AC Power
For *Business-Critical Continuity™*

# *Liebert® APM™*

*User Manual—15-90kVA, 120 and 208V, 50/60Hz*

EMERSON
Network Power

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# SAVE THESE INSTRUCTIONS

This manual contains important instructions that should be followed during installation of the Liebert APM, Liebert Bypass Distribution Cabinet and batteries (where applicable).

Read this manual thoroughly, paying special attention to the sections that apply to your installation, before working with the UPS. **Retain this manual for use by installing personnel.**

A properly trained and qualified electrical contractor should oversee the installation of the equipment.

The Liebert APM cannot be put into operation until it is commissioned by the manufacturer or authorized engineer. Otherwise, human safety may be endangered and damage to the UPS will not be covered by the warranty.

The Liebert APM is designed for commercial and industrial uses and cannot be used as life support equipment.

## WARNING

Exercise extreme care when handling UPS cabinets to avoid equipment damage or injury to personnel. The Liebert APM's weight ranges from 1100 to 2750 lb. (500 to 1250kg).

Determine unit weight and locate center of gravity symbols before handling the UPS. Test lift and balance the cabinet before transporting it. Never tilt equipment more than 15 degrees from vertical.

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

Follow all battery safety precautions when installing, charging or servicing batteries. In addition to the hazard of electric shock, gas produced by batteries can be explosive and sulfuric acid can cause severe burns. When connected, the nominal battery voltage is 288VDC and is potentially lethal.

In case of fire involving electrical equipment, use only carbon dioxide fire extinguishers or those approved for use in fighting electrical fires.

Extreme caution is required when performing maintenance.

Be constantly aware that the UPS system contains high DC as well as AC voltages.

Check for voltage with both AC and DC voltmeters prior to making contact.

## WARNING

As with other types of high power equipment, dangerous voltages are present within the UPS and battery enclosure even after input power has been disconnected. The risk of contact with these voltages is minimized as the live component parts are housed behind a metal panel. Further internal safety screens make the equipment protected to IP20 standards. Never remove panels or covers or open doors that will expose internal components to contact.

Read and follow all warnings, cautions and safety and operating instructions to avoid serious injury or death from electric shock. No risk exists to any personnel when operating the equipment in the normal manner, following the recommended operating procedures.

All equipment maintenance and servicing procedures involve internal access and should be carried out only by trained personnel.

## WARNING

High ground leakage current: Ground connection is essential before connecting the input supply.

This equipment must be grounded in accordance with local electrical codes.

Maximum load must not exceed that shown on the UPS rating label.

# WARNING

The Liebert APM has a control signal available for use with an automatic device, externally located, to protect against backfeeding voltage through the mains static bypass circuit. If this protection is not used with the switchgear that is used to isolate the bypass circuit, a label must be added to the switchgear to advise service personnel that the circuit is connected to a UPS system.

The text must convey the following meaning or is equivalent to: *Isolate the UPS before working on the circuit of this UPS*.

### Ground Leakage Currents

# CAUTION

High Leakage Current

EARTH CONNECTION IS ESSENTIAL BEFORE CONNECTING THE INPUT SUPPLY.

Earth leakage current exceeds 3.5 mA and is less than 1000 mA.

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

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

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

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

# WARNING

Under typical operation and with all UPS doors closed, only normal safety precautions are necessary. The area around the UPS system should be kept free of puddles of water, excess moisture and debris.

Special safety precautions are required for procedures involving handling, installation and maintenance of the UPS system and the internal batteries (internal batteries accommodated by 45kVA frame only). Observe all safety precautions in this manual before handling or installing the UPS system as well as during all maintenance procedures. Observe all battery safety precautions before working on or near the battery.

**This equipment contains several circuits that are energized with high voltage.** Only test equipment designed for troubleshooting should be used. This is particularly true for oscilloscopes. Always check with AC and DC voltmeters to ensure safety before making contact or using tools. Even when the power is turned Off, dangerously high electric charges may exist within the UPS.

**All power and control wiring should be installed by a qualified electrician.** All power and control wiring must comply with the NEC and applicable local codes.

**ONLY qualified service personnel should perform maintenance on the UPS system.** When performing maintenance with any part of the equipment under power, service personnel and test equipment should be standing on rubber mats. The service personnel should wear insulating shoes for isolation from direct contact with the floor (earth ground).

Never work alone, even if all power is removed from the equipment. A second person should be standing by to assist and summon help in case an accident should occur.

# CAUTION

This unit complies with the limits for a Class A digital device, pursuant to Part 15 Subpart J of the FCC rules. These limits provide reasonable protection against harmful interference in a commercial environment. This unit generates, uses and radiates radio frequency energy and, if not installed and used in accordance with this instruction manual, may cause harmful interference to radio communications. This unit is not designed for use in a residential area. Operation of this unit in a residential area may cause harmful interference that the user must correct at his own expense.

### Battery Cabinet Precautions

The following warning applies to all battery cabinets supplied with UPS systems. Additional warnings and cautions applicable to battery cabinets may be found in **3.0 - Battery Installation**.

## WARNING

Internal battery strapping must be verified by manufacturer prior to moving a battery cabinet (after initial installation).

- Battery cabinets contain non-spillable batteries.
- Keep units upright.
- Do not stack.
- Do not tilt.

Failure to heed this warning could result in smoke, fire or electric hazard.

Call 1-800-LIEBERT before moving battery cabinets (after initial installation).

### Battery Hazards

## WARNING

Special care should be taken when working with the batteries associated with this equipment. Batteries are always live. Battery terminal voltage will exceed 300VDC and is potentially lethal.

In addition to the hazard of electric shock, gas produced by batteries can be explosive and sulfuric acid can eause severe burns.

Batteries should be installed, serviced and replaced only by properly trained and qualified service personnel trained in safe battery handling methods and who have the correct PPE (Personal Protection Equipment) and tools.

The following precautions should be observed when working with the batteries:

- Eye protection should be worn to prevent injury from electrical arcs.
- Remove rings, watches and all other metal objects.
- Use only tools with insulated handles.
- Wear rubber gloves and boots.
- When replacing batteries, replace them with the same type and number of batteries or battery packs.
- Do not dispose of batteries in a fire. The batteries may explode.
- Do not open or mutilate batteries. Released electrolyte is harmful to the skin and eyes. It is toxic.
- Never lay metal objects of any type on top of the batteries.
- Disconnect the charging source before connecting or disconnecting battery terminals.
- Determine whether the battery is grounded. If the battery is grounded, remove source of the ground. Contact with any part of a grounded battery can result in electrical shock. The likelihood of such shock can be reduced if such grounds are removed during installation and maintenance

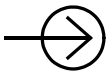
If a battery leaks electrolyte, or is otherwise physically damaged, it must be replaced, stored in a container resistant to sulfuric acid and disposed of in accordance with local regulations.

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

## GLOSSARY OF SYMBOLS

**Risk of electrical shock**

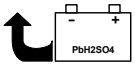
**Indicates caution followed by important instructions**



**AC input**

**AC output**

**Requests the user to consult the manual**




**Indicates the unit contains a valve-regulated lead acid battery**


**Recycle**

**DC voltage**

**AC voltage**

**Equipment grounding conductor**

**Bonded to ground**

# 1.0 INSTALLATION

The Liebert APM is a transformerless, hardware-scalable, online UPS with 208/120V input and 208/120V output capability. The Liebert APM can operate with either a 50 or 60Hz input and provide a matching output. The rack-mounted 15kVA/kW modules allow the UPS to scale it capacity by 15kVA increments from 15kVA to a maximum of 90kVA in a single cabinet.

The Liebert APM provides continuous, high-quality AC power to business-critical equipment, such as telecommunications and data processing equipment. The Liebert APM supplies power free of the disturbances and variations in voltage and frequency common to utility power, which is subject to brownouts, blackouts, surges and sags.

The Liebert APM utilizes the latest in high-frequency, double-conversion pulse width modulation (PWM) technology and fully digital controls to enhance its reliability and increase the ease of use.

Two frame sizes are available: 45kVA/kW and 90kVA/kW. The 45kVA/kW frame is designed to accept internal batteries; the 90kVA/kW frame does not.

This section describes the Liebert APM's environmental requirements and mechanical considerations that must be taken into account when planning the positioning and cabling of the UPS equipment.

Because each site is unique, this section presents a guide to general procedures and practices that should be observed by the installing engineer, rather than step-by-step installation instructions.

**WARNING**

Do not apply electrical power to the UPS equipment before the commissioning engineer arrives at the installation site.

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

**WARNING**

Special care should be taken when working with the batteries associated with this equipment. When connected together, the nominal battery voltage is 288VDC and is potentially lethal.

- Eye protection should be worn to prevent injury from accidental electrical arcs.
- Remove rings, watches and all metal objects.
- Only use tools with insulated handles.
- Wear rubber gloves.

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

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

**NOTE**

*Three-phase, four-wire input power is required.*

**NOTE**

*Input power must be supplied to the Liebert APM from a properly grounded Wye or Delta source. The Liebert APM is not for use with impedance grounded systems, corner-grounded systems or high-leg Delta systems. For these applications, an isolation transformer must be installed between the input power and the Liebert APM.*

## 1.1 Initial Inspections

1. While the Liebert APM and ancillary cabinets are still on the truck, inspect the equipment and shipping container for any signs of damage or mishandling. Do not attempt to install the system if damage is apparent. If any damage is noted, file a damage claim with the shipping agency immediately and contact Emerson Network Power Liebert Services at 1-800-LIEBERT to inform them of the damage claim and the condition of the equipment.
2. Compare the contents of the shipment with the bill of lading. Report any missing items to the carrier and your local Emerson representative immediately.
3. Check the product label on the back of front door and confirm the contents match the UPS model, capacity and main parameters that were ordered.

### 1.1.1 Storing for Delayed Installation

If the equipment will not be installed immediately, it must be stored indoors where the humidity is no higher than 90% and the temperature is no higher than 104°F (40°C). The storage area must protect the Liebert APM from excessive moisture (see **10.2 - UPS Environmental**).

**CAUTION**

If the UPS must remain disconnected from power for more than six (6) months, the batteries (if so equipped) must be recharged before use. To charge the batteries, the unit must be connected to utility power and started up—the charger operates only while the Liebert APM is operating.

**CAUTION**

When batteries are installed in the UPS or are cabinet-mounted adjacent to the UPS, the battery—not the UPS—dictates the designed maximum ambient temperature.

## 1.2 Preliminary Checks

### 1.2.1 Identification

The equipment supplied has an identification tag on the back of the main door listing the type and size of the UPS.

## 1.3 UPS Location

### 1.3.1 Positioning the UPS

Choose a location for the UPS that offers:

- Easy connection to inputs, outputs and auxiliary equipment
- Enough space to service the UPS
- Air circulation sufficient to expel heat produced by UPS
- Protection against moisture and excessive humidity
- Protection against dust and other particulate matter
- Compliance with fire prevention regulations and practices
- Operating environment temperature of 74-80°F (23-27°C) for maximum battery efficiency

### 1.3.2 Environmental Considerations

Before installing the Liebert APM, verify that the UPS room satisfies the environmental conditions stipulated in **10.2 - UPS Environmental**, paying particular attention to the ambient temperature and air exchange system.

The UPS unit should be installed in a cool, dry, clean-air environment with adequate ventilation to keep the ambient temperature within the specified operating range 32°F to 104°F (0°C to 40°C).

For optimal UPS and battery system performance and service life, maintain the operating temperature within the range of 74-80°F, (23-27°C).

The Liebert APM is cooled by internal fans. Cooling air enters the unit through the front of the unit and is exhausted out the back. To permit proper air flow and prevent overheating, do NOT block or cover the ventilation openings or blow air down onto the unit. The UPS requires 24 in. (610mm) ventilation clearance above the unit and 12" (305mm) behind the UPS.

See **Table 38** for details on heat dissipation.

#### Battery Location

Temperature is a major factor in determining battery life and capacity. Battery manufacturers recommend an operating temperature of 77°F (25°C). Ambient temperatures warmer than this reduce battery life; temperatures below this reduces battery capacity. In a typical installation, battery temperature should be maintained between 74°F and 80°F (23-27°C). Batteries should be placed where there are no main heat sources or air inlets to prevent portions of batteries from being either much warmer or much cooler than other parts of the batteries.

## 1.4 Considerations in Moving the Liebert APM

Ensure that the UPS weight is within the designated surface weight loading (lb./ft$^2$ or kg/cm$^2$) of any handling equipment. See **Table 28** for weights of various units.

The Liebert APM may be rolled on its casters for short distances only. For longer distances, move the UPS with a forklift or similar equipment to ease the relocation and to reduce vibration.

The optional battery cabinets should be moved with a forklift or similar equipment.

**WARNING**

Ensure that any equipment that will be used to move the Liebert APM has sufficient lifting capacity. The Liebert APM's weight ranges from 1100 to 2750lb. (500 to 1250kg). See **Table 28** for details.

The UPS presents a tipping hazard. Do not tilt the Liebert APM more than 15 degrees from vertical.

The UPS is fitted with casters—Take care to prevent movement when unbolting the equipment from its shipping pallet. Ensure adequate personnel and lifting equipment are available when taking the Liebert APM off its shipping pallet.

**WARNING**

The casters are strong enough for movement across even surfaces only. Casters may fail if they are subjected to shock loading, such as being dropped or rolled over holes in the floor or obstructions. Such failure may cause the unit to tip over, injuring personnel and damaging the equipment.

Care must be taken when maneuvering units fitted with batteries. Keep such moves to a minimum. For further information, see **Battery Cabinet Precautions on page 3**.

#### Final Positioning

When the equipment has been finally positioned, ensure that the adjustable stops are set so that the UPS will remain stationary and stable (see **5.0 - Installation Drawings**).

The Liebert APM and its auxiliary cabinets must be installed on a concrete or equivalent, non-resilient floor.

## 1.5 Mechanical Considerations

The Liebert APM is constructed with a steel frame and removable panels. Top and side panels are secured to the chassis by screws. The doors may be opened for access to power connections bars, auxiliary terminals blocks and power switches.

The UPS comes with an operator control panel that provides basic operational status and alarm information. The cabinet houses both the power components and the internal batteries. Cooling is provided by internal fans. The unit sits on four casters. Adjustable stops are provided to prevent the UPS from moving once it has been moved to its final position.

**WARNING**

The Liebert BDC and battery cabinets must be properly prepared and secured for lifting. Improper lifting may cause the cabinets to fall, causing personal injury or death and equipment damage.

Emerson recommends lifting the units with one of the following methods:

- Installing four eyebolts in the factory-fabricated holes, one at each corner of the unit, attaching cables or similar strapping to the eyebolts and lifting with a suitable mechanism.
- Placing suitable straps on the Liebert BDC or battery cabinet. The straps must go under the unit to be lifted.

### 1.5.1 Clearances

There are no ventilation grilles on the sides of the UPS. The sides must be accessible during installation. After installation, the unit must have a clearance of 12 in. (305mm) in the rear to permit adequate circulation of air exhausted from the UPS.

To enable routine tightening of power terminations within the UPS, make sure there is sufficient clearance in front of the Liebert APM to permit free passage of personnel with the door fully opened.

Leave a minimum of 24 in. (610mm) between the top of the UPS and the ceiling to permit adequate air circulation above the unit. Emerson recommends against using air conditioning or other systems that blow air onto the top of the unit.

### 1.5.2 Floor Installation

If the Liebert APM, Liebert BDC or battery cabinet is to be placed on a raised floor, the UPS should be mounted on a pedestal that will support the equipment point loading. Refer to the bottom view in **Figures 27**, **31** or **32** to design this pedestal.

### 1.5.3 Cable Entry

Cables can enter the Liebert APM, Liebert BDC and battery cabinets from the top or bottom through removable metal plates.

Some plates have factory-punched holes and others are designed to allow the personnel to punch holes for fitting and securing the conduit. Once the conduit holes are punched, these plates should be reattached to the UPS. The conduit size and wiring method must be in accordance with all local, regional and national codes and regulations, including NEC ANSI/NFPA 70.

The UPS must be accessible from the right side to allow personnel to complete the cable connections and make necessary adjustments. After installation is complete, the Liebert APM may be serviced from the front.

**NOTE**

*When installing the UPS, the customer must provide a disconnect with overcurrent protection at the output of the UPS.*

## 1.6 45kVA and 90kVA UPS Frames—Auxiliary Cabinets

The 45kVA frame consists of a single cabinet housing the UPS components and the internal battery string. The 90kVA frame, also a single cabinet, does not accommodate internal batteries.

Optional battery cabinets are available for each Liebert APM model to provide extended run time. Each battery cabinet houses additional strings of batteries that operate in parallel with the Liebert APM's internal batteries (45kVA frame only). The battery cabinets are designed to be bolted to the left side of the UPS (see **Figure 1**). Refer to **3.4 - External Battery Cabinet Installation** for details.

Optional Liebert BDCs are available. These cabinets house the components necessary to provide an external wraparound maintenance bypass switch for servicing the UPS

Liebert BDCs are designed to be bolted to the right side of the UPS (see **Figure 1**). Refer to **4.3 - Locating the Cabinet** for further details.

### System Composition

A UPS system can comprise a number of equipment cabinets, depending on the system design requirements—e.g., UPS cabinet, External Battery Cabinet and External Bypass Cabinet. In general, all cabinets used will be the same height and are designed to be positioned side-by-side to form an aesthetically appealing equipment suite.

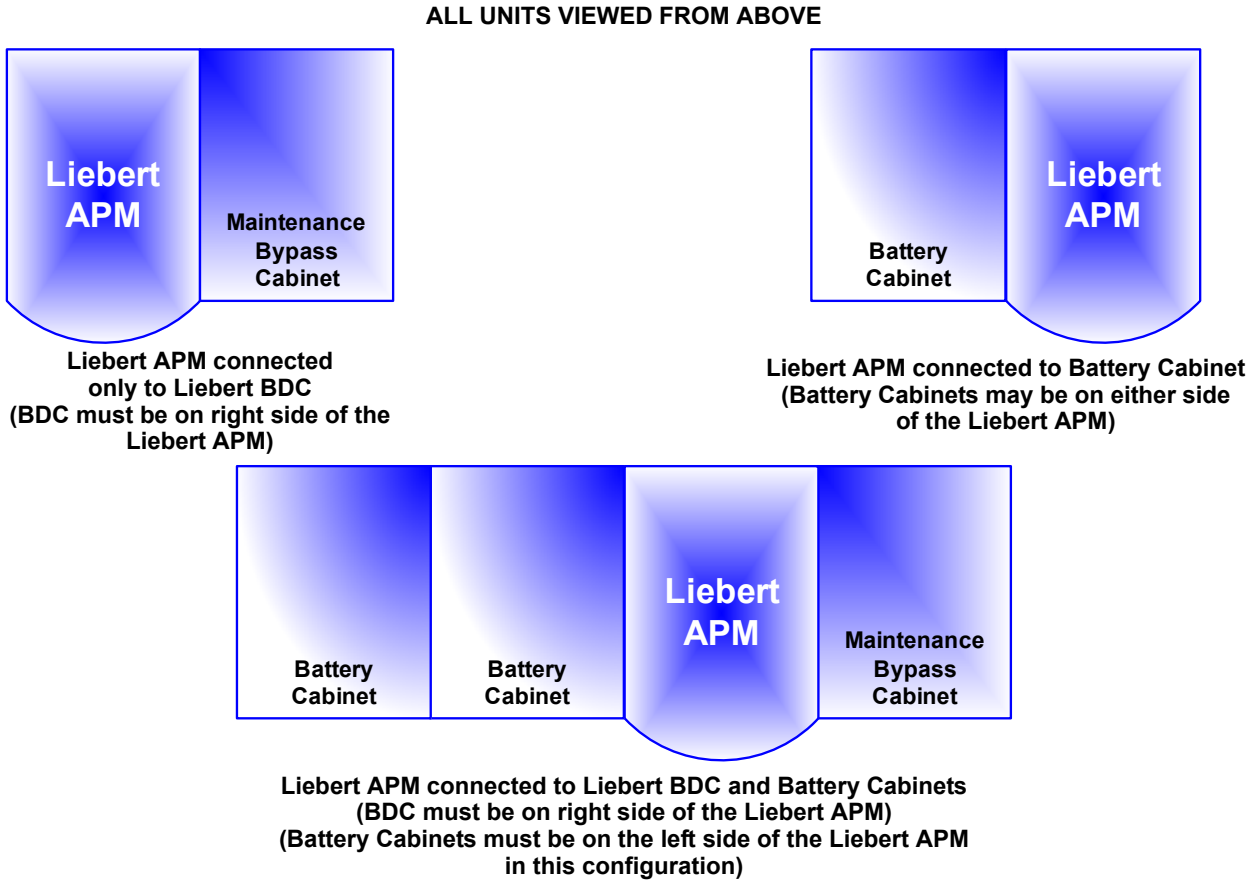
### 1.6.1 Optional Cabinets

If the Liebert APM installation includes a Liebert BDC, the UPS must be positioned to allow the Liebert BDC to be bolted to right side of the Liebert APM (see **Figure 1**).

The Liebert BDC must be cabled and bolted to the Liebert APM **before** the UPS and bypass cabinet are moved into their final position. Connect the input wiring to the Liebert BDC ONLY after the units are connected and positioned.

Battery cabinets may be bolted only to the left side of the Liebert APM; see **Figure 1**.

**Figure 1 Cabinet arrangement**

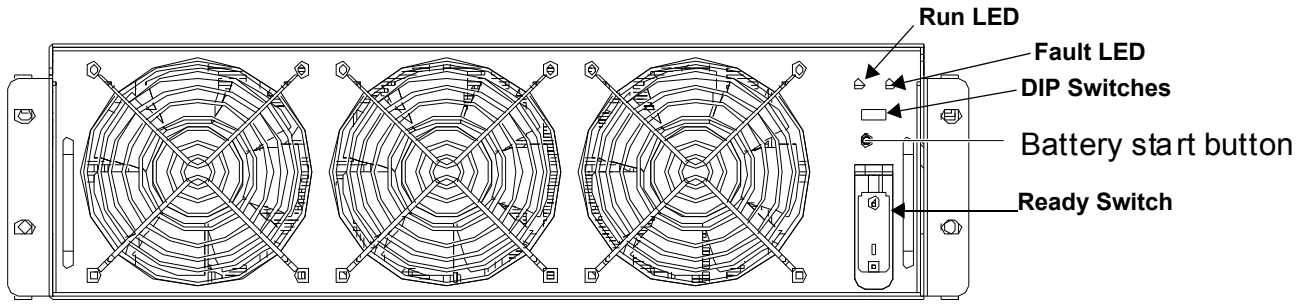


## 1.7 Optional Seismic Brackets

Optional seismic mounting brackets to anchor the Liebert APM, Liebert BDC and battery cabinet to the floor are available. Refer to **Figure 35** for mounting details.

## 1.8 Liebert FlexPower™ Assembly

**Figure 2 Liebert FlexPower assembly indicators and controls**




The Battery start button allows starting of UPS on battery; refer to **9.3 - UPS Battery Start**.

The Run LED is illuminated Green when the Liebert FlexPower assembly is operating normally.

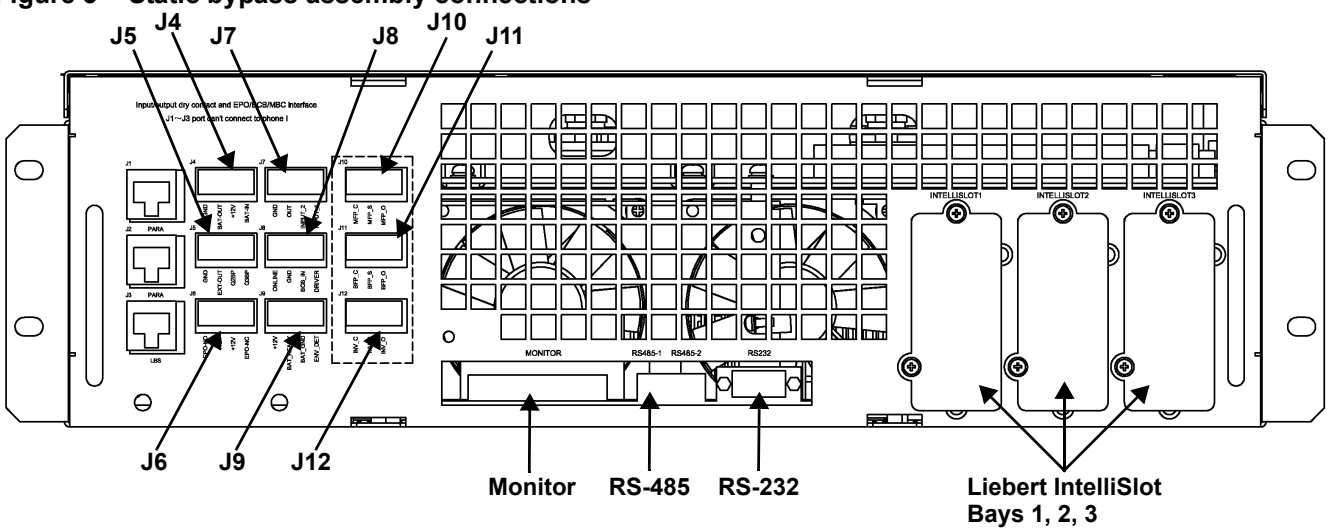
The Fault LED will illuminate red when the Liebert FlexPower assembly has a problem.

**Table 1 LED indications**

| LED Status | Indication |
|---|---|
| **Green LED** | |
| Flashing | The inverter is starting, but has no output yet |
| Constant Green | The inverter has started to supply power. |
| OFF | The inverter has not started up. |
| **Red LED** | |
| Constant Red | Auxiliary power failure (15V or 24V), rectifier overtemperature, rectifier failure (including battery SCR short circuit), battery converter failure, soft start failure, main circuit back feed, abnormal input current, inverter failure, output short circuit, bypass SCR short circuit fault, inverter relay short circuit fault, abnormal bus voltage under non-sleep mode, module not ready, module ID out of range and duplicated module ID. |
| Flashing | Charger failure, abnormal main circuit voltage, abnormal main circuit frequency, main circuit undervoltage, main circuit reverse phase, battery unavailable, reverse battery, input zero-loss, current sharing failure, module overload, inverter relay disconnection fault, bypass SCR disconnection fault and input fuse blown. |
| OFF | No above failures or alarms. |

## 1.9 Static Bypass Assembly

**Figure 3 Static bypass assembly connections**




The Static bypass assembly has three Liebert IntelliSlot interface card bays and connections for ancillary cabinets (Liebert BDC and battery) and for options.

# 2.0 ELECTRICAL CONNECTIONS—UPS

The UPS requires both power and control cabling once it has been mechanically installed. All control cables must run separate from power cables in metal conduits or metal ducts that are electrically bonded to the metalwork of the cabinets to which they are connected.

**WARNING**

Before connecting input power to the Liebert APM, ensure that you are aware of the location and operation of the overcurrent protection devices that connect the UPS input/bypass supply to the power distribution panel.

De-energize and lockout or tagout all incoming high- and low-voltage power circuits before installing cables or making any electrical connections.

## 2.1 Power Cabling

### 2.1.1 Cable Rating

The main factors affecting the choice and size of cable are voltage, current (also taking into account overcurrent), room temperature and conditions of installation of the cable. Refer to ANSI/NFPA 70.

The power cables of the system must be sized with respect to the following description:

- **UPS input cables** - The UPS input cables must be sized for the maximum input current, including the maximum battery recharge current, given in **Table 33**, with respect to the unit rating and the input AC voltage.
- **UPS bypass and output cables** - The bypass and output cables must be sized for the nominal output current, given in **Table 33**, with respect to the unit rating and the output AC voltage.
- **Battery cables** - Each UPS unit has its own internal batteries factory-wired. If connecting an external battery cabinet, the battery cables must be sized for the battery discharge current at the end-of-discharge voltage, as given in **Table 33**, with respect to the unit rating.

**NOTE**

***Table 33*** *gives nominal currents for determining the size of UPS power cables. Other important factors to consider include cable route length and coordination with protective devices.*

The power cables can be sized to suit the UPS unit rating according to **Table 33**.

#### Lug Size and Torque Requirements

Refer to **Table 33** for lug size and torque requirements and to **Table 13** and **Figure 34**.

## 2.2 External Protective Devices

For safety concerns, it is necessary to install external circuit breakers or other protective devices for the input AC supply of the UPS system. This section provides generic practical information for qualified installation engineers. The installation engineers should be knowledgeable about regulatory wiring standards and the equipment to be installed.

To reduce the risk of fire, connect only to a circuit provided with branch circuit overcurrent protection in accordance with NEC ANSI/NFPA 70.

### 2.2.1 Rectifier and Bypass Input Supply of the UPS

#### Overcurrents

Install suitable protective devices in the distribution unit of the incoming mains supply, considering the power cable current-carrying capacity and overload capacity of the system. Generally, the magnetic circuit breaker with IEC60947-2 tripping curve C (normal) at the 125% of the nominal current listed in **Tables 33**, **34** and **35** is recommended.

Split bypass: In case a split bypass is used, separate protective devices should be installed for the rectifier input and bypass input in the incoming mains distribution panel.

**NOTE**

*The rectifier input and bypass input must use the same neutral line.*

*For an IT power network system, a 4-pole protective device must be installed on the external input distribution and external output distribution of the UPS.*

#### Earth Leakage, RCD Devices

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

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

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

The residual earth current introduced by the RFI suppression filter inside the UPS is greater than 3.5mA and less than 300mA. Liebert recommends verifying the selectivity with all other differential devices both upstream of the input distribution board and downstream (toward the load).

### 2.2.2 External Battery

The DC-compatible circuit breaker provides overcurrent protection for UPS system and battery, which is provided by the external battery cabinet.

### 2.2.3 UPS Output

If an external distribution panel is used for load distribution, the selection of protective devices must provide discrimination with those that are used at the input to the UPS (see **Table 39**).

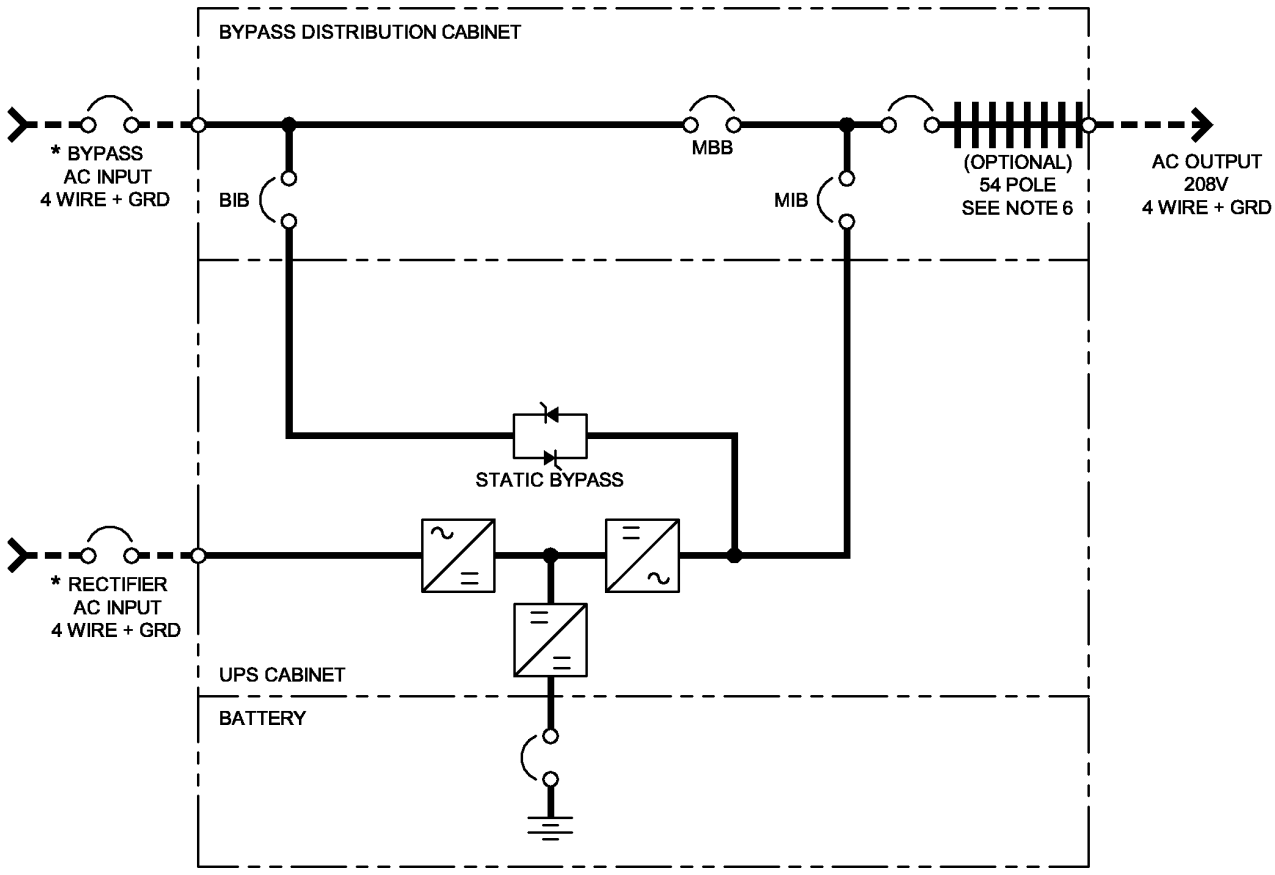
### 2.2.4 UPS Input Configuration

By default, the Liebert APM ships with internal links installed between the bypass input and main (rectifier) input (single input configuration see **Figure 40**).

**Figure 4** shows the Liebert APM in a split bypass (single source dual-input) configuration. In this configuration the static bypass and the maintenance bypass lines are supplied by the same source using separate feeds. Both feeds must be protected externally with properly sized protective devices.

To wire the Liebert APM as a single source dual-input UPS, remove the links and wire the bypass feed to the bypass busbars, then wire the main feed to the main busbars (see **Figure 6**).

**Figure 4 Single UPS block diagram—dual input configuration**




NOTES:
1. INSTALL IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.
2. INPUT AND BYPASS MUST SHARE THE SAME SINGLE SOURCE.
3. A NEUTRAL IS REQUIRED FROM THE SYSTEM AC INPUT SOURCE. A FULL CAPACITY NEUTRAL CONDUCTOR IS RECOMMENDED. GROUNDING CONDUCTORS ARE RECOMMENDED.
4. BYPASS AND RECTIFIER INPUTS AND OUTPUT CABLES MUST BE RUN IN SEPARATE CONDUITS.
5. CONTROL WIRING MUST BE RUN IN SEPARATE CONDUITS.
6. OPTIONAL 54 POLE, 225A FOR 45kVA FRAME ONLY OR OPTIONAL 54 POLE 400A FOR 90KVA FRAME ONLY.

BIB - BYPASS ISOLATION BREAKER
MBB - MAINTENANCE BYPASS BREAKER
MIB - MAINTENANCE ISOLATION BREAKER
* EXTERNAL OVERCURRENT PROTECTION BY OTHERS
FIELD-SUPPLIED WIRING

UAM01023
REV. 1

### 2.2.5 Cabling Guidelines

The following are guidelines only and are superseded by local regulations and codes of practice where applicable. Use wiring rated at 75°C or greater.

1. Take special care when determining the size of the neutral cable, as current circulating on the neutral cable may be greater than nominal current in the case of non-linear loads. Refer to the values in **10.4 - UPS Electrical Characteristics**.
2. The ground conductor should be sized according to such factors as the fault rating, cable lengths and type of protection. The ground cable connecting the UPS to the main ground system must follow the most direct route possible. Control wiring and power wiring must be run in separate conduit. Output and input cables must be run in separate conduit.
3. Consider using paralleled smaller cables for heavy currents—this can ease installation.
4. When sizing battery cables, a maximum voltage drop of 4VDC is permissible at the current ratings in **Table 37**. For terminal connection sizing, see **Tables 33** through **37**.
5. In most installations, the load equipment is connected to a distribution network of individually protected busbars fed by the UPS output, rather than connected directly to the UPS itself. When this is the case, the UPS output cables can be rated to suit the individual distribution network demands rather than being fully load-rated.

**NOTE**
*If more load is added to the distribution panel, the unit's cabling must be resized.*

6. When laying power cables, do not form coils; this will help avoid increasing formation of electromagnetic interference.

