pump Check Valve Requirements

NOTICE: In order to ensure maximum system reliability and water delivery, check valves must be installed in the drop pipe. The first check valve must be installed at the pump discharge if it does not have a built-in check valve in the pump discharge. Additional check valves should be installed every 200 ft (60 m) of vertical pipe after the pump or as recommended by check valve and pump manufacturer. (See the pump owner's manual for additional information.)

Features

Motor Soft-Start

Normally, when there is a demand for water and power is available, the Photon™ Drive will be operating. Whenever the Photon™ Drive detects a need for water, the controller always “ramps up” the motor speed through a gradual increase of motor voltage, resulting in a cooler motor and lower start-up current compared to conventional water systems. In cases where the demand for water is low, the system may cycle on and off. Due to the controller’s soft-start feature this will not harm the motor.

Level Control Switch(es)

Level control switch(es) can be wired into the Photon™ Drive for water level control. This is optional and is not required to run the Photon™ Drive. The controller can be used with none, one, or two control switches. This provides the user maximum adjustability when using the Photon™ Drive. (See Installation section on page 10 for more information on installing and using control switches.)

System Diagnostics

The Photon™ Drive comes equipped with an 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 flash sequence count indicates rotor speed. A flash sequence is defined as follows: LED On for 0.5 seconds, LED Off of 0.5 seconds. Each sequence is separated by a 2 second Off time to give a clear visual indication between flash sequences. Flash sequences and cycles apply to both the red and green LED.

As an example, a 4 flash sequence of the green LED indicates an operating speed between 35 and 45 Hz. (See Table 1: Rapid Flashing Green Light.)

Flash Sequence Count	Rotor Speed (Hz)
1	< 15
2	15–25
3	25–35
4	35–45
5	45–55
6	55–65

Table 1: Rapid Flashing Green Light. Pump/motor is going through start-up sequence.

The Photon™ Drive 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 (see Troubleshooting section on pages 20 & 21 for a list of Fault Codes and correction actions). The following sections detail the conditions in which a fault will occur.

Underload (Dry Well)

The Photon™ Drive monitors both the motor load and rotor speed to electronically detect when the pump runs dry. At approximately 35 Hz (rotor speed) and above, the electronic dry well protection algorithm is active. If the motor load falls below the built-in, dry well trip level while the rotor speed exceeds 35 Hz for a period of 3 seconds, the Photon™ drive will halt the motor. The red LED will begin a 1 flash sequence and continue this flash sequence for a duration of 10 minutes. After which time, the drive will resume normal operation (given the run-command input is still present). See Figure 2: Underload (Dry Well) Protection Algorithm.

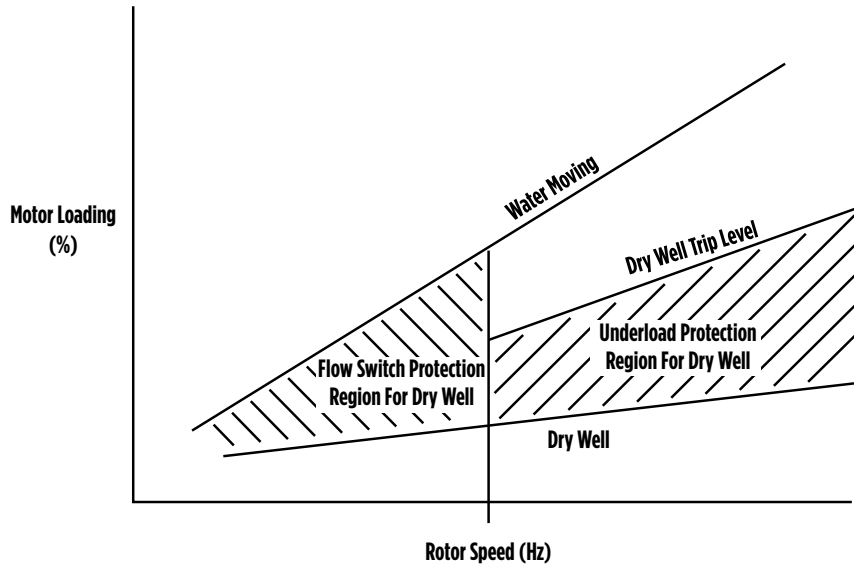


Figure 2: Underload (Dry Well) Protection Algorithm

Overvoltage

This controller is suitable for use with a DC system delivering not more than 850 V DC maximum. The Photon™ Drive monitors the DC input bus voltage for an over-voltage condition. If the voltage exceeds a predetermined voltage level at any time, the Photon™ drive will halt the motor. The red LED will begin a 2 flash sequence and continue this flash sequence for a duration of 3 cycles. After which time, the drive will recheck the bus voltage. The voltage must drop back to a safe level before the drive will resume normal operation; otherwise, the red LED flash sequence will continue.

Locked Rotor

The Photon™ Drive monitors both the motor load and rotor speed to electronically detect when the motor/pump is not rotating. If the motor operates near maximum loading conditions, while the rotor speed is below the minimum operating frequency for a period of 3 seconds, the Photon™ drive will halt the motor. The red LED will begin a 3 flash sequence and continue this flash sequence for a duration of 10 minutes. After which time, the drive will automatically attempt to restart (given the run-command input is still present).

Low Flow Trip

The Photon™ Drive monitors the input flow switch to determine whether water is flowing (see Flow Switch under Features). If the flow does not meet the minimum value to close the switch for a duration of 30 seconds, the Photon™ drive will halt the motor. The red LED will begin a 4 flash sequence and continue this flash sequence for a duration of 10 minutes. After which time, the drive will resume normal operation (given the run-command input is still present).

Open Phase (Open Circuit)

The Photon™ Drive monitors each phase current to the motor. If one of the phases is near zero amps for a duration of 1 second, the Photon™ drive will halt the motor. The red LED will begin a 5 flash sequence and continue this flash sequence for a duration of 3 cycles. After which time, the drive will resume normal operation.

Over Current (Short Circuit)

The Photon™ Drive monitors each phase current to the motor. If one of the phases shows an instantaneous burst of excessive current, the Photon™ drive will halt the motor. The red LED will begin a 6 flash sequence and continue this flash sequence for a duration of 3 cycles. After which time, the drive will resume normal operation.

