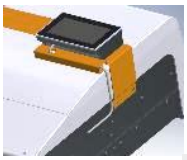
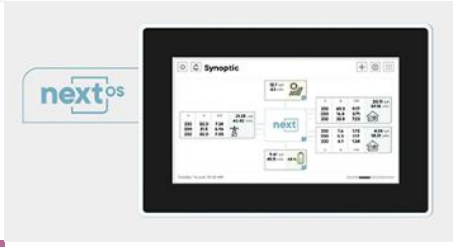
next 3





Detailed Tech Manual

Smart hybrid inverter charger with advanced interface

nx3 16000-48 st | nx3 16000-48 t | nx3 16000-48 s | nx3 16000-48
nx3 16000-48 st rack | nx3 16000-48 t rack | nx3 16000-48 s rack | nx3 16000-48 rack
nx3 16000-48 st AU *for Australian model*

Options :
-s (solar)
-t (transfer)
-i (interface)

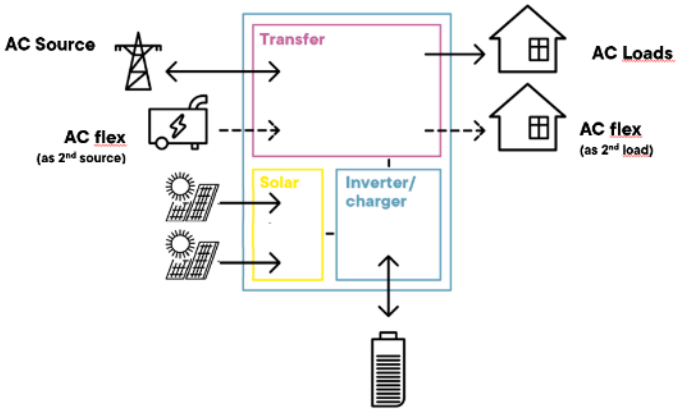
STUDER

Accessories:
Remote control and communication.... ***nx-interface***
Battery temperature sensor..... ***nx tempSensor (included with nx3 device)***
Cables for communication..... ***nx-ethernetCab-1m (ethernet, cat5, 26AWG)***

Contents

1 INTRODUCTION

Congratulations! You are about to install and use equipment from the Studer NEXT range. You have chosen a high-tech converter that will play a central role in the energy production of your solar electrical installation. The next3 has been designed to work as a solar battery charger and hybrid inverter working in both modes "**off-grid**" and "**on-grid**". Its advanced and completely configurable functionalities will guarantee the perfect functioning of your energy system in any situations.
The NEXT range is a family of hybrid inverters, with or without included solar chargers. All models are designed with Swiss quality to have outstanding performances in offgrid and ongrid applications.
When the next3 is connected to batteries and photovoltaic panels, it automatically recharges batteries with all the available solar power. According to the selected programming, the solar can be injected to the grid or used for self-consumption only. The accuracy of the Maximum Power Point Tracking (MPPT) algorithm, the high output and low internal consumption ensure an optimal valorization of the energy produced by the PV modules.
The battery charge profile may be set freely according to the battery type or the operation mode. The charging voltage is corrected depending on the temperature thanks to the external sensor nx-tempSensor. If using lithium batteries, the next3 communicates with battery BMS through a CAN-bus and ensure an optimal operation according to the manufacturer of the battery.
The control, display and programming unit nx-interface allows an optimal setup of the system and guarantees the user permanent control over all important parameters for the installation. Moreover, it enables the recording of the system data to analyze later its functioning (data logging). The nx-interface is also the communication gateway to connect the energy system to the remote monitoring web portal https://portal.studer-innotec.com for distant supervision. The remote supervision can also be done with the APP Studer Easy Monitoring, available for both IOs and Android.
The next3 operates as an independent device and is also designed to be included into a Studer energy system together with other NEXT compatible devices, display modules and the communication modules.
The parallel operation of several inverters is possible and offers modularity and flexibility enabling an optimum dimensioning of your system according to your energy requirements. Working together, these different devices have a synchronised behaviour for a better management of the battery and of the solar resource. The next3 is available in models without the solar charger or without the AC-transfer to fit in various types of systems.



Please read this manual carefully to ensure the perfect start up and operation of your system. It contains all the necessary information regarding the operation of the next3 charger. The installation of such a system requires special expertise and may only be carried out by qualified personnel familiar with the local standards in force.

2 GENERAL INFORMATION

IMPORTANT SAFETY INSTRUCTIONS

This manual contains important safety instructions. Please carefully read the safety and operation instructions before using a next3 device. Take into consideration all the warnings mentioned both on the equipment and in this manual, following all the instructions regarding the operation and use.
The installation and commissioning of the next3 must be entrusted to qualified personnel. The installation and use must comply with the local safety instructions, laws, and standards in force in the country.

Do not excess the maximum rated characteristics of the equipment shown on the Type label and in the datasheet.

HIGH-VOLTAGE DC AND AC INSIDE THE DEVICE: DANGER OF DEATH

When the next3 is under operation, it generates voltages that can be potentially lethal (up to 900Vdc and 400Vac). Any work on or close to the installation must be carried out only by thoroughly trained and qualified personnel. Do not try to carry out ordinary maintenance on this product yourself.
The next3 is in overvoltage category III (OVC III) on AC side, in accordance with the safety standard IEC/EN 62109-1. It is in overvoltage category II (OVC II) for the PV connection and in overvoltage category I (OVC I) for the battery connection.

While working on the electrical installation, it is important to make sure that the source of DC voltage coming from the battery as well as the source of DC voltage coming from the photovoltaic generator, have been disconnected from the electrical installation.
Be also certain the sources of AC voltage coming from a generator or network have been disconnected from the electrical installation.

Even when the next3 is disconnected from the power sources, a potentially dangerous voltage may remain at the terminals. To eliminate this, you must wait **for at least 120 seconds** to allow the electronics to discharge.

After disconnection, check all the terminals voltage with a multimeter in AC and DC modes. The connections compartment can then be opened, and the task carried out safely. All other cover parts of the device shall never be opened without written authorization of Studer Innotec SA company.

The next3 can be installed at altitudes up to 3000m. For installations at higher altitudes, please contact Studer Innotec SA.

If the next3 is used in a manner not specified in this manual, the protection provided by the next3 may be impaired.

Nobody is authorized to proceed with any change, modification, or repair of the equipment without the prior written authorization of Studer Innotec. Use only original parts for any authorized modification or replacement.

QUALITY AND WARRANTY

During the production and assembly of the next3, each unit undergoes several checks and tests which strictly comply with established procedures and device safety requirements. The manufacturing, assembling, and testing of each next3 are entirely carried out in our factory in Sion (CH). The warranty for this equipment depends upon the strict application of the instructions in this manual.
You can download the current warranty conditions from the Internet at www.studer-innotec.com.

2.1.1 Exclusion of warranty

No warranty claims will be accepted for damages resulting from handling, use or treatment that are not explicitly mentioned in this manual. Damages arising from the following causes are excluded from the warranty:

- Voltage higher than 900V across PV terminals.
- Voltage higher than 70V across battery terminals.
- Use of the device outside of the specification of the product.
- Accidental presence of liquids in the equipment or oxidation due to condensation.
- Damage resulting from falls or mechanical shocks.
- Modifications carried out without the explicit authorization of Studer Innotec.
- Nuts or screws that have been too much or not enough tightened during the installation or maintenance.
- Damage due to atmospheric surge voltage (lightning).
- Damage due to inappropriate transportation or packaging.
- Damages due to improper installation
- Disappearance of original identification marks.

	Never take off or damage the rating plate showing the serial number. It enables to check and follow-up the data specific to each equipment and is vital for any warranty claim.

2.1.2 Exclusion of liability

The installation, commissioning, use, maintenance, and servicing of the next3 cannot be subject of monitoring by Studer Innotec. Therefore, we disclaim all responsibility and liability for damage, costs or losses resulting from an installation that does not comply with the instructions, faulty operation or inadequate maintenance. The use of Studer Innotec equipment is in any case under the responsibility of the customer.
This equipment is neither designed nor guaranteed to supply installations used for vital medical care nor any other critical installation entailing potential risks of important damage to people or to the environment.
We assume no responsibility for the infringement of patent rights or other third parties' rights resulting from the use of the inverter.
Studer Innotec reserves the right to make any modifications to the product without prior notification.
Studer Innotec is not liable for incidental, direct or indirect damages of any kind, including any profit loss, revenue loss or damage caused to equipment or goods due to defective equipment.

The next3 is certified for various grid codes. The installer is responsible for setting the proper grid code at commissioning according to the local regulation. Studer Innotec SA doesn't assume any responsibility for modification of grid code or individual settings concerning that subject. Those settings are protected by a user code that is not public (Expert mode).

CONVENTIONS

2.1.3 Glossary

AC: Alternative Current
AC-Load: The AC-Load is a physical connection for the electrical loads. It is separated from the grid in case of grid failure and backed up by the inverter. The connection is 3 phases and neutral. Single phase load can be connected.
AC-Flex: The AC-Flex is a physical connection for 3 phases and neutral. It can be configured for a use as a secondary AC source, or for a use as a controlled secondary AC load.
AC-Transfer: with "transfer" we mean the fact that the AC-Source is connected to the AC-Loads with the internal relays of the next3. The input voltage is "transferred" to the output.
PE: Protective Earth
Solid neutral: when the AC-Source and the AC-Loads neutral are physically connected with a bridging cable.
Transfer: have a transfer means be connected to the AC-source with the internal relay. The inverter switch to a current source mode.
Multi-unit system: a system with several next3 units running in parallel and synchronized with the communication cable.

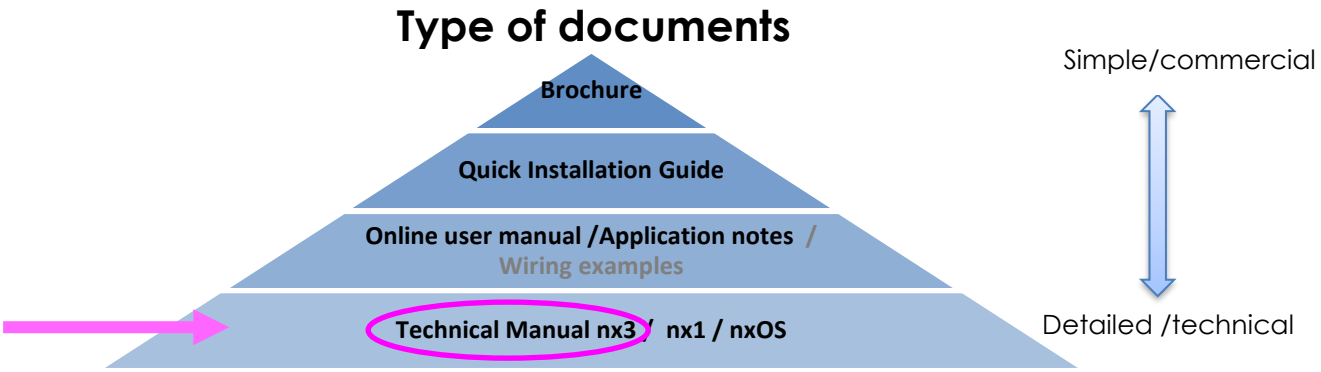
2.1.4 Symbols and conventions

	This symbol is used to indicate safety instructions, which, if not followed, could result in a risk of electrical shock with possible serious personal injury or death to the operator or the user.
	This symbol is used to indicate a risk of material damage and/or the cancellation of the guarantee.
	This symbol is used to indicate a procedure or function that is important for a safe and correct use of the equipment. Failure to respect these instructions may lead to the cancellation of the guarantee or to a non-compliant installation.
	This symbol placed on the product indicates that its surfaces may reach temperatures higher than 60°C.
	This symbol placed on the product indicates that its use must follow the instructions in the user manual.
	PE= protective earth (connected to the enclosure of the device).
	For information specific to the Australian model of the nx3 to be compliant with the standards AS/NZS 4777.2. This is used for the New Zealand as well.

ABOUT THIS USER MANUAL

This manual contains all the necessary information and procedures to install, configure, use and troubleshoot the next3 hybrid inverters. It is the most detailed documentation about this product. An online user manual and applications notes are available at: https://technext3.studer-innotec.com

A summary is provided in the Quick Installation Guide, delivered with the product in a printed version.



This manual does not contain information about photovoltaic modules (PV) or batteries of various brands that can be connected. For this kind of information, please refer to the instructions of each specific manufacturer.

It does not contain specific information on national rules/regulations about electrical installation. It contains only safety requirements about the use of the device next3 according to following International and European standards; IEC/EN 62109 for power converters used in photovoltaic systems and IEC/EN 62477 for power converters used in general systems.

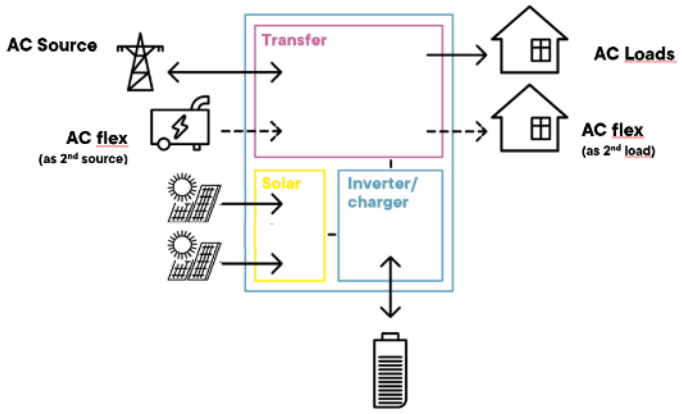
This manual covers the next3 following models and accessories:

- Hybrid inverter charger ***nx3 16000-48*** (with any options) with software version to **1.3.0.0**
- Interface: ***nx interface*** with software version up to **1.3.0.0**
- Battery temperature sensor: ***nx tempSensor***

	This manual is an integral part of the equipment and must be kept available for the operator and/or the installer. It is provided under digital form in the usb key delivered with every unit. The latest version of the manuals can be downloaded on Studer website: https://www.studer-innotec.com

3 ESSENTIALS TO KNOW ABOUT A NEXT3 SYSTEM

The next3 is a hybrid inverter charger, that can work in a stand-alone (offgrid) mode or connected to an external AC source, being a grid or a generator.



A few concepts must be understood to use and configure the next3 systems properly:

- The next3 has a connection named "**AC-Source**" where comes the main AC source: the grid or a generator.
    - This input has a high security level, with doubled security relays for disconnection according to new international grid code and safety standards (for example: IEC 62109, VDE-AR-N 4105, EN 50549-1, …). In case of connection to a distribution grid, always connect the grid to AC-Source.
    - The choice to use AC-source to connect to the grid or to a genset is done during the first configuration of the system. It cannot be change 'live', while the system is working, and would need a complete reset of the system if you want to change it. The behaviour of the next3 is different with a grid or with a genset.
    - The grid code choice must be set properly by the qualified installer during commissioning according to the local requirements of the DSO (Distribution System Operator). This is done during the wizard process. It can only be changed with a complete reset of the system and restart of the wizard process. The access code "Expert" that enable access to the wizard after the first commissioning is not public for this reason.
    - AC-source works with three-phased grid only if a grid code is selected because (all) grid codes ask to have the proper 3 phases for 3-phased systems. Operation on a single phase is not allowed. Operation on a single phase is possible if a genset is selected as source during the wizard.
    - There is only one connection to one AC-source in a system even in a multi-unit system when there are physically multiple connections.
        - Transfers are never used in parallel and only one transfer switch will be operated. That means the max transfer current is 80A even with 3 next3 in parallel.
        - The identification of which AC input is used in multi-system is done during the wizard configuration process.
    - The next3 is an "offline UPS", that means the AC main is supplied directly to the load with the internal transfer switch (no double conversion). This implicate that the voltage and frequency of the grid is the same on the loads side.

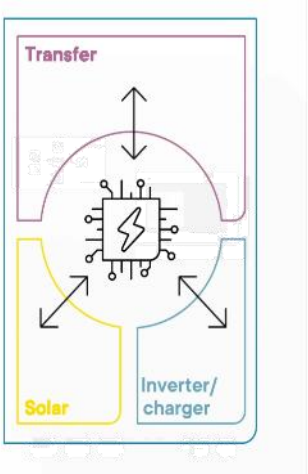
The maximal current/power taken from the AC-Source can be controlled in order to cope with limited connection (per example max amps of the grid connection). The next3 can compensate with battery power with the Smart-Boost function.

- On the other side, it has a connection named "**AC-Loads**" where the load/consumption is connected, that are supplied by the batteries/solar when there is no grid or genset.
    - There is only one AC-load in a system: in multi-units all the AC-loads output must be electrically connected. All next3 work together to create a single voltage (distribution panel).

- The choice to operate "**AC-FLEX"** as a connection for a genset as source or for controllable loads is done at first configuration and cannot be changed (like for the AC Source).
    - Similar to the AC-source, there can only be one AC-Flex as source used in a system.
    - In case it is used as source, the priority can be chosen with a system setting: first one valid that comes in, AC-source or AC-flex.
    - In multi-unit systems the AC-flex connections must not be wired in parallel. The programming of the AC-flex as load are independent for each next3 (slide left and right on the screen to access each individually). The programming is done for each phase L1, L2 and L3 independently. That means for a multi-unit system with 3 next3, there can be up to 9 single phase controllable loads used.

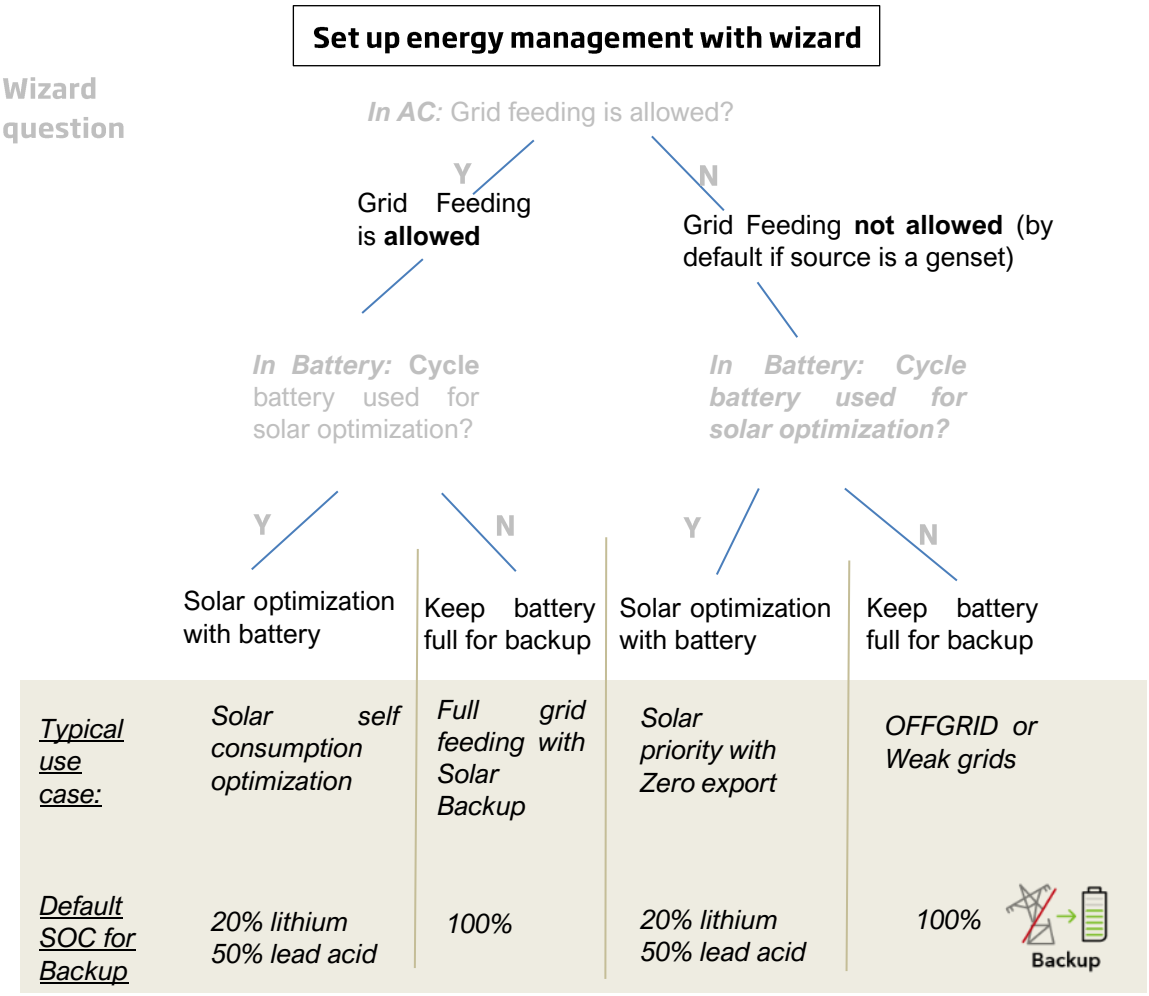
UNDERSTAND THE GENERAL ENERGY STRATEGY

The next3 is a renewable energy friendly converter and always try to optimize the solar in the system. The energy management between all the converters and components of the energy system is done by the *Power Flow Dispatcher* algorithm. This is at the core of the next system.



Studer simplified the use of its product to be transparent to most of the end -user. Four standard energy strategies are available and can be selected during the configuration process in the wizard with only two questions to answer:

- is grid feeding allowed? This question is asked only if you have selected "grid" as connection to AC-source. If you selected "genset", the grid feeding is forbidden.
- Is battery used for solar self-consumption optimization? That means the battery is used daily as energy buffer. Solar energy recharges the battery and is used during the night.

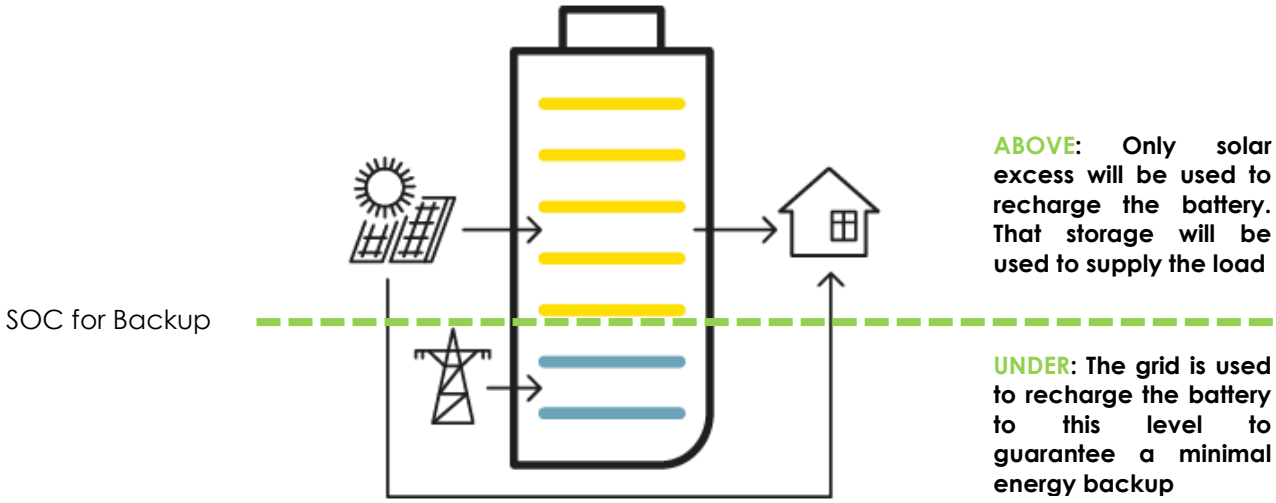


The 4 cases description, defined by those two questions are:

- Use of battery for **solar self-consumption optimization** until a state of charge (SOC) for Back-Up. During the night, the battery is discharged until the given SOC. Under the defined SOC level, a reserve is left in case of blackout. The default level is 20% to use 80% of the battery as buffer for lithium batteries and 50% for lead acid batteries. During the day, when the solar power is produced, that energy is used to supply the AC loads, charge the battery[1] and inject the excess energy to the grid.
- **Full grid feeding**: In this situation, the battery is kept full to be ready in case of blackout. The SOC for back-up is 100%. All the solar power produced supply the loads and the excess is injected to the grid.
- **Solar priority with zero export**. The solar power is used to charge the battery and to supply the loads but is never sent back to the AC-source. In that mode the grid-feeding is not allowed. The battery is used as buffer. When there is more solar than loads, the excess will charge the battery. When the loads are higher than the production, the energy is taken first from the battery. Only when it is at the lower threshold (SOC for Backup) the grid will be used. Like that, there is still some energy left in the battery to run some loads when a blackout happens. When the battery is full and the load is small, the MPPTs will reduce the production, causing some solar energy to be lost.
- **Offgrid or Weak grid:** AC-source is a genset or a grid where the injection is forbidden. The battery is charged to the maximum as soon as the AC source is present ensuring to have energy available in the next blackout event.

Note: in expert mode, it is possible to change the value of the "SOC for backup" setting.

[1] Battery is loaded up to the SOC for grid feeding level. SOC for grid feeding is 100% by default but it can be modified in advanced mode.



All the settings about this general behaviour are set during the "Wizard settings" process. For details about individual settings see the *AC-SOURCE* section and *Battery* section of this manual.

Comments about the State Of Charge (SOC) for backup

If the SOC for backup is set to 100%, the battery will be fully charged with the AC-source (when available) with a target voltage following the cycle (for lead acid: absorption, floating, …) or with the voltage given by the BMS.

If the next3 is in Smart-Boost due to a max current limit on the AC-source, the battery can be discharged below the SOC for backup and down to the SOC for end of discharge.

If the SOC for backup is lower than 100% the charging may stop before reaching the target voltage of the cycle. Voltage limits of the battery cycles are always used as boundaries in any case.
SOC for backup is modified in the battery configuration menu and is available to basic user. It is possible to change it at any time.

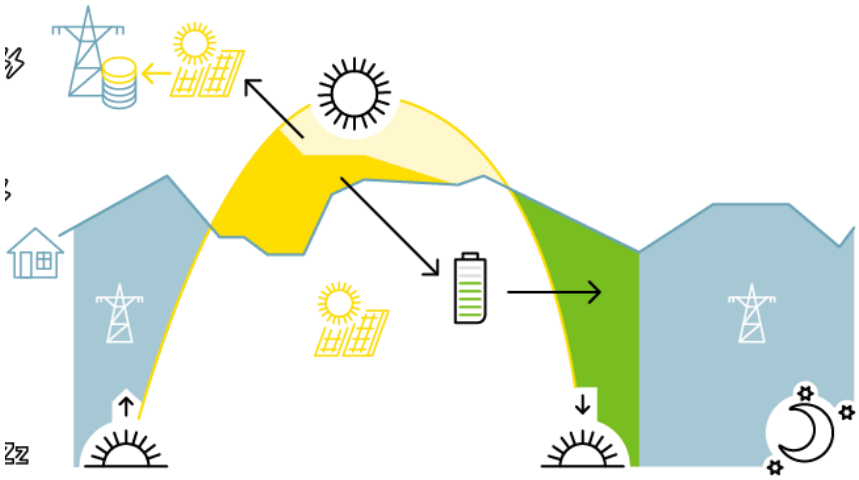
STANDARD USE CASES

Illustrations are provided below for the 4 basic use cases of the next3.

Grid connected installation with grid feeding allowed and use of battery for self-consumption optimization:

Typical answers in the Wizard:

- Grid: YES with grid feeding
- Genset: NO
- Cycle battery: Yes



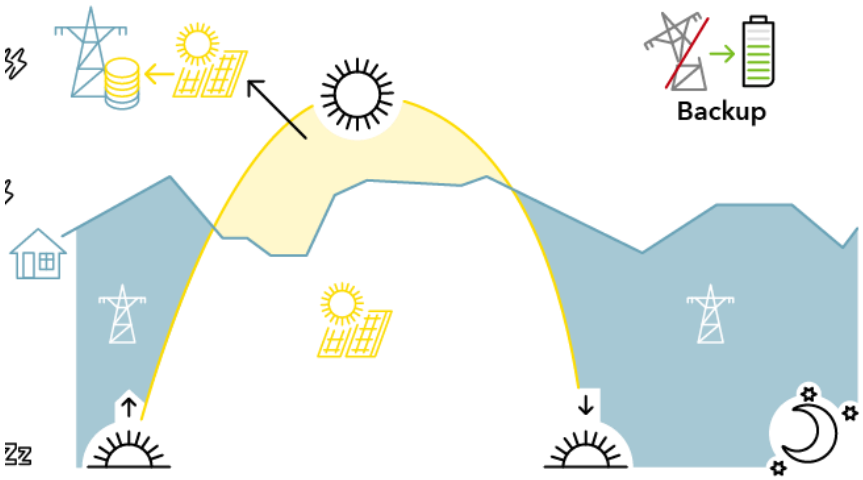
Default behaviour:

- Optimisation with battery use between 100% (SOC for grid feeding) and 30% (SOC for backup)
- If the grid is connected, the battery is charged only up to 30% with grid energy. Above that level, only the solar is used to fill the battery.
- Solar is used for the loads during the day as soon as SOC is above 30%.
- When the battery is full, excess is fed to the grid

Grid connected installation with full grid feeding; the battery is not cycled (kept for backup only):

Answers in the Wizard:

- Grid: YES with grid feeding
- Genset: NO
- Cycle battery: NO



Default behaviour:

- If the grid is connected, the battery is fully charged to 100% to be ready for a blackout.
- Solar is used for the loads during the day and excess is fed to the grid.
- Next3 is like a grid-inverter when the grid is always on.

This is the configuration of UPS or backup use, with or without solar.

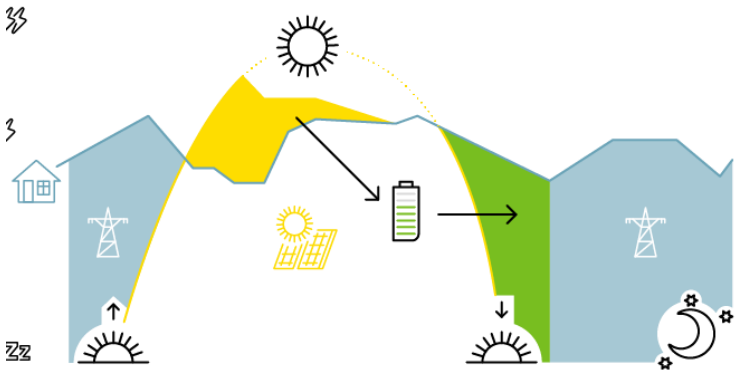
Solar priority without grid feeding: zero export solar backup

Answers in the Wizard:

- Grid: YES without grid feeding
- Genset: NO
- Cycle battery: NO

Default behaviour:

- Energy is never sent back to the grid.
- Solar is used for the loads during the day and to fill the battery, and excess is lost



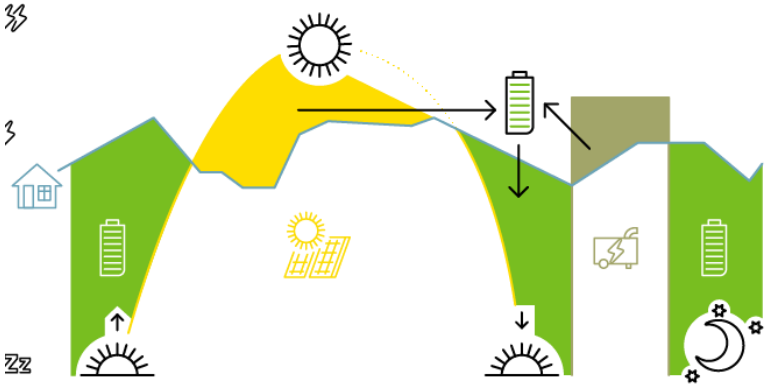
OFFGRID installation (back feeding on genset is forbidden!):

Answers in the Wizard:

- Grid: NO
- Genset: YES, on AC-source
- Cycle battery: NO

Default behaviour:

- Energy is never sent back to the genset.
- As soon as the genset is ON, the batteries are charged.
- Solar is used in priority for the loads during the day



During operation, all the limits and constraints are automatically managed by the NX3. Power production and storage is optimally dispatched in the system due to the OPFD technology (Optimal Power Flow Dispatcher).

4 HANDLING AND MOUNTING

HANDLING AND MOVING

The weight of the next3 with the package is about 60kg. Use an appropriate lifting method as well as help from a third party when installing the equipment.

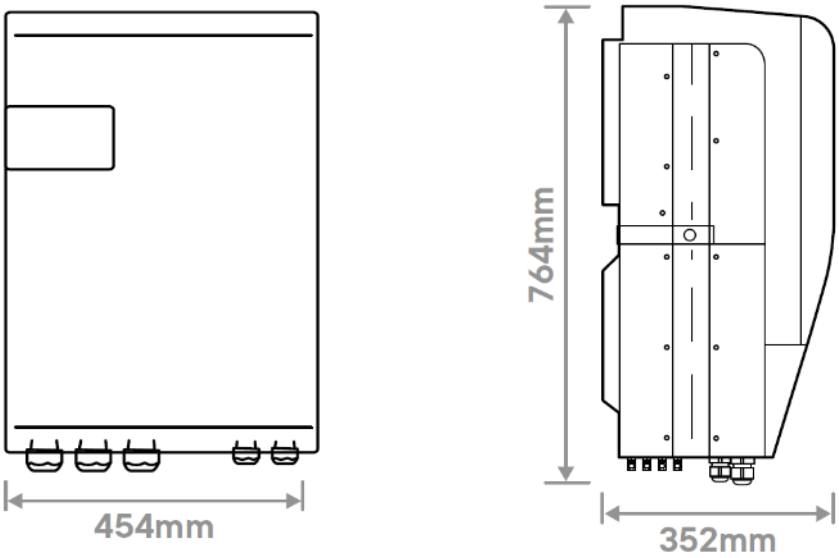
STORAGE

The equipment must be stored in a dry environment at an ambient temperature between -20°C and 60°C. Store it in a location where it is to be used a minimum of 24 hours before commissioning to avoid thermal shocks and condensation problems.

DIMENSIONS

4.1.1 Dimensions of wall mounted next3

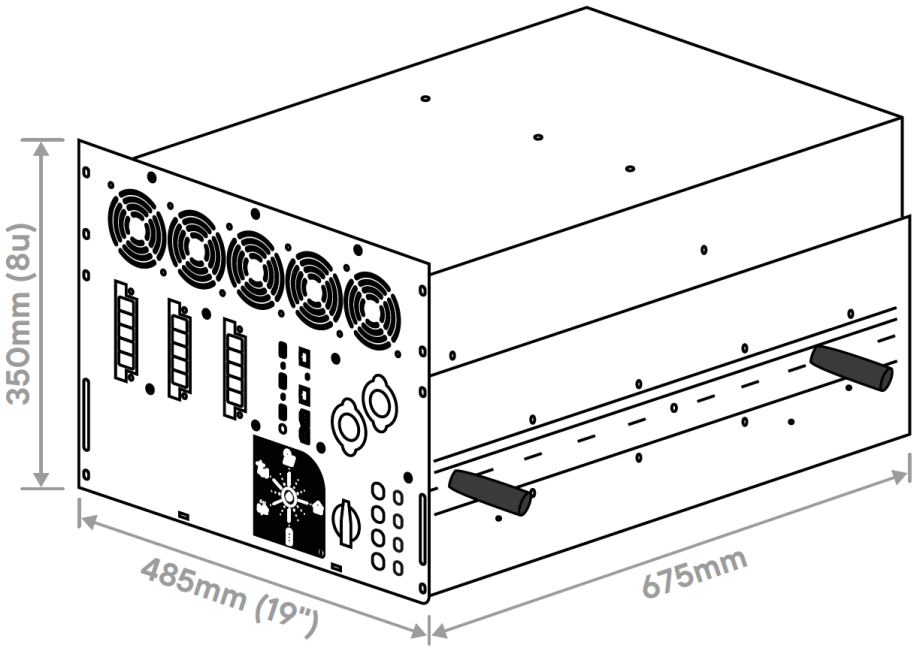
The next3 must be installed vertically. Distances of at least 12cm around the units and 25cm above the equipment are required to guarantee adequate ventilation (see mounting section of this manual).

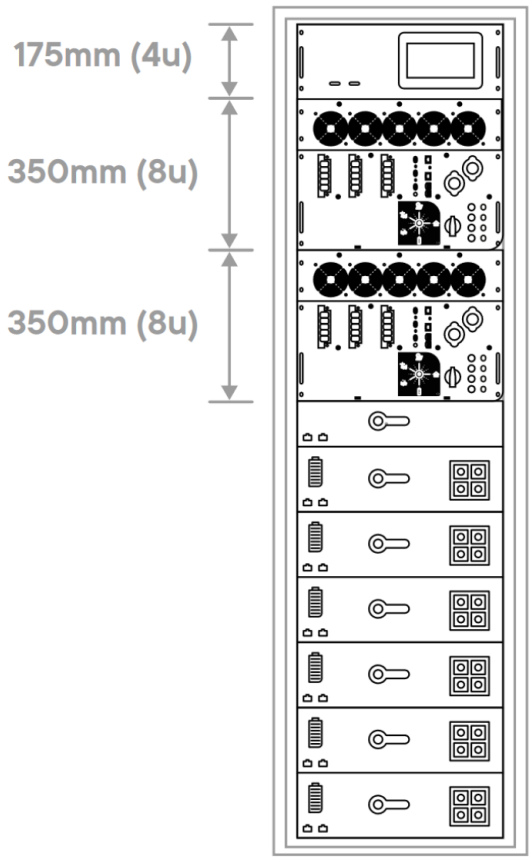


2 removable handles on each side of the device can be screwed to help the lifting of the device and then leave adequate space for them. Never lift the device by handling the plastic cover part!
If the next3 is installed in a closed cabinet, it must have sufficient ventilation to guarantee that the ambient temperature is kept within the operating limits of the next3.

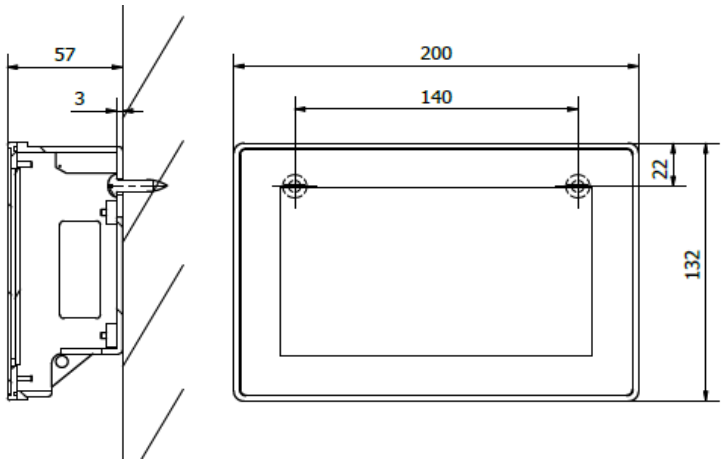
4.1.2 Dimensions of the 19'' rack next3

The rack version of the next3 is for 19" rack and has the equivalent of 8 units in height.





4.1.3 Dimensions of the nx-interface



The nx-interface can be fixed on the inverter with dedicated mounting frame or remotely wall mounted. It can also be integrated on a control panel. See the mounting section for details of installation.

See the Wiring chapter for cabling of communication.

UNPACKING AND MOUNTING

When unpacking, check that the next3 has not been damaged during transport and that all accessories listed below are present. Any fault must be immediately reported to the product distributor or the contact mentioned at the back of this manual. Carefully check the packaging as well as the next3.
Contents:

- Quick Installation Guide and user interface guide
- Next3 inverter-charger
- Nx-interface with
    - Mounting structure
    - USB stick with detailed technical manual, to be used for datalogging with the nx-interface.
    - Kit for front panel fixing
    - 1m communication cable
- Sunclix connectors for PV cables (4 pairs)
- Male connectors for
    - CAN lithium battery communication
    - RS485
    - 2 pieces for AUX contacts
    - 1 piece for CMD inputs
- Temperature sensor nx-tempSensor (with male connector)
- Mounting plate (for wall mounted version) with 1 screw for fixing on the body of the next3. The screws for the wall are **not** provided. Choose the appropriate screws for your wall.
- Fixing belt with 2 screws
- 4 handles
- Cable-glands for battery and AC (for wall mounted version)

4.1.4 Mounting place: environmental factors

Next3 is designed for indoor use (IP20) and the place of installation must satisfy the following criteria:

- Protected from any unauthorised person.
- Protected from water and dust and in a place with no condensation.
- It must not be situated directly above vented lead acid batteries, or in a cabinet with it, due to corrosive gas.
- No easily inflammable material should be placed directly underneath, behind or close to the next3.
- Ventilation holes must always remain clear and be at least 20cm from any obstacle that may affect the ventilation of the equipment (see mounting schematics).

- In mobile applications, it is important to select an installation site that ensures the lowest possible vibration level.
- According to the IEC/EN 62109-1 standard, the level of pollution at the mounting place should not exceed PD2 (second-degree environment), which means that there can be pollution as long as it becomes not electrically conductive and non-flammable.
- Protected from direct solar radiation or heat sources.

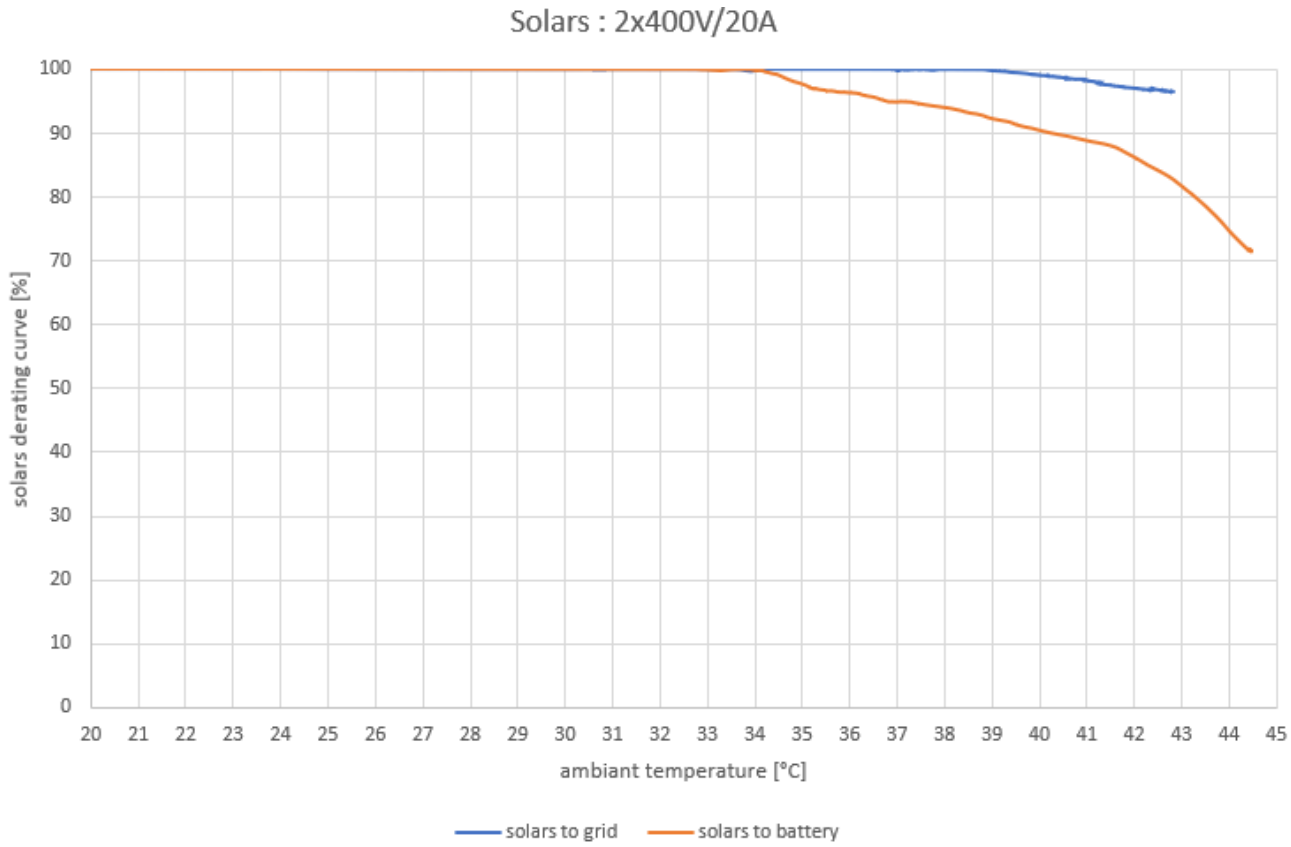
As much as possible, reduce exposure to sudden temperature variation: important heat variation may create undesired and harmful condensation inside the equipment.

The next3 is qualified at 25°C ambient temperature.

Thermal behaviour

The next3 is rated at 25° ambient temperature with proper ventilation (space around the next3). It has several internal temperature measurements and performs a derating of its functionalities in case of overheating. There is a temperature derating of the power capacity in function of the ambient temperature. The derating starts around 35°C for the solar production as seen below:

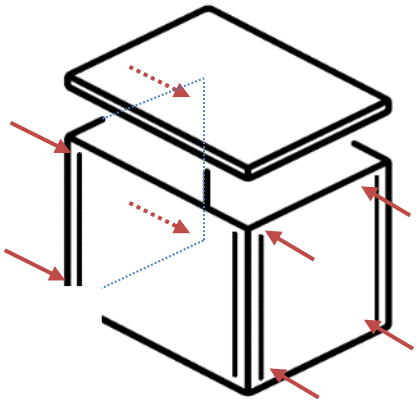
- The solar production is reduced from the maximal current of 20A down to 0A to stabilize the temperature to an acceptable level.
- The battery charging and discharging current is reduced to stabilize the temperature.
- The inverter max power is limited:
    - In island mode, the power is directly given by the loads. If the max current is reached, the voltage drops because the inverter cannot supply the load. When the voltage goes under a voltage threshold of nominal power -10%, the inverter goes to overload.



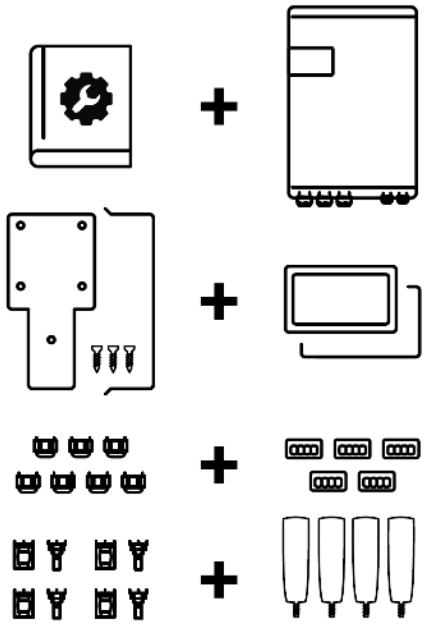
A message indicates if the performances are limited by temperature.

4.1.5 Unpacking and mounting process of the wall mounted next3

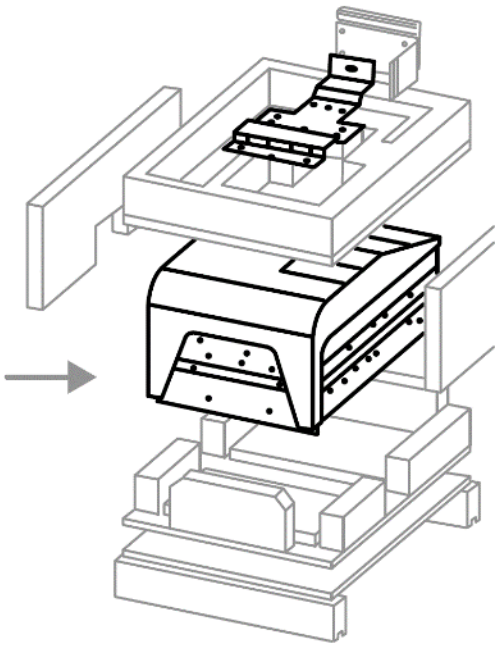
Unscrew the 8 screws situated on the side of the casing.



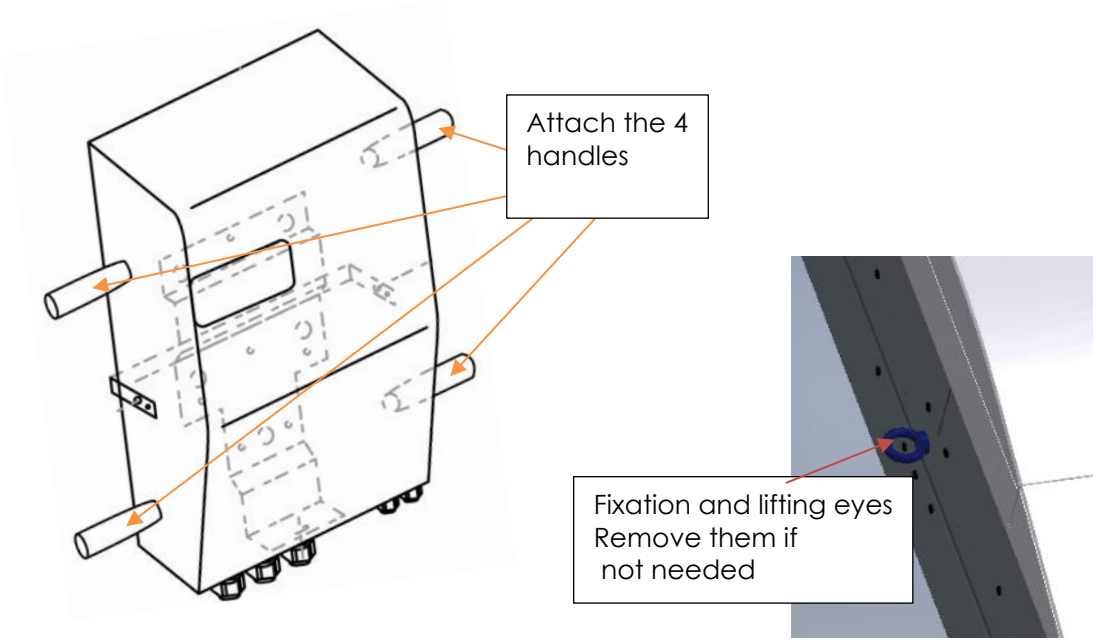
Remove top cover.
Take the manual, the fixation structure, check the content.



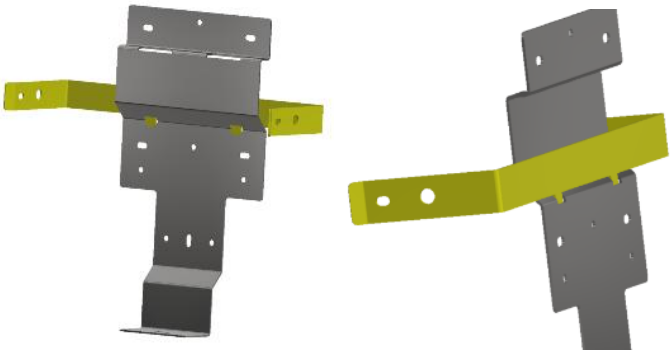
Remove the external casing

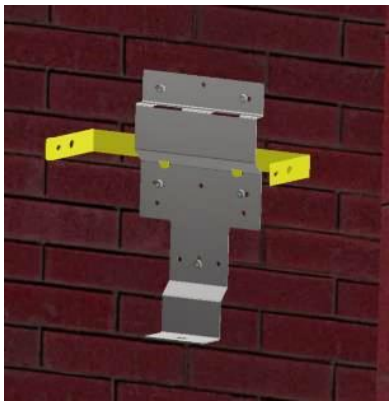


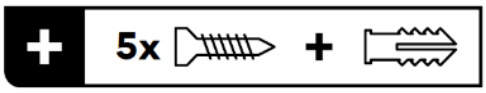
cut the strings maintaining the next 3 to the bottom of the casing.
fix the 4 handles on the two sides of the next3 and remove the loops if you don't need them to move the next3.



Fix the mounting plate on the wall, leaving enough space around the unit for the ventilation and cabling. The next3 must be installed on a non-flammable wall or support. Don't forget to put the fixing-belt in place before screwing the mounting plate on the wall:



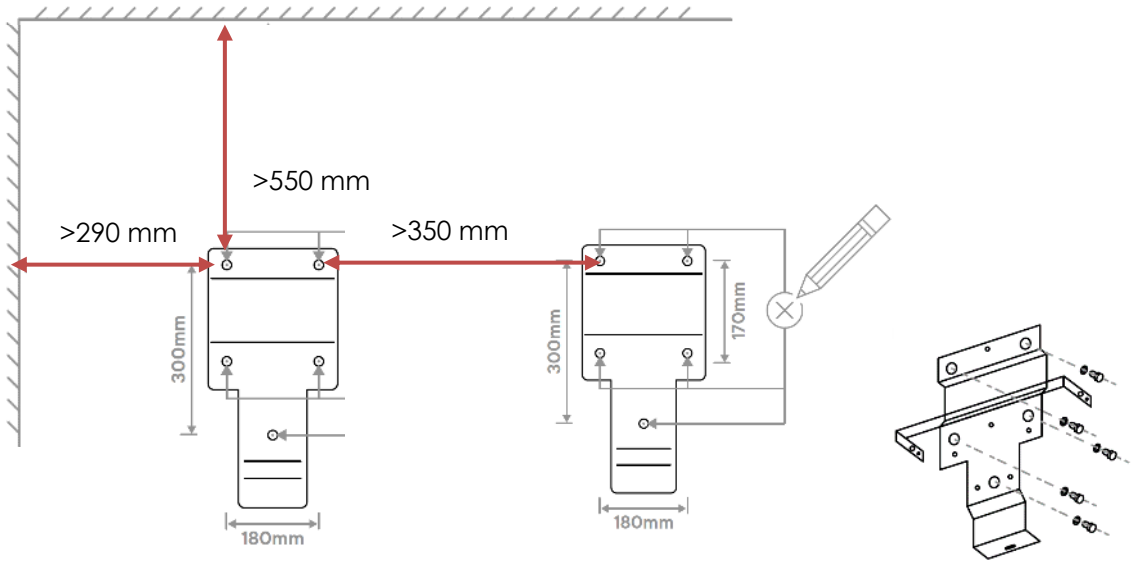


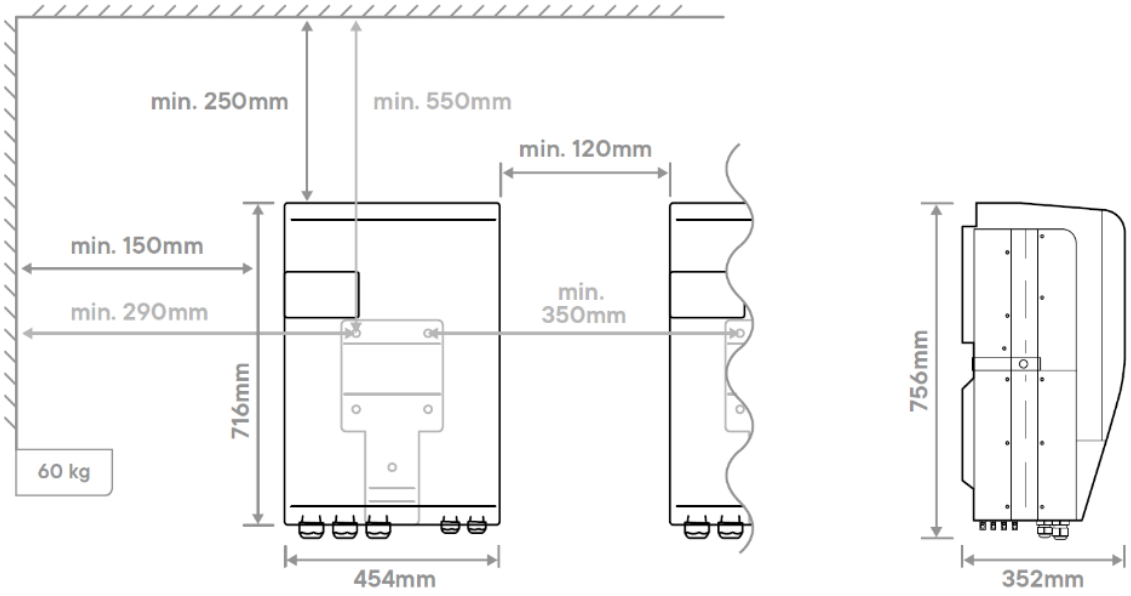


Those are not provided in the package, select the proper screws for your wall type and ensure a solid mounting.
The diameter of the holes in the plate are meant for 8mm screws.

In vehicles (road or marine), or when the support undergoes significant vibrations, the next3 is to be mounted on anti-vibration elements. The fixing belt use is mandatory in those cases.

For the wall mounting plate, use the 5 screws and buffers capable to stand the weight of the inverter in full safety.
When drilling the holes, keep at least 542 mm from the top screws to the ceiling to respect the 250mm clearance above the device.
Keep at least 290mm to the nearest on the left wall (150mm+454mm/2-90mm=287mm) and 350mm to the next next3 (120mm+454mm/2=347); distance from the middle of the plate.
Keep sufficient space below for the cabling.

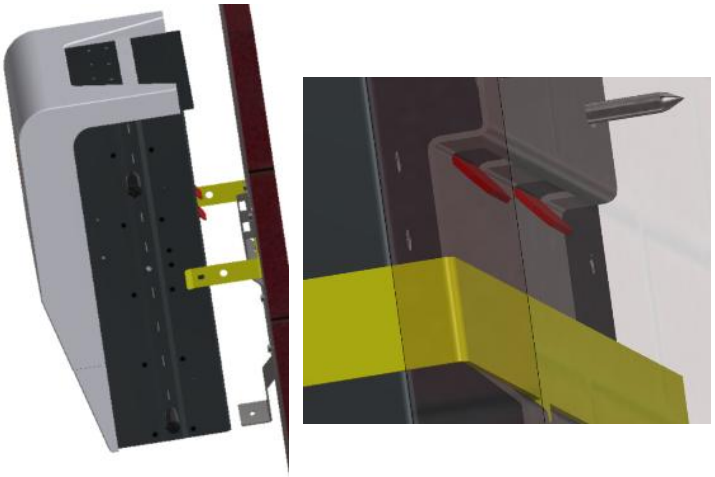


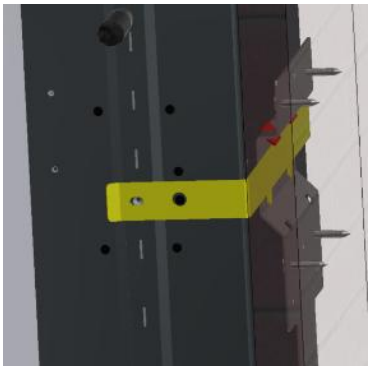


⚠	The next3 is a heavy equipment (~60kg) and must be mounted to a support/structure designed to bear such a load. It is imperative to ensure a complete and safe fastening of the equipment. If simply hung, it may fall down and cause severe damages.

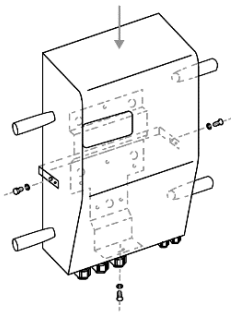
For the next steps there must be 2 people at least!

Hang the next3 on the structure

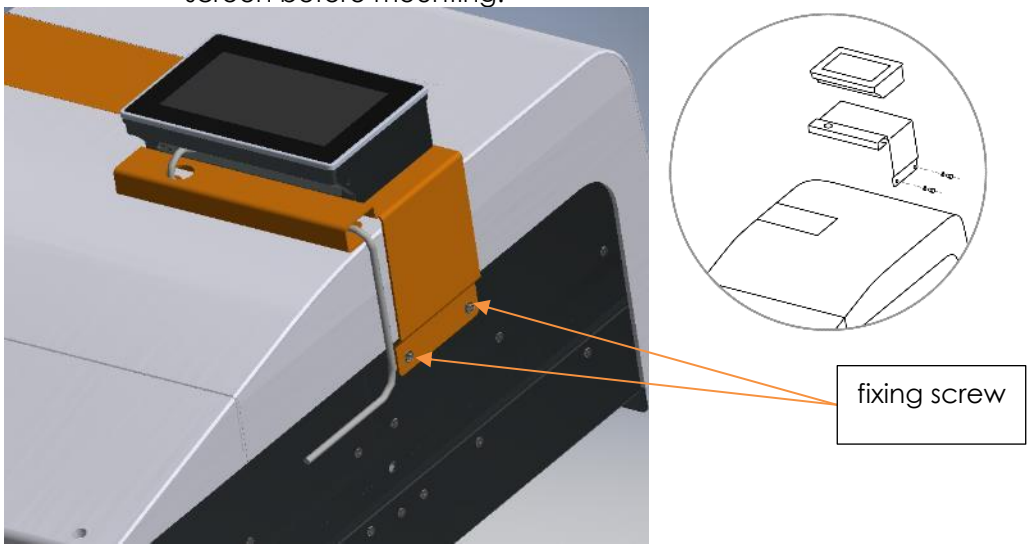




Fix the structure at the bottom with the provided screw
Fix the belt on the sides with the screws provided



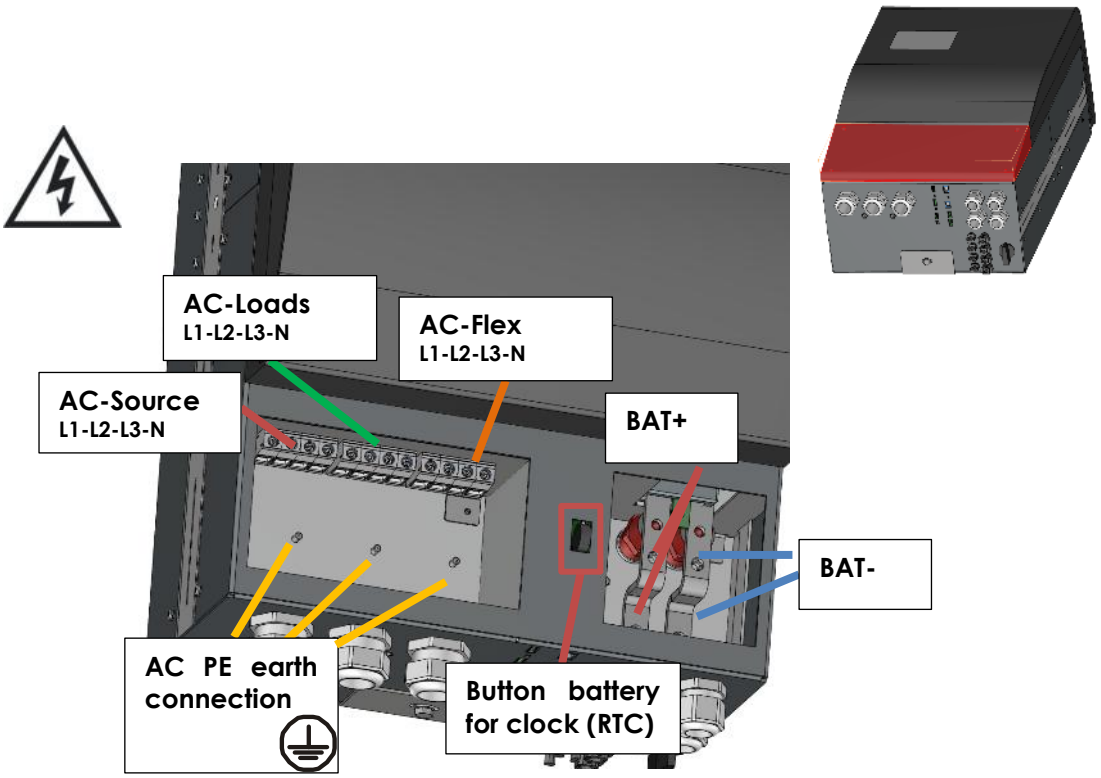
Fix the nx interface with 2 screws provided. Install the communication cable on the screen before mounting.



The nx-communication cable goes in the plug on the left of the nx interface and is easier to install before the mounting on the nx device. The ethernet cable (LAN) goes on the right.

See the wiring sections for details.
Special installation on the wall or in a cabinet is shown in the following chapter below.

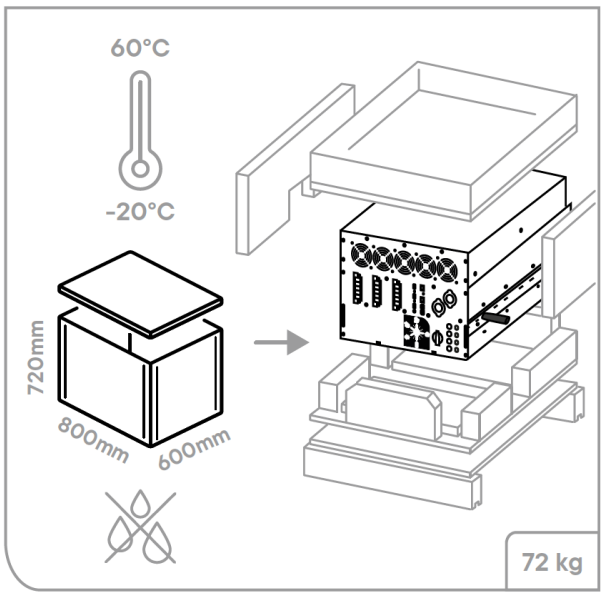
Open the bottom panel and proceed to wiring.



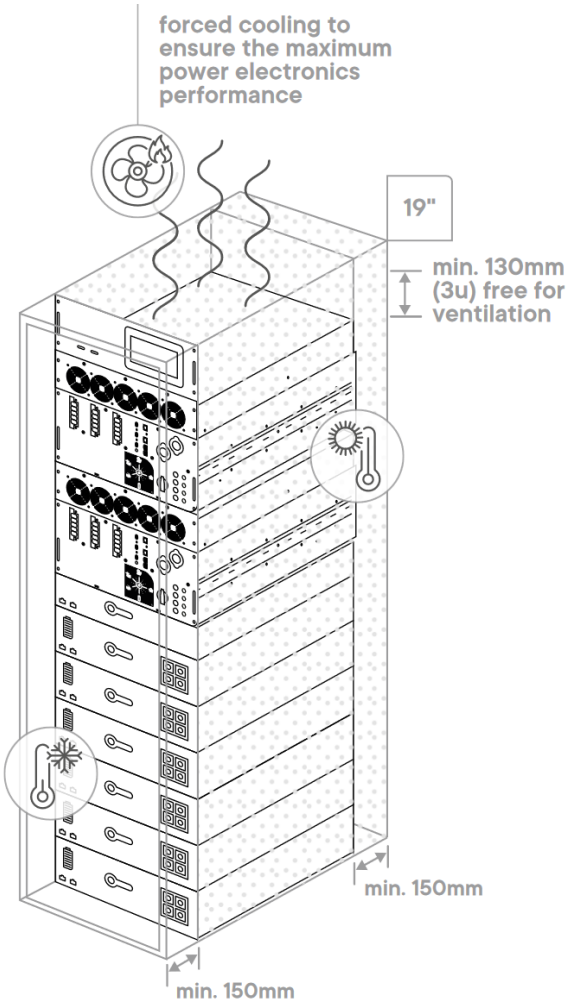
Go to the wiring section of this manual for all explanations about electrical connexions.

4.1.6 Unpacking and mounting process of the rack next3

The first steps of the unpacking of the rack version is similar to the wall mounted version. The same packaging is used.



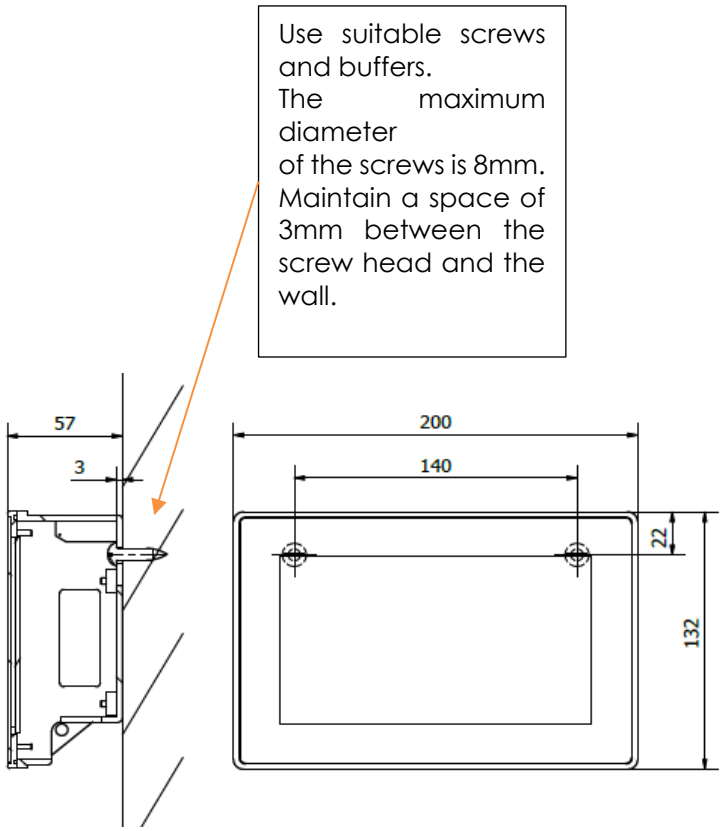
The mounting in cabinet must be performed leaving sufficient space in front and behind the units. If a closed cabinet is used, some extraction fans must be used to evacuation the heat of the power conversion losses.