**NOTE**
*Right-side access may be required when making power connections. Cable connections should be made before a cabinet is attached to the right side of the Liebert APM or before the UPS is placed where another obstruction, such as a wall, is against the Liebert APM's the right side.*

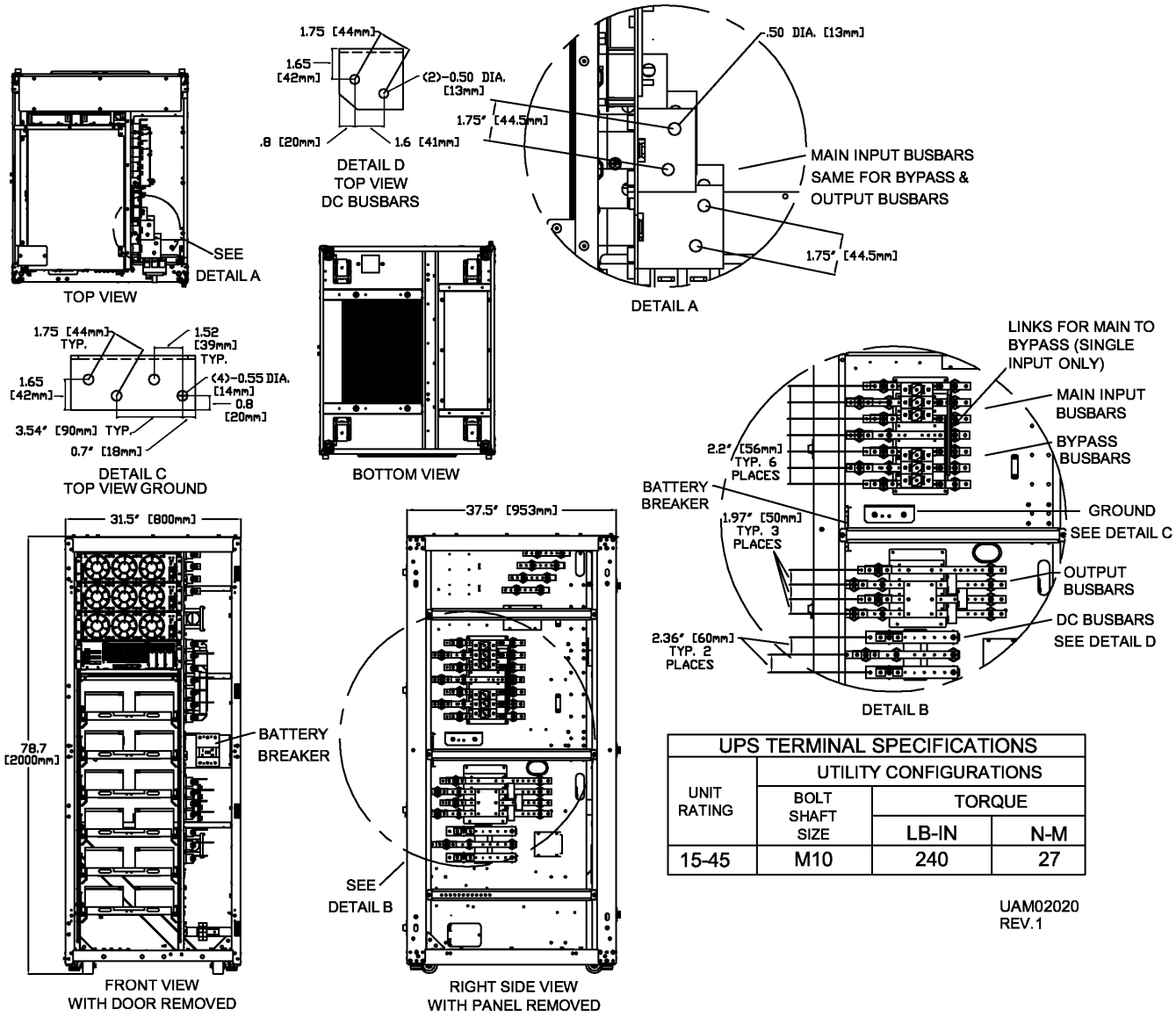
### 2.2.6 Cable Connections

The rectifier input, bypass output and battery are easily accessible from the right side of the unit for installation. All require lug type terminations. They are connected to busbars on the right side of the Liebert APM, as shown in **Figures 5** and **6**. These busbars are accessible when the right side panel is removed.

**WARNING**

When wiring a single-input only system, connect only the power wiring to the input busbars.

**Figure 5 Input busbars—Liebert APM 45kVA frame**

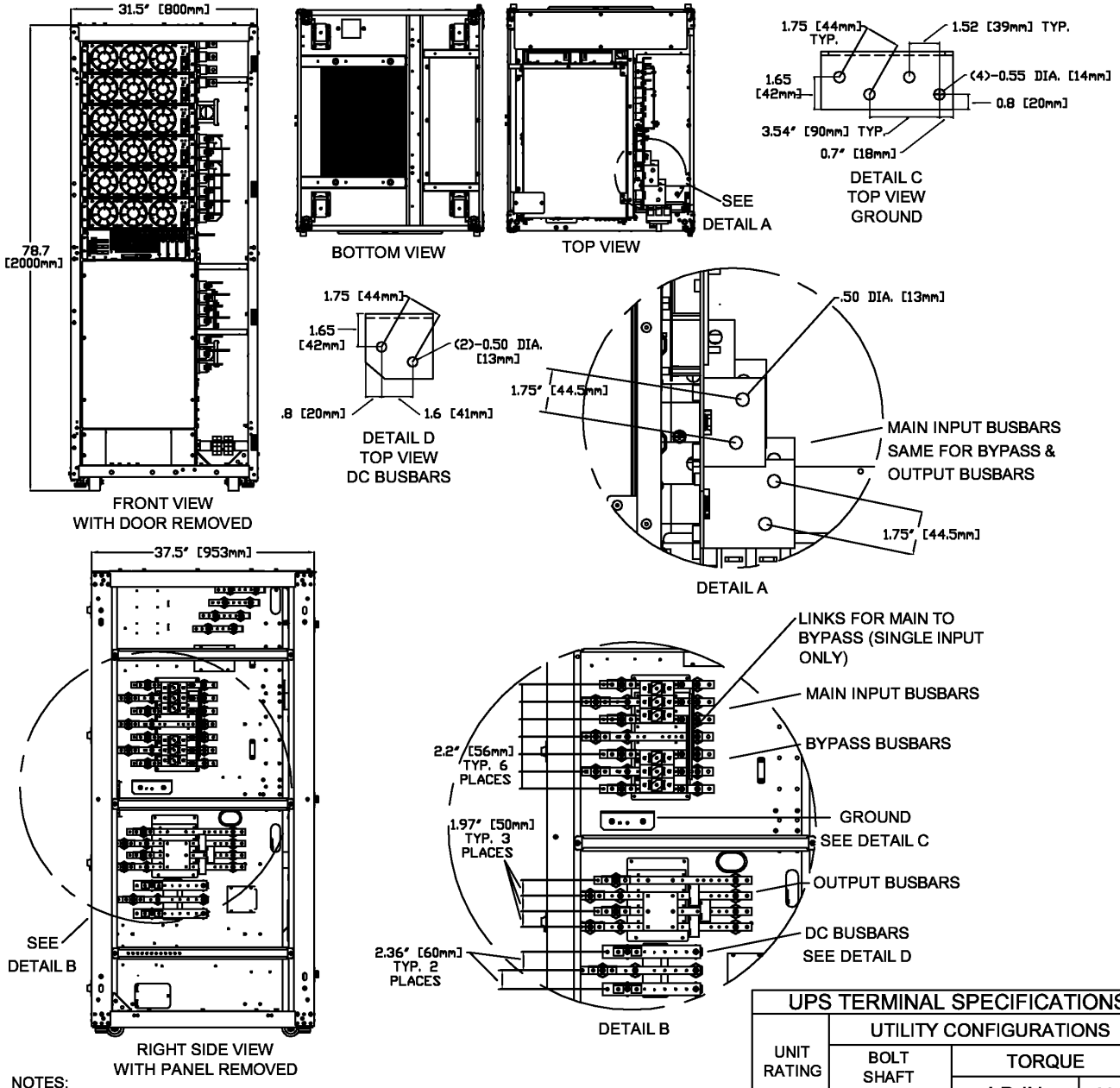



| UPS TERMINAL SPECIFICATIONS | | | |
|---|---|---|---|
| UNIT RATING | UTILITY CONFIGURATIONS | | |
| | BOLT SHAFT SIZE | TORQUE | |
| | | LB-IN | N-M |
| 15-45 | M10 | 240 | 27 |

UAM02020
REV.1

NOTES:
1. ALL DIMENSIONS ARE IN inches [mm].
2. CONTROL WIRING AND POWER WIRING MUST BE RUN IN SEPARATE CONDUITS.
3. COPPER CABLES ONLY ARE RECOMMENDED.
4. ALL WIRING IS TO BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.

**Figure 6 Input busbars—Liebert APM 90kVA frame**




| UPS TERMINAL SPECIFICATIONS | | | |
|---|---|---|---|
| UNIT RATING | UTILITY CONFIGURATIONS | | |
| | BOLT SHAFT SIZE | TORQUE | |
| | | LB-IN | N-M |
| 15-45 | M10 | 240 | 27 |

NOTES:
1. ALL DIMENSIONS ARE IN inches [mm].
2. CONTROL WIRING AND POWER WIRING MUST BE RUN IN SEPARATE CONDUITS.
3. COPPER CABLES ONLY ARE RECOMMENDED.
4. ALL WIRING IS TO BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.

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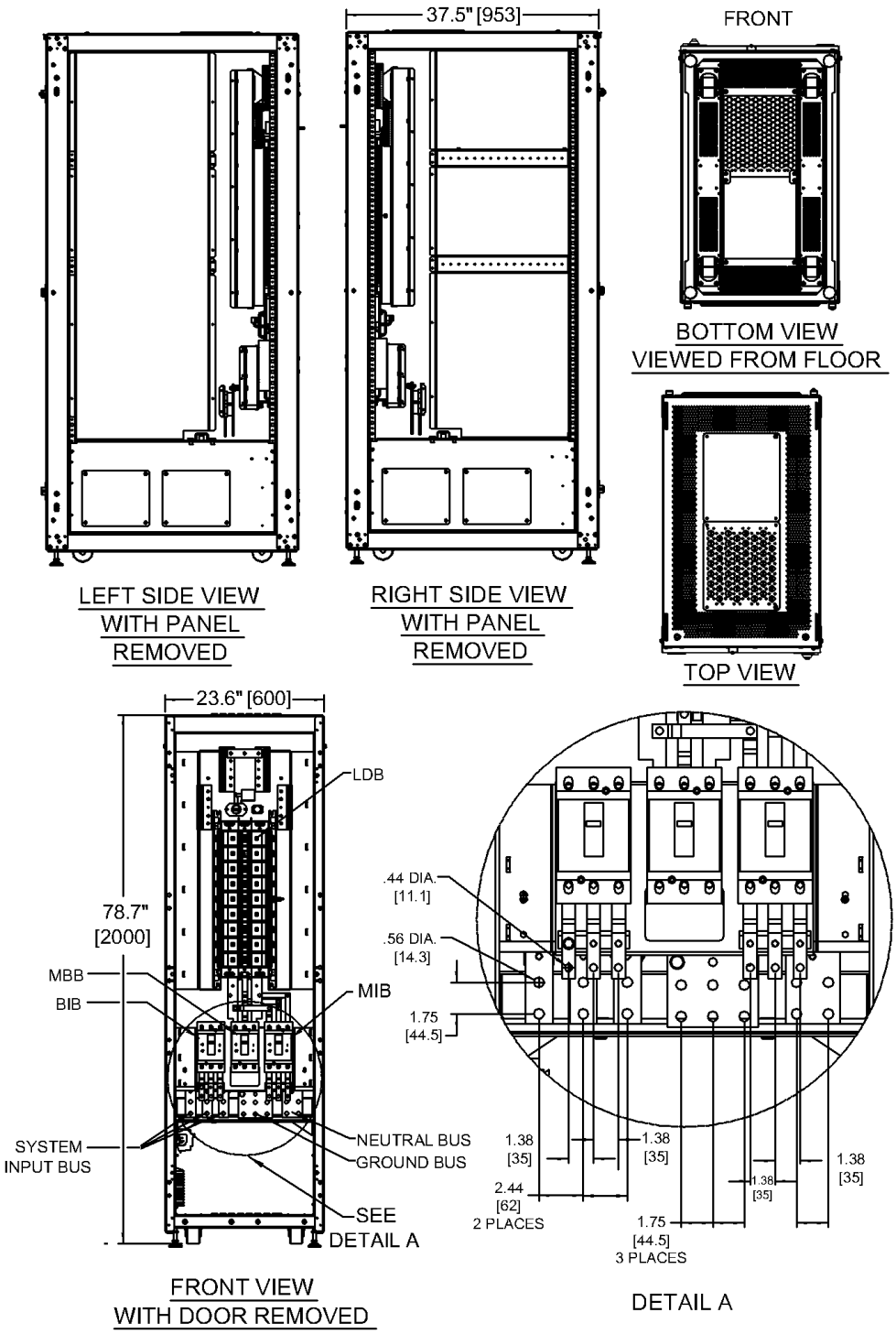
**Figure 7 Busbars—Liebert BDC**




NOTES:

1. ALL DIMENSIONS ARE IN inches [mm].
2. CONTROL WIRING AND POWER WIRING MUST BE RUN IN SEPARATE CONDUITS.
3. COPPER CABLES ONLY ARE RECOMMENDED.
4. ALL WIRING IS TO BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.
5. IF BATT. CABINET IS ATTACHED TO UPS, LIEBERT WILL SUPPLY INTERCONNECT CABLES.

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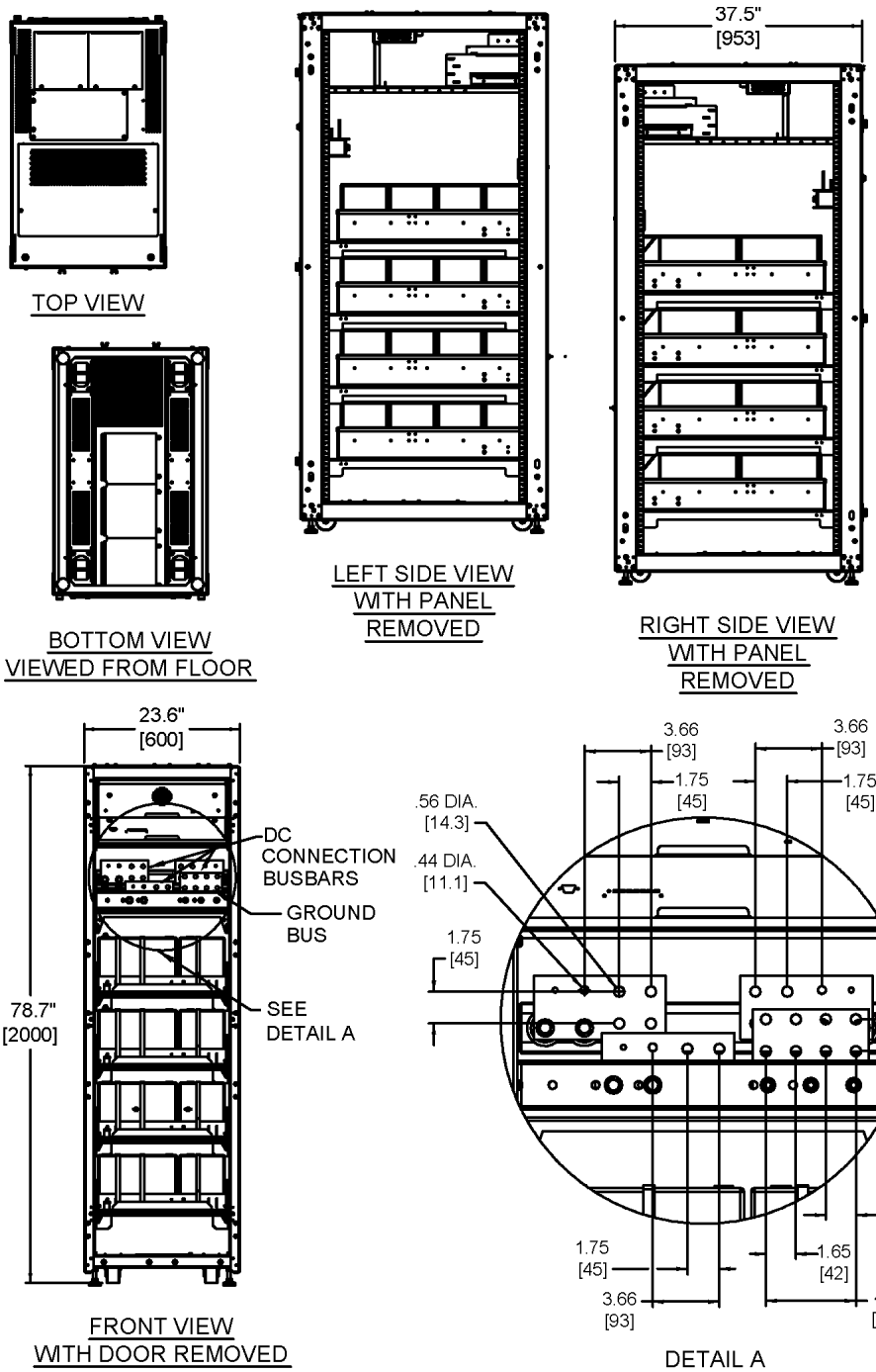
**Figure 8 Busbars—External Battery Cabinet**




NOTES:

1. ALL DIMENSIONS ARE IN inches [mm].
2. CONTROL WIRING AND POWER WIRING MUST BE RUN IN SEPARATE CONDUITS.
3. COPPER CABLES ONLYARE RECOMMENDED.
4. ALL WIRING IS TO BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.
5. IF BATT. CABINET IS ATTACHED TO UPS, LIEBERT WILL SUPPLY INTERCONNECT CABLES.

| TERMINAL SPECIFICATIONS | | | |
|---|---|---|---|
| UNIT RATING | UTILITY CONFIGURATIONS | | |
| | BOLT SHAFT SIZE | TORQUE | |
| | | LB-IN | N-M |
| 15-90 | M10 | 240 | 27 |

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REV. 1

### 2.2.7 Accessory Fuses and Backfeed Breaker Wiring

Two fuse blocks provide power for the backfeed breakers (standard) and the BDSi (optional). See **Figure 9** for fuse holder locations.

The backfeed breaker fuse block provides 120V nominal provided from the UPS output (L-N) and the fuse is rated for 8 amps. **Figure 10** shows the backfeed breaker wiring.

The BDSi fuse block provides 208V nominal from the UPS output (L-L) and the fuse is rated at 8A. The BDSi power wiring is shown in **Figures 19** and **38**.

**Figure 9 Accessory fuses**

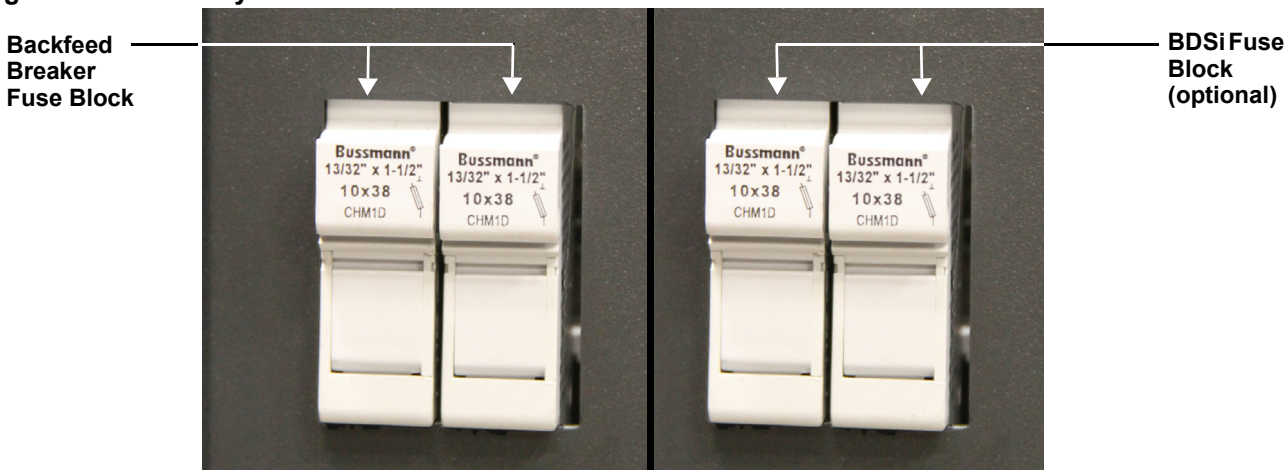
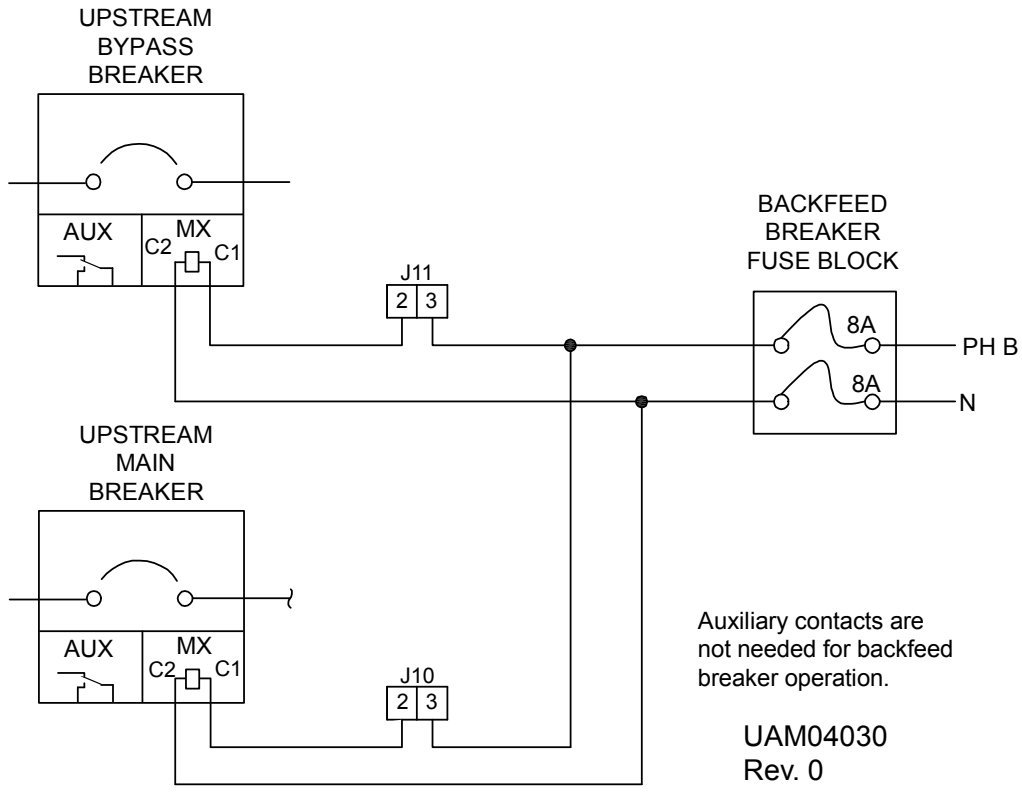



**Figure 10 Backfeed breaker wiring when bypass distribution cabinet not used**




**NOTE**

*Shunt trips are required in upstream breakers to allow backfeed protection to function properly.*

### 2.2.8 Safety Ground

The safety ground busbar is below the neutral input and output busbars as shown in **Figure 11** below. The safety ground cable must be connected to the ground busbar and bonded to each cabinet in the system. This ground busbar is then connected to the ground electrode conductor (GEC).

All cabinets and cable conduit should be grounded in accordance with local regulations.

**WARNING**

Failure to follow proper grounding procedures can result in electric shock hazard to personnel or the risk of fire, should a ground fault occur.

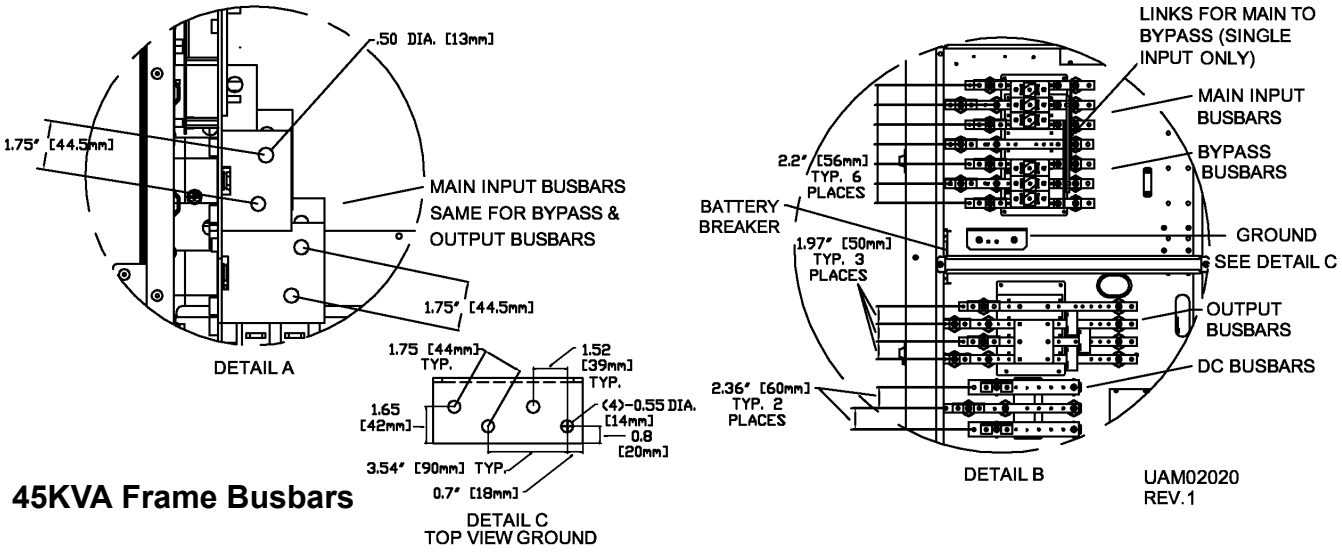
**NOTE**

*Proper grounding significantly reduces problems in systems caused by electromagnetic interference.*

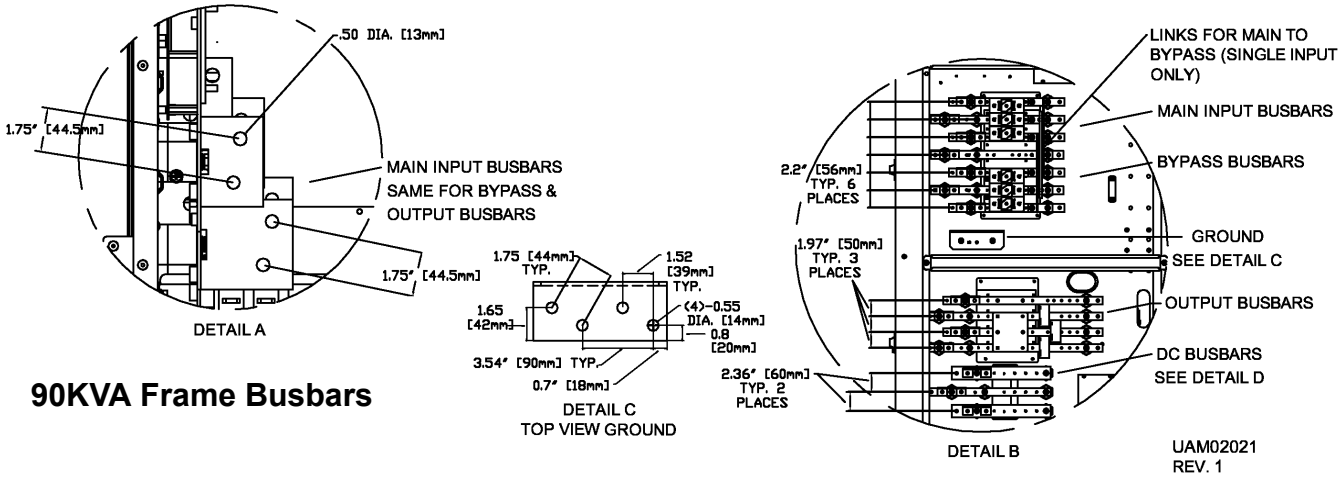
**NOTE**

*The ground and neutral busbars are easily accessible when the right side panel is removed. Cable connections should be made before a cabinet is attached to the right side of the Liebert APM or before the UPS is placed where another obstruction, such as a wall, is against the Liebert APM's the right side.*

**Figure 11 Ground and neutral busbar connections**




**45KVA Frame Busbars**




**90KVA Frame Busbars**

### 2.2.9 Protective Devices

For safety, it is necessary to install circuit breakers in the input AC supply external to the UPS system. Given that every installation has its own characteristics, this section provides guidelines for

qualified installation engineers with knowledge of operating practices, regulatory standards and the equipment to be installed.

### UPS Rectifier and Bypass Input Supply

- **Protection from excessive overcurrents and short circuits in power supply input**

  External overcurrent protection for the AC output circuit is to be provided. See **10.4 - UPS Electrical Characteristics** and **Table 39** for overload capacity.

  A breaker is used for internal battery circuit overcurrent protection. When an external battery supply is used, overcurrent protection for the battery circuit is to be provided by the customer.
- **Dual Input**

  When wiring the UPS with dual inputs, the Rectifier input and the Bypass input must be protected separately. Size the breakers according to the input currents shown in **Table 33**.

### Fuses

The Liebert APM's main input and bypass input busbars are equipped with fuses (six locations; see **Figure 28**). The type is Bussman 170M4465, rated at 550A and 700V.

### System Output

When using an external distribution panel for load distribution, the output neutral and input neutral must be separated at the input to the UPS.

## 2.2.10 Cabling Procedure

**CAUTION**

The operations described in this section must be performed by authorized electricians or qualified technical personnel. If you have any difficulties, contact your local Emerson representative or Liebert Services.

**NOTE**

*Hydraulic pressure pliers, combinative tools and piston ring pliers should be used to connect AC wiring.*

Once the equipment has been positioned and secured for operation, and the battery and ground lugs have been connected (see **2.2.6 - Cable Connections**), connect the power cables as described below. (Study the reference drawing in **5.0 - Installation Drawings**.)

1. Verify that all incoming high and low voltage power circuits are de-energized and locked out or tagged out before installing cables or making any electrical connections.
2. Remove the right side panel to gain easier access to the connections busbars.
3. Connect the safety ground and any easier bonding ground bus cables to the copper ground busbar located on the bottom of the equipment below the power connections. All cabinets in the UPS system must be connected to the user's ground connection.

**NOTE**

*The grounding and neutral bonding arrangement must comply with the National Electrical Code and all applicable local codes.*

4. Identify and make power connections with incoming cables according to **Steps 5** through **8**.

### Common Input Connections

5. For common bypass and main inputs, connect the AC input supply cables to the UPS input terminals (A2-B2-C2-N1) and tighten the connections to 240lb-in. (27N-m) (M10 Bolt). Ensure correct phase rotation.

**NOTE**

*For common bypass and main inputs, the AC input cables must be connected to the bypass terminal (A2-B2-C2-N1) but not the main input terminal (A2-B2-C2).*

### Split Bypass Connections

6. If a split bypass configuration is used, connect the AC input supply cables to the rectifier input terminals (A1-B1-C1-N1) and the AC bypass supply cables to the bypass input terminals (A2-B2-C2-N1) and tighten the connections to 240lb-in. (27N-m) (M10 Bolt). Ensure correct phase rotation.

**NOTE**

*For split bypass operation, ensure that the busbars between bypass and rectifier inputs are removed. The neutral line of the bypass input must be connected to that of the rectifier input.*

### Output System Connections—Ensure Correct Phase Rotation

7. Connect the system output cables between the UPS output busbars (A-B-C-N terminals) and the critical load and tighten the connections to 240lb-in. (27N-m) (M10 bolt).

**WARNING**

If the load equipment will not be ready to accept power when the commissioning engineer arrives, ensure that the system output cables are safely isolated.

### Internal UPS Battery Connections

The UPS internal batteries will be connected at the factory, EXCEPT the connections between the shelves and to the breaker.

**WARNING**

The DC bus is live when this internal battery connection is made. This connection is to be performed ONLY by Liebert Services at startup.

**Observe the battery cable polarity.** Be sure that the battery connection is made with the correct polarity.

8. Refit all protective covers removed for cable installation

## 2.3 Control Cables Details

### 2.3.1 Static Bypass Assembly Features

Based on your site's specific needs, the UPS may require auxiliary connections to manage the battery system (external battery circuit breaker, battery temperature sensor), communicate with a personal computer or provide alarm signaling to external devices or for Remote Emergency Power Off (REPO). Terminations for these functions are located at the front of the static bypass assembly. The main features are:

- Input and output dry contacts signal (one pair of contacts of relay)
- Emergency Power Off control (EPO)
- Environmental parameter input interface
- User communication (for data setting and user background monitor)
- Liebert IntelliSlot® interface
- Temperature detect interface

**Figure 12 Static bypass assembly connections to display cabinet and options**

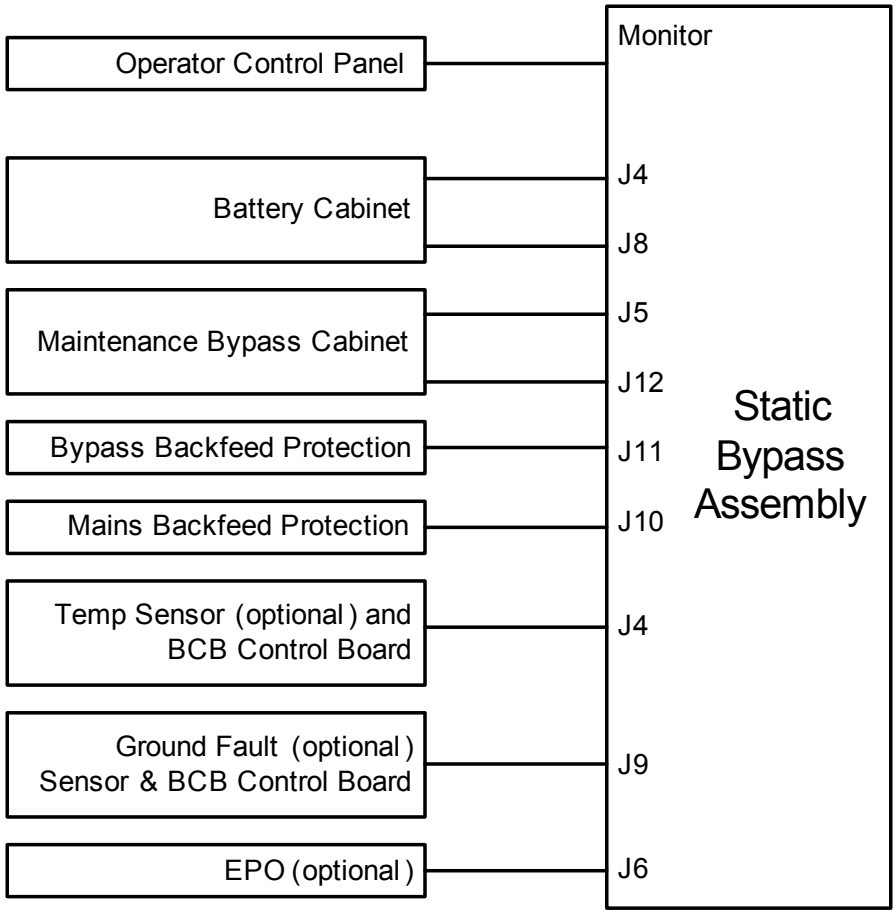
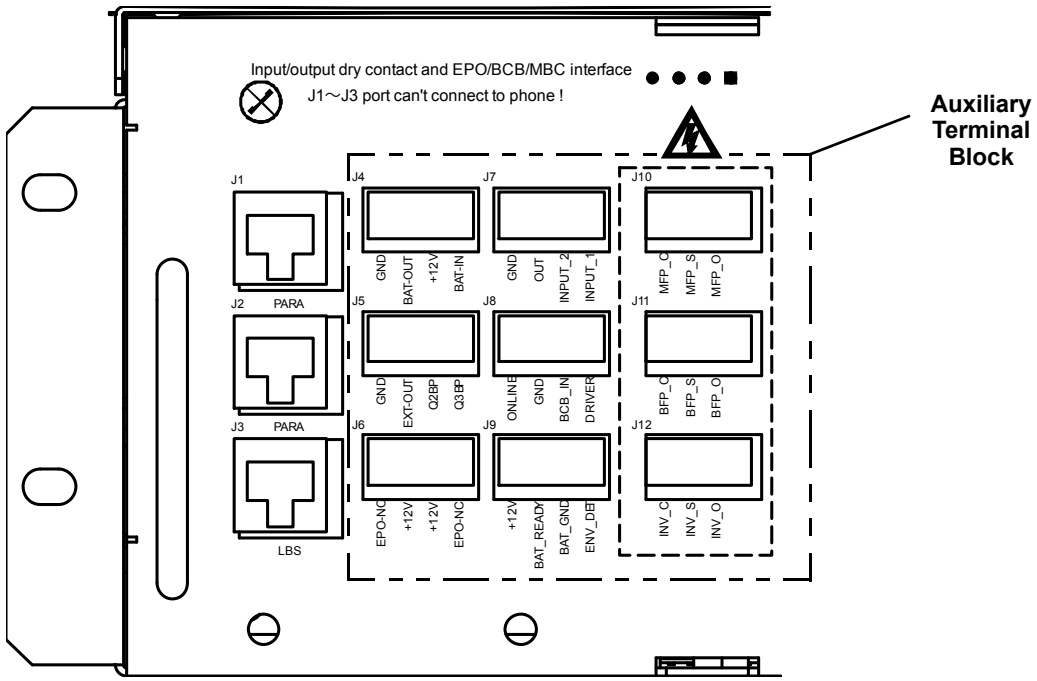



**Figure 13 Auxiliary terminal block detail (static switch assembly front panel)**




**NOTE**

*Terminal block connectors are on the left side of the static bypass assembly.*

## 2.4 Dry Contacts

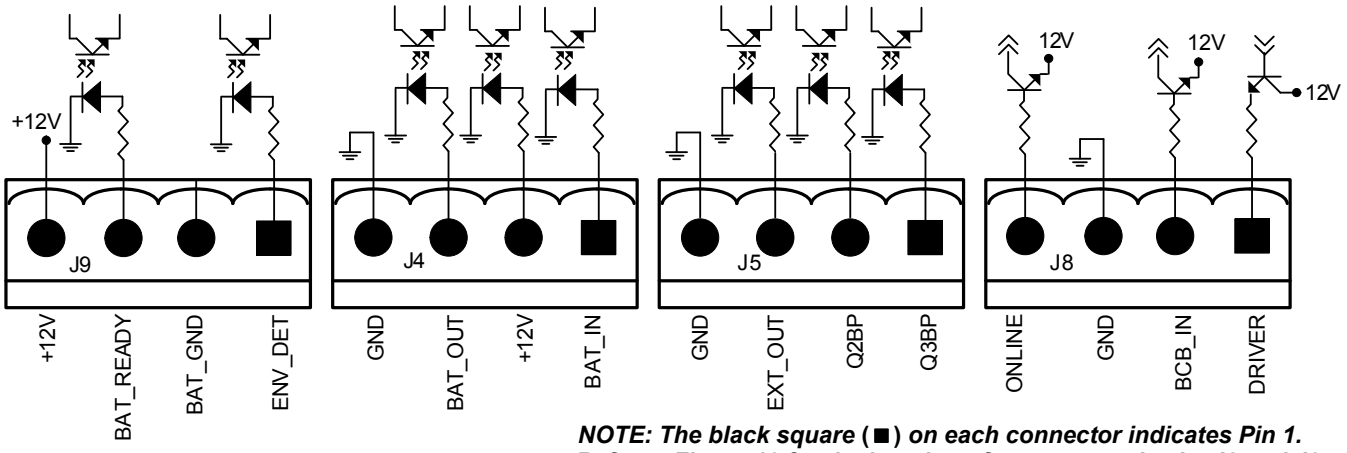
The UPS provides input dry contacts and output dry contacts on the Auxiliary Terminal Block (ATB).

