Reference Manual
Rev 4.0
December 2017

56WM WirelessHART® Power Meter
SensEnable™

EMERSON

56WM WirelessHART Power Meter

56WM Revision	001
HART® Device Revision	1.0
Device Description Revision (DD)	1.0

NOTICE

This manual contains personal and system safety information.

To reduce the risk of serious injury or death due to electric shock, arc flash, fire, or explosion, before installing, maintaining, or using this product, read the Important Safety Information and the other sections of this manual relevant to your task.

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure to thoroughly understand the contents before installing, using, or maintaining this product.

For technical assistance, call:

United States:

419-525-8307

Asia Pacific:

91-22-66620414

Europe and Latin America:

+1-419-525-8315

⚠WARNING! HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- This product must only be installed or serviced by qualified electricians following safe electrical work practices.
- Installers and servicers of this device are responsible for conformance to all applicable codes, including NFPA 70E in the USA, and local codes.
- Installers and servicers are responsible to confirm, with an appropriately rated voltage sensing device, that all power has been removed prior to installing or servicing this device.
- This product must be installed inside a suitable fire and electrically rated enclosure.
- Do not install this device in a hazardous or classified location.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operations.
- This device must be installed to ensure a minimum antenna separation distance of 20 cm from all persons.

Contents

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Section 1 Introduction

1.1 Using this Manual

The sections in this manual provide information on installing, operating, and maintaining the Emerson 56WM WirelessHART Power Meter. The sections are organized as follows:

Section 2: Configuration provides instruction on commissioning and operating the 56WM. Information on commissioning, configuration parameters, and device variables is also included.

Section 3: Installation contains mechanical and electrical installation instructions.

Section 4: Verification contains techniques for verifying proper configuration and installation.

Section 5: Troubleshooting contains troubleshooting tips

Section 6 Appendix A: Specifications supplies reference and specification data, as well as ordering information.

Section 7 Appendix B: Product Certifications contains agency approval information.

Section 8 Appendix C: Non-Device Description (DD) Based Integration contains both alert and device variable information for the 56WM

1.2 Product recycling/disposal

Recycling of equipment and packaging should be taken into consideration and disposed of in accordance with local and national legislation/regulations.

1.3 Glossary

- 56WM: 56WM WirelessHART Power Meter
- CT: Current Transformer
- PT: Potential (Voltage) Transformer
- FCC: Federal Communications Commission
- UL: Underwriters Laboratories
- CE: Conformity European
- IEC: International Electro-Technical Commission
- NIST: National Institute of Standards and Technology
- HART: Highway Addressable Remote Transducer Protocol
- RF: Radio Frequency
- RMS: Root Mean Square
- AVG: Average
- L-to-N: Line-to-Neutral
- L-to-L: Line-to-Line (Phase)
- PF: Power Factor
- DV: Device Variable

Section 2 Configuration

2.1 Overview

This section contains information on configuration that should be performed prior to installation. Field Communicator and AMS Device Manager instructions are given to perform configuration functions.

2.2 Safety

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

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2.3 Device Connections

The 56WM is compatible with shunted current transformers with a 0.333V output only. Serious shock hazard and device damage may occur if unshunted current transformers are used.

When making connections with stranded wire, use ferrules on all terminal block sensor connections.

2.3.1 Voltage Connections

Connect the voltage phase conductors L1, L2, L3, N as necessary to the 56WM. The minimum conductor is 14 AWG, THHN, 600VAC. The neutral connection on the 56WM must always be connected to either the neutral or ground conductor of the load to ensure accurate measurements. See Figure 2-1.

Figure 2-1 – Voltage Connections

2.3.2 Current Transformer Connections

Connect the current transformer conductors so that the phase conductor for CT1 is the same phase conductor for voltage L1, and so on. This ensures proper phasing for accurate measurements. See Section 3.4.2 Electrical Connections for additional information.

2.3.2.1 Hinged Core Current Transformer Connections

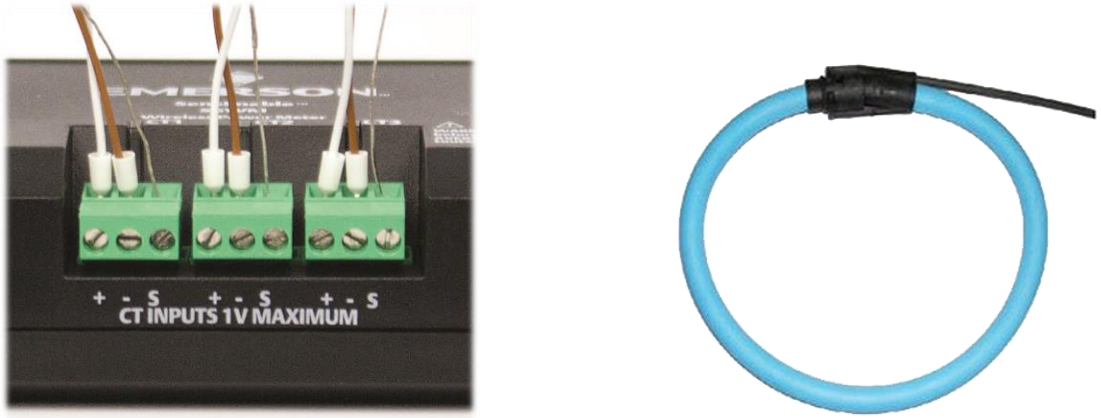
Connect the white wire to the positive terminal and connect the black wire to the negative terminal on the current transformer connector. See Figure 2-2.

Figure 2-2 - Hinged Core Current Transformer Connections

2.3.2.2 Rogowski Coil Current Transformer Connections

Connect the white wire to the positive terminal, connect the brown wire to the negative terminal, and connect the shield wire to the "S" terminal on the current transformer connector. See Figure 2-3.

Figure 2-3 - Rogowski Coil Current Transformer Connections

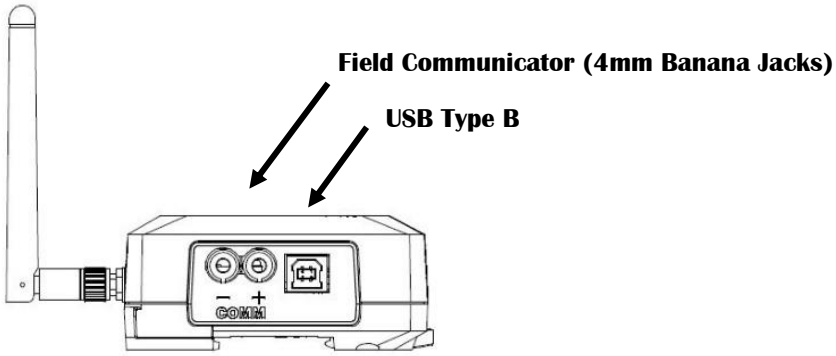


2.3.3 Field Communication Connections

The 56WM must be powered by the USB connection for configuration. The USB Type B connection may also be used for configuring the 56WM from a computer.

Connect the two 4mm banana jacks to a field communicator and the USB connector for power to configure the 56WM. See Figure 2-4.

Figure 2-4 - Field Communication Connections



2.4 Bench Top Configuration

Bench top configuration consists of testing the 56WM and verifying its configuration data. The 56WM must be configured prior to installation, which may be performed either directly or remotely. Direct configuration can be performed using a Field Communicator, AMS Device Manager, or any WirelessHART® Communicator. Remote configuration can be performed using AMS Device Manager, or the Smart Wireless Gateway.

The 56WM must be powered by the USB connection for configuration. To configure the 56WM, connect a field communicator to the field communication connectors.

2.4.1 Field Communicator

When performing device configuration directly, verify that the 56WM is powered on and turn on the field communicator by pressing the **POWER** key. When using a field communicator, any configuration changes must be sent to the 56WM by using the **Send** key.

The field communicator will search for a HART-compatible device and indicate when the connection was made. If the field communicator fails to connect, it will indicate that no device was found. If this occurs, refer to the Troubleshooting of this document.

Note

For HART communication via a field communicator, a 56WM Device Description (DD) is required. To obtain the latest DD, visit the 475 Field Communicator System Software and Device Description site at: http://tinyurl.com/475fieldcommunicator.

2.4.2 AMS Device Manager

When configuring the 56WM using AMS Device Manager or AMS Wireless Configurator, double click the 56WM device icon (or right click and select **Configure/Setup**), then select the **Configure/Setup** tab. AMS Device Manager configuration changes are implemented when the **Apply** button is selected.

Note

For HART communication via AMS, a 56WM Device Description (DD) is required. To obtain the latest DD, visit the Emerson site at: http://tinyurl.com/56WMdevicedescription.

2.4.3 Smart Wireless Gateway

The 56WM supports limited remote configuration through the Smart Wireless Gateway. The Gateway allows configuration of the following device parameters: HART Tag (long tag), Short Tag, Descriptor, and Update Rate.

2.4.4 Default Settings

Unless specified with the Site Assessment Form, the 56WM default configuration is shown below:

HART Tag (long tag)	blank
Short Tag	56WM
Descriptor	T-O-D
Network ID	1111
Join Key	11111111 00000000 00000000 00000000
Update Rate	1 minute
Device Variables	See Update Rate and Device Variables Section

