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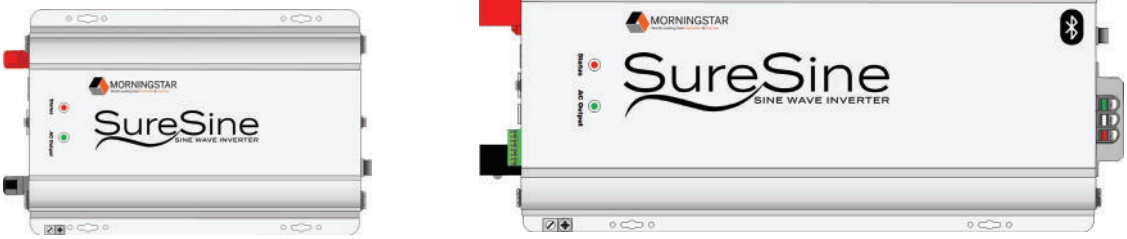
SureSine
SINE WAVE INVERTER



Installation and Operations Manual

150 W, 300 W, 700 W (12 V, 24 V, & 48 V) Models,
1,000 W &1,250 W, (24 V & 48 V) Models,
2,500 W (48 V Only) Models

September 2022 (Rev B08)

About MorningStar:

With well over 4 million products sold in over 100 countries since 1993—functioning in some of the most extreme environments and mission-critical applications in the world—Morningstar Corporation can truly claim to be "the leading supplier of solar controllers and inverters." That success is why Morningstar has had staying power and stable management for over 27 years, along with the lowest employee turnover rate.

- Smarter digital design has been pioneered for solar components, for faster, more agile processing on-board. This allows for the maximum performance from the hardware.
- Advanced thermal engineering is used to eliminate cooling fans—the weak link in competitors' products.
- Finally, internal electronics are laid out for performance and longevity instead of economics—designing for the long-term in order to achieve the industry's lowest hardware failure rates.

For additional information about Morningstar Corporation, go to:
www.morningstarcorp.com

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IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS - This manual contains important safety, installation, and operating instructions for the Morningstar SureSine Inverter.

The SureSine produces voltages and currents capable of causing severe injury or death. Extreme caution must be taken when installing and using the SureSine.

The following symbols are used throughout this manual to indicate potentially dangerous conditions or important safety instructions.

	**WARNING**: Indicates a potentially dangerous condition. Failure to observe this notice could result in severe personal injury or death.
	**CAUTION:** Indicates a critical procedure for safe and proper operation of the SureSine. Use extreme caution when performing this task. Failure to observe this notice could result in personal injury or equipment damage.
	**NOTE:** Indicates a procedure or function that is important to the safe and proper operation of the SureSine Inverter.

GENERAL SAFETY INFORMATION

Throughout this manual, NEC guidance has been provided in order to meet general safety requirements and inform best installation practices. It is the installer's responsibility to ensure that the Installation complies with all local safety and code requirements.

- Read all of the instructions and cautions in the manual before starting the installation.
- Ensure that battery power has been disconnected BEFORE installing, servicing, or removing the SureSine Inverter.
- Do not allow water to enter the SureSine.
- Avoid wearing jewelry while installing this equipment.
- Do not smoke near the battery bank.
- Ensure power connections remain tight to avoid excessive heating from a loose connection.
- Recycle the battery when it is replaced.

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WIRE AND CABLE SAFETY

Proper wire type and size is required for all installations. Use only UL-listed Class B or Class C wire rated for 300 volts and 75°C or higher. Use stranded wire for the battery circuit and solid or stranded wire for the AC and Ground circuits.

Copper wire is recommended instead of aluminum due to its ease of use, superior conductivity, strength and thermal expansion properties.

WARNING: SHOCK HAZARD

- **Installations must be performed by a qualified person trained in electrical safety procedures (minimum qualification).**
- All wiring must comply with local electric code requirements.
- Ensure all sources of **input** are disconnected before connecting **ANY** cabling.

WARNING: RISK OF FIRE

All over-current protection devices and wiring must be sized properly, in accordance with US National Electric Code (NEC) or the local regulations of the country of installation.

WARNING: FIRE HAZARD

A risk of fire may exist if a 120 Vac power source is wired incorrectly to 120/240 Vac panel containing multi-wire branch circuits.

MOUNTING, CLEARANCE, AND LOCATION SAFETY

WARNING: EXPLOSION/FIRE HAZARD

Do not install in a confined area where battery gases can accumulate. Battery gases can create an explosion or fire hazard if ignited by a spark. Ensure the enclosure is ventilated well enough to disperse any accumulated gases.

Do not install over an easily combustible surface, since the heat sink may get hot under certain operating conditions.

CAUTION: EQUIPMENT DAMAGE

- Do not mount in zero-clearance compartment. Overheating may result. Ensure adequate space around the components to ensure sufficient ventilation around the equipment.
- Locate the SureSine on a surface that is protected from direct sun, high temperatures, corrosive fumes, and water.
- Ensure the mounting surface is strong enough to support the weight of the inverter as well as any other devices that may be attached to it. It may be necessary to reinforce the surface with plywood to provide additional support for the equipment.

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CAUTION: HOT SURFACE/BURN HAZARD

The SureSine inverter models 700 Watts to 2,500 W can become very hot. Install the SureSine so that it cannot be accidentally touched by anyone or anything.

BATTERY SAFETY INFORMATION

WARNING: SHOCK HAZARD

- Servicing of batteries should be performed, or supervised, by personnel knowledgeable about batteries, and the proper safety precautions.
- Have someone nearby to assist in case of an accident.
- Carefully read the battery manufacturer's instructions before installing / connecting to, or removing batteries from the SureSine Inverter.
- A battery can present a risk of electrical shock or burn from large amounts of short-circuit current, fire, or explosion from vented gases. Observe proper precautions.
- Remove watches, rings, jewelry and other metal objects before working with batteries.
- Use tools with insulated handles and avoid placing tools or metal objects on top of batteries.
- Disconnect charging source prior to connecting or disconnecting battery terminals.
- Determine if battery is inadvertently grounded. If so, remove the source of contact with ground. Contact with any part of a grounded battery can result in electrical shock. The likelihood of such a shock can be reduced if battery grounds are removed during installation and maintenance (applicable to equipment and remote battery supplies not having a grounded supply circuit).

WARNING: RISK OF EXPLOSION

- Explosive battery gases can be present during charging. Be certain there is enough ventilation to release the gases.
- Proper disposal of batteries is required. Do not dispose of batteries in fire. Refer to local regulations or codes for requirements. Recycle the battery when it is replaced.
- Never smoke in the battery area.

WARNING: CORROSION HAZARD/TOXIC FUMES

- Do not open or mutilate batteries. Released electrolyte is harmful to skin and may be toxic if inhaled.
- Be very careful when working with large lead-acid batteries. Wear eye protection and have fresh water available in case there is contact with the battery acid.
- Wear rubber gloves and boots.
- If battery acid comes into contact with the skin, wash with soap and water. If the acid contacts the eye, flood with fresh water and get medical attention.
- Recycle the battery when it is replaced.

BATTERY SAFETY INFORMATION

(Continued)

CAUTION: EQUIPMENT DAMAGE

- Ensure the battery voltage matches the DC voltage requirements of the model of SureSine inverter to be installed.
- Ensure the battery bank consists of batteries of the same type, make and age.
- Be sure the battery electrolyte level is correct before starting charging. Do not attempt to charge a frozen battery.
- Ensure that the charging equipment implemented in the system meets the charging requirements for the battery bank and varied charging
- The SureSine Low Voltage Disconnect (LVD) and Low Voltage Reconnect (LVR) presets are generally designed for lead acid batteries. Use custom LVD and LVR settings required for the type of battery in the system and minimum desired state of charge (SOC). Note that some battery types may not be compatible.
- Be sure the battery electrolyte level is correct before starting charging. Do not attempt to charge a frozen battery.

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1.0 INTRODUCTION

The SureSine Inverter is a pure sine wave inverter for industrial and residential DC-to-AC applications which require high quality power. The SureSine can be used as a standalone system or as an accessory to larger systems that may include charging sources and energy storage systems.

1.1 Features

SureSine features include:

- DC power to AC power conversion to the following output voltages:
  - 120-volt/60 Hz
  - 230-volt/50 Hz
- Pure sine wave conversion produces a highly efficient AC grid-quality power.
- Supports 12-volt, 24-volt, or 48-volt DC systems (dependent on model purchased).
- Extensive electronic protections ensure protection against faults and user mistakes such as short circuits, overloads, high temperatures, and low voltage disconnects. Recovery from most faults is automatic.
- Two LEDs provide important information to the user regarding battery status and AC output.
- Remote ON/OFF capability.
- Eight DIP switches provide easy adjustment of several system parameters.
- Multiple communication options.
  - Mobile devices can connect through Bluetooth
  - Other network devices can connect through Ethernet and/or EIA-485
  - FUTURE FEATURE: The SureSine Inverter can pair with other Morningstar products that feature MS-CAN Communication for control, adjustments, and monitoring performance

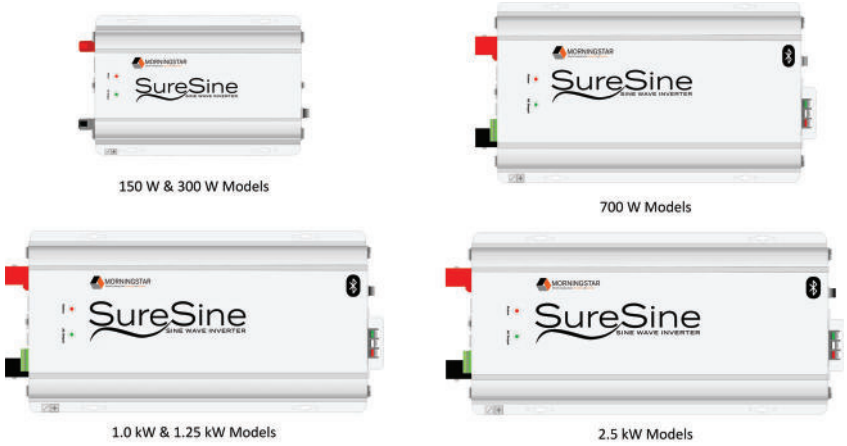

Figure 1: SureSine Inverters Series

1.2 Components of the 150 W & 300 W Models

Figure 2 shows the components included with the 150 and 300 W models.

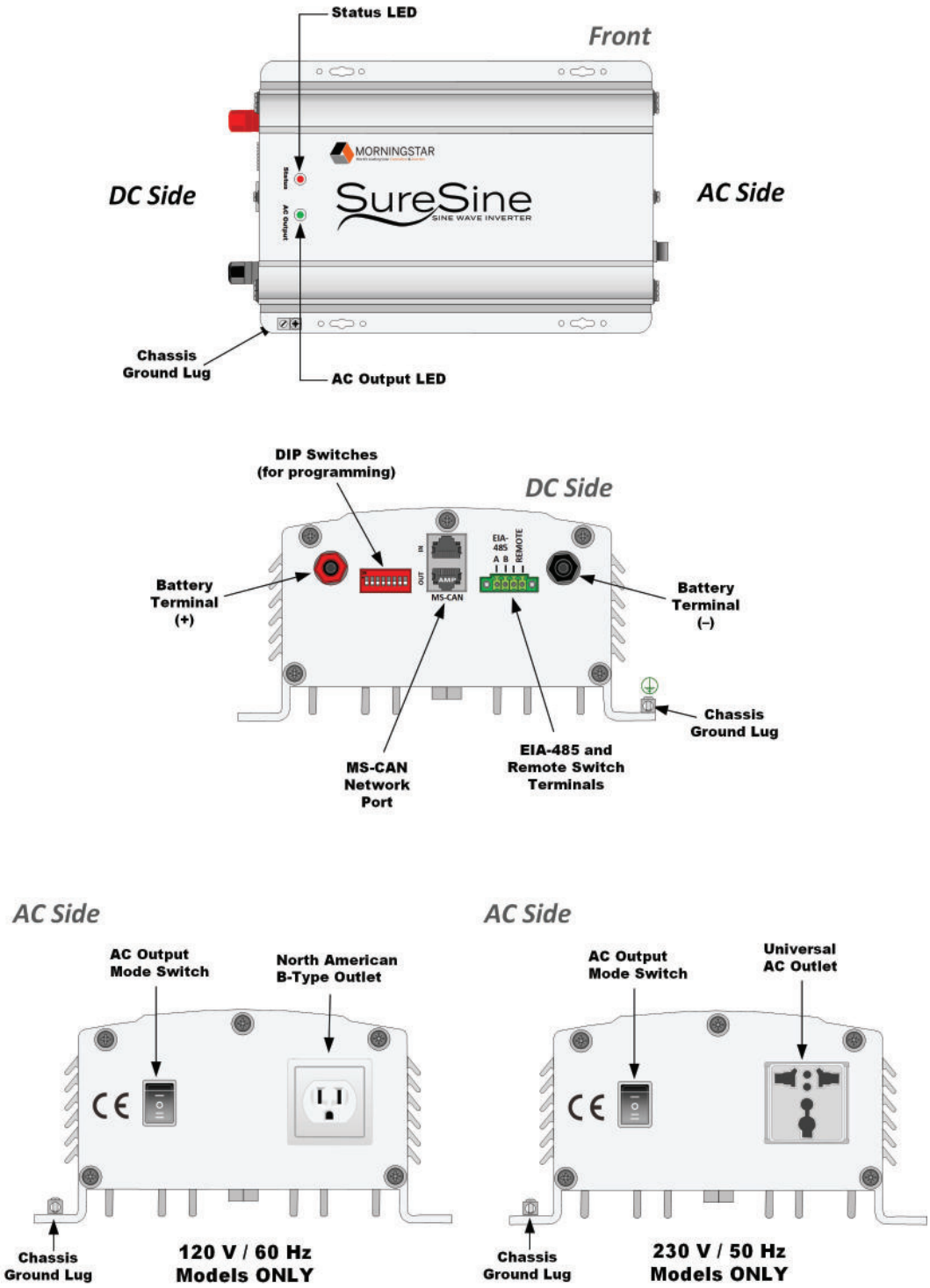

Figure 2: SureSine Inverter Features (150 W & 300 W Models)

1.3 Components of the 700 W Models

Figure 3 shows the components included with the 700 W models.

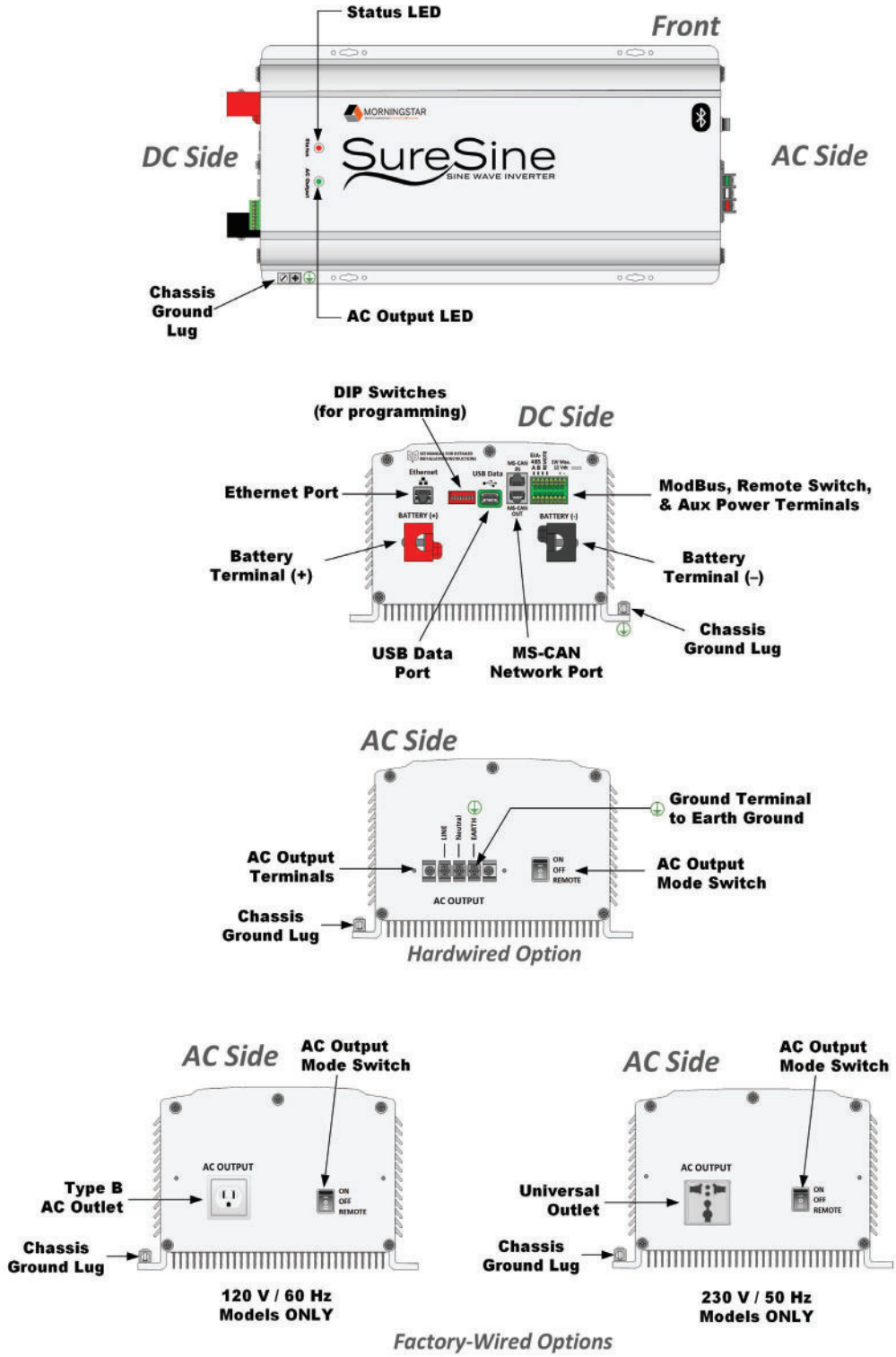

Figure 3: SureSine Inverter Features (700 W Models)

1.4 Components of the 1,000 W to 2,500 W Models

Figure 4 shows the components included with the 1,000 W to 2,500 W models.