### 2.4.1 Input Dry Contacts

External input dry contacts are connected via the ATB. Dry contacts are available for environment detection, battery ground fault detection, etc.

The UPS accepts external signal from zero-voltage (dry) contacts connected through external dry contact terminals produced, and these terminals are on the static bypass assembly. Through software programming, these signals become active when these contacts connect to +12V to ground (in the most left side). The cables connected to the monitor board must be separated from power cables. Moreover, these cables should be double-insulated with a typical cross-section of 0.5 to 1mm$^2$ for a maximum connection length between 82 and 165ft. (25-50m). The ATB has several input dry contacts.

**Figure 14 Input dry contacts**




***NOTE: The black square (■) on each connector indicates Pin 1.***
**Refer to Figure 13 for the location of connectors J4, J5, J8 and J9.**

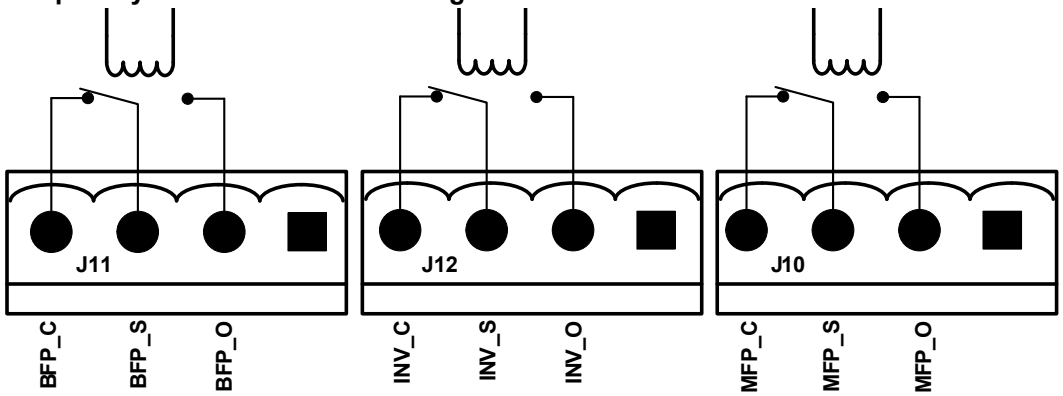
**Table 2 Description of dry contact input port**

| Position | Name | Description |
|---|---|---|
| J9.1 | ENV_DET | Detection of battery room environment (normally closed) |
| J9.2 | BAT_GND | Battery short to ground detection |
| J9.3 | BAT_READY | Not Used |
| J9.4 | +12V | +12V power supply |
| J4.1 | BAT_IN | Internal battery temperature detection |
| J4.2 | +12V | +12V power supply |
| J4.3 | BAT_OUT | External battery temperature detection |
| J4.4 | GND | Power supply GND |

### 2.4.2 Output Dry Contacts

The Auxiliary Terminal Block has three output dry contact relays (see **Figure 15** and **Table 3**).

**Figure 15 Output dry contacts and EPO wiring**




***NOTE: The black square (■) on each connector indicates Pin 1.***
**Refer to Figure 13 for the location of connectors J10, J11 and J12.**

**Table 3 Output dry contact relays**

| Position | Name | Description |
|---|---|---|
| J11.2 | BFP_O | Bypass feedback protection relay. Normally open. Closed when bypass SCR is shorted. |
| J11.3 | BFP_S | Bypass feedback protection relay center |
| J11.4 | BFP_C | Bypass feedback protection relay. Normally closed. Open when bypass SCR is shorted. |
| J12.2 | INV_O | Inverter mode relay. Normally open. Closed when UPS is in inverter mode. |
| J12.3 | INV_S | Inverter mode relay common |
| J12.4 | INV_C | Inverter mode relay. Normally closed. Open when UPS is in inverter mode. |
| J10.2 | MFP_O | Main feedback protection relay. Normally open. Closed when bypass SCR is shorted. |
| J10.3 | MFP_S | Main feedback protection relay common |
| J10.4 | MFP_C | Main feedback protection relay. Normally closed. Open when bypass SCR is shorted. |

**NOTE**
*All auxiliary cables of terminal must be double-insulated. Wire should be 20-16AWG stranded for maximum runs between 80 and 200 feet (25-60m), respectively.*

### 2.4.3 Liebert BDC Interface

The Liebert BDC interface is on the Auxiliary Terminal Block at J5. Refer to **Figure 13** for the location of connector J5 and to **Figure 14** for circuit details.

**Table 4 Liebert BDC interface**

| Position | Name | Description |
|---|---|---|
| J5.1 | Q3BP | Input circuit breaker status of external Liebert BDC |
| J5.2 | Q2BP | Output circuit breaker status of external Liebert BDC |
| J5.3 | EXT_OUT | Input circuit breaker status of internal Liebert BDC |
| J5.4 | GND | Power supply GND |

These contacts cannot be active unless they are set via software.

**NOTE**
*All auxiliary cables of terminal must be double-insulated. Wire should be 20-16AWG stranded for maximum runs between 80 and 200 feet (25-60m), respectively.*

**NOTE**
*Refer to **Table 8** and **Figure 23** for the Liebert BDC wiring.*

### 2.4.4 Battery Cabinet Interface Connectors

The battery cabinet interface is on the Auxiliary Terminal Block at J8 and J4. Refer to **Figure 13** for the location of connectors J4 and J8 and to **Figure 14** for circuit details.

**Table 5 Battery cabinet interface**

| Position | Name | Description |
|---|---|---|
| J4.1 | GND | Power Ground |
| J4.2 | BAT_OUT | External Battery Temperature Detection |
| J4.3 | +12V | +12V Power Supply |
| J4.4 | BAT_IN | Internal Battery Temperature Detection |
| J8.1 | DRIVER | BCB Driver Signal |
| J8.2 | BCB_IN | BCB Contact State |
| J8.3 | GND | Power Ground |
| J8.4 | ONLINE | BCB On-Line - Input (N.O.) - This pin will become active when the BCB interface is connected. |

**NOTE**
*All auxiliary cables of terminal must be double-insulated. Wire should be 20-16AWG stranded for maximum runs between 80 and 200 feet (25-60m), respectively.*

**NOTE**
*Refer to **Table 7** and **Figure 19** for battery cabinet wiring.*

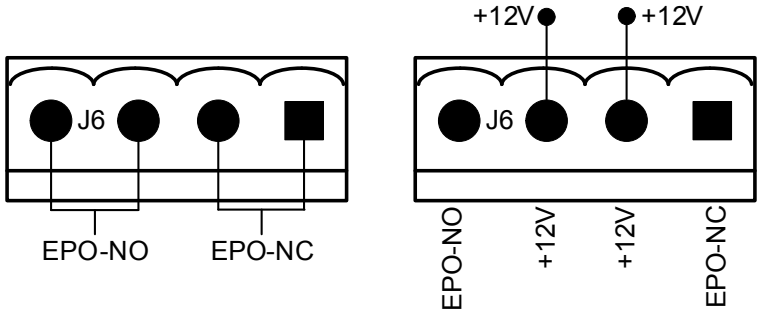
### 2.4.5 EPO Input—Optional

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

The J6 connector, shown in **Figure 16**, is the remote EPO input interface. The EPO has NO/NC contacts that become active when shorting terminals J6: 3 and 4 or open terminal connection J6: 2 and 1.

If an external Emergency Stop capability is required, it is connected at terminals J6: 1&2 and at J6: 3 and 4 on the monitor board. It also is connected to the Normally Open or Normally Closed remote stop switch between these two terminals using shielded cable (see **Figure 16** and **Table 6**). If this function is not used, terminals J6:3 and 4 must be opened and J6:1 and 2 must be closed.

**Figure 16 EPO wiring and signal names for J6**




***NOTE: The black square (■) on each connector indicates Pin 1.***
**Refer to Figure 13 for the location of connector J6.**

**Table 6 EPO input contact relays**

| Position | Name | Description |
|---|---|---|
| J6.1 | EPO_NC | EPO Activated when opened to J6.2 |
| J6.2 | +12V | EPO Activated when opened to J6.1 |
| J6.3 | +12V | EPO Activated when shorted to J6.4 |
| J6.4 | EPO_NO | EPO Activated when shorted to J6.3 |

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

**NOTE**
*Normally Closed EPO – J6: 1, 2, these terminals are supplied factory-linked on the monitor board and must remain installed if using NO contacts.*

**NOTE**
*All auxiliary cables of terminal must be double-insulated. Wire should be 20-16AWG stranded for maximum runs between 80 and 200 feet (25-60m), respectively.*

# 3.0 BATTERY INSTALLATION

## 3.1 Introduction

Emerson recommends that the batteries in external cabinets be the same type and made by the same manufacturer as the internal batteries in the Liebert APM.

If multiple sets of batteries connected in parallel are used to provide the required battery backup run times, fit each set with an isolating device to permit working on one of the battery sets while leaving the others in service and providing backup protection.

## 3.2 Safety

Special care should be taken when working with the batteries associated with the Liebert APM system equipment.

### WARNING

The Liebert APM's internal batteries are connected and energized even if the UPS is turned Off. To minimize the risk of injury, a properly trained and qualified service person should disconnect internal batteries before any maintenance is performed on the unit.

When all batteries are connected together, the battery terminal voltage may exceed 324V and is potentially lethal.

The center of the battery is connected to the neutral of the UPS and is grounded.

A battery can present a risk of electrical shock and high short circuit current. The following precautions should be observed when working on batteries:

- Remove watches, rings and other metal objects.
- Use tools with insulated handles.
- Wear rubber gloves and boots.
- Do not lay tools or metal parts on top of batteries.
- Disconnect charging source prior to connecting or disconnecting battery terminals.
- Determine whether the battery is grounded. If the battery is grounded, remove source of the ground. Contact with any part of a grounded battery can result in electrical shock. The likelihood of such shock can be reduced if such grounds are removed during installation and maintenance

When replacing batteries, replace with batteries of the same type and manufacturer, or equivalent. Refer to **10.2 - UPS Environmental** for a list of approved batteries or contact your Emerson representative.

### CAUTION

Batteries used in the Liebert APM and its auxiliary cabinets must be of an approved type. Replacing batteries with an incorrect type can cause an explosion and fire. Refer to **Tables 31** and **32** for acceptable batteries.

Do not dispose of batteries in a fire. The batteries may explode. Do not open or mutilate batteries. Released electrolyte is harmful to the skin and eyes. It is toxic.

## 3.3 UPS Batteries—Liebert APM 45kVA Frame Only

The Liebert APM's internal batteries are fully charged before the unit is shipped. During storage and transportation, some charge is lost. All batteries should be recharged before use. The battery charger works only when the Liebert APM is connected to input power and turned On.

**NOTE**

*Full safety instructions concerning the use and maintenance of UPS batteries are provided in the appropriate battery manufacturer's manuals, available on the manufacturer's Web site.*

*The battery safety information contained in this section relates to key considerations that must be taken into account during the installation design process and might affect the design outcome, depending on your installation.*

## 3.4 External Battery Cabinet Installation

### 3.4.1 Matching Battery Cabinets

A matching battery cabinet is available. Refer to **Figure 17**. The same model battery cabinet may be installed in parallel in multiple cabinet strings for additional capacity. Battery run time depends on the cabinet model, the number of cabinets and the load on the UPS.

**Handling**—The battery cabinet has casters to facilitate movement over short distances. The bottoms of the battery cabinets are reinforced to permit movement by forklift over longer distances.

**Inspection**—Remove all panels and visually inspect the batteries, bus connections, and cabinet for any damage. Exercise caution; voltage is present within the battery cabinet even before installation. If there are signs of damage, do not proceed. Call Liebert Services at 1-800-542-2378.

**Storage**—The batteries can be stored for up to six months without appreciable deterioration. If planning to store a battery cabinet for longer than six months or at temperatures higher than 77°F (25°C), contact Liebert Services for recommended precautions.

The following notes, in conjunction with the diagrams (**Figure 17**), illustrate the broad principles to be followed when fitting and connecting the majority of battery cabinet installations.

**CAUTION**

Any battery system should be installed by properly trained and qualified personnel.

When installing an external battery cabinet that is NOT a Liebert APM battery cabinet, the customer must provide overcurrent protection. See **Table 37** for sizing of protection devices.

**NOTE**

*When using an external battery supply that is not provided with the UPS, please make reference to the battery manufacturer's installation manual for battery installation and maintenance instructions, available on the manufacturer's Web site. When replacing batteries, Emerson recommends that the batteries in external cabinets be the same type used internally in the Liebert APM. See **Tables 31** and **32** for batteries that are approved for use with the Liebert APM.*

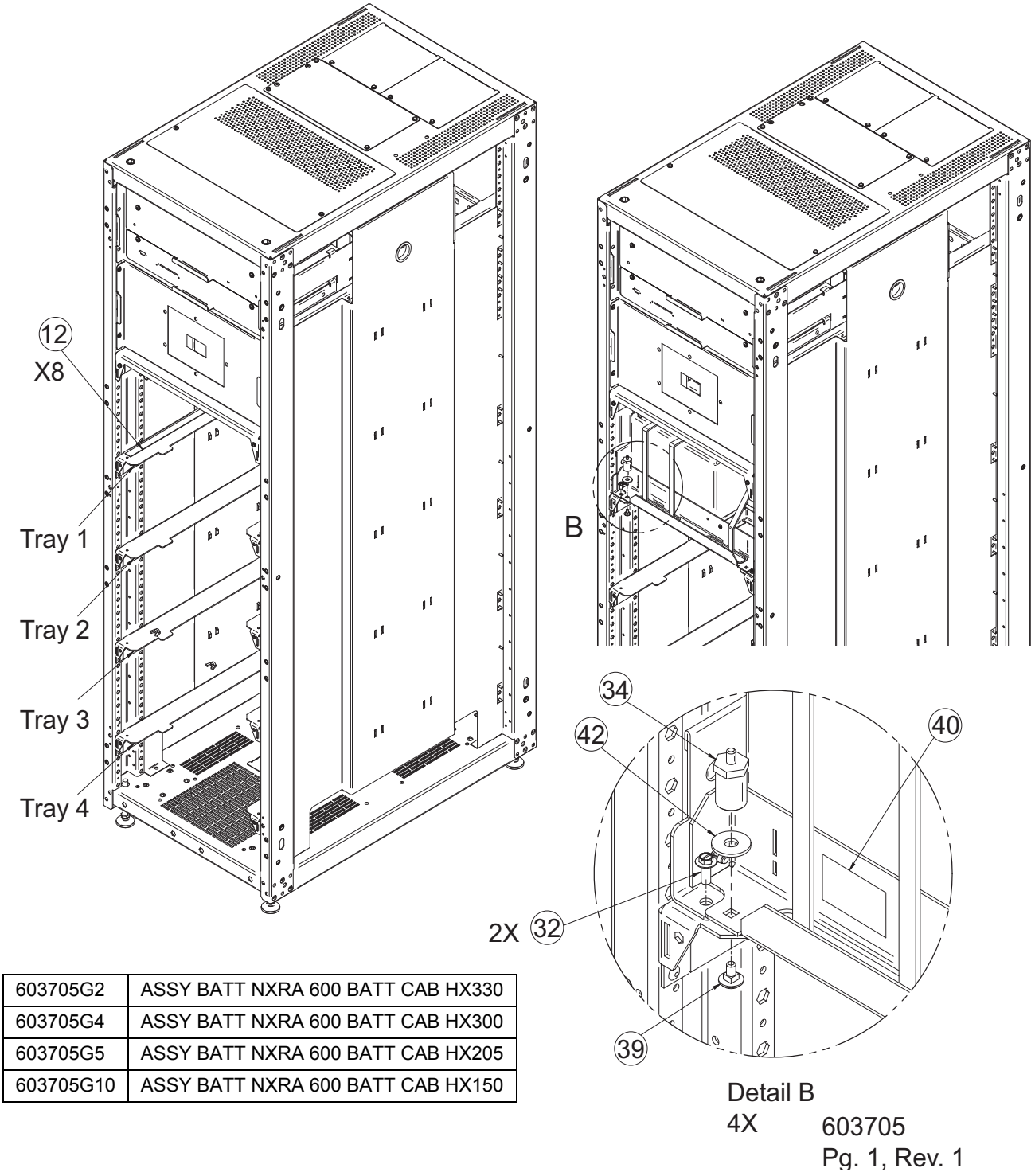
### 3.4.2 Connecting the Batteries

If the Liebert APM battery cabinets are installed on a raised floor, the battery power cables and circuit breaker control cables may be routed to the UPS cabinet through the bottom of the cabinet.

If the Liebert APM battery cabinets are installed adjacent to one another on a solid floor, these cables may be passed between the cabinets through slots in the lower sides of the cabinets.

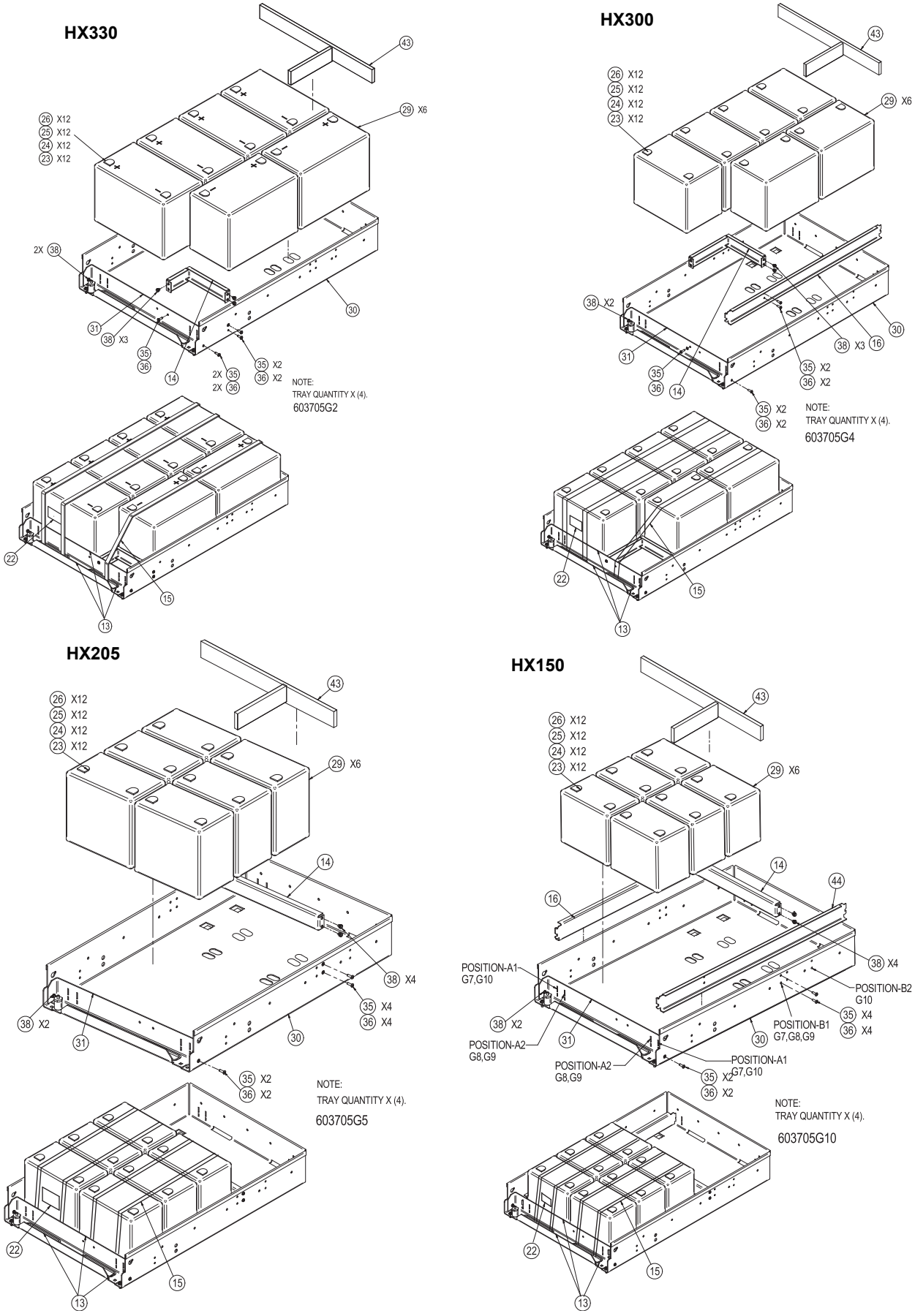
Intertray connections must be made before the battery cabinet may be used.

**Figure 17 Battery cabinet, 600mm wide—details**




| | |
|---|---|
| 603705G2 | ASSY BATT NXRA 600 BATT CAB HX330 |
| 603705G4 | ASSY BATT NXRA 600 BATT CAB HX300 |
| 603705G5 | ASSY BATT NXRA 600 BATT CAB HX205 |
| 603705G10 | ASSY BATT NXRA 600 BATT CAB HX150 |

**Figure 18 Battery trays for 600mm wide battery cabinet**



### 3.4.3 Installation Considerations

**Position**—Liebert battery cabinets come in versions specific to the left side of the UPS. If the system includes a matching Liebert BDC, the cabinet should be mounted to the right of the UPS (nearest the busbars) and the battery cabinet(s) should be installed to the left of the UPS.

The battery cabinet(s) are designed to be located conveniently next to each UPS module, and are also available in stand-alone configurations with painted side panels. The front access design eliminates side and rear service clearance requirements. Refer to **Table 30** for battery cabinet dimensions and weights.

**Bolt-On Cabinets**—Matching battery cabinets are designed to bolt onto the left side of the UPS module cabinet. Use bolts that ship with each unit to connect cabinet frames at posts, two places in the front and two places in the rear.

**Service Clearance**—Allow front access to the battery cabinet at all times for maintenance and servicing. Electrical codes require that the battery cabinet be installed with no less than 3 feet (1m) of clearance at the front of the cabinet when operating. Side and rear panels do not require service clearance.

**Cables**—Cables may be run between the cabinets through cutouts in the top of the cabinet, eliminating the need for external conduit runs. Route cables before moving cabinets into final position for bolting together. No top or bottom entry cables are required, except for remotely located cabinets which require conduits.

**Software**—To allow the UPS to accurately display the battery run time, the number of battery cabinets must be noted when performing initial startup and setup using the configuration software. This is to be performed by the Liebert Services engineer when commissioning the unit.

**Casters and Adjustable Stops**—The adjustable stops are not designed to bear the full weight of the cabinet. Lower the stops until they are finger-tight in contact with the floor. Then tighten a small amount with a wrench (less than two turns) to give a good friction fit. When mounting the battery cabinet on seismic stands, ensure that the casters are bearing the weight of the cabinet.

### 3.4.4 Connecting the Battery Cabinet to the UPS

After the battery cabinet equipment has been positioned and secured for operation and the batteries have been connected, connect the power cables as described below (see **Figure 19**).

1. Verify that all incoming high and low voltage power circuits are de-energized and locked out or tagged out before installing cables or making any electrical connections.
2. Remove the UPS right side panel to gain access to the ground and battery busbars.
3. Remove the battery cabinet front panel to gain access to the busbars.
4. Connect the safety ground and any necessary bonding ground cables to the copper ground busbar. (example: UPS located on the bottom of the equipment below the power connections).

   All cabinets in the UPS system must be connected to the user's ground connection.

**NOTE**

*The grounding and neutral bonding arrangement must be in accordance with the National Electrical Code and all applicable local codes.*

5. Connect the system battery cables from the UPS battery terminals (+ N -) to battery cabinet breaker BCB (+ N -) as shown in **Figure 19**. Be sure that the battery connections are made with the right polarity, and tighten the connections to 240lb-in. (27N-m) (M10 bolt). Do not close the battery circuit breaker before the equipment has been commissioned.
6. Connect TB1 from battery cabinet to J4 and J8 on the UPS according to **Table 7**.

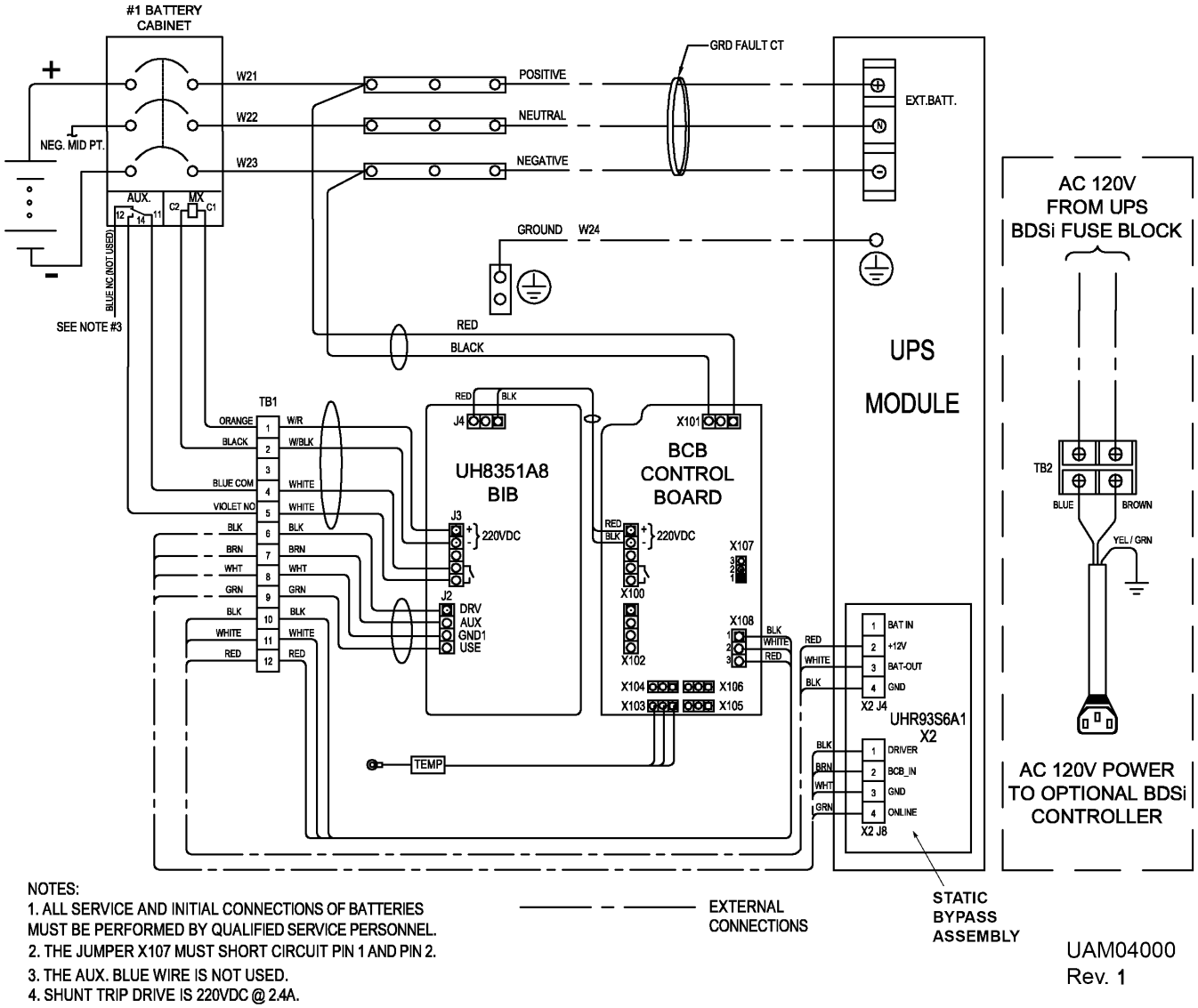
**NOTE**

*The shunt trip drive capability for the battery breaker is 220VDC at 2.4A.*

**Table 7 Control wiring for Liebert APM to battery cabinet**

| From | To |
|---|---|
| **Liebert APM UPS Monitor Board (X2 J4 & J8)** | **Battery Cabinet Terminal Strip (TB1)** |
| J4-2 | TB1-12 |
| J4-3 | TB1-11 |
| J4-4 | TB1-10 |
| J8-1 | TB1-6 |
| J8-2 | TB1-7 |
| J8-3 | TB1-8 |
| J8-4 | TB1-9 |

**Figure 19 Battery cabinet connection to Liebert APM**



## 3.5 Battery Ground Fault Detection Set

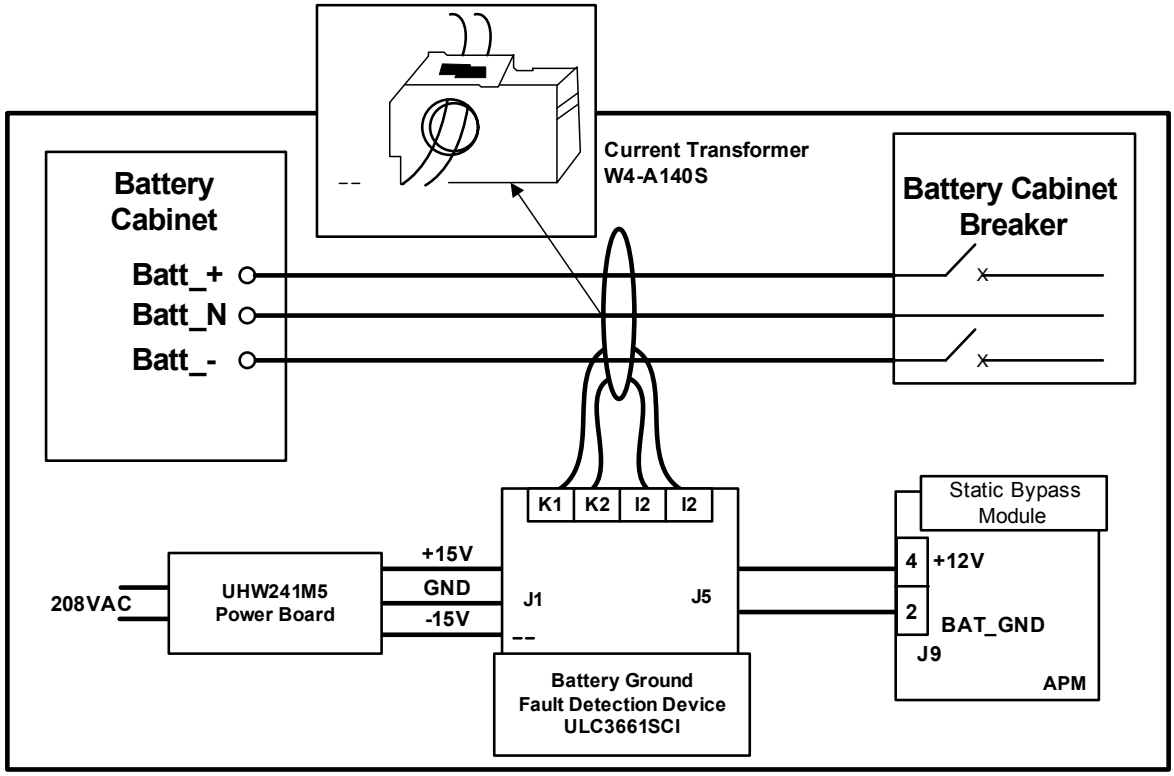
In addition to any residual current device mounted externally and upstream the UPS or when optional isolation transformers are fitted to the UPS, an optional residual battery current device can be fitted to detect leakage current so as to ensure the normal operation of the system. Residual current range monitored: 30mA ~ 3000mA

Power supply: 208VAC (L-L)

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

The battery ground fault detection set contains one current transformer and one DC-sensitive residual current monitor. The connection of this set for UPS is shown in **Figure 20**.

**Figure 20 Wiring of battery ground fault detection set**




## 3.6 Non-Standard Batteries

When batteries other than a matching battery cabinet are used, a remote battery disconnect switch with overcurrent protection is required per the National Electrical Code. Contact your local Emerson sales representative about this option. Refer to **Figures 57** and **58** for details.

Install battery racks, cabinets and batteries in accordance with the manufacturer's instructions.

Verify that the battery area has adequate ventilation and battery operating temperature complies with the manufacturer's specifications and with all applicable national and local codes.

If you have any questions concerning batteries, battery racks or accessories, contact Liebert Services at 1-800-543-2378.

