

ProStar MPPT™

Solar Charging System Controller

Installation, Operation and Maintenance Manual

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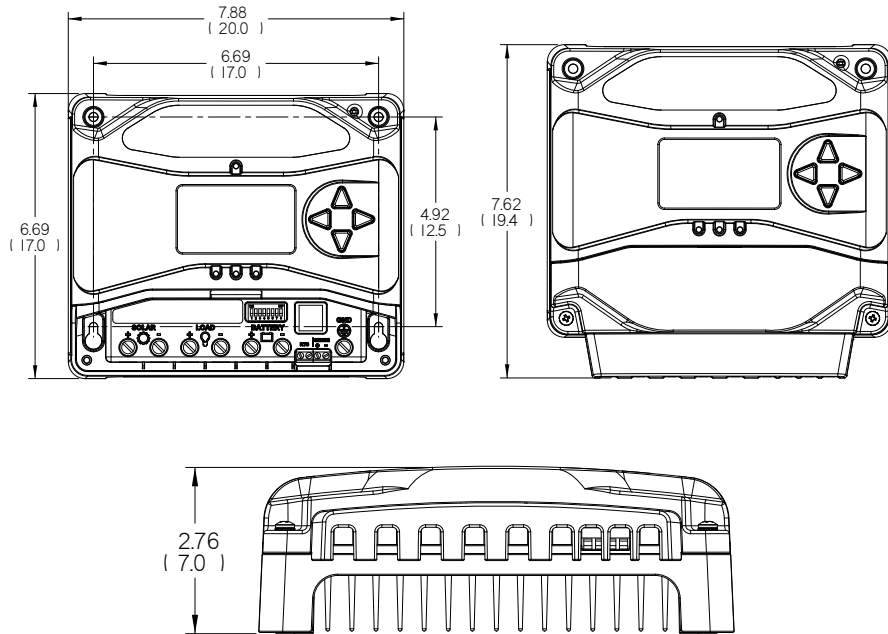
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MODELS

PS-MPPT-25
PS-MPPT-25M
PS-MPPT-40
PS-MPPT-40M



DIMENSIONS [inches (centimeters)]



SPECIFICATION SUMMARY

	PS-MPPT-25	PS-MPPT-40
Nominal Battery Voltage	12/24V	12/24V
Max. PV Open-Circuit Voltage*	120V	120V
Nominal Max. Input Power**	350 / 700W	560 / 1120W
Max. Battery Charging Current	25A	40A
Rated Load Current	25A	30A

*Array voltage should never exceed this limit

**These power levels refer to the maximum wattage the PS-MPPT can process. Higher power arrays can be used without damaging the controller.

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1.0 IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS.

This manual contains important safety, installation, operating and maintenance instructions for the ProStar MPPT solar controller.

The following symbols are used throughout this manual to indicate potentially dangerous conditions or mark important safety instructions:



WARNING: Indicates a potentially dangerous condition. Use extreme caution when performing this task.



CAUTION: Indicates a critical procedure for safe and proper operation of the controller.



NOTE: Indicates a procedure or function that is important to the safe and proper operation of the controller.

CONSIGNES IMPORTANTES DE SÉCURITÉ CONSERVEZ CES INSTRUCTIONS:

Ce manuel contient des instructions importantes de sécurité, d'installations et d'utilisation du contrôleur solaire ProStar MPPT.

Les symboles suivants sont utilisés dans ce manuel pour indiquer des conditions potentiellement dangereuses ou des consignes importantes de sécurité.



AVERTISSEMENT: Indique une condition potentiellement dangereuse. Faites preuve d'une prudence extrême lors de la réalisation de cette tâche.



PRUDENCE: Indique une procédure critique pour l'utilisation sûre et correcte du contrôleur.



REMARQUE: Indique une procédure ou fonction importante pour l'utilisation sûre et correcte du contrôleur.

Safety Information

- Read all of the instructions and cautions in the manual before beginning installation.
- There are no user serviceable parts inside the ProStar MPPT. Do not disassemble or attempt to repair the controller.



WARNING: Risk Of Electrical Shock.

NO POWER OR ACCESSORY TERMINALS ARE ELECTRICALLY ISOLATED FROM DC INPUT, AND MAY BE ENERGIZED WITH HAZARDOUS SOLAR VOLTAGE. UNDER CERTAIN FAULT CONDITIONS, BATTERY COULD BECOME OVER-CHARGED. TEST BETWEEN ALL TERMINALS AND GROUND BEFORE TOUCHING.



WARNING: THE COMMUNICATIONS PORT IS CONSIDERED TO BE DVC B. AN EXTERNAL ISOLATOR IS REQUIRED IF IT IS TO BE CONNECTED TO A DVC A CIRCUIT.

- External solar and battery disconnects are required.
- Disconnect all sources of power to the controller before installing or adjusting the ProStar MPPT.
- There are no fuses or disconnects inside the ProStar MPPT. Do not attempt to repair.

Informations de Sécurité

- Lisez toutes les instructions et les avertissements figurant dans le manuel avant de commencer l'installation.
- Le ProStar MPPT ne contient aucune pièce réparable par l'utilisateur. Ne démontez pas ni ne tentez de réparer le contrôleur.



AVERTISSEMENT: Risque De Choc Électrique. NON ALIMENTATION OU AUX BORNES D'ACCESSOIRES SONT ISOLÉS ÉLECTRIQUEMENT DE L'ENTRÉE DE C.C ET DOIT ÊTRE ALIMENTÉS À UNE TENSION DANGEREUSE SOLAIRE. SOUS CERTAINES CONDITIONS DE DÉFAILLANCE, LA BATTERIE POURRAIT DEVENIR TROP CHARGÉE. TEST ENTRE TOUTES LES BORNES ET LA MASSE AVANT DE TOUCHER.



AVERTISSEMENT: LE PORT DE COMMUNICATION EST CONSIDÉRÉE COMME DVC B. UN ISOLATEUR EXTERNE N'EST NÉCESSAIRE SI C'EST D'ÊTRE CONNECTÉ À UN DVC UN CIRCUIT.

- External solaire et la batterie se déconnecte sont nécessaires.
- Déconnectez toutes les sources d'alimentation du contrôleur avant d'installer ou de régler le ProStar MPPT.
- Le ProStar MPPT ne contient aucun fusible ou interrupteur. Ne tentez pas de réparer.
- Installez des fusibles/coupe-circuits externes selon le besoin.

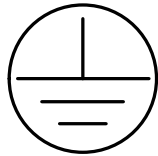
Installation Safety Precautions



WARNING: This unit is not provided with a GFDI device. This charge controller must be used with an external GFDI device as required by the Article 690 of the National Electrical Code for the installation location.

- Mount the ProStar MPPT indoors. Prevent exposure to the elements and do not allow water to enter the controller.
- Install the ProStar MPPT in a location that prevents casual contact. The ProStar MPPT heatsink can become very hot during operation.
- Use insulated tools when working with batteries.
- Avoid wearing jewelry during installation.

