ELTEK VALERE
always on

THEIA™ HE-t

String Inverter ~ 2.0 - 4.4 kW_{AC}, 600 V_{DC}

USER MANUAL

www.eltekvalere.com/renewable

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Contents

1. Introduction

The *THEIA HE-t* inverters are among the most efficient single phase grid connected (grid-tie) inverters on the market, which will result in high yields from the solar array.

DC to AC

In a grid connected photovoltaic system, the interface between the solar array and the utility grid consists of an inverter, which converts DC produced from the solar array into AC adapted to the voltage and frequency of the utility grid.

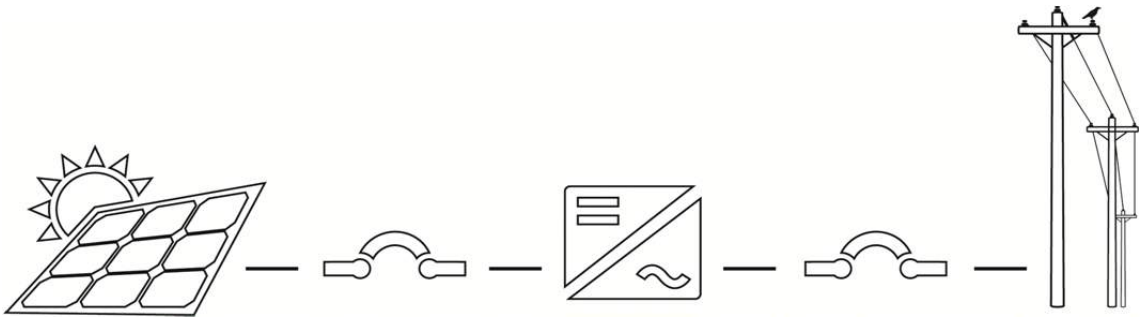


Figure 1.1: System overview

***THEIA HE-t* series**

The topology of the *THEIA HE-t* series consists of an embedded high frequency transformer, which provides galvanic isolation from the utility grid and thereby meets the strictest safety standards. Because of great adaptability and user friendliness, the *THEIA HE-t* is the perfect choice for any photovoltaic (PV) installation. Different configuration options make it suitable for crystalline as well as thin-film modules, and make it easy and affordable to configure for various conditions and country specific requirements. The compact and lightweight construction provides for easy and straightforward installation and maintenance.

Integrated Web Server

The inverter is equipped with an integrated web server, which records data on a daily, monthly, and yearly basis. All information is displayed numerically and in graphs on a color LCD screen on the front of the inverter. The data is also accessible either directly from a PC or via the internet. All settings and data are saved in the integrated logger, which provides storage of data with fifteen minutes intervals for one week, daily intervals for one year or weekly intervals for thirty years.

Automatic System

The system is fully automatic. The inverter starts up in the morning when the solar array generates enough power. During the day the maximum power point tracking (MPPT) function ensures the highest possible energy harvest from the PV panels. The inverter goes into ‘sleep’ mode at dusk when the solar array stops generating power, ready to automatically start-up again in the morning.

2. Product Overview

This chapter gives an overview of the inverter with its supplied components, and how they are assembled. A brief explanation of how to unpack and handle the inverter safely is given, and symbols appearing both on the inverter and in this *User Manual* are explained.

2.1. Standards and Approvals

THEIA HE-t inverters are compatible with the following directives and safety standards:

Grid Protection	Safety	EMC
VDE 0126	EN 50 178	IEC/EN 61 000-6-2 (immunity)
G83/1	IEC 62103, 62109	IEC/EN 61 000-6-3 (emission)
C10/11	AS 3100	IEC/EN 61 000-3-2/-12 (harmonics)
EN 50438		IEC/EN 61000-3-3/-11(flicker)
RD 1663, 663		
AS 4777.2/.3		
DK 5940		
ÖNORM E 8001-4-712		
IEC 61727		

2.2. General Information

Several variants of the *THEIA HE-t* are available for different configurations and country specific requirements.

2.2.1. Variants

The instructions given in this *User Manual* are applicable to the following models of *THEIA HE-t* solar inverters:

- *THEIA 2.0 HE-t*
- *THEIA 2.9 HE-t*
- *THEIA 3.8 HE-t*
- *THEIA 4.4 HE-t*

2.2.2. Options

- Stringbox or connector panel
- DC switch
- Ungrounded PV strings or positive/negative grounded PV strings
- DC fuse holders
- DC plug-in connectors or screw clamp terminals

2.2.3. Key Features

- World's highest peak efficiency for isolated inverters; up to 97.3%
- Flexible system configuration
- Monitoring 24/7
- Internal data logger with storage capacity of 15 minutes intervals for one week, daily intervals for one year or weekly intervals for thirty years
- MPPT range: 230 – 480 V
- DC voltage range: 220 – 600 V
- Automatic ON/OFF switching and temperature regulation
- Anti-islanding protection
- Reverse DC polarity protection (diodes)
- Theft protection

2.3. Symbols Used

The warning symbols used in this *User Manual* highlights **important information** on how to avoid hazards to equipment and people. There are three different types of signal words:

DANGER: Describes a hazard that poses an imminent risk of serious injury or death.
WARNING: Describes a hazard that could result in serious injury or death, or could render equipment permanently inoperative.
CAUTION: Describes a hazard that could result in personal injury or cause equipment damage.
NOTICE: Describes important information or a policy/standard that should be understood and enacted.

This symbol indicates that there is a potential for electric shock or electrocution.

This symbol indicates an important safety note.

Pay particular attention when the symbols appear in this *User Manual*!

2.3.1. Labels

The product label is attached to the lower right side of the inverter housing. It contains important identification parameters and characteristics for the inverter, and must be clearly visible after installation.

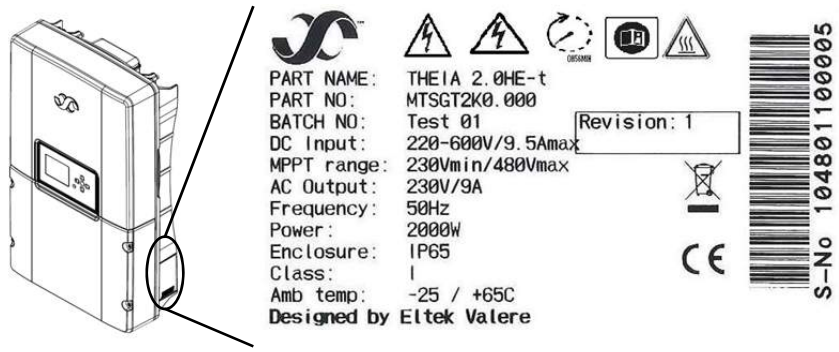


Figure 2.3.1: Product label

Table 2.3.1: Symbols appearing on the product label

Symbol	Description	Symbol	Description
	**Discharge time 60 minutes:** High voltages are still present inside the inverter for 1 hour after switch OFF		**CE Marking:** The product meets the EU safety, health and environmental protection requirements
	**Hot Surface:** The heat sink on the back of the inverter can reach temperatures of up to 90 ° C/194 ° F		**Disposal:** Do not dispose in general waste! Collect the various parts separately and recycle them according to local and national regulations
	**Danger:** High voltages are present		**S – NO:** Serial Number for inverter identification
	**Grounding:** Ground terminal		**DC:** Direct current terminal
			**AC:** Alternating current terminal

2.4. Unpacking and Inspection

To avoid damage to people and equipment the next instructions must be followed to unpack and lift the inverter safely.

2.4.1. Shipping Damage

The *THEIA HE-t* inverters are thoroughly checked and tested in accordance with international standards and approvals prior to dispatch. They are carefully packed before shipping. However, if any damage to the inverter is found when delivered, please provide feedback to your local *Eltek Valere* representative immediately!

2.4.2. Lifting and Carrying the Inverter

Considering the inverter's weight of **20-22 kg / 44–49 lbs.** (depending on model), lifting and carrying the inverter must be correctly performed to prevent back injuries.

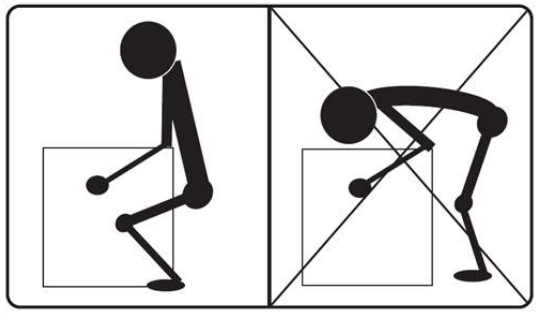


Figure 2.4.1: Correct lifting of the inverter

- When lifting bend the knees and keep the back straight.
- Lift carefully, hold the inverter close to the body and let the leg muscles do the work.
- Turn the whole body as one unit to avoid twisting the lower back.
- Carry the inverter close to the body.

2.4.3. Unpacking

Unpack the inverter as follows:

- Place the box in position, with the top clearly visible and according to the arrow markings on the packaging.
- Cut the seal, and open the box.
- Take out the lock clip, the bag with accessories and the *Installation Guide* lying on the upper section of the foam packaging material.
- Remove the upper part of the foam packaging material.
- Both sides of the inverter case are narrowed in order to get a better grip on the device. Lift up the inverter carefully out of the box using the "handles" illustrated in *Figure 2.4.2*.
- Remove the lower section of the foam packaging and take out the inverter mounting bracket.
- Store all the original packaging for possible later use.

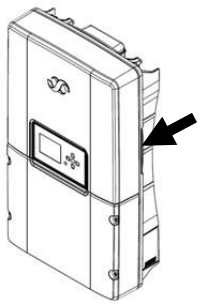


Figure 2.4.2: "Handles"

After unpacking the inverter safely, check that all components are present and in an undamaged condition.

2.4.4. Scope of Delivery

- *THEIA HE-t* single phase inverter
- Mounting bracket with lock clip
- Installation Guide
- Accessories: grounding strap

NOTICE!
The mating parts of the connectors are not part of the standard scope of supply, and must be provided by the system installer.

2.4.5. Inverter Structure

The housing of the THEIA HE-t inverter is designed to:
- IP 65/NEMA 4X for indoor or outdoor use
- Provide a degree of protection from dirt, rain, sleet, snow, dust, water, and corrosion
- Be undamaged by the external formation of ice on the housing.

The inverter has the following dimensions:

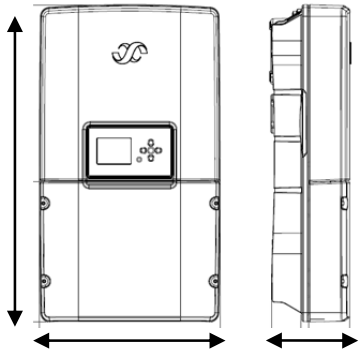


Figure 2.4.3: Mechanical dimensions

H: 610 mm / 24.0 inches
W: 353 mm / 13.9 inches
D: 158 mm / 6.2 inches

The front surface of the inverter consists of an upper and a lower cover.

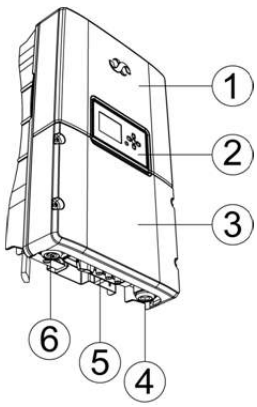


Figure 2.4.4: Inverter structure

1. Upper cover
2. Display
3. Lower cover; customer connection area
4. AC output
5. DC input
6. Network input

The upper cover may only be removed by *Eltek Valere* authorized personnel. Removal of the upper cover by unauthorized persons voids the warranty!
The lower cover protects the customer connection area, and may be removed by the system installer for electrical connection and maintenance of the inverter.

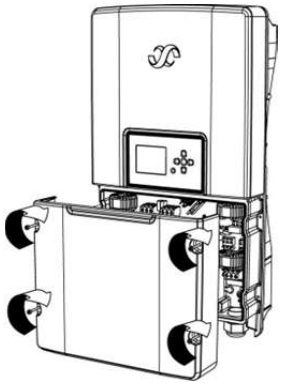


Figure 2.4.5: Lower cover

Removing the lower cover:

- Remove the four screws on the lower cover with a 4 mm hex key.
- Take the cover off carefully.
- Store the lower cover and screws safely to avoid loss or damage.

Fastening the lower cover:

- Fasten the screws on the lower cover with a torque of 1.0 Nm / 0.74 ft-lbf.

DANGER: Always disconnect the power sources prior to removal of the lower cover!

The inverter is charged with high voltages, and removal of the lower cover can have lethal consequences if the inverter is not disconnected.

CAUTION: Never remove the inverter lower cover in wet conditions!

Removal of the inverter lower cover during rain or in damp conditions can damage sensitive internal electronic components.

3. Safety Precautions

This chapter contains instructions on how to install, operate and maintain the *THEIA HE-t* inverters safely. These safety precautions must be read thoroughly and understood prior to the installation, so as to be able to handle the inverter correctly and maintain the warranty of the product.

3.1. General Preparations

The *THEIA HE-t* inverters contain no user serviceable parts, and installation and maintenance must be performed by authorized persons, who have qualified knowledge about the local and national electrical regulations in force and follow the instructions in this *User Manual*.

DANGER: Read the instructions carefully!

The safety precautions and instructions in this *User Manual* must be read thoroughly to be able to install and operate the inverter correctly and to prevent death, injury or material damage.

3.1.1. Connections

Contact the local utility company for interconnection agreements and power approval before connecting to the grid.

DANGER: Ensure correct connection of the inverter!

To ensure safe and correct connection of the inverter the electrical connection must be performed by qualified persons only.

- Prior to the electrical connection, the AC circuit breaker(s) and the DC switch(es) must be turned OFF to ensure that the terminals are discharged and safe to work on.
- Use the connectors as per the manufacturer's instructions only.
- No other devices must be connected to the inverter circuit.
- Do not pull out cables during operation, due to the risk of arcing.

3.1.2. Operation

The inverter must only be operated in accordance with the information in this *User Manual*.

DANGER: Operate the inverter as specified in this *User Manual*!

The *THEIA HE-t* is a grid interactive inverter and must be used exclusively for its designed purpose, which is to convert PV-generated DC electricity into AC electricity to feed into the grid.

- The inverter must be operated in its original and technically intact condition without any unauthorized modifications.
- Always keep the values of operation within the limits given in the technical specifications, due to the risk of possible inverter damage.

CAUTION: Keep the voltage and current within the specified limits!

The voltage generated by the PV modules is inversely proportional to the temperature: at lower temperatures the PV voltage increases from the nameplate rating and at higher temperatures the PV voltage decreases from the nameplate rating.

- Unintended use may damage the inverter or other electrical equipment, may interfere with the operation of the inverter, or it can, at worst, cause injury or death to persons operating and maintaining the inverter.
- Misuse involves ignoring the instructions and information in this *User Manual* and also not performing regular maintenance work.

3.1.3. Maintenance

Prior to service and maintenance the inverter must always be disconnected on both the AC and the DC side and discharged (See *8.1. Switch-Off*)

CAUTION: Avoid invalidating the warranty!

The inverter upper cover is to be opened only by *Eltek Valere* service persons or service partners authorized by *Eltek Valere* due to danger of damage to internal components and hence invalidated warranty.

- The inverter lower cover must only be taken off during electrical connection and maintenance or repairs.
- No unauthorized modifications may be done to the inverter. Contact the system installer or the distributor in case of failure.
- Regular maintenance must be performed to maximize the life expectancy of the inverter (See *8.2. Regularly System Inspection*).
- A safety component must always be replaced by the same type and rating.

3.2. Site Preparations

Observe the following precautions when mounting and installing the *THEIA HE-t* inverter on a suitable site. This is crucial to maintaining the efficiency of the inverter!

3.2.1. Mounting

Sufficient ventilation and appropriate ambient temperatures are needed to prevent temperature build-up inside the inverter, which could lead to possible power losses.

CAUTION: Avoid enclosed areas with poor air flow!

Insufficient cooling may lead to degradation of performance! Ensure sufficient air space around the inverter and unblocked ventilation openings for optimum cooling and efficient operation.

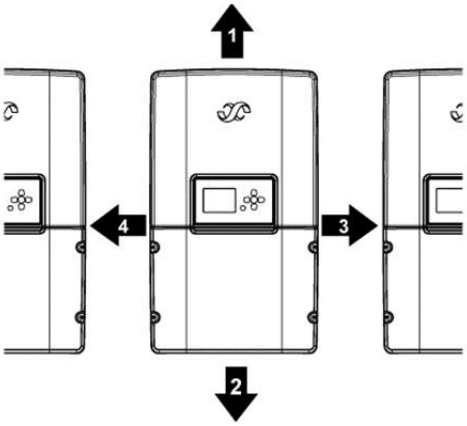


Figure 3.2.1: Minimum distances for optimal cooling

Observe the minimum distances below to maintain optimal cooling.

1. 400 mm / 15.75 inches
2. 300 mm / 11.81 inches
3. 150 mm / 5.91 inches
4. 150 mm / 5.91 inches

WARNING: Ensure a suitable mounting surface!

Correct installation prevents the inverter from falling from the wall. The mounting surface must be suitable for the weight (20-22 kg / 44-49 lbs.) and temperature (90° C / 194° F) of the inverter.

- The inverter must be mounted in a vertical position.
- Keep the lower cover closed when mounting the inverter to avoid damage to internal components.
- It is recommended that the inverters are not installed in living areas due to possible noise levels of the inverters.
- For ease of inspection and maintenance of the inverter, the display should be at eye-level, and the product label must be visible and the connection area readily accessible.

3.2.2. Installation

The installation of the inverter must be performed in accordance with the relevant local and national electrical regulations!

DANGER: Ensure a safe installation of the inverter!

Only persons who are qualified to install high voltage electrical equipment and are familiar with the electrical regulations applicable to the installation site may install the inverter. This to ensure a safe installation and avoid possible injury!

WARNING: Ensure a suitable installation site!

Protect the inverter from flammable and explosive environments to avoid fire, as the inverter heat sink can reach temperatures of up to 90° C / 194° F during long-periods of high performance operation.

- Ensure a clean, non-dusty, dry and cool environment for optimum inverter performance, and a non-flammable and non-explosive environment to avoid possible fire.
- Ambient air temperature during operation should be between -25 °C and +65 °C / -13 °F and 149 °F. If the temperature rises above +45 °C / 113 °F the inverter will automatically reduce power to protect internal components.
- Non-condensing relative humidity must be between 4 % and 99 %.

