



User Manual/ Operation Guide

LeadSolar LS1400

Single-Phase Grid-connected PV Microinverter

Ver 2.2

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Contents

Notes.....	3
Safety Instructions	3
Explanation of Symbols	4
LeadSolar LS1400 System Introduction	6
Installation	9
Compatibility & Capacity	9
Packaging	9
Required Parts & Tools	10
Lightning Surge Suppression.....	10
Installation Procedure	11
Preparation	11
Installation	11
Step 1: Measure Grid AC Voltage at Electrical Utility Connection	12
Step 2: Attach microinverters to PV Racking.....	12
Step 3: Connect microinverter's AC cable	13
Step 4: Terminate unused end of AC cable for each branch	13
Step 5: Install AC branch circuit junction box.....	14
Step 6: Ground system & microinverters	15
Step 7: Complete the installation map.....	15
Step 8: Install the Link nearby the AC main.....	15
Step 9: Connect microinverters to PV modules.....	16
Step 10: Register microinverters	16
LeadSolar Microinverter System Operation Guide.....	17
Microinverter System Trouble Shooting Guide	18
Replacing or Adding a Microinverter.....	19
Rapid shutdown.....	20
Technical Data	21
Technical Considerations.....	21
Specifications.....	21

Notes

This user manual describes the assembly, installation, commissioning, and maintenance and failure identification of the LeadSolar microinverter. To reduce the risk of electrical shock and ensure the safe installation and operation, the following symbols are used in the manual to indicate dangerous conditions.

SAVE THESE INSTRUCTIONS-This manual contains important instructions for model LS1400 that shall be followed during installation and maintenance of the microinverter.

All information, specifications and illustrations in this manual are those in effect at the time of printing. LeadSolar reserves the right to change specifications or design without notice. For latest information about our products, please visit www.lead solarenergy.com .

All trademarks are recognized as the property of their respective owners.



WARNING:

This indicates a safety hazard that could cause personal injury or equipment malfunction. Follow these instructions carefully to avoid or reduce the risk.



NOTE:

This indicates important information that is critical to optimizing system performance.

Safety Instructions





- ✧ **Follow local installation codes.** Make sure to adhere to all applicable national and local electrical codes during installation. Only qualified personnel should install or replace LeadSolar Microinverters.
- ✧ **No DIY repairs.** Users must never attempt to repair or modify the LeadSolar Microinverter themselves. If the microinverter fails to operate, contact LeadSolar customer service for repair or replacement. Tampering with or opening the hardware will void the warranty.
- ✧ **Read the instructions.** Read all instructions and cautionary notes before installing or using LeadSolar hardware.
- ✧ **Disconnect safely.** Disconnect the AC power grid connection first before disconnecting the PV module from the LeadSolar Microinverter.
- ✧ **Microinverter can get hot.** The majority of the LeadSolar Microinverter is a heat sink. Under normal operating conditions, the temperature is 59 °F (15 °C), but it can reach 176 °F (80 °C) under extreme conditions. To reduce risk of burns, use caution when working with

microinverters.

- ✧ **It's already fine-tuned for your region.** Be aware that the LS1400 has different default factory settings for the applications in different regions throughout the world. The LS1400 do not need field adjustment or tuning. It will start to deliver power to the electric grid automatically after installation.
- ✧ **This unit or system is provided with fixed trip limits and shall not be aggregated above 30 kW on a single Point of Common Connection.**

Explanation of Symbols

The following symbols are shown on the microinverter:

