Chapter 3 | UPS with Bypass Electrical Installation

NOTE *If you have a plug-receptacle unit, continue to "Battery Cabinet Installation" on page 57 for installing optional battery cabinets or to "UPS Startup" on page 63.*

WARNING

Only qualified service personnel (such as a licensed electrician) should perform the electrical installation. Risk of electrical shock.

The Powerware 9170+ UPS input power may be hardwired through conduit to either a main power source circuit breaker or to an optional external bypass switch. For hardwired installations, it is recommended that you install a Powerware bypass switch to enable power transfer during maintenance or UPS downtime. If a bypass switch is used, both UPS input and UPS output must be hardwired–**through separate conduits**–to the bypass switch, as shown in Figure 13.

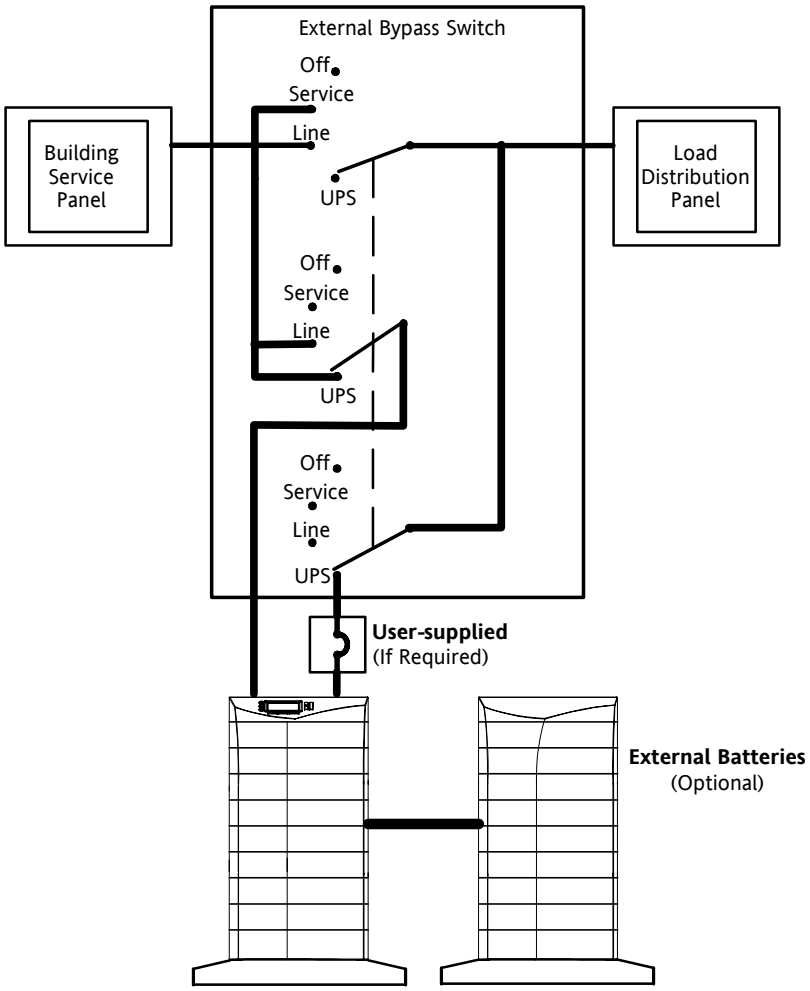


Figure 13. Typical Installation with a Bypass Switch

Input Current Ratings

Table 1 contains the required circuit breaker ratings for hardwired installations. Circuit breaker ratings for units having an input line cord are determined by the current capacity of the line cord.

Table 1. Required Input Circuit Breaker Sizes (200–240 Vac, 50/60 Hz)

UPS Capacity	Input Circuit Breaker Rating
3 kVA	25A
6 kVA	40A
9 kVA	60A
12 kVA	80A
15 kVA	100A
18 kVA	125A

NOTE *If you are installing an optional battery charger module, refer to that user's guide (164201399) for the proper input circuit breaker sizes and ratings.*

NOTE *To accommodate the feature of easy system expandability, it is recommended that initial installation of the Powerware 9170+ UPS contain wiring to support the maximum capacity of the UPS cabinet: 3 kVA for 3-slot cabinets; 9 kVA for 6-slot cabinets; 18 kVA for 9- and 12-slot cabinets.*

See Table 2 for recommended conductor sizes to wire the input circuit breakers.

