EMC-1™

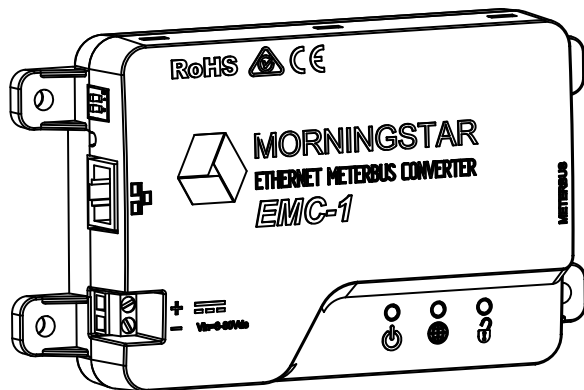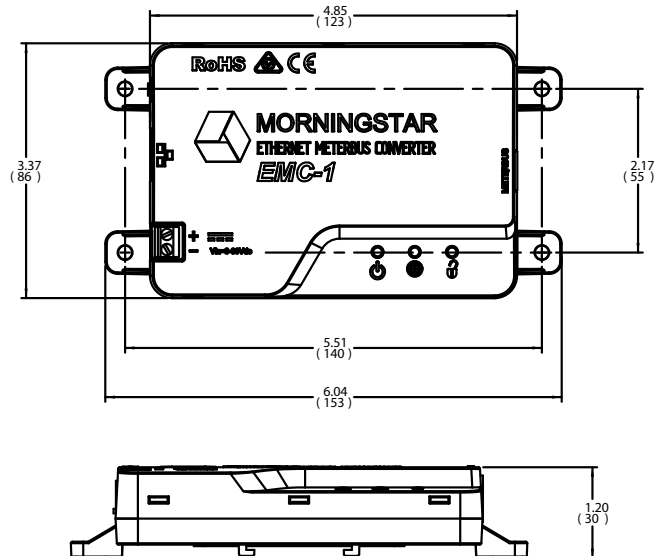## Ethernet-Meterbus Converter

Installation and Operation Manual

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

RoHS ⚠ CE

MORNINGSTAR
ETHERNET METERBUS CONVERTER
EMC-1

+ ⚟
− Vin 8-80 Vdc

⏻ ◉ ⏻

MORNINGSTAR
PROFESSIONAL SERIES
World's Leading Solar Controllers & Inverters

www.morningstarcorp.com

Simple Network Management Protocol
☑ SNMP
ENABLED

DIMENSIONS [inches (millimeters)]

4.85 (123)
3.37 (86)
2.17 (55)
5.51 (140)
6.04 (153)
1.20 (30)

RoHS ⚠ CE

MORNINGSTAR
ETHERNET METERBUS CONVERTER
EMC-1

SPECIFICATION SUMMARY

EMC-1	SPECIFICATION
Required Power Source	System battery for Morningstar Device, or AC-DC converter
Required Power Supply Connection	On-board terminals
Input Voltage	8-80 Vdc (start-up ≥ 9vdc)
Ethernet Speed	10/100Base-T

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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 and local Web pages. 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;

The table below lists products supported by the EMC-1, and includes port and data details. For a current list, see the latest manual version at:

www.morningstarcorp.com

Product	Modbus via RJ-11	RS-232 Port	Logs Historical Data
ProStar Gen 3	Yes	No	Yes
PS-MPPT-25/M	Yes	No	Yes
PS-MPPT-40/M	Yes	No	Yes
SunSaver Duo	Yes	No	No
SunSaver-MPPT-15L	Yes	No	Yes
SureSine-300 (all models)	Yes	No	No
TS-45*	No	Yes	Yes
TS-60*	No	Yes	Yes
TS-MPPT-30*	No	Yes	Yes
TS-MPPT-45*	No	Yes	Yes
TS-MPPT-60*	No	Yes	Yes

* 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

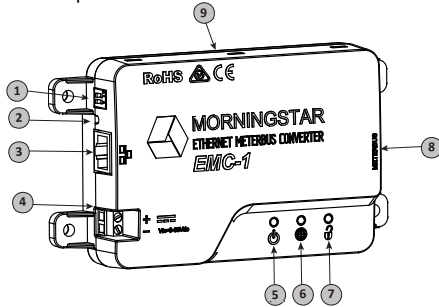The features of the EMC-1 are shown in Figure 1-1 below. An explanation of each feature follows.

