Solar Micro Inverter - MSI1500

User Guide

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Document Version: 1.0
Document Date: April 2018

About this Guide

Introduction

This guide helps users to know about the installation, commissioning, maintenance, and identification of SLS Micro Solar Inverter 1500.

Table below shows the revision history of this user guide.

Version	Date	Description
1.0	April 2018	First Publication

How To Find Information

- The Adobe Acrobat Find feature allows you to search the contents of a PDF file. Use Ctrl + F to open the Find dialog box. Use Shift + Ctrl + N to open to the Go To Page dialog box.
- Bookmarks serve as an additional table of contents.
- Thumbnail icons, which provide miniature preview of each page, provide a link to the pages.
- Numerous links shown in Navy Blue color allow you to jump to related information.

How to Contact SLS

For the most up-to-date information about SLS products, go to the SLS worldwide website at http://www.slscorp.com. For additional information about SLS products, consult the source shown below.

Information Type	E-mail
Product literature services, SLS literature services, Non-technical customer services, Technical support.	support@slscorp.com

Typographic Conventions

The user guide uses the typographic conventions as shown below:

Visual Cue	Meaning
Bold Type with Initial Capital letters	All headings and Sub headings Titles in a document are displayed in bold type with initial capital letters; Example: **SLS Micro Solar Inverter (MSI1500)**
Bold Type with Italic Letters	All Definitions, Figure and Table Headings are displayed in Italics. Examples: ***Figure 1-1. Multi-Inverter System***
Italic type	Variable names are enclosed in angle brackets (< >) and shown in italic type. Example: <*example*>.
1., 2.	Numbered steps are used in a list of items, when the sequence of items is important, such as steps listed in procedure.
•	Bullets are used in a list of items when the sequence of items is not important.
	The hand points to special information that requires special attention
	The caution sign indicates required information that needs special consideration and understanding and should be read prior to starting or continuing with the procedure or process.
	The feet direct you to more information on a particular topic.
	The note point indicates the information that should be read prior to starting or continuing the procedure or processes.

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Contents

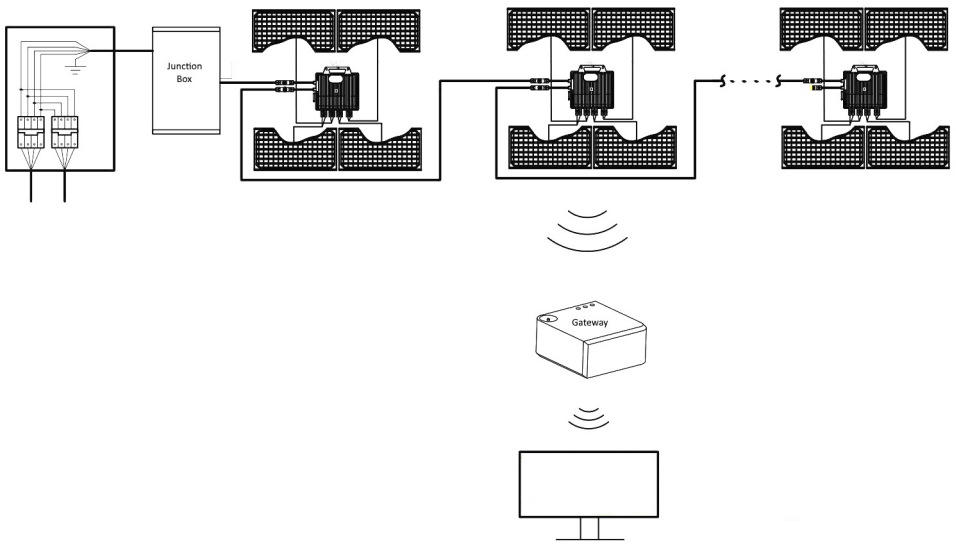
1. Introduction

Overview

Welcome to the growing family of high performance **SLS Micro Solar Inverter (MSI1500)** system owners. The MSI1500 is among the most advanced inverter systems for use in utility-interactive photovoltaic applications. This system is highly reliable, highly efficient, and easy to install. The three key elements of a SLS MSI System include:

- SLS Micro solar inverter
- SLS Communications Gateway
- SLS web-based monitoring and analysis software

Figure 1-1. Multi-Inverter System



For most of the PV applications, the SLS MSI1500 system will benefit the system owner from the initial system design throughout to the entire lifetime of the system.