CAUTION: Avoid installations with direct exposure to sunlight!

Direct sunlight may cause yield losses, as it can result in increased internal temperatures that can lead to reduced power output.

- Ensure a location where people cannot accidentally come in contact with the inverter surface, due to danger of skin burns.
- The inverter is suitable for outdoor operation, but should be sheltered from direct sunlight, snow, rain, dust and sand.
- Location should be in proximity to the PV arrays to minimize DC losses.

3.3. Safety Equipment Required for Grid Connected Systems

Ensure compliance with the local and national electrical regulations to satisfy the safety equipment requirements.

NOTICE!

Safety Equipment: The system installer is responsible for providing safety equipment that meets the requirements for both the DC and AC operations, and to protect the equipment and prevent personal injury, as per the local and national electrical regulations.

3.3.1. Disconnection Devices

Disconnection devices, **switches or circuit breakers**, enable a shut-off from the power source during operation. They protect the current-carrying conductors and other system components from power surges and system malfunctions, and help to shut down the inverter safely for maintenance and repairs.

- Both AC circuit breaker(s) and DC switch(es) are recommended to facilitate maintenance work and repairs of the inverter.
- The disconnect devices must conform to the local and national electrical regulations, and have an interrupt rating sufficient for the voltage and current available in the circuit.
- Each disconnection device must be readily accessible and operable without exposing the operator to live parts. All devices must be permanently marked for their purpose.
- Good practice is to switch OFF the AC circuit breaker(s) before the DC switch(es) to reduce wear of the contacts.

3.3.2. Overcurrent Protection Devices

Overcurrent protection devices, **fuses or circuit breakers,** prevent the circuit conductors from overheating as a result of overload, short circuit or ground fault.

- An overcurrent protection device is required on every live wire.
- If a fuse blows or a circuit breaker trips the cause should always be determined before replacing or resetting them. Contact the system installer, for assistance.
- It is recommended to install an *RCD* (*Residual Current Device*) of **type B** on the supply side of the inverter, to be able to detect leakage current and interrupt fault paths. Devices must comply with the relevant local and national electrical regulations!

DC Fuses

- DC fuses protect the conductors from back-feed currents from parallel strings. They are located in the lower compartment of the stringbox, equipped with finger-safe fuse holders to disconnect each fuse independently (See *4.3.2. Connection Area*).
- The rating of the DC fuses should be as per the recommendations of the PV module manufacturer and the local and national electrical requirements.
- DC fuses are not required for the DC circuits where the short circuit currents (I_{SC}) from all PV modules cannot exceed the rated current carrying capacity of the PV circuit conductors or the maximum overcurrent device size specified on the PV module product label.
- The size of the DC fuses required must be specified at the time of order.

Table 3.3.1: DC current characteristics and fuse rating

Inverter Type	Max DC Current	Min Fuse Rating	Max Fuse Rating
THEIA 2.0 HE-t	9.5A	12 A	20 A
THEIA 2.9 HE-t	13.5A	17 A	30 A
THEIA 3.8 HE-t	18.0A	23 A	35 A
THEIA 4.4 HE-t	21.0A	27 A	40 A

AC Fuses

- AC fuses protect the supply conductors between the inverter and the utility grid.
- They are not part of the scope of supply, and must be provided by the system installer.
- Follow the local and national electrical regulations regarding rating of the AC fuses.

Table 3.3.2: AC current characteristics and fuse rating

Inverter Model	Max AC Current	Fuse Ratings	Tripping Characteristics	Type
THEIA 2.0 HE-t	10.5 A	15 A	B or C	Double Pole
THEIA 2.9 HE-t	15.2 A	20 A		
THEIA 3.8 HE-t	19.7 A	25 A		
THEIA 4.4 HE-t	23.0 A	30 A		

3.3.3. Surge Protection Devices

Overvoltage protection is used to prevent voltage surges through sensitive equipment. The *THEIA HE-t* inverters are equipped with *Temperature protected Metal Oxide Varistors (TMOV)* on both the DC and the AC side, which conduct excessive current from voltage surges to ground.

- PV systems mounted in an open or exposed environment need added protection on both the DC and AC side, as they can act as lightning rods.
- When the conductors are exposed to transients, their behavior limits the effectiveness of a surge arrester. One or more surge arresters are needed in installations with long conductors to obtain the required level of protection.
- Always use qualified assesment when selecting the appropriate kA ratings for the overvoltage protection device!
- *IEEE* provides a good base for selecting kA ratings of the surge arrester: The *THEIA HE-t* inverters are designed for category B: 100 kA – 150 kA per phase.

4. Installation

This chapter describes how to install the inverter correctly, both mechanically and electrically, and details important issues related to the installation. This information is addressed to qualified persons, who are educated in installing high voltage electrical equipment and who follow the installation order as described in this *User Manual*.

DANGER: Never work with live wires!

All work on the inverter must be performed with all voltage and current sources disconnected, as contact with live wires may cause serious injury or death!

NOTICE!

The *Safety Precautions* in chapter 3 and the following detailed installation procedures in this chapter must be read carefully prior to installation.

4.1. Checks Prior to Installation

- ☑ Make sure that both the AC circuit breaker(s) and the DC switch(es) are OFF to prevent shock hazards during the installation of the inverter.
- ☑ Check that the PV and the grid specifications are compatible with the inverter specifications (See *10. Technical Data*).

4.2. Mechanical Installation

The mounting surface and the mounting method must be suitable for the inverter's weight, dimensions and possible housing temperature (See *10.Technical Data*).

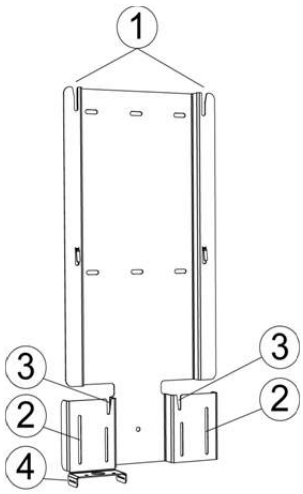
DANGER: Ensure a safe installation of the inverter!

Follow the installation instructions carefully to prevent poor performance or possible lethal consequences.

4.2.1. Wall Bracket

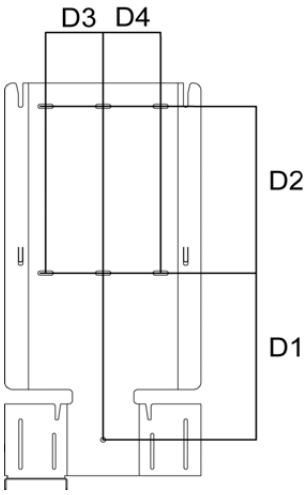
Depending on the mounting surface, different mounting methods may be required to secure the wall bracket. The system installer is responsible for selecting the correct type and number of fixings suitable to support the weight of the inverter on the mounting surface.

- The bracket is designed to support 80 kg / 176.4 lbs.
- The inverter must be mounted in a vertical position!
- Mount the inverter in compliance with the minimum distances to ensure optimum cooling (See *3.2.1. Mounting*). This is important with several inverters installed!



1.
Carrier slots for the inverter
2.
Steering slots for the inverter
3.
Carrier slots for the stringbox
4.
Fixing clip

Figure 4.2.1: Inverter bracket



D1.
232.5 mm / 9.2 inches
D2.
232.5 mm / 9.2 inches
D3.
75 mm / 2.95 inches
D4.
75 mm / 2.95 inches

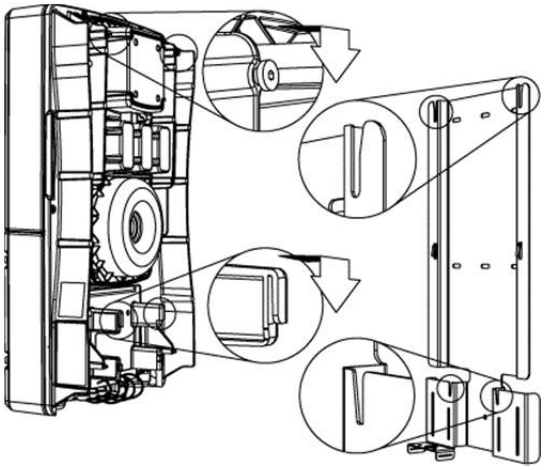
Figure 4.2.2: Distances between the fixing screws

Mounting

- Mark the mounting holes on the mounting surface using the bracket as a template and a spirit level.
- The mounting bracket should be fastened to the studs of a dry wall or to a concrete/masonry wall.
- Drill the holes and fasten the bracket with the number of screws required to support the hanging weight of the inverter.
- Recommended height for the customer onnection area: 1000 - 1400 mm / 39.4 - 55.1 inches above floor level.

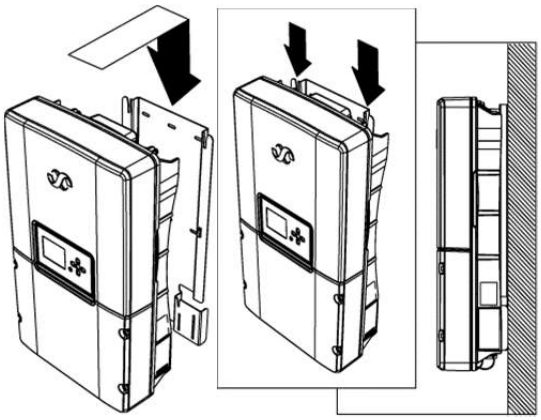
4.2.2. Inverter

Attach the inverter to the mounting bracket as follows:



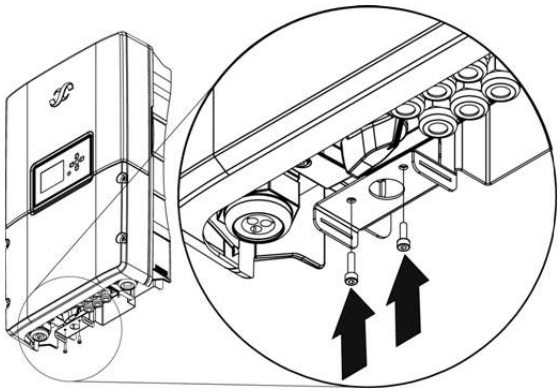
- Locate the hooks for the carrier slots on the upper back of the inverter.
- Locate the hooks for the steering slots on the lower back of the inverter.
- With stringbox included: Use the locating pin taps on the stringbox.

Figure 4.2.3: Hooks on the back of the inverter



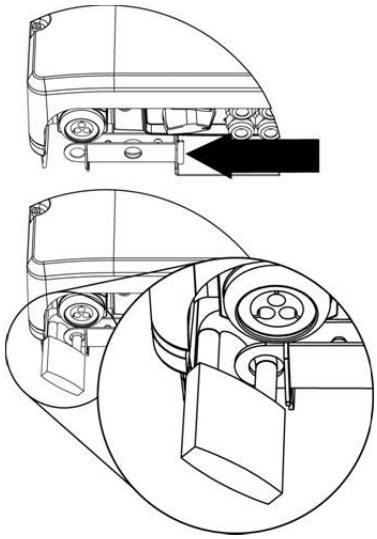
- Lift the inverter and guide the upper hooks into the slots on the bracket.
- Align the lower hooks into the slots.
- Slide the inverter onto the bracket.

Figure 4.2.4: Inverter onto bracket



- Ensure that the inverter is securely aligned in the bracket rails.
- Using a 3 mm hex key, tighten the fixing clip with one screw in the inverter and one in the stringbox (if present).
- Recommended torque is 1.0 Nm / 0.74 ft-lbf.

Figure 4.2.5: Screws through the fixing clip



- For theft protection: guide the lock clip through the fixing clip, and fasten with a padlock.
- The padlock is not a part of the scope of supply.

Figure 4.2.6: Theft protection

NOTICE!

Check that the inverter is properly fastened and secured to the bracket prior to the electrical wiring.

4.3. Electrical Installation

Correct electrical connection is critical for achieving a safe, long-term and reliable operation of the entire PV system.

DANGER: Ensure correct electrical connections!

The electrical connections on the AC and DC side must be performed by qualified persons and comply with local and national electrical regulations and the instructions detailed in this *User Manual*.

Basic PV System Overview

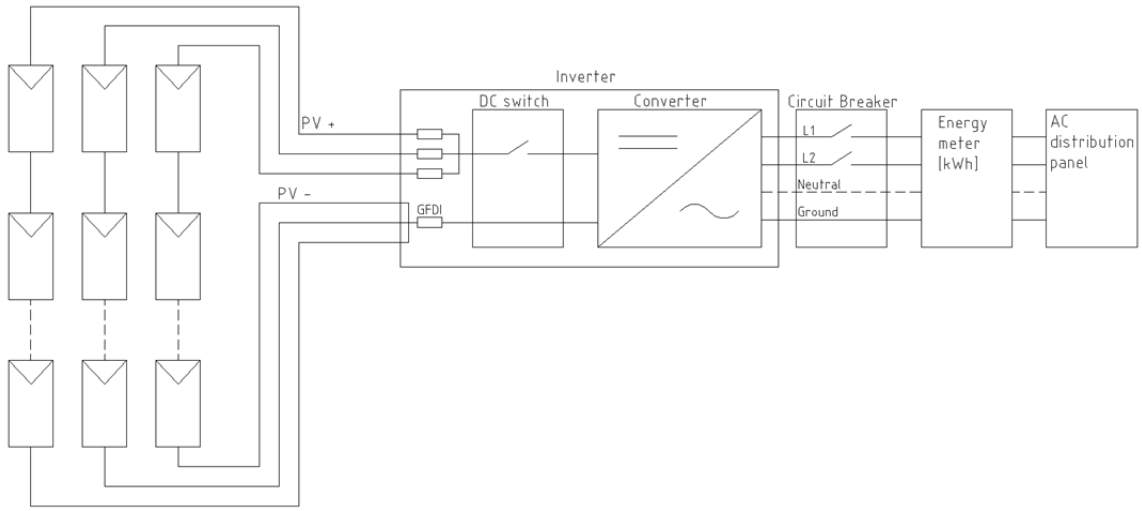


Figure 4.3.1: Simplified PV system overview without DC grounding

4.3.1. Conductors

Two important criteria must be considered in the selection of conductor sizes, namely ampacity and voltage drop. Using correctly sized conductors improves the efficiency of the PV system.

- **Ampacity** refers to the current-carrying capacity of the conductor. The larger the conductor is, the greater its capacity to carry current.
- **Voltage drop** is the loss of voltage due to cross section, current flow and length of the conductor. It is recommended to minimize the system conductor voltage losses, as voltage losses are equal to loss in energy yield.

CAUTION: Avoid overheating and possible fire!

The conductor cross section area and the disconnector ratings must conform to the ratings required by local and national electrical regulations.

- Use adequately sized conductors with the correct temperature rating and sunlight resistance.

CAUTION: Use the correct conductors!

The conductors must be listed for PV applications and the site environment and have the correct color coding to avoid material damage and bodily harm.

- To ensure safe and efficient installation, maintenance and repairs the insulation color-coding of the electrical conductors must be understood. Ensure compliance with the local and national electrical regulations!
- Lead the conductors away from objects that can damage the insulation (sharp edges etc.).

4.3.2. Connection Area

The **DC connections** can be configured in three different ways; either by using a stringbox with DC fuse holders, a stringbox with no DC fuse holders or a connector panel. The configuration of the **AC connections and the network connections** are the same regardless of the different DC connection options.

Prior to the electrical connection the inverter lower cover must be removed (See *2.4.5. Inverter Structure*).

Stringbox with DC Fuse Holders and DC Switch

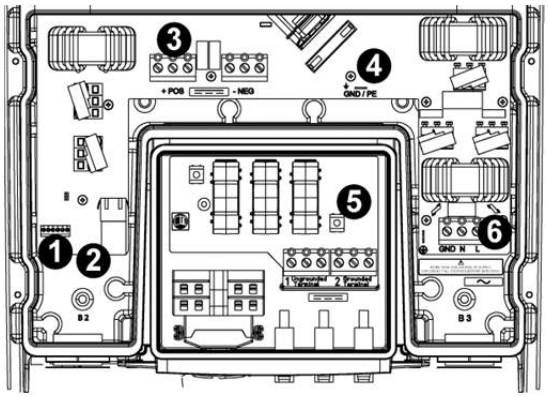


Figure 4.3.1: Customer connection area with stringbox with DC fuse holders and DC switch

1. CAN terminal
2. Ethernet connection
3. Internal DC terminal blocks
4. DC ground terminal
5. Stringbox with fuse holders and DC switch
6. AC terminal block

Stringbox with DC Switch and no DC Fuse Holders

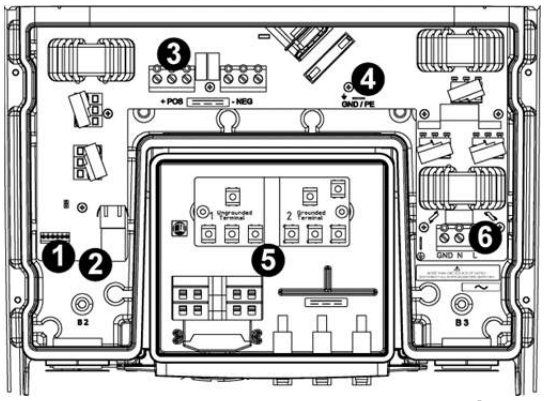


Figure 4.3.2: Customer connection area with stringbox with DC switch

1. CAN terminal
2. Ethernet connection
3. Internal DC terminal blocks
4. DC ground terminal
5. Stringbox with no fuse holders and DC switch
6. AC terminal block

No Stringbox: Connector Panel

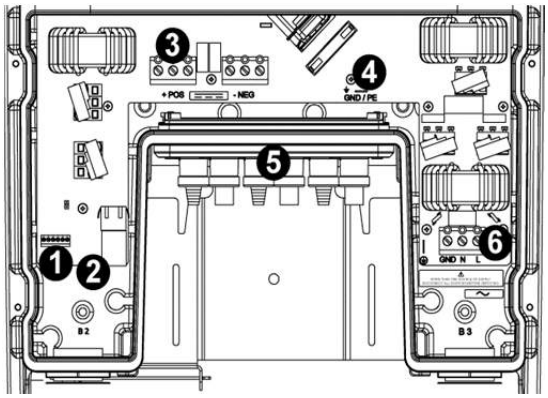


Figure 4.3.3: Customer connection area with connector panel

1. CAN terminal
2. Ethernet connection
3. Internal DC terminal blocks
4. DC ground terminal
5. Connector panel
6. AC terminal block

4.3.3. Grounding

The *THEIA HE-t* inverter meets all relevant safety requirements and includes internal lightning protection. Appropriate grounding of the entire PV system limits voltage surges, gives a common reference point for the conductive parts and facilitates the operation of the overcurrent protection devices.

