Ingeteam

Ingecon®Sun Power Max

Installation manual

AAV2000IKI01_B
09/2011

Important safety precautions

This manual contains important instructions for the installation, handling and use of the following models:

- Ingecon® Sun 250 TL
- Ingecon® Sun 315HE TL
- Ingecon® Sun 365HE TL
- Ingecon® Sun 375 TL
- Ingecon® Sun 400HE TL
- Ingecon® Sun 420HE TL
- Ingecon® Sun 500 TL
- Ingecon® Sun 500HE TL
- Ingecon® Sun 550HE TL
- Ingecon® Sun 600HE TL
- Ingecon® Sun 625HE TL
- Ingecon® Sun 630HE TL
- Ingecon® Sun 730HE TL
- Ingecon® Sun 800HE TL
- Ingecon® Sun 840HE TL

and any models derived from these.

Read these instructions and keep them in a safe place.

General warnings

CAUTION

The operations described in the manual may be performed only by qualified personnel.

All applicable safety-related for electrical work must be complied with. Danger of electric shock.

The entire manual must be read and understood in full prior to manipulating, installing or operating the unit.

CAUTION

The status of qualified personnel referred to in this manual will be, as a minimum, that which meets all the standards, regulations and laws regarding safety applicable to the tasks of installing and operating this unit.

The responsibility for designating qualified personnel will always fall to the company to which the personnel belong. It is necessary to decide which workers are suitable or not for carrying out specific work to preserve their safety at the same time as complying with occupational safety legislation.

These companies are responsible for providing appropriate training in electrical equipment to their personnel and for familiarising them with the contents of this manual.

CAUTION

Opening the doors to the different cubicles does not imply lack of voltage inside.

Only qualified personnel may open them, following the instructions in this manual.

CAUTION

The risk of electric shock exists even after disconnecting from the grid, the PV array and the auxiliary supplies.

CAUTION

Compliance with the safety instructions set out in this manual or in the suggested legislation does not imply exemption from other specific standards for the installation, place, country or other circumstances that affect the inverter.

CAUTION

Carry out all control and handling without voltage.

As a minimum security measure in this operation, the so-called **five golden rules** should always be followed:

1. Disconnect
2. Prevent any possible resupply
3. Check there is no voltage
4. Ground and short circuit the equipment
5. Protect from live elements, if any, and put up safety signs around the work zone.

Until these five steps are completed, the work area cannot be considered voltage-free and any work performed will be considered to be work on live equipment.

CAUTION

Following is a list of the basic obligatory safety standards for each country:

- RD 614/2001 in Spain.
- CEI 11-27 in Italy.
- DIN VDE 0105-100 and DIN VDE 1000-10 in Germany.
- UTE C15-400 in France

CAUTION

Category III - 1000-Volt measuring instruments must be used for checking for the absence of voltage.

Ingeteam Energy, S.A. is not liable for any damages caused by improper use of their equipment.

Potential hazards for people

Bear in mind the following warnings concerning personal safety.

DANGER: Electric Shock.

The equipment may remain charged after disconnecting the PV array and mains power.

Carefully follow the mandatory steps in the manual for removing the voltage.

DANGER: Explosion.

There is a very low risk of explosion in very specific cases of malfunction.

The casing will protect people and property from the explosion only if it is correctly closed.

DANGER: Crushing and joint injuries.

Always follow the indications in the manual on moving and placing the unit.

The weight of this unit can cause lesions, serious injury and even death if not handled correctly.

DANGER: High temperature.

The flow of air from the side and top outlets can reach high temperatures which can cause injury to people exposed.

The back and side of the unit act as a radiator. Do not touch, danger of severe burns.

Potential hazards for the equipment

Bear in mind the following warnings for the protection of your equipment.

CAUTION: Ventilation.

The unit requires quality air flow while it is operating.

Keeping the unit in the upright position and the inlets free of obstacles is essential for this air flow to reach the inside.

CAUTION: Connections.

After all duly authorised handling, check that the inverter is ready to start operation. Only after this can it be connected following the instructions in the manual.

CAUTION: Electrical damage.

Do not touch boards or electronic components. The most sensitive components can be damaged or destroyed by static electricity.

CAUTION: Operation.

Do not disconnect or connect any terminal while the unit is operating. Disconnect and check for absence of voltage first.

Personal protection equipment (PPE)

Use all items comprising the personal protection equipment.

Chapter “4. Safety instructions” contains references to the use of this equipment depending on the situation.

CAUTION: The standard personal protective equipment is:

- Safety goggles for mechanical hazards
- Safety goggles for electrical hazards
- Safety footwear
- Helmet

Table of Contents

1. Overview

The purpose of this manual is to describe the Ingecon® Sun Power Max unit and to give appropriate information for its correct receipt, installation, start-up, operation and maintenance.

1.1. Equipment description

An inverter is a circuit used to convert direct current to alternating current. The function of the Ingecon® Sun Power Max units is to convert the direct current generated by photovoltaic solar panels to alternating current and so enable it to be fed to the electricity grid.

1.1.1. Models

The main models in the Ingecon® Sun Power Max range are:

- Ingecon® Sun 250 TL
- Ingecon® Sun 315HE TL
- Ingecon® Sun 365HE TL
- Ingecon® Sun 375 TL
- Ingecon® Sun 400HE TL
- Ingecon® Sun 420HE TL
- Ingecon® Sun 500 TL
- Ingecon® Sun 500HE TL
- Ingecon® Sun 550HE TL
- Ingecon® Sun 600HE TL
- Ingecon® Sun 625HE TL
- Ingecon® Sun 630HE TL
- Ingecon® Sun 730HE TL
- Ingecon® Sun 800HE TL
- Ingecon® Sun 840HE TL

Some Ingecon® Sun Power Max models also feature a modified version of the same. The modification consists in removing the AC module and passing each of its connections to the bottom of the inverters. This modification is known as NAC.

Ingecon® Sun Power Max inverters may be based on five blocks, depending on the model. The blocks are:

- 125 kW block and output voltage of 220 V between phases
- 156 kW block and output voltage of 275 V between phases
- 183 kW block and output voltage of 320 V between phases
- 200 kW block and output voltage of 345 V between phases
- 210 kW block and output voltage of 360 V between phases

Below you will see the available models and their variants in detail.

Block	Model	Variant
125 kW and output voltage of 220 V between phases	Ingecon® Sun 250 TL	
	Ingecon® Sun 375 TL	Ingecon® Sun 375 TL NAC
	Ingecon® Sun 500 TL	Ingecon® Sun 500 TL NAC
156 kW and output voltage of 275 V between phases	Ingecon® Sun 315HE TL	
	Ingecon® Sun 500HE TL	Ingecon® Sun 500HE TL NAC
	Ingecon® Sun 625HE TL	Ingecon® Sun 625HE TL NAC
183 kW and output voltage of 320 V between phases	Ingecon® Sun 365HE TL	
	Ingecon® Sun 550HE TL	Ingecon® Sun 550HE TL NAC
	Ingecon® Sun 730HE TL	Ingecon® Sun 730HE TL NAC
200 kW and output voltage of 345 V between phases	Ingecon® Sun 400HE TL	
	Ingecon® Sun 600HE TL	Ingecon® Sun 600HE TL NAC
	Ingecon® Sun 800HE TL	Ingecon® Sun 800HE TL NAC
210 kW and output voltage of 360 V between phases	Ingecon® Sun 420HE TL	
	Ingecon® Sun 630HE TL	Ingecon® Sun 630HE TL NAC
	Ingecon® Sun 840HE TL	Ingecon® Sun 840HE TL NAC

1.1.2. Options

All models in the Ingecon® Sun Power Max range can incorporate the following options:

- AC activator kit
- Master-slave Kit
- RTC kit for the BT Enel Distribuzione grid
- 1000 VDC kit

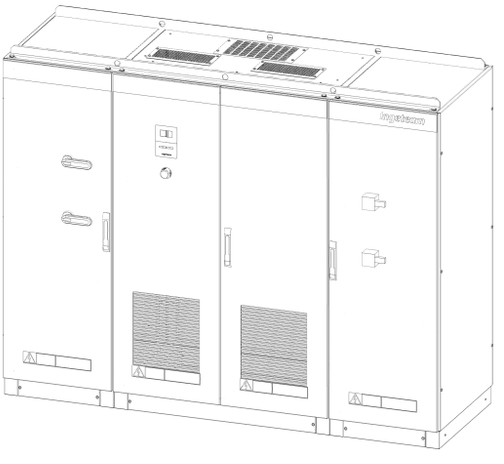
1.1.3. Compositions

Different configurations are possible by combining the various Ingecon® Sun Power Max models with the various options available.

Ingecon® Sun 250 TL, 315HE TL, 365HE TL, 400HE TL and 420HE TL

These units include:

- 2 thermomagnetic circuit breakers on the AC side
- 2 overvoltage protectors on the AC side
- 2 electronics blocks
- 2 MPPT trackers
- 2 fused circuit breakers for PV array

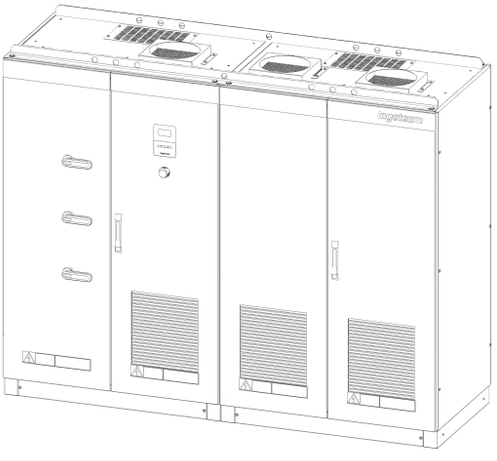


These units can incorporate the PIB kit for Italy, which does not change its outside appearance.

Ingecon® Sun 375 TL, 375 TL NAC, 500HE TL, 500HE TL NAC, 550HE TL, 550HE TL NAC, 600HE TL, 600HE TL NAC, 630HE TL and 630HE TL NAC

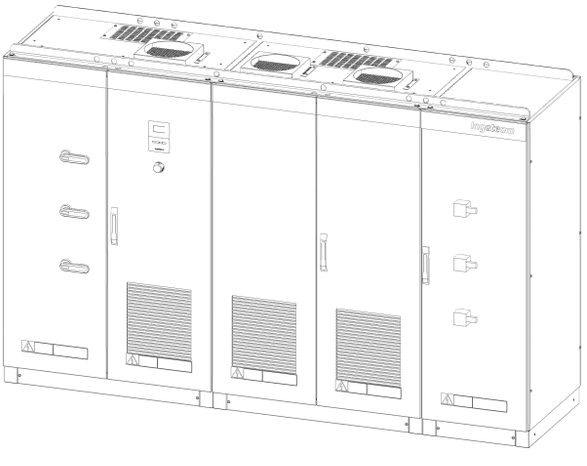
The Ingecon® Sun 375 TL NAC, 500HE TL NAC, 550HE TL NAC, 600HE TL NAC and 630HE TL NAC models include:

- 3 electronics blocks
- 3 MPPT trackers (1 with master-slave configuration)
- 3 fused circuit breakers for PV array
- 3 overvoltage protection elements on the DC side
- 3 overvoltage protection elements on the AC side



Ingecon® Sun 375 TL, 500HE TL, 550HE TL, 600HE TL and 630HE TL models also include:

- 3 thermomagnetic circuit breakers on the AC side

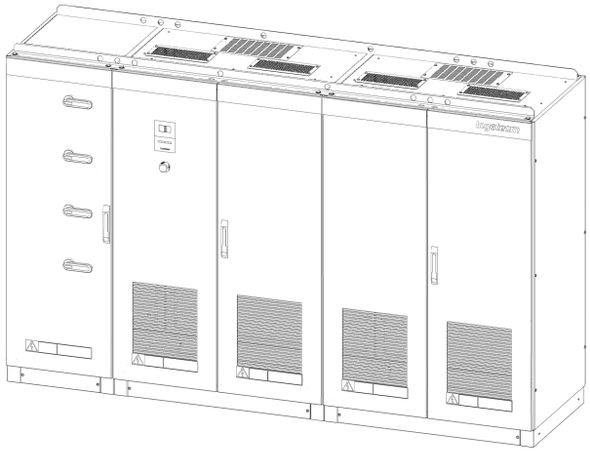


These units can incorporate the PIB kit for Italy, which does not change its outside appearance.

Ingecon® Sun 500 TL, 500 TL NAC, 625HE TL, 625HE TL NAC, 730HE TL, 730HE TL NAC, 800HE TL, 800HE TL NAC, 840HE TL and 840HE TL NAC

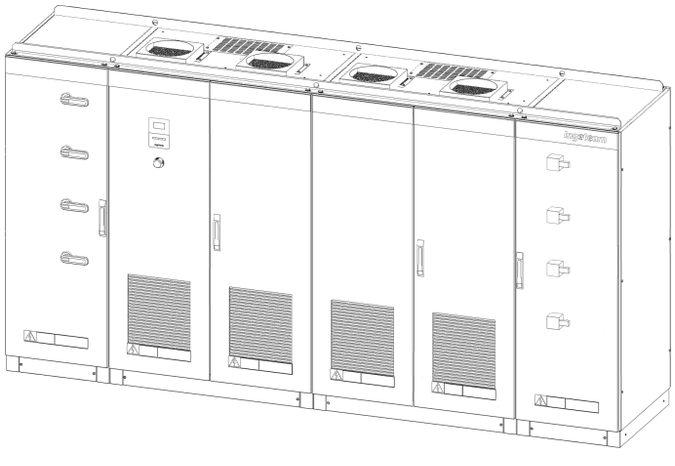
The Ingecon® Sun 500 TL NAC, 625HE TL NAC, 730HE TL NAC, 800HE TL NAC and 840HE TL NAC models include:

- 3 electronics blocks
- 4 MPPT trackers (1 with master-slave configuration)
- 4 fused circuit breakers for PV array
- 4 overvoltage protection elements DC side
- 4 overvoltage protection elements AC side



Ingecon® Sun 500 TL, 625HE TL, 730HE TL, 800HE TL and 840HE TL also include:

- 4 thermomagnetic circuit breakers on the AC side



1.2. Compliance with regulations

This unit can incorporate kits making it adaptable to the regulations for all European countries and countries in other continents.

For projects in the United States or Canada, Ingeteam Energy has the Ingecon® Sun U, families, which have their own manual.

1.2.1. CE marking

CE marking is mandatory for the sale of any product within the European Union, without prejudice to standards or laws. Ingecon® Sun Power Max units have CE marking by reason of their compliance with the following directives:

- *Low Voltage Directive 2006/95/EC*

- *Electromagnetic Compatibility Directive 2004/108/EC*

To comply with each directive, compliance with the parts applicable to our units of the appropriate harmonised standards is sufficient.

Low Voltage Directive

Ingecon® Sun Power Max units comply with this directive by means of compliance with the applicable parts of harmonised standard *EN 50178 Electronic equipment for use in power installations*.

Electromagnetic Compatibility Directive

Ingecon® Sun Power Max units comply with this directive by means of compliance with the applicable parts of harmonised standards:

- *EN 61000-6-2 Electromagnetic Compatibility. Part 6-2: Generic standards - Immunity for industrial environments*.
- *EN 61000-6-4 Electromagnetic Compatibility. Part 6-4: Generic standards - Emission for industrial environments.*

Compliance with these standards calls for compliance with limits and procedures in other standards of the same series.

2. System description

2.1. Location

The Ingecon® Sun Power Max units need to be installed in environments with specific characteristics.

Guidelines are provided in this section for choosing a suitable environment and adapting the unit to it properly.

2.1.1. Environment

CAUTION

Place the units in a place which is accessible for installation and maintenance work and which permits use of the keyboard and the reading of the front indicator LEDs.

CAUTION

The air vents and part of the cabinet close to them can reach 85 °C. Do not place any material nearby which is sensitive high air temperatures.

CAUTION

Avoid corrosive environments that may affect the proper operation of the inverter.

CAUTION

Never place any object on top of the unit.

2.1.2. IP grade

Ingecon® Sun Power Max units have a IP20 level of protection against external agents.

IP20 means that the unit is fully protected against the ingress of dust and also against water streams from any direction as defined for this level of protection in standard *IEC60529*.

Ingecon® Sun Power Max should therefore be installed in an enclosed, covered location.

The environment in which they are assembled should always be dry and free of dust.

They are not suitable for outdoor installation.

2.1.3. Ambient temperature

These units are designed to operate in a temperature range from -20 °C to 65 °C.

2.1.4. Atmospheric conditions

The ambient air must be clean and relative humidity must not exceed 50% at over 40 °C. Higher levels of relative humidity, up to 95%, can be tolerated at below 30 °C.

It should be borne in mind that moderate condensation may occasionally occur as a consequence of temperature variations. For this reason, apart from the unit's own protection, vigilance of these units is necessary once they have been started up on sites where the conditions described above are not expected to be present.

In the event of condensation, never apply voltage to the unit.

2.1.5. Contamination class

The pollution class for which the units have been designed is grade 3.

Suitable measures should be taken to provide dust-free air of sufficient quality in the vicinity of the inverter.

2.1.6. Acoustic contaminación

When on, the inverter generates a buzzing sound.

Do not place it in an occupied room, or on light supports which might amplify this buzz. The mounting surface must be firm and appropriate for the weight of the unit.

2.1.7. Ventilation

A minimum space of 20 cm must be maintained on both sides and in front of the unit to allow the free circulation of air through the circulation vents.

Ingecon® Sun Power Max units have cooling fans on top of each cabinet containing an electronic block. These fans start up for a few seconds each time the inverter is connected to the mains and is about to inject power. This procedure makes it possible to easily check proper operation.

Fans require different air flow for cooling electronics, depending on the number of electronics units and the number of unit cabinets. Always provide for each unit the flow values listed in the following table:

Model	Airflow (m^3/h)
250 TL, 315HE TL, 365HE TL, 400HE TL, 420HE TL	2670
375 TL, 500HE TL, 550HE TL, 600HE TL, 630HE TL	4640
500 TL, 625HE TL, 730HE TL, 800HE TL, 840HE TL	5340

Acceptable pressure loss is 34 Pa and air inlet velocity less than 3 m/s.

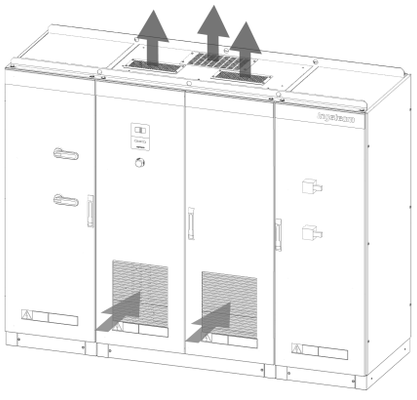
CAUTION

Do not place any object on top of the unit.

Avoid dropping particles that could enter the unit through air vents.

CAUTION

Facilitate the flow of air entering through the front ventilation grids, and the exhaust air through the top grids.



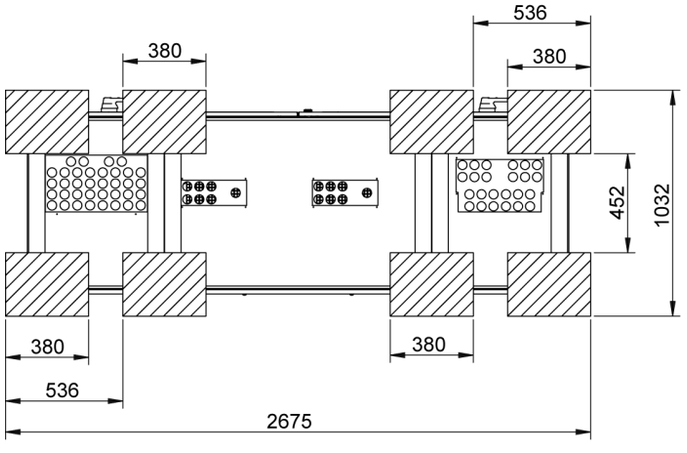
2.1.8. Support surface and fastening

Due to the Ingecon® Sun Power Max unit's heavy weight, the ground on which it rests should be firm and completely level.

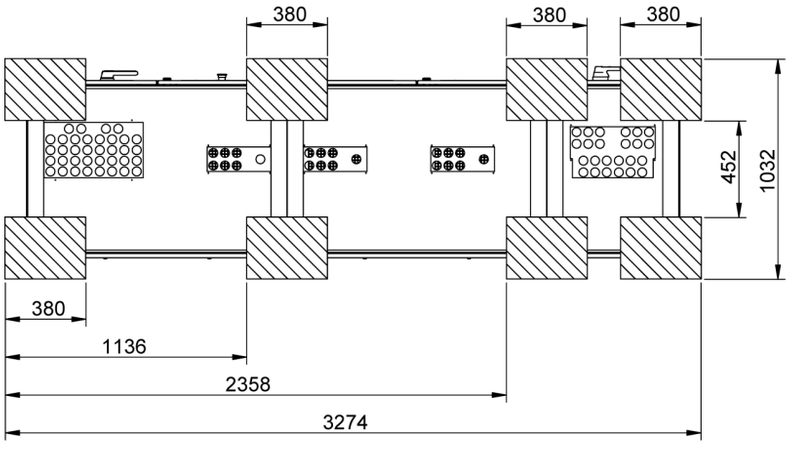
Access to the AC feed varies depending on whether the model is NAC or not. In NAC models, each feed is made from the base of each of the modules. In all other models, however, all the modules are powered through the base of the AC module, which is the one on the right.

If the unit sits on a lower void for cabling, the base should rest on firm ground as much as possible without causing mechanical stresses to the structure. Below you will see minimum supports for each unit (in millimetres).

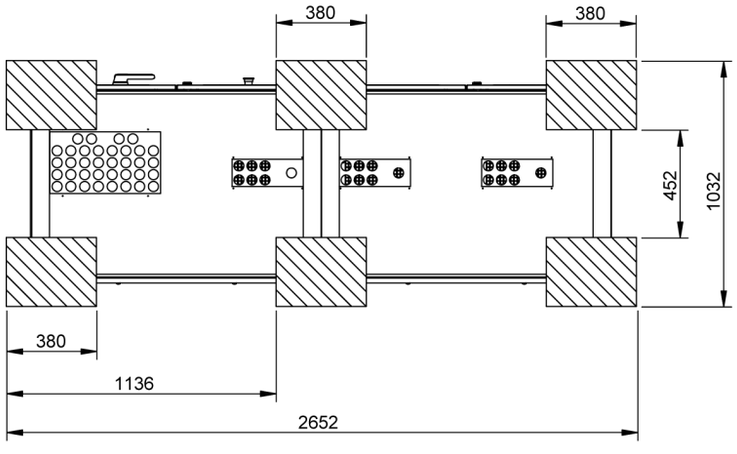
Ingecon® Sun 250 TL, 315HE TL, 365HE TL, 400HE TL and 420HE TL



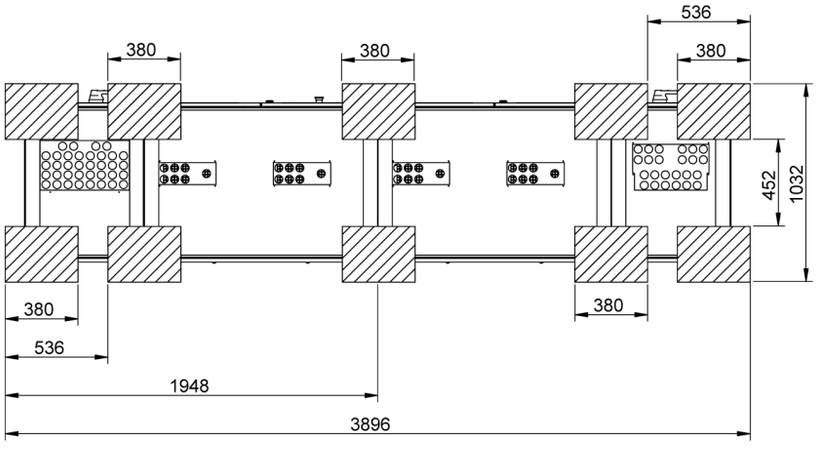
Ingecon® Sun 375 TL, 500HE TL, 550HE TL, 600HE TL and 630HE TL



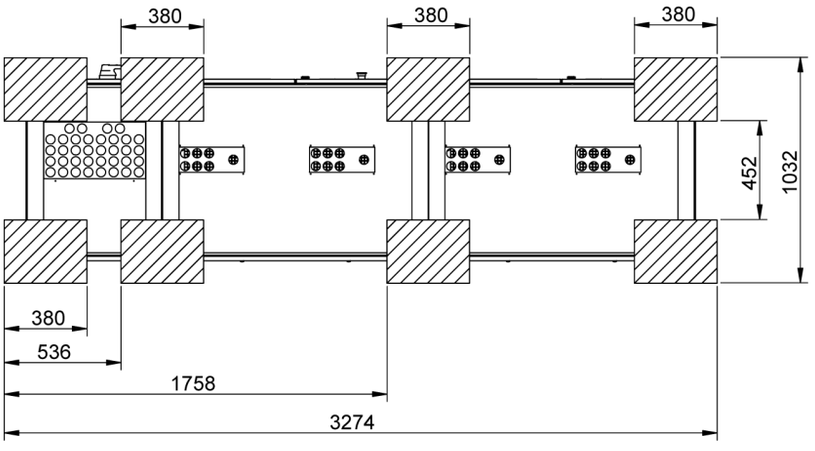
Ingecon® Sun 375 TL NAC, 500HE TL NAC, 550HE TL NAC, 600HE TL NAC and 630HE TL NAC



Ingecon® Sun 500 TL, 625HE TL, 730HE TL, 800HE TL and 840HE TL



Ingecon® Sun 500 TL NAC, 625HE TL NAC, 730HE TL NAC, 800HE TL NAC and 840HE TL NAC



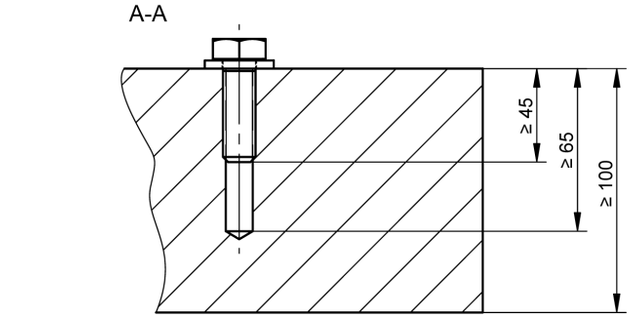
Optional fixing

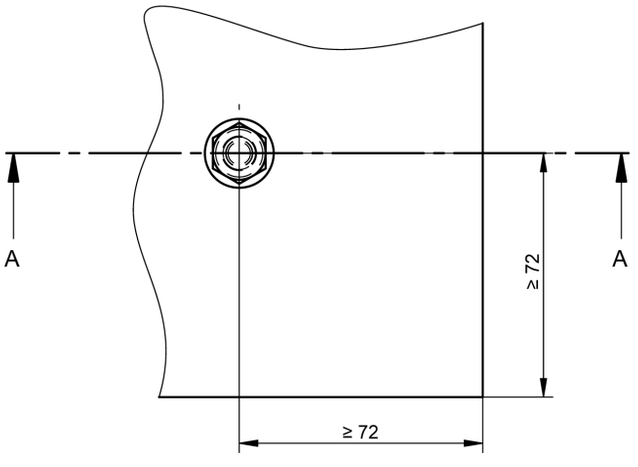
The Ingecon® Sun Power Max units have an optional fixing system.

