EMC-1™

Ethernet Meterbus Converter

Installation and Operation Manual

For the most recent manual revisions, see the version at: www.morningstarcorp.com

DIMENSIONS [inches (millimeters)]

SPECIFICATION SUMMARY

<table>
<thead>
<tr>
<th>EMC-1</th>
<th>System battery for Morningstar Device, or AC-DC converter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Power Source</td>
<td>On-board terminals</td>
</tr>
<tr>
<td>Required Power Supply Connection</td>
<td></td>
</tr>
<tr>
<td>Input Voltage</td>
<td>8-80 Vdc</td>
</tr>
<tr>
<td>Ethernet Speed</td>
<td>10/100Base-T</td>
</tr>
</tbody>
</table>

www.morningstarcorp.com
1.0 GENERAL INFORMATION

1.1 Overview

The EMC-1 is a MODBUS™ Ethernet to Meterbus™ converter that bridges a TCP/IP connection to a Morningstar charge controller or inverter (Morningstar Device) not having built-in Ethernet connectivity. The connected device needs to have a Meterbus (RJ-11) port.

The EMC-1 acts as an Ethernet gateway that serves MODBUS IP, local Web pages, and Web Monitoring Services. Note that the Web Monitoring Service is not available as of this printing. Ethernet connectivity allows users to remotely collect information about their off-grid PV system. Ethernet networks also include local area networks (LANs) and Internet communications.

The EMC-1 supports the following communication capabilities with a Morningstar Device:

- Morningstar LiveView™ Internet Web monitoring and Network settings changes;
- Monitoring, logging and custom programming using Morningstar MSView™ PC software;
- (Future use) Web Monitoring for data reporting and 3rd party visibility

The table below lists products supported by the EMC-1, and includes port and data details. For the most recent list, see the latest manual version at: www.morningstarcorp.com

<table>
<thead>
<tr>
<th>Product</th>
<th>Modbus via RJ-11</th>
<th>RS-232 Port</th>
<th>Logs Historical Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS-MPPT-25/M</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>PS-MPPT-40/M</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>SunSaver Duo</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>SunSaver-MPPT-15L</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>SureSine-300</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>(all models)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TS-45*</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>TS-60*</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>TS-MPPT-30*</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>TS-MPPT-45*</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>TS-MPPT-60*</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* The EMC-1 included Y-cable is required to draw power from the RJ-11 port while communicating via the RS-232 port. See Section 2.3.2.

Table 1-1 Supported Products
1.2 Features
The features of the EMC-1 are shown in Figure 1-1 below. An explanation of each feature follows.

1 - DIP Switches
DIP 1 enables Ethernet write commands. DIP 2 enables Web Monitoring Service (future use)

2 - Ethernet port (RJ-45)
Used to connect the EMC-1 to LAN / Internet

3 - Power Input
8-80 Vdc power input

4 - Status LED
Green and red lights indicate unit status

5 - Web Monitoring Service LED
Green and red LEDs indicate Web Service status

6 - Ethernet Write LED
Green light indicates Ethernet write command capability

7 - Meterbus (RJ-11 port)
Used to connect the EMC-1 to Morningstar Device

8 - DIN rail mounts (bottom of unit)
35mm standard size

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2.0 INSTALLATION

2.1 Mounting
The EMC-1 can be wall-mounted, surface-mounted or DIN rail mounted using basic tools:
Flat head screw driver
Philips head screw driver
Drill (if wall or surface mounting)
1/8” drill bit (if wall or surface mounting)

Option 1 - Wall and Surface Mounting:

Step 1
Locate the EMC-1 on a surface that is protected from direct sun, high temperatures, corrosive fumes, and water. Do not install in a confined area where battery gases can accumulate.

Step 2
Before starting the installation, place the EMC-1 on the surface where it will be mounted and determine where the wires will enter and exit. Be sure there is sufficient bending room for the wires and communication cables. If possible, verify that the mounting screws will not penetrate wires or other objects located on the opposite side of the surface.

Step 3
Place the EMC-1 on the intended mounting surface, mark four holes for drilling. Remove the EMC-1 from the surface, and using a 1/8” bit, drill pilot holes for each of the four mounting screws, as indicated on the surface.
Step 4
Place the EMC-1 onto the surface and align the mounting feet holes with the four pilot holes. Use the included #10 screws to secure the EMC-1 to the surface.

Option 2 - DIN Rail Mounting:
The EMC-1 will also mount to standard 1-3/8” (35mm) DIN rail.

Step 1
Choose the DIN rail mounting location. It should be protected from direct sun, high temperatures, corrosive fumes, and water. Do not install the EMC-1 in a confined area where battery gases can accumulate.

Step 2
Confirm sufficient space above and below the DIN rail mounting location for EMC-1 cable connections. Using screws, secure the DIN rail to the desired surface.

