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Enecsys Installation and Operation Guide

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Contents

Chapter 1 Important Safety Instructions

SAVE THESE INSTRUCTIONS – This manual contains important instructions that must be followed during installation and maintenance of all the micro inverters covered in the manual.

1.1. Audience

This manual is intended for installers and electricians involved in the installation and setup of Enecsys Solar micro inverter systems. It is expected that installers will have knowledge of the necessary steps needed for safe and successful installation of Enecsys Micro Inverters and associated apparatus. Electricians must have knowledge of the electrical codes and regulations of their specific country as well as safe methods of practice.

Installers can view Enecsys installation videos at:

http://enecsys.com/resources/videos/

1.2. Products Covered By These Instructions

This manual covers the following products:

- Micro inverter
- Gateway
- Repeater
- Double Repeater
- Monitoring software

1.3. Conventions Used In This Manual

The following conventions are used throughout this manual. These conventions should be noted and followed at all times.

WARNING
Warning statements must be heeded at all times. A warning symbol indicates that a process or instrument has the potential to harm or cause lethal injury if the correct method of handling is not employed.

CAUTION
Caution Statements are used to indicate where a part of a process may have the potential to damage equipment. Caution statements should be followed at all times.

ATTENTION
Attention statements are used to indicate where a part of the process has a special requirement. Attention statements should be followed at all times.

1.4. Safety

Before installing and using any Enecsys Micro Inverter please ensure that all of the installation instructions have been fully read. Understand and heed all warnings and cautions given.

WARNING
The installation and/or replacement of Enecsys Micro Inverters must only be carried out by qualified professionals.

WARNING
All electrical installations should be performed in accordance with all local and national electrical installation codes and practice.

WARNING
All electrical connectors must be dry before making any connections and must be kept dry during the installation process.

WARNING - Lightning Protection
To avoid voltage being induced by lightning, arrange roof-mounted wiring as radial branches, or as a single branch. Wiring loops or rings must not be used. Further independent active protection against lightning strike may be required, to local and national standards.

CAUTION
PV systems using Enecsys Micro inverters must have an external transient voltage surge arrestor. The external device must be installed at the Point of Common Connection of the PV system and must meet IEC 61643-1 class II requirements. Failure to install this device will void the warranty.

WARNING - Isolation of the AC cabling
The AC wiring from the micro inverters must have provision for electrical isolation from the grid mains supply (for example, a circuit breaker), so that inspection, fault detection, testing, maintenance and repair can be performed.

WARNING
Never disconnect any photovoltaic module from an Enecsys Micro Inverter without first isolating the AC mains.

WARNING
The micro inverter and metalwork must be earthed/grounded in accordance with national and local electrical standards.

WARNING
Enecsys Micro Inverters, gateways and repeaters contain no user-serviceable parts. Do not attempt to open or repair. Opening or tampering with the Enecsys Micro Inverter, gateway or repeater will void the warranty.

- If a micro inverter fails, contact the installer or the Enecsys help desk.
- New units with damage must not be installed: return them to the supplier.

WARNING
If either the gateway or the repeater/double repeater exhibit any of the following, unplug the products from the electrical supply. Contact the distributor or installation company.

- The power supply or its plug is damaged.
- Liquid has been spilled into the product.
- The product has been exposed to rain or water.
- The product does not operate properly.
- The product has been dropped or damaged in any way.
- There are noticeable signs of overheating.

CAUTION
Hot surfaces. To reduce the risk of burns, DO NOT TOUCH when unit is operating.

ATTENTION

Further protection of the AC wiring from the micro inverters must be provided and may be required by local or national regulations. This protection may include Residual Current Devices, Earth Fault Monitors and/or Circuit Breakers.

This product could create AC current with a DC component. Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection in case of direct or indirect contact, only an RCD or RCM of Type B is allowed on the supply side of this product.

ATTENTION - Voltage drop across the AC wiring

To ensure that the system is operating efficiently, the voltage drop across the AC wiring should be measured. This is best done by direct measurement, but can be arrived at by calculations, graphs or tables.

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ATTENTION - Installation Testing: Initial verification

Before being connected to the grid mains supply, the wiring installation must be inspected and tested to verify that the requirements of the regulations have been met. The type and level of the tests must be in accordance with the local and national regulations. Suitably qualified persons must carry out the tests and the interpretation of the results.

ATTENTION

The micro inverter bracket is not designed to support excessive weight. Do not stand on or place excessive weight on Enecsys Micro Inverters.

ATTENTION - Gateway and repeater are for stationary indoor use only.

- Do not mount in a location where they will be exposed to direct/excessive solar and/or heat radiation.
- Do not expose to heat-trap conditions or to water condensation.
- Do not use liquid or aerosol cleaners; clean only with a damp cloth.
- Do not use near water.
- Transition of these items between temperature extremes may cause condensation on some of the internal parts. If there is condensation on or behind the product's display window, allow it to dry naturally before re-connecting to the main electrical supply.

1.5. Installation Compliance Requirements

- The Installation must be wired in accordance with the regulations in force in the country where the micro inverters are to be installed. These are examples only:
  - For the UK: IEE Wiring Regulations, BS 7671, latest edition
  - For the USA: National Electrical Code, ANSI NFPA 70
  - For Canada: Canadian Electrical Code, Part 1
  - For Austrailia: AS 4777
- For UL 1741 compliant Installations:
  - The micro inverters must always be installed on a branch circuit with an external transient voltage surge arrestor.
- For VDE 4105 compliance, installations are limited in size to 3.68kVA.
- In jurisdictions that require it, a location-specific disconnect (such as an ENS box) must be part of the installation.

1.6. Installation Safety Instructions

- The Enecsys Micro Inverters are provided with fixed trip limits for both voltage and frequency.
- The system grounding is the responsibility of the installer.

WARNING
Whenever the PV module is exposed to light, it supplies a DC voltage. Follow all safety instructions and warnings provided by the module manufacturer's documentation.

WARNING
The micro inverters, gateway and repeaters contain no user serviceable parts and must be returned to the supplier in the case of damage. Micro inverters with damage to integrated power supply cords should not be installed or serviced: they must be returned to the supplier.

WARNING
Do not connect this or any other Enecsys Micro Inverter to an external battery.

CAUTION
To reduce the risk of fire, connect only to a circuit provided with 16 amperes maximum branch-circuit overcurrent protection (20A breaker, 16A continuous rating) in accordance with the National Electrical Code, ANSI/NFPA 70.

1.7. System Installation Best Practices

- Be aware of the anodic index of dissimilar metals used in the installation process. Note that graphite is a metal: do not mark rails or other metal components with a pencil.
- Components used to install the PV array should be rated for array conditions and anticipate installation life.

Chapter 2 Planning the Installation

2.1. The Enecsys Micro Inverter System

The Enecsys Micro Inverter converts the DC power from a single solar panel to AC, and feeds it to the AC power system. The micro inverter tracks the MPP (Maximum Power Point) of the panel, and optimizes power output for that panel, regardless of shade or other factors.

The micro inverter has a metal flange designed to make it easy to mount to the PV array rail, or other structure.

2.2. Planning the Installation

There are a few items to consider before beginning the installation. These include:

- Cabling system options
- Hardware for mounting micro inverters
- Enecsys Gateway and optional Repeaters
- Tools & site requirements

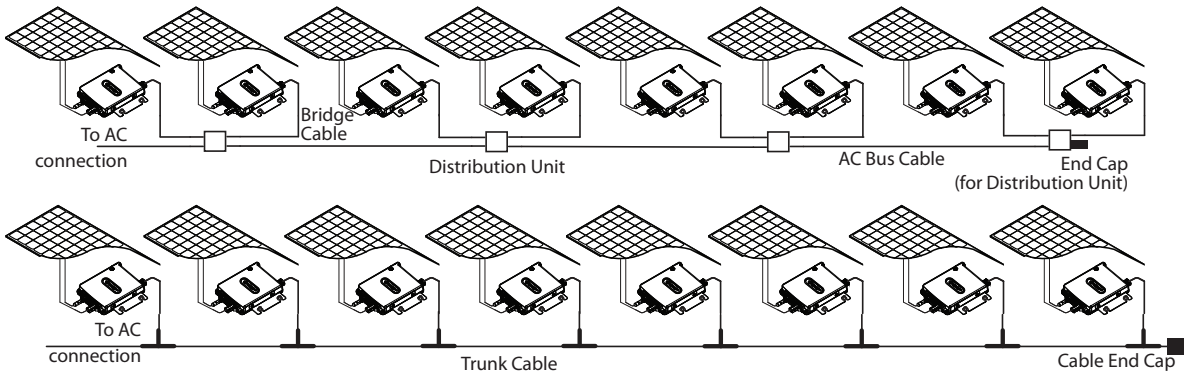
2.2.1. Cabling System Options

Enecsys offers two wiring options. The choice depends primarily on the layout of the panels, and on wiring components already on hand.

The Distribution Unit Cable system uses bridge cables to connect each inverter to a distribution unit. AC Bus cables connect the distribution units together, and to the AC connection point. This system offers the most flexibility for irregular panel arrays.

The Trunk Cable system works well for arrays with a more regular arrangement. It consists of a long cable with branches pre-terminated to connect to the micro inverters. The branches can be spaced at one or two meter (39 or 78 inch) intervals.

Figure 1. Example Wiring Options

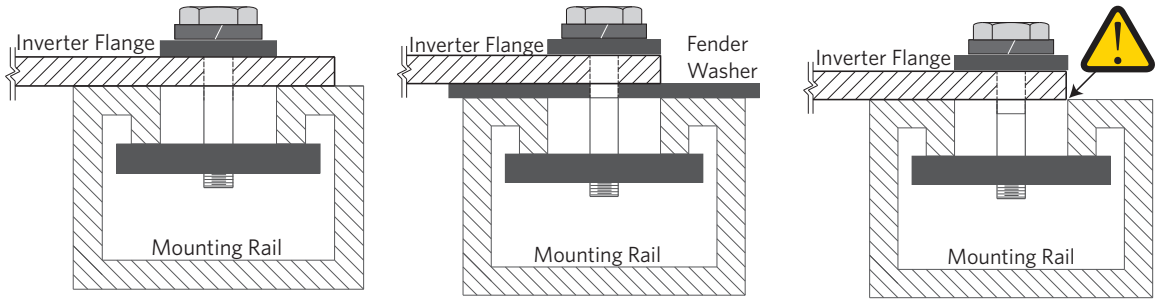


Either cabling type can be used. In addition to the cables, termination caps are needed. Refer to "5.2. AC Bus Cabling Systems and Connectors" on page 18 for more information on planning the cabling requirements.

2.2.2. Hardware for Mounting Micro Inverters

Hardware is needed to mount the micro inverters to the system rails. An M8 bolt and lock-washer is a common choice; other hardware is acceptable. The hardware should be either stainless steel or hot-dip galvanized steel, in order to resist corrosion. Figure 2 shows a typical mount. Note the use of a fender washer where the micro inverter flange does not span the full width of the rail. Clips or other methods of securing the cables should be used.

Figure 2. Correct Hardware for Flange Mount



Micro inverter flange extends across full width of rail.

Micro inverter flange does not span rail; fender washer used for support.

DO NOT DO THIS - the flange will bend or come loose.

2.2.3. Enecsys Gateway and Optional Repeaters

The Enecsys Gateway has two key functions. It displays energy production and status from all of the micro inverters, and it also initializes the micro inverters with the correct performance parameters needed to ensure safe and code-compliant operation. The micro inverters will not operate until they have been initialized by the Enecsys Gateway.

ATTENTION
The micro inverter MUST be configured through the Gateway. Install the Gateway before installing the micro inverters. Short of completing this procedure, the micro inverters will not operate properly.

The Gateway uses a wireless radio standard called ZigBee. In most cases, the micro inverters will be able to establish a direct RF connection with the Gateway. In some cases, such as with a metal roof, or when the Gateway is located a long way away from the micro inverter, one or more repeaters may be needed. Repeaters are described in "Chapter 4 Using Enecsys Repeaters" on page 14.

In most installations, the Gateway is connected to the Internet via the customer's router or Internet gateway. Internet connectivity allows remote monitoring and trouble-shooting of the system. However, an Internet connection is not required for micro inverter operation. An Enecsys Gateway must be used to initialize and configure the micro inverters.

2.2.4. Tools & Site Requirements

Common electrician's tools can be used to install cable end caps and work on connectors. Each bag of connectors includes a tool to dismantle the connector; be sure to have one.

The customer should have a broadband Internet connection with an unused Ethernet port on the router to connect to the Enecsys Gateway, so that the Gateway can communicate with the online monitoring system. This can aid troubleshooting, if required.

If the roof has a metal layer, it may be necessary to install a Double Repeater directly below it, in a loft or attic, for example. If a repeater or double repeater is necessary, there must be a power outlet nearby.

2.3. Overview of Installation Steps

Installation Assumptions

- The overall PV system has been planned to the point where panel locations are known.
- The number of PV panels determines the number of micro inverters needed. The voltage characteristics of the modules chosen will determine which Enecsys Micro Inverter to use.
- Approximate yearly energy yield is calculated when the micro inverters are set up on the Enecsys monitoring system. This figure must be entered as part of the overall monitoring setup.
- Installation plans have taken micro inverter positioning and cabling configuration into account.
- Permits and certifications must be in place before installation.

CAUTION
All work carried out must follow the health and safety instructions for working at height for the country in which the system is installed. (For example, in the UK, there is the Work at Height Regulations 2005. In the US, there are OSHA standards for Fall Protection.)

2.3.1. Installation Sequence Overview

Step 1. Install The Enecsys Gateway

At an early stage during the on-site installation, the installer should connect the Enecsys Gateway to the customer's router. When the Gateway is powered up, it will be ready to configure the Micro Inverters so that they can produce AC power for the grid. The Micro Inverters will not work until they have been configured by the Gateway.

Step 2. Mount The Enecsys Micro Inverters And Cable Harness

The installer must follow the installation design, mount all the micro inverters on the racking/mounting system, prepare the roof penetration conduit and lay the AC branch bus cabling. Note that the micro inverters must not be connected to the panels at this point.

Step 3. Install the AC Cabling

Place the cabling so that it can be connected to the micro inverters, and secure the cables

Step 4. Connect the AC Cabling

First, connect the AC Cabling to the AC connection point, but leave the disconnect open. Then connect the AC Cabling to each micro inverter.

WARNING
Closing of the connection between the AC cable and the utility grid must only be done by a qualified electrician, after the system has been inspected.

Step 5. Install and connect the PV panels

When the PV modules are connected to the micro inverters, the micro inverters will immediately start communicating with the Enecsys Gateway.

Step 6. Test The Communications Between Micro Inverters And Gateway

By looking at the Gateway unit, the installer can see if the Gateway is receiving from all of the micro inverters. If communications cannot be established, install one or more repeaters.

