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POWER CONVERSION/DISTRIBUTION

Precision Power Center

INSTALLATION, OPERATION, & MAINTENANCE MANUAL

3 Phase
15 kVA - 225 kVA
50 & 60 Hz

EMERSON™
Network Power

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NOTE

Read the entire manual before installing or operating the system.

WARNING

THE SHIPPING BANDS MAY BE UNDER TENSION. USE APPROPRIATE EYE, FACE, AND HAND PROTECTION TO SAFEGUARD AGAINST INJURY FROM BAND BACKLASH.

WARNING

VERIFY THAT ALL INCOMING LINE VOLTAGE (POWER) AND LOW-VOLTAGE (CONTROL) CIRCUITS ARE DE-ENERGIZED AND LOCKED OUT BEFORE INSTALLING CABLES OR MAKING CONNECTIONS, WHETHER IN THE JUNCTION BOX OR IN THE UNIT.

EQUIPMENT INSPECTION AND START-UP SHOULD BE PERFORMED ONLY BY TRAINED PERSONNEL. LETHAL VOLTAGES ARE PRESENT DURING START-UP PROCEDURES. ELECTRICAL SAFETY PRECAUTIONS MUST BE FOLLOWED THROUGHOUT INSPECTION AND START-UP.

ONLY QUALIFIED SERVICE PERSONNEL SHOULD PERFORM MAINTENANCE ON THE PRECISION POWER CENTER SYSTEM. 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 BACK-UP. DANGER OF EXPLOSION IF BATTERY IS INCORRECTLY REPLACED. REPLACE ONLY WITH SAME OR EQUIVALENT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO MANUFACTURER'S INSTRUCTIONS.

NOTE

The unit should not be loosened from the shipping pallet until after all handling by fork lift or pallet jack is completed.

All power and control wiring should be installed by licensed electricians and must comply with the NEC and applicable codes.

1.0 INSTALLATION INSTRUCTIONS

1.1 Unpacking and Installation

NOTE
Read the entire manual before installing and operating the system. Upon receipt of a Precision Power Center, the installer should perform the following steps to assure a quality installation.

1.1.1 Unpacking and Preliminary Inspection

A quality installation begins on the receiving dock.

1. **Inspect the shipping crate(s)** for damage or signs of mishandling before unpacking the unit(s). Check Shock-Watch™ indicator.
2. **Open the shipping crates carefully.** (Use care to avoid puncturing the container with sharp objects that would damage the contents.)
3. **Remove the packing and vapor barriers and inspect the equipment** for any obvious shipping damages.

NOTE
The units should not be loosened from the shipping pallet until after all handling by fork lift or pallet jack is completed. Complete internal inspection should be accomplished only after equipment positioning and prior to electrical hookup.

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

Liebert Corporation
1050 Dearborn Drive
P.O. Box 29186
Columbus, Ohio 43229 USA

1.1.2 Handling Considerations

The Precision Power Center (and cables, if furnished) is bolted to a wooden pallet to allow handling by fork lift equipment.

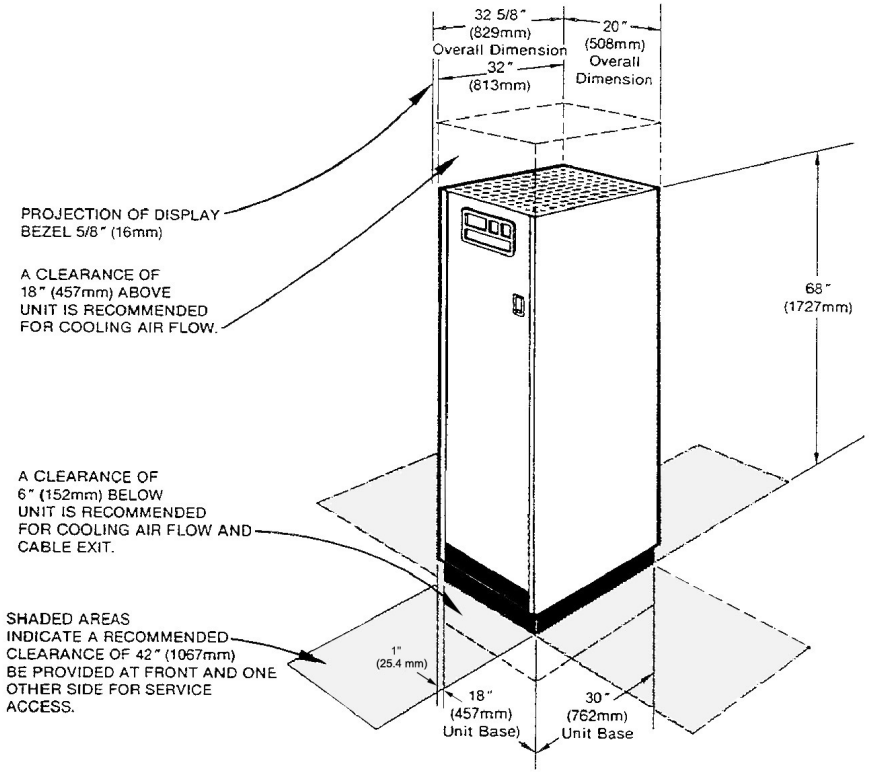
Easily moved - The Precision Power Center and cable reels are furnished with casters to allow the unit to be rolled into place after it has been unbolted from the pallet.

Check size and weight - Refer to the cabinet drawings furnished with the unit for size and weight information. Typical cabinet dimensions and weights are shown in **Figure 1** and **Figure 2**.

Plan the route - The route that the unit will follow to its installation area should be planned to ensure that all passages are large enough to accommodate the unit, and that the floors are adequate to support the weight. (For example: Are the doorway, elevators, ramps, etc., adequate? Are there any non-negotiable corners or offsets in the hallways?)

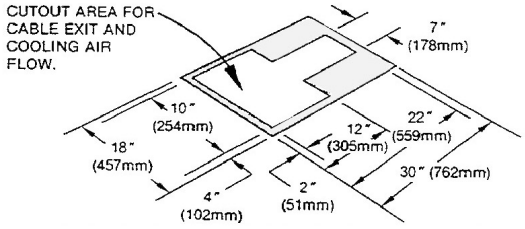
Move with care - In order to prevent panel damage, it is recommended that the exterior panels be removed before the unit is moved. When replacing panels, remember to reconnect all panel ground wires.

Figure 1 Typical cabinet and floor planning dimension data, single panelboard unit, 15-30 kVA

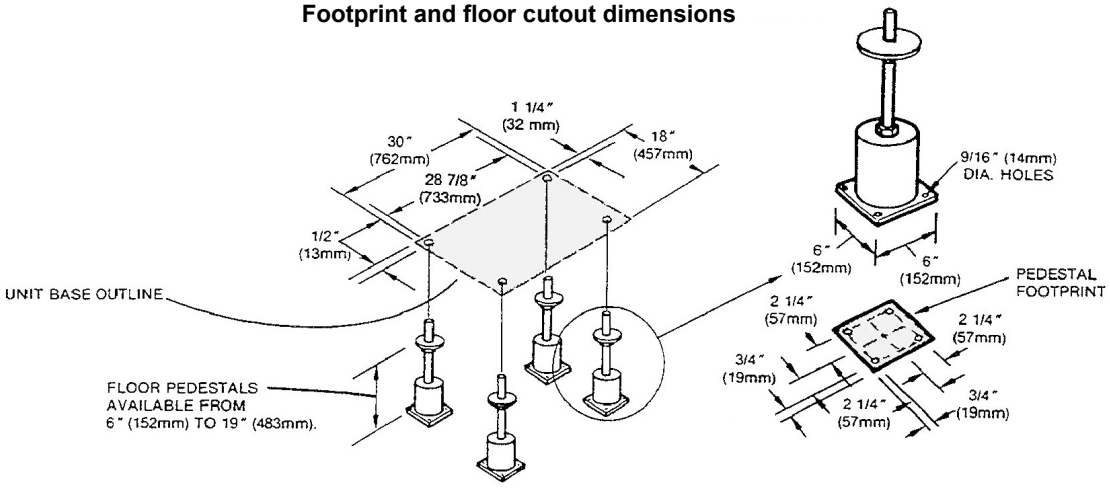


Unit kVA	Weight - lbs (kg)		
	60 Hz	50 Hz	Without Xfmr
15	550 (250)	600 (275)	300 (136)
30	700 (320)	750 (340)	300 (136)

Cabinet dimensional data

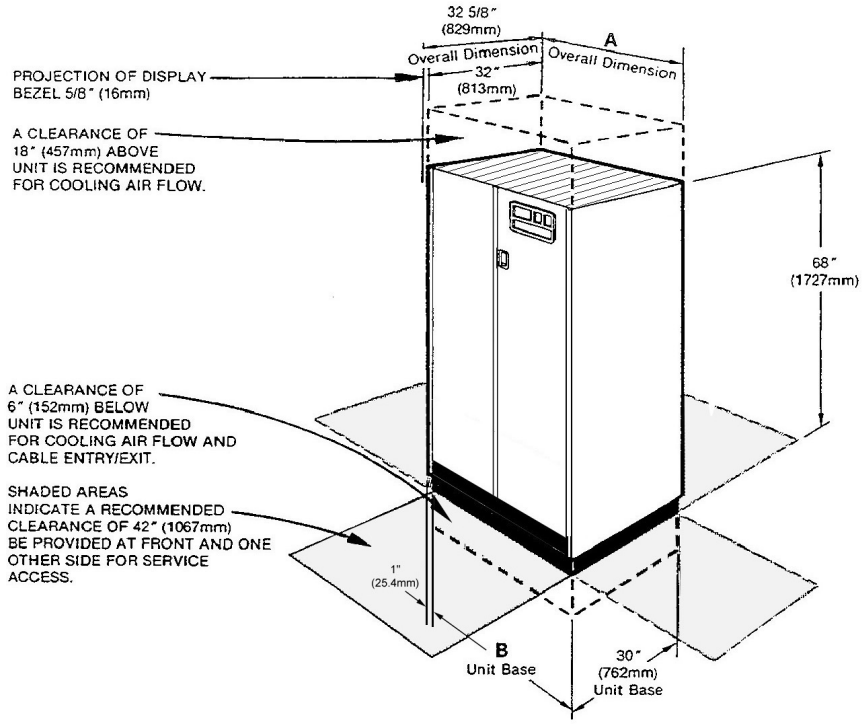


Footprint and floor cutout dimensions



Optional floor pedestals

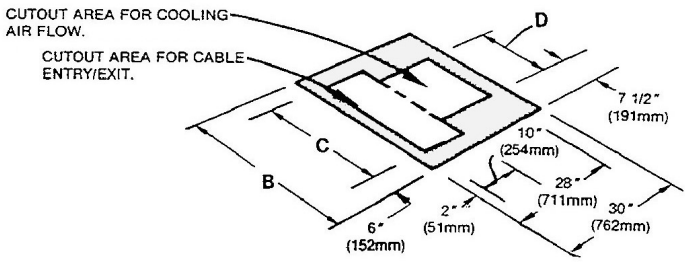
Figure 2 Typical cabinet and floor planning dimension data, two or three panelboard unit



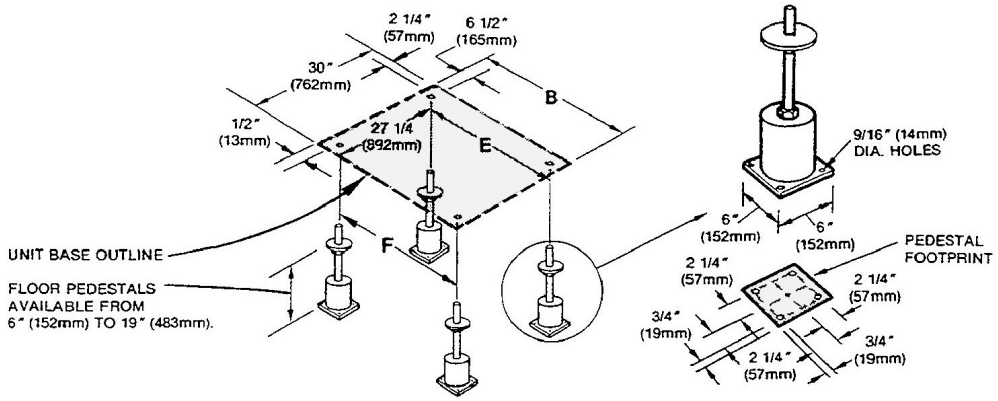
Unit kVA	Weight - lbs (kg)		
	60 Hz	50 Hz	Without Xfmr
15	650 (295)	700 (320)	400 (181)
30	750 (340)	800 (365)	400 (181)
50	850 (380)	925 (420)	400 (181)
75	1050 (470)	1150 (520)	400 (181)
100	1275 (580)	1400 (630)	450 (200)
125	1450 (660)	1575 (710)	450 (200)
150	1750 (794)	1900 (862)	700 (318)
200	2100 (953)	2300 (1043)	700 (318)
225	2250 (1021)	2450 (1111)	700 (318)

Add 300 lbs (136 kg) to 50 thru 125 kVA units with extra panelboard option.