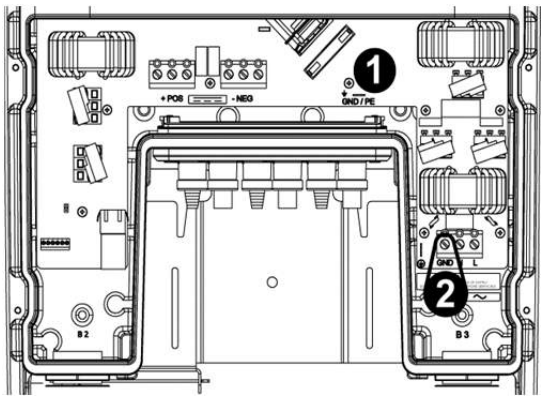


Figure 4.3.4: Ground terminals in the customer connection area

1. The *DC ground terminal* is located to the right of the *–NEG* terminal in the customer connection area and labeled *GND/PE*.

2. The *AC ground terminal* is located in the lower right corner of the customer connection area and labeled *GND*.

DANGER: Ensure correct grounding of the inverter and the PV array!

Grounding should be carried out by qualified persons only, and comply with the relevant local and national electrical regulations.

- The PV strings may be ungrounded, or grounded through either the negative **or** the positive string conductors, which are connected to the *DC ground terminal* via the grounding strap.
- The grounded conductors must be sized according to the local and national electrical regulations, and only carry current when electrical malfunctions occur.
- Follow the safety instructions and specifications from the different PV module manufacturers regarding grounding requirements.
- All metal parts of the *THEIA HE-t* inverters are electrically bonded to ground through the terminal labeled *GND* on the AC side
- Only valid for France: According to *UTE C 15-712-1* a minimum cross section area of 6.0 mm² / 10 AWG is required for the ground wire connection.

CAUTION: Ensure correct grounding of the PV conductors!

If the positive **or** negative PV conductors are grounded , then the grounding strap must be connected to the DC ground terminal and the system must NOT be grounded at any other point, as voltage potentials can appear and possibly damage electrical components.

4.3.4. DC Side (PV) Connections

The DC connections includes wiring from the PV modules, possibly through a combiner box, to the inverter. The inverter may be configured with the optional Stringbox.

DANGER: Never work with live wires!

Disconnect the PV array before starting the connection on the DC side, as the PV array can supply up to 600 V_{DC} to the inverter when exposed to sunlight. Ensure that the output voltage or current from the PV modules is zero.

String Configuration
A PV string consists of a certain number of PV modules connected in series, which in turn can be connected in parallel and attached to the inverter. Due to a large voltage range there are several feasible PV string combinations, which must be accomplished according to the module manufacturer guidelines and the local and national electrical regulations.

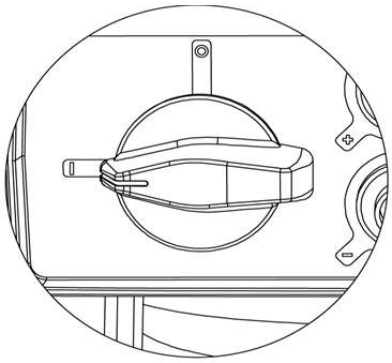
- The **grounding configuration** of the PV strings and the connection to the DC terminals depend on the module technology used and the local or national electrical regulations.
- Use the correct system configuration according to the PV module manufacturer guidelines and the relevant local and national electrical regulations for ungrounded or negative/positive grounded PV strings.
- The inverter is delivered from the factory in an **ungrounded PV string configuration** as standard, but may be configured for **positive or negative grounded PV strings**.
- The configuration of a **negative grounded PV string** differs from an ungrounded PV string with the addition of a grounding strap.
- The configuration of a **positive grounded PV string** differs from an ungrounded PV string with the connection to the DC terminal blocks and the addition of a grounding strap.
- **String configuration** depends on the module technology used. Due to the inverter having one MPP-tracker the number and type of PV modules, and hence the PV power, should be identical for every string.
- Both the positive and negative DC terminal block has three pairs of inputs, for parallel PV string connection. Due to the inverter having **one MPP-tracker** the number and type of PV modules and hence the PV power should be identical for every string.

NOTICE!
Maximum Voltage: The open circuit voltage (V_{OC}) must never exceed 600 V_{DC} under any conditions. The voltage generated by PV modules is inversely proportional to the temperature; at lower temperatures the PV voltage increases from the nameplate rating and at higher temperatures the PV voltage decreases from the nameplate rating. Refer to *3.1.2. Operation*.

Stringbox

If provided, the Stringbox is attached to the bottom of the inverter, and provides PV string connection via the wiring that runs through either plug-in connectors or cable glands. A DC disconnect switch may be provided and mounted in the stringbox.

NOTICE!
Ensure the DC switch is in the OFF position when removing the lower cover to access the connection terminals.



I = ON
0 = OFF

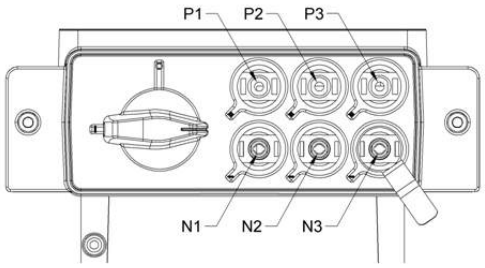
Figure 4.3.5: DC disconnect switch

There are three different configurations of the stringbox:

1.Stringbox with DC fuse holders and DC switch
2.Stringbox with DC fuse holders and no DC switch
3.Stringbox with DC switch and no DC fuse holders

1. Stringbox with DC Fuse Holders and DC Switch

The Stringbox can be equipped with DC fuse holders, DC switch and plug-in connectors or cable glands.



P1, P2, P3:
Positive connectors

N1, N2, N3:
Negative connectors

Figure 4.3.6: Optional DC connectors

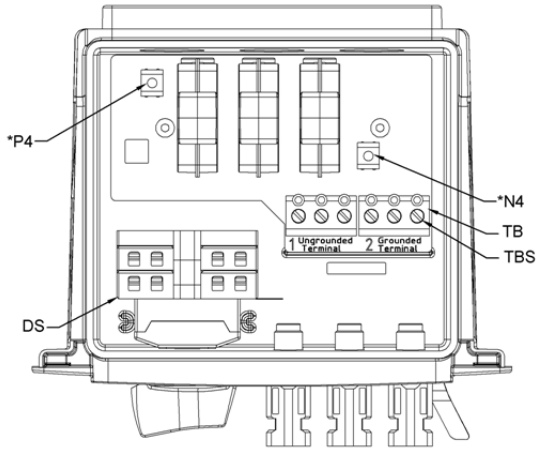


Figure 4.3.7: Stringbox with DC fuse holders and DC switch

***N4:**
Grounding terminal and terminal for the grounding strap

***P4:**
Ungrounded terminal

TB: Terminal Block
TBS: Terminal Block Screw
DS: DC Switch

Positive grounded PV String

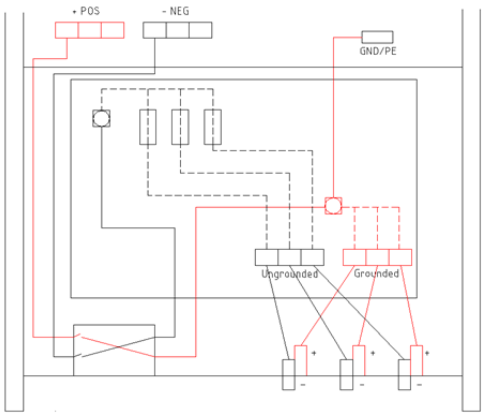
- Connect the positive conductors from the positive connectors to the terminal block labeled *Grounded* and the negative conductors to the terminal block labeled *Ungrounded*.
- Switch the conductors connected to **N4* and **P4*.
- Connect the grounding strap between **N4* and the *DC ground terminal* in the customer connection area (See *4.3.3. Grounding*).

Negative grounded PV String

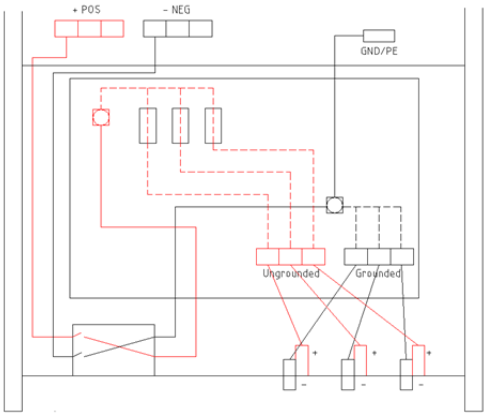
- Connect the grounding strap between **N4* and the *DC ground terminal* in the customer connection area (See *4.3.3. Grounding*).

Wiring Diagram

Positive grounded PV String



Negative grounded PV String



2. Stringbox with DC Fuse Holders and no DC Switch

The Stringbox can be equipped with DC fuse holders and plug-in connectors or cable glands, but no DC switch. A DC switch must be installed separately by qualified persons in compliance with the relevant local and national electrical regulations.

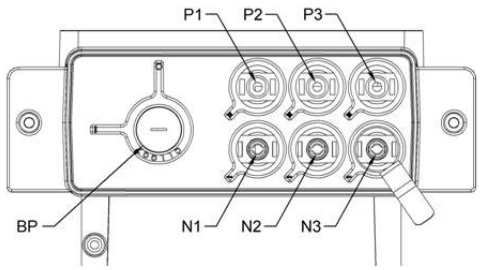


Figure 4.3.8: Optional DC connectors and no DC switch

P1, P2, P3:
Positive connectors

N1, N2, N3:
Negative connectors

BP: Blanking Plug

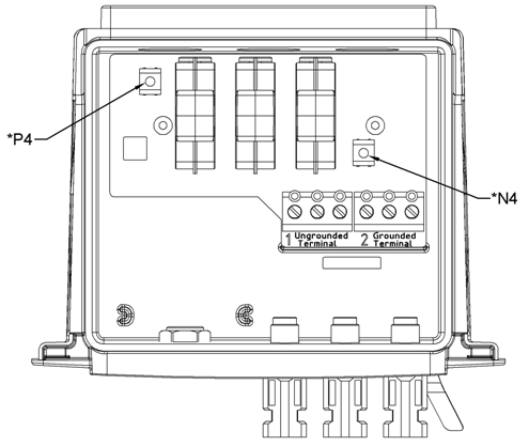


Figure 4.3.9: Stringbox with DC fuse holders and blanking plug

***N4:**
Grounding terminal and terminal for the grounding strap

***P4:**
Ungrounded terminal

Positive grounded PV String

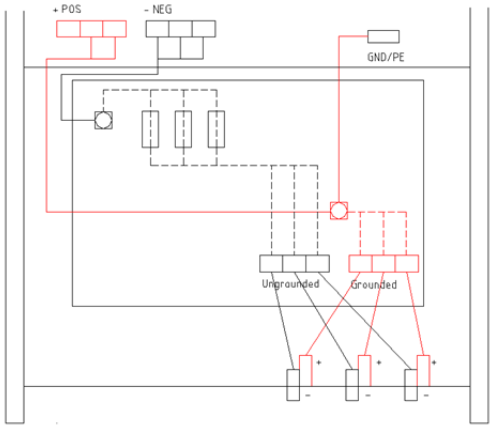
- Connect the positive connectors from the positive connectors to the terminal block labeled *Grounded*, and the negative conductors to the terminal block labeled *Ungrounded*.
- Switch the conductors connected to **N4* and **P4*.
- Connect the grounding strap between **N4* and the *DC ground terminal* in the customer connection area (See *4.3.3. Grounding*).

Negative grounded PV String

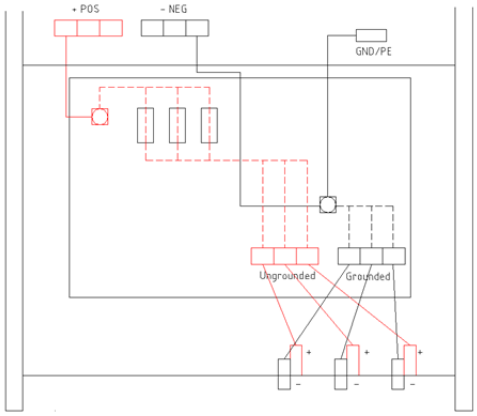
- Connect the grounding strap between **N4* and the *DC ground terminal* in the customer connection area (See *4.3.3. Grounding*).

Wiring Diagram

Positive grounded PV String



Negative grounded PV String



3. Stringbox with DC Switch and no DC Fuse Holders

This option is a Stringbox equipped with DC switch and plug-in connectors or cable glands, but no DC fuse holders.

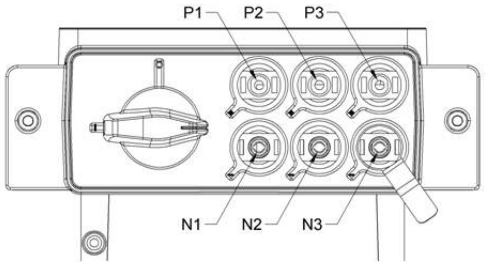


Figure 4.3.10: Optional DC connectors and DC switch

P1, P2, P3:
Positive connectors

N1, N2, N3:
Negative connectors

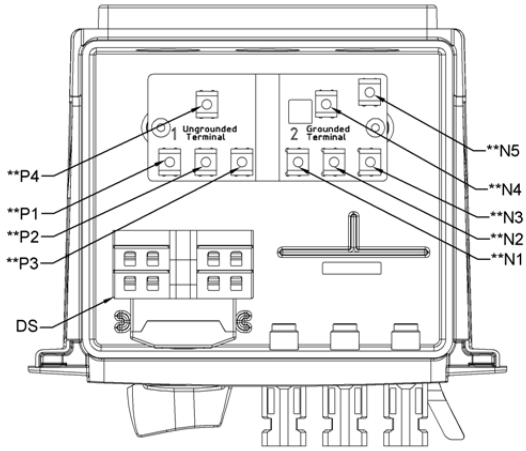


Figure 4.3.11: Stringbox with DC switch and no DC fuse holders

****P1**, ****P2**, ****P3:**
Terminals labeled *Ungrounded*

****N1**, ****N2**, ****N3:**
Terminals labeled *Grounded*

****N4:** Grounding terminal
****P4:** Ungrounded terminal
****N5:** Terminal for the grounding strap

DS: DC Switch

Positive grounded PV String

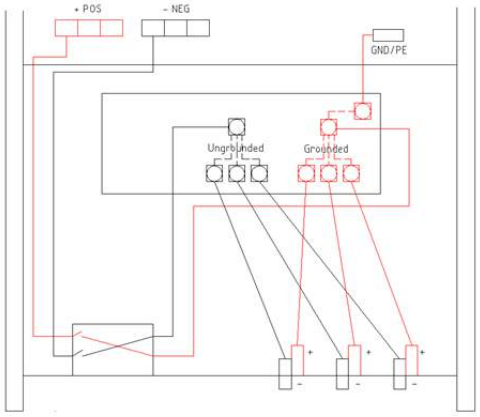
- Connect the positive connectors from the connectors to the terminals ***N1*, ***N2* and ***N3*, and the negative conductors to the terminals ***P1*, ***P2* and ***P3*.
- Switch the conductors connected to ***N4* and ***P4*.
- Connect the grounding strap between ***N5* and the *DC ground terminal* in the customer connection area (See *4.3.3. Grounding*).

Negative grounded PV String

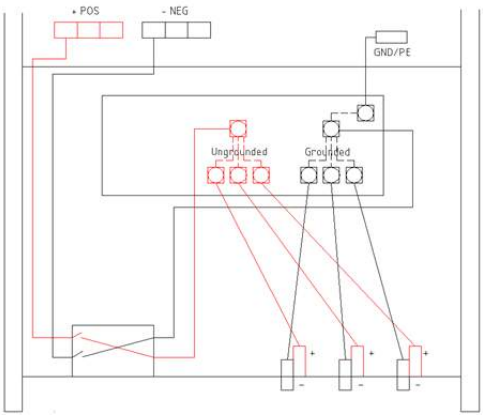
- Connect the grounding strap between ***N5* and the *DC ground terminal* in the customer connection area (See *4.3.3. Grounding*).

Wiring Diagram

Positive grounded PV String



Negative grounded PV String



No Stringbox: Connector Panel

The Stringbox may be replaced with a connector panel containing plug-in connectors or cable glands. A DC switch must then be installed separately by the system installer in compliance with the relevant local and national electrical regulations.