Table 2. Recommended Wire Sizes

Input Circuit Breaker Size	75°C Copper Wire Size	Conductor Screw Torque
25A	10 AWG (5.3 mm^2)	35 in lb (4.0 Nm)
40A	8 AWG (8.4 mm^2)	40 in lb (4.5 Nm)
60A	4 AWG (21.2 mm^2)	45 in lb (5.1 Nm)
80A	3 AWG (26.7 mm^2)	50 in lb (6.6 Nm)
100A	2 AWG (33.6 mm^2)	50 in lb (6.6 Nm)
125A	1 AWG (42.1 mm^2)	50 in lb (6.6 Nm)

FOR U.S. INSTALLATIONS, READ THIS IMPORTANT NOTE!

This table lists the AWG and mm^2 wire size for each circuit breaker size shown on the wiring diagrams. The minimum recommended circuit breaker sizes for each model and voltage application are listed on the wiring diagrams.

Conductor sizes shall be no smaller than the 75°C wire size based on the ampacities given in Table 310–16 of the National Electrical Code, ANSI/NFPA 70-1999, and article 220. All circuit conductors, including the neutral conductor, must be the same size (ampacity) wire. Code may require a larger AWG size than shown in this table because of temperature, number of conductors in the conduit, or long service runs. **Follow local code requirements.**

Bypass Switches

Bypass switches are available in two types: Make-Before-Break (MBB) and Break-Before-Make (BBM).

An MBB switch makes a new connection before it breaks the original connection. For example, if you turn an MBB switch from UPS to LINE, the bypass switch connects the load to AC input power before disconnecting the load from UPS output power. (As noted in Figure 38 on page 55, MBB switches may not be used in certain system configurations.)

A BBM switch breaks the original connection before it makes a new one. If you turn a BBM switch from UPS to LINE, the switch disconnects the load from UPS output power before connecting the load to AC input power.

The bypass switch has four positions as described in Table 3.

NOTE *In the UPS or LINE position, AC input power is still connected to the input terminals inside the UPS.*

Table 3. Bypass Switch Positions

Switch Position	Description
LINE	Connects the load directly to AC input power and disconnects UPS output. AC input power is still connected to the UPS input.
OFF	Disconnects the load from the UPS output power and AC input power, as well as AC input power to the UPS input.
UPS	Connects the UPS output to the load.
SERVICE	Like the LINE position, SERVICE connects the load directly to AC input power and disconnects UPS output. **However, because SERVICE also disconnects AC input from the UPS, this is the appropriate position for UPS maintenance or repair.**

To disconnect AC input power during maintenance or service, turn the bypass switch to the SERVICE position. For MBB switches, you must press the red button beside the switch before you can change the switch position.

Table 4 shows the bypass switch models available for the Powerware 9170+ UPS.

Table 4. Bypass Switch Specifications

Bypass Switch Models		Rating, Continuous	See Figure 14					Weight
BBM	MBB		Height (A)	Width (B)	Depth (C)	Mounting Centers (D)	(E)	
BPE12BBM1A	BPE12MBB1A	40A/300 Vac (CSA) 50A/300 Vac (UL,TÜV)	21.0″ (53.4 cm)	14.0″ (35.6 cm)	6.8″ (17.2 cm)	11.0″ (28.0 cm)	20.0″ (50.8 cm)	27 lb (12.3 kg)
BPE14BBM1A	BPE14MBB1A	80A/300 Vac	21.0″ (53.4 cm)	14.0″ (35.6 cm)	6.8″ (17.2 cm)	11.0″ (28.0 cm)	20.0″ (50.8 cm)	31 lb (14.1 kg)
BPE20BBM1A	BPE20MBB1A	125A/300 Vac	21.0″ (53.4 cm)	14.0″ (35.6 cm)	6.8″ (17.2 cm)	11.0″ (28.0 cm)	20.0″ (50.8 cm)	35 lb (15.9 kg)

