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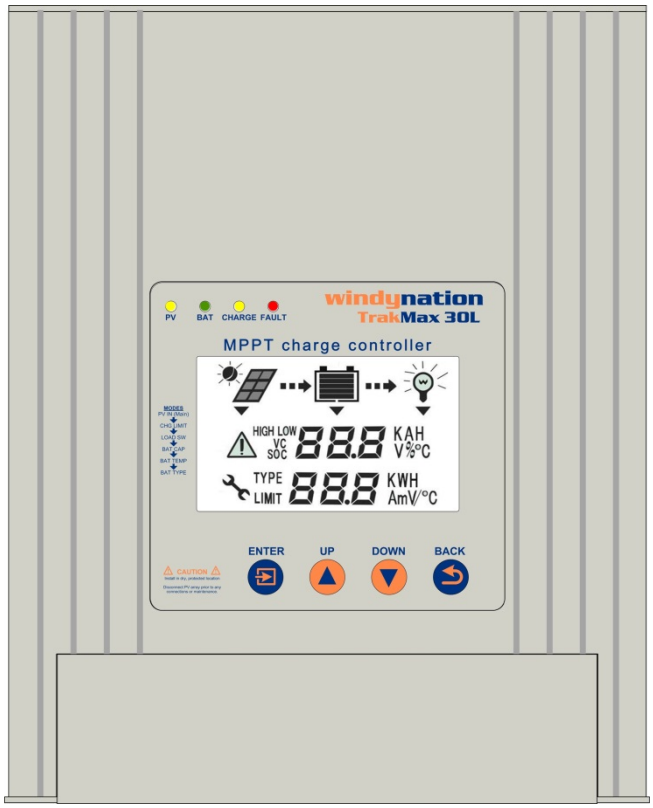


TrakMax 30L

MPPT Solar Charge Controller

CHC-TRMX-30

User's Manual

Table of Contents

1 INTRODUCTION

Thank you for purchasing the TrakMax 30L, another quality product from Windy Nation. This manual is intended for anyone who needs to install and operate the solar charge controller.

The manual will provide safety guidelines, detailed planning, and procedures for installing and setting up the solar charge controller, as well as information about operating and troubleshooting the unit.

The manual will not provide details about any of the connected equipment to the controller (eg: PV panels, batteries, etc.). Information concerning any connected equipment should be available from the equipment manufacturer.

1.1 SAFETY

Windy Nation Inc. ("Windy Nation") is not assembling the wind unit, installing the solar system, or any other product offered by Windy Nation. Windy Nation, and its directors, officers, and employees disclaim, and by purchasing a Windy Nation wind or solar powered product you accept all liability and responsibility for damage to property, injury, or death arising out of or related to the use or misuse of any product offered by Windy Nation.

- Installation and servicing should be referred to qualified service personnel.
- Remove all sources of power, photovoltaic and battery before servicing or installing.
- During operation, the controller can be very hot to the touch.

Battery Safety

Warning: Batteries can produce explosive gasses; observe extreme caution.

- Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing or eyes.
- NEVER smoke or allow a spark or flame in the vicinity of the battery.
- Be cautious of metal items such as jewelry and tools to reduce risk of short circuit.
- Never charge a frozen battery.
- Be sure battery is mounted in a well-ventilated compartment.
- Purge excessive gas from the battery cells by filling each cell with distilled water until battery acid reaches level specified by battery manufacturer. For batteries without cell caps, carefully follow manufacturers charging instructions.

1.2 DEFINITIONS

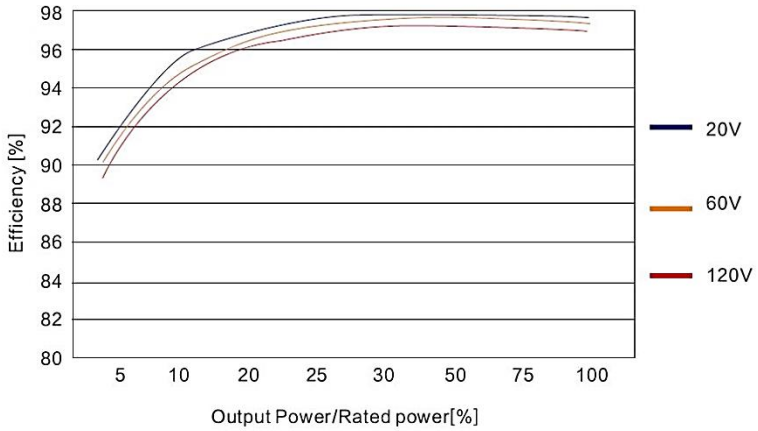
- BTS Battery Temperature Sensor
- DC Direct Current
- LED Light Emitting Diode
- LVD Low Voltage Disconnect
- LVR Low Voltage Reconnect

- B.SELECT Battery Type Selector
- BAT Battery
- CHG.MODE Charge Mode
- PV Photovoltaic
- MPPT Maximum Power Point Tracking
- PWM Pulse Width Modulation

2 PRODUCT OVERVIEW

The TrakMax solar charge controller is a 30 amp 12/24/48 Volt Maximum Power Point Tracking (MPPT) photovoltaic (PV) battery charge controller. Through the use of MPPT technology, TrakMax can increase charge current up to 30% or more compared to conventional solar charge controllers. TrakMax's sophisticated three stage charge control system can be configured to optimize charge parameters to precise battery requirements. The unit is fully protected against voltage transients, over temperature, over current, reverse battery, and reverse PV connections. An automatic current limit feature allows use of the full 30 amp capability without worrying about overload or unnecessary fuse blows from excessive current, voltage, or amp-hour based load control.

Series pass Pulse Width Modulation (PWM) charge voltage control combined with a multistage charge control algorithm leads to superior charging and enhanced battery performance. The filtered PWM power control system uses highly efficient and reliable power MOSFET transistors. The MOSFET's are turned on and off at high frequency to precisely control the charge voltage and the MPPT function.



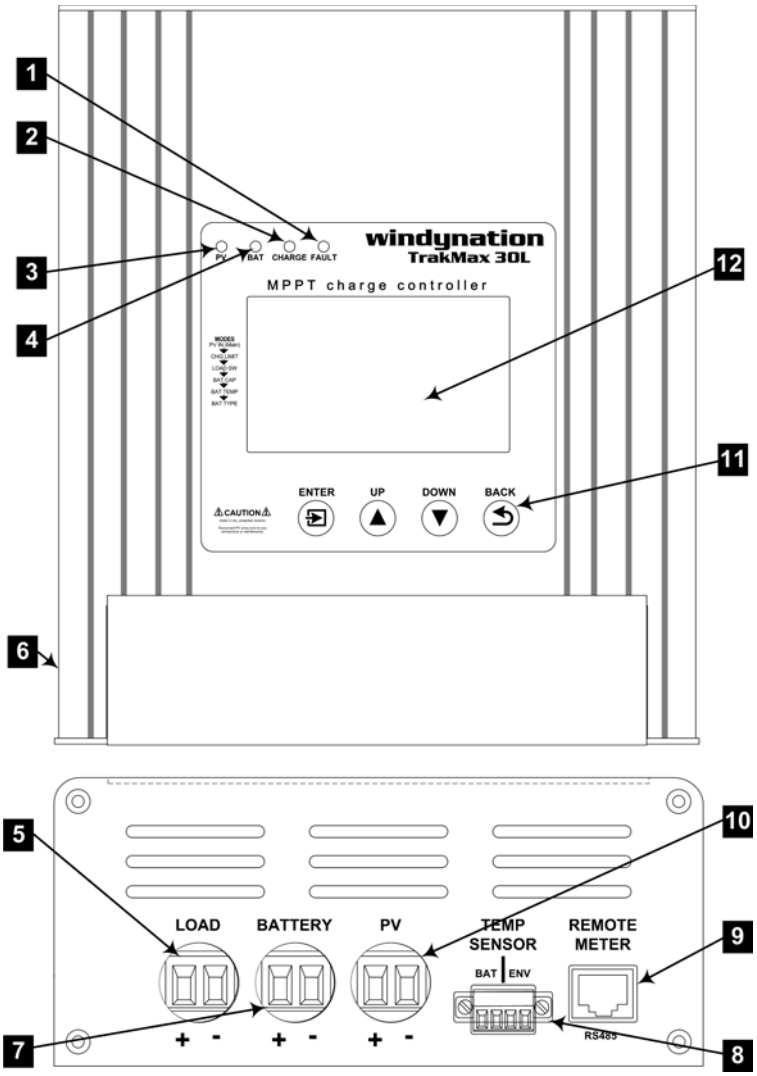
Fully automatic temperature compensation of charge voltage is available to further improve charge control and battery performance. The optional battery temperature sensor (purchased separately) is built for long term reliability. The sensor element is environmentally sealed and encapsulated into a lug, which secures directly to the battery. The TrakMax also includes an isolated RS485 port for connection to a remote monitor (purchased separately).

For large system current applications (greater than 30 amps), multiple TrakMax units can be connected in parallel.

2.1 FEATURES

- ✓ Maximum efficiency of 97%
- ✓ Wide PV Input Range (150V Voc)
- ✓ DC Load Output Port (10A)
- ✓ LCD and LED displays to indicate the status of charge
- ✓ Lightning protection
- ✓ Reverse current protection at night
- ✓ Smart Error detection
- ✓ Automatic overload protection
- ✓ DSP controlled

- ✓ Natural Cooling
- ✓ Silent, pulse width modulated (PWM), high efficiency operation
- ✓ Dual Battery Temperature Compensation; (Optional Requires item CHC-BTSC-02)
- ✓ Optional Remote Monitoring using (Requires item CHC-RMTR-01)
- ✓ Configurable charging current (10A, 20A, 30A)



1	Fault LED	**7**	Battery Terminal
2	Charge LED	**8**	Temperature Sensor Connection*
3	PV LED	**9**	RS485 Remote Monitor Port*
4	Battery LED	**10**	PV Terminal Input
5	DC LOAD Terminal Output	**11**	Function Keys
6	Earth Ground Connection (unit side)	**12**	LCD Display

* Optional Equipment is required for operation (purchased separately)

2.2 SPECIFICATIONS

2.2.1 Electrical Specifications

Parameter	Value @25°C
Battery System Voltage	12 / 24 /48 VDC (auto-detect)

Max Input Current	30 Amp
Max Battery Charging Current	10, 20, or 30 Amp
Load Current	10 Amp
Max PV Open Circuit Array Voltage	150VDC
Efficiency	97% @ full current
Typical Idle Consumption	< 160mA / 80mA / 40mA
Bulk Charge	14.4V(default)
Floating Charge	13.5V / 27V / 54V (default)
Over-voltage Indication	15.0 / 30.0 / 60.0 VDC
Over-voltage Recovery	14.8 / 29.6 / 59.2 VDC
Under-voltage Indication	8.5 / 17.0 / 34.0 VDC
Under-voltage Recovery	9.0 / 18.0 / 36.0 VDC
Temperature Compensation	0 - 10mV/^{o}C (settable)
Load Control	ON / OFF
Low Voltage Reconnect	12.0 / 24.0 / 48.0 VDC
Low Voltage Disconnect	10.5 / 21.0 / 42.0 VDC
Altitude	Operating 6,560ft (2000m)
Enclosure Protection Class	IP20
Battery Temperature Sensor (BTS)	Optional sensor increases charging precision
Terminal Size (fine/single wire)	Maximum 6 AWG

NOTE: The optional battery temperature sensor automatically adjusts the charging process of the controller according to the type of battery selected by the user. With the battery temperature sensor installed, the controller will increase or decrease the battery charging voltage depending on the temperature of the battery to optimize the charge to the battery and to maintain battery performance.