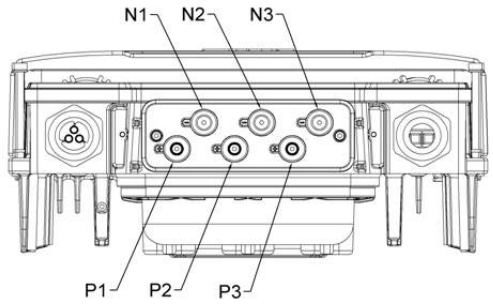


Figure 4.3.12: Connector panel with optional DC connectors

N1, N2, N3:
Negative connectors

P1, P2, P3:
Positive connectors

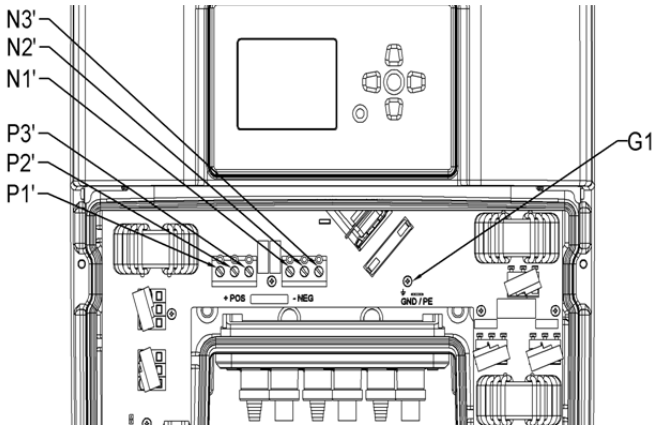


Figure 4.3.13: Customer connection area

P1’, **P2’**, **P3’:**
Terminals labeled *+POS* (Positive)

N1’, N2’, N3’:
Terminals labeled *–NEG* (Negative)

G1:
DC ground terminal
(See *4.3.3. Grounding*)

Positive grounded PV String

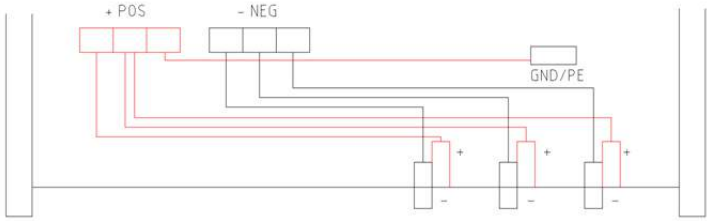
- Connect the grounding strap between *P3’* and *G1*.
- With three strings, two of the string conductors must be connected to the same terminal, so that the grounding strap has a terminal for itself.

Negative grounded PV String

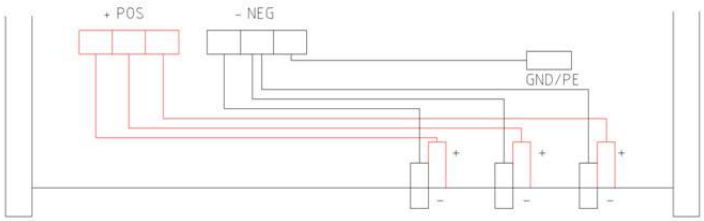
- Connect the grounding strap between *N3’* and *G1*.
- With three strings, two of the string conductors must be connected to the same terminal, so that the grounding strap has a terminal for itself.

Wiring Diagram

Positive grounded PV String



Negative grounded PV String



Connection Procedures

- The DC conductors connecting the PV array to the inverter must each have a minimum rating of 600 V_{DC} at all given operating temperatures. See **NOTICE!** on page *24* regarding maximum allowed DC voltage.
- The DC conductor cables must be sized for correct temperature rating and sunlight resistance. Use copper wire with a cross section area between 6-16 mm^2 /10-6 AWG and temperature rating of 90 °C/194 °F for all connections. Ensure compliance with the relevant local and national electrical regulations!

String Connectors	Cable Glands
The corresponding connectors must be provided by the system installer. Follow the guidelines from the connector manufacturer when choosing cable sizes and assembling them in the connectors. Plug in the connectors and hand-tighten them to the corresponding connector on the inverter. Check if the contacts are firmly tightened by pulling them gently. Only valid for France: Removal of the connectors requires a special tool. Note the relevant national electrical regulations!	Use cables with an overall diameter between 5 mm and 9 mm to be able to seal the gland locknut properly. Unscrew the gland locknut and guide the cables through the opening. Connect the conductors to the corresponding terminals in the Stringbox / connection area according to the PV system grounding used. Tightening torque: • With terminal blocks: 1.5 Nm / 1.11 ft-lbf. • With ring terminals: 2.0 Nm / 1.48 ft-lbf. Pull the conductors gently to ensure that they are firmly tightened, and then tighten and seal the cable gland.

Reversed DC Connection

If the positive and negative conductors are connected to the wrong terminals, the inverter will not start up. The inverter is not damaged due to internal reverse blocking diodes, but high currents are generated in the conductors.

DANGER: Be aware of high currents!

If the DC terminals are mixed up during connection, high currents are generated in the conductors, which can pose shock hazards.

Follow the next instructions to avoid arcing when reconnecting the terminals:

- Turn OFF the DC switch(es) and the AC circuit breaker(s).

DANGER: Never work with live wires!

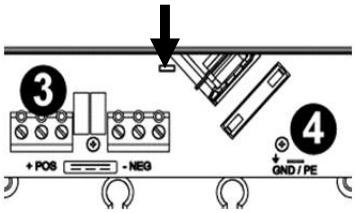
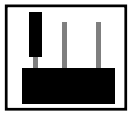
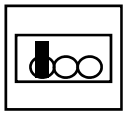
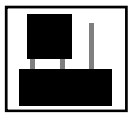
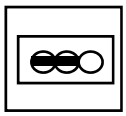
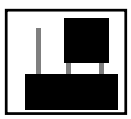
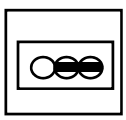
The PV conductors are still charged after the DC switch in the Stringbox is turned OFF, due to power fed from the PV modules. Always turn OFF the remote DC switch and wait until the PV modules do not feed power.

- Remove the PV connectors.
- Check with a voltmeter if the terminals are discharged.
- Disconnect the conductors from the terminal block.
- Connect the conductors to the correct terminal block.
- Test the polarity using a voltmeter before turning ON the DC switch(es) and the AC circuit breaker(s).

Jumper Position for the System Grounding Setup

The jumper above the - *NEG* terminal in the customer connection area monitors the arrangement of the DC connection according to the system grounding setup. When delivered, the jumper is positioned for an ungrounded string configuration as a standard. Depending on the grounding requirements from the module manufacturer the jumper must be pulled up and positioned correctly to match the required grounding of the PV strings.
In case of discrepancy a message will appear in the display (See *7.2. Table of Events*).

Table 4.3.1: Position for the jumper monitoring the grounding setup

Connection Area	From the side	From above	System
			**Ungrounded PV String** There is no connection between the pins.
			**Positive grounded PV String** The jumper short-circuits pin 1 and pin 2.
			**Negative grounded PV String** The jumper short-circuits pin 2 and pin 3.

4.3.5. AC Side (Grid) Connections

The AC connection includes wiring from the AC distribution panel through one or more circuit breakers to the AC terminal block of the inverter.

Verify that the AC grid specifications are compatible with the inverter characteristics before connecting the inverter to the AC grid:

- Single phase/Split phase
- Voltage range (184 – 276 V)
- Frequency range (50 Hz ±5 Hz)

DANGER: Ensure that the AC terminals are discharged!

Turn OFF the AC circuit breaker(s) before connecting the inverter to the AC grid to avoid shock hazards.

The *THEIA HE-t* series are single phase output inverters, which are designed so that they can be connected to a three-phase system. When several inverters are connected together, they must be distributed evenly between the grid phases.

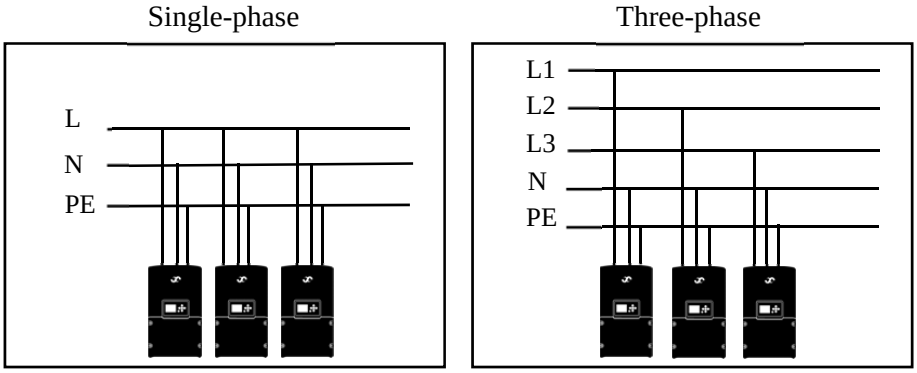


Figure 4.3.14: Connecting the inverter to the grid

- **PE (Protective Earth/Ground) conductor** is an electrical path to true Earth, designed to carry fault currents caused by insulation breakdowns within the equipment.
- **N (Neutral) conductor** in a single phase system is a circuit conductor carrying the same amount of current as the ungrounded phase conductor. In a three phase system it is an equalization conductor, designed to have a similar voltage potential to each of the phase-conductors.
- **L1 / L2 / L3 (Phase) conductors** are the ungrounded live conductors, which carry current to the load.

Connection Procedures

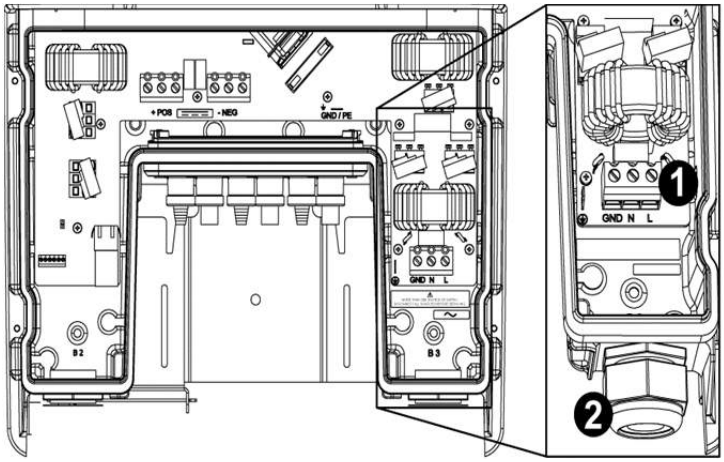


Figure 4.3.15: Customer connection area with AC terminals

1. AC terminal block:

***GND**:* Ground terminal
N: Neutral terminal (TN/TT) or Phase terminal (IT)
L: Phase terminal

2. Cable gland

- The current carrying conductors on the AC side must be rated for the current and have a cross section area of maximum 16 mm^2 / 6 AWG. Ensure compliance with the relevant local and national electrical regulations!
- The AC conductor resistance should be minimized by selecting as large a size of cable cross-section area as possible, up to 16 mm^2 / 6 AWG.
- Unscrew the cable gland locknut.
- Guide the AC cable through the opening, and connect the conductors to the corresponding terminals in the connection area:
    - Phase conductor (L1 or L2 or L3) to *L*
    - Neutral conductor (TN/TT) or Phase conductor (IT) to *N*
    - Grounded conductor to *GND*
- Tightening torque of the terminals is 1.5 Nm / 1.11 ft-lbf.
- Double check if the connection is correctly carried out.
- Hand-tighten the gland locknuts to seal the cable gland.

4.3.6. Network Connections

The inverter is equipped with two network interfaces; Ethernet and CAN. **Ethernet** provides communication between the integrated web server and a computer, either directly connected or via a router/switch. **CAN** allows communication between several inverters.

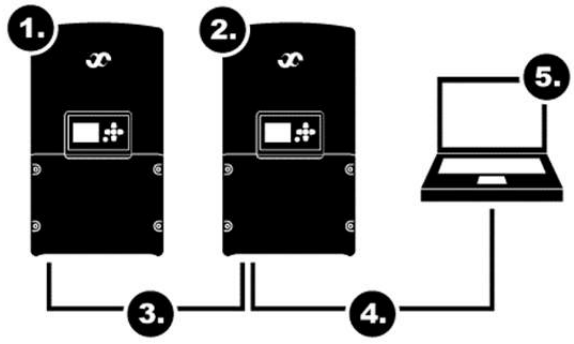
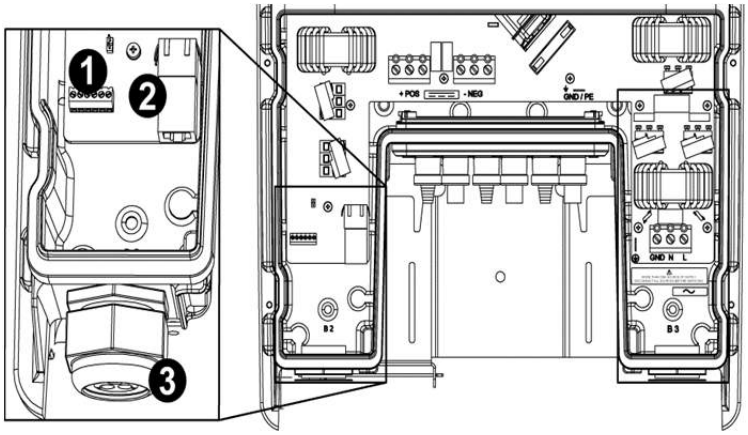


Figure 4.3.16: Network connections

1. Slave inverter
2. Master inverter
3. CAN
4. Ethernet
5. Computer



1. CAN terminal
2. Ethernet connector
3. Network cable gland

Figure 4.3.17: Customer connection area with network terminals

- **Ethernet:** Use CAT5 or better and a maximum length of 100 m.
- **CAN:** Recommended cable size is 0.21 mm^2 / 24 AWG and a maximum length of 100 m.
- Unscrew the network cable gland, and take out the grommet.
- Three-way cable gland insert:

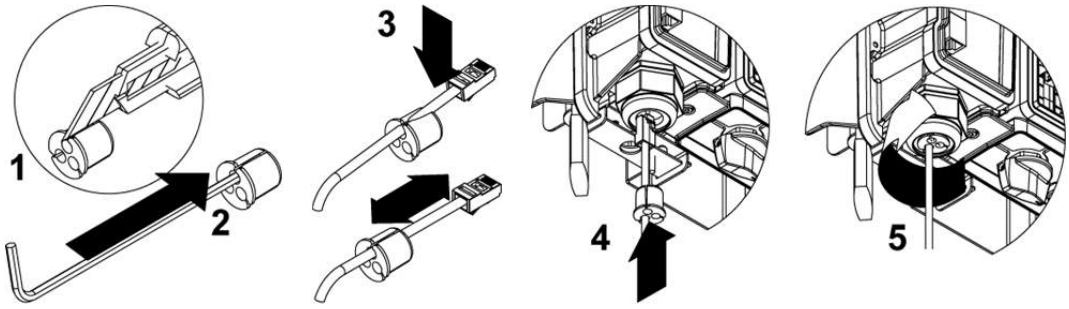


Figure 4.3.18: Insertion of network cables in gland

1. Conductors with connector: Cut through the grommet with a width of about 1mm. With no connector no cutting is necessary
2. Remove the plug from inside the grommet.
3. Assemble the cable in the gap.
   Repeat step 1 – 3 if more cables.

- Guide the assembly into the cable gland.
- Connect the cables to the terminals in the connection area as follows:

Ethernet	CAN
Plug the Ethernet cable directly in its socket.	The conductors must be connected to the same labeled terminals at both ends: i.e. *H* connected to *H*, *L* to *L* etc. Recommended tightening torque is 0.2 Nm / 0.15 ft-lbf.

5. Tighten the cable gland firmly.

NOTICE!

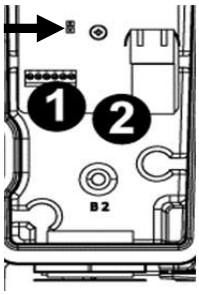
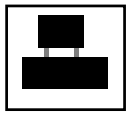
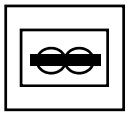
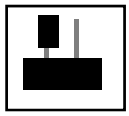
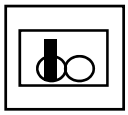
If several inverters are connected together, all inverters must be connected to the CAN bus before *Start Up* to benefit from single installation setup.

Jumper Position for Termination Resistance

With several inverters connected the jumper located behind the CAN terminal in *Table 4.3.2* activates the termination resistance when the pins are short-circuited. This minimizes signal reflections in the cables and helps to avoid interference.

- **Single inverter:** The two pins must be short-circuited (*Default*).
- **Several inverters connected**: The master-slave configuration requires short-circuited pins on the first inverter and on the last inverter in the linked series. The pins must be disconnected on the inverters between the first and last inverter in the linked series.
- To disconnect the pins, the jumper must be pulled up and placed only on one of the pins.
- Be careful not to bend the pins when removing or installing the jumper!

Table 4.3.2: Position of the jumper for the termination resistance

Connection Area	From the side	From above	Pins
			The pins are short-circuited.
			The pins are disconnected.

4.3.7. Checks before Start Up

- ☑ Check that the bracket and the inverter are correctly mounted and secured.
- ☑ Check that all terminals are correctly torqued, and that all connectors and cable glands are correctly tightened and sealed.
- ☑ Verify that the PV open-circuit voltage (V_{OC}) is below the limit of 600 V_{DC}, and that the DC polarity is correct.
- ☑ Verify that the conductors on the AC side are correctly connected to the AC terminal block.
- ☑ Ensure that no cables interfere with the sealing of the inverter lower cover, and fasten the cover firmly to the housing. Recommended tightening torque is 1.0 Nm / 0.74 ft-lbf.

CAUTION: Ensure to tighten the inverter lower cover!

Verify that the lower cover is correctly secured so no moisture enters the housing and damages the electronic components.

5. Start Up

This chapter provides instructions to ensure a safe start-up of the *THEIA HE-t* inverter.

5.1. How to Start Up

A minimum available voltage of 230 V_{DC} and a DC power of >7 W_{DC} is required before the inverter starts feeding power to the grid.

AC Side

- Turn ON the AC circuit breaker(s).

DC Side

- Turn ON the DC switch(es).

5.2. Initial Start

When the inverter is started for the first time, an installation menu is automatically displayed to enable the configuration of certain critical values and operational settings.

5.2.1. Customizing the Inverter Settings

Single Inverter

- When both the AC circuit breaker and the DC switch are turned ON and the inverter is supplied with enough power, the installation menu is displayed on the LCD screen.

Multiple Inverters Connected

- Connect all inverters via the CAN bus so that configuring one inverter configures all inverters. The *Start Up* can then be carried out on any inverter, and if configured as the *master* inverter all the configuration settings of time, date, language and grid settings will be transferred to all the other inverters on the network (s*laves*).
- Each inverter is automatically assigned an ID number from the *master* during *Start Up*.

5.2.2. Display

The display on the front of the inverter contains a LCD screen, three LEDs and six function keys.