Why MSI1500?

More Flexibility, More Productivity

Micro solar inverters are what make a distributed solar system possible. Conventional solar grids string numerous solar panels together and connect them all to a single, central grid-tied inverter. This works well if all panels are under uniform conditions, but efficiency is lost when some of the panels are shaded by cloud, trees, or chimneys. Particularly for roof-top residential and commercial PV applications, the output power from a central inverter architecture is usually not maximized, no matter how advanced PV modules or inverter technologies are used.

Table 1-1 depict difference between traditional and SLS inverters.

Table 1-1. Traditional v/s SLS

	Traditional String Inverter	SLS Micro Solar Inverter
Warranty (yrs)	5	15-25
System Risks	The whole system	Local
Maintenance	Professionally trained technician on site repair	Remote support and problem fixing
DC High Voltage	Yes	No
DC Arc Fire Risk	Yes	No
Electric Generation Control	Cannot turn off in Daylight	Automatic turn off
System Design	High voltage DC wiring	Flexible

In the SLS MSI1500 system, PV modules will not be connected to a central inverter. Instead, each PV module has its own inverter to feed the harvested energy from PV module to electric grid. The maximum power point tracking (MPPT) controller embedded in the MSI will monitor the operation of the PV module in real time and maintain a maximum power point. If one or several PV modules in the system are shaded, the output power of these modules will drop but the other modules will not be affected and continue to output at their maximum power level. SLS's smart solar power system can typically harvest 15% - 25% more electric energy than a traditional system with one central inverter.

Reliability

The MSI1500 provides highly reliable solar installations by removing failure-prone central inverters. With no single point of system failure, MSI1500 are designed to operate at full power with ambient temperatures as high as 60°C. Inverter housing is designed for outdoor installation and complies with the NEMA 6 environmental enclosure rating standard. SLS uses the harshest possible testing conditions; each unit is both tested at the factory and tracked in the field.

System Monitoring & Easy Maintenance

The SLS Communications Gateway provides a unique and convenient way to monitor your system's operation and performance.

To install a SLS Gateway, just plug it into any wall socket in your house and use the provided Ethernet cable to connect it to your broadband router or modem. Then the Gateway will automatically start to work and communicate with MSI1500 in your system. The collected system operation data will be reported to the SLS web server. The software presents current and historical system performance trends, and it informs you of PV system status.

Simple Design & Easy Installation

SLS MSI1500 have a simple design for easy installation. Traditional design procedures (string calculations, panel orientation, etc.) are not necessary for MSI1500 system. Simply attach the microinverter to a compatible PV modules and connect the DC and AC cables to the panel and AC grid. The installation is finished and the system is ready to work.

The system can accommodate new panels at any time. This allows users to adopt solar power at their own pace. One panel's failure does not impede others at all. Maintenance, repair, and replacement do not require the whole system to be shut down -- only the panel that needs repair. Distributed systems eliminate the risk of personnel exposure to lethal doses of voltage (up to 600V), which is common in a string or central inverter system.

2. How to Install

Follow the instructions to install SLS MSI1500.Microinverters.

Only qualified personnel should connect SLS MSI1500 to the utility grid. Installation includes risk of electric shock. PV modules connected to SLS Microinverters must be grounded before installation.

Compatibility & Capacity

The MSI1500 model is compatible with both 60-cell and 72-cell PV modules. For more information, see Table 2-1 & Table 2-2 . The MSI1500 should only be connected to the grid type listed below:

Table 2-1. Electric Compatibility

Part Number	AC Grid	Compatibility PV Module Type	PV Module Connector Type
MSI1500-208-Z	208V	60-cell or 72-cell PV Module	MC-4 compatible
MSI1500-240-Z	240V	60-cell or 72-cell PV Module	MC-4 compatible
MSI1500-277-Z	277V	60-cell or 72-cell PV Module	MC-4 compatible

