AC Power
For Business-Critical Continuity

Liebert NX™

User Manual

50 and 60 Hz, 30-200kVA, 400V

Liebert

EMERSON
Network Power

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Dear Customer:

Please allow us to congratulate you on choosing a Liebert manufactured Uninterruptible Power System.

If this is your first Liebert UPS, we cordially welcome you to a lifetime relationship of after-sales support designed to keep your Liebert UPS and your systems permanently at their peak performance.

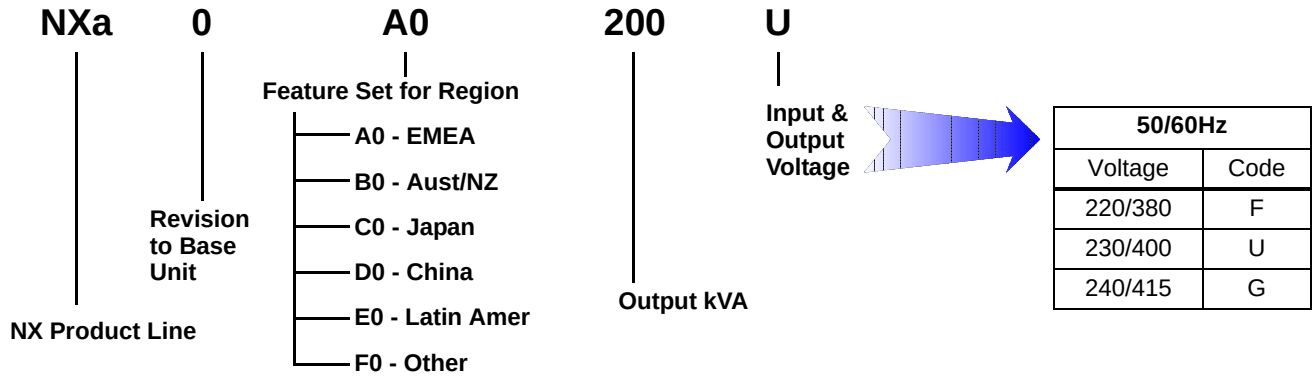
If you already own and use a Liebert UPS, then we are doubly honoured by your decision to continue this valued relationship.

Our philosophy is reflected in our mission statement “Keeping Business in Business,” and with this we strive to contribute to the growth & success of your business.

Please give us your valued feedback to help us realise our mission.

EMERSON NETWORK POWER

Figure i Model number nomenclature



UPS Single Module
Liebert NXa UPS module ratings: 30 & 40kVA (with internal battery) 60, 80, 100, 120, 140, 160, 200kVA (without internal battery)
Example: NXA0A0200U = 200kVA module for Europe and Middle East, 400V/230V output

Options	Model Identification	Note
Narrow battery cabinet	NXA0BCN	Specify: UPS kVA rating, 3, 4 or 5-shelves fuse or circuit breaker protection
Wide battery cabinet	NXA0BCW	
Battery Circuit Breaker Box	NXA0BCB	Specify UPS kVA rating
Battery Start Kit	NXA0UFXBB	—
Battery Ground Fault detection kit	NXA0UFXBGF	—
Battery temperature probe (for external battery)	NXA0UFXBTS	—
Maintenance bypass cabinet (separate bypass input)	NXA0MBX	Specify total system kVA
Transformer cabinet	NXA0TCX	Specify UPS kVA & I/O Voltage
Fan Redundancy kit	NXA0UFXRF	Specify UPS kVA rating
Seismic Anchor kit	NXA0UFXSAN	—
Bypass current sharing inductance	NXA0UFXBK	—
Dual bus control cable 05-10-15 metres	NXA0UFXD	Specify length in metres
Parallel control cable kit 05-10-15 metres	NXA0UFXP	Specify length in metres
Relay Card (On Bat, Bat Low, On Byp, Sum, UPS Fail) Relay Card 4 (4 sets On Bat, bat Low) Webbrowser/TCPIP/SNMP Card Jbus/Modbus Card	RELAYCARD-INT MULTIPORT 4 OCWEB-LB OC485CARD	Intellislot plug-in cards—3 slots available.
RAM - Remote Alarm Monitor	NXA0CFXRAM	Requires RELAYCARD-INT
Modem card	NXA0CFXMOD	—
Large Battery Cabinet	NXA0NBCL	—
Maintenance bypass cabinet (separate bypass input)	NXA0NMBX	—
Transformer cabinet	NXA0NTCX	—
Air Filter (One Filter)	NXA0UFXARF	—
Dual Bus Extension Kit 50-150 Meters	NXXXXMLBSKIT	(XXX: 050 or 150)- 'Specify Length in metres. Used for extension in length or dual bus arrangement between Nx and non-Nx sources'
Individual Battery Monitoring	BDS 40 or BDS 256	Specify number of blocks. Consult Emerson Network Power representatives for complete configuration

SAFETY PRECAUTIONS

This manual contains information concerning the installation and operation of this Emerson Network Power Liebert NX Uninterruptible Power System (UPS).

This manual should be read before commencing installation.

The UPS must be commissioned and serviced by an engineer approved by the manufacturer (or agent).

Failure to do so could result in personnel safety risk, equipment malfunction and invalidation of warranty.

The Liebert NX has been designed for Commercial/Industrial use only, and is not recommended for use in life support applications.

This is a low emission CLASS A Uninterruptible Power System (UPS) product. In a residential environment, this product may nevertheless cause radio interference, in which case, the user may be required to take additional measures.

Conformity and Standards

This equipment complies with CE directives 73/23 & 93/68 (LV Safety) and 89/336 (EMC), with Australia and New Zealand EMC Framework (C-Tick) and with the following product standards for Uninterruptible Power System (UPS).

- EN / IEC / AS 62040-1-1—General and safety requirements for use in operator access area
- EN / IEC / AS 62040-2—EMC requirements; Class A compliant
- EN / IEC / AS 62040-3—Performance requirements and test methods

For more details, see **10.0 - Technical Specifications**

Continued compliance requires installation in accordance with these instructions and the use of manufacturer approved accessories only.

WARNING

High Leakage Current

EARTH CONNECTION IS ESSENTIAL BEFORE CONNECTING THE INPUT SUPPLY.

Earth leakage current exceeds 3.5 mA and is less than 1000 mA for 30-80kVA, less than 2000mA for 100-120kVA. models and less than 2500mA for 140-200kVA models.

Transient and steady-state earth leakage currents, which may occur when starting the equipment, should be taken into account when selecting instantaneous RCCB or RCD devices.

Residual Current Circuit Breakers (RCCBs) must be selected sensitive to DC unidirectional pulses (class A) and insensitive to transient current pulses.

Note also that the earth leakage currents of the load will be carried by this RCCB or RCD.

This equipment must be earthed in accordance with the local electrical code of practice.

WARNING

Back-Feed Protection Notice

This UPS is fitted with a voltage-free contact closure signal for use with an external automatic disconnect device (supplied by others) to protect against back-feeding voltage into the bypass input. If this signal is not used by the installer, a label must be added at the external bypass input disconnect device to warn service personnel that the circuit is connected to a UPS.

The text to use is the following or equivalent:

ISOLATE THE UNINTERRUPTIBLE POWER SYSTEM BEFORE WORKING ON THIS CIRCUIT.

User-Serviceable Parts

All equipment maintenance and servicing procedures involving internal access requires the use of a tool and should be carried out only by trained personnel. There are no user-serviceable parts behind covers requiring a tool for removal.

This UPS is fully compliant with safety regulations for equipment located in an operator accessible area. Hazardous voltage is present within the UPS and battery enclosure but out of reach of non-service personnel. Contact with hazardous voltage is minimized by housing live parts behind safety panels that require a tool for their removal. No risk exists to any personnel when operating the equipment in the normal manner, following the recommended operating procedures.

Battery Voltage Exceeds 400VDC

All physical battery maintenance and servicing requires the use of a tool or a key and should be carried out only by trained personnel.

WARNING

Special care should be taken when working with the batteries associated with this equipment.

When connected together, the battery terminal voltage will exceed 400VDC and is potentially lethal.

Battery manufacturers supply details of the necessary precautions to be observed when working on, or in the vicinity of, a large bank of battery cells. These precautions should be followed implicitly at all times.

Attention should be paid to the recommendations concerning local environmental conditions and the provision of protective clothing, first aid and fire-fighting facilities.

1.0 SINGLE MODULE UPS INSTALLATION

1.1 Introduction

This following section describes the requirements that must be taken into account when planning the positioning and cabling of the Liebert NX uninterruptible power supply and related equipment.

This chapter is a guide to general procedures and practices that should be observed by the installing engineer. The particular conditions of each site will determine the applicability of such procedures.

WARNING

Professional Installation Required

Do not apply electrical power to the UPS equipment before being authorised to do so by the commissioning engineer.

The UPS equipment shall be installed by a qualified electrical tradesperson in accordance with the information contained in this manual. All equipment not referred to this manual is shipped with details of its own mechanical and electrical installation.

NOTE

Three-phase, 4-wire input supply required.

The standard Liebert NX UPS is suitable for connection to 3-phase, 4-wire (+ Earth) TN, TT and IT AC power distribution systems (IEC60364-3). Optional 3-wire to 4-wire conversion transformers are available. If it is used in IT AC power distribution systems, a 4-pole circuit breaker must be used on the input and refer to the relative IT Systems' standard

WARNING

Battery Hazards

Special care should be taken when working with the batteries associated with this equipment. When connected together, the battery terminal voltage will exceed 400VDC and is hazardous.

Eye protection should be worn to prevent injury from accidental electrical arcs.

Remove rings, watches and all other metal objects.

Use only tools with insulated handles.

Wear rubber gloves.

If a battery leaks electrolyte or is otherwise physically damaged, it must be replaced, stored in a container resistant to sulfuric acid and disposed of in accordance with local regulations.

If electrolyte comes into contact with the skin, the affected area should be washed immediately with water.

1.2 Preliminary Checks

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

1. Visually examine the UPS and battery equipment for transit damage, both internally and externally. Report any damage to the shipper immediately.
2. Verify that the correct equipment is being installed. The equipment supplied has an identification tag on the back of the main door reporting: the type, size and main calibration parameters of the UPS.

1.3 Location

1.3.1 UPS Room

The UPS and its internal battery is intended for indoor installation and should be located in an environment with clean air and with adequate ventilation to keep the ambient temperature within the specified operating range (see **Table 33**).

All models in the Liebert NX UPS range are air-cooled with the aid of internal fans. Cold air enters through ventilation grilles at the front of the cabinet for NXa 30-120kVA and through ventilation grilles located at the front and bottom of the cabinet for NXa 140-200kVA. Hot air is released through grilles at the top. Do not cover the ventilation openings.

If necessary to avoid room temperature build-up, install a system of room extractor fans. Optional air filters are available if the UPS is to operate in a dusty environment.

The UPS heat dissipation detailed in **Table 34** can be used as a guide for air conditioning sizing, depending on the selected mode of operation:

- Normal Mode (VFI SS 111 Double Conversion UPS)
- ECO Mode (VFD SS 311 Stand By UPS)

If in doubt use Normal Mode figures.

NOTE
The UPS is suitable for mounting on concrete or other non-combustible surface only.

1.3.2 External Battery Room

Batteries should be mounted in an environment where the temperature is consistent and even over the whole battery. Temperature is a major factor in determining the battery life and capacity. Typical battery manufacturer performance data are quoted for an operating temperature between 20 and 25°C (68 and 77°F). Operating above this range will reduce the battery life while operation below this range will reduce the battery capacity. In a normal installation the battery temperature is maintained between 15°C and 25°C (59 and 77°F). Keep batteries away from main heat sources or main air inlets etc.

Where the batteries are located externally to the main UPS cabinet, a battery protection device (e.g., fuses or circuit breakers) must be mounted as close as possible to the batteries themselves, and connected using the most direct route possible.

1.3.3 Storage

Should the equipment not be installed immediately, it must be stored in a room for protection against excessive humidity and or heat sources (see **Table 33**).

CAUTION
An unused battery must be recharged periodically per battery manufacturer recommendation. Temporarily connecting the UPS to a suitable AC supply mains and activating it for the time required for recharging the batteries can achieve this.

1.4 Positioning

The cabinet is mounted on four casters for ease of positioning and for moving short distances. Jacking feet are provided to prevent the UPS from moving once it has been wheeled to its final position.

For optimal design life, the place chosen must offer:

- Easy connection
- Enough space to easily work on the UPS
- Sufficient air exchange of enough to dispel heat produced by UPS
- Protection against atmospheric agents
- Protection against excessive humidity and very high heat sources
- Protection against dust
- Compliance with the current fire prevention requirements
- Operating environment temperature between 20°C and 25°C (68 and 77°F). The batteries are at maximum efficiency in this temperature range (see **Table 33**).

The UPS cabinet is constructed around a steel chassis with removable panels. The top and side panels are secured to the chassis by screws.

Access to the power terminals, auxiliary terminals blocks and power switches is from the front. Operational status and alarm information is provided through the front door operator control panel. Models 40kVA and below house both the power components and an internal battery. Cooling air enters in the front of the NXa 30-120kVA and the front and bottom of NXa 140-200kVA; it is exhausted out the top of each.

1.4.1 System Cabinets

A UPS may comprise a number of cabinets, depending on design requirements (e.g., UPS cabinet, external battery cabinet, external bypass cabinet). In general, all the Liebert cabinets used in a particular installation are of the same height and designed to be positioned side-by-side to form a matching array.

Refer to **5.0 - Installation Drawings** for assistance on positioning the cabinets described below.

1.4.2 30 to 40kVA UPS

The UPS consist of a single cabinet, which uses typically forty (40) 12V battery blocks, fitted internally and connected in series to provide a nominal battery voltage. The UPS may be shipped without the batteries fitted.

An extended battery option is available. This comprises a separate cabinet containing additional batteries that can be connected to the UPS to increase its battery run time. Battery cabinets and batteries are usually shipped separately.

1.4.3 60-200kVA UPS

The 60 to 200kVA consist of a single cabinet without any internal battery. Usually, with 60 to 200kVA UPS installations, the batteries are contained in a purpose-built battery cabinet, which sits alongside the main UPS equipment. Batteries are accessible in the external cabinet from the front, making it unnecessary to allow for side access.

1.4.4 Moving the Cabinets

WARNING

Ensure that any equipment used to move the UPS cabinet has sufficient lifting capacity.

The UPS is fitted with casters. Take care to prevent the NX from moving when unbolting the unit from its shipping pallet. Ensure that adequate personnel and lifting aids are available when removing the shipping pallet.

Ensure that the UPS weight is within the designated surface weight loading of any handling equipment. See **Table 35**.

UPS and optional cabinets (battery cabinets, top cable entry cabinets, etc.) can be handled by means of a forklift or similar equipment.

The UPS cabinet also can be moved short distances by its casters.

NOTE

Care must be taken when maneuvering units fitted with batteries. Keep such moves to a minimum.

1.4.5 Clearances

The Liebert NX has no ventilation grilles at either side of the UPS. To enable routine tightening of power terminations within the UPS, in addition to meeting any local regulations, Liebert recommends providing adequate clearance in the front of the equipment for unimpeded passage of personnel with the doors fully opened. It is important to leave 800mm (31.5") clearance above the UPS to permit adequate circulation of air coming out of the unit.

1.4.6 Access

The component layout of the UPS supports front and top access while servicing, diagnosing and repairing the UPS, thus reducing the space requirement for side and rear access.

1.4.7 Final Positioning

The UPS cabinets are fitted with casters on the base to allow ease of movement and positioning.

WARNING

Casters are strong enough for movement across even surfaces only. Caster failure could occur if they are subjected to shock loading.

When the equipment has been finally positioned, ensure the adjustable feet are set so that the UPS will remain stationary and stable.

1.4.8 Floor Anchoring

Diagrams in **5.0 - Installation Drawings** show the location of the holes in the base plate through which the equipment may be bolted to the floor. If the equipment is to be installed on a raised floor it should be mounted on a pedestal suitably designed to accept the equipment point loading.

1.4.9 Cable Entry

Cables can enter the Liebert NX UPS and battery cabinet from below. Cable entry is made possible by removing a blanking piece fitted at the bottom of equipment to reveal the cable entry hole.

Top Cable Entry—Optional

Optionally a top cable entry extension may be used. The cabinet extends the overall width of the UPS and permits connection of all incoming AC/DC power cables from above.

The top cable entry option is fitted on the side of the UPS cabinet and is supplied without side panels; the side cover from the UPS being used.

The cabinet with cables coming in from the top for the 30-40 kVA UPS must be positioned on the left side; the cabinet for the 60 to 200 kVA UPS can be positioned on either side.

This facilitates cable entry through the top metal panel after the appropriate cable entry holes have been cut.

NOTE

The top cable entry also includes the power connection cables between the cabinet and the UPS.

1.5 External Protective Devices

Circuit breakers or other protective devices must be installed in the AC supply, external to the UPS. This chapter provides guidelines for qualified installers who must have knowledge of local wiring practices pertaining to the equipment to be installed.

1.5.1 Rectifier and Bypass Input

Overcurrent protection must be installed at the distribution panel of the incoming main supply. The protection must discriminate with the power cables current capacity and with the overload capacity of the system (see **Table 38**). As a guideline, a thermomagnetic circuit breaker, with an IEC 60947-2 trip curve C (normal) for 125% of the current listed in **Table 1** is suitable.

Split-Bypass—If a split-bypass is used, install separate protective devices for the rectifier and for the bypass in the incoming mains distribution panel.

NOTE
Rectifier and bypass input sources must be referenced to the same neutral potential.

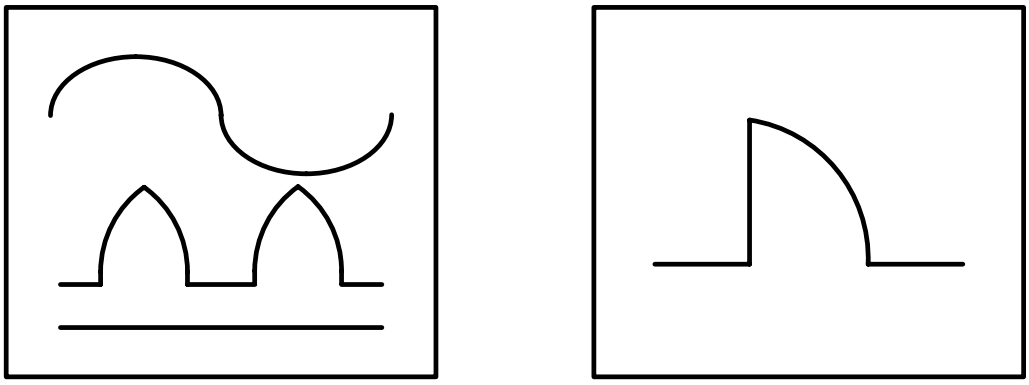
NOTE
For IT power systems, four-pole protective devices must be used, external to the UPS, both upstream of the input distribution panel and downstream (toward the load).

Earth Leakage (RCD)

Any residual current detector (RCD) installed upstream of the UPS input supply must be:

- sensitive to DC unidirectional pulses (Class A)
- insensitive to transient current pulses, and
- must have an average sensitivity, adjustable between 0.3 and 1A.

Figure 1 Residual current circuit breakers (RCCB) symbols



To avoid false alarms, earth leakage monitoring devices when used in systems with split-bypass input or when used in paralleled UPS configurations, must be located upstream of the common neutral sinking point. Alternatively, the device must monitor the combined four-wire rectifier and split-bypass input currents.

The residual earth current introduced by the RFI suppression filter inside the UPS is greater than 3.5mA, 1000mA for 30-80kVA, 2000mA for 100-120kVA models and less than 2500mA for 140-200kVA models. Liebert recommends verifying the selectivity with all other differential devices both upstream of the input distribution board and downstream (toward the load).

1.5.2 External Battery

The UPS and its associated batteries are protected against overcurrents through a DC compatible disconnect device.

1.5.3 UPS Output

Any external distribution board used for load distribution shall be fitted with protective devices that discriminate with those used at the bypass input to the UPS and with the UPS overload characteristics (see **Table 38**).

1.6 Power Cables

The cable design must comply with the voltages and currents provided in this section, follow local wiring practices and take into consideration the environmental conditions (temperature and physical support media).

For cable entry terminal, refer to **Figures 43**, **48**, **52** and **56**.

WARNING

Before starting the UPS, ensure that you are aware of the location and operation of the external isolators that connect the ups input/bypass supply to the mains distribution panel.

Check that these supplies are electrically isolated and post any necessary warning signs to prevent their inadvertent operation.

Table 1 Maximum steady state AC and DC currents

UPS RATING (kVA)	NOMINAL CURRENT: Amps							BUSBAR STUD SIZE			
	Input Mains with full battery recharge 3ph + N			Bypass/Output at full load 3ph + N			Battery at minimum battery voltage (400VDC)	Input/Output/ Bypass Cables		Battery Cables (Bolts)	Torque Load, Nm (lb/ft)
	380V	400V	415V	380V	400V	415V		Bolt	Ø holes		
30	50	47	45	46	43	42	64	M6	7	-	5 (1.12)
40	65	62	60	61	58	56	85				
60	97	92	88	91	86	83	128	M8	9	M10 Ø11	M8: 13 (2.9) M10: 26 (5.8)
80	128	122	117	121	115	111	170				
100	160	152	146	152	145	139	213	M10	11		
120	191	181	175	182	174	167	255				
140	222	211	204	212	201	194	298				
160	254	241	232	242	230	222	340				
200	317	301	290	303	288	277	426				

For terminal location – refer to **5.0 - Installation Drawings**

Table 2 Distance from floor to connection point on the equipment

UPS	Minimum Distance, mm (in)			
	UPS 30/40 kVA	UPS 60-80 kVA	UPS 100-120 kVA	UPS 140-200 kVA
Rectifier AC Input supply	350 (13.8)	305 (12)		324 (12.8)
Bypass AC Input supply	300 (11.8)	250 (9.8)		310 (12.2)
UPS Output AC	260 (10.2)	250 (9.8)		310 (12.2)
Battery Power	1030 (40.5)	230 (9)		360 (14.2)
Auxiliary cables: Monitor board (U2)	1320(52)		1500 (59)	
Communications	1070(42.1)		1250(49.2)	
Earth	350 (13.8)	275 (10.8)		338 (13.3)

WARNING

Failure to follow adequate earthing procedures may result in electromagnetic interference or in hazards involving electric shock and fire.

1.6.1 Cable Termination

NOTE
The operations described in this section must be performed by authorised electricians or qualified technical personnel. If you have any difficulties, do not hesitate to contact our Customer Service and Support Department. See the back page of this manual for contact information.

Once the equipment has been finally positioned and secured, connect the power cables as described in the following procedure.

Refer to the appropriate cable connection drawing in **5.0 - Installation Drawings**.

1. Verify that the UPS equipment is isolated from its external power source and all the UPS power isolators are open. Check that these supplies are electrically isolated and post any necessary warning signs to prevent their inadvertent operation.
2. Open the door to the UPS cabinet and remove one of the two protective cover to gain access to the desired connection bars.
   - the lower protective cover houses the 60-200kVA connection bars
   - the left protective cover houses the 30-40kVA connection bars

   The protective cover on the UPS cabinet of 60 to 200kVA models must be removed after the handles on the power isolators have been removed.
3. Connect the safety earth and any necessary bonding earth cables to the copper earth busbar located on the floor of the equipment below the power connections. All cabinets in the UPS must be connected to the user's ground connection.

NOTE
The earthing and neutral bonding arrangement must be in accordance with local and national codes of practice.

Identify and make power connections for incoming cables according to one of the two procedures below, depending on the type of installation.

Common Input Connections

4. For common bypass and rectifier inputs, connect the AC input supply cables between the mains distribution panel and the UPS input (U1-V1-W1-N terminals) and tighten the connections to 5Nm for M6 bolts, to 13Nm for M8 bolts or to 26Nm for M10 bolts. Ensure correct phase rotation.

Split-Bypass Connections

5. If a split-bypass configuration is used, connect the AC input supply cables to the rectifier input busbars (U1-V1-W1-N terminals) and the AC bypass supply cables to the bypass input (U3-V3-W3-N terminals) and tighten the connections to 5Nm for M6 bolts, to 13Nm for M8 bolts or to 26Nm (M10 bolt). Ensure correct phase rotation.

NOTE
For split-bypass operation, ensure that the linking busbars between bypass and rectifier input are removed.

The AC input and the AC bypass supplies must be referenced to the same neutral point.

Frequency Converter Mode

If a frequency converter configuration is used, connect the AC input supply cables to the rectifier input busbars (U1-V1-W1-N terminals). Torque to 5Nm for M6 bolts, to 13Nm for M8 bolts or to 26Nm (M10 bolt). Ensure correct phase rotation. There will not be any AC bypass supply cables to the bypass input (U3-V3-W3-N terminals) and tighten the connections.

NOTE
For frequency converter operation, ensure that the linking busbars between bypass and rectifier input are removed.

Output System Connections

6. Connect the system output cables between the UPS output (U2-V2-W2-N terminals) and the critical load and tighten the connections to 5Nm for M6 bolts, to 13Nm for M8 bolts or to 26Nm for M10 bolts. Ensure correct phase rotation.

External UPS Battery Connection (60kVA Models and Above, Option for 30-40kVA Models)

Connect the battery cables between the UPS terminals (+\-) and its associated battery circuit breaker. Observe the battery cable polarity.

NOTE
When connecting the cables between the battery extremities to the circuit breaker always connect the circuit breaker end of the cable first.

WARNING

If the load equipment will not be ready to accept power on the arrival of the commissioning engineer, ensure that the system output cables are safely isolated at their ends.

Internal UPS Battery Connection (30/40kVA only)

7. The battery consists of a series string connection of 5 x 8 (or 10) x 12V 6-cell battery blocks.
   a. Ensure that the eight (or 10) battery blocks in each tier (tray) are interconnected.
   b. Connect the positive and negative cables to the UPS terminals.
   c. Plug in the cables between the tiers.
   d. Ensure correct polarity battery string series connections (i.e., intertier and interblock connections are from positive to negative terminals.

WARNING

Hazardous Battery Terminal Voltage 480VDC

Ensure correct polarity of string end connections to the UPS terminals, i.e., positive to positive and negative to negative, but leave these UPS terminal cables disconnected until connection is authorised by the commissioning engineer.

Ensure correct polarity of string end connections to the battery circuit breaker and from the battery circuit breaker to the UPS terminals, i.e., positive to positive and negative to negative, but disconnect one or more battery cell links in each tier.

Do not reconnect these links and do not close the battery circuit breaker before authorised by the commissioning engineer.

8. Refit all protective covers removed for cable installation.

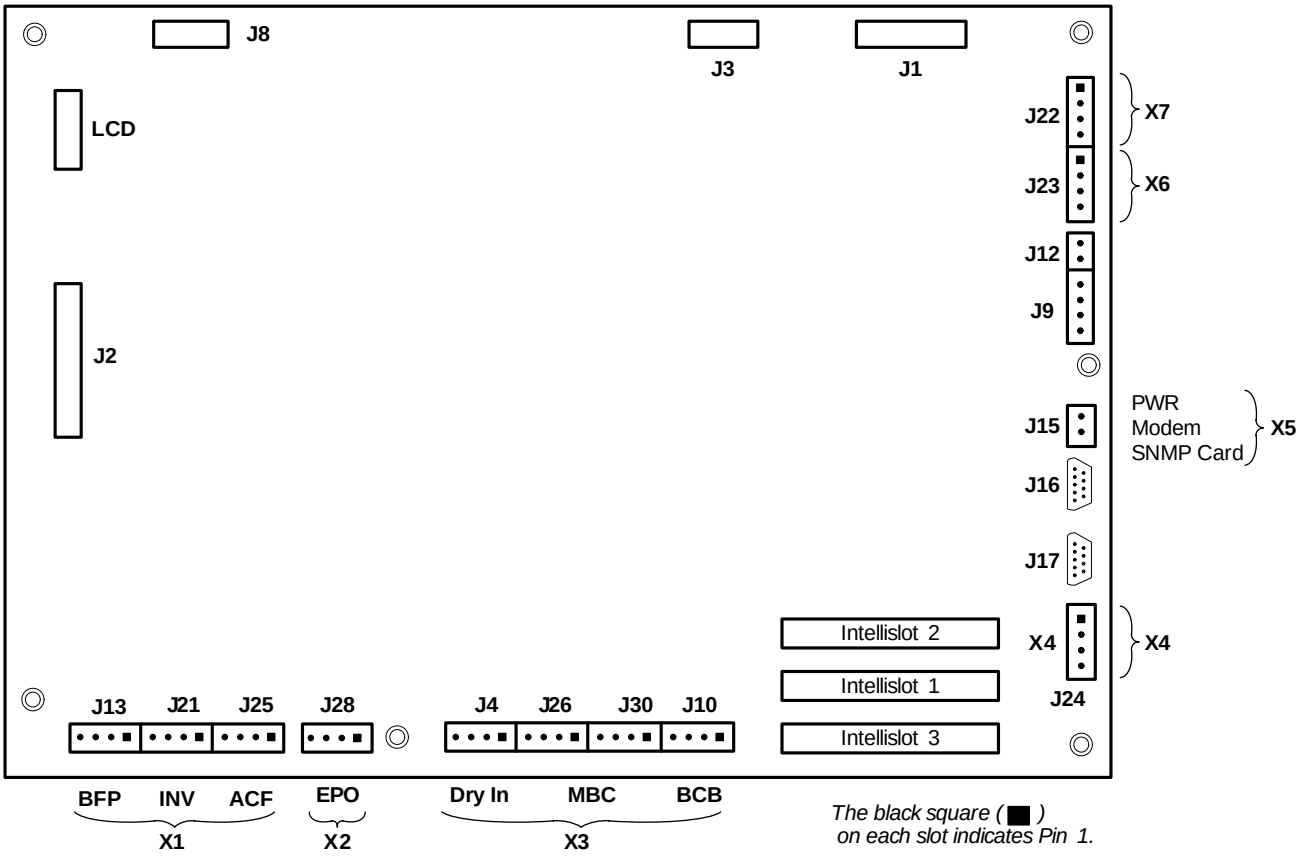
1.7 Control Cables and Communication

1.7.1 Monitor Board Features

Based on your site's specific needs, the UPS may require auxiliary connections to manage the battery system (external battery circuit breaker, battery temperature sensor), communicate with a personal computer or provide alarm signaling to external devices or for Remote Emergency Power Off (REPO). The monitor board, arranged for this purpose, is located on the rear of the operator access door. The main features are:

- Input and Output dry contacts signal (one pair of contacts of relay)
- Emergency Power Off control (EPO)
- Environmental parameter input interface
- User communication (for data setting and user background monitor)
- Intellislot™ interface
- Modem interface
- Temperature detect interface

Figure 2 Monitoring board (U2) auxiliary terminal block detail



1.8 Dry Contacts

The UPS provides input dry contacts and output dry contacts.

1.8.1 Input Dry Contacts

There are several input dry contacts at the X3 slot.

X3 Ancillary Control and Alarms

X3 IN DRY: Environmental, Battery Ground Fault and Generator Contacts

The UPS accepts external signalling from voltage-free (dry) contacts connected to finger-proof, push-in terminal X3 IN DRY. Subject to prior software programming, the signalling is accepted by the UPS when connection between the relevant terminal and the +12V terminal is altered. Cables connected to X3 IN DRY must be segregated from power circuits (for screening purposes), double insulated and of a typical 0.5 to 1mm^2 cross-section area for maximum runs between 25 and 50 meters (82-164 ft), respectively.

Figure 3 Input dry contacts

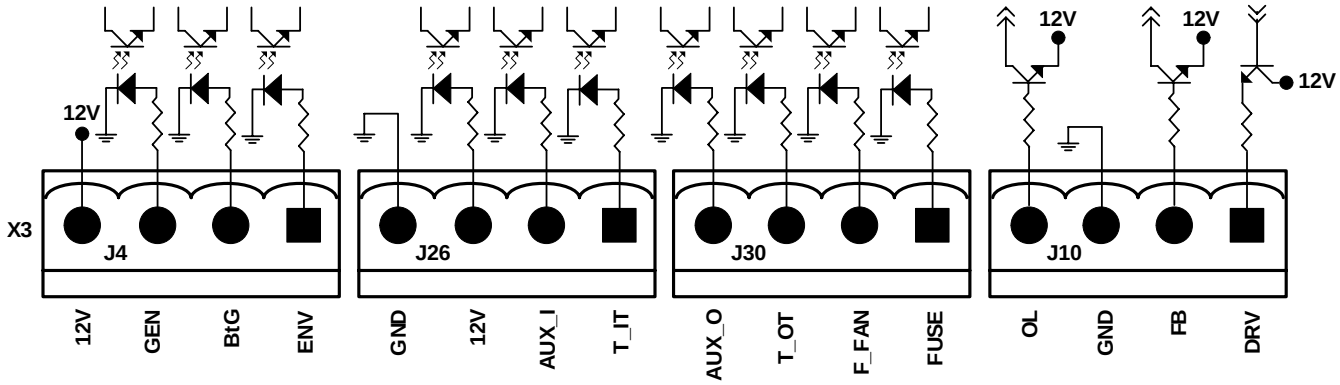


Table 3 Input dry contacts at X3

Position	Name	Description
J4.1	ENV[3]	Battery Room Alarm (NC)
J4.2	BtG	Battery Ground Fault Detection (NC)
J4.3	GEN[1,2]	On Generator (NO)
J4.4	+12V	+12V Power

1 - Must be configured by configuration software before becoming active.
2 - When activated, the charger current can be limited, via software, to a percentage of the full charger current (0-100%).
3 - Activating this feature turns the battery charger off.

NOTE
All auxiliary cables of terminal must be double-insulated. Wire should be 0.5-1.5mm^2 (16-20AWG) stranded for maximum runs between 25 and 50m (82-164 ft.) respectively.

1.8.2 Maintenance Bypass Cabinet Interface

J26 and J30 are the MBC interface.

Table 4 Maintenance bypass cabinet interface

Position	Name	Description
J26.1	T_IT[1]	Input transformer overtemperature (NC)
J26.2	AUX_I	Reserved
J26.3	+12V	+12V Power
J26.4	GND	Power Ground
J30.1	FUSE	Reserved
J30.2	F_FAN	Fan Fail Alarm (NC)
J30.3	T_OT[1]	Output Transformer Overtemperature (NC)
J30.4	AUX_O	Reserved

[1] - Must be configured by software before becoming active

NOTE
All auxiliary cables of terminal must be double-insulated. Wire should be 0.5-1.5mm^2 (16-20AWG) stranded for maximum runs between 25 and 50m (82-164 ft.) respectively.

1.8.3 External Circuit-Breaker Interface

J10 is the interface to any external battery circuit breaker (BCB).

Table 5 External circuit-breaker interface

Position	Name	Description
J10.1	DRV	BCB Driver Signal - Output (N.O.)
J10.2	FB	BCB Contact State - Input (N.O.)
J10.3	GND	Power Ground
J10.4	OL	BCB On-Line - Input - This pin will become active when BCB interface is connected. (N.O.)

NOTE
All auxiliary cables of terminal must be double insulated. Wire should be 0.5-1.5mm^2 (16-20AWG) stranded for maximum runs between 25 and 50 meters (82-164ft.) respectively.

1.8.4 Output Dry Contacts

There are three output dry contact relays at the X1 slot (see **Figure 4** and **Table 6**)

NOTE

All auxiliary cables of terminal must be double-insulated. Wire should be 0.5-1.5mm^2 (16-20AWG) stranded for maximum runs between 25 and 50m (82-164 ft.) respectively.

Figure 4 Output dry contacts and EPO wiring for firmware before M162

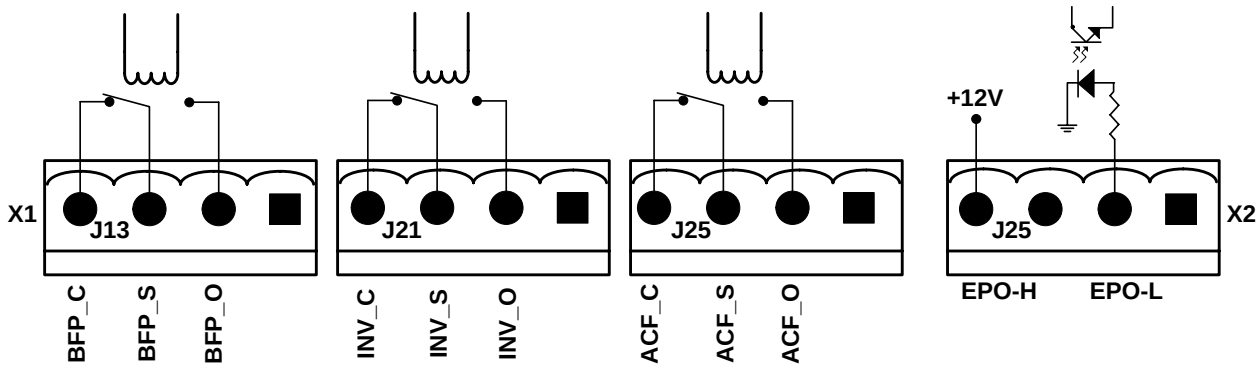
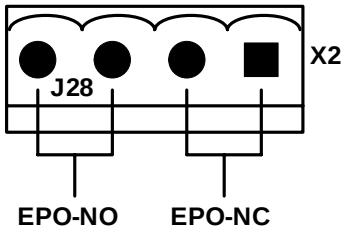


Table 6 Output dry contact relays for firmware before M162

Position	Name	Description
J13.2	BFP_O	Bypass feedback protection relay; normally open. Closed when bypass SCR is shorted.
J13.3	BFP_S	Bypass feedback protection relay center
J13.4	BFP_C	Bypass feedback protection relay; normally closed. Open when bypass SCR is shorted.
J21.2	INV_O	Inverter mode relay; normally open. Closed when UPS is in inverter mode.
J21.3	INV_S	Inverter mode relay center
J21.4	INV_C	Inverter mode relay; normally closed. Open when UPS is in inverter mode.
J25.2	ACF_O	Main input fault relay; normally open. Closed when main input is in fault.
J25.3	ACF_S	Main input fault relay center
J25.4	ACF_C	Main input fault relay; normally closed. Open when main input is in fault.

Figure 5 EPO wiring for firmware M200 or later



1.8.5 Emergency Power Off Input

The UPS has an Emergency Power Off (EPO) function that operates by a button on the control panel or by a remote contact provided by the user. The EPO button is under a hinged, clear plastic shield.

The X2 slot, shown in **Figure 4**, is the remote EPO input interface. The EPO has an NO/NC contact point that becomes active when shorting terminals X2: 3 and 4 or open terminal connection X2: 2 and 1

If an external emergency stop facility is required, it is connected terminals X2: 1&2 or X2: 3&4 of the auxiliary terminal block (X2). It also is connected to the normally open or normally closed remote stop

switch between these two terminals using shielded cable (see **Figure 4** and **Table 7**). If this function is not used, terminals X2: 3&4 must be opened and X2: 1&2 must be closed.

Table 7 EPO input contact relays

Position	Name	Description
J28.1	EPO_NC	EPO Activated when opened to J28.2
J28.2	EPO_NC	EPO Activated when opened to J28.1
J28.3	EPO_NO	EPO Activated when shorted to J28.4
J28.4	EPO_NO	EPO Activated when shorted to J28.3

NOTE
The emergency stop action within the UPS shuts down the rectifier, inverter and static bypass. It does not internally disconnect the input power supply. To disconnect ALL power to the UPS, open the upstream feeder breaker(s) when the remote EPO is activated.

NOTE
Normally closed EPO – X2: 1,2, these terminals are supplied factory-linked on the monitor board and must remain installed if using NC contacts.

NOTE
All auxiliary cables of terminal must be double insulated. Wire should be 0.5-1.5mm^2 (16-20AWG) stranded for maximum runs between 25 and 50 meters (82-164ft.) respectively.

X5: Auxiliary DC Power Output

Auxiliary DC power for modem or external SNMP card. The voltage is between 9V to 12V. The maximum current is 500mA.

X6: Analog Input Interface

Two analog signal channels with an input range is from 0 to +12V. The precision of detection is ÷3%.

- X6 pin 1: Not used
- X6 pin 2: +12V
- X6 pin 3: ENV-T – environment temperature detection
- X6 pin 4: GND

X7: External Battery Temperature Detector Interface

Interface for TMP12Z temperature detector, normally connected to an external battery cabinet (see **Figure 26**).

Pin reference:

- X7 pin 1: Not used
- X7 pin 2: +12V (Power supply for Temperature Monitoring Probe)
- X7 pin 3: BAT-T (Battery Temperature signal)
- X7 pin 4: GND

Serial Ports RS232-1 and RS232-2

RS232-1 provides serial data and is intended for direct use with Liebert MultiLink monitoring and server shutdown software.

RS232-2 provides serial data and is intended for use by authorized commissioning and service personnel.

These serial ports are shared with the optional Web browser, SNMP, ModBus and relay cards. Refer to **Table 31** regarding compatibility of simultaneous use.

Intellislot Web Browser, SNMP, ModBus and Relay Cards Interface

There are three interface slots available for optional Web browser, SNMP, ModBus and Relay cards as illustrated in **9.0 - Options—For Assembly Inside the UPS Cabinet**.

1.8.6 External Bypass Switch Interlock

EXT-Maint X3-1&2 on UPS Parallel Board M3 (leave open if no external bypass switch is used)

Provides external maintenance bypass interlock protection for the UPS. Short circuit means external bypass closed.

EXT-Out (X3-3&4) on UPS Parallel Board (leave shorted if no external output switch is used). Provides external output interlock protection for paralleled UPS modules. Short circuit means external output switch closed.

NOTE
UPS Parallel Board M3 is located behind protective covers accessible after opening the UPS front door—removal of this barrier requires the use of a tool and is restricted to service personnel.

NOTE
Jumper JP1 (located next to X3) needs to be removed for X3:3&4 to work properly.

2.0 BATTERY INSTALLATION

2.1 Introduction

The UPS battery bank consists of battery blocks connected in series to provide a D.C. string voltage as required by the UPS converter. The 'AUTONOMY TIME' (the time during which the battery can maintain supply to the load in the event of a mains failure) is limited by the ampere-hour capacity of the battery blocks and in some cases this results in several strings being connected in parallel.

The NX 30-40kVA has internal batteries, but longer run time is available by using an external battery cabinet.

The battery cabinet will be supplied in one of the following forms:

1. Complete installation, comprising the battery cabinet, batteries and protective device.
2. Battery cabinets and protective device only—batteries supplied by others
3. Battery cabinet only—batteries and circuit breaker supplied by others.

NOTE
30kVA to 40kVA UPS models contain an internal battery compartment that can accommodate up to 42 blocks 24 Ah / 12V batteries.

The battery bank may be disconnected from the UPS for maintenance or service. The circuit breaker can be switched ON or OFF manually and further battery isolation control is achieved through the use of either a battery circuit-breaker undervoltage coil or through an automatic contactor inside the UPS.

2.2 Safety

Special care should be taken when working with the batteries associated with the Liebert NX UPS system. When all the cells are connected together, the battery terminal voltage is potentially hazardous. The battery installation must be segregated from all but appropriately qualified maintenance personnel by locating the cells in a key-lockable cabinet or in a purpose-designed, dedicated battery room.

NOTE

Full safety instructions concerning the use and maintenance of UPS batteries are provided in the appropriate battery manufacturers manuals. The battery safety information contained in this section relates to key considerations that must be taken into account during the installation design process and might affect the design outcome depending on localised conditions.

WARNING

Hazardous battery voltage present behind covers

No user-serviceable parts are located behind covers that require a tool for their removal. Only qualified service personnel are authorised to remove such covers.

When using internal batteries in 30 and 40kVA units, the batteries are always connected through power fuses to the UPS and to the segregated terminal bars available for connection to an external battery.

Isolate any internal battery connections before attempting to access the segregated terminal bars available for connection to an external battery.

The following general battery safety precautions and warnings should be observed at all times:

- A battery can present risk of electric shock or burn from high- short-circuit currents.
- The full nominal string voltage, when the battery blocks are interconnected, is 480VDC, which is hazardous
- Only qualified personnel should install or service batteries.
- Eye protection should be worn to prevent injury from electrical arcs.
- Remove rings, watches, necklaces, bracelets and all other metal objects.
- Use only tools with insulated handles.
- Wear rubber gloves and a rubber apron when handling batteries.
- If a battery leaks electrolyte or is otherwise damaged, it should be placed in a container resistant to sulfuric acid and disposed of in accordance with local regulations.
- If electrolyte comes into contact with the skin the affected area should be washed immediately with plenty of clean water.
- Batteries must always be disposed of according to local environmental laws.
- When replacing batteries, use the same number and type that were originally fitted.
- Disconnect charging source before connecting or disconnecting battery terminals.
- Determine whether the battery is inadvertently grounded. If it is inadvertently grounded, remove the source of the ground. Contact with any part of a grounded battery can result in electrical shock.

2.3 Battery Cabinet

2.3.1 Introduction

This cabinet can also be used in conjunction additional cabinets, to provide the necessary accommodation required by the larger cells associated with system's having a long autonomy time.

Where two (or more) cabinets are used they are positioned alongside each other and secured and bonded together. If the cabinet(s) is located immediately adjacent to the main UPS equipment the two units are bolted together.

2.3.2 Temperature Considerations

Valve-regulated, lead acid battery cells are sensitive to ambient temperature and should be operated between 15°C and 25°C (59-77°F). Battery capacity is increased by 1% for every 1°C (2°F) increase in temperature up to 25°C (77°F). Battery life is reduced at temperatures above 25°C (77°F).

When batteries are mounted in the same room as the UPS unit, it is the battery that dictates the designed maximum ambient temperature, not the UPS. — i.e. in the case of valve-regulated cells, the ambient room temperature should be kept between 15°C and 25°C (59-77°F), and **not** between 0°C and 40°C (32-104°F) (which is the specified main equipment operating temperature range). Temperature deviations are permissible for short periods, provided the average temperature does not exceed 25°C (77°F).

2.3.3 Dimensions

The external dimensions are shown in **Table 8**. These are the same height and depth as the UPS module and provide a matching appearance when bolted together. All cabinets are fitted with doors, which must be fully opened in order to fit or remove the batteries. The door swing must therefore be taken into consideration when planning the positioning of the cabinets.

2.3.4 Weight

The unladen weight is shown below in **Table 8**. When designing the battery installation the weight of the batteries and cables must be added to the unladen weight. This is particularly important when placing the NX on a raised floor.

Table 8 Dimensions and weight

Model	UPS Ratings	Rated Service Current (In)	Rated Uninterrupted Current (IU)	External Cabinet WxDxH, mm (in)	Cabinet Weight Without Batteries, kg (lb)
Narrow Cabinet	30kVA 40kVA 60kVA 80kVA	125A 200A	160A 250A	828x825x1600 (32.6x32.4x63)	200 (441)
Wide Cabinet	30kVA 40kVA 60kVA 80kVA	125A 200A	160A 250A	1490x825x1600 (58.7x32.4x63)	270 (595)
Large Cabinet	100kVA 120kVA 140kVA 160kVA 200kVA	400A 500A	400A 500A	1490x825x1800 (58.7x32.4x76.9)	305 (672)

2.3.5 Circuit Breaker Features

In 30 to 40kVA models fitted with internal battery and in all models fitted with a Battery Start kit, the UPS is fitted with an internal contactor for automatic connection and disconnection of the batteries. External battery banks connected to such models generally are protected by a standard battery circuit breaker (with status contacts and without undervoltage trip coil). Refer to **2.5 - Battery Control** for details.

When no internal contactor for automatic disconnection is installed in the UPS module, the external battery disconnection is performed by fitting a Circuit Breaker Controller Board and an undervoltage coil to the battery circuit breaker.

The circuit breaker can then be manually closed once the DC busbar is above the 'low battery; trip voltage. Once closed, the circuit breaker can be opened manually at any time and is tripped automatically by the UPS module following certain fault occurrences, an emergency power off command or if low/high DC busbar voltage is detected. Refer to **2.5 - Battery Control** for details.

2.3.6 Moving the Battery Cabinets

WARNING

Ensure any lifting equipment used in moving the cabinet has sufficient lifting capacity.

Ensure that the weight is within the designated surface weight loading of any handling equipment. See **Table 8** for weight details.

Battery cabinets can be handled by means of a fork lift or similar equipment.

NOTE

Care must be taken when maneuvering units fitted with batteries. Keep such moves to a minimum.

When the equipment has been finally positioned ensure the adjustable feet are set so that the battery cabinet will remain stationary and stable.

2.3.7 Cable Entry

Cables enter the battery cabinet from either the top or the bottom. Cable entry is made possible by removing a blanking piece fitted at the bottom to reveal the cable entry hole.

2.3.8 General Arrangement Drawings

Refer to **Figures 6** through **10** for general arrangement of battery cabinet models.

