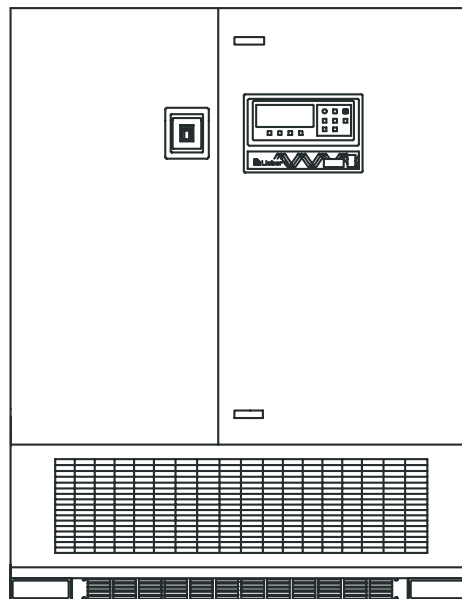


# Liebert Series 610™ UPS

Installation Manual - 100-225kVA, 60Hz, Three Phase Single-Module



## BATTERY CABINET PRECAUTIONS

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The following warning applies to all battery cabinets supplied with UPS systems. Additional warnings and cautions applicable to battery cabinets may be found in:

- **Important Safety Instructions**—page 1
- **Section 2.0 - Unloading and Handling**
- **Section 5.0 - 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 prior to moving battery cabinets (after initial installation).

## CONTACTING LIEBERT FOR SUPPORT

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To contact Liebert Global Services for information or repair service in the United States, call 1-800-LIEBERT (1-800-543-2378). Liebert Global Services offers a complete range of start-up services, repair services, preventive maintenance plans and service contracts.

For repair or maintenance service outside the 48 contiguous United States, contact Liebert Global Services, if available in your area. For areas not covered by Liebert Global Services, the authorized distributor is responsible for providing qualified, factory-authorized service.

For LGS to assist you promptly, please have the following information available:

Part numbers: \_\_\_\_\_

Serial numbers: \_\_\_\_\_

Rating: \_\_\_\_\_

Date purchased: \_\_\_\_\_

Date installed: \_\_\_\_\_

Location: \_\_\_\_\_

Input voltage/frequency: \_\_\_\_\_

Output voltage/frequency: \_\_\_\_\_

Battery reserve time: \_\_\_\_\_

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## IMPORTANT SAFETY INSTRUCTIONS

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### SAVE THESE INSTRUCTIONS

This manual contains important instructions that should be followed during installation of your Series 610 UPS and batteries.



#### WARNING

Exercise extreme care when handling UPS cabinets to avoid equipment damage or injury to personnel. The UPS module weight ranges from 1500 to 4805 lbs. (680 to 2180kg), including input transformer. The battery cabinets weigh from 3050 to 5300 lbs. (1383 to 2404kg).

Locate center of gravity symbols  and determine unit weight before handling each cabinet. Test lift and balance the cabinets before transporting. Maintain minimum tilt from vertical at all times.

Slots at the base of the modules and battery cabinets are intended for forklift use. Base slots will support the unit only if the forks are completely beneath the unit.

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.

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.

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.**



#### 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 battery. Observe all safety precautions in this manual before handling or installing the UPS system. Observe all precautions in the Operation and Maintenance Manual, before as well as during performance of 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 an AC and DC voltmeter to ensure safety before making contact or using tools. Even when the power is turned Off, dangerously high potential electric charges may exist at the capacitor banks and at the batteries.

**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).

One person should 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 and EN550022. 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. Operation of this unit in a residential area may cause harmful interference that the user must correct at his own expense.



## NOTE

*Materials sold hereunder cannot be used in the patient vicinity (i.e., cannot be used where UL 60601-1, cUL 60601-1 or IEC 60601-1 is required). Medical Applications such as invasive procedures and electrical life support equipment are subject to additional terms and conditions.*



## 1.0 INSTALLATION CONSIDERATIONS

Install your Series 610 UPS in accordance with the submittal drawing package and the following procedures.

A Liebert authorized representative must perform the initial system check-out and start-up to ensure proper system operation. Equipment warranties will be voided unless system start-up is performed by a Liebert authorized representative. Contact your local Liebert sales representative or Liebert Global Services at 1-800-LIEBERT to arrange for system start-up.



### CAUTION


Read this manual thoroughly before attempting to wire or operate the unit. Improper installation is the most significant cause of UPS start-up problems.

Do not install this equipment near gas or electric heaters. It is preferable to install the UPS in a restricted location to prevent access by unauthorized personnel.

1. Proper planning will speed unloading, location and connection of the UPS. Refer to **Figures 11** through **44** and **Appendix A**.
2. Be certain that the floor at the final equipment location and along the route (inside the facility) to the installation site can support the cabinet weight and the weight of any moving equipment. The UPS modules can weigh from 1500 to 4805 lbs. (680 to 2180kg). The battery cabinets weigh from 3050 to 5300 lbs. (1383 to 2404kg) each. Refer to **Appendix A**.



### WARNING

Locate center of gravity symbols  and determine unit weight before handling cabinet.

3. Plan the route to ensure that the unit can move through all aisleways and doorways and around corners without risking damage. If the modules and batteries must be moved by elevator, check the size of the door openings and the weight-carrying capacity of the elevator.
4. Refer to information later in this manual regarding the optional battery cabinet(s), Maintenance Bypass Cabinets, Panelboards and Switchboards. **Observe all battery safety precautions when working on or near the battery.**
5. Use the shortest output distribution cable runs possible, consistent with logical equipment arrangements and with allowances for future additions if planned.
6. Recommended ambient operating temperature is 77°F (25°C). Relative humidity must be less than 95%, non-condensing. Note that room ventilation is necessary, but air conditioning may not be required. Maximum ambient operating temperature for the UPS and switchgear is 104°F (40°C) without derating. The batteries should not exceed 77°F (25°C). At elevations above 4000 ft. (1219m), temperature derating may be required for full power output—consult your Liebert sales representative or call 1-800-LIEBERT.
7. Even though your Liebert UPS unit is 92 to 94% efficient, the heat output is substantial. For more specific information, see **Appendix A**. Be sure environmental conditioning systems can accommodate this BTU load, even during utility outages.
8. The installer should attempt to balance the load between the three output phases. The UPS will operate safely with an unbalanced load, but will give optimum performance if the three output phases are loaded within 20 percent of each other.
9. During normal UPS operations, short-term overload current demand from the bypass source may reach 10x the UPS output current rating. This overload current demand may be caused by the magnetizing inrush current of one or more downstream transformers or faults on downstream branch circuits. The instantaneous trip point(s) of the upstream bypass feeder breaker(s) must be set to support these temporary overloads. The magnitude of short-term overload bypass current demand is typically six to eight times the UPS current rating, but must be determined by analysis on a per-site basis. This analysis, generally known as an End-to-End Fault Coordination Study, must be done by a Registered Professional Engineer experienced in this activity and familiar with local codes and related requirements.



### NOTE

*While Liebert can provide typical guidelines, the responsibility for the proper breaker trip settings outside of the Liebert-manufactured UPS equipment resides with the owner. Contact Liebert Global Services at 1-800-LIEBERT for further details.*

10. A breaker coordination study should be performed to ensure proper handling of fault currents.



**NOTE**

*The instantaneous trip setting of the breaker feeding the UPS bypass input should be high enough to accommodate short-duration overloads. The bypass static switch inside the UPS can draw up to 10 times the system's rated current for up to three cycles.*

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## 2.0 UNLOADING AND HANDLING

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The UPS module is shipped in one cabinet to allow ease of handling at the site. Because the weight distribution in the cabinet is uneven, use extreme care during handling and transport. Your installation may also include battery cabinets and a Maintenance Bypass Cabinet.



### **WARNING**

Exercise extreme care when handling UPS cabinets to avoid equipment damage or injury to personnel. The UPS module weight ranges from 1500 to 4805 lbs. (680 to 2180kg). Battery cabinets weigh from 3050 to 5300 lbs. (1383 to 2404kg).

Locate center of gravity symbols before handling cabinet. Test lift and balance the cabinet before transporting. Maintain minimum tilt from vertical at all times.

Slots at the base of the unit and battery cabinets are intended for forklift use. Base slots will support the unit only if the forks are completely beneath the unit.

To reduce the possibility of shipping damage, cabinets are shored with 2x4 bracing, secured with screw-type nails. This shoring must be carefully removed prior to unloading.



### **CAUTION**

Extreme care is necessary when removing shoring braces. Do not strike cabinet with hammers or other tools.

---

## 3.0 INSPECTIONS

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### 3.1 External Inspections

1. While the UPS system is still on the truck, inspect the equipment and shipping container(s) 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 within 24 hours and contact Liebert Global Services at 1-800-LIEBERT to inform them of the damage claim and the condition of the equipment.
2. Locate the bag containing the keys for the front access door. The bag is attached to the cabinet.
3. Compare the contents of the shipment with the bill of lading. Report any missing items to the carrier and to Liebert Global Services immediately.
4. Check the nameplate on the cabinets to verify that the model numbers correspond with the one specified. Record the model numbers and serial numbers in the front of this installation manual. A record of this information is necessary should servicing become required.

### 3.2 Internal Inspections

1. Verify that all items have been received.
2. If spare parts were ordered, verify arrival.
3. Open doors and remove cabinet panels to check for shipping damage to internal components.
4. Check for loose connections or unsecured components in the cabinet(s).
5. Check for installation of circuit breaker line safety shields. There should be no exposed circuit breaker terminals when the cabinet doors are opened.
6. Check for any unsafe condition that may be a potential safety hazard.
7. UPS modules are shipped with internally mounted shipping brackets. The shipping brackets (painted orange) must be removed from the rear (remove rear panels). The installer must remove the orange shipping brackets before final equipment placement, particularly if rear access will be restricted.



## CAUTION

Failure to remove orange shipping brackets from transformers may cause restricted airflow within the UPS. This could cause overheating or reduction of UPS capacity. In some cases, it could cause damage to the UPS module, and such damage would not be covered under the factory warranty. If you foresee a situation where the UPS will be relocated in the near future, the brackets should be removed and stored elsewhere until they are needed.

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## 4.0 EQUIPMENT LOCATION

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1. Handle cabinet(s) in accordance with the safety precautions in this manual, especially in these sections:

- **Battery Cabinet Precautions**—inside front cover
- **Important Safety Instructions**—page 1
- **2.0 - Unloading and Handling**—page 5
- **5.0 - Battery Installation**—page 8

Use a suitable material handling device to move cabinet to its final location. **Exercise extreme care because of the uneven weight distribution.** Carefully lower the cabinet to the floor.

2. Verify that the UPS system is installed in a clean, cool and dry location.
3. Installation and serviceability will be easier if adequate access is provided on all sides of the equipment, but only front access is required.
  - a. Verify that there is adequate clearance to open cabinet doors—4 ft. (1.2m) is recommended. NEC requires sufficient clearance in front of the equipment to fully open all doors without restriction. See drawings and local codes.
  - b. Verify that there is adequate area in front of circuit breakers to perform maintenance. Check installation drawings for location of breakers. Check with local codes.
  - c. Verify that there is adequate clearance above all cabinets to allow exhaust air to flow without restriction. The minimum clearance is 2 ft. (0.6m), unobstructed by conduit or any other items. Liebert recommends against using top-feed air conditioning systems.
4. Align the UPS cabinet, battery cabinets (if used) and optional transformer and maintenance bypass cabinets, as shown in the Line-Up Detail drawings (**Figures 18, 19, 20, 22, 23 and 26 through 29**) and your submittal package.
5. Connect the cabinets, internal cables and busbars, if applicable. Internal control connections should be left disconnected for later installation by Liebert LGS Customer Engineers.

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## 5.0 BATTERY INSTALLATION

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### 5.1 Battery Safety Precautions

Servicing of batteries should be performed or supervised by personnel knowledgeable of batteries and the required precautions. Keep unauthorized personnel away from batteries.

Be sure to observe the grounding recommendations in **6.0 - Configuring Your Neutral and Ground Connections** when installing batteries. When replacing batteries, use the same number and type of batteries.



### CAUTION

Lead-acid batteries contain hazardous materials. Batteries must be handled, transported and recycled or discarded in accordance with federal, state and local regulations. Because lead is a toxic substance, lead-acid batteries must be recycled rather than discarded.

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

Do not install any batteries that are cracked, leaking or show other signs of damage. Contact Liebert Global Services or your local Liebert representative.

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 if battery is inadvertently grounded. If inadvertently grounded, remove source of ground. Contact with any part of a grounded battery can result in electrical shock. The likelihood of such shock will be reduced if such grounds are removed during installation and maintenance.

Lead-acid batteries can present a risk of fire because they generate hydrogen gas. The following procedures should be followed:

- DO NOT SMOKE when near batteries.
- DO NOT cause flame or spark in battery area.
- Discharge static electricity from body before touching batteries by first touching a grounded metal surface.
- After replacing battery jars in a battery cabinet, replace the retaining straps that hold the jars in place on the shelves. This will limit accidental movement of the jars and connectors should the cabinet ever need to be repositioned or relocated. Regular maintenance of the battery module is an absolute necessity. Periodic inspections of battery and terminal voltages, specific gravity and connection resistance should be made. Strictly follow the procedures outlined in the battery manufacturer's manual, available on the manufacturer's Web site.

## 5.2 Battery Safety Precautions in French Per CSA Requirements

### Instructions Importantes Concernant La Sécurité Conserver Ces Instructions



## AVERTISSEMENT

Respecter toutes les consignes de sécurité applicables à l'installation, le chargement ou l'entretien des batteries. En plus du danger de chocs électriques, le gaz produit par les batteries peut exploser dégageant de l'acide sulfurique qui peut entraîner de très graves brûlures.

Toute opération d'entretien/réparation des batteries doit être exécutée ou supervisée par un personnel qualifié dans le domaine et en prenant toutes les précautions nécessaires. Tenir le personnel non autorisé à l'écart des batteries.



## ATTENTION

Les batteries acide-plomb contiennent des substances toxiques dangereuses. Les batteries doivent être manipulées, transportées et recyclées ou jetées conformément à la réglementation en vigueur aux niveaux national et local. Le plomb étant toxique, les batteries acide-plomb doivent être recyclées et non jetées.

Ne pas ouvrir ni endommager la ou les batteries. Les électrolytes diffusés sont dangereux pour la peau et les yeux. Ils sont toxiques. Ne pas jeter la ou les batteries dans le feu. Risque d'explosion.

Ne jamais installer de batteries avec des cellules fissurées ou endommagées. Contacter Liebert Global Services ou le représentant agréé Liebert local.

Une batterie peut poser un risque de choc électrique et de courant élevé provoqué par un court-circuit. Respecter les précautions suivantes lors de travaux sur les batteries:

- Enlever montres, bagues ou autres objets métalliques.
- Utiliser des outils dont les poignées sont isolées.
- Porter des gants et des bottes en caoutchouc.
- Ne pas poser d'outils ou d'objets métalliques sur les batteries.
- Déconnecter la source de chargement avant de connecter ou de déconnecter les bornes de batterie.
- Vérifier que la batterie n'a pas été mise à la masse par inadvertance. Si elle est mise à la masse, éliminer la source de masse. Tout contact avec des composants de batterie mise à la masse peut entraîner un choc électrique. Éliminer le risque de chocs électriques potentiels en retirant les sources de masse avant l'installation et la maintenance.

Les batteries acide-plomb peuvent représenter un risque d'incendie puisqu'elles génèrent de l'hydrogène. Respecter les procédures suivantes :

- NE PAS FUMER près des batteries.
- NE PAS générer de flammes ou d'étincelles près des batteries.
- Éliminer l'électricité statique du corps avant de manipuler les batteries en touchant d'abord une surface métallique mise à la terre.

L'électrolyte est un acide sulfurique dilué qui est dangereux au contact de la peau et des yeux. Ce produit est corrosif et aussi conducteur électrique. Les procédures suivantes devront être observées:

- Porter toujours des vêtements protecteurs ainsi que des lunettes de protection pour les yeux.
- Si l'électrolyte entre en contact avec la peau, nettoyer immédiatement en rincant avec de l'eau.
- Si l'électrolyte entre en contact avec les yeux, arroser immédiatement et généreusement avec de l'eau. Demander pour de l'aide médicale.
- Lorsque l'électrolyte est renversée, la surface affectée devrait être nettoyée en utilisant un agent neutralisant adéquat. Une pratique courante est d'utiliser un mélange d'approximativement une livre (500 grammes) de bicarbonate de soude dans approximativement un gallon (4 litres) d'eau. Le mélange de bicarbonate de soude devra être ajouté jusqu'à ce qu'il n'y ait plus apparence de réaction (mousse). Le liquide résiduel devra être nettoyé à l'eau et la surface concernée devra être asséchée.

### 5.3 Battery Cabinets

Optional battery cabinets are available from Liebert and other qualified vendors. Consult your submittal package for details.

Several models of optional battery cabinets with varying run times are available. Each model is 78" (1981mm) high and has forklift slots. Refer to **Figures 17** through **20**. The battery cabinet cells range from 90 to 150 ampere-hours. The same model battery cabinet may be paralleled in multiple cabinet strings for additional capacity. Battery capacity (in minutes) at your installation will depend on cabinet model, number of cabinets and amount of critical load on the UPS.