2.5 Device Setup

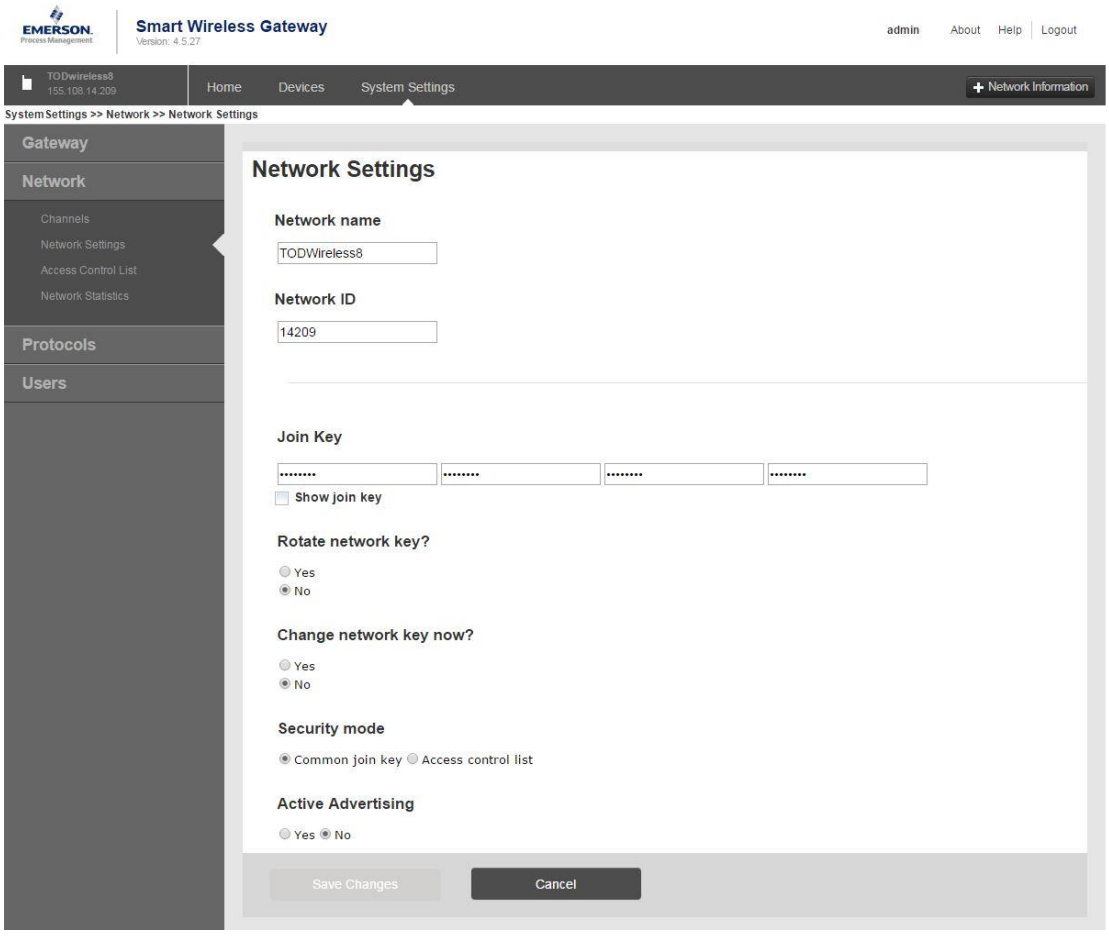
All parameters/settings for the 56WM discussed in the device setup may be changed during field configuration, or at any time via AMS Device Manager or Field Communicator.

2.5.1 Join Device to Network

To communicate with the Smart Wireless Gateway, and ultimately the host system, the 56WM must be configured to communicate over the wireless network.

Using a field communicator or AMS Device Manager to communicate to the 56MW, enter the Network ID and Join Key so they match the Network ID and Join Key of the Smart Wireless Gateway and the other devices in the network. If the Network ID and Join Key are not identical to those set in the Gateway, the 56WM will not communicate with the network. The Network ID may be obtained from the Smart Wireless Gateway on the *System Settings>Network>Network Settings* page of the Smart Wireless Gateway web based user interface. See Figure 2-5.

Figure 2-5 - Smart Wireless Gateway Network Settings Page



2.5.2 Wireless Parameters

The following parameters can be configured either directly with a field communicator or remotely with a HART host.

- **HART Tag (Long Tag):** 32 Characters Maximum
- **Short Tag:** 8 Characters Maximum
- **Descriptor:** 16 Characters Maximum
- **Message:** 32 Characters Maximum
- **Date:** DD/MM/YYYY

2.5.3 Update Rate and Device Variables

The update rate is the frequency at which a measurement is transmitted over the wireless network. This by default is one minute. This may be changed during field configuration, or at any time via AMS Device Manager. The update is user selectable from one second to 60 minutes. Each burst message can have an unique update rate.

The 56WM transmits five burst messages with 39 device variables (DV) by default. The default device variables are shown in Table 2-1.

Table 2-1 - Default Variable Mapping

Burst Message 0		
Slot	**DV**	**Description**
Slot 0	9	L1-L2 Voltage AVG
Slot 1	10	L1 Amperage AVG
Slot 2	5	kW System AVG
Slot 3	6	kWh System
Slot 4	3	Voltage Line-Line System
Slot 5	4	Amperage System
Slot 6	34	Line Frequency AVG
Slot 7	250	Not Used

Burst Message 1		
Slot	**DV**	**Description**
Slot 0	17	L2-L3 Voltage AVG
Slot 1	18	L2 Amperage AVG
Slot 2	19	L2 kW AVG
Slot 3	20	L2 kWh
Slot 4	21	L2 kVA AVG
Slot 5	22	L2 kVAR AVG
Slot 6	23	L2 Displacement PF AVG
Slot 7	24	L2 Apparent PF AVG

Burst Message 2		
Slot	**DV**	**Description**
Slot 0	25	L3-L1 Voltage AVG
Slot 1	26	L3 Amperage AVG
Slot 2	27	L3 kW AVG
Slot 3	28	L3 kWh
Slot 4	29	L3 kVA AVG
Slot 5	30	L3 kVAR AVG
Slot 6	31	L3 Displacement PF AVG
Slot 7	32	L3 Apparent PF AVG

Burst Message 3		
Slot	**DV**	**Description**
Slot 0	11	L1 kW AVG
Slot 1	12	L1 kWh
Slot 2	13	L1 kVA AVG
Slot 3	14	L1 kVAR AVG
Slot 4	15	L1 Displacement PF AVG
Slot 5	16	L1 Apparent PF AVG
Slot 6	33	Voltage Line-Neutral System
Slot 7	1	Onboard Temperature

Burst Message 4		
Slot	**DV**	**Description**
Slot 0	35	kW System Max
Slot 1	36	kW System Min
Slot 2	37	kW System Demand Max
Slot 3	38	kW System Demand Min
Slot 4	0	Sensor Type
Slot 5	7	kVAh System
Slot 6	8	kVARh System
Slot 7	2	Onboard Bus Voltage

The default device variable map and update rate can be changed during field configuration, or at any time via AMS Device Manager or Field Communicator. The update rate can be unique for each burst message. Available device variables are shown below:

Table 2-2 - Device Variables

Instantaneous and Power Variables	
Description	**DV**
Voltage Line to Line System	3
Amperage System	4
Voltage Line to Neutral System	33
kW System Max	35
kW System Min	36
kW Demand System Max	37
KW Demand System Min	38
KW Demand System AVG	39

Energy Variables	
Description	**DV**
kWh system	6
kVAh System	7
kVARh System	8
kWh L1	12
kWh L2	20
kWh L3	28
kVARh L1	48
kVARh L2	50
kVARh L3	52
kVAh L1	47
kVAh L2	49
kVAh L3	51

HART Variables	
Primary Variable (PV)	246
Secondary Variable (SV)	247
Tertiary Variable (TV)	248
Quaternary Variable (QV)	249
Battery Life	243
PV Percent Range	244
PV Loop Current	245

Averaged Variables	
Description	**DV**
Voltage L1 to L2 AVG	9
Voltage L2 to L3 AVG	17
Voltage L1 to L3 AVG	25
Voltage L1 to Neutral AVG	44
Voltage L2 to Neutral AVG	45
Voltage L3 to Neutral AVG	46
Amperage L1 AVG	10
Amperage L2 AVG	18
Amperage L3 AVG	26
Line Frequency AVG	34
Displacement PF L1 AVG	15
Displacement PF L2 AVG	23
Displacement PF L3 AVG	31
Apparent PF L1 AVG	16
Apparent PF L2 AVG	24
Apparent PF L3 AVG	32
Displacement PF System AVG	42
Apparent PF System AVG	43
kW system AVG	5
kVA System AVG	40
kVAR System AVG	41
kW L1 AVG	11
kW L2 AVG	19
kW L3 AVG	27
kVA L1 AVG	13
kVA L2 AVG	21
kVA L3 AVG	29
kVAR L1 AVG	14
kVAR L2 AVG	22
kVAR L3 AVG	30
THD L1	54
THD L2	55
THD L3	56
THD System	57

When selecting device variables, the number of burst messages, and the update rate of each burst message, consideration must be taken for the effect on the mesh network and other transmitters on the network. Below is the maximum network size recommendation for the Smart Wireless Gateway. The number of wireless devices assumes one burst message per device.

- 100 Wireless Devices each with an 8 second update rate
- 50 Wireless Devices each with a 4 second update rate
- 25 Wireless Devices each with a 2 second update rate
- 12 Wireless Devices each with a 1 second update rate

For a mesh network with only 56WM's each configured with five burst messages, the approximate network size is shown below.

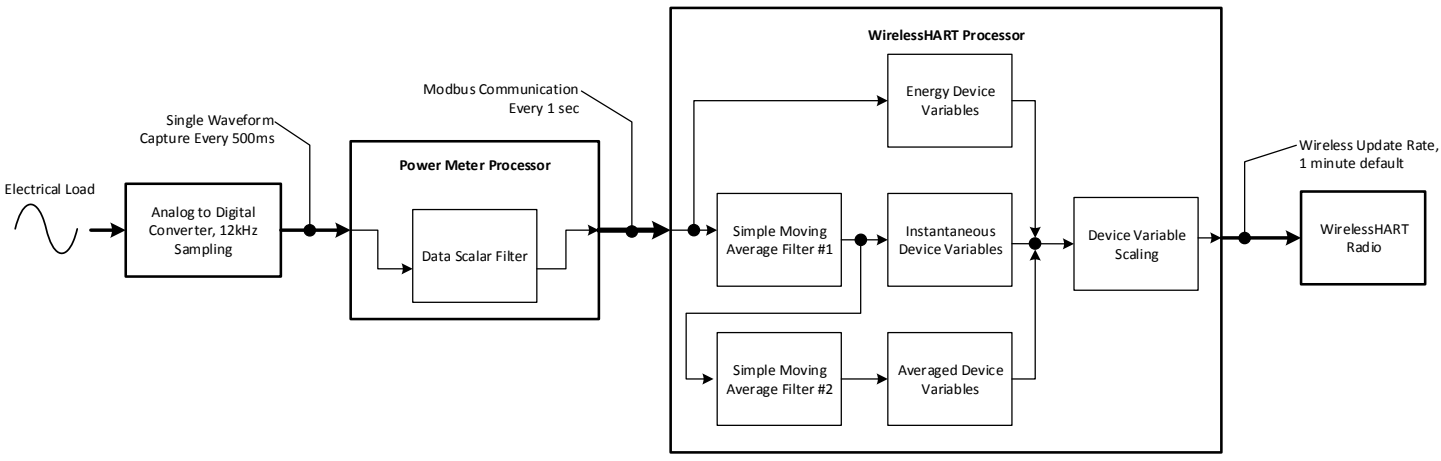
- 20 Wireless Devices each with an 8 second update rate
- 10 Wireless Devices each with a 4 second update rate
- 5 Wireless Devices each with a 2 second update rate
- 3 Wireless Devices each with a 1 second update rate

If possible, each 56WM should be installed so that it can wirelessly transmit directly with the Gateway. This will help to reduce the network load on battery powered transmitters in that mesh network. The network manager may adjust the network paths to maximize data reliability.