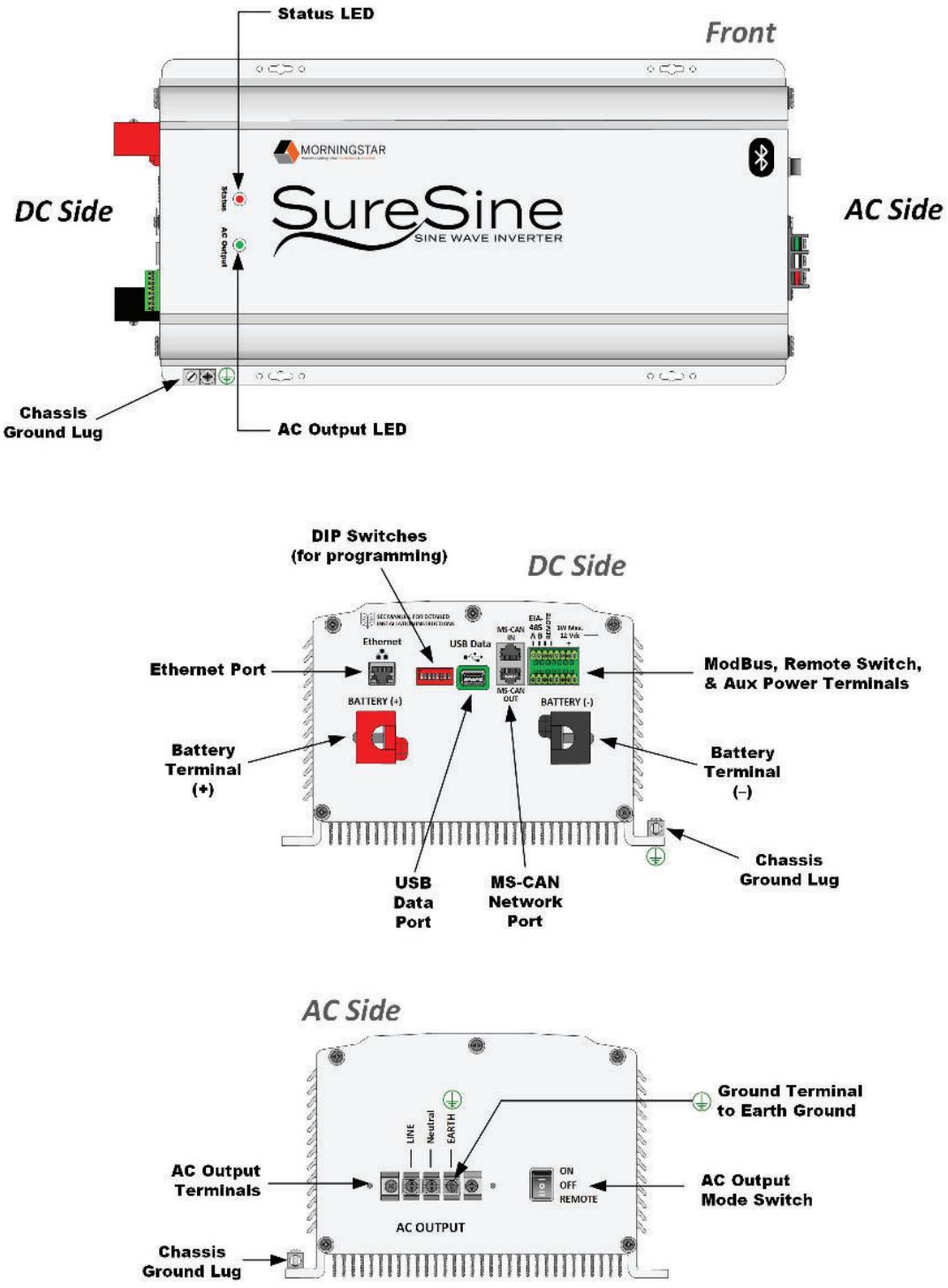

Figure 4: SureSine Inverter Features (1,000 W to 2,500 W Models)

1.5 Dimensions of the 150 W & 300 W Models

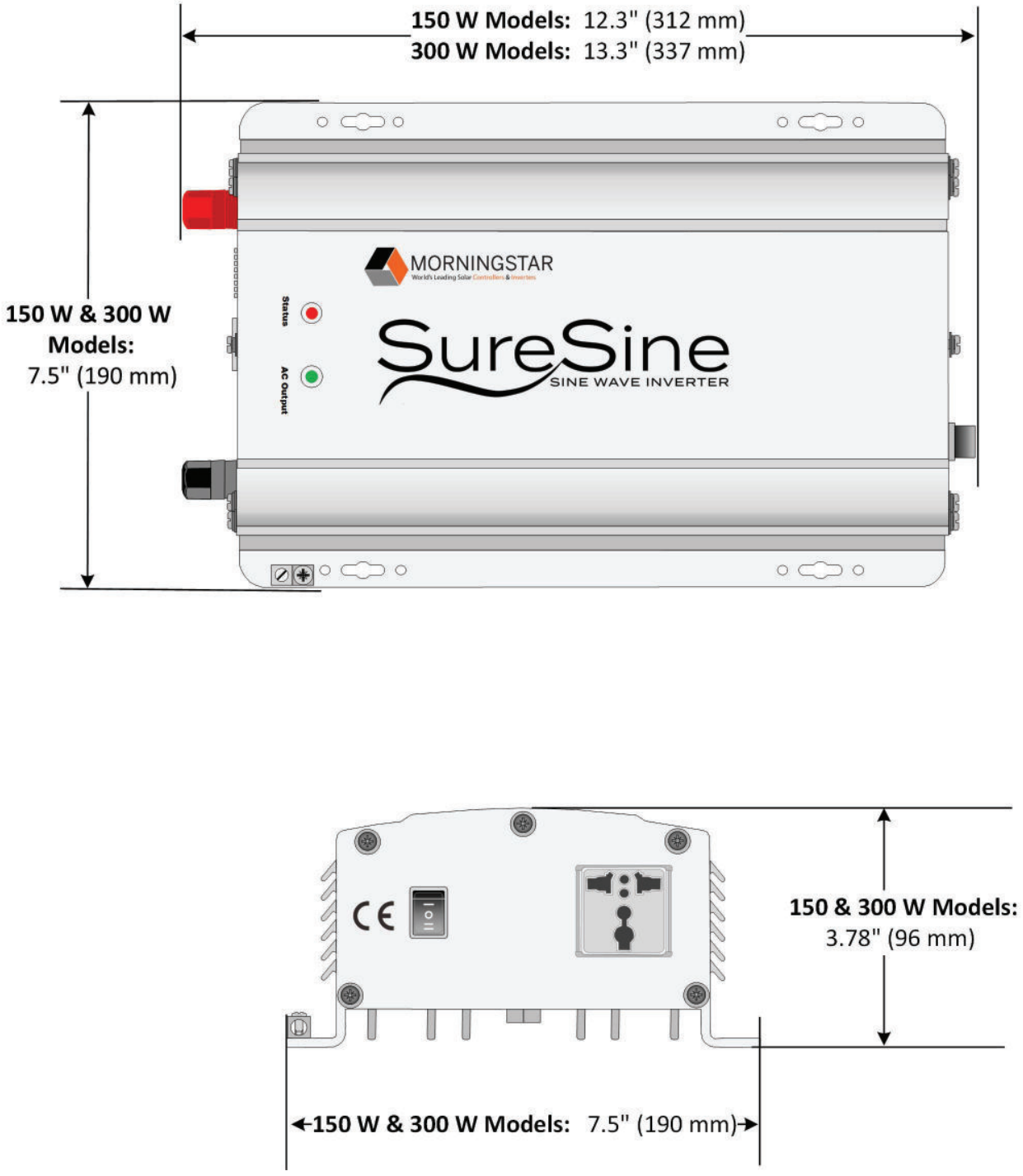

Figure 5: Dimensions - 150 W to 300 W Models

1.6 Dimensions of the 700 W to 2,500 W Models

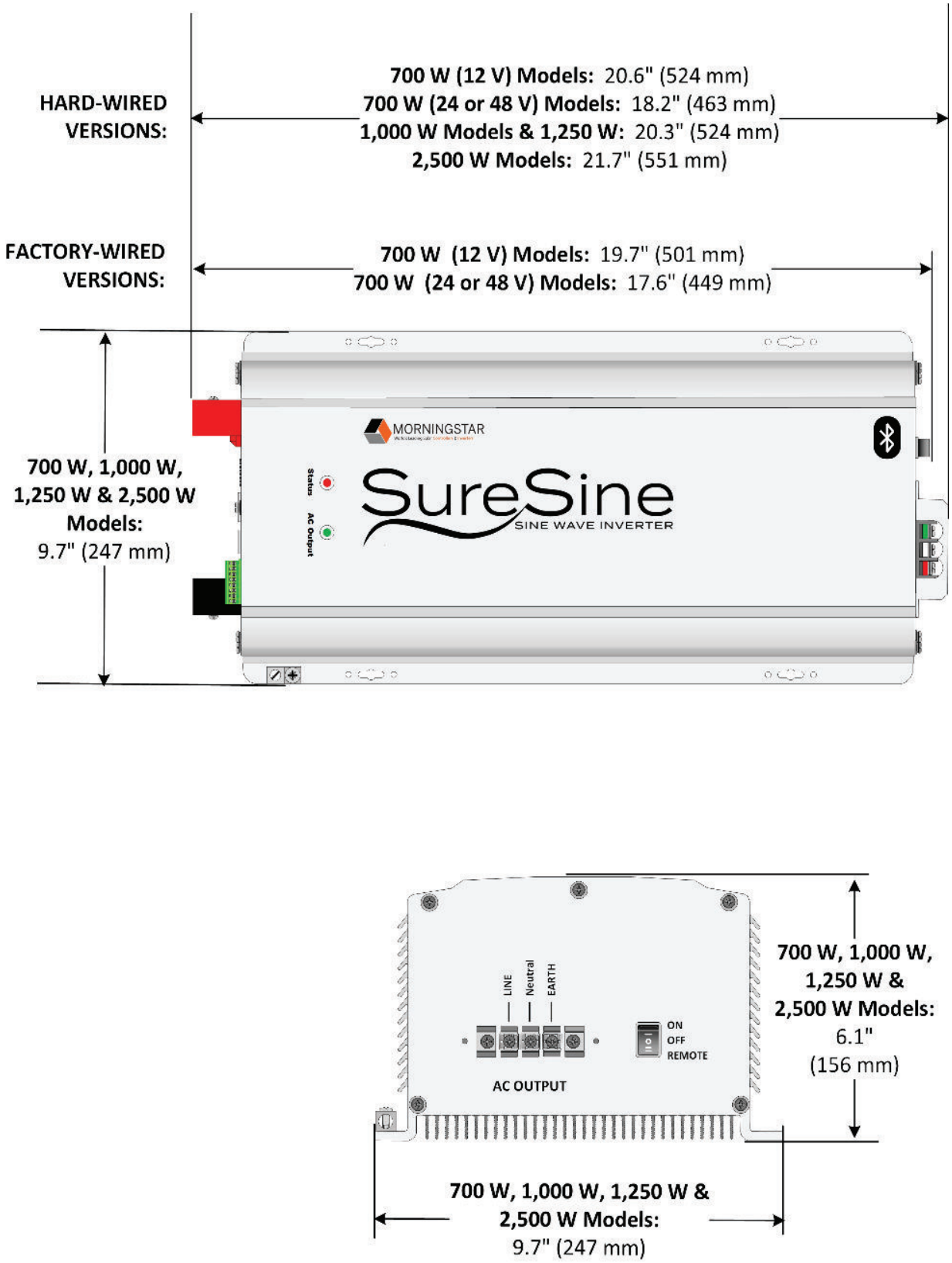

Figure 6: Dimensions - 700 W to 2,500 W Models

2.0 INSTALLATION

Included in the box:

- Mounting Screws (#10 x4)
- CAN Terminal resistor
- Terminal block connector (for Modbus, Remote Switch, Auxiliary Power)

2.1 Required Tools

WARNING: SHOCK HAZARD

This product can produce hazardous voltage. Use insulated tools while working with this equipment.

The minimum required tools include the following. Additional tools may be required depending on the site application.

- Wire cutters/strippers
- Drill and 1/8" (3 mm) drill bit
- #2 Philips and 3/16 (5 mm) & 1/8" (3.8 mm) Flat-head screwdrivers
- Multimeter
- Crimping Tool
- Wrench

2.2 Additional Hardware Requirements

Depending on the type of installation, additional hardware may be required. This hardware is NOT provided with the SureSine Inverter. These types of components include, but are not limited to:

- Battery or battery bank
  - Ensure the battery voltage matches the DC voltage requirements of the model of SureSine inverter to be installed.
  - Ensure the battery bank is comprised of batteries of the same type, make, and age.
- All DC and ground cables
- AC wiring for 700 W to 2,500 W models only
- Sub panels, circuit breakers, fuses Ground Fault Disconnects etc.
- Primary Earth Ground connection (e.g., ground rod)
- Remote Switch (Optional)

Consult the system design diagrams to determine the exact requirements for the installation.

2.3 Mounting

The SureSine may be mounted horizontally on a flat surface (like a table) or vertically (on a wall). If mounted vertically (on a wall), the inverter can be mounted either portrait style or landscape style. Ensure that there is enough space inside the enclosure for the wiring and ventilation. For optimal ventilation and cooling, mount in portrait style orientation.

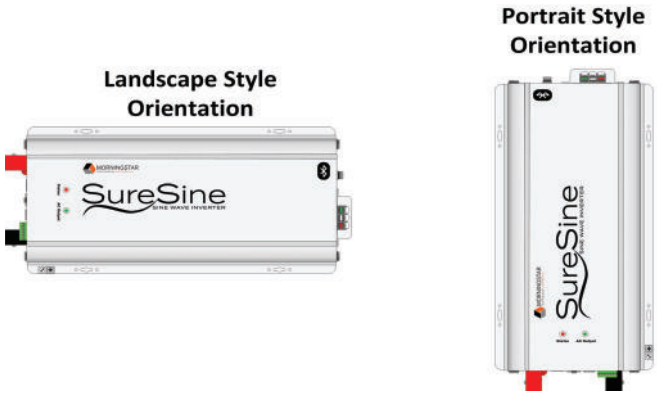

Figure 7: Mounting Orientation

Four Keyhole slots are provided to secure the inverter to the mounting surface.

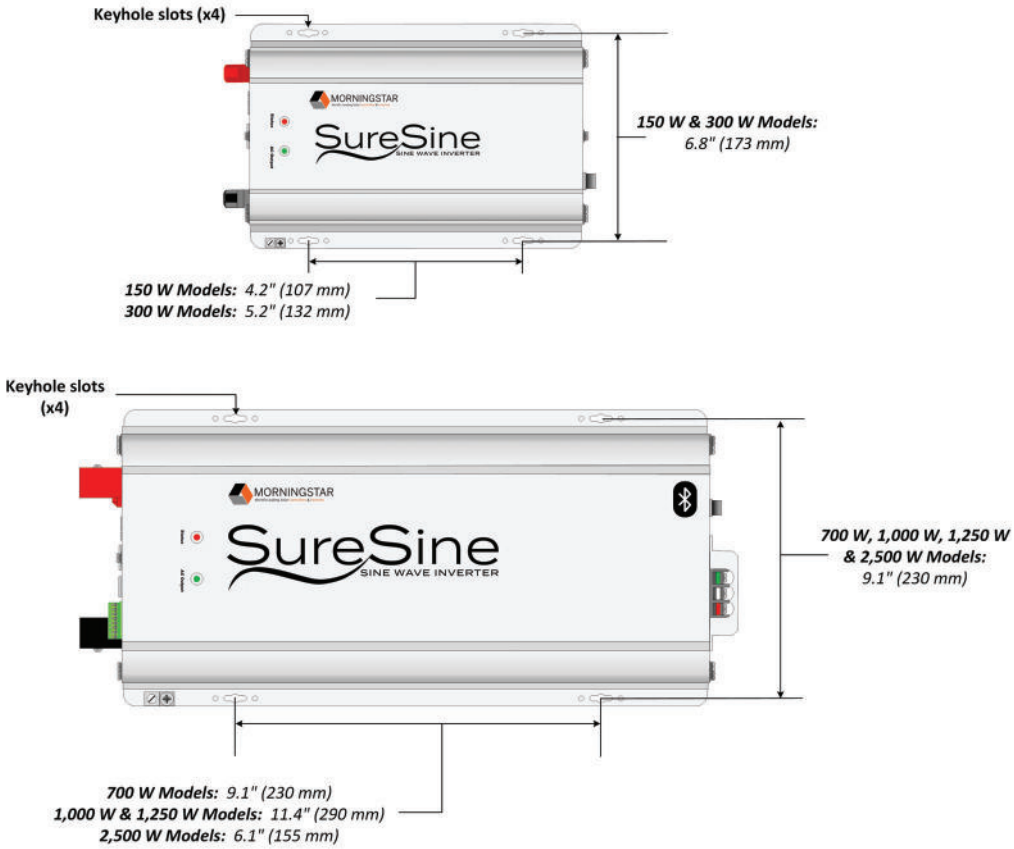

Figure 8: Mounting Holes

2.3.1 Safety Considerations for Mounting

WARNING: EXPLOSION/FIRE HAZARD

Do not install in a confined area where battery gases can accumulate. Battery gases can create an explosion or fire hazard if ignited by a spark. Ensure the enclosure is ventilated well enough to disperse any accumulated gases.

Do not install over an easily combustible surface, since the heat sink may get hot under certain operating conditions.

CAUTION: EQUIPMENT DAMAGE

- Do not mount in zero-clearance compartment. Overheating may result. Ensure adequate space around the components to ensure sufficient ventilation around the equipment.
- Locate the SureSine on a surface that is protected from direct sun, high temperatures, corrosive fumes, and water.
- Ensure the mounting surface is strong enough to support the weight of the inverter as well as any other devices that may be attached to it. It may be necessary to reinforce the surface with plywood to provide additional support for the equipment.

CAUTION: HOT SURFACE/BURN HAZARD

The SureSine inverter models 700 Watts to 2,500 W can become very hot. Install the SureSine so that it cannot be accidentally touched by anyone.

