Liebert® EXL

User Manual

Liebert EXL

UNINTERRUPTIBLE POWER SUPPLY

USER MANUAL

10H52226UM60 - rev. 1

Liebert EXL S1 may differ from the model displayed on the front cover.

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1. INTRODUCTION

This User's Manual contains information on the installation, operation and use of the Liebert EXL S1 Uninterruptible Power System (UPS).
We recommend reading this document before installing the equipment, which must be operated only by qualified personnel.
Afterwards, the manual must be kept and referred to whenever work must be done on the UPS.

1.1. Notes to the CE Declaration of Conformity

Liebert EXL S1 conforms to the following European directives:

2014/35/EU
Directive of the council for adapting the legal regulations of member states on electrical equipment for use within specific voltage limits (superseding the 2006/95/EC and successive amendments).

2014/30/EU
Directive of the council for adapting the legal regulations of member states on electromagnetic compatibility, (superseding the 2004/108/EC and successive amendments).
Conformity is established through compliance with the following standards:

- IEC/EN 62040-1+A1:2013
- IEC/EN 62040-2:2006

Additional information regarding adherence to these directives is included in the appendices NSR and EMC to the Declaration of Conformity. If needed, the Declaration of Conformity can be requested to Vertiv.

1.2. Symbols and pictograms

The following symbols and pictograms are used in this manual:

Warning
Indicates instructions which, if not followed, may result in danger to life, safety, the reliability of your device or data security.

Notice
Indicates additional information and tips.

Indicates a step that you must carry out.

1.3. Terms used

1.3.1. Service Bypass

A switch that provides continuous supply to the load via the bypass input power line during maintenance work; also referred to as the maintenance bypass.

1.3.2. Static Bypass Switch

A thyristor switch which connects the load directly to the power line; also referred to as a static switch or static bypass.

1.3.3. Qualified personnel

Personnel who are familiar with the installation, assembly, placement into service and operation of the product, and are qualified to carry out these procedures.

1.3.4. Touch screen

The operator interface for controlling and testing the machine state includes a touch screen.

1.4. Glossary

MSS = Main Static Switch
RAU = Remote Alarm Unit
TCE = Top Cable Entry
SBS = System Bypass Switch
MBSM = Multiple Bus Synchronization Module

1.5. Documentation structure

These instructions may be supplemented with additional sheets, describing specific extensions or options.

1.6. Information about the presence of foreign materials in the vicinity of UPS equipment installations

Warning

The purpose of this note is to provide information and warnings on a potential risk to the operational integrity of an installed UPS system, as posed by the presence of foreign material inside or in the vicinity of the UPS module and its associated auxiliary equipment/components.

This risk is especially high if conductive materials find their way inside the UPS module or the associated auxiliary equipment/components.

The risk potentially involves damage to the installed UPS equipment and subsequent degradation or loss of power to the connected critical site load.

Vertiv applies the highest safety standards in equipment design to ensure that no live parts are exposed to external contact, and also to ensure that the equipment is protected against the introduction of foreign bodies during operation (built to IP20, with optional filters available for special conditions).

However, it is not possible for Vertiv to ensure that foreign bodies will not be introduced during on-site installation, or when the UPS doors & covers are "open" and the electrical terminals are exposed to allow power line connections to be made by the electrical contractor/installer.

It is also not uncommon to have other personnel working in the same (UPS equipment) room during on-site installation. Such personnel sometimes work above the UPS equipment and associated auxiliary equipment/components.

To prevent major disruption to site operations and risk to property and personnel, including the possibility of a fatality, each site's facility manager or construction manager must prevent foreign bodies from being introduced into the UPS module and associated auxiliary equipment/components.

All UPS modules and associated auxiliary equipment/components are thoroughly inspected by Vertiv engineers prior to placement into service and testing on-site. When conductive foreign bodies are identified, our engineers are instructed to interrupt all work until the equipment and the area have been thoroughly cleaned of any contaminants.

However, the person responsible for the site must ensure that the UPS module and associated auxiliary equipment/components, and the immediate surroundings, are kept clean and free from any possible conductive material such as metal foil, food wraps, cable shields, washers and other hardware, scrap metal, scrap and dust.

If the UPS system is shut down after placement into service & testing are completed, the UPS room must be kept clean to avoid the possibility (during restart) of the considerable volume of air-flow produced by UPS operation to dislodge and/or drag any foreign bodies into the equipment, which would result in system failure and possible supply interruption to the critical site load, and several hours of downtime resulting from the damage typically associated with such events.

If the UPS is left running/operational at the completion of placement into service and testing, the room similarly needs to be kept clean to prevent foreign bodies from entering the UPS module via its forced air-flow.

Vertiv will not accept liability or pay damages deriving from accidents caused by the introduction of conductive foreign bodies into the UPS module or associated auxiliary equipment/components, which occurred before or after the unit is placed into service in its operating environment.

2. PREPARATION FOR USE

2.1. Transport

The equipment must be kept upright at all times and handled with care. Damage may be caused if it is dropped or subjected to severe impact. When moving the equipment with a forklift, secure it against tilting.

2.2. Delivery and storage

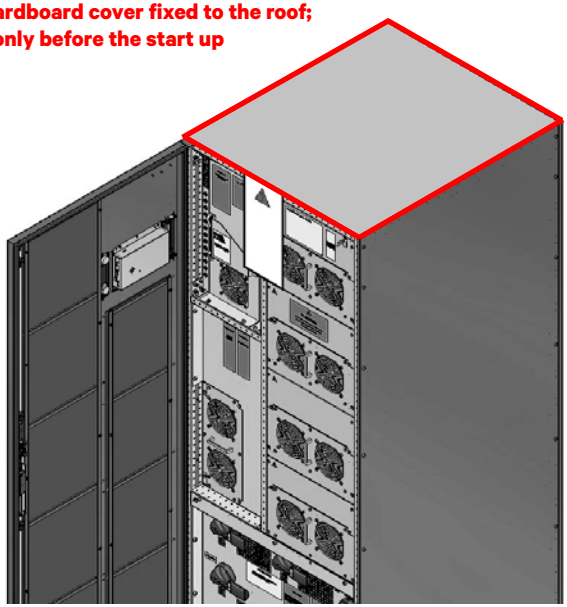
The goods have been checked thoroughly before shipment. On receipt, check the packaging and make sure the contents are undamaged. Any damage or missing parts must be reported to the supplier within 8 days of delivery.
If you do not plan to use the UPS within seven days of delivery, be sure to store it under the conditions that meet product standard.

- If the batteries or the equipment are to be stored, they must be kept in a clean, dry environment and away from extreme temperatures.

2.3. Unpacking and unloading the cabinets from the pallet

The utmost care must be taken when removing the packaging to prevent damage to the equipment.

**Do not remove the cardboard cover fixed to the roof;
it must be removed only before the start up**



Check all packaging materials to ensure that no important items are discarded. Once the packaging has been removed, the UPS must be taken off the pallet by removing the screws as illustrated in Fig. 1 or by removing the L profile as illustrated in Fig. 2, and lifting the unit off using a fork lift (UNI EN

1757). Do not remove the retaining brackets which secure the UPS to the pallet because they are used to fasten the UPS to the floor.

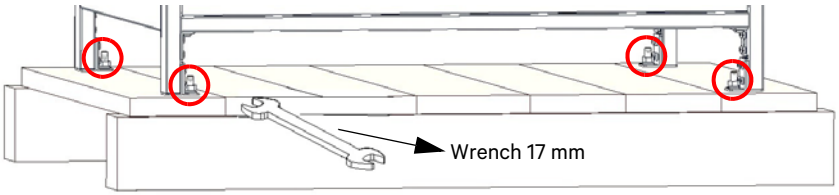


Figure 1 -

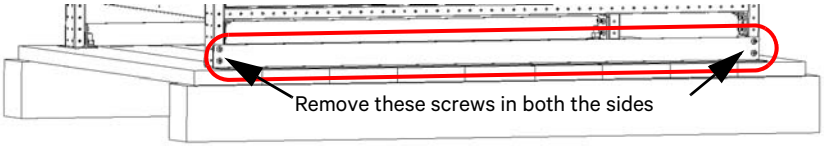


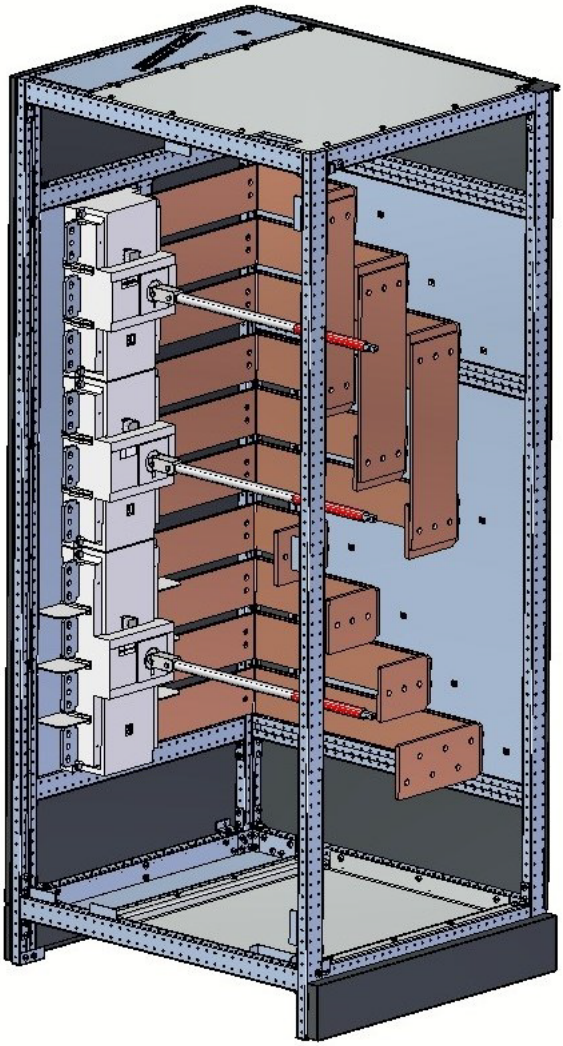
Figure 2 -

2.4. Liebert EXL S1 1000/1200kVA cabinets assembly procedure

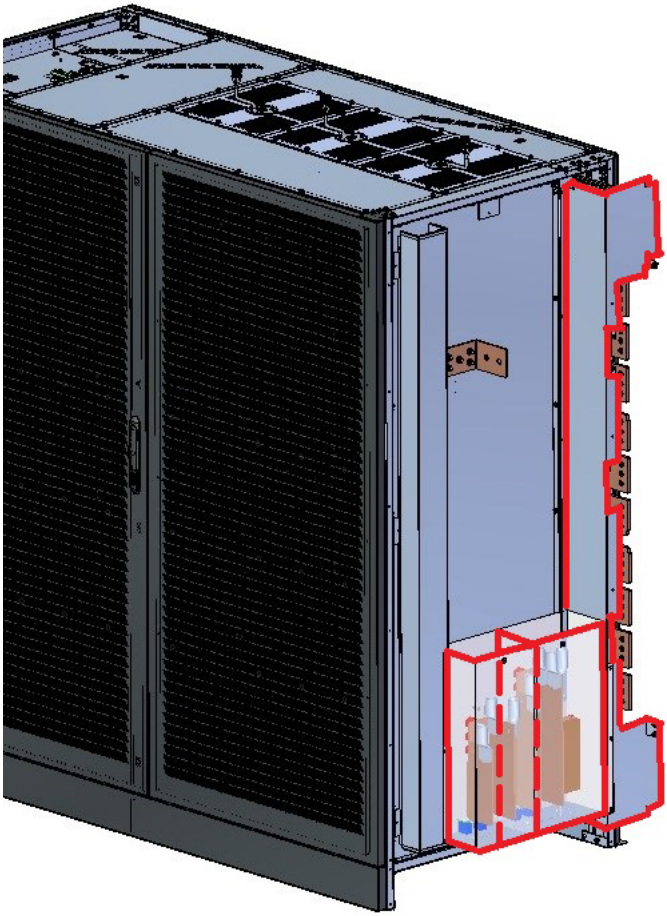
(in case of cabinets shipped separated)

The Liebert EXL S1 1000/1200kVA is composed by two cabinets, one contains the modules and one contains the switches, and they must be assembled and connected together as first step of the installation following the below procedure.

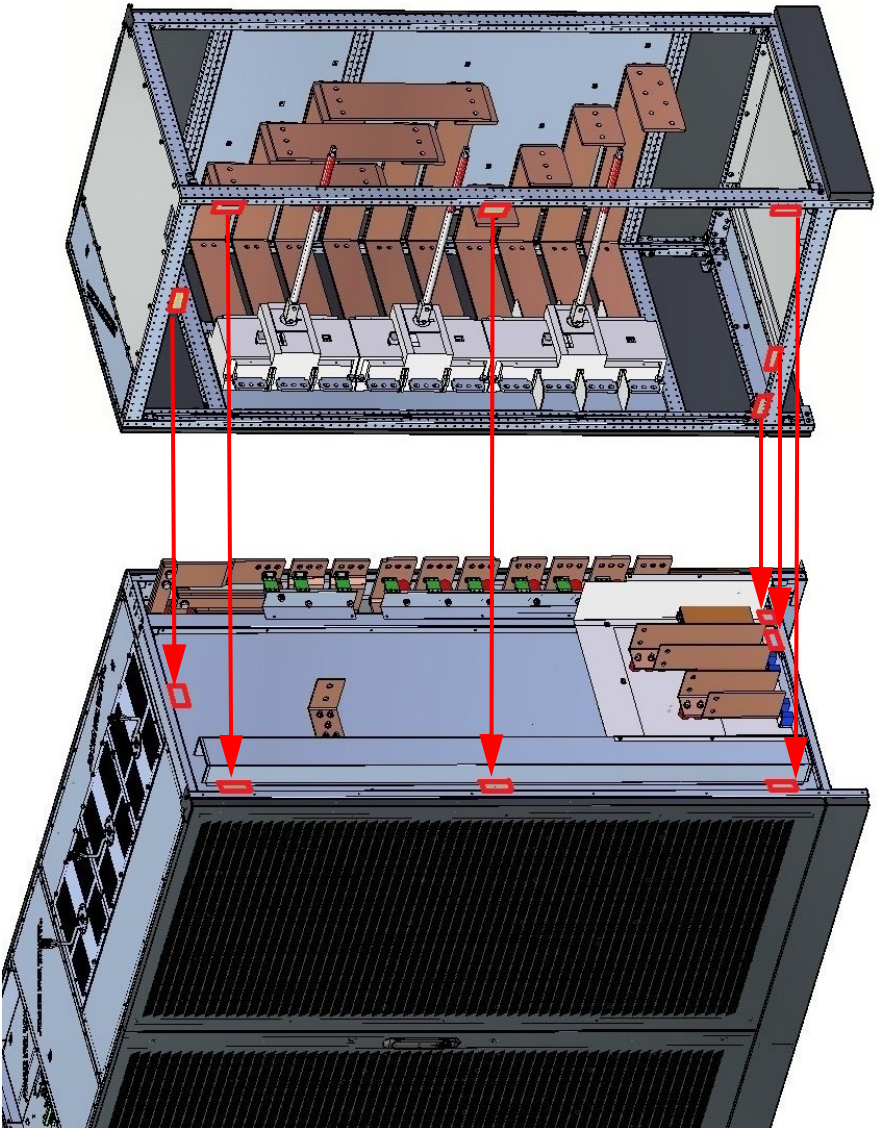
1 In the switches cabinet, remove the external door and the secondary access panels.



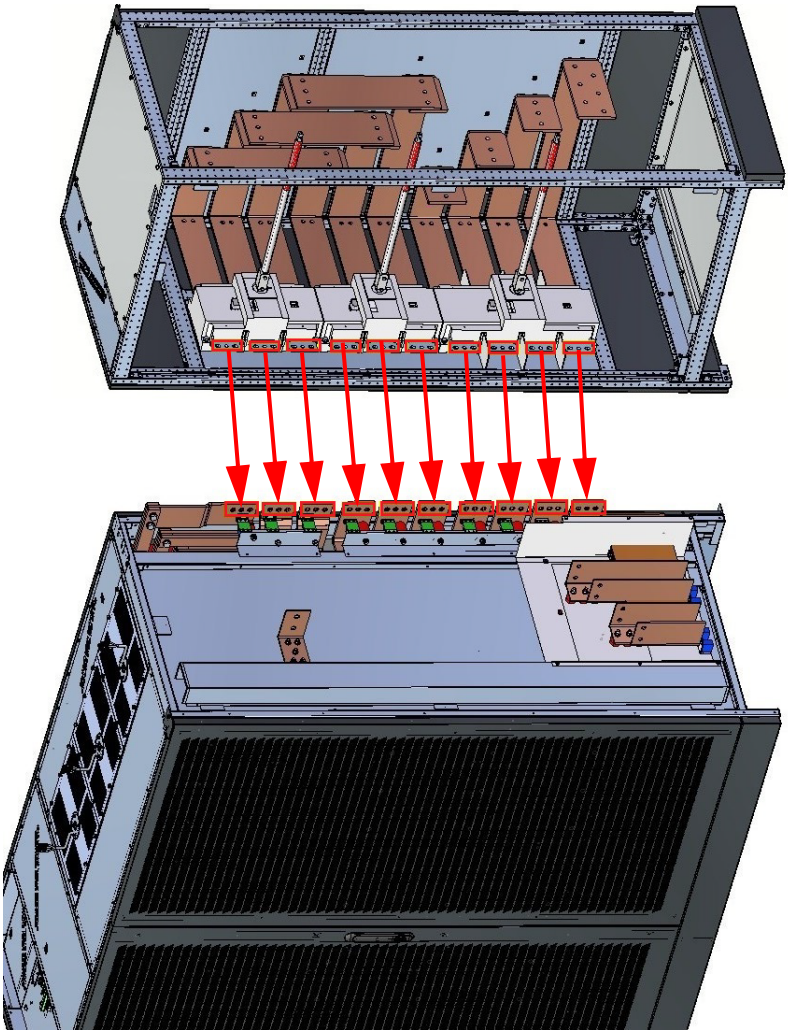
2 In the modules cabinet, remove the two lexan particulars and the iron one indicated below in red.



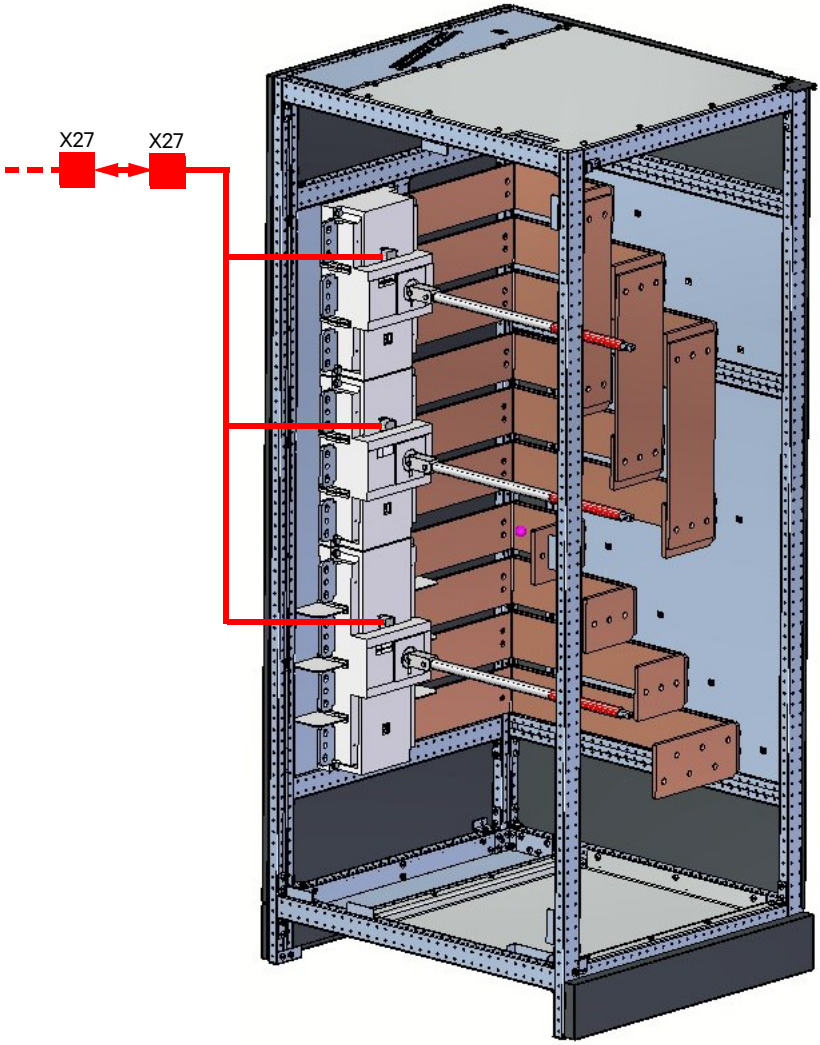
3 Assemble the iron particulars in red as indicated by the arrows using supplied hexagonal head screws M6x30 + grower + washer.



4 Connect the busbars of modules cabinet to the switches terminals in red as indicated by the arrows using supplied hexagonal head screws M12x35 + grower + washer.
For a correct connection and installation of the busbars use contact grease.
For tightening torque, please refer to Table 2.



5 Connect the signal wiring to the switches auxiliary contacts QS1,QS2 and QS4 (pin COM and pin N.O.), as indicated in the functional schematic.



6 Reassemble the two lexan particulars and the iron one previously removed in the modules cabinet; reassemble the secondary access panels and the external door previously removed in the switches cabinet.

2.5. Environmental conditions

The UPS must be installed vertically, on a level and even surface, and in an area protected from extremes of temperature, water and humidity. Do not stack the units or place objects on top of them. The operating temperature range of the UPS is 0°C-40°C.
The ideal environmental temperature range is 15°C to 25°C. The battery life is specified for 20°C. Each increment of 10°C above 25°C reduces the expected life by 50%.

2.5.1. Installation altitude

The maximum operating altitude of the UPS, without derating, is 1000m. At higher altitudes the load must be reduced according to Fig. 3.

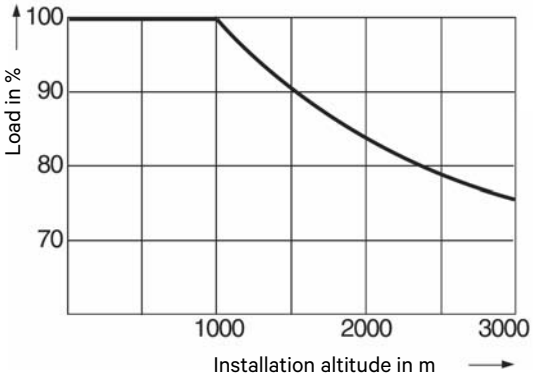


Figure 3 - Permissible load dependent on installation altitude

2.6. Access to service area and cooling system

When installed, the UPS can only be accessed from the front. All front doors have a maximum aperture of 90°. The area must have sufficient space for installation procedures to be carried out. Access doors must be wide enough to permit unobstructed transport of the device (chap. 2. on page 11). To allow correct air flow for the cooling system, leave a minimum distance of 500mm between the top of the cabinet and the ceiling of the installation area. The UPS air intake is at the front, and the air outlet is on the top (see Fig. 4).

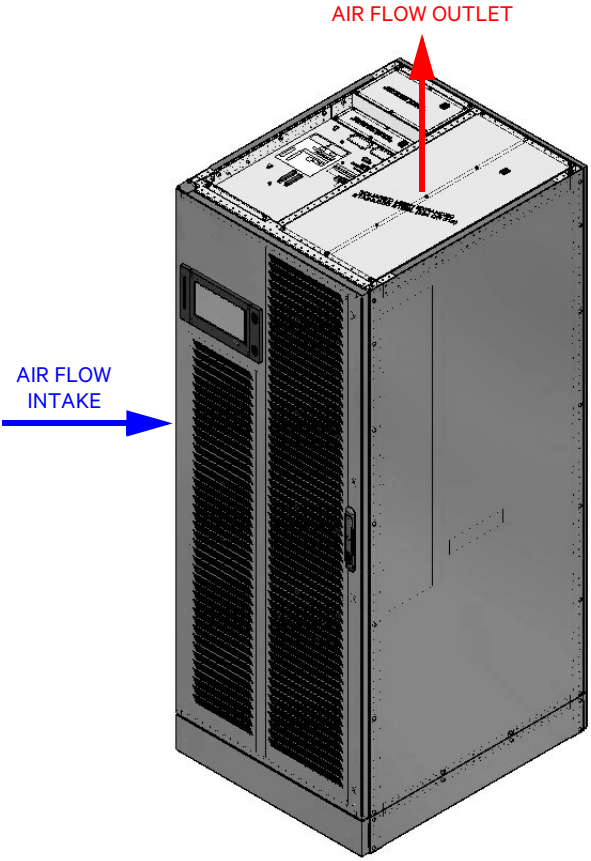


Figure 4 - In/out air flow

2.7. Installation and footprint

The overall external dimensions of the UPS are listed on the final data table.