1. **Handling.** The battery cabinet weighs from 3050 to 5300 lbs. (1383 to 2404kg). Forklift slots are provided for ease of handling.
2. **Cabinet Inspection.** Remove all panels and visually inspect the batteries, bus connections, and cabinet for any damage. If any foam blocks were placed between shelves to restrain movement during shipment, remove them now. **Exercise caution—voltage is present within the battery cabinet even before installation.** If there are signs of damage, do not proceed. Call Liebert Global Services at 1-800-LIEBERT.
3. **Battery Storage.** The batteries used in the battery cabinet retain their charge well. The batteries can be stored indoors in a temperature-controlled environment, for up to six months without any appreciable deterioration. Self-discharge rate of the batteries is approximately 3% per month when the batteries are stored in temperatures of 59°F to 77°F (15-25°C). If the battery cabinet must be stored for longer than six months, contact Liebert Global Services. The battery cabinet should never be stored outdoors or on a loading dock.
4. **Installation.** Battery cabinets must be located on the left side of the UPS module. The front-access-only-design eliminates side and rear service clearance requirements.
5. **Reinstallation.** If at any time it becomes necessary to move the battery cabinet to another location, contact Liebert Global Services to inspect the internal battery hold-down straps.
6. **Environment.** Locate the battery cabinet in a clean, dry environment. Recommended temperature range for optimum performance and lifetime is 68°F to 77°F (20-25°C).
7. **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 ft. (1m) of clearance at the front of the cabinet when operating. Side and rear panels do not require service clearance.
8. **Side Panels.** To connect battery cabinets together, remove the protective side panels by removing the retaining screws that hold the side panels in place. Do not remove the shield plate, explained in Item **9** below.
9. **Shield Plate.** The shield plate in the battery cabinets is required for proper UPS airflow and should be installed between the UPS system and the adjacent battery cabinet. If your system has more than one battery cabinet, ensure that the cabinet with the shield is installed immediately adjacent to the UPS. Move the shield, if necessary, to ensure its location between the UPS and the batteries.



#### NOTE

*The battery cabinet is designed to be bolted ONLY to the left side of the UPS (see **Figures 19** and **20**).*

*Units may be bolted to battery cabinets ONLY if the shield plate is left in place between the UPS module and the battery cabinet.*

10. **Cables.** Multiple battery cabinets may be bolted together in a daisy-chain configuration. Cables for this setup may be run between paralleled battery cabinets through cutouts in the top of the cabinets, eliminating the need for external conduit runs. **Route cables before moving cabinets into final position for bolting together.** Low voltage control wiring must be kept separate from the power wiring. Remove top panels for access. No top or bottom entry cables are required, except for remotely located cabinets, which require conduits. Refer to **Figures 17** through **20** or your submittal drawings for instructions on wiring cabinets in parallel.
11. **Grounding.** The battery cabinets have ground studs near the busbar connections. Use an equipment grounding conductor to connect the lugs of the cabinets together and to connect the cabinets to the ground busbar in the UPS module.



## 5.4 Open-Rack Batteries

When batteries other than Liebert battery cabinets are used, a remote battery disconnect switch with overcurrent protection is required per the National Electrical Code. Refer to Required Battery Disconnect Rating in the site planning data tables in **Appendix A** for recommended overcurrent protection ratings. Contact your Liebert sales representative for more information.

1. Install battery racks/cabinets and batteries per manufacturer's installation and maintenance instructions.
2. Verify battery area has adequate ventilation and battery operating temperature complies with manufacturer's specification. Installations using vented lead-acid batteries **MUST** have adequate ventilation to remove explosive gases per local and national codes.
3. Low voltage control wiring must be kept separate from power wiring and run in separate conduits.
4. Ensure that battery racks are properly grounded according to code requirements in your area.

If you have any questions concerning batteries, battery racks or accessories, contact your local sales representative or Liebert Global Services at 1-800-LIEBERT.



### **CAUTION**

Cables between batteries and the UPS should be run in matched pairs, positive-with-negative, within each conduit or cable run. Grouping like-polarity cables together (i.e., positive-with-positive and negative-with-negative) can cause stress or damage to the cables, conduit or buswork.

## 6.0 CONFIGURING YOUR NEUTRAL AND GROUND CONNECTIONS

Improper grounding is the largest single cause of UPS installation and start-up problems. This is not an easy subject, since grounding techniques vary significantly from site to site, depending on several factors. The questions you should ask are:

- What is the configuration of the input power source? Most of the recommended schemes for UPS grounding require grounded-wye service. The UPS system requires a bypass neutral for sensing and monitoring the quality of the bypass input. If the building service is ungrounded delta or corner-grounded delta, contact your Liebert representative for details about Isolated Neutral kits. A Power-Tie or distributed redundant system has different grounding requirements from stand-alone UPS modules. If using one of those systems, refer to Liebert's Power-Tie configuration user manual, SL-30030.
- Does the system have a bypass isolation transformer? Systems with 480 VAC (or 600 VAC) input and 208 VAC output require a bypass isolation transformer. In some cases, it may be necessary to treat that transformer as a "separately derived source" with its own grounding electrode.
- What are the UPS input and output voltages? Systems with 480 VAC input and output have significantly different needs from systems with 480/208 VAC or 208/208 VAC.
- What is the connected load? Does the critical load consist of one or more Power Distribution Units (PDUs)? Do the PDUs have isolation transformers?

Proper grounding should be based on NEC Section 250, but safe and proper equipment operation requires further enhancements. The following pages detail Liebert's recommendations for grounding various system configurations to ensure optimal UPS system performance.



### NOTE

*Some UPS modules are equipped with input isolation transformers. However, these transformers have no effect upon any system grounding considerations. These modules will be grounded exactly as shown in **Figures 1 through 7**.*



### CAUTION

The UPS ground lug must be solidly connected to the service entrance ground by an appropriately sized wire conductor per NEC Article 250. Each conduit or raceway containing phase conductors must also contain a ground wire, both for UPS input and output, which are solidly connected to the ground terminal at each termination point. Conduit-based grounding systems tend to degrade over time. Therefore, using conduit as a grounding conductor for UPS applications may degrade UPS performance and cause improper UPS operation.

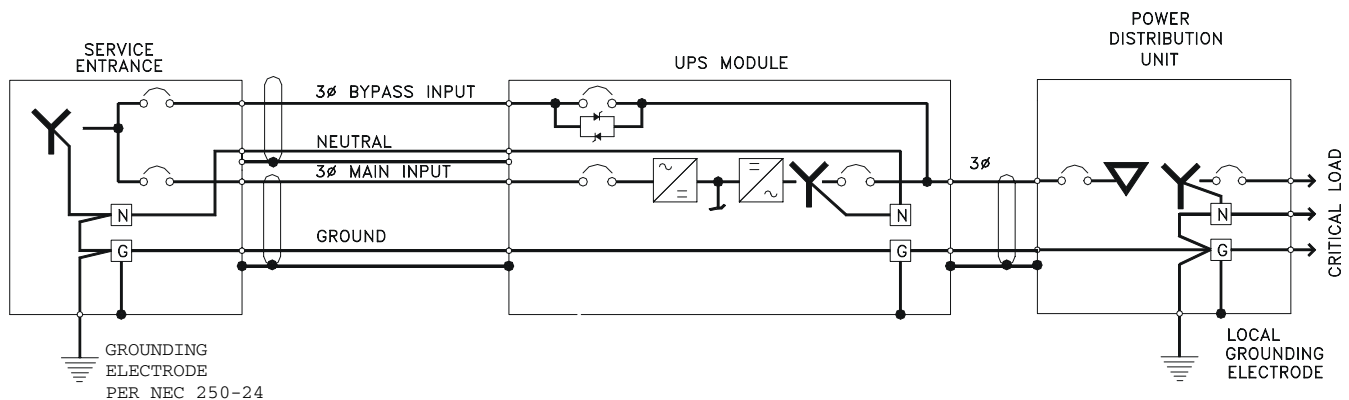
## 6.1 Preferred Grounding Configuration, Wye-Connected Service

One of the most common configurations of Series 610 UPS Single-Module Systems is with 480 VAC input, 480 VAC output and a connected load consisting of multiple Power Distribution Units (PDUs) with isolation transformers in the PDUs to produce 208 VAC. For Canadian customers, the UPS modules usually have 600 VAC input and output. The same principles apply if the connected load is an isolation transformer feeding various loads. **Figure 1** shows a typical installation.

Notice that the UPS module main input and bypass input are connected to a grounded-wye service. In this configuration, the UPS module is not considered a separately derived source. The UPS module output neutral is solidly connected to the building service neutral, which is bonded to the grounding conductor at the service entrance equipment.

The isolation transformers in the PDUs are considered a separately derived source. Therefore the PDU neutral should be bonded to the PDU grounding conductor and connected to a local grounding electrode in compliance with NEC 250-26.

**Figure 1 Preferred grounding configuration, wye-connected service**



Advantages of this configuration include:

- A measure of common-mode noise attenuation, since the isolation (common-mode rejection) occurs as close to the load as practical (i.e., at the PDU).
- The UPS module can be located remotely from the PDU without compromising common-mode noise performance.
- By using UPS modules with 480 VAC input and output and creating 208 VAC at the PDU, smaller and less costly power feeders can be used and less voltage drop (as a percent of nominal) occurs.



### NOTE

*Impedance-grounded wye sources must be grounded in accordance with **6.5 - Grounding Configuration, Corner-Grounded Delta or Impedance-Grounded Wye.***



### NOTE

*Some UPS modules are equipped with input isolation transformers. However, these transformers have no effect upon any system grounding considerations. These modules will be grounded exactly as shown in these pages.*



### NOTE

*If there is a 4-pole Automatic Transfer Switch (ATS) between the service entrance and the UPS, this configuration cannot be used. Refer to **6.2 - Alternate Grounding Configuration, Wye-Connected Service** or **6.3 - Preferred Grounding Configuration With Isolated Bypass** to determine a suitable configuration.*

## 6.2 Alternate Grounding Configuration, Wye-Connected Service

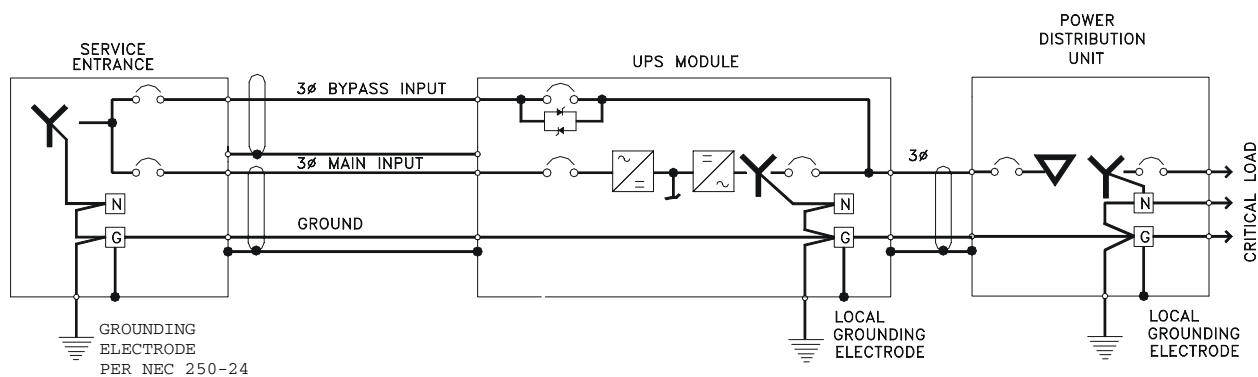
This configuration must NOT be used when single-phase loads are directly connected to the UPS.

The alternate configuration is similar to that shown in **6.1 - Preferred Grounding Configuration, Wye-Connected Service**, except that the service entrance neutral is not brought into the UPS module. In this configuration, the UPS output transformer is considered a separately derived source. The UPS module neutral is bonded to the UPS ground, which is connected to a local grounding electrode in accordance with NEC 250-26.

Please note that this configuration represents a price/performance trade-off. Whenever the UPS module transfers to or from bypass, two AC sources (input and bypass) are briefly connected together and circulating current must flow. In the previous configuration, the current flows through the neutral conductor. In this configuration, the current flows through the ground path, possibly tripping ground fault interrupters (GFIs) and distorting the bypass waveform reference.

Proper adjustment of ground fault interrupters is necessary to avoid unwanted tripping.

**Figure 2** Alternate grounding configuration, wye-connected service



This configuration is reserved for applications that meet all the following criteria:

- The facility has wye-connected service.
- The module rectifier input and bypass input are fed from the same source.
- The connected load is strictly 3-wire (such as one or more PDUs) and does not require a neutral from the UPS.
- Special precautions are taken to prevent tripping the ground fault interrupters. The time delay should be set to at least 0.2 seconds to prevent tripping when the UPS performs a transfer or retransfer operation.



### CAUTION

Failure to properly set the ground fault interrupters could cause loss of power to the critical load.

### 6.3 Preferred Grounding Configuration With Isolated Bypass

Another configuration in this power range is the Single-Module System with 480 or 600 VAC input, 208 VAC output, a Bypass Isolation Transformer and a connected load consisting of multiple distribution panelboards or switchboards. **Figure 3** shows a typical installation.

The Bypass Transformer provides isolation and may step down the voltage to the bypass input. The Bypass Transformer and the UPS module together constitute a separately derived system, since there is no direct electrical connection between the input (service entrance) circuit conductors and the output circuit conductors.

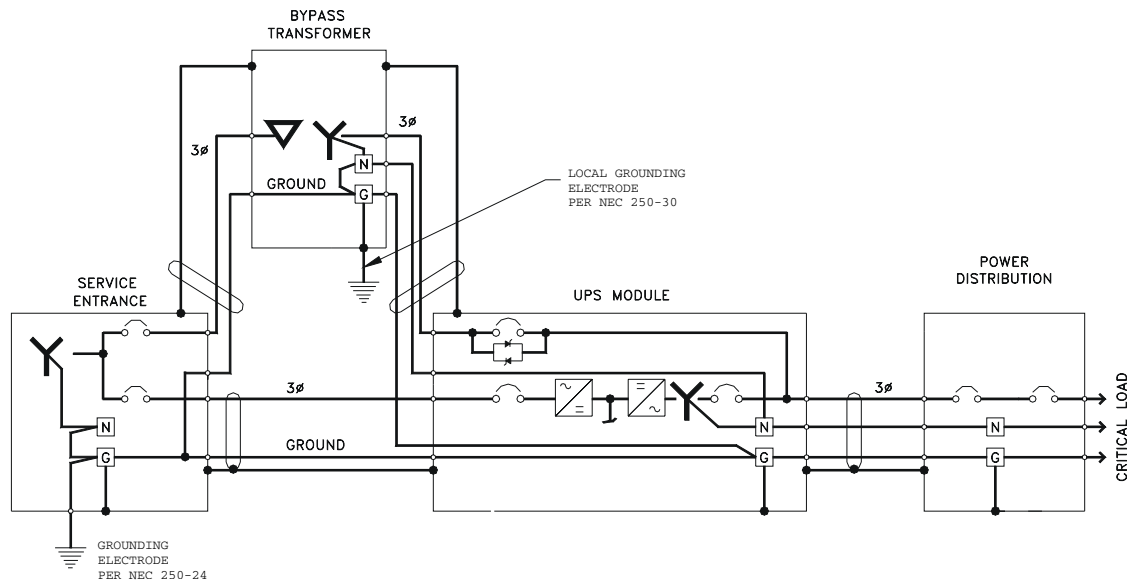


#### NOTE

**Figure 3** shows a wye-connected source, but the same grounding scheme would apply for a delta source at the service entrance.

The bonding of the neutral to the grounding conductor can theoretically be done at either the UPS module or the Bypass Transformer. However, we recommend bonding at the Bypass Transformer because the UPS module will sometimes be powered down for maintenance and its output transformer will be out of the circuit. The neutral should be bonded to ground and a local grounding electrode should be installed at the Bypass Transformer, per NEC 250-30.

**Figure 3 Preferred grounding configuration with isolated bypass**



Features of this configuration include:

- The UPS receives its bypass neutral from the Bypass Transformer
- The output is isolated from the input circuit conductors, and
- Some amount of common-mode noise attenuation can be obtained for sensitive loads **if** the UPS module and Bypass Transformer are located close to sensitive loads.

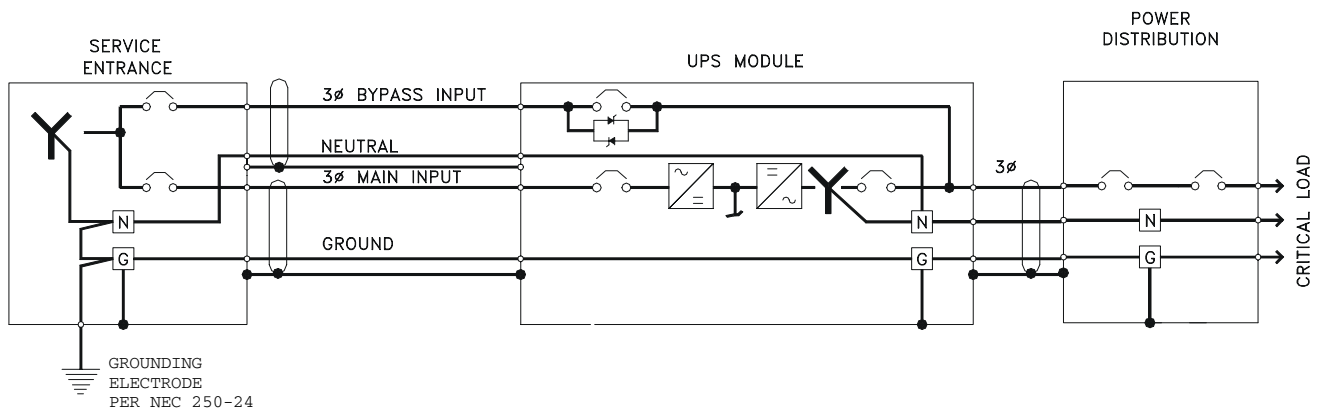
## 6.4 Alternate Grounding Configuration, Non-Isolated

A few applications in this power range have 208 VAC input and output, and a connected load consisting of multiple Power Distribution Units (PDUs), panelboards, switchboards or other items of load equipment which do not have isolation transformers.