2.2.2 Physical Specifications

Parameter	Value
Dimension (H x W x D)	8.2” (210mm) x 6.7” (171mm) x 3.8” (98mm)
Unit Weight	4.4 lb. (2Kg)
Mounting	Vertical wall mount - indoor only
Cooling	Natural cooling
Operating Temperature	14^{o}F to 122^{o}F (-10^{o}C to 50^{o}C) de-rating >104^{o}F (40^{o}C)
Storage Temperature	-25^{o}C to 60^{o}C
Operating Humidity	20 to 80% relative humidity (non-condensing)
Non-Operating Humidity	Greater than 95% relative humidity 38.7^{o}C max wet bulb temperature with no damage

2.2.3 Regulatory Information

The TrakMax has safety approvals as follows:

- CE
- IEC 62109

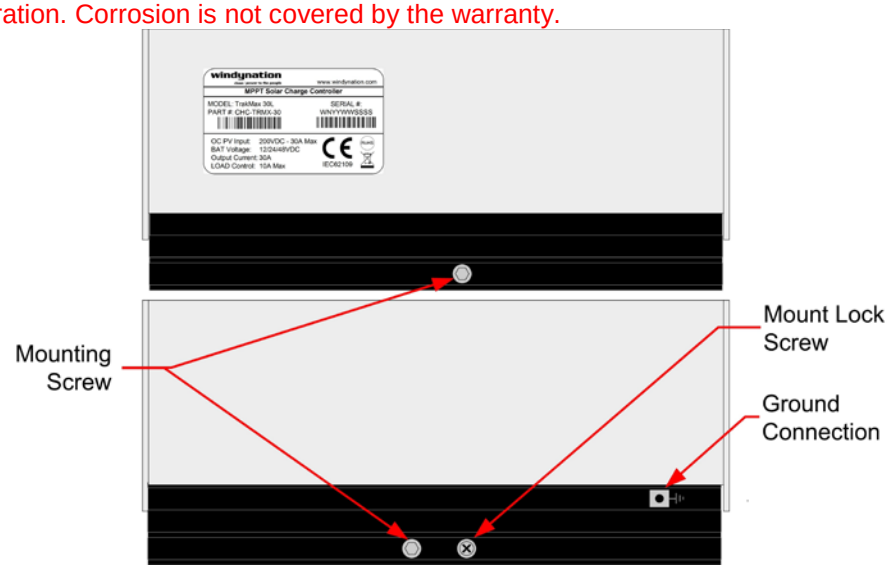
FCC Requirements:
This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

3 INSTALLATION

- Insure all terminating connections are clean and tight to prevent arcing and overheating.
- Do not connect to a PV array capable of producing greater than 30 amps of short circuit current @ 25°C.
- Do not connect to a PV array with an open circuit voltage (VOC) greater than 150VDC.

Important: Installations should meet all local codes and standards. Installations of this equipment should only be performed by skilled personnel such as licensed electricians and Certified Renewable Energy (RE) System Installers.

Caution: Install the Solar charge controller in a dry, protected location away from sources of high temperature, moisture, and vibration. Corrosion is not covered by the warranty.



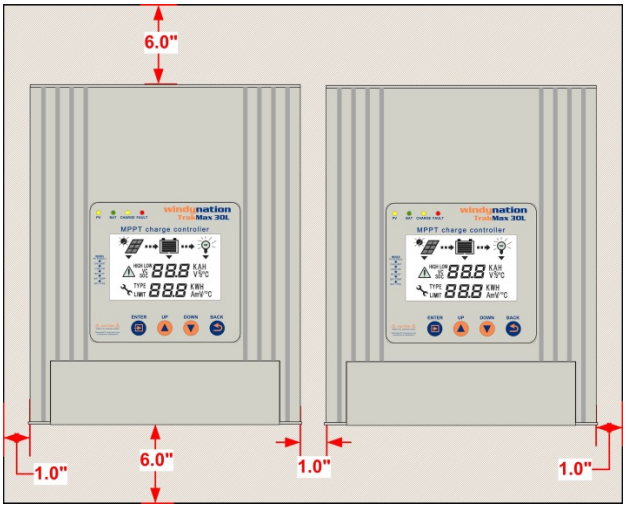
3.1 ELECTROSTATIC (ESD) PRECAUTIONS

All electronic circuits may be damaged by static electricity. To minimize the likelihood of electrostatic damage, discharge yourself by touching an electrical ground (e.g.: copper pipe) prior to handling the unit and avoid touching components on the circuit boards. The risk of electrostatic damage is highest when relative humidity is below 40%.

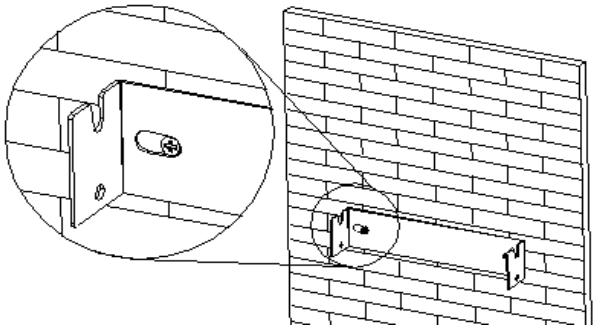
3.2 MOUNTING

The mounting location is important to the performance and operating life of the controller. The environment must be dry and protected from water. If required, the controller may be installed in a ventilated enclosure with sufficient airflow. Never install the TrakMax MPPT in a sealed enclosure. The controller may be mounted in an enclosure with sealed batteries, but never with vented/flooded batteries. Battery fumes from vented batteries will corrode and destroy the TrakMax MPPT circuits.

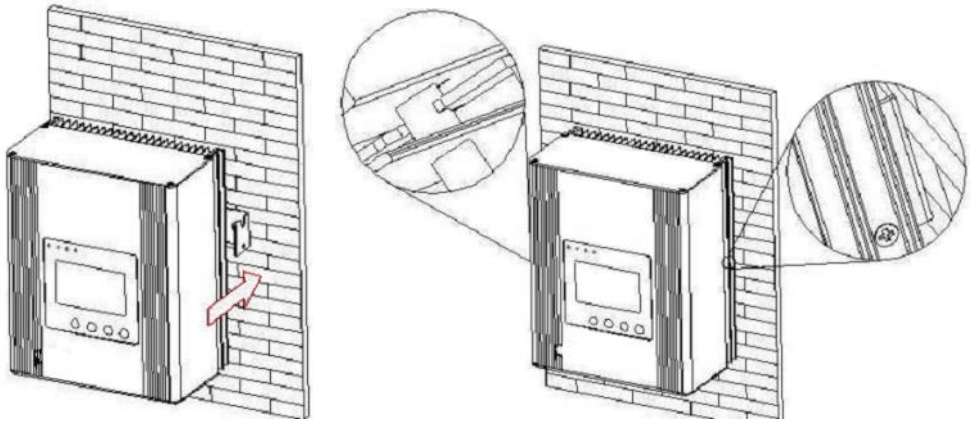
1) Place the TrakMax on a vertical surface protected from direct sun, high temperatures, and water. The TrakMax requires at least 6 in (150 mm) of clearance above and below and at least 1 in (25 mm) on each side for proper air flow as shown in figure below.



2) Place the controller mounting bracket on the desired mounting surface and mark the location of each keyhole (two per unit).



3) Secure the bracket using the two mounting screws (included).
   a) If wall anchors (included) are to be used, a pilot hole will be required at the drill mark.
4) Remove the Mount-Lock screw on the TrakMax and carefully align the open ended keyholes on the mounting bracket with the TrakMax Mounting screw heads and slide the TrakMax down into the keyhole.



5) Replace the Mount-Lock screw on the TrakMax going first through the mounting bracket and into the TrakMax and tighten for safety.

Warning: Explosion/Corrosion Hazard
Do not mount on flammable surface material (e.g.: wooden wall).

3.3 GROUNDING

The TrakMax is designed to work with grounded electrical systems. In the controller, ground is not connected to the input terminal and output terminals.

Use a copper wire to connect the grounding terminal on the TrakMax enclosure to earth ground. The grounding terminal is located on the left side of the enclosure as shown above.

Do not connect the system negative conductor to this terminal. NEC requires the use of an external ground fault protection device (GFPD). The system electrical negative should be bonded through a GFPD to earth ground at one (and only one) location. The grounding point may be located in the solar circuit or the battery circuit.

3.4 CONNECTIONS

WARNING: Shock Hazard
Solar PV array can produce open-circuit voltages in excess of 100 VDC when in sunlight. Verify that the solar input breaker or disconnect has been opened (disconnected) before installing the system wires. Note that the maximum PV open-circuit voltage for the TrakMax is 150 VDC. Do NOT attach the positive and negative PV

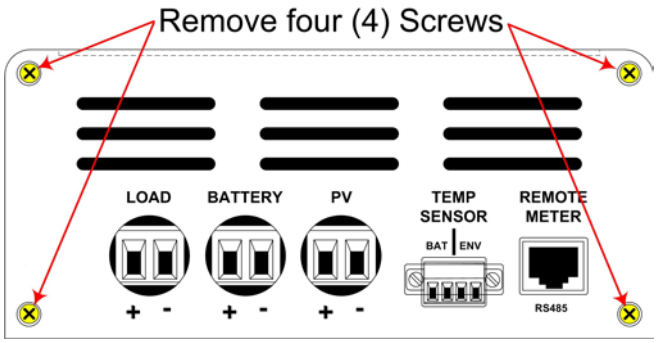
cables to the TrakMax until the TrakMax has been connected to the positive and negative terminals of the battery bank.

It is recommended to use a strain relief (bushings, connectors, clamp connectors, or wire glands) in each of the three ¾ in openings.