Cabinet dimensional data



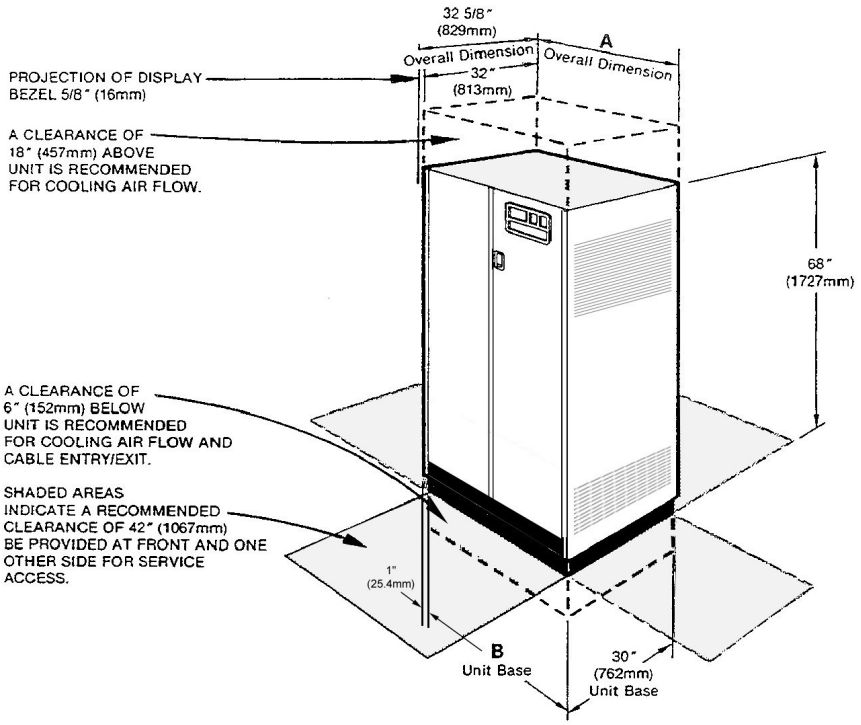
Footprint and floor cutout dimensions



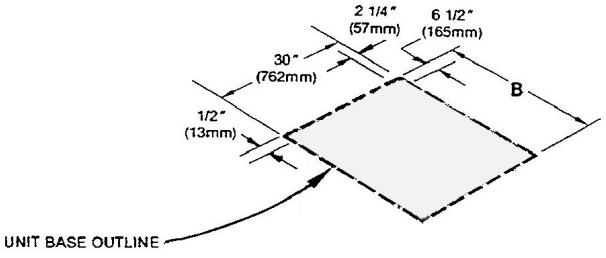
Optional floor pedestals

Unit kVA	No. of panelboards	Dimensional data - inches (mm)					
		A	B	C	D	E	F
15 to 30	2	32 (813)	30 (762)	18 (457)	15 (381)	17 (432)	29 (737)
50 to 125	up to 2	32 (813)	30 (762)	18 (457)	15 (381)	17 (432)	29 (737)
50 to 125	3	44 (1118)	42 (1067)	30 (762)	27 (686)	29 (737)	41 (1041)
150 to 225	up to 3	44 (1118)	42 (1067)	30 (762)	27 (686)	29 (737)	41 (1041)

Figure 3 Typical cabinet and floor planning dimension data, Top Exit unit



Cabinet dimensional data



Footprint dimensions

Weight - Top Exit unit

Unit kVA	Weight - lbs (kg)
15	600 (272)
30	750 (340)
50	900 (408)
75	1100 (499)
100	1325 (601)
125	1500 (680)
150	1750 (794)
200	2100 (953)
150	2250 (1021)

Dimensional data - Top Exit unit

Unit kVA	No. of panelboards	Dimensional data - inches (mm)	
		A	B
15	1	32 (813)	30 (762)
30	1	32 (813)	30 (762)
50	2	44 (1118)	42 (1067)
75	2	44 (1118)	42 (1067)
100	2	44 (1118)	42 (1067)
125	2	44 (1118)	42 (1067)
150	2	44 (1118)	42 (1067)
200	2	44 (1118)	42 (1067)
225	2	44 (1118)	42 (1067)

1.1.3 Unit Preparation

The Precision Power Center may be easily removed from the shipping pallet and installed by customer personnel. A typical procedure is as follows:

1. Set the palletized assembly in a level area, where there is enough room to roll the unit and entire cable assembly off the pallet onto the floor.
2. Cut the shipping bands.

WARNING
THE SHIPPING BANDS MAY BE UNDER TENSION. USE APPROPRIATE EYE, FACE, AND HAND PROTECTION TO SAFEGUARD AGAINST INJURY FROM BAND BACKLASH.

3. Remove the factory-provided ramp from its shipping position. (One ramp is provided per order, packed either in front of, or on top of, a set of cable reel(s).) Place the ramp adjacent to the pallet to provide a smooth path from pallet to floor.
4. Remove side and rear panels from the module. An Allen wrench for the side panels is furnished in the installation packet. (Carefully disconnect panel ground wires by pulling the easy-disconnect terminals at the unit frame.)
5. Remove the bolts holding the unit to the shipping pallet. (Located in each of the four bottom corners.)
6. If cables are on wheeled cable reel(s), remove bolts holding reel(s) to pallet.
7. Remove shipping blocks from under unit and cable assembly, then remove chocks from all casters.
8. Roll unit off pallet onto floor, carefully guiding cable reel(s) after it.
9. Roll unit and cable package to location of installation. For units located on a raised floor, use care when positioning unit over the floor cutout to avoid casters falling through the cutout.

CAUTION
Before maneuvering the unit into its final position, read and follow all advisories in the following paragraphs in 1.1.4 - Location Considerations.

1.1.4 Location Considerations

The Precision Power Center should be located within the computer room, and/or close to the load(s) which it is supplying.

Equipment Location should employ the shortest output distribution cable runs consistent with logical equipment arrangement and allowances for future additions.

Operating Environment - Ambient temperatures of 0°C to 40°C with a relative humidity of 0% to 95% (non-condensing).

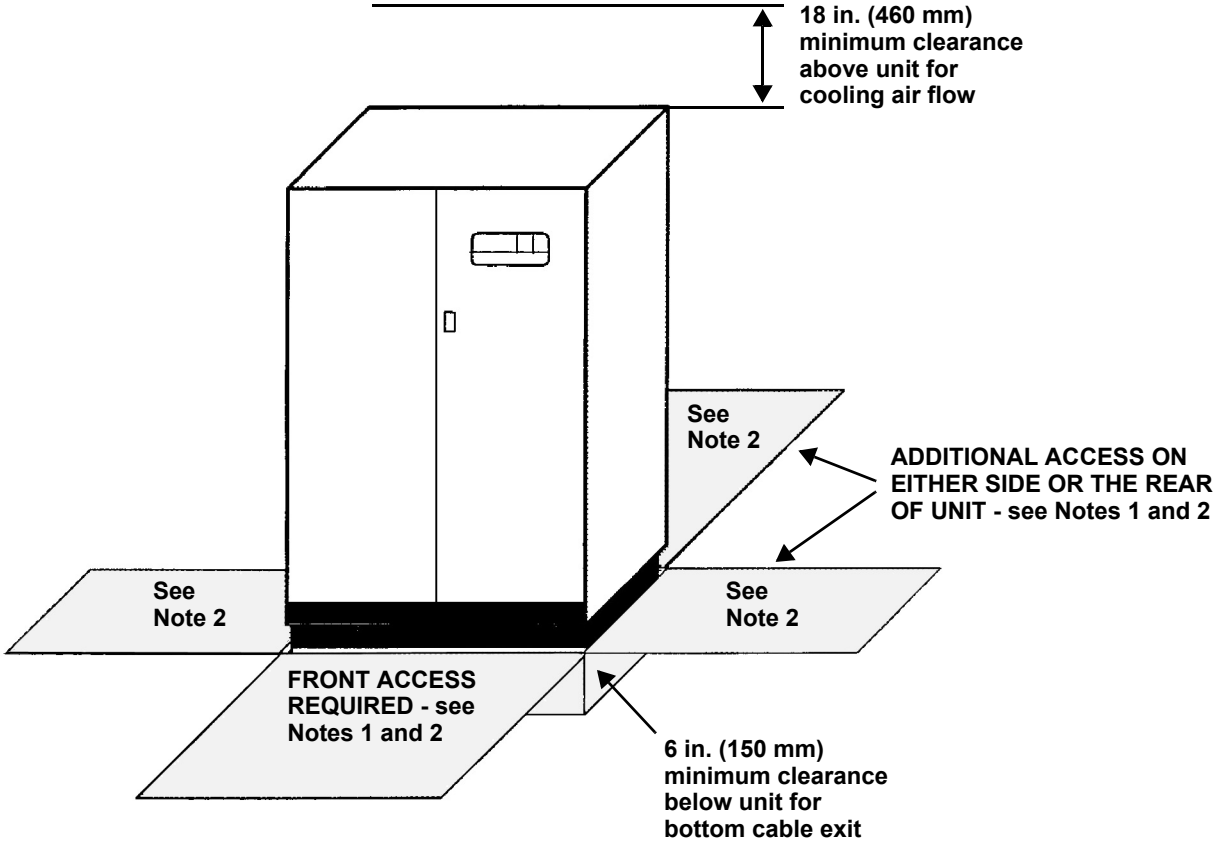
Bottom Clearance is required for exit of cables/conduit and/or for cooling air flow. This clearance is automatically provided by a raised floor (6 in. / 150 mm minimum height). **Figure 1** and **Figure 2** show the typical raised-floor cutout dimensions.

When units are not located on a raised floor (or if the raised floor is not adequate to support the unit), optional floor pedestals may be used. (Non-raised floor applications are not CSA approved.) Units with top cable exit provisions and side vents do not require bottom clearance.

Recommended Minimum Service Clearances are shown in **Figure 4**. The indicated clearances at the front and one other side or rear of the unit are required for service access by the National Electrical Code (NEC) (Article 110-16). Clearance above the unit is required for cooling air flow (exhaust).

Heat Output - As do all electrical devices, the Precision Power Center produces heat under normal operation. (See **Table 1**.) This heat output should be included when calculating the environmental conditions of the room.

Figure 4 Recommended minimum service and ventilation clearances



NOTES:

1. **Service access is required at the front, plus one other side or rear.**
2. **Service access clearance dimensions:**
   36 in. (914 mm) for units up to 150 volts to ground
   42 in. (1067 mm) for units over 150 volts to ground

Table 1 Heat output

Full load heat output - BTU/hr (kW)	
kVA	**BTU/hr (kW)**
15	2,500 (0.73)
30	4,600 (1.35)
50	6,200 (1.82)
75	8,150 (2.39)
100	9,900 (2.90)
125	11,500 (3.37)
150	12,500 (3.66)
200	15,500 (4.54)
225	15,800 (4.63)

1.1.5 Floor Pedestal Installation

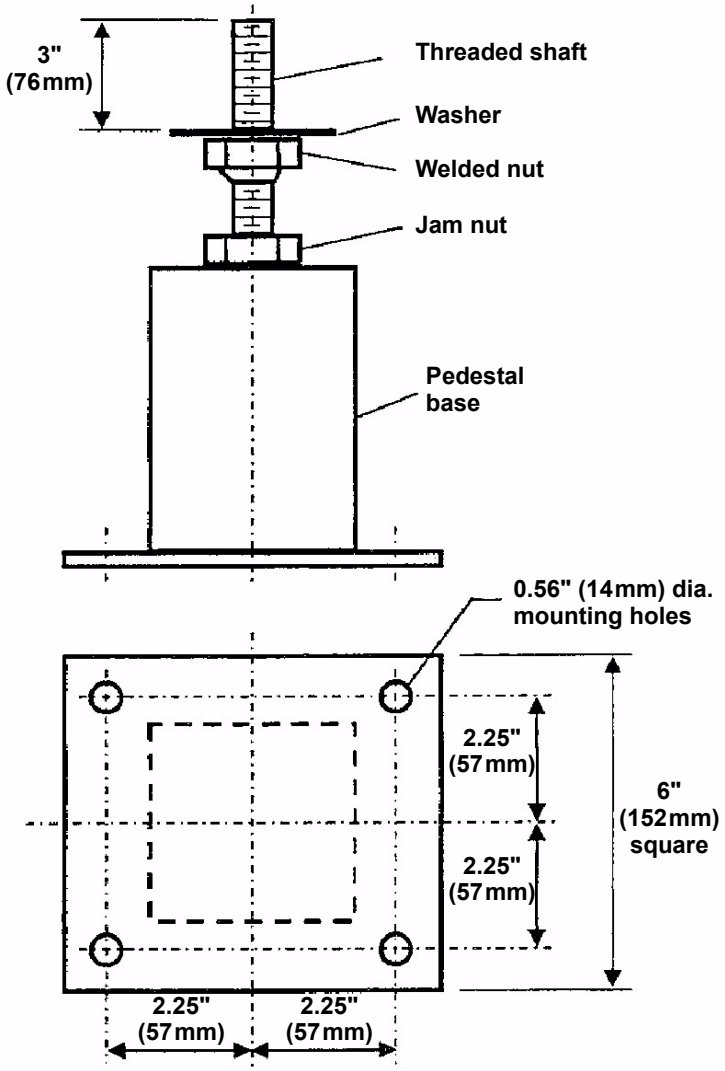
Floor pedestals are optional equipment intended to provide clearance for bottom cable entry without relying on a raised floor to support the unit. The pedestals are adjustable over a limited range (approximately 3-1/2 in.) to allow leveling the unit and minor adjustments in the unit's installed height.

CAUTION
Floor pedestals may be reverse assembled for shipping. Before installation, the pedestals should be reassembled as shown in Figure 5. When the pedestal is properly assembled, the washer on top of the welded nut provides a bearing surface for the unit weight.

1. **Insert the pedestal threaded shaft** into the inside corner tubing of the cabinet base as shown in **Figure 1** and **Figure 2**.
2. **Adjust the pedestal height** by turning the welded nut/shaft assembly into or out of the pedestal base as required.
3. **Lock the height** by tightening the jam nut against the pedestal base.

The pedestal may be mounted to the floor by means of the four holes in the base. Locations of floor pedestals are shown in **Figure 1** and **Figure 2**.

Figure 5 Floor pedestal details



1.2 Distribution Side Section Mounting & Wiring

For Precision Power Centers with more than three panelboards, the additional panelboards are furnished in side-section enclosures which are shipped separate from the main unit.

1.2.1 Side Section Mounting

The additional distribution side section has the same base dimensions as the single panelboard unit (18 in. x 30 in.) and can be mounted on either the left or right side of the main unit, with left side mounting recommended.

Provide a floor cutout for exit of output cables, as shown in **Figure 1**.

Remove the side panel, the upper panel retainers, and the lower panel hooks from the main unit.

Align the distribution side section with the main unit and bolt the two frames together using the four bolts and hardware provided.

If floor pedestals are used for the main unit, two additional floor pedestals are required for the outside corners of the side section. See **Figure 1**.

Install the upper panel retainers and lower panel hooks on the side-section enclosure.

After electrical connections are completed, install the unit side panel on the side-section enclosure.

1.2.2 Side-Section Electrical Connections

Five conductors (3-phase conductors, neutral and ground) are furnished with the distribution side section for connection to the main unit in the field, along with an intercabinet frame ground conductor.

For Precision Power Centers with transformers, the side-section phase conductors are connected directly to the transformer terminals:

Phase A (wire 412) to X1
Phase B (wire 422) to X2
Phase C (wire 432) to X3

The side-section neutral (wire 442) and ground (wire 452) conductors are connected to the Precision Power Center main ground busbar (see unit wiring diagram).