Over Temperature Shutdown

The Photon™ Drive is designed for full power operation from a DC solar array in ambient temperatures up to 122 °F (50 °C). Under extreme thermal conditions, the controller will halt the motor to begin cool down. The red LED will begin a 7 flash sequence and continue this flash sequence for a minimum of 10 minutes. Full pump output is restored when the controller temperature cools to a safe level.

Internal Error

The Photon™ Drive continuously monitors itself for potential, internal failures. If a failure condition is detected, the Photon™ drive will halt the motor. The red LED will begin a 9 flash sequence and continue this flash sequence until power is cycled.

Flow Switch

A flow switch is available with the Photon™ Drive package to detect low flow or no flow conditions and prevent damage to the pump, motor, and plumbing. At times of limited sunlight, a point will be reached where there is not enough solar power available to provide adequate flow. The pump will reach a deadhead condition meaning the pump is spinning, but no water is moving. Continuous operation in a deadhead condition, may overheat the pump, motor, and subsequently the plumbing, since no moving water carries away the heat. This flow switch overrides the “RUN” command from any other control switches.

The flow switch detects adequate flow, permitting continuous operation; or detects zero or low flow, enabling a “deadhead” operation mode which alternates a run-time interval and a cool-down interval, to avoid overheating the motor and pump. This feature is intended to protect the pumping system from heat buildup which may lead to premature failure. If the flow does not meet the minimum value to close the switch for a duration of 30 seconds (run-time interval), the Photon™ drive will halt the motor. The red LED will begin a 4 flash sequence and continue this flash sequence for a duration of 10 minutes (cool-down interval). After which time, the drive will resume normal operation. The controller will operate indefinitely in “deadhead mode”, until available power either increases sufficiently to move adequate water or it decreases sufficiently that the controller is no longer able to spin the motor.

If the system is not capable of filling the plumbing within the run-time interval, the user may place a “jumper wire” across the flow switch terminals. This will allow the system to run indefinitely preventing the possibility of a low flow fault from occurring. It is highly recommended that this configuration not be made permanent as this defeats the built-in protection provided by the Photon™ Drive, thus preventing adequate protection against “deadhead.”

Installation

WARNING

High voltages (both AC and DC) capable of causing severe injury or death by electrical shock are present in this unit. This unit should only be installed or serviced by technically qualified professionals.

Anytime working on or near the Photon™ Drive, or system:

- Turn **OFF** the external DC rated disconnect from the solar array to the Photon™ Drive.
- Securely cover the solar array with an opaque tarp.
- Wait a minimum of five minutes after removing power from the Photon™ Drive before servicing.
- Solar panels that have been exposed to full solar insulation for an extended period of time can achieve high temperatures and can be a potential source of burns to exposed skin if contacted. Use caution when working around solar arrays.

READ THESE INSTRUCTIONS COMPLETELY BEFORE INSTALLATION.

Note: During installation, if a conflict arises between this manual and local or national electrical codes, the applicable local or national electrical codes shall prevail.

- The longevity and performance of the Photon™ Drive package may be adversely affected by improper installation.
- The solar PV array structure, modules, and wiring harness must be properly assembled according to the manufacturer's installation instructions before installing the Photon™ Drive.
- Wiring Requirements: Use 75 °C rated wire sized for a maximum voltage drop of 3% per local electric codes.

Installation Preparation and Requirements

When installing the Photon™ Drive, be aware that:

- High voltage is present in the Photon™ Drive when powered on; use caution when live DC power is on.
- Do not allow any unauthorized persons near the solar array and connection sites while power is applied.
- It is strongly recommended that a DC rated disconnect box be used to disconnect the incoming DC power from the Photon™ Drive during installation and maintenance. Use a Volt Meter to confirm the absence of voltage in the line before proceeding with installation or maintenance.
- The DC disconnect shall be sized to be capable of adequately disconnecting the output open circuit voltage (VOC) and short circuit current (Isc) of the solar array.
- Appropriate consideration shall be given to sizing fuses to protect the wiring from the solar array's short circuit current (ISC). See local or national electrical codes for guidance.
- Keep all flammable materials away from the assembly site, including dry brush and vegetation.
- For optimal performance, avoid placing the PV solar array around any objects that can cast shadows or reduce sunlight to the array.
- Install the Photon™ Drive out of direct sunlight to prevent overheating and reduced performance. The optimum location is on the mounting rack for the PV Solar Array underneath the array for protection from the sun, heat, and weather elements.
- Keep the surrounding area clear of vegetation.
- Do not block airflow around the Photon™ Drive heat sink.
- Limit access of animals to the system.
- Protect wires from damage from wildlife and weathering by using conduit. For additional protection, bury the conduit in the ground.

Controller Location Selection

The Photon™ Drive is intended for operation in ambient temperatures up to 122 °F (50 °C). The following recommendations will help in the selection of the proper location for the Photon™ Drive (Figure 3):

1. The unit should be mounted on a sturdy supporting structure such as a wall or supporting post. Please take into account the weight of the unit.
2. The electronics inside the Photon™ Drive are air-cooled. As a result, there should be at least 18" (45.7 cm) both above and below to allow for air flow and proper cooling. If the Photon™ Drive is mounted under the PV solar array, make sure that it is at least 18" (45.7 cm) beneath the array.
3. The Photon™ Drive should be mounted with the wiring end oriented downward. The controller should not be placed in direct sunlight. Placing the controller in direct sunlight or high ambient temperatures could result in reduced performance due to temperature shutdown protection. For optimum performance, maximize the shading of the controller.

Additional Considerations for Type 4 (IP56) Enclosures

To ensure maximum weather protection, the unit must be mounted vertically with the cover properly aligned and secured with all lid screws. Strain relief fittings, or IP56 rated liquid-tight conduit fittings, should be used to bring the wires inside the enclosure.