Symbol	Explanation
	<p>Treatment</p> <p>To comply with European Directive 2002/96/EC on waste Electrical and Electronic Equipment and its implementation as national law, electrical equipment that has reached the end of its life must be collected separately and returned to an approved recycling facility. Any device no longer required must be returned to an authorized dealer or approved collection and recycling facility.</p> <p>Traitement</p> <p>Conformément à la directive européenne 2002/96/EC relative aux déchets d'équipements électriques et électroniques, et à sa transposition dans la législation nationale, les appareils électriques qui ont atteint la fin de leur durée de vie doivent être collectés séparément et être soumis à un recyclage respectueux de l'environnement. Tout appareil usagé doit être retourné à un revendeur autorisé ou à une organisation approuvée de collecte ou de recyclage.</p>
	<p>UL 1741 Standard for Safety for Inverters, Converters, Controllers and Interconnection System Equipment for use with Distributed Energy Resources. CSA-C22.2 No. 107.1-01 - General Use Power Supplies</p> <p>UL 1741 Norme de sécurité pour les onduleurs, convertisseurs, contrôleurs et de l'équipement d'interconnexion de systèmes pour une utilisation avec des ressources énergétiques décentralisées. CSA C22.2 NO.107.1-01 - Fournitures générales d'utilisation de puissance</p>
	<p>Do not come within 8 inches (20cm) of the microinverter for any length of time while it is in operation.</p> <p>Ne pas entrer dans un rayon minimum de 8 pouces (20 cm) du micro-onduleur pour toute longueur de temps lors de l'opération.</p>
	<p>CAUTION!</p> <p>Risk of Electric Shock, Do Not Remove Cover. No User Serviceable Parts Inside. Refer Servicing To Qualified Service Personnel. Both ac and dc voltage sources are terminated inside this equipment. Each circuit must be</p>

individually disconnected before servicing. When the photovoltaic array is exposed to light, it supplies a dc voltage to this equipment.

Attention!

Risque de choc électrique, ne pas enlever le couvercle. Aucune pièce interne réparable par l'utilisateur. Toute réparation doit être uniquement confiée à du personnel qualifié. A l'intérieur de l'onduleur on retrouve 2 tensions AC et DC. Chaque circuit doit être déconnecté individuellement avant chaque entretien. Lorsque le panneau photovoltaïque est exposé à la lumière, il fournit une tension DC à cet appareil.



CAUTION!

Hot surfaces – To reduce the risk of burns – Do not touch

Attention!

Les surfaces chaudes – pour réduire le risque de brûlure – Ne pas toucher



Read manual first

Please read the installation manual first before installation, operation and maintenance.

Lire d'abord le manuel

Veuillez lire le manuel d'installation avant toute installation, opération et maintenance.



5 minutes



CAUTION!

Do not remove cover until 5 minutes after disconnecting all sources of supply.

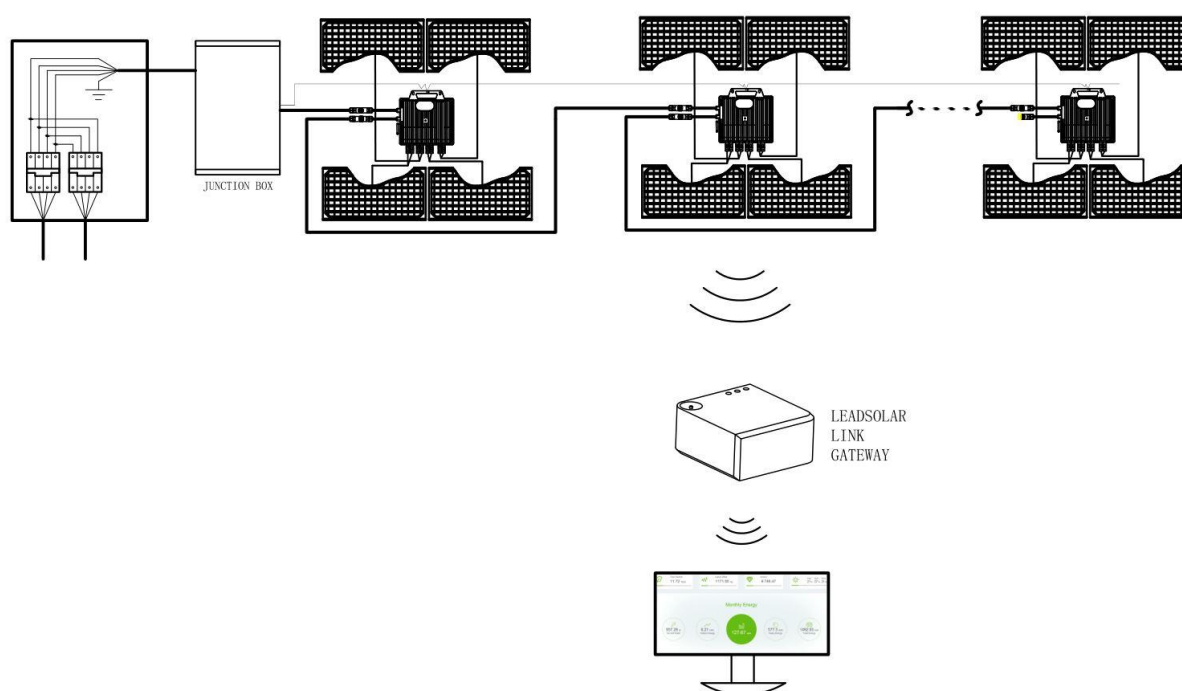
Attention!

