PRODUCT GUIDE

UNINTERRUPTIBLE POWER SUPPLIES (UPS)

SLC CUBE4

7.5 - 80 kVA

General index.

1. INTRODUCTION.

These specifications describe the SALICRU Uninterruptible Power Supply System (UPS) of the **SLC CUBE4 series**. The **SLC CUBE4** series UPS devices ensure optimum protection of any critical load, maintaining the AC voltage to the loads between the specified parameters without interruption during power failure, deterioration or fluctuation of the commercial power supply. They come in a wide range of models (from 7.5 to 80 kVA), enabling end users to select the one that best suits their needs.

The design and construction of the **SLC CUBE4** series UPS has been carried out in accordance with international standards (see "NORMATIVA Y MEDIO AMBIENTE.").

Thanks to the technology used, including PWM (pulse width modulation), **SLC CUBE4** UPSs devices are compact, cool, silent and high-performance.

Consequently, this series has been designed to maximise the availability of critical loads and to ensure that your business is protected against any variations in voltage, frequency, electrical noise, cuts or dropouts that may occur in the power supply. This is the primary goal of **SLC CUBE4** series UPS devices.

1.1. MAIN FEATURES.

Main features of the **SLC CUBE4 series**:

- Built-in dual- or quad-core (depending on the model) full DSP control: rectifier and inverter with 3 levels of switching, PFC, buck-boost battery and bypass.
- Graphical user interface.
- Rectifier controlled by a floating point DSP and THDi <3% at full load, <8% at 25% load and independent of the network THDv rate.
- Input power factor IPF = 1 from 10% load.
- Perfectly balanced input currents with total outflow current imbalance.
- Compensation of the reactive current due to the inclusion of the input filter in the input current adjustment tube.
- High performance inverter controlled by a floating point DSP.
- THDv <1% in linear loads and <4% in linear loads with FC <1 in the output current.
- Short-circuitable inverter, using an inverter current control algorithm. Limitation of the RMS output, peak and IGBT saturation current.
- Compatible with all types of loads:
  - ❐ 100% capacitive.
  - ❐ 100% inductive.
  - ❐ 100% resistive.
  - ❐ Any resistive-inductive-capacitive combination.
  - ❐ Non-linear with FC of up to 3.5.
  - ❐ Motors.
  - ❐ Discharge lamps.
- Transformer-free technology.
- Configurable battery charger: from 8+8 up to 22+22 batteries, depending on the model.
- Remote communications: RS-232, RS-485, USB, Ethernet; Protocol ports: Modbus, SNMP, NIMBUS, RCCMD, UNMS II.
- Compact and accessible mechanical design.
- Power range from 7.5 to 80 kVA.

2. STANDARDS AND ENVIRONMENT.

2.1. STANDARDS.

The **SLC CUBE4** series is designed and manufactured in accordance with **EN ISO 9001** Quality Assurance Standard. The EC marking indicates conformity with EC Directives (listed in brackets) through the application of the following standards:

- **2014/35/EU** of 26 February 2014 on the standardisation of the laws of the Member States regarding the commercialisation of electrical equipment intended to be used within certain voltage limits.
- **2014/30/UE** of 26 February 2014 on the standardisation of the laws of the Member States on electromagnetic compatibility.
- **2011/65/UE** of 8 June 2011 on restrictions on the use of certain hazardous substances in electrical and electronic devices.

In accordance with the specifications of the harmonised standards and certified by an external laboratory. Reference standards:

- **EN-IEC 62040- 1**: UNINTERRUPTIBLE POWER SUPPLIES (UPS) Part 1: General and safety UPS requirements.
- **EN-IEC 60950- 1**: Information technology equipment. Safety Part 1: General requirements.
- **EN-IEC 62040- 2**: Uninterruptible power supplies (UPS). Part 2: Electromagnetic compatibility (EMC) requirements.
- **EN-IEC 62040- 3**: Uninterruptible power supplies (UPS). Part 3: Methods for performance specification and test requirements.

2.2. ENVIRONMENT.

This product has been designed to respect the environment and has been manufactured in accordance with the ISO 14001 standard.

Recycling of the device at the end of its useful life:
We undertake to use the services of authorised and regulatory-compliant companies to process all of the products when they are recovered at the end of their useful life.

Packaging:
For the recycling of the packaging there must be compliance with the legal requirements in force, in accordance with the specific regulations of the country where the device is installed.

Batteries:
Batteries pose a serious hazard to health and the environment. They must be disposed of in accordance with the laws in force.

3. PROTECTION.

The commercial power supply cannot guarantee 100% power continuity at all times. For this reason, operators must take measures to ensure the correct operation of their devices.

The consequences of these interruptions may vary:

- Equipment failure.
- Information loss (data, applications, etc.).
- Interruption of operation.
- And a long etc.

Despite the substantial improvement of the power supply in recent years, there is still an average of 300 minutes per year of poor quality supply (or lack thereof), which indicates that electrical problems are the main cause of the loss of information in Information Systems (45%), in comparison with problems like viruses (3%).

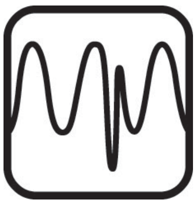
Some 93% of these problems could be avoided by using an Uninterruptible Power Supply (UPS).

In short, it represents a loss of availability and opportunity cost, which can lead to extremely high expenses.

Phenomena in the electricity grid that can result in the loss of information are listed below:

3.1. TRANSIENTS: SPIKES AND NOTCHES.

- **Spikes**: produced by the induction of atmospheric discharges (lightning) in overhead lines.
- **Notches**: produced by sudden variations of load or short circuit currents on line and transformer inductances.

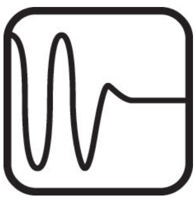


3.2. DROPOUTS.

These are deep voltage drops (below 60% of their nominal value) or total drops, with a duration of a few milliseconds (less than one cycle).

They have two different causes:

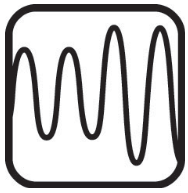
- Short circuits near the point of consumption, subsequently released by the corresponding protection.
- Supply interruptions caused by line switching.

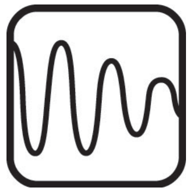


3.3. TRANSIENT OVERVOLTAGES (SURGES) AND UNDERVOLTAGES (SAGS).

Transient overvoltages are short duration voltage increases due to momentary load decreases in networks with poor regulation (high impedance).

Transient undervoltages are short duration voltage drops due to momentary overloads in the network.

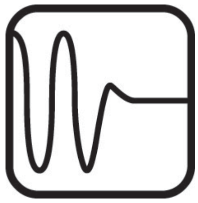




3.4. LONG DURATION OVERVOLTAGES AND UNDERVOLTAGES.

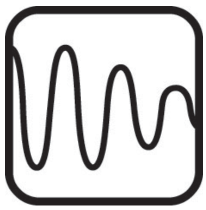
Overvoltages of long duration have the same origin as transient overvoltages, but are more permanent in nature.

Long duration undervoltages have the same origin as transient overvoltages, but are more permanent in nature.



3.5. GRADUAL AND PROLONGED UNDERVOLTAGES (BROWNOUTS).

A slow variation in voltage is considered to be that which occurs for a duration of 10 seconds or more. This occurs due to the variation of loads in electrical networks with high short circuit impedance, as well as lack of power, loss of synchronism, etc. If they exceed the static limits allowed by the devices, they can produce failures in its operation.



Many times this progressive drop usually ends with a total failure of the power supply.

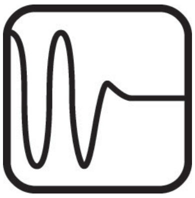
Meanwhile, a rapid change in voltage lasts less than 10 seconds. These occur due to the connection and disconnection of large loads and manoeuvres on power lines. The damage they can cause to devices depends on their amplitude and duration, since a device can withstand a greater amplitude in a shorter time and vice versa. Typical examples of these disturbances are flickers and micro cuts.

3.6. SUPPLY FAILURES (BLACKOUTS).

Long outages are mains voltage overruns (or reductions below 50% of their nominal value) lasting longer than one cycle. These are generally caused by faults or disconnections in power lines and by breakdowns in generation and transformation centres.

Obviously, this type of disturbance causes a total failure of the devices being powered; however, some small computers can withstand a short outage (approximately two cycles).

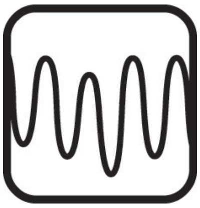
Total supply failures are generally due to the untimely activation of a distribution network protection.



3.7. FLUCTUATIONS OR FLICKERS

This consists of a modulation of the amplitude of the voltage value, which in lighting installations becomes visible to the human eye. They are usually the result of drops in pulsating voltage in power lines, caused by:

- Inertial resonances of large engines or alternators.
- Pulsating loads (pumps and piston compressors, etc.).
- Unstable regulators, arc furnaces and welding equipment.



3.8. CURRENT AND/OR VOLTAGE HARMONICS

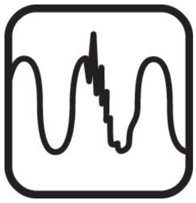
This is a deformation of the voltage waveform, due to the presence of harmonics. Its technical name is Total Harmonic Distortion (THD). It is mainly caused by the connection of machines with saturated magnetic cores, static converters (controlled and uncontrolled rectifiers, uninterruptible power supplies, switch-mode power supplies) and other non-linear loads to the power grid. Almost all critical loads such as electronic devices can withstand a maximum distortion of 5%.

Certain receivers consume non-linear loads, i.e. harmonic currents. These currents produce drops in harmonic voltage that modify the sinusoidal voltage wave produced at the source (in power plant alternators).

3.9. HIGH FREQUENCY DISTURBANCES.

These are high-frequency signals superimposed on the mains voltage. They can consist of signals of any defined frequency or broadband; stationary, burst or repetitive pulses.

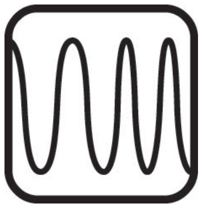
They are the result of unintended coupling of commercial networks with devices using high frequency or switching technologies. Depending on the type of coupling, they can be in common mode or differential mode.



3.10. FREQUENCY VARIATIONS.

Interconnected continental commercial networks (as are most in Europe) provide a virtually unchanging frequency that is very close to nominal. This is because it is controlled in a megasystem that includes a very large number of synchronous machines, with enormous global power and inertia that extends to infinity.

On the other hand, on many islands and other isolated areas, or in independent facilities with small power plants (or power generators), there are often significant variations in frequency. Variations are almost inevitable when there are connections or disconnections of power of comparable magnitude to the power of the whole system.



3.11. CONCLUSIONS.

A review of the different types of common disturbances in the electrical network was presented. These can cause abnormal functioning of electrical charges, even destroying them, so the user’s electrical loads must maintain a safe and quality voltage supply from the electrical network for the correct operation of the devices.

The consequences of the problems caused by the electrical disturbances in the network may result in high economic losses in industrial facilities with continuous manufacturing processes, such as: the metal, cement and chemical industries, among others; it can also cause problems in calculation, computer design and workshop calculation centres, as well as disrupt everyday life and even put human lives at risk if electronic equipment is used that controls vital signs of a patient or computers that control a nuclear plant.

4. NOMENCLATURE.

KIT SLC-80-CUBE4-LBT B1 Q 0/44AB147 T/T AWCO EE666502

EE*	Special customer specifications.
CO	Marking "Made in Spain" in UPS and packaging (for customs).
W	Private-label device.
A	Device for three-phase networks of 3x200 to 3x220 V.
T/T	Delta/delta device.
147	Last three digits of the battery code (devices with batteries for non-standard backup).
AB	Battery family abbreviation (devices with battery for non-standard backup).
44	Number of batteries in a single branch (devices with battery for non-standard backup).
0/	Device ready for backup or batteries requested.
/	Without batteries installed at the factory but with the necessary accessories to install them. The batteries are supplied separately.
Q	Group of 4 languages (English, Spanish, Catalan, Portuguese).
B1	Device with external batteries for non-standard backup.
BC	Device prepared for common battery bank (2-unit parallel systems).
–	Omit for standard backup (only for internal batteries in the cabinet of the device itself).
T	Top cable input.
B	Independent bypass line (only for devices I/I, III/III).
SB	UPS with no bypass line.
L	Input-output configuration, single-phase-single-phase.
MB	Input-output configuration, single-phase-three-phase.
NB	Input-output configuration, three-phase-single-phase.
–	Input-output configuration, three-phase-three-phase.
CUBE4	UPS Series.
80	Power in kVA.
SLC	UPS or frequency converter with batteries.
FC	Frequency converter.
KIT	Only for devices "/" since the batteries are not mounted on them and it is treated as a KIT.

KIT MOD BAT CUBE4 0/2x44AB999 100A BC AWCO EE666502

EE*	Special customer specifications.
CO	Marking "Made in Spain" in UPS and packaging (for customs).
W	Private-label device.
A	Battery module for three-phase network devices of 2x200 to 3x220 V.
BC	Last three digits of the battery code.
100A	Protection size.
999	Last three digits of the battery code.
AB	Letters of the battery family.
44	Number of batteries in a single branch.
*x	Number of parallel battery branches. Disregard for one.
0/	Battery module without batteries, but with the necessary accessories to install them.
/	Battery module without batteries installed at the factory but with a cabinet and the necessary accessories to install them. The batteries are supplied separately.
CUBE4	Battery module series.
KIT	Only for devices "/" since the batteries are not mounted on them and it is treated as a KIT.