The system comprises some plates that bolt the four corners of the base to the concrete pad where the inverter sits.

The following stipulations must be followed when choosing the place where the unit is to be bolted in:

- Minimum distance from the centre of the bore to the edge of the concrete pad: 72 mm
- Diameter of the hole drilled in the concrete pad: 8 mm
- Minimum depth of the hole drilled in the concrete pad: 65 mm
- Minimum thickness of the concrete pad: 100 mm
- Minimum depth of anchoring bolt: 45 mm





- All units must have enough space for four 90-degree fasteners, one for each corner, and two additional 180-degree fasteners for each location with two different cubicles. For each unit, reserve minimum area on the concrete slab as follows:

Equipment	Space
IS 250 TL, 315HE TL, 365HE TL, 400HE TL, 420HE TL	Rectangle 2680 x 1040 mm
IS 375 TL NAC, 500HE TL NAC, 550HE TL, 600HE TL, 630HE TL	Rectangle 2740 x 1040 mm
IS 375 TL, 500HE TL, 550HE TL, 600HE TL, 630HE TL	Rectangle 3280 x 1040 mm
IS 500 TL NAC, 625HE TL NAC, 730HE TL NAC, 800HE TL NAC, 840HE TL NAC	Rectangle 3360 x 1040 mm
IS 500 TL, 625HE TL, 730HE TL, 800HE TL, 840HE TL	Rectangle 3900 x 1040 mm

2.2. Environmental characteristics

The environmental conditions for operation are:

Ambient conditions	
Minimum temperature	-20 °C
Minimum surrounding air temperature	-20 °C
Minimum surrounding air temperature	65 °C
Maximum relative humidity without condensation	95%

For further information see “3. Operating, conservation and transport conditions”

2.3. Characteristics of the electrical installation

Ingecon® Sun Power Max units are designed for connection to a dedicated network with an IT-type neutral connection scheme.

An IT scheme has no directly grounded feed point.

In this system, the resulting intensity of a first phase against mass or phase against ground fault is sufficiently low as to not cause the appearance of dangerous contact voltages.

2.4. EMC requirements

The Ingecon® Sun Power Max units are equipped with the necessary filtering elements to comply with EMC requirements for industrial applications in order to prevent disturbances in other equipment outside the installation.

All Ingecon® Sun Power Max units are connected to the grid through a low to medium voltage transformer with a star-delta configuration. This transformer gives the unit galvanic isolation that affects its good performance in terms of noise emission. This is why:

CAUTION

Any auxiliary element must be connected to the low voltage network powering Ingecon® Sun Power Max units via a galvanic isolation transformer.

3. Operating, conservation and transport conditions

CAUTION

Failure to follow the instructions provided in this section may lead to damage to the equipment.

Ingeteam Energy S.A. accepts no liability for damage resulting from the failure to follow these instructions.

3.1. Symbols

Bear in mind the following symbols:

Move transport packaging with this side up

The contents of the shipping container are fragile

Do not use sharp tools to open the shipping packaging

Do not place anything on top of the shipping packaging

3.2. Equipment reception

Reception

Upon receipt of the shipment, check the terms specified in the *Delivery Note*, sign the *Signature Receiver Goods* field and return the copy to the return address.

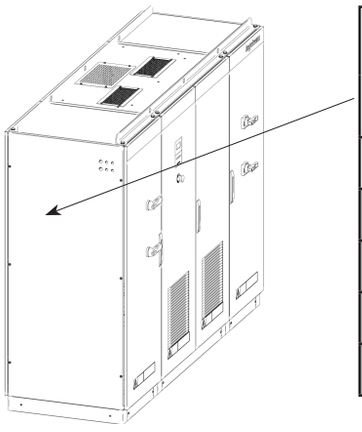
Keep the unit in its packaging until immediately before installation. Maintain the unit **upright** at all times.

The features of the Ingecon® Sun Power Max upon reception are as follows:

Model	Packing pallet	Weight (kg)	Length x Depth x Height (mm)
250 TL, 315HE TL, 365HE TL, 400HE TL, 420HE TL	Bubble wrap and plastic bag on wooden pallet.	1300	2575 x 1050 x 2080
375 TL NAC, 500HE TL NAC, 550HE TL NAC, 600HE TL NAC, 630HE TL NAC		1750	2575 x 1050 x 2080
375 TL, 500HE TL, 550HE TL, 600HE TL, 630HE TL		1800	3175 x 1050 x 2080
500 TL NAC, 625HE TL NAC, 730HE TL NAC, 800HE TL NAC, 840HE TL NAC		2325	3130 x 1050 x 2080
500 TL, 625HE TL, 730HE TL, 800HE TL, 840HE TL		2375	3730 x 1050 x 2080

Identifying the unit

The serial number of the equipment is its unique identifier. This number must be referenced in any communication with Ingeteam Energy S.A.



Ingeteam		Avda. Ciudad de la Innovación, 13 31621 Sarriguren (Navarra) solar.energy@ingeteam.com Tel 948 288000 Fax 948 288001	
Ingecon® Sun 500 TL		IP20	2011
Pac	500 kW	Udc:	405 - 900 Vdc
Uac:	3 x 230 Vac	Freq:	50 Hz
S/N	500080102R50	DEMO 100010060001	
Std:			

Location of the unit's ratings plate

In addition to the unit serial number, each inverter has its own serial number indentified by the last digit. The serial number (S/N) ending in 0 is for the complete unit, and the serial number ending in 1, 2 and 3 is for its respective inverters. For example, inverter number 2 will feature the following ratings plate:

Ingeteam		Avda. Ciudad de la Innovación, 13 31621 Sarriguren (Navarra) solar.energy@ingeteam.com Tel 948 288000 Fax 948 288001	
Ingecon® Sun 500 TL		IP20	2011
Pac	500 kW	Udc:	405 - 900 Vdc
Uac:	3 x 230 Vac	Freq:	50 Hz
S/N	500080102R52	DEMO 100010060001	
Std:			

The ratings plate of the inverters can be found on a prominent place inside the cabinet.

Transport damage

If the equipment has been damaged during transport, proceed as follows:

1. Do not proceed with the installation.
2. Notify the distributor immediately within 5 days of receipt of the equipment.

If ultimately the unit has to be returned to the manufacturer, you must use the same original packaging.

3.3. Handling and unpacking

Correct handling of the units is vitally important in order to:

- Prevent damage to the packaging which enables them to be kept in optimum condition from shipping until they are unpacked.
- Avoid knocks and/or falls which may harm their mechanical characteristics, e.g. cause incorrect closure of doors, loss of IP rating, etc.
- Avoid, as far as possible, vibrations which may cause subsequent malfunction.

If you observe any anomaly, please contact Ingeteam Energy S.A. immediately.

Recycling the Packaging

All the packaging can be delivered to a non-hazardous waste management company.

In any event, each part of the packaging may be recycled as follows:

- Plastic (polystyrene, bag and bubble wrap): the appropriate container.
- Cardboard: the appropriate container.

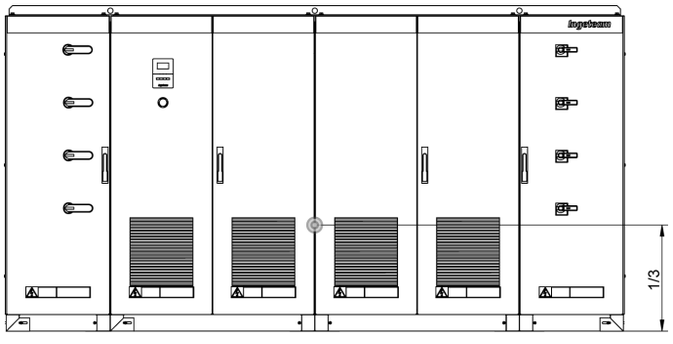
3.4. Moving the equipment

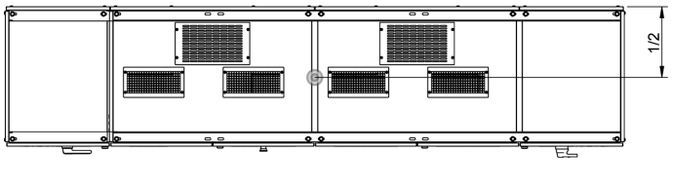
Appropriate transport and storage of the unit are the necessary first steps for correct use and operation. Taking the above section into account and as a preventive measure, Ingeteam Energy S.A. recommends the use of transport companies specialised in the transport of special and/or fragile equipment.

The unit must be protected, during transport and storage, from mechanical knocks, vibrations, water splashes (rain) and any other product or situation which may damage it or alter its behaviour.

Failure to observe these instructions may lead to loss of warranty on the product, for which Ingeteam Energy S.A. is not responsible.

If the equipment has to be moved, be aware that the centre of gravity of these units is at the centre of its vertical projection and at 1/3 of its height.





Transport using goods vehicles

Ingecon® Sun Power Max units transported in vehicles must be kept in an upright position and properly secured in accordance with its weight and size to avoid tipping and bumps.

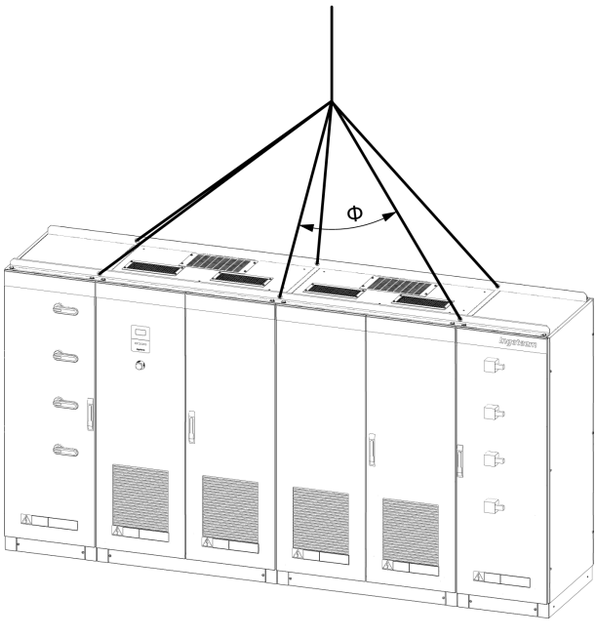
Transport using a forklift truck

At least the following requirements should be observed:

1. Place the packaged unit centred with respect to the forks.
2. Try to locate it as close as possible to the connection between the forks and the chassis.
3. Ensure that the forks are perfectly level to avoid overturning the unit.
4. In any case, observe the instructions in the forklift truck's user manual.

Moving by crane.

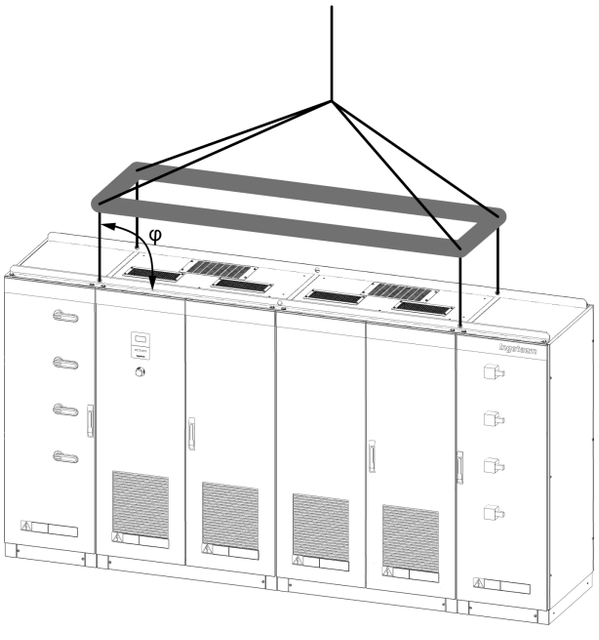
When lifting by crane, the lifting eyes fitted to the top corners of the cabinet should be used, as shown below.



Ensure that the load is distributed evenly between the eyes.

Tie individual cables, chains or ropes to each of the eyebolts, taking into account that the angle Φ is less than or equal to 45° and ensuring that the cables are left as vertical as possible.

It is always advisable to use a load frame as in the adjoining figure for a proper distribution of the loads, bearing in mind that the angle φ should be equal to 90°.



3.5. Storage

If the unit is not installed immediately after receipt, the following points should be taken into account in order to prevent damage:

- The package must be stored in the vertical position.
- Keep the unit free of dirt (dust, shavings, grease, etc) and away from rodents.
- Keep away from water splashes, welding sparks, etc.

- Cover the unit with a breathable protective material in order to prevent condensation due to ambient humidity.
- Units in storage must not be subjected to climate conditions other than those indicated in Section “2.2. Environmental characteristics”.
- It is very important to protect the unit from chemical products which can cause corrosion, as well as from salty atmospheres.
- Do not store the unit outdoors.

3.6. Conservation

In order to permit correct conservation of the units, they must not be removed from their original packaging until it is time to install them.

In case of prolonged storage, the use of dry places avoiding, as far as possible, sharp changes in temperature is recommended.

Damage to the packaging (cuts, holes, etc) prevents the units from being kept in optimum conditions before installation. Ingeteam Energy, S.A. accepts no liability in the case of failing to observe this condition.

3.7. Waste handling

During the various processes for installation, start-up and maintenance, waste is generated which must be handled appropriately according to the regulations in the corresponding country.

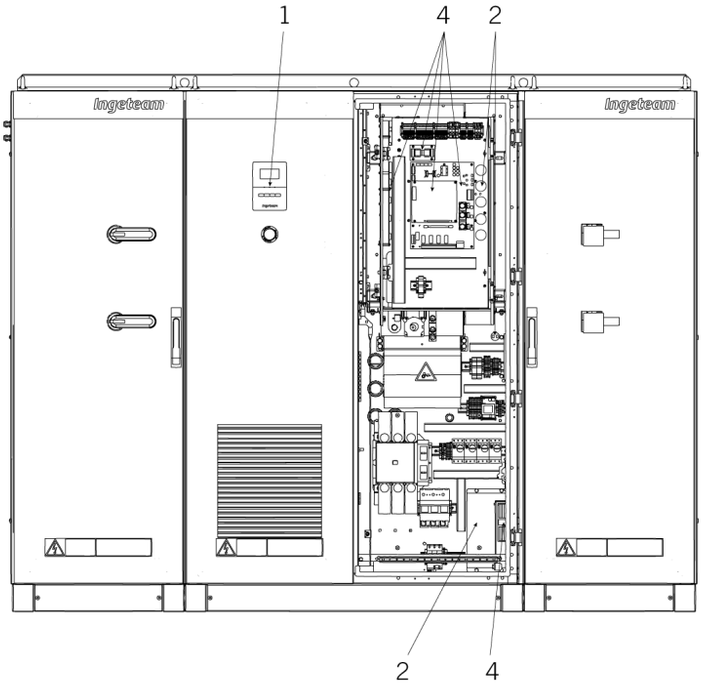
At the end of the unit's life, the waste must be processed by an authorised waste management company.

Ingeteam Energy S.A., in accordance with its policy of respect for the environment, will inform the authorised manager, via this Section, of the location of components to be decontaminated.

The elements within the unit that must be handled individually are:

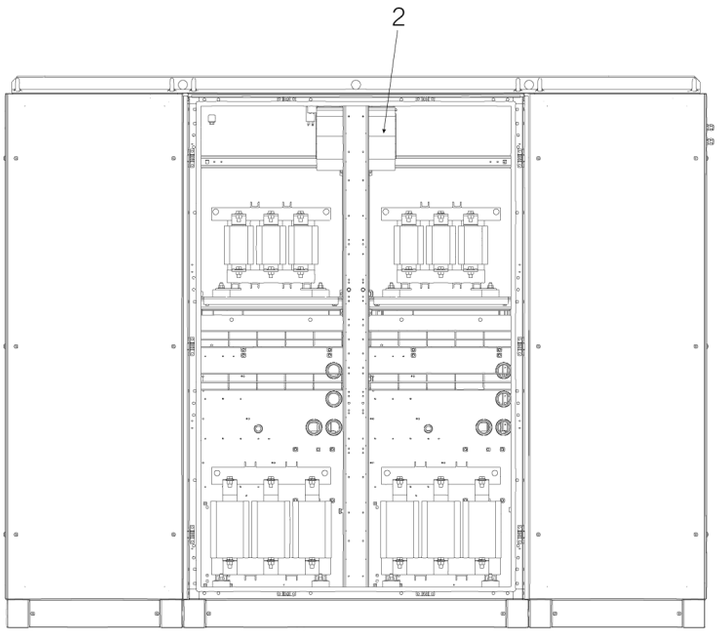
1. Liquid crystal displays.
2. Electrolytic condensers or condensers containing PCB.
3. Batteries and accumulators.
4. Printed circuit cards.

Their location is shown in the following images.



All power modules feature the same elements pictured above, except the display, which is only featured on the first

power module.



The images show the location of the items in the Power Max 250TL unit. In the rest of the units on the Power Max range, the location of these items will remain in power modules.

Waste that can be handled by conventional waste collection means

Most of this waste is from the unit's packaging, which must be properly separated and processed.

All the packaging can be delivered to a non-hazardous waste management company.

In any event, each part of the packaging may be recycled as follows:

- Plastic (polystyrene, bag and bubble wrap): Yellow municipal container (plastic and bottles).
- Cardboard: Municipal blue container (paper and cardboard).

4. Safety instructions

This section contains safety instructions which must be followed when installing, operating and accessing the unit.

Failure to comply with the “Safety instructions” may cause injury or even death or cause damage to the unit.

Read the “Safety instructions” carefully before working on the unit.

4.1. Symbols

The warnings advise of conditions which may cause serious injury or death and/or damage to the equipment. The means of avoiding the hazard to both people and the unit is indicated along with the warning.

The symbols and an explanation of their meaning can be seen below.

DANGER: High voltage

Warning of high voltage: Warns of high voltage which can cause injury or even death and/or damage to the equipment

General warning. Warns of conditions which can cause injury and/or damage to the equipment.

PRECAUTION: Hot surface

Warns of the existence of hot parts which may cause serious burns.

The specific safety warnings and notes which affect specific tasks are included in each affected chapter and are repeated and completed within each chapter in the corresponding critical points.

Please read this information carefully as it is written for your personal safety and to ensure the longest possible service life for the unit and the devices to which it is connected.

4.2. General safety precautions

Installation, start-up, inspection and maintenance operations may only be carried out by personnel appropriately qualified and trained in electrical subjects (hereinafter qualified personnel). You are reminded of the obligation to comply with safety regulations applicable to electrical work.

The fact that the various compartment housings are open in no way implies the absence of voltage. Only qualified personnel following the safety guidelines described in this document may access the compartments.

The set of conditions listed below should be considered as minimum requirements. It is always preferable to shut off the main power supply. Installation defects may result in unwanted feedback. Danger of electric shock.

In addition to the safety measures indicated in this manual, the general measures that apply in this area (specific to the installation, country, etc) must be taken into account.

The electrical installation must not involve a risk of fire or explosion. Workers must be duly protected against accident risks from direct or indirect contact. The electrical installation and protection devices must take the voltage, the external determining factors and the competence of the people who have access to parts of the installation into account.

In compliance with basic safety legislation, all equipment must be appropriate to protect exposed workers against the risk of direct or indirect contacts. In any case, the electrical parts of the work equipment must comply with that laid down in the corresponding specific regulations.

In compliance with Electric Risk basic legislation, all workers who carry out work outdoors will suspend their work in the case of storms, rain or strong winds, snow or any other unfavourable environmental condition which makes visibility or handling tools difficult. Work on installations directly connected to overhead electricity lines must be interrupted in the case of storms.

Ingeteam Energy, S.A. is not liable for any damages caused by improper use of equipment. Any work carried out on any equipment which implies a modification of the original electrical arrangements must be proposed in advance to Ingeteam Energy S.A. These must be studied and approved by Ingeteam Energy S.A.

The necessary means must be arranged to prevent people from outside the installation approaching or handling the equipment.

These instructions must be easily accessible close to the unit and located within reach of all users.

Before installation and start-up, please read these safety instructions and warnings carefully as well as all the notices located on the unit. Ensure that all the notices are perfectly legible and that those which are damaged or have disappeared are restored.

4.3. General

This section defines the preventive measures to take to carry out all types of tasks on the unit, working safely and controlling risks which cannot be avoided.

Protection against direct contact is by means of the housing, which has IP 20 protection class.

The unit has been tested according to the applicable regulations to comply with the safety requirements, the values for insulation distances and leakage paths for the voltages used.

The tools and/or equipment used in handling tasks must as a minimum have double reinforced insulation (Class II).

4.3.1. General risks existing and preventive measures

Impact against immovable objects

- Inform workers of the risk
- Adequate lighting
- Work with care
- Keep sufficient distance to prevent contact with the part causing the risk (control rod in the isolating switch door).

Knocks, punctures and cuts from objects and/or tools

- Keep the lid closed if not working inside
- Adequate lighting
- Order and cleanliness
- Mandatory use of hard hat, safety footwear and gloves when necessary.

Flying particles (fan)

Recommended use of anti-impact glasses when accessing the fan area.

Electrical risk

- Comply with that laid down in the PPE section and “General safety precautions” on page 26
- Inform the worker of the risk
- Comply with *R.D.614/2001* and *REBT*.

4.3.2. Additional risks and measures in handling tasks

Thermal Contact

- Inform workers of the risk
- Recommended use of gloves
- Disconnect the power and wait 10 minutes for the hot parts inside the unit (R1, RAD1) to cool.

4.4. Type of tasks to be carried out

The preventive maintenance tasks for the electrical panels involve Inspection, Control and Handling actions, depending on the case.

Accessing the housing through any other cubicle other than that described in this manual is strictly prohibited.

To open any of the covers of the enclosure (side, rear, top or door) the main power supply outside of the box must be switched off.

4.4.1. Inspection tasks

Definition: Involves opening the enclosure for visual inspection tasks.

4.4.2. Configuration tasks

Definition: Tasks involving loading software, checking and adjusting heating and ventilation systems. Checking voltage at safe measuring points.

Preventive maintenance tasks of the unit which don’t include electrical panels, carried out via man-machine interface.

Control tasks related to testing and changing circuit breaker settings, under no circumstances will the any part thereof (terminals, cables, protections) be accessed or subject to control tasks during this operation, except to the specific control to verify and/or modify the settings.

4.4.3. Handling tasks

Definition: Tasks involving the assembly and/or replacement of parts as well as changes to the setting of panel components. Any task that does not fall under Inspection or Control is considered Handling.

It is always necessary to fir disconnect and check for absence of voltage.

The “5 Golden Rules” must be adhered to.

5 GOLDEN RULES

1. Disconnect

Switching on the possible voltage sources. Bear in mind that any capacitors or other elements powered from uninterruptible power supplies (UPS) are still live.

2. Prevent any possible feedback

The switching devices used to switch off the equipment must be protected against any possible disconnection.

3. Check there is no voltage

Check that there is no voltage in all the active elements of the electrical system or as close as possible to the work area.

4. Ground and short circuit

In the low voltage installations that by induction or for other reasons may be accidentally live. And always in high voltage installations.

5. Rope off and mark the work area

4.4.4. Personal Protection Equipment (PPE)

Inspection

The use of safety footwear to standard EN 345-1:1992 is mandatory and work clothing should be cotton and be free of conductor/metallic elements.

Control

The use of helmets compliant with standard EN 397:1995 and safety footwear compliant with standard EN 345-1:1992 is mandatory. The use of standard safety gloves is also mandatory for voltage-free tasks.

It is also mandatory to use dielectric gloves meeting standard EN-60903-1992 and protective face mask against electric shock for voltage testing tasks and opening or closing automatic switches under load (IP2x).

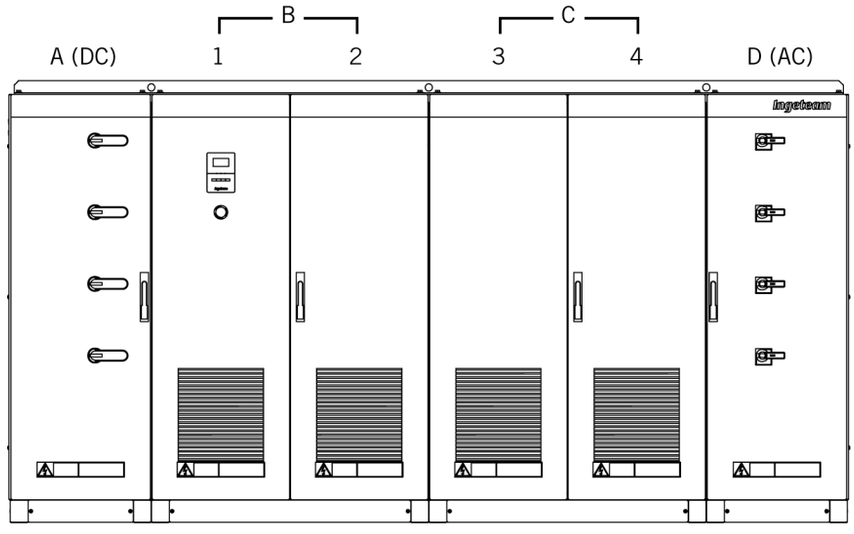
Handling

The use of helmets compliant with standard EN 397:1995 and safety footwear compliant with standard EN 345-1:1992 is mandatory.

It is also mandatory to use dielectric gloves meeting standard EN-60903-1992 and protective face mask against electric shock for voltage testing tasks and opening or closing automatic switches under load (IP2x).

