

## **Using a TriStar MPPT for Bridged Communication on a Morningstar EIA-485 Network**

### **Abstract:**

This document provides details regarding configuration of the TriStar-MPPT-60, along with additional Morningstar devices, for bridged MODBUS/TCP communication on an EIA-485 network.

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## Introduction

Introduced by the Electronic Industries Alliance (EIA) in 1983, EIA-485 is an alternative to RS-232 point to point serial communication. EIA-485's 2 wire, half-duplex communication utilizes differential signaling, supporting multiple devices on a signal bus up to 1200m(4000ft) in length. Along with the use of twisted-pair wiring, EIA-485's Differential signaling results in a communication option less susceptible to external "noise" and interference, making it ideal for commercial and industrial applications.

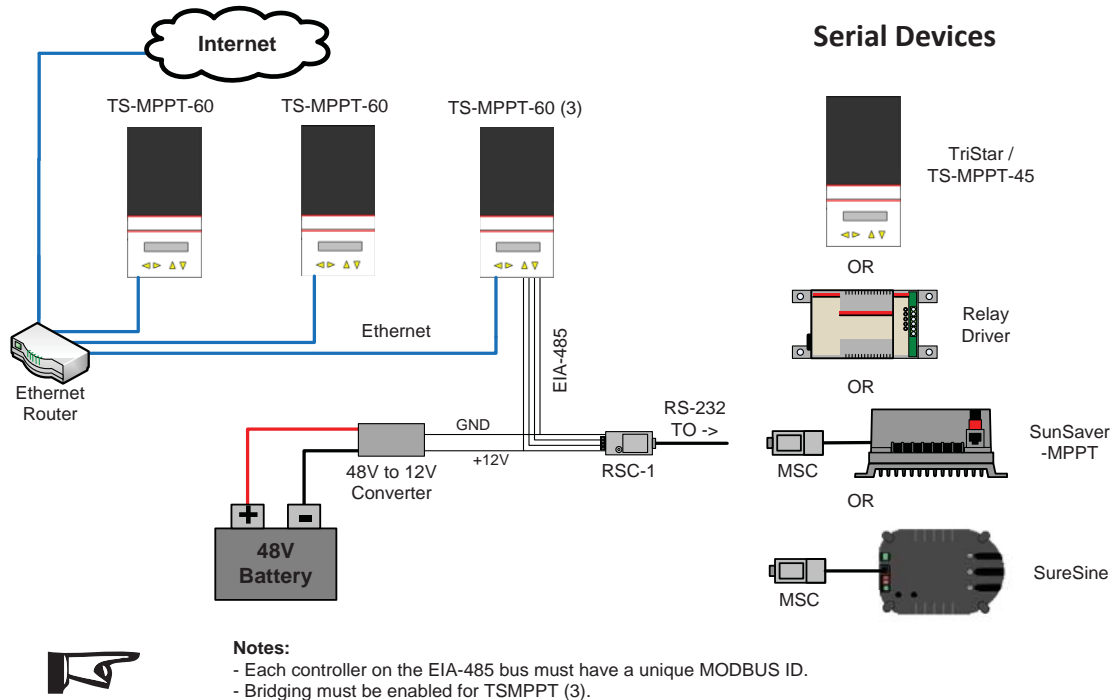
Morningstar has incorporated the EIA-485 communication standard into our TriStar MPPT line of Solar Charge Controllers. To Further enhance the configuration, control, and monitoring potential of our products, we have added EIA-485/MODBUS/TCP bridging to the communication platform of the TS-MPPT-60. Users taking advantage of this configuration, gain the ability to link multiple Morningstar MODBUS devices on a single communication bus and communicate with these devices from a central location via a LAN/WAN/Internet connection.

## Wiring/Adapters

The Morningstar EIA-485 communication bus is comprised of four wires. Technically, only two wires are responsible for communication. Wires A and B (positive and negative) are used for data transmission. In most configurations, these two wires are run using twisted pair cable. Either STP (shielded twisted pair) or UTP(unshielded twisted pair) may be used, however STP will provide additional protection from outside interference and noise. The remaining two wires in the 4 wire configuration are connected to an external power supply and ground. Communications being bridged to and from the bus are received by the Master/ TS-MPPT-60 through the RJ-45/Ethernet connection. The MPPT then bridges MODBUS requests to the bus, and ultimately to the appropriate slave/controller.

Included in the Morningstar product line are the RSC-1 and MSC adapters. These adapters enable users to communicate with Morningstar controllers that are not equipped with an EIA-485 port. The Morningstar RSC-1 adapter enables EIA-485 to serial conversion via the controller's RS-232 serial port. The Morningstar MSC (meterbus adapter) allows for serial communication via the controller's RJ-11 meterbus port, and may be connected to the 485 bus with the addition of the RSC-1. Once connected to the bus, MODBUS communication with these controllers over a WAN/LAN is possible thanks to the IP/MODBUS Bridging capability of the TriStar-MPPT-60.