5. VIEWS AND POWER SUPPLY TOPOLOGIES.

5.1. VIEWS OF THE UPS.

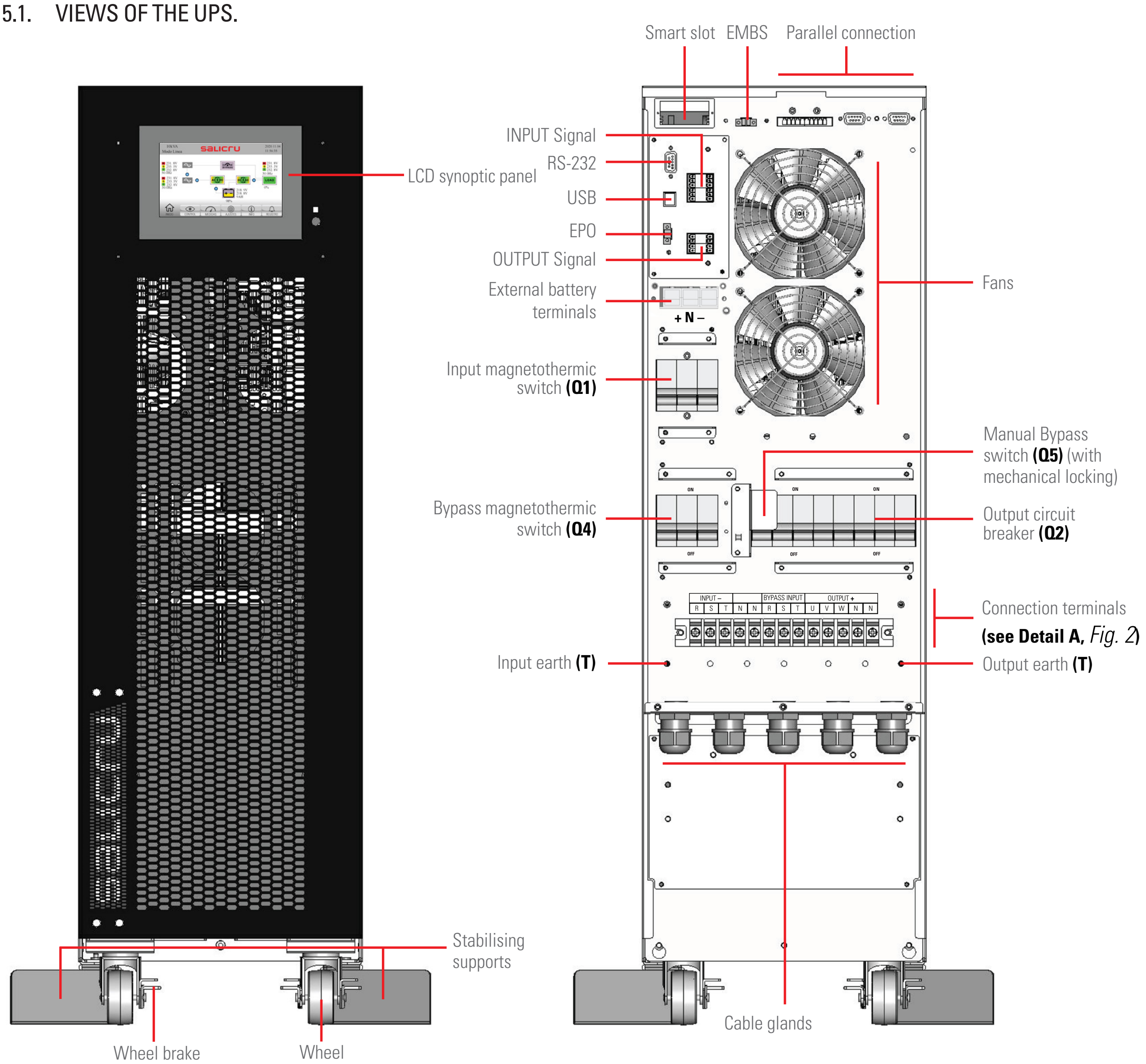


Fig. 1. Front and back views (without the terminal cover) of the cabinet for the SLC CUBE4 (7.5 to 20 kVA) series.

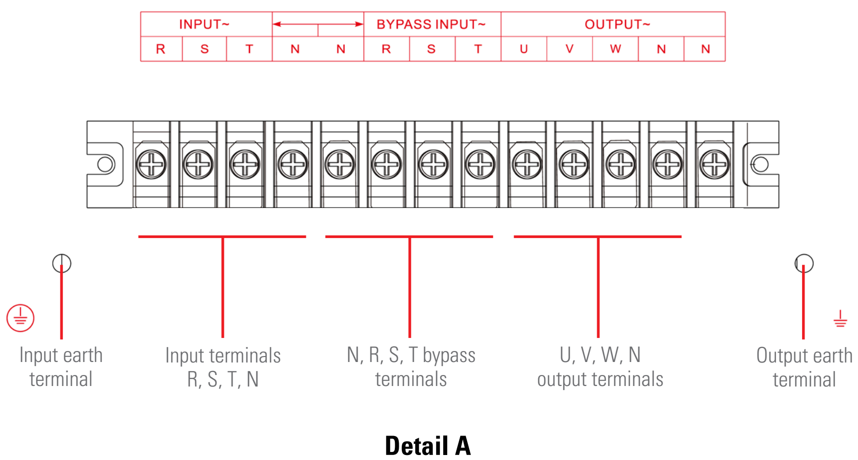
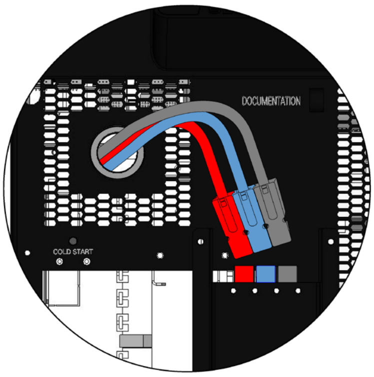


Fig. 2. Detail of the connection terminals.

On the standard device, the bypass line is internally linked to the rectifier and takes its voltage from the same input line. In this case, there is a label covering the marking on the bypass input to show that the bypass terminals are not connected/ available (see detail in *Fig. 26*). Appendix II shows the rest of the possible input/output configurations.



Detail B

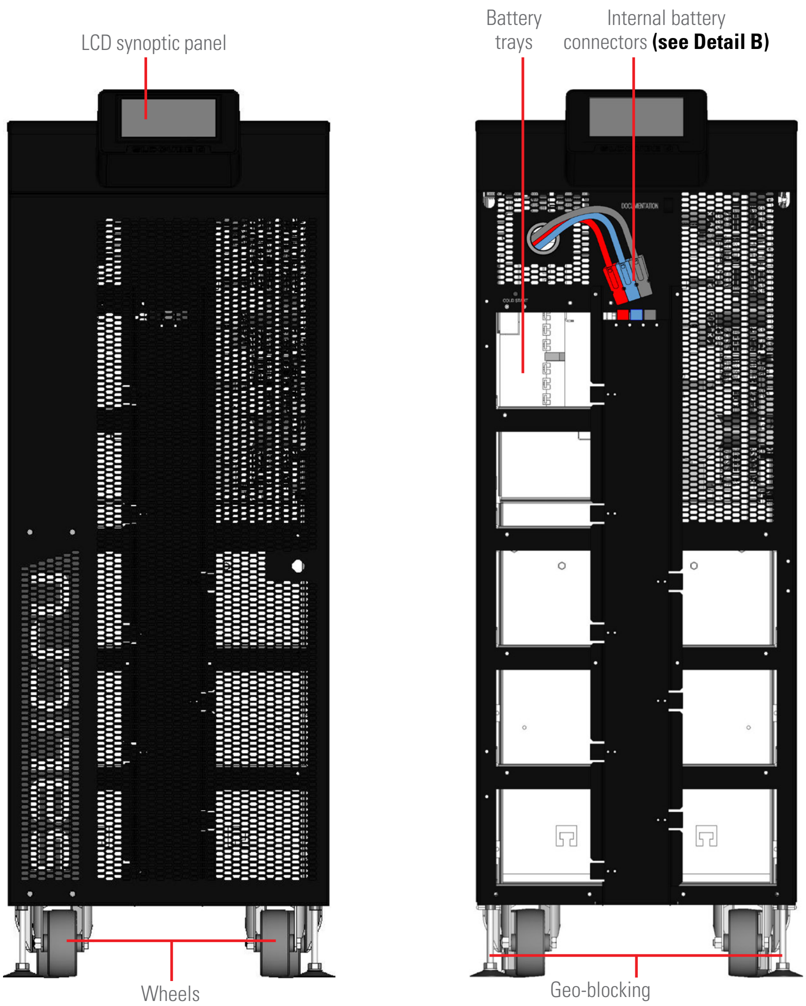
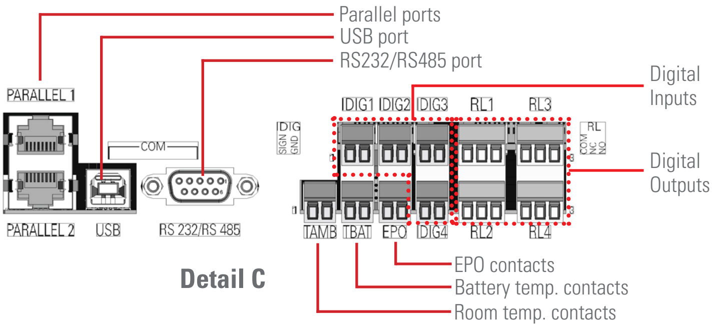
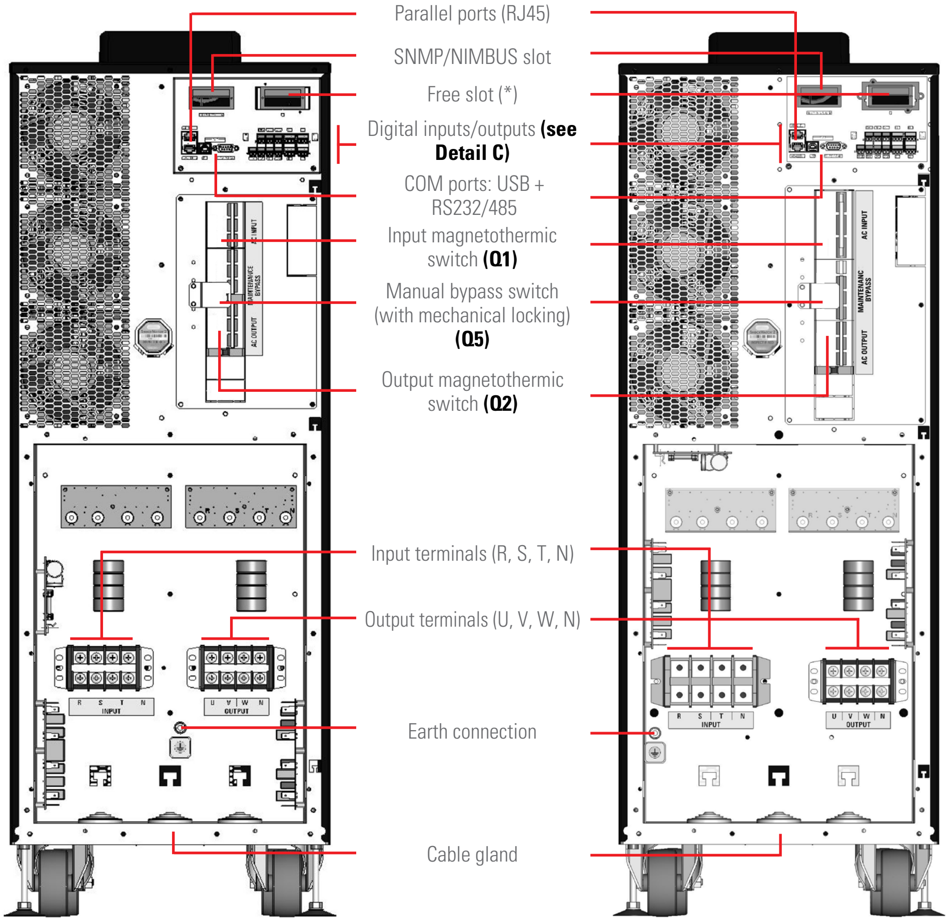


Fig. 3. Front views, with door open and closed, of the 1042 mm cabinet for standard 30 and 40 kVA devices.