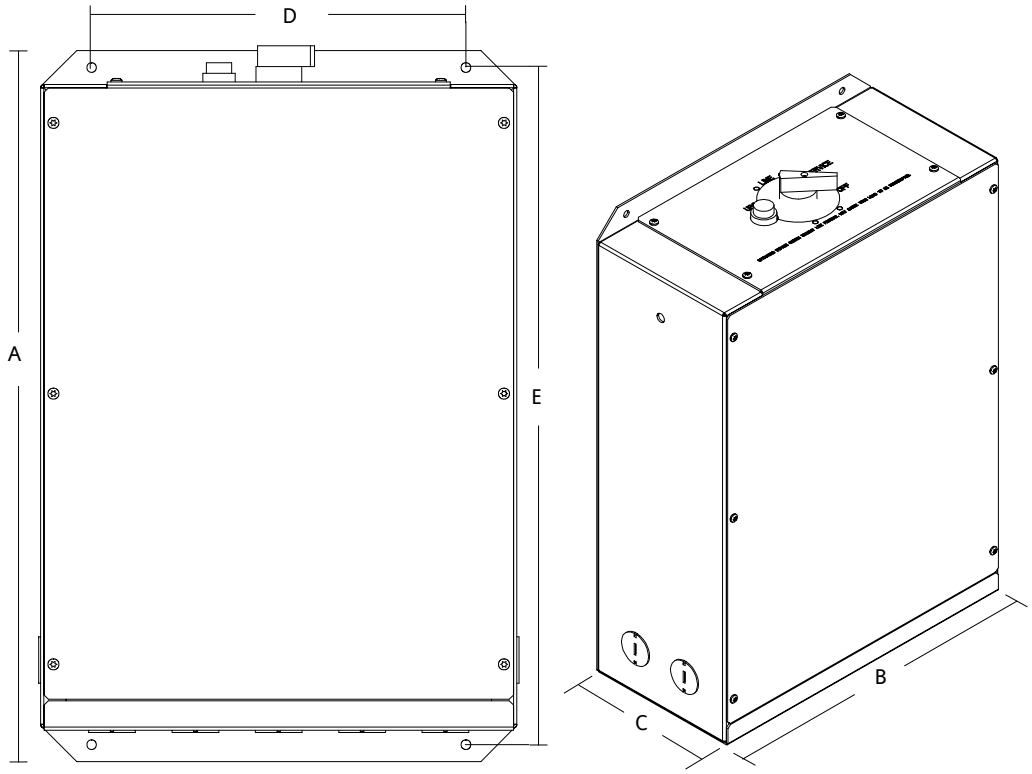


Figure 14. Bypass Switch Mounting Dimensions

UPS Installation with an External Bypass Switch

WARNING

Only qualified service personnel (such as a licensed electrician) should perform the electrical installation. Risk of electrical shock.

CAUTION

To prevent electrical shock or damage to the equipment, verify that the Powerware 9170+ UPS is OFF before you remove the entrance panel. The circuit breaker or disconnect switch must also be off at the AC input service panel. Also, turn OFF the AC disconnect and bypass switches before you connect any wires to the bypass switch terminal strip.

1. Mount the bypass switch within sight of the UPS. If you do not have a Powerware bypass switch or the fuse box or panel is out of sight, you must install a separate disconnect switch next to the UPS.

   The bypass switch should be mounted securely to a sturdy surface. You may need to turn the cabinet 90 degrees (on its side) to enable operator access to the switch handle.

2. Remove the six screws in the bypass switch front panel and remove the panel. Remove any packing material inside the bypass switch.

   Remove knockouts in the bottom of the bypass switch for AC Line Input, AC to UPS Input, AC from UPS Output, and AC to the UPS load.