Figure 1-1 EMC-1 Features

1 - DIP Switches
DIP 1 enables Ethernet write commands
DIP 2 NOT USED

2 - Reset Button
Used for factory reset or firmware failure

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

4 - Power Input
8-80 Vdc (start-up ≥ 9 Vdc)

5 - Status LED
Green and red lights indicate unit status

6 - Green/red LED - NOT USED

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

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

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

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.

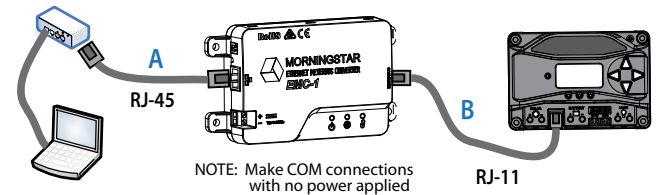NOTE: Make COM connections with no power applied

Figure 2-1. Connecting the COM cables

2.3.2 TriStar and TriStar MPPT Installation Using a Y-cable Adaptor

To communicate with the EMC-1, TriStar and TriStar MPPT controllers must be installed using the included Y-cable adapter. The RS-232 serial and RJ-11 plugs are connected at the controller, and the other RJ-11 plug at the EMC-1.

2.3.3 TriStar with Meter Application

Refer to Figure 2-2 below for EMC–TS-M-2 cable routing.
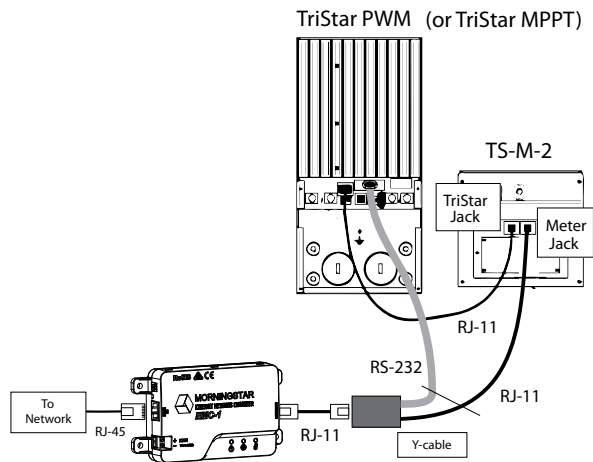
Figure 2-2. EMC–TS-M-2 Cable Routing

2.4 DIP Switch Set-Up

Figure 2-3 below shows DIP switch locations and functions:
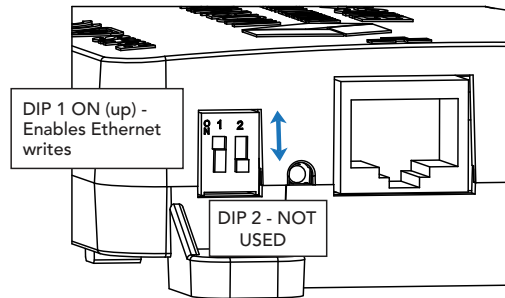
Figure 2-3. DIP Switch Functions

2.4.1 Ethernet Writes

With DIP 1 ON, Ethernet writes are enabled, and custom programs, firmware updates (to the EMC-1) 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 2-4 below.
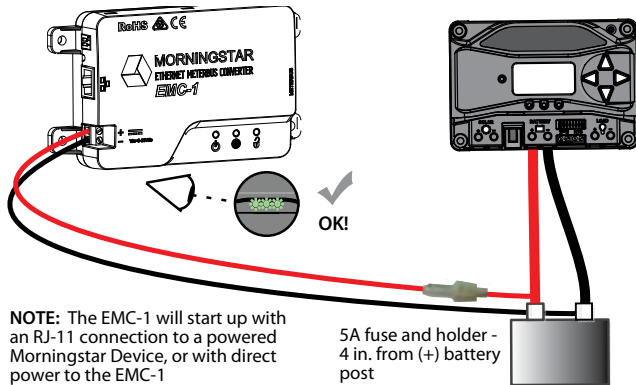

NOTE: The EMC-1 will start up with an RJ-11 connection to a powered Morningstar Device, or with direct power to the EMC-1

5A fuse and holder - 4 in. from (+) battery post

Figure 2-4. Connecting the power wires

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 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); Future Use LED (green / red); Ethernet write enable LED (green).