For Precision Power Centers without transformers, the side-section phase and neutral conductors are connected to the corresponding output power distribution terminal blocks inside the main unit. The side-section ground conductor is connected to the main ground busbar.

For all Precision Power Centers with current monitoring, route each side-section conductor through the appropriate current transformer (CT) in the main unit.

NOTE
Side-section conductors must pass through the current transformers in the same direction as the main unit panelboard conductors. Use the existing main unit panelboard wiring for reference.

1.3 Power and Control Wiring

Power and control wiring should be installed by licensed electricians. All power and control wiring must comply with the NEC and applicable local codes.

1.3.1 Input Power Connections

If the unit is furnished with junction boxes, input power connections are made as detailed in **1.3.2 - Junction Box Installation (If Used)**.

If junction boxes are not furnished, the input power feeder is connected to the input power lugs or blocks located inside the unit. (See **Figure 6**, **Figure 7**, and **Figure 8**.)

WARNING
VERIFY THAT ALL INCOMING LINE VOLTAGE (POWER) AND LOW-VOLTAGE (CONTROL) CIRCUITS ARE DE-ENERGIZED AND LOCKED OUT BEFORE INSTALLING CABLES OR MAKING CONNECTIONS, WHETHER IN THE JUNCTION BOX OR IN THE UNIT.

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

The input feeder circuit should be sized in accordance with the NEC and any local building codes to assure the feeder's ability to safely carry the system's full load current, including losses.

Input feeder conductors should be sized for no more than 2% voltage drop. If operation at under-voltage conditions for extended periods of time is desired, the input feeders must be oversized.

Typical conductor size data is shown in **Table 2**. All connections must comply with the NEC and all other applicable codes.

For units with a transformer, the main input feeder should consist of 3-phase conductors and one (safety) ground conductor (3W + G).

For units without a transformer, the main input feeder must consist of 3-phase conductors, one neutral, and one (safety) ground conductor (4W + G).

Figure 6 Electrical connection locations, single panelboard unit

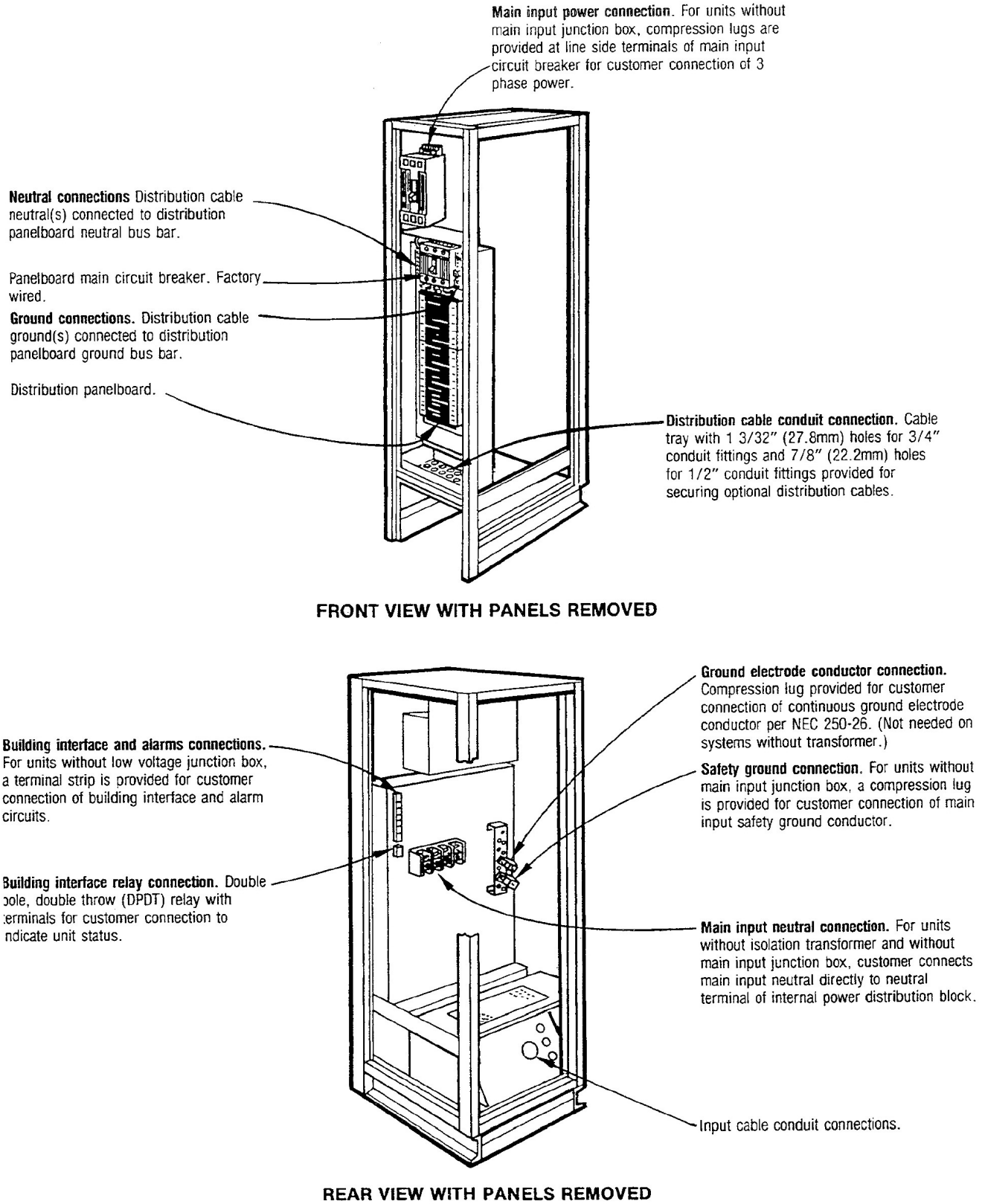
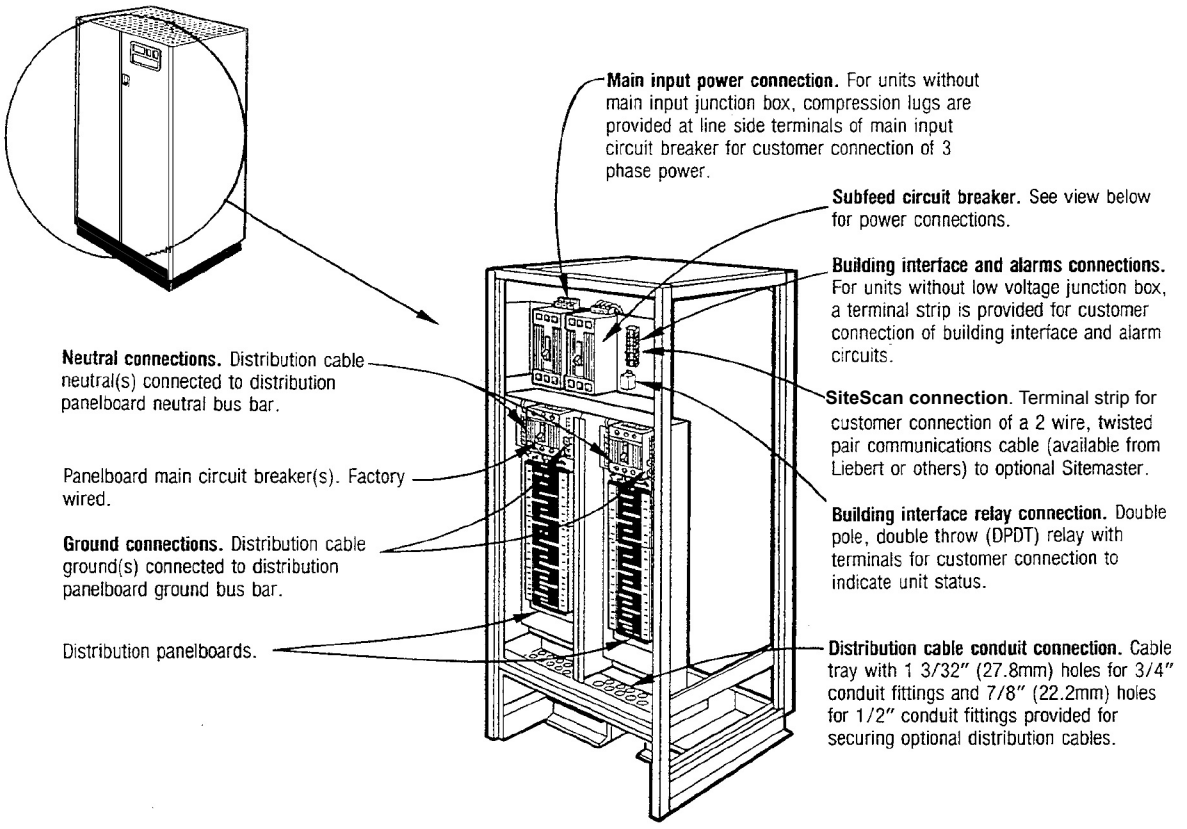
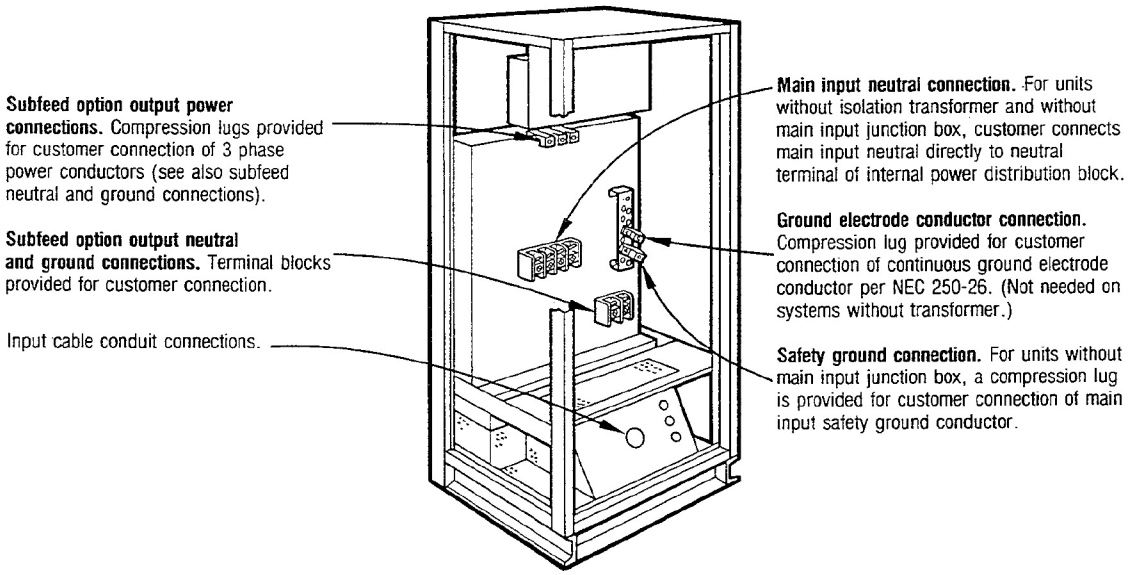