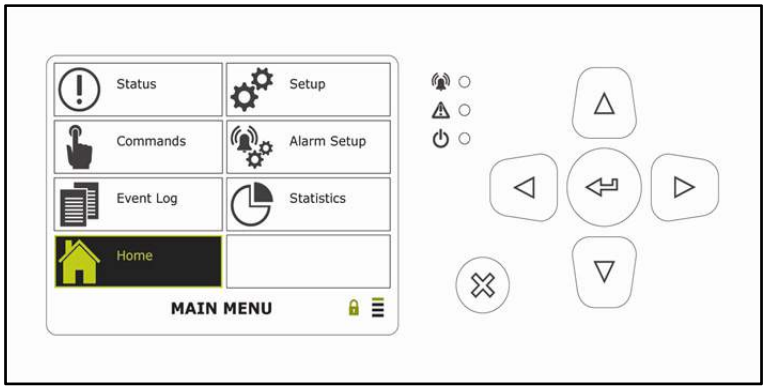


Figure 5.2.1: Inverter display

- To activate the display when the screen saver is 'on' (blank) any key may be pressed.
- With sufficient AC power the display shows the *Start Up* screen:

5.2.3. Function Keys

The function keys have the following uses:

Table 5.2.1: Function keys

Symbol	Function	Symbol	Function
△	*Up*: Scroll up / increase value	▷	*Right:* Navigate one page or value right
▽	*Down:* Scroll down / decrease value	⏎	*Enter:* Select option / go to next level
◁	*Left:* Navigate one page or value left	✕	*Cancel:* Stop operation / back to previous menu item

- The selected item is always highlighted in yellow.
- A registered touch of a button causes a "*click*" sound to be heard.

5.2.4. Start Installation

Start

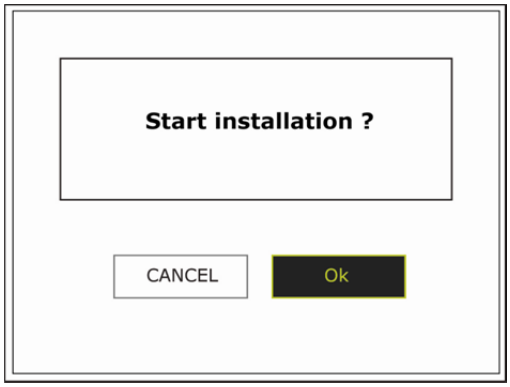
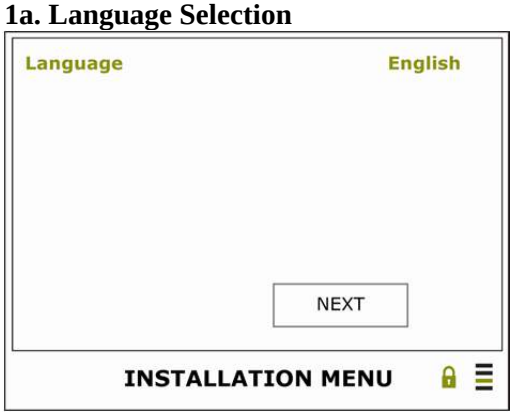


Figure 5.2.2: Start up screen

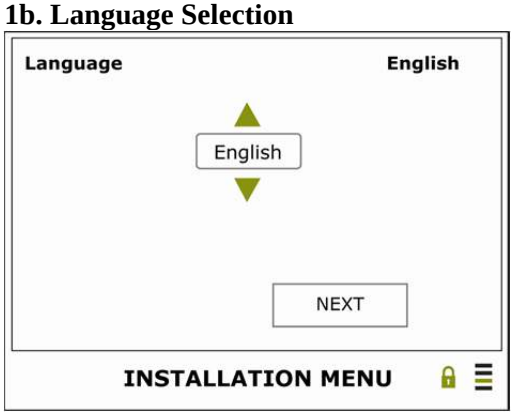
Left or ***Right*** – CANCEL or OK
Enter - Confirm

1a. Language Selection



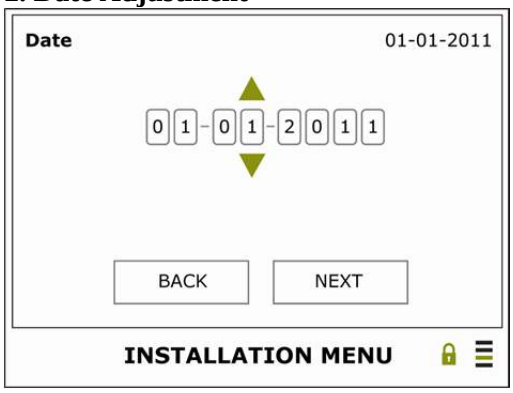
Default – English
Enter – Call up the list of languages

1b. Language Selection



Up or ***Down*** - Navigate through the list to find the preferred language
Enter - Confirm

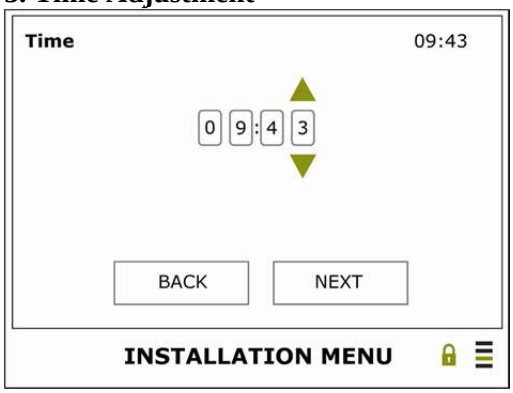
2. Date Adjustment



DD.MM.YYYY

Enter – Call up the date
Up or ***Down*** - Increase or decrease present digit
Right or ***Left*** - Select next or previous digit
Enter - Confirm

3. Time Adjustment

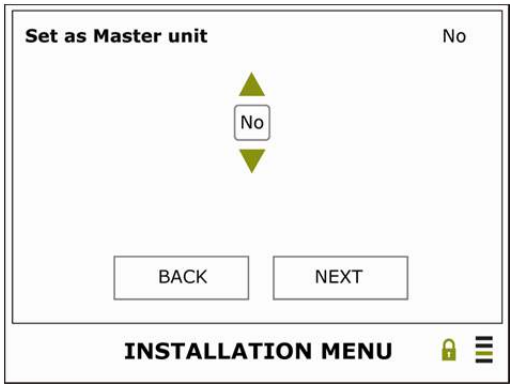


HH.MM (24 H)

Enter – Call up the time
Up or ***Down*** - Increase or decrease present digit
Right or ***Left*** - Select next or previous digit
Enter - Confirm

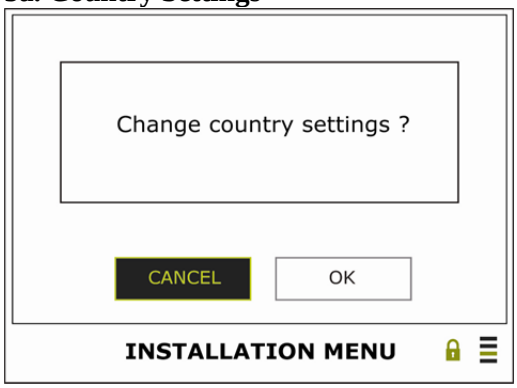
NOTICE!
Correct Time Setting: The time setting must match the time on the actual installation site; otherwise data may be overwritten!

4. Set as Master Unit



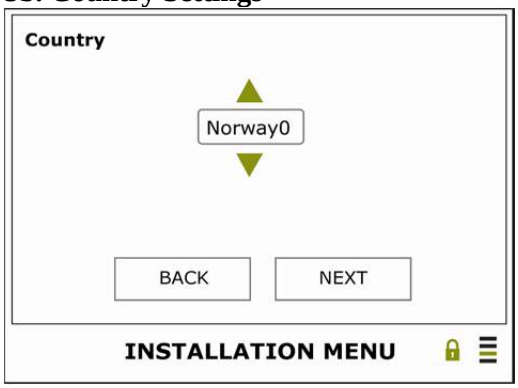
Default – No
Enter – Call up the options
Up or ***Down*** – Navigate through the options YES or NO
Enter - Confirm

5a. Country Settings



Enter – The question "*Change country settings?"* appears on the screen
Left or ***Right*** – Select CANCEL or OK
Enter – Confirm

5b. Country Settings



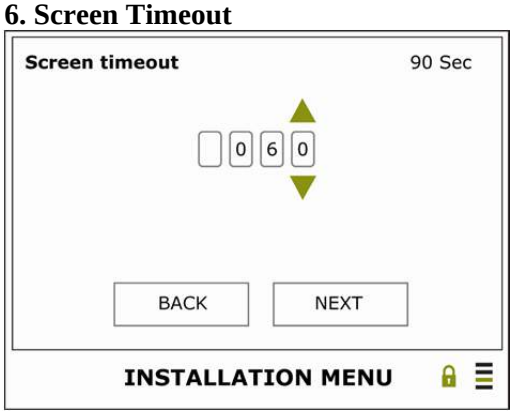
Enter - Call up the list of countries
Up or ***Down*** - Select the country of the actual installation site
Enter – Confirm

NOTICE!
Change Country Settings: An installation timer ensures that the country settings can be changed within the initial 5 hours of feeding power into the grid after installation. Thereafter it is only accessible using the *Installer* password, which may only be obtained for installers and grid operators by contacting *Eltek Valere*.

CAUTION: Ensure correct country settings!

The selected country must match the actual installation site; otherwise the inverter may not operate or be compliant to relevant local and national regulations due to incorrect limit values.

6. Screen Timeout



Enter – Call up the digits
Default: Screen backlight OFF after 60 sec

NOTICE!
The smallest value to be set is **30 sec**, and the highest is **99 sec**.
Setting the value **0** disables the screen timeout and leaves the screen backlight ON.

7. Customer Name

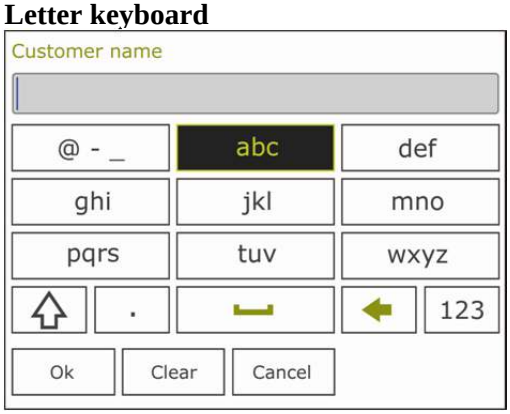
Enter – Call up the keyboard

The keyboard enables the typing of a customer name.

Keyboard

In some of the submenus the settings must be typed by using the function keys:

Letter keyboard



Number keyboard

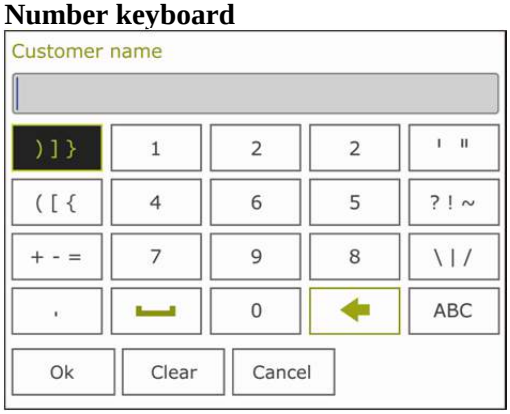


Table 5.2.2: Symbols appearing in the type screens

Symbol	Description	Symbol	Description
	Upper- or lower-case letter	Ok	Confirm changes and exit the menu
	Point	Clear	Clear the typing field
	Space	Cancel	Go back without saving changes
	Cancel last letter	ABC	Go to the Letter keyboard
123	Go to the Number keyboard		

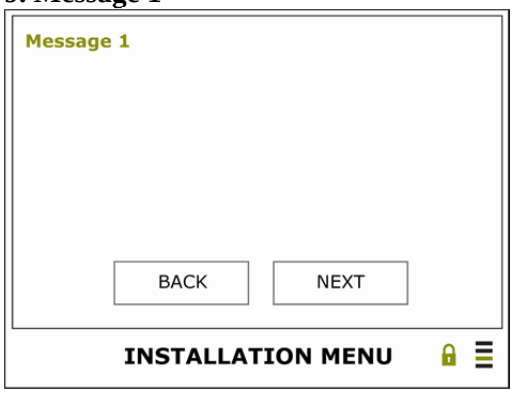
- *Enter* must be pressed until the wanted letter/number/symbol is shown.
- It is possible to navigate between the characters by using the *Up* arrow to set the marker into the text window, then using *Left* and *Right* to navigate between the characters.
- There is a maximum space for 19 symbols in the text window.

8. Site

Enter – Call up the keyboard

The keyboard enables the typing of a site name.

9. Message 1



Enter – Call up the keyboard

This message field is to help distinguish and identify specific inverters in a larger PV plant, or for any other information.

10. Message 2

Enter – Call up the keyboard

This message field is to help distinguish and identify specific inverters in a larger PV plant, or for any other information.

11. Owner Password

Enter – Call up the digits
Default: 0003.
Change the password to 4 optional digits

NOTICE!
This password is not transmitted to other inverters on the CAN bus

NOTICE!
With several inverters connected it must be checked that the installation is carried out on all the slave inverters.

- Look at the displayed menu and the LEDs: It is **not** carried out correctly if the installation menu is still displayed and/or the yellow and red LEDs are lit.
- Check that the connection of the CAN cables are correct, that the DC switches are ON and that the power is >7 W_{DC}.
- If the *Start Up* phase is correctly carried out the inverters are ready to use. They are fully automatic during normal operation, and no manual control is necessary for feeding power into the grid.

5.3. Self Test for Italy

The *Self Test* function is only valid for Italy. It tests the inverters' grid monitoring function of voltage and frequency. The inverter carries out four test sequences, which together takes approximately 2 minutes.

The self-test changes the trip values for the voltage and frequency to the current grid levels to determine:

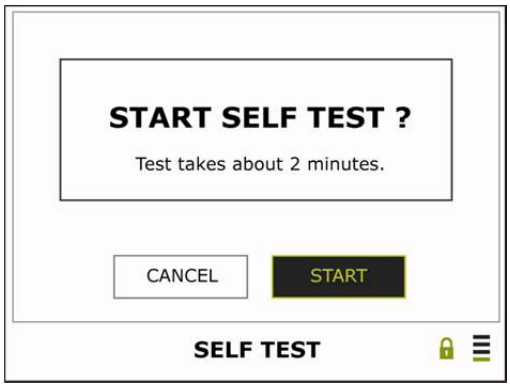
- Whether the threshold equals the actual measured grid values.
- Whether the inverter is triggered to disconnect from the grid by these limits.

Start

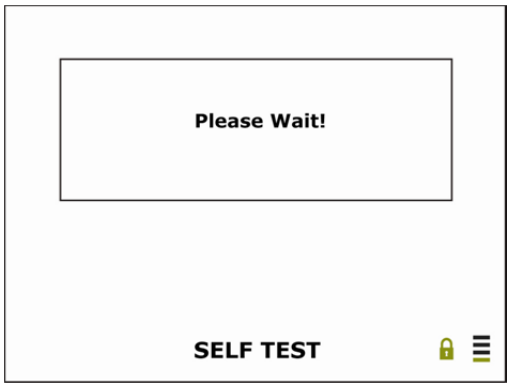
The *Self Test* can only be activated when:

- The installation procedure is executed
- The country configuration is set to *Italy*
- The inverter is in *Running/Derating Mode* (i.e. sufficient irradiation).

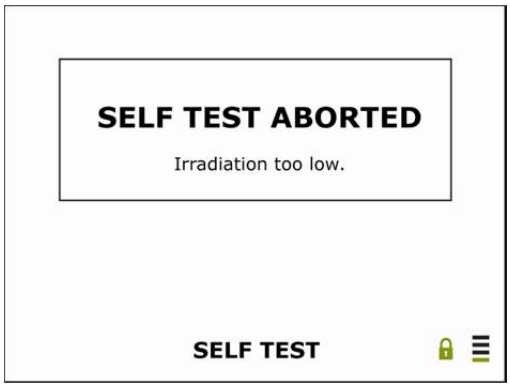
Select: *Commands* > *Inverter Commands* > *Self Test*



Left or ***Right*** – Select START or CANCEL
Enter – Confirm



The test needs some seconds to start.

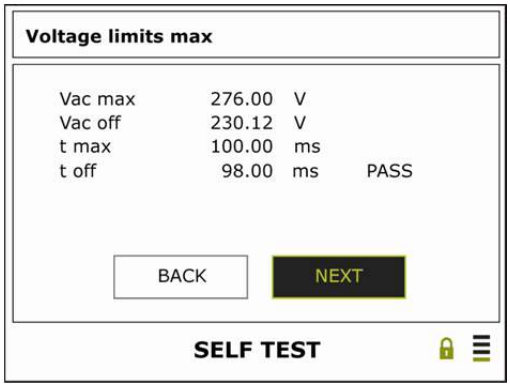


The test can fail if the irradiation is insufficient, as the inverter is unable to feed power to the grid. Restart the test later.

Voltage Monitoring

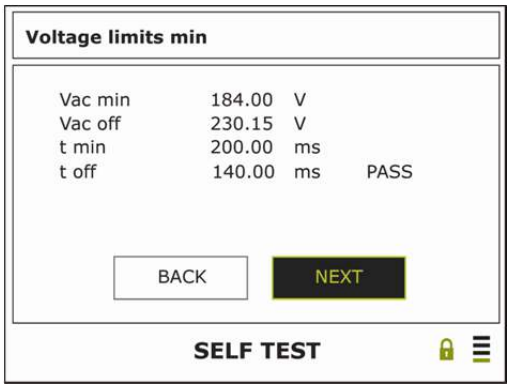
First, the overvoltage monitoring is checked. The voltage trip level is ramped down from the maximum allowed voltage level, 276 V_{AC}**,** and decreased until it equals the current grid voltage. The time it takes from equalization of the voltage to when the inverter disconnects from the grid is measured.

If the sequence is successfully carried out, *PASS* appears. If *FAIL* appears, start the test again later.



$V_{AC\ max}$	Maximum allowed voltage; trip level
$V_{AC\ off}$	Disconnection voltage level; equalization
t_{max}	Maximum allowed disconnection time
t_{off}	Time from equalization to disconnection
PASS	The first sequence is successfully carried out
FAIL	The first sequence has failed – try again later

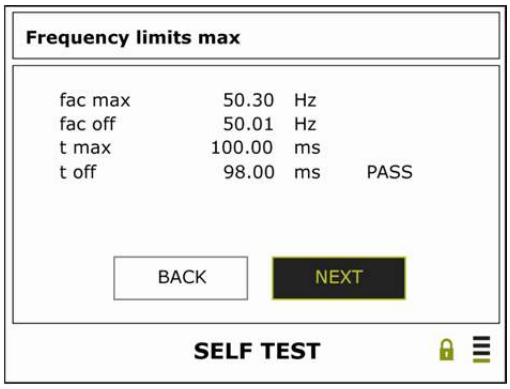
Second, the undervoltage monitoring is checked. The trip level is ramped up from the minimum allowed voltage level, 184 V_{AC}, and increased until it equals the current grid voltage. The time it takes from equalization to disconnection is measured.



