Liebert® EXL S1 480V

User Manual

Liebert EXL S1 480V

UNINTERRUPTIBLE POWER SUPPLY

USER MANUAL

10H52264UM60 - rev. 6

All rights, including rights of translation, reproduction by printing, copying or similar methods, even of parts, are reserved.
Transgressors will be liable for damages.
All rights, including rights deriving from patent license or registration of utility model or design, are reserved.
Delivery subject to availability. Right of technical modifications is reserved.

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

1. INTRODUCTION 5
1.1. Notes to the CE Declaration of Conformity 5
1.2. Symbols and pictograms 5
1.3. Terms used 6
1.4. Glossary 6
1.5. Documentation structure 6
1.6. Pre-installation Planning 6
1.7. Preliminary Checks 7
1.8. Environmental Considerations 7
2. PREPARATION FOR USE 11
2.1. Transport 11
2.2. Delivery and storage 11
2.3. Unpacking and unloading the cabinets from the pallet 11
2.4. Liebert EXL S1 1000/1200kVA cabinets assembly procedure 13
2.5. Environmental conditions 18
2.6. Access to service area and cooling system 19
2.7. Installation and footprint 20
3. INSTALLATION 29
3.1. Electrical preparations 29
3.2. Currents and suggested cable sizes 30
3.3. Physical appearance 32
3.4. External protection devices 34
3.5. Backfeed protection 36
3.6. External electrical connections 37
3.7. Power connections 38
3.8. Configuring Ground Connections 44
3.9. Connecting the batteries 44
3.10. Connections between battery compartments and UPS 45
3.11. Handling the batteries 47
4. CONNECTIVITY PANELS 48
4.1. LCD touch screen 48
4.2. Customer connectivity panel 49
5. NORMAL AND SAFE OPERATION 57
5.1. Function 57
5.2. Special features 58
5.3. Block diagram 58
5.4. Maintenance Bypass Switch (not available for 800/1000/1200kVA) 59
5.5. Operating modes 60
5.6. Placement into service 62
5.7. UPS switching procedures 63
5.8. Inverter STOP/START procedures 65
6. PARALLEL CONFIGURATION 67

6.1. Placement into service 67
6.2. Communication between UPS blocks 68
6.3. Parallel switching procedures 68
7. MAINTENANCE 73
7.1. Limited Life Components 73
7.2. Disposal of batteries 74
7.3. Decommissioning 74
8. OPTIONS 75
8.1. TCE 75
8.2. MopUPS shutdown and monitoring software 77
8.3. ManageUPS adapter 77
8.4. MBSM (up to 6 UPS) 77
8.5. Synchronization box for UPS 78
8.6. Standard Parallel kit (Liebert EXL S1) 78
9. TECHNICAL DATA 79
9.1. Liebert EXL S1 800/1000/1200kVA 79

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.

2011/65/EU
Directive of the council for adapting the legal regulations of member states on the restriction of the use of certain hazardous substances that can be used in the manufacture of electrical and electronic equipment.

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

MBSM = Multiple Bus Synchronization Module

1.5. Documentation structure

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

1.6. Pre-installation Planning

This section describes the requirements that must be taken into account when planning the positioning and cabling of the UPS and related equipment.
Installing personnel should observer these general procedures and practices. The particular conditions of each site will determine the applicability of such procedures.



Warning
Risk of electrical shock. Can cause injury or death. Special care must be taken when working with the batteries associated with this equipment. When the batteries are connected together, the battery-terminal voltage will exceed 400 VDC and is potentially lethal.



Notice
All equipment not referred to in this manual is shipped with details of its own mechanical and electrical installation.



Notice
Risk of incorrect input power connection. Can cause equipment damage.
The standard Liebert EXL S1 Installer Guide UPS is suitable for connection to 50Hz, 3-phase, 3-wire or 4-wire plus ground input power.

Notice

Do not apply electrical power to the UPS equipment before the arrival of the commissioning engineer. Connecting power before the commissioning engineer determines the system is properly installed may void the warranty.

1.7. Preliminary Checks

This section describes the requirements that must be taken into account when planning the positioning and cabling of the UPS and related equipment.

Before installing the UPS, carry out the following preliminary checks:

- Visually examine the UPS equipment for transit damage, both internally and externally. Report any damage to the shipper and to your Vertiv representative immediately.
- Verify that the correct equipment is being installed. The equipment supplied has an identification tag on the interior doors stating the type, size, and main-calibration parameters of the UPS.
- Verify that the UPS room satisfies the environmental conditions stipulated in the equipment specification, paying particular attention to the ambient temperature and air-exchange system.

1.8. Environmental Considerations

This section describes the requirements that must be taken into account when planning the positioning and cabling of the UPS and related equipment.

1.8.1. UPS room

The UPS should be installed vertically, on a level and even concrete or other non-combustible surface, and in an area protected from extremes of temperature and humidity. Refer to chap. 9. on page 79 for detailed product specifications.

The UPS module is intended for indoor installation and should be located in a cool, dry, clean-air environment with adequate ventilation to keep the ambient temperature within the specified operating range (see chap. 9. on page 79).

Notice

Vertiv will not accept liability or pay costs, fees, or damages arising from storing or operating the UPS outside of the specified environmental, performance, or operating ranges and conditions as set forth herein or in other product documentation. Please contact Vertiv Technical Support for more information.

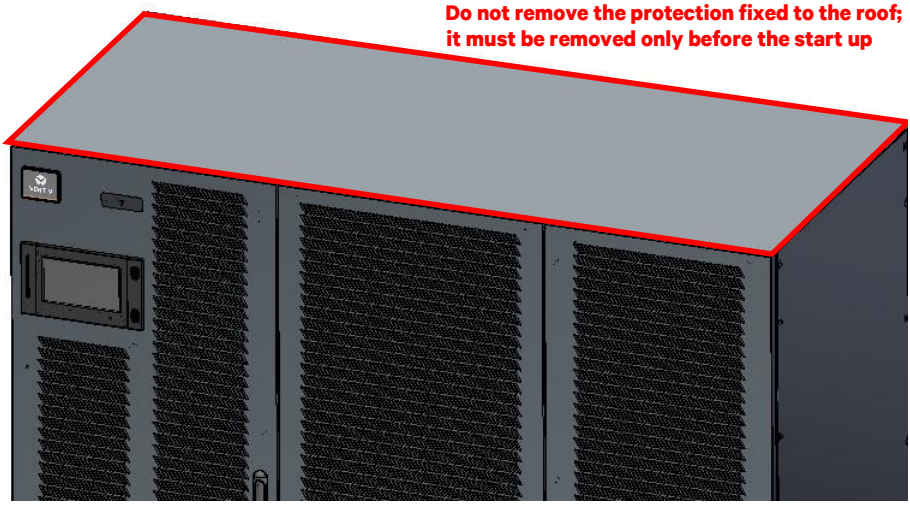
The UPS is cooled with the aid of internal fans. Do not cover the ventilation openings. Cooling air must enter and exit the cabinets freely to prevent overheating or malfunctioning.

The UPS is equipped with air filters behind the front doors. A schedule for inspection of the air filters is required. The period between inspections will depend upon environmental conditions.

When using bottom-entry, the conduit plate must be installed.

Keep all protective shrink wrap on the unit and remove only when required. **If the units does not have an external temporary protection installed on the top of the unit (see image below), contact Vertiv technical support**. The UPS is shipped with external protection material that must remain attached to the UPS to protect potential areas of foreign debris ingress to the UPS. In addition to the external protection material, filters installed on the top and front of the UPS must not be removed during construction activities. All filter media is necessary to prevent debris or dust entry to the UPS throughout the installation process. The external temporary protection at the top of the UPS will be

removed by a Vertiv Customer Engineer during startup and must be reinstalled when the UPS is not operating during construction activities.



Notice

There is a potential risk to the operational integrity of an installed UPS system by the presence of foreign material inside or in the vicinity of the UPS module. This risk is especially high if conductive materials find their way inside the UPS module. 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. 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 and covers are open and the electrical terminals are exposed to allow power line connections to be made by the electrical contractor/installer. 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. All UPS modules are thoroughly inspected by Vertiv engineers before being placed into service and testing on-site. However, the person responsible for the site must ensure that the UPS module and the immediate surroundings are kept clean and free from any possible conductive material such as metal foil, food wrappers, cable shields, washers and other hardware, scrap metal and dust. If the UPS system is shut-down after placement into service and 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 after placement into service and testing, the room must be kept clean to prevent foreign bodies from entering the UPS module via its forced air-flow.

Notice

Ensure the top of the UPS is protected from any metal shaving or debris by using the temporary external filter material that shipped with the UPS. It is the responsibility of the installer to ensure no conductive material enters the unit. Installer will be billed at Vertiv's prevailing labor wage for any cleaning or failure as a result of debris entering the unit

1.8.2. Storing the UPS and Batteries for Delayed Installation

If the UPS system will not be installed immediately, store it indoors in a clean, dry, and cool location (see chap. 9. on page 79). If the system includes a battery cabinet, the batteries' requirements dictate the storage conditions. Unpacked, install, and charge batteries as soon as possible after delivery.

Notice

Risk of failure to properly charge batteries. Can cause permanent damage to batteries and void the warranty.

Batteries will discharge during storage. Batteries must be recharged as recommended by the battery manufacturer. Storage at a higher temperature will increase the rate of self-discharge, which requires earlier recharge. Consult the battery manufacturer on how to determine when the batteries need to be recharged.

BLANK PAGE

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

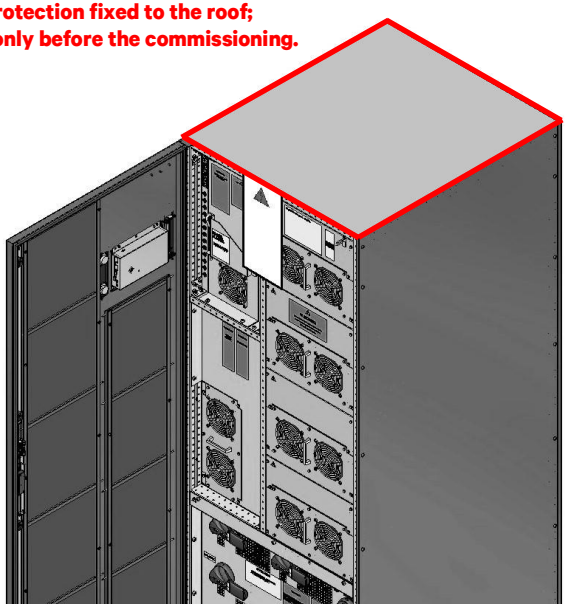
The goods have been checked thoroughly before shipment. On receipt, check the packaging and make sure the contents are undamaged. Any damage or missing parts must be reported to the supplier within 8 days of delivery.
If you do not plan to use the UPS within seven days of delivery, be sure to store it 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 protection fixed to the roof;
it must be removed only before the commissioning.**



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.

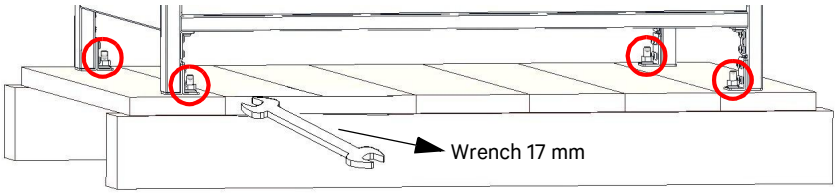


Figure 1 - Removing the screws

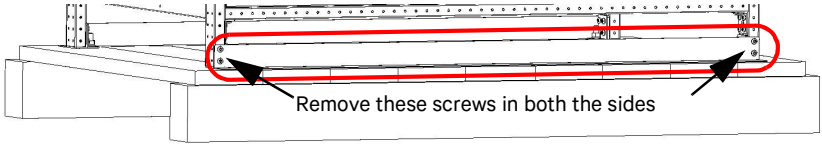
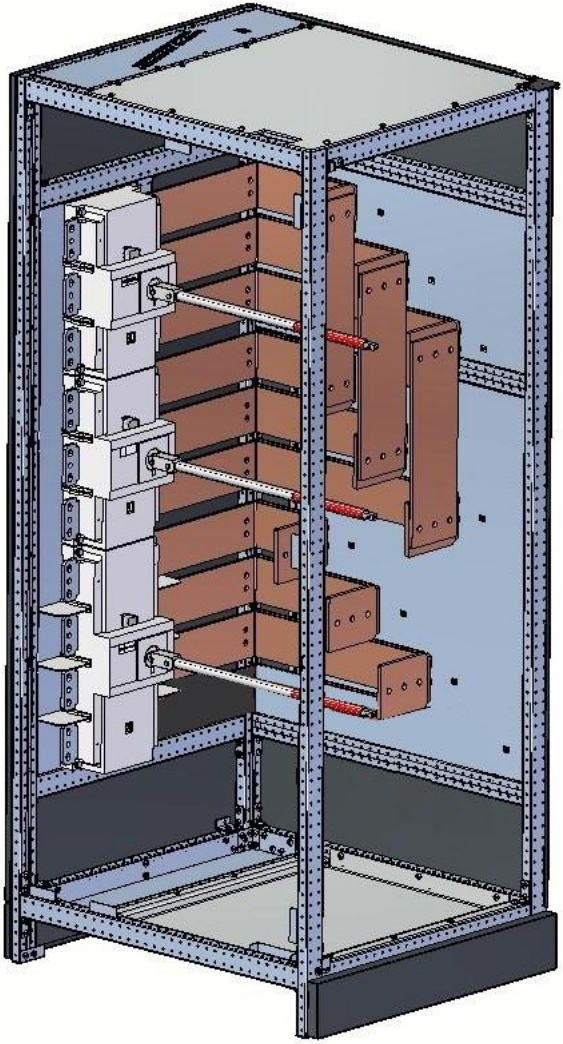


Figure 2 - Removing the L-profile

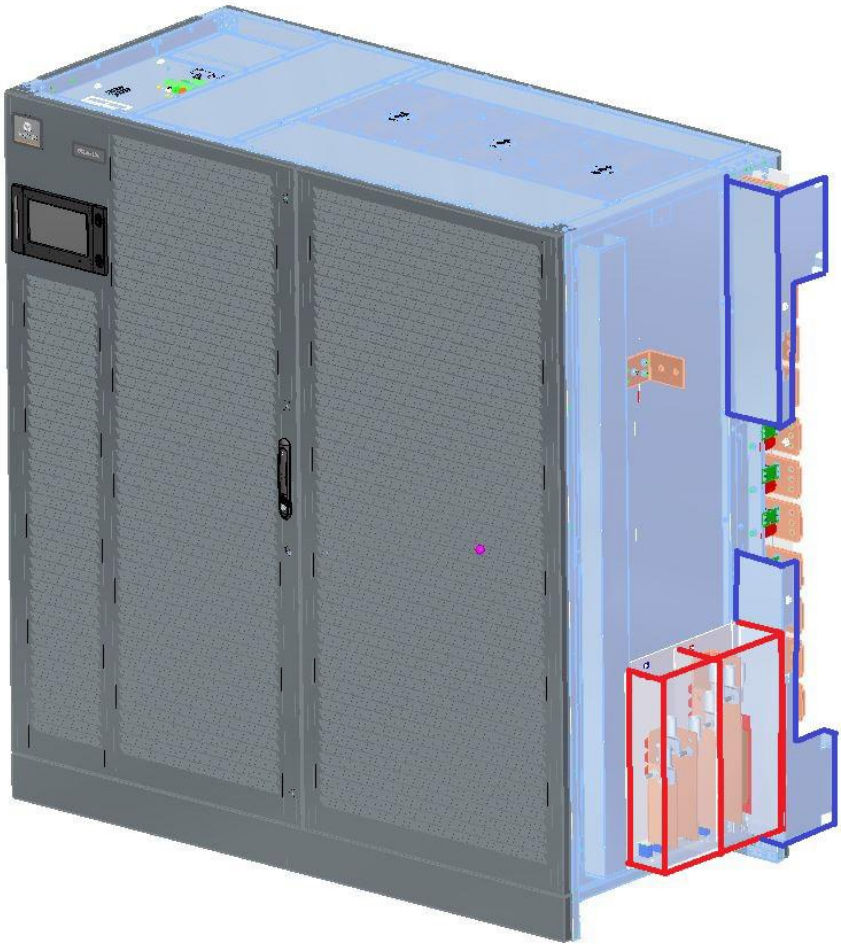
2.4. Liebert EXL S1 1000/1200kVA cabinets assembly procedure

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.