EMC-1 status   FUTURE USE   Ethernet write status
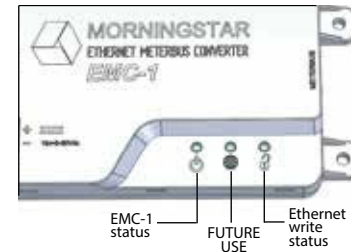
Figure 3-1. LED Indicators

3.2 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 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 SEQUENCE (with MS device connected)

Status LED flash	G
LEDs ON for 3 secs	G + G + (G)

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

ETHERNET JACK INDICATIONS

Condition	Green LED	Yellow LED
Network Connection OK	ON	OFF
Network Activity	ON	Blinking
Error	OFF	ON

3.3 EMC-1 Status LEDs (green and red)

Searching for *Morningstar Device*	Green (1 blink / sec) - may not appear if MS Device is found quickly
Morningstar Device found, communicating	Solid green (heartbeat off)
No valid *Morningstar Devices* found	G-G-G....R-G-G-G… (repeating)
Morningstar Device found, unkown device ID - update EMC-1 firmware	Red / Green (alternating 1 blink / sec)
Firmware upgrade or downgrade in progress. Power should not be removed while in this state.	Green (3 blinks / sec)

Searching for *Morningstar Device*	Green (1 blink / sec) - may not appear if MS Device is found quickly
Internal fault condition	Red (1 blink / 2 secs)

3.4 Ethernet Write LED (green)

DIP 1 OFF (green OFF)	Ethernet writes disabled
DIP 1 ON (green ON)	Ethernet writes enabled

3.5 Connectivity

NOTE: For complete connection details, see the Morningstar Communications Document-Product Connectivity Manual, available on our website:

www.support.morningstarcorp.com

3.5.1 MSView

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

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. The unit's default IP address is 192.168.1.253

3.5.2 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. If DHCP is not in use, the default static IP address is http://192.168.1.253

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:

TriStar MPPT	tsmppt
ProStar MPPT	psmppt
ProStar (Gen 3)	pspwm
SunSaver MPPT	ssmppt
TriStar PWM	ts
SunSaver Duo	ssduo
SureSine	suresine

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:

DHCP	Primary DNS
IP Address	Modbus IP Port 502
Subnet Mask	Default Device (MODBUS) ID
Gateway	HTTP port 80

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.

3.5.3 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.

ADVANCED TOPIC:

3.5.4 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 capabiltiy.

The Morningstar Communications Document describes all aspects of connectivity and programming. See Appendix 1, Section 3 for full details.

3.6 Push-button Functions

3.6.1 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 reset button until the status (left) LED starts to flash R-G, R-G....

2) Release the reset-button.

3) The EMC-1 will re-boot with the factory default settings.

3.6.2 To Recover from a Failed Firmware Update

1) With the EMC-1 powered OFF, press and hold the reset button.

2) Re-apply power, and the green status LED will start flashing three times every second. Release the reset 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.

3.7 Simple Network Management Protocol - v2c (SNMP)

NOTE: A link to the Agent *Management Information Base* (*.MIB) file for a supported device, and OID (see description below) Tables with lists of relevant variables, can be downloaded, at no charge, from the SNMP FAQ on the EMC-1 Product Page. This page will also contain links to the current EMC-1 firmware file (on the Support Site) with release notes, and to an instructional video on how to perform firmware updates.

SNMP is often used by integrated systems to monitor individual pieces of equipment on the system network.

SNMP is supported by all compatible Morningstar devices through the use of the EMC-1 Ethernet adapter. SNMP functionality will be enabled through a remote firmware update of the EMC-1.

While the EMC-1 does not support asynchronous SNMP *Traps*, an SNMP browser running on the *Network Management System (NMS)/Manager* computer can provide effective alert notifications options. Using a polling frequency and conditional logic rule found in the NMS, the browser can be configured to alert the user of abnormalities.

An *Object Identifier (OID)* is a component of a MIB, containing a collection of variables e.g. solar specific values which can be queried by or configured from an SNMP application on a *Network Management System (NMS)/Manager* computer. For telecom and industrial applications that require SNMP monitoring of deployed systems, connected Morningstar devices will run/behave as SNMP Agents and will support the following commands:

NOTE: SNMP does not support the **SET** message, which allows a user to alter a setting on the device. This precaution helps to minimize the security and operational risks associated with unverified user access. Morningstar's MSView PC software can be used to make changes to device settings, if desired.

