eSpire **Nano**

Hybrid Inverter

Applicable to All Fortress Power Nano Inverters

Important Notice

Verify the system configuration prior to installation. A properly engineered system design is required to maintain warranty coverage.

Failure to comply with proper configuration requirements may result in warranty voidance.

Fortress Power reserves the right to update this manual at any time without prior notice

Manual Download

Table of Contents

Introduction:

This manual intends to guide the reader through the Fortress Power eSpire Nano hybrid inverter's features, installation requirements and methods, operating modes, and some of the safety considerations.

This document is equally applicable to all eSpire Nano hybrid inverter types.

This document does not provide information which is specific and/or relevant to eSpire Nano system used in PRO EMS package configuration. A separate document will be available for instructions and guidance in the context of eSpire Nano system in a PRO EMS package configuration.

Each section is structured to help installers, technicians, and other relevant technical parties involved understand the system's capabilities and implement it properly and with confidence.

Before proceeding, we strongly recommend reading this manual in full. Proper installation and operation are essential for achieving optimal performance, ensuring long-term reliability, and maintaining compliance with safety standards.

Please note, acronyms such as PV – photovoltaic, CT – current transformer, DC – direct current, AC – alternating current, ATS – automatic transfer switch, NEC – National Electrical Code, DO – digital output, DI – digital input, SOC – state of charge, SLD – single line diagram, RSD – rapid shut-down, PPE – personal protective equipment, HMI – human-machine interface, will be used in the text.

Also within the text, the terms CT(s) and Rogowski coil(s) will be used interchangeably; for simplicity, the eSpire Nano hybrid inverter will be referred to as Nano inverter, inverter, or Nano hybrid inverter; AC-coupled PV will occasionally be referred to as AC-PV; Utility grid will be referred to as simply – grid.

Terms such as upstream – power supply side, and downstream – opposite to the power supply side, will also be used within the text.

On some of the figures, the following symbols will be used to indicate as shown:


acceptable


unacceptable


preferred

IMPORTANT NOTES:

- Product specifications are subject to change without notice. Every attempt has been made to make this document complete, accurate and up to date. Individuals reviewing this document and installers or service personnel are cautioned, however, that Fortress Power reserves the right to make changes without notice and shall not be responsible for any damages, including indirect, incidental or consequential damages caused by reliance on the material presented including, but not limited to, omissions, typographical errors, arithmetical errors or listing errors in the material provided in this document.
- Fortress Power accepts no liability for customers' failure to comply with the instructions for correct installation and will not be held responsible for upstream or downstream systems Fortress Power equipment has supplied.
- The customer is fully liable for any modifications made to the system; therefore, any hardware or software modification, manipulation, or alteration not expressly approved by the manufacturer shall result in the immediate cancellation of the warranty.
- Given the countless possible system configurations and installation environments, it is essential to verify adherence to the following:
  - There is sufficient space suitable for housing the equipment.
  - Airborne noise produced depending on the environment.
  - Potential flammability hazards.
- Fortress Power will not be held liable for defects or malfunctions arising from:
  - Improper use of the equipment.
  - Deterioration resulting from transportation or environmental conditions.
  - Performing maintenance incorrectly or not at all.
  - Tampering or unsafe/unauthorized repairs.
  - Operation or installation by unqualified persons.
- This product contains lethal voltages and should be installed by qualified electrical or service personnel who have sufficient knowledge and experience to work safely with equipment that carries potentially lethal voltages.
- Follow all applicable electrical codes for your jurisdiction when installing the ESS.
- Follow all applicable and generally recognized norms, precautions, and techniques of working with an electrical equipment.
- Only use components and accessories that are approved by Fortress Power and/or are adequate to be used in conjunction with the Fortress Power equipment.
- Follow proper grounding practices to avoid ground loops and avoid electrical shocks.

Safety and Warning

READ AND UNDERSTAND ALL SAFETY INFORMATION BEFORE INSTALLATION, OPERATION, INSPECTION, MAINTENANCE, OR SERVICE. BE AWARE OF AND ACKNOLEDGE THE DANGER, CAUTION, WARNING, AND OTHER RELATED SIGNS AT, ON, IN, WITHIN THE EQUIPMENT.
Failure to follow these instructions may result in serious injury, death, or property damage.

These inverters have connected to them, or generate, high-voltage DC and high-voltage AC electricity. Interaction with this equipment can result in serious injury or death.

Only qualified individuals are permitted to perform inspection, maintenance, service, repair, or other work on this system. Repair, modification, component replacement, modification, or advanced troubleshooting shall not be performed unless prior authorization and approval have been received from Fortress Power.

General Safety Overview

This system includes the following hazards:

- High-voltage DC electricity
- High-voltage AC electricity
- Thermal, fire, and arc-flash hazards
- Moving mechanical components within the HVAC system, ventilation/cooling system.

Non-serviceable components are contained within this unit. Any service, repair, modification, or replacement of internal components must be performed only with authorization and approval from Fortress Power.

Authorized Work Limitations

DANGER
UNAUTHORIZED ACCESS AND SERVICE HAZARD

- Inspection and routine maintenance may be performed only by individuals who are properly qualified and trained for work on high-voltage energy storage systems.
- Any service, repair, advanced troubleshooting, modification, or replacement of the unit or its internal components shall not be performed unless prior authorization and approval have been received from Fortress Power.
- All work shall be performed in accordance with applicable electrical safety standards, site safety procedures, and local regulatory requirements.

- repair, advanced troubleshooting, modification, or replacement of the unit or its internal components may result in serious injury, death, equipment damage, improper system operation, or voiding of warranty.

If the system is suspected to have developed a problem, contact Fortress Power through approved support channels and obtain authorization before performing any work.

Electrical Hazards

High Voltage – Risk of Shock or Arc Flash

DANGER
HIGH VOLTAGE PRESENT

- This system contains high-voltage DC circuits and high-voltage AC conductors capable of causing severe injury or death.
- Hazardous voltage may be present even when the system appears to be powered off.
- **An electric shock hazard exists when working around the eSpire Nano batteries and inverters, including eSpire Nano hybrid inverters. Inverters, when ON, can impose hundreds of volts of potential between earth ground and the positive or negative battery ports of the inverter and everything connected to either of these ports, including the eSpire battery DC busbar pair — even when the battery/batteries connected to the eSpire Nano inverter(s) are turned off; that is when battery/batteries are not applying DC voltage to the inverter(s) and the inverter/inverters only receive AC voltage or DC voltage from a source other than batteries (PV strings, for example).**
  Before performing any work on an eSpire Nano system, inverters (eSpire Nano inverters or some other inverter type), eSpire Nano batteries, the components of the two, and any other devices connected to them (electrically or otherwise), must be turned OFF and fully deenergized. Ensure that the inverters and the batteries are fully turned off and no AC and no DC voltage is applied to either of them for at least 5 minutes prior to starting the work on the system, it's components or other devices connected to them (electrically or otherwise).
  Follow lock-out/tagout (LOTO practices).

Do not allow AC and/or DC voltage to be applied to the inverters and batteries, their components, or any other devices connected to them (electrically or otherwise) when any of the covers on the inverters, batteries, or devices connected to them are removed. Always wear appropriate PPE.

Safety requirements:

- Electrical work shall be performed only by properly qualified personnel.
- De-energize all power sources prior to accessing internal areas of the equipment.
- Follow applicable Lockout/Tagout (LOTO) procedures when applicable.
- Use appropriate personal protective equipment (PPE) rated for electrical shock and arc-flash hazards.
- Verify absence of voltage using properly rated test equipment.

Mechanical

HVAC System, Ventilation System, and Access Doors

DANGER
MECHANICAL HAZARD

- The system contains moving mechanical components within the cooling and ventilation system and ventilation system, including fans which may present pinch, crush, or impact hazards during operation or movement.
- Mechanical components may start or move automatically during normal operation or emergency conditions.

Safety requirements:

- Inspection, maintenance, or service involving mechanical components shall be performed only by properly qualified personnel.
- Keep hands, tools, and loose clothing away from moving components.
- Use caution when opening or closing access doors.
- Ensure mechanical motion has stopped before working near HVAC or ventilation components.

Emergency Situations

IN CASE OF EMERGENCY:

- Evacuate the area immediately if fire, smoke, chemical odor, vapor release, abnormal sounds, or excessive heat are detected.
- If it is possible to do so safely given the emergency circumstances, immediately activate the Emergency Power Off (EPO) switch to shut down the system.
- Do not attempt to perform inspection, maintenance, or service activities.
- Contact emergency services and follow the site emergency response plan.
- Notify Fortress Power as soon as possible.

The following types of safety instructions and general information appear in this document as described below:

DANGER
"Danger" indicates a hazardous situation which if not avoided, will result in death or serious injury.

WARNING
"Warning" indicates a hazardous situation which if not avoided, could result in death or serious injury.

CAUTION
"Caution" indicates a hazardous situation which if not avoided, could result in minor or moderate injury.

NOTE
"Note" provides tips that are valuable for the optimal operation of your product.

WARNING: Risk of fire
Despite careful construction, electrical devices can cause fires.
- Do not install the inverter in an area containing flammable materials or gases.
- Do not install the inverter in a potentially explosive atmosphere.

General Overview

The Fortress Power Nano hybrid inverter series is comprised of the following three models: a 30kW inverter for 208Y/120V three-phase systems (FP-Nano-30k-L), a 30kW inverter for 480Y/277V three-phase systems (FP-Nano-30k-N), and a 60kW inverter for 480Y/277V three-phase systems (FP-Nano-60k-N). For performance summary, please refer to **Table 1** below. The Fortress Power Nano hybrid inverter series is designed to operate with and generate either 480Y/277V three-phase or 208Y/120V three-phase AC signals, depending on the inverter model selected, but, it must be noted, that the 30kW inverter for 208Y/120V three-phase systems (FP-Nano-30k-L) can also support high-leg delta (240V 3P4W) signal, but only in grid-tied mode, with no backup output on either of its AC ports. For further information about the latter, please refer to **Appendix A**.

	30kW (480V) (FP-Nano-30k-N)	60kW (480V) (FP-Nano-60k-N)	30kW (208V) (FP-Nano-30k-L)
Max. Estimated PV Input Power (42A @ 600V)	75kW	100kW	75kW
Max. Usable PV Input Power	60kW	100kW	60kW
MPPT Quantity	3	4	3
MPPT Voltage Range*	150V-850V	150V-850V	150V-850V
Max. PV Input Voltage*	1000V	1000V	1000V
Max. PV Continuous Current per MPPT*	42A	42A	42A
Max. PV Continuous Current per MPPT Input*	21A	21A	21A
Max. PV Short Circuit Current per MPPT*	65A	65A	65A
Max. Battery Charge/Discharge Power	33kW	60kW	33kW
Rated AC Power Output (grid available)	30kW	60kW	30kW
Max. Apparent AC Power Output	33kVA	60kVA	26kVA
Rated AC Output Current	36.1A	72.2A	72.2A
Max. AC current passthrough (grid to load)	72.2A	144.4A	144.4A
Max. Generator/AC-coupled PV Current Input	36A	72.2A	72.2A
Rated Backup Power Output	30kW	60kW	26kW
Maximum Backup Current Output	43.3A (5min) 50.5A (1min) 54.1A (10s) 57.7A (2s)	86.6A (5min) 101.8A (1min) 108.3A (10s) 115.5A (2s)	86.6A (5min) 101.8A (1min) 108.3A (10s) 115.5A (2s)

*Applies to all MPPTs

Table 1: Nano Inverter Performance Summary

Each inverter is designed to operate within a single AC voltage class and does not function as voltage or phase converters; therefore, all AC ports on the inverter must be connected to the same AC type and voltage configuration. Furthermore, any AC load circuit, or any AC power

source must be connected to a Nano inverter (or a group of them) through a valid and appropriate third-party over-current protection device (OCPD), such as a fuse or a breaker, since the inverter is not equipped with OCPDs.

The inverters, because of their performance capabilities and durable design, are quite heavy, weighing ~196lbs, and sizable (see **Figure 1**). These inverters may only be installed onto the included support bracket, which itself can be installed on an appropriate vertical surface, including walls and eSpire Nano battery cabinet wall/cover. (for the latter method, the use the holes for the fasteners are made from the factory).

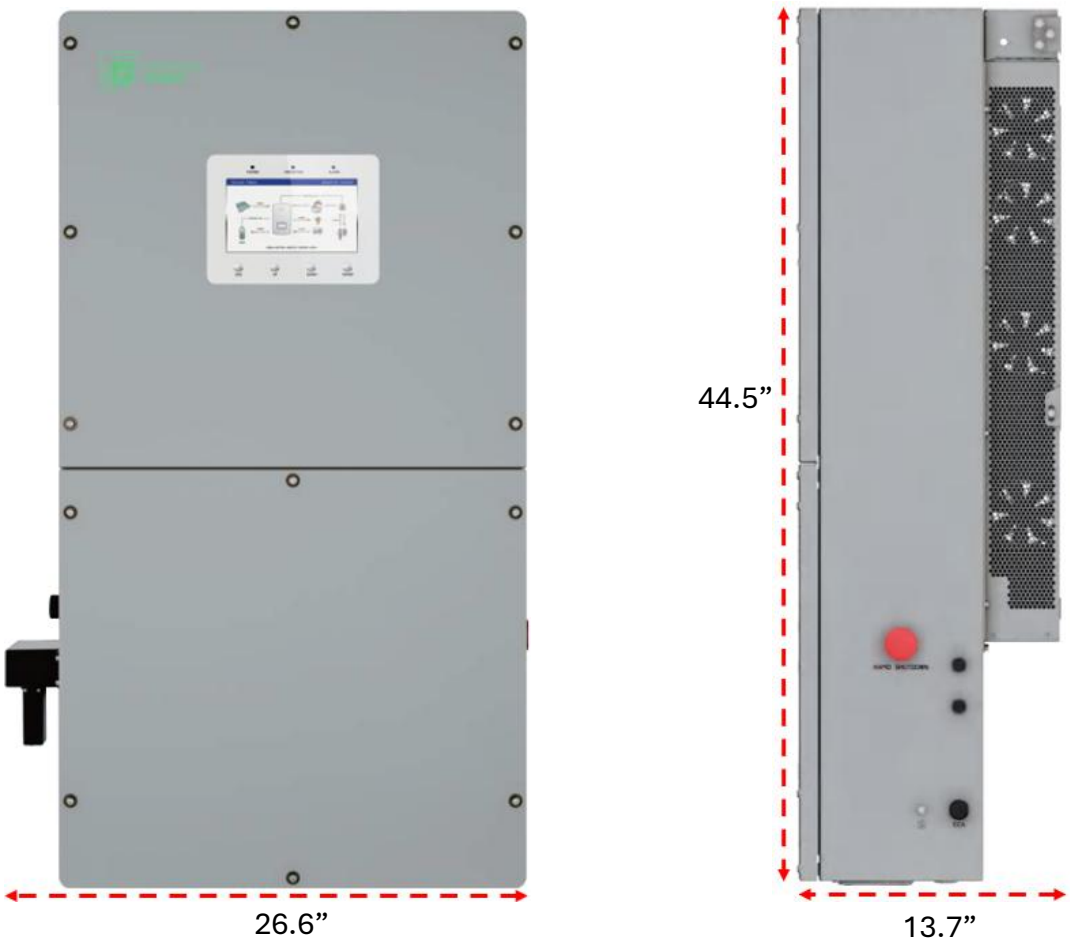


Figure 1: Nano Inverter Geometric Dimensions

Application Overview – DC-Coupled PV

Each Nano inverter is equipped with multiple MPPTs: 30kW inverters, whether for 208V or 480V application, have three MPPTs; 60kW inverters have four MPPTs. Each MPPT on a Nano inverter can accept up to two PV strings.

If two PV strings are connected to a single MPPT, the two PV strings must be identical in all aspects:

- module types in both strings
- module quantity in both strings
- orientation in space for all modules in both strings
- bifacial gain for all modules in both strings (if bifacial panels are used)
- no shading for both strings.

MPPTs themselves are autonomous and independent from one another.

Application Overview – Smart Port

AC-coupled PV or a generator (with 2-wire start supported) may be directly connected to the inverter through the designated AC ports, commonly referred to as smart ports. Unless used for either of latter two AC power sources, the said AC ports may also be used as a programmable AC output source dedicated to powering one load circuit (passthrough and/or backup), allowing to configure in what battery state of charge percentage range the output to the smart port is enabled and how the availability changes based on grid availability. If smart ports are to be used for load, the combined power demand on the smart ports and the inverter backup/load ports must not exceed the inverter's (inverters') AC passthrough and backup power output capabilities.

The smart ports must never be used for two separate AC sources, or an AC source and a load circuit, simultaneously. Prior to commissioning, it must be decided for what purpose the smart ports will be used, and the system is commissioned and operated according to the initial choice and in appropriate configuration.

When a generator is connected directly to the inverter, the battery bank connected to the inverter may be charged using the generator power output.

When AC-coupled PV is connected directly to the inverter, the inverter will keep the AC-coupled PV available even in case of a power outage, if the inverter is configured to provide backup output.

The inverter itself cannot communicate with any AC-coupled PV system (it can be accomplished only if the inverter is working in conjunction with the optional Fortress Power EMS), but can control AC-coupled PV production using the frequency-watt curve outlined in the IEEE1547-2018. It is strongly recommended that the AC-coupled PV system connected to the inverter supports the upper mentioned frequency-watt curve. Otherwise, the inverter doesn't have a dynamic control over the AC-coupled PV output, thus the AC-coupled PV will shutoff when the frequency is shifted and restart when the frequency is corrected. Maximum combined size of the AC-coupled PV output must not exceed the total Nano inverter AC output power rating.

Application Overview – Multiple Inverters

There may be up to six inverters operating in parallel, retaining all functionality that one inverter can offer.

When multiple Nano inverters are working in parallel:

- All inverters must be of the identical model name.
- It is mandatory for them to share all AC inputs and outputs connecting to the same AC panels with the same AC ports (even if some inverters have batteries and some don't).
- It is not mandatory for all of them to utilize a battery, thus in the group of parallel inverters in which some inverters have batteries and some don't, the inverters in the group that are not connected to a battery will function as string inverters, with the advantage of having all information about the PV production reported to one monitoring platform (along with all other data) without a need for additional CTs and/or other monitoring means.
- Each inverter which is to work with a battery, must have its own battery or battery group, to which the other inverters do not connect. Thus, multiple inverters never share a battery or multiple batteries connected in parallel. That is not to say that multiple batteries can't share one inverter. It is strongly recommended for all battery banks of parallel inverters to be of the identical storage size.
- It is strongly recommended to have PV distributed between the inverters in such a way, that the PV power, during normal production, is distributed between the inverters proportionally to the battery storage capacities connected to the inverters.
- For the state-of-charge balancing to work as reliably as possible, grid and/or generator are strongly recommended for the systems with multiple inverters, especially for the systems in which storage is unevenly distributed between the inverters that have batteries connected to them.

Figure 2 is provided help the reader to visualize some of these requirements.