Step 7. Set Up The New Installation On The Enecsys Monitoring Website

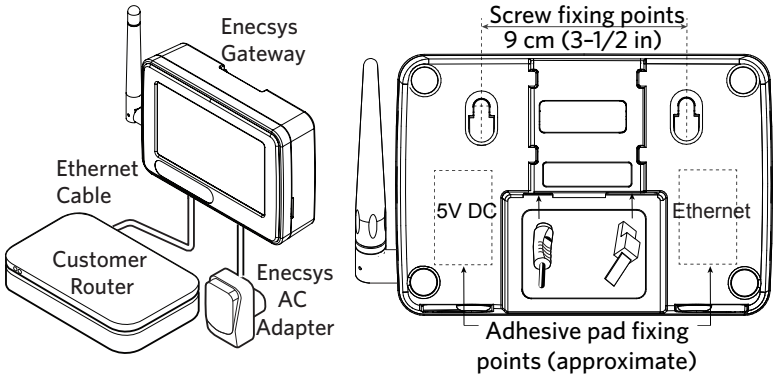
Step 8. Finalize Installation And User Details; Launch The Installation

Chapter 3 Installing & Using the Enecsys Gateway

The Gateway is required; it initializes the micro inverters. If the installation will use the Enecsys Monitoring System, log into the Enecsys Monitoring website with the installer's account and set up the individual installation prior to installing the Gateway.

The installer will need details such as the homeowner's name and email address, street address of site, estimated yearly energy production, and average cost of electricity per kilowatt-hour. First-time Enecsys installers will need to set up an Installer Account.

Figure 3. Enecsys Gateway Setup; Gateway Mounting Points & Connections; Contents



Gateway Kit Contents

1 - Enecsys Gateway

1 - AC power adapter - 5V DC, 1A

1 - Ethernet cable: length 2m

Assorted attachment hardware

Supply AC power and an Ethernet connection. Use a longer Ethernet cable if necessary.

Step 1. Place the Gateway

- The gateway must be installed indoors near an AC power outlet.
- The gateway must be connected to the customer's router via wired Ethernet.
- It can be freestanding: rotate out the plastic feet for stability.
- It can be wall mounted using two screws in the position shown in the diagram.
- It can be mounted using adhesive pads in the position shown in Figure 3. (Adhesive pads are not supplied.)

You may wish to defer final mounting of the Gateway until all micro inverters are installed and RF connectivity is established. Sometimes small changes in the position of the Gateway can enhance RF reception.

Step 2. Connect Ethernet

Connect the Gateway to the customer's router, if available. Gateway connectors are on the backside of the unit. Confirm that the customer's router is connected to the Internet.

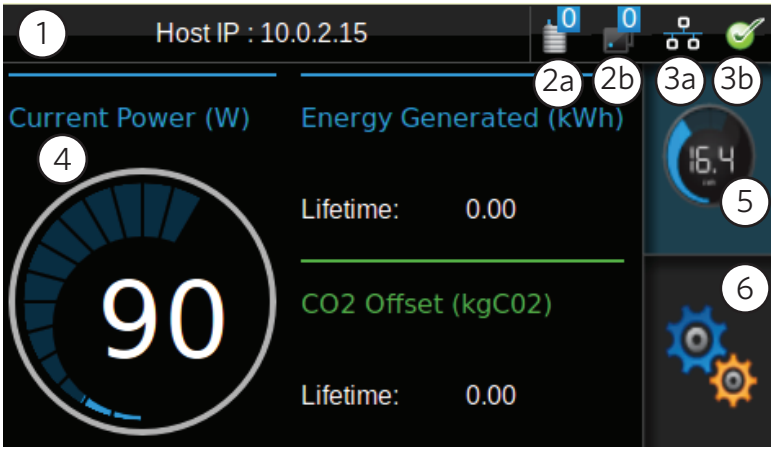
Step 3. Connect Power

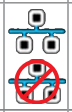
Plug the Gateway power adapter into AC power and into the Gateway. The Gateway will initialize itself and then connect to the Internet. When it does so, it will contact the Enecsys energy monitoring web site, and it will automatically set its time and date. This can take a few minutes. When it is done, it will display the Gateway home screen.

If Internet Access Is Not Available

It is not strictly necessary to have internet access in order to set up and operate the panels and micro inverters. The Gateway is required, and must have its date and time manually configured. Otherwise, Gateway setup and inverter installation is as described herein.

Figure 4. Gateway Home Screen



Callout		Name	Description
1		Status Bar	Displays host IP address. If it is blank, no IP address has been assigned.
2a		Number of micro inverters communicating	If these numbers are less than expected, there is a communication problem between the gateway and micro inverters or repeaters. It may be necessary to install one or more repeaters.
2b		Number of repeaters communicating	
3a		Network Status	Indicates whether the Gateway has been able to contact the Enecsys monitoring web server over the Internet. A red X through this icon indicates that there is no connection to the Enecsys monitoring server.
3b		System Status	Indicates that the Gateway has booted up correctly.*
4		Energy at-a-glance	Compares the day's energy production to lifetime data
5		Energy Production	Returns to the home page when touched.
6		System Configuration	Brings up the Settings screen when touched. View micro inverter, gateway, repeater, and server settings. Lets installers access setup commands.

3.1. Gateway Operation

When the array is installed and the panels are connected to the micro inverters, the Gateway should automatically detect and configure them. The micro inverters power themselves from the panels, not the AC mains. You cannot perform the initial configuration at night.

After installation, step through the Installation Wizard to ensure that the system is correctly configured. Once confirmed, no further intervention is necessary. The micro inverters will continue to operate even if the Gateway is offline.

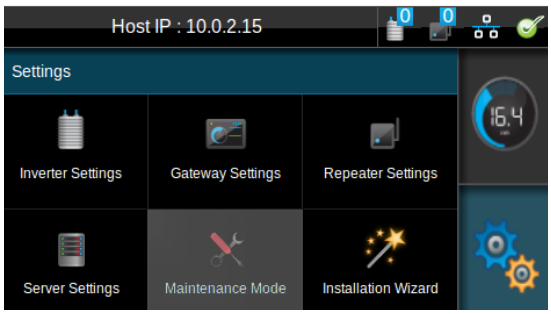
During routine operation, the Gateway shows the information required by the user to ensure that the micro inverters are operating and reporting to the monitoring system. Installer functions include micro inverter setup and system diagnostics, and are password-protected.

* This feature is not currently implemented.

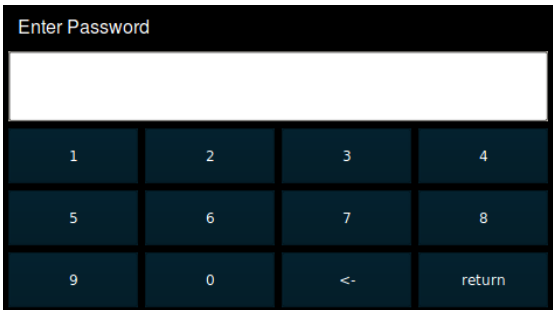
3.2. Enecsys Gateway Installation Wizard

Touch the System Configuration icon in the lower right corner of the home screen to begin.

Step 1. Select Installation Wizard, then Enter the Password



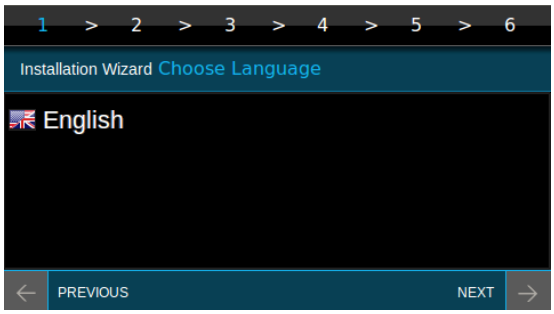
Settings Overview screen



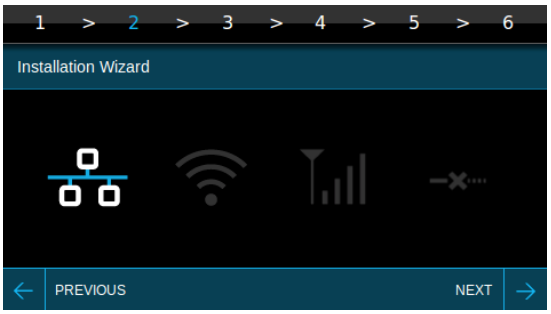
Password screen

Step 2. Choose Language; Then Choose Connection Type

Note that Languages and Connection Type choices may vary from what's shown below.



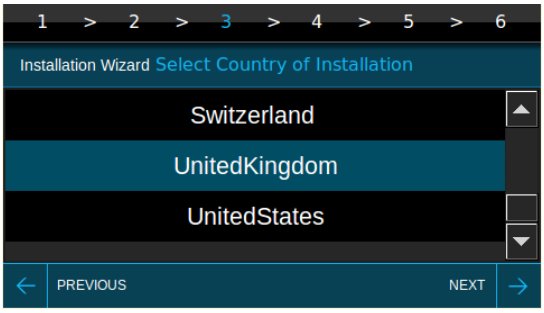
Language Choice screen



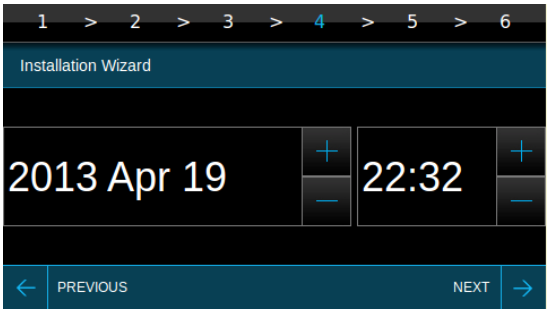
Connection Choice screen

Step 3. Select Country of Installation; Set Date and Time if not Pre-set

If the Gateway has an Internet connection, it will automatically set its date and time, in which case, DO NOT change it. If it is not connected to the Internet, set the time and date manually. Use the '+' and '-' icons to make changes.



Country Selection screen

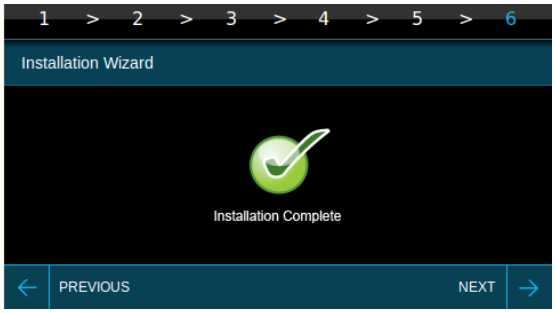


Date and Time screen

Step 4. Check That Inverters Are Reporting; Then Acknowledge Installation Complete

The inverters must be installed and connected to panels. If you have not done so, do it now.

Micro Inverter Serial Number Listing screen

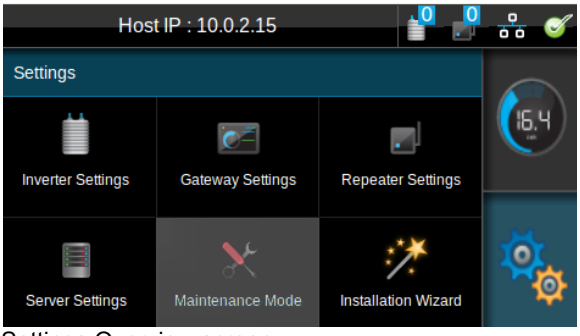


Installation complete

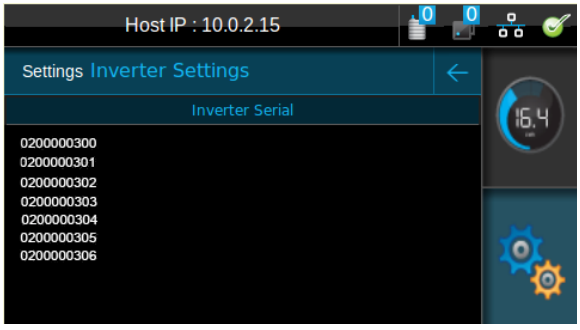
3.2.1. Gateway Installer Settings View

The Settings screen is viewable by all users, but Server Settings, Maintenance Mode, and Installation Wizard can only be accessed with an Installer password. The ability to change micro inverter, gateway, repeater, and server settings; to access Maintenance Mode, and to re-configure the installation is restricted to users who are trained in these functions by Enecsys.

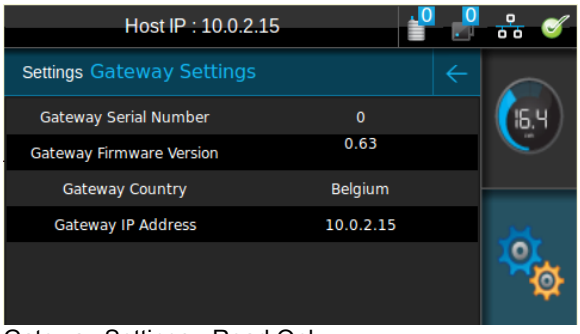
Figure 5. Gateway Installer Settings Screens



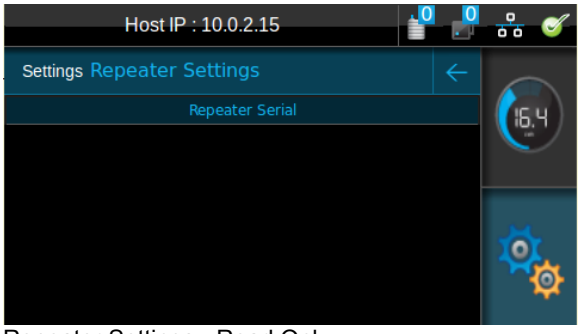
Settings Overview screen



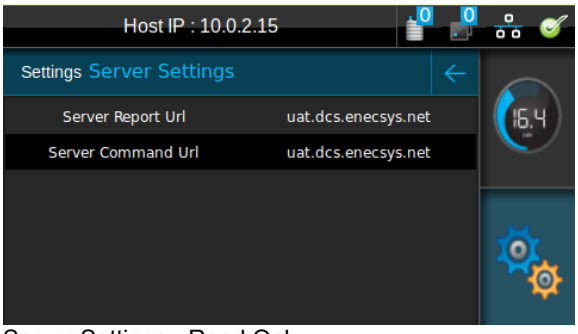
Micro Inverter Settings - Read Only



Gateway Settings - Read Only



Repeater Settings - Read Only



Server Settings - Read Only

After the installation is complete, the gateway should be returned to the default view and left that way during customary operation.

ATTENTION
Attempting to run the installation requires a password. This is to prevent inadvertent change of settings, data loss, and disruption of the correct operation of the system.

Chapter 4 Using Enecsys Repeaters

The Enecsys gateway receives signals from the micro inverters on the roof and broadcasts the data over the Internet to the Enecsys Monitoring server. The micro inverters and the gateway use the ZigBee radio standard, wherein all of the micro inverters can link to each other as well as to the gateway. This helps to ensure reliable communications; if even one micro inverter has a clear signal to the gateway, all micro inverters can share it.

In most cases, this is sufficient. However, in some cases the gateway may be too far from the micro inverters, or materials such as a steel roof or concrete walls can block the signal. In such cases, a repeater is used to ensure reliable communication.