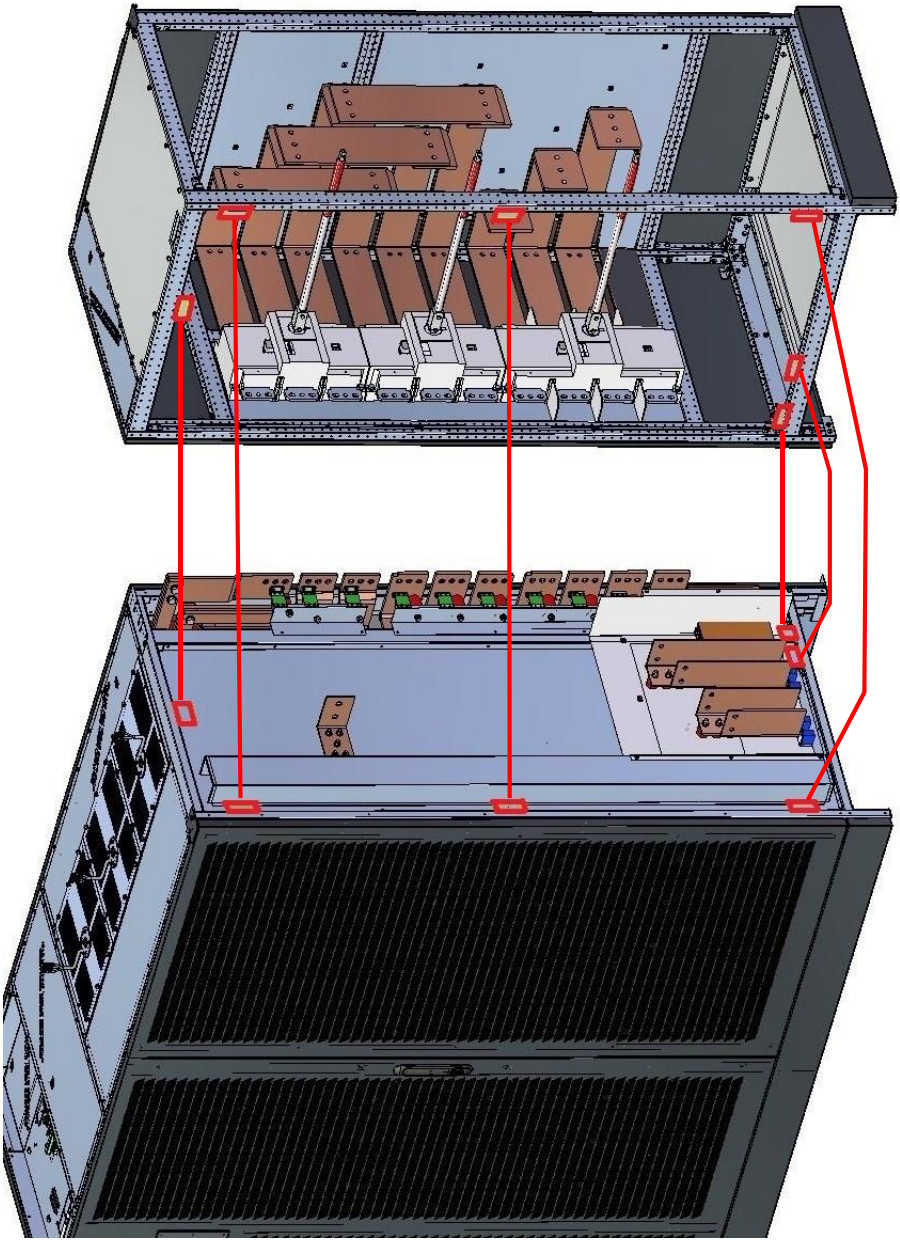
1 In the switches cabinet, remove the left external door, the secondary access panels and the lexan cover.



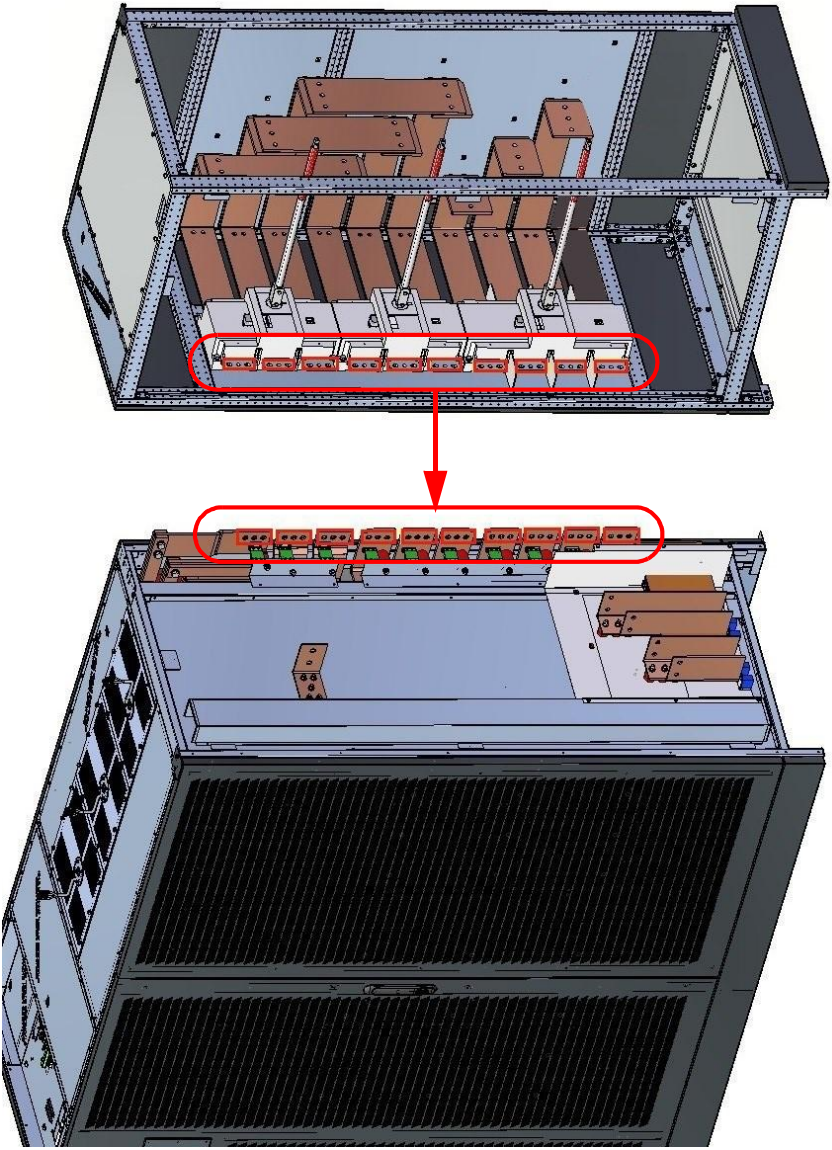
2 In the modules cabinet, remove the two lexan particulars in red and the iron ones indicated below in blue.



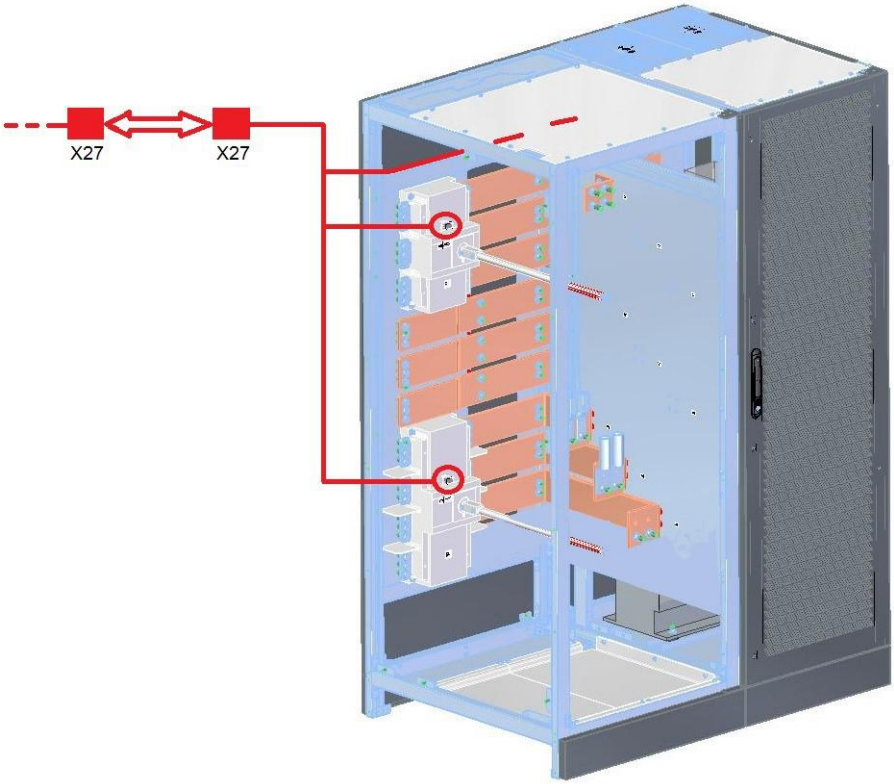
3 Assemble the iron particulars in red as indicated by the arrows using supplied hexagonal head screws M6x30 + grower + washer.



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 3.



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 lexan parts, 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 Table 1.

Table 1:

Altitude (m)	Derating Factor
1000	1.000
1200	0.990
1500	0.975
2000	0.950
2500	0.925
3000	0.900
3500	0.875
3600	0.870
4000	0.850
4200	0.840
4500	0.825
5000	0.800

Refer to Table 1 of IEC/EN 62040-3.

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 clearance of 610mm above unit required for air exhaust and service, and 1270mm front access is required for service. No clearance required at sides or rear of unit. The UPS air intake is at the front, and the air outlet is on the top (see Fig. 3).

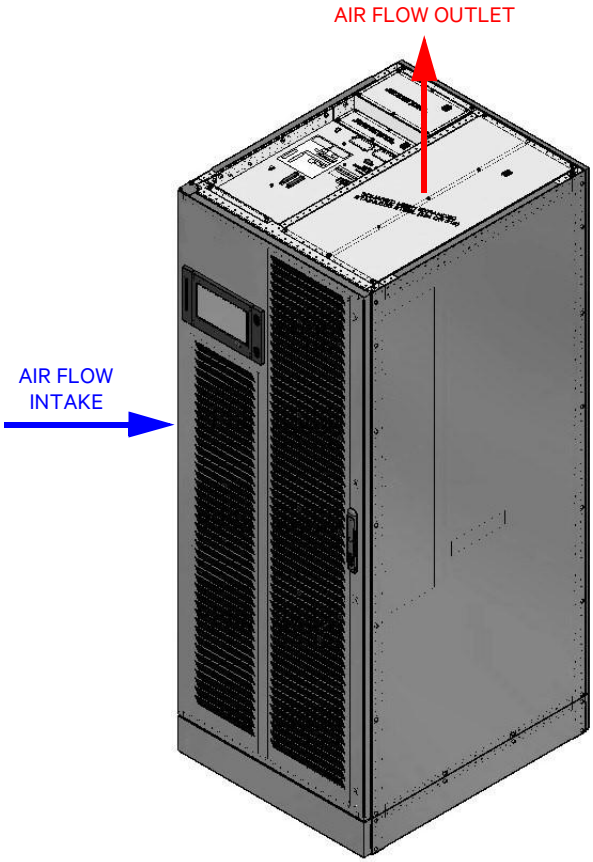


Figure 3 - In/out air flow

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. 5 and Fig. 9, the weight may be found on the Data Tables in chap. 9. on page 79. The cable gland plates are illustrated below.