- The battery bank must be comprised of batteries of same type, make, and age.
- UL/IEC 62109 certified for use in negative ground or floating systems only.
- Do not smoke near the battery bank.
- Power connections must remain tight to avoid excessive heating from a loose connection.
- Use properly sized conductors and circuit interrupters.
- The grounding terminal is located in the case, and is identified by the symbol below:



Ground Symbol

- This charge controller is to be connected to DC circuits only. These DC connections are identified by the symbol below:



Direct Current Symbol

The ProStar MPPT controller must be installed by a qualified technician in accordance with the electrical regulations of the country of installation.

A means of disconnecting all power supply poles must be provided. These disconnects must be incorporated in the fixed wiring.

The ProStar MPPT negative power terminals are common, and must be grounded as instructions, local codes, and regulations require.

A permanent, reliable earth ground must be established with connection to the ProStar MPPT ground terminal.

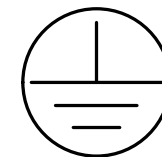
The grounding conductor must be secured against any accidental detachment.

Précautions de Sécurité D'installation



AVERTISSEMENT: *L'appareil n'est pas fourni avec un dispositif GFDI. Ce contrôleur de charge doit être utilisé avec un dispositif GFDI externe tel que requis par l'Article 690 du Code électrique national de l'emplacement de l'installation.*

- Montez le ProStar MPPT à l'intérieur. Empêchez l'exposition aux éléments et la pénétration d'eau dans le contrôleur.
- Installez le MPPT ProStar dans un endroit qui empêche le contact occasionnel. Le dissipateur de chaleur ProStar MPPT peut devenir très chaud pendant le fonctionnement.
- Utilisez des outils isolés pour travailler avec les batteries.
- Évitez le port de bijoux pendant l'installation.
- Le groupe de batteries doit être constitué de batteries du même type, fabricant et âge.
- UL/IEC 62109 certifié pour utilisation au négatif à la masse ou les systèmes flottants seulement.
- Ne fumez pas à proximité du groupe de batteries.
- Les connexions d'alimentation doivent rester serrées pour éviter une surchauffe excessive d'une connexion desserrée.
- Utilisez des conducteurs et des coupe-circuits de dimensions adaptées.
- La borne de mise à la terre se trouve dans l'affaire et est identifié par le symbole ci-dessous :



- Ce contrôleur de charge ne doit être connecté qu'à des circuits en courant continu. Ces connexions CC sont identifiées par le symbole ci-dessous:



Le régulateur MPPT ProStar doit être installé par un technicien qualifié conformément aux règlements du pays d'installation électriques.

Un moyen de déconnexion de tous les poteaux d'alimentation doit être fourni. Ceux-ci se déconnecte doit être intégrée dans le câblage fixe.

Une mise à la terre permanent et fiable s'impose avec raccordement à la borne ProStar MPPT.

Les bornes de puissance négative ProStar MPPT sont communs et doivent être mise à la terre comme les directives, les codes locaux, et les règlements exigent.

Le conducteur de terre doit être protégée contre tout détachement accidentel.

Battery Safety



WARNING: A battery can present a risk of electrical shock or burn from large amounts of short-circuit current, fire, or explosion from vented gases. Observe proper precautions.



AVERTISSEMENT: Une batterie peut présenter a risque de choc électrique ou de brûlure de grandes quantités de court-circuit curlouer, incendie ou explosion de ventilé gaz. Observer précautions appropriées.



WARNING: Risk of Explosion.

Proper disposal of batteries is required. Do not dispose of batteries in fire. Refer to local regulations or codes for requirements.



AVERTISSEMENT: Risque d'Explosion.

Au rebut des piles est nécessaire. Ne pas jeter les piles dans le feu. Se référer aux réglementations locales ou des codes pour les exigences.



CAUTION: When replacing batteries, use properly specified number, sizes, types, and ratings based on application and system design.



PRUDENCE: Lorsque le remplacement des piles, utilisez correctement nombre spécifié, tailles, types et les évaluations basées sur conception de système et d'application.



CAUTION: Do not open or mutilate batteries.

Released electrolyte is harmful to skin, and may be toxic.



PRUDENCE: Ne pas ouvrir ou mutiler les piles.

L'électrolyte est nocif pour la peau et peut être toxique.

- Servicing of batteries should be performed, or supervised, by personnel knowledgeable about batteries, and the proper safety precautions.
- Be very careful when working with large lead-acid batteries. Wear eye protection and have fresh water available in case there is contact with the battery acid.
- Remove watches, rings, jewelry and other metal objects before working with batteries.
- Wear rubber gloves and boots
- Use tools with insulated handles and avoid placing tools or metal objects on top of batteries.
- Disconnect charging source prior to connecting or disconnecting battery terminals.

- Determine if battery is inadvertently grounded. If so, remove the source of contact with ground. Contact with any part of a grounded battery can result in electrical shock. The likelihood of such a shock can be reduced if battery grounds are removed during installation and maintenance (applicable to equipment and remote battery supplies not having a grounded supply circuit).
 - Carefully read the battery manufacturer's instructions before installing / connecting to, or removing batteries from, the ProStar MPPT.
 - Be very careful not to short circuit the cables connected to the battery.
 - Have someone nearby to assist in case of an accident.
 - Explosive battery gases can be present during charging. Be certain there is enough ventilation to release the gases.
 - Never smoke in the battery area.
 - If battery acid comes into contact with the skin, wash with soap and water. If the acid contacts the eye, flood with fresh water and get medical attention.
 - Be sure the battery electrolyte level is correct before starting charging. Do not attempt to charge a frozen battery.
 - Recycle the battery when it is replaced.
-
- Entretien des batteries devrait être effectué ou supervisé, par un personnel bien informé sur les piles et les précautions de sécurité appropriées.
 - Soyez très prudent quand vous travaillez avec des grandes batteries au plomb. Portez des lunettes de protection et ayez de l'eau fraîche à disposition en cas de contact avec l'électrolyte.
 - Enlevez les montres, bagues, bijoux et autres objets métalliques avant de travailler avec des piles.
 - Porter des bottes et des gants de caoutchouc
 - Utiliser des outils avec poignées isolantes et évitez de placer des outils ou des objets métalliques sur le dessus de batteries.

- Débrancher la source de charge avant de brancher ou dis-reliant les bornes de la batterie.
- Utilisez des outils isolés et évitez de placer des objets métalliques dans la zone de travail.
- Déterminer si batterie repose par inadvertance. Dans l'affirmative, supprimer la source du contact avec le sol. Contact avec n'importe quelle partie d'une batterie mise à la terre peut entraîner un choc électrique. La probabilité d'un tel choc peut être réduite si des motifs de batterie sont supprimés pendant l'installation et maintentretien (applicable à l'équipement et les fournitures de pile de la télécommande n'ayant ne pas un circuit d'alimentation mise à la terre).
- Lisez attentivement les instructions du fabricant de la batterie avant d'installer / connexion à ou retrait des batteries du ProStar MPPT.
- Veillez à ne pas court-circuiter les câbles connectés à la batterie.
- Ayez une personne à proximité qui puisse aider en cas d'accident.
- Des gaz explosifs de batterie peuvent être présents pendant la charge. Assurez-vous qu'une ventilation suffisante évacue les gaz.
- Ne fumez jamais dans la zone des batteries
- En cas de contact de l'électrolyte avec la peau, lavez avec du savon et de l'eau. En cas de contact de l'électrolyte avec les yeux, rincez abondamment avec de l'eau fraîche et consultez un médecin.
- Assurez-vous que le niveau d'électrolyte de la batterie est correct avant de commencer la charge. Ne tentez pas de charger une batterie gelée.
- Recyclez la batterie quand elle est remplacée.