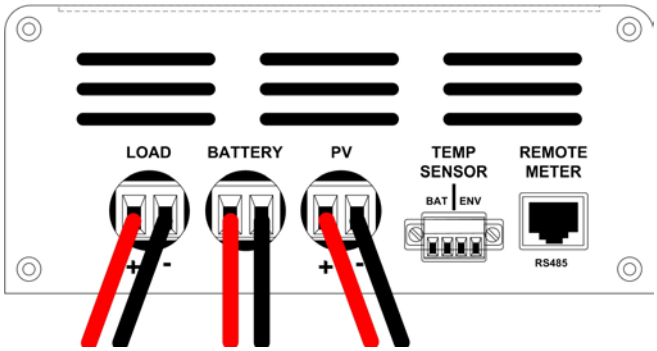
The NEC requires that the wires carrying the system current never exceed 80% of the conductor's current rating. The table below provides the minimum size of copper wire allowed by NEC. Wire types rated for 75°C and 90°C are included.

Wire Type	75°C Wire	90°C Wire
Copper	6 AWG (16 mm^2)	8 AWG (10 mm^2)
Aluminum	4 AWG (25 mm^2)	6 AWG (16 mm^2)

1) Remove the Wiring End Cover from the Top Cover by removing the four securing screws as shown below.



2) Route the relevant cable/wire through the appropriate ¾ in opening as noted on the cover.
Note: If strain reliefs (i.e.: cable clamps, wire glands) are being used, they must be installed prior to routing the wire, and the wire should route through the clamp.



3) Terminal connectors for DC wiring are located on the lower edge of the circuit board. Once the wires have been installed, tighten the terminals with the screw located on the top of the terminals to 1.2Nm (10.6lb-in). Be careful not to over tighten.

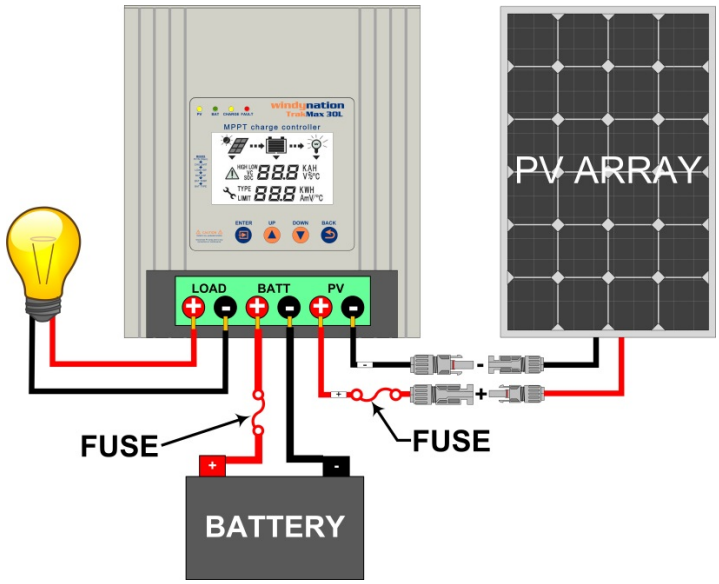
a) Load: Maximum 10A DC Load
- Connect a cable from the TrakMax terminal marked load negative (–) to the negative terminal of your DC load and tighten the screw.
- Connect a cable from the TrakMax terminal marked load positive (+) to the positive terminal of your DC load and tighten the screw.

b) Battery: 30A Rated Charge Current
- Connect a cable from the TrakMax terminal marked battery negative (–) to the negative (–) battery terminal and tighten the screw.
- Connect a cable from the TrakMax terminal marked battery positive (+) on the Solar charge controller to the positive (+) battery terminal and tighten the screw.

IMPORTANT: A properly sized fuse must be placed in the positive wire connecting the charge controller to the battery.

c) PV: Photovoltaic System
- Connect the PV array's positive (+) output to the terminal marked PV positive (+) on the TrakMax and tighten the screw.
- Connect the PV array's negative (–) output to the terminal marked PV negative (–) on the TrakMax and tighten the screw.

IMPORTANT: A properly sized fuse must be placed in the positive wire connecting the solar panels to the charge controller.



4) Double Check All Connections to ensure they are secure.
5) Replace the Wiring Cover removed in step 1 and secure with the four screws.
6) Tighten the cable clamps (if applicable)

CAUTION: Risk of Fire and Shock
Connect battery terminals prior to the connection of array terminals.

3.5 Overcurrent Protection

Circuit breakers or fuses must be installed in both the battery and solar circuits. The protection device ratings and installation methods must conform to NEC requirements.

The battery circuit fuses or circuit breaker must be rated to 125% of the maximum current or more. The minimum fuse/breaker rating allowed for use with each TrakMax is 1.25 x 30 Amps = 37 Amps.

If the TrakMax controller system detects an overload status, it will automatically reset the over current protection system every 6 minutes. If the fault is still present, the controller will shut off and wait for another 6 minutes. This will occur continuously until the problem is corrected.

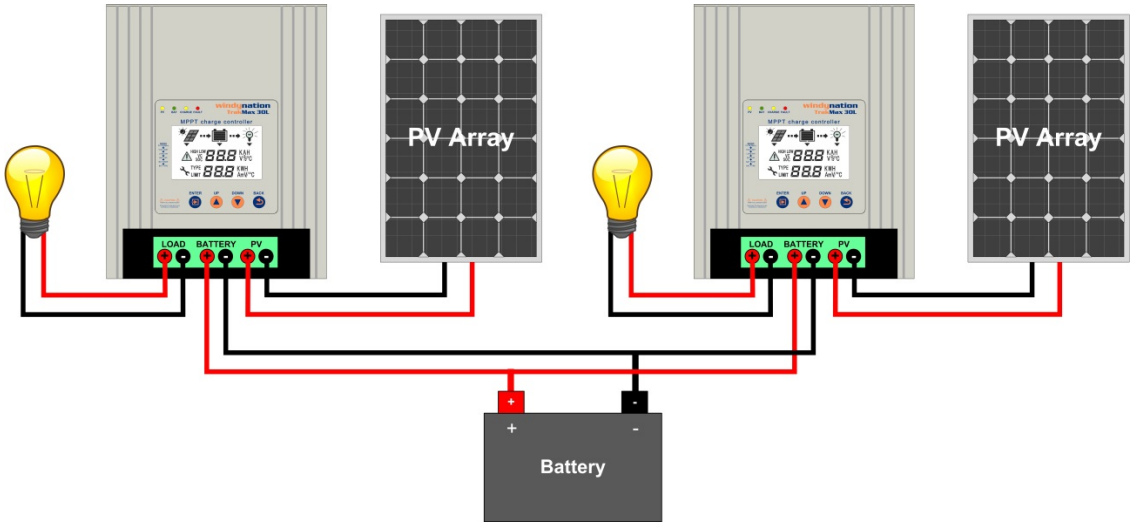
A disconnect is required for the battery and solar circuits to provide a means for removing power from the TrakMax. Double pole switches or breakers are convenient for disconnecting both solar and battery conductors simultaneously.

3.6 Overvoltage – Reverse Polarity Protection

The TrakMax is fully protected against reverse polarity and high voltage transients for both the PV and the battery connections. If the battery is connected in the reverse polarity position, the TrakMax inner fuse will open. If the PV array is connected in the reverse polarity position, the TrakMax will not turn on.

3.7 Parallel Connection

Multiple TrakMax controllers can be installed in parallel on the same battery bank to achieve higher charging current. For example, connecting two TrakMax units in parallel can allow for 60 amps of charging current, and connecting three TrakMax units in parallel can allow for up to 90 amps of charging current. Additional parallel controllers can also be added in the future. Each TrakMax MPPT Controller must have its own PV array. See figure below



3.8 Temperature Sensors (Optional)

The charge voltage required by batteries changes with battery temperature. Temperature compensation of the charge voltage enhances battery performance and life, and decreases battery maintenance.

The TrakMax has dual temperature sensors to detect environmental changes to the battery location as well as detecting excessive battery temperatures that can be harmful to the battery.

Automatic temperature compensation can be provided through use of the optional Temperature Sensor Kit (Part #: CHC-BTSC-02) that includes two temperature sensor cables and the required connector to interface with the TrakMax. Please contact your Windy Nation supplier for availability.

3.8.1 Temperature Compensation

Temperature compensation is based on battery type-5mv/cell for lead acid type batteries and 2mv/cell for alkaline type batteries (NiCad or NiFe). The temperature compensation calculations are derived from the following table:

Battery Type	12 Volt Units	24 Volt Units	48 Volt Units
Lead Acid	0.03 volts (30mv) per degree Celsius	0.06 volts (60mv) per degree Celsius	0.12 volts (120mv) per degree Celsius
NiCad	0.02 volts (20mv) per degree Celsius	0.04 volts (40mv) per degree Celsius	0.08 volts (80mv) per degree Celsius

The table below describes approximately how much the voltage may vary depending on the temperature of the batteries:

Temperature		12 Volt Units		24 Volt Units		48 Volt Units	
Celsius	Fahrenheit	Lead Acid (6 cells)	Lead Acid (12 cells)	Lead Acid (12 cells)	NiCad (20 cells)	Lead Acid (24 cells)	NiCad (40 cells)
60	140	-1.05	-2.1	-2.1	-1.4	-4.2	-2.8
55	131	-0.90	-1.8	-1.8	-1.2	-3.6	-2.4
50	122	-0.75	-1.5	-1.5	-1.0	-3.0	-2.0
45	113	-0.60	-1.2	-1.2	-0.8	-2.4	-1.6
40	104	-0.45	-0.9	-0.9	-0.6	-1.8	-1.2
35	95	-0.30	-0.6	-0.6	-0.4	-1.2	-0.8
30	86	-0.15	-0.3	-0.3	-0.2	-0.6	-0.4
25	77	0	0	0	0	0	0
20	68	0.15	0.3	0.3	0.2	0.4	0.4
15	59	0.30	0.6	0.6	0.4	0.8	0.8
10	50	0.45	0.9	0.9	0.6	1.8	1.2
5	41	0.60	1.2	1.2	0.8	2.4	1.6
0	32	0.75	1.5	1.5	1.0	3.0	2.0
-5	23	0.90	1.8	1.8	1.2	3.6	2.4
-10	14	1.05	2.1	2.1	1.4	4.2	2.8
-15	5	1.20	2.4	2.4	1.6	4.8	3.2
-20	-4	1.35	2.7	2.7	1.8	5.4	3.6
-25	-13	1.50	3.0	3.0	2.0	6.0	4.0
-30	-22	1.65	3.3	3.3	2.2	6.6	4.4
-35	-31	1.80	3.6	3.6	2.4	7.2	4.8
-40	-40	1.95	3.9	3.9	2.6	7.8	5.2

Variances in charging voltage based on battery temperature

3.8.2 Battery Temperature Sensor – BTS (BAT)

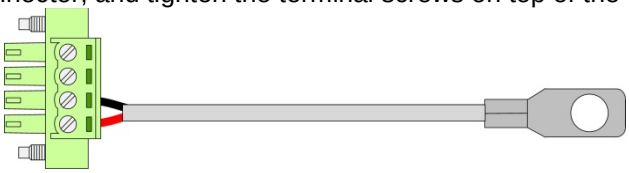
The Battery Temperature Sensor will sense battery temperature and will adjust charging to protect the battery from permanent damage.

