Liebert® PPC Second Generation Power and Distribution Cabinet

Installer/User Guide

225 kVA - 950 kVA, 3-phase, 60 Hz, Custom PDU

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Technical Support Site

If you encounter any installation or operational issues with your product, check the pertinent section of this manual to see if the issue can be resolved by following outlined procedures.

Visit https://www.vertiv.com/en-us/support/ for additional assistance.

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1 Important Safety Instructions

Read this entire manual before installing or operating the system.

WARNING! Risk of cutting bands under tension. Can cause injury or death. The shipping bands may be under tension. Use appropriate eye, face and hand protection to safeguard against injury from band backlash.

WARNING! Risk of electric shock. Can cause injury or death. Verify that all incoming line-voltage (power) and low voltage (control) circuits are de-energized and locked out before installing cables or making connections in the junction box or in the unit. Equipment inspection and startup should be performed only by trained personnel. Lethal voltages are present during startup procedures. Electrical safety precautions must be followed throughout inspection and startup.
Only properly trained and qualified service personnel should perform maintenance on the PPC. All voltage sources to the unit must be disconnected before inspecting or cleaning within the cabinet.
Lethal voltages exist within the equipment during operation. Observe all warnings and cautions in this manual. Failure to comply may result in serious injury or death. Obtain qualified service for this equipment as instructed.
The monitoring system contains a lithium battery for memory backup. Danger of explosion if battery is incorrectly replaced. Replace only with same or equivalent type. Dispose of used batteries according to manufacturer's instructions.

WARNING! Risk of electric shock.Can cause injury or death. All power and control wiring should be installed by licensed electricians and must comply with the NEC and applicable codes.

WARNING! Risk of improper handling. Can cause equipment damage, injury, or death. The PPC is heavy. Its weight ranges from 2750 lb (1312 kg) to 5788 lb (2625 kg) The unit should not be loosened from the shipping pallet until after all handling by forklift or pallet jack is completed.

Electromagnetic Compatibility—The Vertiv™ Liebert® PPC complies with the limits for a Class A digital device, pursuant to Part 15 of FCC rules.

Operation is subject to the following conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

Operating this device in a residential area is likely to cause harmful interference that users must correct at their own expense.

The Liebert® PPC complies with the requirements of EMC Directive 2014/30/EU and the published technical standards. Continued compliance requires installation in accordance with these instructions and use of accessories approved by Vertiv.

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2 Introduction

The variations of the Vertiv™ Liebert® PPC covered in this document are unique configurations of the standard Liebert® PPC. They are differentiated by the value of model number digit eight. This document will cover systems with model digit eight set to '9' and those set to 'F'. The two variations described herein are similar but offer varying advantages over each other and the standard Liebert® PPC product offering.

2.1 Configuration 1

This configuration is defined when model digit eight is set to '9'. This cabinet is 60 in. W x 48 in. D and comes in a variety of kVA rating and distribution option configurations. Most commonly, the kVA rating will be in the 400 kVA-750 kVA range and will house up to eight 600 AF/400 AF subfeed breakers.

There are two distinct varieties for this configuration model:

- There is no main input circuit breaker included in this configuration; instead, over-current protection is provided upstream of the PDU. Busbar landing pads are provided and can accommodate up to 750 kcmil cabling. The distribution allows installation of up to four 600 AF plugin breakers that are fed from the transformer. Each breaker is supplied from the main output breaker or from the alternate output of the tie breaker. The plugin breaker bases are pre-wired from the transformer using busbar. Breaker replacement is as simple as unplugging and replacing the breaker from the front. Monitoring cards and accessories are isolated and there is a sync check setup with an output tie breaker. Monitoring is provided using both the Vertiv™ Liebert® VPMP monitoring system and a Schneider 8244 PM2 power metering system. Optionally, the Schneider Energy Reduction Maintenance Switching (ERMS) is also available. This cabinet is both top and bottom entry/exit.
- There is a main input circuit breaker providing over-current protection for this PDU. The distribution allows for installation of up to eight 600 AF fixed-mount breakers, which are fed from the output of the transformer. Monitoring cards and accessories are isolated for service and maintenance. Monitoring is provided using any of the following: Liebert® VPMP, Vertiv™ Liebert® LDMF, or Vertiv™ Liebert® DPM monitoring systems. This cabinet is both top and bottom entry/exit.

2.2 Configuration 2

This configuration is defined when model digit eight is set to 'F'. This cabinet is 84 in. W x 48 in. D and comes in a variety of kVA rating and distribution option configurations. Most commonly, the kVA rating will be in the 750 kVA-950 kVA range and will house up to eight 600 AF/400 AF subfeed breakers. There is no main input circuit breaker included in this configuration; instead, over-current protection is provided upstream of the PDU. Busbar landing pads are provided and can accommodate up to 750 kcmil cabling. The distribution allows installation of up to eight 600 AF fixed-mount breakers, which are fed from the output of the transformer. Monitoring cards and accessories are isolated for service and maintenance. Monitoring is provided using Liebert's DPM monitoring system. This cabinet is both top and bottom entry/exit.

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3 Equipment Handling and Pre-Install Preparation

NOTE: Read the entire manual before installing or operating the system. Upon receipt of a Vertiv™ Liebert® PPC, perform all of the following procedures to ensure a quality installation.

3.1 Preliminary Inspection and Unpacking

Upon receipt of the equipment:

- Inspect the shipping crate(s) for damage or signs of mishandling before unpacking the unit(s). Check the Shock-Watch indicator if applied.
- Open the shipping crate(s) carefully. Use care to avoid puncturing the container with sharp objects that will damage the contents.
- Remove the packing and vapor barriers. Inspect the equipment for any obvious shipping damage.

NOTE: Do not loosen or remove the unit(s) from the shipping pallet until after all handling by fork lift or pallet jack is completed. Perform a complete internal inspection only after equipment is positioned in the installation location and prior to electrical hook-up.

If you observe any damage as a result of shipping, immediately file a damage claim with the shipping agency and forward a copy to:

Vertiv

1050 Dearborn Drive

P.O. Box 29186

Columbus, Ohio 43229 USA

3.2 Equipment Handling and Moving

The PPC is bolted to a wooden pallet for handling with forklift equipment. When moving the PPC, consider the following:

- Casters—The PPC includes casters to roll the unit into place after removal from the shipping pallet.
- Check size and weight—refer to Table 3.1 below and the drawings furnished with the unit for size and weight information. The unit is heavy. Verify any surfaces can support the full weight of the unit.
- Plan the route—Ensure that the route to the installation area is planned so that all passages are large enough to accommodate the unit and that the floors are strong enough to support the weight. Check all doorways, hallways, elevators, ramps, and other portions of the route to determine if there are any obstructions and to ensure each is large enough and strong enough to allow easy passage.
- Move with care—Move the unit to the installation area on the wooden pallet using a forklift or pallet jack. To prevent damage, we recommend removing the exterior panels before moving the unit. When replacing panels, make sure that all ground wires are reconnected.

Table 3.1 Unit Weights

Unit	Unit Weight, lb (kg)	Skidded Weight, lb (kg)
250 kVA	2750 (1247)	2892 (1312)
400 kVA	3989 (1809)	4131 (1874)
500 kVA	3812 (1729)	3954 (1794)
600 kVA	4208 (1908)	4350 (1919)
750 kVA	5646 (2561)	5788 (2625)
850 kVA	8393 (3807)	8689 (3941)
950 kVA	8714 (3953)	9010 (4089)

3.3 Installation Location Considerations

Consider the following when planning the final location for the Vertiv™ Liebert® PPC installation:

- Install the Liebert® PPC close to the load(s) it is supplying.
- Do not locate the unit over combustible surfaces.
- Employ the shortest output distribution cable runs that are consistent with a logical equipment arrangement and make allowances for future additions.
- Operating environment the Liebert® PPC operates at ambient temperatures of 32 °F to 104 °F (0 °C to 40 °C) with a relative humidity of 0% to 95% (non-condensing).
- Heat Output like any electrical device, the PPC produces heat during normal operation. Include the heat output when calculating the environmental conditions of the room. See Table 3.2 below , for approximate heat output.