2.1 Overview

Thank you for choosing the ProStar MPPT charge controller with TrakStar™ MPPT Technology. The ProStar MPPT is an advanced maximum power point tracking solar battery charger. The controller features a smart tracking algorithm that finds and maintains operation at the power source's peak power point, maximizing energy harvest.

The ProStar MPPT battery charging process has been optimized for long battery life and improved system performance. Self-diagnostics and electronic error protections prevent damage when installation mistakes or system faults occur. The controller also features eight (8) adjustable settings switches, several communication ports, and terminals for remote battery temperature and voltage measurement.

Please take the time to read this operator's manual to become familiar the many benefits the ProStar MPPT can provide for your PV systems, for example:

- Rated for 12 or 24 volt systems, and 25 or 40 amps of charging current
- Fully protected with automatic and manual recovery
- Seven standard charging programs selectable with DIP switches
- Continuous self-testing with fault notification
- LED indications and push-button or meter key functions
- Terminals sized for #2 AWG (35mm²) wire - compliant when used with the optional Morningstar Wire Box, otherwise a maximum of #6 AWG wire.
- Includes battery voltage sense terminals
- Digital meter display options
- Optional remote battery temperature sensor
- 5-year warranty (see Section 6.0)

2.2 Regulatory Information



NOTE: This section contains important information for safety and regulatory requirements.

FCC requirements:

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and,
- (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by Morningstar for compliance could void the user's authority to operate the equipment.



NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to try to correct the interference by one or more of the following measures:

- Re-orient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer, or an experienced radio/TV technician for help.

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

2.3 Versions and Ratings

PS-MPPT-25

- Rated for maximum 25 amps continuous current (battery or load)
- Designed for 12 or 24 VDC systems

PS-MPPT-25M

- Includes metering display
- Rated for maximum 25 amps continuous current (battery or load)
- Designed for 12 or 24 VDC systems

PS-MPPT-40

- Rated for maximum 40 amps of continuous battery current, and 30 amps of continuous load current
- Designed for 12 or 24 VDC systems

PS-MPPT-40M

- Includes metering display
- Rated for maximum 40 amps continuous battery current and 30 amps of continuous load current
- Designed for 12 or 24 VDC systems

2.4 Features

The features of the ProStar MPPT are shown in Figure 2-1 below. An explanation of each feature is provided.

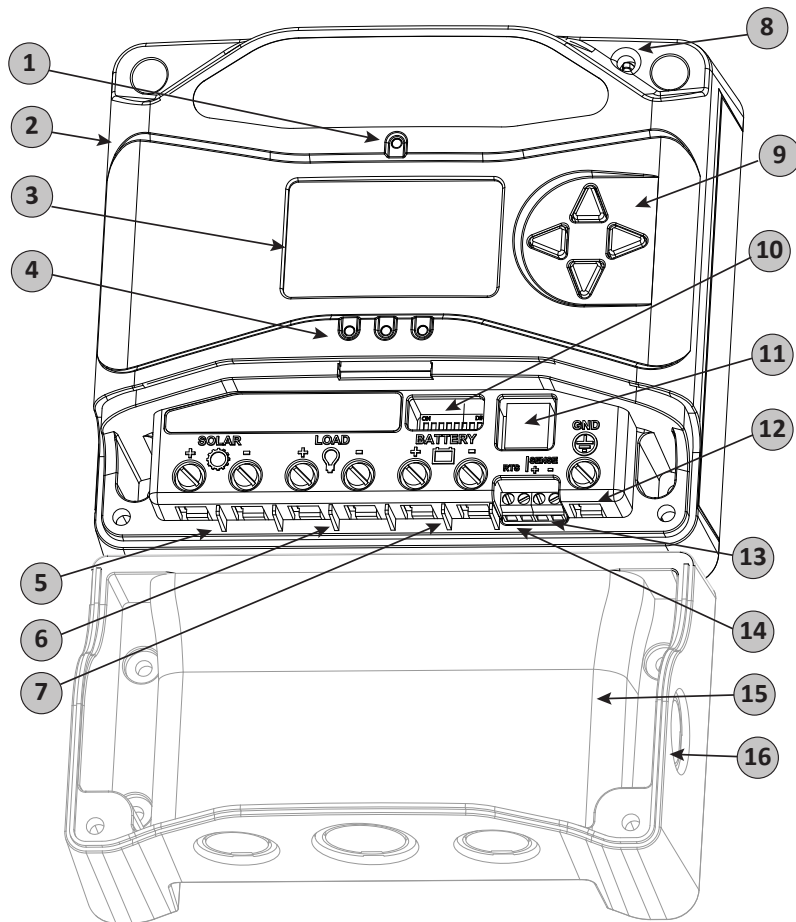


Figure 2-1. PS-MPPT Features

1 - Charging Status / Error LED

Shows charging current and error condition statuses.

2 - Heatsink

Aluminum heatsink (underneath) to dissipate controller heat (the ProStar MPPT is 100% passively cooled for reliability)

3 - Meter Display

Digital LCD monitoring and programming display

4 - Battery Status / Fault LED Indicators

Three state of charge (SOC) LED indicators show charging status and controller faults

5 - Solar Positive and Negative Terminals

Power connections for Solar (+) and (-) cable terminations

6 - Load Positive and Negative Terminals

Power connections for Load (+) and (-) cable terminations

7 - Battery Positive and Negative Terminals

Power connections for Battery (+) and (-) cable terminations

8 - Local Temperature Sensor

Compensates charging based on ambient temperature (not used if Remote Temperature Sensor is connected)

9 - Meter Directional Buttons

Used to navigate throughout meter map

10 - DIP Switches

Eight (8) settings switches to configure operation of the ProStar MPPT

11 - MeterBus™ Port

RJ-11 socket for Morningstar MeterBus™ network connections

12 - Grounding Terminal

Chassis ground terminal for equipment grounding

13 - Battery Sense Terminals

Connection points for battery voltage sensing wires

14 - Remote Temperature Sensor Terminals (RTS)

Connection points for a Morningstar RTS to remotely monitor battery temperature

15 - Wire Box for ProStar-MPPT

Optional accessory to route wiring through knock-outs

16 - Wire Box for ProStar-MPPT Knock-outs

Knock-outs for routing wires to conduit or wire gland terminations

2.5 Optional Accessories

The following accessories are available for purchase separately from your authorized Morningstar dealer:

Remote Temperature Sensor (Model: RTS)

The RTS measures battery temperature for accurate temperature compensation and is recommended when the ambient battery temperature differs from the ambient controller temperature by more than 5° C. The standard cable length is 33 ft (10m).