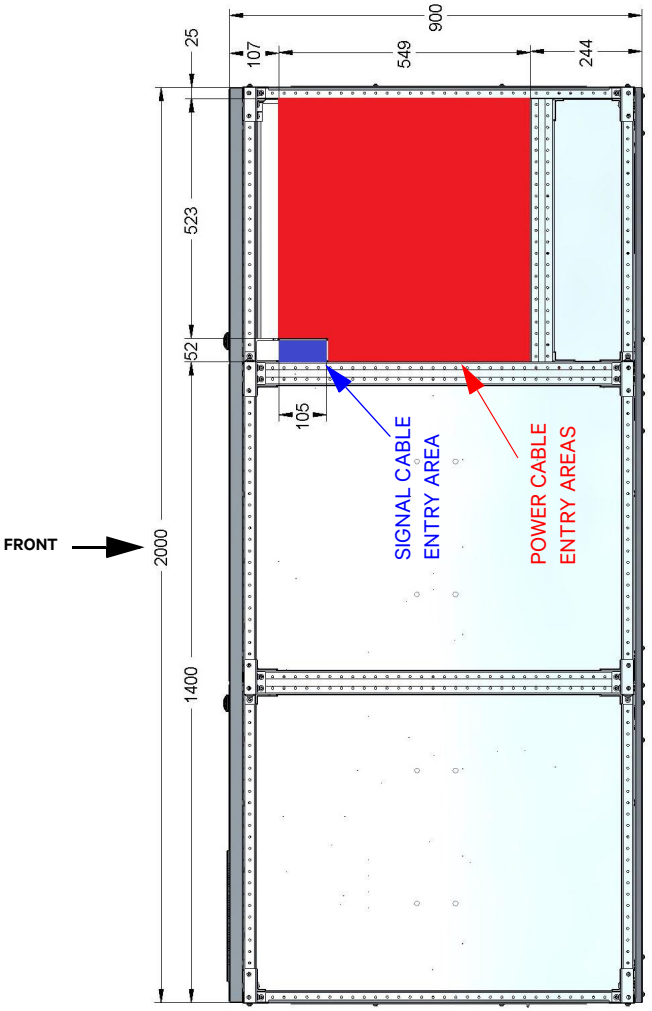


Figure 4 - Liebert EXL S1 800kVA bottom view (gland plate)

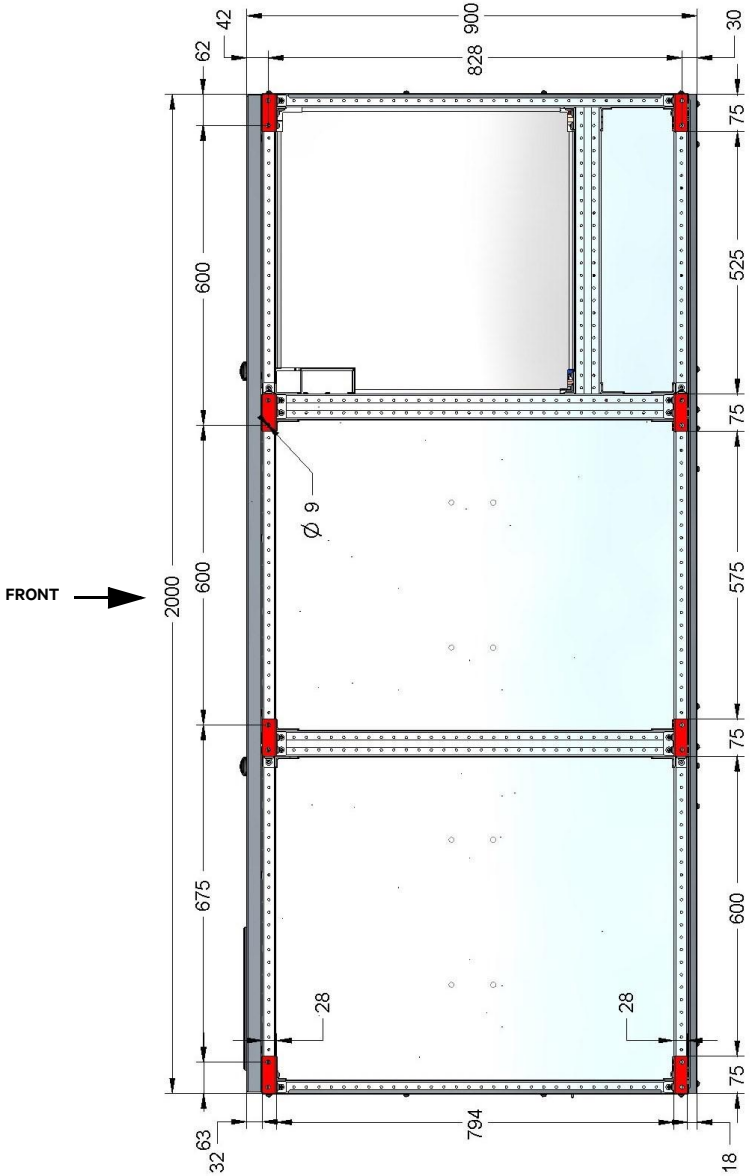


Figure 5 - Liebert EXL S1 800kVA bottom view (footprint and floor mounting holes)

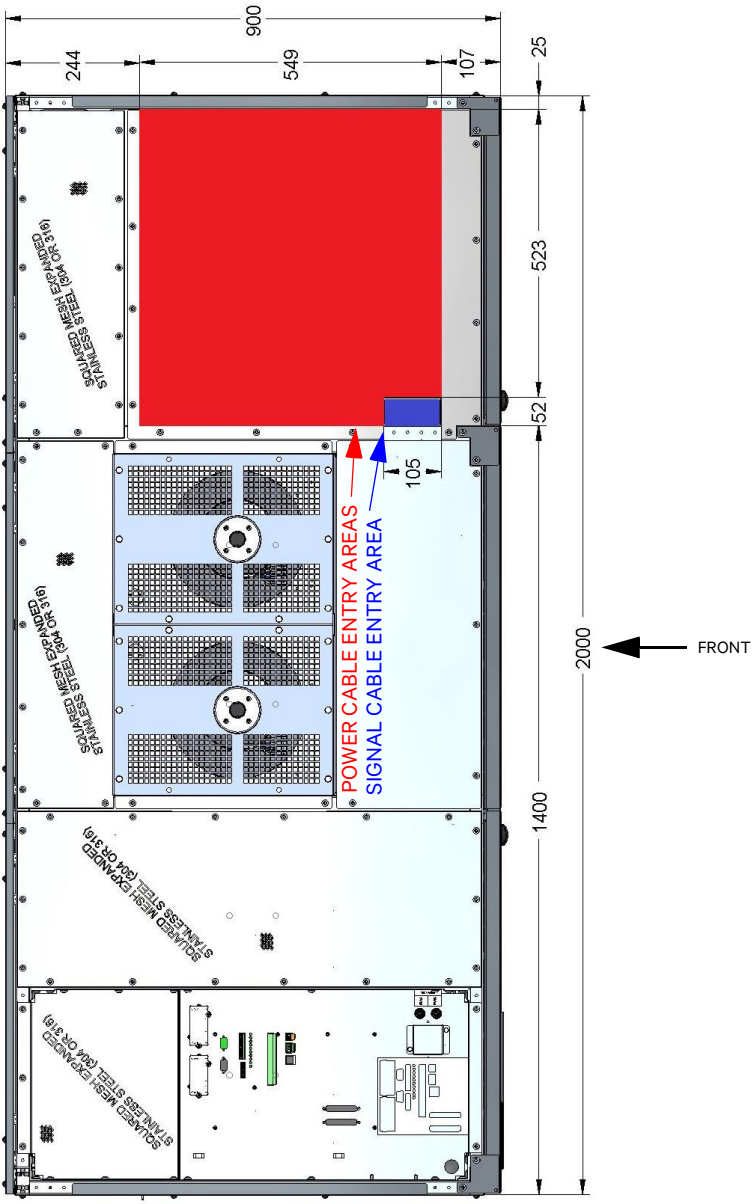


Figure 6 - Liebert EXL S1 800kVA upper view (gland plate)

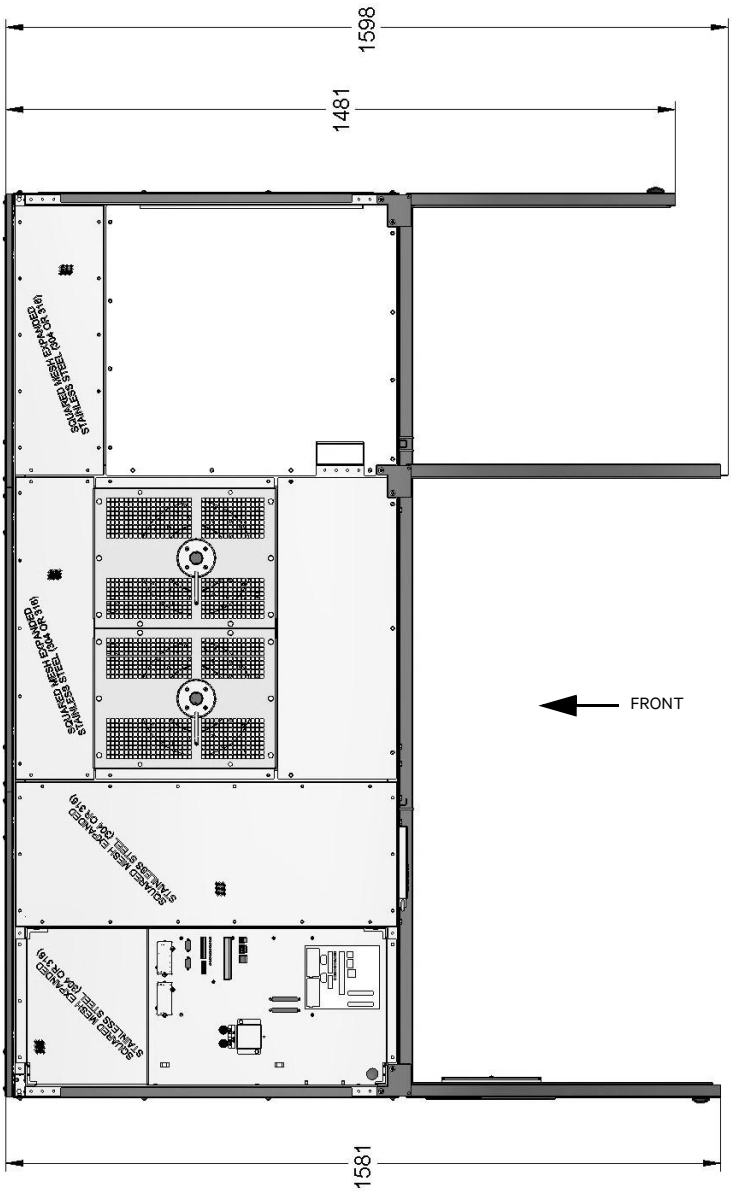


Figure 7 - Liebert EXL S1 800kVA upper view (doors open)

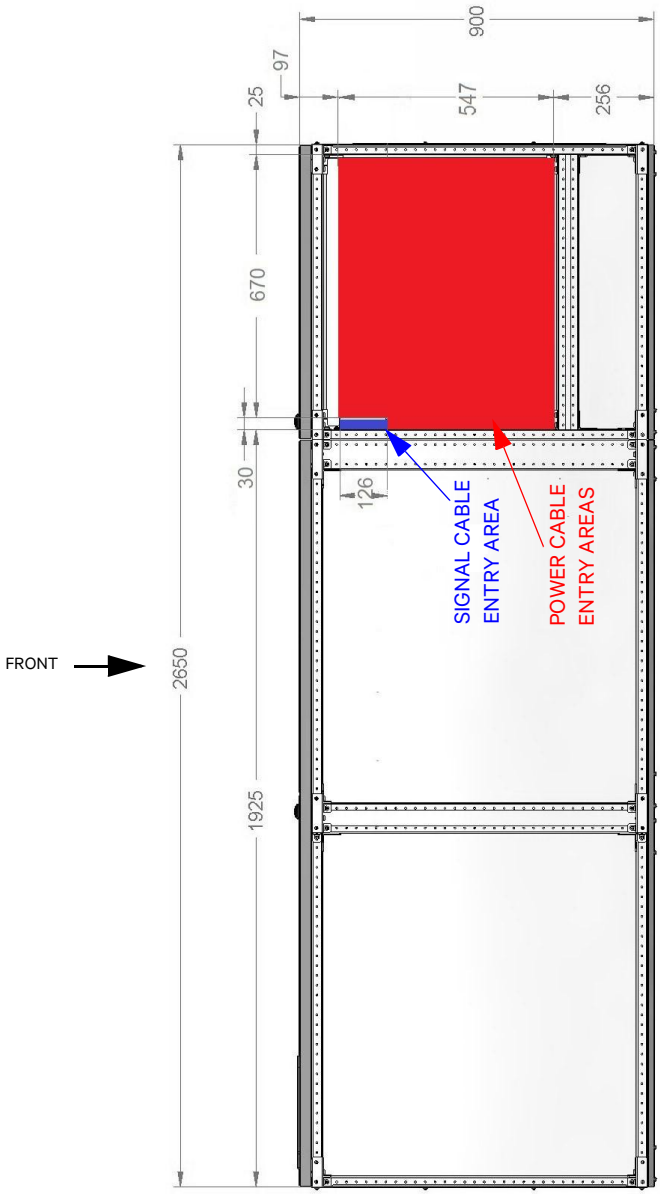


Figure 8 - Liebert EXL S1 1000/1200kVA bottom view (gland plate)

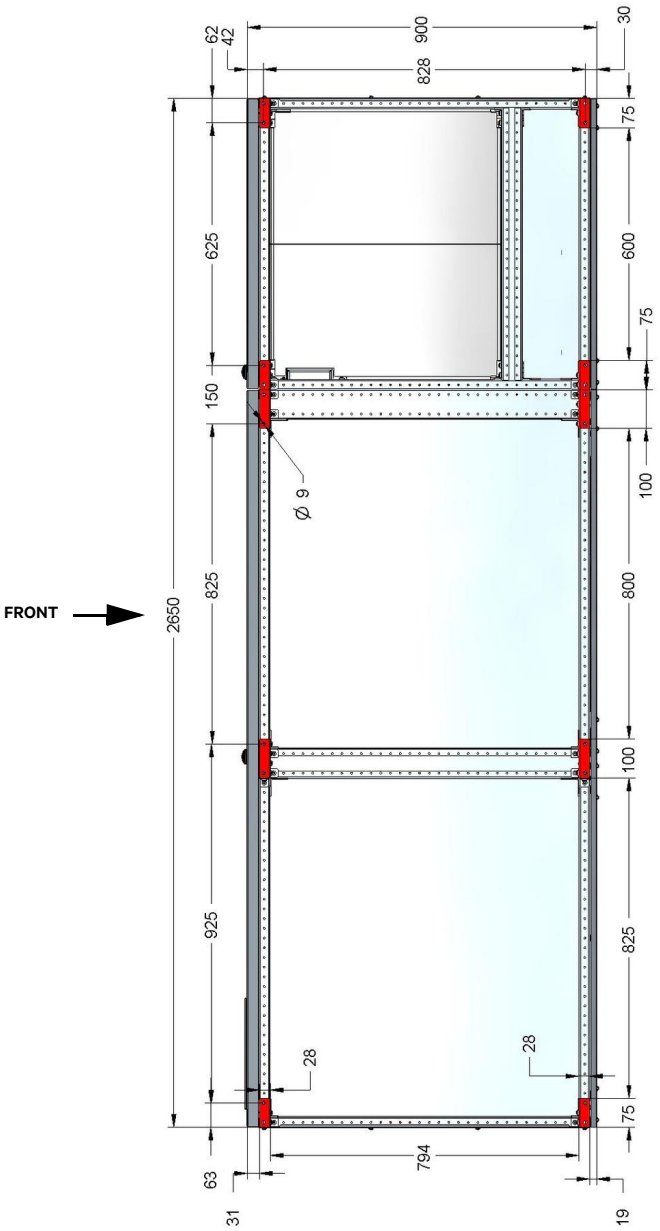


Figure 9 - Liebert EXL S1 1000/1200kVA bottom view (footprint and floor mounting holes)