$V_{AC\ min}$	Minimum allowed voltage; trip level
$V_{AC\ off}$	Grid voltage level
t_{min}	Minimum allowed disconnection time
t_{off}	Time from equalization to disconnection
PASS	The second sequence is successfully carried out
FAIL	The second sequence has failed – try again later

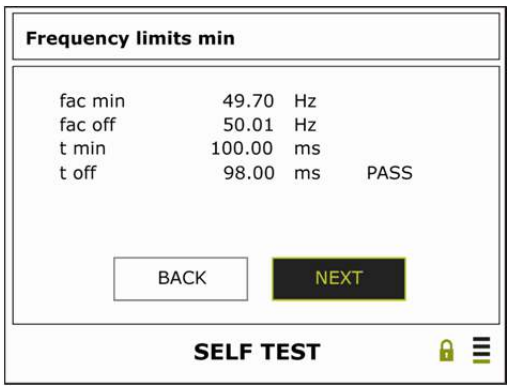
Frequency Monitoring

The inverter repeats the test sequence but with the frequency trip limits. First, the upper frequency trip level is ramped down from the maximum allowed frequency level, 50.3 Hz, and decreased until it equals the current grid frequency. The time it takes from equalization to disconnection is measured.



$f_{AC\ max}$	Maximum allowed frequency; trip level
$f_{AC\ off}$	Disconnection frequency level; equalization
t_{max}	Maximum allowed disconnection time
t_{off}	Time from equalization to disconnection
PASS	The third sequence is successfully carried out
FAIL	The third sequence has failed – try again later

Second, the under frequency monitoring is checked. The trip level is ramped up from the minimum allowed frequency level, 49.7 Hz, and increased until it equals the current grid frequency. The time it takes from equalization to disconnection is measured.



$f_{AC\ min}$	Minimum allowed frequency; trip level
$f_{AC\ off}$	Disconnection frequency level; equalization
t_{min}	Minimum allowed disconnection time
t_{off}	Time from equalization to disconnection
PASS	The fourth sequence is successfully carried out
FAIL	The fourth sequence has failed – try again later

After the test is successfully finalized, the test results are displayed. Press *NEXT* to confirm each result. After entering *FINISH* on the last result, the inverter goes back to the *Inverter Command* menu.

The test results are stored in *Commands* > *Inverter Commands* > *Results Self Test*

If the test fails 4 times, contact *Eltek Valere*.

6. Operation

This chapter describes how to operate the inverter via the LCD display and function keys, or with a PC connected to the embedded webserver.

6.1. LED

There are three LEDs next to the display screen. The upper one is red, the middle is yellow and the lower one is green.

Table 6.1.1: LEDs.

Symbol	LED	Function	Action
	**Red**	Malfunction! Inverter in shutdown	Look for alarms in *Active Alarms*
 	**Green** **&** **Yellow**	Caution! Inverter still operates, but at a limited level	Look for warnings in *Active* Alarms
	**Green**	Operates; inverter feeds power to the grid	No action
NONE	**Yellow**	GUI starts up/firmware update Inverter is OFF (Power < $7W_{DC}$)	No action

6.2. LCD Screen

To navigate in the LCD screen the six function keys must be used. By selecting one of the seven items in the *Main Menu,* a further navigation through different submenus is possible. There are four different menu levels. The highlighted line in the icon  indicates the current menu/submenu level, with the top line being the first level.

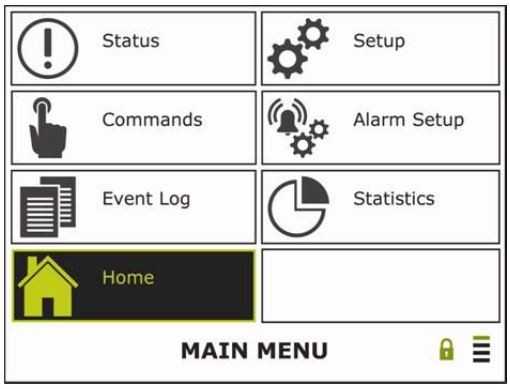


Figure 6.2.1: Main menu

The information and values in the menus *Home*, *Status*, *Event log* and *Statistics* are read-only, while the information and values in the menus *Setup*, *Commands* and *Alarm Setup* can be modified.

Access Levels and Passwords

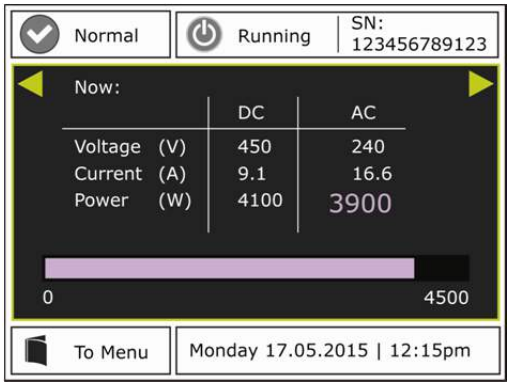
There are three access levels to the different submenus:

Guest	Read all values.
Owner	Read all values and set all values except grid settings and other installer related values. Default *Owner* password is 0003, but can be changed in *Setup>General Setup>Password.* If the password is lost or forgotten, contact *Eltek Valere*.
Installer	Read and set all values. The *Installer* password is based on the serial number; and can only be obtained by contacting *Eltek Valere.*

NOTICE!

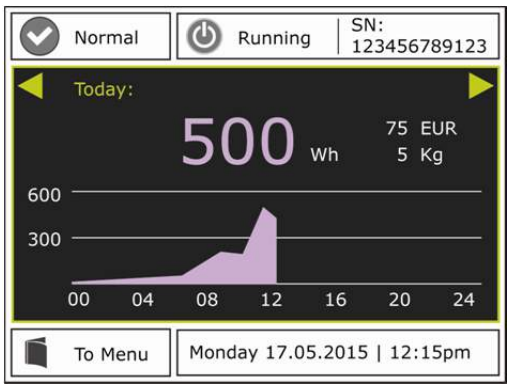
Any change of setting needs a password. Once the password has been entered, modifications must be done within **1 minute** before the access resets to *Guest* level.

6.2.1. Home



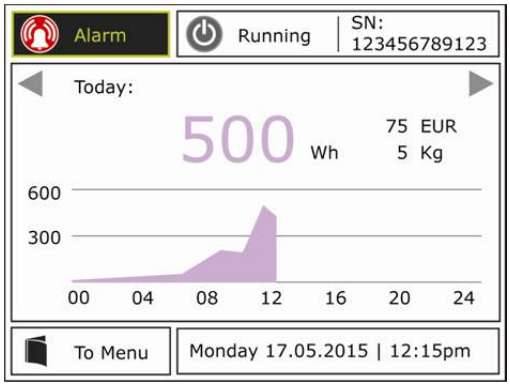
The *Home* screen is the default screen, which is always shown if no buttons are touched for 1 minute.

Values of PV (DC) and feed-in (AC) current, voltage and power are shown numerically. The instantaneous output power is shown as a bar graph.



Up or ***Down*** – Navigate in the screen.
Left or ***Right*** – Observe the daily, monthly and total yearly values of energy harvest [Wh/kWh], peak power [Wp], earning value and avoided CO_2 emission [kg].

Upper Section



The left block shows the status of the inverter (See *Table 6.2*), and is a shortcut to any *Active Alarms.*

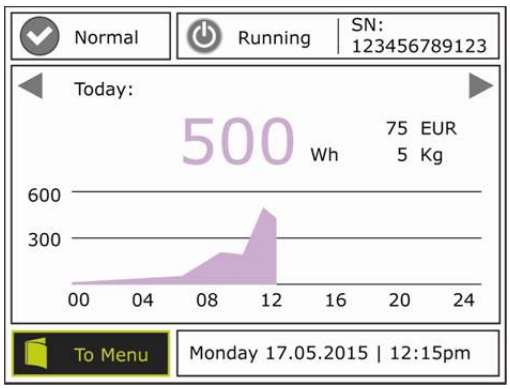
The middle block shows the operation mode of the inverter (See *Table 6.2*).

The right block shows the serial number of the inverter, which is also to be found on the product label.

Table 6.2.1: Inverter's status and mode notifications

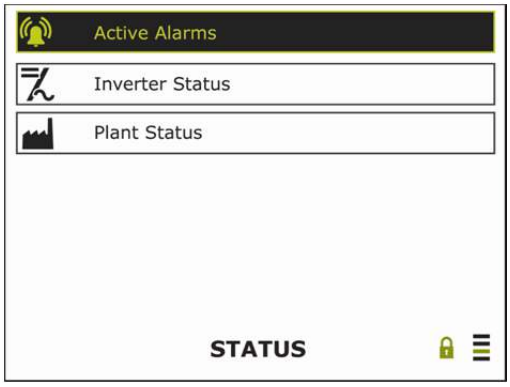
Sign	Status	LEDS
	Normal; inverter operates with no warnings or alarms	**Green**
	Warning; inverter still operates, but there is a warning	**Green&Yellow**
	Alarm; inverter in shutdown, there is an alarm	**Red**
Sign	**Mode**	**LEDS**
	Sleeping; automatic shutdown. Input power is not sufficient to start-up	**Yellow**
	Start-Up; initialization of input values and grid conditions	**Green&Yellow**
	Running; feeding power to the grid	**Green**
	De-rating; output power is reduced to protect the inverter against overheating	**Green&Yellow**
	Shutting Down; inverter in shutdown mode	**Yellow**
	Shutdown; inverter/system failure or unstable operational conditions	**Red**
	Service Mode; inverter can be manually overridden	**Yellow**

Lower Section



The lower section contains a shortcut to the *Main Menu* and the current date and time.

6.2.2. Status



Displays the operating status and mode of the inverter and the PV plant.

Up or ***Down*** – Navigate through the submenus/values
Enter – Select submenu/value

NOTICE!
Plant Status is reserved for future firmware upgrade functions, and is not yet accessible.

Active Alarms

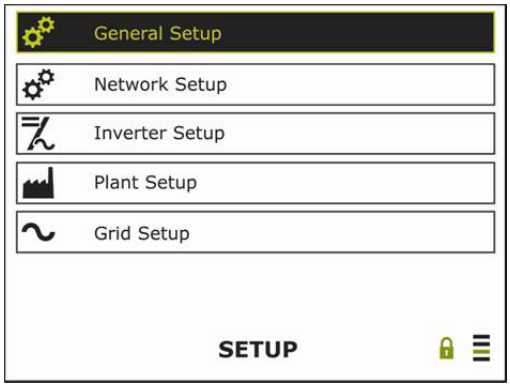
Displays more detailed information about the warnings and alarms shown in the upper left corner of the *Home* screen (See *7.2. Table of Events*).

Inverter Status

Displays the operating mode, errors (if any) and operating parameters of the inverter.

Input Parameters	Values from the PV modules to the inverter; current, voltage and power
Output Parameters	Feed-in values from the inverter to the grid; current, voltage, frequency and power
Inverter Peak Power	Highest power achieved so far today
Energy Today	Total energy harvest throughout the day
Temperature	Temperature inside the inverter
Isolation Resistance	Level for a safe insulation to prevent injury or equipment failure
Operating Hours	Total inverter running time from first start-up

6.2.3. Setup



Displays settings and data from the inverter, the grid and the PV plant.

Up or ***Down*** - Navigate through the settings
Enter – Select value/confirm

NOTICE!
Plant Status is reserved for future firmware upgrade functions, and is not yet accessible.

General Setup

Displays some of the general parameters of the inverter, which can all be changed using the *Owner* password.

Language	The preferred language is set during installation
Date and time	Date and time set during installation
Password	Owner password; default is 0003.
CO_2 Rate	Avoided CO_2 emissions; based on 0.7 kg/kWh
Earnings Rate	Feed-in tariff in the respective country
Earnings Currency	Valid currency in the respective country (three letters)

Network Setup

Displays the settings for the connected network, which can all be changed with the *Owner* password. See *6.3. Connection between Inverter and Computer*.

IP-Address	Unique network address for the inverter
Subnet Mask	Sub-network address; first part of the IP-address
Gateway	Network point acting as entrance to another network
Master Setting	With several inverters connected together, one inverter must be the *master* and the rest of the inverters *slaves*

Inverter Setup

Displays the various data for the specific inverter. This information is set during the manufacturer process. The information is used by service and maintenance personnel.

Model	Inverter model
Serial Number	Unique identifier for each inverter. Also to be found on the product label
***THEIA* Part Number**	Identifier for each inverter hardware configuration within *Eltek Valere*
***THEIA* Version**	Unique version name for keeping track of the development of different inverter versions within *Eltek Valere*
GUI Software Part No	The GUI (Graphical User Interface) software part number. GUI allows interaction with the inverter through the display
GUI Software Version	Version number for the GUI software
GUI Hardware Part No	Identifier for the GUI-card hardware
GUI Hardware Version	Version number for the GUI hardware
SW1 Part No	The DSP1 (Digital Signal Processing) software part number. DSP is a microprocessor controlling the power conversion in the inverter
SW1 Version	Version number for the DSP1 software
Control Board Part No	DSP-card hardware part number
Control Board Version	Version name for the DSP control card hardware
Main Board Part Number	Identifier for the PCB (Printed Circuit Board) hardware. PCB hosts all the components and subsystems of the inverter
Main Board Hardware Version	Unique version number for keeping track of the development of different main board versions
SW2 Part No	The DSP2 software part number
SW2 Version	Version number for the DSP2 software

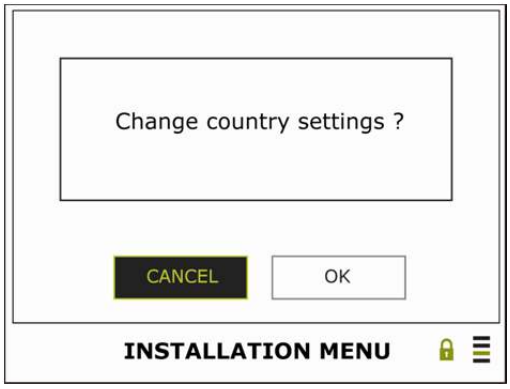
Grid Setup

Displays grid settings based on the selected country. The settings can be changed using the password within 5 hours of feeding in power to the grid after installation. Thereafter it is only accessible by using the *Installer* password, which may only be obtained by contacting *Eltek Valere*.

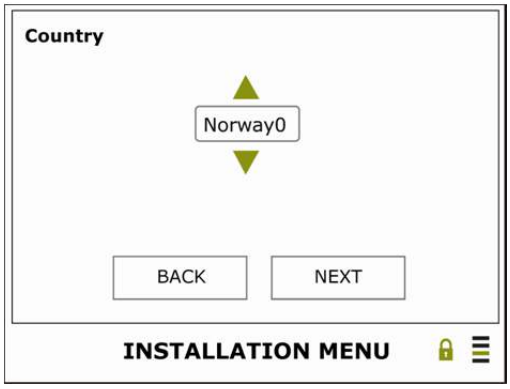
Country	Country of the installation
Country code	Name of the grid protection standards
Grid nom voltage	Nominal voltage of the grid on site
Grid nom frequency	Nominal frequency of the grid on site
Voltage limit min	Lower disconnection limit of the grid voltage on site
Voltage limit max	Upper disconnection limit of the grid voltage on site
Voltage time limits min	Minimum disconnection time limit
Voltage time limits max	Maximum disconnection time limit
Frequency limits min	Lower disconnection limit of the grid frequency on site
Frequency limits max	Upper disconnection limit of the grid frequency on site
Frequency time limits min	Minimum disconnection time limit
Frequency time limits max	Maximum disconnection time limit

Change the Country Settings

- From the *Main Menu:* Select *Setup* > *Grid Setup* > *Country*.
- ***Enter*** - Confirm.
- After 5 hours of feeding in power to the grid after installation the *Installer* password must be used to change the country settings. The *Installer* password is avaialable for installers and grid operators only by contacting *Eltek Valere*.
- The question "*Change country settings?*" appears in the display.



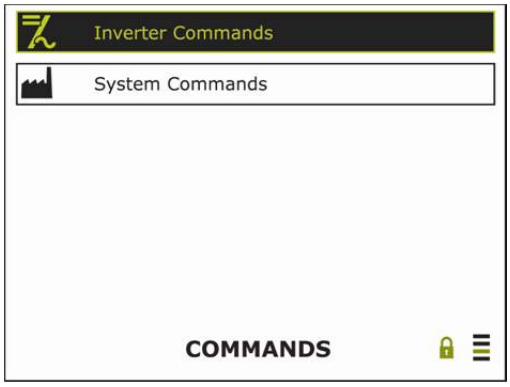
OK – Continue
Cancel - The operation is cancelled



Up **or** ***Down*** - Select the respective country
Enter – Confirm

- After the country settings are changed, the screen will return to the *Grid Setup* screen, showing the new grid settings.

6.2.4. Commands



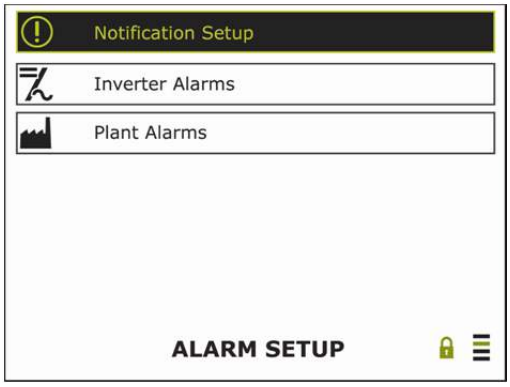
Up or ***Down*** - Navigate through the list
Enter - Select an option/confirm

Inverter Commands

Displays events saved in the inverter data logger, which can be deleted using the *Owner* password to provide storage for more information.