When the 56WM is commissioned with a DeltaV system, DeltaV requires the HART variable PV Loop Current. It is recommended to only use Burst Message 0 and Burst Message 1. PV Loop Current should be mapped to a slot in Burst Message 1. All other burst messages should be turned off. This will minimize unnecessary network traffic and maximize the number of device variables available to the DeltaV system. In addition, it is recommended to map system device variables (i.e., Voltage Line-to-Line System, Amperage System, etc.) to PV, SV, TV, QV since DeltaV requests these HART variables. If the DeltaV system is utilizing Modbus to obtain device variables, additional burst messages may be turned on.

A simplified diagram of the data capture and processing of the 56WM is shown below.

Figure 2-6 - Data Capture and Processing



2.5.4 Current Transformer Settings

The 56WM must be configured to match the current transformers that are connected to it for each application. There are two current transformer types:

CT Type

1. Millivolt CT (Hinged Core CT's)
2. RoCoil (Rogowski Coil CT's)

The CT Amps must be configured to match the CT amperage listed on the CT label for all hinged core CT's. The CT Amps setting does not need to be configured for Rogowski Coils, simply select Rogowski Coil. See Table 2-3.

Table 2-3 - Current Transformer Maximum Amperage

Current Transformer	CT Max Amperage
CT-SRS-005	5A
CT-SRS-050	50A
CT-SRL-100	100A
CT-SRL-200	200A
CT-SRL-400	400A

2.5.5 Demand Window

The 56WM can provide power demand calculations that may be used for utility billing. The default demand window is 15 minutes and is configurable from 1 to 60 minutes. The 56WM can provide maximum and averaged power values over the specified demand window.

2.5.6 Data Scalar

Internally, the 56WM processor uses a data scaling feature to maximize the dynamic range of the measured data. Measurements that can be scaled include volts, amps, power factor, power, and energy. The maximum decimal value of the measurements must be scaled to fit within the range of 0 to 65,535. See Table 2-4.

Table 2-4 - Data Scalars and Values

Data Scalar	Scalar Value				
	Volts	Amps	Power Factor	Power (kW, kVAR, kVA)	Energy (kWh, kVARh, kVAh)
0	0.1	0.01	0.01	0.00001	0.00001
1	0.1	0.1	0.01	0.001	0.001
2	0.1	0.1	0.01	0.01	0.01
3	0.1	0.1	0.01	0.1	0.1
4	1.0	1.0	0.01	1.0	1.0
5	1.0	1.0	0.01	10	10
≥6	1.0	1.0	0.01	100	100

The table below are the minimum recommended scalar settings based on current transformer size.

Table 2-5 - Minimum Data Scalar Settings

Current Transformer Size or Max Amperage	3-Phase System Voltage	
	240 Volts	480 Volts
50	Data Scalar = 1	Data Scalar = 2
100	Data Scalar = 2	Data Scalar = 2
200	Data Scalar = 2	Data Scalar = 2
400	Data Scalar = 2	Data Scalar = 2
600	Data Scalar = 2	Data Scalar = 3
1000	Data Scalar = 3	Data Scalar = 3
3000	Data Scalar = 3	Data Scalar = 3

To determine the appropriate data scalar for an application, use the following formula:

Measured or Calculated Values / Data Scalar Value ≤ 65,535 (Register Value)

If the data scalar is too low, the data may be inaccurate. If the data scalar is too high, the significant digits after the decimal are removed. Below is an example of how to calculate the appropriate data scalar.

Example 1:

- Voltage = 480V
- Amperage = 100A
- Total System Power = (480V) * (100A) * 3 = 144kW
- Select Data Scalar = 2, therefore data scalar value is 0.01
- Register Value = 144kW / 0.01 = 14,400
- Check 14,400 ≤ 65,535: Yes this data scalar is correct.

Example 2:

- Voltage = 480V
- Amperage = 1000A
- Total System Power = (480V) * (1000A) * 3 = 1,440kW
- Select Data Scalar = 1, therefore data scalar value is 0.001
- Register Value = 1,440kW / 0.001 = 1,440,000
- Check 1,440,000 ≤ 65,535: No this data scalar is incorrect.
- Change the data scalar value and check result again.

2.5.7 Scaled Variables

The 56WM can scale the measured values for voltage, current, power, and energy. The 56WM can be configured with a voltage scalar value and/or a current scalar value. The 56WM calculates the appropriate power and energy scalar values from the user defined voltage and current scale values.

For example, in a medium voltage application where the primary voltage of 4.16kV is stepped down with a 10:1 potential transformer to 416V, the 56WM would be configured with a voltage scale of 10.

2.5.8 Filtered Variables

The 56WM has two filters that can be configured to average the measured data. Both filters can filter specific device variable using a simple moving average algorithm. The simple moving average formula is shown below.

$$SMA = \frac{p_M + p_{M-1} + \cdots + p_{M-(n-1)}}{n} = \frac{1}{n}\sum_{i=0}^{n-1} p_{M-i}$$

The number of samples, *n*, can be configured from 1 to 50. The default value for the number of samples to filter is 1. To turn off the filter, set the number of samples to 1. Simplified diagrams of the filters are shown in Figure 2-7 and Figure 2-8.

Figure 2-7 - Filter #1 Diagram

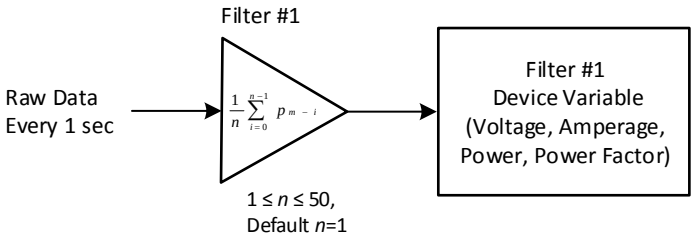
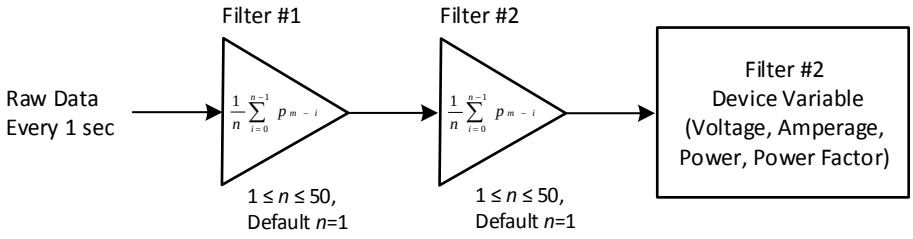


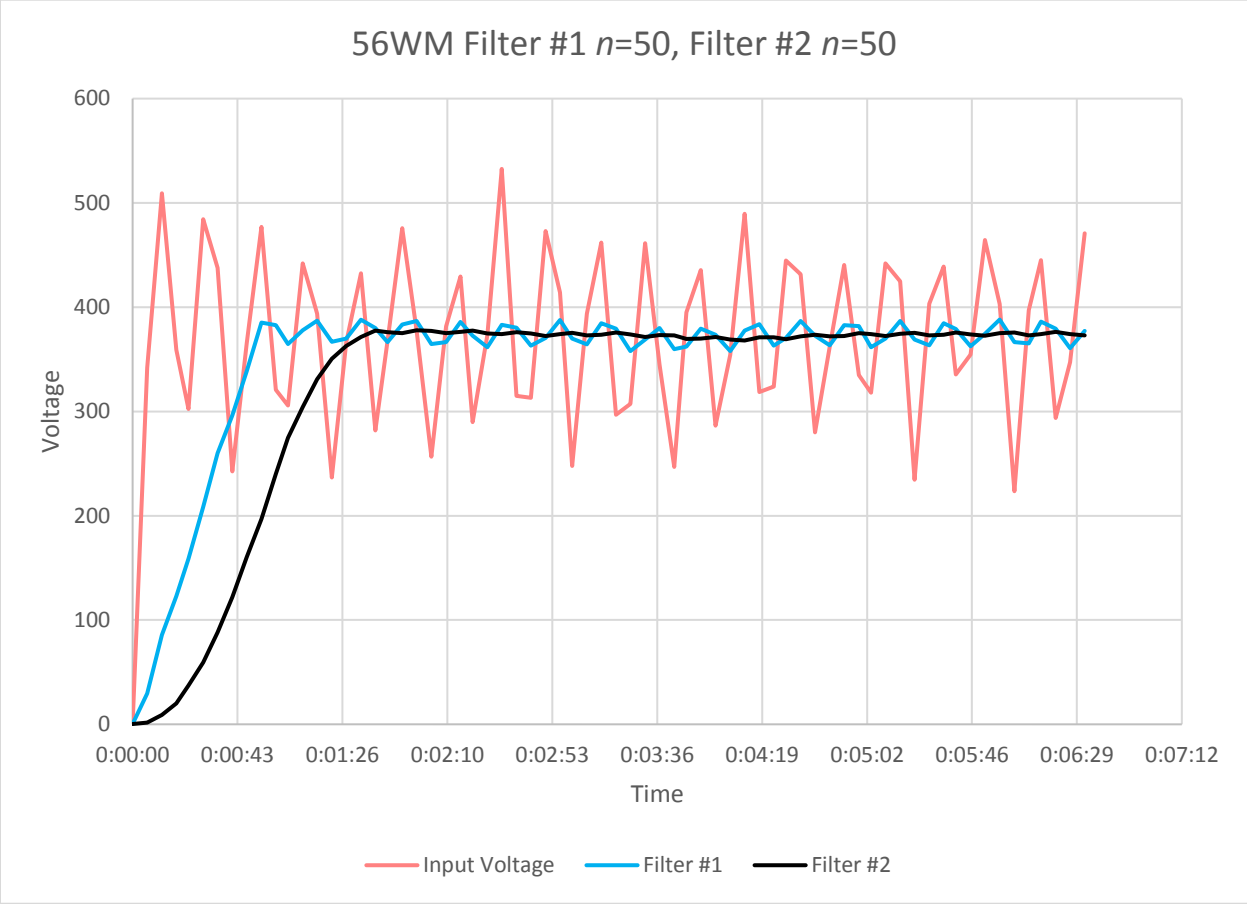
Figure 2-8 - Filter #2 Diagram



The 56WM is a waveform single cycle sampling meter. It samples one cycle of a waveform at 12kHz. It takes this measurement every half second. It measures voltage, current, frequency, and phase angle to compute power factor, power, and energy. The filtered variables are shown in Table 2-2, "Averaged Variables". The default value for the number of samples to filter is 1, which means the filter is off by default. The number of samples for each filter, *n*, can be configured from 1 to 50.