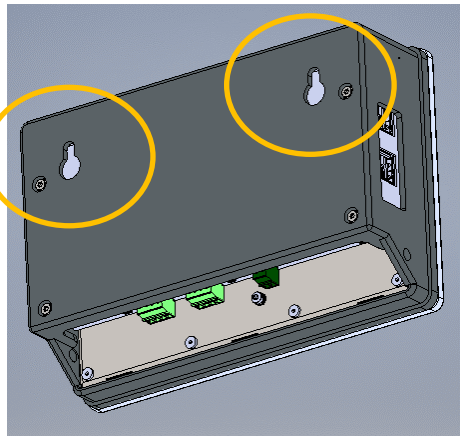


Go to the wiring section of this manual for all explanations about electrical connections.

Nx-interface wall mounting

The nx-interface can be hanged on a wall with two screws. The head of the screw goes in the dedicated slot on the back of the nx-interface.

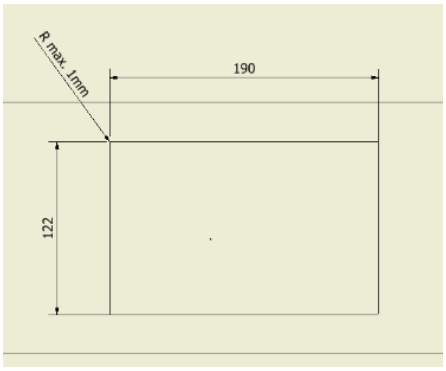




	nx-interface is supplied with a 1m communication cable to mount on the device. Cables of different lengths (3m, 10m and 50m) can be ordered. Item reference is: *nx-ethernetCab 3m/10m/50m*. The length in meters is specified in reference. You can buy your own ethernet cable for communication; it must be ethernet cat5 with 26AWG. The maximal distance between the inverter and the nx-interface depends then on the rest of the cabling. The total communication cable length in one system for the Studer-nx-bus is 75m.

Nx-interface panel mounting

The nx-interface can be integrated in a panel. The maximum thickness of the panel cannot exceed 4mm.

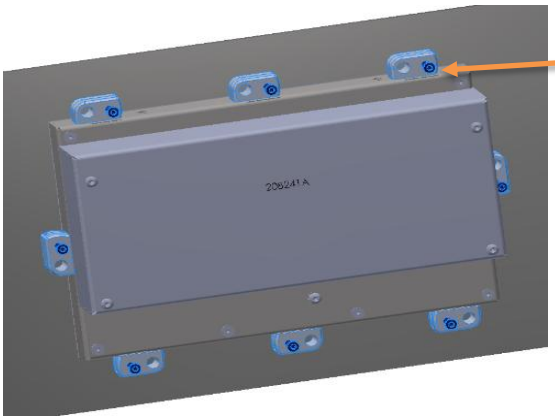


The opening cut in the front panel must be 122 x 190mm with a maximum radius of 1mm in the corners

Mounting Instructions:

Insert the device from the front into the cut-out of the panel and push it carefully until it is fully inserted.
Insert the mounting elements (1) into the provided lateral T cut-outs (2) and push them sideways (3) so that they are locked.
For the first mounting elements in a corner, tighten the fixing screw (4)until it presses on the plate. Tighten the fastening screws to a maximum torque of 0.2 Nm.

Repeat procedure 3 for opposite mounting elements.
Repeat procedure 3 for remaining mounting elements.



Mounting elements and screw are provided

Observe the maximum tightening torque of the fastening screws of the mounting elements otherwise they may be damaged.

Tighten the fastening screws of the mounting elements to a maximum Torque of 0.2Nm.

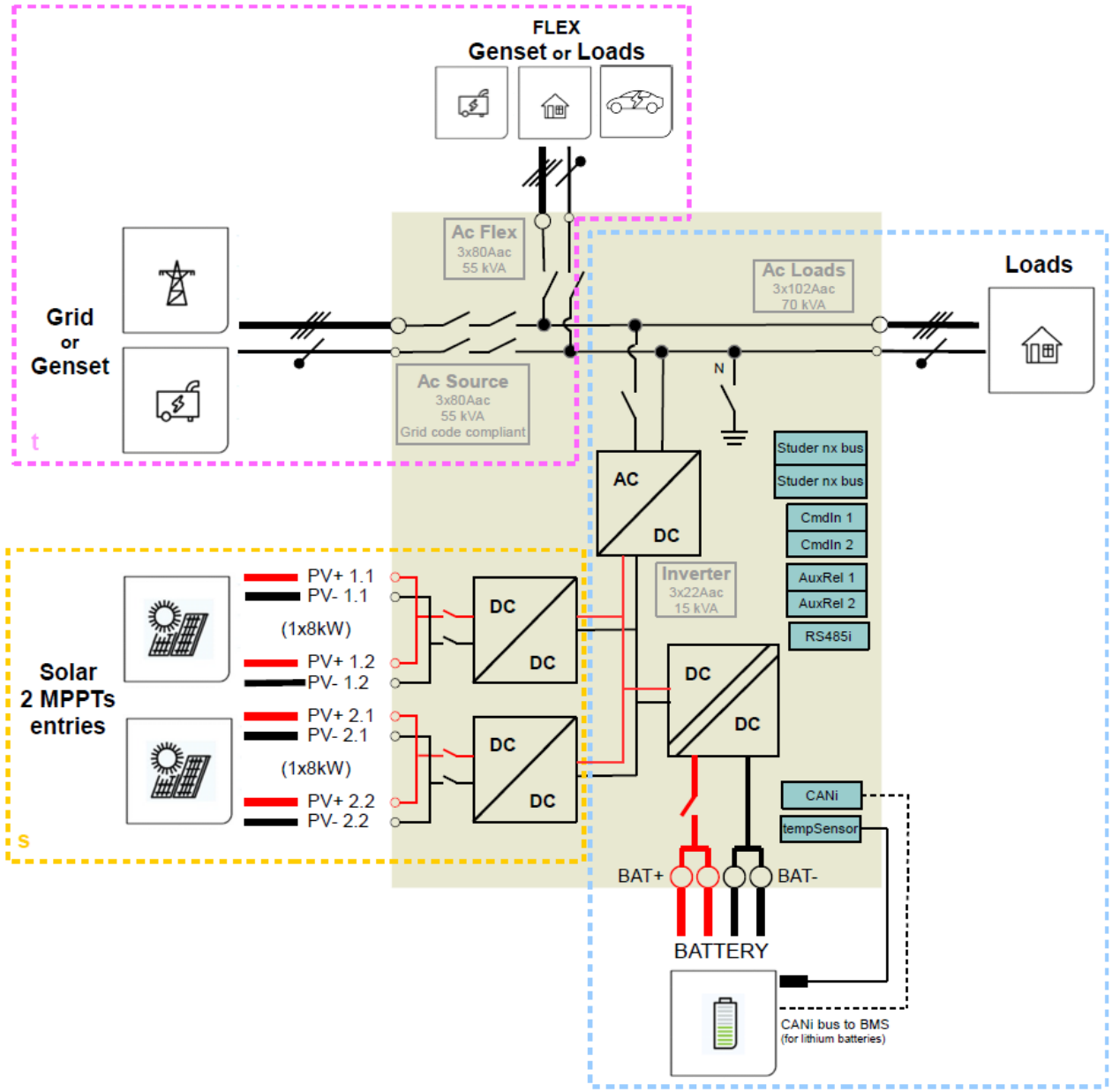
5 WIRING

This chapter covers the wiring/cabling of the next3 installation before powering it !

GENERAL OVERVIEW

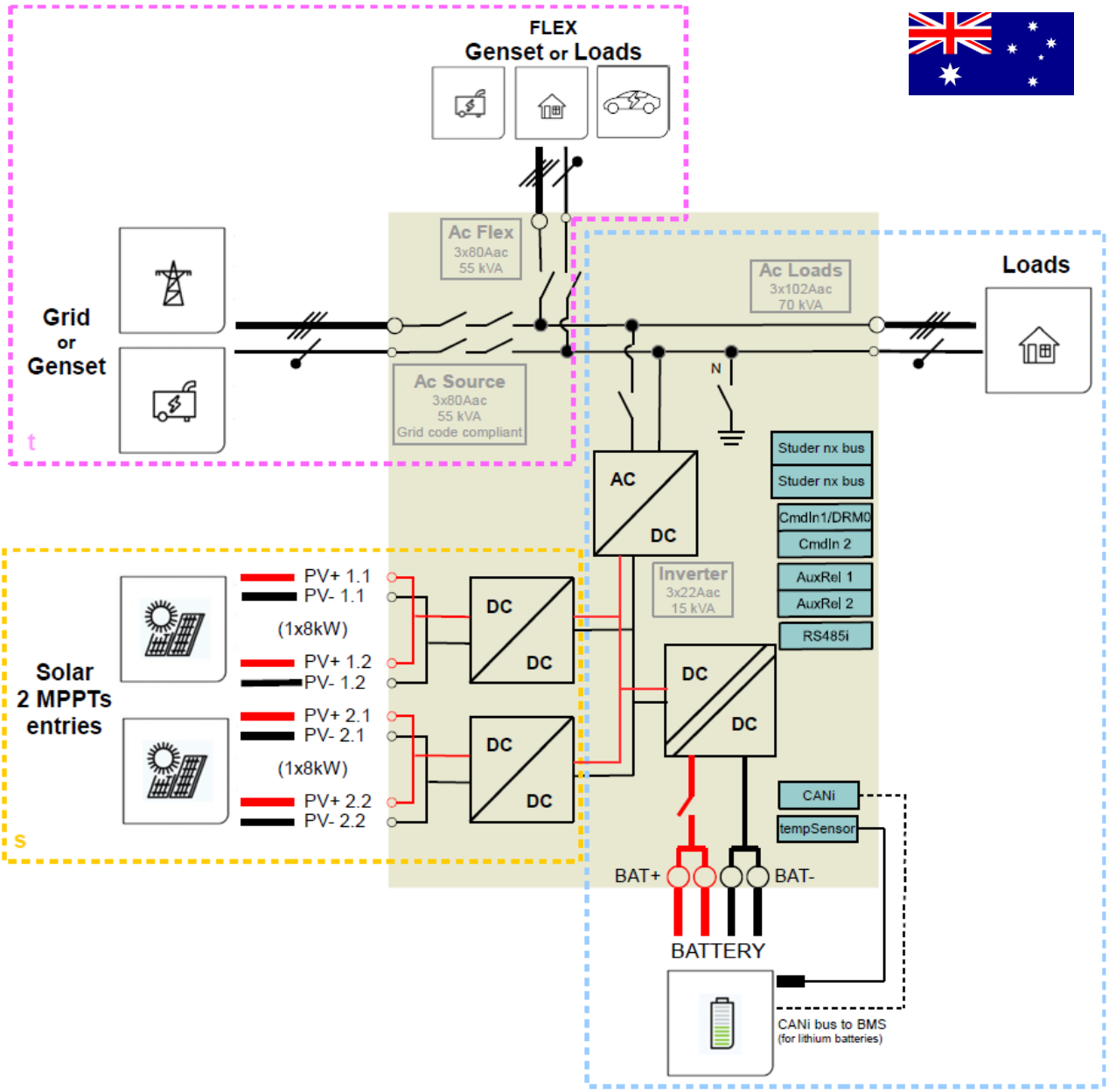
5.1.1 System block diagram

The general schematic diagram of the **next3 st** is given below. Letter **s** is for the solar and **t** for the transfer.



The Australian version has 2 specificities:

- The PV switch has been removed. An external PV -switch must be installed by the installer. This must be listed compliant with the Australian regulation.
- The command input 1 is used for the DRM0 function requested by the AS4777.2



5.1.2 General recommendations

The connection of the next3 charger is an important step of the installation. The next3 is designed to be robust and is electronically protected against overloads, short-circuits, overheating, polarity reversal of the battery and polarity reversal of the PV.

Be aware of the following general guidelines:

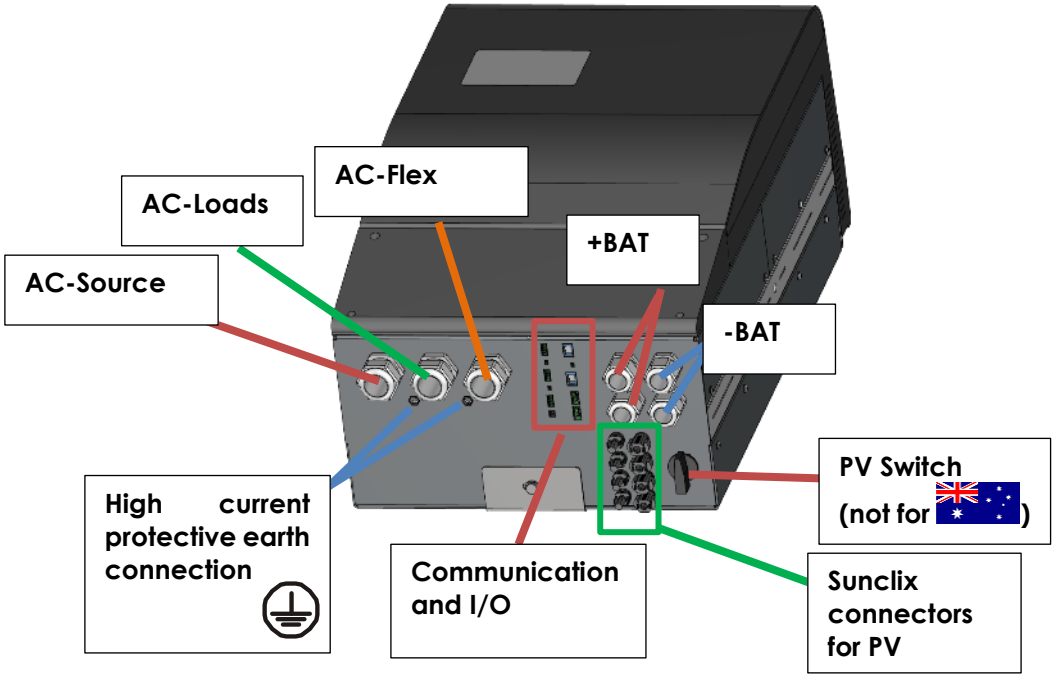
- It may only be carried out by qualified professionals, aware of the rules and regulations in force. The installation must always comply with the local standards.
- The cross-sections of the cables connected to its terminals must comply with local regulations even if indications are given in following chapters.
- The installation materials such as cables, connectors, distribution boxes, fuses, etc. must be adapted and must be conform to the applicable laws and regulations, specially about fire hazards.
- All cables in use should be isolated with PVC, TFE, PTFE, FEP, neoprene or polyimide. The installed cables must withstand at least 70°C wire temperature. Make sure that connections are correctly tightened and that each wire is connected at the right place.

The next3 falls within protection class I. It has a PE connection terminal. It is mandatory that a protective earth is connected to the AC-Source and/or AC-Loads PE terminals. An additional protective earth is located at the bottom of the unit.

	The connection compartment of the next3 must remain permanently closed while the device is operating. Before opening, check that all voltage sources (AC, battery and PV) have been disconnected or switched off and wait for at least 2 minutes before opening the equipment. It is imperative to close the protection cover on the connection terminals after each servicing. Before connecting or disconnecting the entry or exit cables AC-Source, AC-Loads and AC-Flex, the installer must be sure that there is no voltage present in the cables OR on the terminals.

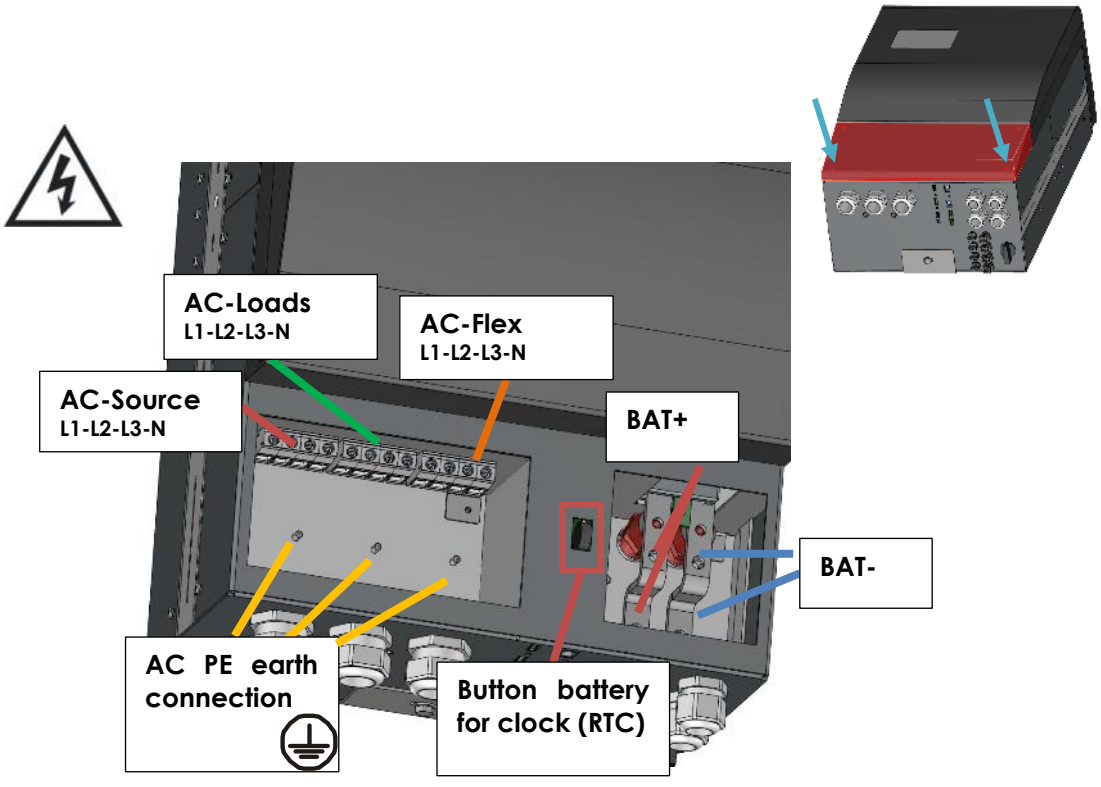
5.1.3 Connections overview

Connections:



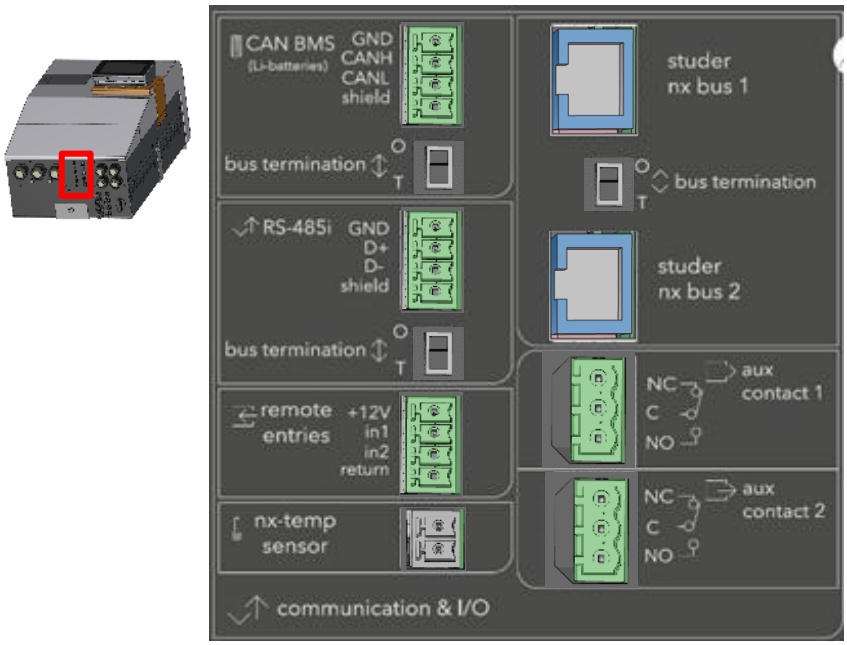
⚠	Any unused cable entry on the device must be sealed to prevent any intrusion. Intrusion of small animals in the unit may cause serious damages not covered by the warranty.

Open the connection compartment by removing front cover:



Denomination	Description	Comment
⏚	Protective earth connection terminal	This terminal is used as primary earth connection protection.
+BAT	Positive pole battery connection terminals	Carefully read sect. 6.3 Take care with the polarity of the battery.
-BAT	Negative battery pole connection terminals	
AC-Source	Connection terminals for the AC power supply (grid or generator)	See sect. 6.2 for cabling and 9.7 for settings. Note: It is imperative that the PE terminal is connected.
AC-Loads	Connection terminals for the device output.	See sect. 6.2 for cabling and 9.8 for settings. Note: It is imperative that the PE terminal is connected.
AC-Flex	Connection terminals which is configurable as second device output (loads) or as second AC source (for a second genset or grid).	See sect. 6.2 for cabling and 9.9 for settings. The main choice between AC-Flex being a source or loads cannot be modified when the unit is running. Note: It is imperative that the PE terminal is connected.
PV Switch	Connection/Disconnection of all PV arrays (positive and negative poles).	 There is no PV Switch for the Australian model. A certified PV switch must be installed independently of the next3.
PV+ / PV-	Sunclix PV connectors	
Button battery for RTC	3.3 V (CR-2032) lithium-ion type battery socket	Used as a permanent supply for the internal clock to keep time when the next3 is not connected to a battery.

Communication and I/O connections:



See corresponding chapter for detailed wiring and protocol in use.

Pos.	Denomination	Description	Comment
	nx-tempSensor	Connector for the battery temperature sensor.	Only connect the original Studer nx-tempSensor.
	Studer nx-bus	Two connectors for internal communication between studer next3 devices such as the nx-interface or other next3 compatible units	Only nx-bus compatible device can be connected. The connection of any other device (LAN routers, can-to-can interfaces, etc.) may damage the device. See chapter 4.6. The nx-bus is not compatible with other communication bus from Studer (for example Xtender bus).
	Termination switch O / T (Open / Terminated)	Switch for terminating the communication bus.	Set position (open) if the 2 connectors (3) are occupied. Set position T if only one is occupied. The connectors at the two ends of the communication bus daisy chain must be terminated.
	AUX1 and AUX2 CONTACT	Programmable dry contacts. 16A/230V	Take care not to exceed the admissible loads. C: Common NC: Normally Closed NO: Normally Open
	CAN BMS	Isolated CAN bus for communicating BMS of lithium batteries	Only for CAN BMS!
	Remote entries	Two digital inputs to indicate external changes to the unit.	See schematics in the "*Wiring auxiliaries I/O*" chapter. The DRM function is implemented on the entry 1
	RS-485i	Modbus connection for accessories	For the communication to the vario solar chargers and powermeter.

5.1.4 Tightening torques

The tightening torque of different connection points should be checked regularly, especially in installations exposed to strong vibrations (mobile systems, vehicles, boats, …). The table below states the recommended tightening torques for each connection:

Connection	Torque
AC connector • AC-Source • AC-Loads • AC-Flex	4Nm
Earthing PE connection	4Nm
Battery DC screws	10 Nm
Fixing belt	4Nm
Plastic cover	1Nm
PV connection	Sunclix connectors provided
Panel mounting accessories on nx-interface	0.2Nm

An annual check of all the connection tightness is recommended.
In mobile installations, the connection tightness should be checked more often.

5.1.5 Max permissible cable cross-sections summary

The maximum permissible cable cross-section for each connection is defined by the size of the corresponding cable gland, which is indicated in the below table:

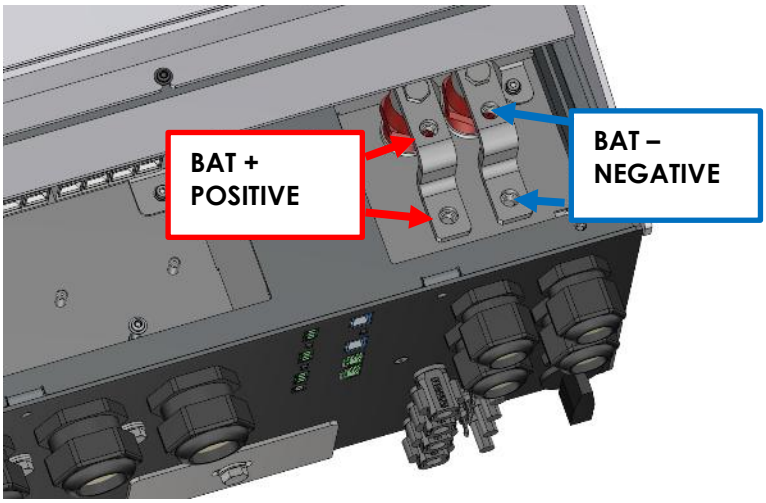
	NX3
Max Section AC [mm2] / Cable gland	5x25 / M40
Max -Min Section DC [mm2] / Cable gland	2x 95 - 2x 70 / M32
Max section auxiliary relay, digital input, CAN and RS485 [mm2]	2,5
Max PV cable [mm2] for Sunclix	6

CONNECTING THE BATTERY

The next3 is a device which DC (battery) connection is to be connected exclusively to a 48V battery. This batterie connection is in overvoltage category 1 (OVC I). The max charging current to the battery is 300A. The maximal discharging current is the same as for charging 300A for standard controlled discharging when grid is connected. The max discharging current in offgrid is given by the load connected and depends on the surge power available, it is up to 24000kW/50V=480A for the short term surge power of 5seconds.

Due to high power of the next3, the battery cables are separated in two entries in parallel to have a more convenient handling. The recommended battery cable size is 70mm2 for a total of 140mm2 with two cables in parallel. The maximal size is 95mm2 for a total of 190mm2 section.

Battery cables must also be as short as possible, and the cross-section must conform with the applicable regulations and standards. Sufficiently tighten the clamps on the "battery" inputs.



⚠	Battery cables must always be protected by one of the following measures: Have a protection and disconnection device (fuse, circuit breaker) on each pole or only on the pole not connected to earth. The protection device must be rated according to the cable cross-section but must not exceed 1.25 x next3 maximum current. It will be mounted as close as possible to the battery. The maximum current in discharge in offgrid with P30 is given with 16000/48=333Adc with factor: 333x1.25=416Adc without considering surge power.

Each next3 is connected directly to the battery through its own protective device (fuse or circuit breaker) and disconnection device. It should never be connected to the output of a DC voltage regulator like solar regulator, without having the battery as a buffer.
All other consumers or sources are connected directly to the battery by their own protective and

disconnection devices.

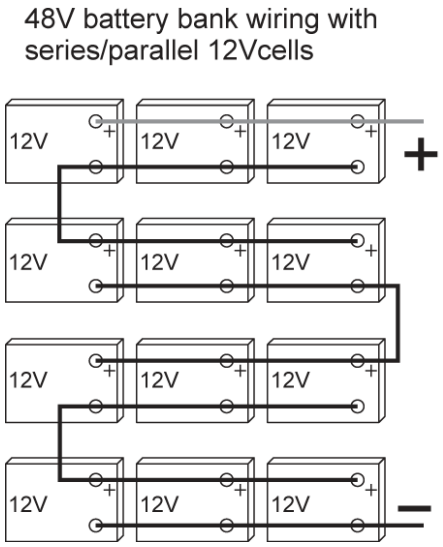
5.1.6 Dimensioning the battery

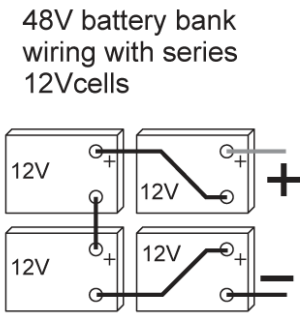
The battery bank is dimensioned depending on the user's daily energy consumption and the number of days of autonomy required. It is sized also in function of the wanted daily Depth Of Discharge (DOD).
The dimensioning of the battery must also consider the power and the type of loads that are connected to the inverter. As rule of thumb, the maximum power of a lead acid battery is given with the capacity divided by five (C/5), in that case if all the power of the next3 is wanted (16kW), the capacity of the battery should be at least16000*5/48=1666 Ah.
For lithium, see the maximum power defined by the manufacturer as lithium batteries are generally rated with a much higher current (C/3 or even 1C).
Take into account the surge power of loads, for example for motor starting and the overload capacity of the inverter to dimension your battery system.

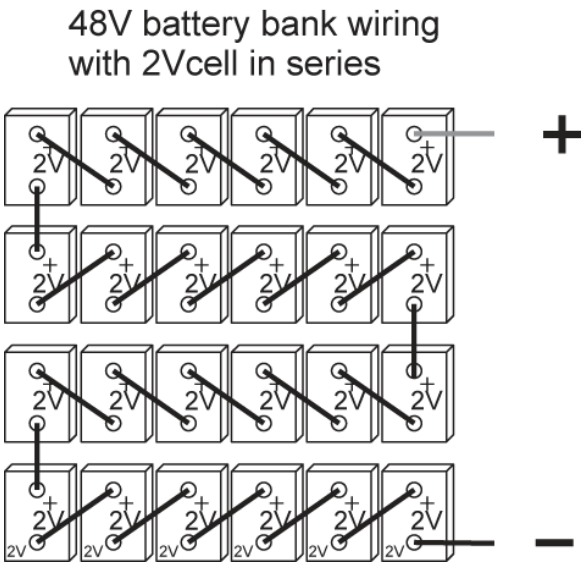
Battery bank design

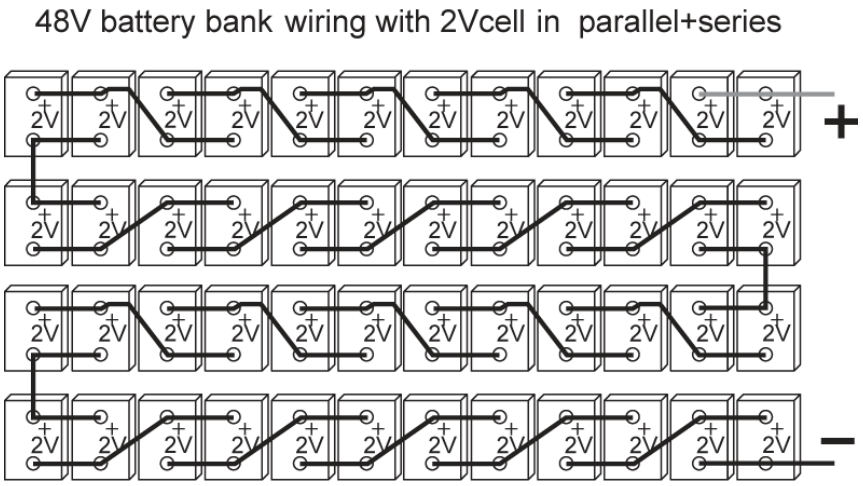
Lead batteries are usually available in 2Vdc, 6Vdc or 12Vdc blocks. To get the correct operating voltage for the next3 (exclusively 48Vdc), several batteries must be connected in series. The capacity of the batteries can be increased using a parallel connection of several battery strings.

The various cabling options for the battery are presented in figures below:









⚠	Strictly conform to the manufacturer's instructions for parallel connections, especially with lithium batteries.

5.1.7 Battery cable cross-section, DC protective and disconnection devices

The battery cables must also be as short as possible. Recommended section for the nx3 battery cables is 2x70mm^2 and a 400Adc protection for standard use. The recommended cable cross-sections are valid for lengths less than 3 m. Beyond this length, it is strongly recommended to oversize the battery cables (possible up to 2x95mm^2 for cables connected to next3 battery poles) and consider the voltage drop in the cables. The maximal battery cable length allowed is 10m.

For safety reasons, we recommend an annual check on the tightening and corrosion of all connections. In mobile installations, the tightening of the connections should be checked even more frequently. For lead acid batteries, an individual measurement of each cell is recommended. Any divergent values can be a sign of problem.

To avoid any further loss and protection redundancy, the next3 does not have an internal fuse.

⚠	The battery cables must be protected by one of the following measures: - protection device (fuse) and disconnection device at each pole - protection device (fuse) and disconnection device on the pole not connected to the earth In all cases check local regulation and normative.

5.1.8 Connecting the battery

Start the connection on the next3 side first, without any voltage. Keep battery poles away/ protected to prevent any unwanted contact with conducting parts.

next3 side connection

Insert the cable glands supplied on the battery cable before tightening the cable lugs. Crimp the cable lugs and fasten the cable gland on the device. Repeat this for all battery cables. Fix the battery cables to the appropriate connections "+ Battery" and "- Battery". The M8 screws must be very well tightened (10Nm).

battery-side connection

Prepare the batteries for connection: appropriate battery clamps, protection device, cables in good conditions with correctly fitted clamps.

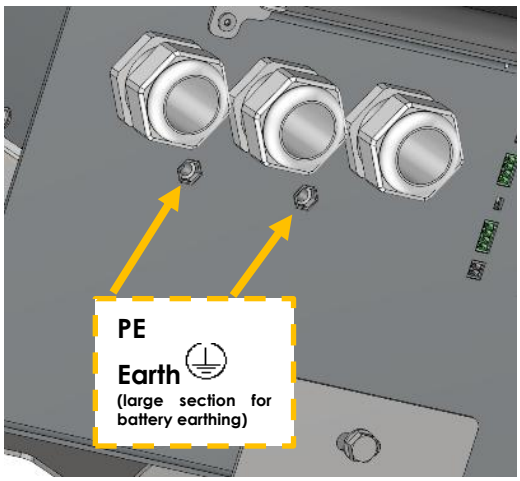
Fasten the negative cable on to the negative pole (-) of the battery and the positive cable on the open protection device.
The cable lugs must be carefully fixed and tightened sufficiently to guarantee minimum loss. Insufficient tightening may cause dangerous heating at the connection point.

	During the first start of the unit, it is necessary to check that the parameter values of the next3 are consistent with the recommendations of the battery manufacturer. Non-conforming values may be dangerous and/or seriously damage the batteries. See the chapter about programming and set the proper values at initial commissioning (with wizard on nx-interface).

5.1.9 Earthing of battery

One of the two battery conductors can be earthed. This may be either the positive or the negative pole as the battery is isolated from the other potentials (PV, AC). In all cases, the installation must be in conformity with the local regulations and usage or specific standards associated with the application.

In case of earthing, the earthing conductor cross-section must at least be equivalent to the cross-section of the battery conductor. The earthing of the equipment must also adhere to these regulations. For this case, use the additional earthing screws, which are located at the bottom of the device under the AC cabling glands.



All the other earthing systems (earthing by means of a protection device, impedance, without earthing or earthed at battery positive pole) require the whole battery circuit to be protected against electric shocks.
Any accidental contact with the conductive parts of the battery circuit is to be avoided by providing a Class II protection level.

5.1.10 Precautions when using batteries

The batteries should only be chosen, dimensioned, and installed by qualified personnel. Lead-acid batteries with liquid or gelled electrolyte produce a highly explosive gas during normal use. Other special types of batteries present similar risks. Avoid source of sparks or fire in the immediate vicinity of the batteries. The batteries must be kept in a well-ventilated place and installed to avoid accidental short-circuits when connecting.
Never try to charge frozen batteries. When working with batteries, a second person is required to give assistance in case of problems.
Fresh water and soap must be kept close at hand to allow adequate and immediate washing of the skin or eyes affected by accidental contact with the battery acid. In the event of accidental contact of the eyes with acid, they must be washed carefully with cold water for 15 minutes. Then immediately consult a doctor.
Care is required when working close to the batteries with metal tools. Tools such as screwdrivers, open-ended spanners, etc., may cause short circuits. Sparks created by short-circuits may cause the battery to explode. Therefore, these kinds of tools must always have isolated handles and never be placed on top of a battery. When working with the batteries, all metal jewellery such as rings, watches with a metal bracelet, earrings, etc., must be taken off. The current supplied by the batteries during a short circuit is sufficiently powerful to melt the metal and cause severe burns.
Batteries at the end of their life cycle should be recycled in accordance with directives from the responsible local authorities or the battery supplier. The batteries should never be thrown into fire as they may explode. Under no circumstances should you try to take apart or dismount the battery, as they contain toxic and polluting materials. For ungrounded battery systems, always check that they are not inadvertently grounded before starting to work on the batteries.
Always carefully follow the instructions of the battery manufacturer.

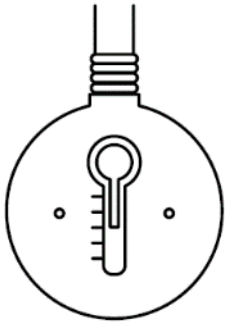
⚠	A battery voltage higher than 80V can cause important damage or destroy the equipment.

5.1.11 Battery temperature sensor connection (nx-tempSensor)

The operating voltages for lead batteries vary depending on the temperature. A temperature sensor is available to correct the battery voltage and guarantee an optimum charge in function of battery temperature.

The temperature range of the sensor is from -25°C to 70°C. The default temperature compensation for lead acid batteries when a sensor is plugged is -3mV/°C/cell compared to 25°C. For a 48V battery this is 72mV/°C. See the configuration section of this manual for modification of the temperature coefficients. A warning is raised at 40°C and error is raised at 55°C; those thresholds can be modified.

The temperature sensor nx-tempSensor is supplied with a 10m cable and the proper male connector beside. The connection has no polarity and can be done in one or the other direction without preference. The sensor should be placed as close as possible of the battery



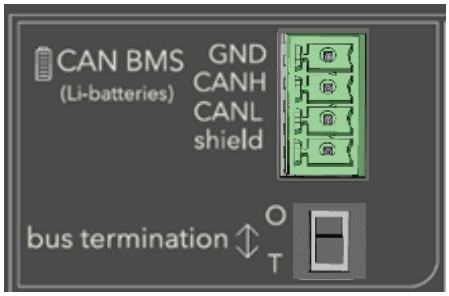
The temperature sensor is automatically recognised, and the correction of the voltage thresholds applied immediately in case of non-communicating battery. If a communicating battery is used the temperature measures by this sensor is not taken into account as the temperature is directly given by the BMS. The nx-tempSensor temperature is recorded in the datalog.

5.1.12 Battery with communicating BMS: CAN connection

The next3 uses a CAN Bus to communicate with the BMS (Battery Monitoring System) of a lithium battery. Lithium batteries are more complex to handle compared to lead acid batteries. A BMS is responsible of cell monitoring and battery safety. The BMS knows the status of each cell, and it computes maximum charging/discharging currents and maximum/minimum target voltages. These values must be respected when the installation is working and BMS communicates to inverter/chargers the proper setpoints for proper operation.
The next3 has several CAN protocols implemented for communication with different battery management systems.
These protocols are compatible with specific batteries. **See the Studer-Innotec website for the up-to-date list of compatible batteries, brand and models**: https://technext3.studer-innotec.com

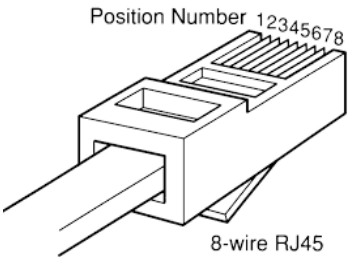
Updates the next3 software to have the latest communication protocol.

Beware of the pinning order (CANH, CANL, GND) on the connector, see instruction of the BMS manufacturer carefully. An appendix about various lithium batteries is available.

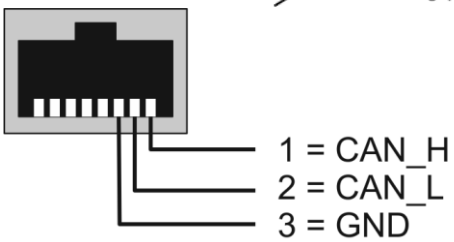


For a point-to-point connection, the bus termination should be set to T (Terminated). If the device is in the middle of a daisy chain, the termination is set to O (Open).
Generally, the next3 is connected point to point to the BMS and the termination should be on T.

Most of batteries BMS have a specific connector for CAN connection and a specific pinning for the wiring. There is no standard.
Even with a RJ45 connector, the pinning may vary.
The cable must be adapted by the installer case to case, respecting the signals (GND, CAN-H, CAN-L).

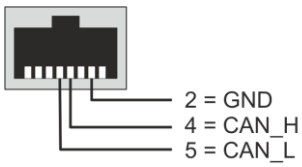
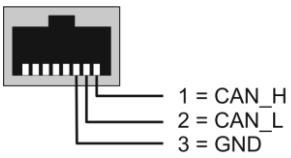
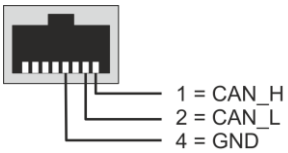


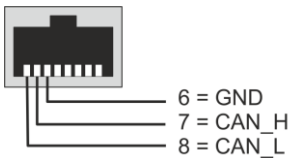
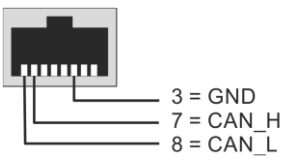
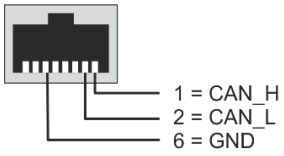
As example here is the pinning for the CIA-303-1 :

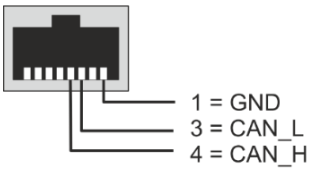
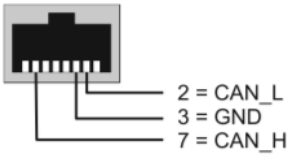
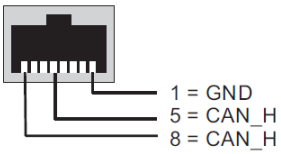
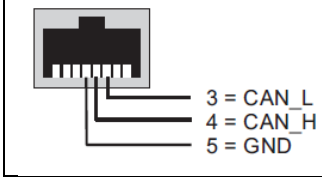
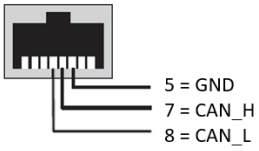
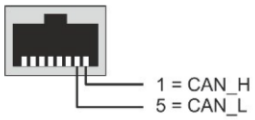


That must be wired/screwed with the provided connector:

Configuration with compatible batteries :

Autarctech - LiRack/ LiTerminal **BMS Orion** – Jr (www.orionbms.com) **BMZ** - ESS 3.0 – ESS 9.0 – X **BSLBATT** – LFP battery **BYD** - Premium LVL/ LVS, B-Box Pro 2.5–10.0, B-Box Pro13.8 **Cegasa** – eBick Ultra 175 ES **Leclanché** - Appollion Cube, TiBox **LG Chem** - RESU series* **Midac** - RES 4.2/5.1 **Pylontech** - UP2500, US2000, US3000, Phantom-S **REC -** Q BMS 16S **Solar MD** - SS4074/SS4037/ SS202 **Systems Sunlight** - Li.ON ESS **Tesvolt** - TS 25-50 **Vision Mechatronics** - LiRack, Lirack Eco **Fortress Power** – eFlex 5.4 	**Archimede Energia** - FXO-048-XXX-TCX **Cegasa** - eBick Pro 180 **Commeo** - 48 V system **Cosun** - RS-Box **Solarni Panely** - HomeGrid BMS **Super-B** - 12V SB12V160E-ZC and SB12V100-ZC **Weco** - 4K4 LFP/ 5K3R20 	**PowerTech** - systems PowerRack 

BlueNova - BN 13-26-52 series **Freedom Won** - Lite Range **Pallas** - RESS 48V50 	**Cegasa** - eBick Ultra 100 **Discover** - AES 44-24-2800 and 42-48-6650, LITHIUM PRO 	**Soltaro** - SOL-R16-2.5KWH and SOL-R16-5.0KWH 

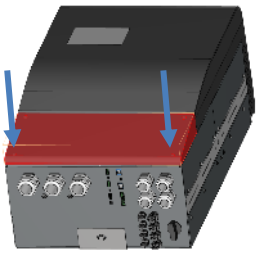
Zruipower *- Power Base Pro* 	***IPS*** *(Integrated Power Solution) liCube modular LiFePO4-System* 	***GS-HUB*** *– Home Hub* 
DLG *– ESS48-2U-L* 	***Zruipower*** *- ZR-FC48100-1630J1, ZR-FC4850-1630J1* 	***UZ Battery*** – Power Lite L051100-A1, L051100-B, L051100-D 

The next3 is supplied without batteries, please, refer to the manufacturer for warranty conditions and availability.

CONNECTING THE AC (ALTERNATIVE CURRENT)

⚠	Dangerous AC may be present on the connection terminals. Make sure that the inverter is deactivated and that there is no AC or DC voltage present on the AC terminals before proceeding with the connection. The AC connection is in overvoltage category 3 (OVC III).

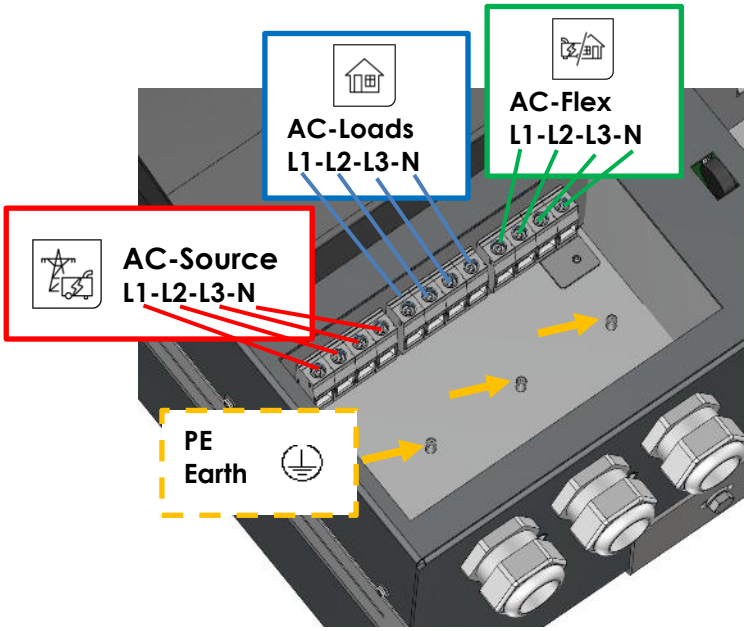
On the next3 model, remove the cover plate by unscrewing the two screws to access the AC terminals and protective earth. The connections inside are shown on the figure below:



There are 3 AC connections:

- **AC-Source**: connection for the main AC source. A grid or a generator. This input has double security relays for disconnection according to safety and grid code requirements like VDE-0126 and others. In case of grid connection, always connect the grid to AC-Source.
  In offgrid, a single-phase source may be used and connected to the L1 of the AC-source. For example, for a single phase genset as a backup. To fulfill voltage fluctuations and flicker limits requirement, the maximum permissible impedance of the wiring must be lower than 0.15Ω + j0.15Ω for each phase and 0.1Ω + j0.1Ω for the neutral.
- **AC-Loads**: connection for the loads, that are supplied by the inverter. The 230 V and 400V consumers must be connected on the "AC-Loads" connection terminals with the wire cross-section conforming to the standards regarding the rated current at the next3 output.
- **AC-Flex**: this is a configurable connection to be connected to loads or to a genset. The choice of configuration is done at the setup of the system during the Wizard procedure. The AC-Flex configuration is fixed and cannot be changed anymore in operation for security reasons.

On models without transfer (nx3-16000-48 and -s) there is no AC-Source and no AC-Flex connections.

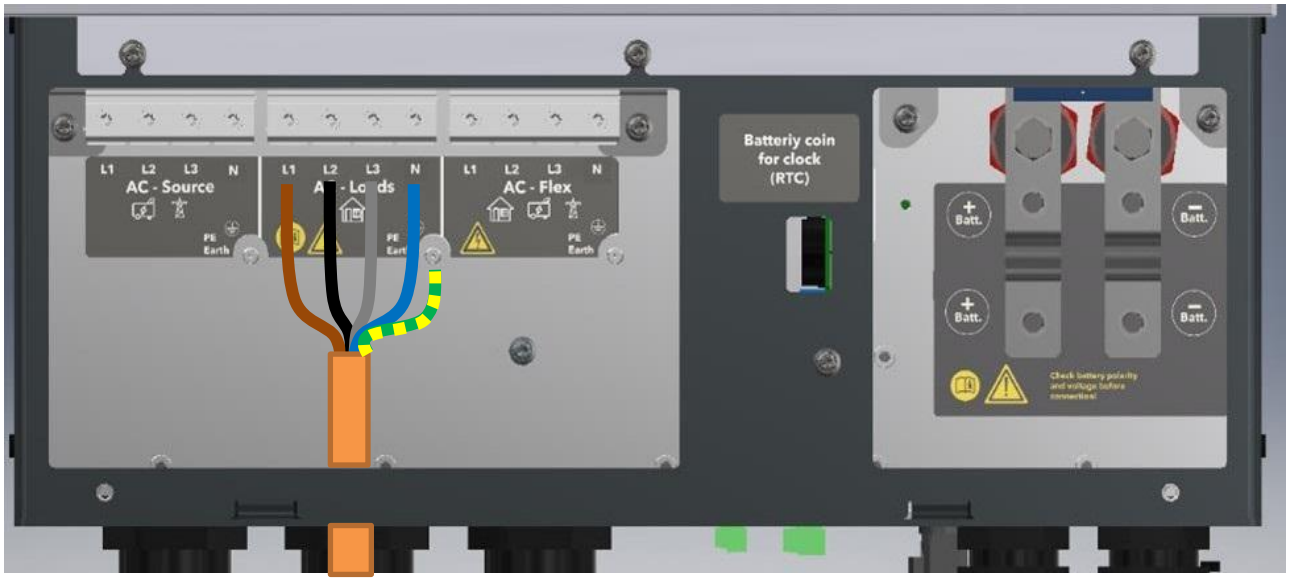


Refer to the general schematics (block diagram) at the beginning of this chapter for a better understanding.
The next3 terminals are marked in the following way:

N = neutral
L = lines (L1, L2, L3)

⏚ = protective earth (connected to the enclosure of the device).

Example of connection for AC loads



ℹ	Insulation tests: At commissioning of an electrical system, insulations tests are performed on the wiring (in some countries, depending on local regulation). It is performed applying high voltages on the cables and measuring the leakage current. This must be done without the next3 in the loop. Overvoltage surge protections included in the next3 will invalidate the tests. Insulation between circuits and the ground is tested in factory for every next3 unit manufactured according to the device IEC/EN 62109 and IEC/EN 62477 safety standards.

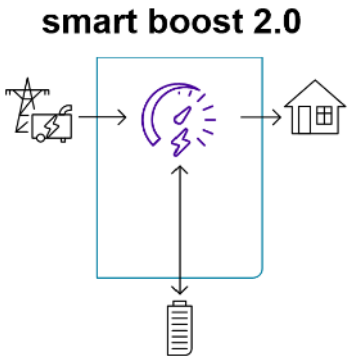
5.1.13 Sizing of AC protective devices

The source must be connected to the input terminals marked "AC-Source" with sufficient wire cross-section, depending on the power output of the source, and protected by a protection device of the appropriate rating. In any case it must be **maximum 80A per nx3**.

For people safety, we recommend using residual current devices (RCD) for loads at the output of the nx3. Take care of the earthing and neutral system for proper operation of the RCD. In any case, AC distribution must comply to the local standards and regulations, and generally, be realised through a distribution panel in an enclosure.

For cables protection, no downstream protective device is formally required if cross-sections of cable used for distribution satisfy to regulatory requirements for the largest rated output current listed on the nameplate of the next3. The next3 is protected against overload and short-circuit and will stop in those cases. When connected to a source, the upstream protection must stop short-circuits currents from the grid/genset.

When next3 connects to any AC source or AC Loads, there is never inrush current.



Due to the source assistance function (Smart-Boost), the current at the output of the device may be higher than the rated current of the inverter. It is the sum of the current supplied by the additional source and the current supplied by the inverter. In this case, the dimensioning of the output cables will be carried out by adding the current indicated on the protection device located on the upstream of the unit, to the nominal current of the inverter.

If circuit brakers (CB) are installed at the output, we recommend B curve devices. They will be sized at maximum to the highest value listed on the unit's nameplate or by the addition of the first value plus the value of the input protective device. (i.e. inverter current + input current). As example, if the AC Source current is 50Aac per phase and knowing that the current of the inverter is (16000/230/3)=23Aac per phase, the total current on the output would be 73Aac per phase.
In any case it must be chosen according to the cable size downstream.

If the source assistance function (Smart-Boost) is not used; the size of the protection device for the AC-loads output will be established at a maximum value equal to the rated current of the inverter, or at the maximum value of the protection device at the input if that one exceeds the rated current of the inverter.

If the AC-source is not used the protective device will be sized equal or smaller than the smaller value indicated on the nameplate.

The next3 is intended to be supplied by alternative voltage sources such as the grid or a generator. Check that the rated voltage of the source corresponds to the rated voltage of the next3 model specified on the nameplate on the side of the next3.

The conditional short-circuit (Icc) is 45Arms at the output (AC-Loads and AC-Flex if configured as secondary loads) of the next3 when next3 is in stand-alone mode. DDR is mandatory for circuit breaker at output (AC-Loads and AC-Flex if configured as secondary loads) of next3.

The maximum prospective short-circuit current Icp of the sources connected to next3 inputs (AC-Source and AC-Flex if configured as secondary source) is 15kArms.

The minimum prospective short-circuit current Icp of the sources connected to next3 inputs (AC-Source and AC-Flex if configured as secondary source) is 1,6kArms.

The rated short time withstand current Icw of the next3 inputs (AC-Source and AC-Flex if configured as secondary source) is 16kArms during 500ms.

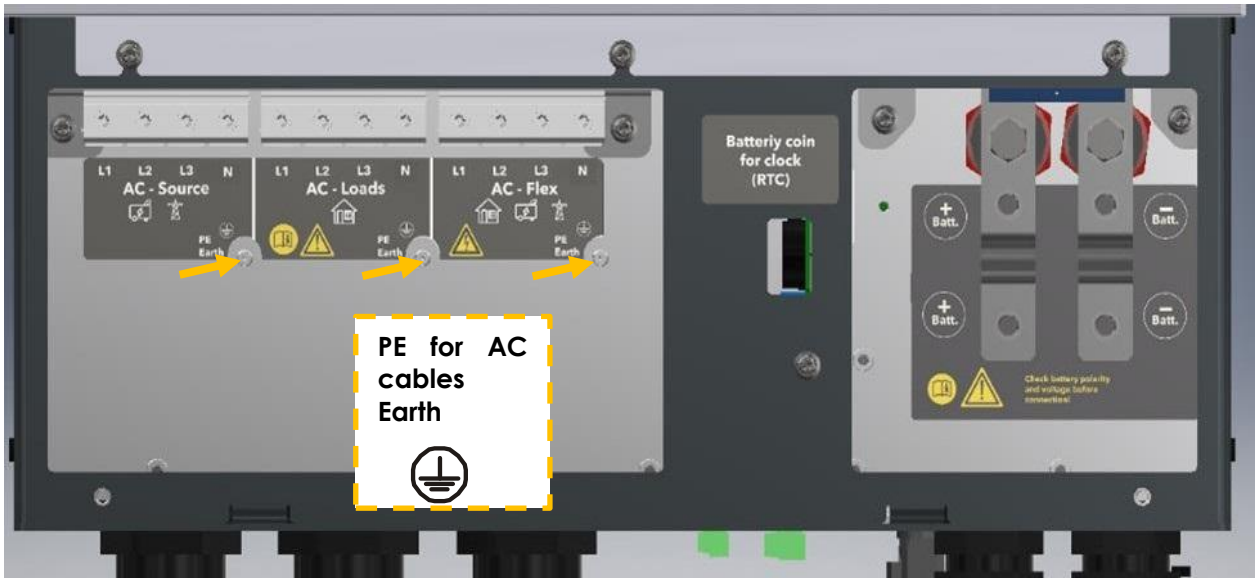
The rated peak withstand current Ipk of the next3 inputs (AC-Source and AC-Flex if configured as secondary source) is 25kArms.

5.1.14 AC Neutral and Earthing system

The next3 is a unit with protection class I, which is intended for cabling in a grid type TT, TN-S or TNC-S. Its metal case must be earthed. The earthing of the neutral conductor is carried out at a sole installation point, upstream of the RCD circuit breaker (in domestic application, generally type A, 30 mAac).
The neutral insulation to the earth is checked by the device and errors will be raised by the next3 if the measurements don't correspond to the settings of the device.

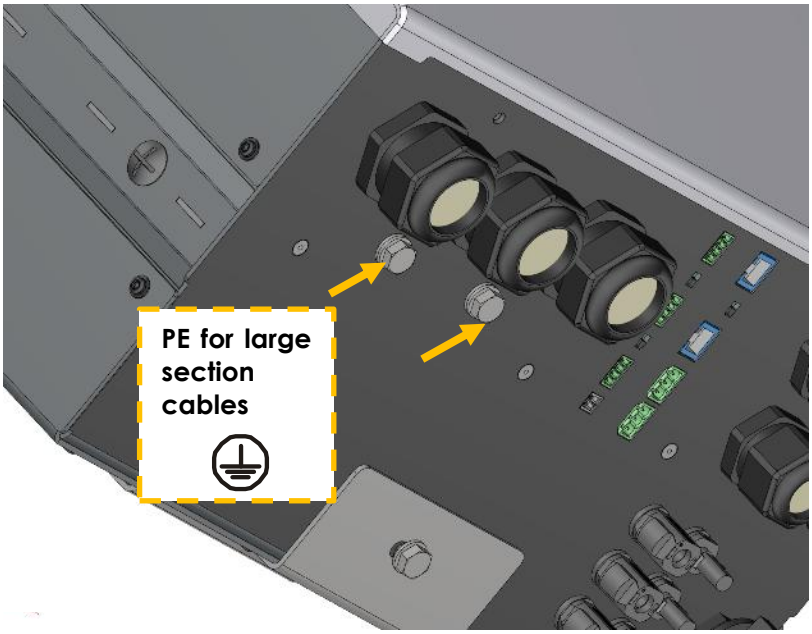
The next3 case and/or the PE connector, depending on the local installation rules, must be connected to earth. The PE cross section must be as big as the cross section of the line or neutral conductor, but the minimum cross section must be at least 10mm^2.

⏚ = protective earth (connected to the enclosure of the equipment).



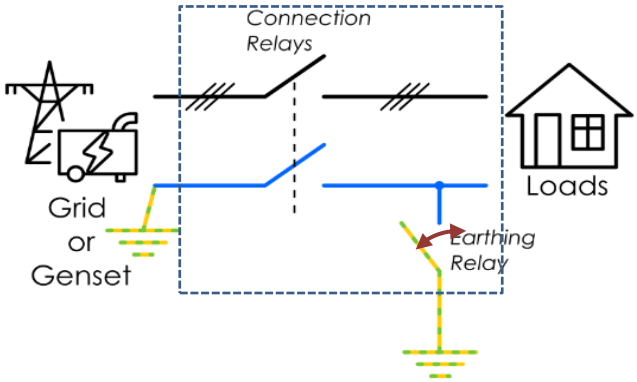
In any case, the protective earth must be connected in accordance with local standards and regulations in force. The protective earth of the equipment must be connected at least to the protective earths of all the Class I equipment after and before the next3 (equipotential connection). The information, notes, recommendations, and diagrams reported in this manual are examples and must in any case be adapted to local installation rules. The installer is responsible for the conformity of the installation with the local standards in force.

ℹ	An additional earthing terminal is present under the AC-cables glands at the bottom of the unit. It can be used instead of a connection on the input terminals of the device, particularly when cable cross-sections used at the output do not allow the use of a five-wire cable (lines L1 L2 L3, earth and neutral) through the conduit glands of the connection cables of the input and output (AC-SOURCE, AC-LOADS and AC-FLEX), or when the earthing of one of the poles of the battery. PE required using same or greater cross-sections than the battery cable when the battery is grounded.



Stationary installation and earth neutral scheme

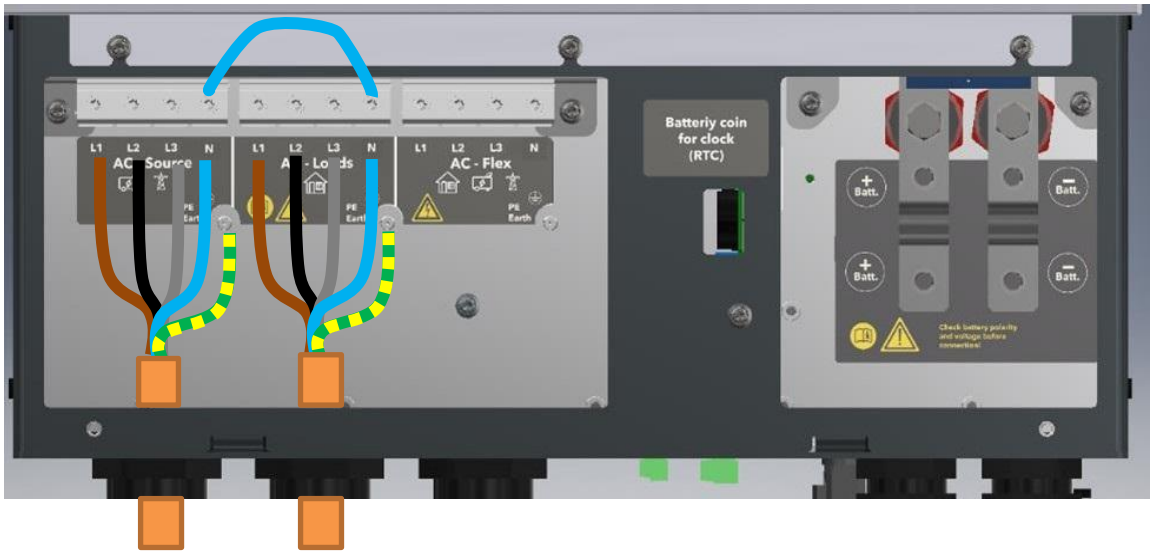
In a stationary installation where the neutral is connected to the earth at a single installation point upstream of the next3, the standard case for the next3 is to use an automatic connection of the neutral output line of the inverter to the earth when operating in island mode (Neutral-Earth is in mode Offgrid Self-Managed). In case of doubt, wire the earth properly and use this default mode.



It is also possible to carry out a connection of the neutrals to preserve an unchanged earthing system downstream, independent of the operating mode of the next3. This is called "Solid Neutral" mode.

It may not be accepted for security reasons. Please check your local installation rules. This configuration is not recommended by Studer.

Example of solid neutral connection inside of the connexion box:



Safety is guaranteed by the equipotential bonding and by any RCD circuit breakers placed downstream.
This solid neutral connection is not permitted in a floating installation if a socket is installed upstream of the next3 (typically in mobile application).
It is not possible to mix the configuration of solid neutral and self-managed programming in the case of use of a grid and of a genset.

See the earthing relay configuration in the system configuration. The description of the earthing errors are done there.

Mobile installation or installation connected to the grid via plug connector

When the input of the device is connected directly to the grid via a plug, the plug must remain accessible.

⚠	The connection (link) between the neutrals upstream and downstream of the next3 is not permitted in this configuration.

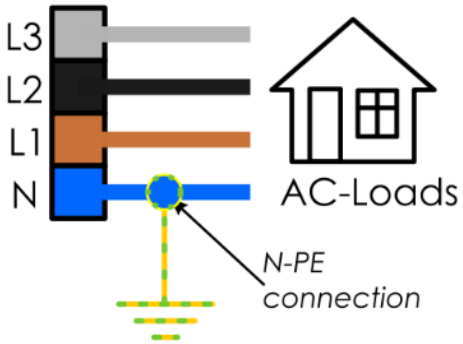
In the absence of voltage at the input, the neutral and live are interrupted, thereby guaranteeing complete isolation and protection of the cabling upstream of the next3.
The earthing system downstream of the next3 is determined by the upstream earthing system when the grid is present. In the absence of the grid, the earthing system downstream of the inverter is in isolated mode. An automatic connection with an internal relay can be programmed with settings.

This connection type guarantees the optimal continuity for supplying the next3 loads. The first isolation fault will not lead to an interruption in the supply.
If the installation requires the use of a permanent isolation controller this would have to be de-activated when the TT network is present at the next3 input.

⚠	All sockets and protection class I devices connected downstream of the next3 must be properly connected to the earth (earthed socket). The cabling rules above remain valid, including in installations, in all cases where the next3 input is connected to the grid via a plug connector.

Next system without transfer

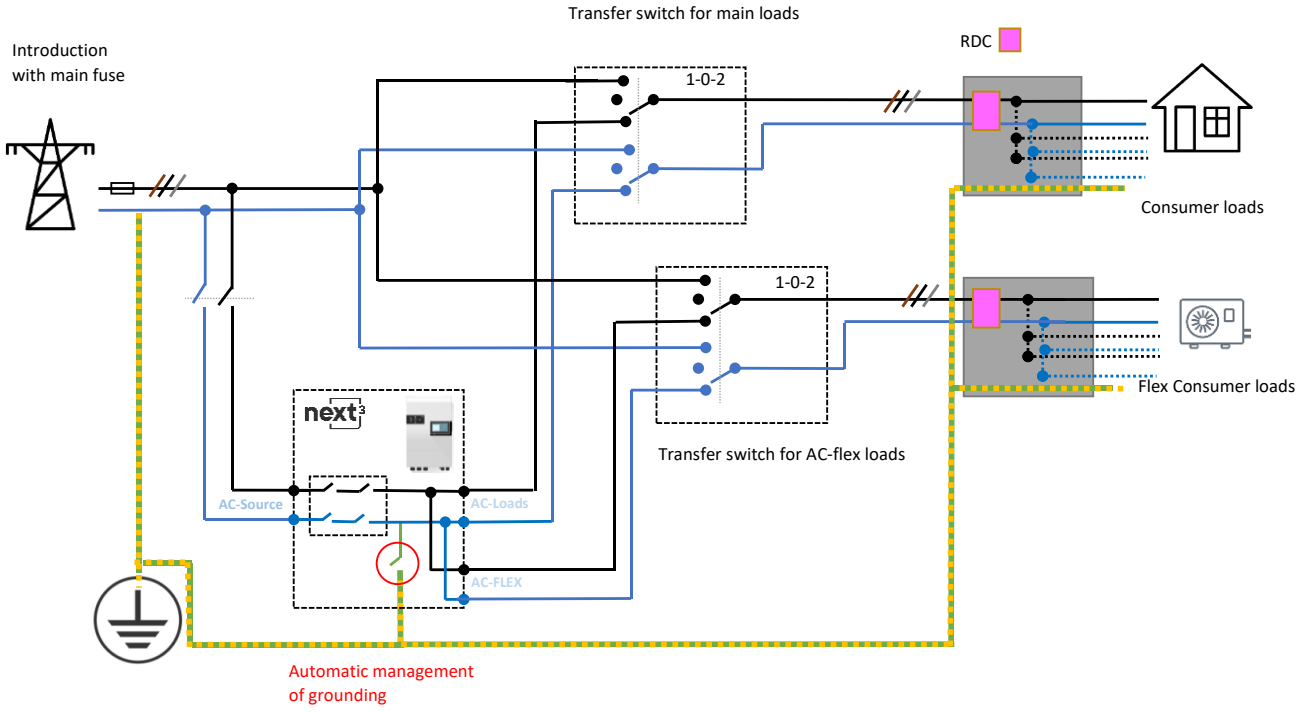
On models without transfer (nx3-16000-48 and -s) there is no AC-Source and no AC-Flex connections. These models do not have programmable earthing relay either. Thus, user must guarantee complete isolation and protection of the system. In such installation it is recommended to bond directly the neutral to the earth at one point in the system.



RCD breakers

For people safety, RCD breakers should always be installed. This requires a proper grounding of the neutral to work properly.
As the next3 can work in offgrid mode and interrupts the live and the neutral wires, the earth automatic connection to neutral (offgrid self-managed setting) should be used. The RCDs are placed after the next3 in the distribution box.

In case of a bypass use with both AC-Load and AC-flex bypass, there must be at least 2 RCD as the live wire are independent.



5.1.15 Commissioning

At commissioning various tests are performed by the electricians (according to the local rules).

Insulation tests

At commissioning of an electrical system, insulations tests are performed on the wiring (in some countries, depending on local regulation). It is performed applying high voltages on the cables and measuring the leakage current. This must be done without the next3 in the loop. Overvoltage surge protections included in the next3 will invalidate the tests.