Figure 6 Narrow battery cabinet with top and bottom cable entry locations

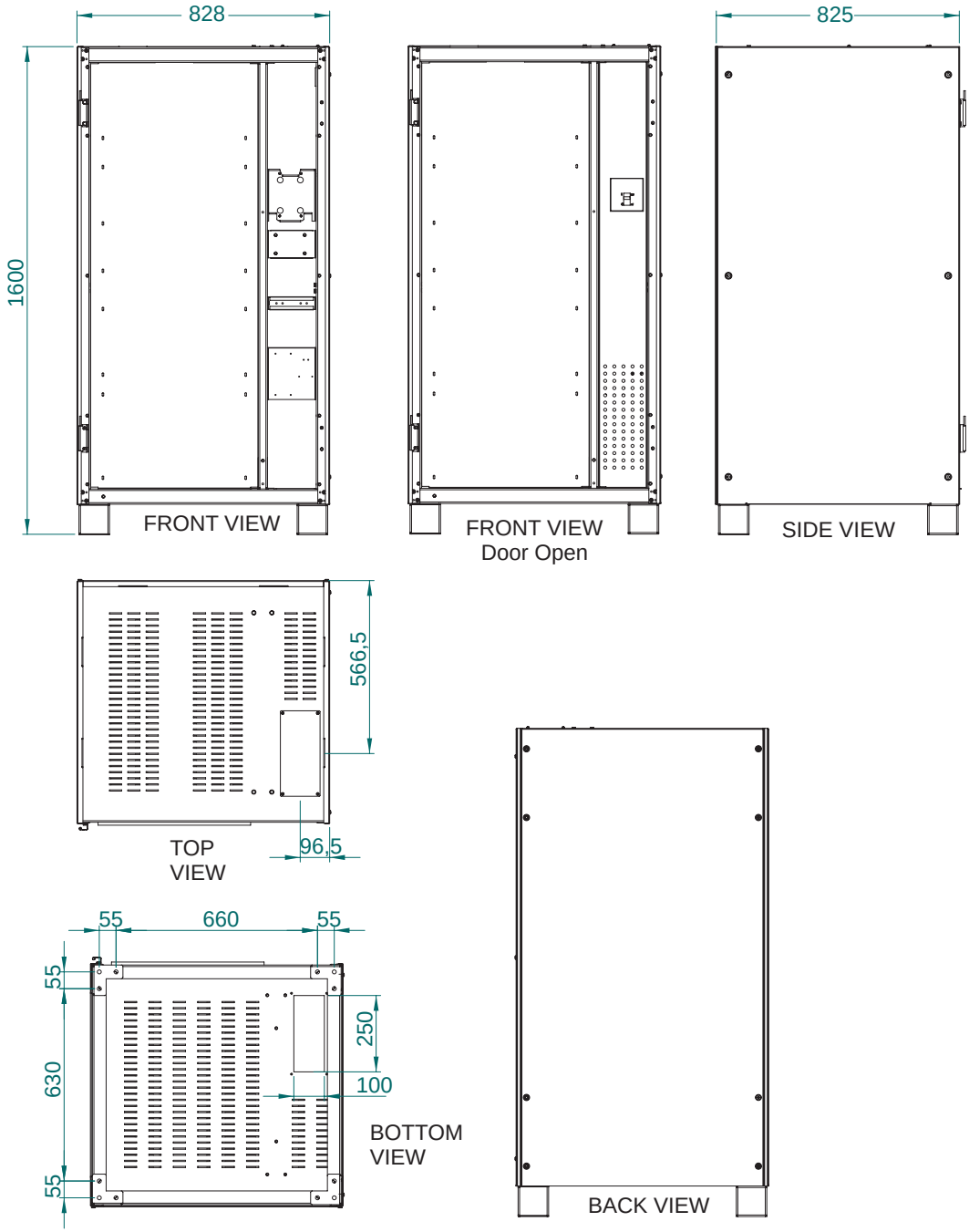


Figure 7 Narrow battery cabinet with top cable entry location

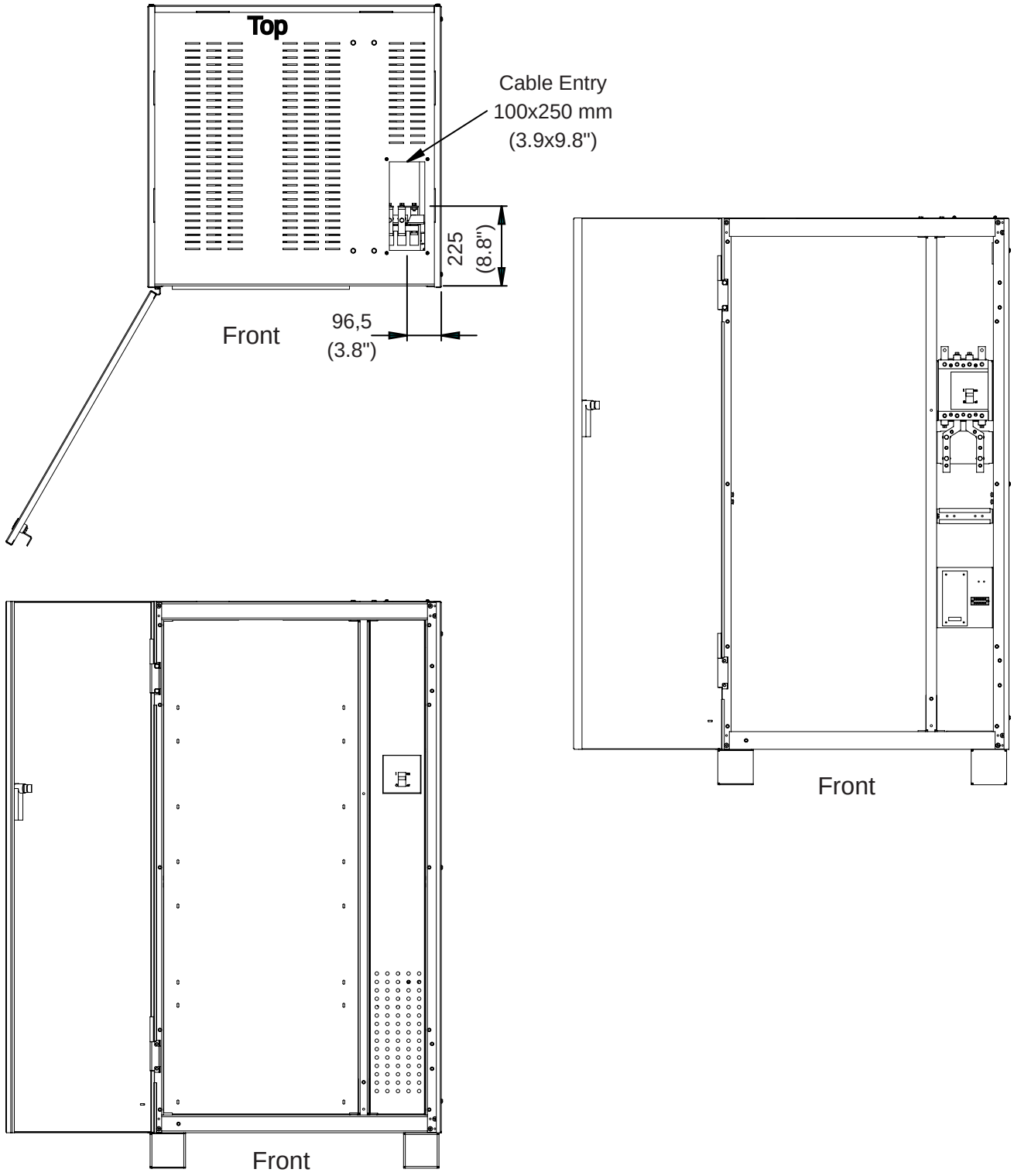


Figure 8 Wide battery cabinet with top and bottom cable entry locations

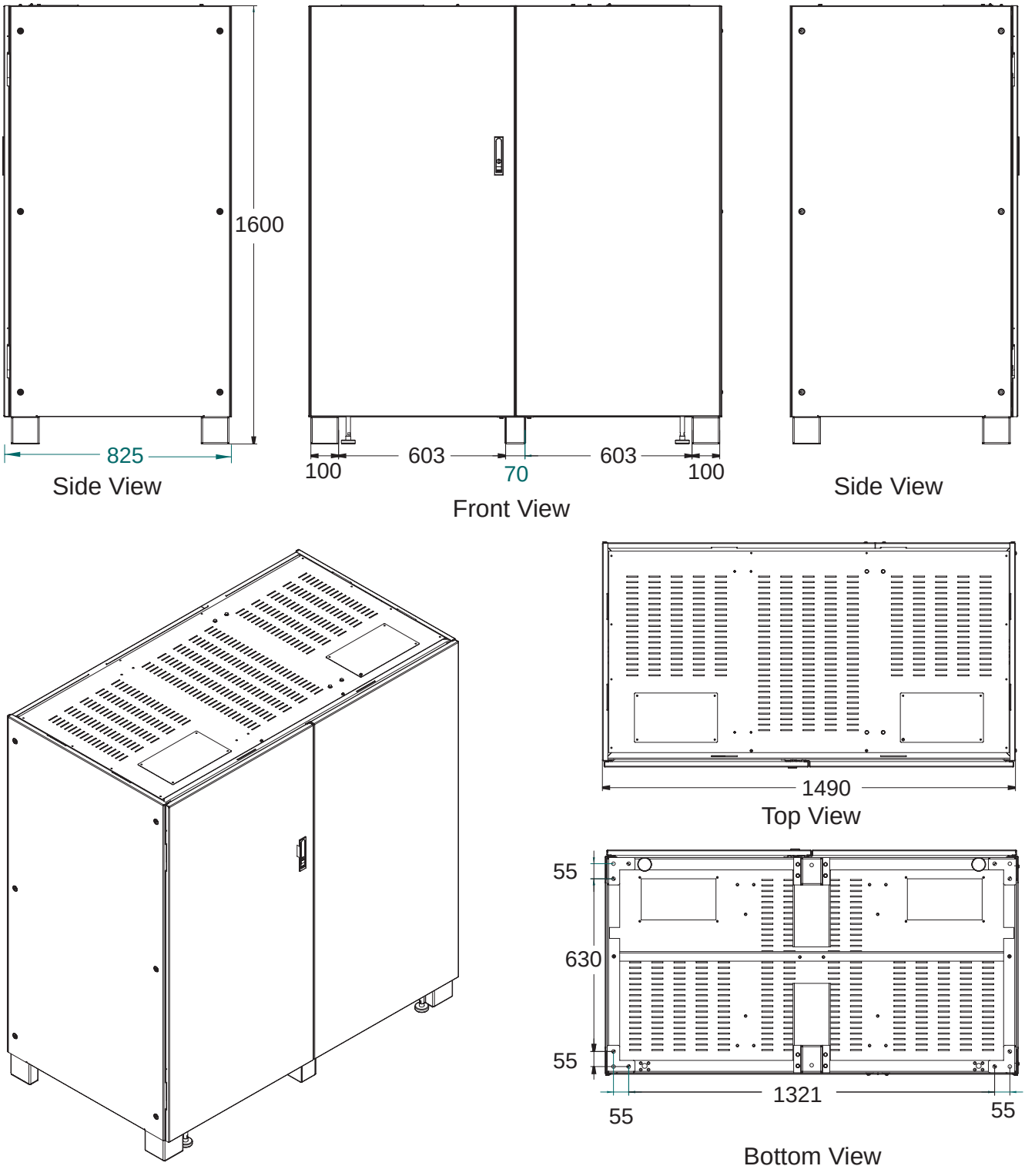
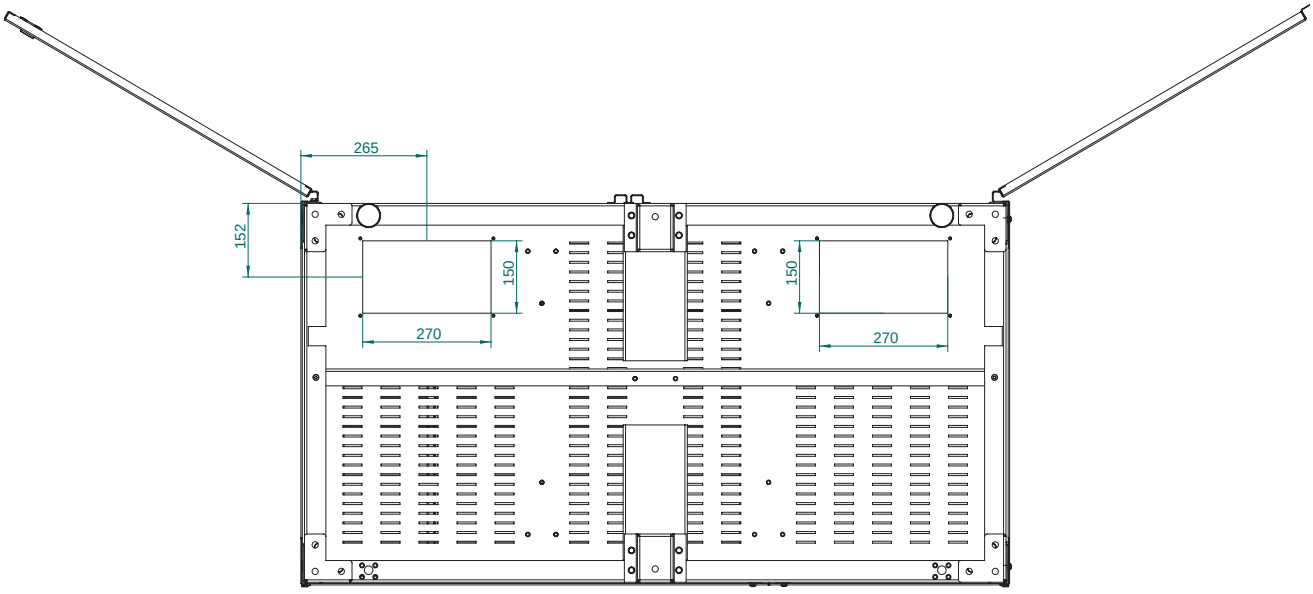
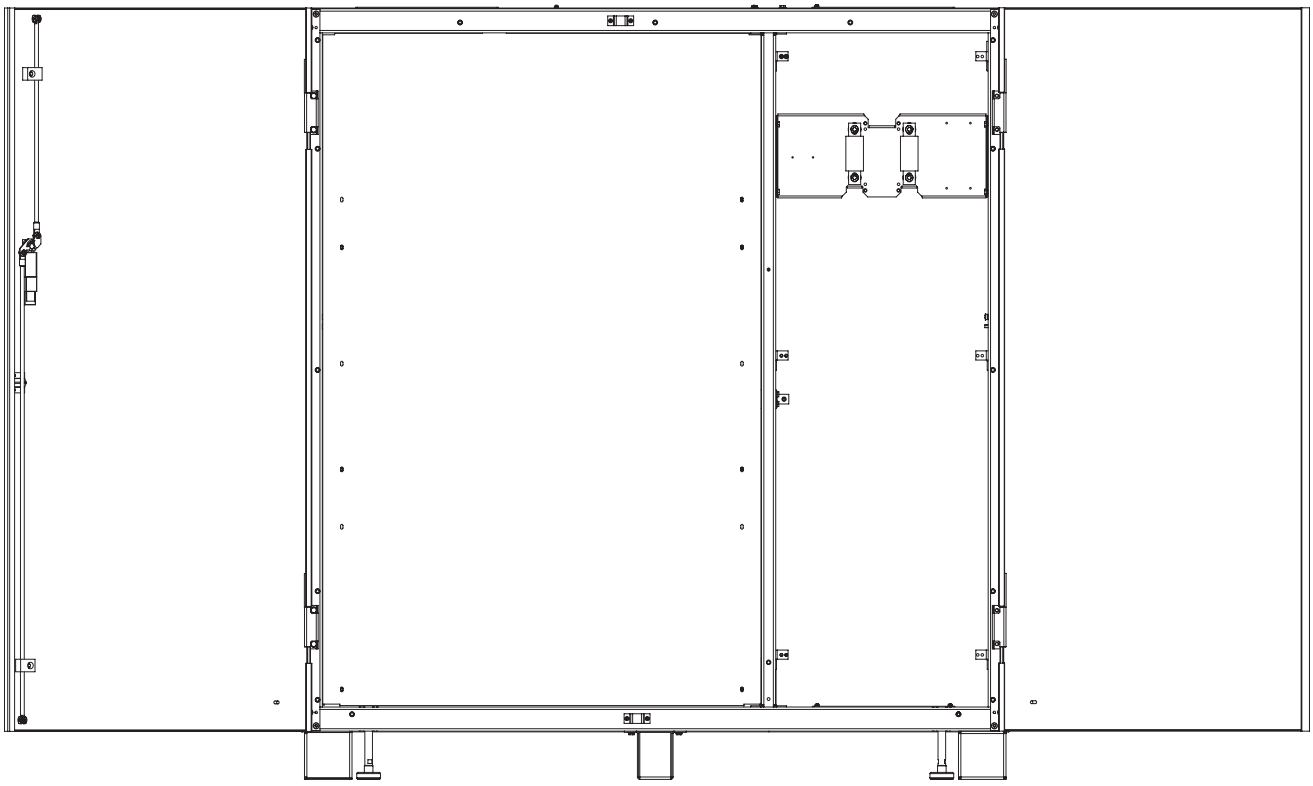


Figure 9 Wide battery cabinet with bottom cable entry location



Bottom View



Front View

Figure 10 Wide battery cabinet with fuse or optional circuit breaker locations

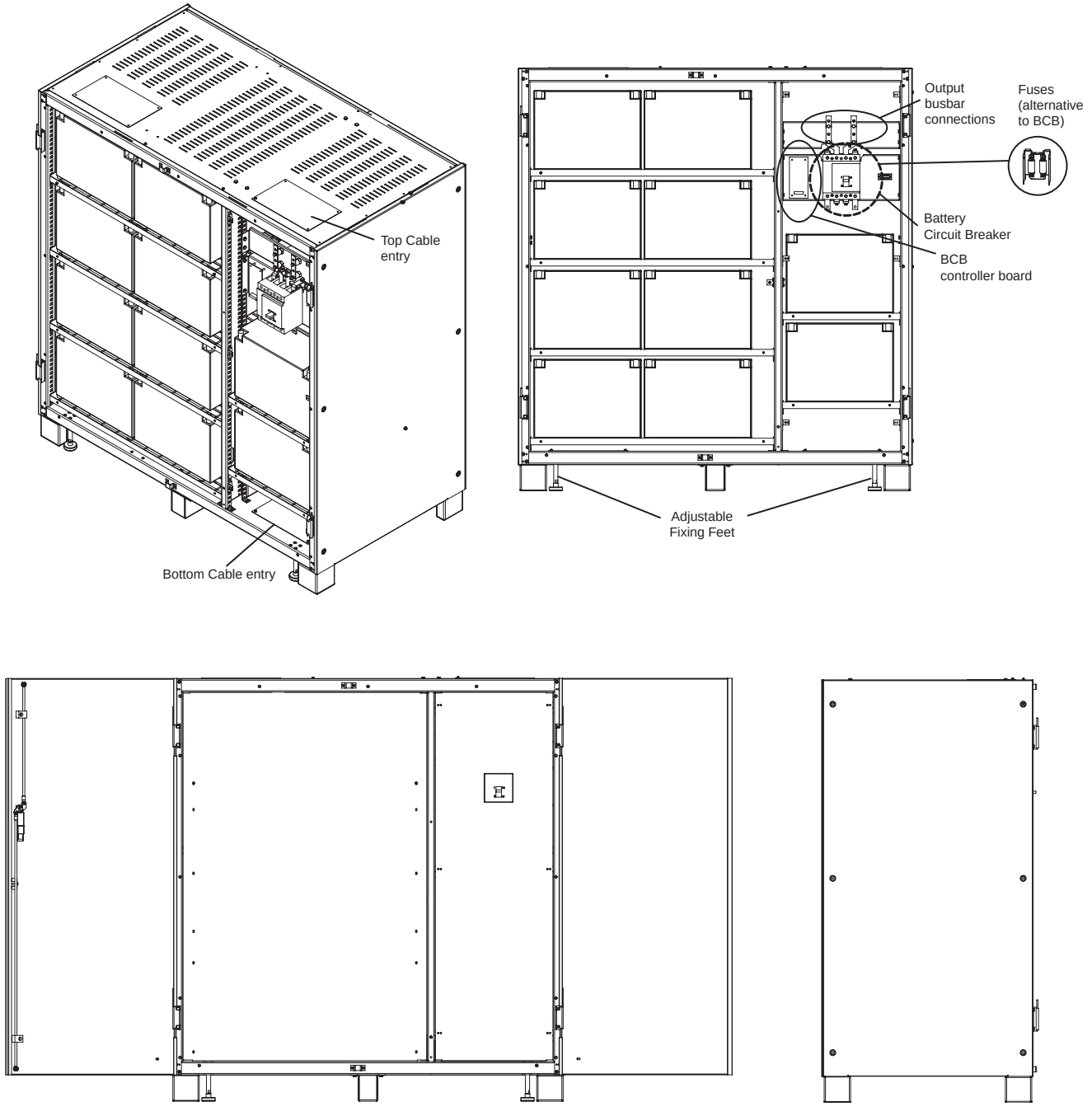


Figure 11 Large battery cabinet dimensions

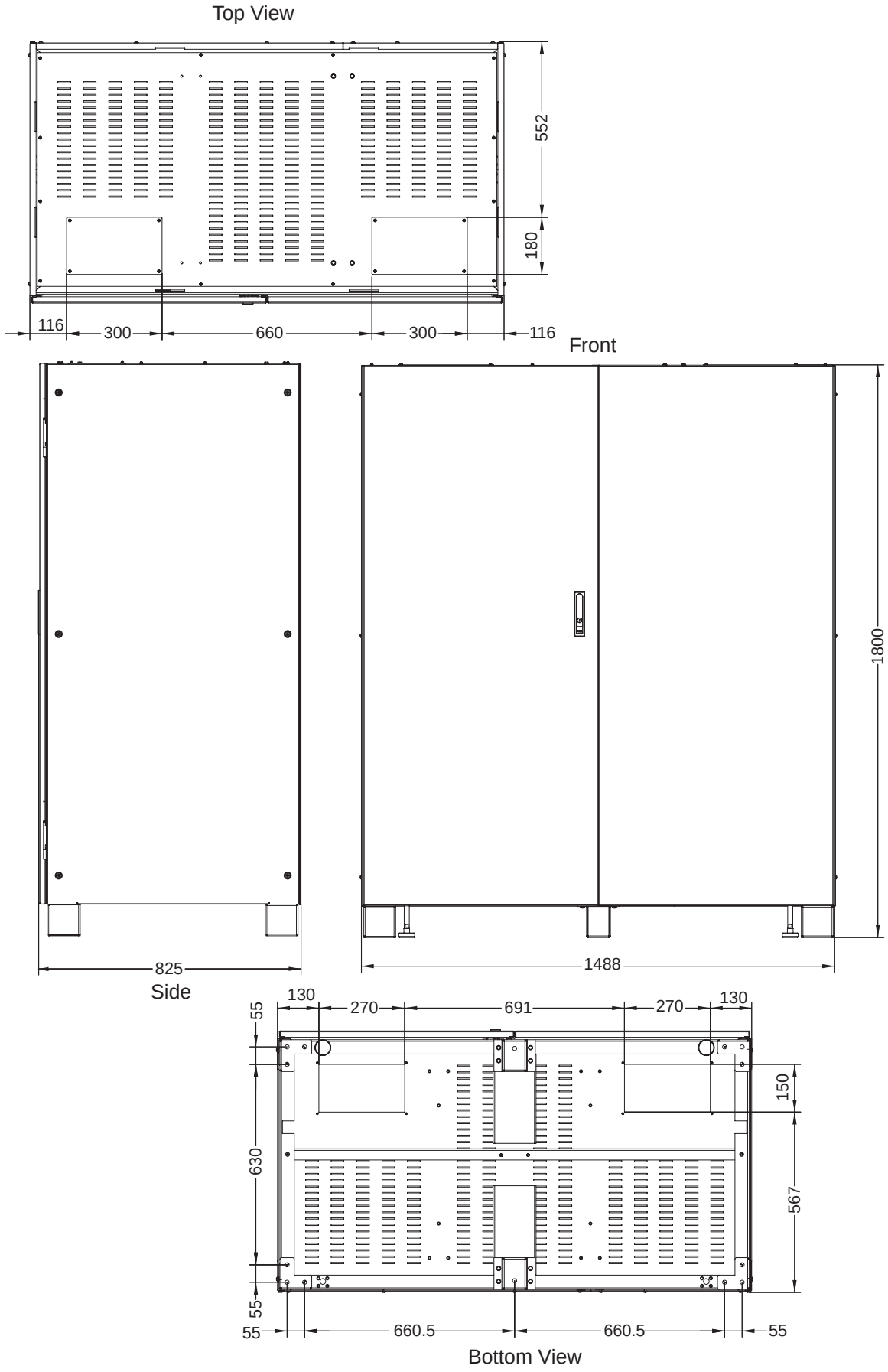
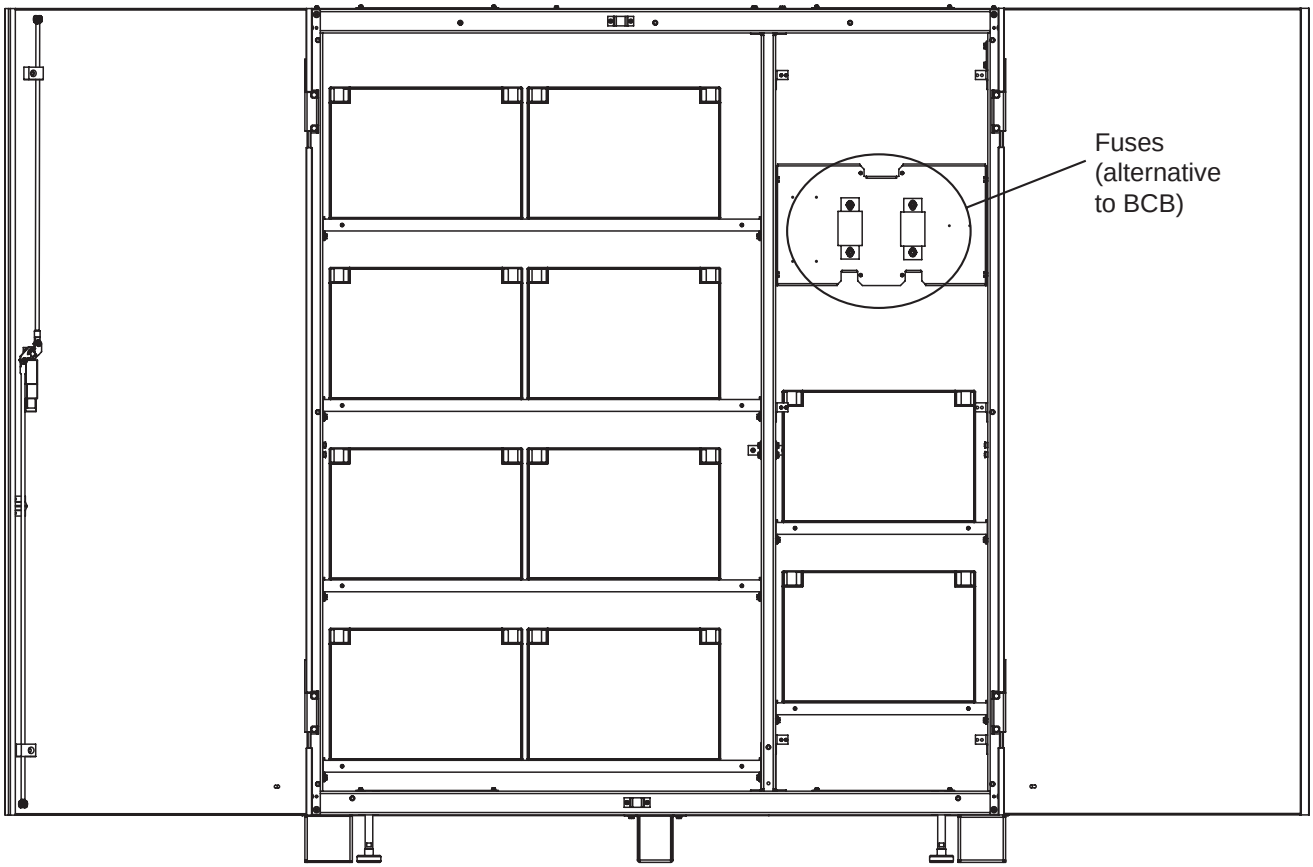