NOTE: *The use of a Remote Temperature Sensor is strongly recommended. Controller location, air flow, and system power can drastically affect the local temperature sensor reading. An RTS will provide optimal charging performance.*

RM-1 Meter

The digital Remote Meter displays system operating information, error indications, and self-diagnostic read-out. Information is displayed on a backlit 4-digit custom LCD display. The large numerical display and icons are easy to read and large buttons make navigating the meter menus easy. Additionally, a status LED and three (3) battery SOC LEDs provide system status at a glance.

The meter can be flush mounted in a wall or surface mounted using the mounting frame (included). The RM-1 is supplied with 33 ft (10.0 m) of cable, a mounting frame, and mounting screws. The RM-1 connects to the RJ-11 Meter port on the ProStar MPPT.

RelayDriver (RD-1)

The Relay Driver™ accessory enables the ProStar MPPT to control external devices. Four (4) relay control ports can be configured (in various combinations) to perform the following tasks:

- generator control (2, 3, and 4-wire configurations)
- dry contacts for alarms and other signals

- advanced load control
- vent fan control
- DIN rail compatible or surface mount

Ground-fault Protection Device (GFPD-150V)

The GFPD-150V detects power source ground faults and interrupts current as required by the U.S. National Electrical Code.

Wire Box for ProStar MPPT

A modular wiring box that can be added to any version of ProStar MPPT controller. The box acts as a junction (using knock-outs) to run controller wiring to external conduit, if desired. The wire box cannot be used with rigid conduit. The communications accessories / adaptors below should be housed in the Wire Box for ProStar MPPT.

Communications Support:

Ethernet MeterBus Converter (EMC-1)

This product is an Ethernet gateway that provides web monitoring services, a Modbus TCP/IP server, and a local web page server. End users can collect information about their off-grid PV system remotely. The EMC-1 supports all products that have a MeterBus port by bridging MODBUS TCP/IP requests to serve LiveView pages for each product.

USB Communications Adapter (UMC-1)

A modular unit that uses a USB-B plug, usually from a USB A-B computer cable, and an RJ-11 plug to connect with a Morningstar controller's MeterBus port, for monitoring and programming using MSView PC software.

PC MeterBus Adapter™ (Model: MSC)

The MSC converts the MeterBus RJ-11 electrical interface to an isolated standard RS-232 interface which enables communication between the ProStar MPPT and a personal computer (PC). The MSC can be used for programming custom charging set-points, and for logging data in MSView. See Section 4.7 for more information on programming.

3.0 INSTALLATION INSTRUCTIONS

3.1 General Installation Notes

- Read through the entire installation section first before beginning installation.
- Be very careful when working with batteries. Wear eye protection. Have fresh water available to wash and clean any contact with battery acid.
- Use insulated tools and avoid placing metal objects near the batteries.



WARNING: Equipment Damage or Risk of Explosion

Never install the ProStar MPPT in an enclosure with vented/flooded batteries. Battery fumes are flammable and will corrode and destroy the ProStar MPPT circuits.



CAUTION: Equipment Damage

When installing the ProStar MPPT in an enclosure, ensure sufficient ventilation. Installation in a sealed enclosure will lead to over-heating and a decreased product lifetime.



AVERTISSEMENT: Endommagement de l'équipement ou risque d'explosion

N'installez jamais le ProStar MPPT dans une enceinte avec des batteries à évent/à électrolyte liquide. Les vapeurs des batteries sont inflammables et corroderont et détruiront les circuits du ProStar MPPT.



PRUDENCE: Endommagement de l'équipement

Assurez une ventilation suffisante en cas d'installation du ProStar MPPT9 dans une enceinte. L'installation dans une enceinte hermétique entraîne une surchauffe et une réduction de la durée de vie du produit.

- Do not install in locations where water can enter the controller.
- Loose power connections and /or corroded wires may result in resistive connections that melt wire insulation, burn surrounding materials, or even cause fire. Ensure tight connections and use cable clamps to secure cables and prevent them from swaying in mobile applications.
- Preset charging profiles are generally designed for lead acid batteries. Custom settings can be used for varied charging requirements (see sections 3.2 and 4.7 for details). Note that some battery types may not be compatible.
- The ProStar MPPT battery connection may be wired to one battery, or a bank of batteries. The following instructions refer to a singular battery, but it is implied that the battery connection can be made to either one battery or a group of batteries in a battery bank.
- The ProStar MPPT uses stainless steel fasteners, an anodized aluminum heat sink, and conformal coating to protect it from harsh conditions. However, for acceptable service life, extreme temperatures and marine environments should be avoided.
- The ProStar MPPT prevents reverse current leakage at night, so a blocking diode is not required in the system.
- The ProStar MPPT is designed to regulate ONLY solar (photovoltaic) power. Connection to any other type of power source e.g. wind turbine or generator may void the warranty. However, other power sources can be connected directly to the battery.
- With the standard terminal cover, the maximum wire size is #6 AWG / 16 mm² (solid/multi-strand) or #8 AWG / 10 mm² (fine strand). When using the Wire Box accessory, the maximum wire size is #2 AWG. Use a flathead insulated screwdriver, and torque tightly up to 35 in-lb.

- Stranded wires to be connected to the ProStar MPPT terminals should be prepared first with e.g. clamped copper heads, etc. to avoid the possibility of one conductor free out of the connection screw, and possible contact with the metal enclosure.
- (3) ferrite chokes are included for individual installation around an RTS cable, a Meterbus cable and a heat-sink ground wire, if used. Each wire must be looped (at least once) through a ferrite choke, as close to the ProStar MPPT as possible, to meet FCC Class B EMI requirements.

WARNING: Solar and battery fuses or DC breakers are required in the system. These protection devices are external to the ProStar MPPT controller, and must be a maximum of 30 amps for the PS-MPPT-25/M and 50 amps for the PS-MPPT-40/M.

AVERTISSEMENT: Solaire et batterie fusibles ou disjoncteurs DC sont nécessaires dans le système. Ces dispositifs de protection sont externes au contrôleur MPPT ProStar et doivent être un maximum de 30 ampères pour le PS-MPPT-25/M et 50 ampères pour le PS-MPPT-40/M.

WARNING: Installation must comply with all US National Electrical Code and Canadian Electrical Code requirements. Breakers and fuses may require lower ratings than referenced above, so as not to exceed any specific wire ampacity.

AVERTISSEMENT: Installation doit être conforme à toutes les requirments US National Electrical Code et Code Canadien d'Electricité. Disjoncteurs et fusibles peuvent exiger des cotes inférieures que mentionnés ci-dessus de manière à ne pas pour dépasser n'importe quel fils particulier admissible.

WARNING: Minimum over-current protection device interrupt ratings must be 2000A for 12V systems, and 4000A for 24V systems.

AVERTISSEMENT: Protection contre les surintensités minimum cotes d'interruption de périphérique doivent être de 2000 a 12V systèmes et 4000 a pour les systèmes de 24V.

3.2 Configuration

The DIP switch block shown in Figure 3.1 below is used to set the operating parameters for the ProStar MPPT.