The insulation between the circuits and ground is tested at the factory for each next3 unit manufactured in accordance with the safety standards IEC/EN 62109 and IEC/EN 62477, before the final installation of the surge protectors. The manufacturer Studer Innotec therefore guarantees the correct insulation of the unit to earth in this case. The installer must check the wiring without the presence of the next3.

Short circuit current and overload behaviour

In island operation (offgrid), when the inverter is not connected to the grid but operates on battery power, the output impedance of the next3 device is so that it cannot pass the standard short-circuit current tests carried out at the commissioning of an electrical installation.
Nevertheless, in case of a fault (short circuit, overload) the current is electronically limited by the device. When a short circuit occurs, it is detected, and the device stops automatically. Safety is ensured in this case. The short-circuit current of the next3 in island mode is 45Arms. In grid connected mode, the short-circuit current is given by the grid as inside of the next3 is just a contactor.

A next3 device detects a short circuit when the voltage falls below 50% of the rated voltage at maximum current limitation, the device will then shut down within 0.5 seconds. For a limited overload, when the voltage drops to less than 80% of the nominal voltage during a current limitation, then the device stops after 3 seconds. By default, the device tries to restart after 1 second for a maximum of 3 times. The number of attempts is reset to zero after 30 seconds of normal operation.
All these parameters can be set in "Expert" mode. Studer Innotec recommends leaving the default values.

CONNECTING THE PHOTOVOLTAIC GENERATOR

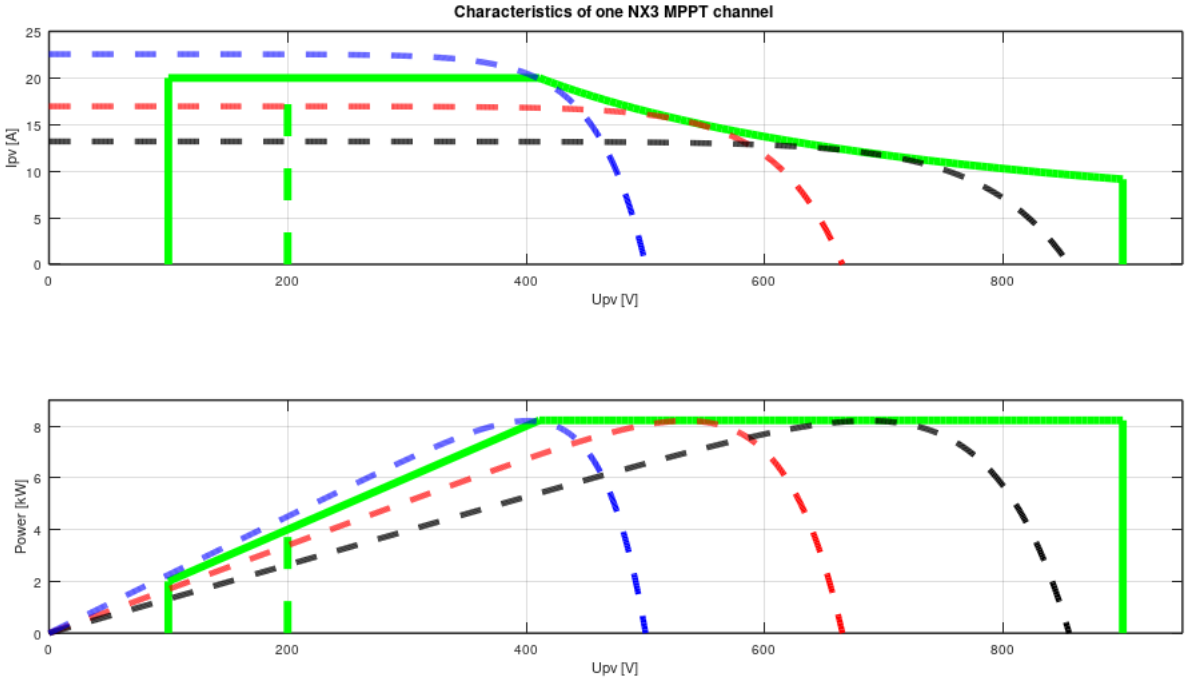
The next3 has an internal solar charge controller made of two independent MPPTs. Each MPPT can stand up to 8kW of photovoltaic (PV) power and has maximum operating PV input current of 20Adc.Each MPPT has 2 inputs and then up to 4 strings can be connected to the device. The two inputs of the top (MPPT1) are connected internally, as well as the two at the bottom (MPPT2). The rated current of the PV generator can be higher as the next3 limits with electronic control the maximum taken from the generator in any case. In any case the maximum short-circuit (Isc) current is 27Adc.

	The next3 solar inputs are intended to be connected exclusively to a source like a photovoltaic generator, excluding any other energy source.

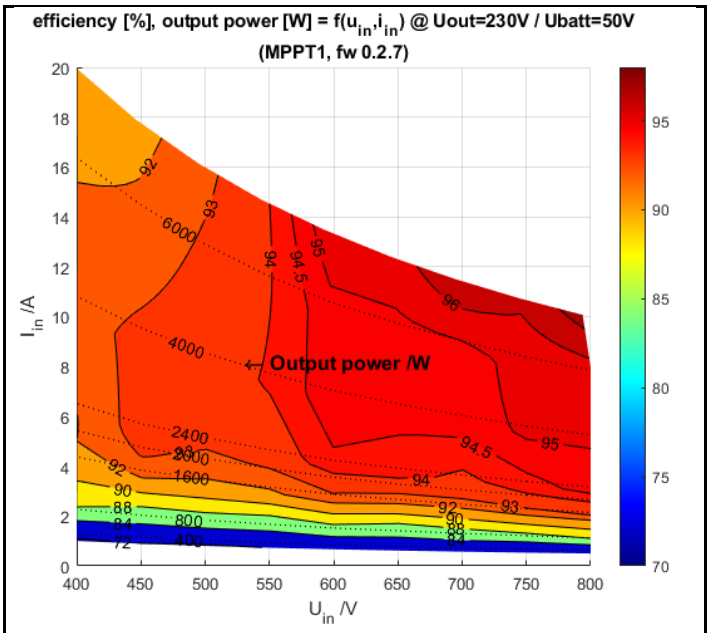
	PV connection is in overvoltage category 2 (OVC II). The next3 is designed for PV generators supplying up to 900Vdc. This voltage is dangerous for human beings. During the installation or the maintenance of the system, it is mandatory to make sure that no dangerous voltage may surge in the system. The disconnection device must be open and secured against any accidental reclosing. When the photovoltaic array is exposed to light, it supplies a d.c. voltage to the next3. PV modules must have a Class A rating according to IEC 61730. The backfeed current to the PV is 0A, it is prevented by design of the electronic.

5.1.16 PV string dimensioning

The next3 accept input voltages between 200Vdc and 900Vdc max. It starts operating from 200Vdc (start-up in the morning) and will continue to operate even if the voltage decreases down to 100Vdc (shut down in the evening, partial shading, etc.). The 200Vdc are necessary to detect a proper ground insulation of the PV before starting the system.
The nominal power of each MPPT channel is 8kW. The maximum short circuit current is 22A and current in operation will be limited to 20 Adc. The maximum voltage allowed is 900Vdc. See below the PV input characteristics:



Tests of the efficiency performed by an independent lab showed the following result for the conversion efficiency from solar to grid:



Efficiencies next3

Max solar to grid conversion:	97.0%
Max solar to battery conversion:	95.0%
Max solar battery to grid conversion:	95.0%
Max mppStatic:	99.7%
Max mppDynamic:	99.0%
European efficiency (*solar to grid):	92.0%
Californian CEC efficiency (*solar to grid):	93.0%

*Upv=700V used for solar efficiencies

Maximum current of the solar generator

The maximum short circuit current Isc allowed for selecting module is 22Adc. In operation the maximum current will be limited to 20A and the power per mppt to 8kW. Over dimensioning of the PV array is allowed. Per example to maximize production in winter even if there are losses in summer. In that case you have to ensure that the cable sizing and protections are installed according to the maximum short-circuit current.
In any case, the next3 will limit the PV current and/or the charging current (battery) to the rated and/or programmed currents. All those limitations are automatically managed by the next3 and there is no risk in case of over dimensioning the PV input power/current. The power production is electronically controlled and optimally dispatched in the system due to the PFD technology (Power Flow Dispatcher).
In some situation, the PV production could be limited by various other reasons at a systemic level because the next3 is in interaction with other elements. The battery has a charging current limit which can be further limited depending on the charging phase or the battery voltage. In offgrid application when the battery is full, the production will equal the AC loads. The maximal PV injection to the grid when there is no battery charging is 15kW (3x5kW grid feeding limitation).

Solar strings design

The solar generator is normally dimensioned to cover an important part or the entire energy requirement of the system. Once the PV power has been decided upon, it will be distributed among one or more MPPT units, wisely combining the modules among them. Modules with the same orientation and the same shading (if there is some) must be connected in the same string or there will be a risk of important mismatching losses.
These combinations in series and in parallel must be carried out according to the voltage and current limits of the next3 MPPT inputs. A margin to the Voc must be taken in countries with cold climate due to the thermal coefficients of the modules. Typically, a factor of 1.15 is taken in Switzerland up to 800m altitude (900V/1.15=782V), a margin of 1.2 between 800 and 1500m (900V/1.2=750V) and 1.25 above (900V/1.25=720V).

An example is provided below for a single MPPT string (example with 310W modules, 60 cells, 41Voc).

	N° modules in a string	1	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
One string	Voc (STC) [V]	41	287	328	369	410	451	492	533	574	615	656	697	738	779	820	861	902
	P dc (STC) [W]	310	2170	2480	2790	3100	3410	3720	4030	4340	4650	4960	5270	5580	5890	6200	6510	6820
	Vmpp NOCT [V]	30	210	240	270	300	330	360	390	420	450	480	510	540	570	600	630	660
	P dc (NOCT) [W]	230	1610	1840	2070	2300	2530	2760	2990	3220	3450	3680	3910	4140	4370	4600	4830	5060
Two strings in parr on one MPPT	P dc (NOCT) with two modules in parrallel [W]	460	3220	3680	4140	4600	5060	5520	5980	6440	6900	7360	7820	8280	8740	9200	9660	10120

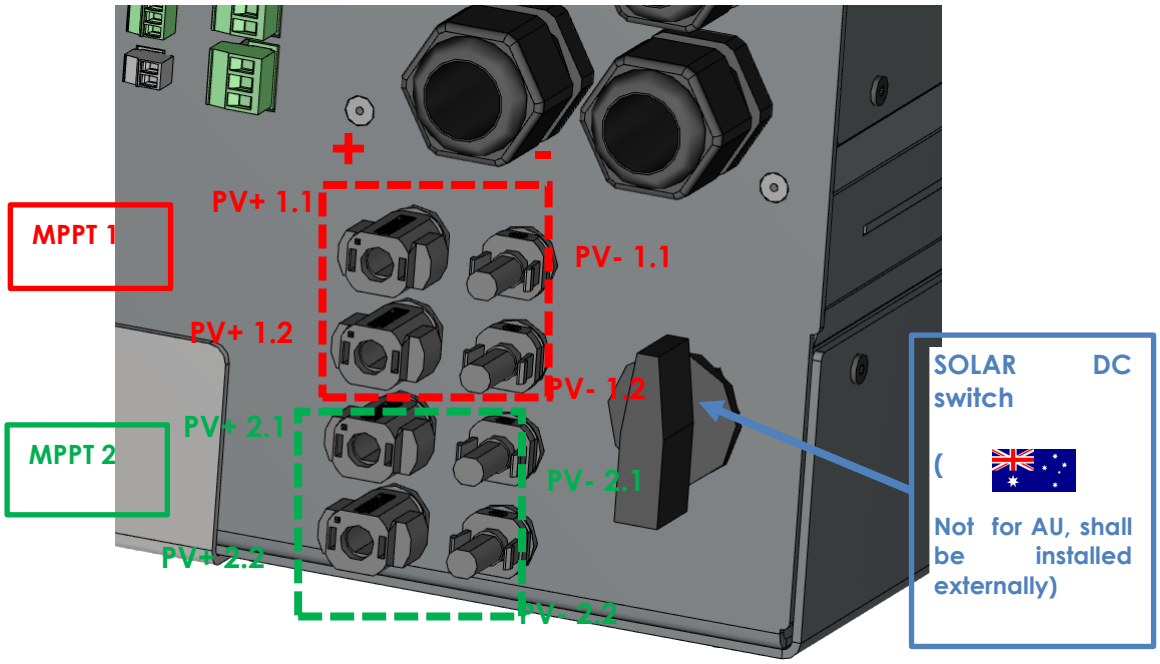
In the case of a 310W module with 60cells between 8 and 20 modules are recommended. 7 modules could be theoretically sufficient to start the inverter but in real conditions this could provide too little voltage.

21 modules in series are possible in hot countries (without margin! Consider the local installation rules) and about 17-18 in cold countries. The open circuit voltage must be carefully checked with temperature coefficients given by the PV modules manufacturer.

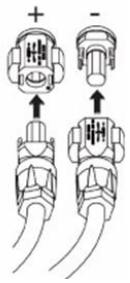
When two strings are in parallel on one MPP channel, there can be up to maximum 17 modules in series order to avoid PV production capping. Up to 20 modules can be used with a high probability of capping.
In total between 10 (3.1kWp) and 80 modules (24.8kWp 4x 20modules) can be connected, giving a high flexibility for the dimensioning of the energy system.

5.1.17 Connection

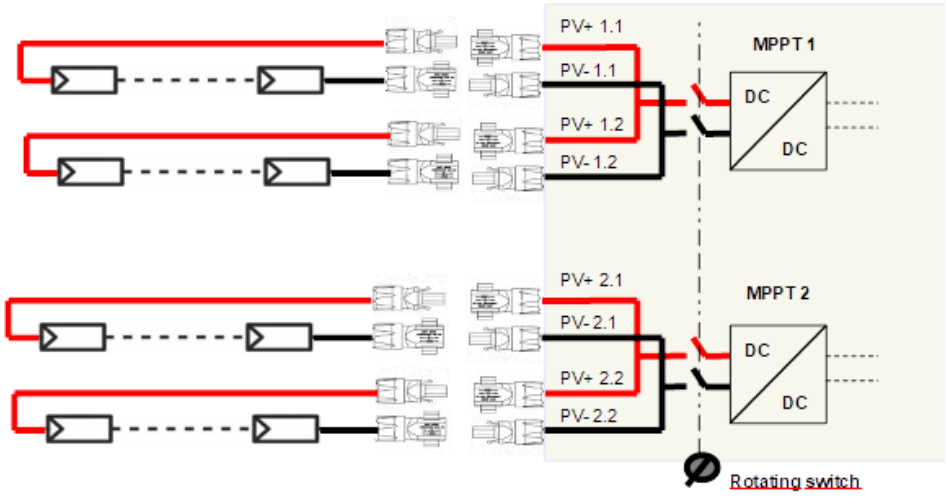
The two MPPT with each 2 connections are situated below the next3:



the PV+ is situated left and the PV- is situated right. Check carefully the indications written on the NX3 in case of doubt.

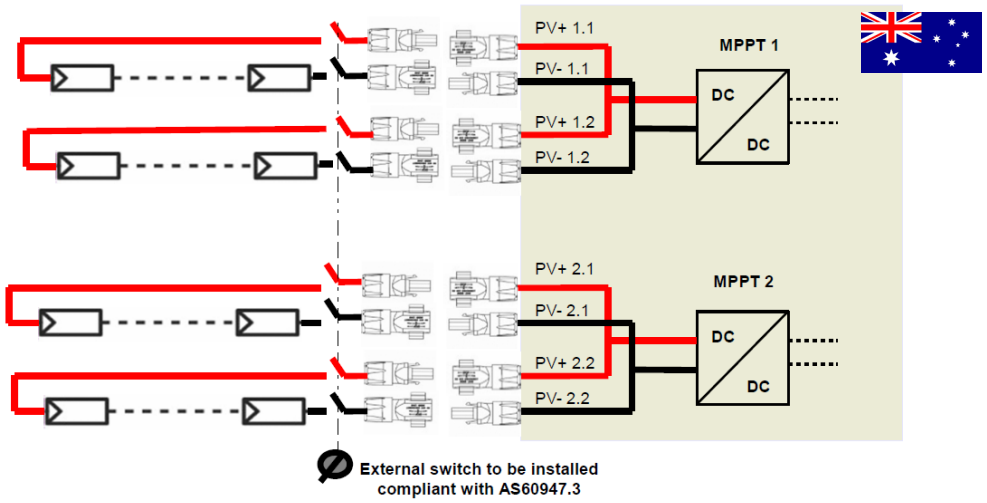


For one MPPT, if two strings are connected in parallel, they must be composed of the same types of modules, and the same number of modules, to avoid voltage mismatch and production losses.



The Australian version has a specificity:

- The PV switch has been removed. An external PV -switch must be installed by the installer. This must be listed compliant with the Australian regulation (DC isolator certificate AS60947.3)

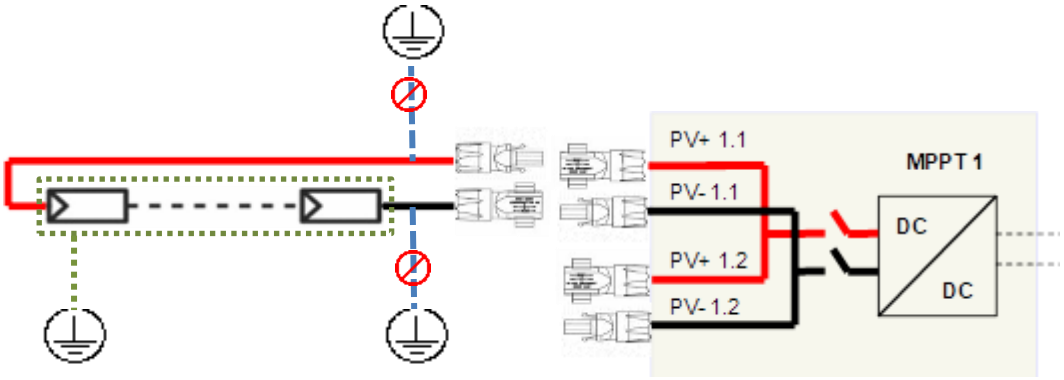


5.1.18 Earthing of PV

The MPPT topology is non-isolated for best efficiency, so the poles of the PV must not be grounded. The electronics was designed to avoid fluctuating voltages on the PV poles. In operation, there is a constant voltage on PV+ and PV- compared to the ground referential. This avoids leakage current through the parasitic capacity between cells and ground and therefore avoid problems with RCD breakers (return current default).

⚠	The PV input of the next3 is non-isolated, which means the PV+ and PV- must be floating (similarly to the majority of Transformer Less, TL, solar inverters). The PV must not be grounded. Accidental grounding will be detected and cause a stop of the next3 inverter. The frame of the PV modules should be grounded. PV modules must have a Class A rating according to IEC 61730.

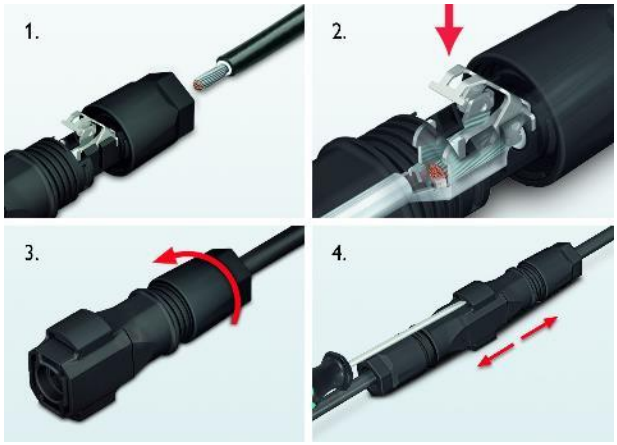
⚠	As the Open Circuit voltage (Voc) of the panel is above 60Vdc (in all the temperature range), the whole solar system must be installed according to protection class II. Use proper connectors and cables for all the solar system, as requested by local regulation.



Never ground PV+ or PV-. Ground the PV modules frames

5.1.19 Cables and cross-section

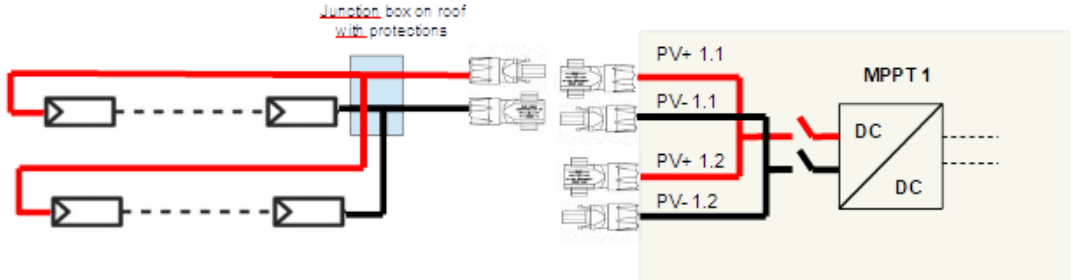
The next3 is build from factory with Phoenix Sunclix connectors for the PV inputs of the MPPTs. There are4 pairs of Sunclix connectors provided with the unit to assemble on your PV wires arriving to the unit. These connectors can be assembled without special tool. A flat screwdriver is necessary to decouple the connected once enclicked.



(image from phoenix contact, supplier of Sunclix connectors)

The minimal section for cables in Sunclix connectors is 2.5mm². Sunclix connectors are rated: 2.5mm²: 27Adc / 4mm²: 40Adc / 6mm²:40Adc. We advise you use a 4 or 6mm² cross section to reduce the cable losses in the system even if a 2.5mm² cross section would have been enough. In any case follow local regulation for cable sizing regarding the short-circuit current (Isc) of the PV generator and length of cables.

If you wish to install two PV strings in parallel for one MPPT, this can be assembled as well out of the Next3, for example in the junction box on the roof. This can minimize the number of cables used. The parallel strings can be connected together before the next3 solar entry as long as the maximal short-circuit current (Isc) of 22Adc is not reached.



5.1.20 Protection devices

Wiring protection devices (fuses, circuit breakers) connecting the PV generator to the next3 must be installed in accordance with local standards and regulations in force. Special rules are existing for fire hazard and access to switching devices by firemen.
The internal PV switch of the NX3 disconnects all poles between the PV generator and the charge regulator.
PV modules are often exposed to stormy weather. It is highly recommended to install lightning protection. This is mandatory in some countries. Please see local standards and regulations in force.

LIGHTNING PROTECTION

According to the installation site, it is highly recommended to develop a protection strategy for your installation. The strategies depend on various factors specific to each site; we recommend therefore a professional approach to this issue.
The next3 has internal protections against lightning by means of surge protection devices. These devices have an energy dissipation capacity limited to 3,5kA (8x20 µs) which guarantees a certain protection level but are not a total protection against lightning. Furthermore, these protections are for single use. Therefore, in the event of a lightning strike where these surge protections are hit, you'll have to send the unit for repair. They cannot be replaced nor repaired on site.

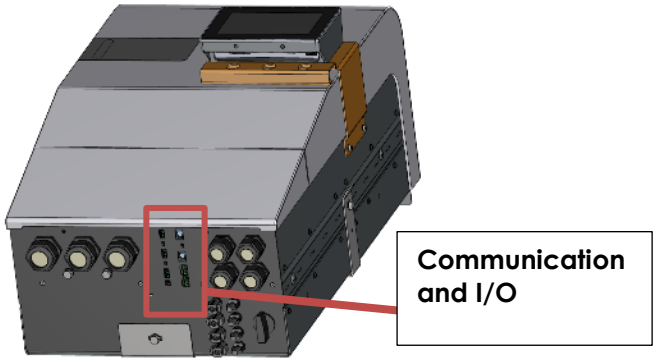
	Damages due to lightning often result in significant costs (full replacing of the printed circuit board, PCB) and are not covered by Studer Innotec's warranty.

Contact a specialist on surge protective strategies to check how you can best protect your system in all inputs/outputs (AC and DC).

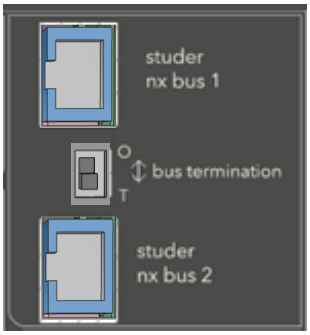
CONNECTING THE STUDER COMMUNICATIONS CABLES

The Studer nx communication bus is used to interconnect next3 inverters in the case of a multi-unit application, to connect the nx-interface or to connect other types of devices with communication compatibility.

The NEXTs are equipped with a pair of RJ45/8 connectors that allow information transfer via a communication bus in between next3 devices or accessories that use the proprietary protocol of Studer-Innotec. In this network, all parties in the network are connected in daisy chain.

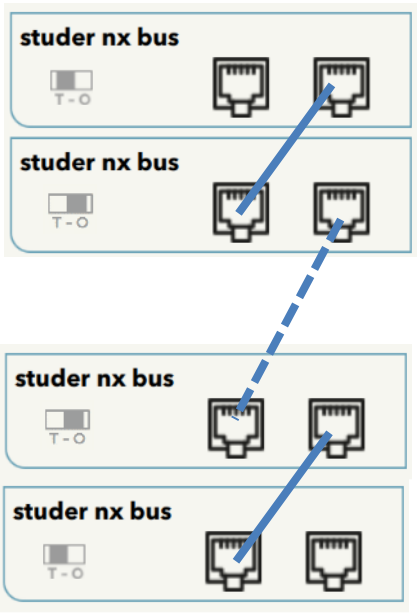


The cables for Studer nx bus are straight ethernet of category 5 exclusively with 26AWG wire size (power supply through cable). They are provided by Studer or you can buy your own as long as it follows these requirements. The total length of the communication bus cable between all units must not exceed 75 m.



The switch for the communication bus termination remains in position T (terminated) except when both connectors are in use. In this case, and only in this case, it must be placed in the O (open) position. If one of the two connectors is not in use, the termination switch will be in position T.

In a system comprising a single next3, the connection of the nx-interface or nx-gateway units may be conducted without stopping the next3 (hot plug).



A single connection is used : T

Both connections are use : O

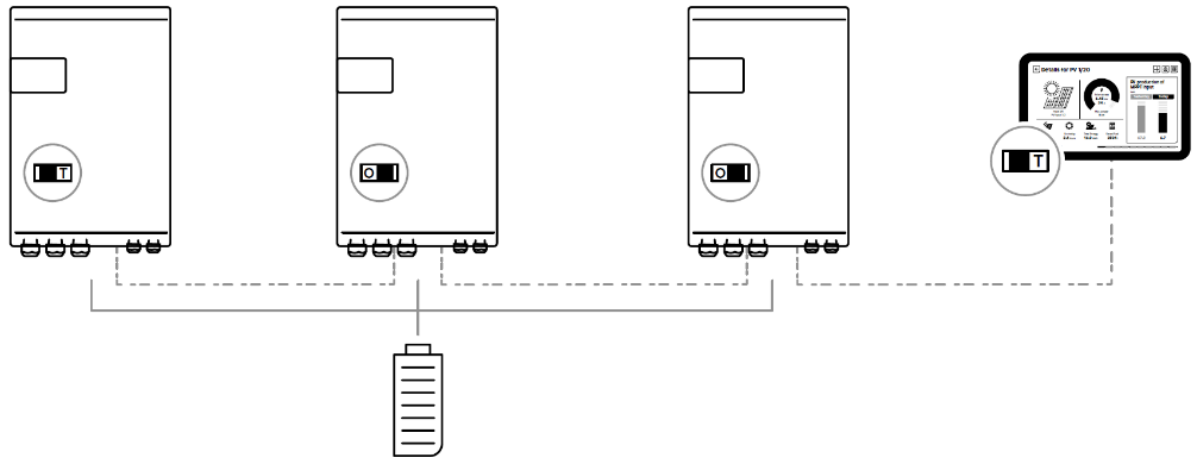
…

Both connections are use : O

A single connection is used : T

⚠	These connectors must be used only to connect a compatible next3 accessory, **excluding any other type of connection such as LAN, Ethernet, ISDN, batteries BMS, etc.** The next3 communication is not compatible with other Studer communication. It is **not** compatible with Xtender devices and it must never be directly connected together. Any unauthorized connections could cause the destruction of the devices.

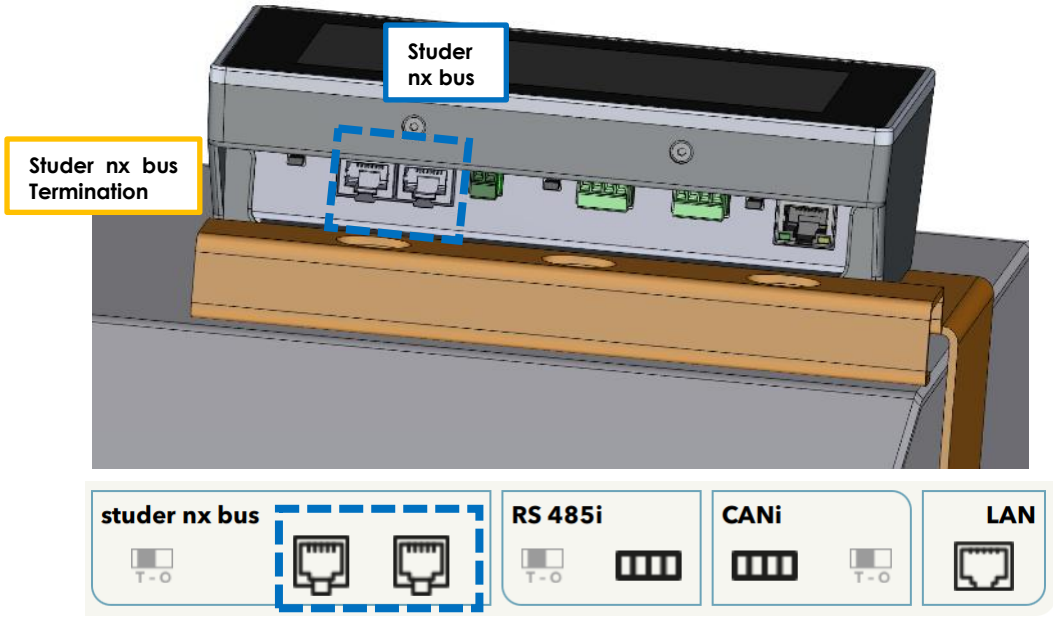
A standard configuration with 3 next3 and one nx-interface is shown here below:



	When connecting one device with other compatible devices using the same communication bus, it is highly recommended to make a software update of all components in the system to guarantee their proper compatibility/functionalities. Therefore, before starting the setup of the device, download the latest software version from our website: www.studer-innotec.com and copy it to an USB key. The update is made by the remote control nx-interface.

5.1.21 Connection of the nx-interface

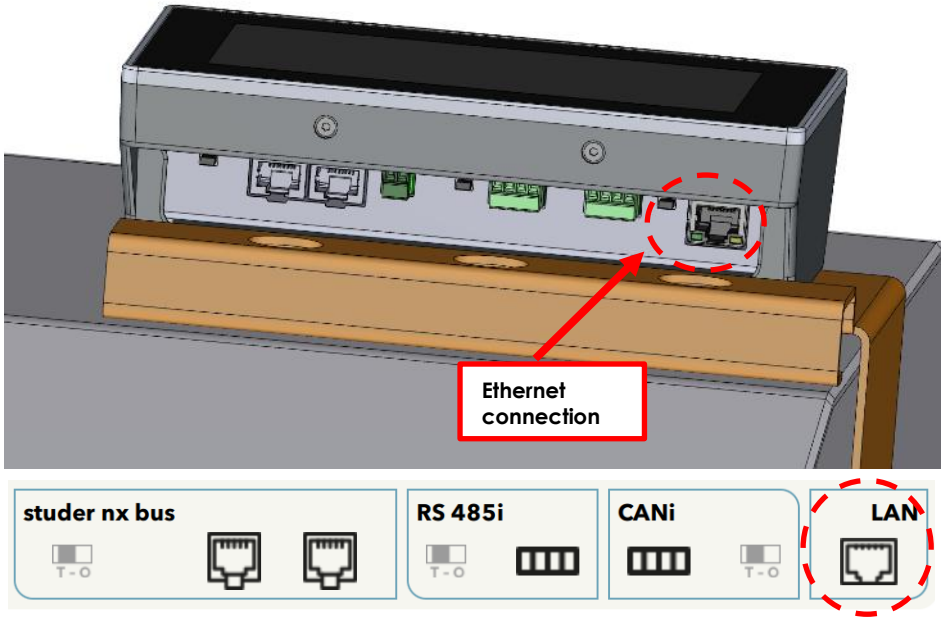
The nx-interface can be fixed on the nx3 with the dedicated support or hanged remotely in a place closer to the end-user of the system. It must be connected to the studer nx-bus.
The total communication cable length in a system is 200m. The nx-interface is powered through the cable, so his type must be ethernet of category 6 exclusively with 24AWG wire size (power supply through cable).



The state of the Studer nx bus termination on the nx-interface can be seen on the screen, this is only for the connectors situated on the nx-interface.
Note: the RS-485i and the CANi on the nx-interface are unused for the moment.

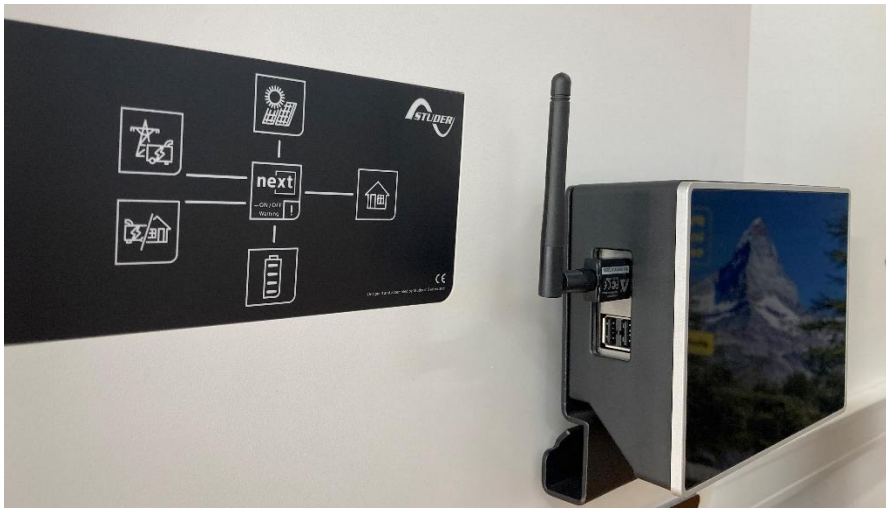
5.1.22 Connection to Internet

The connection to your LAN and internet is done with the nx-interface on the Ethernet port.



Differentiate carefully the ethernet connection with the two led on the low side of the connector.

The second way of connecting the next3 to the internet is the use of Wi-Fi.
This is done with the Wi-Fi USB stick provided by Studer-Innotec. Use only the official Wi-Fi USB stick provided by Studer-Innotec because the nx-interface needs to have the proper driver. There is little chance that a third-party Wi-Fi stick works properly without the proper drivers.



For the LAN connection, there is no setup to do. For the Wi-Fi connections, you must select the Wi-Fi network and enter your password.
The internet connection set up is described in the programming chapter of this manual.
See the chapter “configurations” for the setup of the internet connections.

In remote area, you can find your own GSM 3G/4G/5G router (not provided). Studer-Innotec is not responsible for the proper operation of those devices and of your internet connection.

WIRING AUXILIARY I/O

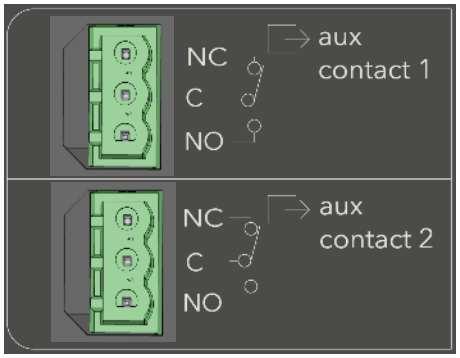
Auxiliaries are all located at the bottom of the next3.

5.1.23 Auxiliary contacts

There are two reversing contacts that are potential-free available in nx3 unit.

Various settings are available to give activation conditions to each contact. To program functions to these contacts, please refer to the chapter about the configuration of the next3 and the section about the auxiliary contact in this manual.

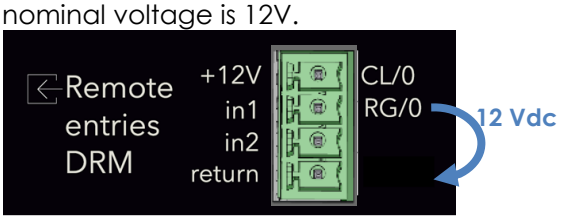
Wire the C (common) in any case and the second position in function of your application and your settings. In relax state, there is a contact between C and NC (Normally Closed). An activation gives contact between C and NO (Normally Open) and disconnect C and NC. The representation of the contact near the terminals corresponds to the status of the contact when not activated.



Male connectors are provided with the NX3. The admissible currents and voltages for these contacts are 16 A: 250 Vac/24Vdc or 3 A: 50 Vdc max.
The connector has a male and female parts. Doublecheck the correct pinning when plugging the connector on the nx3.

5.1.24 Command Inputs

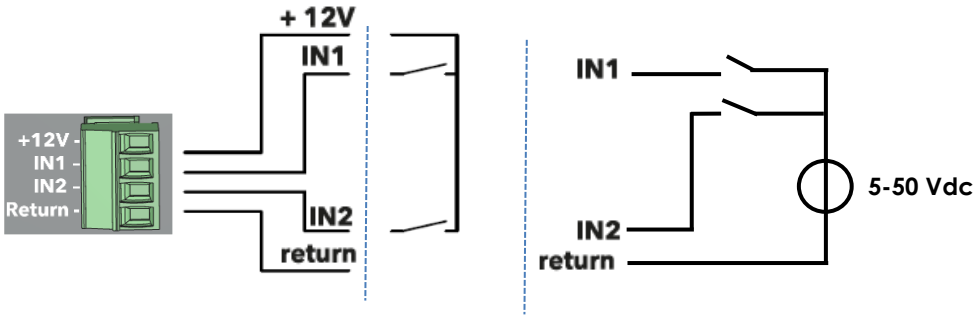
IN1 and IN2 are inputs that can be active with a 5 to 60Vdc voltage to the return reference. The nominal voltage is 12V.



The 4 poles connector is supplied with the nx3. Double check the correct pinning when plugging the connector on the nx3.

A +12Vdc supply is available on the connector for the use of dry contacts. Don't use it for other purpose than the activation of input entries. The current is limited. External 12Vdc are activated/deactivate with settings in the device menu (settings on the nx-interface).

The various possibilities are given with the schematics below:



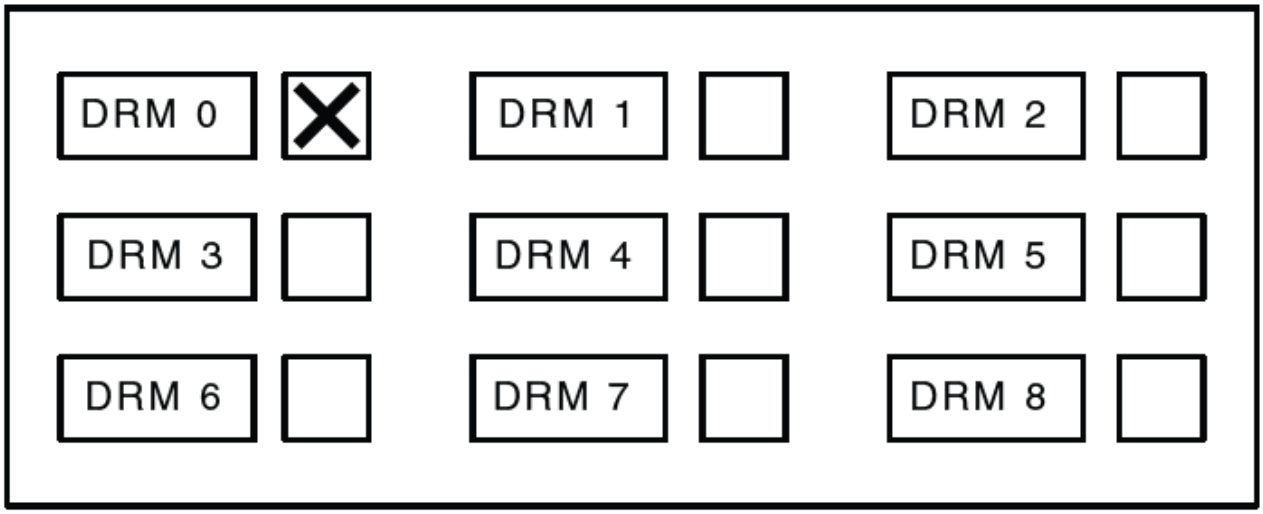
For activation with a dry contact:
Supply voltage with +12Vdc, go to the contact and come back to the wanted input (in1 or in2)

For activation with an external source: a potential of 5Vdc to 60Vdc must be applied between an input and the return.
Entry impedance is 10kOhm

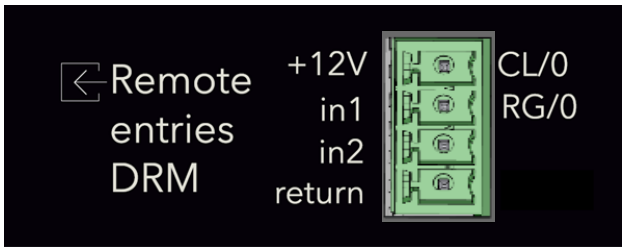
5.1.25 DRM function and command input 1 (AU-NZ version)

The Australian version of nx3 has a specificity regarding the inputs. The command input 1 is used for the demand response mode DRM0 function requested by the AS/NZS4777.2 when Australia or New Zealand grid code are selected.

Available DRM inputs (only DRM0):



The DRM0 mode is asserted by shorting the terminal block "RG/0" and "CL/0" positions of the DRM port. The next3 will detect the DRED system cable missing and the inverter will not connect to the grid.



If no DRED system is connected to the next3, then a DRED bypass device should be connected as specified in the AS4777.2 (15kOhm).

In multi-unit system, always use the remote entry 1 of the first inverter for this functionality.

The second input in2 is available for other freely programmable functions and is activate as described above with a 12V short with a dry contact or an external voltage.

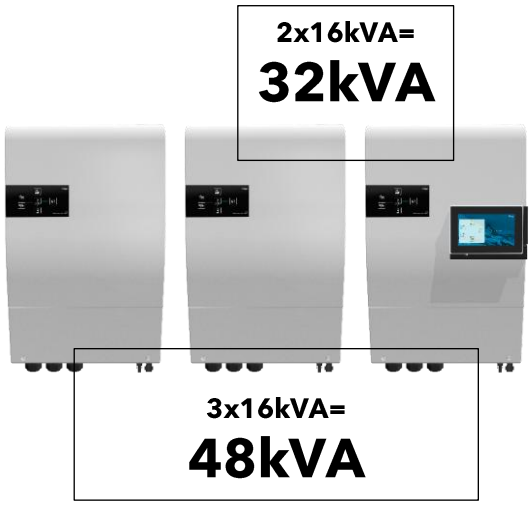
5.1.26 RS485i

This physical connection is unused. A communication to accessories will be available in the future, keep updated…

Note that a Modbus slave to read values and change settings of the system is implemented on the nx-interface, not on this connection. See the chapter about the nx-interface and on Studer website, https://technext3.studer-innotec.com/modbus-next

MULTI-UNIT CONFIGURATIONS

Up to three next3 units may be used together in parallel. They are connected on the same battery bank or on separate battery banks to create a high-power inverter-charger system.
Two units of next3 can work in parallel creating an 32kVA inverter with an 80A transfer (55kVA). Three units of next3 can work in parallel creating an 48kVA inverter with an 80A transfer (55kVA). This is available from the software version 1.3.0.0 and higher.

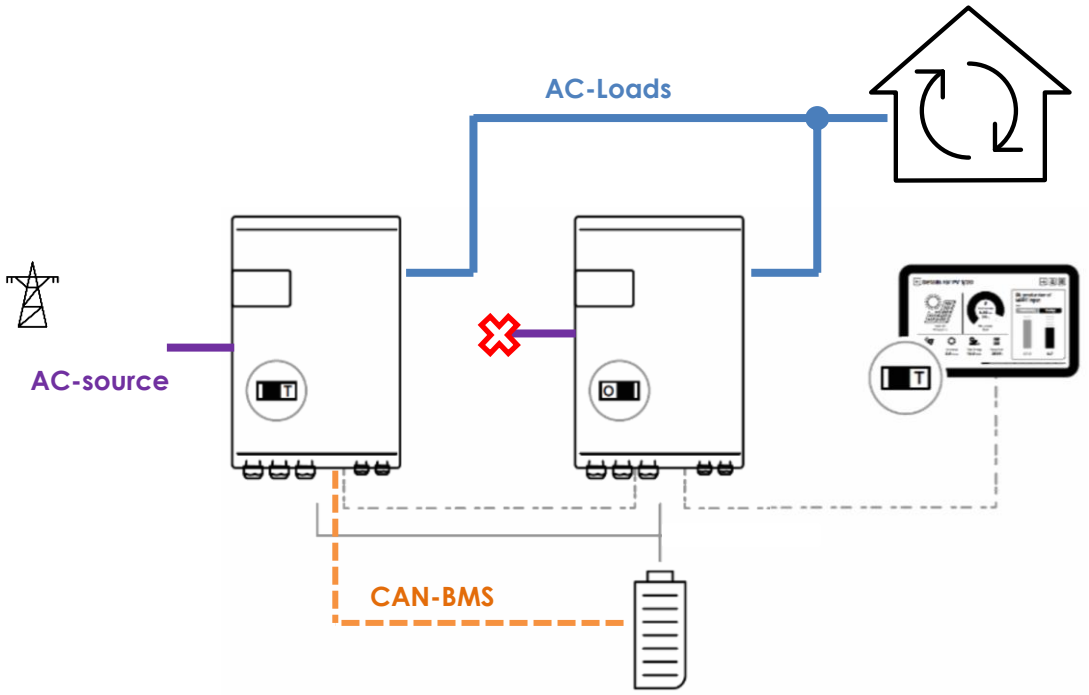


The following points must be followed:

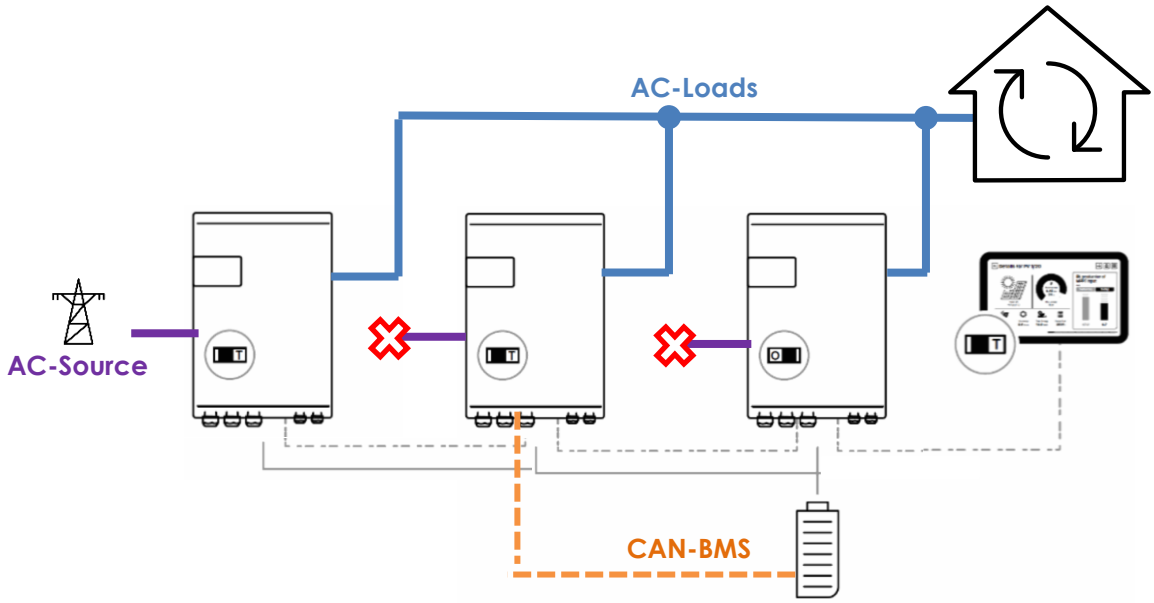
- In multi-unit systems, next3 are interconnected via a communication with "Studer nx communication bus". This is mandatory for proper synchronization of units that must absolutely work together
- Units should be close to each other (in the same room).
- Each device must have the same software version, updates are available on the Studer website (https://technext3.studer-innotec.com or https://studer-innotec.com/downloads/).
- The nx-interface is mandatory for configuration.
- All elements must be connected together and powered before the initial configuration. All elements must be clearly identified during the configuration process with the wizard.
- Use only one nx-interface per system. The system will not work properly with multiple nx-interface communicating at the same time on the bus.
- A reconfiguration of the system with the wizard is mandatory when you add new elements to the system.
- All the AC-Loads connections of each next3 units of a system must be connected in parallel, for each respective phase (through a distribution panel for example).
- All the AC-Source and AC-Flex ports must be kept separated. The purpose of each port is chosen during the wizard.
- All the AC-Flex ports configured as FlexLoad must be kept separated. The different AC-Flex can be programmed separately.
- Only one AC-Source connection for the grid (if available), and one AC-Source or AC-Flex for the genset (if available) will be used in a system. There is an identification process during the configuration of the system with the nx-interface (wizard). That means the maximum transfer is 80A and 80x230x3= 55.2 kVA.
- The three next3 work as one in a system, except for:
    - The PV inputs are independent.
    - The AC-Flex as load can be programmed independently, they must not be wired together.
    - The AUX relays and CMD IN are independent.
- The compatibility is only between next3 units. Don't mix with other Studer-Innotec products like the Xtender. This will not work and probably damages the devices.
- In many countries, the official metering of solar installations change of category above 30kVA and requires a different scheme. Be sure to respect the local regulations for this point.

5.1.27 AC in multi-units

There is only one grid and one genset connection in a system. The different AC-Source of each next3 must be kept separated.
Below is the example for the standard grid-connected case for two units.

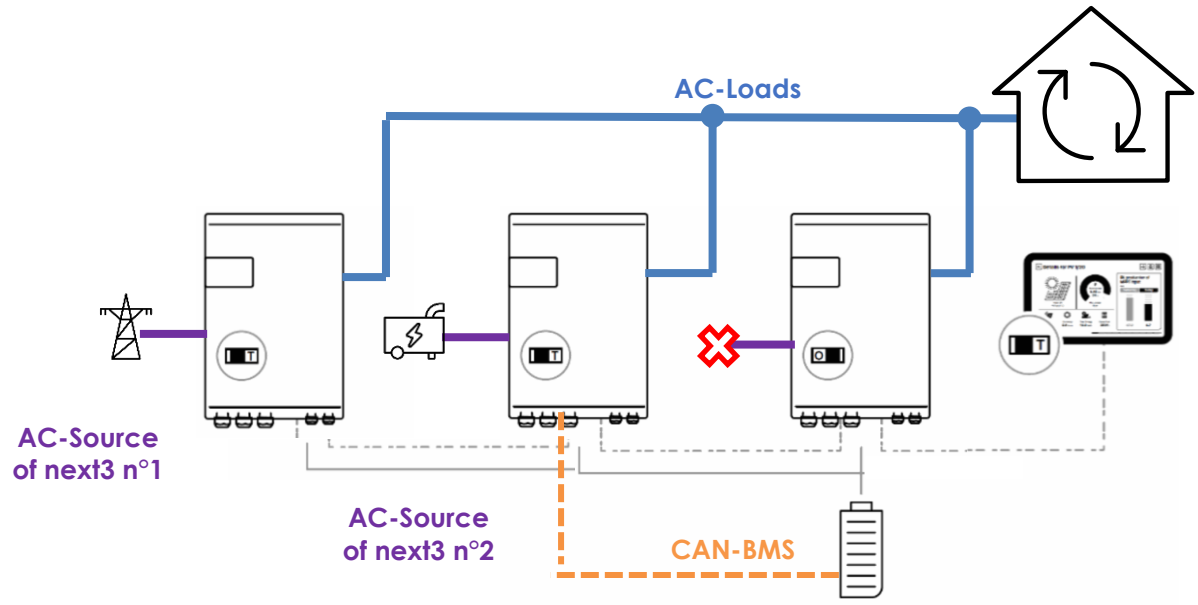


And for three units:



During the wizard, the proper unit that is physically connected to the grid/genset must be selected. See the configuration section of this manual for details about the setup of multi systems with the wizard.

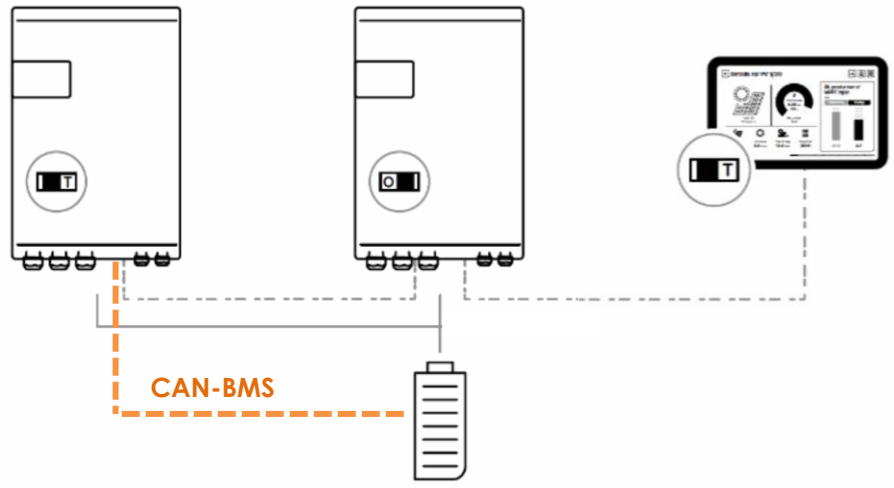
When using a genset at the same time as the grid, it is advised to use the AC-Source of the second inverter. One is connected to the grid and one to the genset.
That way all AC-Flex are available for flexible loads.



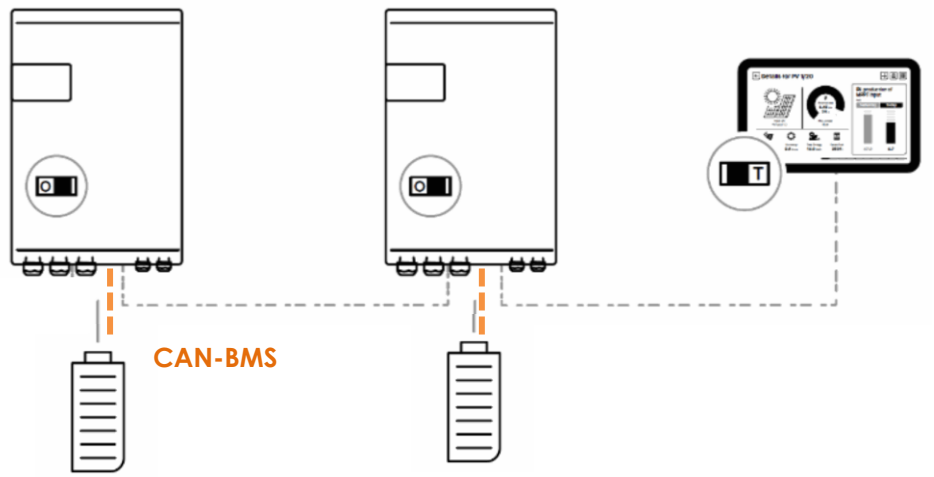
5.1.28 Battery in multi-units

In a multiunit system, one battery with BMS is communicating with one next3, they must be physically connected with the CAN-BMS cable, and it must be paired properly during the wizard process.

It is allowed to have one common battery or multiple batteries. With one common battery, the can-BMS is linked to one next3 only. It must be identified and configured during the wizard process.



Don't mix the communication bus of the batteries with the nx-bus. The communication with am BMS must be done with the battery wired to the same next.



The communication bus to the battery BMS, the battery DC connection and the nx-bus are isolated from each other's. There is no special requirement for the connections of multiple batteries. Per example, the minus (or plus) can be common, but this is not required. Each pole can be grounded or left floating. The installer is not constrained by the next3 but must respect the official installation rules of his country for his type of application.

With lead acid batteries, each next must have its own temperature sensor.

	In multi-unit systems, the charge/discharge current of each unit is automatically chosen by the PFD (Power Flow Dispatcher, which is a patented control algorithm). Just give the properties of each battery during the wizard process. The used rules are: • The charge/discharge is distributed proportionally to each battery capacity. • The charge/discharge limits are used independently. • Each SOC is managed independently and limits are respected (if they are not at the same level at start per example or bad configuration was done). Example: two next3 are in parallel and only one has solar connected to its MPPT entries. In that case the two batteries are charged anyway, proportionally to their battery size. The energy flows through the AC-Loads common connexion.

5.1.29 Extension of an existing installation

It is possible to extend an existing installation by adding one similar next3 units in parallel. The software compatibility of the new and old units is mandatory.

	Equipment belonging to the same system must be operating with the same software version. Download the latest software version from the Studer's website and update the software for all units of the system independently before commissioning.

6 POWER-UP OF THE EQUIPMENT

There are dangerous energy sources inside the cable compartment.
It is imperative that the closing cover for the connection compartment is installed and screwed tight before energizing the installation!

The powering of the next3 starts with the battery. The unit cannot be powered by AC or solar without battery. Verify that the PV DC switch is open and there is no voltage presence on the AC wires.
When supplying the 48Vdc voltage on the battery connection, the next3 device beeps and all lights turn on for a few seconds. After that, your next3 installation is in the following state:

- The next3 is OFF (no AC voltage on the AC load connector)
- The red LED (with"!" sign) is permanently light on, because the next3 is OFF (LED2)
- The battery is connected (battery symbol is light on) (LED6)
- The voltage production on Ac Load is disabled (house symbol is light off) (LED5)
- The solar chargers are disabled (PV array symbol is light off) (LED7)
- The connection to Ac Source is disabled (grid/genset symbol is light off) (LED3)
- The Ac Flex is disabled (both grid/genset and house symbols are light off) (LED4)
- The nx-interface lights-up and start his boot process.

INITIAL CONFIGURATION

A next3 installation requires an initial configuration with the nx-interface. This must be done following the configuration wizard. Be sure to have an nx-interface on your installation for the first commissioning.
The next3 will not start its operation without this first configuration.

FRONT PANEL BUTTON

In the middle of the front panel, the ne[xt] part is a button with the following functions available depending on how long the button is pressed:

- **Impulse push**: clear error(s), stop beeping
- **Short: 1 second < press < 3 seconds**: ON/OFF of next3 and all its functions. Signalled by one beep after 1 second.
- **Long:3 seconds < press < 10 seconds**: the button has no effect when you release it, this is for the case when you pressed long by mistake. Signalled by two beeps after 3 second.
- **Longer: press >10 seconds**: all devices are reset. Signalled by 5 beeps after 10 seconds.

You can hear a beep after ~1sec, ~3sec and ~10sec and you can release the button to achieve the associated function at that moment. The front panel button can be deactivated/activated via the nx-interface (but it's not advised).

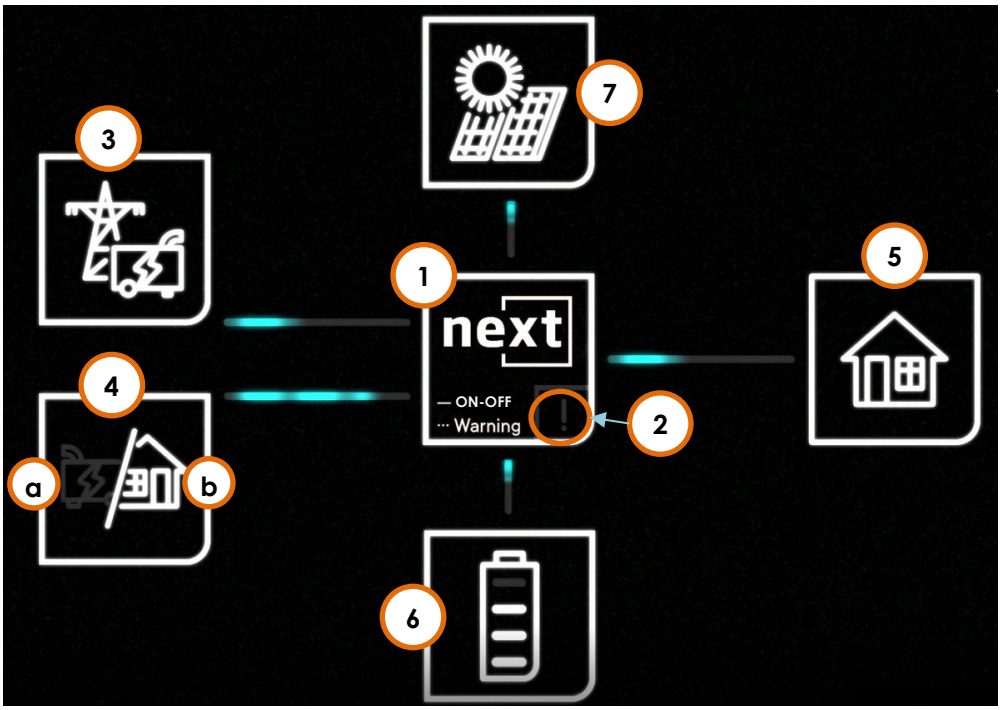
To power ON the next3 and all its functions: push the front panel button until you hear the first beep (or use the ON/OFF button of the nx-interface). After this, your next3 installation is in the following state (please note that it takes ~5sec to start all converters):

- The next3 inverter is ON.
- The "!" red LED is permanently off, because the next3 is now ON without errors
- The battery is connected (battery symbol is light on)
- The voltage is provided to Ac-Loads (house symbol is light on)
- The solar chargers are enabled (PV array symbol is light on if the solar chargers are working, or blinks once if the solar chargers are not working because there is no sun)
- The connection to Ac Source is enabled (grid/genset symbol is light off or light on depending on your configuration)
- The Ac Flex is enabled (grid/genset and house symbols are light off or light on depending on your configuration)

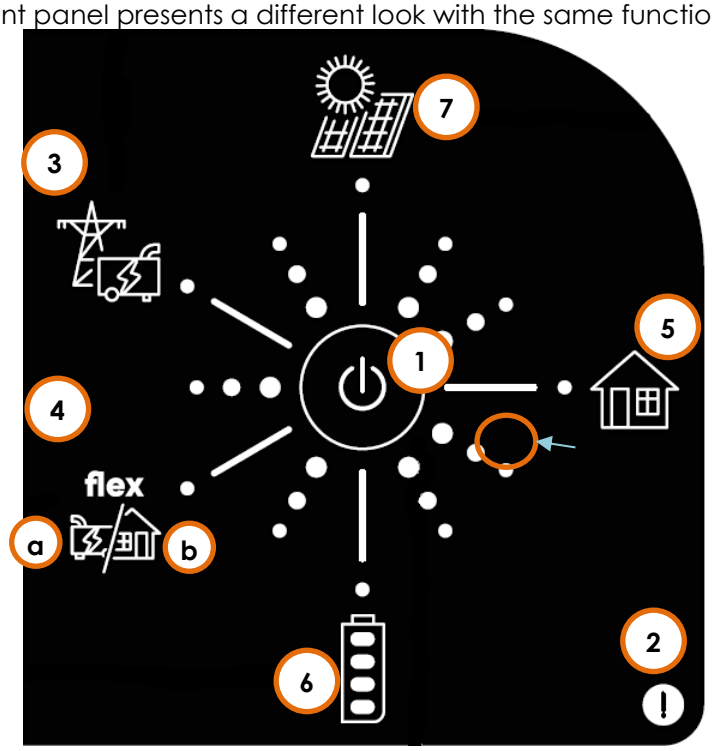
Your installation is now in operation!
If the system requires configuration or setting modifications, carry them out immediately. These must be modified by means of the remote control nx-interface.
Please note that powering from the grid without battery is not possible. The next3 system cannot operate as a PV inverter without storage. If there is no battery connected, the next3 will not start and shows no indications.

FRONT PANEL LED INDICATOR

The front panel has the necessary information to understand the state of the next3 with the LED lights.



The rack version front panel presents a different look with the same functions:



The table hereunder describes the information or type of error according to the number of times an indicator flashes.

N°	Indicator	blinking	Explanation
1	Central ne[xt] indicator (**blue light**)	permanently OFF	next3 is OFF
		permanently ON	next3 is ON
		1x	next3 has warning(s) or error(s) (please see the nx-interface for details in warning messages)
2	Central ! indicator (**red light**)	permanently OFF	no error, at least one converter in the system is turned on
		permanently ON	next3 is OFF
		1x	battery discharge is stopped due to low battery voltage
		2x	overload due to either a short-circuit or too high load for the inverter
		3x	decrease of the inverter power output due to a too high internal temperature. This may be due to overload of the device, too high ambient temperature or obstructed ventilation.
		4x	other error(s) (please see the nx-interface for details in messages)
3	AC-Source indicator	permanently OFF	source is deactivated, or not present
		permanently ON	source is connected and working properly
		1x	source is present but next3 is in waiting procedure for connection
		2x	exceeding the source maximum allowed power
		3x	phases order is incorrect, or one phase is missing
		4x	source has other warning(s) or error(s) (please see the nx-interface for details)
4a	AC-Flex as a source indicator (genset symbol) (house symbol is permanently OFF)	permanently OFF	source is deactivated, or not present
		permanently ON	source is connected and working properly
		1x	source is present but next3 is in waiting procedure for connection
		2x	exceeding the source maximum allowed power
		3x	phases order is incorrect, or one phase is missing
		4x	AC-Flex has other warning(s) or error(s) (please see the nx-interface for details)
4b	AC-Flex as a load indicator (house symbol) (genset symbol is permanently OFF)	permanently OFF	loads are not powered
		permanently ON	loads are properly powered
		1x	standby / load search mode
		2x	AC-Flex has other warning(s) or error(s) (please see the nx-interface for details)
5	AC-Loads indicator	permanently OFF	loads are not powered
		permanently ON	loads are properly powered
		1x	standby / load search mode
		2x	loads have other warning(s) or error(s) (please see the nx-interface for details)
6	Battery indicator	permanently OFF	battery is disconnected, next3 is not powered up
		permanently ON	battery works properly
		1x	battery is almost empty
		2x	battery has other warning(s) or error(s) (please see the nx-interface for details)
7	Solar indicator	permanently OFF	solar is deactivated or not present
		permanently ON	solar is producing properly
		1x	Night or dawn/dusk
		2x	no solar production since 48h
		3x	solar has other warning(s) or error(s) (please see the nx-interface for details)

State of charge indicator: 4 bars in the battery symbol:

- 75 to 100 %
- 50 to 75 %
- 25 to 50 %
- 0 to 25 %

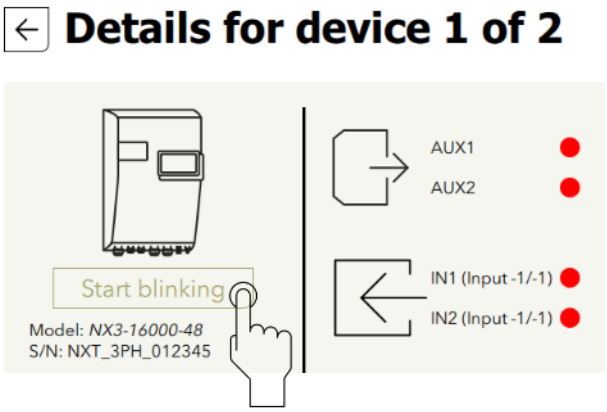
In charge mode, the upper LED line inside the battery blinks indicating the charge phase:

- 1 time: bulk
- 2 times: absorption
- 3 times: equalization
- permanently on: floating

For lithium batteries with BMS, the upper line never blinks as there are no charging phase controlled by the next3. The charge is controlled by the BMS.

Special cases:

- If there is absolutely no light on any of the LEDs, the next is completely without power (battery disconnected) or there is a problem with the display of LEDs.
- When powering up the next3 with the battery, all LEDs blink once during the start check.
- All LEDs can blink at the same time in an identification procedure (with nx-interface). It is possible to identify the devices in multi-unit system that way:



BEEP INDICATOR (BUZZER)

The sound produced by the next3 buzzer uses the same beep sequence as the central "!" red light flashing sequence.

This buzzer can be deactivated/activated with the nx-interface 

This buzzer can also be deactivated/activated with the *next* button of the front panel. The button must be pushed for 5 seconds < push < 7 seconds (release after the 3rd beep to toggle the function). In any case, the sounds when pressing the button to identify the functions described on chapter 5.2 will remain active.

