

SmartHarvest[™] Pole-Mounted PV Solar Power Station

The SmartHarvest[™] Pole-Mounted PV Solar Power Station is composed of a number of pre-installed, pre-wired subsystems. Before proceeding with the installation, verify which charge controller is installed, review this guide to become familiar with the various subsystems. Adhere to the electrical and mechanical safety guidelines indicated in this document, as well as all related documentation for each subsystem.

Refer to the following documents for comprehensive installation instructions and safety information.

Enclosure:

- Alpha Technologies *Alpha Pole Mount Bracket Installation Guide* (Alpha p/n 745-968-C0)

Charge Controllers:

- SmartHarvest[™] SCCM20-100 MPPT Charge Controller/Load Manager
- Morningstar *TriStar MPPT[™]-30 Solar Charge Controller*, (Morningstar p/n MS-000946 v05.1)

Solar Module Racking System, Side of Pole Mount (SPM) – The actual racking system will be determined by the size and power capacity of the system.

- DPW Solar *Side-of-Pole Mount (SPM1) Assembly Instructions*
- DPW Solar *Side-of-Pole Mount (SPM2) Assembly Instructions*
- DPW Solar *Side-of-Pole Mount (SPM3) Assembly Instructions*

Photovoltaic Modules:

- *ET Solar Photovoltaic Modules User Manual*

Batteries:

- OutBack Power Technologies *EnergyCell Battery Owner's Manual* (OutBack Power Technologies p/n 900-0127-01-00)




Audience

This guide is intended for experienced installers familiar with the mechanical and electrical requirements of photovoltaic systems and qualified, licensed installation personnel. Review all included documentation to become familiar with all of the features and functions of the equipment in this system before proceeding. Failure to install and/or use this equipment as instructed in the system documents can result in damage to the equipment. This system is only serviceable by qualified personnel.

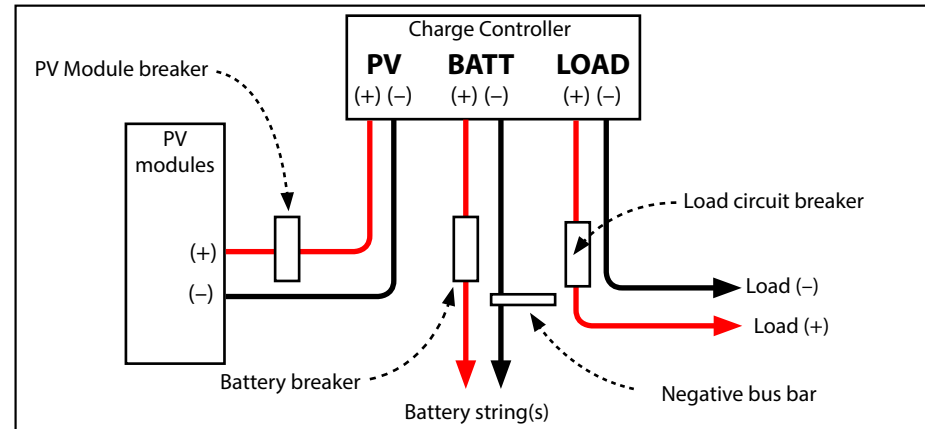
Safety Guidelines

Separate safety documentation, as well as technical manuals for the racking system, PV modules, charge controller, enclosure and batteries are available online, and contain additional product-specific safety information, detailed installation and configuration information. Comprehensive safety information is contained in OutBack Power Technologies' *Important Safety Instructions*.

Classes of Symbols used in these documents

	WARNING: Hazard to Human Life This type of notation indicates that the hazard could be harmful to human life.
	CAUTION: Hazard to Equipment This type of notation indicates that the hazard may cause damage to the equipment.
	IMPORTANT: This type of notation indicates that the information provided is important to the installation, operation and/or maintenance of the equipment. Failure to follow the recommendations in such a notation could result in voiding the equipment warranty.

Simplified System Block Diagram



The PV module(s) convert solar energy into DC power which is then fed to the positive (+) and negative (-) terminals on the charge controller. The design of the charge controller allows for uniform charging of the battery bank and prevents overcharging conditions. The batteries provide power for loads appropriately rated for the battery string (12Vdc to 48Vdc).



IMPORTANT:

The size and capacity of the system determine which charge controller, either the SmartHarvest by OutBack SCCM20-100 MPPT or Morningstar TriStar MPPT-30, is installed in the system. Verify the particular make and model in the system and follow instructions in this and related product documentation

Site Characteristics

In the northern hemisphere, always orient the array to true south. In the southern hemisphere, always orient the array to true north. To optimize power output, verify that no object, including fencing, trees, buildings and/or other obstructions, will cause any shading of the array.

PV Module Tilt

Refer to the accompanying table for recommended tilt angles. The tilt angle is set by the vertical distance (span) between the pole channels, the selection of an attachment point (a, b, or c) and the length of the strut.

For comprehensive information regarding installation and assembly of the Side-of-Pole mounting rack, refer to DPW Solar's *Side-of-Pole Mount Assembly Instructions*.

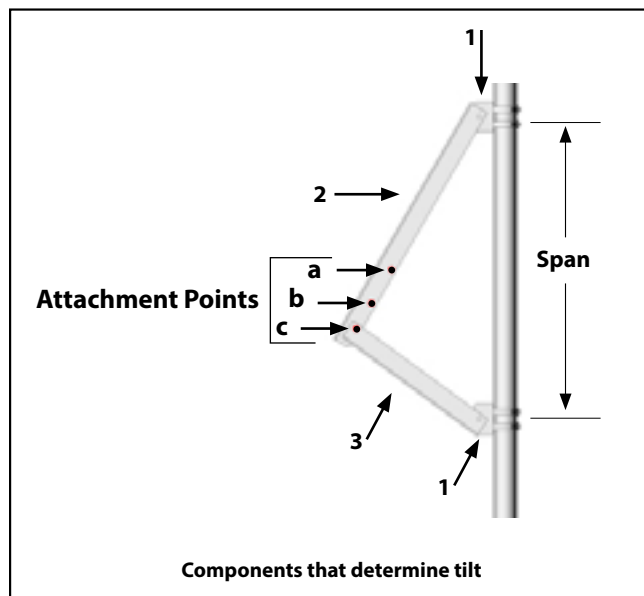


Illustration courtesy of DPW Solar / Preformed Line Products

Item	Description
1	Pole Channel
2	Module Rail (left and right)
3	Strut (left and right)

Site Latitude	Fixed Tilt Angle
0° to 25°	30°
25° to 30°	Latitude +5°
30° to 35°	Latitude +10°
35° to 40°	Latitude + 15°
> 40°	60°

Mounting Rack Assembly



WARNING: Personal Injury

Use care while assembling the rack assembly. During the assembly procedure components could create hazards, obstructing free movement and leading to serious bodily injury. These hazards are at head/eye level. The use of head and eye protection is required.