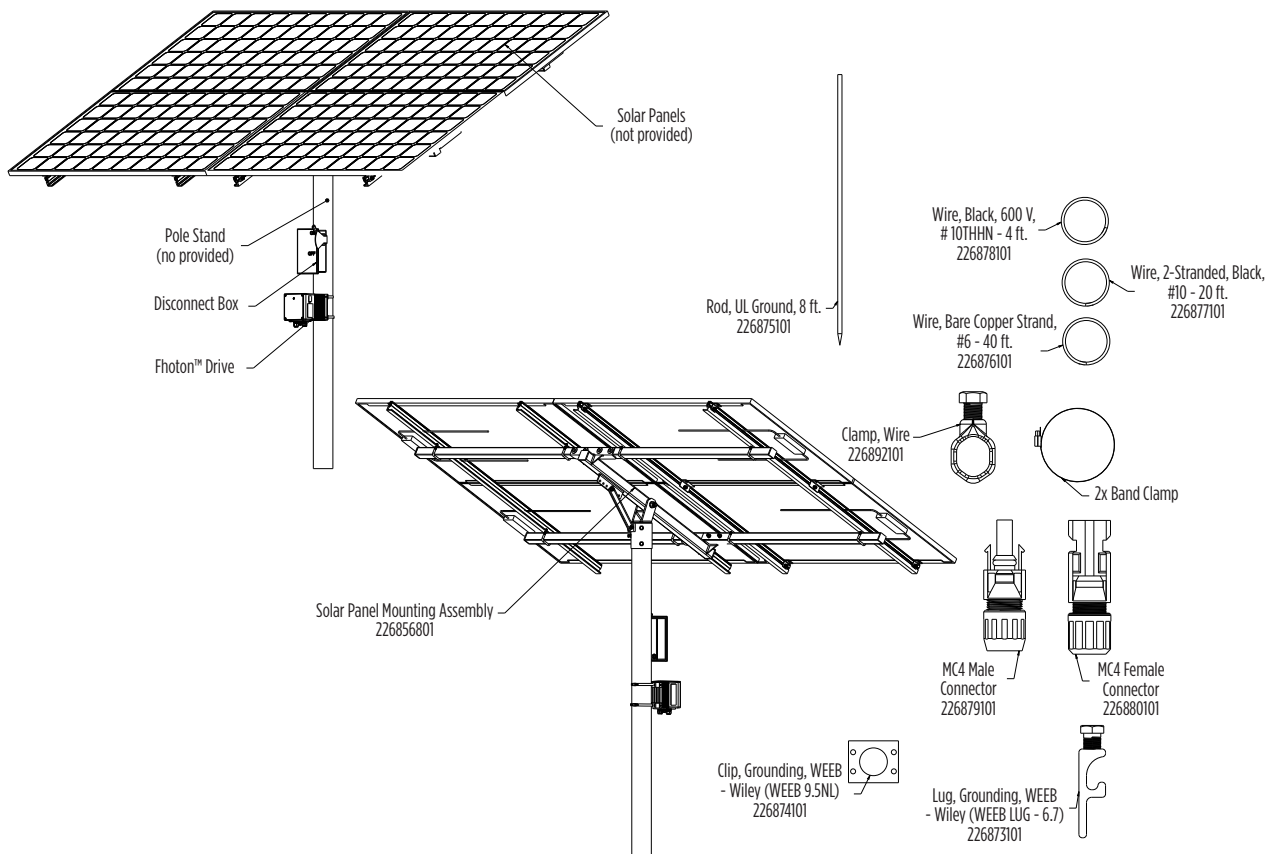


Figure 3: Controller Location

Mounting Procedure

1. Disconnect all electrical power sources.
2. Install the Photon™ Drive securely to the PV rack

Wiring Connections

WARNING

Serious or fatal electrical shock may result from failure to connect the ground terminal to the motor, the Photon™ Drive, 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 minimize risk of electrical shock, disconnect power before working on or around the Photon™ Drive system. Do not use motor in swimming areas.

CAPACITORS INSIDE THE PHOTON™ DRIVE CAN STILL HOLD LETHAL VOLTAGE EVEN AFTER POWER HAS BEEN DISCONNECTED. ALLOW FIVE MINUTES FOR DANGEROUS INTERNAL VOLTAGE TO DISCHARGE BEFORE REMOVING PHOTON™ DRIVE COVER.

The Photon™ Drive is not protected against a “bolted” short to ground at the motor cable terminals. Ensure that the motor leads have been checked for a possible short to ground BEFORE operating the drive.

1. Verify that the power has been shut off.
2. Remove the Photon™ Drive lid.
3. Use appropriate strain relief or conduit connectors. For Type 4 (IP56), 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 based on code recommendations for the maximum operating currents listed in Table 7, page 22. Verify that any protection devices, such as fuses or circuit breakers, are appropriately sized and installed per local and national code.
2. Replace the cover. Do not overtighten the screws.
 - a. Torque screws to 15 in-lbs (1.69 Nm).

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

DC Wiring Connections

1. Make sure that the external disconnect switch is off.
2. Make sure that all wires are properly identified and marked:
 - the cable from the PV to the external DC disconnect switch.
 - the cable from the external DC disconnect to the Photon™ Drive.
3. Connect the cables from the external DC disconnect to the terminal block labeled “Solar Primary DC” and marked +, - and GND (Figure 4). Torque specification: 12 in-lbs / 1.35 Nm (Use copper conductors only. Rated 75 °C minimum.)
4. Ground wire shall be insulated; typically green or green with yellow stripe.
5. **NOTE:** If wires are stranded these can be #20 AWG up to #8 AWG. If wires are solid these can be #20 up to #10 AWG.

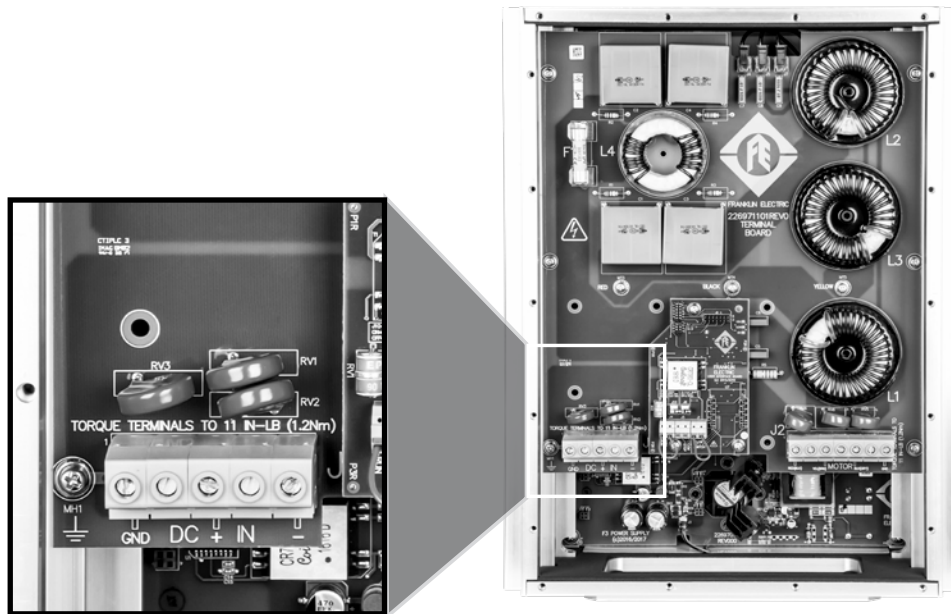


Figure 4: DC Wiring Connection

⚠ CAUTION

Only connect a photovoltaic solar array to the DC input of the Photon™ Drive. This controller is suitable for use on a circuit capable of delivering not more than 5,000 RMS symmetrical amps, 850 V DC maximum.

Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electric Code and any additional local codes. In addition, follow any manufacturer's recommendations for protection of a photovoltaic (PV) array.

Flow Switch Wiring Connections

The Photon™ Drive makes use of a flow switch to protect the centrifugal pump and motor when there is not enough power to generate proper flow. Use of the flow switch is required for installations to prevent running during deadhead/no flow conditions.

1. Make sure that the external disconnect switch is off prior to making any connections to the drive.
2. Connect the cables from the flow switch terminals NO and COM to the Photon™ Drive terminal block labeled “FLOW SWITCH” (Figure 5).

If disconnecting flow switch wires, use small flathead screwdriver, or similar tool, to press the orange button above the wire.

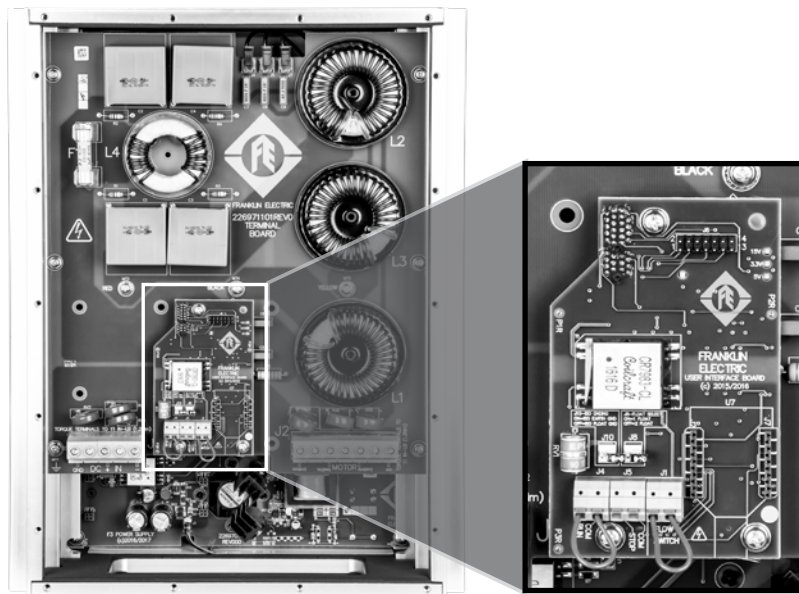


Figure 5: Flow Switch Wiring Connection

⚠ CAUTION

Failure to install a flow switch will result in reduced system performance and may result in centrifugal pump and motor damage if adequate cooling by the surrounding water is not ensured. A flow sleeve is always advised to provide additional cooling in wells larger than 4" (10.16 cm). See the Franklin Electric AIM manual (M1311) for proper cooling flow requirements.

Flow Switch Plumbing Installation

⚠ WARNING

Hazardous Pressure Present: Pressure at the flow switch must be limited according to the water temperature that the flow switch will see in service. Note that this includes the temperature that the water could reach due to heating by the surrounding environment. Pressure at the flow switch must be limited according to the following table.

Flow Switch Pressure Rating vs. Water Temperature		
Maximum Water Temperature (°C)	Gauge Pressure (bar)	Gauge Pressure (psi)
20	18	261
25	15.75	228
30	13.5	196
35	11.25	163
40	9	131
45	6.75	98
50	4.5	65
55	2.25	33
60	0	0

Table 2: Flow Switch Pressure

NOTE: Pressure at the flow switch can be reduced by eliminating plumbing restrictions including reductions in pipe diameter downstream of the flow switch.

On the F21 paddle style flow switch, the paddle must be trimmed to allow it to fit into the plumbing. The paddle should be trimmed so that it is as long as possible, but not closer than 4 mm (0.160"), to the pipe walls when installed. A longer paddle length will increase flow switch sensitivity and therefore water delivery at low power conditions. Additional installation instructions including mounting orientation, paddle trimming, other plumbing requirements, etc. are included with the flow switch. Follow the installation instructions included with the packaging of the flow switch for installation and maintenance information.

Pump/Motor Wiring Connections

1. Connect the cables from the Pump/Motor Assembly to the Terminal Block labeled “MOTOR” and marked BLK, GND, RED, and YEL (Figure 6). Torque specification: 12 in-lbs / 1.35 Nm (Use copper conductors only. Rated 75 °C minimum).
2. Motors with international leads use Table 3 for motor lead color information to ensure correct installation.
3. Ground wire shall be insulated; typically green or green with yellow stripe.

US	Black (BLK)	Ground (GND)	Red (RED)	Yellow (YEL)
International	Gray (GRY)	Black (BLK)	Brown (BRN)	Ground (GND)