Figure 2-9 below is an example of both averaging filters set to maximum.

Figure 2-9 - Filtering Example



2.5.9 Application Alarms

The 56WM has several user configurable application alarms. These alarms include, low voltage tolerance, voltage imbalance tolerance, amperage imbalance tolerance, line frequency tolerance, minimum power factor, and general voltage tolerance. In addition, the 56WM has a configurable number of consecutive readings before setting the alarm. By default, these alarms are turned off.

Transition Filter (Default *n* = 0)
This is the number of consecutive readings before setting and clearing an application alarm. When *n=0* all application alarms are turned off.

Low Voltage Tolerance (Default *n* = 0.8)
The low voltage tolerance checks than no line-to-neutral voltage is low when compared to the other line-to-neutral voltages.

- Voltage L1-N < [(Voltage L2-N* *n*) or (Voltage L3-N* *n*)]
- Voltage L2-N < [(Voltage L1-N* *n*) or (Voltage L3-N* *n*)]
- Voltage L3-N < [(Voltage L1-N* *n*) or (Voltage L2-N* *n*)]

Voltage Imbalance (Default *n* = 0.03)

The voltage imbalance checks that no line-to-line voltage is more than *n*% different than the average line-to-line voltages.

- Voltage L1-L2 Imbalance: Voltage L1-L2 different from Average Line Voltage by *n*%
- Voltage L2-L3 Imbalance: Voltage L2-L3 different from Average Line Voltage by *n*%
- Voltage L1-L3 Imbalance: Voltage L1-L3 different from Average Line Voltage by *n*%

Amperage Imbalance (Default *n* = 0.03)

The amperage imbalance checks that no line amperage is more than *n*% different than the average line amperages.

- Amperage L1-Imbalance: Amperage L1 different from Average Line Amperage by *n*%
- Amperage L2-Imbalance: Amperage L2 different from Average Line Amperage by *n*%
- Amperage L3 Imbalance: Amperage L3 different from Average Line Amperage by *n*%

Line Frequency Tolerance (Default *n* = 0.02)

The line frequency tolerance checks that the line frequency is within ±*n*% of the nominal line frequency.

- [(1.0-*n*) * Nominal Line Frequency] ≤ Nominal Line Frequency ≤ [(1.0+*n*) * Nominal Line Frequency]

Minimum Power Factor (Default *n* = 0.7)

The minimum power factor checks that each line power factor is greater than or equal to the defined minimum.

- Power Factor L1 ≥ *n*
- Power Factor L2 ≥ *n*
- Power Factor L3 ≥ *n*

General Voltage Tolerance (Default *min* = 432, *max* = 528)

The general voltage tolerance checks that all line-to-line voltages are within the specified minimum and maximum. Table 2-6 below is a general table with ±10% of standard voltages.

Table 2-6 - General Voltage Tolerance

Minimum Voltage (-10%)	Nominal Voltage	Maximum Voltage (+10%)
108	**120**	132
187	**208**	229
216	**240**	264
249	**277**	305
432	**480**	528
540	**600**	660

Section 3 Installation

3.1 Overview

The information in this section covers installation considerations. A Quick Start Guide is shipped with every 56WM to describe basic installation and startup procedures. Dimensional drawings and for the 56WM are included in the Appendix.

3.2 Safety

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

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3.3 Wireless Considerations

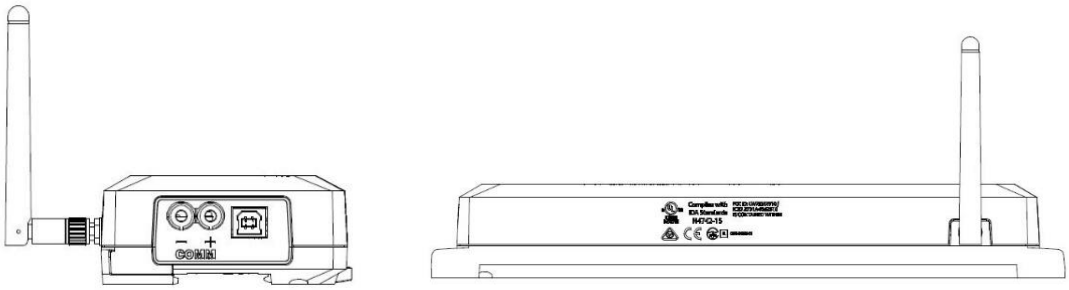
3.3.1 Power Up Sequence

The 56WM and all other wireless devices should be installed only after the Smart Wireless Gateway ("Gateway") has been installed and is functioning properly. Wireless devices should be powered up in order of proximity to the Gateway, beginning with the closest. This will result in a simpler and faster network installation. Enable active advertising on the Gateway to ensure new devices join the network faster. For more information, see the Smart Wireless Gateway Reference Manual located at http://tinyurl.com/smartwirelessgatewaymanual.

3.3.2 Antenna Position

The antenna should be positioned vertically, either straight up or straight down, and should be approximately 3ft. from any large structure, building, or conductive surface to allow for clear communication to other devices. See Figure 3-1.

Figure 3-1 - Antenna Position



3.4 Physical Installation

When selecting an installation location and position consider the proximity from the Smart Wireless Gateway to ensure optimum mesh network reliability. Verify the operating atmosphere of the 56WM is consistent with the appropriate operating specifications. The 56WM is an open type power meter and is required to be installed in an appropriately rated electrical enclosure. No cleaning agents, including water, shall be used on the 56WM.

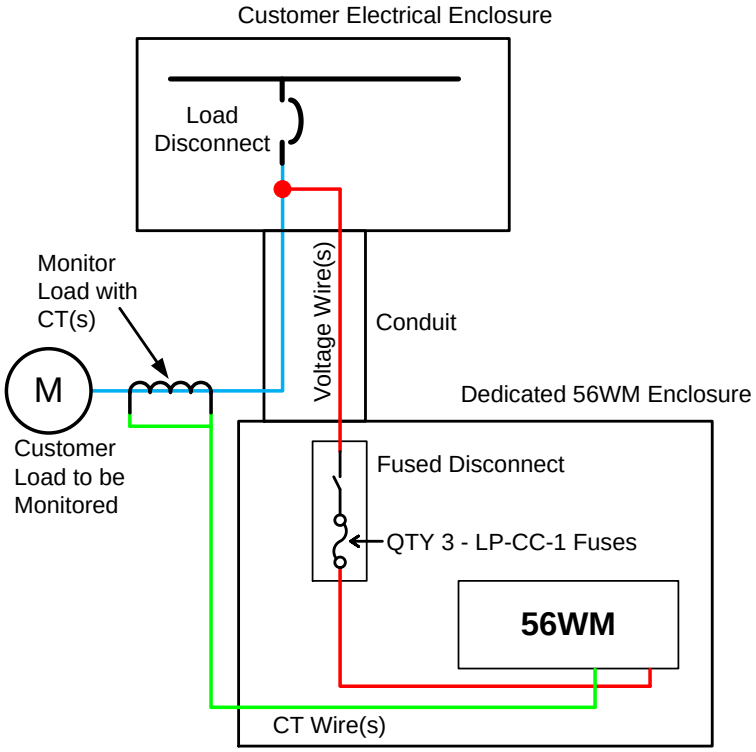
3.4.1 Mounting Enclosure

In compliance with UL, mount the 56WM inside a dedicated, suitable fire and electrical enclosure. Securely mount this enclosure as close to the load to be monitored as possible, to minimize the wiring length.

3.4.2 Electrical Connections

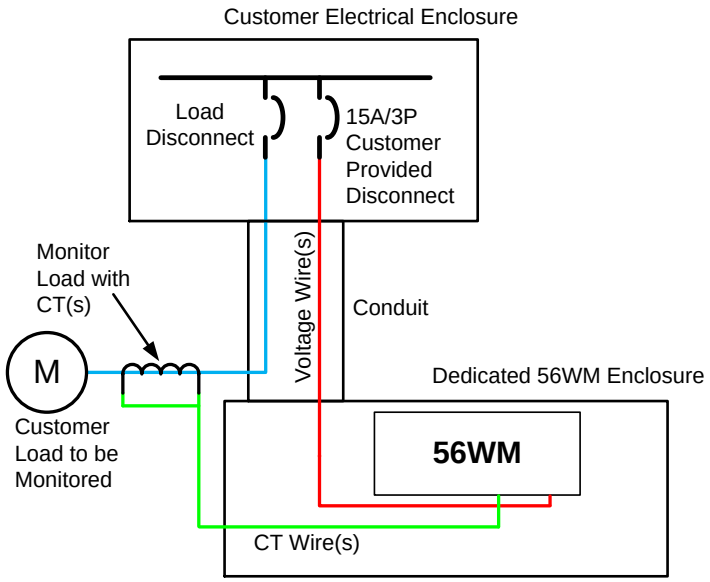
When installing the 56WM, follow the NFPA 70, National Electric Code or applicable local codes. In compliance with NFPA 70 sections 110.9 and 110.10, three Bussmann LP-CC-1 fuses, or equivalent, are required to be installed in each phase conductor upstream of the 56WM. The representative one-line diagram of this connection type is shown in Figure 3-2.

Figure 3-2 - Voltage Connection with Fused Disconnect



In compliance with UL and NFPA 70, provide and clearly mark a suitable disconnecting means for the 56WM. If a circuit breaker is used, the over-current rating should not exceed 15 amps. The representative one-line diagram of this connection type is shown in Figure 3-3.

Figure 3-3 - Voltage Connection with Customer Provided Circuit Breaker



3.4.2.1 Voltage Connections

Connect the voltage conductors to the 56WM (L1, L2, L3) as required for the load to be monitored. The neutral (N) connection must always be connected to neutral or earth ground to ensure proper operation and accurate measurements. All voltages conductors shall have minimum specifications of 14 AWG THHN and 600VAC rated. The connections for typical applications are shown in Figure 3-4, Figure 3-5, Figure 3-6, and Figure 3-7.

All unused voltage connections should be shorted to ground to avoid a floating input to the Power Meter.