Figure 7 Electrical connection locations, two panelboard unit

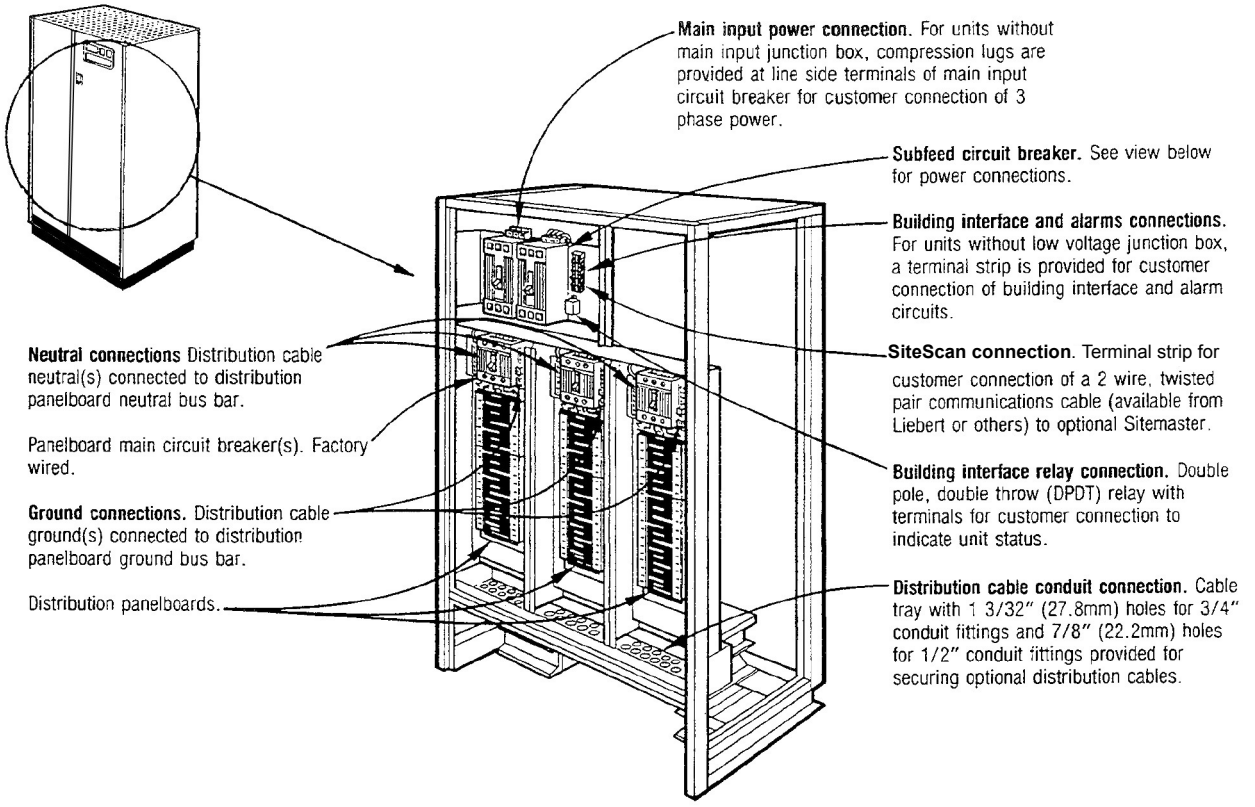


FRONT VIEW WITH PANELS REMOVED

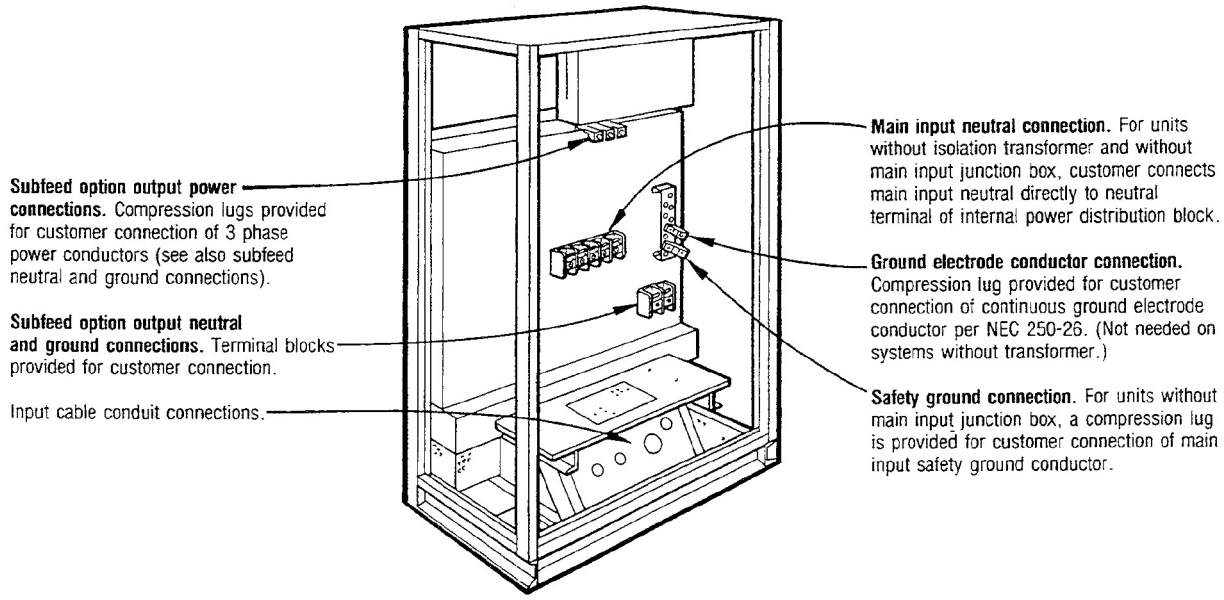


REAR VIEW WITH PANELS REMOVED

Figure 8 Electrical connection locations, three panelboard unit

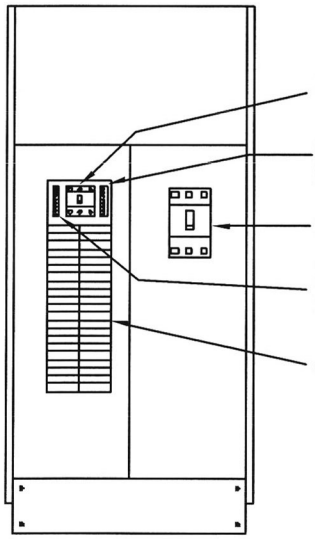


FRONT VIEW WITH PANELS REMOVED



REAR VIEW WITH PANELS REMOVED

Figure 9 Electrical connection locations, Top Exit unit, one panelboard



Panelboard main circuit breaker.
Factory wired.

Ground connections. Distribution cable ground(s) connected to distribution panelboard ground bus bar.

Main input circuit breaker.

Neutral connections. Distribution cables neutral(s) connected to distribution panelboard neutral bus bar.

42 pole distribution panelboard.

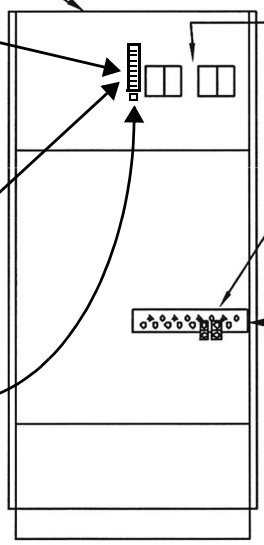
FRONT VIEW WITH PANELS REMOVED

Input cable conduit connections

Building interface and alarms connections.
For units without low-voltage junction box, a terminal strip is provided for customer connection of building interface and alarm circuits.

SiteScan connection.
Terminal strip for customer connection of a two-wire, twisted pair communications cable (available from Liebert or others) to optional SiteScan.

Building interface relay connection.
Double pole, double throw (DPDT) relay with terminals for customer connection to indicate unit status.



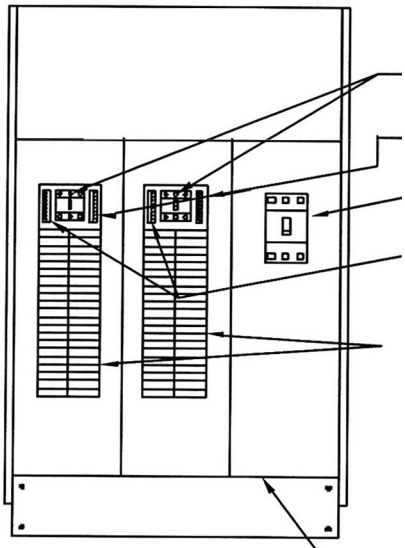
Main input 4 wire plus ground connection.
For units without isolation transformer and without main input junction box, customer connects main input neutral directly to neutral terminal of internal power distribution block.
For 15 to 30 kVA, terminals accept (2) #B AWG to (2) 500 kcmil.
For 50 to 125 kVA, terminals accept (2) #4 AWG to (2) 500 kcmil.

Ground electrode conductor connection.
Compression lug provided for customer connection of continuous ground electrode conductor (not needed on systems without transformer).
Terminals accept #14 AWG to (2) #2/0 AWG.

Safety ground connection.
For units without main input junction box, a compression lug is provided for customer connection of main input safety ground conductor.

REAR VIEW WITH PANELS REMOVED

Figure 10 Electrical connection locations, Top Exit unit, two panelboards



Panelboard main circuit breaker. Factory wired.

Ground connections. Distribution cable ground(s) connected to distribution panelboard ground bus bar.

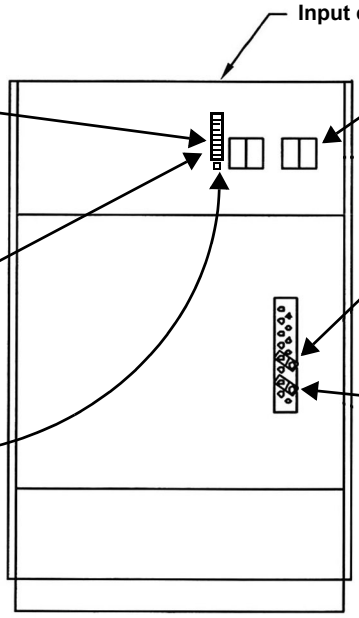
Main input circuit breaker.

Neutral connections. Distribution cables neutral(s) connected to distribution panelboard neutral bus bar.

42 pole distribution panelboard.

Distribution cable conduit connection per panel. Cable tray 1-3/32" (27.8mm) holes for 3/4" conduit fittings and 7/8" (22.2mm) holes for 1/2" conduit fittings provided for securing optional distribution cables.

FRONT VIEW WITH PANELS REMOVED



Input cable conduit connections

Building interface and alarms connections. For units without low-voltage junction box, a terminal strip is provided for customer connection of building interface and alarm circuits.

SiteScan connection. Terminal strip for customer connection of a two-wire, twisted pair communications cable (available from Liebert or others) to optional SiteScan.

Building interface relay connection. Double pole, double throw (DPDT) relay with terminals for customer connection to indicate unit status.

Main input 4 wire plus ground connection. For units without isolation transformer and without main input junction box, customer connects main input neutral directly to neutral terminal of internal power distribution block. Terminals accept (2) #4 AWG to (2) 500 kcmil.

Ground electrode conductor connection. Compression lug provided for customer connection of continuous ground electrode conductor (not needed on systems without transformer). Terminals accept #14 AWG to (2) #2/0 AWG.

Safety ground connection. For units without main input junction box, a compression lug is provided for customer connection of main input safety ground conductor.

REAR VIEW WITH PANELS REMOVED

Table 2 Suggested minimum input wire size data

Input volts	kVA	Units with transformers			Transformerless units		
		Input FLA	Input OPD	Suggested feeder wire size (AWG)	Input FLA	Input OPD	Suggested feeder wire size (AWG)
208V	15	43	60	6	42	60	6
	30	87	110	2	83	110	2
	50	145	200	000	139	175	00
	75	215	300	350 kcmil	208	300	350 kcmil
	100	286	400	(2) 000*	277	350	(2) 00*
	125	358	450	(2) 0000*	347	450	(2) 0000*
	150	427	600	(2) 350 kcmil*	416	600	(2) 350 kcmil*
240V	15	38	50	8	—	—	—
	30	75	100	2			
	50	125	175	00			
	75	186	250	250 kcmil			
	100	248	350	(2) 00*			
	125	310	400	(2) 000*			
	150	370	500	(2) 250 kcmil*			
380V	15	24	30	10	23	30	10
	30	47	60	6	46	60	6
	50	79	100	2	76	100	3
	75	117	150	0	114	150	0
	100	157	200	000	152	200	000
	125	196	250	0000	190	250	250 kcmil
	150	234	300	350 kcmil	228	300	350 kcmil
	200	312	400	(2) 000*	304	400	(2) 000*
	225	351	450	(2) 0000*	342	450	(2) 0000*
400V	15	23	30	10	23	30	10
	30	45	60	6	43	60	6
	50	75	100	2	72	90	2
	75	112	150	0	108	150	0
	100	149	200	000	144	200	000
	125	186	250	250 kcmil	180	225	0000
	150	223	300	350 kcmil	217	300	350 kcmil
	200	297	400	(2) 000*	289	400	(2) 000*
	225	334	450	(2) 0000*	325	450	(2) 0000*
415V	15	22	30	10	21	30	10
	30	43	60	6	42	60	6
	50	72	90	2	70	90	3
	75	108	150	0	104	150	0
	100	143	200	000	139	175	00
	125	179	225	0000	174	225	0000
	150	214	300	350 kcmil	209	300	350 kcmil
	200	285	400	(2) 000*	278	350	(2) 00*
	225	321	450	(2) 0000*	313	400	(2) 000*
480V	15	19	25	10	—	—	—
	30	38	50	8			
	50	63	80	4			
	75	93	125	1			
	100	124	175	00			
	125	155	200	000			
	150	185	250	250 kcmil			
	200	247	350	(2) 00*			
	225	278	350	(2) 00*			
600V	15	15	20	12	—	—	—
	30	30	40	8			
	50	50	70	4			
	75	74	100	2			
	100	99	125	1			
	125	124	175	00			
	150	148	200	000			
	200	197	250	250 kcmil			
	225	222	300	350 kcmil			

* Parallel feeders per NEC 300-20 and 310-4.
FLA = Full Load Amps of Power Center
OPD = Overcurrent Protection Device inside Power Center
Wire Sizes based on NEC 1996 Table 310-16, using 75°C copper conductor.
NOTES:
1. Main input power feeder should be a dedicated feeder direct from service entrance or other power source, if possible.
2. Ground conductors recommended to be insulated conductors run with power conductors for increased system performance. Ground conductor minimum size per NEC Table 250-95. Input power feeder conduit may be used as the safety ground conductor. When conduit is used, adequate electrical continuity must be maintained at conduit connections to enclosures and throughout conduit run.
3. Input feeder wire size listed in this table is the minimum feeder size recommended. Larger wire size may be required because of voltage drop or supply overcurrent protection device.
4. For transformerless units with 3-phase 4W + G input feeder larger wire size may be required because of excessive neutral current (see NEC Table 310-16 notes 8 and 10). For best performance, the unit should be located as close to the load as practical.

Table 3 Main input circuit breaker interrupting rating

Standard interrupting rating*				
Input OPD	**208V**	**480V**	**380-415V**	**600V**
Up to 110 A	65 kA	25 kA	15 kA	18 kA
125 to 250 A	65 kA	25 kA	25 kA	18 kA
300 to 600 A	65 kA	35 kA	35 kA	25 kA
700 to 800 A	65 kA	50 kA	50 kA	25 kA

* Refer to unit specification sheet for units equipped with non-standard main input breakers.

1.3.2 Junction Box Installation (If Used)

Main input (power) and low-voltage (control) junction boxes are available for the Precision Power Center to simplify customer connections.

Shipping Arrangements - The junction boxes, if used, can either be shipped with the system or can be advance-shipped for installation during the roughing-in stage of new construction.

Installation Location - Liebert supplies flexible, 10-foot-long (3 m) cables for connecting the junction boxes to the unit. The junction boxes should be installed a maximum of 8 ft. (2.4 m) from the feeder entrance of the unit.

It is recommended that the junction boxes be centered under an easily removable floor tile.

Junction Box Connections must be installed in compliance with the NEC and all other applicable codes.

WARNING
VERIFY THAT INCOMING LINE VOLTAGE (POWER) AND LOW-VOLTAGE (CONTROL) CIRCUITS ARE DE-ENERGIZED AND LOCKED OUT BEFORE INSTALLING CABLES OR MAKING ANY CONNECTIONS IN THE JUNCTION BOX.

Typical junction box connections are shown in **Figure 11** and described in **1.3 - Power and Control Wiring**.