Table 3: US and International Wire Color Chart

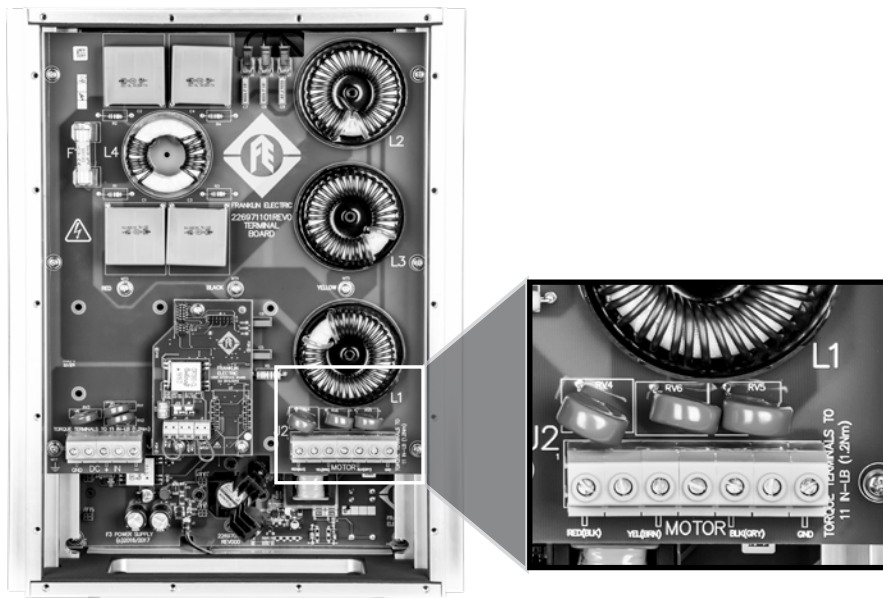


Figure 6: Motor Wiring Connection

⚠ CAUTION

For retrofit application, make sure to check integrity of power and motor leads. This requires measuring the insulation resistance with the suitable megohmmeter. Reference the Franklin Electric AIM Manual for correct measures. (See Table 4: Motor Specifications on page 19.)

Control Switch Wiring Connections (Optional)

The Photon™ Drive can be operated with control switches to control the ON/OFF pumping range. Use a normally closed low-voltage control switch with a contact rating suitable for instrumentation use (i.e. Max: 24 V 15mA):

1. Connect the cables from the “STOP” control switch to the Terminal Block labeled “STOP.”
2. Connect the cables from the “RUN” control switch to the Terminal Block labeled “RUN” (Figure 8).
3. If disconnecting control switch wires, use small flathead screwdriver, or similar tool, to press the orange button above the wire.

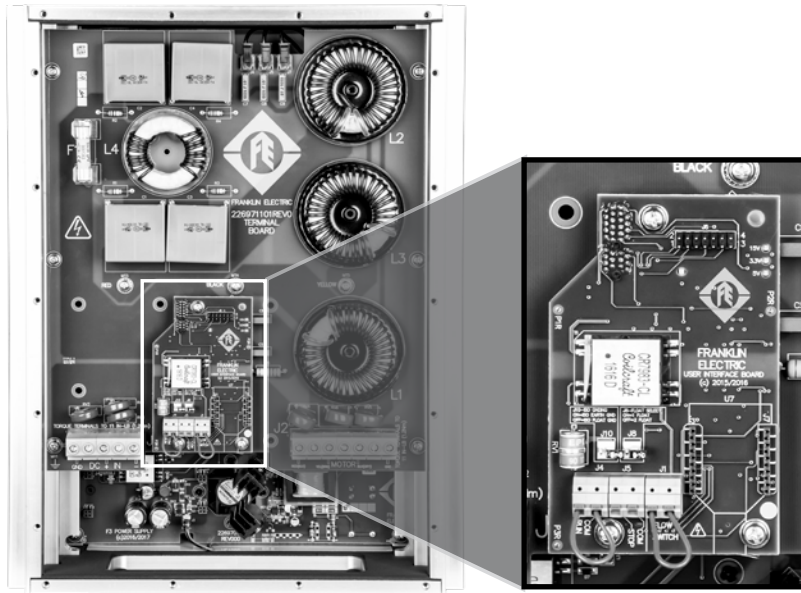


Figure 7: Control Switch Wiring Connection

Two Control Switch Operation

(Remove the factory default jumper, over the “J8” pins, located just above the control inputs)

The Photon™ Drive is designed to utilize up to two control switches for operation. When both switches are installed, the controller starts to pump and waits to shut off until both switches read “OPEN.” Once it shuts off, the controller then waits to run again until both switches read “CLOSED.” An example application (Figure 8) is to use separate level switches to indicate high and low water levels. When using two switch inputs, remove the jumper (on “J8” pins) located immediately above these switch inputs.

One Control Switch Operation

(Leave the factory default jumper in place (on “J8” pins) located just above the control inputs)

Alternatively, the Photon™ Drive may be configured to control water level by using a single input switch. Once properly configured for a single active input with a control switch installed, the controller starts to pump and waits to shut off until the active switch reads “OPEN.” Once it shuts off, the controller then waits to run again until the switch reads “CLOSED.” An example application (Figure 8) would be to use a single contact level switch that keeps the storage tank as full as possible without overflowing. For single level switch control, use only the “RUN” terminal connections. Leave the jumper in place (over “J8” pins), located immediately above these switch inputs.

Zero Control Switch Operation

Lastly, the Photon™ Drive may be configured to not use a control switch. In this configuration the Photon™ Drive will always try to run the motor and pump water as long as there is sufficient power from the solar array, leave the jumper (on “J8”) in place, located immediately above these switch inputs and connect a shorting wire in place of the “RUN” input.

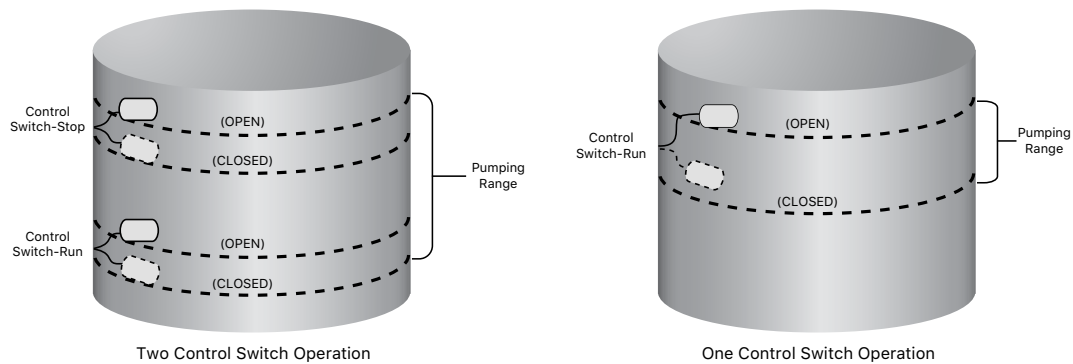


Figure 8: Control Switch Operations

NOTE: All control switch configurations are superseded by the “FLOW SWITCH.” If the flow switch detects low flow it will “OPEN” and override the run signals sent by the control switches to protect the motor and drive.