There are no restrictions on where you can position the UPS. The rear of the machine can be positioned against a wall. On machines with connecting cables at the rear, allow room for the curvature of the cables. Do not crush the cables against the wall. Perform maintenance operations from the front and from the top.

The floor on which the UPS will be installed must be level, flat and suitable for electrical equipment. The load-bearing capacity of the floor must be sufficient to support the weight of the UPS - the UPS footprints are illustrated in Fig. 6, Fig. 9, Fig. 12 and Fig. 16, the weight may be found on the Data Tables in chap. 9. on page 102.

The cable gland plates are illustrated below:

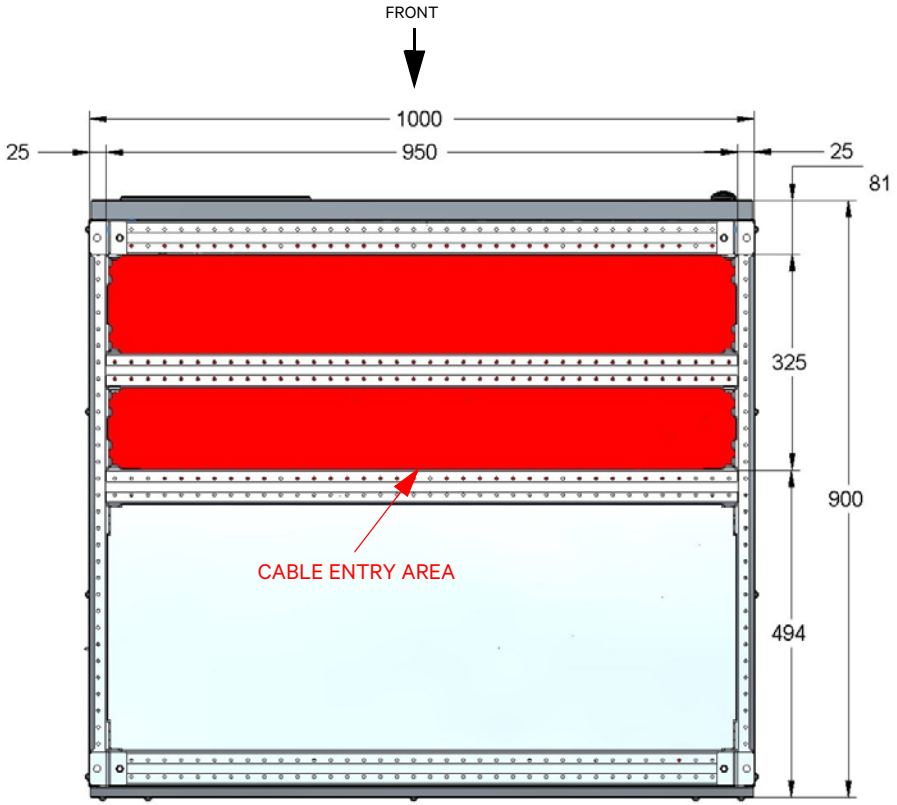


Figure 5 - Liebert EXL S1 300/400kVA - bottom view (gland plate)

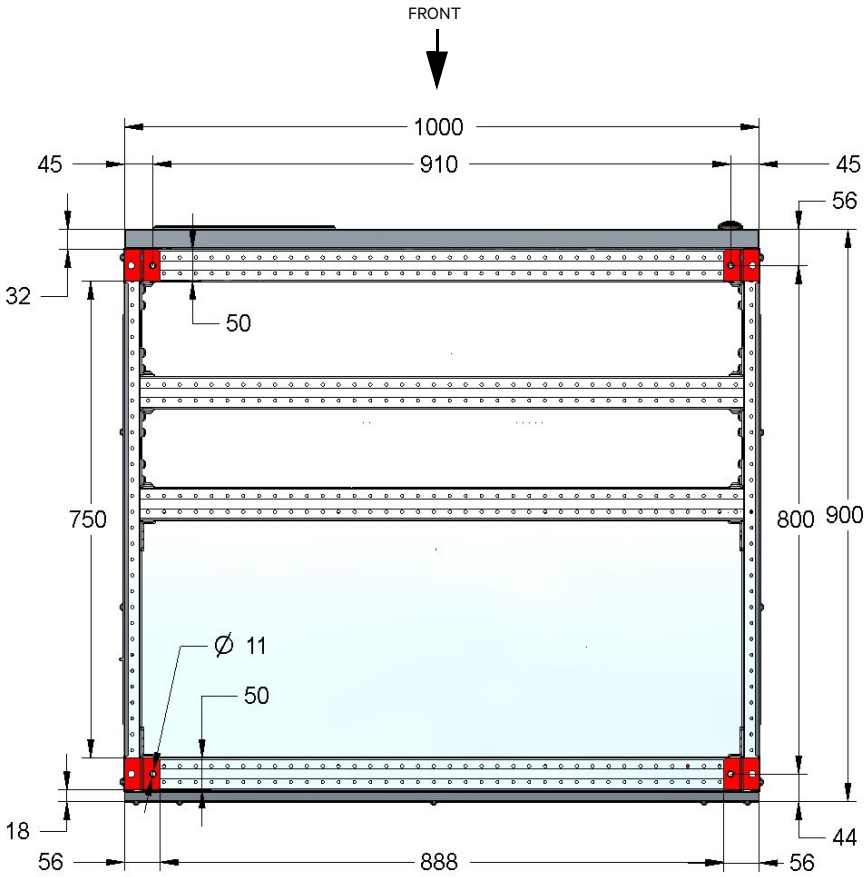


Figure 6 - Liebert EXL S1 300/400kVA
bottom view (footprint and floor mounting holes)

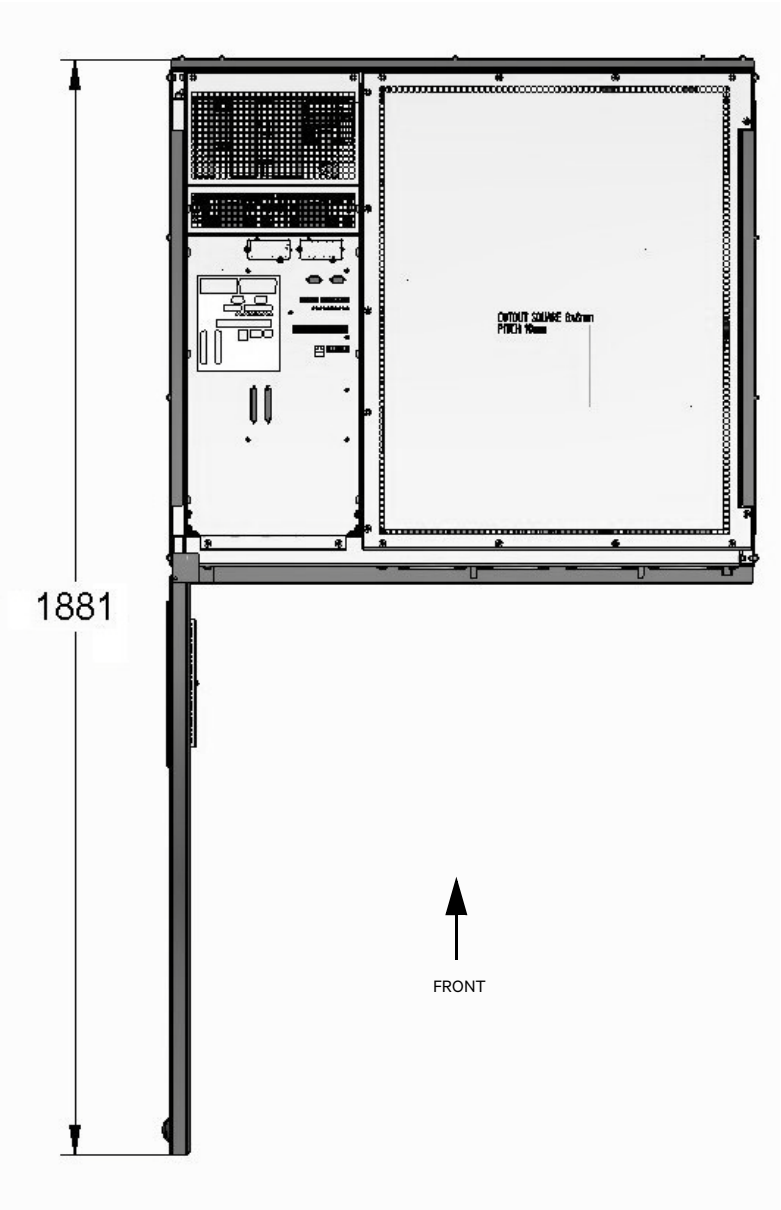


Figure 7 - Liebert EXL S1 300/400kVA - upper view (door open)

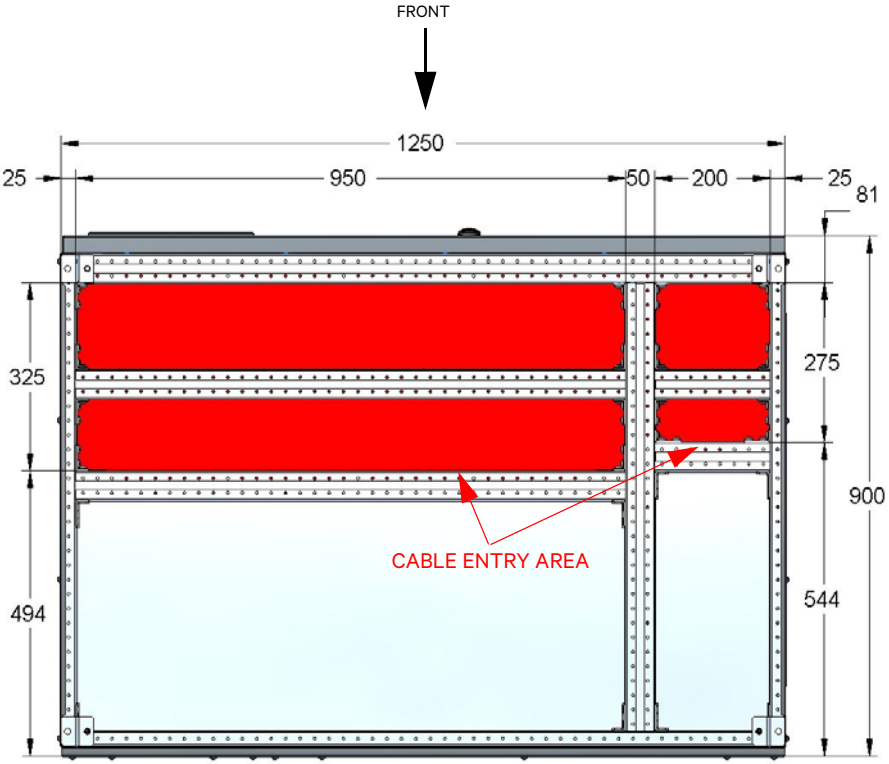


Figure 8 - Liebert EXL S1 500kVA - bottom view (gland plate)

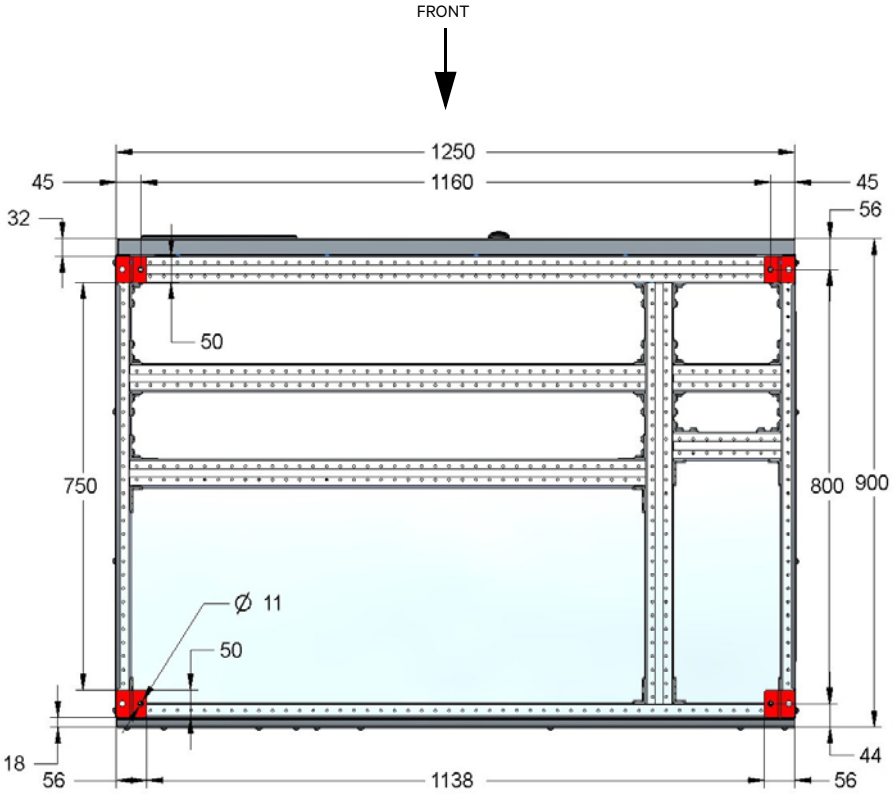


Figure 9 - Liebert EXL S1 500kVA
bottom view (footprint and floor mounting holes)

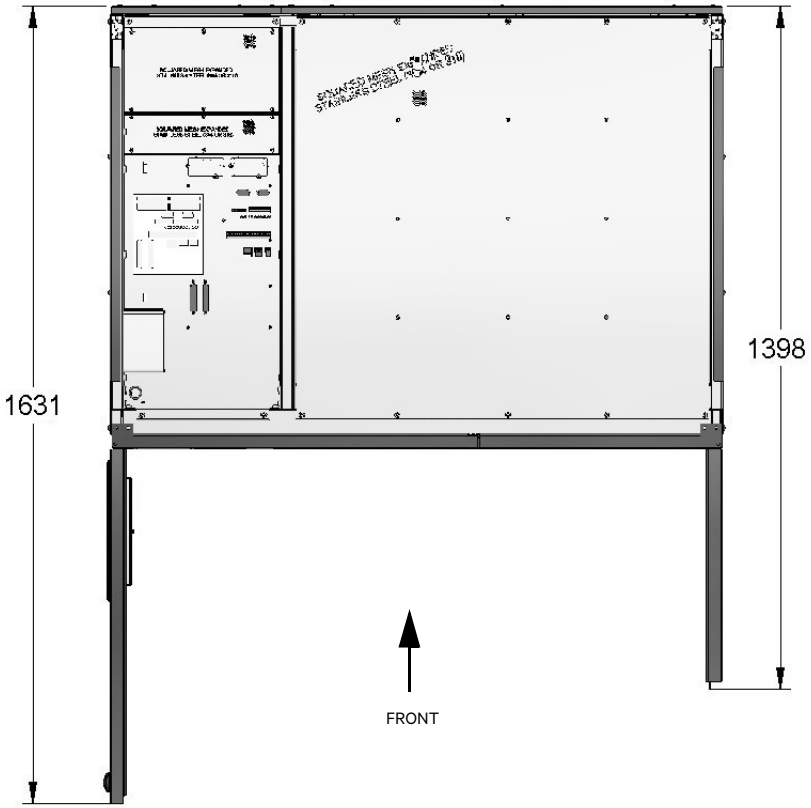


Figure 10 - Liebert EXL S1 500kVA - upper view (doors open)

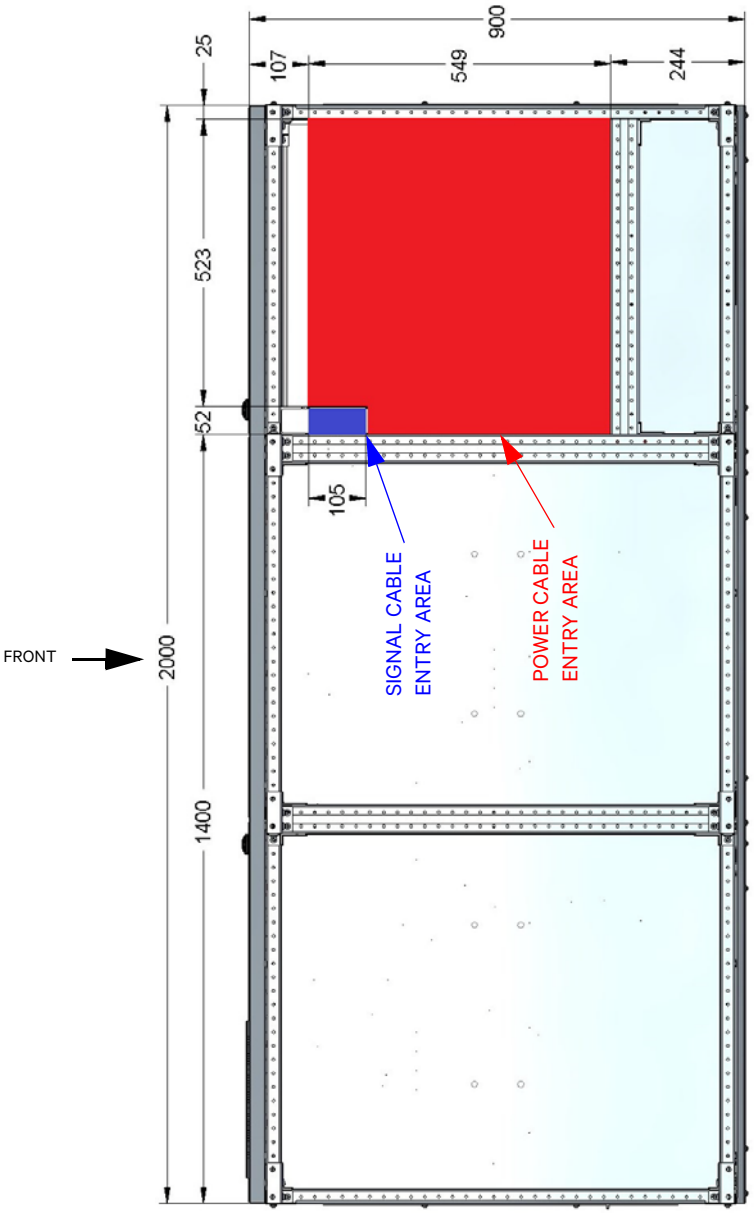


Figure 11- Liebert EXL S1 600/800kVA
bottom view (gland plate)

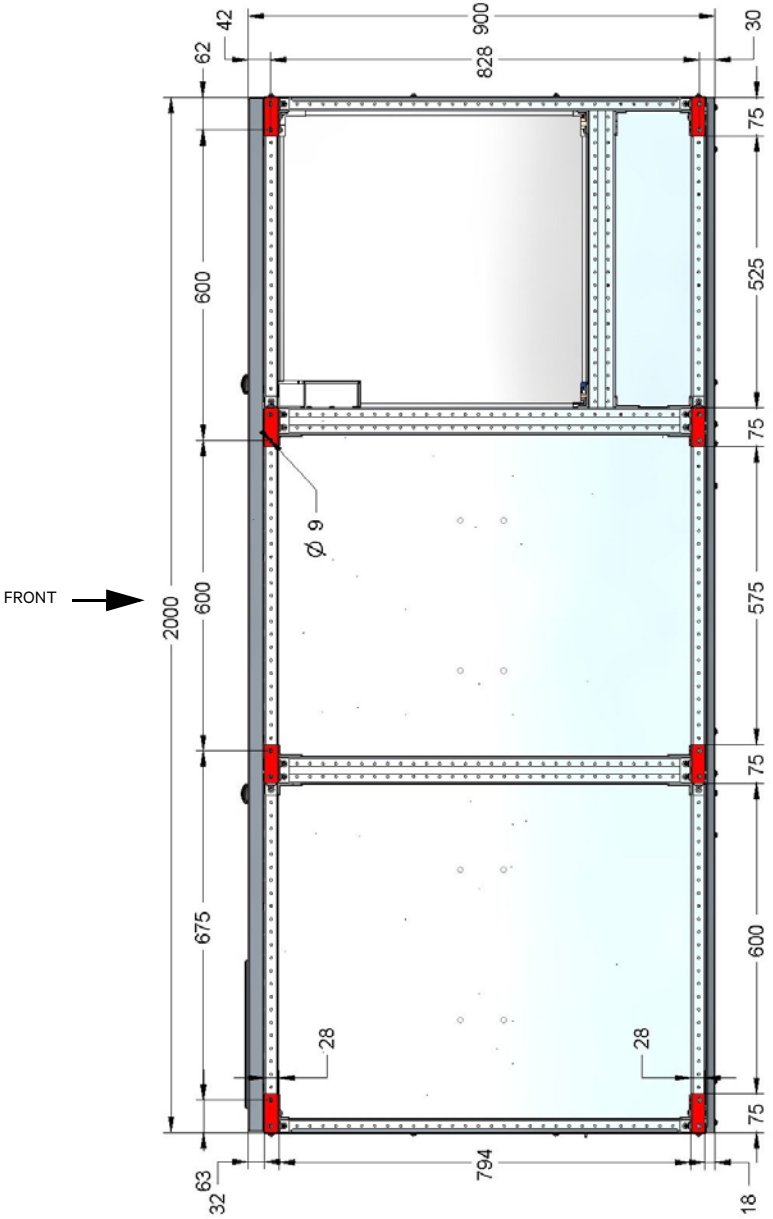


Figure 12 - Liebert EXL S1 600/800kVA bottom view (footprint and floor mounting holes)

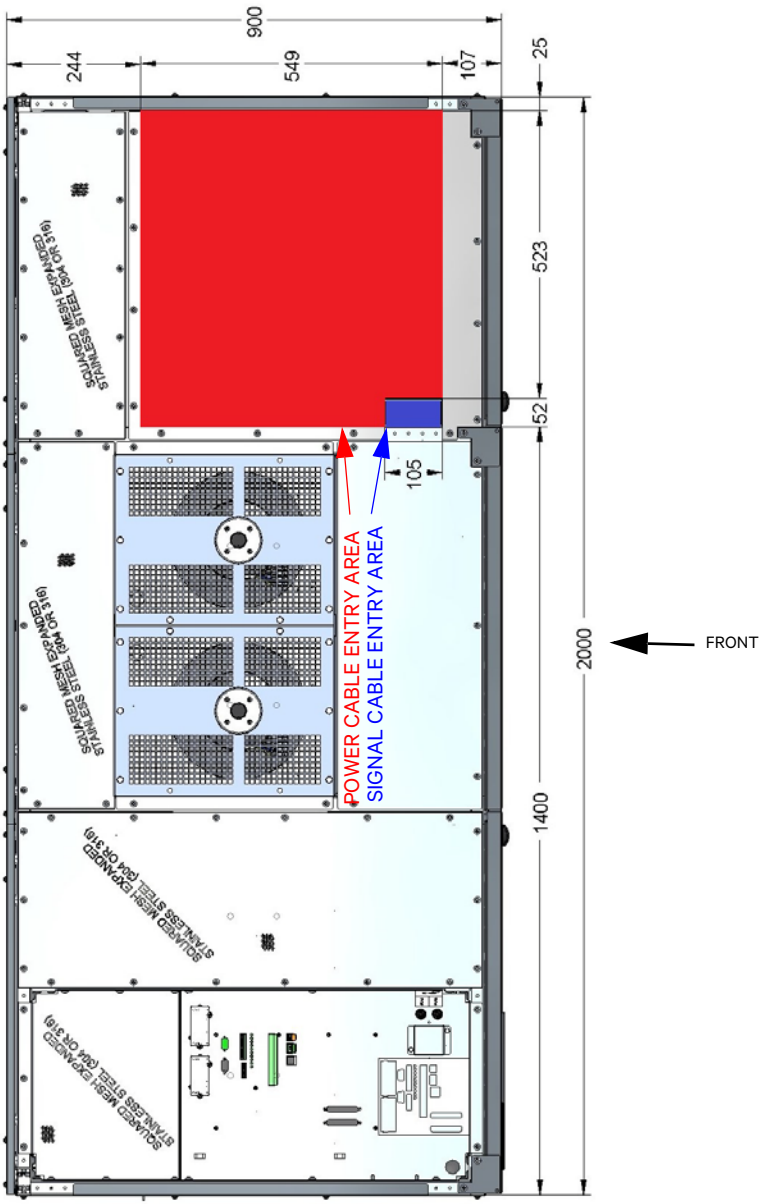


Figure 13 - Liebert EXL S1 600/800kVA
upper view (gland plate)