Ne pas enlever le couvercle durant 5 minutes après la déconnexion électrique totale.

LeadSolar LS1400 System Introduction

Welcome to the growing family of high performance LS1400 microinverter system owners. The LeadSolar Microinverter System 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 LeadSolar Microinverter System include:

- LeadSolar Microinverter
- LeadSolar Link™ Communications Gateway
- LeadSolar Management™ web-based monitoring and analysis software



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

LeadSolar Smart Solar: More Flexibility, More Productivity

Microinverters 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.

Traditional String Inverter

LeadSolar Microinverter

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
Accessories	DC conduit, junction boxes, etc.	AC connection
Installation	Separate inverter installation	Inverter integrated with solar panel

In the LeadSolar microinverter 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 microinverter 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. LeadSolar's smart solar power system can typically harvest 15% - 25% more electric energy than a traditional system with one central inverter.

Reliability

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

System Monitoring & Easy Maintenance

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

To install a LeadSolar Link 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 the microinverters in your system. The collected system operation data will be reported to the LeadSolar Management web server. The Management software presents current and historical system performance trends, and it informs you of PV system status.

Simple Design & Easy Installation

LeadSolar Microinverters have a simple design for easy installation. Traditional design procedures (string calculations, panel orientation, etc.) are not necessary for LeadSolar microinverter systems. 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 is open and can accommodate new panels at any time. This allows users to adopt solar power at their own pace, and as their budget allows. 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.

Installation

Follow the instructions in this section to install LeadSolar LS1400 Microinverters.



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

Compatibility & Capacity

The LS1400 model is compatible with both 60-cell and 72-cell PV modules. For more information, see Technical Data. The LS1400 should only be connected to the grid type listed below:

Electrical Compatibility

Part Number	AC Grid	Compatible PV Module Type	PV Module Connector Type
LS1400-208-Z	208V	60-cell or 72-cell PV Module	MC-4 compatible
LS1400-240-Z	240V	60-cell or 72-cell PV Module	MC-4 compatible
LS1400-277-Z	277V	60-cell or 72-cell PV Module	MC-4 compatible

Maximum # Microinverters per 32 amp AC Branch Circuit

Grid Voltage	Maximum Allowed LS1400 inverters
208V	3
240V	4
277V	4

Packaging

Included in a LeadSolar Microinverter System package are:

Object description	Quantity
1. Microinverter	1
2. Grounding terminal	1 set
3. User Manual/Operation Guide	1
4. Warranty terms and conditions	1

Required Parts & Tools

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

LeadSolar Parts:

- LeadSolar Quick Connect Cables

The LeadSolar 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 Phillips 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 microinverters)

Lightning Surge Suppression

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



Additional surge protection devices are strongly recommended to fully protect your system.

Installation Procedure

Preparation

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



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.

- Step 1: Measure Grid AC Voltage at Electrical Utility Connection
- Step 2: Attach microinverters to PV Racking
- Step 3: Connect microinverter's AC cable
- Step 4: Terminate unused end of AC cable for each branch
- Step 5: Install AC branch circuit junction box
- Step 6: Ground system & microinverters
- Step 7: Complete the installation map
- Step 8: Install the Link nearby the AC main
- Step 9: Connect microinverters to PV modules

Step 10: Register microinverters



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

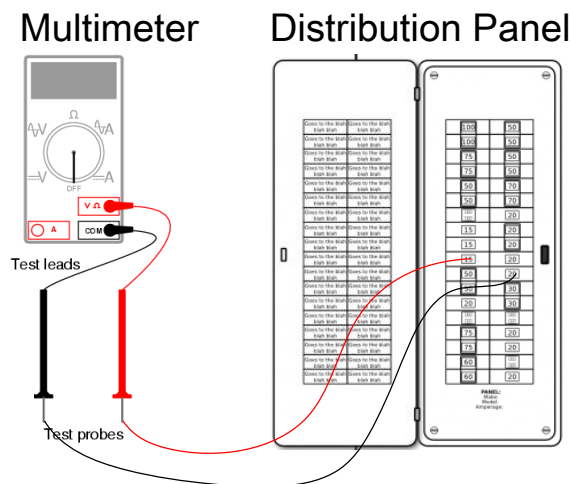
Step 1: Measure Grid AC Voltage at Electrical Utility Connection