Table 2-2. Maximum: Microinverters per 32 amp AC Branch Circuit

Grid Voltage	Maximum Allowed MSI1500
208V	3
240V	4
277V	4

Packaging

Included in a SLS MSI1500 System package are:

Table 2-3. Packaging Material

Object Description	Quantity
Micro Solar Inverter	1
Grounding Terminal	1 set
User Guide/Operational Guide	1
Warranty terms and conditions	1

Required Parts & Tools

During installation, the following parts and tools may be required in addition to the hardware provided:

SLS Parts:

- SLS Quick Connect Cables
  - The SLS quick connect cable is designed to facilitate the system installation. Order the correct cable type according to the grid voltage type.
- Cable clips, sealing caps, as needed (for any unused drops on the cable)
- Terminators, as needed (one needed at the end of each AC branch circuit)

Other Items,

- AC junction boxes
- Gland or strain relief fitting (one per AC junction box)
- Continuous grounding conductor, grounding washers
- Number 2 and 3 screwdrivers
- Torque wrench, sockets, wrenches for mounting hardware
- Adjustable wrench or open-ended wrench (for terminators)
- Handheld mirror (to view indicator lights on the undersides of the microinverter

Lightning Surge Suppression

PV systems are usually installed in open fields or on rooftops -- places where lighting can strike. Lightning causes drastic voltage spikes in solar panels, which may damage equipment. While MSI1500 have built-in surge protection, this may not always protect all equipment from the energy spike caused by lighting. In that case, Additional surge protection devices are strongly suggested.

Installation Procedure

Preparation

Installation tools: multimeter, allen wrench, impact drill, screwdriver and manual wrench.

Figure 2-1. Installation Tools

CAUTION

Make sure AC & DC plugs are drained of electrical charge before installation and maintenance! If the DC side has recently been disconnected, capacitors will still contain a residual charge. Wait for at least 5 minutes to ensure the capacitors are no longer electrified.

For optimal performance, inverters should be installed by a technician.

Installation

Read entire installation procedure before installing. The following procedure must be strictly followed for a proper installation.

CAUTION

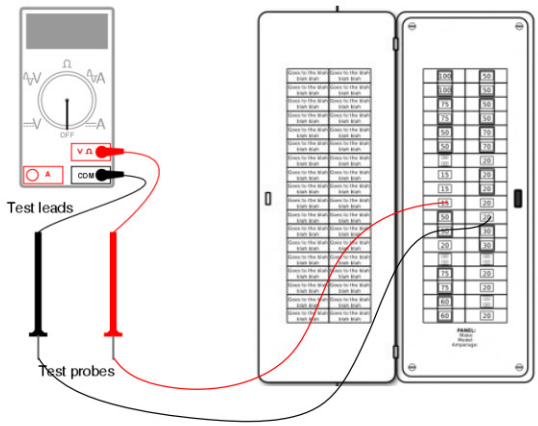
DO NOT connect SLS MSI1500 to the utility grid to energize the AC circuit(s) until you have completed all of the installation procedures.

Step1: Measure Grid AC Voltage at Electrical Utility Connection

Measure AC line voltage at the point of common utility connection coupling to ensure it is within the proper range for the microinverter's operation. Acceptable ranges are shown as below:

Single phase 208V AC: 183 to 232 VAC(L1 to L2) or
Single phase 240V AC: 211 to 264 VAC(L1 to L2) or
Single phase 277V AC: 244 to 305 VAC(L1 to L2)

Figure 2-2. Measurement of Distribution panel with multi-meter



WARNING

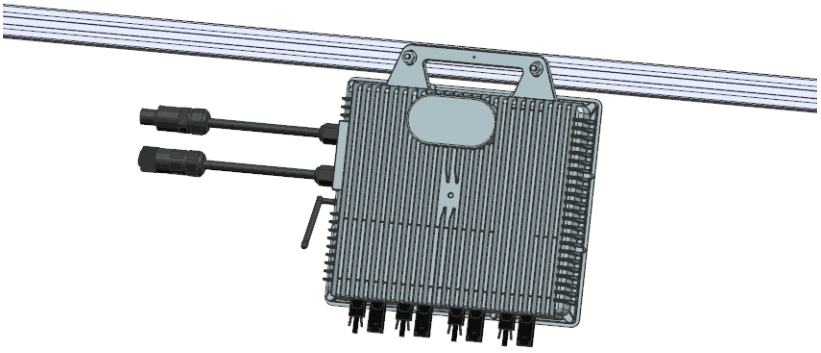
Check cable voltage rating before installation. For SLS Quick Connect cables, voltage rating is marked on the cable's label. Never use cables with insufficient voltage rating for intended use.