Figure 2a: Multiple Inverters

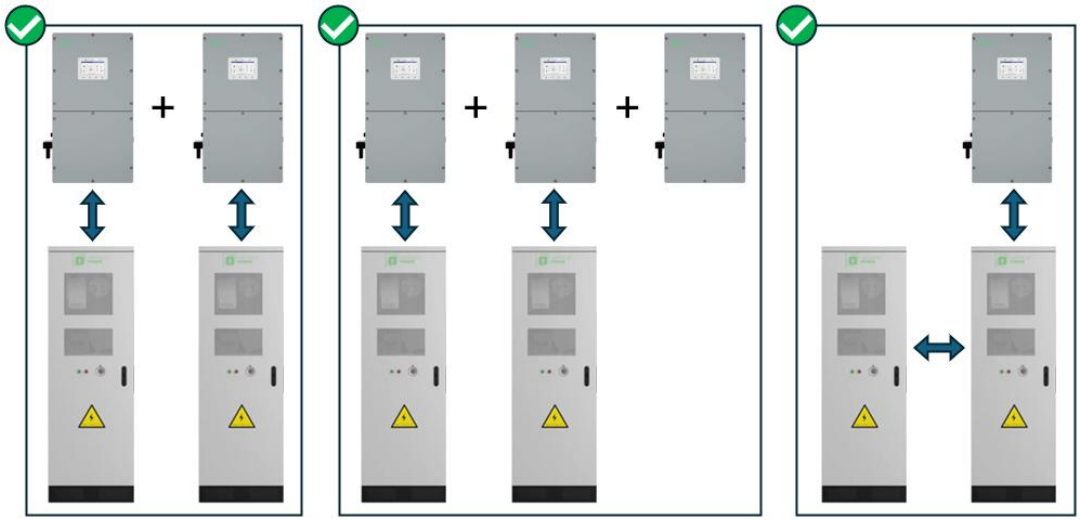


Figure 2b: Acceptable Approaches to Interconnecting Multiple Batteries

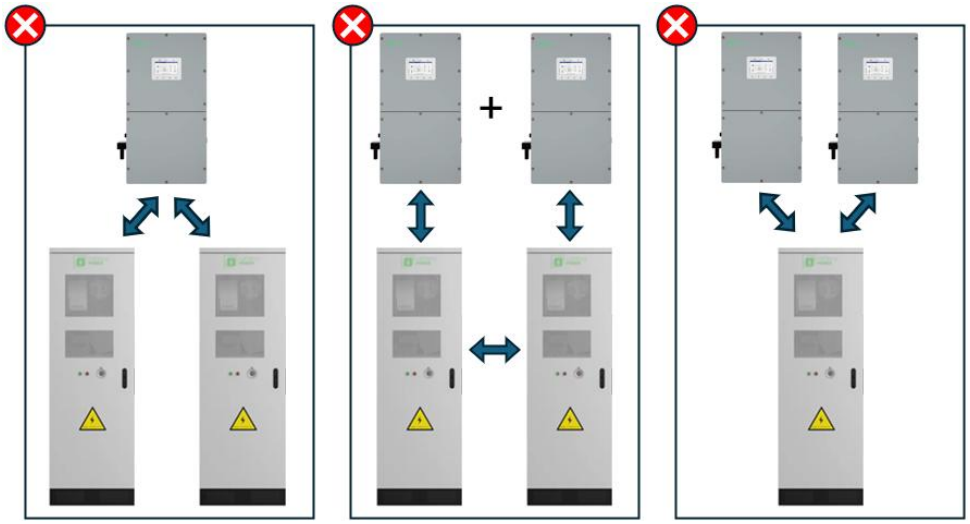


Figure 2c: Unacceptable Approaches to Interconnecting Multiple Batteries and/or Inverters

Summary of Modes of Operation

The inverters support the following modes of operation: self-consumption, export priority, off-grid, peak-shaving, time-of-use optimization, and advanced EMS-controlled operation. Backup power output is applicable to any mode of operation as long there is at least one battery unit is working in conjunction with the a Nano inverter(s). The inverter(s) will only provide backup power to the loads that are downstream of the inverter load ports (sometimes referred to as backup ports). Energy reserve that the inverter keeps in the battery bank for backup purposes is configurable. Modes of operations can be adjusted, and there may be some acceptable overlap between the modes of operation. For example, a Nano inverter which is primarily operating in self-consumption mode can be used to provide backup power output as well; or, outside of time-of-use schedule time intervals the inverter can be operated in self-consumption mode.

The Nano inverters can be used without a battery, providing the same functionality as the string inverters would. In this configuration, if a Nano inverter with no battery connected to it is paired with other a Nano inverter (or multiple of them) that has (have) battery connected to it (them), it is mandatory that all Nano inverters share all AC inputs and outputs connecting to the same AC panels with the same AC ports. If one or multiple Nano inverters are operating as string inverters (i.e. no battery is connected to any of the inverters) then it is not allowed to connect any AC circuits to these inverters except grid connection conductors connected to the grid ports of this (these) inverter(s). In the latter case, the Nano inverter(s) is (are) not to be used for backup purposes, yet, at any point, a battery bank can be added to the Nano inverters operating as string inverters, thus unlocking the rest of the modes of operation of the inverter. Please note, Fortress Power Nano batteries are the only battery types to be used with Nano inverters.

The Fortress Power Nano inverters support export power control. During system commissioning, if power export to the utility is enabled, an export power limit may be configured in kW as well. If the export limit is set, the inverter regulates its output to ensure that power exported to the utility does not exceed the configured value. This is all made possible when the power meter and/or the current transformers (CTs), included with the Fortress Power Nano inverters, are used correctly, namely, the set of three CTs, with one CT installed on each line of a three-phase system, are installed upstream of all loads (both backed-up and non-backed-up) and of the inverter grid connection point. The CTs interface with the meter, and the meter connects to the inverter, enabling the inverter to accurately monitor real-time power flow to and from the utility for system operation and export power control. With the CT and meter configuration in place as described above, the export control can be configured such that the export is disabled altogether. Alternatively, if export limit is not set, the power export capability

of a Nano inverter, by default, is naturally limited to the inverter's maximum/rated AC output limit.

Mode of Operation Overview – Self-Consumption (Self-Use) Mode

In this mode of operation, photovoltaic (PV) generation is prioritized to serve connected loads first, followed by battery charging, with power export occurring last only if export is enabled and the battery is fully charged. The term loads refers to both loads located upstream and downstream of the inverter, including non-backed-up and backed-up circuits. If PV generation is insufficient to meet total load demand, the system supplements the load by discharging the battery bank until either the load demand is satisfied by available PV power or the battery reaches its configured cutoff state-of-charge threshold. Please note that if the combined output of the photovoltaic (PV) system and the battery bank is insufficient to satisfy total load demand, the remaining power deficit is supplied through power import from the utility grid.

Mode of Operation Overview – Export Priority (Selling First) Mode

In this mode of operation, photovoltaic (PV) generation is first used to supply total load demand. Once load demand is fully satisfied, available PV power is exported to the utility grid in accordance with the configured export limits. Only after the export limit has been reached will any remaining PV power be used to charge the battery bank.

Mode of Operation Overview – Peak-Shaving Mode

In this mode of operation, the load demand threshold is entered in the inverter menu. If the inverter detects the loads downstream of the CTs exceeds the load demand threshold, the battery is discharged, thus reducing the peak demand. In this mode of operation, the batteries are normally charged using the PV power only. PV generation itslef is prioritized to serve connected loads first, followed by battery charging, with power export occurring last only if export is enabled and the battery is fully charged.

Mode of Operation Overview – Off-Grid Mode

In this mode of operation, photovoltaic (PV) generation is prioritized to serve the loads first, followed by battery charging. If the PV generation is insufficient to satisfy load demand, the system discharges the battery bank until either PV generation provides sufficient power to fully

meet the load demand or the battery reaches its configured cutoff state-of-charge (SOC) threshold. In this mode of operation, the use of a generator is strongly recommended by utilizing the inverter's designated generator input ports and automatic start functionality. When a generator is used, the generator start SOC percentage must be configured to be at least 1% higher than the battery cutoff SOC. Under this configuration, the battery will discharge to support the load when PV power is insufficient, and discharge will continue until either PV power satisfies the load demand or the battery reaches the generator start SOC, thereby preventing the battery cutoff SOC from being reached (except in cases where the generator fails to start before the battery bank reaches the cutoff SOC threshold). Once started, the generator will continue to operate until the battery SOC reaches the percentage at which the inverter is configured to turn the generator off.

Mode of Operation Overview – Time-of-Use Mode

Inverter(s) allow to configure six time intervals for charge and six time intervals for discharge. There are multiple parameters that need to be configured for each interval.

For charge intervals:

- Interval start time
- Interval end time
- SOC to which the charging continues
- Charge Power

For discharge intervals:

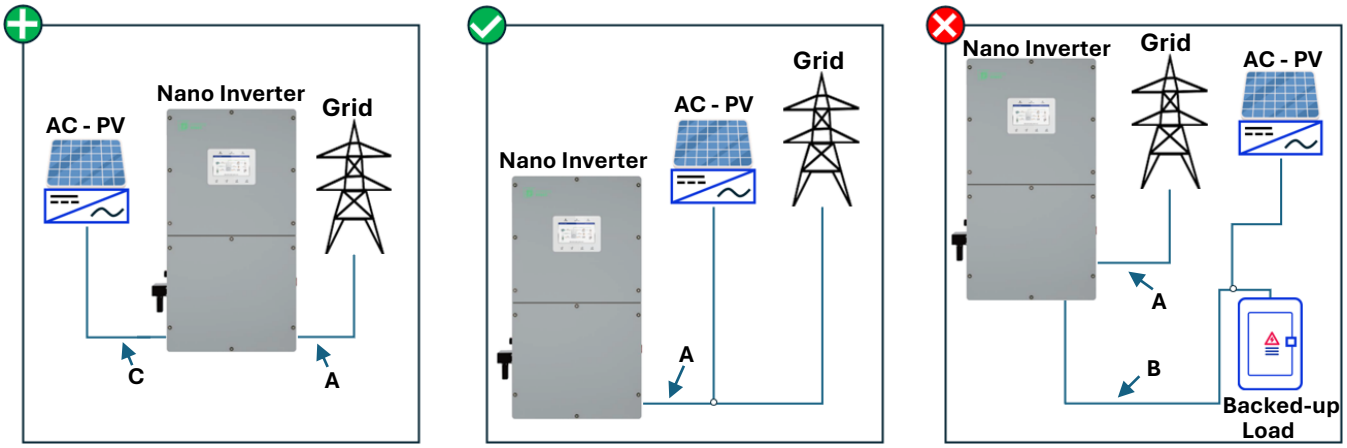
- Interval start time
- Interval end time
- SOC to which the Discharging continues
- Discharge Power

An interval will become effective immediately once it is enabled. Enabled intervals apply to every day. In the time periods between the enabled time-of-use intervals, the inverter will adhere to the mode of operation configured besides the time-of-use intervals.

Application Notes – AC-Coupled PV

Although it is a standard and a strongly recommended approach to connect the AC-coupled PV output to the smart ports of the inverter, this is not the only method. Namely, AC-coupled PV may be connected upstream of the grid ports of the Nano inverter. But, in such case, the inverter will not be able to monitor the AC-coupled PV production, and, perhaps more importantly, the AC coupled PV output will not be available in case of a grid-outage even if the Nano system is providing backup output to its backed-up loads.

Under no conditions is it allowed to have the AC coupled PV output to be connected at or downstream of the Nano inverter's backup/load ports.



(**A –** to inverter **grid ports**, **B –** to inverter **load ports**, **C –** to inverter **smart ports)**

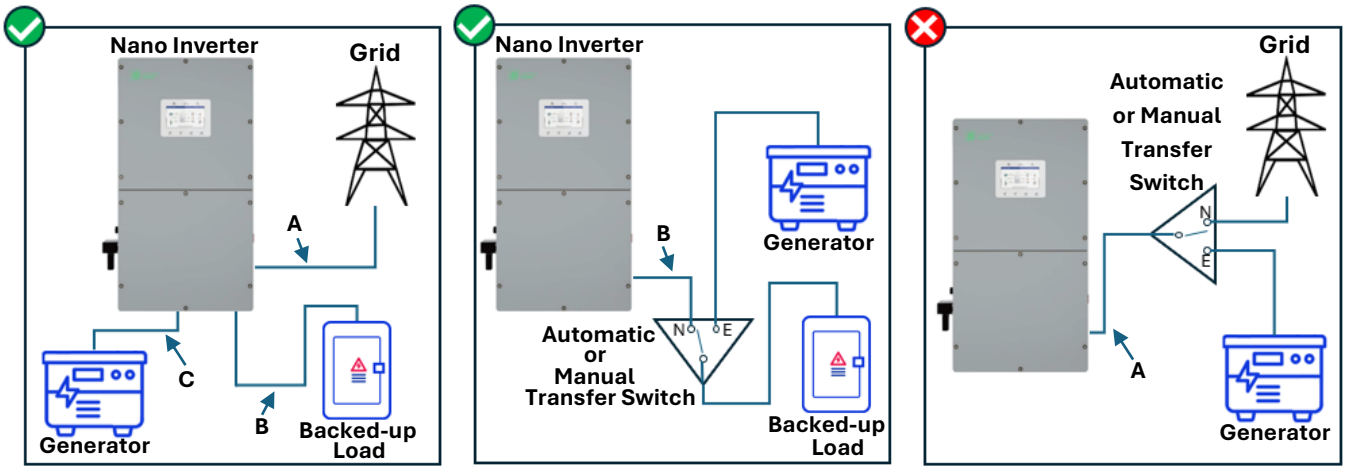
Figure 3: AC-Coupled PV (AC – PV) in Conjunction with a Nano Inverter

Application Notes – Generator

Although it is a standard and a strongly recommended approach to connect the generator to the smart ports of the inverter, this is not the only method. Namely, a generator and its dedicated ATS can be installed downstream of the inverter load/backup port. In this configuration, the inverter load/backup port connects to the normal port of the ATS, generator connects to the emergency port of the ATS, whereas the backed-up load panel connects to the ATS load ports. In such configuration, the generator start/stop and ATS switching happens autonomously. But, the drawbacks, if one may call it that, are the lost ability of charging the batteries using the generator power output and inability to monitor the generator output and the load demand when they are powered by the generator output.

Under no conditions is it allowed to have an ATS connected to the grid and load and have the ATS output connected to the inverter grid (or smart) ports.

For illustrations of these concepts, please refer to **Figure 4** below.

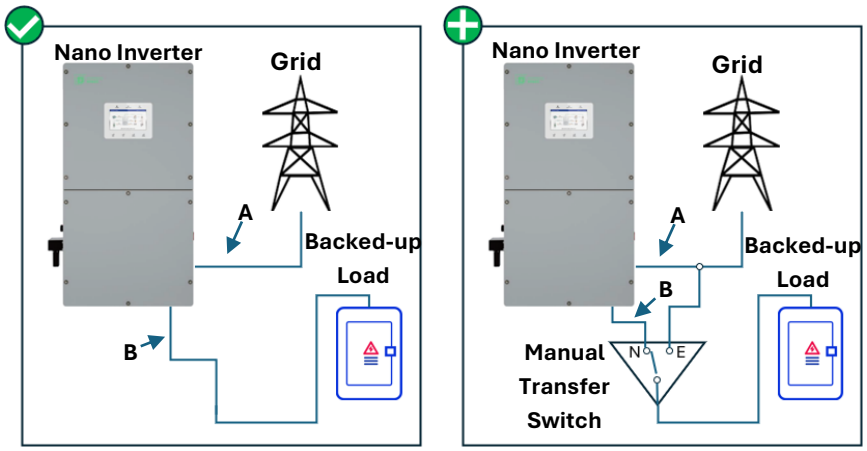


(**A –** to inverter **grid ports**, **B –** to inverter **load ports**, **C –** to inverter **smart ports)**

Figure 4: Generator in Conjunction with a Nano Inverter

Application Notes – Manual Transfer Switch (Bypass Switch)

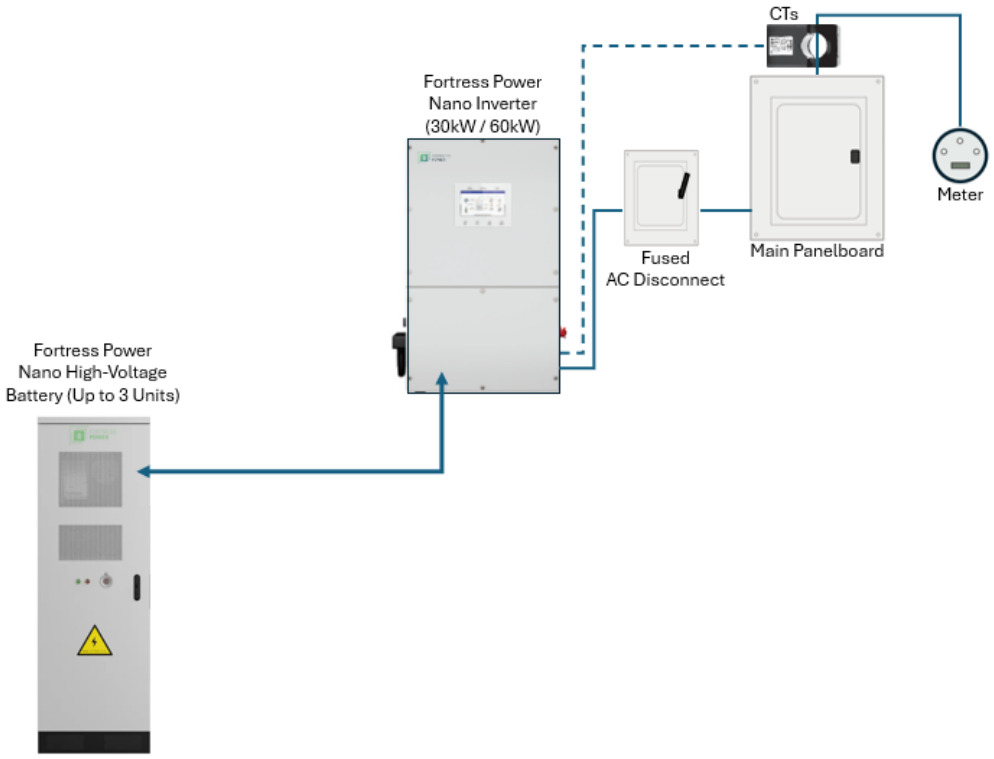
The Nano system may require maintenance, and although extremely unlikely, the possibility of complete and total failure of a Nano inverter cannot be ruled out. Thus, using a manual transfer switch or a bypass switch is recommended. When manual transfer switch is used, it is to have inverter load/backup ports connected to its normal ports, backed-up load panel connected to its load ports, and emergency ports will have power cables connected to them which branch of anywhere between the meter and the grid ports of the inverter. Thus, the switch position will determine whether the power to the loads is delivered from the grid or the inverter backup/load ports. Please note, that even when the power flow is bypassing the Nano inverter(s), that itself doesn't prevent the grid voltage from being applied to the grid ports of the Nano inverter(s).