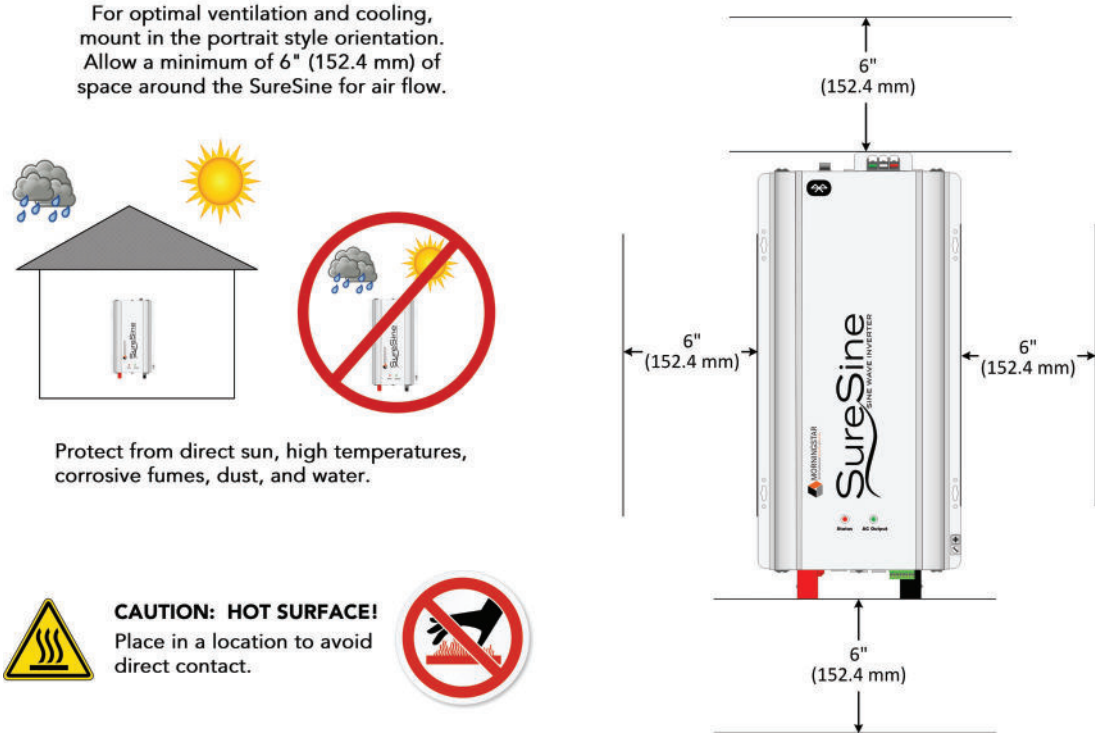

Figure 9: Minimum Clearance Requirements

2.3.2 Mounting Procedure

To secure the inverter to the mounting surface:

1. Place the SureSine on the surface where it will be mounted and determine where the wires will enter/exit.
    - Be sure there is sufficient bending room for the wires and other auxiliary connections, as required by local code.
    - Verify that the mounting screws will not penetrate wires or other objects located on the opposite side of the surface.
    - Ensure the surface is strong enough to support the weight of the inverter and anything else mounted on it. It may require additional support, such as a sheet of plywood.
2. With a pencil or pen, mark the mounting hole locations.
3. With a drill and 1/8" (3 mm) bit, drill pilot holes for each of the four mounting screw locations marked on the mounting surface.
4. Place the SureSine onto the surface and align the mounting feet holes with the four pilot holes. Use the #10 screws (included) to secure the SureSine to the surface.

2.4 Adjusting Settings

The SureSine has eight (8) DIP Switches that allow for adjusting specific operational parameters for the inverter. Each switch has an ON/OFF position. See Section 2.4.2 on page 12 for details on specific settings.

	IMPORTANT:
	Check that the DIP Switches are properly configured for the designed installation prior to installing the inverter.

2.4.1 DIP Switch Location

The DIP switches are located on the DC side of all models.

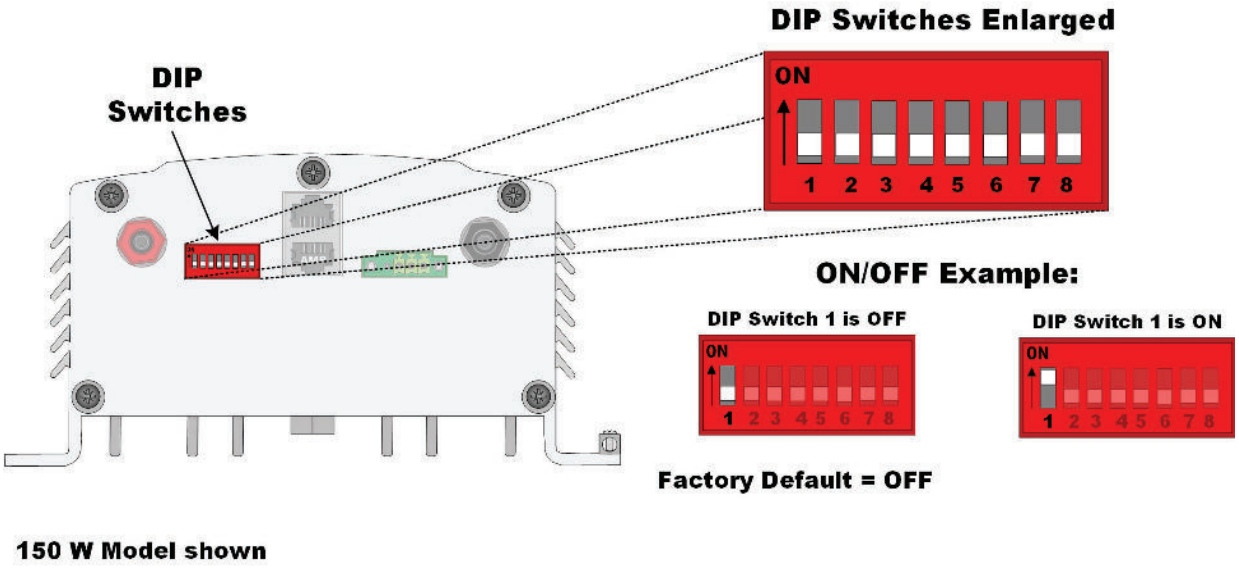

Figure 10: DIP Switches

2.4.2 DIP Switch Configuration Options

DIP Switches control the operational functions of the inverter as follows. The default position for these switches is OFF.

Table 1: DIP Switch Configuration

DIP Switch	Function	Status	Control Content
1	Operational Control	**OFF**	AC Output is controlled by the Remote ON/OFF Switch
		ON	AC Output is controlled by the communication command (digital command).
2	Alarm Sounds	**OFF**	Beeper OFF
		ON	Beeper ON
3	Not Used	**OFF**	Not Used - Default is OFF
		ON	Not Used - Default is OFF
4	Low Voltage Disconnect	**OFF**	CUSTOM. LVD is set according to the factory default values and the non-default values can be modified through RS485 communication port or Bluetooth App.
		ON	PRESETS. LVD is set with the #5 DIP Switch values and cannot be modified.
5	Low Voltage Disconnect PRESETS (I.E., Default) For 12 V (24 V or 48 V) Systems	**OFF**	• Alarms when **DC Input** voltage is 10.8 V, (21.6 V or 44.4 V) • Disconnects **AC Output** when **DC Input** voltage is 10.5 V (21.0 V or 42.0 V), and • Restarts **AC Output** when **DC Input** voltage is 11.6 V (25.2 V or 46.4 V)
		ON	• Alarms when **DC Input** voltage is 11.8 V (23.6 V or 48.4 V), • Disconnects **AC Output** when **DC Input** voltage is 11.5 V (23.0 or 46 V), and • Restarts **AC OUTPUT** when **DC Input** voltage is 12.6 V (25.2 V or 50.4 V).
6	Standby Mode	**OFF**	AC Output is always ON
		ON	AC Output is OFF unless a load > 8 W is detected
7	Not Used	**OFF**	Not Used - Default is OFF
		ON	Not Used - Default is OFF
8	Bluetooth Communication	**OFF**	Bluetooth Disabled
		ON	Bluetooth Enabled

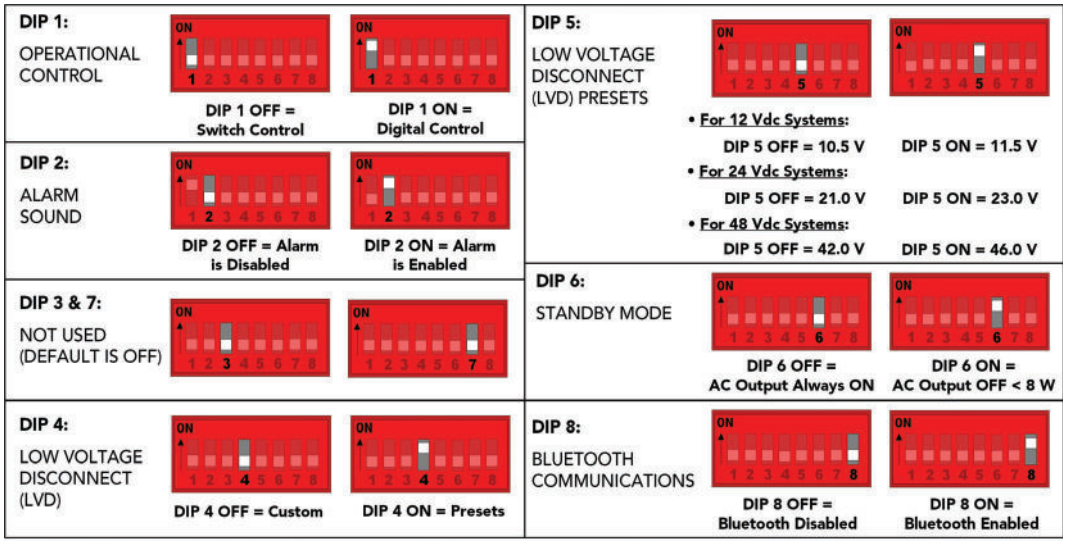

Figure 11: DIP Switch Configurations

2.5 Remote Switch Installation (Optional)

	IMPORTANT:
	Check the AC Output Mode Switch on the AC end of the inverter and ensure it is in the REMOTE position before wiring. See Figure 22 on page 29.

If the site application requires a Remote ON/OFF Switch, the following illustration shows where to connect the wires. **Note:** Closed = ON and Open = OFF.

Remote Switches vary widely by manufacturer. Consult the manufacturer's documentation for specific installation instructions.

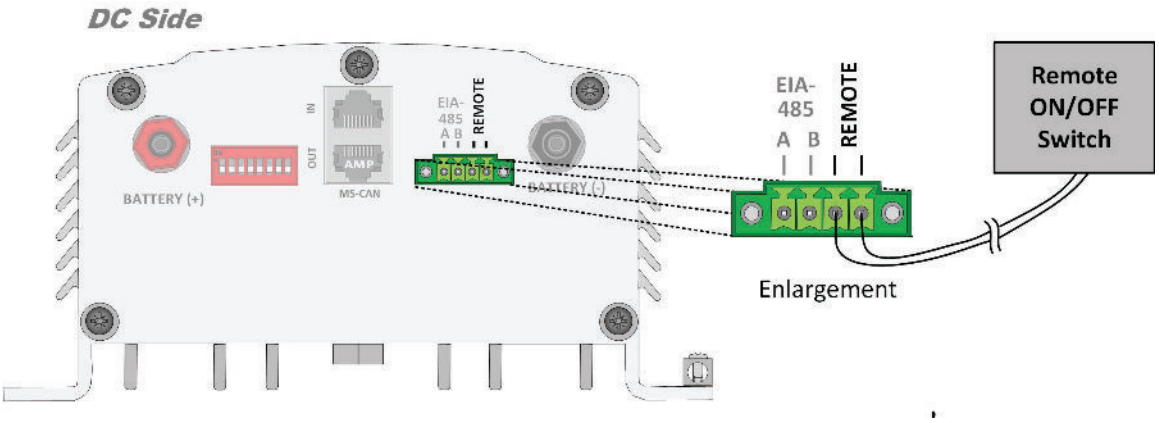

Figure 12: Remote Switch Wiring for 150 W to 300 W Models

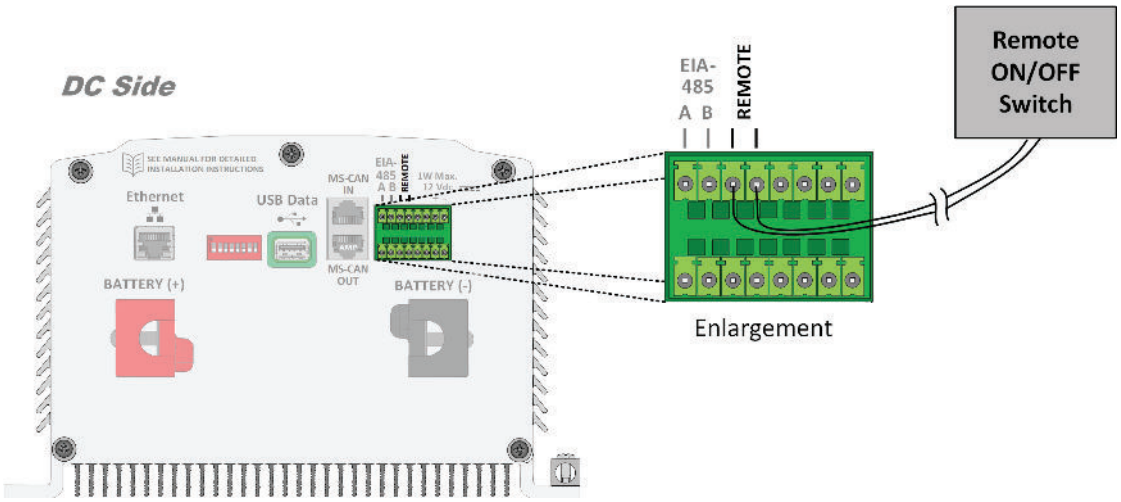

Figure 13: Remote Switch Wiring for 700 W to 2,500 W Models

2.6 Auxiliary Power (Optional)

Auxiliary Power for 1 W (Maximum), 12 Vdc applications is available on the 700 W to 2,500 W Models only. These types of applications include:

- EIA-485 Communication Bus.
- Small DC devices (e.g., LEDs).

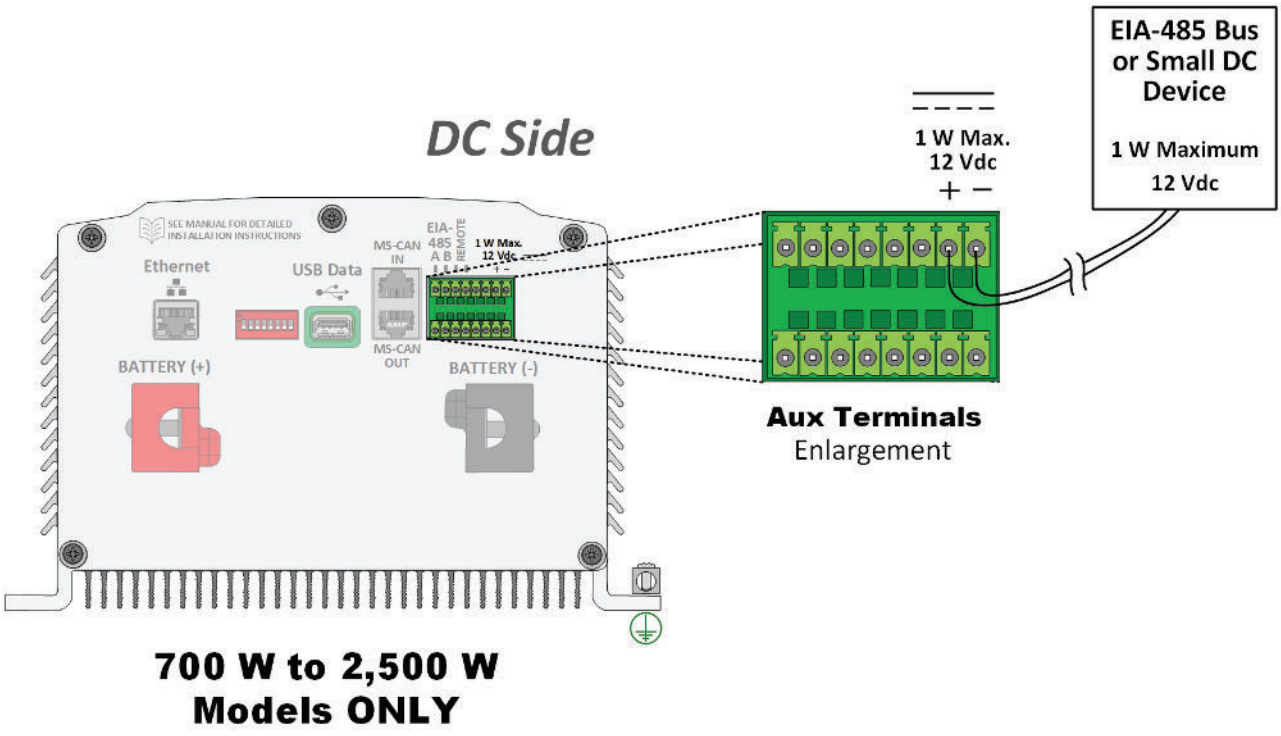

Figure 14: Auxiliary Power Terminals on 700 W to 2,500 W Models

2.7 Inverter Wiring

This section provides general instructions for connecting all the wiring for the inverter. This includes DC, AC, Neutral, and all Ground connections (system and chassis). Ensure **all** connections are made as required by local regulatory code.

WARNING: SHOCK HAZARD

- **Installations must be performed by a qualified person trained in electrical safety procedures (minimum qualification).**
- All wiring must comply with local electric code requirements.
- Ensure all sources of **input** are disconnected before connecting **ANY** cabling.

WARNING: RISK OF FIRE

All over-current protection devices and wiring must be sized properly, in accordance with US National Electric Code (NEC) or the country of installation's local regulations.

CAUTION: EQUIPMENT DAMAGE

Do not connect the SureSine inverter's AC Output in parallel with any AC power sources. The SureSine inverter is not capable of synchronizing AC output phases. AC power from utility, generator, and inverter AC power can feed back into the unit and instantly damage the inverter and may also pose a fire and safety hazard.

2.7.1 Terminal Torque Requirements

Tighten all connections as specified in Table 2.

Table 2: Terminal Torque Requirements

Terminal	Terminal Type	Terminal Stud Size or Wire Size	Torque to:	
			In-lbs.	Nm
Chassis Ground Lug	Stud Terminal	0.xxx" (x.xxx mm) Note 1		
DC (+) (–) Input Terminals	Stud Terminal	Note 2		
AC Neutral, Line and Ground Terminals	Slot Terminal	Note 3		
Modbus, Remote Switch, Auxiliary Power Terminals	Screw Terminal			

Note 1 - Use Ring Terminal (included) or solid copper wire with Chassis Ground stud.