Notice in **Figure 4** that the UPS module main input and bypass input are connected to a grounded-*wye* service. In this configuration, the UPS module is not considered a separately derived source.

The UPS module output neutral and the load neutral are solidly connected to the building service neutral, which is bonded to the grounding conductor at the service entrance equipment.

**Figure 4** Alternate grounding configuration, non-isolated



This arrangement may be used for systems with 208 VAC input and output. However, it does not provide any isolation or common-mode noise attenuation for sensitive loads. For this reason, this configuration is not a preferred installation method.



### NOTE

*If there is a 4-pole Automatic Transfer Switch (ATS) between the service entrance and the UPS, this configuration cannot be used. Refer to **6.3 - Preferred Grounding Configuration With Isolated Bypass** to determine a suitable configuration.*

## 6.5 Grounding Configuration, Corner-Grounded Delta or Impedance-Grounded Wye

As previously mentioned, Series 610 UPS modules require a bypass input neutral for sensing and monitoring. With a wye-connected input source, the installer should always connect the building service neutral to the module output neutral to achieve this. When the building service is delta-connected, however, the installer must take special steps to ensure reliable UPS functioning.

If the building service is corner-grounded delta or impedance-grounded wye, the UPS requires the Series 610 Isolated Neutral Kit. This kit uses control isolation transformers to create a reference point. For this application, the UPS output neutral must **not** be bonded to the UPS ground.

Figure 5 Grounding configuration, corner-grounded delta

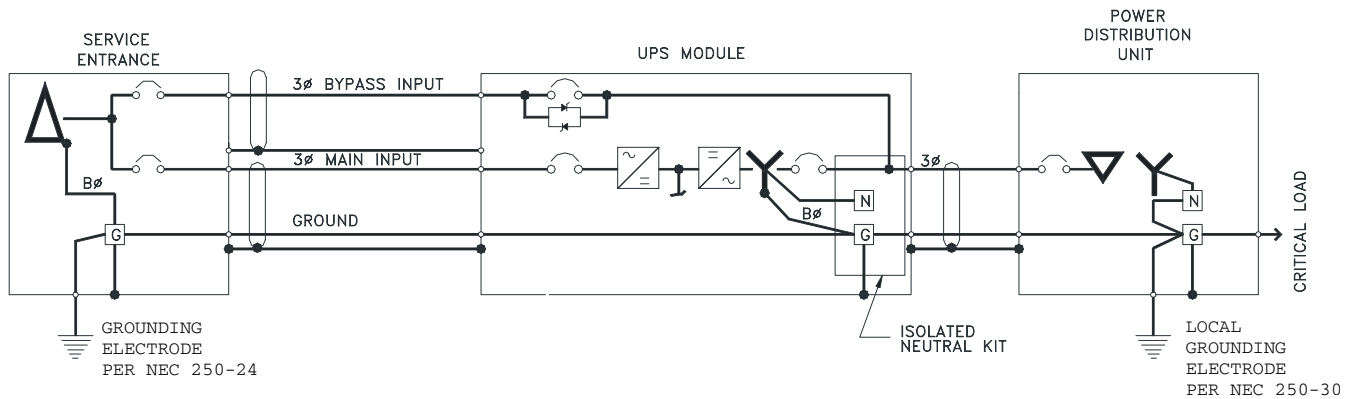
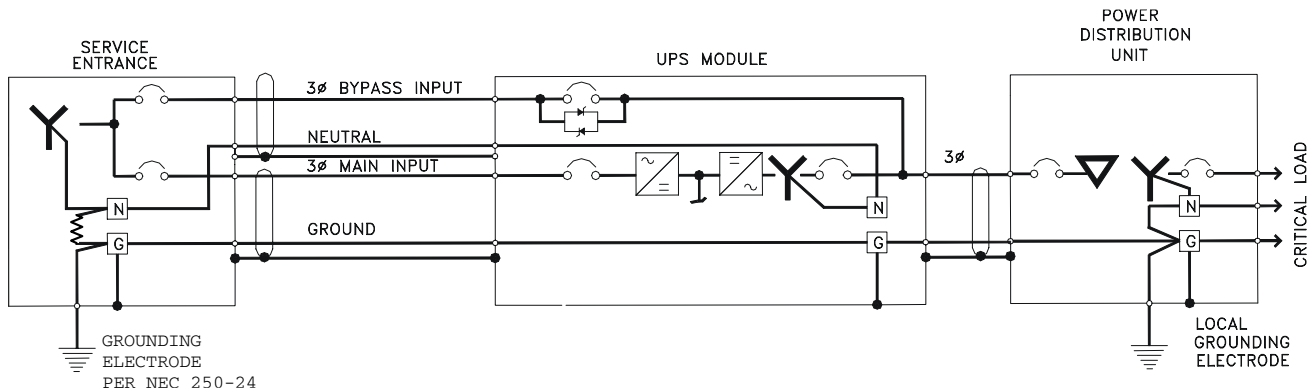


Figure 6 Grounding configuration, impedance-grounded wye



These configurations have the same restrictions as explained in **6.2 - Alternate Grounding Configuration, Wye-Connected Service**, except for the wye input. The UPS input and bypass must be fed from the same source. The load must be strictly 3-wire. And the GFI time delay should be set to at least 0.2 seconds to prevent tripping during transfer or retransfer operations.



### CAUTION

Failure to properly set the ground fault interrupters could cause loss of power to the critical load.

## 6.6 Preferred Grounding Configuration, Battery Systems

**Open-rack battery systems**, depending on local code requirements and customer preference, are normally:

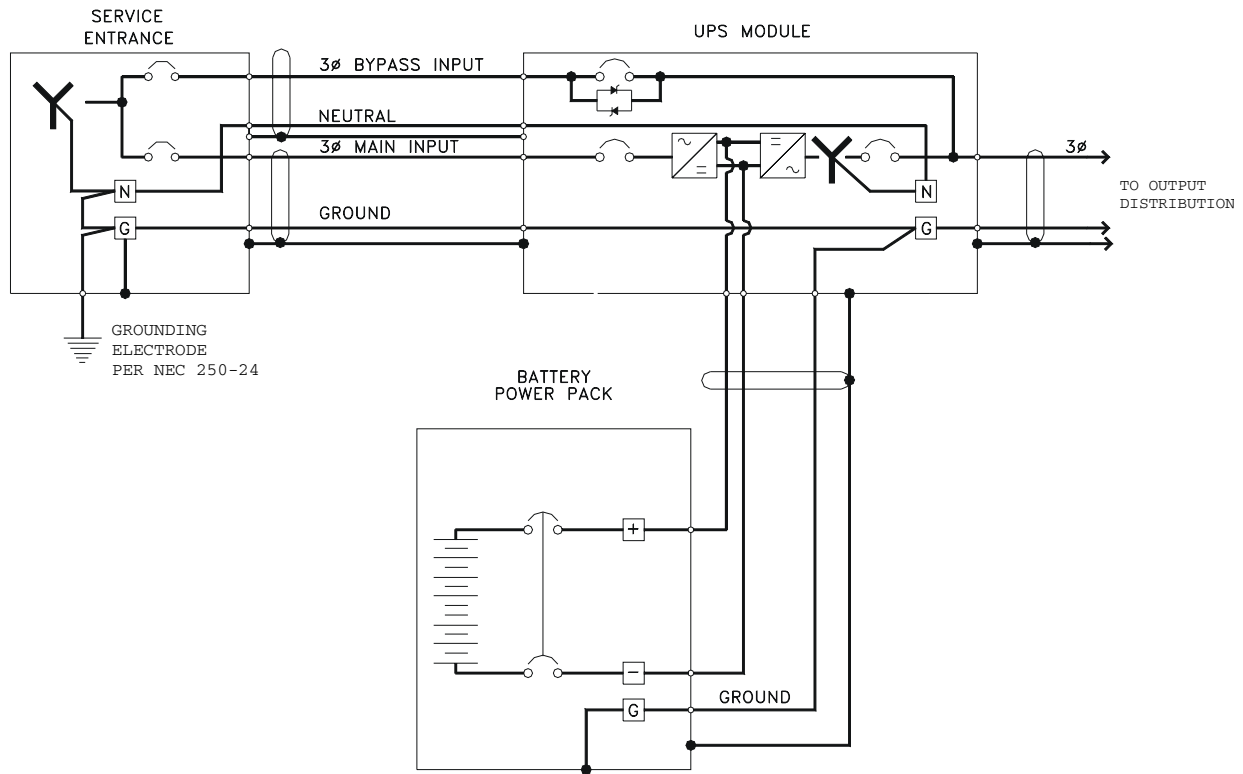
1. Floating (ungrounded),
2. Center-tapped and floating or
3. Center tapped and grounded.

**Battery cabinet systems** must be connected as floating (ungrounded) systems—**Option 1** above. Center-tapped or grounded battery systems are not possible with battery cabinet systems.

Whether the battery system is open-rack or cabinet, the metal rack parts or cabinet must be grounded to the UPS module ground bus.

**Figure 7** illustrates how a simple, one-cabinet system would be grounded. For systems with multiple cabinets, the same configuration would apply. However, for simplicity, the installer can connect all the battery cabinet grounds for a particular module together and run a single ground conductor to that UPS module ground (in the same conduit as the phase conductors).

**Figure 7 Preferred battery cabinet grounding configuration**





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## 7.0 WIRING CONSIDERATIONS

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### WARNING

All power connections must be completed by a licensed electrician experienced in wiring this type of equipment. Wiring must be installed in accordance with all applicable national and local electrical codes. Improper wiring may cause damage to the equipment or injury to personnel.

Verify that all incoming high and low voltage power circuits are de-energized and locked out before installing cables or making any electrical connections.

Refer to **Appendix A** and drawings in **10.0 - Installation Drawings**. Determine AC currents for your system (kVA, voltage and options). Also refer to the equipment nameplate for the model number, rating and voltage. For wire termination data, refer to **Tables 2** through **4**.



### NOTE

*Use 75°C copper wire. Select wire size based on the ampacities in **Table 5** of this manual, a reprint of Table 310-16 and associated notes of the National Electrical Code (NFPA 70).*



### CAUTION

The weight of power cables must be adequately supported to avoid stress on busbars and lugs. In addition to weight support, the following restraining method is recommended to control cable movement during external fault conditions:

- Wrap line cables together at 6 and 12 in. (152 and 305mm) from the terminals with five wraps of 3/8 in. (9.5mm) nylon rope or equivalent (tensile strength of 2000 lbs.; 907kg).
- Support the remainder of the cable with five wraps every 6 in. (152mm) or one wrap every 1 in. (25mm).

## 7.1 Power Wiring

1. Power wiring—rectifier input, bypass input, UPS output and battery cables—must be run in individual, separate conduits or cable trays. Refer to the Outline and Terminal Details drawings (**Figures 11 through 16, 21, 24, 25, and 40 through 44**) for locations of the various power connections within the UPS and ancillary equipment. In particular, note the location of the rectifier input power connections.



### CAUTION

Power and control wiring must be separated!

2. Observe local, state and national electrical codes. Verify utility power and its overcurrent protection rating will accommodate the UPS input rating, including battery recharging.
3. A safety ground wire must be run from the building ground to a ground point in the UPS Module Cabinets, ancillary equipment, and the Power-Tie Cabinet (if applicable). See **6.0 - Configuring Your Neutral and Ground Connections**. The grounding conductor shall comply with the following conditions of installation:
  - a. An insulated grounding conductor must be sized in accordance with the NEC and local codes. It must be green (with or without one or more yellow stripes) and be installed as part of the branch circuit that supplies the unit or system.
  - b. The grounding conductor described above is to be grounded to earth at the service equipment or, if supplied by a separately derived system, at the supply transformer or motor-generator set in accordance with the instructions in **6.0 - Configuring Your Neutral and Ground Connections**.
  - c. The attachment-plug receptacles in the vicinity of the unit or system are all to be of a grounding type, and the grounding conductors serving these receptacles are to be connected to earth ground at the service equipment.
4. Observe clockwise phase rotation of all power wiring. Phase A leads Phase B leads Phase C. A qualified electrician should check the phase rotation.
5. AC power cables must be rated for less the NEC-rated line drop at the maximum rated system current. DC power cables from the UPS to the battery terminals and return must be sized for less than 2 volts total loop drop at the maximum rated system current.
6. If site equipment includes a backup generator and automatic transfer switch(es), consult the manufacturers of those devices for information on sizing and interfacing to the UPS system.
7. Removable access plates are available for power wiring. Refer to the Outline Drawings (**Figures 11, 14, 21, 24 and 25, and 40 through 44**) for your particular model.

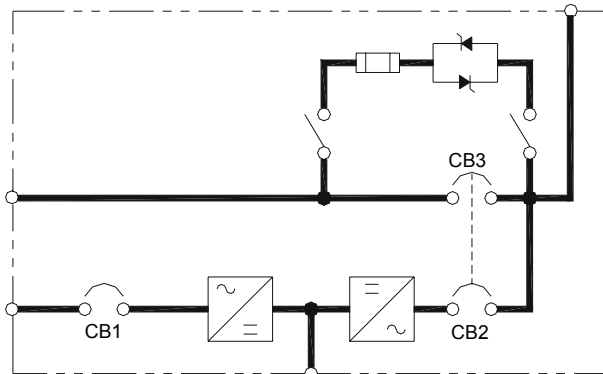


### CAUTION

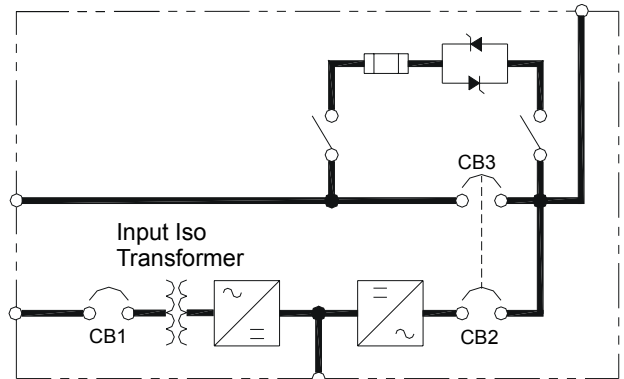
After cutting holes in the access plates, be certain that no foreign matter (metal shavings, sawdust, insulation or wire fragments, etc.) remains inside the UPS. Likewise be certain to block any “extra” holes in the plates through which foreign matter could later enter the UPS.

Figure 8 Power single-line diagrams, standard SMS\*

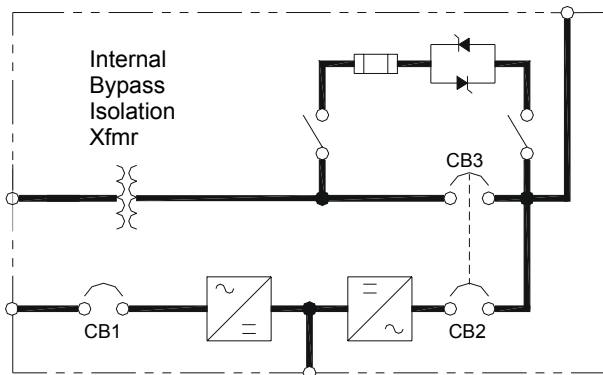
\* These configurations are for illustrative purposes only. They represent only a sample of the possible configurations. Refer to the submittals supplied with your order for more information or for order-specific details.