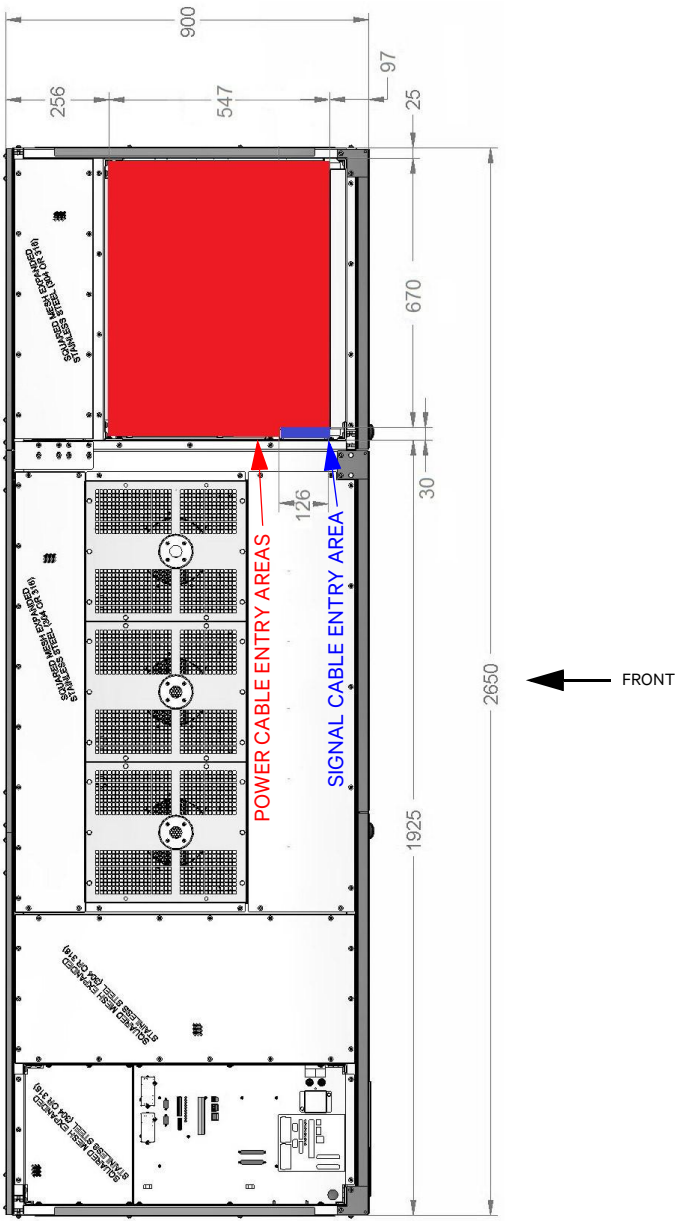


Figure 10 - Liebert EXL S1 1000/1200kVA upper view (gland plate)

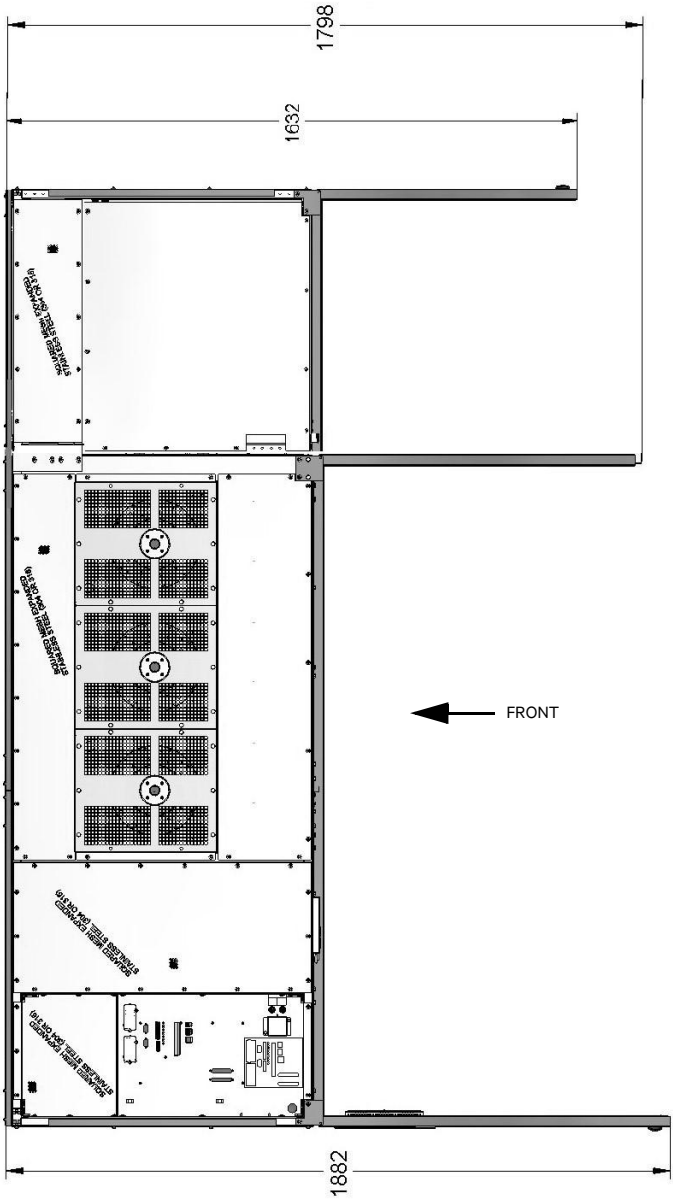


Figure 11 - Liebert EXL S1 1000/1200kVA upper view (doors open)

BLANK PAGE

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 480V 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 2 on page 31 for the max currents and max cable sizes usable in the UPS. See chap. 9. on page 79 for the overload currents.
Connect the line power cables to UPS terminals U, V, W.
Connect the bypass line power cables to UPS terminals U1, V1, W1.
Connect the load to UPS terminals U2, V2, W2 (see Fig. 14 on page 37).
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
- control wiring and power cables must be run in separate conduits. Control wiring must be stranded tinned conductors.



Notice

Tinned lugs are required if aluminum cable is to be used. If aluminum cable is to be used, top and bottom cable entry may be required. Contact Vertiv Technical Support for more information.



Notice

All wiring must be selected in accordance with national and local electrical codes, and coordinated with protection devices installed ahead of the UPS.

Table 2: Currents and maximum cable sizes

UPS devices (kVA)	800	1000	1200
Primary Power line			
Max. current (A) [1]	1200	1500	1800
Max. number of conductors connectable to BUS-BAR & cross section (mm^2)	4x300	6x300	6x300
Screw size	M12	M12	M12
Bypass Power line/Load			
Nominal current (A) [1]	962	1203	1443
Max. current (A) [1]	1058	1323	1587
Max. number of conductors connectable to BUS-BAR & cross section (mm^2)	4x300	6x300	6x300
Screw size	M12	M12	M12
Battery, external +, -			
Max. current (at 1.8V/cell - 240 cells) (A) [2]	1933	2416	2900
Max. number of conductors connectable to BUS-BAR & cross section (mm^2) [3]	6x300	8x300	8x300
Screw size	M12	M12	M12
Ground			
Max. number of conductors connectable to PE BUS-BAR (mm^2) [4]	2x300	4x300	4x300
Screw size	M12	M12	M12
Type of connector	BUS-BARS		

1) Overload current specified in chap. 9. on page 79 must be considered
2) To select the cross section, see the actual installation data and national and local codes. Number and cross section of battery conductors can be sized for a maximum continuous current at 1.8V/cell and a maximum voltage drop of 2.0Vdc at 1.67V/cell EOD.
3) Power cable from module DC bus to battery should be sized for a total maximum 2.0 volt line drop (power cable drop plus return cable drop as measured at the module) at maximum discharge current
4) Grounding conductors to be sized per 60364-5-54:2011 and per national wiring standards.

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

Table 3: Tightening torque

Screw size	Nm (+/-20%)
M12	50

3.3. Physical appearance

Legend:

- QS1 = PRIMARY MAINS INPUT SWITCH
- QS2 = BYPASS MAINS SWITCH
- QS4 = OUTPUT SWITCH

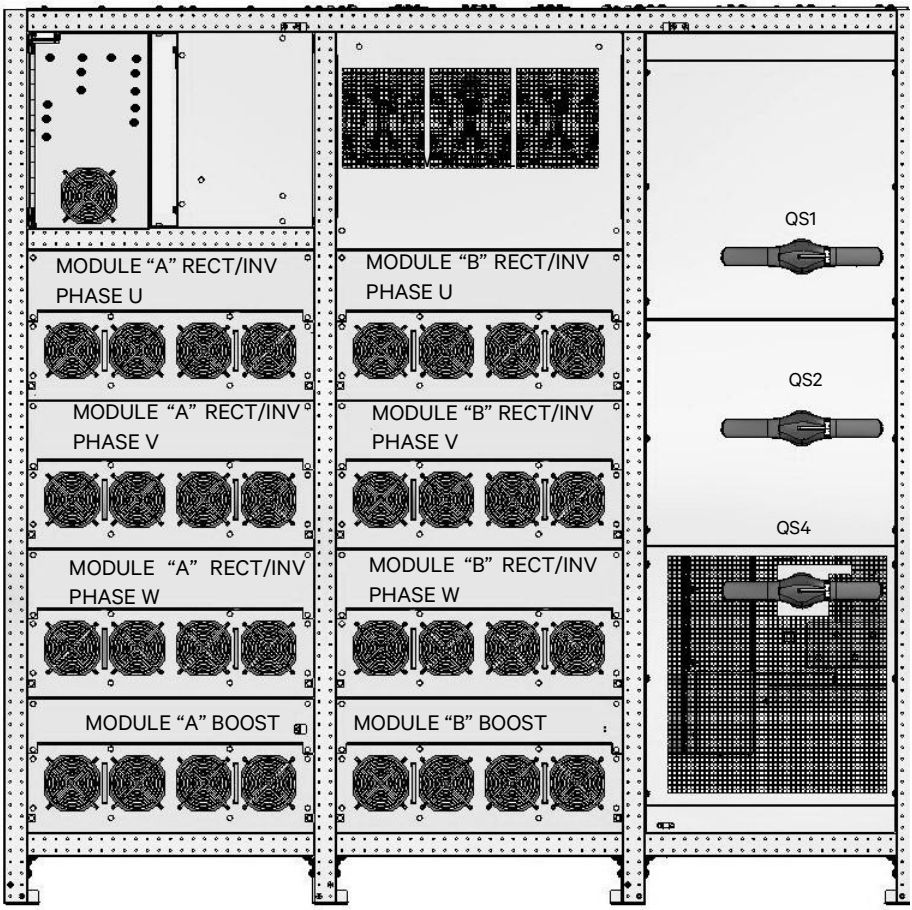


Figure 12 - Liebert EXL S1 800kVA - front view

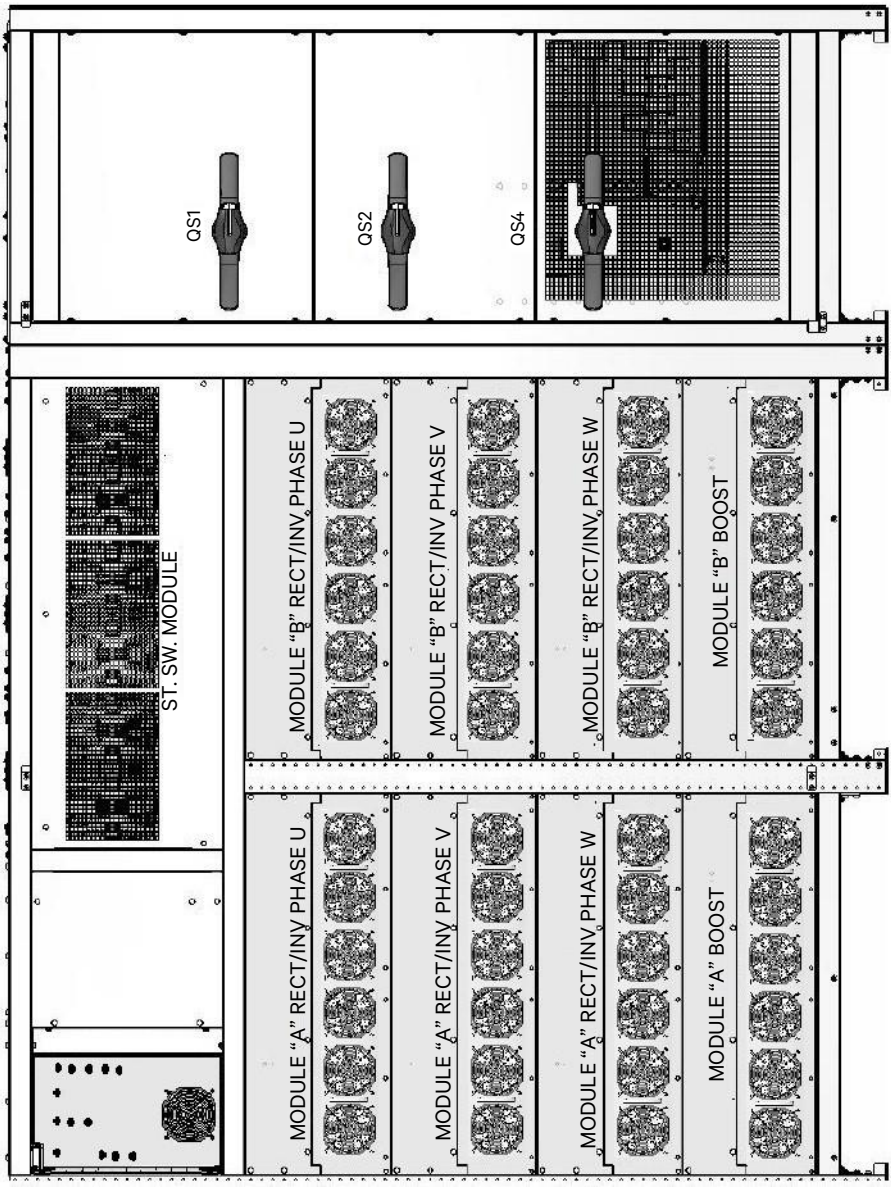


Figure 13 - Liebert EXL S1 1000/1200kVA - front view

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

Notice

In a neutral isolated system (IT) the installation of the UPS can modify the level of the impedance of the system respect the ground, so it can interfere with existing insulation monitoring devices. It is recommended to select adjustable devices in order to set the threshold values in accordance with the actual impedance, taking in account the presence of the UPS.

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 protection devices 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 2 on page 31) 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 2 on page 31;

2 I^2t rating lower than the thyristor rating (see chap. 9. on page 79 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 79 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 protection devices 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 2 on page 31. These devices should be installed as close as possible to the battery.

- Vertiv recommends installing a local battery disconnect near the battery for safe maintenance. If this is not possible, it is required to use a lock-out tag-out device in the battery room and always check for hazardous voltage before performing maintenance on the UPS.
- An external battery protection device shall be installed to ensure adequate protection in case of short circuit fault: fuses or automatic breakers suitable for DC applications. The external battery protection device shall be sized in accordance to the available battery short circuit current and the battery string voltage.