Note 2 - The 150 W and 300 W DC (+) (–) models terminals are hand tightened and have gripping lock washers that can be used with stranded copper. Use Ring Terminals (included) with 700 W - 2500 W models.

Note 3 - Use slotted terminals (included) or solid copper wire with AC Neutral, Line, and Ground terminals.

2.7.2 Over-current Protection Requirements

WARNING: RISK OF FIRE

Fuses or circuit breakers are required in the DC battery circuit (all models) and AC output circuit (700-2,500 W models) and shall be provided by the installer.

Locate battery breakers or fused disconnects for easy access and free from hydrogen gas/sulfuric acid fumes. The battery DC circuit breaker or fuse should be within 6 inches from the battery bank or as close as possible.

WARNING: SHOCK HAZARD

- Fuses, single-pole circuit breakers or single-pole disconnect switches should **NEVER** open grounded system conductors. This could create a shock hazard that could be fatal to personnel and/or damage the equipment.
- Fuses, single-pole circuit breakers, or single-pole disconnect switches must only be installed on ungrounded system conductors.
- It is acceptable to use double-pole breakers or double-pole disconnect switches which break both the grounded and ungrounded conductors with the SureSine inverter.

2.7.2.1 Recommended Battery Over-current Protection Device Sizing

Use Table 3 to determine the size of the over-current protection device required for the battery conductor.

Table 3: Recommended DC Battery Circuit Breaker/Fuse Size

Model Power Rating	Battery Circuit Breaker/Fuse Ratings*		
	12 Vdc Model	24 Vdc Model	48 Vdc Model
150 W			
300 W			
700 W			
1,000 W			
1,250 W			
2,500 W			

*Meets U.S. National Electrical Code Requirements

2.7.2.2 Recommended AC Over-current Protection Device Sizing

Use Table 4 to determine the size of the over-current protection device required for the AC conductor.

Table 4: AC Circuit Breaker/Fuse Size

Model Power Rating	AC Circuit Breaker/Fuse Ratings*	
	120 Vac Model	230 Vac Model
700 W		
1.0 kW		
1.25 kW		
2.5 kW		

*Meets U.S. National Electrical Code Requirements

2.7.3 DC and AC Conductor Sizing Requirements

Accepted practice for system design requires AC and DC conductors sufficiently sized to limit voltage drop losses to 2% or less. Section 8 provide conductor sizing information for maximum 2% voltage drop in DC input and AC output wiring depending on wire distance to the SureSine. Table 5 and Table 6 provide the minimum conductor sizing requirements, but may need larger wires for longer distances.

Copper wire is recommended, and the tables below show the minimum sizing requirements (for 75°C wire) allowed by U.S. National Electrical Code of each SureSine model when operated at the maximum continuous current rating of the inverter. Conductors rated for 90°C wire can also be used, but because the SureSine terminals are rated to 75°C, conductor size cannot be smaller than the 75°C wire size based on the ampacities given in Table 310.15(B)(16) of the U.S. National Electrical Code, ANSI / NFPA 70. Larger wires may be required for or ambient temperatures higher than 30°C (86°F) according to the de-rating factor specified in 310.15 (B)(2)(a) of the NEC.

Use Table 5 to determine the minimum size for the DC Battery cables.

Table 5: Minimum DC Battery Cable Size*

Model Power Rating	Battery Circuit Breaker/Fuse Ratings		
	12 Vdc Model	24 Vdc Model	48 Vdc Model
150 W			
300 W			
700 W			
1,000 W			
1,250 W			
2,500 W			

*Meet U.S. National Electrical Code Requirements - ambient temperatures to 30°C (86°F)

Use Table 6 to determine the minimum size for the AC output wires.

Table 6: Minimum AC Output Wire Size*

Model Power Rating	AC Wire Size*	
	120 Vac Model	230 Vac Model
700 W		
1,000 W		
1,250 W		
2,500 W		

*Meet U.S. National Electrical Code Requirements - ambient temperatures to 30°C (86°F)

2.7.4 Grounding and Bonding Requirements

A proper grounding system is required for safety, equipment protection and electromagnetic noise reduction.

Ground connections must be made for the chassis and to the primary earth ground for AC connections.

There must be a DC ground bond, AC neutral-ground bond, and a chassis ground connection.

The DC input is isolated from the AC output and chassis so the inverter can have a positive or negative DC system ground depending on the application. DC system grounding is the responsibility of the installer.

The default bond to earth ground is a factory connection between the Neutral Terminal and the metal chassis. The SureSine inverter includes an internal neutral-ground jumper that can allow for the choice between an internal grounded neutral or an external grounded neutral for models which include AC terminals. With the jumper in place the AC Neutral is bonded to ground through the chassis equipment ground wiring.

Refer to DC wiring diagrams in Section 2.7.6 for battery and chassis grounding details.

2.7.4.1 Removing the Internal Neutral-Ground Bond for External Grounded Neutral (Hardwired AC models only)

SureSine models that require AC wiring be hardwired include an internal neutral-ground jumper that can allow for the choice between an internal grounded neutral or an external grounded neutral. The default is set as an internal grounded neutral with the bond in place at the factory.

- One and only one AC neutral-ground bond can be present in the system.
- The internal ground bond must be removed if there is an external AC ground bond.
- Do NOT remove the neutral-ground bond without having a permanent external neutral-ground bond.
- This can only be performed by qualified personnel and requires tool access to the interior of the inverter.
- Removal of the internal neutral ground bond should only be done with models which include AC terminals.
- Do NOT remove the neutral-ground bond for models that come factory wired with an AC outlet.

The AC neutral-ground bond should typically be located at the AC power source. Therefore, it is recommended that the SureSine be installed with the internal AC neutral-ground jumper in place and not have an external neutral-ground bond unless required.

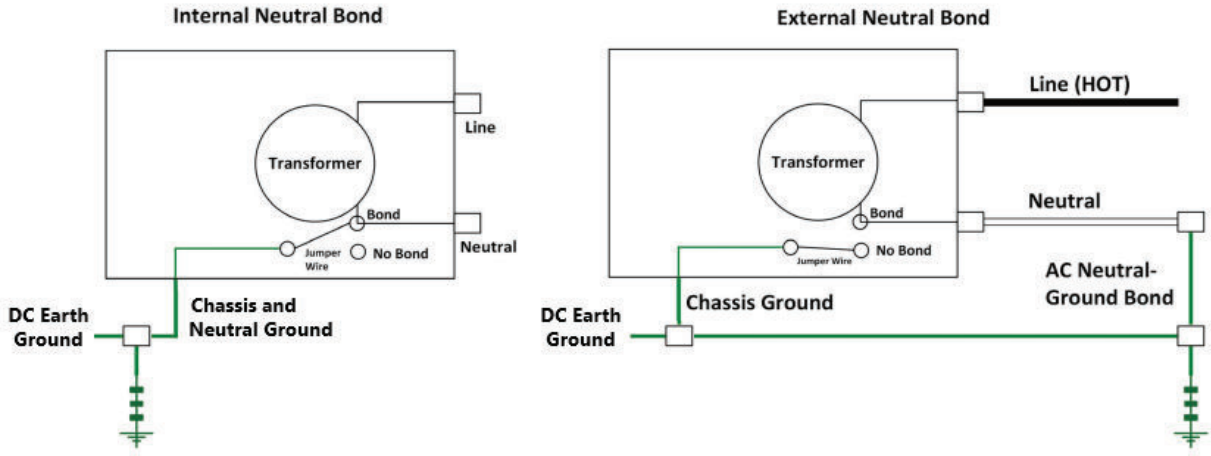

Figure 15: Internal Grounded Neutral vs. External Grounded Neutral (Internal Neutral Ground Bond removed)

Removing the internal neutral ground should only be implemented for applications which require an external Neutral-Ground bond. Two applications where this is required are:

- Inverter as AC grid backup power using a single-pole AC transfer switch
- Integration with AC Generator using a single-pole AC transfer switch

These applications can use a single-pole AC transfer switch with another AC power source and share the same neutral-ground bond at all times. The external AC neutral-ground bond for the SureSine inverter would be located at the external AC source (main utility panel, generator, or distribution panel).

A double-pole transfer switch which switches both the Line and Neutral can be used instead of a single pole transfer switch for these applications.

Double-pole transfer switches are required with mobile applications (RV, marine etc.) where the inverter neutral is bonded to the vehicle or ship metal frame and grid (shore) power is bonded to the "shore" earth ground.

With both neutral and line isolated from the other AC source with a double-pole transfer switch, the SureSine inverter can have independent neutral-ground bonds and the SureSine inverter keeps the internal neutral-ground bond. This type of transfer switch is preferred as it maintains the neutral-ground bond at each of the AC power sources (inverter, grid main panel or generator).

2.7.5 Grounding Connections

U.S. installed grounding systems must conform to all U.S. National Electrical Code (NEC) requirements, and/or to any local regulations. Non-U.S. grounding systems must meet all national and local requirements of the country of installation.

NOTE: Resistive-earthed systems are acceptable.

Use only one grounding electrode unless multiple grounding electrodes are reliably bonded together.

All grounding conductors must conform to local codes and regulations.

NOTE: Conductors identified by the color green (or green and yellow) shall only be used for grounding purposes.

Interrupt all power input to the SureSine before working on the grounding system.

2.7.5.1 Chassis Ground

The SureSine chassis grounding terminal is located on the outside of the case as shown in the DC wiring diagrams in Section 2.7.6. Use copper wire to connect the chassis grounding terminal, and other dead metal, to earth ground. A ring wire terminal is required for stranded copper wiring. A terminal is not required for solid copper wiring.

Use Table 7 to size the equipment grounding wire for the chassis based on the DC over-current protection rating per NEC requirements.

Table 7: Minimum Wire Sizes for Copper Ground Cable

Over Current Protection Device Rating (Amps)	Minimum Copper Wire Size (AWG / mm^2)
15	#14 / 2.08
20	#12 / 3.31
30-60	#10 / 5.26
100	#8 / 8.36
200	#6 / 13.3

If the equipment ground wiring is combined with other equipment grounding wiring to a common bus bar, the equipment grounding wire sizing requirement from the bus bar to ground is sized to the highest over-current protection rating of the DC System.

2.7.5.2 DC System Ground

Ensure that the DC system ground is properly bonded to ground.

NEC Section 250.166(B) states that the DC Grounding Electrode Conductor (GEC) must be sized not smaller than the largest DC conductor in the system, and not smaller than the 8 AWG. However, NEC Section 250.166(C) indicates that for DC GEC connections to rod, pipe, or plate grounding electrodes, #6 AWG is adequate.

If the system grounding and equipment grounding is combined to a common bus bar, the earth ground wiring must be sized to the larger of the two.

The internal AC neutral-ground bond is grounded with the chassis equipment grounding.

If the AC Neutral internal bond jumper is removed, an external AC neutral-earth bond is required. For details, refer to Figure 15 “Internal Grounded Neutral vs. External Grounded Neutral (Internal Neutral Ground Bond removed)”in Section 2.7.4.1 “Removing the Internal Neutral-Ground Bond for External Grounded Neutral (Hardwired AC models only)”.

2.7.6 DC Connections

DC Connections will vary by site application. The SureSine Inverter can support 12-volt, 24-volt, and 48-volt battery systems.

WARNING: HAZARDOUS CURRENT, RISK OF FIRE OR EXPLOSION

- Do NOT allow the positive (+) DC cable to touch the Negative (–) DC cable. Allowing these cables to touch can create dangerous current or a possible fire/explosion hazard.
- Locate battery breakers or fused disconnects for easy access and free from hydrogen gas/sulfuric acid fumes. The battery DC circuit breaker or fuse should be within 6 inches from the battery bank or as close as possible.

IMPORTANT:

- Since battery banks can vary widely, the DC wiring illustrations do not show individual batteries or their connections. Consult the system designer and installer for proper cabling of the specific site configuration.
- Be certain that the battery connection is made with correct polarity. The SureSine has battery reverse polarity protection implemented with an internal fuse which will have to be replaced if connected with reverse polarity.
- Secure the cable to the battery bank following industry Best Practices. Hardware may vary depending on site application and local regulatory code.
- Measure the voltage on the open battery wires BEFORE connecting to the SureSine. Ensure the correct voltage of the battery is used with the selected model to be installed.
- A circuit breaker or fuse is required in the ungrounded battery cable. See Section 2.7.2 Over-current Protection Requirements for more information.
- Refer to Section 2.7.2 Over-current Protection Requirements for recommended DC battery circuit breaker/fuse ratings and Section 2.7.3 DC and AC Power Wire Sizing Requirements for DC battery wire sizing.
- Use a proper crimping Tool to crimp the terminals to the bare ends of the wires where required. Connections should be tight so they can't slide out.

2.7.6.1 Negative Grounding

For wiring diagrams showing **NEGATIVELY** grounded DC Wiring:

- **For 150 W & 300 W Models:** See Figure 16 on page 24
- **For 700 W, 1,000 W, 1,250 W & 2,500 W Models:** See Figure 18 on page 25

2.7.6.2 Positive Grounding

For wiring diagrams showing **POSITIVELY** grounded DC Wiring:

- **For 150 W & 300 W Models:** See Figure 17 on page 24
- **For 700 W, 1,000 W, 1,250 W & 2,500 W Models:** Figure 19 on page 25

2.7.6.3 DC Wiring Procedure

STEP 1. Before wiring, verify that all breakers are in the open/disconnected position, and that all fuses are removed from the holders.

STEP 2. Connect a battery cable between the **grounded** battery bank post (–) for a negative grounded system or (+) for a positive grounded system) and inverter battery terminal of the same polarity.

STEP 3. Connect a battery cable to the **ungrounded** DC input terminal (+) for a negative grounded system or (–) for a positive grounded system).

STEP 4. Wire a breaker or in-line fused disconnect switch in the ungrounded battery cable no further than 12" (305 mm) from the ungrounded battery post. When wiring a fused disconnect switch, make sure the fuse is between the battery and the switch. Make sure the breaker or disconnect switch is in the OPEN position. **Do not connect the ungrounded battery cable to the battery at this time.**

WARNING: SHOCK HAZARD

Do not close the battery breaker or disconnect switch until all system wiring is completed.