4.5. Cabinets for the various models

Ingecon® Sun Power Max units comprise 2 to 4 cabinets:



- Cubicle A: DC Module
- Cubicle B: Inverter modules 1-2
- Cubicle C: Inverter module 3 or inverter modules 3-4
- Cubicle D: AC Module

The table below indicates which cabinets each model includes:

Model	Cubicles
250 TL, 315HE TL, 365HE TL, 400HE TL, 420HE TL	Cubicles A, B and D
375 TL NAC, 500HE TL NAC, 550HE TL NAC, 600HE TL NAC, 630HE TL NAC	Cubicles A, B and C
375 TL, 500HE TL, 550HE TL, 600HE TL, 630HE TL	Cubicles A, B, C and D
500 TL NAC, 625HE TL NAC, 730HE TL NAC, 800HE TL NAC, 840HE TL NAC	Cubicles A, B and C
500 TL, 625HE TL, 730HE TL, 800HE TL, 840HE TL	Cubicles A, B, C and D

It is strictly forbidden to gain access to the inside of the electrical panel through any other point than the access cover provided for the purpose. Opening any of the enclosure covers and/or accessing them (from the side, rear or top) triggers a general shutdown of all power to the panel (PV array, 3-phase feed and auxiliary single-phase feed). Always access when the unit is voltage-free.

Any work carried out which implies a modification of the original electrical settings must be proposed to and accepted by Ingeteam Energy S.A.

Below are the obligatory safety standards and the various tasks that may be performed in the various cubicles.

4.5.1. Module DC (cubicle A)

Opening system: cubicle door A is opened and closed by a handle with a double-bit lock. Mechanically interlocked door via controls in the isolating switch door.

Inspection

The protective elements (methacrylates) of the terminals and connection plates should be properly positioned at all times (avoid direct access to live parts).

Control

The only control task which can be carried out on this DC panel is the communication with the team via the communication terminal strip (COM).

The preventive measures for control tasks are the same are for inspection tasks.

Handling

To carry out handling on the unit, the voltage must be disconnected.

The following points must be taken into account to disconnect the unit from the power supply:

1. Stop the inverter associated with the unit from the display by switching status to stop or by using the emergency stop button located in cubicle B. Using the emergency stop button shuts down all power modules at the same time.
2. Switch on all existing circuit breakers in the DC panel itself (PV array). (*)
3. Isolate PV array powering cubicle A (module DC) from outside the panel. (**)
4. Wait 10 minutes for the internal capacitances to discharge and for internal resistors to cool.
5. Check that there is no voltage by using an appropriate multimeter. Use the PPE listed in the PPE section.
6. Signal cut-off points (DC/AC) with a sign indicating the type.

(*) When the DC module circuit breakers (cubicle A) and the AC module circuit breakers (cubicle D) are switched to the OFF position (no voltage) a consignment lock will be placed on the door knobs (mechanical lockdown) and a sign reading “Do not touch. Personnel at work” will be posted.

(**) If the PV array powering cubicle A (module DC) cannot be isolated from outside the panel. It should be taken into account that the feed of the DC circuit breakers will be live and work must be done with the appropriate PPE (dielectric gloves appropriate for the operating voltage, face shield, safety boots, work clothes, fire-retardant clothing recommended, etc.).

Any work carried out which implies a modification of the original electrical settings must be proposed to and accepted by Ingeteam Energy S.A.

4.5.2. Inverter modules 1-2 and 3-4 (cubicles B and C)

Opening system: Access doors to the inverter module 2 (cubicle C) and inverter module 4 (cubicle C) are opened and closed by a handle with a double-bit lock. For opening and closing the doors to the inverter module 1 (cubicle A) and inverter module 3 (cubicle C) you will need to open the doors to inverter module 2 and inverter module 4.

Inspection

Inspection tasks with the unit live are not allowed in these cubicles.

Control

The only control tasks that can be performed in cubicle B (inverter module 1 and 2) and cubicle C (inverter module 3 and 4), are:

- Settings from existing display in inverter 1 door module (cubicle B). This task must be carried out with the doors closed and the unit powered up.

1. Stop the inverter associated with the unit from the display by switching status to stop or by using the emergency stop button located in the inverter 1 module (cubicle B).
2. Switch on all existing circuit breakers in the DC panel itself (PV array). (*)
3. Wait 10 minutes.

4. Isolate PV array powering cubicle A (module DC) from outside the panel. (**).

5. Disconnect the auxiliary supply.

6. Switch off three-phase protection from the corresponding protection outside the units.

7. Cut the single-phase auxiliary feed voltage to x220 terminals (D cubicle) from the corresponding protection outside of the panel and from the -Qaux protection located in the inverter 1 module (cubicle B).

8. Wait 10 minutes for the internal capacitances to discharge (harmonic filter, etc.), for the existing internal resistors to cool and the fan blades to stop turning.

9. Check that there is no voltage by using an appropriate multimeter. Use the PPE listed in "Important safety precautions".

10. Signal cut-off points (DC/AC) with a sign indicating the type.

(*) When the DC module circuit breakers (cubicle B) and the AC module circuit breakers (cubicle C) are switched to the OFF position (no voltage) a consignment lock will be placed on the door knobs (mechanical lockdown) and a sign reading "Do not touch. Personnel at work" will be posted.

(**) If the PV array powering cubicle A (module DC) cannot be isolated from outside the panel. It should be taken into account that the feed of the DC circuit breakers will be live and work must be done with the appropriate PPE (dielectric gloves appropriate for the operating voltage, face shield, safety boots, work clothes, fire-retardant clothing recommended, etc.).

The preventive measures for control tasks are the same are for inspection tasks.

Handling

To manipulate elements inside cubicles B (inverter module 1 and 2) and C (inverter module 3 and 4), you must first power down.

To disconnect the voltage it is necessary to:

1. Stop the inverter associated with the unit from the display by switching status to stop or by using the emergency stop button located in the inverter 1 module (cubicle B).

2. Switch on -Qdc1, -Qdc2, -Qdc3 and -Qdc4 circuit breakers in the DC module (PV array). (*)

3. Isolate PV array powering cubicle A (module DC) from outside the panel. (**)

4. Cut three-phase supply (circuit breakers -Qac1,-Qac2, -Qac3 and Qac4 located in cubicle D of the AC module). In the absence of an AC module, cut three-phase power from the protection outside the unit.

5. Cut the single-phase auxiliary feed voltage to x220 terminals (D cubicle) from the corresponding protection outside of the panel and from the -Qaux protection located in the inverter 1 module (cubicle B).

6. Wait 10 minutes for the internal capacitances to discharge (harmonic filter), for the existing internal resistors to cool and the fan blades to stop turning.

7. Check that there is no voltage by using an appropriate multimeter. Use the PPE listed in the "Important safety precautions" section.

8. Signal cut-off points (DC/AC) with a sign indicating the type.

(*) When the DC module circuit breakers (cubicle A) and the AC module circuit breakers (cubicle D) or the external switch, if there is an AC module, are switched to the OFF position (no voltage) a consignment lock will be placed on the door knobs (mechanical lockdown) and a sign reading "Do not touch. Personnel at work" will be posted.

(**) If the PV array powering cubicle A (module DC) cannot be isolated from outside the panel. It should be taken into account that the feed of the DC circuit breakers will be live and work must be done with the appropriate PPE (dielectric gloves appropriate for the operating voltage, face shield, safety boots, work clothes, fire-retardant clothing recommended, etc.).

4.5.3. AC Module (cubicle D)

Opening system: Cubicle door D (AC) is opened and closed by a handle with a double-bit lock. Door mechanically interlocked via four controls in the AC breaker door.

Inspection

Inspection work may be performed in this cubicle with the unit live.

Control

Performing any type of control tasks in this cubicle is not allowed.

The preventive measures for control tasks are the same are for inspection tasks.

Handling

To carry out handling on the unit, the voltage must be disconnected.

1. Stop the inverter associated with the unit from the display by switching status to stop or by using the emergency stop button located in the inverter 1 module (cubicle B).
2. Switch on existing circuit breakers in the AC panel itself (*).
3. Cut the feed voltage to auxiliary AC terminals (1,2,3,4) from the corresponding protection outside the panel.
4. Isolate PV array powering cubicle A (module DC) from outside the panel. (**)
5. Cut the single-phase auxiliary feed voltage to x220 terminals (D cubicle) from the corresponding protection outside the panel. The new mechanical set-up, the QAux switch that protects the 230 Vac auxiliary power supply is located in cabinet 1. This control task should be noted for cubicle B (cabinet 1) in option 4x and 2x and cubicle A (cabinet 1) in option 3x.
6. Wait 10 minutes for the internal capacitances to discharge and for internal resistors to cool.
7. Check that there is no voltage by using an appropriate multimeter. Use the PPE listed in the PPE section.
8. Signal cut-off points (DC/AC) with a sign indicating the type.

(*) When circuit breakers/circuit breakers/fuses (AC/DC) are switched to the OFF position (no voltage), a consignment lock will be placed on the door-mounted control (mechanical lockdown) and a sign reading “Do not touch. Personnel at work” will be posted.

(**) If the PV array powering cubicle A (module DC) cannot be isolated from outside the panel. It should be taken into account that the feed of the DC circuit breakers will be live and work must be done with the appropriate PPE (dielectric gloves appropriate for the operating voltage, face shield, safety boots, work clothes, fire-retardant clothing recommended, etc.).

5. Installation

Before installing the Ingecon® Sun Power Max unit, the packaging must be removed, taking special care not to damage the housing.

Check that there is no moisture inside the packaging. If there are signs of moisture, the unit must not be installed until you are sure it is completely dry.

All installation operations must comply with current regulations.

5.1. General requirements for installation

Ventilation and the space for work, which must be suitable for maintenance tasks according to current regulations.

The external connection devices, which must be suitable and sufficiently close as set forth in current regulations.

The connecting cables must be of the appropriate section for the maximum current.

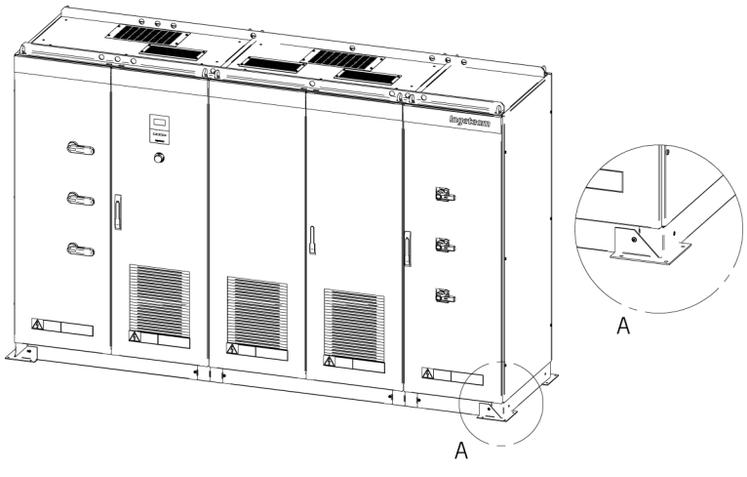
Special care must be taken to ensure that there are no external elements near the air inlets and outlets to obstruct proper ventilation of the unit.

5.2. Fixing the unit to the floor

The Ingecon® Sun Power Max units have an optional fixing system.

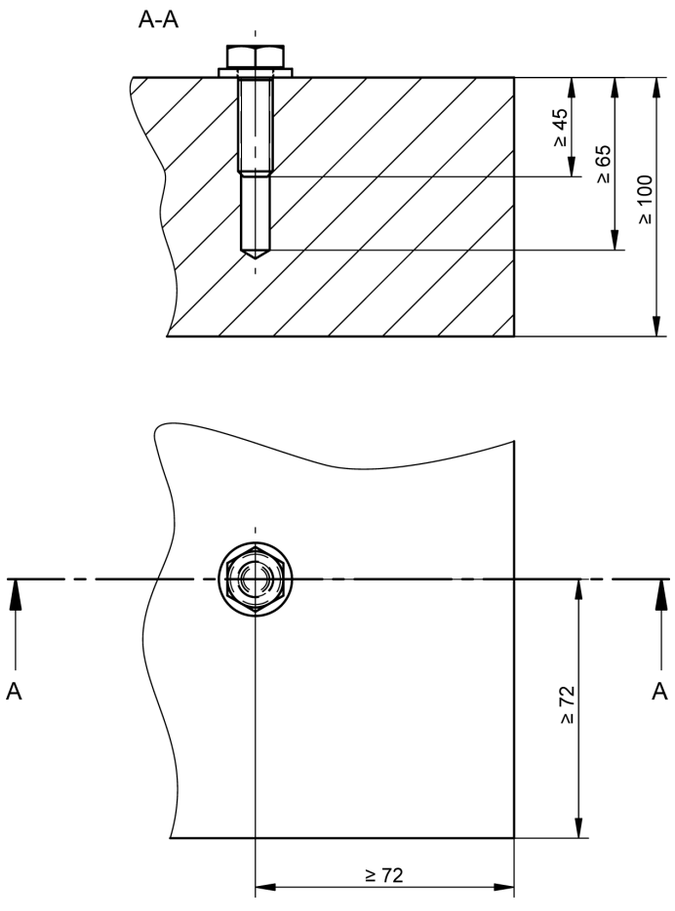
The system comprises some plates that bolt the four corners of the base and the parts of the base where various cabinet blocks are bolted to the concrete pad where the inverter sits.

The figure below shows the shape of these plates and how they bolt onto the enclosure.



Please observe the following requirements in all cases when fastening the fixing system:

- Minimum distance from the centre of the bore to the edge of the concrete pad: 72 mm.
- Diameter of the hole drilled in the concrete pad: 8 mm.
- Minimum depth of the hole drilled in the concrete pad: 65 mm.
- Minimum thickness of the concrete pad: 100 mm.
- Tightening torque: 20 Nm.
- Minimum depth of anchoring bolt: 45 mm.



Once it has been corrected selected, follow these steps:

1. Mark the fixing points for the plates on the floor.
2. Drill the floor with a recommended drill for the fixture supplied with the fastening plate.
3. Anchor the sheet metal fixing points to the floor.
4. Screw the sheet metal fixing points to the unit.
5. Check that the unit is properly secured.

5.3. Requirements for transformers and insulation monitor

5.3.1. Grid connection transformer

This section lists the technical characteristics of the grid connection transformer which converts the medium or high supply voltage to the operating voltage of the Ingecon® Sun Power Max unit.

1. The transformer's power must be greater than the sum of the power ratings of the connected inverters. Take into account the environmental conditions of the site.

2. Ingecon® Sun Power Max inverters connected to the inverter's low voltage winding must be synchronised.

3. MPPTs connected by Ingecon® Sun Power Max to the same transformer must have the same voltage settings.

4. The Ucc short circuit voltage of the transformer must be equal or less than 6%.

5. We recommend inserting a grounded metal screen between the high voltage winding and low voltage winding.

6. The low voltage winding must withstand pulsating voltage components with dU/dt of 500 V/uS voltage. Because of inverter operation, the voltage between a phase and ground can reach 3/2 of the open circuit voltage of

the PV array.

7. We recommend using the Dy11 connection.

8. The neutral of the low voltage winding must not be grounded.

9. The connection to the medium voltage network will be the nominal connection point.

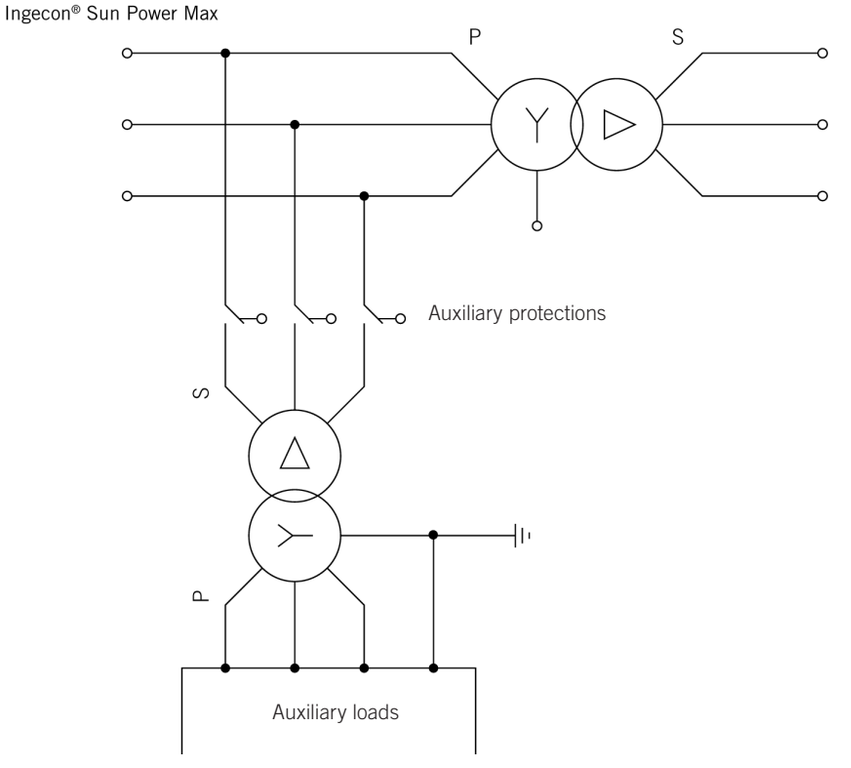
10. We advise using transformers equipped with five-point voltage regulators, with the possibility of selecting the following options:

5% 2.5% 0% -2.5% -5%

No electronic equipment may be connected to the power grid. All auxiliary loads must be isolated from the power grid through a transformer with galvanic isolation.

5.3.2. Auxiliary transformer

The auxiliary transformer transforms the voltage from the power part of the unit to its control and consumption part.



The primary circuit is connected to the power input. We recommend installing protection and switching components to protect this transformer.

The technical requirements of the auxiliary transformer are:

1. The transformer's power should be suitable for the loads connected to it. Take into account the environmental conditions of the site.

2. The power winding must withstand pulsating voltage components with dU/dt of 500 V/uS. Because of inverter operation, the voltage between a phase and ground can reach 3/2 of the open circuit voltage of the PV array.

3. Delta connection is advised in the power part and star connection in auxiliary loads. We advise connecting the neutral of auxiliary loads to ground.

Insulation monitor

For installations that so require, the installer will connect an IT network insulation monitor.

The insulation monitor should withstand and be able to measure 1000 VDC networks.

The unit's insulation monitor controls the IT network when the unit is powered up.

Installing leakage protection at the output of each power block in master-slave units is not allowed.

5.4. Electrical connection

Once the unit has been mounted in its final position and has been solidly secured, make the electrical connections to it.

Care must be taken to ensure the equipment is not live when accessing its interior.

All the doors on the cabinet are arranged so that they can only be opened when the AC thermomagnetic circuit breaker, the DC circuit breaker and any auxiliary external supplies are disabled.

Since NAC models do not include an automatic AC circuit breaker, the system's AC breaker must be operated under load conditions.

When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.

While the door is open, do not alter the position of the thermomagnetic or CD circuit breaker, do not operate the controls on the door nor apply force to the internal electrical devices which they control.

They must also be in the OFF position for the door to be able to be closed.

After setting the AC thermomagnetic circuit breaker, the DC circuit breaker and any auxiliary external supplies to OFF, wait at least 10 minutes before opening the door. Internal capacitances may still hold hazardous voltages.

During inspection and handling work:

Take care, since even with the AC thermomagnetic and the DC circuit breaker on OFF, cables directly connected to the grid or panels may still hold hazardous voltages. This includes feed plates and wires between switches/breakers.

As long as the panels are exposed to the light, the DC cables will carry potentially dangerous voltage levels.

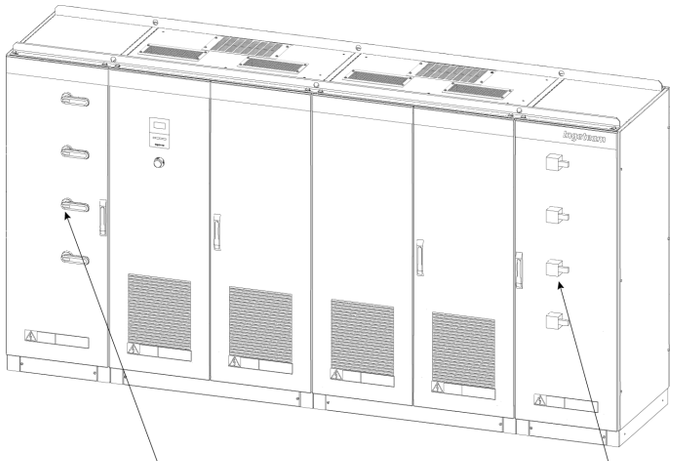
During handling work:

Remove all sources of voltage to the equipment: the grid, the PV array and any auxiliary power supply.

After setting the AC thermomagnetic and DC circuit breaker to OFF, wait at least 10 minutes before opening the door. Internal capacitances may still hold hazardous voltages.

Once the equipment is open, check there is no electrical hazard in the voltage inputs from the grid, the PV array or any auxiliary supply.

When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.



5.4.1. Description of cable inlets

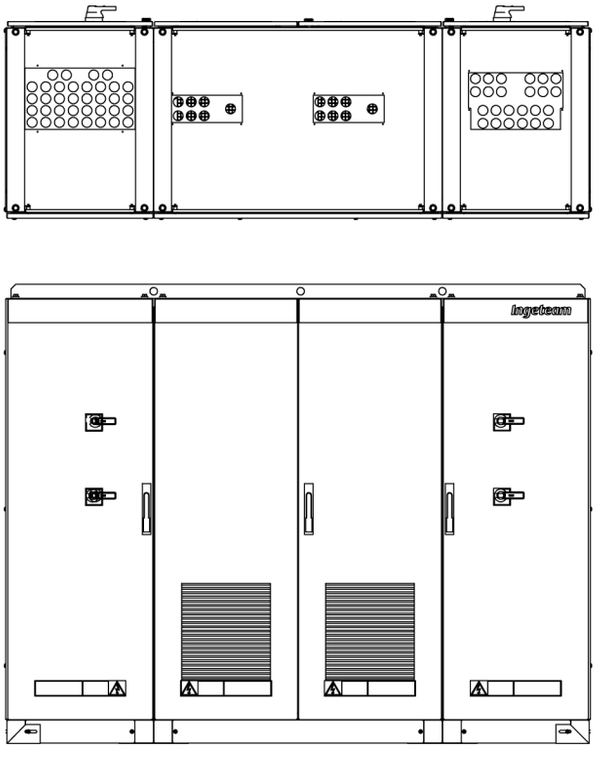
All power cables of the Ingecon® Sun Power Max units access the unit through glands located on the bottom of the cabinet as shown in the following drawings.

Ingecon® Sun 250 TL, 315HE TL, 365HE TL, 400HE TL and 420HE TL

D40 tapered grommet. Power access and PV array connection.

D40 tapered grommet. Power access, grid connection and free multi-purpose access.

D40 tapered grommet. Power access and grid connection for models with AC kit.

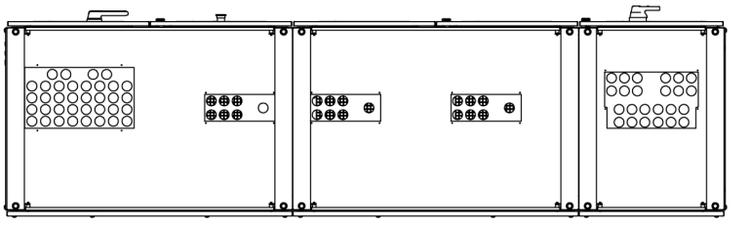


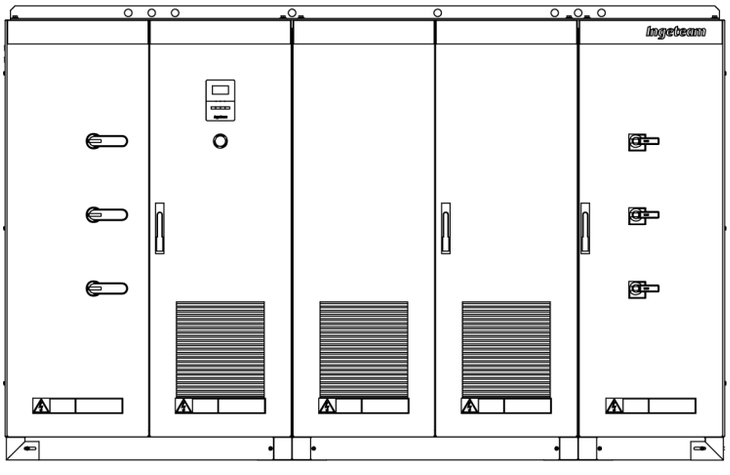
Ingecon® Sun 375 TL, 500HE TL, 550HE TL, 600HE TL and 630HE TL

D40 tapered grommet. Power access and PV array connection.

D40 tapered grommet. Power access, grid connection and free multi-purpose access.

D40 tapered grommet. Power access and grid connection for models with AC kit.



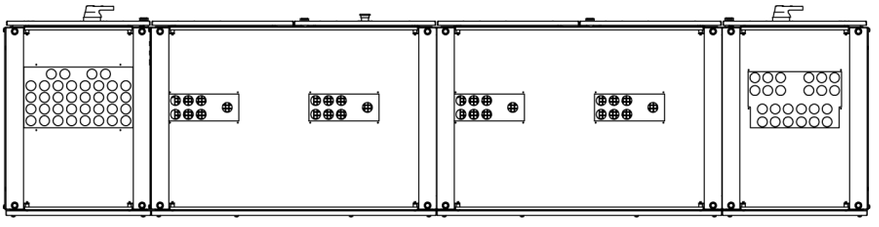


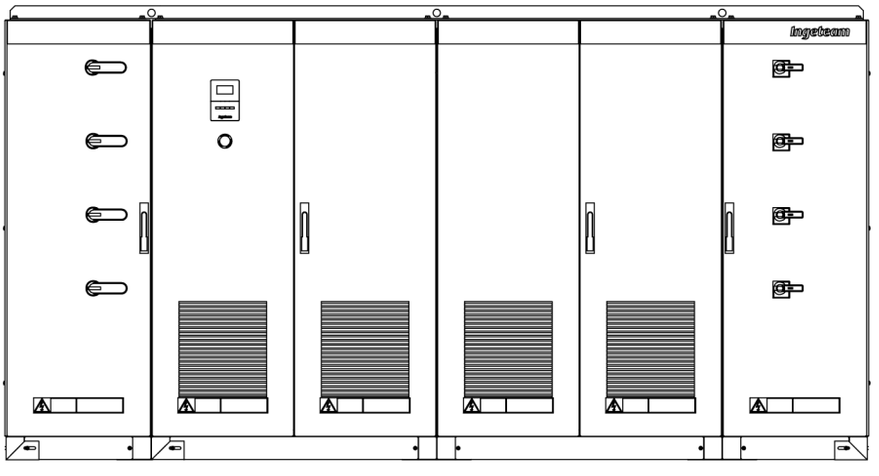
Ingecon® Sun 500 TL, 625HE TL, 730HE TL, 800HE TL and 840HE TL

D40 tapered grommet. Power access and PV array connection.

