Technical Guide for Installation, Commissioning, Use and Maintenance

sinepower

SINEGPU | SINESFC
30, 45, 60 & 90kVA

SAVE THESE IMPORTANT SAFETY INSTRUCTIONS

This manual contains important instructions that should be followed during installation, start up and maintenance of the equipment. Installers, operators and maintenance personnel should be thoroughly familiar with its contents and refer to it when necessary. If additional maintenance or installation assistance is needed, contact our service department at +351 234946000 or technical@sinepower.com.

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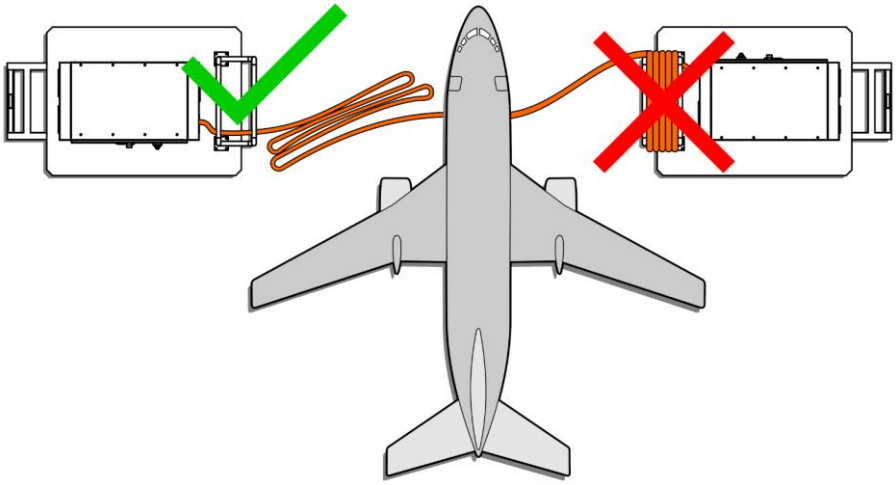
CAUTION

IMPROPER INSTALLATION AND MAINTENANCE COULD CAUSE SYSTEM DAMAGE AND VOID THE WARRANTY. PLEASE SAVE THESE INSTRUCTIONS AND KEEP THIS TECHNICAL GUIDE IN A SAFE PLACE FOR FUTURE REFERENCE.

1. Safety instructions

- Print this technical guide and place it next to the equipment;
- Follow local electricity rules and regulations, as relevant;
- Use PPE's for installation, commissioning and maintenance;
- Electrical, magnetic, dynamic parts and hot parts are the four main risks present in the equipment;
- This equipment is suitable for mounting on concrete or other non-combustible surfaces only;
- Since there are heat losses in the equipment, care must be taken in providing the correct ventilation or air-conditioning for the room when the equipment is going to be installed indoors;
- Do not use the equipment under adverse climatic conditions;
- Do not open the covers in the rain or snow;
- This equipment can only be used under the operating conditions specified on Environmental conditions;
- Do not operate the equipment if any physical defect detected such as, broken or damaged component mechanical or electrical, or other damage are observed. In this case contact your dealer;
- Unauthorised modifications or conversions are not permitted;
- Do not remove any warning label, specification plate or cable markings;
- If the equipment emits an unusual noise, switch off the input circuit breaker, shut down mains supply and proceed to a detailed visual inspection;
- Use only spare parts provided or recommended by the manufacturer;
- Use only fuses of the same caliber as those installed and slow type;
- Never touch live parts, hazardous voltages may exist that can cause dead;
- Never touch hot magnetic parts, they can cause severe burns;
- Always let the capacitors discharge before any type of intervention;
- Always let the equipment cool down before any type of intervention;
- Always check the output cable and contact terminals for damage and contamination before use;
- Never use output or input cables if they are damage;
- Never use dirty or wet contact terminals;
- Be careful with the cables and connectors, avoid stepping on them;
- The manufacturer cannot be held responsible for any injuries or damage resulting from improper use;
- If the equipment is to be mounted on a trailer, the trailer velocity shall not be high. Excessive vibration can damage components or cause mechanical breakage. The manufacturer is not responsible for damage caused by excessive vibration;
- Use the Annex VI – , for control and tracking of all interventions on this equipment;
- If using equipment with a cable winder/cable support, never operate the equipment with the cables wound on the winder/cable support. Always unwind the cable completely and lay it out on the ground. There is a risk of overheating, Figure Figure 1



- ***Figure 1 –*** *Unwind the cable before operating the equipment.*

Note: This is a product containing electronic components. At the end of its life-cycle it cannot be disposed of as urban waste. Please follow the Directive 2012/19/EC and redirect to a collection centre for special and differentiated waste or to a distributor that provides the service.

2. Product description

This equipment (Figure2) guarantees a supply free of disturbances and of high quality with maximum reliability. The use of high frequency PWM ensures exceptional performance and extremely quiet operation. A 4 quadrant Power Factor Corrected RECTIFIER guarantees lower input currents, reduced harmonics, THD<5% and the capability to handle any type of load including regenerative ones. The advantages of this technology are:

- Fast response to load changes;
- Quiet operation;
- Reduction in size and weight;
- High efficiency;
- Short circuit protection.

The equipment comprises the following:

- Input circuit breaker;
- Input EMI filter;
- Input contactor;
- Input chokes;
- Rectifier (IGBT);
- Inverter (IGBT);
- Inverter chokes;
- Galvanic isolation transformer;
- Output EMI filter;
- Output contactor.

Figure 2 – *Generic equipment diagram*

3. Information data

Name: Sinepower, Lda.

Address: Zona Industrial de Mamodeiro Rua Augusto Marques Branco, Lote 21-A, 3810-783, Aveiro, Portugal

Catalogue name/number: **SINEGPU-90KVA**

Electrical ratings:

- input voltage = **480 VAC ±10%**

- input current = **132 AAC**
- output voltage = **200 VAC**
- output current = **260 AAC**
- power rating = **90kVA**
- number of input phases = **3 Phase 3 wire + PE**
- number of output phases = **3 Phase 4 wire1**
- input nominal frequency range = **50/60 Hz**
- output nominal frequency = **400Hz**
- protective class **I**

Others characteristics:

- Type of electrical supply system to which the equipment may be connected: **TNC, TNS, TNCS, TT and IT**
- Prospective short circuit current rating by **electronic current limiting**
- Output short circuit current **by electronic**
- IP rating for enclosure: **IP54**
- Operating storage environment **-40ºC ~ +40ºC**

Standard reference(s):

AVIATION

- ISO 6858 Aircraft ground support electric supplies
- SAE ARP5015 Ground equipment – 400Hz Ground Power Performance Requirements

MILITARY

- MIL-STD-704 Aircraft electric power characteristics;

EMC

- EN 61000-6-4 Generic emission standard;
- EN 61000-6-2 Generic immunity standard;

SAFETY

- IEC 62477-1 Safety requirements for power electronic converter systems and equipment;
- IEC 60529 Degrees of protection provided by enclosures (IP).

For equipment Test Report data see Annex I – **Declaration of Conformity**.

4. Installation

CAUTION

IMPROPER INSTALLATION AND MAINTENANCE

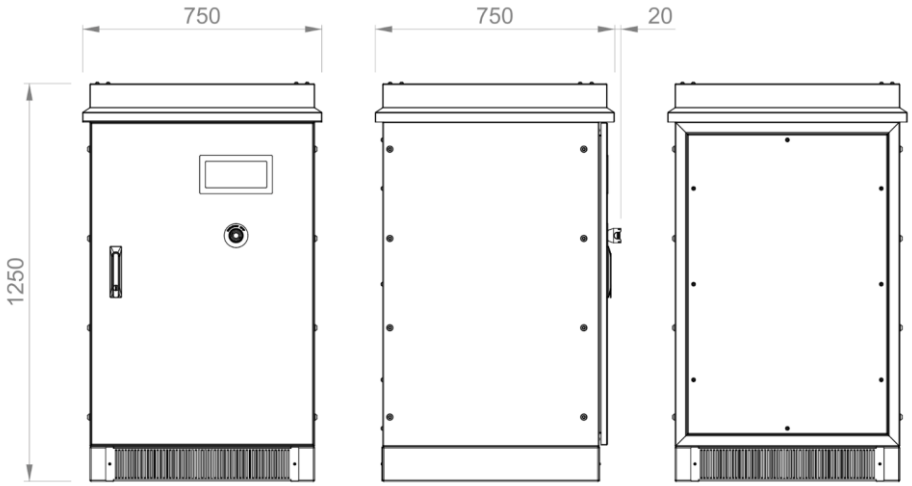
COULD CAUSE SYSTEM DAMAGE AND VOID THE WARRANTY.

Note: Since these operating instructions cover several models, the characteristics and technical drawings of your equipment may differ slightly from those described in this technical guide. If in doubt, contact your supplier or the equipment manufacturer technical department.

Observe any external damage to the crate during transport. If any, follow the procedures to activate insurances, take pictures and request a signed declaration from the forwarder confirming the damage. If possible, unpack the unit and observe and document any damage in the presence of the forwarder or representative. Needed equipment:

- PPE's required;
- Tools: shaft nut spinner set, allen key set; two open-ended spanner key set, screwdriver set, driller and drill bit set;
- Measuring instruments: Multimeter 400Hz and Scope (optional);

[1]If dual output equipment the output is split in 2×3 Phase 4 wire



- Forklift;
- Crane (load lifting straps 4 lifting eye and 1 steel ring).

Recommendations:

- Since there are heat losses in the equipment, care must be taken in providing the correct ventilation or air-conditioning for the room when the equipment is going to be installed indoors;
- Don't obstruct equipment airflow inlet and outlets;
- Allow at least 50 cm side and rear clearance, more if available;
- Allow 60 cm top clearance for ventilation and fan maintenance;
- Allow at least 100 cm front clearance for easy access;
- Remember that this type of equipment is a heat source, additional room cooling may be required when used indoors;
- Run AC cables in the same conduit, or in close proximity if using cable trays;
- Do not run Alarm and Signal wiring in close proximity to the AC cables;
- Verify that all equipment breakers are open (OFF);
- Remove the gland plate from the equipment;
- Punch or drill appropriate conduit holes in gland plate;
- Do not allow metal shavings to enter the equipment;
- Run conduits and install cable glands (see Figure 21, 22 and the example in Annex I**II – Gland Plate**);
- For three-phase connections, proper phase rotation is important. The phase connections are marked: ØL1, ØL2, ØL3 and N. Phase rotation must be A-B-C respectively;
- A proper earth cable must be connected to the Safety Earth Terminal according to wiring rules. The earth current in normal operation can be in excess of 100mA;

4.1 Weight and dimensions

Weight ≈ 500kg (90KVA)

Equipment dimensions *(mm)*

Power Rating	Enclosure	Width	Depth	Height	IP
30kVA – 90kVA	650	750	770	1250	Up to IP54
30kVA – 90kVA	H650	1220	725	705	Up to IP54

Table 1 – *Enclosures*

Figure 3 – *Enclosure 650*

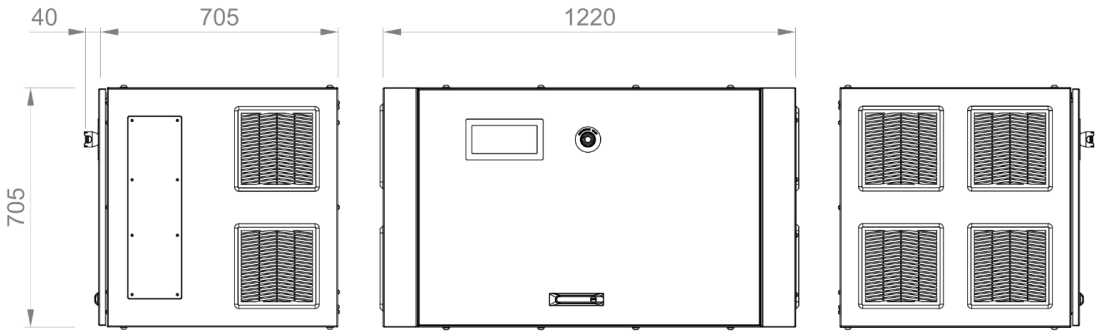


Figure 4 – *Enclosure H650*

4.2 Environmental and Storage conditions

Service conditions for operation, storage and transportation:

- Operating temperature (min/max): -40ºC[2] to +40ºC;
- Relative humidity (min/max): 0% ~ 90% without condensation;
- Pollution degree 2;
- UV resistance;
- Overvoltage Category: OVC 3;
- Altitude up to 2000m.

If the equipment system is to be in storage for an extended period of time, either prior to installation, or after installation, some storage procedures are necessary:

Storage Procedures (prior to instalation):

If the equipament is to be in storage prior to installation, observe the following:

- The equipment must be stored indoors in a dry controlled environment of 0-40ºC;
- Mantain the original packing.

Storage Procedures (after to instalation):

If the equipment system is to be in storage after installation, observe the following:

- Shut down the equipament following the procedures in this manual;
- Verify that all circuit breakers are off.

[2]With heater (optional)

4.3 Unpacking, moving and lifting

DANGER

HEAVY LOAD RISK OF SHOCK WITH OBJECTS, ENTRAPMENT AND CRUSH

Forklift needed to unload the equipment from the transport vehicle, driven by a qualified personnel for the job. Follow the safety measures Figure 5:

- Insert forks under the entire wooden pallet;
- Secure the package to the forklift with a safety strap;
- Drive carefully avoiding sudden movements.

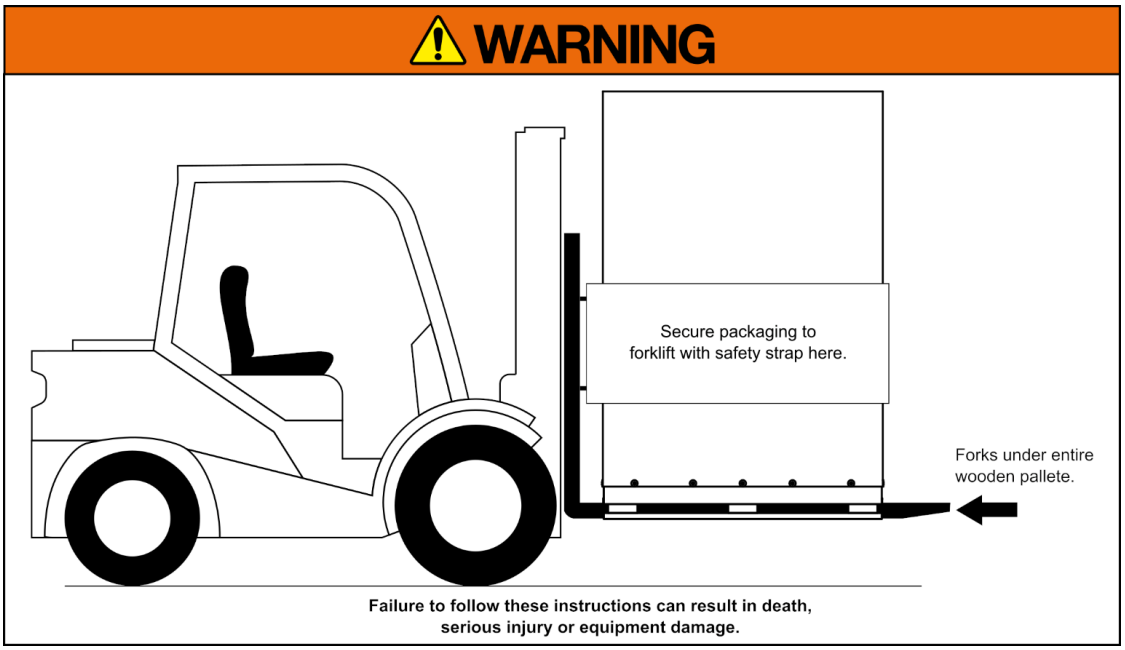


Figure 5 – *Unload equipment*

4.3.1 Unpacking

- **Plywood Packaging:** remove the screws that hold the box to the wooden pallet, then carefully remove the plywood box. Two persons needed. Remove the rest of the protective material by hand (Figure 6);

Cellophane Packaging: remove the cellophane layer by hand;

- For vertical equipment, with a allen key remove the bottom grids placed in the front and back of the equipment, with one open-ended spanner key and one ratchet size 17, remove the 4 screws that hold the equipment to the wooden pallet (Figure 7);
- For horizontal equipment, with a spanner key or a ratchet size 17, remove the 8 screws that hold the equipment to the wooden pallet (Figure 8).

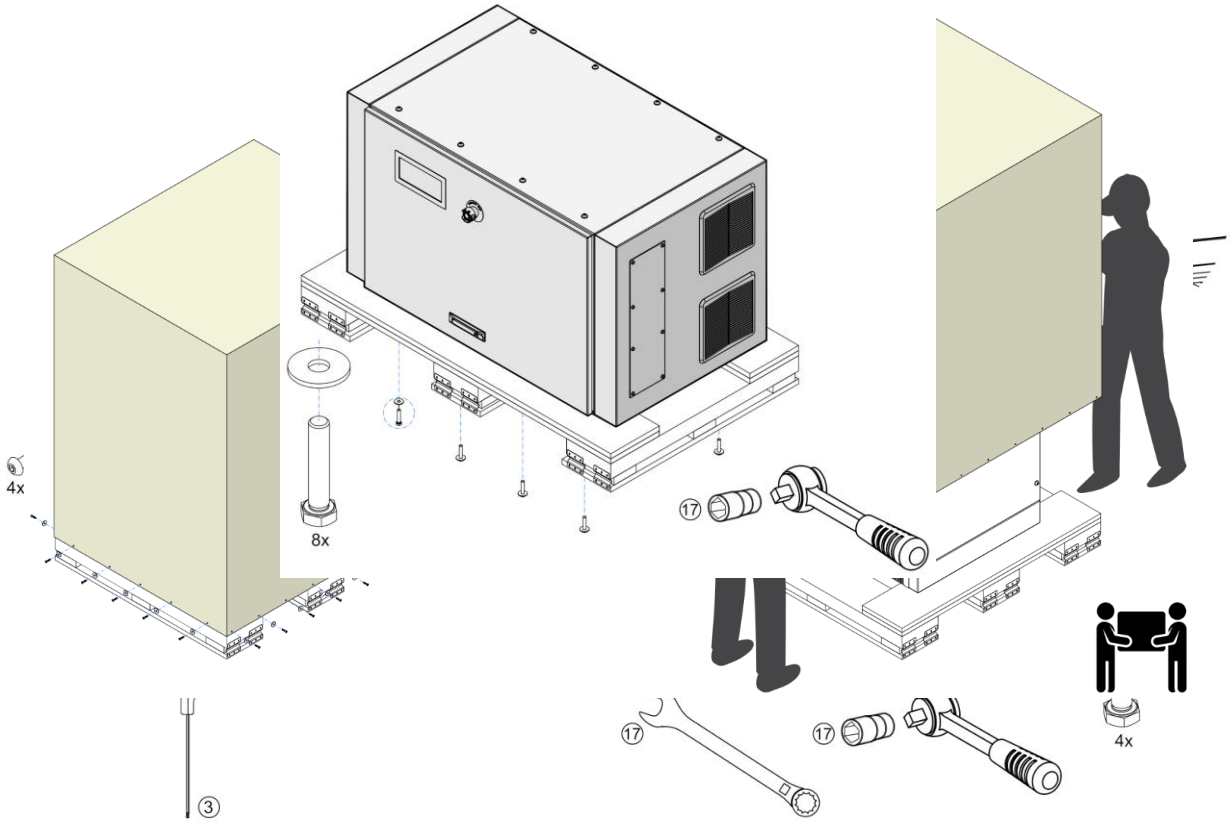


Figure 6 – *Remove Plywood*

Figure 7 – *Remove screws form wooden pallet (vertical equipment)*

Figure 8 – *Remove screws form wooden pallet (horizontal equipment)*

Note: The use of scissor or x-act is not recommended, paint damage can occur!