BEHAVIOR IN PROBLEMATIC CONDITIONS

In operation the next3 protects itself with some programmed behavior

6.1.1 Thermal behaviour

The next3 is rated at 25° ambient temperature with proper ventilation (space around the next3). It has several internal temperature measurements and performs a derating of its functionalities in case of overheating:

- The solar production is reduced from the maximal current of 20A down to 0A to stabilize the temperature at acceptable level.
- The battery charging and discharging current is reduced to stabilize the temperature.
- The inverter max power is limited:
    - In islanded mode, the power is directly given by the loads. If the max current is reached, the voltage drops because the inverter cannot supply the load. When the voltage goes under a voltage threshold of nominal power -10%, the inverter goes to overload.

A message indicates if the performances are limited by temperature.

6.1.2 Overload

In case of overload the inverter stops.

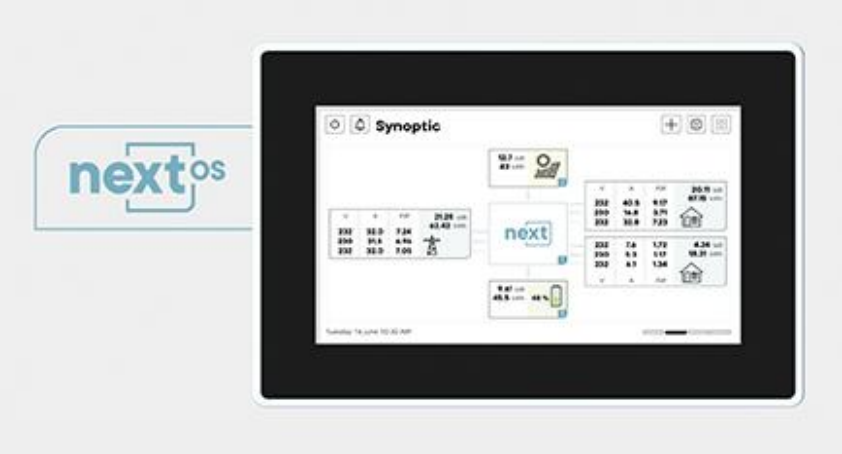
7 HMI: USE OF NX-INTERFACE

The end-user can interact with the next3 with different interfaces: the remote control nx-interface, on the web monitoring portal and with the APP on a smartphone/tablet. It is also possible to communicate with the next3 with machine to machine via communications through Web API to the portal.and MODBUS.

This chapter describes the use of the nx-interface. This device is a local interface connected to the next with a communication/power cable and allows to:

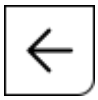
- **Visualize** the state of the next3 system, present and past values, including the log of the events that happened to the system.
- **Configure** the devices: The next3 configuration can be modified by the installer/user at commissioning to adapt the equipment to the energy system in the best possible way. The normal process to configure the next3 is the use of the "Configuration Wizard" at the commissioning. This is a step-by-step procedure that helps you to configure the system in a simple way. This avoid mistakes and is the preferred way to configure the device. Individual settings are also accessible for each part of the next3. The factory values of these settings are reported in the table at the end of this manual.
- **Record monitoring data:** In order to analyse what happed in the energy system, the nx-interface stores measurements data in its internal memory and on a usb memory stick for later analysis (csv files).
- **Be connected:** The nx-interface is also the gateway to the outside world. It allows to connect a system to the internet and the Studer monitoring portal. If the nx-interface is connected to the internet, the recorded data can be sent to the Studer web portal user account(https://portal.studer-innotec.com). The nx-interface is also the gateway to MODBUS communication with third party control systems.

A user level system allows the installer to manage the access rights and the complexity of what is shown to the end user, from "*View Only*" to "*Expert*" with the right to modify any settings.

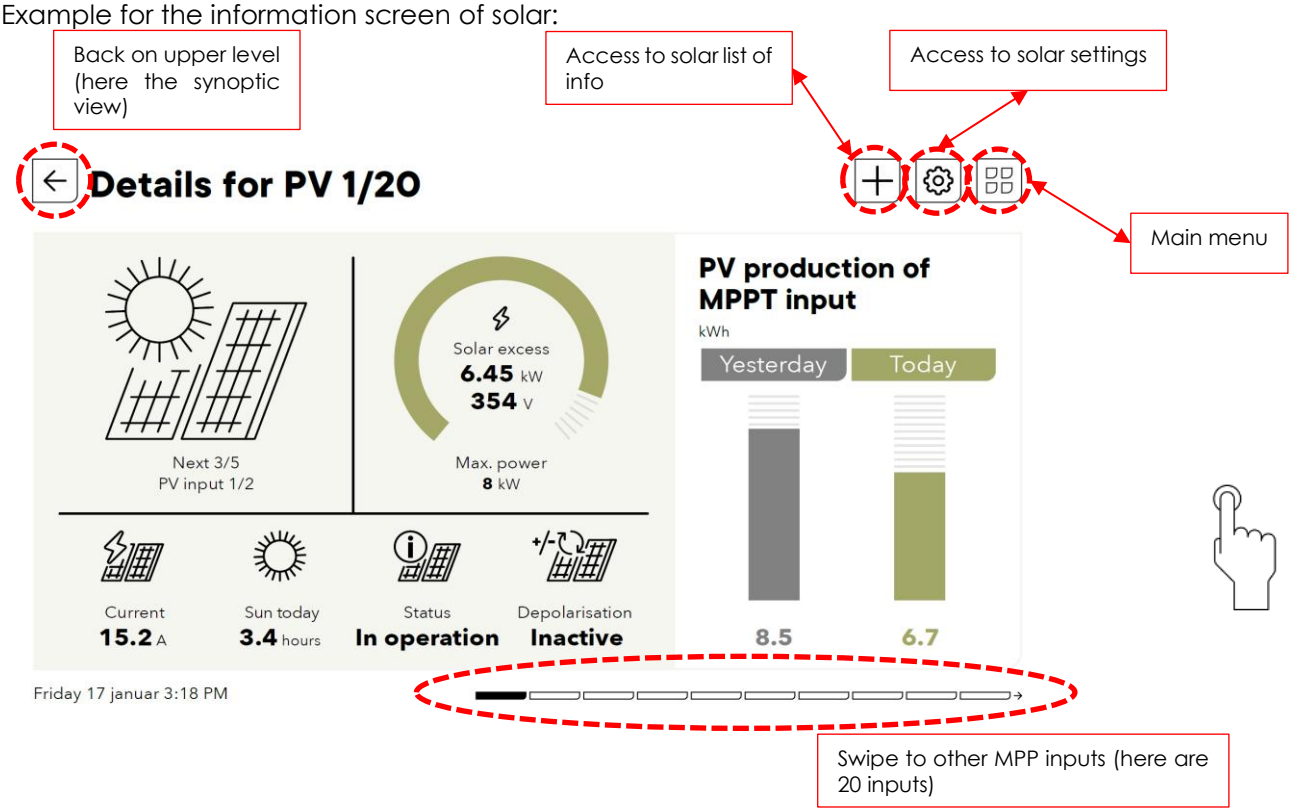


GENERAL NAVIGATION AND USE

The nx-interface a touch screen display. The navigation from one page to another is done by pointing/clicking on an element.
The main icons used for navigation are:

	Access to main menu. This icon is on every screen and click on it to come back to the top level and navigate quickly
	Access to settings (level3). There are prepared graphical screens for setting and an access to the whole list of settings with the + symbol from there in EXPERT mode.
	Access to detailed lists of information (from info screen) or list of settings (from settings screen). The + is accessible only in EXPERT MODE for list access.
	ON/OFF of all the functions of the inverter. A confirmation is asked
	Back on the previous screen in the menu hierarchy
	Enable or mute the beeping of the remote and the inverters.
	Page indicator: you can swipe left/right to move to different pages of the same level. For example, when there are many solar chargers in the system, you can navigate from one to another.

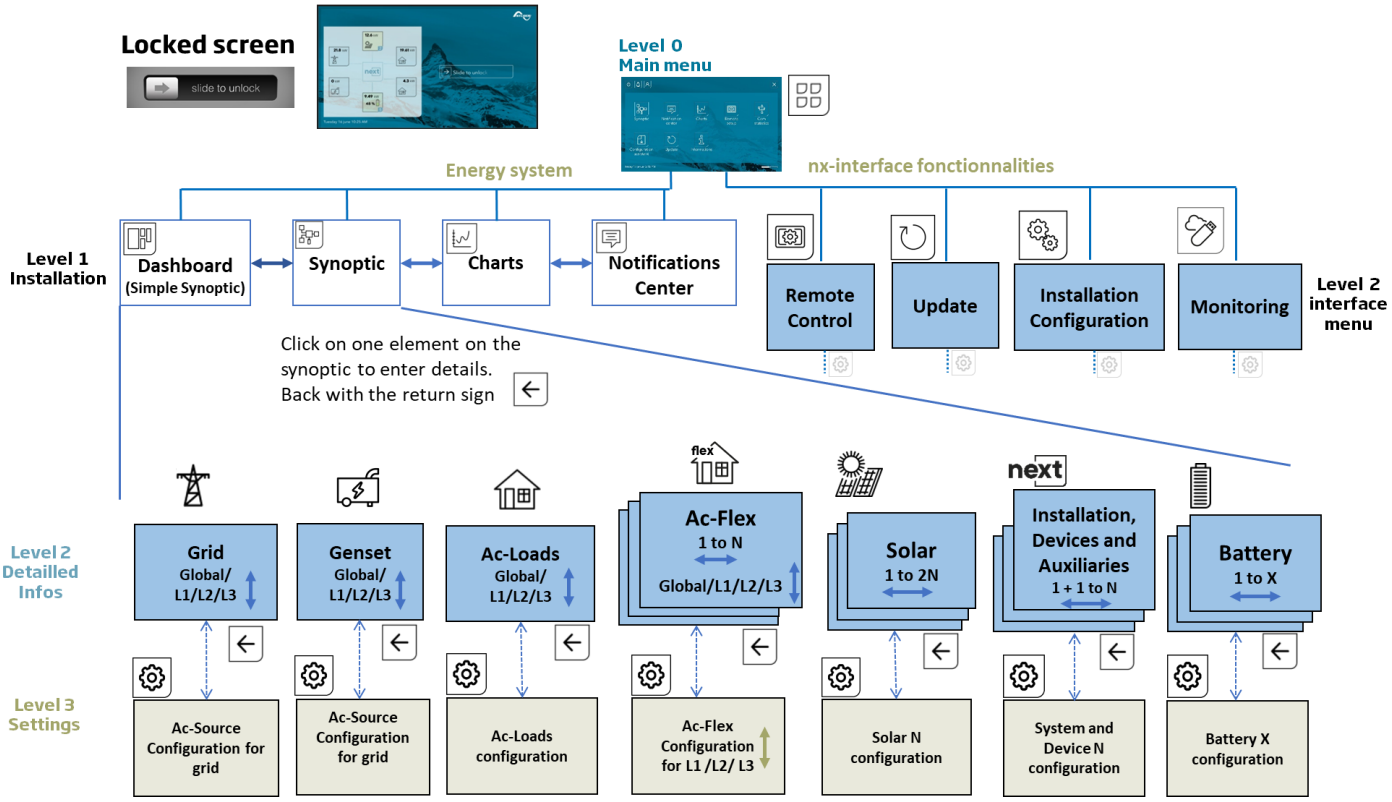
Example for the information screen of solar:



7.1.1 Screens map

The navigation on the nx-interface is organized as given by the picture below. A locked screen appears after some time of inactivity on the nx-interface. It is unlocked with a slide move or with a code. From the locked screen you go back to the last screen that was displayed before entering sleep mode.

The main menu is always accessible form any screens with the icon:  available on each screen.



The nx-interface screen is organized with screen levels

- **LEVEL1**: general view of the state of the energy system, the instant values, the history, and the message log.

- **LEVEL2**: Information about each component (AC-source, Battery, solar,…)

Many detailed information that can be obtained from the next3 about the inverters operation. For example the AC-reactive power of the phase 2 on the AC-source connection can be seen by going on the AC-source from the main synoptic.

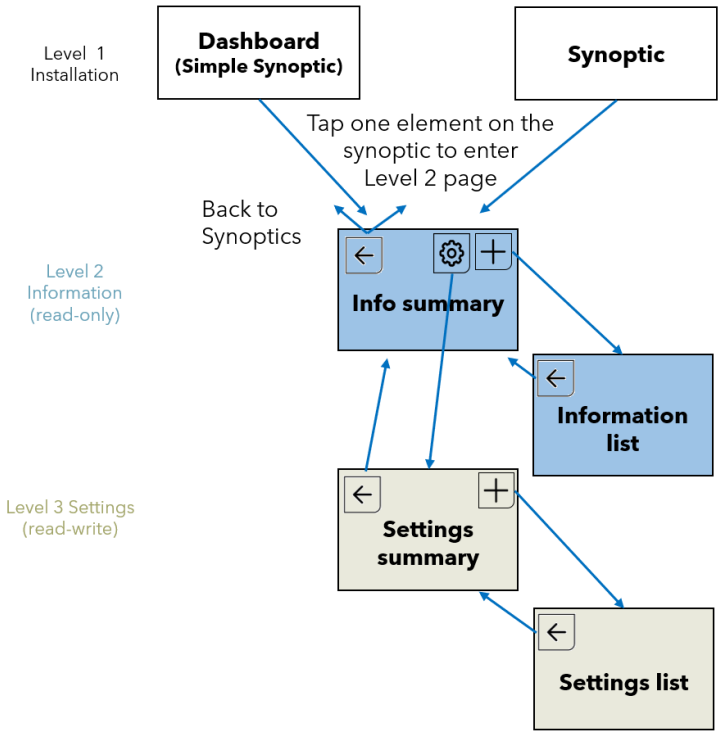
- **LEVEL3**: Programming: the settings about each component can be seen or modified.

  Note: when on a configuration screen (Level 3), the settings are for a unique component. Per exemple there are two solar mppt entries on one next, the settings are accessed individually.

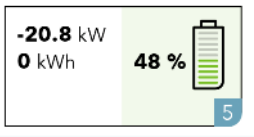
For convenience and simplicity, not all information can fit on one screen. From the level 2, the "plus" button allows to access a list of detailed information.
From the level 3, the "plus" button allows to access a list of detailed settings.

The "plus" of level 2 and 3 is accessible at expert level only. The unique reference identification number are used in communication and to clearly identify the information/settings.

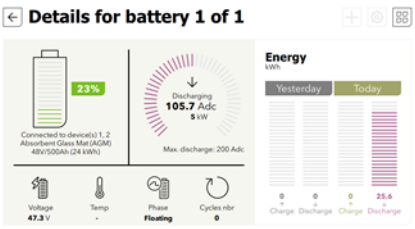
Navigation from the synoptics to the detailed information and settings of parameters:



Example with the battery

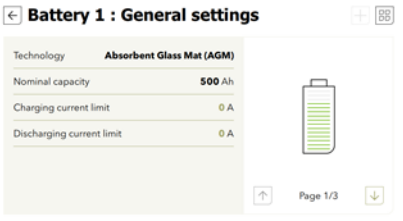


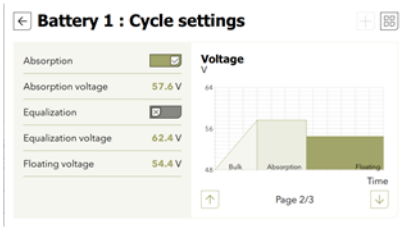
Synoptic (level 1)
A few general information about the battery

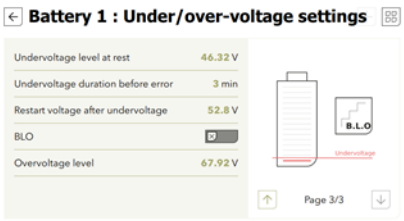


Visualize (level 2)
Information screen is always with the inversed T screen organization. Bar-graph of today and yesterday energies for comparison on the right side of the screen.

List of all possible information with the sign +







Basic Settings (level 3) access with ⚙
Image on the right and selected

Advanced settings:
access to the full list in expert level with the sign +

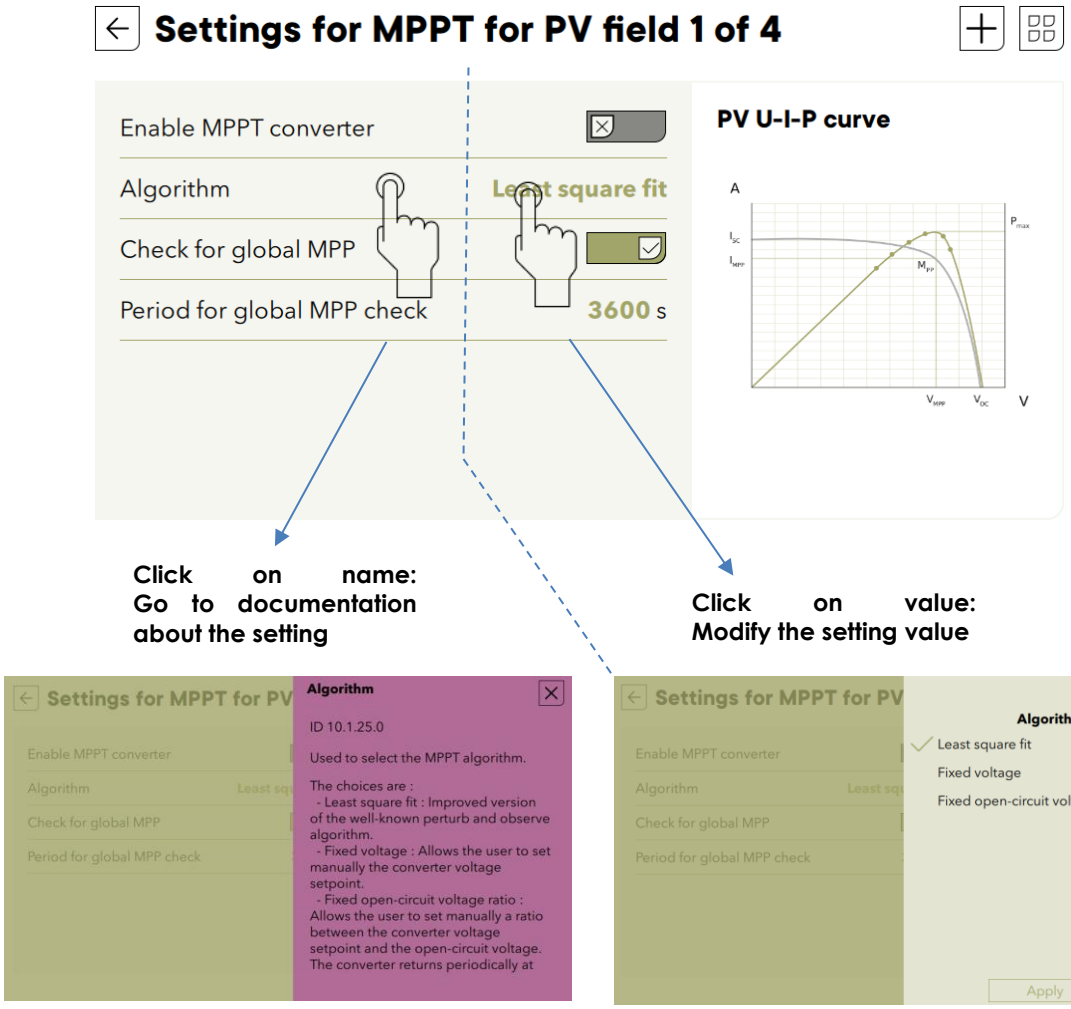
Full list of settings is in appendix of this manual.

See the following chapter to have details about each component of the energy system (the solar, the AC-source, the AC-Flex, the battery, …).

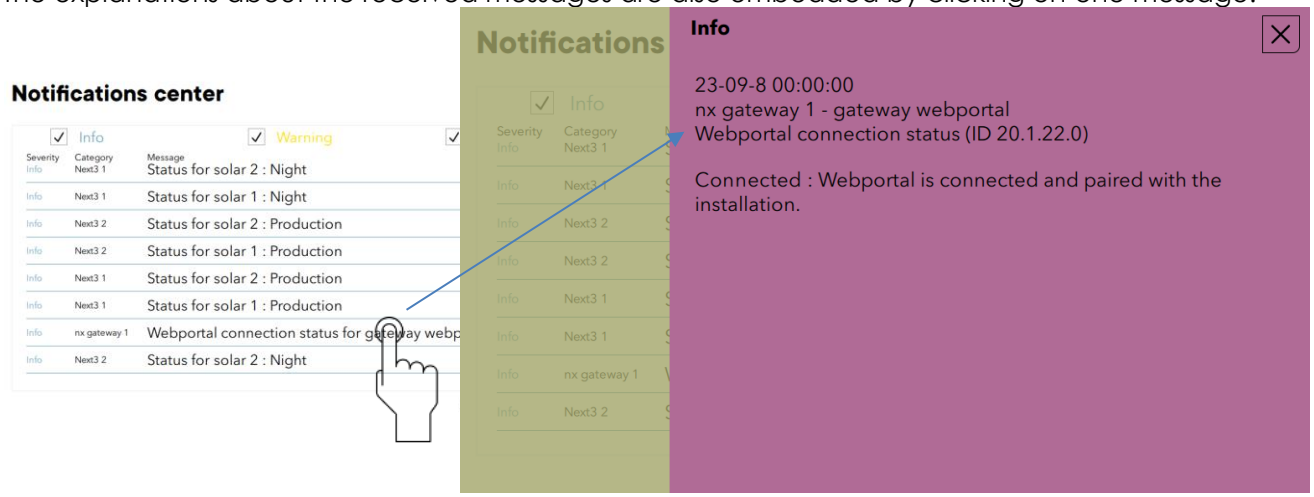
7.1.2 Embedded documentation

The nx-interface has an embedded documentation about all information (level 2) and settings (level 3) available.

- Access to documentation about one setting/information by clicking on its name
- Change the settings by clicking on its value



The explanations about the received messages are also embedded by clicking on one message.



The full list of information and settings with their default values, units, ranges, and explanations can be found in the Object Model description. Each parameter/setting/information has its own unique identification number starting with the prefix ID. The same documentation is embedded in the nx-interface.

7.1.3 Accessibility

User accessibility: can be changed in the nx-interface menu with user levels.
The levels are:

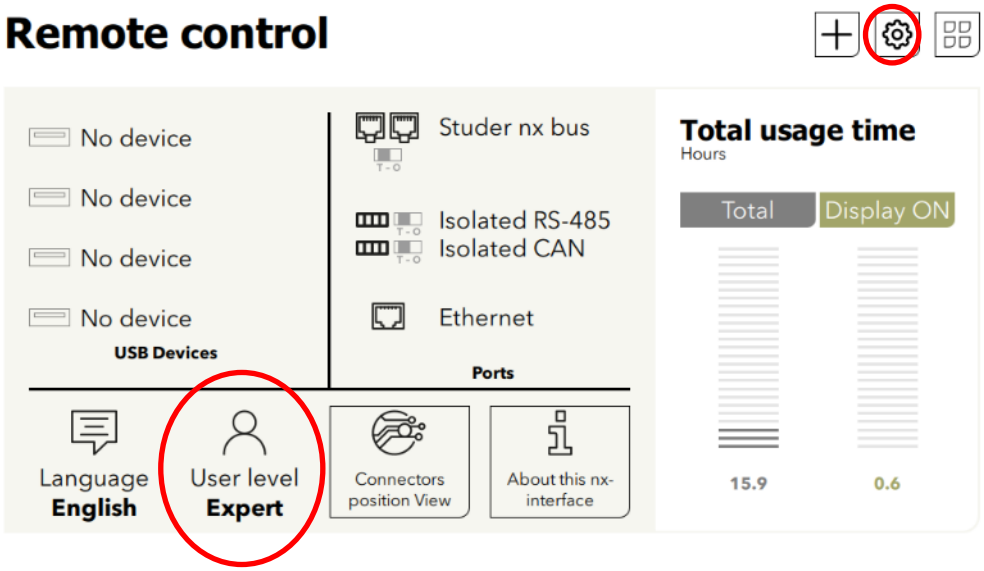
- **View Only**: the user has access to levels 1 and 2 of the screens (dashboard, synoptic, graph, messages, view of components information). The configuration icon is not accessible and the user cannot change anything in the configuration of the system. Code is 00000.
- **Basic:** the user has accessed to the level 2 and 3 It is possible to modify the configuration of the next without the full list of settings (the full list icon is not accessible). The important settings for the standard operation of the next system are available on the prepared screens of level 3. Code is 815566.
- **Expert**: the user has accessed to all information and settings. Access is restricted for end-user as the grid code settings must be chosen by the qualified installer at commissioning and modifications are not allowed. The expert code is delivered only to qualified installers.

On the first commissioning the nx-interface is set to Expert to allows the use of the wizard process and then automatically set down to View Only.

The modification of the user level is done with codes in the nx-interface, in the remote control screen and then on the configuration menu (→)

The codes are beside:

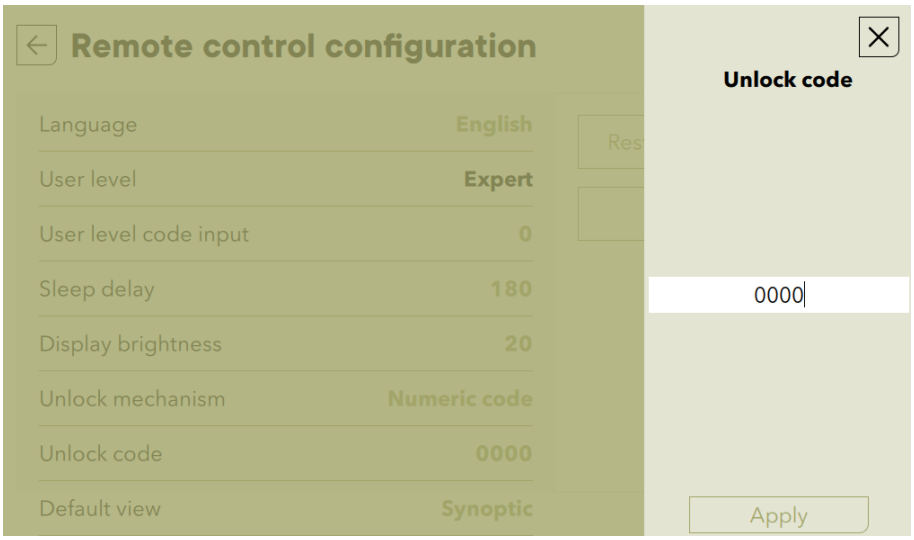
View Only:	000000
Basic	815566
Expert	For professionals only



Blocking access with customized code

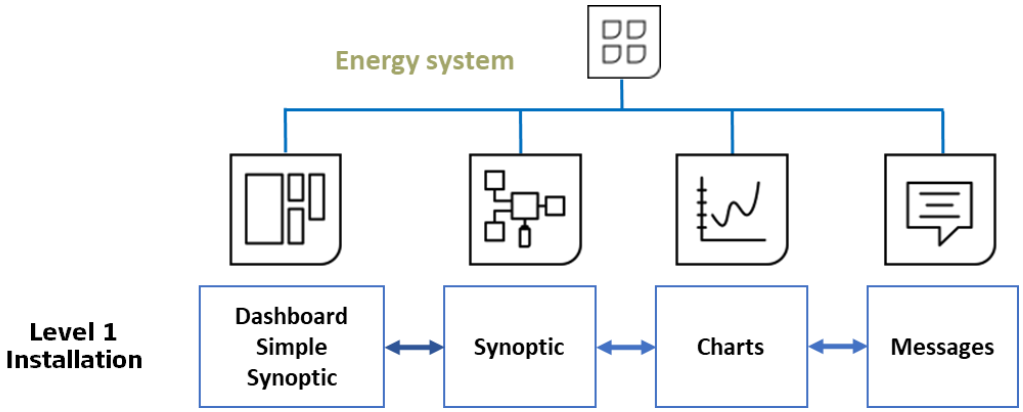
The slider of the locked screen can be replaced by a code to unlock. This prevents the modification of the system by unwanted peoples.

The activation of this code is done in the remote control screen and then on the configuration menu ( → ). It is available for experts only.
The unlock code can be freely chosen.



DISPLAYING THE STATE OF THE ENERGY SYSTEM ON THE NX-INTERFACE

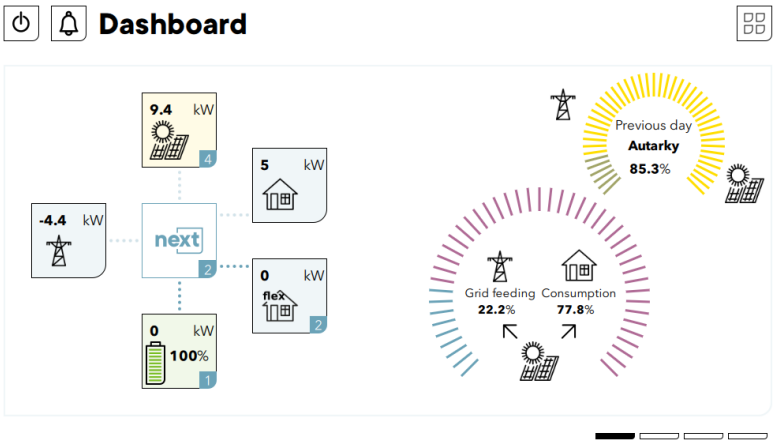
The actual and historical state of the energy system can be seen on the screens of Level 1 of the energy system.

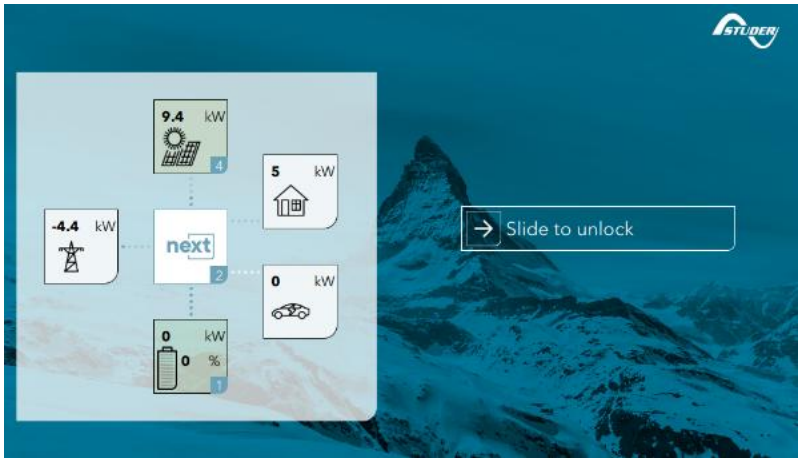


The status of the energy system is seen with two screens the simplified dashboard of the synoptic

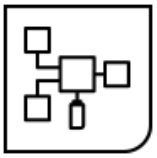
7.1.4 Simple dashboard

Power fluxes and state of the battery can be seen. In one blink you know what your production is, consumption and general state of the system. All powers are the sum of all devices and all phases. The same general overview is on the "locked screen".





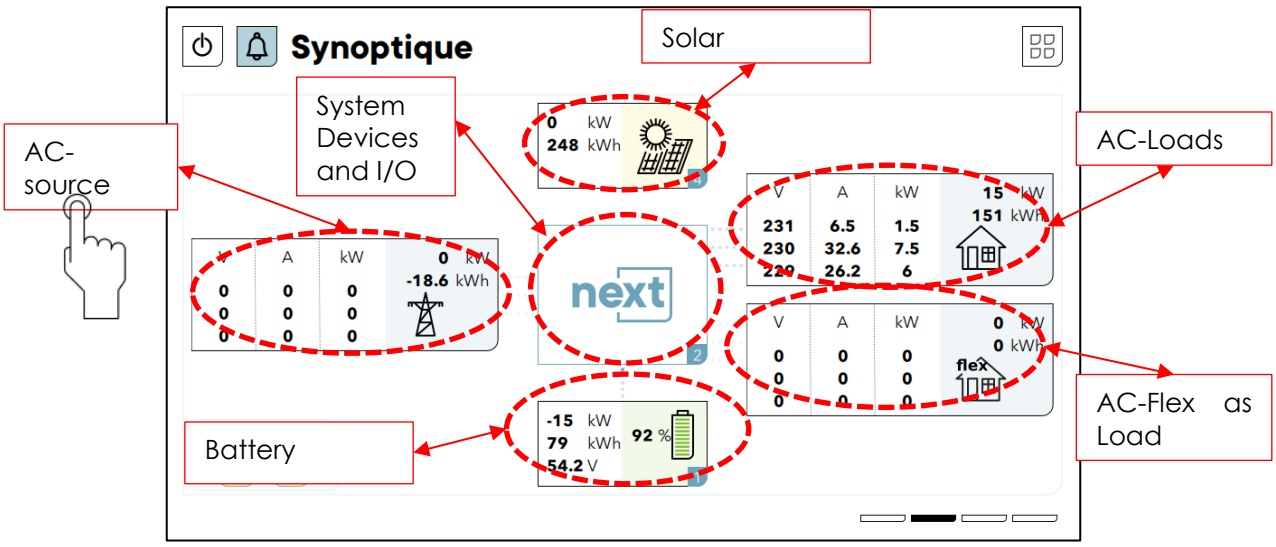
7.1.5 Synoptic



The detailed synoptic gives access to the information and the programming of the various components (click on it):

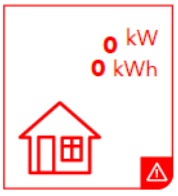
- **AC-Source**: the AC-grid or a genset. There is only one AC-source connection in a system.
- **AC-Loads**: the consumers: there is only
- **AC-Flex**: A special entry that can be configured as
    - A second source, there is only one second source connection in a system. The AC-source has priority of connection over the AC-flex as second source.
    - A controllable load, in that case there are as many AC-Flex as loads than the number of nx device in the system.
- **Battery**: there can be many in a system.
- **Solar**: connect the two PV strings.
- **Device** and I/O (AUX contacts, Remote Entries, COMM ports, …): on every nx device of a system.

From the dashboard or the synoptic, the details of each component are accessed by clicking on it. See the general screens map in previous chapter for an overview of the navigation.

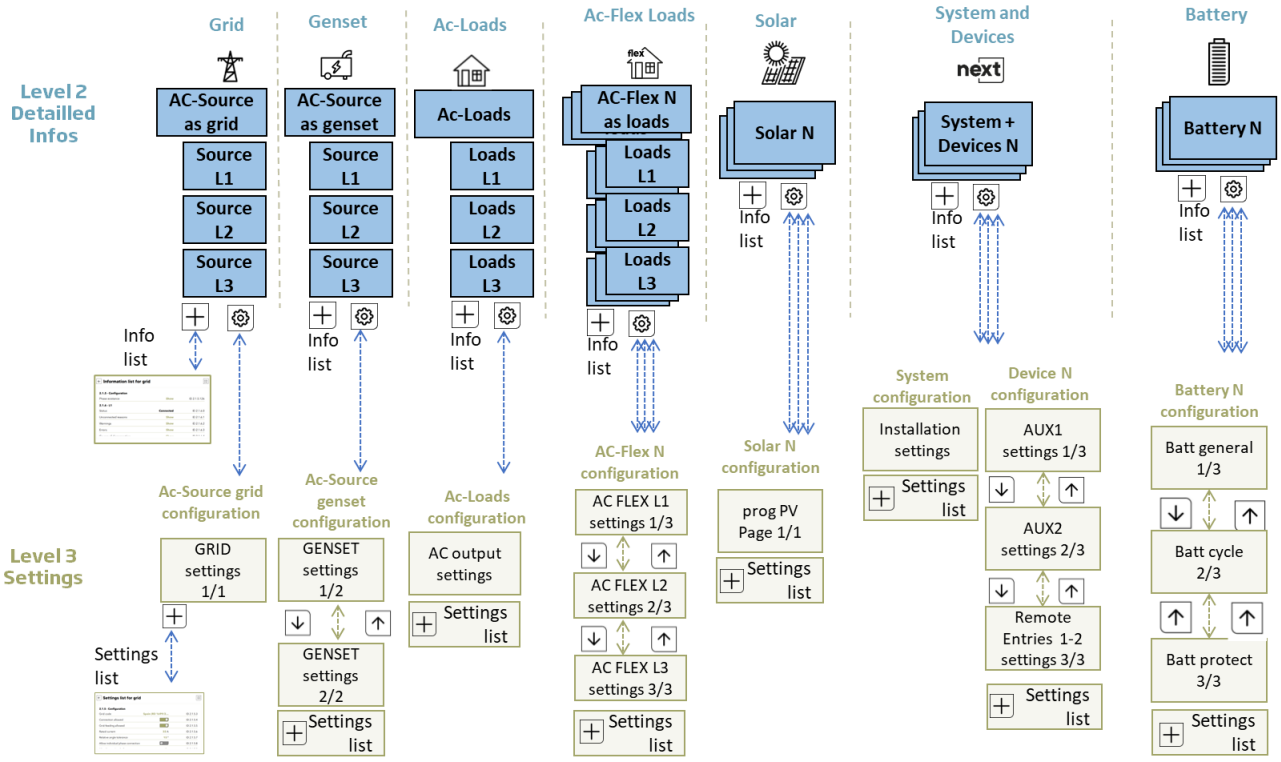


Note that the AC-source as genset and the AC-flex as genset are missing on the figure above as we cannot display all the different configurations on the same screen.

An important alert on one of the components can be seen with a change of color. It is associated with a warning or error and with a message explaining what happens.

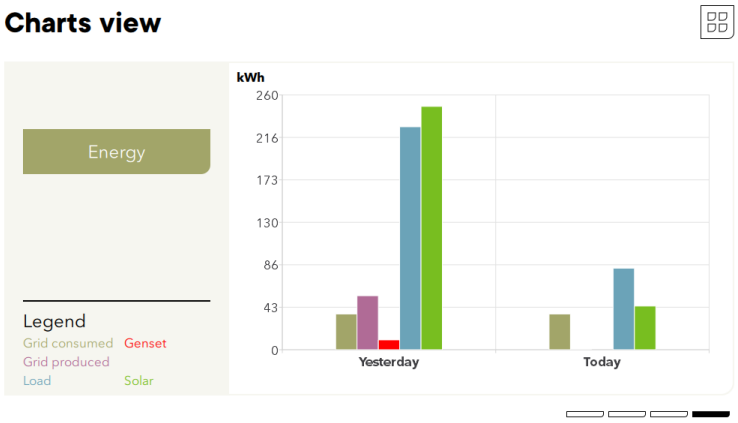


Detailed maps of levels 2 (information) and 3 (configuration) for the energy system:



7.1.6 Simple chart

The energies of yesterday (00:00 to 23:59)and today (00:00 to now) are shown in a bar graph.



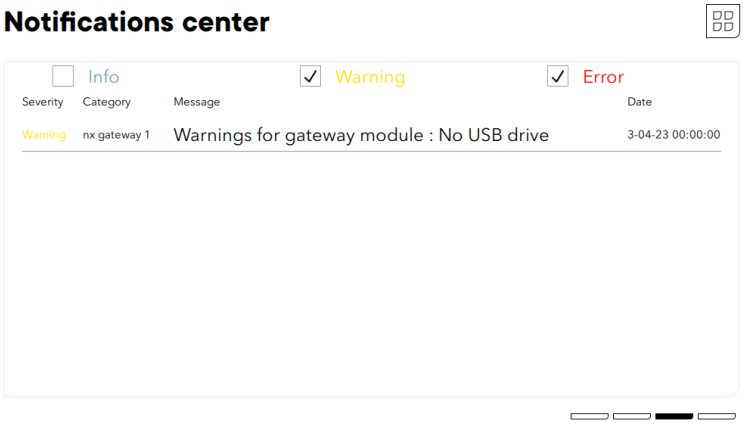
Power and battery timeseries will appear with future updates.

7.1.7 Messages

List of messages/ events that happened to the system.

The errors and warnings are in red when they appear and in green when they are cleared.
It is possible to filter the message in function of their severity:

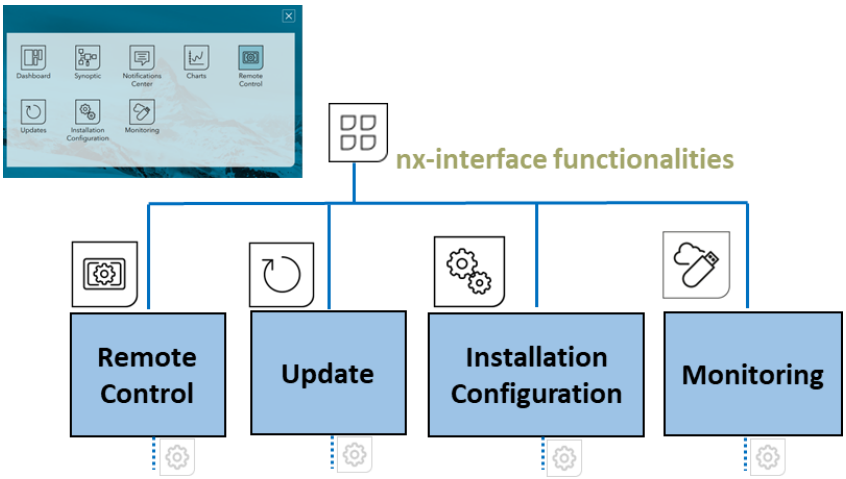
- **Information**: an normal event happened in the system and is logged
- **Warning**: something abnormal happens and the next3 operation can be restricted but the device is not stopped.
- **Error**: an event that stops the operation of one of the component of the next3 or the whole next3 happened.



THE NX-INTERFACE FUNCTIONALITIES

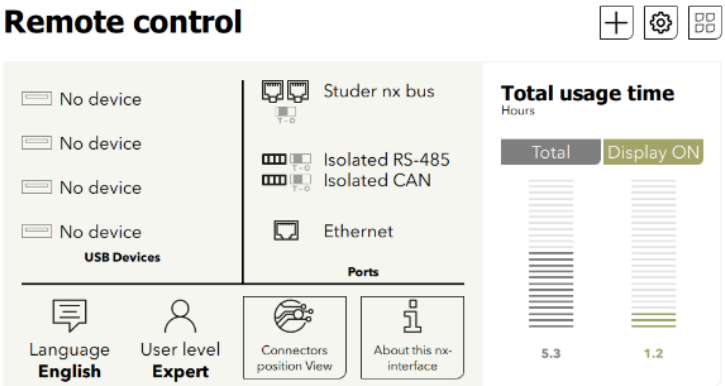
The nx-control has 4 dedicated menus for settings and actions specific to the interface:

- **Remote control**: manage the nx-interface itself (user access, language, brightness of the screen,…)
- **Updates**: update of the whole system is done with the nx-interface with by copying the new firmware on the usb key.
- **Configuration of the installation**: start a new configuration wizard here.
- **Monitoring and internet**: set connection to the Studer webportal and manage the datalog on the usb-key. The Modbus M2M communication for monitoring by external SCADA system is also managed here.



7.1.8 Remote Control

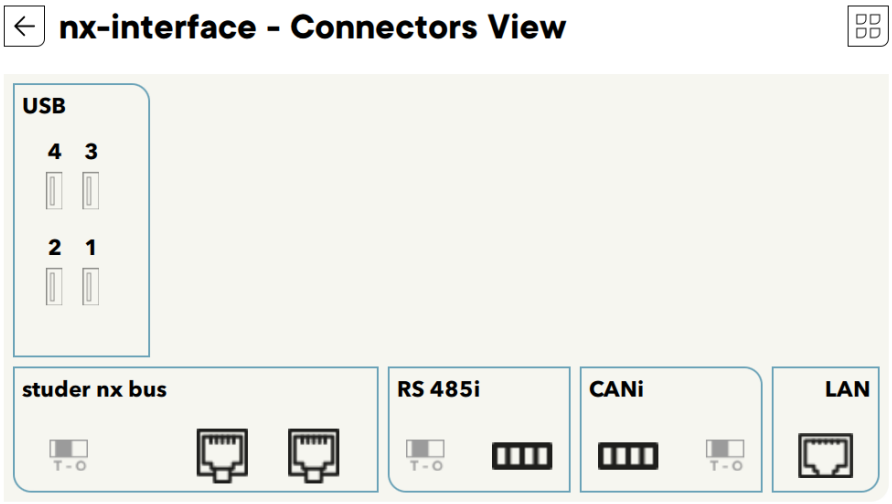
This menu is for the nx-interface itself (Language, user level, brightness of the screen, …). The physical connections are also shown, with the positions of the bus terminations on the nx-interface: very useful to find them as they are a little bit hidden under the nx-interface.



This menu give access to the user levels. The codes are:

- **View Only**: **000000**
- **Basic : 815566**
- **Expert :** For professionals only

The connection view helps to locate the connectors on the side (usb) and under the nx-interface:

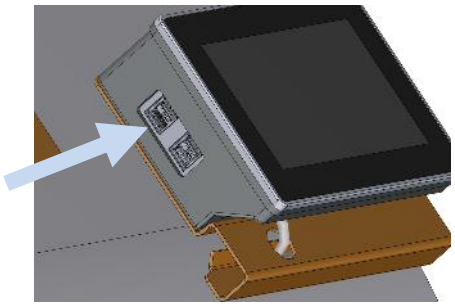


Date and time

The next3 features a real time clock that allows among others to have a correct date and hour for the datalogging records. This clock must be set using the remote control nx-interface. Thanks to an internal battery, this setting is retained even when the equipment is disconnected from its voltage source (battery or PV).
If the nx-interface is connected to the internet, the date and time is automatically updated if you accepted it at the initialisation (during the wizard).

USB memory stick management

Hot Plug of USB memory is possible. Always remove the USB using the EJECT button on the nx-interface. The eject button is available in different menu and has the same effect.



The USB-stick is also used for

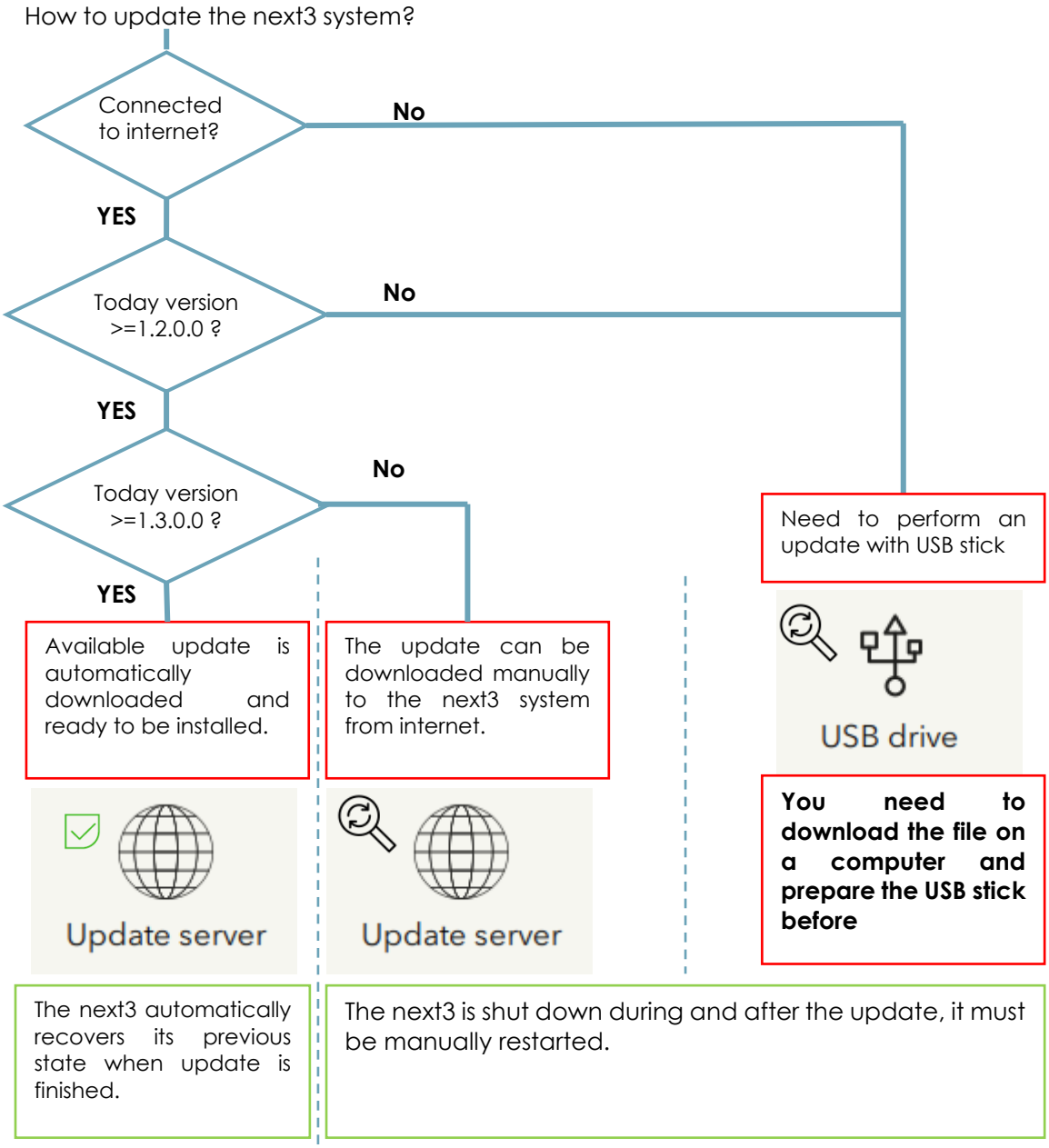
- Datalogging backup
  - Procedure: see the monitoring section
- Update of the systems.
  - Procedure: see the update section
- Manual savings of the configuration and files (to come)
  - Procedure: see the configuration section

	With the code version 1.3.0 of the nx-interface, only one USB key per system is managed. If a USB is already plugged in and you want to plug another key, remove it first.

7.1.9 Update

This part describes the update of the next system (inverters, nx interface and accessories) using the nx-interface.

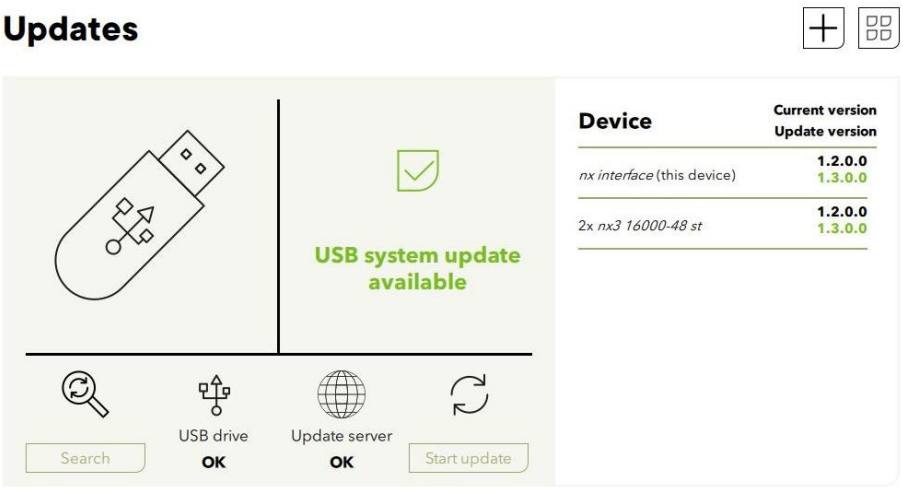
The internet connection and recent versions of the next3 allows for an easier update of the system. Systems with old versions or without internet connection requires the use of the USB stick. First determine in which case you are:



If you need to prepare the USB key in advance:

- Download the latest software version from our website: https://www.studer-innotec.com/en/downloads/ in the support and download section.
- Unzip and copy the whole folder called "next3-system-update" at the root of the key.
- Make sure that the copy process is finalized before removing the USB from the computer.
- We advise to eject the USB properly to avoid any file corruption issue.

On the update page:



The current version (in black) and the available updates (in green)can be seen on the right side. An information will be displayed in case of software incompatibility.

For the 3 cases described above:

- **Automatic update download (from version 1.3.0.0)**
  If an update is available, simply click the "start update" button.
  The check for new update is done once a week. If you are informed that there is a new version available before the automatic search, it is always possible to click the search button to check the update server at that time.

- **Non-automatic update download (from version 1.2.0.0)**
  Click the search update button and then when the update is available, click the, "start update" button.

- **USB key update (older versions or without internet)**
  Insert the USB key in the nx-interface. There must be only one USB stick in the nx-interface. If there was already one, you should eject it before.
  If there is no update automatically available, you can click "Search USB" to confirm if the update file is on the USB unit. When an available update appears in green, click the "start update" button.

The USB-key must not be removed until the end of the updating process. If for some reason the updating process is interrupted, restart it to let the process finish.

	The USB key presence is mandatory even for the internet update, as the files are copied on the USB key. Always keep the provided USB key on the nx-interface

During and after the update

You will see a message to inform that the system will restart during the update procedure. Please be aware that the next3 will turn off and on during the update process.
In older version, the update is performed in many steps: first the nx-interface is updated and then you must press again on the "start update" button again for the next3 devices. After version 1.1.0.0 all updates are performed automatically one after another.

If you update from version 1.3.0.0 or later to a higher version. The next3 will recover its initial state, that means the inverter will restart automatically if it was ON before launching the update. In any case there is a short interruption of the powersupply to the AC-loads. It will be OFF after update if it was already stopped before the update.

Before version 1.3.0.0, the next3 is always stopped for the update and a manual start with the front button (2 seconds), or the "ON/OFF" button in the next interface.

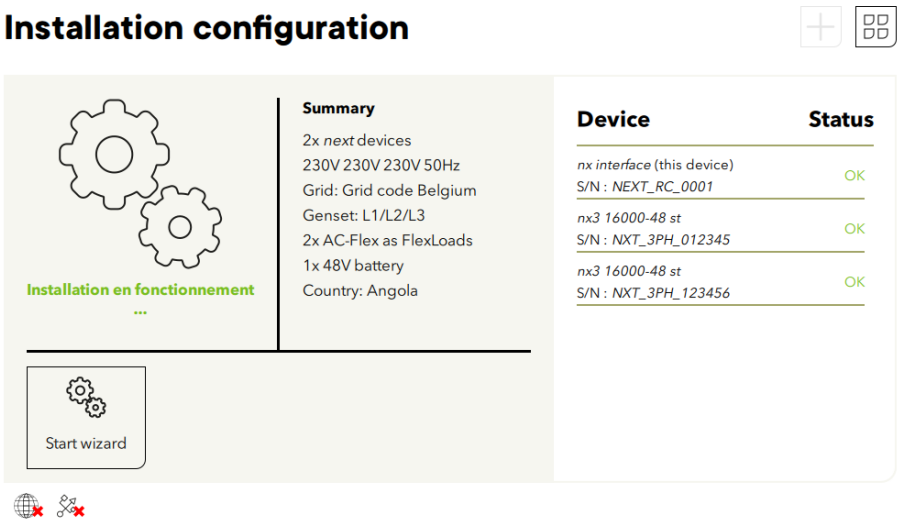
Note: The usb key must not be removed until the end of the updating process. If for some reason the updating process is interrupted, please restart it, and make sure to let the process finish.

	The updating process can take between 3 and 15 minutes. NEVER disconnect the battery during an update. During this process, the installation is stopped, and the AC power supply is interrupted. Choose the proper moment to process an update.

	When multiple elements are connected to the nx-interface I and to the next3 by the communication bus, it is possible that the software versions are not compatible. It is highly recommended to update the software of all components in the system to guarantee all functionalities. Therefore, before starting the setup of the device, download the latest software version from our website: www.studer-innotec.com on an USB key. Follow the instructions in this manual for a successful installation.

7.1.10 Installation Configuration

In those pages you can reconfigure the next energy system from the start with the wizard. The configuration pages are available at expert level only.
A summary of the system is available on the main screen and a list of all present devices of the system is situated on the left.



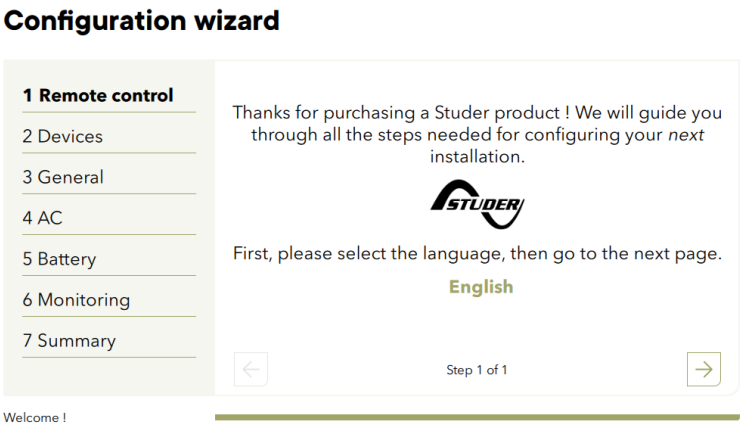
For a factory setting reset, you must run the wizard again. It will reset all the values with the factory values according to your configuration.

Configuration Wizard

The standard configuration of the next3 energy system is done with a configuration wizard. It is possible to modify single settings individually later the pages dedicated to each topic of the converter. On the first commissioning of the next3, the wizard will be automatically started, and all steps must be followed. To restart with factory settings, you must run the wizard again on an installation.
All the settings previously set are forgotten when running a new wizard.

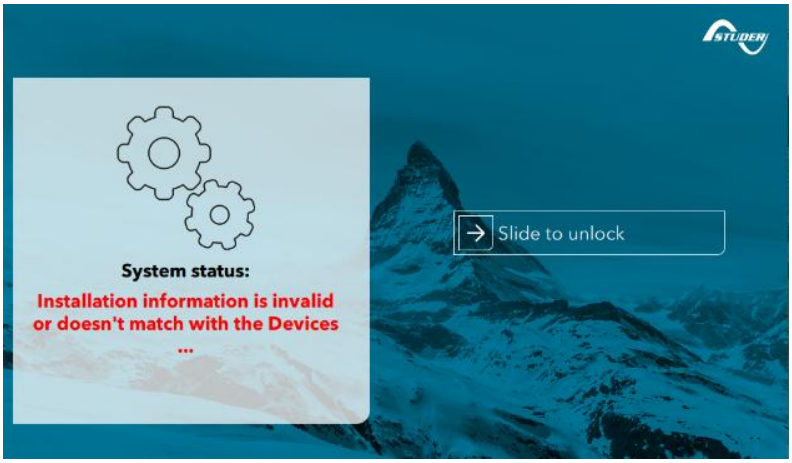
	The wizard is automatically launched on the first commissioning of the next3. At the end of the wizard process, the nx-interface is set back to the basic level. This is necessary to avoid the change of critical settings later by end customer (grid codes). To access the wizard, you need the expert level.

In the first steps of the process, the wizard asks the language that will be used for the configuration and later.



Then questions are given to configure the energy system itself. Comments are done about the steps in the corresponding sections of this manual, in the chapter "configuration and operation of the next".

If you stopped in the middle of the process or the installation has changed, there will be an error message:



Finish or restart the wizard process in that case.

7.1.11 Monitoring & dataloging

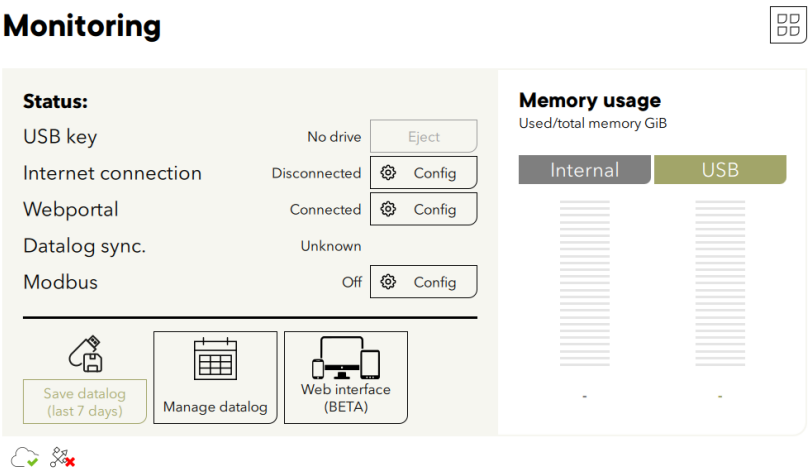
Today, monitoring a renewable energy system is essential. The Studer monitoring provide continuous information (real-time and past behaviour) for a deep understanding of the operation of the system. Having the right information at hand facilitates the follow up of the main performance indicators as well as remote diagnostics and problem anticipation.

There are two kinds of monitoring and control in the Studer environment:

- **Local monitoring and control**: this is done with the nx interface and the daily storage of data on the usb key. At any moment all the data can be retrieved on the usb key and analysed locally on a computer, even in remote area without internet. An local web interface is available at the adress
- **Remote monitoring and control** via Internet is possible with two options:
  - for professionals and advanced users – Studer Portal is a web site with multiple functionalities (visualization, graphs, email alerts, download of data, …). Connect your nx-interface to the internet to get all the advantages of the Studer Portal available here: https://portal.studer-innotec.com.
  - for end-users – Studer Easy Monitoring App is a simple and intuitive way to see the status of the system and its history. It is available in IOs and Android. The Easy Monitoring APP uses the webportal as backend and accounts must be created on the portal to use the APP.
- **Own monitoring:** the user can develop its own monitoring and control of a next system with the use of MODBUS communication. Modbus RTU and TCP are supported. RTU with RS485 connection and TCP with the Ethernet connections, both situated on the nx-interface.

On the nx-interface all settings necessary for the monitoring are managed in the Monitoring menus. On the main screen, the state of the different aspects of monitoring can be checked quickly:

- Is there an usb key and space left for datalogging on it?
  - Eject to take the key away to copy data on a computer
- Is internet connected?
  - View the connection status and setup the wifi connexion
- Is the studer webportal connected and operational?
  - Set up the pairing with the portal with the GUID number.
- Modbus
  - Enable modbus communication with TCP or RTU (disabled by default)



The status of monitoring is also seen with the logos at the bottom of each screen, here with portal connected and no usb key:

Local monitoring: Dataloging in internal memory and on usb-key

A record of all electrical values is done in nx-interface but also in the next3 devices themselves. In all cases, the usb key on nx-interface is the way to take the data out of the system.

The USB memory is used for a periodical backup of monitoring data. A daily .csv files is copied automatically as soon as an USB memory stick is plugged on the nx-interface and has sufficient storage space left. The daily files contain all the data recorded with 1min/1hour/1day/1month rate, and the day notifications.
There is no limit for the USB key capacity, however the USB key must have a valid FAT32 partition where the data will be saved.
For a 32 GB partition on USB key, and same installation as described hereabove, the partition can hold more than 10 years of data. When the USB key is full, a message is shown on the nx-interface.

The internal memory of the next3 is limited and stores the data for a limited timeframe. The quantity of log data that can be stored in a next3 device depends on the type of next3 device (-s, -t, -st, …). Here is an indication of the data that can be stored in the next3:

- 1min data: at least the last 3.5 days of data (nx3 with full options), up to the last 50 days (nx3 inverter only).
- 1hour data: at least the last 50 days of data, up to the last 3 years
- 1day data: at least the last year of data, up to the last 15 years
- 1month data: at least the last 26 years of data
- List of notifications: 130'000 last notifications (~15 years if 1 notification/hour)

In the nx-interface, the quantity of data that can be stored depends on several factors:

- Installation configuration, number of devices
- Other data saved in nx-interface internal memory, e.g. datalog from previously connected installations.

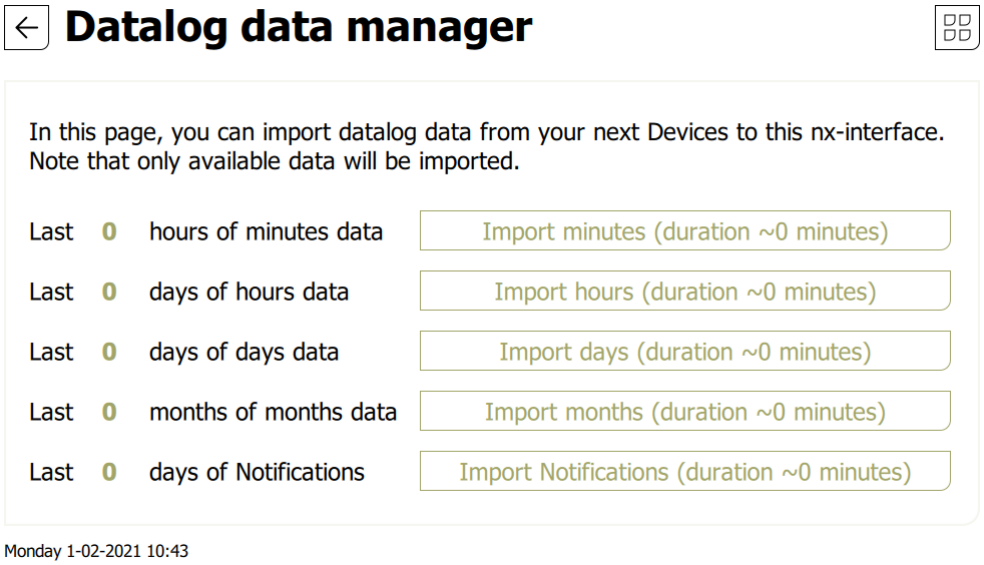
Here is an indication of the data that can be stored in the nx-interface, assuming there is only one installation datalog in internal memory, and this installation has only one next3 device:

- 1min data: last 200 days of data
- 1hour data: last 6 years of data
- 1day data: at least the last 10 years of data
- 1month data: at least the last 10 years of data
- List of notifications: at least the last 10 years of data

The memory for each type of data is managed with a first-in first-out strategy: when the memory is full, the oldest data are overwritten.

If a new USB key is plugged in the nx-interface, it is possible export the monitoring data recorded internally. This is performed in the "manage datalog" app.

As the transfer can take a long time, the menu allows you to choose what is transferred.

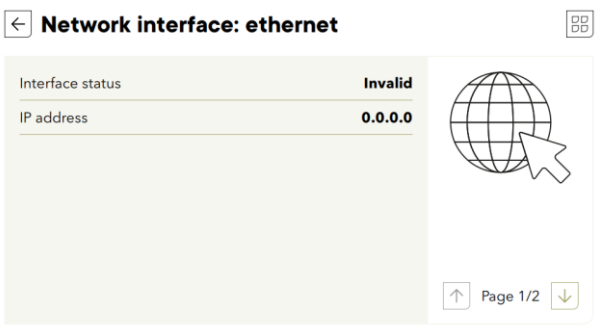


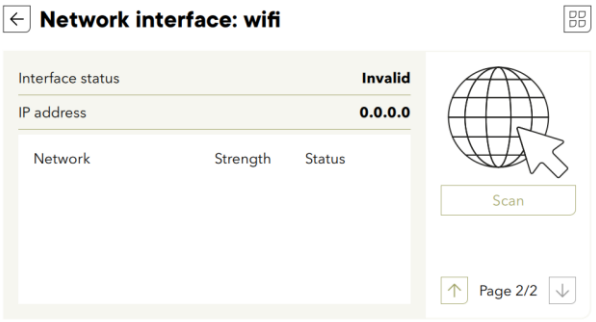
When removing the USB storage, always wait for the end of the data transfer and use the "eject" button for a proper end of operation.

Set up of the internet connection

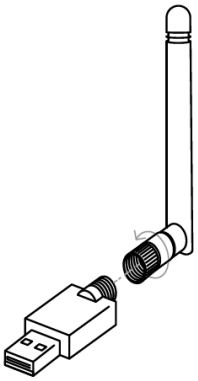
The connection can be done with

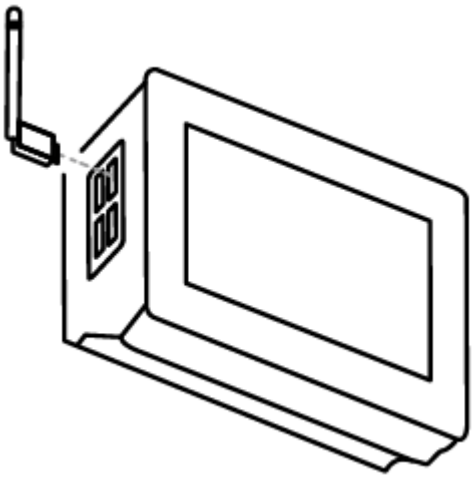
- A connection with an LAN cable as described in the wiring chapter. If Internet is available at your router, there is no special configuration to do.
- An wifi connection that can be selected in the second page of the internet connection configuration. Scan the available wifi, select one and enter your password.





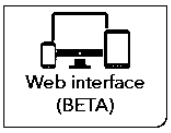
The wifi connection requires the usb-wifi stick provided by Studer. Don't use any other stick as there are drivers necessary and there is a high probability that it will not work.