D40 tapered grommet. Power access, grid connection and free multi-purpose access.

D40 tapered grommet. Power access and grid connection for models with AC kit.

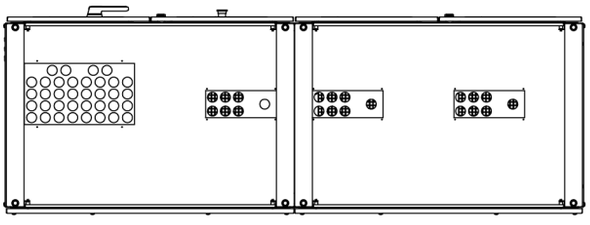




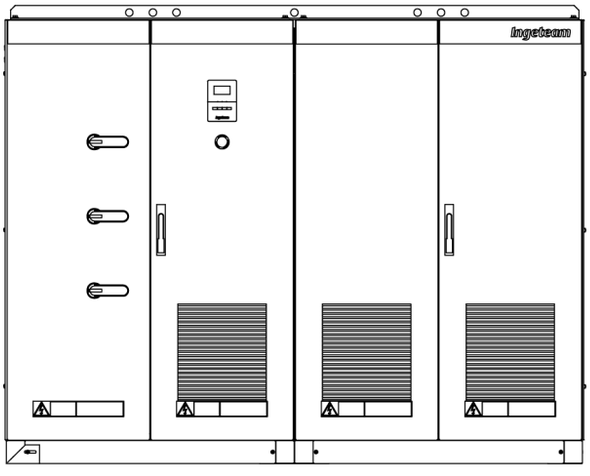
Ingecon® Sun 375 TL NAC, 500HE TL NAC, 550HE TL NAC, 600HE TL NAC and 630HE TL NAC

D40 tapered grommet. Power access and PV array connection.

D40 tapered grommet. Power access, grid connection and free multi-purpose access.



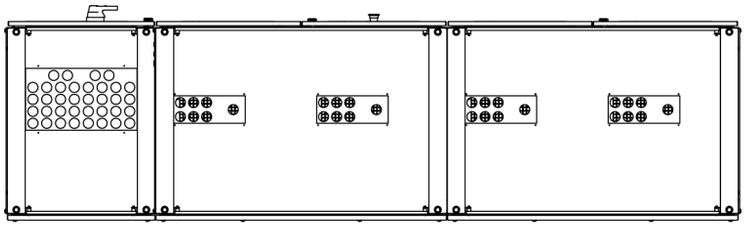
Bottom view



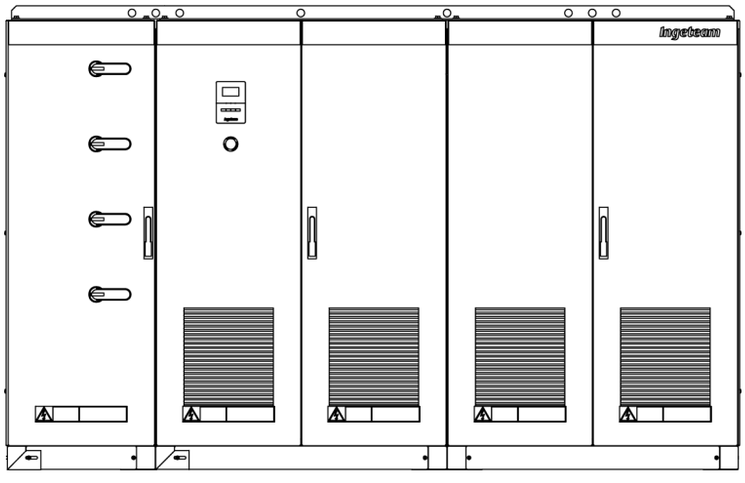
Ingecon® Sun 500 TL NAC, 625HE TL NAC, 730HE TL NAC, 800HE TL NAC and 840HE TL NAC

D40 tapered grommet. Power access and PV array connection.

D40 tapered grommet. Power access, grid connection and free multi-purpose access.



Bottom view



Access points common to all Ingecon® Sun Power Max units

Access for communication cables or auxiliary inputs is located on the left side of the DC cabinet in all versions.

Each gland allows for a range of cable diameters:

Gland diameter (mm)	Cable diameter (mm)
40	19 ~ 28
16	4.5 ~ 10
12	3.5 ~ 7

The tapered grommets allow wire diameter of up to 40 mm.

Care must be taken to ensure the equipment is not live when accessing its interior.

All the doors on the cabinet are arranged so that they can only be opened when the AC thermomagnetic circuit breaker, the DC circuit breaker and any auxiliary external supplies are disabled.

When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.

While the door is open, do not alter the position of the thermomagnetic or CD circuit breaker, do not operate the controls on the door nor apply force to the internal electrical devices which they control.

They must also be in the OFF position for the door to be able to be closed.

After setting the AC thermomagnetic circuit breaker, the DC circuit breaker and any auxiliary external supplies to OFF, wait at least 10 minutes before opening the door. Internal capacitances may still hold hazardous voltages.

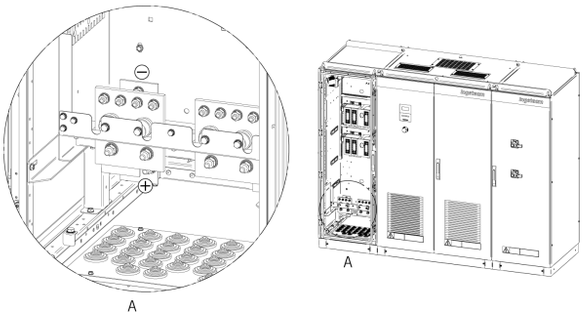
During inspection and handling work:

Take care, since even with the AC thermomagnetic and the DC circuit breaker on OFF, cables directly connected to the grid or panels may still hold hazardous voltages. This includes feed plates and wires between switches/breakers.

As long as the panels are exposed to the light, the DC cables will carry potentially dangerous voltage levels.

5.4.2. Description of cabling connections

Ingecon® Sun Power Max units have the following cabling connections:

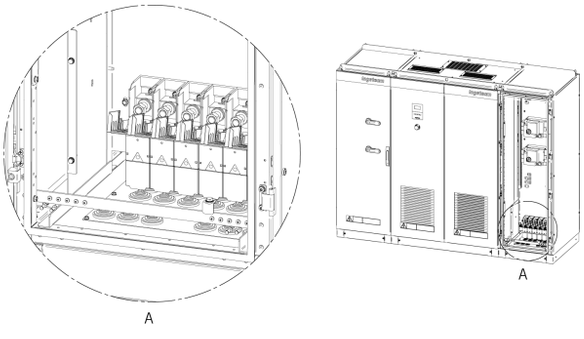


Plates for DC connection.

2 pairs for Ingecon® Sun Power Max with two inverters.

3 pairs for Ingecon® Sun Power Max with three inverters.

4 pairs for Ingecon® Sun Power Max with four inverters.

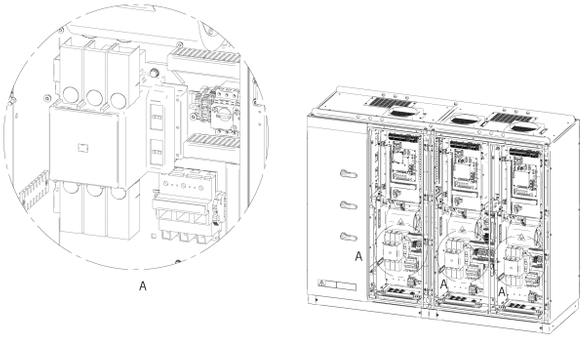


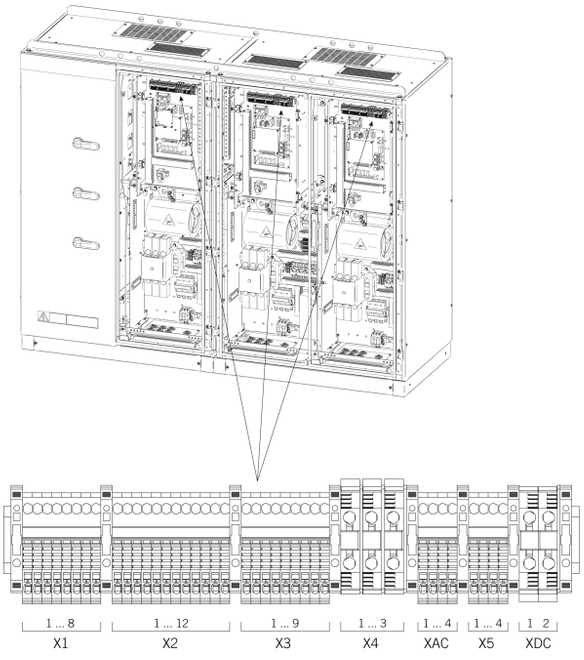
Plates for AC connection.

2 sets of three for Ingecon® Sun Power Max with two inverters.

3 sets of three for Ingecon® Sun Power Max with three inverters.

4 sets of three for Ingecon® Sun Power Max with four inverters.



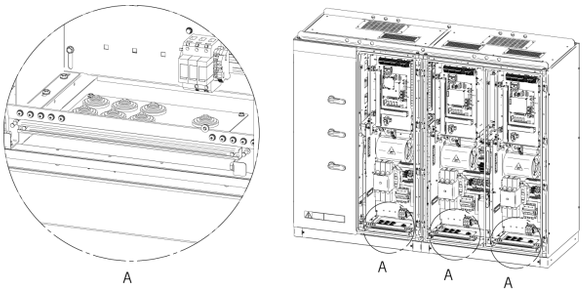


Terminal strips for connecting the insulation fault indicator.

2 terminals for Ingecon® Sun Power Max with two inverters.

3 terminals for Ingecon® Sun Power Max with three inverters.

4 terminals for Ingecon® Sun Power Max with four inverters.

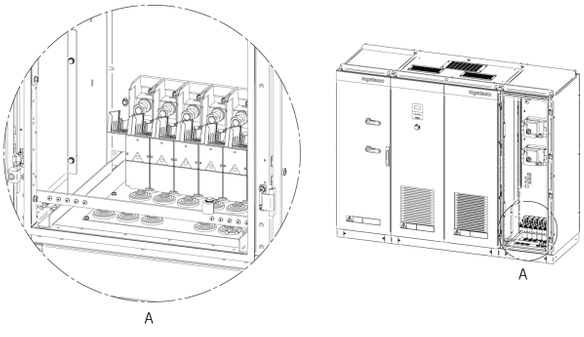


Copper bar with threaded holes for earthing connection.

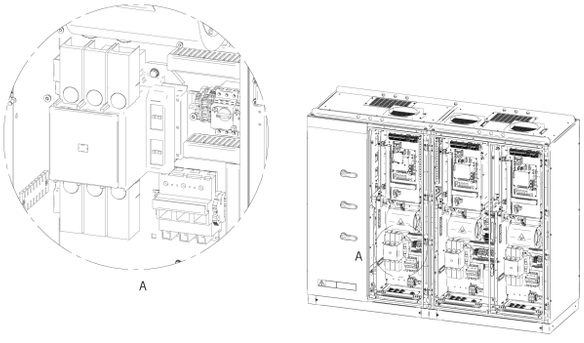
2 bars for Ingecon® Sun Power Max with two inverters.

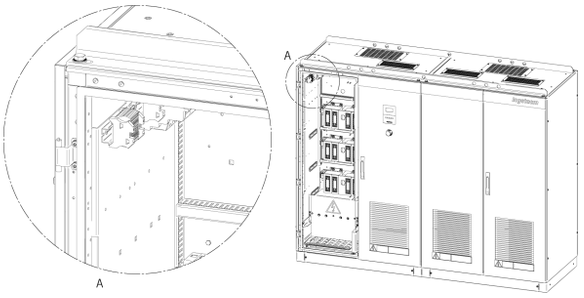
3 bars for Ingecon® Sun Power Max with three inverters.

4 bars for Ingecon® Sun Power Max with four inverters.



220 V auxiliary supply connector.





Terminal strip for communications accessories

CAUTION:

As long as the panels are exposed to the light, the DC cables will carry potentially dangerous voltage levels.

Never handle the connections before disconnecting the inverter from the grid and the PV array.

5.4.3. Order of connecting the unit

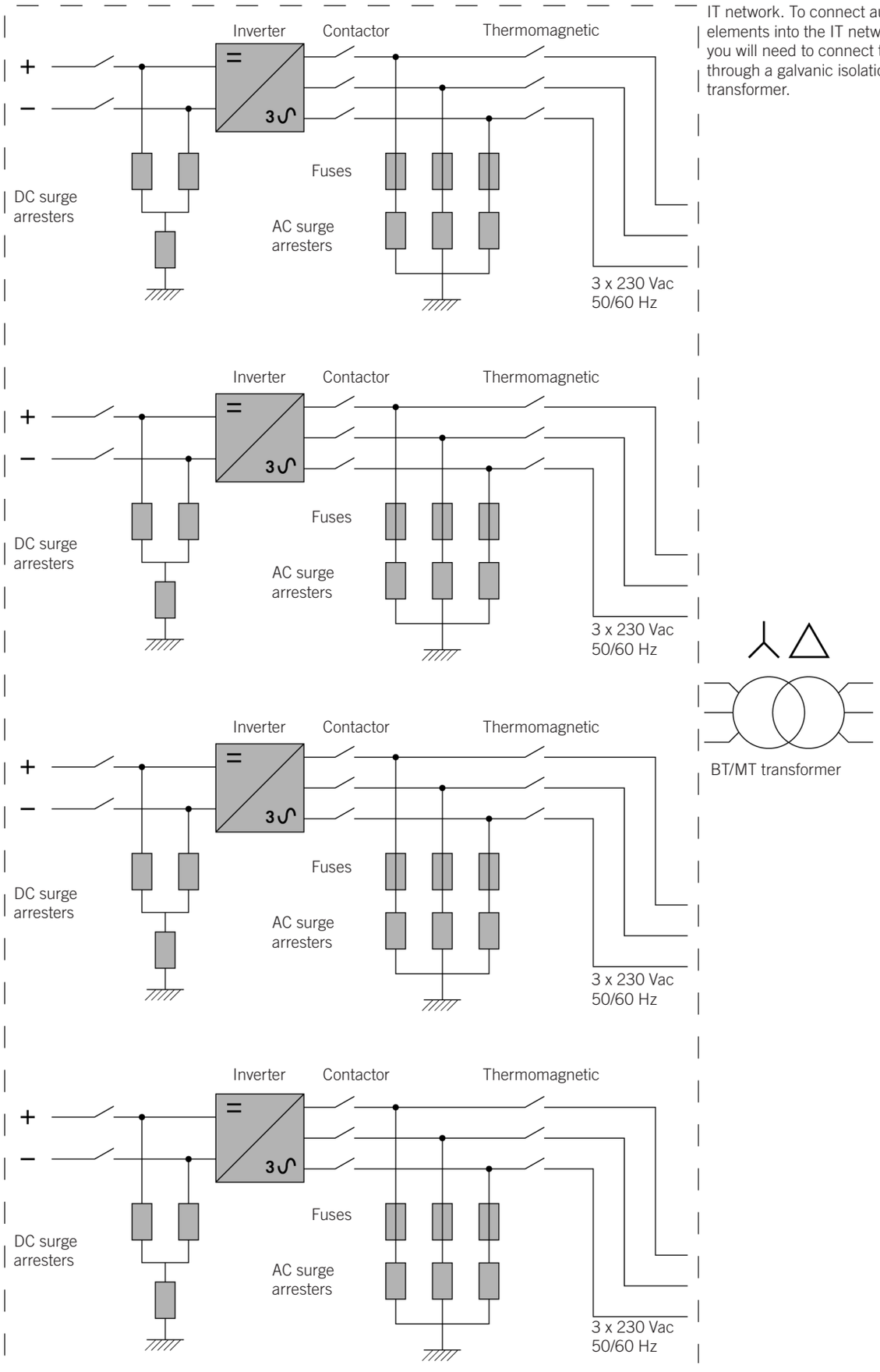
The basic connections to be made with the Ingecon® Sun Power Max units are as follows, in this order:

1. Connecting the insulation failure detection switch (optional).
2. Communication line (optional).
3. Connecting the various grounding connections.
4. Connecting the auxiliary supply.
5. Connecting the 3-phase inverter system to the power grid.
6. Connecting the DC cables from the PV array.

The following sections describe how to make these connections.

5.4.4. System wiring diagram

The electrical system of Ingecon® Sun Power Max units matches the following diagram (for example, a 500TL model):



IT network. To connect auxiliary elements into the IT network you will need to connect them through a galvanic isolation transformer.

BT/MT transformer

5.4.5. Insulation fault contact / grid connection indicator

The inverter incorporates a normally open volt-free auxiliary contact. It can be used for one of two functions:

- Detection of insulation fault in the DC circuit.

  -Open contact: there is no insulation fault in the DC circuit.

  - Closed contact: there is an insulation fault in the DC circuit.

- Indicator showing that the unit is connected to the mains via its internal contactor.

  -Open contact: internal contactor for connecting to the grid is open; the inverter is not connected to the grid.

  - Closed contact: internal contactor for connecting to the grid is closed; the inverter is connected to the grid.

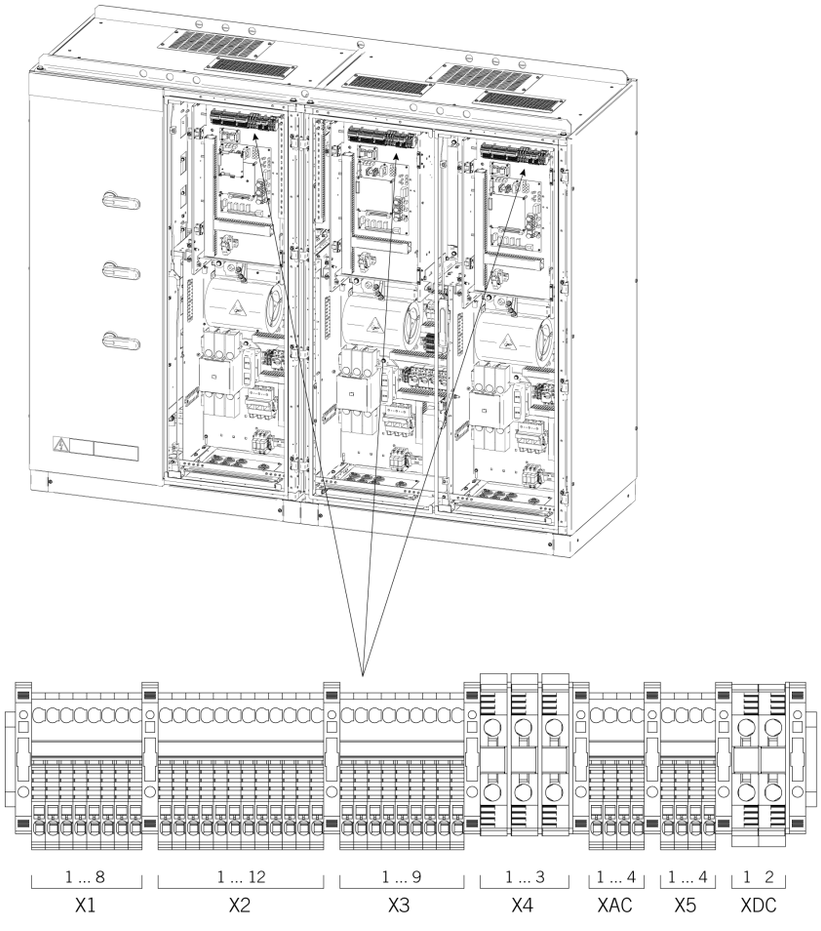
The unit always measures the insulation separately from the contact configuration.

The configuration of the equipment to make the contact perform one or another function is factory set and must be specifically requested from Ingeteam Energy S.A. in the order.

This normally open contact withstands a voltage of 230 Vac and a maximum current of 10 A.

Each inverter is assigned its own contact, which detects the operation or fault of the insulation of the inverter in question. If the unit is equipped with the MS kit, only the inverter contact operating as "master" will work. For this reason, all contacts must be connected in parallel.

The terminals used are X5.1 and X5.2.

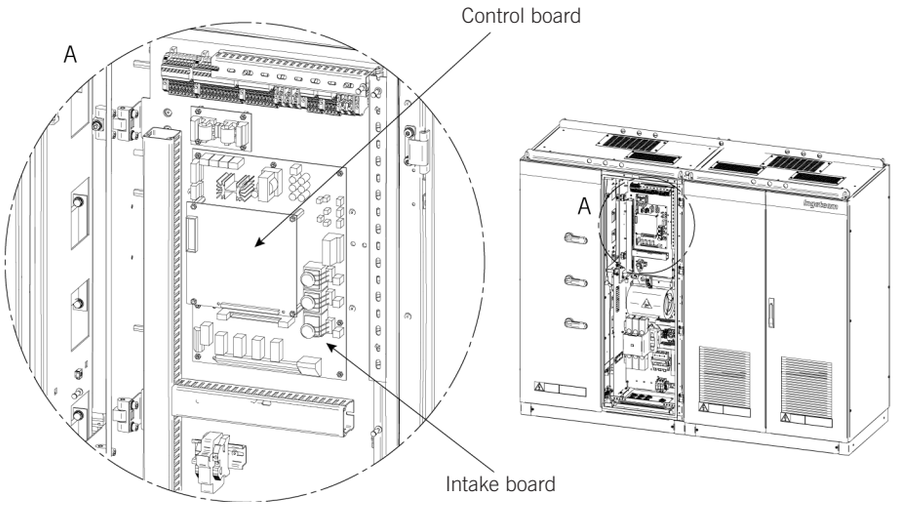


5.4.6. Access to auxiliary connections

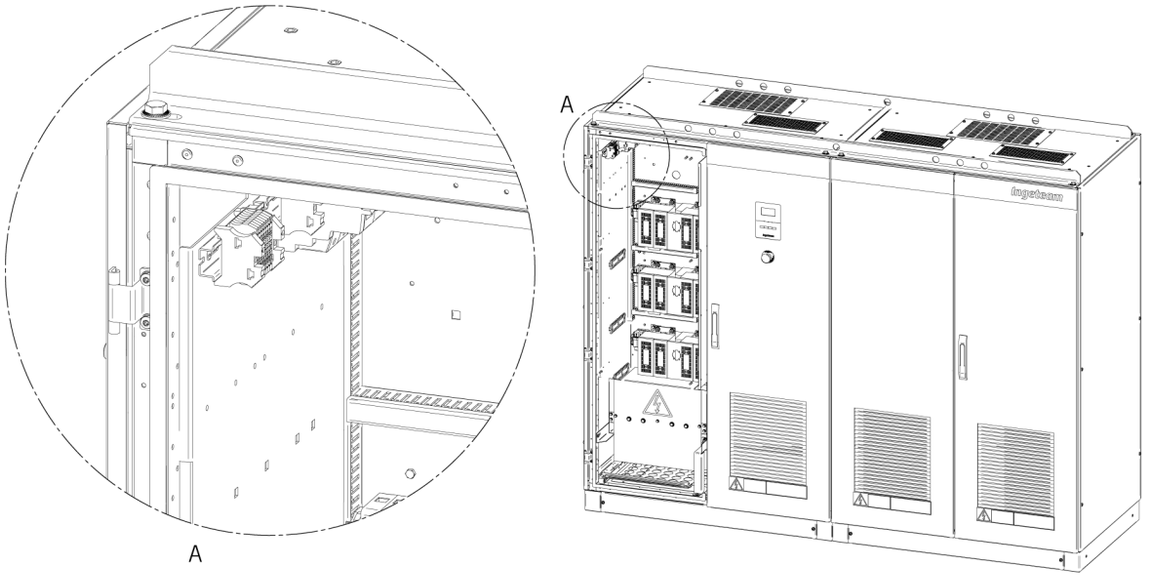
Some PV installations require the inverter to be connected to auxiliary equipment, such as solar radiation sensors, heat sensors and anemometers.

Consult the manufacturer when ordering.

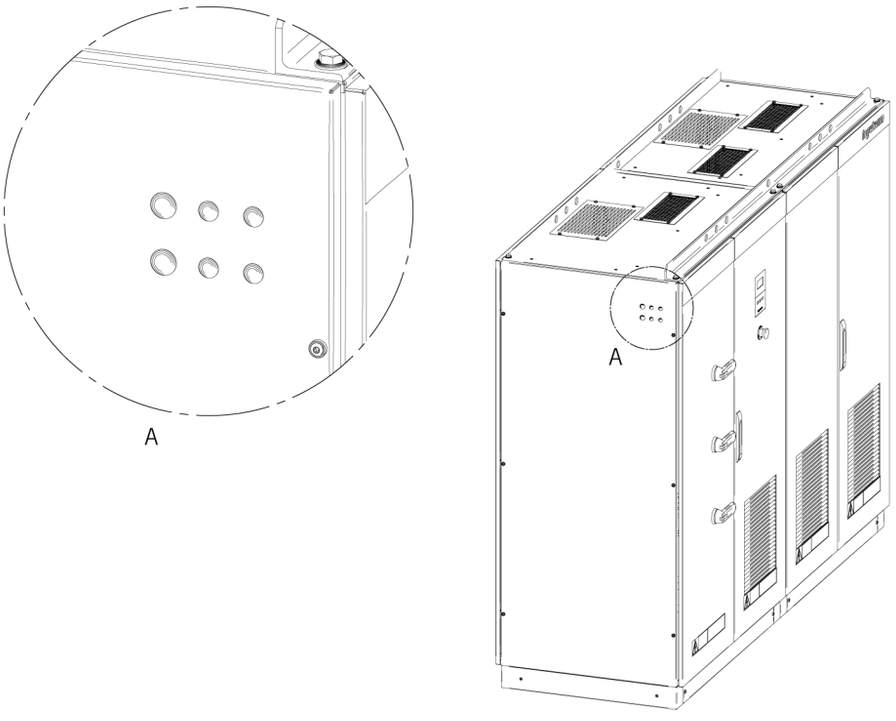
For best performance, the cables carrying these auxiliary signals will be removed from the power cables.