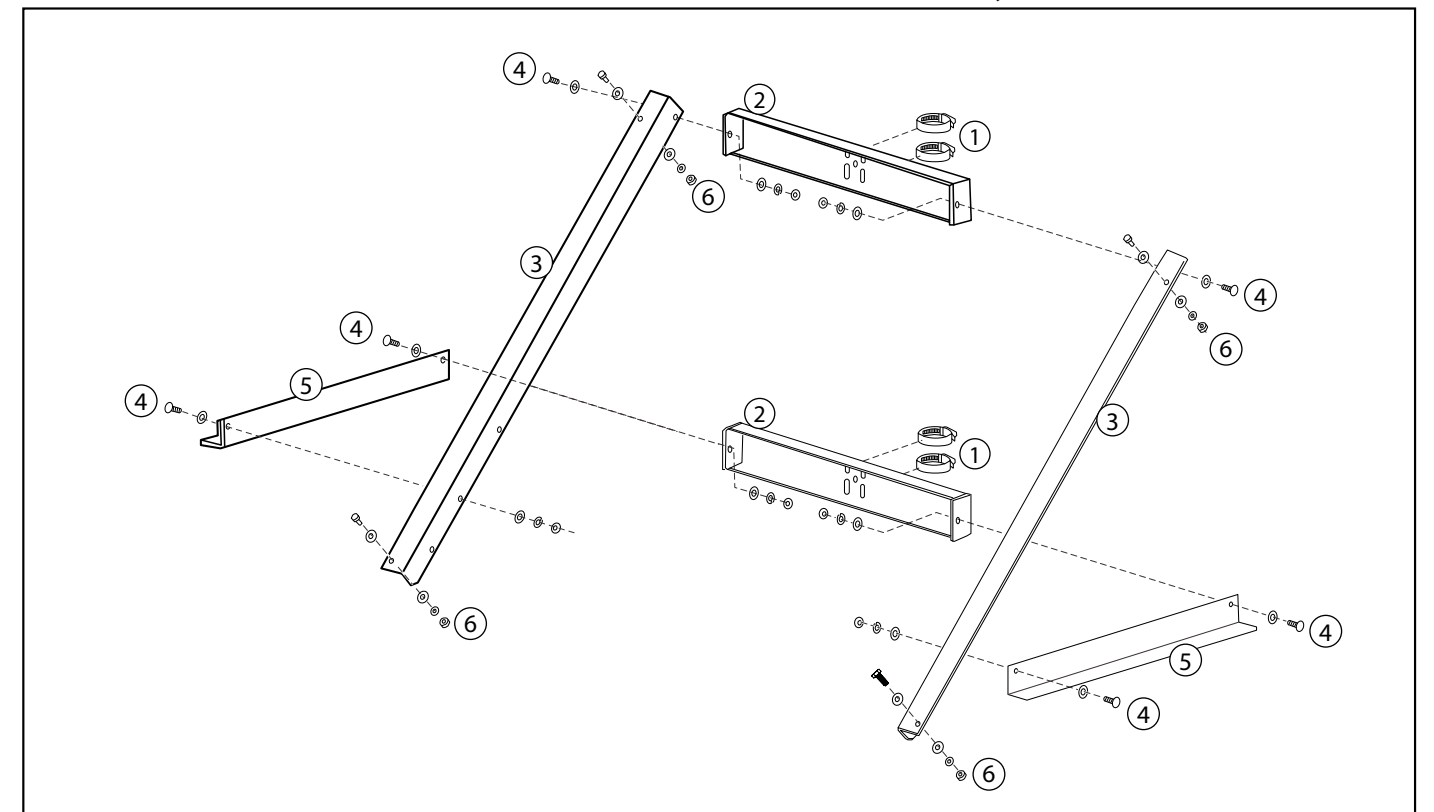
IMPORTANT:

The SPM-1 racking system is designed for poles 2" to 3.5" in diameter. The SPM-2 and SPM-3 racking systems are designed for poles 3" to 4.5" in diameter.

Tools required for racking assembly:

- 7/16" wrench for 1/4" module hardware
- 9/16" wrench for 3/8" hardware
- Torque wrench (optional, recommended)
- Ratchet and extension bar
- Safety eyewear
- Safety headgear

Illustration courtesy of DPW Solar / Preformed Line Products



Item	Description	Quantity
1	Hose Clamp (standard)	4 per rack
2	Pole Channel	2 per rack
3	Module Rail (left and right)	2 per rack
4	3/8" x 1" hex bolt, lock washer, flat washers	6 sets per rack
5	Strut	2 per rack
6	1/4" x 3/4" hex bolt, lock washer, flat washers, nut	4 sets per rack

Mounting the Photovoltaic (PV) Module



Warning: Electrical Hazard

Photovoltaic modules convert light energy to DC power and are designed for outdoor use. Proper design of support structures is the responsibility of the system designer and installer. Cover modules with opaque material until modules are installed and connected to the PV circuit breaker.



WARNING: Personal Injury

Due to the weight and size of the PV module, two installers are required to attach the PV module to the rails.

PV modules are secured to the mounting rails using 1/4" x 3/4" bolts, with hardware tightened to a torque setting of 7 ft-lb. Refer to *ET Solar Series Photovoltaic Modules User Manual* for additional information.