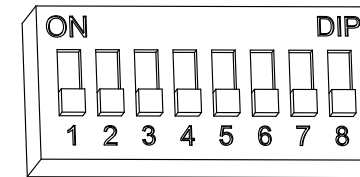


Figure 3.1. DIP Switch Block to set charging parameters

Switch 1: Load / Lighting

Mode	Switch 1
Normal	OFF
Lighting	ON

Switches 2, 3: System Voltage

Three (3) system voltage configurations are available as shown in the table below:

System Voltage	Switch 2	Switch 3
Auto	OFF	OFF
12	OFF	ON
24	ON	OFF

NOTE: Before connecting the battery, measure the open-circuit voltage. It must be over 10 volts to start the controller. If the system voltage Settings Switches are set to Auto-detect, battery voltage over 15.5V will be detected as a 24V nominal battery, and the unit will charge accordingly. The 12/24V auto selection is

only done at start-up, and the detected system voltage will never change during operation.

Generally, the specific system voltage is known, and it is best to set DIPs 2,3 accordingly; the auto-detect setting should be used only in rare circumstances.

Switches 4, 5, 6: Battery Type Selection

Preset ProStar MPPT battery charging options are shown in table 3-1 below. All voltage settings listed are for nominal 12 volt batteries.

Multiply the voltage settings by two (2) for 24 volt systems.



NOTE: These settings are general guidelines for use at the operator's discretion. The ProStar MPPT can be programmed to satisfy a wide range of charging parameters. Consult the battery manufacturer for optimal battery charge settings.

DIP Switch Settings 4-5-6	Battery Type	Absorp. Stage (volts)	Float Stage (volts)	Equalize Stage (volts)	Absorp. Time (mins)	Equalize Time (mins)	Equalize Timeout (mins)	Equalize Interval (days)	LVD (volts)	LVR (volts)
off-off-off	1 - Sealed*	14.00	13.50		150				11.50	12.60
off-off-on	2 - Sealed*	14.15	13.50	14.40	150	60	120	28	11.30	12.80
off-on-off	3 - Sealed*	14.30	13.50	14.60	150	60	120	28	11.50	13.00
off-on-on	4 - AGM/Flooded	14.40	13.50	15.10	180	120	180	28	11.70	13.20
on-off-off	5 - Flooded	14.60	13.50	15.30	180	120	180	28	11.90	13.40
on-off-on	6 - Flooded	14.70	13.50	15.40	180	180	240	28	12.10	13.60
on-on-off	7 - L-16	15.40	13.40	16.00	180	180	240	14	12.30	13.80
on-on-on	8 - Custom	Custom	Custom	Custom	Custom	Custom	Custom	Custom	Custom	Custom

* "Sealed" battery type includes gel and AGM batteries

Table 3.1. Battery charging settings for each selectable battery type

Switch 7: Battery Equalization


Mode	Switch 7
Manual Equalization	OFF
Auto Equalization	ON

Switch 8: Meterbus / MODBUS Settings

Mode	Switch 8
Meterbus	OFF
MODBUS	ON

3.3 Mounting

Inspect the controller for shipping damage. Mount the ProStar MPPT to a vertical surface (4-#8 stainless steel self-tapping screws are included). Tighten the mounting screws, using care not to crack the plastic case. Do not install directly over an easily combustible surface since the heat sink may get hot under certain operating conditions.

 **NOTE:** The heat sink must be in a vertical position (fins up and down).

For proper air flow, allow at least 15 cm (6 in) of space above and below the controller, and 50 mm (2 in) at the sides - see Figure 3-2 below. Install in an area protected from direct rain and sun.

If the controller is installed in an enclosure, some ventilation is recommended. Do not locate in an enclosure where battery gases can accumulate.

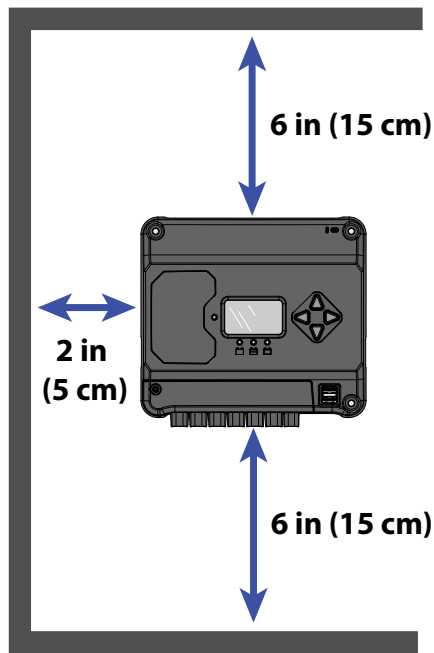


Figure 3-2. Proper Clearances for Passive Cooling

3.4 Wiring

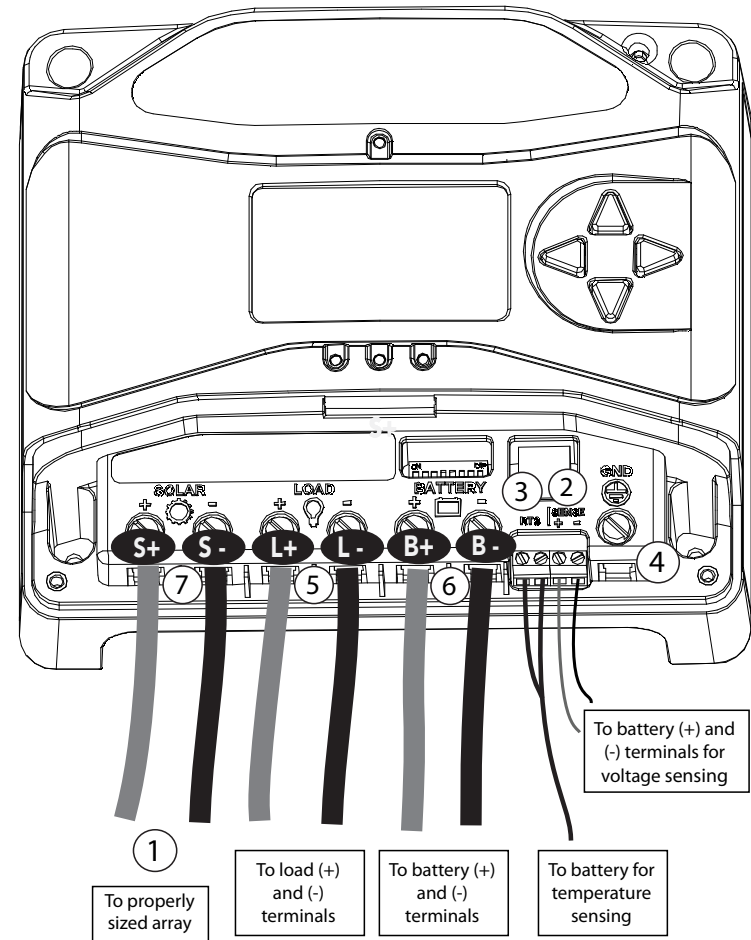



Figure 3-3. Wiring the PS-MPPT

REFER TO FIGURE 3.3 WHEN USING THE WIRING INSTRUCTIONS BELOW.