Location of the control board and the intake board



Location of communication accessories terminal strip



Location of communication accessories wiring holes

Connection for communication via RS-485 serial port

Ingecon® Sun Power Max units incorporate hardware for communicating through an RS-485 serial line. This hardware comprises two to four "AAP0022 Com RS-485" boards (one per module) that are supplied mounted on the control board in each power block, the communications terminal strip and the wiring between boards and terminal strip.

Thanks to this pre-installation, the installer will only need to make the connection via the terminal, located as shown in the following figure in the DC module at the top of the sidewall.

To access this terminal, use the access openings in this area of the enclosure.

The unit is provided with a 211 Ohm ferrite rod. The cable connecting the "AAP0022 Com RS-485" board of the first inverter to the terminals must be inserted as close as possible to the board, turning it around the centre hole twice.

For more information on board operation, see "AAX2002IKH01 Installation Guide for Communications Devices".

5.4.7. Connection for communication via modem-GSM/GPRS + RS-485

At the request of the installer, inverters may optionally be equipped with hardware for communication via GSM/GPRS phone. This hardware comprises one to three "AAP0022 Com RS-485" boards (one per module except for module 1) that are supplied mounted on the control board in each power block, a "AAX0001 Com GSM/GPRS + RS-485" board (for module 1), the rod for the modem, the communications terminal strip and the wiring between boards and terminal strip.

The unit is provided with a 211 Ohm ferrite rod. The cable connecting the "AAX0001 Com GSM/GPRS + RS-485" board of the terminal (RS-485 output) must be inserted as close as possible to the board, turning it around the centre hole twice.

The board is provided assembled on the control board and a bag (attached with a plastic tie) containing the rod cable. Connect the rod cable to the cable's rod output, and feed it out through the holes on the upper left side of the enclosure. Connect the end that goes outside to the rod and attach it via its magnet to the unit's enclosure.

If you obtain the "AAX0001 Com GSM/GPRS + RS-485" board after having the Ingecon® Sun Power Max with communication via standard RS-485, install the new board. To do this, the "AAP0022 Com RS-485" board of the first module must be replaced with the "AAX0001 Com GSM/GPRS + RS-485" board. Observe the precautions stipulated in section "4.3.2. Additional risks and measures in handling tasks" for Handling tasks (page 28).

Once mounted on the board, the communication RS-485 cables must be wired as they were on the other board, and the rod must be connected as described above.

Connect the rod cable to the cable's rod output, and feed it out through the holes on the upper left side of the enclosure. Connect the end that goes outside to the rod and attach it via its magnet to the unit's enclosure.

See "AAX2002IKH01 Installation Guide for Communications Devices".

5.4.8. Connection for ethernet communication

At the request of the installer, inverters may optionally incorporate hardware for communicating via ethernet. This hardware comprises one to three "AAP0022 Com RS-485" boards (one per module except for module 1) that are supplied mounted on the control board in each power block, a "AAX0004 Com Ethernet + RS-485" board (for module 1), the communications terminal strip and the wiring between boards and terminal strip.

The unit is provided with a 211 Ohm ferrite rod. The cable connecting the "AAX0004 Com Ethernet + RS-485" board of the terminal (RS-485 output) must be inserted as close as possible to the board, turning it around the centre hole twice.

The board is provided assembled on the control board and a bag (attached with a plastic tie) containing the Ethernet cable. Connect the cable to the board's Ethernet output and feed it out through the holes on the upper left side of the enclosure.

If you obtain the "AAX0004 Com Ethernet + RS-485" board after having the Ingecon® Sun Power Max with communication via standard RS-485, install the new board. To do this, the "AAP0022 Com RS-485" board of the first module must be replaced with the "AAX0001 Com GSM/GPRS + RS-485" board. Observe the precautions stipulated in section 4 for Handling tasks.

Once mounted on the board, the communication RS-485 cables must be wired as they were on the other board, and the rod must be connected as described above.

See "AAX2002IKH01 Installation Guide for Communications Devices".

5.4.9. Connection for fibre optic communication

At the request of the installer, inverters may optionally incorporate hardware for communicating via fibre optic cable. This hardware comprises one to four "AAP0009 Com Fibra" boards (one per module except module 1) that are supplied mounted on the control board in each power block, a +5/10 W power supply and wiring between the blocks (AQL0019 units).

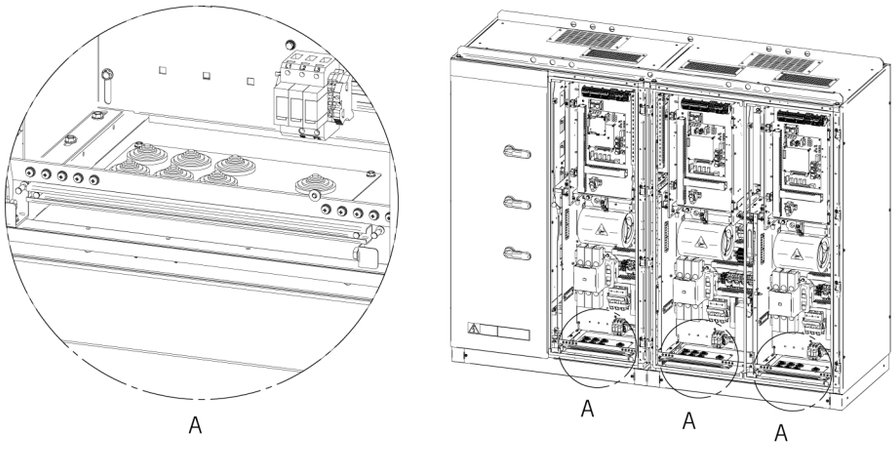
The boards are supplied fully assembled, connected by fibre optic cables and fed from the power source located in the first power module. The cable connecting the unit to the outside will have to be connected to the fibre optic cable connecter closest to the power feed for module 1.

See "AAX2002IKH01 Installation Guide for Communications Devices".

5.4.10. Ground Connections

The metal parts of the inverter (equipment ground) are electrically connected to the earthing bar on the front of each cubicle containing the the electronics of the equipment.

To ensure the safety of personnel, this terminal must be connected to the installation's ground.



5.4.11. Connecting the auxiliary supply

The fans, contactors, auxiliary power electronics and lighting of the cabinet if any, require backup power to operate.

This power must be provided at the two-terminal terminal strip installed for this purpose and should be 220 V 50 Hz. The power it should provide depends primarily on the number of fans it has to feed:

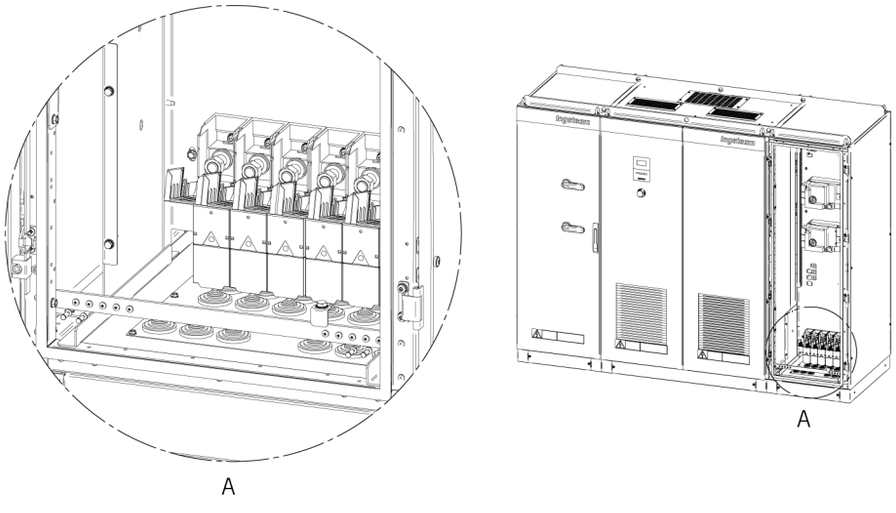
- Units with 4 blocks: 2500 VA
- Units with 3 blocks: 2100 VA
- Units with 2 blocks: 1300 VA

The location changes depending on whether the unit is equipped with the AC kit or not. We'll mention two representative units as examples:

Ingecon® Sun 250 TL, 315HE TL, 365HE TL, 375 TL, 400HE TL, 420HE TL, 500 TL, 500HE TL, 550HE TL, 600HE TL, 625HE TL, 630HE TL, 730HE TL, 800HE TL and 840HE TL

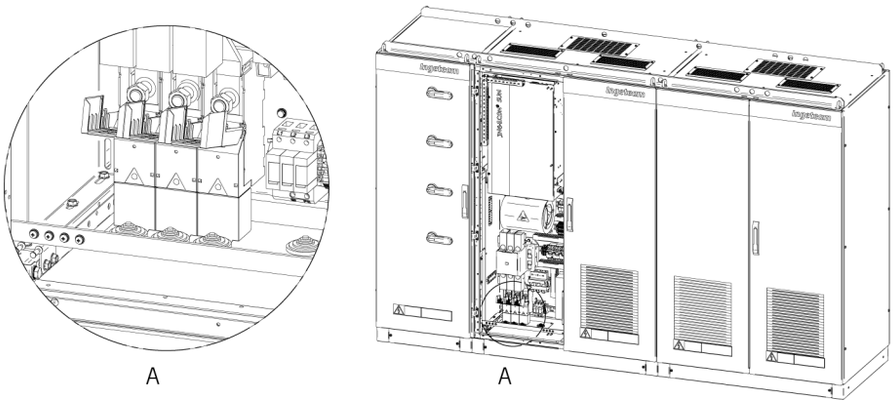
In all units with an AC cabinet, the auxiliary power terminal strip is in the last cubicle on the right.

In these units, the auxiliary input is on the cubicle of the first inverter. In all multi-inverter units, the auxiliary connection is under the inverter no. 1 between the AC feed and the EMC filter.



Ingecon® Sun 375 TL NAC, 500 TL NAC, 500HE TL NAC, 550HE TL NAC, 600HE TL NAC, 625HE TL NAC, 630HE TL NAC, 730HE TL NAC, 800HE TL NAC and 840HE TL NAC

In these units, the auxiliary input is on the cubicle of the first inverter. In all multi-inverter units, the auxiliary connection is under the inverter no. 1 between the AC feed and the electromagnetic interference filter.



Location of grounding bars

5.4.12. Grid connection

The cables for connecting the unit to the grid enter through the glands at the base of the cabinet. They must withstand at least the phase voltage and 1000 V between a phase and ground.

If the inverter and the grid connection point are far enough apart to require the use of longer cables, an external distribution box must be used close to the investor to make this connection.

The cable gauge must be suitable in each case for the power rating of the unit and site conditions.

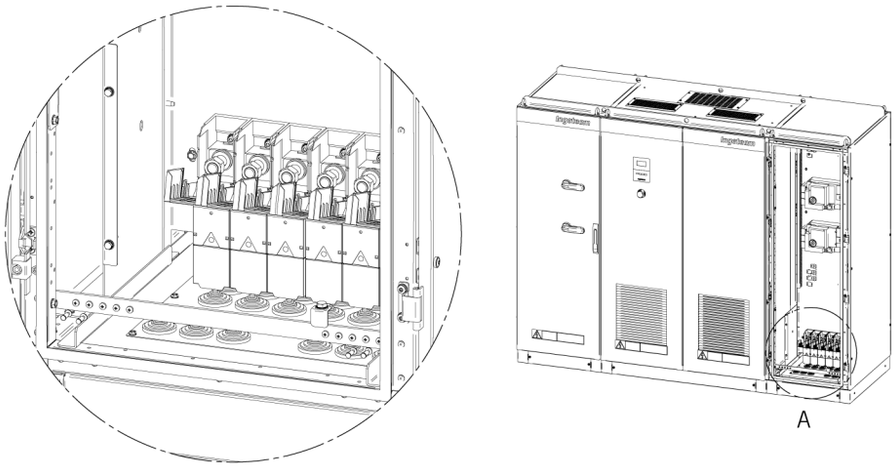
Protections for the inverters to the electrical grid (all versions which include them) can withstand a short-circuit current of up to 70 kA. NAC models do not have this protection. It must be assembled outside the unit and coordinated with the installation.

Before any handling, check that there is no electrical hazard in the voltage input from the grid.

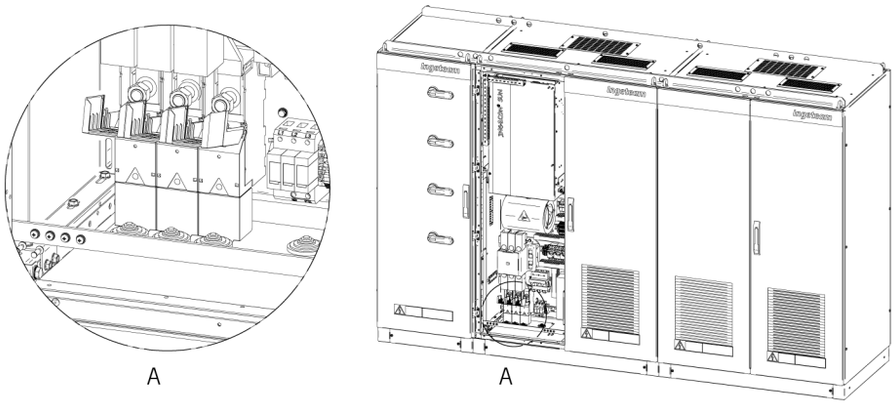
When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.

The autonomous three-phase outputs with no neutral of these units is as follows:

Ingecon® Sun Power Max units with AC cabinet have as many autonomous three-phase, non-grounded outputs with no neutral as electronics blocks, i.e., 1, 2, 3 or 4. They should be connected using an IT scheme. Each three-phase feed comprises three 275 V or 220 V bimetallic terminals, depending on the model, and up to 368 A. These comprise an M16 stud ring terminal for cable up to 300 mm2 or double cable up to 240 mm2. They are in the far right cubicle.



The Ingecon® Sun Power Max NAC (without AC cabinet) units have as many three-phase non-grounded outputs with no neutral not related to each other as electronics blocks, i.e., 1, 2, 3 or 4. They should be connected using an IT scheme. Each three-phase feed comprises three 275 V or 220 V bimetallic terminals, depending on the model, and up to 368 A. These comprise an M16 stud ring terminal for cable up to 300 mm2 or double cable up to 240 mm2. Each feed is under its respective electronic block.



5.4.13. Connecting to the PV array

The cables for connecting the unit to the PV array enter through the conical glands in the base.

Before any handling, check that there is no electrical hazard in the voltage input from the PV array.

Never forget that whenever they receive solar radiation, the panels' terminals generate voltage.

The inverter can therefore have voltages of up to 900 volts even when not connected to the grid.

When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.

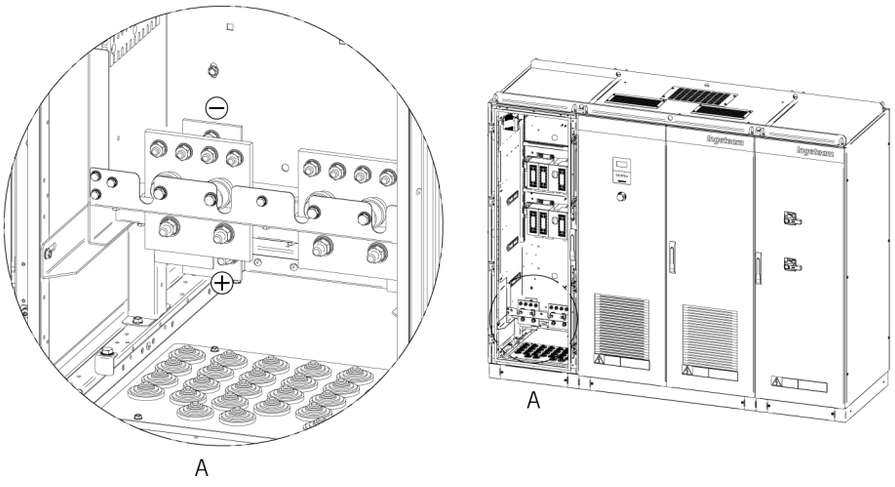
CAUTION

Connect the positive pole of the panel series to the terminals marked ⊕, and the negative pole to the terminals marked ⊖.

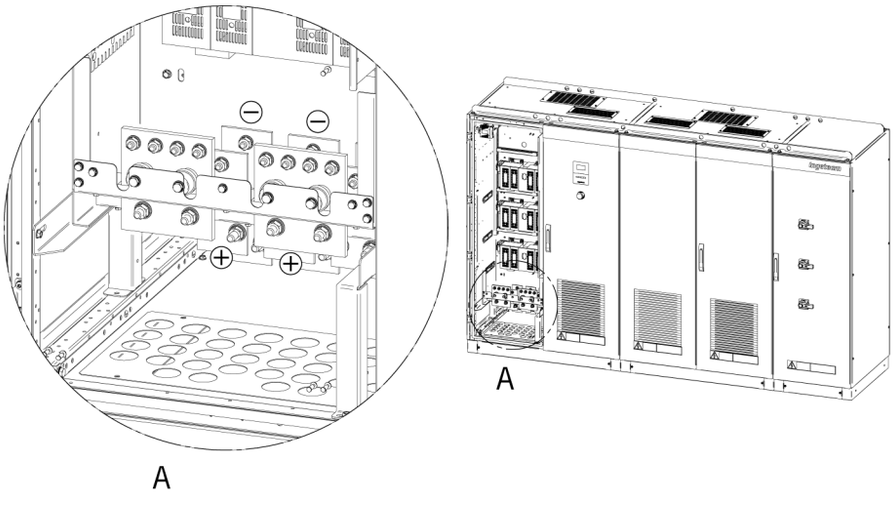
If the distance between the inverter and the PV array connection point requires the use of longer cables, an external distribution box must be used close to the inverter to make this connection.

The units have as many independent PV array input plates as electronic blocks. The following figures show the arrangement of plates in each model of the range:

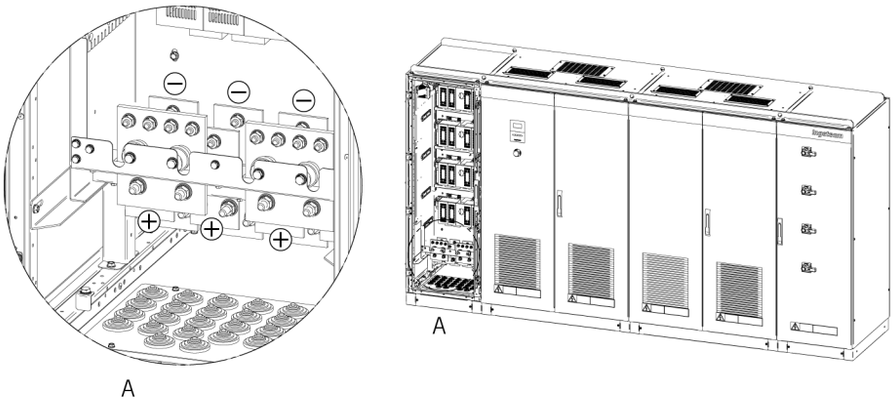
Ingecon® Sun 250 TL, 315HE TL, 365HE TL, 400HE TL and 420HE TL



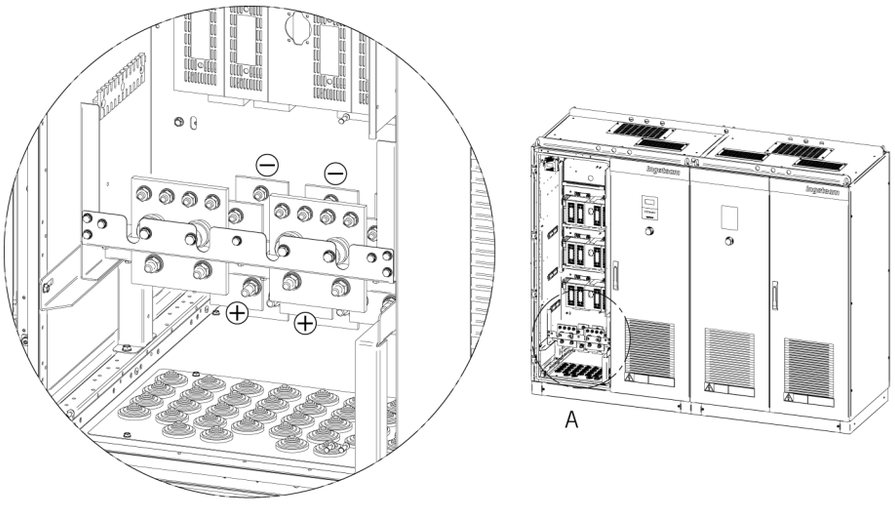
Ingecon® Sun 375 TL, 500HE TL, 550HE TL, 600HE TL and 630HE TL



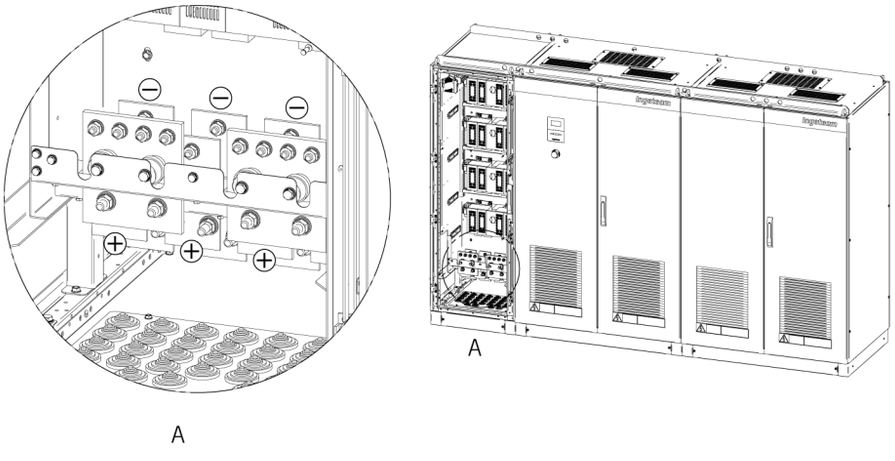
Ingecon® Sun 500 TL, 625HE TL, 730HE TL, 800HE TL and 840HE TL



Ingecon® Sun 375 TL NAC, 500HE TL NAC, 550HE TL NAC, 600HE TL NAC and 630HE TL NAC



Ingecon® Sun 500 TL NAC, 625HE TL NAC, 730HE TL NAC, 800HE TL NAC and 840HE TL NAC



The two front plates shown in the above figures may not appear on some units.

The unit power should be distributed evenly between the number of inputs available. Each one has its own positive and negative plate. Each plate has two M12 metric holes for four ring-terminated cables with a recommended size of 95 mm2. Two are inserted in the front and two in the back. So up to four cables can be connected to each strip. Can support up to 4 ring-terminated cables of up to 240 mm2.

To avoid arcing, once the wires are connecting to the strips, check the safety clearances between live parts on each strip or any other metal point on the unit. We recommend a clearance of 20 mm.

To access these terminals the protective polycarbonate sheet must be removed.

After working on the terminals the polycarbonate guard must be put back into place.

5.5. Equipment configuration

Once the unit has been mounted in its final position and has been solidly secured, ensure that the inverter is properly set up.

The units always come with factory settings, but when one of the inverters of the units is replaced or repositioned, the inverter in question must be set up.

Care must be taken to ensure the equipment is not live when accessing its interior.

5.5.1. CAN number setting of an electronic block

Note that in case of inverter change, the inverters come with default factory settings.

Once the unit is properly wired and before connecting it to the network and the PV array:

1. Press the emergency stop button.
2. Disconnect optical fibre cable from the inverter to be replaced.
3. Open Q4 circuit breaker on the power module controlling the inverter.
4. Connect DC supply. Alarm 1143 will be activated.
5. In the display (see Chapter 9 for details), find the "SETTINGS" menu. Select "Change NumCAN". Press OK. When prompted by the display, enter the installer code (3725) and press OK. Input the inverter node. If it was a replaced inverter, proceed to the next step. If the set-up was for the inverters of a unit dependant on another unit, repeat the process for each inverter.
6. Reset the alarms. To do so, close the Q4 thermomagnetic circuit breaker and connect the optical fibre cables. Alarm 1000 will remain.
7. Once all units are properly configured and connected by fibre optic communication cable, connect the unit after making the checks stipulated in Chapter 6, Commissioning.

5.5.2. Configuring the Modbus Node of an electronic block

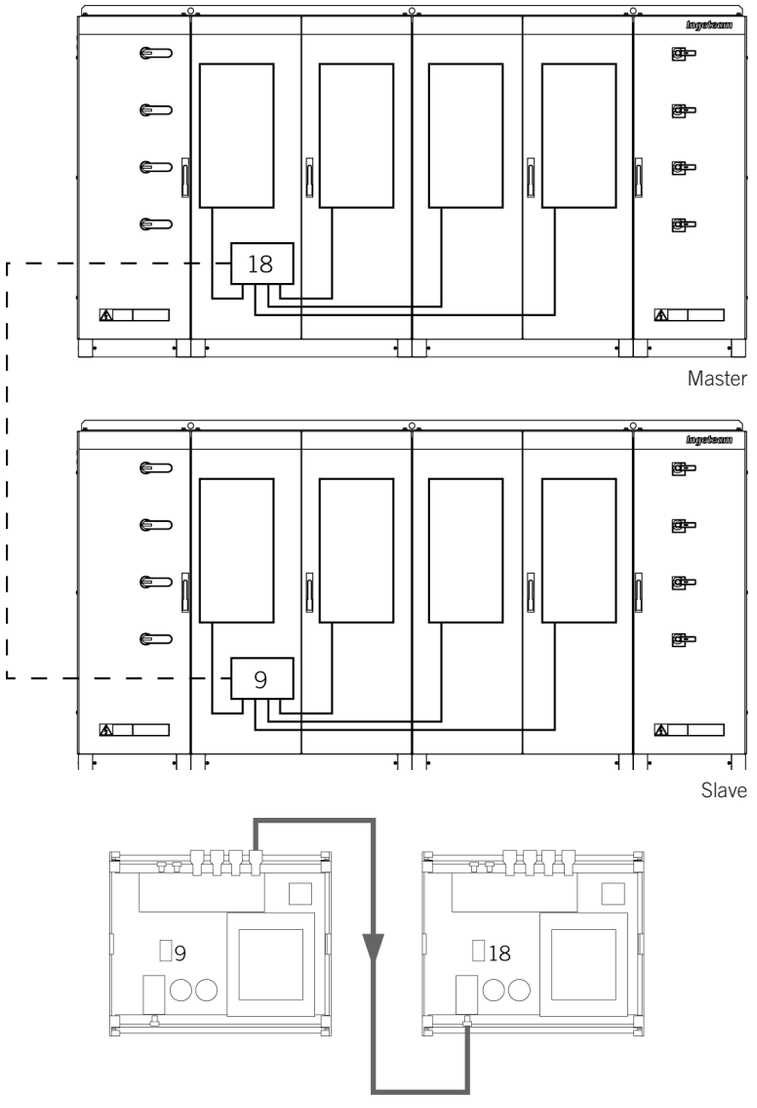
Once the unit is properly wired, with CAN assigned and connected at least to the PV array:

1. Check that the communication elements are in proper working order.
2. In the "SETTINGS" menu. Select "Change inverter number" and introduce the right one.
3. Check that the communication also works with the new node number.