Figure 12 Large battery cabinet with fuse or optional circuit breaker locations



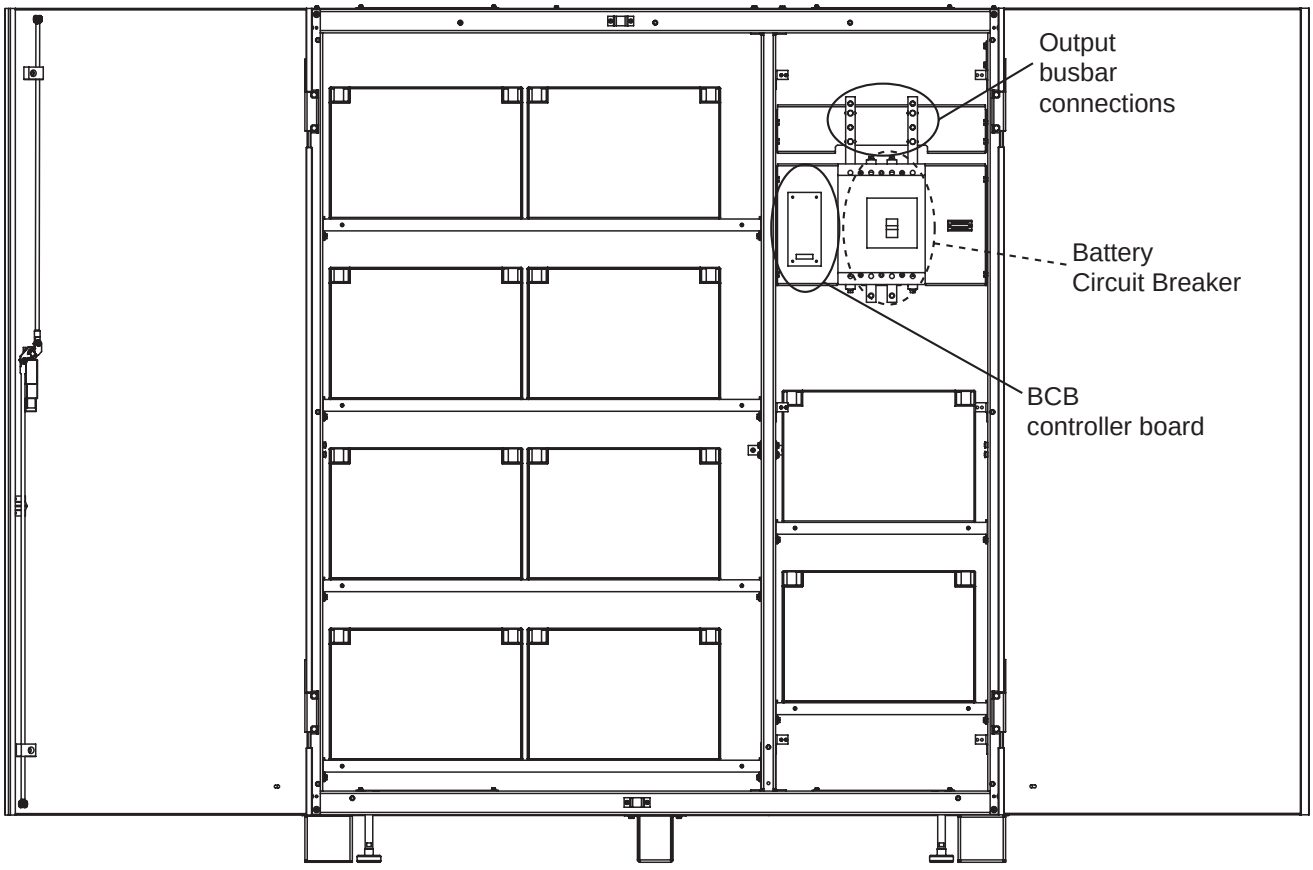


Figure 13 SENXA0NBCN4LCB.eps

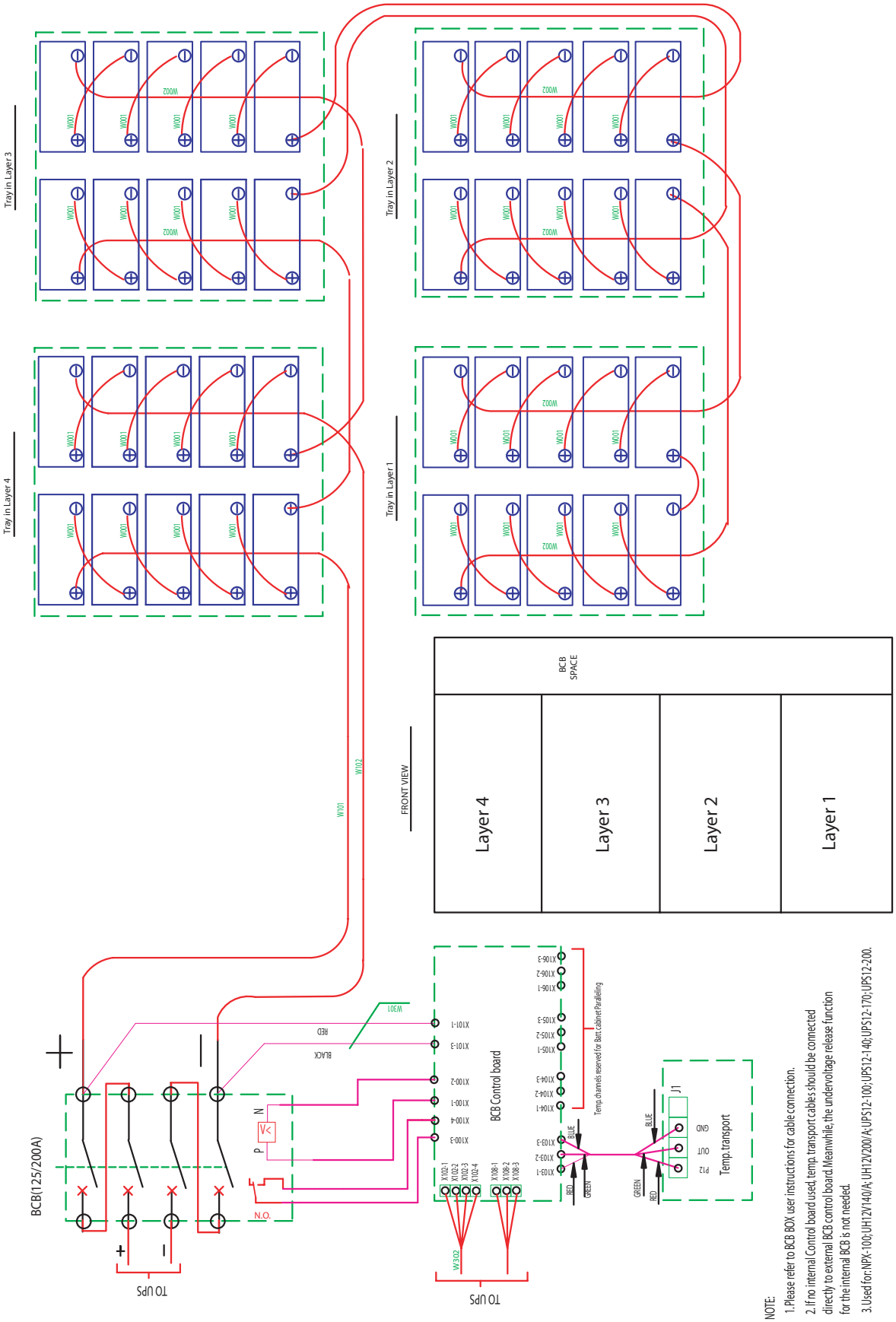


Figure 14 SENXA0NBCN4LF

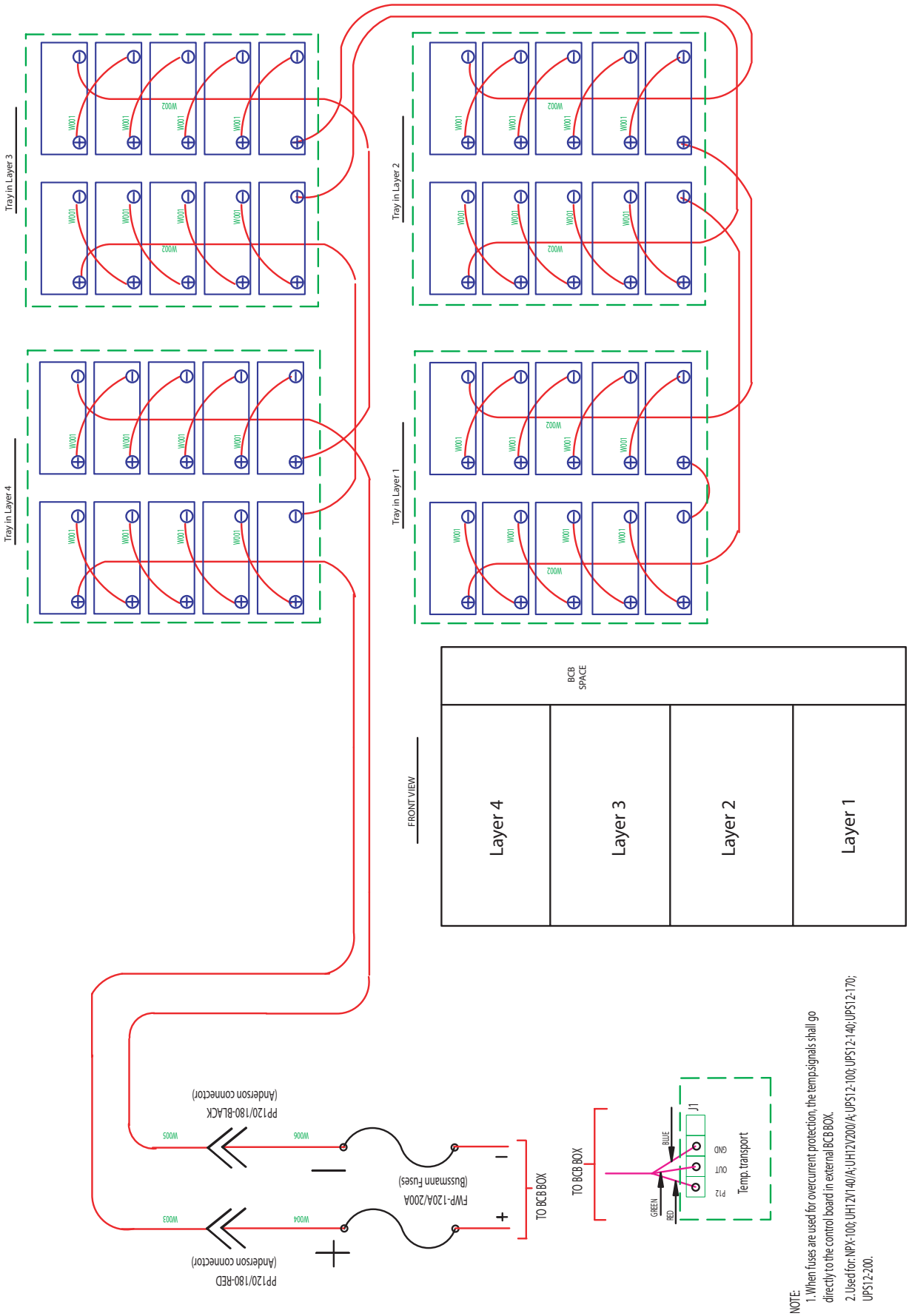


Figure 15 SENXA0NBCN5LCB

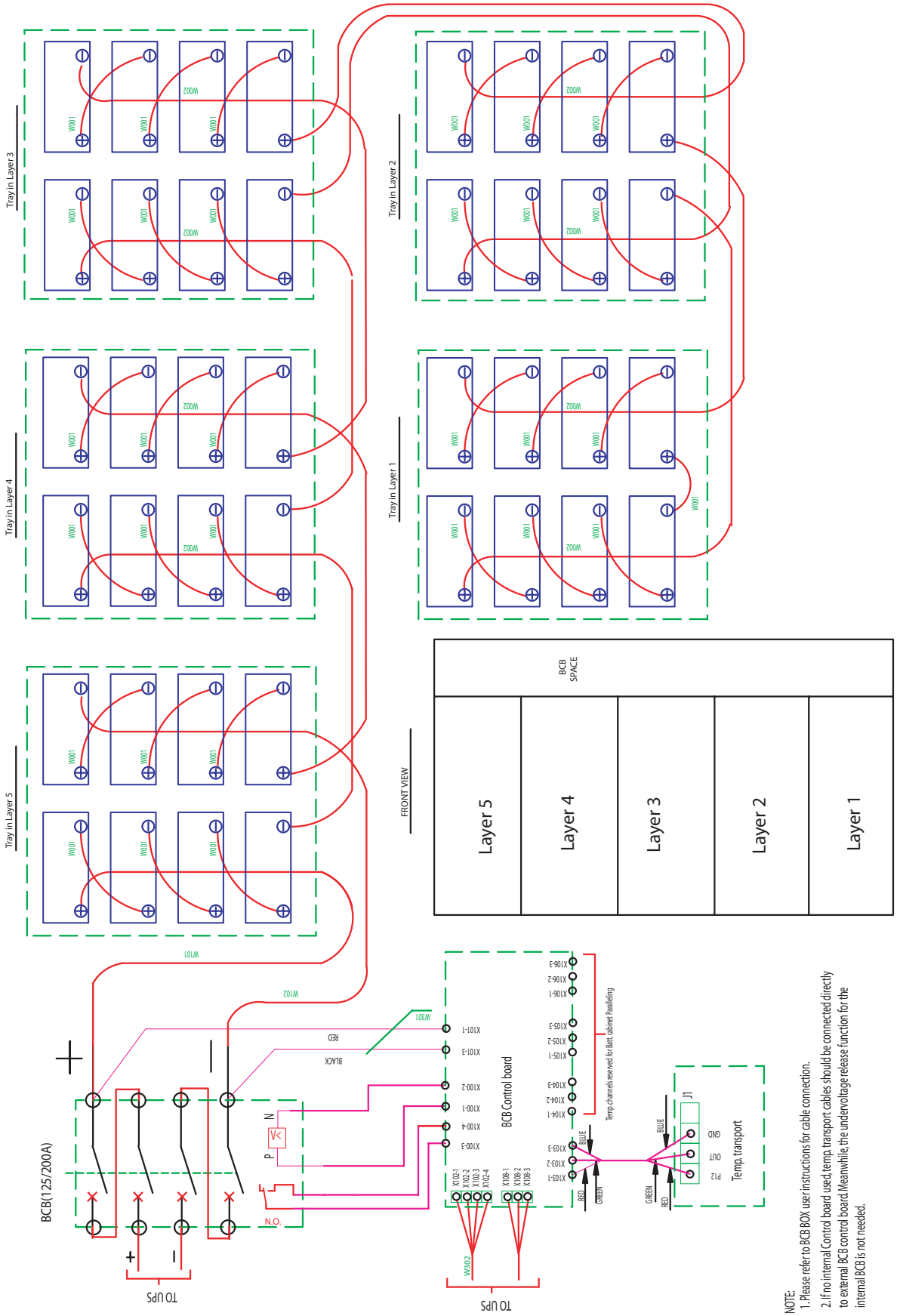


Figure 16 SENXA0NBCN5LF

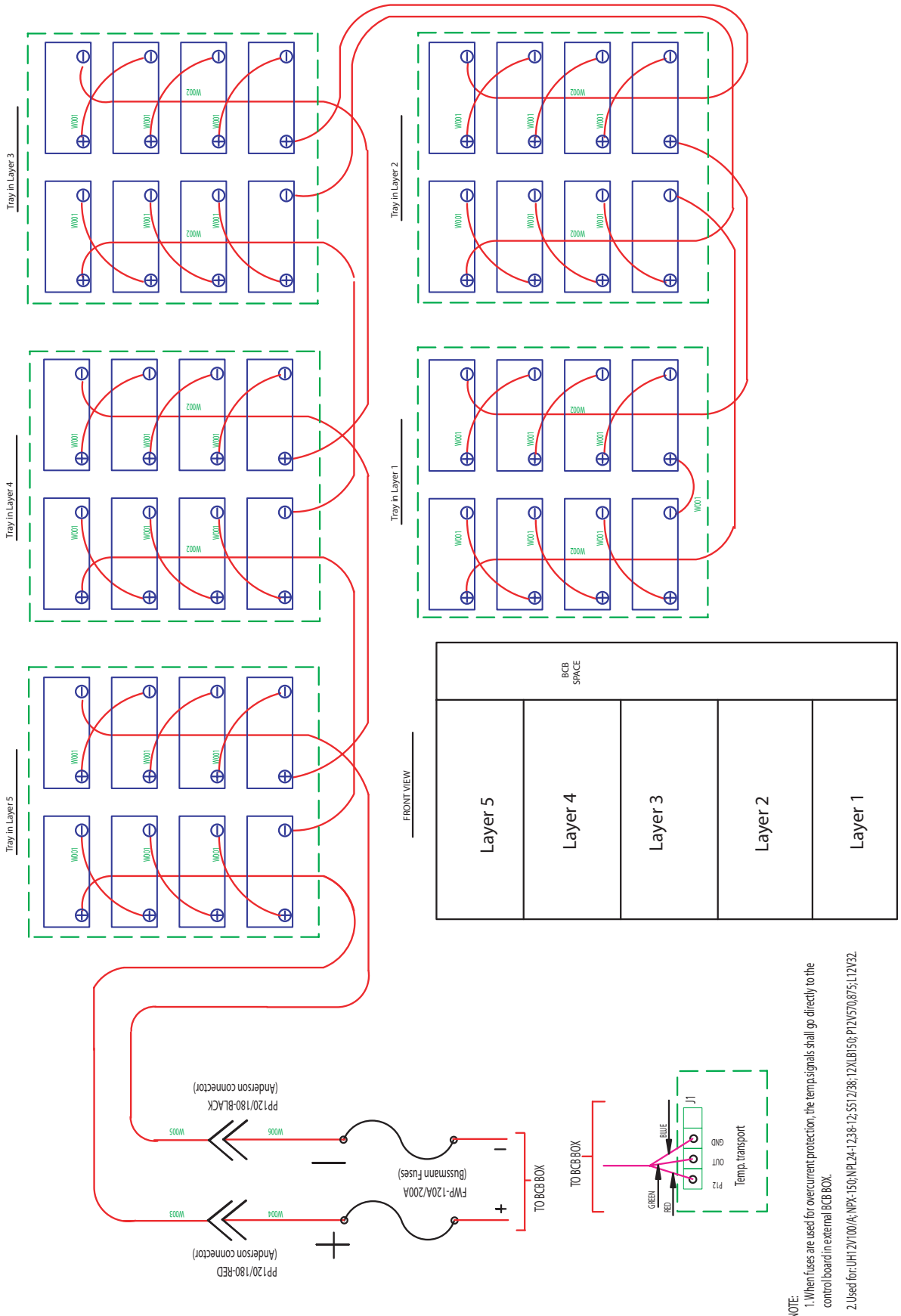


Figure 17 SENXA0NBCWXX3LCB

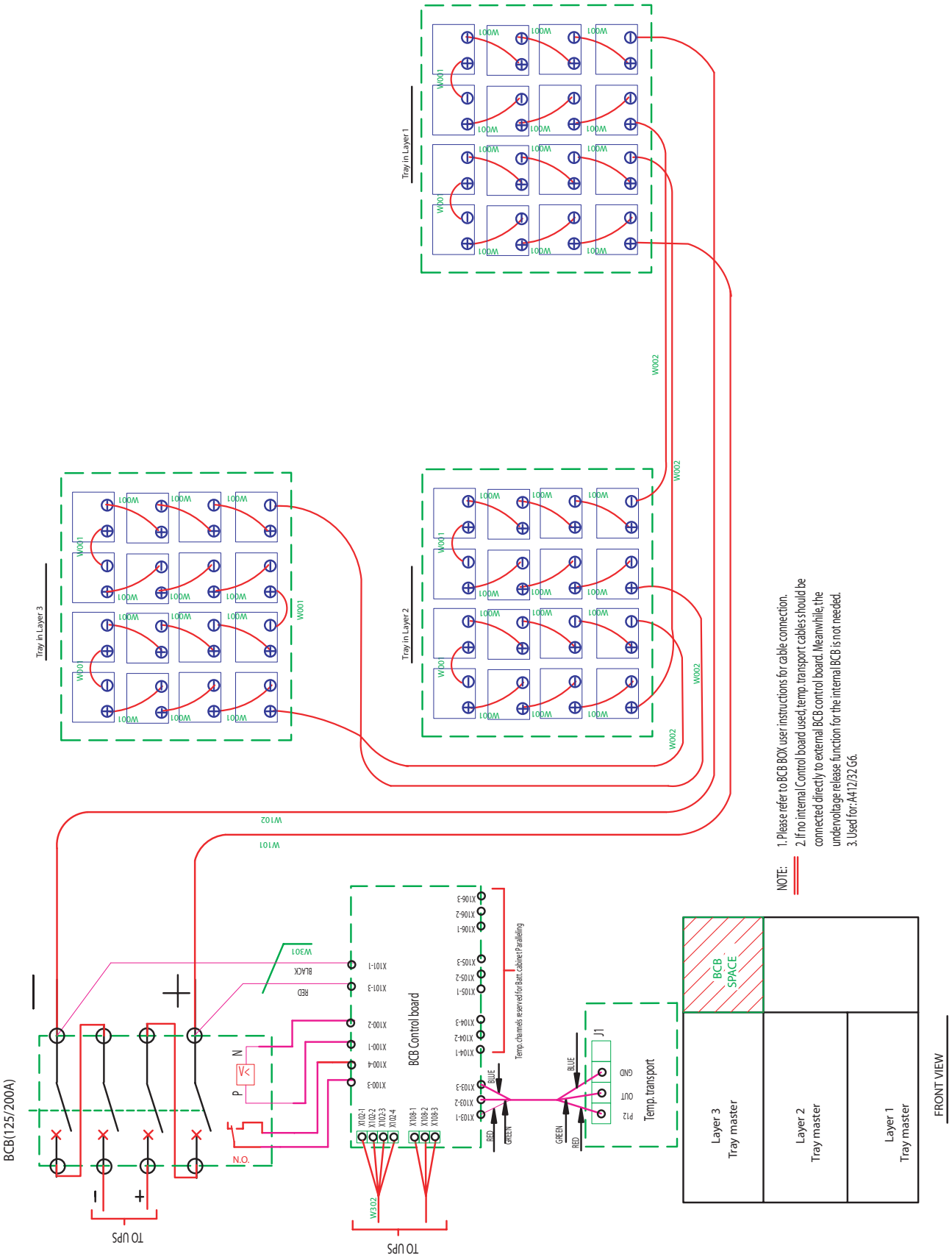


Figure 18 SENXA0NBCWXX3LF

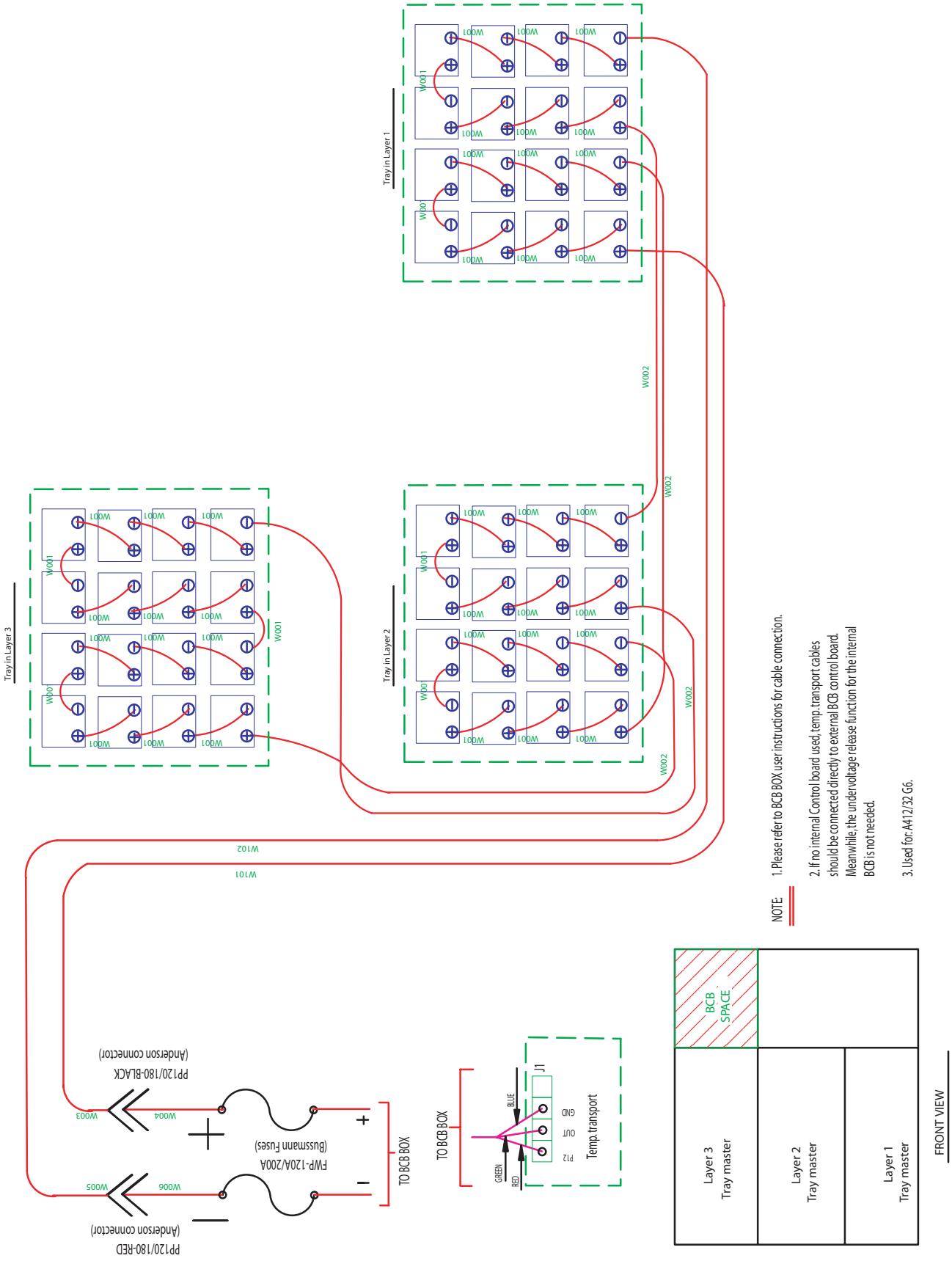
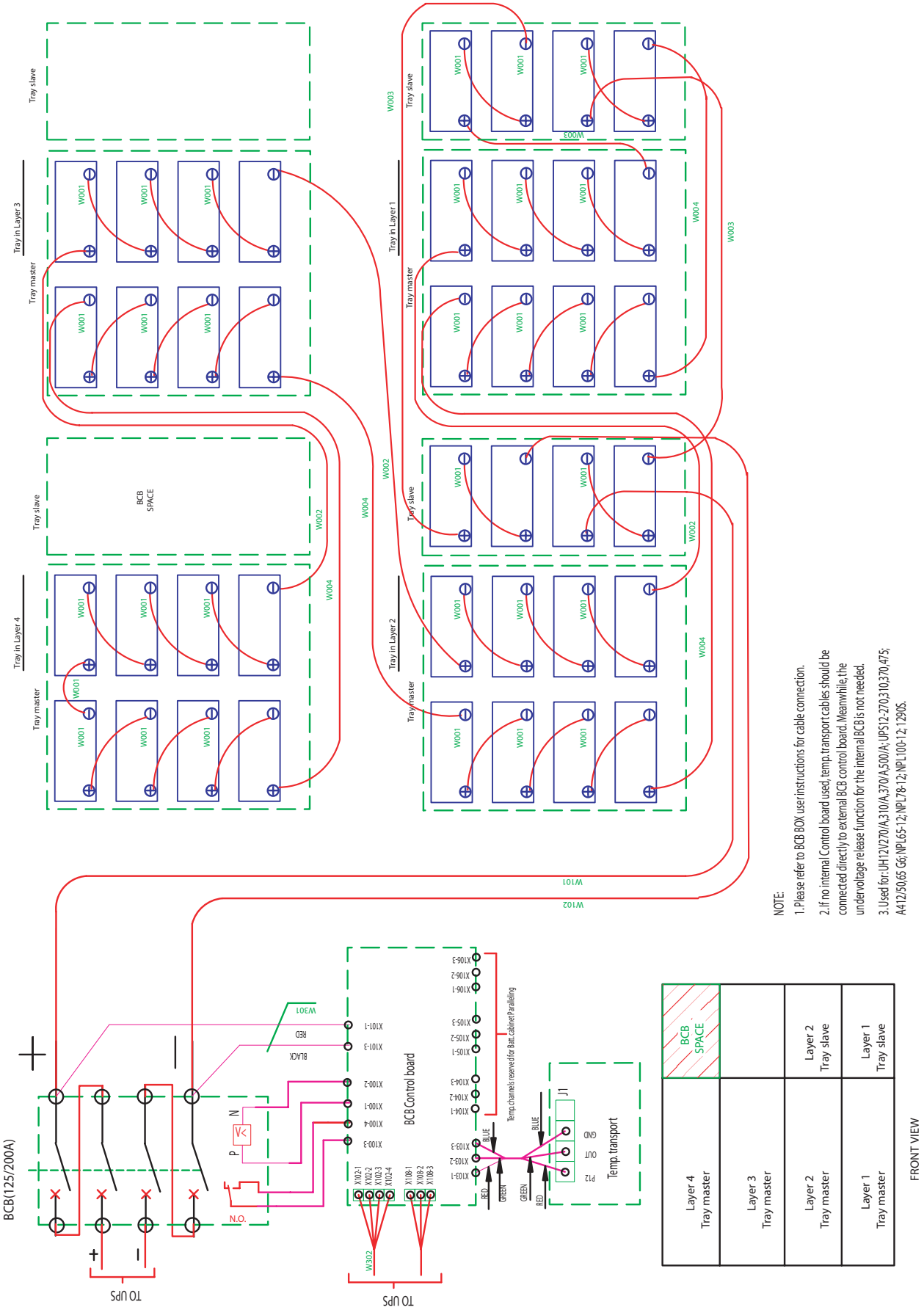


Figure 19 SENXA0NBCWXX4LCB_2x4



NOTE:
1. Please refer to BCB BOX user instructions for cable connection.
2. If no internal Control board used, temp. transport cables should be connected directly to external BCB control board. Meanwhile, the undervoltage release function for the internal BCB is not needed.
3. Used for: LIH12V270/A,310/A,370/A,500/A; UPS12-270,310,370,475; A412/50,65 G6; NPL65-12; NPL78-12; NPL100-12; 12905.

Figure 20 SENXA0NBCWXX4LCB_4x2

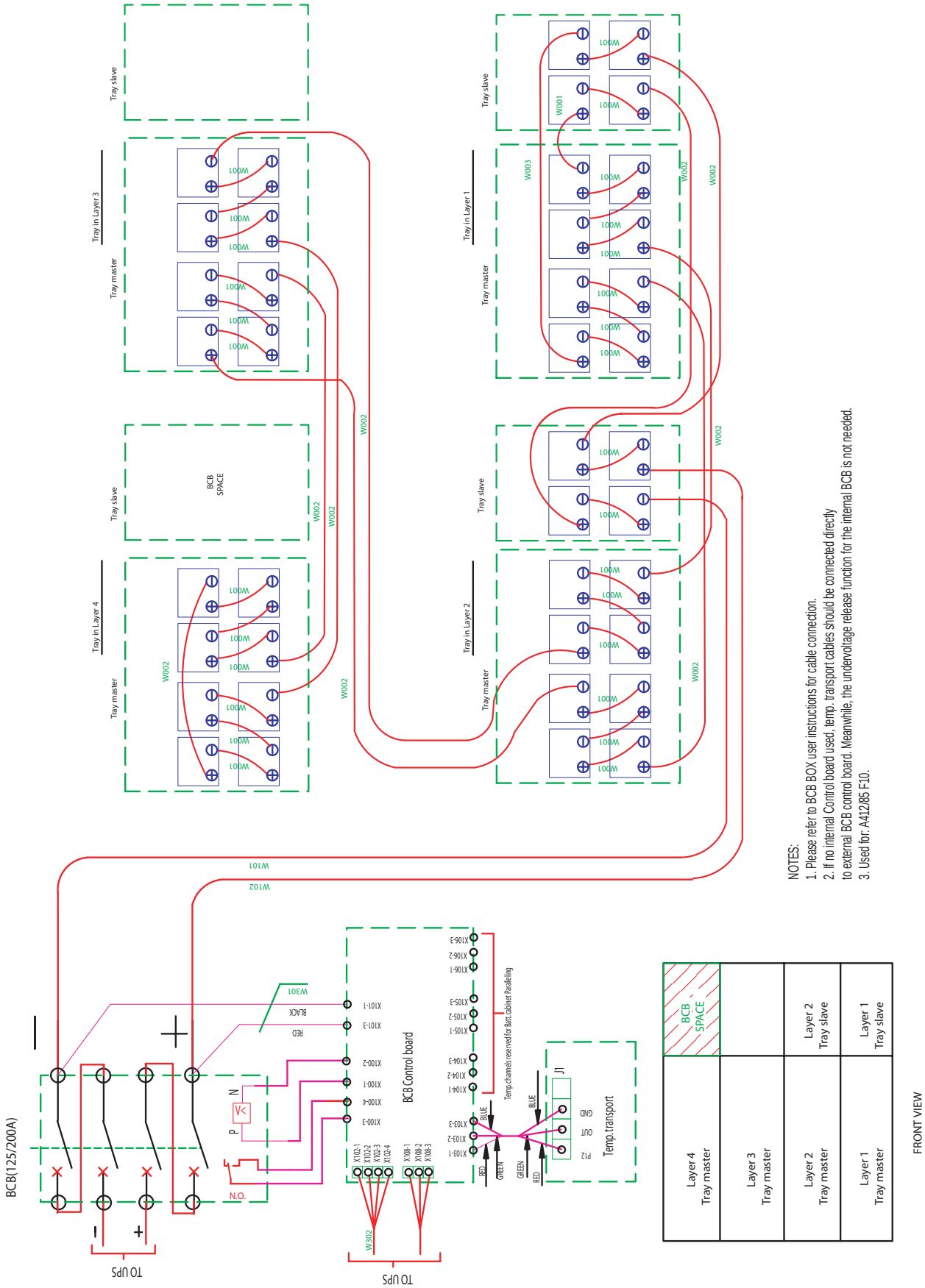


Figure 21 SENXA0NBCWXX4LF_2x4

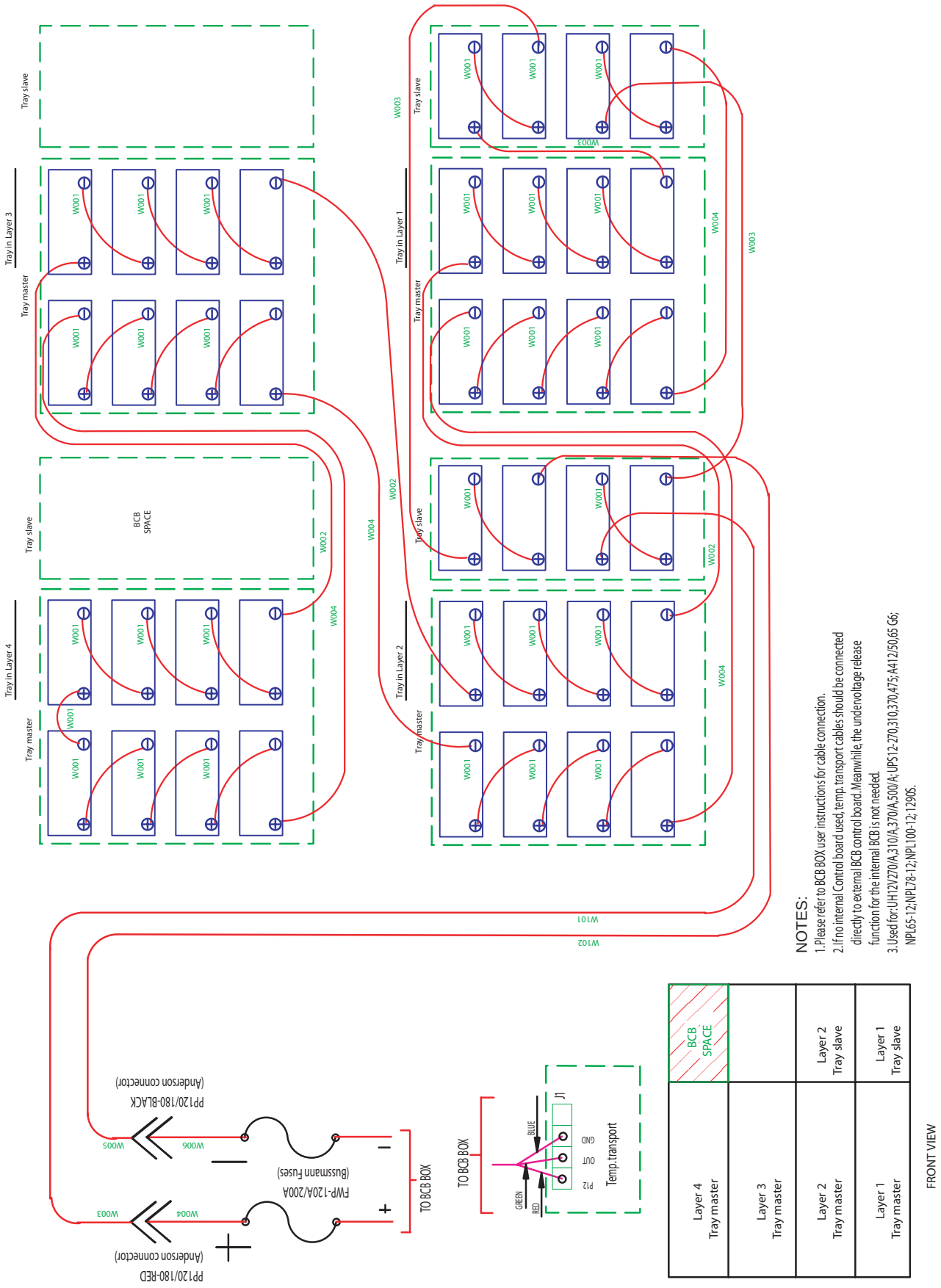
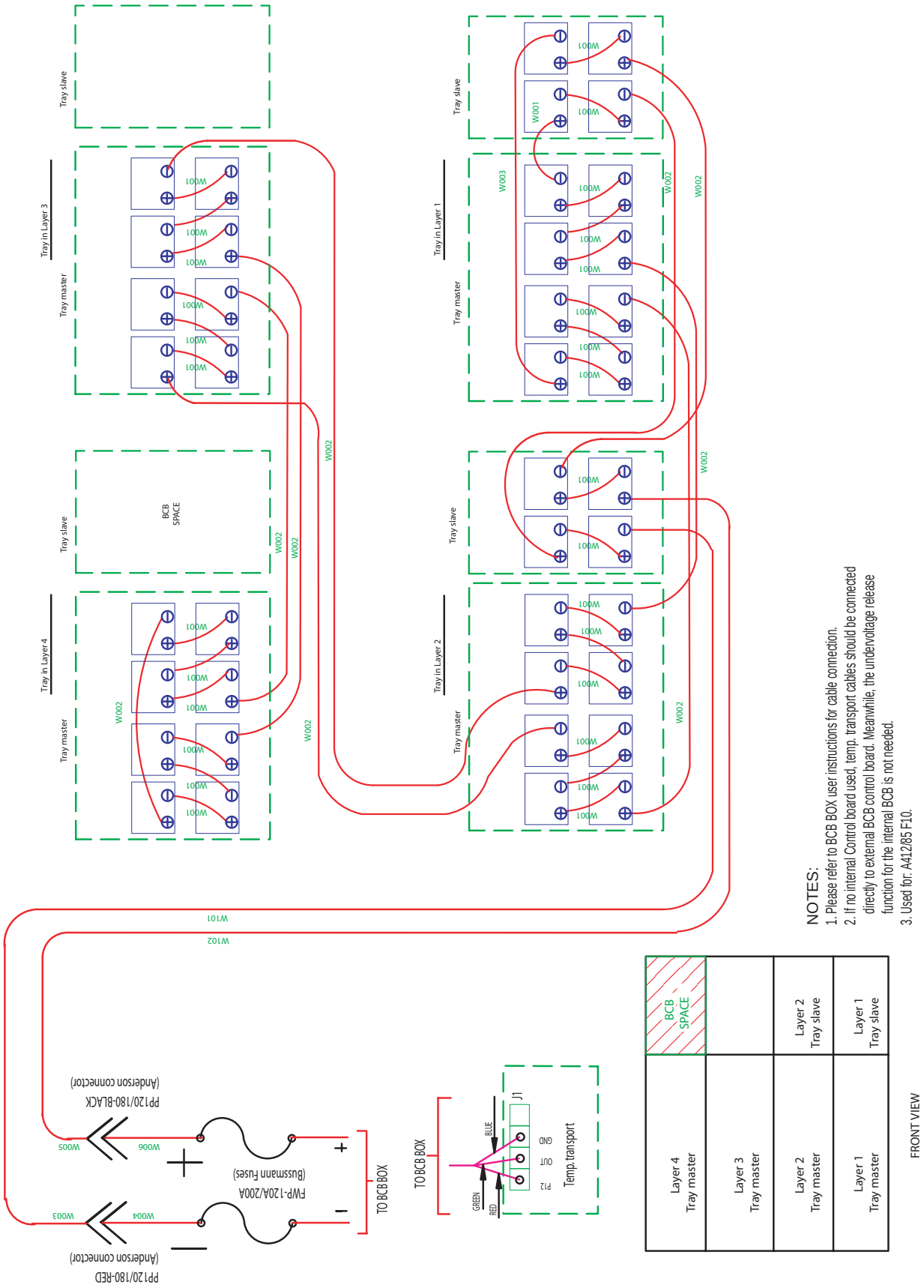


Figure 22 SENXA0NBCWXX4LF_4x2



2.4 Battery Power Cables

2.4.1 Connection Principles

The following notes, in conjunction with the diagrams, illustrate the broad principles to be followed when fitting and connecting the majority of battery installations.

2.4.2 Fitting the Batteries

1. In general, at least 10mm (3/8") must be left unobstructed on all vertical sides of the battery blocks to permit free air movement around the cells.
2. Clearance should be allowed between the top of the cells and the underside of the shelf above (this is necessary for monitoring and servicing the cells).
3. When installing the batteries on racks always work from the bottom shelf upwards to prevent raising the centre of gravity.

2.4.3 Connecting the Battery

1. When the battery cabinet is installed on a raised floor the battery power cables and optional circuit breaker control cables can be routed to the UPS cabinet via the floor of the cabinet. If the UPS and battery cabinet are located adjacent to each other and located on a solid floor these cables can be passed between the cabinets via the lifting apertures located in the lower sides of the cabinets.
2. In general it is recommended that the inter-connecting cables be fitted to the batteries within their particular level before fitting the inter-level connecting cables, followed finally by the cables to the circuit breaker.
3. An insulating shroud should be fitted to each terminal after its connection has been made.
4. When connecting the cables between the battery string ends to the optional circuit breaker always connect the circuit breaker end of the cable first.

2.4.4 Battery Room Design

Whatever the type of mounting system selected, the following conditions should be noted:

- Cell Layout—**1**

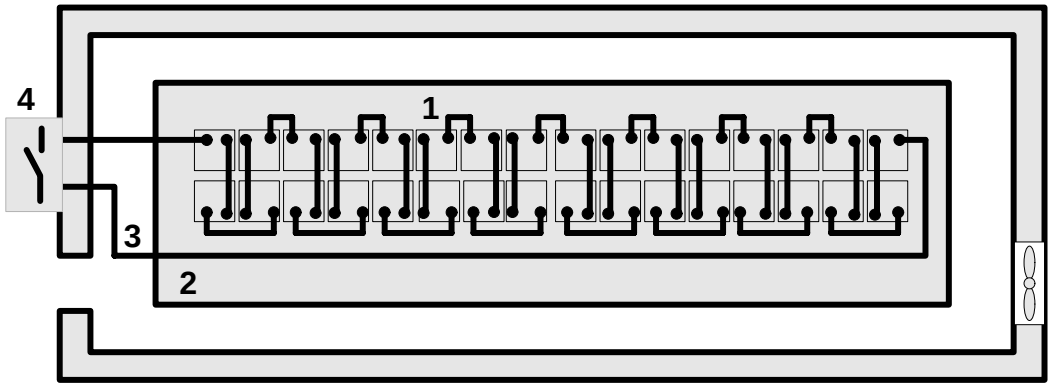
  Whichever battery mounting system is used, the batteries should be arranged to prevent the possibility of simultaneous contact with two exposed live parts having a potential greater an 150V. Where this is not possible, insulated terminal shields must be installed and insulated cables must be used for connections.
- Service Platform—**2**

  The service platform (or duckboard) must be slip-proof, insulated from the floor and at least one metre (39 in.) wide.
- Connections—**3**

  All connections must be as short as possible.
- Battery Protection Fuses/Circuit Breaker—**4**

  The battery circuit breaker is generally installed at the front of the battery room. See **2.5 - Battery Control** for details on connecting the circuit breaker box available for the Liebert NX.

Figure 23 Battery room design



2.5 Battery Control

The battery circuit breaker is controlled by the battery circuit breaker controller board, which is located within the battery cabinet or adjacent to the battery circuit breaker when the batteries are rack-mounted. This board controls the circuit breaker's undervolt release coil and also provides a path for the circuit breaker auxiliary contacts to signal the circuit breaker status back to the UPS control logic. Refer to **Figure 25**. All connections between the controller board and the UPS unit are made via auxiliary terminal Block X3 BCB of the Monitor Board, which is located at the rear of the door in the UPS Cabinet (refer to **1.8.3 - External Circuit-Breaker Interface**).

Battery temperature sensor cables are connected between UPS auxiliary terminal block X3 BCB, the Battery Circuit Breaker controller board and the battery as shown in **Figures 25** and **26**.

Cables connected to X3 BCB must contain a protective earth wire or a shield, be segregated from power circuits, double insulated and of a typical 0.5 to 1mm^2 cross-section area for maximum runs between 25 and 50 meters respectively. The shield should be connected to the protective earth of the battery cabinet or battery breaker, not at the UPS

CAUTION

UPS containing an internal automatic battery contactor do not require BCB board, nor undervoltage control of the BCB.

In this case, direct wiring to the NX Monitor Board is required:

- the auxiliary NO contact of the battery circuit breaker is wired directly to the NX monitor board terminal X3 BCB: 2-3.
- “On-Line” X3 BCB terminals 4-3 of the NX monitor board are linked.
- Any temperature sensor is wired directly to the NX monitor board terminal X7: 2(+12V),3(signal),4(GND).

For details, refer to **1.7 - Control Cables and Communication**

The above applies to:

- 30 to 40kVA models with internal battery
- - any model with the Battery Start option
- The commissioning engineer must program the UPS accordingly (e.g., enable or disable battery temperature compensation, enable internal battery contactor).

2.6 Battery Circuit Breaker Box

The box contains a battery isolating circuit breaker and the circuit breaker controller board as also mounted in the battery cabinet.

A range of battery circuit breaker boxes is available for use in installations where the battery is not installed in the battery cabinet, in which case the appropriate battery box is fitted as close as possible to the battery and connected to the UPS equipment as illustrated in **Figure 25**.

The battery circuit breaker box, used with the circuit breaker controller board, is required to protect the battery from deep discharging and overcurrents. It also provides electrical isolation between the UPS and the battery, permitting technical service personnel to reduce the risks involved in maintenance work to a minimum. Inside the box are connection bars for power cables arriving from the UPS and from the battery.

NOTE
The control cables from the UPS unit to the controller board must be made using a 5-core shielded cable located in a separate conduit to that containing the battery power cables.

The control signal cable is connected to the circuit breaker controller board through the terminal board.

The cable shield must be earthed to prevent induced noise affecting the control operation, and a separate safety earth must be connected between the UPS unit and circuit breaker box.

The configurations in **Table 9** are available, depending on the UPS power rating.

Table 9 UPS-circuit breaker configurations

UPS	Dimensions HxWxD, mm (in)	Weight kg (lb)	Circuit Breaker
30 to 40 kVA	558x378x180 (22x14.9x7)	21.5 (47.4)	125A 4p
60 to 80 kVA			200A 4p
100 to 120 kVA		25 (55)	400A 4p
140 to 160kVA	825x530x195 (32.4x21x7.7)	30 (66)	400A 4p
200kVA		32 (71)	500A 4p

Listed weights do not include packaging.

The BCB box contains a battery isolating circuit breaker and a circuit breaker controller board and offers the following features:

- Short-circuit and End Of Discharge protection—The circuit-breaker (or internal UPS battery contactor when fitted) automatically opens when the EOD voltage is reached
- UPS Emergency Stop compatibility—The circuit-breaker (or internal UPS battery contactor when fitted) opens when the emergency stop button is pressed on the UPS front panel.

NOTE
*30 to 40kVA UPS models fitted with internal battery and any UPS models fitted with a Battery Start kit contain an internal UPS battery contactor for automatic connection and disconnection of the batteries and the battery circuit breaker undervoltage coil is not used. Refer to **2.5 - Battery Control** for details*

Figure 24 Battery circuit breaker box—30-120kVA and 140-200kVA

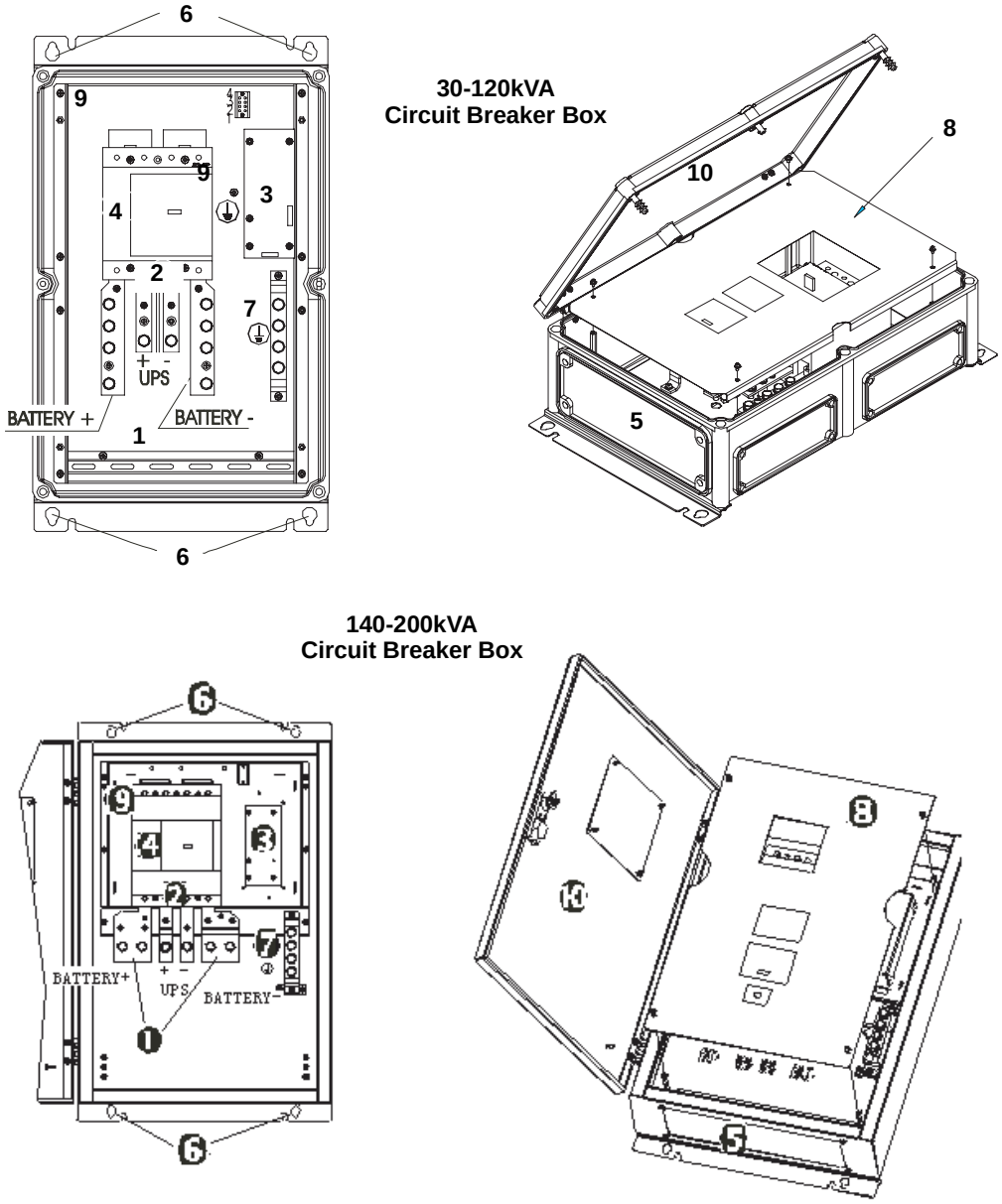
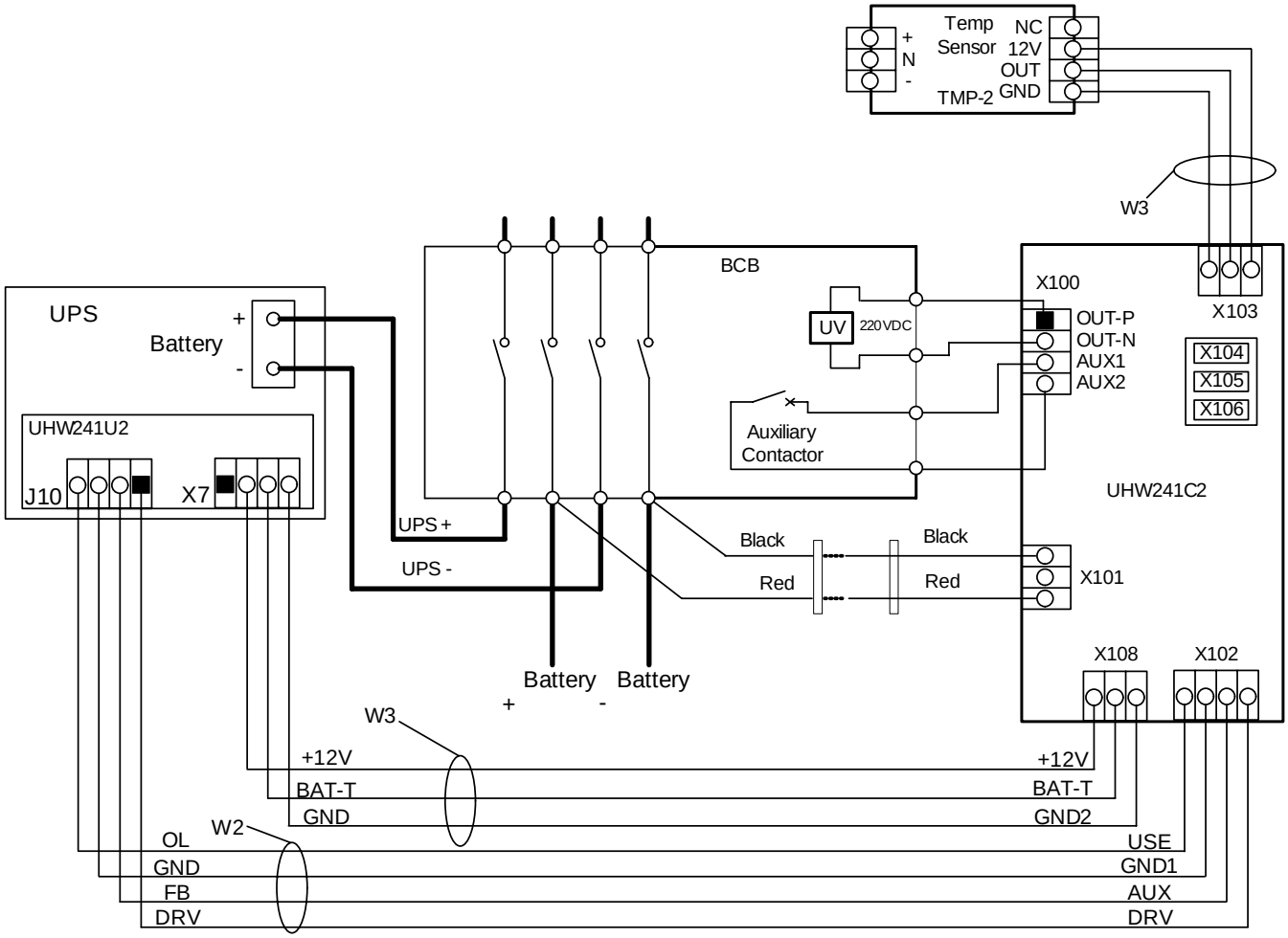


Table 10 Battery circuit breaker box legend

Key #	Component
1	Battery connections, positive and negative
2	Connections from UPS, positive and negative
3	Battery circuit breaker controller board
4	Battery circuit breaker
5	Plate for cabling holes (User to size and cut holes for the cables to be used)
6	Wall mounting holes
7	Earth bar
8	Insulating cover
9	Top plate
10	Hinged door

Standard cable entry is from bottom side. The baseplate can be rotated to permit top cable entry.

Figure 25 Battery circuit breaker box connection



NOTES

1. *Cable W3 supplied with temperature sensor (5m) and with BCB Box (30m)*
2. *Cable W2 supplied with BCB Box (30m)*
3. *X102 labels are 1(DRV), 2(AUX), 3(GND1), 4(USE) - refer to* ***Table 11*** *for full X102 label descriptions*
4. *X101 - HAZARDOUS VOLTAGE - do not connect to battery bus before authorised by the commissioning engineer*
5. *X103-X106 are for connecting temperature sensors from multiple battery cabinets.*

Table 11 Battery control label description (X102)

BCBB X-102 Ref Label		Monitor Bd Reference Label	Description	Signal status
1 DRV	BCB-X3 on U2 Monitor board	DRV	Battery circuit breaker tripping control signal from UPS	Normal: H level voltage, BCB can close Abnormal: L level voltage, BCB trips
2 IN (AUX)		FB (IN)	Bat CB auxiliary status contact (Open contact = CB open)	Normal: OV when BCB is closed. Abnormal: open when BCB is open
4 USE		OL = On Line	Bat CB Board status signal (GND = OV from BCB Bd)	Normal: 0V, the BCB Board is in use. Abnormal:. open, the BCB Board is not in use.
3 GND1		GND	GND1	GND1 to GND on U2 board
5 (1) +12V	X7 on U2 Monitor board	P12	+12V Power supply from Monitor Bd to Temp Monitoring Probe & Buffer	Power available: 3W.
6 (3) 0V		GND2	GND2	GND2 to GND on U2 board
7 (2) Out		OUT	Buffered Bat temp Probe signal from BCB Bd to Monitor Bd	

1. Cables connected to X3 BCB must be segregated from power circuits, double insulated and of a typical 0.5 to 1mm2 cross section area for maximum runs between 25 and 50 meters respectively.
2. Battery temperature sensing cables must be less than 10 m long.
3. 30 and 40kVA UPS models fitted with internal battery and any UPS models fitted with Battery Start kit contain an internal UPS battery contactor for automatic connection and disconnection of the batteries and the battery circuit breaker undervoltage coil is not used. Refer to **2.5 - Battery Control** for details.

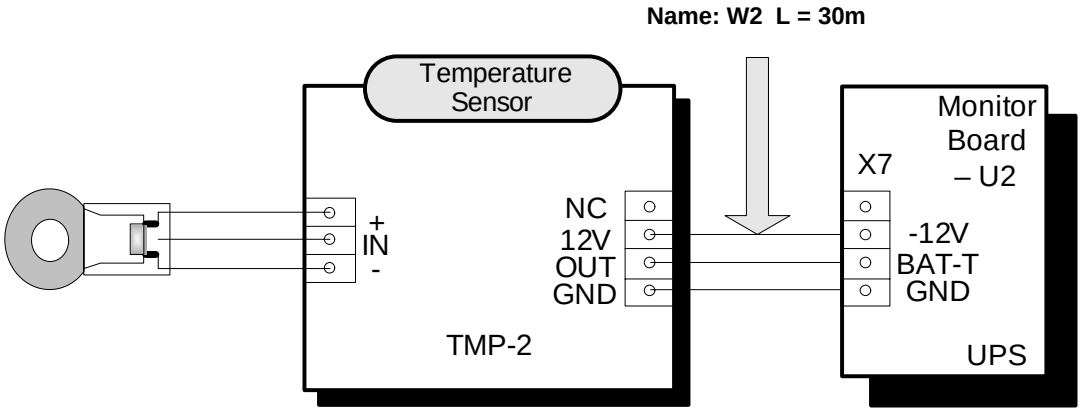
CAUTION

Leave terminals open if the corresponding facility is not used. The commissioning engineer must program the UPS accordingly (e.g., disable battery temperature compensation, enable internal battery contactor)

2.6.1 Battery Temperature Sensor—Optional

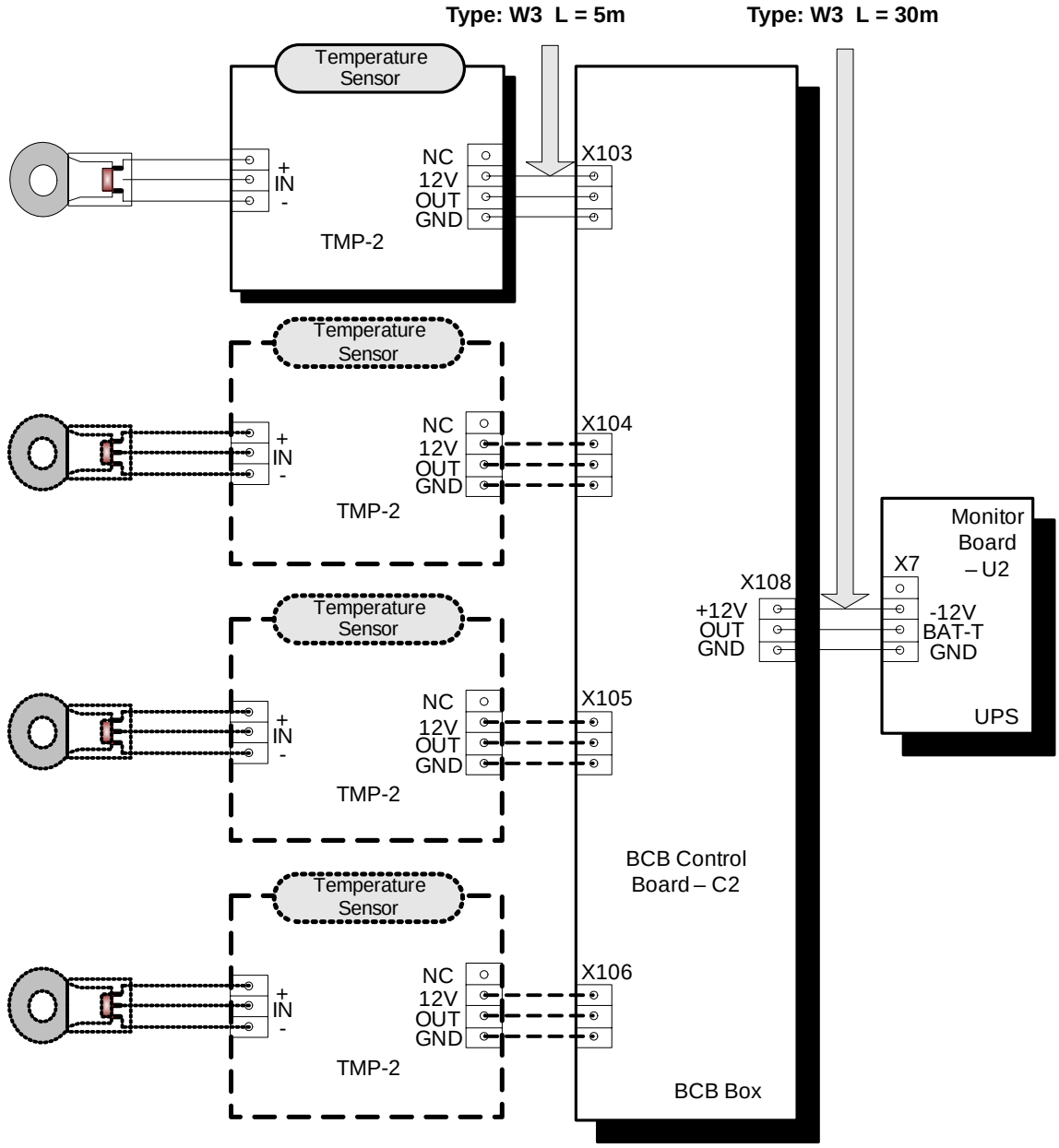
The optional external battery temperature sensor kit, supplied separately from the battery circuit breaker, contains one probe and one temperature transport board as illustrated in **Figure 26**. It is connected to the UPS Monitor Board (either directly or in case of multiple sensors, through the battery circuit breaker board - see **Figures 26** and **27**).

Figure 26 Single temperature sensor and monitor board—U2



Cable W2 is packed with the temperature sensor.

Figure 27 Multiple temperature sensors, battery circuit breaker box and UPS module



Cable W3 (L=5m) is packed with the temperature sensor.
Cable W3 (L=30m) is packed with the BCB box.

NOTE:

1. *Each probe consists one OT6-4 terminal and one precision temperature sensor that is sealed in the OT6-4's terminal. The whole probe is supplied as one cable.*
2. *The type of temperature transport board illustrated in* ***Figure 27*** *is TMP-2.*
3. *The signal cables in the* ***Figure 27*** *must be shielded and double insulated.*
4. *The temperature monitoring cable must be less than 10m while the signal transmission distance of the transport board must be less than 100m.*

3.0 UPS MULTI-MODULE INSTALLATION

3.1 General

The installation of a multi-module UPS configuration must follow the installation procedure for a single UPS module with the additional requirements detailed in this chapter.

In addition to the local EPO push button on the front panel of the UPS module (that stops operation of that module), the UPS supports also a remote emergency stop to permit simultaneous multi-module shutdown.

NOTES

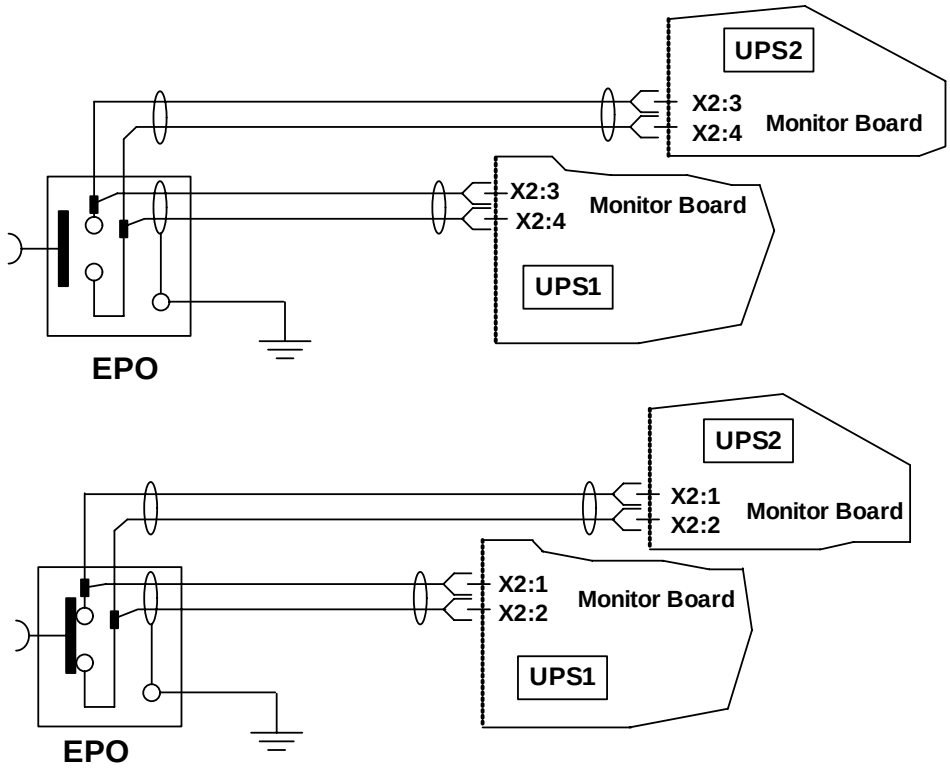
1. The remote emergency power off switch must be voltage-free and Normally Open or Normally Closed.

2. The open voltage supplied is 12VDC, < 20mA

3. This external emergency stop may be supplied with a second set of contacts that can be used to trip incoming mains or bypass supply circuit breakers supplied by others and fitted with remote trip units.