(**A –** to inverter **grid ports**, **B –** to inverter **load ports**, **C –** to inverter **smart ports)**

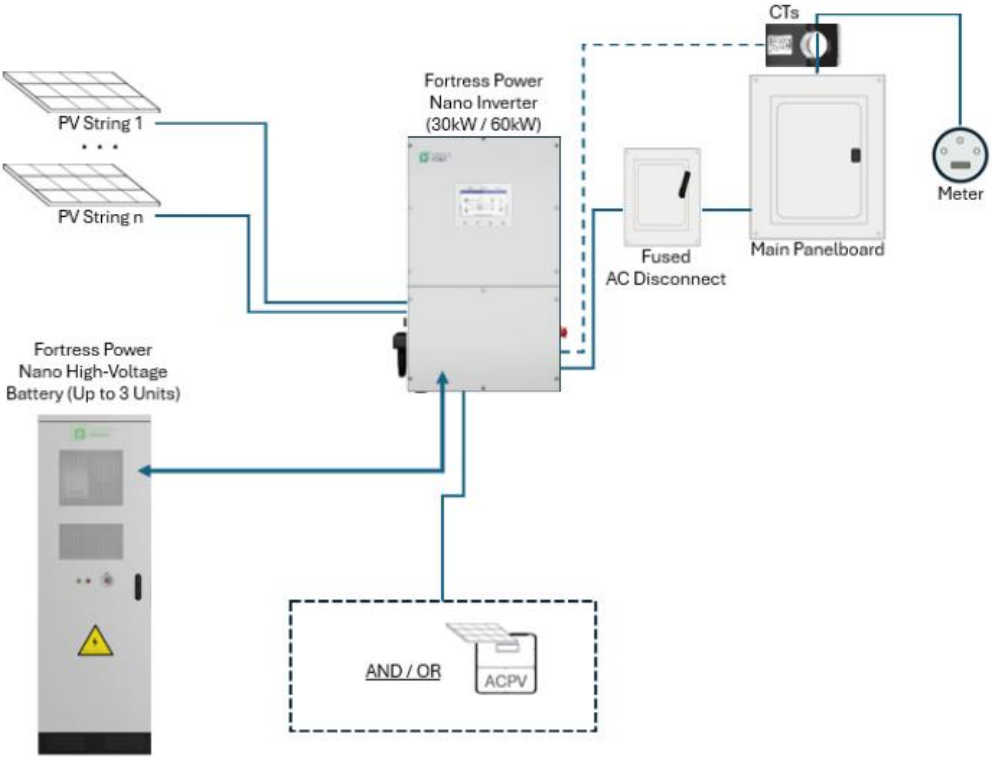
Figure 5: AC-Coupled PV (AC – PV) in Conjunction with a Nano Inverter

Sample Conceptual SLDs



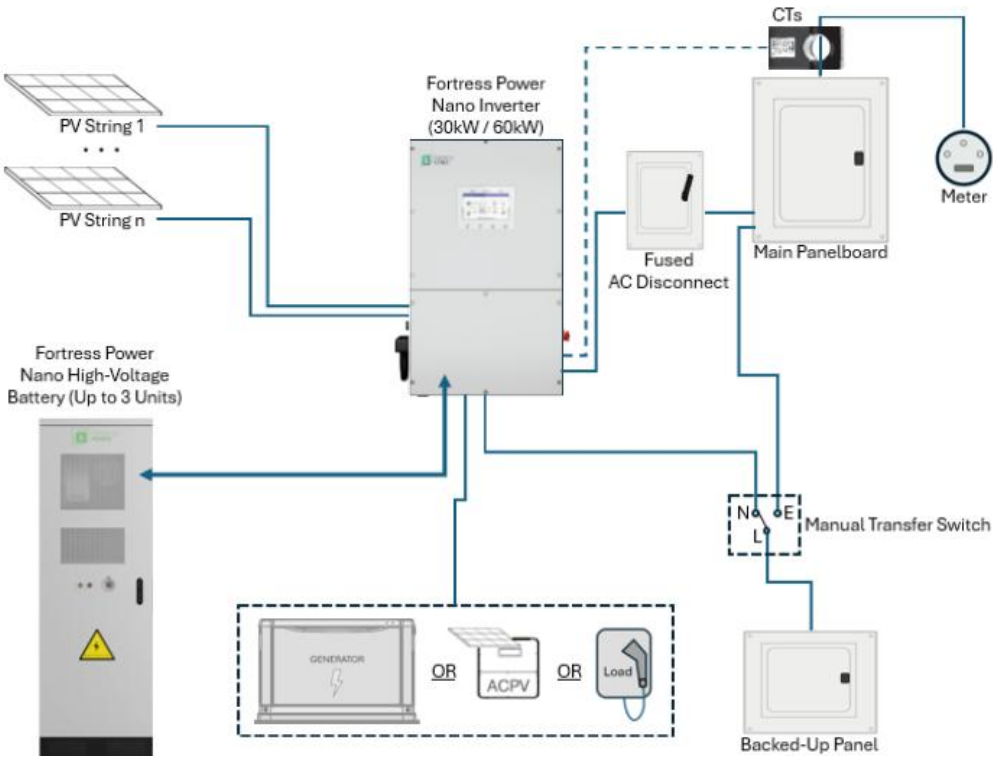
- AC Disconnect may be "skipped"
  If it is allowed to have only breaker as an only OCPD
- In many cases, Rogowski coils are used instead of CTs
- Included meter is not shown but is assumed to be present

Figure 6: non-backup application (TOU/peak-reduction)



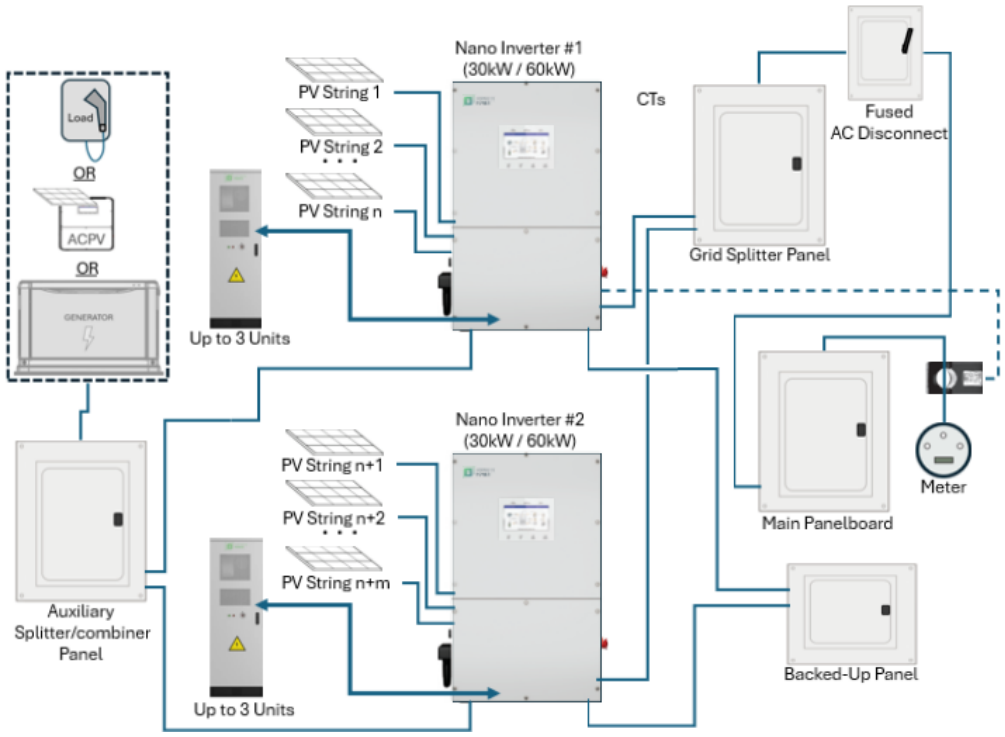
- AC Disconnect may be "skipped"
  If it is allowed to have only breaker as an only OCPD
- In many cases, Rogowski coils are used instead of CTs
- Included meter is not shown but is assumed to be present

Figure 7: non-backup application with PV (TOU/peak-reduction/self-consumption)



- AC Disconnect may be "skipped"
  If it is allowed to have only breaker as an only OCPD
- In many cases, Rogowski coils are used instead of CTs
- Included meter is not shown but is assumed to be present
- Manual Transfer/bypass switch is an optional, but a recommended item

Figure 8: backup application with PV (TOU/peak-reduction/self-consumption + backup)



- AC Disconnect may be "skipped"
  If it is allowed to have only breaker as an OCPD
- In many cases, Rogowski coils are used instead of CTs
- Included meter is not shown but is assumed to be present
- Manual Transfer/bypass switch is an optional, but a recommended item

Figure 9a: backup application with multiple inverters and PV, without ESS bypass (TOU/peak-reduction/self-consumption + backup, no bypass)

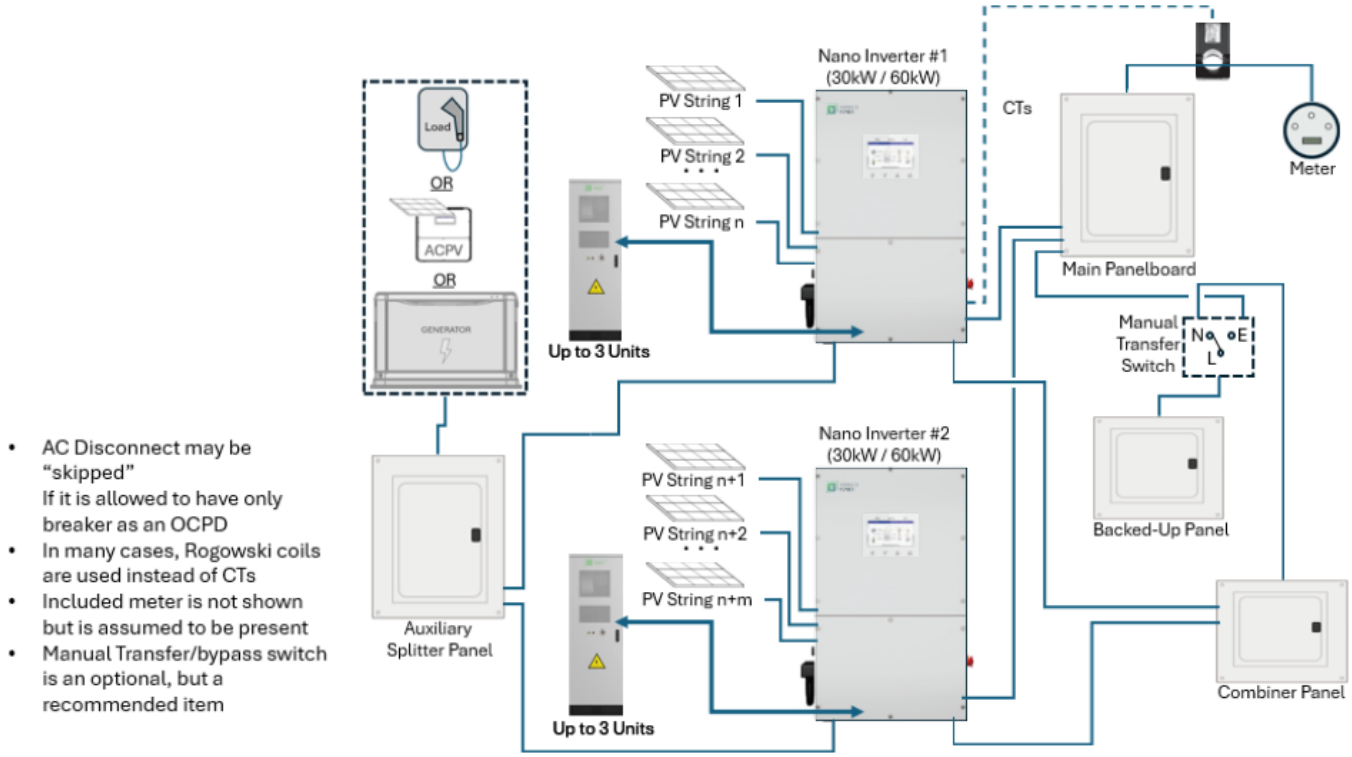


Figure 9b: backup application with multiple inverters and PV, with ESS bypas (TOU/peak-reduction/self-consumption + backup)

Storage Guidelines

If the inverter is not installed immediately after it is delivered, it must be stored as per the storage instructions provided below.

- If the package was opened, reseal and repackage the inverter in its original box. Make sure to reseal the package using the adhesive tape, and to have the desiccant inside the box.
- Store inverters on a flat, hard surface. The package must not be inclined or upside down.
- Do not stack more than two inverters on top of one another.
- Store the inverter in a clean and dry place, free of dust and dirt. The storage temperature must be between –22 to 158°F and humidity should be between 0 to 100%, non-condensing.
- Keep the box(es) away from corrosive materials to avoid damage to the inverter enclosure.
- Inspect the packaging regularly. If packaging is damaged (wet, pest damage, etc.), repackage the inverter immediately.

- Do not remove the desiccant packet that is included with the inverter. It is included to ensure that any residual moisture is absorbed quickly.
- Restarting after a long period of non-use requires the equipment to be inspected and, in some cases, the removal of oxidation and dust that has settled inside the equipment will be required.
- Perform an annual visual inspection of the inverter box for signs of damage if the equipment is stored for over a year.
- If the inverter has been removed from the box and then replaced, put desiccant packets in the inverter service compartment to ensure the internal components stay dry.
- Do not store the inverter outdoors or in a place that does not have environmental controls.

Installation Overview

WARNING: Risk of Fire

Despite careful installation, electrical equipment can cause fires.

- Do not install the inverter in an area that contains flammable materials, liquids, or gases.
- Do not install the inverter in a potentially explosive environment.
- The structure on which the inverter is being mounted must be fireproof.

WARNING: Risk of Shock

Despite careful installation, electrical devices present a shock hazard.

- Install the equipment out of reach of children if children may be present.
- Ensure that the equipment covers are always in place whenever the equipment is not being serviced.
- Never service live equipment. Always turn the equipment off first. Use a multimeter to verify that conductor voltages are zero.

CAUTION: Hot Surface

- The temperature of the inverter heat sink can reach 167°F. Do not touch the heat sink while the inverter is operating.

WARNING:

The inverter is very heavy. Please use proper lifting techniques to avoid potential injury. It is recommended that two people lift the inverter together.

WARNING

Only devices in compliance with SELV (IEC 62368-1) may be connected to the RS485 and USB interfaces

WARNING

Do not connect PV array positive (+) or negative (-) to ground, doing so could cause serious damage to the inverter.

WARNING

Electrical installations must be done in accordance with local and national electrical safety standards.

WARNING

Do not touch any internal parts until 5 minutes after disconnection from the utility grid, PV array, and battery.

WARNING

To reduce the risk of fire, over-current protective devices (OCPD) are required for all circuits connected to the inverter.
The DC OCPD shall be installed per local requirements. All photovoltaic source and output circuit conductors shall have isolators that comply with the NEC Article 690, Part II.
All Fortress three phase inverters feature an integrated DC disconnect switch.

CAUTION

Risk of electric shock, do not remove the cover. There are no serviceable parts inside, refer servicing to qualified and accredited service technicians.

CAUTION

The PV conductors are energized with high voltage DC when the PV modules are exposed to sunlight.

CAUTION

The surface temperature of the inverter can reach up to 75 (167°F).
To avoid risk of burns, do not touch the surface of the inverter while it is operating. The inverter must be installed out of direct sunlight exposure.

NOTE

PV modules used with inverter must have an IEC 61730 Class A rating.

WARNING

Operations must be accomplished by a licensed electrician or a person authorized by Fortress.

WARNING

Installer must wear personal protective equipment during the entire installation process in case of electrical hazards.

WARNING

The AC Backup Port of the inverter cannot be connected to the grid.

WARNING

Please refer to the product manual of the battery before installation and configuration to the inverter.

The inverter package comes with multiple items included (**Figure 10**). Generally, it is expected for all of these items to be used during installation.

There are no tools included with the package. The tools expected to be required during installation are shown in **Figure 11,** yet additional tools not shown in the said figure may also be needed in specific cases. Furthermore, it is strongly recommended to have a smartphone and internet connection at the site to fully commission the system, including monitoring platform configuration.

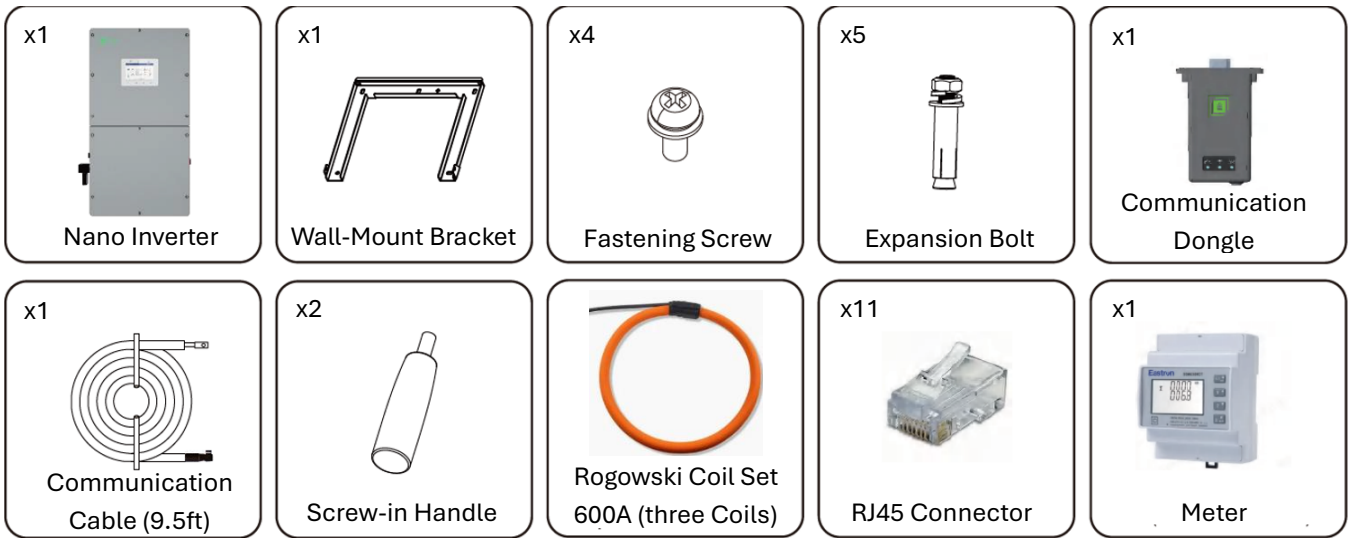


Figure 10: Items included with Nano inverters

Figure 11: Tools Expected to be needed for Nano inverter installation

The installation area for a Nano inverter must be selected carefully. The ambient temperature and relative humidity of the installation environment must meet the following requirements:

- Minimum ambient temperature: -13ºF (-25ºC)
- Maximum ambient temperature: 140ºF (60ºC)
- Relative humidity: up to 100%, non-condensing

Although the inverter is outdoor rated, it is not allowed to have an installation in which the inverter is installed such that it faces south (in the northern hemisphere, or north in the southern hemisphere) without adequate shading over it to prevent it from being exposed to direct sunlight for prolonged periods of time. If this restriction is not followed the inverter may have reduced performance, premature wear of the electrical, electronic, and mechanical components and the warranty on the unit may be void.

Installation area must be selected such that there is at least 20 inches of clearance on either side of the inverter (left, right, top, bottom) and anything else. If two inverters are installed across one horizontal line, the clearance between them must be no less than 31.5 inches.

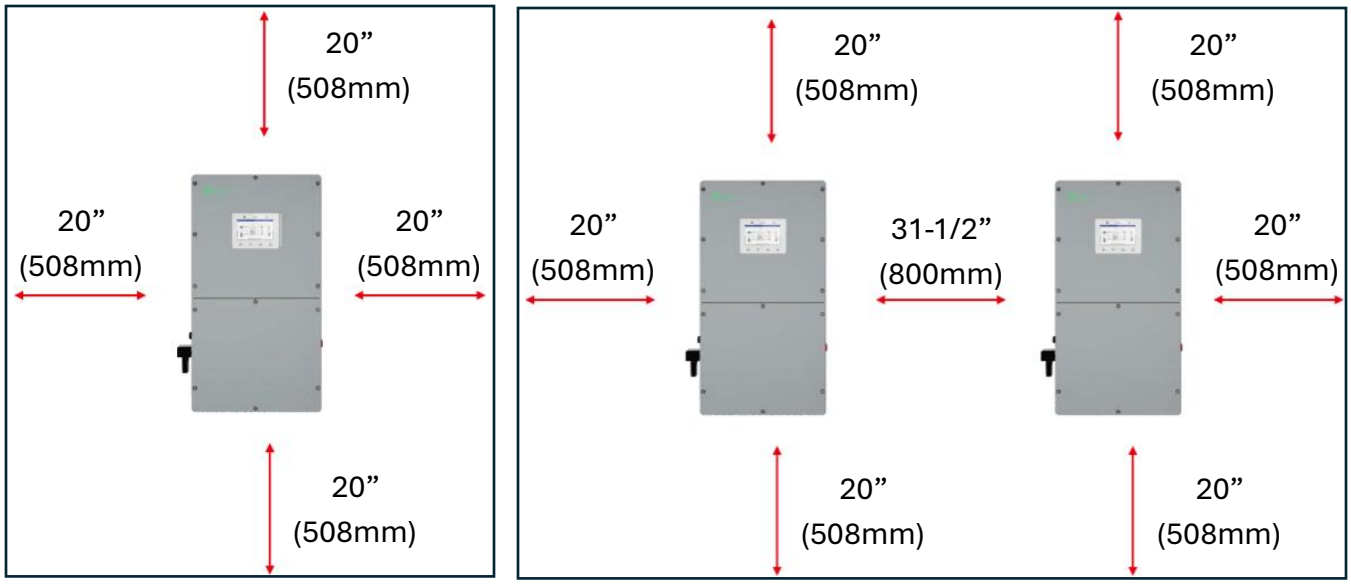


Figure 12: Clearance requirements for one (left) or multiple (right) Nano inverters

A Nano inverter must not be installed:

- in areas or rooms where the air cannot circulate freely. To prevent the unit overheating, always ensure that the air flow around the inverter is not blocked.
- in a living area where prolonged presence of people or animals is expected. Note that depending on where the inverter is installed and the quality of the electricity supply, the sound level from the inverter can be uncomfortable to hear.
- near flammable substances. A Nano inverter must be at least 10ft (3m) away from flammable substances at all times.
- at a higher elevation than 8208ft/2500m (unless the unit is derated accordingly)

A Nano inverter must always be installed such that it is mounted on its wall bracket (included with every Nano inverter). The bracket itself must be flush against the surface on which it is installed. The surface at which the bracket is installed must be vertical and have no tilt. The arrow cutout on the bracket must be pointing up when installed. The wall at which the bracket is installed (i.e. the inverter is installed on as well) must be made of a nonflammable materials and must have a load bearing capacity of at least four times the combined weight of the Nano inverters installed on the wall. It is allowed to have multiple inverters installed on the opposing sides of a wall, but in such case the distance between the opposite planes must be at least 12”.