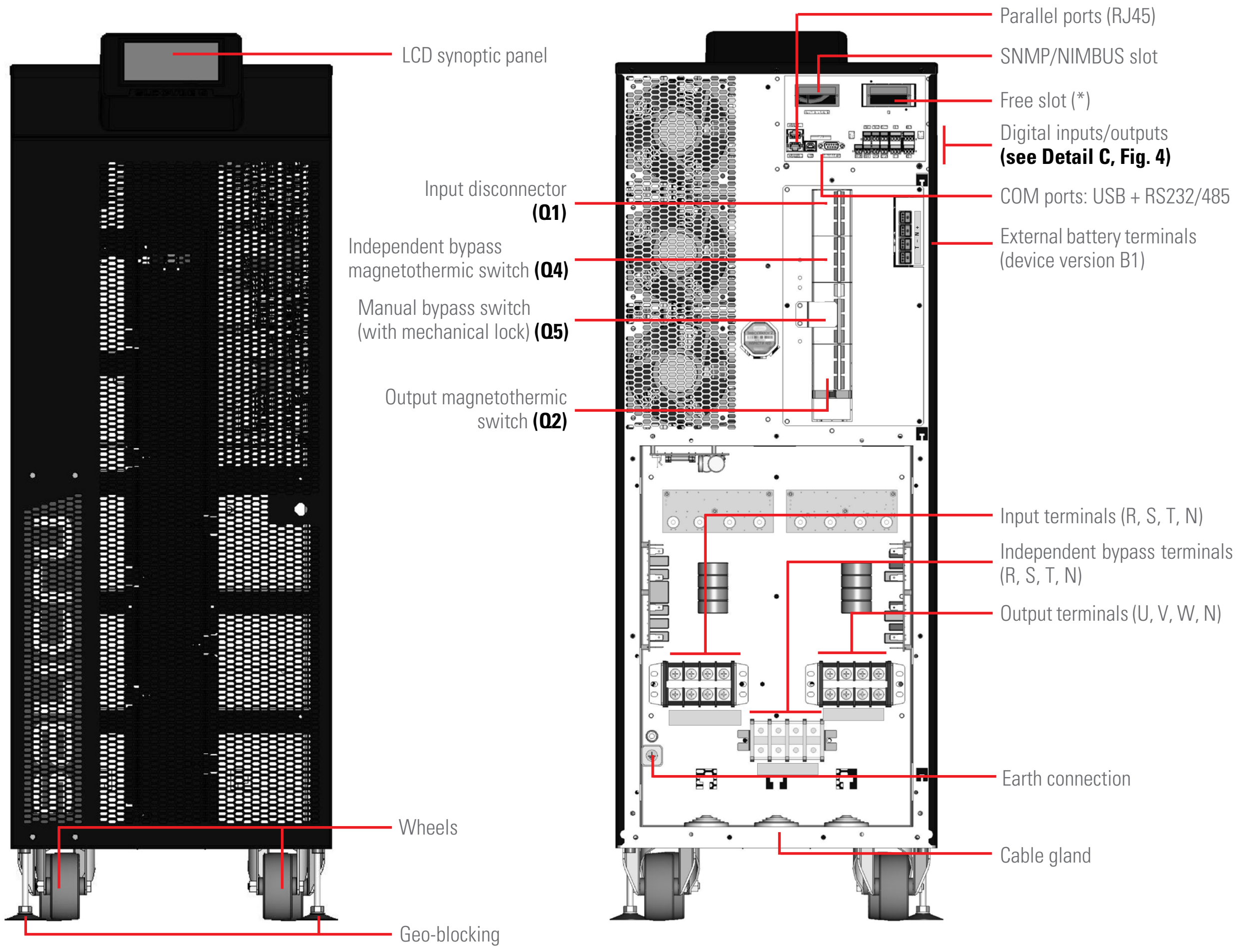


Detail C



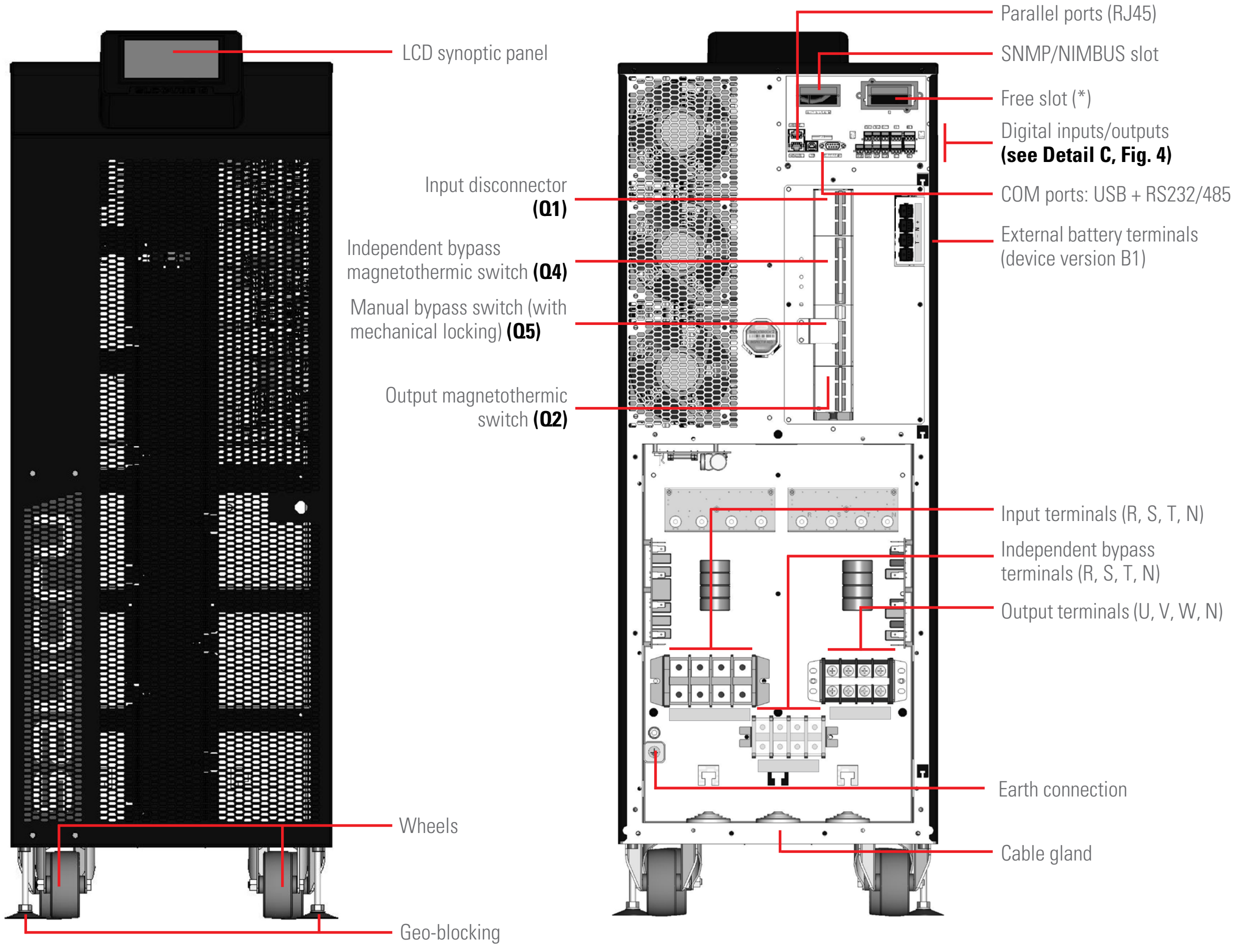
(*) Options:
- SNMP.
- RS232, RS485, USB.
- AS400 (relay extension).
- Remote battery temperature.

Fig. 4. Front and back views of the 1042 mm cabinet for 30 kVA (left) 40 kVA (right) standard devices.



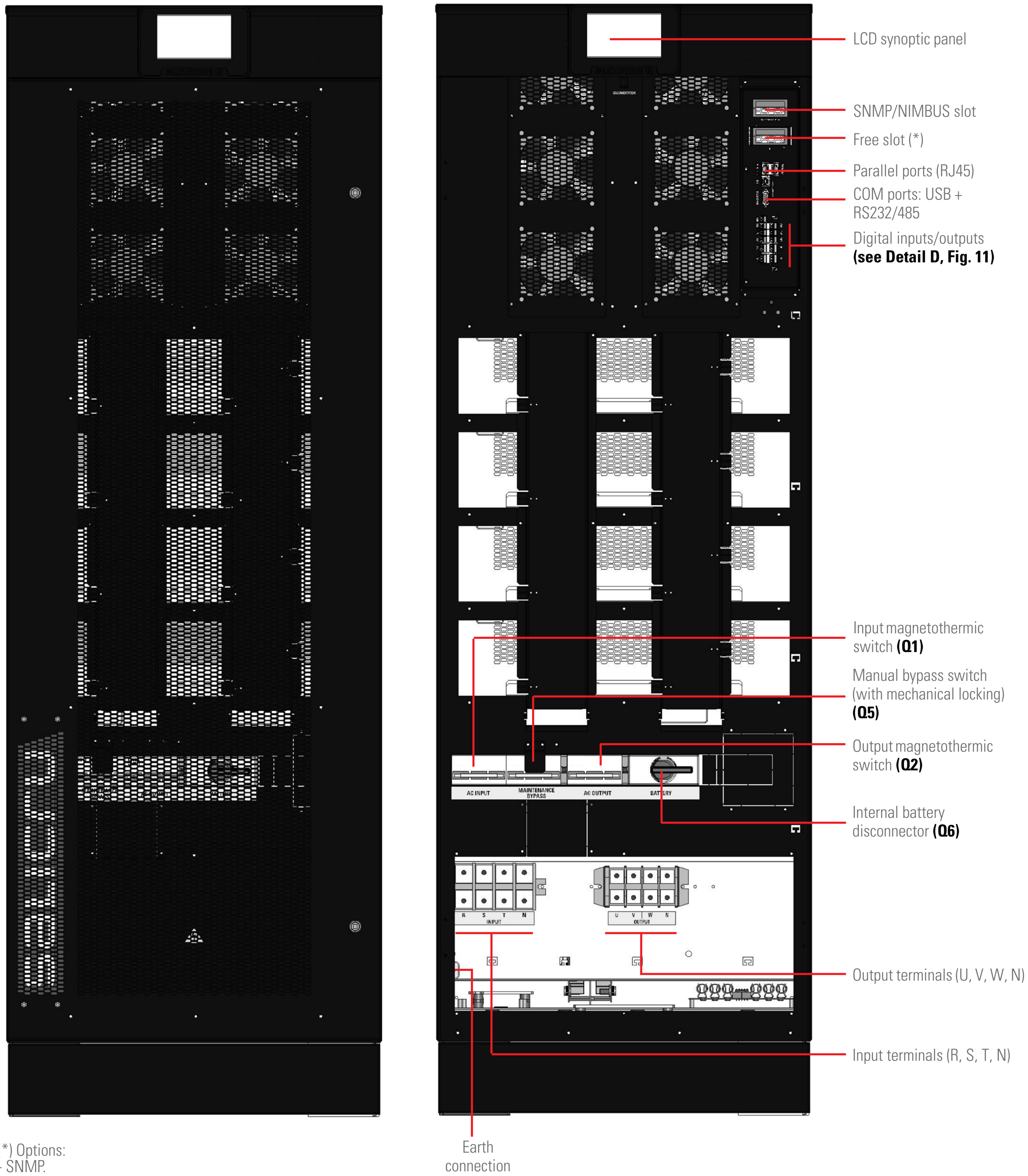
(*) Options:
- SNMP.
- RS232, RS485, USB.
- AS400 (relay extension).
- Remote battery temperature.

Fig. 5. Front and back views of the 1042 mm cabinet for 30 kVA devices with optional features.



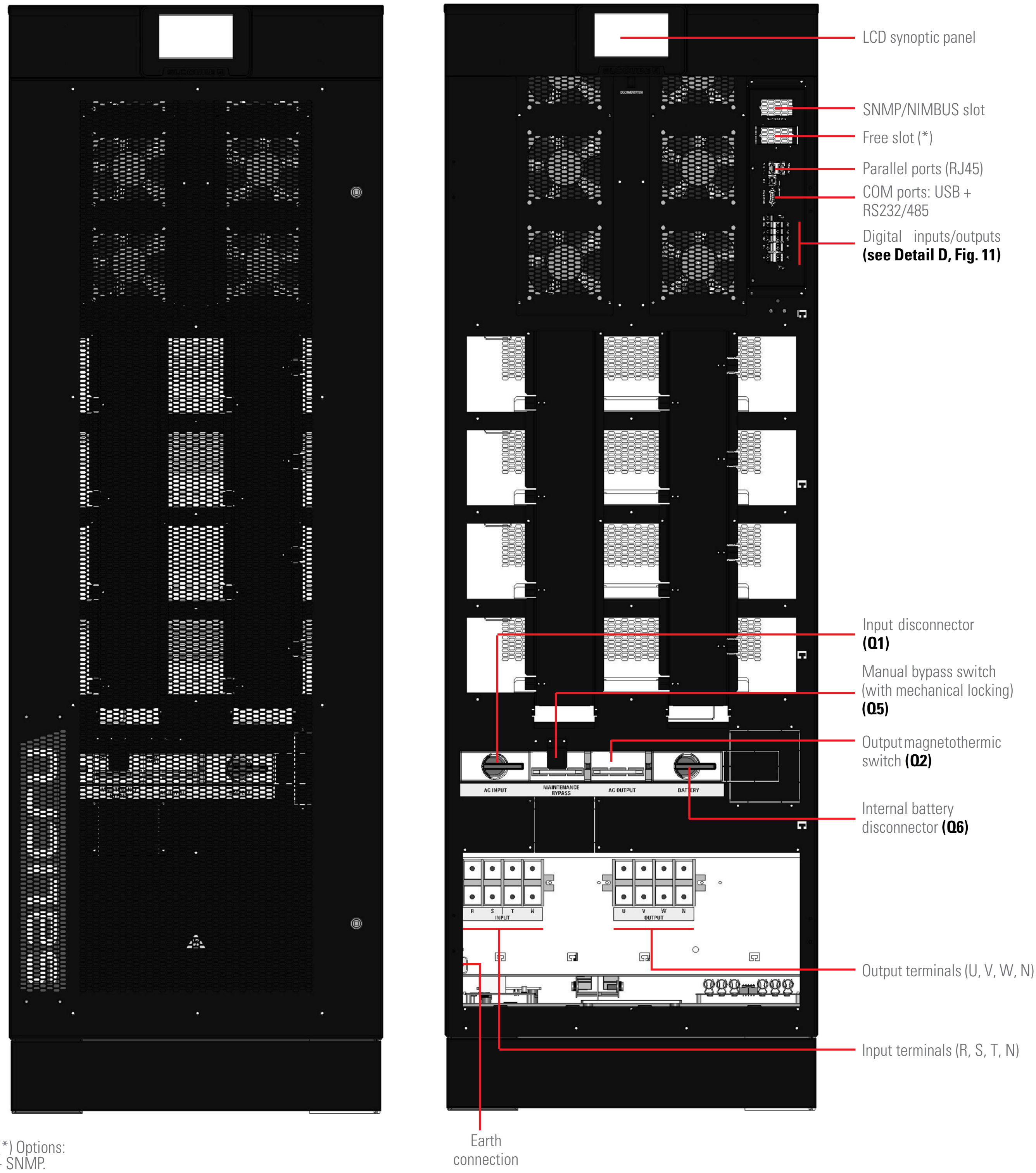
(*) Options:
- SNMP.
- RS232, RS485, USB.
- AS400 (relay extension).
- Remote battery temperature.

Fig. 6. Front and back views of the 1042 mm cabinet for 40 kVA devices with optional features.



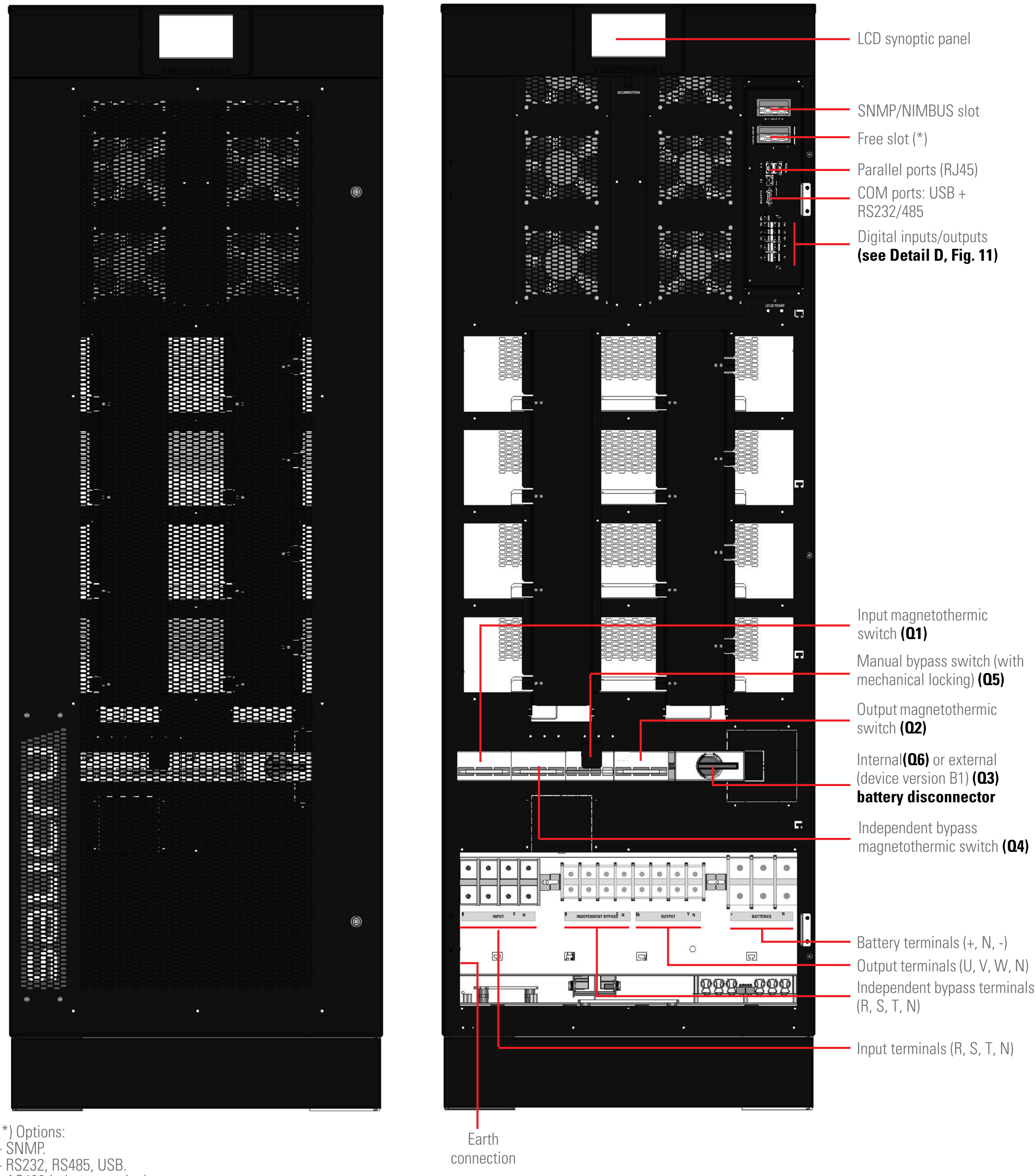
(*) Options:
- SNMP.
- RS232, RS485, USB.
- AS400 (relay extension).
- Remote battery temperature.