4. Normally Closed EPO - X2: 1&2, these terminals are supplied factory-linked on the monitor board.

Figure 28 Emergency power off connections



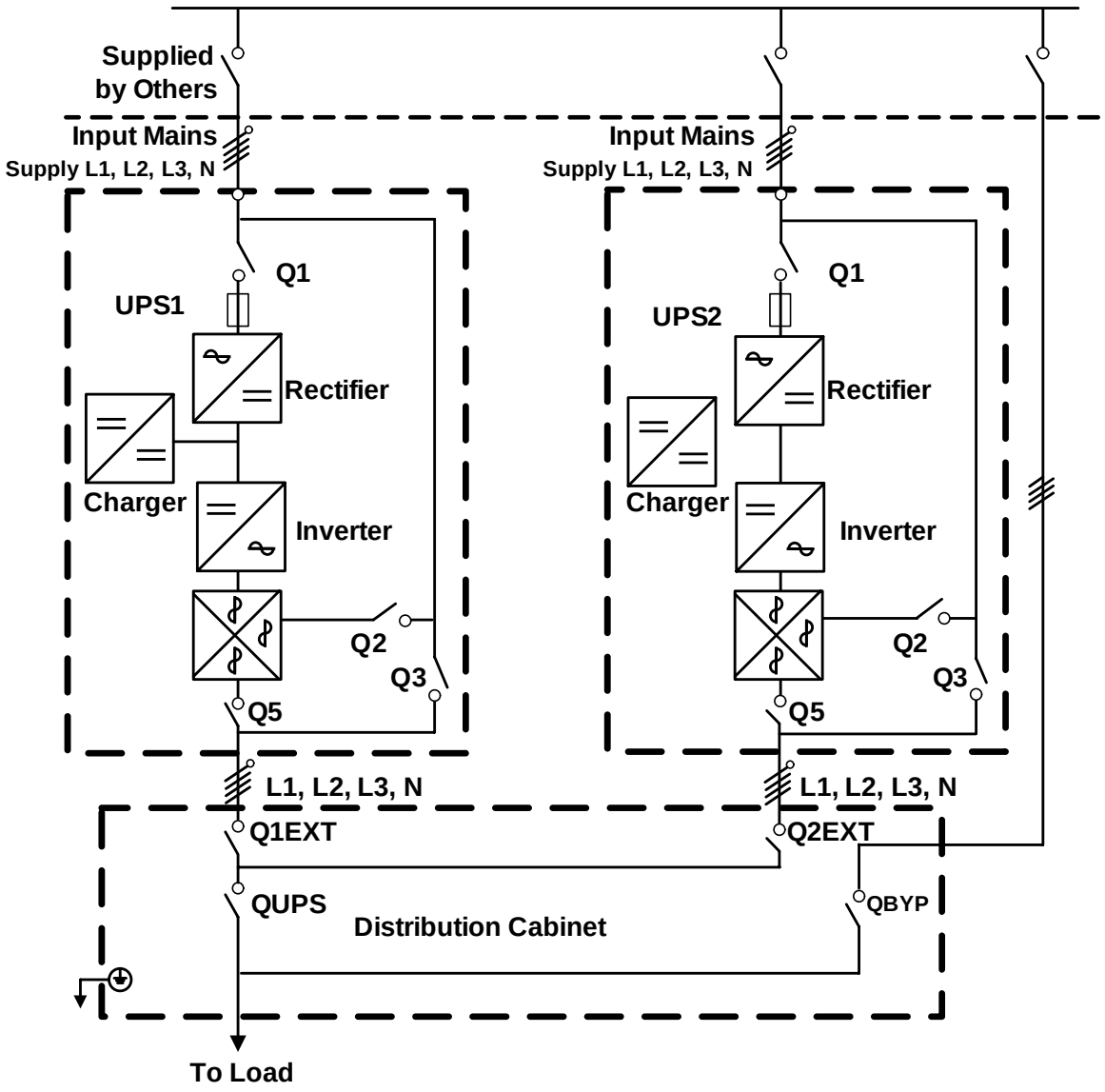
3.2 Paralleled UPS Modules

The basic installation procedure of a parallel system comprising two or more UPS modules is the same as that of single module system. The following sections only introduce the installation procedures specific to the parallel system.

3.2.1 Cabinet Installation

Place the UPS modules side by side and interconnect as shown in **Figure 29**. The distribution panel (external bypass cabinet) is optional but recommended for ease of maintenance and system testing.

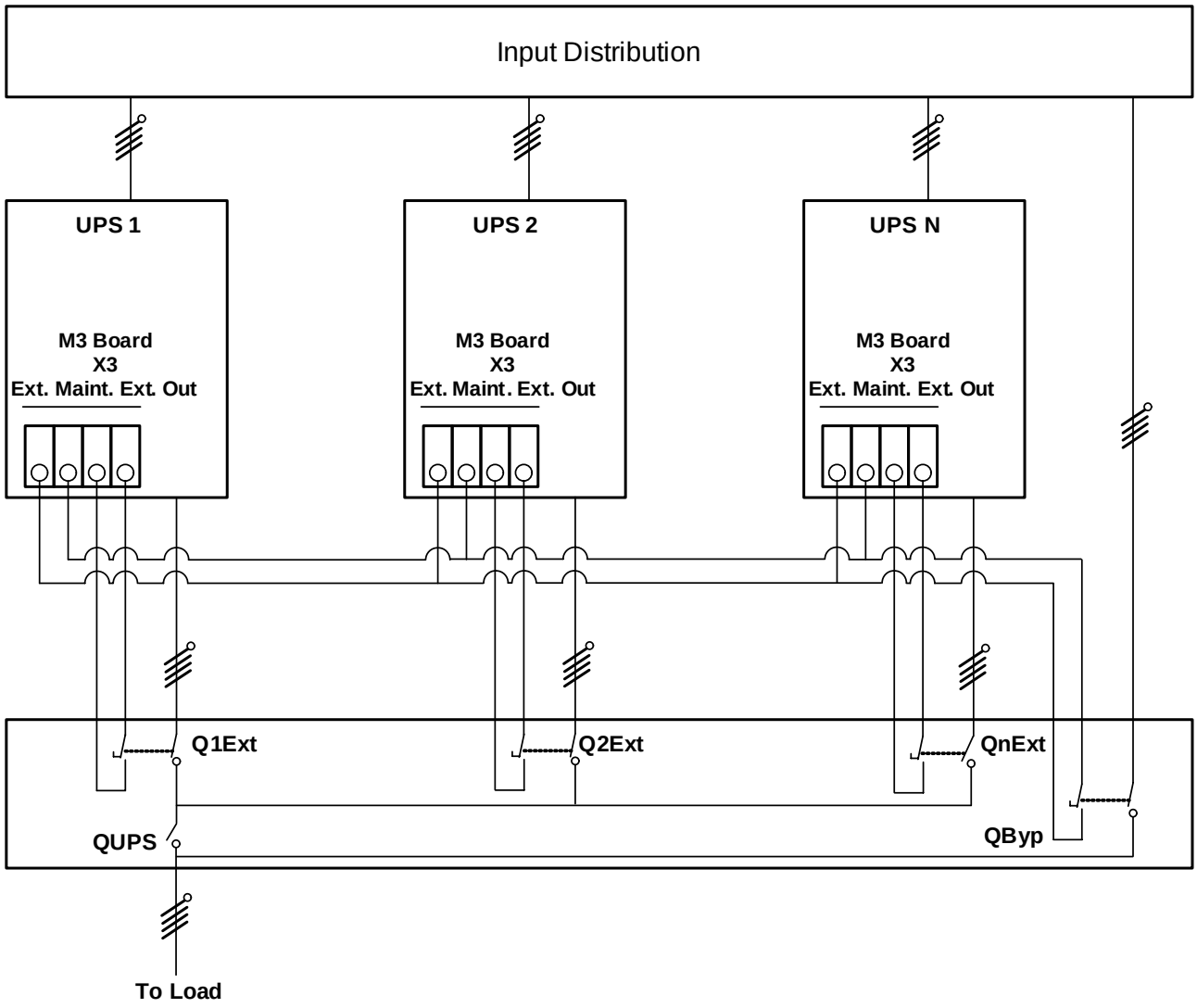
Figure 29 Typical 1+N system block diagram with common input supply, with separate batteries and optional output / bypass distribution panel



NOTE

Internal maintenance bypass switch Q3 must be removed when the load exceeds the capacity of one UPS module.

Figure 30 Dry contacts, multiple UPS modules with distribution panel



3.2.2 External Protective Devices

Refer to the instructions in **1.0 - Single Module UPS Installation**.

3.2.3 Power Cables

The wiring of power cables is similar to that of single module system. The Bypass and the Main input sources must be referenced to the same neutral potential and input earth leakage monitoring devices, if installed, must be located upstream of the common neutral sinking point. Refer to the instructions in **1.0 - Single Module UPS Installation**.

NOTE

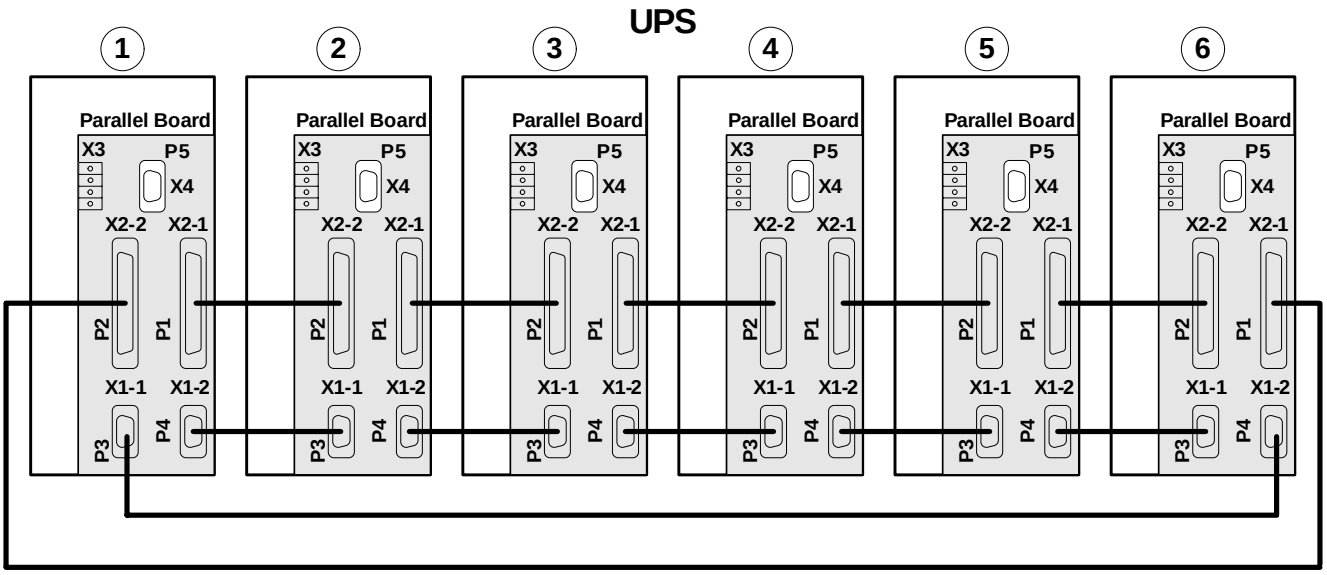
The length and specification of power cables including the bypass input cables and UPS output cables should be the same. This facilitates load sharing when operating in bypass mode.

3.2.4 Control Cables

Intermodule Control

Shielded and double insulated control cables available in lengths of up to 30 meters must be interconnected in a ring configuration between UPS modules as shown below. The parallel control board is mounted on the top, behind protective cover of each UPS module (refer to **Figure 44**). The ring configuration ensures high reliability of the control (refer to **Figure 31**).

Figure 31 Connection of 1+N system parallel control cables



3.3 Hot-Standby UPS Modules

3.3.1 Cabinet Installation

Place the UPS modules side by side and interconnect as shown below.

The hot standby mode comprises two series-connected UPS modules of the same rating. One module is designated as the hot standby master (downstream), and the other module is designated as the hot standby slave (upstream). Their roles are determined by power connection and configuration software. In normal operation, both slave and master operate in normal mode and the output from one upstream (slave) UPS feeds the bypass input to the other (downstream, master) UPS. The output of the downstream (master) UPS is connected to the critical load and is always synchronised to the output of the upstream (slave) UPS. If the inverter of the UPS connected to the load fails, the inverter of the upstream (slave) UPS supplies the load through the downstream (master) UPS bypass circuit. The system can be programmed to cycle the downstream (master) UPS between normal mode and bypass mode so that both UPS units are equally exercised.

NOTE
If it is a hot-standby system, the master must be turned on first.

3.3.2 External Protective Devices

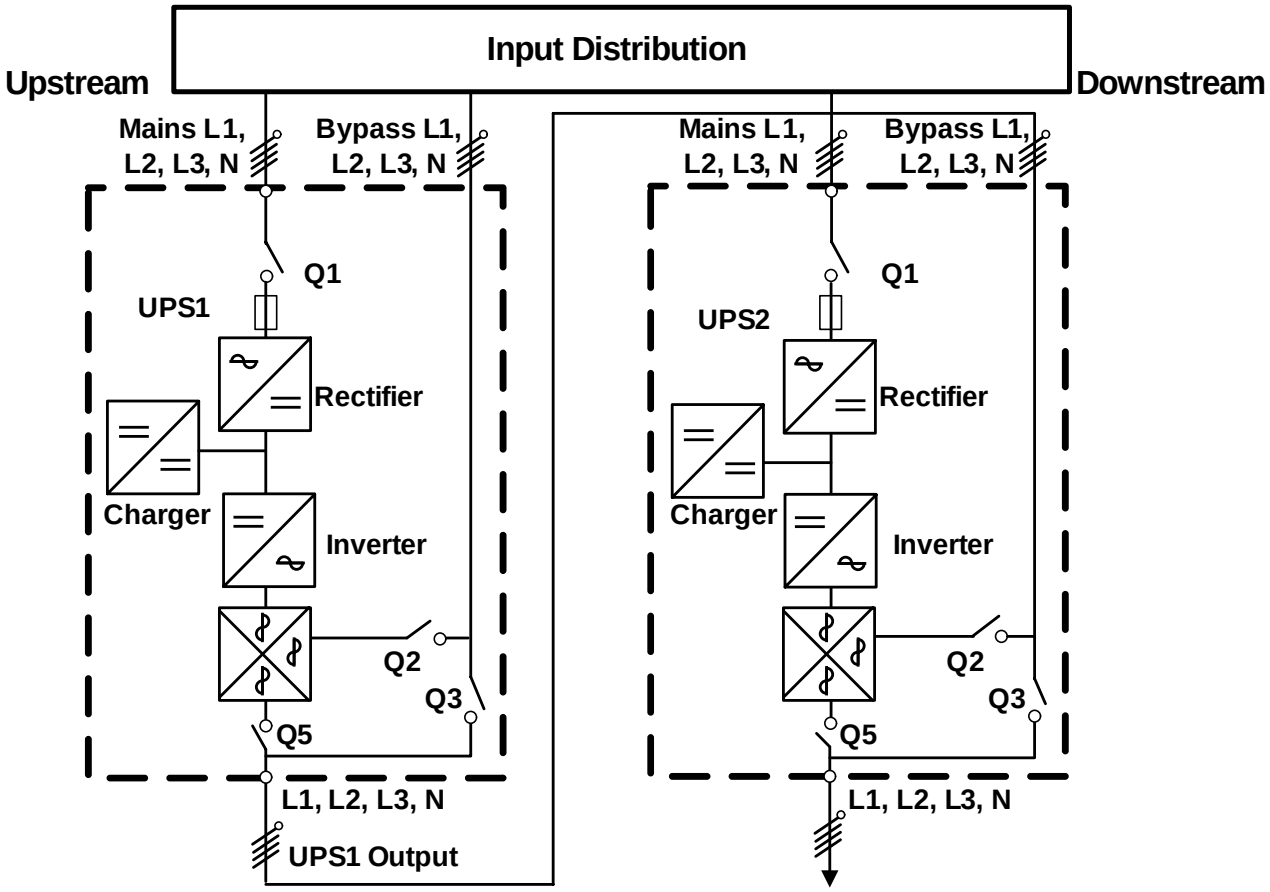
Refer to the instructions in **1.0 - Single Module UPS Installation**.

3.3.3 Power Cables

The wiring of power cables is similar to that of single module system except that the output of the upstream UPS is fed into the bypass input of the downstream UPS, and the load is fed by the downstream UPS through its inverter or bypass. The bypass and the main input sources must be referenced to the same neutral potential and input earth leakage monitoring devices, if installed, must be located upstream of the common neutral sinking point. Refer to the instructions in **1.0 - Single Module UPS Installation**.

No control wires other than those specified for the single module configuration are required.

Figure 32 Hot standby configuration



3.4 Dual Bus System

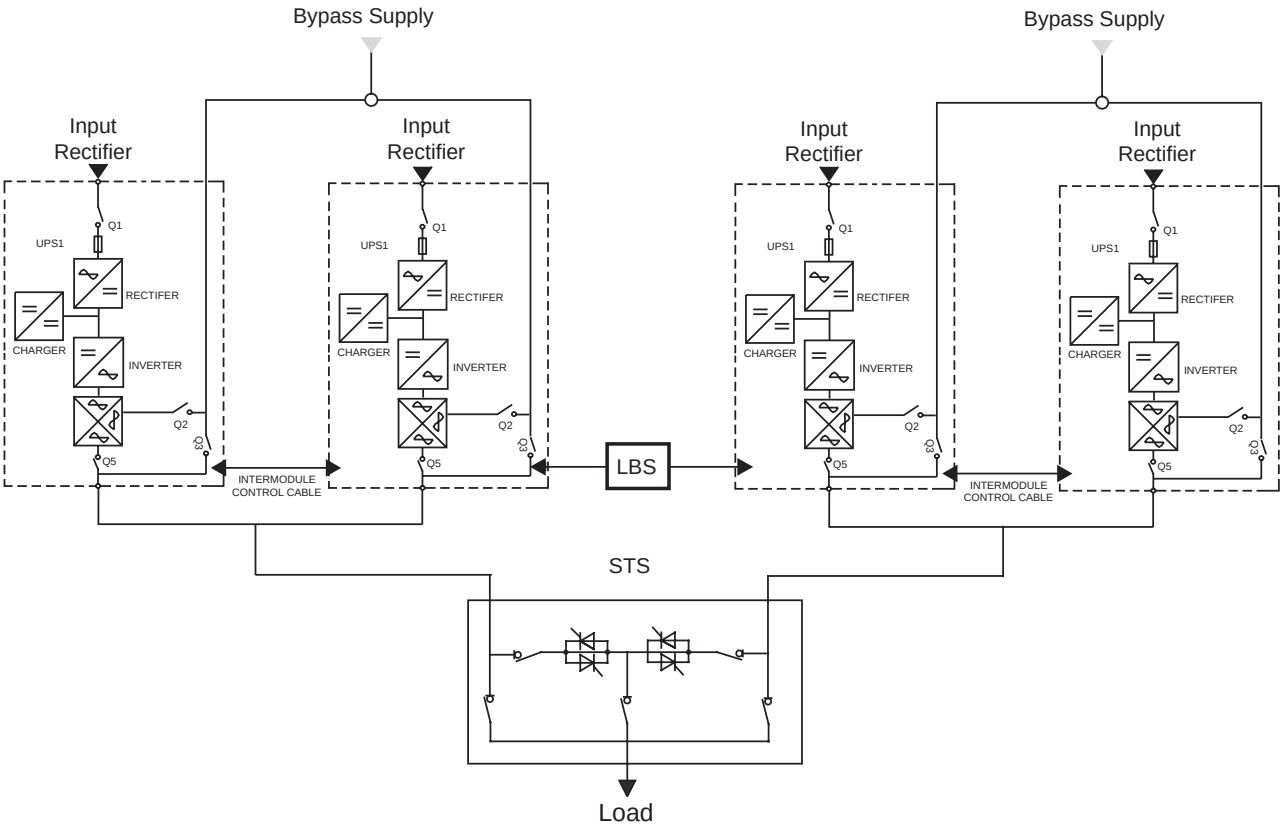
3.4.1 Cabinet Installation

The Dual Bus System consists of two independent UPS configurations each consisting of one or more UPS modules. Dual Bus Systems are high availability configurations suitable for loads with multiple input terminals. For single input loads an optional Static Transfer Switch may be added and the standard Load Bus Synchroniser activated. Depending on the configuration, follow the appropriate installation instructions for each system.

Place the UPS modules side by side and interconnect as shown below.

The objective of the Dual-bus Synchronizer (DBS) is to keep the output of two independent UPS systems (or parallel systems) in synchronization. One system is designated as the master; the other is designated as the slave. The operating modes covered comprise master and or slave operating inverter or bypass mode.

Figure 33 Typical dual bus system configuration with static transfer switch and Load Bus Synch



3.4.2 External Protective Devices

Refer to the instructions supplied in **1.0 - Single Module UPS Installation**.

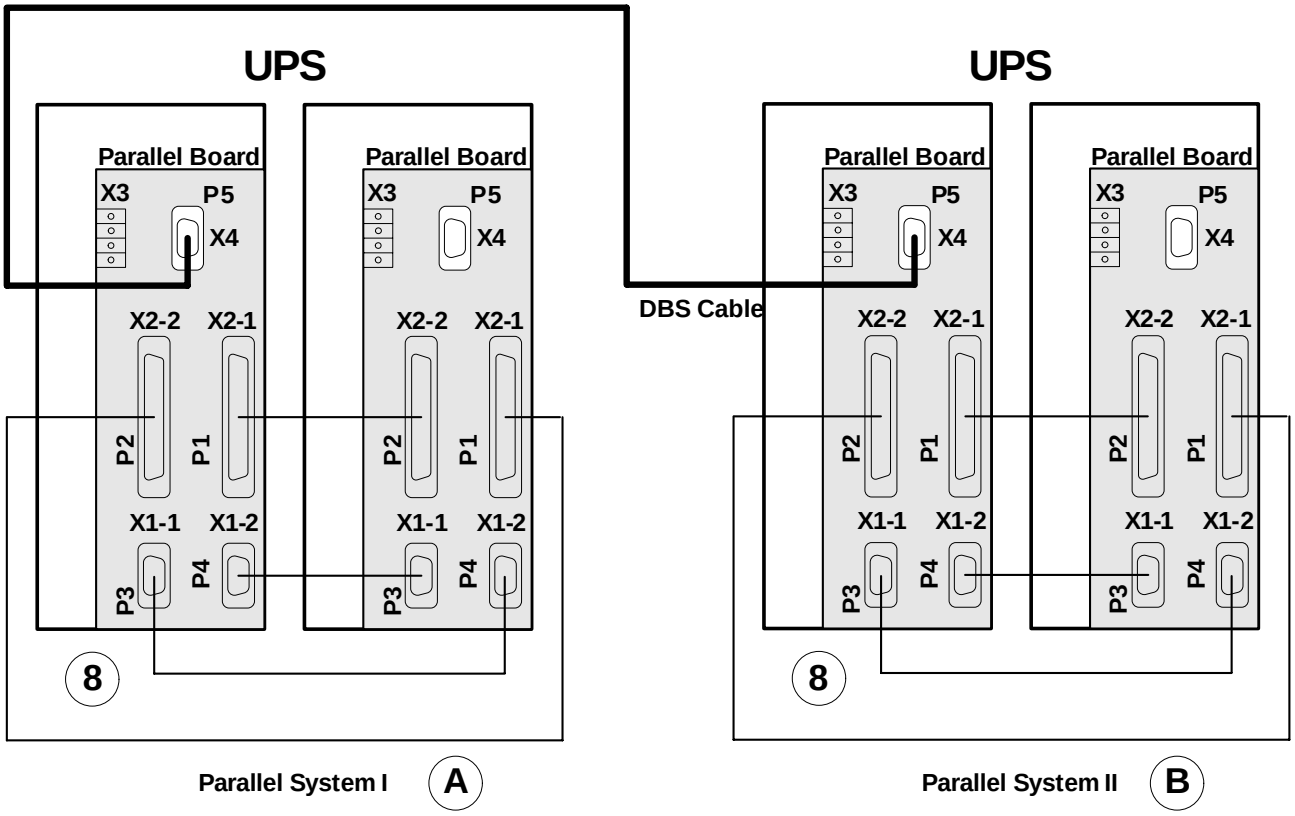
3.4.3 Power Cables

The wiring of power cables is similar to that of single module system. The Bypass and the Main input sources must be referenced to the same neutral potential and input earth leakage monitoring devices, if installed, must be located upstream of the common neutral sinking point. Refer to the instructions in **1.0 - Single Module UPS Installation**

3.4.4 Control Wires

For Liebert NX to NX dual bus configuration, interconnect the optional DBS cable between any DBS ports of two parallel systems as illustrated in **Figure 34**.

Figure 34 Connections of a typical dual bus system utilising Load Bus Synch



NOTE
Example shown with ring control cables ("8") for DSB applied to two 1+1 paralleled systems.

3.4.5 Extended Dual Bus Synchronization Option (DBS Interface Box)

For Liebert NX to non- NX (whether another Liebert UPS range or not) dual bus configuration, one DBS interface box shall be mounted on the non- Liebert NX UPS and one on the Liebert NX UPS. In this situation, the other UPS system is always treated as a master and the following conditions are covered:

- Master and slave are both on inverter
- Master on bypass, slave on inverter

NOTE
Extended DBS interface box is also used for extending DBS cable length up to 150 metres for DBS configuration between two groups of NX UPS systems.

4.0 EXTERNAL OPTIONAL CABINETS

4.1 External Maintenance Bypass Cabinets

The bypass cabinet enables maintenance operations and repairs to be performed in full isolation while also allowing the disabling of each UPS without affecting the ordinary operation of the system (depending on the redundancy level).

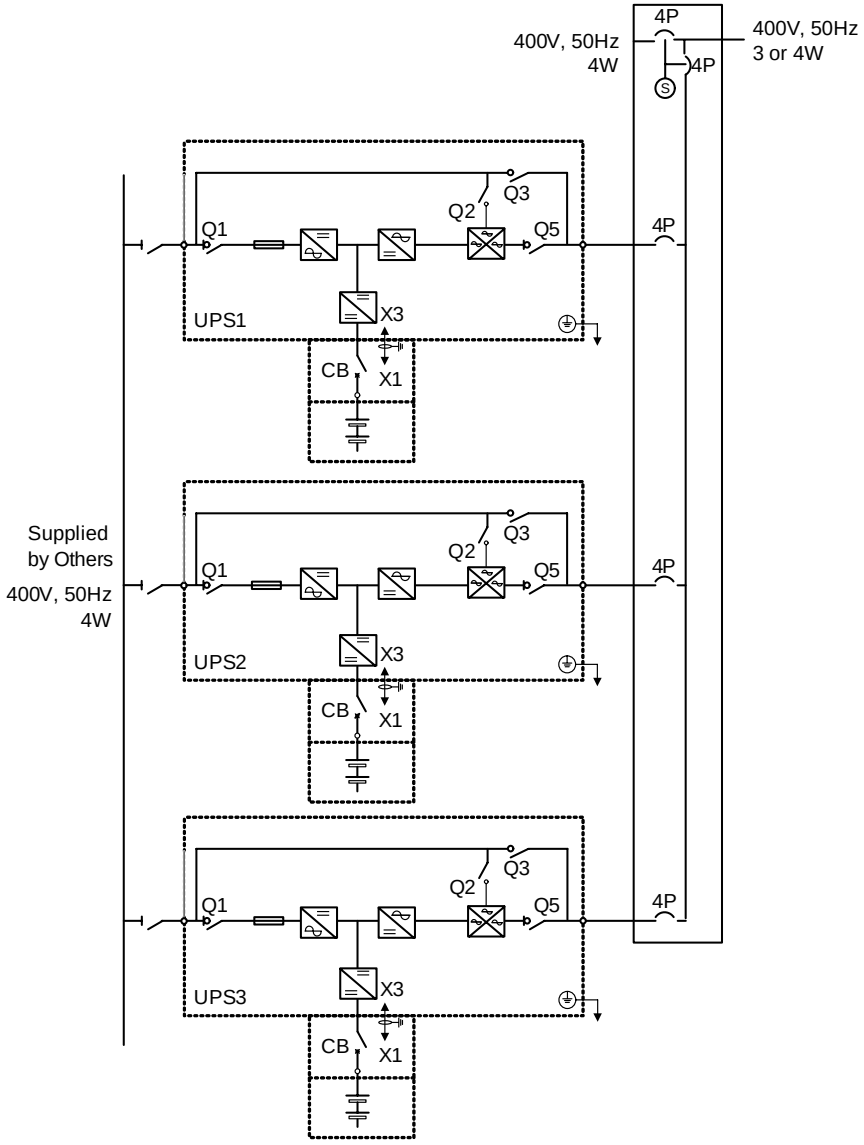
The optional maintenance bypass cabinet must be used in all configurations where one internal maintenance bypass switch is insufficient to supply the full system load.

Each kVA rating has maintenance bypass cabinets sufficient to supply the full system load up to six units in parallel power operation.

4.2 Interlock with UPS Module

Interlock the External Maintenance Bypass Switch with the operation of the UPS module(s) prevents backfeed of the External Bypass AC power into the Inverter if an incorrect switching sequence is used. A volt-free auxiliary status contact from external bypass switch QF3 is connected to UPS terminal X3 (MBC interface) of the parallel control board (M3).

Figure 35 External maintenance bypass cabinet with separate bypass input



EXT-Maint X3-1&2 on UPS Parallel Board M3 (leave open if no external bypass switch is used). Provides external maintenance bypass interlock protection for the UPS. Short circuit means external bypass closed.

EXT-Out (X3-3&4) on UPS Parallel Board (leave shorted if no external output switch is used). Provides external output interlock protection for paralleled UPS modules. Short circuit means external output switch closed.

4.3 Isolation Transformer Option

Isolation transformers are required in cases requiring galvanic isolation between the input supply mains and the UPS.

These options are housed in cabinets and they are available for every range of UPS.

These optional cabinets provide the Top Cable entry function.

NOTE

Terminals and cabling for the battery connection is not a part of the MBP or TC cabinet.

Figure 36 Equipment arrangement—UPS, battery cabinet and top-entry Isolation Transformer Cabinet

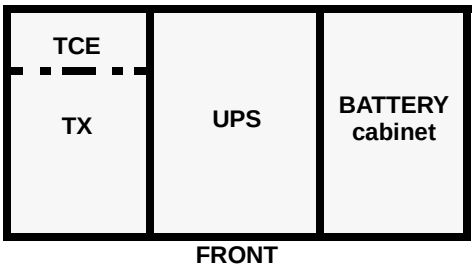


Figure 37 Single input external isolation transformer cabinet

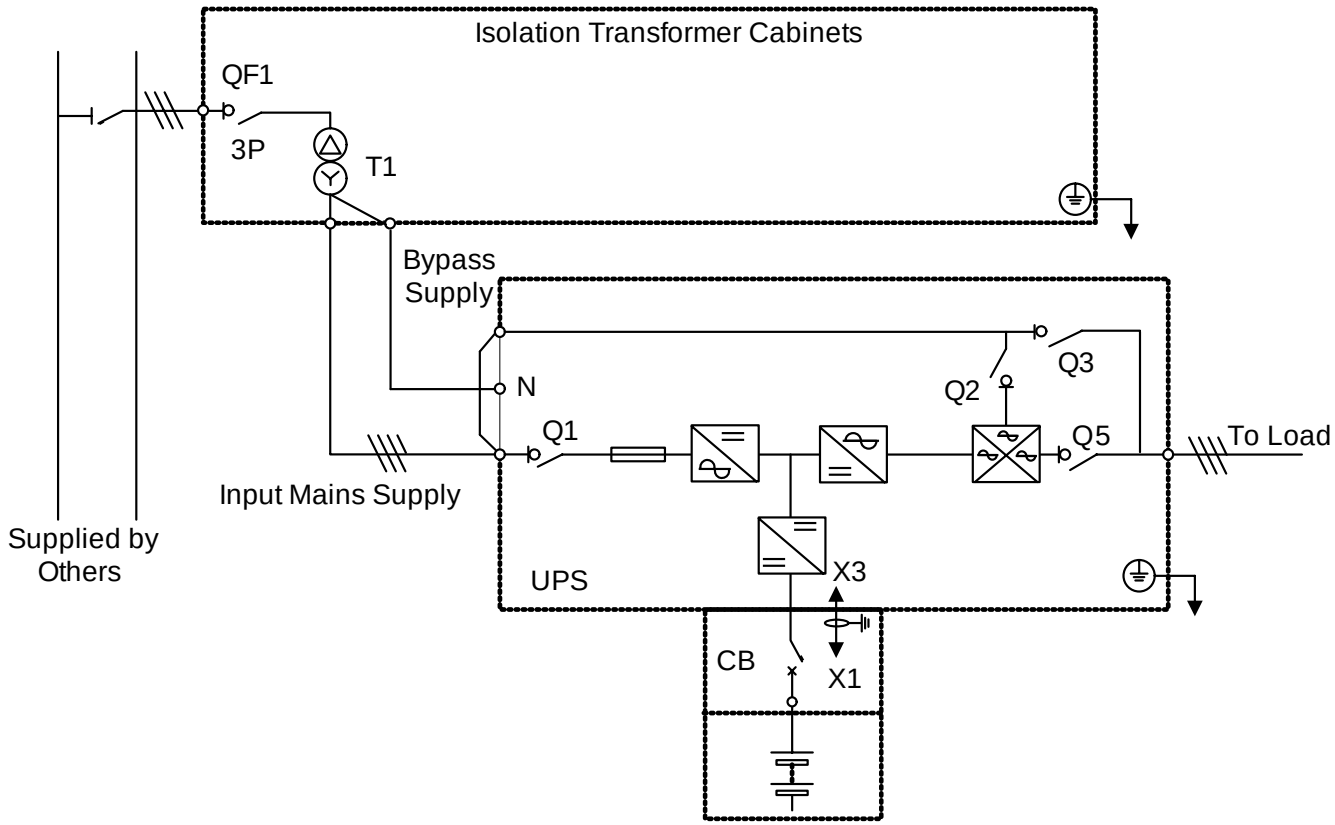


Figure 38 Dual input external isolation transformer cabinet

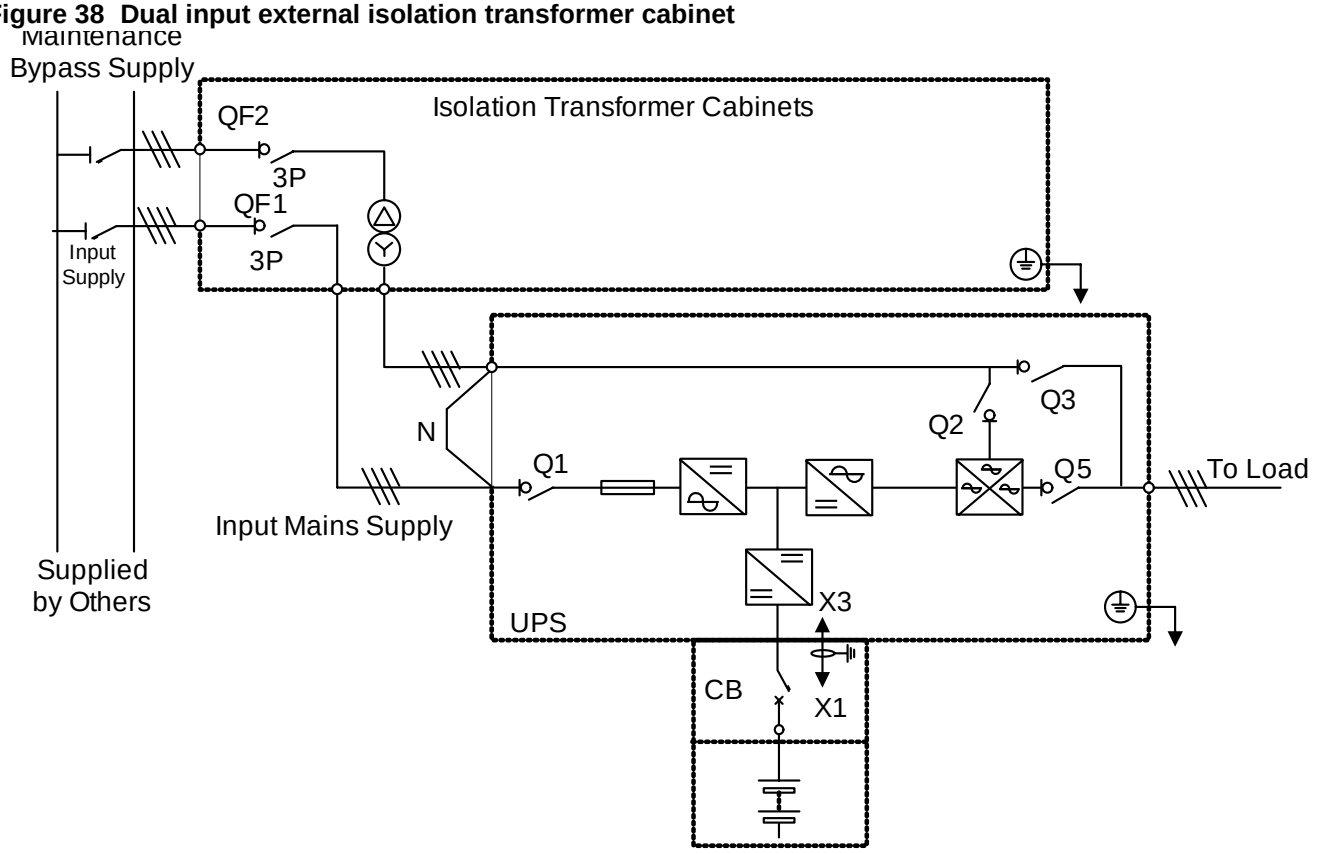
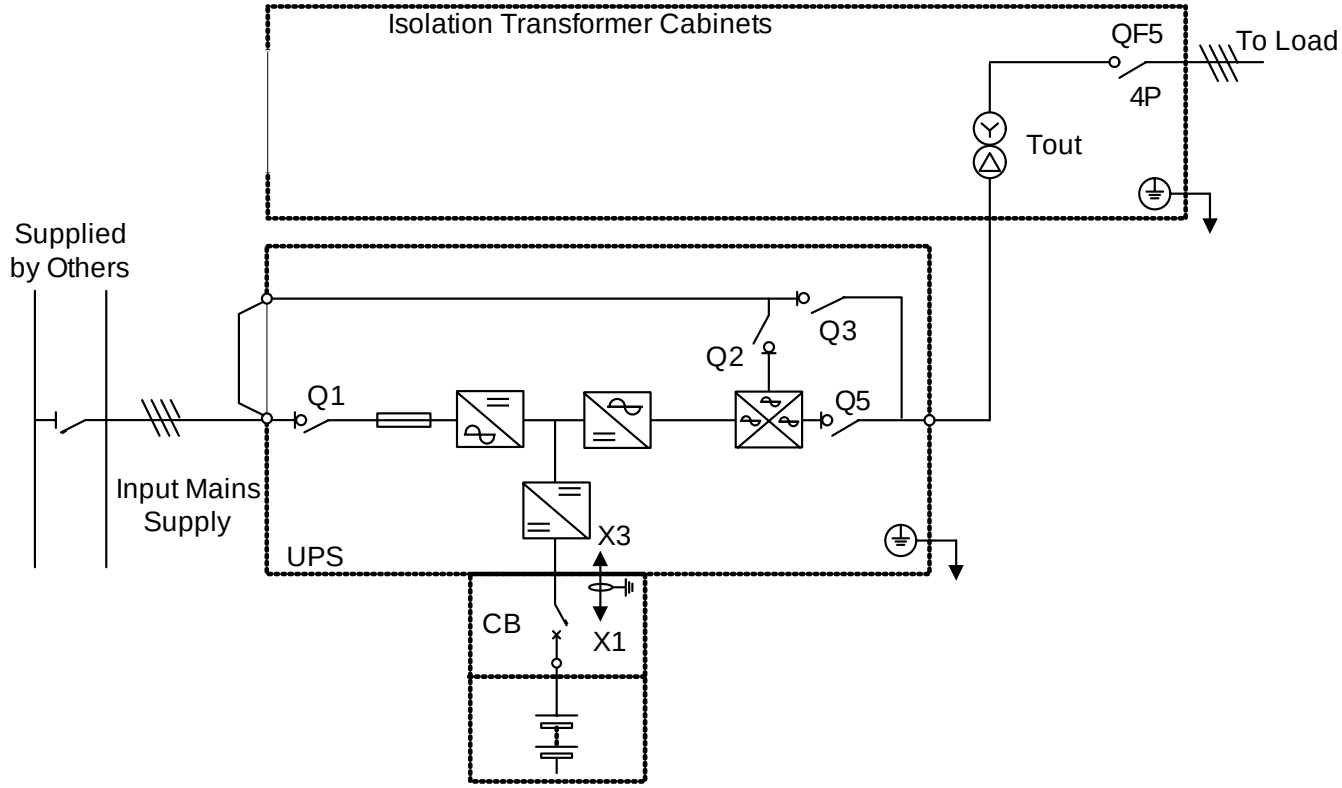


Figure 39 Output external isolation transformer cabinet



4.4 Top Cable Entry Option

Optional Top Cable entry cabinets are available for every range of UPS.

5.0 INSTALLATION DRAWINGS

Figure 40 Electrical connections

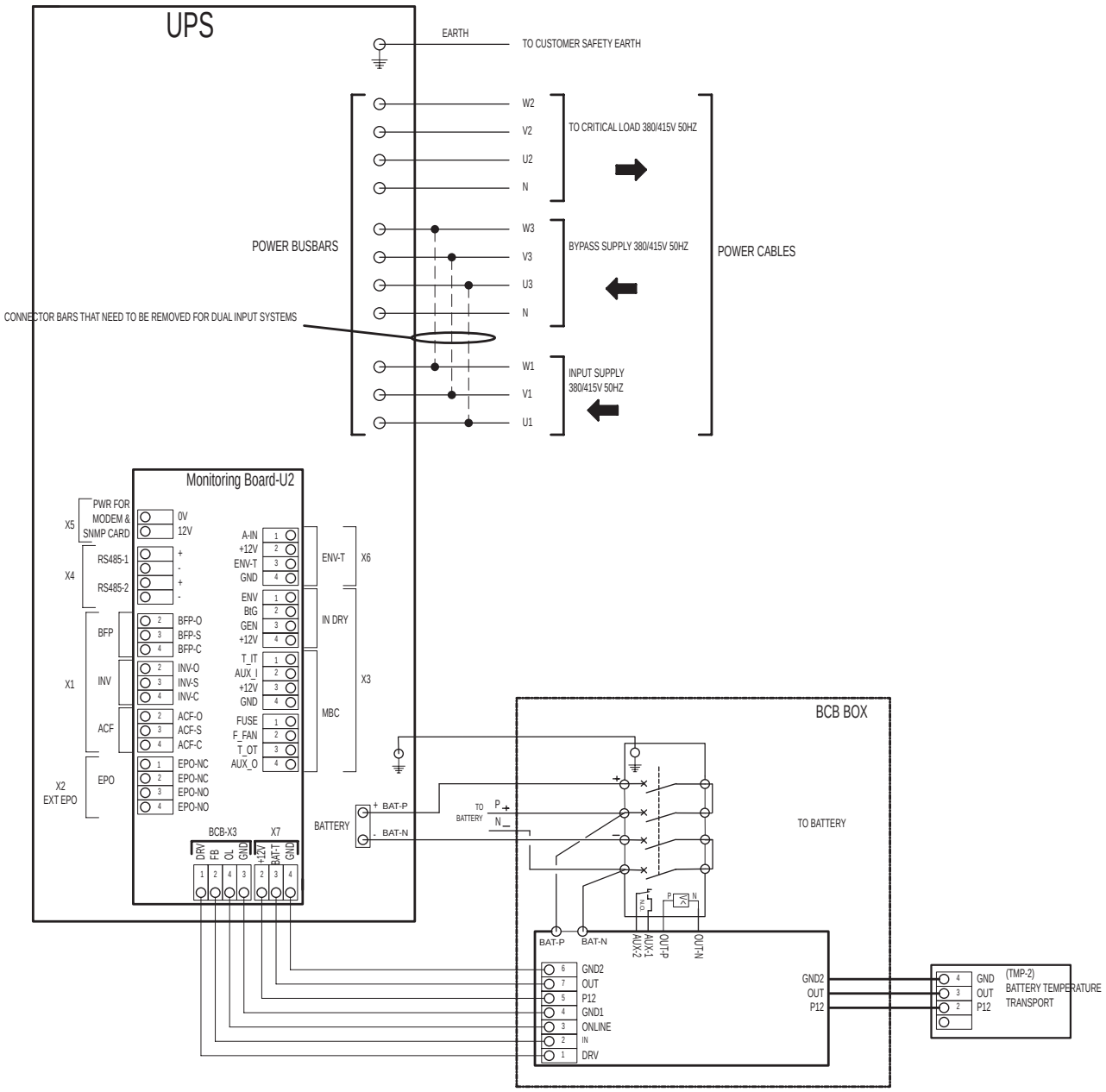
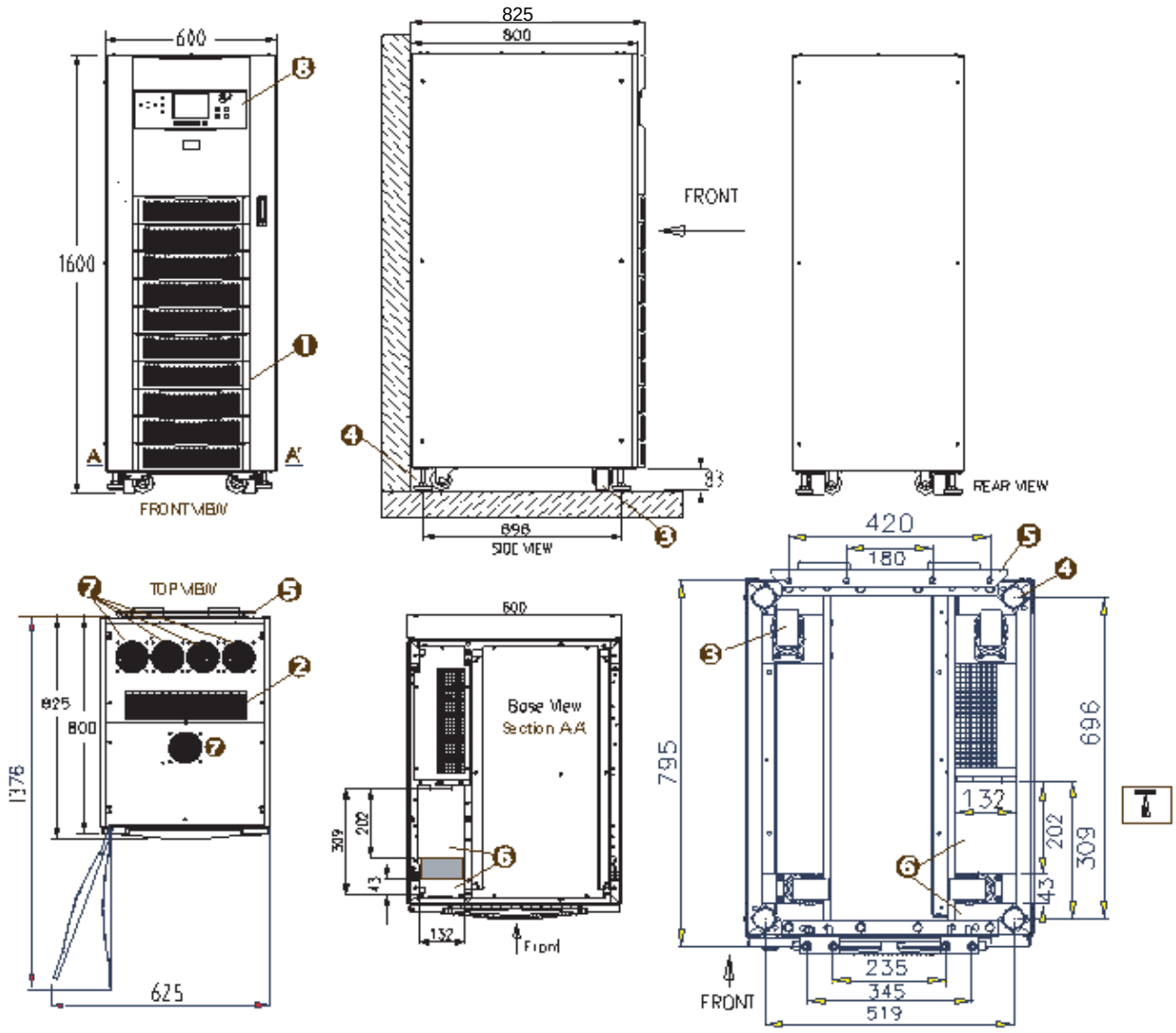


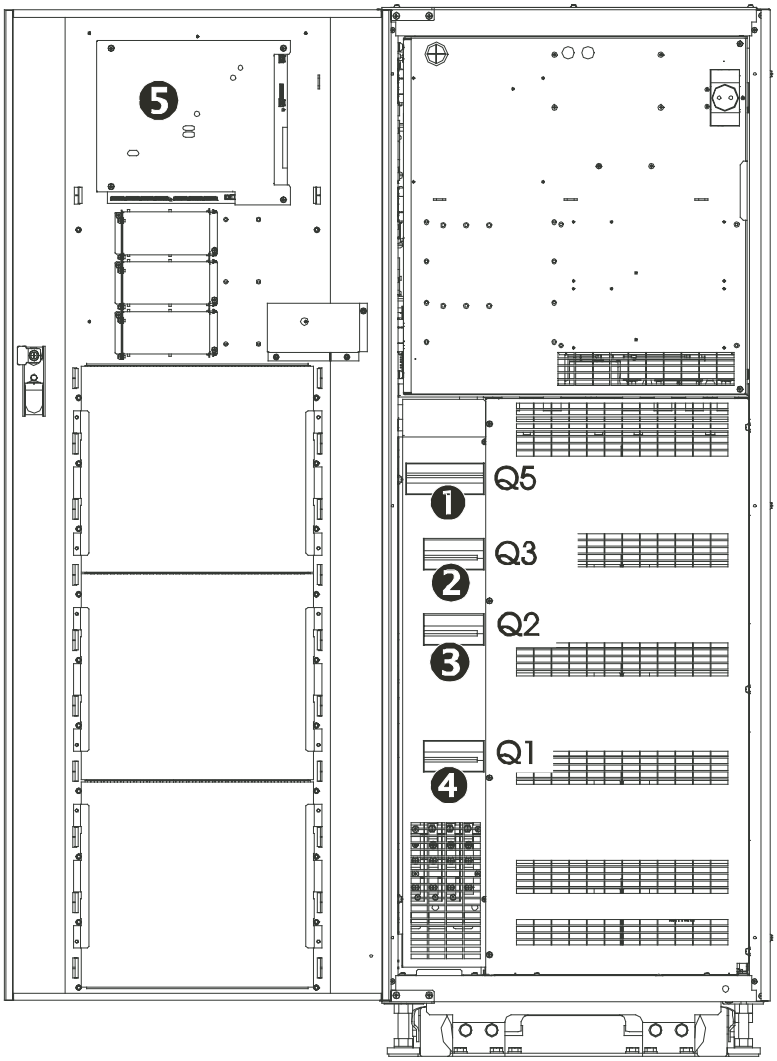
Figure 41 General arrangement—30-40kVA UPS



1) Air inlet grille
2) Air outlet grille
3) Castors for manoevring
4) Adjustable fixing feet
5) Seismic anchors (Optional)
6) Cable entry
7) Fans
8) Operator control and display panel

All dimensions are in mm.