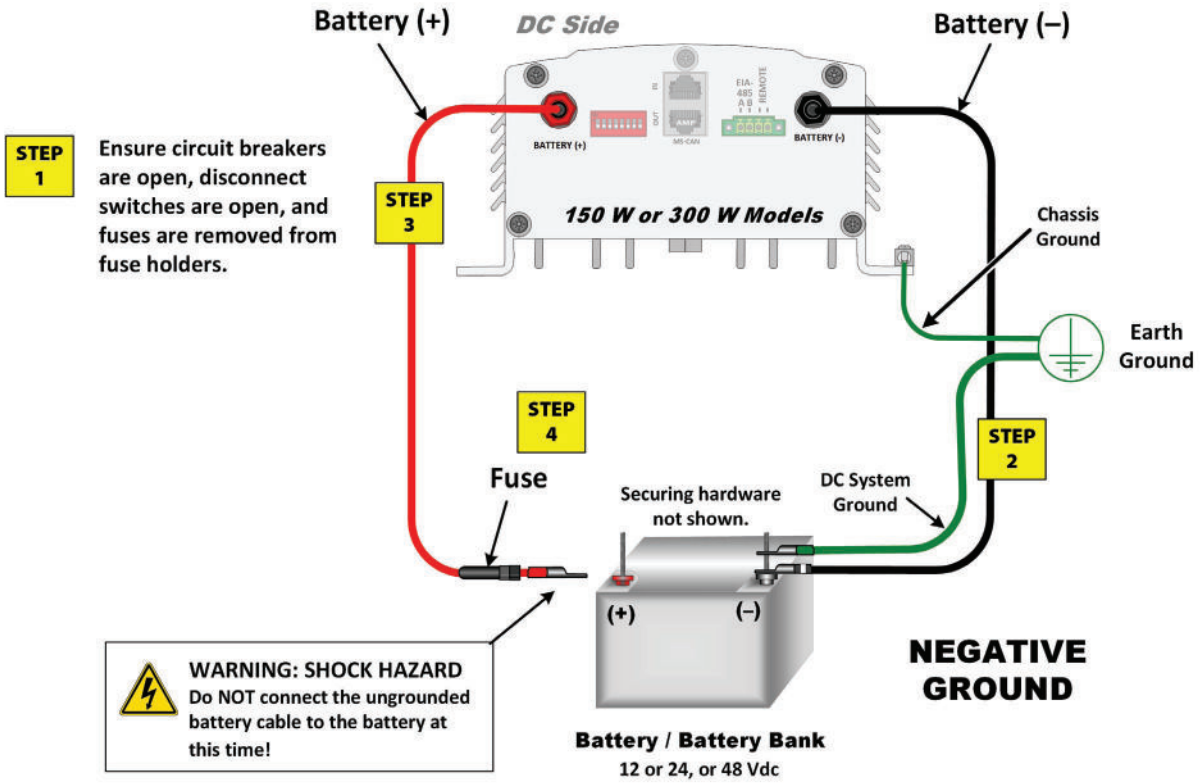

Figure 16: DC Connections on 150 W & 300 W Models with Negative Grounding

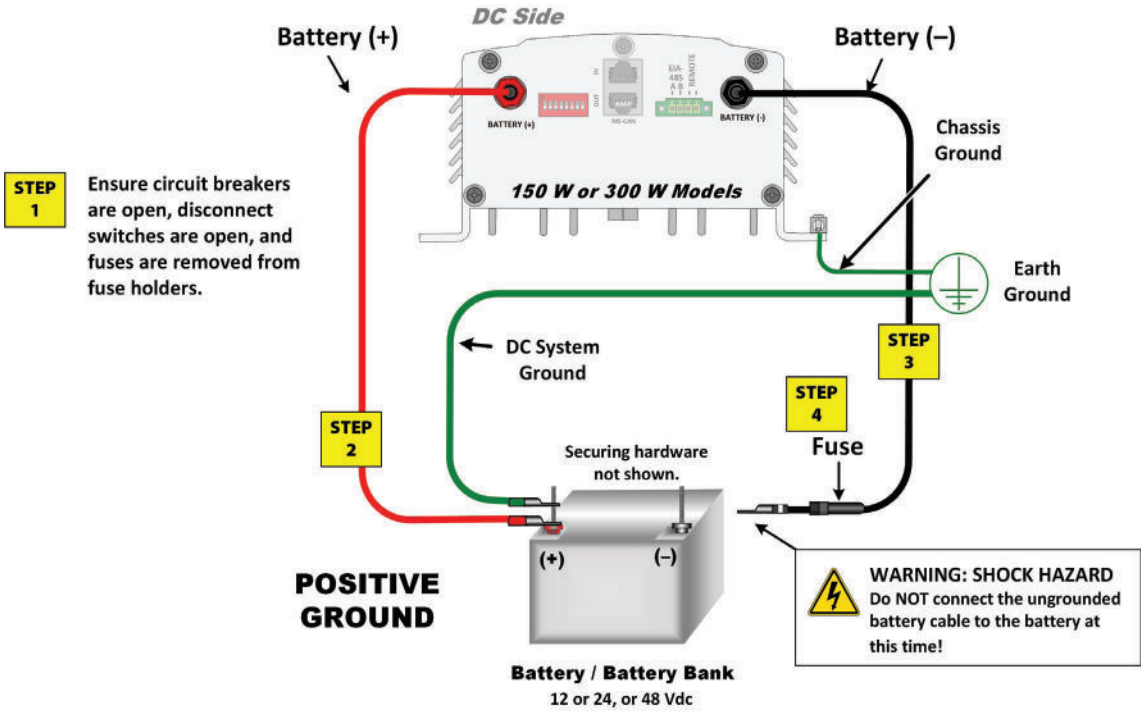

Figure 17: DC Connections on 150 W & 300 W Models with Positive Grounding

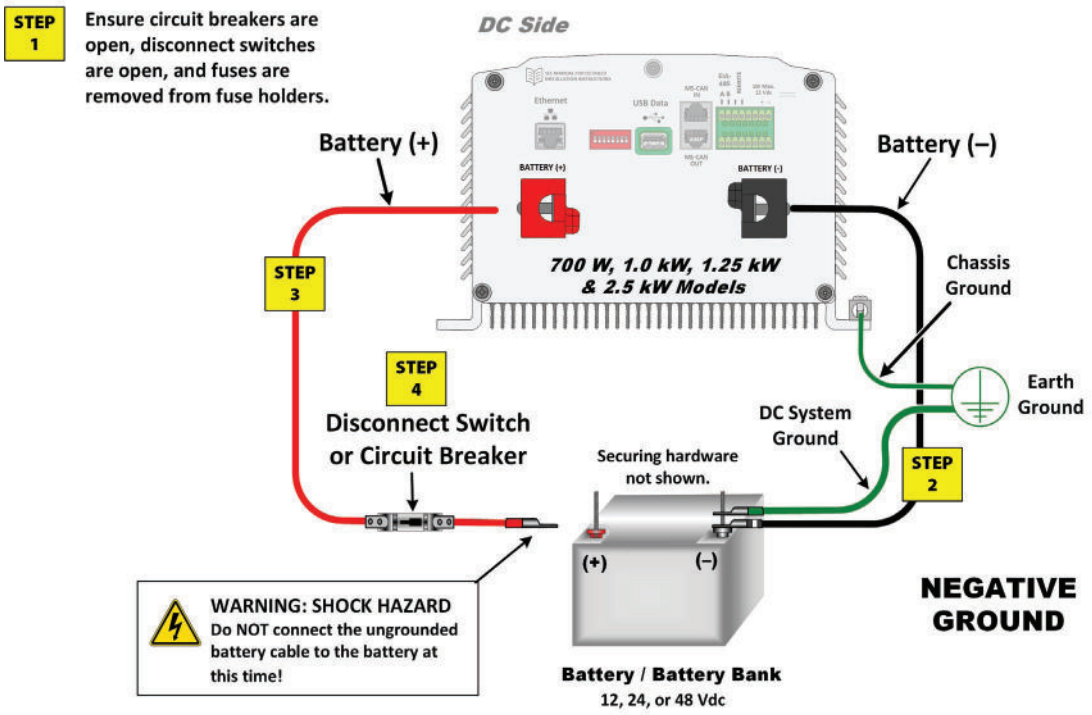

Figure 18: DC Connections on 700 W to 2,500 W Models with Negative Grounding

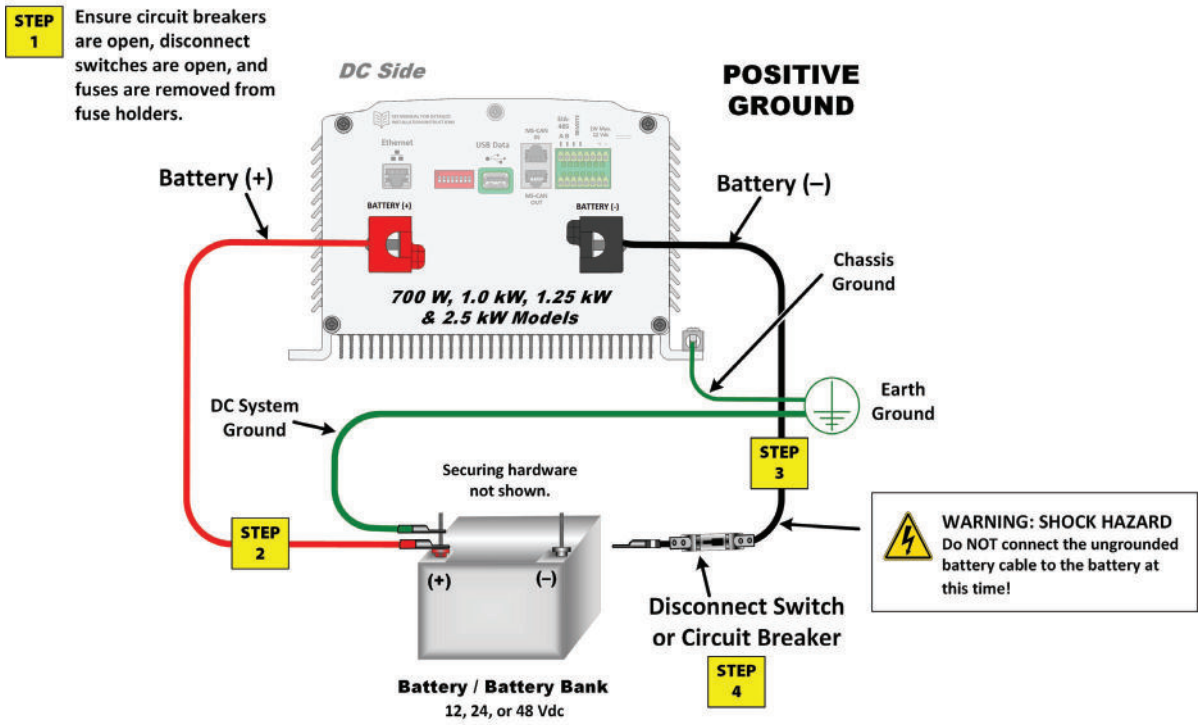

Figure 19: DC Connections on 700 W to 2,500 W Models with Positive Grounding

2.7.7 AC Connections

WARNING: SHOCK HAZARD

This unit is not provided with a GFDI device. This inverter must be used with an external GFDI device as required by the Article 690 of the National Electrical Code for the installation location.

CAUTION: EQUIPMENT DAMAGE

- AC loads should not exceed the continuous and surge power ratings. Exceeding these ratings could cause a fault and shut off the inverter. Loads that have inrush currents that can exceed the highest power surge current rating could damage the inverter.
- There are many types of loads that have high starting surges including pumps, fans, refrigerator or air conditioner, air compressors, electric motors, switched mode power supplies, and power tools. These loads can have a power surge of 2 to 5 times the running power of the load or even higher. If the manufacturer does not provide a surge rating for the load, check with the manufacturer or multiply the maximum power by an appropriate sizing factor for the type of load being used. If there are other loads in the system, the surge power requirement must be added to the total running power of the other loads in the AC system.
- Observe AC output voltage and frequency markings on the SureSine. Be sure AC loads are compatible for proper load operation and to avoid damage to loads and/or inverter.

Models which include AC terminals require permanent, hardwired AC connections. This may require additional hardware such as sub-panels, circuit breakers, fuses, disconnect switches or ground-fault circuit interrupter (GFCI) breakers or outlets. **AC wiring must comply with local regulatory code for the specific site.**

No additional AC wiring is required with models that come factory wired with an AC outlet. A Ground Fault Interrupter power strip or plug-in outlet is recommended.

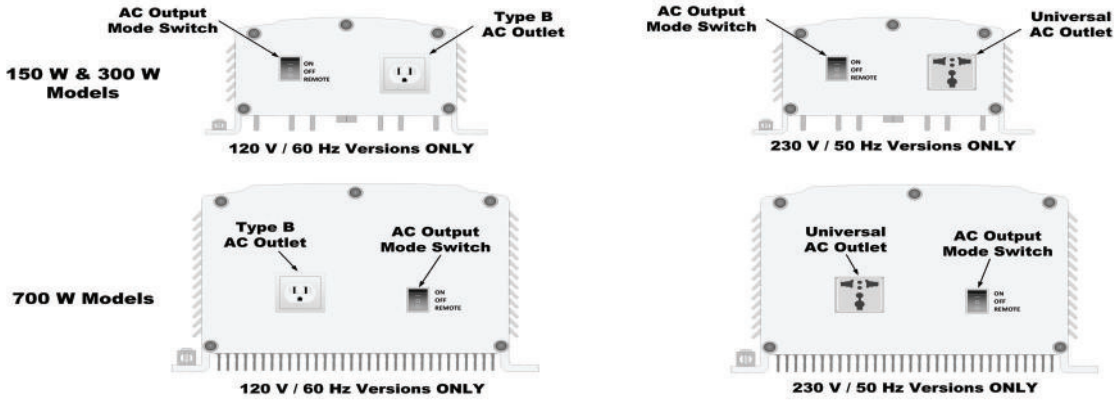

Figure 20: AC Connections on 150 W, 300 W, & 700 W Models (with Factory Wiring)

2.7.8 AC Wiring

The 700 W Model comes either factory-wired or has the option of being hardwired. The 1,000 W to 2,500 W Models require permanent, hardwired connections. **Wiring must comply with local regulatory code for the specific site.**

WARNING: RISK OF FIRE

Ensure wire sizes comply with local regulatory code.

IMPORTANT:

- A circuit breaker or fuse is required on the hot AC line wire near the inverter.
- Refer to Section 2.7.2 for recommended AC circuit breaker/fuse ratings
- Refer to Section 2.7.3 DC and AC Power Wire Sizing Requirements for AC wire sizing.
- Use a proper crimping tool to crimp the terminals to the bare ends of the wires where required. Connections should be tight so they can't slide out.
- There must be one and **only one AC neutral ground bond**. Do not install The SureSine inverter with an external neutral-ground bond unless the internal neutral-ground bond has been removed. Refer to Section 2.7.4.1 for details.

A three-conductor copper cable with at least a 75°C insulation rating can be used for wiring the AC circuits.

2.7.8.1 AC Wiring Procedure

STEP 1. Before wiring, verify that the AC Output Mode Switch is in the Center/ OFF position, all breakers in the system are in the open/ disconnected position, and all fuses are removed from the holders.

STEP 2.

a. Connect the AC line wire between the AC Line terminal of the SureSine inverter and the fuse or AC circuit breaker.

b. Then connect another wire between the fuse or AC circuit breaker and the line connection of the AC receptacle or AC distribution panel.

STEP 3. Connect the AC Neutral wire between the AC neutral terminal of the SureSine inverter and the neutral connection of the AC receptacle or AC distribution panel. Ensure that the distribution panel does not have a neutral ground connection.

STEP 4. Connect the earth/ ground wire between the Earth terminal of the SureSine inverter and the earth ground connection of the AC device, AC receptacle, or AC distribution panel.

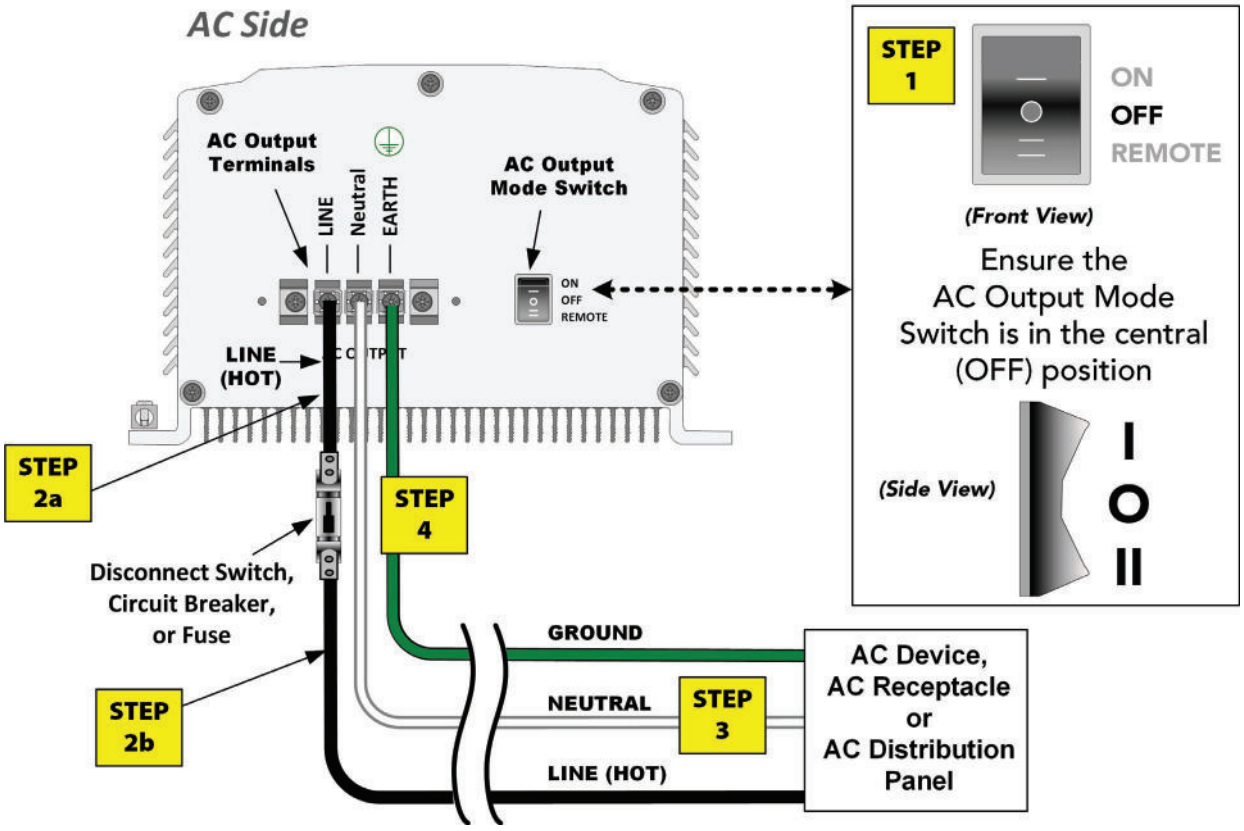

Figure 21: AC Wiring

2.8 Check Wiring and Power Up

1. Review wiring steps and double-check all wiring and connections.
2. Verify that the battery is wired with correct polarity to the SureSine.
3. Connect the ungrounded battery cable to the ungrounded battery post.

WARNING: RISK OF EXPLOSION

Connecting the battery to the SureSine with the breaker or disconnect closed will cause a spark at the point of connection. There is a RISK OF EXPLOSION in hazardous areas or locations where explosive gases have accumulated.

4. Close the battery breaker or disconnect switch to power up the inverter.
5. The SureSine Status LED should illuminate solid Green indicating successful startup and no faults.
6. Use the SureSine AC Output Mode Switch to turn on and off the AC output of the inverter. See Table 8 on page 29 for the AC output power status LED.

3.0 OPERATION

3.1 LED Indications

Two Light Emitting Diodes (LEDs) are on the front of the unit to provide Status and AC Output Status. Table 8 defines what the LEDs represent.

Table 8: LED Indications

AC Output LED	STATUS LED	Operation or State
OFF	OFF	No power or Battery below 9.5 V
OFF	GREEN	AC Output OFF
GREEN	GREEN	AC Output ON
GREEN (BLINK)*	GREEN	AC Standby Mode
RED (BLINK)*	GREEN	Low Voltage Disconnect (LVD) Warning
RED	GREEN	Low Voltage Disconnect (LVD)
RED (not blinking)	RED	Inverter or System Fault * (Critical Fault. Requires a reboot.)
OFF (not blinking)	RED	Inverter or System Fault *
*0.5 Hz rate.		

3.2 AC Output Mode Switch Operation

The AC Output Mode Switch will always turn the inverter on directly in the ON (up) position. To enable ON/OFF control with a wired remote switch or a communication command (digital command), the switch must be in the REMOTE position. Select remote switch or digital command using DIP Switch # 1.

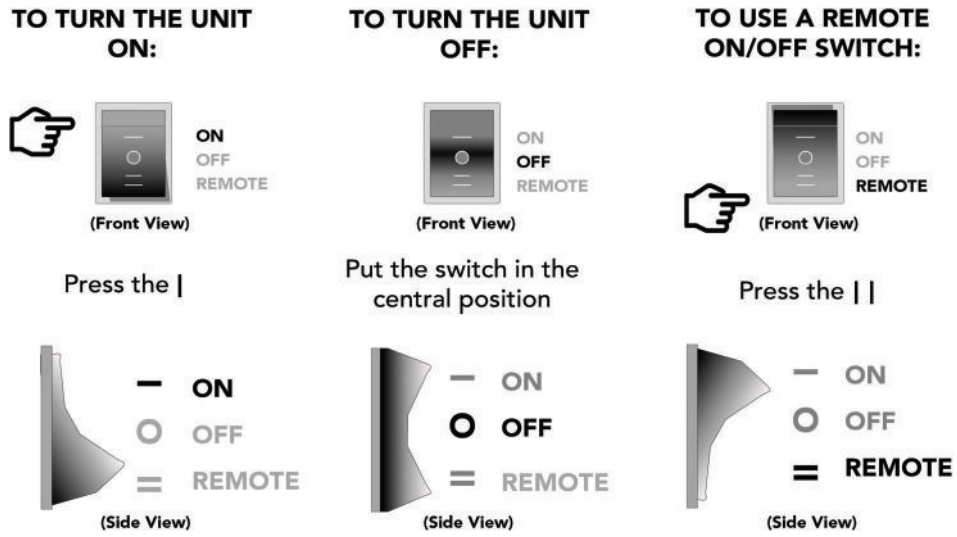

Figure 22: AC Output Mode Operation and Bluetooth Activation

4.0 COMMUNICATION OPTIONS

The SureSine Inverter line provides communication options to monitor system data and control operations using a computer or mobile device.