Step 2: Attach microinverters to PV Racking

The position for the microinverter on the PV racking is flexible and is usually determined before installation.

Put the microinverter under the PV module, out of direct sunlight. Also, leave at least 0.6in (1.5cm) clearance between the roof and the bottom of the microinverter; and at least 0.6 in (1.5cm) clearance between the back of the PV module and the top of the microinverter. See Figure 2-3.

Figure 2-3. Microinverter with PV Rack



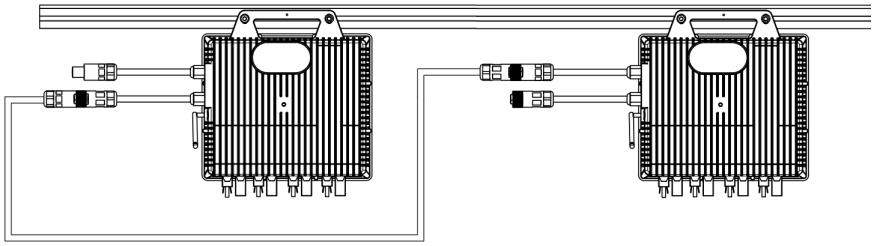
Step 3: Connect microinverter's AC cable

CAUTION

Do NOT exceed the maximum number of microinverters in an AC branch circuit as specified in this user-guide.

Before connecting the AC cables of the microinverter, check the number of microinverters in each AC branch circuit. Beginning with the end of the branch, connect one of the AC cable of the last microinverter in a branch to the adjacent microinverter. Then repeat this step for each microinverter in a branch and eventually any adjacent microinverter's AC cables should be connected. Then connect the 2nd AC cable of the first microinverter to the AC cable running from the junction box. See Figure 2-4.

Figure 2-4. Microinverter Connection

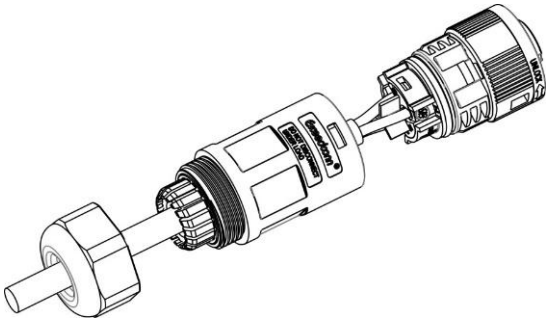


Step 4: Terminate unused end of AC cable for each branch

For the microinverter, which is located at the end of a branch circuit and one of its AC cables is not connected to other microinverters.

It is unsafe to leave this AC cable exposed to the field, since it will still be energized and may bring electrical hazard. These cables should be terminated with protective caps as shown in FIfure.

Figure 2-5. Protective Caps



WARNING

Never leave unused AC cables open/floating in the system. Terminate the unused end of an AC cable with provided protective caps. Terminate the unused end of the AC cable for each branch.

Step 5: Install AC branch circuit junction box

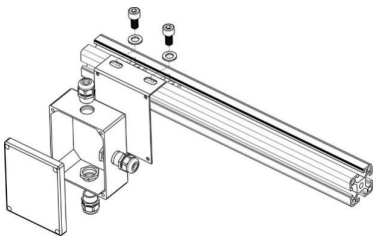
CAUTION

Risk of Electrical Shock. Remove AC power from system before installing the AC branch circuit junction box. Each AC branch circuit must have a 32A maximum circuit breaker.

Additional lightning protection equipment may be necessary for some locations.