Table 3.2 Heat Output

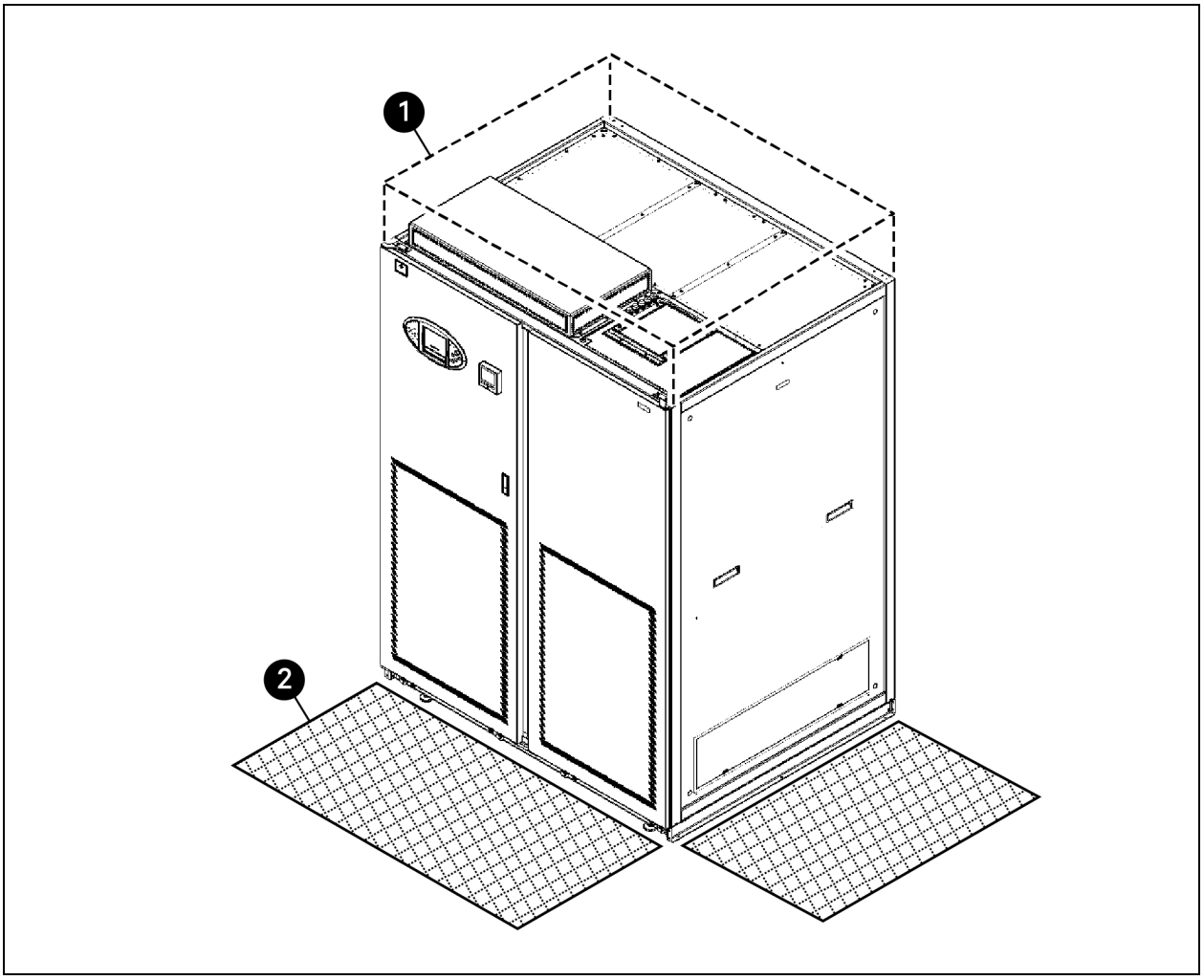
Unit Size	Approximate Heat Output, BTU/hr (kW)
250 kVA	19,449 (5.6)
400 kVA	20882 (6.1)
500 kVA	31,392 (9.2)

Table 3.2 Heat Output (continued)

Unit Size	Approximate Heat Output, BTU/hr (kW)
600 kVA	35,827 (10.5)
750 kVA	34,121 (10)
850 kVA	23,859 (7.0)
950 kVA	25,825 (7.6)

- Minimum clearances for operation and service required by the National Electrical Code (NEC) Article 110-26:
  - The recommended minimum clearance at the top or bottom of the unit for cables/conduit and colling airflow is 18 in. (475 mm). See Figure 3.1 below Item 1.
  - The required minimum service clearance is 36 in. (918 mm) for units with voltages up to 150 V to ground and 442 in. (1067 mm) for units with voltages over 150 V to ground. See Figure 3.1 below , Item 2.

Figure 3.1 Service Clearance (Right and Top Clearance Shown)



Item	Description
1	Minimum 18 in. (457 mm) clearance recommended above unit for cooling air flow.
2	Minimum 42 in. (1067 mm) clearance recommended at front and one side of unit for service access.

NOTE: Legacy display shown.

3.4 Removing the Unit from the Shipping Pallet

Before removing the unit from the pallet, move the unit as close as possible to the final installation location, see Equipment Handling and Moving on page 6 .

To remove the from the pallet:

1. Set the palleted unit in on an open, level surface, then cut the shipping bands.

WARNING! Risk of cutting bands under tension. Can cause injury or death. The shipping bands may be under tension. Use appropriate eye, face, and hand protection to safeguard against injury from band backlash.

2. Using the Allen wrench supplied in the installation package, remove the side and rear panels from the unit, and carefully disconnect the panel ground wires by pulling the easy disconnect terminals at the unit frame.
3. Remove the bolts that hold the unit to the pallet, then remove the shipping brackets from under the unit.
4. Use the provided ramp to roll the unit to the floor on its casters.

   – or –

   Use a forklift to lift the unit from the pallet, and set it on the floor.

NOTE: If you use a forklift to move the unit, make sure that the forks extend completely across the unit because you must use all 3 frame beams on the unit when lifting it with a forklift.

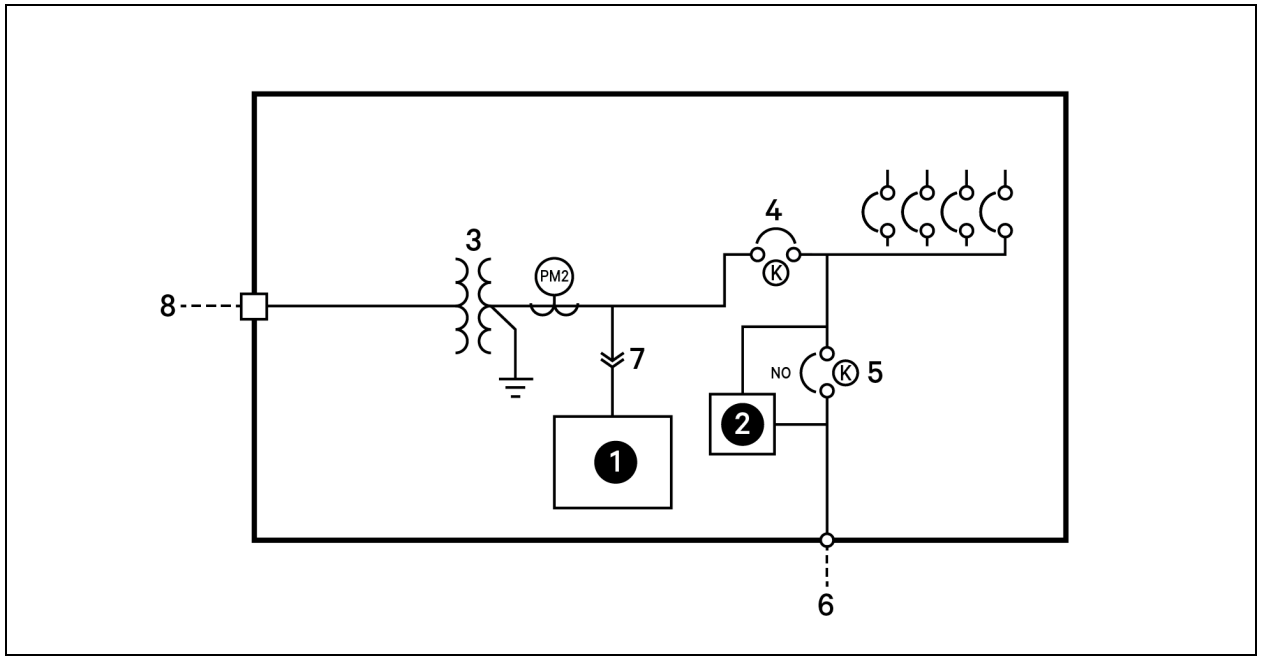
5. Read the advisories in Installation Location Considerations on page 6 , and follow them when rolling the unit to the installation locations.

NOTE: For units installed on a raised floor, use care when you position the unit to prevent the casters from falling through the floor cut out.

4 Power and Control Wiring Installation

Power and control wiring must be installed by licensed electricians. All power and control wiring must comply with the NEC and applicable local codes. See Figure 4.1 below , for a typical one-line diagram.

Figure 4.1 Typical One-line Diagram



Item	Description
1	Output spike suppression module (optional)
2	Sync check relay (optional)
3	Isolation transformer
4	1200 A 4 pole main output breaker
5	1200 A 4 pole tie breaker
6	To alternate PDU
7	Anderson disconnect
8	Input, 3-phase, 3 wire + G

4.1 Input Power Connection

WARNING! Risk of electric shock. Can cause injury or death. Verify that all incoming line voltage (power) and low voltage (control) circuits are de-energized and locked out before installing cables or making connections in the junction box or in the unit.

The input power feeder enters through the top of the unit and routes to bus bars in the front of the unit. The tie breaker input feeder enters through the top of the unit and routes to bus bar terminals connected to the tie breaker.

To minimize disturbances caused by other loads in the building, supply the 3-phase power input to the unit directly from the service entrance or other power source (a dedicated power feeder).

Size the input feeder circuit in accordance with the NEC and any local building codes to ensure the feeder's ability to safely carry the system's full load current, including losses.

Size input-feeder conductors for no more than 2% voltage drop. To operate at undervoltage conditions for extended periods of time, the input feeders must be oversized.

The main input feeder should consist of three-phase conductors and one (safety) ground conductor (3W + G).

Reference submittal drawings for the recommended feeder sizes.

4.2 System Grounding

The performance and safety of any power-conditioning system depends on proper grounding. Figure 4.2 on the facing page , shows the typical grounding arrangements for the PPC.

Proper grounding is required for safe operation and enhances equipment performance. All power feeders must include equipment grounding means as required by the NEC and local codes. An insulated ground conductor is recommended to be run in each feeder conduit. Ground conductors must be at least the minimum size per NEC Table 250-122. You may use larger wire sizes for increased system performance. If you use the input power feeder conduit as a grounding conductor, you must maintain adequate electrical continuity at all conduit connections.

Using isolating bushings in a metal conduit run can be a safety hazard, and is not recommended.

Signal reference grid if the unit supplies power to a computer room, an area equipped with a signal reference grid, or a grounded, raised floor stringer system, connect a grounding conductor from the system-ground bus to the grid or floor system. The conductor should be stranded or braided #8 AWG or larger and as short as practical. We recommend less than 3 ft (1 m).