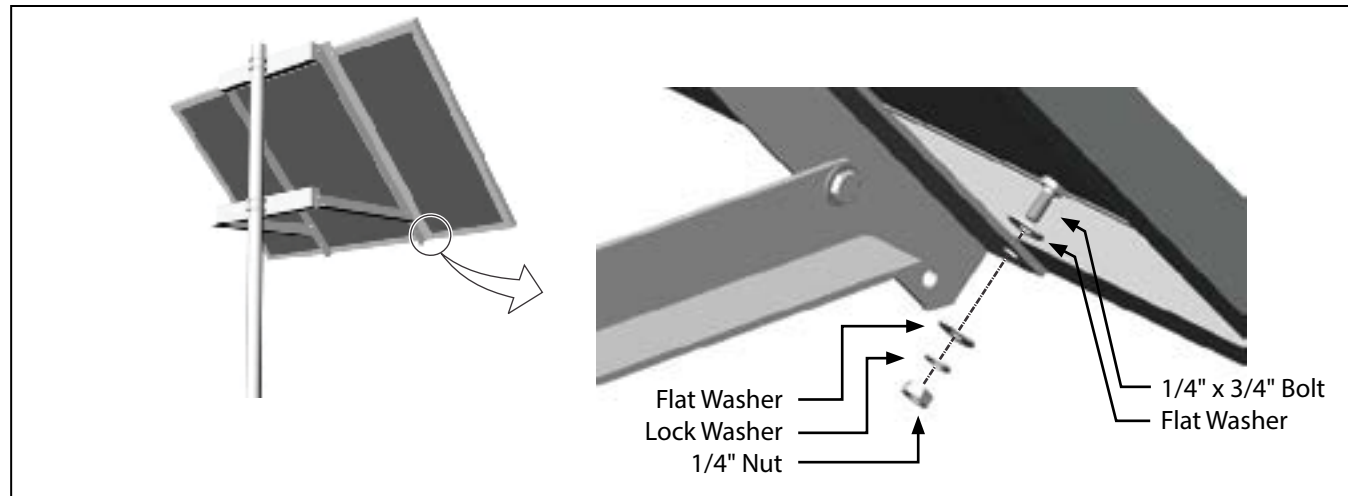


Illustration courtesy of DPW Solar / Preformed Line Products

Enclosure Installation

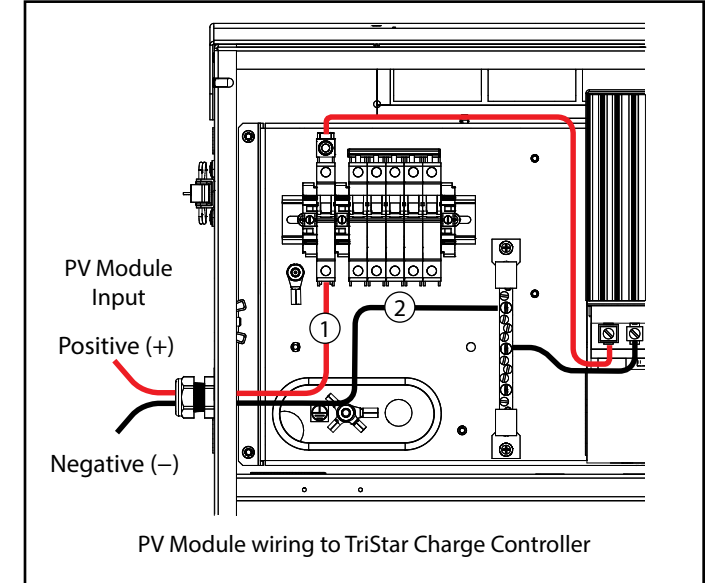
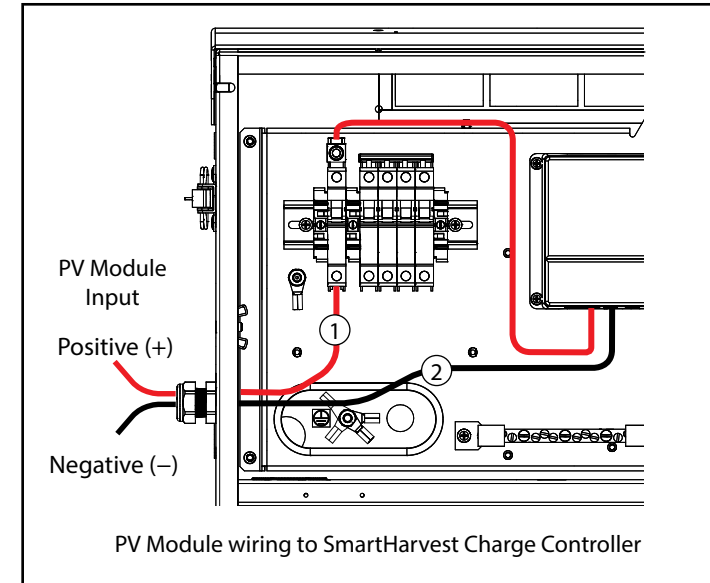


IMPORTANT:

The enclosure must only be installed by qualified personnel.

Pole-mounted systems will use either Alpha Technologies' PWE-3 or PWE-6 enclosures. Refer to the *Alpha Pole Mount Installation Guide* (745-968-C0) for complete installation and configuration instructions. Read and follow all safety instructions contained in the manual.

PV Module Connections



CAUTION: Hazard to Equipment

In systems configured with a SmartHarvest Charge Controller: Connect PV module negative (-) directly to PV negative (-) point on the charge controller.

In systems configured with a TriStar Charge Controller: Connect PV module negative (-) to the negative bus bar; the connection between the negative bus bar and PV negative (-) on the charge controller is pre-wired.

Each system requires the PV module connections to be made as shown above. Connecting the PV modules with reversed polarity will damage the charge controller.



IMPORTANT:

All PV modules must be wired in series.






PV module/SmartHarvest Charge Controller connections

- ① PV module positive (+): Connect to the lower position of PV input circuit breaker.
- ② PV module negative (-): Connect to the charge controller PV negative (-).

PV module/TriStar Charge Controller connections

- ① PV module positive (+): Connect to the lower position of PV input circuit breaker.
- ② PV module negative (-): Connects directly to the negative bus bar.

Battery Installation

	<p>CAUTION: Equipment Damage Never reverse the polarity of the battery cables. Always verify correct polarity.</p>
	<p>WARNING: Fire Hazard Always ensure a circuit breaker or overcurrent device is installed on the DC positive conductor for each device connected to the batteries.</p>
	<p>WARNING: Fire Hazard Never install extra washers or hardware between the mounting surface and the battery cable lug or interconnect. The decreased surface area can build up heat.</p>
	<p>WARNING: Personal Injury</p> <ul style="list-style-type: none"> Some batteries can weigh in excess of 69 lb (31 kg). Use safe lifting techniques when lifting this equipment as prescribed by the Occupational Safety and Health Association (OSHA) or other local codes. Lifting machinery may be necessary. Wear appropriate protective equipment when working with batteries, including eye or face protection, acid-resistant gloves, an apron, and other items. Avoid touching bare skin or eyes while working near batteries. Keep plenty of fresh water and soap nearby in case battery acid contacts skin, clothing, or eyes. If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters the eye, immediately flood it with running cold water for at least 20 minutes and get medical attention as soon as possible. Wash hands after any contact with the lead terminals or battery electrolyte.
	<p>WARNING: Explosion, Electrocuting, or Fire Hazard</p> <ul style="list-style-type: none"> Ensure clearance requirements are strictly enforced around the batteries. Ensure the area around the batteries is well ventilated and clean of debris. Never smoke or allow a spark or flame near the batteries. Always use insulated tools. Avoid dropping tools onto batteries or other electrical parts. Never charge a frozen battery. Insulate batteries as appropriate against freezing temperatures. A discharged battery will freeze more easily than a charged one. If a battery must be removed, always remove the grounded terminal from the battery first. Make sure all devices are de-energized or disconnected to avoid causing a spark. Do not perform any servicing other than that specified in the installation instructions unless qualified to do so and have been instructed to do so by OutBack Technical Support personnel.

Battery Specifications

Battery Model Specifications		
EnergyCell RE Top Terminal	78RE	106RE
Nominal Voltage per cell	12Vdc	12Vdc
Capacity Rates (1.75VPC)	20Hr: 75Ah 100Hr: 78Ah	20Hr: 100Ah 100Hr: 106Ah
Cycle Life (50%DOD @25°C)	1800 cycles	1800 Cycles
Float Cycle Life (@25°C)	10 years	10 years
Weight (lbs)	54	69
Dimensions L x W x H (in)	10.2 x 6.8 x 8.0	13.5 x 6.8 x 8.5
Warranty	2 years	2 years

Battery Connections

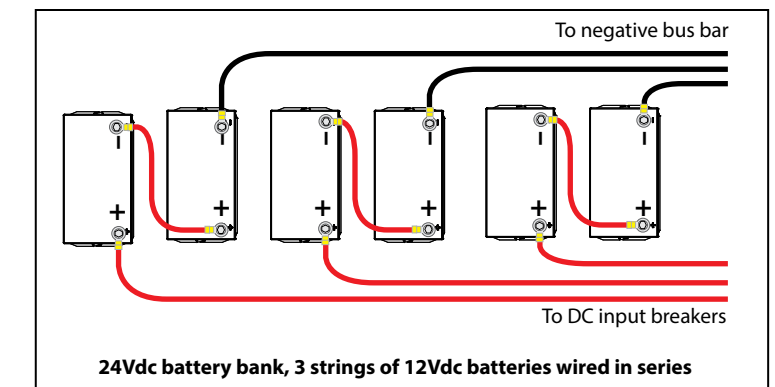
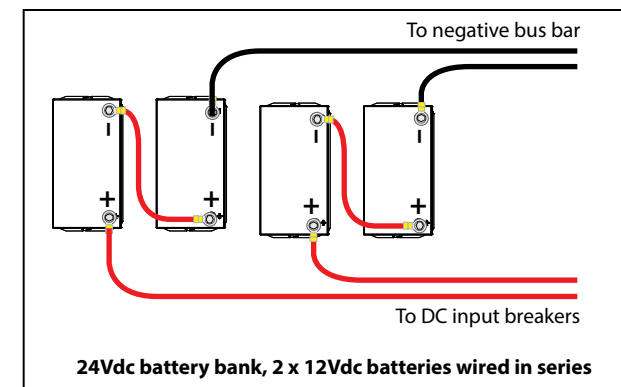
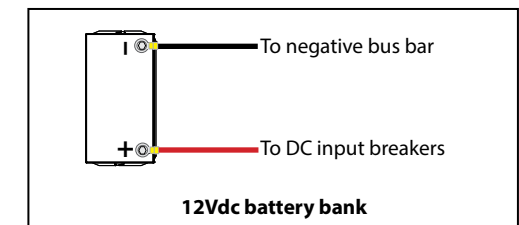
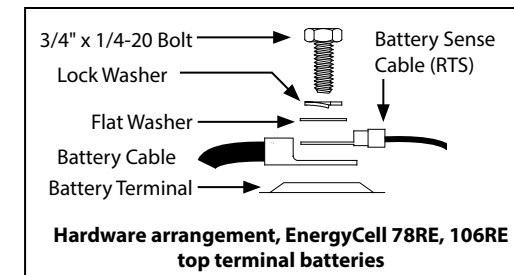
Battery String(s)

Battery positive(s) (+) are pre-wired to the DC bus via circuit breakers and battery negative(s) (-) are connected to the negative bus bar. Cables are terminated with ring lugs. Connect the cables to battery positive (+) and negative (-) terminals. The charge controllers can provide battery sense voltage as well as remote temperature sensing. Pair the battery sense wires with the longest leads in the battery cable kit and connect them to the same battery. Connect the remote temperature sensor (if used) to a point in the center of the highest battery string.