For each AC branch, an AC junction box is required for routing the AC grid to the microinverters. Follow the steps listed below carefully to install the AC junction box:

1. Install the AC junction box to a proper location of the branch circuit. The most common location for the junction box is the beginning or middle of an AC branch. For the latter location, be aware that two microinverters in one AC branch circuit have unused AC cables to be terminated.



2. Put the AC cable from inverter side into the junction box with anti-pull accessories and proper washers.
3. Pay attention to the wire colors in the cable. The electrical codes usually have the following specification for the wire color: Red-Hot wire; Black- Neutral wire; Ground: yellow/green double color wire.
4. Connect and secure the cable from AC grid side to the terminals inside the junction box. This step will connect the microinverter to the AC grid. Make sure the AC grid power is always removed during this step.
5. Close the cover of the AC junction box tightly by securing the screws on the corners of the cover.

Table 2-4. Wire Colors

Grid	Microinverter Wire Color
L1	Red
L2	Black
GND (Ground)	Green/Yellow

Step 6: Ground system & microinverters

For safety considerations, all non-current carrying elements in a photovoltaic system (including PV module, PV racking and microinverter case) must be securely grounded before operation. Choose one of the two methods below for system grounding:

1. Run a continuous grounding conductor from each microinverter to the AC grounding electrode. This is the most common method. Connect the PV module frame, PV racking and microinverter case to this grounding conductor by using grounding washers. Tighten the grounding clamp screw.
2. For systems with PV racking that is already grounded, securely attach the PV module and microinverter to the grounded PV racking by using washers and tightening the grounding clamp screw.

Never start system operation before finishing system grounding. The ground fault detection device (GFDI) inside the microinverter may be tripped if the system is not securely grounded.

Step 7: Complete the installation map

We need series numbers of installed microinverters for registering in our service later.

The Installation Map is a diagrammatic representation of the physical location of each microinverter in you PV installation. The virtual array in our web APP is created from the map you created. You can create a blank according to your previous system design before placing the microinverters to the arrays.

Each microinverter has a removable serial number label located on the top of our microinverters, when installing the microinverters, remove the serial number labels located and place in the correct order on your drawing of the system. Remember to keep a copy of the installation for your records.

You are not done yet! Complete the Operation Guide section to begin use properly. It is important to record the series number of the microinverters and communication gateways for adding these devices in our database.

Step 8: Install the Link nearby the AC main

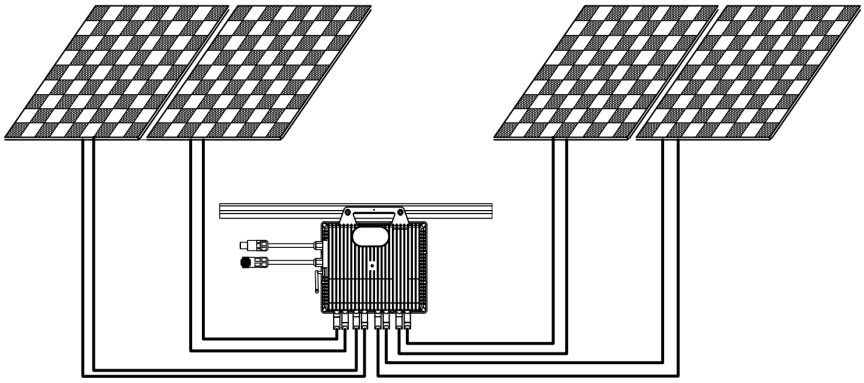
Link is an integral component of the SLS Micro solar inverter system. Its functions as a communication gateway and monitors the microinverters that are connected to the PV modules. The Link collects energy and performance data from the microinverters via on-site AC power lines.

SLS recommends that the Link be placed as close to the AC mains as possible. This ensures that the Link receives the strongest possible signal from each microinverter. The Link must be indoors and can be placed on a table or mounted on the wall. The AC outlet Link plugged in must be close to the AC mains and keep the same phase with the point that PV system tied in.

Step 9: Connect microinverters to PV modules

Connect each microinverter DC input terminals to the adjacent four PV modules output terminals through the Quick Connect cable. Make sure all the microinverters in the system are securely connected to the PV modules.