- If the problem is one of range, a single repeater placed roughly halfway in between the micro inverters and the gateway will usually solve the problem. For extremely long ranges, use two repeaters.
- If the problem is due to a metal roof, metal-foil-backed insulation, or concrete, a double repeater unit can be used. It has two antennas; one antenna should be placed outside of the barrier material (e.g. the steel roof) and the other inside,

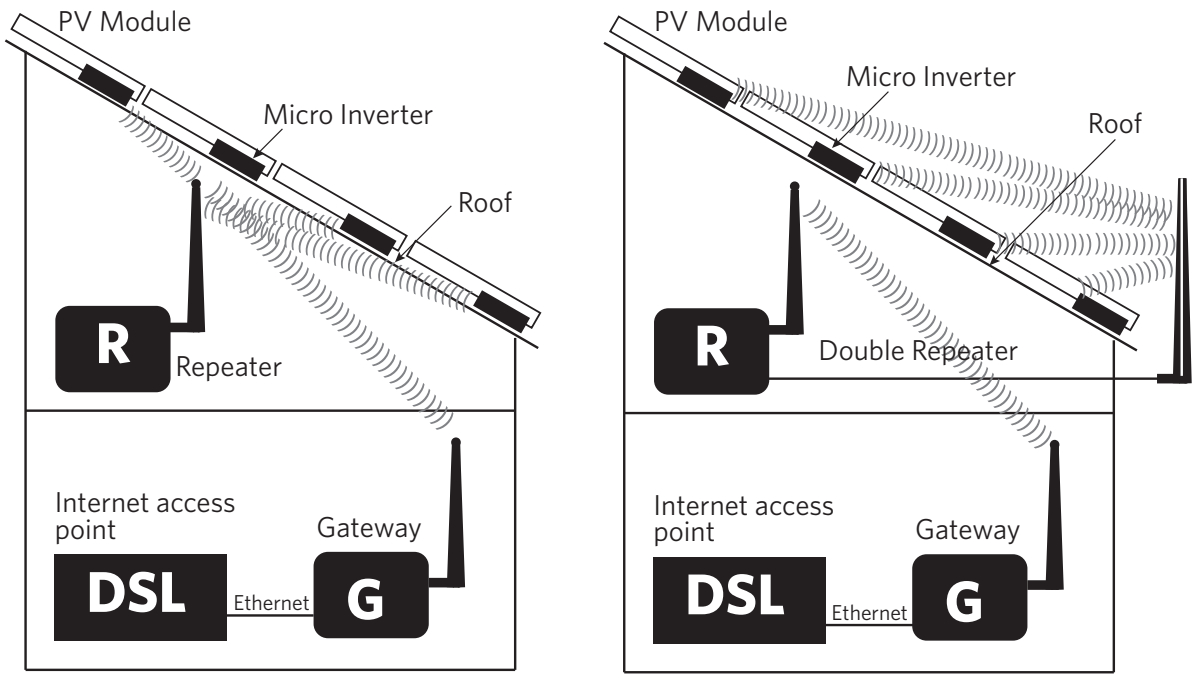
Determining If the Communication Link is Reliable

- If the Enecsys gateway displays the check symbol "✓" on the Installer Mode screen, communications link between the gateway and the micro inverters is established and is reliable.
- If the gateway displays either the "?" or "X" symbol, the communications link may not be strong enough to be reliable.

If the "X" symbol is displayed on the gateway, one or more single repeaters can be used. Start with one and look for the "X" to change to a "✓".

If the "?" symbol is displayed, signal quality is poor. Distance between the micro inverters and gateway may be the problem: installing a second single repeater may help.

Figure 6. Repeaters, Gateway, and Router



4.1. Installing Repeaters

Enecsys offers two repeaters, a single-antenna model and a dual-antenna model, called a double repeater. Both are in similar plastic housings and use the same power supply, which is included. Both are intended for indoor use only. Either repeater may be mounted in any orientation. In general, the antennas will work best when oriented vertically, but if there are signal strength problems, try other orientations.

The single and double repeaters include an indoor antenna. An optional outdoor antenna and 15m or 30m coaxial cable is available for use with the double repeater. The single and double repeater kits, less mounting hardware, are shown in Figure 7.

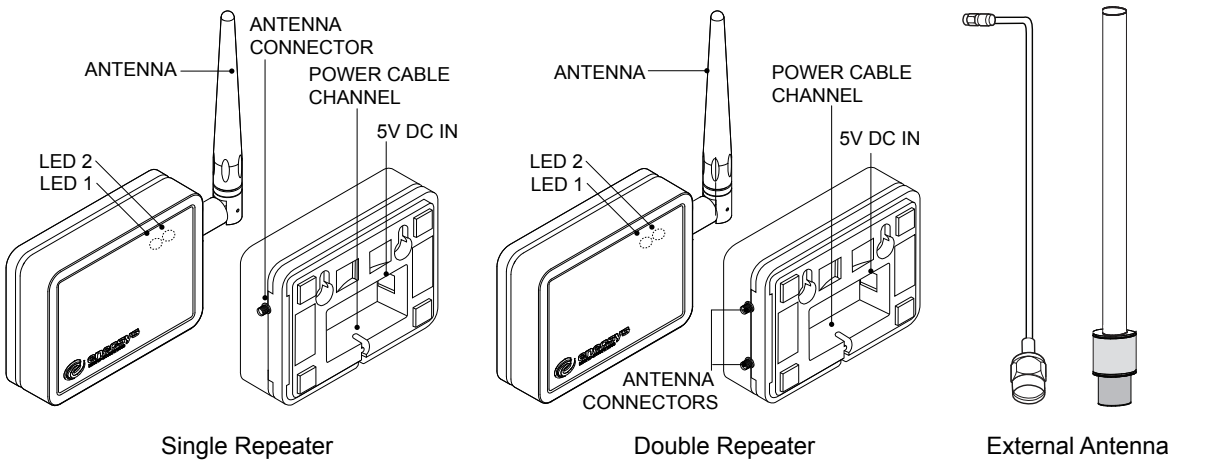
Ideally, a repeater should be installed in the attic space, near the micro inverters. It should be installed near an AC power outlet. If a second repeater is needed, locate it on one of the intermediate floors between the repeater in the roof space and the Enecsys gateway.

The repeaters have two LEDs, as shown in Figure 7. When powered up, LED 2 blinks rapidly for about one-half second, then LED 1 blinks rapidly for about one-half second, then both turn off.

When the repeater is attempting to connect with the gateway, LED 1 blinks irregularly. When the connection is made, LED 2 blinks rapidly for about one-half second.

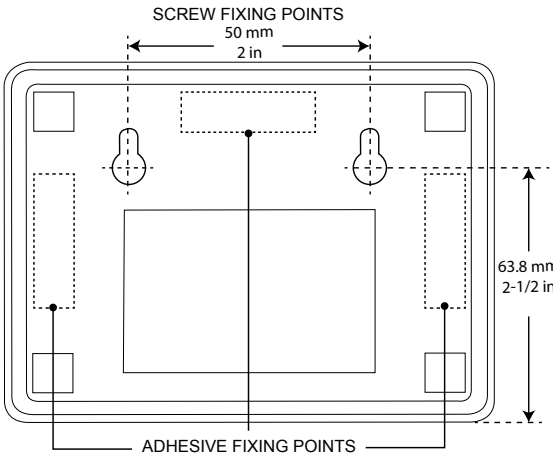
Irregular LED 1 blinking will continue during normal operation.

Figure 7. Single and Double Repeater Kits; External Antenna Kit



4.1.1. Mounting the Repeater

The repeater can be mounted using two screws spaced 50mm (2 in) apart, or via adhesive pads. Select a location close to AC power. Small changes in repeater position affect reception; try moving the repeater around before finalizing its location.



The double repeater's external antenna should be mounted on the roof above any metal roof layers. Connect it to the repeater inside the building via coaxial cable. Make sure it is close enough to the antenna for the supplied cable to connect them. This cable should not be lengthened or shortened. Loosely coil excess cable, without kinks.

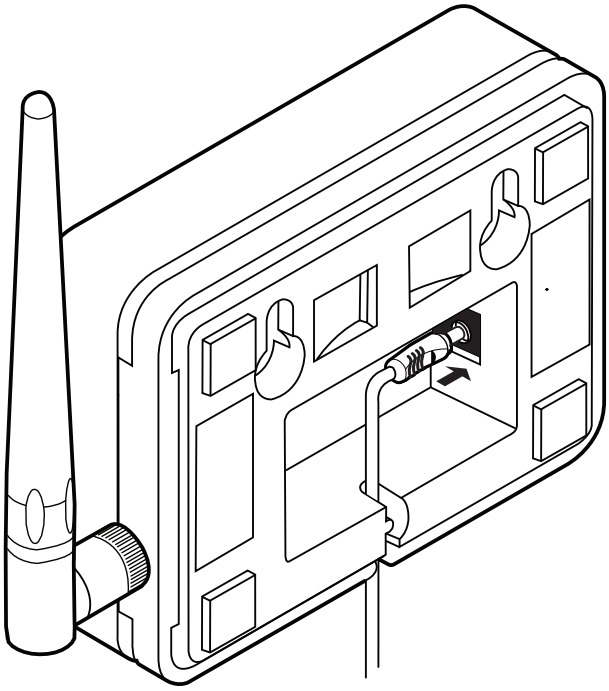
ATTENTION
Leave a drip loop (low point) on the external antenna cable so that water does not run down the cable and enter the building. After the system has been tested and is working, waterproof the external antenna connection.

4.1.2. Connecting The Repeater

The repeater requires 5V DC power input from the plug-top power supply.

- Pass the DC power cable through the slot in the lower side of the case as shown in Figure 8.
- When the DC power adapter receives power from the mains, the repeater will start working immediately.
- Observe the communication connection quality on the Enecsys gateway Installer Mode screen – it should now display the green check symbol.

Figure 8. 5V DC Connection for Repeater



Chapter 5 Installing the Micro Inverters

5.1. The Enecsys Micro Inverter System

The Enecsys Micro Inverter System consists of:

- The micro inverter itself
- An AC cabling system
- The gateway-monitor
- Optional wireless repeaters

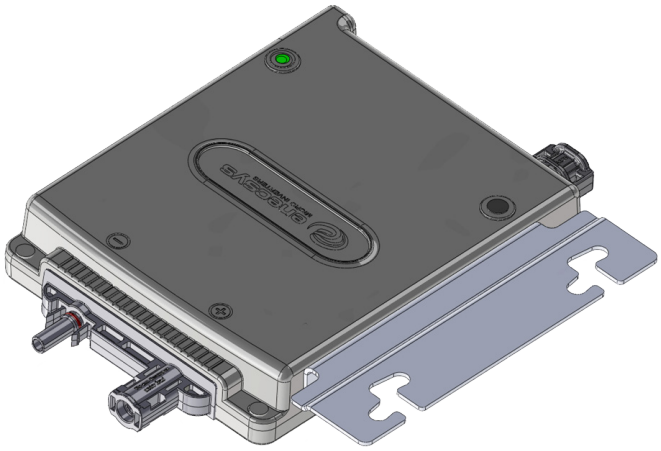
The micro inverters communicate wirelessly with the gateway. Wireless repeaters can be used if the gateway is too far from the micro inverters for good reception.

Micro inverters are available in the following models with various power ratings and DC input MPP tracking voltage ranges:

Model	Maximum AC Output Power*	MPPT Range (DC Volts)*
220-60-MP	220W	24V - 35V
240-60-MP	240W	24V - 35V
260-60-MP	260W	24V - 35V
280-60-MP	280W	24V - 35V
300-60-MP	300W	24V - 35V

*Consult Enecsys datasheets for the most current information. All technical specification information is subject to change without prior notice.

The Micro Inverter



- Each micro inverter connects to one photovoltaic module.
- Use the "Chapter 9 PV Module/Micro Inverter Serial Number Form" on page 40 to keep track of the micro inverter serial numbers as they are installed in place. The stickers on the micro inverter should be removed and stuck to the sheet to refer to later. The sheet will be used during the installation finalization step: see "Chapter 6 Monitoring Setup and Installation Launch" on page 27 for details.

Each micro inverter includes a serial number sticker, on the micro inverter body.

ATTENTION

The serial number stickers are used to correlate the position of the micro inverter and its module to its location in the installation. Without installation location information, the physical location of the micro inverters and modules will not be known, and this knowledge is needed for the installation setup. A form for the stickers is provided: see "Chapter 9 PV Module/Micro Inverter Serial Number Form" on page 40.

5.2. AC Bus Cabling Systems and Connectors

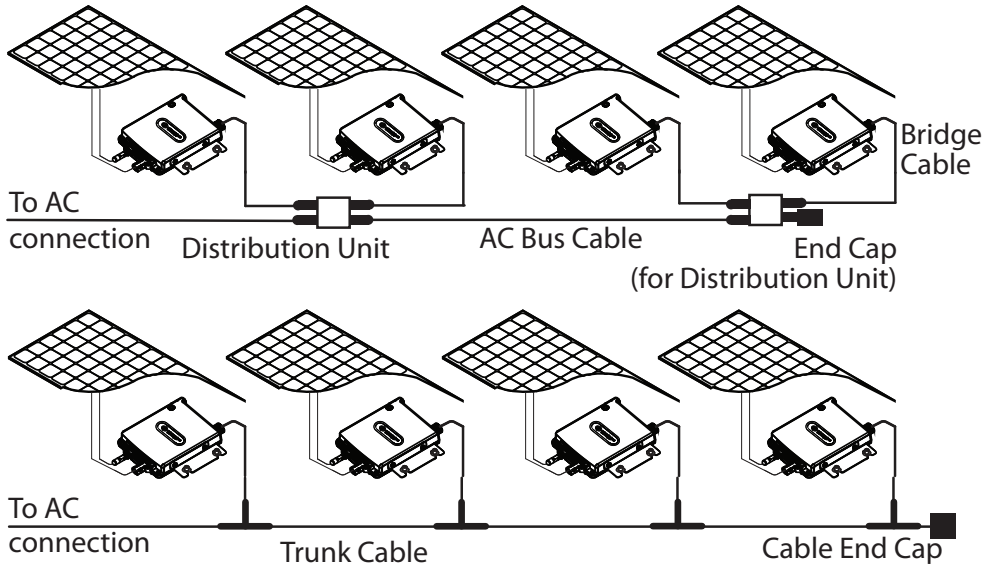
Two types of cabling systems are available:

- **Distribution Unit Cable System**, using bridge cables, AC bus cables, and distribution units.
- **Trunk Cable System**, using "T" cabling that has connections already configured.

The two systems are shown in Figure 9. Both systems perform equally well; the choice of which to use depends primarily on the arrangement of the solar panels.

- The Trunk Cable system is probably the best choice if the solar panels are all in a row.
- If the layout is more irregular, the Distribution Unit Cable system offers more flexibility in cabling.

Figure 9. Bridge Cable and Trunk Cable Systems



The AC connector on the micro inverter is a 5-position, 3-conductor connector. This connector is unique; it is only used between the micro inverter and the cabling system. Connections within the cabling system use a different, 3-position connector.