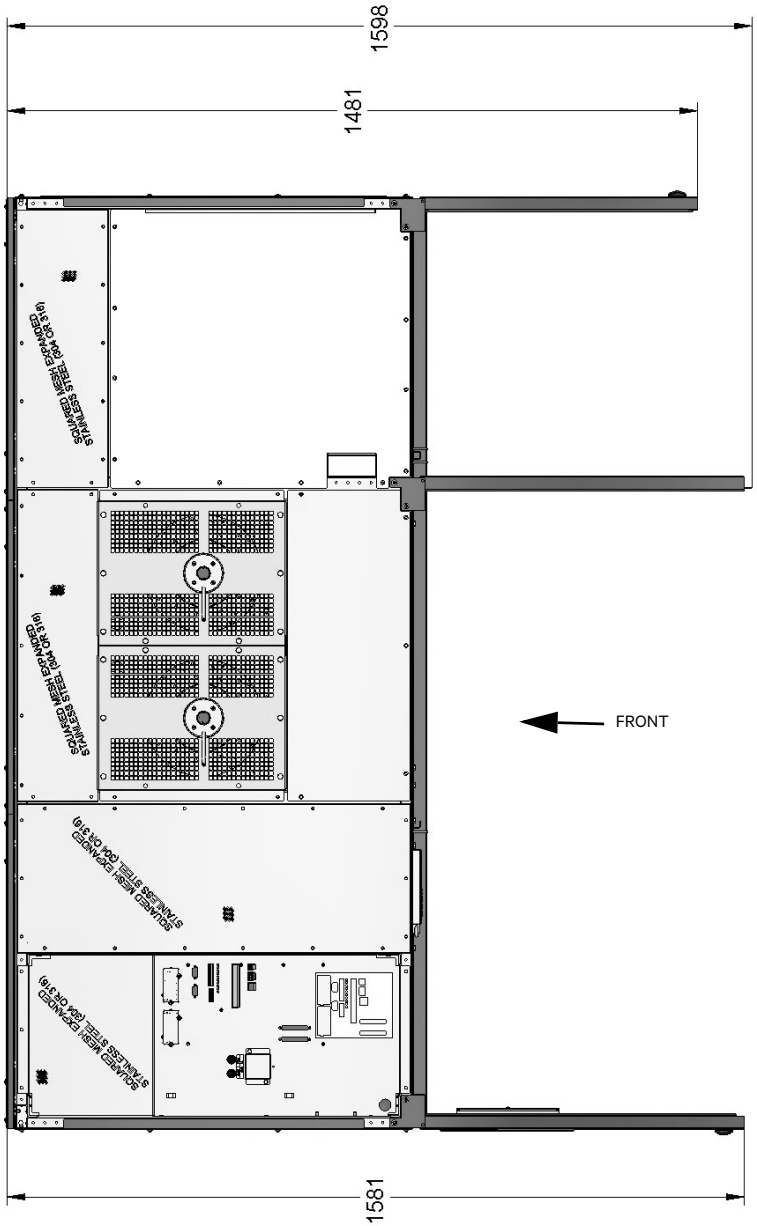


Figure 14 - Liebert EXL S1 600/800kVA
upper view (doors open)

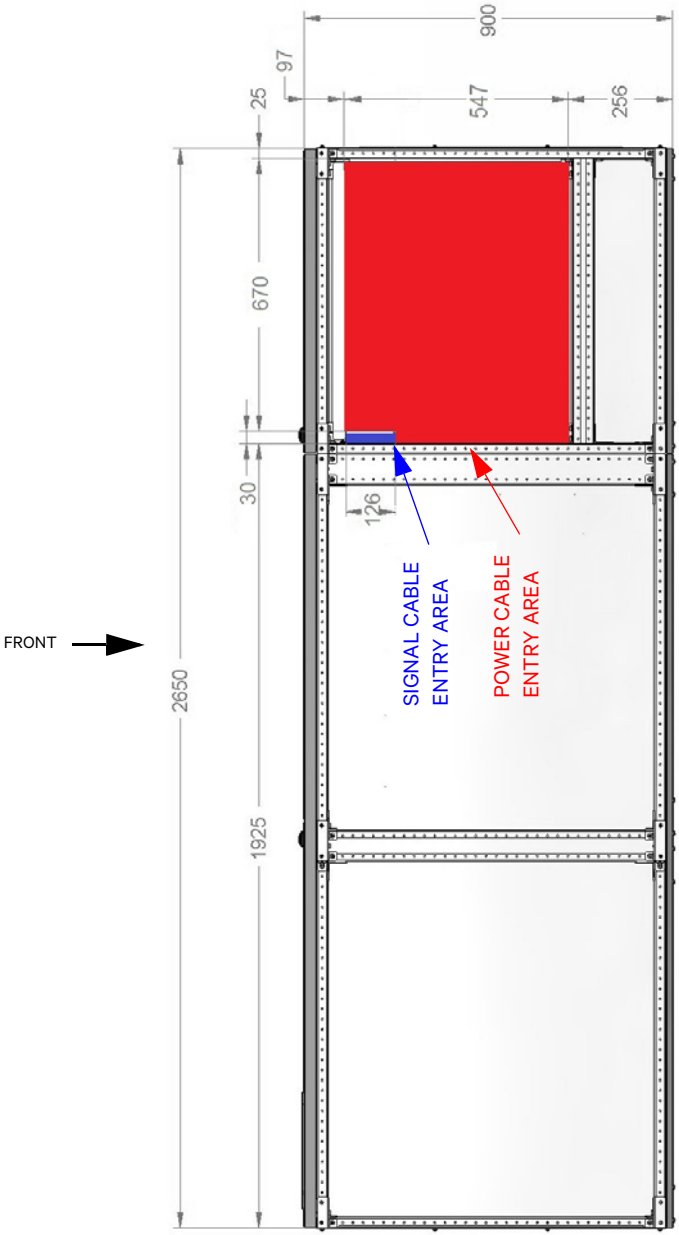


Figure 15 - Liebert EXL S1 1000/1200kVA
bottom view (gland plate)

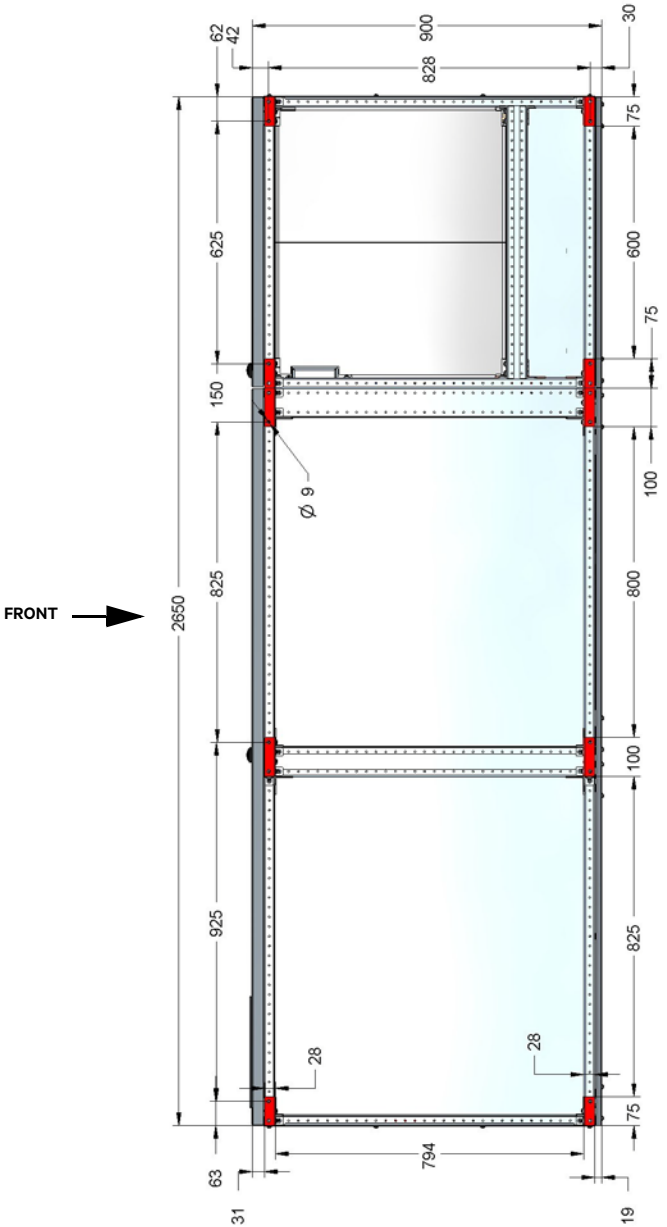


Figure 16 - Liebert EXL S1 1000/1200kVA
bottom view (footprint and floor mounting holes)

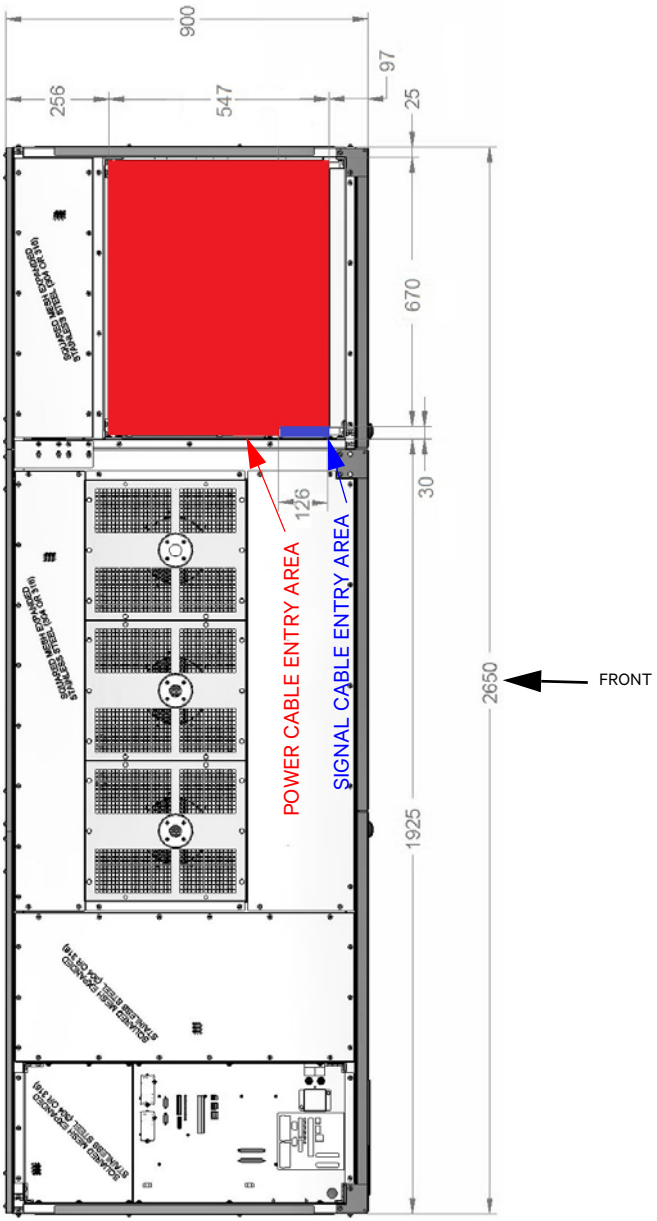


Figure 17 - Liebert EXL S1 1000/1200kVA
upper view (gland plate)

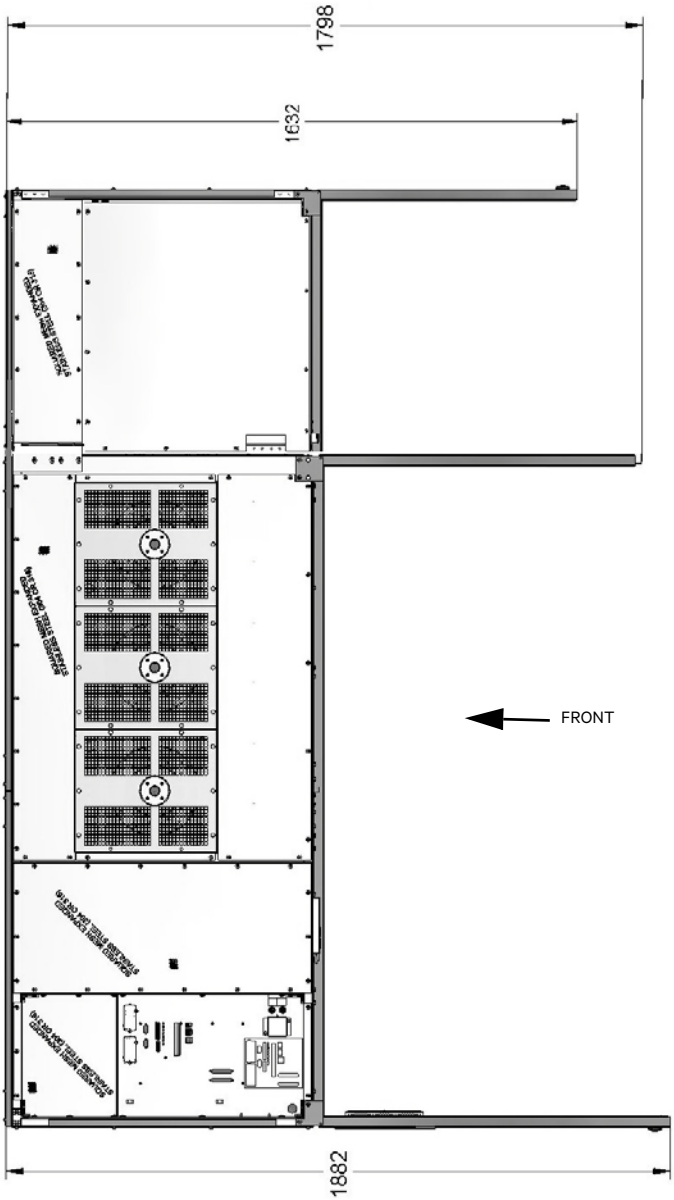


Figure 18 - Liebert EXL S1 1000/1200kVA
upper view (doors open)

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3. INSTALLATION

3.1. Electrical preparations

Warning

For reasons of safety, the secondary access panel MUST NOT BE REMOVED. If, for any reason, it is necessary to remove this panel, the entire installation must be switched off and de-energized; otherwise complete safety cannot be guaranteed.

The UPS is connected to 400/230V three-phase power lines; DC voltages above 500V are also found in the battery circuit. Installation must only be carried out by qualified personnel in accordance with these operating instructions and both national and local electrical codes. Since UPS devices create a large leakage current, connect the device to ground prior to placement into service. Improper connection can damage the device and lead to injuries and even death.

Warning

With regard to electromagnetic conformance, the device was developed in accordance with product standard IEC/EN 62040-2:2006. The UPS must be protected against overvoltages in line power in excess of those at which it was tested. Over voltages in the power supply system may occur for several reasons, including lightning strikes, ON/OFF switching of inductive or capacitive loads (such as power transformers or capacitor banks), and short-circuit shutdowns.

Notice

QS1, QS2 and QS4 are used for disconnecting.

Warning

Do not operate the battery switch battery breaker when the inverter is ON.

3.2. Currents and suggested cable sizes

For external wiring requirements refer to the local regulations for the selection of the proper conductors sizes. See Table 1 on page 38 for the max currents and max cable sizes usable in the UPS. See chap. 9. on page 102 for the overload currents.
Connect the line power cables to UPS terminals U, V, W, N.
Connect the bypass line power cables to UPS terminals U1, V1, W1, N.
Connect the load to UPS terminals U2, V2, W2, N. (see Fig. 23 on page 46).
In case of single input feed, connect jumpers between U and U1, V and V1, W and W1.

Notice

To prevent the overheating of the UPS terminals, the temperature reached by the selected cables must not exceed 70°C.

Notice

The voltage drop due to the external cables must not exceed 3% of the nominal voltage.

Notice

To avoid electrical interference:

- power cables (primary input, bypass input, battery, output load cables) should be routed separately
- communication and data lines should be routed using proper conduits and kept separate from all power cables.

Notice

The cross section of the ground cables must be selected in accordance with national and local rules, and coordinated with protection devices installed ahead of the UPS.

Table 1: Currents and maximum cable sizes

UPS devices (kVA)	300	400	500	600	800	1000	1200
Primary Power line Max. current (A) [1) 2)] Max. number of conductors connectable to BUS-BAR & cross section (mm^2) Screw size	473 2x240 M12	630 2x240 M12	788 2x300 M12	945 4x300 M12	1250 4x300 M12	1575 6x300 M12	1880 6x300 M12
Bypass Power line/Load Nominal current (A) [2)] Max. number of conductors connectable to BUS-BAR & cross section (mm^2) Screw size	433 2x240 M12	577 2x240 M12	722 2x300 M12	866 4x300 M12	1155 4x300 M12	1443 6x300 M12	1732 6x300 M12
Battery, external +, - Max. current (at 1.8V/cell - 240 cells) (A) [3)] Max. number of conductors connectable to BUS-BAR & cross section (mm^2) Screw size	651 3x240 M12	868 3x240 M12	1085 4x300 M12	1302 6x300 M12	1736 6x300 M12	2170 8x300 M12	2604 8x300 M12
Neutral (N) from line power/ to load N Coefficient for oversizing the neutral line conductor when non-linear load is supplied	1						
Max. number of conductors connectable to BUS-BAR & cross section (mm^2) Screw size	4x240 M12	4x240 M12	4x300 M12	8x300 M12	8x300 M12	12x300 M12	12x300 M12
Ground Max. number of conductors connectable to PE BUS-BAR (mm^2) Screw size	1x240 M12	1x240 M12	1x300 M12	2x300 M12	2x300 M12	4x300 M12	4x300 M12
Type of connector	BUS-BAR						

1) For a nominal voltage of 380V, multiply the current value by 1.05; for 415V, multiply by 0.96
2) Overload current specified in chap. 9. on page 102 must be considered
3) To select the cross section, see the actual installation data and national and local codes.

The following table lists the tightening torque for the hex-head terminal connection screws supplied with the UPS.

Table 2: Tightening torque

Screw size	Nm (+/-20%)
M10	39
M12	68

3.3. Physical appearance

Warning

If static switch module and relative switches are not assembled, refer to MSS user manual.

Legend:

- QS1 = PRIMARY MAINS INPUT SWITCH
- QS2 = BYPASS MAINS SWITCH
- QS3 = MAINTENANCE BYPASS SWITCH (not available for 600/800/1000/1200kVA)
- QS4 = OUTPUT SWITCH