Start-Up and Operation

After all appropriate connections have been made, place the cover on the Photon™ Drive, then apply power to the controller. A steady green light in the center of the cover indicates that the Photon™ Drive has DC power connected. No light can indicate that the polarity is reversed, assuming sufficient DC voltage is available. Additionally, use a DC voltmeter to confirm proper polarity and sufficient DC voltage.

NOTE: For optimal operation results, it is recommended to flush the bore well system until the water being discharged is clear and free of debris. The flow switch should not be installed in-system during the flush. This will reduce the chances of the flow switch being clogged by sediment and debris during initial start-up. (See Flow Switch section for details on bypassing flow switch to clear debris on initial start-up.)

Three-Phase Motor Specifications

4" Motors											
MOTOR MODEL	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	KVA CODE
	HP	kW	VOLTS	Hz	S.F.	AMPS	WATTS	AMPS	WATTS		
234 317 XXXXG	5.0	3.7	230	60	1.15	14.2	4710	16.4	5410	1.0 – 1.3	K
234 347 XXXXG	5.0	3.7	380	60	1.15	8.6	4710	9.9	5410	2.9 – 3.6	K
234 348 XXXXG	7.5	5.5	380	60	1.15	12.7	7000	14.9	8020	1.9 – 2.3	L
234 549 XXXXG	10.0	7.5	380	60	1.15	16.1	9200	18.6	10620	1.5 – 1.9	K

6" Motors											
MOTOR MODEL	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	KVA CODE
	HP	kW	VOLTS	Hz	S.F.	AMPS	WATTS	AMPS	WATTS		
236 600 XXXX	5.0	3.7	230	60	1.15	15.0	4700	17.6	5400	1.0 – 1.2	H
236 660 XXXX	5.0	3.7	380	60	1.15	9.1	4700	10.7	5400	2.6 – 3.2	H
236 661 XXXX	7.5	5.5	380	60	1.15	13.4	7000	15.0	8000	1.6 – 2.1	H
236 662 XXXX	10.0	7.5	380	60	1.15	17.6	9400	19.6	10800	1.2 – 1.5	H

Table 4: Motor Specification Data

Maximum Motor Cable Length (in feet)								
Drive Model	Motor HP	Motor Volts	AWG Copper Wire Size (75 °C Insulation)					
			14	12	10	8	6	4
581038501994-XXXXX	5.0	230	-	230	370	590	920	1430*
581038501994-XXXXX	5.0	380	400	640	1010*	1590*	2490*	3870*
581038501994-XXXXX	7.5	380	270	440	690	1090*	1710*	2640*
581038501994-XXXXX	10	380	-	320	510	800	1250*	1930*

Maximum Motor Cable Length (in meters)								
Drive Model	Motor KW	Motor Volts	Square Millimeter Copper Wire Size, (75 °C Insulation)					
			1.5	2.5	4	6	10	16
581038501994-XXXXX	3.7	230	-	50	80	120	210	330*
581038501994-XXXXX	3.7	380	80	140	230	350*	570*	900*
581038501994-XXXXX	5.5	380	50	90	150	230	390*	610*
581038501994-XXXXX	7.5	380	40	70	120	190	310*	490*

Table 5: Wire Sizing Charts

* Maximum cable length from the drive to the motor is 1000 ft (305 m). External filtering is required for motor cable lengths exceeding this maximum distance or nuisance tripping might occur. Contact Franklin Electric for additional assistance with external filtering for distances larger than 1000 ft (305 m).

Motor Lead Installation

NOTE: The included motor in the Photon™ SolarPAK does come with a factory installed individual conductor lead. To replace or install a new lead, please refer to the Franklin Electric AIM Manual for further information on motor lead installation and replacement

Fault Codes and Troubleshooting

The Photon™ Drive will attempt to operate the pump 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. When adverse conditions arise, the controller will continue to deliver as much water as possible at a reduced output if necessary, and will shut down only in extreme cases. Full operation will resume automatically whenever abnormal conditions subside.

Error conditions may suspend certain features, reduce output, or shut down operation of the system for varying amounts of time depending on the nature and severity of the error. Problems that merely reduce features or performance generally restore full operation when the trouble condition subsides without stopping the pump or flashing an error code. An error code is displayed by the flashing LED light.

If the drive has stopped to indicate a fault code, the associated time-out delay will vary depending on the nature of the fault.

See Table 6 for the list of Fault Codes and possible causes.

For Fuse Replacement Use

Fuse: F1 – R/C (JFGA.E339112)

LITTELFUSE INC, model SPF020, (rated 1000VDC, 20A, 20kA interrupt).

Alternate: R/C (JFHR2.E342342)

PHOENIX CONTACT GMBH & CO. KG, model FUSE 10.3x38 20A, (rated 1000VDC, 20A, 30kA interrupt).

Alternate: R/C (JFGA.E335324)

BUSSMANN, model PV-20A10F, (rated 1000VDC, 20A, 50,000A interrupt).

Fault Flash Sequence	Fault	Possible Causes	Corrective Action
1	Motor Underload	Air-locked pump. Overpumped or dry well. Worn pump, damaged shaft or coupling, blocked pump or pump screen.	Wait for well to recover and auto restart to occur. (See description in Underload [Dry Well] section.) If the problem persists, check pump and motor.
2	Overvoltage	Misconnected input leads. Incorrect sizing of solar array.	Ensure array wiring is correct. Check series/parallel connections. Confirm array ratings are within Photon™ Drive input range.
3	Locked Pump	Motor/pump misaligned. Pump bound up with sand or abrasive. Dragging motor or pump.	Unit will attempt to free a locked pump. If it is unsuccessful, check the motor and pump.
4	Low Flow Trip	Flow switch miswired. Flow switch clogged. Inadequate power to generate flow. Motor wired incorrectly.	Check that “FLOW SWITCH” terminal is correctly wired to flow switch. Check that flow switch is properly installed in pipe discharge. Check that the flow switch is not clogged. Check that pipe discharge is not blocked. Wait for sufficient solar power to pump adequate water. Check that the motor is wired correctly and spinning in the correct direction.
5	Open Circuit	Loose or open connection to motor. Defective motor or cable.	Check motor cable connections. If problem persists, check cable and motor.
6	(a) At power-up: Short Circuit (b) While running: Over Current	(a) Short in motor connections at terminal or within motor cable. (b) Debris in pump.	(a) Check motor connections at terminal. (b) Check pump. If problem persists, check motor cable and pump.
7	Overheated Controller	Unit in direct sunlight. High ambient temperature. Obstruction of air flow.	Shade unit. Clean any debris from heat sink fins on rear of enclosure. This fault automatically resets when temperature returns to safe level.
9	Internal Error	Controller internal processing has encountered an incorrect value.	Cycle input power.*

Table 6: Fault Code / Troubleshooting

* “Cycle input power” means disconnecting PV power (if used) for at least five minutes, then reconnecting power.