Figure 3-4 - Three-Phase, Four-Wire

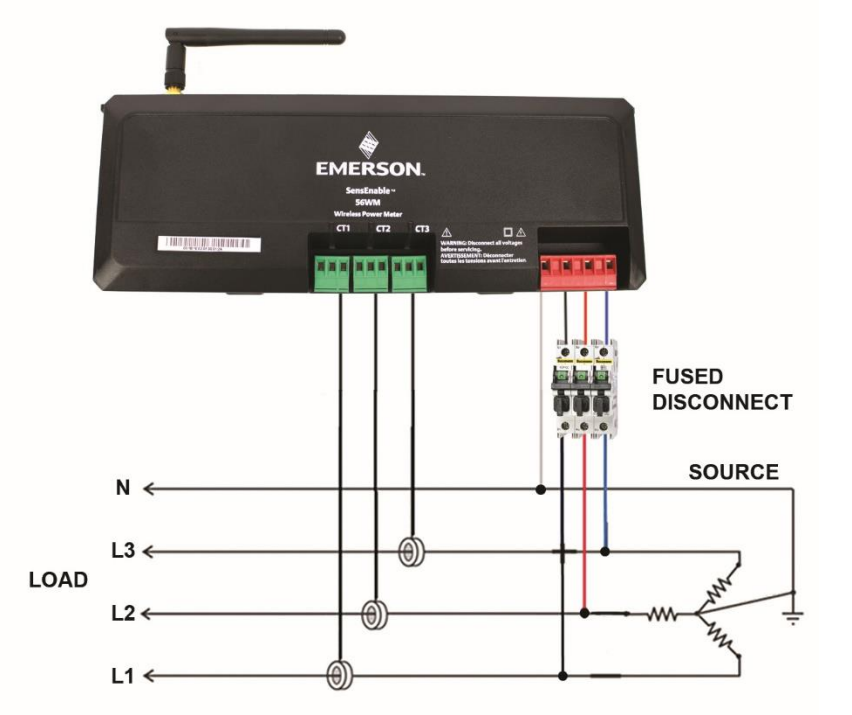


Figure 3-5 - Three-Phase, Three-Wire

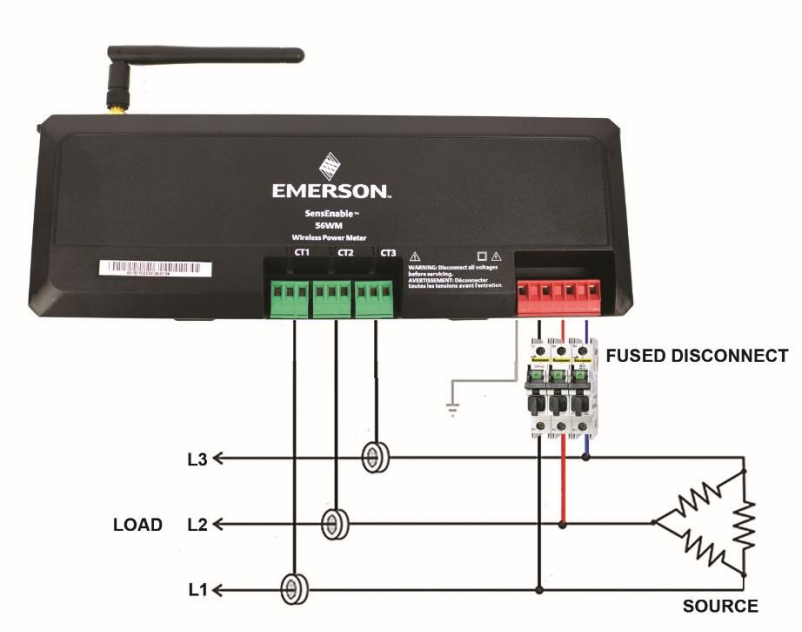


Figure 3-6 - Single-Phase, Three-Wire

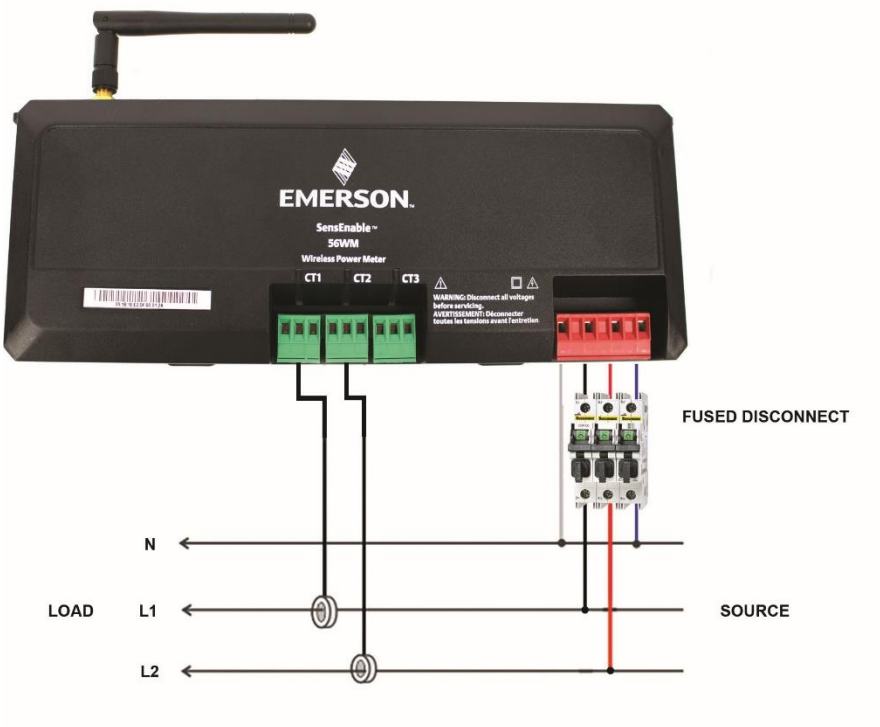
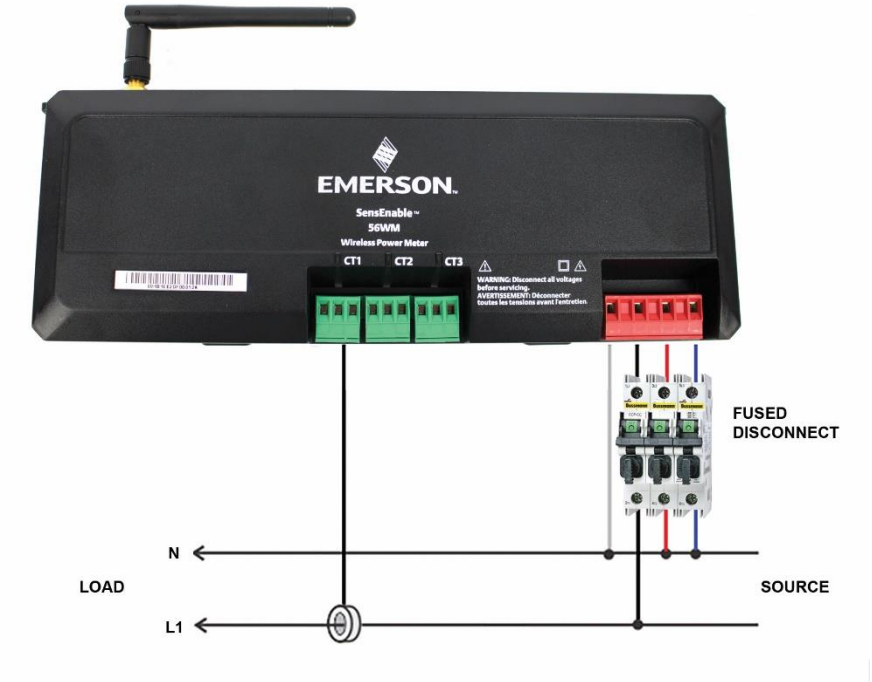


Figure 3-7 - Single-Phase, Two-Wire



3.4.2.2 Current Transformer Connections

In compliance with UL, only current transformers that are UL 2808 listed shall be installed inside a panelboard or switchboard. Correct orientation of a CT is required to ensure proper measurement. If an arrow is shown on the CT label, the CT should be installed so the arrow is pointing toward the load. Otherwise, use the instructions printed on the CT.

It is important that the current transformer and voltage connections are connected to the same phase conductor for proper phasing. For example, the voltage connection L1 needs to be connected to the same phase conductor that CT1 is clamped around, and so on. The LEDs will flash green if the connections are phased properly. If an LED flashes red, see the LED PhaseChek™ table in the verification section of the manual for troubleshooting information.

If needed, the CT wiring may be extended up to 75 feet with 18 AWG THHN conductors.

All unused CT connections should be shorted to ground to avoid a floating input to the Power Meter.

3.4.2.3 Powering Device

The 56WM may be powered from either the L1-L2 line voltage connection or the USB 5VDC connection. In applications where the load to be monitored is power cycled, i.e. motor, it is necessary to connect the 56WM to the USB power source to provide continuous power, to the meter.

Section 4 Verification

4.1 Overview

The information in this section covers verification considerations. A Quick Start Guide is shipped with every 56WM to describe basic installation and startup procedures.

4.2 Safety

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

⚠WARNING! HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- This product must only be installed or serviced by qualified electricians following safe electrical work practices.
- Installers and servicers of this device are responsible for conformance to all applicable codes, including NFPA 70E in the USA, and local codes.
- Installers and servicers are responsible to confirm, with an appropriately rated voltage sensing device, that all power has been removed prior to installing or servicing this device.
- This product must be installed inside a suitable fire and electrically rated enclosure.
- Do not install this device in a hazardous or classified location.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operations.
- This device must be installed to ensure a minimum antenna separation distance of 20 cm from all persons.

4.3 Verify Operation

The 56WM should be commissioned prior to installation to ensure proper operation and to become familiar with its functionality. Operation can be verified in four locations: at the device, using a field communicator, the Smart Wireless Gateway's integrated web interface, or using AMS.

4.3.1 56WM

During normal operation the 56WM LEDs will flash green in sequence if the voltage and current transformer connections are properly connected. If any PhaseChek™ LED flashes red, the most likely cause is that a voltage and current transformer connection is connected out-of-phase. The PhaseChek™ LED error descriptions and potential corrections are shown in Table 4-1.

Table 4-1 - PhaseChek™ LED Table

CT1 LED	CT2 LED	CT3 LED	Error Description	Correction
🟢	🟢	🟢	Installation is correct and the system power factor is greater than 0.55	No correction required
🔴	🔴	🔴	All CTs connections are out-of-phase	Change the CT connections until all LEDs are green. Note: It is recommended to move all CT connections by one, CT1 to CT2, CT2 to CT3, and CT3 to CT1
🔴	🔴	🔴	The system power factor is less than 0.55	The CT connections are connected properly but there is a problem with the load
🟢	🔴	🔴	CT2 and CT3 are reversed	Switch CT2 and CT3 connections
🔴	🔴	🟢	CT1 and CT2 are reversed	Switch CT1 and CT2 connections
🔴	🟢	🟢	CT1 is out-of-phase	Switch CT1 and CT2 connections
🔴	🟢	🟢	CT1 is out-of-phase	Switch CT1 and CT3 connections
🟢	🔴	🟢	CT2 is out-of-phase	Switch CT2 and CT1 connections
🟢	🔴	🟢	CT2 is out-of-phase	Switch CT2 and CT3 connections
🟢	🟢	🔴	CT3 is out-of-phase	Switch CT3 and CT1 connections
🟢	🟢	🔴	CT3 is out-of-phase	Switch CT3 and CT2 connections
🔴	🟢	🔴	CT1 and CT3 are out-of-phase	Switch CT1 and CT3 connections

4.3.2 Field Communicator

For 56WM communication with a Field Communicator, a 56WM DD is required. To obtain the latest DD, visit the 475 Field Communicator System Software and Device Description site at www.emerson.com/field-communicator.