The SureSine Inverter comes with the following communication options:

- 150 W & 300 W Models:
  - Bluetooth for wireless communication to a computer or mobile device
  - EIA-485 for connection to a EIA-485 network with other devices in the system which may include other SureSine inverters, Morningstar products, and 3rd-party equipment
  - (Future Feature Improvement) MS-CAN (Morningstar Communication Area Network) for a wired communication connection to other Morningstar products
- 700 W to 2,500 W Models
  - Bluetooth for wireless communication to a mobile device
  - Ethernet (for Modbus TCP/IP connection over WAN/LAN)
  - EIA-485 for connection to a EIA-485 network with other devices in the system which may include other SureSine inverters, Morningstar products, and 3rd-party equipment
  - USB Data Port for firmware updates
  - (Future Feature Improvement) MS-CAN (Morningstar Communication Area Network) for a wired communication connection to other Morningstar products

Figure 23 shows the locations of the communication ports on each model.

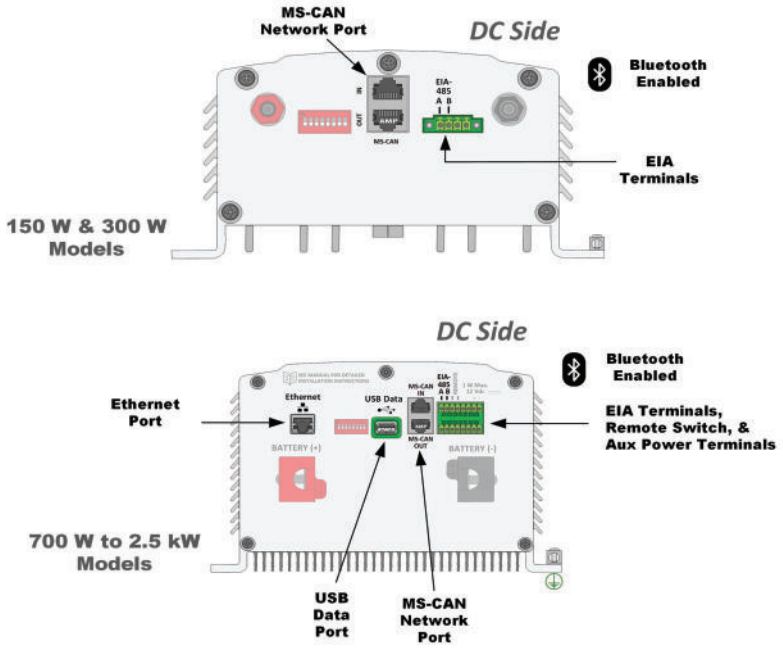

Figure 23: Communication Port Locations

4.1 Bluetooth

Bluetooth is for connecting a mobile device to the SureSine Inverter. DIP Switch #8 must be enabled (ON) for this feature to function. See Section "2.4 Adjusting Settings" on page 11 for details on enabling this feature.

4.1.1 To Connect the SureSine using Bluetooth

1. Set the AC Output Mode Switch to REMOTE.
2. Make sure the Bluetooth feature on your digital device is turned ON.
3. See Section 4.1.2 on page 32 for instructions on downloading and installing the SureSine Utility App to your digital device.
4. Use the SureSine Utility mobile app to control and monitor the activities of the SureSine Inverter.

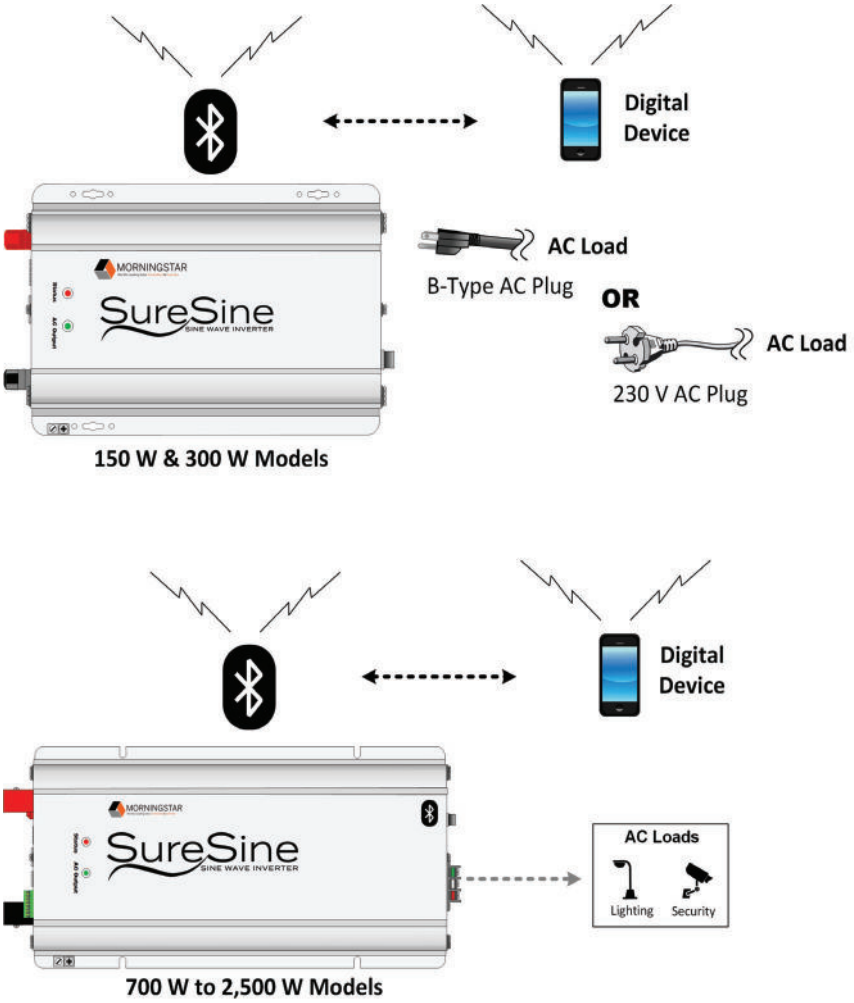

Figure 24: Communication using Bluetooth

4.1.2 SureSine Utility App

The SureSine inverter has a Utility App available for monitoring and settings adjustments. This app is designed for Android and Apple devices and connects using Bluetooth.

The SureSine Utility App is available at Google Play and Apple App stores. Download and install the App and follow the instructions from the App for set up and operation.

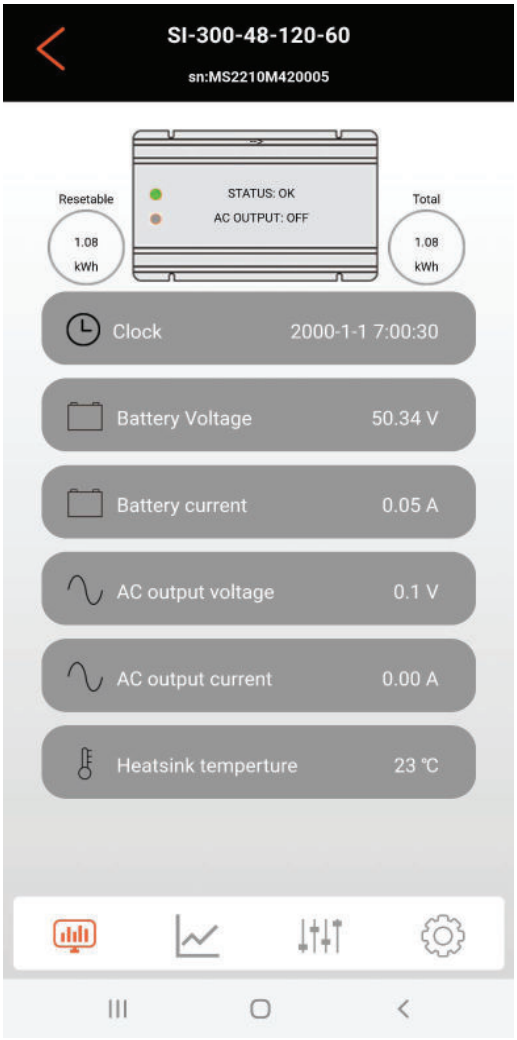

Figure 25: SureSine Utility App (Main Dashboard)

4.2 Ethernet (for Modbus™ TCP/IP)

The Ethernet port is for communicating by Modbus TCP/IP. The Modbus specification document is available at www.morningstarcorp.com. The Modbus specification document details on register locations, scaling, and variable definitions.

Use a CAT5, CAT6, or CAT7 cable with an RJ-45 plug for connections.

4.2.1 To Connect to the Internet using Modbus Protocols

1. Insert one end of a CAT5, CAT6, or CAT7 cable into the Ethernet Port on the SureSine Inverter.
2. Insert the other end of that cable into a router or Ethernet Switch.
3. Connect using the Modbus software of choice.
   The factory default Modbus ID = 1.

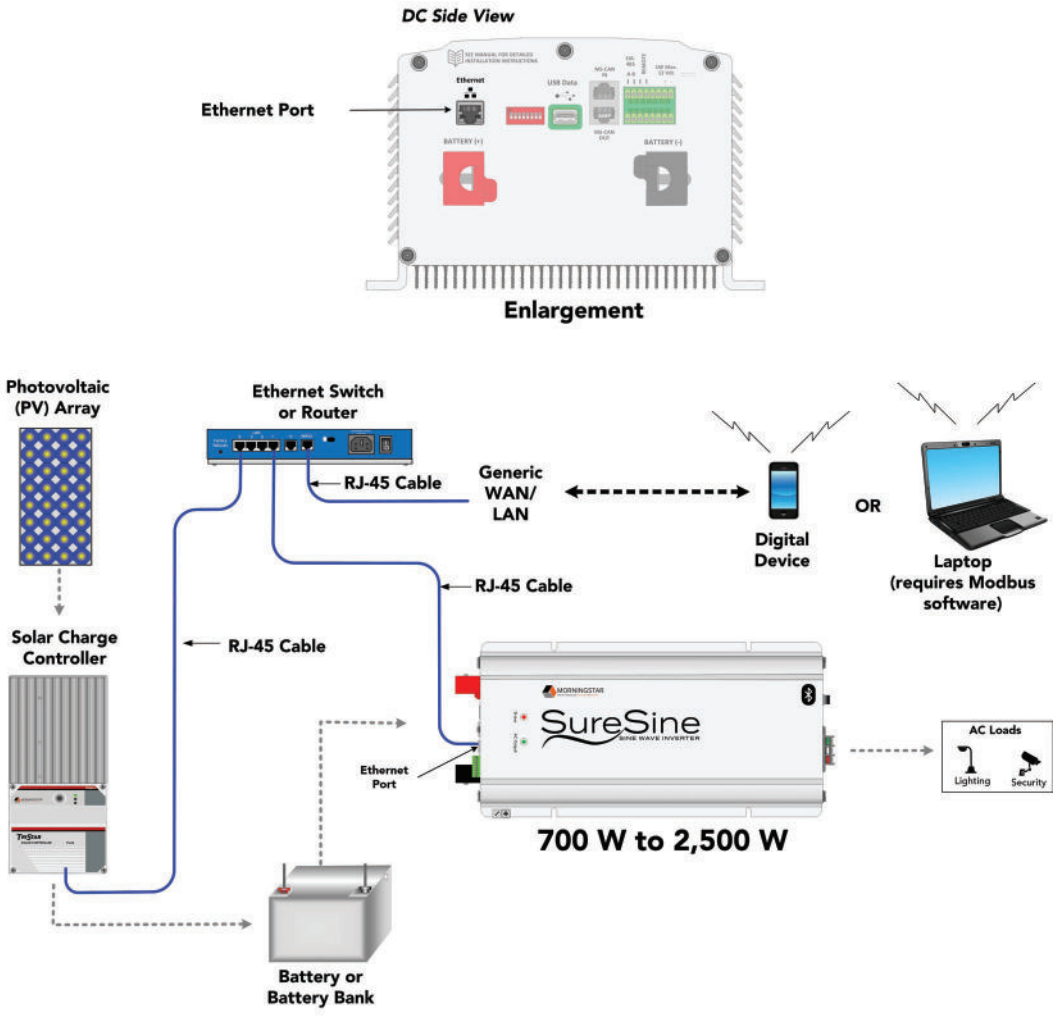

Figure 26: Communication using Ethernet

4.3 EIA-485 Device Communication

EIA-485 is a networking standard for serial communication between multiple devices on a bus. The EIA-485 port on the SureSine inverter is for connecting to one or more devices on a EIA-485 network through the open standard ModBus™ protocol.

Morningstar EIA-485 devices include the GenStar, TriStar-MPPT-60/M (150 and 600 V) models, or with other Morningstar products with the RSC-1 Serial-to-EIA-485 Adapter.

The TriStar-MPPT Charge Controller and RSC Serial adapters require an external 12 V power source to enable the EIA-485 communications. The 12 Vdc Auxiliary Power feature of 700 W to 2,500 W models can be used, therefore, to power Morningstar EIA-485 devices in an EIA-485 Network.

Figure 27: EIA-485/RS-232 Communications Adapter (RSC-1)

For more information on EIA-485 networking, refer to the Morningstar Product Connectivity Manual, Networking & Communications, at https://www.morningstarcorp.com/wp-content/uploads/2014/02/MS-Comm-Document-2010.pdf.

4.3.1 To Connect the SureSine Inverter to an EIA-485 Device

1. Connect the A and B wires from the EIA-485 device to the A and B terminals on the DC Side of the SureSine Inverter.
2. Connect the other ends of the A and B wires to the EIA-485 device.

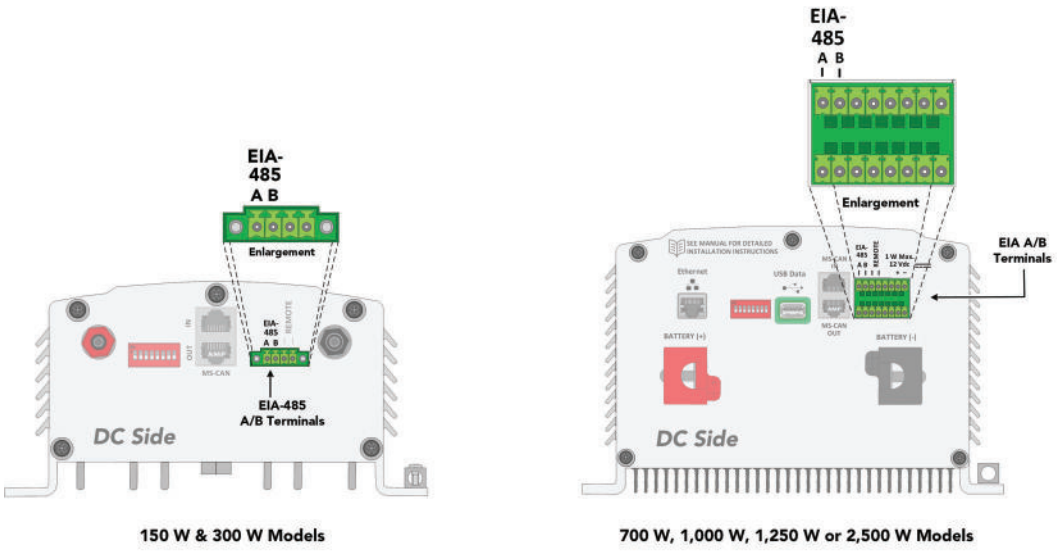

Figure 28: Connecting to an EIA-485 Device

3. If using the Auxiliary Power feature of a SureSine 700 W to 2,500 W model to power Morningstar EIA-485 devices in an EIA-485 Network:
   - connect the Ground (GND) terminal wire from the EIA-485 device(s) to the –12 V terminal of the SureSine inverter
   - connect the Power terminal wire from the EIA-485 device(s) to the (+12 V) terminal of the SureSine inverter.

Note: The 12 V Auxiliary Power rating is 1 Watt which will limit the number of EIA-485 devices that can be powered.