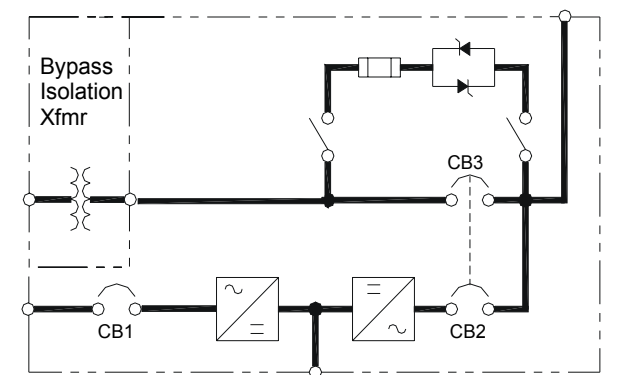
Standard SMS, with 208/208, 480/480 or 600/600 VAC input/output



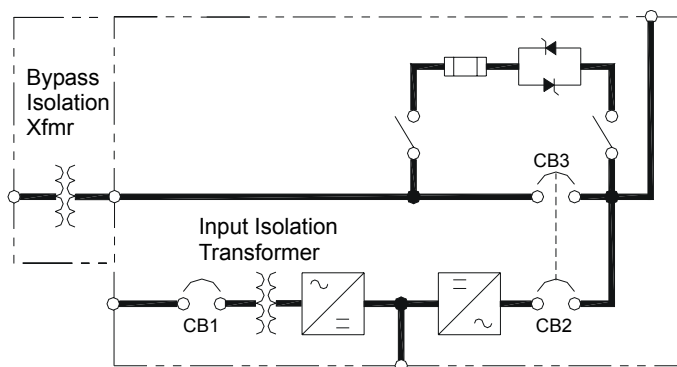
SMS with input Isolation transformer and 208/208, 480/480 or 600/600 VAC input/output



480/208 VAC module with internal bypass isolation transformer



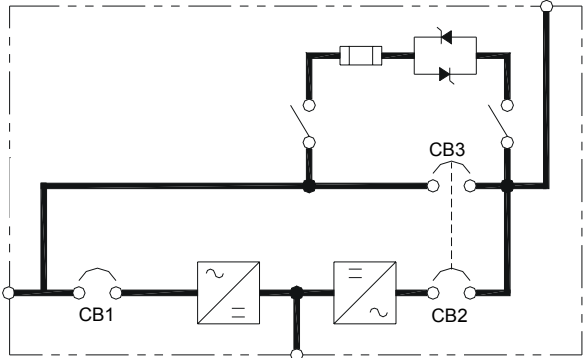
600/208 VAC module with external bypass isolation transformer



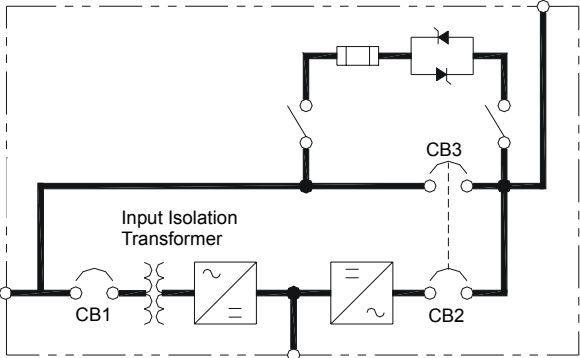
480/208 or 600/208 VAC module with both internal input isolation transformer and external bypass isolation transformer

Figure 9 Power single-line diagrams, optional input transformer\*

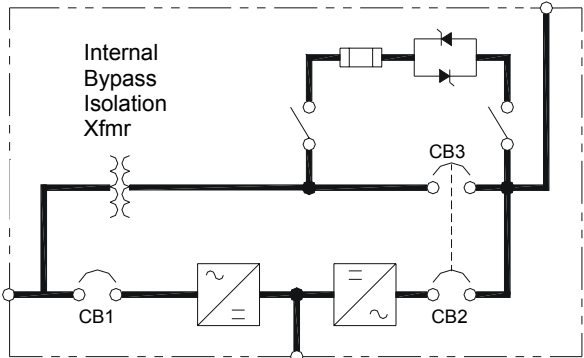
\* These configurations are for illustrative purposes only. They represent only a sample of the possible configurations. Refer to the submittals supplied with your order for more information or for order-specific details.



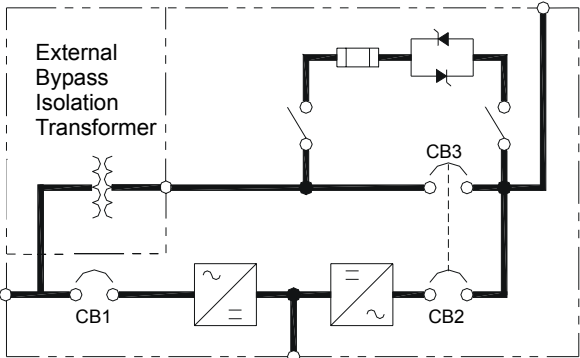
Standard single-input SMS with 208/208, 480/480 or 600/600 VAC input/output.



Single-input SMS with input isolation transformer and 208/208, 480/480 or 600/600 VAC input/output.



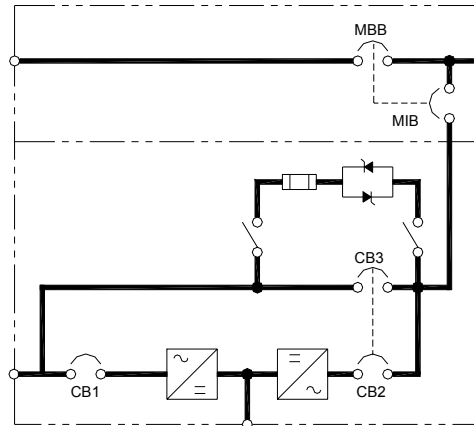
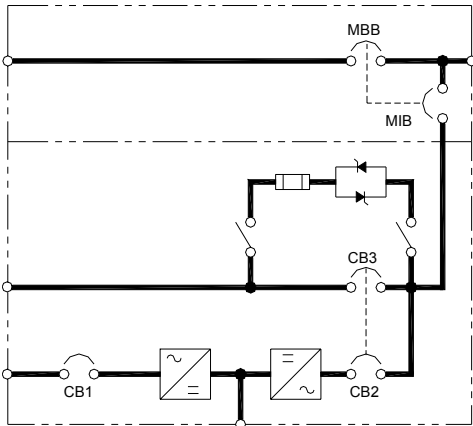
480/280 VAC single-input SMS with bypass isolation transformer. Single-input modules are not available with both bypass and input isolation transformers.



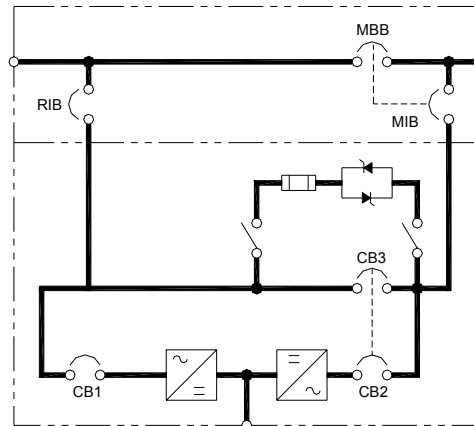
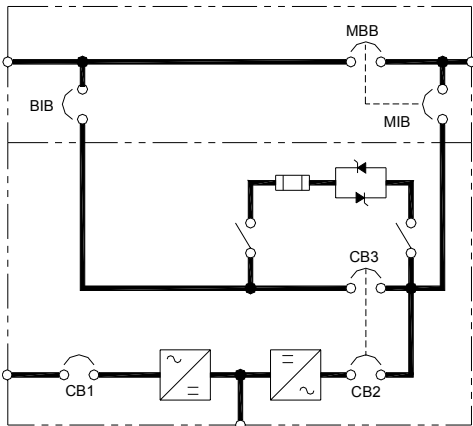
600/208 VAC single-input SMS with bypass isolation transformer. Single-input modules are not available with both bypass and input isolation transformers.

Figure 10 Power single-line diagrams, optional Maintenance Bypass Cabinets\*

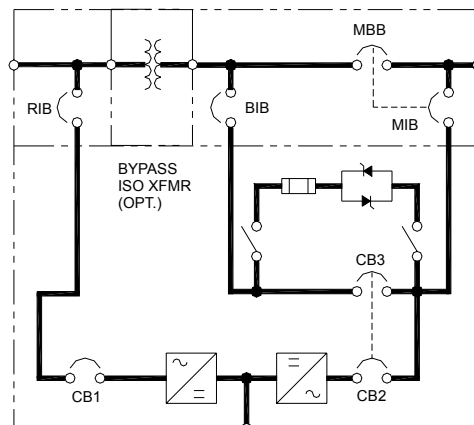
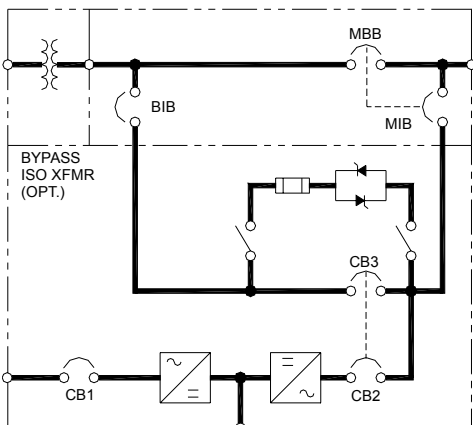
\* These configurations are for illustrative purposes only. They represent only a sample of the possible configurations. Refer to the submittals supplied with your order for more information or for order-specific details.



2-breaker Maintenance Bypass Cabinets for standard (left) and single-input (right) modules



3-breaker Maintenance Bypass Cabinets for standard (left) and single-input (right) modules



3-breaker and 4-breaker Maintenance Bypass Cabinets for stepdown-voltage applications

Table 1 Abbreviations for circuit breakers

BIB	Bypass Isolation Breaker
MBB	Maintenance Bypass Breaker
MIB	Maintenance Isolation Breaker
RIB	Rectifier Input Breaker

## 7.2 Control Wiring

Control wiring must be flexible stranded, tinned copper and run in individual separate steel conduits. Control wiring must be separated from power wiring. In addition, each control wiring cable group should be run in a separate conduit to minimize control signal interference.

If your system has any installed options, special wire lists will be included in your Submittal Drawing Package. Contact your Liebert Sales Representative for assistance if the submittal drawings have been lost or misplaced.

All control cable groups are connected to different Interface Modules (IFMs) and/or terminal blocks inside the UPS. **Figure 30** shows the typical location of each IFM inside the UPS. The position of a particular IFM may be different for your UPS, depending on the model and the installed options.



### NOTE

*The UPS control and communication wiring are considered Class 2 circuits by NEC standards. However, NEC Class 1 wiring methods are required for these circuits to ensure proper operation of the UPS.*

## 7.3 Battery Wiring

Power wiring to the battery cabinet connects positive, negative, and ground power cables from the battery cabinet to the associated UPS. Connection of the UPS to the battery cabinet serves to both charge and discharge the batteries (when needed). The battery disconnect (circuit breaker) requires a control cable. Liebert battery cabinets include power and control cables to join multiple cabinets together into a system. Additional (field-supplied) power or control wiring might be necessary to connect the battery cabinet system to the UPS. Refer to **Figures 24** through **29**.



### WARNING

A battery intercell connection on each tier of the Liebert battery cabinet is disconnected for safety during shipment. Do not complete these connections. A Liebert Global Services representative will complete these connections as part of start-up. An improperly installed unit can result in injury to personnel or damage to equipment.



### CAUTION

Be sure polarity is correct when wiring the battery cabinet to the connected equipment (positive to positive; negative to negative). If polarity is not correct, fuse failures or equipment damage can result.



### CAUTION

Cables between batteries and the UPS should be run in matched pairs, positive-with-negative, within each conduit or cable run. Grouping like-polarity cables together (i.e., positive-with-positive and negative-with-negative) can cause stress or damage to the cables, conduit or buswork.

Call Liebert Global Services to schedule installation check-out, final battery intercell connections and start-up.



### NOTE

*A Liebert Battery Specialist can perform a detailed inspection of the entire battery system to ensure it meets current IEEE standards. This inspection service is recommended because batteries are a very critical part of the UPS system.*

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## 8.0 WIRING CONNECTIONS

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### WARNING

Verify that all incoming high and low voltage power circuits are de-energized and locked out before installing cables or making electrical connections.

All power connections must be completed by a licensed electrician experienced in wiring UPS equipment and in accordance with all applicable national and local electrical codes.

Improper wiring may cause damage to the UPS or injury to personnel.



### CAUTION

All shielded cables, non-shielded cables, non-shielded control wires, non-shielded battery breaker control wires and non-shielded remote control wires must be housed in individual, separate, steel conduits. Placing multiple cables in the same conduit with other control or power wiring may cause system failure.



### NOTE

*Use appropriately sized wire as a grounding conductor. Solid metal conduit is not a suitable ground conductor for UPS systems and could negatively affect system performance.*

## 8.1 Specific Connections

Refer to the drawings in this manual and any other drawings provided by Liebert for this installation.



### NOTE

*If your installation includes a Maintenance Bypass Panelboard or a Transformer Cabinet, some or all power cables will be terminated in these cabinets. Make sure all required wiring between the UPS module and the optional cabinets is completed per the submittal drawings. Observe phase rotation.*

Make all of the following connections:

1. AC power cables from input power source circuit breaker (RIB) to UPS Module Input. Observe phase rotation.
2. AC power cables from bypass power source circuit breaker (BIB) to UPS Module Bypass input. Observe phase rotation.



### CAUTION

If there are line-to-neutral loads connected to the UPS output, the bypass input source must be wye connected and have three phases plus neutral plus ground. If the specified input is not available, an isolation transformer is required. Refer to **6.1 - Preferred Grounding Configuration, Wye-Connected Service**, **6.3 - Preferred Grounding Configuration With Isolated Bypass** and **6.4 - Alternate Grounding Configuration, Non-Isolated**.

See **6.0 - Configuring Your Neutral and Ground Connections** for an explanation of proper grounding techniques.

3. AC power cables from UPS Module Output to critical load. Observe phase rotation.



### CAUTION

UPS bypass and output neutral must be connected to only one common point in the UPS. This neutral line must be grounded at the source. See **6.0 - Configuring Your Neutral and Ground Connections**.

4. For battery cabinets: DC power cables and ground from battery cabinet to UPS module and between battery cabinets. Observe polarity. When multiple conduits are used, an equal number of positive and negative cables should be contained in each conduit.



### NOTE

*DC power and battery circuit breaker control cables are provided with Liebert battery cabinets for use between multiple cabinets when bolted together. Power cables are sized for interconnecting battery cabinets. Battery cabinets specified for bolting up to the UPS are shipped with power cables to connect the battery cabinet system to the UPS module. Field-supplied cabling must be provided to connect stand-alone battery cabinets to the UPS module. Connections from the final battery cabinet to the UPS are provided in the field.*



### WARNING

Do not make any connections between battery tiers in the battery cabinet. These connections will be made by the Liebert Global Services representative during start-up.

5. For remote battery: DC power cables (and ground) from battery to Module Battery Disconnect, and then to UPS Module DC bus. Observe polarity. DC power cables should be installed in conduit with conductors in matched pairs (positive and negative).
6. Module Battery Disconnect control wiring to UPS module (and between battery cabinets, if applicable).
7. Control wiring to the optional Remote Monitor Panel, if used. Selected alarm messages are also available for customer use through a set of contacts on an optional separate terminal board. Wiring must be run in individual separate steel conduit.
8. Emergency Power Off control wiring must be run in separate steel conduit.
9. Communications wiring for optional site monitoring or modem must be run in separate steel conduit.
10. Power and control connections required for the Maintenance Bypass.
11. Any additional special wiring required at your site.



## 9.0 WIRING INSPECTION

1. Verify all power connections are tightened per the torque specifications in **Table 3**.
2. Verify all control wire terminations are tight.
3. Verify all power wires and connections have proper spacing between exposed surfaces, phase-to-phase and phase-to-ground.
4. Verify that all control wires are run in steel conduit, separate from all power wiring.

**Table 2 Power wiring terminals, factory supplied**

UPS Module Rating	Connection Type
100-225kVA	For "SpaceSaver" modules in the 48" frame, rectifier and bypass input wiring is top-entry, directly to lugs on top of their respective circuit breakers. DC link and critical bus output connection are top-entry, to frame-mounted lugs. Standard modules with top-and-bottom entry have access plates and a wireway on the right side of the modules. All power connections are to busbars in the wireway.

Use 75°C copper wire. Select wire size based on the ampacities in **Table 5** of this manual, a reprint of Table 310-16 and associated notes of the National Electrical Code (NFPA 70).

Use commercially available solderless lugs for the wire size required for your application. Refer to **Table 3**. Connect wire to the lug using tools and procedures specified by the lug manufacturer.