4.3 Grounding Electrode Conductor

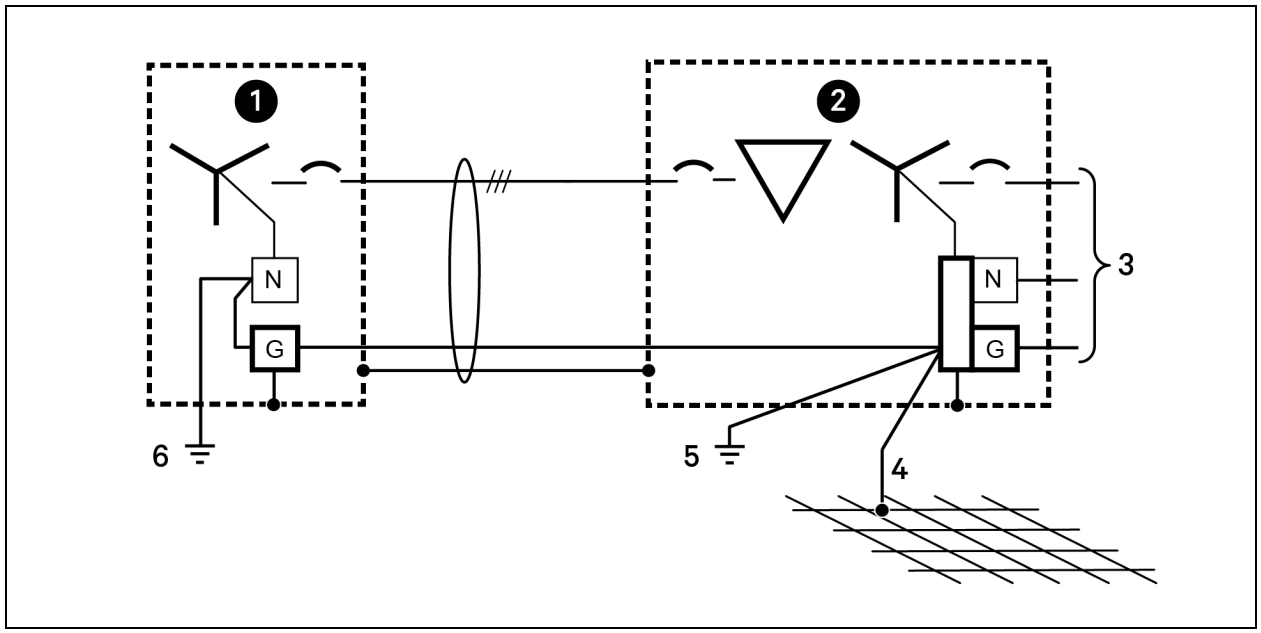
Required by code the PPC should be grounded according to the safety practices of NEC 250.30. We recommend a local grounding electrode conductor in addition to the equipment-safety ground that is normally run with the input power conductors.

Electrode connection as shown in Figure 4.2 on the facing page , the grounding electrode conductor is run from the unit to the nearest effectively grounded item from the following, listed in order of preference:

- Building steel
- Metal water pipe
- Other made grounding electrode

Sizing of the grounding electrode conductor is based on the secondary circuit conductors, per NEC Table 250.66.

Figure 4.2 Typical PPC Grounding Arrangement



Item	Description
1	Service entrance
2	PPC unit
3	Output
4	Signal-reference grid (if used)
5	Local grounding electrode conductor per NEC 250.30
6	Service-entrance grounding electrode system.

The following are recommended methods for running the grounding electrode conductor, in order by preference for system performance and as acceptable by local and other applicable codes:

- Outside of conduit (where not subject to damage)
- Inside non-metallic conduit
- Inside non-ferrous conduit
- Inside ferrous conduit, bonded to the ferrous conduit at both ends, as acceptable by local and other applicable codes

4.4 Output Power Connection

For best performance, locate the PPC as close to the load as practical.

Initial system output loading should be between 50% and 75% of rated capacity to allow for the addition of future loads without immediately investing in another power conditioner. The high partial load efficiency of the unit permits such sizing without imposing an energy use penalty during initial operation.

Keep the load balanced—the balancing of loads is good design practice on any 3-phase system. Arrange all additions to the system to preserve balance.

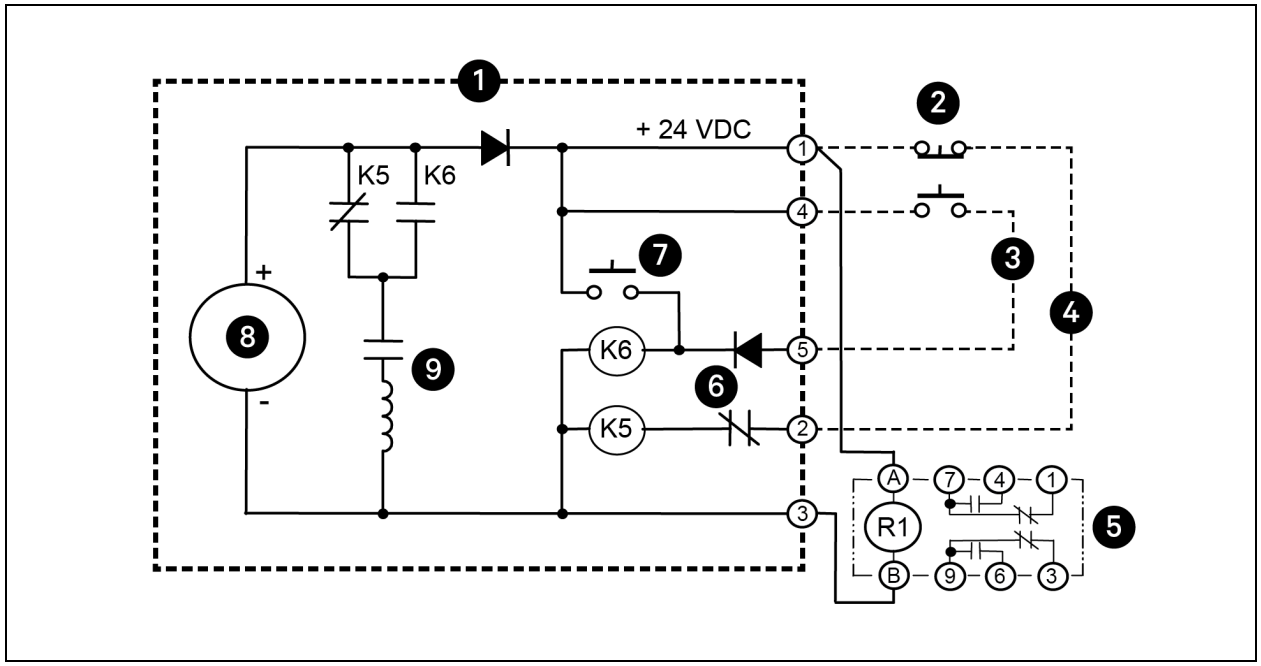
Code compliance—all output cables and connections must comply with the NEC and all other applicable codes.

Padlock-off provisions—You must equip all output breakers that are hard wired to the load equipment with a padlock-off accessory for the output circuit breaker. The padlock-off accessory is used during lock out and tag of the circuit breaker for service on the hard wired load equipment in accordance with OSHA safety rules.

4.5 Control Wiring Connections for VPMP/LDMF (if Equipped)

The NEC Article 645 requires that Emergency Power Off (EPO) switches be located at the principal room exits. All standard, Liebert power-conditioning systems provide for external shut down control from Remote Emergency Power Off (REPO) stations. Figure 4.3 below , is a simplified diagram of the PPC shut down circuitry.

Figure 4.3 Typical REPO Circuit



Item	Description
1	PPC unit
2	Remote shut down devices
3	N.O. REPO
4	N.C. REPO
5	Building interface relay
6	over temperature switch
7	Unit EPO
8	24 VDC source
9	Main input-breaker shunt trip

Low-voltage control circuit—as shown in **Figure 4.3** on the previous page , the control circuit operates on 24 VDC. The shut down device (represented by the REPO switch) activates a low-current, 24 VDC relay that operates the shunt-trip mechanism. The shunt-trip solenoid opens the main breaker, which de-energizes the Vertiv™ Liebert® PPC.

Multiple-unit shut down—In multiple-PPC installations, actuation of a single device (for example, REPO) typically must shut down all PPC units. The low voltage control circuits of all standard PPC systems meet this requirement.