Table 4 Main input junction box wire ranges

Junction box size	Wire range
14" x 16" x 6"	#14 to #2/0 AWG
16" x 30" x 6"	(2) #4 to (2) 500 kcmil

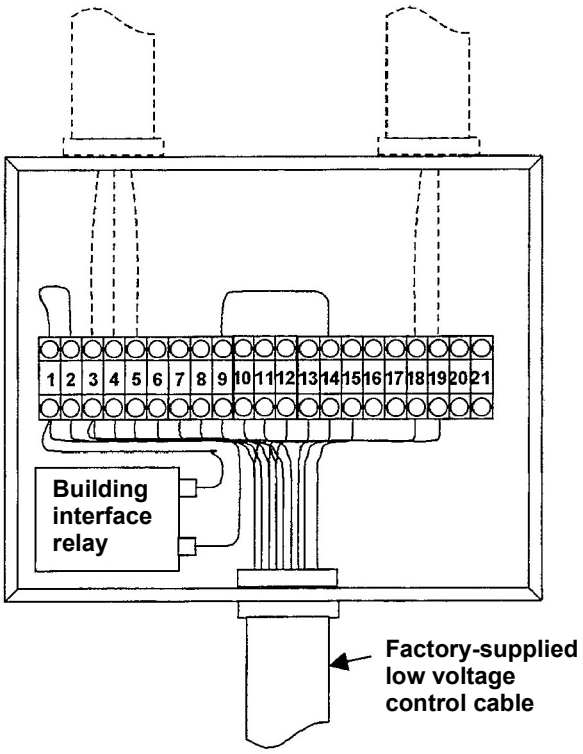
Dimensions - Dimensions are given on the drawings furnished with the unit. Typical dimensions of the junction boxes are as follows:

Table 5 Typical dimensions of junction boxes

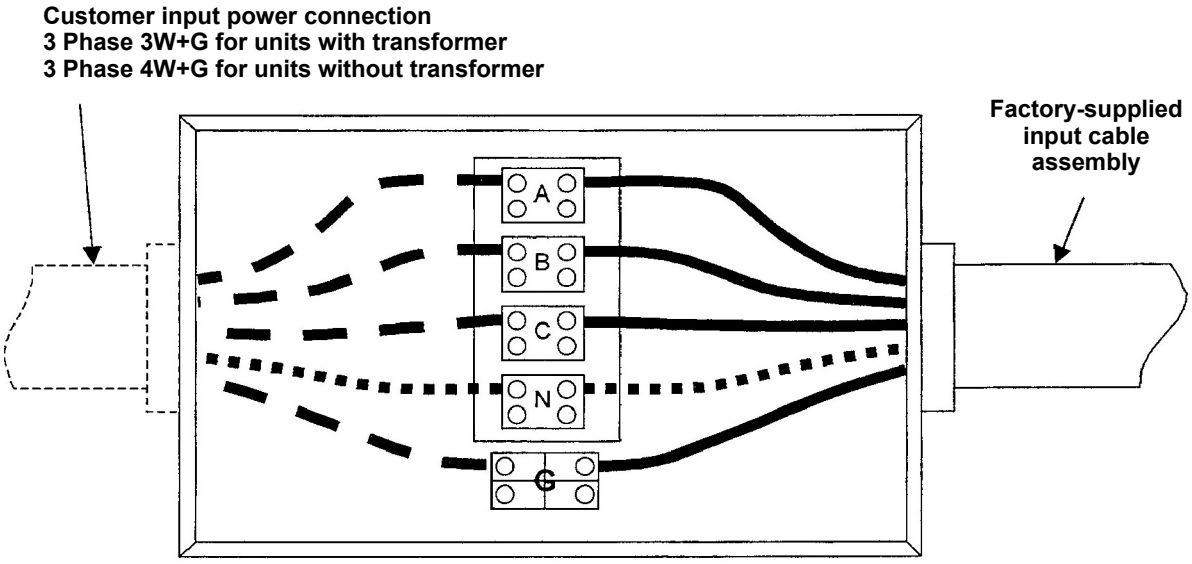
Low-voltage (control) junction box - dimensions in inches (mm)	
Width	8 (203)
Length	10 (254)
Height	4 (102)

Main input (power) junction box - dimensions in inches (mm)				
Unit kVa / Dimension		**Input voltage**		
		208-240V	**380-415V**	**480-600V**
15-30 kVA	Width	14 (356)	14 (356)	14 (356)
	Length	16 (406)	16 (406)	16 (406)
	Height	6 (152)	6 (152)	6 (152)
50 kVA	Width	16 (406)	14 (356)	14 (356)
	Length	30 (762)	16 (406)	16 (406)
	Height	6 (152)	6 (152)	6 (152)
75 kVA	Width	16 (406)	16 (406)	14 (356)
	Length	30 (762)	30 (762)	16 (406)
	Height	6 (152)	6 (152)	6 (152)
100-225 kVA	Width	16 (406)	16 (406)	16 (406)
	Length	30 (762)	30 (762)	30 (762)
	Height	6 (152)	1 (152)	6 (152)

Figure 11 Typical junction box connections



Low-voltage control junction box



Main input junction box

1.3.3 System Grounding

The performance and safety of any power conditioning system depend upon proper grounding. **Figure 12** shows the typical grounding arrangements for the Precision Power Centers.

Equipment grounding - Grounding is primarily for safety. Correct implementation of grounding also 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 250-95. Larger wire sizes may be used for increased system performance.

If the input power feeder conduit is used as a grounding conductor, adequate electrical continuity must be maintained 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 is used to supply power to a computer room or area that is equipped with a signal reference grid or a grounded raised-floor stringer system, a grounding conductor should be connected from the system ground bus to the grid or floor system. This conductor should be stranded or braided #8 AWG or larger, and as short as practical. Less than 3 ft. (1 m) is recommended.

1.3.4 Grounding Electrode Conductor (Units With Transformer)

Required by code - The Precision Power Center with transformer should be grounded according to the safety practices of NEC 250-26. A local grounding electrode conductor is recommended in addition to the equipment safety ground which is normally run with the input power conductors.

Unit connection - A terminal is furnished inside the unit for field-connection of the grounding electrode conductor. (See **Figure 6**, **Figure 7**, and **Figure 8**.)

Electrode connection - As shown in **Figure 12**, the grounding electrode conductor is run from the unit to the *nearest effectively grounded* (in order of preference):

1. Building steel
2. Metal water pipe
3. Other made grounding electrode

Sizing of the grounding electrode conductor is based on the secondary circuit conductors. **Table 6** shows the minimum recommended grounding electrode conductor according to the NEC (Table 250-94).

Table 6 Minimum grounding electrode conductor size (AWG)

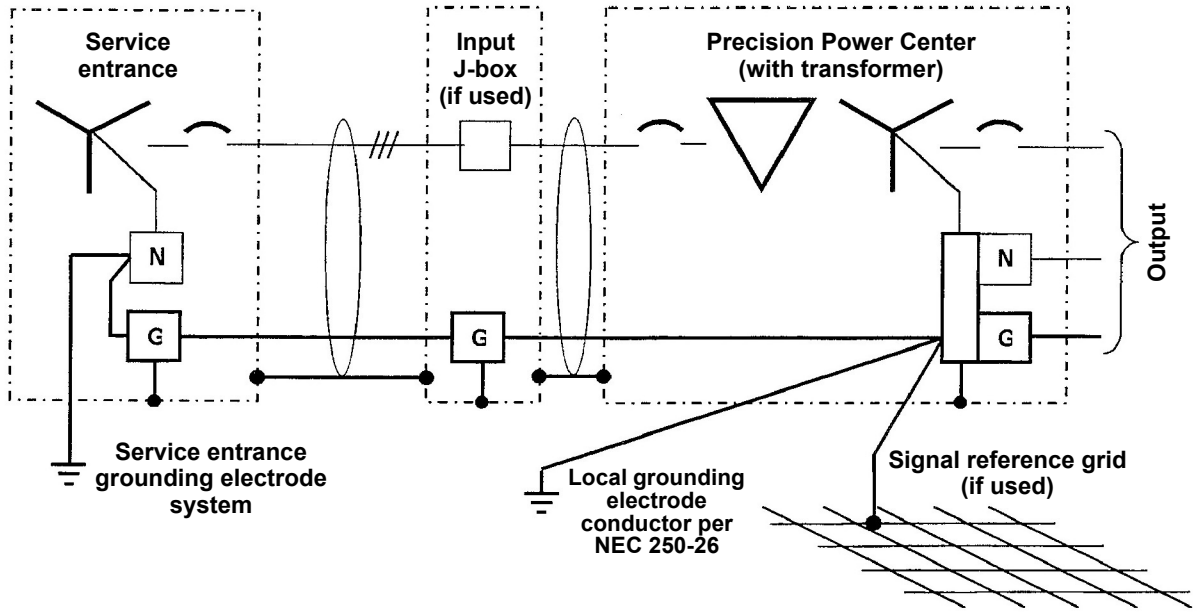
kVA	Output voltage		
	208V	380V	415V
15	8	8	8
30	8	8	8
50	4	8	8
75	2	6	6
100	0	4	4
125	0	2	2
150	00	2	2
200	00	0	0
225	00	0	0

AWG wire size based on 75°C copper conductors

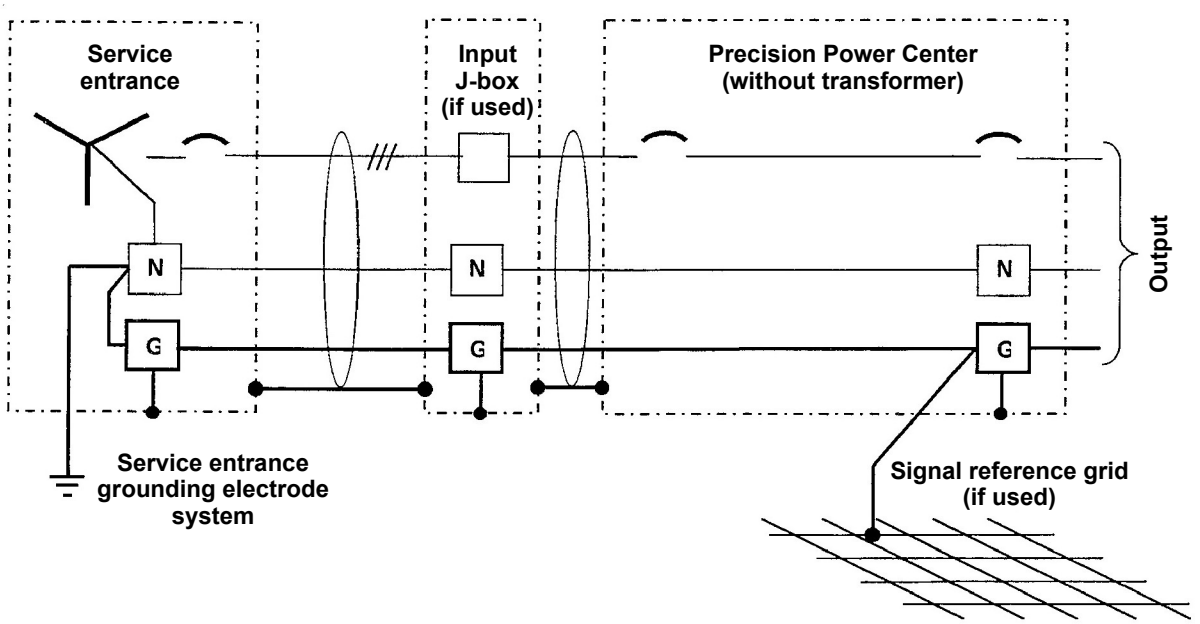
Recommended methods for running the grounding electrode conductor (arranged by preference for system performance; as acceptable by local and other applicable codes):

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

Figure 12 Typical grounding arrangements



Typical Precision Power Center with transformer grounding arrangement



Typical Precision Power Center without transformer grounding

1.3.5 Output Power Connections

Output circuit breaker(s) and/or panelboards with ground and neutral provisions are provided inside the unit for connecting load(s) as required. (See **Figure 6**, **Figure 7**, and **Figure 8**.)

Flexible output distribution cables for use in data processing areas under a raised floor are optional and may be factory supplied. Cable lengths and layout should be well-planned:

- **Cable access** - Cable routes should follow aisles between equipment. This will facilitate access to cables for installation, routine inspection, and future changes.
- **Cable length** - Measure the distance to the load equipment following right-angle paths, rather than diagonally or directly. Always measure to the extreme far side of the equipment with respect to the unit to insure adequate cable length.
- **Air circulation** - Prevent restriction of airflow under the raised floor by running the flexible conduits flat on the sub-floor, in parallel paths.

For best performance, the Precision Power Center should be located as close to the load as practical.

Initial system output loading should be between 50% and 75% of rated capacity. This allows 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 - Balancing of loads is good design practice on any 3-phase system. Accordingly, each distribution panel is load-balanced at the factory, based on output branch circuit breaker sizes. All additions to the system should be arranged so as to preserve this balance.

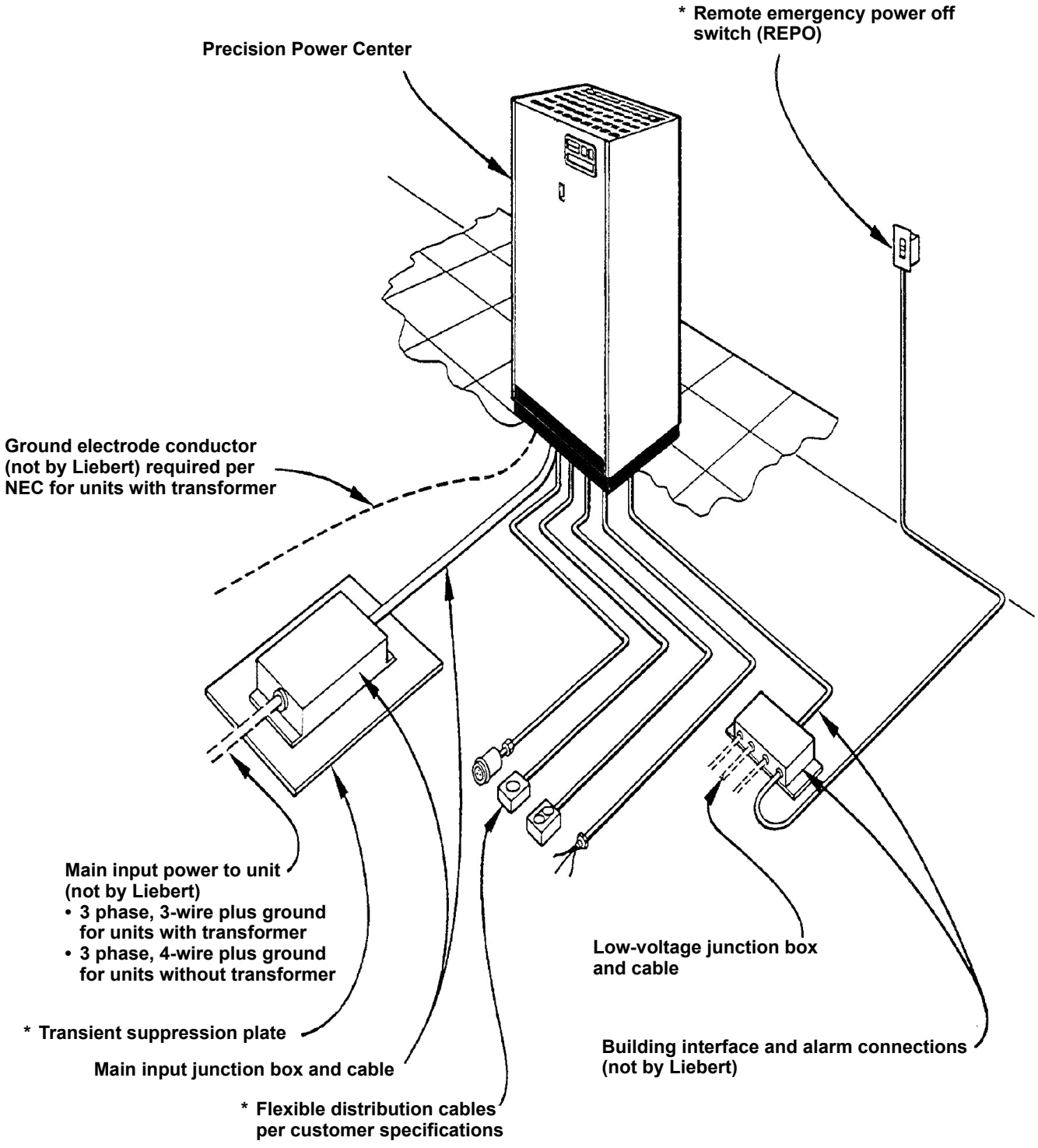
For phase-shifted, multi-output units, to ensure proper harmonic current cancellation, the loads should be balanced across the multiple outputs as well. For example, with a dual-output unit, the loads should be balanced across the six output phases. For a quad-output unit, the loads should be balanced across the 12 output phases.