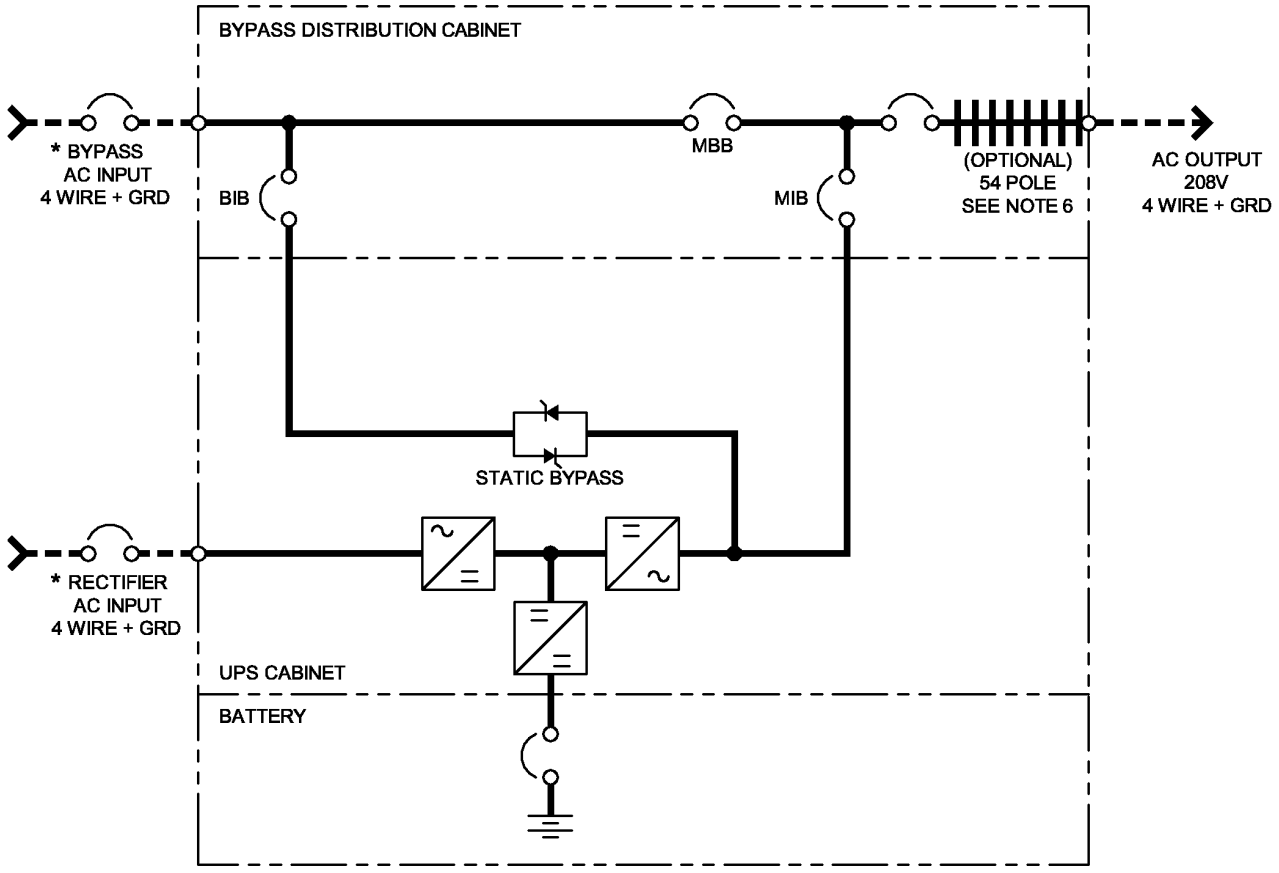
**NOTE**

*The user-supplied battery DC bypass breakers or fuses should have a minimum overload rating of 8kA and 500V.*

# 4.0 LIEBERT BDC

The Liebert BDC is designed to operate in UPS mode, bypass mode and maintenance mode.

**Figure 21 Single UPS with external Liebert BDC—typical configuration**




NOTES:
1. INSTALL IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.
2. INPUT AND BYPASS MUST SHARE THE SAME SINGLE SOURCE.
3. A NEUTRAL IS REQUIRED FROM THE SYSTEM AC INPUT SOURCE. A FULL CAPACITY NEUTRAL CONDUCTOR IS RECOMMENDED. GROUNDING CONDUCTORS ARE RECOMMENDED.
4. BYPASS AND RECTIFIER INPUTS AND OUTPUT CABLES MUST BE RUN IN SEPARATE CONDUITS.
5. CONTROL WIRING MUST BE RUN IN SEPARATE CONDUITS.
6. OPTIONAL 54 POLE, 225A FOR 45kVA FRAME ONLY OR OPTIONAL 54 POLE 400A FOR 90KVA FRAME ONLY.

BIB - BYPASS ISOLATION BREAKER
MBB - MAINTENANCE BYPASS BREAKER
MIB - MAINTENANCE ISOLATION BREAKER
* EXTERNAL OVERCURRENT PROTECTION BY OTHERS
FIELD-SUPPLIED WIRING

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## 4.1 Normal (UPS) Mode

While the Liebert BDC is in Normal mode (MBB open; BIB/MIB closed), the UPS is supplying the connected load with continuous, high-quality AC power. In this mode of operation, the load is protected by the UPS.

### 4.1.1 Bypass Mode

When the Liebert BDC is in Bypass mode, it provides an alternate path for power to the connected equipment. Should the UPS need to be taken out of service for limited maintenance or repair, manual activation of the bypass will cause an immediate transfer of the equipment from the UPS inverter to the bypass source. In this mode, power will still be supplied to the UPS; however, the load is NOT protected by the UPS.

## 4.2 Maintenance Mode

When the Liebert BDC is in Maintenance mode (MBB closed; BIB/MIB open), it provides an alternate path for power to the connected equipment. Should the UPS need to be taken out of service for limited maintenance or repair. In this mode of operation, no power is supplied to the UPS and the load is NOT protected by the UPS.

## 4.3 Locating the Cabinet

This Liebert BDC may be mounted to the left of the UPS or installed as a stand-alone unit. In either case, ensure that the unit is in a well-ventilated area and that there is clearance for access to the switches and cable connections as required by national and local codes.

## 4.4 Cable Installation

### 4.4.1 Wiring Preparation

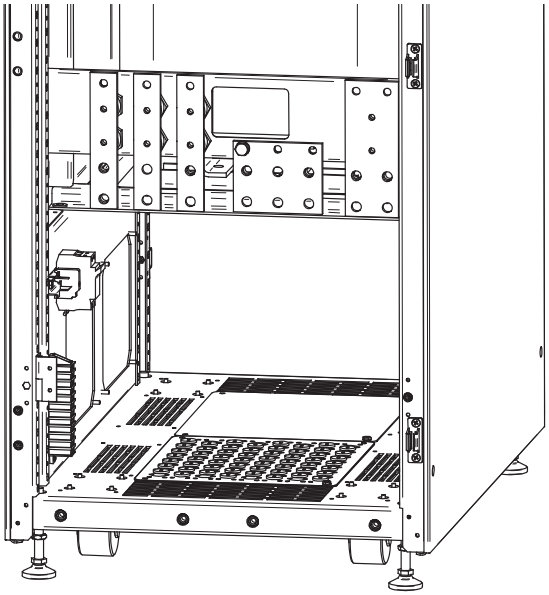
Be sure that the unit is not connected to any AC utility power source or UPS before installing any wiring to this unit. This Liebert BDC should be installed by a qualified / certified electrician.

**WARNING**
Please read this section thoroughly before attempting to install wiring to this unit.

#### Removing the Cover Plates

Plates cover the input and output terminals on the front of the Liebert BDC (see **Figure 22**). Remove these and keep the screws and plates for reinstallation.

**Figure 22 Liebert BDC—access plate removed**



### 4.4.2 Power Cable Installation

Refer to **Table 37** when selecting cables.

**NOTE**
*Transient and steady state earth leakage currents may occur when starting the equipment. This should be taken into account when selecting ground current detection devices because these will carry the earth leakage currents of both the UPS equipment and the load.*

### 4.4.3 Input/Output Wiring

Follow the steps below to connect the input wiring:

**NOTE**
*Input wiring must be installed using conduit if cabinet is not mounted to the immediate right of the UPS.*

1. Locate the input wiring access (top or bottom access), remove the conduit landing plate and punch the appropriate size hole for the size conduit being used. Pull the three/four input wires through it, allowing some slack for installation. For cabinets that are located to the immediate left of the UPS, the access plate is on the lower right of the cabinet. Remove the access plate and verify that the edge guarding is installed and intact.
2. Secure the conduit to the access plate of the Liebert BDC.
3. Input power cables connect to the system input circuit breaker; refer to **Figure 33** and to **Table 13**.
4. Connect the ground (earth) wire to the earth busbar and tighten it to 240lb-in. (27N-m) (M10 bolt).
5. Locate UPS input and output cables and access panel to UPS on lower right side.

**NOTE**
*If the Liebert BDC is not to be bolted to the UPS, use either top or bottom access plate.*

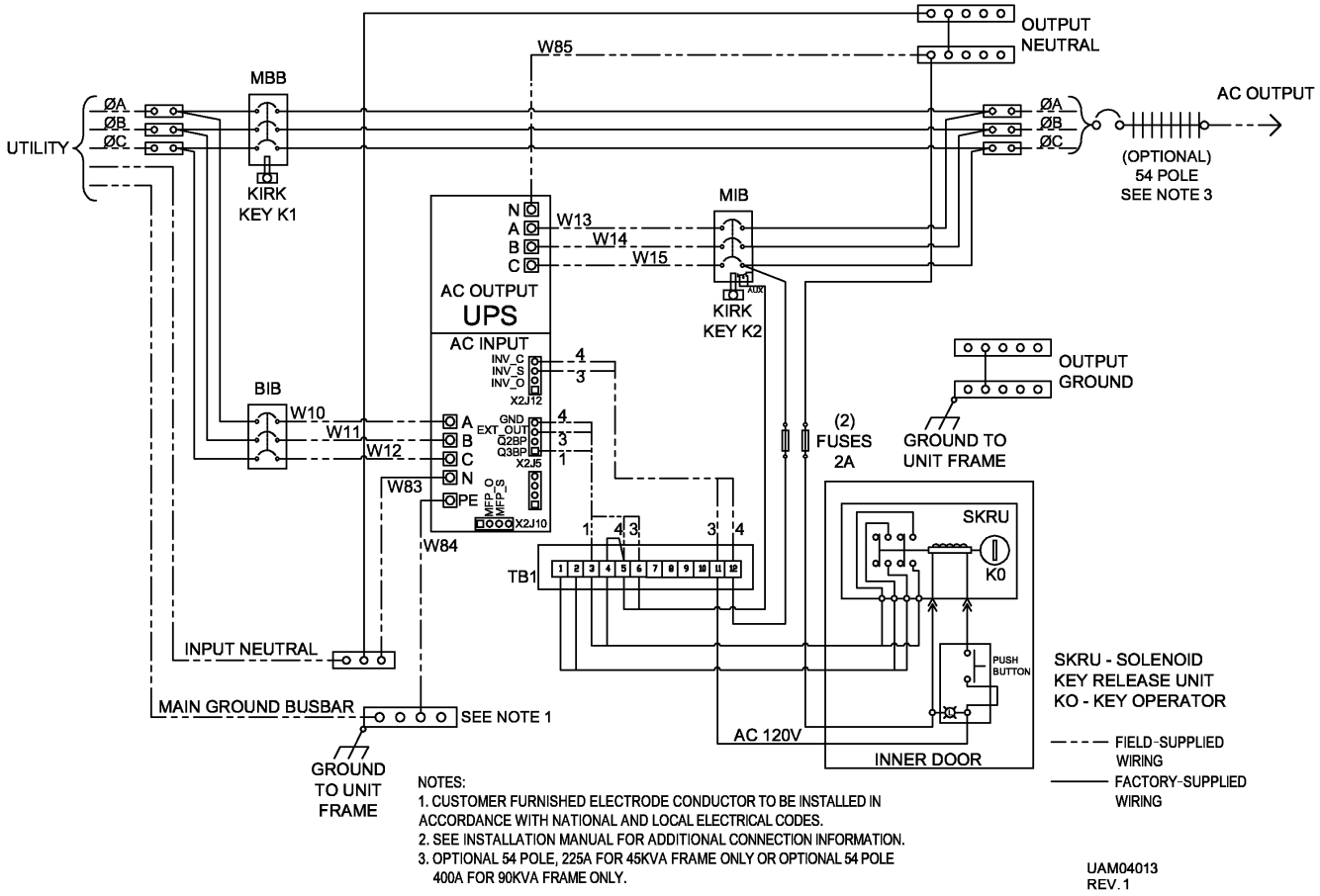
6. Connect the system ground cable between the Liebert BDC and UPS and tighten the connections to 240lb-in. (27N-m) (M10 bolt).
7. Connect the system input cables between the Liebert BDC “UPS Input” Busbars (A-B-C N terminals) and UPS input busbars (A-B-C N terminals) and tighten the connections to 240lb-in. (27N-m) (M10 bolt).
8. Connect the system output cables between the Liebert BDC 'UPS Output' Busbars (A-B-C N terminals) and UPS output busbars (A-B-C N terminals) and tighten the connections to 240lb-in. (27N-m) (M10 bolt).
9. Connect TB1 from the Liebert BDC to J5 and J12 on the Liebert APM.

**WARNING**
The control wire must be installed to ensure proper operation of the system and fully protect the load when switching between bypass cabinet and UPS.

**Table 8 Control wiring for Liebert APM UPS to Liebert BDC**

| From | To |
|---|---|
| Liebert APM UPS Monitor Board (X2 J5 & J12) | Liebert BDC Terminal Strip (TB1) |
| J12-3 | TB1-11 |
| J12-4 | TB1-12 |
| J5-1 | TB1-3 |
| J5-3 | TB1-6 |
| J5-4 | TB1-5 |
| | Jumper TB1-4 to TB1-5 |

**Figure 23 BDC connection to Liebert APM**




**NOTE**

*Install jumper on TB1 pins 4 and 5.*

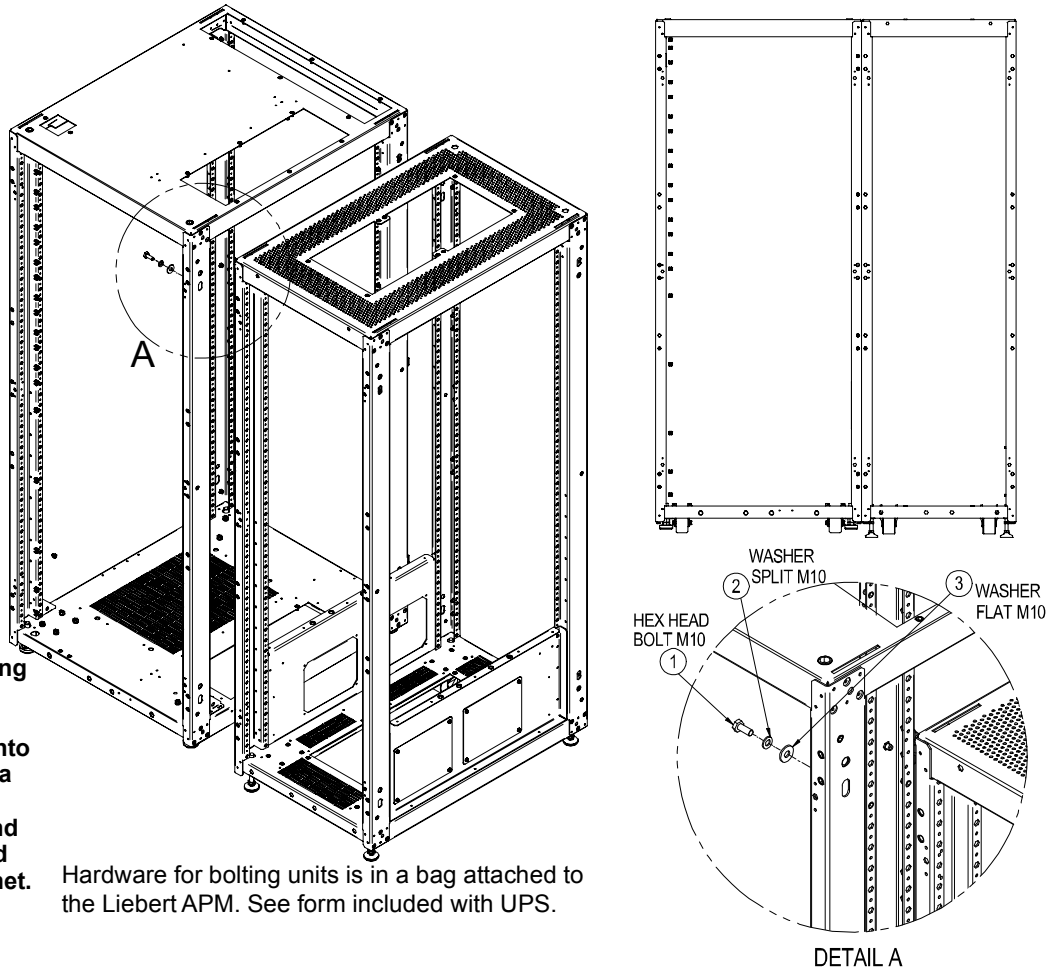
*For startup procedure, see* ***9.2 - UPS Startup****.*

## 4.5 Bolting Cabinets Together

**NOTE**
*UPS wiring must be completed before the cabinets are bolted together.*

1. Line up cabinets so that mounting holes are aligned.

**Figure 24 Bolting Liebert APM to a Liebert BDC**




**Place cabinets so mounting holes are aligned.**
**A bolt from the adjacent cabinet may be screwed into the threaded top hole, or a bolt may be inserted through the lower hole and screwed into the threaded hole in the adjacent cabinet.**

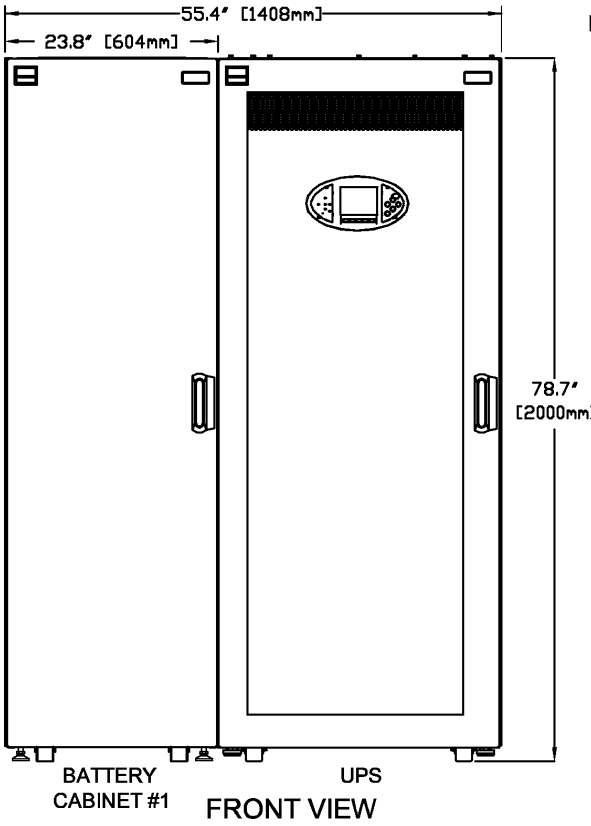
Hardware for bolting units is in a bag attached to the Liebert APM. See form included with UPS.

2. Using supplied hardware, bolt the cabinets together. The bolts may be inserted from either the UPS side or from the Liebert BDC side, whichever is more convenient.

# 5.0 INSTALLATION DRAWINGS

The diagrams in this section illustrate the key mechanical and electrical characteristics of the Liebert APM UPS System cabinets (UPS, Liebert BDC and battery).

**Figure 25 UPS dimensions- front view**




NOTES:
1. ALL DIMENSIONS ARE IN inches [mm].
2. 24" [610] MINIMUM CLEARANCE ABOVE UNIT AND 12" [305] REAR CLEARANCE REQUIRED FOR AIR EXHAUST. 36" [914] FRONT ACCESS REQUIRED FOR SERVICE.
3. KEEP CABINET WITHIN 15 DEGREES OF VERTICAL.
4. TOP AND BOTTOM CABLE ENTRY AVAILABLE THROUGH REMOVABLE ACCESS PLATES. REMOVE, PUNCH TO SUIT CONDUIT SIZE AND REPLACE.
5. UNIT BOTTOM IS STRUCTURALLY ADEQUATE FOR FORKLIFT HANDLING.
6. CONTROL WIRING AND POWER WIRING MUST BE RUN IN SEPARATE CONDUITS.
7. COPPER CABLES ONLY ARE RECOMMENDED.
8. ALL WIRING IS TO BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.
9. ALL BATTERY CABINETS MUST BE POSITIONED ON THE LEFT SIDE OF UPS.

| TOTAL WIDTH WITH ADDITIONAL BATTERY CABINETS | |
|---|---|
| NO. OF BATT. CABINETS | TOTAL WIDTH |
| 2 | 79.1 [2008] |
| 3 | 102.7 [2608] |
| 4 | 126.3 [3208] |

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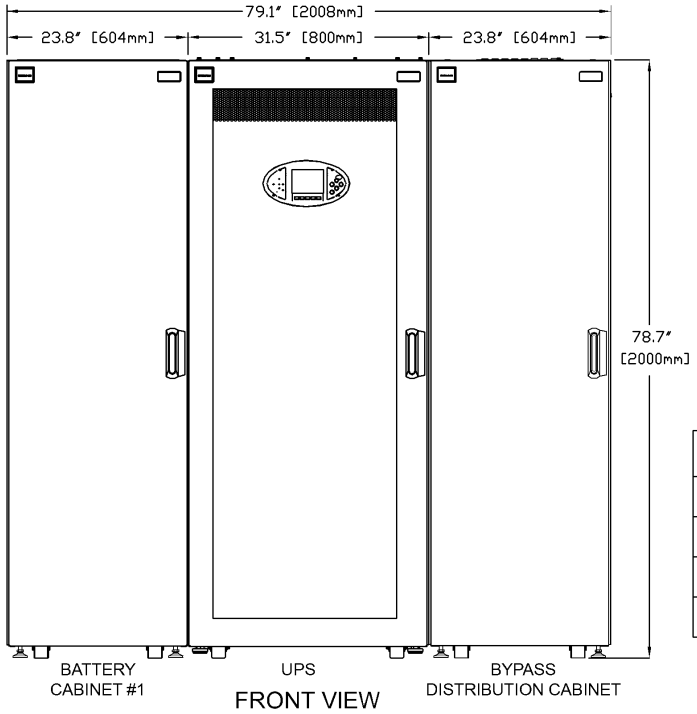
**Figure 26 Lineup arrangement, Liebert APM with battery and Liebert BDCs**




NOTES:
1. ALL DIMENSIONS ARE IN inches [mm].
2. 24" [610] MINIMUM CLEARANCE ABOVE UNIT AND 12" [305] REAR CLEARANCE REQUIRED FOR AIR EXHAUST. 36" [914] FRONT ACCESS REQUIRED FOR SERVICE.
3. KEEP CABINET WITHIN 15 DEGREES OF VERTICAL.
4. TOP AND BOTTOM CABLE ENTRY AVAILABLE THROUGH REMOVABLE ACCESS PLATES. REMOVE, PUNCH TO SUIT CONDUIT SIZE AND REPLACE.
5. UNIT BOTTOM IS STRUCTURALLY ADEQUATE FOR FORKLIFT HANDLING.
6. CONTROL WIRING AND POWER WIRING MUST BE RUN IN SEPARATE CONDUITS.
7. COPPER CABLES ONLY ARE RECOMMENDED.
8. ALL WIRING IS TO BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.
9. ALL BATTERY CABINETS MUST BE POSITIONED ON THE LEFT SIDE OF UPS.
10. MAINTENANCE BYPASS MUST BE POSITIONED ON THE RIGHT SIDE OF UPS.

| TOTAL WIDTH WITH ADDITIONAL BATTERY CABINETS | |
|---|---|
| NO. OF BATT. CABINETS | TOTAL WIDTH |
| 2 | 102.7 [2608] |
| 3 | 126.3 [3208] |
| 4 | 149.9 [3808] |

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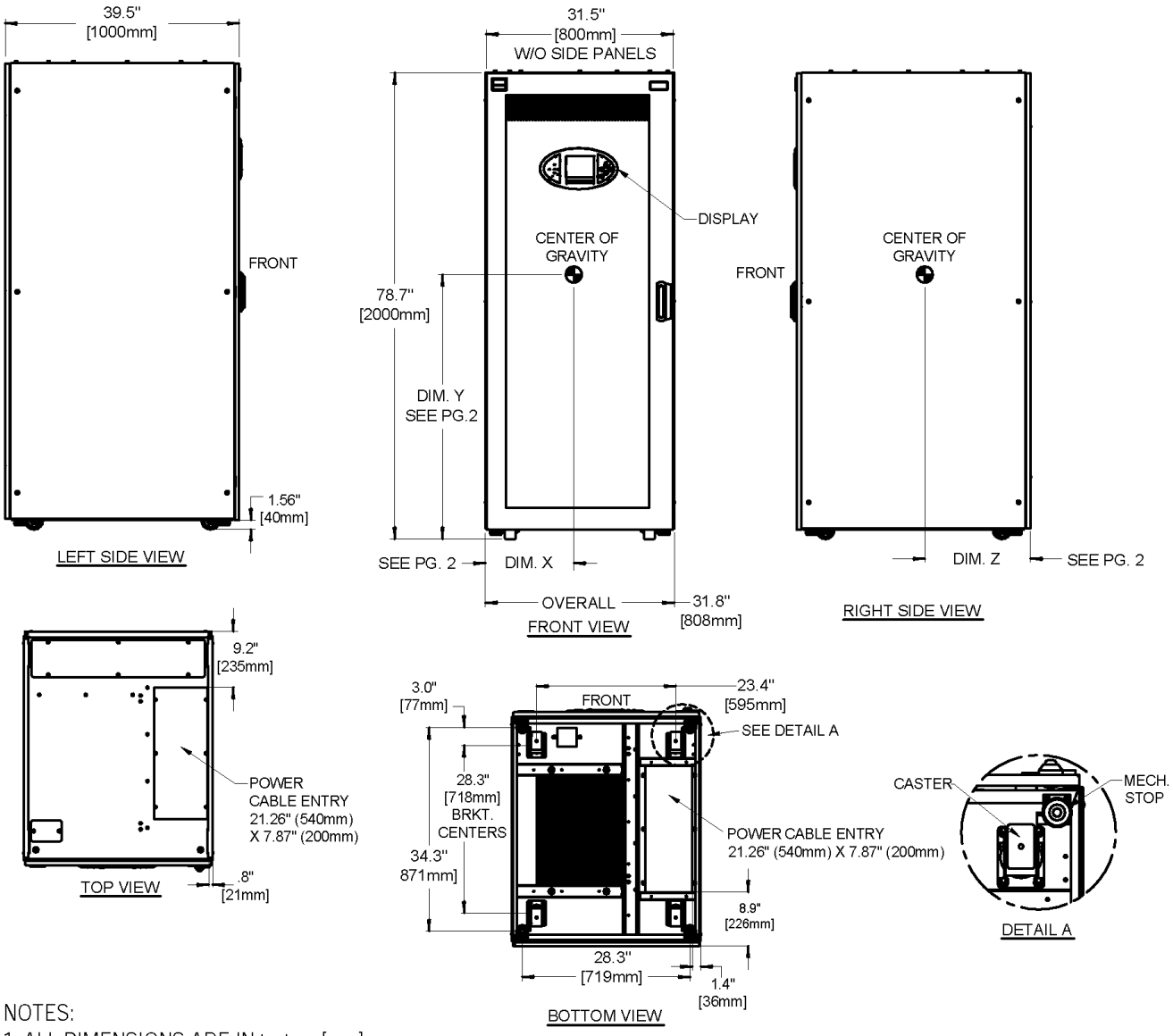
**Figure 27 UPS dimensions continued, center of gravity—side, top and bottom views**




NOTES:

1. ALL DIMENSIONS ARE IN inches [mm].
2. 24" [610] MINIMUM CLEARANCE ABOVE UNIT AND 12" [305] REAR CLEARANCE REQUIRED FOR AIR EXHAUST AND 36" [914] FRONT ACCESS REQUIRED FOR SERVICE.
3. KEEP CABINET WITHIN 15 DEGREES OF VERTICAL.
4. TOP AND BOTTOM CABLE ENTRY AVAILABLE THROUGH REMOVABLE ACCESS PLATES. REMOVE, PUNCH TO SUIT CONDUIT SIZE AND REPLACE.
5. UNIT BOTTOM IS STRUCTURALLY ADEQUATE FOR FORKLIFT HANDLING.
6. CONTROL WIRING AND POWER WIRING MUST BE RUN IN SEPARATE CONDUITS.
7. ONLY COPPER CABLES ARE RECOMMENDED.
8. ALL WIRING IS TO BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.
9. SEE PAGE 2 OF 2 DRAWING: UAM02010B FOR WEIGHT TABLE AND CENTERS OF GRAVITY.

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**Refer to Tables 9 and 10 for Dimensions X, Y and Z in each Liebert APM model.**

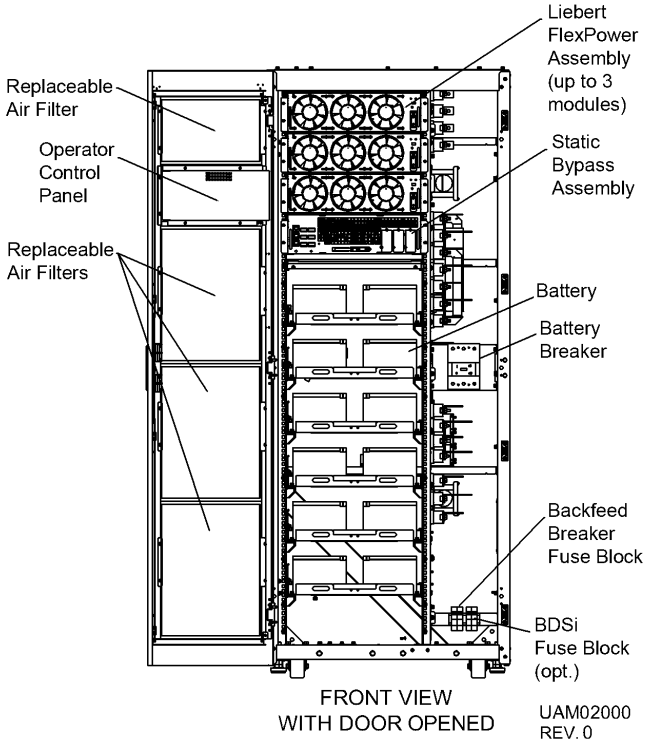
**Table 9 Center of gravity and weights for Liebert APM 90 kVA frame UPS**

| KVA Rating | Center of Gravity | | | Weight, lb (kg) | |
|---|---|---|---|---|---|
| | Dimension X | Dimension Y | Dimension Z | Unit | Shipping |
| **No Internal Batteries** | | | | | |
| 15 | 16.65 (423) | 37.64 (956) | 18.78 (477) | 705 (320) | 775 (352) |
| 30 | 16.18 (411) | 38.66 (982) | 18.54 (471) | 780 (354) | 850 (386) |
| 45 | 15.79 (401) | 39.88 (1013) | 18.35 (466) | 855 (388) | 925 (420) |
| 60 | 15.47 (393) | 41.30 (1049) | 18.15 (461) | 930 (422) | 1000 (454) |
| 75 | 15.16 (385) | 42.87 (1089) | 17.99 (457) | 1005 (456) | 1075 (488) |
| 90 | 14.88 (378) | 44.57 (1132) | 17.83 (453) | 1080 (490) | 1150 (522) |

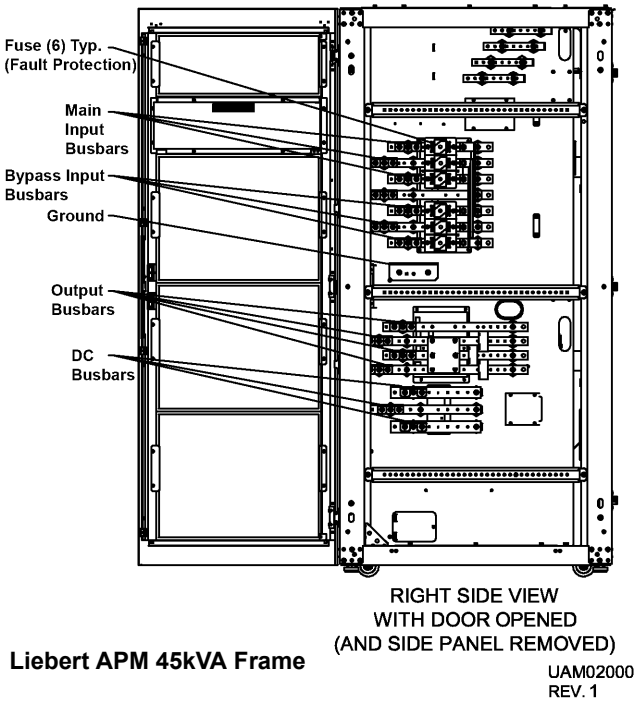
**Table 10 Center of gravity and weights for Liebert APM 45 kVA frame UPS**

| KVA Rating | Center of Gravity | | | Weight, lb (kg) | |
|---|---|---|---|---|---|
| | Dimension X | Dimension Y | Dimension Z | Unit | Shipping |
| **No Internal Batteries** | | | | | |
| 15 | 15.87 (403) | 36.18 (919) | 18.31 (465) | 919 (417) | 989 (449) |
| 30 | 15.71 (399) | 37.64 (956) | 18.19 (462) | 994 (451) | 1064 (483) |
| 45 | 15.59 (396) | 39.13 (994) | 18.07 (459) | 1069 (485) | 1139 (517) |
| **12HX100 Batteries** | | | | | |
| 15 | 14.29 (363) | 31.50 (800) | 21.30 (541) | 1981 (899) | 2051 (930) |
| 30 | 13.94 (354) | 33.46 (850) | 21.59 (548.4) | 2052 (931) | 2122 (963) |
| 45 | 13.62 (346) | 35.04 (890) | 21.73 (552) | 2127 (965) | 2197 (997) |
| **12HX150 Batteries** | | | | | |
| 15 | 14.25 (362) | 30.91 (785) | 21.54 (547) | 2455 (1114) | 2525 (1145) |
| 30 | 13.78 (350) | 32.87 (835) | 21.81 (554) | 2530 (1148) | 2600 (1179) |
| 45 | 13.39 (340) | 34.72 (882) | 22.05 (560) | 2605 (1182) | 2675 (1213) |

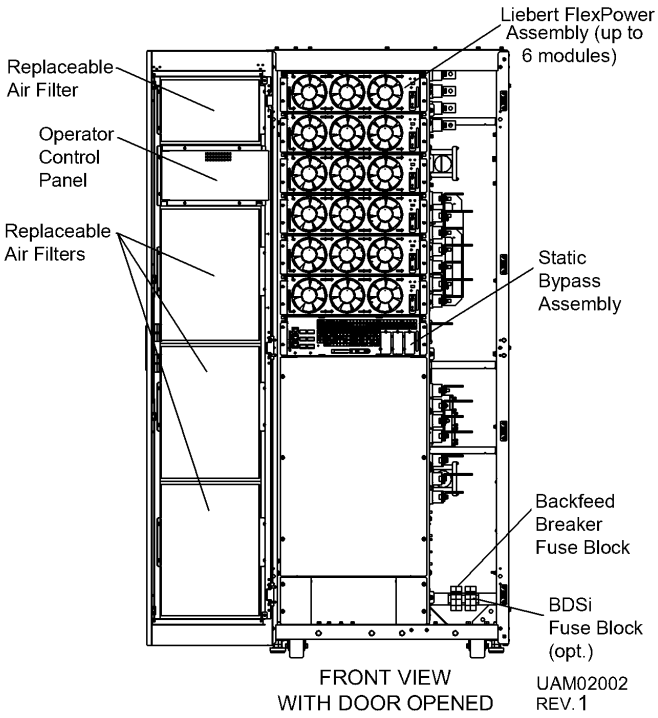
**Figure 28 UPS main components—typical unit**