Fig. 7. Front view, with door open and closed, of the 1654 mm cabinet for 60 kVA standard devices.



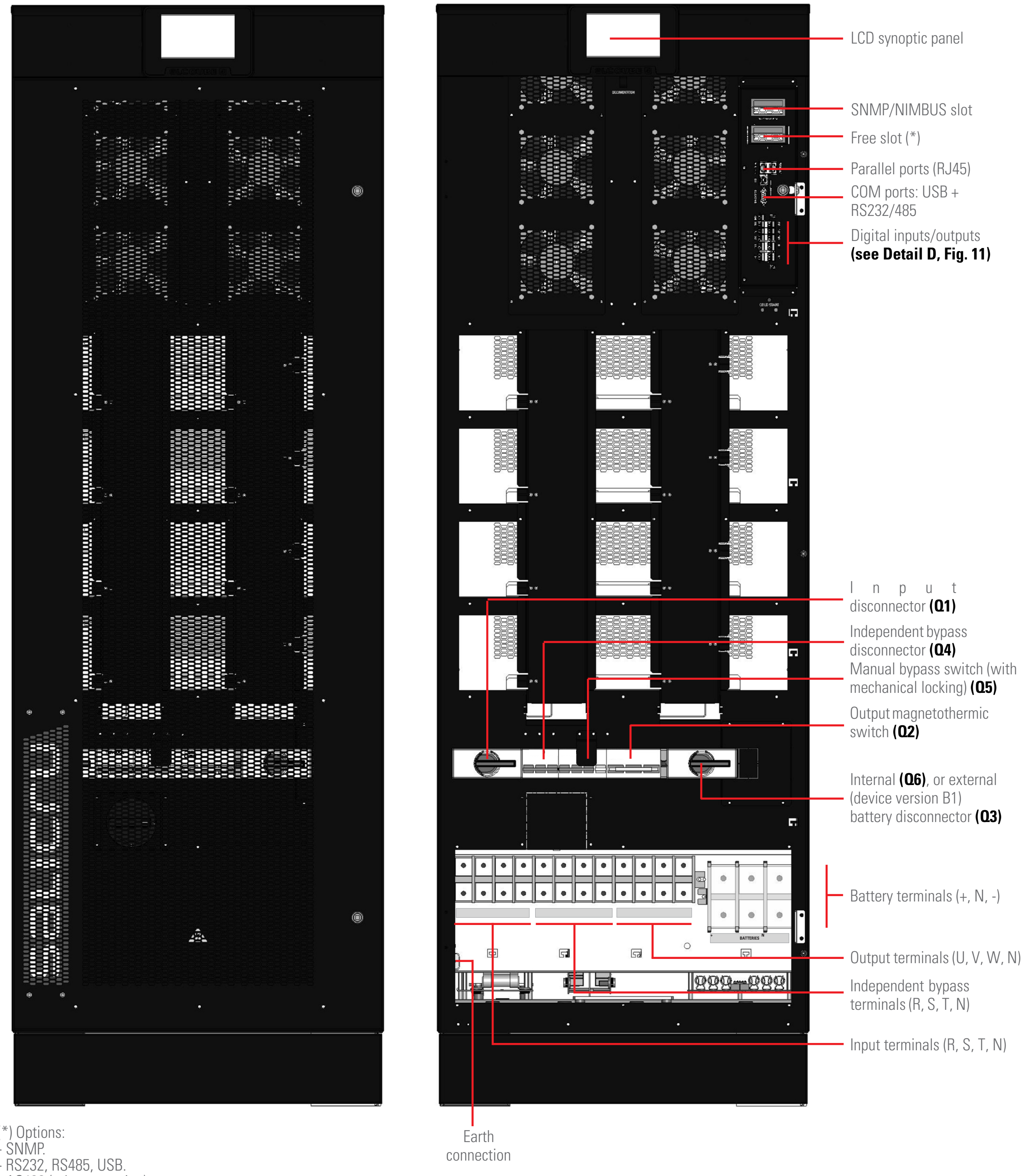
(*) Options:
- SNMP.
- RS232, RS485, USB.
- AS400 (relay extension).
- Remote battery temperature.

Fig. 8. Front view, with door open and closed, of the 1654 mm cabinet for 80 kVA standard devices.



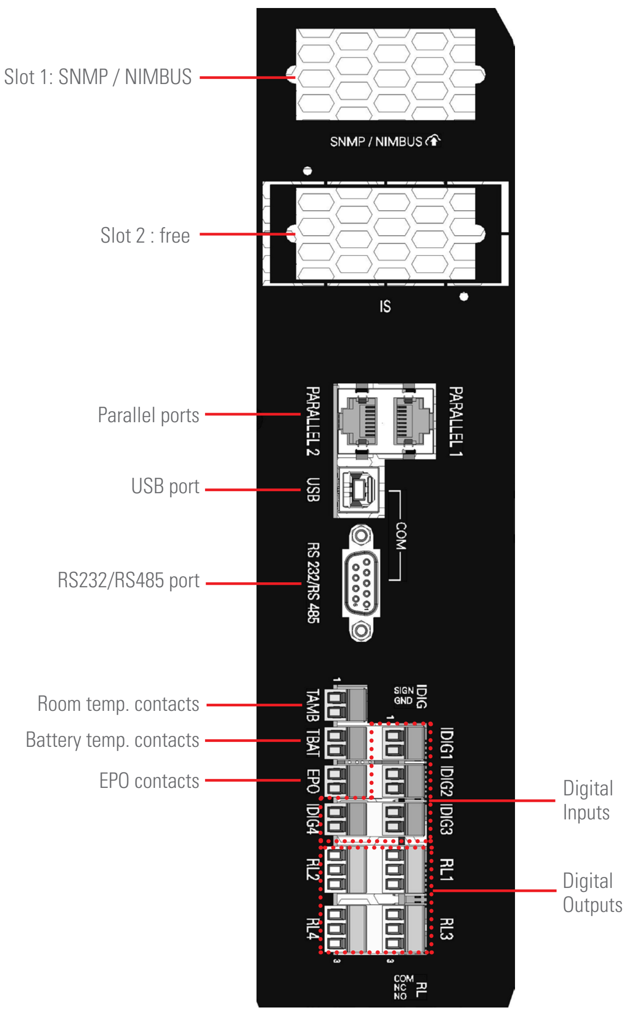
(*) Options:
- SNMP.
- RS232, RS485, USB.
- AS400 (relay extension).
- Remote battery temperature.

Fig. 9. Front view, with door open and closed, of the 1654 mm cabinet for 60 kVA devices with optional features.



(*) Options:
- SNMP.
- RS232, RS485, USB.
- AS400 (relay extension).
- Remote battery temperature.

Fig. 10. Front view, with door open and closed, of the 1654 mm cabinet for 80 kVA devices with optional features.



Detail D

Fig. 11. Details of external and communications interface.

5.2. VIEWS OF BATTERY CABINETS.

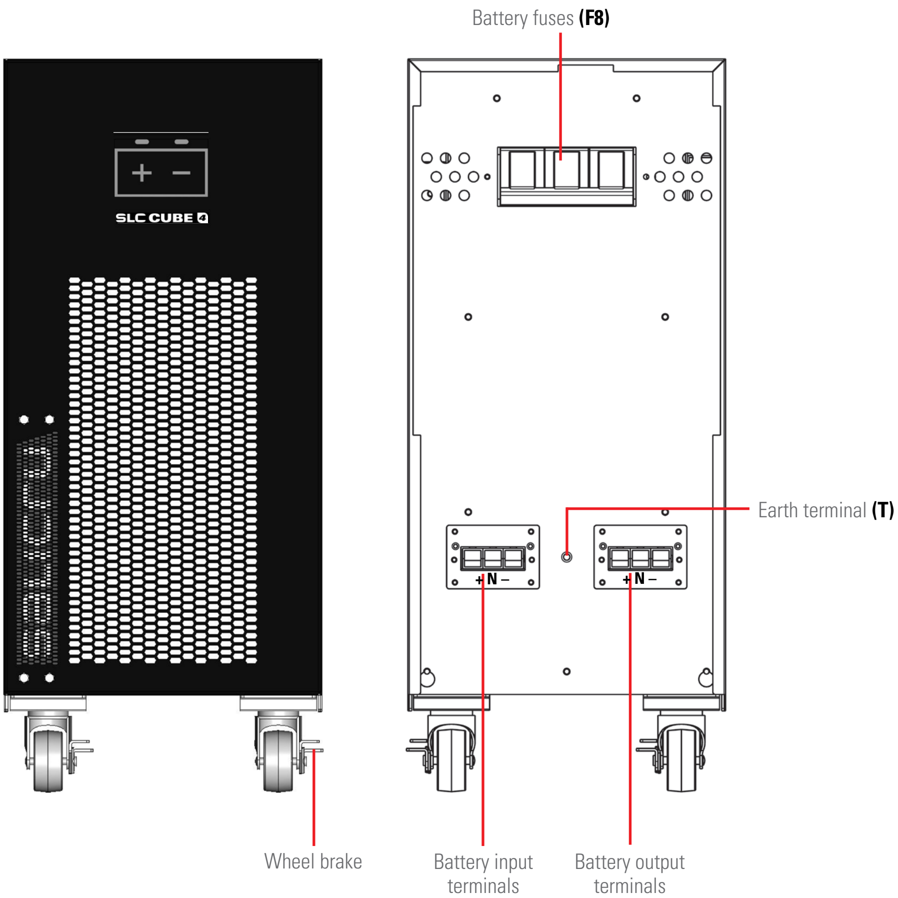


Fig. 12. Front and back views of the 576.5 mm battery cabinet.

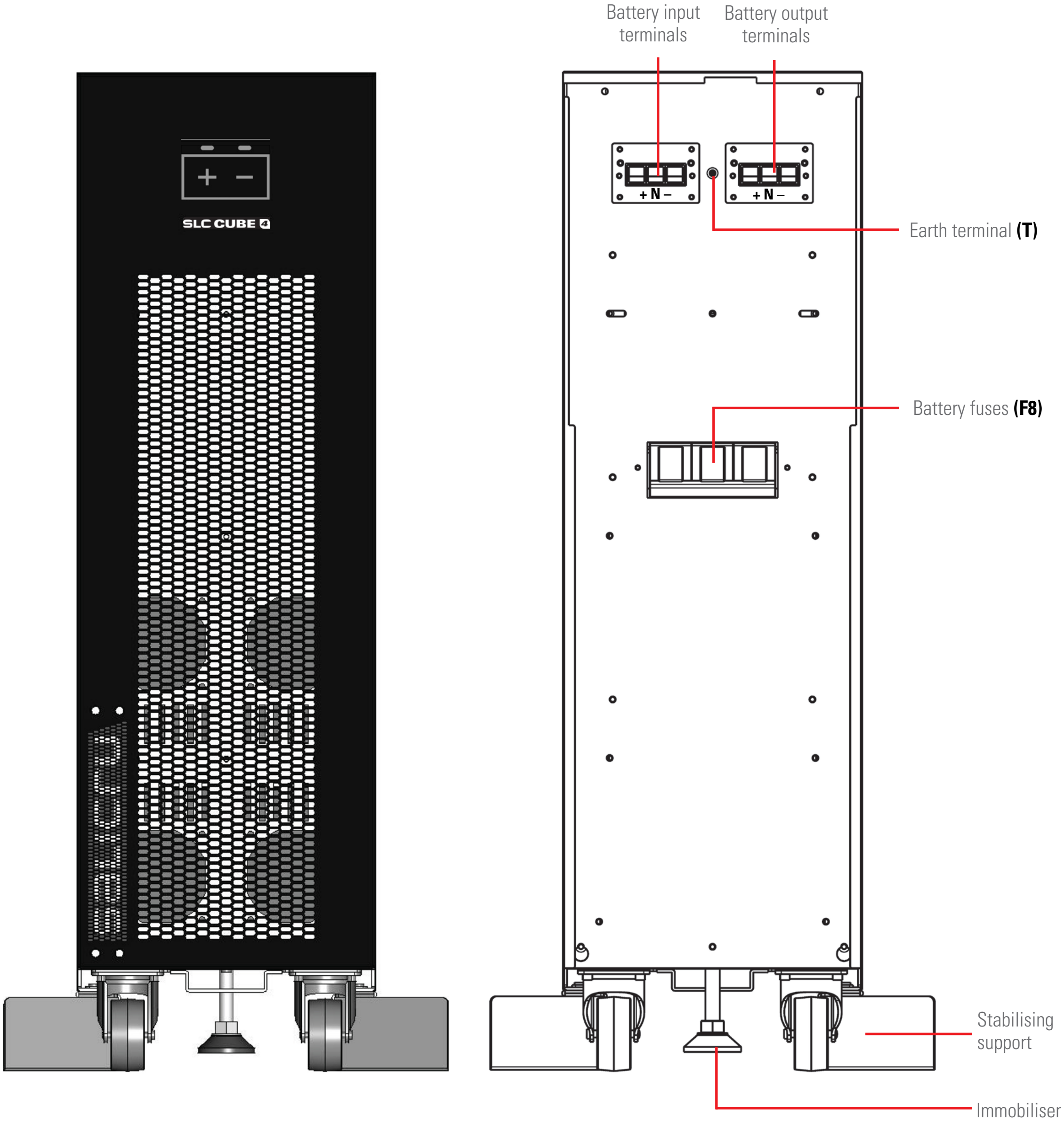


Fig. 13. Front and back views of the 836.5 mm battery cabinet.