Figure 13: Minimum wall width requirement for a wall with multiple inverters on opposite sides

Four fasteners must be used to secure the bracket onto the wall, ensuring that the bracket does not come off the wall. All four of them must be embedded appropriately to bear the inverter weight.

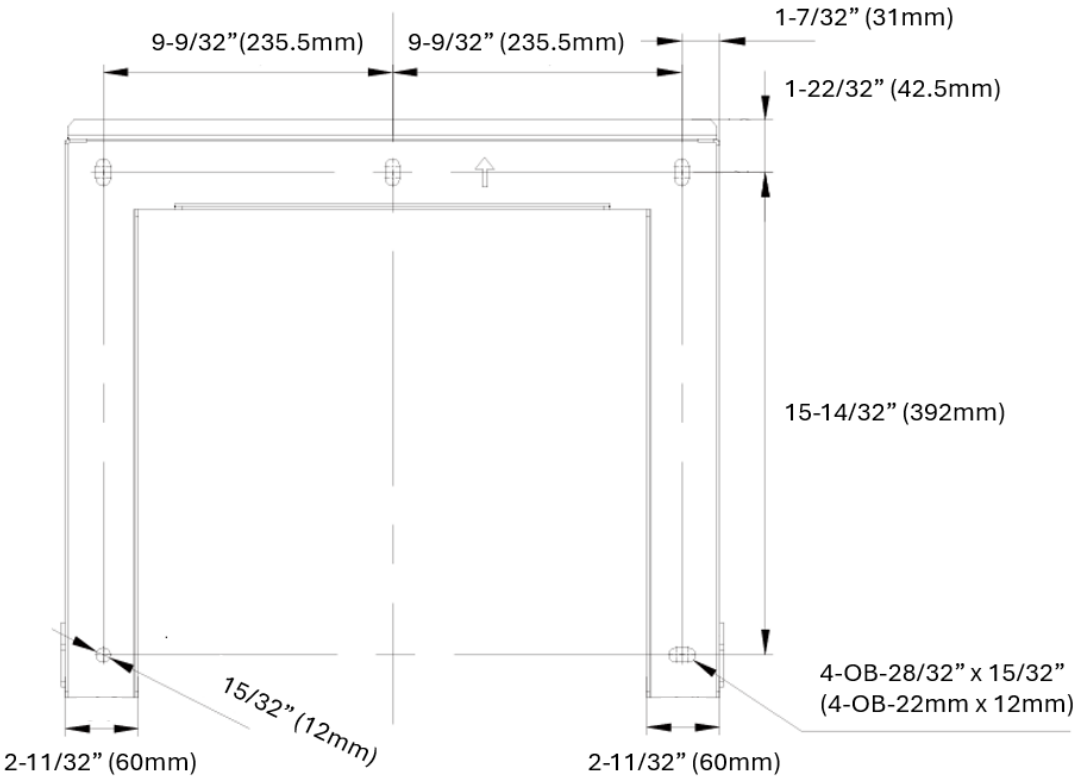


Figure 14: Nano Inverter Wall Bracket Dimensions

The Nano inverters come with two screw-in black handles. It is strongly recommended to use the handles to safely lift and maneuver the inverter. The handles are not pre-attached to the inverter, rather they must be screwed in before moving the inverter. Once the inverter is installed in its permanent location, the handles may be removed. At least two people are required to lift the inverter. Use of special power/hydraulic/mechanical lifting equipment is strongly recommended for lifting and handling the inverter. The inverter must be lifted and moved slowly and gently to prevent damage the inverter, its accessories, and its internal components.

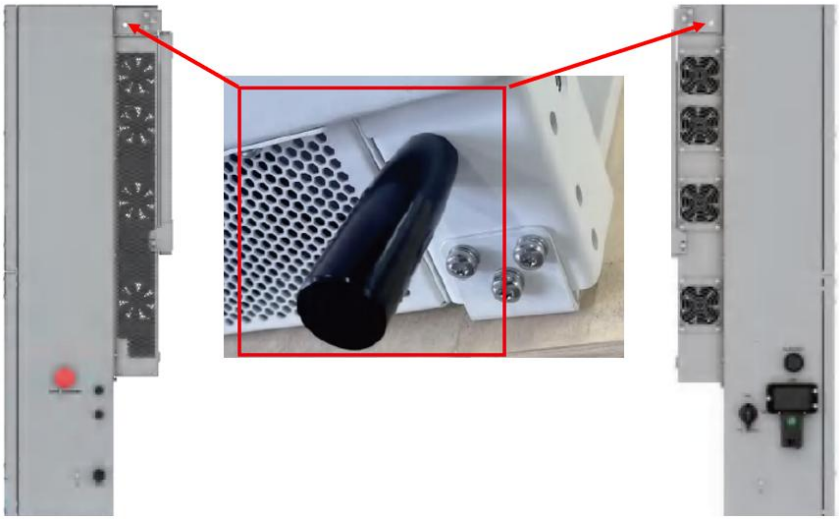


Figure 15: Nano inverter handle screw-in locations

To Mount the inverter onto the bracket:

- Lift the inverter and align the back two hooks on the heat sink with the two tabs on the inverter mounting bracket
- Lower the inverter hooks down onto the mounting bracket tabs and ensure the hooks have a solid bite before releasing the inverter
- Install the two set screws that are included with the inverter for stabilization.

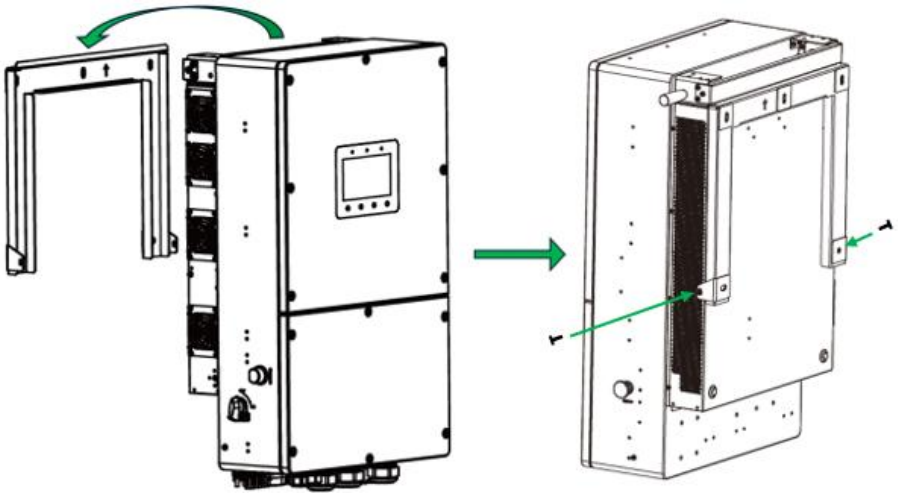
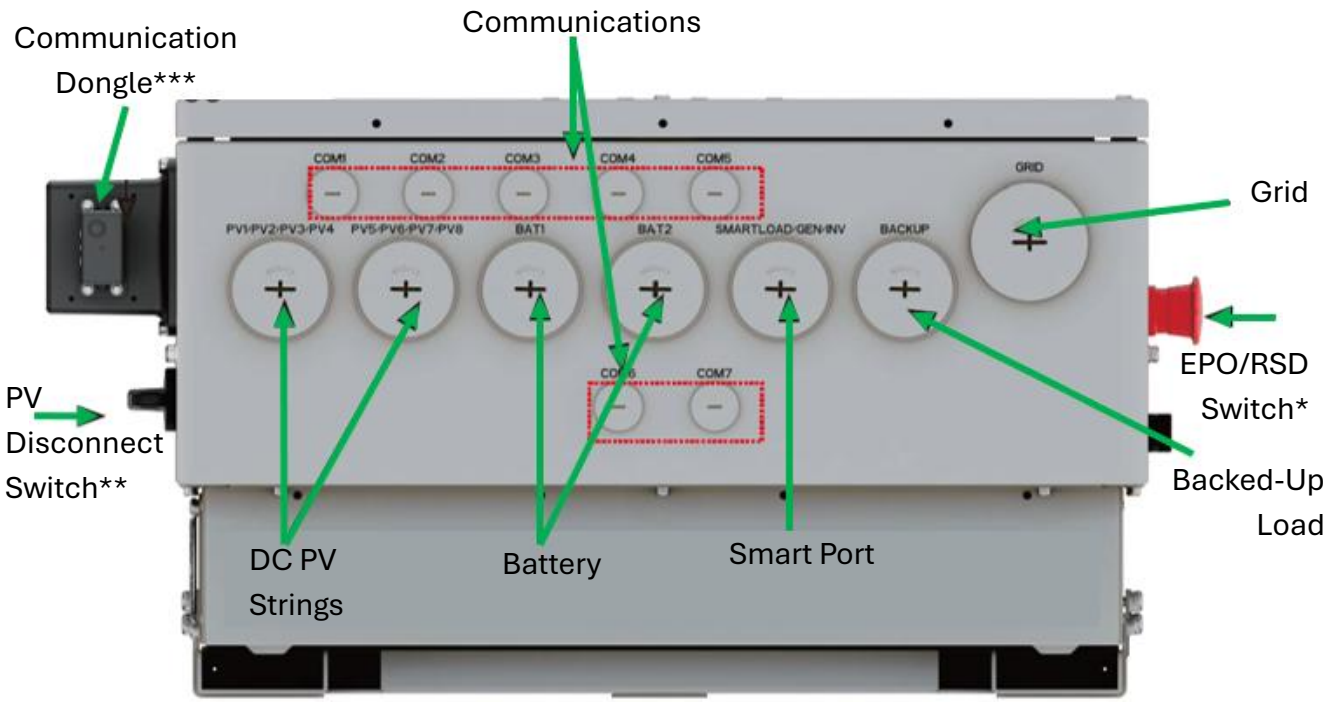


Figure 16: “Hang” and secure the Nano inverter onto its support bracket

The inverters have multiple conduit inlets/holes/entrances. Although these inlets are labeled for specific use to achieve most optimal installation of cables and conductors, it is allowed to use the conduit entrances for conductors and conduits of different purpose than the labels suggest.

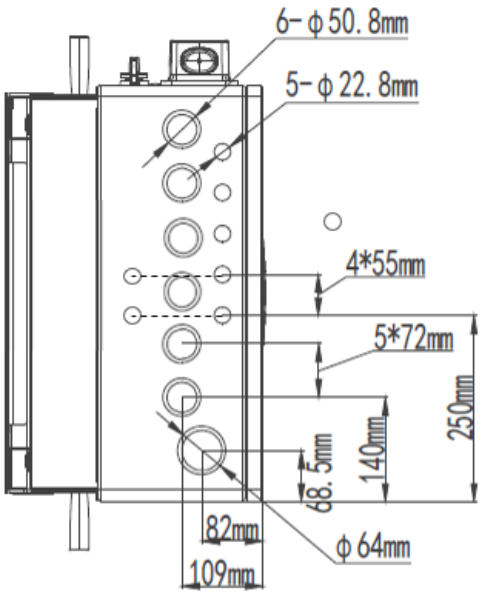


***When pushed-in enables PV rapid shut down using the built-in APSystems transmitter**

****When in the off position, prevents voltage from the PV array being applied to the MPPTs**

*****Must be installed at all times regardless of application. Simply plug the dongle in the designated port and secure it in place with the four screws included.

Figure 17: Conduit entrances and exterior switches/buttons



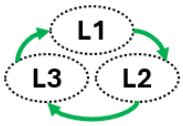
Unit Conversion Table

mm	in. (Fraction)	in. (Decimal)
22.8	29/32	0.898
50.8	2	2.000
55	2-11/64	2.165
64	2-17/32	2.520
68.5	2-45/64	2.697
72	2-27/32	2.835
82	3-15/64	3.228
109	4-19/64	4.291
140	5-33/64	5.512
250	9-27/32	9.843

Figure 18: Conduit entrance dimensions

Power Conductor, Ground, and Neutral Ports

All conductor ports on the Nano inverters must be used as designated (**Figure 19, Table 2**):



- Grid ports must not receive any other signal but the AC signal from the grid. To avoid equipment damage, phase rotation of the AC signal delivered to the inverter grid ports must be checked to be valid/clockwise. Furthermore, Each AC line must connect to the matching port on the meter and the Nano inverter. For example, if line 1 of the grid AC signal is connected to the Nano inverter's L1 grid port, then voltage reference wire of the line 1 must also connect to the meter's L1 terminal. The same one-to-one pairing applies for line 2 and line 3.
- If a Nano inverter is used for off-grid application, there may be no conductor connected to the grid ports on the inverter.
- Smart ports on the inverter must be used for one of these three purposes: to connect a generator output to the inverter, to connect the AC-coupled PV output to the inverter, to connect one load or load circuit to the inverter.
- Battery ports on the inverter must be used for battery to inverter connection only (power cables). Both positive and both negative ports must connect to one battery or busbar.
- Load/backup ports are to be used for only connecting the backed-up load panel/circuit to the inverter. There may be no other AC power source connected to the backed-up circuit which can output power simultaneously with the inverter load/backup ports.
- PV ports are to be used for connecting DC PV strings to the inverter. There may be no more than one string connecting to a single pair of positive and negative PV ports. Furthermore, one string must be connected to one pair of ports. For example, it is not allowed to connect the positive cable of a string to "PV1+" port and connect the negative cable of the same string to any other port than "PV1-".

For information on conductor sizes and torque specs for each port, please refer to **Table 2b**.

Four Hex bit sizes are required:

- grid ports – 8mm, Neutral – 7mm, AC ground – 5mm, DC ground – 3mm – 3mm.

Fortress Power recommends to use appropriately sized ferrules at the end of the power, signal, ground, and neutral conductors that connect to the Nano inverter.

Tools are not required for PV ports – to open the lock mechanism, simply rotate the orange spring clamp up with your fingers till you hear a distinctive click, enabling the conductor (with 0.5'' of it exposed without the jacket) to slide in; once the conductor is in, hold it in place while rotating the spring clamp down to secure the conductor in place. Gently pull the conductor down to ensure that it is locked in place securely. Please note, once the conductor is in place, there must be no visible metal portion of the conductor outside of the port (**Figure 20**).

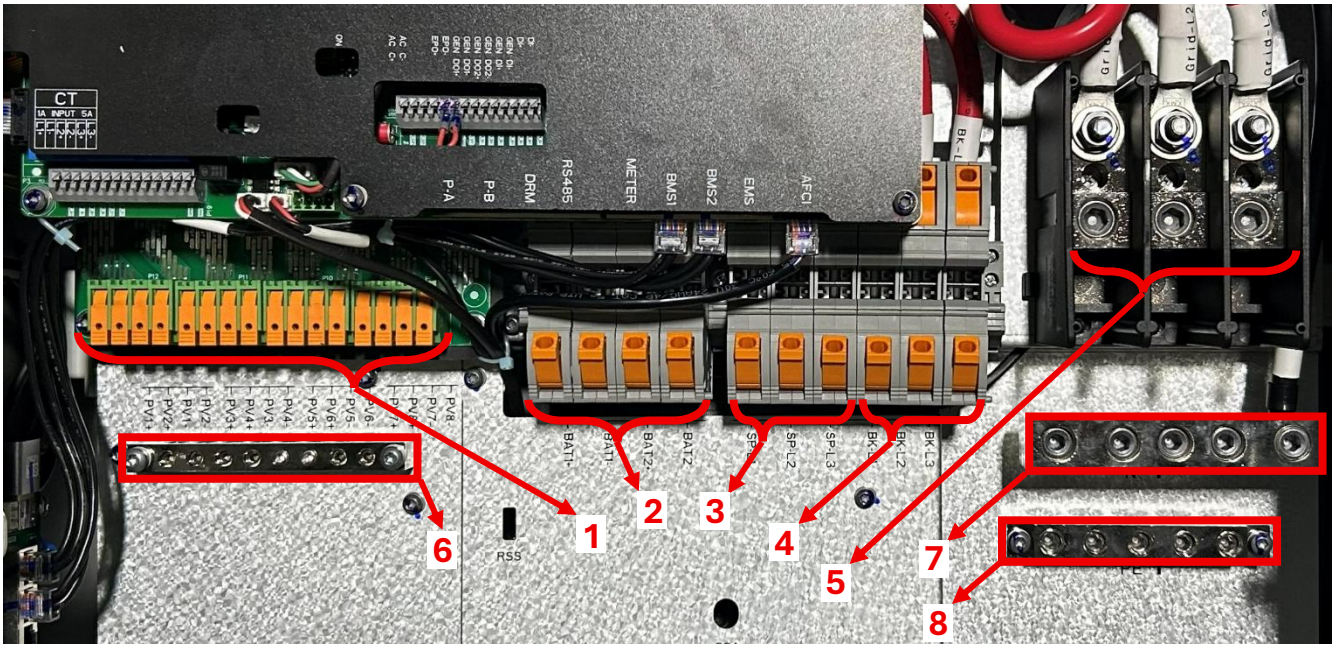


Figure 19: Inverter ports for power, ground, and neutral cables

	Description	Notes (sequences listed left to right)
1	DC PV ports	First group of 4 ports is MPPT1(PV1 PV2), second group of 4 ports is MPPT2(PV3,PV4), etc. On one MPPT first two ports are positive and second two ports are negative. For example, on MPPT1 (left to right: PV1+, PV2+, PV1-, PV2-.
2	Battery ports	Unlike MPPTs, battery ports are (left to right): BAT1+, BAT1-, BAT2+, BAT2-
3	Smart ports	Left to right: L1, L2, L3.
4	Backup/Load ports	Left to right: L1, L2, L3.
5	Grid ports	Left to right: L1, L2, L3.
6	DC Ground bar	Used only for DC ground.
7	Neutral bar	Used only for Neutral
8	AC Ground bar	Used only for AC ground.