**Table 3 Torque specifications**

NUT AND BOLT COMBINATIONS				
Bolt Shaft Size	Grade 2 Standard		Electrical Connections with Belleville Washers	
	Lb-in	N-m	Lb-in	N-m
1/4	53	6.0	46	5.2
5/16	107	12	60	6.8
3/8	192	22	95	11
1/2	428	22	256	29

CIRCUIT BREAKERS WITH COMPRESSION LUGS (FOR POWER WIRING)		
Wire Size or Range	Lb-in	N-m
#6 - #4	100	11
#3 - #1	125	14
1/0 - 2/0	150	17
3/0 - 200 MCM	200	23
250 - 400 MCM	250	28
500 - 700 MCM	300	34

CIRCUIT BREAKERS WITH COMPRESSION LUGS (FOR POWER WIRING)		
Current Rating	Lb-in	N-m
400 - 1200 Amps	300.00	34.00

TERMINAL BLOCK COMPRESSION LUGS (FOR CONTROL WIRING)		
AWG Wire Size or Range	Lb-in	N-m
#22 - #14	3.5 to 5.3	0.4 to 0.6

**NOTE:** Use the values in this table unless the equipment is labeled with a different torque value.

**Table 4** Field-supplied lugs

One-Hole Lugs						
	T & B <sup>1</sup> Lug Style	Wire Size	Bolt Size (in.)	Tongue Width (in.)	T & B <sup>1</sup> P/N	Liebert P/N
1	Stak-On	#1 AWG	3/8	0.76	H973	12-714255-46
2		1/0 AWG	3/8	0.88	J973	12-714255-56
3		2/0 AWG	3/8	1.00	K973	12-714255-66
4		3/0 AWG	3/8	1.10	L973	12-714255-76
5		4/0 AWG	3/8	1.20	M973	12-714255-86
6	Color-Keyed Aluminum/ Copper	#1 AWG	3/8	0.75	60124	—
7		1/0 AWG	3/8	0.88	60130	—
8		2/0 AWG	3/8	0.97	60136	—
9		3/0 AWG	3/8	1.06	60142	—
10	Color-Keyed Copper Cable Long Barrel	#1 AWG	5/16	0.67	54947BE	—
11		1/0 AWG	3/8	0.75	54909BE	—
12		2/0 AWG	3/8	0.81	54910BE	—
13		3/0 AWG	1/2	0.94	54965BE	—
14		4/0 AWG	1/2	1.03	54970BE	—
15		250 MCM	1/2	1.09	54913BE	—
16	Narrow-Tongue Copper Cable	350 MCM	1/2	1.09	55165	—
17		500 MCM	1/2	1.20	55171	—

1. Manufacturer: Thomas & Betts (T & B), 1-800-862-8324

**Table 5 Table 310-16, National Electrical Code (Reprint)**

**Allowable Ampacities of Insulated Conductors Rated 0-2000 Volts, 60° to 90°C (140° to 194°F) <sup>1</sup>**

Not More Than Three Conductors in Raceway or Cable or Earth (Directly Buried), Based on Ambient Temperature of 30°C (86°F)

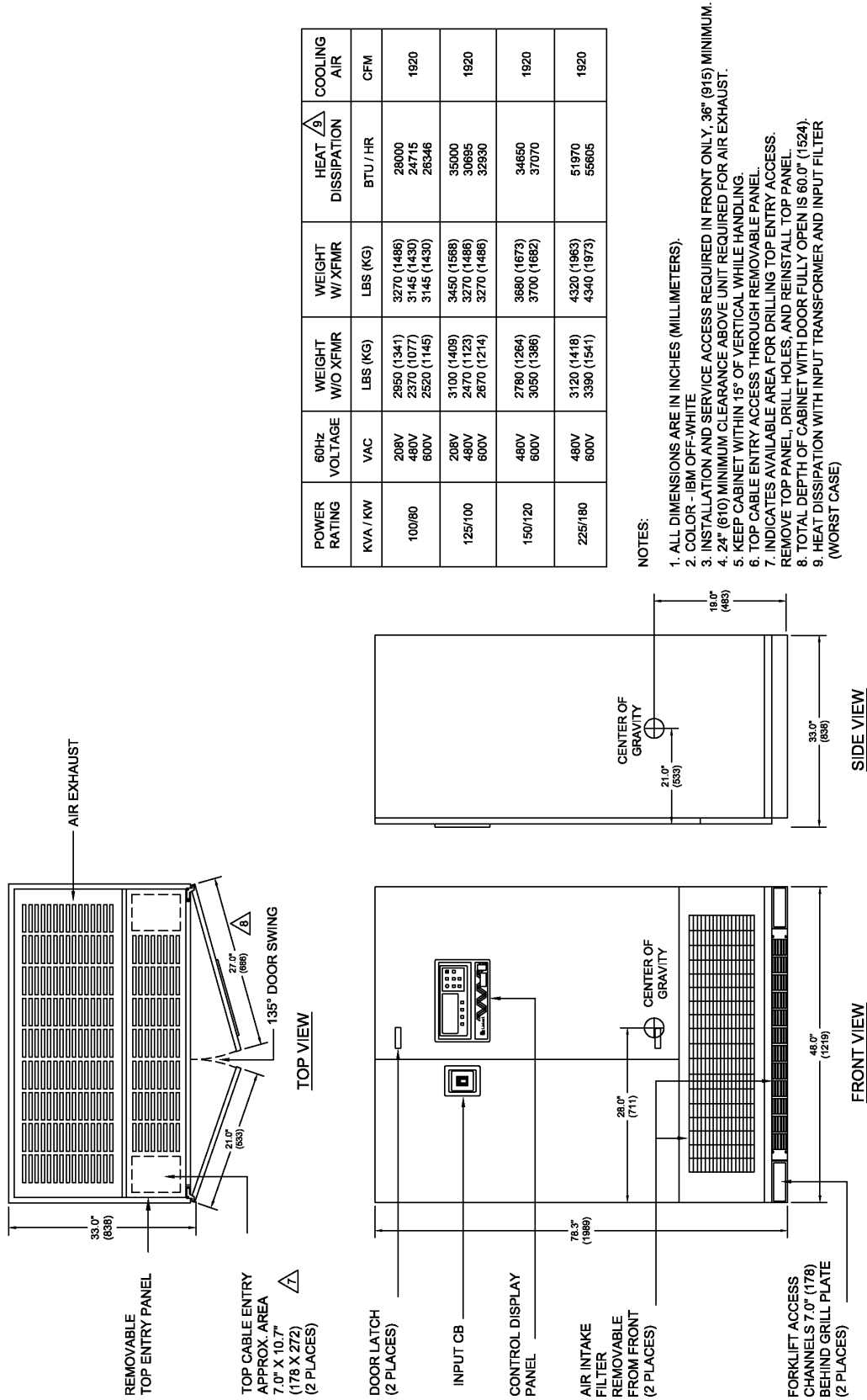
SIZE	TEMPERATURE RATING OF CONDUCTOR. SEE TABLE 310-13.						SIZE
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	TYPES TW= UF=	TYPES FEPW= RH, RHW= THHW= THW= THWN= XHHW= USE= ZW=	TYPES TBS, SA, SIS, FEP= FEPB=, MI, RHH= RHW-2 THHN=, THHW= THW-2, THWN-2, USE-2, XHH, XHHW= XHHW-2, ZW-2	TYPES TW= UF=	TYPES RH=, RHW= THHW= THW= THWN= XHHW= USE=	TYPES TBS, SA, SIS, THHN= THHW= THW-2, THWN-2, RHH=, RHW-2, USE-2, XHH, XHHW= XHHW-2, ZW-2	
AWG kcmil	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			AWG kcmil
18	.....	.....	14	.....	.....	.....	.....
16	.....	.....	18	.....	.....	.....	.....
14*	20	20	25	.....	.....	.....	.....
12*	25	25	30	20	20	25	12*
10*	30	35	40	25	30	35	10*
8	40	50	55	30	40	45	8*
6	55	65	75	40	50	60	6
4	70	85	95	55	65	75	4
3	85	100	110	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	150	85	100	115	1
1/0	125	150	170	100	120	135	1/0
2/0	145	175	195	115	135	150	2/0
3/0	165	200	225	130	155	175	3/0
4/0	195	230	260	150	180	205	4/0
250	215	255	290	170	205	230	250
300	240	285	320	190	230	255	300
350	260	310	350	210	250	280	350
400	280	335	380	225	270	305	400
500	320	380	430	260	310	350	500
600	355	420	475	285	340	385	600
700	385	460	520	310	375	420	700
750	400	475	535	320	385	435	750
800	410	490	555	330	395	450	800
900	435	520	585	355	425	480	900
1000	455	545	615	375	445	500	1000
1250	495	590	665	405	485	545	1250
1500	520	625	705	435	520	585	1500
1750	545	650	735	455	545	615	1750
2000	560	665	750	470	560	630	2000
CORRECTION FACTORS							
Ambient Temp °C	For ambient temperatures other than 30°C (86°F), multiply the allowable ampacities shown above by the appropriate factor shown below.						Ambient Temp °F
21-25	1.08	1.05	1.04	1.08	1.05	1.04	70-77
26-30	1.00	1.00	1.00	1.00	1.00	1.00	78-86
31-35	.91	.94	.96	.91	.94	.96	87-95
36-40	.82	.88	.91	.82	.88	.91	96-104
41-45	.71	.82	.87	.71	.82	.87	105-113
46-50	.58	.75	.82	.58	.75	.82	114-122
51-55	.41	.67	.76	.41	.67	.76	123-131
56-60	.....	.58	.71	.....	.58	.71	132-140
61-70	.....	.33	.58	.....	.33	.58	141-158
71-80	.....	.....	.41	.....	.....	.41	159-176

\* Unless otherwise specifically permitted in Section 240-3 of this Code, the overcurrent protection for conductor types marked with an asterisk (\*) shall not exceed 15 amperes for No. 14, 20 amperes for No. 12, and 30 amperes for No. 10 copper; or 15 amperes for No. 12 and 25 amperes for No. 10 aluminum and copper-clad aluminum after any correction factors for ambient temperature and number of conductors have been applied.

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# 10.0 INSTALLATION DRAWINGS

Figure 11 Outline drawing, Single-Module System, SpaceSaver

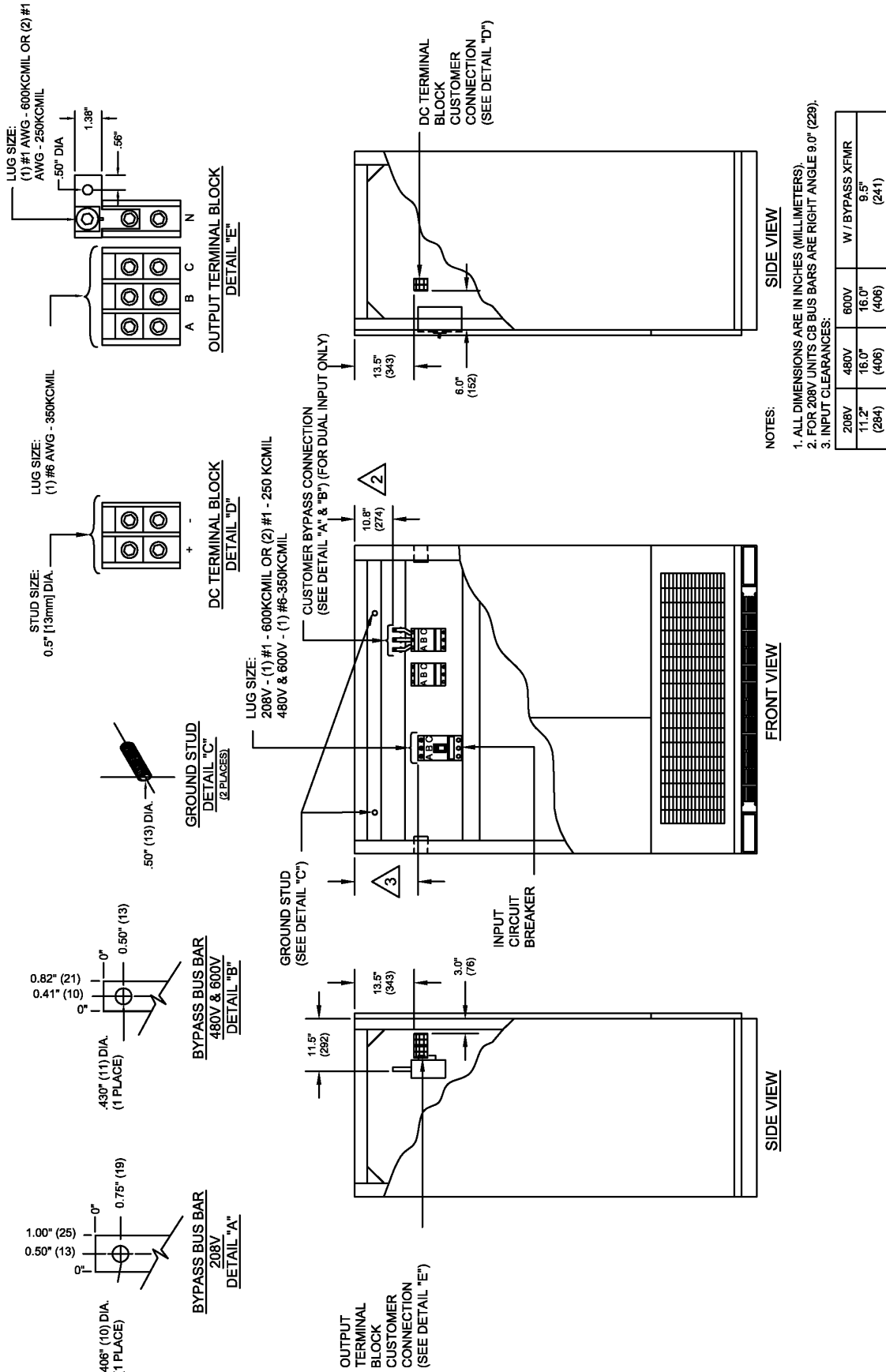


POWER RATING	60HZ VOLTAGE	WEIGHT W/O XFMR	WEIGHT W/ XFMR	HEAT DISSIPATION	COOLING AIR
KVA / KW	VAC	LBS (KG)	LBS (KG)	BTU / HR	CFM
100/80	208V 480V 600V	2950 (1341) 2370 (1077) 2520 (1145)	3270 (1486) 3145 (1430) 3145 (1430)	28000 24715 26346	1920
125/100	208V 480V 600V	3100 (1409) 2470 (1123) 2870 (1214)	3450 (1568) 3270 (1486) 3270 (1486)	35000 30695 32930	1920
150/120	480V 600V	2780 (1264) 3050 (1386)	3680 (1673) 3700 (1682)	34650 37070	1920
225/180	480V 600V	3120 (1418) 3390 (1541)	4320 (1963) 4340 (1973)	51970 55605	1920

- NOTES:
- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS).
  - COLOR - IBM OFF-WHITE
  - INSTALLATION AND SERVICE ACCESS REQUIRED IN FRONT ONLY, 36" (915) MINIMUM.
  - 24" (610) MINIMUM CLEARANCE ABOVE UNIT REQUIRED FOR AIR EXHAUST.
  - KEEP CABINET WITHIN 15° OF VERTICAL WHILE HANDLING.
  - TOP CABLE ENTRY ACCESS THROUGH REMOVABLE PANEL.
  - INDICATES AVAILABLE AREA FOR DRILLING TOP ENTRY ACCESS. REMOVE TOP PANEL, DRILL HOLES, AND REINSTALL TOP PANEL.
  - TOTAL DEPTH OF CABINET WITH DOOR FULLY OPEN IS 60.0" (1524).
  - HEAT DISSIPATION WITH INPUT TRANSFORMER AND INPUT FILTER (WORST CASE)

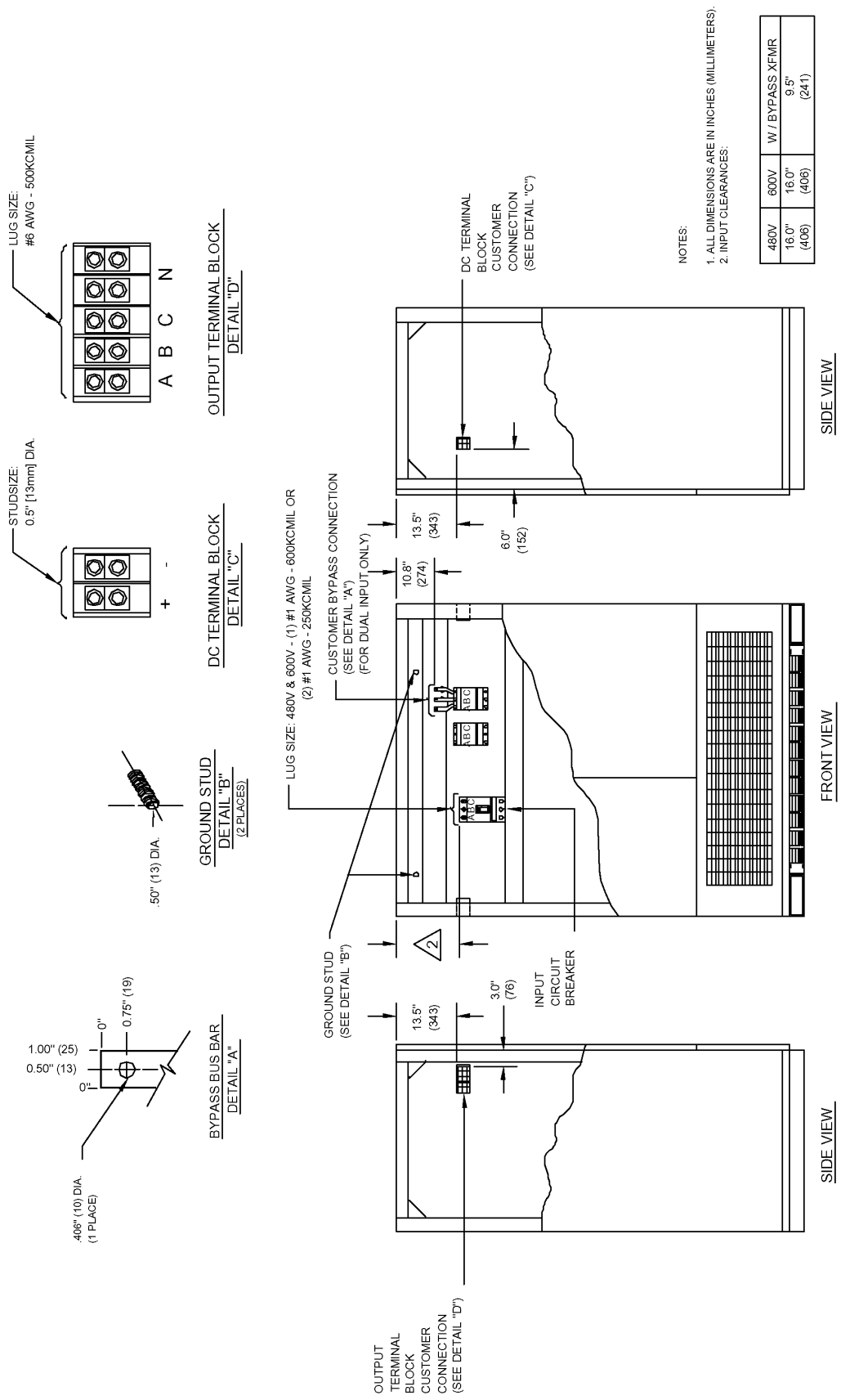
88-797606-02  
Rev. 04

Figure 12 Terminal details, Single-Module System, 100 & 125kVA, SpaceSaver



88-797606-08  
 Rev. 07

Figure 13 Terminal details, Single-Module System, 150 & 225kVA - 480V, 600V SpaceSaver