5.5.3. Synchronisation of electronic blocks in units connected to the same inverter

All electronic blocks should be synchronised.

The inverter blocks have built-in synchronisation of the inverter blocks. If you wish, you may connect two units to a single transformer, provided these are not setup in the master-slave configuration, in which case two separate windings would have to be used.



To perform this synchronisation, turn the switch of a unit to position 18 and the other to 9, as shown in the figure. The cards will also be connected via a fibre cable.

The configuration of PV array voltages should be the same.

MPPTs connected by TL inverters to the same transformer should have the same voltage settings.

5.6. Available kits

The main kits that can be added to the various versions of the Ingecon® Sun Power Max.

5.6.1. Nighttime power supply

The control power of Ingecon® Sun Power Max inverters is fed from the PV array. Therefore, when the PV array has no power, the inverter control turns off. In order to communicate with the unit at night, you have the option of ordering the NIGHT POWER SUPPLY KIT, which feeds the inverter control from the mains.

To supply the inverter from the grid, an auxiliar supply of 230 Vac at 50/60 Hz must be supplied.

The kit comprises the power supply for the control (AAS0018) for each block.

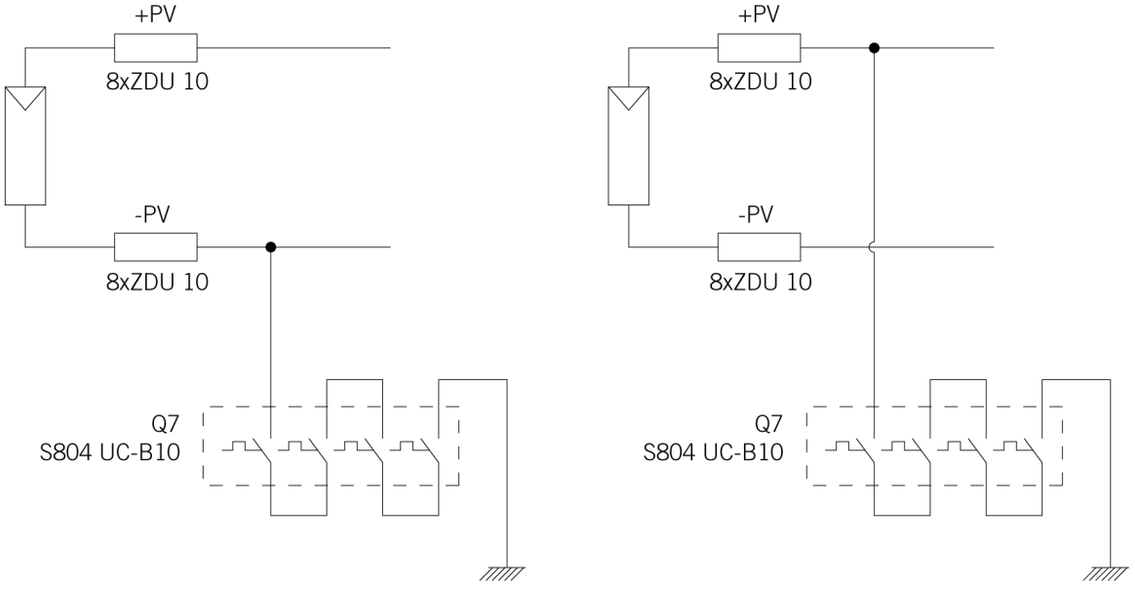
When this kit is installed in the unit and powered by 230 Vac, the display will be operational, allowing users to navigate through the menus and access the inverter via communications, but the inverter settings may not be changed until the voltage of the PV array is within the MPPT range.

The number of power supplies must be the same as electronics power blocks.

5.6.2. Grounding kit

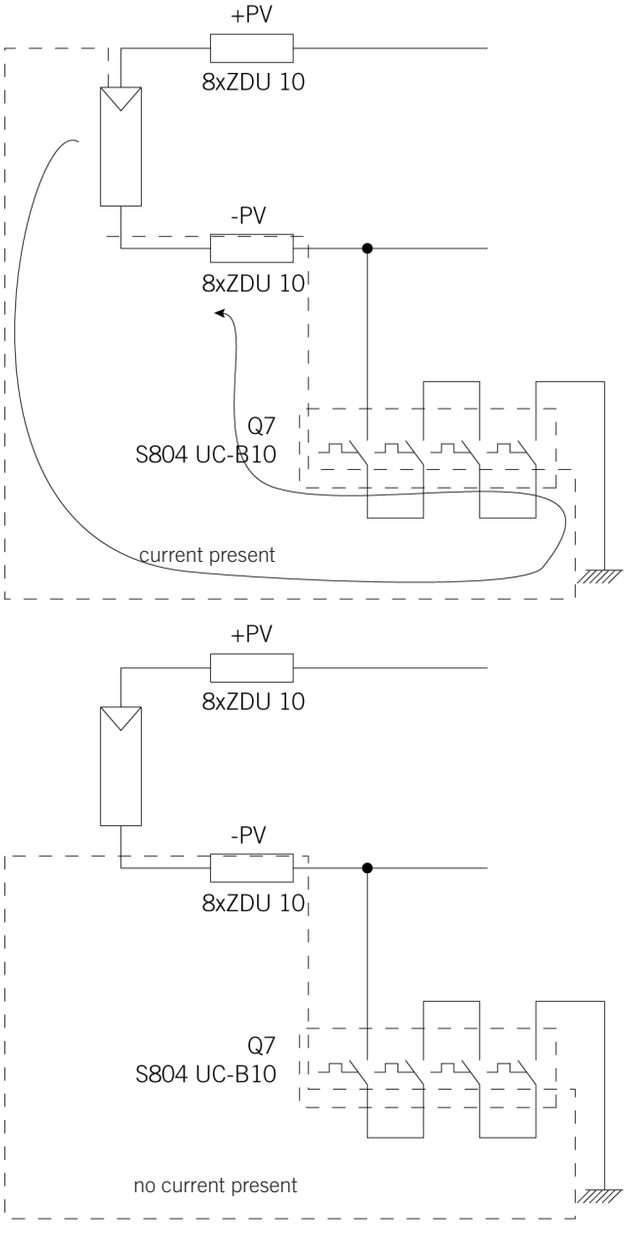
The PV array is grounded by a thermomagnetic circuit breaker that connects one pole of the PV array, negative or positive, to ground. The polarity of the connection depends on the type of panel technology.

Each MPPT can have only one ground reference, so this kit can only be installed on Ingecon® Sun Power Max inverters set up in the master-slave configuration.



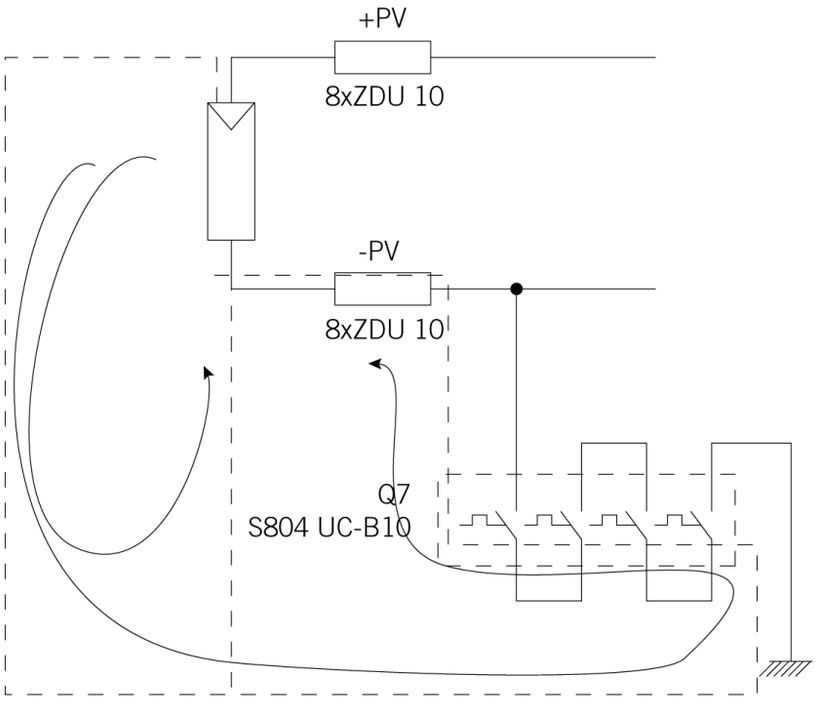
The thermomagnetic circuit breaker protection will open the PV array connection to ground when an insulation fault in the PV array generates a current through the connection which is greater than the protection's release current.

The current generated by the panels is closed by the lack of a positive pole, closing via the negative pole connection, until it returns to the panel. When the current exceeds the thermal value of the protection (10 A), the circuit is opened and current ceases to flow to ground.



If there is an insulation fault in the system on the same pole connected to ground by the protection, this fault is not detected. This situation does not generate current flow.

In this situation there is no reason for a second fault to be detected by the protection. Since two return paths are created, one by the protection and one by the insulation fault of the second pole.



To avoid this situation, check that there are no insulation faults in the grounded pole by inspecting the installation. This procedure should be carried out in compliance with the security measures described in this manual.

Turn off the unit to perform the following procedures:

1. Measure the voltage between positive and negative in the panel (Voc)
2. Measure the voltage between the positive pole and ground (VP)
3. Measure the voltage between the negative pole and ground (VN)

The PV array will be properly insulated if VP and VN are less than the value of Voc divided by two.

If VP or VN have a value greater than Voc/2, the PV array will have faulty insulation in one of its parts.

The protection will be monitored by the inverter control, and when the breaker opens the connection of the PV array to ground, the control will shut down the unit, triggering the 0x0200 DC Protection alarm.

In 250 to 625 kW TL models in which the MS option has been added, the 4-pole thermomagnetic circuit breaker shall be placed in cubicle A.

5.6.3. Remote triggering kit

In some countries, current regulations require remote protection to be implemented in inverters to open the connections. To achieve this a kit may be used which opens the thermomagnetic circuit breaker on the grid connection.

To activate the coils that make the thermomagnetic circuit breakers open, just close a volt-free contact in the remote activation terminals. The contact must be able to work with 230 Vac 50 Hz and a power of 40 VA.

The remote activation terminals are placed in cubicle D (AC module), next to terminal 220.

6. Commissioning

6.1. Equipment inspection

Ingecon® Sun Power Max units are equipped with a series of thermomagnetic switches to protect various components. These should be closed prior to unit start-up.

Before working on the thermomagnetic circuit breakers, check that there are no electrical hazards inside the unit.

When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.

6.1.1. Inspection

Before inverter start-up, a general inspection of the units must be carried out involving mainly:

Wiring

- Check that there are no loose wires. The insulation clearance is 20 cm between cables.
- Check that the protective switchgear such as circuit breakers, switches, arresters and fuses in general are in the correct position and in proper working condition.

Removing the perspex-type protections for performing this inspection is strictly forbidden.

DC Module

Check that the DC arresters are properly inserted into the base and that their "status window" is not red.

Inverter module

- Check that the protective thermomagnetic circuit breakers are in the correct position.
- Check also that in each module the fuses (DC intake) are correctly installed in the green “tub” located below and to the right of the inverter block.

AC Module

The following checks must be made to the AC output module:

- Auxiliary thermomagnetic circuit breaker switched to ON.
- Fuses correctly inserted into their sockets.
- Arresters correctly inserted into their sockets. Check that the status window is not red.

6.1.2. Shutting down

During installation, make sure that the protection grade of the equipment has not been altered.

In all connections through cable glands, give cabling enough length inside the unit so they don't pull on the internal electrical connection terminals.

Ensure that unused glands have been properly sealed.

Safety measures

Opening the front door of the cabinet is conditional on both the AC thermomagnetic (if there is one in this version) and the DC circuit breaker being in the OFF position. The must also be in that position for the door to be closed.

Do not alter the position of the AC thermomagnetic or the DC circuit breaker with the door open. do not operate the controls on the door nor apply force to the internal electrical devices which they control.

6.2. Start-up

First carry out a general visual inspection and wiring check, then proceed to connect power to the unit while keeping it switched off, following the guidelines in the instruction manual of the unit.

The tasks outlined for this step must be carried out with the unit door always closed, thus avoiding possible contact with live parts without IP2X protection.

6.2.1. Start-up

Check that the inverter switches on and that no LED error lights are on except for the manual shutdown light. Next, check that the variables on the monitoring menu are consistent; in particular the Vac Vdc levels.

The Vdc reading shows the voltage of the PV array at any given moment.

It allows you to check that the PV array is balanced. To do this, click "OK" on the Vdc display screen and confirm that the displayed PVP and PVN values (indicating the voltage of each PV array pole to ground) are similar.

Finally, check that the inverter only displays the manual stop alarm (Alarm 1000H) on the monitoring menu.

Once the tasks described above are performed, you may proceed to start the inverter. Failure to comply with the verification tasks described above releases Ingeteam Energy S.A. from any liability for possible damage to the system or the inverter itself caused by such failure.

Proceed to start the inverter.

6.2.2. Checking and measurement

Once connected to the unit network, the LED "Start" is lit, verify that no error LED display is on.

Check that the monitoring menu parameters are consistent:

- The voltage of the PV array should be between 400 and 900 Vdc and must remain balanced (similar PVN and PVP).
- Vac tension shown on the display must fall within operating ranges.
- The RMS value of currents Iac1, Iac2 and Iac3 displayed should be similar.
- There are no alarms in the inverter (0000H).

It is always advisable to check the waveform of the current generated in the three phases using an ammeter clamp. Use the PPE listed in the "Personal Protective Equipment" section (working with voltage) to get this reading.

7. Preventive maintenance

The recommended preventive maintenance tasks must be carried out at least **annually,** except for the checking the fans and filters, which must be done **monthly.**

The various maintenance tasks must be performed by qualified personnel. Danger of electric shock.

To access the various compartments, take into account the safety recommendations in previous chapters.

All maintenance checks listed here should be done with **no voltage on the inverter** and in safe conditions for handling.

The following paragraphs describe the actions to follow for proper installation of Ingecon® Sun Power Max inverters.

7.1. Maintenance tasks

Check status of the enclosure

A visual check of the status of the enclosure must be performed, verifying the status of locks, doors and handles and the unit fixings at both lower and, if any, upper anchorage points. In addition, the condition of the enclosure must be checked for dents, scratches or rust that might degrade the cabinet or cause it to lose its protection classification. If this type of defects are noticed, the parts affected must be substituted.

Check the status of the cables and terminals

- Check the correct path of the cables so they do not come into contact with live parts.
- Check for insulation faults and hot spots by checking the colour of the insulation and terminals.

Tightness of strip fasteners and power cables

Check tightness in accordance with the following torques:

Metric threads	Tightening torque (Nm)
M8	24
M10	47
M12	64

As per DIN 13.

Check plates

Visually check that the AC feeds comply with safe distances and maintain their initial electrical properties.

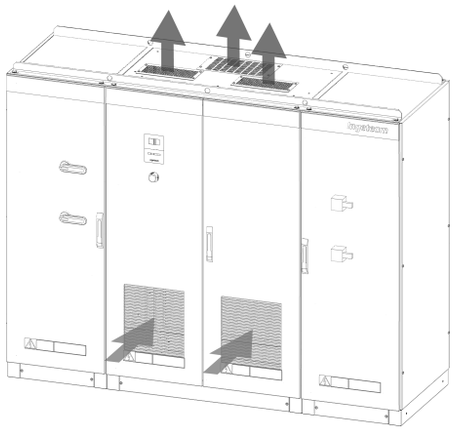
Check that there is no moisture inside the cabinet

If moisture exists, dry before making electrical connections.

Fixings

Check the correct fixing of the cabinet components to their corresponding anchorage points.

Ensure adequate ventilation of the unit



Checking the status of exhaust fans, cleaning and replacing them if necessary.

Clean vents grids

Check the state of the filters in the front and side ventilation grids.

To do this you must first remove the grille of the air intake, behind which is the filter.

- Unscrew the four nuts from the grid, accessible from the inside of the door.
- Remove the grid.
- Remove the filter from inside the grid.

Accumulated dust and dirt in the filter may adversely affect the cooling ability of the fan and result in anomolous heating of the equipment. To solve this problem, clean and replace the filter and grid:

- With a moderately dirty, dry filter, lightly tap until the dirt has been removed.
- If the dirt does not disappear, wash in water at 40 °C.
- If the filter is soiled with grease or oil, replace it with a new one.

If the problem persists, contact Ingeteam Energy, S.A.

When on, the inverter generates a buzzing sound.

Check the environment to avoid amplifying or transmitting the buzz.

The unit should be located in a place readily accessible for installation and maintenance work, enabling keyboard handling, display reading and access to the unit's various internal components.

8. Troubleshooting

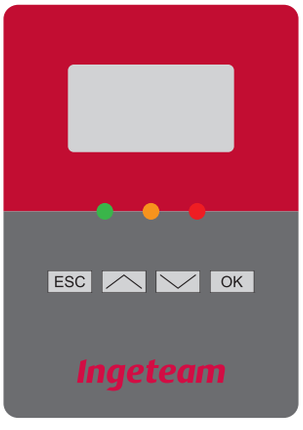
This is a guide for troubleshooting problems that may arise in the installation of the Ingecon® Sun Power Max unit.

It also explains how to perform simple operations such as component replacement and unit configuration.

Troubleshooting for the Ingecon® Sun Power Max unit must be performed by qualified personnel in compliance with the general safety instructions in this manual.

8.1. LED messages

Some of the LEDs indicate some kind of problem in the PV installation.



Display Ingecon® Sun Power Max

8.1.1. Green LED

This is the LED that should light up in normal start-up and operating conditions, while the others remain off. It has three modes:

Slow flashing

Standby due to low solar radiation. Flashing every 3 seconds. This alarm is triggered when the PV array does not receive enough solar radiation to supply the minimum voltage required by the inverter to inject power. This occurs commonly between sunset and sunrise, or at times when rain, clouds or other atmospheric phenomena produce overcast conditions above the PV array.

If this situation occurs on a day which is not particularly dark, check that the panels are clean and properly installed.

Fast flashing

This type of blinking indicates that the PV array is feeding the right amount of voltage to the inverter and it is about to start up. In this state, the inverter checks the grid parameters to feed current into the grid at the latter's precise voltage and frequency. This process takes about 1 minute (adjustable).

Steady light

Inverter connected to the grid.

8.1.2. Orange LED

This LED indicates that alarms have been set off in the inverter.

Fast flashing

This flashing indicates that an alarm has occurred in the inverter, but the anomaly in the operation does not require stopping the inverter. The most frequent alarm of this type is the high temperature protection:

The inverter is in self-limiting mode because it has reached the maximum permissible temperature.

In this situation, check that the fans are running, that the air inlets and vents are free from obstacles, and that there are no sources of intense heat near the inverter. If the problem persists, contact Ingeteam Energy S.A.

8.1.3. Red LED

This LED indicates that alarms have been set off in the inverter.

Steady light

The inverter shuts down. This flashing indicates that an alarm has occurred in the inverter which requires it to shut down. The most common alarms that require inverter shutdown are:

1000H Manual shutdown. The unit has been stopped manually. Check that the emergency stop buttons have not being pressed accidentally, and try to restart from the display by removing the manual shutdown.

0001H Grid frequency out of range.

0002H Grid voltage out of range.

Chances are that the problem is a power failure. When power returns, the inverter will restart. If not, check the connections to the grid.

If the grid has the appropriate grid quality parameters, check the grid connections.

If the problem persists, contact Ingeteam Energy S.A.

0400H Insulation fault in DC circuit.

There are two possible causes:

- There is an insulation fault on the panel circuit.
- An arrester has triggered.

0020H Temperature alarm in the power electronics.

The temperature of the unit is too high and has stopped feeding current to the grid. When the temperature drops, the unit will reconnect.

An insulation fault can pose a hazard to personnel.

The repair of an insulation fault must be carried out by qualified personnel.

Procedure to determine the cause of the insulation fault

1. Open the DC circuit breaker. If the voltages of the PV array with respect to ground are in balance, the insulation fault is outside the inverter.
2. If the insulation fault persists, the fault is inside the unit. Check the surge arresters.
3. Disconnect the unit from the power grid and the PV array.
4. Wait at least 10 minutes for the capacitances to discharge.
5. Open the inverter and check the status of the DC arresters. Each of these arresters has an visual indicator. If the indicator is black, the arrester has been triggered.
6. Check the status of the DC fuses or thermomagnetic circuit breaker protecting the arresters.
7. Replace defective components if necessary.

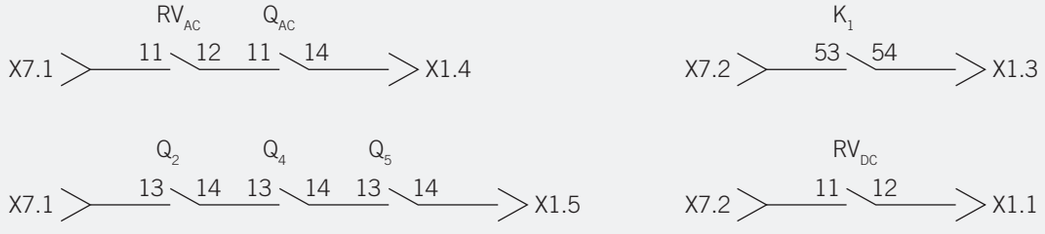
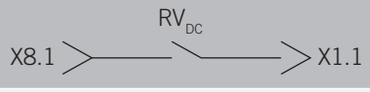
8. Close the inverter, reconnect the unit to the grid and to the PV array.
9. If the fault indicator persists, check the PV array insulation. Pinpoint the fault and correct it.

8.2. List of alarms and stop reasons

The following table details the possible reasons for each alarm.

Code	Alarm	Reason for shutdown	Description
0008H	Reset	Reset	Indicates that the inverter has reset, inverter firmware fault
0010H	Effective grid current	Effective grid current	RMS current exceeds maximum allowed
0020H	Temperature	Power electronics temperature.	The temperature of power electronics exceeds 80 °C.
		Auxiliary temperatura sensor	The auxiliary temperature sensor has triggered an alarm
0040H	Hardware fault	Adc reading error	A higher-than-normal reading of the top Adc has been detected on an unexpected input. Synchronism or auxiliary power supply has been lost.
		Adc latency	Internal error of the analogue to digital converter
		Master-slave	Error on master-slave system or optical fibre
0080H	Instantaneous grid current	Instantaneous grid current	Instantaneous current value out of range
0100H	AC protections	Varistors	Error in AC varistors
		Contactor	The state of the contactor is not correct for the current inverter status.
		AC protections	Error in some of the AC protectors, arresters, fuses, etc.
		Thermomagnetic	Error in the three-phase input circuit breaker.
0200H	DC protections	DC protections	Blown DC input fuse or DC arresters
0400H	AC insulation	AC insulation	Insulation fault in the PV array on inside the inverter
		Varistors	Error in DC varistors
0800H	Branch fault alarm	Fault in branch #1	Fault in branch #1 of the power electronics
		Fault in branch #2	Fault in branch #2 of the power electronics
		Fault in branch #3	Fault in branch 3 of the power electronics
1000H	Manual shutdown	Manual shutdown	Manual shutdown with the emergency stop button via display or communications
2000H	Configuration	Configuration	Shutdown due to a change in firmware
		Firmware	Shutdown due to firmware load
4000H	High input voltage	High input voltage	High DC input voltage
8000H	Panel voltage	Low input voltage	Shutdown due to low input voltage.
		Hardware fault	Reason for internal shutdown, hardware failure
		Low power	Shutdown due to low power, (typical at nightfall)
		Fatal error	Due to five consecutive errors in the branches, or consecutive contactor shutdowns.

8.3. Inverter alarms due to protections

Code	Description
0100H	AC circuit protection. This alarm goes off when an AC protection element is triggered. The items monitored are: Q_1, Q_2, Q_4, Q_5, F_{AC}, R_{VAC}, K_1 Which are the protections for the filters and AC intakes and DC intakes and contactor. In normal operation, all contacts should be closed, except for the contactor circuit. Check the signalling circuit to see where it is broken. The causes may be broken cables in the circuit, a triggered protection, fused arresters or a connector out of its base. 
0200H	DC circuit protections. This alarm goes off when a DC protection element is triggered. The items monitored are arresters and grounding kits: Q_6, RV_{AC} In normal operation all contacts must be closed. Check the signalling circuit to see where it is broken. The causes may be broken cables in the circuit, a triggered protection, fused arresters or a connector out of its base. 
4000H	Overvoltages in the panel inputs. This alarms indicates an out-of-range voltage at the PV input. A voltage greater than 900 V_{DC} will cause the equipment to shut down. Voltages greater than 1000 V_{DC} will damage the equipment.
8000H	Very low voltage and the input from the panels. This alarms indicates an out-of-range voltage at the PV input. The equipment will be on standby until the panel voltage reaches the necessary value for a connection.
0020H	Temperature alarm in the power electronics. The temperature of the unit is too high and has stopped feeding current to the grid. When the temperature drops, the unit will reconnect.

8.4. Action protocol for responding to incidents

If the unit should stop interacting with the network due to the emergence of issues relating to the installation and/or the inverter, the fastest way to resolve the issue is as follows:

1. Check on the display the alarm and the reason for shutdown reported by the unit.

Search in this guide's index to see if the alarm or reason for shutdown is indicated. If it is covered, proceed to step 2; if on the contrary it is not covered, take note of the unit's serial number and contact Ingeteam's telephonic technical service, the number of which is listed on a sticker on the document pocket behind the door.

2. Disconnect the unit from the supply. This will disconnect both the AC and auxiliary connections by opening the thermomagnetic circuit breaker and the DC section by opening the PV array breaker. After AC and DC power is switched off, wait 10 minutes before opening the unit, to ensure that their internal capacitance is discharged.