Required Tools

- 7/16" wrench for 1/4" hardware
- 9/16" wrench for 3/8" hardware
- Torque wrench
- Torque screwdriver
- Slotted screwdriver
- #2 Phillips screwdriver
- Pozidriv #2 Combi head
- Digital voltmeter (DVM)
- Work gloves
- Safety glasses
- Battery spill clean-up kit

Additional battery information is available in OutBack Power Technologies' *EnergyCell Battery Owner's Manual*.



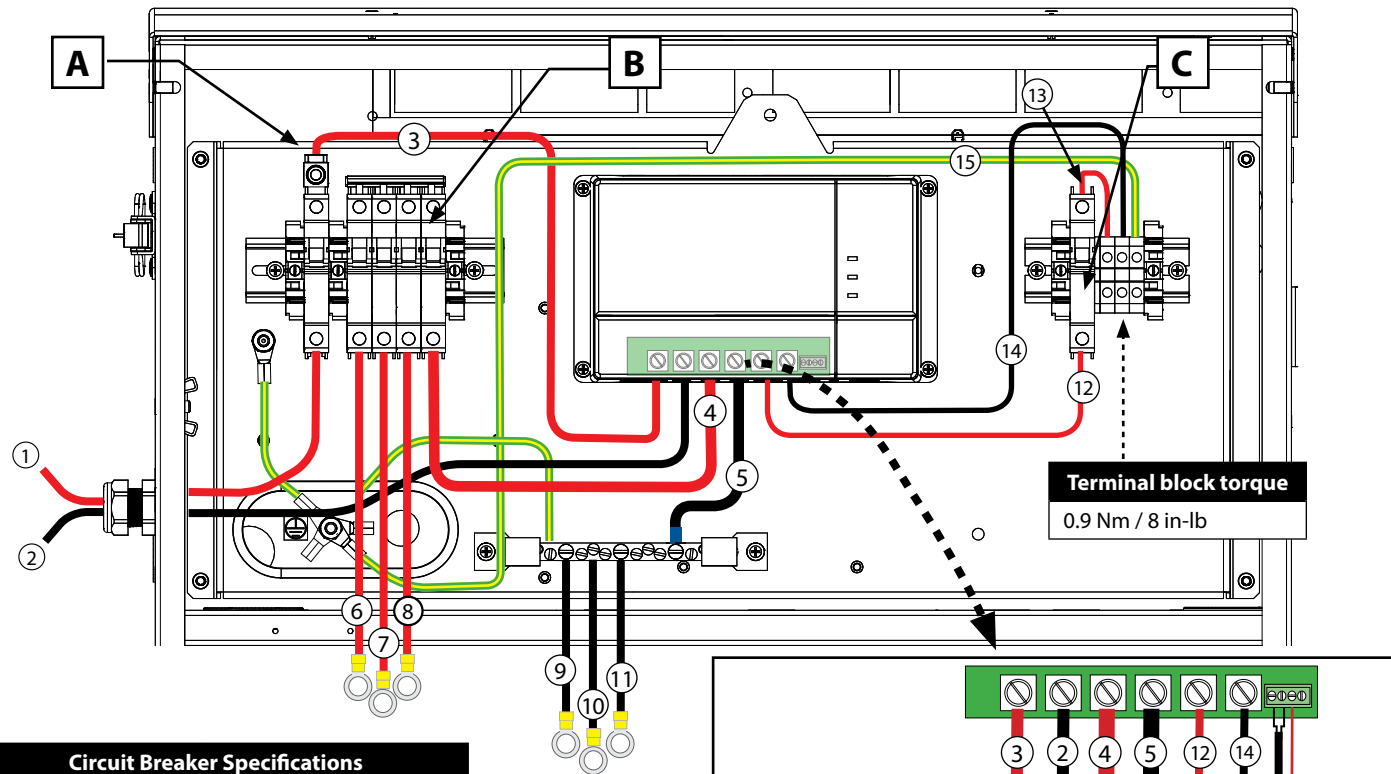
Wiring the System, SmartHarvest SCCM20-100 Charge Controller

The system is shipped with the bulk of the wiring connections already in place. Remove the fixing screw on the underside of the cover plate to expose the connection terminals and make connections as shown. Verify pre-existing wiring is still in place and tightened to proper torque settings. Replace the cover plate after inspecting the connections.



WARNING: Electrical Hazard

Only qualified personnel should install and wire the system or have access to the inside of the enclosure.



Circuit Breaker Specifications	
Wire Size mm ² (IEC)	0.75 to 35 mm ²
Wire Gauge (UL)	18 to 2 AWG
Torque (IEC)	2.5 Nm
Torque (UL)	20 in-lb
Comments	Pozidriv #2 Combi head

- A** PV module circuit breaker
- B** DC bus master breaker
- C** Load output circuit breaker

PV module connections

- ① PV module positive (+) to PV breaker
- ② PV module negative (-) to charge controller negative (-)

Charge Controller connections

- ③ PV module breaker to charge controller PV positive (+)
- ④ Battery positive (+) from charge controller to master DC circuit breaker
- ⑤ Battery negative (-) from charge controller to negative bus bar