When the BTS detects a temperature of 40°C (104°F) the TrakMax will reduce the charge current by 50% to reduce heat dissipation.

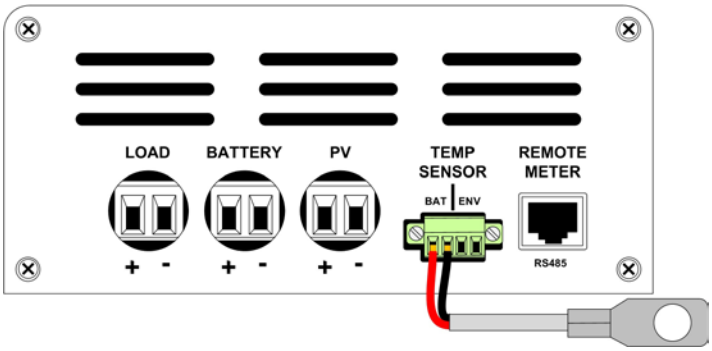
When the BTS detects a temperature of 50°C (122°F) the TrakMax will stop the charge current until the temperature is within a safe operating zone.

3.8.2.1 BTS Installation

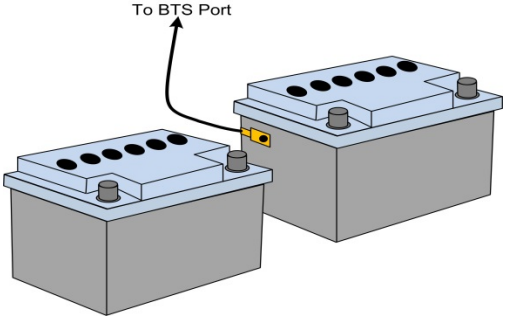
1) The BTS cable is 5m in length and has two plain wires on one end and lug on the other end.
2) Strip approximately ¼" from each wire end, insert the bare wire into the two left terminals on the temperature sensor connector, and tighten the terminal screws on top of the connector as shown below.



3) Plug the provided Temperature Sensor Connector into the socket located on the controller labeled "Temp Sensor" and tighten the two captive screws to secure the connector in place as shown below.



4) Secure the BTS on the side of the battery below the electrolyte level as shown below. It is best to place the sensor between batteries and place the batteries in an insulated box to reduce the influence of the ambient temperature outside the battery enclosure.

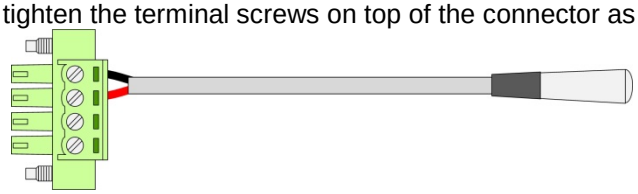


3.8.3 Environment Temperature Sensor (ENV)

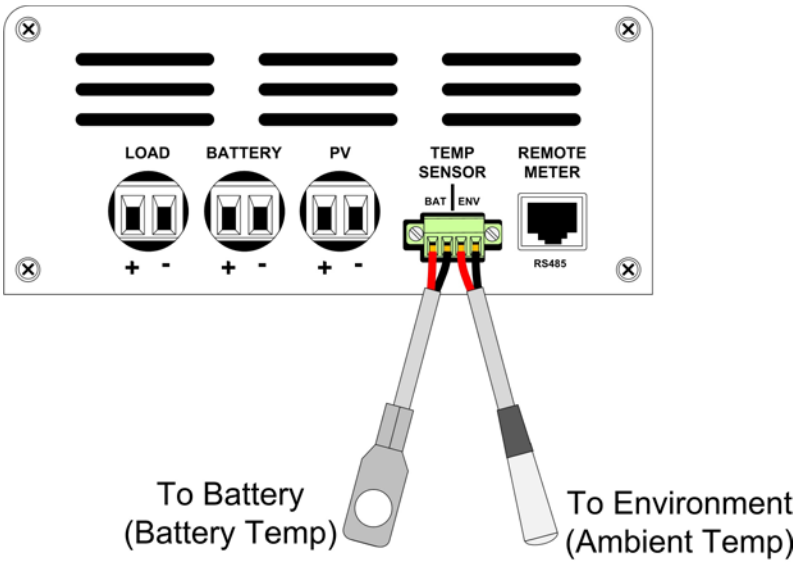
The Environment Sensor is used to automatically compensate the charging voltage based on the Battery Temperature Compensation setting; See Sec 4.7.5.

3.8.3.1 ENV Installation

1) The ENV cable is 5M in length and has two plain wires on one end and a thermocouple sensor on the other end.
2) Strip approx. ¼" from each wire end, insert the bare wire into the two right terminals on the temperature sensor connector, and tighten the terminal screws on top of the connector as shown below.



3) Plug the provided Temperature Sensor Connector into the socket located on the controller labeled "Temp Sensor" and tighten the two captive screws to secure the connector in place as shown below.

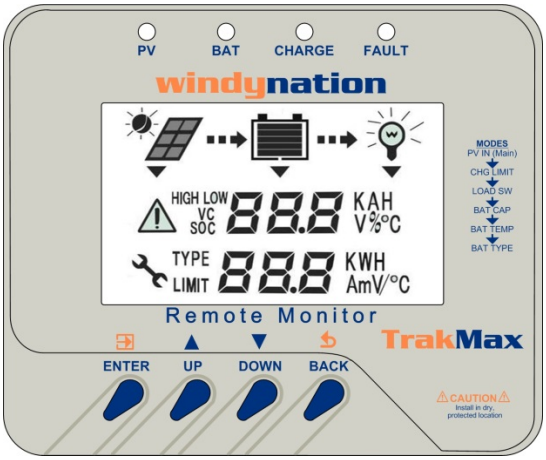


4) Place the sensor close to the batteries but not in direct contact with the batteries.

CAUTION: High power electrical systems pose dangers and it is the user's responsibility to be familiar with these dangers and take any necessary action to ensure safe use. Shorting a battery or connecting your controller to a battery can supply huge currents and have serious consequences including explosions, causing fire, damage to equipment, and personal injury.

3.9 REMOTE MONITOR (OPTIONAL)

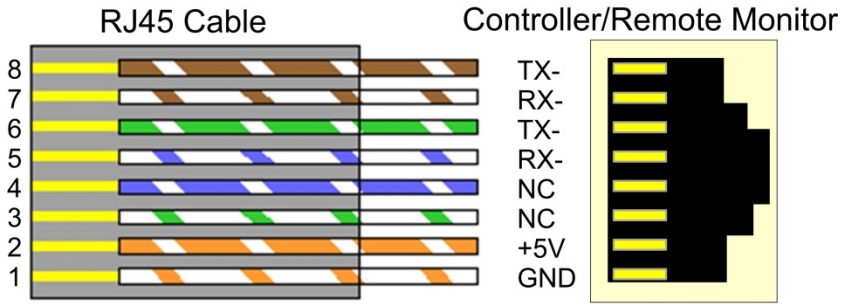
Windy Nation offers an optional remote monitor (CHC-RMTR-01) that allows the user to monitor and configure the system from the remote LCD interface as opposed to the LCD interface located on the TrakMax. The Remote Monitor comes with a 5m cable and mounting bracket.



Parameter	Value
Dimension (H x W x D)	3.62” (92mm) x 4.33” (110mm) x 1.30” (33mm)
Unit Weight	7.2 oz. (204g)
Mounting	Vertical wall mount - indoor only
Enclosure Protection Class	IP20
Operating Temperature	14°F to 140°F (-10°C to 60°C)
Power Supply	5VDC – 200mA
Communication Type	RS-485
Communication Range	1000M

3.9.1 Communication Cable

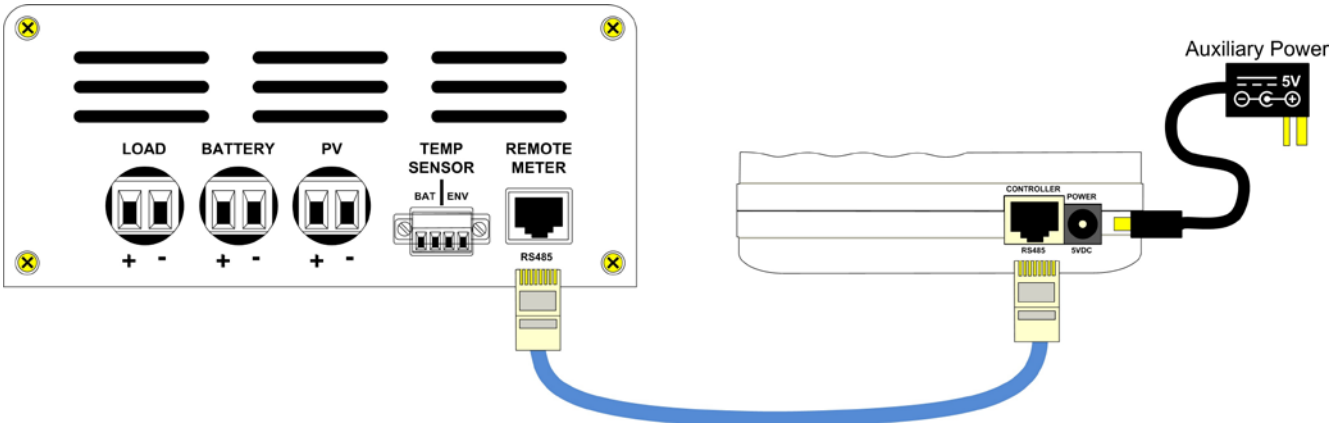
The remote monitor uses RS485 communication via a standard 8-wire RJ45 telephone cable (straight-through, not a Null Modem / cross-over). If possible, pull the cable through conduit before crimping on the RJ45 connectors. If using pre-assembled cables, take care not to damage the plugs when the cables are pulled through conduit.



WARNING: Shock Hazard
Never route network cables in the same conduit as the power conductors.

3.9.2 Connections

The RJ45/RS485 communication port on the controller will provide power to the Remote Monitor for lengths of 5M or less. For distances greater than 5m, the Remote Monitor will require an auxiliary 5VDC power input.
IMPORTANT: Cable length cannot exceed 1 kilometer.

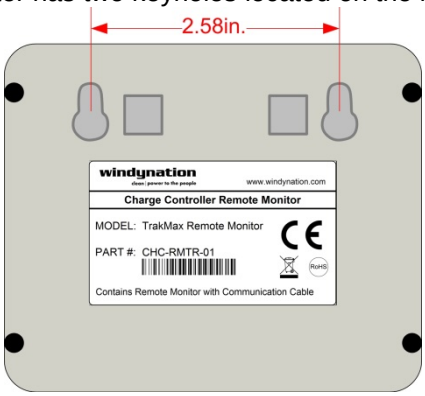


IMPORTANT: If the Remote Monitor shows error “102”, please check the cable connection.