Step 3
The EMC-1 is designed for tool-less installation onto a DIN rail. There are four hooks on the bottom of the EMC-1 that slide over the upper and lower lips of the DIN rail.

2.2 Configuration
For communication via the EMC-1, the Morningstar Device’s DIP switches, if applicable, must be set for MODBUS communication. The SunSaver MPPT, ProStar MPPT, and the SureSine products need to have the appropriate DIP switch set for MODBUS communication. See Section 2.4 for EMC-1 DIP switch settings.

2.3 Connections
2.3.1 Installing the EMC-1

NOTE: Make COM connections with no power applied
Insert an Ethernet cable (A) into the RJ-45 jack of the EMC-1. Insert the plug on one end of a six-conductor RJ-11 cable (B) into the RJ-11 jack on the EMC-1. Insert the plug on the other end of the RJ-11 cable into the RJ-11 port of the Morningstar Device. See the Operation section (3) for details on the start-up procedure.

Figure 2-1. Connecting the COM cables

2.3.2 TriStar and TriStar MPPT Installation Using a Y-cable Adaptor
TriStar and TriStar-MPPT controllers must use the included Y-cable adapter to connect to the EMC-1. The RS-232 serial and RJ-11 plugs are connected at the controller, and the other RJ-11 plug at the EMC-1.
2.4 DIP Switch Set-Up
Figure 2-2 below shows DIP switch locations and functions:

2.4.1 Ethernet Writes
With DIP 1 ON, Ethernet communication is enabled, and custom programs and network settings can be written to a Morningstar Device. Though this DIP switch is a safety feature designed to prevent unintended configuration changes to the Morningstar Device, DIP 1 is not a replacement for proper network security.

2.5 Connecting the Power Wires
The EMC-1 is powered from an 8-80 Vdc supply, such as an AC-DC converter or system battery connected to the power input provided on the EMC-1 unit. See the Operation section (3) for details on the start-up procedure. Connect the power wires as indicated in Figure 2.3 below.

NOTE: The EMC-1 will start up with an RJ-11 connection to a powered Morningstar Device, or with direct power to the EMC-1

NOTE: Although the Morningstar Device will provide power to the EMC-1 through the Meterbus port, it may not be sufficient under all operating conditions. The 8-80V power supply is required as a constant, reliable power source.
3.0 OPERATION

3.1 Start-up

After the EMC-1 has been installed, as described in Section 2.3.1, the unit is started by connecting the power supply, as described in section 2.5.

On start-up, the status LED will flash green once, and then all three LEDs (green, green, green) will light simultaneously for three seconds. Next, the EMC-1 will automatically begin searching for valid Morningstar Devices. If equipped, the Morningstar Device must have its MODBUS DIP switch enabled for the connection to be made.

**EMC-1 START-UP INDICATION**

<table>
<thead>
<tr>
<th>Status LED flash</th>
<th>green</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEDs ON for 3 secs</td>
<td>green + green + green</td>
</tr>
</tbody>
</table>

With the EMC-1 powered, and the RJ-45 cable connected, LEDs will light as indicated in the table below.

**ETHERNET JACK INDICATIONS**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Green LED</th>
<th>Yellow LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Connection OK</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>Network Activity</td>
<td>ON</td>
<td>Blinking</td>
</tr>
<tr>
<td>Error</td>
<td>OFF</td>
<td>ON</td>
</tr>
</tbody>
</table>

3.2 LED Indicators

There are three EMC-1 LED indicators - see Figure 3-1 below - that will show all statuses of the EMC-1 - left to right: Status LED (green / red); Web Service LED (green / red); Ethernet write enable LED (green).

![LED Indicators Diagram](image)

**Figure 3-1. LED Indicators**

3.3 EMC-1 Status LEDs (green and red)

<table>
<thead>
<tr>
<th>Flashing green: 1 every sec</th>
<th>Searching for Morningstar Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid green</td>
<td>Morningstar Device found, communicating</td>
</tr>
<tr>
<td>Solid red</td>
<td>No valid Morningstar Devices found</td>
</tr>
<tr>
<td>Flashing red - green: 1 every sec</td>
<td>Morningstar Device found, unknown device ID - update EMC-1 firmware</td>
</tr>
<tr>
<td>Flashing green: 3 every sec</td>
<td>Firmware upgrade or downgrade in progress. Power should not be removed while in this state.</td>
</tr>
<tr>
<td>Flashing red: 1 every 2 sec</td>
<td>Internal fault condition</td>
</tr>
</tbody>
</table>


3.4 (Future Use) Web Service LEDs (green and red)