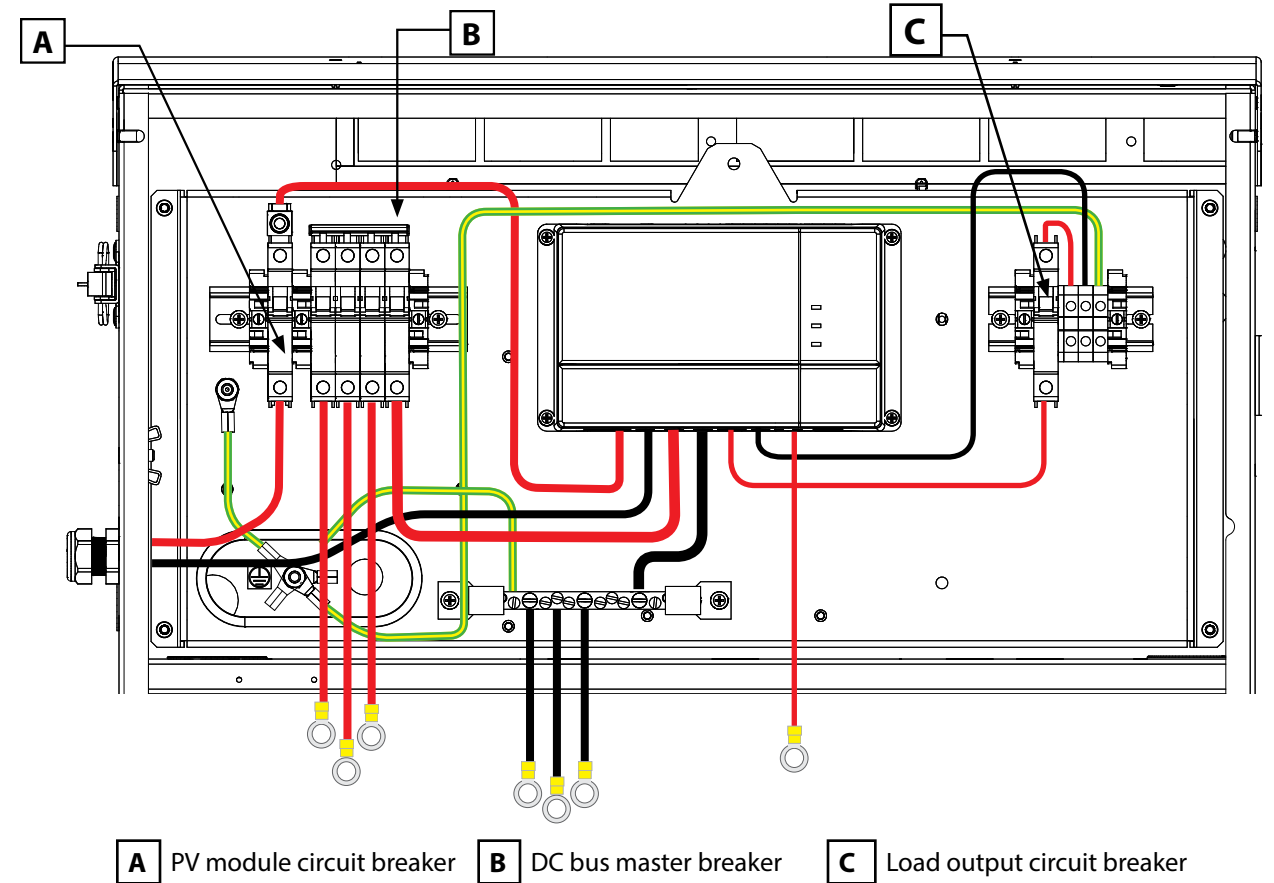
Battery string connections

- ⑥ String #1 positive (+)
- ⑦ String #2 positive (+)
- ⑧ String #3 positive (+)
- ⑨ String #1 negative (-)
- ⑩ String #2 negative (-)
- ⑪ String #3 negative (-)

Load connections

- ⑫ Charge controller DC (+) to load output circuit breaker
- ⑬ DC output voltage positive (+)
- ⑭ DC output voltage negative (-)
- ⑮ Ground connection

System Startup, SmartHarvest SCCM20-100 Charge Controller



- A** PV module circuit breaker
- B** DC bus master breaker
- C** Load output circuit breaker



CAUTION: Hazard to Equipment

Reversed polarity will damage the charge controller.



CAUTION: Hazard to Equipment

Failure to close the battery breakers before closing the PV breaker will damage the charge controller.

Before Startup:

- Verify the PV breaker is open.
- Verify the DC bus master breaker and any used battery string breakers are open.
- Verify the load breaker is open.

Startup Procedure

1. Close the connected battery string breaker(s).
2. Close the DC master breaker. The three LEDs on the front panel of the charge controller will flash once and go out.
3. Close the PV input breaker. The three LEDs on the front panel of the charge controller will flash once, then remain off. After approximately 20 seconds, the green LED will light and be on solid, indicating the presence of PV input. The yellow LED will blink indicating the state of charge of the battery string.
4. Measure across the Load positive (+) and Load negative (-) terminals on the charge controller. The voltage measured should match the battery string voltage.
5. Close the Load breaker and measure between the load terminal positive (+) and negative (-). The voltage measured should match the voltage measured at the charge controller.



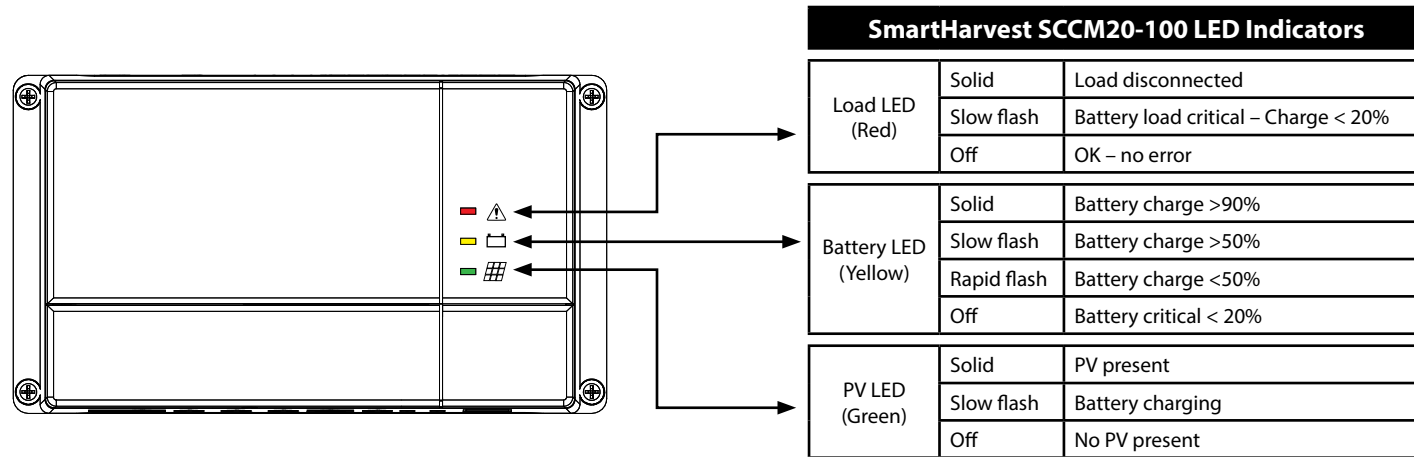
IMPORTANT:

The SCCM20-100 requires a minimum load to wake up from sleep mode. Refer to SCCM20-100 manual for details.