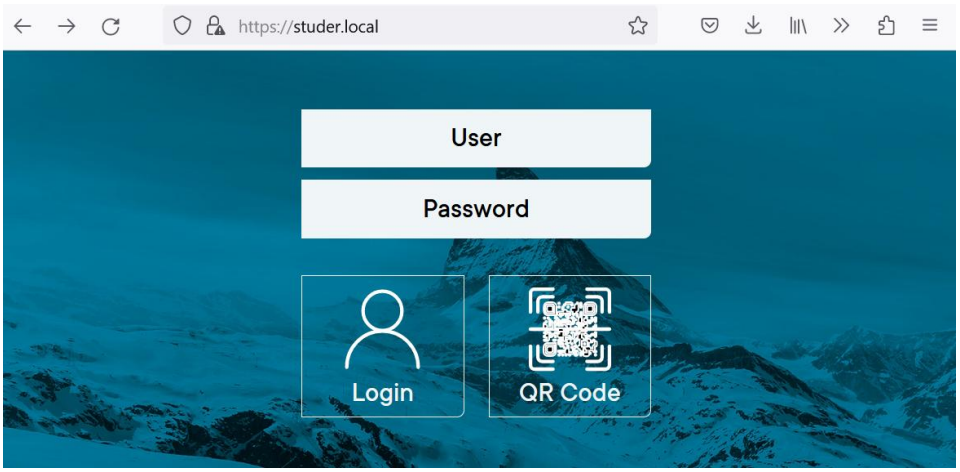


Local web interface via server

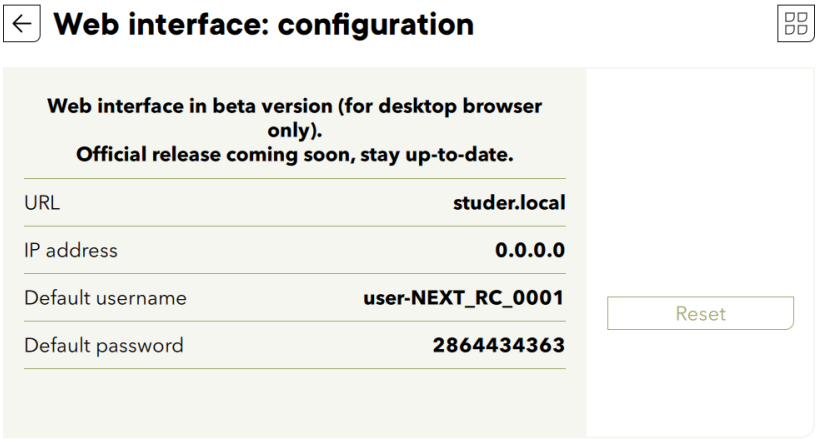
A web interface is available at address http://studer.local/ when the user is situated in the same LAN or WLAN as the next3 system.



A login is necessary to access the device for cybersecurity reasons.



The username and password are available on the dedicated nx-interface screen:



This is a beta version. More information and features will come soon…

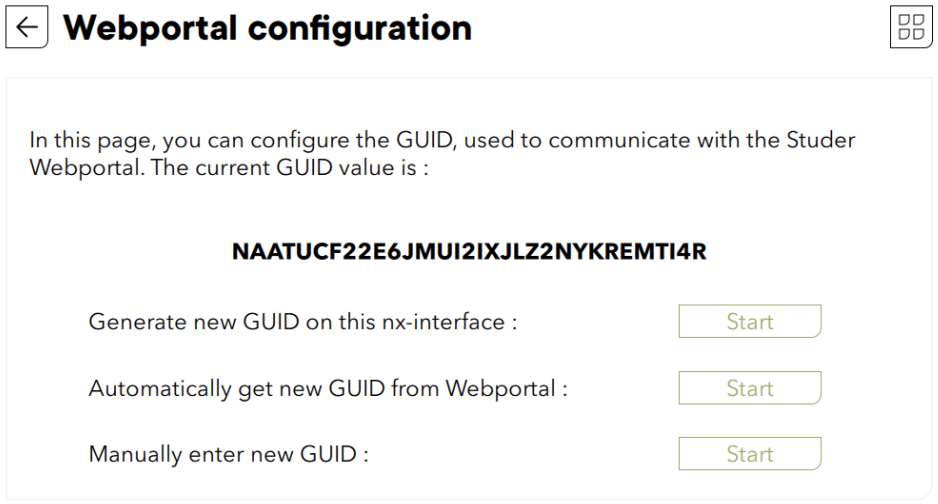
In case of troubles of connexion:

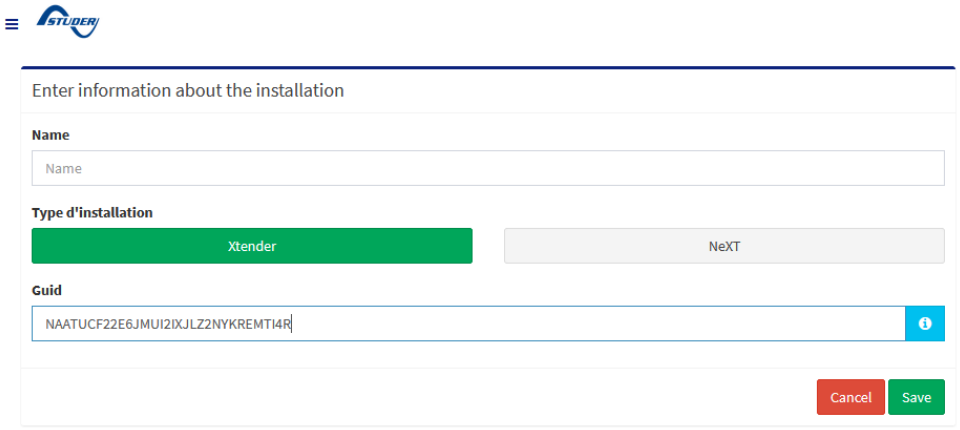
- Connect with the IP address and not the name studer.local in the address bar of your browser. Some routers don't work with the replacement name.

Remote Monitoring with Studer Web Portal (Internet)

The remote monitoring is done via the Studer Monitoring Portal: https://portal.studer-innotec.com

To connect an installation on the web portal, you'll need a to perform a pairing, which means you have to identify an installation and make the link to your portal account. This is none with a unique identification number called GUID that is entered on both side of the communication channel: in the next3 and in the web portal:



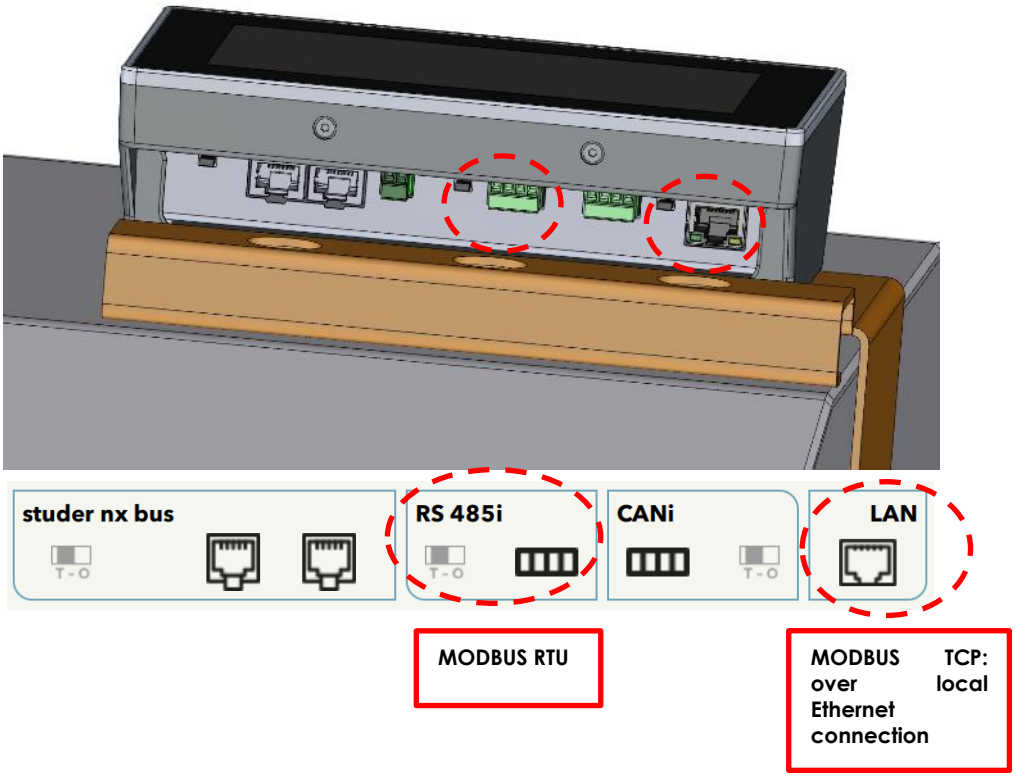


Never give the same GUID two times to two different installations. In case of doubt, use the automatic GUID generation

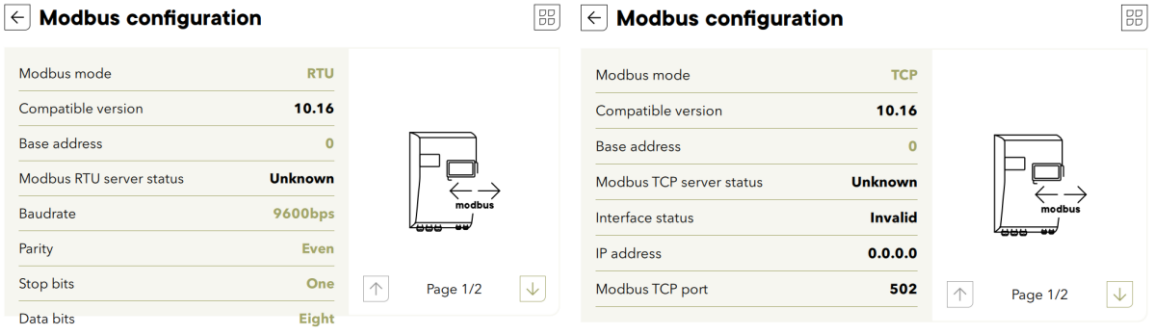
If a proper GUID is entered, the webportal info will be "connected and paired".
When all the csv files are transferred to the webportal, the datalog synch info will be "synchronised".

SCADA monitoring: MODBUS

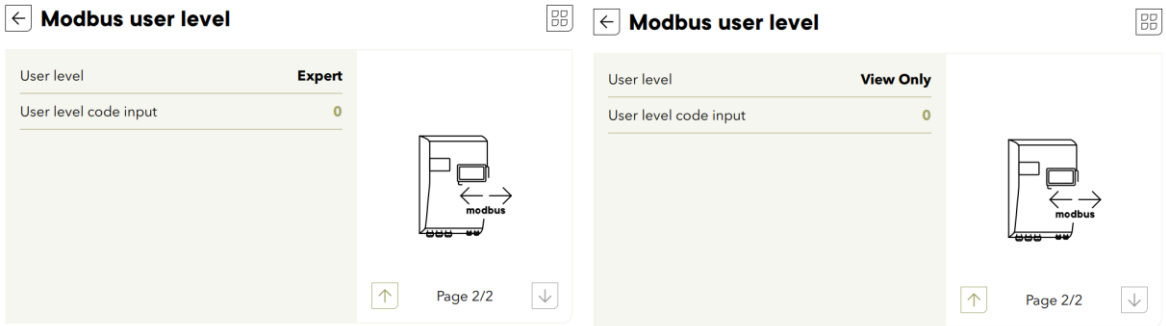
The user can develop its own monitoring and control of a next system with the use of MODBUS communication. Modbus RTU and TCP are supported. RTU with RS485 connection and TCP with the Ethernet connections, both situated on the nx-interface.



Only one Modbus mode at a time can be used. It is not possible to use RTU and TCP at the same time. This is selected with the "Modbus mode"



For security reasons, the Modbus is deactivated by default and there is a specific user level for the Modbus communication to limit the access through this channel. Per example use the View only to block all changes and accept only read requests. It is located on the second page of the Modbus menu:



The Modbus specification with the registers list is given in a dedicated document for developers.[2] Code examples is available on Studer GitHub: https://github.com/studer-innotec/next-modbus

[2] On Studer website, https://technext3.studer-innotec.com/modbus-next

8 CONFIGURATION AND OPERATION OF THE NEXT3 ENERGY SYSTEM

This chapter of the manual explains how to configure and operate the next3 with the nx-interface for each functionality of the next3 inverter. See the chapter about the nx-interface for its general use.

CONFIGURATION

Many settings can be changed to adapt the configuration of the next3 to the environment/system.

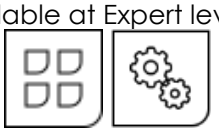
The nx-interface operates as a terminal and is not mandatory in a system. It can be plugged to the system and removed. When an inverter/converter setting is modified using the remote control (nx-interface), it is sent to the next3 and stored in the device permanently. If the nx-interface is removed from the system, this parameter continues to be used by the next3 with this modified value.
If the next3 is de-energized and then energized again, the settings can be retrieved from the non-volatile memory. This allows for example to pre-program a next3 at the workshop and to supply it to a customer, ready for his specific application.

The settings are secured against inadvertent or unauthorized change by the user level. The change of the user level is protected by password and must not be done by unauthorized personnel.

The next3 cannot operate until a regional setting (grid code) has been selected during the configuration wizard. The configuration wizard shall be done by an authorized person. If the initial configuration is not finished, the inverter does not start and the ! red light of the front panel blinks permanently. That means without a proper selection/activation of the regional configuration the inverter doesn't start and doesn't connect to the grid.

8.1.1 Configuration Wizard

At the first commissioning of the next3 a configuration assistant called the "Configuration Wizard" will be automatically started on the nx-interface. With a set of questions, the user is invited to configure the next3. Very specific settings can always be accessed later in each component's menu.
The process with the wizard is mandatory for new installations and with multi-unit systems.
It is also possible to run it later by going to the nx-interface menu "Installation Configuration" (available at Expert level).

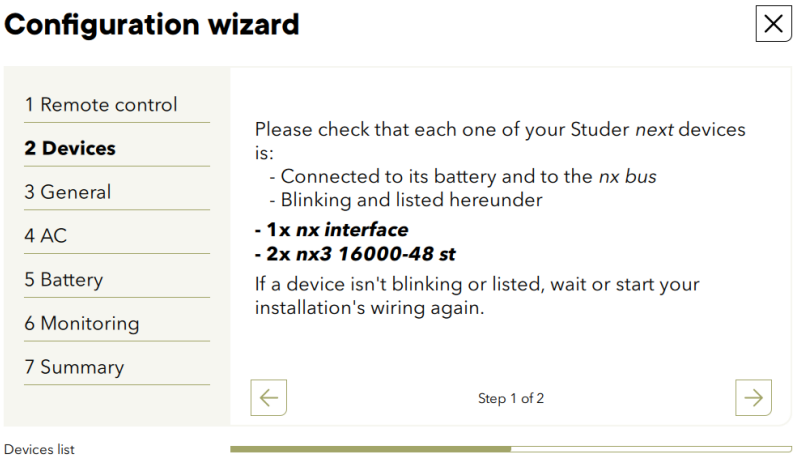
Path:  launch→ 

It will reset all the settings with the factory values according to your configuration/answers to questions. Old configurations are completely erased with a wizard process.

	During the wizard process, the installation is stopped, and the AC power supply is stopped. Choose the proper moment to perform a configuration wizard.

	The use of wizard is mandatory in case of multi-unit systems. That means an nx-interface is mandatory for the commissioning of multi-unit systems.

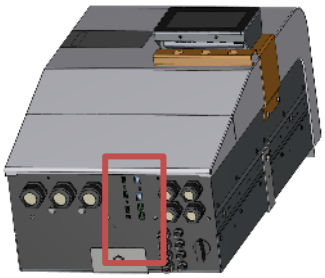
After a few questions for the remote control / nx-interface configuration (time, date, …), a scan of the devices present on the communication bus is performed:

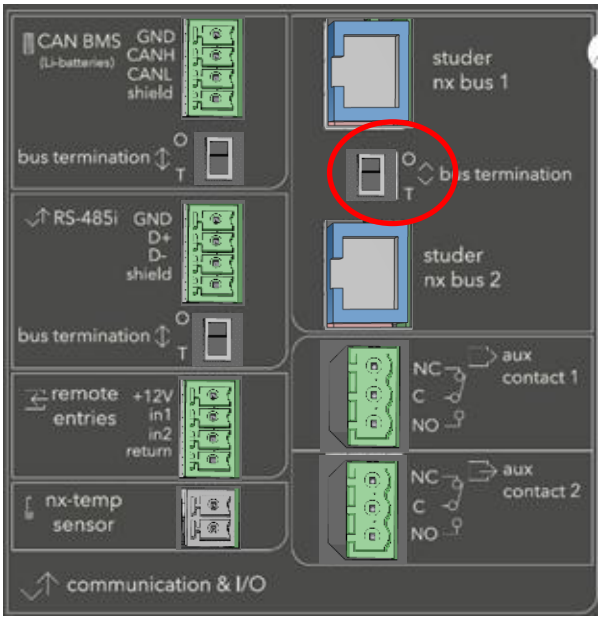


Check that all the elements you want in the system are connected. LEDs of front pannel of the next are all blinking during this process. If not, that means the communication cannot be established. Check the communication cabling (presence of cable and termination switch) and that all the units are powered on (energized from a battery).

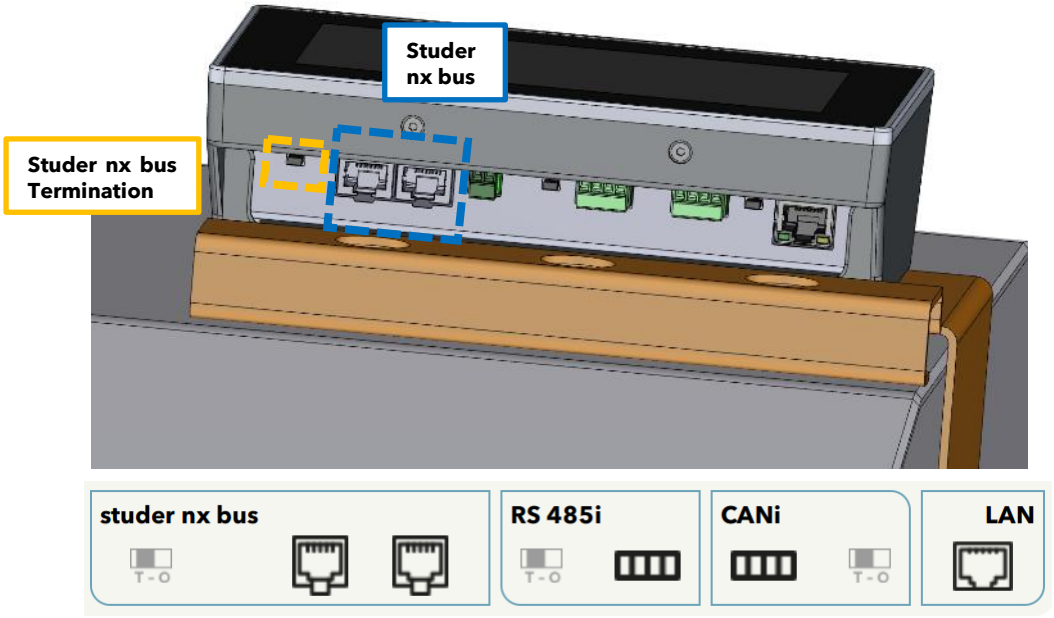
On a can bus, impedances are connected at the two ends of the communication line to "terminate" the line. Without those terminations as pull down resistors, the communication doesn't work at all. If the system doesn't see any nx3 in the system, check the nx bus termination switch on each device. It has to be on 'T' at the end of the line (when there is only one communication cable to the device) and on 'O' in between (when there are 2 communication cables to the device).
In the next step, the system checks that 2 impdances are activated:

The termination switch is at the bottom of the next3: set T for terminated and O for open

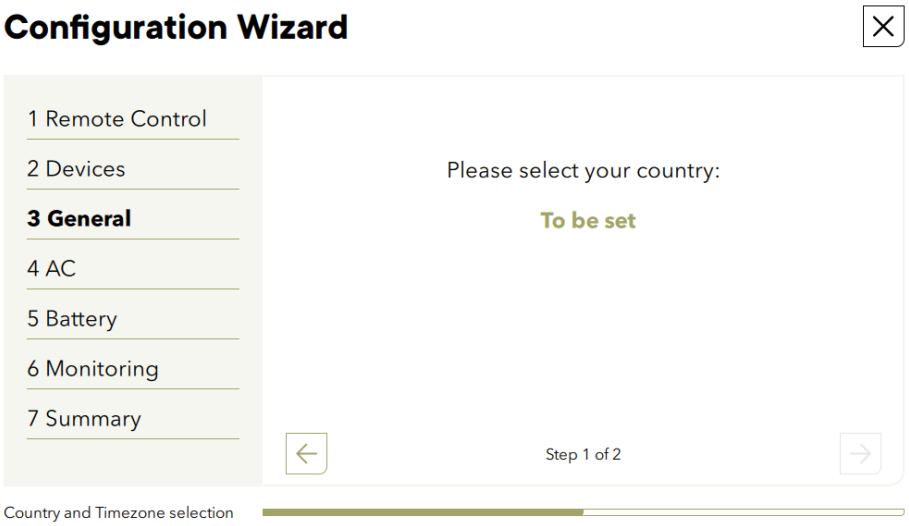




And on the nx interface:



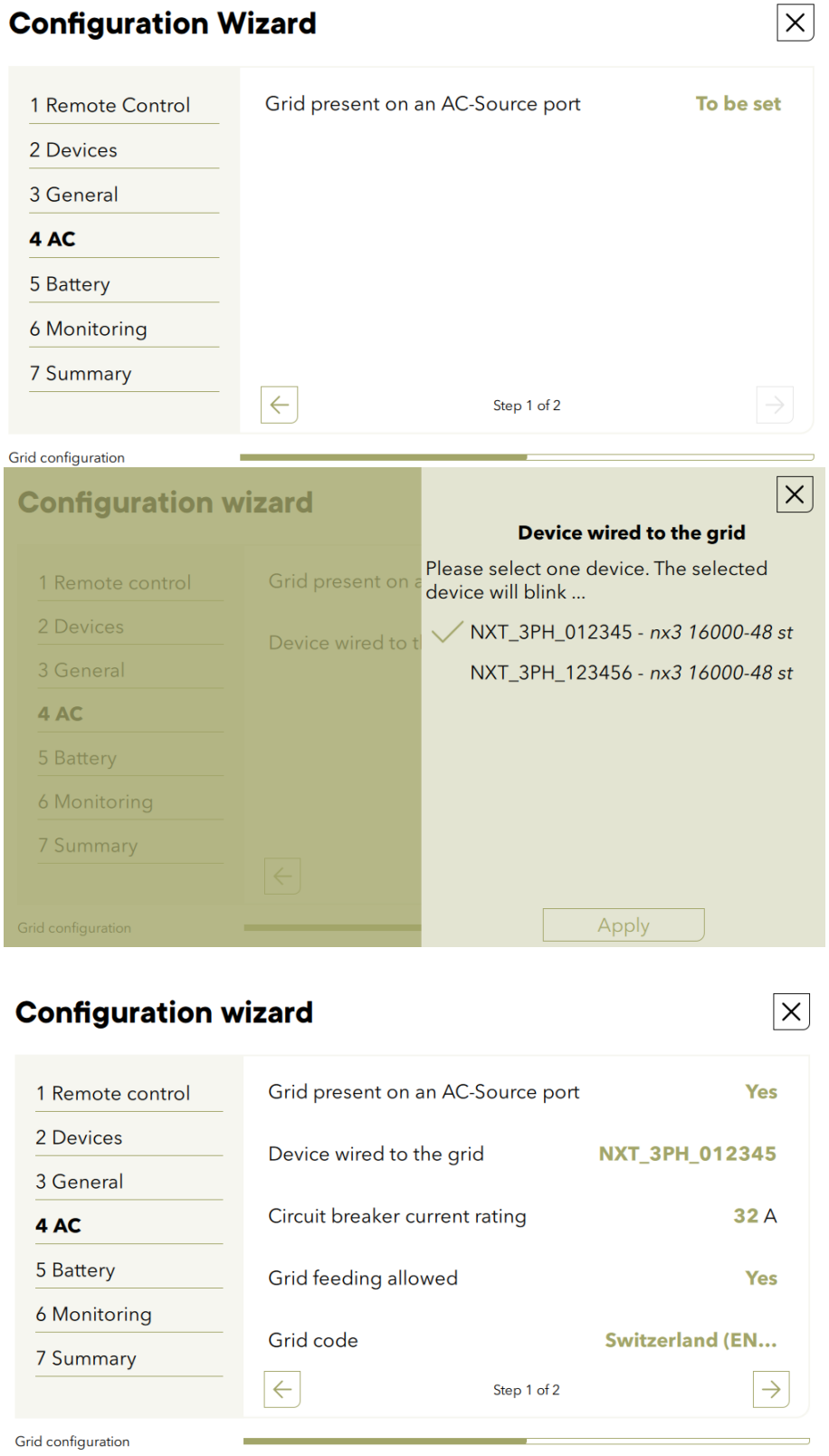
Once all devices are connected and detected by the nx-interface you can go forward. The country and time zone is set in the point 3: general:



The country selection doesn't influence the grid code choice that is set with the AC configuration (to cope with different local rules in the same country):

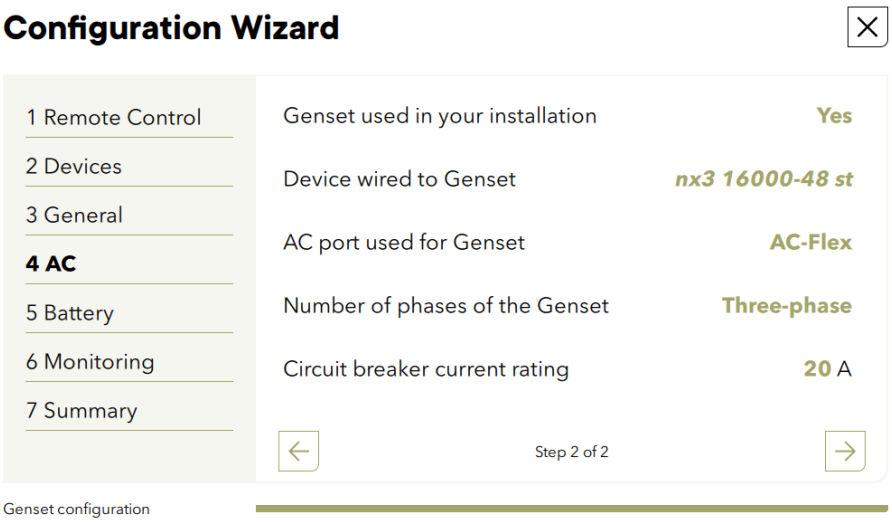
Next step contains the question about the AC (sources and loads)

- First question is to know if there is a grid or not connected to AC-source. The grid is always assigned to the AC-source due to the double security relays.
    - If YES the properties of the grid connection are asked:
        - introduction amps (circuit breaker size)?
        - Is grid feeding allowed or not?
        - Which grid code must be used? the grid code must be set according to the DSO requirements.
    - Those values cannot be changed later except with a complete reset of the system.
    - In a multi-system, you must indicate which device is physically connected to the grid as there is only one device/transfer used per system. The selected device is blinking for a visual check.
    - Don't connect a genset on the AC-source programmed for grid as the configuration is very different. If you have a genset, simply say no to this first question and the genset question is on the next page.

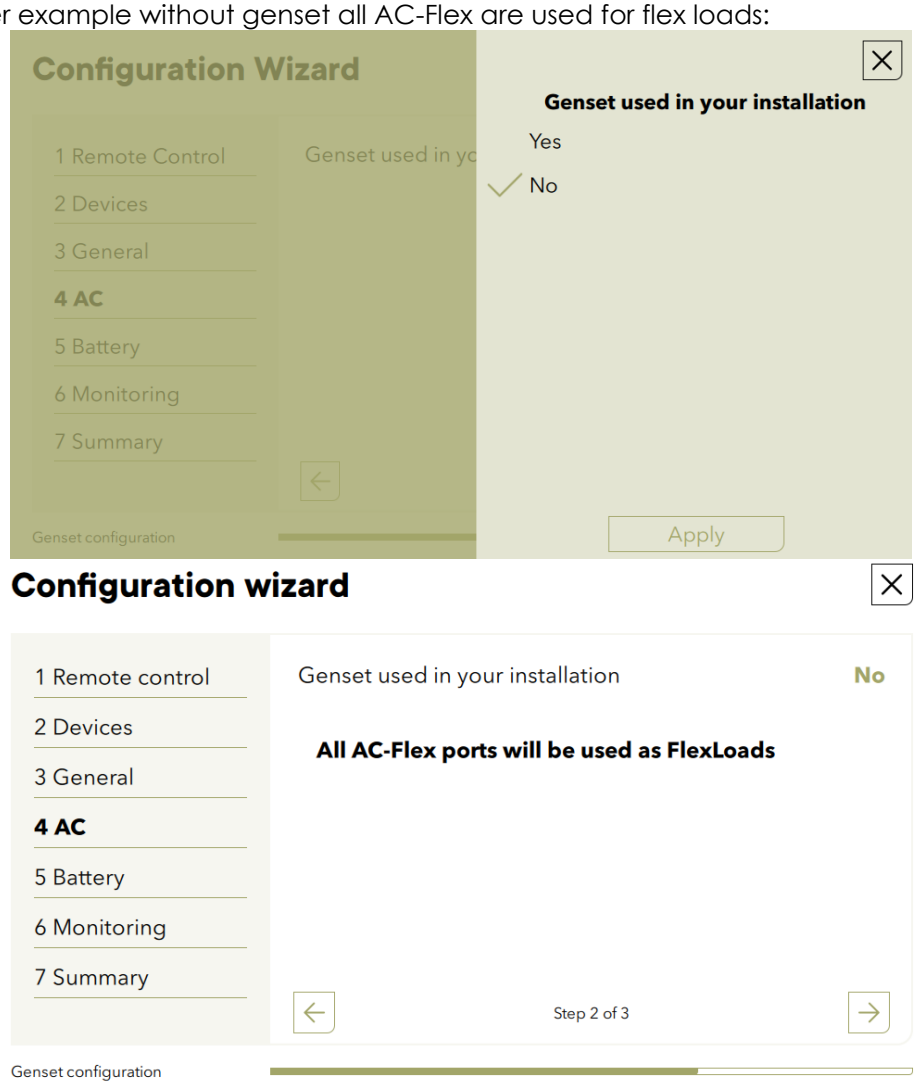


Use of the proper grid code is a legal requirement; you must be sure (as installer) to respect the local regulation. Associated with a general grid code (like the EN-50549), there can be special local settings. In case of doubt contact your local DSO (Distribution System Operator) before selecting the grid code in the country list:

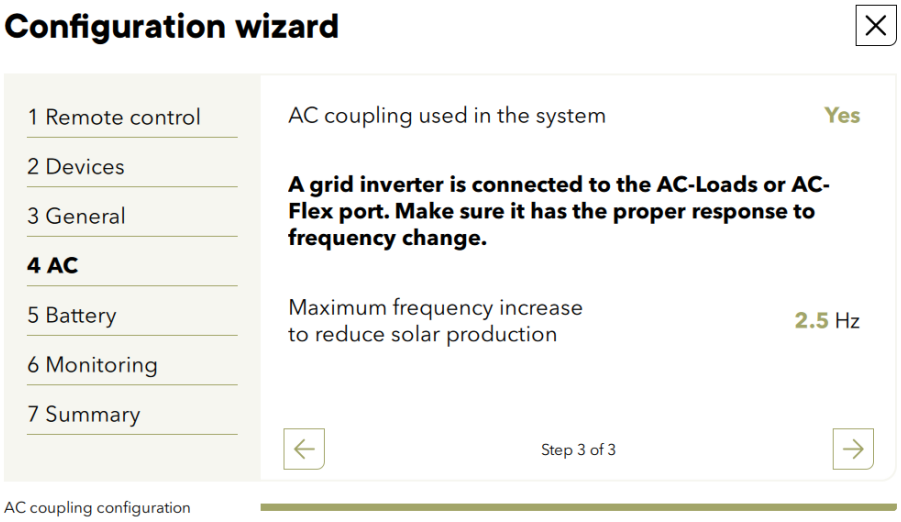
- Then comes the genset question to know if there's one in the system:
  - If there is a genset, the user must indicate to which connection it comes. A genset can be connected to the AC-source or the AC-flex connection.
    - In a single device system, if the AC-source connection is used by the grid, only the AC-flex is left. If there is no grid (OFFGRID), the user has the choice to use AC-source or AC-flex. It makes more sense to use AC-source as it leaves the AC-flex for loads.
    - In multi-units system, if there is a genset, the connection could be done on any of the free AC-source or AC-flex and this must be indicated. It is better to use an AC-source connection if possible and let the AC-flex free for loads.
  - The maximal power taken from the genset will be the lowest of the power given and the current limit.
    - When a genset is three-phase the power is divided by 3, and the power limited by the current of the circuit breaker expects a 230Vac.
- All AC-flex that are not explicitly given as AC inputs will be configured as loads, even if there is no specific question asking for it.



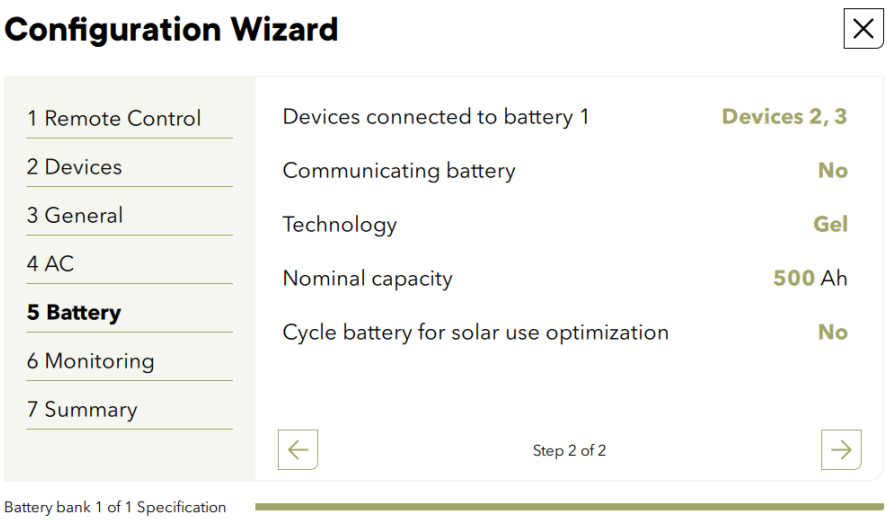
Per example without genset all AC-Flex are used for flex loads:



And last point for the AC is the question for the AC-coupling. If the grid inverter is connected to the AC-FLEX connection, you should make the proper settings for the AC-flex relays. See the AC-coupling chapter at the end of this manual for details.



- Then come the battery questions with, first, the choice if the battery is communicating or not is done. If not (simple lead acid batteries for example), then you must enter the type and the capacity in Ah.



The capacity is asked in Ah, if this is not given directly by the manufacturer this is obtained with the formula: kWh / voltage x 1000
The non-communicating batteries are generally lead batteries. Choose the appropriate type in the proposed list. In case of doubt select AGM batteries: it has the less risky levels (lowest voltages) for any types of batteries, even if the charging would not be optimal for other cases:

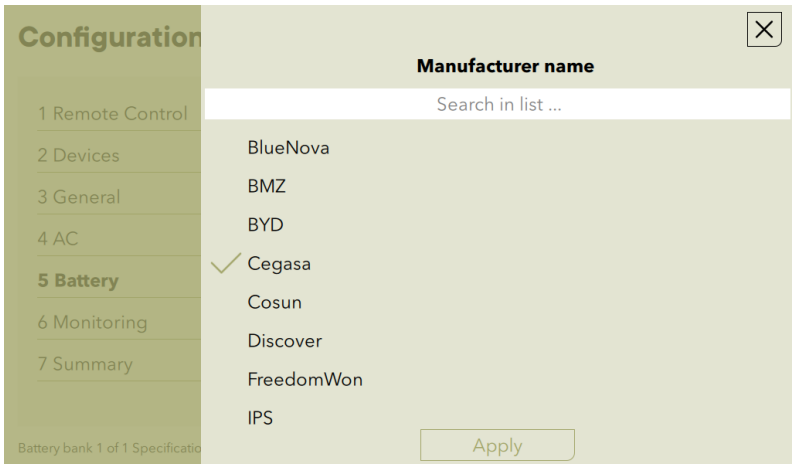
Battery type	Floating voltage	Absorption voltage/period	Equalization	Charge current
Flooded Lead Acid (without equalization)	54.4V	57.6V / 2h	No	C/5
Flooded Lead Acid (with periodic equalization)	54.4V	57.6V / 2h	63.2 V during 30min- every 30 days	C/5
GEL	55.2V	56.8 / 2h	No	C/10
AGM	53.6V	57.2V / 2h	No	C/3

There is no reduced floating phase or periodic absorption phase for any of those choices by default.

If you are not satisfied with one of those pre-sets, you can go to the battery menu later and adjust the levels as you want.
The battery capacity is generally given in Ah for lead batterie and other special types. For a battery bank composed of many cells, the arrangement gives the total capacity. To calculate the capacity, only one cell capacity must be considered in a series and not the sum. If the battery bank is composed of several series/strings in parallel, the total capacity is the sum of the capacities in parallel.
Per example a with 24 units of a 200Ah/2V cell in series, the total battery bank is 200Ah 48V. With 72 cells arranged in 3 strings of 24 units, the bank is 600Ah 48V.

To determine the charging current, the most frequently used value is of one fifth of the battery capacity. Ex. for 500Ah: 500/5 = 100A. See manufacturer indication for details.

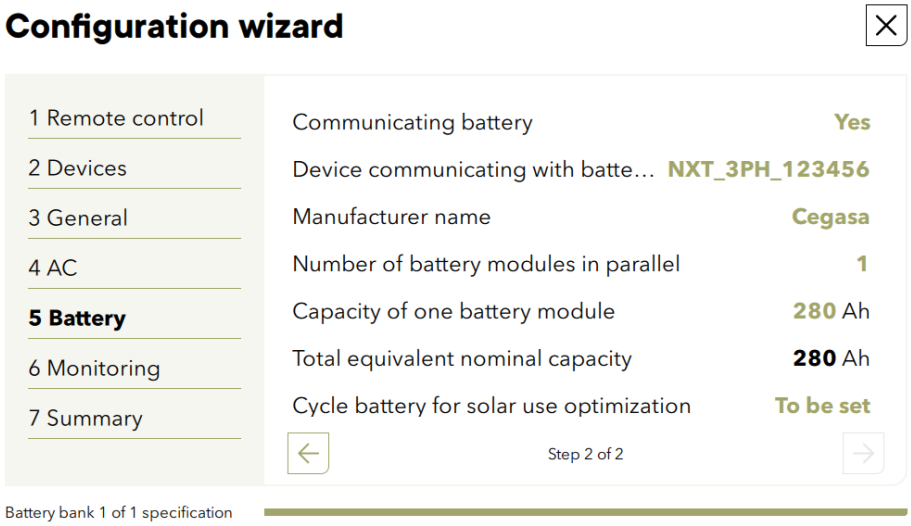
- If the battery has a communication BMS (typically for lithium battery), you'll have to choose the manufacturer in the list for the next3 to use the proper communication protocol. Verify that the manufacturer is in the compatible list.
  If it is not the case, contact your provider to avoid any mistake which can lead on problems in your installation.



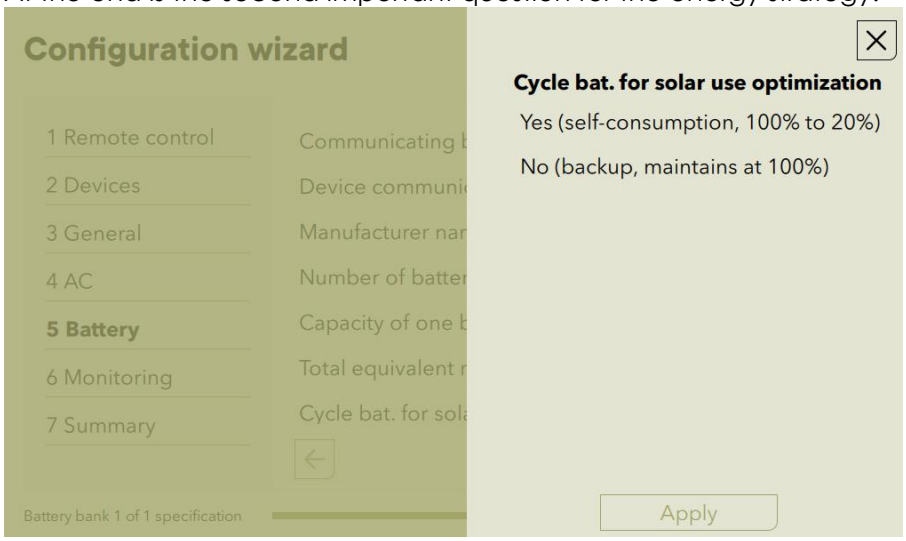
Then enter the capacity of the battery. Very often the lithium battery has a capacity given in kWh and not in Ah. Convert with the following formula:

*Capacity in kWh *1000/Battery voltage =Capacity in Ah*

For example, a 10kWh at 50V battery has 200Ah.

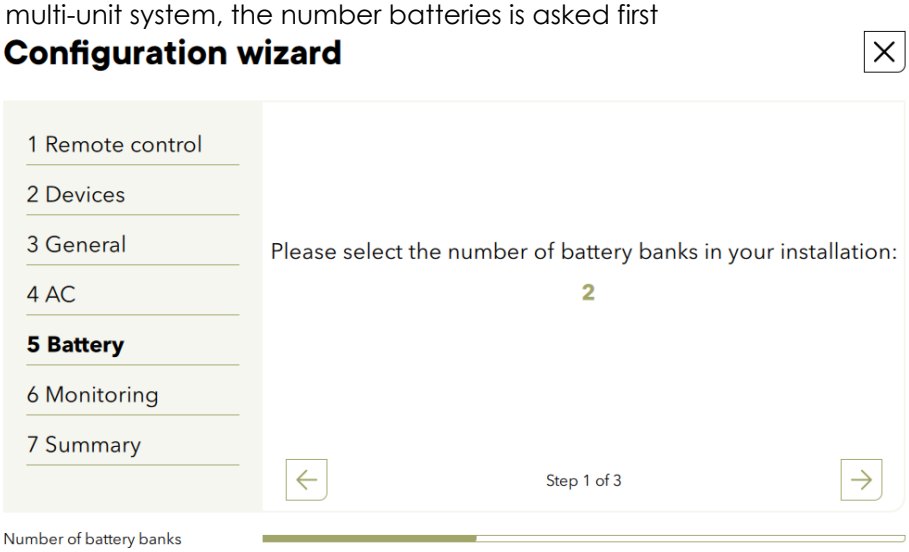


- At the end is the second important question for the energy strategy:

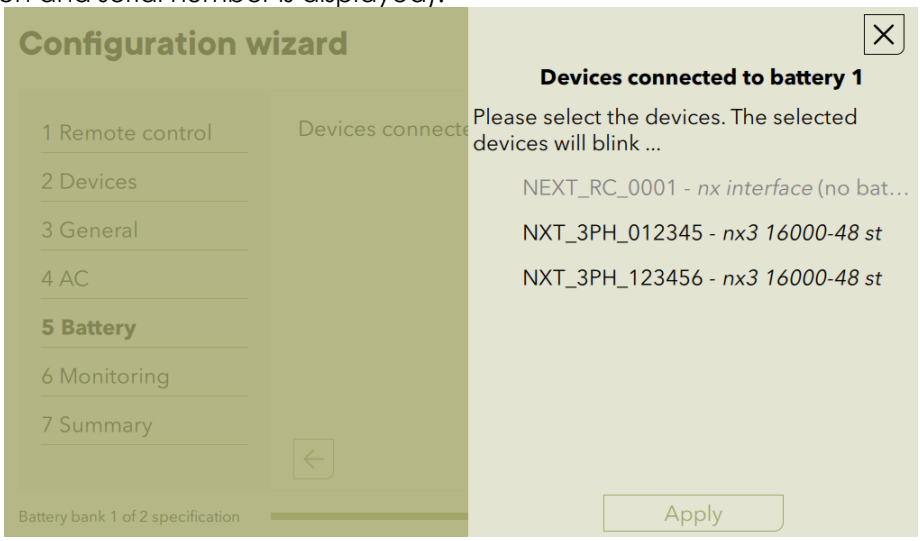


If the battery cycling is wanted (charge-discharge frequently), the SOC for backup will be set to 20% (for lithium and 50% for lead acid). If not, it will be set to 100%.

- In case of multi-unit system, the number batteries is asked first



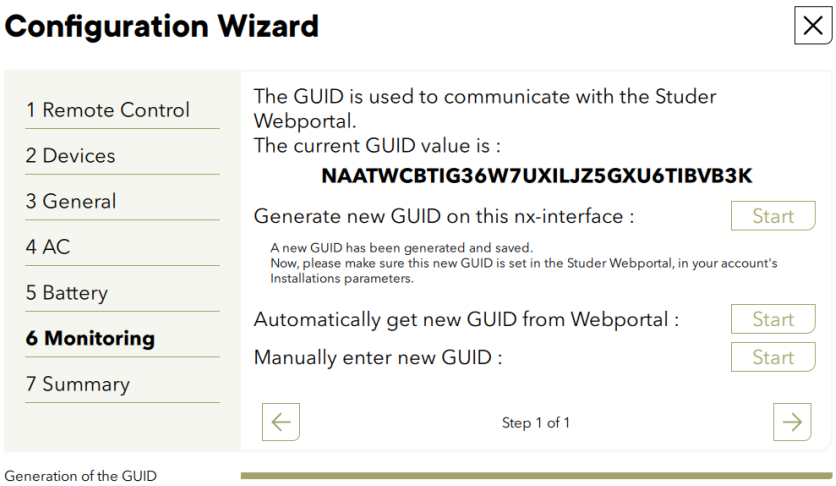
And then each battery must be associated with its next3 correctly (with the blinking of LEDs identification and serial number is displayed).



For a single battery in a system with multiple next3, it is necessary to say which next3 is physically connected with the CAN communication cable as only one device communicates to the BMS.

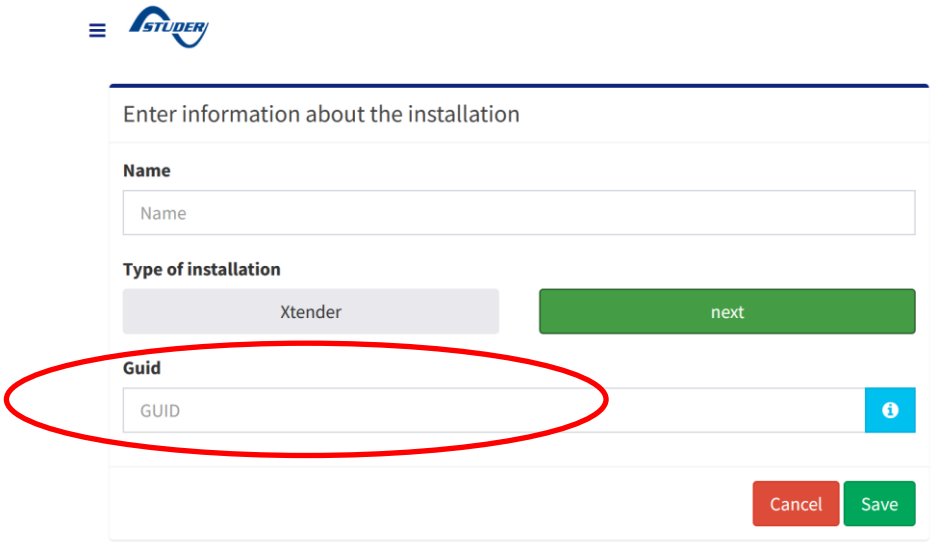
- If your next3 is connected to internet and to the Studer web portal (www.portal.studer-innotec.com) you must make the pairing with your account. This is done with the unique number called GUID. Copy exactly this number on both side for pairing. A GUID can be

generated by the nx-interface, or by the web portal.

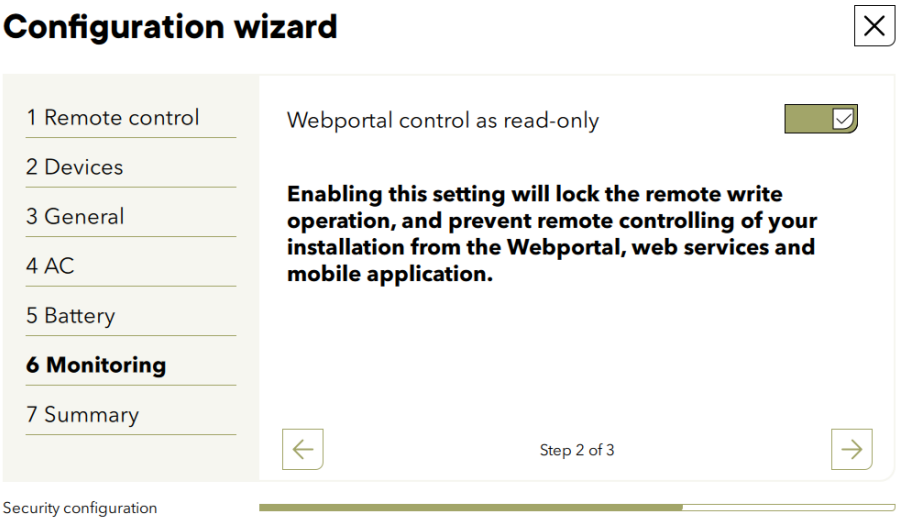


Generation of the GUID

This GUID must be copied on the webportal in the GUID field when creating a new installation:

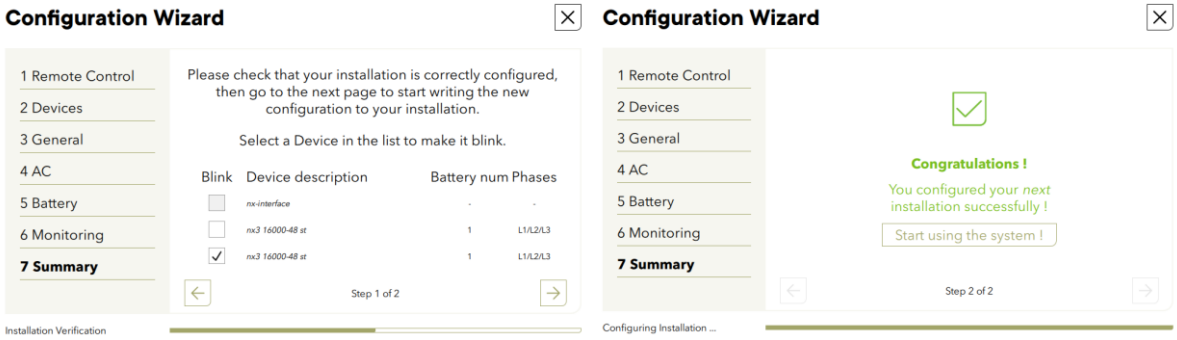


The remote monitoring can be restricted to "view only" access. This option is check by default (security by default). Uncheck it if you want to be able to change remotely setting after the commissioning. This can be very useful for the installer to avoid to travel physically to the site for some adjustments. The communication infrastructure of Studer-Innotec is up to date and secure but some customers want this restrict this functionality and option is available.



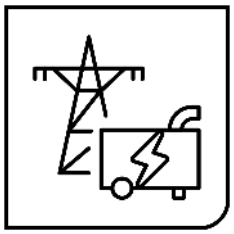
Finally, the terms and conditions of the webportal must be accepted for privacy reasons. The load curves are personal data and the end user must give its agreement that the data are sent to Studer-Innotec. Else the next3 will work normally but will not connect to the portal.

- Final check: a summary of the installation is given and the configuration process is finished. Press "Start using the system!"



After the first configuration with the wizard, the next3 is ready to be used.

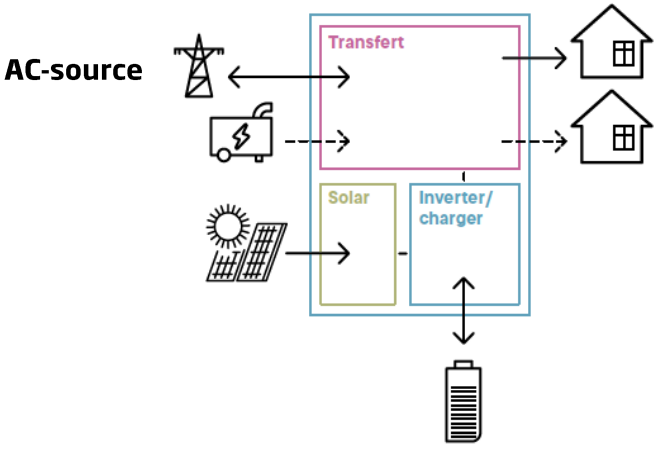
AC-SOURCE

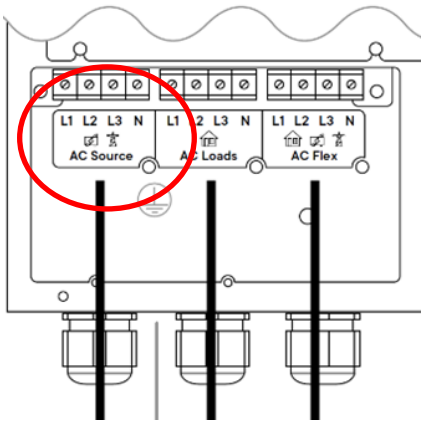


8.1.2 General information

The next3 is a hybrid inverter charger, that can work in a stand-alone (offgrid) mode or connected to an external AC source, being a grid or a generator.
The next3 has a connection named "**AC-Source**" where the main AC source is connected: the grid or a generator.
This input:

- is limited to 80Aac and is designed for 3 phases system 400Vac with neutral.
- has a high security level with double security relays for disconnection according to VDE-AR-N 4105, EN 50549-1, IEC/EN 62109-1 and other standards. In case of connection to a distribution grid, always connect the grid to AC-Source. The proper opening of the relay is checked with measurements.
- is unique in a system. Only one AC-Source is physically connected in a system even with multiple next3 devices.

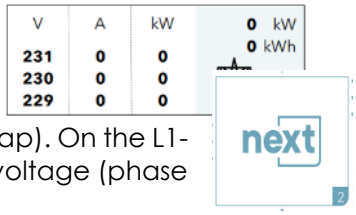




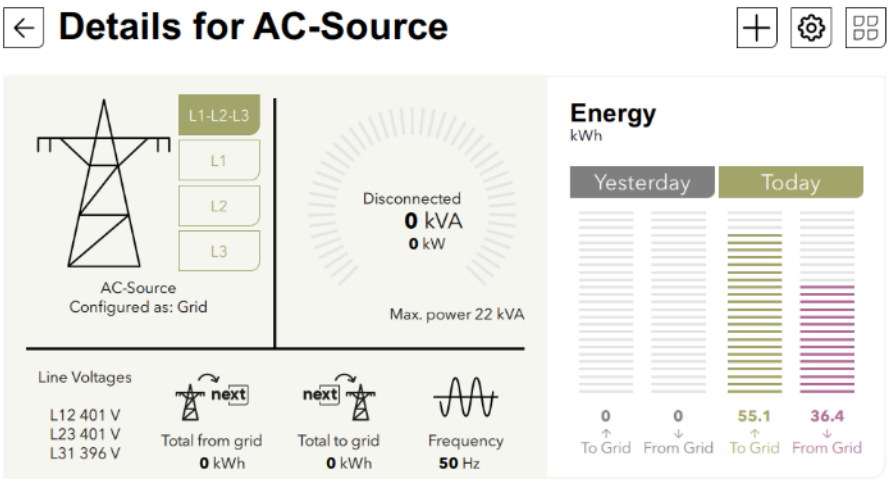
- The maximum accepted voltages at the input are by default (for grid connection, VDE values):
  - 125% of nominal voltage for 10ms (for fault ride thought: 230*1.25=287.5V
  - 120% for 5 second: 230*1.2=276V
  - 115% for 60sec means: 230*1.15=264V

8.1.3 AC-source Information

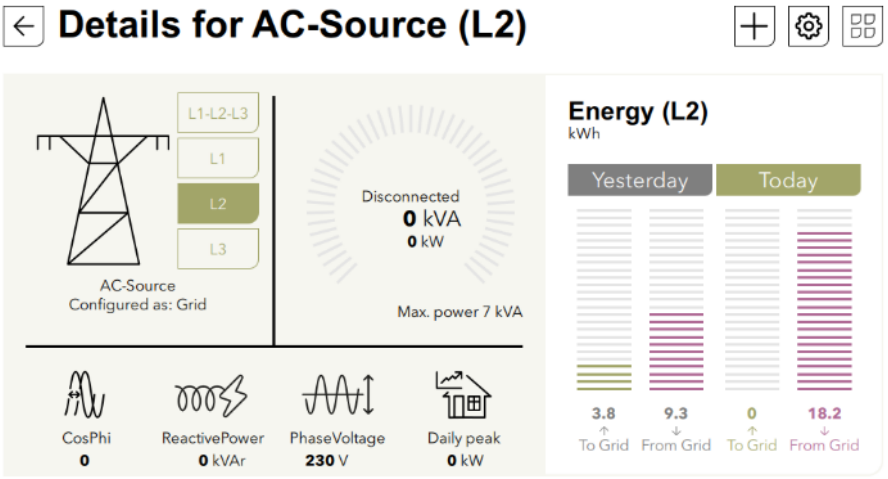
The detailed information about the grid is available by clicking on the AC-source picture of the synoptic screen (see screens map for an overview of navigation).



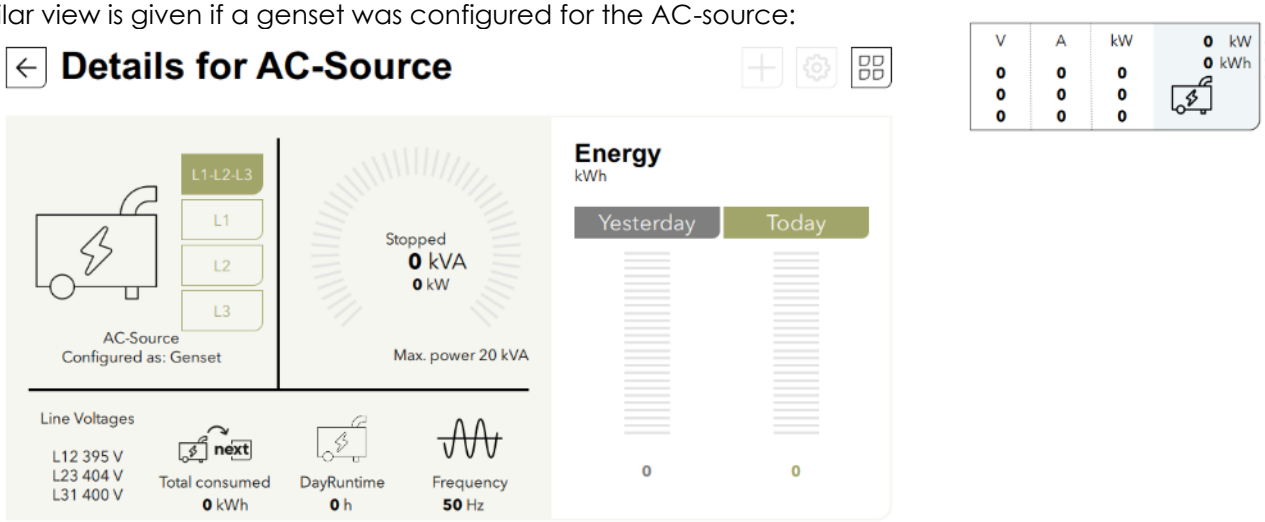
There are dedicated screens for AC-source information (see the screen map). On the L1-L2-L3 screen, the sum of all phases is displayed as well as the composed voltage (phase to phase).
The scale for the max power is given with the current given by the maximal power introduced during the wizard process.



The detailed information about all voltages and currents for each phase is available with a click on the phase number:



Similar view is given if a genset was configured for the AC-source:



The full list of available information is accessible with the '+' and is described in the appendix. Unique identification numbers are used to clearly identify each information value.

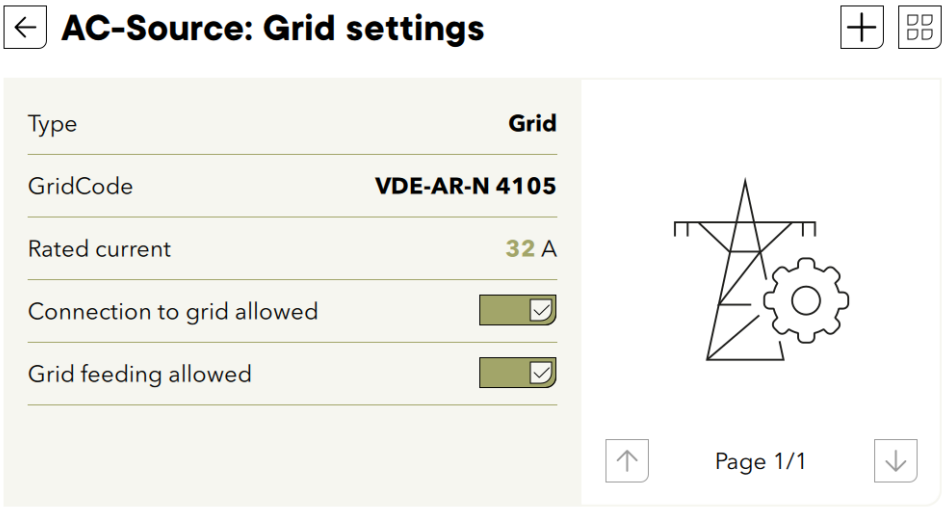
AC-Source : Information list

PreviousDayPeakActivePower	**0** W	ID 2.1.1.37
2.1.2 - L1		
Frequency	**50** Hz	ID 2.1.2.0
PhaseVoltage	**231** V	ID 2.1.2.4
Current	**0** A	ID 2.1.2.8
ActivePower	**0** W	ID 2.1.2.12
ReactivePower	**0** VAR	ID 2.1.2.16

8.1.4 AC-source Settings for Grid

The wizard is mandatory for a proper setting of AC-source as many points are configured during commissioning and cannot be changed later. Carefully read the questions to avoid mistakes in your answers.
One example is the grid code setting that must be set according to the DSO requirement by the qualified installer and cannot be changed later by the end-user. The end-user has no access to this parameter as it is protected by the EXPERT code.

At BASIC level only the following settings are accessible:



Concerning the grid code, the anti-islanding function implemented is based on the power variation method (called also "vector shift" method in EN and VDE). The reactive power management with functions Q fix, Q(U), cosφ fix and cosφ(P) can be configured, if necessary, after the wizard. The general control function (section 6 of AS-NZS 4777.2) is not implemented. The multiple inverter combination (section 5 of AS-NZS 4777.2) does not apply as the next3 is an all-in-one three phase inverter.

Reactive power management

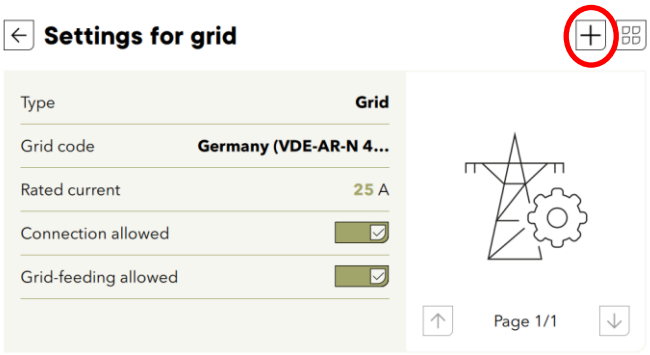
Power injection in networks has the effect of increasing the voltage due to the impedance of the line. This is the opposite effect of the voltage drop with consumers. To compensate for local voltage increases in the network due to distributed generators, the DSO can require that the distributed devices produce reactive power.

It is possible to activate various operating modes managing the reactive power in the next3:

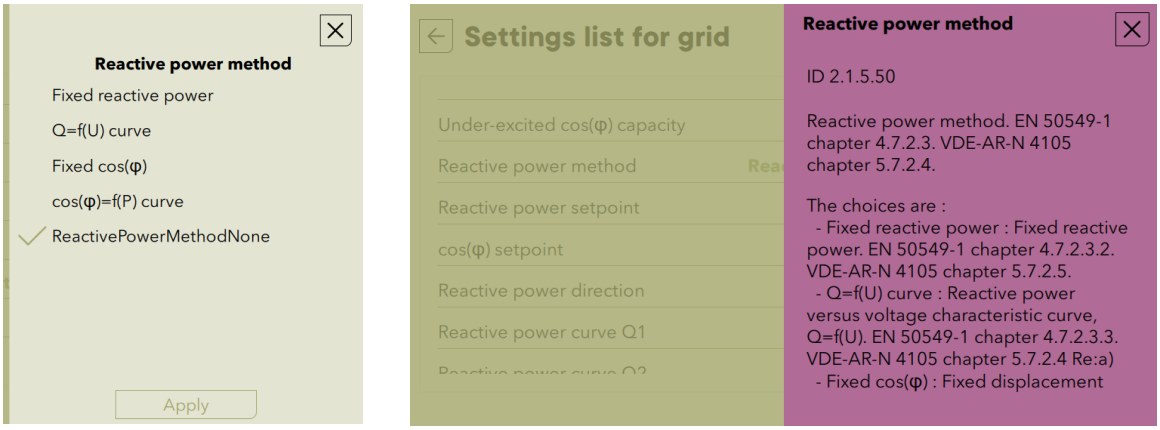
- Generate at a certain cos(phi) :
  - Fixed
  - Depending on the active power produced
- Generate reactive power depending on the voltage
- Produce reactive power directly.

The injection of reactive power, in addition to the production of energy with active power, makes it possible to correct the effect of the active power. This is highly dependant on the impedance (Z) of the line/cable, if it is more resistive (R) or reactive (X).
Do not activate these functions without the approval of the DSO. They must be calculated by him according to the properties of the lines. The production of reactive power generates losses in the next3 device and in the lines and is not necessary in most cases.

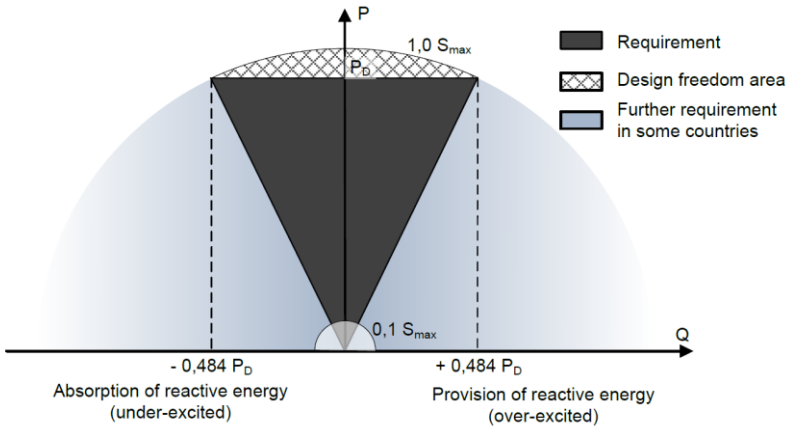
These settings are accessible in EXPERT(=Professional) mode. They are located in the network section of the nx-interface. Use the " + " button to access the list of advanced settings:



The choice of the type of reactive power production is made with parameter 2.1.5.50.



The maximum reactive production range required by the standards is a cos(phi) of +/- 0.9. Beyond this, the inverter is not obliged to supply reactive power and this limit is respected in all operating modes.



The sign convention used in the settings is identical to the figure above. The reactive load of the inverter (= as an inductive load that reduces the voltage) has a negative sign.