WARNING
VERIFY THAT INCOMING LINE VOLTAGE CIRCUITS ARE DEENERGIZED AND LOCKED OUT BEFORE INSTALLING OUTPUT BREAKERS AND CABLES.

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

Padlock-off provisions - All output cables without receptacles that are hard-wired to the load equipment must be equipped with a padlock-off accessory for the output circuit breaker. The padlock-off accessory is to be used to lock-out and tag the circuit breaker when service is performed on the hard-wired load equipment in accordance with OSHA safety rules.

Figure 13 Typical Precision Power Center equipment arrangement



* Optional devices—refer to the specification sheet for options supplied

1.3.6 Control Wiring Connections

The NEC Article 645 requires that emergency power off (EPO) switches be located at the principal room exits. All standard Liebert power conditioning systems have provision for external shutdown control from Remote Emergency Power Off (REPO) stations. **Figure 14** is a simplified diagram of the shutdown circuitry of the Precision Power Center.

Low-voltage control circuit - As shown in **Figure 14**, the control circuit operates on 24 VDC. The shutdown device (represented by the REPO switch) activates a low-current 24 VDC relay which in turn operates the shunt-trip mechanism. The shunt-trip solenoid opens the Main Input Breaker, which de-energizes the power center.

Multiple-unit shutdown - When more than one power center is installed by the user, a typical requirement is that actuation of a single device (REPO for example) must shut down all power centers. The low-voltage control circuits of all standard Liebert Precision Power Center systems are designed to meet this requirement.

External control wiring connections for remote shutdown, alarm, and/or monitoring are made to the low-voltage junction box (if used) or to the low-voltage control terminal strip located inside the unit.

Control wiring connections vary with the type of monitoring system furnished with the unit. Two typical control wiring configurations are shown in **Figure 15** and **Figure 16**.

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

WARNING
VERIFY THAT ALL INCOMING HIGH-VOLTAGE (POWER) AND LOW-VOLTAGE (CONTROL) CIRCUITS ARE DE-ENERGIZED AND LOCKED OUT BEFORE INSTALLING CABLES OR MAKING CONNECTIONS, WHETHER IN THE JUNCTION BOX OR IN THE UNIT.

Figure 14 Simplified shutdown circuit

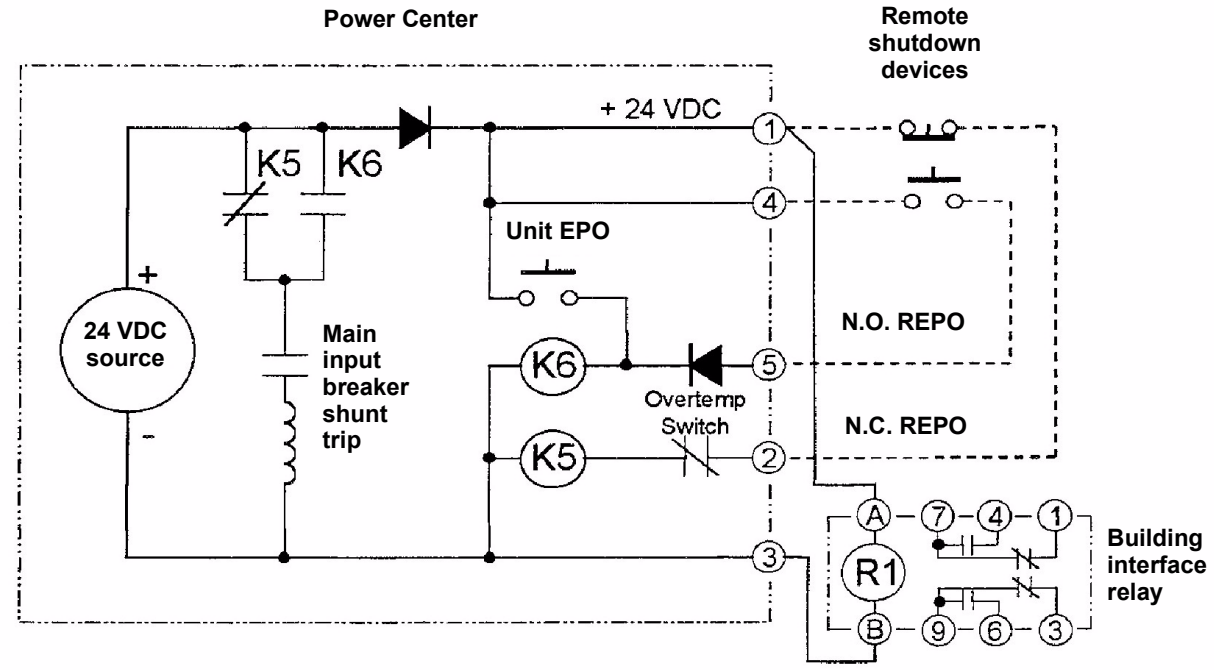
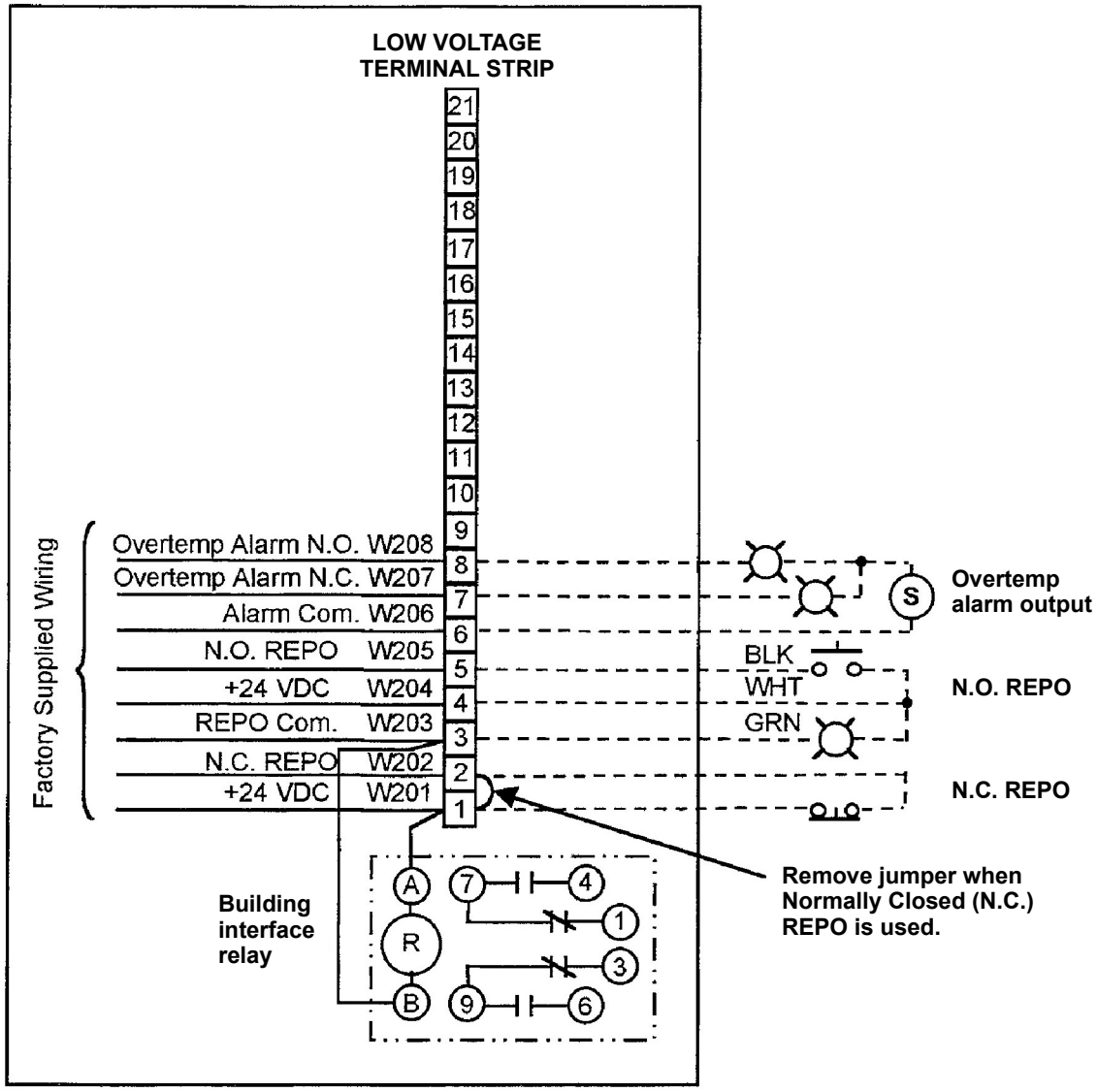


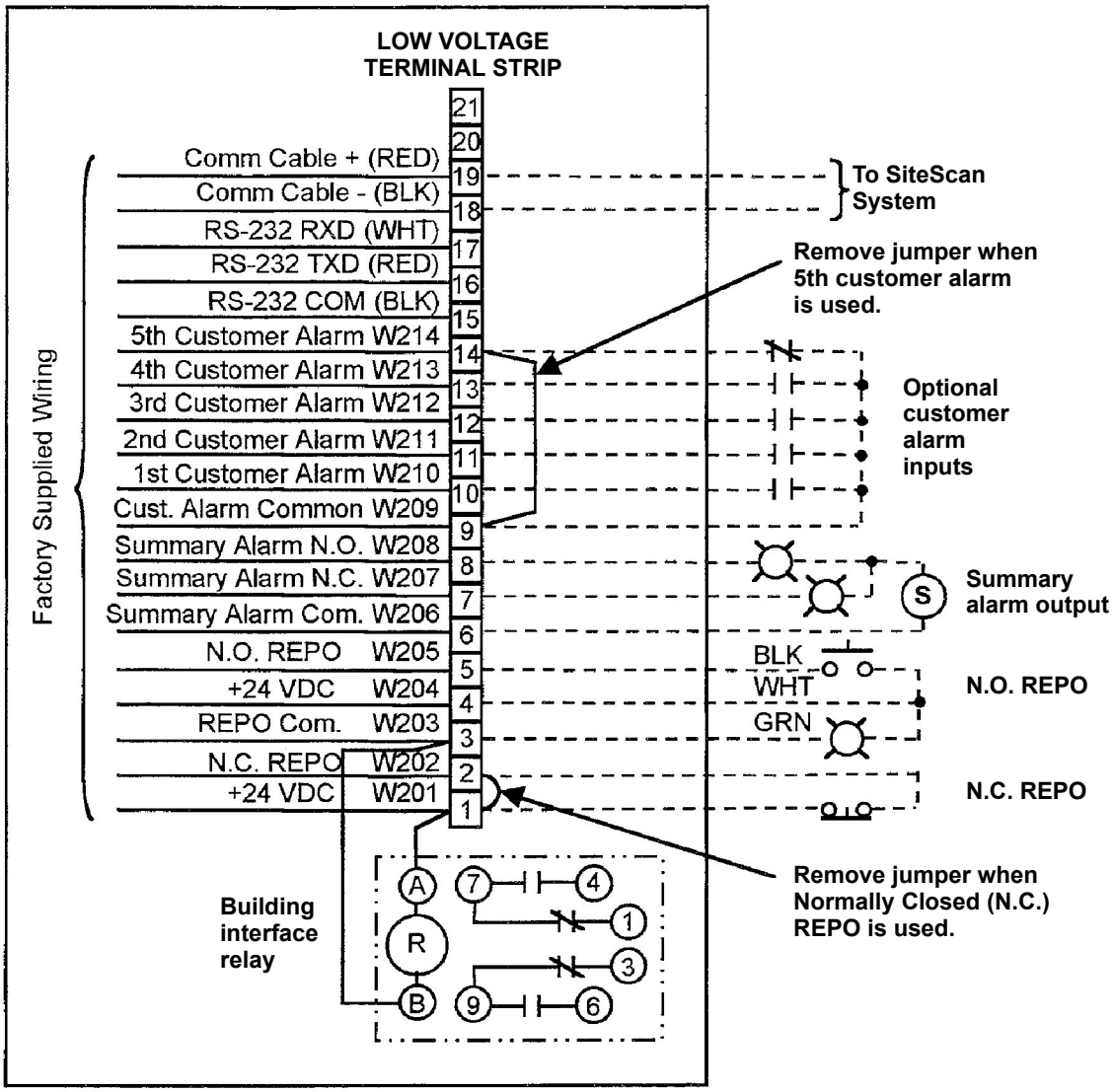
Figure 15 Typical control wiring for units without monitoring



NOTES

1. **Building Interface Relay can be used for remote shutdown or alarm. Relay is energized during normal operation. DPDT contacts rated 1/4 HP at 120 VAC, 10A at 28 VDC or 240 VAC.**
2. **Other N.O. REPO devices may be wired in parallel to the N.O. REPO contacts. Other N.C. REPO devices may be wired in series to the N.C. REPO contacts. Multiple REPO lamps and other 24 VDC loads may be wired in parallel to the REPO lamps. Max. 24 VDC supply available is 1 Amp total. Both N.O. and N.C. REPO switches are powered from the same supply.**
3. **All Auxiliary Control Devices and Cabling to be Field Supplied except as noted.**
4. **Overtemp Alarm contacts change state when unit overtemperature is sensed.**

Figure 16 Typical control wiring for units with power monitoring



NOTES

1. **Building Interface Relay can be used for remote shutdown or alarm. Relay is energized during normal operation. DPDT contacts rated 1/4 HP at 120 VAC, 10A at 28 VDC or 240 VAC.**
2. **Other N.O. REPO devices may be wired in parallel to the N.O. REPO contacts. Other N.C. REPO devices may be wired in series to the N.C. REPO contacts. Multiple REPO lamps and other 24 VDC loads may be wired in parallel to the REPO lamps. Max. 24 VDC supply available is 1 Amp total. Both N.O. and N.C. REPO switches are powered from the same supply.**
3. **All Auxiliary Control Devices and Cabling to be Field Supplied except as noted.**
4. **Overtemp Alarm contacts change state when unit overtemperature is sensed.**
5. **RS-232 Port connected to low voltage terminal strip inside unit. Connect using suitable 300V communication cable.**

2.0 EQUIPMENT INSPECTION AND START-UP

2.1 Internal Inspection

A detailed internal inspection should be performed after the unit is in place and before it is energized, to ensure trouble free start-up. The same internal inspection should be carried out when performing preventive maintenance.