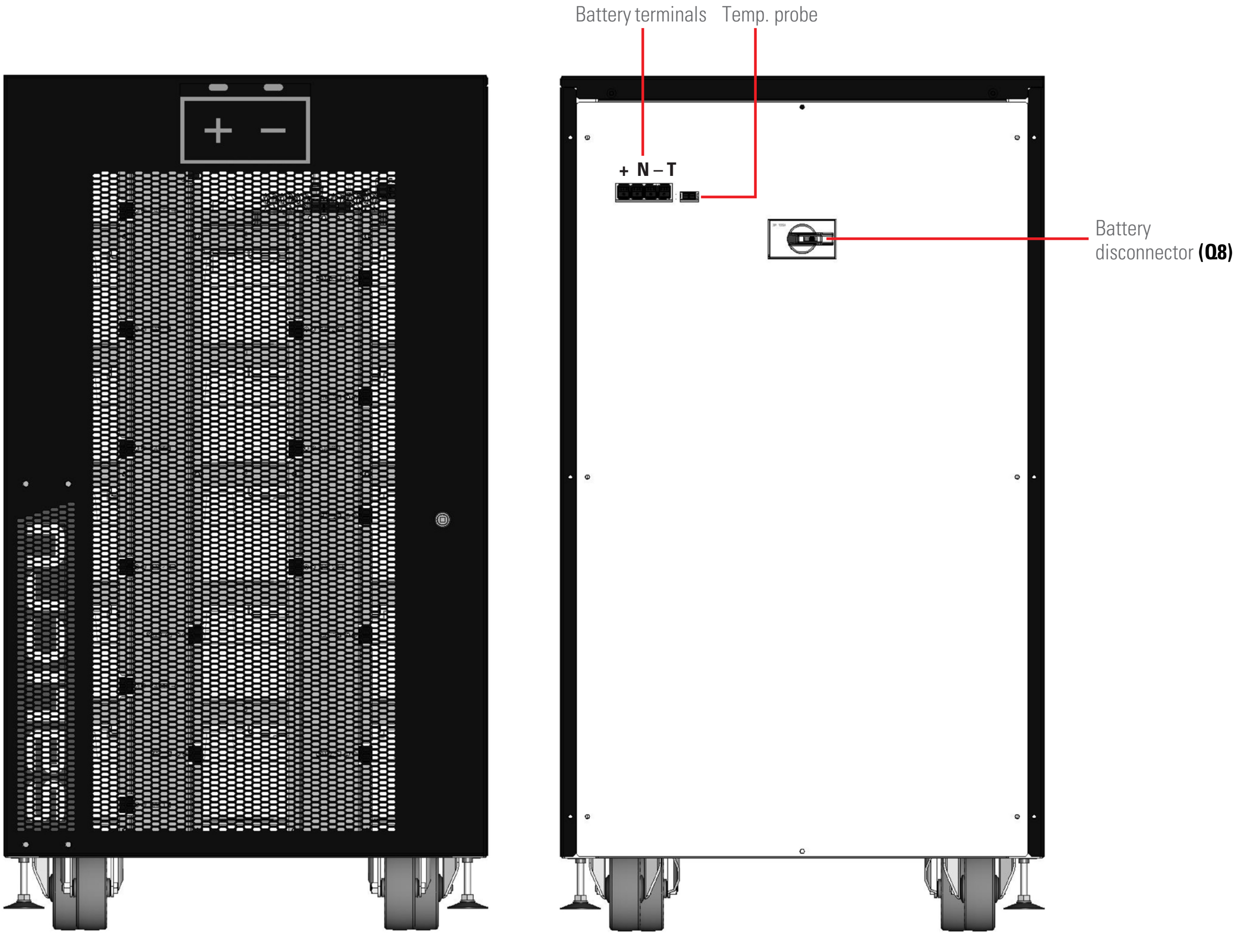


Fig. 14. Front and back views of the 1004 mm battery cabinet for 30 and 40 kVA devices.

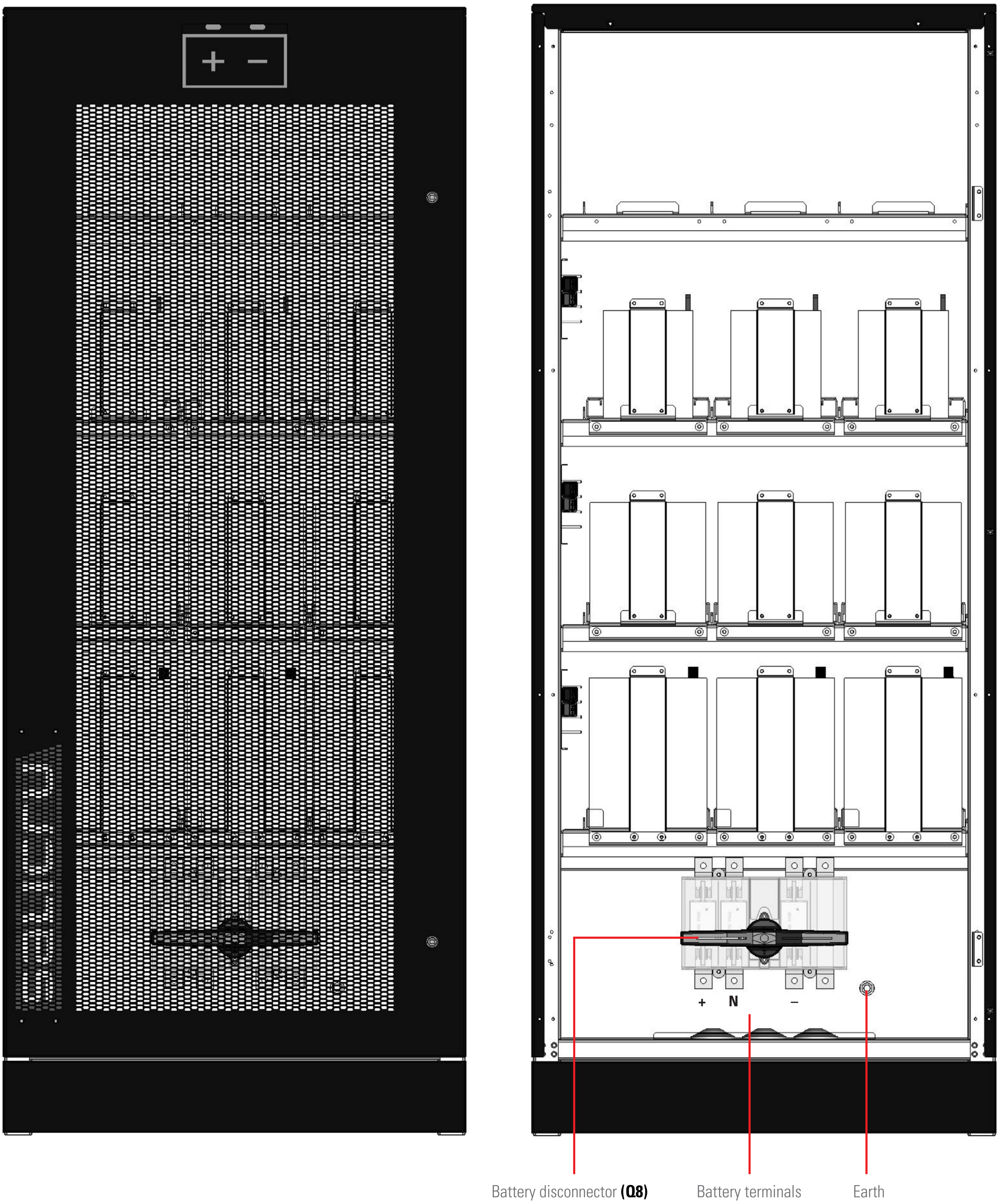


Fig. 15. Front view, with door open and closed, of the 1654 mm battery cabinet for 60 and 80 kVA devices.

5.3. VIEW OF THE CONTROL PANEL.

The device's control panel, fully integrated into a 5 "touch screen, includes monitoring, indications, control, adjustment and other functions.
The information and functions on said screen, as we will see in detail in this section, is organized into 4 basic display areas:

1. System Information.
2. Main viewing area.
3. Submenus or related functions.
4. Main Menu.

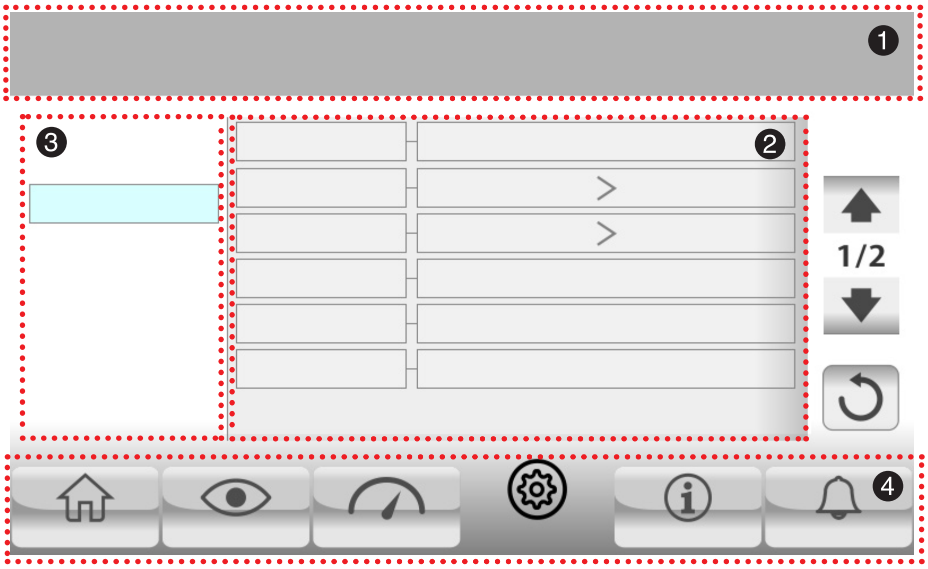


Fig. 16. Distribution of the information on the generic screen (7.5 kVA - 20 kVA).

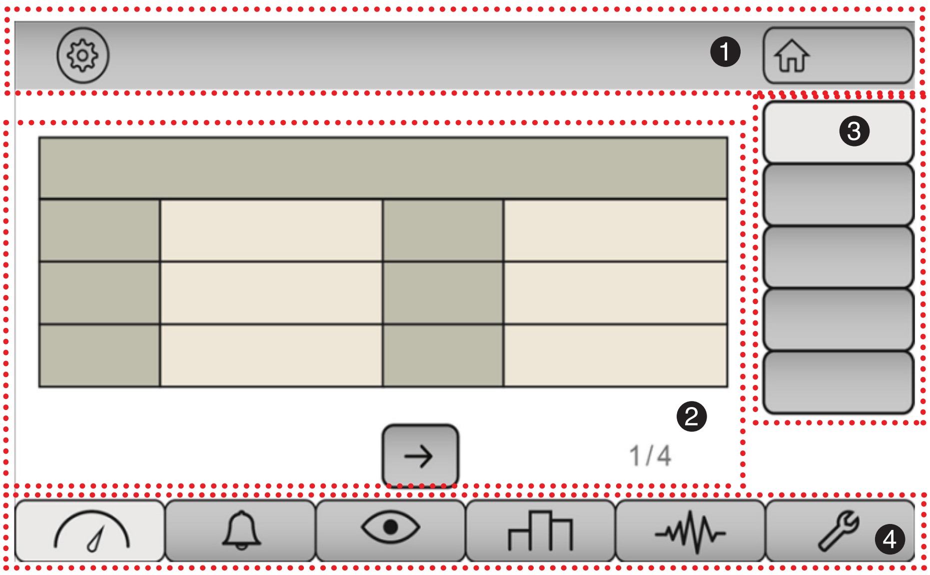


Fig. 17. Distribution of the information on the generic screen (30 kVA - 80 kVA).

5.3.1. Description of the touch panel.

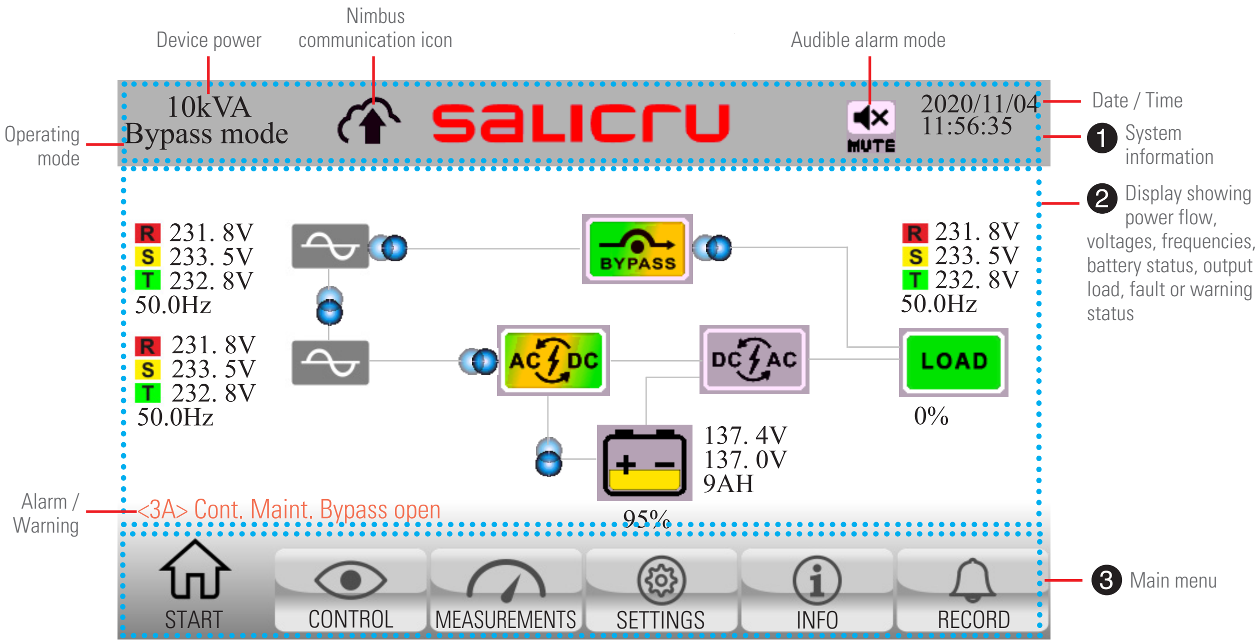


Fig. 18. Description of the control panel (7.5 kVA - 20 kVA).

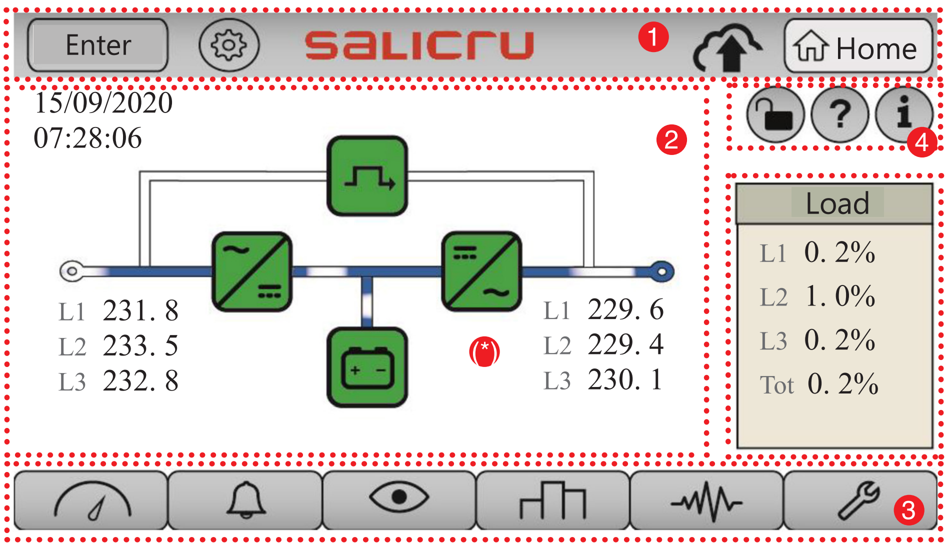


Fig. 19. Description of the control panel (30 kVA - 80 kVA).