3.9.3 Mounting

There are two ways of mounting the Remote Monitor.

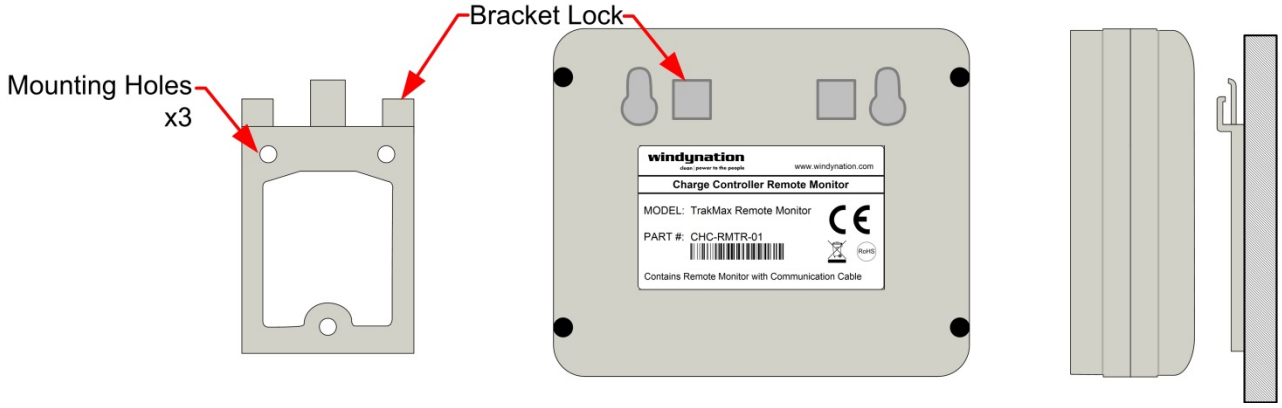
1. Key Holes: The Remote Monitor has two keyholes located on the rear of the enclosure



   a. Secure two screws onto the mounting surface 2.58” (65mm) apart.
   b. Align the keyholes with the head of the screws.

c. Slide the Monitor down until the monitor is secure in place.

2. Mounting Bracket (included)
   a. Secure the mounting bracket in desired location using two or three screws.
   b. Align the bracket locks on the bracket with the bracket locks on the rear of the monitor.
   c. Slide the monitor down until a click is heard and the monitor is secured in place.



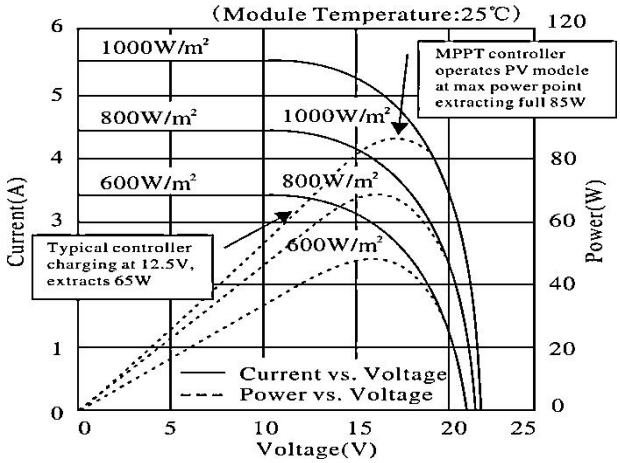
4 OPERATION

4.1 MAXIMUM POWER POINT TRACKING (MPPT)

Maximum Power Point Tracking, frequently referred to as MPPT, is an electronic system that operates the Photovoltaic (PV) modules in a manner that allows the PV modules to produce all the power they are capable of producing.

MPPT and associated current boost operation is fully automatic and will function whenever sufficient PV voltage and current are available. The percent increase in output charge current relative to PV current is variable, and will change with operating conditions. When conditions are such that insufficient PV power is available to produce an increase in output current, the unit will stop its internal DC-DC power conversion and operate as a series pass PWM controller with very low forward voltage drop.

The principal operating conditions which affect current boost performance are PV array temperature and battery voltage. At constant solar intensity, available PV power changes with PV temperature. A PV array's power vs. temperature characteristic is such that a cool PV array can produce a higher voltage and more power, than a hot PV array. When PV voltage is sufficiently high for MPPT to operate, a constant power output is delivered to the battery. Since output power is constant while MPPT is operating, a decrease in battery voltage produces corresponding increase in charge current. This means that the greatest current increase occurs with a combination of cool ambient temperature and low battery voltage. The unit delivers the greatest charge current increase when you need it most, in cold weather with a discharged battery. Additionally, anything that can be done to lower PV array temperature will also lead to increased charge current by increasing PV power production. In cool/comfortable temperatures and typical battery states of charge, most systems see about 10 – 20% increase. Charge current increase can go to zero in hot temperatures, whereas charge current increase can easily exceed 30% with a discharged battery and freezing temperatures.



Current / Power vs. Voltage Characteristics

4.1.1 How MPPT Works

A PV module is a constant current type device. As shown on a typical PV module voltage vs. current curve, current remains relatively constant over a wide range of voltage. A typical 75 watt module is specified to deliver 4.45 amps @ 17 volts @ 25 C cell temperature. Conventional PV controllers essentially connect the PV array directly to the battery when the battery is discharged. When a 75 watt PV module is connected directly to a battery charging at 12 volts, the PV module still provides approximately the same current. But because output voltage is now at 12 volts rather than 17 volts, the PV module's power production is artificially limited and the 75W PV module only delivers 53 watts. This wastes 22 watts of available power.

TrakMax's MPPT technology operates in a very different fashion. Under these conditions TrakMax calculates the maximum power voltage (V) at which the PV module delivers maximum power, in this case 17 volts. It then operates the PV module at 17 volts which extracts maximum available power from the PV module. TrakMax continually recalculates the maximum power voltage as operating conditions change. Input power from the maximum power tracking controller, in this case 75 watts, feeds a switching type power converter which reduces the 17 volt input to battery voltage at the output. The full 75 watts which is now being delivered at 12 volts would produce a current of 6.25 amps. A charge current increase of 1.8 amps or 40% is achieved by converting the 22 watts that would have been wasted into useable charge current. Note that this example assumes 100% efficiency to illustrate the principal of operation. In actual operation, the power boost will be somewhat less.

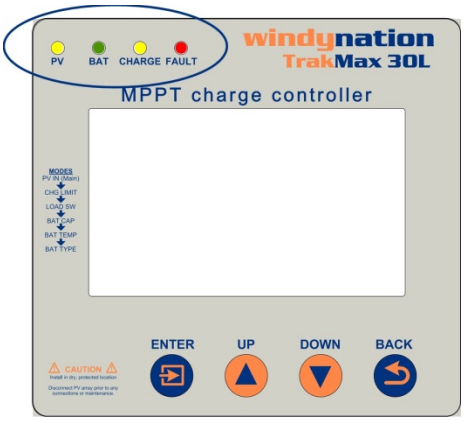
4.2 POWER

Once the controller is properly connected to a battery, the solar controller will start automatically. The main display interface will appear in the LCD and the current PV / Solar panel voltage and current will be displayed. Press the 'UP' or 'DOWN' buttons to cycle through the six different interfaces available on the TrakMax controller. The cycle pattern of the interfaces is presented in Section 4.5 and some of the parameters are user configurable. When any key is pressed, the LCD backlight will automatically turn on. The backlight will automatically turn off when the controller is idle for 30 seconds.

To power down the controller, cover the solar panels and disconnect the PV input to the controller. Remove the battery connection and check the charge controller status. Once the LEDs and LCD display turn off, the charge controller is shut off.

4.3 LED MODES

The TrakMax has four LED indicators to quickly observe the operating status of the controller.

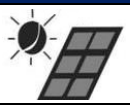


LED	ON	OFF
PV	PV input voltage present	No input PV voltage
BAT	BATTERY voltage present	No BATTERY voltage
CHARGE	CHARGING in process	No CHARGING
FAULT	FAULT or abnormality present	Normal Operation

4.4 Button Definitions

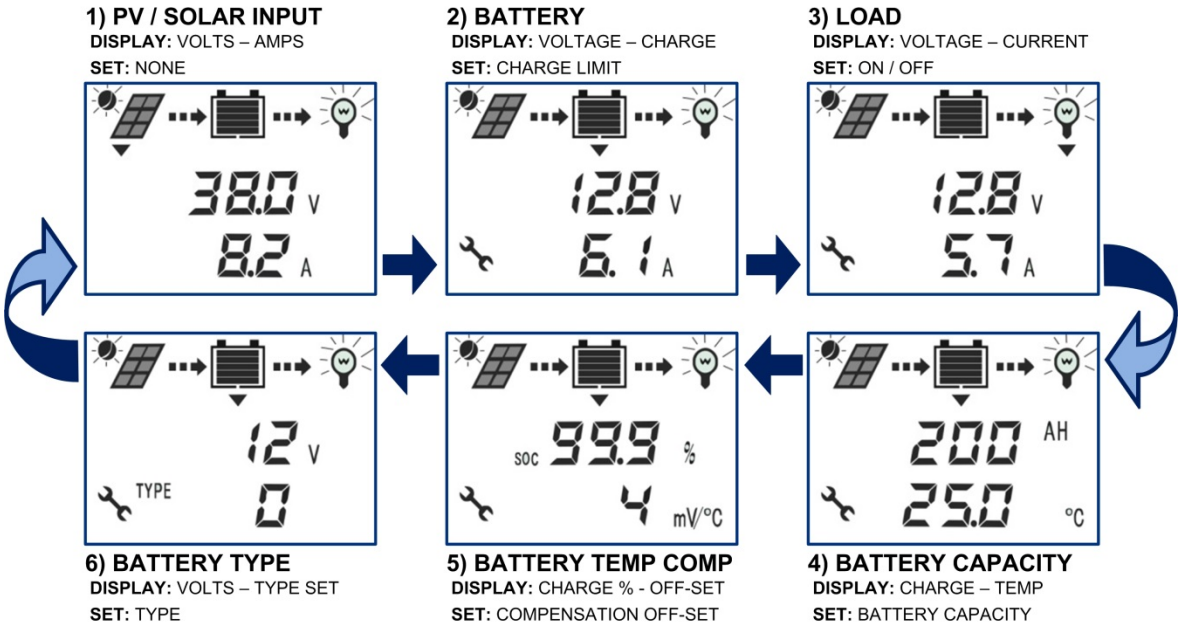
Button	Name	Description
ENTER	ENTER	Enter into current parameter setting state. Once in provisioning mode, the parameter will blink. Once finished, press ENTER again to save parameter settings.
UP	UP	Cycle interface settings to next available interface. Positive (+) parameter adjustments to modify parameter values.
DOWN	DOWN	Cycle interface settings to previous available interface. Negative (-) parameter adjustments to modify parameter values.
BACK	BACK	Escape interface setting without saving the current parameters and return to MAIN page