WARNING
VERIFY THAT ALL INCOMING POWER AND CONTROL CIRCUITS ARE DE-ENERGIZED AND LOCKED OUT BEFORE PERFORMING THE INTERNAL INSPECTION.

Open the unit - Gain access to the internal components of the Precision Power Center unit by removing the exterior panels.

Visually inspect - Be sure wiring and components are not damaged.

Check power connections - Check **all** power connections for tightness. Refer to **Table 7** for torque requirements of all electrical connections.

Perform formal detailed inspection - Follow the procedures described in **3.0 - Inspection and Start-Up Checklist** when performing detailed inspection.

2.2 Start-Up

Checklists - Follow the detailed step-by-step checklist (**3.0 - Inspection and Start-Up Checklist**) when installing and starting up the Precision Power Center.

Initial system start-up - A qualified electrician should be employed to perform the equipment inspection and start-up. Liebert system start-up may be arranged by calling your local Liebert sales representative or Liebert Global Services. In the USA, call 1-800-LIEBERT.

Warranty effectivity - A copy of the appropriate checklist (furnished with the equipment) must be completed, signed, dated, and returned to Liebert Corporation. **Warranty coverage of the equipment is not effective unless the Checklist is received by the factory.**

WARNING
EQUIPMENT INSPECTION AND START-UP SHOULD BE PERFORMED ONLY BY TRAINED PERSONNEL. HAZARDOUS VOLTAGES ARE PRESENT DURING START-UP PROCEDURES.

ELECTRICAL SAFETY PRECAUTIONS MUST BE FOLLOWED THROUGHOUT INSPECTION AND START-UP.

Table 7 Torque specifications (unless otherwise labeled)

A. Nut and bolt combinations

Bolt shaft size	Grade 2 standard		Electrical connections with Belleville washers	
	lb-in	N-m	lb-in	N-m
1/4	53	6.0	46	5.2
5/16	107	12.1	60	6.8
3/8	192	21.7	95	10.7
1/2	528	60.0	256	28.9

B. Main input and main output circuit breakers

Breaker size	Wire size	Compression lug	
		lb-in	N-m
Up to 110 amp	#14 - #10	35	4.0
	#8 - #3	100	11.4
	#2 - #3/0	150	17.1
125 to 250 amp	#3 - #1 #1/0 - 350 kcmil	200	22.8
		275	31.3
300 to 600 amp	#2 - 600 kcmil	375	42.7

C. Panelboard main circuit breaker

	lb-in	N
Busbar-to-breaker	90	10.2
Compression lug	250	28.5

D. Branch circuit breakers

Breaker size	lb-in	N-m
Up to 30 amp	35	4.0
40 to 100 amp	45	5.1

E. Terminal block compression lug

AWG wire size or range	lb-in	N-m
#14 - #10	35	4.0
#8	40	4.5
#6 - #00	120	13.6
#6 - 350 kcmil	275	31.1
#4 - 500 kcmil	375	42.4

3.0 INSPECTION AND START-UP CHECKLIST

Unit Serial Number: _____

Unit Model Number: _____

Date: _____

3.1 Inspection

WARNING
ALL EQUIPMENT INSPECTION PROCEDURES ARE TO BE PERFORMED WITH POWER TO THE UNIT TURNED OFF AND LOCKED OUT.

Exterior Inspection

___ 1. Confirm that the exterior of unit is undamaged (including cables and receptacles, if furnished).

___ 2. Confirm that service and ventilation clearances are adequate. (See **Figures 1**, **2**, **3**, and **4**.)

Interior Inspection

___ 3. Remove accessible exterior panels.

NOTE
When removing exterior panels, DISCONNECT PANEL GROUND WIRES BY SEPARATING THE EASY-DISCONNECT TERMINALS LOCATED ON THE FRAME. When replacing exterior panels, reconnect all panel ground wires.

___ 4. Inspect all wire and conductor insulation for damage.

___ 5. Check all transformer terminal connections for tightness. Retorque if necessary.

___ 6. Check all breaker connections for tightness. Retorque if necessary.

___ 7. Check all terminal block connections for tightness. Retorque if necessary.

___ 8. Check transformer mounting bolts for tightness. Retorque if necessary.

___ 9. Remove any foreign objects from the components or the interior area of the unit. **Make sure air passages on transformers are clear and free of debris!**

___ 10. Check that the intake and exhaust air screens are clean and free of obstructions.

___ 11. Replace side panels, leaving access to circuit breakers for the following start-up procedure.

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

3.2 Start-Up

WARNING
START-UP PROCEDURES SHOULD BE PERFORMED ONLY BY QUALIFIED PERSONNEL. HAZARDOUS VOLTAGES ARE PRESENT IN THE EQUIPMENT THROUGHOUT THE MAJORITY OF THE START-UP PROCEDURE. USE PROPER SAFETY EQUIPMENT. PROCEED WITH CAUTION.

___ 12. Make certain that all circuit breakers are in the OFF position and that power to the unit is locked out.

NOTE
*Steps **13** through **17** apply to the Main Input Junction Box. If this installation is not provided with a Main Input Junction Box, proceed directly to Step **18**.*

___ 13. Remove the cover of the Main Input Junction Box. Verify proper input power connections to unit, including equipment grounding conductor.

___ 14. Turn ON the building power to the junction box. Check the phase rotation at the junction box. Phase rotation should be A, B, C, as indicated.

___ 15. Check and record the input voltages at the junction box:
Volts, phase A to phase B = _____
Volts, phase B to phase C = _____
Volts, phase C to phase A = _____

___ 16. Turn OFF and lock out the building power to the input junction box.

___ 17. Replace the junction box cover.

___ 18. Verify proper input power connections to unit, including equipment grounding conductor and local grounding electrode conductor.

___ 19. Turn ON the building input power to the unit.

___ 20. Check the phase rotation at the main input breaker. Phase rotation should be A, B, C, left-to-right.

___ 21. Check and record the input voltage at the main input breaker. Measured voltages should correspond to the unit's nameplate input voltage.
Volts, phase A to phase B = _____
Volts, phase B to phase C = _____
Volts, phase C to phase A = _____

___ 22. Turn ON the main input breaker; wait one minute. (If breaker trips OFF, check for wiring errors including control connections. Contact Liebert Global Services or the location factory representative for assistance.)

___ 23. Check the phase rotation at the line side terminals (top) of the panelboard main breaker(s) and any subfeed output circuit breaker(s). The rotation should be A, B, C, left-to-right.

___ 24. Check and record the voltages at the line-side terminals of the output circuit breaker. Measured voltages should correspond to the unit's nameplate output voltage (within +4%,-0%).

Volts, phase A to phase B = _____
Volts, phase B to phase C = _____
Volts, phase C to phase A = _____
Volts, phase A to neutral = _____
Volts, phase B to neutral = _____
Volts, phase C to neutral = _____

If output voltage is incorrect, check for wiring errors, incorrect input voltage, or improper transformer tap. Contact Liebert Global Services at 1-800-LIEBERT in the USA or the local factory representative for assistance.

NOTE

The Precision Power Center transformer has input voltage taps for each input phase. The taps are arranged in 2-1/2% or 5% intervals ranging from -10% to nominal to +5%. This permits the transformer to provide the proper output voltage for a range of input voltages. Should it be necessary, the tap arrangement may be changed to match the input voltage:

- *Open main input circuit breaker.*
- *Select tap arrangement to match input voltage. (Refer to transformer nameplate for tap information.)*
- *Secure each line to its proper tap.*
- *Repeat Steps **22** to **24**.*

___ 25. Depress the local EMERGENCY POWER OFF switch and verify system shutdown. Turn the unit back on.

___ 26. Repeat Step **25** for each remote EMERGENCY POWER OFF switch with which the system is equipped.

Note that the Remote Emergency Power Off switch may shut down more equipment or systems than just the Precision Power Center.

3.3 Monitoring System Check-Out

___ 27. **BASIC INDICATORS:**

- ___ a. Turn ON the building power to the unit, then turn the main input breaker ON.
- ___ b. Check that the local EMERGENCY POWER OFF button is illuminated and that the second indicator (TRANSFORMER OVERTEMP or ALARM PRESENT) is off.

___ 28. **MANUAL RESTART CHECK. If unit is equipped with Manual Restart:**

- ___ a. Turn on building power to the unit. Turn Main Input breaker ON.
- ___ b. Turn off all building power to unit.
- ___ c. Observe that Main Input breaker automatically trips open upon power loss.
- ___ d. Restore building power to the unit and return Main Input breaker to ON.

___ 29. **POWER MONITOR PANEL. If unit is equipped with a Power Monitor Panel:**

Turn the unit ON. Ensure that the voltage values indicated by the Monitor Panel correspond to the voltage values measured at the input and output circuit breaker (Steps **21** and **24**).

___ 30. **CENTRALIZED MONITOR. If the unit is connected to a Centralized Monitoring System:**

Turn the unit and Centralized Monitoring System ON. Verify proper communication to the monitor system operation.

___ 31. **CONTROL VOLTAGE:**

- ___ a. Obtain access to the low voltage terminals in the Low-Voltage Junction Box (if used), or in the low voltage control section inside unit.
- ___ b. With the unit ON, measure and record the DC control voltage on terminals 1 (+) and 3 (com).
- ___ c. **Control Voltage =** _____

  (Voltage should be between 20 and 28 VDC).

___ 32. **CUSTOMER ALARMS. If customer alarms are provided:**

- ___ a. With the unit ON, simulate alarm operation by jumpering the appropriate low voltage control terminals. (Refer to the control wiring installation drawing furnished with the unit.)
- ___ b. Verify correct alarm annunciation by the Power Monitor Panel and/or by the Centralized Monitoring System.

3.4 Equipment Connection Check-Out (For Units With Distribution Cables)

CAUTION

All loads should be disconnected or turned off before proceeding with the following steps.

For units with output distribution cables, be sure that there are NO output receptacles connected to load equipment plugs, and that the receptacles are not in contact with foreign objects.

Pay special attention to those output cables intended for direct wiring connection; the exposed conductor ends of these cables must not be in contact with each other or with any foreign objects.

___ 33. Turn on main input power to the unit, then turn on the panelboard main output breaker(s).

___ 34. Individually turn on each branch circuit breaker and check the output voltage (also phase rotation, if a 3-phase circuit) at the receptacle or cable end.

___ 35. Turn OFF all branch circuit breakers and the panelboard main output circuit breaker(s).

___ 36. Connect the load equipment per equipment manufacturer's specifications and recommendations.

___ 37. Turn on the panelboard main output breaker(s).

___ 38. Turn on branch circuit breakers to the load equipment.

Observe the power-up sequence recommended by the equipment manufacturer.

___ 39. Verify that all load equipment operates properly.

___ 40. Replace all unit panels.

After performing the inspection and start-up procedure described in **3.0 - Inspection and Start-Up Checklist** in this manual, complete the Start-Up and Inspection form furnished with the unit, sign the completed form and return it to:

Liebert Corporation
1050 Dearborn Drive
P.O. Box 29186
Columbus, Ohio 43229 USA

NOTE

Warranty is not in effect unless inspection and start-up form is received by the factory.

4.0 OPERATING INSTRUCTIONS

4.1 Start-Up Procedures

Before the unit is placed into service after initial installation, after equipment relocation, or after equipment has been de-energized for an extended period of time, perform equipment inspection and start-up procedures as detailed in the previous two sections, **2.0 - Equipment Inspection and Start-Up** and **3.0 - Inspection and Start-Up Checklist**.

After initial system start-up, the following guidelines can be used for standard equipment operation. These guidelines should be reviewed for any special equipment modifications, special site considerations, or company policies which may require changes to the standard equipment operation.

4.1.1 Emergency Shutdown

To perform an immediate system shutdown during emergency conditions, lift the protective clear cover and push the "Emergency Power Off" (EPO) switch located on the unit front door.

NOTE
Depending on the particular control circuit wiring, operation of the unit EPO switch may cause other equipment to also shutdown.

If the site is equipped with a Remote Emergency Power Off (REPO) switch (such as is required by NEC Article 645 at the principal exit doors), to perform an immediate room shutdown, activate one of the REPO switches.