Figure 42 Front view, door open30-40kVA NX

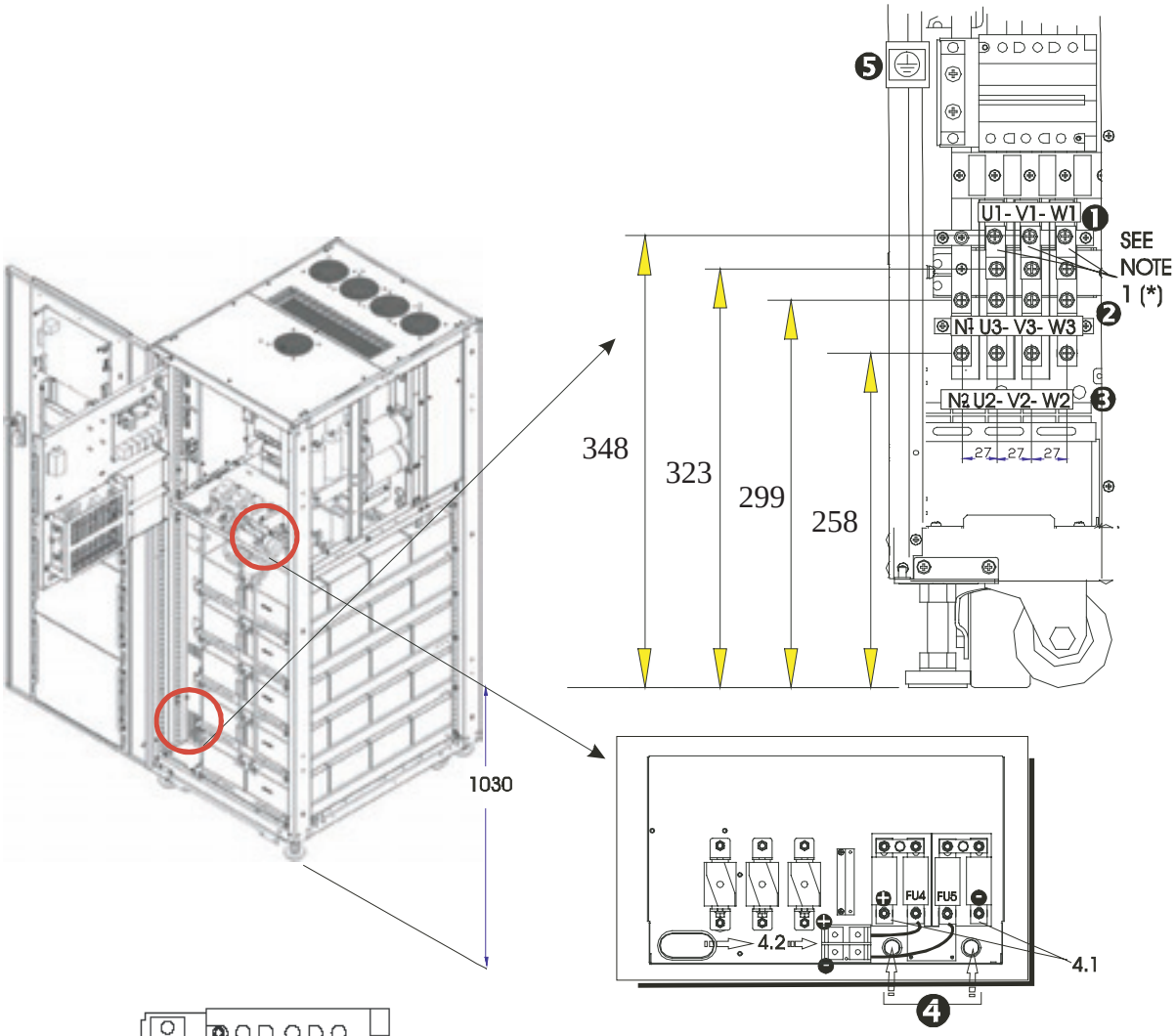


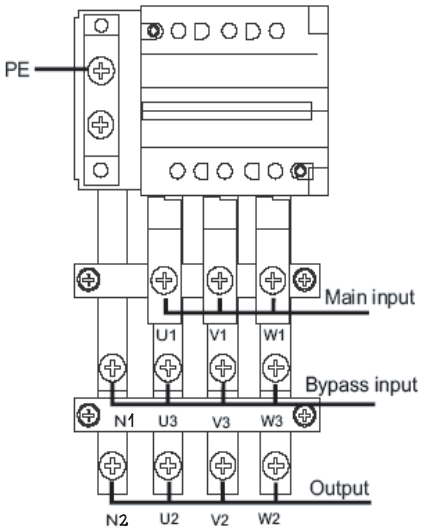
NXa 30-40kVA
Front View

Internal battery trays behind cover
5x (159 x 364 x 685mm) HWD

1) Output Switch—Q5
2) Maintenance Bypass Switch—Q3
3) Bypass Input Switch—Q2
4) Mains Input Switch—Q1
5) Monitor Board—U2

Figure 43 Cable terminal layout—30-40kVA NX





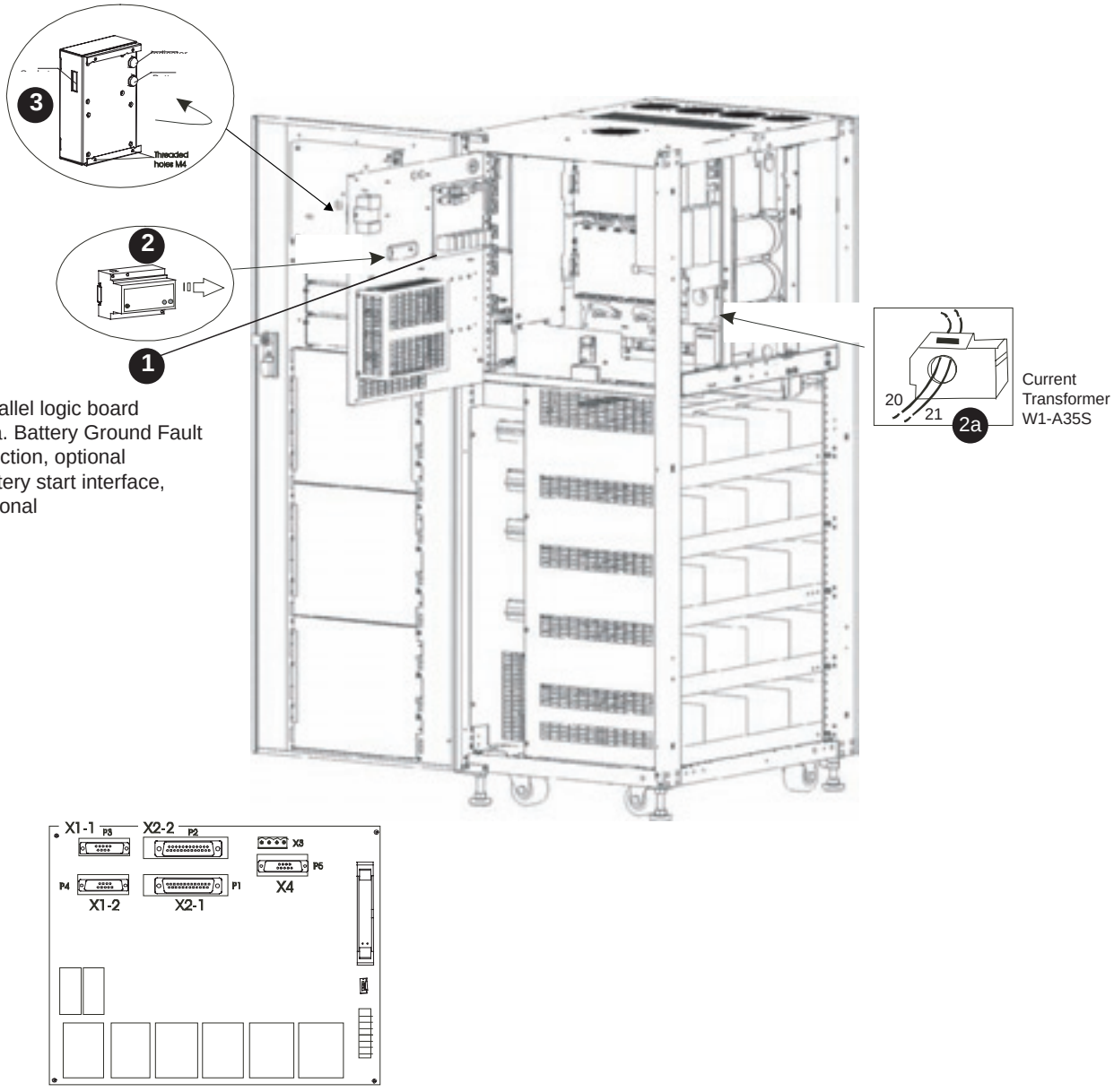
Cable connections

1) Main (Rectifier) connections (N1-U1-V1-W1)
2) Bypass connections (N1-U3-V3-W3)
3) Output connections (N2-U2-V2-W2)
4) Battery connections (+/-)
4.1 > to internal battery
4.2 > to external battery
5) Earth

Note 1: For split Bypass operation ensure that the busbars (*) between Bypass and Rectifier input are removed.

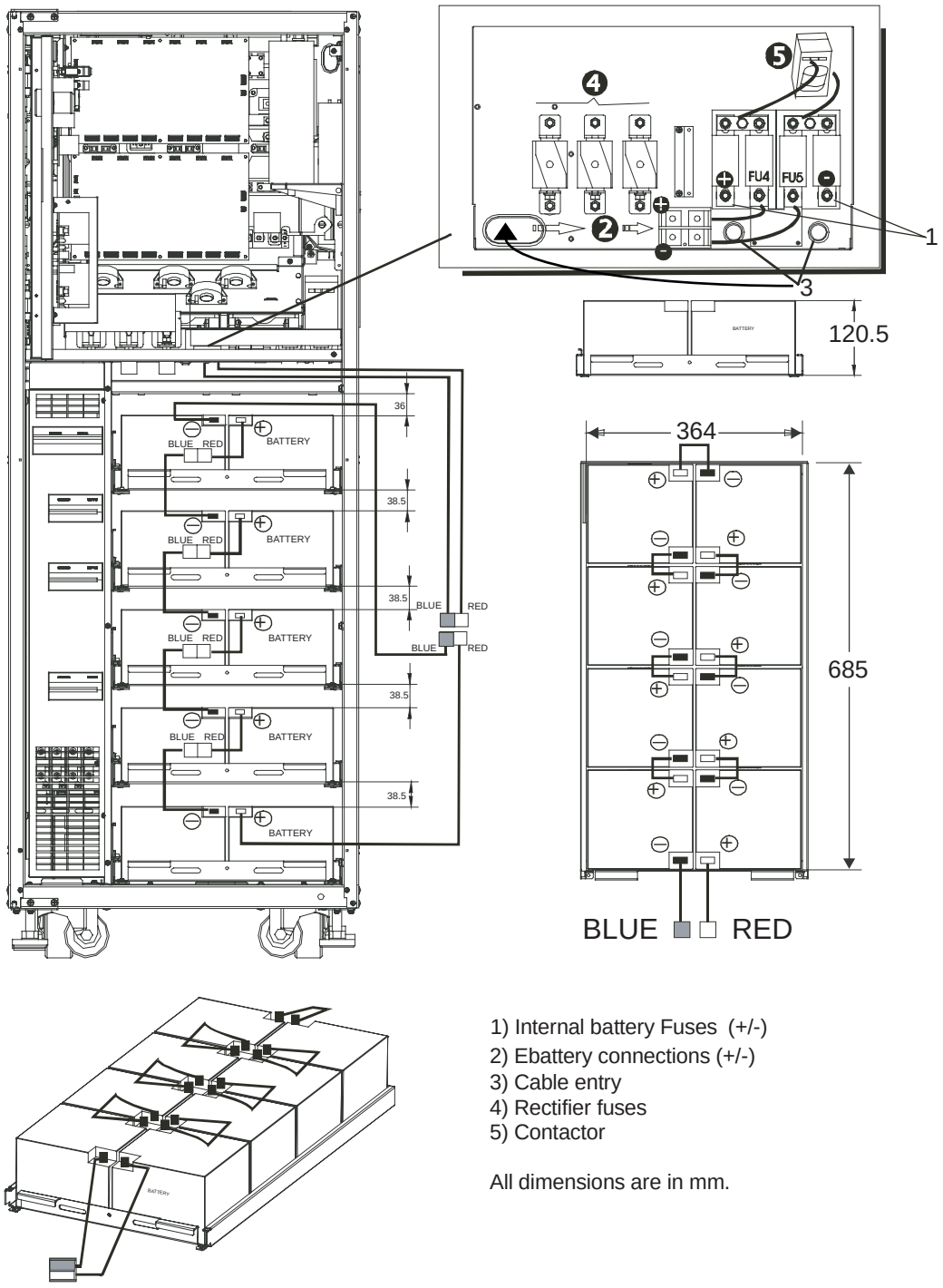
All dimensions are in mm.

Figure 44 Location of parallel logic board M3 and options—30-40kVA NX



1. Parallel logic board
2 & 2a. Battery Ground Fault detection, optional
3. Battery start interface, optional

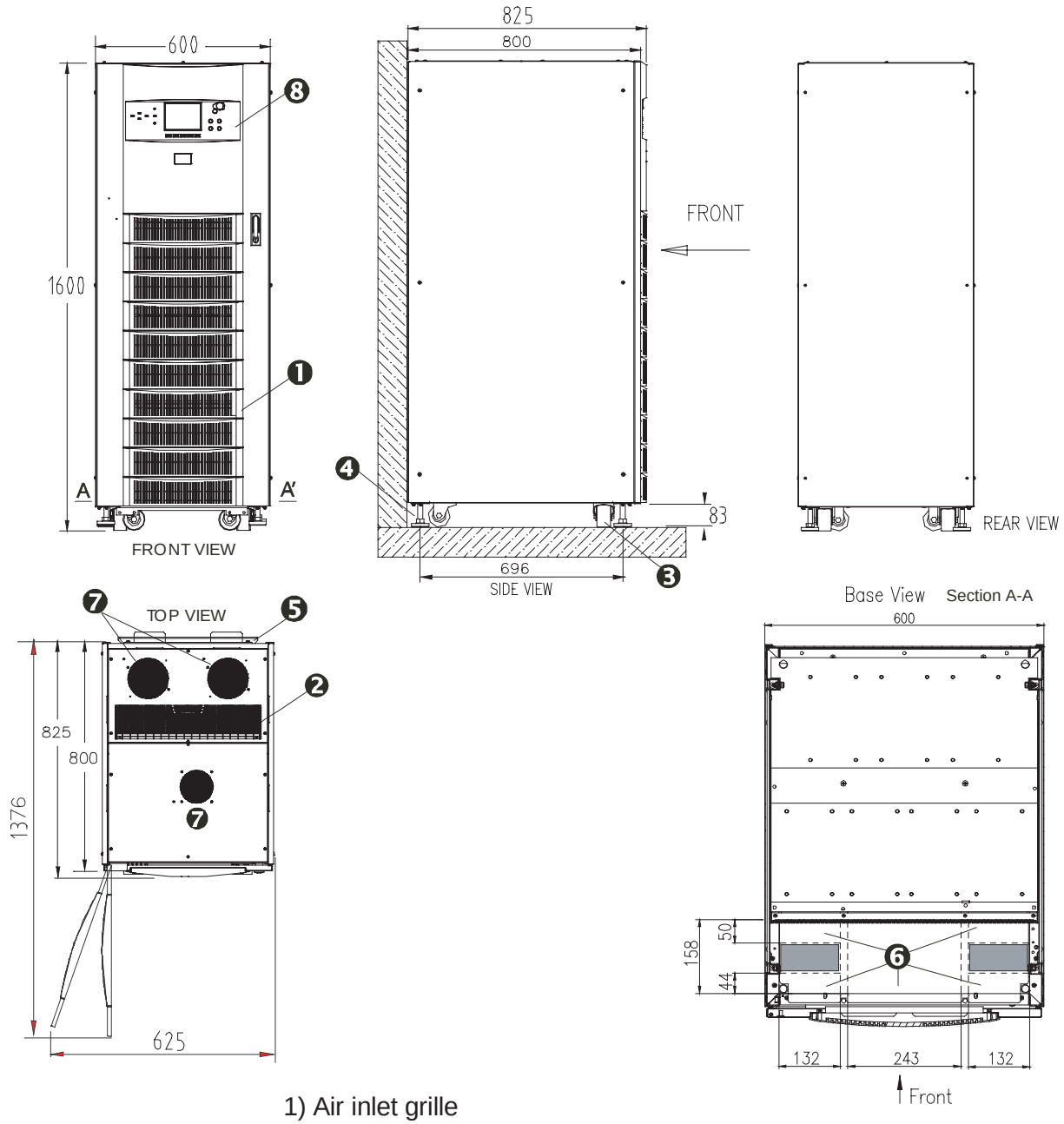
Figure 45 Internal battery layout and connections—30-40kVA NX



1) Internal battery Fuses (+/-)
2) Ebattery connections (+/-)
3) Cable entry
4) Rectifier fuses
5) Contactor

All dimensions are in mm.

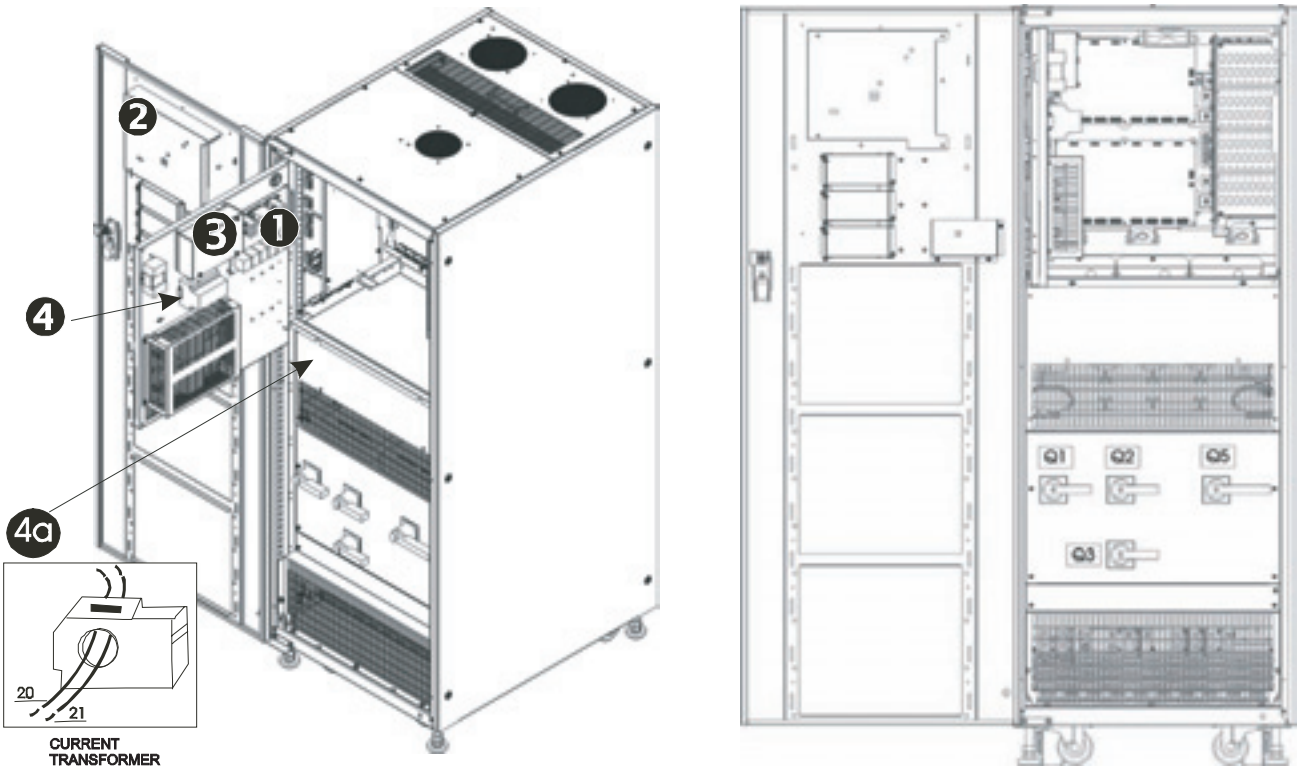
Figure 46 General arrangement—60-80kVA NX



1) Air inlet grille
2) Air outlet grille
3) Castors for manoevring
4) Adjustable fixing feet
5) Seismic anchors (Option)
6) Cable entry
7) Fans
8) Operator control and display panel

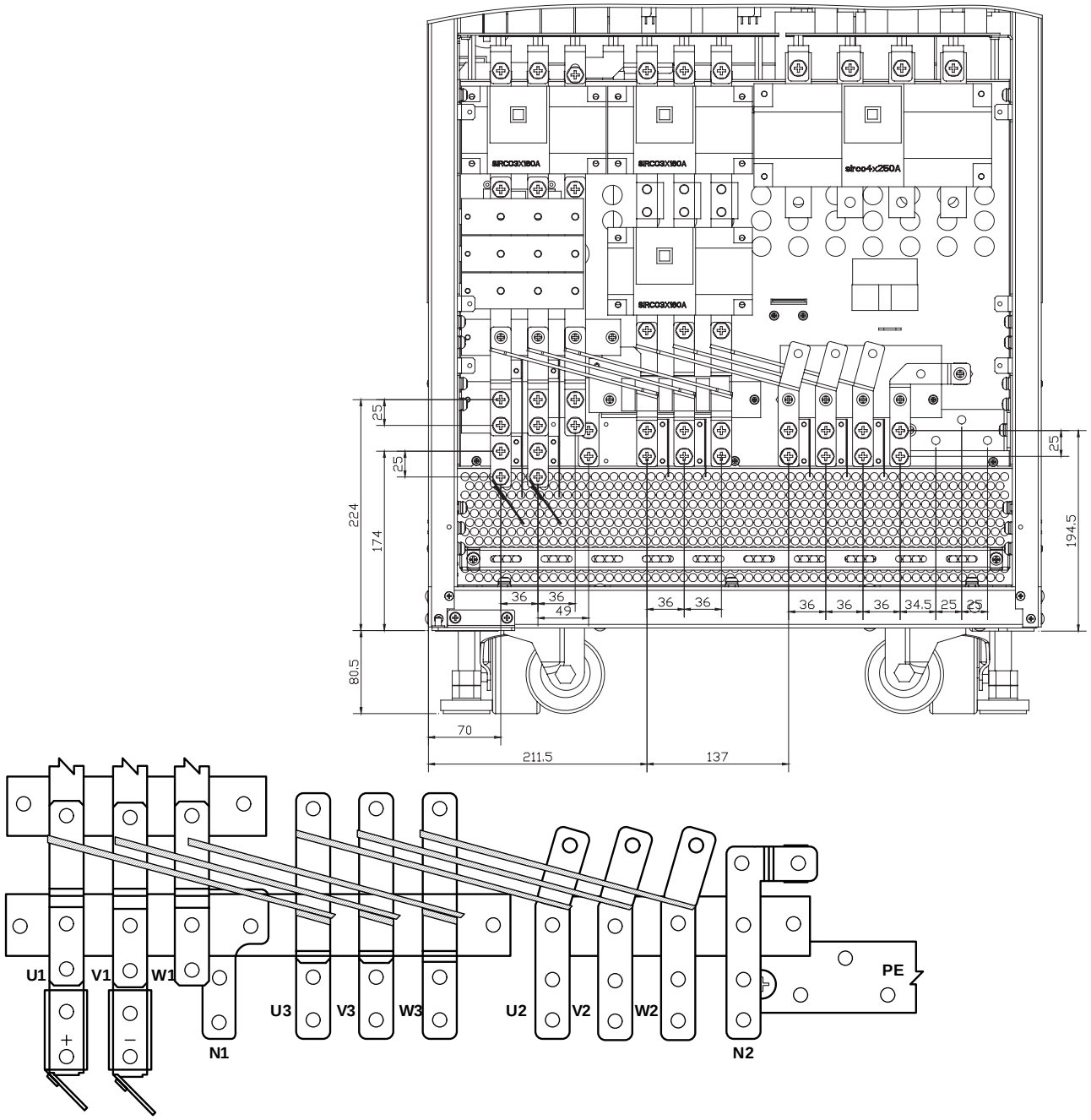
All dimensions are in mm.

Figure 47 Front view doors open—60-80kVA NX



1) Parallel logic board
2) Monitor board
3) Battery start Interface
4 and 4a) Battery Ground Fault detection (optional)

Figure 48 Cable terminal layout—60-80kVA NX



U1	V1	W1	N1	Batt +	Batt -	N1	U3	V3	W3	U2	V2	W2	N2
Input				Batt		Bypass				Output			

1. Main (Rectifier) connections (N1-U1-V1-W1)
2. Bypass connections (N1-U3-V3-W3)
3. Output connections (N2-U2-V2-W2)
4. Battery connections (+ / -)
5. Earth
6. Mains Input isolator (Q1)
7. Bypass Input isolator (Q2)
8. Maintenance bypass isolator (Q3)
9. Output isolator (Q5)

NOTE

1. *For split bypass operation, ensure that the busbars (*) between bypass and rectifier input are removed.*
2. *All dimensions are in millimeters.*

Figure 49 General arrangement—100-120kVA NX

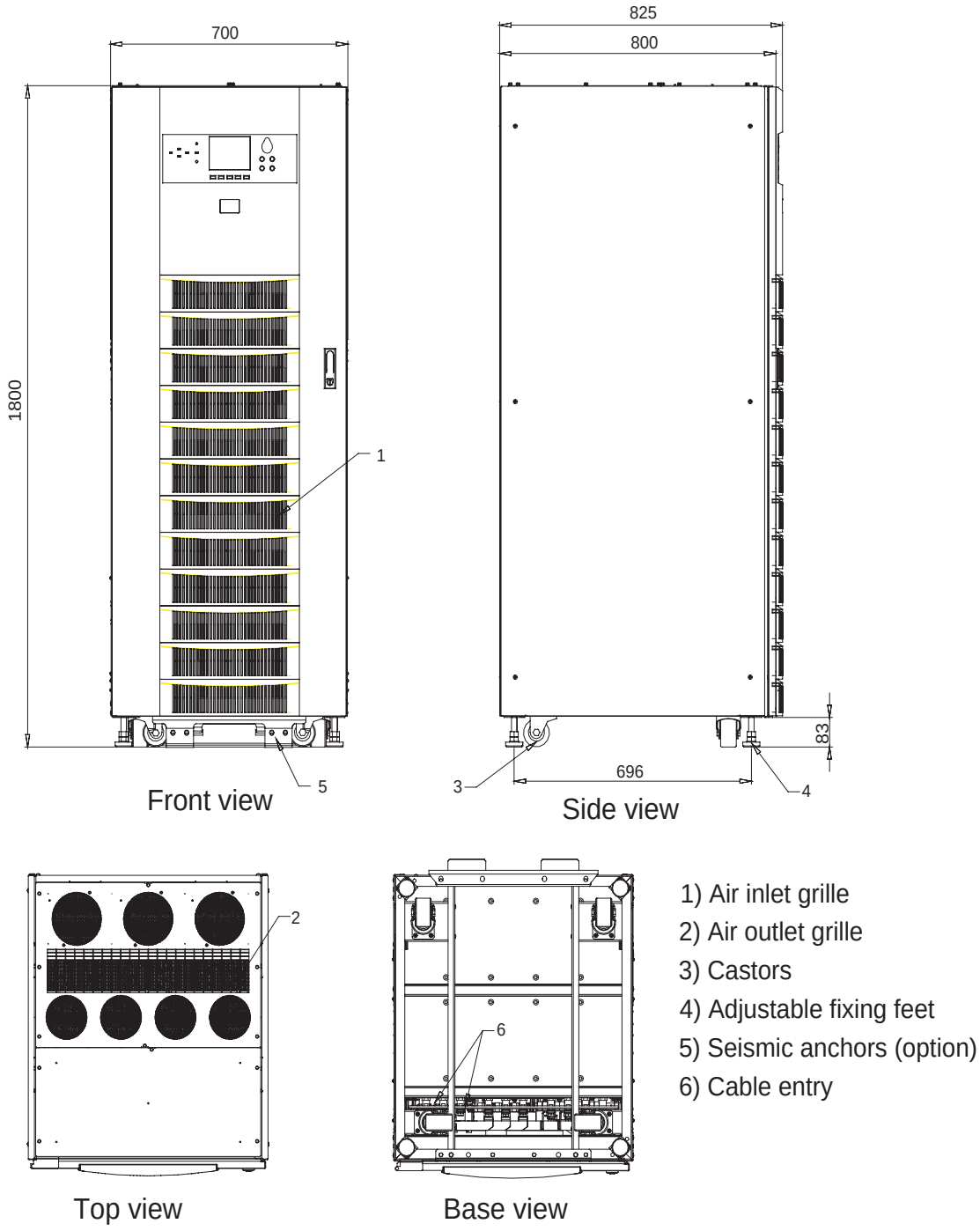


Figure 50 Front view, door open—100-120kVA NX

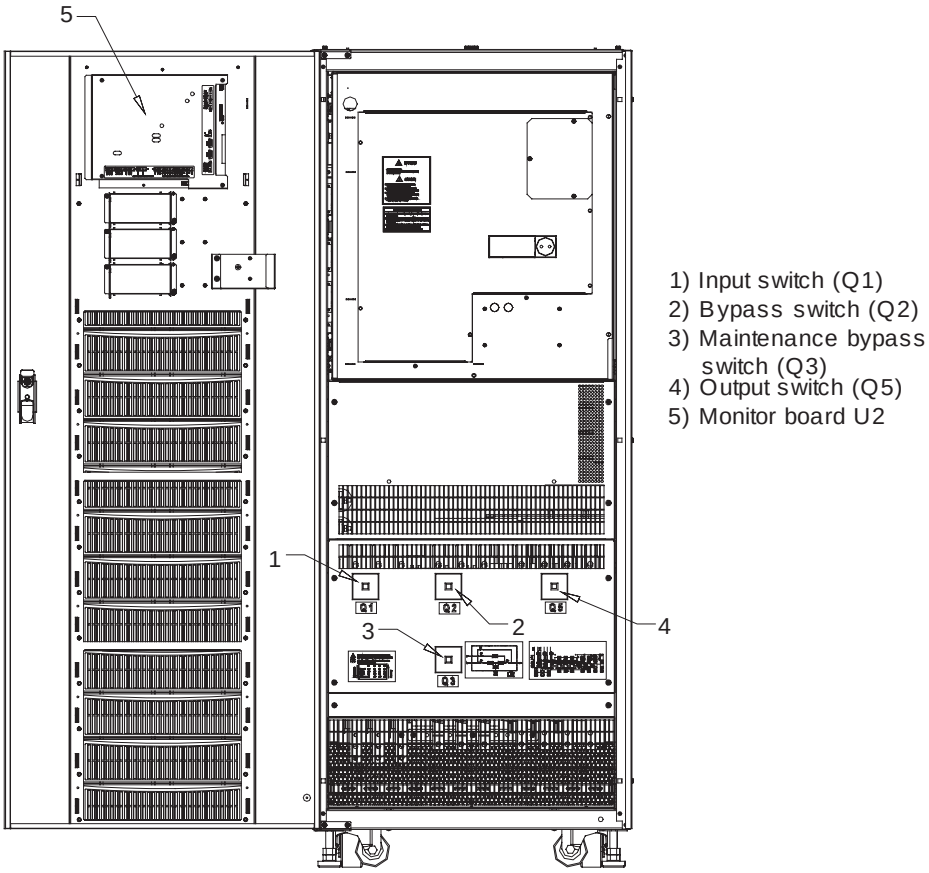


Figure 51 Parallel logic board location—100-120kVA NX

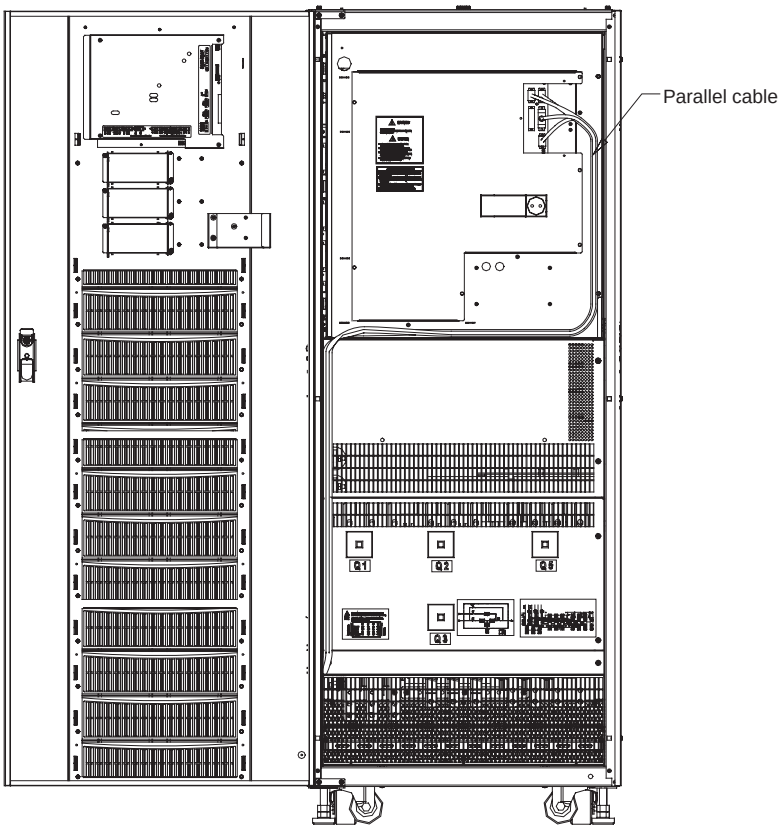
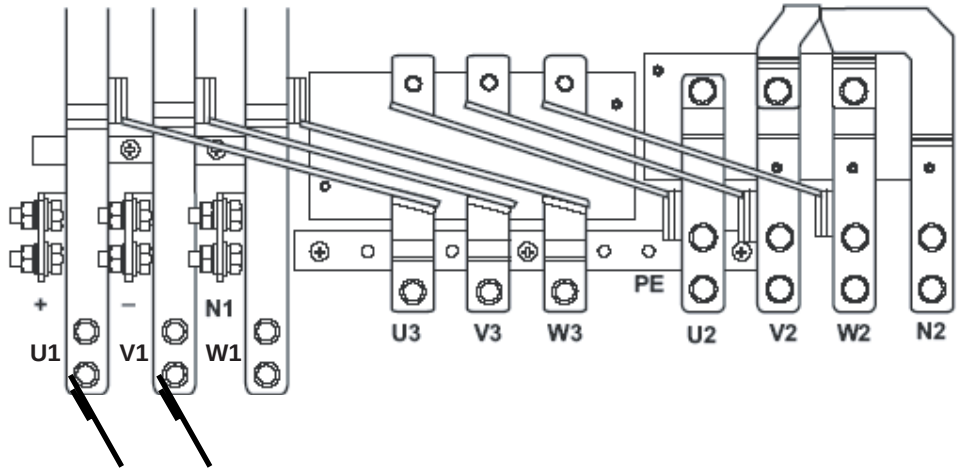
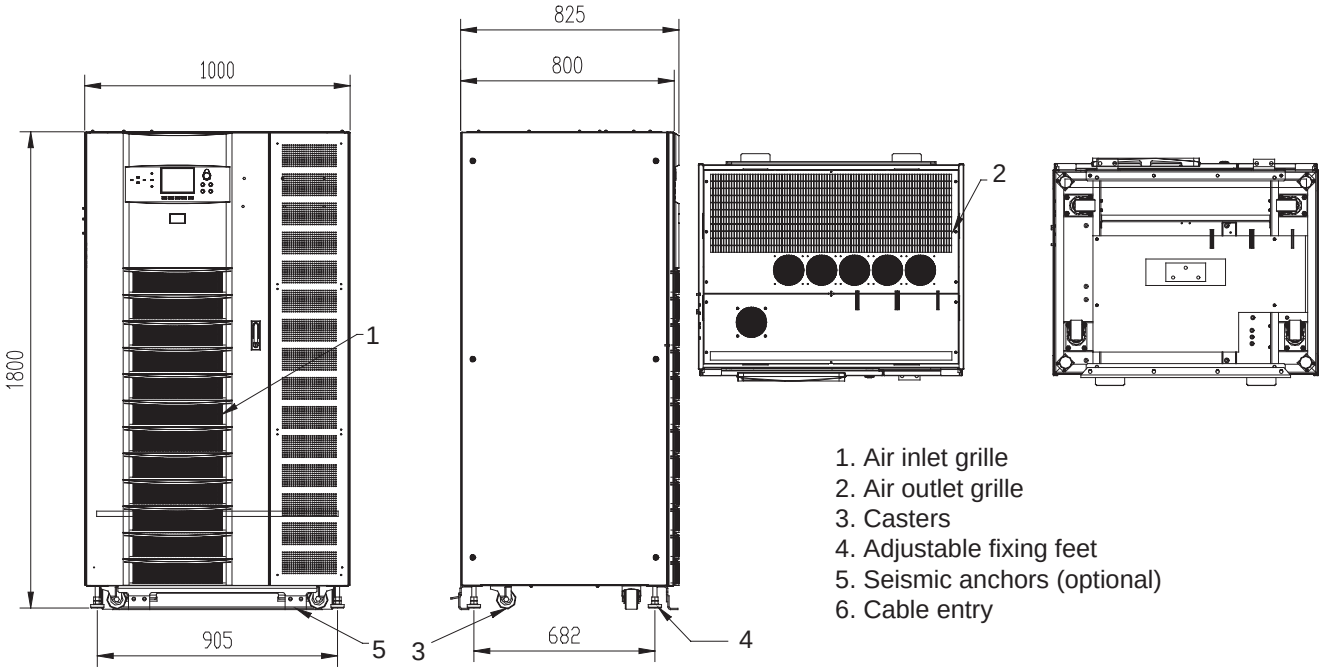


Figure 52 Cable terminal layout—100-120kVA NX



U1	V1	W1	N1	Batt +	Batt -	N1	U3	V3	W3	U2	V2	W2	N2
Input				Batt		Bypass				Output			

Figure 53 General arrangement—140-200kVA NX



1. Air inlet grille
2. Air outlet grille
3. Casters
4. Adjustable fixing feet
5. Seismic anchors (optional)
6. Cable entry

Figure 54 Front view, door open—140-200kVA NX

1. Input switch, Q1
2. Bypass switch, Q2
3. Maintenance bypass switch, Q3
4. Output switch, Q5
5. Monitor board, U2

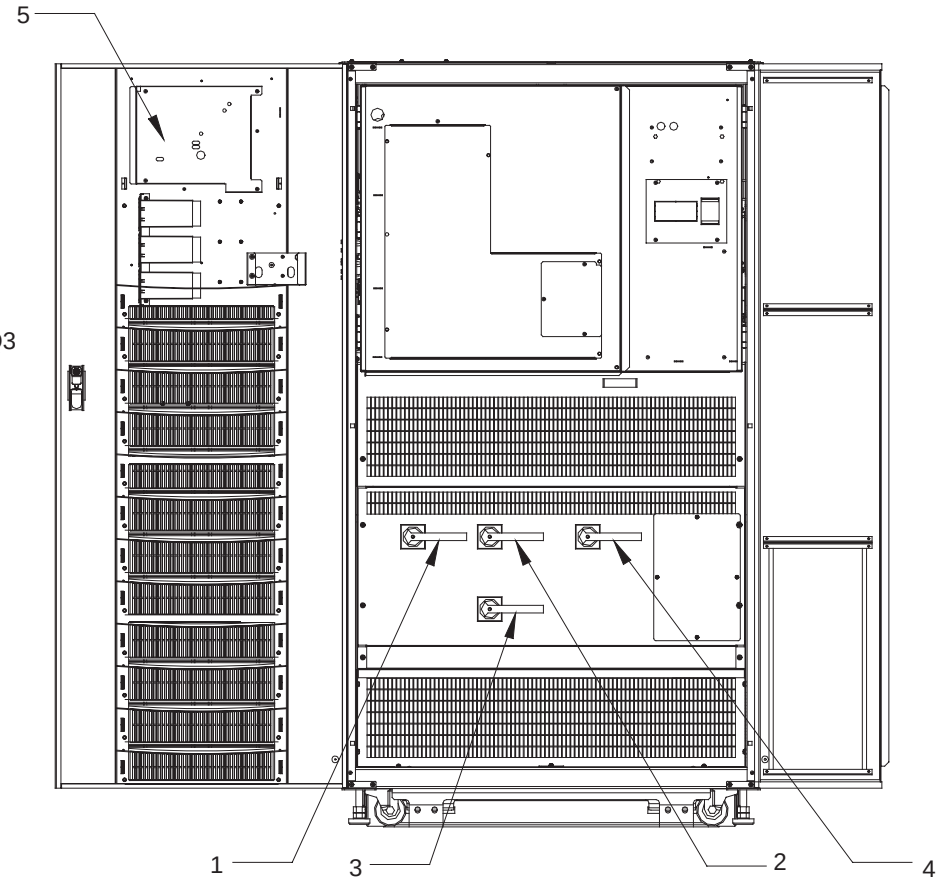


Figure 55 Parallel logic board location—140-200kVA NX

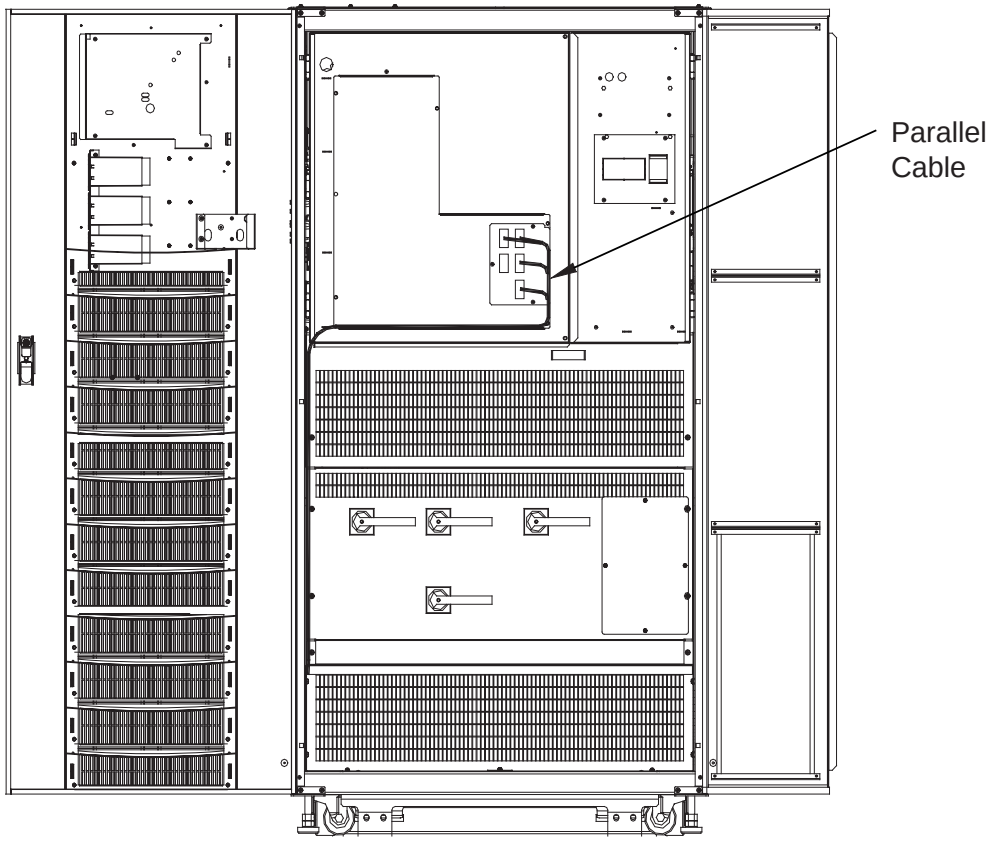
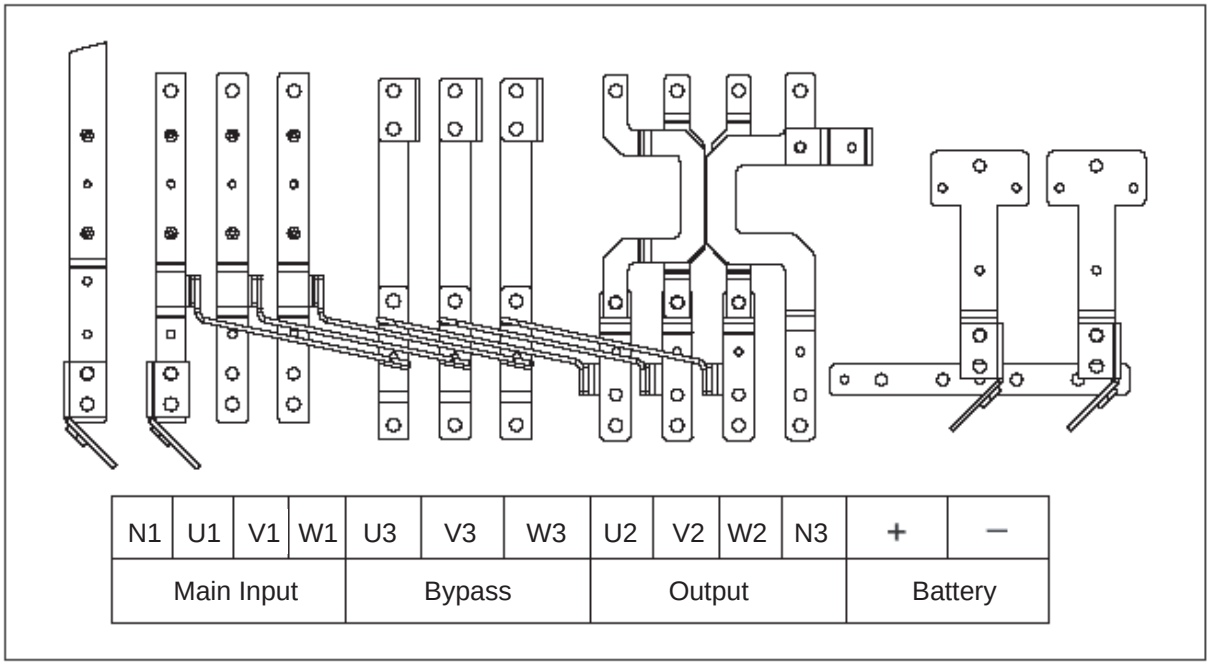