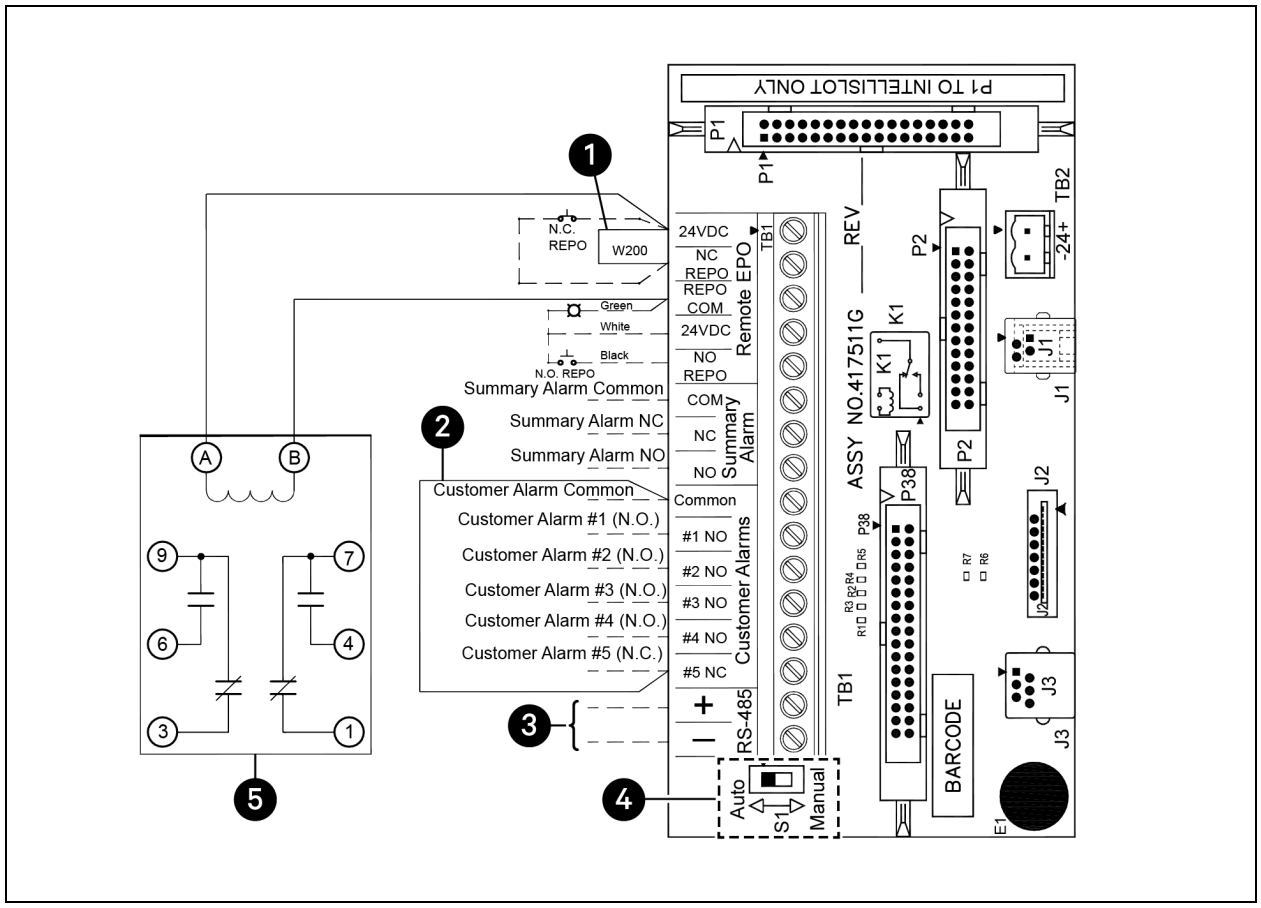
Make external control-wiring connections for remote shut down, alarm, and/or monitoring to the Adapter Board TB1 terminal block inside the unit. Control-wiring connections are shown in **Figure 4.4** on the next page .

Code compliance - Control wiring connections must comply with the NEC and all other applicable codes.

Observe the following notes when referring to **Figure 4.4** on the next page

1. All switching devices must be suitable for switching low-current 24 VDC. Minimum recommended wire size is 18 AWG, stranded copper with 300 V insulation. All wiring and devices are field-supplied except where noted.
2. The total load on the 24 VDC supply (both N.O. and N.C. REPO circuits) must be limited to 1 A.
3. Multiple normally open (N.O.) REPO switches may be paralleled. Multiple Normally closed (N.C.) REPO switches may be connected in series. All lamps, if used, are connected in parallel.
4. The summary-alarm contacts are reated for 0 to 30 VAC or VDC, 0.5 A, 10 W maximum.
5. Customer-alarms 1 to 4 are Normally open (indicate alarm on contact closure). Customer-alarm 5 is Normally closed (indicates alarm on contact opening).
6. For Vertiv™ Liebert® SiteScan™ connection, use #22-AWG, shielded cable, maximum distance 1000 ft (300 m).

Figure 4.4 Typical Control Wiring for Power Monitoring

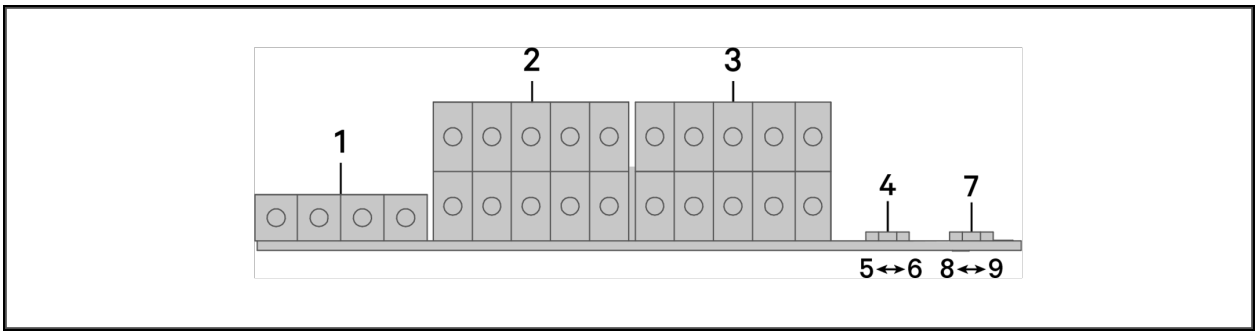


Item	Description
1	Remove jumper when using Normally closed (N.C.) REPO.
2	Remove jumper when using Customer Alarm #5.
3	To Vertiv™ Liebert® SiteScan™ system.
4	Auto-Manual re-start switch
5	Building-interface relay

For more information about the LDMF connections, please refer to the LDMF User Manual on the Vertiv.com website at this link: https://www.vertiv.com/48e472/globalassets/products/critical-power/power-distribution/liebert-ldmf-distribution-monitoring-user-manual_00.pdf

4.6 Control Wiring Connections for DPM (if Equipped)

Figure 4.5 External Interface Board Connections (Right Side View)



Item	Description
1	TB4, Alarm input, see Input Alarm Connections on page 17 .
2	TB3, output contacts, see Output Alarm Connections on page 17 .
3	TB1, EPO input, see Emergency Power off (EPO) Loop below .
4	Auto/Manual restart switch, see Auto or Manual Restart Selection on the next page .
5	Enable auto restart.
6	Enable manual restart.
7	High temperature shut down switch, see High Temperature Shut Down Selection on page 17
8	Disable high temperature shut down.
9	Enable high temperature shut down.

4.6.1 Emergency Power off (EPO) Loop

All standard PPC units include connections for external shut down from Remote Emergency Power off (REPO) stations.

The EPO control and logic resides on the transformer monitor board. The EPO system is powered by a 24 VAC control transformer. The 24 VAC is also used to detect loss of system input power.

There are multiple methods of triggering the EPO circuit (shunt trip the MICB):

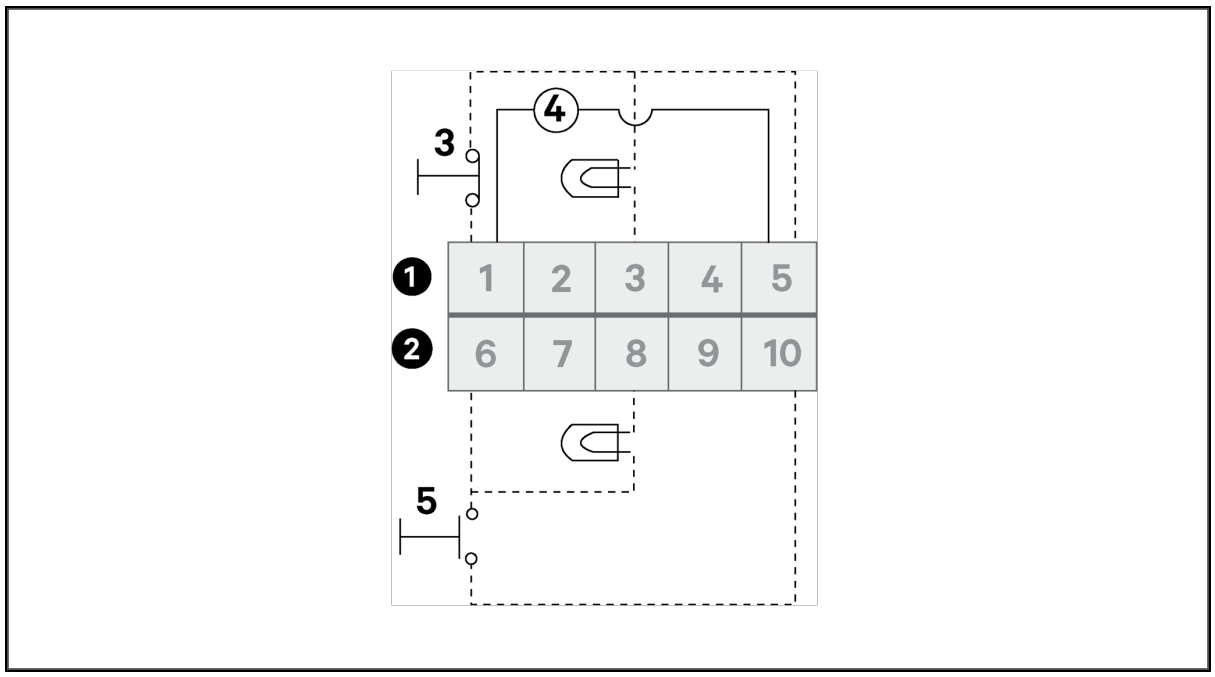
- Pressing the local EPO button next to the touchscreen display on the front of the PPC, which sends a CAN message to the transformer monitor board requesting unit shut down.
- Pressing the remote EPO button (field provided and field connected to the EPO contacts on the External Interface Board EPO), which sends a CAN message to the transformer monitor board requesting unit shut down.
- Transformer over temperature. If the 200 °C transformer thermal switch opens and high temperature shut down is enabled, a digital input on the transformer monitor board requests unit shut down.
- System undervoltage. If an under voltage event occurs and manual restart is active, the unit is shut down.

The contact inputs for the remote Normally open (NO) and remote Normally closed (NC) wire loop connections are on TB1 on the External Interface Board. See Figure 4.6 on the next page for the NO and NC loop connections.

- A jumper is factory-installed between TB1-1 and TB1-5 to close the NC loop. Remove the jumper to use the NC EPO loop.

- NO REPO devices may be wired in parallel to the NO REPO Contacts.
- NC REPO devices, such as lamps, may be wired in series to the NC REPO contacts.
- Multiple REPO lamps and other 24 VDC loads may be wired in parallel to the REPO lamps.
- The loop provides 24 VDC (nominal) up to 200 mA.