<table>
<thead>
<tr>
<th>LED State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Service OFF (DIP 2 Off)</td>
<td>Broadcasts disabled</td>
</tr>
<tr>
<td>Web Service ON (DIP 2 On)</td>
<td>Broadcasts enabled</td>
</tr>
<tr>
<td>Flashing green - 1 every 2 secs</td>
<td>Searching for server / establishing connection</td>
</tr>
<tr>
<td>Solid green</td>
<td>Connection made / broadcasting</td>
</tr>
<tr>
<td>Solid red</td>
<td>Cannot connect to server</td>
</tr>
<tr>
<td>Flashing red</td>
<td>TBD</td>
</tr>
<tr>
<td>Flashing red - green: 1 every 2 sec</td>
<td>Invalid log-in credentials* (connected to server)</td>
</tr>
</tbody>
</table>

* Log-in and/or server registration error

3.5 Ethernet Write LED (green)

<table>
<thead>
<tr>
<th>DIP State</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIP 1 OFF (green OFF)</td>
<td>Ethernet writes disabled</td>
</tr>
<tr>
<td>DIP 1 ON (green ON)</td>
<td>Ethernet writes enabled</td>
</tr>
</tbody>
</table>

3.6 Connectivity

3.6.1 MSView

MSView is a Morningstar software utility that allows a real-time system data interface with a PC, the capability to custom program charging parameters, and to log data. MSView is available for download, at no charge: www.morningstarcorp.com/msview/

For complete connection details, see the Product Connectivity Manual, available on our website: www.morningstarcorp.com/wp-content/uploads/2014/02/

The Device tab in MSView can be used to, “Search for Connected Devices”. The search screen will show the Morningstar Device, its 8-digit serial no. and the common IP address of the EMC-1 / Morningstar Device. The IP address can then be used to view Web pages as described in Section 3.6.2 below.

3.6.2 LiveView Web Pages

Using a Web browser, the EMC-1 allows access to a Morningstar Device’s LiveView Web pages via two methods:

1) Enter the Morningstar Device’s IP address into the Address bar e.g. http://192.168.1.186.

2) Enter a Morningstar Device’s NetBIOS name [product abbreviation + 8-digit serial no.] into the Address bar e.g. http://ssmppt15320850

Product NetBIOS Abbreviations:

<table>
<thead>
<tr>
<th>Product</th>
<th>NetBIOS Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>TriStar MPPT</td>
<td>tsmppt</td>
</tr>
<tr>
<td>ProStar MPPT</td>
<td>psmppt</td>
</tr>
<tr>
<td>SunSaver MPPT</td>
<td>ssmppt</td>
</tr>
<tr>
<td>TriStar PWM</td>
<td>ts</td>
</tr>
<tr>
<td>SunSaver Duo</td>
<td>ssduo</td>
</tr>
<tr>
<td>SureSine</td>
<td>suresine</td>
</tr>
</tbody>
</table>

NOTE: Many networks are DHCP-enabled, and the IP address assignment will change after some period of time. The NetBIOS address is a static Morningstar Device identifier, and will always point to the Morningstar Device.
After connection to the LiveView server, the following Web pages are available for viewing:

**LiveView**
This is the default Web Page, which displays basic real-time system data, faults and alarms.

**Network**
This Web Page shows the *Morningstar Device*’s current Network settings, and allows the option of changing COM settings, and port forwarding:

<table>
<thead>
<tr>
<th>DHCP</th>
<th>Primary DNS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP Address</td>
<td>Modbus IP Port 502</td>
</tr>
<tr>
<td>Subnet Mask</td>
<td>Default Device (MODBUS) ID</td>
</tr>
<tr>
<td>Gateway</td>
<td>HTTP port 80</td>
</tr>
</tbody>
</table>

**Data Log**
This Web Page displays the current day, and a certain period of detailed historical system information, depending on the number of variables set for logging.

**System**
The System Web Page is used to update EMC-1 firmware. Connected device firmware cannot be updated through the System Web Page. The System Web page also shows specific EMC-1 diagnostic information.

3.6.3  Connecting to a LAN / WAN
After installing MSView on a PC on a local network, and with COM and power connections made, as described in Section 2.3, 2.4, a DHCP enabled router will automatically assign an IP address and network settings to the EMC-1. The *Morningstar Device* will also be read for specific device information before connection is made. After the original assignment, Network settings can be changed as desired using the LiveView Network Web Page.

For complete connection and addressing information, see Appendix I of the Product Connectivity Manual:
www.morningstarcorp.com/wp-content/uploads/2014/02/

**ADVANCED TOPIC:**

3.6.4 Connecting to the EMC-1 from a Remote Location (outside of the LAN) via the Internet / WAN

**Basic Procedure:**

1. Verify that the *Morningstar Device* is correctly connected by accessing it via a Web browser (see Section 3.6.2). Navigate to the Network Page.

2. In another browser window, enter the network router default gateway IP address (probably 192.168.1.1, but see Appendix I, Section II of Product Connectivity Manual - link below).