Table 1. Micro Inverter AC Connector Pin Out

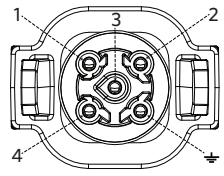
		United States		Europe & Australia	
	Pin 1	L1	black	L	brown
	Pin 2	L2	red	N	blue
	Pin 3	N/A	N/A	N/A	N/A
	Pin 4	N/A	N/A	N/A	N/A
	equipment ground		green	equipment ground	green/yellow

Table 2. AC Bus Cable Pins

Location	Pin 1	Pin 2	Pin 3
North America	L1	L2	Equipment Ground
Europe and Australia	L	N	Equipment Ground

5.2.1. Cable System Components

Table 3. Distribution Unit Cable System Components

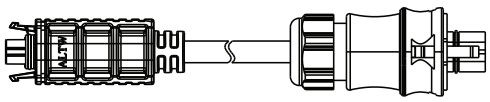
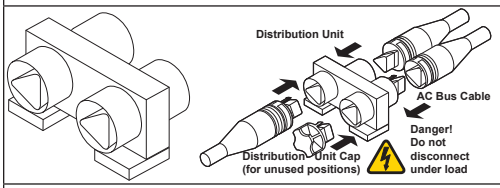
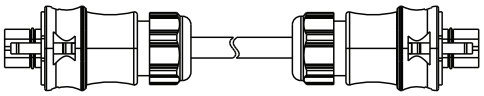
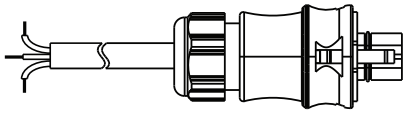
Item	Description
	Bridge Cable - used to connect each micro inverter to the AC Bus Cable, via the Distribution Unit. If the Distribution Unit Cabling system is being used, one Bridge Cable for each micro inverter is needed. The cable is about 0.8m (31 in) long.
	Distribution Unit - used to connect Bridge Cables and AC Bus Cables. Three of the positions are identical; the fourth one is of the opposite gender. Typical installations connect two micro inverters and two AC Bus Cables, but other combinations may be used as needed to meet the topology of the panel array.
	End Cap - must be used to seal all unused positions on Distribution Units.
	AC Bus Cable - these connect Distribution Units together.
	Grid Connection Cable - used with Distribution Units to connect the cabling system to the AC connection point (i.e. mains breaker). Connect the bare end of this cable to the AC connection point first, and only to the Distribution Unit after ALL other AC wiring is complete.

Table 4. Trunk Cable System Components

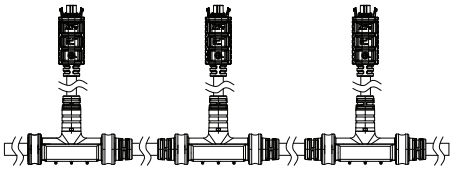
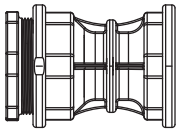
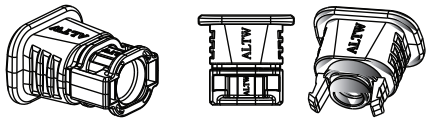
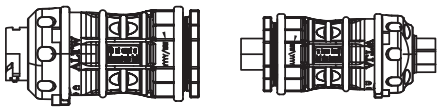
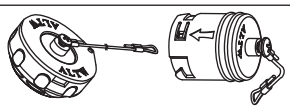
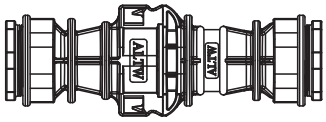
Item	Description
	Trunk Cable - used to connect a series of micro inverters, more-or-less in a row. There are two versions; one has one-meter (40 in) spacing of the individual drops, the other has two-meter (80 in) spacing.
	Cable End Cap - must be used on the far end of each Trunk Cable.

Table 5. Trunk Cable System Accessories

Item	Description
	Weatherproof Cap, Female; and Weatherproof Cap, Male. The female cap should be used on any open connector on the end of the drop branch of a Trunk Cable, or the micro inverter end of a Bridge Cable, if no micro inverter is connected. The male cap is not usually needed, but can be used to cover the AC connector on an unused micro inverter.
	Field-Installable Connectors, Male and Female - used to connect cables. Unlike a Cable Joiner, use of these connectors allows the cables to be disconnected.
	Male and Female Caps for the Field-Installable Connectors. Use these on unconnected Field-Installable Connectors to protect the contacts.
	Cable Joiner - splices two cables together, but is not disconnectable.

There are a few special tools and techniques used with the connectors.

Table 6. Special Tools and Techniques

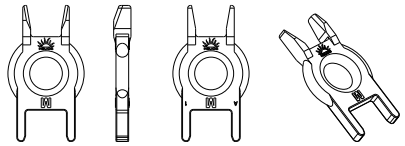
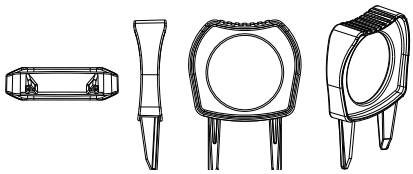
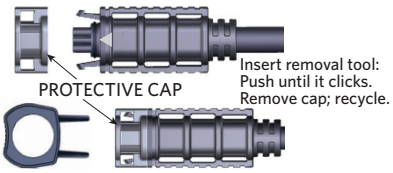
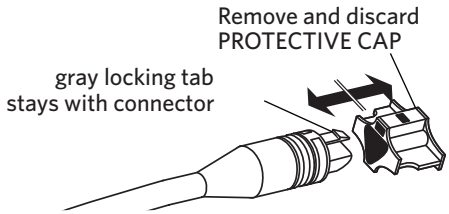
Item	Description	Application
	DC Connector Disconnect Tool	Disconnects micro inverter DC connection from module.
	Micro Inverter AC Connector Disconnect Tool	
No Tool Required	AC Bus Cable Protective Cap Removal	

Figure 10. Trunk Cable End Cap Installation Instructions

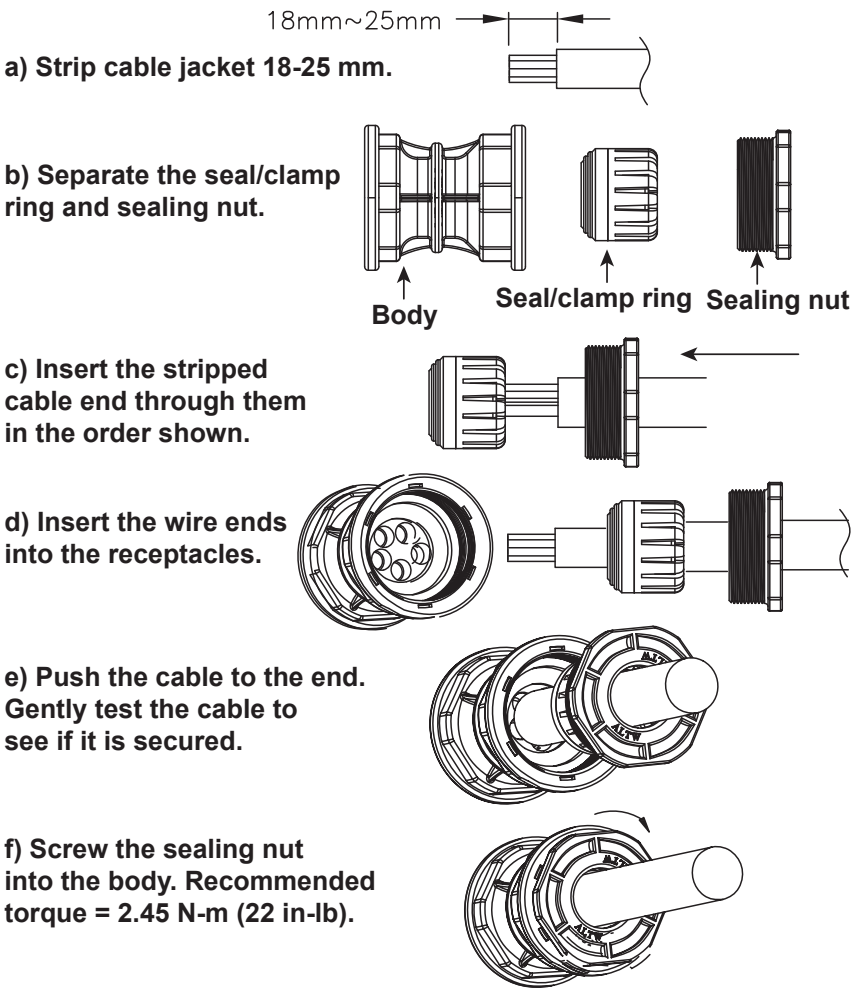
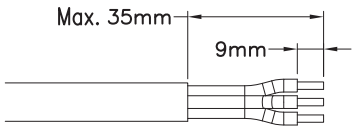
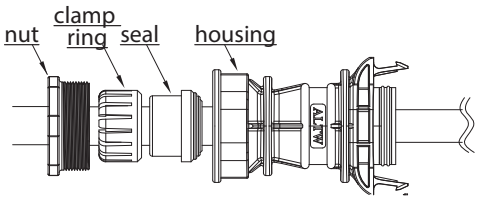


Figure 11. Cable Joiner Installation Instructions

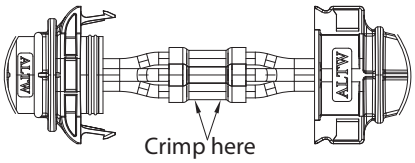
a) Strip cable jacket & wire as shown.



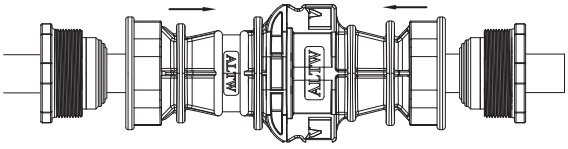
b) Insert cable through nut, clamp ring, seal, and housing.



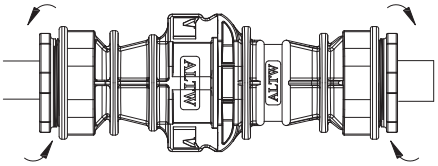
c) Crimp the terminals. Use a certified crimp tool if possible.



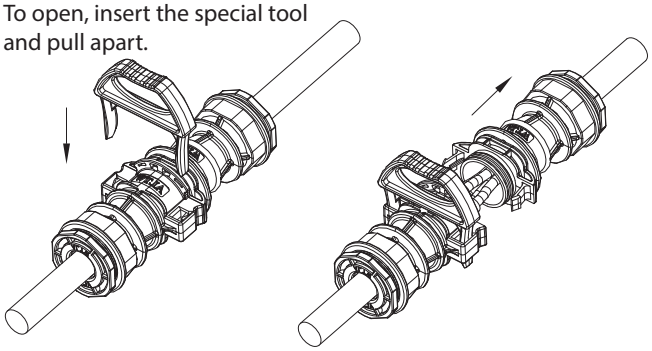
d) Assemble both housings by locking them together.



e) Tighten the nuts of both sides. Torque to 2.45 N-m (22 in-lb).



To open, insert the special tool and pull apart.



Regardless of the type of cabling used, please heed the following:

WARNING
Whenever the PV module is exposed to light, it supplies a DC voltage. Follow all safety instructions and warnings provided by the module manufacturer's documentation.

WARNING
There must not be any exposed AC connection points. These AC points will be live when the system is connected to the utility grid. Always use the end caps provided to seal the open connection points on the distribution units.

WARNING
Depending on the model used, the maximum number of micro inverters in any AC branch must not exceed the maximum number allowed by regulations in the local jurisdiction.

WARNING
All electrical connectors must be dry before making any connections and must be kept dry during the installation process. Micro inverter AC cables are supplied with protective end caps that should only be removed immediately before making the connections.

WARNING
A "protective cap" is not a permanent end cap: It is only for protecting the connectors during shipping. It should stay on the micro inverter connector to keep it dry during the installation process. Discard the protective caps only while making the micro inverter connections. Do not attempt to re-use protective caps.

CAUTION
PV systems using Enecsys Micro inverters must have an external transient voltage surge arrestor. The external device must be installed at the Point of Common Connection of the PV system and must meet IEC 61643-1 class II requirements. Failure to install this device will void the warranty

ATTENTION
Do not allow the cable to lie in contact with the roof surface. If necessary, route the cable neatly along the racking using cable clips.

ATTENTION
For the micro inverters to be installed correctly, the AC bus cable connections must be fully engaged. If they are connected properly, an audible "click" can be heard. To avoid damaging the micro inverter or cables, do not force together the AC drop cable and micro inverter AC connectors. The connectors are keyed to prevent misalignment.

ATTENTION
Observe the micro inverter AC Out connector. There is a gray triangular orientation mark that must align with the same marking on the cable connector.

ATTENTION
Disconnecting a drop cable connection from the micro inverter AC connector requires the micro inverter AC disconnect tool. It is the same tool that is used to remove the protective caps from the drop cable connectors.

5.3. Mounting The Micro Inverter

The micro inverter mounts via a metal plate. The plate has two cut-outs and is intended to be bolted to a rail. Choose the best location for mounting the micro inverter.

- An M8 bolt is recommended, but not included. Installers must provide mounting hardware.
- **The body of the micro inverter must not be in contact with either the roof surface or the PV module.**
- There must be at least 10mm clearance between the body of the micro inverter, the roof surface and the rear of the PV module. **Ensure that the bolts used are well clear of the module back-sheet, even under the module's anticipated snow load conditions.**

Figure 12. Enecsys Micro Inverter

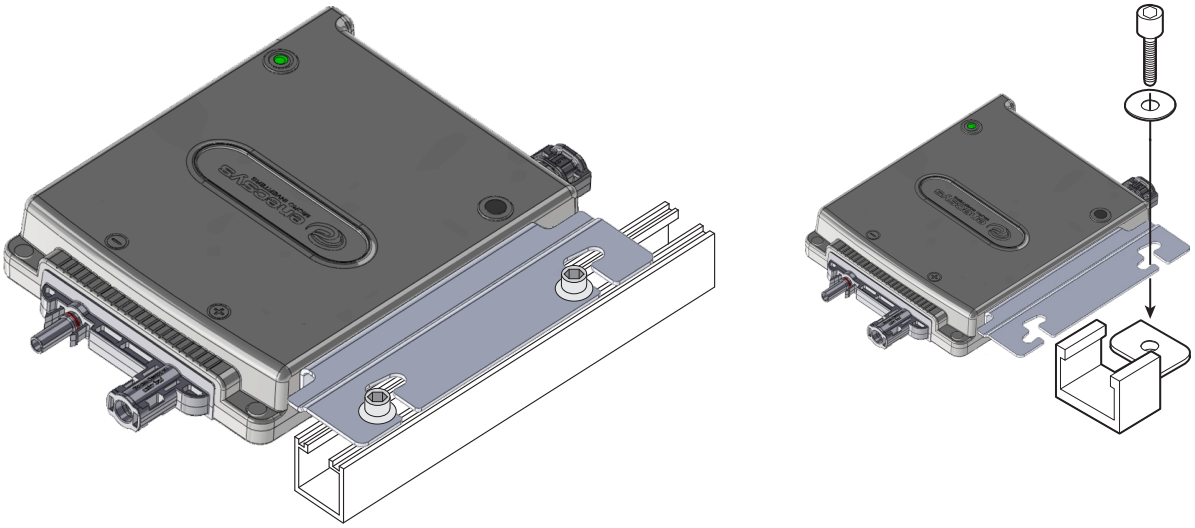


Figure 13 shows a typical mount. Note the use of a fender washer for installations where the micro inverter flange does not span the full width of the mounting rail.