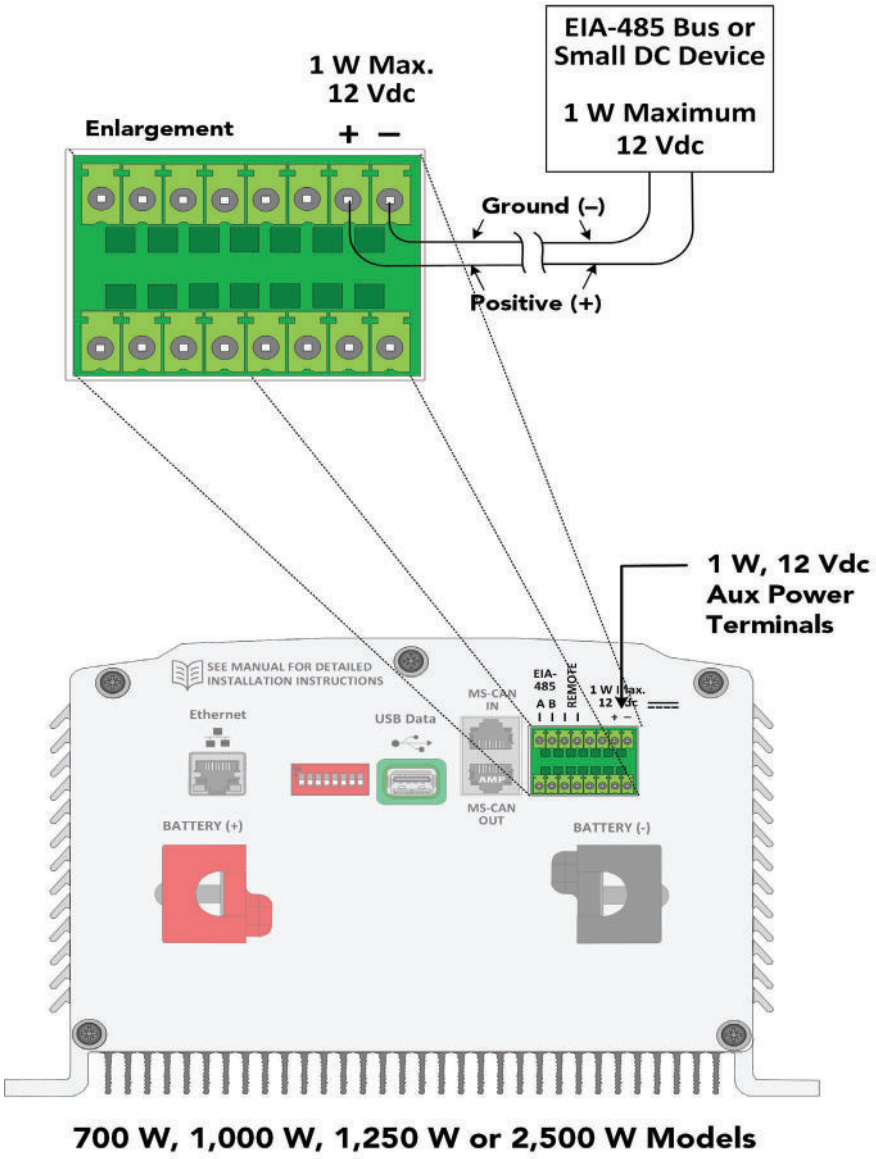

Figure 29: Auxiliary Power Connections (700 W, 1,000 W, 1,250 W or 2,500 W Models ONLY)

4.4 USB Port

A USB port is available on the 700 W, 1,000 W, 1,250 W, and 2,500 W models. The USB port is used for connecting a USB device for firmware updating. This port requires a USB-A plug. This feature works with the following USB devices:

- USB flash drive
- External hard drive

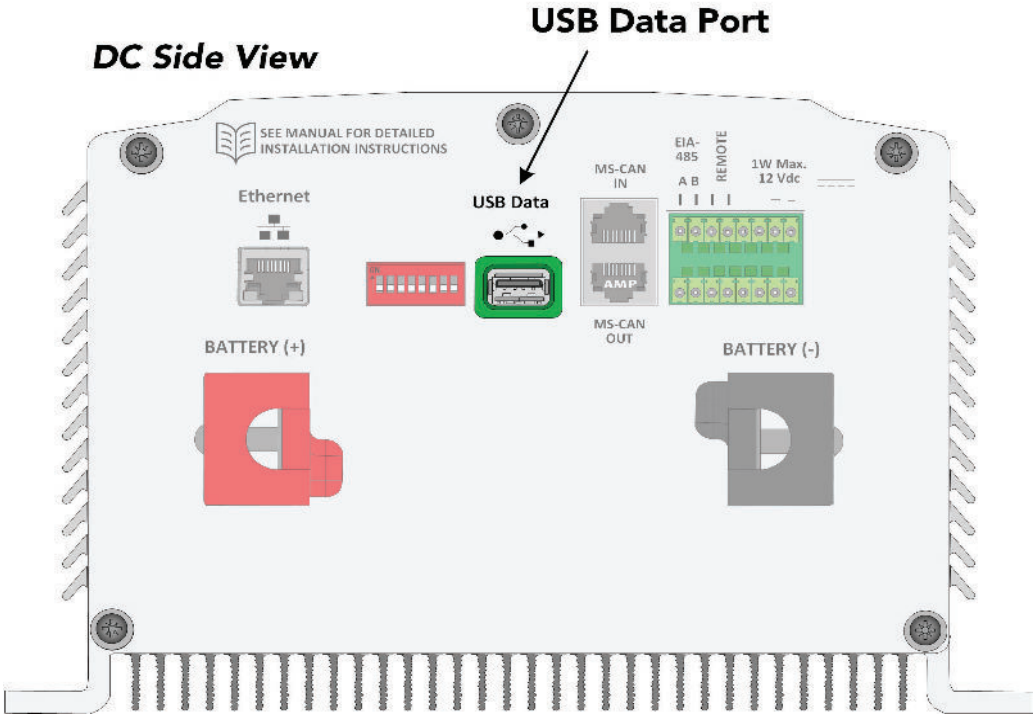

Figure 30: USB Port Locations

4.4.1 To Connect to the USB Port

1. Insert a USB-A plug for a USB data storage device into the USB data port.
2. Use the SureSine Utility App to activate the firmware update. See Section 5.0 on page 38 for details.

4.5 MS-CAN (Future Feature)

MS-CAN is for communicating with other Morningstar components within the network. This feature is not available at this time. Check the Morningstar website (www.morningstarcorp.com) for updates. **Note:** The Morningstar component must be MS-CAN enabled.

4.5.1 To Connect the SureSine to another Morningstar Device

1. Insert one end of an RJ-45 cable (CAT5, CAT6, or CAT6e) into the **MS-CAN IN** port on the SureSine Inverter.
2. Insert a terminator resister into the **MS-CAN OUT** port, if no other Morningstar devices are to be connected.
3. Connect the other end of the RJ-45 cable to the other Morningstar device.

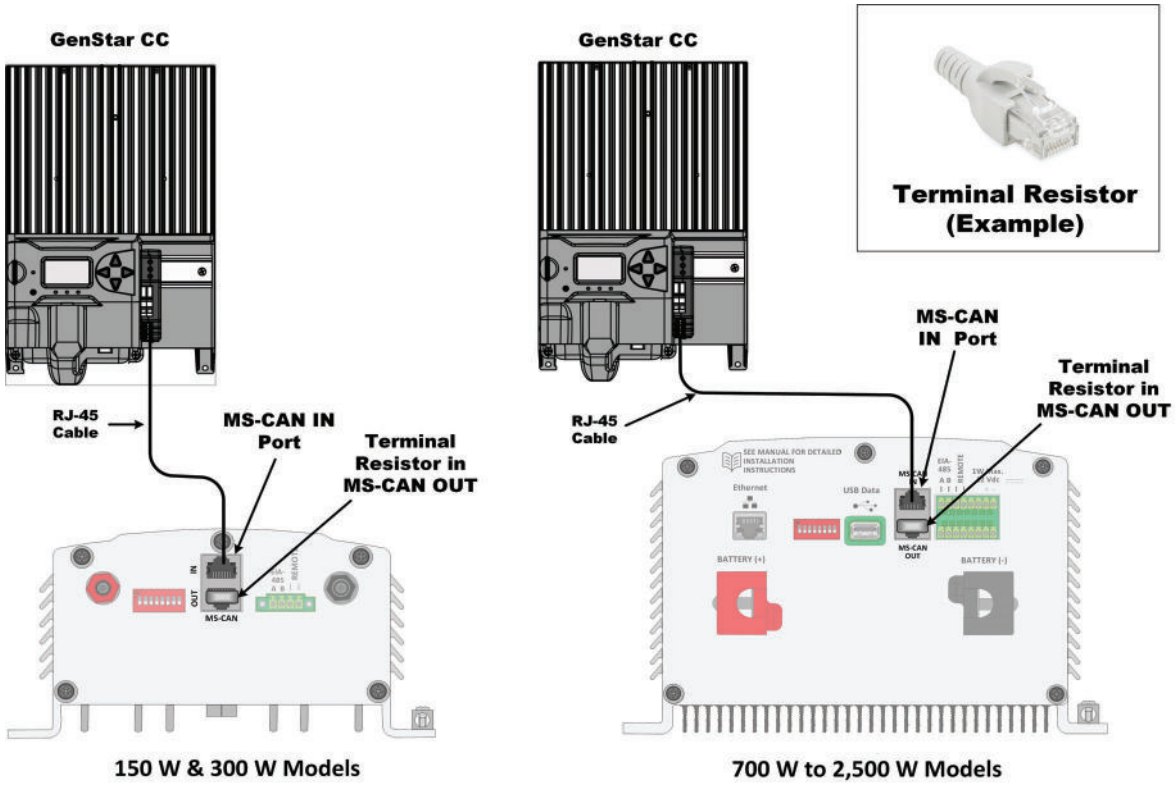

Figure 31: Communication Using MS-CAN

4.5.2 To Connect the SureSine to a Morningstar Network

1. Insert one end of an RJ-45 cable (CAT5, CAT6, or CAT6e) into the **MS-CAN OUT** port on the first device in the daisy chain.
2. Insert the other end of that RJ-45 cable into the **MS-CAN IN** port on the SureSine Inverter.
3. Insert another RJ-45 cable into the **MS-CAN OUT** port on the SureSine Inverter.
4. Insert the other end of the RJ-45 cable into the **MS-CAN IN** port on the next Morningstar device in the network.
5. Insert a 120 Ohm CANBUS terminator resister into the **MS-CAN OUT** port on the final device, if no other Morningstar devices are to be connected.

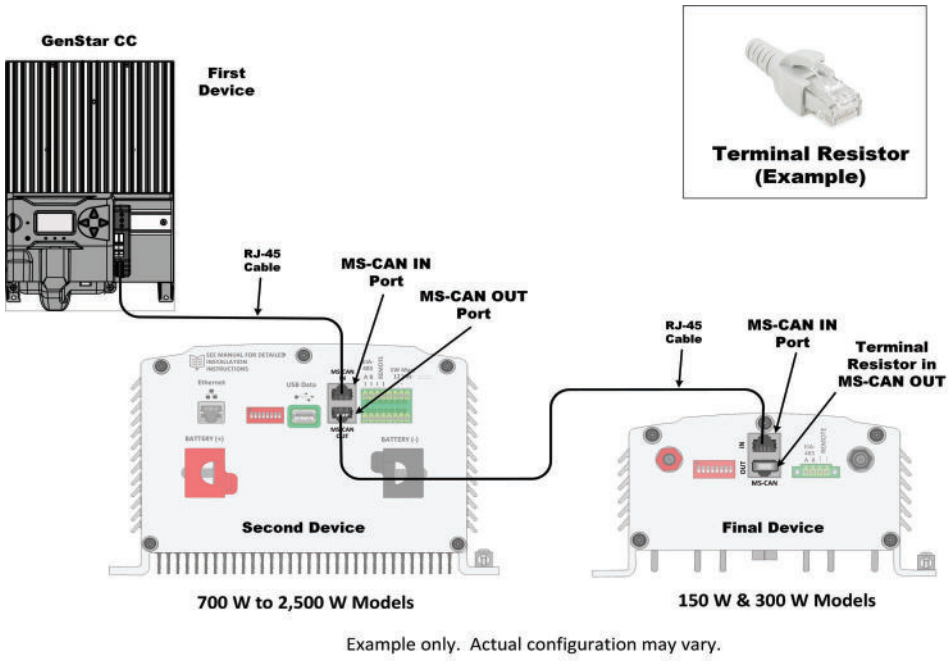

Figure 32: Communication Using MS-CAN with Multiple Devices

5.0 FIRMWARE UPDATE PROCEDURE

To update the SureSine firmware, perform the following procedure.

6. Go go to **www.morningstarcorp/support** and copy the firmware update program to a USB data storage device (such as a flash drive).
7. Insert a USB-A plug for a USB data storage device into the USB data port.
8. Use the SureSine Utility App to activate the firmware update.

6.0 SPECIFICATIONS

This section provides the specifications for the SureSine Inverter Industrial Line.

Table 9: Specifications for the SureSine 150 and SureSine 300

Specification		Model					
		SureSine 150			SureSine 300		
Rated Battery Voltage		12 V	24 V	48 V	12 V	24 V	48 V
Battery Voltage Range		10.5 to 16.5 V	21.0 to 33.0 V	42.0 to 66.0 V	10.5 to 16.5 V	21.0 to 33.0 V	42.0 to 66.0 V
Maximum Continuous DC Input Current							
Maximum Continuous AC Input Current							
Maximum DC Input Voltage (without damage)							
Maximum Continuous AC Output Current							
Auxiliary Power Output							
Continuous Power @25°C		150 W			300 W		
Power Surge @25°C		300 W			600 W		
Surge Duration @25°C		5s			5s		
1 minute Surge Power @40°C		225 W			450 W		
3 minute Surge Power @40°C		180 W			360 W		
Transient Surge Protection							
Cooling		Fanless natural convection			Fanless natural convection		
Operating Temperature Range		TBD - 50°C			TBD - 50°C		
Storage Temperature Range							
Operational Humidity Level		100% RH non-condensing			100% RH non-condensing		
Peak Efficiency		92.5%			93%		
Output Voltage Model Options		120/230 V ±5%			120/230 V ±5%		
Output Frequency (Hz) Model Options		50/60 Hz			50/60 Hz		
Waveform		Pure Sine Wave			Pure Sine Wave		
Total Harmonic Distortion (THD)		< 2%			< 2%		
Galvanically Isolated		Y			Y		
Self-Consumption	AC Output On	2.6 W			3.9 W		
	AC Output Off	0.65 W			0.65 W		
Electronic Protections		AC Short Circuit, AC Overload, High/Low Voltage			AC Short Circuit, AC Overload, High/Low Voltage		
Battery Reverse Polarity		Replaceable internal fuse			Replaceable internal fuse		
AC Output Protection Against Short Circuit		Yes			Yes		
AC Output Protection Against Overload		Yes			Yes		
DC Protection Against Inverter Input Polarity Reversal and Overvoltage		Yes			Yes		
Low Voltage Alarm, Disconnect, Reconnect		Yes			Yes		
High Voltage Alarm, Disconnect, Reconnect		Yes			Yes		
High Temperature Alarm, Disconnect, Reconnect		Yes			Yes		

Table 9: Specifications for the SureSine 150 and SureSine 300

Specification	Model	
	SureSine 150	SureSine 300
Product Weight (kg)	3.8 kg	5.2 kg
Shipping Weight		
Dimensions (L × W × H)	12.3" x 7.5" x 3.78" 312 mm × 190 mm × 96 mm	13.0" x 7.5" x 3.78" 332 mm x 190 mm x 96 mm
IP Rating	IP 20	IP 20
Terminal Types: (See Table 2 on page 15 for torque requirements)		
AC Terminals	Factory Installed, NA B-Type or UNI Outlet	Factory Installed, NA B-Type or UNI Outlet
DC Terminals	Ring, sized _____	Ring, sized _____
Chassis Ground Terminals	Slotted, sized _____	Slotted, sized _____
Modbus, Remote Switch, Auxiliary Power	Slotted, sized _____	Slotted, sized _____
Wired Communications	RS-485, MS-CAN	RS-485, MS-CAN
Wireless Communications	Bluetooth	Bluetooth
Wireless App	Android or Apple	Android or Apple
Data Storage	4 MB / 5 years internal	4 MB / 5 years internal
UL Certifications	UL 1471, UL 458, UL 62368	UL 1471, UL 458, UL 62368
CE Compliant	Yes	Yes
IEC Compliance	IEC/EN 61000, IEC/EN 62109, IEC/EN 55032, IEC/EN 55011	IEC/EN 61000, IEC/EN 62109, IEC/EN 55032, IEC/EN 55011
Warranty	5 Years	5 Years

Table 10: Specifications for the SureSine 700 and SureSine 1000

Specification	Model					
	SureSine 700			SureSine 1000		
Rated Battery Voltage	12 V	24 V	48 V	12 V	24 V	48 V
Battery Voltage Range	10.5 to 16.5 V	21.0 to 33.0 V	42.0 to 66.0 V	10.5 to 16.5 V	21.0 to 33.0 V	42.0 to 66.0 V
Maximum Continuous DC Input Current						
Maximum Continuous AC Input Current						
Maximum DC Input Voltage (without damage)						
Maximum Continuous AC Output Current						
Auxiliary Power Output						
Continuous Power @25°C	700 W			1,000 W		
Power Surge @25°C	1,400 W			2,000 W		
Surge Duration @25°C	5s			5s		

Table 10: Specifications for the SureSine 700 and SureSine 1000

Specification		Model	
		SureSine 700	SureSine 1000
1 minute Surge Power @40°C		1,050 W	1,500 W
3 minute Surge Power @40°C		840 W	1,200 W
Transient Surge Protection			
Cooling		Fanless natural convection	Fanless natural convection
Operating Temperature Range		TBD - 50°C	TBD - 50°C
Storage Temperature Range			
Operational Humidity Level		100% RH non-condensing	100% RH non-condensing
Peak Efficiency		94.2%	95.0%
Output Voltage Model Options		120/230 V ±5%	120/230 V ±5%
Output Frequency (Hz) Model Options		50/60 Hz	50/60
Waveform		Pure Sine Wave	Pure Sine Wave
Total Harmonic Distortion (THD)		< 2%	< 2%
Galvanically Isolated		Y	Y
Self-Consumption	AC Output On	< 9.4 W	< 10 W
	AC Output Off	< 2.8 W	< 2.3 W
Electronic Protections		AC Short Circuit, AC Overload, High/Low Voltage	AC Short Circuit, AC Overload, High/Low Voltage
Battery Reverse Polarity		Replaceable internal fuse	Replaceable internal fuse
AC Output Protection Against Short Circuit		Yes	Yes
AC Output Protection Against Overload		Yes	Yes
DC Protection Against Inverter Input Polarity Reversal and Overvoltage		Yes	Yes
Low Voltage Alarm, Disconnect, Reconnect		Yes	Yes
High Voltage Alarm, Disconnect, Reconnect		Yes	Yes
High Temperature Alarm, Disconnect, Reconnect		Yes	Yes
Product Weight (kg)		8.1 kg	10.6 kg
Shipping Weight			
Dimensions (L × W × H)		18.2"x 9.7" x 6.1" 462 mm x 247 mm x 156 mm	20.3" x 9.7" x 6.1" 524 mm x 247 mm x 96 mm
IP Rating		IP 20	IP 20
Terminal Types: (See Table 2 on page 15 for torque requirements)			
AC Terminals		Slotted, sized _____	Slotted, sized _____
DC Terminals		Ring, sized _____	Ring, sized _____
Chassis Ground Terminals		Slotted, sized _____	Slotted, sized _____
Modbus, Remote Switch, Auxiliary Power		Slotted, sized _____	Slotted, sized _____
Wired Communications		RS-485, USB, Ethernet, MS- CAN	RS-485, USB, Ethernet, MS-CAN

Table 10: Specifications for the SureSine 700 and SureSine 1000

Specification	Model	
	SureSine 700	SureSine 1000
Wireless Communications	Bluetooth	Bluetooth
Wireless App	Android or Apple	Android or Apple
Data Storage	4 MB / 5 years internal	4 MB / 5 years internal
UL Certifications	UL 1471, UL 458, UL 62368	UL 1471, UL 458, UL 62368
CE Compliant	Yes	Yes
IEC Compliance	IEC/EN 61000, IEC/EN 62109, IEC/EN 55032, IEC/EN 55011	IEC/EN 61000, IEC/EN 62109, IEC/EN 55032, IEC/EN 55011
Warranty	5 Years	5 Years