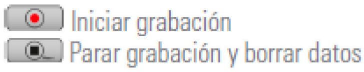
The information shown on the touch screen is divided into four sections:

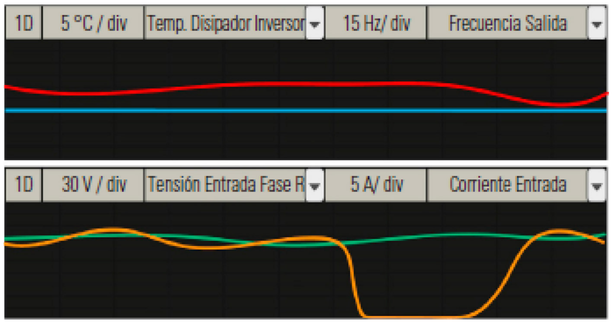
Item	Category	Description
1	Title	It indicates user category and allows access to the home screen and basic system configuration. It appears on the upper part of the screen.
2	Contents	It shows the information on the user section and allows modification according to parameters depending on each section. It appears on the central part of the screen.
3	Main Menu	It allows quick access to all device information at all times, since this menu is always visible at the bottom of the screen.
4	Side Menu	Dynamic menu that allows users to move around within each section. It is used on the home screen to show the device load. It appears on the right of the screen.
(*)	Additional information	Information only shown in systems configured for parallel operation. Although you can assign any "Id" number, it is recommended to use 1 to 4, with 4 being the maximum number of units to parallel. The assignment or modification of the "Id" address is reserved for authorized personnel with restricted access using a Password.

The Charts section has two modes for recording data (available on the 30 kVA - 80 kVA models):

1. The first mode allows you to view up to four measurements of the device temporarily, displaying the current status and previous ones.
2. The second, called the recorder, is used to define the period of time in which the user wants to record data. In both modes the user has zoom buttons on the side to enlarge or reduce the size of each division. The following measurements can be selected from content section of the screen:
   - PFC heat sink, inverter or battery temperature.
   - RMS L1, L2 and L3 input or output voltage.
   - L1, L2 and L3 input or output current.
   - Battery charge or discharge current.
   - Positive and negative voltage of the voltage of the DC battery or bus.
   - Input, output or bypass frequency.

   In recorder mode, the user has the **"Settings"** button to view the status of the chart recorder and configure the duration, as well as to start or stop recording. As long as no recording is taking place, the icon appears in the upper left corner of the oscilloscopes. The buttons in the "Settings" section perform the following operations:





6. OPERATING PRINCIPLE.

The **SLC CUBE4** series UPS is an AC/DC, DC/AC double conversion system with a sinusoidal output that provides safe protection in extreme power supply conditions (variations in voltage, frequency, electrical noises, cuts and micro-cuts, etc.). These devices are prepared to ensure the quality and continuity of the electrical supply for all types of loads to be protected.

It basically operates as follows:

- The rectifier, an IGBT three-phase bridge device, converts AC to DC voltage by absorbing a sinusoidal current (THDi <3%).
- A charger that charges the batteries at constant current/voltage.
- The batteries supply the power required by the inverter in the event of grid failure.
- The inverter deals with transforming the DC bus voltage into AC, providing a sinusoidal AC output, stabilised in voltage and frequency, suitable for supplying the loads connected to the output.
- The basic double conversion structure also has two new functional blocks, the static and manual bypass switches.

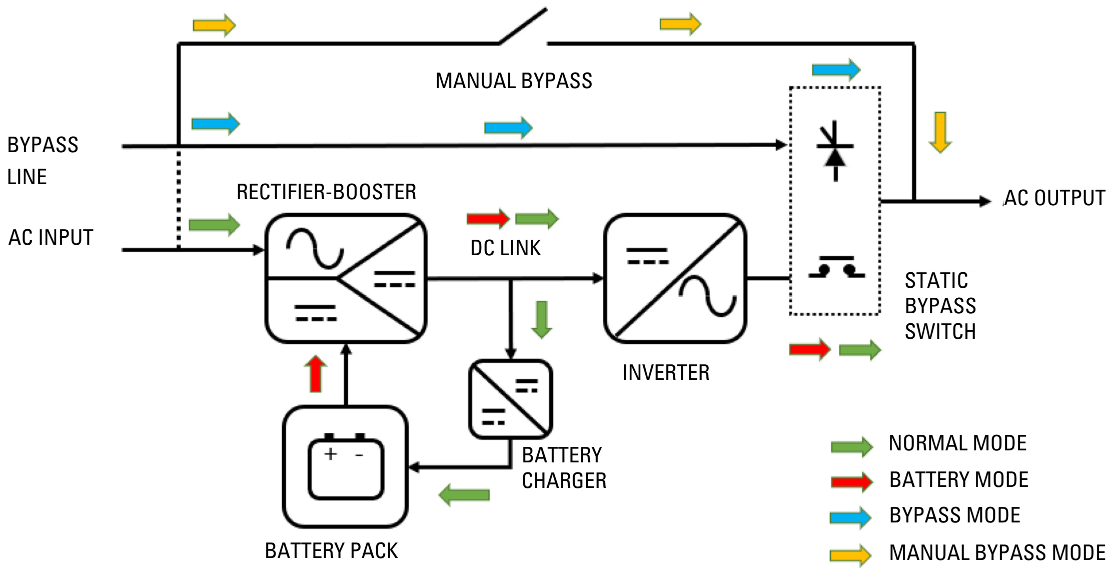


Fig. 20. SLC CUBE4 UPS block diagram with operating flows.

- The static bypass switch connects the output load directly to the bypass network in special circumstances such as overload or overtemperature and reconnects it back to the inverter when normal conditions are restored.
- The optional **SLC CUBE4-B** version has separate lines for the inverter and bypass blocks to increase the safety of the facility, since it allows the use of a second network (power generator, another company, etc.).
- The manual bypass switch isolates the UPS from the mains and the loads connected at the output, which enables maintenance operations to be carried out inside the UPS without interrupting the supply to the loads.
- The block diagrams of and show the basic structure of a standard device and another with the independent bypass line, by way of example, for a three-phase input and output configuration. For any other configuration, only the number of input, output or bypass cables and terminals will vary, never the internal structure of the device.
- In a device with an independent static bypass line, a galvanic isolation transformer must be inserted in either of the two UPS power lines (rectifier input or static bypass), to avoid the direct connection of the neutral of the two lines through the internal wiring of the device.
- This applies only when the two power lines come from two different networks, such as:
  - Two different electricity companies.
  - An electricity company and a power generator, etc.

6.1. NORMAL OPERATION (➡)

When connected to the mains, the rectifier converts the AC input voltage into DC, raising the DC voltage to a level suitable for powering the inverter and the battery charger.

The inverter deals with transforming the DC bus voltage into AC, providing a sinusoidal AC output, stabilised in voltage and frequency, suitable for supplying the loads connected to the output (Fig. 20 and Fig. 24).

6.2. OPERATION WITH MAINS FAILURE OR BATTERY MODE ( )

In the event of a mains failure or a micro-cut, the battery pack supplies the energy needed to power the inverter.

The inverter continues to operate normally without the mains power and device backup depends solely on the capacity of the battery set (Fig. 20 and Fig. 24).

When the battery backup voltage runs out, the control blocks the output as protection against deep battery discharging. When the power supply returns and after the first seconds of analysis, the UPS starts working again as indicated in the sub-chapter "Normal operation".

6.3. OPERATION WITH NON-ACTIVE INVERTER ( )

The inverter is idle due to alarms being triggered in situations of overloads, overtemperature, end of backup, etc., as well as if the UPS has been configured to work in ECO-mode. In this case, the rectifier continues to charge the batteries to keep them fully charged. The inverter also remains idle if start-up has not been performed using the control panel keypad. In this case the rectifier will be idle.

In both cases, the output voltage of the UPS is supplied by the emergency bypass line through the static bypass switch (Fig. 20 and Fig. 24), provided that the EPO is idle.

6.4. OPERATION ON MANUAL BYPASS ( )

When you want to carry out a maintenance check on the device, it can be disconnected from the mains without shutting off the system's power supply or affecting the critical load. The UPS can only be serviced by technical or maintenance personnel, using the manual bypass switch.

6.5. OPERATION WITHOUT BATTERIES.

If the device battery is disconnected for maintenance, it will be disconnected from the DC bus and the inverter using a disconnector **(Q3)**. The **SLC CUBE4** series UPS will continue to function in the same way with all its specifications and characteristics, except when the inverter has to be powered by the battery (mains failure).

7. OPERATING MODES

- Normal mode.
- Normal Mode with Transformer.
- Normal Mode with independent bypass line.
- Eco Mode.
- Frequency Converter Mode.
- Frequency Converter Mode with Isolation Transformer at the output.

7.1. REGARDING THE OPERATING MODE.

7.1.1. Normal Mode (➡)

The basic UPS consists of an IGBT rectifier with PFC, charger, inverter, bypass switch, manual bypass or maintenance, protection switches and the specified accessories.

This standard or basic structure requires having a commercial power supply with a neutral connection, where the output and input neutrals are the same. This makes it impossible to directly connect the output neutral to a socket other than that from the commercial power supply.

See in the operating flow of this mode.

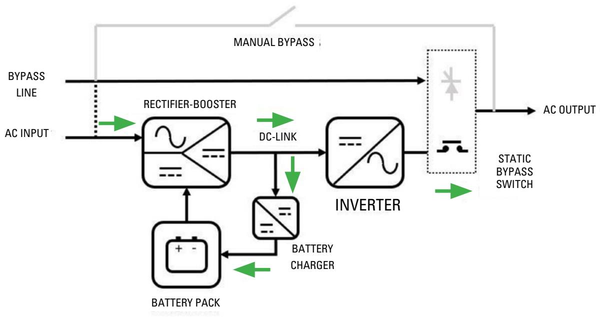


Fig. 21. Flowchart in Normal Mode.

7.1.2. Normal Mode with Transformer.

This structure is identical to that indicated in the previous point, except that it is equipped with an additional transformer with a star-delta connection at the output.

This configuration allows users:

- To create the neutral for those electrical installations where the commercial power supply does not have it.
- To galvanically isolate the output from the input power supply, which will allow the UPS output neutral to be connected to a different socket from the commercial supply.
- To cancel the 3rd harmonic of the non-linear loads supported by the UPS during static bypass operation.

7.1.3. Normal Mode with independent bypass line.

As can be seen in the , the UPS consists of an active IGBT rectifier with PFC, charger, inverter, static, manual or maintenance bypass switch, protection switches and the specified accessories.

The standard or basic structure, with an independent bypass line, requires having a commercial power supply with the same neutral for the bypass and the IGBT-based active rectifier. The rectifier and bypass line output and input neutrals are the same. This makes it impossible to directly connect the output neutral to a socket other than that from the commercial power supply.

7.1.4. Eco Mode (➡)

For loads less sensitive to fluctuations in the commercial network, these can be powered directly by the static bypass switch as long as this is within the acceptable voltage and frequency ranges. The inverter will be operating with the output disconnected, but maintaining its voltage and phase parameters the same as those of the bypass network. In this way, only the losses of the bypass itself plus those of the converters working at no load will be produced, which will allow us to achieve an efficiency of more than 98%.

In the event of a mains failure, the inverter will take over, powered by the batteries and connecting its output to the loads through the static bypass switch.

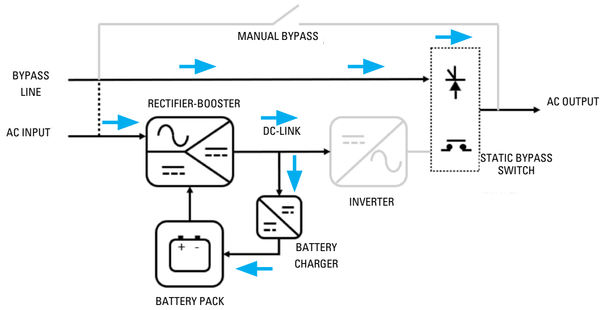


Fig. 22. Flowchart in ECO mode.

7.1.5. Frequency Converter Mode.

This operating mode will establish the output frequency at a fixed value (50 or 60 Hz) and will disable the bypass.

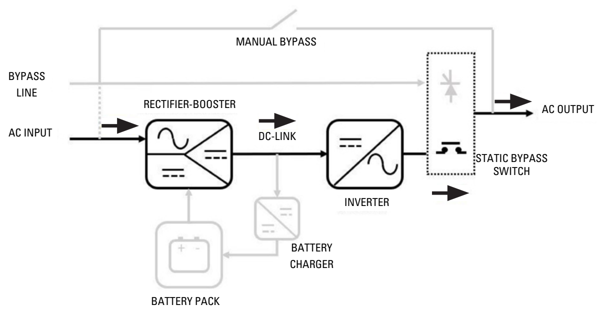


Fig. 23. Flowchart in Frequency Converter mode.

7.1.6. Frequency Converter Mode with Isolation Transformer at the output.

When you want to combine the configurations described in points and , the devices allow you to make a compensatory adjustment using the parameter shown on the "Compens. Transfor." screen. This makes it possible to mitigate the voltage drop resulting from the use of the isolation transformer at the output. By setting this parameter to a value above 0.0%, the frequency converter will always have a ramp start. If you not want this ramping to affect the loads, there is an optional contactor at the output that will delay the device connection for a period of 5 seconds, thereby preventing the ramping from being transferred downstream.

Additionally, when a transformer is connected to the output with a ratio other than 1:1, the frequency converter allows you to adjust the output voltage shown on the display to that of the transformer's secondary winding, thereby making it possible to view the output voltage of the entire set-up. This adjustment must only be made by a specialist technician.

8. DESCRIPTION OF THE UPS/COMPONENTS.

8.1. GENERAL DESCRIPTION AND BLOCK DIAGRAM.

The **SLC CUBE4** device is a double-conversion "on-line" Uninterruptible Power Supply (UPS) system. The classification regarding its performance is in accordance with the international standard for UPS devices (IEC 62040-3), corresponding to "VFI-SS-111" [(1)].

The UPS achieves the maximum benefits of efficiency, reliability, availability and adaptability to the needs of each facility, due to its advanced design:

- Control system based on a quad-core floating point DSP (Digital Signal Processor) for devices of 30 kVA and above.
- Dual-core control for devices of up to 20 kVA.
- Rectifier and Inverter with 3 switching levels.
- "State of the art" in electronic switching devices.
- Compact mechanical design and optimised for maintenance.
- Advanced control techniques to achieve the best power supply.
- "Unlimited" parallel system, non-critical communications.

The main parts of this device are:

- EMI Input and Output filters.
- Active rectifier with power factor correction (PFC) and low harmonic absorption (THD-i) for the input current. It also serves as a battery booster.
- Three-level inverter, and low voltage harmonic distortion.
- Batteries (they can be outside the device), and charger.
- Static bypass.
- Manual or maintenance bypass.
- Control Panel.
- External signal and communications interface.

8.2. EPO TERMINALS.

The UPS has two terminals for the installation of an external emergency power off (EPO) button. EMI Input and Output filters.