Table 2a: Description of inverter power, ground, and neutral ports

	Description	Conductor Size Range	Torque Specification
1	DC PV ports	10 AWG – 8 AWG	N/A (Spring Clamp)
2	Battery ports	12 AWG – 2 AWG	N/A (Spring Clamp)
3	Smart ports	12 AWG – 2 AWG	N/A (Spring Clamp)
4	Backup/Load ports	12 AWG – 2 AWG	N/A (Spring Clamp)
5	Grid ports	2 AWG – 2/0 AWG	13 N·m – 15 N·m (8 lb·ft – 11 lb·ft)
6	DC Ground bar	6 AWG – 1 AWG	6.5 N·m – 8 N·m (4.8 lb·ft – 5.9 lb·ft)
7	Neutral bar	6 AWG – 2/0 AWG	10 N·m – 12 N·m (7.4 lb·ft – 8.9 lb·ft
8	AC Ground bar	2 AWG – 2/0 AWG	6.5 N·m – 8 N·m (4.8 lb·ft – 5.9 lb·ft)

Table 2b: Conductor size range and torque spec. for inverter power, ground, and neutral ports

The battery, backup/load, and smart ports require a flathead screwdriver (or any appropriate metal rod), the diameter of which allows the screwdriver to reach the end of the spring clamp lever hole yet it is still of a diameter wide enough that the gap between the interior of the lever and the flathead screwdriver (or any appropriate metal rod) is minimal.

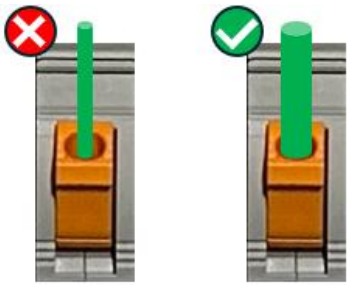


Figure 20: Illustration of the information in the paragraph above

As one may have correctly concluded, the Nano inverters are not equipped with or have included in the package the power conductors, overcurrent protection devices or conduits. These items must be procured and installed by relevant parties outside of Fortress Power. While selecting an appropriate OCPD devices, please refer to current ratings given in **Table 1**.

Conductor, conduit, and overcurrent protection device sizing shall be done in accordance with the NEC and local electrical codes & standards.

Connecting Conductors to Battery, Backup, and Smart Ports

Before connecting a wire to either grid, backup/load, or smart ports, the insulation at the end of the cable must be removed such that ~0.5” of conductor is exposed at the end of the wire that is to connect to either of the above mentioned ports. Once ensured that the spring clamp lever is in the unlocked position, the wire into the port, and while holding it in place, use the scredriver to put the spring clamp lever in the locked postion (pulling it down). Gently pull down on the wire to ensure that it is firmly secured and connected. Please note, once the conductor is in place, there must be no visible metal portion of the conductor outside of the port.

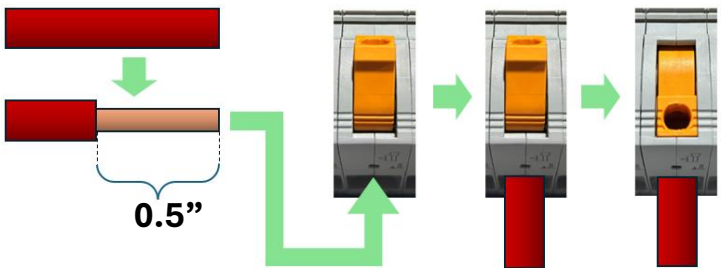


Figure 21: Illustration of the information in the paragraph above

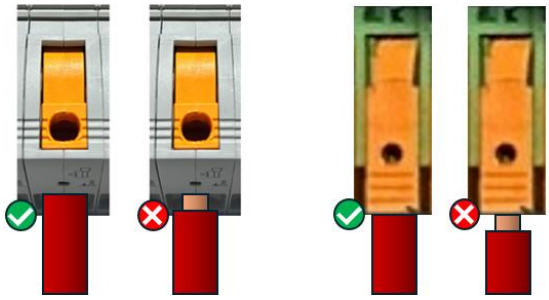
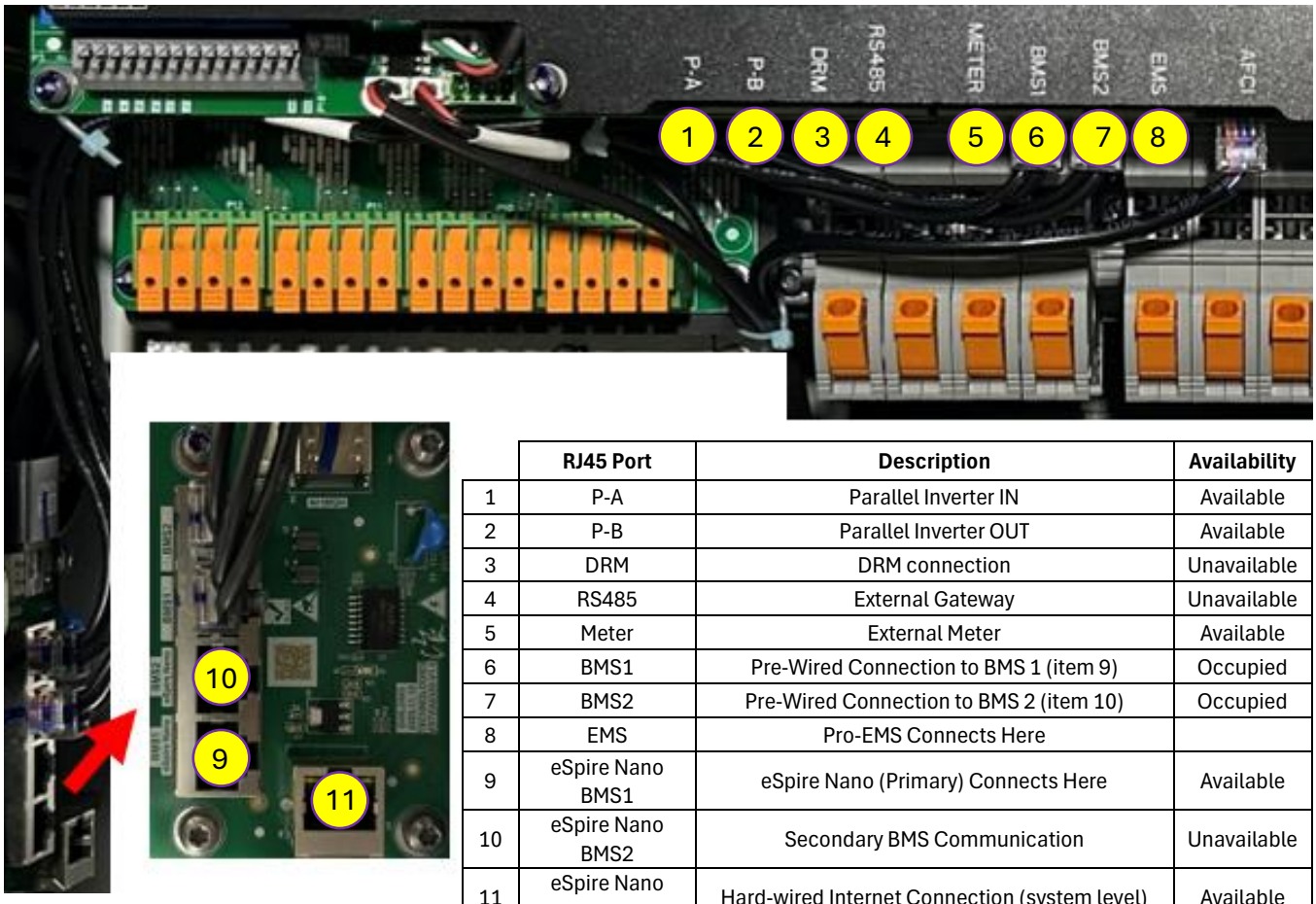


Figure 22: Illustration of Correctly Connected Conductors to the Spring Clamps

RJ45 Communication Ports

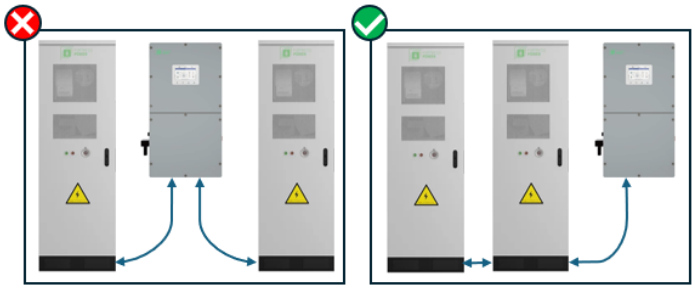
Nano inverter is equipped with two communication boards, each of which has multiple ethernet (RJ45) ports. The two boards are interconnected from the factory and are to remain so. Each port must be used as designated and never for any other purpose but the one it is intended for. Please refer to **Figure 23** and below for port definition and information.



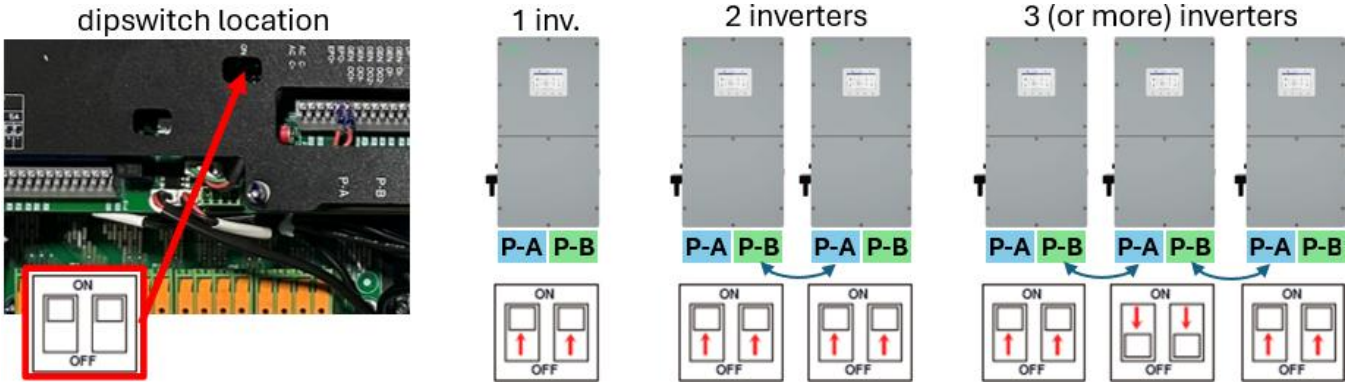
	RJ45 Port	Description	Availability
1	P-A	Parallel Inverter IN	Available
2	P-B	Parallel Inverter OUT	Available
3	DRM	DRM connection	Unavailable
4	RS485	External Gateway	Unavailable
5	Meter	External Meter	Available
6	BMS1	Pre-Wired Connection to BMS 1 (item 9)	Occupied
7	BMS2	Pre-Wired Connection to BMS 2 (item 10)	Occupied
8	EMS	Pro-EMS Connects Here	
9	eSpire Nano BMS1	eSpire Nano (Primary) Connects Here	Available
10	eSpire Nano BMS2	Secondary BMS Communication	Unavailable
11	eSpire Nano Ethernet	Hard-wired Internet Connection (system level)	Available

Figure 23: RJ45 Ports

- The communication cable from the included meter connects to the “Meter” port (item 5 in **Figure 23**).
- The communication between a battery (or a battery group) is established beteween the primary battery in the group and the Nano inverter with which the battery (or the battery group) is to work. Communication cable from the primary battery connects to the Nano inverter’s and the inver primary battery from the battery bank connects to “BMS1 eSpire Nano” port (item 9 in **Figure 23**). The battery to inverter communication cable is included with the battery package.

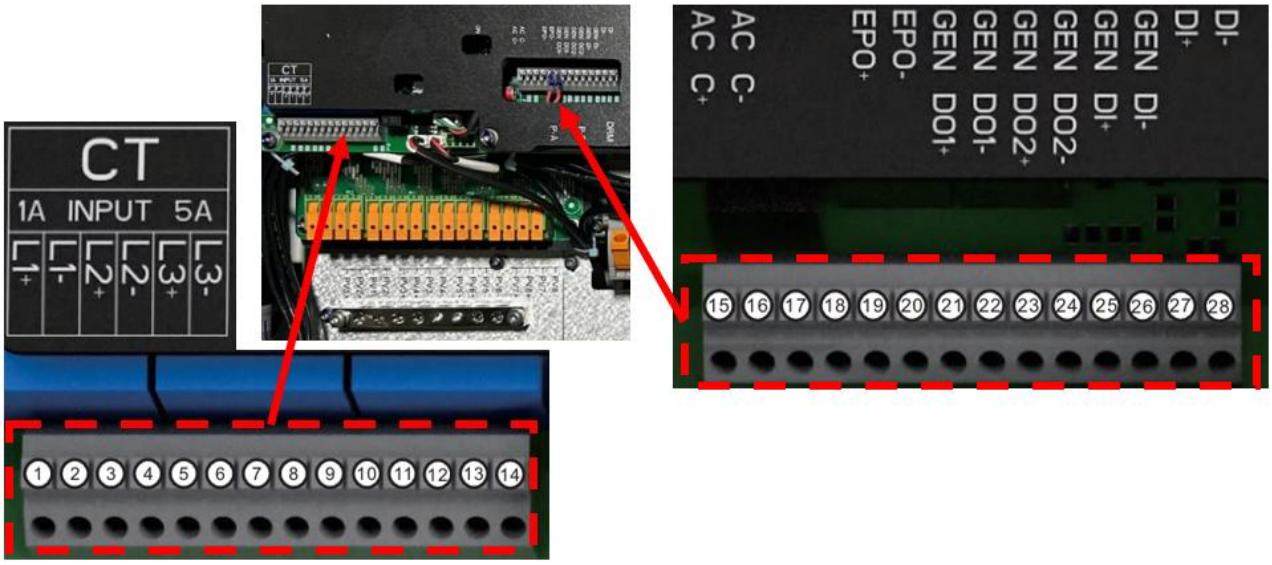


- If instead of wireless internet signal a hard-wired internet is to be used for the Nano system to be online, hard-wired internet cable must connect to “Ethernet eSpire Nano” port (item 11 in **Figure 23**). The communication dongle connection to the inverter is required in this case as well.
- **If multiple Nano inverters are used in parallel**, except for the last inverter in the sequence, each inverter must have a communication cable (CAT5/CAT6) connected between its P-A port and the P-B port of the next inverter in the sequence. **Additionally**, the first and the last inverter in the sequence must have the communication dipswitches in the ON position, whereas all other inverters in the sequense must have the communication dipswitches in the OFF position. Please note, **if there are only two** inverters in the sequence, both of them must have the communication dipswitches in the ON position (since there are only two inverters, one of them has to be first one in the sequence, whereas the other in the inverter is the last). In **one-inverter systems**, the communication dipswitch must be in the ON position. See the illustration below.



Signal Communication Ports

Nano inverters are equipped with signal communication ports. Currently, at the moment of writing this document, there are four ports which are available for use: two EPO, and two GEN DO2 ports (labeled on **Figure 24** as 19, 20, 23, and 24, respectively). GEN DO2 ports output NO (normally open) signal and allow to connect generator 2-wire start wires to the inverter. EPO ports allow to connect an external emergency power-off switch to the Nano Inverter. To do so, the factory installed jumper must be removed and the EPO switch wires connected. Please note, the system enters the EPO mode if the continuity between the EPO+ and EPO- ports is interrupted (**Figure 24**).



	Port	Description	Availability
1	CT_L1+	CT set L1	Unused
2	CT_L1-		Unused
3	CT_L2+	CT set L2	Unused
4	CT_L2-		Unused
5	CT_L3+	CT set L3	Unused
6	CT_L3-		Unused
7	Unassigned		Reserved
8	Unassigned		Reserved
9	Unassigned		Reserved
10	Unassigned		Reserved
11	Unassigned		Reserved
12	Unassigned		Reserved
13	Unassigned		Reserved
14	Unassigned		Reserved

	Port	Description	Availability
15	AC+	Dry, External Switching Signal	Unavailable
16	AC-		
17	Unassigned		Reserved
18	Unassigned		Reserved
19	EPO+	Dry, External EPO Button/Switch	Available
20	EPO-		
21	GEN DO1+	Dry, Generator 2-Wire Start (Autostart)	Unavailable
22	GEN DO1-		
23	GEN DO2+	Dry, Generator 2-Wire Start (Autostart)	Available
24	GEN DO2-		
25	GEN DI+	5V/12V, ATS Switching Signal	Unavailable
26	GEN DI+		
27	DI+	Dry, ATS Switching Signal (5V/12V)	Unavailable
28	DI-		

Figure 24: Signal communication ports

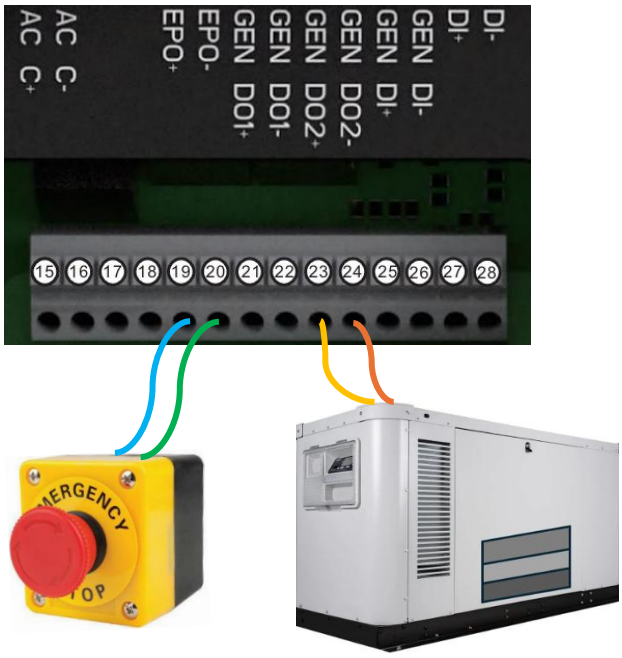


Figure 25: Auto-start and external eStop button signal wires connected to a Nano inverter

Connecting signal wires doesn't require special tools, simply press in the button above the port and slide in the exposed portion (~0.25") into the port, and while holding the wire in place, release the button. Gently tug on the wire to make sure that it is firmly in place. Note, the wire size must not be smaller than 22AWG or greater than 16AWG.

Meter Interconnection

Each Nano inverter package includes Eastron SDM630MCT meter. The inverters are UL3141 certified with the said meter type. Even though the inverters are equipped with appropriate ports to which three CTs can be connected, these ports are not to be used, but rather a CT set (three CTs) must be connected to the included meter, which itself is connected to a Nano inverter. If multiple inverters are used in parallel, the meter connects to the primary Nano inverter of the group. Refer to **Figure 26** for visualized information on meter interconnection method.
Besides the meter, three 600A Rogowski coils are also included with the inverter. If CTs of different current-monitoring capabilities are needed for a project, Fortress Power can provide CTs or Rogowski coils of rating different than 600A, upon request and for additional charge.

Important Notes:

- Only CTs/Rogowski coils that are on Fortress Power approved equipment list must be used with the meter.

- CTs/Rogowski coils must be installed such that their arrows point away from the meter.
- CTs/Rogowski coils must always be installed such that the meter is immediately upstream and the panels/panelboards are downstream of them, otherwise the CTs/Rogowski coils will not be able to capture the total powerflow to/from the site.
- The meter is not outdoor-rated. It is strongly recommended to install the meter in either of these locations: service compartment of a Nano inverter, electrical panel in which the CTs are installed, dedicated outdoor-rated enclosure.
- Wherever the meter is installed, it must be secured in place, at least by the means of a doublesided tape, such that the meter is secured and stationary in its permanent location.
- In the cases when there is an unusually long distance between the eSpire Nano inverter and the location where the CTs are installed, the meter and the CTs installed close to one another, and have a longer run of a meter to Nano inverter communication cable. The included CTs have cable lengths of 13.2ft (4m) and are not to be extended under any circumstances, since such extension may lead to significantly inaccurate readings.
- Besides the CTs, the meter must have line coltage reference wires connected to it as well: L1, L2, L3, N. Always ensure that the reference cables are connected in a correct phase rotation sequence. There are two main ways to originate the line voltage reference wires from an electrical panel: direct tap where the conductors connect to the electrical panel, installing a dedicated breaker to the busbar set and originate the line voltage reference wires from the breaker.
- CTs and line voltage reference wires must be matched correctly. For example, if a CT connects to #2 S1 and S2 ports, the CT must be matched to the same busbar as the L2 voltage reference wire (refer to **Figure 26**).
- The meter is powered by AC signal, namely by connecting LA and NA ports of the meter to to line and neutral, respectively (may that be 120V or 277V L to N; L1, L2, and L3 are equally appropriate). Please refer to **Figure 26** for a recommended way of delivering the AC voltage to the meter. 1A fast-blow fuse must be used upstream of the LA port, to protect the meter from a potential damage.
- Nano inverter to meter communication cable must be modified such that pins 3,4,5,6,7, and 8 cannot transmit a signal, whereas the pin 1 connects to TX+ A port and pin 2 connects to TX- B port on the meter. Please refer to **Figure 26**.