Figure 56 Cable terminal layout—140-200kVA NX



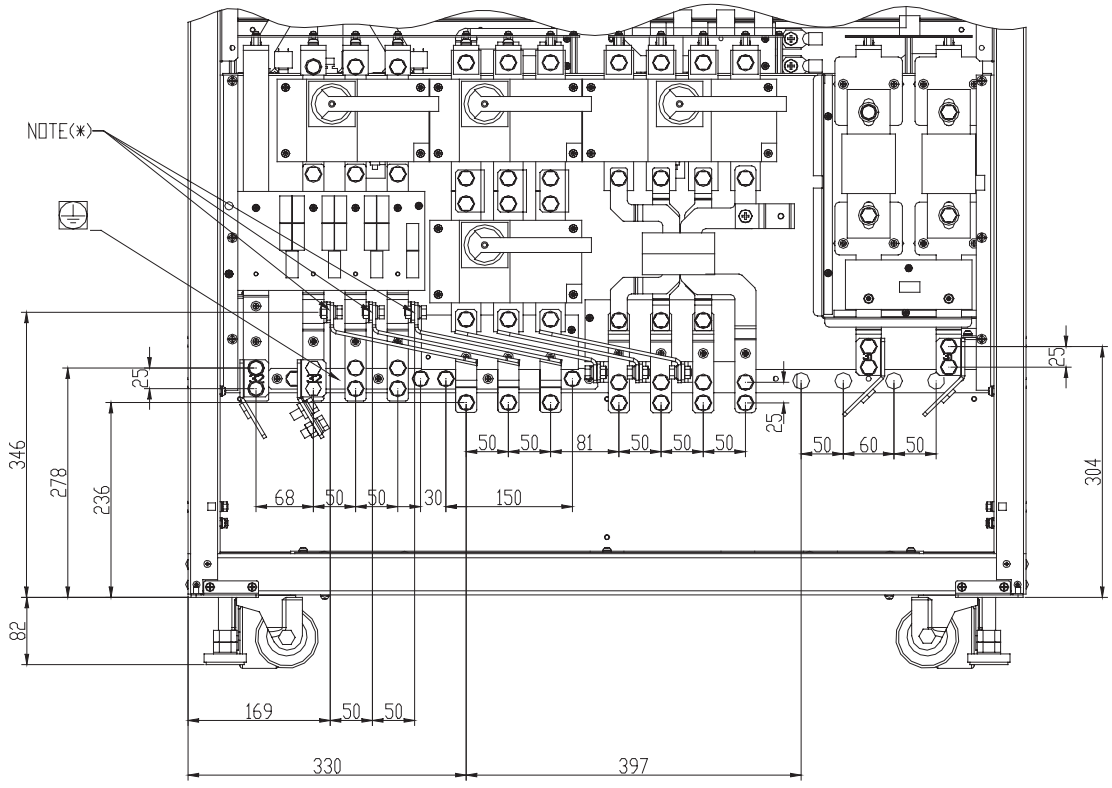


Figure 57 Optional external Maintenance Bypass Cabinet, 600mm wide

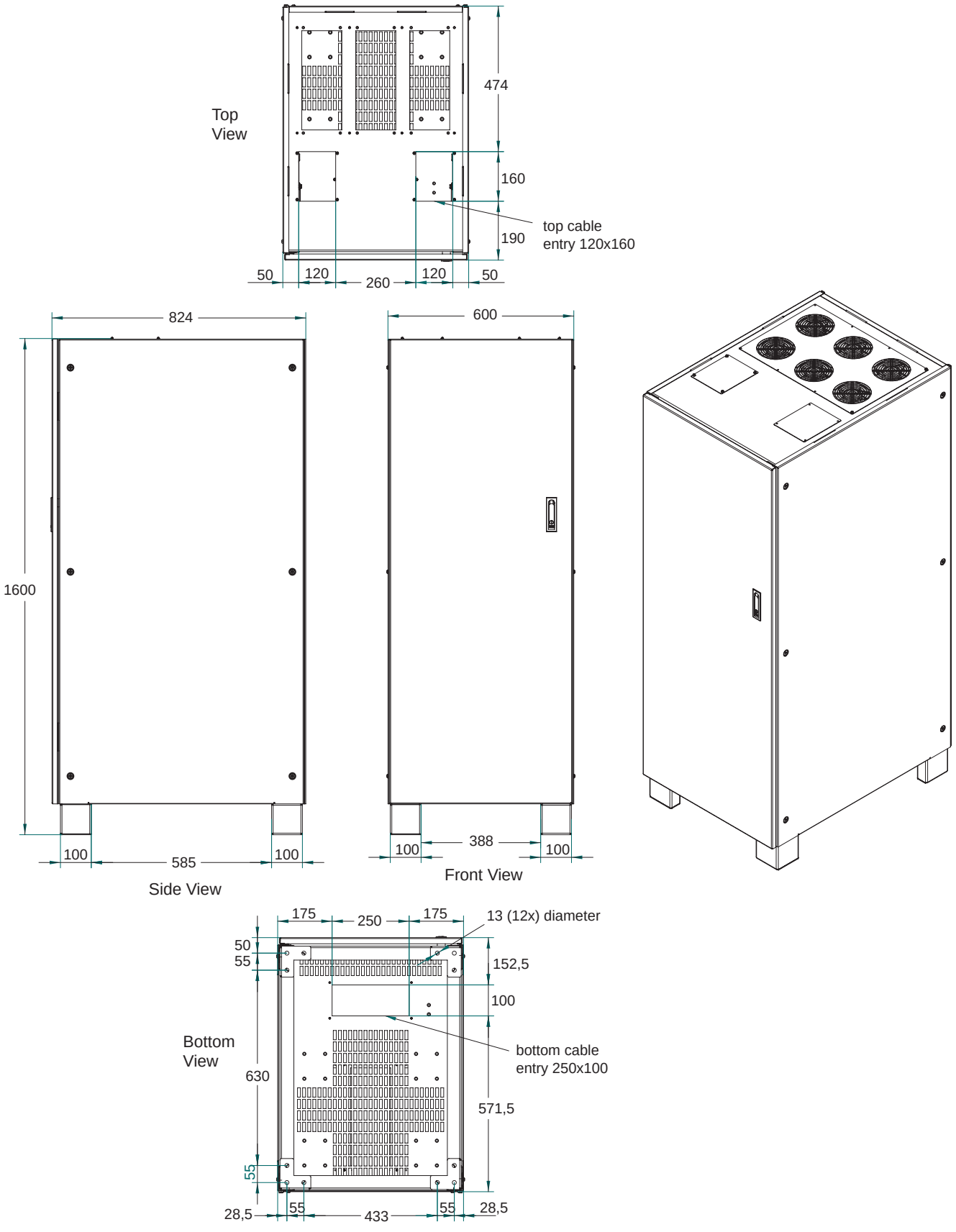


Figure 58 Optional external Maintenance Bypass Cabinet, 800mm wide

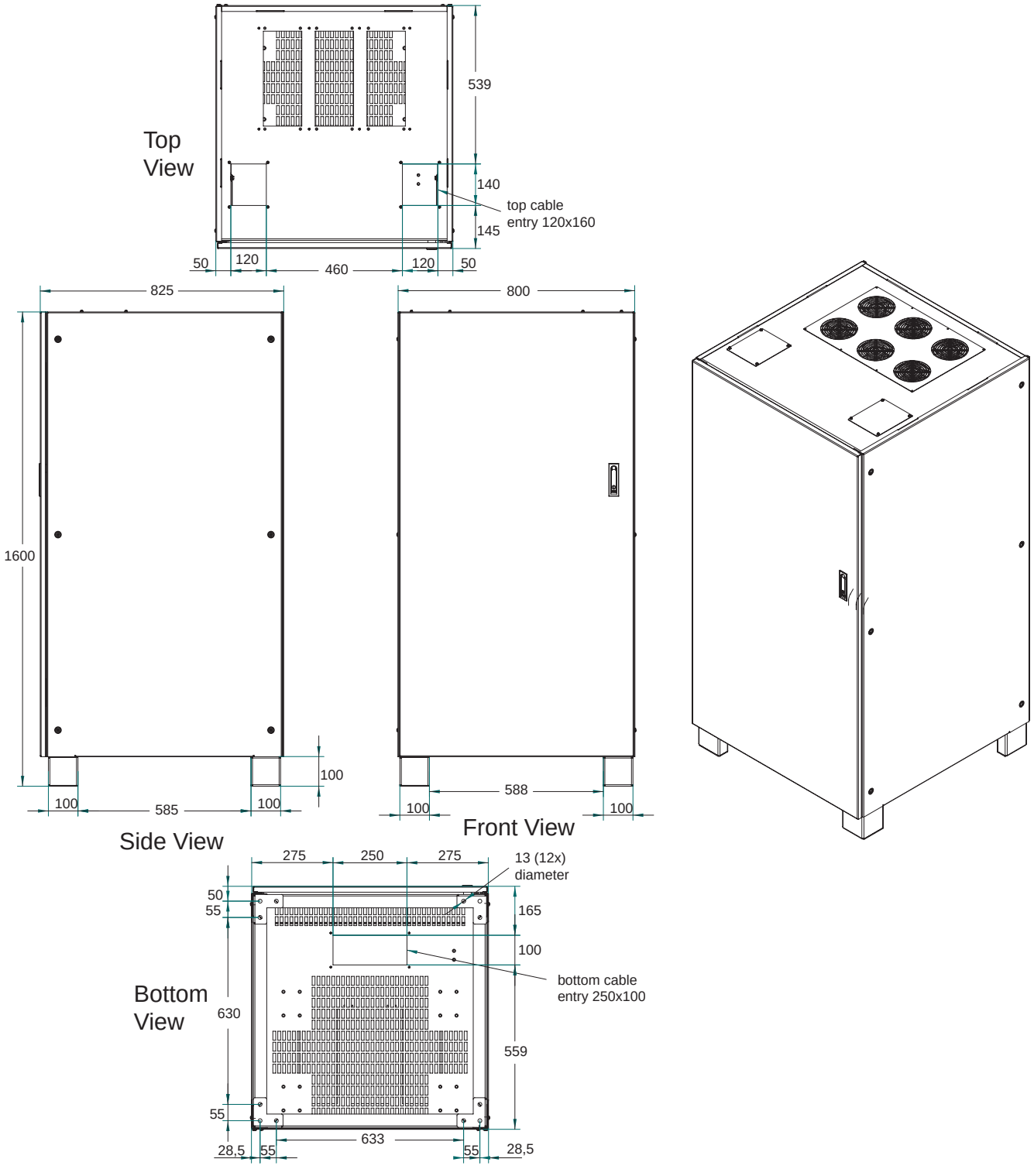


Figure 59 Optional External Maintenance Bypass Cabinet, 850mm wide

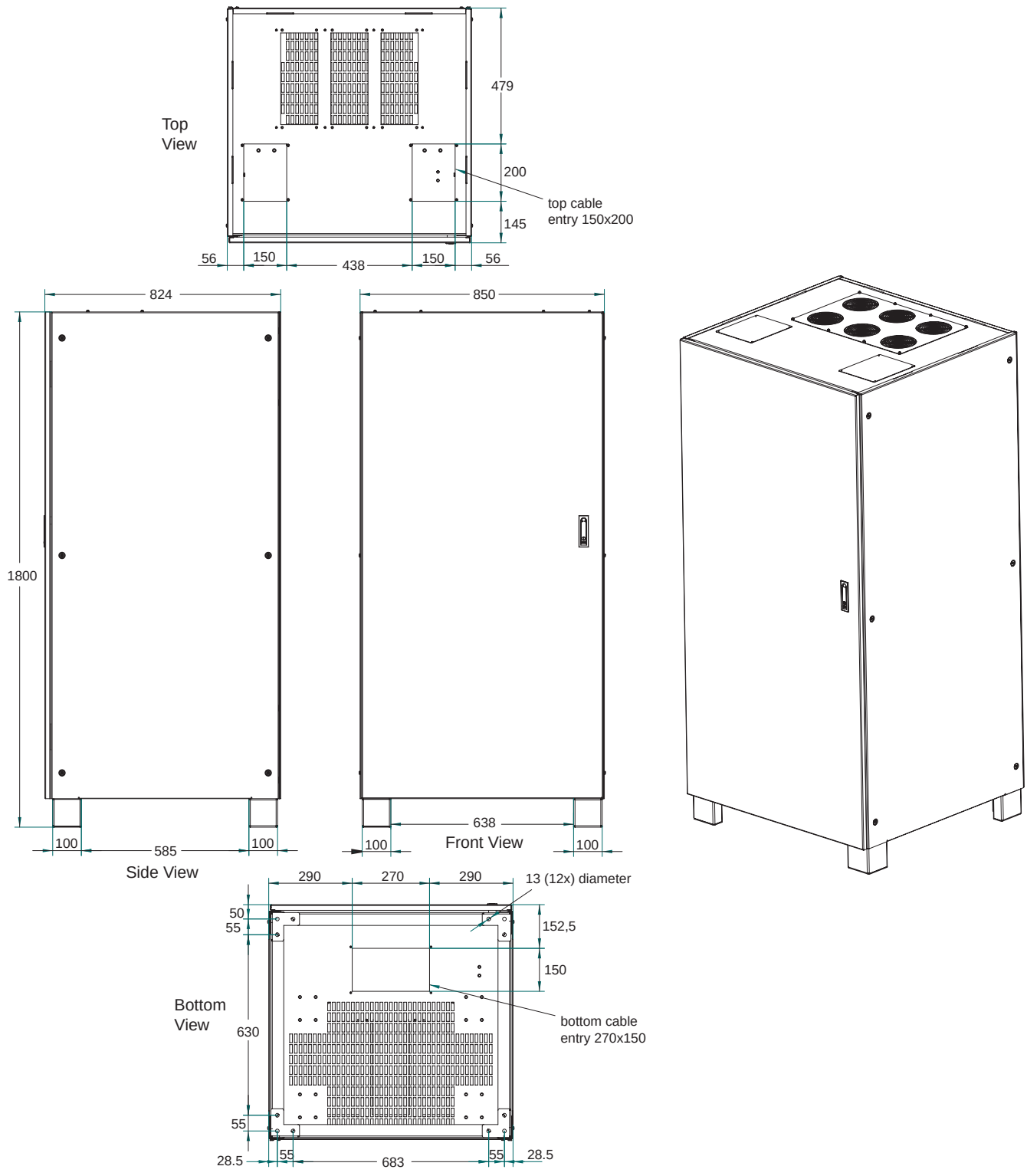


Figure 60 Cabling diagram, 30-200kVA, MBP-T cabinet, configuration 1.1.1

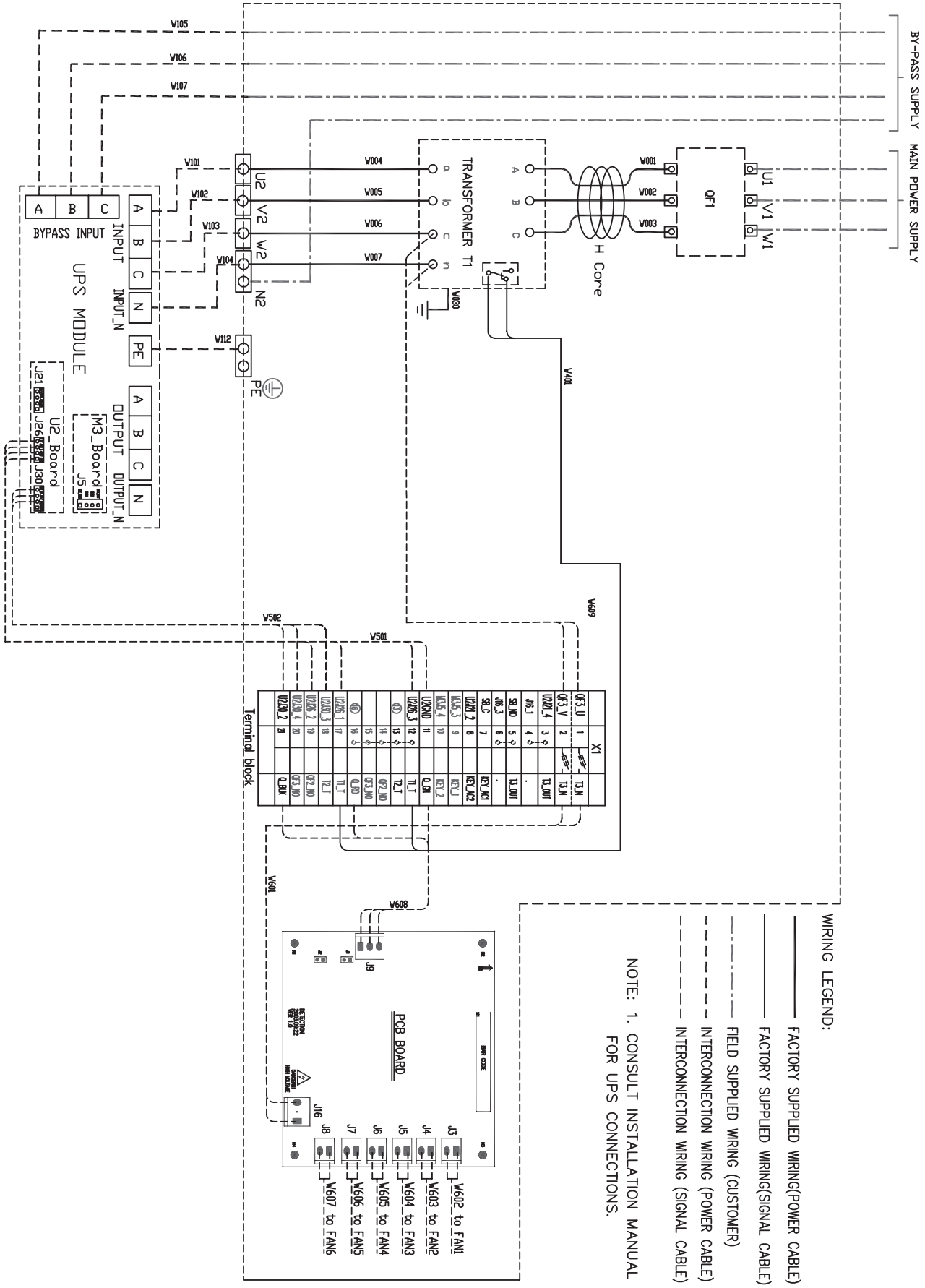


Figure 61 Cabling diagram, 30-200kVA, MBP-T cabinet, configuration 1.1.3

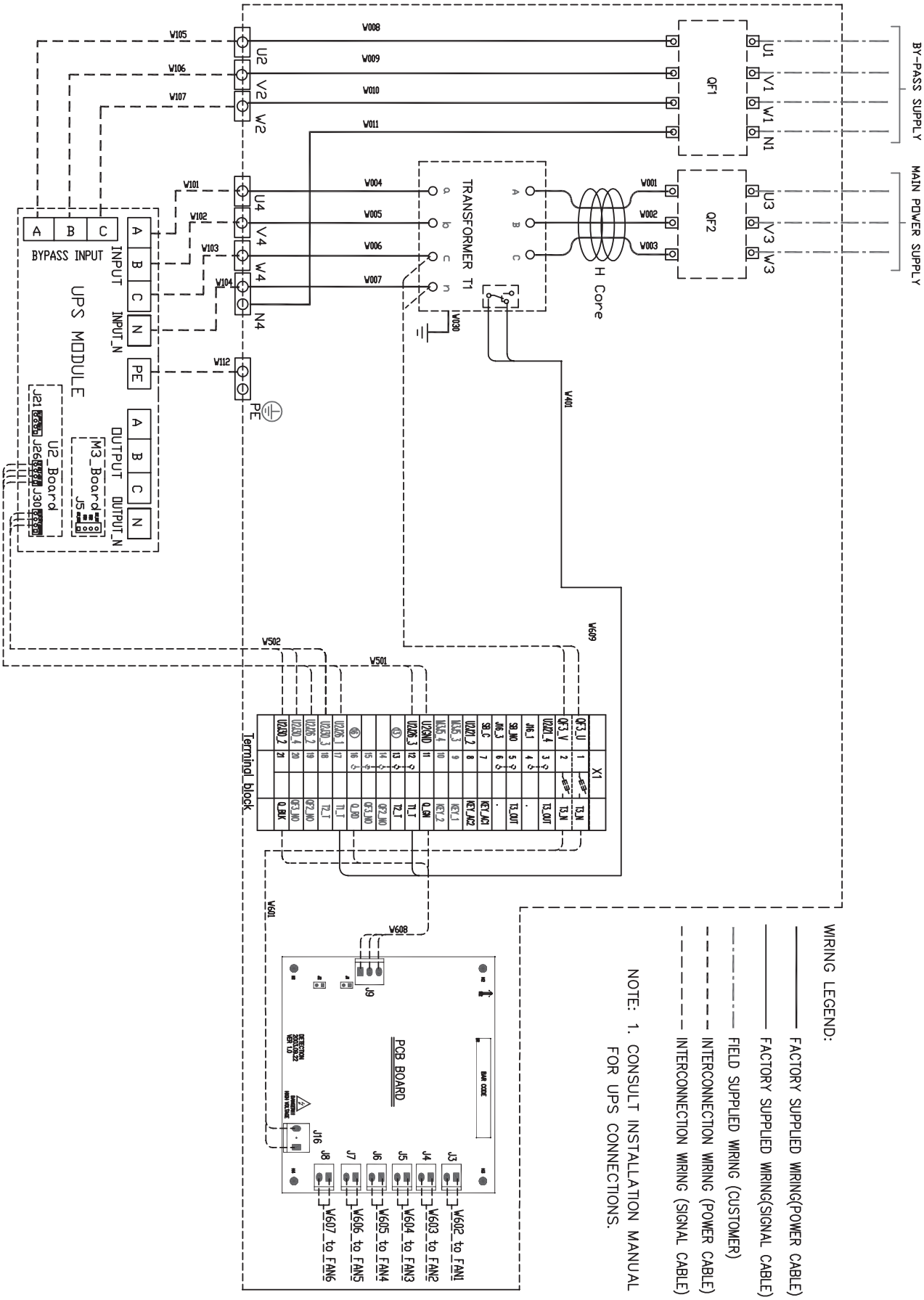
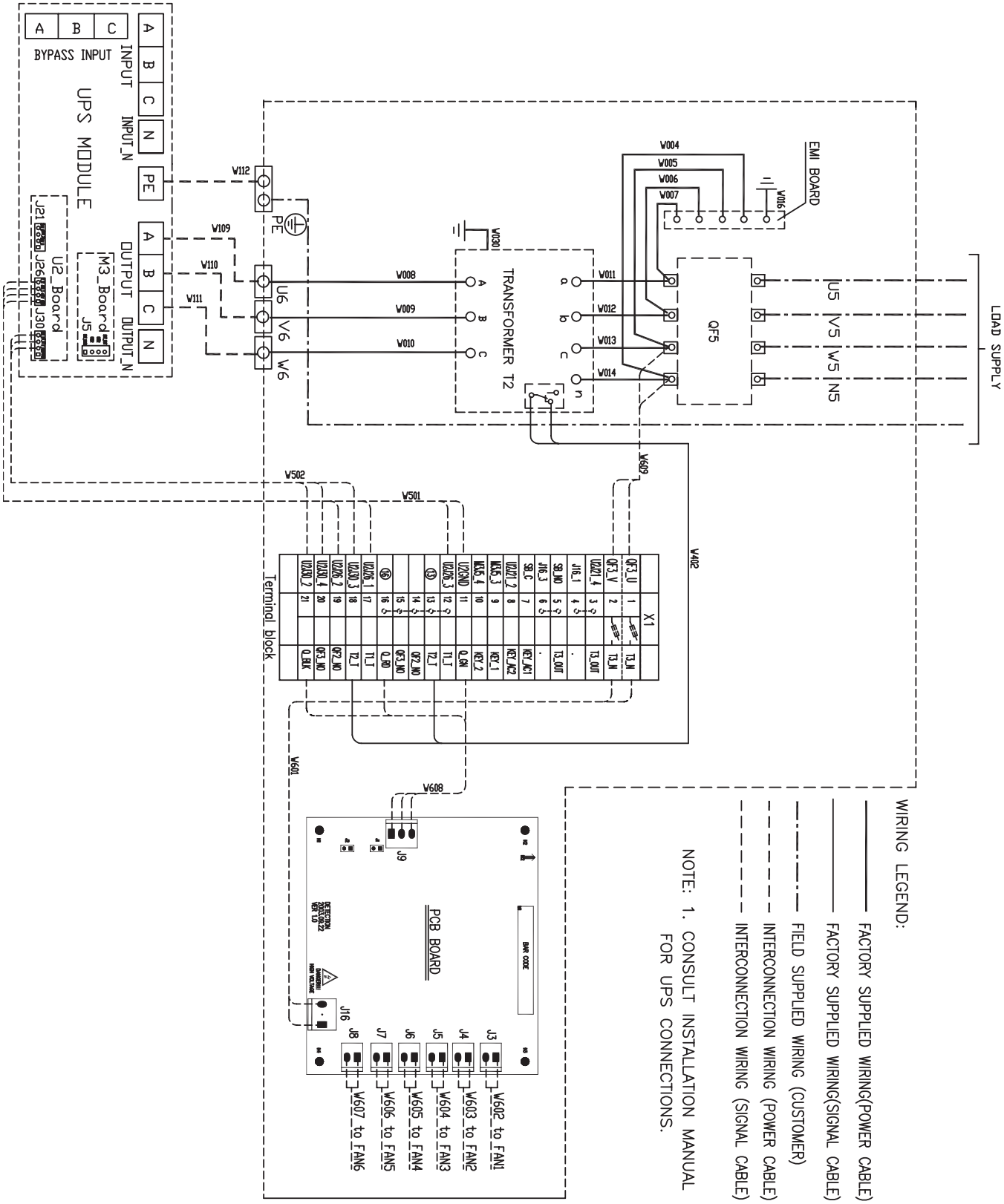


Figure 62 Cabling diagram, 30-200kVA, MBP-T cabinet, configuration 1.1.5



6.0 OPERATION

WARNING

Hazardous mains and / or battery voltage present behind covers.

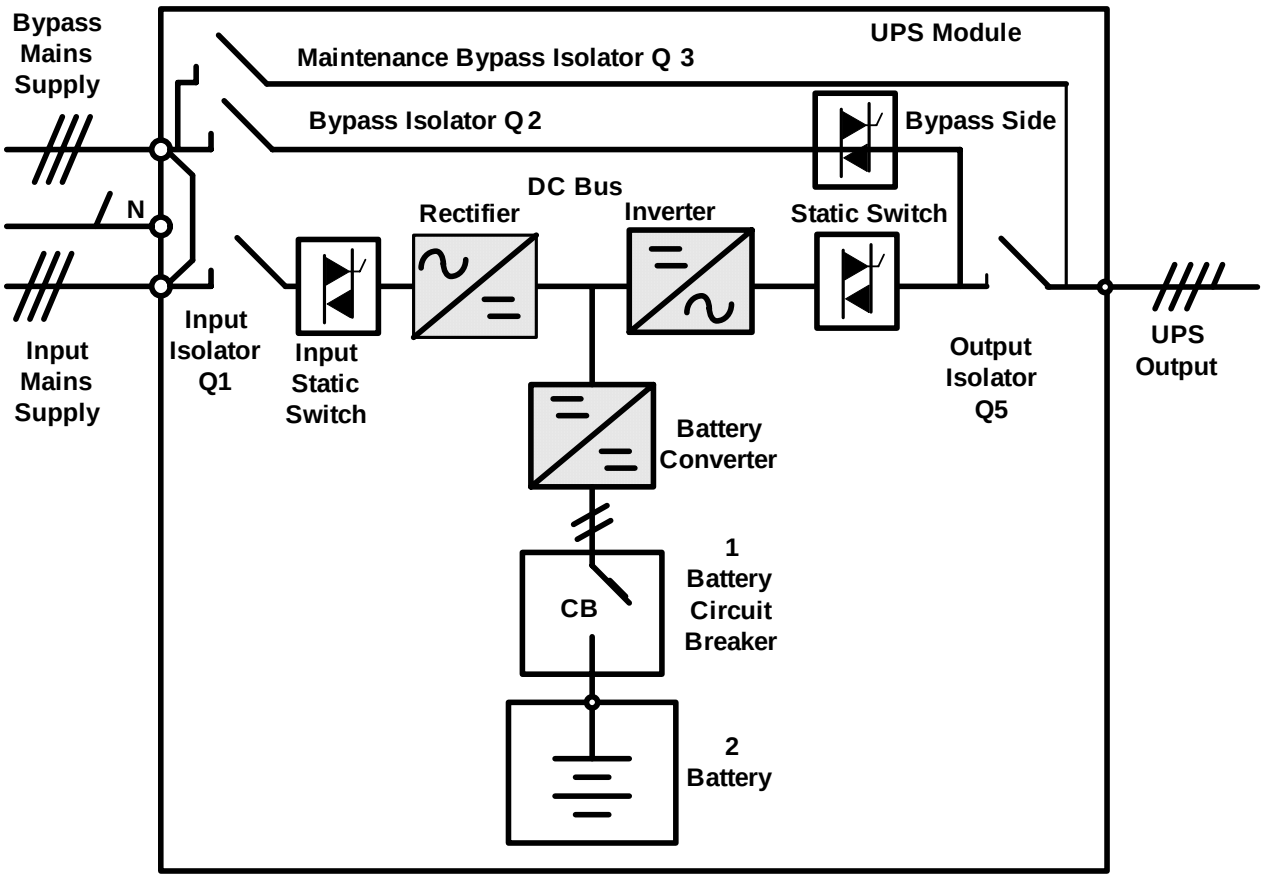
No user-serviceable parts are located behind covers that require a tool for their removal. Only qualified service personnel are authorised to remove such covers.

6.1 Introduction

The Liebert NXa Uninterruptible Power System is connected between the Mains AC input source and the critical load to provide uninterruptible power to the latter. The power from the UPS is free from voltage and frequency variations and from disturbances experienced at the Mains AC input supply. This is achieved through high frequency double conversion power pulse width modulation (PWM) associated with full digital signal processing control (DSP).

As shown in **Figure 63**, the AC input mains source is supplied at Q1 and converted into a DC source. This DC source feeds a DC/DC Bidirectional Battery Converter (that ensures the battery to remain charged at all times) and at the same time feeds the Inverter that converts the DC source into a clean and input independent AC source. The battery powers the load through the bidirectional battery converter and through the inverter in case of an AC input mains power failure. In case of Inverter unavailability or excessive overload, the load may also be powered from an external AC Bypass source through input isolator Q2 and the static bypass. Besides this, if maintenance or repair of the UPS is necessary, the UPS can support the load through the internal and manually controlled maintenance bypass isolator Q3. With the exception of the maintenance bypass isolator, all the isolators shown are closed during normal UPS operation.

Figure 63 Single unit block diagram with split-bypass input



6.1.1 Split-Bypass Input

Figure 63 illustrates the Liebert NX UPS in what is known as the **split-bypass** configuration wherein a separate power switch to a dedicated bypass power source that also feeds the maintenance bypass line connects the static bypass line. Where a separate power source is not available, the bypass and rectifier input supply connections are linked.

6.1.2 Static Transfer Switch

The circuit blocks labeled **Static Switch** in **Figure 63** contain electronically controlled switching circuits that enable the critical load to be connected to either the inverter output or to a bypass power source via the static bypass line. During normal system operation the load is connected to the inverter; but in the event of a UPS overload or inverter failure, the load is automatically transferred to the static bypass line.

To provide a clean (no-break) load transfer between the inverter output and static bypass line, the static switch activates, connecting the load to bypass. To achieve this, the inverter output and bypass supply must be fully synchronized during normal operating conditions. This is achieved through the inverter control electronics, which make the inverter frequency track that of the static bypass supply, provided that the bypass remains within an acceptable frequency window.

A manually controlled, maintenance bypass supply is incorporated into the UPS design. It enables the critical load to be powered from the utility (bypass) supply while the UPS is shut down for routine maintenance.

NOTE
When the UPS is operating in bypass mode or on maintenance bypass, the connected equipment is not protected from power failures or surges and sags.

6.1.3 Battery Circuit Breaker

Any external battery is connected to UPS through a circuit breaker fitted inside the battery cabinet – or located adjacent to the batteries where a battery cabinet is not used. This circuit breaker is closed manually, but it contains an undervoltage release coil, which enables it to be tripped from the UPS control electronics following certain detected faults. It also has a magnetic trip facility for overload protection. The undervoltage release coil control is replaced by a battery contactor located inside the UPS fitted with either internal batteries or with battery start option or both

6.1.4 Battery Temperature Compensation

For 30-40kVA UPS with internal batteries, a standard temperature probe is installed to measure the internal battery temperature to optimize battery management. The measured temperature can be displayed from the UPS front panel.

For UPS with external batteries, an optional battery temperature interface equally optimises the external battery management by connecting up to four external temperature sensors from the battery cabinet(s) to a control unit inside the UPS.

For details, refer to **Figure 27**.)

6.1.5 Redundant Control Power Supply Board

The UPS is equipped with two identical and fully redundant control power supply boards. Each of them takes inputs from the AC and DC sources. When one of the sources or even if one of the control power boards fails, the UPS system can still operate normally. This feature further enhances the reliability of the system.

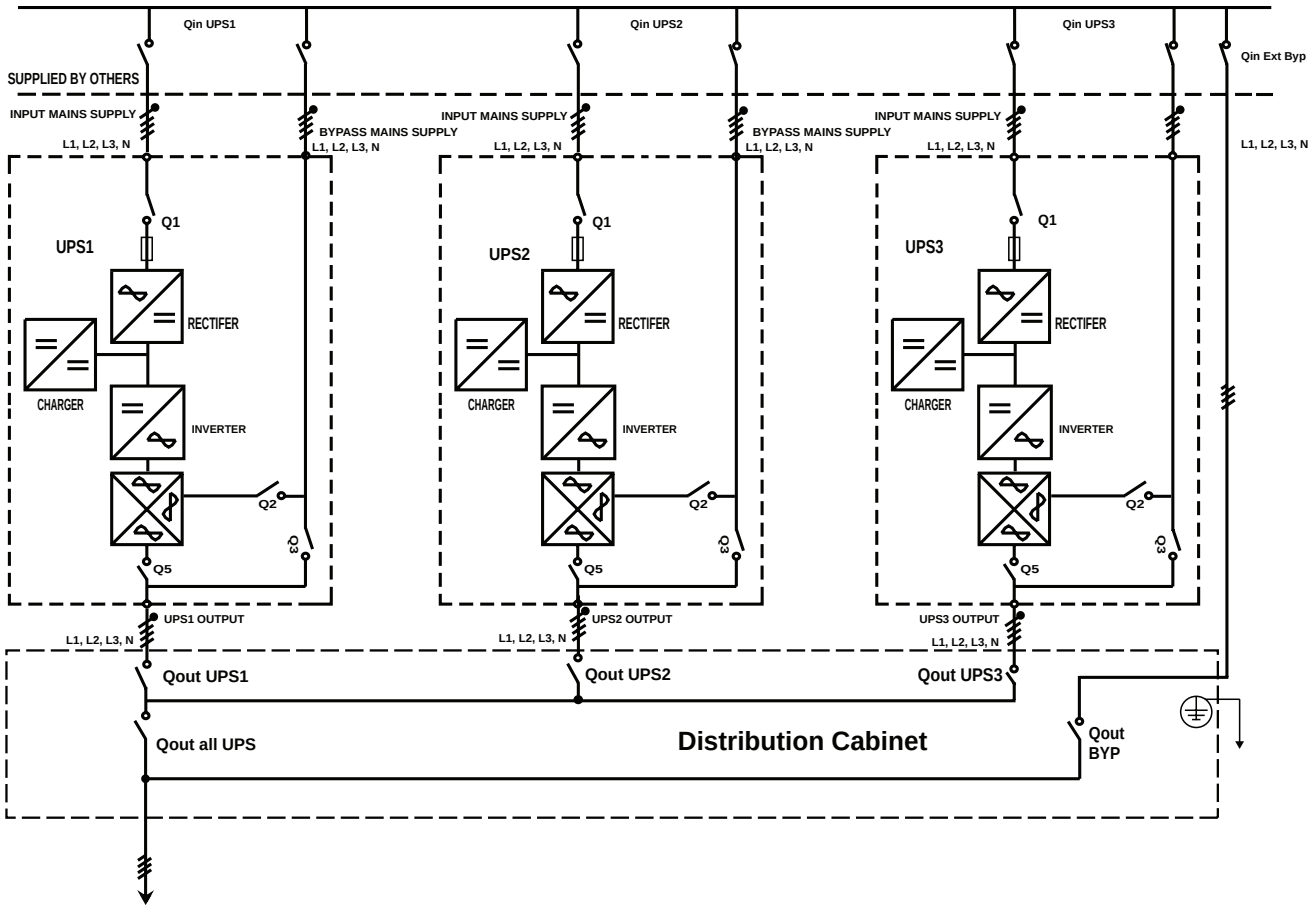
6.1.6 Socket Outlet

One single-phase Shuko-type universal outlet of 3A current handling capability provides nominal UPS output voltage of up to 3A current capacity for the ease of testing, commissioning & servicing of the UPS.

6.2 Multi Module UPS—1+N

Multi-module UPS are formed by several "single unit" UPS modules to constitute "1+N"system where groups of one or more, up to six, single units operate together for the purpose of providing additional power or reliability or both. The load is equally shared between any paralleled UPS.

Figure 64 1+N multi-module UPS with external maintenance bypass switch



Further, single unit or 1+N groups may be configured as "distributed redundant" systems with independent outputs that nevertheless are synchronised through a Load Bus Synchroniser (LBS) so that critical loads can be seamlessly transferred from one system to another. See **6.3 - Modes of Operation** for more information.

6.2.1 Features of NX Multi-Module UPS Configurations

1. The hardware and firmware of single module UPS units is completely compatible with the requirements of a multi-module system. Multi-module configuration is achieved merely through settings in configuration software and control cables.
2. Parallel control cables are connected in a ring, providing both performance and redundancy. Dual-bus control cables are connected between any two UPS modules of each bus. The intelligent paralleling logic provides the user with maximum flexibility. For example, shutting down or starting up UPS modules in a parallel system can be done in any sequence. Transfers between Normal and Bypass modes of operation are synchronised and self –recovering e.g. following overloads and their clearance.
3. The total load of the multi-module system can be queried from each module's LCD.

6.2.2 Requirements for Paralleling of UPS Modules

A group of paralleled modules behave as if it were one large UPS with the advantage of presenting higher reliability. In order to assure that all modules are equally utilised and to comply with relevant wiring rules, the following requirements apply:

1. All UPS modules must be of the same rating and must be connected to the same bypass source.
2. The bypass and the main input sources must be referenced to the same neutral potential.
3. Any RCD, Residual Current monitoring device, if installed, must be of an appropriate setting and located upstream of the common neutral bonding point. Alternatively, the device must monitor the combined 4-wire rectifier and split-bypass input currents of the system. Refer to the **High Leakage Current Warning on page 1**.
4. The outputs of all UPS modules must be connected to a common output bus.

NOTE

Optional isolation transformers are available for applications where sources do not share the same neutral reference or where the neutral is not available.

5. Passive bypass current equalising chokes are available as an option in systems comprising more than three parallel redundant UPS modules (or two or more parallel capacity UPS modules).

6.3 Modes of Operation

The NX UPS is an on-line, double-conversion, reverse-transfer UPS that permits operation in these modes:

- Normal Mode
- Battery Mode (Stored Energy Mode)
- Auto-Restart Mode
- Bypass Mode
- Maintenance Mode (Manual Bypass)
- ECO Mode
- Parallel Redundancy Mode
- Hot-Standby Mode
- Frequency Converter Mode

6.3.1 Normal Mode

The UPS inverter continuously supplies the critical AC load. The rectifier/charger derives power from the AC mains input source and supplies DC power to the inverter while simultaneously FLOAT or BOOST charging its associated backup battery.

6.3.2 Battery Mode (Stored Energy Mode)

Upon failure of the AC mains input power; the inverter, which obtains power from the battery, supplies the critical AC load. There is no interruption in power to the critical load upon failure or restoration of the AC mains input power after which the “Normal Mode” operation will continue without the necessity of user intervention.

6.3.3 Auto-Restart Mode

The battery may become exhausted following an extended AC mains failure. The inverter shuts down when the battery reaches the End Of Discharge voltage (EOD). The UPS may be programmed to “Auto Recovery after EOD” after a delay time. This mode and any delay time are programmed by the commissioning engineer.

6.3.4 Bypass Mode

If the inverter overload capacity is exceeded, or if the inverter becomes unavailable for any reason, the static transfer switch will perform a transfer of the load from the inverter to the bypass source, with no interruption in power to the critical AC load. Should the inverter be asynchronous with the bypass, the static switch will perform a transfer of the load from the inverter to the bypass with interruption in power to critical AC load. This is to avoid paralleling of unsynchronised AC sources. This interruption is programmable but typically set to be less than 3/4 of an electrical cycle, e.g., less than 15ms (50Hz) or less than 12.5ms (60Hz).

6.3.5 Maintenance Mode (Manual Bypass)

A manual bypass switch is available to ensure continuity of supply to the critical load when the UPS becomes unavailable e.g. during a maintenance procedure. This manual bypass switch is fitted in all UPS modules and rated for full load of one module.

6.3.6 ECO Mode (Single UPS Only)

If ECO mode is selected, the double-conversion UPS operation is inhibited at most times for the purpose of saving energy. In this mode of operation, not unlike UPS of line-interactive or stand-by technology, the bypass is the preferred source and only when the voltage and / or frequency of the bypass supply are beyond pre-defined and adjustable limits the critical AC load is transferred to the inverter. This transfer takes place with an interruption of less than 3/4 of an electrical cycle, e.g., less than 15ms (50Hz) or less than 12.5ms (60Hz).

6.3.7 Parallel Redundancy Mode (System Expansion)

For higher capacity or higher reliability or both, the outputs of up to six UPS modules can programmed for directly paralleling while a built-in parallel controller in each UPS ensures automatic load sharing.

6.3.8 Hot-Standby Mode

This is an alternative 1+1 redundancy application that ensures higher availability or better usage control or both. Two UPS are connected in Hot Stand By mode as follows: UPS 1connects to the critical load, and UPS 2 connects to the bypass of UPS 1. The remaining AC inputs are connected to the incoming AC mains supply. UPS 1 synchronises to the output of the UPS 2 ensuring uninterrupted load transfer from UPS 1 to UPS 2 or vice versa. This ensures that any specified load is supplied by a UPS while still providing a bypass path to cater for overloads. Further, the system can also be programmed to reverse UPS1 between Normal and Bypass Modes so that each UPS is equally utilised. This interval is programmable from 1 to 4,320 hours (180 days).

6.3.9 Frequency Converter Mode

The NX UPS can be programmed into frequency converter mode for either 50Hz or 60Hz stable output frequency. The input frequency may vary from 40Hz to 70Hz. In this mode the static bypass operation is disabled, and the battery becomes optional depending on any requirement to operate in battery mode (stored energy mode).

6.3.10 Source Share Mode (Co-Generation)

NXa modules have the capability of fully supporting their critical load while limiting the amount of power taken from the incoming AC mains supply. Any balance of power required is supplied by the UPS battery. This feature is useful e.g. in applications where peak-hour tariffs apply or where a generator smaller than needed feeds the UPS during mains outages. The Source Share Mode is user-activated and the ratio of the main AC input power is programmable from 20% to 100% of the rated UPS power.

6.4 Battery Management—Set During Commissioning

6.4.1 Normal Function

- **Constant charging current**—Current can be set up to limit charging power.
- **Constant boost voltage** (if applicable)—Voltage of boost charging can be set as required by the type of battery.

  For Valve Regulated Lead Acid (VRLA) batteries, maximum boost charge voltage should not exceed 2.4V / cell.
- **Float Charge**—Voltage of float charging can be set as required by the type of battery.

  For VRLA, float charge voltage should be between 2.2V to 2.3V.
- **Float Charge Temperature Compensation** (optional)—A coefficient of temperature compensation can be as required by the type of battery.
- **End of discharge protection (EOD)**—If the battery voltage is lower than the EOD, the battery converter will shut down and the battery is isolated to avoid further battery discharge. EOD is adjustable from 1.6V to 1.75V per cell (VRLA) or 0.9 to 1.1 V per cell (NiCd).
- **Battery Low Warning Time**—Adjustable between 3 and 60 minutes. The default is 5 minutes.

6.4.2 Advanced Functions (Software Settings Performed by the Commissioning Engineer)

Battery Self-Test and Self-Service

At periodic intervals 20% of the rated capacity of the battery will be discharged automatically at a rate equal to 15% (kW) of the rated UPS (kVA) capacity. During discharge the rectifier provides the balance necessary to feed the load. The minimum amount of load must exceed 20% of the nominal rating of the UPS module. If the load is less than 20%, auto-discharge cannot be executed. The periodic interval can be set from 30 to 360 days. The periodic testing can also be inhibited.

- **Conditions**—Battery at float charge for at least 5 hours, load 20~100% of rated UPS capacity
- **Trigger**—Manually through the command of Battery Maintenance Test in LCD panel or automatically
- **Battery Self-Test Interval**—30-360 days (default setting is 60 days)

6.5 Battery Protection (settings by commissioning engineer)

Battery Undervoltage Pre-warning

The battery undervoltage pre-warning occurs before the end of discharge. After this pre-warning, the battery should have the capacity for 3 remaining minutes discharging with full load. The time is user configured from 3 to 60 minutes.

Battery End of Discharging (EOD) Protection

If the battery voltage is lower than the EOD, the battery converter will be shut down. EOD is adjustable from 1.6V to 1.75V per VRLA cell (or 1.0 to 1.1 V per NiCd cell).

Battery Contactor Fault Warning

If the battery contactor monitor status is different from the drive signal, this warning will occur.

Battery Disconnect Devices

For 30- 40kVA models with internal batteries and for any model fitted with a Battery Start kit, the UPS contains an internal contactor for automatic connection and disconnection of the batteries. The relevant features are:

- Low battery safety cutoff
- Connect/disconnect status displayed via LCD
- Overcurrent protection
- Maximum discharging time protection (1 to 72 hours)

For models above 40kVA and not fitted with an internal contactor:

The features above (except automatic connect) are performed by connecting the external battery to the UPS through an external battery circuit breaker, which is manually closed and electronically tripped via the UPS control circuits.

7.0 OPERATING PROCEDURES

WARNING

Hazardous mains and / or battery voltage present behind covers.

No user-serviceable parts are located behind covers that require a tool for their removal. Only qualified service personnel are authorised to remove such covers.

7.1 Introduction

Following installation and commissioning by an authorised service engineer, the UPS will operate in one of the modes described in **6.3 - Modes of Operation**. This chapter describes the various procedures available for the operator to intervene with the UPS mode of operation including starting up, transferring load to bypass and shutting down.

NOTE

*All the user controls and indicators mentioned in these procedures are identified in **8.0 - Operator Control Panel and Display**.*

*All power switches mounted inside the cabinet and accessible after opening the key-locked front door are shown in **Figure 63** and described in **7.0 - Operating Procedures**.*

7.2 Startup in Normal Mode

This procedure must be followed when turning on the UPS from a fully powered down condition - i.e., where the load is not being initially supplied at all or where supplied by the maintenance bypass switch. It is assumed that the installation is complete, the system has been commissioned by authorized personnel and the external power isolators are closed.

In multi-module systems—perform each step of the procedure in every UPS module before proceeding to the next step.

WARNING

Mains Voltage will be applied to UPS output terminals.

This procedure results in mains voltage being applied to the UPS output terminals.

- Isolate and attach warning labels to any downstream load connections, as applicable.
- No operator serviceable parts are located behind covers that require a tool for removal.
- Only qualified service personnel are authorised to remove such covers.

1. Open the UPS door to gain access to the main power switches.
2. Close Bypass input power switch Q2 and UPS output power switch Q5.

   Close also any external output isolation switches, where used.

   The LCD becomes active and after initialization, the UPS output is powered from the bypass, with the bypass and load indicators turned on.

   The UPS Mimic LED's will indicate (refer to **Figure 67**):

# LED	LED Function	Status
3	Bypass indicator	Green
5	Output indicator	Green
2	Battery indicator	Red
6	Alarm indicator	Amber / red

3. Close the Rectifier AC Input Power Switch Q1.

   The *Rectifier indicator* flashes on the UPS mimic panel during the startup of rectifier and becomes steady green once the rectifier reaches normal operation state after about 30s.
4. Close external battery circuit breaker (where an external battery is used). This breaker is located inside the battery cabinet (if used) or is otherwise adjacent to the battery racks
5. Following battery availability being detected by the UPS, the red battery indicator extinguishes moments after when the battery charger starts operation.
6. Open (or confirm open) the internal Manual Bypass Power Switch Q3.

   Open also any external Maintenance Bypass Switch, where used.
7. Press *INVERTER ON* button for two seconds.

   The inverter will start up and the inverter indicator flashes while it synchronises to the bypass voltage frequency.

   After the inverter is ready, the UPS transfers from bypass to inverter, the bypass indicator turns off, and the inverter indicator becomes steady green.
8. Check that no “Warning” message is displayed in the top right corner of the LCD Monitor and the status of the indicators are:

# LED	LED Function	Status
1	Rectifier indicator	Green
2	Battery indicator	Off
3	Bypass indicator	Off
4	Inverter indicator	Green
5	Output indicator	Green
6	Alarm indicator	Off

The UPS is now operating in NORMAL mode.

7.3 Startup into ECO Mode

Applies only to a single module UPS and when programmed by the commissioning engineer to perform ECO mode control of the power delivered to the load.

Follow **7.2 - Startup in Normal Mode** and observe at the end of the procedure that the mimic panel bypass indicator remains green (indicating that the load is supplied by the bypass mains).

The UPS is now operating in ECOMODE.

7.4 Battery Test Mode Procedures

The Battery test mode procedures transfer the UPS into shared source mode wherein approximately 15% of the rated load power is supplied by the battery and the balance by the AC input mains. There are two Battery tests to select from:

Maintenance test—verifies battery integrity and leads to a 20-percent battery discharge.

Battery Capacity test—verifies the battery's precise capacity and leads to a full battery discharge (until "Battery Low" alarm).

The battery test procedures are password-controlled and menu-driven. The test is immediately terminated in the event of a battery or a mains failure and the total load power is supported from the remaining source without interruptions.

The tests can be carried out from the UPS control panel by the operator when the following conditions are satisfied:

- The load must be between 20% and 100% of rated UPS capacity
- The battery must have been float charging for 5 hours or more.

7.4.1 Test Procedure

1. Select "Commands" window on the UPS control panel.
   Use the right or left arrow keys to navigate to the "Commands" window.
2. Select desired Test.
   Use "page" (F1) and up / down arrow keys (F2, F3) to highlight the desired test. Press "enter" (F4). When prompted, enter each password digit with up arrow (F2) and use right arrow (F3) to access next field. Press "enter" (F4) when all digits have been entered.
3. Wait until the test completes.
   This tests updates the battery information used to calculate the expected back-up time (displayed during AC input failure) and the battery capacity percentage when compared to a new battery (displayed in normal mode).
4. Stop test.
   If required, the test may be stopped before completion by selecting "Stop Test" in the "Commands" window.

For more details on how to operate the UPS control panel refer to **8.0 - Operator Control Panel and Display**.