**Liebert APM 90kVA Frame**




**Liebert APM 45kVA Frame**



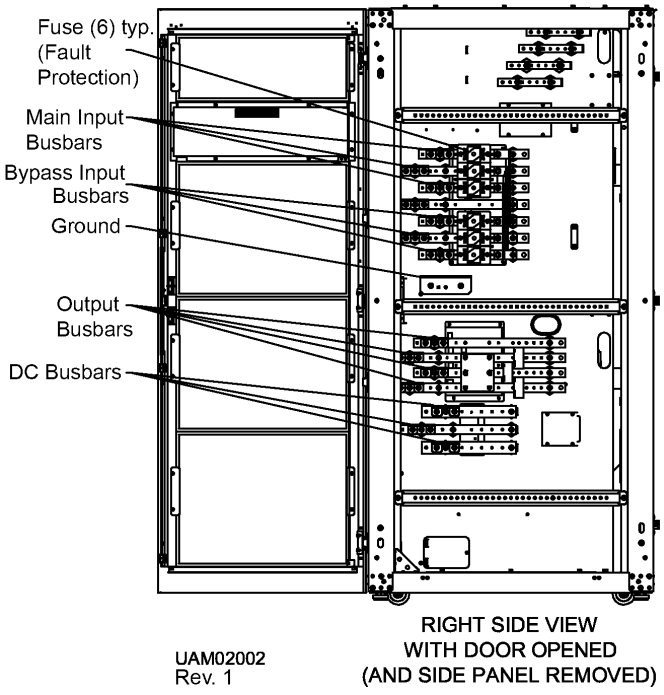
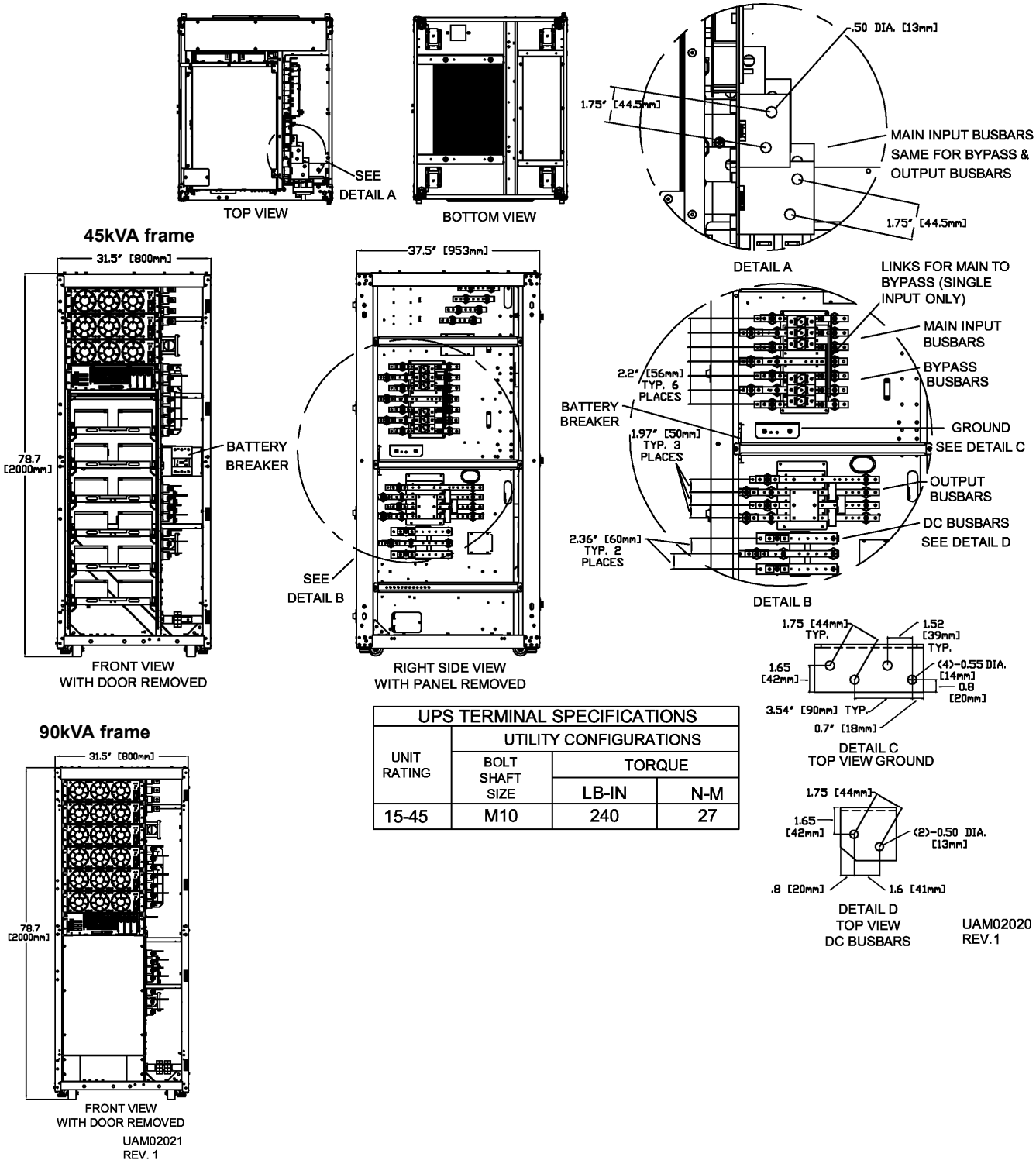



**Figure 29 UPS cable connections—45kVA and 90kVA frames**

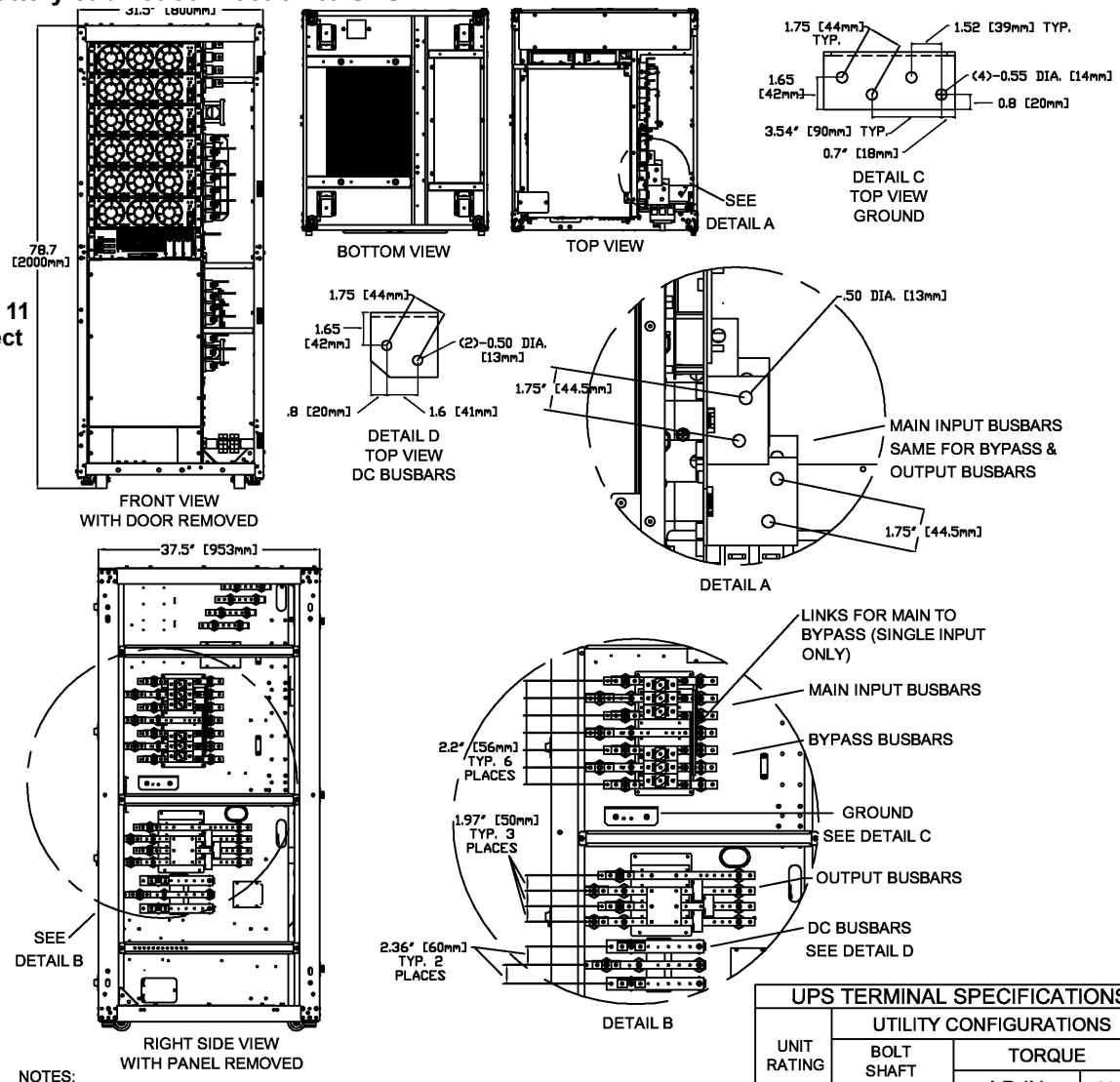



| UPS TERMINAL SPECIFICATIONS | | | |
|---|---|---|---|
| UNIT RATING | UTILITY CONFIGURATIONS | | |
| | BOLT SHAFT SIZE | TORQUE | |
| | | LB-IN | N-M |
| 15-45 | M10 | 240 | 27 |

NOTES:
1. ALL DIMENSIONS ARE IN inches [mm].
2. CONTROL WIRING AND POWER WIRING MUST BE RUN IN SEPARATE CONDUITS.
3. COPPER CABLES ONLY ARE RECOMMENDED.
4. ALL WIRING IS TO BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.

## Figure 30 Battery cabinet connection to UPS

**Refer to Table 11 for interconnect wiring**




| UPS TERMINAL SPECIFICATIONS | | | |
|---|---|---|---|
| UNIT RATING | UTILITY CONFIGURATIONS | | |
| | BOLT SHAFT SIZE | TORQUE | |
| | | LB-IN | N-M |
| 15-45 | M10 | 240 | 27 |

NOTES:
1. ALL DIMENSIONS ARE IN inches [mm].
2. CONTROL WIRING AND POWER WIRING MUST BE RUN IN SEPARATE CONDUITS.
3. COPPER CABLES ONLY ARE RECOMMENDED.
4. ALL WIRING IS TO BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.

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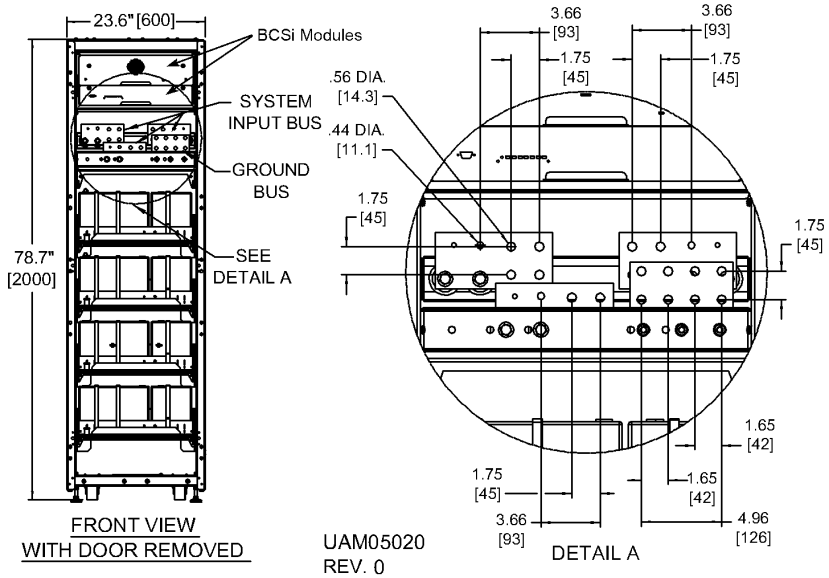


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**Table 11 Interconnect wiring for Liebert APM to battery cabinet**

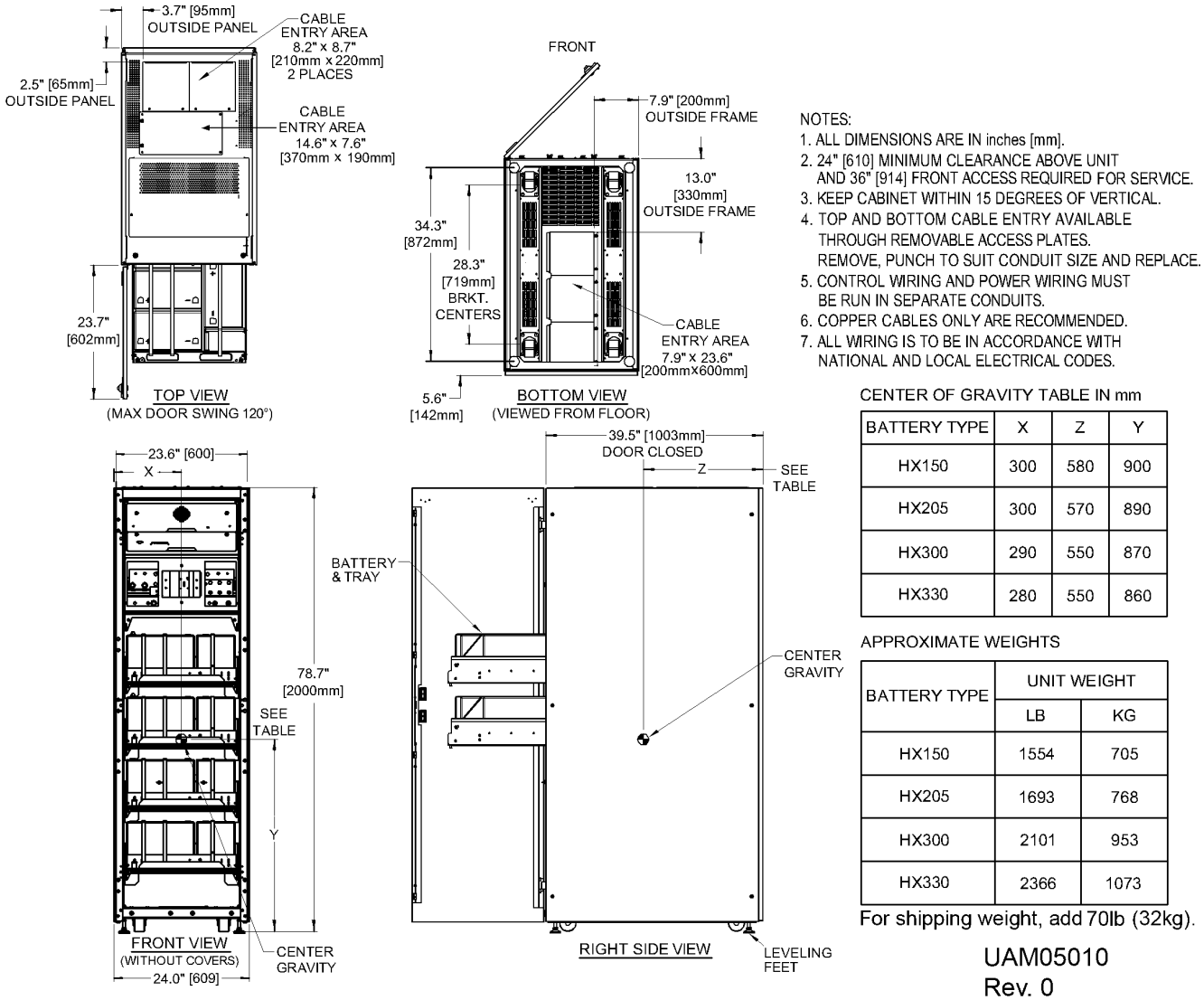
| Run | From | To | Conductors |
|---|---|---|---|
| A | UPS Battery Busbar | External Battery Cabinet Busbar | Positive, Midpoint, Negative |
| B | Battery Cabinet Terminal Block TB1 | UPS Static Bypass Assembly<br>J4 and J8 | Battery Breaker Shunt and Aux Contacts |

See **Figure 19** for additional details.

**NOTE**

*Wiring is supplied when the UPS and external battery cabinet are ordered as a system.*

**Figure 31 Battery cabinet outline drawing, weights and center of gravity**




CENTER OF GRAVITY TABLE IN mm

| BATTERY TYPE | X | Z | Y |
|---|---|---|---|
| HX150 | 300 | 580 | 900 |
| HX205 | 300 | 570 | 890 |
| HX300 | 290 | 550 | 870 |
| HX330 | 280 | 550 | 860 |

APPROXIMATE WEIGHTS

| BATTERY TYPE | UNIT WEIGHT | |
|---|---|---|
| | LB | KG |
| HX150 | 1554 | 705 |
| HX205 | 1693 | 768 |
| HX300 | 2101 | 953 |
| HX330 | 2366 | 1073 |

For shipping weight, add 70lb (32kg).

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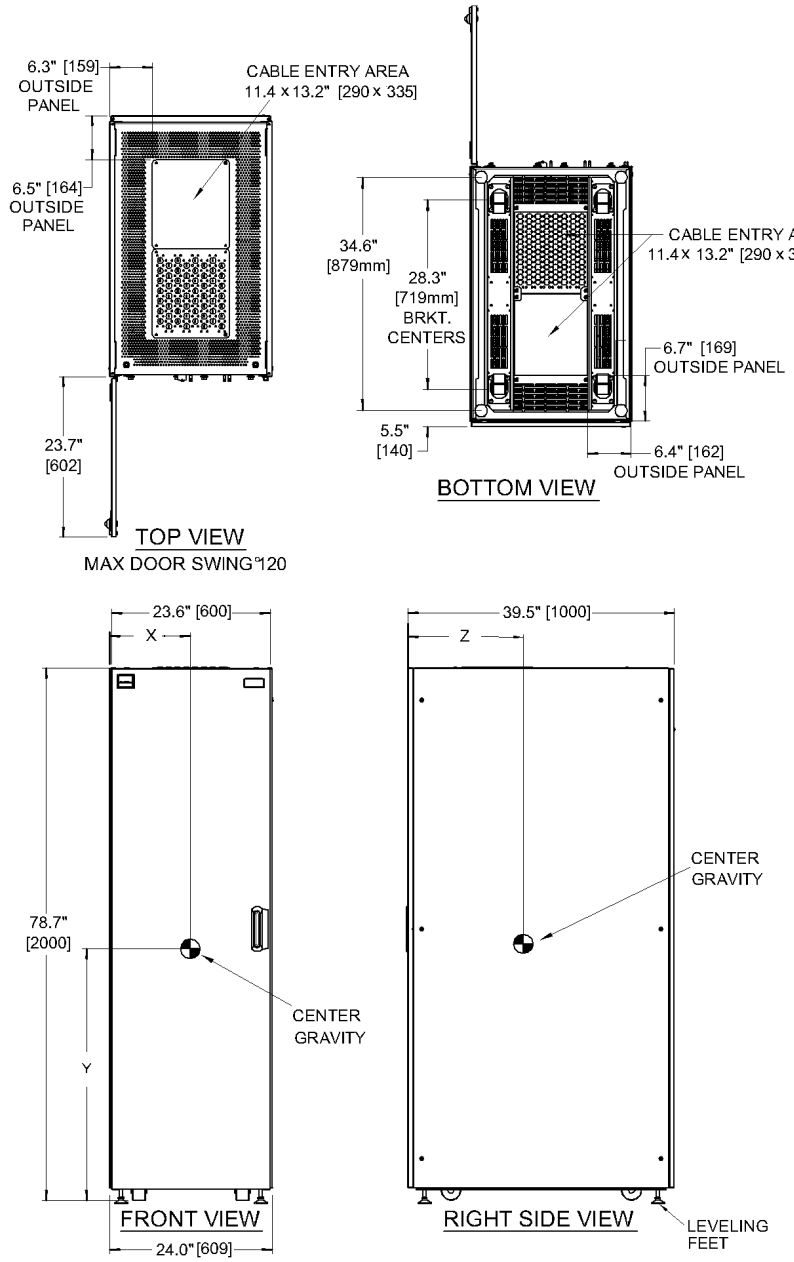
**Figure 32 Outline drawing, Liebert BDC for Liebert APM, 15-90kVA**




APPROXIMATE WEIGHTS

| BYPASS, CABINET TYPE | UNIT WEIGHT | |
|---|---|---|
| | LBS | KG |
| WITHOUT TRANSFORMER | 902 | 410 |

For shipping weight, add 70lb (32kg).

LOCATIONS FOR CENTER OF GRAVITY

| DIM. / MODEL | X | Z | Y |
|---|---|---|---|
| BYPASS CAB WITHOUT TRANSFORMER | 11.8" [300] | 14.9" [379] | 39.4" [1000] |

NOTES:

1. ALL DIMENSIONS ARE IN inches [mm].
2. 24" [610] MINIMUM CLEARANCE ABOVE UNIT AND 36" [914] FRONT ACCESS REQUIRED FOR SERVICE.
3. KEEP CABINET WITHIN 15 DEGREES OF VERTICAL.
4. TOP AND BOTTOM CABLE ENTRY AVAILABLE THROUGH REMOVABLE ACCESS PLATES. REMOVE, PUNCH TO SUIT CONDUIT SIZE AND REPLACE.
5. CONTROL WIRING AND POWER WIRING MUST BE RUN IN SEPARATE CONDUITS.
6. COPPER CABLES ONLY ARE RECOMMENDED.
7. ALL WIRING IS TO BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.

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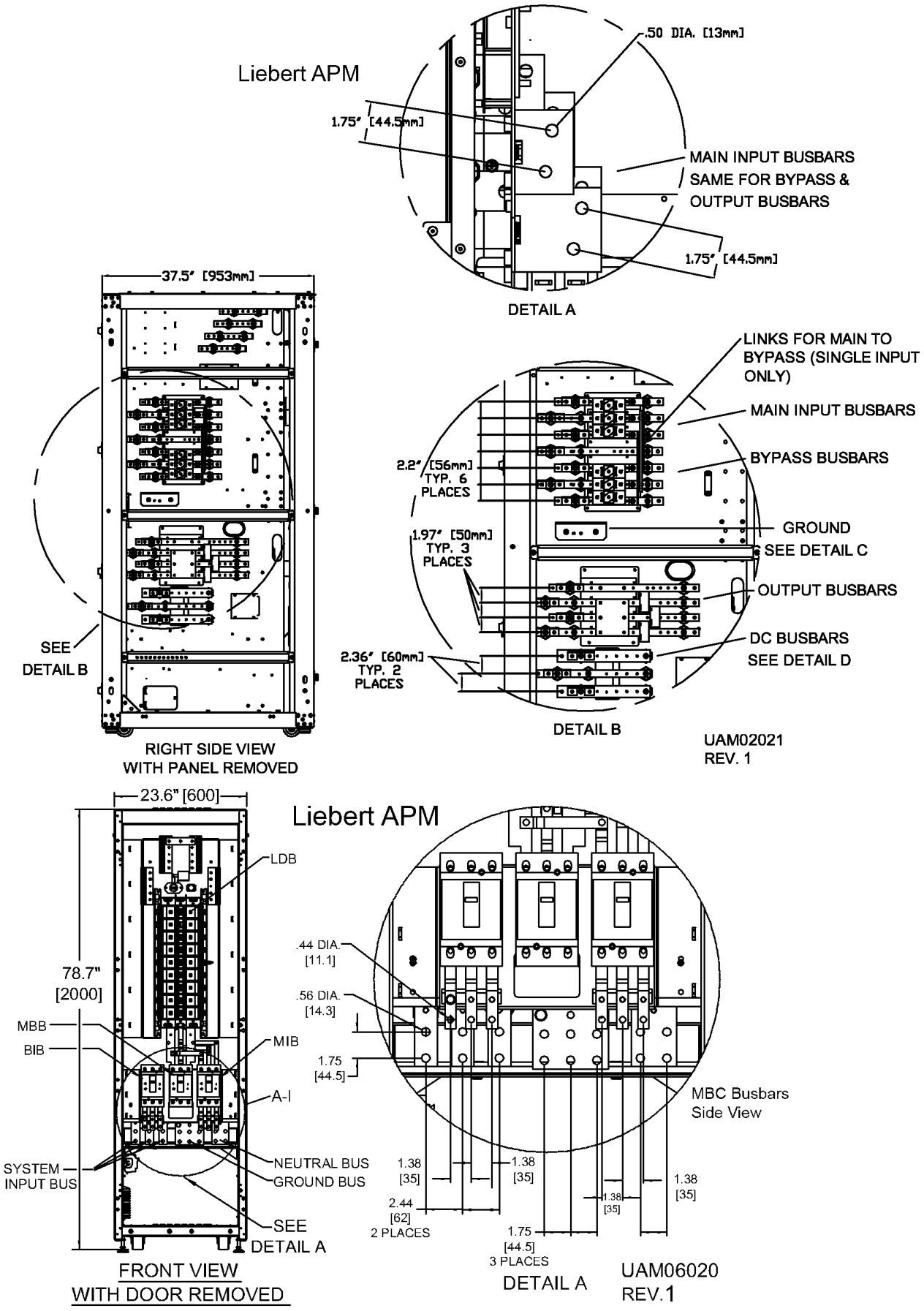
**Figure 33 Liebert BDC connection to UPS**



## NOTES

1. All Liebert-supplied cable must be repositioned prior to and while the cabinets are being placed in their final installed location.
2. All interconnection hardware supplied by Liebert.
3. AC connections must be made to the UPS module before attaching Liebert BDC to UPS module.
4. All cabling will be field-supplied when a Liebert BDC is configured as a stand-alone cabinet.
5. Liebert BDCs must attach to the right side only of the Liebert APM.
6. Refer to the individual drawing of each piece of equipment for additional details.

**Table 12 Interconnect wiring for Liebert APM to Liebert BDC**

| Run | From | To | Conductors |
|---|---|---|---|
| A | Utility AC source | BDC System Input Bus | Phase A, B, C |
| B | Utility AC Source | BDC System Input Bus | Neutral |
| C | BDC Bypass Isolation Breaker | UPS Main Input | Phase A, B, C |
| D | BDC Bypass Isolation Breaker | UPS Main Input | Neutral |
| E | UPS Output | MBC Maintenance Isolation Breaker | Phase A, B, C |
| F | UPS Output | MBC Maintenance Isolation Breaker | Neutral |
| G | BDC Panelboard | Load AC Connection | Phase A, B, C |
| H | BDC Panelboard | Load AC Connection | Neutral |
| I | Utility AC Source | All Ground Connections | Ground |
| J | BDC Terminal Block TB1 | UPS Static Bypass Module J5 and J12 | Wiring for KO on MBC |

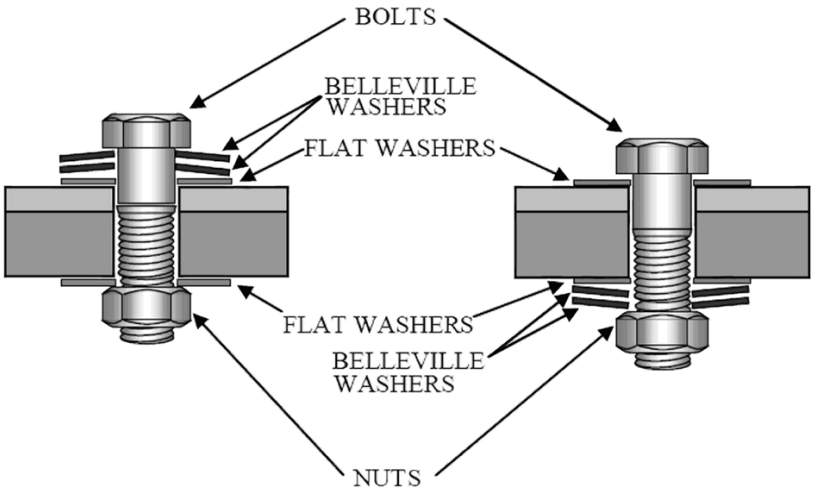
See **Figure 23** and **Table 8** for additional details.

**NOTE**
*Wiring is supplied when the UPS and Liebert BDC are ordered as a system.*

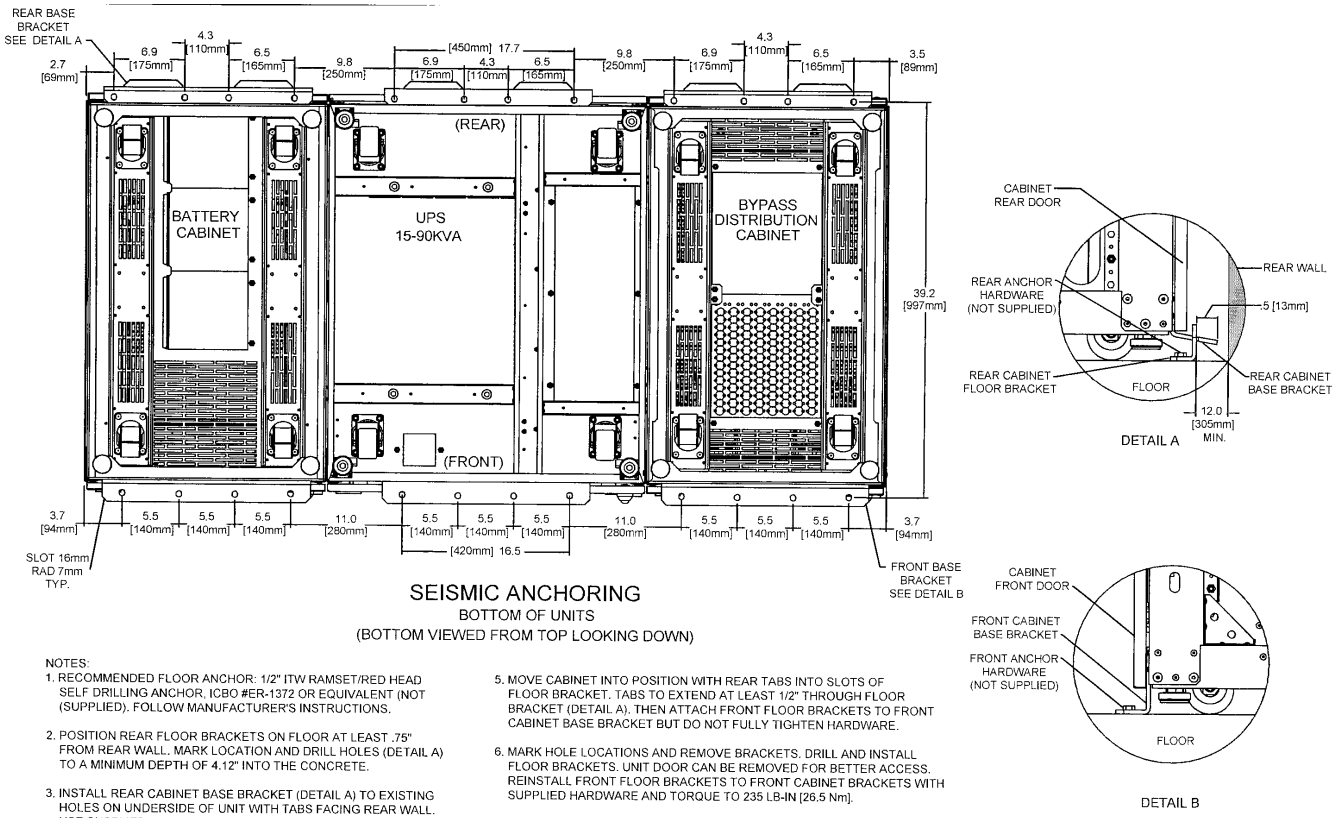
**Table 13 Spring washer torque application**

| Hardware | Two Belleville Washers |
|---|---|
| M10 (3/8") | 240 lb-in. (27 N-m) |

**Figure 34 Acceptable hardware configuration for torque application**



## Figure 35 Seismic mounting bracket details




SEISMIC ANCHORING
BOTTOM OF UNITS
(BOTTOM VIEWED FROM TOP LOOKING DOWN)

NOTES:

1. RECOMMENDED FLOOR ANCHOR: 1/2" ITW RAMSET/RED HEAD SELF DRILLING ANCHOR, ICBO #ER-1372 OR EQUIVALENT (NOT (SUPPLIED). FOLLOW MANUFACTURER'S INSTRUCTIONS.
2. POSITION REAR FLOOR BRACKETS ON FLOOR AT LEAST .75" FROM REAR WALL. MARK LOCATION AND DRILL HOLES (DETAIL A) TO A MINIMUM DEPTH OF 4.12" INTO THE CONCRETE.
3. INSTALL REAR CABINET BASE BRACKET (DETAIL A) TO EXISTING HOLES ON UNDERSIDE OF UNIT WITH TABS FACING REAR WALL. USE SUPPLIED HARDWARE AND TORQUE TO 365 LB-INCH [41.2 NM]. NOTE. LOOSEN LEVELING BOLT LOCKING NUT AND TIGHTEN AFTER BRACKET IS SECURED.
4. INSTALL FRONT CABINET BASE BRACKET (DETAIL B) TO EXISTING HOLES ON UNDERSIDE OF UNIT WITH BENT FLANGE FACING FRONT. USE SUPPLIED HARDWARE AND TORQUE TO 365 LB-INCH [41.2 NM]. NOTE. LOOSEN LEVELING BOLT LOCKING NUT AND TIGHTEN AFTER BRACKET IS SECURED.
5. MOVE CABINET INTO POSITION WITH REAR TABS INTO SLOTS OF FLOOR BRACKET. TABS TO EXTEND AT LEAST 1/2" THROUGH FLOOR BRACKET (DETAIL A). THEN ATTACH FRONT FLOOR BRACKETS TO FRONT CABINET BASE BRACKET BUT DO NOT FULLY TIGHTEN HARDWARE.
6. MARK HOLE LOCATIONS AND REMOVE BRACKETS. DRILL AND INSTALL FLOOR BRACKETS. UNIT DOOR CAN BE REMOVED FOR BETTER ACCESS. REINSTALL FRONT FLOOR BRACKETS TO FRONT CABINET BRACKETS WITH SUPPLIED HARDWARE AND TORQUE TO 235 LB-IN [26.5 Nm].
7. AFTER ALL CABINETS ARE MOVED INTO PLACE AND SECURED TO THE FLOOR, MULTIPLE CABINET CONFIGURATIONS ARE THEN BOLTED TOGETHER.
8. IF SIDE WALLS ARE PRESENT, 1.0" [25.4MM] MINIMUM DISTANCE FROM EITHER SIDE WALL IS REQUIRED.

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# 6.0 OPTION INSTALLATION

## 6.1 Liebert IntelliSlot Communication

The Liebert APM has three Liebert IntelliSlot ports to allow field-installation of optional communication cards. Liebert IntelliSlot cards communicate via Liebert's proprietary Velocity protocol to cards that translate the information into such protocols as SNMP and Modbus. Other cards provide dry contact signals for external signaling of operating status.

The Liebert IntelliSlot communication ports may be installed or removed while the Liebert APM is operating.

## 6.2 Liebert IntelliSlot Web Card—SNMP/HTTP Network Interface Card

This network interface card provides all real-time data and status information as SNMPv1 traps for connection to a 10/100-baseT Ethernet connection. The same card also will transmit the same status information and all measured parameters for display via a Web browser. The Liebert IntelliSlot bays are on the right side of the control module and labeled as IntelliSlot1, IntelliSlot2 and IntelliSlot3.

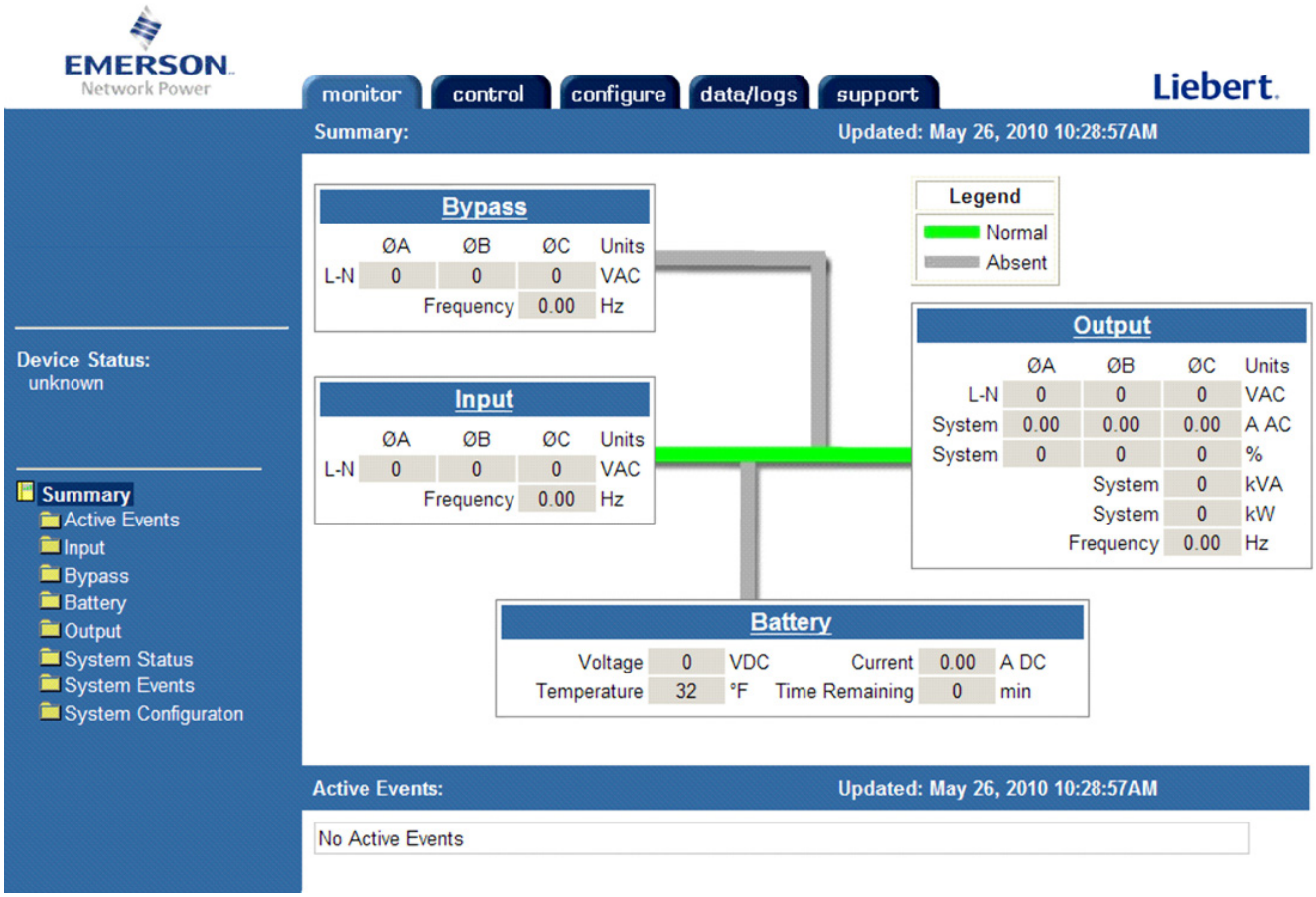
**Table 14 Liebert APM communication options**

| Port Type and Location | Labeled ID Name of Port | Monitoring Devices Supported |
|---|---|---|
| Left Liebert IntelliSlot | IntelliSlot 1 | MultiPort 4 |
| | | Relaycard-int |
| | | ISWEB-L |
| | | Modbus |
| Center Liebert IntelliSlot | IntelliSlot 2 | MultiPort 4 |
| | | Relaycard-int |
| | | ISWEB-L |
| | | Modbus |
| Right Liebert IntelliSlot | IntelliSlot 3 | MultiPort 4 |
| | | Relaycard-int |
| | | ISWEB-L |
| | | Modbus |

## 6.3 Web Card—Optional

An optional Web card is available that provides remote access to the UPS. A wide variety of status and summary information is available through an Ethernet connection.