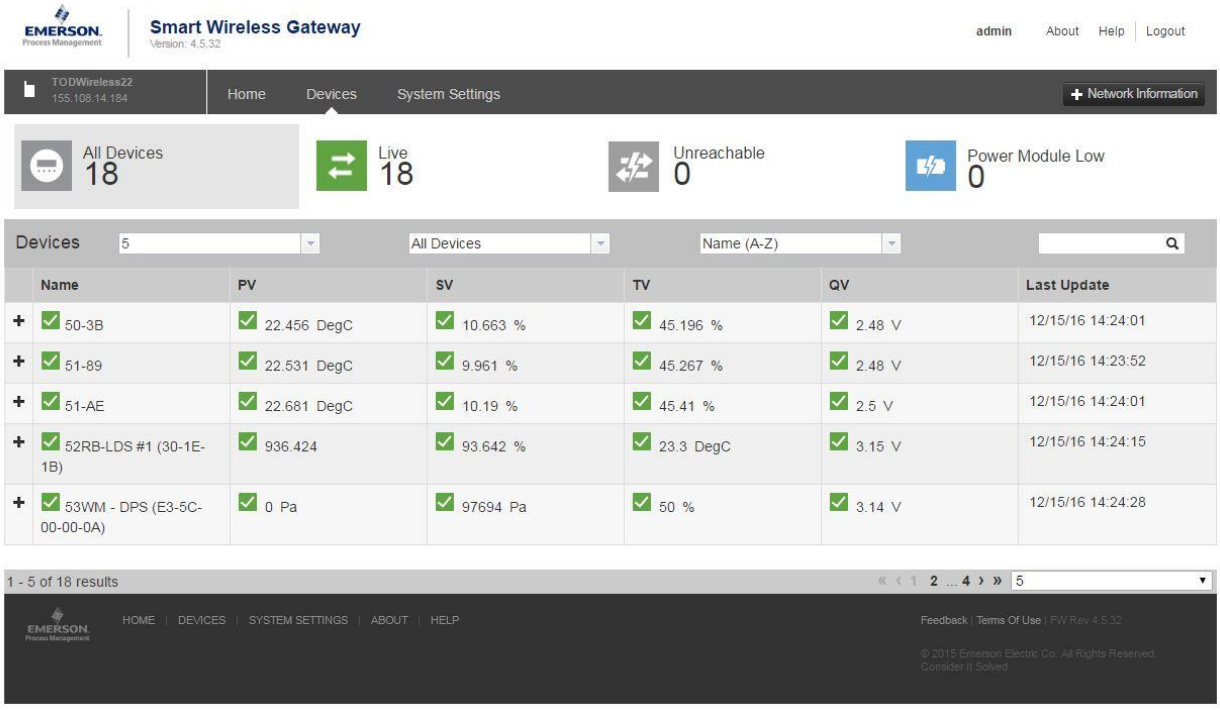
4.3.3 Gateway

If the 56WM was configured with the Network ID and Join Key and sufficient time for network polling has passed, the 56WM will be connected to the network. To verify device operation and connectivity using the Smart Wireless Gateway's web based user interface, shown in Figure 4-1, navigate to the *Devices* page. This page will also display the 56WM's tag, PV, SV, TV, QV, and Last Update time. Refer to the Smart Wireless Gateway User Interface Manual Supplement for terms, user fields, and parameters used in the Smart Wireless Gateway web based user interface.

Note

The time to join the new device(s) to the network is dependent upon the number of devices being joined and the number of devices in the existing network. For one device joining an existing network with multiple devices, it may take up to ten minutes. It may take up to 60 minutes for multiple new devices to join an existing network.

Figure 4-1 - Smart Wireless Gateway Devices Page



4.3.4 AMS

For 56WM communication with AMS, a 56WM DD is required. To obtain the latest DD, visit the Emerson Process Management Easy Upgrade site at emersonprocess.com/en-US/documentation/deviceinstallkits/Pages/deviceinstallkitsearch.aspx/

Section 5 Troubleshooting

5.1 Overview

The tables in this section provide summarized maintenance and troubleshooting suggestions for the most common operating problems. If you suspect malfunction despite the absence of any diagnostic messages on the Field Communicator display, follow the procedures here to verify the 56WM hardware and process connections are in good working order. Always deal with the most likely checkpoints first.

5.2 Safety

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

⚠WARNING! HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- This product must only be installed or serviced by qualified electricians following safe electrical work practices.
- Installers and servicers of this device are responsible for conformance to all applicable codes, including NFPA 70E in the USA, and local codes.
- Installers and servicers are responsible to confirm, with an appropriately rated voltage sensing device, that all power has been removed prior to installing or servicing this device.
- This product must be installed inside a suitable fire and electrically rated enclosure.
- Do not install this device in a hazardous or classified location.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operations.
- This device must be installed to ensure a minimum antenna separation distance of 20 cm from all persons.

NOTICE

For technical assistance, call:
United States:
419-525-8307
Asia Pacific:
91-22-66620414
Europe and Latin America:
+1-419-525-8315

5.3 Device Status

Table 5-1 - 56WM Device Status Information

Device Status	Description	Recommended Action
Electronics Defect	An electronics error that could impact the device measurement reading has occurred	1. Reset the device 2. Reconfirm all configuration items in the device
Radio Failure	The wireless radio has detected a failure or stopped communicating	1. Reset the device
Electronics Temperature has Exceeded Limits	The electronics temperature has exceeded the device's maximum range	1. Verify environmental temperature is within the device's range 2. Remote mount the device away from process and environmental conditions 3. Reset the device
HI HI Alarm	The primary variable has surpassed the defined limit	1. Verify the process variable is within the specified limits 2. Reconfirm the defined alarm limit 3. If not needed, disable this alert
HI Alarm	The primary variable has surpassed the defined limit	1. Verify the process variable is within the specified limits 2. Reconfirm the defined alarm limit 3. If not needed, disable this alert
LO Alarm	The primary variable has surpassed the defined limit	1. Verify the process variable is within the specified limits 2. Reconfirm the defined alarm limit 3. If not needed, disable this alert
LO LO Alarm	The primary variable has surpassed the defined limit	1. Verify the process variable is within the specified limits 2. Reconfirm the defined alarm limit 3. If not needed, disable this alert
Simulation Active	The device is in simulation mode and may not be reporting actual information	1. Verify that simulation is no longer required 2. Disable Simulation mode in Service Tools 3. Reset the device
MODBUS Failure	There is no communication between the co-processors	1. Reset the device
Sensor Failure	The onboard sensor is not properly communicating	1. Reset the device

5.4 Wireless Network

Table 5-2 - Wireless Troubleshooting

Symptom	Recommended Action
Device not joining the network	1. Verify network ID and join key 2. Verify network is in active advertise mode 3. Wait longer (30 minutes) 4. Verify device is within range of at least one other device 5. Power cycle the device to try again 6. See troubleshooting section of Smart Wireless Gateway for more information
Limited bandwidth error	1. Reduce the update rate on the device 2. Reduce the number of burst messages on the device 3. Increase communication paths by adding more wireless points 4. Check that the device has been online for at least an hour 5. Check that the device is not routing through a limited routing node 6. Create a new network with an additional Smart Wireless Gateway

5.5 Application Alarms

Table 5-3 - 56WM Application Alarms (See section 2.5.9 Application Alarms of this manual for more information)

Device Status	Description	Recommended Action (1)
Voltage L1 Low	Voltage L1-to-Neutral is less than defined tolerance	1. Check load being monitored for potential failure 2. WARNING! Turn off power to the device and verify that all wires are securely connected to the voltage connector on the device 3. Check voltage source for potential failures 4. Increase the defined tolerance 5. Reset the device
Voltage L2 Low	Voltage L2-to-Neutral is less than defined tolerance	1. Check load being monitored for potential failure 2. WARNING! Turn off power to the device and verify that all wires are securely connected to the voltage connector on the device 3. Check voltage source for potential failures 4. Increase the defined tolerance 5. Reset the device
Voltage L3 Low	Voltage L3-to-Neutral is less than defined tolerance	1. Check load being monitored for potential failure 2. WARNING! Turn off power to the device and verify that all wires are securely connected to the voltage connector on the device 3. Check voltage source for potential failures 4. Increase the defined tolerance 5. Reset the device
Voltage L1-L2 Imbalance	Voltage L1-L2 is less than the defined tolerance for imbalance with the other line voltages	1. Check load being monitored for potential failure 2. WARNING! Turn off power to the device and verify that all wires are securely connected to the voltage connector on the device 3. Check voltage source for potential failures 4. Increase the defined tolerance 5. Reset the device
Voltage L2-L3 Imbalance	Voltage L2-L3 is less than the defined tolerance for imbalance with the other line voltages	1. Check load being monitored for potential failure 2. WARNING! Turn off power to the device and verify that all wires are securely connected to the voltage connector on the device 3. Check voltage source for potential failures 4. Increase the defined tolerance 5. Reset the device
Voltage L1-L3 Imbalance	Voltage L1-L3 is less than the defined tolerance for imbalance with the other line voltages	1. Check load being monitored for potential failure 2. WARNING! Turn off power to the device and verify that all wires are securely connected to the voltage connector on the device 3. Check voltage source for potential failures 4. Increase the defined tolerance 5. Reset the device