The details for each of the operating modes are:

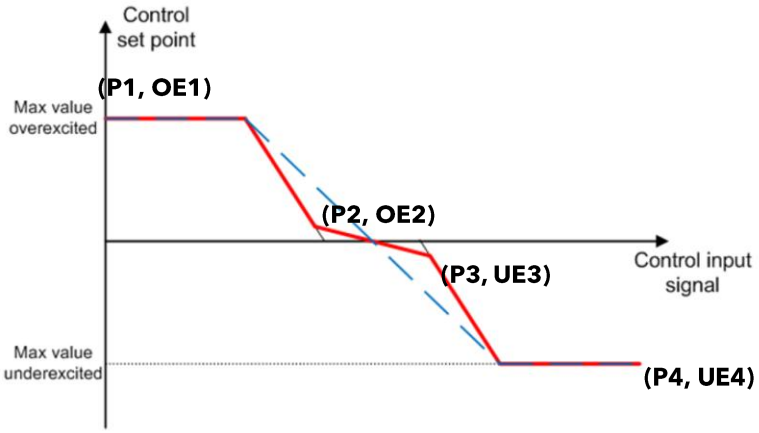
- For fixed cos(phi) :
  - Set the desired cos(phi), typically 0.96
  - Use underexcited, i.e. as an inductive load so that the effect is a voltage drop on an inductive line.

cos(φ) setpoint	1	ID 2.1.5.52
Reactive power direction	Under-excited	ID 2.1.5.53

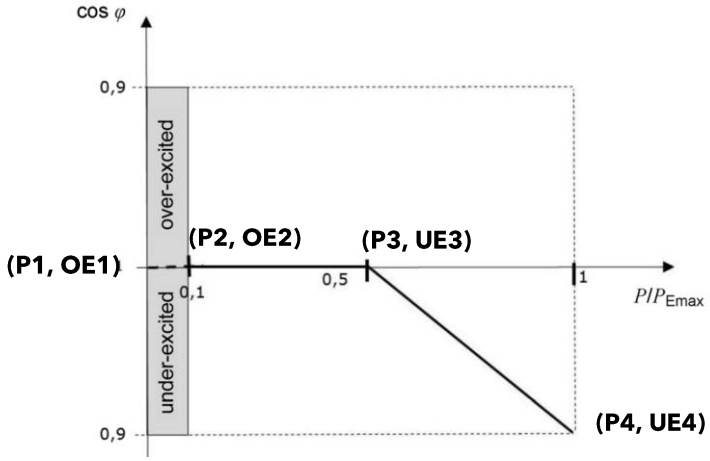
- For cos(phi) versus power: it is possible to define the point at which the reactive power is produced. Indeed, when the production is low, the voltage increases are small and do not require countermeasures. The signs of the reactive power produced are explained with the titles :
  - OE=Over-Excited
  - UE=Under-Exited

React. pow. curve cos(φ) OE1	1	ID 2.1.5.66
React. pow. curve cos(φ) OE2	1	ID 2.1.5.67
React. pow. curve cos(φ) UE3	1	ID 2.1.5.68
React. pow. curve cos(φ) UE4	0.9	ID 2.1.5.69
Reactive poewr curve P1	0 %	ID 2.1.5.70
Reactive poewr curve P2	10 %	ID 2.1.5.71
Reactive poewr curve P3	50 %	ID 2.1.5.72
Reactive poewr curve P4	100 %	ID 2.1.5.73

The general curve is given below:



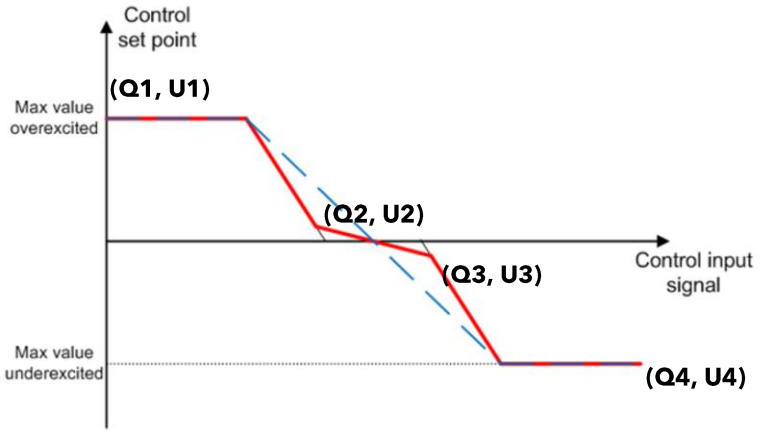
And its typical use is:



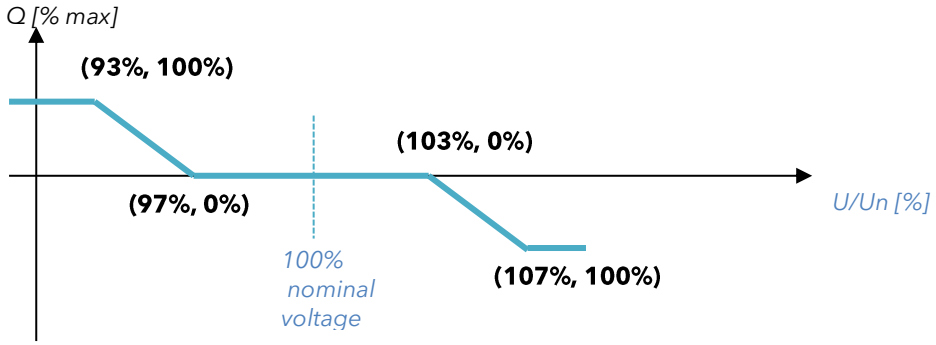
- For cos(phi) versus voltage: in this case, reactive power is produced only if the voltage increases (or decreases) according to certain thresholds. The maximum reactive power (100%) corresponds to a minimum cos(phi) of 0.9.

Reactive power curve Q1	100 %	ID 2.1.5.54
Reactive power curve Q2	0 %	ID 2.1.5.55
Reactive power curve Q3	0 %	ID 2.1.5.56
Reactive power curve Q4	-100 %	ID 2.1.5.57
Reactive power curve U1	93 %	ID 2.1.5.58
Reactive power curve U2	97 %	ID 2.1.5.59
Reactive power curve U3	103 %	ID 2.1.5.60
Reactive power curve U4	107 %	ID 2.1.5.61

The control signal is the voltage and the controlled variable is the reactive power:



The typical use of this function is given below:



- For fixed reactive production: use setting ID 2.1.5.51 in % of nominal power. It is useful for a system where an external controller dynamically manages the reactive power by sending instructions via Modbus. The reactive power is limited by the cos(phi) min which is 0.9 by default.

Reactive power setpoint

ID 2.1.5.51
Unit [%]

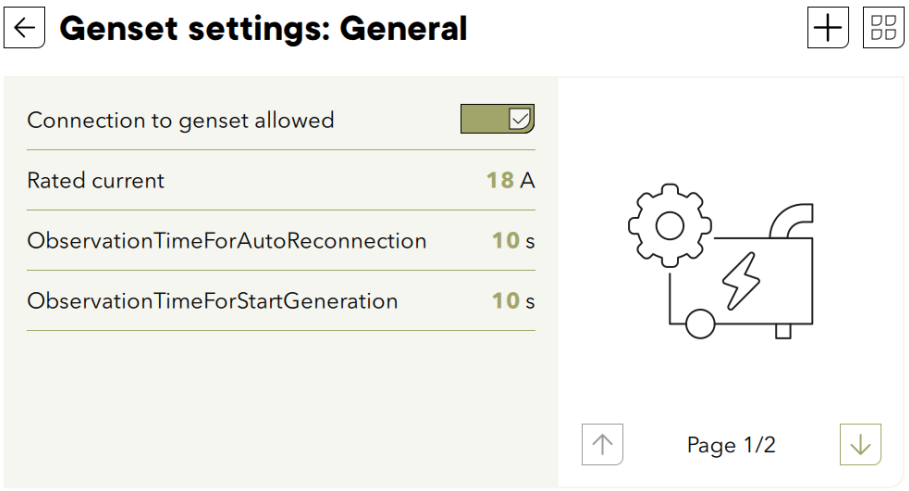
Produced reactive power setpoint, percentage of rated active power. Negative value for a consummed reactive power. EN 50549-1 chapter 4.7.2.3.2. VDE-AR-N 4105 chapter 5.7.2.5

Note: In case of stability problems the reaction speed (PT1 filtering) can be adjusted with ID 2.1.5.62. Details can be found in the VDE and EN standards mentioned as reference.

8.1.5 AC-source Settings for Genset

The wizard is mandatory for a proper setting of AC-source as many points are configured during commissioning and cannot be changed later. Carefully read the questions to avoid mistakes in your answers.

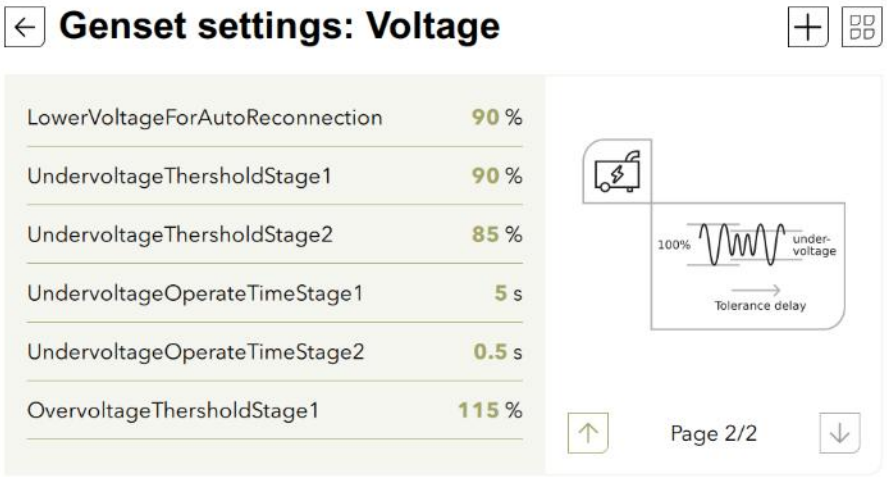
If the source is a genset, the available settings are given on 2 screens:



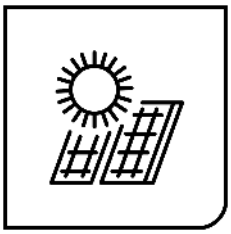
The rated current taken on each phase can be changed on the fly when the generator is running to adapt to its real ability.

The *Observation Time* can be understood as a delay for the genset to warmup.

The tolerances on the voltage fluctuations of the genset can be adapted:



SOLAR PV



Two strings of solar photovoltaic modules can be connected to the next3 with two independent MPPTs. Indications about the connection and dimensioning of the PV array is given in the "*Wiring*" chapter 0. Be careful to meet the electrical specifications and never exceed the maximal values to avoid damaging the unit.
This section explains the operation of the solar MPPTs. All information and settings are accessible via the nx-interface.

8.1.6 General information

The next3 is a renewable energy friendly converter and always try to optimize the solar part in the system. For a standard user, there is nothing/little to modify for the solar converter: as soon as there is solar energy, the next tries to use it first.
All the settings about this general behaviour are set during the "Wizard settings" process. During operation, all the limits and constraints are automatically managed by the NX3. Power production and storage is optimally dispatched in the system thanks to the OPFD technology (Optimal Power Flow Dispatcher®).
The solar grid feeding can be authorized or disabled depending on the AC Source type: grid or genset. There are dedicated screens in the AC-source settings on the wizard where you chose if grid feeding is allowed or not.

The PV production depends on the irradiance on the PV modules of course, but also on other constraints in the system:

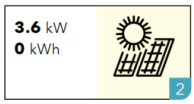
- If it is an off-grid system, the solar energy will directly supply the loads and charge the batteries. However, if the battery is full and the loads are small, the solar production will be reduced. That is because the energy can go nowhere, so the excess is lost to avoid overcharging the battery.
- The charging limits are given by the battery settings (see Battery section 0). The next3 smart inverter can be connected to lithium batteries with communicating BMS on CAN bus (see compatible list in chapter 5.1.12). In that case the manufacturer BMS decides the voltage levels and currents that are optimal for the battery. There are dedicated screens for the battery settings on the wizard.
- During grid feeding, the max power will be limited according to the AC-source breaker amps configured during the wizard.
- The solar production can be limited according to the grid code that requires grid support function, for example the production reduction in function of the grid frequency.

To optimize the solar power use, for example with dump load connection, you can use the AC-Flex connection or the auxiliary contacts. See the section "AC-Flex" (chapter 0) and Aux-contacts" (chapter 8.1.24) to adjust their settings for solar maximization.
The proper insulation of the PV+ and PV- is checked at every start-up. An error will be shown on the screen if there is ground fault and the inverter doesn't work for security reasons.

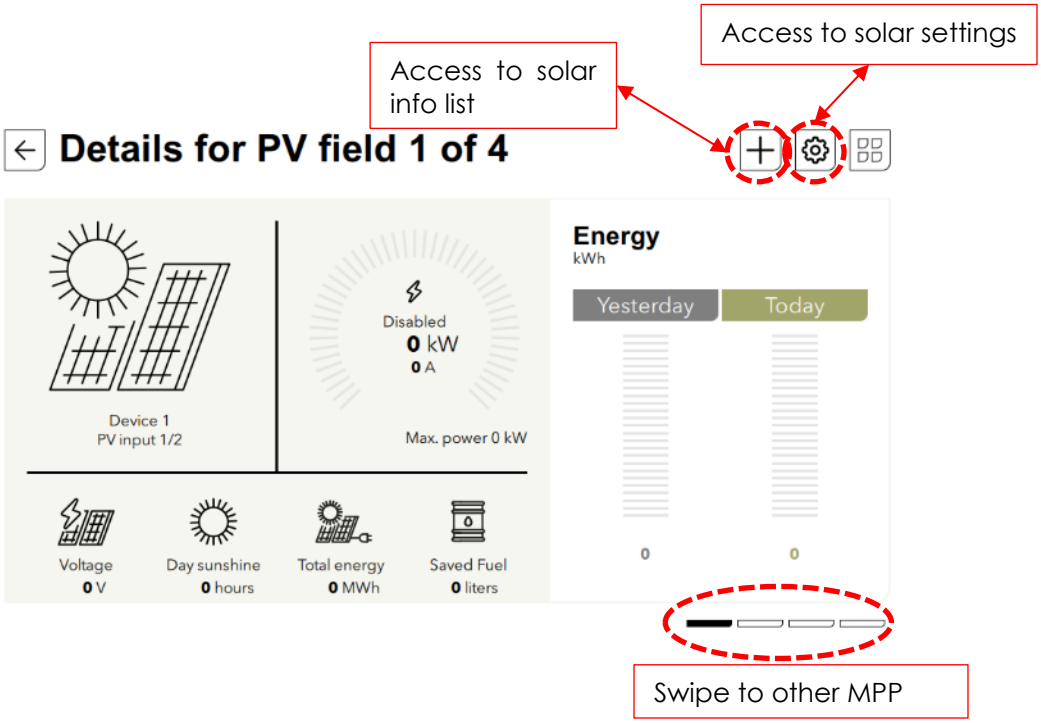
8.1.7 Solar Information

The solar MPPT electrical information can be seen on the remote control nx-interface, on the web portal and the APP (if connected) or accessed through communication (MODBUS TCP or RTU).
On the nx-interface, the synoptic info screen shows the power fluxes in the system in kW. This view shows the solar power sum of all devices (all solar chargers, all nexts, …) in the communication bus.

The detailed information about all voltages and currents for each MPP entry is available by clicking on the solar picture of the synoptic screen (see screens map for an overview of navigation).



The detailed screen shows the information of only one MPPT channel at a time. Swipe right or left to access the information from the other MPPTs.



Note: one nx3 device has two (2) PV MPPT inputs and there are therefore two screens. In case of multi-inverter system, you can swipe from one solar charger to the other. The picture above shows the case with 2 NX3 and then 4 MPPTs.

Comments about the information displayed on the nx-interface:

The power, voltage and current displayed are an average of 1 second

The charged and discharged energy of the day are calculated from midnight to the actual time. The energy of yesterday is computed from 00:00 to 23:59 the previous day.

The state information are:

- **Production**: The converter is producing normally, without limitations
- **Current Limited**: The converter is producing but limited because the maximum current is reached
- **Temperature Limited:** The converter is producing power but is limited because of the temperature (temperature derating is applied)
- **Solar Excess**: The converter cannot convert all the available energy because there is no way to use it (battery full, no load, no grid feeding, etc.)
- **Night**: The converter is not producing because there is not enough sun to work properly (night)
- **Dawn/Dusk**: there is voltage on solar generator but not enough to start the equipment.
- **Disabled**: The converter is disabled. The equipment is manually turned off by the operator with the main on/OFF button, the nx-control, or communication.
- **Starting:** The converter is starting
- **Error**: Some errors are pending, prohibiting the converter to work properly. See the messages list for more information.

The total energy is the recorded since the first start of the next

The saved fuel is computed on the base of a standard genset efficiency in hybrid systems (25% efficiency on diesel, which is even quite optimistic, that mean the savings are probably higher than this estimation).

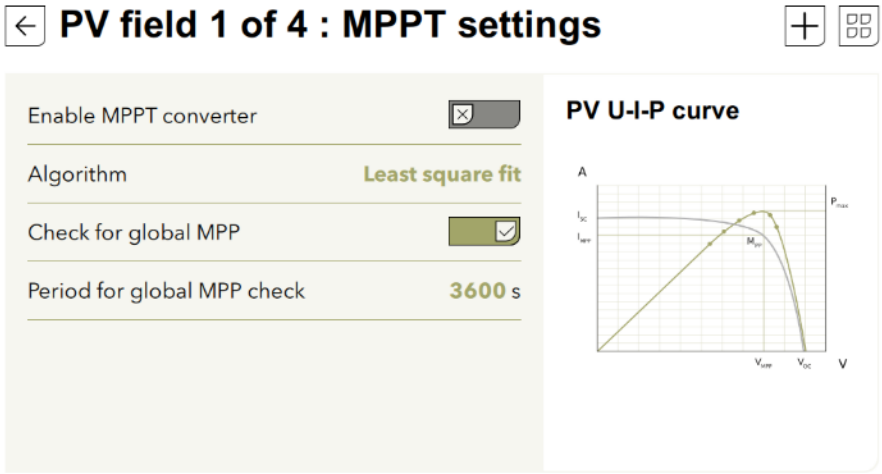
8.1.8 Solar Settings

There is no "wizard screen" for solar part as the next3 is "plug n play" for standard applications. Connect PV modules with proper voltages according to the next3 specifications and as soon as there is sun, the solar charger works automatically.

The default configuration is:

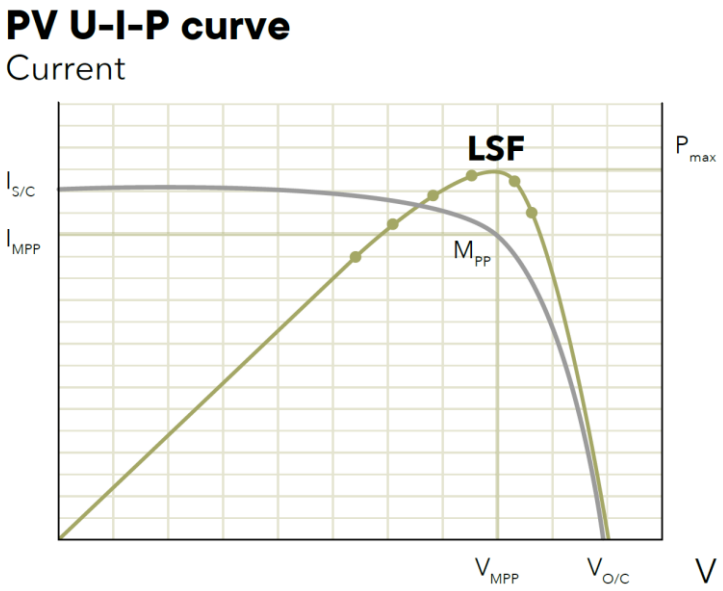
- PV ground fault is checked
- Best algorithm chosen: LSF
- No depolarization during the night
- A global check of the MPP is done once per hour to avoid local maxima (can happen with shading).

From the info screen of the solar, the settings are accessed with the configuration button. 



The settings are:

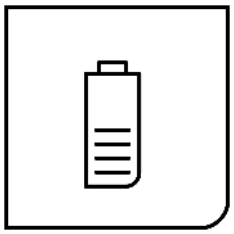
- **Enable MPPT converter:** this stops the operation of the mppt entry. Beware that it is not all the solar but only one entry. If you are on the MPPT2 screen, only the MPPT2 will stop/start. The inverter function is not affected by this setting. If one mppt entry is not used disable it otherwise a warning message will be given after 48h without production.
- **Algo Select:**
  - LSF: A standard Perturb and Observe algorithm, optimised with a least square fit to find the exact voltage of the mpp for best efficiency.
    - Period for global MPP check: interval of time between scan of the full pv curve to detect the max
  - Fixed Voltage set point: this is very useful for special applications like working on a lab voltage source for tests or others.
  - OC voltage ratio: regularly the open circuit voltage is checked and the converter operate at a fixed voltage corresponding to a ratio of this measurement. For example, 500Voc is measured then the converter will operate at 400V with a 0.8 ratio.
- **Check for global MPP:** every hour, a scan of the PV curve is performed to detect local maxima.



Detailed solar settings list

The full list (expert level) of settings and information with their description is available in appendix of this manual.

BATTERY



8.1.9 General information

The next3 is a fully automatic charger designed to guarantee an optimum charge for the most used battery types: lead (liquid acid, gel or AGM), and Lithium among others. The next3 charger will use the energy either from solar or from the grid/genset. The choice of the battery type is done during the wizard at commissioning and cannot be changed during operation.
Standard lead batteries with liquid (VLA, VRLA), gelled (GEL) and AGM electrolyte may be used. The next3 can easily be configured to adapt the charging profile (bulk, absorption, equalization, floating) and voltages to the battery type connected. Other battery types as Ni-Cd, NiFe, Vanadium, Aquion, etc. can also be used as the configuration possibilities for voltage levels and currents are very flexible.
The next3 can be connected to lithium Battery Management System (BMS) with CAN bus if the protocols of communication are compatible. In that case the BMS decides the voltage levels and currents that are optimal for the battery and communicates this information to the next3 system.
The solar battery charger enters automatically into operation as soon as the solar irradiation is sufficient and PV modules produce enough voltage (200V start-up voltage). The charging from the grid/genset is performed according to the AC energy management settings. When charging from the grid/genset, the next3 follows the same charging cycle as the solar. The maximum charge current of the battery will limit both the charging with solar and with the grid. The solar has the priority, and the power coming from AC source is decreased first.
The next3 configuration can be modified by the user or the installer to adapt the equipment to the chosen battery in the best possible way. These parameters can be modified by means of the remote control nx-interface.

	The use of other battery types like NiFe, Ni-Cd, non-communicating Li-ion or others is possible if the charge profile is properly programmed, in accordance with the specifications of the battery manufacturer, in agreement with the battery manufacturer and under the responsibility of the installer.

8.1.10 Battery Information

Much information can be obtained from the next3 about the battery state and the inverters operation. The information can be seen on the remote control nx-interface, on the web portal and the APP (if connected to internet for monitoring), or with a dedicated communication (MODBUS TCP or RTU).
See chapter "6 Behavior in problematic conditions
In operation the next3 protects itself with some programmed behavior

8.1.11 Thermal behaviour

The next3 is rated at 25° ambient temperature with proper ventilation (space around the next3). It has several internal temperature measurements and performs a derating of its functionalities in case of overheating:

- The solar production is reduced from the maximal current of 20A down to 0A to stabilize the temperature at acceptable level.
- The battery charging and discharging current is reduced to stabilize the temperature.
- The inverter max power is limited:
    - In islanded mode, the power is directly given by the loads. If the max current is

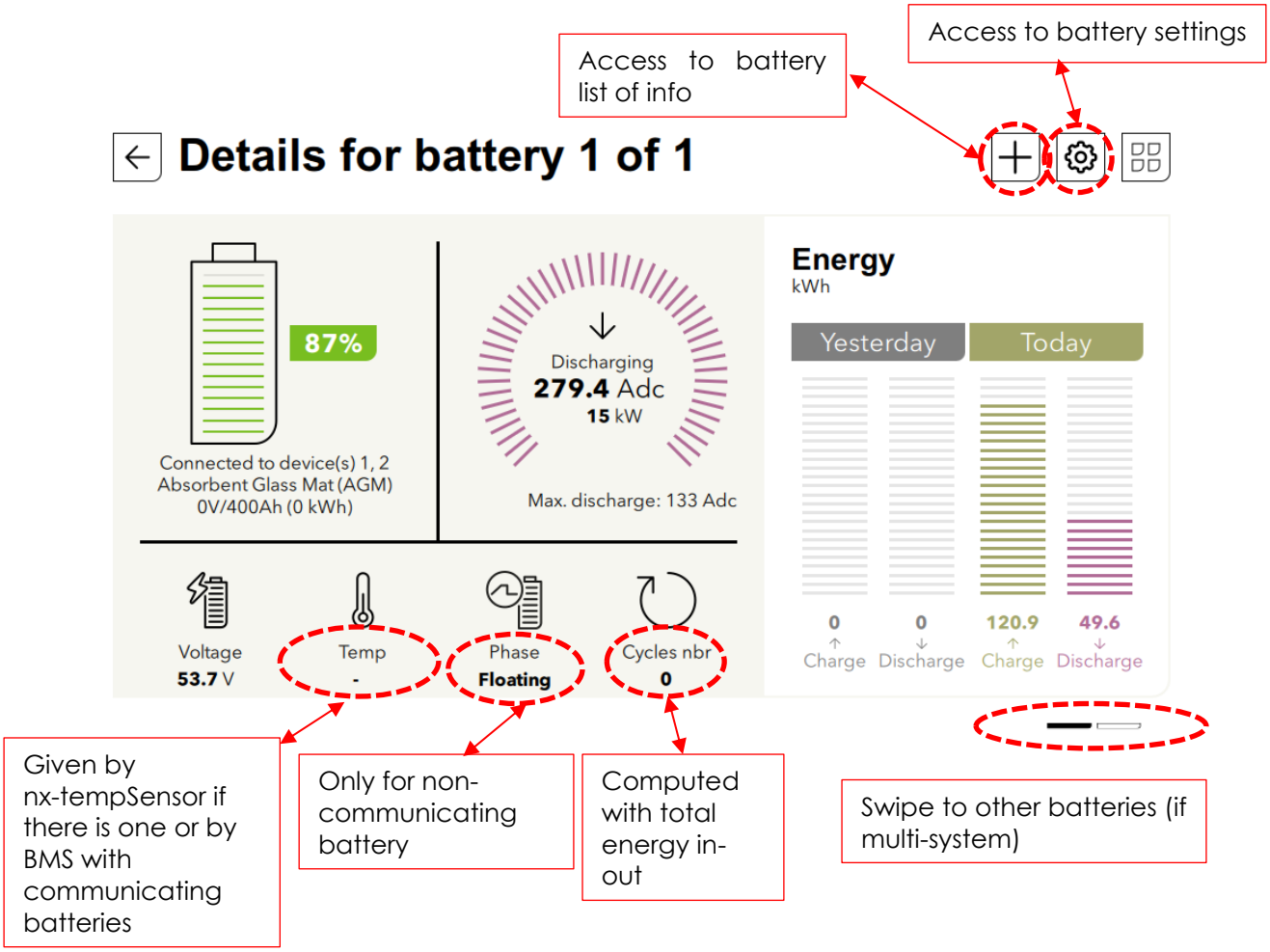
reached, the voltage drops because the inverter cannot supply the load. When the voltage goes under a voltage threshold of nominal power -10%, the inverter goes to overload.

A message indicates if the performances are limited by temperature.

8.1.12 Overload

In case of overload the inverter stops.

HMI: Use of nx-interface" to have the map of all screens.
The information screen seen on the nx-interface for the battery is as below:



For multiple batteries, each can be seen independently with a left/right swipe.

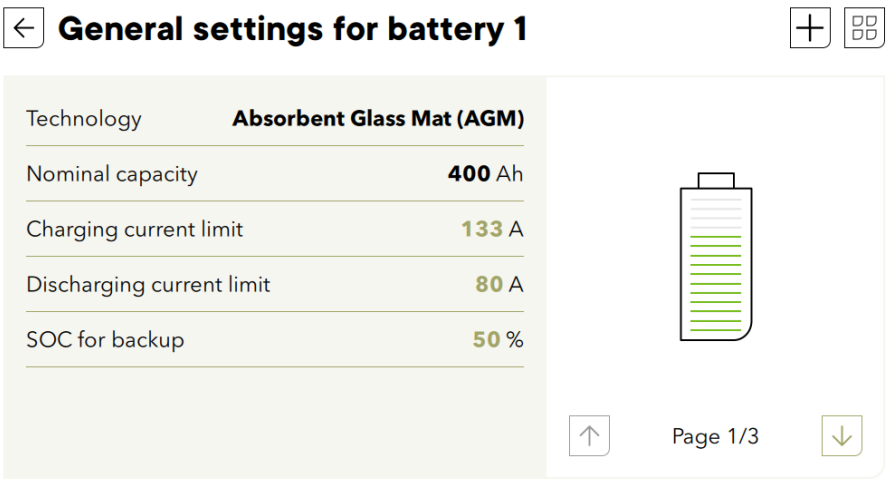
Comments about the basic information displayed on the nx-interface:

- When connected to a communicating lithium battery BMS, info is given by the BMS.
- The day charged and discharged energy (**Today**) are calculated from midnight to the actual time. The energy of previous day (**Yesterday**) is computed from 00:00 to 24:00 the previous day.
- The **Temperature** is given only if there is a measurement, else "--" is displayed and the temperature compensations are not used. The temperature can come from the nx-tempSensor or send by the battery BMS through communication. When both are available the BMS data is used in priority.
- The power and current shown in this display is correct only if there are only next3 compatible devices in the system .
- The % **SOC** can only be accurate with exclusively next3 inverters connected to the battery in case of non-communicating battery. If other chargers or loads are directly connected to the battery, their energy consumption/production cannot be measured, so the current measurement will not be correct.

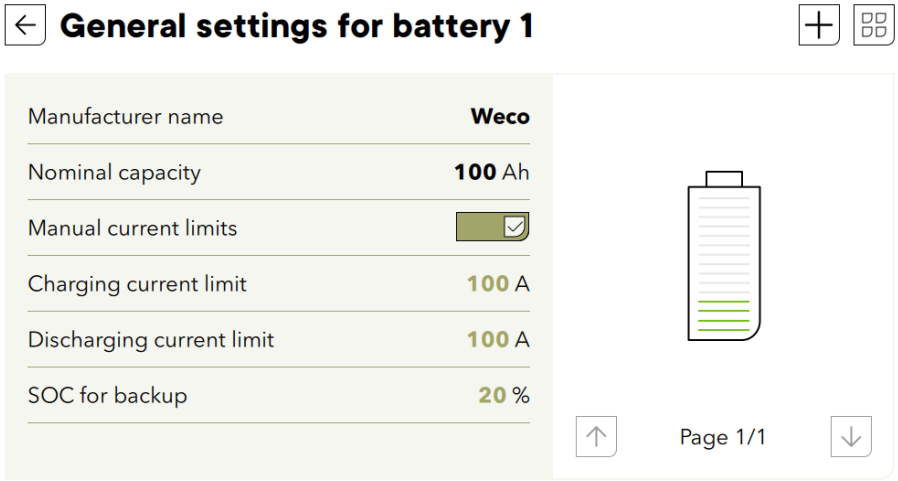
8.1.13 Battery Settings

The basic configuration is done with the wizard during commissioning.
On the dedicated screens, the settings are organised with topics:

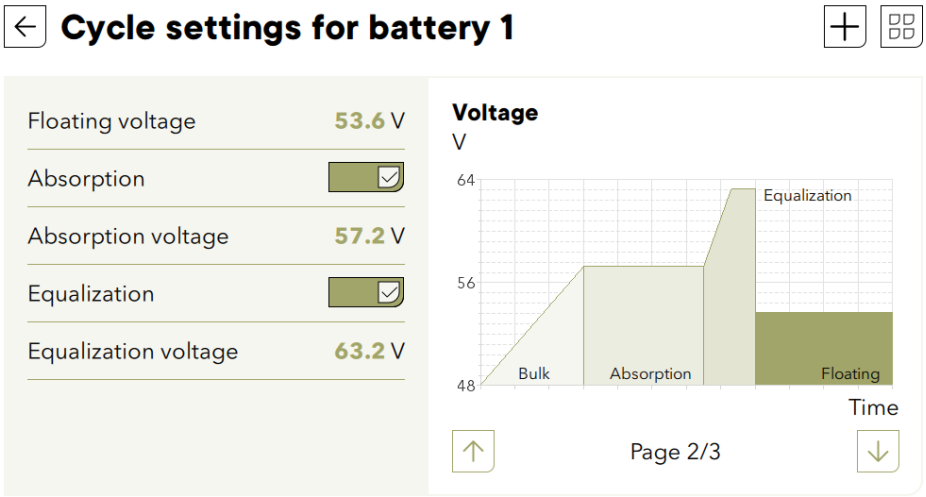
- **Battery General Setting**: type of battery (if it was a communicating battery, it cannot be changed on the fly), max charging current
- **Battery Cycle**: Parameters defining the charging profile (when it is not a communicating battery).
- **Battery Protection**: Parameters that defines how the battery is protected: for example, when to stop the inverter (when it is not a communicating battery).



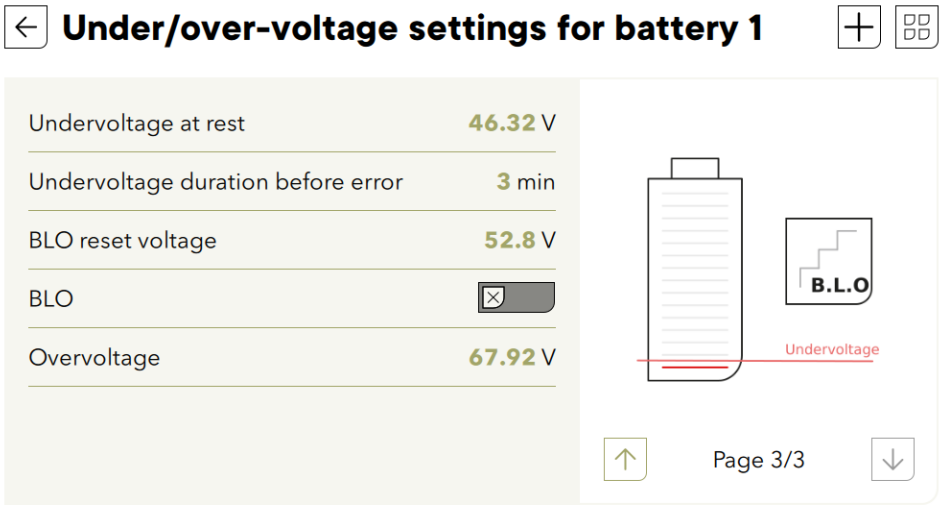
For the lithium batteries with BMS, this first screen is a little bit different, as the charge/discharge current limits are given by the BMS. Then if the user wants to have other current limits, he must activate the manual limits. Notes that the maximal currents given by the BMS are always respected first.



The battery cycle settings are useful and shown only for non-communicating batteries.



Advanced settings (durations, intervals, reduced floating, …) can be accessed with the + sign.



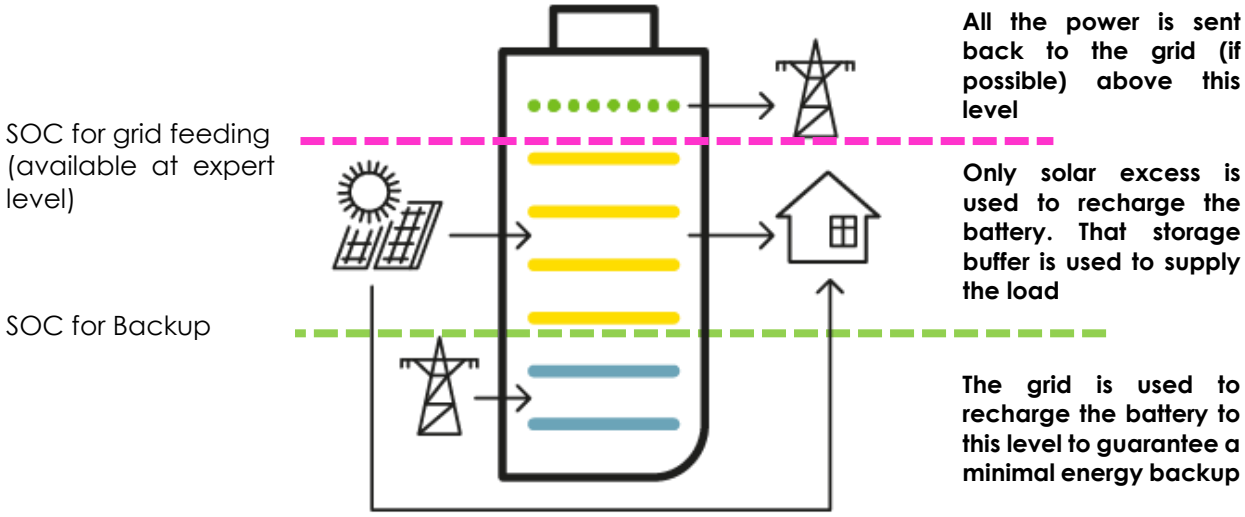
The B.L.O (Battery Life Optimizer) is a special algorithm that saves the lead-acid battery life. A battery permanently operating at low state of charge sees its lifetime drastically reduced. To force the user to recharge the battery, the undervoltage threshold is increased with each disconnection, and returns to its original value if the battery has been recharged up to a certain voltage. For this reason, the user will not be able to constantly discharge the battery without at least having recharged it.

8.1.14 Battery: additional explanations

Energy management of the battery

The energy management of the battery is performed with the "*SOC for backup*" mainly. In the advanced setting the "*SOC for gridfeeding*" is also available.

The default values are 100% for SOC for gridfeeding, 20% for SOC for backup with lithium and 50% soc for backup with lead acid batteries.



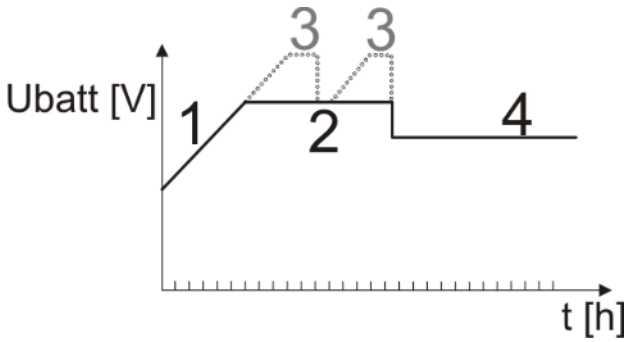
Comments about the State Of Charge (SOC) for grid feeding

The principle of the SOC for grid feeding is that if the SOC is higher than this threshold, the battery is discharged in the grid (if grid available and grid feeding allowed). After some time, the SOC will be at the setting value and there will be no grid feeding from the battery anymore.
The SOC for grid feeding can be used for
Buffering peak solar production when grid feeding power is limited.
Discharging the battery voluntarily for tests by a manual change of the parameter.
Keep the battery at a lower SOC than 100% without losing the energy production
If the SOC for grid feeding is 100%, the battery voltage is maintained at the target voltage of the cycle (for example absorption voltage).
When discharging the battery, the low boundary for voltage will be limited to undervoltage level +2% higher. That means the battery will go down to the SOC you adjusted but keeping that minimum voltage to reduce the discharging current.

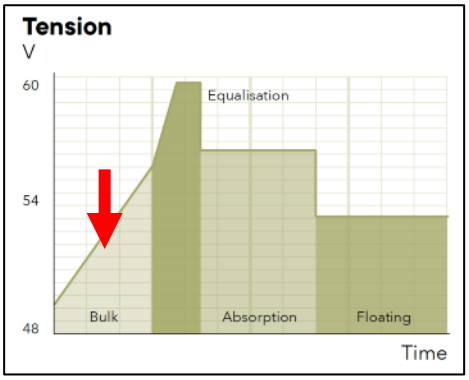
The SOC for grid feeding must be set higher than the SOC for backup.

Battery Cycle for lead acid battery

The next3 is a fully automatic solar and grid charger designed to guarantee an optimum charge for most type of batteries: lead/liquid acid, lead/gel, AGM batteries or Lithium. The battery charger enters automatically into operation as soon as the irradiation is sufficient, and the photovoltaic panel voltage is sufficient.
The charging from the grid/genset is performed according to the AC energy management settings. When charging from the grid/genset, the next3 follows the same charging cycle as the solar.
The batteries can be fully charged by the successive phases 1 to 4 described hereunder:

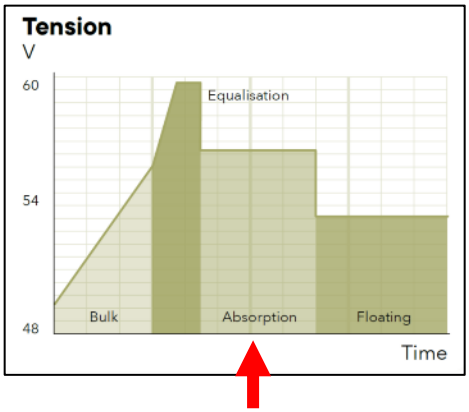


Bulk phase
The bulk phase is the stage where the next3 applies the maximum charging current (if there is enough energy available on solar and/or AC source) to charge the battery. This will lead to an increase of the battery voltage up to the next phase voltage limit; absorption, equalisation or floating, depending on the charging profile adjusted.
The bulk phase will allow a quick charge thanks to the high current. For lead batteries, this phase will charge them up to 90% SOC.
It is important that the maximum battery charge current is set according to the battery specifications to prevent damaging them. This current can be limited with the setting "Charging current limit". The maximum charging current might not be reached due to diverse conditions like the solar irradiation is not enough in an off-grid system, or the available power from AC source is too low, or the ambient temperature is creating a derating on the power electronic, etc...



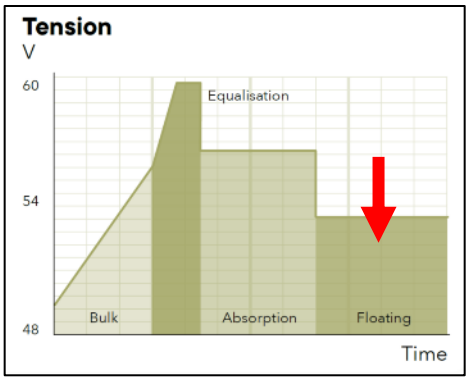
Absorption phase

This constant voltage phase, mainly used in lead batteries, allow to charge the last percents of the batteries. Because of keeping the voltage stable and the battery accepting less and less energy, the charging current will diminish progressively.
It can be ended by time (if there is enough energy to keep the phase for longer periods) or by current (if the battery ends his charge before the adjusted time)
Be aware that due to the current reduction during the phase, the power required to charge the battery will also be reduced. This can cause a reduction of the PV production if the excess energy is not used for other purposes than for charging the battery.

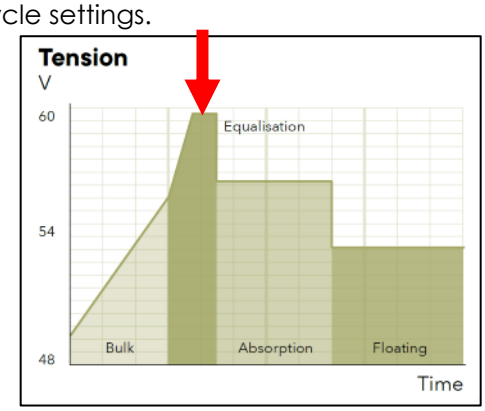


Floating phase

When the battery is charged, a constant voltage is applied to the battery to keep it full and compensate his self-discharge.



Equalization phase
Some types of battery need equalization in order to avoid the stratification of the water and acid they contain.
This phase is allowed only for flooded/wet batteries with liquid electrolyte. During this phase, the charging voltage target is temporarily higher. It allows, on one hand, to equalize the electrolyte density (stratification control) and, on the other hand, to equalize the voltage among the cells in series/parallel of the battery bank. During this process, the charging current can be limited by parameter "equalization current".
By default, the equalization phase is forbidden because it is incompatible with gel and AGM batteries and these are the most used batteries in the field. It can be activated/deactivated by the dedicated parameter in the battery cycle settings.



In a general manner, lead batteries charging profile consist of 3 to 4 phases while the lithium only need 2; bulk and floating.

When connected to a communicating lithium battery BMS, the charging profile is given by the BMS and cannot be adjusted in the next settings.

For more information, contact your battery supplier who will inform you on the values to be applied for his products.

	Caution: the equalization of open liquid electrolyte batteries (vented) produces highly explosive and corrosive gas (hydrogen/oxygen). The battery room and/or compartment must be adequately ventilated. Be careful: this charging phase may bring the batteries to voltage levels that can damage sensitive loads connected to the battery DC bus. Check that the connected loads are compatible with the highest voltage levels possible **taking into account any compensation of the temperature sensor**. A too long or frequent equalization phase can lead to an excessive consumption of electrolyte, a premature ageing or destruction of the battery. Follow scrupulously the instructions and recommendations of your battery supplier.

	Caution: incorrect values which do not comply with the manufacturer's instructions can lead to a premature ageing and even the destruction of the batteries.

Temperature compensation

For non-communicating battery (no BMS) with a nx-tempSensor, the voltage adjustment levels for charging the battery (absorption, equalization, floating…) are automatically corrected in real time according to the battery temperature.
The value of this compensation is given in V/°C for a reference temperature of 25°C by a parameter. Default value corresponds to -3mV/°C/cell which is -0.072V/°C for a 48V battery. For example at a temperature of 30°C, the voltage compensation is: (30-25)*(-0.072) = -0.36V. For a floating voltage value set to 54.4V, the effective floating voltage (compensated) will be 54.04V at 30°C.
Another example with 5°C, the compensation will be (5-25)*(-0.072) = +1.44V, so a floating voltage that goes from 54.4V to 55.84V.

SOC for end of discharge

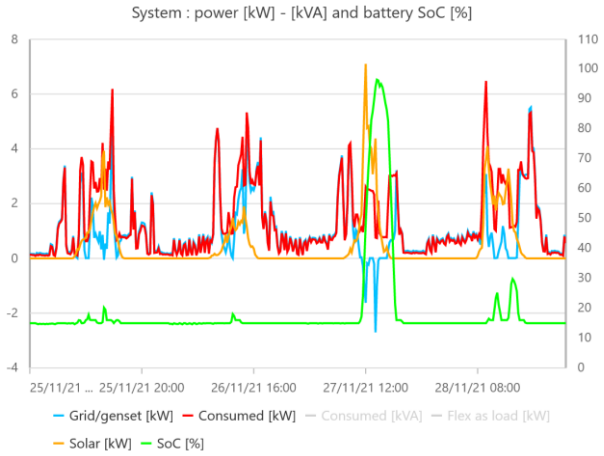
To prevent a stop/disconnection of the battery by the BMS that would require a manuel reset or that would definitely block the system, a SOC for end of discharged can be chosen. That way, the next3 stops to discharge the battery before the signal of the BMS and before the opening of the BMS contactors that would completely unpower the whole system. The next day, or when the grid/genset or the sun are back, it is possible to recharge the battery and recover.

An error is set if the SOC is lower than this value. The discharge of the battery is prohibited when the error is set but the charge is still allowed. The error is reset if the SOC is greater than or equal to the SOC for backup or if the bit "SOC for end of discharge" in the property: "Conditions for energy management" is not set.

By default, the function is deactivated for non-communicating batteries and activated with an initial value of 15% for communicating batteries.

Adaptive SOC for backup

The goal of this function is to prevent the battery to stay at a low state of charge during a long period of time and to avoid that the inverters are disabled due to an unwanted undervoltage. The lithium batteries are managed by the SOC given by the BMS of the battery manufacturer. One point recurrently observed in practice is that the SOC is not always accurate. It can drift and recalibrations are often done at 100% SOC when the BMS is sure that the battery is full. In practice, there are undervoltage problems when batteries are cycled at low SOC without reaching 100% regularly. That may be the case per example in self-consumption systems during the winter when the solar production is low.

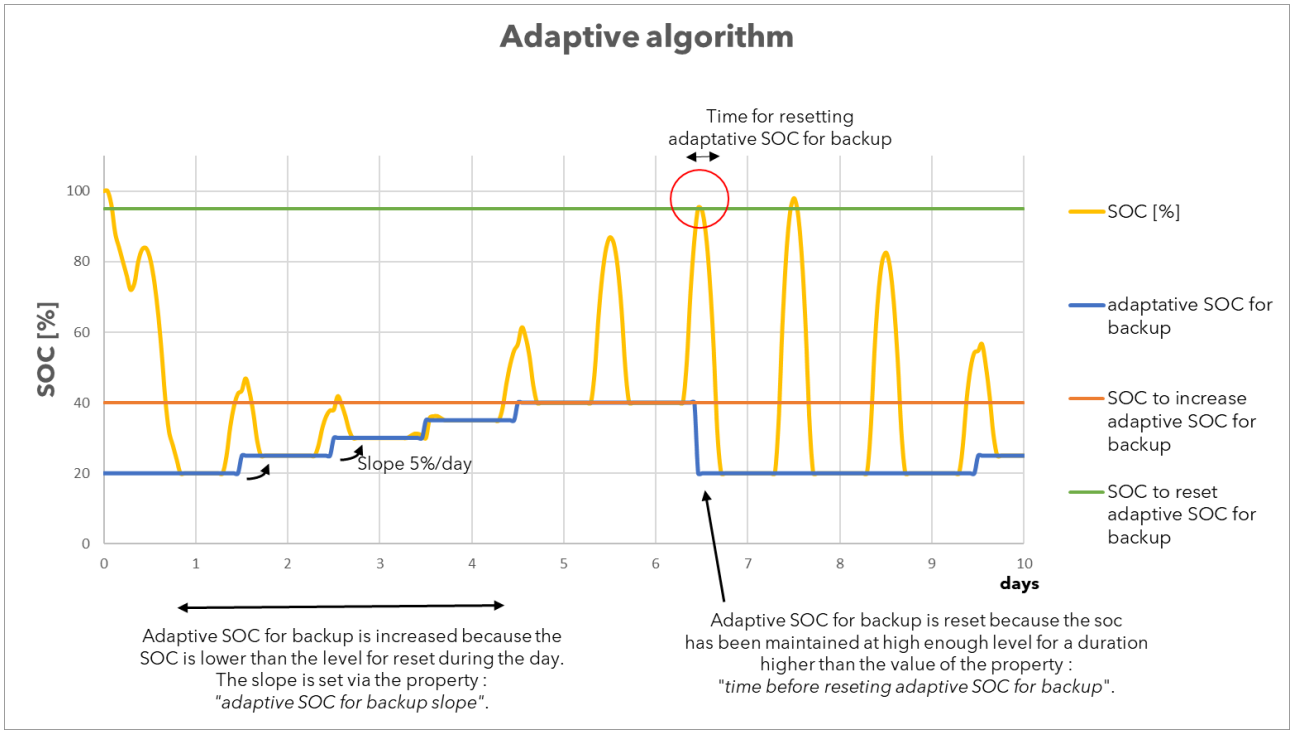


To cope with this problematic situation, an advanced adaptative algorithm has been developed.

The adaptive SOC function is enabled/disable in the advanced battery menu with « *Adaptive SOC for backup* » (Y/N). If the function is enabled, the adaptive SOC for backup is:

- increased every day if the SOC has been < «*SOC to increase adaptive SOC for backup* » during the day. The increase step is set via the value: « *Adaptive SOC for backup slope* ». The slope is given in %/day; per example 5% per day is the default value.
- reset to its initial value: «*SOC for backup* » if the SOC is reaching more than «SOC to reset adaptive SOC for backup » for more than «*Time before resetting adaptive SOC for backup* ». This value is used to set a minimum waiting time with a fully charged battery before resetting the adaptive SOC for backup. Typically, 5minutes (300 seconds) at 99%.
- The adaptive SOC for backup pushes the «*SOC for gridfeeding*» and the «*SOC for end of charge*» upward for proper operation when it gets to the same level.
- The adaptive SOC is increased by a value « *Adaptive SOC for backup undervoltage increment* » if a warning or an undervoltage error has been detected. This prevents to turn off the inverters due to a low battery voltage only because SOC calculation drifted.

The following graph illustrates the behaviour:



In those cases, with low solar production, the battery is anyway not getting full. There is then almost no loss of capacity for storage. It only optimizes the use and life of the battery by cycling it at a higher mean SOC.

The default values are:

- This function is implemented and activated by default.
- The adaptive SOC for backup starts at the same level as SOC for backup, it is 20% by default for lithium batteries and 50% for lead-acid.
- The SOC to increase adaptive SOC for backup is at 99% for non-communicating batteries and 98% for communicating batteries: that mean it can really force the battery to be fully recharged by default (and allows recalibration of the battery by the BMS).
- The SOC to reset adaptive SOC is at 99.9% for non-communicating batteries and 98.9% for communicating batteries. If you modify this parameter, take care that some BMS stay at 99% for a long time.
- The time before resetting adaptative SOC for backup is 5 minutes (300 seconds).
- The slope of increase is 5% per day.
- The SOC for grid-feeding is at 100%, if it is lower than the SOC to reset adaptive SOC, this one can never be reached and the adaptive SOC for backup increases all the way.

⚠	The default values were chosen to fit in most situations with the different brands of batteries tested. Be careful not to mix those levels with the SOC for gridfeeding and SOC for end of charge. Improper settings will cause bad behavior of the system. Always respect the following order: SOC for end of charge ≥ SOC for gridfeeding ≥ SOC to reset adaptive SOC ≥ SOC to increase adaptative SOC for backup.

Periodical recharge and discharge

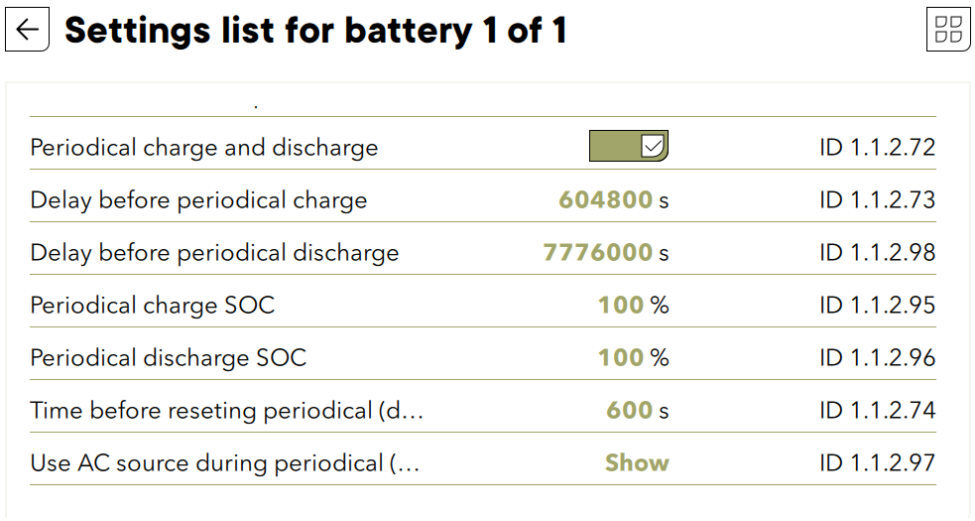
There are possibilities to perform regularly full recharge or discharge of the battery to improve its life.

For batteries that have a limited end of charge level (per example 90%) there is always the risk that the calibration of 100% SOC is not performed properly by the battery BMS. In that case a periodical recharge to 100% is a good option.

Some batteries that are always in floating mode should be sometimes cycled. In that case a periodical discharge is a good option.

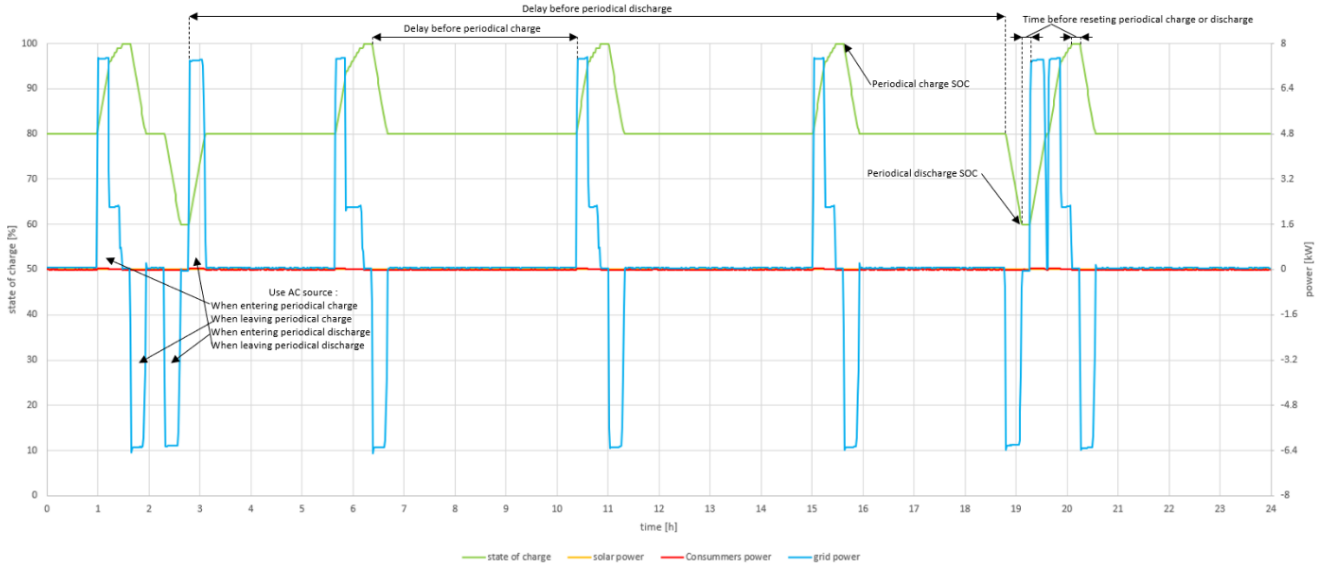
A setting « *Periodical charge and discharge* » can be activated deactivated and associated settings adjusted:

- *Periodical charge and discharge* (used to enable or disable the function): true by default.
- Delay before periodical charge: set to 7days by default.
- Delay before periodical discharge: set to 3months by default.
- Time before resetting periodical charge or discharge: set to 10min by default.
- Periodical charge SOC: set to 100% by default. If the user reduces the soc for grid feeding value, periodical charge will be automatically enabled.
- Periodical discharge SOC: set to 100% by default. 100% ensures that no periodical discharge will be done automatically.
- Use AC source during periodical charge or discharge: default value: yes for backup application and no for standard application. This ensures a fast periodical discharge following by a fast charge in backup application and ensures a periodical charge with solar power and a discharge in the loads in other applications.



Note that it's also possible to combine both functions. For example, a backup application could have a soc for grid feeding at 80% with a periodical full charge each 7days and a periodical discharge down to 60% each 3months.

Example of periodical charge and discharge in test application:



Example of a periodical charge without using the grid when entering and leaving periodical charge on a real house:

In that case the time since the last full charge at 100% is counted. If the time reach « *Waiting Time Between Periodical Full Charge* », then the level of «*SOC for grid feeding*» and a «*SOC for end of charge*» are set temporary to 100%.
The forcing is released after « *Time Fully Charged Before Resetting Periodical Full Charge* » spent at 100%.

Maximal current with lithium batteries

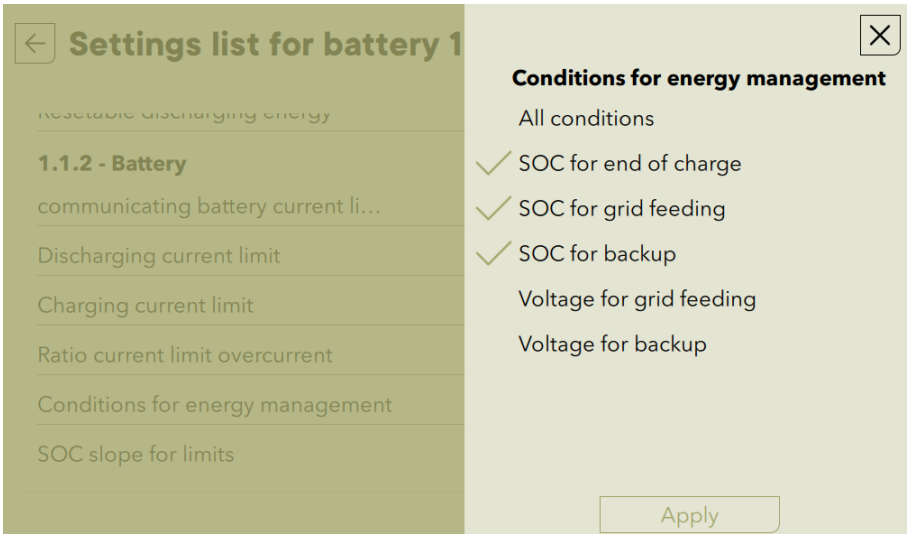
The BMS sends the maximal current limits accepted by the battery. In practice, Studer observed that the reaction of the BMS when going to the limits differs from one BMS to another. Some stops immediately, some have a tolerance to go up to that level and work at that limit. That is why a margin factor of 0.8 is used by default to work in all cases. Per example if the BMS says 200A max charging, then the next3 will go up to 200*0.8=160A. This margin factor can be increase up to 1.

Manual current limits	☒	ID 1.1.2.24
Discharging current limit	**100** A	ID 1.1.2.25
Charging current limit	**100** A	ID 1.1.2.26
Ignore BMS recommended currents	☒	ID 1.1.2.84
Current limits marging factor	**0.8**	ID 1.1.2.27

Manual current limits can be given. They must be lower than the maximal current of the BMS that is respected in any case.

Energy management by voltage

The standard energy management is done with the SOC. In expert mode, it is possible to add voltage limits to manage the battery. This can help with special types of batteries, with non-communicating batteries or are securities for batteries with inaccurate SOC calculation by the BMS.



The voltages are given by the settings situated a little bit lower in the list:

Voltage for grid feeding	**54** V	ID 1.1.2.39
Voltage for backup	**48** V	ID 1.1.2.40

Note that the undervoltage level and max charging voltage level sent by the BMS of the battery or set by setting are always respected.

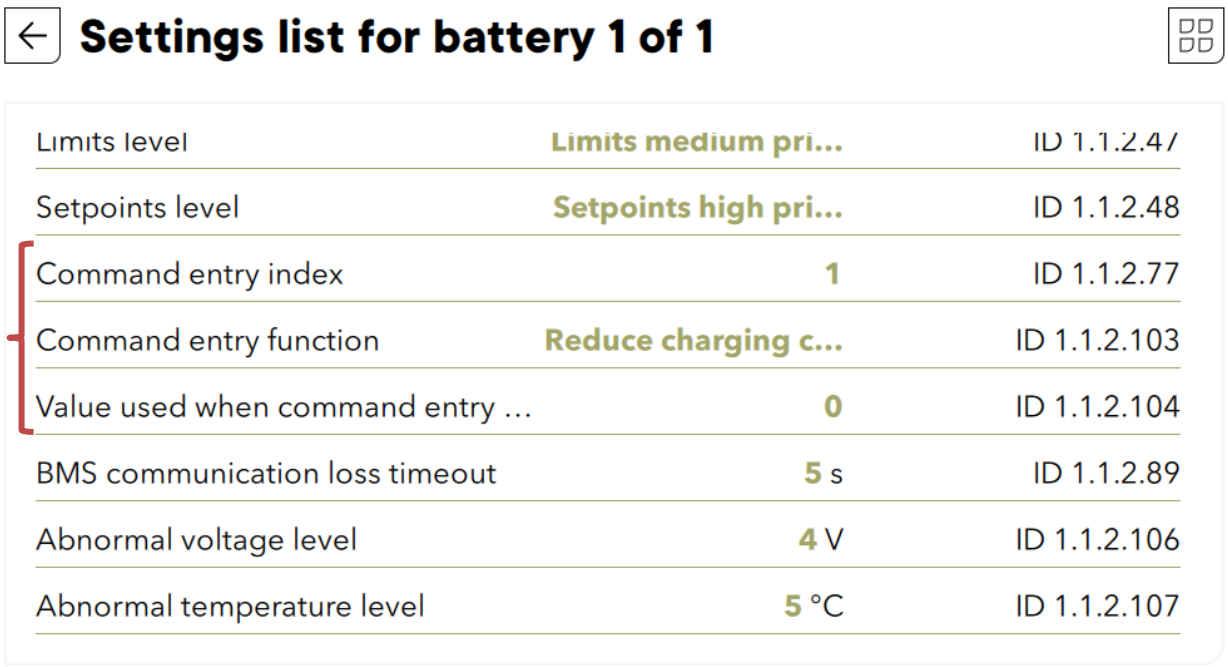
Recover from a low battery

When an undervoltage happens, the inverter stops. In order not to stay blocked in that situation, a button "clear error" will appear on the synoptic screen. When used, it leaves the system to restart temporary and per example recharge from the grid of from a generator. The "clear error" function is also performed with a short press on the front face button of the next3.

In case of undervoltage, the inverter function is disabled but not the solar. The next morning when the sun comes back the next3 will automatically restart.

External management of the battery with external contact

It is possible to modify the behavior of the next to the battery in function of the command entry entry (dry contact input, see chapter 4.7.2)



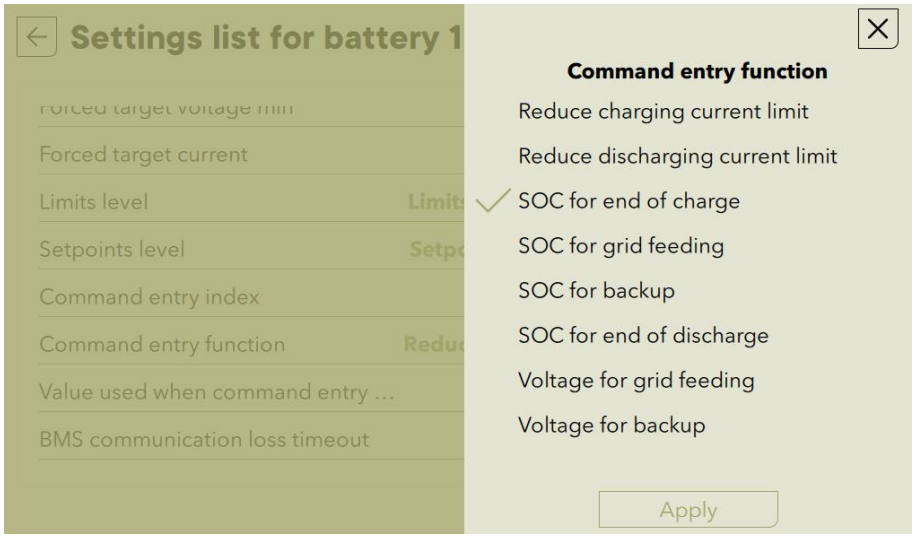
The available settings are :

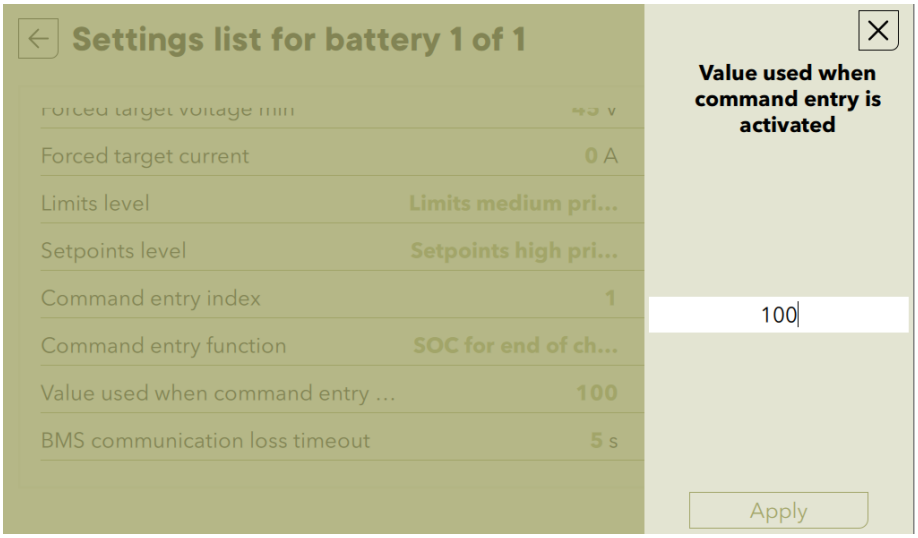
- Select the Command entry index.
- Select the desired Command entry function:
  - Charge current limit reduction
  - Reduce discharge current limit
  - Modification of the SOC for end of charge
  - Modification of the SOC for grid feeding
  - Modification of SOC for grid backup
  - Modification of SOC for end of discharge
  - Modification of voltage for grid feeding
  - Modification of voltage for backup
- Select the value associated with the chosen function (Value used when command entry is activated)

The default values are :

- No command entry is selected (value 0 for Command entry index)
  The function is: Load current limit reduction
  The associated value is 0A.

Per example to charge the battery to 100% only during the afternoon, have it at 50%, but change it to 100%:





And control the time with the AUX relay connected to the CMD entry.

