

TriStar MPPT Networking Companion Document



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I. Introduction

Certain models of the TriStar MPPT family of charge controllers have Ethernet ports and web features. These models can be connected to your home network so that operating information can be displayed on any computer on the network.

This companion document covers the steps required to connect your ethernet-enabled TriStar MPPT controller to your home network. Instructions are also included to configure your network router to allow remote access to your TriStar MPPT via the internet. For users that only need to access the TriStar MPPT from within their home network, the Remote Access steps are not required. Only set up remote access if you would like to view system performance on a computer or other network device outside of your home network via the internet.

II. Connect to the Local Area Network (LAN)

The following section will guide you through the process of connecting your TriStar MPPT controller to your home/business local network.

Getting Started

The TriStar MPPT was designed for easy setup on your home or business network through DHCP. DHCP is a service that automatically assigns a network configuration to a computer or device that appears on your network. The vast majority of residential and business network routers support DHCP and the service is usually turned on by default. Since DHCP is enabled by default in the TriStar MPPT, the network settings will be automatically assigned when connected.

How can I tell if DHCP is enabled on my network?

If you have residential or business DSL, Cable, Fiber, or satellite internet service and the network router was provided by the internet provider, chances are really good that DHCP is already enabled. Just to be sure, you can go to any computer on your network and check its network settings.

Obtain info using a Windows PC

Click the start menu button

Choose the **Run...** menu item

Type **cmd** in the Open text field and click OK

At the prompt type **ipconfig /all** and hit enter. (note: there is a space between the "g" and "/")

Network information similar to the screenshot below will be displayed

```
Windows IP Configuration

Host Name . . . . . : LOCAL-AREA-PC
Primary Dns Suffix . . . . . : 
Node Type . . . . . : Unknown
IP Routing Enabled. . . . . : No
WINS Proxy Enabled. . . . . : No
DNS Suffix Search List. . . . . : 

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix . . . . . : 
    Description . . . . . : Broadcom NetXtreme 57xx Gigabit Controller
    Physical Address. . . . . : 
    Dhcp Enabled. . . . . : Yes
    Autoconfiguration Enabled . . . . . : Yes
    IP Address. . . . . : 192.168.1.106
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.1.1
    DHCP Server . . . . . : 192.168.1.1
    DNS Servers . . . . . : 192.168.1.99
                           151.196.0.38
    Lease Obtained. . . . . : 05 Aug 2009 09:12 AM
    Lease Expires . . . . . : 10 Aug 2009 09:12 AM
```

Figure 1. Windows PC ipconfig network info

In figure 1 above, the arrow points to the DHCP information. If your computer has DHCP enabled, then your network supports DHCP. Proceed to Step 1 in this section to connect your TriStar MPPT controller to your network. If DHCP is disabled, you will need to configure the TriStar MPPT with the correct network settings before proceeding. Follow the steps in Appendix A: Manual Network Configuration.

Obtain info using a Mac

Click the Apple icon in the top left corner

Select "System Preferences" from the menu

Click the “Network” icon under *Network & Internet*
Choose the network adapter to view the network info

If your computer has DHCP enabled, then your network supports DHCP. Proceed to Step 1 in this section to connect your TriStar MPPT controller to your network. If DHCP is disabled, you will need to configure the TriStar MPPT with the correct network settings before proceeding. Follow the steps in Appendix A: Manual Network Configuration.

What happens if my local network does not have DHCP enabled, but I connect the TriStar MPPT to the network anyway?

The TriStar MPPT will search for a period of time for a valid DHCP server. If no server is found, the TriStar MPPT will default to the network settings listed in Appendix B.

The default network settings may or may not be compatible with your network. Because your network does not support DHCP, the TriStar MPPT could not obtain a network configuration. You will need to verify if the default settings are compatible with your network and modify them if necessary. Follow the steps in Appendix A: Manual Network Configuration.

Step 1

Connect the TriStar MPPT to your network using an Ethernet cable. The unit must be powered up to communicate. Before proceeding to the next step, allow 5 minutes for the controller to connect to the network and acquire its network settings.

Step 2

Next, connect to the controller using a computer on the network.

Microsoft Windows and Mac OS X v10.2 or later

Open a web browser

1. In the internet address bar type the following:

`http://tsmpptXXXXXXXX/test.html`

where “XXXXXXXX” is the 8-digit serial number of the controller. The serial number can be found on the label on the side of the unit. This address is the controller’s NETBIOS name, which is a permanent address that always points to the controller on the network.