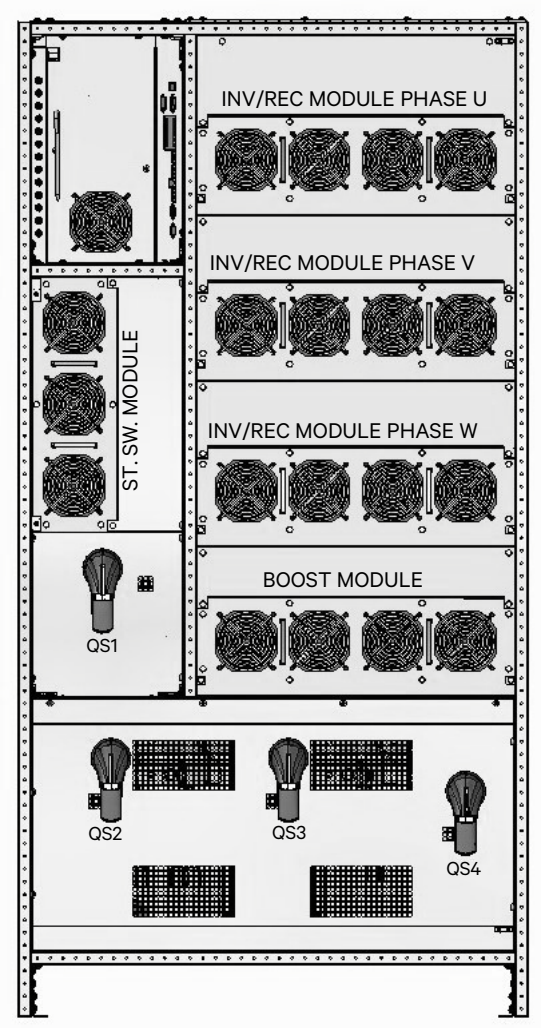


Figure 19 - Liebert EXL S1 300/400kVA - front view

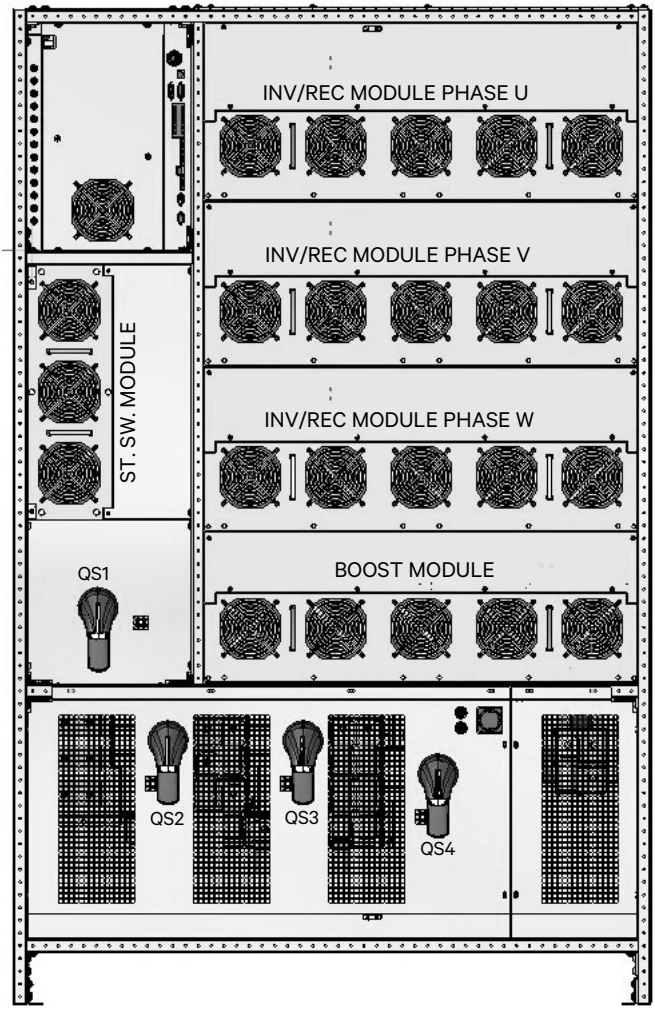


Figure 20 - Liebert EXL S1 500kVA - front view

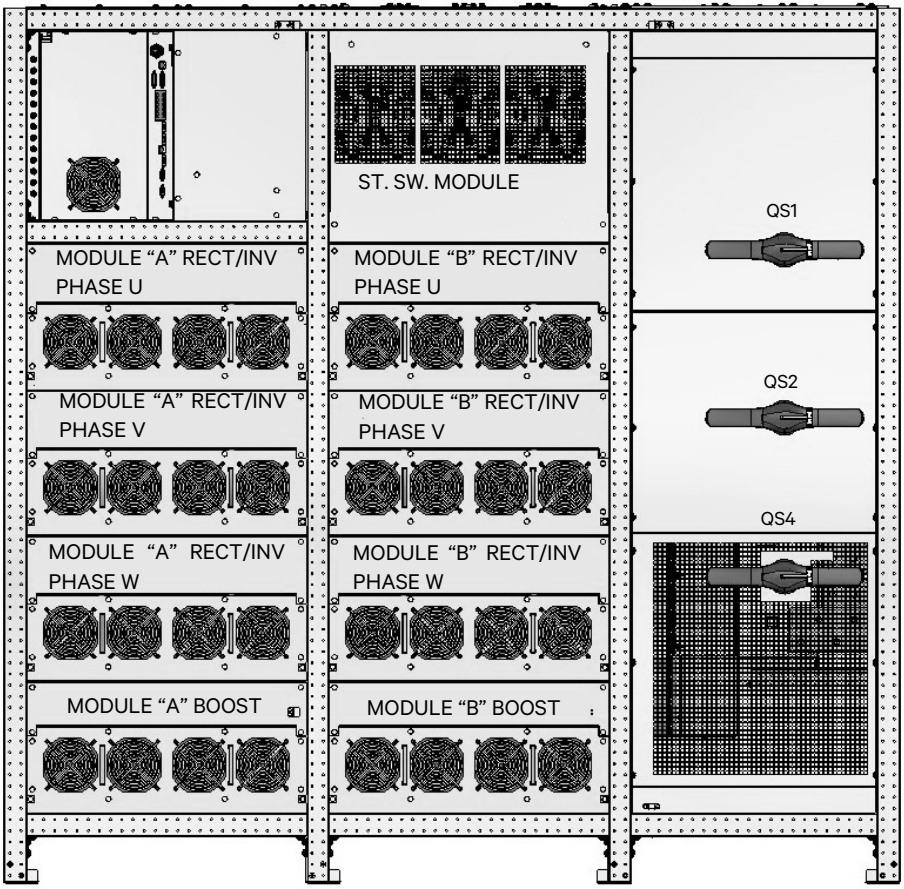


Figure 21 - Liebert EXL S1 600/800kVA - front view

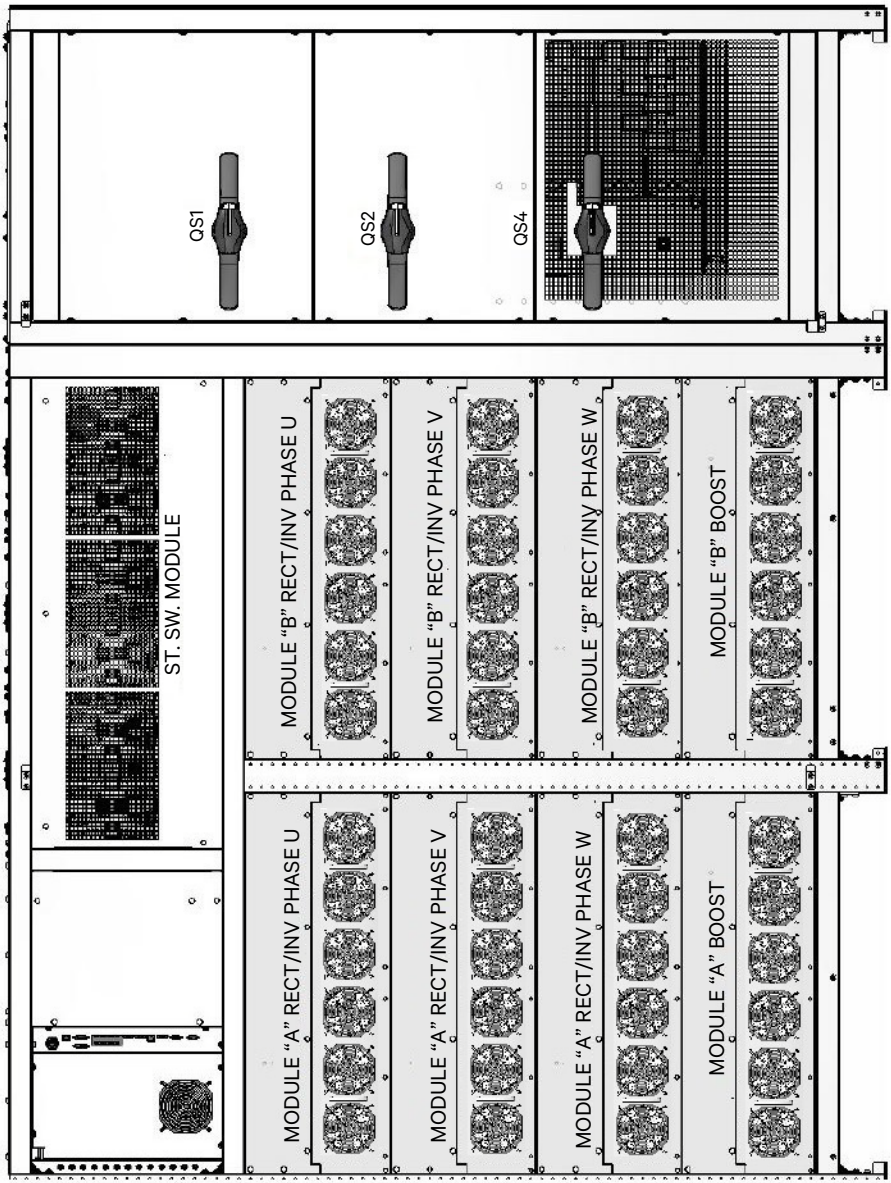


Figure 22 - Liebert EXL S1 1000/1200kVA - front view

3.4. External protection devices

This device is equipped with manual switches intended only for Service Bypass and Internal Service operations. It is therefore essential that the customer install external protection devices at the installation site. These must be installed near the unit and labelled as the line power separation device for the UPS (see IEC/EN 62040-1+A1:2013).

Warning

The following label must be displayed on all switching devices installed in the same electrical system as the UPS, even when they are located far from the area where the system is located (according to European standard IEC/EN 62040-1+A1:2013):

MAKE SURE THE UNINTERRUPTIBLE POWER SYSTEM IS ISOLATED
BEFORE WORKING ON THIS CIRCUIT

3.4.1. Use of differential protection devices

Notice - Differential Current Breakers

- The UPS does not require differential protection devices connected ahead of it. However, when these devices are installed in compliance with local regulations, note that separate DCBs in the line power and bypass line power circuits may trip unexpectedly, thus interrupting the power supply to the unit. Therefore, if a DCB must be installed, only one should be used for both primary and bypass inputs.
- In parallel distributed systems, only one common differential protection device should be installed ahead of the point where the line divides into the UPS primary and bypass line power circuits. If separate DCBs are installed in different configurations, they may trip unexpectedly.
- In order to guarantee correct distribution in the neutral cables, installation personnel shall make sure that the lengths of the cables are as equal as possible.
  However, if the bypass lines lead from sources that are electrically isolated from each other, a differential protection device may be installed on each line.
  In this case, and in cases when the load is supplied from the Bypass via the Static Bypass Switch, the isolated sources are connected in parallel. A case-by-case analysis should be made as to whether any resulting imbalance between the currents on the Bypass lines is compatible with the respective protection devices.

A differential device installed on the primary and bypass inputs supply senses the sum of all ground leakage currents in both the UPS and the load it supplies.

To avoid spurious operation, the following must be taken into consideration when selecting differential protection devices for installation on input lines:

1 The nominal value of ID must take into account the ground leakage current of the UPS and the load under normal operating conditions: ID = ID_{UPS} + load leakage current.
  N.B. The maximum limit for UPS ground leakage current is 5% of nominal input current (see IEC/EN62040-1+A1:2013)

2 Be of a delayed operation type (greater than 30 0mS);

3 The type of differential switch used must conform to product regulation IEC/EN62040-1+A1:2013.

3.4.2. Primary line power input

These should be capable of protecting the primary AC line power ahead of the UPS. It should be able to handle the maximum input current of the UPS (Table 1 on page 38) and to interrupt the circuit at its maximum current level during a short circuit.

3.4.3. Bypass line power input

Bypass line power input protection devices must have the following characteristics:

1 Maximum current rated in accordance with the values in Table 1 on page 38;

2 I^2t rating lower than the thyristor rating (see chap. 9. on page 102 for pre-arc I^2t ratings) in order to protect it in case of output short circuit. To allow for component tolerances, the external protection device pre-arc I^2t rating should not exceed 80% of the thyristor I^2t rating;

3 Pre-arc I^2t rating higher than that of the Inverter fuse (already installed inside the UPS - see chap. 9. on page 102 for pre-arc I^2t ratings) so that the Inverter fuse will blow in case of an overcurrent caused by an internal failure. In this case the load is supplied by the Bypass - to allow for component tolerances, the external protection device pre-arc I^2t rating should be at least 20% higher than that of the Inverter fuse.

3.4.4. Battery input

These should be capable of protecting the battery against short-circuits, and should take into account the maximum current drain (during discharge at 1.8V per cell), see Table 1 on page 38. These devices should be installed as close as possible to the battery.

3.4.5. UPS Output line

Since load(s) can be supplied through the Uninterruptible Power System from two sources, the ratings of the following supplies should be taken into account when designing the output line protection system.
Supply from inverter:
see Table 1 on page 38 and chap. 9. on page 102
Supply from Static Bypass Switch and maintenance Static Bypass Switch:
see Table 1 on page 38 and chap. 9. on page 102

N.B. If a single differential breaker is installed ahead of the UPS, any fault in the installation grounding system will result in the interruption of power to both the line power input and the direct line.

3.5. Backfeed protection

To prevent electric shock hazards caused by backfeed through the Static Bypass Switch, an external disconnector must be installed in conformance with Product Standard IEC/EN 62040-1+A1:2013. The UPS generates a logic command at X29 (see Fig. 40) to ensure that the disconnector operates correctly.

N.B. In case of single-line feeder, the disconnector must be installed ahead of the UPS primary and bypass inputs. When this disconnector is activated, the UPS switches to Battery Mode.

N.B. The PE and N terminals must be connected in accordance with the requirements of the local line power distribution system (TN-C, TN-S, TN-C-S, TT etc.). For instance, in
TN-C installations the PEN conductor from the supply transformer must be connected to the UPS PE and N terminals. See para. 3.6 on page 46 and Fig. 50 on page 91.

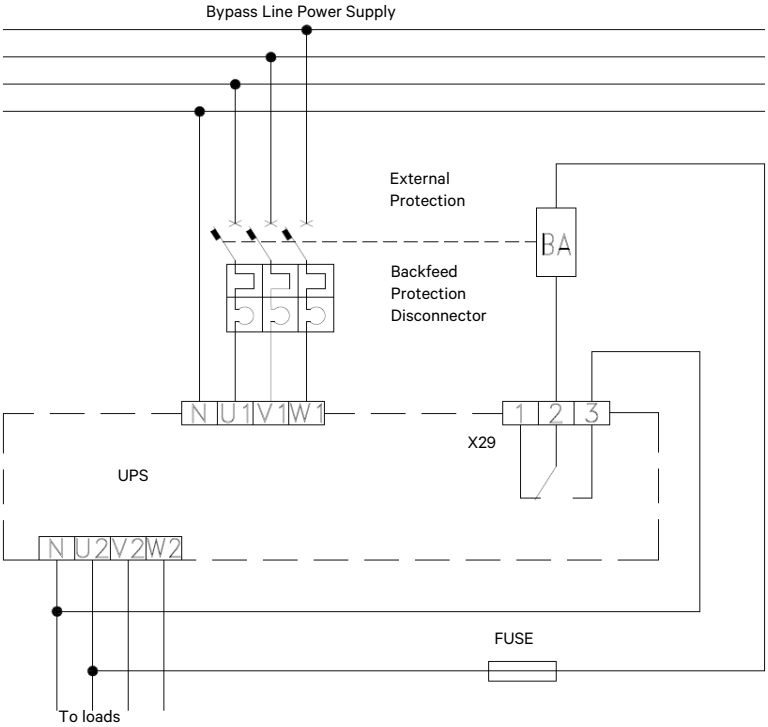


Figure 23 - External protection devices

3.6. External electrical connections

To access the external electrical connections, open the front door of the UPS and remove the secondary access panel (see Fig. 19-Fig. 22). Connect the ground cable (PE) first at ⏚.

Notice

For a TN-C distribution system, connect an insulated jumper between UPS ground ⏚ and the UPS Neutral connector.
Refer to local Standards and regulations for the correct jumper cross section.
Connect line power cable PEN to the UPS Neutral connector (N).

Notice

Ensure that the line power and load conductors are connected to the UPS as a clockwise (right hand) 3 phase system.

Make sure the UPS is isolated before removing panels.

3.7. Power connections

The power connections (see Fig. 24-Fig. 37) on the front of the UPS are:

- U, V, W - LINE POWER INPUT
- U1, V1, W1 - LINE POWER BYPASS (only at the standard UPS type)
- N - NEUTRAL BAR (PEN/N) (COMMON TEST POINT FOR PRIMARY INPUT NEUTRAL, BYPASS INPUT NEUTRAL AND OUTPUT NEUTRAL)
- U2, V2, W2 - UPS OUTPUT TO LOAD
- D-, C+ - BATTERY TERMINALS
- GROUND CONNECTION (PE) ⏚

The 600/800/1000/1200kVA ratings are supplied without the maintenance bypass switch (corresponding to QS3 on other ratings). It is recommended that the Customer provide an external Bypass switch, ensuring that it is correctly rated (see Table 1 on page 38, chap. 9. on page 102). Auxiliary signal contacts shall be assigned to a programmable input of XP11 (see Fig. 41), so that the status of the switch can be monitored during the normal operation.

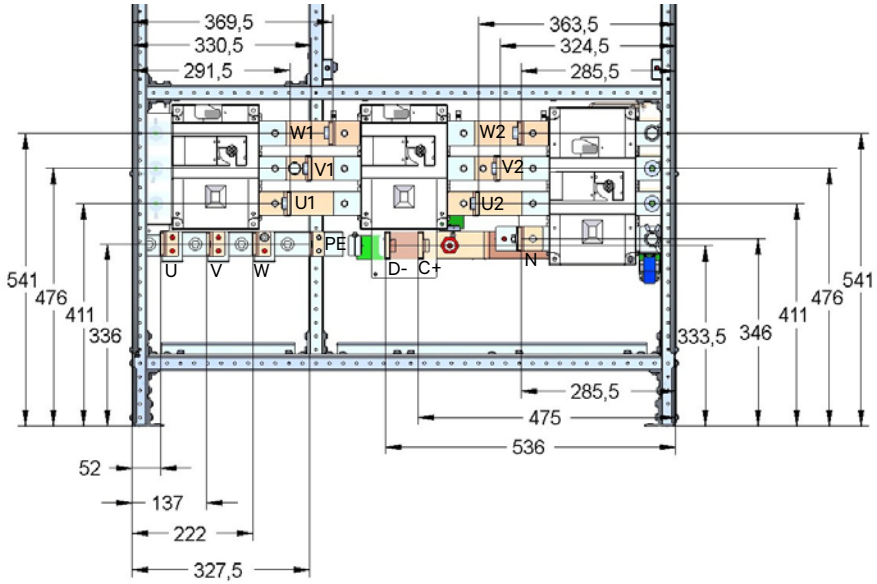


Figure 24 - Liebert EXL S1 300/400 kVA
Customer power connections (front view)

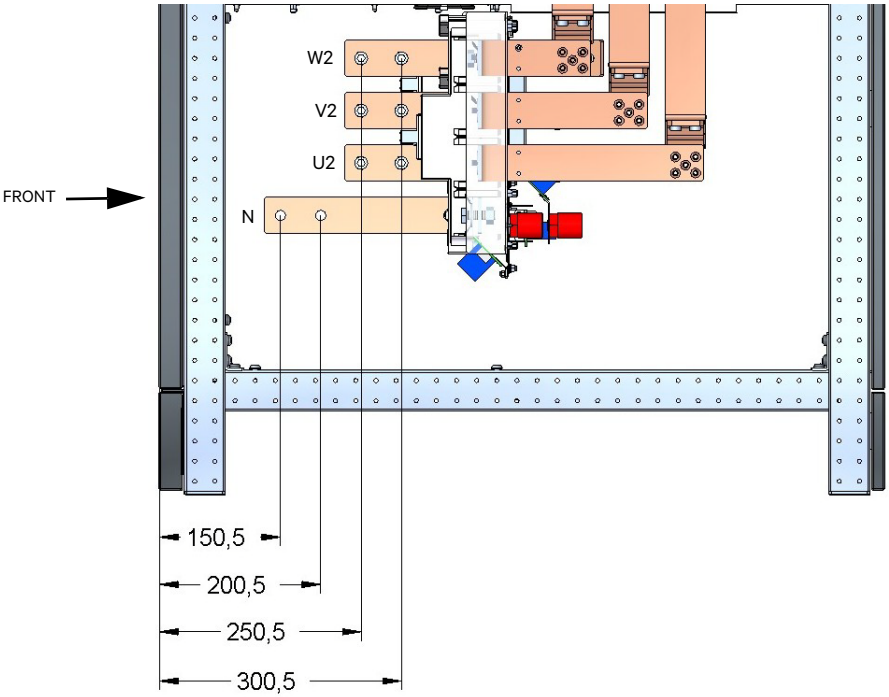


Figure 25 - Liebert EXL S1 300/400 kVA
Customer power connections (right side view)

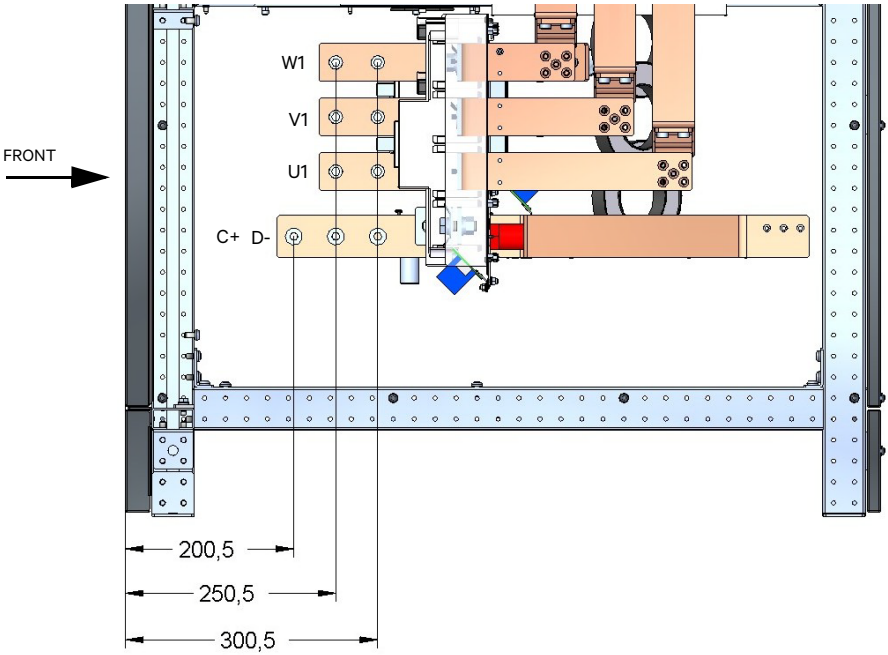


Figure 26 - Liebert EXL S1 300/400 kVA
Customer power connections (right side view)

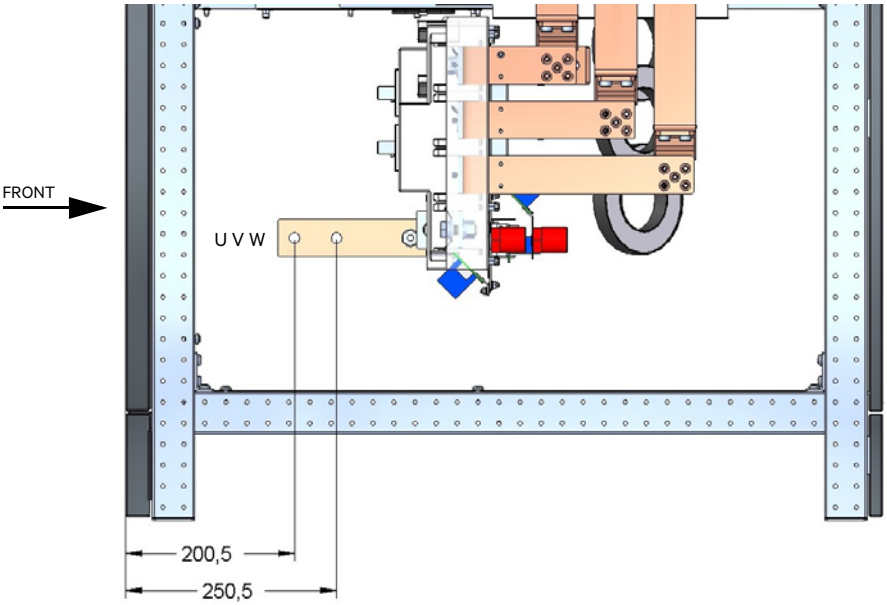


Figure 27 - Liebert EXL S1 300/400 kVA
Customer power connections (right side view)

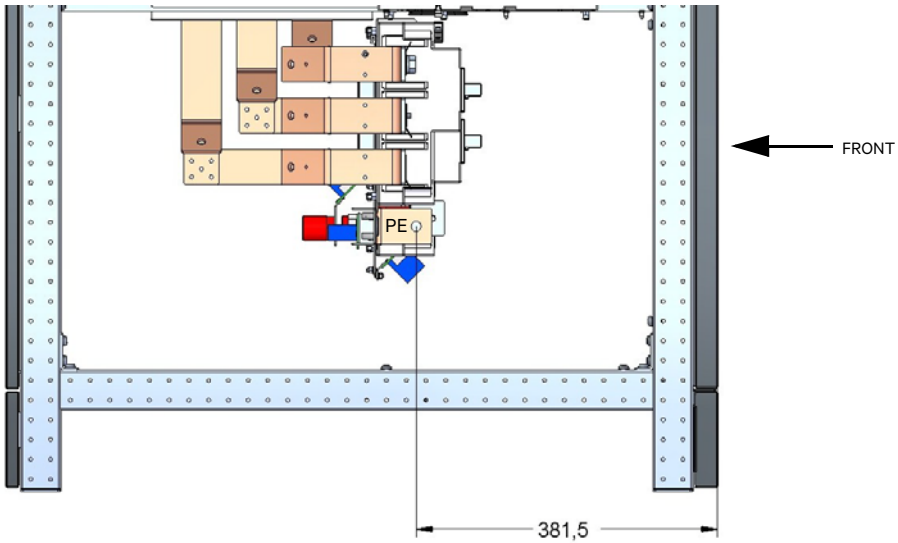


Figure 28 - Liebert EXL S1 300/400 kVA
Customer power connections (left side view)

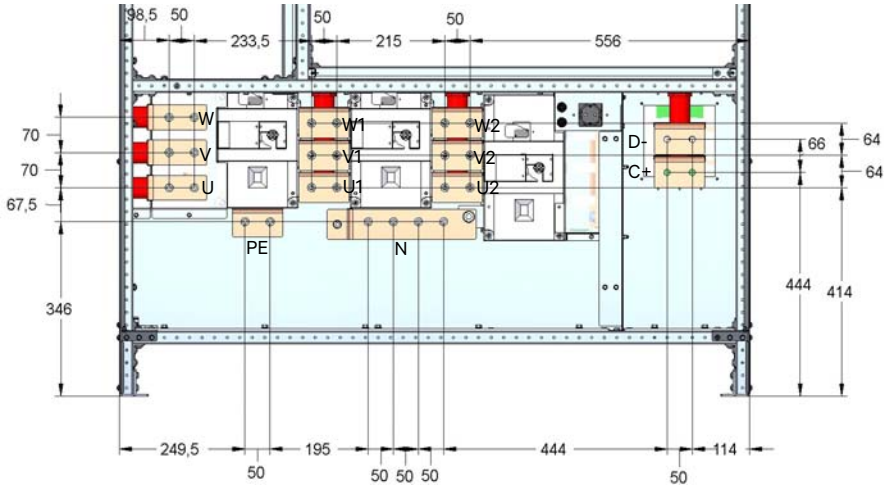


Figure 29 - Liebert EXL S1 500 kVA
Customer power connections (front view)

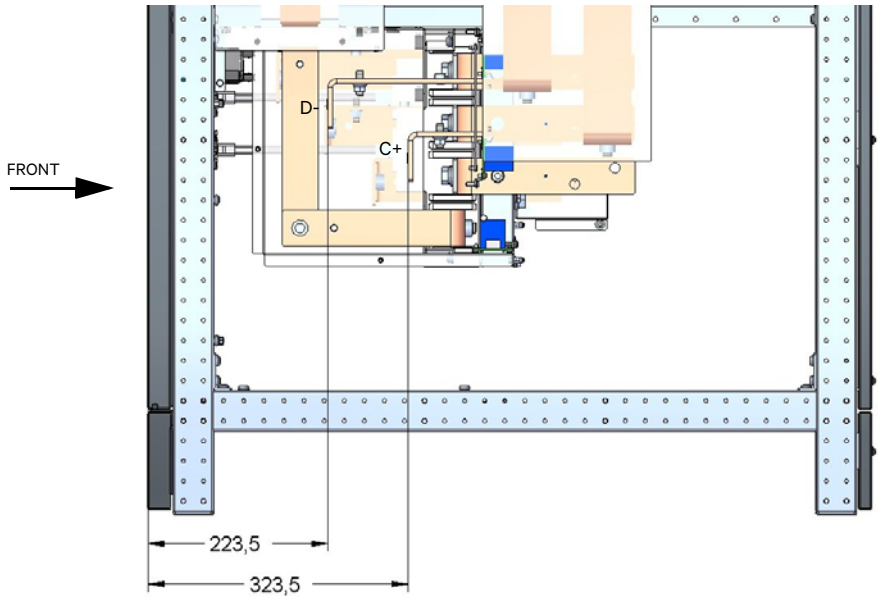


Figure 30 - Liebert EXL S1 500 kVA
Customer power connections (right side view)