**Figure 36 Liebert IntelliSlot Web card display**



## 6.4 Relay Card

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

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

The relay card is rated for 24 VAC/DC at 1A. and supported in any of the three Liebert IntelliSlot bays on the Liebert APM.

**Table 15 Relay Card pin configuration**

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

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

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

**Table 16 Relay card jumper configuration**

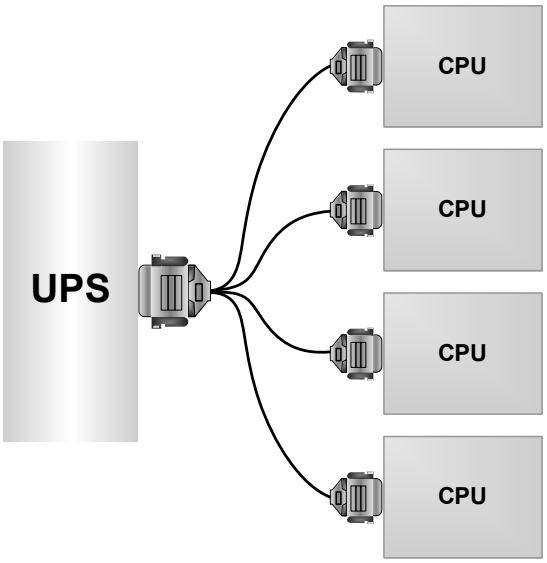
| Number | Connection | Description |
|---|---|---|
| JP01 | Pin 9 to Pin 17 | Allows all relay COMMONS to be tied together. |
| Any JP02 | Pin 7 to Pin 17 | **REMOVE** - Interconnects all relay COMMONS and the (not supported) MODE SHUTDOWN Return |

## 6.5 Liebert IntelliSlot MultiPort 4 Card

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

This card is supported in any of the three Liebert IntelliSlot bays on the Liebert APM.

**Figure 37 Liebert IntelliSlot MultiPort 4 card pin assignment**




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

## 6.6 Alber BDSi Battery Monitoring System—Optional

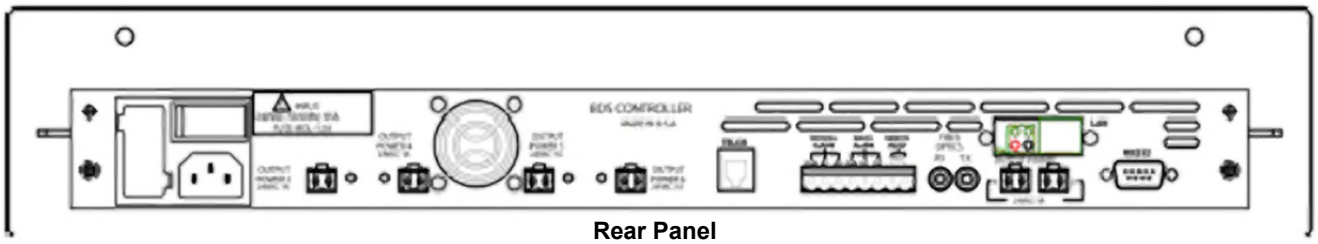
The matching Liebert battery cabinets allow installing an optional Alber BDSi battery monitoring system inside the cabinet. The Alber BDSi by Liebert continuously checks all critical battery parameters, such as cell voltage, overall string voltage, current and temperature. Automatic periodic tests of internal resistance of each battery will verify the battery's operating integrity. Additional capabilities include automatic internal DC resistance tests and trend analysis providing the ability to analyze performance and aid in troubleshooting.

The Alber BDSi system is installed inside the battery cabinet as shown in **Figure 30**. The monitoring system power inlet is wired to the Alber BDSi Fuse Block on the UPS (see **Figure 38**). The Alber BDSI fuse block supplies 120VAC and has an 8A fuse.

If required, power can be supplied from the output terminals of the UPS, a distribution panel or another UPS-protected source.

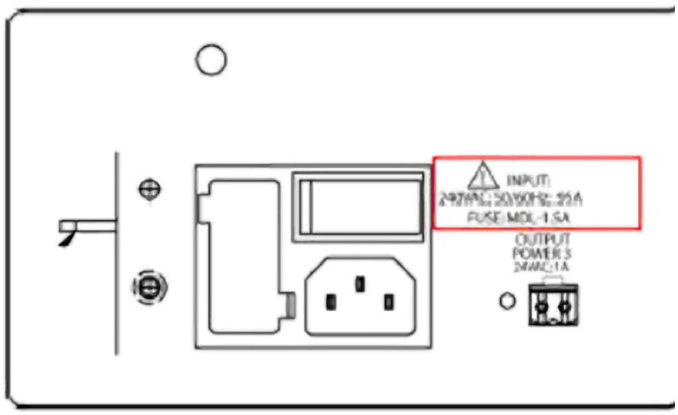
For details about operating the Alber system, see the Alber Monitoring System manual.

**Figure 38 Alber BDSi controller and input connection**



**Rear Panel**

**120VAC 50/60Hz**

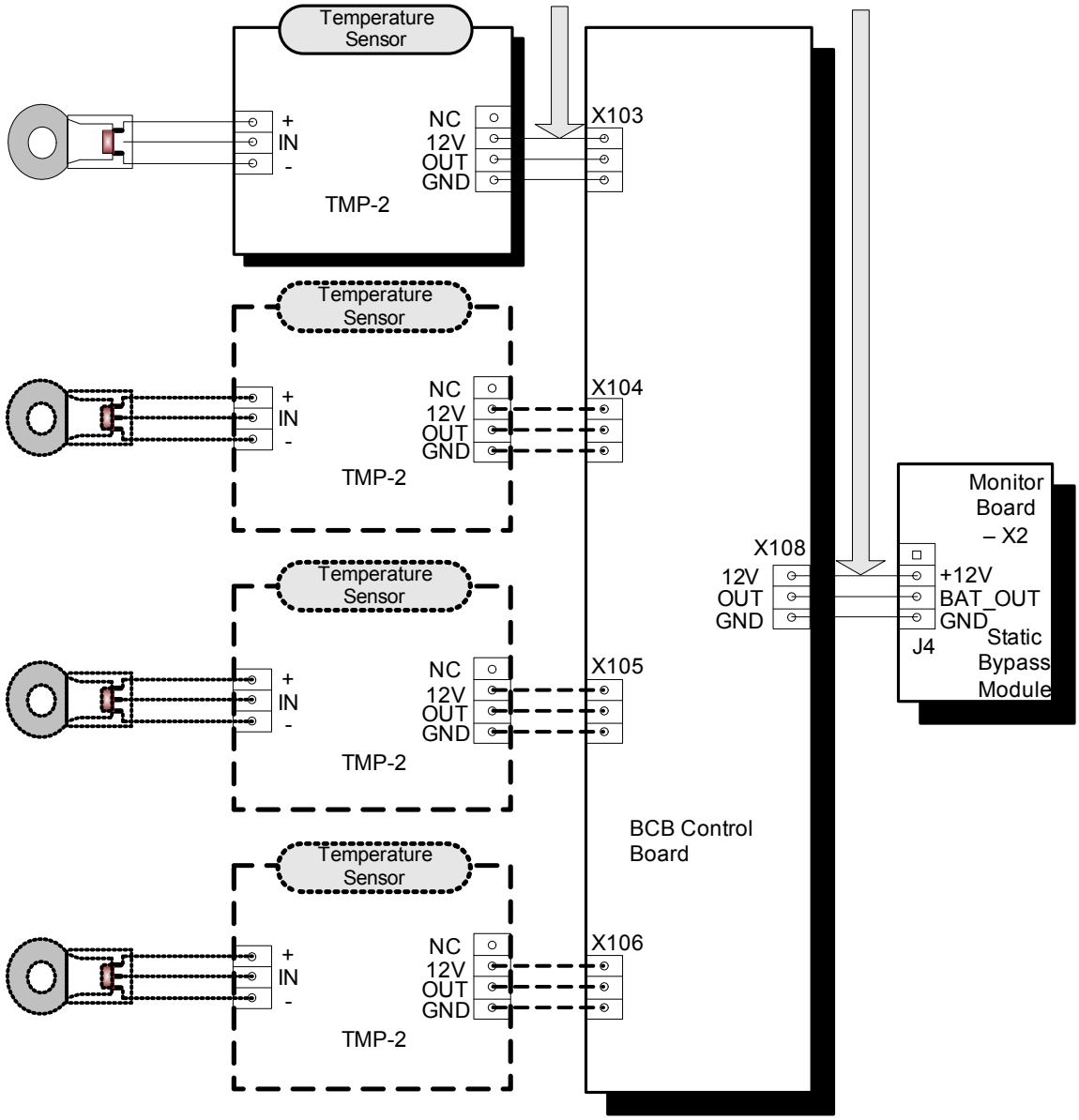



**Input**

## 6.7 Battery Temperature Compensation

For a UPS with external batteries, an optional battery temperature interface optimizes the external battery management by connecting up to four external temperature sensors from the battery cabinets to a control unit inside the UPS.

**Figure 39 Multi-temperature sensors**



# 7.0 OPERATION

**WARNING**

The Liebert APM contains high voltages internally. Components that can only be accessed by opening the protective cover with tools cannot be serviced or replaced by the user.

Only properly trained and qualified service personnel are authorized to remove the protective covers.

The Liebert APM operates in the modes shown in **Table 17**. This section describes various kinds of operating procedures under each operating mode, including transfer between operating modes, UPS setting and procedures for turning on/off inverter.

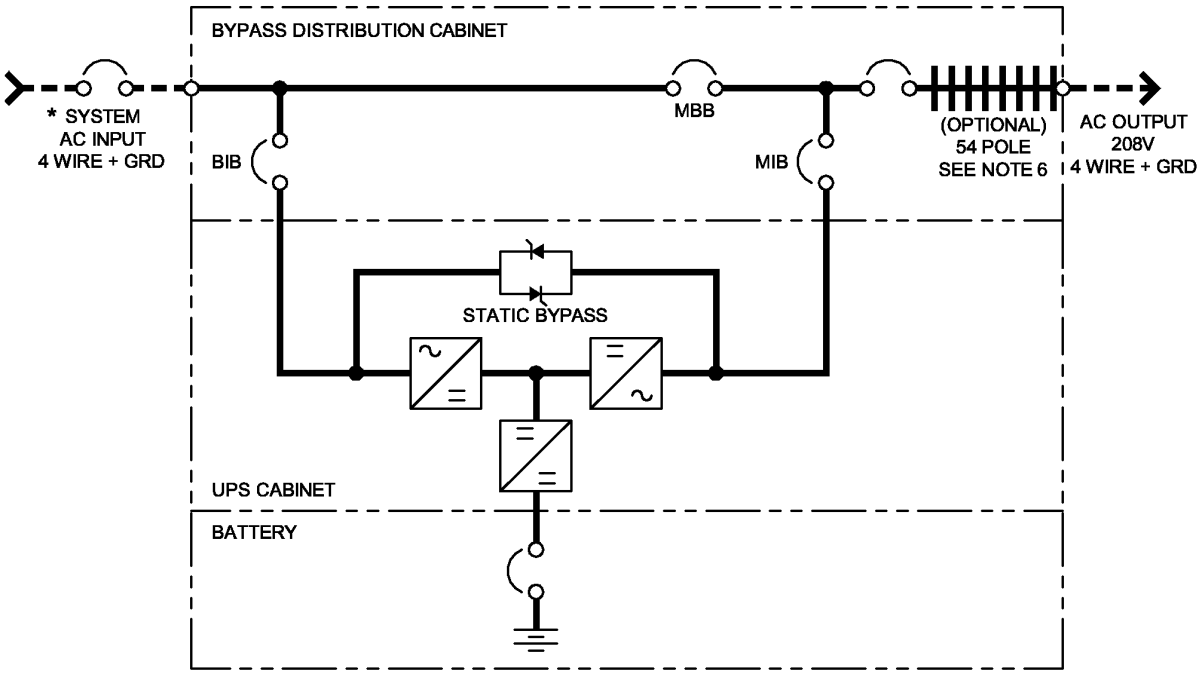
**Table 17 UPS operating modes**

| Operating mode | | Descriptions |
|---|---|---|
| Normal mode | NORMAL | UPS powers the load |
| Bypass mode | BYPASS | The load power supply is provided by the static bypass. This mode can be regarded as a temporary transition mode between the normal mode and maintenance bypass mode, or a temporary abnormal operating status |
| Maintenance Mode | MAINT | UPS shuts down, the load is connects to the mains through the Liebert BDC. In this mode the load is not protected against abnormal input utility power. |

As shown in **Figure 40**, the AC utility source is supplied through the input breaker, and the rectifier converts the alternating current into DC power. The inverter converts the AC power from the utility—or DC power from the batteries—into AC power for the load. The batteries power the load through the inverter in the event of a power failure. The utility source can also power the load through the static bypass.

If maintenance or repair of the UPS is necessary, the load can be switched without interruption in service using the Liebert BDC.

**Figure 40 Single module block diagram—Single input configuration with three-breaker Liebert BDC**




NOTES:
1. INSTALL IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.
2. INPUT AND BYPASS MUST SHARE THE SAME SINGLE SOURCE.
3. A NEUTRAL IS REQUIRED FROM THE SYSTEM AC INPUT SOURCE. A FULL CAPACITY NEUTRAL CONDUCTOR IS RECOMMENDED. GROUNDING CONDUCTORS ARE RECOMMENDED.
4. UPS SYSTEM INPUT AND OUTPUT CABLES MUST BE RUN IN SEPARATE CONDUITS.
5. CONTROL WIRING MUST BE RUN IN SEPARATE CONDUITS.
6. OPTIONAL 54 POLE, 225A FOR 45kVA FRAME ONLY OR OPTIONAL 54 POLE 400A FOR 90KVA FRAME ONLY.

BIB - BYPASS ISOLATION BREAKER
MBB - MAINTENANCE BYPASS BREAKER
MIB - MAINTENANCE ISOLATION BREAKER
* EXTERNAL OVERCURRENT PROTECTION BY OTHERS
FIELD SUPPLIED WIRING

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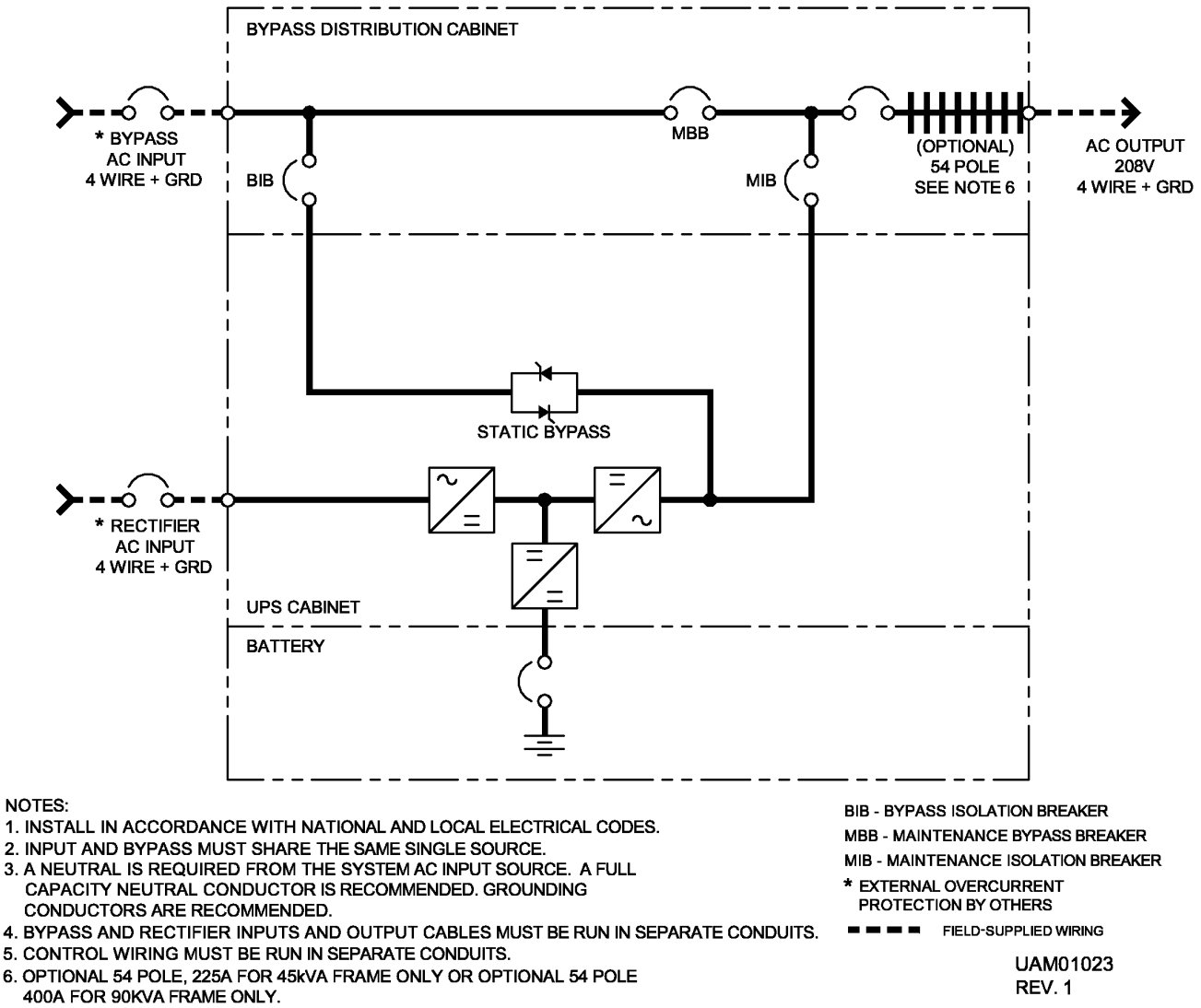
**Figure 41 Single module block diagram—Dual input configuration with three-breaker Liebert BDC**




## 7.1 Static Bypass Switch

The circuit block labeled "Static Bypass" in **Figure 40** contains an electronically controlled switching circuit that enables the critical load to be connected to either the inverter output or to a bypass power source via the static bypass line. During normal system operation the load is connected to the inverter and the inverter contactor is closed; but in the event of a UPS overload or inverter failure, the load is automatically transferred to the static bypass line.

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

**NOTE**

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

## 7.2 Operating Modes

The UPS is designed to operate as an on-line, double-conversion, reverse-transfer system in the following modes:

- Normal Mode
- Battery Mode
- Auto-Restart Mode
- Bypass Mode
- Battery Start Mode
- Maintenance Mode (Manual Bypass)

### Normal Mode

Operating in normal mode, the Liebert APM's rectifier derives power from a utility AC source and supplies regulated DC power to the inverter, which regenerates precise AC power to supply the connected equipment. The rectifier also uses the utility source power to charge the batteries.

### Battery Mode

When utility AC power fails, the Liebert APM protects the critical load by instantaneously channeling battery power to the inverter which continues supporting the critical load without interruption. When utility power returns and is within acceptable limits, the Liebert APM automatically shifts back to Normal mode, with the rectifier powering the critical load.

### Auto-Restart Mode

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

### Bypass Mode

When the Liebert APM is in bypass mode, the load is directly supported by utility power and is without battery backup protection.

The Liebert APM's static transfer switch will shift the load from the inverter to bypass mode without an interruption in AC power if the inverter is synchronous with the bypass and any of the following occurs:

- inverter fails
- inverter overload capacity is exceeded
- inverter is manually turned off by user

**NOTE**

*If the inverter is asynchronous with the bypass, the static switch will transfer the load from the inverter to the bypass WITH interruption in AC power to the critical load. This interruption will be less than 15ms (in 50Hz), or less than 13.33ms (in 60Hz). This interruption time may be altered by modifying the Output transfer interrupt time setting.*

### Battery Start Mode

The battery start option permits starting the Liebert APM with power supplied only by the batteries (at charged condition).

### Maintenance Mode

For maintenance or repair, the Liebert APM may be operated in maintenance mode. To place the Liebert APM in maintenance mode, follow the instructions in **9.4 - Switching the UPS from Normal Operation to Maintenance Bypass**.

**WARNING**

The UPS input and output must be protected with external overcurrent protection devices. In maintenance mode, the input and output busbars remain energized.

# 8.0 Operator Control and Display Panel

## 8.1 Operator Control Panel

The control panel and LCD on the front of the Liebert APM lets the operator:

- Turn the UPS On or Off
- Transfer into the various operating modes
- Silence alarms
- Check the status of the UPS and its batteries, including all measured parameters, events and alarms

The main areas of the control panel are shown below in **Figure 42** and explained in **Table 18**.

- **Mimic Display** - view the status of the Liebert APM in single-line diagram format—indicators show status by changing color when ON, flashing or OFF
- **Liquid Crystal Display (LCD)** and **Navigation keys** - view status and operational data from the Liebert APM in tabular format
- **Control buttons** - turn the Liebert APM on or off, silence alarms

**Figure 42 Overview of control panel**


**Table 18 Descriptions of UPS operator control and display panel**

| Mimic Current Path | |
|---|---|
| **Item #** | **Function** |
| 1 | Rectifier indicator (AC to DC) |
| 2 | Battery indicator (backup DC power) |
| 3 | Bypass input indicator |
| 4 | Inverter indicator (DC to AC) |
| 5 | Load indicator (AC output) |
| 6 | UPS status and alarm indicator |
| 7 | Audible alarm (buzzer) |
| 8 | Protective cover for EPO button |

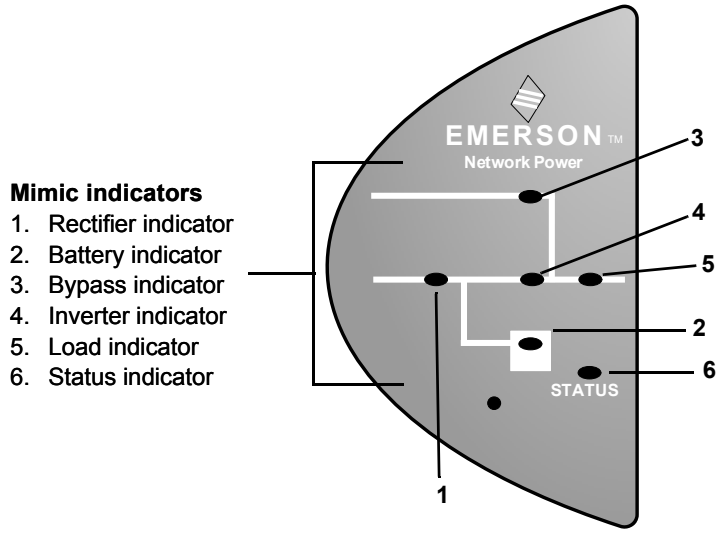
| Control Buttons | |
|---|---|
| **Button** | **Function** |
| EPO | EPO switch |
| INVERTER ON | Inverter start button |
| INVERTER OFF | Inverter shutdown button |
| FAULT CLEAR | Fault reset button |
| SILENCE ON/OFF | Alarm mute button |
| **Menu Buttons** | |
| **Button** | **Function** |
| F1 through F4 and HELP | LCD menu keys |

**NOTE**

*Help button menus are not active. Future units will ship with an F5 legend in place of the HELP legend.*

## 8.2 Mimic Display Indicators

**Figure 43 Mimic display indicators location**




Mimic indicators show the operational status of the Liebert APM by their color—green, amber or red—and whether they are ON (solid), flashing or OFF. **Table 19** provides a guide to interpreting the various states of the indicators.

**Table 19 Mimic display status indicators**

| Indicator (see Figure 43) | Green | Flashing Green / Amber | Red | Off |
|---|---|---|---|---|
| **1. Rectifier** | Load on Rectifier | Flashing Green: Utility normal, but rectifier not operating | Rectifier fault | Rectifier is normal, but utility is abnormal |
| **2. Battery** | Battery Powering the Load | Flashing Green: Battery pre-warning (low battery) | Battery or battery converter abnormal* | Battery and converter are normal, and battery is not discharging |
| **3. Bypass** | Load on Bypass Power | — | Bypass out of normal range | Bypass Normal |
| **4. Inverter** | Inverter Powering the Load Normally | Flashing Green: Inverter on standby | Inverter fault | Inverter normal, but Off |
| **5. Load** | UPS output On | — | UPS output overloaded | UPS has no output power |
| **6. Status** | No Alarms—UPS Working Normally | Amber: UPS has a general alarm | UPS has a serious alarm | — |

* Battery or battery converter abnormal events include these event messages (see **Table 1** in **Appendix A**): No Battery, Battery Replaced, Battery Reverse, Batt. Conv. Over. Curr., Batt. Converter Fault, Batt. Converter Overtemp.

## 8.3 Control Buttons

The **Control Buttons** on the front panel may be used to shut down the UPS completely, turn the inverter on or off, restart the UPS after a fault and silence the alarm, as shown in **Figure 44**. The function of each button is described in **Table 20**.

**NOTE**
*To activate a button properly, press and hold until you hear a short beep—about two seconds.*

**Figure 44 Control button layout**


**Table 20 Control buttons**

| Button (see Figure 44) | Function |
|---|---|
| EPO | Completely shuts down the UPS, including the static switch.<br>**CAUTION:** Use caution before pressing the Emergency Power Off (EPO) button. This button completely shuts down the unit and the critical load. |
| INVERTER ON | Press this button to start the inverter and transfer from static bypass to inverter.<br>**NOTE:** If the inverter is not ready, this will not activate the UPS. |
| INVERTER OFF | Press this button to shut down the inverter during operation. The load will be transferred to static bypass. |
| FAULT CLEAR | After the UPS shuts down due to a fault and the alarm condition has been resolved, press this button to clear the fault and restart the UPS. |
| SILENCE ON/OFF | Press this button once to silence the alarm buzzer when an alarm is active. Any new fault will sound the buzzer again.<br>If the alarm buzzer is not beeping, press this button to test the alarm sound. |

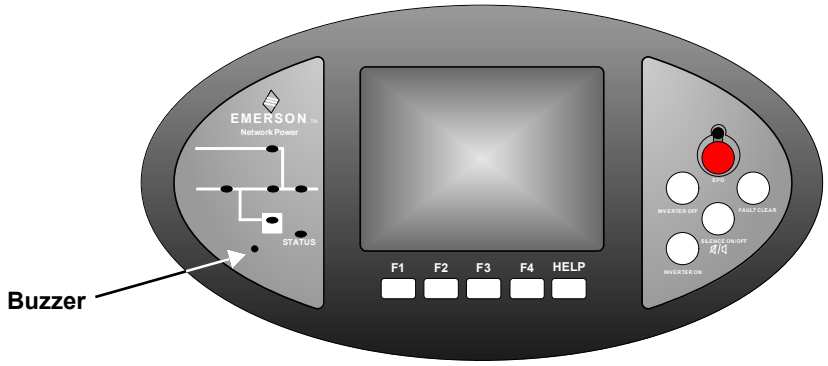
## 8.4 Alarm Buzzer

The alarm buzzer produces three types of sounds:

- **Single beep** - when any Control button is pressed
- **Single beep repeating every two seconds** - the system has a general alarm
- **Continuous** - the system has a serious fault

If the alarm buzzer makes no sound, the system may be operating properly or the alarm may have been silenced manually.

**Figure 45 Alarm buzzer location**



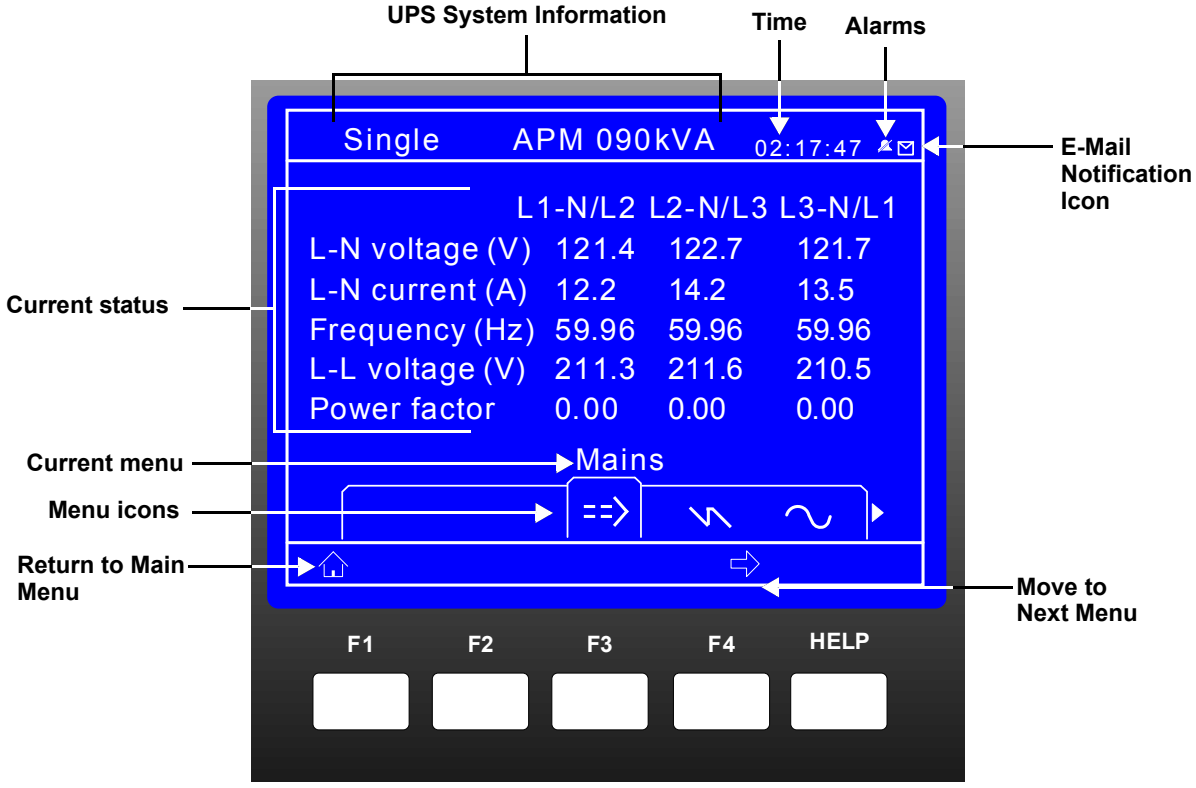

## 8.5 LCD Overview

The LCD on the front panel has five main sections, as shown in **Figure 46**. Press the F1 key below the LCD to scroll through these sections.

- **UPS system information** - view UPS name and model, date and time, overall status.
- **LCD Menu** - choose a category of data items to appear below the menus (see **Table 22**).
- **Data and settings** - view data items for the selected menu (see **Table 22**).
- **Current status messages** - check the most recent UPS event and alarm messages (see **Table 1** in **Appendix A**).
- **Navigation key icons** - look at the icon above each navigation key to determine how the key operates when pressed (see **8.6 - Navigation Keys**).

The LCD displays alarm information in real time. After appearing in the current status section of the LCD, status messages are stored in the history log—512 records can be stored and retrieved.

**Figure 46 Sections of the LCD**



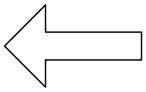
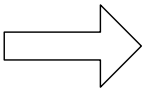
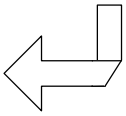
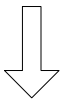
## 8.6 Navigation Keys

The navigation keys on the front panel—F1 through F4 and Help—are used to access the LCD to view the current status and other information about the Liebert APM.

Navigation key icons on the LCD appear above each key to indicate its operation (see **Table 21**). The keys are "soft keys" that can change functions according to the icon.

- Use **F1** to move to the home portion of the LCD.
- Use **F3** and **F4** as cursor keys to move left and right or up and down, depending on the icons displayed above the keys.
- Use **F2** as an ESC key.
- Use **HELP** to access help information on the LCD or to enter a choice.

**Table 21 Icons for navigation keys**

| Key | F1 | F2 | F3 | F4 | HELP |
|---|---|---|---|---|---|
| Functions Available |  Home | ESC Exit |  Left |  Right |  Enter |
| | | |  Up |  Down |  Help |

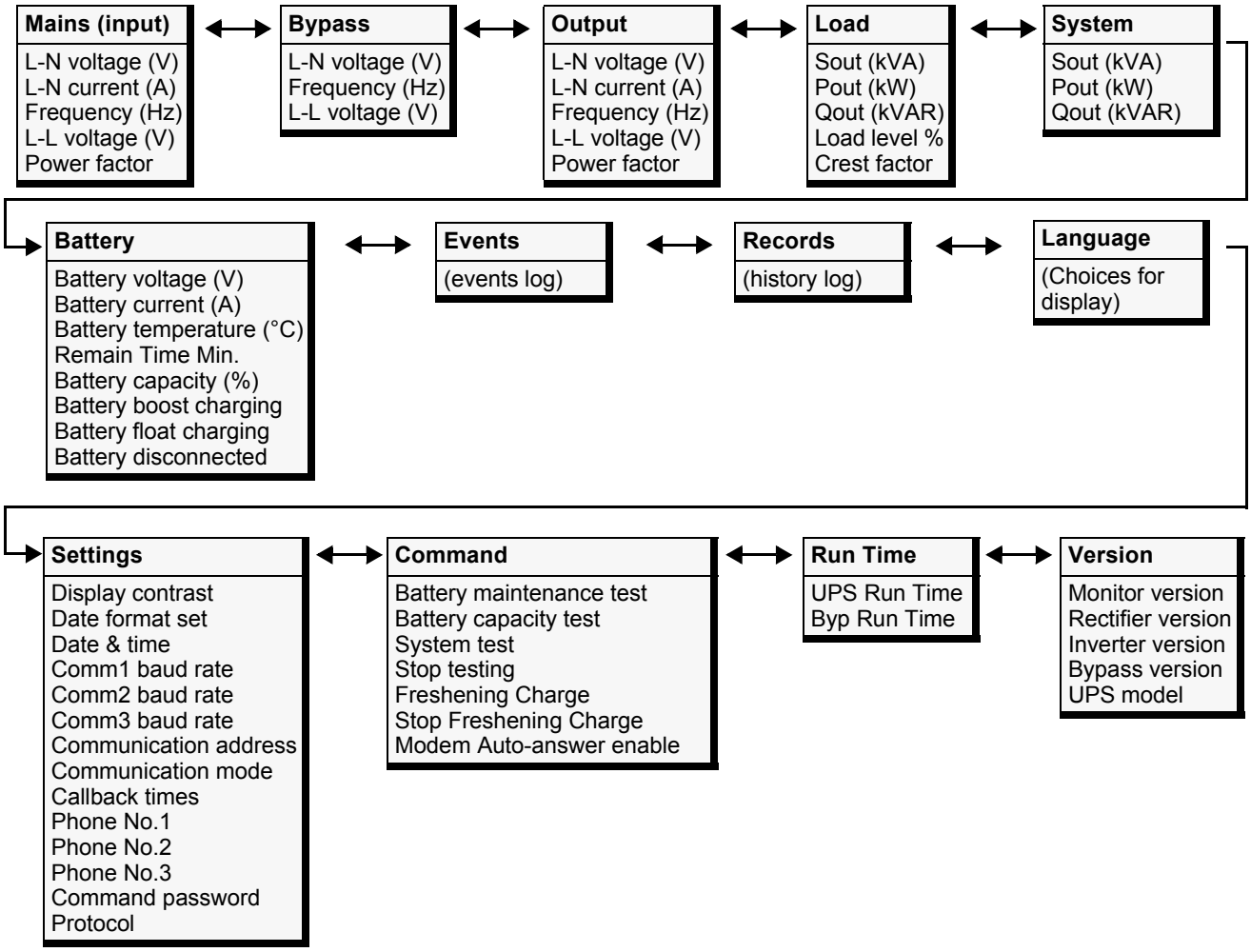
## 8.7 LCD Menus and Data Items

The LCD menus provide access to the following categories of information and settings for the UPS. Selecting a menu changes the information displayed in the UPS data items portion of the LCD. The menu choices are listed below and described in detail in **Table 22**.