Photon™ Drive Specifications

Absolute maximum input voltages

PV, DC	581038501994-XXXXX 850 V, open circuit
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NOTE: Only connect a photovoltaic solar array to the DC input of the Photon™ Drive. This controller is suitable for use on a circuit capable of delivering not more than 5,000 RMS symmetrical amps, 850 V DC maximum.

Controller Model No.	581038501994-XXXXX
Output	
Output voltage, nominal	Up to 460 V AC, 3-phase
Max Amps (RMS)	Up to 19.9 A, each phase
Output Frequency	30–60 Hz
Max Power; Efficiency	10.8kW; 98% efficiency (approx.)
Absolute Maximum Input Voltage	
PV DC	850 V, open circuit
PV source	
Input Voltage	*200 – 850 V DC
Max. Amps Input	19.3 A DC, continuous
Power	Up to 11.7 kW
Controller Size L x W x D	
Millimeters	400 x 324 x 233 mm
Inches	15.75" X 12.76" X 9.17"
Operating Conditions	
Temperature Range	-25 °C to 50 °C Max. -13 °F to 122 °F Max.
Relative Humidity Range	0 to 100% Condensing
Enclosure Type	Type 4 / IP56
Altitude Rating	2000 m

Table 7: Photon™ Drive Specifications

* 200 V DC for the 581038501994 models should not be interpreted as an adequate rated PV array output voltage for any installation. See the PV Solar Array Specifications and System Sizing program for indication of adequate array voltage to provide useful pumping capability.

Electrical Diagram

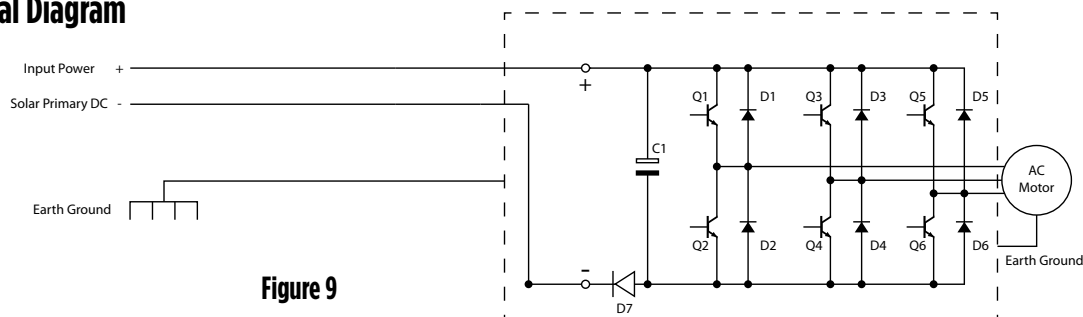


Figure 9

Solar Panel Wiring Configurations

Solar Panels Wired in Series

When solar panels are wired in series, the positive terminal of one solar panel is wired to the negative terminal of the next solar panel.

When panels are connected in series:

- Voltage accumulates (adds) for each panel in series.
- Wattage accumulates (adds) for each panel in series.
- Current (Amps) remains the same as a single panel in the series.

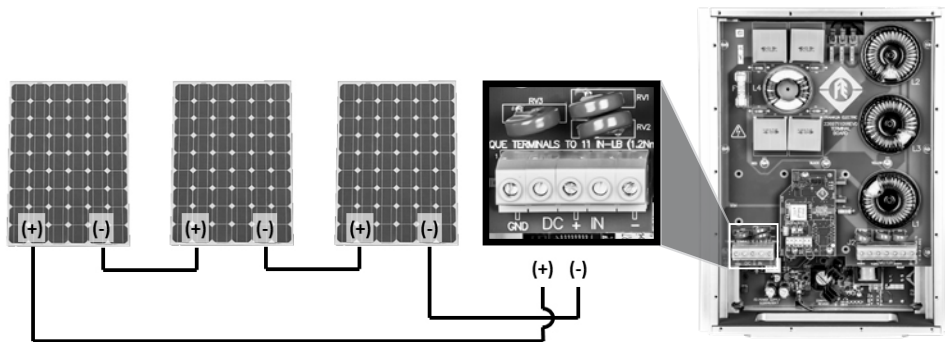


Figure 10

Solar Panels Wired in Parallel

When solar panels are wired in parallel, the positive terminal of one solar panel is wired to the positive terminal of the next solar panels.

Likewise, the negative terminals are connected together to the negative terminals of the next solar panel.

When panels are connected in parallel:

- Voltage remains the same as a single panel in the parallel connection.
- Wattage accumulates (adds) for each panel added.
- Current (Amps) accumulates (adds) for each panel wired in parallel.

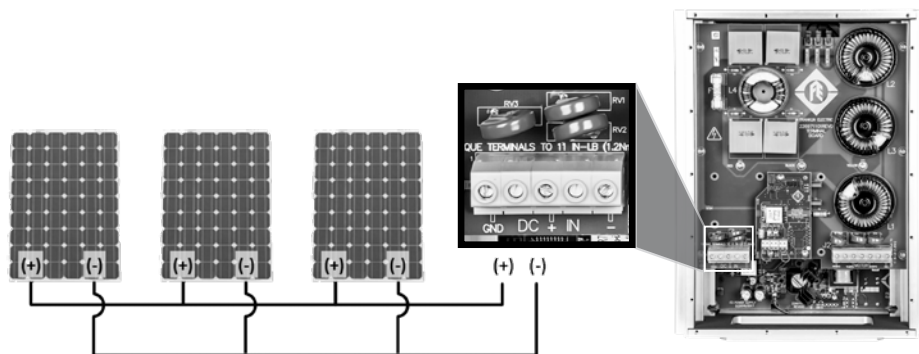


Figure 11

Solar Panels Wired in Combination

Series/parallel combination wiring requires that at least two sets (or strings) of panels wired in series are connected in parallel.