Notice

Batteries are able to withstand an external short circuit under specific conditions and for a specified duration. Fuses, circuit breakers and cables must be selected in accordance to the battery characteristics. Please contact Vertiv Technical Support for more information.



Notice

External shorts can lead to irreversible battery damage and a reduced battery service life.



Warning

In case of missing or incorrect battery protection extensive damage to the batteries, the UPS, and ancillary equipment can occur.

Notice
Vertiv will not accept liability or pay costs, fees, or damages resulting from missing or incorrect sizing of the battery protection device(s). Please contact Vertiv Technical Support for more information.

Vertiv recommends using a proprietary battery breaker control option to remotely trip the battery breaker and safely disconnect the battery when an undervoltage condition is detected. Please contact Vertiv Technical Support for more information.

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 2 on page 31 and chap. 9. on page 79
Supply from Static Bypass Switch and maintenance Static Bypass Switch:
see Table 2 on page 31 and chap. 9. on page 79

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. 23) 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. In case of dual-line feeder, the disconnector must be installed upstream of the UPS bypass input. When the disconnector is activated, the bypass line is no longer available

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 37.

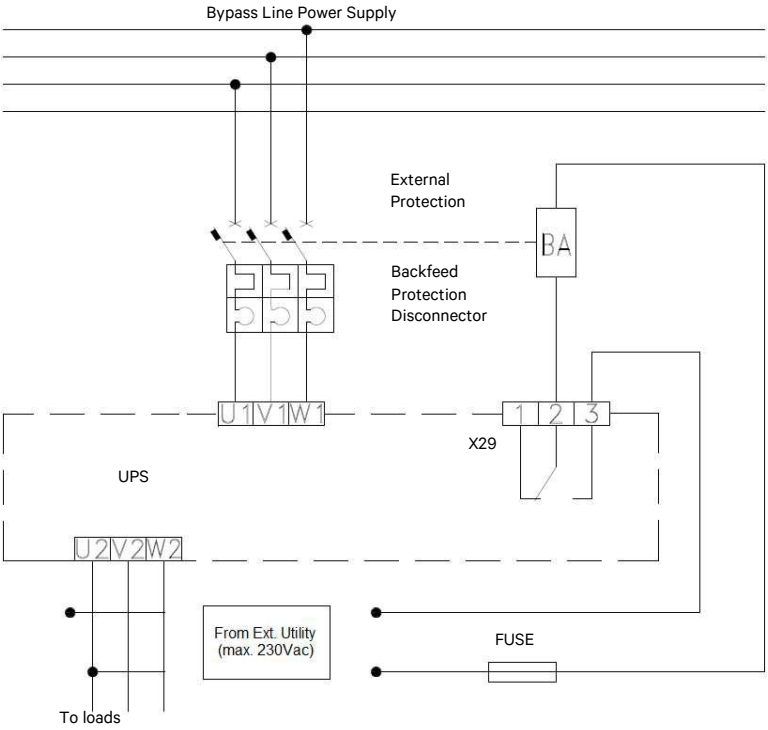


Figure 14 - External protection devices

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. 15-Fig. 20). 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.

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. 15-Fig. 20) 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)
- U2, V2, W2 - UPS OUTPUT TO LOAD
- D-, C+ - BATTERY TERMINALS
- GROUND CONNECTION (PE) ⏚

The 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 2 on page 31, chap. 9. on page 79). Auxiliary signal contacts shall be assigned to a programmable input of XP11 (see Fig. 24), so that the status of the switch can be monitored during the normal operation.

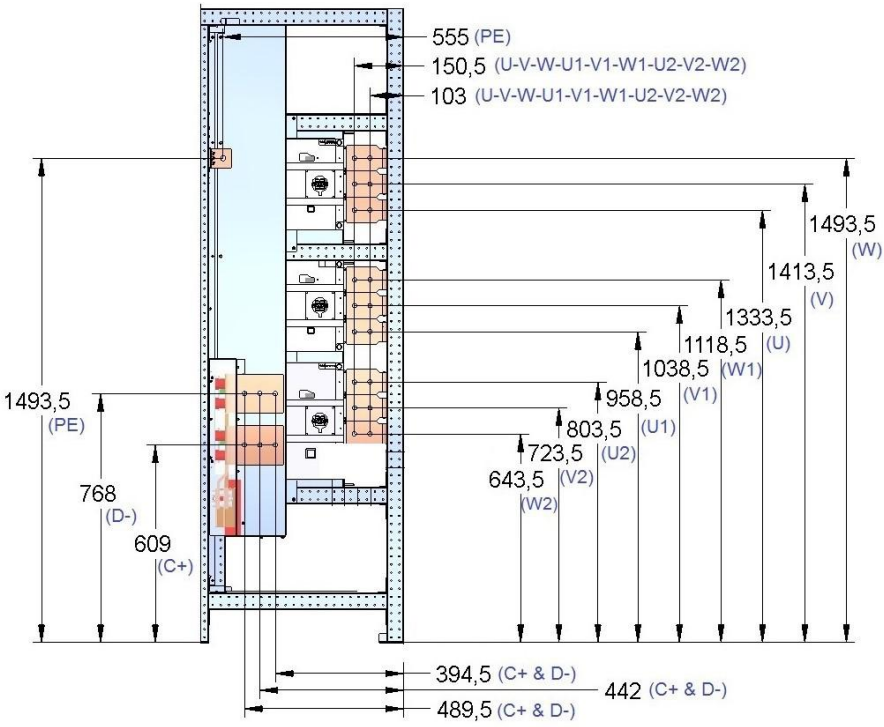


Figure 15 - Liebert EXL S1 800kVA
Customer power connections (front view)

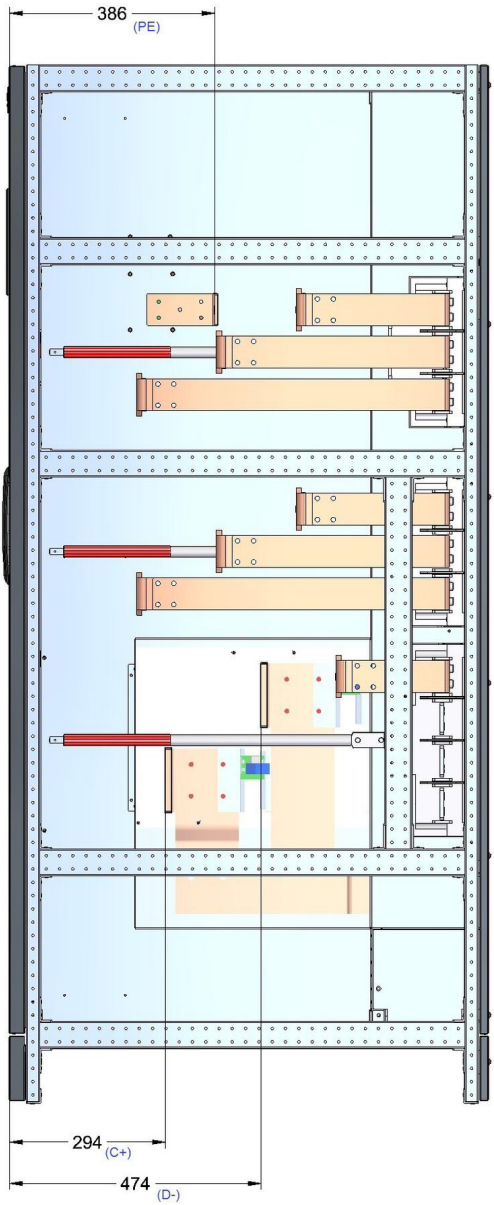


Figure 16 - Liebert EXL S1 800kVA
Customer power connections (right side view)

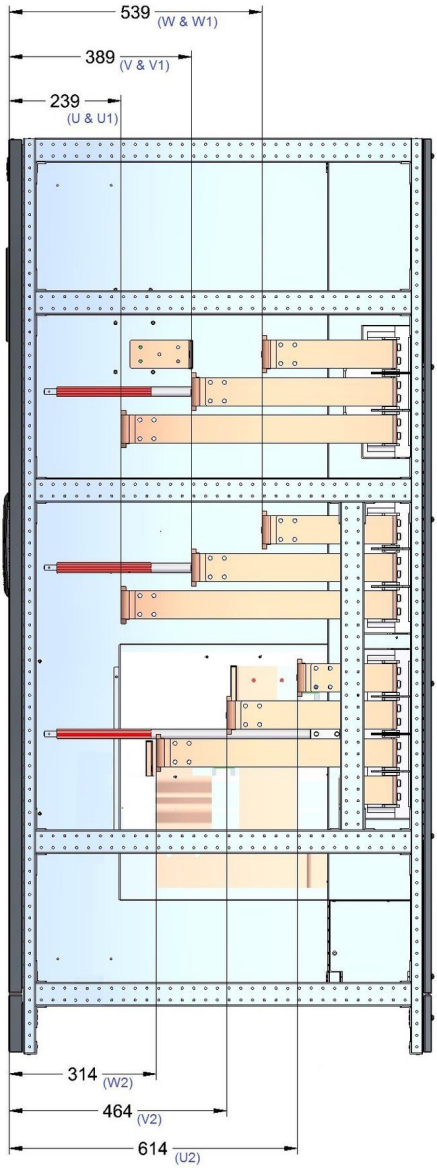


Figure 17 - Liebert EXL S1 800kVA
Customer power connections (right side view)

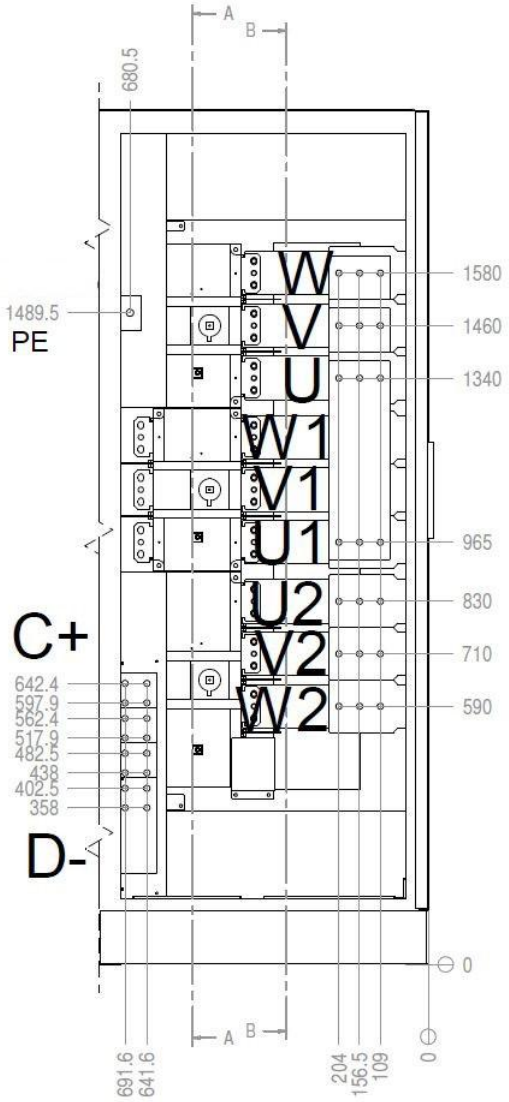


Figure 18 - Liebert EXL S1 1000/1200kVA
Customer power connections (front view)

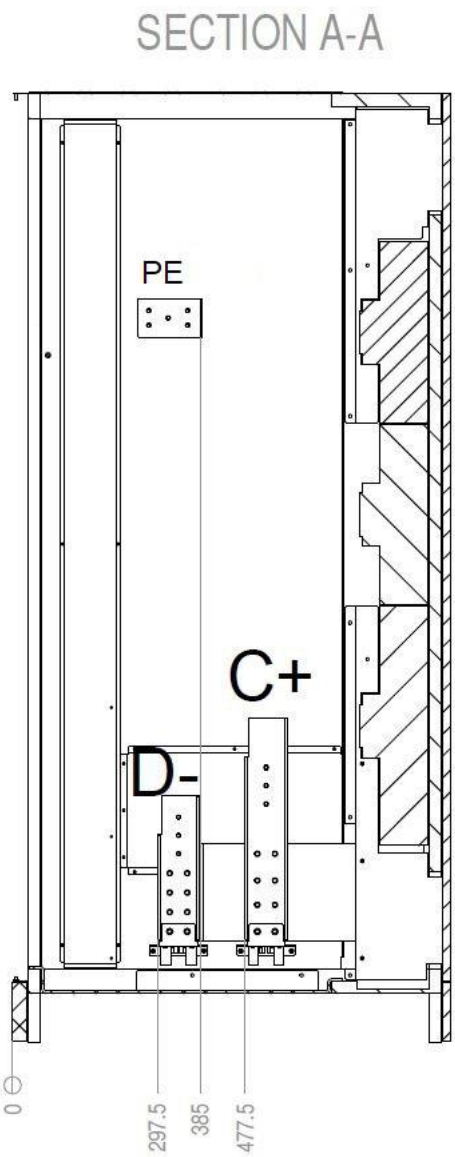


Figure 19 - Liebert EXL S1 1000/1200kVA
Customer power connections (SECTION A-A)

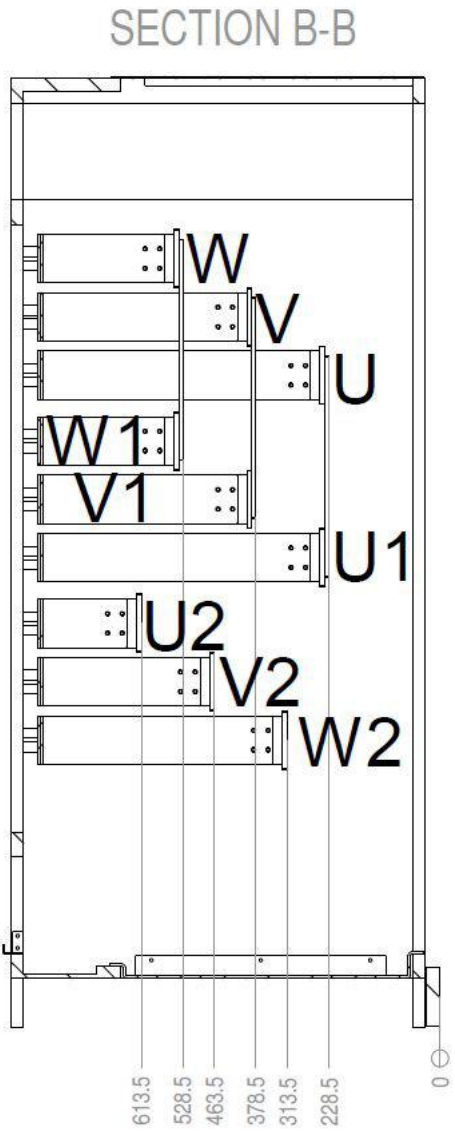


Figure 20 - Liebert EXL S1 1000/1200kVA
Customer power connections (SECTION B-B)

3.8. Configuring Ground Connections

Improper grounding is the largest single cause of UPS installation and start-up problems. Grounding techniques vary significantly from site to site, depending on several factors.
Proper grounding should be based on the appropriate IEC 60364 sections and/or local wiring rules, but safe and proper equipment operation requires further enhancements.