4.5 LCD Graphic Indicators

LCD Symbol	Description
	PV – Solar Panel Array Symbol.
	BATTERY Symbol. Each cell corresponds to 20% of the battery capacity. Capacity is calculated based on 100% of full voltage.
	LOAD Symbol

	ERROR Symbol. When present check the TrakMax controller and refer to Section 5 (Error Conditions) and 6 (Troubleshooting)
	PARAMETER SET Symbol When present in a particular interface, there is a user configurable parameter available. Press ENTER and the

4.6 LCD Interface Cycle

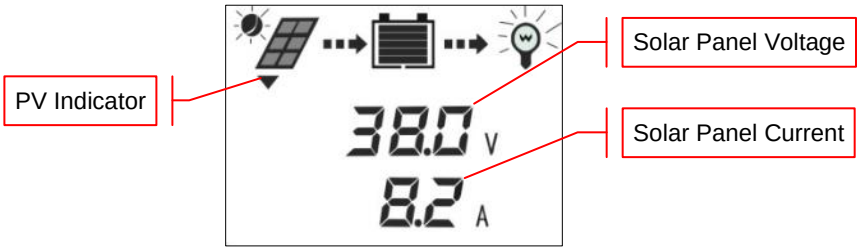


4.7 Interface Definitions

The TrakMax has six different graphical interfaces. Each interface contains different information. There are five interfaces with the symbol, these interfaces contain configurable parameters.

4.7.1 PV / Solar Input Interface (Main)

This is the MAIN Interface and the displayed number is the present Solar Panel voltage (displayed in Volts) and the solar panel current (displayed in Amps).

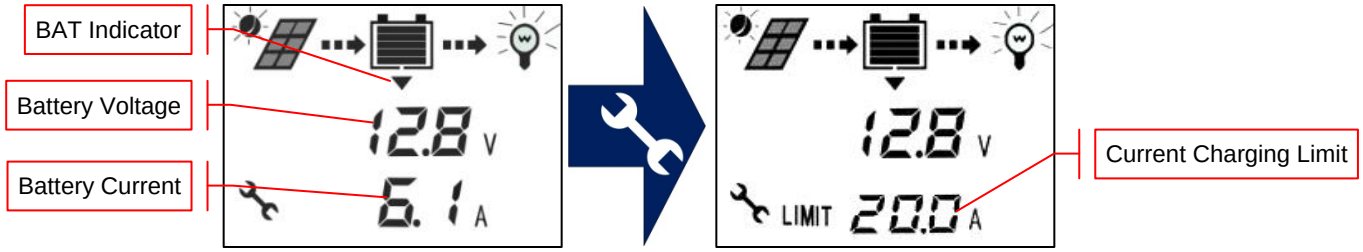


4.7.2 Battery Interface – Charge Limit Setting

The Battery Interface displays the current Battery voltage and current. The TrakMax supports a maximum charging current of 30A, but this can be modified to limit the charge to 10A, 20A, or 30A. Default Setting: 30A.

From the Battery Interface, press the ENTER key and hold for 3 seconds to enter setup mode. Once in setup mode will blink and “LIMIT” will be displayed. Press the UP or DOWN keys to adjust to the desired value and press ENTER to save and return to main page.

NOTE: If you do not want to save the setting, press the BACK key to return to main page and original set value.

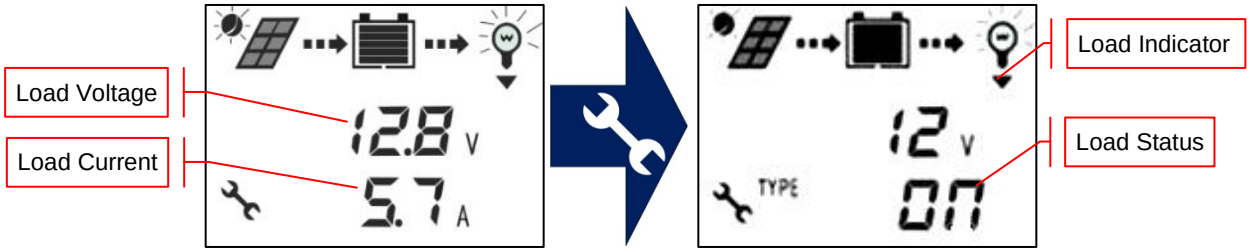


4.7.3 Load Interface

The value displayed in this interface is the output voltage and current from the controller to the load; i.e.: the current being consumed by the load (displayed in Amps).

From the Load Interface, press the ENTER key and hold for 3 seconds to enter setup mode. Once in setup mode will blink and "TYPE" will be displayed. Press the UP or DOWN keys to adjust the DC Load to be "ON" or "OFF". Once correct, press ENTER to save and return to main page.

NOTE: If you do not want to save the setting, press the BACK key to return to main page and original set value.

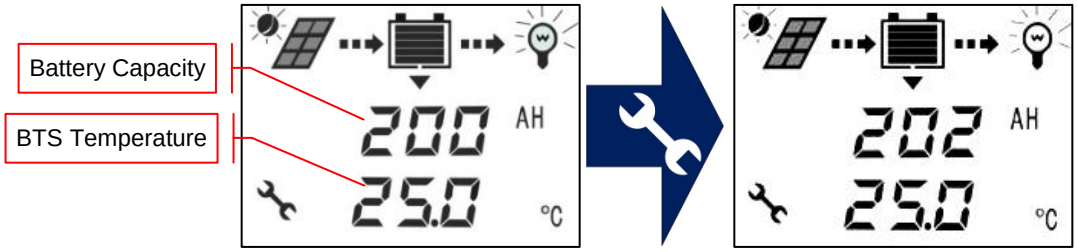


4.7.4 Battery Capacity Interface

The Battery Capacity Interface displays the battery capacity as set by the user and the temperature at the Battery Temperature Sensor (BTS) as described in Section 3.8 (displayed in degrees Celsius). The temperature is used for the temperature compensation of battery charging. The battery capacity can be modified to accurately depict the end user system.
Default Setting: 200Ah.

To set the Battery Capacity, press the ENTER key and hold for 3 seconds to enter setup mode. Once in setup mode will blink. Press the UP or DOWN keys to adjust to the desired value and press ENTER to save and return to main page. Valid Range: 1 to 999Ah.

NOTE: If you do not want to save the setting, press the BACK key to return to main page and original set value.

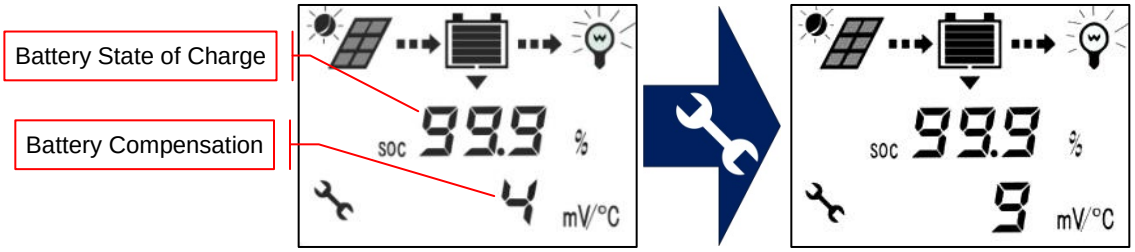


4.7.5 Battery Temperature Compensation Interface

The values displayed in the Battery Temp Compensation interface is the current battery's state of charge and the current temperature compensation setting as described in Section 3.8.1 (displayed as millivolts per degree Celsius).
Default Setting: 4mV/^{o}C
Note: Set to 0 mV/^{o}C when the Temperature Sensors are not used.

To set the Battery Temperature Compensation, press the ENTER key and hold for 3 seconds to enter setup mode. Once in setup mode will blink. Press the UP or DOWN keys to adjust to the desired value and press ENTER to save and return to main page. Valid Range: 0 to 10 mV/°C; when set to '0' there is no temperature compensation. Refer to Section 3.8.1 for recommended values and additional information.

NOTE: If you do not want to save the setting, press the BACK key to return to main page and original set value.



4.7.6 Battery Type Interface

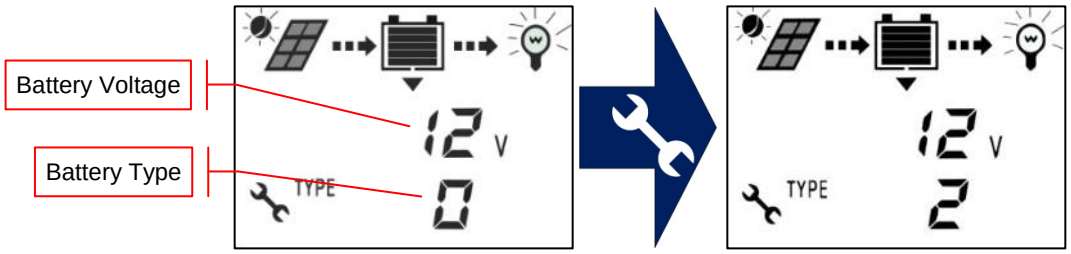
It is important to select the battery type that matches the system battery to ensure proper charging and long battery life. The battery type is selected through this interface and used to set the TrakMax for the proper float and bulk voltage levels. These levels are selected depending on the type of batteries used. Refer to the table below for the charge voltages of the various types. Refer to the specifications provided by the battery manufacturer and choose a setting that best fits the recommended charging profile.

To set the Battery Type, press the ENTER key and hold for 3 seconds to enter setup mode. Once in setup mode will blink. Press the UP or DOWN keys to adjust to the desired value and press ENTER to save and return to main page.

- Battery Type: The common battery type associated with the specified charging settings.
- Float Stage: When the battery is fully charged, the charging voltage will be reduced to the Float voltage setting.