 **NOTE:** THE PS-MPPT IS UL 1741 COMPLIANT WHEN USED WITH THE OPTIONAL WIRE BOX. THE WIRE BOX CANNOT BE USED WITH RIGID CONDUIT. THE PS-MPPT IS UL RECOGNIZED FOR USE IN A UL LISTED ASSEMBLY WITHOUT THE WIRE BOX FOR THE PS-MPPT.

STEP 1: Check Controller Limitations

Verify that the highest temperature compensated solar array open-circuit voltage (Voc), and load current do not exceed the ratings of the ProStar MPPT version being installed.

Multiple controllers can be installed in parallel on the same battery bank to achieve greater total charging current. In this type of system, each ProStar MPPT must have its own solar array. The load terminals of multiple controllers can only be wired together if the total load draw does not exceed the nameplate current of the LOWEST rated controller.

STEP 2: Battery Voltage Sense Wires

Due to connection and cable resistance, voltage drops are unavoidable in power cables that carry current, including the ProStar MPPT battery cables. If *Battery Sense* wires are not used, the controller must use the voltage reading at the battery power terminals for regulation. This voltage may differ from the actual battery bank voltage due to voltage drop.

Battery Voltage Sense is a high impedance connection that enables the ProStar MPPT to measure the battery terminal voltage precisely with small gauge wires that have no voltage drop. When connected directly to the battery, the sense wires will improve battery charging accuracy. Battery voltage sense wires are recommended if the controller is more than three meters (10 ft) from the battery.

Generally accepted wiring practice is to limit voltage drops between the charger and the battery to 2%. Even properly sized wiring with 2% drop can result in a 0.3 volt drop for 14.4V charging. Voltage drops will cause some undercharging of the battery. The controller will begin Absorption or limit equalization at a lower battery voltage because the controller measures a higher voltage at the controller's terminals than is the actual battery voltage. For example, if the controller is programmed to start Absorption at 14.4V, when the controller "sees" 14.4 volts at its battery terminals,

the true battery voltage would only be 14.1 volts, if there is a 0.3 volt drop between the controller and battery.

Note that the battery sense wires will not power the controller, and the sense wires will not compensate for losses in the power wires between the controller and the battery. The battery sense wires are used to improve the accuracy of the battery charging.

The two sense wires, can range in size from 1.0 to 0.25 mm² (16 to 24 AWG), and should be cut to length as required to connect the battery to the voltage sense terminals. A 2-position terminal (see figure 3.3) is used for the battery sense connection. A twisted pair cable is recommended but not required. Use UL rated 300 Volt conductors. The voltage sense wires may be pulled through conduit with the power conductors.

Observing correct polarity, connect both battery voltage sense wires to the ProStar MPPT at the 2-position *Battery Sense* terminal, and to battery (+) and (-) terminals. No damage will occur if the polarity is reversed, but the controller cannot read a reversed sense voltage.

Tighten the connector screws to 5 in-lb (0.56 Nm) of torque.

The maximum length allowed for each battery voltage sense wire is 98 ft (30 m).

Connecting the voltage sense wires to the RTS terminal will cause an alarm.



NOTE: If the battery input voltage is greater than 5 volts different than the *Battery Sense*, due to voltage drops or faulty connections, the *Battery Sense* input will not be recognized by the ProStar MPPT.

A battery voltage sense connection is not required to operate the ProStar MPPT controller, but it is recommended for best performance.

STEP 3: Remote Temperature Sensor



WARNING: Risk of Fire.

If no Remote Temperature Sensor (RTS) is connected, use the ProStar MPPT within 3m (10 ft) of the batteries. Internal Temperature Compensation will be used if the RTS is not connected. Use of the RTS is strongly recommended.



AVERTISSEMENT: Risque d'incendie.

Si non Capteur de température distant (RTS) est connecté, utilisez le MPPT ProStar moins de 3m (10 pi) de les batteries. Compensation de la température interne sera utilisée si la RTS n'est pas connecté. Utilisation de la RTS est fortement recommandé.

All charging settings are based on 25°C (77°F). If the battery temperature varies by 5°C, the charging setting will change by 0.15 Volts for a 12 Volt battery. This is a substantial change in the charging of the battery, and the use of the optional Remote Temperature Sensor (RTS) is recommended to adjust charging to the actual battery temperature. The RTS can be added at any time after the system has been installed.

Connect the RTS to the 2-position terminal located between the battery (-) and chassis ground terminal lugs (see figure). The RTS is supplied with 33 ft (10 m) of 22 AWG (0.34 mm²) cable. There is no polarity, so either wire (+ or -) can be connected to either screw terminal. The RTS cable may be pulled through conduit along with the power wires. Tighten the connector screws to 5 in-lb (0.56 Nm) of torque. Separate installation instructions are provided inside the RTS bag.



WARNING: Equipment Damage

Never place the temperature sensor inside a battery cell. Both the RTS and the battery will be damaged.



AVERTISSEMENT: Endommagement de l'équipement

Ne placez jamais la sonde de température dans un élément de batterie. Le RTS et la batterie seraient endommagés.



CAUTION: The ProStar MPPT will use the local temperature sensor for compensation if the RTS is not used.



PRUDENCE: Le ProStar MPPT ne compense pas la température des paramètres de charges si le RTS n'est pas utilisé.



NOTE: The RTS cable may be shortened if the full length is not needed. Be sure to reinstall the ferrite choke on the end of the RTS if a length of cable is removed. This choke ensures compliance with electromagnetic emissions standards.



REMARQUE: Le câble de RTS peut être raccourci si la totalité de la longueur n'est pas nécessaire. Assurez-vous de réinstaller la bobine en ferrite sur l'extrémité du RTS si une longueur de câble est enlevée. Cette bobine assure la conformité avec les normes d'émissions électromagnétiques.

STEP 4: Grounding and Ground Fault Interruption



WARNING:

This unit is not provided with a GFDI device. This charge controller must be used with an external GFDI device as required by the Article 690 of the National Electrical Code for the installation location.



NOTE:

Depending on the country of installation, conductors identified by the color green, or a combination of green/yellow, shall only be used for earthing conductors.



AVERTISSEMENT :

L'appareil n'est pas fourni avec un dispositif GFDI. Ce contrôleur de charge doit être utilisé avec un dispositif GFDI externe tel que requis par l'Article 690 du Code électrique national de la région de l'installation.

Use copper wire to connect the grounding terminal in the case, and other dead metal, to earth ground. The grounding terminal is identified by the ground symbol on the case, just above the terminal, as shown below:

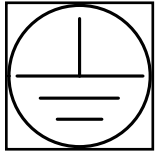


Figure 3-4. Ground Symbol

Per NEC 690.45 (A) and NEC Table 250.122, minimum sizes for equipment copper grounding wire are:

- ProStar MPPT-25 10 AWG (5 mm²)
- ProStar MPPT-40 10 AWG (5 mm²)

Per IEC 62109, minimum sizes for equipment copper grounding wire are:

- ProStar MPPT-25 7 AWG (10 mm²)
- ProStar MPPT-40 7 AWG (10 mm²)

OR, of the same, or greater, cross-sectional area as the PV wires.