4.3.2 Lifting and Moving

- Follow the steps below for lifting and moving:
  - If a **forklift is** available (only vertical equipment):
    - Place the forks for lifting as show in Figure 9. Insert the forks under the unit from one side to the other to support the entire base;
    - Install the equipment in an adequate location (see content 4.5);

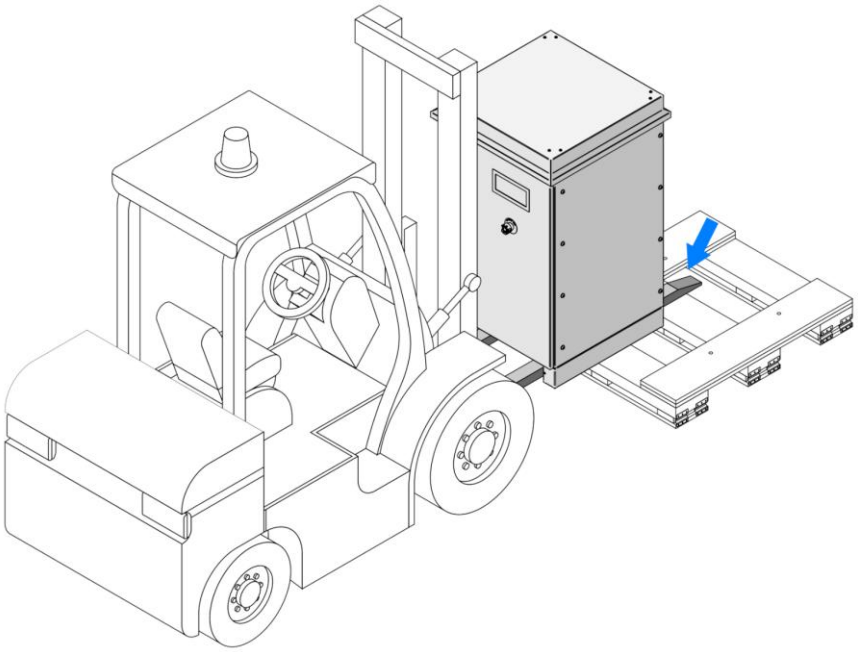
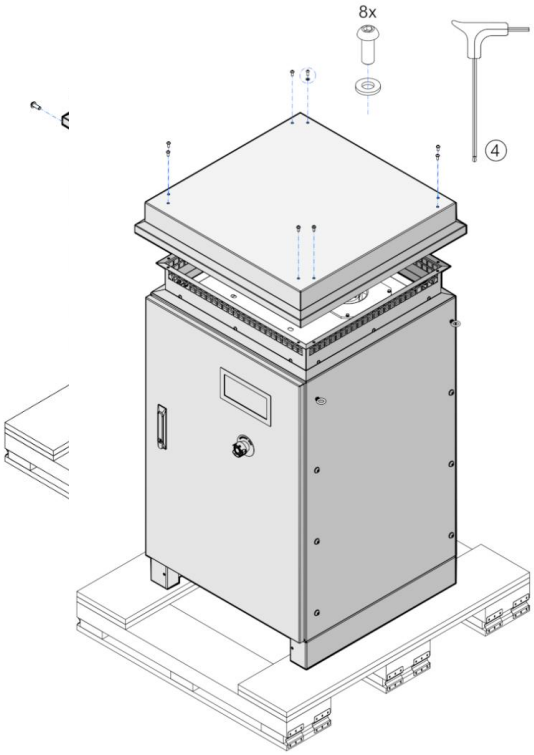
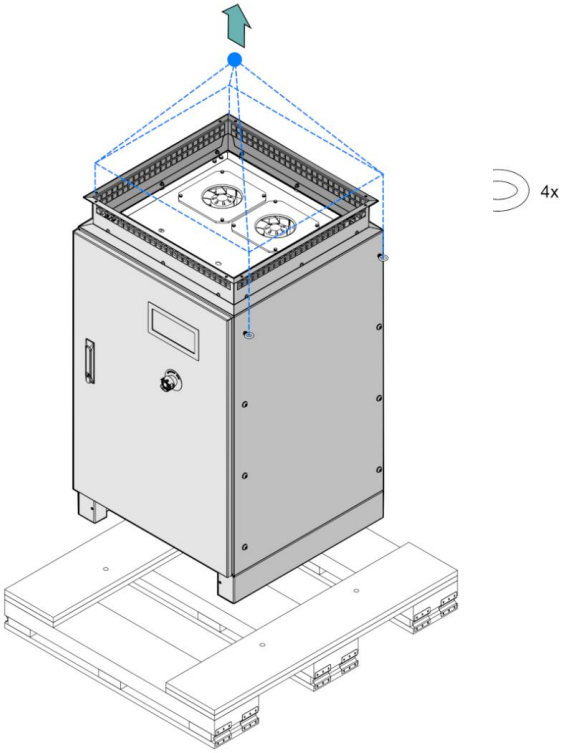


Figure 9 – *Remove enclosure form wooden pallet*

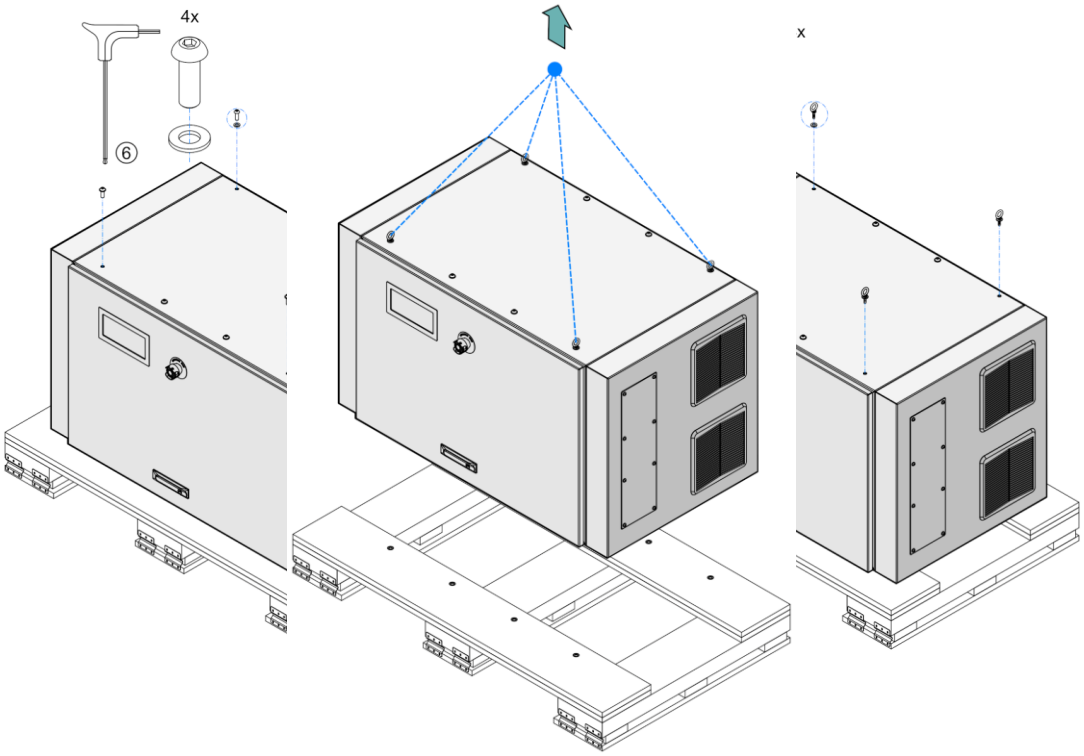




- If a **crane** is available (vertical equipment):
  - Replace the 4 top screws of each side with the 4 lifting eyes supplied separately. Use the nylon washer (Figure 10)
  - With a allen key, remove the top (Figure 11);
  - Use a strap harness to lift the equipment with a crane (Figure 11);
  - Install the equipment in an adequate location (see content 4.5);
  - After confirming the equipment is adequately in place remove the eye lifts and replace them with the nylon washers;
  - Put the top back in place and screw back in the 8 top screws.

Figure 10 – *Replace the top for screws for lifting eyes*

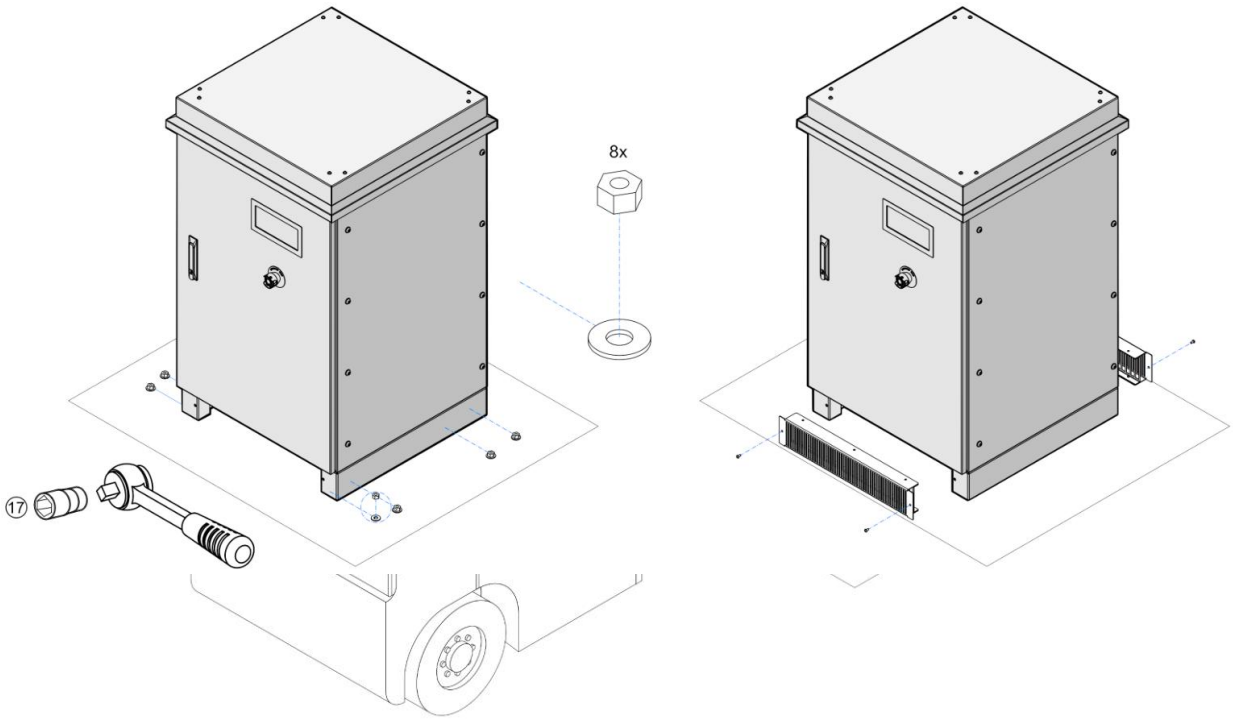
Figure 11 – *Remove top and apply strap harness to lift*



- A **crane is** needed to lift and move:
  - Replace the 4 screws with the 4 lifting eyes supplied separately. Use the nylon washer (Figure 12)
  - Use a strap harness to lift the equipment with a crane (Figure 13);
  - Install the equipment in an adequate location (see content 4.5);

Figure 12 – *Replace the top for screws for lifting eyes*

Figure 13 – *Apply strap harness to lift*



4.4 Packing

For a higher degree of protection of the equipment during transport we recommend Plywood packing Standard cellophane packaging is an option too though it offers less protection for the equipment during transport. All equipment are fixed to a wooden pallets and Warning labels shall be part of the package containing the following information:

- Manufacturer's name or trademark;
- Catalogue number;
- Mass (SI units)
- Handling requirements; “This side up”, “Fragile”, Handle with care” and “Do not stack” symbols must be at the package.

4.5 Strength and rigidity of mounting surface and fastening

Keep in mind the strength and rigidity of mounting surface, it must be able to support the equipment weight.

For standard asphalt or concrete based mounting surfaces:

Fastening: use the drawing in Annex IV – Ground fixture drawing, for reference on positioning of the anchor fixing points. When positioning the equipment for installation, take into account the clearance around it, see Annex – Clea . Drill holes in the mounting surface and insert the anchors in them. Align the unit with the holes and connect the unit to the mounting surface (Figure 14 to Figure 16). Finish by tightening the respective nuts and placing the grids previously removed.

Figure 14 – *Mark concrete following drawing (Annex IV – Ground fixture drawing), drill and apply mechanical anchor*

Figure 15 – *Install equipment*

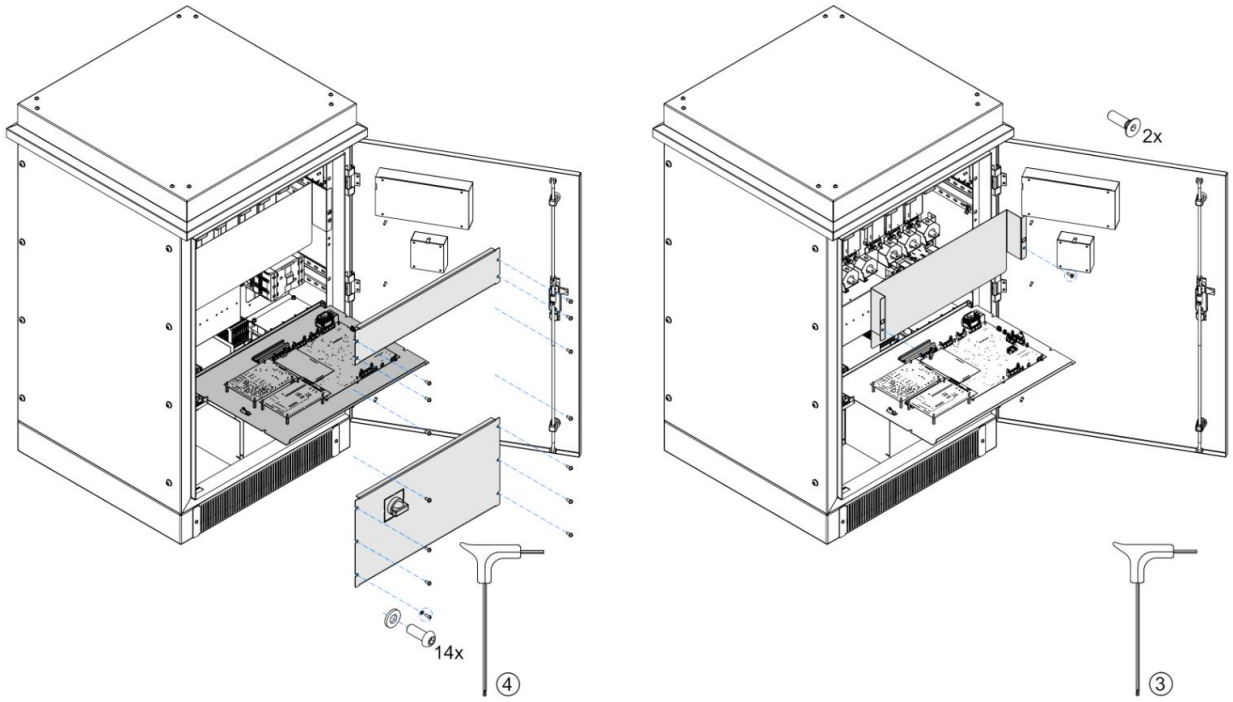
Figure 16 – *Fix equipment and replace grids*

4.6 Access for operation, adjustment and maintenance

WARNING

DOOR ON HORIZONTAL VERSION IS EQUIPPED WITH GAS SPRINGS.

STAND CLEAR AFTER UNLOCKING THE DOOR. DOOR MAY OPEN FAST.



For normal operation the unit must not be open. For adjustment and maintenance open the front door and remove front panels, with the due care for personal protection. Fatal voltages may be present connected to mains power. Rear cover shall be removed for commissioning, installation, maintenance or cleaning proposes only after power is disconnected at the Input circuit breaker (Figure 17 to 20). **Important: All electronics adjustments made when the equipment is energized have to be done with the IGBT protection in place and with proper PPE.**

Figure 17 – *Remove front panels and IGBT protection (vertical equipment)*

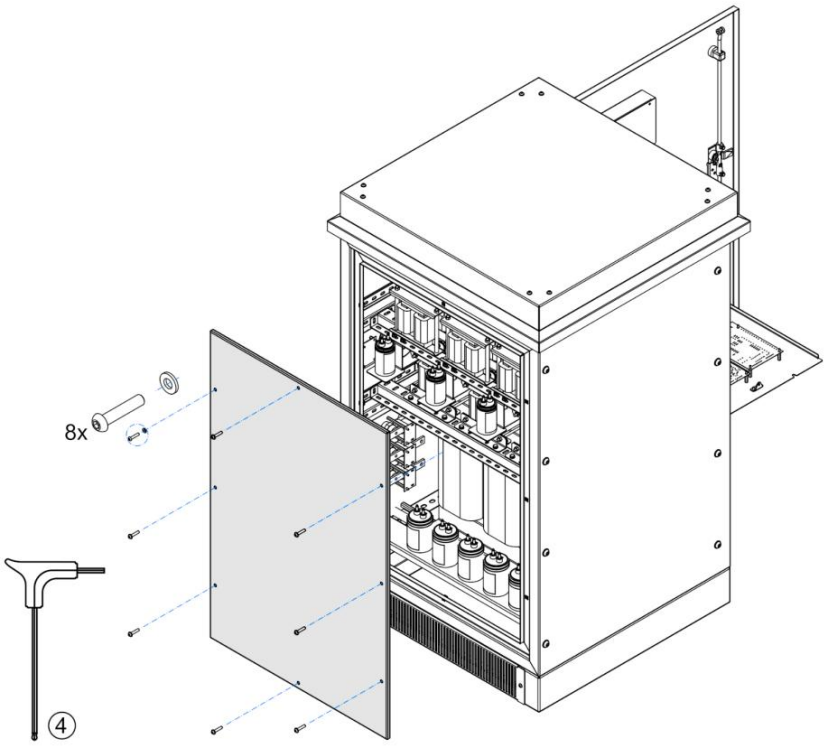


Figure 18 – *Remove rear cover (vertical equipment)*

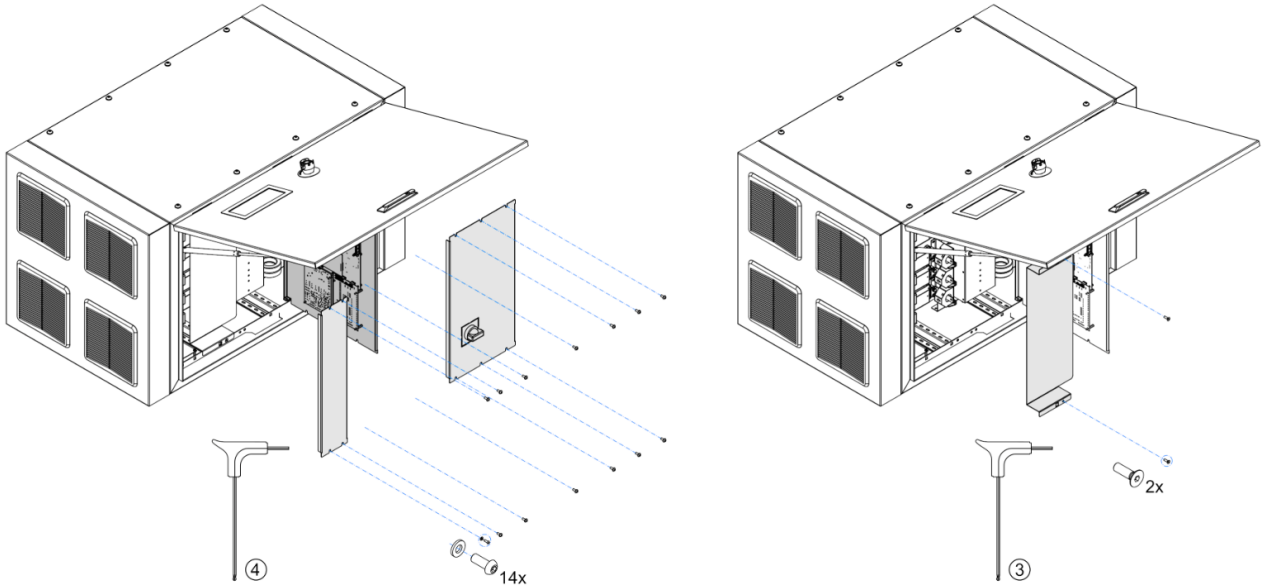


Figure 19 – *Remove front panels and IGBT protection (horizontal equipment)*

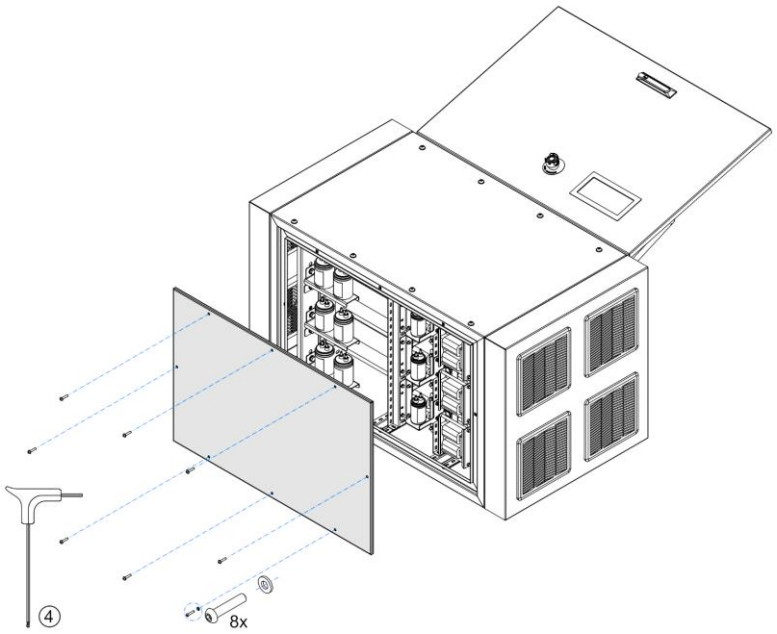


Figure 20 *– Remove rear cover (horizontal equipment)*

4.7 Connecting the equipment

WARNING

OPENING THE GPU CABINET BY UNAUTHORIZED PERSONNEL IS NOT RECOMMENDED! ONLY COMPETENT PERSONNEL AWARE OF ELECTRICAL HAZARDS SHOULD BE ALLOWED TO OPEN OR SERVICE THE GPU SYSTEM.

DANGER

THIS EQUIPMENT CONTAINS HAZARDOUS VOLTAGES THAT CAN CAUSE FATAL SHOCK AND SEVERE BURNS.

HAZARDOUS VOLTAGES MAY EXIST EVEN WHEN POWER HAS BEEN REMOVED FROM THE GPU SYSTEM.

4.7.1 Cable selection and terminals

The equipment wiring diagram is available in Annex VII **– Equipment Wiring Diagram**, for consultation. For the selection of the cables cross-section and using the IEC 60364-5-52 standard, refer to table B.52.12 in Annex I **– C** , if the cable is XLPE or EPR insulated. Use the correction factor for 40ºC from table B.52.14 in the same annex. See Table 23 for current and terminals info. The values shown refer to 3 phase input and output standard equipment with 400 VAC input voltage and 200 VAC output voltage. Recalculate current values if input/output voltages are different. See Figure 21 and 22 for input and output connections.

Equipment Power Rating (kW)	Input Max Current[4] (AAC)	Input MCB (A)	Input Terminals	Output Max Current (AAC)	Output Terminals
30[5]	53	63	Ring M8	87	Ring M8
45	79	80	Ring M8	130	Ring M8
60	106	125	Ring M8	173	Ring M10
90	159	160	Ring M8	260	Ring M12

Table 2 – *Currents and terminals*

4.7.2 Protective Earth Cable selection recommend

Use a M8 ring terminal for PE connection. The minimum protective earth cable section where, S_{PE}=earth cable section and S_{PHASE} = phase cable section, should be:

- If $S_{PHASE} \leq$ 16mm2, $\mathbf{S_{PE}=S_{PHASE}}$
- If 16mm2 < $S_{PHASE} \leq$ 35mm2, $\mathbf{S_{PE}=16mm2}$
- If S_{PHASE} > 35mm2, $S_{PE}=$ $\mathbf{S_{PHASE}/2}$

4.7.3 Protection

The input circuit breaker feeding the equipment should be of at least the same rating, not exceeding 125% and of the same type as the equipment breaker in the equipment. Table 3 shows different circuit breakers recommend for the different power rating equipment:

POWER	TYPE	RATING	BREAKING CAPACITY
30kVA	3 POLE	63A	50KA
45kVA	3 POLE	80A	50KA
60kVA	3 POLE	125A	50KA
90kVA	3 POLE	160A	50KA

Table 3 – *Input MCB type and Rating*

NOTE: For glands installation see Annex I**II – Gland Plate** as example.