IMPORTANT

Only in the event of an insulation fault triggered by alarm 0400H will the AC power be switched off and the DC power be left.

3. Open the unit and find the section in this guide that deals with the alarm or reason for shutdown recorded in the first step.

4. Use a category III, 1000 V_{DC} multimeter which can measure continuity, resistance and capacitance, and proceed to carry out the checks listed here.

5. If unable to solve the problem using this guide, take note of the unit's serial number and contact technical service.

Below is a list of possible reasons for shutdown, their associated alarms and troubleshooting guidelines. If more than one alarm takes place, the alarm on the display will be the sum of all active alarms.

E.g.:

Code	Alarm
0001H	Grid frequency
0002H	Voltage
0003H	Grid frequency + voltage

8.4.1. Voltage and/or frequency out of range

One reason for shutdown associated with out-of-range voltage and/or frequency features the alarm codes listed below:

Code	Alarm	Reason for shutdown	Description
0001H	Grid frequency	Grid frequency	Grid frequency out of range
0002H	Voltage	Voltage	Voltage out of range
0003H	Grid frequency + voltage	Grid frequency + voltage	Grid frequency out of range + Voltage out of range

In the event of a “0001H” and/or “0002H” alarm, you must check the status of the Q4 breaker protection and all the wiring associated with it. This check requires verifying the correct status of the following areas of the unit:

1. Check that Q4 is switched ON in each of the power modules (Q4.1, Q4.2, etc.).

2. Check the proper status of fuses F16, F17, F18, F26, F27, F28, F36, F37, F38, F46, F47, F48.

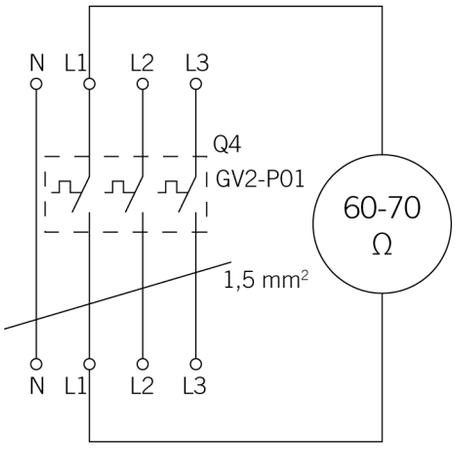
3. Status of RVac1, RVac2, RVac3 and RVac4 arresters located in the AC output module of the units. To verify its correct status, verify that they are properly attached to their base and that the status window of none of them is red.

4. Once the arresters have been checked, check that the QAC1, QAC2, QAC3 and QAC4 thermomagnetic circuit breakers located in the AC module at the inverter output are switched ON.

Note: The AC module must be closed to switch ON the thermomagnetic circuit breakers listed above.

In the event that Q4s in all power modules are switched ON and none of the fuses are blown, the next step will be to ensure that both the AC voltage intake and the inverter are powered. The procedure requires performing the following checks:

1. Check that the Q4 thermomagnetic circuit breakers are not damaged. With Q4 switched ON, measure the flow resistance offered by Q4 for each phase. The resistance for each of the phases must be within the 60 to 70 Ohm range. The following figure details the test to be performed.



The figure has verified the resistance of phase 1, L1. Testing required for L2 and L3.

2. Check for continuity between Rcapt, Scapt and Tcapt terminals of the inverter's Q4 thermomagnetic circuit breaker and XAC terminal strip, according to the following sequence of terminals (see figure):

- Rcapt – XAC.2.
- Scapt – XAC.3.
- Tcapt – XAC.4.

3. Check continuity between the inverter's XAC terminal and the intake board as per the following list:

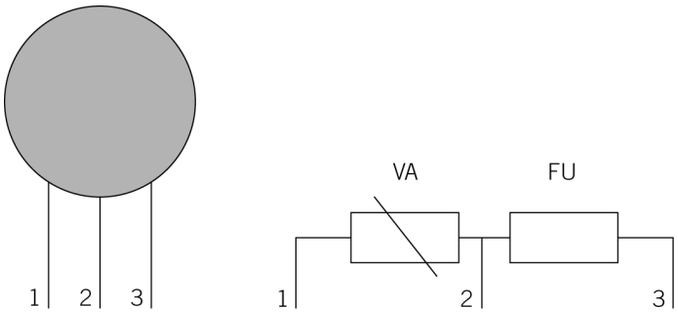
- XAC.1 – J8.2
- XAC.2 – J8.1
- XAC.3 – J7.1
- XAC.4 – J6.1

Another task to be performed is a visual inspection of the varistors on the intake board. Check that the thermal fuse is not damaged.

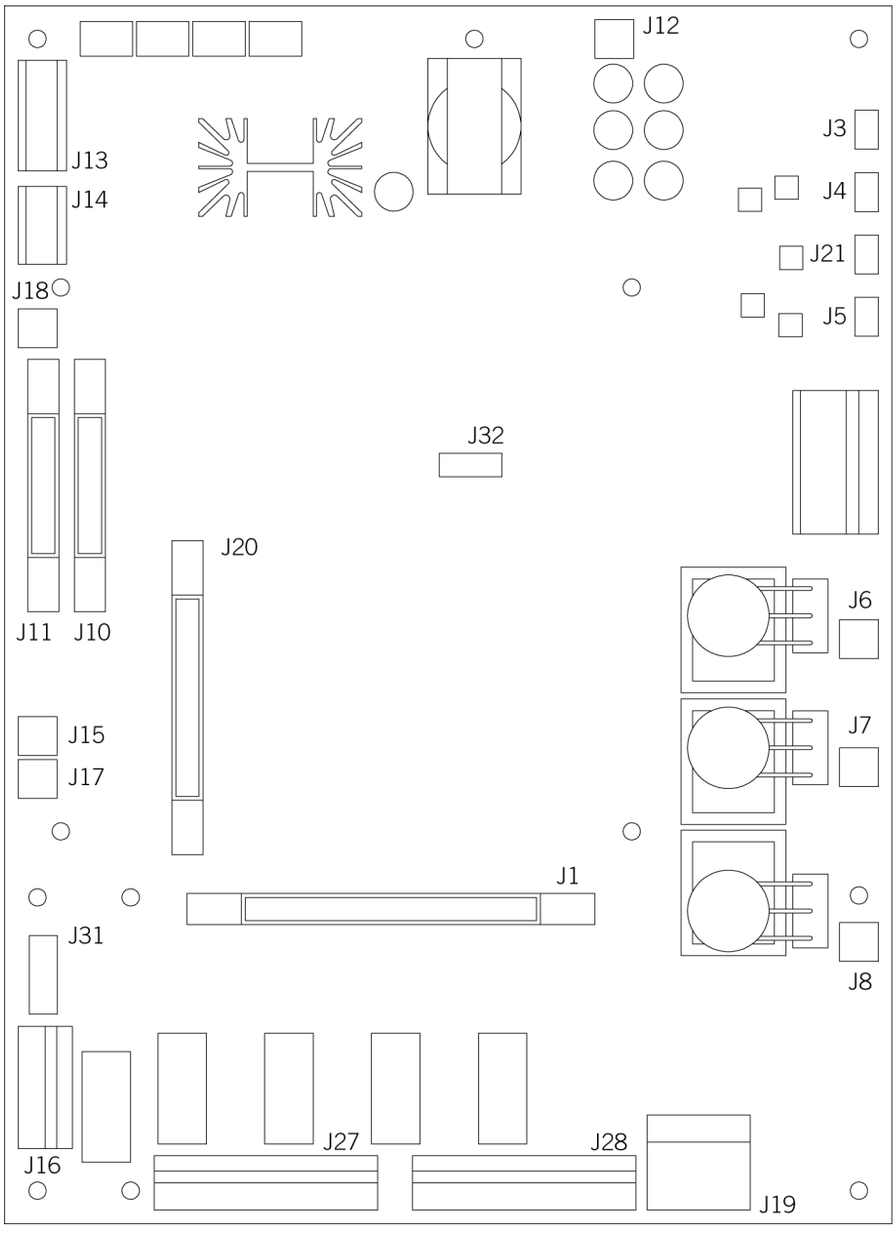
The measurement board varistors comprise a thermal fuse (FU) and a varistor (VA). The way to check that the varistor is operating correctly is to perform the checks listed below:

Between pins 1 and 2, you must get a high impedance reading of around kOhm.

Between pins 2 and 3 you must get a reading of 0 ohms approximately.



If all the above checks have been done correctly and a 0002H alarm persists, what remains to be checked is that the impedance of each phase of the inverter output to ground is very high. To do this, open fuses F16, F17, F18, F26, F27, F28, F36, F37, F38, F46, F47, F48.



Intake board

8.4.2. Temperature

Code	Alarm	Reason for shutdown	Description
0002H	Temperature	Power electronics temperature.	The power electronics exceeds 80 °C
		Auxiliary temperatura sensor	The auxiliary temperature sensor has triggered an alarm

In the event of a shutdown with reason “Motivo_Paro_Temperatura”, the first step is to check if the 0020H alarm persists. If so, check the temperature of the unit’s radiator via the display menu:

MONITORING → TempRad

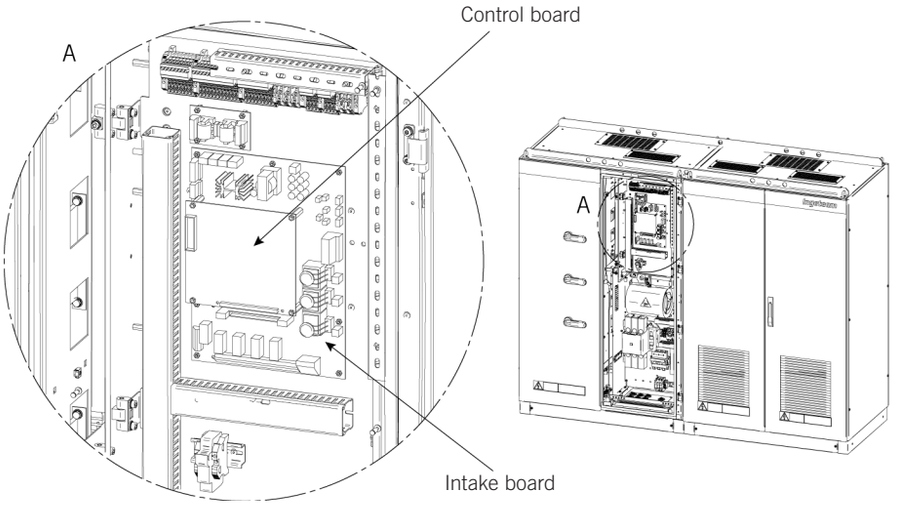
- If the temperature displayed is close to or above 80 degrees, the unit has failed to inject power as a precaution against a potentially damaging radiator temperature for the unit. The inverter will remain in this state until the radiator has cooled, and then it will reconnect to the network.

If the problem occurs frequently, you should check the ventilation (fans and air intake grills) of the inverter and the enclosure in which it is installed.

- If the temperature shown is less than 60 °C and the alarm persists, the problem could be in the thermal switch built into the inverter in its radiator.
- If the displayed temperature is abnormally low (compared to room temperature), the root of the problem could be with the NTC built into the inverter.

Checking the NTC

To check the NTC of the unit you will need to access the J18 terminal of the intake board. This terminal is located under the control board and the intake board as shown in the following pictures.

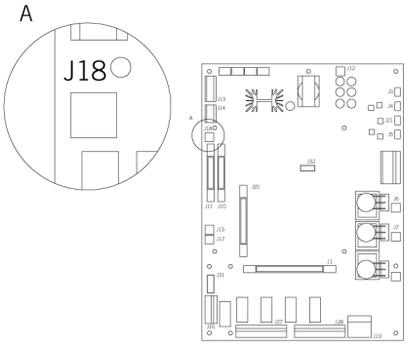


Location of the control board and the intake board

In terminal J18, do not connect wires coming into J18.1 and J18.2, and use a multimeter to measure resistance between them. The resistance measured should be approximately 5 kOhm at around 25 °C ambient temperature.

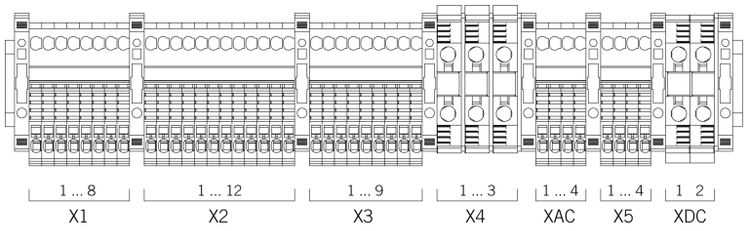
Re-wire the NTC on the J18.1 and J18.2 connector and measure resistance between connector pins themselves with the multimeter. The resistance measured should be approximately 1 kOmh.

In case any anomaly in the inverter's NTC is found, contact technical support.



Checking the thermal switch

To verify that the thermostatic switch is functioning properly, check for continuity between terminals X1.2 and x1.7 in the upper left corner of the inverter. The figure represents the entire terminal strip to identify it more easily.



If there is continuity between X1.2 and x1.7 proceed to check continuity between J19.2 and J12.1 in the intake board.

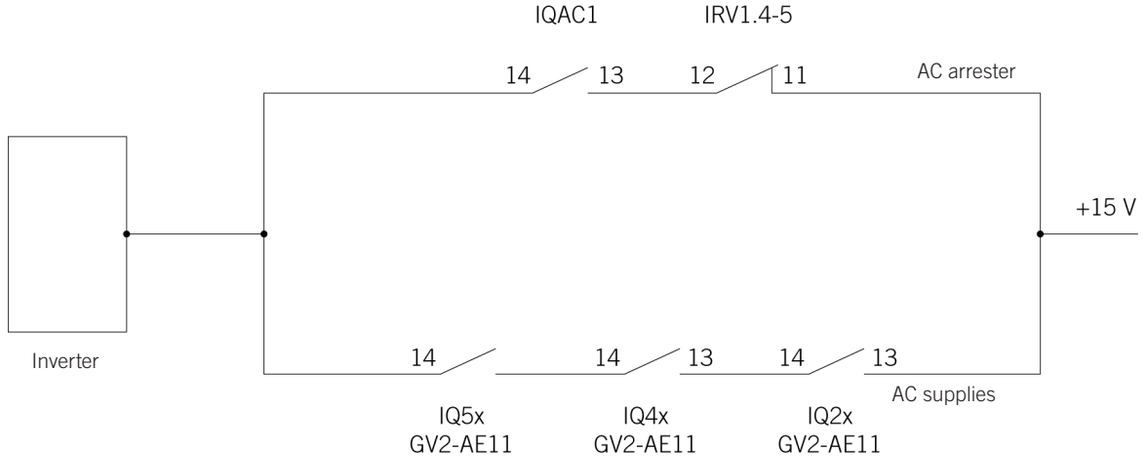
To locate the position of the terminals within the intake board, see explanatory drawing titled “Intake board” on page 72.

If you do not have continuity, you should contact technical support.

8.4.3. AC circuit protection

Code	Alarm	Reason for shutdown	Description
0100H	Alarma_Prot_AC	Motivo_Paro_Prot_AC	Error in some of the AC protectors, arresters, fuses.

In the event of a “*Motivo_Paro_Prot_AC*” reason for shutdown, check the status and monitoring of the AC circuit protections of the module in question.



To check the status of the protections, perform an in-depth check of section “6. Commissioning” in this document.

If the AC circuit protection status is correct, proceed to verify their monitoring. To do this, you will need to check the monitoring branches:

- AC PROTECTIONS

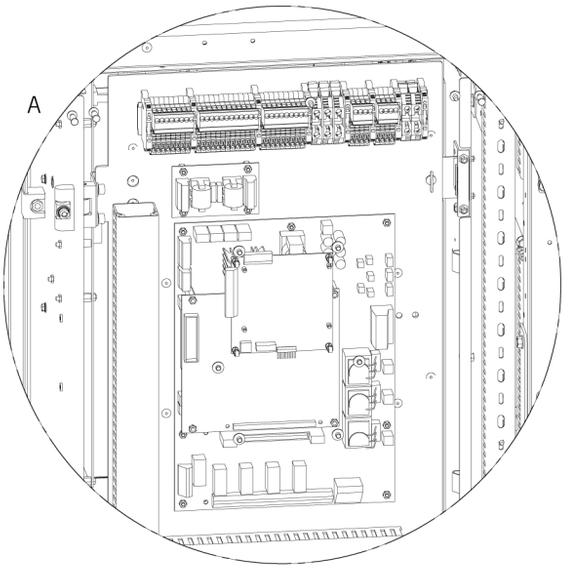
Comprised by IQx2, IQx4 and IQx5 thermomagnetic circuit breakers.

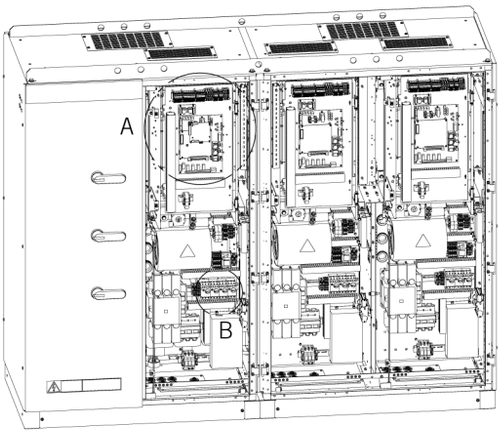
Note: x corresponds to the number of the inverter module that has shut down.

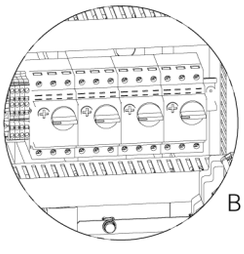
- ARRESTER + AC FEED CIRCUIT BREAKER

Comprised by IRVx.4-5 and IQACx (x corresponds to the number of the inverter module that has suffered the shutdown).

To check the AC protection branch, you should see continuity between the ends of the monitoring circuit: Between X7.1 and J19.6.



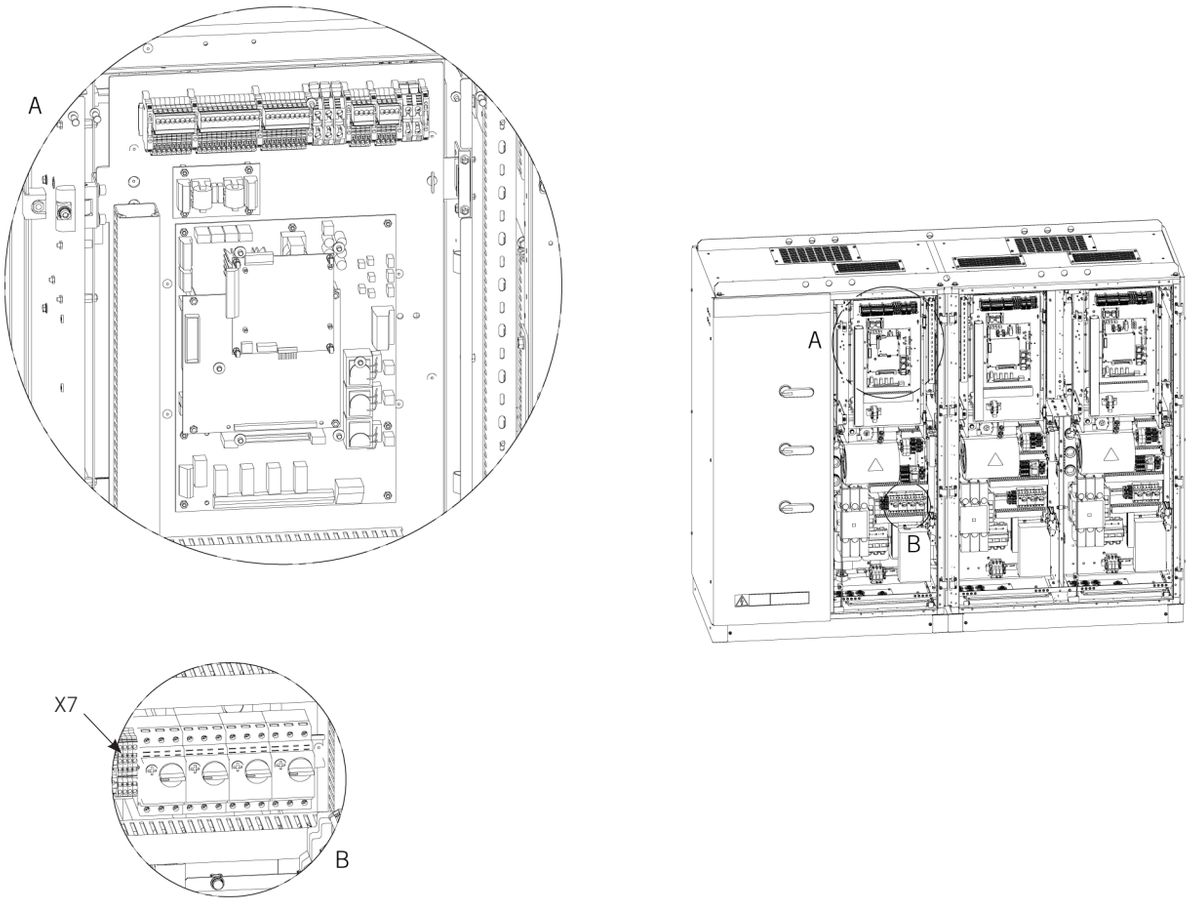




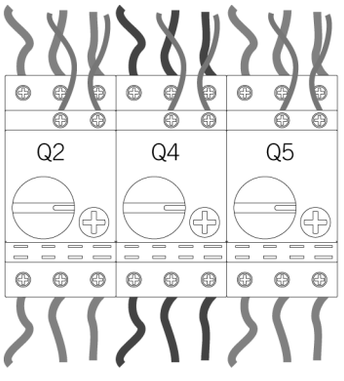
If there is no continuity, you can narrow down the exact spot where the problem is by checking between X7.1 Q2, between Q2 and Q4, between Q4 and Q and between Q5 and J19.6.

To locate the position of the terminals within the intake board, see explanatory drawing titled “Intake board” on page 72.

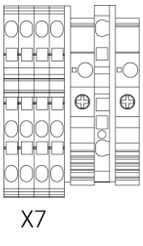
The following figure details the location of the various terminals which need to be checked. As it indicates, the first block has four terminals and the following modules have three.



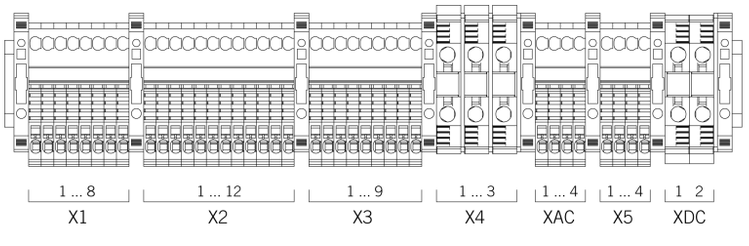
Location of X1, X2, X3, X4, XAC, X5 and XDC and Q2, Q4 and Q5 terminal strips



Q2, Q4 and Q5 terminal strips



X7 terminal strip



X1, X2, X3, X4, XAC, X5 and XDC terminal strips

Between X7.1 and Q2

Q2, input monitoring terminal (left blue wire).

See illustrations on page 76.

Between Q2 and Q4

Q2, output monitoring terminal (right blue wire).

Q4, input monitoring terminal (left blue wire).

See illustrations on page 76.

Between Q4 and Q5

Q4 output monitoring terminal (right blue wire).

Q5, input monitoring terminal (left blue wire).

See illustrations on page 76.

Between Q5 and J19.6

Q5 output monitoring terminal (right blue wire).

J19.6: see illustration titled “Intake board” on page 72 to locate it.

See illustrations on page 76.

Between X1.5 and J19.6

Then you should check that there is power from X.1.5 to the inverter. To do this, check that there is continuity between terminal X1.5 and J19.6 (see illustration titled “Intake board” on page 72 for help in locating it).

See illustrations on page 76.

Between X7.1 and X1.4

If there is continuity between terminals X7.7 and X1.4 of the AC branch arrester, it is running properly.

See illustrations on page 76.

8.4.4. Reason for contactor shutdown

Code	Alarm	Reason for shutdown	Description
0100H	Alarma_Prot_AC	Motivo_Stop_Contactor	The state of the contactor is not correct for the current inverter status.

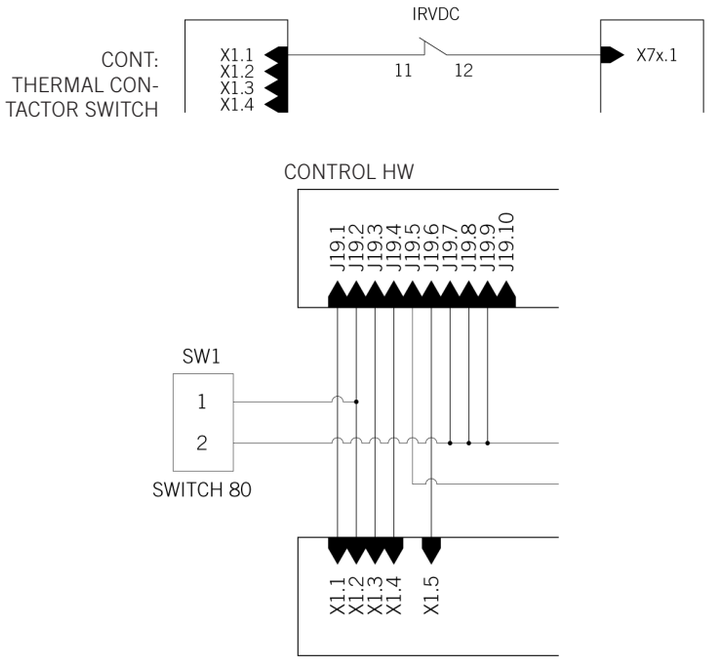
The “contactor” reason for shutdown is associated to alarm 0100H. This reason for shutdown requires checking the following points:

- Contactor coil wiring. There should be continuity between terminals X3.1 and X3.2. Proceed to check that the inverter is powered. To do this, check continuity in the following points:
  - X3.1 – J16.1.
  - X3.2 – J16.2.
- Check continuity first between X8.1 and X3.1 and then between X3.1 and X8.2.
- Signalling status. Resistance between terminals x7.5 and x1.3 should be approximately 5.5 kOhm.

See illustrations on pages 72 and 76.

8.4.5. DC circuit protections

Code	Alarm	Reason for shutdown	Description
0100H	AC protections	DC fuses	Blown DC input fuse or DC arresters.