		12 Volt		24 Volt		48 Volt	
TYPE	**Battery Type**	**Float Stage (Volts)**	**Bulk Equalize (Volts)**	**Float Stage (Volts)**	**Bulk Equalize (Volts)**	**Float Stage (Volts)**	**Bulk Equalize (Volts)**
0	Maintenance Free Lead Acid	13.6	14.4	27.2	28.8	54.4	57.6
1	Gel Cell	13.7	14.3	27.4	28.6	54.8	57.2
2	Deep Cycle Wet Lead Acid	13.6	14.3	27.2	28.6	54.4	57.2
3	Lithium	12.6	12.6	25.2	25.2	50.4	50.4

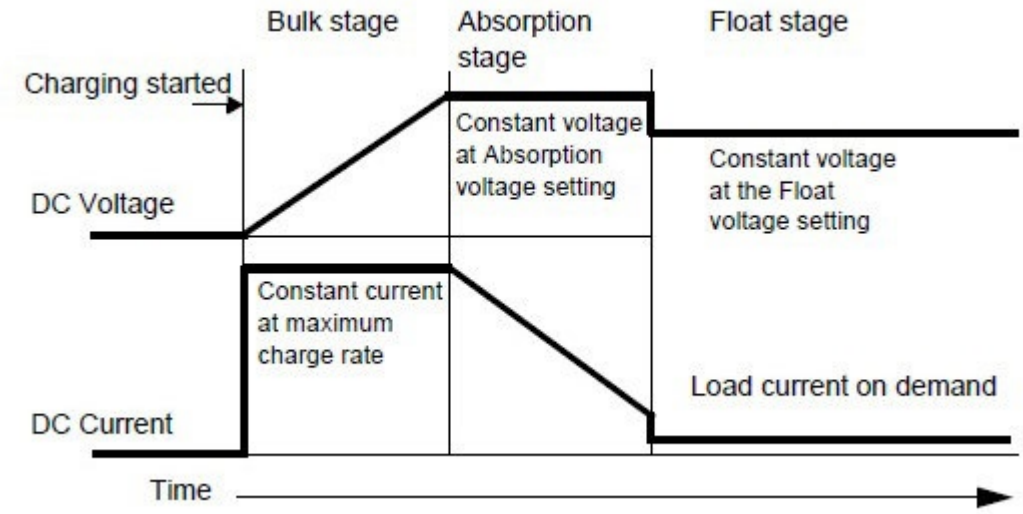
NOTE: If you do not want to save the setting, press the BACK key to return to main page and original set value.



4.8 CHARGE MODE

4.8.1 Three Stage Charge

The TrakMax is configured for a three stage charging process, Bulk, Absorption, and Float. The three stage charge process provides a somewhat higher charge voltage to charge the battery quickly and safely. Once the battery is fully charged, a somewhat lower voltage is applied to maintain the battery in a fully charged state without excessive water loss. The three stage charge process charges the battery as quickly as possible while minimizing battery water loss and maintenance.



Charge Mode	Maintenance Free Lead Acid	Gel	Deep Cycle Wet Lead Acid	Lithium
Bulk	14.4V	14.3V	14.3V	12.6V
Absorption	14.4V	14.3V	14.3V	12.6V
Float	13.6V	13.7V	13.6V	12.6V

12V Set Points

4.8.1.1 Bulk Stage

When charge starts the TrakMax attempts to apply the bulk charge voltage to the battery. The system will switch to Bulk charge if the battery is sufficiently discharged and/or insufficient charge current is available to drive the battery up to the bulk voltage set point.

During this stage, the batteries are charged at the bulk voltage setting. And the unit delivers as much charge current as possible to rapidly recharge the batteries. When the battery voltage reaches the bulk voltage setting, the charge controller activates the next stage (absorption). TrakMax will again switch to Bulk charge if battery voltage drops below the present charge voltage set point. Maximum Duration: 3 hours

4.8.1.2 Absorption Stage

During this stage, the unit changes to a constant voltage mode where the absorption voltage is applied to the battery. When charge current decreases to the float transition current setting, the battery is fully charged and the unit switches to the float stage. Maximum Duration: 8 hours

4.8.1.3 Float Stage

During this stage, the float voltage is applied to the battery to maintain it in a fully charged state. When battery voltage drops below the float setting for a cumulative period, a new bulk cycle will be triggered.

4.9 DC LOAD CONTROL

The TrakMax can operate as a PV charge controller and can regulate up to 30 Amps of continuous photovoltaic (PV) array current at 12, 24, or 48 volts DC for charging batteries. At the same time the TrakMax can provide a maximum of 10 Amps of current to a DC load.

The TrakMax uses voltage set points to determine when to disconnect or reconnect loads depending on battery voltage. TrakMax prevents damage to the battery from over-discharge during periods of poor weather or excessive loads and can charge the batteries in this function.

4.9.1 Low Voltage Disconnect

The TrakMax will disconnect the load from the batteries when it reaches the low voltage disconnect (LVD) setting as shown in the table below.

Battery Voltage	Battery Type			
	Maintenance Free Lead Acid	Gel	Deep Cycle Wet Lead Acid	Lithium
12V	10.5V	10.5V	10.5V	9.0V
24V	21.0V	21.0V	21.0V	18.0V
48V	42.0V	42.0V	42.0V	36.0V

4.9.2 Low Voltage Reconnect

The TrakMax will also provide automatic reconnection of the loads at the low voltage reconnect (LVR) setting. Reconnection of the load is allowed once the battery voltage has exceeded the low voltage reconnect (LVR) setting as shown in the table below.

Battery Voltage	Battery Type			
	Maintenance Free Lead Acid	Gel	Deep Cycle Wet Lead Acid	Lithium
12V	12.0V	12.0V	12.0V	9.6V
24V	24.0V	24.0V	24.0V	19.2V
48V	48.0V	48.0V	48.0V	38.4V

5 ERROR CONDITIONS

When the ERROR Symbol  appears in the LCD display the controller has detected an abnormality in the system and an error code will appear in the second line on the display.

The list of Error codes is presented in the table below and can help identify a possible equipment failure, fault or incorrect setting - configuration. All attempts to correct or clear a fault must be performed by qualified personnel. Typically, the error can be cleared once the fault is removed but a restart of the charge controller is recommended after each attempt to remedy the situation by removing battery power for 30 seconds.

If after restarting the controller the error remains, it may indicate a fatal error and will require you to contact the supplier or Windy Nation for warranty services.

Error Code	Description	Possible Remedies
101	EEPROM Fault	• Power down and restart the controller.
102	Remote Communication Fault	• Check Remote Monitor connections. • Verify cable is correctly wired • Check cable for any damage
103	Low Input PV Voltage	• Ensure the PV panel is in direct sun-light. • Remove PV connection and check the PV voltage.
104	High Input PV Voltage	• Remove PV connection and check the PV voltage. • Adjust solar panel wiring to be within acceptable range
105	Low Battery Voltage (≤9.0V)	• Check the battery voltage. • Charge battery as necessary

106	High Battery Voltage (≥15.0V)	• Check the battery voltage • Check internal fuse for damage.
107	High Charge Current	• Restart the solar charge controller. • Adjust charging current
108	High Load Current	• Check the DC load. • Reduce Load
109	High Battery Temperature	• Check the temperature sensor. • Check ambient temperature surrounding batteries • Increase ventilation around batteries
110	High Controller Temperature	• Check ambient temperature surrounding controller • Increase ventilation around controller • Check air vents on controller for blockage

6 TROUBLESHOOTING AND SUPPORT

The TrakMax is ruggedly constructed and requires minimal care. It is recommended to inspect all the controller connections two times per year for insulation damage or corrosion and to ensure all connections are tight and secure.

CAUTION: Shock Hazard
Disconnect all power sources to the controller before removing the wiring box cover. Never remove the cover when voltage exists on the power connections.

6.1 CARE

- Clean the heat sink and area around the controller of any dirt or debris with a moistened cloth.
- Ensure controller air vents are clear of obstructions.
- Tighten the screws on the terminals. Inspect for loose, broken, or burnt wire connections.
- Inspect the battery bank for cracked or bulging cases and corroded terminals.
- For wet cell flooded batteries, make sure the water level is maintained according to the manufacturer's recommendations.

6.2 TROUBLESHOOTING

Problem	Possible Remedies
No LED indications, controller does not appear to be powered	• Check the voltage at the battery terminals on the TrakMax. Battery voltage must be a constant 12 VDC or greater. If no voltage is measured, check wiring connections, fuses, and breakers. • If the voltage on the battery terminals of the controller is between 12 and 36 VDC and no LEDs are lit, contact your dealer for service.
Charge LED on, but no output charge current	• Is the battery voltage greater than the charge voltage set point? This is normal operation. Output is off due to high battery voltage which may be caused by other charging systems. • Battery voltage must be at least 9VDC for the unit to operate.
Unit is on, but charge status LED is off	• Check PV connections for reverse polarity. • PV must supply at least 0.25Amp at 3V more than battery voltage to begin charge. • Check ground (-) connections. PV- & BAT- must be separate for operation.
Charge current or PV current is lower than expected	• Check battery voltage, current is reduced if battery voltage is at set points. • Check atmospheric haze, dirty PV's, or sun low on horizon, etc. • Check PV voltage; if system has been changed from 24VDC to 12VDC (or vice versa), battery and PV power must be momentarily disconnected from the TrakMax to reboot the unit and load initial 12 or 24VDC control values. • Check ground (-) connections. PV- & BAT- must be separate for operation.

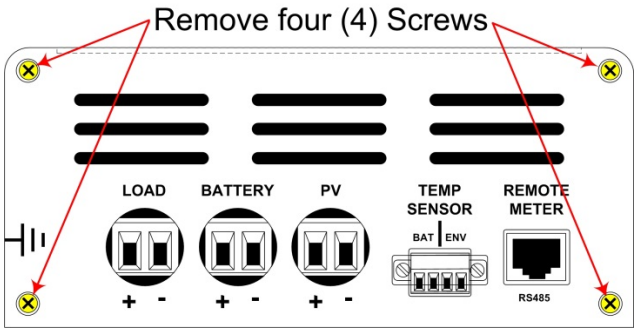
Charge OFF at high temperature	• The system temporarily shuts down due to high heat sink temperatures. • Improve ventilation or reduce PV power to prevent over temp shut down.

6.3 FUSE REPLACEMENT

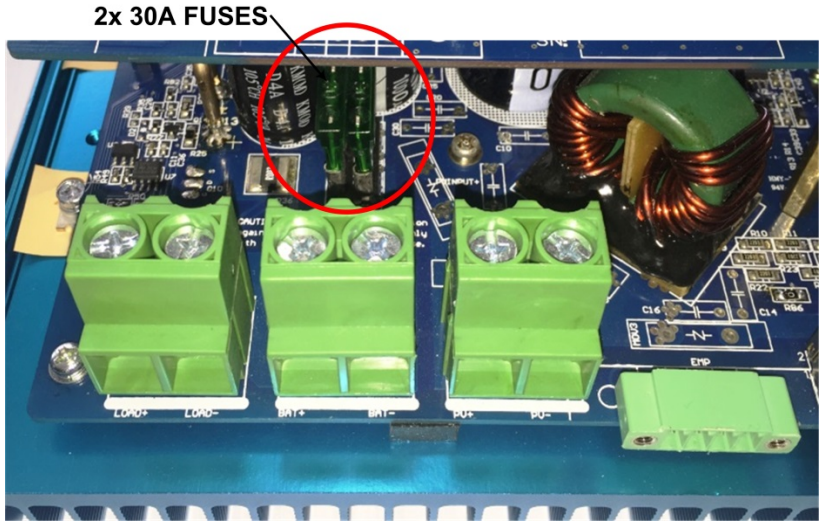
WARNING: Shock Hazard
Verify that the solar input and battery breaker or disconnect has been opened (disconnected) before opening the controller.