2. A test page should load with links to the Live View and Network Setup pages.
3. Click the Live View link to view real time operating information.
4. You may want to bookmark the page for future reference.



NOTE:

Mac OS X users may be required to enable Windows File Sharing (SMB) which uses the NETBIOS protocol. Consult Apple’s support and documentation for more information.

Final Notes

Congratulations! At this point the controller is successfully connected to your network. Following are a few notes about routinely connecting to your TriStar MPPT on your home or business network.

- You can now connect to the TriStar MPPT using a web browser, MSView, or any other software that supports the TriStar MPPT from inside your home network.
- Windows PC computers can always access the TriStar MPPT using its NETBIOS name (tsmpptXXXXXXXX).
- Apple Mac computers may not support the use of NETBIOS names by default.
- The IP address assigned by DHCP may change periodically and is not a reliable way to connect to your controller. However, if you manually assigned network settings then the IP address will never change.
- MSView can connect to the TriStar MPPT using the IP address or NETBIOS name. We recommend using the NETBIOS name since it never changes. If you save the workspace, it's better to use the NETBIOS name so that MSView always reconnects properly.
- At this point, the TriStar MPPT cannot be accessed outside of your home or business network. See *Section III: Configure Remote Access* for details on how to connect to the TriStar MPPT from remote locations.

III. Configure Remote Access

Configure remote access to allow communication with your TriStar MPPT from any computer or device on the internet. Use MSView or a web browser to view your solar system's real-time operating information.



NOTE:

Before proceeding, make sure the TriStar MPPT is correctly configured and connected to your home/business network per the directions in Section II.



NOTE:

Because there are many different types and manufacturers of network routers, the exact steps required cannot be fully documented here. However, details are provided on where to get further information.



CAUTION:

All incoming requests addressed to controllers and devices that are connected (bridged) to the EIA-485 port on the TriStar MPPT will be passed both READ and WRITE modbus requests without exception. Setting switch #8 on the TriStar MPPT only prevents WRITE requests to the local controller. For this reason, we do not recommend enabling remote access to systems with bridged EIA-485 networks unless extra network security measures are implemented.

Is this secure?

The vast majority of viruses, malware, scripts, etc are designed to exploit security flaws in major operating systems and their software. Malicious attackers wishing to do harm will only have access to the TriStar MPPT. The TriStar does not have an operating system or web browser to exploit. It only accepts and responds to properly structured MODBUS TCP requests. If setting switch #8 is in the OFF position, the controller will only allow requests to read information and will not allow requests to write data. While anything is possible, it is unlikely that this configuration poses a significant security risk.

It is also worth noting that the networking and charge controller functions of the TriStar MPPT are separate and executed by two (2) separate processors. If the network processor crashes for any reason, the charge controller functionality will continue unaffected.

Part A - Configure the Network Router and TriStar MPPT

A router provides a gateway between the internet and your private local network. A router is usually provided to DSL, cable, fiber, and satellite customers by their internet service provider (ISP). The router connects to the incoming phone line, cable coax, or fiber line and provides one (1) or more Ethernet ports for your home/business computers.

Most network routers have a web interface for configuration. This interface is usually protected by password. If your router was supplied by your ISP (Cable, DSL, satellite company), they can provide you with the login/password needed to access the router configuration. If you purchased and installed your own router, the factory default password should be provided in the router documentation.

Step 1 - Retrieve the Current TriStar MPPT Network Settings

- a. Open a web browser on any computer on your local network
- b. Open the TriStar MPPT live view webpage
- c. Click the "Network" link at the top of the page
- d. Write down all the information in the Current Network Settings section
- e. Also note under the "Settings" section if "Obtain IP address from DHCP server" is selected.

Step 2 - Login to the network Router

- a. Open a web browser on any computer on your local network
- b. Enter the IP of the “Default Gateway” listed in the TriStar MPPT network settings
- c. When prompted enter the login/password information for the router
- d. Keep this browser window open since access to the router settings will be needed throughout these instructions

Step 3 - Program the TriStar MPPT with Static Network Information

If the TriStar MPPT is configured for DHCP, you will need to disable DHCP and specify your own static network settings. If a Static IP address is already assigned to the TriStar MPPT, you can skip Step 3 and go straight to Step 4.