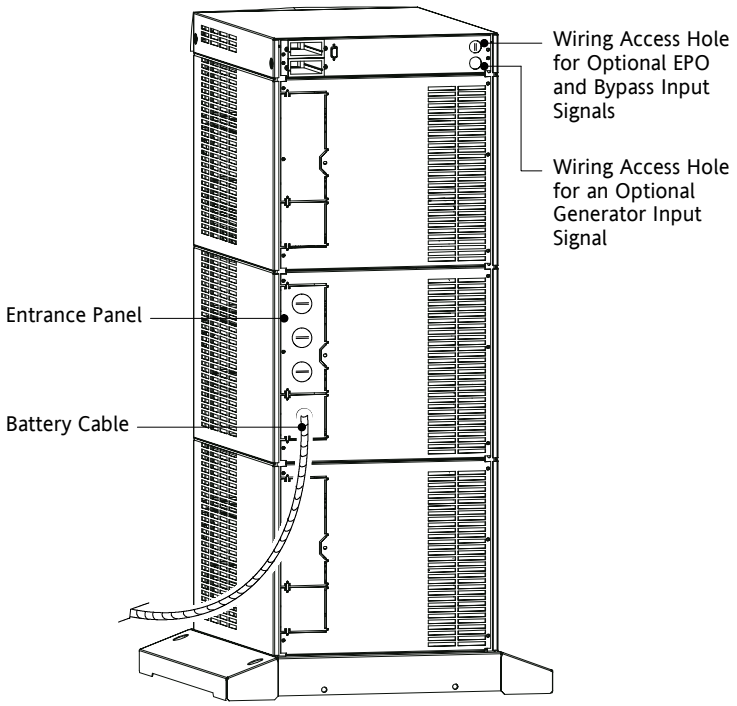


Figure 15. UPS Power Entrance Panel (Nine-Slot Cabinet Shown)

3. Unscrew and remove the rear panel(s) of the UPS (top panel on 3- or 6-slot; top 2 panels on 9- and 12-slot). See Figure 15.

The entrance panel contains knockout openings for entrance and exit conduits and for conduit to an optional external battery cabinet. The entrance panel is located on the top 3-slot section for 3- and 6-slot cabinets; on the second section for 9- and 12-slot cabinets as shown in Figure 15.

Wiring for optional emergency power-off (EPO) and bypass input signals passes through the opening at the top back of the cabinet. Wiring for an optional generator input signal must pass through a separate opening. Installing this wiring is described in Steps 12 and 13 on page 31.

4. Remove the knockouts in the entrance panel for AC input and AC output wiring.

5. Install the conduit adapters. AC input and AC output conductors must be run through separate conduits. UPS output circuits must be installed in dedicated conduit systems and not shared with other electrical circuits.

6. Find the terminal strip inside the bypass switch cabinet. Using the label on the back of the bypass switch access panel and the proper installation wiring diagram, make the terminal strip connections and tighten all connections as specified in Table 2 on page 22. Use copper wire that is the appropriate size for the current draw. Figure 16 shows a sample label.

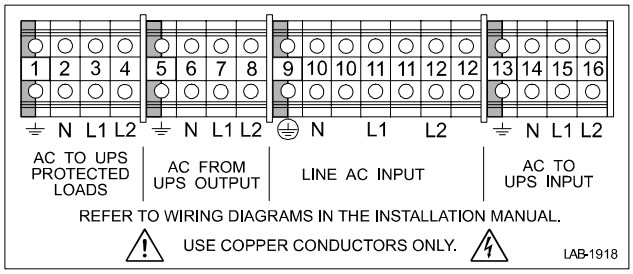


Figure 16. Bypass Switch Wiring Label

7. After installing bypass switch wiring, torque the screws holding all input and output power conductors to the values specified in Table 2 on page 22.