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)

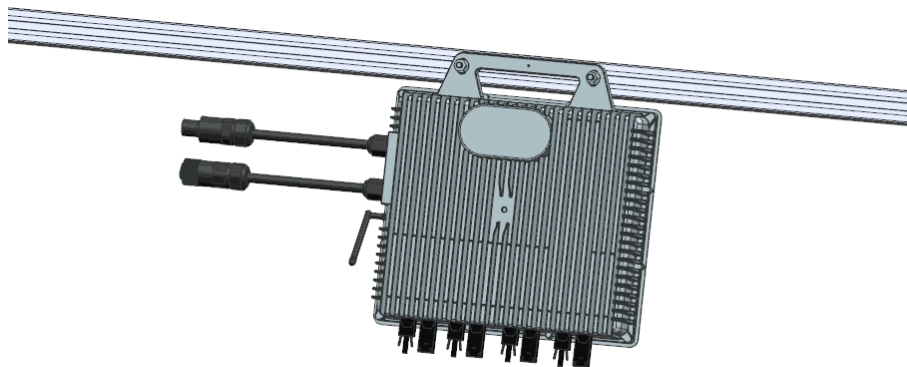


Check cable voltage rating before installation. For LeadSolar Quick Connect cables, voltage rating is marked on the cable's label. Never use cables with insufficient voltage rating for intended use.

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.

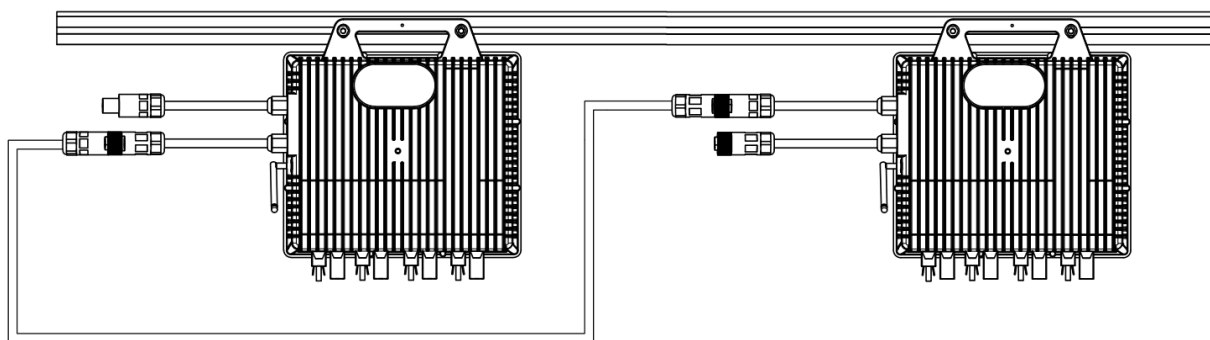


Step 3: Connect microinverter's AC cable



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

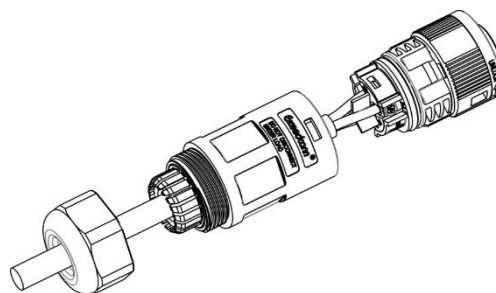
Before connecting the AC cables of the microinverter, check the number of the microinverters in each AC branch circuit. Beginning with the end of the branch, connect one of the AC cable of the last microinverter in a branch to the adjacent microinverter. Then repeat this step for each microinverter in 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.



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

For the microinverter located at the end of a branch circuit, 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.