Figure 13. Correct Hardware for Flange Mount

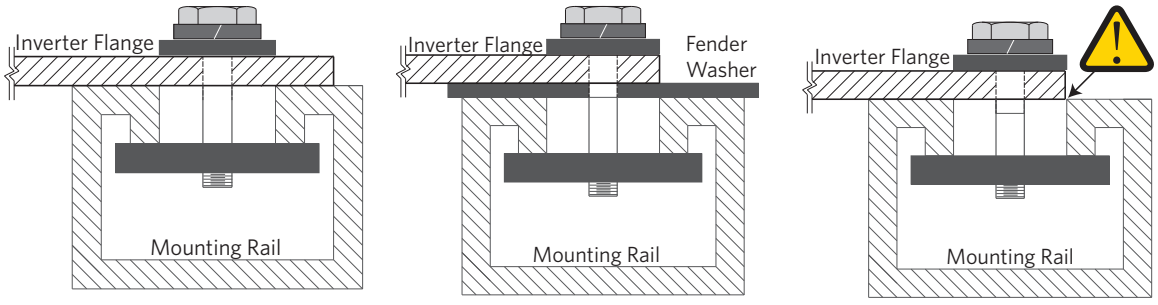
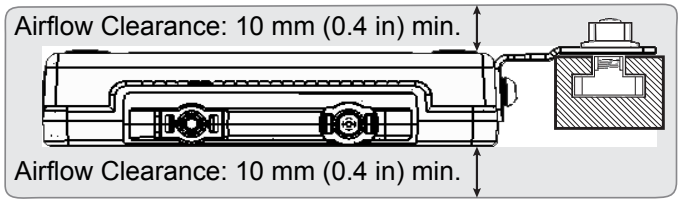


Figure 14. Minimum micro inverter body clearance



5.3.1. Connecting Micro Inverters Using the Trunk Cabling System

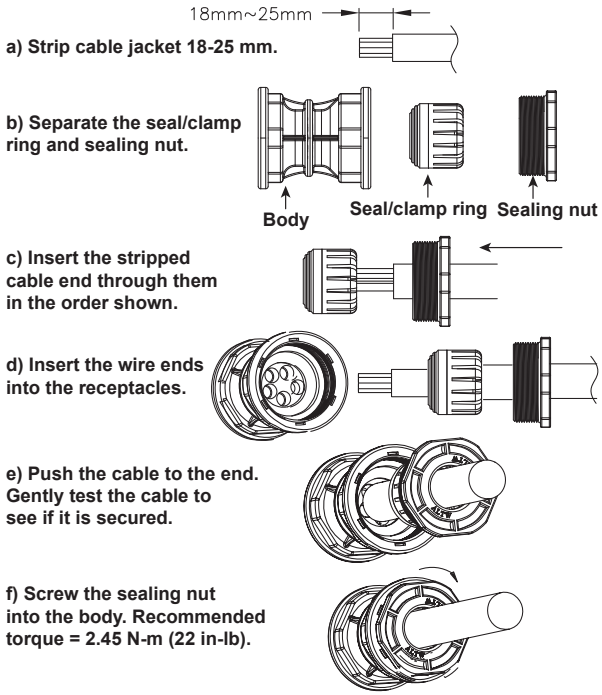
- The Trunk Cable consists of a continuous length of cable with micro inverter trunk drops spaced at one or two meter intervals.
- Trunk Cables must be cut to the appropriate length for a branch circuit and terminated with a Cable End Cap.
- Each trunk drop connects to one micro inverter. Unused trunk drops must be covered by permanent weatherproof female caps.
- Field-installable male and female connectors are available to add more cabling options.

Step 1. Lay Out the Trunk Cable.

Unroll and position the Trunk Cable in the approximate location of the micro inverters.

Step 2. Cut the Trunk Cable at the far end.

Step 3. Install a Cable End Cap on the far end.



Step 4. Terminate the Trunk Cable at the AC connection point.

Step 5. Secure the Trunk Cable to the rack.

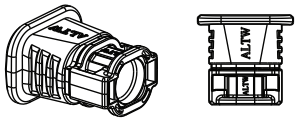
Step 6. Connect a Trunk Drop to each micro inverter.

At each micro inverter, remove the protective cap from the cable.

Connect the cable to the micro inverter. It should slide into place without excessive force, and it should click when fully connected.

Step 7. Terminate any exposed AC connection points.

Unused micro inverter trunk drops (if any) must be covered with a Female Weatherproof Cap.

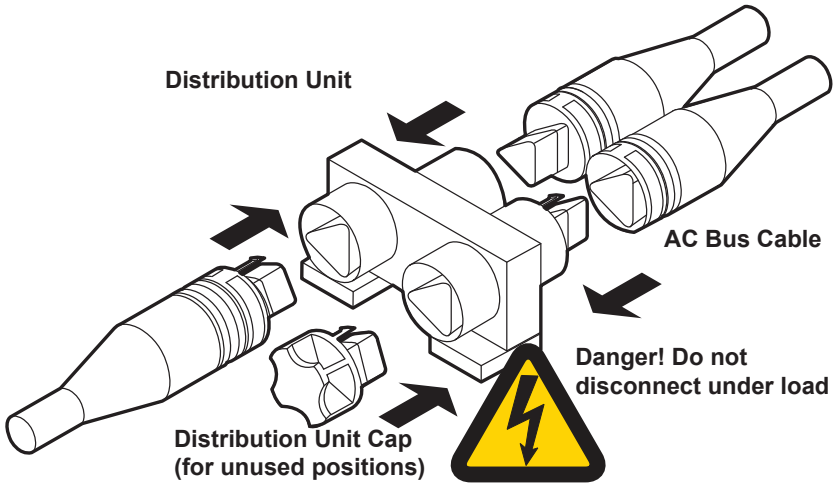


5.3.2. Connecting Micro Inverters Using Bridge Cabling

Step 1. Connect The AC Bridge Cables To The Distribution Units.

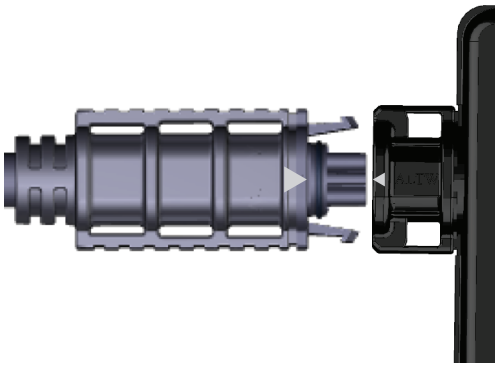
Do not remove the protective caps from the Bridge Cables until the cables are ready to be connected to the panels and the micro inverter. Note that the gray locking tabs stay within the micro inverter connector. Do not discard them.

A maximum of three micro inverters can be connected to any one distribution unit. Use end caps to seal any open AC connection points.



Step 2. Connect the AC Bridge Cables to the micro inverters.

Remove the protective cap (see "Table 6. Special Tools and Techniques" on page 20) and plug the cable into the micro inverter. Be sure to align the two marks on the cable and on the micro inverter.



Step 3. Connect AC Bus Cables between distribution units.

Repeat until the desired number of branches are assembled. Do not connect the DC Link cables yet.

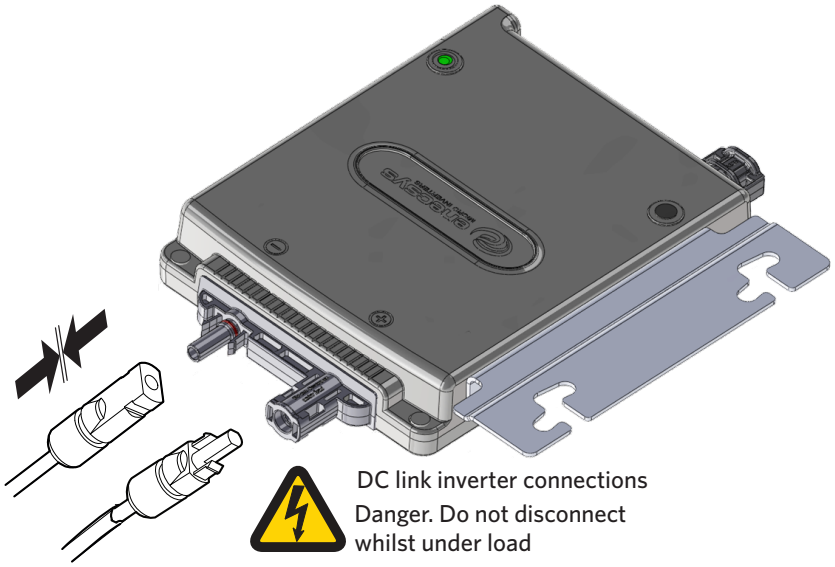
Step 4. Connect an AC Grid Cable to the AC termination point

E.g. circuit breaker or junction box.

Step 5. Connect the AC Grid Cable to the closest Distribution Unit.

5.3.3. Making DC Connections

As the final assembly step, connect the DC leads from each PV module to its micro inverter.



DC link inverter connections
Danger. Do not disconnect whilst under load

5.4. Cable Disconnection Instructions

Should there be a need to disconnect cables for any reason, follow these steps.

- Isolate the AC side of the micro inverter bus cabling from the mains grid using the isolation switch or circuit breaker, as applicable in the country of installation.
- Disconnect the micro inverter's AC branching cable from the distribution unit and use an end cap to seal the open connection point on the distribution unit.
- Disconnect the DC link cables between the micro inverter and the PV module's junction box.

Chapter 6 Monitoring Setup and Installation Launch

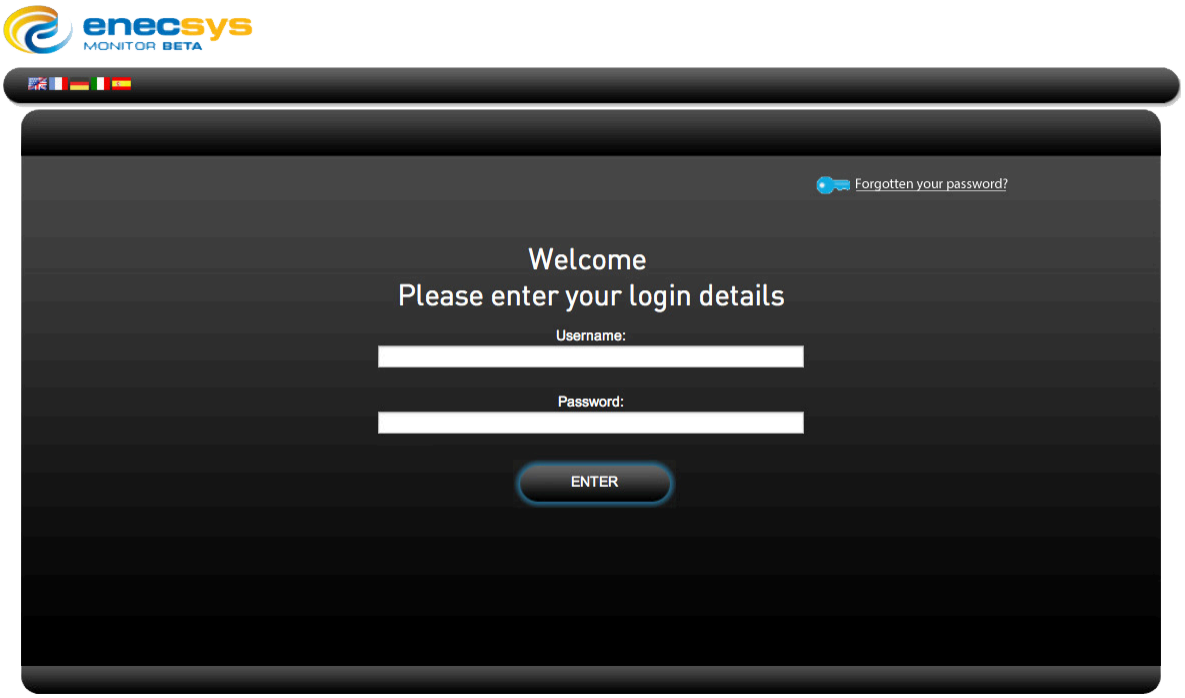
6.1. Logging Into the Enecsys Monitoring System for Installers

New installers will need to obtain an installer account credential from Enecsys. Please contact http://www.enecsys.com/contact/technical-support/

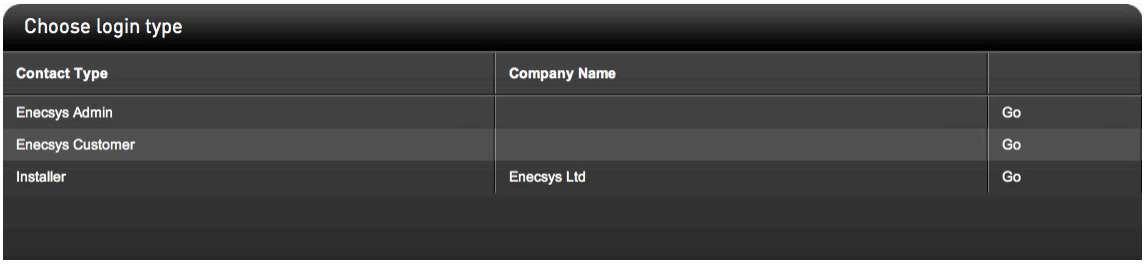
Step 1. Go to the http://monitor.enecsys.net monitoring website.

Use a standard PC and browser.

Step 2. Click on the Installer line to log in as an installer.



Step 3. Choose "Installer" login type



6.2. Navigating the Web Site

After logging in, the default view shows the live installations registered under the account name used to log in. New users will not see any listing here initially. As more sites are added, this list will grow. Note in this example there are four pages of live installation listings (see page count at the bottom of the screen).

Installation Name	System Size (kWp)	Current Power (kW)	Lifetime Energy (kWh)	Go Live Date	Number of Inverters	System Status	Location	Weather
Stephanie'...	5.68	0.00	4988.10	17 Dec 2009	23		Cambridge, United Kingdom	50°F/ 10°C Cloudy
City House...	4.0	0.00	5434.50	21 Apr 2010	20		Rhein-Main..., Germany	59°F/ 15°C Mostly cloudy
Test Canad...	5.68	0.00	0.00	01 Aug 2012	23		Canada Cit..., USA	64°F/ 18°C Fair
Sandia Nat...	6.88	0.00	0.00	07 May 2013	7		Albuquerqu..., USA	70°F/ 21°C Partly cloudy
Lutje Bere...	4.32	0.00	2797.30	28 Apr 2011	12		TD Zeist, France	48°F/ 9°C Clear
Xandex 001...	0.8	0.00	153.90	04 May 2011	4		Petaluma, USA	59°F/ 15°C Partly cloudy
1 Plam st	0.44	0.00	0.00	29 Jun 2011	2		Toronto, Canada	72°F/ 22°C Mostly cloudy

Languages

Select among the available languages by clicking on the appropriate flag, at top left.