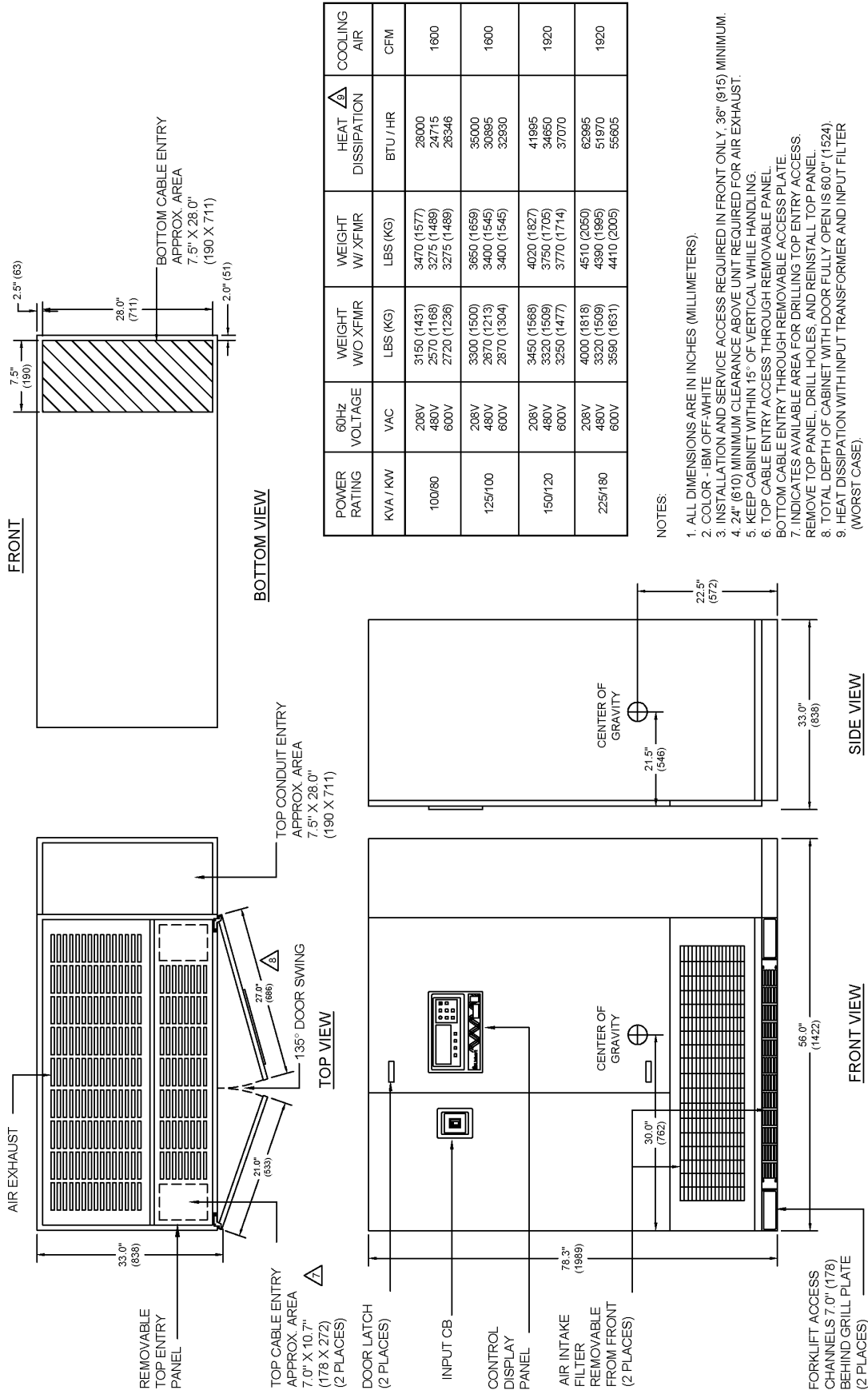


NOTES:  
 1. ALL DIMENSIONS ARE IN INCHES (MILLIMETERS).  
 2. INPUT CLEARANCES:

	480V	600V	W / BYPASS XFMR
	16.0" (406)	16.0" (406)	9.5" (241)

88-797606-06  
 Rev. 08

Figure 14 Outline drawing, Single-Module System, Standard

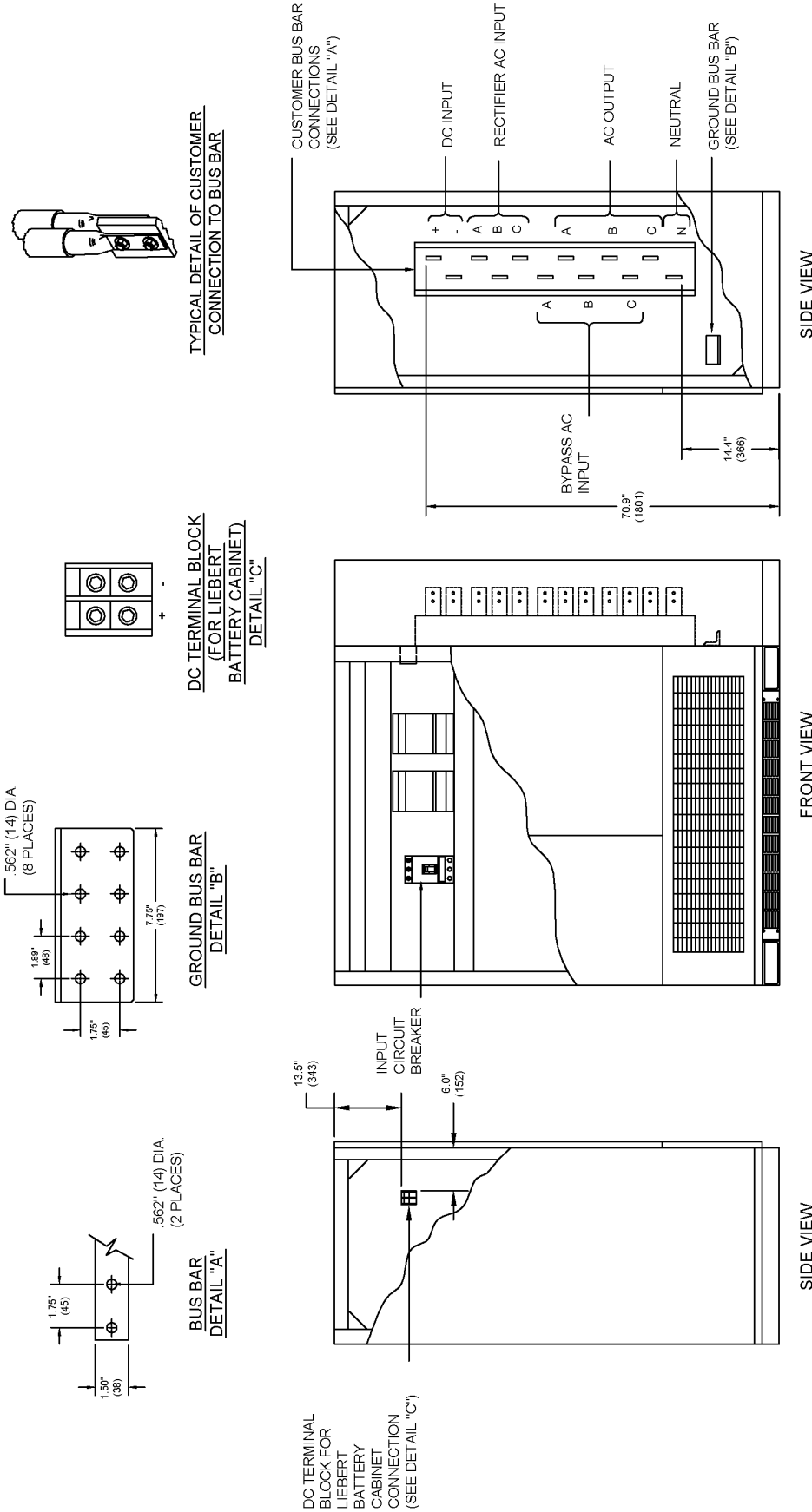


POWER RATING	60-HZ VOLTAGE	WEIGHT W/O XFMR	WEIGHT W/ XFMR	HEAT DISSIPATION	COOLING AIR
KVA / KW	VAC	LBS (KG)	LBS (KG)	BTU / HR	CFM
100/80	208V 480V 600V	3150 (1431) 2570 (1168) 2720 (1236)	3470 (1577) 3275 (1489) 3275 (1489)	28000 24715 26346	1800
125/100	208V 480V 600V	3300 (1500) 2870 (1213) 2870 (1304)	3650 (1659) 3400 (1545) 3400 (1545)	35000 30385 32930	1800
150/120	208V 480V 600V	3450 (1568) 3320 (1509) 3250 (1477)	4020 (1827) 3750 (1705) 3770 (1714)	41995 34650 37070	1920
225/180	208V 480V 600V	4000 (1818) 3320 (1509) 3590 (1631)	4510 (2050) 4390 (1985) 4410 (2005)	62995 51970 55605	1920

- NOTES:
1. ALL DIMENSIONS ARE IN INCHES (MILLIMETERS).
  2. COLOR - IBM OFF-WHITE
  3. INSTALLATION AND SERVICE ACCESS REQUIRED IN FRONT ONLY, 36" (915) MINIMUM.
  4. 24" (610) MINIMUM CLEARANCE ABOVE UNIT REQUIRED FOR AIR EXHAUST.
  5. KEEP CABINET WITHIN 15° OF VERTICAL WHILE HANDLING.
  6. TOP CABLE ENTRY ACCESS THROUGH REMOVABLE PANEL.
  7. INDICATES AVAILABLE AREA FOR DRILLING TOP ENTRY ACCESS. REMOVE TOP PANEL, DRILL HOLES, AND REINSTALL TOP PANEL.
  8. TOTAL DEPTH OF CABINET WITH DOOR FULLY OPEN IS 60.0" (1524).
  9. HEAT DISSIPATION WITH INPUT TRANSFORMER AND INPUT FILTER (WORST CASE).

88-797606-03  
Rev. 03

Figure 15 Terminal details, Single-Module System, 100 & 125kVA

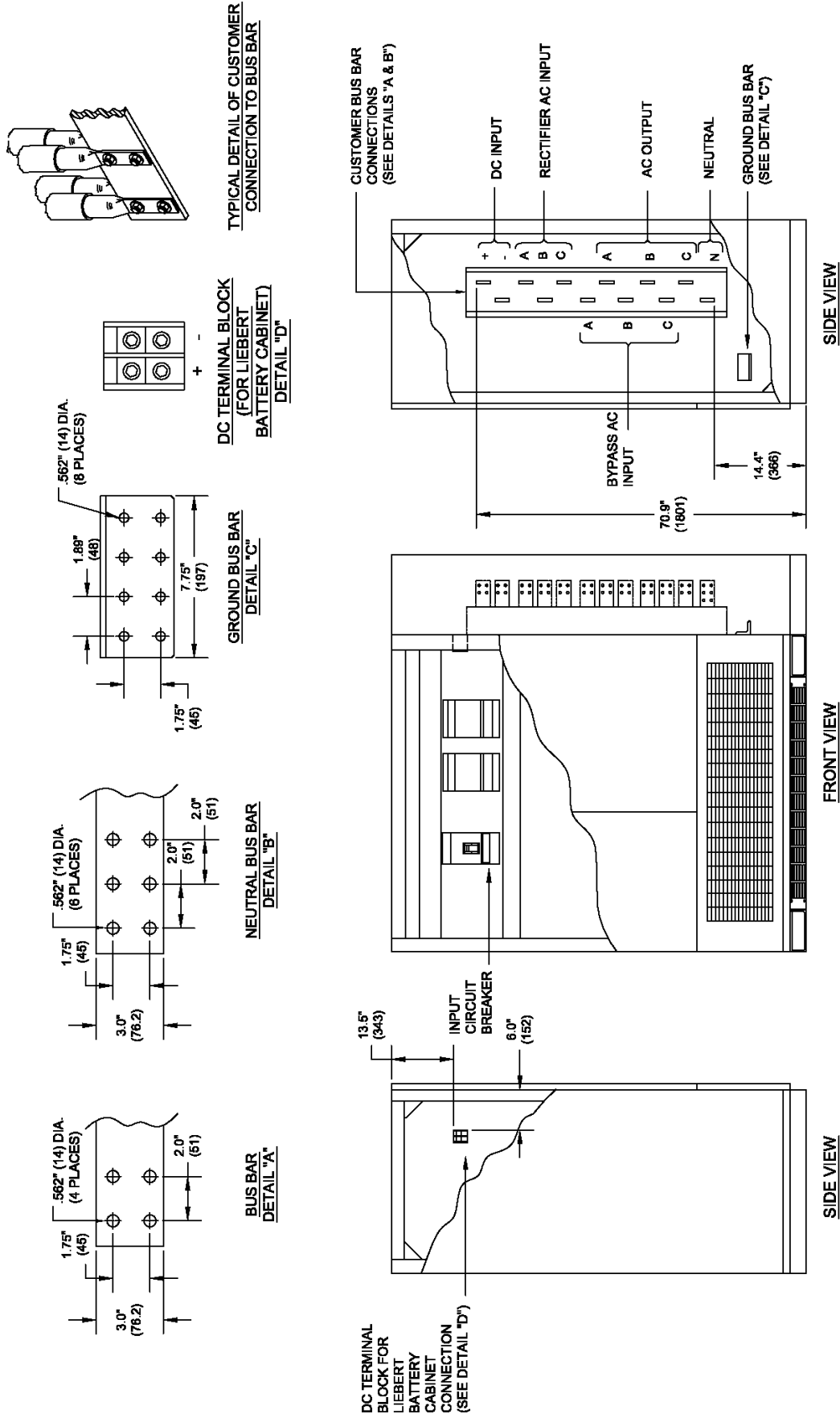


NOTES:  
1. ALL DIMENSIONS ARE IN INCHES (MILLIMETERS).