- **Mains** - view utility power input data: voltage, current, frequency and power factor
- **Bypass** - view bypass data: voltage and frequency
- **Output** - view output data: voltage, current, frequency and power factor
- **Load** - view load data: load percent, output current, output power and crest factor (CF)
- **System** - view system data
- **Battery** - view battery characteristics—voltage, current, temperature, remaining time and capacity—and messages when the battery is boost/float charging or disconnected
- **Events** - view the events log—displays all recent events added to the log (new records added at end)
- **Records** - access the history log—displays all records in the log (new records added at end)
- **Language** - select a language for LCD text (choices appear in the native language)
- **Settings** - configure UPS settings: adjust the display contrast, choose a format for date display, set the date and time, set up the UPS for modem communications (baud rate, address, mode and phone numbers to dial for alarm notifications) and change the password
- **Command** - start or stop a battery maintenance test, battery capacity test or system test
- **Run Time** - view available backup time for the UPS and bypass
- **Version** - view firmware versions for the inverter, rectifier and software display board and the model information for the UPS

**Figure 47** shows a menu tree of the options available from the LCD menus.

**Figure 47 Menu tree**



## 8.8 Language Selection

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

1. From the main menu, press the **F4** (shift) key to move the cursor to the **Language** menu at the bottom of the screen.
2. Press **HELP** to access the language choices.
3. Press **F3** and **F4** (left and right arrows) as needed to highlight the desired language.
4. Use **HELP** to select the required language.
5. Return to the main menu by repeatedly pressing **F2** (ESC) and **F1**.
   All text on the LCD will now be displayed in the selected language.

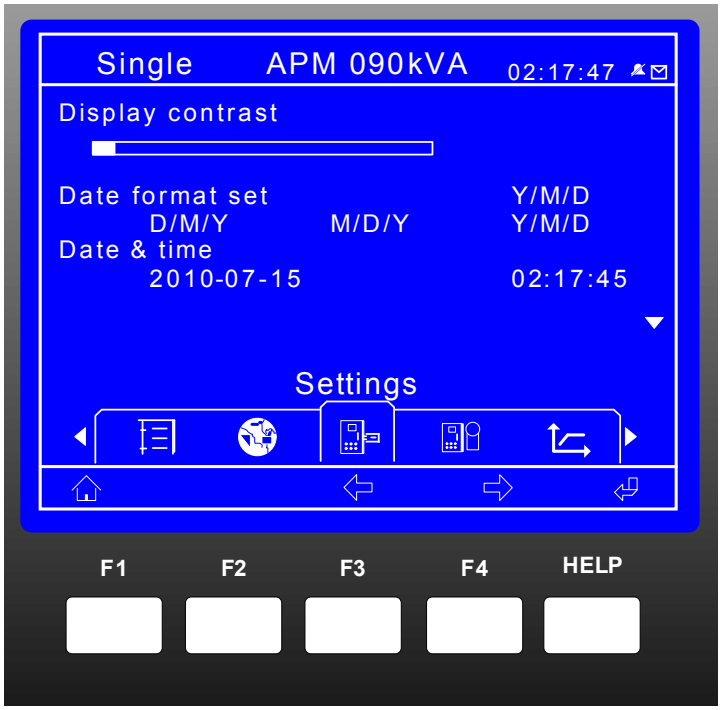
**Figure 48 Language selection screen**


## 8.9 Current Date and Time

To change the system date and time:

1. From the main menu, press the **F4** (shift) key to move the cursor to the **Settings** menu at the bottom of the screen.
2. Press **HELP** to select the **Settings** menu.
3. Use **F3** and **F4** (up and down) to select the **Date & Time** option, then press **HELP** (enter).
4. Use **F4** to position the cursor on the row where the date and time are displayed, then press **HELP** (enter).
5. Using the **F3** (up), enter the current time and date information.
6. Press **HELP** (enter) to save the settings.
7. Press **F2** (ESC), then **F1** to return to the main screen.

**Figure 49 Date and time screen**

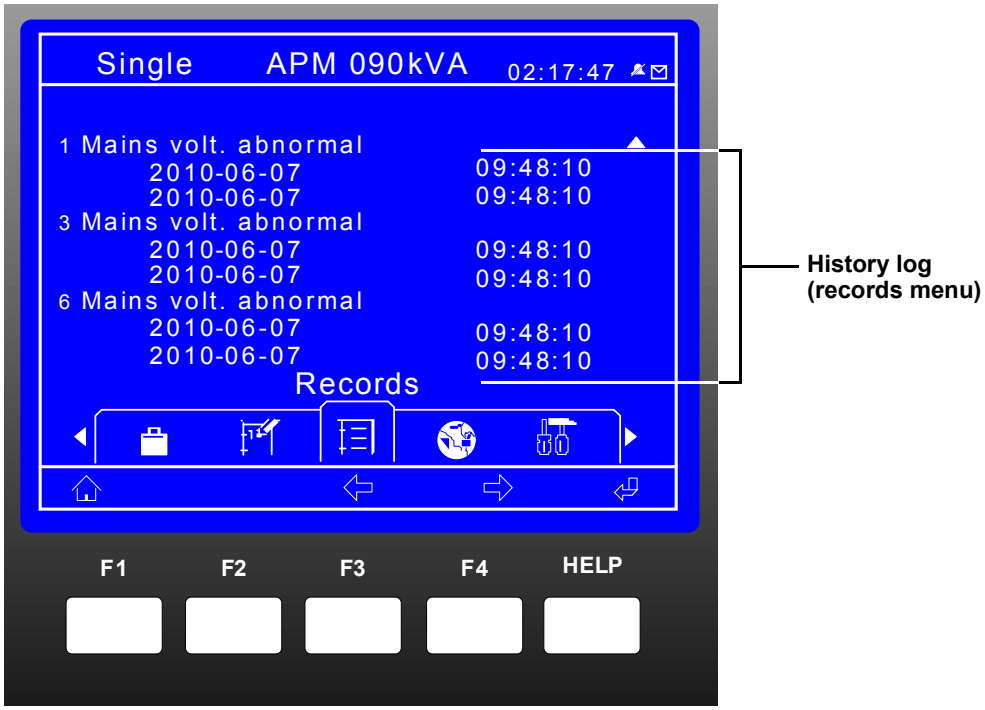



## 8.10 UPS History Log

The Liebert APM displays status changes as they occur and stores that data in the **history log**, as shown in **Figure 50**.

- **History Log:** When a record moves to the history log, the time the status changed is recorded. The history log can hold up to 512 records. History log records may be viewed by accessing the Records menu.

**Figure 50 History log records**




See **Table 1** in **Appendix A** for a complete list of status messages, along with a description and any recommended actions.

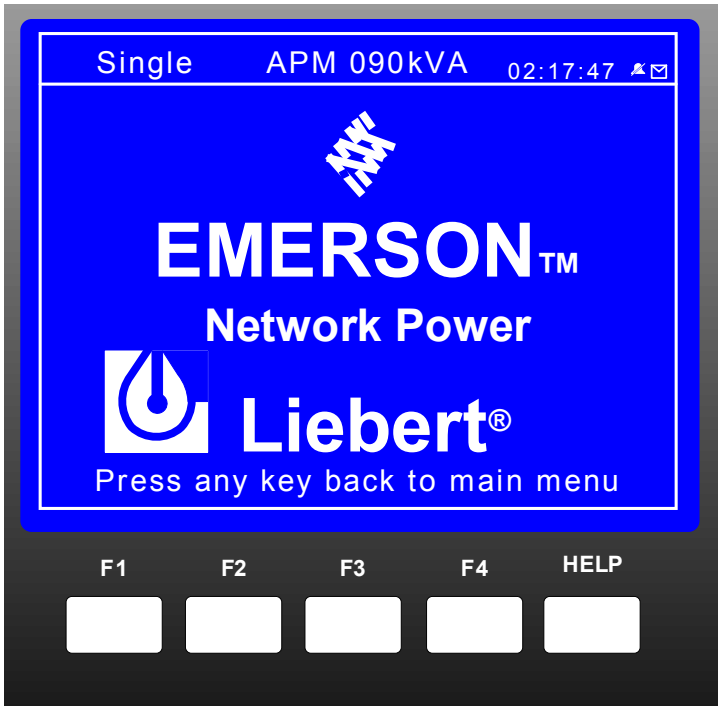
## 8.11 Types of LCD Screens

This section provides a quick guide to the main types of LCD screens.

### 8.11.1 Opening Display

As the UPS begins powering up, the opening display appears, as shown in **Figure 51**.

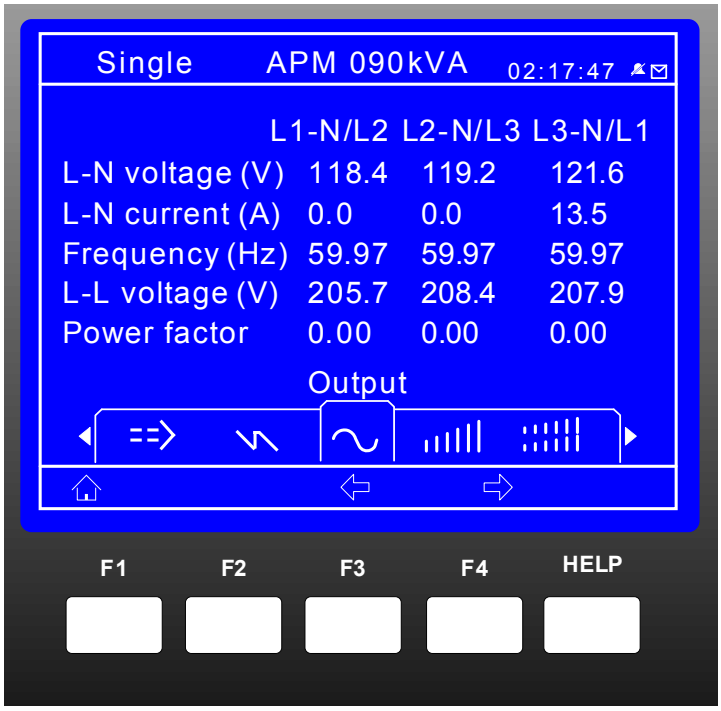
**Figure 51 Opening display**




### 8.11.2 Default Screen

After the UPS has powered up and completed a self-test, the output screen appears, as shown in **Figure 52**. This window is the default screen.

**Figure 52 Default screen**



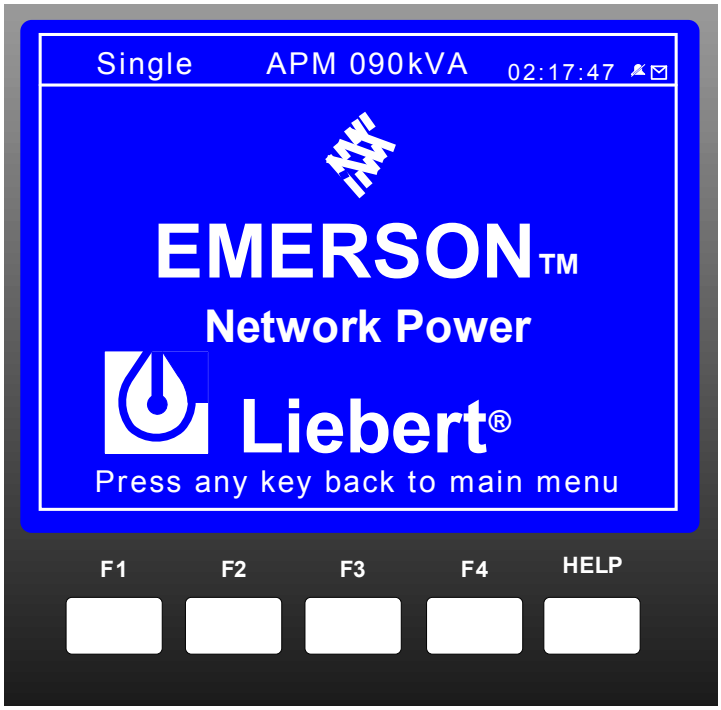
### 8.11.3 UPS Help Screen

Press the HELP key below the LCD to display the Help window. (Press the HELP key again to exit the Help window.)

### 8.11.4 Screen Saver Window

If there has been no interaction with the Liebert APM's LCD for 2 minutes, the screen saver window appears. It remains on the LCD for 2 minutes, then the screen will go dark. The LCD will become active again when any key is pressed.

**Figure 53 Screen saver window**




## 8.12 Pop-Up Windows

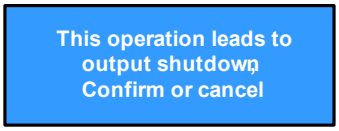
Pop-up prompt windows appear when the user must confirm a choice or perform an operation. This section describes the pop-up windows. Some operations require entering a password; refer to **8.12.7 - Enter Control Password** for help.

### 8.12.1 From Bypass to Inverter Mode With Power Interruption

If the bypass voltage or frequency exceeds the synchronized range and utility voltage or frequency is normal, the inverter cannot be in synchronization with the bypass, and the output can only transfer to inverter after an interruption of about 15ms when the user presses the INVERTER ON button. Before transferring, the system will let the user confirm whether the interruption can be accepted, as shown at right. If the bypass voltage returns to normal before the user makes confirmation, the UPS will transfer to inverter mode automatically. At the same time, the prompt window will close.


### 8.12.2 From Inverter to Bypass Mode With Interruption

If the bypass voltage or frequency exceeds the synchronized range and the UPS is in inverter mode, the system must let the user to confirm and accept the power interruption danger before pressing the INVERTER OFF button to shut down the output of the inverter. The user can also cancel the shutdown operation, as shown at right. If the bypass voltage returns to normal before the user makes the confirmation, the UPS will transfer to bypass operation mode automatically, and at the same time the prompt window will disappear soon.



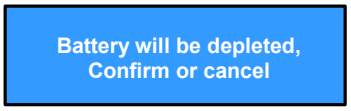
### 8.12.3 System Self-Test

When a system self-test is completed, a pop-up window reports the results of the test, as shown at right.


- Press the **Help** (Enter) key and the pop-up window closes.

### 8.12.4 Battery Capacity Test Confirmation

When a battery capacity test is started from the Command menu, the battery will be discharged to low-battery warning level. The Liebert APM asks for confirmation before the test is started, as shown at right.



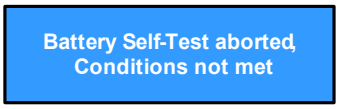

- To confirm the choice and begin the battery capacity test, press the **Help** (Enter) key and the pop-up window disappears.
- To cancel the test, press the **F2** (ESC) key. The pop-up window disappears.

**NOTE**

*For a battery capacity test to function properly, the load must be between 20% and 100%.*

### 8.12.5 Battery Self-Test Aborted, Condition Not Met

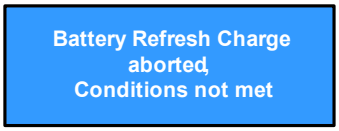
When a battery capacity test is started from the Command menu and the battery self-test condition is inadequate, the Liebert APM will not perform a battery test. User should check whether the battery state is boost charging and whether the load level is greater than 20 percent.




- Press the **Help** (Enter) key and the pop-up window closes.

### 8.12.6 Battery Refresh Charge Aborted, Condition Not Met

When a battery refreshening charge is started from the Command menu and battery refreshening condition fails to meet requirements, the Liebert APM will not perform a battery refreshening charge. User should check if boost charging condition is not enough, such as (No battery, charger failed, etc.).




- Press the **Help** (Enter) key and the pop-up window closes.

### 8.12.7 Enter Control Password

When a UPS control operation requires a password, the pop-up at right will be displayed. The password is 12345.


Use the Right or Left arrow to move the cursor along the password field. Then use the Up and Down arrows to advance until the desired number is displayed. Enter the password one digit at a time.

**Table 22 UPS menus and data window items**

| Menu Type | Item Type | Explanation |
|---|---|---|
| **Mains (input)** | L-N voltage (V) | Phase voltage |
| | L-N current (A) | Phase current |
| | Frequency (Hz) | Input frequency |
| | L-L voltage (V) | Line-line voltage |
| | Power factor | Power factor |
| **Bypass** | L-N voltage (V) | Phase voltage |
| | Frequency (Hz) | Bypass frequency |
| | L-L voltage (A) | Line-line voltage |
| **Output** | L-N voltage (V) | Phase voltage |
| | L-N current (A) | Phase current |
| | Frequency (Hz) | Output frequency |
| | L-L voltage (V) | Line-line voltage |
| | Power factor | Power factor |
| **Load** | Sout (kVA) | Sout: Apparent power |
| | Pout (kW) | Pout: Active power |
| | Qout (kVAR) | Qout: Reactive power |
| | Loadlevel % | The percent of the UPS rating load |
| | Crest factor | Output current Crest Factor |
| **System** | Sout (kVA) | Sout: Apparent power |
| | Pout (kW) | Pout: Active power |
| | Qout (kVAR) | Qout: Reactive power |
| | Single unit | When configured as a single unit, UPS displays only native load, no system load. |
| **Battery** | Battery voltage (V) | Battery bus voltage |
| | Battery current (A) | Battery bus current |
| | Battery temperature (°C) | Internal battery temperature °C |
| | Remain Time Min. | Battery run time remaining |
| | Battery boost charging | Battery is boost charging |
| | Battery float charging | Battery is float charging |
| | Battery disconnected | Battery is not connected |
| **Events** | (event log) | Displays recent events |
| **Records** | (history log) | Displays all records in the history log |
| **Language** | (choices for text displayed) | User may select any of 12 languages for LCD text. |

**Table 22 UPS menus and data window items (continued)**

| Menu Type | Item Type | Explanation |
|---|---|---|
| **Settings** | Display contrast | Adjust the LCD display contrast |
| | Date format set | Choose the format for date display: YYYY MM DD, DD MM YYYY and MM DD YYYY |
| | Date & time | Set the date and time |
| | Comm1 baud rate | Communication baud rate setting for Liebert IntelliSlot 1 |
| | Comm2 baud rate | Communication baud rate setting for Liebert IntelliSlot 2 |
| | Comm3 baud rate | Communication baud rate setting for Liebert IntelliSlot 3 |
| | Communication address | This setting is applicable to RS485 communication mode |
| | Communication mode | Communication Mode Setting |
| | Callback times | When Liebert IntelliSlot 1 Communication mode is Modem, this parameter sets the number of times a number is redialed to send an alarm notification. |
| | Phone No.1 | When Liebert IntelliSlot 1 Communication mode is Modem, this is the first phone number to be dialed (to send an alarm notification). |
| | Phone No.2 | When Liebert IntelliSlot 1 Communication mode is Modem, this is the second phone number to be dialed (to send an alarm notification). |
| | Phone No.3 | When Liebert IntelliSlot 1 Communication mode is Modem, this is the third phone number to be dialed (to send an alarm notification). |
| | Command password | User can modify the command password. |
| | Protocol | System protocol |
| **Command (start/stop battery & system tests)** | Battery maintenance test | This test performs a partial discharge of the battery to obtain a rough estimate of the battery capacity. Load must be between 20% and 80%. |
| | Battery capacity test | This test performs a full discharge of the battery to obtain a precise measure of the battery capacity. Load must be between 20% and 80%. |
| | System test | This is a self-test of the UPS. When the user activates this function, a pop-up window appears about 5 seconds later to show the results. |
| | Stop testing | Manually stops a battery maintenance test, battery capacity test or system test. |
| | Freshening Charge | Allows a temporary Equalize charge for the batteries. This charge is configurable for 1 to 36 hours. |
| | Stop Freshening Charge | Manually stops a Freshening Charge. |
| | Modem Auto-answer enabled | Manually enable the modem's auto-answer function. |
| **Run Time** | UPS Run Time | UPS Run Time |
| | Byp Run Time | Bypass Run Time |
| **Version** | UPS model | Provides UPS model information—for example, 208V-60Hz. |
| | Monitor Version | Monitor Firmware Version |
| | Rectifier Version | Rectifier Firmware Version |
| | Inverter Version | Inverter Firmware Version |
| | Bypass Version | Bypass Firmware Version |

# 9.0 OPERATION

## 9.1 Liebert APM Operating Modes

The Liebert APM can operate in any of three modes, as shown in **Table 23**. This section provides instructions on switching between modes, resetting the UPS, switching the inverter On and Off and performing other operations.

**Table 23 UPS operating modes**

| Operating Mode | Description |
|---|---|
| **Normal Operation** | The UPS is powering the load. |
| **On Maintenance Bypass** | The UPS is shut down but the load is connected to utility power via the Maintenance Bypass Supply line.<br>**NOTE**: The load is not protected against disturbances in AC input power in this mode. |
| **On Static Bypass** | The load power is supplied through the static bypass line. This may be considered as a temporary mode during load transfers between inverter and maintenance bypass or supply under abnormal operating conditions. |

**NOTE**

1. *The user controls and indicators mentioned in these procedures are identified in **8.0 - Operator Control and Display Panel**.*
2. *The audible alarm may sound at various points during these procedures. It can be canceled at any time by pressing the SILENCE ON/OFF push button.*

**NOTE**

*This unit refers to some modes and conditions that are set or adjusted using proprietary service software. To take advantage of all the available features for the Liebert APM, the unit must be commissioned by an Emerson-authorized engineer.*

## 9.2 UPS Startup

The Liebert APM must be fully installed and commissioned before startup, and external power isolators must be closed. Once those general conditions are met, the UPS may be started.

**WARNING**

During this procedure the output terminals will become live.

If any load equipment is connected to the UPS output terminals, please check with the load user and ascertain whether it is safe to apply power to the load. If the load is not ready to receive power, then ensure that it is safely isolated from the UPS output terminals.

### 9.2.1 Startup Procedure

To start the UPS from a fully powered-down condition:

1. Open the external power switch.
2. Open the UPS door.
3. Connect the power supply cables
4. Ensure the correct phase rotation.
5. Confirm that the address DIP switch of the main Liebert FlexPower assemblies are different from each other, and they are within 1 to 6. If they are the same, adjust them to create different Liebert FlexPower assembly addresses.

**NOTE**
*For standardization, if the quantity of modules in system is less than 6, for example 45kVA system, Emerson recommends setting the address bits of the modules as 1, 2, 3 respectively.*

6. Close the external input circuit breaker and connect input power.
   The LCD activates. The rectifier indicator flashes while the rectifier is starting. The rectifier enters normal operation state, and after about 30 seconds, the rectifier indicator stops blinking and is illuminated in a steady green. After initialization, the bypass static switch turns on. The mimic LEDs appear as shown **Table 24**.

**Table 24 Mimic indicators after initialization**

| LED | Status |
|---|---|
| Rectifier Indicator | Green |
| Battery Indicator | Red |
| Bypass Indicator | Green |
| Inverter Indicator | Off |
| Load Indicator | Green |
| Status Indicator | Amber |

7. Ensure that the Liebert FlexPower assembly ready switches are latched (in Down position).
8. Close the external output circuit breaker.
9. Press the INVERTER ON button for 2 seconds. The inverter indicator flashes while the inverter is starting. After the inverter is ready, the UPS transfers from bypass to inverter, the bypass indicator turns Off, and the inverter indicator turns On. The UPS is in Normal Mode. The mimic LEDs will appear as shown below.

**Table 25 Mimic indicators for normal mode operation with battery breaker open**

| LED | Status |
|---|---|
| Rectifier Indicator | Green |
| Battery Indicator | Red |
| Bypass Indicator | Off |
| Inverter Indicator | Green |
| Load Indicator | Green |
| Status Indicator | Amber |

10. Close the battery breaker.

**Table 26 Mimic indicators for normal mode operation with battery breaker closed**

| LED | Status |
|---|---|
| Rectifier Indicator | Green |
| Battery Indicator | Off |
| Bypass Indicator | Off |
| Inverter Indicator | Green |
| Load Indicator | Green |
| Status Indicator | Green |

### 9.2.2 Switching Between UPS Operation Modes

**To switch from Normal Mode to Static Bypass Mode**—Press the INVERTER OFF button to switch to Bypass Mode (see **Figure 44**).

**NOTE**

*In Static Bypass Mode, the load is being powered by the utility and is not protected from fluctuations in input power: spikes, sags and failure.*

**To switch from bypass mode to normal mode**—When the UPS is in Bypass Mode, press the INVERTER ON button. After the inverter enters normal operation, the UPS transfers to Normal Mode.

## 9.3 UPS Battery Start

The battery start option permits starting the Liebert APM with power supplied only by the batteries (at charged condition).

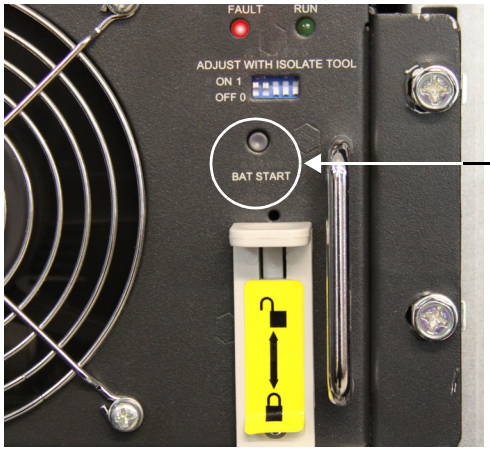
**CAUTION**

Before attempting to start the UPS without utility power present, ensure that the batteries are fully charged—over 2.1V per cell—and will supply adequate run time to the load.

1. Verify that the battery cabinet is properly connected (see **Figure 20**) and that the battery breaker is closed.
2. Press the battery start button on the front panel of any Liebert FlexPower assembly for two seconds (see **Figure 54** for the button's location).

   The LCD displays the start screen, and the battery indicator flashes green. It stops flashing and becomes solid green about 30 seconds after the rectifiers enter normal operation.
3. Press and hold the INVERTER ON key for two seconds, and the UPS will begin operating in battery mode.

**Figure 54 Battery start button location**



## 9.4 Switching the UPS from Normal Operation to Maintenance Bypass

Follow the procedure below to transfer the load from the UPS inverter output to the Maintenance Bypass system.

**CAUTION**

This procedure must be performed by properly trained and qualified personnel who are knowledgeable about the operation of this system. Failure to follow these instructions will result in loss of power and possible damage to critical equipment.

Before performing this operation, read any messages on the LCD to be sure that bypass supply is regular and the inverter is synchronous with it. If those conditions are not present, there is a risk of a short interruption in powering the load.

This procedure assumes that UPS is operating normally.

1. Press the INVERTER OFF button on the right side of the operator control panel for longer than 2 seconds.

   The Inverter indicator will turn Off, the status indicator will turn amber and an audible alarm will sound. The load will transfer to static bypass (internal) and the inverter will shut off.

**NOTE**

*Pressing the Alarm Silence Switch cancels the audible alarm, but leaves the warning message displayed until the appropriate condition is rectified.*

2. Open the Liebert BDC door to gain access to the bypass isolation breaker (BIB), maintenance bypass breaker (MBB) and maintenance isolation breaker (MIB).
3. When the lamp indicator on the BDC is illuminated, press and hold the adjacent push button and remove the Key from the lock (K0).
4. Insert the Key into the lock on the MBB and turn the Key.
5. Close the MBB.
6. Verify the MBB is closed. Failure to close the MBB will interrupt power to the load.
7. Open the MIB.
8. Remove the key from the lock on the MIB. Insert the key into the lock (K0) and turn the key.
9. The UPS system is now isolated from the critical load.
10. For a single-input system, the bypass isolation breaker (BIB) remains closed; this allows power to remain present at the UPS input; refer to **Figure 40**.
11. For a single-source, dual-input system, the bypass isolation breaker (BIB) can be opened to further isolate the UPS from input power; refer to **Figure 55**.

**WARNING**

Wait 5 minutes for the internal DC busbar capacitors to discharge before attempting to remove the internal protective barriers.

**WARNING**

Even with the UPS in maintenance bypass and Off, portions of the Liebert APM system are still energized. Service must be performed by properly trained and qualified personnel only.

**CAUTION**

The load equipment is not protected from normal supply aberrations when the Liebert APM is operating in the maintenance bypass mode.

## 9.5 Switching the UPS from Maintenance Bypass to Normal Operation

Follow the procedure below to transfer the load from the Maintenance Bypass system to the UPS inverter output.

These conditions must be met for this operation to proceed:

- the UPS must be operating normally
- the BIB breaker must be closed
- the UPS system must be in the Maintenance Bypass mode of operation.

**CAUTION**

This procedure must be performed by properly trained and qualified personnel who are knowledgeable about the operation of this system. Failure to follow these instructions will result in loss of power and possible damage to critical equipment.

Before performing this operation, read any messages on the LCD to be sure that bypass supply is regular and the inverter is synchronous with it. If those conditions are not present, there is a risk of a short interruption in powering the load.

1. Verify that the Liebert APM is in Maintenance Bypass mode.

**NOTE**

*Pressing the Alarm Silence Switch cancels the audible alarm, but leaves the warning message displayed until the appropriate condition is rectified.*

2. Open the Liebert BDC door to gain access to the bypass isolation breaker (BIB), maintenance bypass breaker (MBB) and the maintenance isolation breaker (MIB).
3. When the Lamp indicator on the BDC is illuminated, press and hold the adjacent push button and remove the key from the lock (K0).
4. Insert the key into the lock on the MIB, and turn the key.
5. Close the MIB.
6. Verify the MIB is closed. Failure to close the MIB will interrupt power to the load.
7. Open MBB.
8. Remove the key from the lock on the MBB.
9. Insert the key into the lock (K0) and turn the key.

   The UPS system is now supplying power to the critical load.
10. Press the INVERTER ON button on the right side of the operator control panel for longer than 2 seconds.

    The Inverter indicator flashes while the inverter is starting.

    After the inverter is ready, the UPS transfers from static bypass to inverter, the bypass indicator turns Off and the inverter indicator turns On. The UPS is in Normal Mode. The indicator will appear as shown in **Table 26**.

## 9.6 Powering Down the UPS

To power down the UPS completely, follow the procedures in **9.4 - Switching the UPS from Normal Operation to Maintenance Bypass**.

**NOTE**

*To continue supplying power to the load by maintenance bypass, before beginning to shut down the UPS, check the LCD to be sure that the bypass supply is available and the inverter is synchronous with it. Ensuring those conditions exist should avert interrupting power to the load.*

1. Press EPO button to power down the Liebert APM (see **Figure 44** for the button's location).
2. For a single input system, open the bypass isolation breaker (BIB); refer to **Figure 40**.
3. For a single-source, dual-input system, open the bypass isolation breaker (BIB) and the Main (Rectifier) breaker, which is external to the UPS; refer to **Figure 55**.
4. Open the breaker of the external battery cabinets and, if the Liebert APM has internal batteries, open the battery breaker on the UPS.

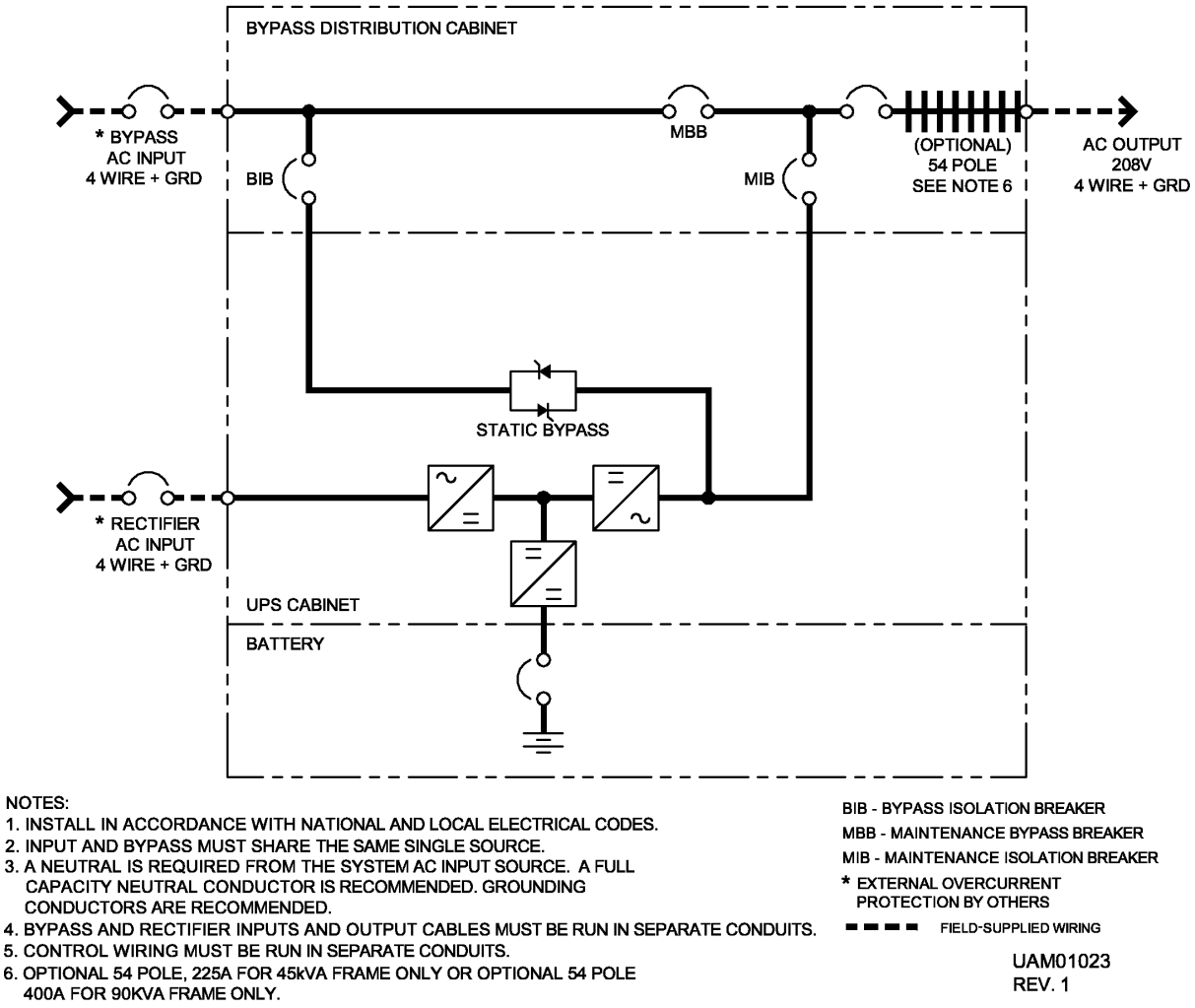
# WARNING

To prevent injury to personnel, lockout and tag out the service supplies.

On the primary input distribution panel, which is often located distant from the UPS area, a label should be posted advising service personnel that the UPS circuit is under maintenance.

Wait 5 minutes to let the internal capacitors fully discharge. After the internal capacitors are fully discharged, the UPS should be powered down completely.

**Figure 55 Typical configuration for single UPS with external Liebert BDC**



## 9.7 Emergency Shutdown With EPO

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

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

## 9.8 Auto Restart

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

The UPS will automatically restart and enable output power:

- after utility power is restored
- if "Auto Recovery after EOD Enabling" is enabled in the UPS configuration (set by factory or by Liebert Services).
- after the "Auto Recovery after EOD Delay Time" expires (the default delay is 10 minutes)

  During the auto recovery delay, the Liebert APM will be charging its batteries to provide a safety margin for equipment shutdown if input power fails again.

If the "Auto Recovery after EOD Enabling" feature is disabled, the system must be restarted manually.

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

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

When the user confirms that the fault is cleared:

1. Press the FAULT CLEAR button to let the system exit the emergency off state.
2. Press the INVERTER ON button on the right side of the operator control panel for longer than 2 seconds (after the rectifier has qualified).

**NOTE**

*The rectifier will start automatically 5 minutes after the of overtemperature fault is cleared.*

After the EPO button is pressed, if the input utility is removed, the UPS will shut down completely. When input utility is restored, the EPO condition will clear, and the UPS will enable the static bypass and restore the output.

## 9.10 Battery Protection

### 9.10.1 Battery Undervoltage Pre-Warning

Before the end of discharge, the Liebert APM displays a low battery warning. After this warning, the battery has the capacity for 5 minutes discharging with full load (default time). The Liebert APM can be user-configured to display this warning from 3 to 60 minutes before end-of-discharge.