Figure 2-6. Microinverter with PV modules



Step 10: Register microinverters

Go to http://energy.slscorp.com. For more information, refer to the “SLS Smart Grid Web Application”.

3. Operation Guide

Congratulations on finishing up the installation! Follow these steps to begin operation:

1. Close the AC circuit breaker for each branch circuit (usually 32A rating breakers).
2. Close the main circuit breaker for the entire system. This breaker should be chosen based on your PV system capacity. The microinverter system will begin operation in about 1 minutes.
3. Plug the Ethernet cable into the Link and the other end of the cable into a spare port on the broadband router. Place the Link so that its AC cord can reach this outlet. Try unplugging any other device that may be sharing the outlet with the Link.
4. The Link must be obtain a DHCP (Dynamic Host Configuration Protocol) IP address and have a path to the internet after power on and then the Link will query the data of the microinverters that registered in our website.
5. Login into your user account and monitor real-time operation of system.

Please note that after installation, the system may need ~10 minutes (first time only) to establish communication between each microinverter and Gateway. This portal will display the power generated by each microinverter, along with fault reports for quick trouble shooting.

After initial power up, check the LEDs. The basic operation status of each microinverter will be displayed on indicator LEDs. Each microinverter will self-check its connection after being connected to DC Power. The Status LED will blink green ten times to indicate continued connection. A solid red status indicates disconnection. Make sure all plugs are fully connected. Table below describes the LED indicator's operation after self-checking:

Table 3-1. LED status information

LED Status	Description
Solid Green	Producing power normally
Flash green 2s/times	Ready

4. Trouble Shooting Guide

- Leave troubleshooting to qualified electrical professionals.
- Do not unplug microinverter during operation. This may damage the microinverter and expose the operator to electrical hazard. First open the AC circuit breaker; then disconnect the AC grid; then unplug the inverter from the PV module. (To disconnect the entire system from the AC grid, open the main circuit breaker. To disconnect a particular AC branch circuit, open the circuit breaker connected to that branch.)

Please follow the steps below for troubleshooting system problems:

1. Make sure the AC grid voltage and frequency are both in the allowed range for proper operation. Refer microinverter datasheet for the accepted AC grid conditions.
2. Check the connection of the system. Disconnect the AC side and then the DC input side of the microinverter.
3. Check the PV module open circuit voltage. The open-circuit voltage of PV module should stay in the range specified in the microinverter datasheet.
4. Reconnect the DC side cable and check the LED status of the microinverter. If the green LED light is flashing, the DC connection is good.
5. Check the AC grid side connection. If the entire system doesn't work, check the main AC circuit breaker. For a particular branch problem, check the AC circuit breaker connected to that branch. For a particular microinverter problem in a branch, check the AC cable connection of that microinverter. If the LED is solid green after blinking 10 times, the grid connection is good.

Do Not attempt to repair the microinverter. This will void the warranty and can bring electrical hazard to those attempting it. Contact SLS customer support to initiate an inverter return process.

5. Replace or Add Microinverter

Identify the circuit breaker for the branch in which a microinverter will be replaced or added. Open that circuit breaker before starting the replacement/ adding procedure.

Follow the steps below to replace a microinverter:

1. Disconnect branch AC circuit breaker
2. Cover PV module connected to microinverter to be replaced
3. Disconnect AC connection cable from adjacent microinverter
4. Disconnect PV module from microinverter
5. Remove failed microinverter from PV rack
6. Follow Installation Instructions to install new microinverter
7. Remove PV module cover and close branch circuit breaker
8. New microinverter will begin operating in 1 minutes
9. Register new microinverter on SLS website

New PV modules and microinverters can be added to existing distributed system any time. Please follow the 'How to Install' section to complete the new installation of PV modules and microinverters.