Figure 4.6 EPO Connections to TB1 on External Interface Board



Item	Description
1	TB1 top row
2	TB1 bottom row
3	Normally-closed (NC) contact
4	Factory-installed jumper. Remove to use Normally closed (NC) EPO loop.
5	Normally open (NO) contact

4.6.2 Auto or Manual Restart Selection

Auto/Manual restart controls unit function after loss of input power.

- Auto restart automatically powers the unit back up when input power is restored.
- Manual restart trips the main input circuit breaker (if equipped) and prevents multiple restarts with unstable voltage to allow an orderly system restart.

NOTE: To manually restart the system, see Normal System Startup on page 23 .

To select the restart function, set the switch on the External Interface Board. See Figure 4.5 on the previous page , for the location of the switch.

4.6.3 High Temperature Shut Down Selection

Thermal switches in the PPC transformer provides warning and immediate shut down, if the unit begins to overheat. high temperature shut down operates as follows:

- An over temperature condition occurs when the transformer coil temperature reaches 356 °F (180 °C). A warning displays on the touchscreen controller.
- You should investigate and correct the cause of the warning. Possible causes include excessive non-linear loading, inadequate ventilation, high or low input voltages, or monitoring system malfunction.
- When the transformer coils reach 392 °F (200 °C) and high temperature shut down is enabled, the EPO circuit shunt trips the main input breaker causing an immediate loss of power to the load. If high temperature shut down is disabled, the unit alarms the over temperature condition.

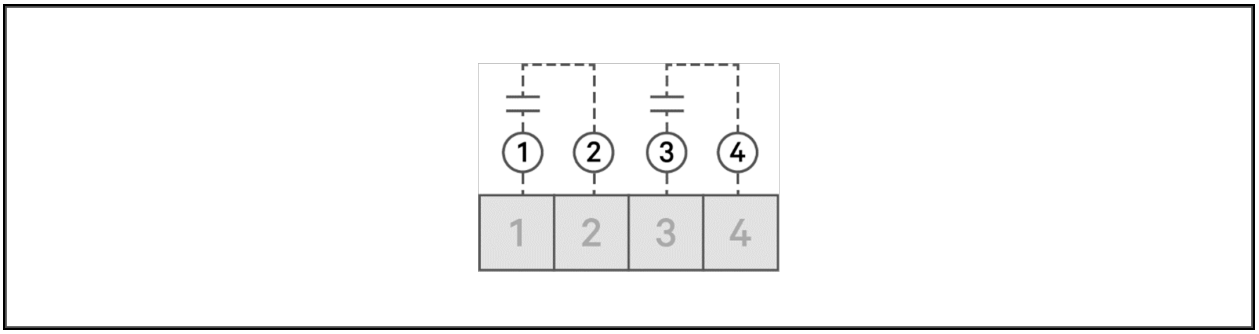
NOTE: Equipment damage may occur if high temperature shut down is disabled and the unit continues to run in over temperature conditions. Any damage caused by over temperature conditions when high temperature shut down is disabled is not covered by warranty.

To select the high temperature shut down function, set the switch on the External Interface Board. See Figure 4.5 on page 15, for the location of the switch.

4.6.4 Input Alarm Connections

When the PPC includes DPM monitoring, two contacts on the External Interface Board (TB4, see Figure 4.5 on page 15) provide alarm inputs with 12 VDC wetting voltage. Figure 4.7 below, shows the wiring for the input alarm contacts.

Figure 4.7 Input-Contact Wiring on TB4



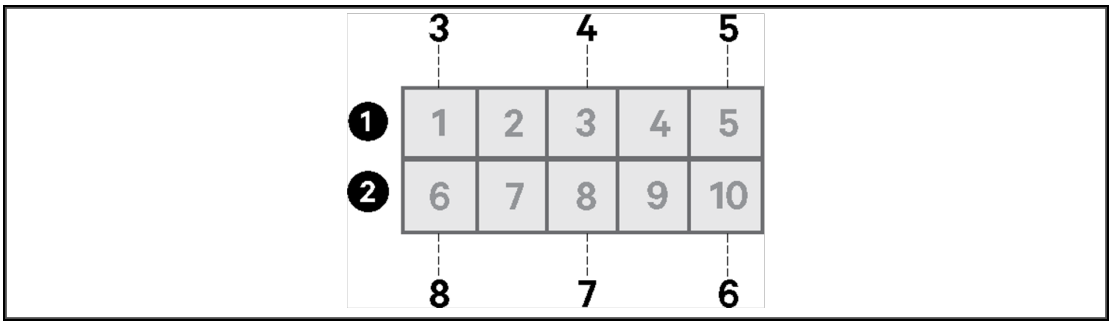
Item	Description
1	Input Alarm 1
2	Input 1 Common
3	Input Alarm 2
4	Input 2 Common

4.6.5 Output Alarm Connections

When the Vertiv™ Liebert® PPC includes DPM monitoring, two programmable, Form C contacts on the External Interface Board (TB3, seeFigure 4.5 on page 15) provide output contacts that may be triggered by system events.

Output contacts are rated for 30 VDC 1 A (30 W maximum resistive) or 125 VAC 0.5 A (62.5 V A maximum resistive). Figure 4.8 below , shows the wiring for the output-alarm contacts.

Figure 4.8 Output-Contact Wiring on TB3



Item	Description
1	TB3 top row
2	TB3 bottom row
3	Customer Alarm 1 Common
4	Customer Alarm 1 Normally closed.
5	Customer Alarm 1 Normally open.
6	Customer Alarm 2 Normally open.
7	Customer Alarm 2 Normally closed.
8	Customer Alarm 2 Common.

4.6.6 Communication Cards

The PPC has two slots for communication cards, which accept the Vertiv™ Liebert® IntelliSlot™ RDU101 card.

The Liebert® IntelliSlot™ RDU101 card provides SNMP monitoring of the PPC across the network and/or building management system and lets you monitor external temperature, humidity and contact closure inputs using external sensors.

To install a card:

1. Remove the right-top cover from the control area on the unit. See Figure 4.8 above , for the location of the card slots.
2. Remove the cover from the slot, slide the card into the slot and secure it with two screws.
3. Run the cable through control conduit plate, see Figure 4.7 on the previous page , for cable routing and connect to the card.

Follow instructions provided with the Liebert® IntelliSlot™ card to configure the card for the power- distribution system or any additional equipment for the Vertiv™ Liebert® PPC. for more information about the DPM connections, please refer to the DPM User Manual on the Vertiv.com website at this link: https://www.vertiv.com/49676f/globalassets/products/critical-power/power-distribution/liebert-dpm-user-manual SL-11326.pdf

5 Inspection and Startup

At initial system startup, employ a qualified electrician to perform the equipment inspection and startup. You may arrange the initial system startup by contacting your local Vertiv sales representative or Vertiv Services, at 1-800-543-2378.

NOTE: To obtain warranty coverage, a copy of the checklist must be completed, signed, dated and returned to Vertiv. Warranty coverage of the equipment is not effective unless the checklist is received by the factory.

Print the checklist, Inspection and Startup Checklist on page 33 . Complete the checklist while performing the inspection, startup, and monitoring check procedures, then sign, date, and return the completed Inspection and startup Checklist form to:

Vertiv

1050 Dearborn Drive

P.O. Box 29186

Columbus, Ohio 43229 USA

5.1 Internal Inspection

Perform a detailed internal inspection after the unit is in place and before it is energized to ensure a trouble free startup. In addition, perform this internal inspection when performing preventive maintenance.

WARNING! Risk of electric shock. Can cause injury or death. Verify that all incoming line voltage (power) and low voltage (control) circuits are de-energized and locked out before installing cables or making connections in the junction box or in the unit.

To perform the inspection:

1. During initial installation and startup, use a printed copy of Inspection and Startup Checklist on page 33 , to check off each item as you perform the following steps.
2. Confirm that the exterior of the unit is undamaged.
3. Confirm sufficient service and ventilation clearance for the unit, see Figure 3.1 on page 7 .
4. Remove the accessible exterior panels.

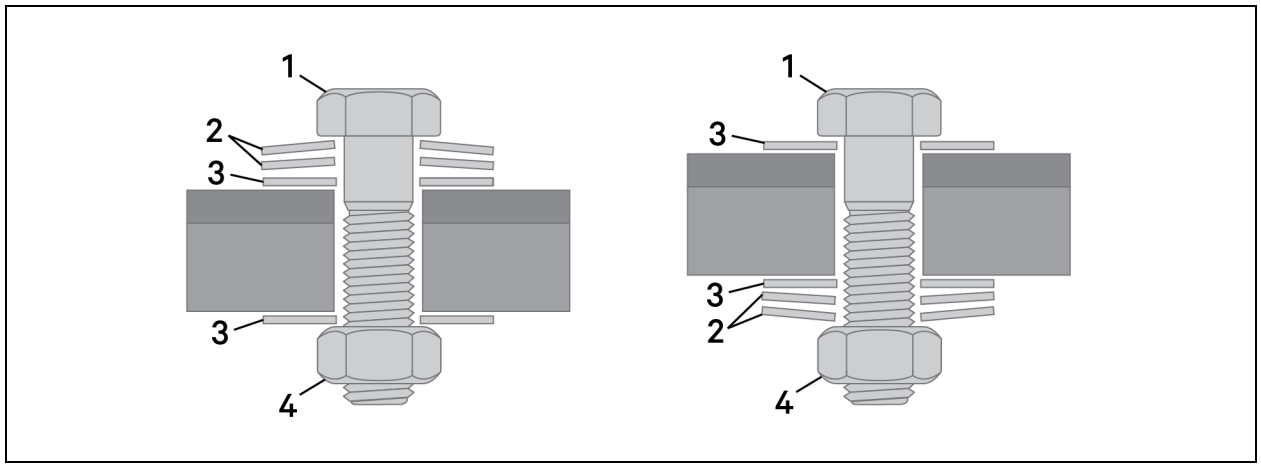
NOTE: When removing exterior panels, disconnect panel ground wires by separating the easy disconnect terminals on the frame. When replacing exterior panels, reconnect all panel ground wires.