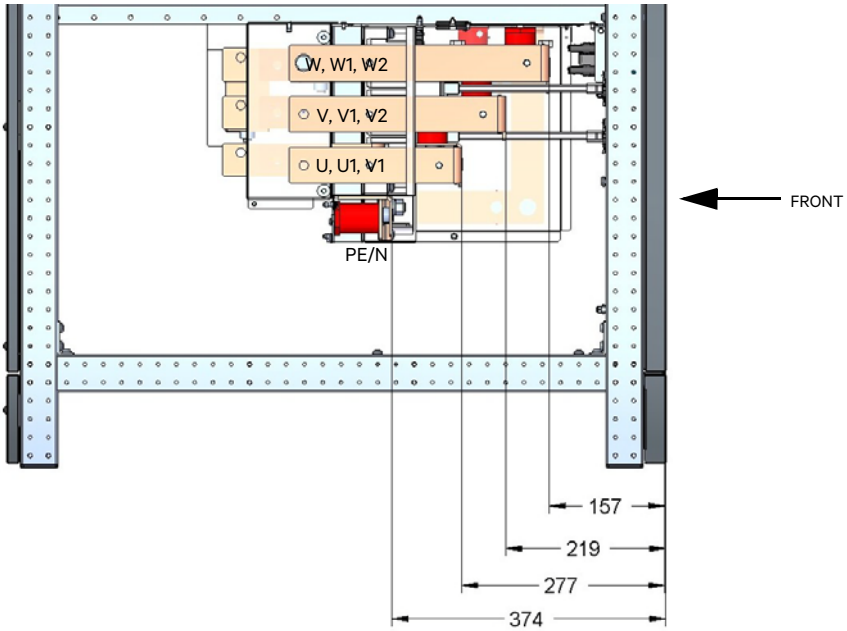


Figure 31 - Liebert EXL S1 500 kVA
Customer power connections (left side view)

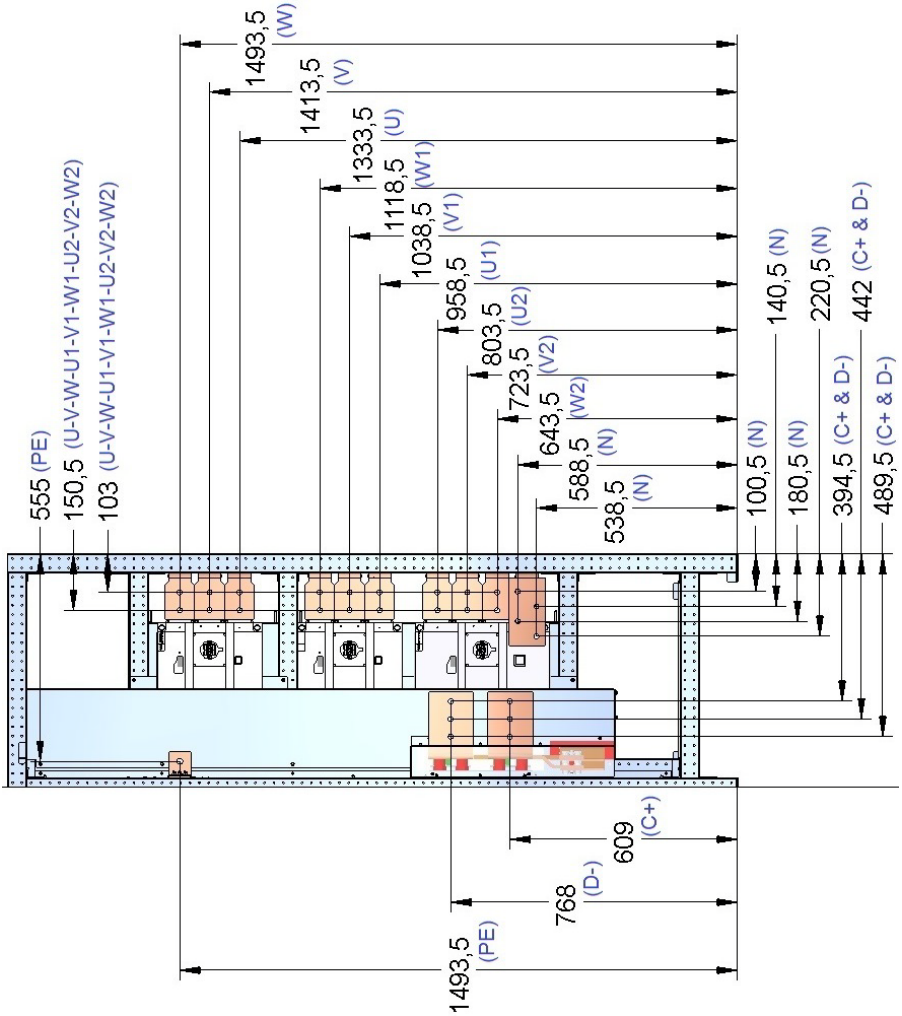


Figure 32 - Liebert EXL S1 600/800kVA
Customer power connections (front view)

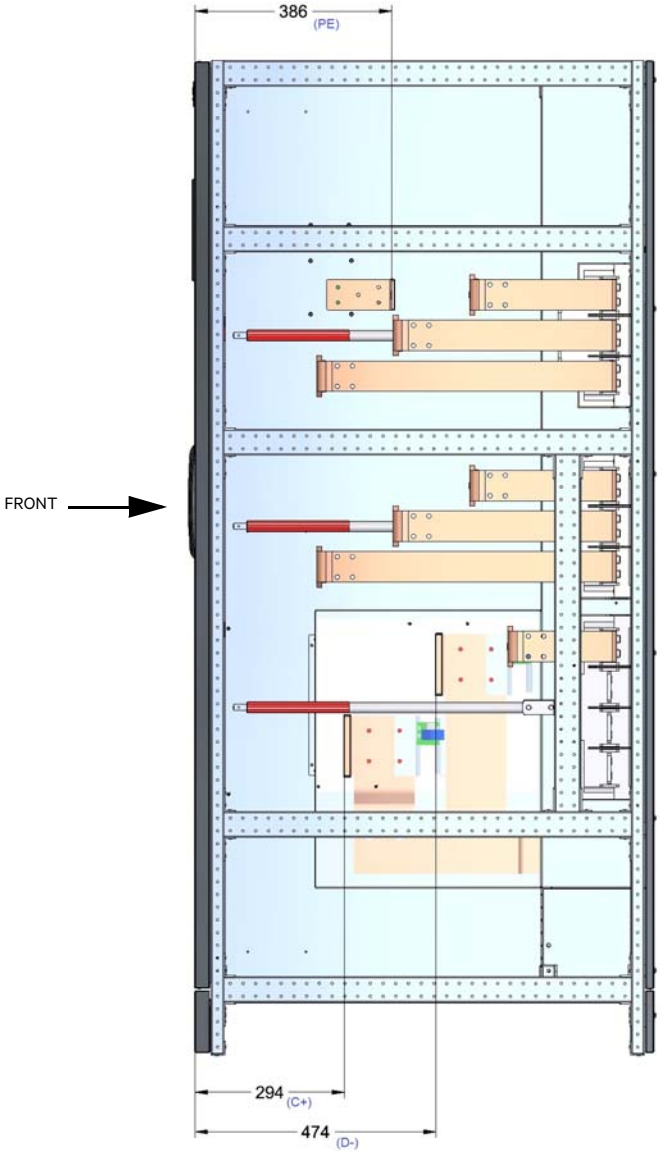


Figure 33 - Liebert EXL S1 600/800kVA
Customer power connections (right side view)

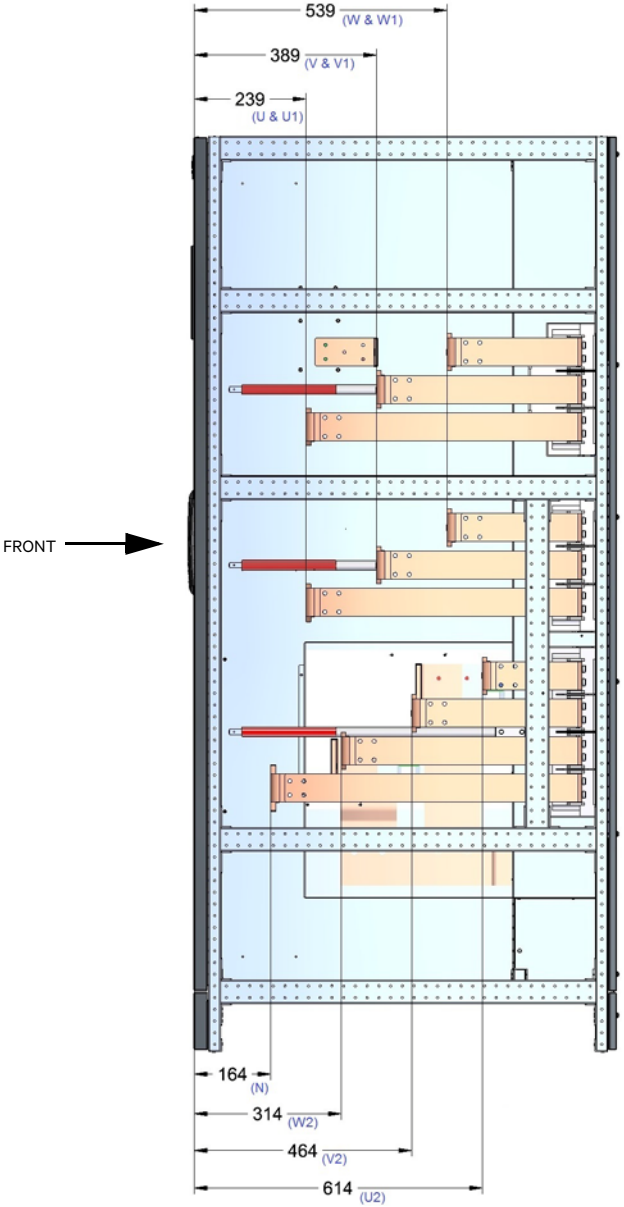


Figure 34 - Liebert EXL S1 600/800kVA
Customer power connections (right side view)

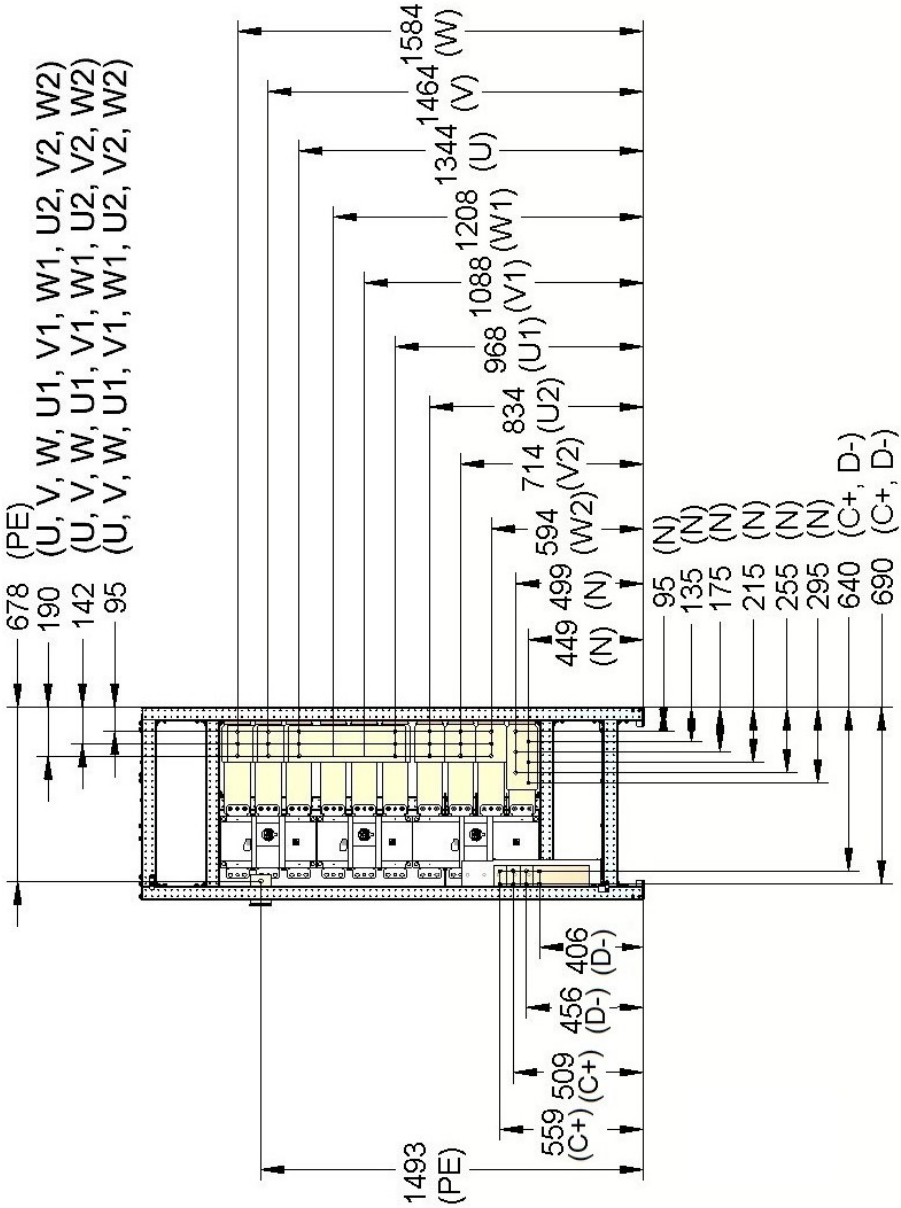


Figure 35 - Liebert EXL S1 1000/1200kVA
Customer power connections (front view)

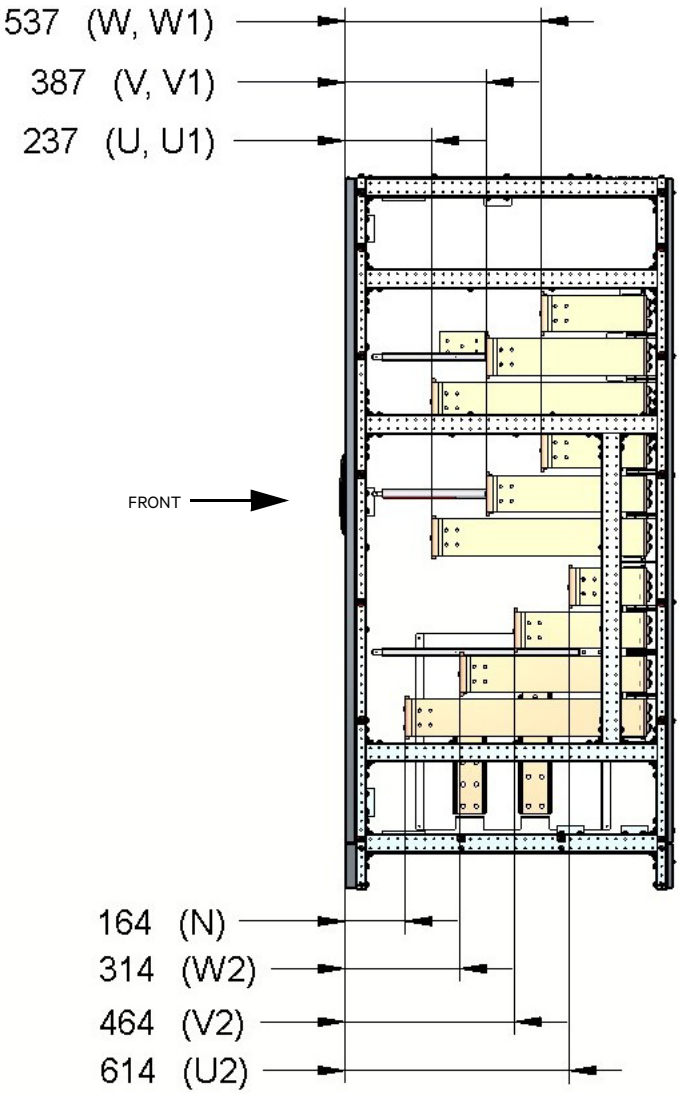


Figure 36 - Liebert EXL S1 1000/1200kVA
Customer power connections (right side view)

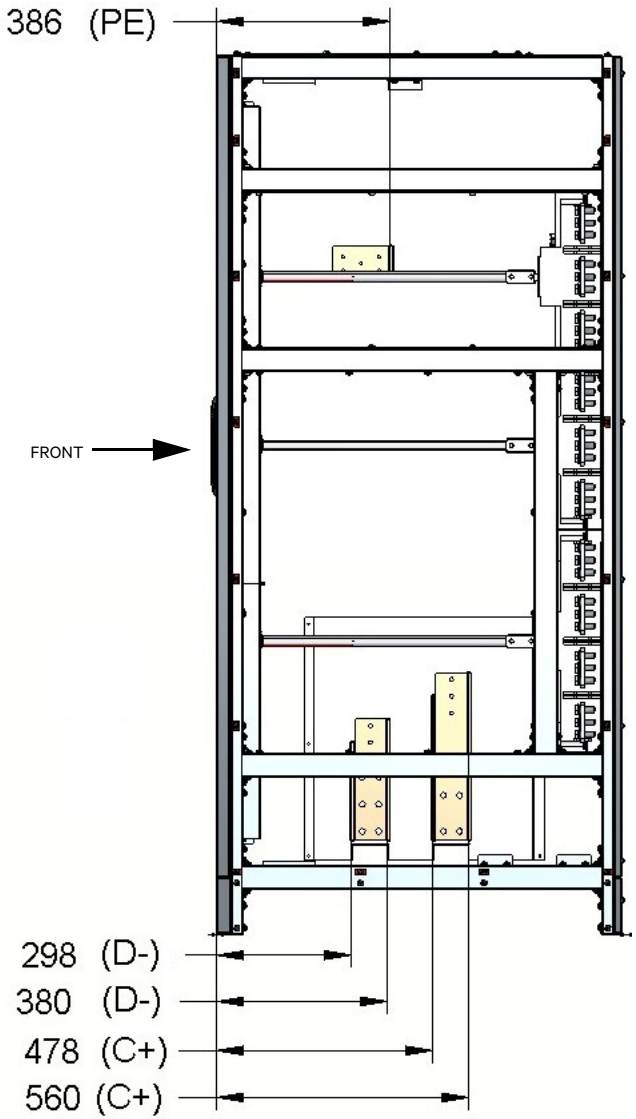


Figure 37 - Liebert EXL S1 1000/1200kVA
Customer power connections (right side view)

3.8. Connecting the batteries

UPS are supplied without the battery switch. It is mandatory that the Customer provides an external battery protection device, ensuring that they are correctly rated.
Auxiliary signal contacts shall be assigned to a programmable input of XP11, so that the status of the switch can be monitored during the normal operation.

▶ **Before connecting the batteries, please read the notice and warning label on the UPS or battery compartment.**

Notice

Full safety instructions on the use and maintenance of UPS batteries are provided in the appropriate battery manufacturers' manuals. The battery safety information contained in this section consists of key considerations which must be taken into account when designing the installation and may affect its outcome, depending on local conditions.

Warning

Special care should be taken when working with the batteries associated with the Liebert EXL S1. When all batteries are connected together the overall voltage exceeds 500V.
It is very important to make sure that the batteries are separately installed in a specially designed, lockable, dedicated battery cabinet or battery room.
Battery cabinet specifications can be found in para 8.3. on page 98 of this manual.

Warning

In the event of malfunction, the battery shelves and/or cabinet or battery holders may become live!

Notice

The requirements of EC directives are met when battery compartments with original accessories are used. If other batteries are used, make sure that the applicable EC directives are met and that conformance is declared. The UPS must still be parameterized with the service software and equipped with an all-pole disconnecting device and fuses, as per Table 1 on page 38. When dimensioning your battery cables, note the connection tolerances at terminals +/-.

Warning

ENSURE CORRECT POLARITY!

Notice

The most common battery type used in UPS installations is the valve regulated battery.

Valve regulated cells are not sealed.

The amount of gas given off is less than for flooded cells, but when planning the battery installation, allowance must be made for adequate ventilation and heat dissipation.

Valve-regulated cells are not completely maintenance-free. They must be kept clean and their connections checked periodically to ensure they are tight and that there is no evidence of corrosion.

It is inevitable that batteries will lose some charge during transportation and storage. Before attempting a capacity test, make sure the batteries are fully charged, as this may take several hours.

Cell performance typically improves after a few discharge/recharge cycles.

Notice

The battery charger can be configured for different types of batteries and different numbers of cells. In the technical data table (chap. 9. on page 102) lists the type of batteries that can be used and the number of the cells for which the battery charger is configured. The maximum charging current is selectable and depends on the rating of the UPS and its operating conditions (chap. 9. on page 102). Several charging methods (depending on the type of battery) are available and can be configured by qualified personnel only.

3.9. Connections between battery compartments and UPS

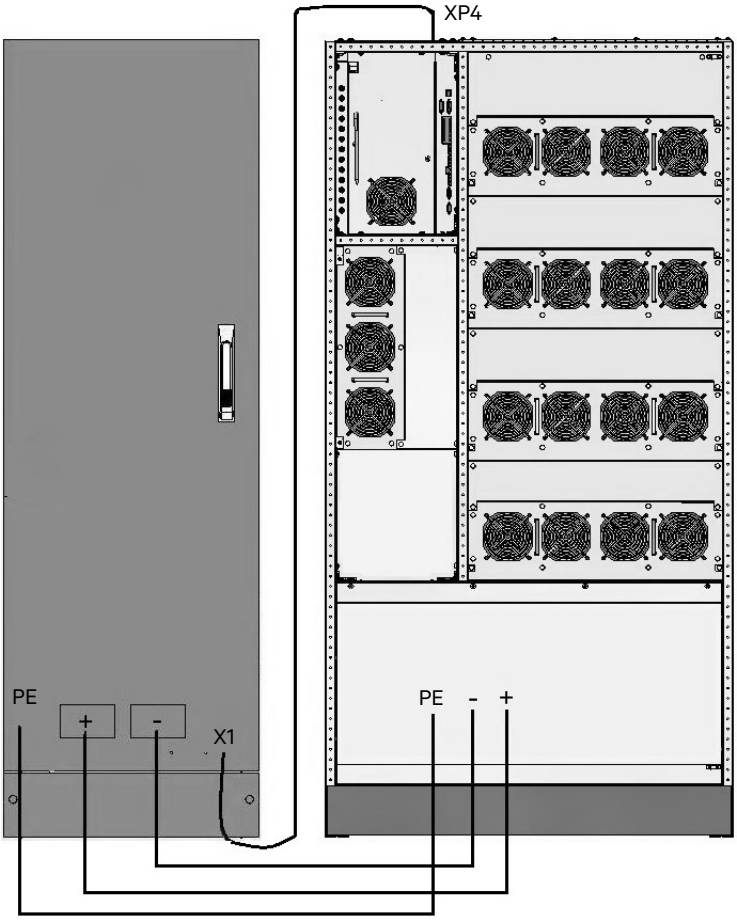
The cables for connecting the UPS to the battery cabinets are not supplied. They can be provided by the manufacturer upon special request.

A battery area temperature sensor is supplied as standard equipment and includes a connecting cable with length of 15 meters. Place the sensor in the battery cabinet and monitor it after the UPS installation.

- The battery cabinet should be installed adjacent to the UPS (see Fig. 24-Fig. 37 for the position of the input battery connections inside the UPS).
- Make the ground connections (PE).
- Connect the batteries with cables, as suggested in Table 1 on page 38 to terminals + (positive pole) and - (negative pole), and in accordance with the connection diagram.
- Connect the battery area temperature sensor to connector XP4 in the connectivity panel (Fig. 40).
- The wires that connect the temperature probe must be shielded and routed in dedicated conduits that are separate from the power cables.
- If the battery has an external battery disconnector, use customer I/O to monitor the position of the switch. Appropriate function should be assigned while setting the I/O options.

Warning

Before the system starts, ensure that UPS battery connection polarity is correct. Wrong connections can damage the system and endanger operator safety**.**



For details about XP4 position, see Fig.40.

Figure 38 - External Battery Connections

3.10. Handling the batteries

Warning

Batteries are a potential source of danger due to their electrical charge and chemical composition. Therefore, observe the handling instructions provided by the battery manufacturer. These usually can be found in the material which is included in the shipment.

3.10.1. Recharging batteries

Notice

When recharging, follow the instructions printed on the packaging

3.10.2. Replacing batteries

Notice

Before replacing batteries, make sure the new batteries are fully charged.

3.10.3. Connecting external batteries

Warning

If a battery has been disconnected and must be reconnected, the battery isolator may be reconnected only after you have made certain that voltage with the correct polarity is present in the intermediate circuit (see Connecting the Batteries).

4. CONNECTIVITY PANELS

4.1. LCD touch screen

LCD is placed on the door as shown in Fig. 39.