7.5 UPS Self-Test

The UPS test procedure checks the control functions of the UPS, the mimic flow chart LEDs and the audible alarm. This self-test is password controlled and menu driven. It can be carried out from the UPS front panel by the operator and takes 5 seconds.

7.5.1 UPS Self-Test Procedure

1. Select "Commands" window on the UPS front panel.
   Use the right or left arrow keys to navigate to the "Commands" window
2. Select desired Test.
   Use "page" (F1) and up / down arrow keys (F2, F3) to highlight the desired test. Press "enter" (F4). When prompted, enter each password digit with up arrow (F2) and use right arrow (F3) to access next field. Press "enter" (F4) when all digits have been entered.
3. Wait until the test completes.
   After 5 seconds, a popup window will appear to showing the result of this diagnosis: Rectifier, Inverter, Monitor OK or Fault
4. Stop test.
   If required, the test may be stopped before completion by selecting "Stop Test" in the "Commands" window.

For more details on operating the UPS front panel, see **8.0 - Operator Control Panel and Display**.

7.6 Maintenance Bypass Procedure and UPS Shutdown

The following procedure transfers the load supply from being protected by the UPS into being connected directly to the AC input bypass supply though a maintenance bypass switch. This switch is either:

- **internal** (Q3- located behind the front door) for "Single module" or "1+1 redundant multi-module" UPS applications.
- **external** (located in the bypass cabinet) for "1+1 capacity" and "1+N redundant" multi-module UPS applications – refer to **Figure 64**.

In multi-module systems—perform each step of the procedure in every UPS module before proceeding to the next step.

CAUTION

Risk of Load Interruption

Except in emergency situations, so as not to risk a short interruption in powering the load, before initiating this bypass procedure, confirm that no WARNING status is displayed in the top right corner of the UPS Monitor.

If a WARNING status is displayed, the operator will be prompted to confirm ("enter") or cancel ("ESC") any action that can lead to load interruption.

1. Press INVERTER OFF direct access key on the UPS front panel.
   The UPS inverter will shut down and the load is supplied through the Static Bypass supply.The UPS Mimic indicator Inverter ON (4) will extinguish, the Status LED (6) turns on.
2. In "Single module" or "1+1 redundant" multi-module UPS—Close the internal maintenance bypass power switch Q3 and any external maintenance bypass switch, if used.
3. In "1+N redundant" or "1+1 capacity" multi-module UPS—Close the external maintenance switch only.
4. The Maintenance Bypass supply is now in parallel with the UPS Static Switch supply.
5. The display window will show messages reflecting the actions taken (i.e. Maintenance Bypass closed, etc.).
6. Open output power switch Q5.
   This ends the Bypass Procedure. The load is now powered directly from the Maintenance Bypass supply.

NOTE

The load equipment is NOT protected from AC supply aberrations.

Proceed with the following steps to shutdown the rectifier and battery.

7. Press the EPO (Emergency Power Off) button at the UPS front panel of this UPS module ***only***. This will disable further Rectifier, Inverter, Static Switch and Battery operation. This will not affect the manual maintenance bypass power switch.

NOTE
Do not press any remote EPO button.

8. Open the Rectifier input power switch Q1 and Static bypass input power switch Q2
9. When an external battery is connected, open external battery circuit breaker. This breaker is located inside the battery cabinet (if used) or is otherwise adjacent to the battery racks
   All mimic panel LED indications and messages will extinguish as the mains driven internal power supplies decay.

The load is now powered from the maintenance bypass supply and the UPS is completely shut down.

WARNING

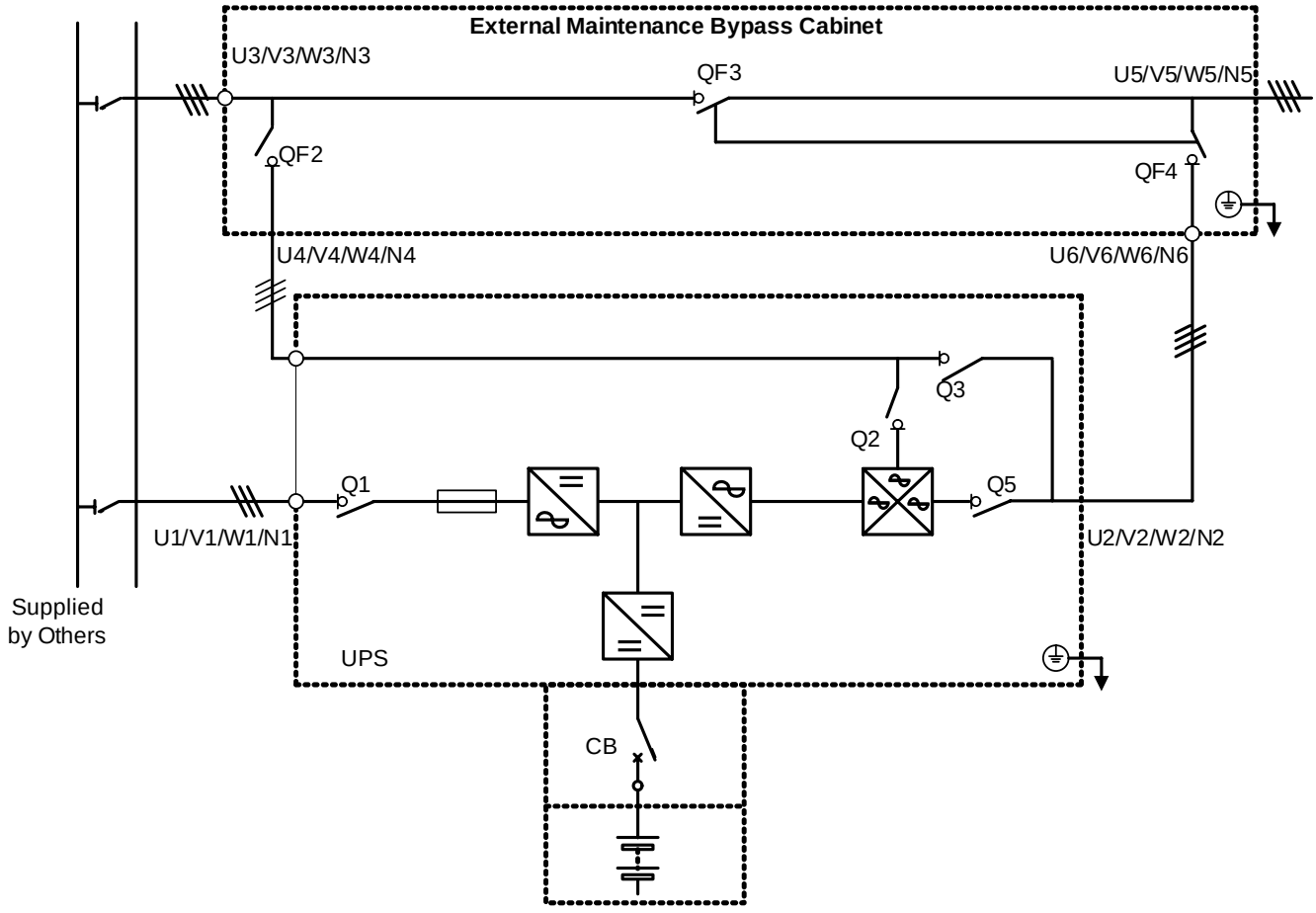
Hazardous Voltage at UPS terminals

No operator-serviceable parts are located behind covers that require a tool for their removal.

Only qualified service personnel are authorised to remove such covers.

The input and output AC and DC battery and connecting terminals remains energized at hazardous voltage levels at all times. The battery is located behind protective covers that require a tool for their removal. inside the UPS cabinet (30 and 40kVA models), inside a free-standing battery cabinet or on open racks inside a dedicated battery room that may be locked.

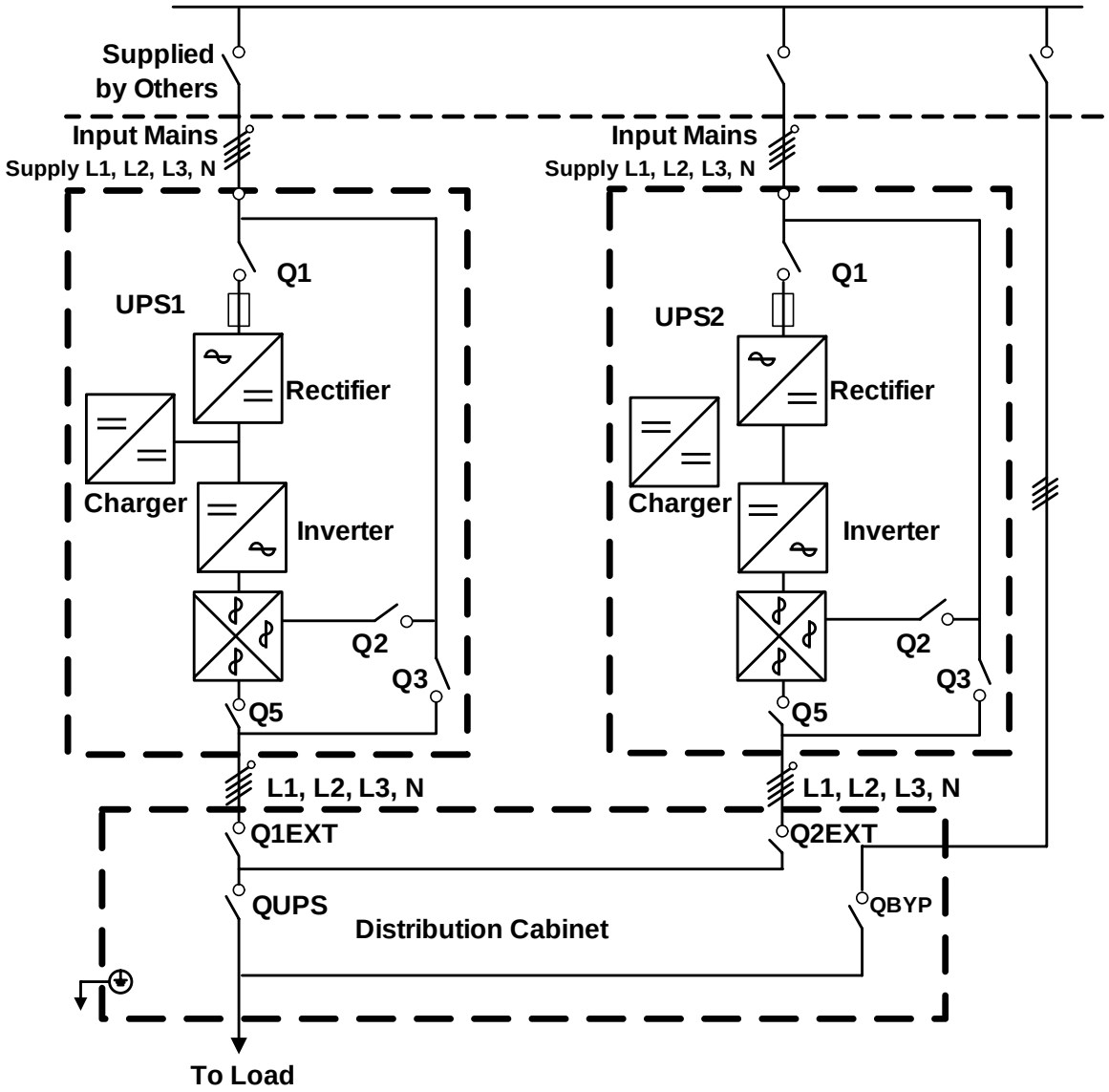
Figure 65 Example of configuration for single UPS with external Maintenance Bypass Cabinet



7.7 Isolation of One Module in a Multi-Module System

7.7.1 Multi-Module Systems With External Output CB1

Figure 66 Typical 1+N system block diagram with common input supply, with separate batteries and optional output / bypass distribution panel



1. Turn Off inverter.
2. Open External Output isolator (Q1ext or Q2ext).
   The UPS enters Isolation Status automatically, parallel signaling and communication becomes masked, and output becomes inhibited.
3. Power Off unit for maintenance.
4. Power On unit.
5. Unit enters Test Mode by configuration software setting.
6. Diagonosis or testing.
7. The UPS exits Test Mode by configuration software setting.
   Output becomes inhabited because of Isolation Status.
8. Return all switches to the Normal position.
9. Close External Output isolator (Q1ext or Q2ext).
   The UPS exits Isolation Status automatically, parallel signaling and communication recovers,

output becomes enabled but interlocking works now.

10. Turn On inverter and join the parallel system.

7.7.2 Multi-Module System Without External Output Circuit Breaker 1

This procedure is indicated for isolation of one UPS module from other modules of a group of otherwise normally operating paralleled UPS modules. Only the power switches, isolators and circuit breakers in the module to be isolated will be opened. This procedure does not require the supply of any bypass power to the critical load.

1. Turn Off the inverter
2. Open Internal Output isolator (Q5) but keep Internal Maintenance Circuit Breaker open.
   The UPS enters Isolation Status automatically, parallel signaling and communication become masked, and internal output becomes inhibited.
3. Power Off unit for maintenance.
4. Power On unit with Internal Output isolator (Q5) open.
5. The UPS enters Test Mode by configuration software setting.
6. Diagonosis or testing.
7. The UPS exits Test Mode by configuration software setting.
   Output becomes inhibited because of Isolation Status.
8. Return all switches of Unit 1 to the Normal position, including Internal Output Circuit Breaker 1.
   When Internal Output isolator (Q5) is closed, unit will exit Isolation Status automatically, parallel signaling and communication recovers, output becomes enabled but interlocking works now.
9. Turn On Inverter1 and join the parallel system.

WARNING

Hazardous Battery Voltage

No operator serviceable parts are located behind covers that require a tool for their removal.

Only qualified service personnel are authorised to remove such covers.

The UPS battery and connecting terminals remains energized at hazardous voltage levels at all times. The battery is located behind protective covers that require a tool for their removal: inside the UPS cabinet (30 and 40kVA models), inside a free-standing battery cabinet or on open racks inside a dedicated battery room that may be locked.

7.8 Insertion of One Module in a Multi-Module System

This procedure is indicated to reintegrate a UPS module that has been previously isolated from other modules of a group of paralleled UPS modules. It is assumed that the installation is complete, the system has been commissioned by authorized personnel and the external power isolators are closed.

WARNING

Mains voltage will be applied to UPS output terminals.

No operator serviceable parts are located behind covers that require a tool for their removal.

Only qualified service personnel are authorised to remove such covers.

1. Open the UPS door to gain access to the main power switches.
2. Open (or confirm disabled) maintenance bypass power switch Q3
3. Close input bypass power switch Q2 and UPS output power switch Q5.
   (Close also any external output isolation switches, where used). The LCD display becomes active.
4. Close the Rectifier AC Input Power Switch Q1.
   The *Rectifier indicator* flashes on the UPS mimic panel during the startup of rectifier and becomes steady green once the rectifier reaches normal operation state after about 30s.
5. Close external battery circuit breaker QF1 (where an external battery is used). This breaker is located inside the battery cabinet (if used) or is otherwise adjacent to the battery racks
6. Following battery availability being detected by the UPS, the red battery indicator extinguishes moments after when the battery charger starts operation.
7. Press *INVERTER ON* button for two seconds.
   The inverter will start up and the inverter indicator flashes while it synchronises to the load voltage frequency. After the inverter is ready, the UPS connects to the load, the inverter indicator becomes steady green and the output indicator turns green.
8. Check that no "Warning" message is displayed in the top right corner of the LCD Monitor and the status of the indicators as follows:

# LED	LED Function	Status
1	Rectifier indicator	green
2	Battery indicator	off
3	Bypass indicator	off
4	Inverter indicator	green
5	Output indicator	green
6	Alarm indicator	off

The UPS is now operating in NORMAL mode

7.9 Shutdown Procedure—Complete UPS and Load Shutdown

This procedure must be followed to completely power down the UPS and **LOAD**. All power switches, isolators and circuit breakers will be opened and power will be removed from the load.

In multi-module systems – perform each step of the procedure in every UPS module before proceeding to the next step.

CAUTION

The following procedure will switch off all power to the load equipment.

1. Press the EPO (Emergency Power Off) button at the UPS front panel **only.** This will disable Rectifier, Inverter, Static Switch and Battery operation. The Load will be de-energised.

NOTE

Except in an emergency situation, do not press any remote EPO button.

2. Open the UPS door to gain access to the main power switches.
3. Open the Rectifier input power switch Q1
4. Open external battery circuit breaker (where an external battery is used). This breaker is located inside the battery cabinet (if used) or is otherwise adjacent to the battery racks
5. Open Output power switch Q5
6. Open bypass input power switch Q2
7. Ensure maintenance bypass power switch Q3 is open.
8. All mimic panel LED indications and messages will extinguish as the mains driven internal power supplies decay.
9. To completely isolate the UPS from the AC supplies, the main external power input isolator (both isolators, where split supplies are provided for rectifier and bypass) and external output isolator must be opened and tagged with warning labels accordingly.

WARNING

Hazardous Battery Voltage

No operator serviceable parts are located behind covers that require a tool for their removal.

Only qualified service personnel are authorised to remove such covers.

The UPS battery and connecting terminals remains energized at hazardous voltage levels at all times. The battery is located behind protective covers that require a tool for their removal: inside the UPS cabinet (30 and 40kVA models), inside a free-standing battery cabinet or on open racks inside a dedicated battery room that may be locked.

7.10 Emergency Shutdown With EPO

This circuit has been designed to switch off the UPS in emergency conditions (i.e., fire, flood, etc.). The system will turn off the rectifier, inverter and stop powering the load immediately (including the inverter and bypass), and the battery stops charging or discharging.

If the input utility is present, the UPS's controls will remain active; however, the output will be turned off. To remove all power from the UPS, the external feeder breaker should be opened.

7.11 Reset After Shutdown for Emergency Stop (EPO Action) or Other Conditions

Once all appropriate measures have been taken to correct the problem indicated by the alarm message appearing on the operator control panel display, carry out this procedure to restore the UPS to regular operation following an EPO action or for the following reasons: Inverter Overtemperature, Cut-off Overload, Battery Overvoltage, excessive switching (BYP: XFER COUNT BLOCK), etc.

When the user confirms that the fault is cleared & the remote EPO signal is not active:

1. Press the FAULT CLEAR button to let the system exit the Emergency Off state.
2. Press the INVERTER ON button on the right side of the operator control panel for longer than 2 seconds.

NOTE:
UPS manufactured before March 2006 may first require a full power down, i.e., manual opening of the input isolators, for the "Fault Clear" to take effect

NOTE
The rectifier will start again, and the bypass will begin to power the load (for units with internal battery contactor installed, the battery contactor will close). The Rectifier indicator flashes while the rectifier is starting up. When the rectifier enters the normal operation state (about 30 seconds), the rectifier indicator turns green.

NOTE
The rectifier will be turned On automatically when the overtemperature fault disappears at 5 minutes after the disappearance of overtemperature signals.

After the EPO button is pressed, if the input utility is removed, the UPS will shut down completely.

When input utility returns, if the Bypass input power switch (Q2) and UPS output power switch (Q5) are closed, the UPS will startup on Bypass. There will be power at the output terminals of the UPS.

WARNING
If the internal Manual Bypass Power Switch (Q3) is closed and input utility is present, there will be power at the output terminals of the UPS.

7.12 Auto Restart

When the main and bypass sources fail, the UPS draws power from the battery system to supply the load until the batteries are depleted. When the UPS reaches its end of discharge (EOD) threshold, it will shut down.

The UPS will automatically restart and enable output power:

- After utility power is restored
- If “Auto Recovery after EOD Enabling” is enabled
- After the “Auto Recovery after EOD Delay Time” expires (the default delay is 10 minutes) .

If the “Auto Recovery after EOD Enabling” feature is disabled, the user may restart the system manually by pressing “Fault Clear” button.

7.13 Language Selection

The LCD menus and data display are available in 12 languages: Chinese, Dutch, English, French, German, Italian, Japanese, Polish, Portuguese, Russian, Spanish and Swedish.To select a different language than the one being displayed:

1. From the main menu, press the F1 (shift) key to move the cursor to the menu at the top of the screen.
2. Press F2 and F3 (left and right arrows) as needed to select the Language menu.
3. Press F1 (shift) to move the cursor to the data and settings area of the LCD.
4. Use F2 and F3 (up and down) to select the required language.
5. Press the F4 (enter) key to accept the language selection.
6. Return to the main menu by repeatedly pressing F1 (ESC) as needed; all text on the LCD will now be displayed in the selected language.

7.14 Changing the Current Date and Time

To change the system date and time:

1. From the main menu, press the F1 (shift) key to move the cursor to the menu at the top of the screen.
2. Press F2 and F3 (left and right arrows) as needed to select the Settings menu.
3. Press F1 (shift) to move the cursor to the data and settings area of the LCD.
4. Use F2 and F3 (up and down) to select the Date & Time option, then press F4 (enter).
5. Position the cursor on the row in which the date and time are displayed, then press F4 (enter).
6. Using the F2 and F3 (up and down) keys, enter the current time and date information.
7. Press F4 (enter) to save the settings, then press F1 (ESC) to return to the main menu.

7.15 Command Password

Password protection is used to limit the control functions accessible to the operator. The default password is *12345*. This password provides access to UPS and battery test functions.

8.0 Operator Control Panel and Display

8.1 Introduction

The operator control panel and display is located on the front door of the UPS. The panel is the access point for operator control and monitoring of all measured parameters, UPS and battery status and of event and alarm logs.

Figure 67 UPS control and display panel

The operator control panel is divided into three functional areas

Mimic Power Flow Chart **Graphic LCD monitor with menu keys** **Direct Access keys**

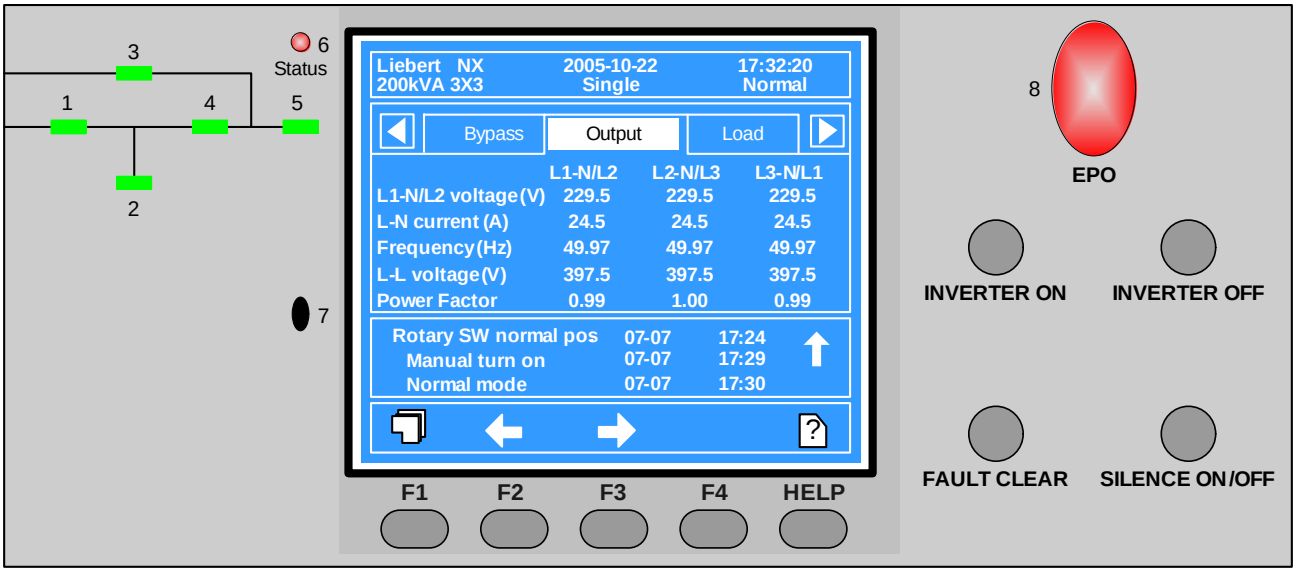


Table 12 UPS control and display panel components

Component #	Function
1	Rectifier (Input AC to DC)
2	Battery (DC Back-up)
3	Bypass Input
4	Inverter (DC to AC)
5	Load (AC Output)
6	UPS Status and Alarm indicator
7	Audible Alarm (Buzzer)_
8	Emergency Power Off Button cover

Button	Function
EPO	Emergency Power Off button
Inverter ON	Inverter start button
Inverter OFF	Inverter shutdown button
Fault Clear	Reset button
Silence On/Off	Audible Alarm Mute
—	—
F1-F4, Help	LCD Menu keys
—	—

8.1.1 Mimic Power Flow

The LED mounted on the mimic flow chart represent the various power paths and current UPS operational status.

Table 13 Rectifier indicator—1

Green	Rectifier in Normal Operation
Flashing Green	Input AC Normal, but rectifier not operating
Red	Rectifier Failed
Off	Rectifier Not operating, Input AC Not Available or out of normal range

Table 14 Battery indicator—2

Green	Battery Normal, but discharging and powering the load
Flashing Green	Battery End of Discharge pre-warning
Red	Battery abnormal (Failed, Absent or Polarity Reversed) or Battery Converter abnormal (Failed, overcurrent, overtemperature)
Off	Battery and Converter Normal, Battery charging.

Table 15 Bypass indicator—3

Green	Load on Bypass power
Red	Bypass not available, out of normal range or Static bypass switch fault.
Off	Bypass Normal, load not on bypass

Table 16 Inverter indicator—4

Green	Inverter Normal and powering the load
Flashing Green	Inverter ON, starting up, synchronising, or standing by (ECO mode)
Red	Inverter failed
Off	Inverter not operating

Table 17 Load indicator—5

Green	UPS output ON and Normal
Red	UPS output ON and Overloaded
Off	UPS output OFF.

Table 18 Status (Alarm) indicator—6

Green	Normal Operation
Yellow	UPS Warning e.g. AC Input Failure
Red	UPS fault e.g. Fuse or Hardware failure

8.1.2 Audible Alarm (Buzzer)

UPS activity is accompanied by the following sounds

Table 19 Audible alarm key

Single beep	Direct Access key acknowledgement
One beep per second	UPS Warning e.g. AC Input Failure
Continuous beep	Fault e.g. Fuse or Hardware failure

8.1.3 Direct Access Push Buttons (Keys)

Emergency Power Off (EPO)	Disconnects Power to the Load. Disables rectifier, inverter, static bypass and battery operation.
Inverter ON	Enables Inverter Operation
Inverter OFF	Disables Inverter Operation
Fault clear	Resets blocked UPS functions (subject to any fault being cleared)
Silence ON/OFF	Toggle type buzzer mute. Any new fault re-enables the buzzer.

Press and hold Direct Access key briefly until acknowledged by a single beep.

8.1.4 LCD Monitor and Menu keys

The user-friendly and menu-driven 320 x 240 dot graphic LCD monitor displays real time data and at the same time stores 512 historical records that can retrieve for reference and diagnosis.

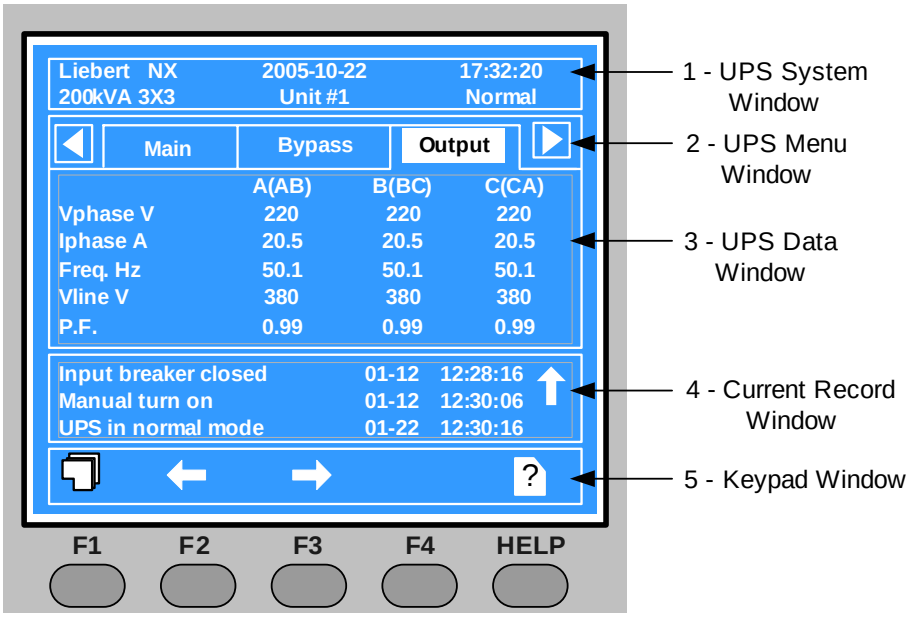
The user can perform commands or easily browse through the input, output, load and battery parameters. For quick reference, the UPS status and any warnings are always highlighted without the need of navigating through the menu. The versions of converter firmware, inverter firmware and internal monitor firmware can also be displayed on the LCD.

Menu keys F1 to F4 are used to navigate within the graphic LCD monitor windows.

Table 20 Menu key Icons and their meaning

Key	F1	F2	F3	F4	Help
Window Type 1	Next Data Window	LEFT	RIGHT	ENTER	HELP
Window Type 2	ESC Escape	UP	DOWN		

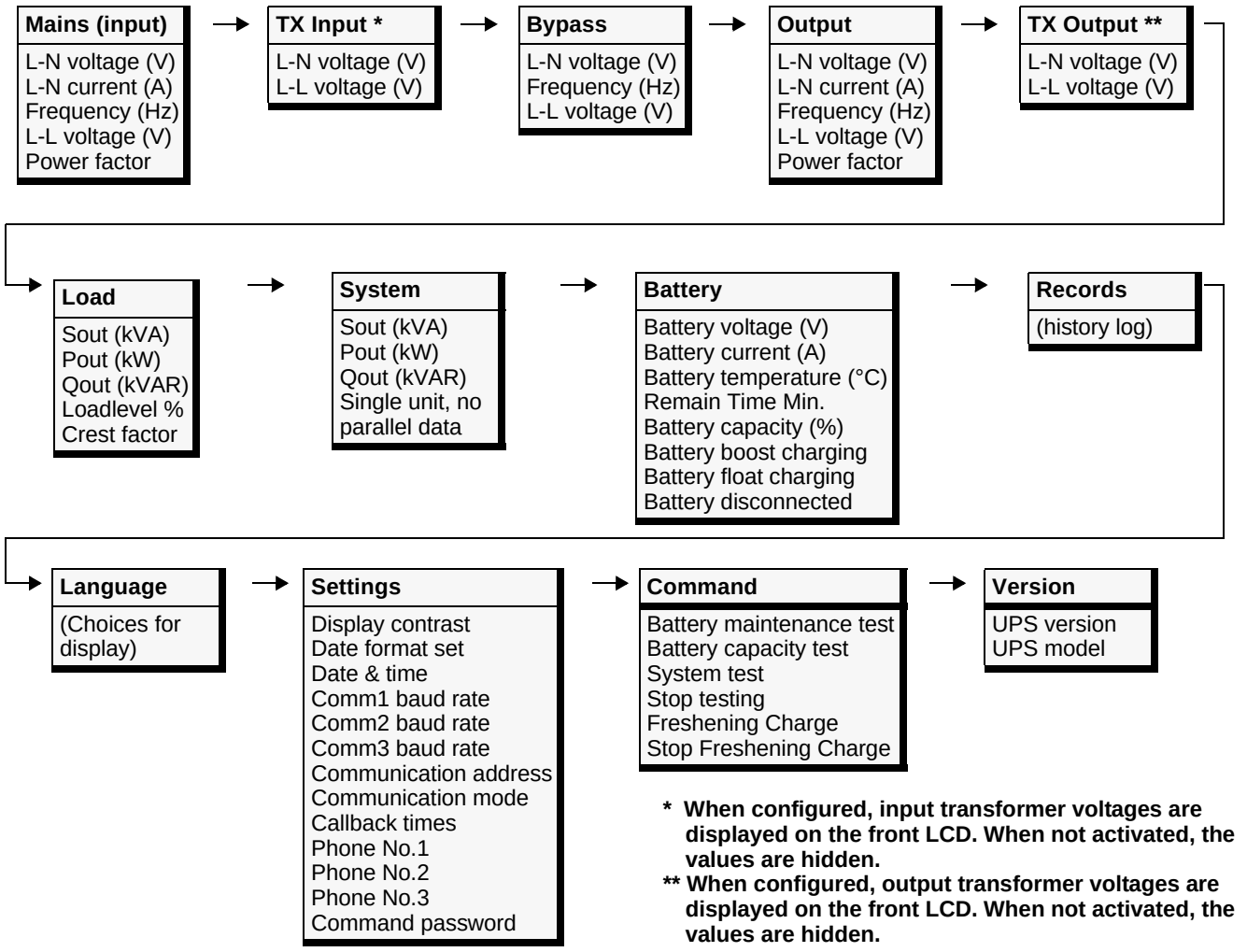
Figure 68 Graphic LCD monitor windows and keypad



The function of keys F1 to F4 is shown by a self-explanatory icon as appropriate for the particular window. As shown in **Figure 68** above, pressing F1 moves the cursor (resting in "OUTPUT") from the *UPS Menu Window (2)* to *current record window (4)* where it would first rest in "Input breaker closed'. In a similar manner, pressing F2 would move the cursor from the Output data window to the Bypass data window.

The summary menu tree is shown below. Refer to **8.2 - All Status and Event Messages Displayed on the UPS Front Panel** for a detailed description of each menu item.

Figure 69 Menu tree



*** When configured, input transformer voltages are displayed on the front LCD. When not activated, the values are hidden.**

**** When configured, output transformer voltages are displayed on the front LCD. When not activated, the values are hidden.**

8.1.5 Detailed Description of Menu Items

The description that follows refers to the graphic LCD monitor window shown on **Figure 68**.

UPS System Window: This fixed-pane window displays current time and date and identifies the UPS, its configuration and its status.

Table 21 UPS system window

Description	Explanation
Liebert NX	UPS family name
2005-10-22	YYYY-MM-DD (see Settings menu for other date formats)
12:30:36	Current Time (24 hr HH:MM:SS format)
200kVA-3x3	200kVA = UPS rated output, 3 x 3 = 3-phase input and output
(Configuration) Single, ECO, Master, Slave or Unit # 1	Single = single double-conversion unit ECO = single stand-by unit with double-conversion fall-back Master = master in a 1+1 Hot Stand By system Slave = slave in a 1+1 Hot Stand By system Unit # 1 = of max 6 double-conversion units in a parallel system
(Status) Normal, Warning or Fault	Normal = UPS operating Normal Warning = System attention required, e.g. AC Input Failure Fault = UPS Fuse or Hardware Failure

Menu and Data Window

Use the horizontal arrow keys to navigate between any of the selectable menu and data windows.

Table 22 Descriptions of UPS menus and data window items

Menu Type	Item Type	Explanation
Mains (input)	L-N voltage (V)	Phase voltage
	L-N current (A)	Phase current
	Frequency (Hz)	Input frequency
	L-L voltage (v	Line-line voltage
	Power factor	Power factor
TX Input	L-N voltage (V)	Phase voltage
	L-L voltage (V)	Line-line voltage
Bypass	L-N voltage (V)	Phase voltage
	Frequency (Hz)	Bypass frequency
	L-L voltage (A)	Line-line voltage
Output	L-N voltage (V)	Phase voltage
	L-N current (A)	Phase current
	Frequency (Hz)	Input frequency
	L-L voltage (V)	Line-line voltage
	Power factor	Power factor
TX Output	L-N voltage (V)	Phase voltage
	L-L voltage (V)	Line-line voltage
Load	Sout (kVA)	Sout: Apparent power
	Pout (kW)	Pout: Active power
	Qout (kVAR)	Qout: Reactive power
	Loadlevel %	The percent of the UPS rating load
	Crest factor	Output current Crest Factor

Table 22 Descriptions of UPS menus and data window items (continued)

Menu Type	Item Type	Explanation
System	Sout (kVA)	Sout: Apparent power
	Pout (kW)	Pout: Active power
	Qout (kVAR)	Qout: Reactive power
	Single unit, no parallel data	When configured as a single unit, UPS has only native load, no system load.
Battery	Battery voltage (V)	Battery bus voltage
	Battery current (A)	Battery bus current
	Battery temperature (°C)	Internal battery temperature °C
	Remain Time Min.	Battery run time remaining
	Battery capacity (%)	Percentage of battery life remaining
	Battery boost charging	Battery is boost charging
	Battery float charging	Battery is float charging
	Battery disconnected	Battery is not connected
Records	(history log)	Displays all records in the history log
Language	(choices for text displayed)	User may select any of 12 languages for LCD text.
Settings	Display contrast	Adjust the LCD display contrast
	Date format set	Choose the format for date display: M/D/Y, D/M/Y, M/D/Y, Y/M/D
	Date & time	Set the date and time
	Comm1 baud rate	Communication baud rate setting for Intellislot 1
	Comm2 baud rate	Communication baud rate setting for Intellislot 2
	Comm3 baud rate	Communication baud rate setting for Intellislot 3
	Communication address	This setting is applicable to RS485 communication mode
	Communication mode	Communication Mode Setting
	Callback times	When Intellislot 1 Communication mode is Modem, this parameter sets the number of times a number is redialed to send an alarm notification.
	Phone No.1	When Intellislot 1 Communication mode is Modem, this is the first phone number to be dialed (to send an alarm notification).
	Phone No.2	When Intellislot 1 Communication mode is Modem, this is the second phone number to be dialed (to send an alarm notification).
	Phone No.3	When Intellislot 1 Communication mode is Modem, this is the third phone number to be dialed (to send an alarm notification).
	Command password	User can modify the command password.
Command (start/stop battery & system tests)	Battery maintenance test	This test performs a partial discharge of the battery to obtain a rough estimate of the battery capacity. Load must be between 20% and 80%.
	Battery capacity test	This test performs a full discharge of the battery to obtain a precise measure of the battery capacity. Load must be between 20% and 80%.
	System test	This is a self-test of the UPS. When the user activates this function, a pop-up window appears about 5 seconds later to show the results.
	Stop testing	Manually stops a battery maintenance test, battery capacity test or system test.
	Freshening Charge	This command will allow a temporary Equalize charge for the batteries. This charge is configurable for 1 to 36 hours
	Stop Freshening Charge	Manually stops a Freshening Charge
Version	UPS version	Provides UPS firmware version numbers for the inverter, rectifier and software display board.
	UPS model	Provides UPS model information—for example, 208V-60Hz.

Current Record Window

Keeps a log the events that resulted in the current mode of operation. Ignores transient conditions that have been resolved.

Use “page” (F1) and up / down arrow to read the events.

For a complete history log, refer to the Records tab of the Menu and Data Window.

Refer to **Table 23** for a complete list of supported status messages.

8.2 All Status and Event Messages Displayed on the UPS Front Panel

This is the complete list of UPS events and status messages supported for display in either the Record window (Historic data) or in the Current window (Prevailing data) as described in **8.1.4 - LCD Monitor and Menu keys**.

Table 23 UPS messages

Message	Description / Suggested Action (if any)
Inverter Comm. Fail	Internal RS485 communication failure between monitor and inverter
Rectifier Comm. Fail	Internal RS485 communication failure between monitor and rectifier
Parallel Comm. Fail	The CAN communication between different UPSs within a parallel system fails. 1.Check if there are some UPSs not powered on in the parallel system. If so, power on these UPSs and check if the alarm disappears. 2. Press Fault Clear push button.
Battery Overtemp.	The Battery temperature is over limit. Check the battery temperature and ventilation
Ambient Overtemp.	The Ambient temperature is over limit. Check the ventilation of UPS room.
Battery Fault	Battery detected faulty **(Reserved)**
Replace Battery	Battery test failed, Battery should be replaced.
Battery Low Pre-warning	Before the end of discharge, battery undervoltage pre-warning should occur. After this pre-warning, battery should have the capacity for 3 minutes discharging with full load. The time is user-configured from 3 to 60 minutes. Shut down the load in time.
Battery End of Discharge	Inverter turned off due to low battery voltage. Check the utility failure and try to recover it.
Mains Volt. Abnormal	Mains Voltage exceeds the upper or lower limit and results in rectifier shutdown. Check the input line-to-neutral voltage amplitude of rectifier.
Mains Undervoltage	Mains Voltage is undervoltage with derated load. Check the input line-to-line voltage amplitude of rectifier
Mains Freq. Abnormal	Mains frequency is out of limit range and results in rectifier shutdown. Check the rectifier’s input voltage frequency
Rectifier Fault	Rectifier detected faulty. Rectifier shuts down. Battery discharges.
Rectifier Overtemp.	The temperature of heat sink is too high to keep the rectifier running. The UPS can recover automatically. Check the environment and ventilation.
Batt. Contactor Fail	Battery contactor or circuit breaker not responding to control signals.
Batt. Charger Fault	The voltage of the battery charger is too high.
Control Power 1 Fail	UPS operates but Redundant Control Power is not available.
Mains Phase Reversed	AC Input phase sequence is reversed.
Rectifier Overcurrent	Rectifier is overloaded.
Soft Start Fail	Rectifier could not start due to low DC bus voltage

Table 23 UPS messages

Message	Description / Suggested Action (if any)
Bypass Unable to Trace	This alarm is triggered by an inverter software routine when the amplitude or frequency of bypass voltage is beyond the normal range. The amplitude threshold is fixed for positive and negative 10% rating. This alarm automatically resets once the bypass voltage goes normal. 1. First verify that the bypass voltage and frequency displayed on the panel is within the selected range. Note here the rated voltage and frequency are specified by “Output voltage level” and “Output frequency level” respectively. 2. If the displayed voltage is believed to be abnormal, then verify the bypass voltage and frequency presented to the UPS. Check the external supply if it is found to be faulty.
Bypass Abnormal	This alarm is triggered by an inverter software routine when the amplitude or frequency of bypass voltage exceeds the limit. This alarm automatically resets once the bypass voltage goes normal. First check if there are some relevant alarms such as “Bypass disconnect open”, “Bypass phase reverse” and “Mains neutral lost”. If they appear, solve them first. 1. Then verify that the bypass voltage and frequency displayed on the panel is within the bypass limit. Note here the rated voltage and frequency are specified by “Output voltage level” and “Output frequency level” respectively. 2. If the displayed voltage is believed to be abnormal, then verify the bypass voltage and frequency presented to the UPS. Check the external bypass supply if it is found to be faulty. If the utility is likely to trigger this alarm frequently, the bypass limit can be changed a little larger through the configuration software according to the customer’s agreement.
Inverter Asynchronous	This alarm is triggered by an inverter software routine when the inverter and bypass waveforms are misaligned by more than 6 degrees in phase. This alarm resets automatically once the condition is no longer true. 1. First check if the alarm “Bypass unable to trace” or “Bypass abnormal” occurs. If so, solve it first. 2. Verify the waveform of the bypass voltage. If it is too distorted, ask the customer to verify and seek any possible measurements.
Inverter Fault	Inverter output voltage beyond limits. Load transfers to bypass.
Inverter Overtemp.	The temperature of the inverter heat sink is too high to keep inverter running. This alarm is triggered by the signal from a temperature monitoring thermostat on the inverter bridge heat sink. The UPS will recover automatically after a 5 minute delay from the disappearance of the overtemperature signal. If the overtemperature condition is true, then check for and verify: 1. high ambient air temperature. 2. blocked cooling airway. 3. any fan failure. 4. prolonged inverter overload
Fan Fault	At least one of the cooling fans has failed
Inverter STS Fail	At least one of the static switches of inverter side is open or short circuit. This fault is locked until power off.
Bypass STS Fail	At least one of the static switches of bypass side is open or short circuit. This fault is locked until power off
Operation Invalid	This record is registered following an incorrect operation:
Output Fuse Fail	At least one of the inverter output fuses is blown. Inverter shuts down. Load transfers to bypass.
Control Power 2 Fail	UPS operates but Redundant Control Power is not available.
Unit Over load	The UPS is confirmed to be overload when the load arises above 105% nominal rating. The alarm automatically resets once the overload condition is removed. 1. Confirm that the alarm is true by checking the load percent indicated on the LCD panel to determine which phase is being overloaded. 2. If the alarm is true, measure the actual output current to verify that the indications are valid. Disconnect unnecessary load and ensure the safety. In a parallel system, a severe load sharing error can also leads to the alarm.

Table 23 UPS messages

Message	Description / Suggested Action (if any)
System Over load	The UPS parallel system is confirmed to overload when the total load arises above 105% nominal rating for the set basic number of UPSs. The alarm automatically resets once the overload condition is removed. 1. Confirm that the alarm is true by checking the system load percent indicated on the LCD panel to determine which phase is being overloaded. 2. If the alarm is true, measure the actual output current to verify that the indications are valid. Disconnect unnecessary load and ensure the safety. In a parallel system, a severe load sharing error can also leads to the alarm.
Unit Over load Timeout	The UPS is confirmed to overload and the overload times out. Note 1: the highest loaded phase will indicate overload timing-out first. Note 2: When the timer is active then alarm “unit overload” should also be active as the load is above nominal. Note 3: When the timer has expired, the inverter Static Switch is opened and the load transferred to bypass. The inverter shutdown and will restart after 10 seconds. Note 4: If the load decreases lower than 95% after 5 minutes, the system will transfer back to inverter mode. Confirm that the alarm is genuine by checking the load percent indicated on the LCD. If an overload is indicated then check the load, and investigate any additional load connected prior to the alarm (if applicable).
Byp. Abnormal Shutdown	Both bypass and inverter voltages unavailable. Load interruption
Inverter Over Current	Inverter Pulse Width Modulation module overloaded.
Bypass Phase Reversed	The phase sequence direction of bypass voltage is reversed. Normally, the phase of phase B lags 120 degrees behind phase A, and the phase of phase C lags 120 degrees behind phase B. Verify that the phase rotation of the bypass supply presented to the UPS is correct, and rectify it if it is found to be in error
Load Impact Transfer	A transfer to bypass occurred due to a large step load. The UPS should recover automatically. Turn on connected equipment in sequential order to reduce the step loading of the inverter.
Transfer Time-out	The load is on bypass power due to excessive number of transfers that occurred within the last hour. The UPS will recover automatically and will transfer the load back to inverter power within an hour.
Load Sharing Fault	UPS modules within a parallel system are not sharing the load current equally.
DC Bus Abnormal	DC input voltage to inverter beyond limits. Inverter shuts down. Load transfers to bypass.
System Transfer	The whole paralleled UPS system transferred to bypass at the same time. This message will appear on the UPS which passive transfer to bypass
Parallel Board Fault	Malfunction of the paralleling control circuits of this UPS module. Can cause “System Transfer” to bypass.
DC Bus Over Voltage	Rectifier, inverter and battery converter were shutdown because DC bus voltage is too high. Check whether there is a fault in rectifier side. If no, then check whether overload occurs. Restart the inverter after resetting the fault
Parallel Connect Fault	The parallel cables are not connected correctly in a parallel system. Reset the fault by pressing the “fault clear” button, then restart the inverter by pressing the “inverter on” button.
Bypass Over Current	Bypass current is over limit above 135% rating. The UPS just alarms and does nothing.
LBS Active	Load Bus Synchronisation is active. The UPS is acting as an LBS master or slave in a dual bus configuration.
Setting Save Error	History records not saved. ***(Reserved)***
Mains Neutral Lost	AC Input mains reference neutral not detected.
Protocol version clash	Firmware incompatibility between Monitor Board and Digital Signal Processor Board.
Battery ground fault	Battery leakage to ground detected (option)
Inv. turned On Manually	Manual Turn On via front panel

Table 23 UPS messages

Message	Description / Suggested Action (if any)
Inv. turned Off Manually	Manual Turn Off via front panel
EPO	Emergency Power Off direct access key pressed or external command received
Transfer Confirm	Prompt to press “enter” key to acknowledge that an interrupted load transfer to bypass will happen.
Transfer Cancel	Prompt to press “ESC” key to avoid that an interrupted load transfer to bypass will happen.
Unit Off Confirm	Prompt to press “enter” key to acknowledge that the UPS will be disconnected from other paralleled UPS modules.
System Off Confirm	Prompt to press “enter” key to acknowledge that the all paralleled UPS will be disconnected from the load.
Fault Reset	Fault clear direct access key pressed
Alarm Silence	Silence On/Off direct access key pressed
Turn On Fail	Inverter failed to turn on when Inverter On direct access key was pressed. This may be as a result of Invalid Operation (Maintenance bypass on) or DC bus or rectifier not ready.
Alarm Reset	Fault clear or Silence On/Off direct access key pressed
Bypass Mode	Load supplied from AC input bypass supply.
Normal Mode	Load supplied from Inverter output through double conversion of the AC mains input supply.
Battery Mode	Load supplied from Inverter output through double conversion of the Battery supply.
Source share mode	Load supplied from Inverter output through shared double conversion of the AC mains input supply and of the Battery supply.
UPS Shutdown	UPS Shutdown, output power-down
Check UPS Output	Inverter off during normal startup (diagnostics information only)
Generator Connected	Generator active signal received. Source share mode may be activated pending UPS settings.
BCB open	Battery Circuit Breaker status (open)
BCB closed	Battery Circuit Breaker status (closed)
Battery Float Charging	Battery status (Float charge mode)
Battery Boost Charging	Battery status (Boost charge mode)
Battery Discharging	Battery status (discharge mode)
Battery Period Testing	Automatic periodic battery maintenance discharge test (20% capacity discharge)
Batt. Capacity Testing	User initiated battery capacity discharge test (100% capacity discharge)
Batt. Maint. Testing	User initiated maintenance discharge test (20% capacity discharge)
UPS System Testing	User initiated UPS self test
Inverter in Setting	Inverter starting up and synchronising
Rectifier in Setting	Rectifier starting up and synchronising
MBP-T cabinet Fan Fault	Maintenance bypass cabinet fans fault.
Ext Input TX Overtemp	External Input Isolation Transformer Over Temperature
Ext Output TX Overtemp	External Output Isolation Transformer Over Temperature
Battery Room Alarm	Environment in Battery Room Needs Attention
Rotary Sw. Test Pos.	Rotary switch is in test position.
Rotary Sw. Normal Pos.	Rotary switch is in normal position.
Rotary Sw. Bypass Pos.	Rotary switch is in bypass position.
Rotary Sw. Maint. Pos.	Rotary switch is in maintenance position.
Battery Contactor Open	Battery Contactor Open
Battery Contactor Close	Battery Contactor Closed
Battery Reverse	Connect the battery again and check the wiring of batteries
No Battery	Check the battery and the wiring of batteries

Table 23 UPS messages

Message	Description / Suggested Action (if any)
Auto start	After UPS was shutdown at EOD, inverter auto starts when utility restore
REC FLASH UPDATE	Rectifier firmware is being updated
INV FLASH UPDATE	Inverter firmware is being updated
MONITOR FLASH UPDATE	Monitor firmware is being updated
Input contactor fault	Input contactor fault
Contactor P.S. 1 fault	Contactor Power Supply board 1 Fault
Contactor P.S. 2 fault	Contactor Power Supply board 2 Fault
LBS abnormal	LBS is abnormal
DSP firmware error	The inverter firmware does not match with the rectifier firmware.
Input Fuse	Fail Internal AC Input Fuse to Rectifier Failed. Rectifier shuts down. Battery discharges. Not applicable for 30-40kVA models.
Input Disconnect Open	AC mains input power switch open
Input Disconnect Closed	AC mains input power switch closed
Maint. Disconnect Open	Maintenance bypass power switch open
Maint. Disconnect Closed	Maintenance bypass power switch closed
Bypass Disconnect Open	AC bypass input power switch open
Bypass Disconnect Closed	AC bypass input power switch closed
Output Disconnect Open	UPS Output power switch open
Output Disconnect closed	UPS Output power switch closed
Input Inductor Overtemp.	Overheating of Rectifier input filter choke. Rectifier shuts down. Battery discharges.
Balancer Fault	Internal VDC(+) and VDC(-) off-set by over 50V exceeding the Inverter DC offset compensation capacity. Inverter shuts down. Load transfers to bypass.
Balancer Over Current	Internal Inverter DC off-set balancing IGBT current rating exceeded 300%. Inverter shuts down. Load transfers to bypass.
Balancer overtemp.	Inverter voltage offset control choke overheated. Inverter shuts down. Load transfers to bypass.
Inv. Inductor Overtemp.	Inverter output filter choke overheated. Inverter shuts down. Load transfers to bypass.
Batt. Converter Fault	Battery converter output voltage beyond limits or battery fuse failed. Battery converter shuts down. Battety backup not available.
Batt. Conv. Over. Curr.	Battery converter overloaded. Battery converter shuts down. Battery backup not available.
Batt. Converter Overtemp.	Overheating of Battery converter heatsinks. Battery converter shuts down. Battery backup not available.
Output Disabled	UPS Output Disabled (test mode)

8.3 Prompt (Pop-Up) Windows

The prompt window is displayed during the operation of the system to alert the user to certain conditions and / or to require user confirmation of a command.