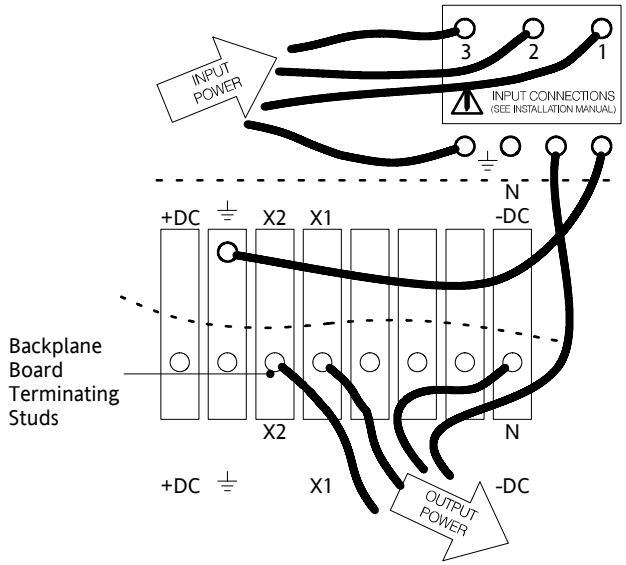


Figure 17. UPS Input and Output Terminals

8. Wire the UPS for the proper input voltage as shown in Figure 18.

Split-phase power modules (model ASY-0673, with brown labels on the front) is capable of supplying two output voltages: 100/100 for 200, 110/110 for 220, 120/120 for 240, 120/120 for 208, or 127/127 for 220 Vac, as selected through the front panel display. These modules produce two output voltages, typically required in North America, South America, and Japan.

Universal power modules (model ASY-0674, with black labels on the front) is capable of supplying a single-phase output voltage: 200, 208, 220, 230, or 240 Vac, as selected through the front panel display. These modules produce a single output voltage, typically required in Europe, the Middle East, Asia, and Africa.

CAUTION

Confirm that the UPS is wired for the proper input voltage as shown in Figure 18, and that the proper power modules (either split-phase or universal) are installed to produce the desired output voltage. Do not mix the two types of power modules in the same UPS cabinet.

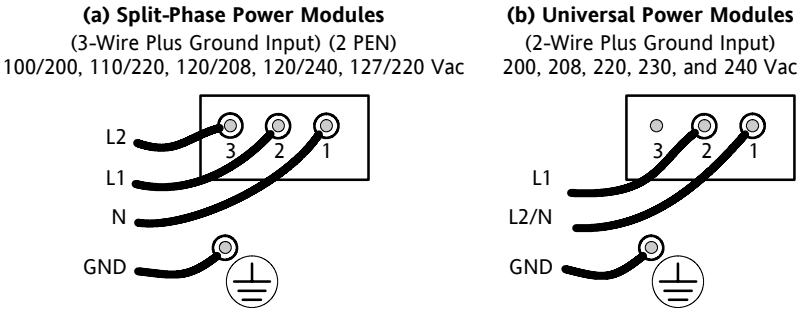


Figure 18. UPS Input Wiring

9. **For isolated output only.** See Chapter 5, "Isolated Output Wiring Diagrams" on page 51 to complete the wiring for isolated output.

10. See the wiring diagrams beginning on page 32 which show output configurations for various voltages and isolation options. Make UPS output connections on the backplane board terminating studs. Compression lugs (supplied in the accessory kit) may be installed on the proper terminating studs. Wires may also be terminated with ring terminals, which are attached to the output terminating studs.

    Figure 19 and Figure 20 describe output wiring configurations for various output voltages. You must also set the operating menu parameter 4-2-4 for the required output voltage as shown in the wiring configuration drawings.

NOTE *For Powerware 9170+ UPS models with low-voltage hardwire output, it is recommended to divide the total load as equally as possible between X1 and X2, as shown in Figure 19.*

NOTE *Failure to balance the loads may cause an overload alarm even if the full capacity of the UPS has not been reached.*

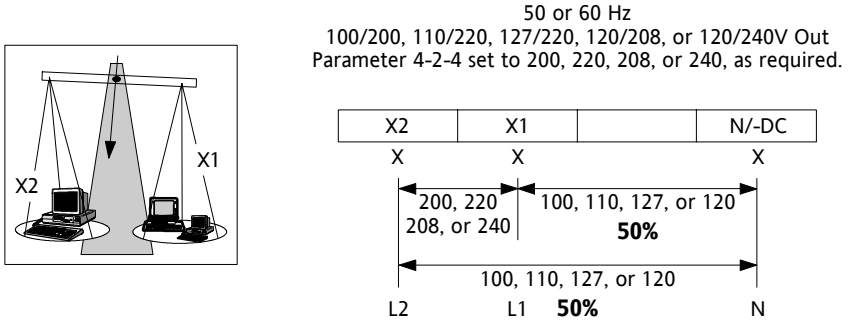


Figure 19. Split-Phase Power Modules with Non-Isolated Output

NOTE *The factory-default wiring for all high-voltage receptacles in a chassis without a power cord is 3-wire plus ground input. If you have a Universal Power Module (ASY-0674), all receptacles MUST be re-wired for a 2-wire plus ground input configuration as shown in Figure 20.*