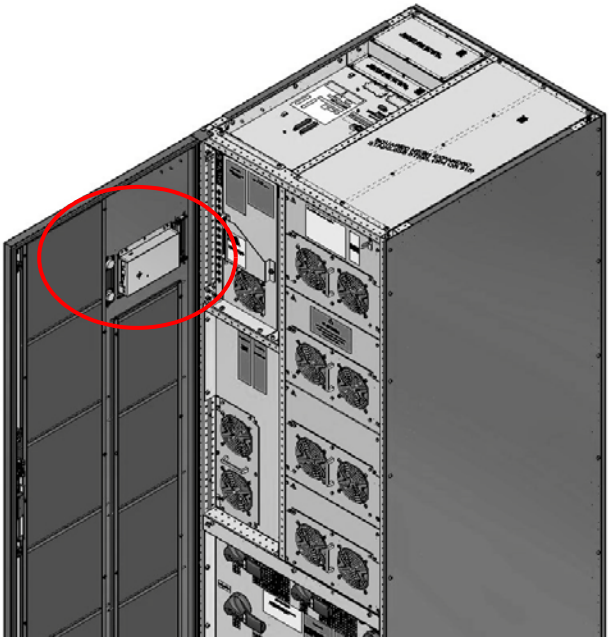


Figure 39 - LCD touch

screen Liebert EXL S1 is equipped with the following interfaces:

- ETHERNET 2 - provision for future options
- ETHERNET 1 - RJ-45 Ethernet Interface for Service and Placement into service only

4.1.1. ETHERNET 2 - provision for future options

4.1.2. ETHERNET 1 - RJ-45 Ethernet Interface for Service and Placement into service only

This interface is a 10/100 MBit autonegotiation full/half duplex Ethernet Interface for LAN communication with Vertiv service software. This allows the setup and implementation of UPS parameters such as Battery detail and performance of the UPS.
The Interface is SELV - isolated from UPS primary circuits.

4.2. Customer connectivity panel

The customer connectivity panel is placed as shown in Fig. 40.

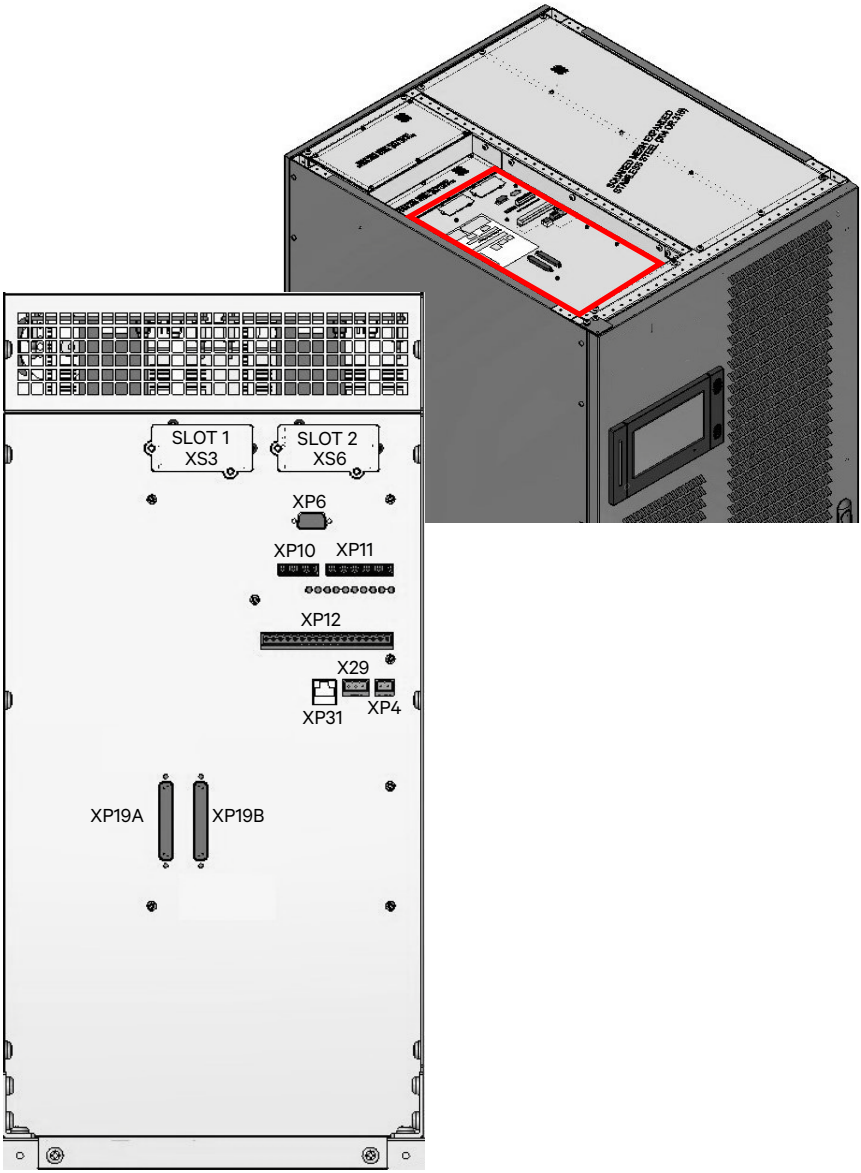


Figure 40 - Customer connectivity panel

Liebert EXL S1 is equipped with the following interfaces:

- XS3 - Slot for Connectivity Products
- XS6 - Slot for LIFE^{TM} modem
- XP6 - Serial Interface for external LIFE^{TM}
- XP10 - EPO connector
- XP11 - Input Connector
- XP12 - Output Connector
- XP31 - RJ-45 Interface for synchronization with external signal
- X29 - 3 pole screw connector for Backfeed output contact
- XP4 - 2 pole Battery Area Temperature sensor (input)
- XP19A/B - 2x37 pole connectors for parallel UPS connection

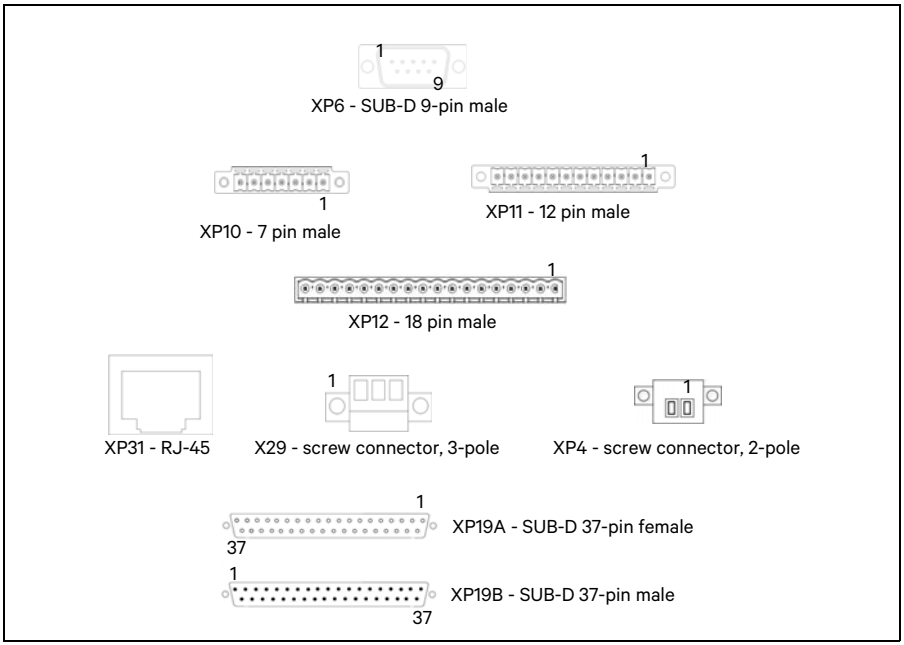


Figure 41 - Connector/terminal identification

4.2.1. XS3 - Slot for Connectivity Products

This slot is the recommended interface for the SNMP Adapter ManageUPS NET. This Adapter provides an independent external network interface for communication with connectivity products. The Slot is SELV - isolated from UPS primary circuits.

4.2.2. XS6 - Slot for LIFE^{TM} Products

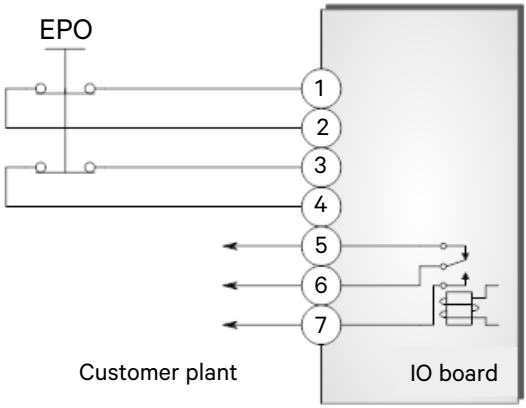
This slot is the reserved interface for LIFE^{TM} modem card. This card provides an independent external modem interface for communication with LIFE^{TM} service station. Ask your local Vertiv dealer for more details on LIFE^{TM} and its benefits for your UPS system.
When a LIFE^{TM} modem card is inserted into XS6, interface XP6 is connected to Slot XS6 to allow parameterisation and diagnosis of the LIFE^{TM} modem card. The Slot is SELV - isolated from UPS primary circuits.

4.2.3. XP6 - Serial Interface for Connectivity Products (serial input/output)

The service Interface is a SUB-D 9pin male connector for RS232 serial communication. It is used for communications with external LIFE^{TM} modem (e.g. GSM modem) or other special Vertiv applications. The Interface is SELV - isolated from UPS primary circuits.

4.2.4. XP10 - EPO connector

Connection with customer plant:
7-wire connector with screw terminals and screws for fixing it.
Connection should be as follows:



The emergency stop action shuts down the rectifier, inverter, and static bypass. It does not however internally disconnect the input mains supply. If required, this additional action can be facilitated by acting on a second contact of the emergency stop switch placed on an upstream breaker.
To perform a remote emergency power off, it is necessary to connect an emergency stop button to the UPS via a twisted/shielded cable not exceeding 20 m in length. The contact must be "CLOSED" under normal operating conditions. When this contact opens, the load will be cut off and a fault will

appear on the display. To resume normal operation, the operator should turn EPO button to CLOSED position, reset the fault on the display and turn on the UPS.
If this button is not installed, one jumper lead must be connected between pins 1 and 2.
For an indication of EPO status, connect pins 5, 6 and 7 to an external supervision system.
To ensure compliance of the wiring installation with European Harmonized Document HD384-4-46 S1, an Emergency Switching Device (ESD) must be installed after the UPS.

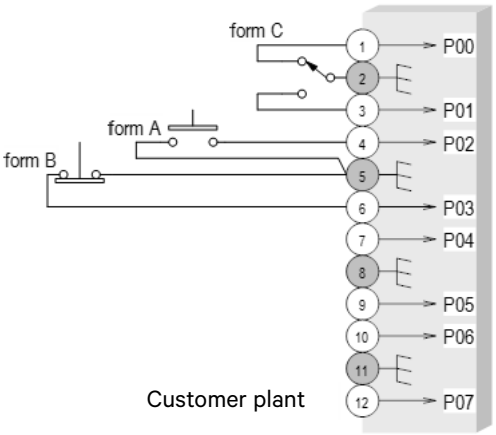
PIN	Signal	Explanation
PIN 1-2	1° EPO INPUT	EPO is ON when either input 1 or input 2 are open; the inputs are independent and in OR logic [1)]
PIN 3-4	2° EPO INPUT	
PIN 5-6-7	RPO Status CONTACT	Form C dry contact. 1A @24 Vdc

[1)] Contact Vertiv technical support for different configuration
The maximum cable diameter is 0.75 mm^2.

Warning
The external Push-Button must be voltage free and isolated from all sources and GND.
The external EPO supervisor Input must not exceed 24V 1A.

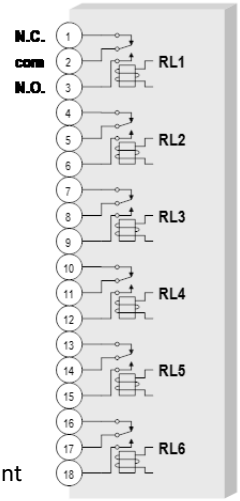
4.2.5. XP11 - Input Connector

Connection with customer plant:
12-wire connector used for dry contacts, only safe operating voltage should be connected here.
The current level for all inputs is less than 5mA at 12 or 24V.
Connection should be as follows:



4.2.6. XP12 - Output Connector

This connector will be connected to the customer plant.
18-wire connector suitable for 250V signals. Functional insulation between pins and reinforced insulation between XP10 and XP11 is required. The current range of the contacts is 1A at 250Vac or 1A at 24Vdc.
Connection should be as follows:



Customer plant

Example:

- General alarm
- General warning
- Circuit breaker: QS5 closed

4.2.7. XP31 - RJ-45 Ethernet interface for synchronization with external signal

This Interface is used to communicate with an external synchronization device, such as MBSM.
It can be used to synchronize the outputs of multiple UPS devices, even when they do not supply a common output. This enables an external static switching device (e.g. CROSS) to commutate between UPS outputs in the event of a malfunction, without creating synchronization problems.

Warning
This interface and its function are for authorized Vertiv service technicians, only. Do not remove any connected cable from this interface or connect any cable to it.

The Interface is SELV-isolated from UPS primary circuits.

4.2.8. X29 - Connector for Backfeed Status (Output)

This contact will provide Backfeed Protection according to IEC/EN 62040-1+A1:2013. This output can be used to trip or drive a contact in order to insulated the bypass input line when a SCR failure occurs. This 3-pole screw connector is used to activate an external magnetic contactor (MC) if the UPS detects a Backfeed current through the bypass in double conversion mode.
This can be caused by a short circuit in the bypass thyristor branch of the UPS.

PIN	Signal	Explanation
PIN 1	Backfeed switch n.c.	Open when backfeed is detected
PIN 2	Backfeed switch common	Common contact
PIN 3	Backfeed switch n.a.	Close when backfeed is detected

The maximum cable diameter is 0.75mm^2.
The Interface is SELV - isolated from UPS primary circuits.

Warning

The output of the external backfeed circuit connected to X29 must not exceed:

- 24VDC, 1A
- 230VAC, 3A

Warning

X29 are voltage free contacts fully isolated from UPS primary circuits.
If a voltage higher than 40V is applied to control an external disconnection device, X29 can no longer be considered safe.

4.2.9. XP4 - Battery Area Temperature sensor (input)

Pin	Signal	Explanation
1-2	TEMPERATURE SENSOR	Temperature sensor

Input for the battery area temperature sensor.
The interface is a 2-pole screw terminal (Phoenix 1.5/2 STF) that accepts wires up to 0.75mm^2.

4.2.10. XP19A/B - SUB-D connector for parallel UPS connection

This interface is used for paralleling 2 or more UPS with each other.
It enables data exchange between UPS electronics so that the UPS can provide a common output.
The Interface is SELV-isolated from UPS primary circuits.

Warning

This interface and its function are for authorized Vertiv service technicians, only. Do not remove any connected cable from this interface or connect any cable to it.

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5. NORMAL AND SAFE OPERATION

5.1. Function

The uninterruptible power supply (UPS) is connected between line power and electrical load. It protects the load from line power interruptions and power failures.

Warning

To avoid overheating inside the UPS, do not operate the unit for extended periods with the rectifier running, the Inverter switched off and the Bypass switch open.

5.1.1. On-line Principle

In on-line operation, the alternating voltage of the line power is converted into direct voltage. This DC voltage is used simultaneously to charge the battery and supply the inverter. The inverter converts the direct voltage into interference-free alternating voltage at a fixed frequency and amplitude, which supplies the connected loads. This protects the load from line power disturbances and provides a secure supply for electrical loads (PCs, network servers, multi-console systems).
In case of a line power failure, the batteries provide uninterrupted power to the loads for a given period, depending on battery capacity and connected load.

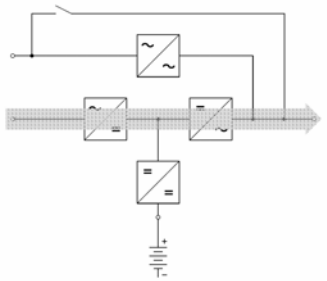

Figure 42 - UPS in on-line operation

5.1.2. Battery management

The battery is charged and discharged, as well as monitored, using a dedicated microprocessor control. This ensures maximum battery life. For details, see para 5.2. on page 75.

5.1.3. Bypass-line principal and overload management

In the event of an overload (e.g. > 150% of nominal load), the load is supplied by the inverter for a limited time (see chap. 9. on page 102, inverter output section) after which, if the Bypass line is available, the load will be transferred to Bypass; otherwise, the supply to the load will be interrupted. A corresponding fault message is displayed on the touch screen. To restore the initial conditions, the output load must first be reduced, and then a manual reset must be carried out to clear the fault message from the touch screen. Contact customer service for more information. In the event of an inverter fault, the supply for the load is transferred immediately to the Bypass line. The touch screen displays the corresponding fault message. Before carrying out a manual reset to restore initial conditions, it is necessary to remove the root cause of the fault. It is strongly recommended you contact customer support for more information.

5.1.4. Communication

The UPS offers several interfaces for communication with computers. Further information is included in chap. 4. on page 67.

5.2. Special features

5.2.1. Safe and reliable operation

- Real on-line functioning, i.e. complete de-coupling of the load from all abnormalities in line power
- Important features of the UPS, such as vector control and high flexibility, are supported by the DSP board).
- Static Bypass Switch increases the reliability of electrical supply

5.2.2. Easy installation and operation

- Parameterisation using bundled PC software
- No Operator presence required during normal operation
- Simple touch screen provides clear indication of status, load and battery quality. The concept behind the display and the way it operates is easy to understand.
- Event memory for fault analysis
- Fault display and audible signal

5.2.3. Battery management

- Automatic battery management ensures maximum battery life
- Automatic battery circuit test
- Temperature-dependent charging

5.2.4. Environment, EMC

- EMC limits values to comply with European regulations and standards
- Energy savings due to high efficiency
- Low noise level
- Special EMC filter for higher demands (optional)

5.2.5. Modern technology

- Interfaces with software for all operating systems
- IGBT power transistors
- Highly integrated digital electronics (ASICs)
- Especially well suited for computer loads

The UPS can also be used as a frequency converter for 50/60Hz or vice versa.

5.3. Block diagram

(see Fig. 43).

KEY TO SWITCHES:

- QS1 = PRIMARY MAINS INPUT SWITCH
- QS2 = BYPASS MAINS SWITCH
- QS3 = MAINTENANCE BYPASS SWITCH (not available for 600/800/1000/1200kVA)
- QS4 = OUTPUT SWITCH

5.3.1. Components

The UPS consists of the following components:

- Rectifier - Provides regulated DC voltage to inverter and booster/charger.
- Inverter - Provides controlled AC output voltage to the critical load
- Battery converter - Charges the battery when line power is present. Supplies the inverter from the battery when line power is not present.
- Static Bypass Switch
- Maintenance Bypass - Disconnects the Power Module during servicing, without interrupting the supply to the load

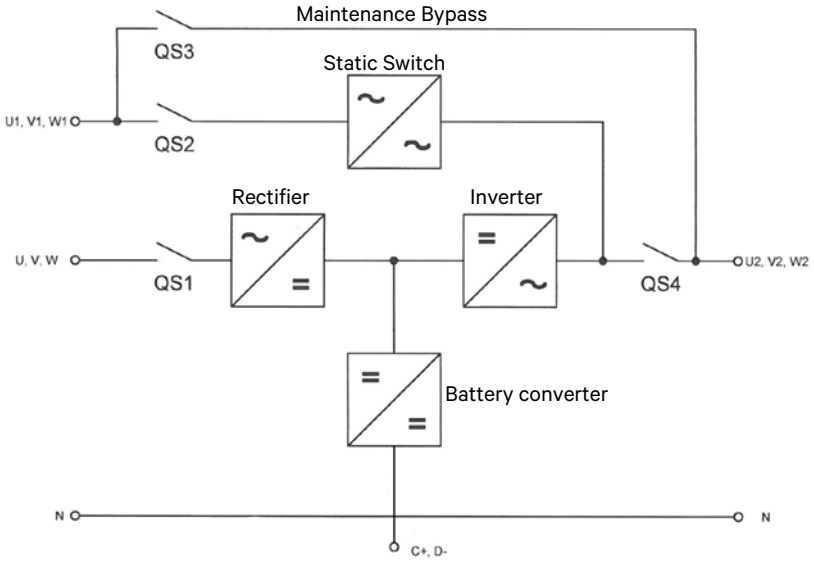

Figure 43 - Liebert EXL S1 block diagram

5.4. Maintenance Bypass Switch (not available for 600/800/1000/1200kVA)

Liebert EXL S1 is equipped with a Maintenance Bypass Switch (QS3) that allows the user to perform maintenance on the UPS without interrupting the supply to the load.
Transfer to and from Maintenance must be done in accordance with the procedures 3 and 4 described in para 5.7. on page 80.

- QS1 = OPEN
- QS2 = OPEN
- QS3 = CLOSED
- QS4 = OPEN

(see Fig. 19-Fig. 22)

Warning

During parallel operation, switching of the load on the built-in Service Bypass must be performed by an external device (see chap. 7. on page 86).

5.5. Operating modes

The UPS has four different operating modes. These are described below.

5.5.1. On-line operation

Normal UPS operating mode. The connected loads are supplied from line power via the Inverter. The batteries are charged as necessary. The inverter reliably filters line power disturbances and provides a stable, interference-free supply to the load. The Normal state is displayed.
In this operating mode, the UPS switches to battery operation if a line power failure occurs. If an overload or short circuit occurs on the UPS output, or if there is a fault in the inverter, the UPS switches to Bypass operation.

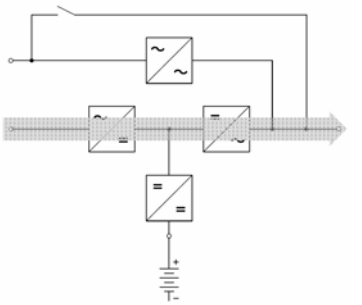

Figure 44 - Power flow in on-line operation

5.5.2. Battery operation

In this operating mode, the connected load is supplied from the batteries via the inverter. In the event of power failure, battery operation is automatically activated and supplies the loads without interruption. If the power failure lasts longer than 30s, the UPS signals a fault condition. The battery's operating condition is displayed. From this operating mode, the UPS automatically reverts to on-line operation within the backup time after the line power returns. If the duration of the power failure is longer than battery capacity under current load, the UPS provides the relative information via its interfaces. Computers can be automatically powered down with additional software (optional).

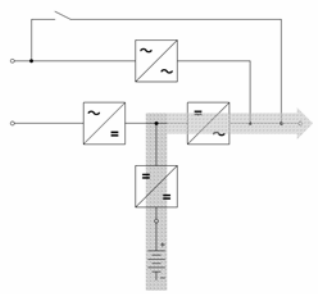

Figure 45 - Power flow during battery operation

5.5.3. Bypass operation

In this operating mode, the connected loads are supplied from line power via the Static Bypass Switch. The Static Bypass Switch is used to provide power to the loads. If an overload or short-circuit on UPS output occurs, the Static Bypass Switch is automatically activated to provide uninterrupted power to the loads. The Bypass operating condition is displayed. From this operating mode, the UPS automatically reverts to on-line operation after the fault is corrected.
Bypass operation can also be specifically selected from the control panel using the push button.

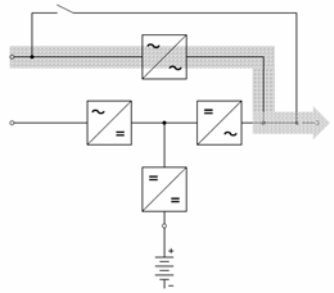

Figure 46 - Power flow in Bypass operation

5.5.4. Maintenance Bypass

In this operating mode, the connected loads are supplied directly from line power. The Display/Control Panel is disabled.
Maintenance Bypass is used to supply the connected loads during maintenance work on the UPS.

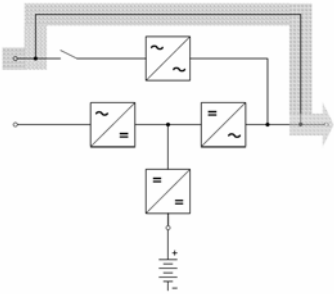

Figure 47 - Power flow during Service Bypass operation

5.6. Placement into service

5.6.1. Forming

If the UPS devices have not been used for one year or more, the intermediate circuit capacitors must be reformed. If the UPS devices are placed into service within one year after delivery (check nameplate), this action is not necessary.

▶ **Contact customer service if the intermediate circuit capacitors must be reformed.**

▶ **Carry out placement into service as follows:**

5.6.2. Switch on the UPS

- Check that the UPS is connected according to chap. 3. on page 36. For parallel operation please check chap. 7. on page 86.
- Make sure the ventilation grilles are unobstructed
- Make sure the ground connection is in place
- Make sure that any external switches are in the OFF (0) position and that the UPS is completely de-energized
- Make sure that **any external batteries are disconnected**

Warning
Do not connect any devices that may overload the UPS or draw direct current from it.