88-797606-15  
Rev. 05



Figure 16 Terminal details, Single-Module System, 150 & 225kVA

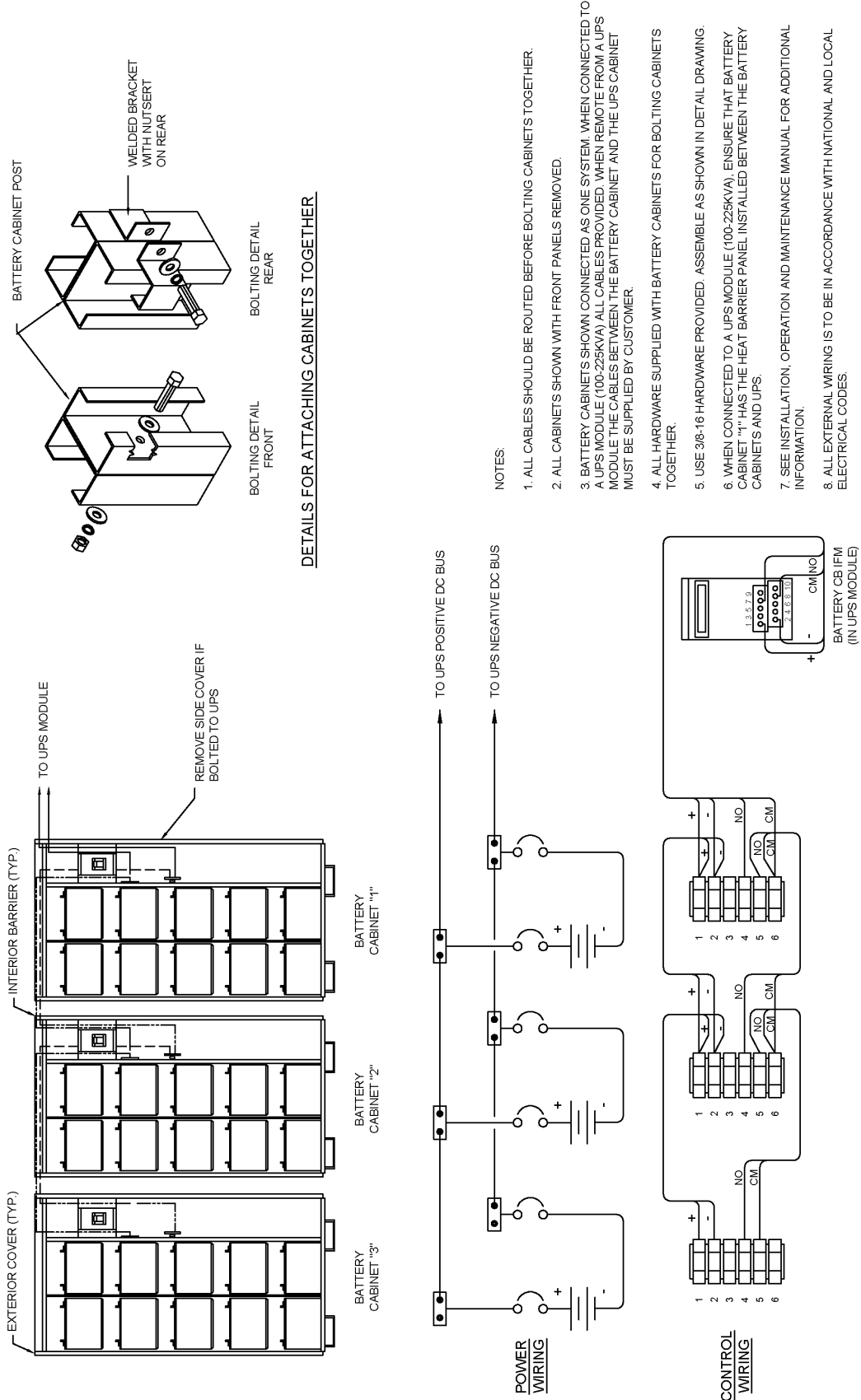


NOTES:

1. ALL DIMENSIONS ARE IN INCHES (MILLIMETERS).

88-797606-09  
Rev. 05

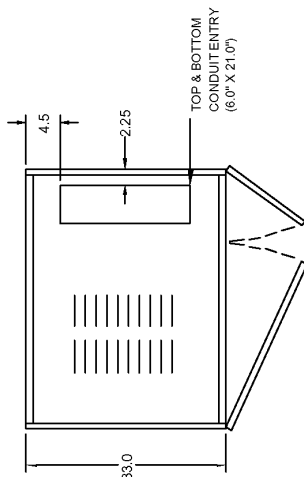
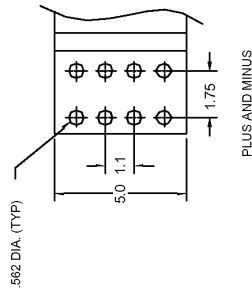
Figure 17 Battery power pack system



88-797616-03  
Rev. 08

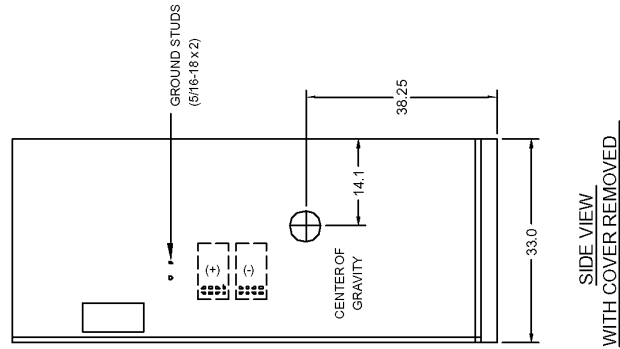
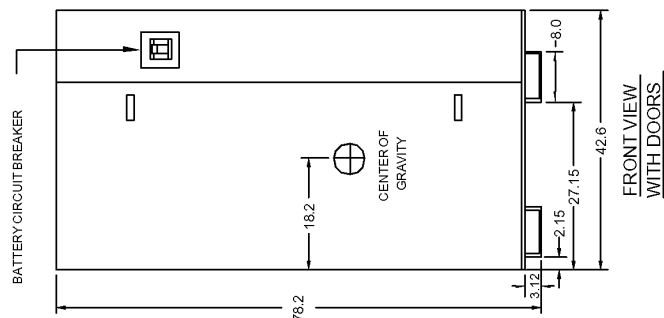
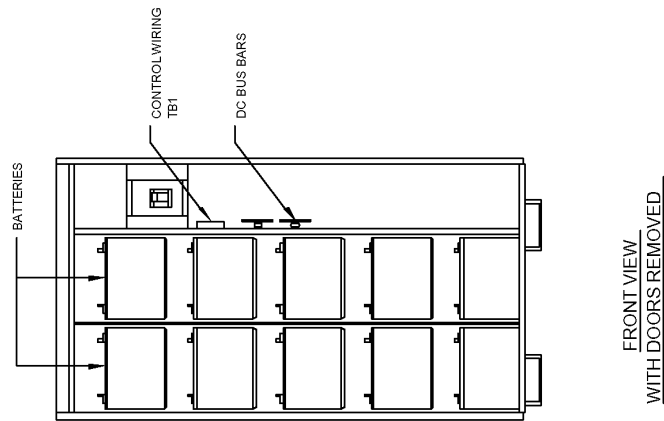
Figure 18 Battery power pack, Size A

- NOTES:
1. COLOR - IBM OFF-WHITE
  2. ALL DIMENSIONS ARE IN INCHES
  3. INSTALLATION AND SERVICE ACCESS REQUIRED IN FRONT, .38" (915 MM) MINIMUM.
  4. KEEP CABINET WITHIN 15° OF VERTICAL WHILE HANDLING.
  5. LIFT FROM BOTTOM ONLY.
  6. RECOMMENDED OPERATING TEMPERATURE RANGE: 20°C (68°F) TO 25°C (77°F).
  7. CONTROL AND POWER WIRING MUST BE RUN IN SEPARATE CONDUITS.
  8. ALL WIRING IS TO BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.



PLUS AND MINUS

TOP VIEW

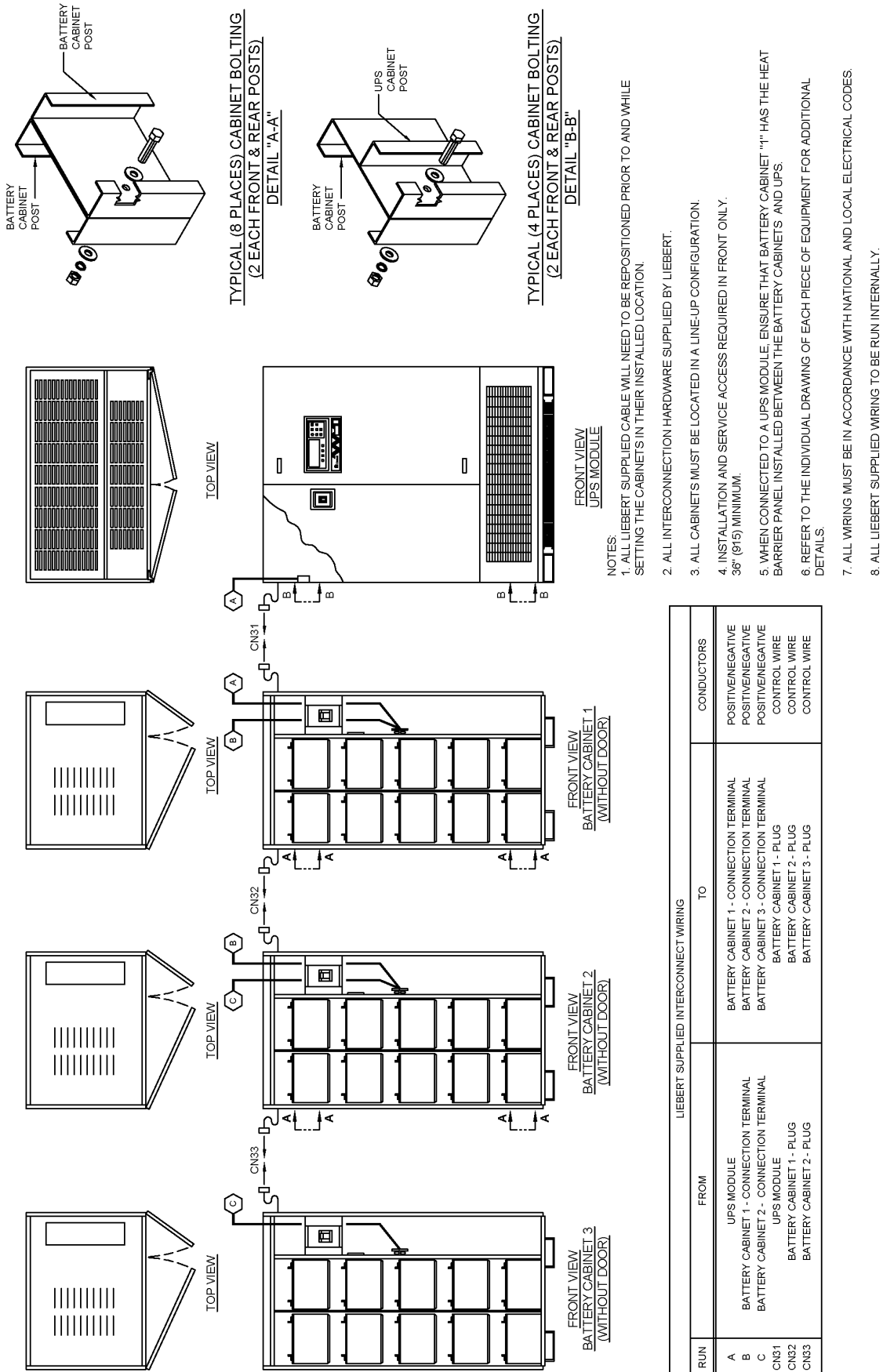


APPROXIMATE WEIGHTS

MODEL NUMBER	BATTERY TYPE	UNIT WEIGHT	
		LBS	KG
U36BP_MJ	UPS12-200	3050	1383
U36BP_RJ	UPS12-270	3060	1388
U36BP_RL	UP512-310	3380	1533
U36BP_RJ	UP512-370	3780	1715
U36BP_WJ	UP512-475	4900	2223
U36BP_XJ	UP512-530	4900	2223
U36BP_HL	L512-80	4100	1860
U36BP_NK	HX205-FR	3170	1438
U36BP_PX	HX300-FR	3180	1442
U36BP_RX	HX330-FR	3540	1606
U36BP_UX	HX400-FR	4120	1869
U36BP_WX	HX500-FR	5300	2404

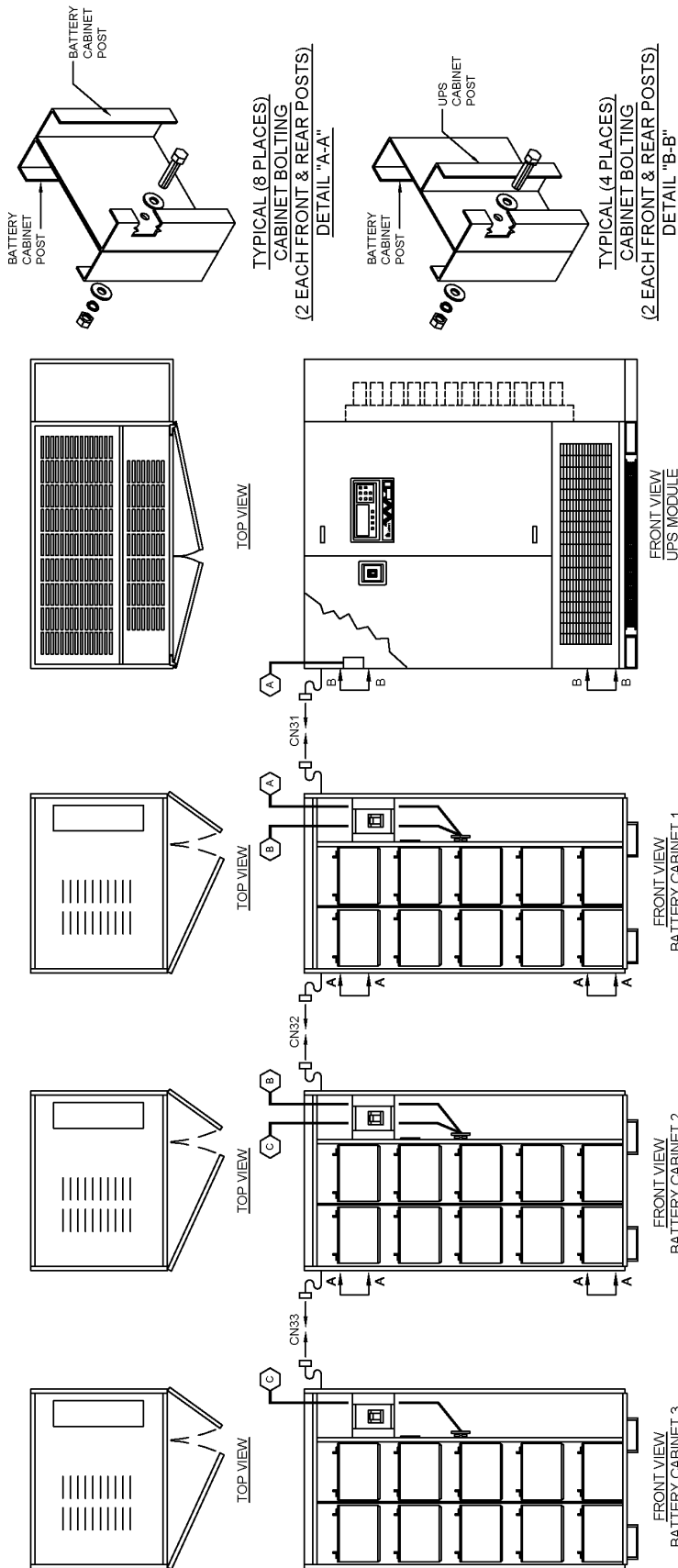
88-797616-01  
Rev. 10

Figure 19 Line-up detail, Single- or Multi-Module System, SpaceSaver with battery cabinets



88-797607-48  
Rev. 05

Figure 20 Line-up detail, Single- or Multi-Module System, with battery cabinets



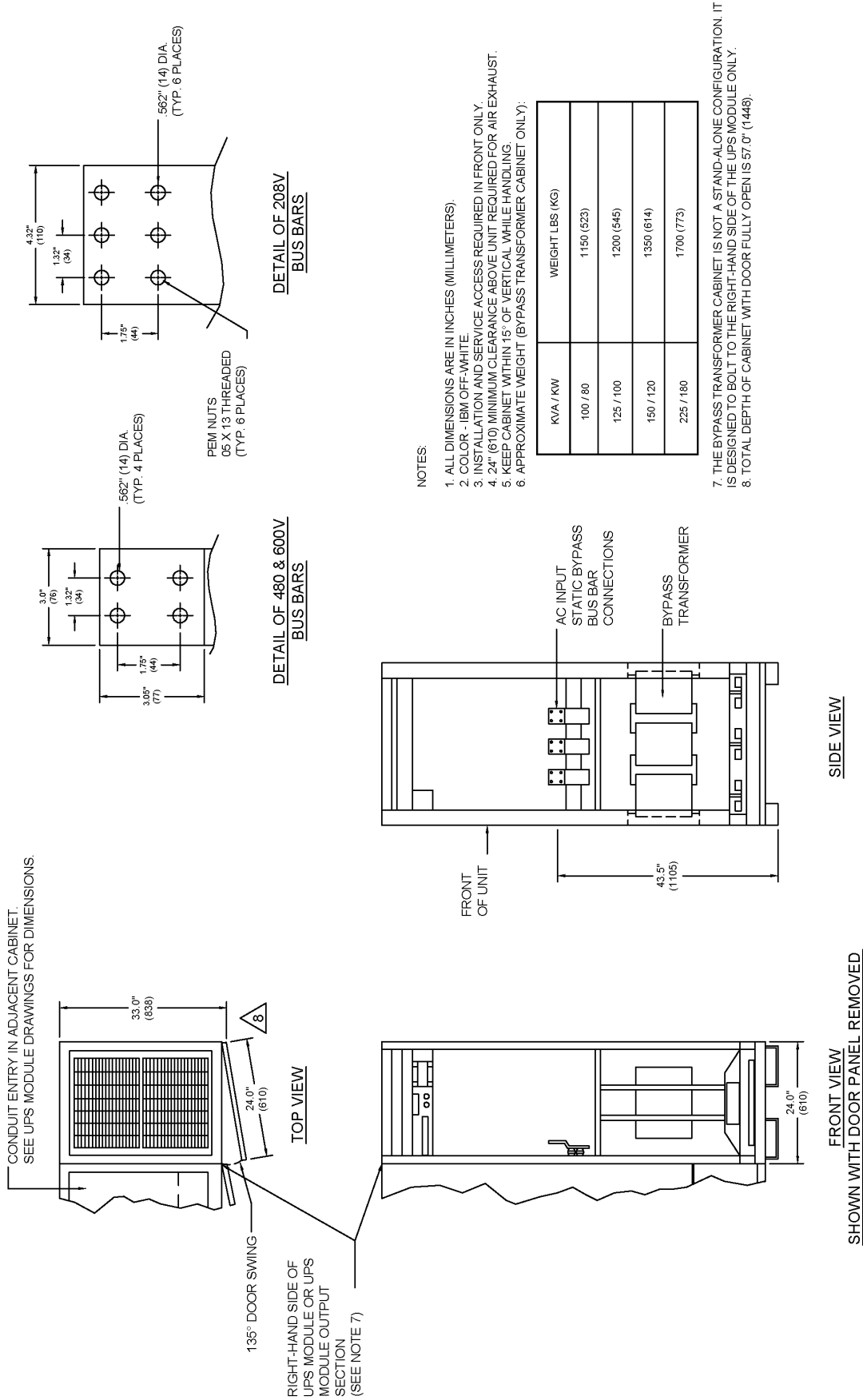
NOTES:  
 1. ALL LIEBERT SUPPLIED CABLE WILL NEED TO BE REPOSITIONED PRIOR TO AND WHILE SETTING THE CABINETS IN THEIR INSTALLED LOCATION.  
 2. ALL INTERCONNECTION HARDWARE SUPPLIED BY LIEBERT.