6.2.1. Live Installations

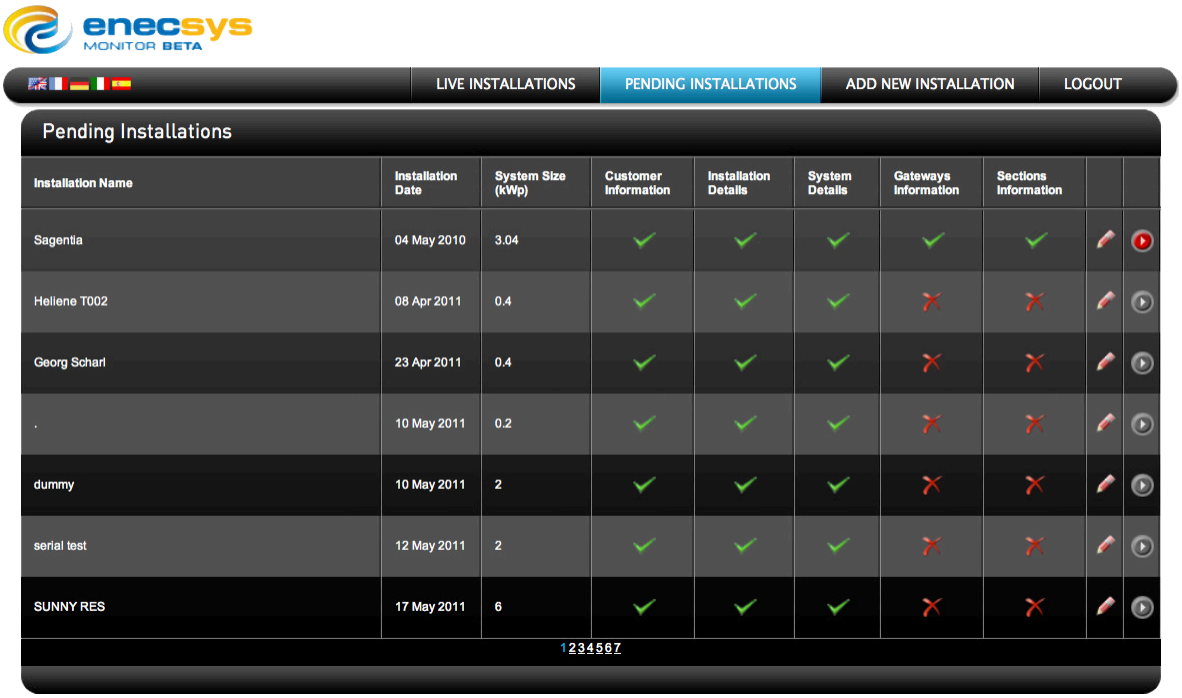
Live Installations

This tab shows all of the installations that have been completed to 'live' status.

	Indicates that all data has been entered and that the system has been moved to the 'live' category. It does not mean that the system is currently on line. To determine if a system is on line, click on the Monitor icon.
	Indicates that the monitoring web site has not been able to communicate with the Gateway. This cannot be diagnosed from the web site; it must be diagnosed at the Gateway location.
	Sends an email to the customer containing their login information.
	The Monitor icon shows current and historical energy production data for the installation.
	Reverts the installation to Pending. This must be done in order to edit any installation information.

6.2.2. Pending Installations

The Pending Installations screen shows all in-progress installations. New users will not see any listing here initially. As more sites are added, this list will grow. Note in this example there are seven pages of pending installation listings (see page count at the bottom of the screen).

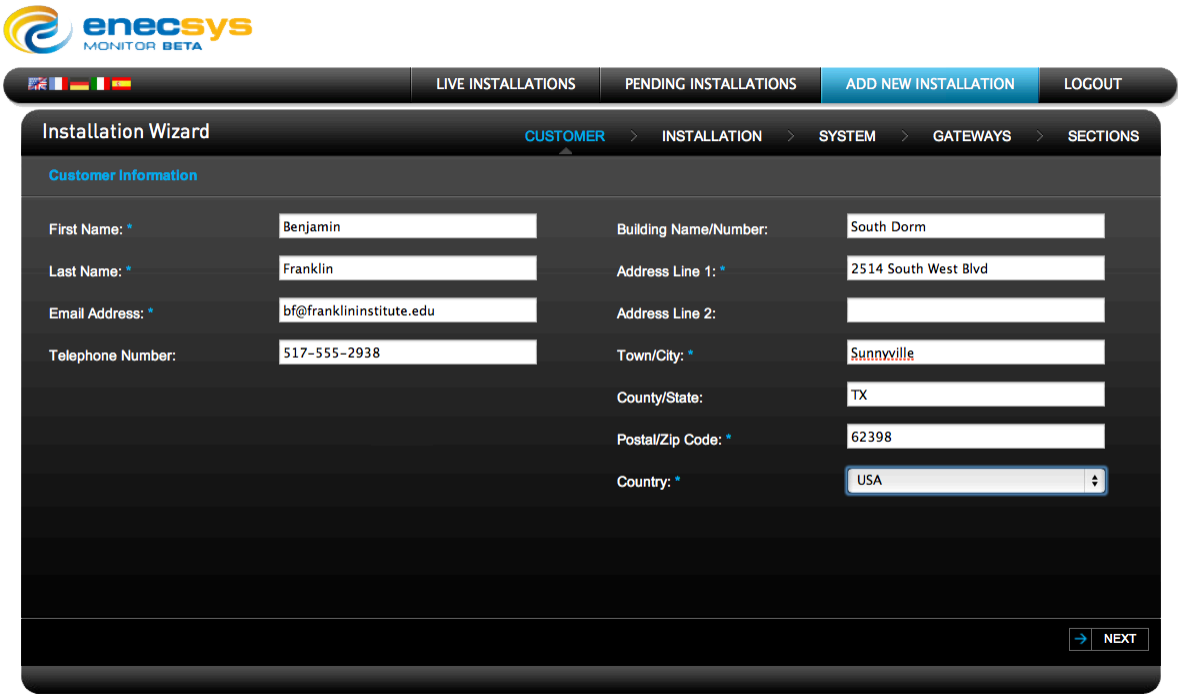


	Indicates the stage of installation is complete.
	Indicates the stage of installation is not complete.
	Opens the installation for editing and data entry.
	If red, transfers the installation from Pending to Live. All stages must be complete and green, or this button will be grayed out.

6.3. Adding a New Installation

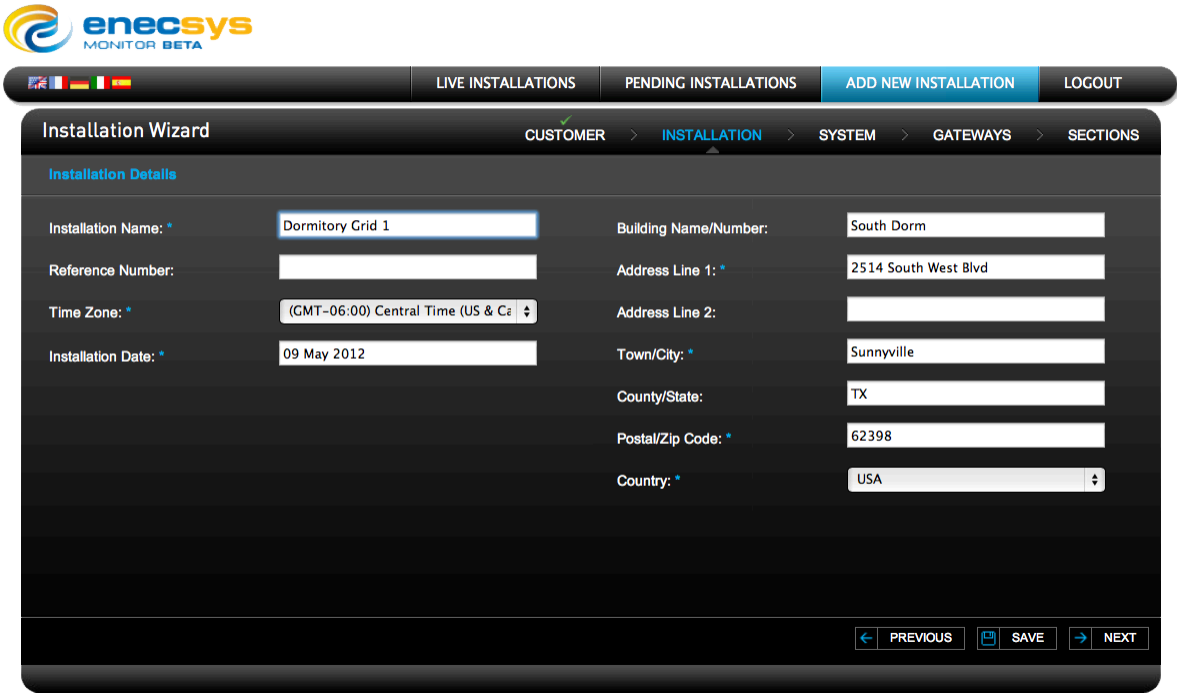
Step 1. To begin adding a new installation, select the **Add New Installation** tab.

Enter the customer data. Fields with asterisks (*) are required. Click **Next** when done.



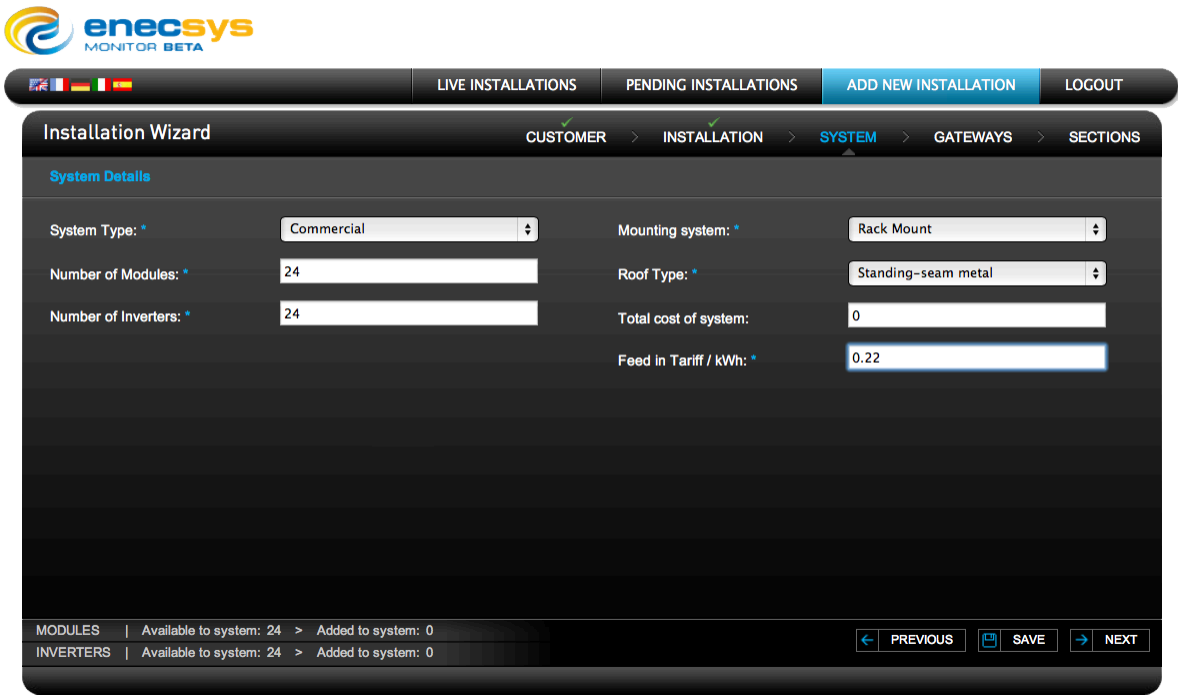
Step 2. Enter installation site details.

- The Installation Name is used to identify the installation site: this name will also be displayed on the installation owner's monitoring dashboard, so use something customer-viewable.
- Reference Numbers are optional: for example, they can help the installer to cross-reference the installation site to an account number.



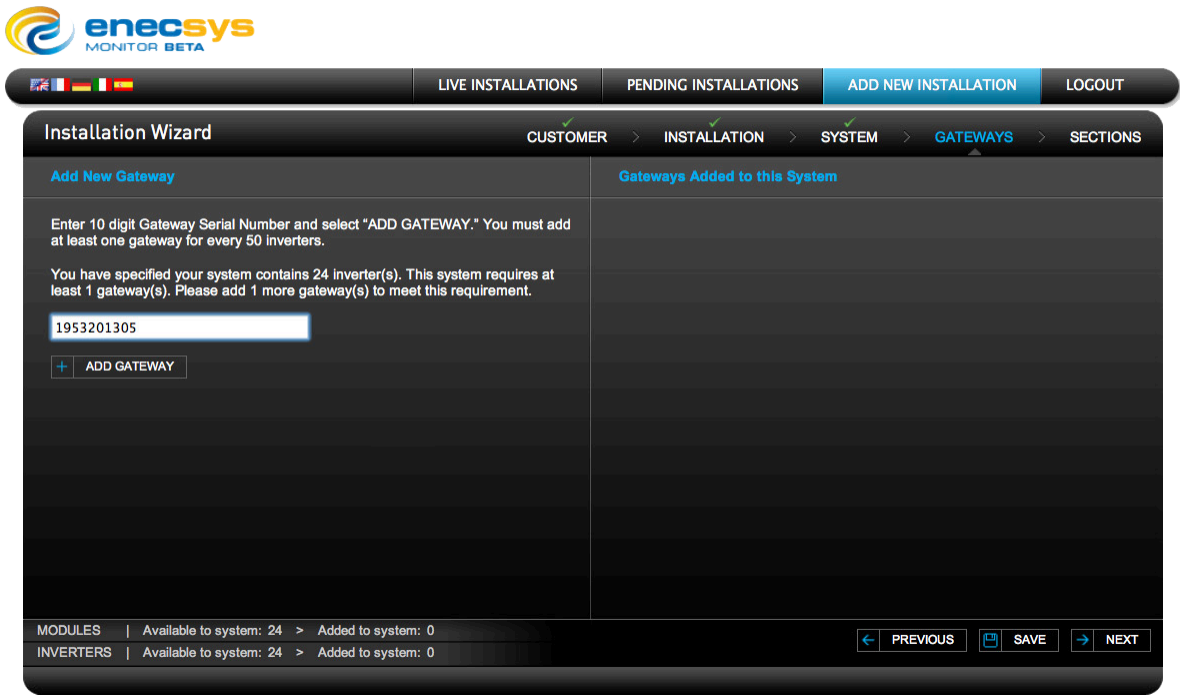
Step 3. Input the system information.

- System information describes the PV system: Type, Number of Modules, number of micro inverters, Mounting system, and Roof Type are entered here.
- "Total cost of system" and "Feed in Tariff" are used to calculate report values.



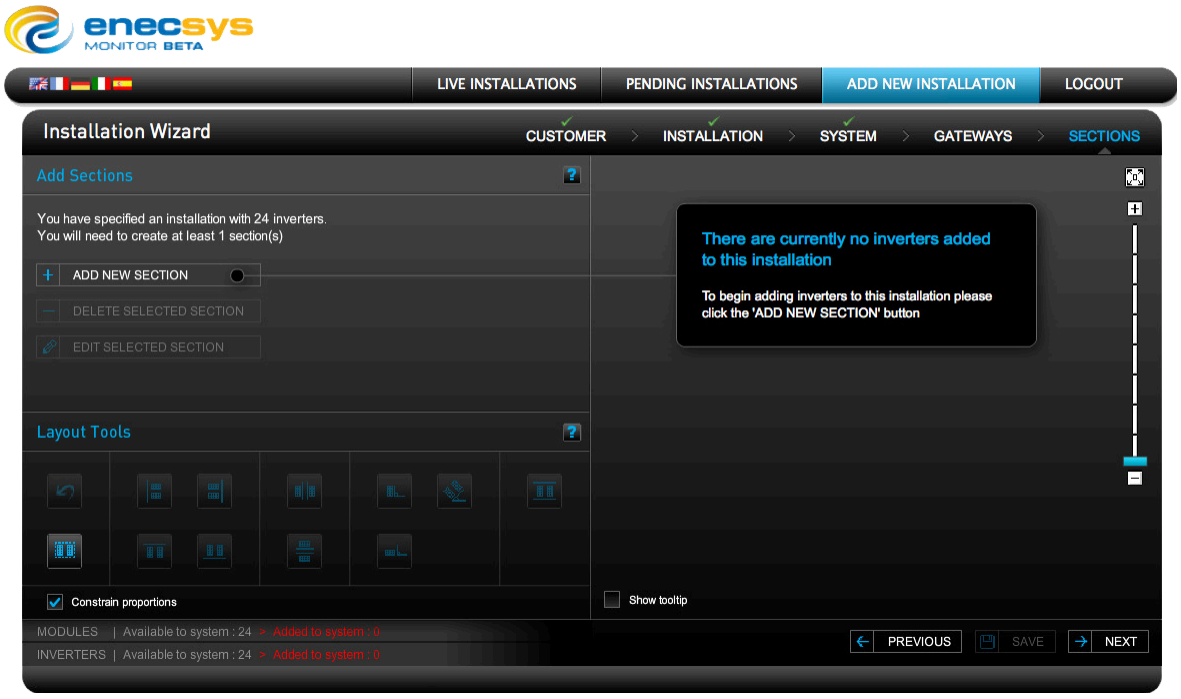
Step 4. Add gateway serial number.