6. Rapid Shutdown

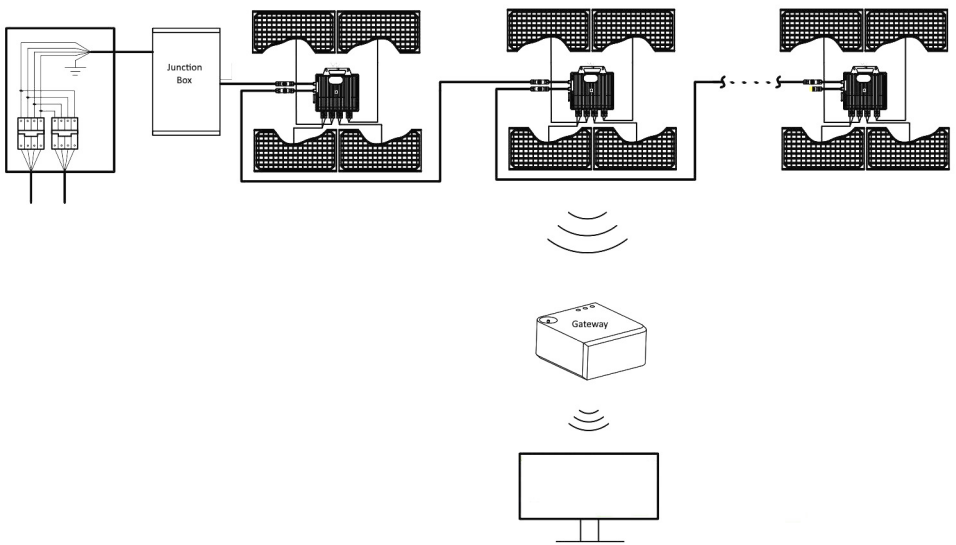
SLS Micro Solar Inverter system is compliant with the NEC 2014 and NEC 2017 Rapid Shutdown code requirements, without any additional device. This function is designed to decrease the risk emergency responders—particularly firefighters—face when they work on a fire at a building with a PV system.

Follow the steps below to shutdown the system safely:

1. Disconnect the main AC circuit breaker.
2. Disconnect the branch AC circuit breakers.

Then, the whole system will be under 80V, which meet the 2014 NEC article 690.12 Rapid Shutdown code requirements.

Figure 6-1. Multi-inverter system



7. Technical Data

Technical Consideration

The SLS MSI1500 is electrically compatible with most 60-cell or 72-cell PV modules. Be sure to verify the voltage and current specifications of your PV module match those of the microinverter. For more information, refer to our list of compatible PV modules.

The PV module's maximum open circuit voltage must not exceed the microinverter's maximum input voltage.

The output voltage and current of the PV module depends on the quantity, size and temperature of the PV cells, as well as the isolation on each cell. The highest PV module output voltage occurs when the temperature of the cells is the lowest and the PV module is at open circuit (not operating). The maximum short circuit current rating of the PV module must be equal to or less than the maximum input DC short circuit current rating of the microinverter.

Specifications

INPUT DATA D.C.	
Recommended Input Power	230 - 350W
Maximum Voc (DC V)	60V
MPPT Voltage Range (Full Power)	32 - 45V
Operating Voltage Range	22 - 55V
Number of MPPT	4
Maximum Input String	4
Maximum DC Short Circuit Current (DC A)	60A (15A per MPPT)
Maximum Input Current (DC A)	40A (12A per MPPT)
OUTPUT DATA AC	
Peak power	1500W
Maximum Continuous Output Power (W)	1200-1500W
Maximum continuous output current	5.22 - 6.09A

Nominal Voltage	230V
Nominal Operating Voltage Range	202 - 268V
Nominal Operating Freq. (Hz)	48 - 52Hz
Power Factor	>0.99 (±0.8 adujstable)
Total Harmonic Distortion	<3%
Nominal Output Current (AC A)	15A
Maximum Units Per 20A branch	5
EFFICIENCY	
Peak Inverter Efficiency	95.0%
Static MPPT Efficiency	99.9%
CEC Weighted Efficiency	94.5%
MECHANICAL DATA	
Operating Ambient Temp. Range	- 25 ºC to 60 ºC
Dimensions (W X H X D)	32.2 cm X 27.8 cm X 8.0 cm (12.7" X 10.9" X 3.1")
Weight	7.5 Kgs (16.5 lbs)
OTHER FEATURES	
Reactive Power Compensation	Yes (PF adjustable)
Night Time Power Consumption	<200mW
Communication	Zigbee / 6LoWPAN