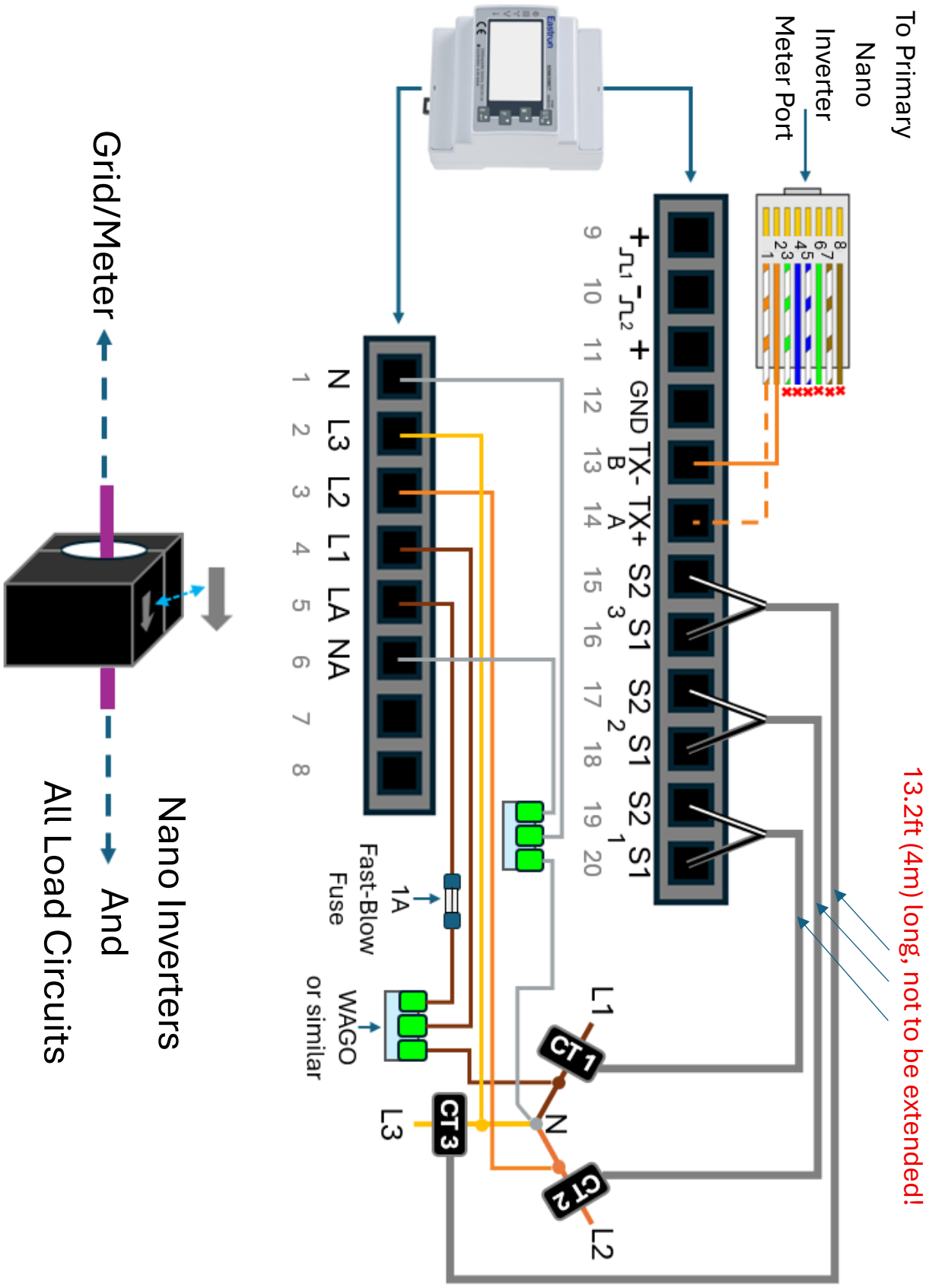
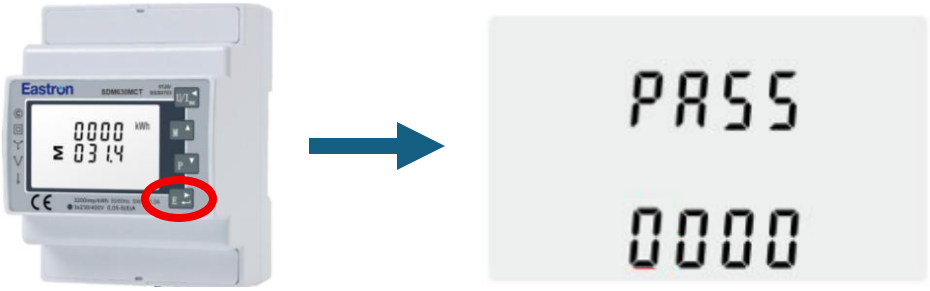


Figure 26: Meter Connection

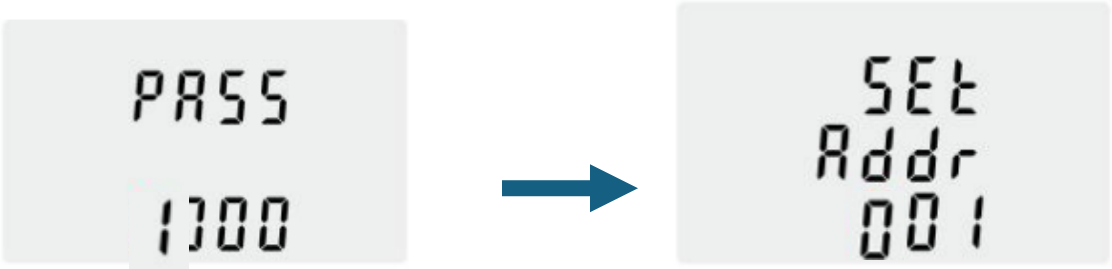
Meter Programing

The meter (and the primary Nano inverter) must be programmed appropriately to avoid incorrect readings.

1. Enable the AC power supply to the meter such that the line-to-neutral voltage is applied to the LA and NA ports of the meter.
2. Press in the “enter” button and keep it held in until the displayed information on the screen changes.



3. Now the password is to be entered. The default password is “1000”. Use the up (M) and down (P) arrow buttons to increase or decrease the value of the blinking digit, use enter button (single press) to enable chinging of the next digit, once the correct password is entered, Press in the enter button and keep it held in until the displayed information on the screen changes.



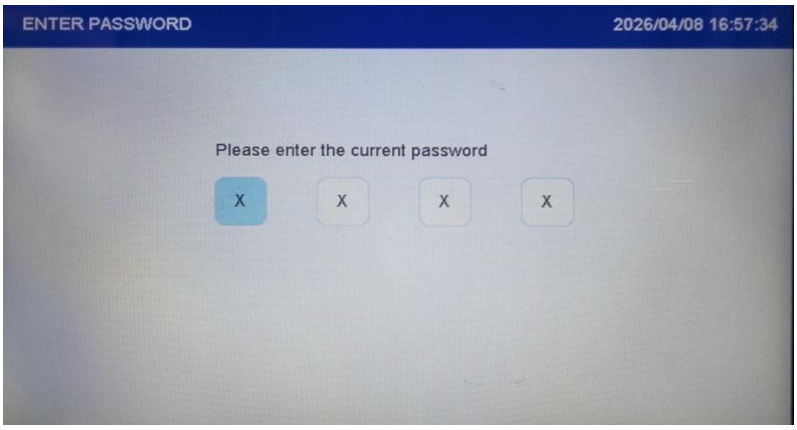
4. Using the down (P) arrow button, navigate to the menu item shown below (SEt Ct 2), ensure that the value is set to “1”. To adjust the value press in the “enter” keep it held in until the displayed value starts blinking. Use the up (M) and down (P) arrow buttons to increase or decrease the value of the blinking digit. Once the value is set to “1”, press in the enter button and keep it held in until the displayed value stops blinking. Once the new value is acknowledged, screen will display the message which reads “GOOd“

5. Using the down (P) arrow button, navigate to the menu item shown below (SEt Ct 1), ensure that the value is set to “60”. To adjust the value press in the “enter” keep it held in until the displayed value starts blinking. Use the up (M) and down (P) arrow buttons to increase or decrease the value of the blinking digit. Use the enter button (single press) to enable changing of the next digit. Once the value is set to “60”, press in the enter button and keep it held in until the displayed value stops blinking. Once the new value is acknowledged, screen will display the message which reads “GOOd“.

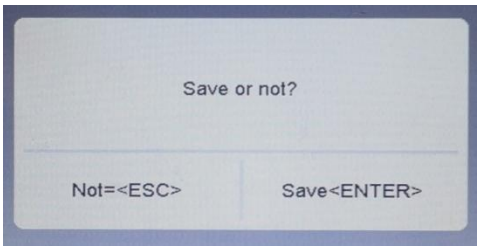
Nano Inverter HMI General Overview

The Nano inverters are equipped with non-touchscreen LED screens and four buttons to navigate the HMI menus and make adjustments. These buttons are: UP, DOWN, ESC, and ENTER. UP and Down buttons allow to navigate within the screen, adjust values, and move to the next or the previous page. ESC button brings to the previous screen/menu. ENTER button allows to enter into a menu, in some menu screens pressing it once enables to navigate within the screen, select an item to be adjusted, enter a new value and confirm the selection, check/uncheck an item within the settings.

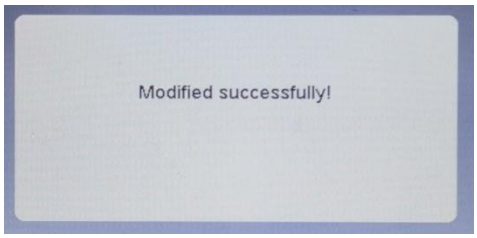
For some settings, a password/pin is to be entered to, which by default is “0010”. While entering the password, use the DOWN button to move to the next digit to be configured, and UP button to change the value of the digit selected. Once all four digits are assigned correct values, press ENTER to enter the password.



Furthermore, for any screen/menu/page, after all changes are made, the ESC button must be pressed in, which will initiate a confirmation screen



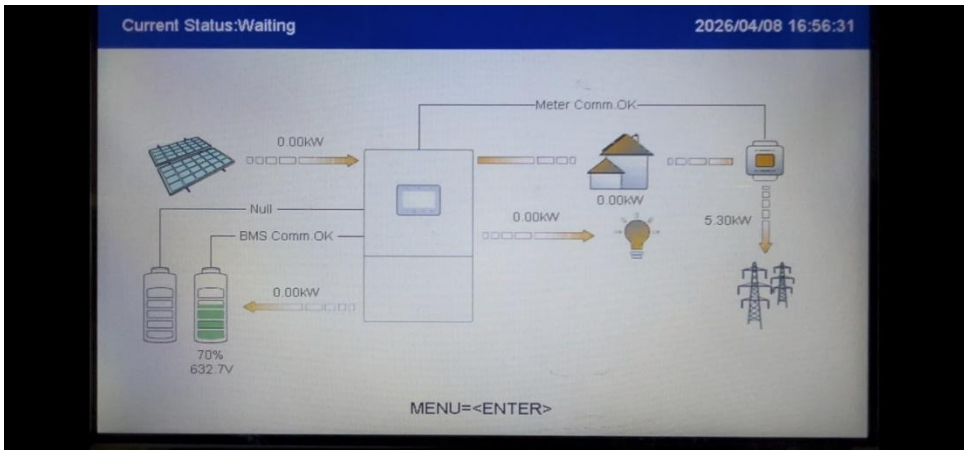
To confirm the settings configured and entries made, press ENTER, after which the inverter will show a message indicating that the settings and entries were adopted.



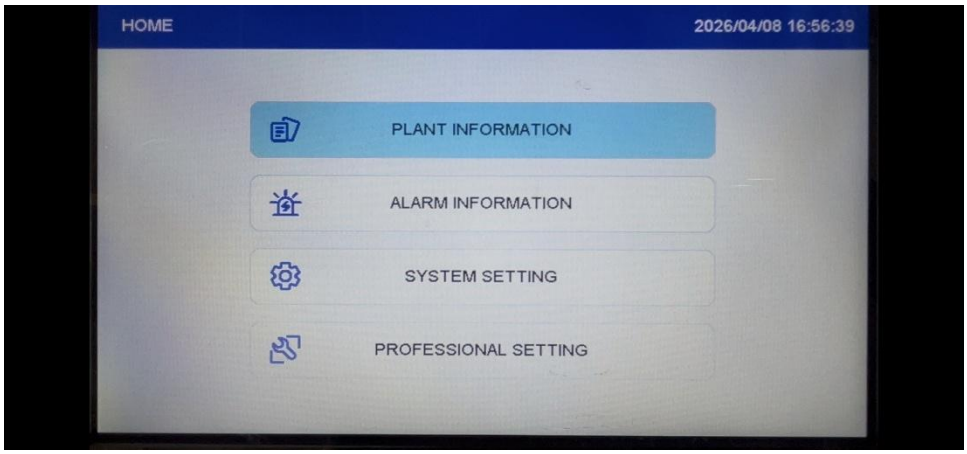
If ESC button is pressed, none of the changes will be confirmed and adopted and one will be returned to the previous screen.

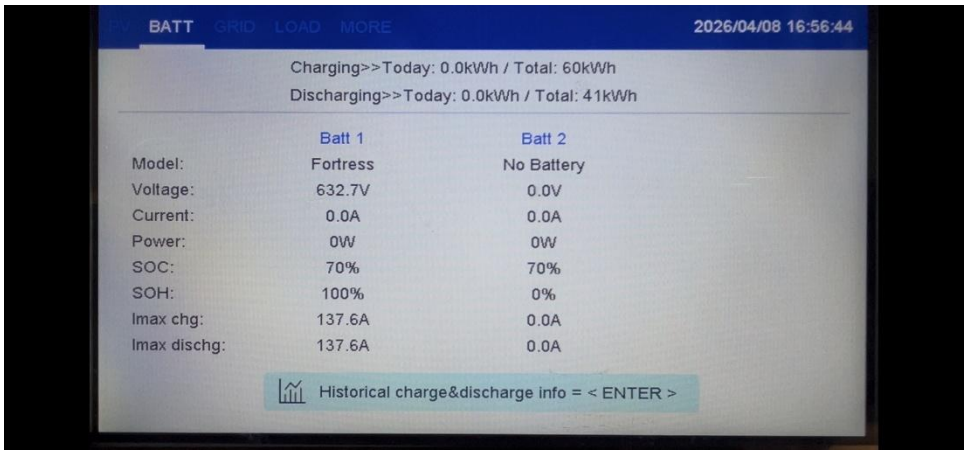
Next, in this section, is the overview of various menus, status screens, and settings pages, accessible via the HMI screen. Although this is a general overview of the HMI, the sequence of the items covered reflects the suggested sequence of programing a Nano inverter during commissioning.

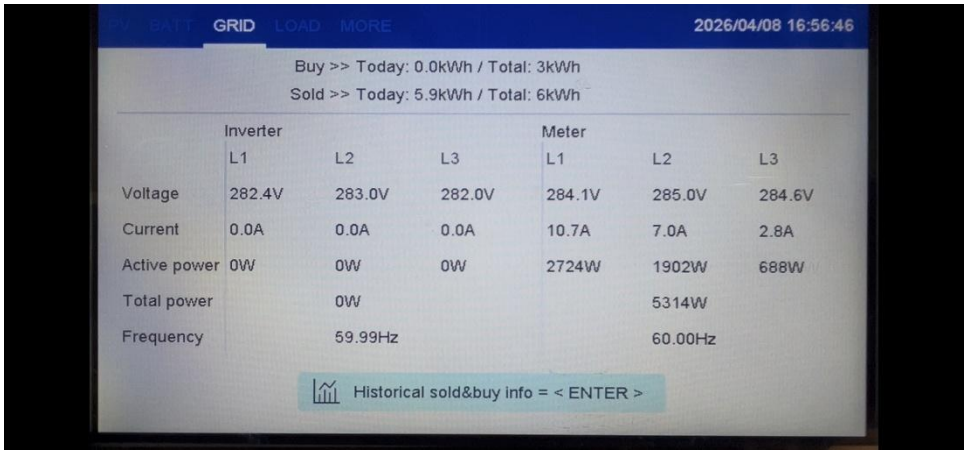
1. By default, the inverter screen shows the status of the system and displays the information about the powerflows.