When panels are connected in combination:

- Voltage accumulates (adds) for each panel in a single series circuit, but does not accumulate for additional strings wired in parallel.
- Wattage accumulates (adds) for each panel in a single series string AND each string in parallel circuit (all panels in the array contribute additively to the total wattage).
- Current (Amps) remains the same for single panels in a series, but accumulates (adds) for additional strings connected in parallel.

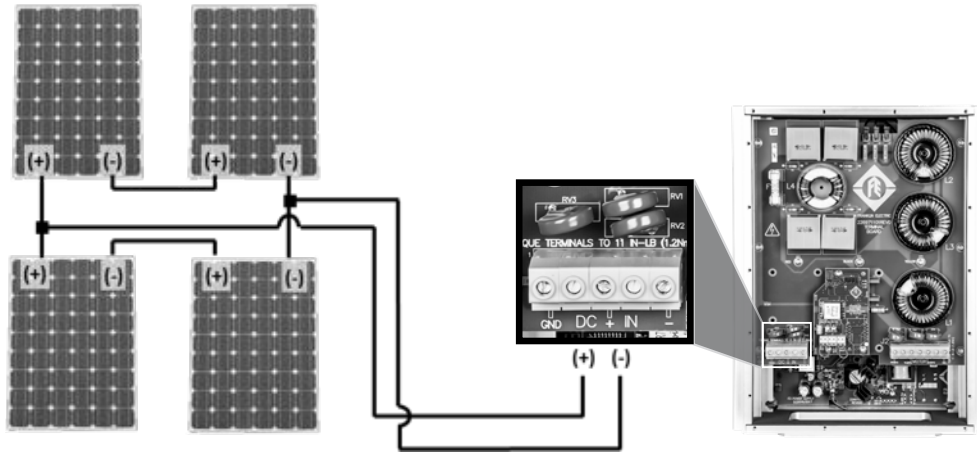


Figure 12

Photon™ Drive Dimensions

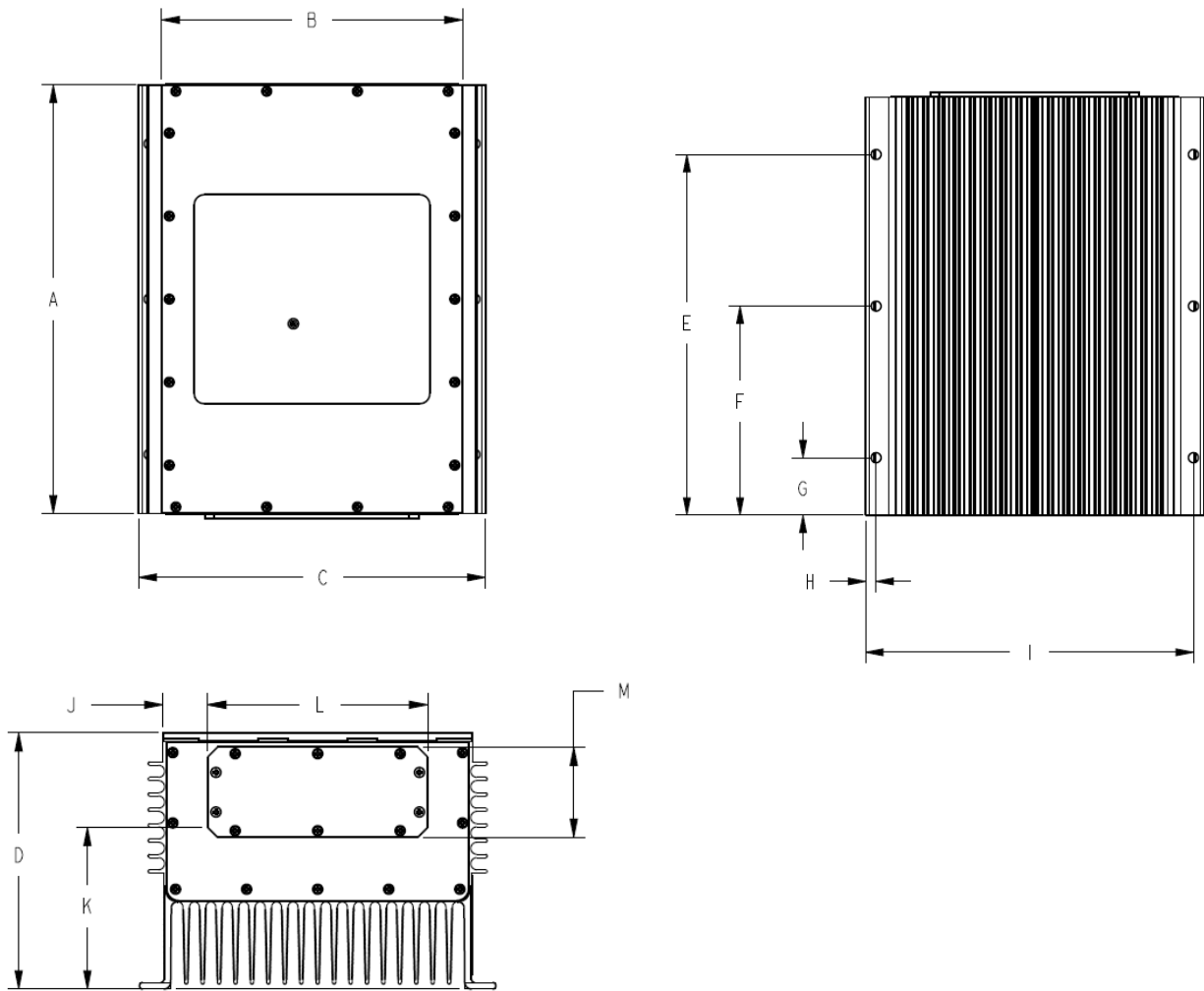


Figure 13: Photon™ Drive Line Drawing

Photon™ Drive Dimension	A	B	C	D	E	F	G	H	I	J	K	L	M
Inches	15.75	11.06	12.76	9.17	13.58	7.87	2.17	0.39	12.36	1.59	5.79	7.87	3.22
Millimeters	400	281	324	233	345	200	55	10	314	40.5	147	200	82

NOTE: All dimensions are approximate

Table 8: Photon™ Drive Dimensions

Notes

Notes

FE USA Technical Service Hotline
1.800.348.2420



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