[3]**The protective device, the Output switch/contactor as well as cable selection may vary from equipment to equipment due to its characteristics. The manufacture is not responsible for a wrongly calculated electrical installation. In case of doubt contact the equipment supplier or/and use the local electrical rules.**

[4]At rated power.

[5]Only available for GPU equipments.

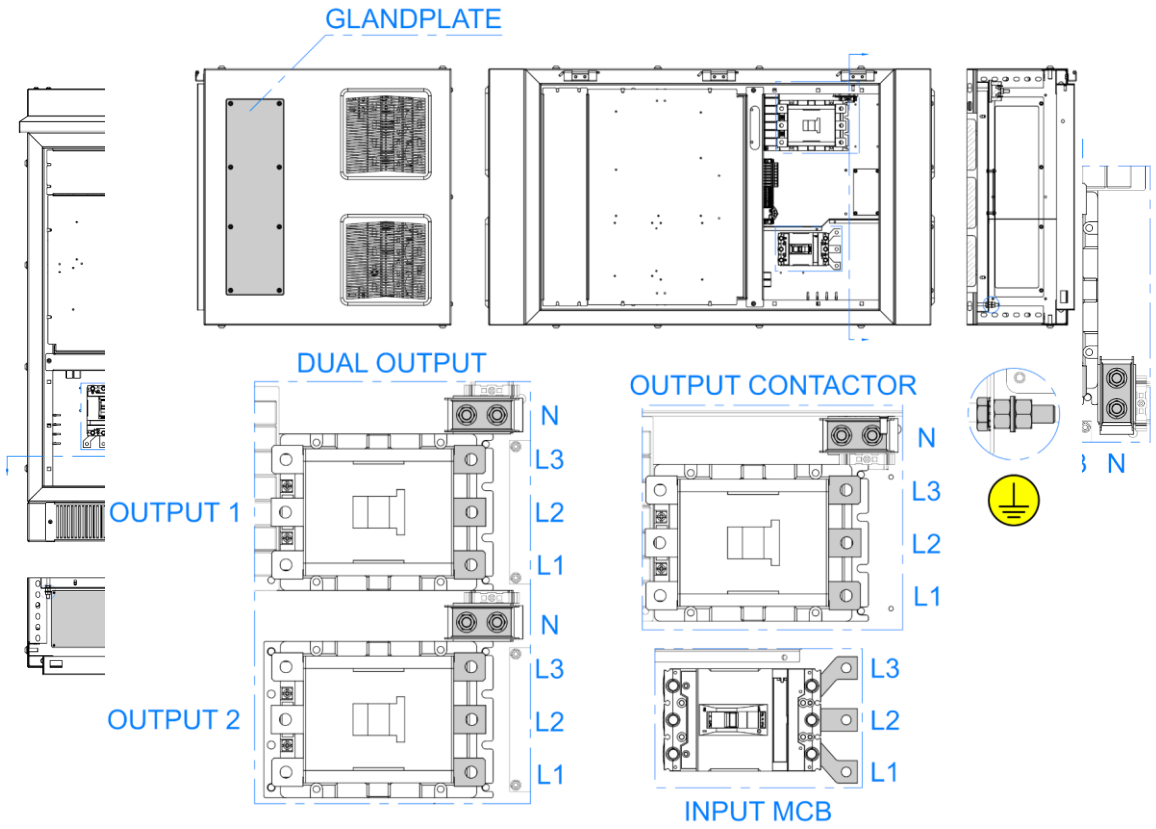


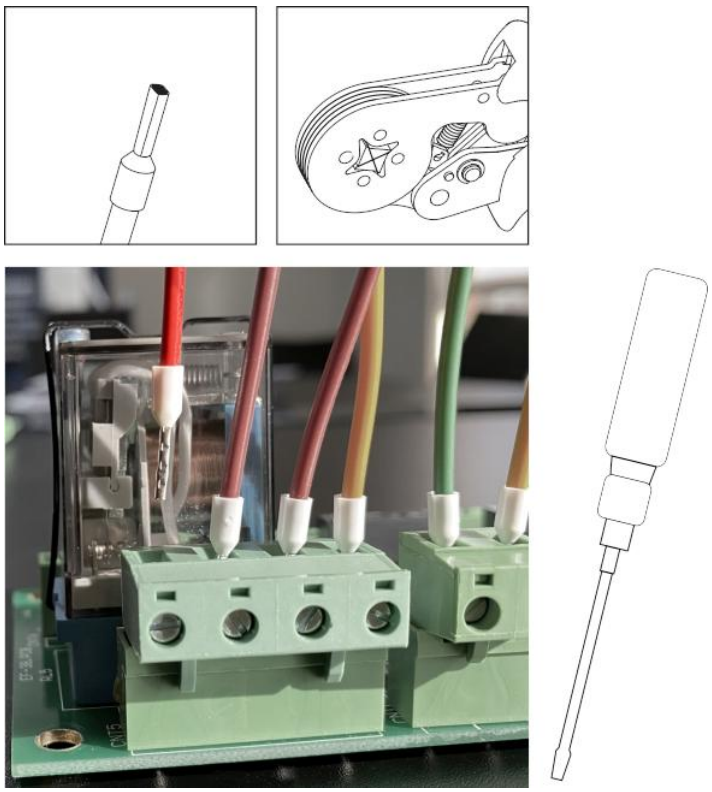
Figure 21 – *Terminals (vertical equipment)*

Figure 22 – *Terminals (horizontal equipment)*

4.7.4 EF interlock6, micro-switch and remote feedback for GPU equipment

See Annex VII **– Equipment Wiring Diagram**, for connections and Annex II **– Components**, for PCB MVA EF location (18). Eight signal wires needed, normally identified with small tags by the aircraft socket supplier: E, F, us1, us2, L1(A), L2(B), L3(C) and N.

[6]ISO 6858 – 7.2.2 Interlock signal characteristics



Use crimping pliers for ferrule terminal

EF interlock (Figure 23):

- connect E and F signal wires in the empty positions of CNT.2 of PCB MVA EF;
- use ferrule terminal and make **proper correspondence with pcb serigraphy**;
- Leave N wire connected as it is.

Note: If the aircraft socket doesn't have this function leave the connector like it is.

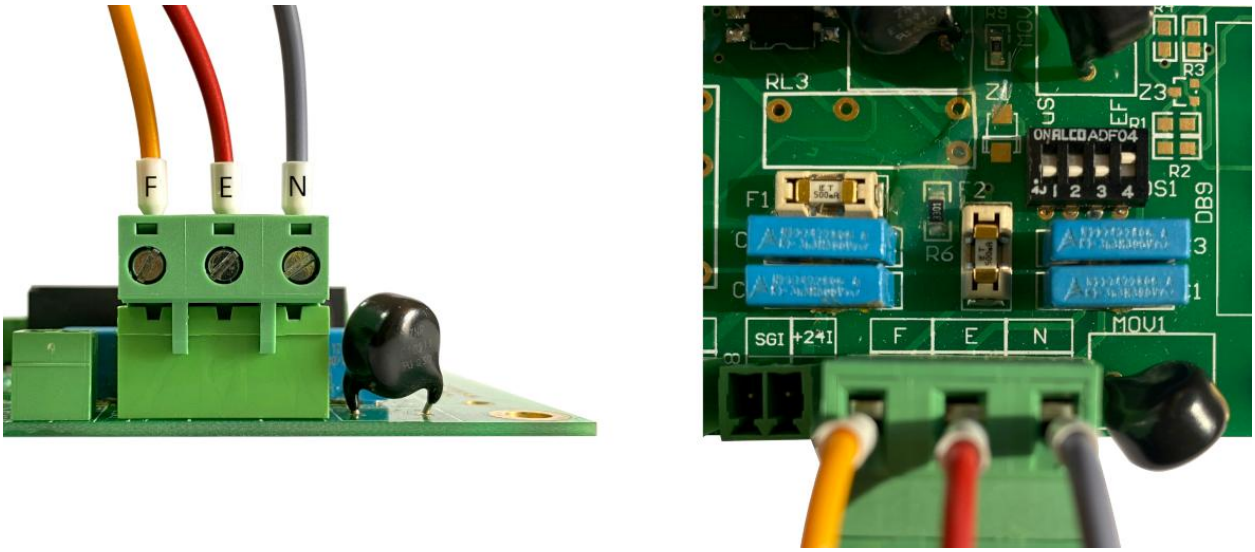


Figure 23 – *EF Interlock (colours are exemplary)*

Micro-switch function (RECOMMENDED) Figure 24:

- connect us1 and us2 in the connector supplied, position is indifferent;
- use ferrule terminal;
- connect to CNT-1 of PCB MVA EF;
- the equipment can work automatically.

Note: If the aircraft socket doesn't have this function leave this connector empty.

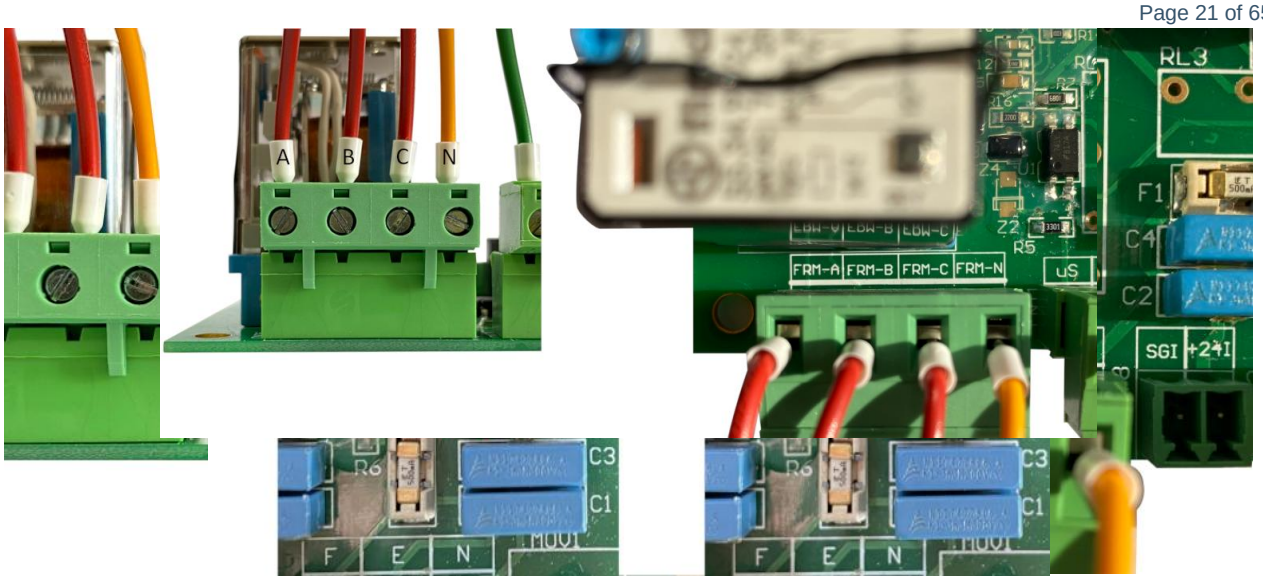


Figure 24 – *Micro-switch function (colours are exemplary)*

Note: If there is no micro-switch available on the aircraft socket proceed the following way:

- on DS1 of PCB MVA EF switch pin1 to pin 8. Figure 25;
- After turn on the equipment on the display go to: MENU select ADJ then AUTO START and change to OFF mode;
- the equipment will work manually.

Figure 25 – *Micro-switch function*

IMPORTANT NOTICE: The micro-switch function is optional when buying the aircraft socket, we highly recommend choosing sockets with micro switch enabled to avoid problems such as sparks when removing the connector from the aircraft plug. To close the output contactor, the GPU needs 90% of the socket fitted into the aircraft plug.

Remote feedback Figure 26:

- carefully pull CNT-5, insulate it and leave it unplugged;
- connect 4 signal wires 3 phases + Neutral in the connector supplied;
- use ferrule terminal and make **proper correspondence with pcb serigraphy** FRM-A = L1(A), FRM-B = L2(B), FRM-C= L3(C), FRM-N = N;
- connect on CNT-5 of PCB MVA EF.

Note: If the aircraft socket doesn't have this function leave this connector empty.

Figure 26 – *Remote Feedback (colours are exemplary)*

4.7.5 Accessible parts and circuits

When back cover and front panels are removed, several circuits with DVC (Decisive Voltage Class) greater than class A become exposed. The equipment must only be energized when all covers and panels are in place. Removing warning labels is prohibited.

4.7.6 Touch current

PE terminal identified and placed near de input. The minimum size of the PE conductor shall comply with the local safety regulations.

5. Commissioning

WARNING

OPENING THE GPU CABINET BY UNAUTHORIZED PERSONNEL IS NOT RECOMMENDED! ONLY COMPETENT PERSONNEL AWARE OF ELECTRICAL HAZARDS SHOULD BE ALLOWED TO OPEN OR SERVICE THE EQUIPMENT.

The following procedures should be implemented immediately after receiving units shipped from the manufacturer.

5.1 Preliminary checks

- Observe for any external damage to the crate that may have occurred during transport.
- With an Allen key remove all covers and panels of the equipment and do a thorough inspection:
  - Check that all components are in the correct position;
  - Check for loose wires, power and signal;
  - Inspect if all connectors are well connected and Inspect the quality of crimps and terminals by pulling with moderate force;
  - For all power cable connections check the verification marks blue and red, they should be aligned if not, tight them with proper torque;
- If OK, put all covers, panels, screws and washers back in place.

Note: If any wire or component is found disconnected or misplaced, consult the wiring diagram for its correct placement or contact the manufacturer.

5.2 Powering the Unit

- Connect mains to the input terminals, making sure the voltages are according to the equipment specifications;
- Confirm the IGBT protection is in place before switching on the input circuit breaker, see Figure 17 or 19 for location;
- Switch on input circuit breaker and check DC voltage on RCT page of the display. The voltage must be around 550 VDC if the input voltage is 400 VAC;
- Start the equipment by pressing ON/OFF button. Measure the output voltages, Phase to Neutral and Phase to Phase, making sure it is according to the equipment specifications. Use the function Bypass to activate the output contactor(s), see how to do it in chapter 6.5.3;
- Put the panels back in place and close the unit.;
- With the equipment closed restart it and load it with full load, if possible, to observe proper operation;
- Check that the Display is operational and the values are correct, within a 2% margin.

NOTE: If nothing happens after switch on the input circuit breaker, switch off and check all fuses. See location in Annex II – **Components** (TERMINAL BLOCK FUSES).

WARNING

THIS EQUIPMENT CONTAINS HAZARDOUS VOLTAGES THAT CAN CAUSE FATAL SHOCK AND SEVERE BURNS.

HAZARDOUS VOLTAGES MAY EXIST EVEN WHEN POWER HAS BEEN REMOVED FROM THE EQUIPMENT.

6. Instructions for use

The content of this technical guide refers to two types of equipment, Static Frequency Converters (SFC) and Ground Power Units (GPU). The main difference is that our GPU is prepared to connect directly to an aircraft. GPU can work as SFC if intended, though the opposite is not possible.

Since these operating instructions cover several models, the characteristics of your equipment may differ slightly from those described in this technical guide. If in doubt, contact your supplier or the equipment manufacturer technical department.

6.1 Display and controls

Figure 27 shows the equipment display. If you purchased this equipment with remote display (optional), it will work the same way and show exactly the same thing as the one installed on the equipment.

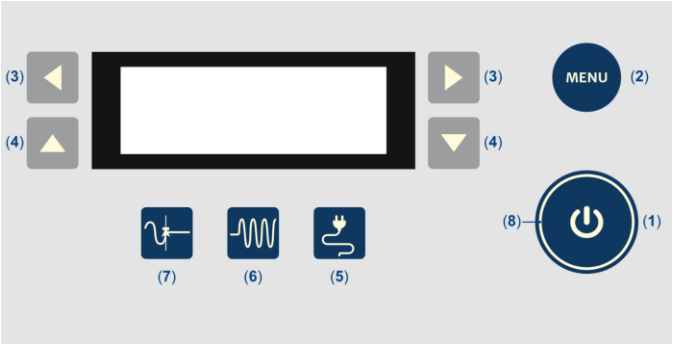


Figure 27 – *Display*

Legend:

(1) ON/OFF BUTTON – Start and Stop the equipment. Used as Enter button when in Menu mode;

(2) MENU – Enters or Exits the Menu mode;

(3) SCROLL LEFT/RIGHT ARROWS;

(4) SCROLL UP/DOWN ARROWS;

(5) SOCKET STATE (when available);

(6) INVERTER STATE – red if Inverter OFF, green if Inverter ON and yellow if overload above 110%;

(7) RECTIFIER STATE – red if Rectifier OFF, green if Rectifier ON and yellow if overload above 110%;

(8) CONTACTOR STATE – no light if output contactor is OFF (open), yellow if it is ON (closed).

6.2 Digital LCD display

6.2.1 Meter display single output

The LCD has three pages, the inverter page (home page), the rectifier page (second), and the miscellaneous page (third). After one minute without being used, the display returns to home page. The different pages are scrolled by the top buttons (3). The second and third rows of the LCD are used for meter functions as described below. They can be scrolled by the two bottom buttons (4). After 10 minutes of inactivity, the display enters saving mode and it turns off (the equipment will continue in operation). To reactivate it, just press any button.

- INV page[7] contains information regarding the Inverter:
  - **VP** – Output phase voltage;
  - **LD** – Output load percentage;
  - **VL** – Output line voltage;
  - **IO** – Output current;
  - **FRQ** – Output frequency.
- RCT page contains information regarding the Rectifier:
  - **VL** – Input line voltage;
  - **II** – Input current;
  - **VDC** – DC link voltage;
  - **FRQ** – Input frequency
- MISC page contains miscellaneous information related with the equipment and environmental conditions:
  - **TEMP** – Temperature measured at the mainboard pcb;
  - **RH** – Relative humidity measured at the mainboard pcb;
  - **RUNT** – Inverter working time count;
  - **S/N** – Serial number;
  - **PWR** – Equipment power;
  - **SWVD XX.XX.XX** – Display firmware version;
  - **SWVM XX.XX.XX** – Mainboard firmware version.

6.2.2 Status line and messages

FIRST LINE – The first line of the display shows the page title (INV, RCT or MISC) and the status of the inverter or the Rectifier. The following status indications are available:

MESSAGE	STATUS
INV → OFF	Inverter is off.
INV → STARTING	The equipment is checking if the inverter output is within parameters.
INV → RUNNING	If the inverter output is within parameters the output contactor is ready to connect the GPU to load.

[7] In a dual output equipment the INV page is divided in Out 1 and Out 2. The values VP, LD, VL and IO shown, refer upstream of the output contactors.

INV → FAILURE	If the Inverter output is not within parameters or a protection flag is active, the inverter trips.
RCT → OFF	The rectifier is off.
RCT → STARTING	The equipment is checking if the rectifier output is within parameters.
RCT → RUNNING	If the rectifier output is within parameters the inverter will be allowed to start.
RCT → STANDBY	If the inverter is switched off the rectifier will carry on working for 5 min (this indication will be present); After 5 min the rectifier will switch off to save energy and the indication will change to “RCT→ OFF”.
RCT → FAILURE	If the rectifier output or input is not within parameters or a protection flag is active the rectifier trips. The inverter will also trip if it was running.

LAST LINE – Provides information for the equipment user to know the operational status, as well as a simple explanation of any fault message. The following indications are available:

MESSAGE	STATUS
CLEAR	Waiting for a command.
90% OFF (On GPU equipment)	When the output socket is not connected to the aircraft or not well connected.
EF BYPASS (On GPU equipment)	The EF interlock is bypassed and the output contactor will activate when the ON button is pressed.
EF OFF (On GPU equipment)	The GPU is not getting the EF interlock signal from the aircraft.
WAITING FOR EF (On GPU equipment)	When the ON button is pressed to connect the GPU to the aircraft, the output contactor will activate for a moment to get the EF interlock signal. During that time this message will be visible until the EF signal is received.
EF ON (On GPU equipment)	Message after the EF interlock signal is received by the unit.
OUT ON	Message that indicates the unit is connected to the aircraft after the interlock sequence is successful.
WAITING FOR CAN DATA	The communications between the control board and the display failed. Call or email Sinepower Technical department.
MAINS LOW SW	Mains are bellow limits.
SAT PROTECT; OVERCURR; UNDERVOLT SW; UNDERVOLT HW; OVER VOLT SW; OVER VOLT HW	These indications indicate that the inverter has been subjected to high stress such as excessive current flown through the IGBT’s causing the inverter to trip. If after restarting the inverter, any of these indications persist, there is a fault in the inverter and the equipment supplier should be contacted. No further attempts at restarting the inverter should be made.
START TIMEOUT	If after the button ON is pressed and the output voltage is not nominal after 10 seconds the inverter will trip and this indication will appear. An inverter fault can cause this.
OVERTEMP	The equipment heat sinks temperature has exceeded 80ºC. Check if there is any obstruction to the ventilation inlets or outlets of the equipment and remove it. If that is not the problem, it is likely that one of the fans has gone faulty. Contact the equipment supplier. This indication is self-latching.
SHORT CIRCUIT	When the load current exceeds approximately 2.5 times the nominal full load value and the output voltage drops below the inverter undervoltage set point, the inverter is switched off. No output will be available. At this stage, this indication and the audible alarm are active. Before trying to reset the equipment, make sure that the short circuit on the load is removed.
OVERLOAD	When the load current exceeds 110%, this indication will be triggered. LEDs (7), (6) and (5) turns yellow. The inverter will try to cope with the overload, being protected by an inverse time protection, i.e. the larger the overload, the shorter the time the inverter will take to switch off. Typically 10 minutes for a 120% overload and 60 seconds for 150%.
DC OFFFSET	Trips the inverter if the control fails and shows DC offset at the Inverter current.
PHASE ROT	If the input phase rotation is not correct (A-B-C), the indication will be displayed. This happens when one of the phases is swapped around or failed. The rectifier will not start. Normally this type of

	problem only arises in the initial installation of the machine and is easily rectified by swapping around two of the input phases.
DC OVERVOLT SW; **DC OVERVOLT HW;** **MAINS LOW SW;** **MAINS LOW HW;** **MAINS HIGH SW;** **MAINS HIGH SW;** **MAINS TIMEOUT;** **RCT START TO;** **RCT FAULT**	The following conditions can cause these indications to be displayed: • Mains failure; • Mains input breaker in the equipment tripped; • Mains input incorrect; • Rectifier fault (DC overvoltage or control voltage failure); • Time out Indications refer to a failed pre-charge that cause the input contactor to not engage.
DC PRECH TO	DC BUS voltage failed to get the predefined value.