- a. Open the web browser that contains the router settings from Step 2
- b. Find the DHCP range (dynamic IP range) under the DHCP settings. It may look something like this:

Dynamic IP Range
Range Start : 192 . 168 . 1 . 100
Range End : 192 . 168 . 1 . 149

- c. Pick an IP that lies *outside* of this range. For the example range above, 192.168.1.50 would be a good choice
- d. Browse back to the network settings page in the TriStar MPPT live view
- e. In the Settings section, change the selection from “Obtain IP address from DHCP server” to “Use Static IP address”
- f. In the IP Address fields, enter the IP chosen in step c.
- g. Fill out the rest of the network settings with the info obtained in Step 1. (essentially, copy the info from the Current Settings section on the same page)
- h. Click the “Save” button to use the new settings

Step 4 - Setup Port Forwarding

Next, you need to setup port forwarding. Port forwarding commands the router to direct all incoming traffic from the internet on a specific port to a computer or device inside your private network. In this case, you want to direct all incoming requests on port 502 directly to the TriStar MPPT.

Additionally, you may also want to forward port 80 to the TriStar MPPT. This will allow you to view the TriStar Web View pages from any computer on the internet. This is not required however.

There are many different router models so we cannot provide specific directions in this document for configuring port forwarding. However, the website:

<http://www.portforward.com>

provides a comprehensive list of routers and instructions for forwarding ports. The forwarding information for the TriStar MPPT is as follows:

To enable remote access to your TriStar MPPT using MSView or other 3rd party software

IP: Static IP assigned to the controller in Step 3f
port: 502 (some routers ask for a range of ports, in this case specify 502 to 502)
protocol: TCP

If you want to view TriStar Live View webpages from any computer on the internet, the following additional port must also be forwarded in addition to port 502.

IP: Static IP assigned to the controller in Step 3f
port: 80 (some routers ask for a range of ports, in this case specify 80 to 80)
protocol: TCP

Part B - Set up Dynamic DNS Service

Many ISPs allocate dynamic IP addresses to their customers. In plain English this means that the public address that uniquely identifies your home/business router on the internet changes. This is equivalent to having your mailing address change randomly. The postal service can't deliver your mail if they don't know your address!

Your ISP can tell you if you have a *static IP* or *dynamic IP*. If you have a static IP, your address never changes and you can skip this section - go straight to *Part C - Testing Your Connection*. If you have a dynamic IP you'll need a reliable way to find your router's address so that you can always contact your TriStar MPPT controller.

The solution is to use Dynamic DNS Service (DDNS). DDNS maps a static internet address to your home network's dynamic IP. A client must be installed on a computer in your network which will automatically update the DDNS when your router's public IP has changed.



NOTE:

Many modern routers now support DDNS which eliminates the need to run a client on your home computer. If your router supports DDNS, it can be configured to automatically update the DDNS servers whenever the IP address changes. Check your router's documentation or check the approved vendors list at <http://www.dyndns.com>.