WARNING: Risk of Fire

DO NOT bond DC system electrical negative to earth grounding terminal on the controller. Per NEC, system negative must be bonded to earth ground at only one point, and through a GFPD if required.



AVERTISSEMENT : Risque d'incendie

NE LIEZ PAS le côté négatif du système à la mise à la terre au niveau du contrôleur. Selon les exigences du CNE, le côté négatif du système doit être mis à la terre par un GFPD à un seul point.

For safety, and effective lightning protection, it is recommended, and may be required by code, that the negative conductor of the charging system be properly grounded. Do not connect the grounding electrode conductor (GEC) to the case ground terminal. The ProStar MPPT does not have internal ground fault protection; but where the NEC requires the use of a ground fault protection device (GFPD), the system electrical negative should be bonded through a GFPD to earth ground at only one point.

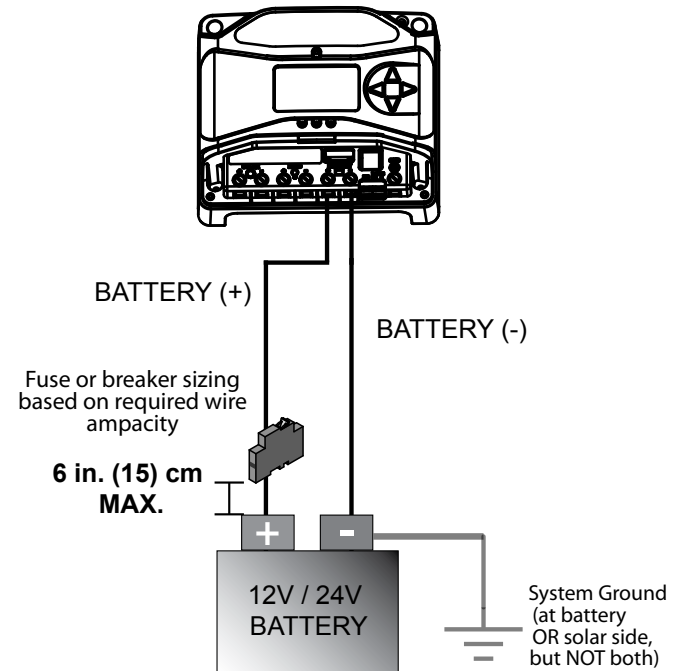
The grounding point may be located in the solar, or the battery circuit. For system grounding electrode conductor sizing requirements, refer to the NEC Section 690.47, or applicable local regulations or code.

STEP 5: Battery Connections - see diagram below

Be sure that DIP switches 2 and 3 are set for 12 or 24V, as described in Section 3.2

NOTE: Before connecting the battery, measure the open-circuit voltage. It must be over 10 volts to start the controller. If the system voltage Settings Switches are set to Auto-detect, battery voltage over 15.5V will be detected as a 24V nominal battery, and the unit will charge accordingly. The 12/24V auto selection is only done at start-up.

With the battery disconnect open, connect the battery (+) and (-) wires from the battery to controller. **DO NOT CLOSE THE BREAKER AT THIS TIME.**



STEP 6: Solar Connections - see diagram below



WARNING: Shock Hazard

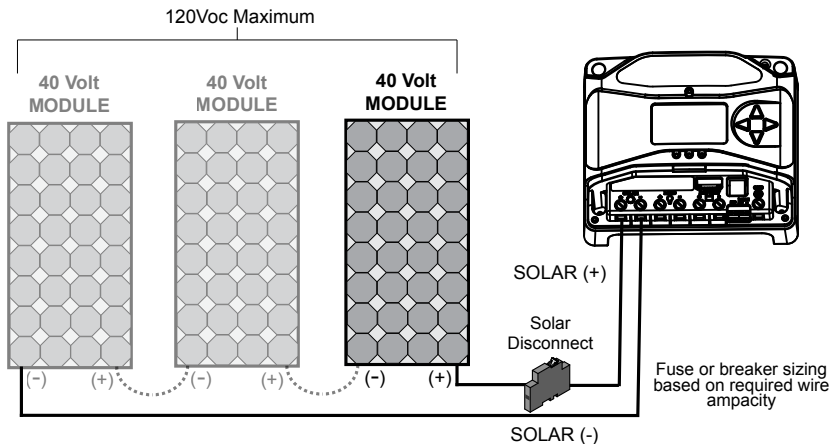
The solar PV array can produce open-circuit voltages in excess of 120 Vdc when in sunlight. Verify that the solar input breaker or disconnect has been opened (disconnected) before installing the system wires.



AVERTISSEMENT: Risque de décharge électrique

Le réseau PV solaire peut produire des tensions de circuit ouvert supérieures à 120 Vdc à la lumière du soleil. Vérifiez que le coupe-circuit ou l'interrupteur d'entrée solaire a été ouvert (déconnexion) avant d'installer les câbles du système.

With the solar disconnect open, connect the solar (PV) array wires to the PS-MPPT solar terminals. Use caution, since the solar array will produce current whenever in sunlight. A solar disconnect is a convenient way to break the PV connection when necessary. **DO NOT CLOSE THE BREAKER AT THIS TIME.**



STEP 7: Load Connections - see diagram below



CAUTION: Equipment Damage

Do not wire any AC inverter to the load terminals of the

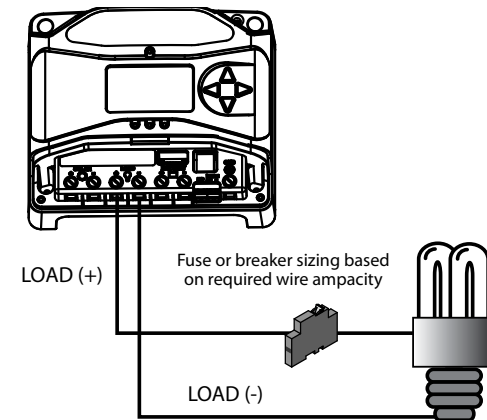
ProStar. Damage to the load control circuit may result. An inverter should be wired to the battery. If there is a possibility that any other load will sometimes exceed the Prostar's maximum voltage or current limits, the device should be wired directly to the battery or battery bank. If load control is required, contact Morningstar Tech Support for assistance.



PRUDENCE : Dommages matériels

Ne pas raccorder n'importe quel convertisseur aux bornes de la ProStar. Pourrait endommager le circuit de commande de charge. S'il y a une possibilité que n'importe quelle autre charge dépassera parfois la tension maximale de la Prostar ou limites de courant, l'appareil doit être câblé directement sur la batterie ou la batterie. Si le régulateur de charge est nécessaire, contacter le Support technique de Morningstar d'assistance.

Turn the loads off, and connect the load wires to the load terminals. **DO NOT CLOSE THE BREAKER AT THIS TIME.**



STEP 8: Power-Up and Verify System Operation



NOTE: Carefully observe the LEDs after each connection. The LEDs will indicate proper polarity and a good connection.

Close the battery breaker to power on the controller. Watch the the charging status, and then the three battery state-of-charge (SOC) LEDs blink in sequence (G-Y-R), confirming proper start-up. If they do not light, check the battery

polarity (+/-) and battery voltage.