8.3. CONTROL PANEL.

The **SLC CUBE4** series UPS has a sophisticated control panel, fully integrated into a 5 "touch screen, including monitoring, indications, control, adjustment and other functions.

8.4. CONTROL SOFTWARE.

8.4.1. Low level control password.

1. **AFC (Adaptive Feedforward Cancellation) Control** It consists of the use of digital parallel resonators located at those frequencies where instructions to follow or disturbances to be rejected are expected.

   This control technique allows users to monitor the sinusoidal reference signals of the output voltage in the inverter and the input current in the active rectifier.

   It is important to note that the different UPS controls do not operate either in isolation or locally, but rather interact with each other to achieve a global coupled controller. This results in operating advantages such as immediate adaptation of the rectifier to load conditions.

   The low level control software works at several different levels.

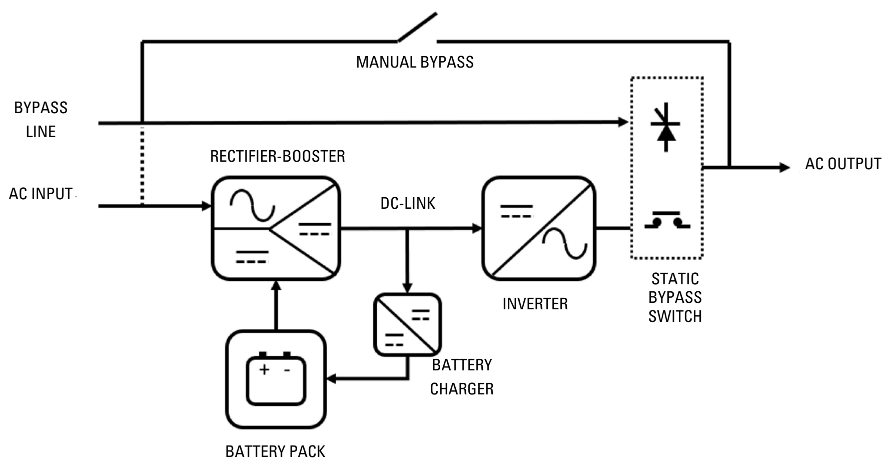


Fig. 24. Block diagram of the SLC CUBE4 UPS.

[1)]Note:
"VFI" ("Voltage Frequency Independent"), indicates that the UPS output and input voltage and frequencies are independent.
"SS" (Sinusoidal-Sinusoidal): sinusoidal output voltage both in normal and in battery mode.
"111" (dynamic response classification "1", see. IEC 62040-3): both in operating mode changes, linear load jumps, and non-linear load jumps, the dynamic response is the best possible (response speed, voltage drop) within the classification specified by the standard in question.

2. **Input three-phase boost-rectifier controller**: PFC control loops. The independent phase cascade control structure adopted. Furthermore, the AFC control technique was implemented to ensure that the network currents are sinusoidal, with a THDi <3%, and are in phase with the voltages, and with the active power balance of the entire system, accelerating its response and desensitising it to load transients.

   In normal operating mode, the rectifier is powered by the AC input voltage, and maintains the DC Bus voltage that supplies power to the inverter and the battery charger. That is, it operates as an AC/DC rectifier.

   When the AC input voltage or frequency of the rectifier is outside the correct operating ranges, it switches its power source from the AC supply to the batteries, so that the rectifier-booster starts to operate in DC/DC conversion (as a booster), maintaining the DC bus for the inverter. This operation can be maintained until the battery voltage drops to the end of backup level, or until the AC input returns to its correct operating ranges and to AC/DC conversion.

3. **Output 3-phase inverter controller**: independent per phase, easily adapts to different configurations, whether single-phase or three-phase.

   It should be noted that the use of the AFC control technique allows users to obtain an output voltage with a THDv lower than 3%, with a non-linear output load and a good dynamic response to sudden load changes.

4. **Battery charger controller**: the battery charger circuit is also digitally controlled with control software included in a device control board DSP. In normal mode, the battery charger control will charge the batteries, first at constant current, and when the battery float voltage is reached, at constant voltage. Battery floating voltage compensation according to temperature.

5. **Bypass thyristor switching algorithm**: in order to minimise the transfer time from the output to the static bypass line, in the event of a fault or alarm in the inverter.

6. **Parallel control**: non-critical communications for parallel inverters, which gives the system robustness in the event of communications failure, as it allows the device to continue working even in the event of a power failure.

8.5. COMMUNICATIONS.

8.5.1. Parallel bus connection.

To preserve the quality, it must be installed separately from other lines carrying dangerous voltages (power distribution line).

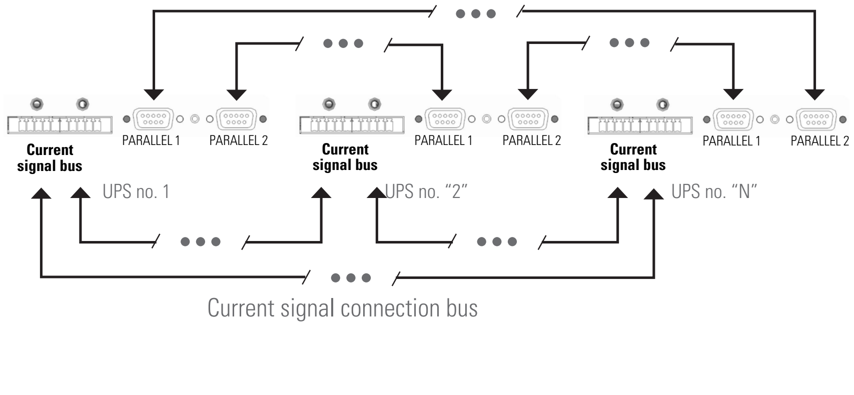


Fig. 25. Current signal and communication bus connection. Devices from 7.5 kVA to 20 kVA.

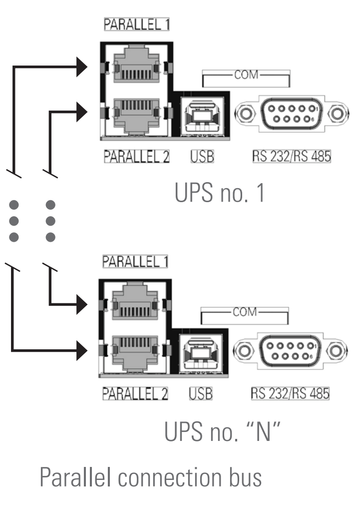


Fig. 26. RJ45 connectors on the parallel communication bus. Devices from 30 kVA to 80 kVA.

Parallel connection bus. Use the parallel cables supplied to link up to 16 **SLC CUBE4** devices. It is imperative to close the bus loop in parallel.

Beyond the communication bus, it is necessary to provide the installation with a parallel system, a board provided with the individual input and output protections and a manual bypass with mechanical locking.

8.5.2. Digital inputs, dry contacts and communications.

The **SLC CUBE4** series UPS devices incorporate the following connections for communication with external peripherals or with other identical equipment:

- Eight digital inputs for devices up to 20 kVA (see Table 2) and 4 digital inputs for devices from 30 to 80 kVA (see Table 3) via the terminal block.
- Six outputs for devices from 7.5 to 20 kVA (see Table 2) and 4 outputs for devices from 30 to 80 kVA (see Table 3) with relay interface via the terminal block.
- Communication via RS232/RS485* ports (subD9) or USB.

  * Only for 30 kVA to 80 kVA devices.

- 2 ports for parallel communication.
- On devices above 30 kVA there are two slots: (slot 1) for adding an SNMP/NIMBUS card; and (slot 2) free, in order to accommodate different connectivity options. On 7.5 kVA to 20 kVA devices there is a single free slot with various accessory options.
- AS400 (relay extension). Optional, depending on the model.

All connectors related with communications are grouped together on the interface panel and can be accessed from the bypass module after removing the cover, which covers them completely.

The communication interface has the following connections via terminal block:

- Temperature sensors input.
- TBAT: Sensor for the compensation of the floating voltage of batteries. Parameter shown on the control panel display. Included in models above 20 kVA.
- TAMB: Sensor for measuring room temperature. Parameter shown on the control panel display. Included in models above 20 kVA.
- Signal input for the external EPO button.
- Multiple programmable digital inputs (see Table 1 and Table 2).
- Multiple programmable relay outputs (see Table 1 and Table 2).
- EMBS, built-in signal input for an external bypass contactor. Included in models up to 20 kVA.

Digital Inputs (voltage-free contacts)	
Pin	**Description**
1	UPS remote start-up.
2	UPS remote shutdown.
3	Shutdown-Restore: UPS shuts down and restarts in 1 min.
4	UPS powered by generator (generator function active).
5	External output switch auxiliary contact. When the output switch on the external control board is opened, warning no. 45 ("External output switch open") is activated and the device is disconnected from the parallel system.
6	External battery switch auxiliary contact. When the battery switch on the external control board is opened, warning no. 46 ("External battery switch open") is activated.
7	Signal provided for an auxiliary contact of the external bypass line switch. When the bypass switch on the external control board is opened, warning no. 47 ("External bypass switch open") is activated.
8	External input line switch auxiliary contact. When the input line switch on the external control board is opened, warning no. 48 ("External input switch open") is activated.
Relay outputs (Voltage-free contacts)	
Pin	**Description**
1	Device in Line or Normal Mode.
2	Device in Bypass Mode.
3	Device in Battery Mode.
4	Battery low. Alarm for end of battery backup (anticipated activation).
5	Any warning relating to the device. The UPS continues to operate in Normal Mode.
6	Sum of various alarms (Bypass Mode / Battery Mode / battery disconnected / loss of Bypass / fault / warning / line failure).

Table 1. Programming the digital inputs and relay outputs. Devices from 7.5 kVA to 20 kVA.

Digital Inputs (voltage-free contacts)		
IDIG1	Power generator.	Other programmable functions (for consultation).
IDIG2	Shut-down	
IDIG3	Maintenance bypass	
IDIG4	Output magnetothermic switch	
Relay outputs (Voltage-free contacts)		
RL1	Device in bypass mode	Each relay can be programmed to respond to the status of an alarm/warning or a combination of these.
RL2	Mains failure, battery discharging	
RL3	Battery low	
RL4	General alarm	

Table 2. Programming the digital inputs and relay outputs. Devices from 30 kVA to 80 kVA.

All of the connections mentioned can be seen in Details B and C of the Fig. 4 and Fig. 11, respectively.

8.6. ETHERNET/SNMP ADAPTERS: INTEGRATION IN IP NETWORK.

For full integration of the UPS in the IT network, it is better not to depend exclusively on a computer, so the Ethernet/SNMP (Nimbus) adapter allows the UPS to be totally independent without the need for any associated PC or server.

Enables the UPS to be integrated into the IT network.

Fig. 27. SNMP Nimbus Card adapters.

8.7. OTHER UPS ELEMENTS.

- Software:
  - ❒ Up to 6 languages available: English, Spanish, French, German, Portuguese and Catalan.
  - ❒ Battery test (no risk for the load, maintaining double conversion), and prediction of backup time.
  - ❒ Battery floating control according to temperature.
  - ❒ Record of alarm history.
  - ❒ Parameters for advanced or special configurations.
- Regarding physical elements ("hardware"):
  - ❒ Ultra-fast fuses for the protection of UPS inverters and power elements.
  - ❒ Terminals for auxiliary contacts of switches external to the device (output switch, maintenance bypass switch).
  - ❒ Built-in neutral disconnector, to facilitate maintenance tasks when the Manual Bypass is activated.
  - ❒ Temperature sensors for: batteries, PFC, inverter and bypass (from 7.5 kVA to 20 kVA models).
  - ❒ Temperature sensors for: batteries, environment, rectifier and inverter (from 30 kVA to 80 kVA models).
  - ❒ Devices (and management) for attenuation of the ripple current on the batteries.

9. CASING.

9.1. MATERIALS.

All materials in the **SLC CUBE4** series are the current high quality materials in production and have not been used previously, except as required during the verification of the device. All device components are solid-state.

9.2. CABINET.

The active rectifier unit, batteries, inverter, static bypass, maintenance bypass, control panel, etc., are located inside a compartmentalised cabinet, made of 1.5 and 2 mm-thick zinc-plated iron sheeting (depending on the model) for the structure, while the enclosures and access doors are made of 1 mm-thick galvanised sheeting.

Models up to 40 kVA are equipped with casters to facilitate their movement. Models between 50 and 80 kVA can be installed against the wall due to their front access and maintenance.

For devices of 30 kVA and above, the door has a document holder and a key lock and offers an opening angle of 120º.

The **SLC CUBE4** series is mounted in cabinets with IP20 protection level, painted in polyester with RAL 9005.

The cabinet ventilation is forced to ensure that all the components of the UPS are within the appropriate temperature ranges.

The device is equipped with temperature sensors to monitor the most important temperature parameters.

The **SLC CUBE4** series cabinet is structurally designed to be transported by a forklift.

9.3. WIRING.

The internal wiring of the device complies with EC marking regulations. All electrical connections are tightened to the required torque and marked with a visual indicator.

The wiring is arranged in flexible single-pole copper cable hoses and each end has a tight terminal with an anti-shear and non-release system.

For the 7.5 kVA to 20 kVA models, the cables enter the interior of the cabinet via the lower section at the rear; for the 30 kVA to 80 kVA, models, the cables enter via the lower section at the front.

10. OPTIONS.

10.1. EXTENDED BACKUP TIMES.

The **SLC CUBE4** devices include a standard battery backup configuration that can be extended according to the client's needs either within the same device, in cabinets exclusively for batteries or with part of the batteries in the device and the other part in an additional cabinet, depending on each **SLC CUBE4** model and the desired backup.

10.2. ETHERNET/SNMP ADAPTERS: INTEGRATION IN IP NETWORK.

Apart from the Nimbus card already included by default, users can also purchase the Ethernet/SNMP adapter (SNMP, V1, V2 or V3).

BOX or CARD versions. Enables the UPS to be integrated into the IT network. This adapter has two versions, box and insertable card, for the smart slots of Salicru's devices. Temperature and humidity sensors can also be connected and a channel with a TCP, RS-232 and RS-485 MODBUS communication protocol is also available.

Fig. 28. SNMP adapters.

10.3. REMOTE RCCMD SHUTDOWN APPLICATION.

The management and monitoring of a UPS device in heterogeneous IT networks, in which different systems coexist, becomes virtually impossible. RCCMD is an application that allows simultaneous and secure shutdown of the different servers or workstations of 95% of existing platforms. As with the most complete monitoring software, RCCMD is able to send messages or commands to different clients in the network. Compatible with all operating systems, including virtual systems (vmware, citrix and hyperv).

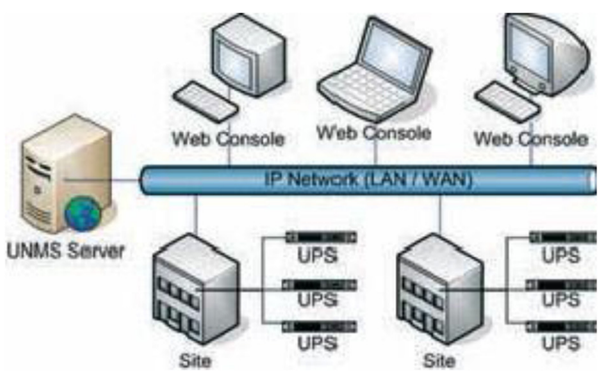


Fig. 29. UNMS, UPS management.