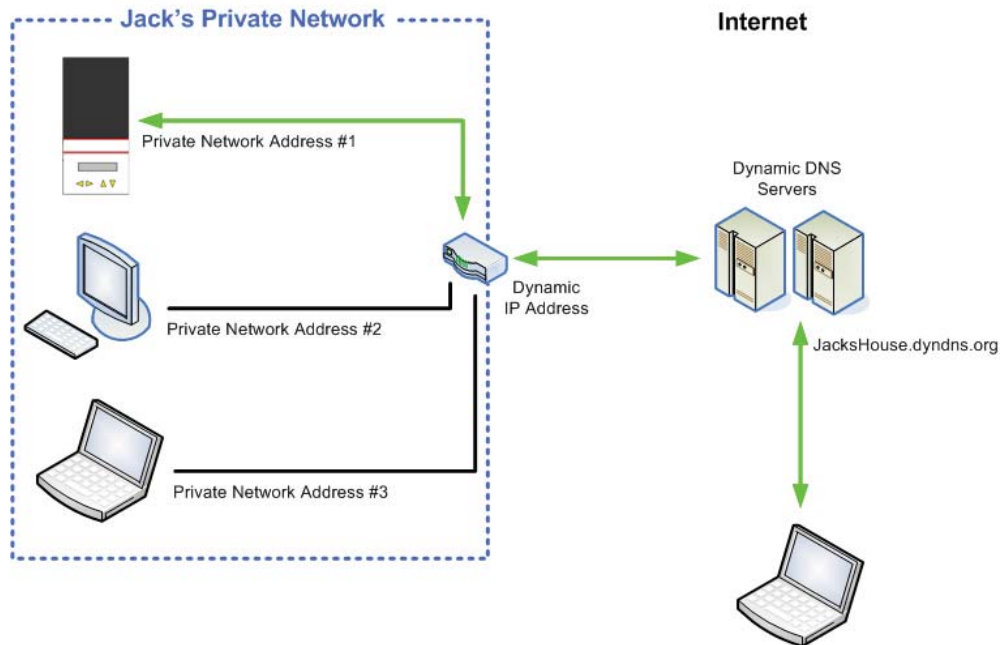


Figure 2. Dynamic DNS service

Figure 2 above illustrates how DDNS works. Dynamic DNS servers are notified by a computer on Jack's private network whenever the router IP changes. The address: JacksHouse.dyndns.org points to the DDNS servers which in turn forward the request to the latest IP address of Jack's Private Network.

Who provides this service and how much does it cost?

We recommend using Dynamic DNS service provided by www.DynDNS.com. It's free, reliable, and has a proven track record. However, there are other free DDNS services that will work just as well. Detailed setup information is available on their websites.

Part C - Testing Your Connection

Now that the controller has a fixed IP address on your private network and a fixed public address, you can now connect to your TriStar MPPT controller from any computer on the internet.

Test with MSView

- From the Devices menu, choose Manual Connection
- Choose TS-MPPT from the device list
- Change Connection Type to Remote (TCP)
- Input the Dynamic DNS address into the IP address field
- By default, the control address is 1 (leave the same unless you specifically changed this value)
- The control TCP Port should be 502
- Click OK.
- Right-click on the device icon in the tree and select Connect
- The icon should turn green indicating a successful connection.

Test with a Web Browser (only if Port 80 is forwarded in Part A - Step 4)

In the browser address bar, type the Dynamic DNS address. The TriStar Live View web page should load.

IV. Multi-controller Networking Options

Two or More TriStar MPPT Controllers

Whenever possible, network multiple TriStar MPPT controllers using Ethernet. This network scheme results in the lowest cost and most control over each controller in the network. TriStar MPPT controllers that do not have Ethernet ports should be connected via EIA-485 (see the next section)

Be sure to set the Ethernet Security settings switch (switch #8) to Disable Writes if the Ethernet network is accessible via the internet.

TriStar MPPT Controller(s) + Other Morningstar Products

A TriStar MPPT 60 can be connected to other Morningstar products on a network using the built-in EIA-485 interface. The TriStar MPPT 60 connects to a network router using the Ethernet port. All devices in the system are connected together on a EIA-485 bus. Incoming requests from the LAN or Internet that are addressed to devices on the network are bridged through the TriStar MPPT 60 onto the EIA-485 bus.

For products such as the Relay Driver that have a serial port, an EIA-485 adapter (model:RSC-1) can be used to connect to the EIA-485 bus as shown in figure 3 below. Products that do not have a serial port require an additional Meterbus adapter (model: MSC) to convert the RJ-11 interface to serial.