3. Login to the network router, and choose a static IP address outside of the listed dynamic range.

4. Return to the LiveView Network Page window, change the selection to, “Use Static IP Address”, enter the IP address chosen in the previous step, re-enter the remaining network settings listed in the box, including port 502, to direct incoming Internet requests to the *Morningstar Device*, and port 80 to view *Morningstar Device* Web pages on any Internet connected PC, then click the “Save” button.

5. To maintain a recognizable public IP address, set up a Dynamic DNS service, or verify your router’s Dynamic DNS capability.
The Product Connectivity Manual describes all aspects of connectivity and programming:
www.morningstarcorp.com/wp-content/uploads/2014/02/
See Appendix 1, Section 3 for full details.

3.7 Push-button Functions

3.7.1 Factory Reset
The EMC-1’s communication settings can be restored to the factory default conditions. The following values will be reset:
- TCP / IP settings
- Stored non-volatile product data

To Perform a Factory Reset:
1) With the EMC-1 powered ON, press and hold the push-button until the status LED (left) starts to flash R-G, R-G....
2) Release the push-button.
3) The EMC-1 will reboot with the factory default settings.

3.7.2 To Recover from a Failed Firmware Update
1) With the EMC-1 powered OFF, press and hold the push-button.
2) Re-apply power, and the green status LED will start flashing three times every second. Release the push-button after the flashing begins.
3) The recovery down-grade is in progress, and when complete, the EMC-1 will serve the System Web Page, and allow the user to attempt to re-load newer firmware.

4.0 TROUBLESHOOTING

4.1 Faults and Corrections
The following table 4.1 shows the main EMC-1 error conditions:

<table>
<thead>
<tr>
<th>Solid red</th>
<th>No valid Morningstar Devices found</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flashing red / green - 1 every sec</td>
<td>Morningstar Device found, unknown device ID</td>
</tr>
<tr>
<td>Flashing red - 1 every 2 sec</td>
<td>Internal fault condition</td>
</tr>
</tbody>
</table>

Table 4.1. Error Conditions

Problem:
No valid Morningstar Devices found.
Solution:
Use an RJ-11 cable to connect Morningstar Device to EMC-1.

Problem:
Morningstar Device found, unknown device ID
Solution:
Update EMC-1 firmware using System Web Page - see Section 3.6.1.

Problem:
Internal fault condition
Solution:
Contact Morningstar dealer for assistance
Problem:

Cannot connect to the controller via Ethernet

Solutions:

Confirm that the Morningstar Device is powered on.

Verify good Ethernet cables and connections.

Verify that NetBIOS name or IP address is correctly entered in the Web browser address bar - using http:// instead of https:// may help.

For complete connection details, see the Product Connectivity Manual, available on our website:

www.morningstarcorp.com/wp-content/uploads/2014/02/

5.0 WARRANTY

LIMITED WARRANTY Morningstar Solar Controllers and Inverters

All Morningstar products, with the exception of the SureSine™ 300 inverter and SHS™ controller, are warrantied to be free from defects in materials and workmanship for a period of FIVE (5) years from the date of shipment to the original end user. Morningstar's SureSine 300 Inverter and SHS products are warrantied to be free from defects in material and workmanship for a period of TWO (2) years from the date of shipment to the original end user. Morningstar will, at its option, repair or replace any such defective products.

WARRANTY EXCLUSIONS AND LIMITATIONS:
This warranty does not apply under the following conditions:
♦ Damage by accident, negligence, abuse or improper use
♦ PV or load currents exceeding the ratings of the product
♦ Unauthorized product modification or attempted repair
♦ Damage occurring during shipment
♦ Damage results from acts of nature such as lightning and weather extremes

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R17-8/16
6.0 TECHNICAL SPECIFICATIONS

Electrical:
DC Input supply voltage range                          8-80 Vdc
Self-consumption                          ~2W

Data & Communications:
Communications Ports                               MeterBus (RJ-11)
                                                    Ethernet (RJ-45)
COM Protocols                                    Morningstar MeterBus;
                                                    MODBUS TCP/IP
Ethernet speed                                    10/100Base-T

Mechanical:
IP Indoor, IP20                                    Plastic enclosure
DIN-rail mount                                    Standard 35mm
Weight (unit only):                                0.28 lb / 0.13 kg

Environmental:
Operating temperature range                       -40°C to +60°C
Storage Temperature                               -55°C to 80°C
Humidity                                         100% non-condensing

7.0 CERTIFICATIONS

• C-Tick RCM compliant
• FCC Class B compliant

ENs Directives:
• Complies with ENs standards for CE marking
• Immunity: EN 61000-4-3: 2006
                                                    EN 61000- 4-6: 2009
• Emissions: CISPR 22: 2008

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