10.5. SICRES ADAPTER FOR REMOTE MANAGEMENT.

To be informed at all times of the status and even advance to eventual device failures, SALICRU offers the NIMBUS solution; the remote maintenance service through Internet connection with different modalities, enabling clients to be notified in case of failure, device monitoring via the web, access the to the device for control purposes, among others. This avoids unnecessary travel of maintenance personnel and enables problems to be reported and solved before the user notices them.

10.6. TEMPERATURE AND HUMIDITY SENSORS.

For cases in which it is essential to have ambient data for the room in which the UPS device is located, Salicru has a temperature and humidity sensor which allows this data to be included in the monitoring software itself without the need to use a totally external system. The sensor is equipped with the Ethernet/SNMP adapter communication cable.

Fig. 30. Temperature and humidity sensor module

10.7. EXTERNAL MANUAL BYPASS.

An external manual bypass, used as a UPS add-on peripheral, is an option that allows the load to be powered from the UPS or directly from the commercial power supply. The optional isolation transformer provides galvanic isolation between the primary and secondary windings, and this greatly attenuates electrical noise and transients from the mains, and also reduces their transfer to the secondary.

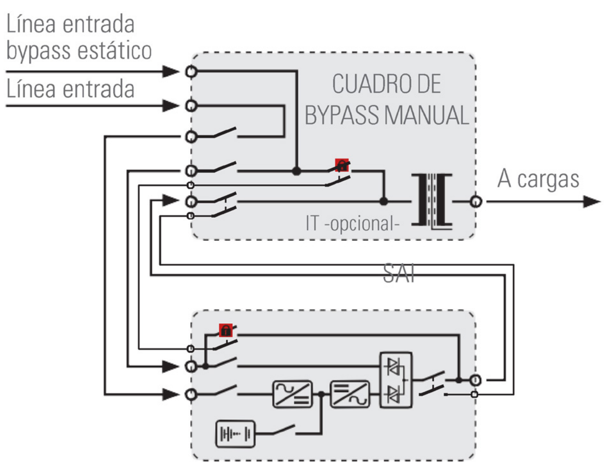


Fig. 31. External manual bypass panel

10.8. FREQUENCY CONVERTER 50 Hz A 60 Hz OR 60 Hz AT 50 Hz.

The **SLC CF CUBE4** devices allow users to work at different input and output frequencies, either 50 Hz input and 60 Hz output or 60 Hz input and 50 Hz output.

10.9. BACS II.

System for care and analysis of the battery integrated in a monitoring and management network. It regularly checks the internal resistance, temperature and voltage of each individual battery. It is also possible to adjust the charging voltage of each battery and manage environmental measurements (temperature, humidity, hydrogen gas content). This ensures that the batteries always remain in optimum operating conditions. Constant monitoring and individual control of the load voltage of each battery guarantees full availability at all times.

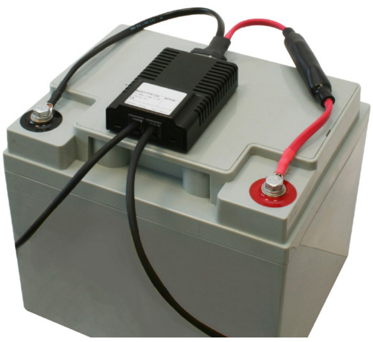


Fig. 32. BACS battery control and analysis system.

10.10. DUAL-LEVEL CHARGER FOR NICD, GEL, LITHIUM ION BATTERIES.

The 30 kVA and above devices are equipped with a dual voltage system (float voltage and fast charge voltage) that enables the use of Ni-Cd, gel and Li-ion batteries.

The smaller devices do not have this dual system; however, they are compatible with the use of Li-ion batteries.

10.11. ISOLATION TRANSFORMER.

The isolation transformer provides galvanic isolation to completely isolate the output from the input. The placement of an electrostatic screen between the primary and secondary windings of the transformer provides a high level of electrical noise attenuation. The isolating transformer can be installed at the UPS input or output and is available for those cases in which the output load must be galvanically isolated from the power supply.

11. TECHNICAL SPECIFICATIONS.

11.1. INTERNATIONAL STANDARDS.

Information	Standards
Quality and Environmental Management	ISO 9001 & ISO 14001
General UPS safety requirements	IEC/EN 62040-1
Safety requirements for semiconductor power conversion systems and devices. Part 1: General	IEC/EN 62477-1
Electromagnetic compatibility (EMC) requirements for UPS devices	EN-IEC 62040-2
Method of specifying the performance and test requirements of UPS	VFI-IEC-111 (EN-IEC 62040-3)

Table 3. Standards applied.

11.2. ENVIRONMENTAL CHARACTERISTICS.

Environmental	7.5 kVA	10 kVA	15 kVA	20 kVA	30 kVA	40 kVA	60 kVA	80 kVA
Acoustic noise at 1 metre distance	< 55.0 dB (A)		< 57.0 dB (A)		< 54.0 dB (A)		< 61.5 dB (A)	
Operating altitude	2,400 masl							
Relative humidity	0.. 95%, non-condensing							
Operating temperature	0.. 40ºC (battery life is reduced by 50% for every 10ºC increase over 20ºC)							
Storage and transport temperature	–15ºC .. + 60ºC (UPS) / 0ºC .. + 35 ºC (Battery)							

Tab. 4. Environmental characteristics.

11.3. MECHANICAL CHARACTERISTICS.

Specifications of the cabinets		7.5 kVA	10 kVA	15 kVA	20 kVA	30 kVA	40 kVA	60 kVA	80 kVA
Dimensions (Depth × Width × Height)		688.5 x 370 x 826.5 mm.				909 x 377 x 1042 mm.		919 x 560 x 1654 mm	
Weight	**without batteries**	43 Kg.		47 Kg.		100 Kg.		230 Kg.	
	With batteries (standard backup)	88 Kg.	98 Kg.	118 Kg.	132 Kg.	220 Kg.	311.2 Kg.	450 Kg.	546.8 Kg.
Colour		RAL 9005							
Level of protection, IEC (60529)		IP 20							

Table 5. Mechanical characteristics.

11.4. ELECTRICAL CHARACTERISTICS.

11.4.1. Electrical characteristics (rectifier input).

Specifications of the cabinets	7.5 kVA	10 kVA	15 kVA	20 kVA	30 kVA	40 kVA	60 kVA	80 kVA
Active power (kW)	7.5	10	15	20	30	40	60	80
Technology	Two-phase winch, 3-level switching							
Three-phase nominal voltage (3P + N + E)	3 x 380 V / 3 x 400 V / 3 x 415 V							
Input voltage range	+30% / -50% (< 50% of the load load) +20% / -20% (> 50% of the load load)				+15% / -20% (for 3 x 400 V)			
Frequency	50 Hz / 60 Hz ± 5 Hz (46 a 64 Hz)				50 Hz / 60 Hz ± 5 Hz (45 a 65 Hz)			
Nominal input current (A)	11	15	23	30	46	61	92	122
Max. input current (A)	25	29	37	46	54	72	108	143
Input power factor (load ≥ 10%)	1.0							
Input THDi	@ 100% load: THDi < 3.0% @ 50% load: THDi < 5.0% @ 25% load: THDi < 8.0%							

Table 6. Rectifier input characteristics.

11.4.2. Electrical characteristics (Bypass Input).

Static bypass specification	7.5 kVA	10 kVA	15 kVA	20 kVA	30 kVA	40 kVA	60 kVA	80 kVA
Nominal voltage (3P + N+ E)	3 x 360 V / 3 x 380 V / 3 x 400 V / 3 x 415 V				3 x 380 V / 3 x 400 V / 3 x 415 V			
Technology	STS solid state (SCR)				Solid state + relays			
Activation criteria	Digital Control							
Transfer time	Invalid							
Voltage range	-23 % ~ +15 %				-15% ~ +12%			
Overload	100% ~ 130% (permanently) >130% (for 60 min.)				100% ~ 110% (permanently) 110% ~ 125% (for 60 min.) 125 % ~ 150 % (for 10 min.) 150% ~ 200% (for 10 sec.) >200%(immediate)			
Transfer time	0							
Manual bypass type	Uninterrupted							
Rated current of neutral line	1.7 × In							
Frequency	50 / 60 Hz. ± 4 Hz. (programmable)				50 / 60 Hz. ± 5 Hz. (programmable between 0.5 and 5 Hz)			
Nominal bypass current (A)	11	14.5	22	29	44	58	87	116
Permanent max. bypass current (A)	18.4	24.6	36.9	49.2	59	78	118	157

Table 7. Static bypass characteristics.

11.4.3. Electrical characteristics (Battery charger).

Battery charger specification		7.5 kVA	10 kVA	15 kVA	20 kVA	30 kVA	40 kVA	60 kVA	80 kVA
Maximum charge current (A)		Adjustable from 1 to 12				8		8 (expandable to 16)	
Default charge current (A)		Standard: 1; Model B1: 3				0.2 x Capacity			
Charging method		Constant current/voltage							
Battery number	**Standard**	8+8	10+10	16+16		22+22 (default) 16+16 ~ 22+22 for PbCa and up to 220 batteries for NiCd			
	B1	8+8, 10+10, 16+16, 20+20		16+16 , 20+20					
Battery charger bus voltage		± 106.5 V ~ ± 141 V for the 8+8/10+10 configuration, ± 208 V ~ ± 282 V for the 16+16/20+20 configuration		Configurable between ± 208 V ~ ± 282 V		Configurable between ± 180 ~ 330 V.			
Charging time		5 hours (90% capacity)							
Float voltage (at 25°C)		13.6 V / battery (programmable between 13.4 V ~ 14 V)				13.65 V / battery (programmable between 1.3 ~ 14 V)			
Voltage compensation according to temperature		– 3 mV / ºC*Cell. (Default for PbCa) (Programmable 0.0 ~ 9.9 mV / ºC*Cell.)				– 18 mV / ºC / Bat. (Default for PbCa) (Programmable 0.0 ~ 1000.0 mV / ºC)			
Voltage ripple		≤1 %							
Power ripple		≤5 %							
Quick charge voltage (equalisation)		14 V				13.65 V(default) (programmable between 1.35 ~ 14.5 V)			
End of discharge voltage	**Standard**	10.7 V/pcs (0 ~ 30% charge) 10.2 V/pcs (30 ~ 70% charge) 9.6 V/pcs (> 70% charge)				Variable between 9.6 ~ 10.5 V (programmable)			
	B1	10.5 V/pcs (default) (programmable between 10.5 V ~ 12.0 V)							
Estimated remaining backup time		Yes							

Table 8. Characteristics of parameters related to batteries.

11.4.4. Electrical characteristics (Inverter output).

Inverter specification	7.5 kVA	10 kVA	15 kVA	20 kVA	30 kVA	40 kVA	60 kVA	80 kVA
Active power (kW) (*)	7.5	10	15	20	30	40	60	80
Technology	3-level phase inverter							
Three-phase nominal voltage (3P + N + E)	3 x 360 V (**) / 3 x 380 V / 3 x 400 V / 3 x 415 V				3 x 380 V / 3 x 400 V / 3 x 415 V			
Output voltage accuracy	Static regime (0% ~ 100% charge / mains-battery): ± 1%				Static regime (0% ~ 100% charge / mains-battery): ± 0.5 %			
	Dynamic regime (0% ~ 100% ~ 0%): ± 10 %, 20 ms.							
Dynamic recovery time	After 20 ms, nominal value ± 10 %				After 20 ms, nominal value ± 2%			
Waveform	Pure sinusoidal							
Frequency	50 Hz / 60 Hz ± 0.1 Hz (fixed value or automatic detection, selectable)				50 Hz / 60 Hz ± 0.05% (fixed value or automatic detection, selectable)			
Nominal output current (A)	11	14.5	22	29	43.5	58	87	116
Short circuit current (A)	32.6	43.5	65	87	130	174	261	348
Short circuit protection	Yes							
Efficiency (%)	94.93				98.0			
Power factor	1							
Admissible crest factor	3:1							
Overload	100% ~ 110% (for 60 min.) 110% ~ 125% (for 10 min.) 126% ~ 150% (for 1 min.) > 150% (immediate transfer to Bypass)				110% ~ 125% (for 10 min.) 125 % ~ 135 % (for 5 min.) 135 % ~ 150 % (for 1 min.) > 150% (immediate transfer to bypass)			
Maximum overcurrent	300 %							
Output THDv	≤ 2% (linear load) / < 4.0 (non-linear load)				≤ 1% (linear load) / < 4.0 (non-linear load)			
Maximum synchronous speed	1.0 Hz/s. (default value)				10.0 Hz/s. (default value)			
Inverter voltage range	± 10 %				± 5 %			

(*) From 7.5 kVA to 20 kVA devices: Power reduced to 60% of the nominal value as a frequency converter in I/I configuration.
(**) Power reduced to 90% of the nominal value.

Table 9. Inverter characteristics.

11.4.5. Communications.

Specification of Communications	Parameters
Communication port 1	RS 232 / RS 485 (1)
Communication port 2	USB
Expansion slot 1	NIMBUS card
Expansion slot 2	Free slot (*)
Digital inputs	4 - 8 (2) inputs
Relay interface	4 - 6 (3) programmable relays
Protocol	PRIVATE (4) / MODBUS RTU (1)
Display	5" touch screen
EPO function	2-pole contact normally set to closed
EMBS signal: External maintenance bypass auxiliary contact	

(*) Options:

- SNMP.
- RS485 for models up to 20 kVA / RS232, RS485, USB for models of 30 kVA - AS400 (relay extension) and above.
- Remote battery temperature for models of 30 kVA and above.

(1) Only for models of 30 kVA and above.
(2) 8 inputs for 7.5 to 20 kVA / 4 inputs for 30 kVA and above.
(3) 6 programmable relays for 7.5 to 20 kVA / 4 for 30 kVA and above.
(4) For 7.5 to 20 kVA devices.

Tab. 10. Available communications.

11.4.6. Efficiency.

Specification of Efficiency		7.5 kVA	10 kVA	15 kVA	20 kVA	30 kVA	40 kVA	60 kVA	80 kVA
Efficiency, Normal Mode and linear load	25% load	91.86		95.21		up to 96.2 %			
	50 % load	94.33		95.77					
	75 % load	94.30		95.30					
	100 % load	94.15		94.93					
Efficiency, Battery Mode and linear load	25% load	94.95		94.18		-			
	50 % load	93.05		95.16		up to 96.5%			
	75 % load	94.23		95.06					
	100 % load	93.98		93.6					
Heat losses, normal mode, 100% load (W)		438	585	760	1014	1470	1920	2700	3680
Cooling air volume (m^3/h)		266				427		854	

Table 11. Efficiency characteristics.

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