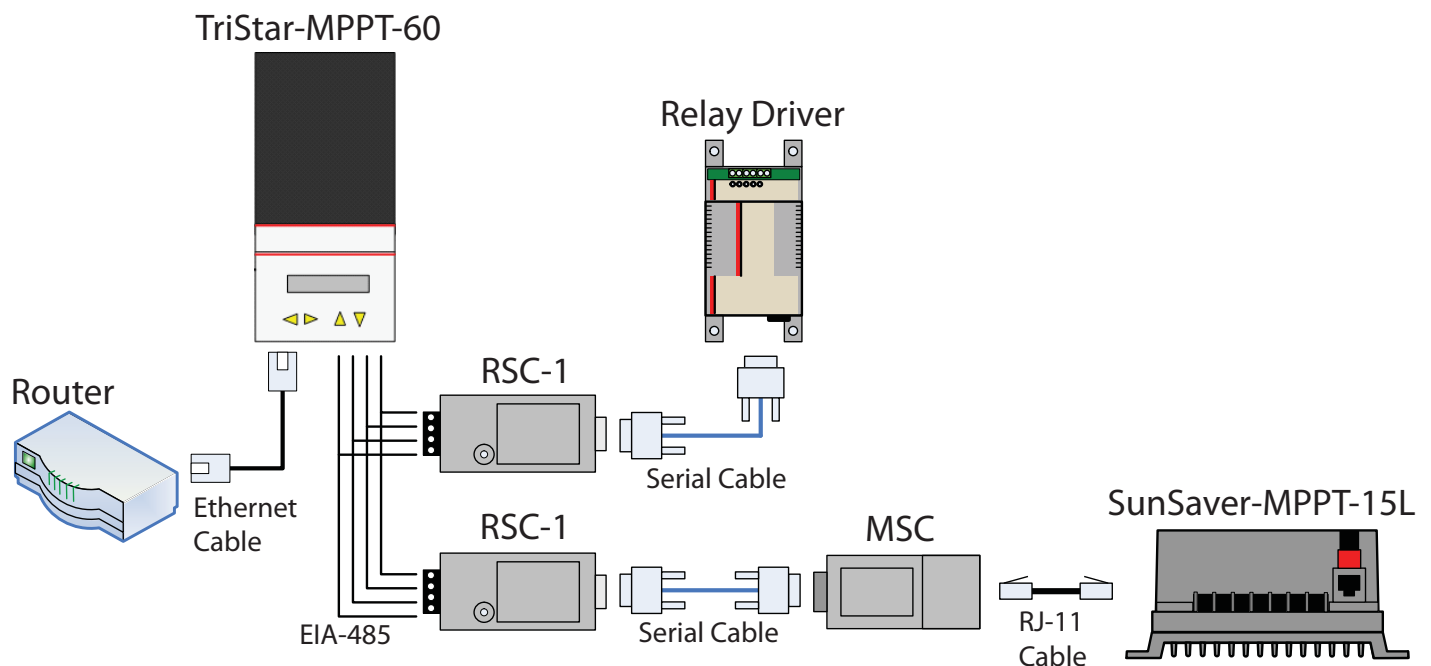


Figure 3. Networking Morningstar products that do not have Ethernet ports.

The EIA-485 bridging feature must be enabled in the network settings of the TriStar MPPT 60 controller as follows:

- Open the TriStar Live View webpage
- Click the "Network" link at the top

- c. Under the “Settings” section, check the box for the “*Bridge Ethernet MODBUS requests to EIA-485 network*” option.
- d. Click the “Save” button



NOTE:

The RSC-1 EIA-485 adapter requires power from the battery or DC-DC converter to power the bus. The RSC-1 can be powered directly from a 12V system battery. For 24 or 48V systems, a DC-DC power converter is required.



CAUTION:

All incoming requests addressed to controllers and devices that are connected (bridged) to the EIA-485 port on the TriStar MPPT will be passed both READ and WRITE modbus requests without exception. Setting switch #8 on the TriStar MPPT only prevents WRITE requests to the local controller. For this reason, we do not recommend enabling internet access to systems with bridged EIA-485 networks unless extra network security measures are implemented.

Appendix A - Manual Network Configuration

For networks that do not support DHCP, the TriStar MPPT must be configured manually. Follow these steps to manually configure the network settings for the TriStar MPPT.

- a. Open a web browser on any computer on your local network
- b. Enter the IP of the “Default Gateway” listed in the network settings information. Instructions for obtaining the network information are provided in the introductory notes in Section II.
- c. When prompted, enter the login/password information for the router. If you do not know this information, contact your ISP or consult the router documentation for the factory default login/password.
- d. Find the DHCP range (dynamic IP range) under the DHCP settings in the router configuration menus. It may look something like this:

Dynamic IP Range

Range Start : 192 . 168 . 1 . 100

Range End : 192 . 168 . 1 . 149

- e. Pick an IP that lies *outside* of this range. For the example range above, 192.168.1.50 would be a good choice
- f. Browse to the network settings page in the TriStar MPPT live view
- g. In the Settings section, change the selection from “Obtain IP address from DHCP server” to “Use Static IP address”
- h. In the IP Address fields, enter the IP chosen in step c.
- i. Fill out the rest of the network settings with the info obtained in the introductory notes in Section II.

Appendix B - Default TriStar MPPT Settings

Port Assignments

Port 80:	HTTP Server
Port 502:	MODBUS via TCP/IP
Port 161:	SNMP Agent Port

Network Settings

Static IP address:	192.168.1.253
Subnet Mask:	255.255.255.0
Default Gateway:	192.168.1.1.
Primary DNS	192.168.1.1
Secondary DNS	0.0.0.0

Bridged Ethernet MODBUS requests to the EIA-485 network are **Disabled**.

SNMP MIB file TSMPPPT.mib can be downloaded from the HTTP Server's root directory. A link is also provided on the Network settings page.