AC-LOADS

8.1.15 General information

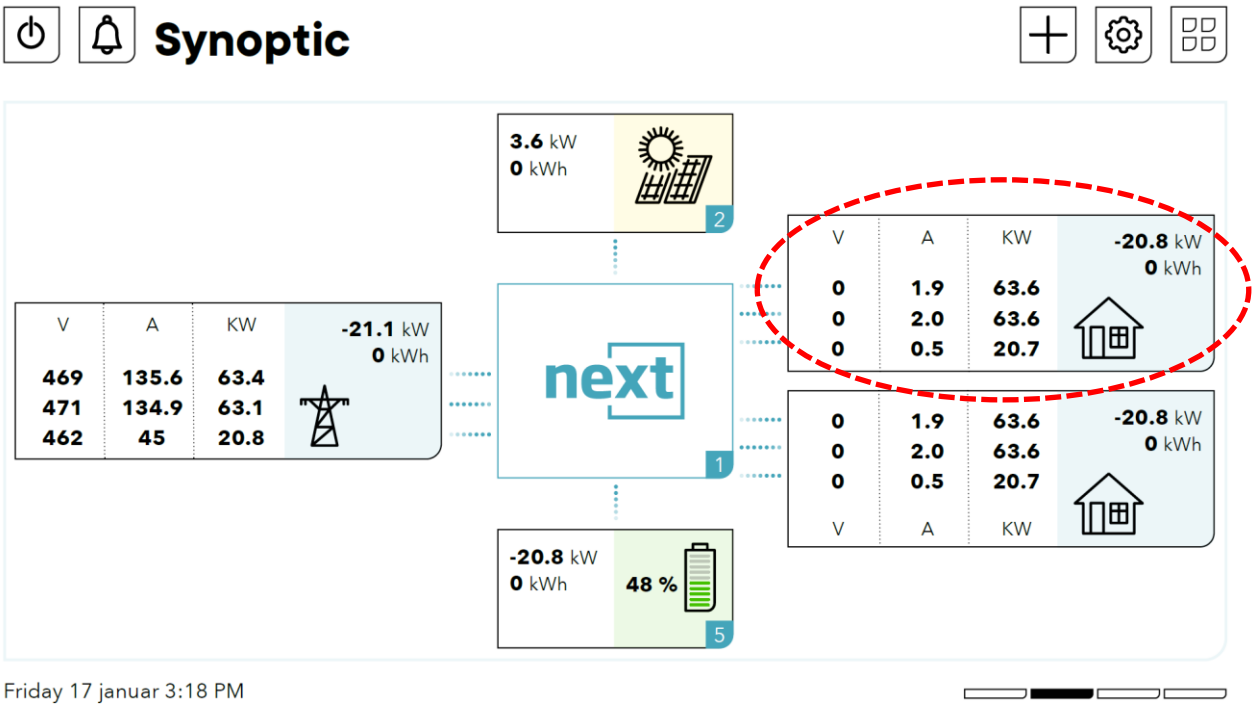
The AC-Loads is where the user electrical consumptions are connected.
The output voltage is 230V phase to neutral and 400V phase to phase in standard three phased configuration (default). The frequency is fixed at the nominal frequency of 50Hz for the NX3 by default.

The AC-loads are monitored and recorded in the datalog.

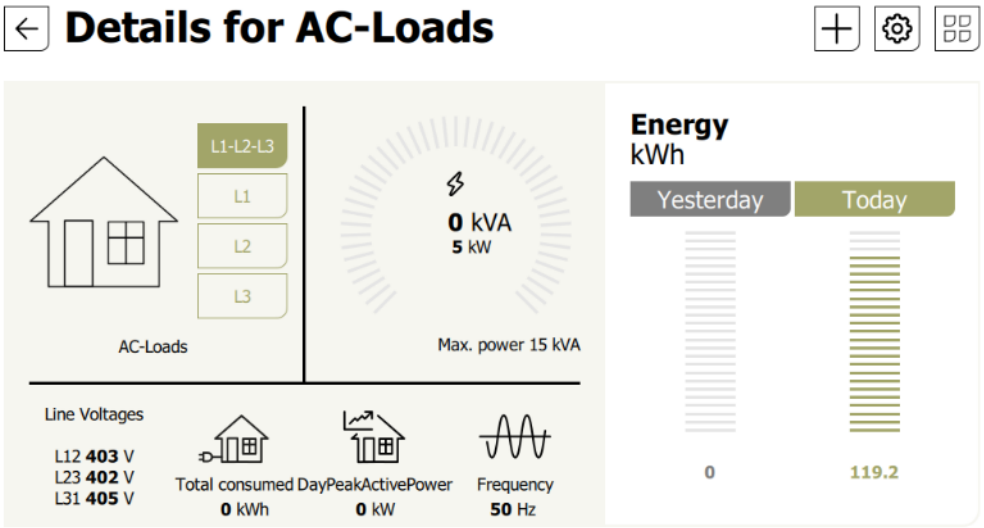
AC-coupling of grid inverters on the inverter Loads side is only permitted with restrictions. See the special application chapter for details about it.

8.1.16 AC-Loads Information

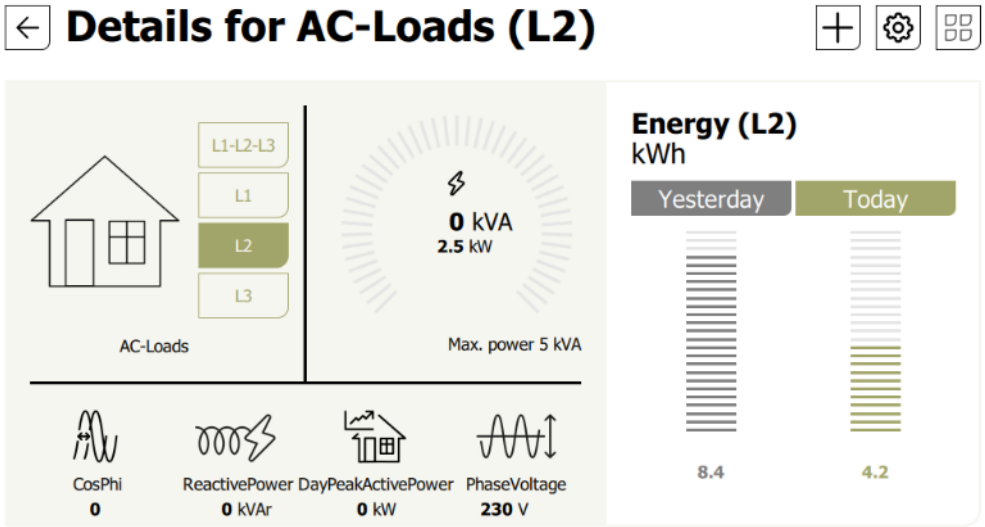
The general information on output is seen on the synoptic:



Clicking on the component AC-loads give you access to the level 2 and see the details about AC-loads.



Details of each phase are available by clicking on the phase buttons:

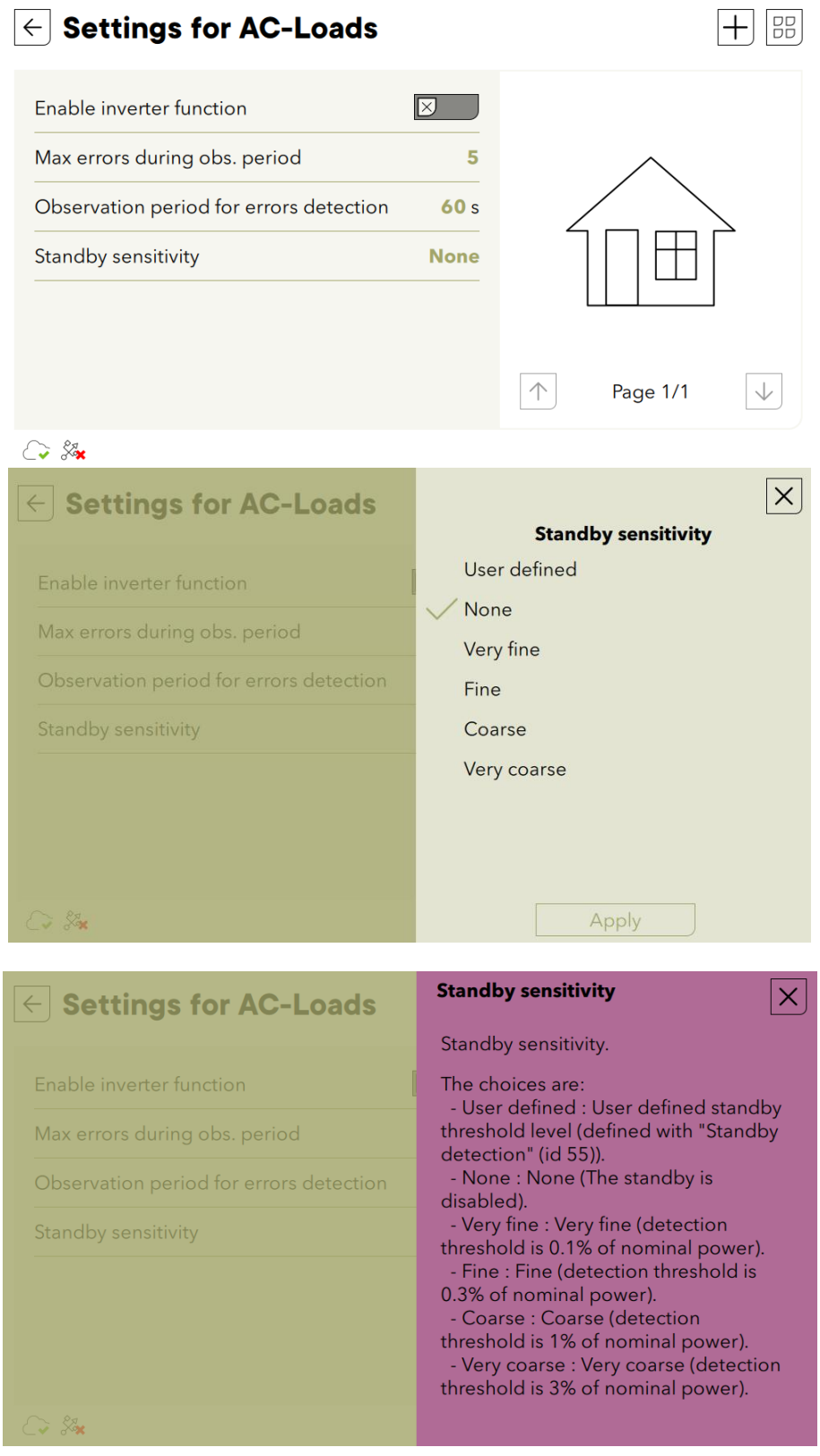


8.1.17 AC-Loads settings

There is nothing to set in the wizard for the AC-loads.

In basic level, the available settings are:

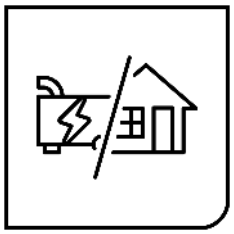
- ON/OFF of the inverter function only. It will deactivate the inverter mode (DC to AC converter) and still allow the solar to work. Use this to disable the inverter function only. When there is a grid/genset connected, theirs is either a voltage at the output. Use this setting for the wintertime for example, when you want the solar to continue to charge the battery but stop to power supply the loads.
  By deactivating this function, all the modes will be switched on/off at the same time.
- Behaviour In overload:
  - Number of restart attempts
- Standby: to spare energy, the inverter will deliver a voltage pulse once per second. This allow to detect if there is a load connected and reactivate the inverter if it is the case. The sensitivity of load detection can be set from 0.1% of the nominal power (15W) up to 1% (150W).



Detailed AC-Loads settings list

The full list (expert level) of settings (Read/Write) and information (only Read) with their description are available in the appendix of this manual.
Notable parameter is the one about AC-coupling to accept a backfeeding of power on that port. In case of AC-coupling with standard grid inverter, the best is to program it during the wizard. See the AC-coupling chapter in the Special application section of this manual.

AC-FLEX



8.1.18 General information

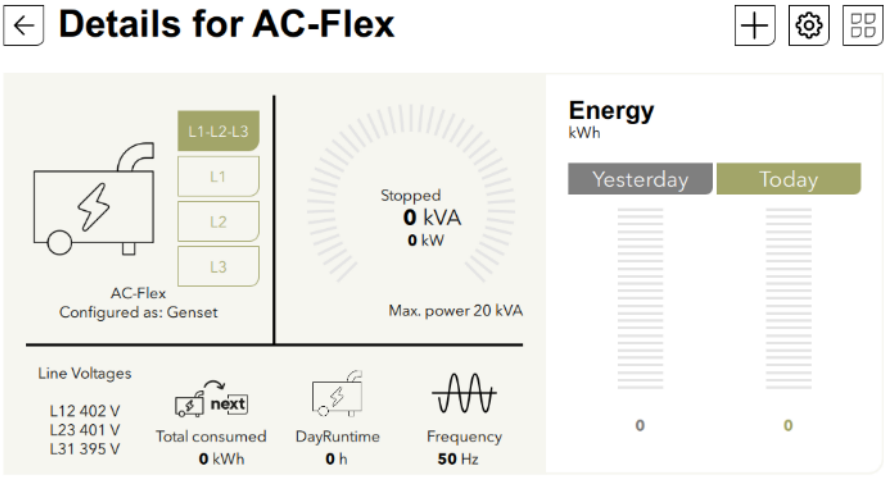
The next3 has an AC connection that can be freely programmed as:

- A second AC-Source, for example for
  - Grid /genset in hybrid installations with grid and a generator backup that don't require grid connections securities.
  - Gensets of different sizes for fuel consumption optimisation
  - Shore connection/onboard generator for boats
- A second AC-Loads, for example for
  - load shedding, non-priority loads, dump loads, etc.
  - load monitoring

The choice of configuration is done at the system set up with the configuration wizard. The AC-Flex behaviour is fixed and cannot be changed during operation for security reasons. To change the configuration, you will need the expert access code and to run the wizard again (restart the settings).

8.1.19 AC-Flex as source; information and settings

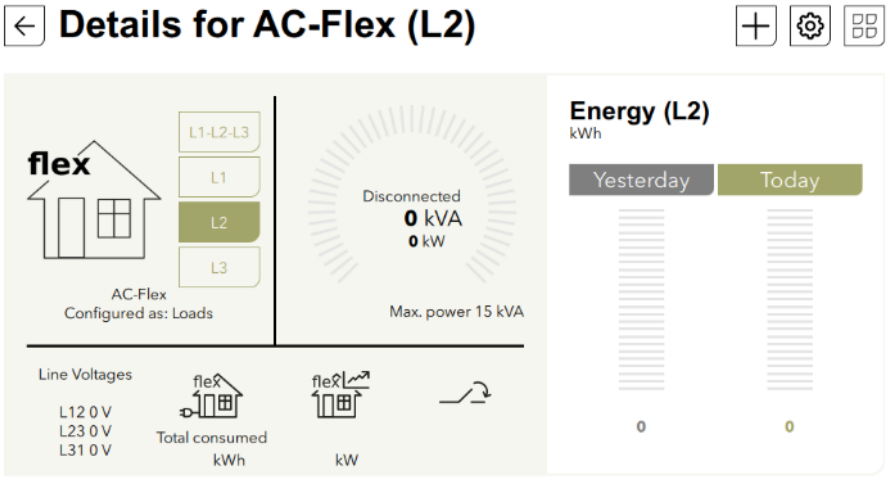
The information display for the AC-Flex as a source is like the AC-source when you select a genset, as shown below.



The settings for the AC-flex as a source are the same as for the standard AC Source. It is exactly similar for the genset connected on the AC source, so it is not repeated here (see AC-source settings chapter 8.1.4).

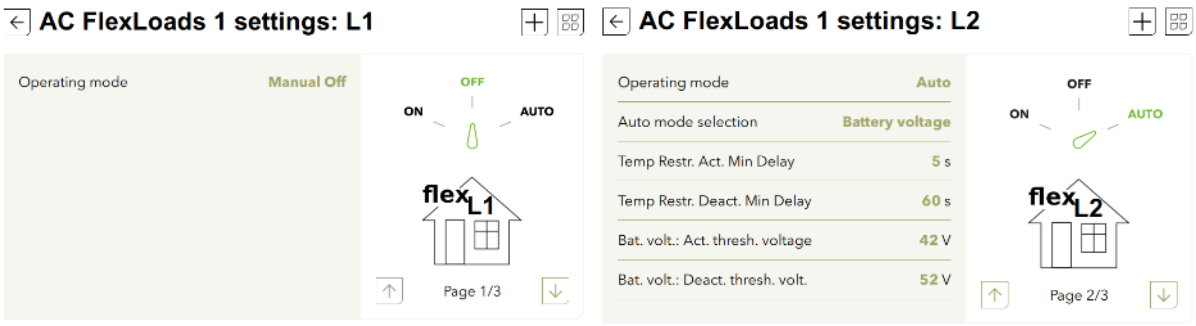
8.1.20 AC-Flex as Loads; information

The information display for the AC Flex as load is like the standard AC-loads, as shown below.

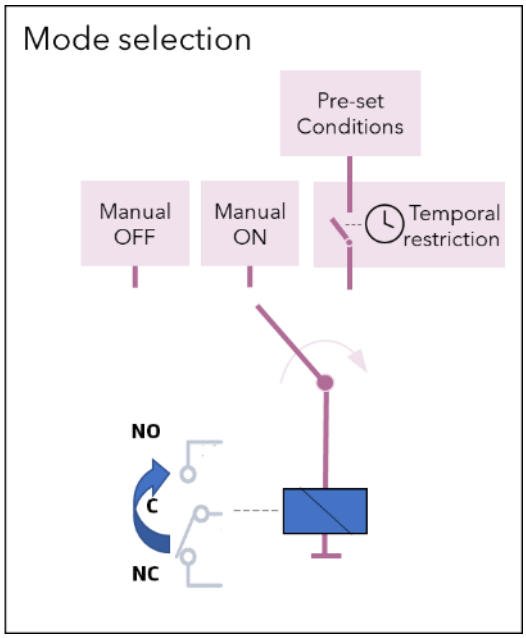


8.1.21 AC-Flex as load; Settings

The main choice for the ac-flex being an AC-source entry or an AC load output is done during the commissioning with the wizard. There is no possibility to change this again live without stopping all the systems.
The 3 AC-Flex load contacts of each phase of one device can be programmed independently to open and close under various conditions. The contact corresponding to the neutral is automatically switched on when at least one phase is activated.
The programming is organised at the level 2 with a simplified menu (level 3) proposing the choice between Modes:



Manual OFF: always deactivated, in position NO. This is also the unpowered state.
Manual ON: always activated, in position NC
AUTO: some activation/deactivations conditions are used. This can be chosen in a list of simple use pre-set cases (one is selectable at a time)



- **Battery voltage**: An hysteresis is used to activate relay when battery voltage reaches threshold activation voltage and deactivate relay when threshold deactivation voltage is reached. Used for example for load shedding when the battery gets empty.
- **Battery SOC :** An hysteresis is used to activate relay when battery SOC reaches threshold activation SOC and deactivate relay when threshold deactivation SOC is reached. Used for example for a genset start on battery state of charge or a load shedding when the battery is empty.
- **Battery temperature:** for example to start a heater when the battery temperature is too low to avoid freezing.
- **Battery charge phase**: for example to run a fan in equalization for open lead acid battery.
- **Power AC :** This is used for load shedding, when there is too much load, the relay is activated until the power is reduced under another level.
- **Solar excess OnGrid:** activated when power is fed to the grid over a given level. This can be used for example to switch on loads for self-consumption optimisation. The hysteresis and delay allow to optimize the switching the load (avoid turn on and off repeadly).
- **Solar excess:** activated when at least one solar converter in the system is power limited. the battery is full and there is unused solar. This is used in order to optimize the use of solar in offgrid or grid-feeding not allowed.
- **Scheduled time**: chose a time frame during the day to activate the contact.
- **On-source**: This is used for example to connect some loads when connected to an AC-source if you don't want to have them running on the batteries.
- **Off**-source: relay is activated when inverter is operating offgrid.
- **Cmd entry**: The relay is closed in association with a command entry.
- **Error/Warning**: relay is activated when there is an alarm in the system.

The detailed levels are chosen by default to fit in most situations, we then advice to only activate one function without changing detailed parameters.

Most of the above pre-set signals can be temporally processed using a temporal restriction.

Battery voltage

Activation and deactivation of the AC-Flex load contact in function of the battery voltage. The parameters to setup this function are:

Activation threshold voltage [V]	If the battery voltage exceeds this value, the relay is activated.
Deactivation threshold voltage [V]	If the battery voltage exceeds this value, the relay is deactivated.

These 2 values are the boundaries of a hysteresis function.

Battery SOC

Activation and deactivation of the AC-Flex load contact in function of the state of charge of the battery connected to the device. The parameters to setup this function are:

Activation threshold SOC [%]	If the battery SOC exceeds this value, the relay is activated.
Deactivation threshold SOC [%]	If the battery SOC exceeds this value, the relay is deactivated.

These 2 values are the boundaries of a hysteresis function.

Battery temperature

Activation and deactivation of the AC-Flex load contact in function of the temperature of the battery connected to the device. The parameters to setup this function are:

Activation threshold temperature [°C]	If the battery temperature exceeds this value, the relay is activated.
Deactivation threshold temperature [°C]	If the battery temperature exceeds this value, the relay is deactivated.

These 2 values are the boundaries of a hysteresis function.

Battery charging state

AC-Flex load relay is energized when the current battery charging state corresponds to one of the selected states in the following list:

- None
- Bulk
- Reduced Floating
- Floating
- Periodical Absorption
- Absorption
- Equalization

Multiple states can be selected.

Power AC

Activation and deactivation of the AC-Flex load contact in function of the active power of a selected AC terminal. The parameters to setup this function are:

Power selection	Selection of the active power in the system used for AC-Flex load relay control: • AcSource All • AcSource L1 • AcSource L2 • AcSource L3 • AcFlex Source All • AcFlex Source L1 • AcFlex Source L2 • AcFlex Source L3 • AcFlex Load All • AcFlex Load L1 • AcFlex Load L2 • AcFlex Load L3 • AcLoad All • AcLoad L1 • AcLoad L2 • AcLoad L3
Activation threshold Power [W]	If the measured active power exceeds this value, the relay is activated.
Deactivation threshold Power [W]	If the measured active power exceeds this value, the relay is deactivated.

The 2 threshold values are the boundaries of a hysteresis function.

Solar excess on-grid

Activation and deactivation of the AC-Flex load contact in function of the injected power into the grid. The Solar excess on-grid pre-set is typically used for self-consumption. To limit the feed power into the grid, loads are activated using AC-Flex load relays. The parameters to setup this function are:

Activation threshold Power [W]	If the measured total active power injected into the source exceeds this value, the relay is activated.
Deactivation threshold Power [W]	If the measured total active power injected into the source exceeds this value, the relay is deactivated.

These 2 values are the boundaries of a hysteresis function.

Solar excess

Activation of the AC-Flex load contact when at least one solar converter in the system is power limited. The Solar excess pre-set is typically used to add loads when there is an excess of solar production. In order to prevent relay oscillations, it is important to set correctly the activation and deactivation delays.

Schedule time

The schedule time pre-set allows to activate and deactivate the AC-Flex load relay in a daily base. Restrictions can also be applied to avoid undesired activations. The parameters to setup this function are:

Starting date [secs from 01.01.1970]	Starting date of the scheduled daily activation-deactivation. Before this date, the relay is disabled.
Starting time [secs from midnight]	Time of the day at which the relay is activated
Ending time [secs from midnight]	Time of the day at which the relay is deactivated
Selected weekday	Allowed weekdays for relay activation.
Recurrence weeks	Allow the relay to be daily activated each given week. For example, with a value of 2 for this parameter, the relay will be disabled every two weeks.
Range of recurrence selection	Selection of the ending of the recurrences:
	• No end date: the daily activation-deactivation continue indefinitely • End after occurrence • End date

On-source

Activates the relay when inverter is connected to a source (AC-Source). Typically used when extra loads require to be connected only with external source.
This is used to connect the grid inverter in simplified AC-coupling mode.

Off-source

Activates the relay when inverter is on and not connected to a source (off-grid). Typically used to activate specific loads when inverter is operating off-grid.

Cmd-entry

AC-Flex load contact is controlled by a command entry available in the system. This entry is selected by entering its index number (available in CMD-IN settings). Any command entry in the system can be used to activate-deactivate the relay.

Errors and warnings

AC-Flex load relay is controlled according to the system alarms. Errors and/or warnings can be used to activate the relay. The following possibilities are available:

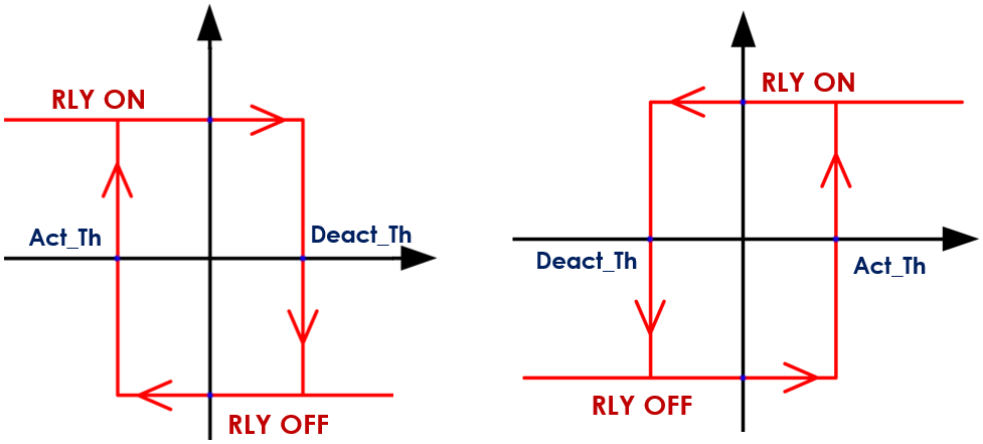
- Triggered by Errors
- Triggered by Warnings
- Triggered by errors and Warnings

Additional info regarding hysteresis operating mode

The following Pre-sets modes use a hysteresis-based logic to activate and deactivate the relay:

- Battery voltage
- Battery SOC
- Battery temperature
- Solar excess Ongrid
- On AC power

The hysteresis is given by 2 values configurable by the user: Activation threshold and deactivation threshold. According to the numerical values set into the 2 thresholds, the hysteresis can follow 2 distinct behaviours (figure below). Having a value attributed to activation threshold higher than the one attributed to deactivation will invert the hysteresis logic.



For example, the voltage battery pre-set could be configured with an Act_Th < Deact_Th to activate a generator and charge the battery when the voltage is too low. The generator is then stopped when the voltage corresponding to a charged battery is reached (Deact_Th).
The inverted hysteresis (Act_Th>Deact_Th) could be used for example to connect an additional load when the voltage reaches a level of battery charged (Act_Th). This load is then disconnected if the battery voltage reaches the Deact_Th level.

Additional info regarding Temporal Restriction

A temporal restriction can be applied to all the pre-sets mode expect "Scheduled time". The temporal restriction can be seen as an intermediate block between the signal of activation and the relay coil. The following parameters can be set:

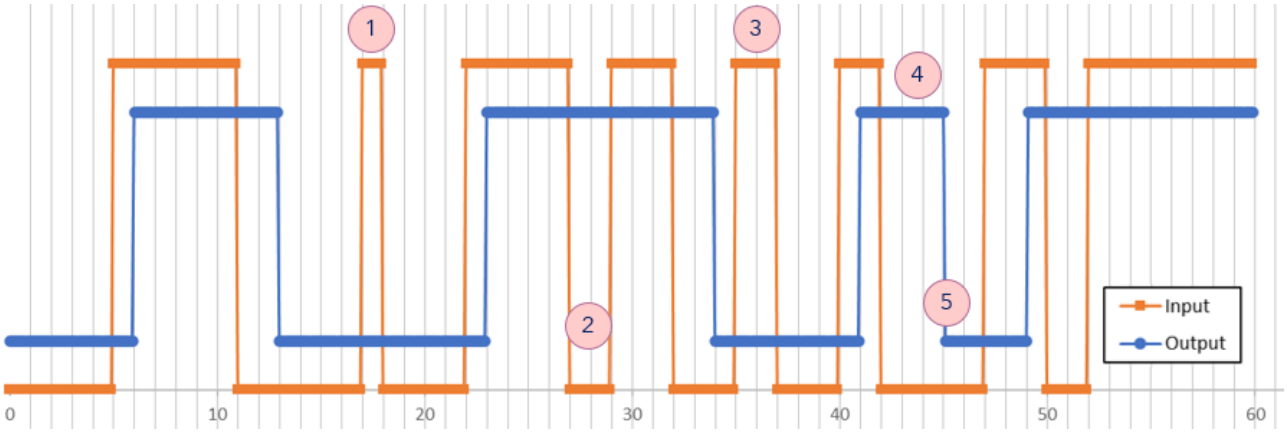
- **Activation Min Delay [sec]:** Minimum delay before activation. The condition signal must be high during all this period to activate the output.
- **Deactivation Min Delay [sec]:** Minimum delay before deactivation. The condition signal must be low during all this period to deactivate the output.
- **Activation Min Time [sec]:** Minimum time during which the relay remains in activated position.
- **Deactivation Min Time [sec]:** Minimum time during which the relay remains in deactivated position.
- **Activation Max Time [sec]:** Maximum time during which the relay remains in activated position. To disable this parameter, enter the "-1" value.
- **Activation Hour Allowed 1&2 [sec]:** Daily time range during which the relay activation is allowed. The 2 daily hours are given in seconds starting from midnight.
- **Activation Weekdays Allowed:** Weekdays allowing the relay to be activated. The different days are represented in a bitfield format corresponding to:

Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit 0
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**

Below an example of temporal restriction applied to a pre-set condition:
Parameters:

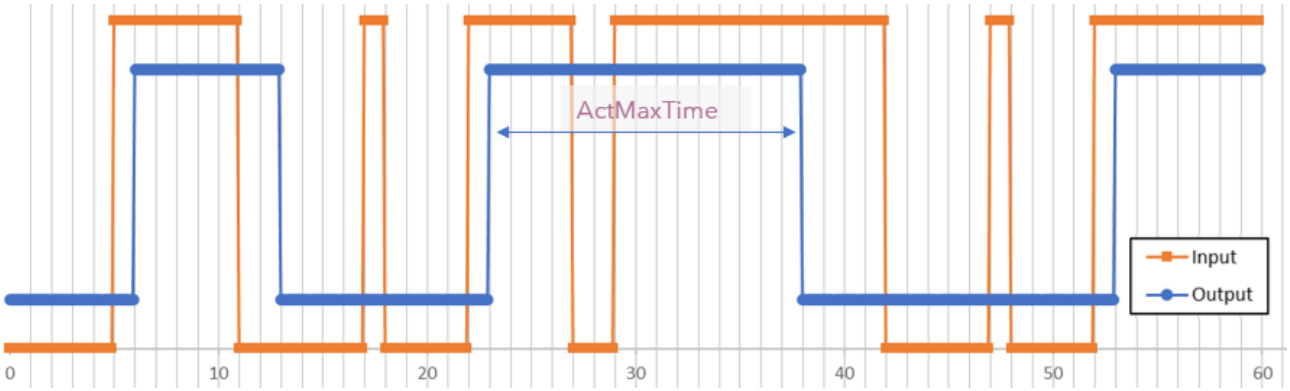
Activation Min. Delay	*1 [sec]*
Deactivation Min. Delay	*2 [sec]*
Activation Min. Time	*4 [sec]*
Deactivation Min. Time	*4 [sec]*
Activation Max. Time	*15 [sec]*
Activation Hour Allow1	*12 :00*
Activation Hour Allow2	*12 :00*

Activation Week Days Allow	*All days selected*



- On time < Activation Min. Delay
- Off time < Deactivation Min. Delay
- Input signal is active during deactivation Min.Time
- Activation Min. Time
- Deactivation Min Time

Example with "Activation Max. time":



If the activation max. time is reached and the activation condition is still present, the contact will not be reactivated as long as the condition is present. The contact will remain locked in deactivated state until the activation condition disappears or the user switches to manual Off operating mode. Use this parameter with care and only as a security.

Detailed AC-FLEX settings list

The full list (expert level) of settings and information with their description are available is in appendix of this manual.

DEVICE AND I/O: AUX CONTACTS, INPUTS AND COMMUNICATION

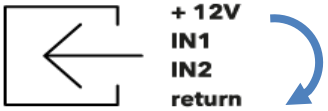
This part is for one next unit and the hardware belonging to one unit. The information and settings are accessed with the central sign next on the synoptic. There are as many screens as the number of next that can be accessed with the left/right slide:

8.1.22 General points

One next3 inverter is equipped with following interfaces:

- 2 AUX-contacts:
  - The auxiliary contacts are useful for simple automation tasks in energy systems such as load management, automatic start of generator, simple self-consumption optimisation, …
  - The unpowered state of the relay is a contact between C (common) and NC (normally closed). When the auxiliary relay is activated, the contacts switchover and is between C and NO (normally open).

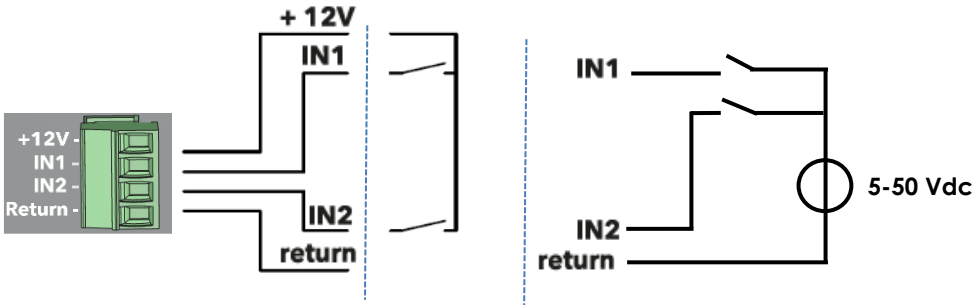
- 2 remote entries:
  - The remote entries IN1 and IN2 are inputs that can be active with a 5 to 60Vdc voltage to the return reference. An +12V supply is available on the connector for the use of dry contacts. Don't use it for other purpose than the activation of input entries.



Give a voltage signal between on of the IN and the return.

The +12V can be directly for this

The various possibilities are given with the schematics below



For activation with a dry contact:
Supply voltage with +12V, go to the contact and come back to the wanted input (in1 or in2)

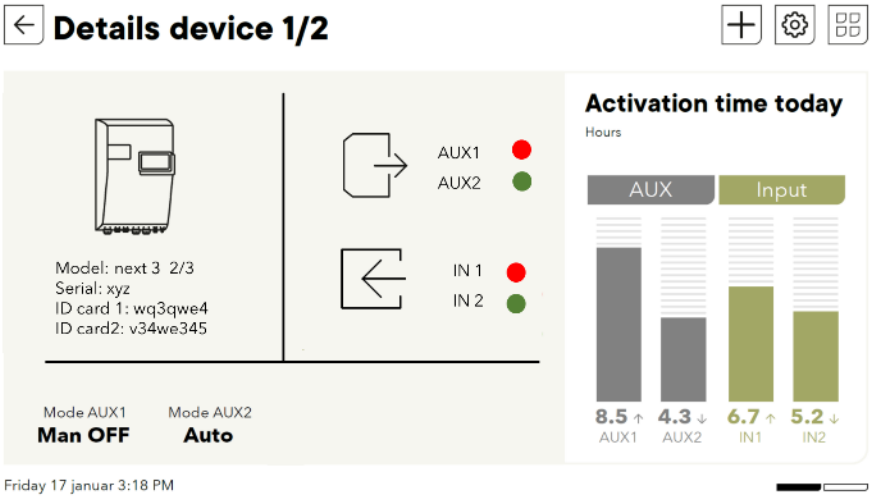
For activation with an external source: a potential of 5Vdc to 60Vdc must be applied between an input and the return.
Entry impedance is 10kOhm

External 12V can be deactivate with settings in the device menu (on nx-interface).

- 1 RS485i for M2M communication. It is not used in first versions of the software and will come with future firmware updates. Control of the next3 system with MODBUS is performed through the nx-interface port and not the physical port situated on the next3 itself.
- 1CANi for lithium BMS communication (setup in the battery menu, see the battery chapter of this manual).

8.1.23 Device Information

On the nx-interface, the information screen for the device and its auxiliaries is shown below:



Explanation:
Red point: mean the relay/entry is deactivated. For the relay, it means it is in the NC position.
Green point: mean the relay/entry is activated. For the relay, it means it is in the NO position.

A list of all available information's can be accessed with the + sign from this screen: 

8.1.24 AUX-contacts settings

The auxiliary contacts can be programmed to open and close under various conditions.
For the end-user, the most common use of the contact is to start a generator, or to switch on/off a load (up to 16A ac).
The programming is done mainly with a simplified menu (at level 3) proposing the choice between Modes:

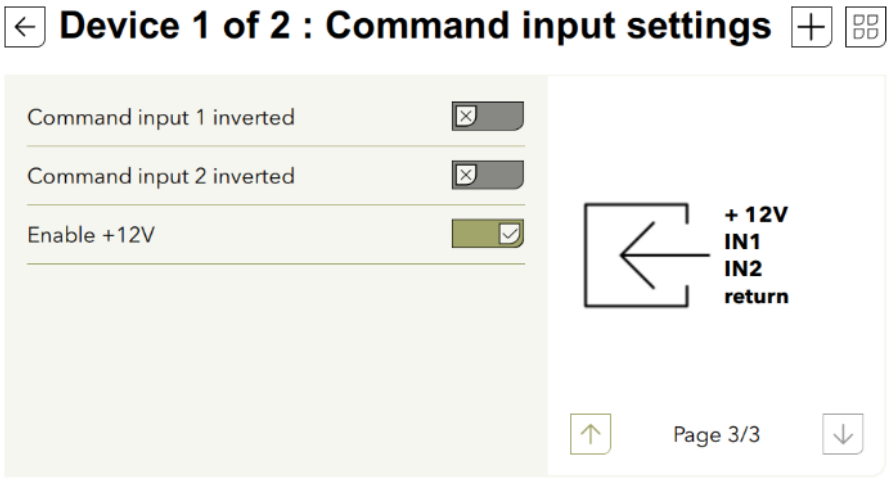
- **Manual OFF**: always deactivated, in position NO. This is also the unpowered state.
- **Manual ON**: always activated, in position NC
- **AUTO**: some activation/deactivations conditions are used. This list of possibilities are exactly the same as for the Flex load and will not be repeated below.

8.1.25 IN-CMD settings

The remote entry is used to give orders to the next system with external contacts. It can be useful to perform simple automation tasks with the next.

	Then command input 1 is used for DRM0 function in the Australian version and cannot be freely programmed.

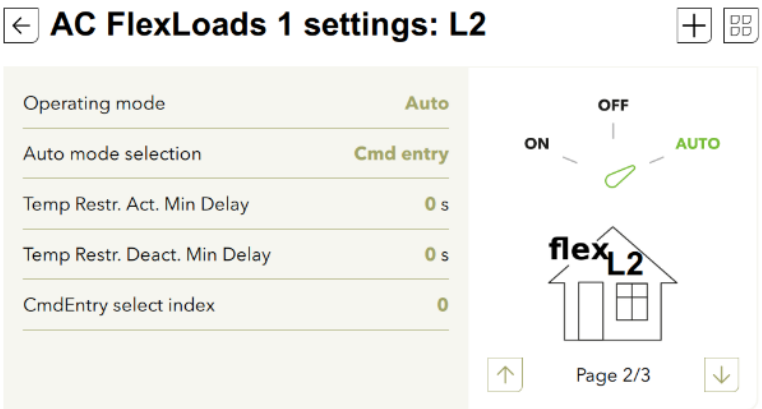
The CMD menu is situated in the device (click on the next icon in the middle of the synoptic)



The following functions can be activated through the command entries:

- **Connect AC-FLEX loads**
- **Activate an AUX contact**
- **Stop the inverter**
- **Change the charge/discharge levels of the battery for voltage, current, SOC.**
- **…** More possibilities will be implemented in the future.

The settings are dispatched in each part of the next, and there is no special menu for command entry. For example, the activation of the flex load with command entry is shown below; it is situated in the :

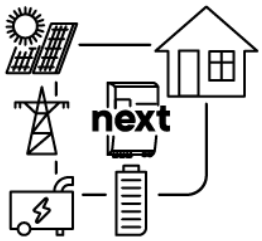


The CmdEntry selection index gives which entry is considered.

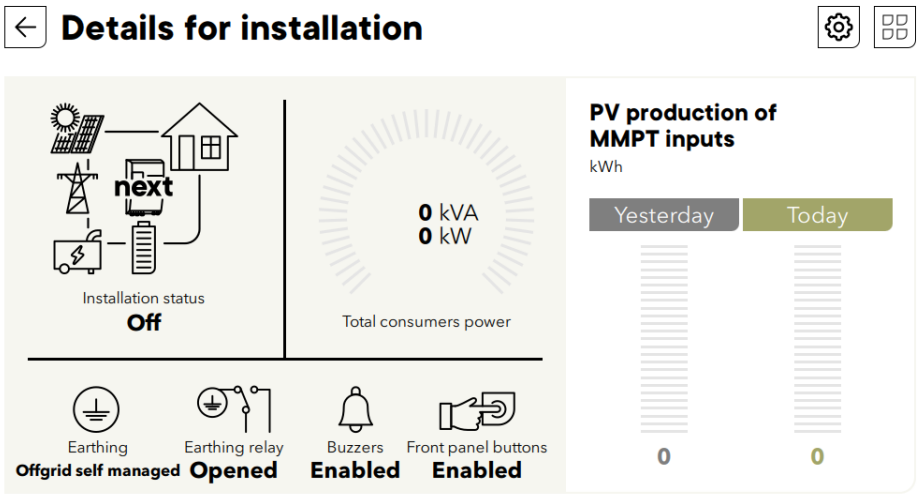
8.1.26 RS485i Settings

The RS485i connection on the next3 itself is unused for the moment. Functionalities will be added in the future software updates. Keep in touch… There is a Modbus slave RS485 on the nx-interface.

SYSTEM SETTINGS



There are settings related to the whole installation and not only one part or one device. The systems aspects are accessed with the detail button on the synoptic view: [+]

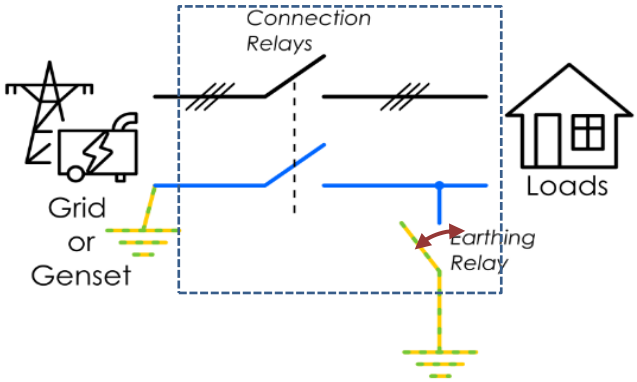


By system, we mean elements concerning many devices at the same time (in multi-units) and that couldn't be placed in an individual menu. Per example the grounding impacts all the elements at the same time. Similar for the neutral regime, it cannot be programmed individually.

8.1.27 Neutral and earthing relay

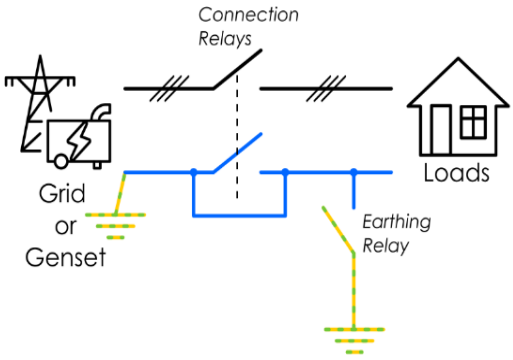
The protective earth must be connected in accordance with local standards and regulations in force. To do this, the next3 with transfer is equipped with a programmable earthing relay able to bond the Neutral wire (on Load side) to the earth (case of the device).
This relay can be configured in the following mode:

- **Offgrid self-managed** (default): With "Offgrid self-managed" selected the system will handle the connection and disconnection of the earthing relay depending on the inverter working mode: Offgrid or Ongrid. This mode can only be selected in a discontinuous neutral wiring configuration.
  Between each Ongrid-Offgrid transition a relay inspection is realized and the grounding path is validated to ensure system safety.
  Typical installations where "Offgrid self-managed" should be selected are:
  - Mobile installations.
  - Installations connected to grid/genset via a plug connector.
  - Standard stationary installations.

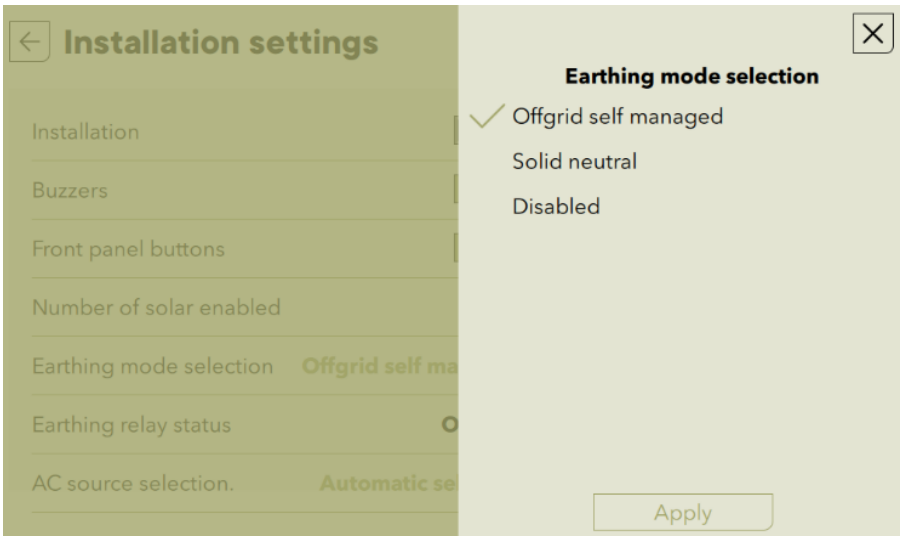


With this mode a permanent check of the neutral voltage is performed. RCD breakers should be placed on the load side.

- **Solid neutral**: This configuration is used when continuous neutral is required. In this case the system will never close the earthing relay since the Neutral to earth bonding should exist downstream. Grounding path is monitored to ensure system safety. An error is raised if grounding is not correct or if neutral continuity is not correct.
  Typical installations where "Solid neutral" should be selected are stationary installations where local rules specify explicitly continuous neutral wiring.



- **Disabled**: Disabled mode keeps earthing relay opened and no earthing path verification is realized. This mode should be used with precaution since user must ensure installation safety in any case.
  Typical installations where "Disabled" should be selected are installations with IT earthing system. In an IT network there is no grounding connection and safety isolation is ensured by an external impedance check device.



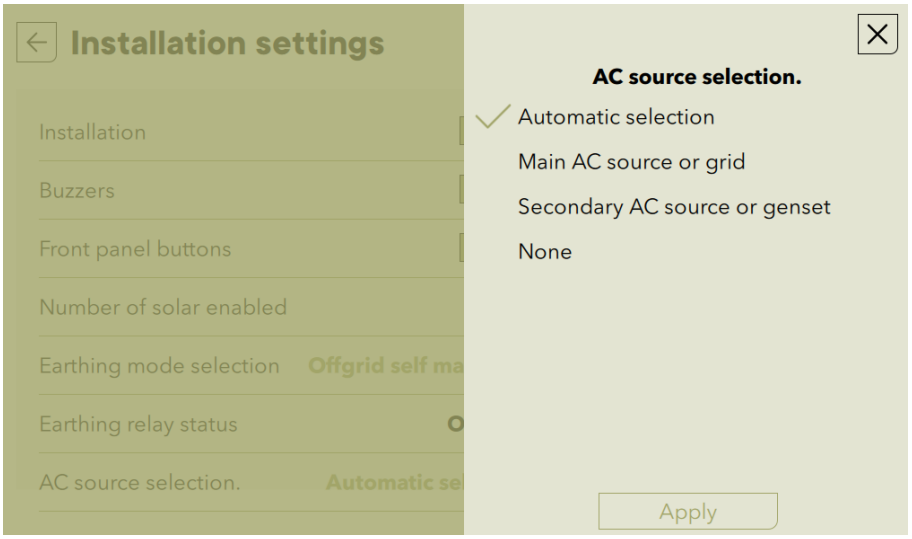
There is a check on the neutral-earth isolation in function of each case except for disabled.

The selection of the operating mode depends on the wiring configuration and the local standards. Refer to chapter 5.1.14 for the earth wiring information.

8.1.28 Source priority

When several AC-sources exists, the one that will be used is determined according to this setting:

- Automatic selection: the first AC source with voltage and frequency in the allowed range is used and kept as long as it is correct.
- Main AC-source or grid: the AC-source connection configured for the grid has priority (in multi-unit system the AC-source of an inverter can be configured as grid and another for genset). If a genset is used and the grid comes in, the next switch to the grid.
- Secondary AC-source or genset: genset AC-port has priority.
- None : all are disabled



9 SPECIAL APPLICATIONS

AC-COUPLING

AC-coupling is the use of battery inverters and PV inverters in the same system. The different elements are connected via the AC lines.

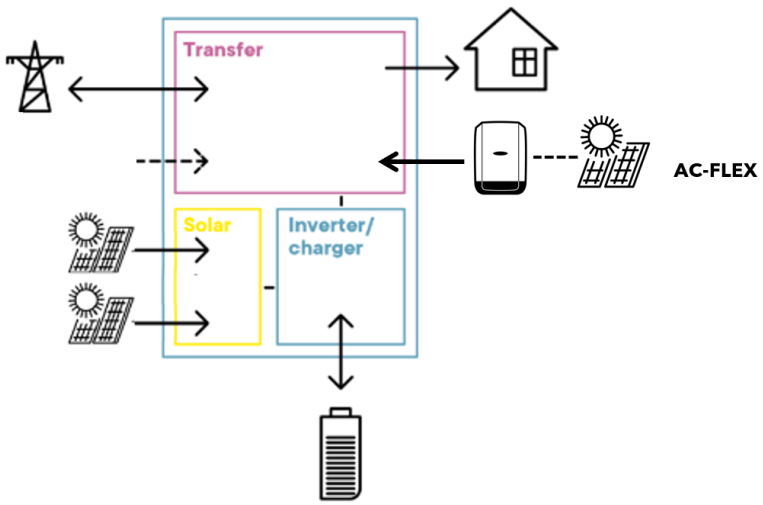
The AC-coupling can be useful in various situations.

- To add solar on an existing next3 system directly in AC.
- To update an existing solar system with more solar and batteries with the use of the next3. The grid inverter is left in place and some additional solar is connected to the new next3. It is a premium choice for the case where microinverter or optimizers are used because it would be complicate to rewire the solar roof.
- It is also interesting for large systems, as it is not always wanted to have the full power with the backup inverter. Per example a 50kW solar system with 30kW of backup capacity would have 2 next3 in parallel and a grid inverter with up to 30kW of solar.

9.1.1 General system design

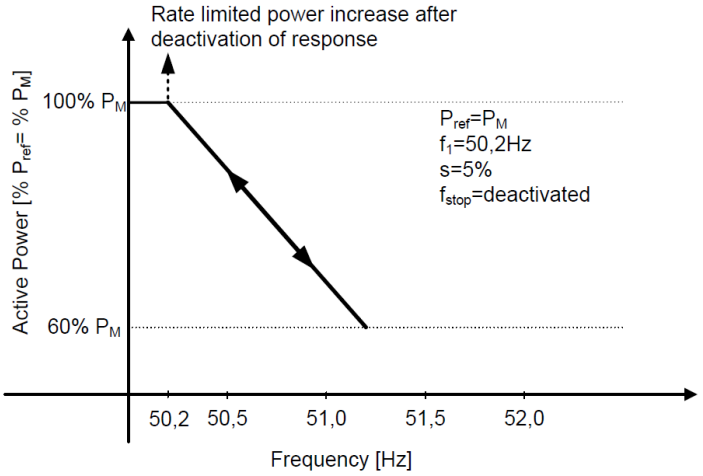
Studer-Innotec advises the following design rules for AC-coupling systems:

- The solar power in Ac-coupling should be smaller than the battery inverter power.
  - For one nx3, the AC-coupled solar should be smaller or equal to 15kW.
- The grid inverter should have the modern function of power production reduction in function of the frequency of the grid to work in island mode. Else use to the simplified AC-coupling configuration.
- The battery capacity should be sufficient to absorb all the AC-coupled power.
  - At least C/5 power with lead acid battery
  - At least C/2 power with lithium battery
- For robustness of the system use a mix of AC-coupling and DC-coupling.
  - This allows for black start of the units after an undervoltage of the battery.
  - With ac-coupling, if the battery inverter is stopped, everything is stopped.
- In case of use of a genset on AC.-source instead of the grid, it is not allowed to have backfeeding to the genset. It may be causing troubles to the generator.
  - In that case the designer must take countermeasures to avoid this. The simplest way is to disconnect the solar inverter when the genset is connected.
- The standard way to make AC-coupling is to use of the AC-FLEX connection with the proper settings. That way all the solar can be monitored automatically. This is important to understand later what happen in the system for the end user of the system.



9.1.2 AC-coupling with frequency shift

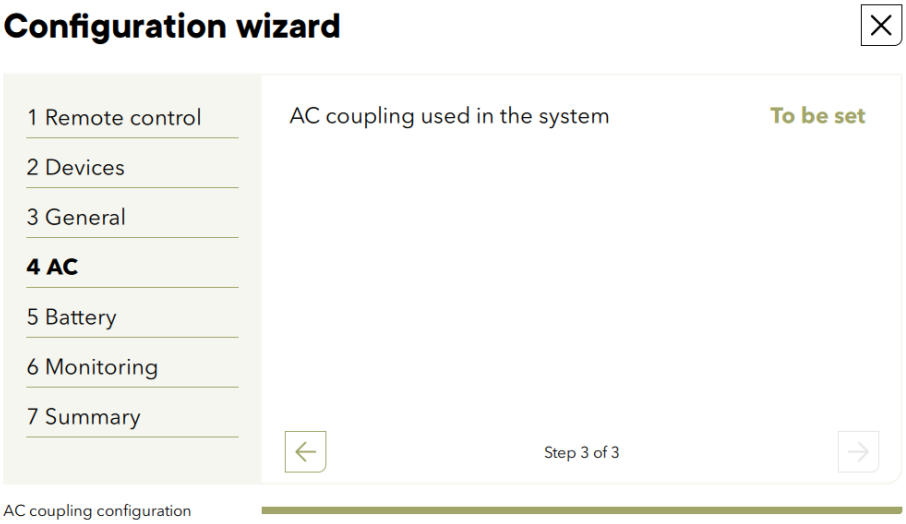
The frequency shift control uses the properties of grid inverters that must reduce the power production when the frequency of the grid increases in order to participate to the grid stability.
The frequency between 50 and 50.2Hz is used for primary control of the grid. The solar inverter must reduce linearly their power production between 50.2 and 51.5Hz.



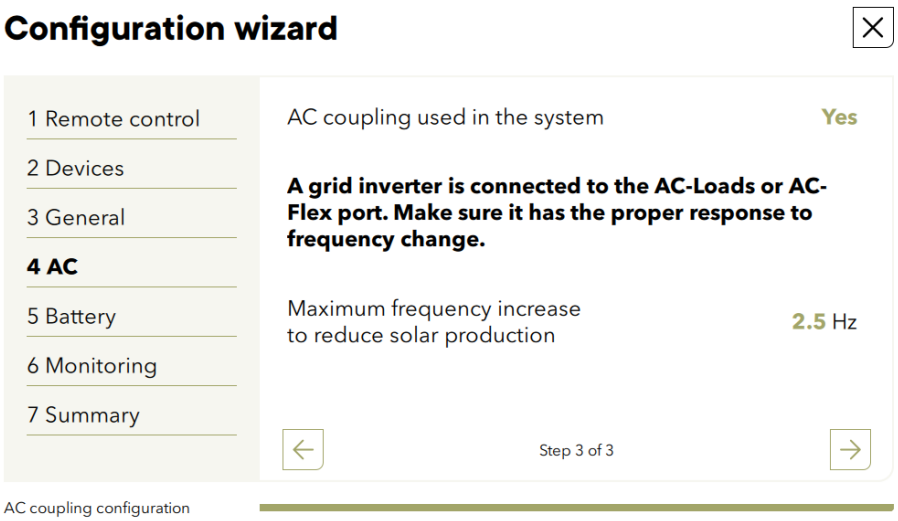
In Offgrid mode, the next3 creates the voltage/frequency and then will modulate the frequency in function of the energy needs in the system.

Setup

The main programming is done at the commissioning of the installation during the wizard. This is the quickest and safest way to program the system. The answer YES to the AC-coupling question will set the proper values to all the individual settings given below.
The question is asked during the AC configuration:



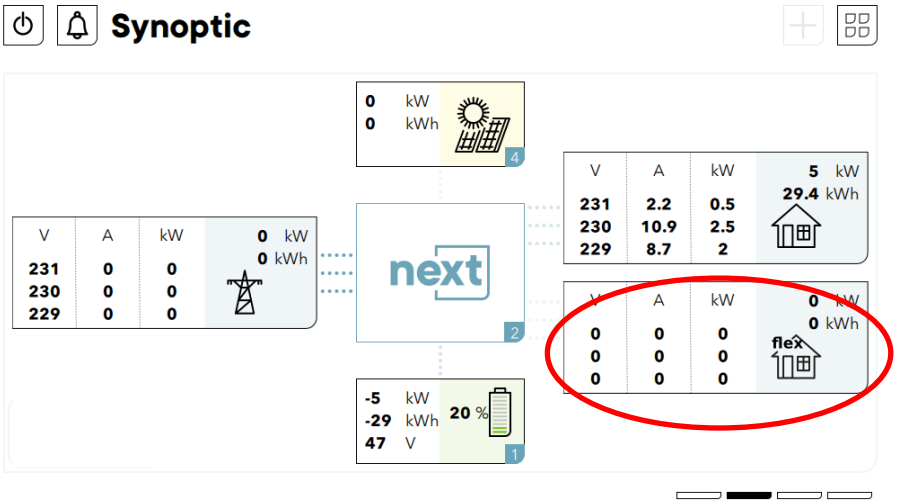
The max frequency increase is set by default to 2.5Hz which corresponds to today grid codes. Don't modify it except if you have special or old grid inverters.



AC coupling configuration

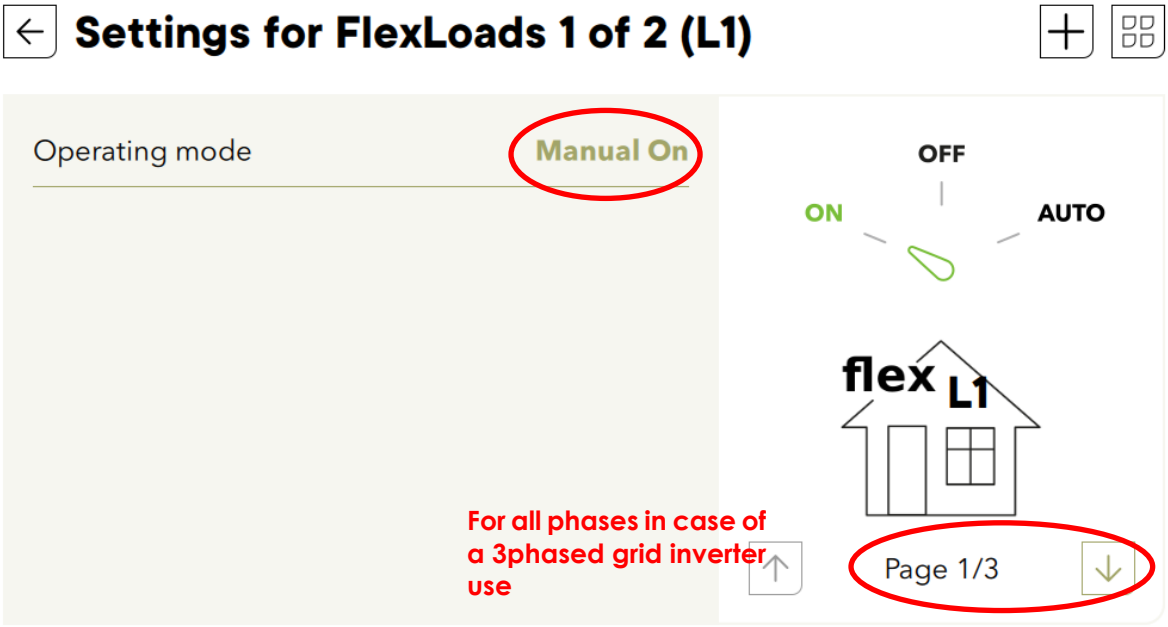
If the AC-coupling is connected to the AC-Flex, the relay programming to have it always connected must be done later with individual settings. If lithium batteries are used there is also special programming to do. Please read the following chapter anyway.

The grid inverter is connected to AC-FLEX and the relay must be always close. To program this, click on the AC-Flex part.

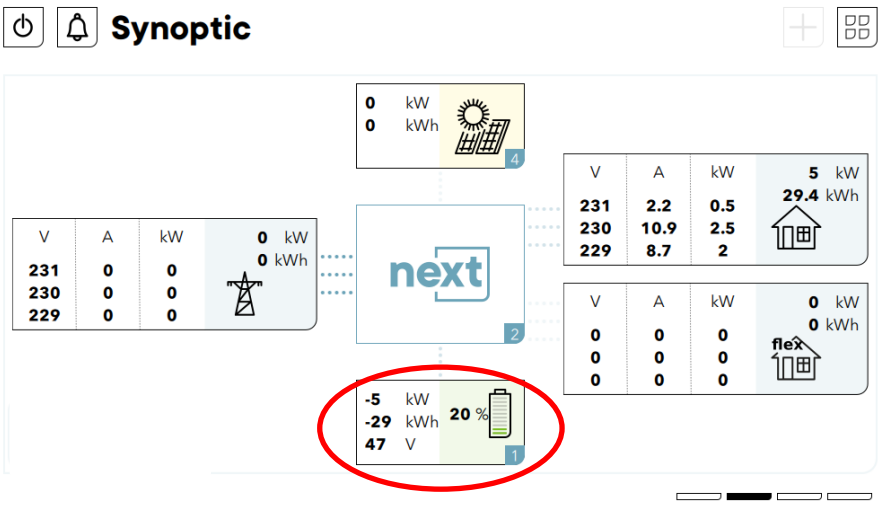


And in configuration

The AC-flex must be always ON for all phases:

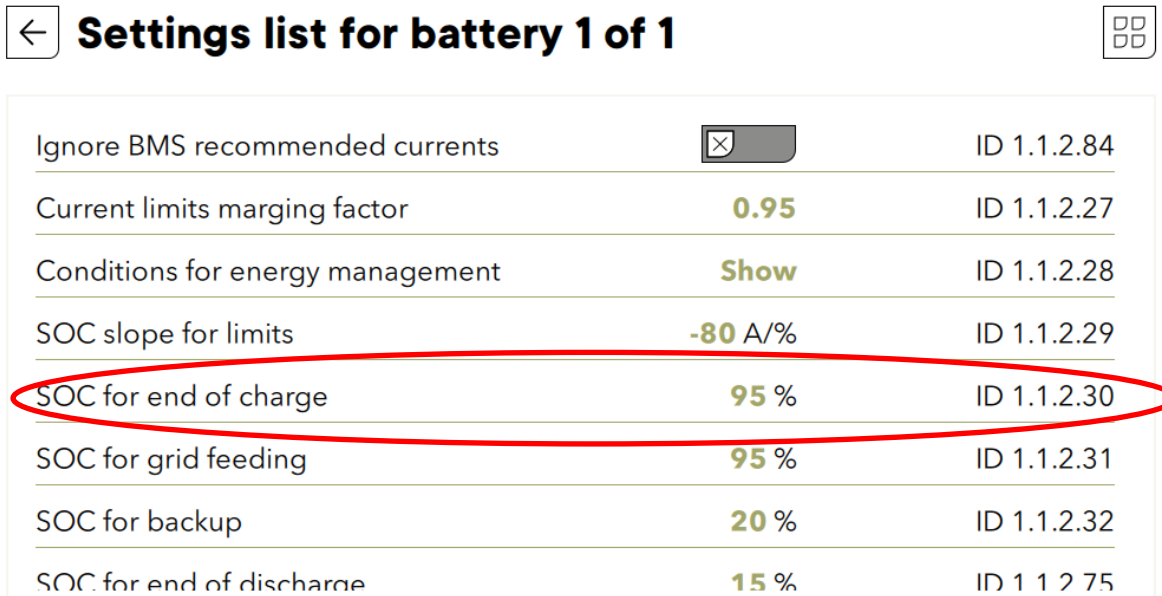


From practice it is advised to manage the lithium battery charging a little bit differently with AC-coupling. If the battery is full, the BMS requires zero charge current and makes an error if this is not respected. In transitions from grid connected to offgrid, there is the risk to have the production of the grid inverter that is maintained for a few seconds, during the time it takes for the grid inverter to react to the increasing frequency. To limit the risk of having a battery error in that transition, Studer advises to use an charge at charge à 95% with a periodical full charge.



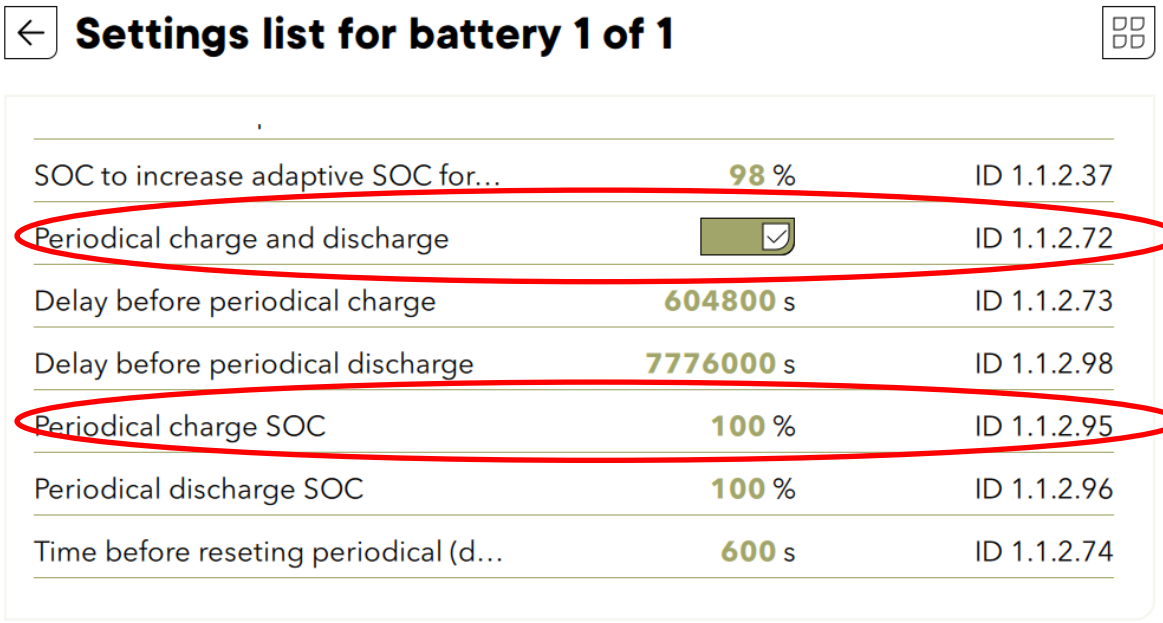
Then the config  and the advanced list 

Set the 1.1.2.30 SOC for end of charge at 95% and check that the periodical charge at 100% is enabled.