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

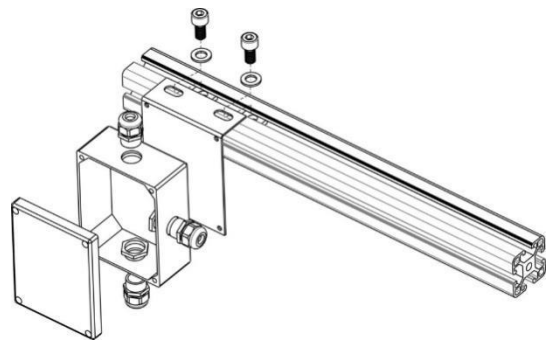


Risk of Electrical Shock. Remove AC power from system before installing the AC branch circuit junction box. Each AC branch circuit must have a 32A maximum circuit breaker.

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.



NOTE: Wire colors are listed in the following table

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.

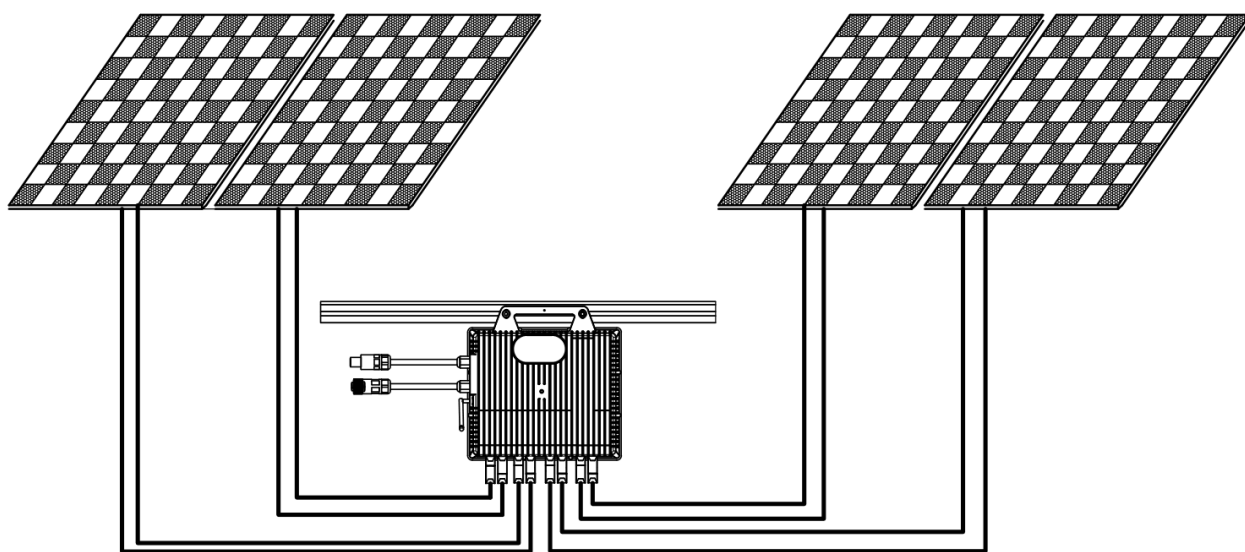
Step 8: Install the Link nearby the AC main

Link is an integral component of the LeadSolar Energy Microinverter 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.

LeadSolar 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 that the 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 the each microinverter DC input terminals to the adjacent four PV modules output terminals through the Quick Connect cable. Check your work to make sure all the microinverters in the system are securely connected to the PV modules.



Step 10: Register microinverters

Go to www.leadsolarenergy.net. For more information, refer to the “LeadSolar Smart Grid Web Application”.

LeadSolar Microinverter System Operation Guide

Congratulations on finishing the PV system 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 Ethernet port on 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 to your user account on www.lead solarenergy.com and monitor the operation of your system in real-time.

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

The basic operation status of each microinverter is also displayed by the indicator LEDs on each microinverter. It is recommended to take a quick check of the LEDs after initial power up. 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.

The table below summarizes the description of the LED indicators' operation after self-checking:

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

Microinverter System Trouble Shooting Guide



Leave troubleshooting to qualified electrical professionals.



Do not unplug the 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 to the 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 LeadSolar customer support to initiate an inverter return process.