Indications/Alarms, SmartHarvest SCCM20-100 Charge Controller

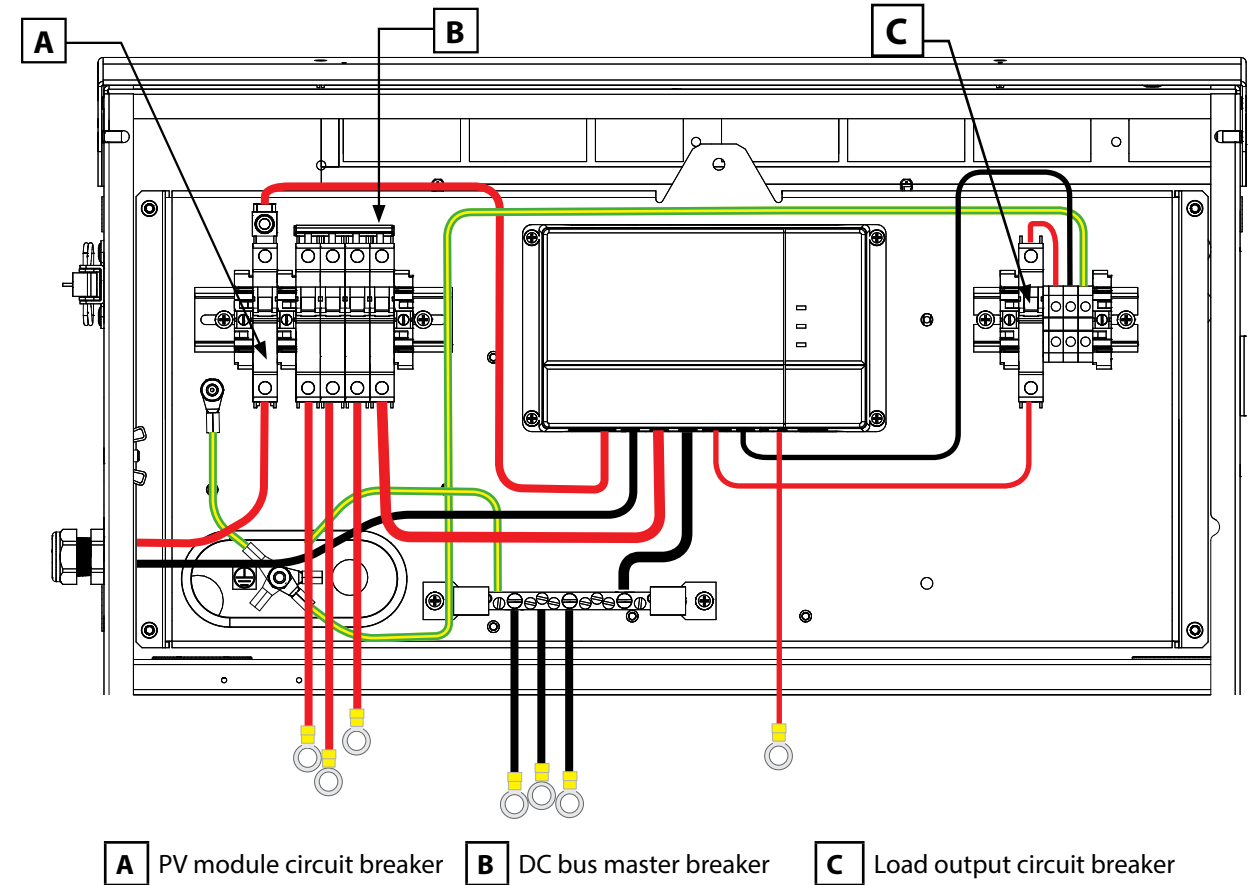
Charge Control / Load Control

LEDs on the SmartHarvest™ SCCM20-100 Charge Controller indicate battery state, operational status and alarm conditions as indicated in the table below.



Troubleshooting	
Problem	Possible remedies (perform in order shown)
Battery not charging	1) Check battery connections 2) Check PV voltage and connections 3) Check breakers. 4.) Allow charger to cool
No LED indicators with PV power available	1) Check battery voltage at controller terminals 2) Check panel voltage at controller terminals
Red LED on	1) Disconnect load 2) Disconnect PV 3) Disconnect battery 4) Reconnect battery 5) Reconnect PV 6) Reconnect load
Red LED flashing	1) Disconnect loads 2) Recharge battery
Yellow LED not on	Charge battery
Charging to wrong voltage	1) Check position of battery selection jumper 2) Check installation of thermistor
Load not powered	Check minimum load for charge controller

System Shutdown, SmartHarvest SCCM20-100 Charge Controller



	WARNING: Electrical Hazard Prior to beginning the shutdown procedure, cover the PV modules with opaque material to prevent the conversion of light energy into DC power.
	CAUTION: Hazard to Equipment Opening the battery breakers before opening the PV or load breaker will damage the charge controller.
	CAUTION: Hazard to Equipment The master battery breaker must be opened during periods of no solar input that extend beyond the rated 3 day blackout autonomy e.g. solar panel service, prolonged snow cover, debris build up on panel. Failure to either recharge the batteries or open the master battery breaker during an extended outage may result in permanent damage to the batteries.

1. Open the Load output breaker.
2. Open the PV input breaker.
3. Open the master DC circuit breaker.
4. Open any connected battery breakers.
5. Measure across the Load positive (+) and Load negative (-) terminals on the charge controller. Verify a reading of 0 Vdc, indicating the system is offline.

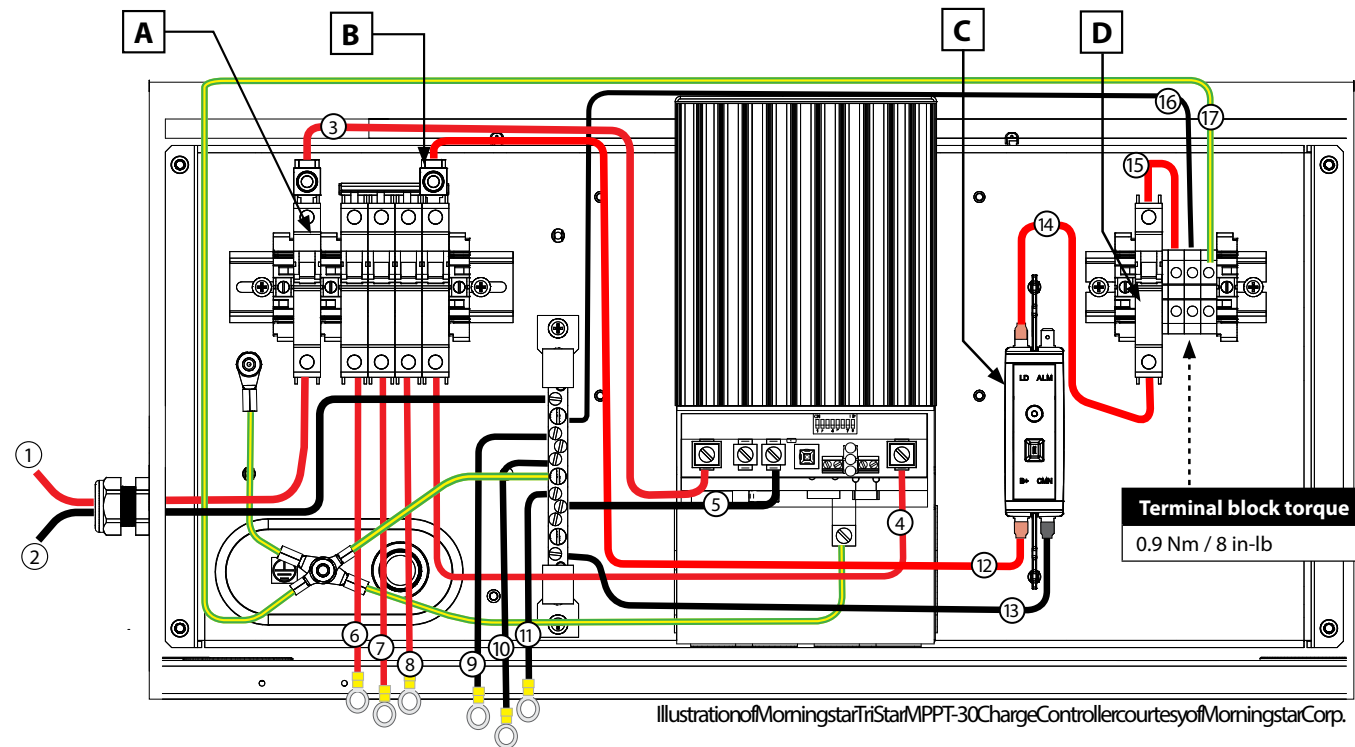
Wiring the System, Morningstar TriStar MPPT-30 Charge Controller

The system is shipped with the bulk of the wiring connections already in place. Use a #2 Phillips screwdriver to remove the four (4) screws that secure the wiring box cover. Verify the pre-existing wiring is still in place and tightened to proper torque settings. Replace the cover after inspecting the connections.



WARNING: Electrical hazard

Only qualified personnel should install and wire the system or have access to the inside of the enclosure.