Warning

The UPS ground lug must be solidly connected to the service entrance ground by an appropriately sized wire conductor per the IEC 60364-5-54. Each conduit or raceway containing phase conductors must also contain a ground wire, both for UPS input and output, which are solidly connected to the ground terminal at each termination point

Warning

In addition to safety requirements it is important to follow grounding best practices for EMC requirements. For example, daisy chain grounding connection between UPS modules located in different electrical rooms or floors is not recommended.

3.9. 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.

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 2 on page 31. 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 79) 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 79). Several charging methods (depending on the type of battery) are available and can be configured by qualified personnel only.

3.10. 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.

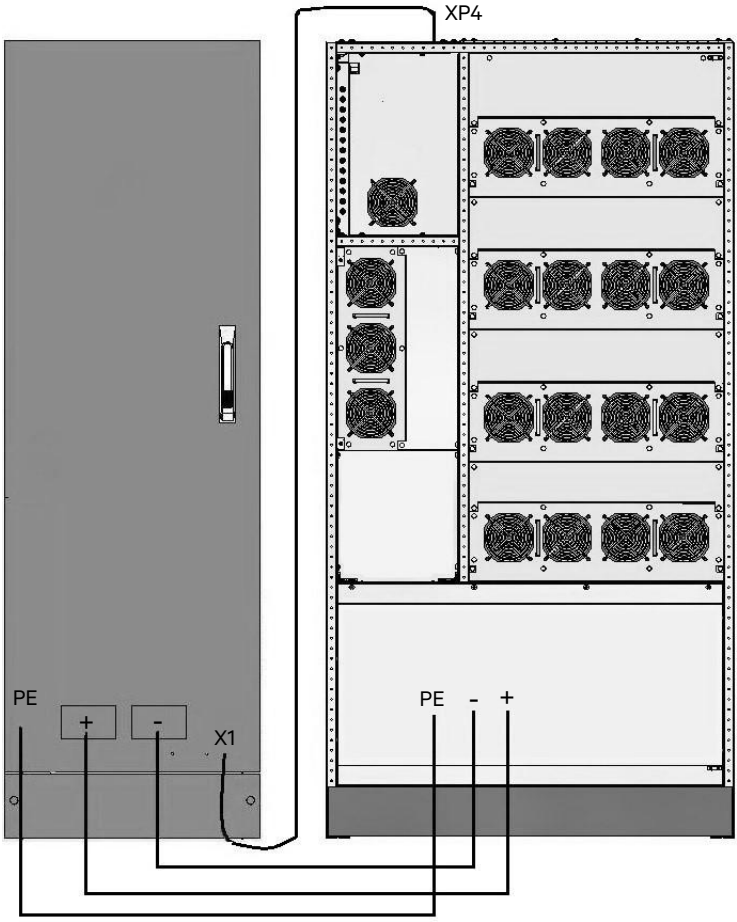
A battery area temperature sensor is supplied as standard equipment and includes a connecting cable with length of 15 meters. Place the sensor in the battery cabinet and monitor it after the UPS installation.

- The battery cabinet should be installed adjacent to the UPS (see Fig. 15-Fig. 20 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 2 on page 31 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. 23).
- 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. 23.

Figure 21 - External Battery Connections

3.11. 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.

3.11.1. Recharging batteries

Notice

When recharging, follow the instructions printed on the packaging

3.11.2. Replacing batteries

Notice

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

3.11.3. 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. 22.

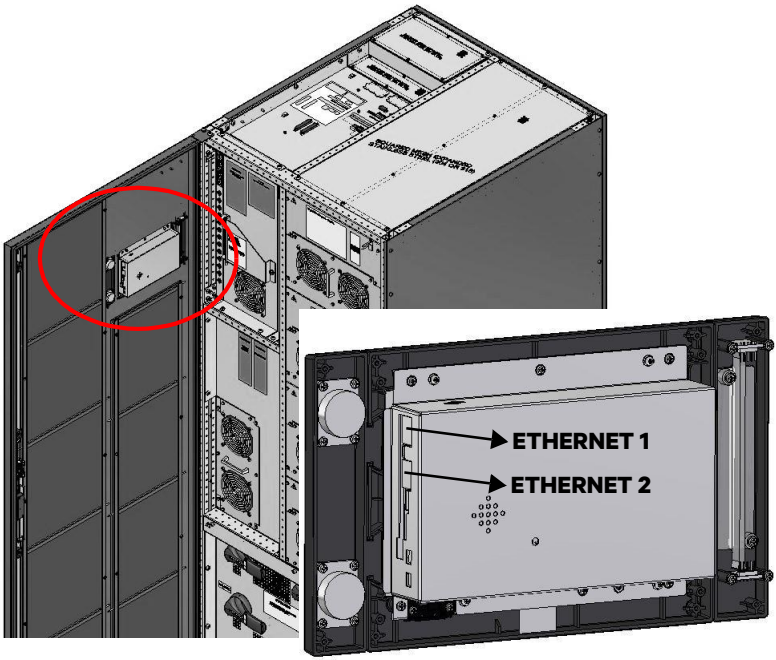


Figure 22 - LCD touch screen

Liebert EXL S1 is equipped with the following interfaces:

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

4.1.1. ETHERNET 1 - provision for future options

4.1.2. ETHERNET 2 - 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. 23.

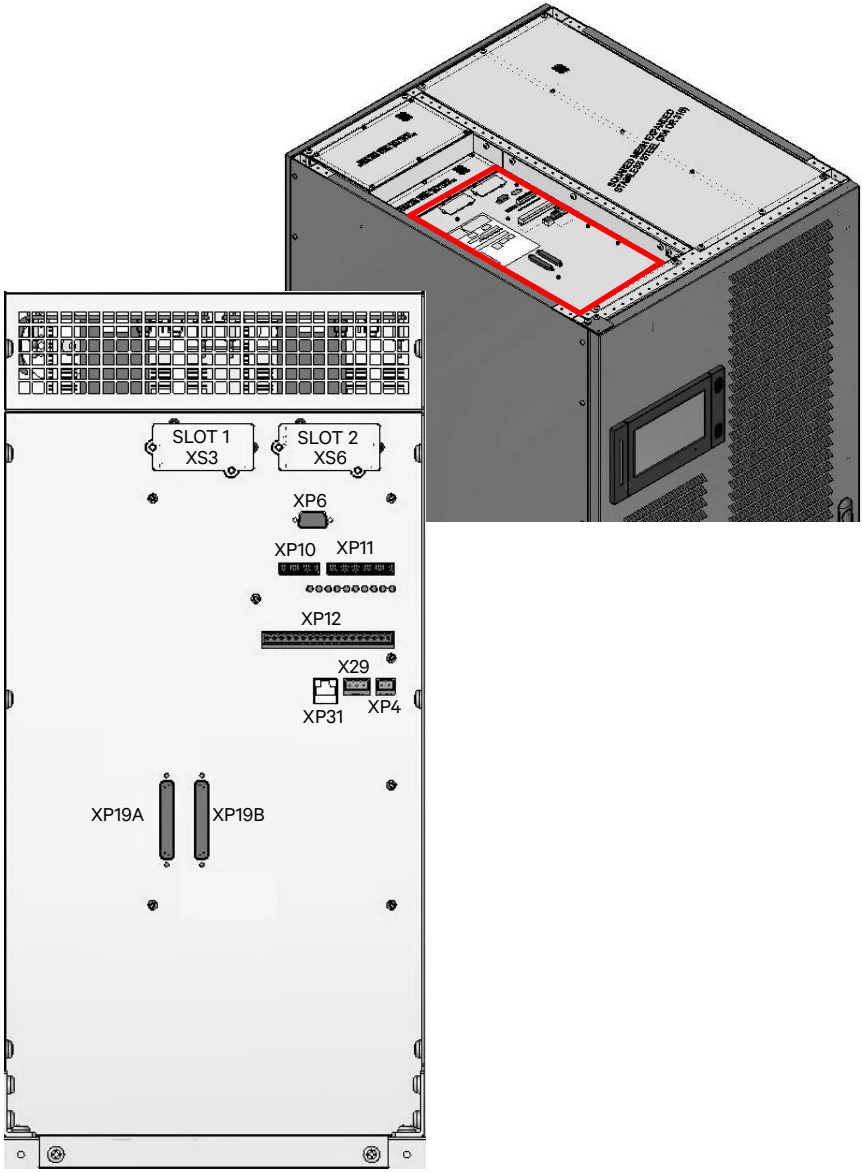


Figure 23 - Customer connectivity panel

Liebert EXL S1 is equipped with the following interfaces:

- XS3 - Slots for Liebert IntelliSlot Cards - SLOT1
- 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

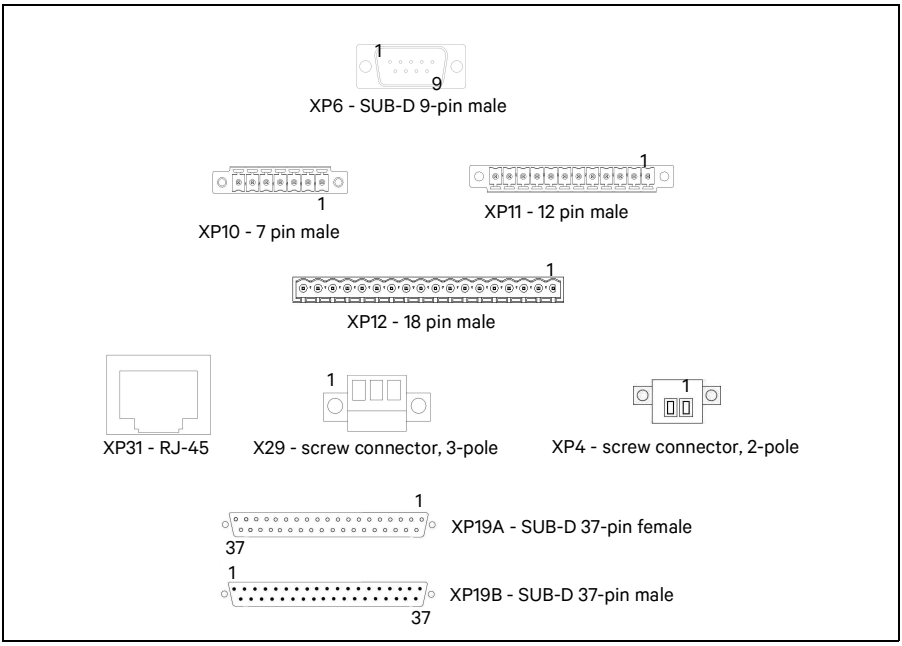


Figure 24 - Connector/terminal identification

4.2.1. XS3 - Slots for Liebert IntelliSlot Cards - SLOT1

This slot permits installing Liebert network-communication cards. This adapter provides an independent external network interface for communication with network monitoring and building management systems. The Slot is SELV - isolated from UPS primary circuits.
The Liebert IntelliSlot platform includes the Liebert IS-UNITY-DP card. The platform communicates with Vertiv software tools and services, including Trellis, Liebert SiteScan Web and Liebert Nform.
The IS-UNITY-DP card supports up to two third-party protocols along with HTTP/S (Web), Vertiv Protocol, SMTP and SMS. Third-party protocols available on the IS-UNITY-DP card are:

- BACnet IP—BACnet over Internet Protocol
- BACnet MSTP—BACnet Master-Slave/Token-Passing (MSTP) communications protocol over an RS-485 serial network (also known as BACnet MSTP RS-485)
- Modbus RTU
- Modbus TCP
- SNMP versions 1, 2c and 3

When determining the protocols, consider the following:

- No more than two protocols may be enabled on one card.
- Only one version of BACnet may be selected, either BACnet IP or BACnet MSTP.
- Only one version of Modbus may be selected, either Modbus TCP or Modbus RTU.

Only one of the protocols can use the 485 port; choosing two 485 protocols will cause conflicts.

4.2.2. XS6 - Slot for LIFE™ Products

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

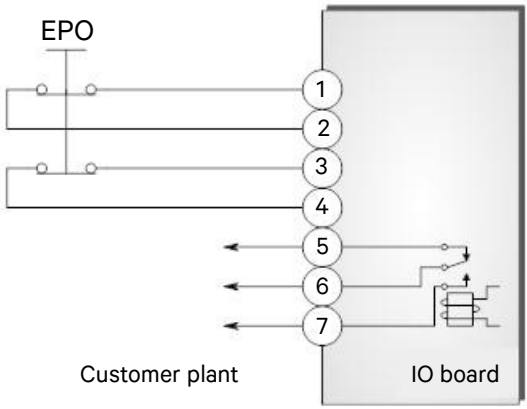
4.2.3. XP6 - Serial Interface for Connectivity Products (serial input/output)

The service Interface is a SUB-D 9pin male connector for RS232 serial communication. It is used for communications with external LIFE™ 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.