Replacing or Adding a 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 LeadSolar website

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

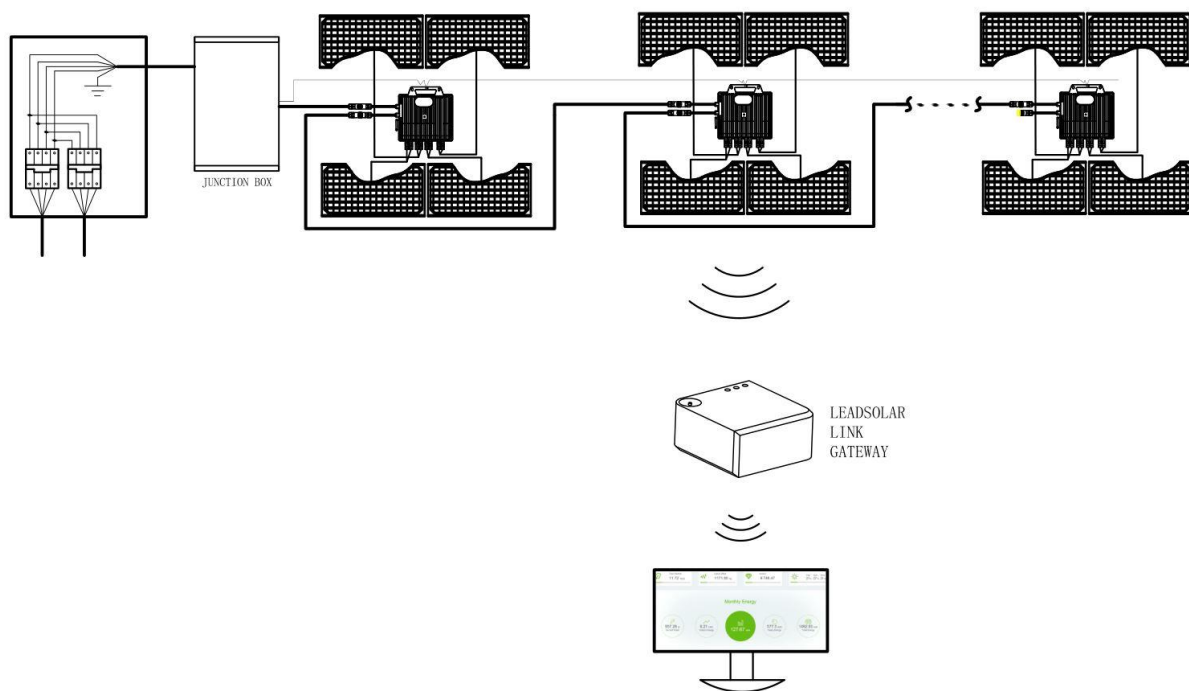
Rapid shutdown

LeadSolar Microinverter 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.



Technical Considerations

The LeadSolar LS1400 Microinverter 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 [DC]			
Recommended PV module power (STC)	230 - 350W		
Maximum input voltage	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	60A (15A per MPPT)		
Maximum input current	40A (10A per MPPT)		
OUTPUT DATA [AC]			
Peak power	1400W	1400W	1400W
Maximum continuous output power	1200 – 1400W	1200 – 1400W	1200 – 1400W
Maximum continuous output current	5.77 - 6.73A	5.00 - 5.83A	4.33 - 5.05A
Nominal grid voltage	208V	240V	277V
Operating grid voltage range	184-228V	212 - 264V	244 - 305V
Operating frequency range	59.3-60.5Hz		

Power factor	>0.99 (±0.8 adjustable)		
Total harmonic distortion	<3%		
Maximum output overcurrent protection (AC)	15A		
Maximum units per 32A branch	3	4	4
EFFICIENCY			
Peak inverter efficiency	95.0%		
CEC weighted efficiency	94.5%		
Static MPPT efficiency	99.9%		
MECHANICAL DATA			
Operating ambient temp range	-25°Cto 60°C		
Dimensions (W x H x D)	32.2 cm x 27.8 cm x 8.0 cm(12.7 in x 10.9 in x 3.1 in)		
Protect function	Overload, short circuit, over / under voltage, high temperature, Reactive power compensation, anti-islanding		
Weight	7.5 Kg (16.5 lbs)		
Cooling	Natural convection		
Enclosure environmental rating	TYPE 6		
OTHER FEATURES			
Reactive Power Control	YES. (PF adjustable)		
Night time power consumption	<200mW		
Compliance	IEC 61727, IEC 62116, IEC/EN 62109-1, 62109-2, AS4777.2, AS4777.3, AS/NZ 3100, UL 1741/IEEE 1547, FCC Part 15B, CAN/CSA-C22.2 NO.0-M91, 0.4-04, and 107.1-01		
Communication	ZigBee / RF		