- A** PV module breaker **B** DC bus breaker **C** Low voltage disconnect (LVD) **D** Load output breaker

Circuit Breaker Specifications	
Wire Size mm ² (IEC)	0.75 to 35 mm ²
Wire Gauge (UL)	18 to 2 AWG
Torque (IEC)	2.5 Nm
Torque (UL)	20 in-lb
Comments	Pozidriv #2 Combi head

PV module connections

- ① PV module positive (+)
- ② PV module negative (-)

Charge Controller connections

- ③ PV module positive (+) to charge controller PV positive (+)
- ④ Battery positive (+) from charge controller to DC bus master circuit breaker
- ⑤ Battery negative (-) from charge controller to negative bus bar

Battery string connections

- ⑥ String #1 positive (+)
- ⑦ String #2 positive (+)
- ⑧ String #3 positive (+)
- ⑨ String #1 negative (-)
- ⑩ String #2 negative (-)
- ⑪ String #3 negative (-)

Load connections

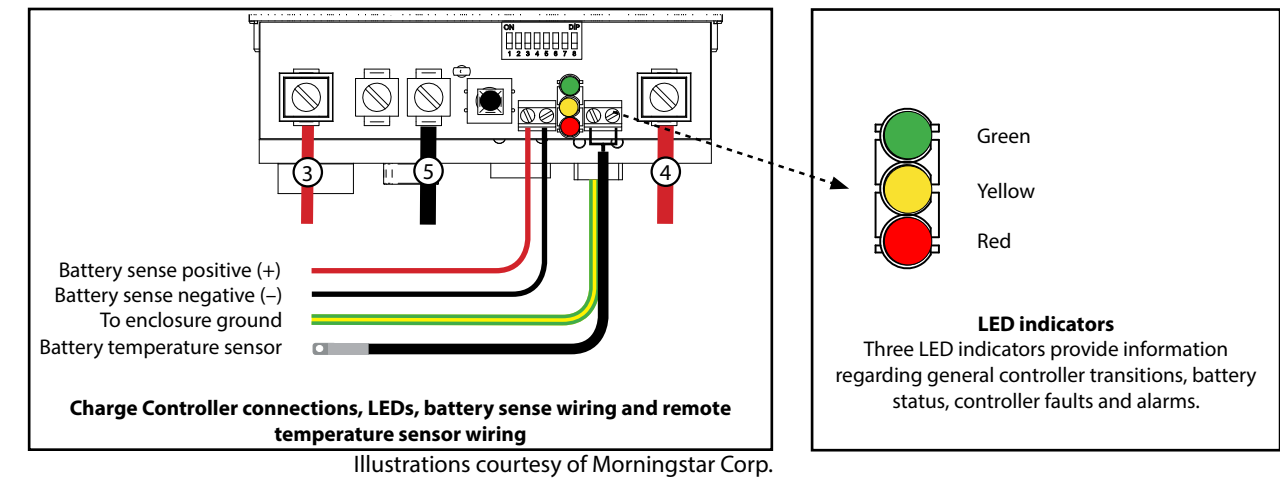
- ⑫ Battery bus to LVD positive (+)
- ⑬ LVD negative (-) to negative bus bar
- ⑭ LVD (Load) to Load output circuit breaker
- ⑮ DC output voltage positive (+)
- ⑯ DC output voltage negative (-)
- ⑰ Ground connection (-)

Terminal block wiring torque value = 0.9 Nm / 8 in-lb

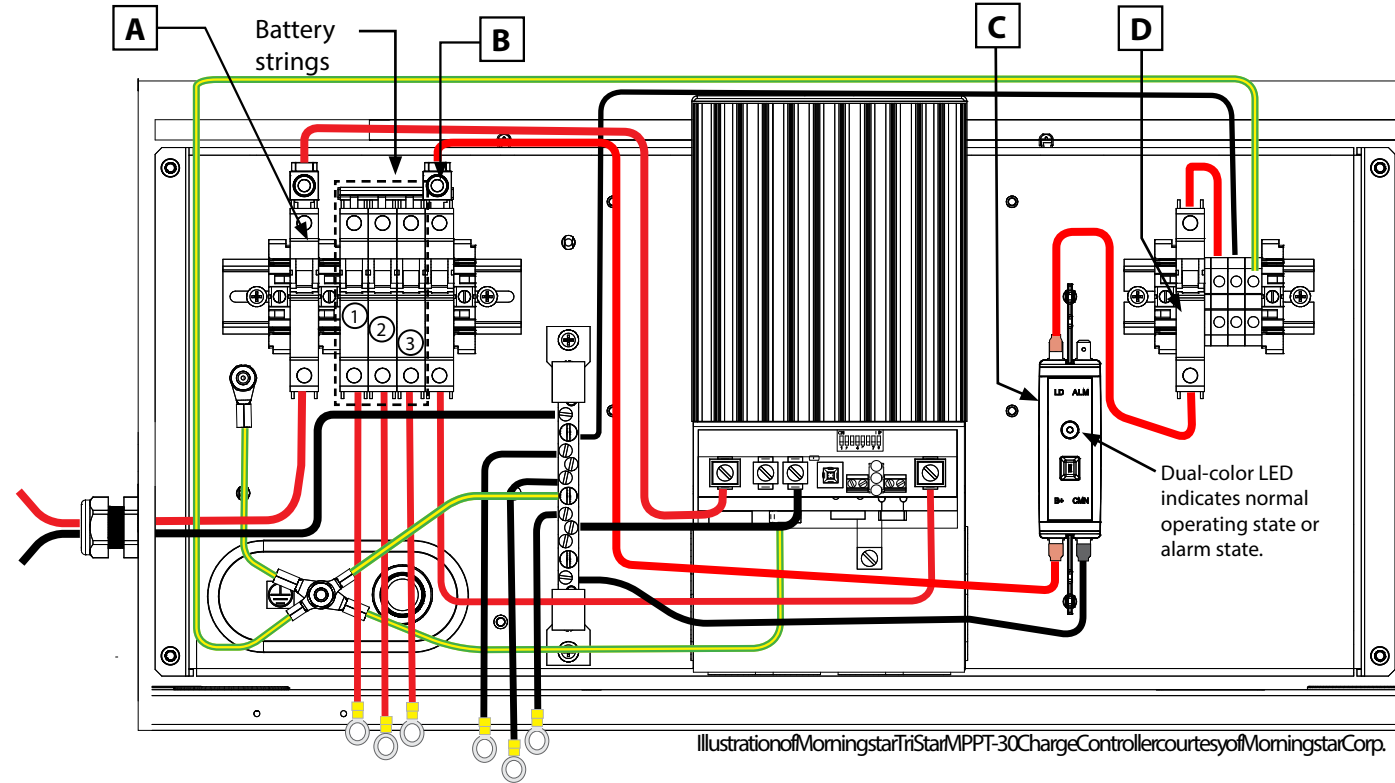
Wiring the System, Morningstar TriStar MPPT-30 Charge Controller

Connection detail, charge controller termination board

- ③ PV module positive (+) to the charge controller PV positive (+)
- ④ Battery positive (+) from the charge controller to the master DC circuit breaker
- ⑤ Battery negative (-) from the charge controller to the negative bus bar



System Startup, Morningstar TriStar MPPT-30 Charge Controller



A PV disconnect **B** Battery disconnect **C** Low voltage disconnect (LVD), Model PT10 **D** Load disconnect

CAUTION: Hazard to Equipment
Reversed polarity will damage the charge controller.

CAUTION: Hazard to Equipment
Failure to close the battery breakers before closing the PV breaker will damage the charge controller.

Before Startup:

- Verify the PV disconnect is open.
- Verify the Battery disconnect and any used battery string disconnect(s) are open.
- Verify the load disconnect is open.

Startup Procedure

1. Confirm the polarities of the PV module wiring and Battery string wiring are correct.
2. Close the connected battery string breakers (1 through 3).
3. Close the master battery disconnect. The LEDs on the charge controller will sequentially blink one cycle of Green-Yellow-Red, indicating a successful startup.