5. Inspect all wire and conductor insulation for damage.
6. Check all transformer terminal connections for tightness, and retorque if needed, see Table 5.1 on the next page .
7. Check all breaker connections for tightness, and retorque if needed, see Table 5.1 on the next page .

Table 5.1 Electrical-connection Torque Requirements

Bolt Shaft Size	Grade 5 - Imperial Grade 8.8 - Metric, in.-lb (nm)	Electrical Connections	
		1 Belleville washer, in.-lb (nm)	2 Belleville washers, in.-lb (nm)
10-32 (M5)	25 (3)	—	—
1/4-20 (M6)	53 (6)	40 (4.5)	80 (9)
5/15-18 (M8)	107 (12)	80 (9)	160 (18)
3/8-16 (M10)	192 (22)	120 (13.6)	240 (27.1)
1/2-13 (M12)	428 (48)	480 (54.2)	—

Figure 5.1 Applicable Hardware Configuration for Torque Specifications



Item	Description
1	Bolt
2	Belleville washer
3	Flat washer
4	Nut

8. Check the trip settings of adjustable breakers.
9. Check all terminal block connections for tightness, and retorque if needed.
10. Check the transformer mounting bolts for tightness, and retorque if needed.
11. Remove an foreign objects from the components and the interior of the unit, and make sure that the air passages on the transformers are clear and free of debris.
12. Check all intake and exhaust air screens, and make sure they are clean and free of obstructions.
13. Replace the side panels, leaving access to the circuit breakers for startup, see Unit Startup on the facing page .

NOTE: When replacing the side panels, be sure to reconnect the panel ground wires.

5.2 Unit Startup

WARNING! Risk of electric shock. Can cause injury or death. Verify that all incoming line voltage (power) and low voltage (control) circuits are de-energized and locked out before installing cables or making connections in the junction box or in the unit.

To startup the unit:

1. During initial installation and startup, use a printed copy of Inspection and Startup Checklist on page 33 , to check off each item as you perform the following steps.
2. Make certain that all circuit breakers are in the Off position and that power to the unit is locked out.
3. Verify proper input power connections to the unit, including equipment-grounding conductor and local grounding electrode conductor.
4. Turn On the building input power to the unit.
5. Check the phase rotation at the main breaker: A, B, C, top to bottom.
6. Measure the following input voltages, and record them in the appropriate lines on the checklist. Make sure that the measured voltages correspond to the input voltage on the unit nameplate.
    a. Voltage, phase A to phase B
    b. Voltage, phase B to phase C
    c. Voltage, phase C to phase A
7. Turn On the main breaker and wait 1 minute. If the breaker trips Off, check for wiring errors including control connections. Contact Vertiv Services or the local Vertiv factory representative for assistance.

NOTE: The Vertiv™ Liebert® PPC ISO transformer has input-voltage taps for each input phase to provide the proper output voltage for a range of input voltages. See Transformer Input Voltage Taps on the next page , to change the tap arrangement to match the input voltage, then return to this procedure and start at this, step 7 .

8. Check the phase rotation at the load side terminals of the subfeeds: A, B, C, top to bottom.
9. Measure the following voltages at the load side terminals of the output breakers, and record them in the appropriate lines on the checklist. Make sure that the measured voltages correspond to the output voltage on the unit nameplate within +4%, –0%.

    If the output voltage is incorrect, check for wiring errors. Incorrect input voltage or improper transformer taps. Contact Vertiv Services or the local Vertiv factory representative for assistance.

    a. Voltage, phase A to phase B
    b. Voltage, phase B to phase C
    c. Voltage, phase C to phase A
    d. Voltage, phase A to neutral
    e. Voltage, phase B to neutral
    f. Voltage, phase C to neutral
10. Press the local Emergency Power Off (EPO) button and verify that the system shuts down, then turn the unit back on.
11. If the system is equipped with Remote Emergency Power Off (REPO) switches, test each switch to verify proper operation.

NOTE: Any REPO switch may shut down equipment or systems other than the PPC under inspection.

5.2.1 Transformer Input Voltage Taps

The Vertiv™ Liebert® PPC-ISO transformer has input-voltage taps for each input phase, to provide the proper output voltage for a range of input voltages

- 225 kVA unit taps include: three above nominal voltage (+2.6% and +1.9% 2X) and three below nominal voltage (-2.6% 3X).
- 750 kVA units, the taps are arranged in 2.7% increments. Taps include: two above nominal voltage (upper range limit of 5.4%) and four below nominal voltage (lower range limit of -10.8%).

To change the arrangement of the input-voltage taps:

1. Shut down the unit using the steps in Normal System shut down on page 23 , and lock out building power to the unit.
2. Refer to the transformer's nameplate, and set the tap arrangement to match input voltage.
3. Secure each line to its proper tap.
4. Return to Unit Startup on the previous page , and proceed with step 7 .

5.3 Monitoring System Check

1. During initial installation and startup, use a printed copy of Inspection and Startup Checklist on page 33 , to check off each item as you perform the following steps.
2. Turn on building power to the unit, then turn On the main input breaker.
3. Confirm that the Power Indicator (green LED) next to the local display is illuminated.
4. Confirm manual restart if the unit is equipped with manual restart:
   a. Turn on building power to the unit, then turn On the main input breaker.
   b. Turn off all building power to the unit, and observe that the main input breaker automatically trips-open when power is lost.
   c. Restore building power to the unit, and turn On the main input breaker.
5. At the monitor panel, verify that the voltage values displayed by the VPMP correspond to the values measured at the main circuit breaker. See step 6 , of Unit Startup on the previous page .
6. If the unit is equipped with a Schneider 8244 PM2, verify that the voltage values displayed by the VPMP correspond to the values measured at the main circuit breaker. See step 6 , of Unit Startup on the previous page .
7. If the unit is connected to a centralized monitoring system, turn on the unit and centralized system, then verify proper communication between the two.
8. Access the low voltage terminals in the low voltage-control section inside the unit.
9. With the unit On, measure the following DC-control voltage on +Vout (+) and -Vout (com), and record them in the appropriate lines on the checklist:
   a. 12 V control voltage (between 11.76 and 12.24 VDC).
   b. 24 V control voltage (between 23.5 and 24.5 VDC).
10. Simulate alarm operation by referring to the control-wiring drawing provided with the unit and jumpering the appropriate low voltage control terminals, then verify correct alarm operation at the local display and the centralized monitoring system (if equipped).

6 PPC Operation

In the following scenarios, perform the initial inspection and startup procedures detailed in Inspection and Startup on page 19 . Otherwise, use these procedures for standard, day-to-day operation.

- Before the unit is placed into service after initial installation.
- After equipment relocation.
- After equipment is de-energized for an extended period of time

Review these guidelines for any special equipment modifications, special site considerations, or company policies that may require changes to the standard equipment operation.

6.1 Emergency shut down

NOTE: Depending on the control circuit wiring, activating the unit EPO switch may also shut down other equipment.

To perform an immediate system shut down during emergency conditions:

1. On the front door of the unit, locate the EPO button on the monitoring panel, see Figure 6.1 on the next page .
2. Move the *protective*, clear cover out of the way, and push the button.

   – or –
   Press a *REPO switch*, if the site is equipped withe remote EPO switches at the principle exit doors as required by NEC Article 645.

6.2 Normal System shut down

To shut down the system:

1. shut down the *load equipment* by turning Off at each piece of equipment per the manufacturer's recommendations or at the PPC output distribution breakers located behind the front door of the unit.
2. Turn Off all unit *output breakers*, then turn Off the main circuit breaker and/or tie circuit breaker.
3. To remove all power from the unit, turn Off the building power to the unit.

6.3 Normal System Startup

To startup the system:

1. Locate the *unit circuit breakers* behind the front door of the unit, and make certain that all unit circuit breakers are in the Off position.
2. Turn On *building power* to the unit to energize the transformer.
3. Turn On the *unit's main circuit breaker*.
   - If the circuit break was tripped Off, instead of turned Off, move the circuit breaker handle to Off before moving to On.
4. Verify the *output voltages* before proceeding to the next step.
5. Turn On *each output circuit breaker* individually while following the load equipment manufacturer's startup sequence.

6.4 Manual Restart

If your system includes the manual restart feature, a power outage trips the main circuit breaker, which prevents repetitive application of unstable voltage and allows orderly restart of the system.

To manually restart the system after power is restored, follow the steps in Normal System Startup on the previous page .

6.5 Sync Check Indicator

If the optional sync check indicator option is included on unit, the sync lamp is located behind the front door of the unit. The sync lamp illuminates when two sources are suitably matched, and it is safe to close the breaker.

You may adjust the indication level for a 10% to 30% difference in the input signals using the potentiometer on the front of the sync check unit, which is accessed through the top of the PDU.

6.6 Vertiv™ Liebert® Power Monitor Panel with Velocity Protocol (if Equipped)

The power-monitor panel with Velocity protocol (VPMP) is mounted on the front door of the PPC and includes a monochrome LCD, power and alarm LEDs, an audible alarm, alarm silence push button, and Emergency-Power Off push button, see Figure 6.1 below . The Vertiv™ Liebert® VPMP provides a view of:

- Input voltage
- Output current and voltage
- Various other power parameters
- Alarm messages. The monitored parameters and alarms will be displayed on the local display and be available for communication to a customer or Liebert monitoring system.

Monitored parameters and alarms are also available for third-party or Liebert monitoring systems, see Monitoring Communication Connections on page 28 .