In the event of a “0100H” alarm, check the status of the DC fuse branch. To check for proper status observe the following:

- Continuity between terminals X7x.1 and X1.1.
- Continuity between X1.1 and J19.1.

See illustrations on page 76.

8.4.6. Insulation fault

Alarm 0400h is related to an insulation fault and can be one of two types:

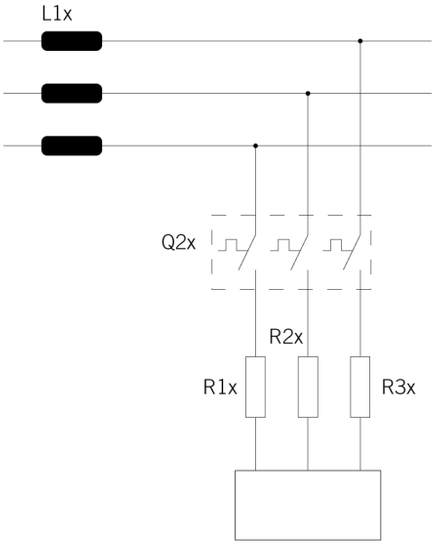
- External to the unit. This is the first thing you should check.
- Internal to the unit.

External to the unit

To check whether the insulation fault is external to the unit, see whether the Rpv+ and Rpv- impedances are displayed on the display screen (selecting the fifth screen from the monitoring menu). Given the insulation fault, one or both will be 0 or a low figure.

Disconnect the power and open the DC breaker. If the Rpv+ and Rpv- impedances cease to be invalid, the fault is in the photovoltaic field. If one of them is balancing out and gives an intermediate reading, the inverter is triggering the insulation fault.

Inspect the installation.



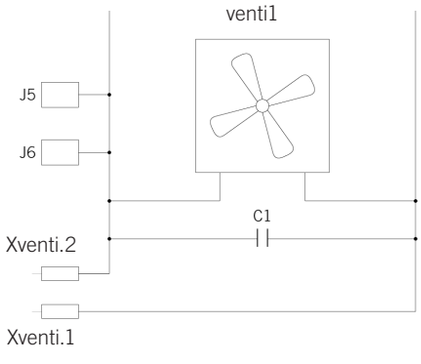
Switching harmonics filtering

Internal to the unit.

If the insulation fault is caused by the unit, you must cut the DC power supply and wait 10 minutes before opening the inverter for the first time. First, ensure that the 64-way ribbon cable on the AAP0019 control board is correctly inserted into the J1 intake board.

If the fault is not as specified earlier, it will be necessary to look for it in the DC and/or AC part of the unit.

In the DC part of the unit, you will need to check the arresters and wiring. Using a multimeter, check that the resistance and ground capacitance of each pole of the DC battery bus is the same.



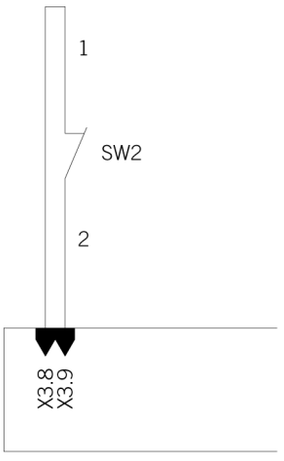
In the AC part of the inverter, check that the resistance of each of the inverter's outputs to ground are around MOhm. Check also that the Q2x filter or the wiring of the unit's fans aren't producing the earth fault. To do so, open Q2x to separate circuits. In the filter is causing the ground fault you will need to check the wiring. If the fans are causing the ground fault, you will need to disconnect terminals XVENT1.1 and XVENT1.2.

8.4.7. Manual shutdown

Code	Alarm	Reason for shutdown	Description
0100H	Manual shutdown	Manual shutdown	Manual shutdown with the emergency stop button via display or communications.

To verify that the emergency stop button works properly, check for continuity between terminals X3.8 and x1.7, and between terminals X3.9 and J19.8.

See illustrations on pages 72 and 76.



Emergency stop button

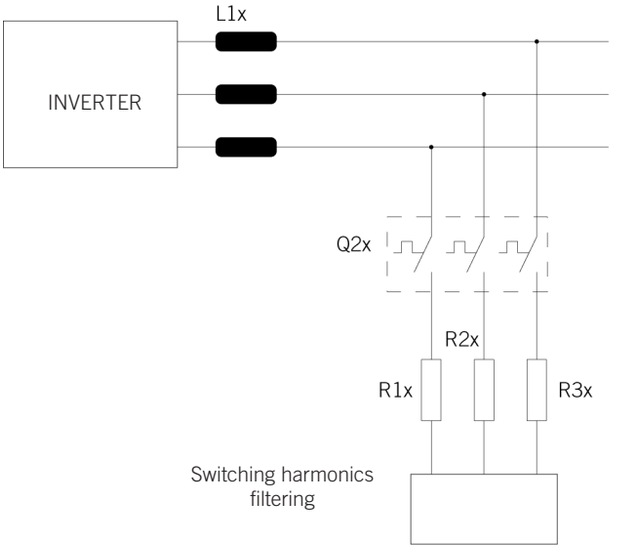
8.4.8. Thermomagnetic Q2

The Q2 thermomagnetic circuit breaker belongs to the switching filter. The way to determine the reason for shutdown of the Q2 thermomagnetic circuit breaker will be by performing the following procedure:

1. Check that the protection in question is turned to maximum. If not the case, calibrate it to the maximum and check operation.

2. If the problem persists, check that the capacitance of the switching harmonics filter in each of the three phases is adequate. Use a multimeter to measure the capacitance between phases and check that all have the same value. If not the case, proceed to replace the filter.

3. If after taking the 3 steps above the problem persists, take note of the unit's serial number and look at what version of firmware it has. If you do not know what version of firmware the equipment has, it will be enough to power the unit with DC and check it through display by: OK ➔Monitoring ➔ Status. The status will show digit coding of the form _letter, whereby the letter indicates the unit's firmware version. Ensure that the firmware version is letter N or later. Once you have all this information, call technical service. on the number on the cable protectors on the bottom of the unit's door.



8.5. Replacing the inverter

The unit's main electronic boards (control board, power board, IGBTs, etc.) are its core element, and they are grouped in a stainless steel cabinet known as the "electronics block".

In case of equipment damage requiring the replacement of this "electronics block", proceed as follows:

The electronics block is a heavy element. We suggest that it be carried by two people or with mechanical assistance.

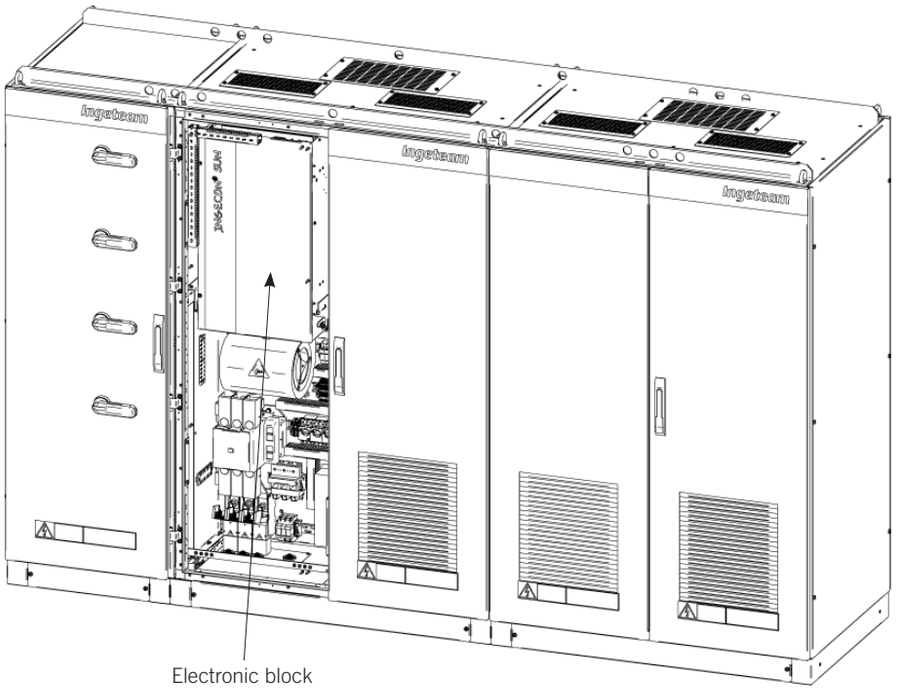
When handling the block, personal protective equipment (PPE) must be worn: helmet, goggles and safety boots.

The tools needed to replace the electronics block are:

- Flat screwdriver for terminal connections.
- Ratchet and spanner 17 (M12) for AC and DC connections.

For supporting the inverter:

- Ratchet 13 (M8) for fixing the inverter.
- Ratchet 7 (M4) for removing the top cover.



Proceed in the following order:

1. Disconnect the unit from the power grid and the PV array.
2. Wait at least 10 minutes for the capacitances to discharge.
3. Check that there are no voltages inside the unit.
4. Disconnect optical fibre cable
5. Unscrew the top cover.
6. Disconnect the "Power cables" at the bottom of the block.
7. Disconnect the wires entering the "Terminal strip" from outside the block.
8. Disconnect communication boards or analogue inputs.
9. Disconnect the display cable.
10. Unscrew the four anchor points or "fastenings".
11. Remove it.

For reassembly, we will perform the same steps in reverse order and finally will need to set the electronic blocks:

1. Mount it.
2. Tighten the fixing screws
3. Disconnect the display cable
4. Connect communication boards or analogue inputs.
5. Connect the wires entering the "Terminal strip" from outside the block.
6. Connect the "Power cables" at the bottom of the block.
7. Screw on the top cover.
8. Connect the optical fibre cable
9. Connecting the unit to the PV array.

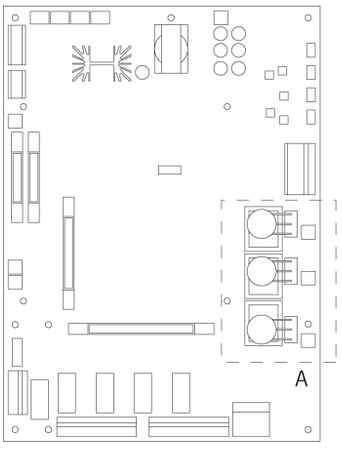
10. Configure the can number.
11. Configure the node number.

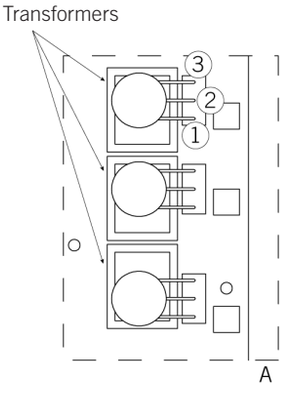
8.6. Replacing varistors in the intake board

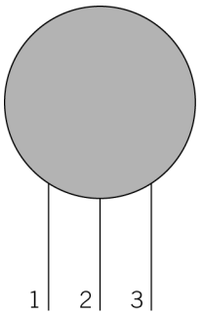
The varistor is connected to the 3-pin connector on pins 1 and 2. Pin 3 is for connecting the thermal fuse.

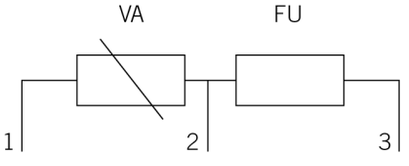
The varistor must be connected as follows:

- Check continuity of the fuse with the varistor outside the board using the tester.
- Place the varistor on the board in position 1-2 varistor, 2-3 fuse.





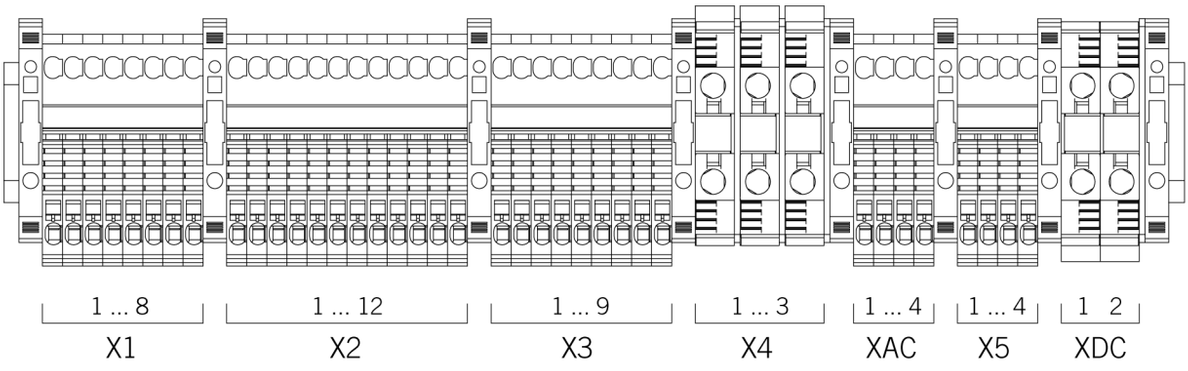




Inserting the varistor back-to-front will destroy it.

8.7. Description of terminal strip

The terminal strip is made up of type ZKS plug-in connectors and type WDU screw-in terminals.



X1 Monitoring signals

X1.1	DC monitoring	X1.5	Monitoring AC thermomagnetic circuit breakers X1.6
X1.2	Thermal monitoring	X1.6	GND
X1.3	Monitoring of contact	X1.7	+15
X1.4	Monitoring of AC arresters	X1.8	+15

X3 Contactor, communications, start-stop

X3.1	Contactor coil 1	X3.8	Start-stop 1
X3.2	Contactor coil 2	X3.9	Start-stop 2

X4 Panel voltage intake

X4.1	- BUS (negative from the PV array)	X4.5	+ BUS (negative from the PV array)
X4.3	Ground		

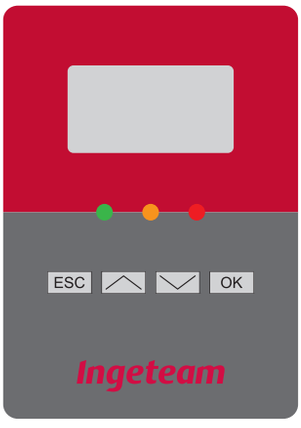
X5 Insulation fault, grid voltage intake, fans

X5.1	NO contact insulation fault/power on	X5.3	AC fans
X5.2	NO contact insulation fault/power on	X5.4	AC fans

XDC Night supply connection

XDC.1	+ night SUPPLY	XDC.2	- night SUPPLY

9. Display control



Ingecon® Sun Power Max inverters incorporate a display and keypad unit to interface with the installer and the user.

This interface allows the display of the main internal parameters and the configuration of the entire system during installation.

Parameters, variables and commands are organised as menus and submenus.

9.1. Keypad and LEDs

The keypad has four keys:

ESC **Esc.** To exit a parameter, leave a menu and returning to the next level up in the structure, to not -confirm a change or not -accept a proposal.

Up. With this key you can scroll up the list of parameters or folders within the same level or increase the value of an editable parameter by one base unit.

Down. With this key you can scroll down the list of parameters or folders within the same level or decrease the value of an editable parameter by one base unit.

OK **OK.** Serves to accept a parameter as valid, to enter a lower level menu in the structure, to confirm a change or accept a suggestion.

The front panel has three LEDs:

Green LED

- Slow flashing: Standby due to low irradiance.
- Fast flashing: Start-up process.
- On: Inverter connected to the grid.

Orange LED

Fast flashing: Alarm set off which does not shut down the inverter.

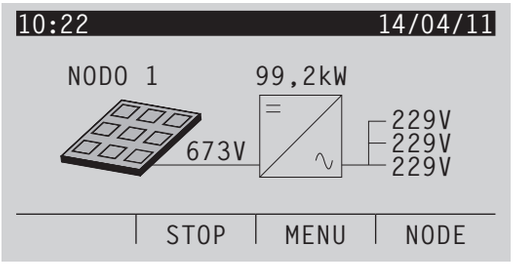
Red LED

On: Alarm set off which shuts down the inverter.

Special combintations

Rapid flashing of all three LEDs: Fatal error status.

9.2. Display



The current date and time on the top line. The internal clock automatically changes the time from summer to winter and vice versa.

The node number for which data is being viewed appears beneath the top line on the left.

The central section provides instantaneous PV array voltage, power fed in by the inverter and output voltages.

The bottom line displays the functions for each of the keys.

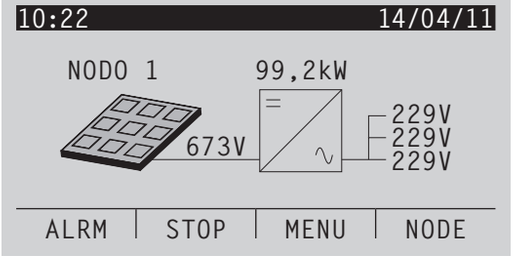
If the inverter is manually shut down, the display will read "STOPPED" instead of displaying the power fed in by the inverter.

In the initial screen, in normal operation, the keypad functions are as follows:

 Manual shutdown.

 Main menu access.

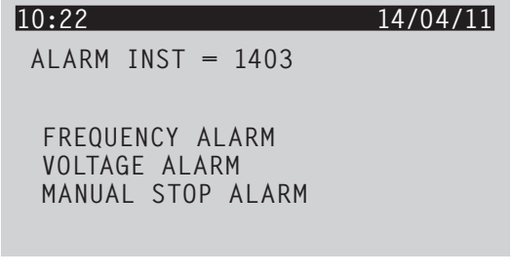
OK Change node.



If there are any active alarms in the inverter, the bottom, empty box will flash "ALRM". By pressing the ESC key,

ESC you can see all the alarms which are active at that moment.

For example:

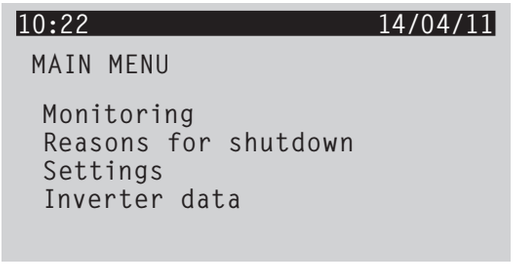


To exit this screen, press ESC again.

9.3. Main menu

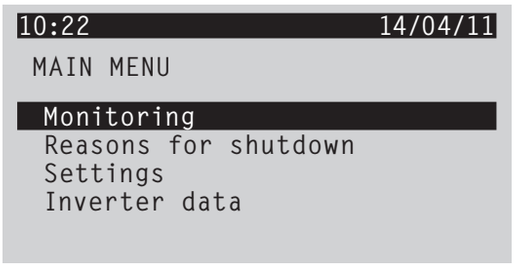
The main menu contains the following submenus:

- Monitoring. This displays the main internal parameters and variables that indicate the operation status of the unit.
- Reasons for shutdown. This option shows the reasons why the inverter was shut down the last five times.
- Settings. This menu displays all the settings that affect the inverter.
- Inverter data. This option offers inverter-specific data.



9.4. Monitoring

This menu is accessed by pressing the OK key in the MONITORING menu.



See below for the structure and interpretation of the variables in this menu:

Screen 1

Pac	Power inverter is delivering into the grid, in kW.
Pdc	Power supplied by solar panels, in kW.
Etot	Total energy in kWh delivered by the inverter to the grid from the date it was manufactured. Recording the serial number of the equipment marks the start of this power log.
ParE:	Total energy in kWh delivered by the inverter to the grid since the last time the counter was reset.

Screen 2

Vdc	Voltage supplied by solar panels to the inverter.
Vac1	Inverter output voltage in phase one of the grid.
Vac2	Inverter output voltage in phase two of the grid.
Vac3	Inverter output voltage in phase three of the grid.

Screen 3

Idc	Current supplied by solar panels to the inverter.
Iac1	Inverter output current in phase one.
Iac2	Inverter output current in phase two.
Iac3	Inverter output current in phase three.

Screen 4

Frec1	Phase one frequency.
Frec2	Phase two frequency.
Frec3	Phase three frequency.
Cos.Phi	Cosine of Phi. Cosine of the phase shift angle between grid voltage and current supplied by the inverter.

Screen 5

Rpv Impedance of the entire PV array to ground.

Rpv+ Impedance of the positive pole of the PV array to ground.

Rpv- Impedance of the negative pole of the PV array to ground.

Screen 6

Alarms Status of inverter alarms.

0000H	No alarms.
0001H	Grid frequency out of range.
0002H	Grid voltage out of range.
0004H	PI current saturation.
0008H	Unexpected reset.
0010H	Continuous overload at output.
0020H	Temperature alarm in the power electronics.
0040H	Hardware fault. Synchronisation fault.
0080H	Instantaneous overload at output.
0100H	AC circuit protection.
0200H	DC circuit protection.
0400H	Insulation fault.
0800H	Power electronics fault.
1000H	Manual shutdown alarm.
2000H	Configuration change alarm.
4000H	Panel input overvoltage.
8000H	Low voltage in the PV array.

Alarm hist. Alarms since the last connection. This value is reset each time the inverter is connected to the grid. It has the same code as the "alarms" variable.

TempInt Inverter power electronics temperature.

TempCL: Inverter control electronics temperature.

Screen 7

Conn.N: Number of grid connections made during all hours of operation.

ParConn.N Number of grid connections since counter was last reset.

ConnT:	Number of hours the inverter has been connected to the grid.
Par.ConnT:	Number of hours the inverter has been connected to the grid since the counter was last reset.

Screen 8

System status This parameter can have three states:

Initial status	In start-up status.
Operational Status	
Error status	

MPPT Power Power injected by the inverter configured as master.

Slave power Power injected by the inverter of the node being measured.

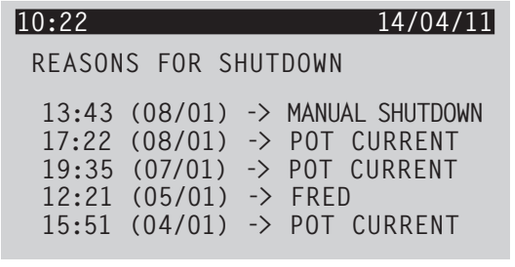
Total Power Power injected by all the inverters configured in this master-slave system.

Screen 9

This screen displays a histogram of the power output from each of the inverters configured in the master-slave system.

9.5. Reasons for shutdown

This menu shows the last five inverter shutdowns, with reasons and corresponding date and time.



Meaning of reasons for shutdown:

MP VIN	High input voltage from the panels.
MP FRED	Incorrect grid frequency.
MP VRED	Incorrect grid voltage.
MP VARISTORES	Varistor fault.
MP AISL.DC	DC insulation fault.
MP INT AC RMS	Continuous overvoltage on AC output.
MP TEMPERATURA	Overtemperature in the power electronics.
MP CONFIG	Shutdown for configuration change.
MP PARO MANUAL	Manual shutdown.
MP B VPV MED	Low input voltage from the panels.
MP HW_DESCX2	Internal fault.
MP IAC INST	Voltage surge on AC output.
MP CR.FIRMWARE	Shutdown due to firmware change.
MP LEC ADC	AD converter (internal) reading fault.
MP CONSUMO POT	Insufficient solar radiation. Does not trigger alarm.
MP FUSIBLE DC	Input fuse fault.
MP TEMP AUX	Redundant temperature sensor fault.
MP PROTECCION AC	AC Protection.
MP MAGNETO AC	Thermomagnetic circuit breaker error.
MP CONTACTOR	Contactor failed to close.
MP RESET_WD	Stopped for Watch Dog reset (internal).
MP LAT ADC	Converter (internal) fault.
MP ERROR FATAL	Fatal error in the inverter.
MP FALLO RAMA1	Power electronics fault.
MP FALLO RAMA2	Power electronics fault.
MP FALLO RAMA3	Power electronics fault.
MP PI CORR SAT	PI current saturation (internal).
MP LATENCIA SPI	Communication fault with redundant system.
MP REDUNDANTE	The redundant system has caused a shutdown.
MP PROTECCIÓN PIB	The PIB has caused a shutdown.

9.6. Settings

Date and Time

From this menu you can change the date and time. The internal clock automatically changes the time from summer to winter and vice versa.

Inverter number

From this menu you can assign the node number to the inverter. This is required for configuring communications.

Language

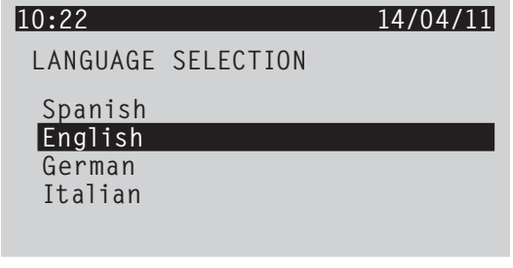
With this option, you can select the display language.

In the main screen, press the "down" key (an arrow pointing downwards). Main menu access.

From the main menu, by pressing the ^ or v keys or navigating through the menu to “SETTINGS". Once highlighted, press OK to access the submenu.

Within the “SETTINGS" submenu with the ^ or v keys or navigating through the menu to the “Language” option. Once highlighted, press OK to access the language change screen.

From the "Language” screen, which looks as follows:



Press the v button to scroll down the various languages.

Grid limits

In this menu, you can change the grid quality parameters. This menu is only active after the security code has been input.

Ground connection

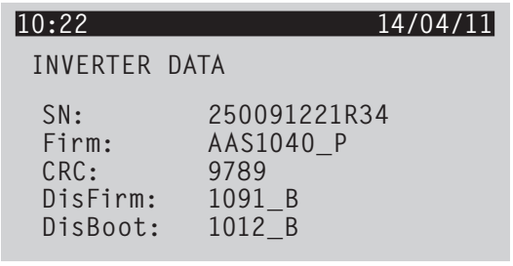
Through this option, you can change the type of grounding for the PV array. This menu is only active after the security code has been input.

Connection time

This menu allows you to modify the delay before the inverter connects to the grid. This menu is only active after the security code has been input.

Total reset

With this option, the user can reset all inverter counters. This menu is only active after the security code has been input.



Other adjustments

Various internal adjustments.

CAN Num Change

From this menu you can change the inverter's node number. This is needed for configuring the inverters. Because this action involves hardware-altering operations, instructions for changing the node number are given at the unit's set point.

9.7. Inverter data

This window displays inverter-specific data:

Serial Number (SN)	Number that identifies the inverter.
Firmware Version (Firm)	Shows the name and version of the inverter firmware.
Display firmware version (DisFirm)	Shows the name and version of the inverter display.
Boot version of the display (DisBoot)	Shows the name and version of the display Boot.

9.8. Change inverter number

From this menu you can assign the inverter a number. This is required for configuring communications.

With keys ⌃ and ⌄ you can change the inverter number. Press OK to confirm the number selected.

Notes

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09/2011

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