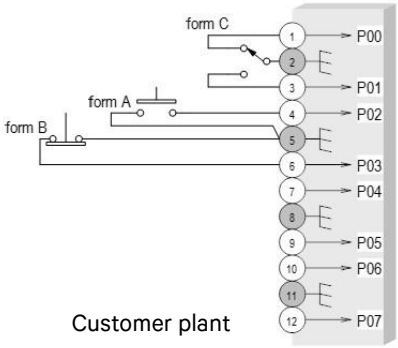
PIN	Signal	Explanation
PIN 1-2	1° EPO INPUT	EPO is ON when either input 1 or input 2 are open; the inputs are independent and in OR logic [1)]
PIN 3-4	2° EPO INPUT	
PIN 5-6-7	RPO Status CONTACT	Form C dry contact. 1A @24 Vdc

[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

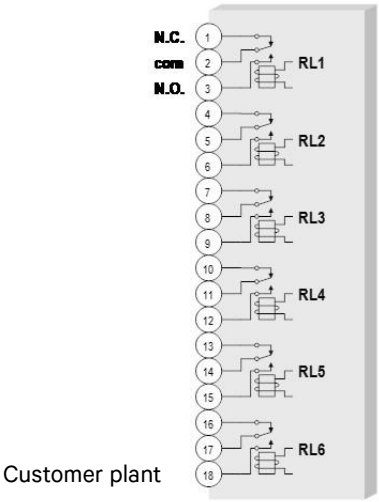
Connection with customer plant:
12-wire connector used for dry contacts, only safe operating voltage should be connected here.
The current level for all inputs is less than 5mA at 12 or 24V.
Connection should be as follows:



INPUT CONTACT	INPUT CONNECTOR
Second stage rectifier current limit/ Second stage battery current limit	Standard Input contact XP11: Pos 1
Inverter Inhibit (from Castel Key fitted in LV Panel)	Standard Input contact XP11: Pos 2

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

OUTPUT CONTACT	OUTPUT CONNECTOR
UPS mains failure	Contact XP12: RL1 p1/p3 (Common p2)
UPS on bypass/UPS string operating on static switch	Contact XP12: RL2 p4/p6 (Common p5)
UPS on battery	Contact XP12: RL3 p7/p9 (Common p8)
UPS low battery	Contact XP12: RL4 p10/p12 (Common p11)
UPS common alarm/UPS string common alarm	Contact XP12: RL5 p13/p15 (Common p14)
UPS module fault	Contact XP12: RL6 p16/p18 (Common p17)

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

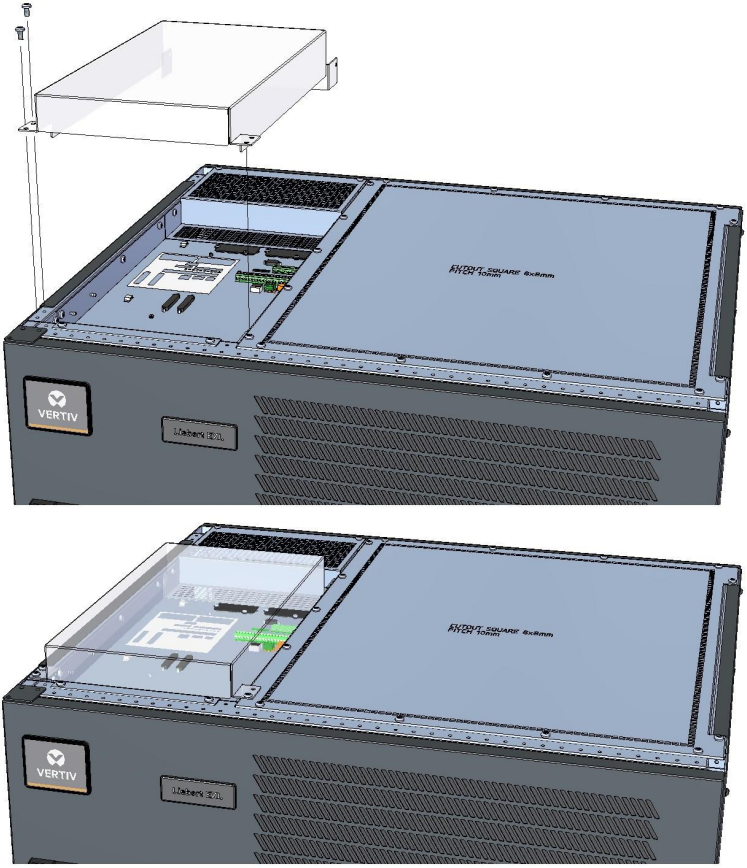
This interface is used for paralleling 2 or more UPS with each other.
It enables data exchange between UPS electronics so that the UPS can provide a common output.
The Interface is SELV-isolated from UPS primary circuits.

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.

4.2.11. Customer connectivity panel protection

It is possible to protect the connectors present in the customer connectivity panel by mounting the supplied lexan protection, as indicated in the below figures, and fixing it using the supplied screws.



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.

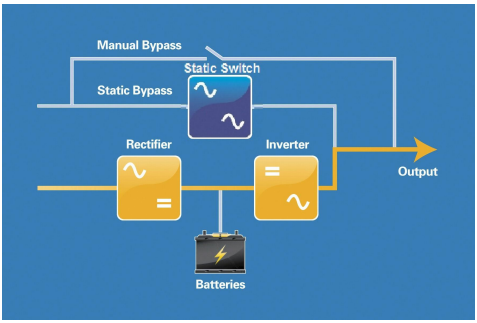


Figure 25 - UPS in on-line operation

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 58.

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 79, 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 48.

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. 26).

KEY TO SWITCHES:

- QS1 = PRIMARY MAINS INPUT SWITCH
- QS2 = BYPASS MAINS SWITCH
- 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

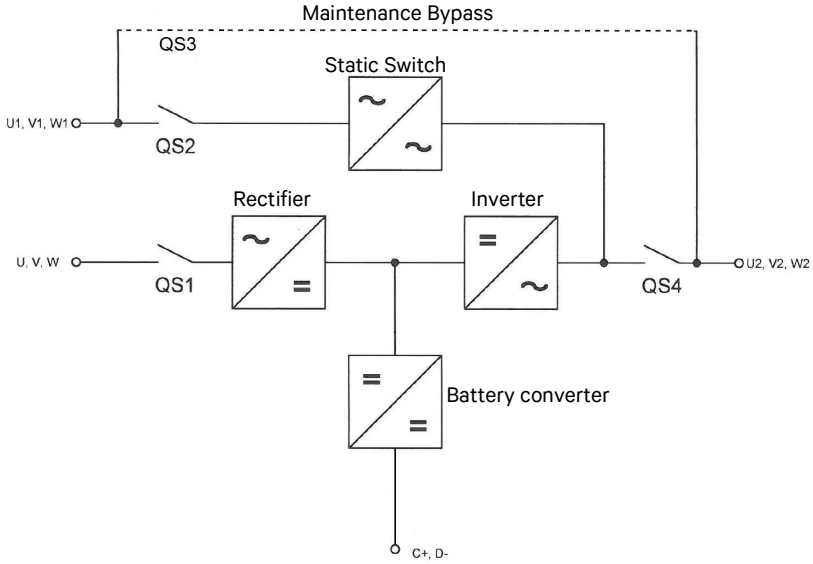


Figure 26 - Liebert EXL S1 block diagram

5.4. Maintenance Bypass Switch (not available for 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 63.

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

(see Fig. 12, Fig. 13)

Warning

During parallel operation, switching of the load on the built-in Service Bypass must be performed by an external device (see chap. 6. on page 67).

5.5. Operating modes

The UPS has 5 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.

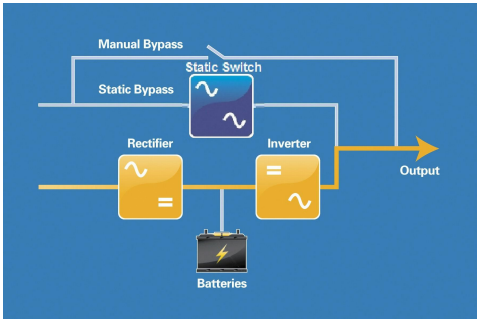


Figure 27 - Power flow in on-line operation

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).

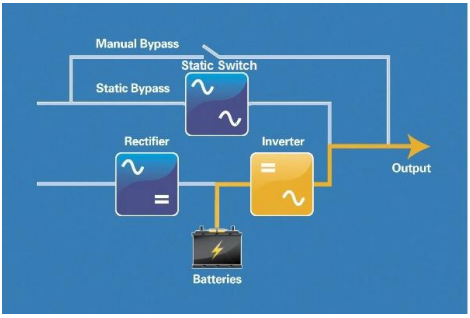


Figure 28 - Power flow during battery operation

5.5.3. Dynamic online operation

This mode is available as option and compensates for output load THDi, output load PF. It reduces line power disturbances such as sags and swells. The load is fed by the bypass line, and the inverter works as an active filter, which compensates for the reactive power required by the load. In a typical condition, this mode offers 96.5 - 98.5% efficiency, depending on the type of load (e.g. nonlinear or linear) and the condition of input line power.

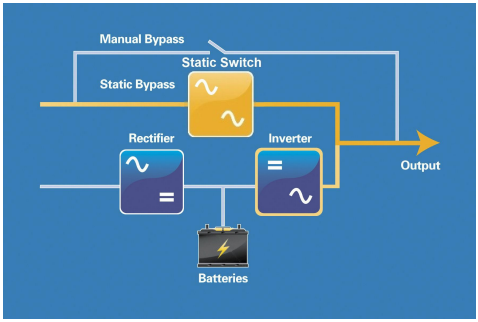


Figure 29 - Power flow in Dynamic online operation

5.5.4. 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.

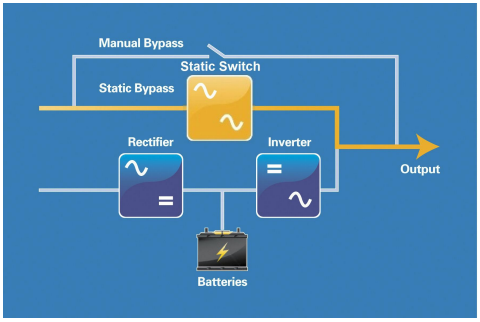


Figure 30 - Power flow in Bypass operation

5.5.5. 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.

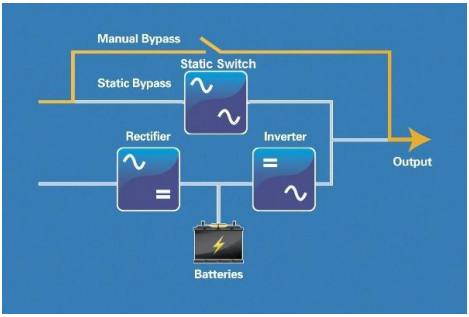


Figure 31 - Power flow during Service Bypass operation

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 29. For parallel operation please check chap. 6. on page 67.
- 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. 15-Fig. 20).



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 63).

5.7. UPS switching procedures

The following procedures refer to para 5.3. on page 58.

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	Check the charger is on then close external battery switches then set battery breaker [1] to the ON position [2]	
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
2) Before closing the battery breaker check DC voltages across the circuit breaker to ensure voltage level is consistent with the battery configuration

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 800/1000/1200kVA (see para 3.3. on page 32)

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 800/1000/1200kVA (see para 3.3. on page 32)

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.

BLANK PAGE

6. 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%.

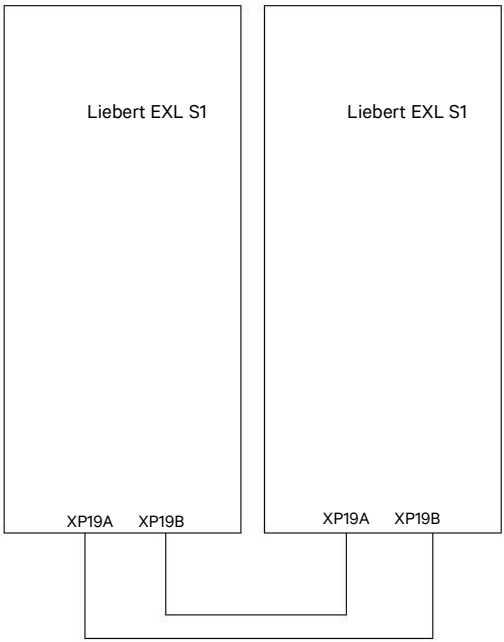


Figure 32 - Parallel connection between Liebert EXL S1

6.1. Placement into service

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

6.2. Communication between UPS blocks

UPS units exchange information through the connector cable (37 pin connector). Fig. 33 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.

6.3. Parallel switching procedures

The following procedures refer to para 5.3. on page 58.

6.3.1. 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

6.3.2. 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". Additional steps might be presented on display, select Unit or System. At this point, select System to switch off all units in the parallel system	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

6.3.3. 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". Additional steps might be presented on display, select Unit or System. At this point, select System to switch off all units in the parallel system	System in Bypass Mode
2	Switch battery breaker[1] to the OFF position	Battery disconnector
3	Switch QS3[2] to the ON position. If present, switch the external maintenance bypass 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 800/1000/1200kVA (see para 3.3. on page 32)

6.3.4. 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 on each unit of parallel system	Rectifier start up
2	Switch QS2 to the ON position on each unit of parallel system (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 on each unit of parallel system	
4	Switch QS4 to the ON position on each unit of parallel system	System in Bypass Mode - Output voltage present
5	Switch QS3[2)] to the OFF position. If present, switch the external maintenance bypass 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 800/1000/1200kVA (see para 3.3. on page 32)

1) 37-way Sub-D plug cable

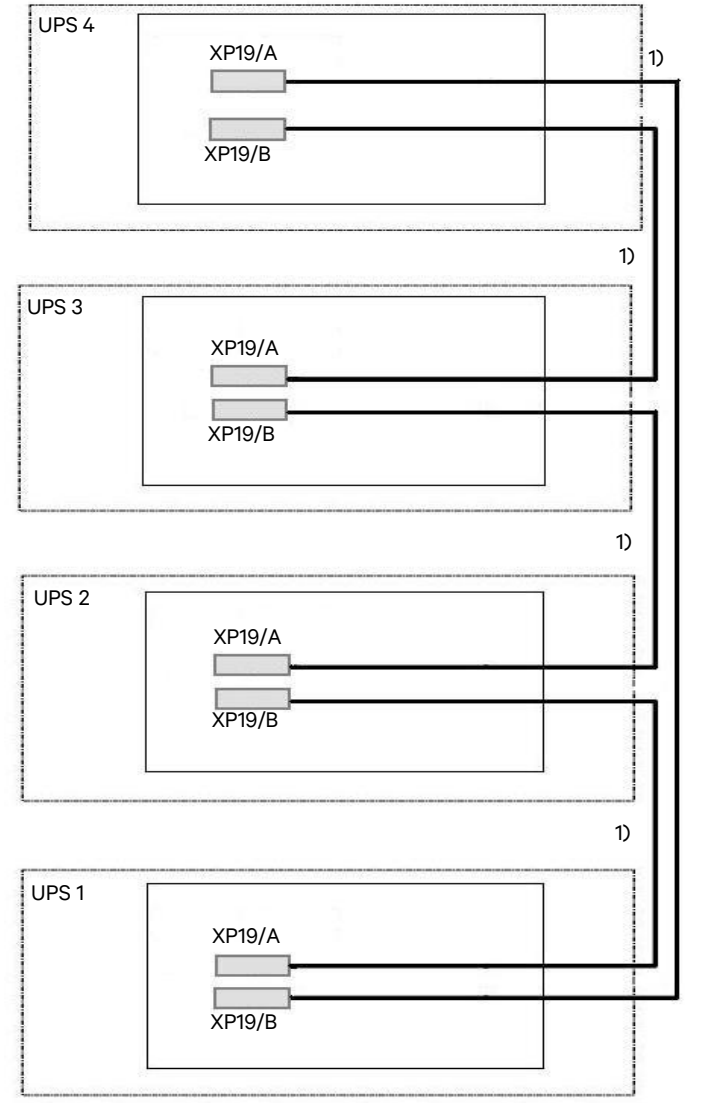


Figure 33 - Loop circuit for parallel UPS

BLANK PAGE

7. MAINTENANCE

Vertiv recommends that regular maintenance checks be carried out on-site by an authorized customer service.