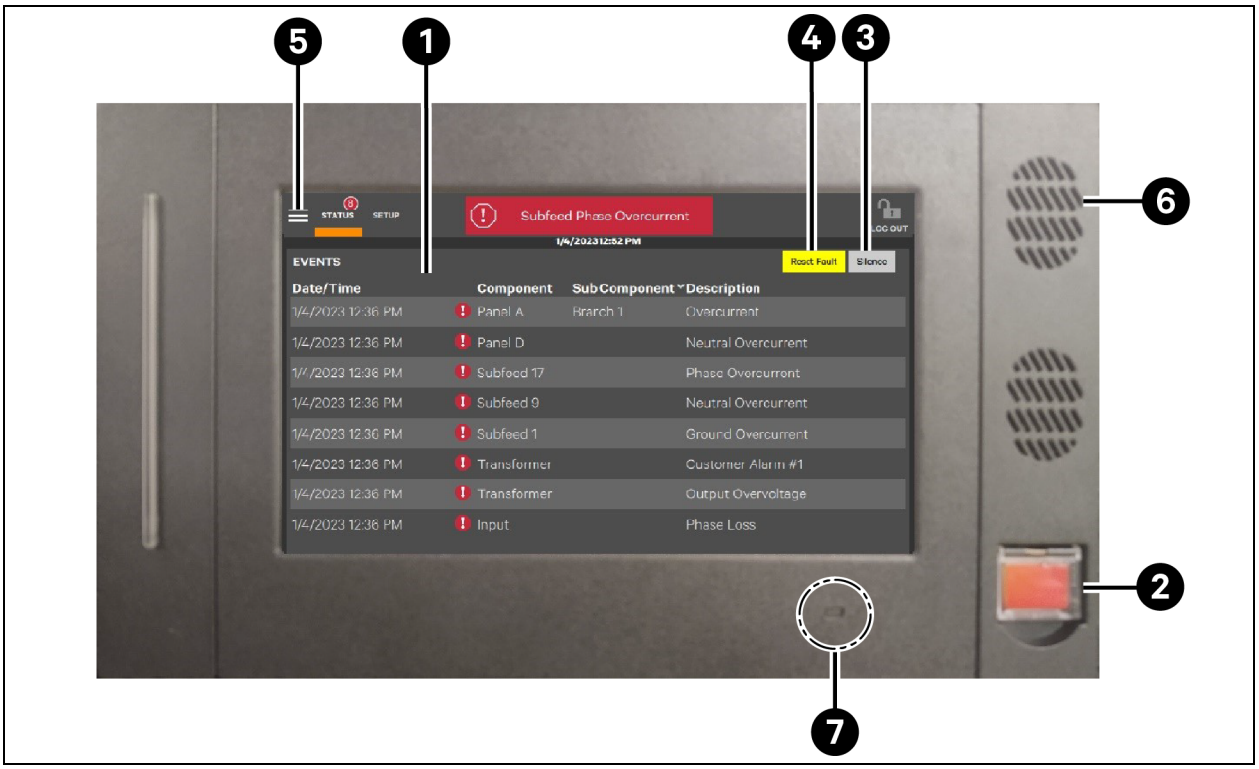
Figure 6.1 Monitoring Panel Layout

Item	Description
1	LCD displays power parameters and alarm data.
2	Emergency Power Off (EPO) button trips the input circuit breaker (if supplied) to turn the unit off. See Emergency shut down on page 23 .
3	Silence/Reset button silences the audible alarm. • Press and release the button to silence the audible alarm. • Press and hold the button to clear the alarm and turn off the red alarm status LED. If the alarm condition still exists, the alarm will annunciate again.
4	Navigation, soft-function keys F1 through F4 and Help. See **Table 6.1** below , for descriptions.
5	Audible-alarm (speaker symbol) sounds when an alarm condition is detected.
6	Power indicator (Green LED) illuminates when power is applied to the PPC.
7	alarm status indicator (Red LED) illuminates when an alarm condition is detected and remains illuminated until the alarm condition is cleared.

Table 6.1 Navigation and Help Function Keys

Key	Description
F1	Selects the next Main Breaker, next Subfeed or next Branch.
F2	Sequence key. Selects the next set of items at the current level or the next item on a list.
F3	Selects Subfeed (if supplied and monitored) at the top level or selects a menu item at a lower level.
F4	Selects Branch Breakers at the top level or provides "Back" function at lower levels. • At lower levels, F4 navigates to the top level (Main). • In the Help screen, F4 navigates to the previous screen.
Help	Opens the Help screen.

Figure 6.2 Monitoring Panel Layout – Current HMI



Item	Description
1	LCD displays power parameters and alarm data.
2	Emergency Power Off (EPO) button trips the input circuit breaker (if supplied) to turn the unit off. See Emergency shut down on page 23 .
3	Silence button silences the audible alarm.
4	Reset button to clear alarms and turn off the red alarm status LED. If the alarm condition still exists, the alarm will annunciate again.
5	Navigation menu
6	Audible alarm sounds when an alarm condition is detected.
7	Alarm status indicator (LED) illuminates RED when an alarm condition is detected and remains RED until the alarm condition is cleared. When no alarm condition exists, the LED illuminates GREEN.

6.6.1 Alarms and Alarm Thresholds

Alarms are stare stored in non-volatile memory to protect against erasure by a power outage.

You must reset alarms manually after correcting the condition that caused the alarm. Use the Silence/Reset button on the display or, if connected to a remote monitoring system, reset the alarm via the monitoring system. See 6.6 on page 24 , to use the Silence/Reset button.

The VPMP detects and annunciates alarm messages for the following conditions:

- Output Overvoltage
- Output Undervoltage
- Output Overcurrent
- Neutral Overcurrent
- Ground Overcurrent
- Output Voltage Distortion
- Frequency Deviation
- Phase Sequence Error
- Phase Loss
- Transformer over temperature

Table 6.2 below , lists the factory-default alarm thresholds. To adjust alarm thresholds to match your site requirements, use the VPMP configuration software and the DB-9 setup port. See Monitoring Communication Connections on the next page , to connect and install the software.

Table 6.2 Factory-default Alarm-threshold Setpoints

Alarm	Setpoint
Output Overvoltage	Voltage exceeds +6% of nominal.
Output Undervoltage	Voltage falls below –13% of nominal.
Output Overcurrent	Current exceeds 95% of full-load amps.
Neutral Overcurrent	Current exceeds 95% of full-load amps.
Ground Overcurrent	Current exceeds: 15 amps (300 kVA); 20 amps (450 kVA).
Output Voltage Distortion	Output-voltage THD exceeds 10%.
Frequency Deviation	Output frequency exceeds ±0.5 Hz of nominal.

Summary Alarm

The summary alarm detects and annunciates any alarm to provide remote alarm status. The VPMP has form C, one NO and one NC, summary alarm contacts rated at 24 VAC @ 1 A. The contacts change state when any alarm/warning occurs, then resets when the alarm is cleared. Summary-alarm contacts are on the adapter board, which is located on top of the monitoring enclosure.

6.6.2 Metered Parameters

Metering - The following metering parameters may be displayed on the VPMP:

- Input Voltage, Line to Line for all three phases.
- Output Voltages, Line to Line for all three phases.
- Output Voltages, Line-to-Neutral for all three phases.
- Output Voltage Total Harmonic Distortion (THD) for all three phases.
- Output Current for all three phases.
- Output Current Total Harmonic Distortion (THD) for all three phases.
- Output Current Crest Factor (Peak/RMS) for all three phases.
- Output Current Harmonic K-Factor for all three phases.
- Output Neutral Current
- System Ground Current
- Output Frequency
- Output kVA
- Output kW
- Output Power Factor
- Output kW-Hours
- Percent Load
- Date & Time

6.6.3 Remote Monitoring Communication

You may plug one card into the Vertiv™ Liebert® IntelliSlot™ port provided with the VPMP system. Liebert® IntelliSlot™ cards provide connections to a building-management system (BMS) or to remote-monitoring systems. The following cards are available:

- IS-WEBS Card provides SNMP/WEB output. An RJ-45 connector is supplied for customer connection to Ethernet LAN.
- IS-485S Card provides Modbus 485 output. A terminal strip is provided for 2-wire connection.
- IS-IPBMS Card provides Modbus IP output. An RJ-45 connector is supplied for customer connection
- Vertiv™ Liebert® IS-UNITY-DP Card for HTTP/HTTPS, Vertiv Velocity Protocol, e-mail, SMS, SNMP v1/v2c/v3, BACnet IP/MSTP and Modbus TCP/RTU output using a serial RS-485 two-wire connection.

You can connection to Vertiv™ Liebert® SiteScan™ via RS-485 terminals on TB1, which are on the adapter board located on top of the monitoring enclosure.

6.6.4 Monitoring Communication Connections

The PPC provides various monitoring options via a single, TCP/IP connection using a standard RJ-45 Ethernet connector on top of the unit, see Figure 6.3 on the facing page . The connection provides access to all IP-capable equipment in the Vertiv™ Liebert® PPC.

In addition, a DB-9 serial port is located behind the front door of the unit and is used to configure the Vertiv™ Liebert® VPMP. The VPMP configuration software and instructions are available at www.Vertiv.com , select *Support* > *Software/Firmware Downloads* > *Power Distribution Product Downloads*.