Current L1 Imbalance	Current L1 is less than the defined tolerance for imbalance with the other line currents	1. Check load being monitored for potential failure 2. WARNING! Turn off power to the device and verify that all wires are securely connected to the current connector on the device 3. Check voltage source for potential failures 4. Increase the defined tolerance 5. Reset the device
Current L2 Imbalance	Current L2 is less than the defined tolerance for imbalance with the other line currents	1. Check load being monitored for potential failure 2. WARNING! Turn off power to the device and verify that all wires are securely connected to the current connector on the device 3. Check voltage source for potential failures 4. Increase the defined tolerance 5. Reset the device
Current L3 Imbalance	Current L3 is less than the defined tolerance for imbalance with the other line currents	1. Check load being monitored for potential failure 2. WARNING! Turn off power to the device and verify that all wires are securely connected to the current connector on the device 3. Check voltage source for potential failures 4. Increase the defined tolerance 5. Reset the device
Line Frequency Tolerance	Line frequency is outside the defined tolerance of the expected line frequency	1. WARNING! Turn off power to the device and verify that all wires are securely connected to the voltage connector on the device 2. Check voltage source for potential failures 3. Increase the defined tolerance 4. Reset the device
Power Factor L1 Low	Power Factor L1 is less than the defined minimum	1. Check load being monitored for potential failure 2. WARNING! Turn off power to the device and verify that all wires are securely connected to the current and voltage connectors on the device 3. Check voltage source for potential failures 4. Increase the defined tolerance 5. If the asset is a motor, verify that the motor is sized appropriately 6. Reset the device
Power Factor L2 Low	Power Factor L2 is less than the defined minimum	1. Check load being monitored for potential failure 2. WARNING! Turn off power to the device and verify that all wires are securely connected to the current and voltage connectors on the device 3. Check voltage source for potential failures 4. Increase the defined tolerance 5. If the asset is a motor, verify that the motor is sized appropriately 6. Reset the device

Power Factor L3 Low	Power Factor L3 is less than the defined minimum	1. Check load being monitored for potential failure 2. WARNING! Turn off power to the device and verify that all wires are securely connected to the current and voltage connectors on the device 3. Check voltage source for potential failures 4. Increase the defined tolerance 5. If the asset is a motor, verify that the motor is sized appropriately 6. Reset the device
Voltage L1-L2 Tolerance	Voltage L1-L2 is outside the defined tolerance for the standard voltage	1. Verify the correct minimum and maximum voltages are defined 2. Check load being monitored for potential failure 3. WARNING! Turn off power to the device and verify that all wires are securely connected to the voltage connector on the device 4. Check voltage source for potential failures 5. Increase the defined minimum and maximum voltages 6. Reset the device
Voltage L2-L3 Tolerance	Voltage L2-L3 is outside the defined tolerance for the standard voltage	1. Verify the correct minimum and maximum voltages are defined 2. Check load being monitored for potential failure 3. WARNING! Turn off power to the device and verify that all wires are securely connected to the voltage connector on the device 4. Check voltage source for potential failures 5. Increase the defined minimum and maximum voltages 6. Reset the device
Voltage L1-L3 Tolerance	Voltage L1-L3 is outside the defined tolerance for the standard voltage	1. Verify the correct minimum and maximum voltages are defined 2. Check load being monitored for potential failure 3. WARNING! Turn off power to the device and verify that all wires are securely connected to the voltage connector on the device 4. Check voltage source for potential failures 5. Increase the defined minimum and maximum voltages 6. Reset the device

(1) If an application alarm is too sensitive, increase the number of consecutive readings required before an alarm is triggered (See section 2.5.9 Application Alarms of this manual for more information).

Section 6 Specifications

6.1 Specifications

Service Type	Single Phase, 3 Phase 4 Wire (WYE), 3 Phase 3 Wire (DELTA)
Power Input	L1-L2 Phase 80-600VAC or USB 5VDC, 100mA
Fuse	0.5A Time-Delay CC Class, 200kAIC, 600VAC
Voltage Channels	80-346VAC Line-to-Neutral, 600VAC Phase-to-Phase
Current Channel	0.520VAC max, 0.333VAC CTs, 0-4000A
Overvoltage Category	CAT III, 600VAC
Line Frequency	50/60 Hz
Waveform Sampling	200 samples/60Hz waveform, 240 samples/50Hz waveform
Accuracy	0.2%, ANSI C12.20-2010 Class 0.2, True RMS Measurement
Power Meter Safety	UL 61010-1, UL 61010-2-30, CSA C22.2 No. 61010-1
Current Transformer Safety	For use with UL 2808 listed CTs only
EMC	IEC 61326-1:2012 Class B
Temperature	-20°C to 55°C
Relative Humidity	Up to 90% RH, Non-Condensing
Enclosure	ABS Plastic, 94-V0 flammability rating
Ingress Protection	IP20
Update Rate	1 minute (default), 1 second to 60 minutes
HART Variables	39 Device Variables (Default)

6.2 Dimensional Drawings

Figure 6-1 - Dimension are shown in INCHES (mm)

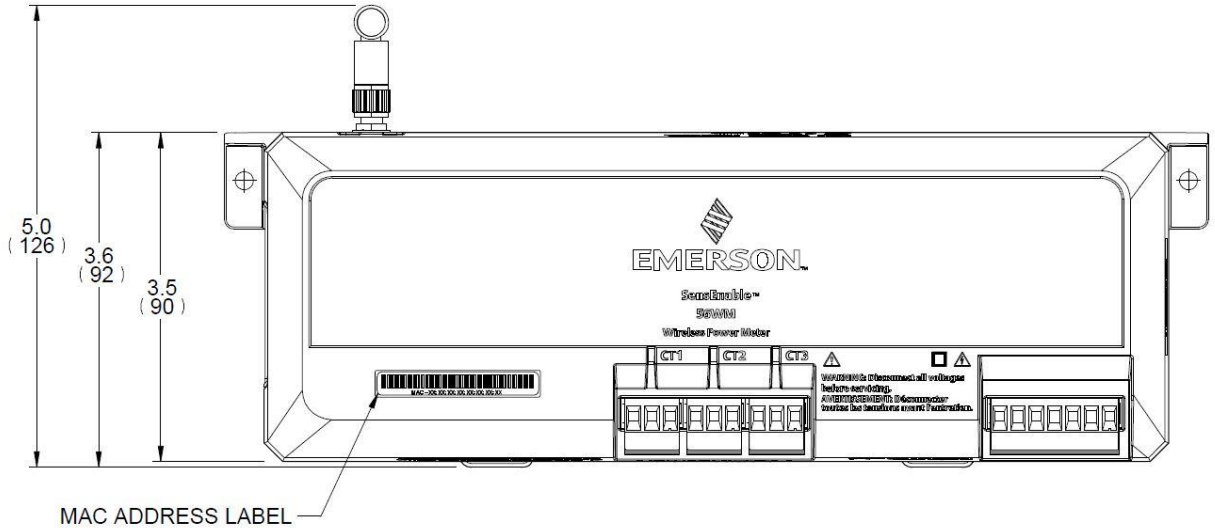


Figure 6-2 - Dimension are shown in INCHES (mm)

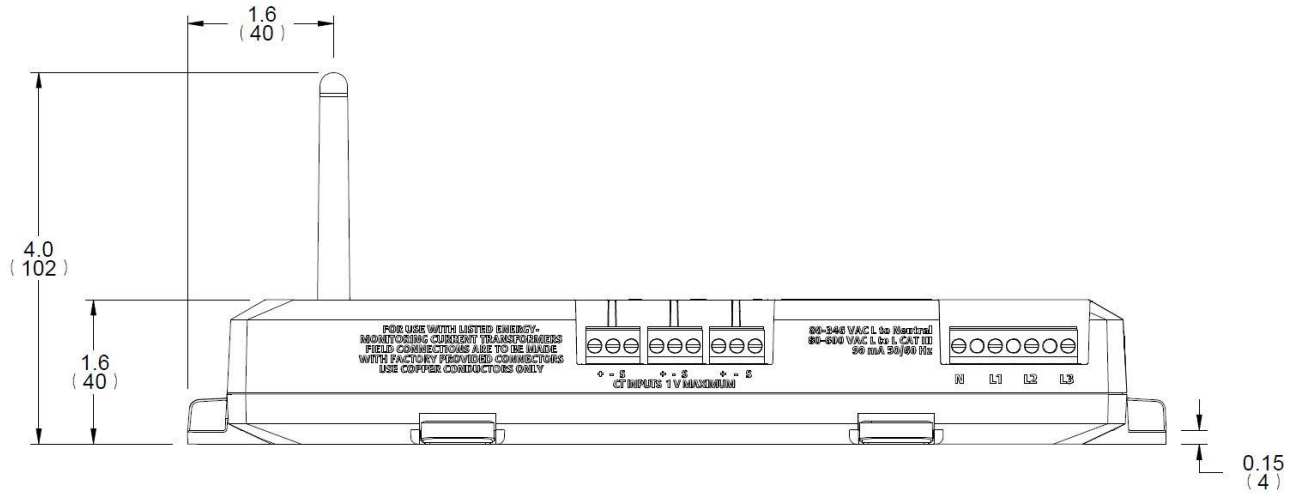
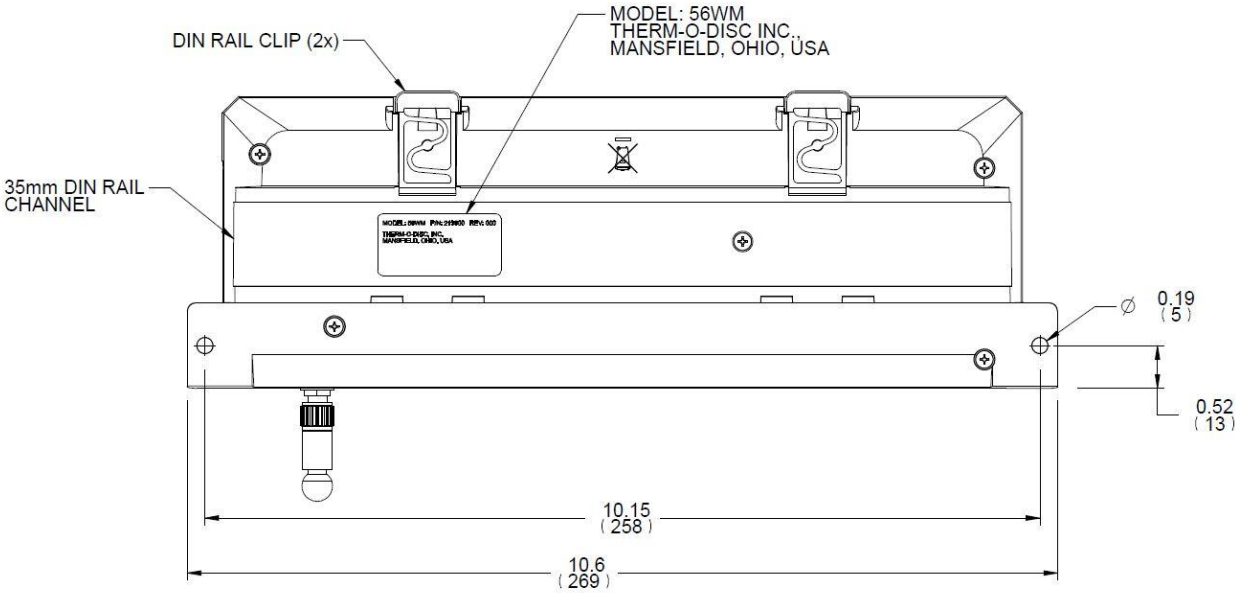