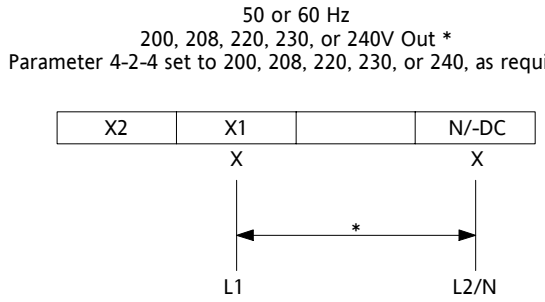


Figure 20. Universal Power Modules with Non-Isolated Output

11. If the bypass switch is an MBB style, notice the cable routed out of the left side of the bypass switch cabinet. The red and black pair of wires (normally open) in this cable must be connected to terminals 3 and 4 in Steps 12 and 13. (Do not connect the white and black pair of wires in this cable.)

12. If any external hardwired control signals are required (EPO or Generator On), unscrew and remove the top rear panel of the cabinet and locate the terminal block (see Figure 21).

CAUTION

EPO and external bypass circuits are not isolated from line voltage, and wiring must be installed according to local codes using conduit or suitable primary supply cables.

The Generator On signal is isolated from line voltage and can be treated as NEC Class 2 wiring.

Use 14–20 AWG, 600V wire (UL) or 14–26 AWG, 300V wire (CSA) for all input control signals.

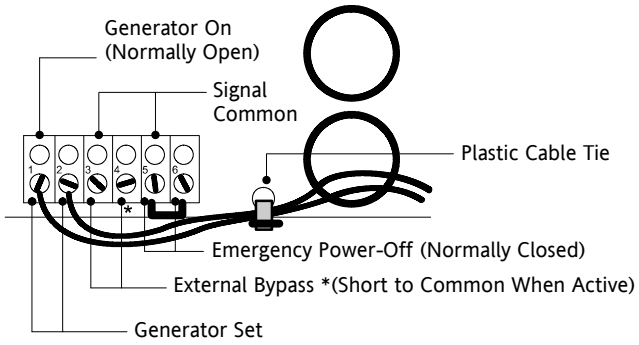


Figure 21. Input Control Signal Wiring

13. Place the signal wires through the proper conduit or grommet above the terminal block and attach to appropriate terminals. Secure each connection by torquing terminal screws to a maximum 3.5 in lb (0.4 Nm). Provide strain relief for cables by installing plastic cable ties.

NOTE *Do not strain relieve EPO or external bypass wiring with the same cable tie used for Generator On wires.*

14. Remove the jumper between terminals 5 and 6 only if you are wiring from an EPO switch. (See “Changing Parameter Settings” on page 81 for information about accessing menu 4, submenu 3, item 2 to view or change the EPO switch type.)

15. When all connections have been made and checked, reinstall the bypass switch front panel and UPS cabinet rear panels using the original screws.

System Wiring Diagrams

Select wiring diagrams from Table 5 based upon the installation voltage.

Table 5. UPS with Bypass Wiring Diagrams for Non-Isolated Output

UPS Input Voltage	UPS Output Voltage	Output Wires	Wiring Diagrams		
			Input	Output	System
100/200 110/220 120/208 120/240 127/220	100/200 110/220 120/208 120/240 127/220	L1, L2, N*	Figure 18a on page 29	Figure 19 on page 30	Figure 22 on page 34
200 208 220 230 240	200 208 220 230 240	L1 – L2	Figure 18b on page 29	Figure 20 on page 30	Figure 23 on page 34
220 230 240	220 230 240	L1 – N	Figure 18b on page 29	Figure 20 on page 30	Figure 24 on page 35

*Split-phase power modules required.

The following notes are referenced in the non-isolated system wiring diagrams (Figure 22 through Figure 24).