Settings list for battery 1 of 1

Ignore BMS recommended currents	☒	ID 1.1.2.84
Current limits marging factor	0.95	ID 1.1.2.27
Conditions for energy management	Show	ID 1.1.2.28
SOC slope for limits	-80 A/%	ID 1.1.2.29
SOC for end of charge	95 %	ID 1.1.2.30
SOC for grid feeding	95 %	ID 1.1.2.31
SOC for backup	20 %	ID 1.1.2.32
SOC for end of discharge	15 %	ID 1.1.2.75



Settings list for battery 1 of 1

SOC to increase adaptive SOC for…	98 %	ID 1.1.2.37
Periodical charge and discharge	☑	ID 1.1.2.72
Delay before periodical charge	604800 s	ID 1.1.2.73
Delay before periodical discharge	7776000 s	ID 1.1.2.98
Periodical charge SOC	100 %	ID 1.1.2.95
Periodical discharge SOC	100 %	ID 1.1.2.96
Time before reseting periodical (d…	600 s	ID 1.1.2.74

9.1.3 Simplified AC-coupling (no island mode) with AC-Flex

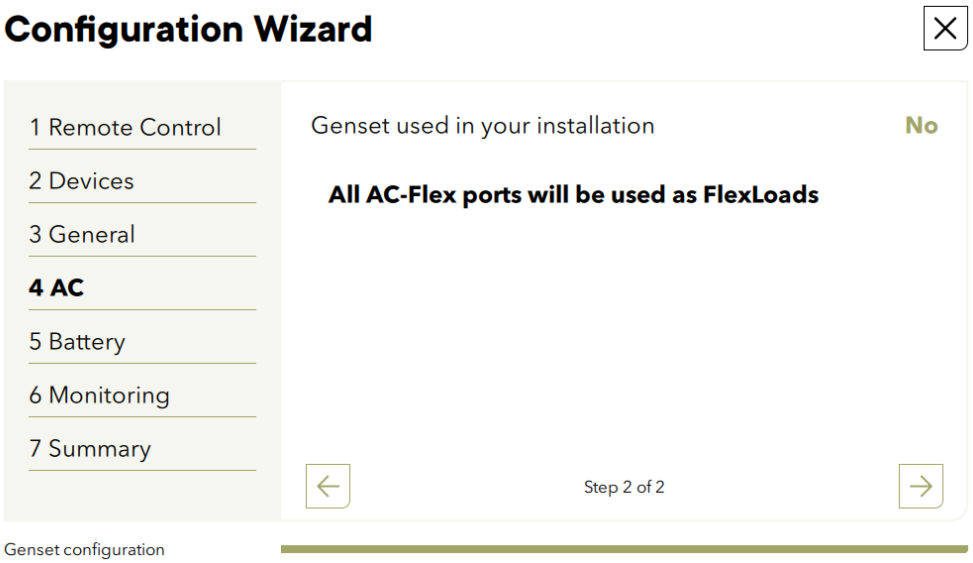
This case is for grid connected system with an existing grid inverter that would not respond to frequency increase with a reduction of power. In that case it is necessary to disconnect the inverter in case of island mode because it is not safe to work with an uncontrolled recharged of the battery.

This works with any kind of grid inverters and there are no special requirements on the grid inverter. The unit may not be compatible with frequency shift control, that is why it must be used with grid presence only and the grid inverter is disconnected when going to island mode. This prevents unwanted/uncontrolled charging of the battery.

The connection/disconnection of the grid inverter is performed with the AC-flex relay with the proper programming given below.

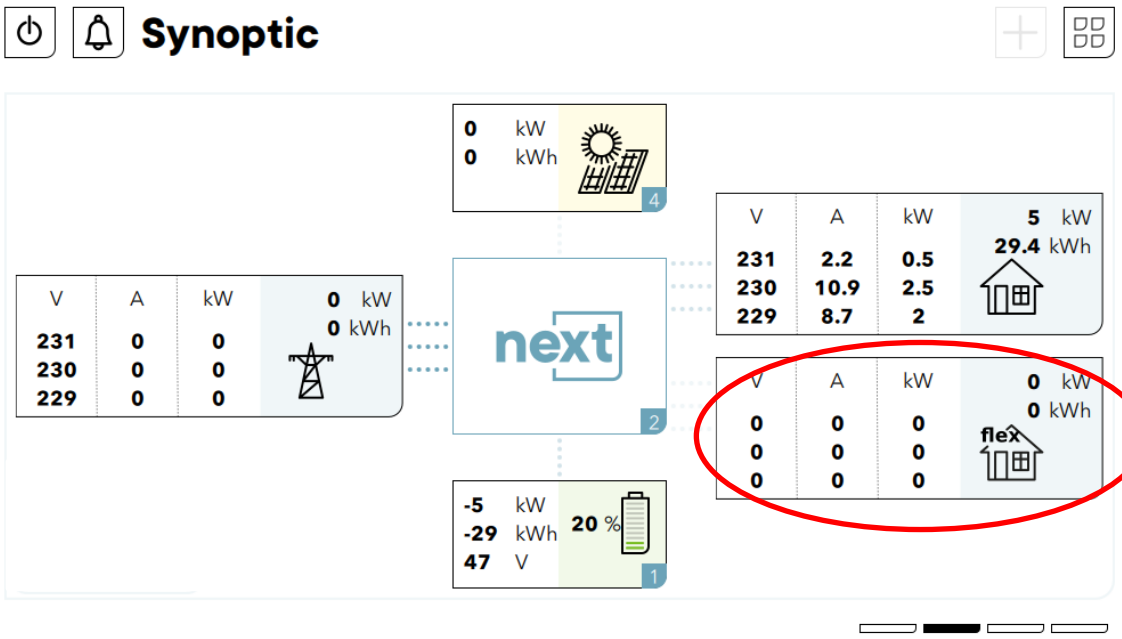
Setup

The AC-Flex must be configured as a load in the configuration wizard. Answer NO to question of genset presence.

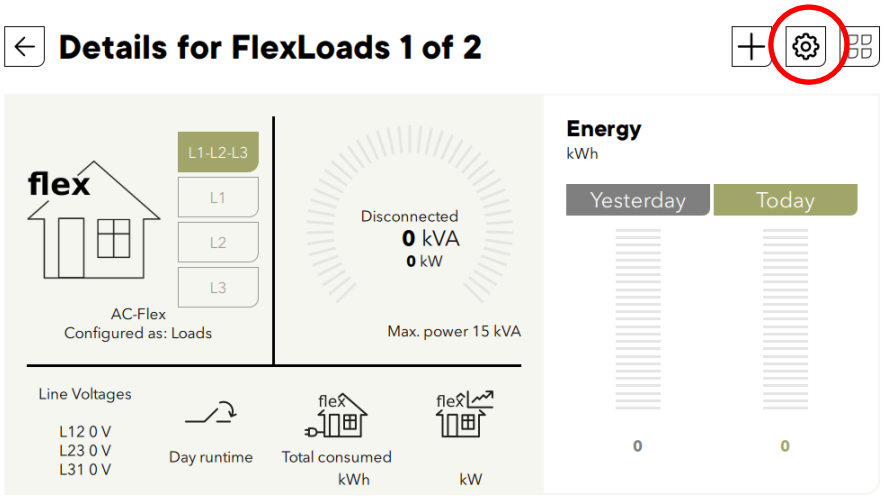


And Yes to the AC-coupling question.

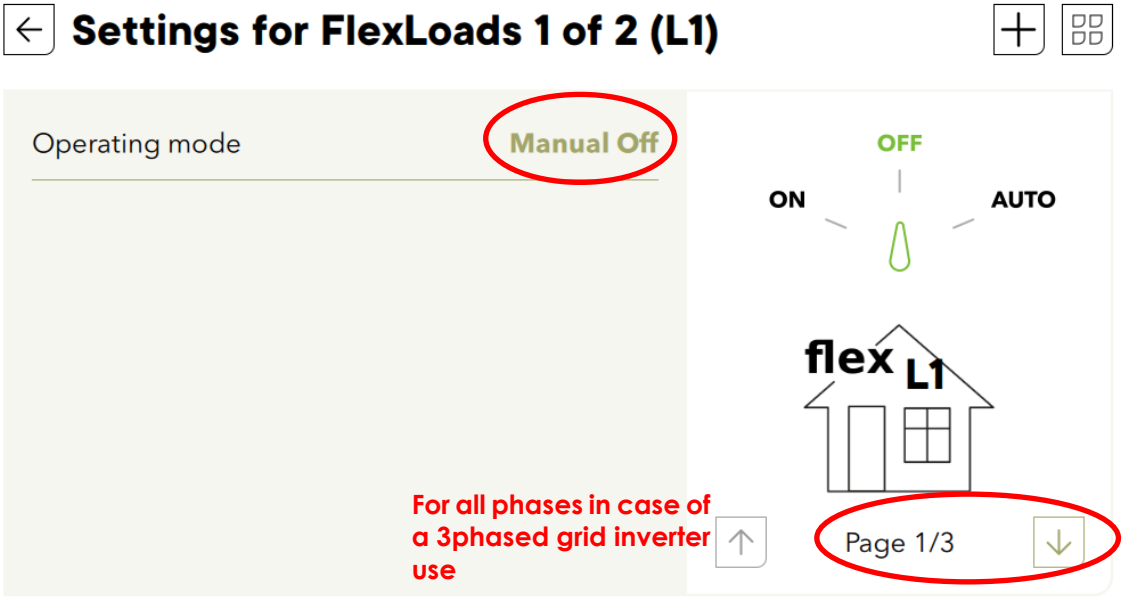
The connection/disconnection in function of grid presence must be setup. Click on the AC-Flex part.



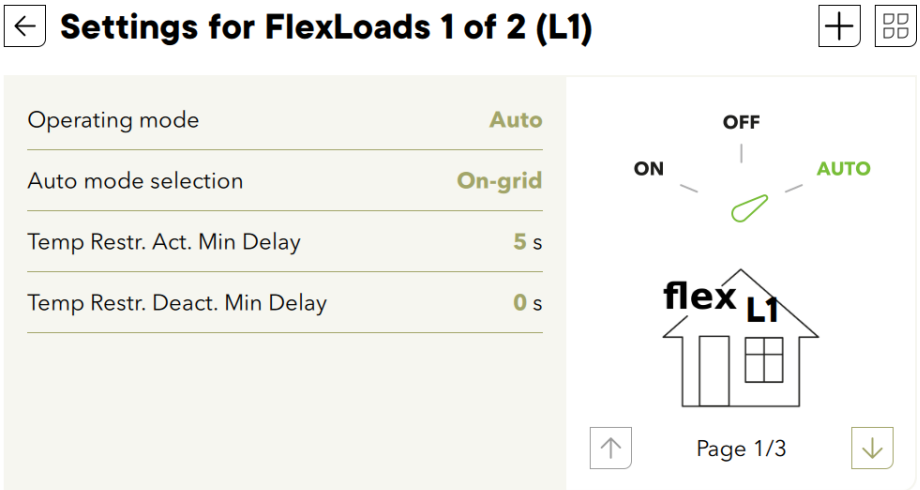
And in configuration



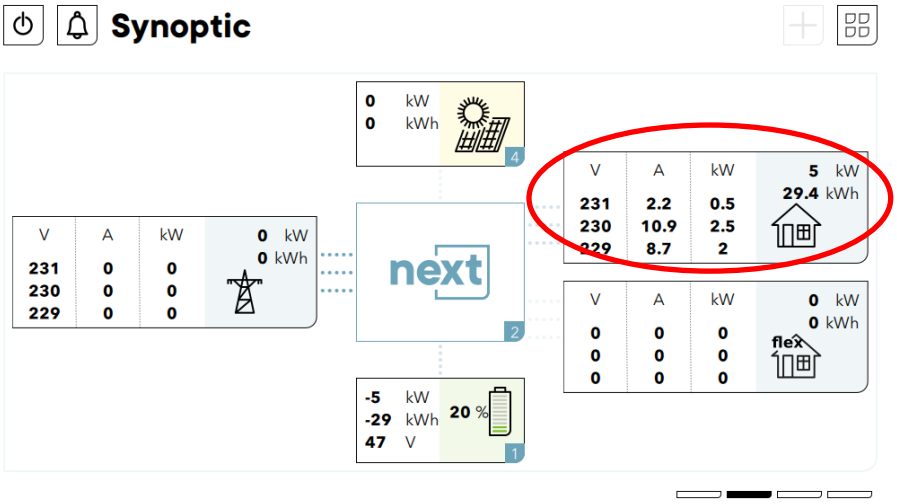
Change for <u>each</u> phase (for 3 phased grid inverters), the operating mode to AUTO.



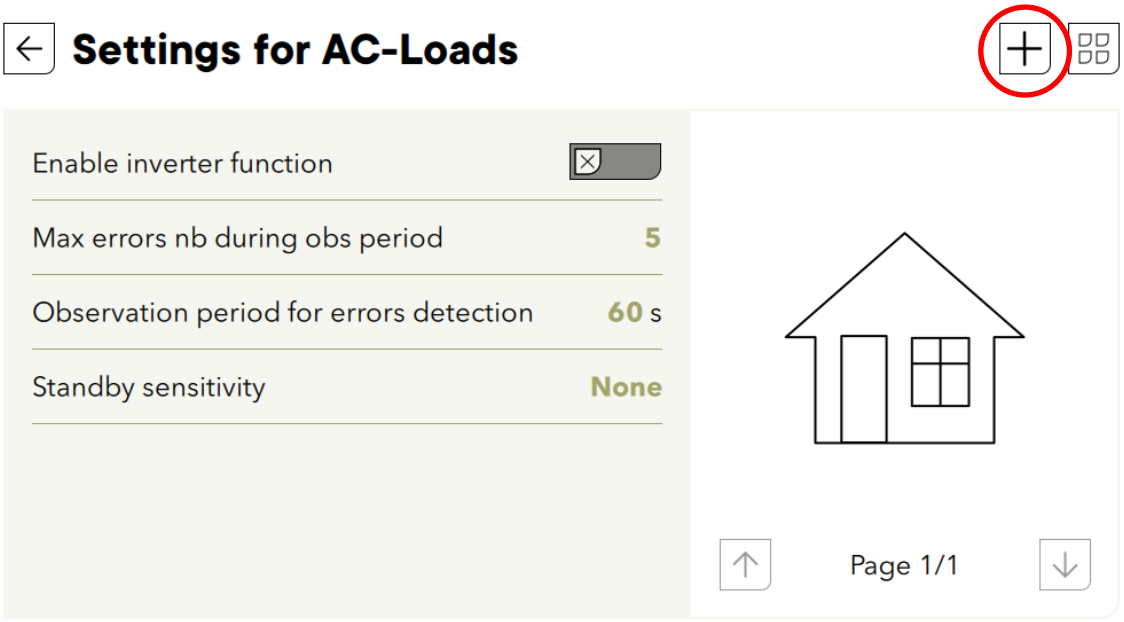
And set the connection condition to "on-grid". Add a small delay of a few seconds to be sure the connection to the grid is stabilized.



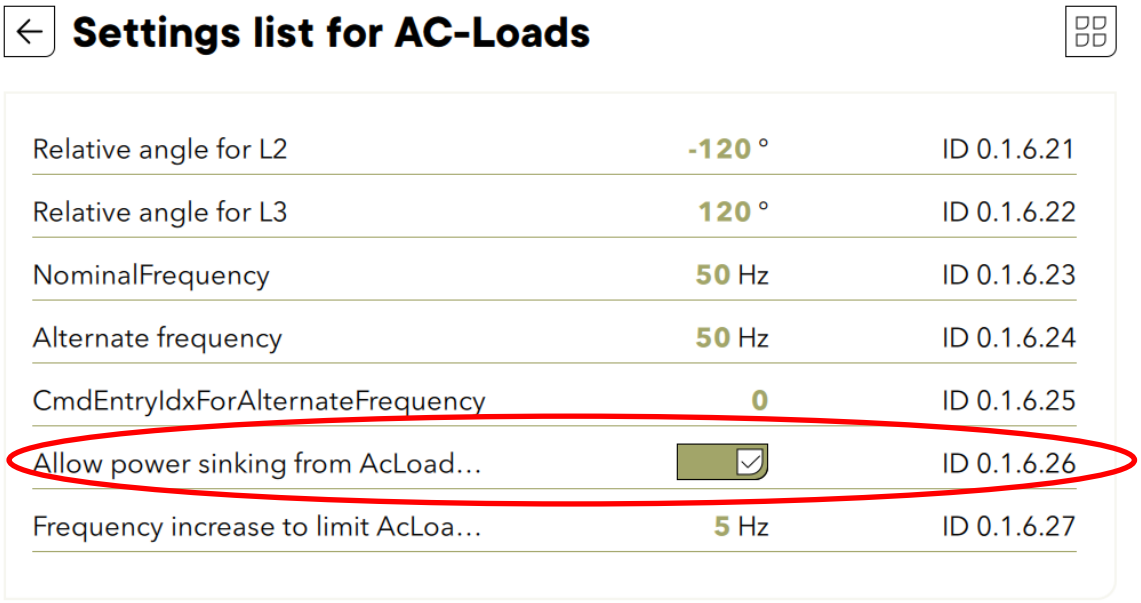
It is not a standard situation to have power coming from the AC-Load or AC-FLEX and this must be explicitly allowed with a setting, else an "back feeding" error will be raised. This is modified in the advanced settings of the AC-Loads.

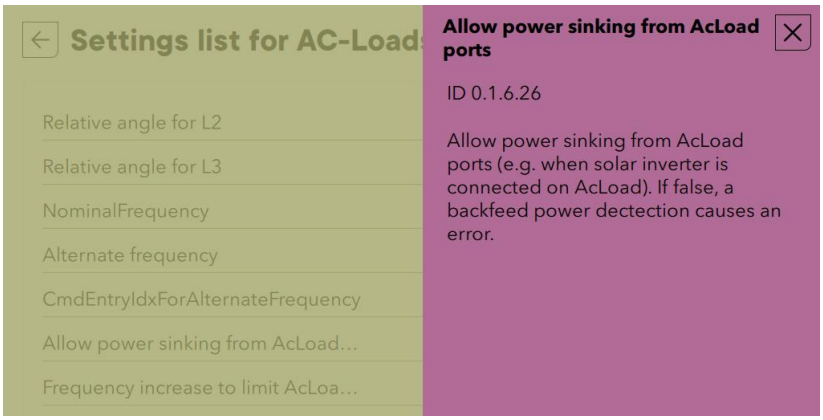


Then the config  and the advanced list 



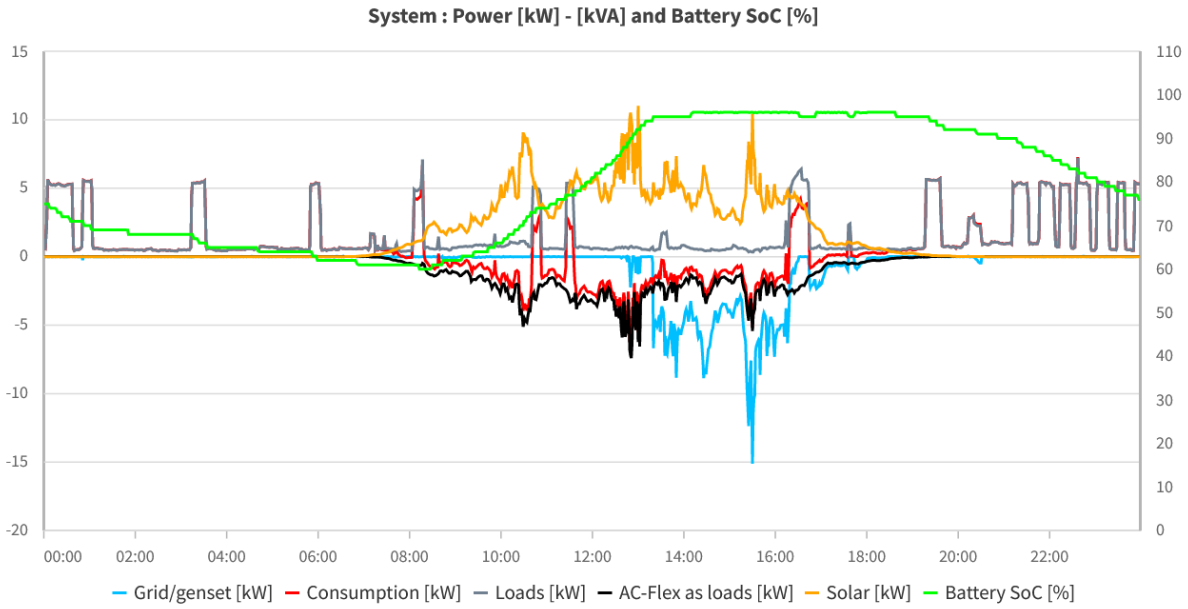
And find the 0.1.6.26 in the list and set to YES





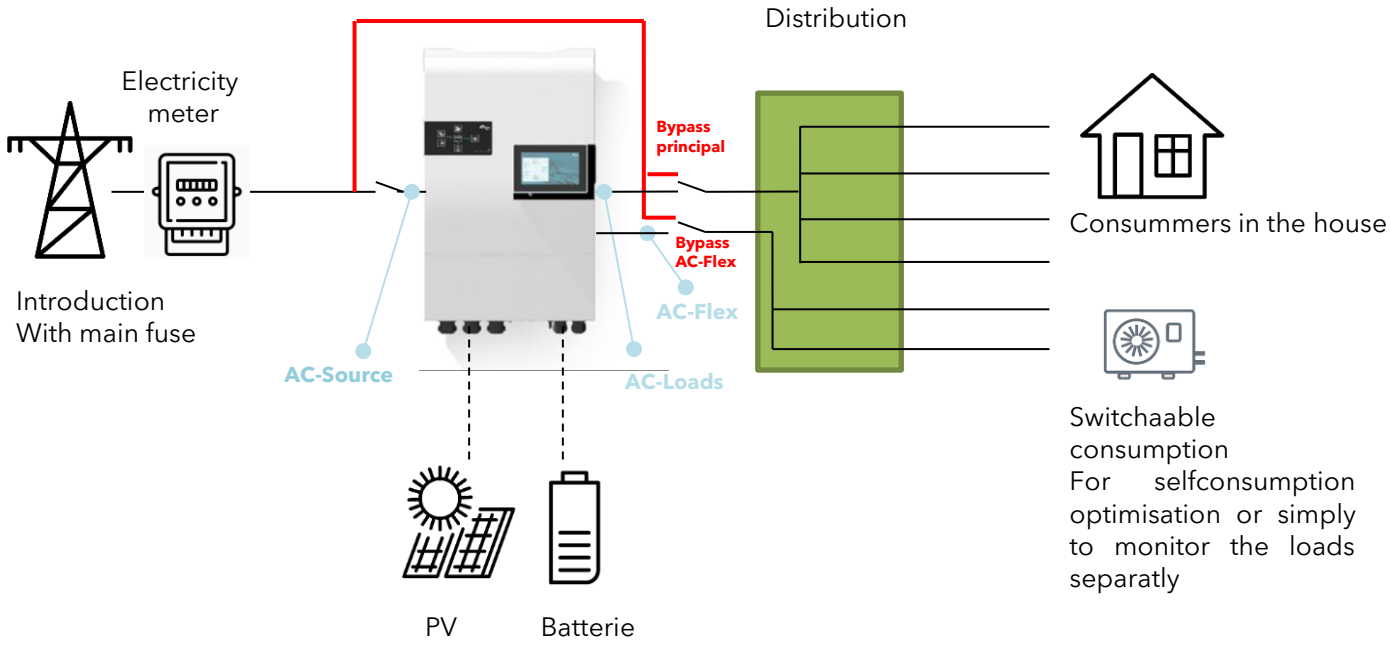
9.1.4 Example of use

Example by a customer having installed a mix of AC and DC-coupling:
The power production is monitored with the AC-flex measurement. The power flux on this connection is seen negative.



EXTERNAL BYPASS FOR REDUNDANCY

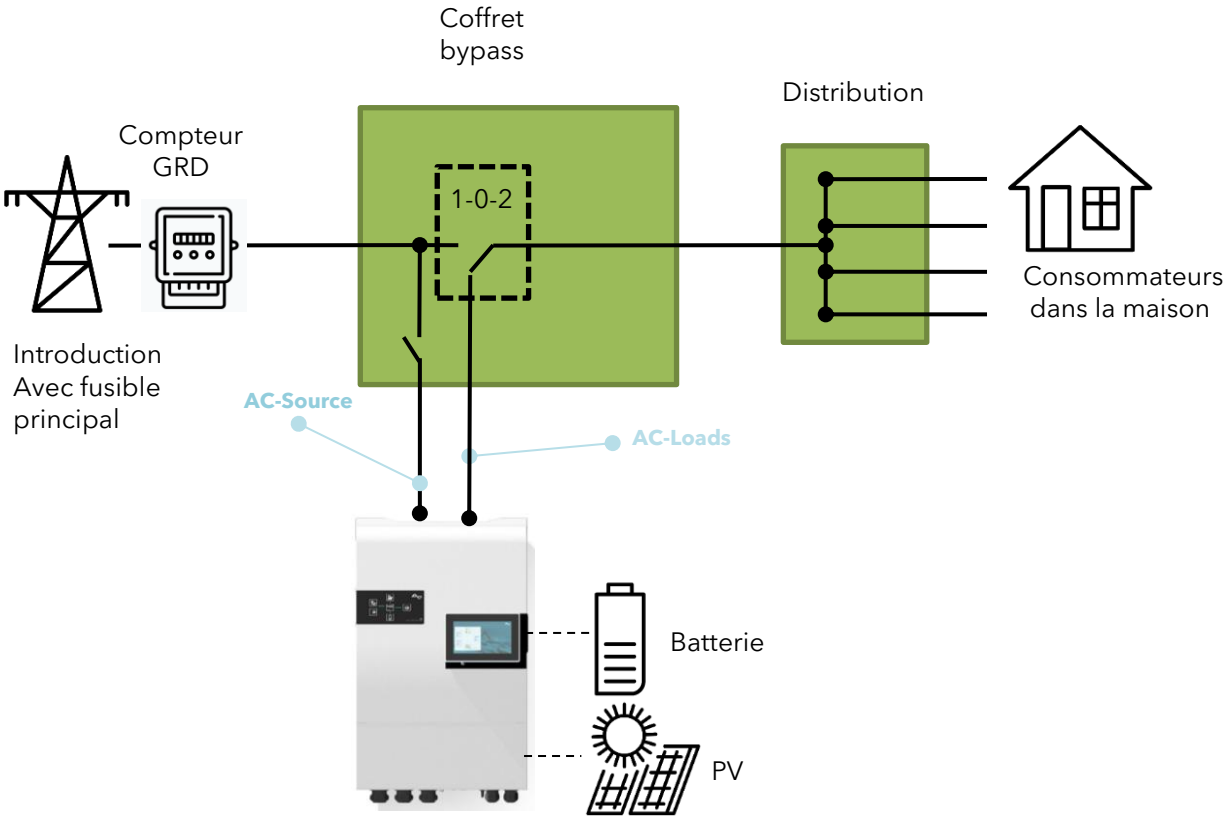
The next3 is an all-in-one hybrid solar inverter (with battery). This device is connected between the grid and the house, directly after the introduction and the main meter. The grid is connected to the AC-source terminal, the loads are connected to the AC-Loads and AC-Flex terminals. The AC-Loads and AC-Flex terminals can be powered by the batteries in case of a mains failure. An internal relay in the next3 device opens in the event of a power failure.
The AC-Flex output is a second output of the inverter which can be driven (internal relay of the device) or simply used to measure the consumptions separately (the Next3 monitors/records all electrical flows).
A bypass should be installed for redundancy in case of inverter failure. A double bypass can be installed if AC-Flex is used.



The bypass can be of several types: automatic or manual, single or double (for AC-flex included).

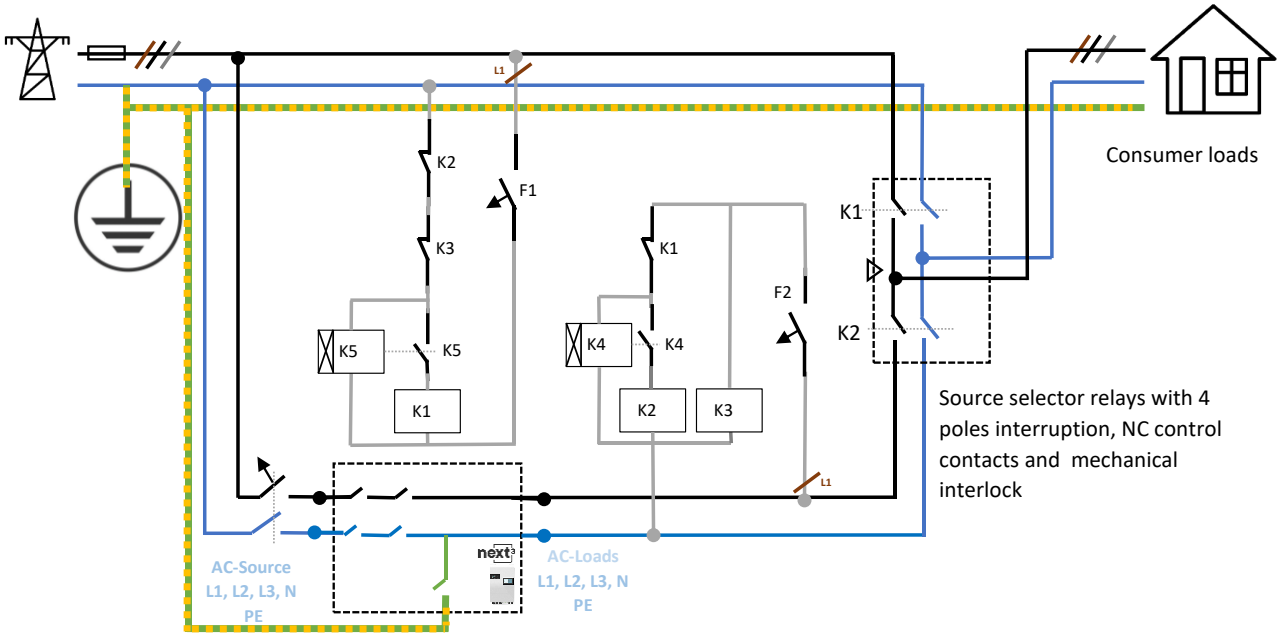
9.1.5 Simple manual bypass

In that case a simple manual swich over is used.



9.1.6 Automatic bypass

In this case, an automatic bypass is realized by relays controlled by the presence or absence of voltage of the grid or of the next3.
The following schematics is recommended by Studer:



As in all source selector, a mechanical interlock is mandatory to ensure that no short-circuit is possible. An electrical interlock of the controls guarantees a defined state. A relay is used to give a priority to the next3 if is working (K3).

EXTERNAL CONTROL OF THE NEXT3 BY SCADA

Studer Innotec proposes open access and tools to integrate its devices in a larger system. That is the **openstuder** concept.

The next series can be monitored and controlled from outside with various mean:

- With direct local control over MODBUS TCP or RTU (RS485) [4]
- With remote control through internet and through the Studer portal API

One of the most common applications of an external control is the integration in a local energy management system that considers larger view of the site. That is done either with direct connected to RS485 on the next3 or on the local network (no need to have internet connection) with TCP.

Taking the control of the next3 with an PLC, or a computer means an M2M communication (machine to machine). For this it is important to understand which information can be read and which parameters that can be written. The description of the next3 is done by the next "**Object Model**"datamodel. The Object Models (OM) is organised in groups and then details are in specific sub-objects. This organisation is expressed in the ID of each properties (=parameter or infos available) that is then associated with an Modbus register that can be R or R/W.

FIRST number: The **Group** (element of a system). The different objects each belong to one of the following groups:

- 0: System settings
- 1: Battery settings
- 2: AC ports as Source
- 3: AC ports as Dumpload
- 4 to 9: unused yet, future elements
- Next3
- Next1
- to 19: unused yet, future devices
- 20 nx-interface
-

SECOND number: The **Instance** (element of a group). That is for the case when several objects of the same type are present in the installation. For example when there are two units of next3 in parallel with two batteries, the second is addressed with x.**2**.y.z

THIRD number: The Object **index** for each element. For example for the battery group:

- BatteryCommon: ID = 0
- Battery: ID = 1
- BatteryCycle: ID = 2
- ...

FOURTH number: The Property ID in the object. If we take the Solar object as an example, the different properties are each defined by an ID:

- Voltage (ID0)
- Average Voltage(ID1)
- Max Voltage (ID2), Current (ID3)

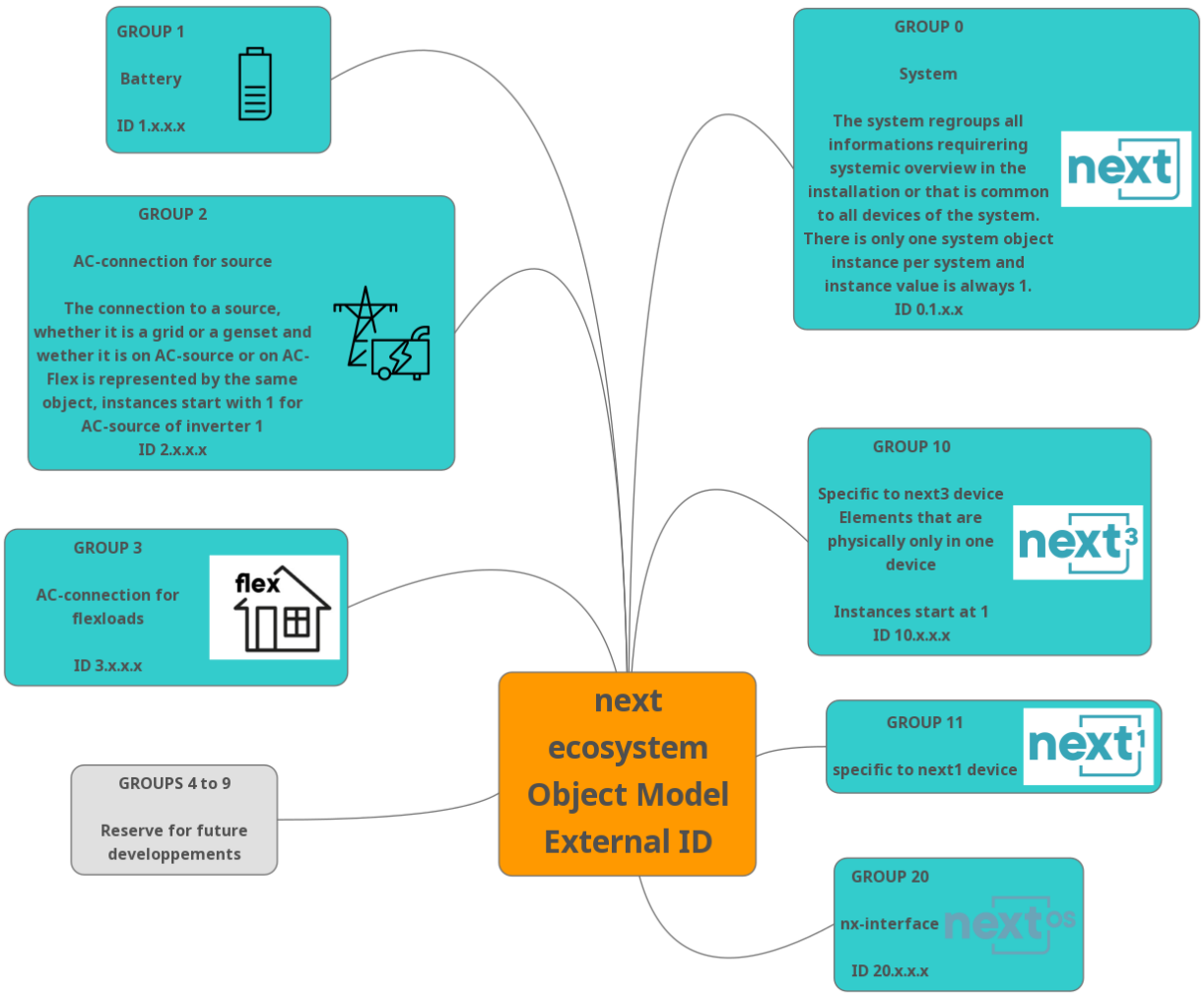
[4] https://technext3.studer-innotec.com/modbus-next

- etc...

Examples:

- The daily energy production of the 2nd PV input on the third next3 of the system is referenced with ID 10.3.62.10 (Group: 10 Next3, Instance: 3rd Next, Object ID: ObjIdSolarCommon2 = 62,Property Day energy: 10)
- The undervoltage level in charge of the second battery of a system with 1 Next3 is referenced with ID 1.2.2.2 (Group: 1 Battery settings, Instance: 2nd Battery, Object ID: ObjIdBattery = 2, Property Undervoltage: 2)

Overview of groups



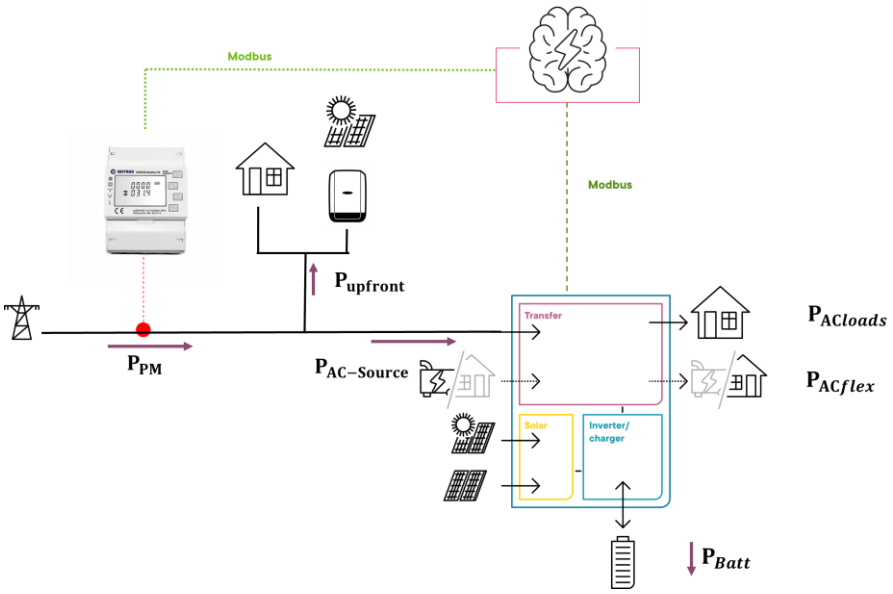
After a major update of the next system, with a different Object Model version major number (the left number, e.g. going from 6.41 to 7.0), the devices addresses can change, and the properties register addresses can change as well. Be sure to have updated model on both side of the communication.

Useful resources available for this topic:

- The online manual with the Modbus section: https://technext3.studer-innotec.com/modbus-next
  - The latest version of the Object Model description is available in .pdf on that page with the list of modbus registers.
- Example in python provided on github https://github.com/studer-innotec/next-modbus with a mapping already realized between OM and Modbus registers.

9.1.7 Example of control of next3 in function of an external smartmeter

In this example the power of the next3 is controlled in function of external measurement.



The power $P_{AC\text{-}Source}$ could be controlled using either:

- By setting "Use triphase target active power" to True (True by default), ID 2.1.5.120. Modus register 1429 to have a global target power and by setting "Target active power per phase", to the desired value (Default value is 0W: if there is energy for load in the battery or space for solar energy the nx3 tries to take nothing on its AC-Source). Per example if you want to take globally 3kW on the AC-source, set 1kW for the register 1430.
- or by setting "Target sourced active power" if the power of each phase should be controlled individually, ID 2.1.6.13, 2.1.7.13, 2.1.8.13 and Modbus registers 1822, 2122, 2422. If the individual phases control is wanted the phase balancing should be disabled (ID 2.1.5.149). The external control must make it's own balance for each phase.

Here is an example of a simple control algorithm with the goal to maximise the overall self-consumption by minimizing the power taken from the grid:

1. Reads the power of the smart meter P_{SM} and the $P_{AC\text{-}Source}$ (ID2.1.1.16. Modbus register 8). Then $P_{upfront}$ could be computed as follows: $P_{upfront} = P_{SM} - P_{AC\text{-}Source}$
2. Write the desired $P_{AC\text{-}Source}$ with one of the two methods presented above (tri-phased value or value for each phase)
   $P_{AC\text{-}Source} = P_{GridSetpoint} - P_{upfront}$
   $P_{GridSetpoint}$ is the desired power taken from the grid, zero in this example.
3. Wait a certain time (depending on the wanted control loop frequency, 1s could be a good choice) and go back to the point 1.

The nx PowerFlowDispatcher keeps working normally, so the behaviour related to the SOC for backup/gridfeeding, the maximum charge/discharge current of the batteries or the nx solar priority are not altered. In the case of a such limit (e.g. maximum charging current) is reached, the real $P_{AC\text{-}Source}$ could be different as the one written by the control algorithm.

This way of controlling the nx system would also works fine with more complex systems (several nx3 and several batteries) and most of the complexity of the power flow management is smartly handled by the next PowerFlowDispatcher, keeping the external control algorithm as simple and easiest as possible.

10 MAINTENANCE OF THE INSTALLATION

The next3 does not require any maintenance.

Check regularly:

- Check that the venting is not obstructed by objects or dirt.
- Check of the connections (tightening, general condition).
- Check if software updates are available. The next3 can be connected to internet and it is important to regularly perform the updates.

For the rest of the energy system, we can advise:

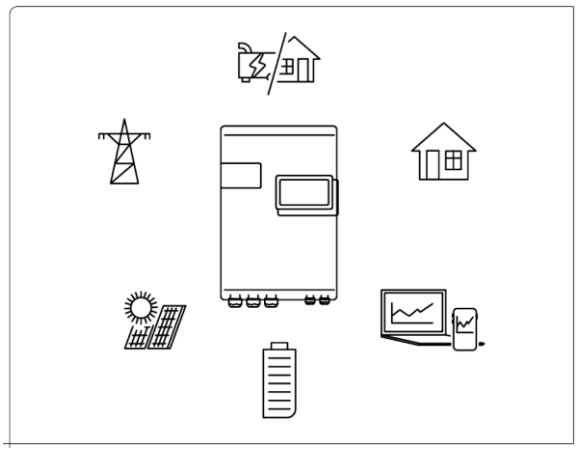
- See battery manufacturer for specific advice on battery maintenance.
- Clean regularly your PV panel to optimize the production, check the general state.

The monitoring/datalogging of the next3 will help you to understand what happens in the system.

11 TECHNICAL DATA

next3

Our versatile 3-phase smart inverter charger with built-in solar MPPT inputs and a wide range of extraordinary features. Ensuring the swiss quality to have outstanding performances for both offgrid and ongrid applications, the next generation brings the battery-based systems to the next level.



next nx3

STUDER

Inverter + battery charger Onduleur + chargeur de batterie | Wechselrichter + Batterielader | Inversor + Cargador de batería

Continuous power 25°C Puissance continue 25°C | Dauerleistung 25°C | Potencia continua 25°C	15000 VA
Power 30 min. 25°C Puissance 30 min. 25°C | Leistung 30 Min. 25°C | Potencia 30 min. 25°C	16000 VA
Power 5 sec. 25°C with solar / inverter / 1-phase Puissance 5 sec. 25°C avec solaire / onduleur / 1-phase | Leistung 5 Sek. 25°C mit PV / weschelrichter / 1-Phase | Potencia 5 seg. @25°C con solar / inversor / 1 fase	30000 / 24000 / 10000 VA
Nominal output voltage, line to neutral* Tension sortie nominale, phase-neutre | Nennausgangsspannung - Phase zum Neutralleiter | Tensión nominal de salida, fase-neutro	pure sine wave 220/230/240 Vac (±1%)
Nominal output voltage, line to line* Tension sortie nominale, phase-phase | Nennausgangsspannung - Phase zum Phaseleiter | Tensión nominal de salida, fase-fase	pure sine wave 380/400/415 Vac (±1%)
Nominal output frequency* Fréquence sortie nominale| Nennausgangsfrequenz | Frecuencia nominal de salida	50/60 Hz (±0.02%)
Nominal battery voltage (input range) Tension nominale de la batterie (plage de tension) | Nominalspannung der Batterie (Spannungsbereich) | Tensión nominal de batería (rango de tensión)	48 Vdc (36 - 68 Vdc)
Maximum charging current / power* Courant / puissance de charge maximum | Maximaler Ladestrom / Leistung | Corriente / potencia de carga máxima	300 Adc / 15000 W

Cos φ 0.1-1 | **Harmonic distortion** < 1 % | **Charge characteristic*** 6 steps: bulk, absorption, floating, equalization, reduced floating, periodic absorption | **Temperature compensation*** with nx tempsensor (included)

Cos φ 0.1-1 | **Distorsion harmonique** < 1 % | **Caractéristique de charge*** 6 étapes : bulk, absorption, maintien, egalisation, maintien réduit, absorption périodique | **Compensation de la température*** avec nx tempsensor (inclus)

Cos φ 0.1-1 | **Klirrfaktor** < 1 % | **Ladecharakteristik*** 6 Stufen: Bulk, Absorption, Schwebeladung, Equalisierung, reduzierte Schwebeladung, periodische Absorption | **Temperatur Kompensation*** mit nx tempsensor (inbegriffen)

Cos φ 0.1-1 | **Distorsión armónica** < 1 % | **Características de carga*** bulk, absorción, flotación, ecualización, flotación reducidad, absorción periódica | **Compensación por temperatura*** con nx tempsensor (incluido)

Solar PV Solaire PV | Solar PV | Solar FV

Number of MPPT inputs Nombre des entrées MPPT | Anzahl der EingängeMPPT | Número de entradas MPPT	2
Max PV short circuit current per PV input Courant max de court circuit par entrée PV | Max PV-Strom pro PV-Eingang | Corriente max de cortocircuito por entrada FV	27 Adc
Maximum PV open voltage (Voc) Tension de circuit ouvert maximum | Max Spannung des PV-Generators | Tensión máxima de circuito abierto	900 Vdc
Start up voltage / Shut off voltage Tension de démarrage / Tension de coupure | Anlaufspannung / Abschaltspannung | Tensión de arranque / Tensión de apagado	200 / 100 Vdc
Maximum solar power produced (electronic limitation) Puissance solaire max. produite | Max. produzierte PV-Leistung | Potencia solar max. producida	2 x 8000 W
Maximum solar power recommended (@STC) Puissance solaire max. recommandée (@STC) | Max. Leistung des PV-Generators (@STC) | Potencial solar máxima recomendada (@CEM)	2 x 12000 W
MPP voltage range recommended Plage de tension MPP | MPP-Spannungsbereich | Rango de tensión MPP	300 - 700 Vdc

Maximum efficiency solar to grid / EU / CEC 97 / 92 / 93% | **MPP efficiency static / dynamic** > 99 / 99% | **Maximum efficiency solar to battery** 95 %

Rendement de conversion max. solaire au réseau / EU / CEC 97 / 92 / 93% | **Efficacité MPP statique / dynamique** > 99 / 99% | **Rendement de conversion max. solaire à batterie** 95 %

Max. Effizienz von Solar zu Netz / EU / CEC 97 / 92 / 93% | **MPP-Wirkungsgrad statisch / dynamisch** > 99 / 99% | **Max. Effizienz von Solar zu Batterie** 95 %

Rendimiento de conversión max. solar a red / EU / CEC 97 / 92 / 93% | **Eficiencia MPP estática / dinámica** > 99 / 99% | **Rendimiento de conversión max. solar a batería** 95 %

Transfer Transfert | Transfer | Transferencia

AC source (grid or genset) Source AC (réseau ou génératrice) | AC-Quelle (Netz oder Generator) | Entrada AC (red o generador)

Maximum rated current Courant nominal maximal | Maximaler Nennstrom | Corriente nominal máxima	3 x 80 Aac
Operating voltage range, line to neutral Plage de tension, phase-neutre | Betriebsspannungsbereich, Phase zum Neutralleiter | Rango de tensión de funcionamiento, fase-neutro	176 – 288 Vac
Nominal voltage, line to neutral / line to line* Tension nominale, phase-neutre / phase-phase | Nennspannung - Phase zum Neutralleiter / Phase zum Phaseleiter | Tensión nominal, fase-neutro / fase-fase	220 – 230 – 240 / 380 – 400 – 415 Vac
Nominal frequency* Fréquence nominale| Nennfrequenz | Frecuencia nominal	50 / 60 Hz
Overvoltage category (OVC) Catégorie de surtension | Überspannungskategorie | Categoría de sobretensión	III
Grid code compliance* Catégorie de surtension | Überspannungskategorie | Categoría de sobretensión	EU Commission Regulation 2016/631 (NC RfG), EN 50549-1:2019, VDE-AR-N 4105:2018, IEC 62116, IEC 61727

AC flex (2nd source or load) AC flex (2ème entrée ou sortie) | AC flex (2. steuerbare AC-eingang oder ausgang) | AC flex (2da entrada o salida)

Maximum rated current Courant nominal maximal | Maximaler Nennstrom | Corriente nominal máxima	3 x 80 Aac
Operating voltage range, line to neutral Plage de tension, phase-neutre | Betriebsspannungsbereich, Phase zum Neutralleiter | Rango de tensión de funcionamiento, fase-neutro	176 – 288 Vac
Nominal voltage, line to neutral / line to line* Tension nominale, phase-neutre / phase-phase | Nennspannung - Phase zum Neutralleiter / Phase zum Phaseleiter | Tensión nominal, fase-neutro / fase-fase	220 – 230 – 240 / 380 – 400 – 415 Vac
Nominal frequency* Fréquence nominale| Nennfrequenz | Frecuencia nominal	50 / 60 Hz

AC loads Sortie AC | AC-Ausgang | Salida AC

Maximum output current Courant maximal sortie | Maximaler Ausgangstrom | Corriente máxima de salida	3 x 102 Aac

General data Données générales | Allgemeine Daten | Datos generales

Product dimensions h/w/l and weight Dimensions h/l/L et poids du produit | Produktabmessungen H/B/L und Gewicht | Dimensiones A/a/l y peso del producto	wall-mounted : 320 / 450 / 760 mm 58 kg rack 19" : 350(8u) / 485 / 675 mm 58 kg
Transport dimensions h/w/l and weight Dimension h/l/H et poids du transport | Transportabmessungen H/B/L und Gewicht | Dimensiones A/a/l y peso del transporte	600 / 800 / 720 mm 72 kg
Selfconsumption OFF / Standby / ON Autoconsommation OFF / Standby / ON | Eigenverbrauch OFF / Standby / ON | autoconsumo OFF / Standby / ON	6 / 7 / 41 W (+5 W with nx interface)
I/O Communications I/O Communications | I/O Kommunikation | I/O Comunicación	2 x nx communication bus RJ45/8, 1 x CAN BMS, 1 x RS485i (Modbus), 1 x nx tempSensor
Multifunction I/O contacts Contacts multifonctions I/O | Multi-funktionskontakte I/O | Contactos multifuncionales I/O	2 x Input, 2 x Output, rating 16 A each
Interfaces Interfaces | Interfaces | Interfaces	nx interface, datalogger USB 1-min resolution, 1 x RS485i, 1 x CANi, 1 x LAN, 4 x USB, nx wifidongle, studer portal + easy monitoring APP
Safety+EMC conformity (CE marking) Confirmité sécurité+CEM (CE) | Sicherheits+Elektromagnetische Konformität (CE) | Conformidad seguridad+CEM (CE)	EU Low Voltage Directive (LVD) 2014/35/EU, EU Electromagnetic Compliance (EMC) 2014/30/EU

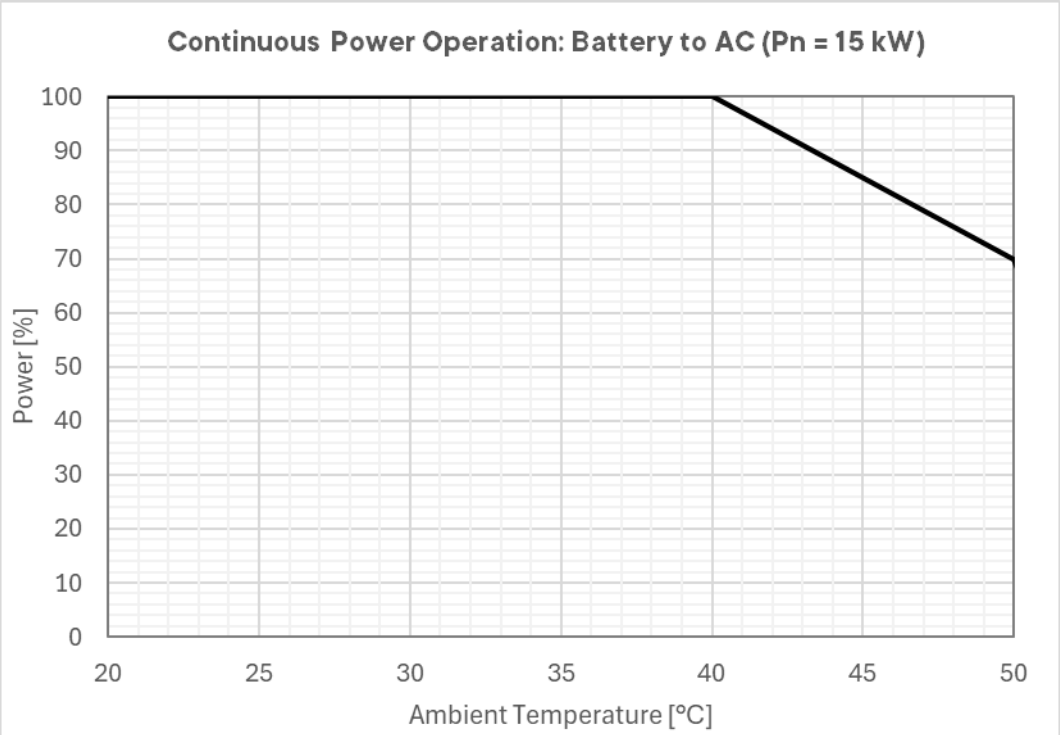
Ingress Protection according to IEC60529 IP20 | **Operating ambient temperature range** -20 to 55°C | **Relative humidity operation range** 5 to 95 % (non condensing) | **Mounting location** Indoor, unconditioned

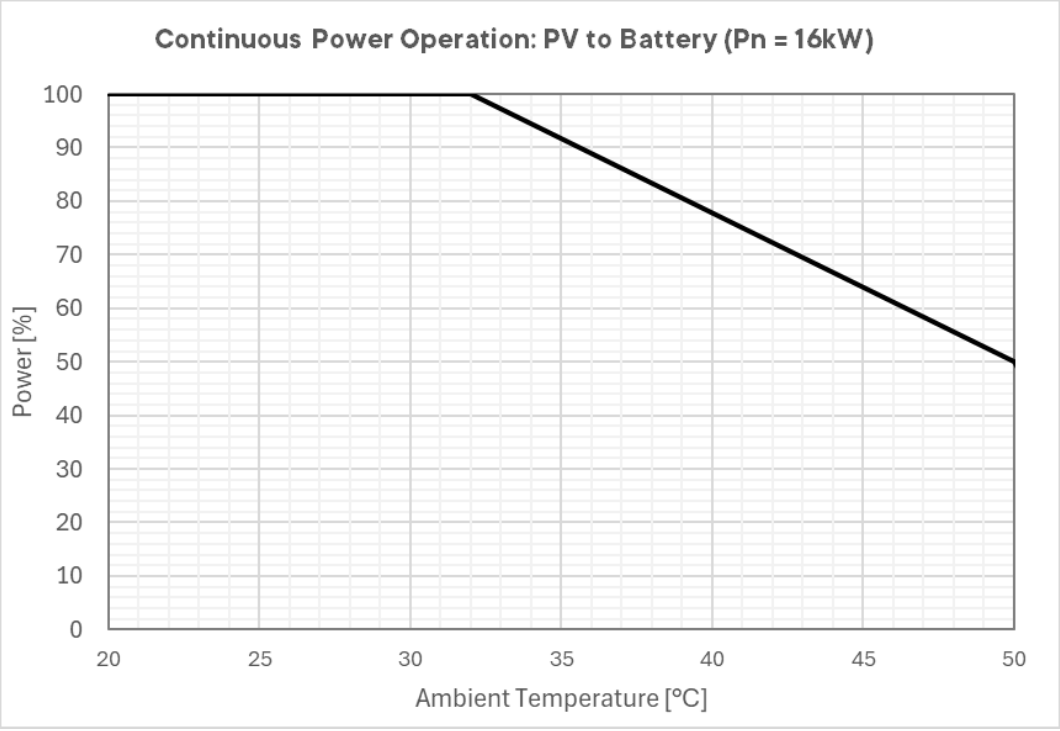
Indice de protection selon IEC60529 IP20 | **Plage de température de travail** -20 to 55°C | **Humidité relative de fonctionnement** 5 - 95 % (sans condensation) | **Emplacement de montage** intérieur, non conditionné

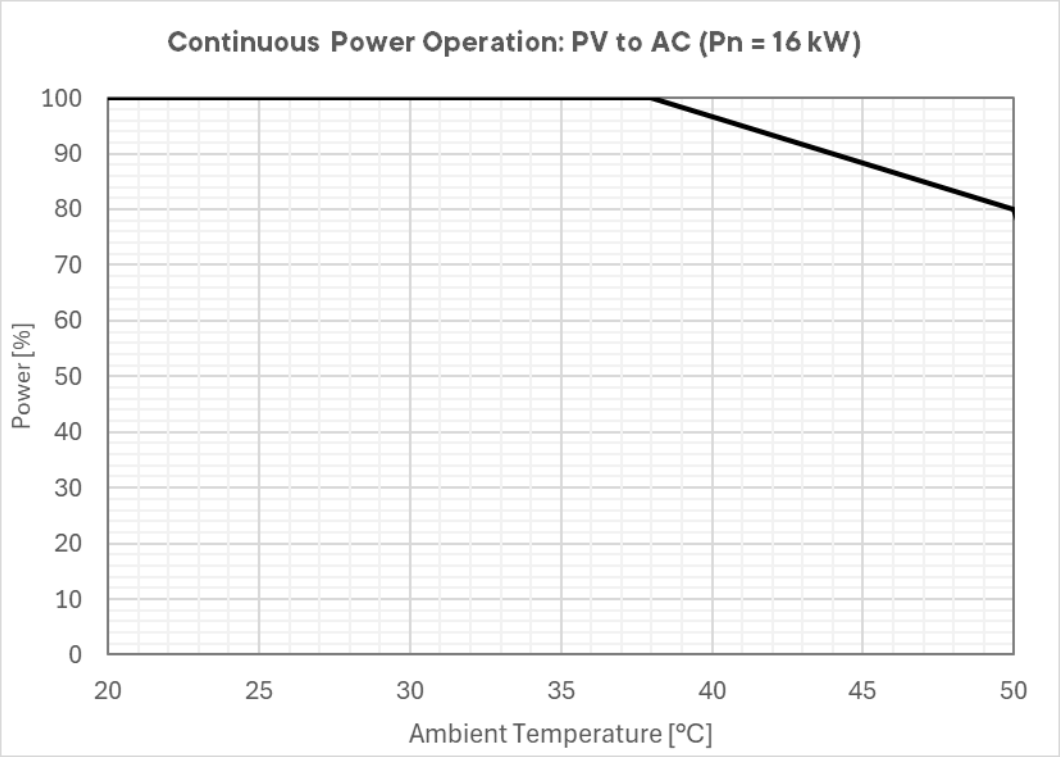
Schutzart nach IEC60529 IP20 | **Betriebstemperatur** -20 to 55°C | **Relative Lüftfeuchigkeit bei Betrieb** 5 - 95 % (nicht Kondensierend) | **Montageort** Indoor, unkonditioniert

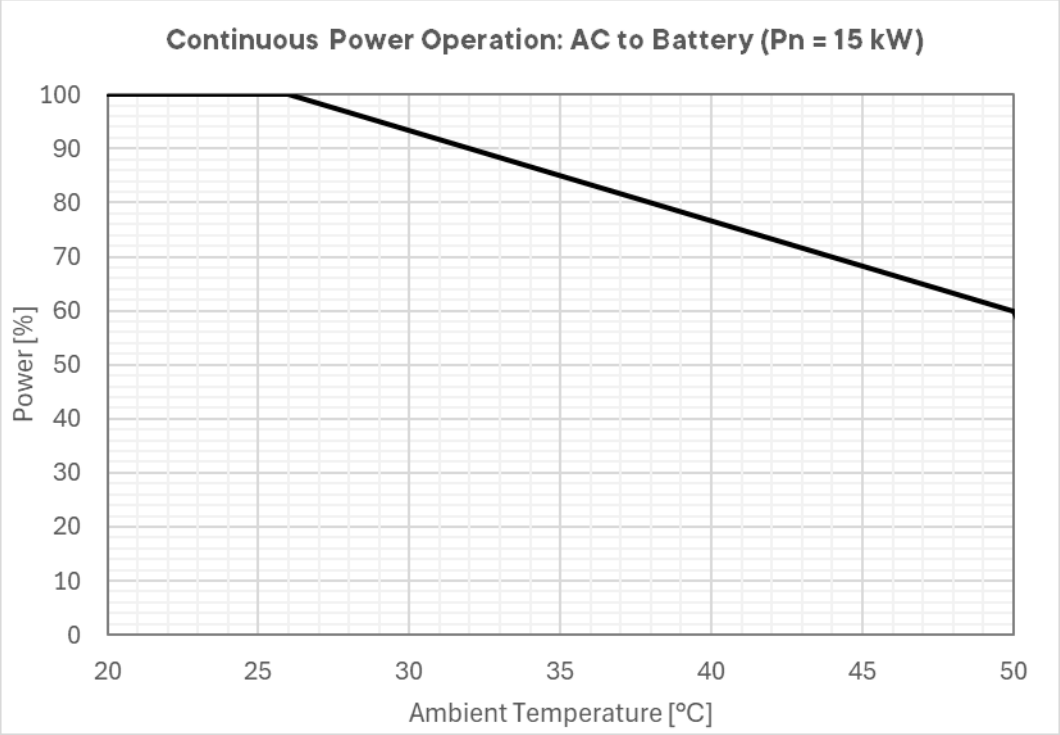
Índice de protección según IEC60529 IP20 | **Rango de temperatura de trabajo** -20 to 55°C | **Humedad relativa de funcionamiento** 5 - 95 % (sin condensación) | **Lugar de montaje** interior, sin acondicionar

DERATINGS WITH TEMPERATURE



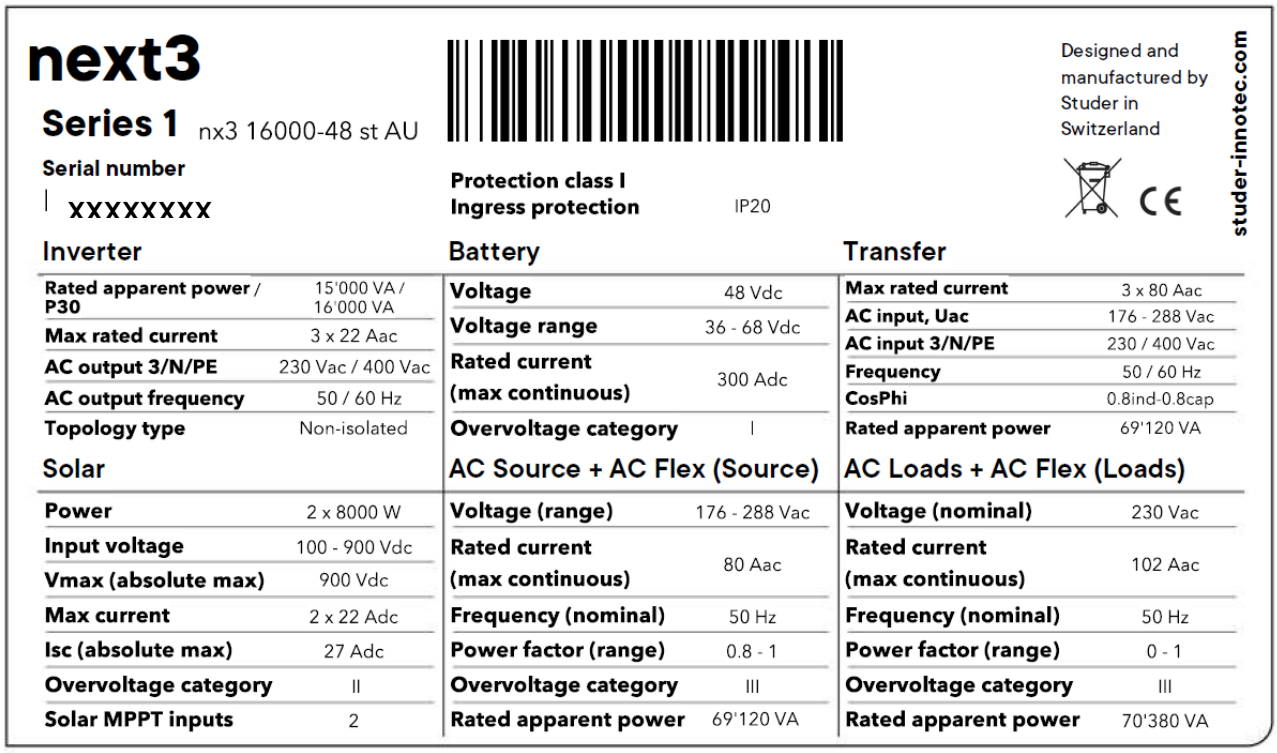



Continuous Power Operation: PV to AC (Pn = 16 kW)
Power [%]
100
90
80
70
60
50
40
30
20
10
0
20
25
30
35
40
45
50
Ambient Temperature [°C]


Continuous Power Operation: AC to Battery (Pn = 15 kW)
Power [%]
100
90
80
70
60
50
40
30
20
10
0
20
25
30
35
40
45
50
Ambient Temperature [°C]

AUTRALIAN LABELLING

The Australian version has a specific labelling to comply with the requirement of the Australian regulation:



next3

Series 1 nx3 16000-48 st AU

Serial number
XXXXXXXX

Protection class I
Ingress protection IP20

Designed and manufactured by Studer in Switzerland

studer-innotec.com

Inverter		Battery		Transfer	
Rated apparent power / P30	15'000 VA / 16'000 VA	**Voltage**	48 Vdc	**Max rated current**	3 x 80 Aac
Max rated current	3 x 22 Aac	**Voltage range**	36 - 68 Vdc	**AC input, Uac**	176 - 288 Vac
AC output 3/N/PE	230 Vac / 400 Vac	**Rated current (max continuous)**	300 Adc	**AC input 3/N/PE**	230 / 400 Vac
AC output frequency	50 / 60 Hz			**Frequency**	50 / 60 Hz
Topology type	Non-isolated	**Overvoltage category**	I	**CosPhi**	0.8ind-0.8cap
				Rated apparent power	69'120 VA
Solar		**AC Source + AC Flex (Source)**		**AC Loads + AC Flex (Loads)**	
Power	2 x 8000 W	**Voltage (range)**	176 - 288 Vac	**Voltage (nominal)**	230 Vac
Input voltage	100 - 900 Vdc	**Rated current (max continuous)**	80 Aac	**Rated current (max continuous)**	102 Aac
Vmax (absolute max)	900 Vdc				
Max current	2 x 22 Adc	**Frequency (nominal)**	50 Hz	**Frequency (nominal)**	50 Hz
Isc (absolute max)	27 Adc	**Power factor (range)**	0.8 - 1	**Power factor (range)**	0 - 1
Overvoltage category	II	**Overvoltage category**	III	**Overvoltage category**	III
Solar MPPT inputs	2	**Rated apparent power**	69'120 VA	**Rated apparent power**	70'380 VA

SECURITY CATEGORIES

Overvoltage category AC connexion: OVC III
Overvoltage category PV connexion: OVC II
Overvoltage category Battery connexion: OVC I
Class equipment: class I

12 PRODUCT RECYCLING

The next3 meets the European directive 2011/65/EU on hazardous substances and does not contain the following elements: lead, cadmium, mercury, hexavalent chrome, PBB or PBDE.

To dispose of this product, please use the service for the collection of electrical waste and observe all obligations in force in the place of purchase.

13 CONFORMITY

The inverter charger next3 described in this manual has been designed and manufactured in accordance with the following European directives:
Low Voltage Directive (LVD) 2014/35/EU
Electromagnetic Compliance (EMC) Directive 2014/30/EU
Restriction of use of certain Hazardous Substances (RoHS) Directive 2011/65/EU

Official up to date EU declaration of conformity (DoC) can be found on our website www.studer-innotec.com as well as some certifications performed by external accredited certification bodies.

GRID CODE CONFORMITY

The next3 is compliant for grid codes (from version 1.3.0.0):

- VDE-AR-N 4105:2018-11 (tested according to DIN VDE V 0124-10:2020-06)
- EN 50549-1:2019
- IEC 62116:2014
- AS/NZS 4777.2 2020
- TOR Erzeuger Typ A Version 1.1 (tested according to OVE-Richtlinie R25 Ausgabe 2020-03-01)
- C10/11 edition 2.2 and homologated according C10/26
- UNE 206007-1:2013 IN - RD 1699/2011 and RD 413/2014 - UNE 217002 Octubre 2020
- DIN VDE 0126-1-1 VFR2019
- PŘÍLOHA 4 PPDS 2018 (with EN 50549-1:2019)
- EIFS 2018:2 (with EN 50549-1:2019)

The grid code is selected during the commissioning with the wizard. To be compliant the installer must not change later any individual settings concerning grid code. The modification of grid code or individual settings concerning that subject is protected by a user code.

Scans of grid code certification test result are available on the product page and the certification can be found on the product documentation webpage: https://technext3.studer-innotec.com
Each country requirement is described on the page about compatibility: https://technext3.studer-innotec.com/compatibility#2.-Grid-code-compatibility

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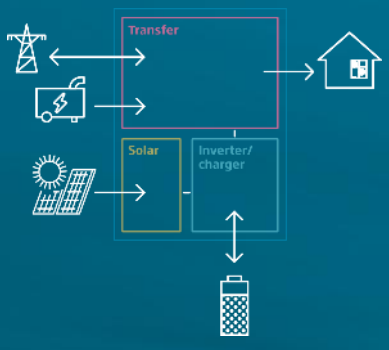

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