The TrakMax is shipped with two spare fuses. In the event a fuse is blown due to surges, the fuse can be replaced or examined in the field.

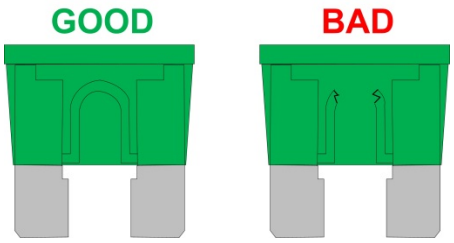
1) Remove the Wiring End Cover from the Top Cover by removing the four securing screws as shown below.



2) Locate the two fuses as shown in the image below and carefully pry each fuse from the socket.



3) Inspect the fuse to see if the fuse is blown. A blown fuse will have the internal connection broken; see image below.



4) Replace the fuse by carefully inserting the fuse back into the relevant socket from Step 2.
5) Reconnect all connections as instructed in Sec 3.4.
6) Replace the Wiring Cover removed in step 1 and secure with the four screws.
7) Tighten the cable clamps (if applicable)

6.4 SUPPORT

If you are experiencing technical problems, and cannot find a solution in this manual, you can contact Windy Nation Inc. for further assistance.

- Call: (805) 323-6445
- Email: info@windynation.com
- Write: 398 S. Ash St. Unit C, Ventura, CA 93001

For challenging issues or to just ask a question, consider using our FREE Community Forums! Consult our community of DIY'ers for fast answers to all your questions.

Post on our Forums: Windy Nation Community Forum

6.5 LIMITED WARRANTY

Windy Nation warrants that the MPPT Charge Controller (the "Product"), will be free from manufacturing defects in materials and workmanship under normal authorized use consistent with product instructions for a period of one (1) year from the date the original purchaser ("Customer") receives the Product (the "Warranty Period"). This warranty extends only to the original purchaser. The Customer's sole and exclusive remedy and the entire liability of Windy Nation, its suppliers and affiliates for breach of the warranty is, at Windy Nation's option, either (i) to replace the Product (or defective component part(s)) with a new or reconditioned Product (or component part(s)); (ii) to repair the reported problem; or (iii) to refund the purchase price of the Product. Repaired or replaced products are warranted for the remainder of the original warranty period only. No employee, agent, dealer or other person is authorized to give any warranties on behalf of Windy Nation not expressly set forth in this limited warranty.

6.6 RESTRICTIONS

No warranty will apply if the Product (i) has been altered or modified except by Windy Nation; (ii) has not been installed, operated, repaired, or maintained in accordance with instructions supplied by Windy Nation; (iii) has been subjected to abnormal physical, thermal or electrical stress, misuse, negligence, or accident. If Windy Nation determines that the problem with the Product is not due to a manufacturing defect in Windy Nation's workmanship or materials, or otherwise does not qualify for warranty repair, then the Customer will be responsible for the costs of all necessary repairs and expenses incurred by Windy Nation.

6.7 WARRANTY CLAIMS & RETURN PROCEDURES

To be eligible for service under this warranty, the Customer must submit a service request within the Warranty Period by contacting Windy Nation in writing or via telephone and obtaining a Returned Materials Authorization ("RMA") number. This RMA must be obtained before returning any product under this warranty. Notification must include a description of the alleged defect, the manner in which the Product was used, the serial number, and the original purchase date in addition to the name, address, and telephone number of the Customer. Within five (5) business days of the date of notification, Windy Nation will provide the Customer with an RMA number and the location to which the Customer must return the defective Product. Any Product returned for warranty service shall be shipped at the expense and risk of the Customer. The Customer must return the entire Product kit (or, if authorized by Windy Nation, the defective component parts), within fifteen (15) days after issuance of the RMA number. Windy Nation will be under no obligation to accept any returned Product that does not have a valid RMA number. Customer's failure to return the Product within fifteen (15) days of its receipt of an RMA number may result in cancellation of the RMA. All parts that Windy Nation replaces shall become Windy Nation's property on the date Windy Nation ships the repaired Product or part back to the Customer. Windy Nation will use all reasonable efforts within thirty (30) days of receipt of the defective Product to repair or replace

such Product. If a warranty claim is invalid for any reason, the Customer will be charged at Windy Nation's then-current rates for services performed and will be charged for all necessary repairs and expense incurred by Windy Nation. If Windy Nation determines that a warranty claim is valid, it will ship the repaired or replaced Product to Customer at Windy Nation's cost.

6.8 DISCLAIMER

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7 APPLICATION

7.1 BATTERIES

Batteries come in different sizes, types, amp-hour capacity, voltages and chemistries. Here are a few guidelines that will help in battery selection, and ensure that the batteries are properly maintained. The best source of the most appropriate settings for the TrakMax will be from the manufacturer or supplier of the batteries.

7.1.1 Automotive Batteries

Automotive and truck batteries are designed for high cranking power – not deep-cycling. Do not use them unless no other battery type is available. They simply will not last long in a cycling application.

7.1.2 Maintenance-Free Batteries

This type of battery is often sold as a RV or marine battery, but is rarely appropriate for use with a PV system. They typically have an additional reserve of electrolyte, but are vented. This is not the same as a sealed battery.

7.1.3 Deep-Cycle Batteries

Best suited for use with PV systems, this type of battery is designed to be more deeply discharged before being recharged. Deep-cycle batteries are available in many sizes and types. The most common is the vented liquid electrolyte battery. Vented batteries usually have battery caps. The caps may appear to be sealed, but are not. The caps should be removed periodically to check the level of electrolyte. When a cell is low, distilled water should be added after the battery is fully charged. If the level is extremely low, add only enough distilled water to cover the plates before recharging. The electrolyte volume increases during the charging process and the battery will overflow if it is filled all of the way up before recharging. Use only distilled water because impurities will reduce battery performance. A popular and inexpensive deep-cycle battery is the “golf cart” battery. It is a 6-volt design, typically rated at 220amp-hours. RV and marine deep-cycle batteries are also popular for small systems. They are usually referred to as Group 24 or Group 27 batteries and are rated at 80 to 100 amp-hours at 12volts. Many larger systems use L16 batteries, which are usually rated at 350amp-hours at 6-volts each. They are 17 inches high and weigh about 130pounds. 8D batteries are available with either cranking or deep-cycle construction. Purchase only the deep-cycle version. The 8D is typically rated at 220 amp hours at 12 volts.

7.1.4 Sealed Batteries

Another type of battery construction is the sealed gel cell. They do not use battery caps. The electrolyte is in the form of a gel rather than a liquid, which allows the batteries to be mounted in any position. The advantages are no maintenance, long life (800 cycles claimed) and low self-discharge. Absorbed glass mat (AGM) electrolyte batteries are also acceptable. Their electrolyte is contained in mats between the battery plates. Sealed batteries reduce the maintenance requirements for the system and are good for remote applications. They are much more sensitive to the charging process and can be ruined in as little as a day of overcharging.

7.1.5 Battery Sizing

Batteries are the fuel tank of the system. The larger the batteries, the longer the system can operate before recharging is necessary. An undersized battery bank results in short battery life and disappointing system performance. To determine the proper battery bank size, compute the number of amp-hours that will be used between charging cycles. Once the required amp-hours are known, size the batteries at approximately twice this amount. Doubling the expected amp-hour usage ensures that the batteries will not be overly discharged and will extend battery life.

7.1.6 Equalization Charging

Approximately every month, some batteries may need to be “equalized.” Since the individual cells of the battery are not identical, some cells may not be fully charged when the charging process is completed. If the batteries have been left in a discharged condition for long periods of time, the plates will have sulfates on them from the electrolyte. If the sulfate remains on the plates for an extended period of time, it will harden and seal off a percentage of the plate area, reducing the capacity of the battery. By equalizing the batteries before the sulfate hardens, the sulfate is removed from the plates. Batteries with liquid electrolyte may become stratified. Stratification concentrates the sulfuric acid into the bottom of the cell while the top becomes diluted. This corrodes the lower portion of the plates, reducing battery life. Mixing of the electrolyte by the formation of gas bubbles during the equalization process reduces stratification. Two methods can be used to determine if a battery needs to be equalized. If possible, measure the voltage of each individual cell while the battery is at rest (not being charged or discharged). A variation of 0.05 volts between cells indicates an imbalance exists. If the

battery construction prevents measurement of the individual cell voltages, use a hydrometer. A variation of 0.020 in the specific gravity between cells is considered significant. Both conditions can be corrected by an equalization charge. A proper equalization charge will not damage a vented, liquid electrolyte type battery. It may, however, cause significant electrolyte usage and require that the battery be refilled with distilled water to the correct level. This may be a problem with unattended systems in remote areas which do not receive regular maintenance. Consult the battery manufacturer for their recommendations.

7.1.6.1 Equalization Set Points (Non-Sealed Batteries Only)

Battery Type	Bulk Volts	Float Volts	Equalizing Charge
Default Settings	14.0 VDC	13.5 VDC	Disabled
Sealed Gel Lead Acid	14.1 VDC	13.6 VDC	Not recommended; Consult battery manufacturer
AGM Lead Acid	14.4 VDC	13.4 VDC	Charge to 15.5 VDC or per manufacturer.
Maintenance-Free RV/Marine	14.4 VDC	13.4 VDC	Limited; Only if water level can be checked.
Deep-Cycle, Liquid Electrolyte Lead Antimony	14.6 VDC	13.4 VDC	Charge to 15.5 VDC or per manufacturer.
NiCad or NiFe Alkaline	16.0 VDC	14.5 VDC	Not recommended; Consult battery manufacturer

7.2 Wire Gauge Reference

AWG	Diameter inches (mm)	Ohms per 1000ft	Break Force	Square mm2
16	0.051 (1.29)	4.016	75 lbs	1.30
14	0.064 (1.63)	2.525	119 lbs	2.08
12	0.081 (2.05)	1.588	197 lbs	3.30
10	0.102 (2.59)	0.999	314 lbs	5.26
8	0.129 (3.26)	0.628	480 lbs	8.30
6	0.162 (4.11)	0.395	760 lbs	13.30
4	0.204 (5.19)	0.249	1210 lbs	21.15
2	0.258 (6.54)	0.156	1930 lbs	33.62
1	0.289 (7.35)	0.124	2430 lbs	42.41
0 (1/0)	0.325 (8.25)	0.098	3060 lbs	53.49
00 (2/0)	0.365 (9.27)	0.078	3860 lbs	67.43
000 (3/0)	0.410 (10.4)	0.062	4860 lbs	85.01
0000 (4/0)	0.460 (11.68)	0.049	6120 lbs	107.22