4.1.2 Normal System Shutdown

To perform a normal system shutdown, perform an orderly load equipment (computer system) shutdown according to the load equipment manufacturer's recommended shutdown sequence. The load equipment can be turned OFF at each piece of load equipment or at the power center's output distribution (circuit breaker) panels located behind the unit's front door. Turn OFF all unit output breakers, then turn OFF the unit's main input circuit breaker. To remove all power from the unit, turn OFF the building power to the unit's input breaker or junction box.

4.1.3 Normal System Turn ON

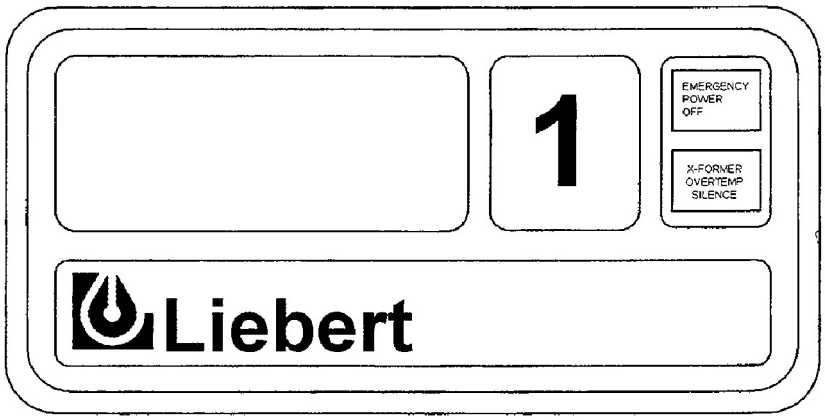
Make certain all unit circuit breakers are in the OFF position. All unit circuit breakers are located behind the front doors. Turn ON building power to the unit. Turn ON the unit's main input circuit breaker. If the circuit breaker has been tripped OFF (instead of being turned OFF), the circuit breaker handle must be moved to the OFF position before being turned ON. If the unit has a voltage monitoring panel, verify proper output voltages before turning ON output circuit breakers. Turn ON the panelboard main breakers. Individually turn ON each output circuit breaker following the load equipment manufacturer's start-up sequence.

4.1.4 Manual Restart

If unit's manual restart feature has been selected, the unit's main input circuit breaker will be tripped upon a power outage, preventing repetitive application of unstable voltage and allowing for an orderly system restart. If the main input circuit; breaker is tripped upon a power outage, after power is restored, follow the instructions outlined in **4.1.3 - Normal System Turn ON**.

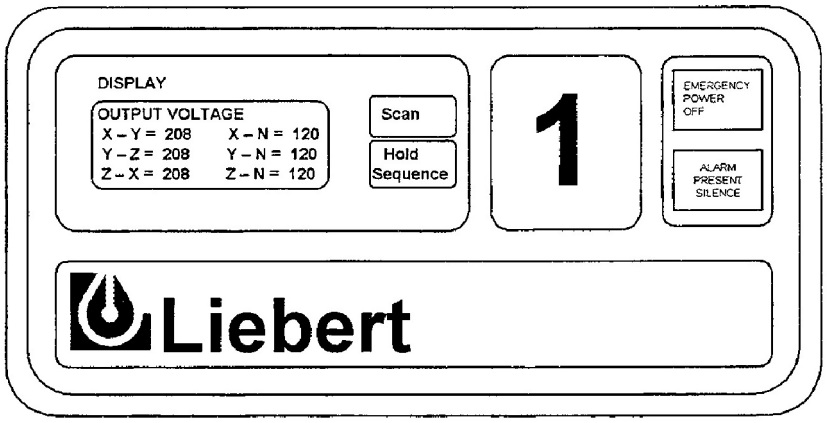
4.2 Basic Monitor Panel (Units Without Monitoring)

Xformer Over Temp/Silence - Upon occurrence of a transformer overtemperature condition, the "Xformer Over Temp/Silence" switch will become illuminated and the audible alarm will be activated. Pushing the "Xformer Over Temp/Silence" switch will silence the audible alarm. The cause of the overtemperature condition should be investigated and corrected. Possible causes include transformer overload, excessive non-linear loading, inadequate ventilation, high or low input voltage, or monitoring malfunction. Failure to correct the overtemperature condition may result in an automatic system shutdown due to the second stage of overtemperature sensing. After correction of the alarm condition, the alarm will automatically reset.



4.3 Power Monitor Panel

Monitored Parameters - A 4 x 20 character LCD display is provided to indicate the input voltages (line-to-line), output voltages (line-to-line and line-to-neutral), output currents (each phase, neutral and ground), output voltage THD, output current THD, crest factor, K-factor, output kVA, kW, kW-Hours, power factor, percent load, and output frequency. Pressing the "Scan" switch will activate the "Autoscan" mode where all monitored parameters are sequentially displayed automatically. Momentarily pressing the "Hold/Sequence" switch interrupts the "Autoscan" mode. Pressing the "Hold/Sequence" switch allows manual selection of the sequentially displayed parameters.



Alarms - Upon occurrence of any of the following alarms, the alarm message appears on the LCD display, the "Alarm Present/Silence" switch is illuminated, and the audible alarm is activated. Pressing the "Alarm Present/Silence" switch silences the audible alarm. After the alarm condition is corrected, the alarm can be reset by pressing the "Alarm Present/Silence" switch when prompted by the LCD display or by way of any Central Monitoring System.

- **Output Overvoltage** - Indicates one or more of the output phase voltages has exceeded the preset limit (normally +6% of nominal). The high output voltage should be verified and corrective action taken. In the absence of other procedures, a normal (orderly) system shutdown should be performed to prevent load equipment damage.
- **Output Undervoltage** - Indicates one or more of the output phase voltages has exceeded the preset limit (normally -13% of nominal). The low output voltage should be verified and corrective action taken. In the absence of other procedures, a normal (orderly) system shutdown should be performed to prevent load equipment damage.
- **Output Voltage THD** - Indicates that the voltage distortion on one or more of the output phases has exceeded the preset limit (normally 10% THD). The cause of the high output voltage distortion should be investigated and corrective action (if any) taken.
- **Transformer Overtemp** - Indicates a unit transformer overtemperature condition. The cause of the overtemperature condition should be investigated and corrected. Possible causes include unit overload, excessive non-linear loading, inadequate ventilation, high or low input voltage, or monitoring malfunction. Failure to correct the overtemperature condition may result in an automatic system shutdown due to the second stage of overtemperature sensing.
- **Output Overcurrent** - Indicates one or more of the output phase currents has exceeded the preset limit (normally 95% of the unit's full load amp rating). The overcurrent condition should be verified and corrective action taken. In the absence of other procedures, some of the output loads should be turned off to reduce unit loading. If unbalanced phase currents exist, some of the loads should be shifted from the higher loaded phase(s) to the lower loaded phase(s).
- **Neutral Overcurrent** - Indicates that the neutral current has exceeded the preset limit (normally 95% of the unit's full load amp rating). The overcurrent condition should be verified and investigated to see if corrective action is required. In some cases, high neutral current indicates phase current unbalance which should be corrected. Where high neutral currents are the result of harmonic load currents, all affected components (including output wiring) should be verified to be suitable for the current.
- **Frequency Deviation** - Indicates that the output frequency has exceeded preset limits (normally ±0.5 Hz). The frequency deviation should be verified and the cause investigated and corrected.
- **Phase Sequence Error** - Indicates that the output phase sequence is not A, B, C. The phase sequence should be verified and corrective action taken. 3-phase loads sensitive to phase sequence should not be operated without proper phase sequence.
- **Phase Loss** - Indicates that one or more of the phase voltages is low or missing. The low voltage condition should be verified and corrective action taken. In the absence of other procedures, a normal (orderly) shutdown should be performed to prevent equipment damage.
- **Ground Overcurrent** - Indicates the system ground current has exceeded the preset limit (normally 5 amps). The overcurrent condition should be verified and corrective action taken. Possible causes are wiring errors, ground faults, or excessive leakage current.
- **Customer Alarms (5)** - Indicates customer-designated alarms. The cause and corrective action depend on the nature of the alarm. See **1.3.6 - Control Wiring Connections** for contact closure connection information.

To Set Unit Clock - To set the clock from the unit front panel, simultaneously press the Scan and Hold membrane switches while the time and date screen is displayed on the LCD. A cursor should appear on the selected time and date field. Use the Scan switch to increment the highlighted field and the Hold switch to decrement the highlighted field. Use the Silence push button to select the next time and date field. The time can be displayed in AM/PM or 24-hour format. Simultaneously press the Scan and Hold switches to exit the clock set screen.

RS-232 ASCII Communications Port - Units with power monitoring are equipped with an isolated RS-232 ASCII Communications Port, which allows access to unit monitored parameters and alarm information. The RS-232 port connections are located on the low voltage control terminal strip inside the unit. See typical control wiring in **Figure 16**.

The ASCII interface default parameters are shown in **Table 8**.

Table 8 ASCII interface default parameters

Parameter	Default
Interface	RS-232 using EIA voltage levels
Baud rate	9600
Parity	None
Data bits	8
Stop bits	1
Terminator	<CR>
Hand shaking	Not supported
Structure	Half-duplex
Echo	OFF
Change to receive after transmit	1.28 msec
Minimum delay to transmit after receive	120 μsec
Maximum response time turn around	300 msec
Maximum response completion time	500 msec
Minimum delay between commands	500 msec
Maximum intercharacter delay	12.5 msec

The ASCII port uses a Query-Response Format.

Table 9 shows the list of available customer commands. Only one command is serviced at a time. Valid commands are terminated with a carriage return [0Dh]. Commands are accepted in upper or lower case. Responses are in upper case, terminated with a line feed [0Ah] and carriage return [0Dh].

Table 9 RS-232 ASCII port customer commands

Command	Description	Typical Response
Time?<CR> Date?<CR>	Unit Time Unit Date	03:40:37A<LF><CR> 05-15-97<LF><CR>
UID?<CR> kVA?<CR> V?<CR>	Unit ID Nominal kVA Nominal L-L Voltage	Unit_No._PDU_21B____<LF><CR> 0150<LF><CR> 0208<LF><CR>
SS1?<CR>	System Information (20-character fields with comma separators)	UNIT_MODEL_NUMBER___,SERIAL_NUMBER________, SITE_ID_NUMBER_____,TAG_NUMBER_____<LF><CR>
SA?<CR>	Number of Active Alarms (20-character alarms with time stamp)	02,OUTPUT_OVERVOLTAGE__,05-15-97,01:25:30A, OUTPUT_OVERCURRENT__,05-15-97,01:27:46A<LF><CR>
UPMD?<CR>	Monitored Parameters (32 comma-separated data fields—see **Table 10** for descriptions of field positions)	0484,0485,0483,0210,0212,0211,0121,0122,0121,0068, 0085,0120,0131,0018,0030,0092,0033,0600,0038,0041, 0043,0549,0632,0599,0000,1528,0018,0019,0020,0045, 0047,0049,0044<LF><CR>

Table 10 Monitored parameters data definitions

Field number	Data item	Units
1	Input Voltage A-B	Volts
2	Input Voltage B-C	Volts
3	Input Voltage C-A	Volts
4	Output Voltage X-Y	Volts
5	Output Voltage Y-Z	Volts
6	Output Voltage Z-A	Volts
7	Output Voltage X-N	Volts
8	Output Voltage Y-N	Volts
9	Output Voltage Z-N	Volts
10	Output Current X	Amps
11	Output Current Y	Amps
12	Output Current Z	Amps
13	Neutral Current	Amps
14	Ground Current	0.1 Amps
15	Output Power	kW
16	Power Factor	0.01 Power Factor
17	Output Power	kVA
18	Output Frequency	0.1 Hz
19	Output Vx THD	0.1%
20	Output Vy THD	0.1%
21	Output Vz THD	0.1%
22	Output Ix THD	0.1%
23	Output Iy THD	0.1%
24	Output Iz THD	0.1%
25	Output kW-Hrs	kW-Hrs
26	Output Ix Crest Factor	0.1
27	Output Iy Crest Factor	0.1
28	Output Iz Crest Factor	0.1
29	Output Ix K-Factor	0.1
30	Output Iy K-Factor	0.1
31	Output Iz K-Factor	0.1
32	Output Loading	% of Full Load

5.0 MAINTENANCE

5.1 Corrective Maintenance (Repair)

Even the most reliable equipment may fail. Liebert Global Services is at your service to assure fast repair of your unit and minimum downtime of your installation.

WARNING
ONLY QUALIFIED SERVICE PERSONNEL SHOULD PERFORM MAINTENANCE ON THE PRECISION POWER CENTER SYSTEM.

Standard electrical troubleshooting procedures should be used to isolate problems in the unit. If there are questions, don't hesitate to contact Liebert Global Services.

Repair or replacement of standard items, such as circuit breakers, fuses, transformers, capacitors, and indicator lights can be either handled by qualified electricians or referred to Liebert Global Services.

Repairs related to the monitoring system should be referred to Liebert Global Services.

To contact Liebert Global Services for information or repair service in the USA, call 1-800-LIEBERT.

5.2 Preventive Maintenance (Inspection & Cleaning)

Air circulation through the cabinet may cause dust to accumulate on internal components. Cleaning should be done as necessary during electrical inspections.

Annual general system inspections, cleaning, and operation checks are recommended to ensure system performance and long service life.

WARNING
ONLY QUALIFIED SERVICE PERSONNEL SHOULD PERFORM MAINTENANCE ON THE PRECISION POWER CENTER SYSTEM. ALL VOLTAGE SOURCES TO THE UNIT MUST BE DISCONNECTED BEFORE INSPECTING OR CLEANING WITHIN THE CABINET.

Inspection Schedule

- It is difficult to establish a schedule for periodic cleanings since conditions vary from site to site. Inspections after the first 24 hours, 30 days and 6 months of operation should help determine a pattern for the inspection schedule.
- Electrical connections and component mountings should be inspected after the first 24 hours, 30 days, and 6 months of operation. Inspections should be conducted annually thereafter.
- Ventilation openings and grilles should be inspected and cleaned every six months to one year.
- A complete inspection and operational checkout should be performed annually. This is best done by performing the inspection and start-up procedure as detailed in **3.0 - Inspection and Start-Up Checklist**.
- Liebert Global Services offers a complete range of preventive maintenance services. These include thorough equipment performance checks, and calibration of electronics. Contact Liebert Global Services in the USA (1-800-LIEBERT) for details.

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INSTALLATION, OPERATION, & MAINTENANCE MANUAL

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SL-20140 (6/02)

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