The above anomalies should be corrected as soon as possible by calling the equipment supplier or Sinepower Technical department.

6.3 MENU

By pressing MENU button it´s possible to access/set the following sub-menus:

- **LOG** (Logger):
  - **EVENT** – records the event information;
    - **EVENT NUMBER** (starting with the most recent)
    - **DT –** Date;
    - **TM** – Time;
    - **CND** – Condition;
    - **Vi** – Input voltage;
    - **Ii** – Input current;
    - **Vo** – Output voltage;
    - **DC** – DC link voltage;
    - **MBT** – Mainboard temperature.
  - **FAILURE** – records a failure information:
    - **FAILURE NUMBER** (starting with the most recent)
    - **DT –** Date;
    - **TM** – Time;
    - **ER** – Error;
    - **Vi** – Input voltage;
    - **Ii** – Input current;
    - **Vo** – Output voltage;
    - **DC** – DC link voltage;
    - **MBT** – Mainboard temperature.
- **ADJ** – Adjustment options:
  - **BUZZER** – Increase or decrease beep buzzer volume, from 0 (lower) to 100 (loudest);
  - **uSW/EF BYP** – Bypass the micro-switch and EF interlock (available on GPU equipment);
  - **AUTO START** – Enable or disable AUTO START mode;
  - **OUT CNT EN** – Enable or disable Output Contactor (available on SFC equipment);
  - **VOLT ADJ** – Adjust output voltage (optional);
  - **FREQ ADJ** – Adjust output frequency (optional).
- **TIME** – Set clock;

- **DATE** – Set date.

6.4 Auto start and power up/down sequence for SFC equipment

The SFC equipment can operate with power up AUTOSTART mode, normally applicable for equipment in remote areas or difficult access. The equipment is always sent with this function disabled.

Follow the steps below to power up manually:

- Switch ON the Input Circuit Breaker, you will hear a beep sound;
- (7) and (6) turns red;
- After a few seconds input contactor closes and the equipment is ready to start;
- Briefly press ON/OFF BUTTON, a beep sounds, the Inverter starts and the Output Contactor closes;
- (7) and (6) turns green.

Follow the steps below to enable the AUTOSTART mode:

- Switch ON the Input Circuit Breaker, you will hear a beep sound, (7) and (6) turns red;
- Press MENU BUTTON (2) to enter the Menu;
- By using the scroll arrows and the ON/OFF Button select: “ADJ” → “AUTOSTART” → switch the Active Val to “ON”;
- A 30 second count down starts and the equipment will start up at the end of the countdown; output contactor closes;
- (7) and (6) turns green.

Follow the steps below to enable/disable the Output Contactor. Used for maintenance purposes allows to power up the unit without power the load:

- Switch ON the Input Circuit Breaker, you will hear a beep sound, (7) and (6) turns red;
- Press MENU BUTTON (2) to enter the Menu;
- By using the scroll arrows and the ON/OFF Button select: “ADJ” → “OUT CNT EN” → switch the Active Val to “OFF”;
- Briefly press ON/OFF BUTTON, you will hear a beep sound, the Inverter starts and the Output Contactor remains open;

Note: If the equipment doesn’t start up after 3 (3×30secs) attempts it will stop trying to automatically start.

Follow the steps to power down:

- A long press ON/OFF BUTTON stops the Inverter, (6) turns red and you will hear a beep sound;
- Switch OFF the Input Circuit Breaker.

Note: After stopping the Inverter, the Rectifier will remain ON, (7) remains green, if the circuit breaker is left ON. After 5 minutes the equipment turns “Green Mode” ON and shuts down the Rectifier.

6.5 Power up/down sequence for GPU equipment

The GPU equipment can operate in three different modes:

- 6.5.1 Automatic mode;
- 6.5.2 Manual start up mode;
- 6.5.3 Microswitch (uSW) / EF Bypass mode.

6.5.1 Automatic mode

A GPU equipment is always sent with the AUTOSTART ON mode enable. There are two conditions that must be validated for the Automatic start up, they are: Micro-switch (uSW) and EF Interlock.

Note: If there is no uSW function in the socket, to maintain the Automatic Start Up you have to switch ON position 1 of dip switch DS1 at PCB MVA EF see Figure 28 and Annex II **– Components**, for PCB location (18). If there is no EF interlock in the socket/plug the Automatic start up mode is not possible.

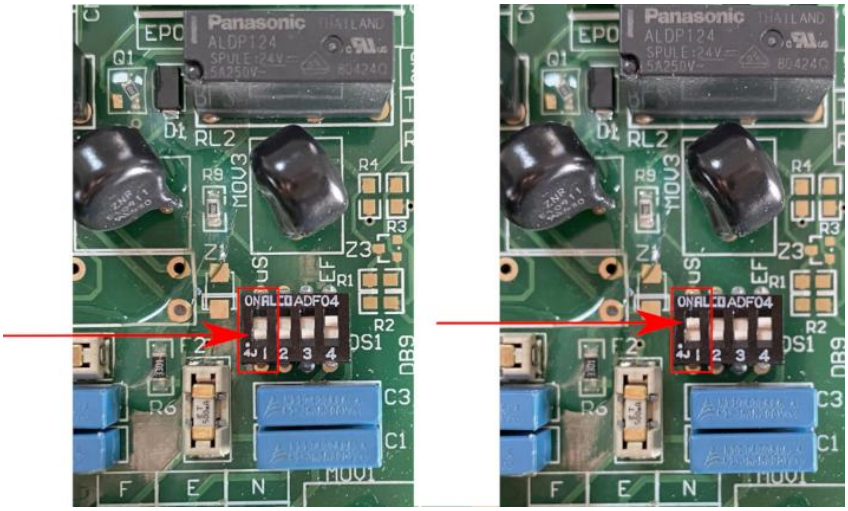


Figure 28 – *uSW function*

Follow the steps below to power up:

- Switch ON the Input Circuit Breaker, you will hear a beep sound and (7) (6) (5) turns red;
- The equipment will enter standby mode awaiting connection to the aircraft;
- Connect the GPU socket to the aircraft's plug and the GPU will star automatically, you will hear a beep sound, output contactor close and (7) (6) (5) turns green.

Follow the steps below to power down:

- Remove the socket from the aircraft plug or,
- a long ON/OFF BUTTON press to stop the equipment, (6) and (5) turns red;
- Switch OFF the Input Circuit Breaker.

Note: After stopping the Inverter, the Rectifier will remain ON, (7) remains green if the circuit breaker is left ON. After 5 minutes the equipment turns "Green Mode" ON and shuts down the Rectifier.

6.5.2 Manual start up mode

For manual start up mode follow the steps below:

- Switch ON the Input Circuit Breaker, you will hear a beep sound and (7) (6) (5) turns red;
- Press MENU BUTTON (2) to enter the Menu;
- By using the scroll arrows and the ON/OFF Button select: "ADJ" → "AUTOSTART" → switch the "Active Val" to "OFF";
- A brief press ON/OFF BUTTON (1) starts the Inverter, (7) and (6) turns green;
- A brief press ON/OFF BUTTON (1) closes the output contactor, (5) turns green after receive EF signal from the aircraft.

Follow the steps below to power down:

- a long ON/OFF BUTTON press to stop the equipment, (6) and (5) turns red;
- Switch OFF the Input Circuit Breaker;
- Remove socket from the aircraft plug.

Note: After stopping the Inverter, the Rectifier will remain ON, (7) remains green, if the circuit breaker is left ON. After 5 minutes the equipment turns "Green Mode" ON and shuts down the Rectifier.

6.5.3 Microswitch (uSW) / EF Bypass mode

This mode is used for maintenance or adjustment purposes.

Follow the steps below to power up:

- Switch ON the Input Circuit Breaker, you will hear a beep sound and (7) (6) (5) turns red;;
- Press MENU BUTTON (2) to enter the Menu;
- By using the scroll arrows and the ON/OFF Button select: "ADJ" → "uSW/EF BYP" → switch the "Active Val" to ON;

- A brief press ON/OFF BUTTON (1) starts the equipment (7) and (6) turns green;
- A brief press ON/OFF BUTTON (1) closes the output contactor, (5) blinks yellow.

Follow the steps below to power down:

- a long ON/OFF BUTTON press to stop the equipment, (6) and (5) turns red;
- Switch OFF the Input Circuit Breaker;
- Remove socket from the aircraft plug.

Note: This mode is always automatically reset when the equipment is powered off.

6.6 Dual Output equipment

If you have a dual output equipment, this chapter is for you, otherwise you can skip it. Everything that has been said so far is valid, the main difference is that in this solution there are two output contactors that work independently, see Figure 29. Thus it is possible to have control over output 1 and output 2 with the on/off button (1) on the respective display page. The status of the output contactors can be seen through the led (5) and (8), if on/closed, (5) turns green and (8) orange, if off/open, (5) turns orange and (8) without any light.

In this equipment it's not possible to have remote feedback so any type of output voltage adjustment will be for the two outputs in the same way: See chapter 6.7.1 for output voltage adjustment.

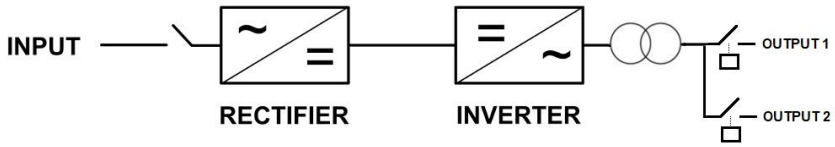


Figure 29 – *Dual output equipment generic diagram*

6.7 Emergency power off EPO

By Pressing the EPO button the Rectifier and the Inverter are switched off and the Input and Output contactors are tripped. The equipment is stopped.

6.8 Adjustments

WARNING

OPENING THE GPU CABINET BY UNAUTHORIZED PERSONNEL IS NOT RECOMMENDED! ONLY COMPETENT PERSONNEL AWARE OF ELECTRICAL HAZARDS SHOULD BE ALLOWED TO OPEN OR SERVICE THE EQUIPMENT.

Some adjustments may be needed during the equipment installation. This necessity may be due to installation peculiarities, environmental conditions, etc. This type of intervention is only authorized to qualified personal, with proper factory training. The use of PPE and insulated tools is required. Do not do this under severe climatic conditions such as rain, snow or hail.

Open front door and remove screws from the electronic panel as show in Figure 30. Carefully open the panel, keeping in mind that there are important cable electronic connections. After the intervention double check if all the connectors and pcb´s remain in place.

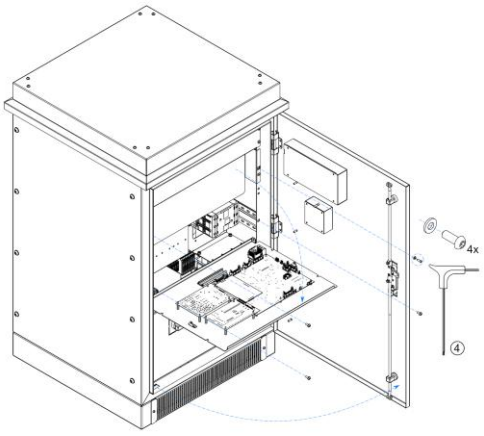
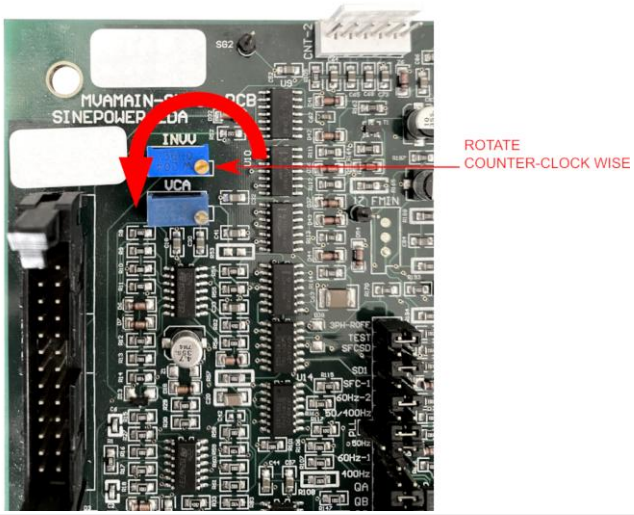


Figure 30 – *Access electronic*



6.8.1 Output voltage

When using very long output cables significant drop voltage can occur if the unit has no Voltage Compensation (Optional) or Remote Feedback (Optional). If the output voltage measured at the end of the cable differs more than 1% of the nominal value go to **INVV** trimpot of PCB MVA MAIN SM, Figure 30 and Annex II **– Components**, for PCB location (36). Use a proper trimpot adjust key, in alternative use a small screwdriver. Slowly turn anti-clockwise to increase voltages to his nominal value, measuring on the load side.

Note: In case of a 400Hz equipment, use a voltmeter capable of reading this frequency.

Figure 31 – *Output voltage regulation*

6.8.2 Offset

If, without the presence of a load, the equipment is emitting a loud noise like a high-pitched sound, it means that the DC current offset shifted to a higher value than +/-10 mVDC. With the equipment running: On the PCB MVA FDB 3PH (Annex II **– Components**, for PCB location (37)), with a voltmeter on a mV scale and DC mode, measure between ground and TP 14, TP 15 and TP 16 for Phase C, B and A respectively. If above +/-10mV, adjust to a value between -10mV and +10 mV, using a proper trimpot adjust key or alternatively use a small screwdriver on the trimpots OFFS-A, B and C (Figure 32).

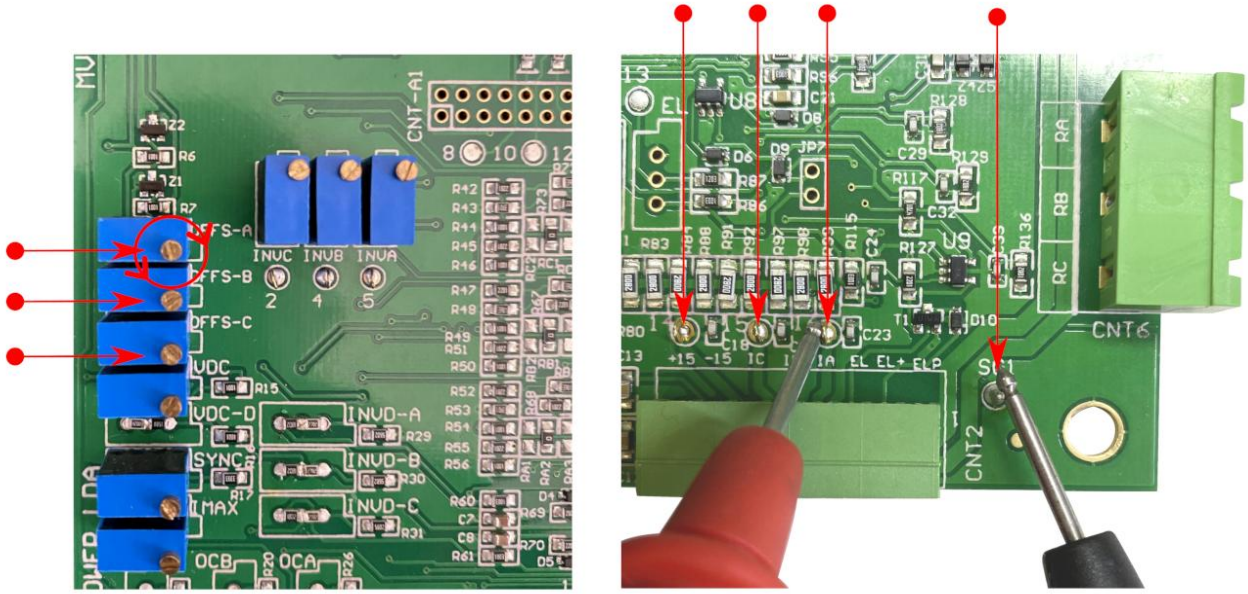


Figure 32 – *Offset adjustment*

6.8.3 Voltage Adjust and Frequency adjust

This equipment may be purchased with the optional voltage adjustment and/or frequency adjustment add-ons. If that is the case simply go to MENU select sub-menu ADJ and select VOLT ADJ or FREQ ADJ. Increase or decrease to the desired value using the display arrows (3) and (4). Press ON/OFF button (1) to confirm the desired value.

7. Maintenance

WARNING

OPENING THE EQUIPMENT BY UNAUTHORIZED PERSONNEL IS NOT RECOMMENDED! ONLY COMPETENT PERSONNEL AWARE OF ELECTRICAL HAZARDS SHOULD BE ALLOWED TO OPEN OR SERVICE THE EQUIPMENT.

DANGER

THIS EQUIPMENT CONTAINS HAZARDOUS VOLTAGES THAT CAN CAUSE FATAL SHOCK AND SEVERE BURNS.

HAZARDOUS VOLTAGES MAY EXIST EVEN WHEN POWER HAS BEEN REMOVED FROM THE EQUIPMENT.

Proper preventive maintenance, is the key to optimal operation of the equipment and will ensure a long and useful life of the system. Preventive maintenance includes regularly performed procedures designed to prevent system malfunction and obtain maximum operational efficiency.

Remedial maintenance requires troubleshooting to repair the system. Troubleshooting the equipment involves following a logical sequence of steps which will determine the cause of an alarm and/or malfunction within the shortest time frame possible so as to expedite the repair and return of the equipment to normal service.

In order to safely and successfully perform maintenance on the equipment, certain safety precautions must be observed. Necessary tools, Personal Protective Equipment (PPE), and test equipment must be available. The following basic safety practices should always be observed:

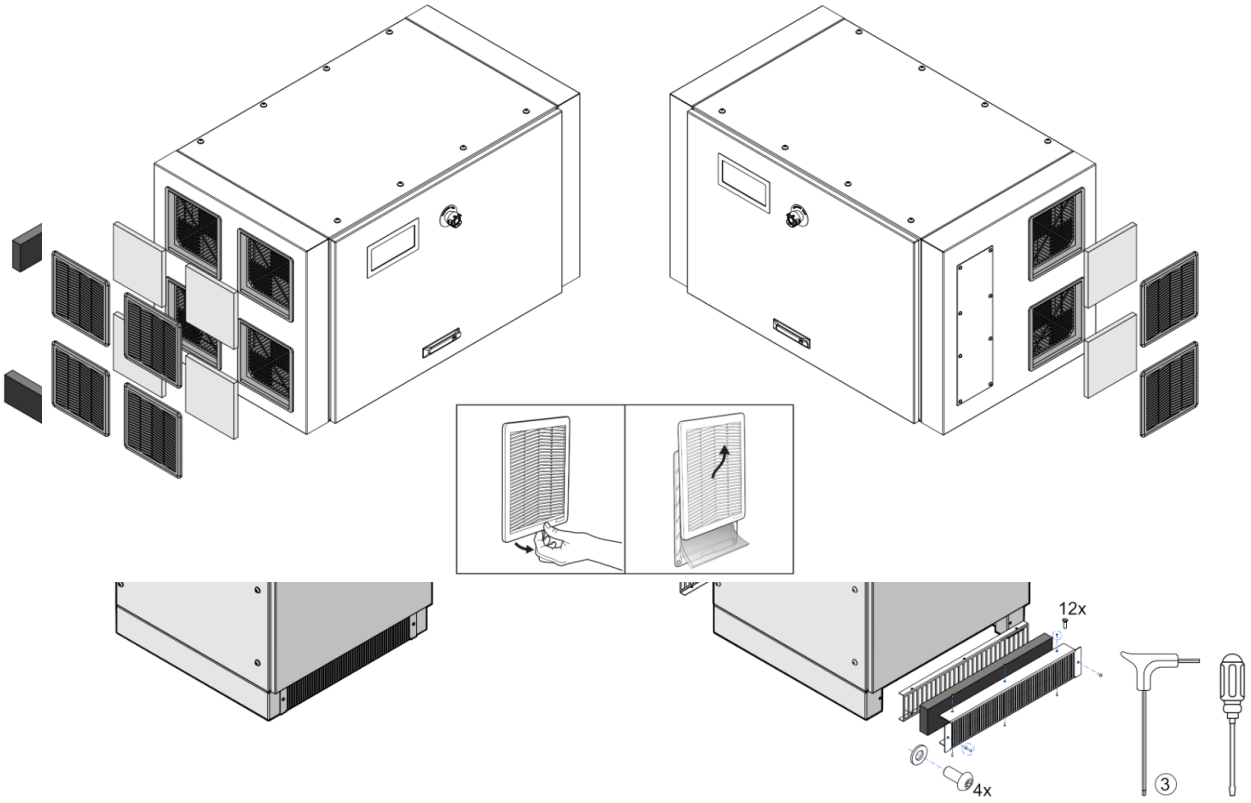
- Always be aware that hazardous voltages are present within the equipment even when the system is not operating;
- Ensure that equipment operating and maintenance personnel are thoroughly familiar with the equipment and the contents of this technical guide;
- Never wear metal jewellery such as rings, necklaces, or wristwatches while working on the equipment;
- Keep equipment cabinet doors and panels closed and secured during normal operation;
- Replace any component with the same type and rating;
- Never guess about safety procedures. If any doubt exists, ask someone who knows;
- Always be aware of the presence of high voltage within the equipment. Check with a voltmeter to verify that power is off and conditions are safe before attempting to make repairs, adjustments, etc;
- Above all, always use common sense.

Consult Table 4 for maintenance instructions and action periodicity.

	Check for	Periodicity	What to do
Air filters	Contamination by dust or any type of particles	monthly (or less in dustier environments)	Remove and Blow with a compressor or use water with soap to clean, replace after fully dry
Cooling fans	Proper rotation speed with no bearing noise	semi-annually	Replace stopped, slow moving or noisy cooling fans
Capacitors checks	Bulges and signs of oil leakage	semi-annually	Replace set
Cable connections checks	Signs of overheating, corrosion, contamination and loose terminals	annually	Re-tighten or replace in case of advanced degradation
Fuse checks	Signs of overheating	annually	Replace
Power semiconductor checks	Signs of overheating	annually	Replace in case of advanced degradation[8]
Heat sink	Dust accumulation on the fins	annually	Use a vacuum cleaner to remove the dust
Magnetics and transformers	Dust accumulation	annually	Use a vacuum cleaner to remove the dust

[8]IMPORTANT: When replacing power semiconductors proper mounting torque is important and adequate thermal compound is required for proper cooling, see IGBT manufacturer datasheet.