Event Log	Deletes the log of events that the inverter has recorded
Energy Log	Deletes the energy log items and summarized values
Data Log	Deletes the 15 minutes average power values
Self-Test	Start Self-Test (Italy only)
Result Self-Test	View the results from the last run Self-Test (Italy only)

6.2.5. Alarm Setup



Setup menu for sending information regarding production, alarms/warnings and operation mode on email.

Notification Setup

Displays the settings for remote monitoring of notifications and alarms. Includes settings for the mail server, the sender and the email-receiver details.

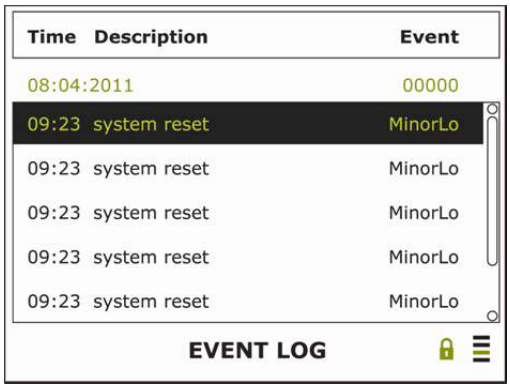
User Name	Mail user name
Password	Digits, letters and symbols making up the user password for the mail server.
Sender email address	A valid email address, requireded to be able to send notifications
Receiver email 1	Where to send notifications for recipient 1
Receiver email 2	Where to send notifications for recipient 2
SMPT server	**S**imple **M**ail **T**ransfer **P**rotocol server for delivering e-mails

Inverter Alarms

Displays the settings of inverter notification details for what to send and how often to send notifications to e-mail address 1 and 2.

Notification time	Specified time for sending the production email (in hours)
Notification time	Specified time for sending the production email (in minutes)
Interval	Specified interval between the notifications in minutes. 1440 = 24 hours/daily.
Send production on email 1	Send inverter energy production data to email 1 at the specified notification time
Send mode on email 1	Send operation mode change to email 1 (sent immediately)
Send alarm on email 1	Send warning and alarm change to email 1 (sent immediately)
Send production on email 2	Send inverter energy production data to email 2 at the specified notification time
Send mode on email 2	Send operation mode change to email 2 (sent immediately)
Send alarm on email 2	Send warning and alarm change to email 2 (sent immediately)

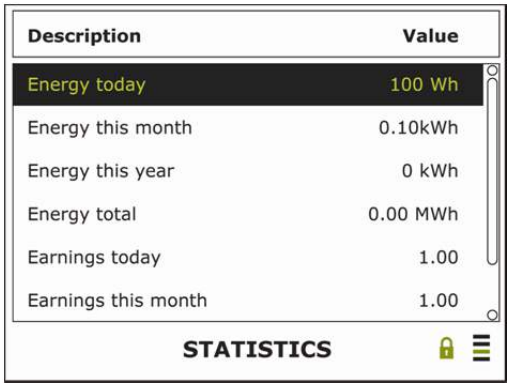
6.2.6. Event Log



Displays information about events that the inverter has logged. The events are listed with the most recent event first.

Warning On means that a warning event has occurred.
Warning Off means that an event has cleared.

6.2.7. Statistics



Displays values for the daily, monthly, yearly and total energy harvest, earnings, CO_2 savings and peak power.

Up or ***Down*** – Read the different values

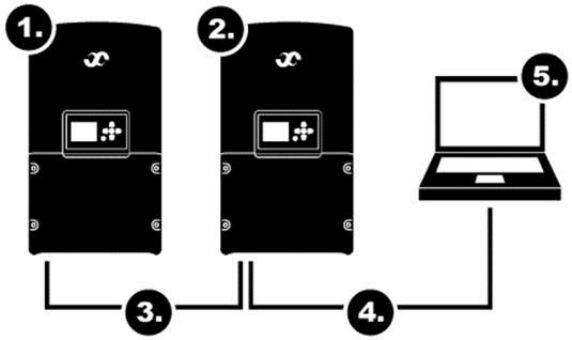
Energy	Total energy produced in kWh
Earnings	Depending on the feed-in tariff: Cash value of the feed-in energy in currency/kWh
CO_2 avoided	CO_2 emissions avoided by using solar power compared to fossil fuel in kg/kWh
Peak Power	Largest instantaneous amount of power produced [W]

6.3. Connection between Inverter and Computer

The site performance can be checked remotely by using a computer. The connection can be achieved between between the inverter and the computer either directly or via a network.

6.3.1. Without Network

To connect the inverter and the computer directly a regular CAT5 Ethernet cable is needed. If the network card in the computer does not support *Autosense*, a crossover cable is needed to create a connection to the inverter.



1. Slave inverter
2. Master inverter
3. CAN
4. Ethernet
5. PC

Figure 6.3.1:Connection without network

The computer's and the inverter's IP address must be in the same range, ie. If the inverter's IP address is *192.168.10.X*, the computer's IP address must be *192.168.10.Y*, where X and Y are two different numbers between 1 and 254.

To change the computer's IP address:

The next configuration is taken from *Windows 7*, but may vary slightly between different operating systems.

1. Open the network menu by clicking *Start*
2. Click *Control Panel > Network and Sharing Center*
3. Click *Local Area Connection > Properties*
4. Select *Internet Protocol Version 4 (TCP/IPv4) > Properties*
5. Select *Use the following IP address*.
Enter the default parameters: IP address *192.168.10.10*, subnet mask *255.255.255.0*.
Click *OK* and *OK*

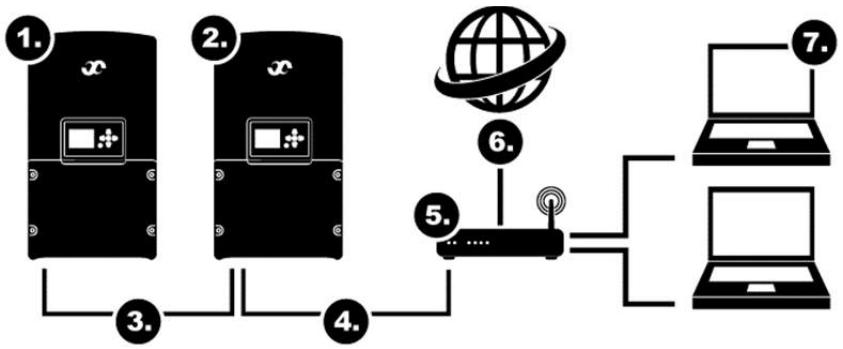
To connect to the *THEIA HE-t*, the inverter's IP address must be entered into the web browser address line.

NOTICE!

With several inverters connected together via CAN bus the CAT5 cable must be attached to the master inverter only.

6.3.2. With Network

If a network is present, the availability of DHCP (*Dynamic Host Configuration Protocol*) determines the configuration between the inverter and the computer. With DCHP, normally a router or a switch distributes the needed parameters (IP address and Subnet Mask) for devices to operate in the network.



1. Slave inverter
2. Master inverter
3. CAN
4. Ethernet
5. Router/Switch
6. World Wide Web
7. PC

Figure 6.3.2:Connection with network and World Wide Web

Connect the inverter and the PC to the router/switch with a regular CAT5 Ethernet cable.

With DHCP

In the inverter:
1. Go to *Setup>Network Setup*.
2. Set the IP address to *000.000.00.00*. With this setting the router/switch assigns the network parameters automatically to the inverter.

When changing the network settings the GUI will restart after pressing *OK*.

Without DHCP

In the inverter:
1. Go to *Setup>Network Setup*.
2. Set the IP address to the desired, unique address of the inverter. The inverter IP address must be an unused IP address in the network.

6.3.3. Access from the Internet

In order to make the inverter(s) accessible from the internet further parameters must be set within the network settings.

- First the HE-t inverter must be assigned a static IP address in the local network, this can either be done through the inverter as described above, or can be configured within the network router/switch.
- Next it will be required to set up ‘Port Forwarding’ within the local network router. This will usually be in the ‘advanced settings’ of the router/switch, but will vary from manufacturer to manufacturer. Port ‘80’ of the router must be forwarded to the static IP

address assigned to the HE-t. With this completed it should now be possible to reach the HE-t webserver by typing in the external IP address of the local network.

- The external IP address of the local network can be found by visiting http://www.whatismyip.com.

NOTICE!

If the local network is assigned a dynamic IP address from their Internet Service Provider (ISP) the external IP address is unlikely to remain constant over a long time period. It is possible to set up a free account with **DynDNS,** or other similar companies, who will provide the user with a 'normal' web address that is linked to the IP address of the local network. In order for the DynDNS service to operate correctly the user's router must be capable of reporting its IP address to the DynDNS service. This will be present in a section of the router asking for the details for the users account with DynDNS. If the user's router does not have this functionality and has a dynamic IP address then periodically a manual update of the DynDNS settings will be required.

6.4. Internal Web Server

The inverter has an internal, onboard web server providing detailed information about the operation, warnings/alarms and energy production.

Figure 6.3.5: THEIA Analyzer web page

- Changes can be done in *Setup > Plant Setup*.
- Default administrator account is: **User:** *admin*, **Password:** *admin*
- This should be changed if the web server is connected to the internet. The web page is best viewed in *Firefox 4.0* or *Internet Explorer 8.0*.

7. Troubleshooting

This chapter contains useful information if the inverter malfunctions during start-up or operation. Start by checking that the installation is carried out correctly, and then check the information in *7.2. Table of Events* for possible solutions. If this does not help solve the problem, please contact the system installer.

7.1. Check List by Failure

If the inverter does not feed power to the grid, try to solve the problem by checking:

- ☑ That all connection points in the system are properly tightened.
- ☑ That both the AC circuit breaker(s) and DC switch(es) are ON.
- ☑ That the irradiation is sufficient to generate power (> 7 W).
- ☑ That the operation mode of the LEDs is normal (See *6.1. LED*).
- ☑ That there are no warnings or alarms in the display (See *7.2. Table of Events*).
- ☑ That the values of the PV voltage, current and power match those in the display.

If all these items are OK, and there is still no power fed to the grid, please contact the system installer.

7.2. Table of Events

The inverter automatically identifies operational issues and displays the messages on the screen. Detailed information about warnings and alarms can be found in the *Event Log* menu. See *6.2.6. Event Log*.

Messages that can appear in the display:
W = Warning
A = Alarm

Table 7.1: Description of messages appearing in the display during inverter failure

Display Message	Description	Action
Panel fault (**W/A**)	PV module failure	- Contact the module supplier*****
Input circuit breaker open (**A**)	DC switch(es) is open	- Turn ON the DC switch(es)***** - If already ON, contact the system installer
Inverter failure (**W/A**)	Inverter failure	*****
Output circuit breaker open (**A**)	AC circuit breaker(s) is open	- Turn ON the AC circuit breaker(s)***** - If already ON, contact the system installer

Grid fault (**W/A**)	No detection of the grid, not able to synchronize with the grid or fault within the country-settings	- Verify if the AC circuit breaker is ON and operational - Measure that the grid voltage is present at the AC terminals - Check that the DC switch(es) is ON and that the DC power is > 7W - Check that the country settings have been successfully set in *Setup>Grid Setup* - If country is set to Italy, has the *Self-Test* failed. Run test again
GUI fault (**W/A**)	Display is not responding	- Turn off the AC side. Wait for 3 seconds and then turn on again. Wait 30 seconds for the GUI to turn on - If still fault, contact your distributor
High voltage on input side (**A**)	DC voltage threshold of 600 V_{DC} is exceeded	- Contact your distributor
Low voltage on input side (**A**)	DC voltage is too low to operate the inverter	- Fault is cleared automatically when PV voltage exceeds 230 V - If the inverter remains in this fault during daylight, and the V_{DC} is >230V, contact your distributor
Low PV isolation resistance (**A**)	PV isolation resistance is below permitted level	- Check the position of the DC jumper (See *Jumper Position for the System Setup*) - If the jumper is correctly positioned, contact your distributor
Failure on DC side (**W/A**)	Inverter failure on the DC side	- Failure on the DC side. Other **W/A** will be displayed - If the inverter is in *Shutdown*, turn off the AC side and then the DC side. Wait for 30 seconds, then turn on the AC side and then the DC side - If the fault persists, contact your distributor
Failure on AC side (**W/A**)	Inverter failure on the AC side	- Failure on the AC side. Other **W/A** will be displayed - If the inverter is in *Shutdown*, turn off the AC side and then the DC side. Wait for 30 seconds, then turn on the AC side and then the DC side - If the fault persists, contact your distributor
High inverter temperature (**W/A**)	Maximum permissible internal inverter temperature is exceeded	- Check that the ambient temperature is within the specification (See *10. Technical Data*) - Check if the ventilation is sufficient, the minimum distances are compliant with those stated in

		this *User Manual* and the inverter is shielded from direct sunshine - Clean ventilation (See *8.2.7. Ventilation*)
Low inverter temperature(**W/A**)	Low internal inverter temperature	- Contact your distributor
Current / power limitation (**W/A**)	PV power exceeds inverter rating	- The inverter will try to start up again when the temperature is within the permissible range again - Check if the ventilation is sufficient, the minimum distances are compliant with those stated in this manual and the inverter is shielded from direct sunshine - Clean ventilation (See *8.2.7. Ventilation*)
Communication failure (**A**)	Internal communication failure	- If the inverter is in *Shutdown*, turn off the AC side and then the DC side. Wait for 30 seconds, then turn on the AC side and then the DC side - If the fault persists, contact your distributor
Fan failure (**W/A**)	Internal air circulation has failed	- Contact your distributor for replacement
Fuse fault (**A**)	One or more fuses or circuit breakers are blown	- Contact the system installer for replacement
Active power limitation (**W/A**)		*
Reactive power compensation (**W/A**)		*
Microprocessor fault (**W/A**)		- If the inverter is in *Shutdown*, turn off the AC side and then the DC side. Wait for 30 seconds, then turn on the AC side and then the DC side - If the fault persists, contact your distributor
Ground current trip (**A**)		*
High AC voltage (**A**)	Too high AC voltage, the inverter stops feeding power	- The inverter will restart when the voltage is within the permissible range - Check that the country settings have been successfully set in *Setup > Grid Setup* - If the failure persists, contact the system installer

Low AC voltage (**A**)	Too low AC voltage, the inverter stops feeding power	- The inverter will restart when the voltage is within the permissible range - Check that the country settings have been successfully set in *Setup > Grid Setup* - If the failure persists, contact the system installer
High frequency on output side (**W/A**)	The frequency of the utility voltage is above the upper limit	- The inverter tries to restart when the frequency is within the permissible range - Check that the country settings have been successfully set in *Setup > Grid Setup* - If the failure persists, contact the system installer
Low frequency on output side (**W/A**)	The frequency of the utility voltage is below the lower limit	- The inverter tries to restart when the frequency is within the permissible range - Check that the country settings have been successfully set in *Setup > Grid Setup* - If the failure persists, contact the system installer
High output DC current (**W/A**)	Too high proportion of DC current in the grid feed	- The inverter tries to restart when the fault is cleared - If the fault still occurs, contact your distributor
Output current imbalance (**W**)	Imbalance in the output current between the phases (3 phase only)	*****
Grid fault, still running (**W**)	Fault ride-through	*****
VDR fault DC side	The varistors on the DC side are damaged.	- Contact your distributor for new parts

***** Reserved for future use

8. Maintenance

This chapter explains how to switch OFF and discharge the inverter safely. It also provides an overview of important regular maintenance procedures to ensure trouble-free operation of the *THEIA HE-t* inverters. Finally, it is explained how to remove and return the inverters.

8.1. Switch-Off

Always turn OFF and disconnect the inverter in the following order prior to maintenance work or repairs:

AC Side

- Turn OFF the AC circuit breaker(s).

DC Side

- Turn OFF the DC switch.
- Disconnect the connectors.
- Discharge the DC capacitor bank (See *8.1.1. Discharge*).

DANGER: Never work on live wires!

Never perform work on the inverter without disconnecting both the DC and AC side because of deadly voltages present at the terminals.

DANGER: Discharge the inverter completely prior to service or maintenance!

High voltages are still present inside the inverter after switch OFF because of a charged capacitor bank. It must be discharged before performing service or maintenance work on the inverter.

8.1.1. Discharge

High voltages are still present inside the inverter after the DC switch is switched OFF. For service or maintenance the inverter must be de-energized for either 1 hour, or for at least 10 seconds using an external resistance to quickly discharge the capacitor bank.

Prior to the discharge, the inverter upper cover must be removed by loosening the four screws on the back of the inverter.

CAUTION: The inverter upper cover must be opened by authorized service personnel only!

The discharge process using a resistor must be performed by *Eltek Valere* authorized service personnel only, as it requires removal of the inverter upper cover, which can damage internal components and invalidate the warranty!

- Use a *WELWYN WH50 1K JI* resistor from Farnell, order number *9508163*, or similar resistor.
- Attach clamps to the resistor.
- Keep the clamps on the two solder-pads labeled *Discharge* on the right side of the DC capacitor banks for at least **10 seconds** for the capacitors to discharge.
- Before performing work on the inverter, check with a voltmeter that the solder-pads and the DC and AC terminals are voltage free!
- Put on the cover and fasten the screws with a torque of 1.0 Nm / 0.74 ft-lbf.

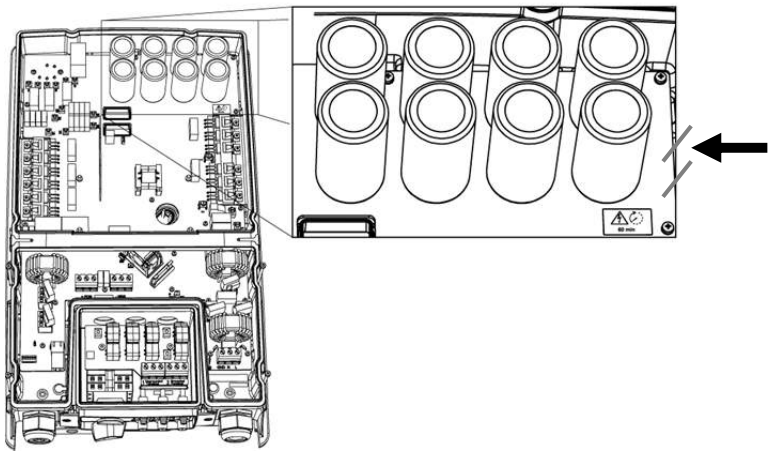


Figure 8.1.1: Discharging the capacitor bank inside the inverter

8.2. Regular System Inspections

The *THEIA HE-t* inverters are manufactured to operate trouble-free for several years. Performing regular maintenance will ensure high efficiency and a long service life.