GET
A Manager-to-Agent request to retrieve the value of a variable or list of variables on a specific OID. Retrieval of the specified variable values is an atomic operation by the Agent i.e. it will not be completed without all requested values returned.

GETNEXT
A Manager-to-Agent request to discover available variables and their values. Method used by SNMP manager to work through an ordered list of OIDs according to the standard MIB hierarchy. Returns a response with variable binding for the next variable in the MIB.

GET BULK
A sequence of GetNext requests, allowing a large segment of the MIB hierarchy to be queried by the SNMP manager from a managed device.

RESPONSE

Used by the SNMP agent to deliver requested information. Also acts as an acknowledgment.

DEFAULT PORT ASSIGNMENT

Port 161 (EMC-1) SNMP Agent Receiving Port

3.7.1 SNMP Troubleshooting

Confirm data inconsistency with other MS monitoring platforms (MSView, LiveView, etc), and then ensure the following:

- The most up-to-date EMC firmware is being used. The MIB files are current and all reference MIBs are uploaded simultaneously (i.e MORNINGSTAR.mib, EMC-1.mib, and [DEVICE].mib)
- Scaling factors (contained in the MIB descriptions) for all relevant OIDs have been applied appropriately
- Each OID references the appropriate data value type listed in the MIB file
- The community string names are properly configured (will reset when the device is powered off). Write Community should be set to, "private"
- The network monitoring software is set to poll SNMP v2c
- The correct IP address and Root OID are used for SNMPWalk

4.0 TROUBLESHOOTING

4.1 Faults and Corrections

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

G-G-G….R-G-G-G… (repeating)	No valid *Morningstar Devices* found
Flashing red / green - 1 every sec	*Morningstar Device* found, unknown device ID
Flashing red - 1 every 2 secs	Internal fault condition

Table 4.1. Error Conditions

Problem:

No valid *Morningstar Devices* found.

Solutions:

Use an RJ-11 cable to connect *Morningstar Device* to EMC-1

Turn on *Morningstar Device* MODBUS DIP switch.

Problem:

Morningstar Device found, unknown device ID

Solution:

Update EMC-1 firmware using System Web Page - see Section 3.6.2.

Problem:

Internal fault condition

Solution:

Contact Morningstar dealer for assistance

Problem:

Cannot connect to the controller via Ethernet

Solutions:

Turn on *Morningstar Device* MODBUS DIP switch.

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.

5.0 WARRANTY

LIMITED WARRANTY - Morningstar Solar Controllers and Inverters

All Morningstar *Professional Series™* products, <u>except</u> the SureSine™ inverter, 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. Warranty on replaced units, or field-replaced components, will be limited only to the duration of the original product coverage.

Morningstar *Essentials Series™,* and SureSine™ inverter, products are warrantied to be free from defects in materials and workmanship for a period of TWO (2) years from the date of shipment to the original end user. Warranty on replaced units, or field-replaced components, will be limited only to the duration of the original product coverage.

Morningstar will, at its option, repair or replace any such defective units.

CLAIM PROCEDURE:

Before requesting warranty service, check the Operator's Manual to verify product failure. Return the defective product to your authorized Morningstar distributor with shipping charges prepaid. Provide proof of date and place of purchase.

An RMA number <u>must</u> be issued by Morningstar prior to return of any unit(s) under this warranty. RMA information must include product model, serial number, detailed failure description, panel type, array size-configuration, type of batteries and system load details. This information is critical to rapid disposition of your warranty claim.

Morningstar will pay the return shipping charges if the repairs are covered under the warranty.

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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R15-1/20

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; SNMP
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

* Start-up voltage must be $\geq$ 9V

7.0 CERTIFICATIONS

$\mathsf{C}\mathsf{E}$ TÜVRheinland CERTIFIED   ALL COMPONENTS REACH COMPLIANT — Registration, Evaluation and Authorization of Chemicals

- Electromagnetic Compatibility Directive 2014/30/EU

  EN 61000-6-1:2007 EMC Immunity, Industrial Environments

  EN 61000-6-3:2007 +A1:2011 EMC Emissions

  CISPR 22: 2008

- FCC (Title 47 of CFR), Part 15 Subpart B Class B digital device - Tested for Compliance
- RoHS Directive 2011/65/EU and Amendment 2015/863/EU (RoHS2)

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