Table 4 – *Maintenance and periodicity*



7.1 Air Filters

Air filters eliminate dust particles from the cooling air stream. In time, dust particles in the filter will reduce airflow causing a rise in operating temperatures. Dirty air filters will eventually trigger an over-temperature alarm condition, possibly resulting in a shutdown of the equipment.

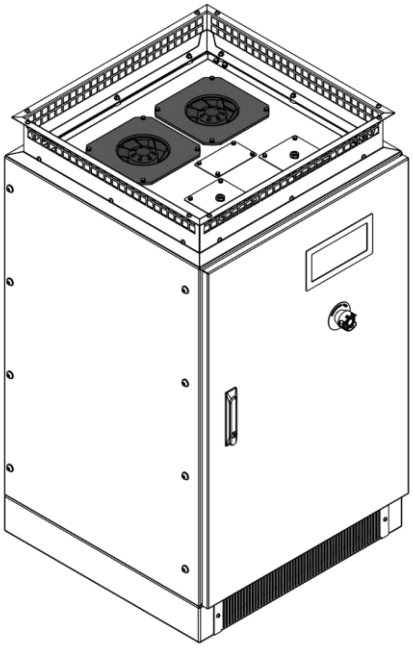
- **Vertical equipment**:
  - With an allen key, remove the screws from the top and the screws from the bottom grids placed in the front and back of the equipment and remove the filters (Figure 33);
  - After cleaning, replace the top and grids previously removed.

- **Horizontal equipment**:
  - To remove the filter media, slide the cover on the base by raising the bottom tongue and pushing it upwards (Figure 34);
  - Re-insert the cover into the base after cleaning media (Figure 34).

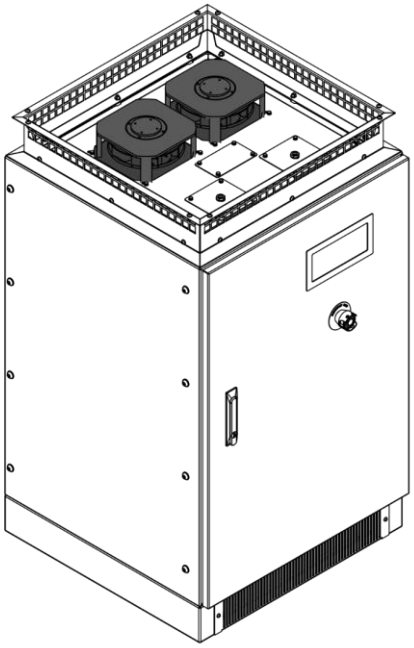
Figure 33 – *Air filters for vertical equipment*

Figure 34 *– Air filters for horizontal equipment*

IP54 COLLING FAN POSITION



IP20 COLLING FAN POSITION



7.2 Cooling fans

High ambient temperatures around the cooling fans will shorten their average operational life. A failed fan causes increased ambient temperatures inside the equipment resulting in shorter life of internal components and may trigger an over-temperature alarm condition, possibly resulting in a shutdown. Fan replacement every 5 years is recommended, depending on the usage frequency.

NOTE: Before beginning the maintenance/replacement, always take pictures before disconnecting the wires to ensure they will be connected in exactly the same way.

- **Vertical equipment**:
  - Fans can be in two different position for IP54 e IP20 (Figure 35);
  - With an allen key, remove the screws from top (Figure 36);
  - With a ratchet wrench, remove the 4 screws that hold the born plate and disconnect the fan wires (Figure 36),
  - With the same key, remove then the fan (Figure 37);
  - After cleaning, replace the top previously removed.

- **Horizontal equipment**:
  - Dismount the filter using fine-nose pliers, apply light pressure to the clips while pushing inwards towards the enclosure. This will release the clips from the base.(Figure 38);
  - Remove the left side part, removing the 12 screws with a ratchet wrench (Figure 38)
  - With a ratchet wrench, remove the 4 screws that hold the born plate and disconnect the fan wires (Figure 39),
  - With the same key, remove then the fan (Figure 39);
  - After cleaning, replace the parts previously removed.

Figure 35 – *Fan position on vertical units*

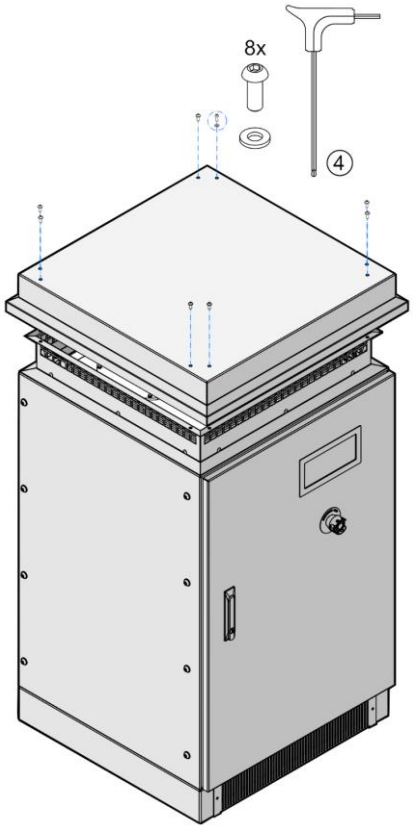


Figure 36 – *Remove top of unit*

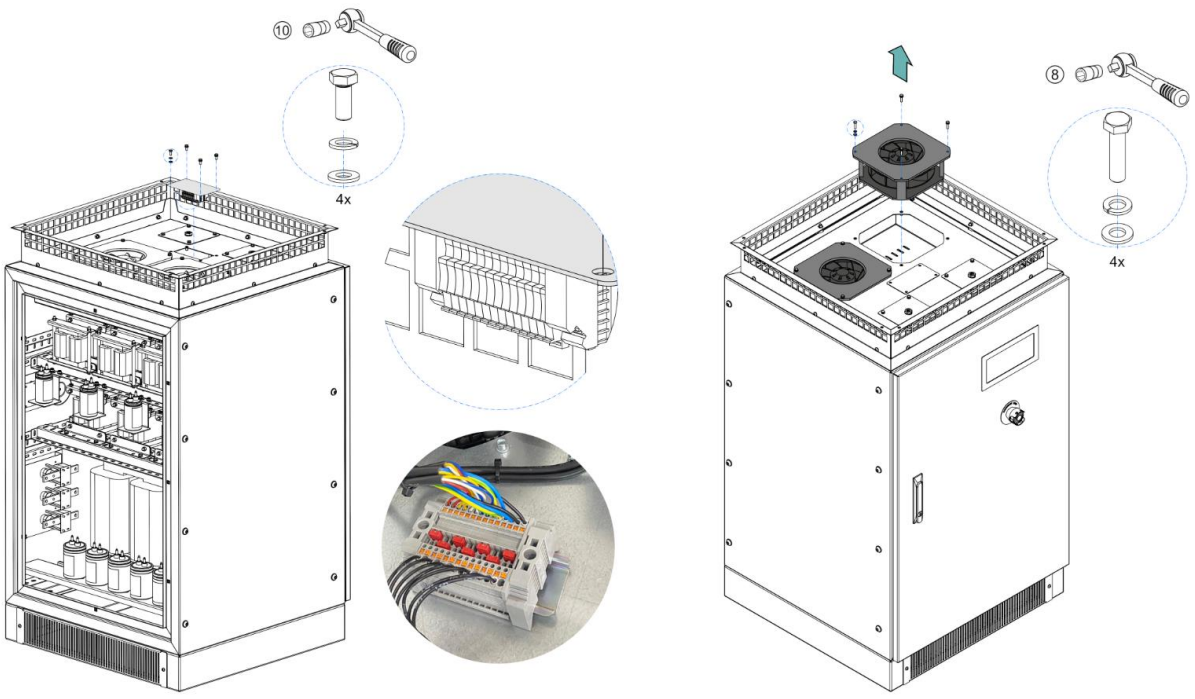
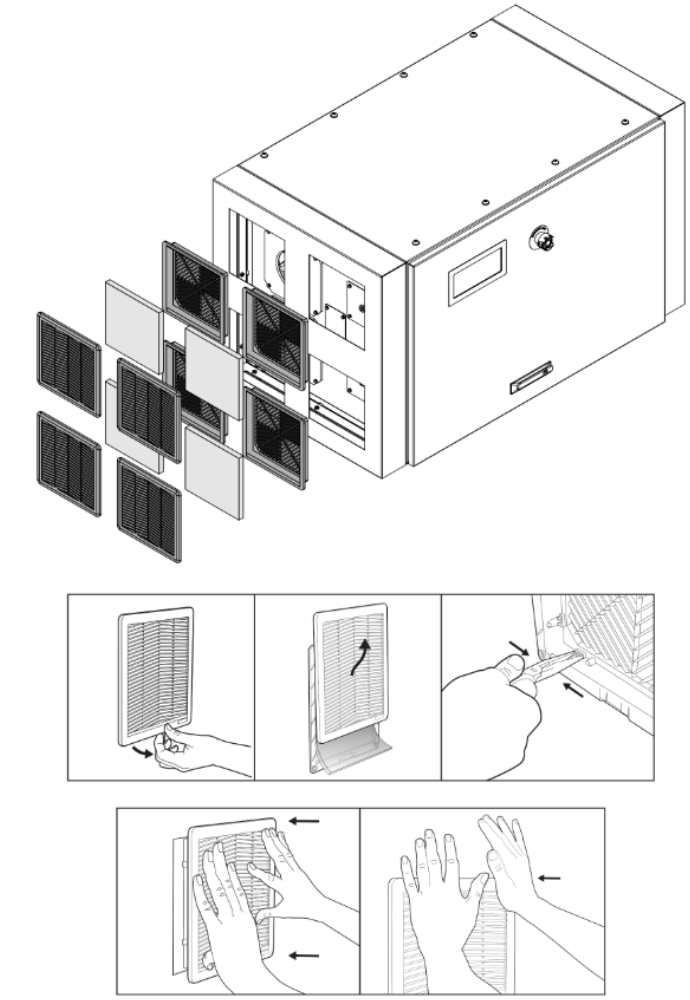


Figure 37 – *Disconnect wires and remove fan*



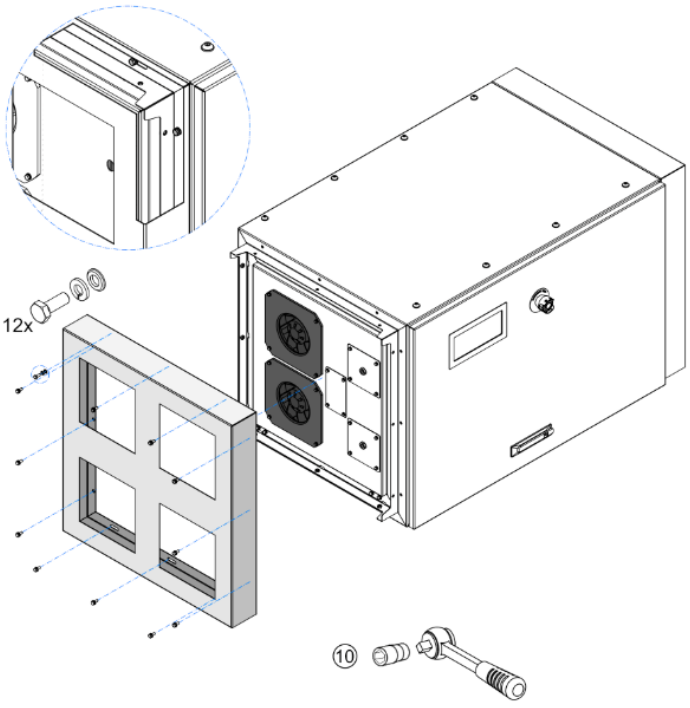


Figure 38 – *Access cooling fans on horizontal equipments*

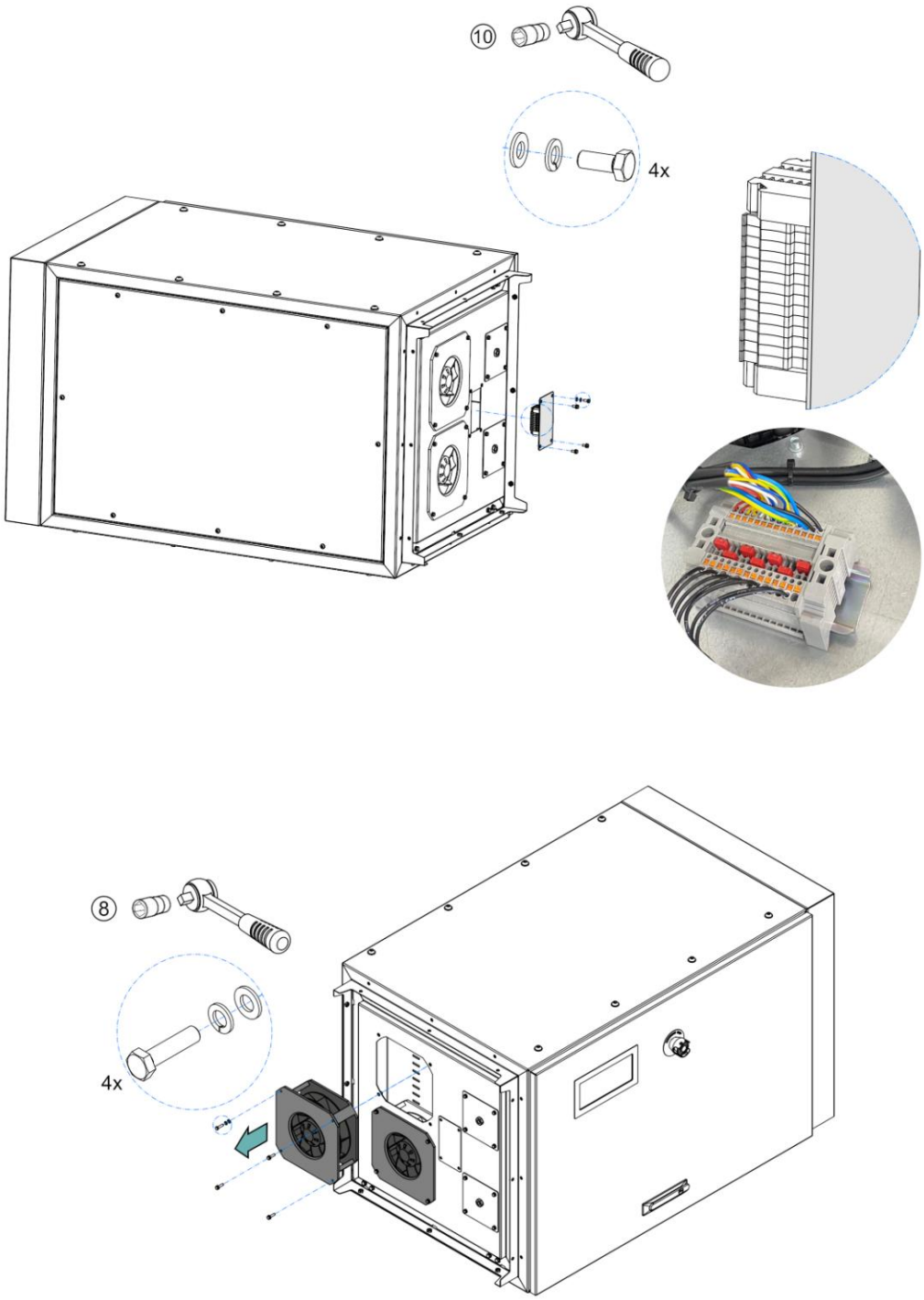
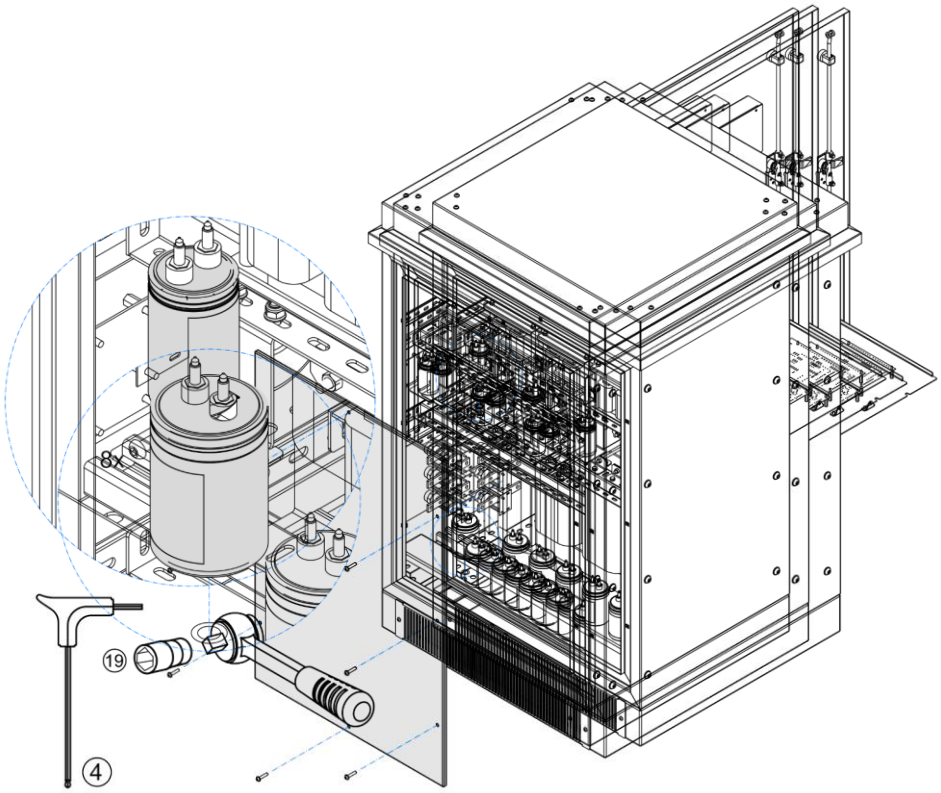


Figure 39 – *Disconnect wires and remove fan*



7.3 Capacitors

Due to its life cycle and also to the operating conditions, capacitors lifetime may vary. Although the capacitors have long life they can be checked when the fans are replaced and changed if necessary. If replacement is necessary, proceed as follows below. Usually capacitors banks are replaced as sets.

For **Input and Output AC Capacitors** follow the next steps (see Annex II **– Components** for location (1) and (9)):

- Switch off the Input Circuit Breaker and wait 10 min for capacitors discharge;
- For vertical and horizontal equipment:
  - remove the back cover with an allen key, Figure 40;
  - take several pictures before disconnecting any cable;
  - with a ratchet wrench remove the nuts on both terminals of the capacitor;
  - for Input capacitors (1), with a ratchet wrench, remove the nut and washer of each capacitor, Figure 41;
  - disconnect cables, unscrew the capacitor and replace for the new one;
  - for Output capacitors (9), disconnect cables, unscrew the capacitor by hand, and replace for the new one Figure 42;
  - check pictures previous taken or consult the wiring diagram to reconnect all cables, replace the nuts and tighten to the proper torque, normally written on capacitor case.

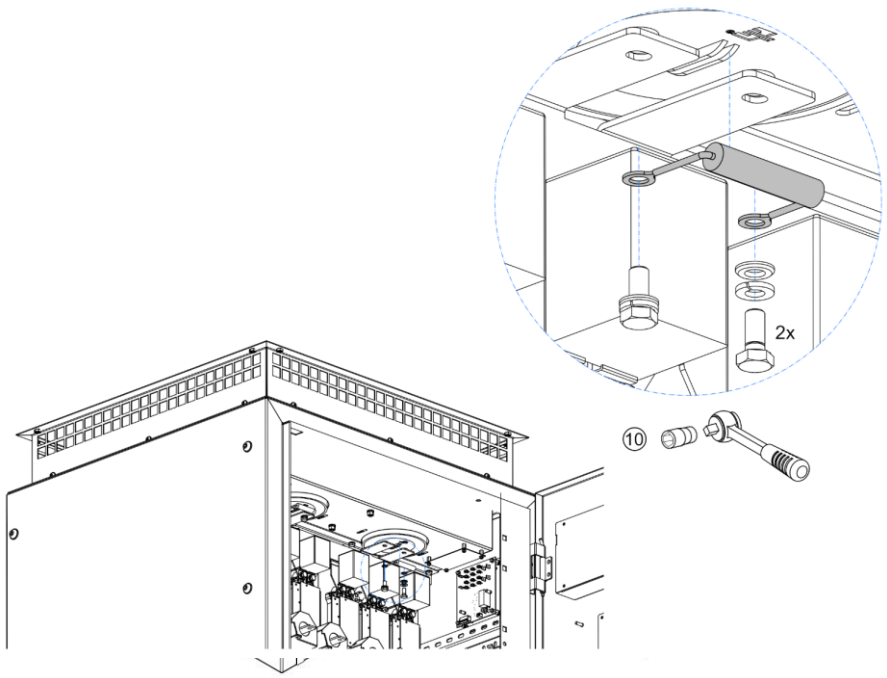
Figure 40 – *Remove the back cover*

Figure 41 – *Input Capacitors*

Figure 42 – *Output Capacitors*

For **DC Bus Capacitors** follow the next steps (see Annex II **– Components** for its location (21)):

- Switch off the Input Circuit Breaker and wait 10 min for capacitors discharge;
- For vertical equipment:
  - open front door, open electronic panel and remove IGBT protection and the top of the unit, Figure 43
  - remove the screws that connect the Capacitors to the DC link and reserve the discharger resistors, Figure 44;
  - where the fans are assembled, with a ratchet wrench remove the screws of the plate in grey, and remove the nut that hold the capacitors, Figure 45;
  - remove the capacitor and replace for the new one, Figure 46;
  - replace screws and discharger resistors connected to the DC link;
  - replace the top and screws.



- For horizontal equipment:
  - open front door, open electronic panel and remove IGBT protection and the left cover of the unit, Figure 47 ;
  - remove the screws that connect the Capacitors to the DC link and reserve the discharger resistors, Figure 48;
  - where the fans are assembled, with a ratchet wrench remove the screws of the plate in grey, and remove the nut that hold the capacitors, Figure 49;
  - remove the capacitor and replace for the new one, Figure 50;
  - replace screws and discharger resistors connected to the DC link;
  - put the fans panel back in place, replace screws and nuts;
  - replace the top and screws.