CAUTION: Only qualified persons to perform work inside the inverter!

Maintenance work involving removal of the inverter covers must be performed by qualified persons only, due to damage to electrical components and the warranty of the product.

8.2.1. Modules

Maintain the PV modules as recommended from the manufacturer.

8.2.2. Cables

Regularly check the cables inside and outside for signs of overheating, i.e. warm conductors or surface corrosion. Replace frayed conductors immediately, find and fix the reason for the damage!

8.2.3. Fixing Points

Regularly check that the terminals and plugs are firmly tightened, and that the insulation is not deteriorated or corroded. If a combiner box is used, also check the terminals and plugs in the combiner box!

8.2.4. Fuses/Circuit Breakers

Frequently blown fuses or tripped circuit breakers are a clear warning sign of overload, short circuit or ground fault.

- Always determine the reason for blown fuses/tripped circuit breakers prior to replacement/resetting.
- The replacement/resetting must be performed by qualified persons only!

8.2.5. DC Fuses

If a DC fuse blows, a message will appear in the display (See *7.2. Table of Events*).

DANGER: Never work with live wires!

Always disconnect both the DC and AC side before opening the inverter lower cover, due to the risk of electrocution.

DANGER: Be aware of power feeding modules!

The PV modules feed power when exposed to light and produce hazardous voltages, which are still present at the terminal blocks and fuse holders after switch OFF. Always replace the DC fuses when the PV modules are not exposed to light, or when the PV modules are not in circuit!

Replacement Procedure

- Turn OFF both the AC circuit breaker(s) and DC switch(es).
- Remove the inverter lower cover (See *2.4.5. Inverter Structure*).
- Check that the terminals are voltage free.
- Always check the cause of the defective fuse prior to replacement.
  - Measure the voltage and current: If the voltage is close to or 0 V_{DC} or there is a measurable current do not remove the fuse holder. Recheck wiring for dead shorts or reversed polarity.
- If the voltage and current measurement are correct, remove and replace the fuse(s).
- Always exchange the fuses with the same type and rating.

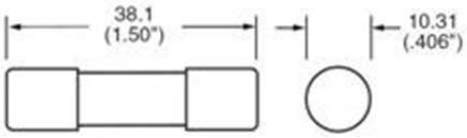


Figure 8.2.1: Dimensions of the DC fuses

- Make sure that the replaced fuse(s) is correctly inserted in the fuse holder.
- Fasten the inverter lower cover firmly (See *2.4.5. Inverter Structure*).
- Turn on the AC circuit breaker(s) and the DC switch(es).

8.2.6. DC Disconnector Switch

To prevent welding of the contacts and hence a longer service life, the DC switch(es) must be operated at least once per year, preferably at night or when the AC is off.

8.2.7. Inverter

It is recommended that the inside of the inverter is checked by the system installer for humidity and dust every 3 – 4 years.

8.2.8. Fan

The fan circulates the air inside the inverter, which distributes heat and thereby maintains the conversion capacity. The replacement of the fan requires removal of the inverter lower cover and must be performed by qualified persons only!

- A message is shown in the display when the fan needs replacement (See *7.2. Table of Events*).
- If the fan fails, the inverter continues to feed the same amount of power until a certain temperature threshold, at which point it starts to reduce power to protect itself against overheating.
- A new fan can be ordered from *Eltek Valere* with part number *276747*.

Removal of the fan

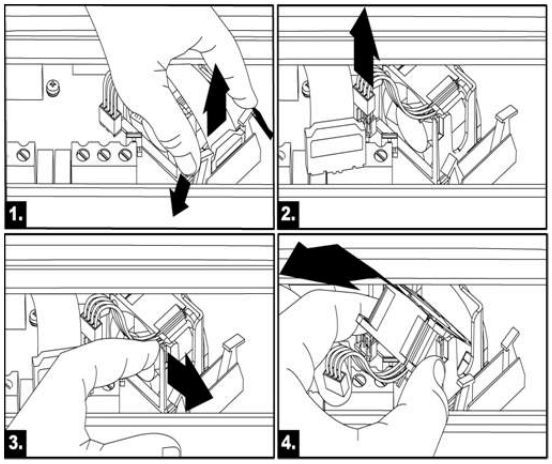


Figure 8.2.2: Removal of the fan

1. Remove the ribbon cable covering the fan by pressing the two “handles” on the connector to either side.
2. Pull out the plug-in fan terminal.
3. Ease the fan bracket to the side.
4. Pull the fan out.

Insertion of the fan

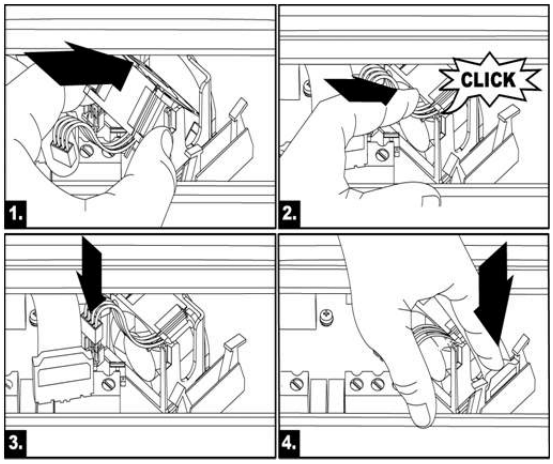
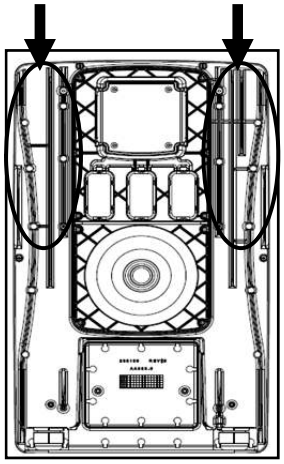


Figure 8.2.3: Insertion of the fan

1. Ease the fan bracket to the side, and insert the new fan in the bracket.
2. Press the fan gently into the bracket until the sound of a click.
3. Plug the fan terminal in the connector.
4. Plug the ribbon cable in the connector.

8.2.9. Ventilation

The heat sink on the back of the inverter conducts heat away from the electronic components, and must be clean to ensure sufficient cooling performance and thereby prevent yield losses. This is accomplished by using either:



- Vacuum cleaner
- Soft brush
- Compressed air

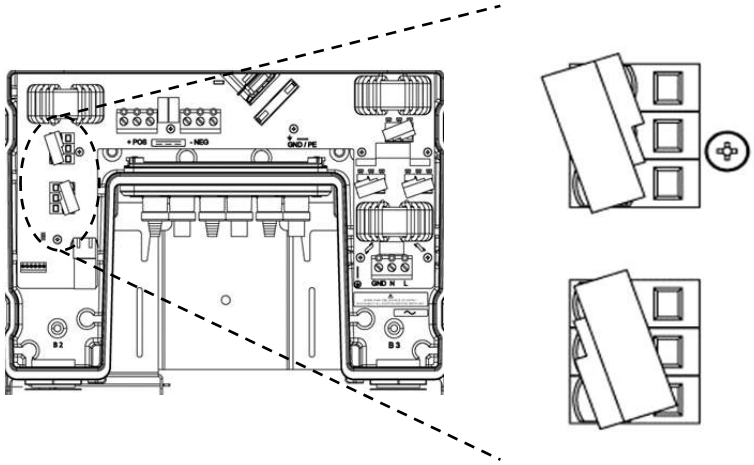
Figure 8.2.4: Heat sink

8.2.10. Varistors (VDR)

Varistors have a finite life expectancy, and therefore need regularly inspections (at least once per year). When exposed to transients they degrade and lose their protective function and need to be replaced. The replacement requires removal of the inverter lower cover and the use of the VDR service tool, and must be performed by qualified personnel only!

DC Side

- A message is shown in the display when a DC varistor needs replacement *(*See *7.2. Table of Events*).
- Replace the damaged varistor with *DC Varistor Kit* ordered from your local *Eltek Valere* representative, part number *271539.*



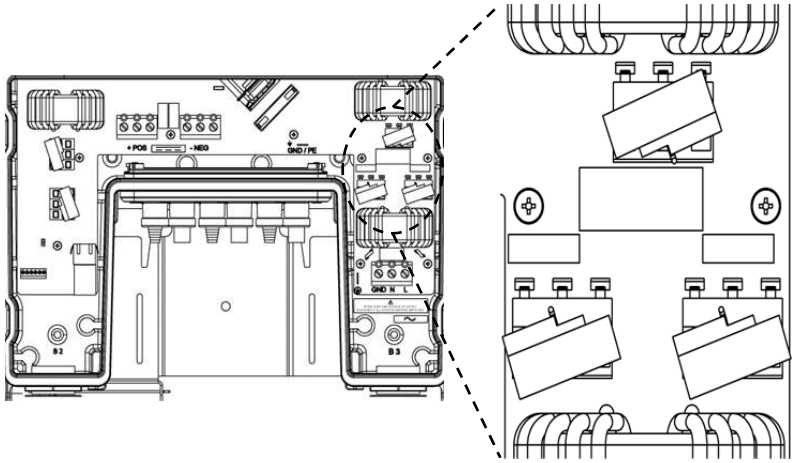
The two varistors on the DC side are located above the network connection on the left side of the customer connection area.

Note the orientation of the varistors if they need to be replaced.

Figure 8.2.5: Varistors on the DC side

AC Side

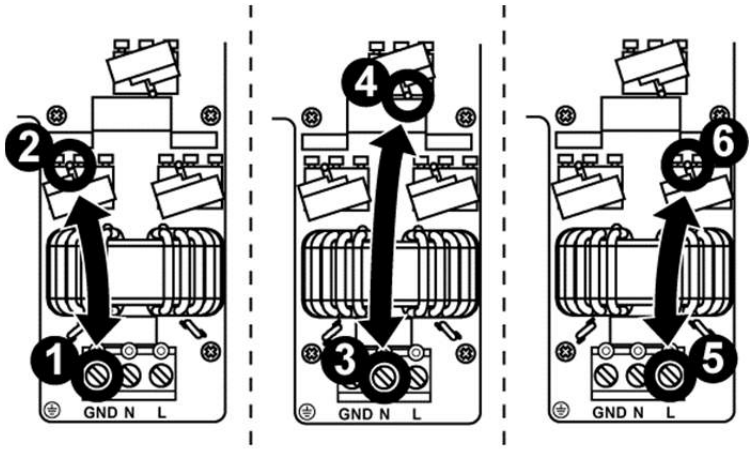
- No alarms are raised regarding the condition of the varistors on the AC side. Therefore, they need to be checked regularly (at least once per year) or after lightning strikes.
- Replace the damaged varistor with *DC Varistor Kit* ordered from *Eltek Valere,* part number *263574.*



The three varistors on the AC side are located in the right side of the connection area above the AC terminal area.

Note the orientation of the varistors if they need to be replaced.

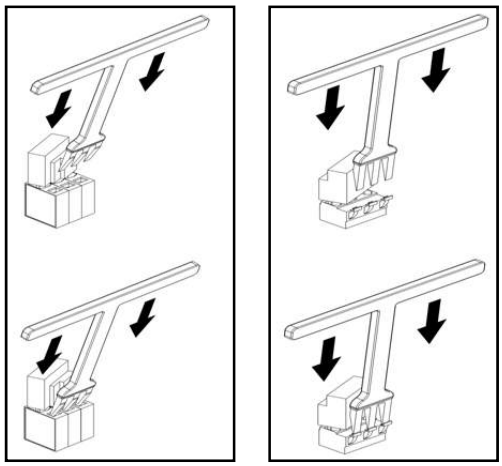
Figure 8.2.6: Varistors on the AC side



Measure the ohms between the terminal and the bended pin on each varistor:
1– 2
GND - Left VDR: 0 Ω
3 – 4
N – Middle VDR: 0 Ω
5 – 6
L –Right VDR: 0 Ω

If a measurement is high-ohmic the varistor is damaged.

Figure 8.2.7: Checking the AC varistors



Use the service tool delivered in the packaging with the new varistors from *Eltek Valere* to open the terminal clamps and remove the damaged varistor(s).

Also use the service tool to open the clamps when inserting the new varistor(s).

Figure 8.2.8: Service tool to open the terminals

8.3. Replace Devices

It is possible to add new inverters, or replace existing inverters, in a PV system.

Slave

- If the replaced inverter is a slave, the master inverter will automatically identify the replaced device, transfer critical settings, and put it into operation.
- The device number is automatically maintained.

Master

- If the replaced inverter is the master and master functionality is desired, an existing inverter must be set up as master. This is done in *Setup>Network Setup>Set as Master unit*. Select *YES*, and an automatic logon-sequence is performed.

8.4. Return and Disposal

When replacing an inverter, it can either be returned to your distributor, to *Eltek Valere* direct, or disposed of according to local and national regulations. *Eltek Valere* is committed to its policy of environmental responsibility, and therefore appeals to end users who are disposing of inverters to follow local environmental legislation and to seek safe, responsible means of disposal.

8.4.1. Return

For return to *Eltek Valere* the inverter should always be in its original packaging or equivalent packaging.

In case of return of the product as a result of inverter failure, a fault report must be submitted to obtain a *Return Material Authorization* (*RMA*) number.

The fault report template can be found at: *http://www.eltekvalere.com/support*

Prior to Return:

- Loosen the locking screws attached to the fixing clip on the mounting bracket.
- Pull the inverter up and out of the bracket.
- Pack the inverter securely in the packaging.
- Add a fault report if relevant.
- Return to the given address in the respective country/continent

8.4.2. Disposal

In case of end of service life, the inverter can be returned to your distributor, to *Eltek Valere* direct, or disposed of in the respective country. The shipping to the distributor or *Eltek Valere* is paid by the sender.

Recycling and disposal of the *THEIA HE-t* inverter must be done according to the rules and regulations applicable in the country of disposal. All the inverter packaging material is recyclable.

9. Warranty

This chapter gives a brief introduction to the valid warranty of the *THEIA HE-t* inverters. The inverters are compatible with all relevant standards and are guaranteed to be free of defects from the date of purchase.

9.1. Warranty Service

The standard warranty applies for 5 years after the date of installation, with an optional extension of up to 20 years. The installation must be completed within 6 months after purchase to maintain the warranty.

CAUTION: Ensure a valid warranty!

To maintain the warranties the inverter must be installed, operated and maintained according to the instructions detailed in this manual and any relevant local and national electrical regulations.

9.2. Warranty Disclaimer

The warranty is void through misuse or when unauthorized repairs are performed on the inverter. The warranty does not cover normal wear and tear of the inverters or costs related to installation and troubleshooting of the electrical system. The warranty is only valid with an identifiable and accepted serial number.

***Eltek Valere* takes no responsibility for damages to the inverter due to:**

- Unauthorized persons remove the inverter upper cover.
- Unauthorized modifications are made to the inverter.
- The inverter is installed, commissioned, operated or maintained incorrectly.
- Relevant safety regulations and instructions in this manual are ignored.
- The inverter operates beyond the limit values given in *10. Technical Data* .
- The inverter is exposed to external conditions that are not covered by the operational conditions as specified (lightening, storm, fire etc.)

10. Technical Data

IINPUT DATA (PV SIDE)	*THEIA 2.0 HE-t*	*THEIA 2.9 HE-t*	*THEIA 3.8 HE-t*	*THEIA 4.4 HE-t*
Nominal DC power	2100 W	3000 W	4000 W	4600 W
Max recommended PV power	2625 W	3750 W	5000 W	5750 W
Max input current	9.5 A	13.5 A	18.0 A	21.0 A
Max DC voltage	600 V			
MPPT–Range	230 – 480 V			
Number of PV string inputs	3			
Number of MPP trackers	1			
Input features	Reverse polarity protection Ground fault monitoring Integral DC switch (optional) Integral DC fuse holders for string inputs (optional) Field configurable for ungrounded, positive and negative grounded PV systems			
OUTPUT DATA (GRID SIDE)				
Nominal output power	2000 W	2900 W	3800 W	4400 W
Nominal output current	9.0 A	13.0 A	17.0 A	20.0 A
Max output current	10.5 A	15.2 A	19.7 A	23.0 A
AC voltage	184 – 276 V_{AC}, single or split phase			
Mains frequency	50 Hz ± 5 Hz			
Power Factor (cos φ)	1			
PERFORMANCE DATA				
Maximum efficiency	96.9 %	97.0 %	97.2 %	97.3 %
CEC efficiency	96.1 %	96.4 %	96.9 %	97.0 %
EU efficiency	96.0 %	96.2 %	96.6 %	96.9 %
Power feed starts at	< 7 W			
Night mode power	< 1 W			
MECHANICAL DATA				
Protection degree	IP 65 / NEMA 4X			
Dimensions	**H:** 610 mm / 24.03 inches **W:** 353 mm / 13.9 inches **D:** 158 mm / 6.22 inches (169.5 mm / 6.68 inches with bracket)			
Weight	19 kg / 42 lbs.	19 kg / 42lbs.	21 kg / 46 lbs.	21 kg / 46 lbs.
Cable access	Bottom			
Input cable connection	MC3, MC4, Tyco, Screw terminals, cable gland, others on request			
Output cable connection	Screw terminals, cable gland			
DESIGN STANDARDS				
EM compatibility	EN 61000-6-2, EN 61000-6-3, FCC level B			
CE / UL marking	Yes			
Other standards	IEC 62109, IEC 61727, DIN VDE 0126, G83/1, EN 50438, AS 4777, ENEL Guidelines (DK 5940), EN 61000-3-2/11, EN 61000-3-3/12, UTE C 15-712-1, C10/11 ++			
ENVIRONMENTAL DATA				
Operating temperature	-25 to +65 °C / -13 to +149 °F (Possible power derating above +45 °C / +113 °F)			
Storage temperature	-30 °C to + 80 °C / -22 to +176 °F			
Ventilation	Convection cooling			
ADDITIONAL FEATURES				
Topology	High frequency transformer, galvanic isolation			
Noise emission	≤ 40 dB			
Communication	Graphical, color display with touch sense buttons, 3x LEDs for visual status indication, embedded web-server, Ethernet, CAN bus			
Warranty	5 years, 10 years, 15 years, 20 years options			

11. Contact Information

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