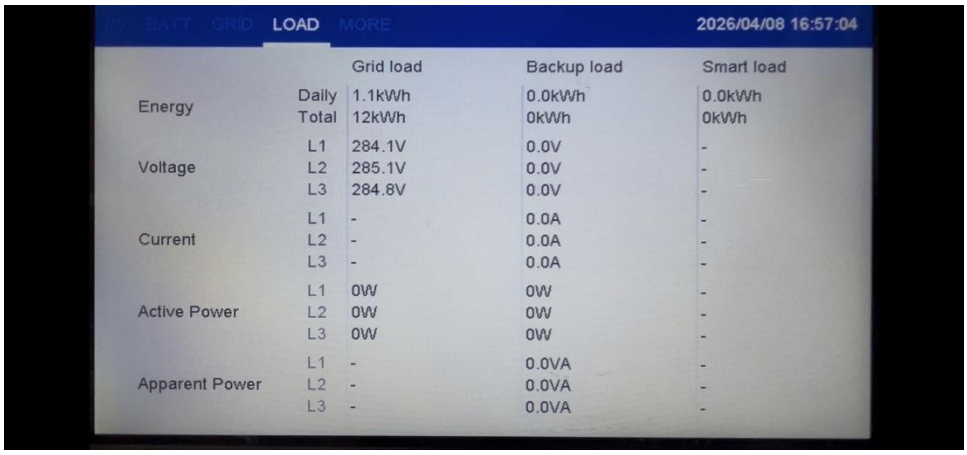


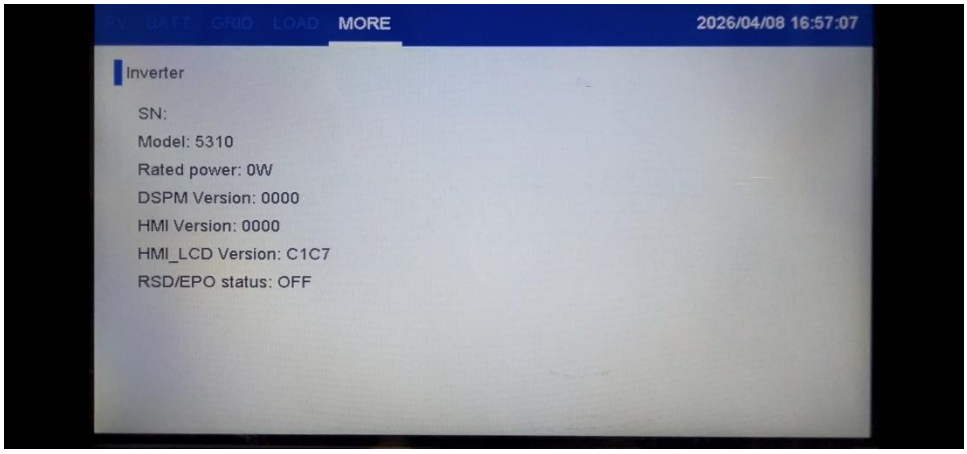
2. To enter the main menu, press ENTER.
3. For summary of current information about the system and its readings, select and enter “PLANT INFORMATION” in the main menu



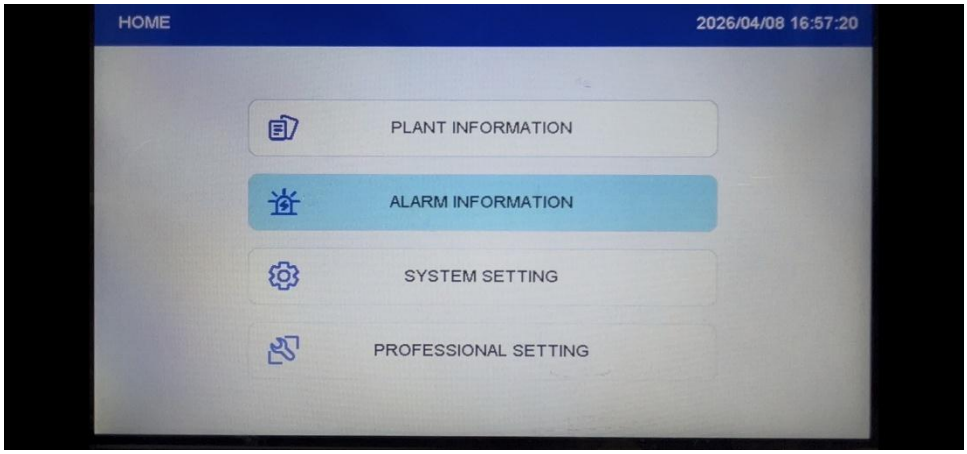


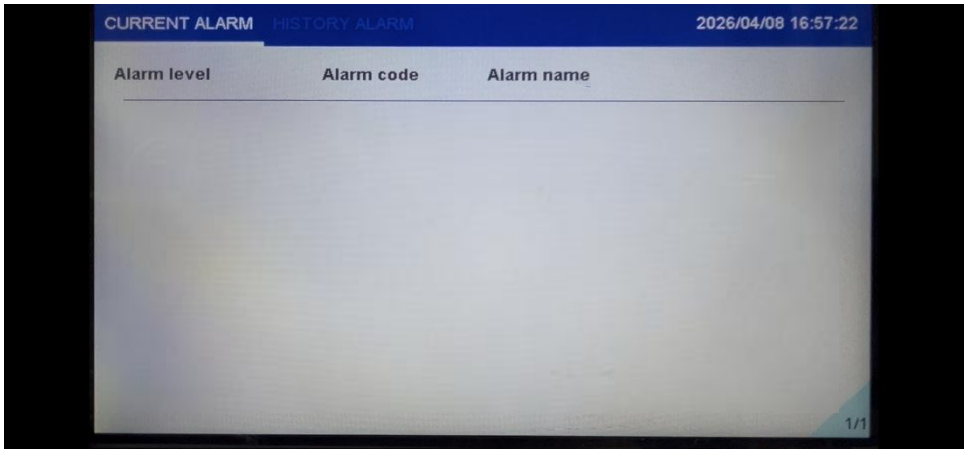


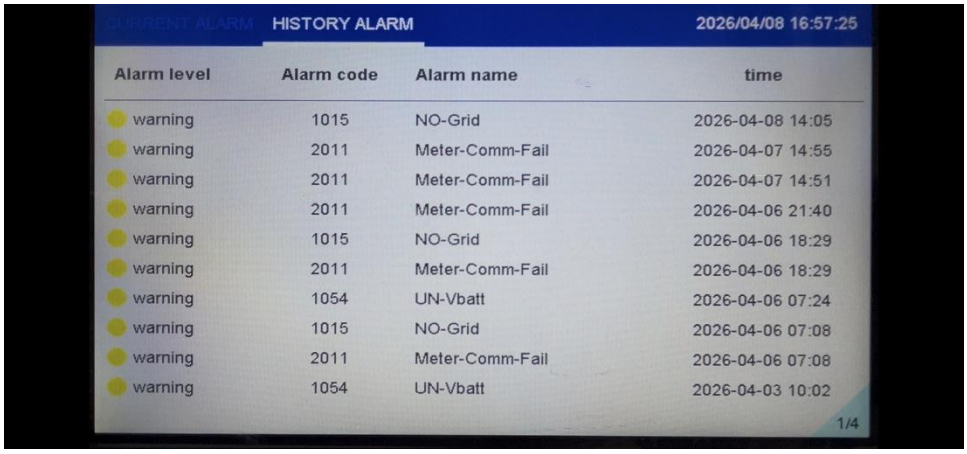




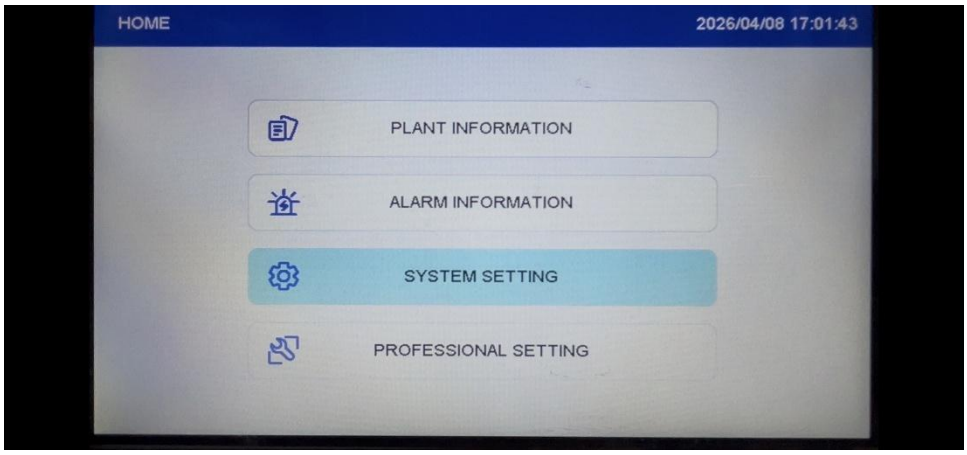
4. For current and previous alarms, select and enter “ALARM INFORMATION” in the main menu


HOME
2026/04/08 16:57:20
PLANT INFORMATION
ALARM INFORMATION
SYSTEM SETTING
PROFESSIONAL SETTING

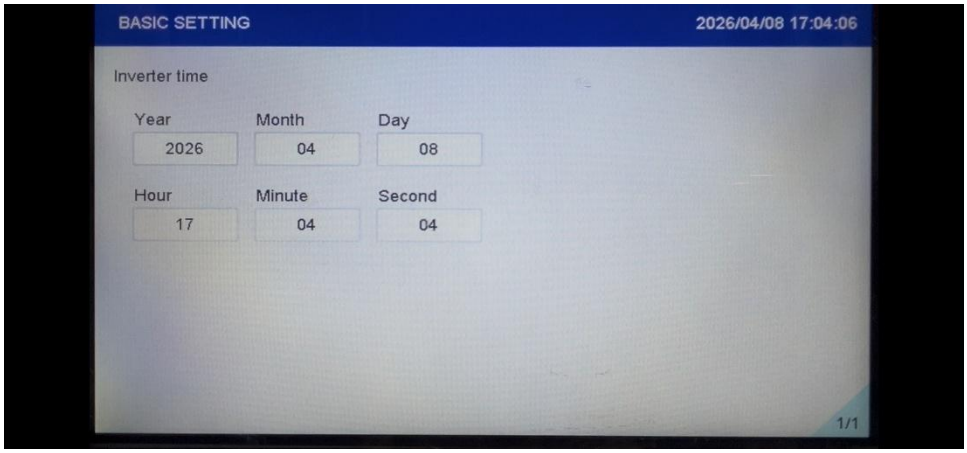

CURRENT ALARM
HISTORY ALARM
2026/04/08 16:57:22
Alarm level
Alarm code
Alarm name
1/1


CURRENT ALARM
HISTORY ALARM
2026/04/08 16:57:25
Alarm level
Alarm code
Alarm name
time
warning 1015 NO-Grid 2026-04-08 14:05
warning 2011 Meter-Comm-Fail 2026-04-07 14:55
warning 2011 Meter-Comm-Fail 2026-04-07 14:51
warning 2011 Meter-Comm-Fail 2026-04-06 21:40
warning 1015 NO-Grid 2026-04-06 18:29
warning 2011 Meter-Comm-Fail 2026-04-06 18:29
warning 1054 UN-Vbatt 2026-04-06 07:24
warning 1015 NO-Grid 2026-04-06 07:08
warning 2011 Meter-Comm-Fail 2026-04-06 07:08
warning 1054 UN-Vbatt 2026-04-03 10:02
1/4

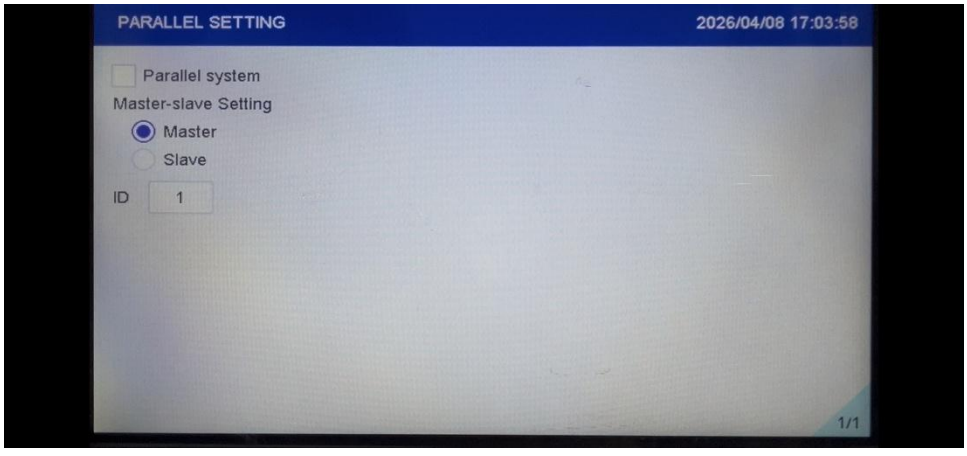
5. For configure system settings on the unit, select and enter “SYSTEM SETTING” in the main menu



6. To adjust time and date, within the “SYSTEM SETTING” menu select and enter “BASIC SETTING”

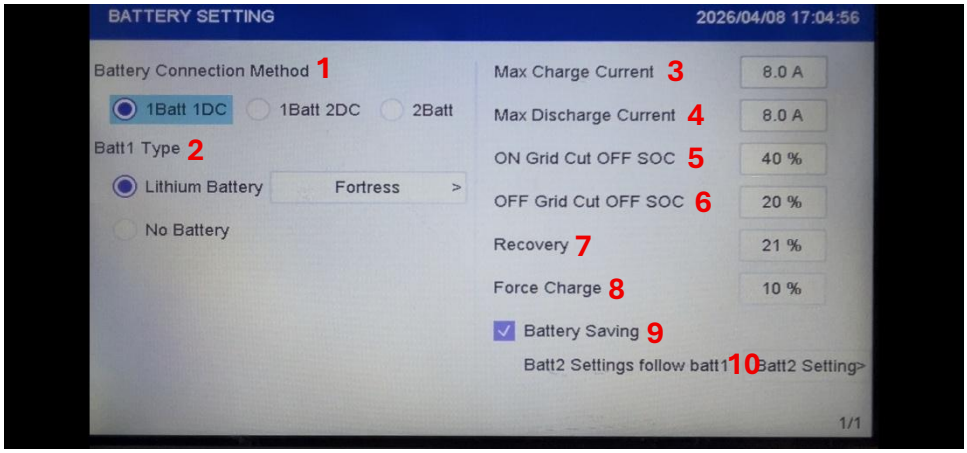


7. When multiple inverters are to work in parallel, each of them must have a unique ID and a role assigned to them. To do so, within the “SYSTEM SETTING” menu select and enter “PARALLEL SETTING”. (Note, adjustments on this page are not to be made if there is only one Nano inverter within the ESS).



First inverter, the one with no communication cable going to its “P-A” (parallel-in) port must be set as “Master” with an ID of 1. Starting with the First inverter, assign the IDs in the accending order to the other inverters in the same sequence as the communication cables between them suggest. Except for the first inverter, all others in parallel must be configured as “Slave”. “Parallel system” system must be checked on EVERY Nano inverter in the communication sequence.

8. To adjust battery settings, within the “SYSTEM SETTING” menu select and enter “BATTERY SETTING”



1	“1Batt 2DC” is to be selected since the Nano inverter has two positive and two negative cables of identical type and length (sized appropriately to the application) connected from the primary battery, as per Fortress Power recommendation
2	Select “Fortress” for the battery-inverter communication to exist
3	In “1Batt 1DC” configuration the max. allowed number is 84A
4	In “1Batt 1DC” configuration the max. allowed number is 84A
5	SOC at or below which the battery will not be discharged when the grid is available
6	SOC at or below which the battery will not be discharged when the grid is unavailable. Must be set no lower than 20%
7	SOC at which battery becomes available again after it has reached SOC described a cutoff SOC (on-grid or off-grid). Must be set higher than the largest of the two cutoff SOC values.
8	SOC at which the inverter starts using grid power (if charging from the grid is enabled) to charge the battery bank regardless of mode of operation
9	Checked by default
10	Unchecked at all times

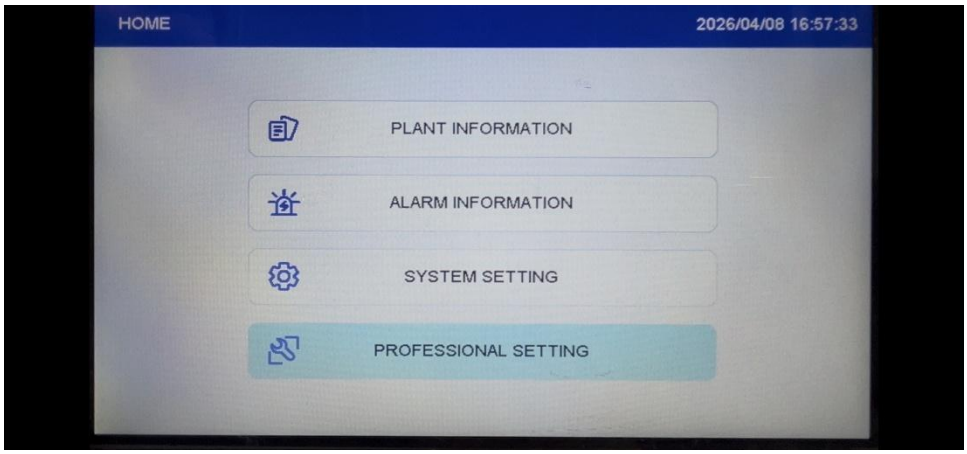
9. To configure parameters for AC signal from the grid, within the “SYSTEM SETTING” menu select and enter “GRID PORT”

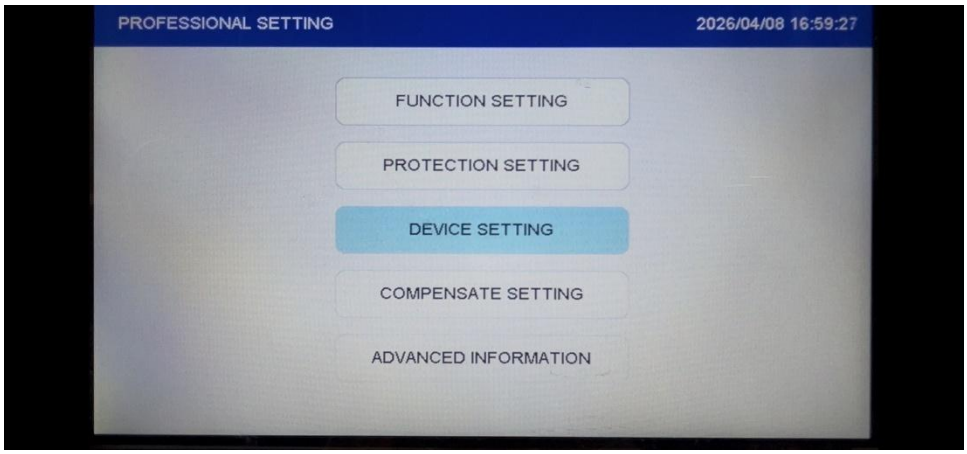
1	Press ENTER to enable navigating the screen (otherwise the UP and DOWN buttons will only allow to change page, since this a two-page settings menu), using the UP and DOWN buttons, navigate to “Unlocking grid code settings” and press ENTER. The inverter will request the four-digit password (default – “0010”) to be entered. To do so, use the DOWN button to move to next digit to be configured, and UP button to change the value of the digit selected. Once all four digits are assigned correct values, press ENTER to enter the password. Thus, editing the parameters is enabled.
2	Navigate to “Grid Code”, and press enter to see the list of the pre-entered grid parameters to be selected. Select the parameter that is suitable for the inverter in the region/jurisdiction in which it is installed/commissioned. If the pre-entered parameters don’t contain the required parameters, each of the items, such as HV1, HV2, HF1, etc., can be adjusted separately. Simply navigate to the parameter that needs to be adjusted, press ENTER, and adjust the parameter to a correct value, press ENTER again, and move to the next parameter to be adjusted. Please note, “GRID PORT” setting menu is a 2-page menu.
3	Check/uncheck as needed. Except in some cornenr cases, almost for every installation this item must be checkmarked, since the inverter neutral bar is to be connected to the neutral of the site.

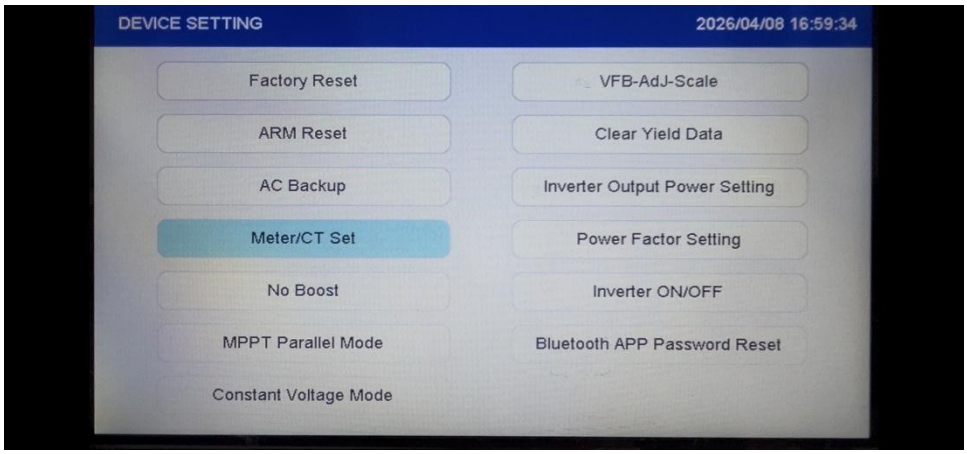
10. Recall, once the meter and the CTs (or Rogowski coils) are installed, the meter needs to be configured. It is of equally critical importance to configure a Nano inverter such that there is a valid communication between the meter and the Nano inverter.