Figure 6.3 Ethernet and DB-9 Port Locations

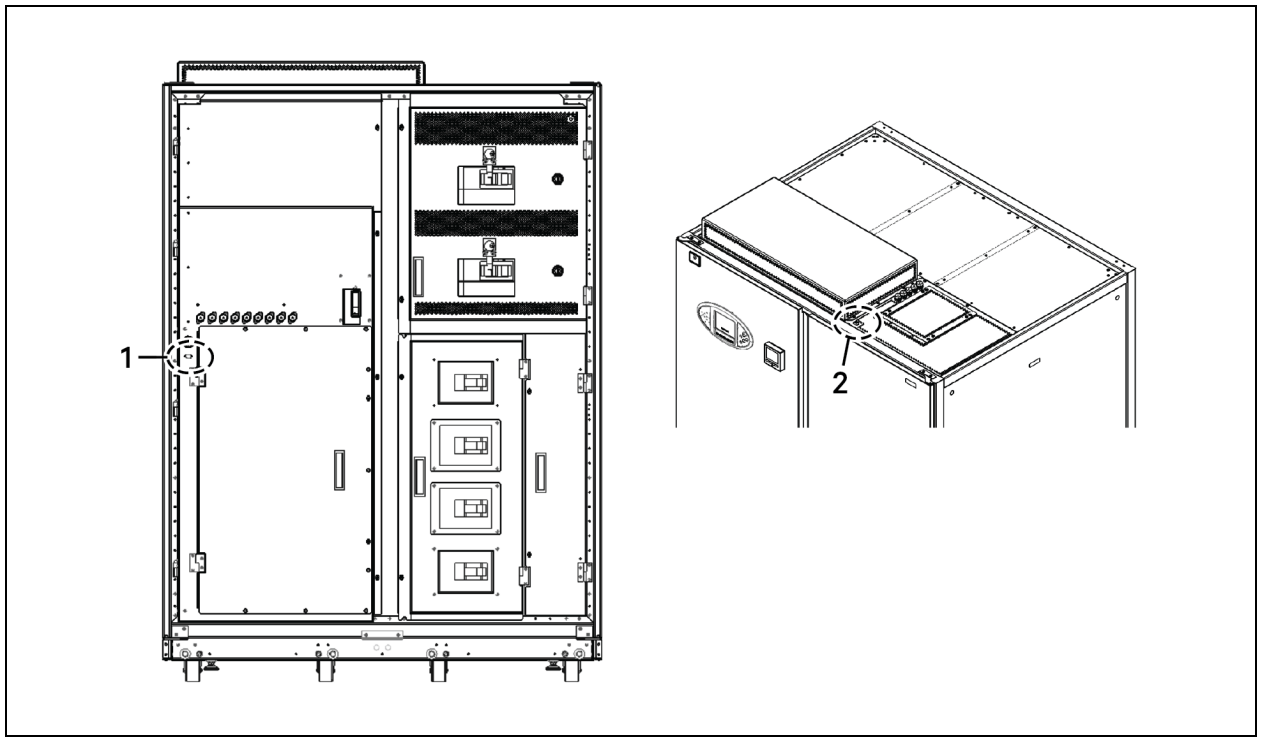


Table 6.3 Communication Connections

Item	Description
1	DB-9 serial-port connection to VPMP
2	RJ-45 Ethernet connection for TCP/IP communiction

NOTE: Legacy display shown.

6.7 Vertiv™ Liebert® Distributed Power Monitoring (DPM) (if Equipped)

The Distributed Power Monitoring system (DPM) includes a user-interface monitor mounted on the front door of the PPC and includes a color LCD display touchscreen panel, an audible alarm, an Emergency Power Off push button. The DPM provides a view of:

- Input Voltage, Line to Line for all three phases.
- Output Voltages, Line to Line for all three phases.
- Output Voltages, Line to Neutral for all three phases.
- Output Voltage Total Harmonic Distortion (THD) for all three phases.
- Output Current for all three phases.
- Output Current Total Harmonic Distortion (THD) for all three phases.
- Output Current Crest Factor (Peak/RMS) for all three phases.
- Output Current Harmonic K-Factor for all three phases.
- Output Neutral Current
- System Ground Current

- Output Frequency
- Output kVA
- Output kW
- Output Power Factor
- Output kW-Hours
- Percent Load
- Date & Time

The monitored parameters and alarms will be displayed on the local display and will be available for communication to a customer or Vertiv monitoring system.

For a detailed description of the functionality and use of the DPM monitoring system, please refer to the Vertiv™ Liebert® DPM User Manual (Vertiv manual SL-11326), which is available athttps://www.vertiv.com/49676f/globalassets/products/critical-power/power-distribution/liebert-dpm-user-manual-sl-11326.pdf"

7 Maintenance

7.1 Repair

Even the most reliable equipment may fail. Contact Vertiv Services at 1-800-543-2378 for fast repair of your unit and minimum downtime of your installation.

WARNING! Risk of electric shock. Can cause injury or death. Verify that all incoming line voltage (power) and low voltage (control) circuits are de-energized and locked out before installing cables or making connections in the junction box or in the unit.

Use standard electrical troubleshooting procedures to isolate problems in the unit. Contact Vertiv Services if you have questions.

Your can refer the repair or replacement of standard items, such as circuit breakers, fuses, transformers, capacitors, and indicator lights to a qualified electrician or refer these to Vertiv Services.

Refer monitoring-system repairs to Vertiv Services.

7.2 Preventive Maintenance

WARNING! Risk of electric shock. Can cause injury or death. Verify that all incoming line voltage (power) and low voltage (control) circuits are de-energized and locked out before installing cables or making connections in the junction box or in the unit.

Air circulation through the cabinet may cause dust to accumulate on internal components. Clean internal components as necessary during electrical inspections.

We recommend annual general system inspections, cleaning, and operation checks to ensure system performance and long service life.

7.3 Inspection Schedule

Because conditions vary from site to site, it is difficult to prescribe a standard schedule for periodic cleanings. We recommend performing inspections after the first 24 hours, 30 days, and 6 months of operation to help determine a pattern for the inspection schedule.

- Inspect electrical connections and component mountings after the first 24 hours, 30 days, and 6 months of operation. Then conduct inspections per local-site procedure or annually at minimum thereafter.
- Inspect and clean ventilation openings and grilles every 6 months to annually at minimum.
- Perform a complete inspection and operational check annually. We recommend performing the procedures outlined in Inspection and Startup on page 19 .

Vertiv Services offers a complete range of preventive maintenance services including thorough equipment-performance checks and calibration of electronics. Call 1-800-543-2378 for details.

7.3.1 Fuse List

Table 7.1 below , lists the control power fuses in the unit.

Table 7.1 Fuse List

Fuse	Rating	Function
F1	5 A	240 V/120 V LINE to 12 VDC power supply
F2	2 A	415 V Line 1 to Control Transformer
F3	2 A	415 V Line 2 to Control Transformer
F4	7.5 A	240 V input to transfer relay
F5	7.5 A	120 V alternate input to transfer relay.
F6	2 A	Voltage Sense to PM8244
F7	2 A	Voltage Sense to PM8244
F8	2 A	Voltage Sense to PM8244
F9	5 A	240 V/120 V LINE to 24 VDC power supply
F10	0.5 A	Sync check tie breaker A phase input sense
F11	0.5 A	Sync check tie breaker B phase input sense
F12	0.5 A	Sync check tie breaker A phase output sense
F13	0.5 A	Sync check tie breaker B phase output sense
F14	0.5 A	Sync check lamp supply

Appendices

Appendix A: Inspection and Startup Checklist

Place a check mark next to each item as you complete the steps in the appropriate procedure.

NOTE: To obtain warranty coverage, a copy of the checklist must be completed, signed, dated and returned to Vertiv. Warranty coverage of the equipment is not effective unless the checklist is received by the factory.

Print the checklist, and complete the checklist while performing the inspection, startup, and monitoring-check procedures, then sign, date, and return the completed form to:

Vertiv

1050 Dearborn Drive

P.O. Box 29186

Columbus, Ohio 43229 USA

Record the unit information. Sign and date when the checklist is complete.

Unit Serial Number:	
Unit Model Number:	
Inspection Date:	
Signature:	

Internal Inspection

Checked	Item
_____	1. Unit exterior is undamaged.
_____	2. Service and Ventilation clearance is sufficient.
_____	3. Wire and Conductor insulation is damage free.
_____	4. Transformer-terminal connections properly tightened.
_____	5. Breaker connections properly tightened.
_____	6. Adjustable-breaker trip settings are correct.
_____	7. terminal block connections properly tightened.
_____	8. Transformer mounting bolts properly tightened.
_____	9. Foreign objects removed from unit interior.
_____	10. Transformer air passages clear and free of debris.
_____	11. Intake/Exhaust-air screens clean and obstruction free.

System startup

Checked	Item
_____	1. All circuit breakers in Off position and input power to unit is locked-out.
_____	2. Proper connections to input power, equipment-grounding conductor, and local grounding electrode conductor.
_____	3. Phase rotation at the main breaker is A, B, C, top to bottom.
_____	4. Measured input voltages at the main breaker match the unit nameplate input voltage. a. Voltage, phase A to phase B = _____ b. Voltage, phase B to phase C = _____ c. Voltage, phase C to phase A = _____
_____	5. Main breaker does not trip after turned On.
_____	6. Phase rotation at the load side terminals of the subfeeds is A, B, C, top to bottom.
_____	7. Measured output voltages at the load side terminal of the output breakers match the unit nameplate voltage within +4%, –0%: a. Voltage, phase A to phase B = _____ b. Voltage, phase B to phase C = _____ c. Voltage, phase C to phase A = _____ d. Voltage, phase A to neutral = _____ e. Voltage, phase B to neutral = _____ f. Voltage, phase C to neutral = _____
_____	8. Local EPO button shuts-down the system.
_____	9. Each REPO switch, if equipped, shuts-down the system. **NOTE: Any REPO switch may shut down equipment or systems other than the PPC under inspection.**

Monitoring System

Checked	Item
_____	1. Basic indicators(if equipped): Power indicator (Green LED) is lit when unit is On.
_____	2. Manual re-start (if equipped): Main input break trips open on power loss.
_____	3. Monitor panel: HMI display voltages match those measured at main circuit breaker.
_____	4. Monitor panel: Schneider 8244 PM2 (if equipped) display voltages match those measured at main circuit breaker.
_____	5. Centralized monitoring system (if connected): Unit is communicating properly with centralized monitoring system.
_____	6. Control voltage: Measured DC-control voltage on +Vout (+) and -Vout (com): • 12-V control voltage = _____ (between 11.76 and 12.24 Vdc). • 24-V control voltage = _____ (between 23.5 and 24.5 Vdc).
_____	7. Customer alarms: Correct alarm operation at the local display and at the centralized monitoring system (if equipped).

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