- Enter a serial number for each gateway used. Note that the micro inverter serial numbers will auto-populate as the installation is finalized.
- Note that the user interface says "You will need one gateway for every fifty inverters": larger installations may use multiple gateways.



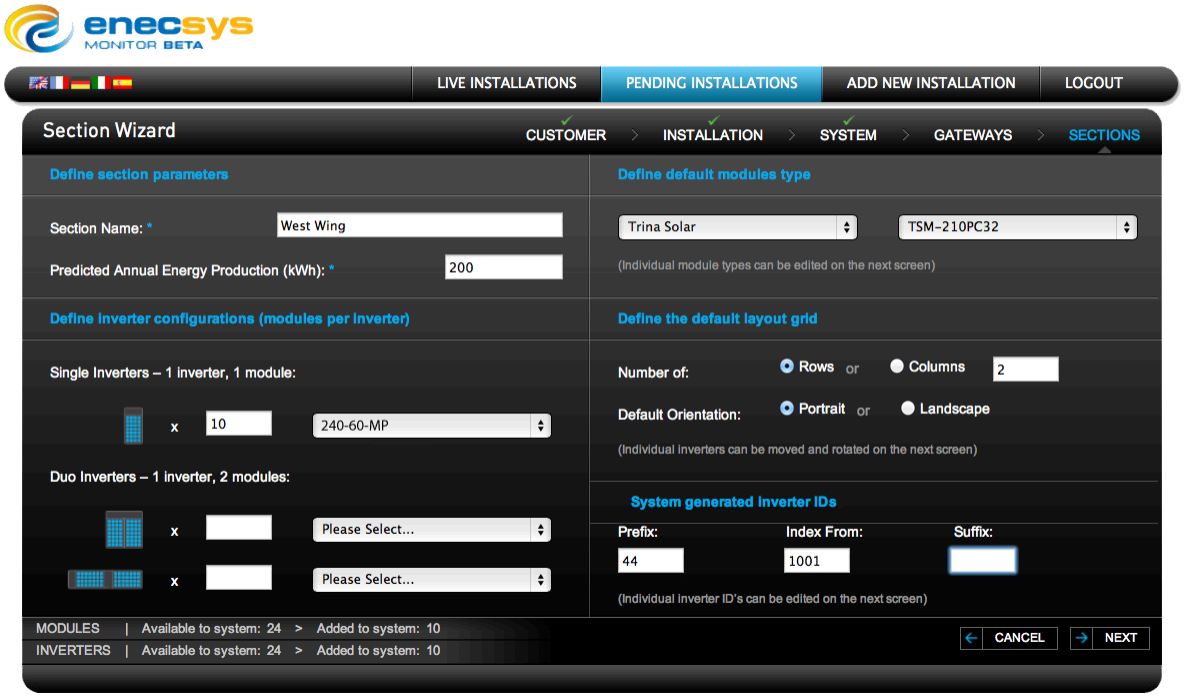
Step 5. Begin layout by adding a section.

Installations may have areas of different energy production characteristics: different module types, layout characteristics such as orientation to the sun, or other factors to be defined separately to refine data collection. Before any sections are created, the screen will appear as below. Select the ADD A NEW SECTION button to create a new PV System layout.



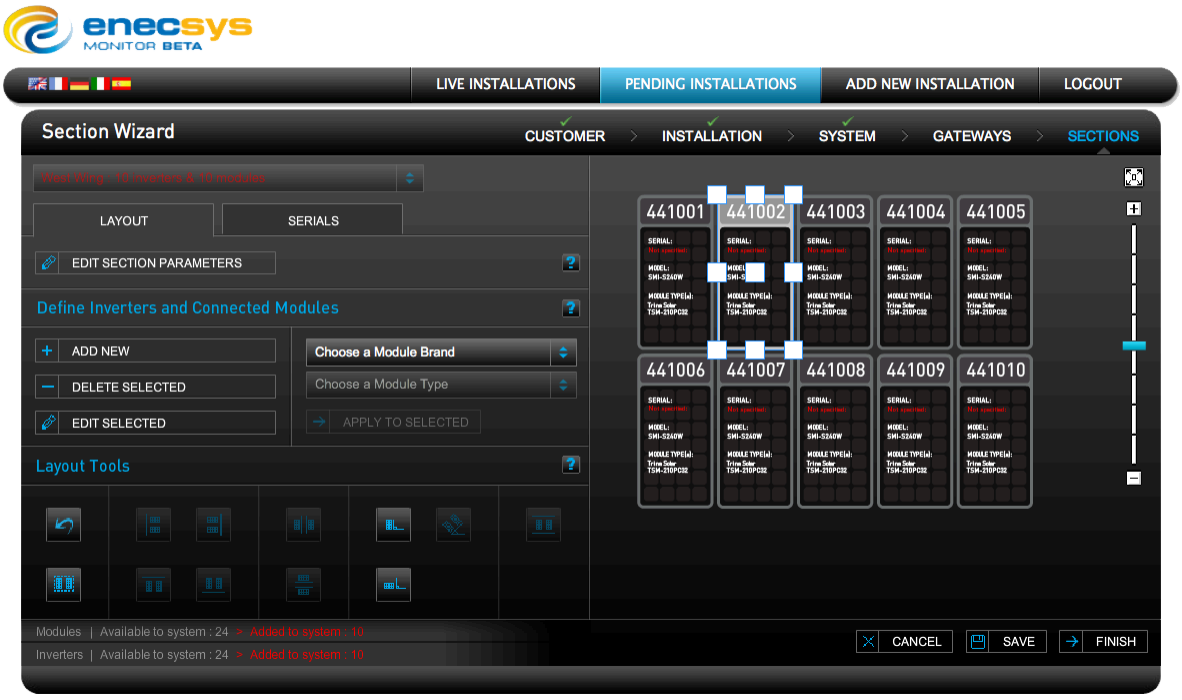
Step 6. Enter section details.

- Define section parameters, predicted energy yield, and type of modules.
- Define micro inverter configuration: choose the appropriate icon and micro inverter model. This is for the layout to fill properly.
- Define the default layout grid. The grid can be changed later.
- The system-generated micro inverter ID field will look up entries to prevent errors.

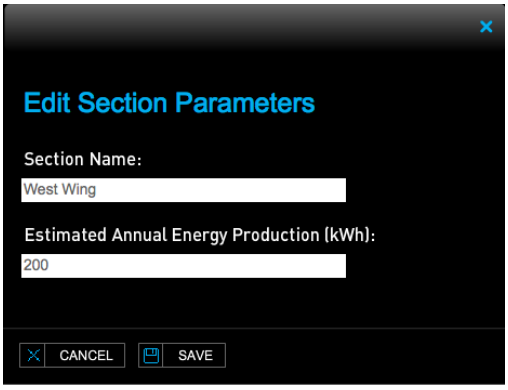


Step 7. Adjust section layout, if required.

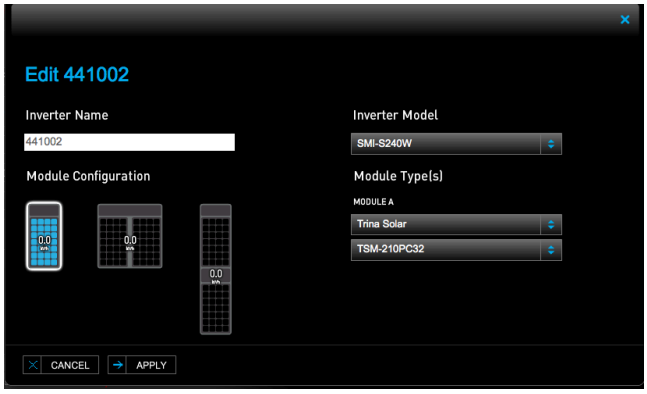
Adjust, re-size, or reposition the section. Use the layout tools to assist with layout design.



Double-click on EDIT SECTION PARAMETERS to edit the parameters for that section.



Double-click on a panel to edit individual panel details.



Installation Layout Tools Key									
									
Select All	Align: Left, Right, Top, Bottom				Distribute Horizon-tally & Vertically		Match Rotation	Match Scale	Undo

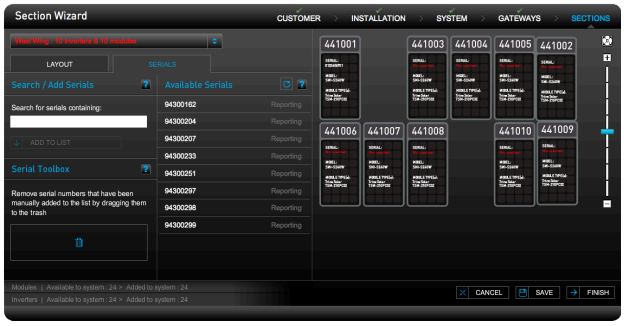
Rather than using the array layout tools, the installer can manually adjust the panels and enter the micro inverter serial numbers one-by-one.

- The LAYOUT tab allows the user to manually use the screen controls to access the PV modules in the layout view.
- Select the module, then click the EDIT SELECTED button to add or change panel characteristics. To add more modules, use the ADD NEW button.
- A selected module appears with white “handles”: it can be moved, turned, and stretched as needed.

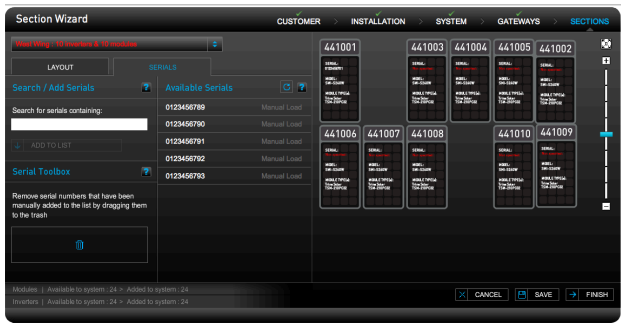
Step 8. Select a method to enter the serial numbers.

Automatic versus Manual Serial Number Assignment

- The list of micro inverter serial numbers should be visible if:
  - The gateway serial number has been entered.
  - The array design was set up previously.
  - The gateway is communicating correctly.
- The SERIALS tab allows the user to manually load the micro inverter serial numbers, or to edit numbers that are already there.

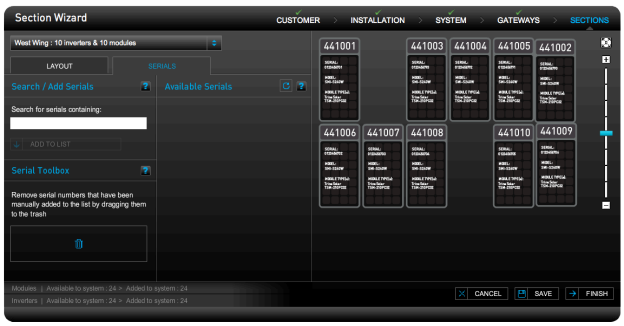


Automatically-discovered serial numbers will appear and be labelled ‘Reporting’.

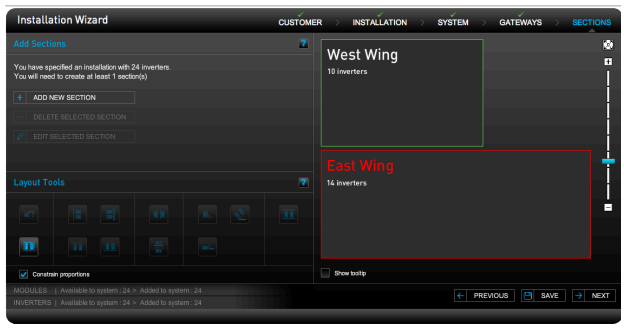


Manual serial number entry - the SERIAL tab. Serial numbers are entered in the Search box. ADD TO LIST will highlight. Serial numbers will be labelled ‘Manual Load’.

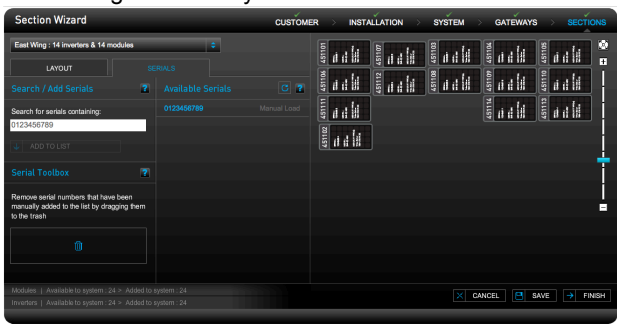
In either case, drag each micro inverter serial number to the appropriate module. Use the “PV Module/Micro Inverter Serial Number Form” that was filled during installation for inverter positions in the array. Continue until all panels have an assigned serial number.



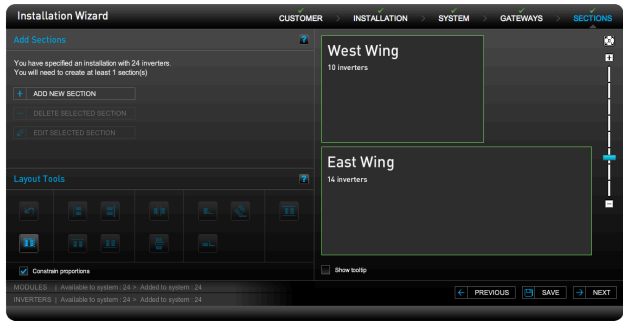
Here, serial numbers have been assigned to the section ‘West Wing’ in the array.



As a result, ‘West Wing’ now shows green in the Sections view.