NOTE 1 *The customer must provide input overcurrent protection as stated in NEC Section 240-21 or local codes. Size the protection device according to local code requirements (see Table 1 on page 21).*

NOTE 2 *The UPS bypass switch must be installed within sight of the UPS. To properly install, complete the voltage and phase check procedure in "Startup for Hardwired Units" on page 68. The wires coming from the side of the switch must be connected as described in Step 11 on page 30.*

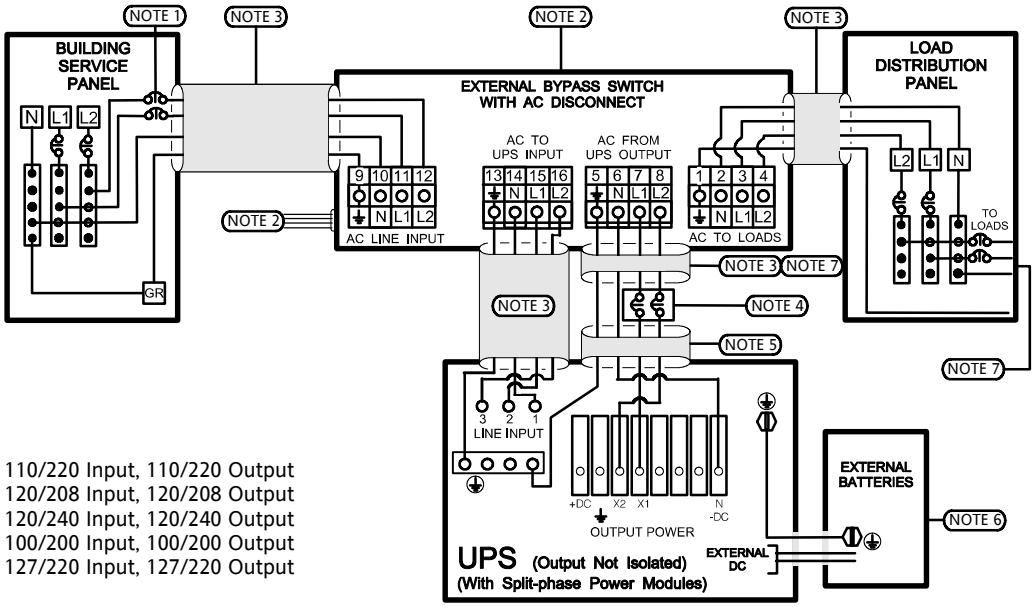
NOTE 3 *All AC circuit conductors, including the neutral conductor, must be the same size (ampacity), have the same rating (75°C) copper wire, and be sized according to the input circuit breaker. The UPS input and output conductors must be run through separate conduits.*

NOTE 4 *The customer must provide output overcurrent protection. See NEC Section 240-21 or local requirements. See Table 16 and Table 17 on pages 97 and 99 for maximum output overcurrent protection device ratings.*

NOTE 5 *See "Equipment Clearances" on page 7 for installation and service clearances before installing the UPS. Use flexible conduit on the UPS or the external battery cabinet if either must be moved.*