Notice
If these instructions are not observed correctly, problems may occur with the supply of power.

5.6.3. Connect the batteries

Before the system starts, make sure that UPS battery connection polarity is correct. Wrong connections can damage the system and endanger operator safety.

Warning
This operation must be carried out by qualified personnel.
To prevent damage to the system, before closing battery breaker, use a suitable instrument to make sure that the polarity of the battery voltage measured on the external side of battery breaker matches the polarity indicated in (see Fig. 24-Fig. 37).

Warning
Close battery breaker only after battery polarity has been carefully checked.

5.6.4. Switch to on-line operation

- Set the UPS to On-line Operation (see para 5.7 on page 80).

5.7. UPS switching procedures

The following procedures refer to para 5.3. on page 76.

Warning
If static switch module and relative switches are not assembled, refer to MSS user manual.

5.7.1. Procedure 1: UPS TURN-ON PROCEDURE

Starting with the UPS completely deenergized, this procedure explains how to switch on the UPS and set it to Normal Operating Mode.

Step	Action	Status
1	Switch QS1 to the ON position	Rectifier start up
2	Switch QS2 to the ON position (wait for the Static Bypass Switch to switch on)	Static Bypass Switch ON and fans ON
3	Close external battery switches then set battery breaker[1)] to the ON position	
4	Switch QS4 to the ON position IMPORTANT: when QS4 is closed, the output of the UPS and all the loads connected to it will be energized.	System in Bypass Mode - Output voltage present
5	Touch “Inverter On” on the touch screen.	Normal Mode

1) Not available for all ratings

5.7.2. Procedure 2: UPS TURN-OFF PROCEDURE

Starting with the UPS in the Normal Mode, this procedure explains how to switch off the UPS. When this procedure is followed, the output voltage is completely turned off and any load connected to UPS output is shut down.

Step	Action	Status
1	Touch “Inverter Off” on the touch screen.	System in Bypass Mode
2	Switch battery breaker[1)] to the OFF position	
3	Switch QS4 to the OFF position	Load not supplied
4	Switch QS2 to the OFF position	
5	Switch QS1 to the OFF position	

1) Not available for all ratings

5.7.3. Procedure 3: TRANSFER FROM NORMAL MODE TO MAINTENANCE BYPASS MODE

Starting with the UPS in the Normal Mode, this procedure explains how to transfer the load to Maintenance Bypass and shut down the UPS.

Step	Action	Status
1	Touch “Inverter Off” on the touch screen.	System in Bypass Mode
2	Switch battery breaker[1)] to the OFF position	Battery disconnector
3	Switch QS3[2)] to the ON position	
4	Switch QS4 to the OFF position	Service Mode
5	Switch QS1 and QS2 to the OFF position	Maintenance Bypass Mode - UPS completely de-energized

1) Not available for all ratings
2) Not available for 600/800/1000/1200kVA (see para 3.3. on page 39)

5.7.4. Procedure 4: TRANSFER FROM MAINTENANCE BYPASS MODE TO NORMAL MODE

Starting with the UPS in the Maintenance Bypass mode, this procedure explains how transfer the load to Normal Mode and start the UPS.

Step	Action	Status
1	Switch QS1 to the ON position	Rectifier start up
2	Switch QS2 to the ON position (wait for Static Bypass Switch to turn on)	Static Bypass Switch ON and fans ON
3	Close external battery switches then set battery breaker[1)] to the ON position	
4	Switch QS4 to the ON position	System in Bypass Mode - Output voltage present
5	Switch QS3[2)] to the OFF position	
6	Touch “Inverter On” on the touch screen.	Normal Mode

1) Not available for all ratings
2) Not available for 600/800/1000/1200kVA (see para 3.3. on page 39)

5.8. Inverter STOP/START procedures

5.8.1. Single UPS - Start Inverter

UPS in Bypass mode: To start the inverter and transfer the load to the inverter touch 'Inverter On' on the touch screen.

5.8.2. Single UPS - Stop Inverter

UPS in normal mode: To stop the inverter and transfer the load to the Bypass line touch 'Inverter Off' on the touch screen.

5.8.3. Parallel UPS system - Start Inverter

System in Bypass mode: To start all the inverters and transfer the load to the inverters touch 'Inverter On' on the touch screen on each machine. The inverters will start when all 'Inverter On' commands have been given.

5.8.4. Parallel UPS system - Stop Inverter

System in normal mode: To shut down all the inverters and transfer the load to the Bypass line touch 'Inverter Off' on the touch screen on each machine. The inverters will shut down when all 'Inverter Off' commands have been given.

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6. MAINTENANCE

6.1. Maintenance intervals

Vertiv recommends that regular maintenance checks be carried out on-site by an authorized customer service. The UPS informs the user when the normal service life of a fan has ended. A replacement fan is recommended.

6.2. Disposal of batteries

When the useful life of the batteries has ended, they must be replaced by your Customer Service representative. Exhausted accumulator batteries are classified as “harmful toxic waste” that must be disposed of in the EU by a certified disposal specialist. Outside the EU, they must be disposed of in accordance with the applicable regulations for the given country. The Customer service centre is fully equipped to deal with such batteries in accordance with regulations and with full respect for the environment.
The typical useful life of the battery is 3 to 5 years at 25°C ambient temperature. However, useful life also depends on the frequency and duration of line power failures.

6.3. Service addresses

On site service is available worldwide. Service telephone and fax numbers can be found on the last page of this manual.

6.4. Decommissioning

6.4.1. Taking out of service

N.B. Switch to Service Bypass

- Switch the UPS to Maintenance Bypass operation (see para 5.7.3. on page 81)

N.B. Disconnect the batteries

- Open the battery isolator or battery switch if other external batteries are used.
- Before continuing work, measure the voltage on the battery terminals and on the line power input, and wait until these have dropped to 0V; or wait at least 5 min. Failure to do so may cause severe electrical shock and possibly death.

The UPS is now in the maintenance Bypass operating mode. The only voltage present is at the line power and load terminals. Qualified personnel may now carry out maintenance work while taking the corresponding safety measures.

N.B. Disconnect line power

If the loads no longer need power, you may open the external line power separation device for the UPS.

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7. PARALLEL CONFIGURATION

Up to 8 Liebert EXL S1 units can be connected in parallel to increase power capacity and thus to provide more secure power to the load (redundancy).
The modules in parallel exchange information via a 37-wire shielded cable.
The total load current is shared between the modules.
For optimum performance of the parallel system and proper current sharing, especially in the Bypass mode, make sure that the series impedance of the modules in parallel is the same.
The cross section and length of the power cables used to connect the inputs of each UPS module must be the same. The same applies to the output cables and the battery cables, if the modules are connected to the same DC source.
Differences of 20% are allowed for power cable lengths of up to 20m. For larger distances, cable lengths may not vary by more than 10%.
For parallel connection between 80-NET and Liebert EXL S1, use the Parallel kit - adapter option (para 8.9. on page 98) and see below:

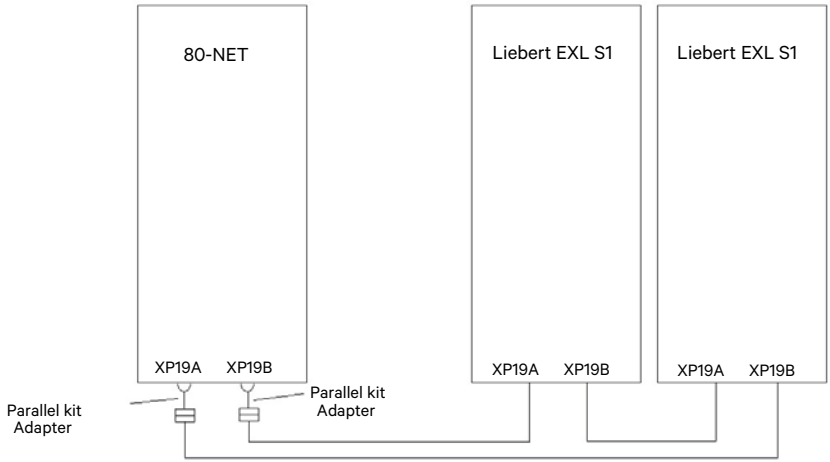

Figure 48 - Parallel connection between 80-NET and Liebert EXL S1

7.1. Placement into service

Placement into service of multiple-block systems must be carried out by appropriately trained technicians.

7.2. System configurations

Fig. 49 and Fig. 50 illustrate the schematic diagram of a multiple-block system with SBS in various configurations. Contact Vertiv Technical Support for more information. The SBS shown in the diagrams may be installed in Liebert EXL S1 parallel systems where standard, 400V units are installed.

7.3. Communication between UPS blocks

UPS units exchange information through the connector cable (37 pin connector). Fig. 51 displays the loop circuit, which is electronically monitored. The communication cables are shielded and must be run separately and away from the power cables.
The CAN communication among the units will be possible only if two of the units making the parallel are equipped with terminators over the CAN line.
The CAN bus termination can be set using jumper J2 over the Parallel Board; if the jumper is in position 1-2 the terminator will be ON. When 3 or more units are connected in a parallel, remove the exceeding terminators placing the jumper in position 2-3.

7.4. Parallel switching procedures

The following procedures refer to para 5.3. on page 75.

Warning
If static switch module and relative switches are not assembled, refer to MSS user manual.

7.4.1. Procedure 1: UPS TURN-ON PROCEDURE

Starting with each UPS completely deenergized, this procedure explains how to switch on UPS units and set them to Normal Operation Mode. On each UPS, perform the following procedure:

Step	Action	Status
1	Switch QS1 to the ON position	Rectifier start up
2	Switch QS2 to the ON position (wait for Static Bypass Switch to switch on)	Static Bypass Switch ON and fans ON
3	Close external battery switches then set battery breaker[1)] to the ON position	
4	Switch QS4 to the ON position IMPORTANT: when switch QS4 is closed, the output of the UPS and all the loads connected to it will be energized.	System in Bypass Mode - Output voltage present
	When the above steps have been completed for all the UPS units in the parallel system:	
5	Touch “Inverter On”. At this point, the Inverters synchronize and take over the Load	Normal Mode (On Line)

1) Not available for all ratings

7.4.2. Procedure 2: UPS TURN-OFF PROCEDURE

Starting with each UPS in Normal Mode, this procedure explains how to switch off the UPS units. When this procedure is followed completely, the output voltage will be completely turned off and any load(s) connected to the UPS output will be shut down. On each UPS, perform the following procedure:

Step	Action	Status
1	Touch “Inverter Off”. At this point, the Load is supplied by the Bypass	System in Bypass Mode
2	Switch battery breaker[1)] to the OFF position	
3	Switch QS4 to the OFF position	Load not supplied
4	Switch QS2 to the OFF position	
5	Switch QS1 to the OFF position	

1) Not available for all ratings

7.4.3. Procedure 3: TRANSFER FROM NORMAL MODE TO MAINTENANCE BYPASS MODE

Starting with each UPS in the Normal Mode, this procedure explains how transfer the load to Maintenance Bypass and shut down the UPS. On each UPS, perform the following procedure:

Step	Action	Status
1	Touch “Inverter Off”. At this point, the Load is supplied by the Bypass	System in Bypass Mode
2	Switch battery breaker[1)] to the OFF position	Battery disconnector
3	Switch QS3[2)] to the ON position	
4	Switch QS4 to the OFF position	Service Mode
5	Switch QS1 and QS2 to the OFF position	Maintenance Bypass Mode - UPS completely de-energized

1) Not available for all ratings
2) Not available for 600/800/1000/1200kVA (see para 3.3. on page 39)

7.4.4. Procedure 4: TRANSFER FROM MAINTENANCE BYPASS MODE TO NORMAL MODE

Starting with each UPS in Maintenance Bypass, this procedure explains how transfer the load to Normal Mode and start the UPS. On each UPS, perform the following procedure:

Step	Action	Status
1	Switch QS1 to the ON position	Rectifier start up
2	Switch QS2 to the ON position (wait for the Static Bypass Switch to switch on)	Static Bypass Switch ON and fans ON
3	Close external battery switches then set battery breaker[1)] to the ON position	
4	Switch QS4 to the ON position	System in Bypass Mode - Output voltage present
5	Switch QS3[2)] to the OFF position	
	When the above steps have been completed for all the UPS in the parallel system:	
6	Touch “Inverter On”. At this point, the Inverters synchronize and take over the Load	Normal Mode (On Line)

1) Not available for all ratings
2) Not available for 600/800/1000/1200kVA (see para 3.3. on page 39)

1) For fuse ratings, see the chapter with technical data
2) Values are determined by the dimensions of the Service Bypass
3) Switch, fused switch or circuit breaker

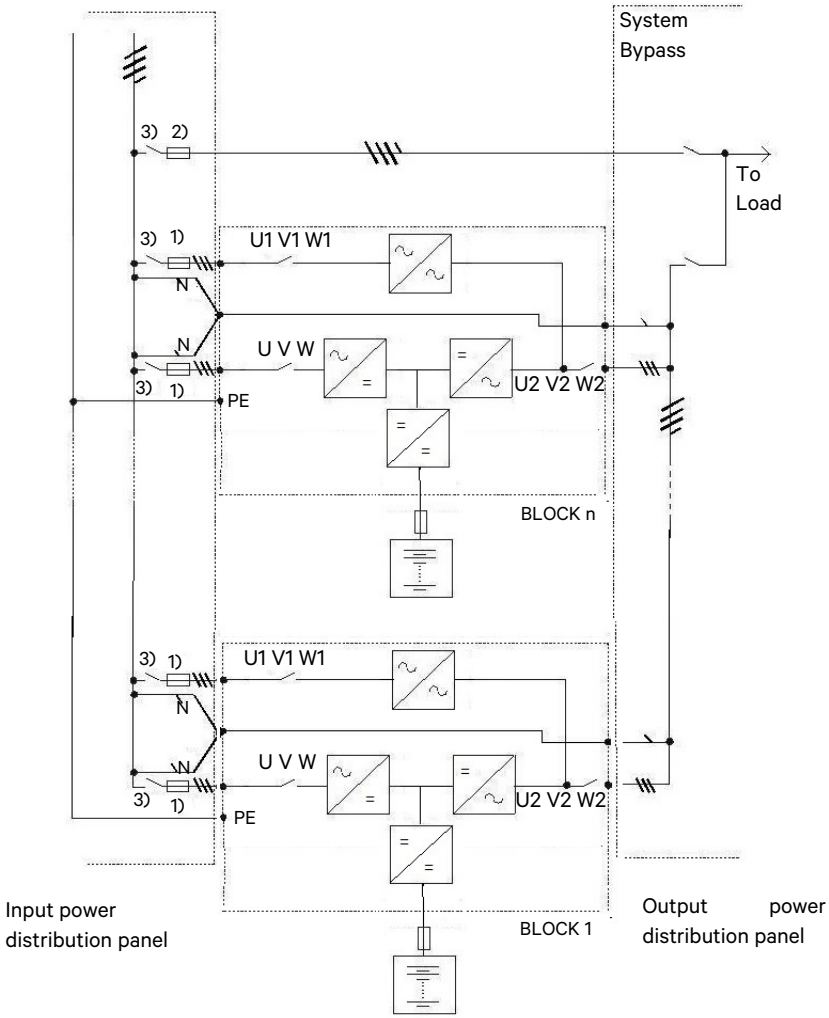

Figure 49 - Schematic diagram of a multiple block system

1) For fuse ratings, see the chapter with technical data
2) Values are determined by the dimensions of the Service Bypass
3) Circuit breaker or fuse
4) External Service Bypass (Ext. SBS) - must be a switch, a fused switch or a circuit breaker

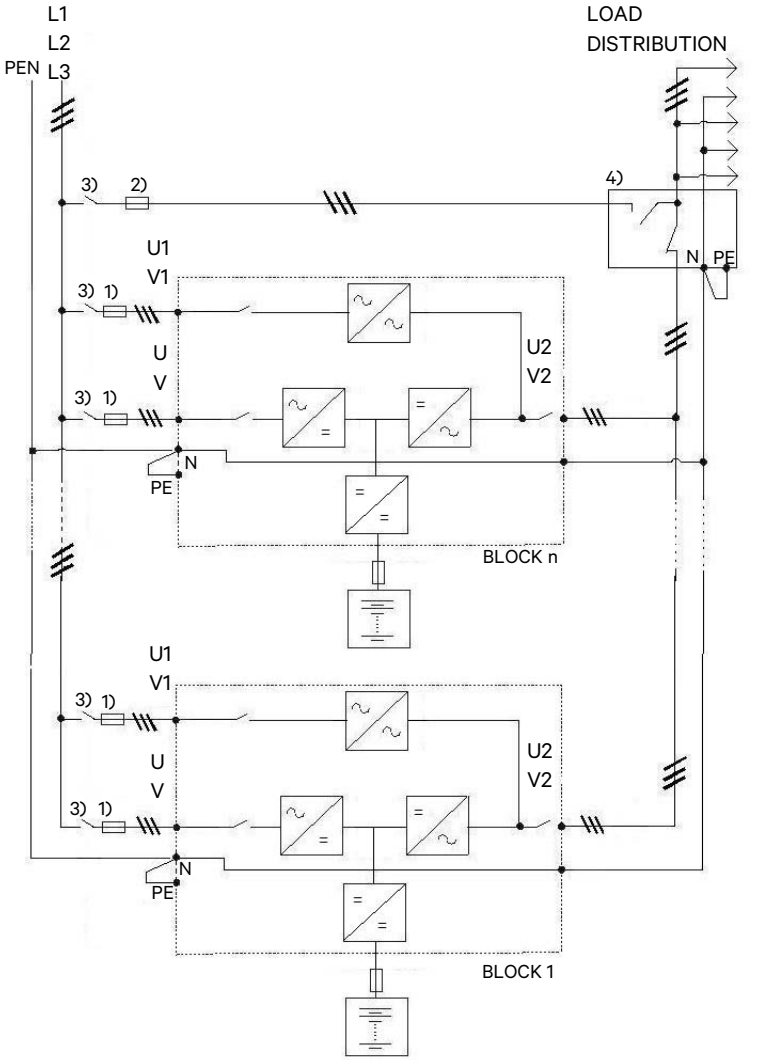

Figure 50 - Schematic diagram of a multiple block system in a TN-C grounding system

1) 37-way Sub-D plug cable

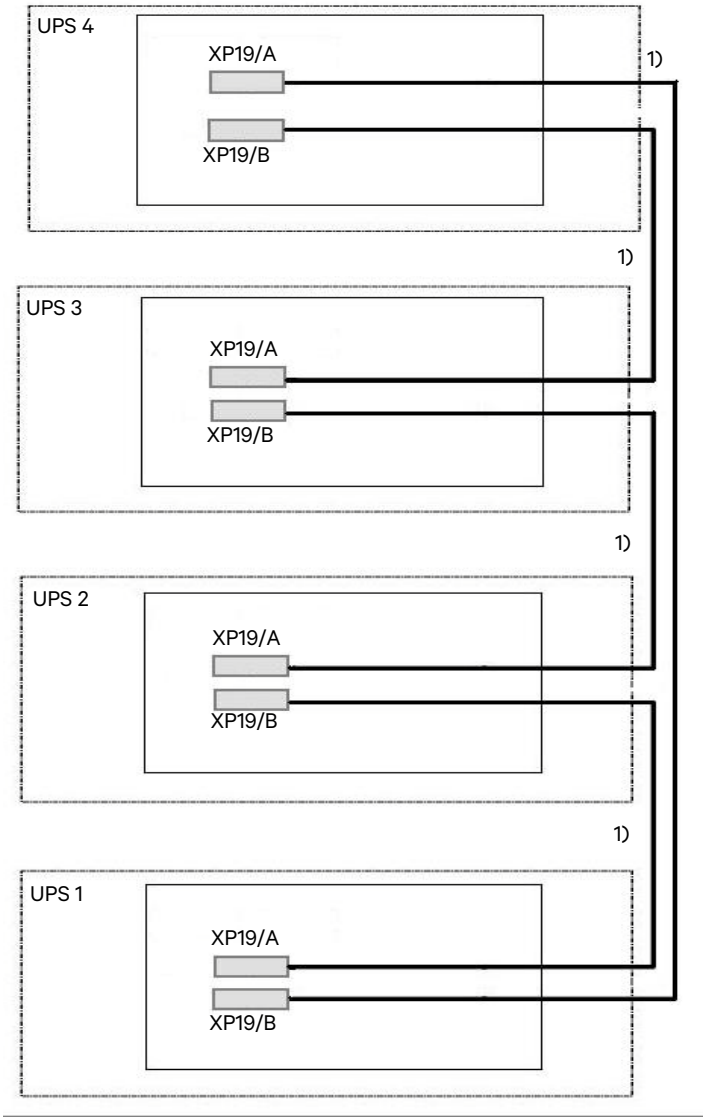

Figure 51 - Loop circuit for parallel UPS

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8. OPTIONS

Some of the options listed in this section may modify the data on the standard technical data tables (see chap. 9. on page 102). It may not be possible to use certain options simultaneously on the same UPS.

8.1. RAU

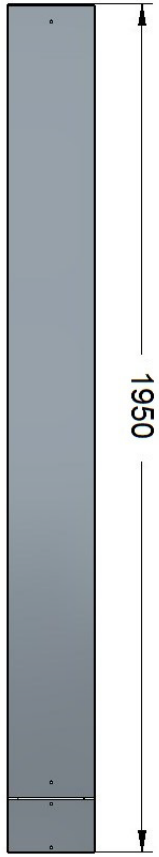
A remote alarm panel is available for displaying important individual UPS messages. The length of the connection cable must not exceed 300m.

8.2. TCE

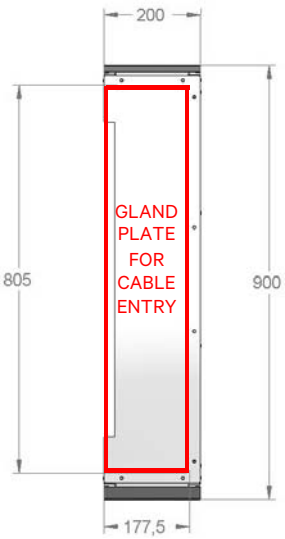
TCE 200mm

This option permits power cables to be routed through the top of the UPS. It can be installed both on the right and the left of the UPS. The TCE weighs 55kg.

Footprint



Front view

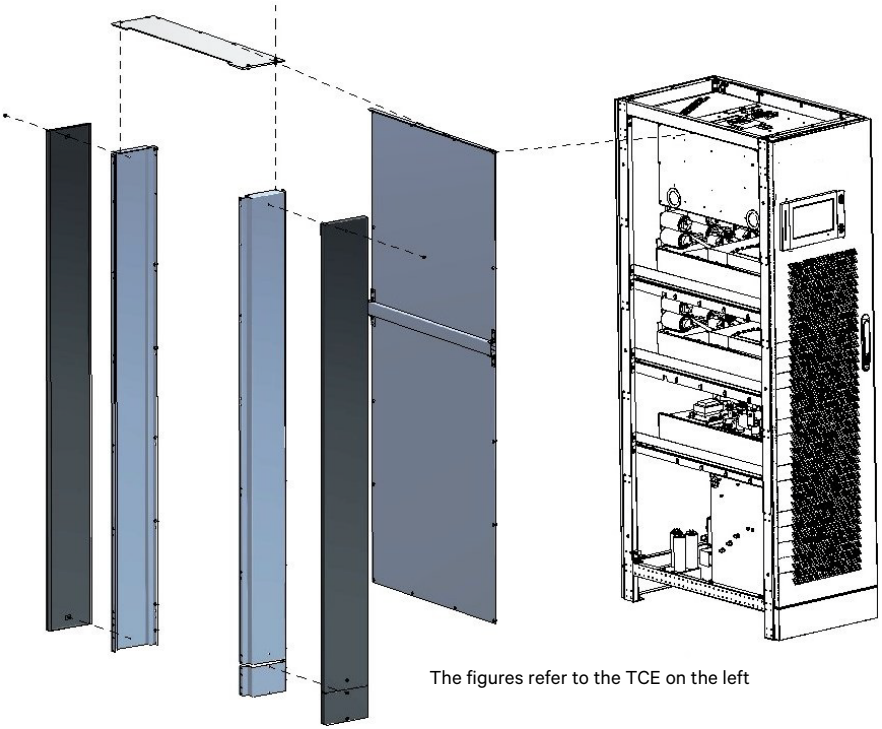


Upper view

The figures refer to the TCE on the left

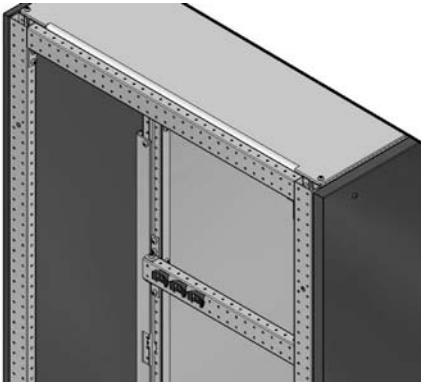
Installation

Remove the lateral painted panel of UPS. Assemble TCE and UPS together using the loose supplied material with TCE, see below figures.