    To start configuring the meter settings on the inverter unit, select and enter “PROFESSIONAL SETTING” in the main menu of the HMI screen. The inverter will request the four-digit password (default – “0010”) to be entered. Just like in other cases when the passwrod is to be entered, use the DOWN button to move to next digit to be configured, and UP button to change the value of the digit selected. Once all four digits are assigned correct values, press ENTER to enter the password. Thus, the access to the “PROFESSIONAL SETTING” menu is

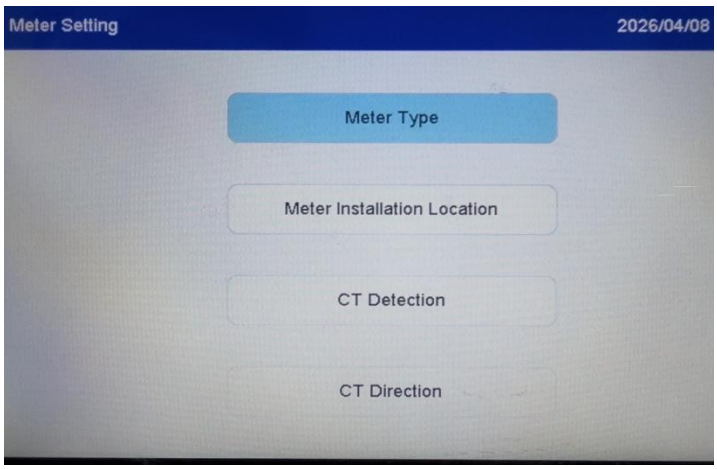
obtained. **DO NOT ADJUST ANY SETTINGS/PARAMETERS IN THE "PROFESSIONAL SETTING" MENU, BESIDES THE METER SETTINGS.**
On the screen that is displayed after entering the password, navigate to "DEVICE SETTING" and press ENTER. Aterwards, select and enter "DEVICE SETTING" and in the next screen that opens, select and Enter "METER/CT Set"

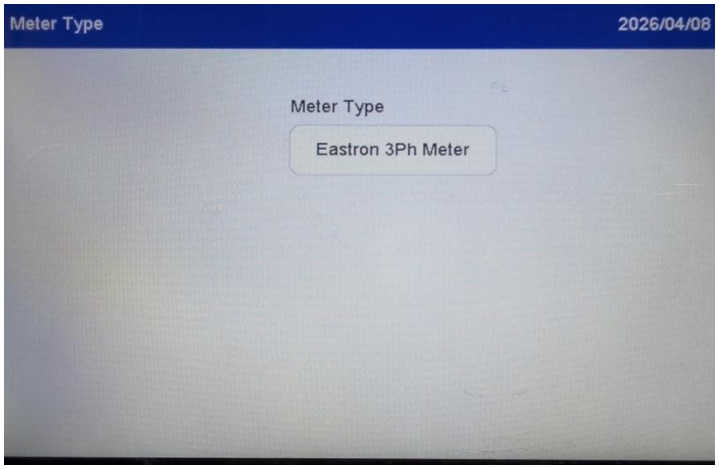




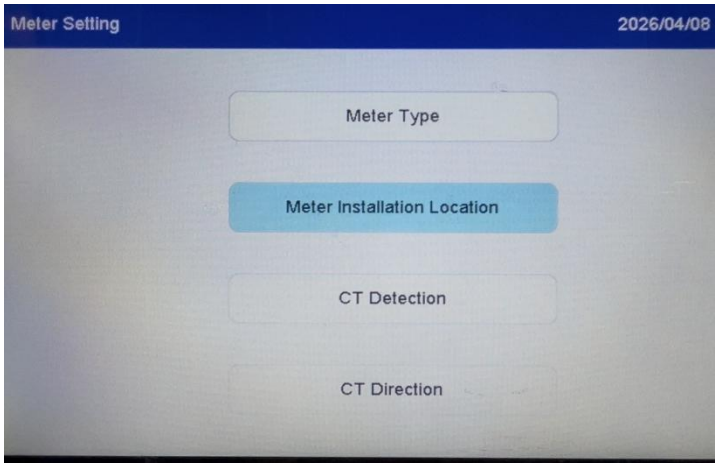


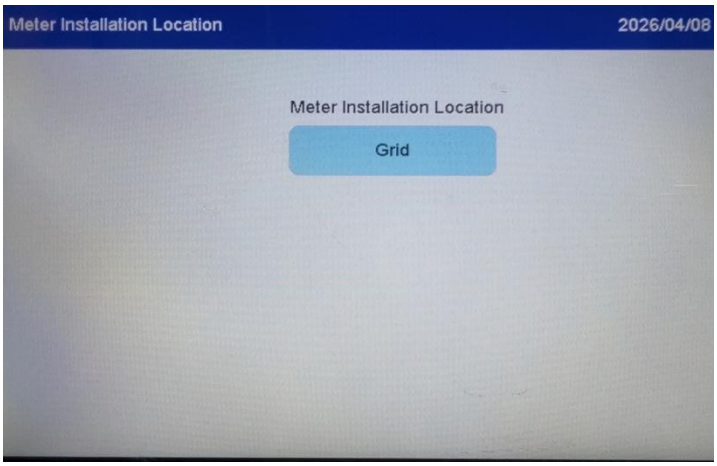
On the next screen, select "Meter Setting (use UP and DOWN buttons) and press ENTER.



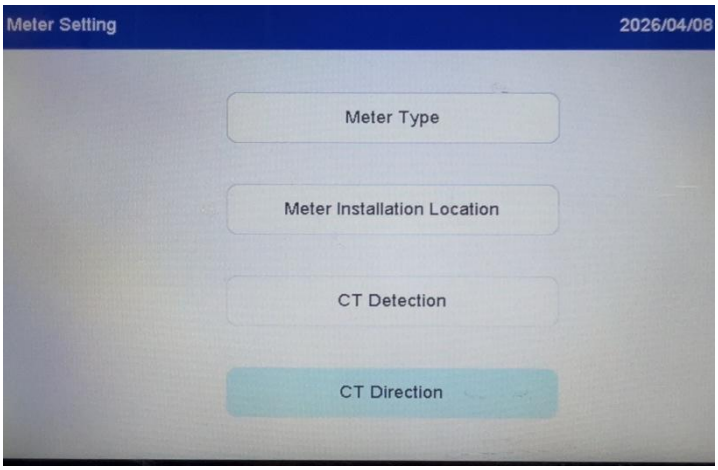


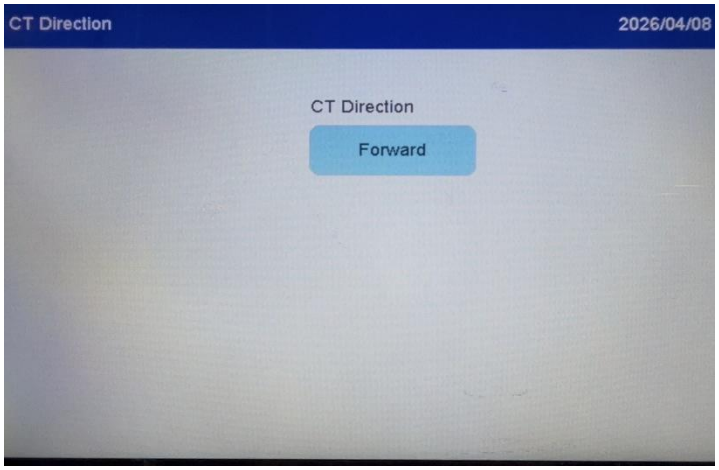
For “Meter Type” select “Eastron 3Ph Meter” and press ESC;





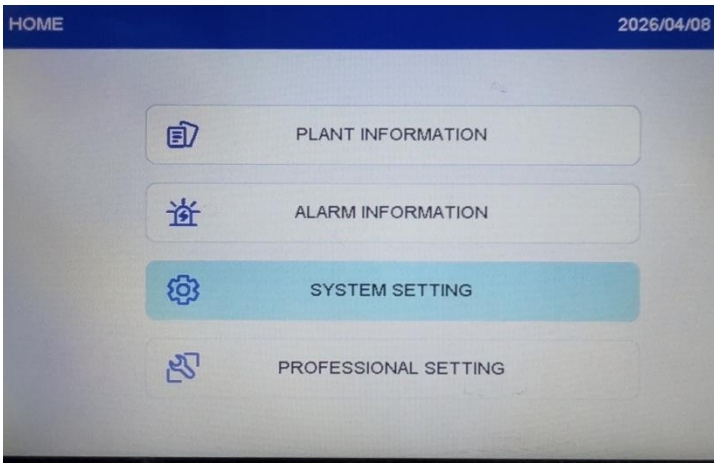
For “Meter Installation Location” select “GRID” and press ESC;

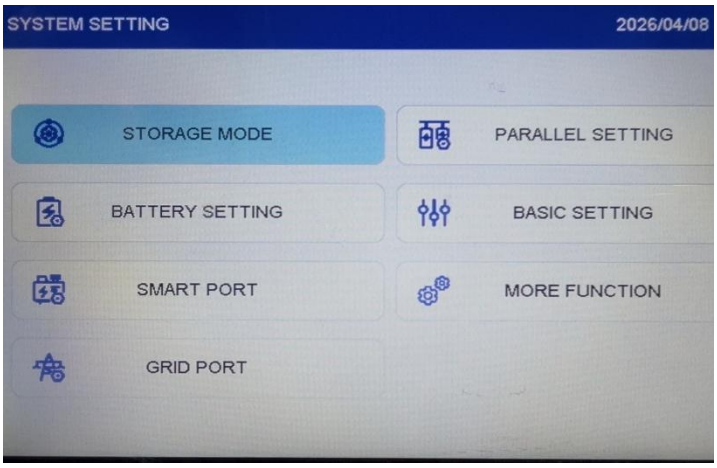


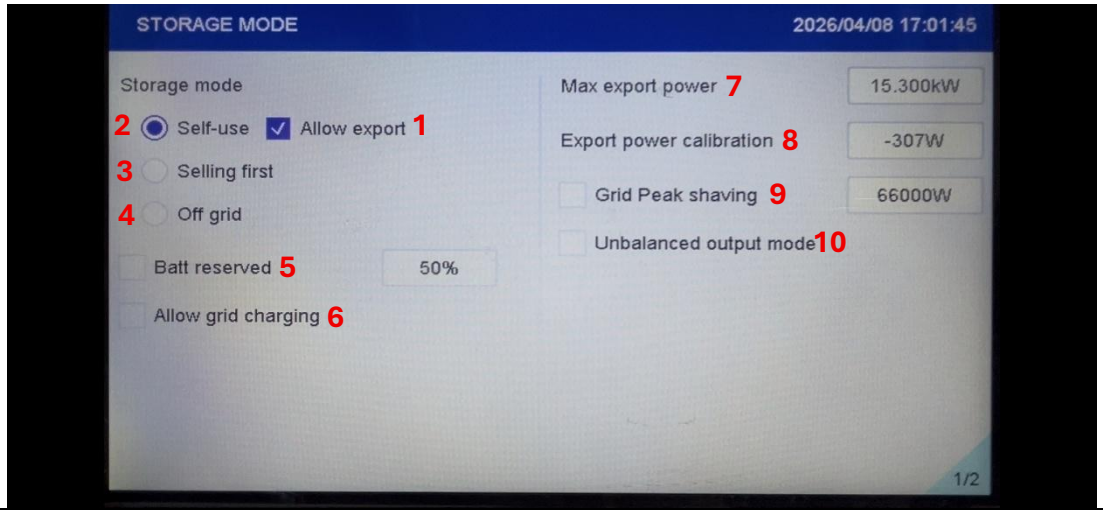


For “CT Direction” select “FORWARD” and press ESC;
REMEMBER TO ALWAYS CONFIRM SETTINGS AFTER PRESSING **ESC**

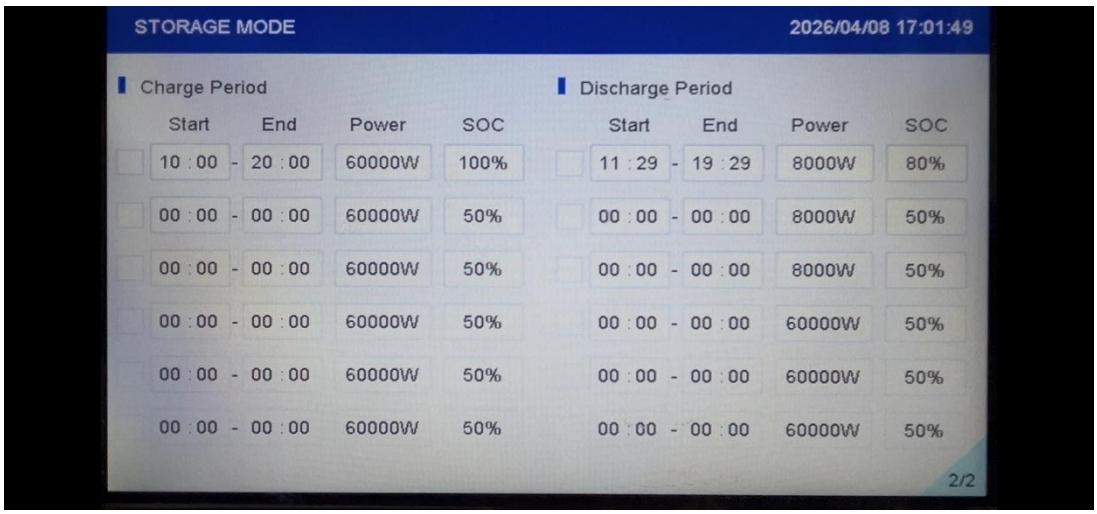
11. From the “SYSTEM SETTING” menu enter “STORAGE MODE”, thus accessing the 2-page menu which allows to configure the mode of operation of the system.







1	If not checkmarked, neither PV nor battery power will be exported to the grid.
2	Select if the self-consumption is the desired mode of operation (PV prioritized as follows: load, battery, export; battery discharges down to forced charge or cutoff SOC percentage at up to its allowed power/currnet limit if PV power is insufficient to satisfy total load demand, battery doesn’t charge from the grid if forced charge SOC is not reached).
3	Select if the export priority is the desired operation (PV prioritized as follows: load, export, battery; battery discharges down to forced charge, battery reserve, or cutoff SOC percentage at up to its allowed power/currnet limit if PV power is insufficient to satisfy total load demand, battery doesn’t charge from the grid if forced charge SOC is not reached.
4	Select if the system is to operate off-grid. If this mode of operation is selected, there must be no AC signal deliver to the grid ports at any point.
5	Enter percentage that is desired to be reserved at all times for backup purposes in case the grid AC power becomes unavailable. If it is a non-backup application, adjust the value to match on-grid cutoff SOC.
6	Checkmark as needed.
7	Export power limit.
8	Calibration value, adjust to zero unless required otherwise.
9	Enable grid peak shaving if it is the desired mode of operation. If checkmarked, adjust the power threshold as needed. The battery will only discharge if the total site load demand exceeds the threshold.
10	Enable if the system is to provide backup output, or if the system is to operate off-grid.



On page two of the said settings menu one may configure time of use parameters. Note, the time of use settings may override some of the other limits and the entries if there are conflicting entries between the time of use settings and other parameters entered. There are 6 charge intervals (under “Charge Period”) and 6 discharge intervals (under “Discharge Period”). Checkmark next to the row enables the interval. Each interval has four parameters in the row to be configured: “Start”, “End”, “Power”, and “SOC”.

Start	Charge/Discharge period start time in 24HR format.
End	Charge/Discharge period end time in 24HR format.
Power	Target Power setpoint for charge/discharge
SOC	Charge–upper SOC limit. If the battery bank reaches this SOC the charging will stop even if the end time of the period is not reached. Discharge–lower SOC limit. If the battery bank reaches this SOC the discharging will stop even if the end time of the period is not reached.

General Commissioning Sequence

Before attempting commissioning, ensure that all tools and materials are removed from the system compartments, and that all components are clean and free of dust or debris. Ensure that all ESS components and electrical panels have been reassembled and there are no removed covers or loose conductors. Ensure that all switches, breakers, and disconnects, on Fortress Power equipment and the relevant ones beyond, for AC/DC power sources and AC loads are in the OFF position.

Please follow the steps below to safely power up the system. Note, if Nano inverters are commissioned without the batteries, from the rest of this section, only steps 3, 4, 6 (if the smart ports have AC-coupled PV connected to them), and 7 are applicable.

Make necessary configurations and adjustments on the battery units (such as paralleling and SOC/voltage verification if multiple batteries are connected per inverter) before proceeding with steps below.

Ensure that none of the EPO buttons are pressed in.

1. Turn on all batteries connected to all inverters to apply DC voltage to the Nano inverters to power them up.
2. Configure the settings on the Nano inverters (refer to the previous section).
3. (if not an off-grid application) Enable continuity from the Nano inverter grid ports to the grid and before proceeding further, wait for 5 minutes and ensure that the Nano inverters successfully connect to the grid.
4. (if not an off-grid application and the meter is used) Enable AC signal to the meter and configure the meter settings
5. (if backup application) Enable continuity from the Nano inverter backup ports to the backed-up panel.
6. (if utilized) Enable continuity from the smart-ports to the load panel (or power source) connected to the smart ports
7. (if applicable) Enable the DC-coupled PV input the Nano inverters (put the PV disconnects on the Nano inverters, and PV disconnects outside of the Nano inverters in the ON position)
8. Put the 2-pole breakers in the battery cabinets in the ON position.
9. Turn on the UPS units in the battery cabinets.

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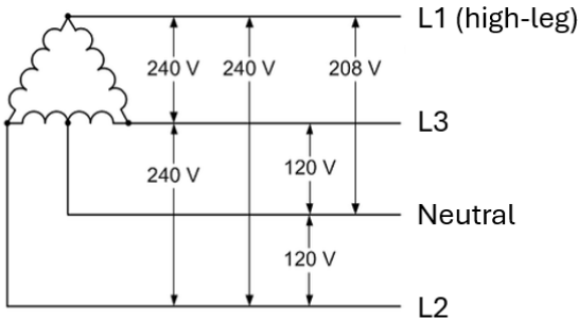
If you encounter any problems with the Fortress Power eSpire Nano energy system, or any of its components, contact us via phone – +1(877)497-6937 ext. 2, or create a support ticket using the following link: https://www.fortresspower.com/support/support-ticket/.

Compliant with:

CA Rule 21 & HECO Rule 14H Certified UL 1741 SB Certified to UL Std. No. 1741-Second Edition & CSA-C22.2 No.107.1-16. UL 3141 Certified

Appendix A: High-Leg Delta (240V 3P4W) Grid Parameters

The 30kW inverter for 208Y/120V three-phase systems (FP-Nano-30k-L) can support high-leg delta (240V 3P4W) signal (see signal diagram below), but only in grid-tied mode. In such applications, the inverter must not have a backed-up load connected to neither backup, not smart ports (items 3 and 4, respectively, in **Figure 19**).



It is crucial and mandatory, that the inverter(s) working in such configuration must have the grid parameters configured correctly (ride-through settings). See below the grid parameters (ride-through settings) to be entered into the inverters working with the high-leg delta AC signal.

Parameter	Adjustment Range V/pu/S/Hz	Default V/pu/S/Hz
OV-G-V01	264≤V≤290.4 1.10≤V≤1.21	264V 1.10Vn
OV-G-V01-T	0.1≤t≤13 S	13 S
OV-G-V02	288≤V≤312 1.20≤V≤1.30	288V 1.20Vn
OV-G-V02-T	0.1≤t≤5 S	0.16 S
UN-G-V01	12≤V≤211.2 0.05≤V≤0.88	211.2V 0.88Vn
UN-G-V01-T	0.16≤t≤50 S	21 S
UN-G-V02	12≤V≤168 0.05≤V≤0.70	120V 0.5Vn
UN-G-V02-T	0.16≤t≤21 S	2 S
UN-G-V03	12≤V≤120 0.05≤V≤0.50	120V 0.5Vn
UN-G-V03-T	0.16≤t≤21 S	2 S
OV-G-F01	60.5≤fs≤66 Hz	61.2 Hz
OV-G-F01-T	0.16≤t≤1000 S	300 S
OV-G-F02	60.5≤fs≤66 Hz	62 Hz
OV-G-F02-T	0.16≤t≤1000 S	0.16 S
UN-G-F01	50≤fs≤59.5 Hz	58.5 Hz
UN-G-F01-T	0.16≤t≤1000 S	300 S
UN-G-F02	50≤fs≤58 Hz	56.5 Hz
UN-G-F02-T	0.16≤t≤1000 S	0.16 S