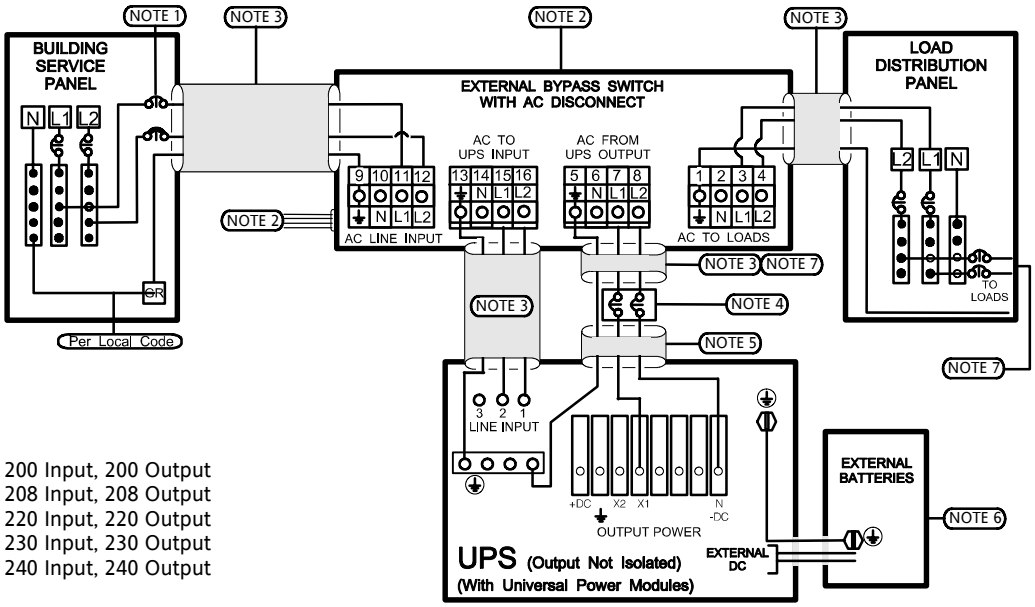
NOTE 6 *External UPS battery cabinets are optional. See "Battery Cabinet Installation" on page 57 for installation instructions.*

NOTE 7 *UPS output circuits shall be installed in dedicated conduit systems and not shared with other electrical circuits.*



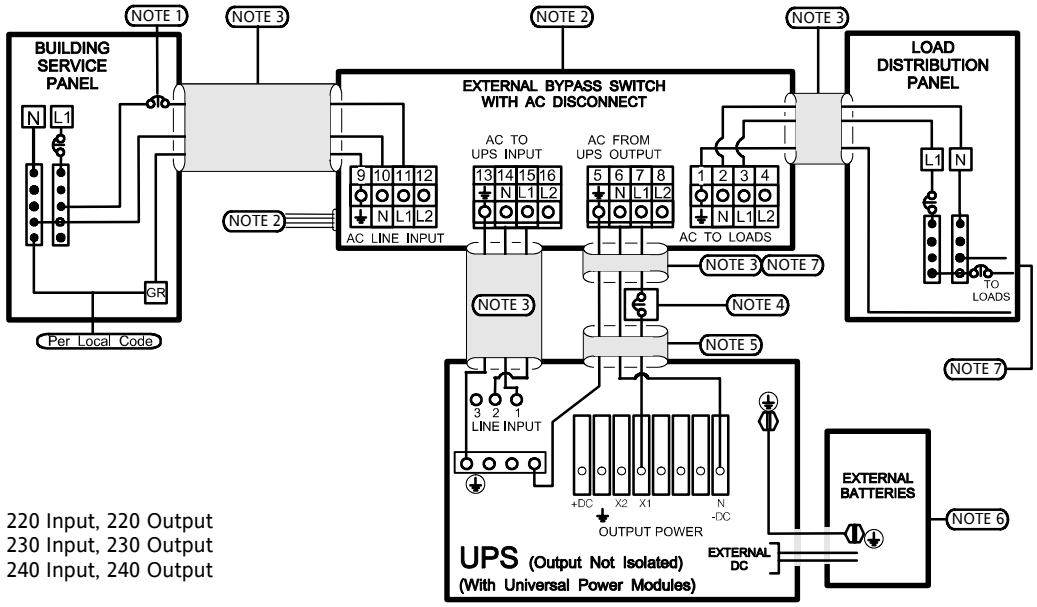
- 110/220 Input, 110/220 Output
- 120/208 Input, 120/208 Output
- 120/240 Input, 120/240 Output
- 100/200 Input, 100/200 Output
- 127/220 Input, 127/220 Output

Figure 22. External Bypass Switch (L1, L2, N), Non-Isolated Output, Split-Phase Power Modules



- 200 Input, 200 Output
- 208 Input, 208 Output
- 220 Input, 220 Output
- 230 Input, 230 Output
- 240 Input, 240 Output

Figure 23. External Bypass Switch (L1, L2), Non-Isolated Output, Universal Power Modules



- 220 Input, 220 Output
- 230 Input, 230 Output
- 240 Input, 240 Output

Figure 24. External Bypass Switch (L1, N), Non-Isolated Output, Universal Power Modules