Figure 43 – *Remove front cover, IGBT protection, top and open the electronic panel*

Figure 44 – *Remove screws and reserve the discharger resistor*

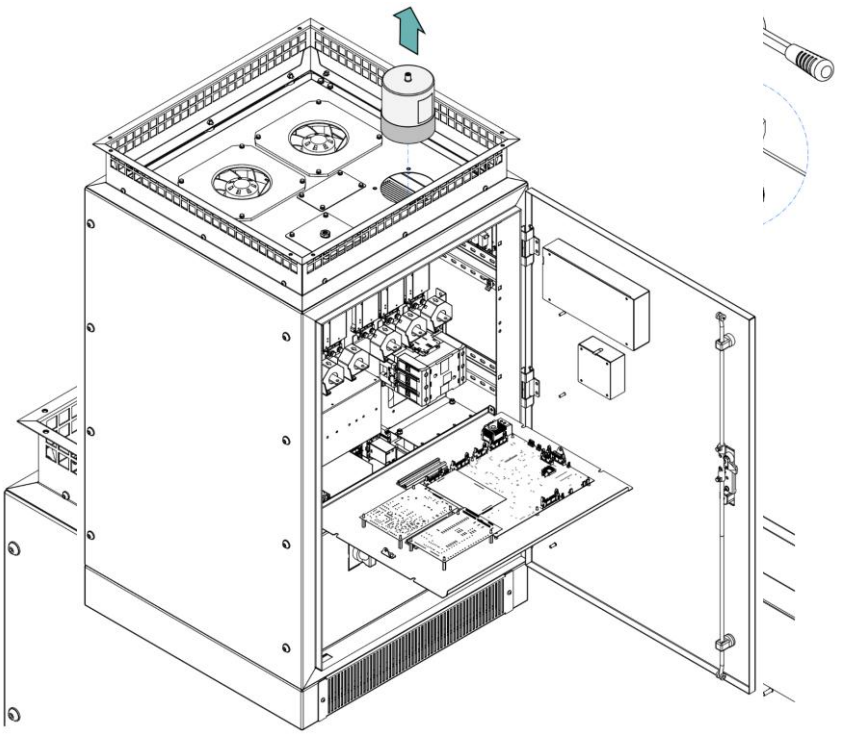


Figure 45 – *Remove screws and nut that and the plate*

Figure 46 – *Replace the capacitor for a new one*

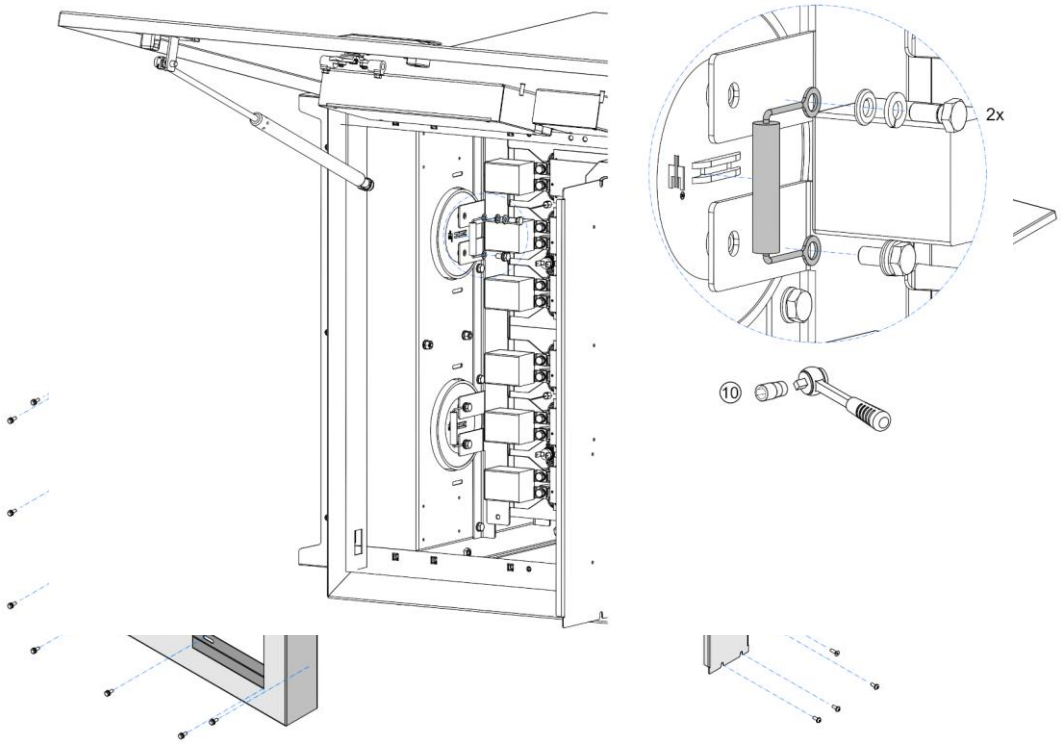


Figure 47 – *Remove front cover, IGBT protection, left cover and open the electronic panel*

Figure 48 – *Remove screws and reserve the discharger resistor*

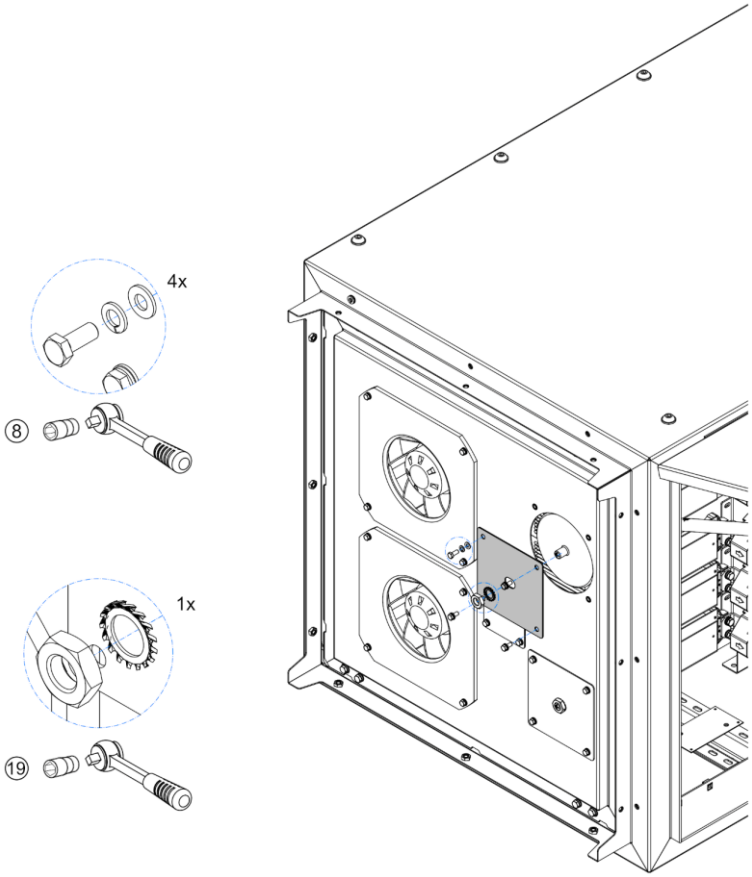


Figure 49 – *Remove screws and nut that and the plate*

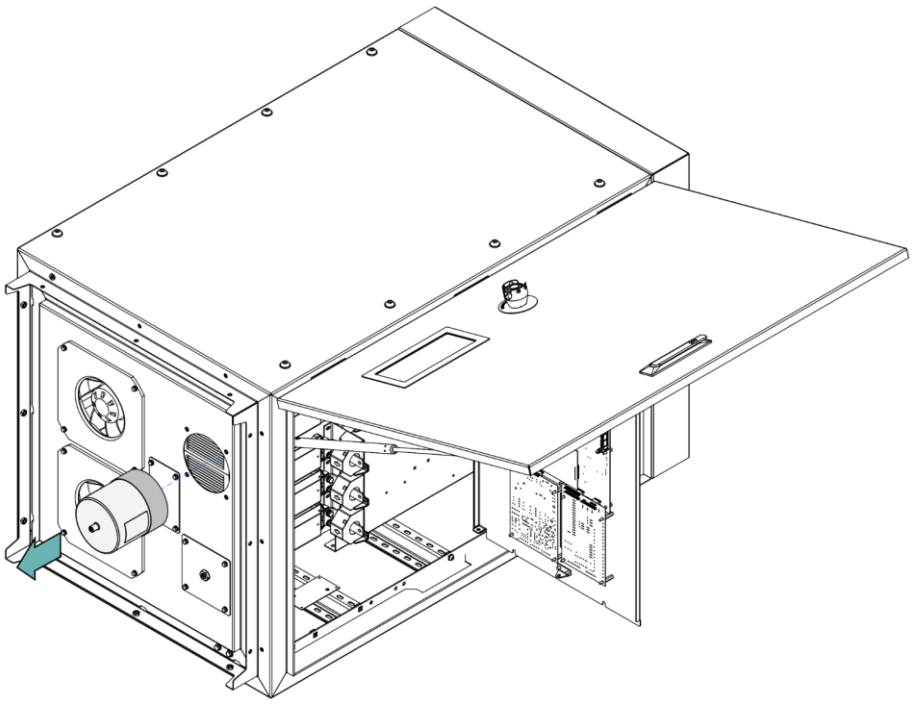


Figure 50 – *Replace the capacitor for a new one*

7.4 FuseS

DANGER

NEVER REPLACE A FUSE WITH A DIFFERENT CHARACTERISTIC, AMPERAGE AND TYPE. RISK OF FIRE!

Switch off the input circuit breaker and check the continuity of the fuses with a multimeter. If any fuse is damaged, replace it with one with the same characteristics, amperage and type. See table 5. See Annex II **– Components**, Terminal block fuse location (15).

	Fuse Rate (A)	Characteristic
F1 **F2**	2.5	FUSE 5x20mm 250VAC TIME DELAY CERAMIC CARTRIDGE
F3 **F4**	3.15	FUSE 5x20mm 250VAC TIME DELAY CERAMIC CARTRIDGE

Table 5 – *Fuses Rating*

8. Warranty

All units manufactured by Sinepower, Sociedade de Consultoria e Projectos de Engenharia Electrónica Lda., are tested in our facilities as part of our quality control.

Sinepower offers 12 month warranty on faulty components and bad workmanship. The warranty is valid from the dispatch date onwards.

Sinepower Warranty terms:

1. Installation is at the responsibility of the customer and/or installer contracted by the customer.
2. All units must be run under normal conditions as specified in Sinepower's official technical documentation.
3. This warranty covers shipping of spares and/or repair Kits to repair faulty components or bad workmanship that may have occurred during manufacturing. Distributor or OEM is responsible for the repair of the unit.
4. This Warranty does not cover: Incorrectly installed units, incorrect layout, lack of ventilation in installation sites, incompatible temperature ranges, mishandling, improper cleaning (water, detergents or cleaners that can damage the electrical part), the use of alkaline solutions, and transportation to the installation site, failure to follow instructions for installation, preventive maintenance and operation of equipment. In these cases, the total cost of repair is the responsibility of the customer.
5. This warranty does not cover the following components:
    a) batteries.
6. This warranty does not cover damage caused by:
    a) Events of *Force Majeure* (ex: atmospheric or geological phenomena);
    b) Inappropriate or illegal installation;
    c) Transport risks: on delivery all units should be checked for damages to the packaging. If any should be found the transportation insurance should be activated.
7. In the case of financial liabilities, Sinepower may suspend this warranty until all financial matters are resolved. The warranty will be restored after a settlement is achieved and the warranty period remains as initially defined (the time that passes between suspension and restoration of warranty is deducted to warranty period).
8. WARRANTY – SINEPOWER applies only to equipment (workmanship in manufacturing process, manufacturing parts). Spares availability guaranteed for 10 years.

IMPORTANT:

This warranty will be irrevocably invalidated as a result of tampering, repairing or altering of any part or assembly of parts of the unit(s), which have not been done by Sinepower or by an authorized technician, in writing, by Sinepower.

In the event of a Sinepower technician being requested for any technical repairs, all cost will be supported by the customer including all accommodation and transport.

Sinepower Warranty may be extended on a case-to-case basis depending on clients requirements.

9. Abbreviations

PPE	Personal Protective Equipment
EC	European Commission;
GPU	Ground Power Unit
SFC	Static Frequency Converter
PWM	Pulse Width Modulation
THD	Total Harmonic Distortion
EMI	Electrical Magnetic Interference
IGBT	Insulated Gate Bipolar Transistor
AC	Alternating Current
VA	Volt Ampere
PE	Protective Earth
T	Earth, from the French: *Terre*
I	Isolated, from the French: *Isolé*
N	Neutral
S	Separated, from the French: *Séparé*
C	Combined, from the French: *Combiné*
IEC	International Electrotechnical Commission
EN	European Standards
ISO	International Organization Standardization
MIL-STD	Military Standard
SAE ARP	Society of Automotive Engineers Aerospace Recommended Practice
UV	Ultra Violet
OVC	Overvoltage Category
SI	International System
XLPE	Cross lenked polyethylene insulation
PCB	Printed Circuit Board
us	Micro-switch
CNT	Connector
FRM	Feedback remote
MCB	Miniature Circuit Breaker
DVC	Decisive Voltage Class
RCT	Rectifier;
INV	Inverter
OEM	Original Equipment Manufacturer

Annex I – Cable cross-section

Table B.52.12 – Current-carrying capacities in amperes for installation methods E, F and G of Table B.52.1 – XLPE or EPR insulation, copper conductors – Conductor temperature: 90 °C, reference ambient temperature: 30 °C

Nominal cross-sectional area of conductor mm²	Installation methods of Table B.52.1						
	Multi-core cables		Single-core cables				
	Two loaded conductors	Three loaded conductors	Two loaded conductors touching	Three loaded conductors trefoil	Three loaded conductors, flat		
					Touching	Spaced	
						Horizontal	Vertical
							
	Method E	Method E	Method F	Method F	Method F	Method G	Method G
1	2	3	4	5	6	7	8
1,5	26	23	–	–	–	–	–
2,5	36	32	–	–	–	–	–
4	49	42	–	–	–	–	–
6	63	54	–	–	–	–	–
10	86	75	–	–	–	–	–
16	115	100	–	–	–	–	–
25	149	127	161	135	141	182	161
35	185	158	200	169	176	226	201
50	225	192	242	207	216	275	246
70	289	246	310	268	279	353	318
95	352	298	377	328	342	430	389
120	410	346	437	383	400	500	454
150	473	399	504	444	464	577	527
185	542	456	575	510	533	661	605
240	641	538	679	607	634	781	719
300	741	621	783	703	736	902	833
400	–	–	940	823	868	1085	1008
500	–	–	1083	946	998	1253	1169
630	–	–	1 254	1 088	1 151	1 454	1 362

NOTE 1 Circular conductors are assumed for sizes up to and including 16 mm². Values for larger sizes relate to shaped conductors and may safely be applied to circular conductors.

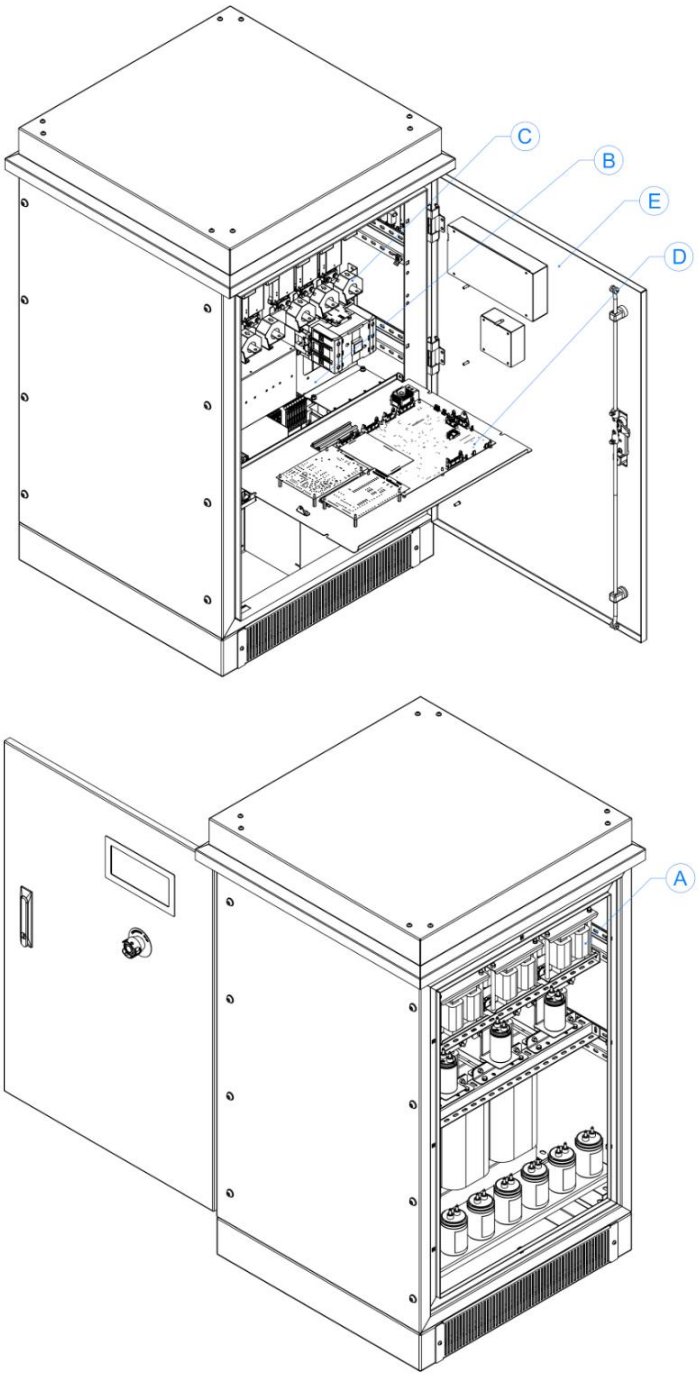
NOTE 2 D_e is the external diameter of the cable.

Table B.52.14 – Correction factor for ambient air temperatures other than 30 °C to be applied to the current-carrying capacities for cables in the air

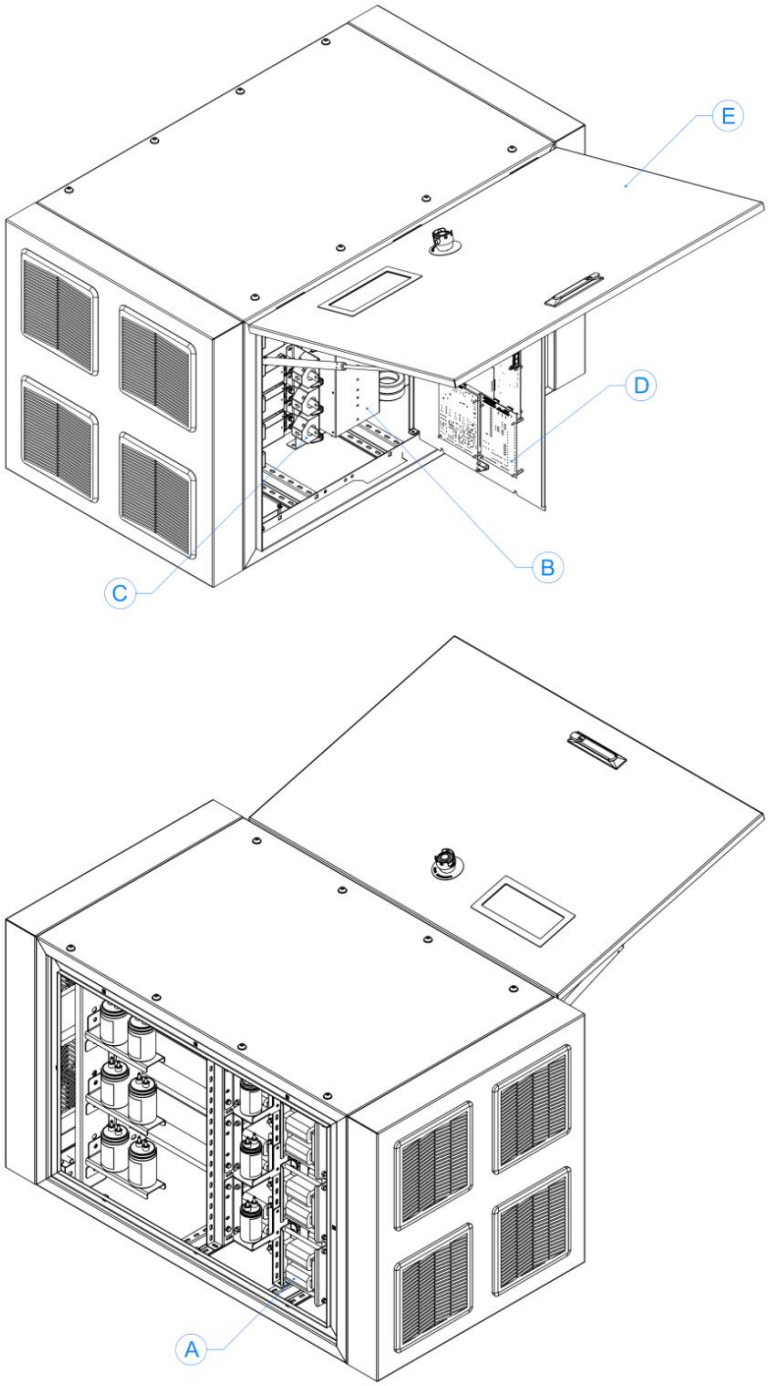
Ambient temperature[a] °C	Insulation			
	PVC	XLPE and EPR	Mineral[a]	
			PVC covered or bare and exposed to touch 70 °C	Bare not exposed to touch 105 °C
10	1,22	1,15	1,26	1,14
15	1,17	1,12	1,20	1,11
20	1,12	1,08	1,14	1,07
25	1,06	1,04	1,07	1,04
30	1,00	1,00	1,00	1,00
35	0,94	0,96	0,93	0,96
40	0,87	0,91	0,85	0,92
45	0,79	0,87	0,78	0,88
50	0,71	0,82	0,67	0,84
55	0,61	0,76	0,57	0,80
60	0,50	0,71	0,45	0,75
65	–	0,65	–	0,70
70	–	0,58	–	0,65
75	–	0,50	–	0,60
80	–	0,41	–	0,54
85	–	–	–	0,47
90	–	–	–	0,40
95	–	–	–	0,32

[a] For higher ambient temperatures, consult the manufacturer.