## TS-MPPT EIA-485 Bridging Network

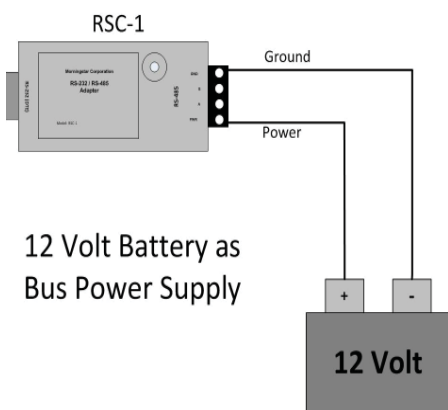


## External Power

Although the TS-MPPT-60 is equipped with an integrated RS-485 port, the controller does not provide operating voltage to the bus, resulting in the need for external power. Additionally, the RSC-1 adapter requires an external power source to provide the 8-16Vdc needed for operation. Details regarding this external power source must be taken into consideration when designing a Morningstar RS/EIA-485 network.

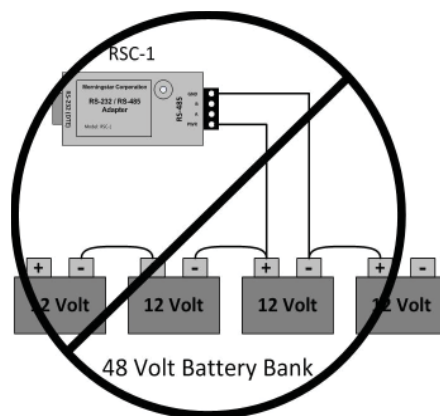
Considering the controllers do not supply bus power, the most convenient source of necessary operating voltage would be the system battery bank. A 12V battery configuration easily provides the required operating power for the 485 bus, as well as the RSC-1. The supply and ground wires can, in most cases, be connected to the battery positive (+) and negative (-) terminals. Bus voltage may also be supplied from 24V, 36V, and 48V battery configurations with the addition of a DC to DC converter. The converter is required to ensure the voltage being supplied to the bus is within an acceptable range (8-16Vdc). It is also important to note when using the batteries to supply bus power, the power should be taken from across the entire battery bank. Tapping into a single battery can cause a voltage imbalance, possibly resulting in damage to the battery.

Third party converters can easily be found by performing an online search for “DC to DC converters.” The following converters we were found and acquired using similar search methods and determined to be compatible with the Morningstar RSC-1 : the Salmex America SDC-12 and the V-INFINITY VYB10W-T.

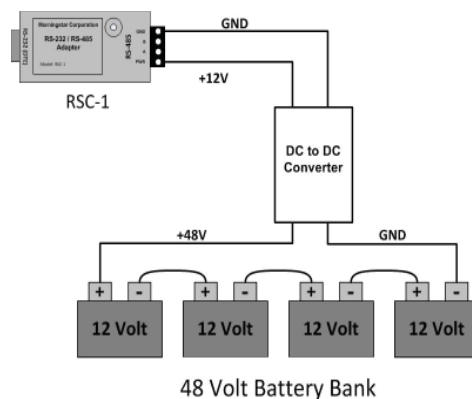


12 Volt Battery as Bus Power Supply

*12Volts supplied to bus using 12V battery*



*Incorrect 12V supply configuration*



*Correct configuration for 12V from 48V bank. Note the use of DC to DC Converter*

### MS View Set-up

To take advantage of the TS-MPPT -60's TCP/MODBUS Bridging capability, all controllers must be properly configured. Setup of the TS-MPPT is accomplished with the use of the MS View TriStar MPPT Set Up Wizard. To access the set up wizard, connect to the TS-MPPT using MS View.

Note: Connecting to a TriStar controller via Ethernet can be accomplished using the "Search for connected devices" option. A serial connection requires the use of the "Manual Connection" option.

1. Select "Manual Connection."
2. Choose TriStar MPPT from list of available controllers.
3. Ensure all communication settings are correct and click "OK."

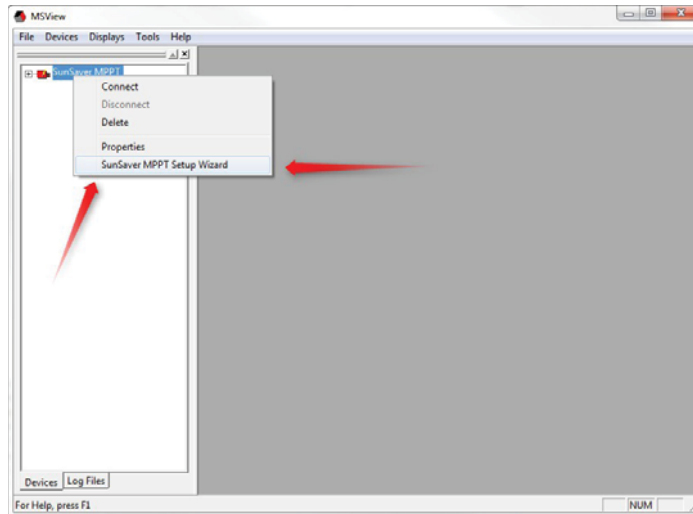
In the Device Pane, right-click the TS-MPPT and select TS MPPT wizard. The Communication Settings page of the Wizard allows users to customize communication settings for the TS-MPPT-60. Enter a unique Modbus ID for controller. To enable EIS- 485 Bridging, users must select "Bridge Modbus/TCP requests to EIA-485 network." (Prior to completing the wizard setup, users should make note of the TriStar Modbus Address and the IP address for future reference. Once configured as the Bridge, the TriStar-MPPT-60 becomes the Master controller, sending and receiving MODBUS requests and commands to Slave controllers. Please refer to Unique Modbus Addressing section for slave controller set up.