Table 11: Specifications for the SureSine 1250 and SureSine 2500

Specification	Model					
	SureSine 1250			SureSine 2500		
Rated Battery Voltage	12 V	24 V	48 V	12 V	24 V	48 V
Battery Voltage Range	10.5 to 16.5 V	21.0 to 33.0 V	42.0 to 66.0 V	10.5 to 16.5 V	21.0 to 33.0 V	42.0 to 66.0 V
Maximum Continuous DC Input Current						
Maximum Continuous AC Input Current						
Maximum DC Input Voltage (without damage)						
Maximum Continuous AC Output Current						
Auxiliary Power Output						
Continuous Power @25°C	1250 W			2,500 W		
Power Surge @25°C	2,500 W			5,000 W		
Surge Duration @25°C	5s			5s		
1 minute Surge Power @40°C	1,050 W			1,500 W		
3 minute Surge Power @40°C	840 W			1,200 W		
Transient Surge Protection						
Cooling	Fanless natural convection			Fanless natural convection		
Operating Temperature Range	TBD - 50°C			TBD - 50°C		
Storage Temperature Range						
Operational Humidity Level	100% RH non-condensing			100% RH non-condensing		
Peak Efficiency	95.2%			95.6%		
Output Voltage Model Options	120/230 V ±5%			120/230 V ±5%		
Output Frequency (Hz) Model Options	50/60			50/60		
Waveform	Pure Sine Wave			Pure Sine Wave		
Total Harmonic Distortion (THD)	< 2%			< 2%		
Galvanically Isolated	Y			Y		

Table 11: Specifications for the SureSine 1250 and SureSine 2500

Specification		Model	
		SureSine 1250	SureSine 2500
Self-Consumption	AC Output On	12 W	18.6 W
	AC Output Off	< 2.2 W	< 2.4 W
Electronic Protections		AC Short Circuit, AC Overload, High/Low Voltage	AC Short Circuit, AC Overload, High/Low Voltage
Battery Reverse Polarity		Replaceable internal fuse	Replaceable internal fuse
AC Output Protection Against Short Circuit		Yes	Yes
AC Output Protection Against Overload		Yes	Yes
DC Protection Against Inverter Input Polarity Reversal and Over-voltage		Yes	Yes
Low Voltage Alarm, Disconnect, Reconnect		Yes	Yes
High Voltage Alarm, Disconnect, Reconnect		Yes	Yes
High Temperature Alarm, Disconnect, Reconnect		Yes	Yes
Product Weight (kg)		13.3 kg	22.1 kg
Shipping Weight			
Dimensions (L × W × H)		20.3" x 9.7" x 6.1" 524 mm x 247 mm x 96 mm	21.7" x 9.7" x 6.1" 551 mm x 247 mm x 156 mm
IP Rating		IP 20	IP 20
Terminal Types: (See Table 2 on page 15 for torque requirements)			
AC Terminals		Slotted, sized _____	Slotted, sized _____
DC Terminals		Ring, sized _____	Ring, sized _____
Chassis Ground Terminals		Slotted, sized _____	Slotted, sized _____
Modbus, Remote Switch, Auxiliary Power		Slotted, sized _____	Slotted, sized _____
Wired Communications		RS-485, USB, Ethernet, MS- CAN	RS-485, USB, Ethernet, MS-CAN
Wireless Communications		Bluetooth	Bluetooth
Wireless App		Android or Apple	Android or Apple
Data Storage		4 MB / 5 years internal	4 MB / 5 years internal
UL Certifications		UL 1471, UL 458, UL 62368	UL 1471, UL 458, UL 62368
CE Compliant		Yes	Yes
IEC Compliance		IEC/EN 61000, IEC/EN 62109, IEC/EN 55032, IEC/EN 55011	IEC/EN 61000, IEC/EN 62109, IEC/EN 55032, IEC/EN 55011
Warranty		5 Years	5 Years

APPENDIX A: CONDUCTOR SIZING

The following tables provide the 1-way, maximum length for cables and wires based on the system voltage and ampacity with a 2% voltage drop.

A.1 Stranded Copper Wire Rated for 75°C

Table 12: Maximum 1-way Wire Distance for 12-Volt Systems, Stranded Copper, 2% Voltage Drop

1-Way Wire Distance (feet), 12 Volt System										
Wire Size (AWG)	60 Amps	55 Amps	50 Amps	45 Amps	40 Amps	35 Amps	30 Amps	25 Amps	20 Amps	15 Amps
2/0 **	22.4	24.4	26.9	29.9	33.6	38.4	44.8	53.8	67.2	89.6
1/0 **	17.8	19.4	21.3	23.7	26.6	30.4	35.5	42.6	53.3	71.0
2	11.2	12.2	13.4	14.9	16.8	19.1	22.3	26.8	33.5	44.7
4	7.0	7.7	8.4	9.4	10.6	12.1	14.1	16.9	21.1	28.1
6	4.4	4.8	5.3	5.9	6.6	7.6	8.8	10.6	13.2	17.7
8	2.8	3.0	3.3	3.7	4.2	4.8	5.6	6.7	8.4	11.1
10	1.7	1.9	2.1	2.3	2.6	3.0	3.5	4.2	5.2	7.0
12	1.1	1.2	1.3	1.5	1.6	1.9	2.2	2.6	3.3	4.4
14	0.7	0.8	0.8	0.9	1.0	1.2	1.4	1.7	2.1	2.8
1-Way Wire Distance (meters), 12 Volt System										
Wire Size (mm^2)	60 Amps	55 Amps	50 Amps	45 Amps	40 Amps	35 Amps	30 Amps	25 Amps	20 Amps	15 Amps
70 **	6.83	7.45	8.20	9.11	10.24	11.71	13.66	16.39	20.49	27.32
50 **	5.41	5.91	6.50	7.22	8.12	9.28	10.83	12.99	16.24	21.65
35	3.40	3.71	4.08	4.54	5.11	5.84	6.81	8.17	10.21	13.62
25	2.14	2.34	2.57	2.86	3.22	3.68	4.29	5.15	6.43	8.58
16	1.35	1.47	1.61	1.79	2.02	2.31	2.69	3.23	4.04	5.38
10	0.85	0.93	1.02	1.13	1.27	1.46	1.70	2.04	2.55	3.40
6	0.53	0.58	0.64	0.71	0.80	0.91	1.07	1.28	1.60	2.13
4	0.33	0.36	0.40	0.44	0.50	0.57	0.67	0.80	1.00	1.33
2.5	0.21	0.23	0.25	0.28	0.32	0.36	0.42	0.50	0.63	0.84

** Wires sizes larger than 2 AWG (35 mm^2) must be terminated at a splicer block located outside of the SureSine Inverter wiring box. Use 2 AWG (35 mm^2) or smaller wire to connect to the SureSine Inverter to the splicer block.

Notes:

- The specified wire length is for a pair of conductors from the solar or battery source to the controller (1-way distance)
- For 24-volt systems, multiply the 1-way length in the table by 2.
- For 48-volt systems, multiply the 1-way length in the table by 4.
- Shaded cells in the table indicate that the current exceeds the ampacity of the wire for a given ambient temperature as defined in the following key:

Wire Ampacity* Key		
		Exceeds wire ampacity at 60°C ambient temperature
		Exceeds wire ampacity at 50°C ambient temperature
		Exceeds wire ampacity at 40°C ambient temperature
		Exceeds wire ampacity at 30°C ambient temperature

A.2 Solid Copper Wire Rated for 75°C

Table 13: Maximum 1-way Wire Distance for 12-Volt Systems, Solid Copper, 2% Voltage Drop

1-Way Wire Distance (feet), 12 Volt System										
Wire Size (AWG)	60 Amps	55 Amps	50 Amps	45 Amps	40 Amps	35 Amps	30 Amps	25 Amps	20 Amps	15 Amps
2/0 **	27.8	30.3	33.4	37.1	41.7	47.7	55.6	66.7	83.4	111.2
1/0 **	22.0	24.1	26.5	29.4	33.1	37.8	44.1	52.9	66.1	88.2
2	13.9	15.1	16.6	18.5	20.8	23.8	27.7	33.3	41.6	55.4
4	8.7	9.5	10.5	11.6	13.1	14.9	17.4	20.9	26.2	34.9
6	5.5	6.0	6.6	7.3	8.2	9.4	11.0	13.2	16.5	21.9
8	3.4	3.8	4.1	4.6	5.2	5.9	6.9	8.3	10.3	13.8
10	2.2	2.4	2.6	2.9	3.3	3.7	4.3	5.2	6.5	8.7
12	1.4	1.5	1.6	1.8	2.0	2.3	2.7	3.3	4.1	5.5
14	0.9	0.9	1.0	1.1	1.3	1.5	1.7	2.1	2.6	3.4
1-Way Wire Distance (meters), 12 Volt System										
Wire Size (mm^2)	60 Amps	55 Amps	50 Amps	45 Amps	40 Amps	35 Amps	30 Amps	25 Amps	20 Amps	15 Amps
70 **	8.47	9.24	10.17	11.30	12.71	14.53	16.95	20.34	25.42	33.90
50 **	6.72	7.33	8.06	8.96	10.08	11.52	13.44	16.13	20.16	26.88
35	4.23	4.61	5.07	5.63	6.34	7.24	8.45	10.14	12.68	16.90
25	2.66	2.90	3.19	3.54	3.99	4.56	5.32	6.38	7.97	10.63
16	1.67	1.82	2.01	2.23	2.51	2.87	3.34	4.01	5.01	6.69
10	1.05	1.15	1.26	1.40	1.58	1.80	2.10	2.52	3.15	4.21
6	0.66	0.72	0.79	0.88	0.99	1.13	1.32	1.59	1.98	2.64
4	0.42	0.45	0.50	0.55	0.62	0.71	0.83	1.00	1.25	1.66
2.5	0.26	0.29	0.31	0.35	0.39	0.45	0.52	0.63	0.78	1.05

** Wires sizes larger than 2 AWG (35 mm^2) must be terminated at a splicer block located outside of the SureSine Inverter wiring box. Use 2 AWG (35 mm^2) or smaller wire to connect to the SureSine Inverter to the splicer block.

Notes:

- The specified wire length is for a pair of conductors from the solar or battery source to the controller (1-way distance)
- For 24-volt systems, multiply the 1-way length in the table by 2.
- For 48-volt systems, multiply the 1-way length in the table by 4.
- Shaded cells in the table indicate that the current exceeds the ampacity of the wire for a given ambient temperature as defined in the following key:

Wire Ampacity* Key		
		Exceeds wire ampacity at 60°C ambient temperature
		Exceeds wire ampacity at 50°C ambient temperature
		Exceeds wire ampacity at 40°C ambient temperature
		Exceeds wire ampacity at 30°C ambient temperature

A.3 Stranded Copper Wire Rated for 90°C

Table 14: Maximum 1-way Wire Distance for 12-Volt Systems, Stranded Copper, 2% Voltage Drop

1-Way Wire Distance (feet), 12 Volt System										
Wire Size (AWG)	60 Amps	55 Amps	50 Amps	45 Amps	40 Amps	35 Amps	30 Amps	25 Amps	20 Amps	15 Amps
2/0 **	22.4	24.4	26.9	29.9	33.6	38.4	44.8	53.8	67.2	89.6
1/0 **	17.8	19.4	21.3	23.7	26.6	30.4	35.5	42.6	53.3	71.0
2	11.2	12.2	13.4	14.9	16.8	19.1	22.3	26.8	33.5	44.7
4	7.0	7.7	8.4	9.4	10.6	12.1	14.1	16.9	21.1	28.1
6	4.4	4.8	5.3	5.9	6.6	7.6	8.8	10.6	13.2	17.7
8	2.8	3.0	3.3	3.7	4.2	4.8	5.6	6.7	8.4	11.1
10	1.7	1.9	2.1	2.3	2.6	3.0	3.5	4.2	5.2	7.0
12	1.1	1.2	1.3	1.5	1.6	1.9	2.2	2.6	3.3	4.4
14	0.7	0.8	0.8	0.9	1.0	1.2	1.4	1.7	2.1	2.8
1-Way Wire Distance (meters), 12 Volt System										
Wire Size (mm^2)	60 Amps	55 Amps	50 Amps	45 Amps	40 Amps	35 Amps	30 Amps	25 Amps	20 Amps	15 Amps
70 **	6.83	7.45	8.20	9.11	10.24	11.71	13.66	16.39	20.49	27.32
50 **	5.41	5.91	6.50	7.22	8.12	9.28	10.83	12.99	16.24	21.65
35	3.40	3.71	4.08	4.54	5.11	5.84	6.81	8.17	10.21	13.62
25	2.14	2.34	2.57	2.86	3.22	3.68	4.29	5.15	6.43	8.58
16	1.35	1.47	1.61	1.79	2.02	2.31	2.69	3.23	4.04	5.38
10	0.85	0.93	1.02	1.13	1.27	1.46	1.70	2.04	2.55	3.40
6	0.53	0.58	0.64	0.71	0.80	0.91	1.07	1.28	1.60	2.13
4	0.33	0.36	0.40	0.44	0.50	0.57	0.67	0.80	1.00	1.33
2.5	0.21	0.23	0.25	0.28	0.32	0.36	0.42	0.50	0.63	0.84

** Wires sizes larger than 2 AWG (35 mm^2) must be terminated at a splicer block located outside of the SureSine Inverter wiring box. Use 2 AWG (35 mm^2) or smaller wire to connect to the SureSine Inverter to the splicer block.

Notes:

- The specified wire length is for a pair of conductors from the solar or battery source to the controller (1-way distance)
- For 24-volt systems, multiply the 1-way length in the table by 2.
- For 48-volt systems, multiply the 1-way length in the table by 4.
- Shaded cells in the table indicate that the current exceeds the ampacity of the wire for a given ambient temperature as defined in the following table:

Wire Ampacity* Key		
		Exceeds wire ampacity at 60°C ambient temperature
		Exceeds wire ampacity at 50°C ambient temperature
		Exceeds wire ampacity at 40°C ambient temperature
		Exceeds wire ampacity at 30°C ambient temperature

A.4 Solid Copper Wire Rated for 90°C

Table 15: Maximum 1-way Wire Distance for 12-Volt Systems, Solid Copper, 2% Voltage Drop

1-Way Wire Distance (feet), 12 Volt System										
Wire Size (AWG)	60 Amps	55 Amps	50 Amps	45 Amps	40 Amps	35 Amps	30 Amps	25 Amps	20 Amps	15 Amps
2/0 **	27.8	30.3	33.4	37.1	41.7	47.7	55.6	66.7	83.4	111.2
1/0 **	22.0	24.1	26.5	29.4	33.1	37.8	44.1	52.9	66.1	88.2
2	13.9	15.1	16.6	18.5	20.8	23.8	27.7	33.3	41.6	55.4
4	8.7	9.5	10.5	11.6	13.1	14.9	17.4	20.9	26.2	34.9
6	5.5	6.0	6.6	7.3	8.2	9.4	11.0	13.2	16.5	21.9
8	3.4	3.8	4.1	4.6	5.2	5.9	6.9	8.3	10.3	13.8
10	2.2	2.4	2.6	2.9	3.3	3.7	4.3	5.2	6.5	8.7
12	1.4	1.5	1.6	1.8	2.0	2.3	2.7	3.3	4.1	5.5
14	0.9	0.9	1.0	1.1	1.3	1.5	1.7	2.1	2.6	3.4
1-Way Wire Distance (meters), 12 Volt System										
Wire Size (mm^2)	60 Amps	55 Amps	50 Amps	45 Amps	40 Amps	35 Amps	30 Amps	25 Amps	20 Amps	15 Amps
70 **	8.47	9.24	10.17	11.30	12.71	14.53	16.95	20.34	25.42	33.90
50 **	6.72	7.33	8.06	8.96	10.08	11.52	13.44	16.13	20.16	26.88
35	4.23	4.61	5.07	5.63	6.34	7.24	8.45	10.14	12.68	16.90
25	2.66	2.90	3.19	3.54	3.99	4.56	5.32	6.38	7.97	10.63
16	1.67	1.82	2.01	2.23	2.51	2.87	3.34	4.01	5.01	6.69
10	1.05	1.15	1.26	1.40	1.58	1.80	2.10	2.52	3.15	4.21
6	0.66	0.72	0.79	0.88	0.99	1.13	1.32	1.59	1.98	2.64
4	0.42	0.45	0.50	0.55	0.62	0.71	0.83	1.00	1.25	1.66
2.5	0.26	0.29	0.31	0.35	0.39	0.45	0.52	0.63	0.78	1.05

** Wires sizes larger than 2 AWG (35 mm^2) must be terminated at a splicer block located outside of the SureSine Inverter wiring box. Use 2 AWG (35 mm^2) or smaller wire to connect to the SureSine Inverter to the splicer block.

Notes:

- The specified wire length is for a pair of conductors from the solar or battery source to the controller (1-way distance)
- For 24-volt systems, multiply the 1-way length in the table by 2.
- For 48-volt systems, multiply the 1-way length in the table by 4.
- Shaded cells in the table indicate that the current exceeds the ampacity of the wire for a given ambient temperature as defined in the following table:

Wire Ampacity* Key		
		Exceeds wire ampacity at 60°C ambient temperature
		Exceeds wire ampacity at 50°C ambient temperature
		Exceeds wire ampacity at 40°C ambient temperature
		Exceeds wire ampacity at 30°C ambient temperature

APPENDIX B: WARRANTY

The SureSine™ inverters 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 will, at its option, repair or replace any such defective unit.

B.1 Claim Procedure

Before requesting warranty service, check the operator's manual, including any troubleshooting section, to verify product failure.

To begin the warranty replacement process, contact your authorized Morningstar distributor or dealer for assistance with troubleshooting and, if necessary, obtaining an Return Material Authorization (RMA) number.

An RMA number must be issued by Morningstar prior to return of any unit(s) under this warranty. Required RMA information:

(A) purchase location - business or company name - and date

(B) full model and serial numbers (SN is 8-digits on unit bar label)

(C) failure behavior, including LED indications

(D) array configuration, panel Pmax, Voc, Vmp, Isc, and nominal battery voltage; these specifications are needed to receive assistance.

(E) multi-meter available (for field troubleshooting)

If the dealer is contacted, and is not able to assist with warranty claim, contact Morningstar Tech support at support@morningstarcorp.com. Provide proof of date and place of purchase, and all details listed in preceding paragraph.

B.2 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 resulting from acts of nature such as lightning, weather extremes, or infestation

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Notes:

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MS-003650 Rev B08