Annex II – Components

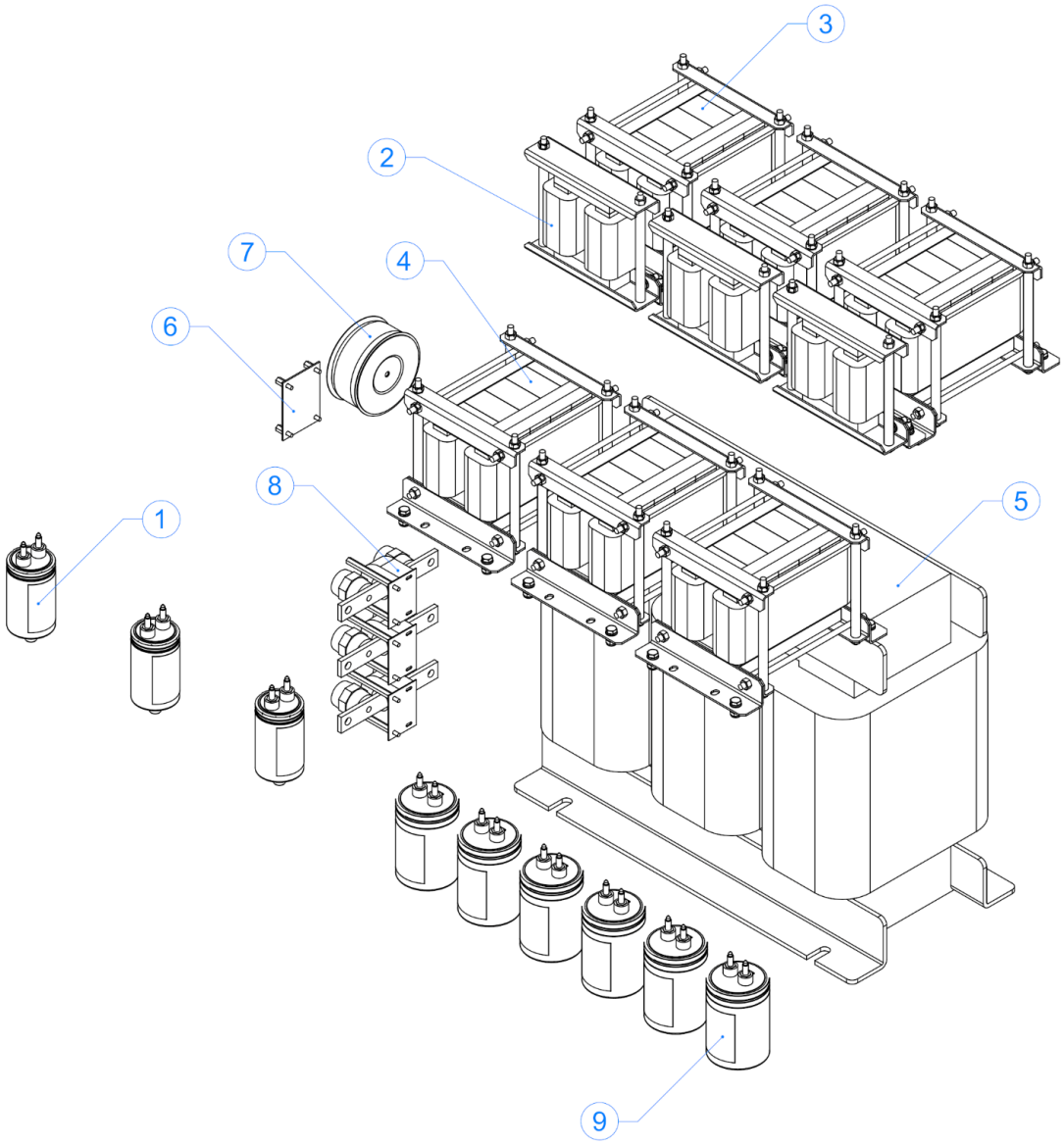


A	POWER COMPONENTS
B	MAIN PANEL
C	POWER PACK
D	MAIN PCB'S
E	DISPLAY



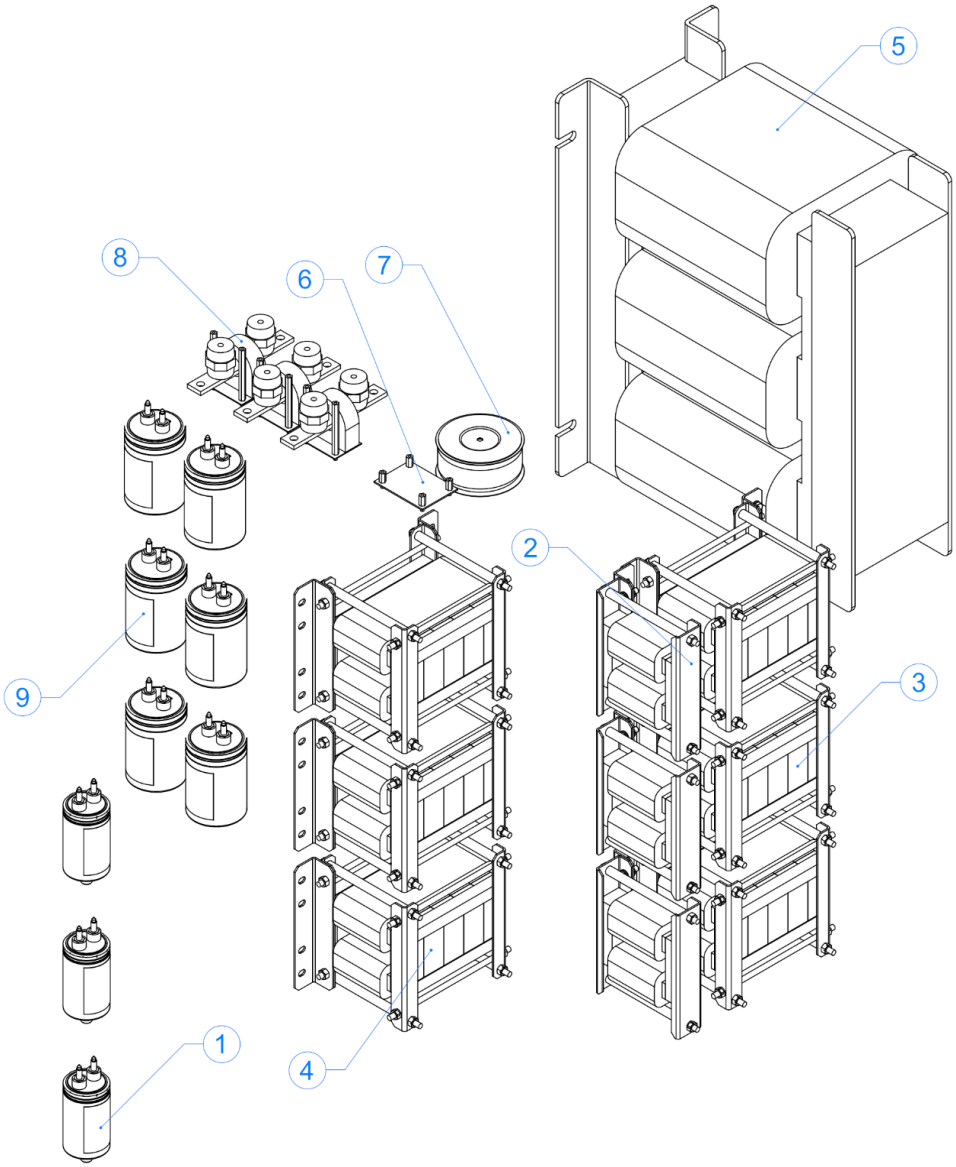
A	POWER COMPONENTS
B	MAIN PANEL
C	POWER PACK
D	MAIN PCB'S
E	DISPLAY

A – POWER COMPONENTS (VERTICAL UNIT)



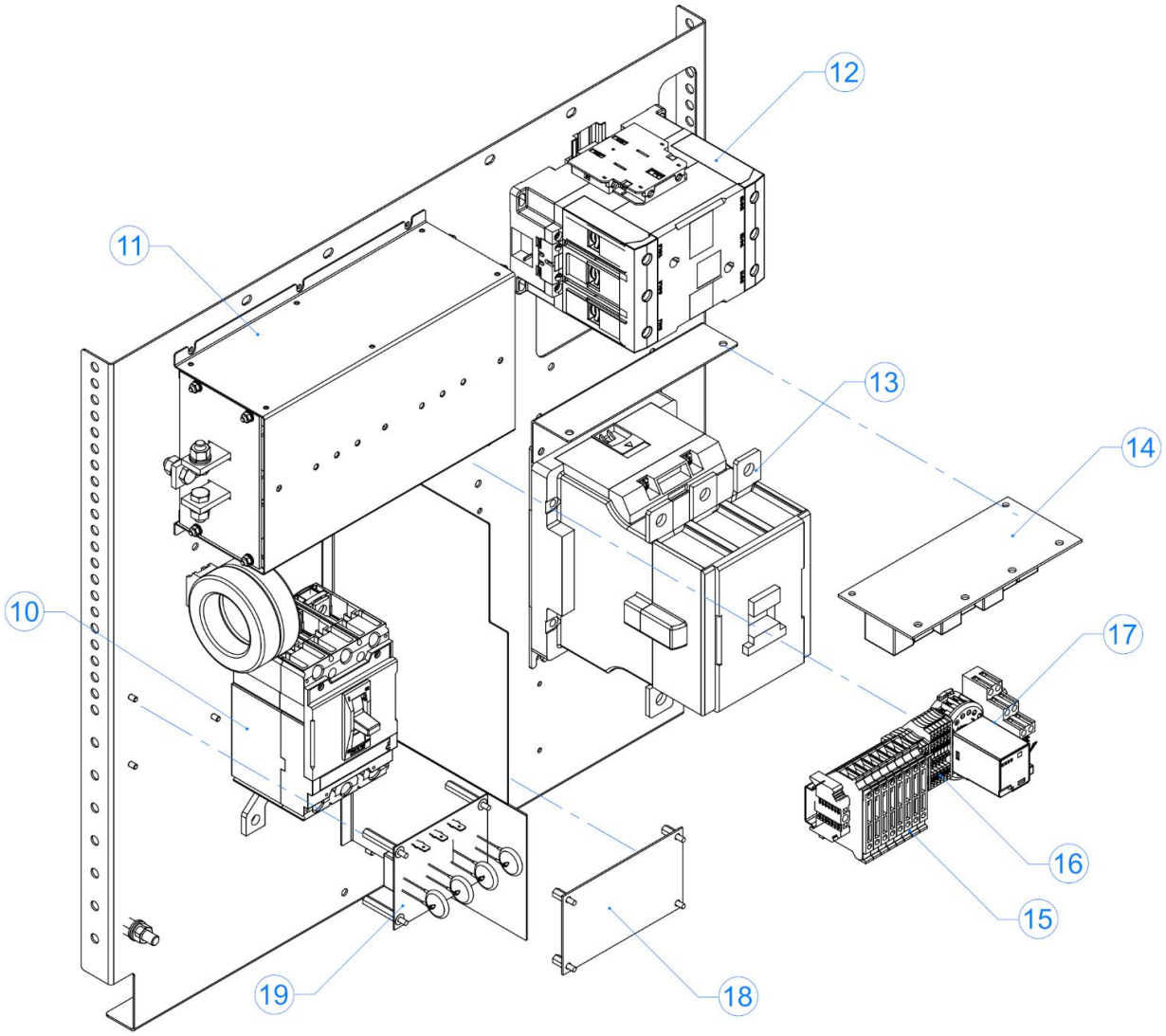
1	INPUT AC CAPACITORS
2	INPUT INDUCTORS
3	RECTIFIER INDUCTORS
4	INVERTER INDUCTORS
5	MAIN TRANSFORMER
6	PCB MVA TRAFOSOFT
7	TRANSFORMER AUXILIARY TOROIDAL
8	PCB MVA LEM 4 (CT 200A)
9	OUTPUT AC CAPACITORS

A – POWER COMPONENTS (HORIZONTAL UNIT)



1	INPUT AC CAPACITORS
2	INPUT INDUCTORS
3	RECTIFIER INDUCTORS
4	INVERTER INDUCTORS
5	MAIN TRANSFORMER
6	PCB MVA TRAFOSOFT
7	TRANSFORMER AUXILIARY TOROIDAL
8	PCB MVA LEM 4 (CT 200A)
9	OUTPUT AC CAPACITORS

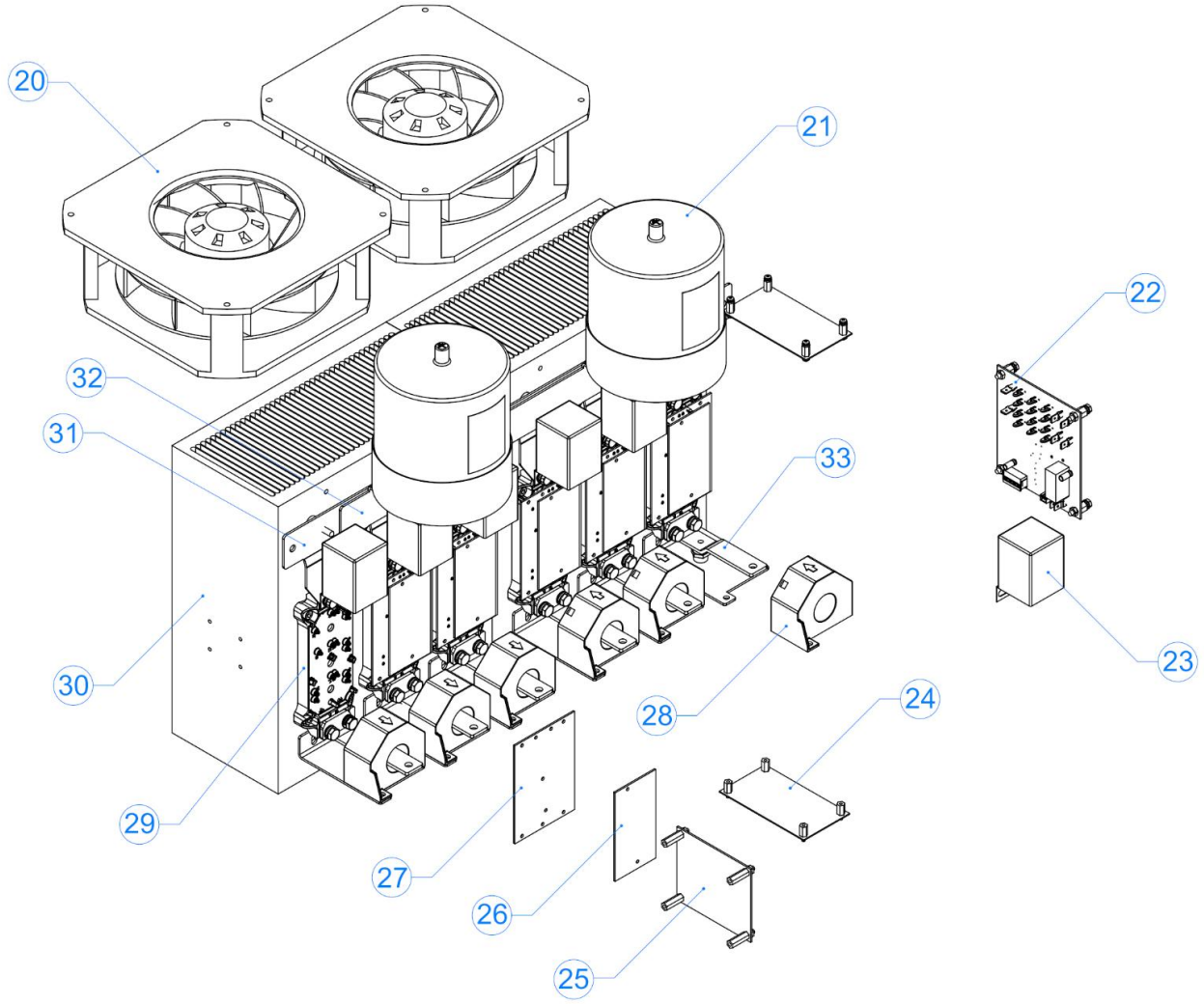
B – MAIN PANEL



10	INPUT MCB
11	INPUT RFI FILTER
12	INPUT CONTACTOR
13	OUTPUT CONTACTOR
14	OUT RFI FILTER
15	TERMINAL BLOCK FUSES
16	BORNES
17	RELAY

18	PCB MVA EF
19	PCB MVA MOV

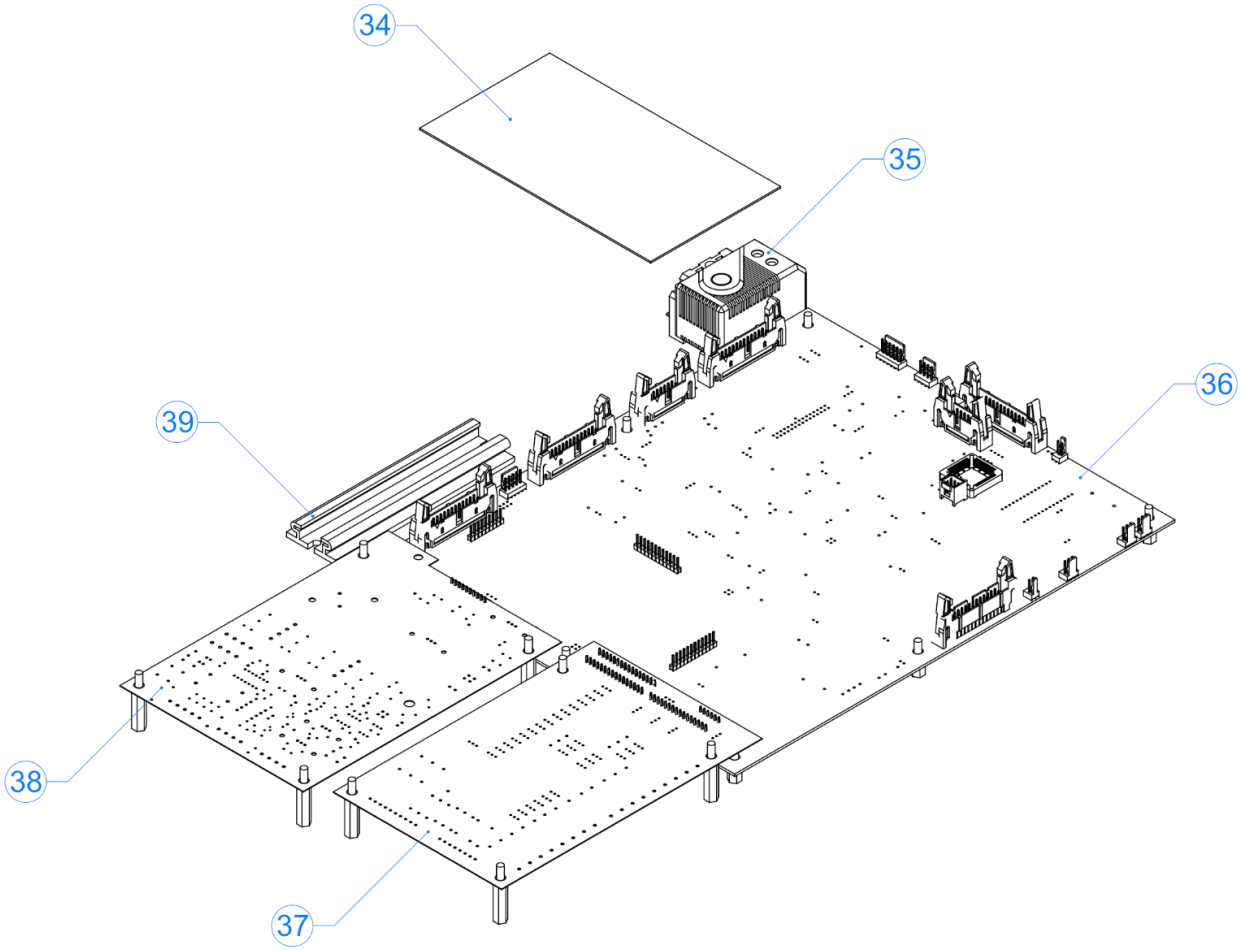
C – POWER PACK



20	COOLING FANS
21	ICAR LNK-M3R-1-950-90
22	PCB MVA SOFTSTART
23	ICAR LNK-P1X-25-100
24	PCB MVA SEMIX-INF-SM-9
25	PCB MVA FANCONTROL
26	PCB MVA SEMIX-SUP-SM
27	PCB MVA SEMIX-DR-S3-SM-IGBT
28	LEM TELCON HT200M
29	SEMiX 453GB12E4s / 303GB12E4s
30	HEATSINK
31	NEGATIVE DC LINK