*Note: Only one controller may be configured to Bridge Modbus/TCP on the bus.*

## Unique Modbus addressing

All communication on the Morningstar EIA-485 network is accomplished via MODBUS protocol and, as a result, all controllers must have a unique Modbus ID/address. Therefore, each controller's MODBUS ID must be configured prior beginning bridged communication. This is also accomplished with the use of our MS VIEW software. All controllers capable of EIA-485 communications have a respective set up wizard in MS View. As with connecting to the EIA-485 bus, those controllers lacking EIA-458 ports require the use of our MSC adapter to establish communications with user's computer for MS View set up. The exact location/tab where Modbus ID's are selected varies in each controller's Set up Wizard. Access the device set up wizard in the same manner as with the TS-MPPT. (Tristar Serial connections require Manual Connection, while Ethernet connections can be accomplished by Searching for Connected Devices.) First connect to the device using MS View. Then, right-click the controller in the Device pane and select the device "...Wizard" option. It is important to note the MODBUS ID for each of the controllers, as they will be needed to complete Bridged connections.



*Note: The Morningstar Relay Driver has a default Modbus ID of 9.*

## Connecting to Remaining Controllers

Bridged communication on the 485 network requires both physical and software connections be made with each controller manually. The sequence in which these connections are made does play a role in ensuring reliable communication. Begin by removing all power from the bus and controllers. This is a critical step as physically connecting wire/cable to controllers during normal operations has been shown to result in communication errors. Once power has been removed, connect all wire/cable to the controllers/adapters. Ensure TS-MPPT-60 configured to bridge communications had been connected to both the bus and LAN/WAN. Restore power to all devices and observe proper LED indications (if equipped).

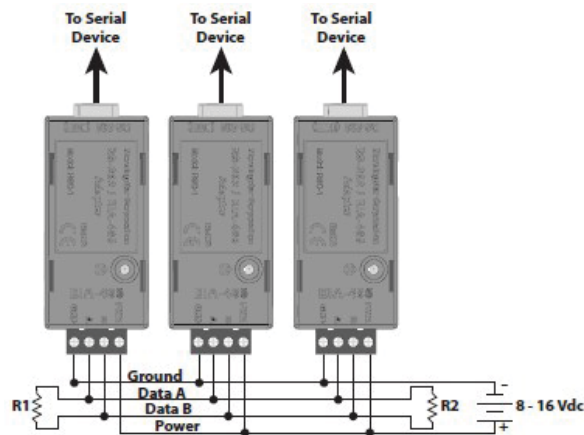
Once all equipment has been physically connected to the 485 bus, software (MS View) connections must be established to allow for bridged communications. To begin, the user must first establish communications with the Bridge Enabled Master/TS-MPPT-60. Once connected to the Master controller, the IP address may be verified by viewing the Connection tab within Device Properties. Each subsequent device must be manually added and connected to the network using the procedure listed below:

- 1: In MS View, select Devices => Manual Connection.
2. Highlight the device to be connected and click OK. This will open Device Properties page.
3. Change Connection Type to "Remote (TCP)" on the Connection Tab on the Device Properties Page
4. Enter the IP address the TS-MPPT-60 configured as the Modbus/IP Bridge
5. Enter the controller Modbus ID in the "Control Address" field and click OK
  - \*the Controller should now be displayed in the MS View Device pane.
6. Right-click the controller and click Connect.

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## Termination Resistors

Smaller networks typically do not require termination. However, larger, high speed networks require proper termination to ensure reliable Master/Slave communication. EIA 485 networks, due to potentially long distance, high frequency communication, are susceptible to signal reflections on the transmission line. These reflections are the result of differences in the characteristic impedance of the transmission line and the node. As the signal wave form travels down the line, it encounters the discontinuity of the destination node or wire end. It is this discontinuity that causes the reflection. Large enough mismatches result in significant reflections capable of causing errors in the data. The errors occur as the nodes on the line receive multiple leading edge HI's as the reflections are detected as well as the actual data. A Line termination that matches the characteristic impedance of the line helps reduce the discontinuity, greatly reducing the reflected wave forms. The termination resistors should be placed at the far ends of the line in parallel with the nodes. Typical twisted-pair wire has a characteristic impedance of  $120\Omega$ , therefore, each of the termination resistors must be  $120\Omega$  resistors.



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Version/Revision

Date

V 1.0

12/21/2011