Figure 6-3 - Dimension are shown in INCHES (mm)



Section 7 Product Certifications

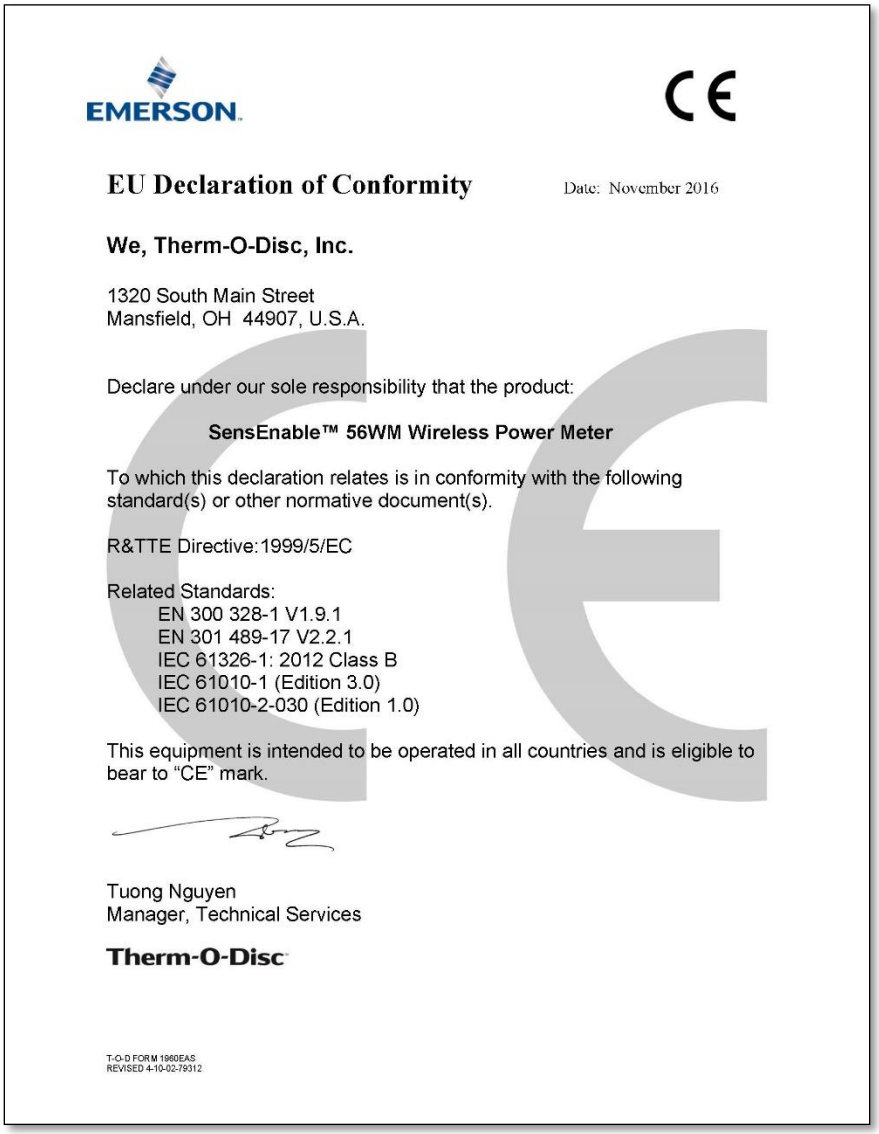
7.1 FCC/IC

This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions: This device may not cause harmful interference. This device must accept any interference received, including interference that may cause undesired operation. This device must be installed to ensure a minimum antenna separation distance of 20 cm from all persons.

7.2 Telecommunications

All wireless devices require certification to ensure they adhere to regulations regarding the use of the RF spectrum. Nearly every country requires this type of product certification. Emerson is working with governmental agencies around the world to supply fully compliant products and remove the risk of violating country directives or laws governing wireless device usage.

7.3 EU



EMERSON

CE

EU Declaration of Conformity Date: November 2016

We, Therm-O-Disc, Inc.

1320 South Main Street
Mansfield, OH 44907, U.S.A.

Declare under our sole responsibility that the product:

SensEnable™ 56WM Wireless Power Meter

To which this declaration relates is in conformity with the following standard(s) or other normative document(s).

R&TTE Directive:1999/5/EC

Related Standards:
- EN 300 328-1 V1.9.1
- EN 301 489-17 V2.2.1
- IEC 61326-1: 2012 Class B
- IEC 61010-1 (Edition 3.0)
- IEC 61010-2-030 (Edition 1.0)

This equipment is intended to be operated in all countries and is eligible to bear to "CE" mark.

Tuong Nguyen
Manager, Technical Services

Therm-O-Disc

T-O-D FORM 1960EAS
REVISED 4-10-02-79312

7.4 ANSI

This device meets ANSI C12.20-2010 Class 0.2 with 0.2% accuracy, 0.1% accuracy typical.

7.5 UL

This device is UL Listed certificate number 20140314-E186827. This device conforms to UL 61010-1, Third Edition (2012), CSA C22.2 No. 61010-1, Third Edition (2012), IEC 61010-1, Third Edition, and IEC 61010-2-030, First Edition. This device is an Over-Voltage Category III device. Over Voltage Category III devices are for measurements performed in the building. Examples are measurements on electrical distribution equipment, stationary motors, or other permanent, fixed installations for industrial use. Use approved rubber gloves with mechanical protection and goggles when operating the device.

Symbols on the 56WM

 This symbol on the product indicates that caution is required and that the manual must be consulted for information about potential hazards and how to avoid them.

 DENOTES HIGH VOLTAGE. RISK OF ELECTRICAL SHOCK. LIFE THREATENING VOLTAGES MAY BE PRESENT. QUALIFIED PERSONNEL ONLY

 Equipment protected throughout by double insulation (IEC 536 Class II)

Section 8 Non-DD Based Integration

8.1 Alert Message Mapping

This outlines the most important alerts in HART® command 48 Additional Status Field for the 56MW. The information in this section can be used by a host for alert monitoring, and in the Smart Wireless Gateway for Additional Status mapping in Modbus®, OPC, etc.

To view Active Alerts with a Field Communicator, from the Home screen, go to Service Tools>Active Alerts.

Table 8-1 - Failure Alerts

Message	Additional Status Bit Definition	Description
Electronics Failure	Byte 0 :: Bit 0 Byte 0 :: Bit 3 Byte 0 :: Bit 6 Byte 0 :: Bit 7 Byte 8 :: Bit 1 Byte 8 :: Bit 2 Byte 8 :: Bit 6	An electronics error that could impact the device measurements has occurred
Radio Failure	Byte 1 :: Bit 1 Byte 1 :: Bit 6 Byte 1 :: Bit 7	The wireless radio has detected a failure or has stopped communicating and may impact the device measurements
Modbus Failure	Byte 1 :: Bit 5	The Modbus bus has stopped communicating and may impact the device measurements

Table 8-2 - Maintenance Alerts

Message	Additional Status Bit Definition	Description
Electronics Warning	Byte 0 :: Bit 4 Byte 0 :: Bit 5	The device has detected an electronics error that does not currently impact the device measurements
Electronics Temperature has Exceeded Limits	Byte 1 :: Bit 2 Byte 1 :: Bit 3	The electronics temperature has exceeded the device's maximum range

Table 8-3 - Advisory Alerts

Message	Additional Status Bit Definition	Description
HI HI Alarm	Byte 5 :: Bit 4	The primary variable has surpassed the defined limit
HI Alarm	Byte 5 :: Bit 5	The primary variable has surpassed the defined limit
LO Alarm	Byte 5 :: Bit 6	The primary variable has surpassed the defined limit
LO LO Alarm	Byte 5 :: Bit 7	The primary variable has surpassed the defined limit
Simulation Active	Byte 8 :: Bit 0	The device is in simulation mode and may not be reporting actual information

Table 8-4 - Application Alerts

Message	Additional Status Bit Definition	Description
Current L3 Imbalance	Byte 3 :: Bit 0	Current L3 has surpassed the defined limit for imbalance
Line Frequency Tolerance	Byte 3 :: Bit 1	Line Frequency is outside the defined tolerance
Power Factor L1	Byte 3 :: Bit 2	Power Factor L1 is less than the defined limit
Power Factor L2	Byte 3 :: Bit 3	Power Factor L2 is less than the defined limit
Power Factor L3	Byte 3 :: Bit 4	Power Factor L3 is less than the defined limit
Voltage L1-L2 Tolerance	Byte 3 :: Bit 5	Voltage L1-L2 has surpassed the defined limit for tolerance
Voltage L2-L3 Tolerance	Byte 3 :: Bit 6	Voltage L2-L3 has surpassed the defined limit for tolerance
Voltage L1-L3 Tolerance	Byte 3 :: Bit 7	Voltage L1-L3 has surpassed the defined limit for tolerance
Voltage L1 Low	Byte 4 :: Bit 0	Voltage L1-N is less than the defined tolerance
Voltage L2 Low	Byte 4 :: Bit 1	Voltage L2-N is less than the defined tolerance
Voltage L3 Low	Byte 4 :: Bit 2	Voltage L3-N is less than the defined tolerance
Voltage L1-L2 Imbalance	Byte 4 :: Bit 3	Voltage L1-L2 has surpassed the defined limit for imbalance
Voltage L2-L3 Imbalance	Byte 4 :: Bit 4	Voltage L2-L3 has surpassed the defined limit for imbalance
Voltage L1-L3 Imbalance	Byte 4 :: Bit 5	Voltage L1-L3 has surpassed the defined limit for imbalance
Current L1 Imbalance	Byte 4 :: Bit 6	Current L1 has surpassed the defined limit for imbalance
Current L2 Imbalance	Byte 4 :: Bit 7	Current L2 has surpassed the defined limit for imbalance

Important Notice

The warranty of this product stated in the terms and conditions of sale does not extend to any losses or damages due to misuse, accident, abuse, neglect, normal wear and tear, negligence (other than Seller's), unauthorized modification or alteration, use beyond rate capacity, or improper installation, maintenance or application. To the extent that Buyer or its agents has supplied specifications, information, representation of operating conditions or other data to Seller in the selection or design of the product and the preparation of Seller's quotation, and in the event that actual operating conditions or other conditions differ from those represented by Buyer, any warranties or other provisions contained herein which are affected by such conditions shall be null and void. Buyer is solely responsible for determining the suitability of this product for its application. Furthermore, Buyer is solely responsible for the function of the end-use product.

Seller terms and conditions apply.

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