The figures refer to the TCE on the left

If necessary, fix the cables to the mounting using the base cable fixing. These materials are loose supplied.



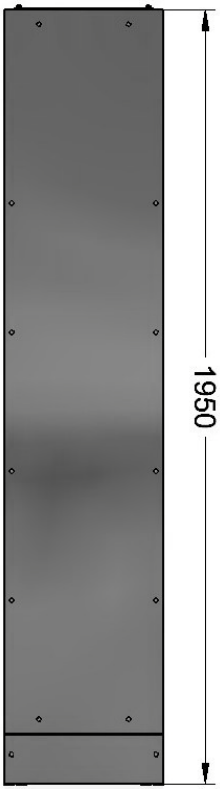
The figure refers to the TCE on the left

Mount the lateral painted panel previously removed on the side of TCE.

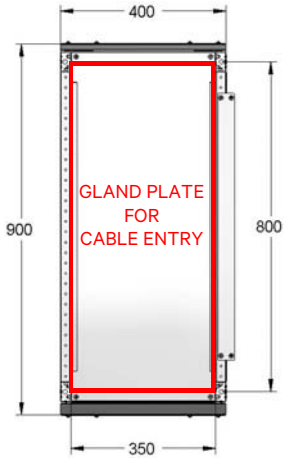
TCE 400mm

This option permits power cables to be routed through the top of the UPS. It can be installed both on the right and the left of the UPS, but the despatched configuration includes the TCE on the left. The TCE weighs 75kg.

Footprint



Front view

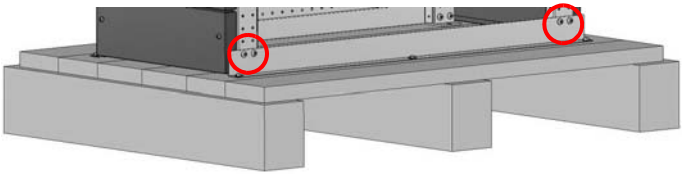


Upper view

The figures refer to the TCE on the left

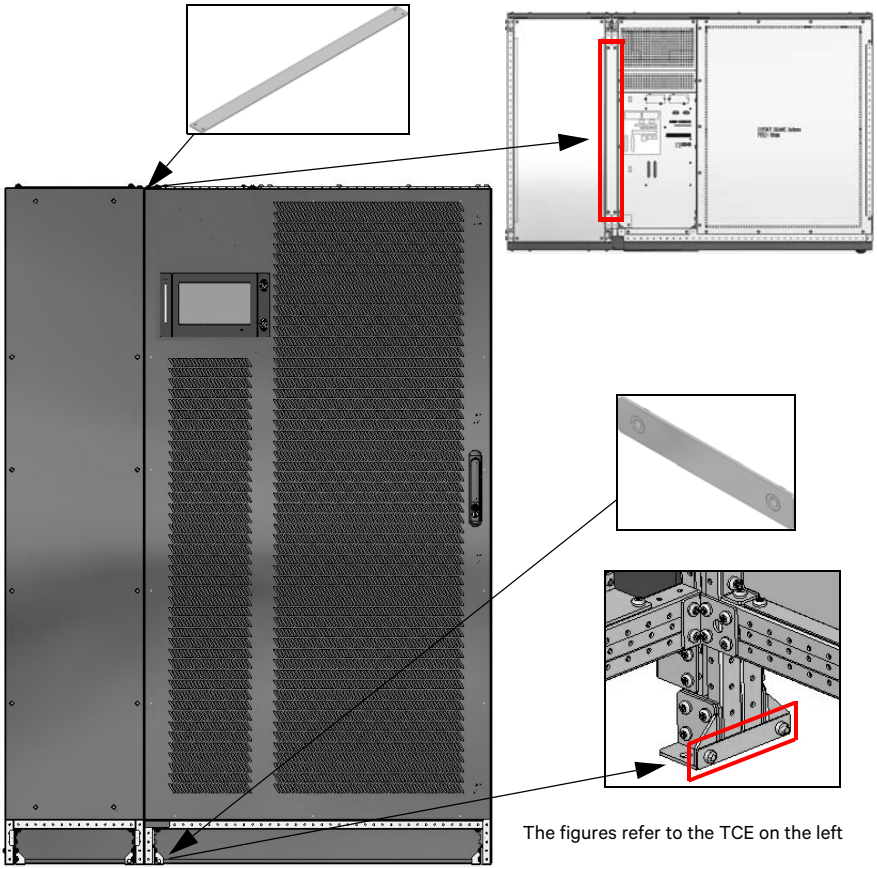
Unpacking

Remove the TCE from the pallet by removing the four fixing screws in both the sides.



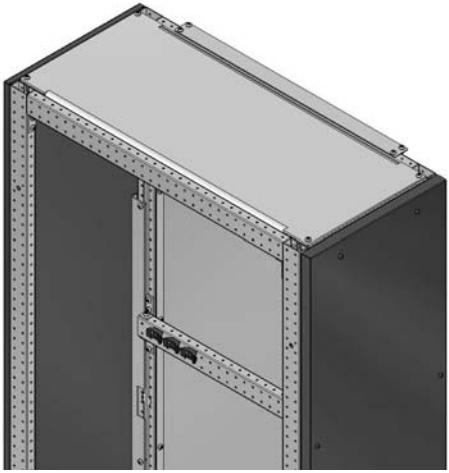
Installation

Only for TCE mounted on the right, remove the lateral galvanized panel and mount it on the opposite side of the TCE. **For both the versions**, remove the lateral painted panel of UPS. Assemble TCE and UPS together using the loose supplied material with TCE, see below figures.



The figures refer to the TCE on the left

If necessary, fix the cables to the mounting using the base cable fixing. These materials are loose supplied.



The figure refers to the TCE on the left

Mount the lateral painted panel previously removed on the side of TCE.

8.3. Empty battery compartment

These compartments consist of:

- Compartment
- Disconnecting device
- Safety panel
- Connection terminals

8.4. MopUPS shutdown and monitoring software

For details, see http://connectivity.chloridepower.com

8.5. ManageUPS adapter

For details, see http://connectivity.chloridepower.com

8.6. MBSM (up to 6 UPS)

The MBSM is a device which is basically studied to provide on its outputs a frequency reference signal (spitted in a certain number of channels = normally 6). This signal is a square wave generated by an incoming source reference or by an internal quartz. Each UPS connected to the MBSM is able to receive the frequency reference signal and, under particular conditions, to automatically phase lock the inverter.

Each UPS composing the system is supplied by a common electrical bus; the UPS Synchronization source (reference) is per default the power source connected on its reserve input and, as a consequence, being the power source common to all the UPS, the inverters outputs will be in synchronism.

Once the main power (reserve inputs) shall fail, each UPS will synchronize the inverter to the signal coming from the MBSM (Fref.) and, as a result, the inverters are still in synchronism.
Shall be the Fref. not available (or the MBSM not installed), each UPS will synchronize the local internal quartz, therefore the inverters outputs would be, in this case, asynchronous.
It is than clear that the MBSM has a simple PASSIVE rule in relation to the UPS. The UPS will decide with maximum independence the source of Synchronization on the base of the following priority scale:

HIGHEST PRIORITY = LOCAL RESERVE INPUT
MEDIUM PRIORITY = MBSM REFERENCE
LOWEST PRIORITY = LOCAL QUARTZ OSCILLATOR

For installations and operations please consult the User Manual MBSM

8.7. Synchronization box for UPS

This device has been designed for use in complex power source systems, consisting of different distributions and CROSS switches supplied by Vertiv and other manufacturers. It provides Synchronization between Vertiv Trinergy™ Cube, 80-NET, 80-*e*XL, Liebert EXL S1 and 90-NET UPS and third party systems, when it cannot be guaranteed by the system configuration or when temporary conditions prevent it (e.g. during battery operation).
Examples of configurations where the External Sync. Box can be used:

- Installation consisting of two Vertiv systems;
- Installation consisting of Vertiv systems and electrical generating devices;
- Installation consisting of Vertiv and third party systems.

The device operates by identifying one of the connected units as the Master and using its frequency as a reference for the other units (Slaves). While other brand UPS can be used as the Master, only Vertiv UPS can be used as Slave units.
Depending on their configuration, the Slave units will follow the reference frequency all the time, or only when their reserve mains supply is out of tolerance.
The reference frequency will be generated only when the Master mains supply line is within acceptable limits.
The device can drive up to two separate units, which may be independent of one another, or connected together in a parallel system: where the installation consists of more than two Slave units, or the Master/Slave configuration is not the preferred option we advise using Vertiv MBSM.

For installations and operations please consult the User Manual Synchronization Box.

8.8. SBS

This option must be installed in parallel systems comprising more than two UPS and it allows doing maintenance to the system maintaining continuity (the rating available are 400A, 800A, 1600A and 2500A).

8.9. Parallel kit - adapter (Liebert EXL S1 to legacy 80-NET)

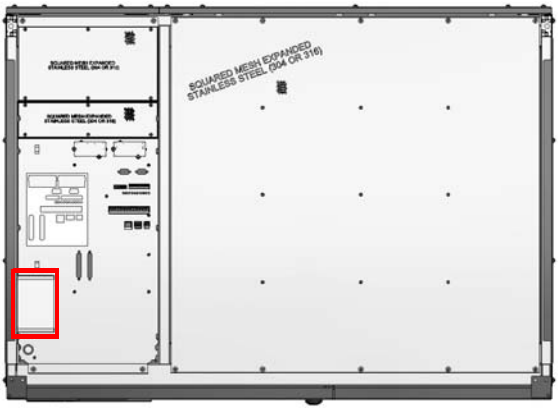
It is used for parallel connection between Liebert EXL S1 and 80-NET, because of different connectors installed.

8.10. Standard Parallel kit (Liebert EXL S1)

This cable is used for connecting two o more UPS in parallel configuration.

8.11. MSS

This option is available for unit with MSS installed. The synch distribution from MSS to UPS is managed by a switch on the top of UPS, see below figure.



For the connection of the cables of the synch distribution, refer to the MSS manual.

Warning

This switch has to be operated by authorized Vertiv service technicians, only.

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9. TECHNICAL DATA

9.1. Liebert EXL S1 300-500kVA

General conditions of technical data table:
The data shown are typical and refer to 25°C ambient temperature and nominal input and output conditions, unless otherwise specified. Not all data shown apply simultaneously. Data apply to the standard version, unless otherwise specified.
For test conditions and measurement tolerances not specified in the table, see the Witness Test Report procedure.

UPS model		**Liebert EXL S1**		
Power (kVA)		**300**	**400**	**500**
System data				
AC/AC efficiency in VFI mode without charging current, with resistive load [1) 2)]	25% load (%) 50% load (%) 75% load (%) 100% load (%)	up to 96.4 up to 96.8 up to 96.7 up to 96.3		
AC/AC efficiency in Intelligent ECO mode without charging current, at maximum resistive load [1) 2)]		98.7		
Heat dissipation at nominal output load	Float mode VFI (kW)	10.4	13.8	17.3
	(Btu/h)	35400	47200	59000
	ECO (kW)	3.6	4.7	5.9
	(Btu/h)	12140	16180	20230
Noise at 1 m as per ISO 3746 [1) 2)] (dBA ± 2dBA)		≤65 @ partial load		
Noise at 1 m as per ISO 3746 [1) 2)] (dBA ± 2dBA)		≤69	≤71	≤73
Protection degree with doors open		IP20		
Mechanical dimensions:				
Height (mm)		1950		
Width (mm)		1000		1250
Depth (mm)		900		
Shipping Weight (kg)		775		1060
Net Weight (kg)		725		990
Number of cabinets		1		
Frame color		RAL7021		
Floor area (depth w/o handle: 830 mm) (m^2)		0.90		1.13
Floor loading (kg/m^2)		806		880
Cable entry		Bottom		
Service access		Front and top		
Cooling		Forced Ventilation, front air intake, top air outlet		
(m^3/h)		2522		3153
Location		Indoor (free from corrosive gases and conductive dust)		
Operating temperature (°C)		0-40		
Max. relative humidity @ 20°C (non condensing) (%)		up to 95		

UPS model		**Liebert EXL S1**		
Power (kVA)		**300**	**400**	**500**
Max. altitude above sea-level without derating (m)		1000 (for higher altitudes complies with IEC/EN 62040-3)		
Immunity to electrical interference		IEC/EN 62040-2:2006		
EMC CLASS		IEC/EN 62040-2:2006 Class C3		
Input				
Nominal voltage [3] (V)		380/400/415		
Input voltage range @ nominal load without battery discharge (V)		200 [4] to 460		
Nominal frequency (Hz)		50 (60 selectable)		
Maximum input current		473	630	788
Power Factor @ nominal load [2]		≥0.99		
I/p current distortion @ max. input current [2] [5] (%)		≤3		
Walk in/Soft start (s)		15 (1 to 90 selectable)		
Rectifier Hold-off (s)		10 (1 to 90 selectable)		
Inrush current/$I_{max.}$		≤1		
Battery				
Permissible battery voltage range (V)		396 to 700		
Number of cells	VRLA	240-300		
	Wet	240-300		
	NiCd	375-468		
VRLA float voltage @ 20°C (V/cell)		2.27		
VRLA end voltage (V/cell)		1.65		
VRLA float voltage temperature compensation		-0.11% per °C		
Float mode DC ripple for 10 min. operating capacity as per VDE0510		<0.05C_{10}		
Float voltage stability in steady state (%)		≤1		
DC ripple voltage without battery (%)		≤1		
Optimum battery temperature (°C)		15 to 25		
DC/AC _efficiency in discharge mode @ nominal active load (%)		96.0		
Recharge current setting range for 240 cells @ nominal output power [2] (A)		Up to 82	Up to 109	Up to 137
Battery o/p power in discharge mode, with nominal load (kW)		281	375	469
End battery voltage with 240 cells (V)		396		
End battery current with 240 cells and nominal load (A)		710	947	1184
Inverter output				
Nominal apparent power (kVA)		300	400	500
Nominal active power (kW)		300	360	450
Nominal output current (A)		433	577	722

UPS model		**Liebert EXL S1**		
Power (kVA)		**300**	**400**	**500**
Overload capacity [6]	110%	continuous		
	125%	10 min.		
	150%	1 min.		
Short circuit current for ≤200ms		2,2In		
Nominal output voltage (V)		380/400/415		
Nominal output frequency (Hz)		50 (60 selectable)		
Voltage stability in steady state condition for input variations (AC & DC) and step load (0 to a nominal load) (%)		±1		
Voltage stability in dynamic condition for i/p variations (AC & DC) and step load		Complies with IEC/EN 62040 - 3 CLASS 1		
Voltage stability in steady state with nominal load imbalance (0, 0, 100) (%)		±3		
Output frequency stability	synchronized with Bypass line (%)	±2 default (2, 3, 4, 5 selectable)		
	synchronized with internal clock (%)	±0.1		
Frequency slew rate (Hz/s)		<1 default (selectable up to 5Hz)		
Output voltage distortion at nominal linear load (%)		≤1.5		
Output voltage distortion at @ reference non-linear load as per IEC/EN62040-3 (%)		<5		
Load Crest Factor without derating (I_{pk}:I_{rms})		3:1		
Phase angle accuracy with balanced loads		±1°		
Phase angle accuracy with 100% unbalanced loads		±3°		
Static Bypass				
Nominal Bypass voltage [3] (V)		400 (3ph + N + PE) or 400 (3ph + PE)		
Voltage range (%)		±10 (5 to 15 selectable)		
Nominal frequency (Hz)		50 (60 selectable)		
Frequency range (%)		±1 (2, 3, 4 selectable)		
Overload capacity	125%	10 min.		
	150%	1 min.		
	700%	600 ms		
	1000%	100 ms		
SCR	I^2t @ T_{vj}=125 °C 10 ms (kA^2s)	1201		
	I_{TSM} @ T_{vj}=125 °C 10 ms (A)	15500		
Bypass fuses [7]		1250A, aR class I^2t 860kA^2s (@400V) prearc 355kA^2s		
Prospective short circuit current Icp [7] [8] (kA)		50		

UPS model		Liebert EXL S1		
Power (kVA)		**300**	**400**	**500**
Transfer time with inverter synchronous to Bypass	Inverter to Bypass (ms)	No Break		
	Bypass to Inverter (ms)	≤2		
Default transfer delay time (inverter to Bypass) with inverter not synchronized to Bypass (ms)		20		

1) For tolerances see IEC/EN 60146-1 or DIN VDE 0558. The data refers to 25°C ambient temperature
2) Nominal input voltage and input frequency
3) In case of 4 wires split input configuration, the primary input and the Bypass input must have a common neutral reference
4) Referred to derated load conditions
5) With input voltage at nominal value and voltage distortion THD_V ≤1%
6) Value obtained at 25°C ambient starting from a specified load condition
7) For additional information, contact the technical support
8) Maximum allowable value of prospective short-circuit current at the input terminals of the UPS

Notice

Read and heed the information provided on device labels.

9.2. Liebert EXL S1 600-1200kVA

General conditions of technical data table:

The data shown are typical and refer to 25°C ambient temperature and nominal input and output conditions, unless otherwise specified. Not all data shown apply simultaneously. Data apply to the standard version, unless otherwise specified.

For test conditions and measurement tolerances not specified in the table, see the Witness Test Report procedure.

UPS model		**Liebert EXL S1**			
Power (kVA)		**600**	**800**	**1000**	**1200**
System data					
AC/AC efficiency in VFI mode without charging current, with resistive load [1) 2)]	25% load (%) 50% load (%) 75% load (%) 100% load (%)	up to 96.4 up to 96.6 up to 96.5 up to 96.1			
AC/AC efficiency in Intelligent ECO mode without charging current, at maximum resistive load [1) 2)]		98.6			
Heat dissipation at nominal output load	Float mode VFI (kW)	21.9	29.2	36.5	43.8
	(Btu/h)	74780	99700	124600	149500
	ECO (kW)	7.7	10.2	12.8	15.3
	(Btu/h)	26160	34880	43600	52300
Noise at 1 m as per ISO 3746 [1) 2)] (dBA ± 2dBA)		≤70 @ partial load		≤72 @ partial load	
Noise at 1 m as per ISO 3746 [1) 2)] (dBA ± 2dBA)		≤76		≤78	
Protection degree with doors open		IP20			
Mechanical dimensions:					
Height (mm)		1950			
Width (mm)		2000		2650 [3)]	
Depth (mm)		900			
Shipping Weight (kg)		1670		2400 [4)]	
Net Weight (kg)		1550		2155 [5)]	
Number of cabinets		1		2	
Frame color		RAL7021			
Floor area (depth w/o handle: 830 mm) (m^2)		1.8		2.39	
Floor loading (kg/m^2)		861		954	
Cable entry		Top/bottom			
Service access		Front and top			
Cooling		Forced Ventilation, front air intake, top air outlet			
(m^3/h)		4529		6794	
Location		Indoor (free from corrosive gases and conductive dust)			
Operating temperature (°C)		0-40			
Max. relative humidity @ 20°C (non condensing) (%)		up to 95			
Max. altitude above sea-level without derating (m)		1000 (for higher altitudes complies with IEC/EN 62040-3)			
Immunity to electrical interference		IEC/EN 62040-2:2006			

UPS model		Liebert EXL S1			
Power (kVA)		**600**	**800**	**1000**	**1200**
EMC CLASS		IEC/EN 62040-2:2006 Class C3			
Input					
Nominal voltage[6] (V)		380/400/415			
Input voltage range @ nominal load without battery discharge (V)		200 [7] to 460			
Nominal frequency (Hz)		50 (60 selectable)			
Maximum input current (A)		945	1250	1575	1880
Power Factor @ nominal load [2]		≥0.99			
I/p current distortion @ max. input current [2] [8] (%)		≤3			
Walk in/Soft start (s)		15 (1 to 90 selectable)			
Rectifier Hold-off (s)		10 (1 to 90 selectable)			
Inrush current/$I_{max.}$		≤1			
Battery					
Permissible battery voltage range (V)		396 to 700			
Number of cells	VRLA	240-300			
	Wet	240-300			
	NiCd	375-468			
VRLA float voltage @ 20°C (V/cell)		2.27			
VRLA end voltage (V/cell)		1.65			
VRLA float voltage temperature compensation		-0.11% per °C			
Float mode DC ripple for 10 min. operating capacity as per VDE0510		<0.05C_{10}			
Float voltage stability in steady state (%)		≤1			
DC ripple voltage without battery (%)		≤1			
Optimum battery temperature (°C)		15 to 25			
DC/AC _efficiency in discharge mode @ nominal active load (%)		96.0			
Recharge current setting range for 240 cells @ nominal output power [2] (A)		Up to 162	Up to 204	Up to 270	Up to 312
Battery o/p power in discharge mode, with nominal load (kW)		563	750	938	1125
End battery voltage with 240 cells (V)		396			398
End battery current with 240 cells and nominal load (A)		1420	1894	2367	2841
Inverter output					
Nominal apparent power (kVA)		600	800	1000	1200
Nominal active power (kW)		600	720	900	1080
Nominal output current (A)		866	1155	1443	1732
Overload capacity [9]	110%	continuous			
	125%	10 min.			
	150%	1 min.			

UPS model		**Liebert EXL S1**			
Power (kVA)		**600**	**800**	**1000**	**1200**
Short circuit current for ≤200ms		2,2In			
Nominal output voltage (V)		380/400/415			
Nominal output frequency (Hz)		50 (60 selectable)			
Voltage stability in steady state condition for input variations (AC & DC) and step load (0 to a nominal load) (%)		±1			
Voltage stability in dynamic condition for i/p variations (AC & DC) and step load		Complies with IEC/EN 62040 - 3 CLASS 1			
Voltage stability in steady state with nominal load imbalance (0, 0, 100) (%)		±3			
Output frequency stability	synchronized with Bypass line (%)	±2 default (2, 3, 4, 5 selectable)			
	synchronized with internal clock (%)	±0.1			
Frequency slew rate (Hz/s)		<1 default (selectable up to 5Hz)			
Output voltage distortion at nominal linear load (%)		≤1.5			
Output voltage distortion at @ reference non-linear load as per IEC/EN62040-3 (%)		<5			
Load Crest Factor without derating (I_{pk}:I_{rms})		3:1			
Phase angle accuracy with balanced loads		±1°			
Phase angle accuracy with 100% unbalanced loads		±3°			
Static Bypass					
Nominal Bypass voltage[6] (V)		400 (3ph + N + PE) or 400 (3ph + PE)			
Voltage range (%)		±10 (5 to 15 selectable)			
Nominal frequency (Hz)		50 (60 selectable)			
Frequency range (%)		±1 (2, 3, 4 selectable)			
Overload capacity	125%	10 min.			
	150%	1 min.			
	700%	600 ms			
	1000%	100 ms			
SCR	I^2t @ T_{vj}=125 °C 10 ms (kA^2s)	2530		5611	
	I_{TSM} @ T_{vj}=125 °C 10 ms (A)	22500		33500	
Bypass fuses[10]		1250A, aR class I^2t 860kA^2s (@400V) prearc 355kA^2s		2000A, aR class I^2t 3100kA^2s (@400V) prearc 1150kA^2s	
Prospective short circuit current Icp [10) 11)] (kA)		100			
Transfer time with inverter synchronous to Bypass	Inverter to Bypass (ms)	No Break			
	Bypass to Inverter (ms)	≤2			
Default transfer delay time (inverter to Bypass) with inverter not synchronized to Bypass (ms)		20			

1) For tolerances see IEC/EN 60146-1 or DIN VDE 0558. The data refers to 25°C ambient temperature
2) Nominal input voltage and input frequency

3) The modules cabinet is 2100mm wide and the switches cabinet is 750mm wide. The sum of these two widths is greater than the width of the fully assembled unit, which is indicated in the table. This difference is due to the protrusion of some connecting bars and closures from the modules cabinet, which need to be assembled to the switches cabinet during the installation in field.
4) The modules cabinet weighs 2000kg and the switches cabinet weighs 400kg.
5) The modules cabinet weighs 1815kg and the switches cabinet weighs 340kg.
6) In case of 4 wires split input configuration, the primary input and the Bypass input must have a common neutral reference
7) Referred to derated load conditions
8) With input voltage at nominal value and voltage distortion THD_V ≤1%
9) Value obtained at 25°C ambient starting from a specified load condition
10) For additional information, contact the technical support
11) Maximum allowable value of prospective short-circuit current at the input terminals of the UPS

Notice

Read and heed the information provided on device labels.

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