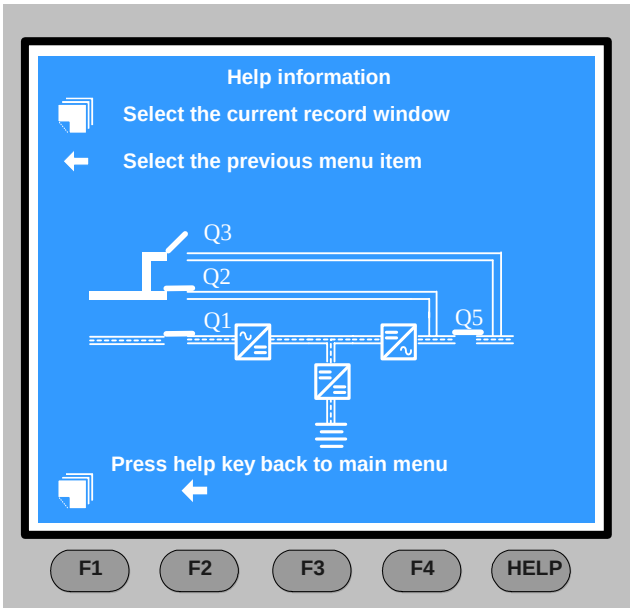
Table 24 Prompt windows, meanings

Prompt	Meaning
Transfer with interrupt, please confirm or cancel	Inverter and Bypass supplies are not synchronised and any load transfer between the supplies will cause a brief load interruption.
The load is too high to be transferred with interrupt	The total load must be less than the capacity of one unit to allow a parallel system to perform an interrupted transfer from bypass to inverter.
This Operation Leads to Output Shutdown, Confirm or Cancel	No alternative supply is available and any Inverter Off operation will cause the load to be de-energised.
This operation leads to inverter overload, confirm or cancel	The turn-off this inverter will lead to the overload of remaining inverter(s) in a parallel system.
Turn on more UPS to carry current load	The number of paralleled inverters already turned on is insufficient to carry the existing load.
Battery will be depleted, confirm	Battery Capacity test discharges the battery 100%
System self test finished - everything is ok.	No action required
System self test finished - Please check the current warnings.	Check “Current Records” window
Enter control password	Required for Battery or UPS test (default = 12345)
Battery Self Test aborted, condition not met	Battery self-test condition is not enough. User should check whether battery state is boost charging and whether load level is greater than 20 percent.
Battery Refresh Charge aborted, condition not met	Boost charging condition is not enough, such as no battery, charger has failed, etc).

8.4 Dynamic Energy Flow Chart and UPS Help Screen

This screen displays a mimic diagram of the UPS that includes energy flow and status of isolation and transfer switches. Press the Help key to activate this screen. Press again to toggle between this screen and the main screen.

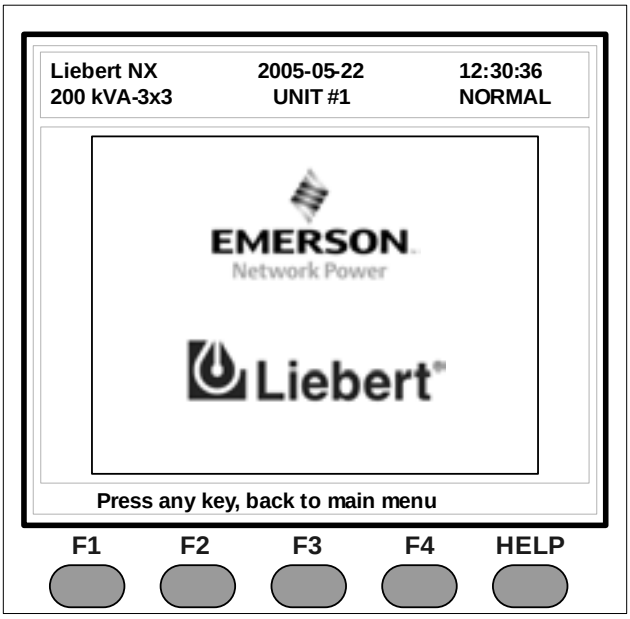
Figure 70 Help screen



8.5 Default Screen Saver

This default screen is displayed following at least 2 minutes of operation with no new alarm. After another delay, the backlight turns off. Press any key (F1-F4 or Help) to reactivate the screen.

Figure 71 Default screen



9.0 OPTIONS—FOR ASSEMBLY INSIDE THE UPS CABINET

Several items of optional equipment are available for connection to the Liebert NX UPS. These are described in this section of the manual and should be fitted prior to installation.

9.1 Protection

9.1.1 Redundant Back-Feed Protection

In addition to the dry output back-feed protection contact provided for tripping of an external circuit-breaker upon a shorted static bypass semiconductor condition (refer to **1.8.4 - Output Dry Contacts**), an optional contactor can be fitted in series with bypass semiconductors (SCR) in order to provide air-gap isolation between upstream of the UPS input bypass mains and the Inverter output. The power supply to the coil of contactor is taken from the bypass mains input line voltage. When the bypass mains input is unavailable, the contactor is opened and the UPS is disconnected from the bypass mains supply.

9.1.2 Seismic Anchors

Seismic anchors avoid or lessen the damage caused by a possible earthquake or vibration and ensure that the UPS does not overturn or move laterally under such a situation.

Table 25 Seismic anchor sizing

UPS	Anchor Width mm (in)	Anchor Length mm (in)
30-120kVA	500 (19.7)	83 (3.3)
140-200kVA	750 (29.5)	83 (3.3)

The Seismic Anchor classification when bolted into a suitable concrete slab, exceeds the requirements of Level 2, Table 2 IEC60068.3.3 and complies with UBC 1994, Seismic Zone 4 for strong to very strong earthquakes

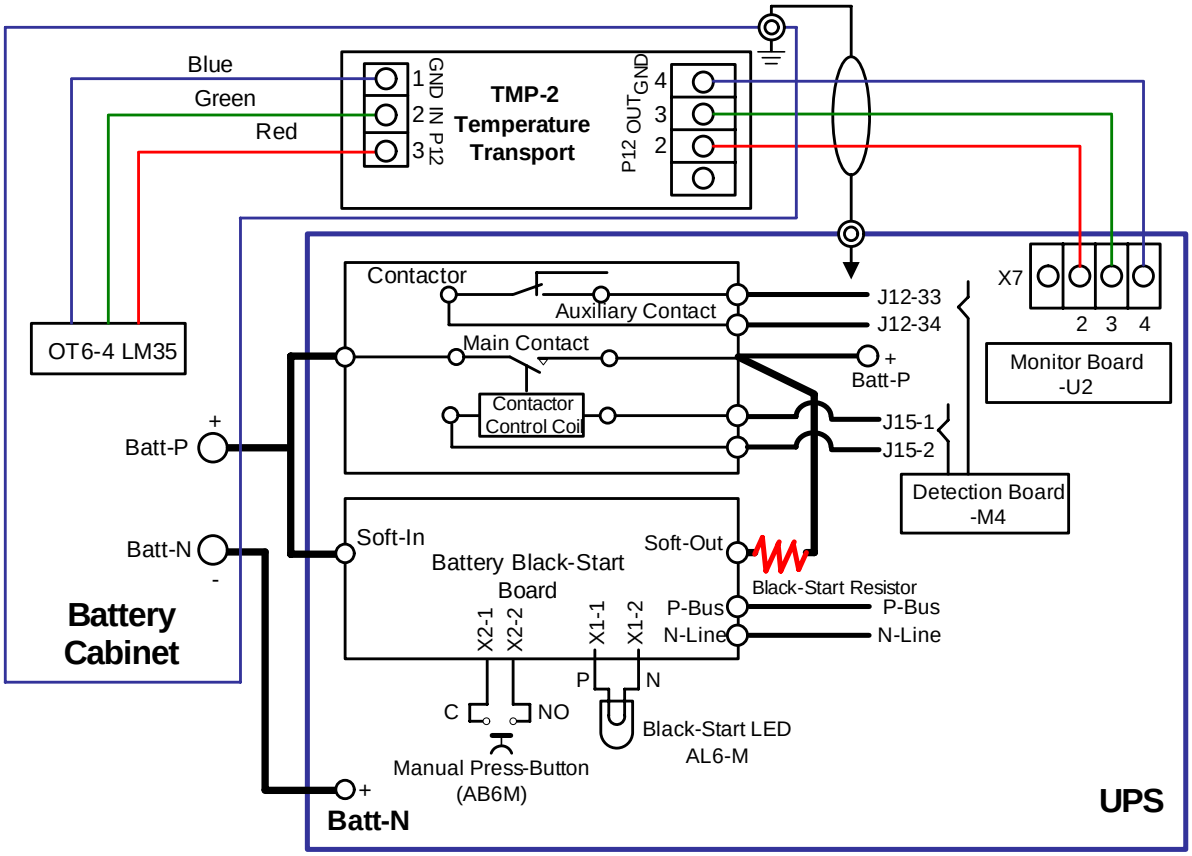
9.1.3 Degree of Protection for the UPS Enclosure

The standard degree of protection is IP20. A canopy option for IP21 is also available.

9.1.4 Battery Start Facility

The battery start kit consists of controls, a push button, a charging resistor and an internal battery contactor that replaces any end of discharge battery circuit breaker trip control. The battery is permanently connected to the UPS DC input.

Figure 72 Battery Start Option for UPS with external battery



NOTE

Battery contactor opens after Inverter shutdown at end of battery discharge. Battery Start settings disable the end of discharge trip command to external battery circuit breaker.

9.1.5 Bypass Current Sharing Inductors

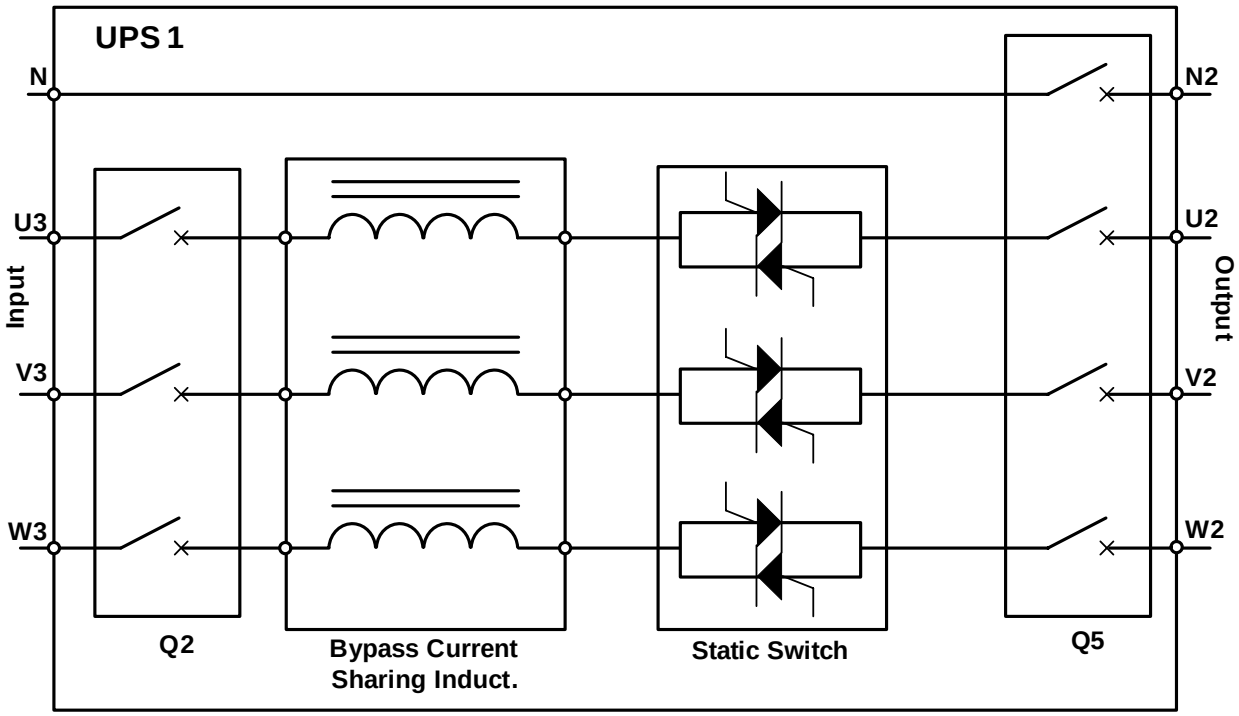
Applicable in paralleled UPS configurations to ensure that the (passive) static bypass switches, when activated, share the load current. The inductors provide droop type current compensation for the otherwise inherent current dispersion due to SCR and cable impedance differences.

Table 26 Bypass current sharing inductors-dimensions, values

UPS	Dimensions WxLxH, mm (in)	Inductor Value (uH)
30/ 40 kVA	70x100x140 (2.8x3.9x5.5)	122
60/80 kVA	140x100x200 (5.5x3.9x7.9)	65
100/120kVA	210x100x250 (8.3x3.9x9.8)	40
140/160kVA	160x190x240 (6.3x7.5x9.4)	26
200kVA	160x190x240 (6.3x7.5x9.4)	22

Three bypass current sharing inductors are assembled within each UPS cabinet without requirement of additional footprint. The resulting degree of unbalance is typically less than 20% of the rated system current depending on the external cable configuration. Cable lengths from the Bypass supply to each UPS module and from the UPS module output to the paralleling point should be kept as identical as possible.

Figure 73 Bypass current sharing inductances



9.1.6 Battery Ground Fault Detection

In addition to any residual current device mounted externally and upstream the UPS or when optional isolation transformers are fitted to the UPS, an optional residual battery current device can be fitted to detect leakage current from the battery into the PE (Protective Earth) Residual current range monitored: 30~3000mA.

Power supply voltage for the set: AC230V (L-N);

When a battery ground fault is detected, an alarm will appear on the UPS display panel.

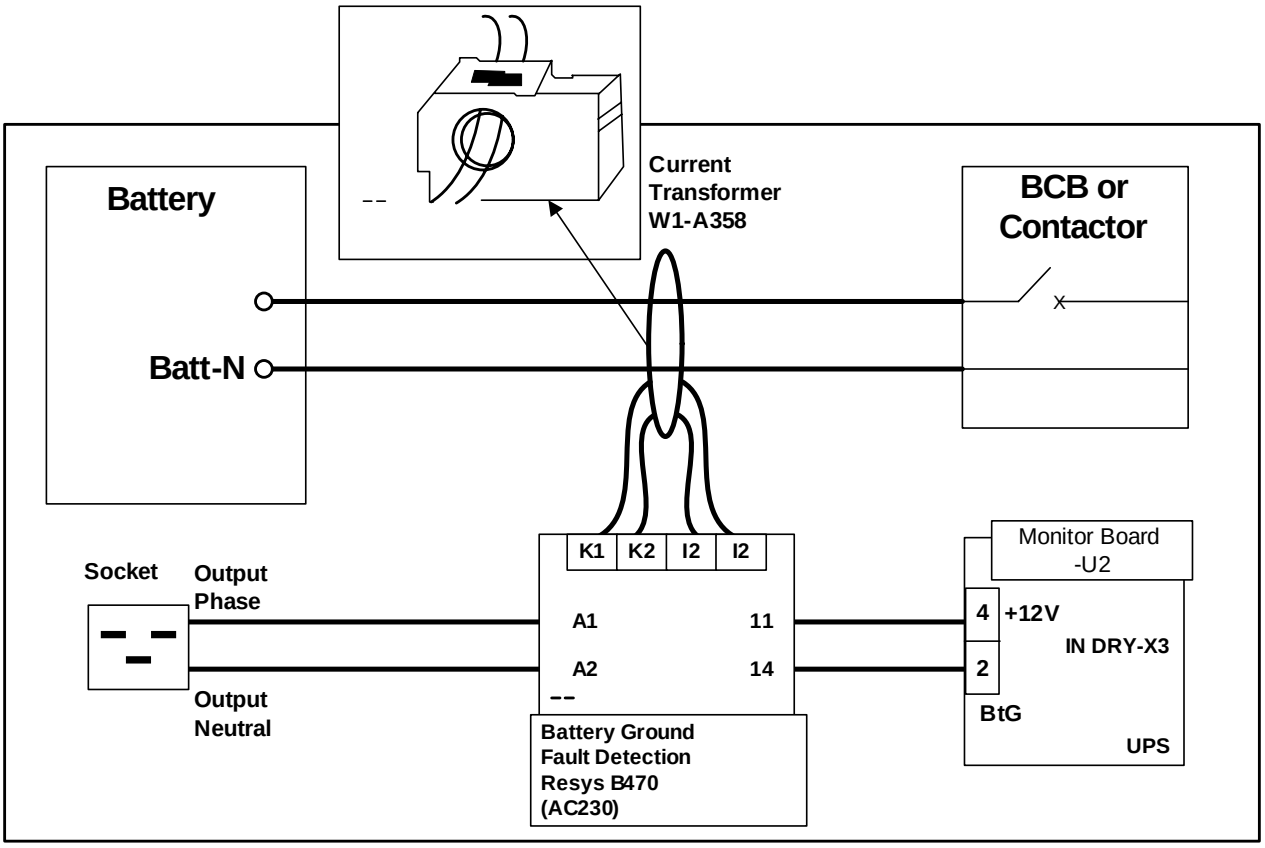
An additional Dry contact fault Alarm signal is available for remote monitoring:

Table 27 Dry contact fault alarm signal is available for remote monitoring

Terminal	Name	Definition
21	Common	Battery Ground Fault Detection – can be programmed as Alarm or Pre-Alarm
22	NC	
24	NO	

The Battery ground fault detection set contains one CT (current transformer) and one DC sensitive residual current monitor. The connection of this set for UPS is illustrated as follows.

Figure 74 Battery ground fault detection set connections



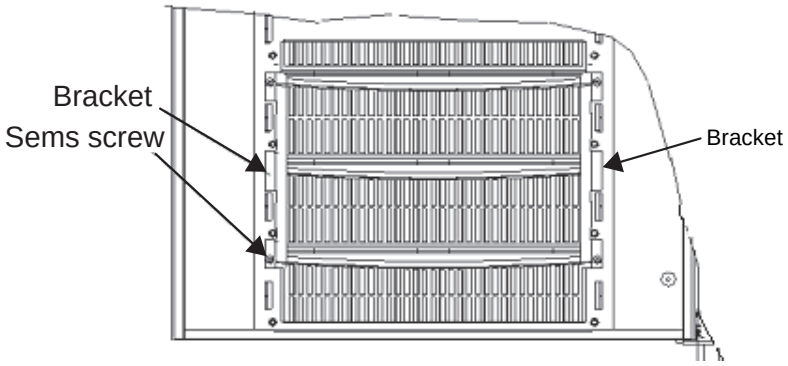
The Battery Ground Fault Detection Set is assembled within the UPS cabinet.

9.1.7 Replacing Dust Filters

Installing the two dust filters in the Liebert NX requires only a Phillips screwdriver. Each filter is held in place by a bracket on either side of each filter. To install each filter:

1. Open the UPS door and locate the filters on the back side of the front door (see **Figure 75**).
2. Remove one bracket and loosen the screw on the second bracket. The second bracket need not be removed (see **Figure 75**).
3. Remove the dust filter to be replaced.
4. Insert the clean filter.
5. Reinstall the bracket, tightening the screw securely.
6. Tighten the screw on the second bracket.

Figure 75 Replacing the dust filters

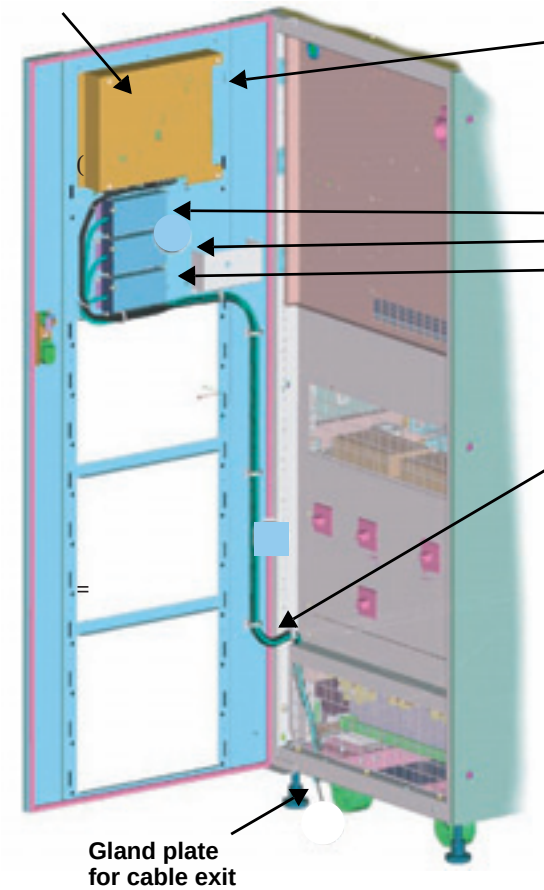


9.1.8 Redundant Fan for Power Module

In addition to the monitored fans installed in the UPS cabinet to ensure sufficient cooling power at various operation modes with 100% rated load, a redundant power module fan set can be supplied, thus ensuring continuity of UPS operation even with the failure of some fans. No extra footprint is required.

9.2 Communication and Monitoring

Figure 76 Communication bays and cable location



Location	Preferred Device This Location
RS-232-1 DB-9 (COM Port 1)	Serial MultiLink Software (Port Setting 2400 Baud)
RS-232-2 DB-9 (COM Port 2	Service Access Software (Port Setting 9600 Baud)

Location	Preferred Device This Location
Top Bay	Relay Card (no port setting req'd)
Mid Bay	Multiport4 (no port setting req'd)
Bottom Bay	OCWeb LB / OC485 (port setting 2400 Baud)

Suggested routing of customer-supplied communication cables

Notes:
a) All Intellislot cards are supported in any bay.
b) Port sharing is:
- PERMITTED between RS232-x DB9 devices and Relay / Multiport4 Intellislot cards (i.e., Serial Multilink software will work from RS232-1 DB9 also when relay card is inserted in the top bay.
- NOT PERMITTED between RS-232-x D-B9 devices and OCWeb / OC485 cards (i.e., Serial MultiLink software will not work from RS232-1 DB-9 when OCWeb card is inserted in the top bay.
c) Monitor board firmware version will be m131 or greater. The version may be verified from the UPS LCD (refer to 8.0 - Operator Control Panel and Display).

9.2.1 OC Web Card - SNMP/HTTP Network Interface Card

This network interface card provides all real-time data and status information as SNMPv1 traps for connection to a 10/100-baseT Ethernet network and in addition the same card will also transmit the same status information and all measured parameters for display via a Web browser.

This card is supported in the top, middle and bottom Intellislot bays.

Figure 77 OC Web Card data summary window

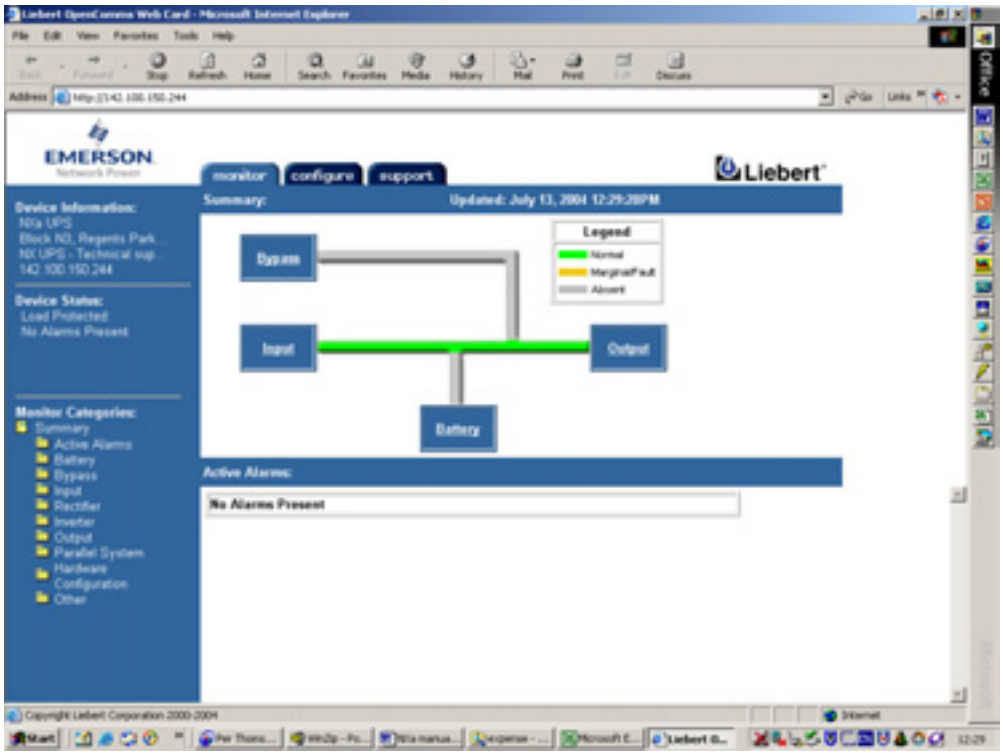
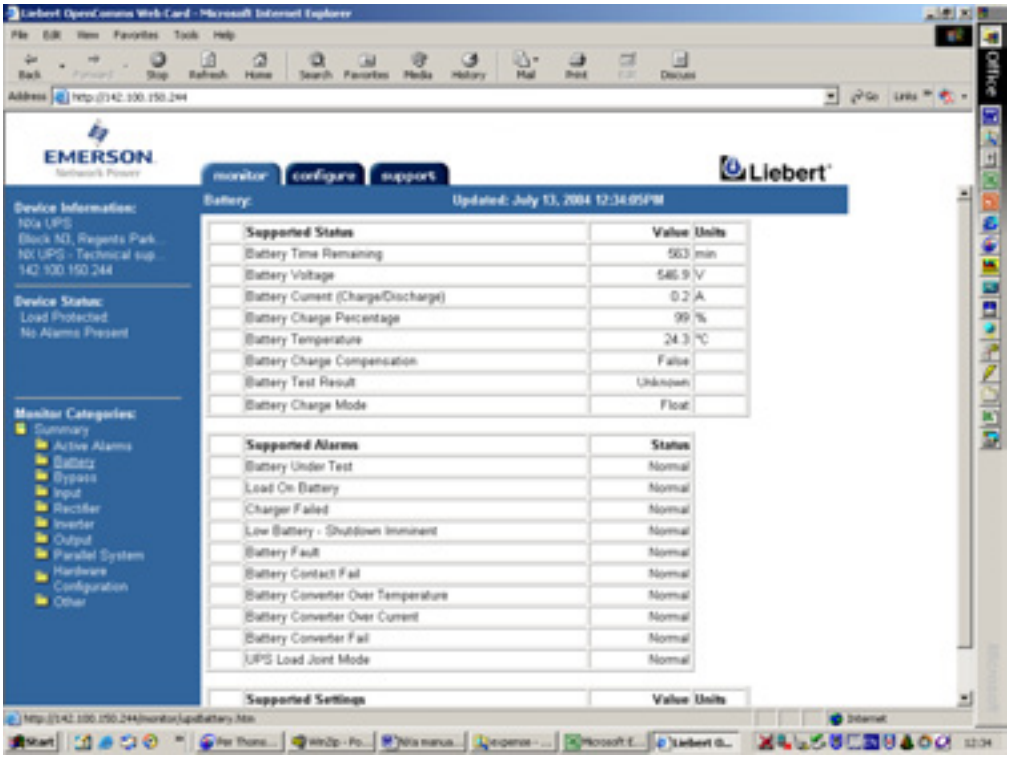


Figure 78 OC Web Card battery data summary



9.2.2 Relay Card

The Relay card provides voltage-free contact closures for remote monitoring of alarm conditions.

Delivering On Battery, On Bypass, Low Battery, Summary Alarm, UPS Fault and On UPS signals, the easy-to-install card integrates with AS/400 computers (additional cable required) and other relay contact monitoring systems.

The Relay card is rated for 24 VAC/VDC at 1A and supported in any of the three NX Intellislot bays.

Table 28 Relay Card pin configuration

Pin	Function	Operation
1	UPS Fault	Closed if no UPS failure
2-3	Not Used	
4	UPS Fault	Closed if UPS fails
5	Summary Alarm**	Closed if SUMMARY ALARM** occurs
6	Summary Alarm**	Closed if no alarm conditions are present
7	Any Mode Shutdown return	Not – use External EPO terminal
8	Not Used	
9	Common - Low Battery	
10	Low Battery	Closed if battery is OK
11	Low Battery	Closed if LOW BATTERY point occurs.
12-13	Not Used	
14	UPS Any Mode Shutdown	Not support– use External EPO terminal
15	On UPS	Closed if ON UPS (inverter) power
16	On Battery	Closed if ON BATTERY power (Utility failure)
17	Common - UPS Fault, Summary Alarm, On UPS, On Battery, On Bypass	
18	On Battery	Closed if not ON Battery power (Utility OK)
19 ÷ 23	Not Used	
24	On Bypass	Closed if ON BYPASS
25	Not Used	

**A *Summary Alarm* occurs when any of the following conditions exist:

- Utility power is out of the acceptable range (voltage and/or frequency)
- UPS is in BYPASS MODE (load not on Inverter power)
- UPS Battery is LOW
- UPS fault has occurred

Table 29:

#	Connection	Description
JP01	Pin 9 to Pin 17	Allows all relay COMMONS to be tied together.
JP02	Pin 7 to Pin 17	**REMOVE** - (Interconnects all relay COMMONS and the (not supported) ANY MODE SHUTDOWN Return.

9.2.3 Multiport-4 Card

The Multiport-4 card provides 4 sets of voltage-free contact closures for remote monitoring of alarm conditions UPS operation On Battery and battery low condition. A typical application is to allows a maximum of four computer systems to simultaneously monitor the status (e.g., utility power failure / low battery) of a single UPS.

This card is supported in any of the three NX Intellislot bays.

Figure 79 SiteNet MultiPort4 Intellislot pin configuration

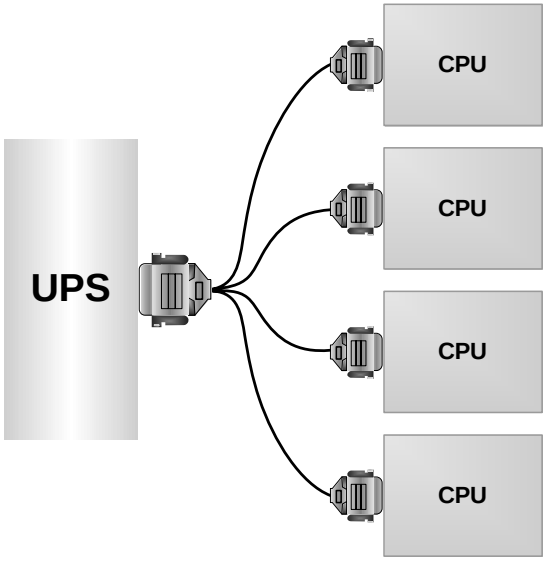


Table 30 SiteNet MultiPort4 Intellislot pin assignment

Pin	Assignment Description
1	Low Battery
2	Not Used
3	Not Used
4	Not Used
5	Not Used
6	Not Used
7	Low Battery Common
8	Utility Fail Common
9	Utility Fail

9.2.4 OC485 Web Card – Modbus, Jbus, IGM Net

The OpenComms 485 Card facilitates SiteScan Web or Building Management Systems monitoring.

The RS232 port is used for connection to a personal computer for setting up.

The RS-485 port supports IGM Net and Modbus/JBus protocols and maps the operation of the UPS including status, alarms and data (voltages, currents, frequency, power, power factor, temperatures etc.)

Figure 80 OC485 Web card

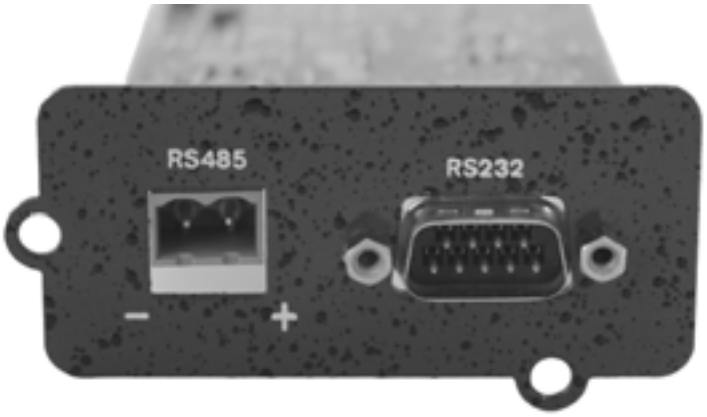


Table 31 NX communication options

Physical description of port	Labeled ID Name of Port	On the UPS LCD screen, under Settings, controlled by:	Monitoring Devices supported	Baud rate	Comments
Top Intellislot	Intellislot 2 (On Monitor Board)	Comm 1	Multiport 4	any	
			Relaycard-int	any	
			OCWEB-LB	2400	Not simultaneous with Multilink in RS232-1
			Modbus/Jbus	2400	
Middle Intellislot	Intellislot 1 (On Monitor Board)	Comm 2	Multiport 4	any	
			Relaycard-int	any	
			OCWEB-LB	2400	Not simultaneous with Multilink in RS232-2
			Modbus/Jbus	2400	
Bottom Intellislot	Intellislot 3 (On Monitor Board)	Comm 3	Multiport 4	any	
			Relaycard-int	any	
			OCWEB-LB	2400	
			Modbus/Jbus	2400	
Top DB9 port	RS232-1	Comm 1	Multilink Serial	9600	Not simultaneous with Web card in top Intellislot.
Bottom DB9 port	RS232-2	Comm 2	Service Software (Reserved)	9600	Not simultaneous with Web card in middle Intellislot.

9.2.5 Remote Alarm Monitor

Status and alarm conditions are available on an optional remote alarm monitor (RAM) panel that is driven by volt-free alarm status contacts from an optional relay alarm board.

10.0 TECHNICAL SPECIFICATIONS

10.1 Conformity and Standards

The UPS has been designed to conform to the following European and international standards:

Table 32 Compliance with European, international standards

Description	Normative reference
General and safety requirements for UPS used in operator access areas	EN 50091-1-1 /IEC 62040-1-1 / AS 62040-1-1
Electromagnetic compatibility (EMC) requirements for UPS	EN 50091-2 / IEC 62040-2 / AS 62040-2 (Class A)
Method of specifying the performance and test requirements of UPS	EN 50091-3 / IEC 62040-3 / AS 62040-3 (VFI SS 111)

The above mentioned product standards incorporate relevant compliance clauses with generic IEC and EN standards for safety (IEC/EN/AS60950), electromagnetic emission and immunity (IEC/EN/AS61000 series) and construction (IEC/EN/AS60146 series and 60529). For more details, see below:

Description	Normative reference
Safety for Information technology equipment	EN60950 / IEC 60950 / AS 60950
Degrees of protection provided by enclosures (IP code).	EN 60529/ IEC60529 / AS 60529
Semiconductor convertors. Part 1: General requirements and line commutated convertors. Part 1-1: Specifications of basic requirements	IEC 60146-1-1 / AS 60146-1-1
Electromagnetic compatibility (EMC): immunity test	IEC / AS 61000-4-2, -3-4, -5, -6
Limits for harmonic current emission	IEC / AS 61000-3-2, -3-4, -3-6

The product standards in **Table 32** incorporate relevant compliance clauses with generic IEC and EN standards for safety (IEC/EN/AS60950), electromagnetic emission and immunity (IEC/EN/AS61000 series) and construction (IEC/EN/AS60146 series and 60529).

Table 33 Environmental characteristics

Rated Power, kVA	Unit of Measurement	30	40	60	80	100	120	140	160	200
Acoustic noise level at 1 meter	dBA	55	55	59	59	62	62	65	65	66
Altitude of Operation	m (ft)	≤1000 (3280) above sea level derate power by 1% per 100m between 1000 and 2000 (3280-6562)								
Relative Humidity	—	0 to 95% non condensing								
Operating Temperature	°C (°F)	0 to 40 (32 to 104) Note: Battery life is halved for every 10°C increase above 20°C								
UPS Storage-Transport Temperature	°C (°F)	-20 to 70 (-4 to 158)								
Recommended Battery Storage Temperature	°C (°F)	-20 to 30 (-4 to 86) (20 for optimum battery storage)								

Table 34 Efficiency, AC/AC

Input and output voltage 400VAC, battery charged, full rated linear load										
Rated Power, kVA	**Unit of Measurement**	**30**	**40**	**60**	**80**	**100**	**120**	**140**	**160**	**200**
Normal Mode (dual conversion)	%	89	90	91	91	90.6	91.1	92.5	92.7	92.8
ECO Mode	%	94	94.8	94.3	95	95	95.6	95.5	95.7	95.7
Inverter Efficiency (DC/AC) (battery at nominal voltage 480VDC and full-rated linear load)										
Battery Mode	%	93	93	94	94	94	94	94	94	94
Heat Losses & Air Exchange—Ventilation										
Normal Mode	kW	3.0	3.6	4.7	6.3	7.9	9.5	10.8	11.8	14.5
ECO Mode	kW	1.5	1.6	2.0	2.6	3.5	4.3	7.0	7.6	9.9
No Load	kW	1.3	1.4	1.9	2.4	3.0	3.7	4.9	4.9	5.6
Forced air cooling (front intake, top exhaust)	L/sec	333	333	458	458	500	500	671	671	721
	M^3/hr	1200		1650		1800		2415		2595

Table 35 Mechanical characteristics

Rated Power, kVA	**Unit of Measurement**	**30**	**40**	**60**	**80**	**100**	**120**	**140**	**160**	**200**
Dimensions, H x W x D	mm (in)	1600 x 600 x 825 (63 x 23.6 x 32.5)				1800 x 700 x 825 (70.8 x 27.5 x 32.5)		1800 x 1000 x 825 (70.8 x 39.4 x 32.5)		
Mass, without batteries	kg (lb)	312 (688)	341 (752)	401 (884)	445 (981)	720 (1587)	720 (1587)	960 (2116)	960 (2116)	1060 (2337)
Finish	Colour	Pantone 877 (Silver grey) eqvl Becker Silver epoxy polyester powder 041-37-2								
Protection Degree	IEC 60529	IP20 (finger-proof with front doors open or closed)								

Values listed are the mass of the units with options added (ground fault sensor, bypass share inductors and redundant fans).

Table 36 Rectifier AC input (mains)

Rated power, kVA	**Unit of Measurement**	**30**	**40**	**60**	**80**	**100**	**120**	**140**	**160**	**200**
Rated AC Input Voltage [1]	VAC	380/400/415 V (three-phase and sharing neutral with the bypass input)								
Input voltage tolerance [2]	VAC	305V to 477V 304V to 208V (output de-rated from 99% to 70%)								
Frequency [1]	Hz	50/60Hz (tolerance 40Hz to 72Hz)								
Power Factor										
full load	kW/kVA	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
half load		0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Input power										
rated [3]	kVA	27.2	35.9	53.3	71.0	88.8	107	122	139	174
maximum [4]		32.9	43.0	64.6	85.2	107	128	159	182	228
Input current										
rated [3]	A	39	52	77	103	128	154	177	201	252
maximum [4]		48	62	93	123	154	185	231	264	330
Harmonic Current Distort (with linear or non-linear balanced load and at input THVD ≤ 2%)	THID % FL	3	3	3	3	3	3	3.5	3	3
Duration of progressive power walk-in	sec	10 seconds to reach full rated current (selectable 5 through 30 seconds in 5 second intervals)								

1. Rectifier operates at any of the rated supply voltages and frequencies without further adjustment.
2. At 305V input mains, the UPS maintains the specified output voltage at rated load without discharging a previously charged battery.
3. EN 50091-3: at rated load and input voltage 400V, battery charged
4. EN 50091-3: at rated load and input voltage 400V, battery charging at maximum rated power.

Table 37 Intermediate DC circuit, battery

Rated Power, kVA	Unit of Measurement	30	40	60	80	100	120	140	160	200
Battery bus voltage	VDC	Nominal: 480V (VRLA Float charge is 540V) Range: 400V ~ 600V								
Quantity of lead-acid cells										
Nominal	—	240 = [40 x 6-cell (12V) blocks]								
Maximum	—	252 = [42 x 6-cell (12V) blocks]								
Minimum	—	228 = [38 x 6-cell (12V) blocks]								
Float Voltage (VRLA)	V/cell	2.25 V/cell (selectable from 2.2 –2.3V/cell) Constant current and constant voltage (IU) charge mode								
Temperature compensation	mV/°C/cl	- 3.0 (selectable 0 to – 5.0 around 25°C [77°F] or 20°C [68°F]or inhibit)								
Ripple Voltage	% V float	≤1								
Ripple Current [1]	% C_{10}	≤5								
Boost Voltage (VRLA)	V/cell	2.35 V/cell (selectable from 2.30-2.40V/cell) Constant current and constant voltage (IU) charge mode								
Boost Control	—	- float-boost current trigger 0.050 C_{10} (selectable 0.030-0.070) - boost-float current trigger 0.010 C_{10} (selectable 0.005-0.025) with 24 hr safety time-out (selectable 8-30 hr) - boost mode inhibit also selectable								
End Of Discharge (VRLA)	V/cell	1.63 V/cell (selectable from 1.60~1.75 V/cell Auto Inverse EOD voltage x discharge current mode (The end of discharge voltage increases at low discharge currents).								
Battery Charge	V/cell	2.4 V/cell (selectable from 2.3-2.4V/cell) Constant current and constant voltage (IU) charge mode Programmable auto trigger or inhibit of boost mode								
Battery Charging Power [2]	kW	5.1	6.7	10	13	17	20	23.8	27.2	34
Max Current (Adjustable) [3]	A	13	17	25	33	43	50	60	68	85

1. For a battery capacity of 24Ah or that corresponding to a rated back-up time of 10 minutes, whichever is greatest.
2. At low input voltage the UPS recharge capability increases with load decrease (up to the maximum capacity indicated).
3. Maximum currents listed are for end of discharge voltage of 1.67 V/cell for 240 cells.

Table 38 Inverter output to critical load

Rated Power (load pf 0.8 lag)	**kVA**	**30**	**40**	**60**	**80**	**100**	**120**	**140**	**160**	**200**
(load pf unity)	**kW**	**24**	**32**	**48**	**64**	**80**	**96**	**112**	**128**	**160**
(load pf 0.9 lead)	**kVA**	**24**	**32**	**48**	**64**	**80**	**96**	**112**	**128**	**160**
Rated AC Voltage [1]	V (ac)	380/400/415 V (three-phase, four-wire with neutral referenced to the bypass neutral)								
Frequency [2]	Hz	**50** / 60								
Overload	% rated	110% for 60 min 125% for 10 min 150% for 1 min 225% for 200 msec								
Fault Current	% rated	320% current limitation for 200 msec								
Non linear load capability [4]	% rated	100%								
Neutral current capability	% rated	170%						152%		135%
Steady state voltage stability 5	%	± 1 (balanced load), ± 2 (100% unbalanced load),								
Transient voltage response [6]	%	± 5								
Total Harmonic Voltage Distortion (THDV) [4]	%	< 1 (linear load) <3.5 (non linear load, 380V) <4.0 (non linear load, 400V < 4.5 (non linear load, 415V)								
Synchronisation - Window - Slew Rate (Max change rate of synch frequency)	Hz	Rated frequency ± 2 Hz (selectable ± 0.5 to ± 3Hz)								
	Hz/sec	1 Hz/sec selectable 0.1 to 3Hz/s (single UPS), 0.2Hz/sec (paralleled.UPS)								
Inverter Voltage Tolerance	%V (AC)	± 5								

1. Factory set to 400V – 380 or 415V selectable by commissioning engineer.
2. Factory set to 50Hz; 60 Hz selectable by commissioning engineer. Frequency converter operation also selectable.
3. EN 50091-3 (1.4.50).
4. Crest factor > 3:1 limited by IEC 62040-3 definition of non linear load.
5. EN 50091-3 (4.3.4).
6. EN 50091-3 (4.3.7) also for 0-100-0% load transient. Transient recovery time: return to within 5% of steady state output voltage within half a cycle.

Table 39 Bypass input

Rated Power, kVA	Unit of Measurement	30	40	60	80	100	120	140	160	200
Rated AC Voltage [1]	V (ac)	380/400/415 V three-phase four-wire, sharing neutral with the rectifier input and providing neutral reference to the output								
Rated current										
380V	A	45	61	91	121	151	182	212	242	303
400V		43	58	87	116	145	174	202	230	288
415V		42	56	83	111	139	167	194	222	278
Overload capacity	%	135% long term 170% 10 min 1000% 100 ms						125% long term 150% 10 min 1000% 100 ms		
Upstream protection, bypass line (by others)		Thermomagnetic circuit-breaker, rated up to 125% of nominal output current. IEC 60947-2 curve C.								
Current rating of neutral cable	A	1.7 In						1.52In		1.35In
Frequency [2]	Hz	50 / 60								
Transfer time (between Bypass and Inverter)	ms	Synchronous transfer: ≤ 1ms Asynchronous transfer (default): 15 ms (50 Hz), 13.3 ms (60 Hz) or 40, 60, 80, 100 ms selectable								
Bypass voltage tolerance	% V (ac)	Upper limit: +10, +15 or +20, default +15 Lower limit –10, -20, -30 or -40, default: -20 (delay time to accept steady bypass voltage: 10 sec)								
Bypass frequency tolerance	%	± 2.5, ±5, ±10 or ±20 default ±10								
Synchronisation - Window	Hz	Rated frequency ±2 Hz (selectable ± 0.5 to ± 3Hz)								

1. Factory set to 400V – 380 or 415V selectable by commissioning engineer.
2. Factory set to 50Hz; 60 Hz selectable by commissioning engineer. Bypass condition ignored when UPS set as frequency converter.

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