### 9.10.2 Battery End-of-Discharge (EOD) Protection

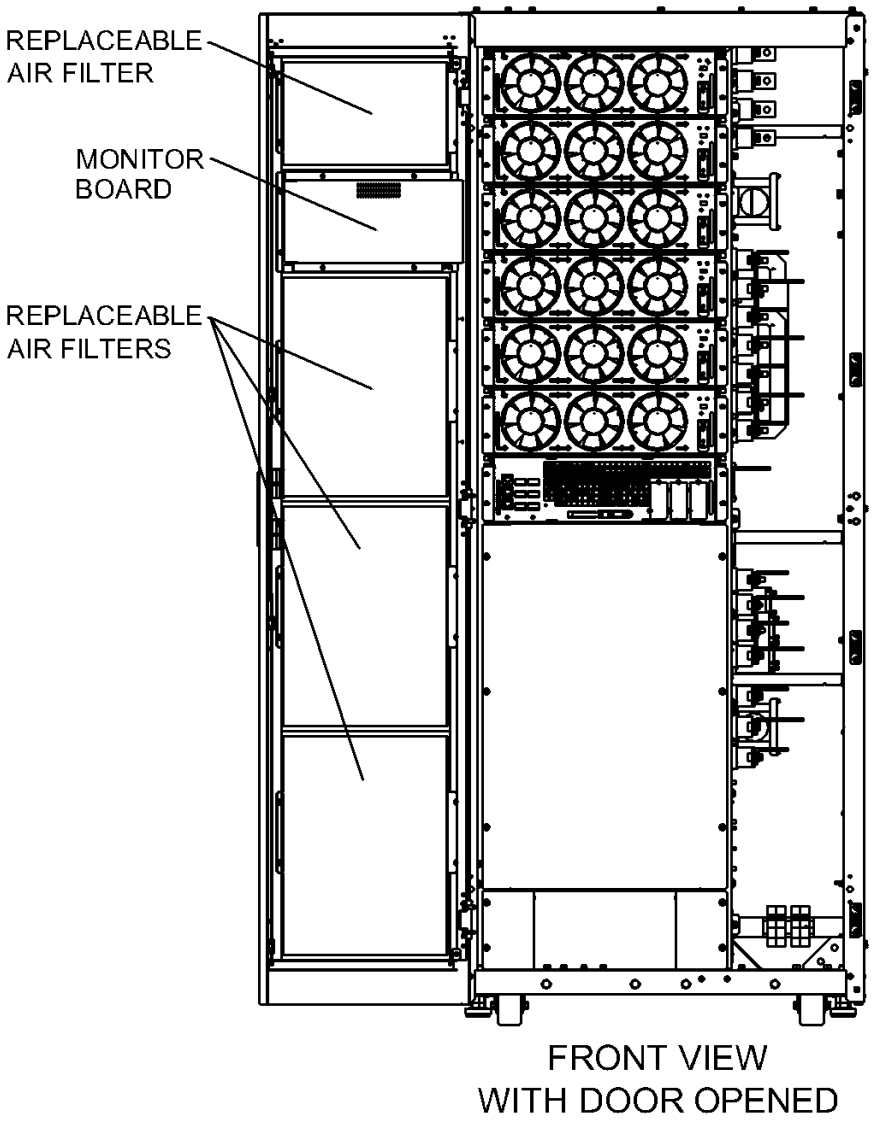
If the battery voltage is lower than the end-of-discharge voltage, the battery converter will be shut down.

## 9.11 Replacing Dust Filters

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

1. Open the UPS front door and locate the filters on the back side of the front door (see **Figure 56**).
2. Remove one bracket and loosen the screw on the second bracket. The second bracket need not be removed
3. Remove the dust filter to be replaced.
4. Insert the clean filter.
5. Reinstall the bracket, tightening the screw securely.
6. Tighten the screw on the second bracket.

**Figure 56 Dust filter replacement**



# 10.0 SPECIFICATIONS AND TECHNICAL DATA

## 10.1 Conformity and Standards

The Liebert APM has been designed to conform to the following standards:

| | |
|---|---|
| Safety | UL 1778, CSA 22.2 107.3, 4th Edition |
| Surge | ANSI 62.41 Cat A3 and B3 |
| Harmonics | IEC 61000-3-4 |
| Electrical Fast Transient | IEC 61000-4-4 Level 4, Criteria A |
| ESD | IEC 61000-4-2 Level 4, Criteria A |
| FCC | Part 15, Class A |
| Radiated Immunity | IEC 61000-4-3 Level 3, Criteria A |
| Conducted Immunity | IEC 61000-4-6 Level 4, Criteria A |
| Low-Frequency Signals | IEC 61000-2-2 Criteria A |
| Transportation | ISTA Procedure 1H |
| ISO | 9001 |
| Misc | OSHA, ASME, NEMA PE-1 |

The Liebert APM has UL and c-UL approval.

## 10.2 UPS Environmental

The Liebert APM is designed to operate under the following environmental conditions without damage or degradation in electrical operating characteristics:

**Table 27 Environmental requirements**

| Item | Requirements |
|---|---|
| Acoustical Noise, dBA, at 39 in. (1m) | 57 (45kVA); 60 ((90kVA) |
| Operating Altitude | 3300 ft. (1000m) above sea level; derate power by 1% per 330 ft. (100m) between 3300 and 6000 ft. (1000m and 2000m) |
| Relative Humidity | 0 to 95% non condensing |
| Operating Temperature, °F (°C) | 32 to 104 (0 to 40)*<br>Battery life is halved for every 18°F (10°C) increase above 68 (20) |
| UPS Storage/Transport Temperature, °F (°C) | -4 to 158 (-20 to 70) |
| Recommended Battery Storage Temperature, °F (°C) | -4 to 86 (-20 to 30)<br>68 (20) for optimum battery storage |

**Table 28 UPS mechanical characteristics**

| Rated Power, kVA | 15 - 90 |
|---|---|
| Dimensions, W x D x H, in (mm) | 31-1/2 x 39-1/2 x 78-3/4 (800 x 1000 x 2000) |
| Weight, without batteries, lb (kg) | 1100 (500) |
| Color | Black |
| Protection Degree IEC (60529) | IP20 (finger-proof with front doors open or closed) |

**Table 29 Liebert BDC mechanical characteristics**

| Rated Power, kVA | 15 - 90 |
|---|---|
| Dimensions, W x D x H, in (mm) | 23-5/8 x 39-1/2 x 78-3/4 (600 x 1000 x 2000) |
| Weight, lb (kg) | 902 (410) |
| Color | Black |
| Protection Degree IEC (60529) | IP20 (finger-proof with front doors open or closed) |

**Table 30 Battery cabinet mechanical characteristics**

| Rated Power, kVA | 15 - 90 |
|---|---|
| Dimensions, W x D x H, in (mm) | 23-5/8 x 39-1/2 x 78-3/4 (600 x 1000 x 2000) |
| Weight, lb (kg) | 1554 (705) with HX150 batteries<br>1693 (768) with HX205 batteries<br>2101 (953) with HX300 batteries<br>2366 (1073) with HX330 batteries |
| Color | Black |
| Protection Degree IEC (60529) | IP20 (finger-proof with front doors open or closed) |

## 10.3 Batteries Approved for Use in Liebert APM Systems

**Table 31 Batteries approved for use in External Battery Cabinet, 600mm**

| Supplier | Part Number |
|---|---|
| Enersys | 12HX150-FR |
| Enersys | 12HX205-FR |
| Enersys | 12HX300-FR |
| Enersys | 12HX330-FR |

**Table 32 Internal batteries approved for use with 45kVA frame Liebert APM**

| Supplier | Part Number |
|---|---|
| Enersys | 12HX100-FR |
| Enersys | 12HX150-FR |

## 10.4 UPS Electrical Characteristics

Refer to additional circuit breaker notes in **2.2.7 - Accessory Fuses and Backfeed Breaker Wiring**.

**NOTE**

*The breakers and cables used must be in accordance with NEC ANSI/NFPA 70. A disconnect breaker must be provided for AC input, DC input and AC output. Recommended cable sizes are suitable for operation at a maximum temperature of 86°F (30°C). For continuous operation at temperatures above 86°F (30°C), the site design should include cables that meet requirements for 104°F (40°C) installations.*

**Table 33 UPS currents and terminals—Input (for single input unit 208V operation)**

| Unit Rating | Nominal Input Current | Maximum Input Current | OCP Device Rating | Bolt Size | Maximum Recommended Lug (T&B) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | 75C Wire Current, tot | Wire | Compression Lug Two Hole 3/8" Bolt | Mechanical Lug Two Hole 3/8" Bolt |
| 15 | 45 | 60 | 80 | M10 (3/8") | 130 | (1) #1 | 54857BE | 32209 |
| 30 | 90 | 120 | 150 | M10 (3/8") | 150 | (1) 1/0 | 54860BE | 32209 |
| 45 | 134 | 180 | 225 | M10 (3/8") | 200 | (1) 3/0 | 54864BE | 32211 |
| 60 | 179 | 240 | 300 | M10 (3/8") | 300 | (2) 1/0 | 54860BE | 32209 |
| 75 | 224 | 300 | 400 | M10 (3/8") | 350 | (2) 2/0 | 54862BE | 32209 |
| 90 | 269 | 360 | 450 | M10 (3/8") | 460 | (2) 4/0 | 54866BE | 32211 |

**Table 34 UPS currents and terminals—Input (for dual input unit only 208V operation)**

| Unit Rating | Nominal Input Current | Maximum Input Current | OCP Device Rating | Bolt Size | Maximum Recommended Lug (T&B) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | 75C Wire Current, tot | Wire | Compression Lug Two Hole 3/8" Bolt | Mechanical Lug Two Hole 3/8" Bolt |
| 15 | 45 | 60 | 80 | M10 (3/8") | 130 | (1) #1 | 54857BE | 32209 |
| 30 | 90 | 120 | 150 | M10 (3/8") | 150 | (1) 1/0 | 54860BE | 32209 |
| 45 | 134 | 180 | 225 | M10 (3/8") | 200 | (1) 3/0 | 54864BE | 32211 |
| 60 | 179 | 240 | 300 | M10 (3/8") | 300 | (2) 1/0 | 54860BE | 32209 |
| 75 | 224 | 300 | 400 | M10 (3/8") | 350 | (2) 2/0 | 54862BE | 32209 |
| 90 | 269 | 360 | 450 | M10 (3/8") | 460 | (2) 4/0 | 54866BE | 32211 |

**Table 35 UPS currents and terminals—Bypass input (for dual input units 208V operation)**

| Unit Rating | Nominal Input Current | OCP Device Rating | Bolt Size | 75C Wire Current, tot | Wire | Maximum Recommended Lug (T&B) | |
|---|---|---|---|---|---|---|---|
| | | | | | | Compression Lug Two Hole 3/8" Bolt | Mechanical Lug Two Hole 3/8" Bolt |
| 15 | 42 | 60 | M10 (3/8") | 130 | (1) #1 | 54857BE | 32209 |
| 30 | 83 | 125 | M10 (3/8") | 150 | (1) 1/0 | 54860BE | 32209 |
| 45 | 125 | 175 | M10 (3/8") | 175 | (1) 2/0 | 54862BE | 32209 |
| 60 | 167 | 225 | M10 (3/8") | 230 | (1) 4/0 | 54866BE | 32211 |
| 75 | 208 | 300 | M10 (3/8") | 300 | (2) 1/0 | 54860BE | 32209 |
| 90 | 250 | 350 | M10 (3/8") | 350 | (2) 2/0 | 54862BE | 32209 |

**Table 36 UPS currents and terminals—Output 208V)**

| Unit Rating | Nominal Output Current | OCP Device Rating | Bolt Size | 75C Wire Current, tot | Wire | Maximum Recommended Lug (T&B) | |
|---|---|---|---|---|---|---|---|
| | | | | | | Compression Lug Two Hole 3/8" Bolt | Mechanical Lug Two Hole 3/8" Bolt |
| 15 | 42 | 60 | M10 (3/8") | 130 | (1) #1 | 54857BE | 32209 |
| 30 | 83 | 125 | M10 (3/8") | 150 | (1) 1/0 | 54860BE | 32209 |
| 45 | 125 | 200 | M10 (3/8") | 175 | (1) 2/0 | 54862BE | 32209 |
| 60 | 167 | 225 | M10 (3/8") | 230 | (1) 4/0 | 54866BE | 32211 |
| 75 | 208 | 300 | M10 (3/8") | 300 | (2) 1/0 | 54860BE | 32209 |
| 90 | 250 | 350 | M10 (3/8") | 350 | (2) 2/0 | 54862BE | 32209 |

**Table 37 UPS currents and terminals—Battery ( 288V string)**

| Unit Rating | Battery Current | OCP Device Rating | Bolt Size | 75C Wire Current, tot | Wire | Maximum Recommended Lug (T&B) | |
|---|---|---|---|---|---|---|---|
| | | | | | | Compression Lug Two Hole 3/8" Bolt | Mechanical Lug Two Hole 3/8" Bolt |
| 15 | 67 | 80 | M10 (3/8") | 130 | (1) #1 | 54857BE | 32209 |
| 30 | 135 | 150 | M10 (3/8") | 175 | (1) 2/0 | 54862BE | 32209 |
| 45 | 202 | 225 | M10 (3/8") | 230 | (1) 4/0 | 54866BE | 32211 |
| 60 | 269 | 300 | M10 (3/8") | 300 | (2) 1/0 | 54860BE | 32209 |
| 75 | 336 | 350 | M10 (3/8") | 400 | (2) 3/0 | 54864BE | 32211 |
| 90 | 404 | 450 | M10 (3/8") | 460 | (2) 4/0 | 54866BE | 32211 |

**Table 38 AC/AC efficiency, loss and air exchange**

| AC/AC Efficiency | Data | | | | | |
|---|---|---|---|---|---|---|
| Normal mode (dual conversion), % | 94 maximum | | | | | |
| **Inverter Efficiency (DC/AC) (battery at nominal voltage 288VDC and full-rated linear load)** | | | | | | |
| Rated Power, kVA | 15-90 | | | | | |
| Battery Mode, % | 94 | | | | | |
| **Heat Losses & Air Exchange** | | | | | | |
| Rated Power, kVA | 15 | 30 | 45 | 60 | 75 | 90 |
| Normal Mode, kW | 0.9 | 1.8 | 2.7 | 3.6 | 4.5 | 5.4 |
| No Load, kW | 0.3 | 0.6 | 0.9 | 1.2 | 1.5 | 1.8 |
| Maximum forced air cooling (front intake, rear exhaust), L/sec ($m^3$/hr) | 102 (173) | 204 (346) | 306 (519) | 408 (692) | 510 (865) | 612 (1038) |
| Heat Dissipation, BTU/Hr (kWH) | 3074 (0.9) | 6147 (1.8) | 9220 (2.7) | 12295 (3.6) | 15368 (4.5) | 18442 (5.4) |

**Table 39 Rectifier input**

| Parameter | 15-90kVA |
|---|---|
| Rated AC Input Voltage [3] | 208/120V or 220/127V, 60Hz, 3-Phase, 4-Wire Plus Ground |
| Input Voltage Range, Startup/Operating | 96-138V or 102-146V or -20%, +15% (Full Load) |
| Input Voltage Range, Operating | 72-138V or 76-146V or -40%, +15% (<80% Load) |
| Frequency | 50 or 60Hz (40-70Hz Range) |
| Power Factor | 0.99 Full Load, 0.98 Half Load |
| Input Current, Rated [1] | 45/90/135/180/225/270 A |
| Input Current, Max [2] | 60/120/180/240/300/360 A |
| THD | 3% THDI Full Load |

1. At rated load and 208V input with battery charged (EN 62040-3 / 50091-3).
2. At rated load and 208V input with battery charging at maximum power (EN 62040-3 / 50091-3).
3. Three-phase, four-wire and shared neutral with the bypass input.

**Table 40 Battery DC intermediate circuit**

| Parameter | 15 - 90kVA | | | | | | |
|---|---|---|---|---|---|---|---|
| Battery Bus Voltage | Nominal: 288VDC (VRLA Float charge is 324V) 24 jars of 12V VRLA | | | | | | |
| Number of Lead-Acid Cells | 144 = [24 x 6 cell (12V) blocks], nominal | | | | | | |
| Float Voltage | 2.25V/cell, selectable from 2.2 - 2.3V/cell<br>Constant current and constant voltage charge mode | | | | | | |
| Temperature Compensation | -3.0mV/°C, selectable from 0 to -5.0mV/°C around 77°F (25°C) or 86°F (30°C) or inhibit | | | | | | |
| Ripple Voltage | ≤1% | | | | | | |
| Ripple Current, ~ $C_{10}$ | ≤5% | | | | | | |
| Boost Charge Voltage | 2.35 V/cell (selectable from 2.30-2.40V/cell)<br>Constant current and constant voltage charge mode | | | | | | |
| Boost Control | • Float-boost current trigger 0.050 $C_{10}$ (selectable 0.030-0.070)<br>• Boost-float current trigger 0.010 $C_{10}$ (selectable 0.005-0.025)<br>24 hr safety time-out (selectable 8-30 hr)<br>Boost charge mode inhibit also selectable | | | | | | |
| End of Discharge | 1.63 V/cell (selectable from 1.60-1.750V/cell)<br>Auto Inverse EOD voltage x discharge current mode<br>(The end of discharge voltage increases at low discharge currents) | | | | | | |
| Battery Charge | 2.4 V/cell (selectable from 2.3-2.4V/cell)<br>Constant current and constant voltage charge mode<br>Programmable auto trigger or inhibit of boost mode | | | | | | |
| Battery Charging Power[1] Max Current (Adjustable)[2] | **UPS (kVA)** | **15** | **30** | **45** | **60** | **75** | **90** |
| | Battery Charging Power (kW) | 2.25 | 4.5 | 6.75 | 9 | 11.25 | 13.25 |
| | Max Charging Current (A) | 11 | 22 | 33 | 44 | 55 | 66 |

1. At low input voltage, the UPS recharge capability increases with load decrease (up to the maximum capacity indicated).
2. Maximum currents listed are for end of discharge voltage of 1.67 V/cell for 144 cells.

**Table 41 Inverter output to critical load**

| Parameter | 15 - 90kVA |
|---|---|
| Rated AC Voltage [1] | 208/120, 220/127VAC, 60Hz, 3-phase, 3- or 4-wire plus ground |
| Frequency [2] | 60Hz |
| Overload Capacity | 110% load, 60 min<br>125% load, 10 min<br>150% load, 60 sec |
| Fault Current | Short circuit for 200 ms |
| Non-Linear Load Capability [3] | 100% |
| Neutral Current Capability | 170% |
| Steady State Voltage Stability | ±1% (balanced load) |
| Voltage Regulation | ±1% for balanced load<br>±5% for 100% unbalanced load |
| Phase Balance | 120° ±1° for balanced load<br>120° ±15°± for 100 unbalanced load |
| Transient Voltage Response [4] | ±5% |
| THD | < 1% (linear load), <4% (non linear load [3]) |
| Sync Frequency Range | Rated frequency ± 2Hz (selectable ± 0.5 to ± 3Hz) |
| Frequency Slew Rate | 0.2 to 3Hz/sec |
| Frequency Regulation | ±0.1% (single Liebert FlexPower Assembly)<br>±0.25% (six Liebert FlexPower Assemblies) |
| Voltage Adjustment Range | ±5% |

1. Factory set to 208V or 220V selectable by commissioning engineer.
2. Factory set to 60Hz; 50Hz selectable by commissioning engineer. Frequency converter operation also selectable.
3. EN50091-3 (1.4.58) crest factor: 3:1
4. IEC62040-3/ EN 50091-3 also for 0-100-0% load transient. Transient recovery time: return to within 5% of steady state output voltage within half a cycle.
5. Three-phase, 4 wire and shared neutral with the bypass input.

**Table 42 Bypass input**

| Parameter | | 15 - 90kVA |
|---|---|---|
| Rated AC Voltage [1 2] | | 208/220V 3-phase |
| Rated current | 208V | 252A |
| | 220V | 240A |
| Overload | | 135% load, long term |
| Upstream protection, bypass line | | Thermomagnetic circuit-breaker, rated up to 125% of nominal output current. IEC 60947-2 curve C. |
| Current rating of neutral cable, A | | 1.7×In |
| Frequency, Hz | | 60 |
| Transfer time between Bypass and Inverter, ms | | Synchronous transfer: 0ms<br>Asynchronous transfer (default): 15 ms (50 Hz), 13.3 ms (60 Hz)<br>or 40, 60, 80, 100 ms selectable |
| Bypass voltage tolerance, %VAC | | Upper limit: +10, +15 or +20, default +15<br>Lower limit: -10, -20, -30 or -40; default: -20 (delay time to accept steady bypass voltage: 10 sec) |
| Bypass frequency tolerance, % | | ±10 or ±20; default ±10 |
| Synchronization - Window | | Rated frequency ± 2Hz (selectable ± 0.5 to ± 3Hz) |

1. Factory-set to 208 or 220V selectable by commissioning engineer.
2. Three-phase, 4 wire and shared neutral with the rectifier input. Neutral referenced to the output.

**Figure 57 Battery, circuit breaker and UPS wiring with external batteries with four connecting wires**

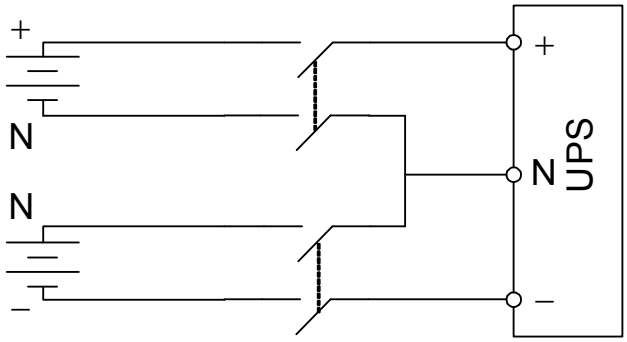
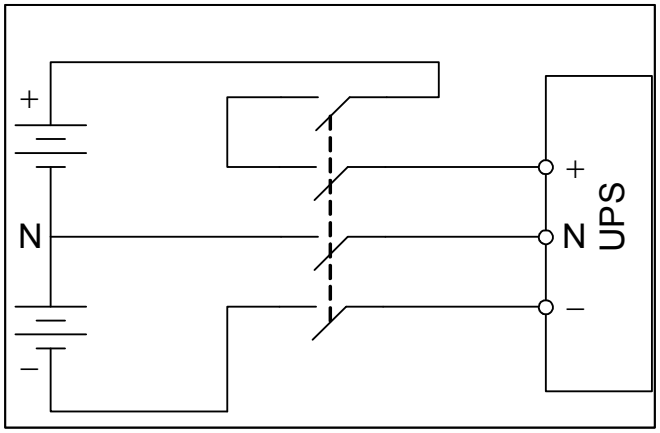



**Figure 58 Battery, circuit breaker and UPS wiring with external batteries with three connecting wires**



# APPENDIX A HAZARDOUS SUBSTANCES OR ELEMENTS ANNOUNCEMENT

**Table 43 Hazardous substances or elements**

| Part Name | Hazardous Substances | | | | | |
|---|---|---|---|---|---|---|
| | Lead | Mercury | Cadmium | Chrome | Polybrominated Biphenyl | Polybrominated Diphenyl Ethers |
| | Pb | Hg | Cd | $Cr^{6+}$ | PBB | PBDE |
| Hex copper stud | X | ✔ | ✔ | ✔ | ✔ | ✔ |
| PCBA | X | ✔ | ✔ | ✔ | ✔ | ✔ |
| AC capacitor | X | ✔ | ✔ | ✔ | ✔ | ✔ |
| DC capacitor | X | ✔ | ✔ | ✔ | ✔ | ✔ |
| Fan | X | ✔ | ✔ | ✔ | ✔ | ✔ |
| Cables | X | ✔ | ✔ | ✔ | ✔ | ✔ |
| LCD | X | X | ✔ | ✔ | ✔ | ✔ |
| Sensors | X | ✔ | ✔ | ✔ | ✔ | ✔ |
| Large-medium power magnetic components | X | ✔ | ✔ | ✔ | ✔ | ✔ |
| Circuit breaker / rotating switch | X | ✔ | ✔ | ✔ | ✔ | ✔ |
| Semiconductors | X | ✔ | ✔ | ✔ | ✔ | ✔ |
| Battery (when applicable) | X | ✔ | ✔ | ✔ | ✔ | ✔ |
| Insulation monitoring device (when applicable) | X | ✔ | ✔ | ✔ | ✔ | X |

✔= Means the content of the hazardous substances in all the average quality materials of the part is within the limits specified in SJ/T-11363-2006

**X** = Means the content of the hazardous substances in at least one of the average quality materials of the part is outside the limits specified in SJ/T11363-2006

Emerson Network Power Co., Ltd. has been committed to the design and manufacturing of environment-friendly products. It will reduce and eventually eliminate the hazardous substances in the products through unremitting efforts in research. However, limited by the current technical level, the following parts still contain hazardous substances due to the lack of reliable substitute or mature solution:

1. All solders in the products contain lead.
2. Copper alloy contains lead.
3. Backlight bulb contains mercury.
4. The ceramic materials of the ceramic capacitor, the copper terminals and copper leads of metallic film capacity contain lead.
5. The glass of resistor contains lead.
6. The glass of LCD contains lead, and the backlight lamp contains mercury.
7. The lead in the battery is determined by the battery feature and technical levels.
8. The insulation monitoring device contains lead and PBDE.

About Environment Protection Period: The Environment Protection Period of the product is marked on the product. Under normal working conditions and normal use of the products observing relevant safety precautions, the hazardous substances in the product will not seriously affect the environment, human safety or property in the Environment Protection Period starting from the manufacturing date.

About battery: The battery life is dependent on the ambient temperature and charging / discharging times. The battery life will be shortened if the battery is used under high temperature or in deep discharging status. Refer to the manufacturer's product literature for details.

Applicable scope: Liebert APM 90kVA UPS

# APPENDIX B UPS STATUS MESSAGES

**Table 44** shows all event messages as they appear in the current status area of the LCD or the history log, along with a description and recommended actions, if any. For further information on the current status area and the history log, see **8.10 - UPS History Log**.

**Table 44 UPS status messages**

| Event Message | Description / Suggested Action (if any) |
|---|---|
| Comm. Fail | The CAN communication between internal monitor and rectifier/inverter/bypass fails. Contact Liebert Services at 800-543-2378 for assistance. |
| Battery Overtemp. | The Battery temperature is over limit. Check the battery temperature and ventilation |
| Ambient Overtemp. | The Ambient temperature is over limit. Check the ventilation of UPS room. |
| Replace Battery | Battery should be replaced. Contact Liebert Services at 800-543-2378 for assistance. |
| Battery Low Pre-warning | Before the end of discharging, battery under-voltage pre-warning should occur. After this pre-warning, battery should have the capacity for 3 minutes discharging with full load. The time is user configured from 3 to 60 minutes.<br>Shut down the load in time |
| Battery End of Discharge | Inverter turned off due to low battery voltage.<br>Check the utility failure and try to recover it. |
| Mains Volt. Abnormal | Mains Voltage exceeds the upper or lower limit and results in rectifier shutdown.<br>Check the input line-to-neutral voltage amplitude of rectifier. |
| Mains Undervoltage | Mains Voltage is undervoltage (120v~132V) with derated load.<br>Check the input line-to-line voltage amplitude of rectifier. |
| Mains Freq. Abnormal | Mains frequency is out of limit range and results in rectifier shutdown.<br>Check the rectifier's input voltage frequency |
| Rectifier Fault | Rectifier Fault; Contact Liebert Services at 800-543-2378 for assistance. |
| Rectifier Overtemp. | The temperature of heat sink is too high to keep the rectifier running.<br>The UPS can recover automatically. Check the environment and ventilation. |
| Charger Fault | The Charger is fault. Contact Liebert Services at 800-543-2378 for assistance. |
| Input Fuse Fail | Input fuse is open. Contact Liebert Services at 800-543-2378 for assistance. |
| Control Power 1 Fail | Control Power 1 has failed or has been lost. Contact Liebert Services at 800-543-2378 for assistance. |
| Mains Phase Reversed | Input phase sequence is inverse. Contact Liebert Services at 800-543-2378 for assistance. |
| Soft Start Fail | Rectifier could not start due to low DC bus voltage. Contact Liebert Services at 800-543-2378 for assistance. |
| Bypass Unable to Trace | This alarm is triggered by an inverter software routine when the amplitude or frequency of bypass voltage is beyond the normal range.<br>The amplitude threshold is fixed for positive and negative 10% rating.<br>This alarm automatically resets once the bypass voltage goes normal.<br>1. First verify that the bypass voltage and frequency displayed on the panel is within the selected range. Note here the rated voltage and frequency are specified by "Output voltage level" and "Output frequency level" respectively.<br>2. If the displayed voltage is believed to be abnormal, then verify the bypass voltage and frequency presented to the UPS. Check the external supply if it is found to be faulty.<br>Contact Liebert Services at 800-543-2378 for assistance. |
| Bypass Abnormal | This alarm is triggered by an inverter software routine when the amplitude or frequency of bypass voltage exceeds the limit.<br>This alarm automatically resets once the bypass voltage goes normal.<br>First check if there are some relevant alarms such as "Bypass disconnect open", "Bypass phase reverse" and "Mains neutral lost". If they appear, solve them first.<br>1. Then verify that the bypass voltage and frequency displayed on the panel is within the bypass limit. Note here the rated voltage and frequency are specified by "Output voltage level" and "Output frequency level" respectively.<br>2. If the displayed voltage is believed to be abnormal, then verify the bypass voltage and frequency presented to the UPS. Check the external bypass supply if it is found to be faulty. If the utility is likely to trigger this alarm frequently, the bypass limit can be changed a little larger through the configuration software according to the customer's agreement.<br>Contact Liebert Services at 800-543-2378 for assistance. |

**Table 44 UPS status messages (continued)**

| Event Message | Description / Suggested Action (if any) |
|---|---|
| Inverter Asynchronous | This alarm is triggered by an inverter software routine when the inverter and bypass waveforms are misaligned by more than 6 degrees in phase. This alarm resets automatically once the condition is no longer true.<br>1. First check if the alarm “Bypass unable to trace” or “Bypass abnormal” occurs. If so, solve it first.<br>2. Verify the waveform of the bypass voltage. If it is too distorted, ask the customer to verify and seek any possible measurements.<br>Contact Liebert Services at 800-543-2378 for assistance. |
| Inverter Fault | This alarm indicates a fault condition exists within the inverter.<br>Contact Liebert Services at 800-543-2378 for assistance. |
| Fan Fault | At least one of the cooling fans fails. Contact Liebert Services at 800-543-2378 for assistance. |
| Inverter STS (relay) Fail | At least one of the static switches of inverter side is open or short circuit. This fault is locked until power off. Contact Liebert Services for assistance at 800-543-2378 for assistance. |
| Bypass STS Fail | At least one of the static switches of bypass side is open or short circuit. This fault is locked until power off.<br>Contact Liebert Services at 800-543-2378 for assistance. |
| Output Fuse Fail | At least one of the output fuses is open. Contact Liebert Services at 800-543-2378 for assistance. |
| Control Power 2 Fail | Control Power 2 is abnormal or lost. Contact Liebert Services at 800-543-2378 for assistance. |
| Unit Overload | The UPS is confirmed to be overload when the load arises above 105% nominal rating.<br>The alarm automatically resets once the overload condition is removed.<br>1. Confirm that the alarm is true by checking the load percent indicated on the LCD panel to determine which phase is being overloaded.<br>2. If the alarm is true, measure the actual output current to verify that the indications are valid. Disconnect unnecessary load and ensure the safety. In a parallel system, a severe load sharing error can also leads to the alarm.<br>Contact Liebert Services at 800-543-2378 for assistance. |
| System Overload | The UPS parallel system is confirmed to overload when the total load arises above 105% nominal rating for the set basic number of UPSs. The alarm automatically resets once the overload condition is removed.<br>1. Confirm that the alarm is true by checking the system load percent indicated on the LCD panel to determine which phase is being overloaded.<br>2. If the alarm is true, measure the actual output current to verify that the indications are valid. Disconnect unnecessary load and ensure the safety. In a parallel system, a severe load sharing error can also leads to the alarm. |
| Unit Overload Timeout | The UPS is confirmed to overload and the overload times out.<br>**Note 1:** The highest loaded phase will indicate overload timing-out first.<br>**Note 2:** When the timer is active then alarm “unit overload” should also be active as the load is above nominal.<br>**Note 3:** When the timer has expired, the inverter Static Switch is opened and the load transferred to bypass. The inverter shutdown and will restart after 10 seconds.<br>**Note 4:** If the load decreases lower than 95% after 5 minutes, the system will transfer back to inverter mode.<br>Confirm that the alarm is genuine by checking the load percent indicated on the LCD. If an overload is indicated then check the load, and investigate any additional load connected prior to the alarm (if applicable). |
| Bypass Phase Reversed | The phase sequence direction of bypass voltage is reversed.<br>Normally, the phase of Phase B lags 120 degrees behind Phase A, and the phase of Phase C lags 120 degrees behind Phase B.<br>Verify that the phase rotation of the bypass supply presented to the UPS is correct, and rectify it if it is found to be in error. Contact Liebert Services at 800-543-2378 for assistance. |
| Load Impact Transfer | A transfer to bypass occurred due to a large step load. The UPS should recover automatically.<br>Turn on connected equipment in sequential order to reduce the step loading of the inverter. |
| Transfer Timeout | The load is on bypass power due to excessive number of transfers that occurred within the last hour.<br>The UPS will recover automatically and will transfer the load back to inverter power within an hour. |
| Load Sharing Fault | UPS working within a parallel system are not sharing load current correctly. Contact Liebert Services at 800-543-2378 for assistance. |

**Table 44 UPS status messages (continued)**

| Event Message | Description / Suggested Action (if any) |
|---|---|
| DC Bus Abnormal | Shut off inverter due to abnormal DC bus voltage.<br>Contact Liebert Services at 800-543-2378 for assistance. |
| System Transfer | The whole paralleled UPS system transferred to bypass at the same time. This message will appear on the UPS which passive transfer to bypass. |
| DC Bus Overvoltage | Rectifier, inverter and battery converter were shutdown because DC bus voltage is too high. Check whether there is a fault in rectifier side. If no, then check whether overload occurs. Restart the inverter after resetting the fault. If fault does not clear, contact Liebert Services at 800-543-2378 for assistance. |
| LBS Active | The LBS setting is active. The UPS is acting as an LBS master or slave in a dual bus configuration. |
| Battery ground fault | Battery ground fault from dry contact signal. Contact Liebert Services at 800-543-2378 for assistance. |
| Inverter turned On manually | Manual Turn On via front panel |
| Inverter turned Off manually | Manual Turn Off via front panel |
| EPO | Emergency Power Off |
| Transfer Confirm | Interrupted Transfer Confirm |
| Transfer Cancel | Interrupted Transfer is cancel |
| Unit Off Confirm | Unit Turned Off Confirm |
| System Off Confirm | System Turned Off Confirm |
| Fault Reset | Fault Reset |
| Alarm Silence | Alarm Silence |
| Turn On Fail | Turn On Fail |
| Alarm Reset | Audible Alarm Reset |
| Bypass Mode | UPS in Bypass Mode |
| Normal Mode | UPS in Normal Mode |
| Battery Mode | UPS in Battery Mode |
| Output Disabled | UPS Output Disabled |
| Maint. Disconnect Closed | Maintenance Disconnect Closed |
| Reserved | |
| Output Disconnect Open | Output Disconnect Open |
| Battery Reverse | Connect the battery again and check the wiring of batteries |
| No Battery | Check the battery and the wiring of batteries |
| Auto start | After UPS was shutdown at EOD, inverter auto starts when utility is restored. |
| BCB closed | BCB closed from dry contact signal. |
| BCB open | BCB open from dry contact signal. |
| Battery Float Charging | Battery is float charging |
| Battery Boost Charging | Battery is boost charging |
| Battery Discharging | Battery is discharging |
| Battery Period Testing | Battery is period self-testing. |
| Batt. Capacity Testing | Battery is capacity self-testing. |
| Batt. Maint. Testing | Battery is maintenance self-testing. |
| Inverter in Setting | Inverter is in parameter setting |
| Rectifier in Setting | Rectifier is in parameter setting |
| Batt. Converter Fault | Battery converter output voltage beyond limits or battery fuse failed. Battery converter shuts down. Battery backup not available. |
| Operation Invalid | This record is registered following an incorrect operation. |

**Table 44 UPS status messages (continued)**

| Event Message | Description / Suggested Action (if any) |
|---|---|
| Byp. Abnormal Shutdown | Both bypass and inverter voltages unavailable. Load interruption. |
| Mains Neutral Lost | AC Input mains reference neutral not detected. |
| Battery Room Alarm | Environment in Battery Room Needs Attention |
| Rec Flash Update | Rectifier firmware is being updated |
| Inv Flash Update | Inverter firmware is being updated |
| Monitor Flash Update | Monitor firmware is being updated |
| LBS abnormal | LBS is abnormal |

# NOTES

# *Ensuring The High Availability Of Mission-Critical Data And Applications.*

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