32	POSITIVE DC LINK
33	IGBT BUSBAR

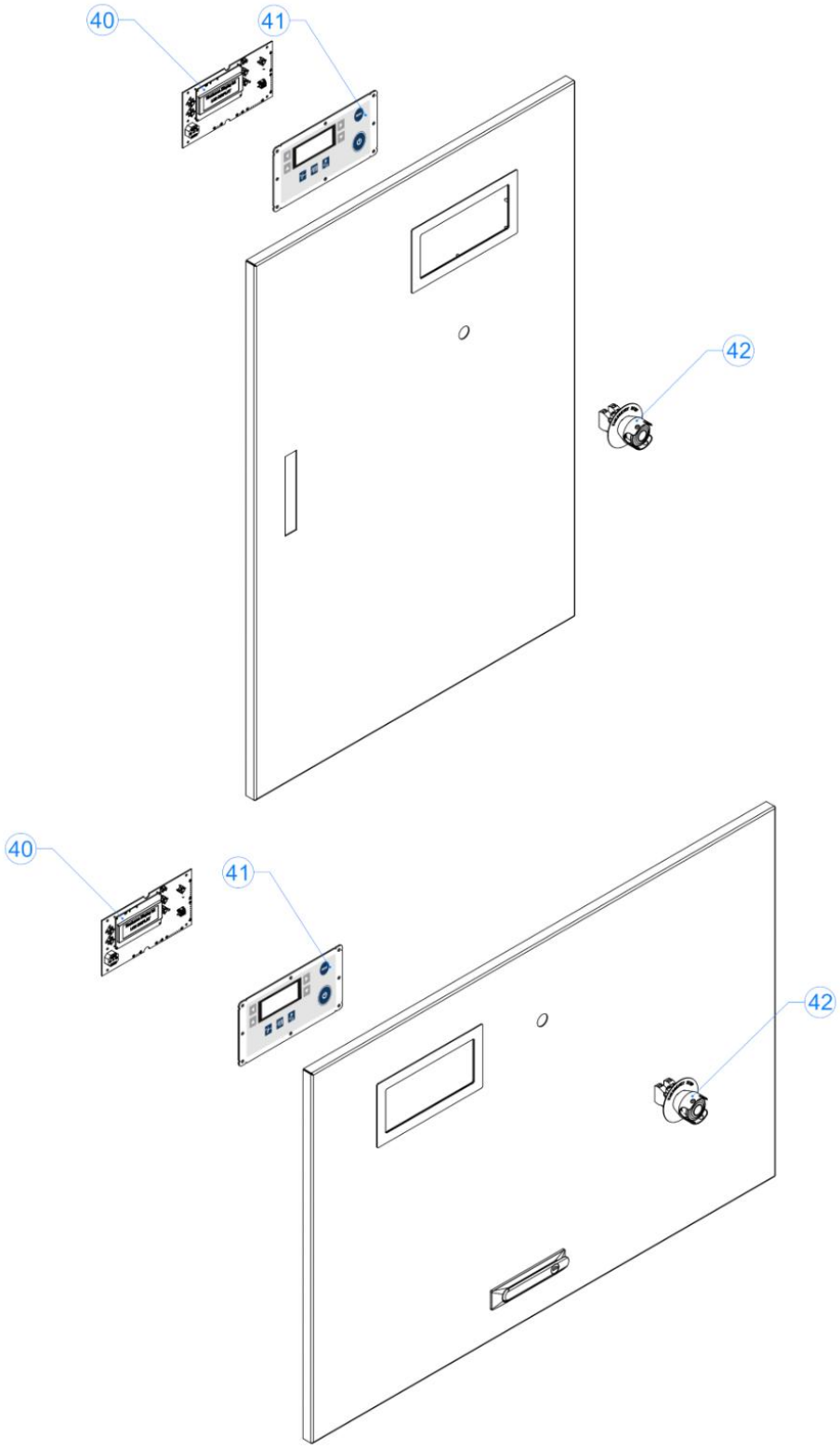
D – MAIN PCB's



34	PCB MVA MAINRCT 4Q
35	THERMOSTAT TEMPERATURE CONTROL
36	PCB MVA MAIN SM

37	PCB MVA FDB 3PH
38	PCB MVA PS
39	RESISTOR HEATER

E – DISPLAY

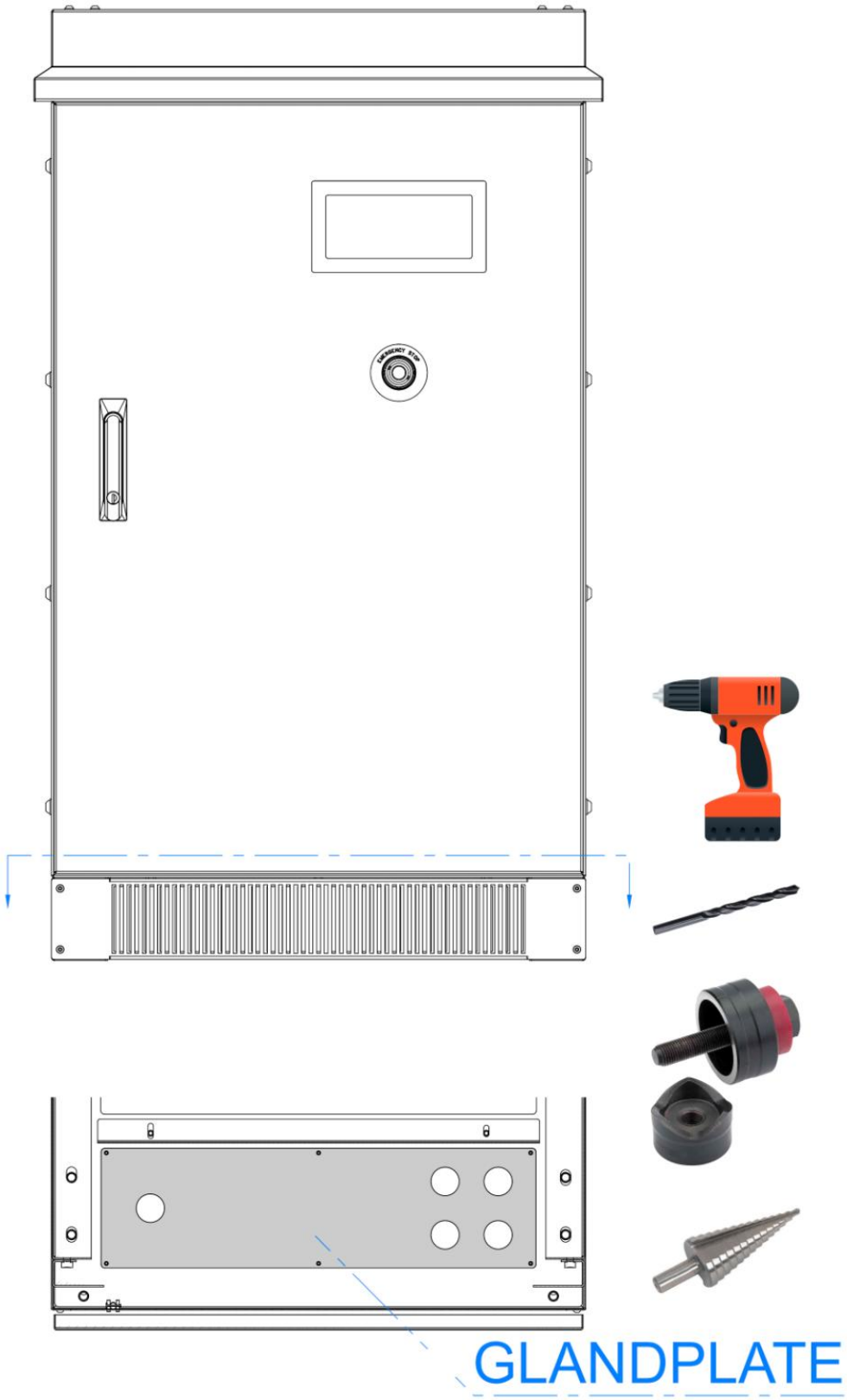


40	PCB DISPLAY STAND ALONE
41	LCD LABEL GPU

42	EPO

Annex III – Gland Plate

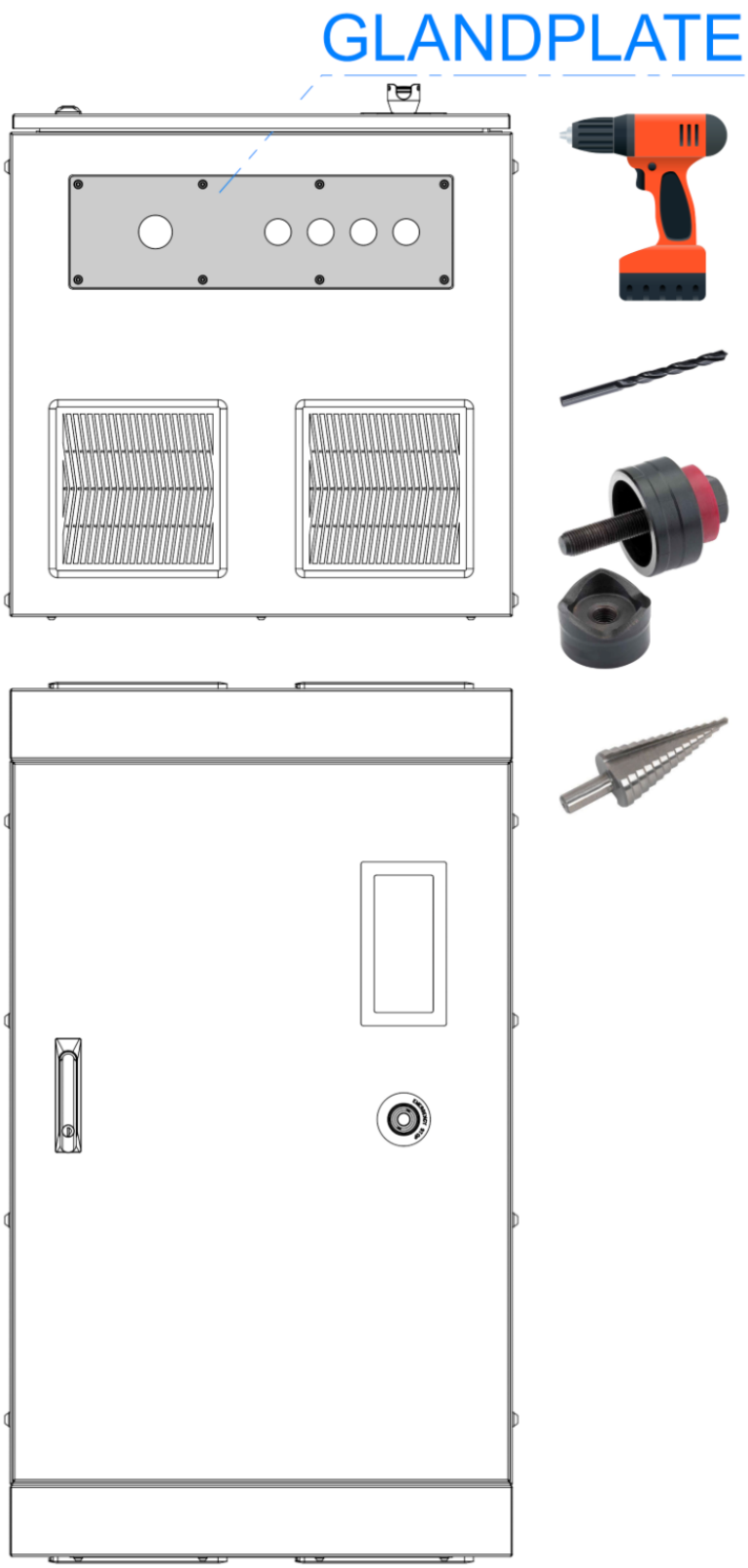
VERTICAL EQUIPMENT:



For opening the holes, use a power drill, drill to start and for the final hole,

a hole cutter or a conical cutter to achieve the diameter needed.

HORIZONTAL EQUIPMENT:

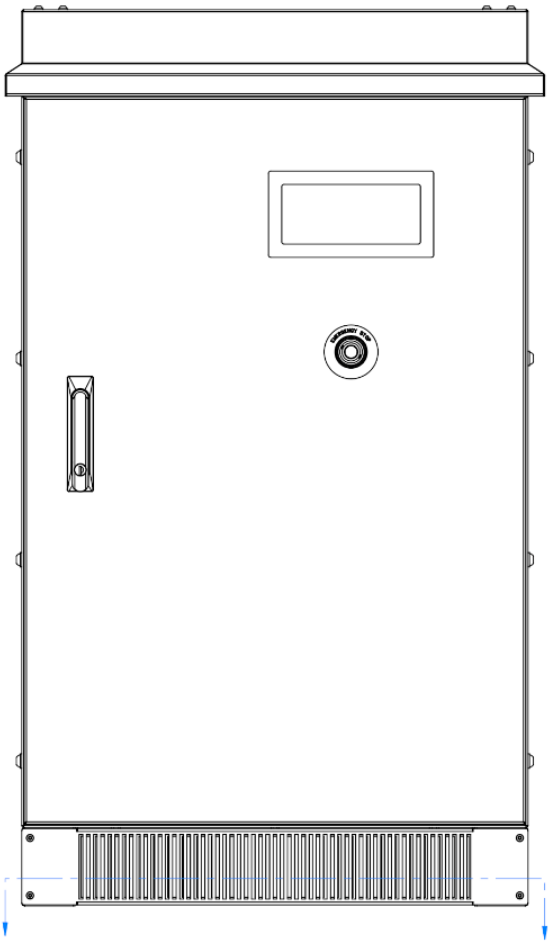


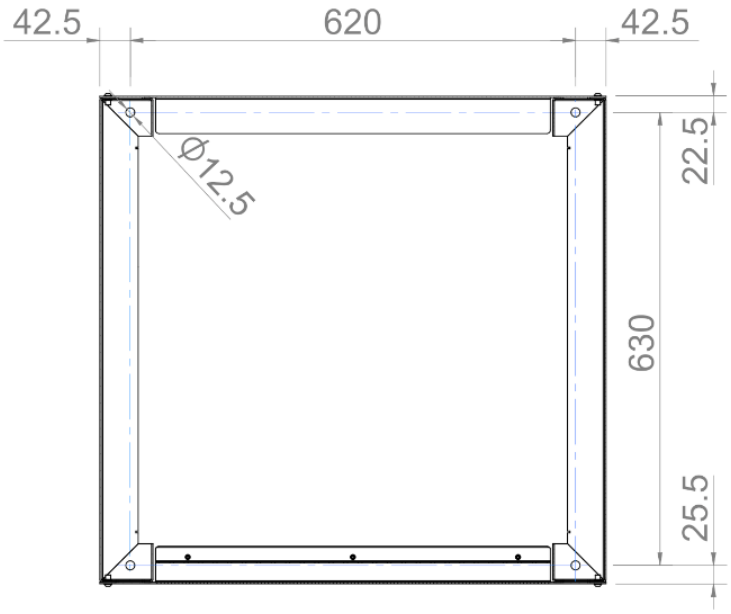
For opening the holes, use a power drill, drill to start and for the final hole,

a hole cutter or a conical cutter to achieve the diameter needed.

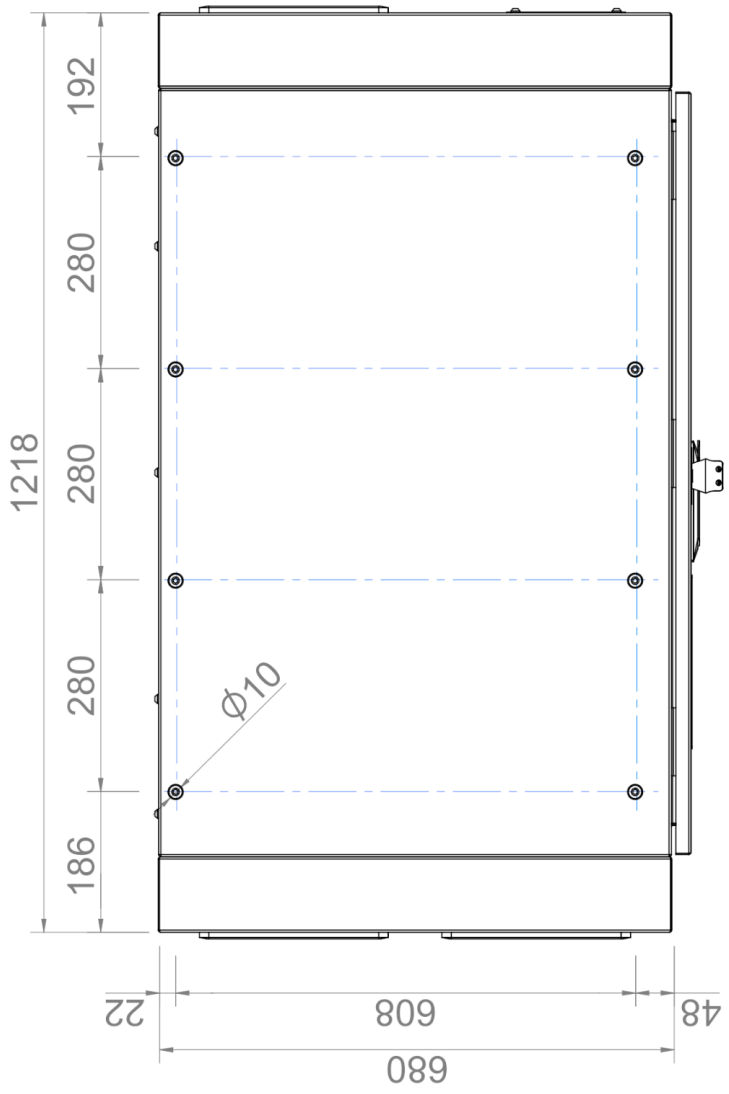
Annex IV – Ground fixture drawing

VERTICAL EQUIPMENT:



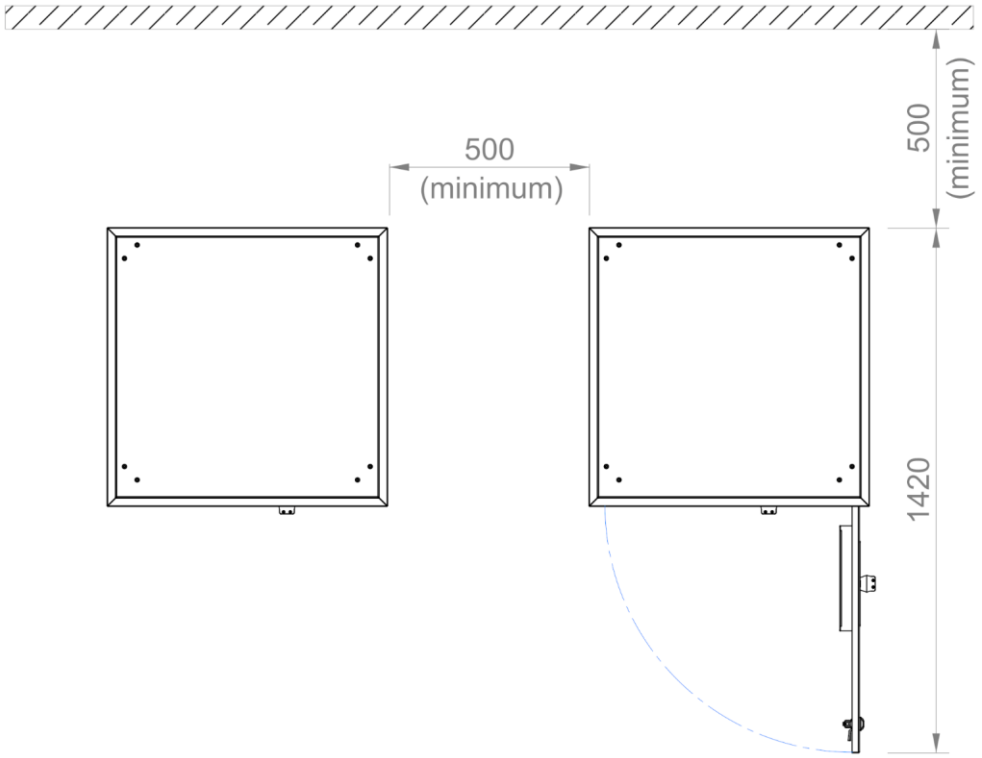


HORIZONTAL EQUIPMENT:

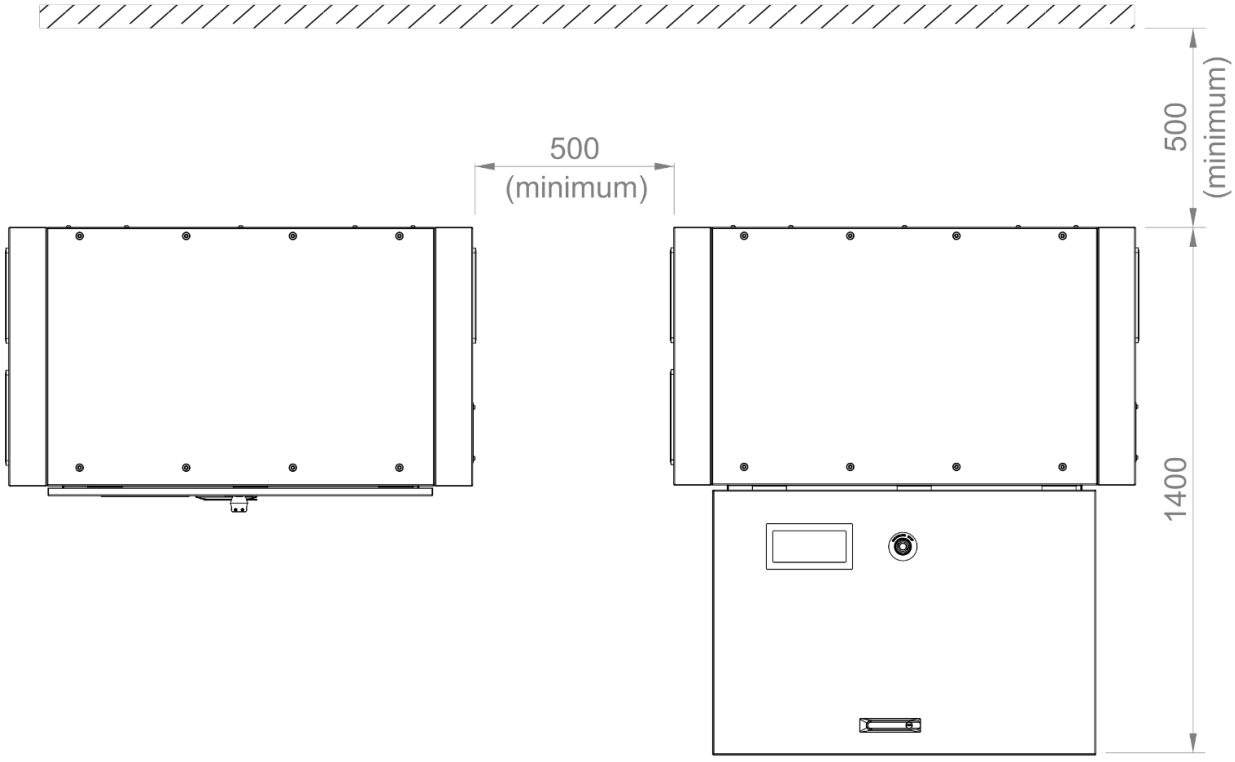


Annex V – Clearance

VERTICAL EQUIPMENT:



HORIZONTAL EQUIPMENT:



Annex VI – Intervention Log

Intervention Description (ex: Commissioning, Maintenance, Repair, Cleaning, etc)	Date	Made by

Annex VII – Equipment Wiring Diagram

Annex VIII – Equipment Test Report

Annex IX– Declaration of Conformity

See pages below.