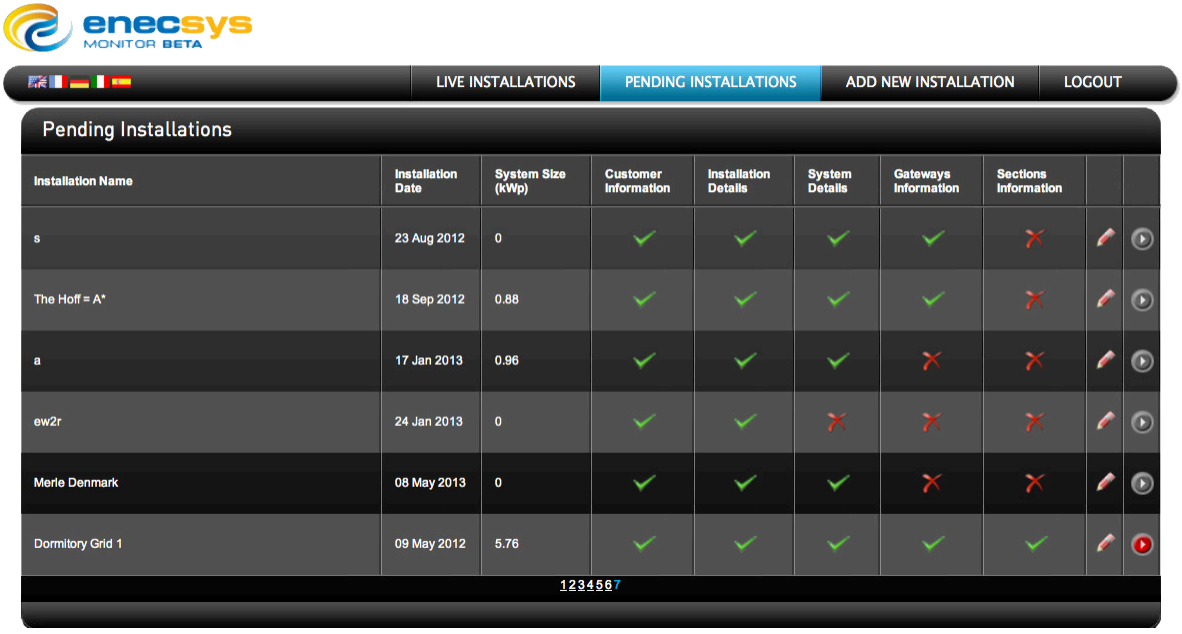
The process is repeated for the next section, ‘East Wing’.



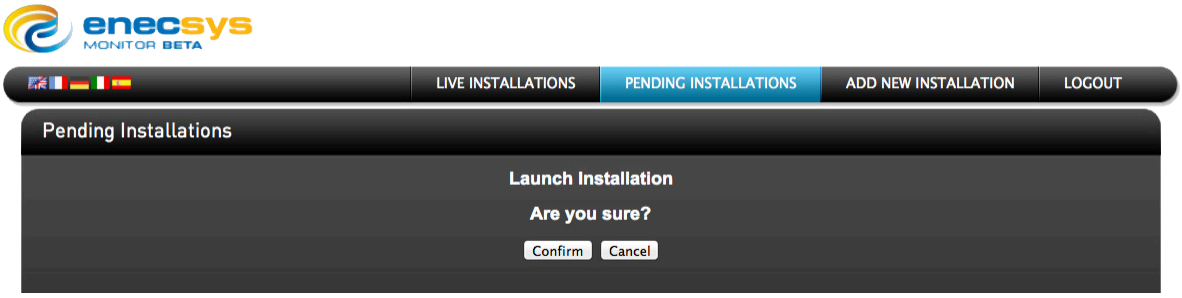
Both sections are now complete and ready to go live.

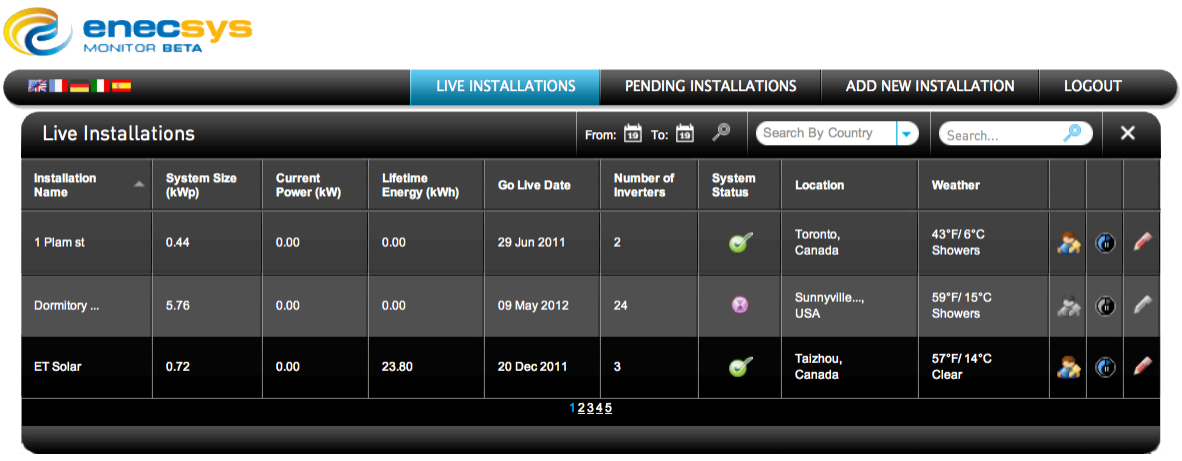
Step 9. Check work and launch installation.

- When serial numbers have been assigned to all panels, save and finish. The PENDING INSTALLATIONS Screen will appear.
- Find the row for the current installation. Note that it may not be visible until the correct page is selected. Installations can be sorted by name or date by clicking on the appropriate column. In this example, 'Dormitory Grid 1' is shown at the bottom of the screen
- There should be green check marks all across the row. If there is a red "x" in a column, it means that the information is not complete. Click on the edit (pencil) icon to add the information.
- If all the information is complete and correct, select the red 'Go Live' button, on the right.



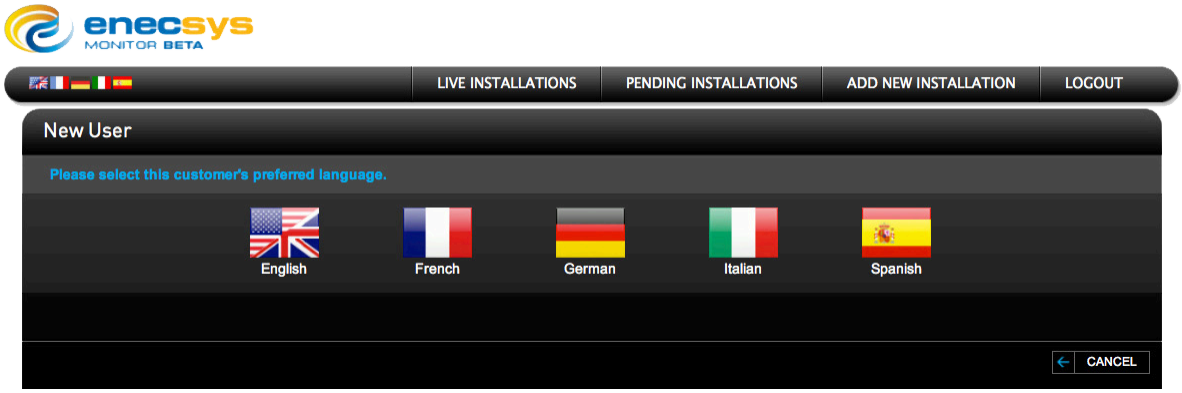
- You will see a confirmation screen. After setting the installation live, click Confirm. The installation will no longer be visible in the Pending Installations screen, but it will be visible in the Live Installations screen.

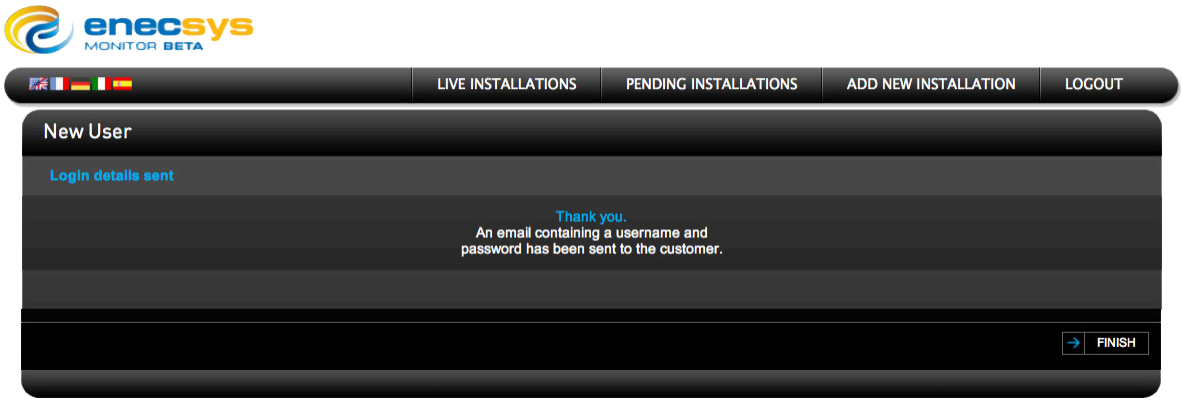




Step 10. Inform the customer.

- The user (customer) data has already been entered. Click the New User icon  .
- The system will prompt for language choice, then send the installation owner a User Name and Password to access the monitoring account. The customer information the installer used for the owner details will be used to generate the email.





Instructions for the Customer

- The customer should log in to the Enecsys monitoring website at http://monitor.enecsys.net using the Username and Password provided in the email. There is also a link to the "Monitoring System logon" on the Enecsys website.
- The customer should fill in all the screens with their details, and also set their username, password, and security questions to values that the customer can remember.
- When this is done, the customer clicks CONTINUE and can then use the new Username and Password on the Enecsys monitoring website to view Owner Monitoring screens and reports

Saving A Pending Installation

- In order to be able to pause and return to finalize the installation later, if necessary, after the layout is done, click the SAVE button.

Re-Opening a Pending Installation.

- Log on to the Enecsys monitoring site with the Installer information. Go to the "Pending Installations" tab and select a saved installation to view or modify it.

Chapter 7 Troubleshooting

Contact the system installer or Enecsys support for assistance if the problem cannot be solved by these suggestions.

7.1. Micro Inverter LED Functions

The micro inverter body has an LED on its exterior. If the LED shows green, it indicates proper function. A red LED indicates a fault condition.

LED action	Description
Red - no blinking	No DC link or GFDI.
Red - single blink	DC Link OK, grid voltage out-of-bounds
Red - two blinks, pause between	DC Link OK, grid frequency out-of-bounds
Red - three blinks, pause between	DC Link OK, no power-good signal

7.2. Communication

Problem	Solution
No illuminated display presented when the Gateway is powered on.	Make sure you have AC power at the receptacle. Replace the Enecsys gateway.
No IP address appears on the Gateway screen.	This means that the Gateway has not been able to connect to the Internet. Check that the Ethernet cable is correctly connected to the router. Check that the router is configured to supply DHCP addresses. Verify that the router has a connection to the Internet. (E.g. check Internet access with a local PC or laptop.) Replace the Enecsys gateway.
The Gateway shows 0 micro inverters even when the micro inverters are installed.	Verify that the micro inverters been installed correctly. Verify that the PV panels are connected to the micro inverters. Verify the AC connections have been made: the connectors should snap lock together during connection. Verify that no cabling has become pinched by the PV modules. If the installation is on a metal roof or on a roof with a metal liner, has a repeater been installed? Try temporarily moving the Gateway to the rooftop; if it then works, the problem is one of RF connectivity.
The Gateway is not showing the correct number of installed micro inverters.	Check PV module / micro inverter connections. Is there sufficient sunlight on the modules? (During the night the gateway will always show 0 unless a Repeater or Double Repeater has been installed, in which case the Gateway will show 1 or as many repeaters as there are in the installation).

7.3. RF

Problem	Solution
The Gateway detects micro inverters when placed on or near the roof, but not inside the building.	Move the Gateway (or a Repeater) to different locations within the building to find a spot with good RF. If a location is found, place a repeater there. If no location can be found inside the building, a Double Repeater must be used, with one antenna outdoors and one indoors.
The Gateway randomly loses connection with the micro inverters.	There may be RF interference. The Gateway uses the same 2.4 GHz band shared by many Wi-Fi base stations, cordless phones, and microwave ovens. Try changing the channel used by Wi-Fi equipment or cordless phones. Place the Gateway far from any microwave ovens.

7.4. Monitoring

Problem	Solution
The installation cannot be set to “live” on the monitoring site.	Check that information on all tabs on the monitoring site have been filled in correctly and that no red “X” is present.
All the micro inverters show 0W power.	Inspect the number showing on the gateway to make sure all the micro inverters are communicating. Check that the system is properly connected to the utility grid. Check that there is grid voltage from the AC cable on the roof.
One, or just a few, micro inverters are showing 0W power.	Inspect the number showing on the gateway to make sure the micro inverters are communicating.
Cannot log in after installation has been set live by installer and user account created.	Installers: call customer support.
Excessive time elapses when downloading monitoring data.	Click the tab again or refresh the page.

7.5. No AC

Problem	Solution
There is no AC power flowing from the array.	Verify that the micro inverters have been configured by the Gateway. Check the LED on each micro inverter. Verify that the AC cable is correctly connected at the grid-tie point. Verify that no circuit-protection devices are tripped. Verify that there is grid AC. The micro inverters will not deliver power when the grid is down. Contact Enecsys.

Chapter 8 Product Return Process

If an Enecsys Micro Inverter is experiencing a problem in the field, the installer or distributor who purchased the product from Enecsys should contact Enecsys:

The most up-to-date listing of Enecsys contact information is available on our website: www.enecsys.com, “Contact us” tab.

Email inquiries: support@enecsys.com.

Enecsys will provide troubleshooting assistance and determine if issues can be fixed or if the product needs to be returned to the manufacturer.

For the customer (installer or distributor)

Determine with the assistance of Enecsys support whether the issue can be resolved in the field, or if product needs to be returned.

In the case of component failure under warranty, Enecsys support can authorize and issue an RMA number.

Customer then ships the product to be returned along with the Returned Materials Authorization number to the warehouse address designated by Enecsys support.

At the receiving end, the RMA number will be matched against the returned product. The returned goods must match for the RMA to be processed successfully.

For the end user

If the end user experiences a problem with the Enecsys Micro Inverters that are a part of their PV system, contact the system installer. The installer or distributor who purchased the micro inverters from Enecsys can work with Enecsys support to resolve issues.

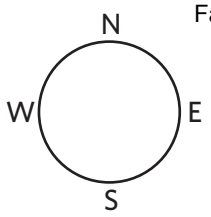
If the end user needs assistance with determining their installer or distributor, contact Enecsys at support@enecsys.com.

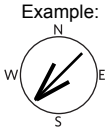
Chapter 9 PV Module/Micro Inverter Serial Number Form

Print out this form: make copies if necessary for installations with multiple sections.

<table>
<tr><td>Customer Name

Section or Other Site Information</td><td>Installer</td><td># of PV Modules:

Roof Angle</td><td>Facing Direction:
 

Example:

</td></tr>
<tr><td>Gateway and Optional Repeater Serial #s:</td><td colspan="3">Instructions:
Rough out the positions of the PV modules in the array or section below.
Note the serial number of each micro inverter that is installed on each PV module.
Remove the micro inverter serial number stickers from the packaging and affix each on the corresponding PV module for reference during installation launch.</td></tr>
<tr><td colspan="4"></td></tr>
</table>

Enecsys Limited is the premier supplier of smart, highly reliable grid-connected micro inverters and monitoring systems. Enecsys Micro Inverters maximize the energy conversion of DC power generated by each solar module within a PV array into usable AC power for homes and businesses. Advantages of Enecsys products include maximized energy harvest, improved safety, increased reliability, module-matching lifetime, enhanced performance monitoring, and simplified PV array design and installation. Founded at Cambridge University, Enecsys maintains corporate, sales and support offices in Cambridge, UK; Redwood Shores, US; Bad Homburg, Germany; and Taipei, Taiwan.

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