7.1. Limited Life Components

The Liebert EXL S1 has a design life well in excess of 10 years. Well-maintained units can continue to provide economic benefits for 20 years or more. Long-life components are used in the UPS wherever practical and cost-effective. However, due to the currently available component material, manufacturing technology limitations and the general function and use of the component, a few components in the Liebert UPS will have a shorter life cycle and require replacement in less than 10 years.

The following components utilized in the UPS have a limited life cycle and are specifically exempt from warranty. To prevent a wear-out failure of one of these components affecting the critical load operations, Vertiv recommends these components be periodically inspected and replaced before the expected expiration of their life cycle. The expected life of each component listed below is simply an estimate and is not a guarantee. Individual users may have site-specific requirements, maintenance and other environmental conditions that affect the length of the component's useful life cycle.

Replacement components must exactly match the original component specifications.

For assistance with specific component specifications, replacement component selection and sourcing, contact Vertiv technical support. For customers using Vertiv Services' preventive maintenance services, periodic inspection of these components is part of this service, as well as recommending component replacement intervals to customers to avoid unanticipated interruptions in critical load operations.

Component	Expected life	Replace in
Power AC Filter Capacitors	15 years	12 to 15 years
Power DC Filter Capacitors	15 years	12 to 15 years
Low-Profile Fans	> 7 years	5 to 6 years
Air Filters	1 to 3 years	Check Four Times per Year
Battery, Lithium Logic Memory Backup	10 years	8 to 9 years
Battery, Storage		
Lead-Acid Wet-Cell (User Selection)	15 to 20 years	12 to 15 years
Valve-Regulated, Lead-Acid (VRLA)	5 years	2 to 3 years
	10 years	3 to 4 years
	20 years	8 to 12 years
Lithium-Ion	15 years	10 years

Expected Life is sometimes referred to as *Design Life*.

7.2. 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.

7.3. Decommissioning

7.3.1. Taking out of service

N.B. Switch to Service Bypass

- Switch the UPS to Maintenance Bypass operation (see para 5.7.3. on page 64)

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.

8. OPTIONS

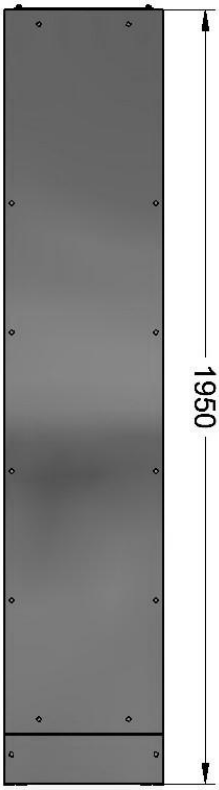
Some of the options listed in this section may modify the data on the standard technical data tables (see chap. 9. on page 79). It may not be possible to use certain options simultaneously on the same UPS.

8.1. TCE

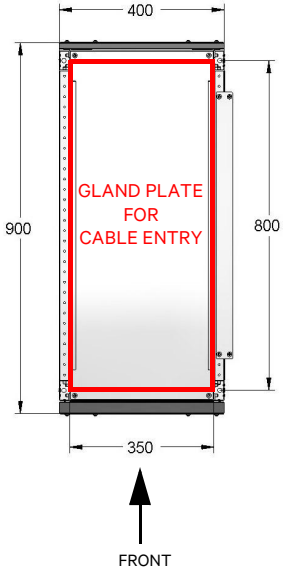
TCE 400mm

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

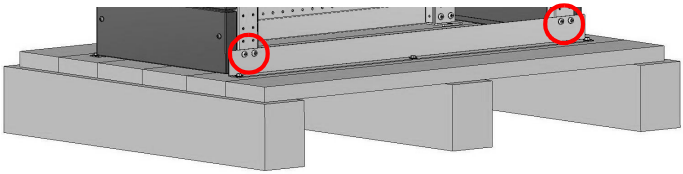


Upper view

The figures refer to the TCE on the left

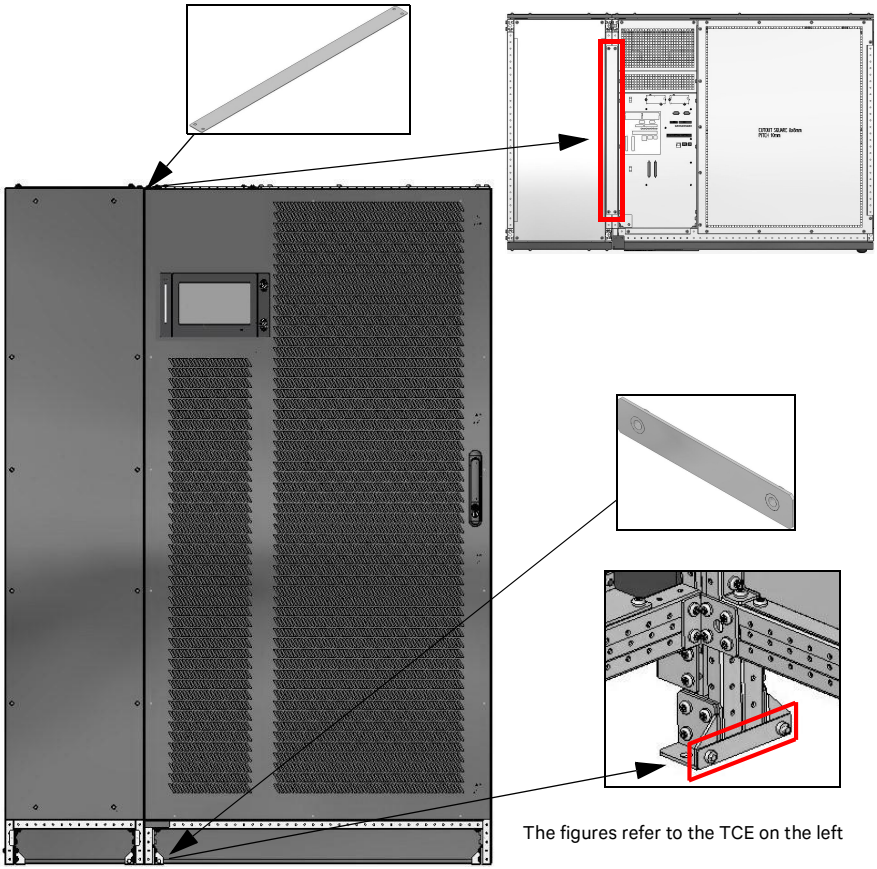
Unpacking

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



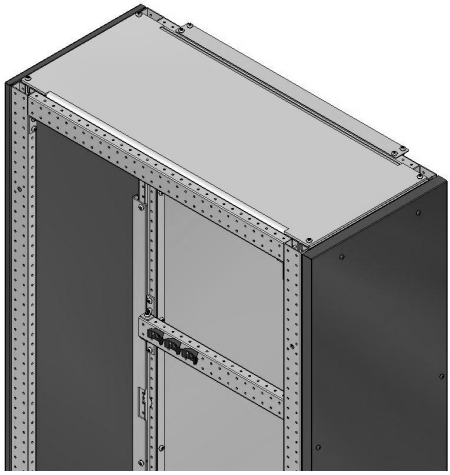
Installation

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.

8.2. MopUPS shutdown and monitoring software

For details, see www.liebert.com.

8.3. ManageUPS adapter

For details, see www.liebert.com.

8.4. 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

8.5. 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-*EXL S1*, 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.

8.6. Standard Parallel kit (Liebert EXL S1)

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

9. TECHNICAL DATA

9.1. Liebert EXL S1 800/1000/1200kVA

Not all the data shown apply simultaneously and may be changed without prior warning. Data apply to the standard version, if not otherwise specified. If the options are added, the data shown in the Technical Data Table may vary. For test conditions and measurement tolerances not specified in the table refer to the Witness Test Report procedure.

POWER (kVA)		**800**	**1000**	**1200**
INSTALLATION REQUIREMENTES				
Nominal System Rating	kVA	800	1000	1200
Nominal System Rating	kW	800	1000	1200
Unit Rated Temperature	°C	40		
Max continuos output power @30°C	kVA	880	1100	1320
Nominal Voltage	V	480		
Max Input Current	A	1115	1390	1670
Nominal Output Current	A	962	1203	1443
Short Circuit (<200 ms) [1)]	A	1925	2400	2887
Efficiency @ nominal Load	%	96,3		
AC/AC efficiency in Dynamic online mode without charging current, at maximum resistive load	%	Up to 99		
Heat Dissipation (Double conversion, Floating)	kW	30	41	46
Heat Dissipation (Double conversion, Max charging power)	kW	43	52	62
Number of Cells	-	240-300		
Max Charging Current @ nominal Load @ nominal input voltage	A	270 @ 240 cells	340 @ 240 cells	400 @ 240 cells
PRIMARY INPUT				
Input voltage range @ nominal load w/o battery discharge @ Nominal load	V	-15% +10%		
Nominal frequency	Hz	50 (60 selectable)		
Frequency range	%	±10		
Power factor @ nominal load & nominal input conditions		≥0.99		
Input current distortion @ nominal input conditions & nominal load	%	≤3		
Walk in/Soft start	s	15 (1 to 90 selectable)		
Rectifier Hold-Off	s	1 (1 to 180 selectable)		
Inrush current / Imax input		≤1		
INVERTER OUTPUT				
Nominal output voltage	V	480 3Ph		
Nominal output frequency	Hz	50 (60 selectable)		
Voltage stability in steady state condition for input (AC & DC) variations and step load (0 to Nominal load)	%	±1		
Voltage stability in dynamic condition for input variation (AC & DC) and step load (0 to Nominal load and vice versa)		Complies with IEC/EN 62040-3, Class I		
Voltage stability in steady state for 100% load imbalance (0, 0, 100)	%	±3		
Output frequency stability (synchronized with bypass mains)	%	±2 (2, 3, 4, 5 selectable)		
Output frequency stability (synchronized with internal clock)	%	±0.1		
Frequency slew rate	Hz/sec	<1		
Output voltage distortion with 100% linear load	%	<1,5		

Output voltage distortion @ reference non linear load as for IEC/EN 62040-3	%	<5		
Load crest factor handled without derating the ups (Ipk/Irms)		(3:1)		
Phase angle precision with balanced loads		±1		
Phase angle precision with 100% unbalanced loads		±3		
Maximum overload capacity with respect to nominal load:				
For 10 minutes [2]	%	125		
For 1 minute [2]	%	150		
BATTERY				
Float Charging voltage @ 20°C	V/cell	2,27		
Boost Charging Voltage	V/cell	2,4 ÷ 2,5 V/cell		
EOD Voltage	V/cell	1,65 V/cell		
Float voltage temperature compensation	% per °C	-0.11		
DC ripple current in float mode for a 10 min autonomy as per VDE0510		<0.05 * C_{10}		
Recharge current setting range for 264 cells @ maximum output power (PF = 1)[3]	A	Up to 53	Up to 80	Up to 85
Float Voltage stability in steady state condition	%	≤1		
DC ripple voltage without battery	%	≤1		
Battery temperature range		Average 25°C		
STATIC BYPASS				
Nominal bypass voltage	V	480 3ph		
Nominal frequency	Hz	50 (60 selectable)		
Frequency range	%	±1 (2, 3, 4 selectable)		
Voltage range	%	±10 (5 to 15 selectable)		
SCR - I^2t @ Tvj=125°C; 10ms	kA^2s	2531	5600	
SCR - I_{TSM} @ Tvj=125°C; 10ms	A	22500	33500	
Bypass fuse [4]		1250A, aR class pre-arc I^2t 370kA2s total clearing I^2t 1350kA^2s (500V)	2000A, aR class pre-arc I^2t 950kA2s total clearing I^2t 3240kA^2s (500V)	
Maximum overload capacity with respect to nominal load: For 10 minutes [2] For 1 minutes [2]		125 150		
SYSTEM DATA				
Mechanical dimensions (WxDxH)	mm	2000x900x1950	2650x900x1950	
Net weight	kg	1550	2155	
Immunity to electical interference		IEC/EN 62040-2		
EMC Class		IEC/EN 62040-2 Class C3		
AC Power distribution		TT, TN-C, TN-S, IT		
Frame colour	RAL	7021		
Protection degree		IP20		
Max. relative humidity up to 35°C (non condensing)	%	0% to 95%, maximum non-condensing for operation and storage		

1) Valid for ambient temperature range 0÷25°C. For ambient temperatures greater than 25°C please contact the Technical Support
2) Value obtained at 25°C ambient and input voltage at nominal value. Depending on the load level in kW the maximum rectifier input current maybe reached, in this case a portion of the power to critical load is fed from the battery. Overload is a stressful condition for the semiconductors and an ageing factor, and therefore cannot be repetitively performed in a limited amount of time

3) Nominal input voltage and input frequency
4) These values can be considered valid also for the mains fuses



Notice

Read and heed the information provided on device labels.

BLANK PAGE

APPENDICES

Appendix A: Current Ratings

Tables A.1, A.2 and A3 below show the current ratings for input, output and battery.

Table A.1 Current ratings -rectifier input

UPS Rating (kVA)	Voltage (VAC)	Nominal Current (A)	Maximum Current (A)
800	480	999	1115
1000	480	1247	1390
1200	480	1499	1670

Table A.2 Current ratings - Bypass/Output

UPS Rating (kVA)	Voltage (VAC)	Nominal Current (A)	Maximum Current (A)
800	480	962	1058
1000	480	1203	1323
1200	480	1443	1587

Table A.3 Current ratings - Battery

UPS Rating (kVA)	Nominal (VDC)	Maximum Battery Current, EOD
		240 Cells
800	480	2073
1000	480	2588
1200	480	3110

1) Nominal rectifier AC input current (considered continuous) is based on full rated output load. Maximum current includes nominal input current and maximum battery recharge current (considered non-continuous).
2) For breaker coordination while the module is overloaded, see the current-versus-time values on the overload curves.
3) Nominal battery voltage is shown at 2.0 volts/cell.
4) Nominal AC output current (considered continuous) is based on full rated output load.
5) 5) Bypass AC input current (considered continuous) is based on the full rated output load.

NOTICE TO EUROPEAN UNION CUSTOMERS: DISPOSAL OF OLD APPLIANCES



This product has been supplied from an environmentally responsible manufacturer that complies with the Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/CE. The “crossed-out wheelie bin” symbol on the right is placed on this product to encourage you to recycle wherever possible. Please be environmentally responsible and recycle this product at your local recycling facility at its end of life. Do not dispose of this product as unsorted municipal waste. Follow local municipal waste ordinances for proper disposal provisions to reduce the environmental impact of waste electrical and electronic equipment (WEEE). For information regarding the scrapping of this equipment please contact your closest Vertiv Representative.



Vertiv.com | **Vertiv Infrastructure Limited,** George Curl Way, Southampton, SO18 2RY, VAT Number: GB188146827

Vertiv and the Vertiv logo are registered trademarks or trademarks of Vertiv Co. All other names and logos referred to are trade names, trademarks, or registered trademarks of their respective owners. © 2021 Vertiv Co. All rights reserved.