Next, the green, yellow or red LED will light depending on the battery state-of-charge (SOC). Confirm that one of these LEDs is on before going to the next step.

Close the solar disconnect. If the solar input is connected while in sunlight, the charging LED indicator will light.

Confirm proper connection by observing the charging LED.

Close the load disconnect, and turn the load on, to confirm a proper connection.

If the load does not turn on, it could be for various reasons:

- the ProStar MPPT is in LVD (red LED on)
- there is a short circuit in the load (LEDs blinking R/G – Y)
- there is an overload condition (LEDs blinking R/Y - G)
- the load is not connected, not working, or turned off

After all connections have been completed, observe the LEDs to make sure the controller is operating normally for system conditions. If the optional digital meter is used, observe that the display is scrolling with proper voltage and current values. Also, a self- test can be performed with digital meter units.

STEP 9: To Power-down



WARNING: Risk of Damage

ONLY disconnect the battery from the ProStar MPPT AFTER the solar input has been disconnected. Damage to the controller may result if the battery is removed while the ProStar MPPT is charging.



AVERTISSEMENT: Risque d'endommagement

Le ProStar MPPT MPPT 150V SEULEMENT déconnecter la batterie APRÈS l'entrée solaire a été déconnectée. Le contrôleur pourrait endommager si la batterie est retirée quand le ProStar MPPT MPPT 150V est en charge.

- To prevent damage, power-down must be done in the reverse order as power-up.

4.0

OPERATION

4.1 TrakStar™ MPPT Technology

The ProStar MPPT utilizes Morningstar's TrakStar Maximum Power Point Tracking technology to extract maximum power from the solar module(s). The tracking algorithm is fully automatic and does not require user adjustment. Trakstar technology will track the array maximum power point voltage (Vmp) as it varies with weather conditions, ensuring that maximum power is harvested from the array through the course of the day.

Current Boost:

In many cases, TrakStar MPPT technology will "boost" the solar charge current. For example, a system may have 2 amps of solar current flowing into the ProStar MPPT and 5 amps of charge current flowing out to the battery. The ProStar MPPT does not create current! Rest assured that the power into the ProStar MPPT is the same as the power out of the ProStar MPPT. Since power is the product of voltage and current (Volts x Amps), the following is true*:

(1) Power Into the ProStar MPPT = Power Out of the ProStar MPPT

(2) Volts In x Amps In = Volts Out x Amps Out

* assuming 100% efficiency i.e. if no losses in wiring and conversion existed.

If the solar module's Vmp is greater than the battery voltage, it follows that the battery current must be proportionally greater than the solar input current so that input and output power are balanced. The greater the difference between the maximum power voltage and battery voltage, the greater the current boost. Current boost can be substantial in systems where the solar array is of a higher nominal voltage than the battery as described in the next section.

High Voltage Strings and Grid-tie Modules

Another benefit of TrakStar MPPT technology is the ability to charge 12 or 24 volt batteries with solar arrays of higher nominal voltages. A 12 volt battery bank can be charged with a 12, 24, 36 or 48V nominal off-grid solar array. Certain grid-tie solar modules may also be used as long as the solar array open circuit voltage (V_{oc}) rating will not exceed the ProStar MPPT 120V maximum input voltage rating at worst-case (lowest) module temperature. The solar module documentation should provide V_{oc} vs. temperature data. Higher solar input voltage results in lower solar input current for a given input power. High voltage solar input strings allow for smaller gauge solar wiring. This is especially helpful for systems with long wiring runs between the solar array and the ProStar MPPT.

An Advantage Over Traditional Controllers

Traditional controllers connect the solar module directly to the battery when recharging. This requires that the solar module operate in a voltage range that is below the module's V_{mp} . In a 12V system, for example, the battery voltage may range from 10 - 15 Vdc but the module's V_{mp} is typically around 17V. Figure 4.1 shows a typical current vs. voltage output curve for a nominal 12V off-grid module.

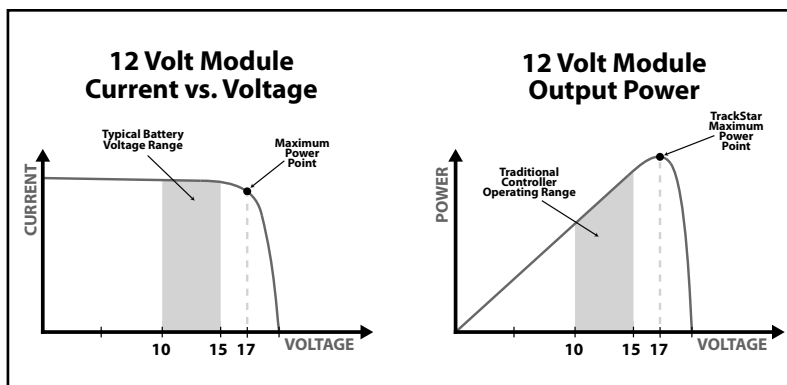


Figure 4.1. Nominal 12 volt solar module I-V curve and output power graph

4.2 Battery Charging

4-Stage Charging

The ProStar MPPT has a 4-stage battery charging algorithm for rapid, efficient, and safe battery charging. Figure 4-2 shows the sequence of stages.

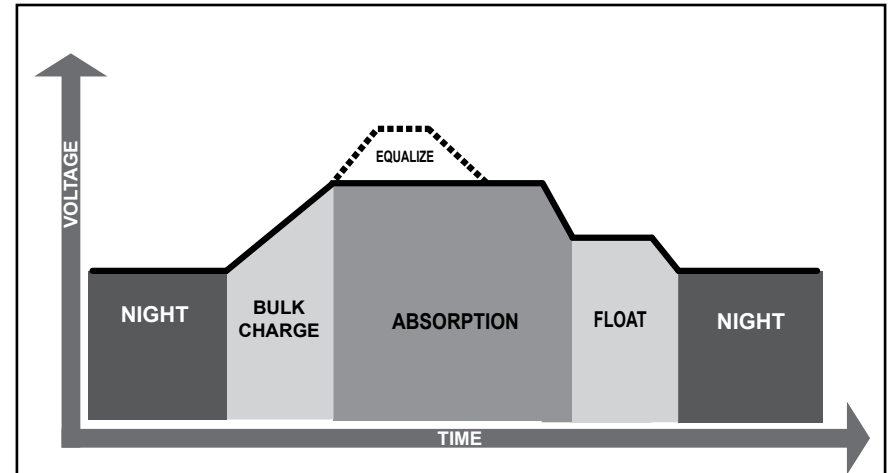


Figure 4.2. ProStar MPPT Charging Algorithm

Bulk Charge Stage

During Bulk charging, the battery is not at 100% state of charge and battery voltage has not yet charged to the Absorption voltage set-point. The controller will deliver 100% of available solar power to recharge the battery.

Absorption Stage

When the battery has recharged to the Absorption voltage set-point, constant-voltage regulation is used to maintain battery voltage at the Absorption set-point. This prevents heating and excessive battery gassing. The battery is allowed to come to full state of charge at the Absorption voltage set-point. The green SOC LED will blink once per second during Absorption charging.

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