NOTE:
A battery must be connected to the TriStar MPPT to start and operate the controller. The controller will not operate only from solar input.

4. Close the PV disconnect. The color and activity of the LEDs will indicate the state of charge of the battery string.
5. Close the Load disconnect. The green LED on the Low Voltage Disconnect device will be on solid indicating battery voltage is within the disconnect (10.5 Vdc) and reconnect (12.5 Vdc) voltage limits as set by the factory.
6. Measure across the Load positive (+) and Load negative (-) on the charge controller to verify the battery voltage.

Indications/Alarms, Morningstar TriStar MPPT-30 Charge Controller with PT-10 Low Voltage Disconnect

Charge Control / Load Control

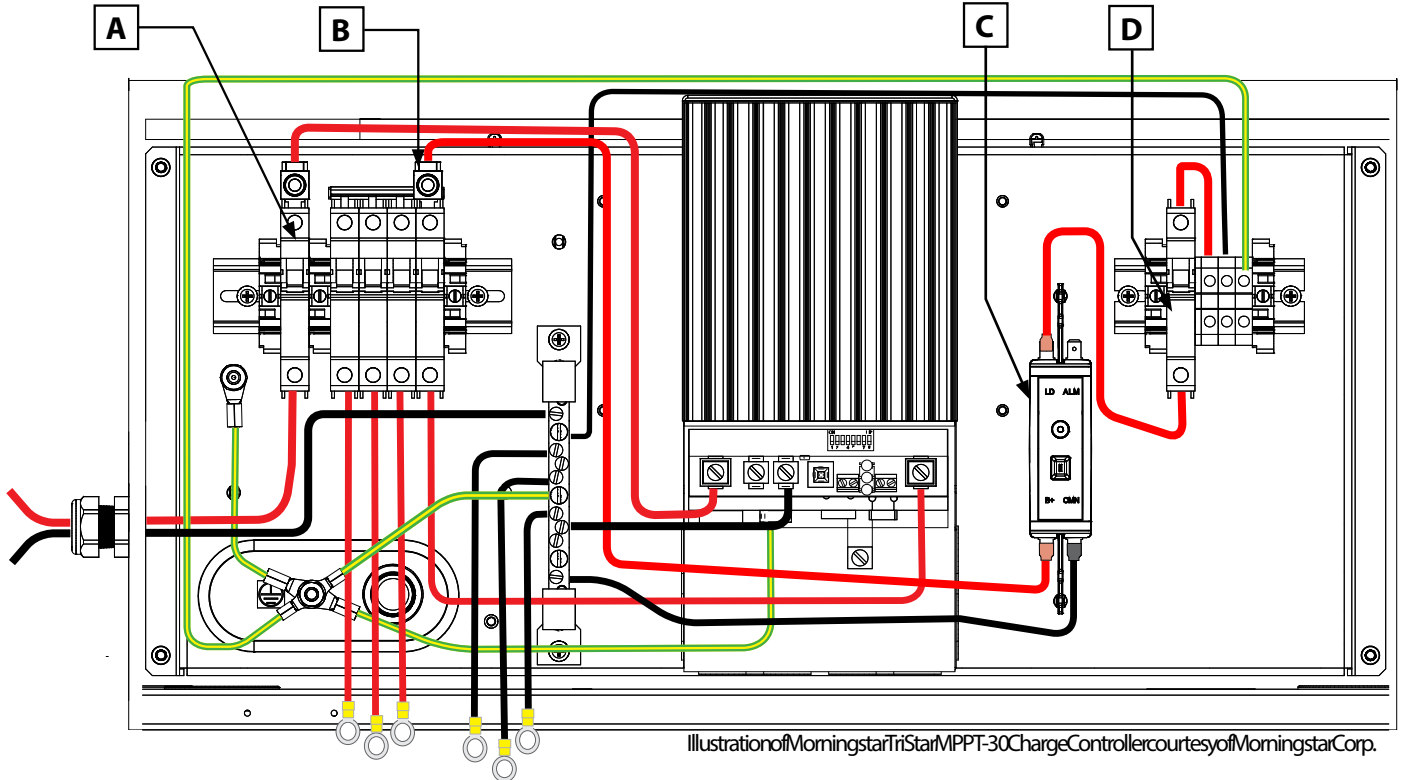
LEDs on the Morningstar TriStar MPPT-30 Charge Controller indicate battery state, operational status and alarm conditions as listed in the table below. Detailed information regarding alarm states can be found in the *TriStar MPPT-30 Solar System Controller*, technical manual (p/n MS-000946 v05.1)

TriStar TS-MPPT-30 LED Indicators	
General Transitions	LED Indications
Controller start-up	Green / Yellow / Red (one cycle)
Equalize request start	Green + Yellow + Red / Green + Yellow + Red / Green / Green
Equalize cancelled	Green + Yellow + Red / Green + Yellow + Red / Red / Red
Battery service is required*	All 3 LEDs blinking until service is reset
*Battery service notification is only enabled in custom settings	
Battery Status (General State of Charge)	LED Indications
80% to 95%	Green
60% to 80%	Green + Yellow
35% to 60%	Yellow
0% to 35%	Yellow + Red
Battery is discharging	Red
Absorption state	Green blinking (½ second on / ½ second off)
Equalization state	Green fast blink (2.5 times per second)
Float state	Green slow blink (1 second on / 1 second off)
Faults & Alarms	LED sequence; repeating until the fault is cleared
Over-temperature	Yellow / Red (sequencing)
Battery high voltage disconnect	Green / Red (sequencing)
DIP switch fault or DIP switch changed	Red / Yellow / Green (sequencing)
Self-test faults	Red / Yellow / Green (sequencing)
Custom settings edit	Red / Green / Yellow (sequencing)
Remote Temperature Sensor (RTS)	Green + Yellow / Yellow + Red (sequencing)
Battery voltage sense failure	Green + Yellow / Yellow + Red

The dual-color LED on the PT-10 Low Voltage Disconnect indicates whether the unit is in normal operation or in an alarm state as indicated in the table below.

Low Voltage Disconnect (Model PT10)			
Event	Result	Indication	Action
Normal operation	Low voltage disconnect is closed; voltage supplied to load	Green LED is on solid	None required
Battery voltage decreases to disconnect level (10.5Vdc)	Low voltage disconnect opens and removes load from batteries.	Red (Alarm) LED is on solid.	Recharge batteries.
Battery voltage increases to reconnect level (12.5Vdc)	Low voltage disconnect closes and reconnects load to batteries.	Alarm LED switches from Red to Green; LED is on solid	Load reconnected; No action required.

System Shutdown, Morningstar TriStar MPPT-30 Charge Controller



A PV module breaker **B** DC bus breaker **C** Low voltage disconnect (LVD) **D** Load output breaker



WARNING: Electrical Hazard

Prior to beginning the shutdown procedure, cover the PV modules with opaque material to prevent the conversion of light energy into DC power.



CAUTION: Hazard to Equipment

Opening the battery breakers before opening the PV or load breaker will damage the charge controller.



CAUTION: Hazard to Equipment

The master battery breaker must be opened during periods of no solar input that extend beyond the rated 3 day blackout autonomy e.g. solar panel service, prolonged snow cover, debris build up on panel. Failure to either recharge the batteries or open the master battery breaker during an extended outage may result in permanent damage to the batteries.

1. Open the load output circuit breaker (the Green LED on the LVD will remain on).
2. Open the PV module circuit breaker.
3. Open the DC bus master circuit breaker (the Green LED on the LVD will turn off at this time).
4. Open any connected battery breakers.
5. Measure across the Load positive (+) and Load negative (-) on the charge controller. Verify a reading of 0 Vdc, indicating the system is offline.