3. ALL CABINETS MUST BE LOCATED IN A LINE-UP CONFIGURATION.
4. INSTALLATION AND SERVICE ACCESS REQUIRED IN FRONT ONLY. 36" (915) MINIMUM.
5. WHEN CONNECTED TO A UPS MODULE, ENSURE THAT BATTERY CABINET "1" HAS THE HEAT BARRIER PANEL INSTALLED BETWEEN THE BATTERY CABINETS AND UPS.
6. REFER TO THE INDIVIDUAL DRAWING OF EACH PIECE OF EQUIPMENT FOR ADDITIONAL DETAILS.
7. ALL WIRING MUST BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.
8. ALL LIEBERT SUPPLIED WIRING TO BE RUN INTERNALLY.

LIEBERT SUPPLIED INTERCONNECT WIRING		
RUN	FROM	TO
A	UPS MODULE	CONDUCTORS
B	BATTERY CABINET 1 - CONNECTION TERMINAL	POSITIVE/NEGATIVE
C	BATTERY CABINET 2 - CONNECTION TERMINAL	POSITIVE/NEGATIVE
CN31	UPS MODULE	CONTROL WIRE
CN32	BATTERY CABINET 1 - PLUG	CONTROL WIRE
CN33	BATTERY CABINET 2 - PLUG	CONTROL WIRE

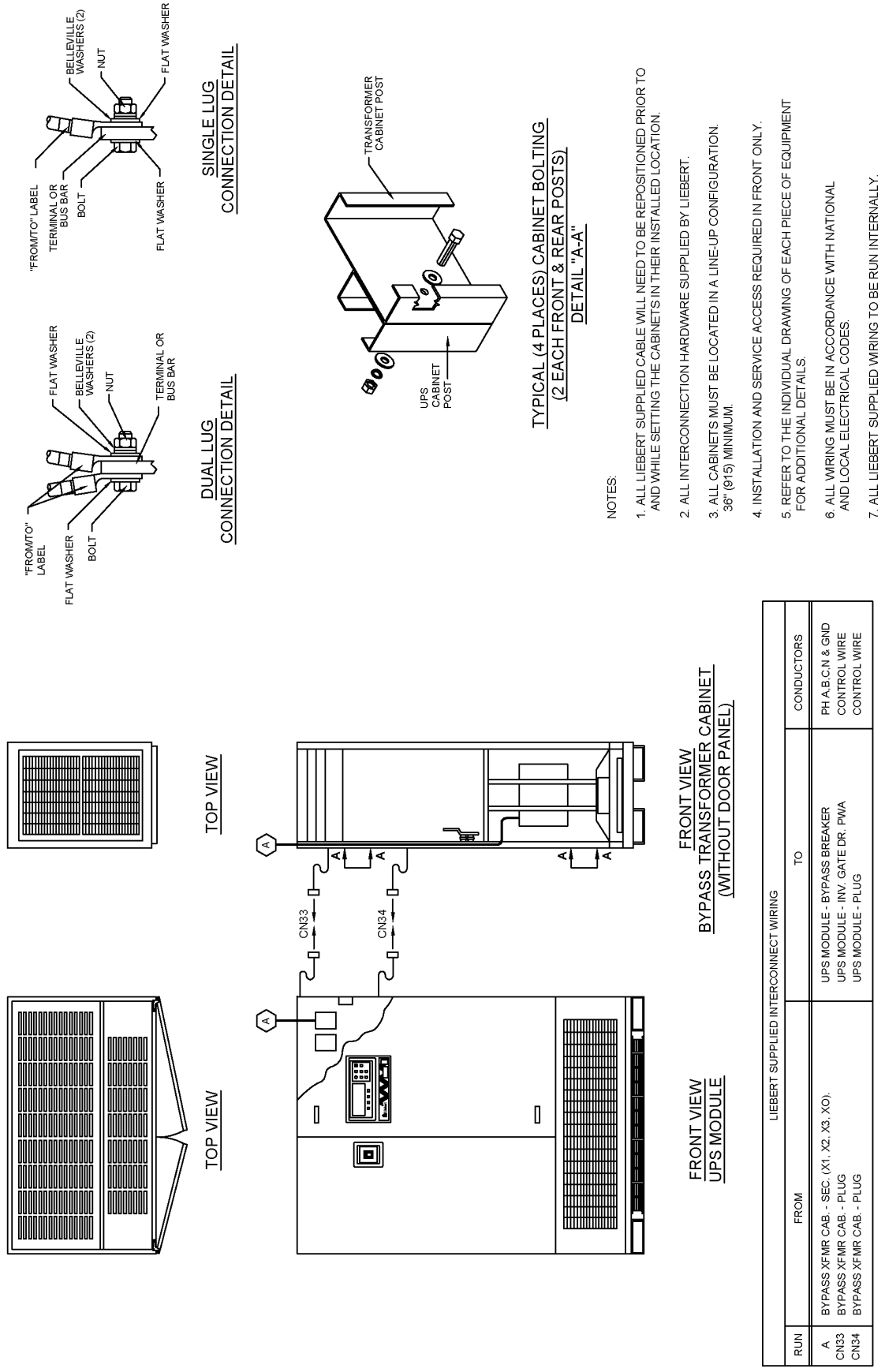
88-797607-49  
 Rev. 05

Figure 21 Outline drawing, Bypass Transformer Cabinet, 208V, 480V, 600V



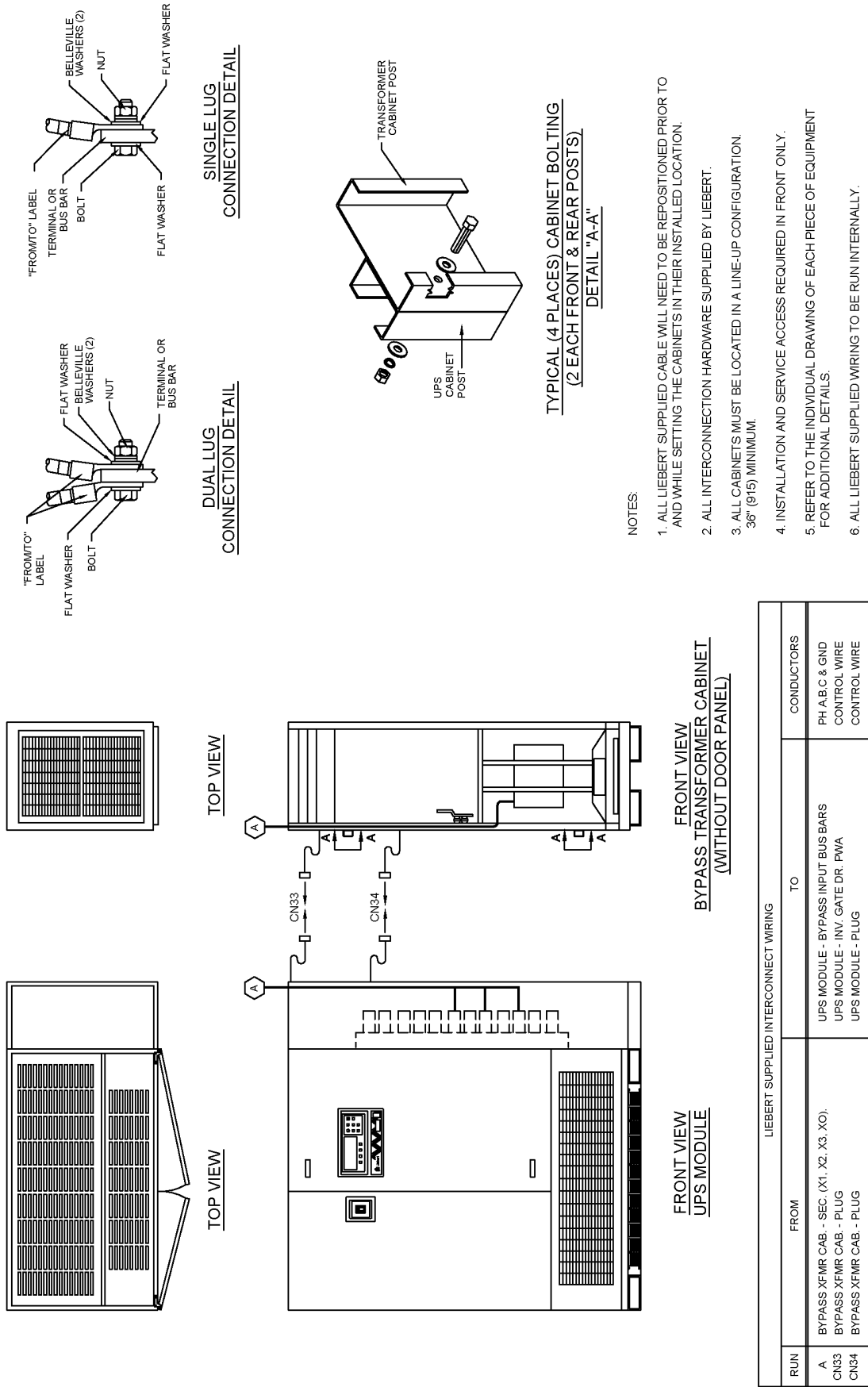
88-797609-14  
Rev. 03

Figure 22 Line-up detail, Single-Module System, SpaceSaver with Bypass Transformer Cabinet



88-797607-11  
Rev. 05

Figure 23 Line-up detail, Single-Module System, with Bypass Transformer Cabinet



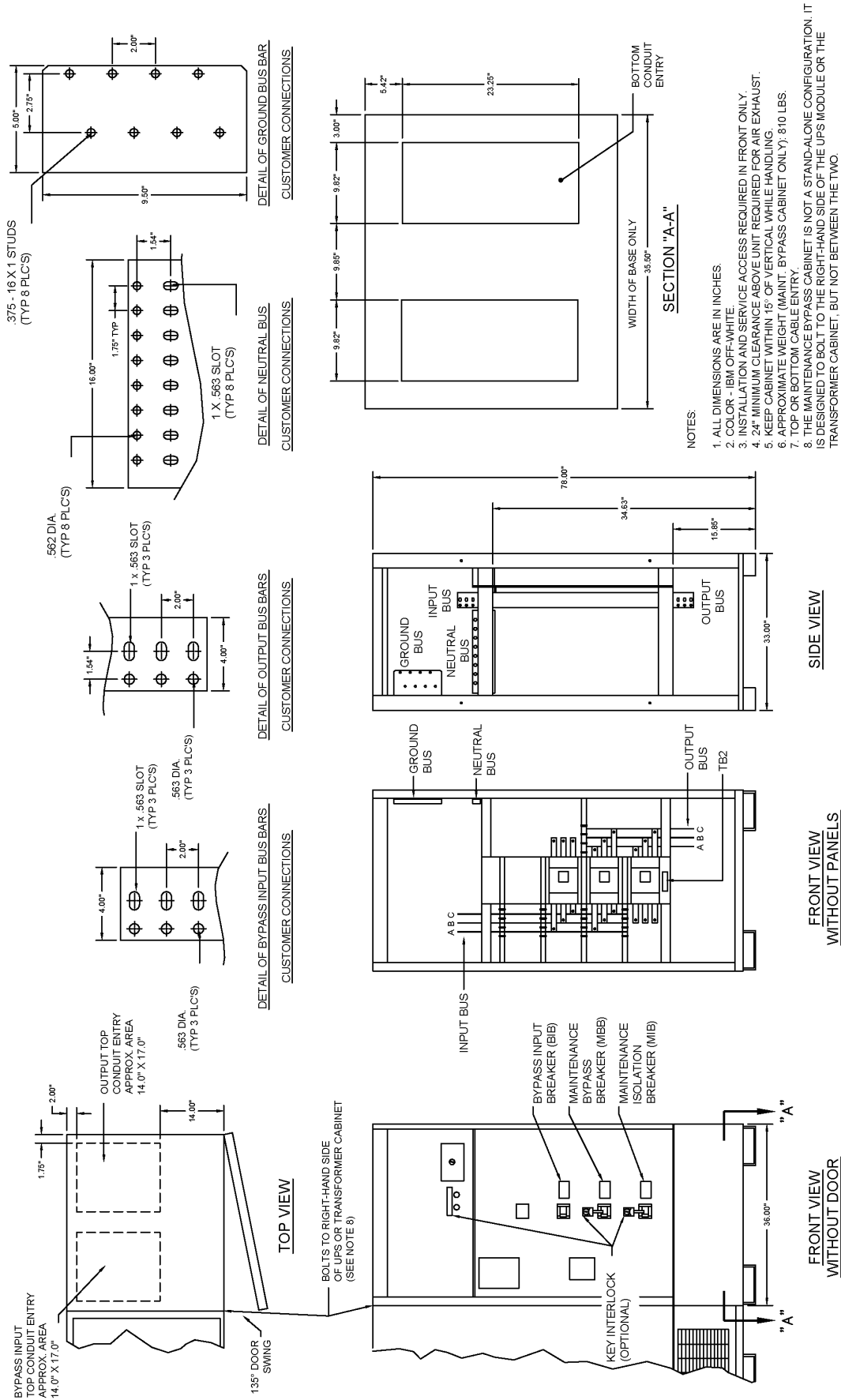
88-797607-21  
Rev. 04

LIEBERT SUPPLIED INTERCONNECT WIRING		CONDUCTORS
FROM	TO	
A	UPS MODULE - BYPASS INPUT BUS BARS	PH A B C & GND
CN33	UPS MODULE - INV. GATE DR. PWA	CONTROL WIRE
CN34	UPS MODULE - PLUG	CONTROL WIRE
	UPS MODULE - BYPASS INPUT BUS BARS	PH A B C & GND
	UPS MODULE - INV. GATE DR. PWA	CONTROL WIRE
	UPS MODULE - PLUG	CONTROL WIRE



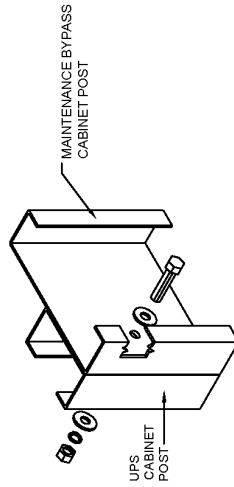
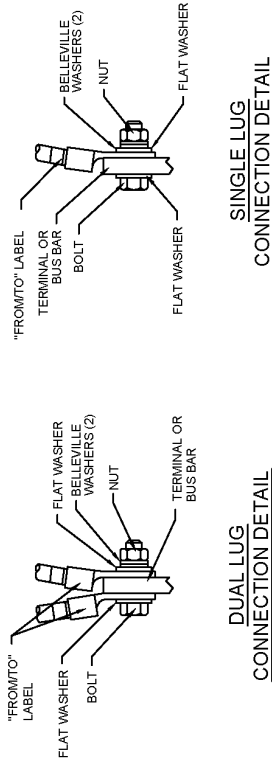


Figure 25 Outline drawing, 3-breaker Maintenance Bypass Cabinet, 450-800A



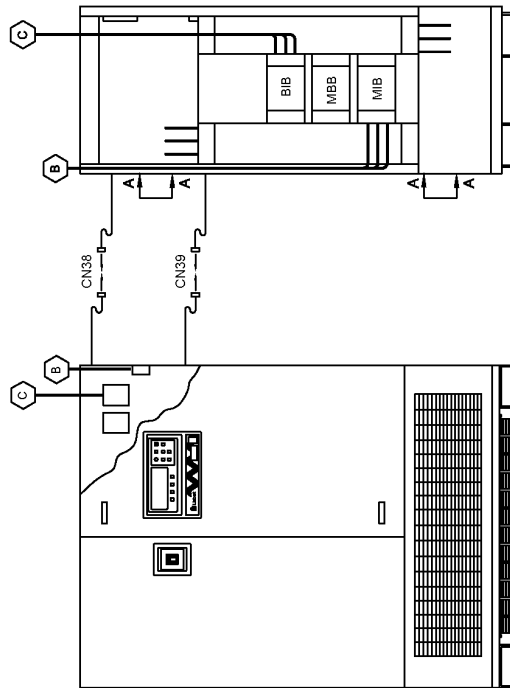
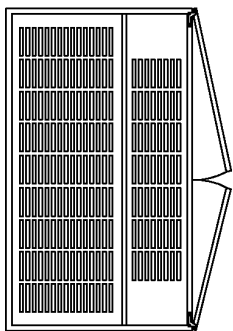
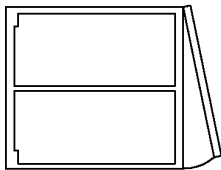
88-791615-31  
Rev. 07

Figure 26 Line-up detail, Single-Module System, SpaceSaver with 3-breaker Maintenance Bypass Cabinet



NOTES:

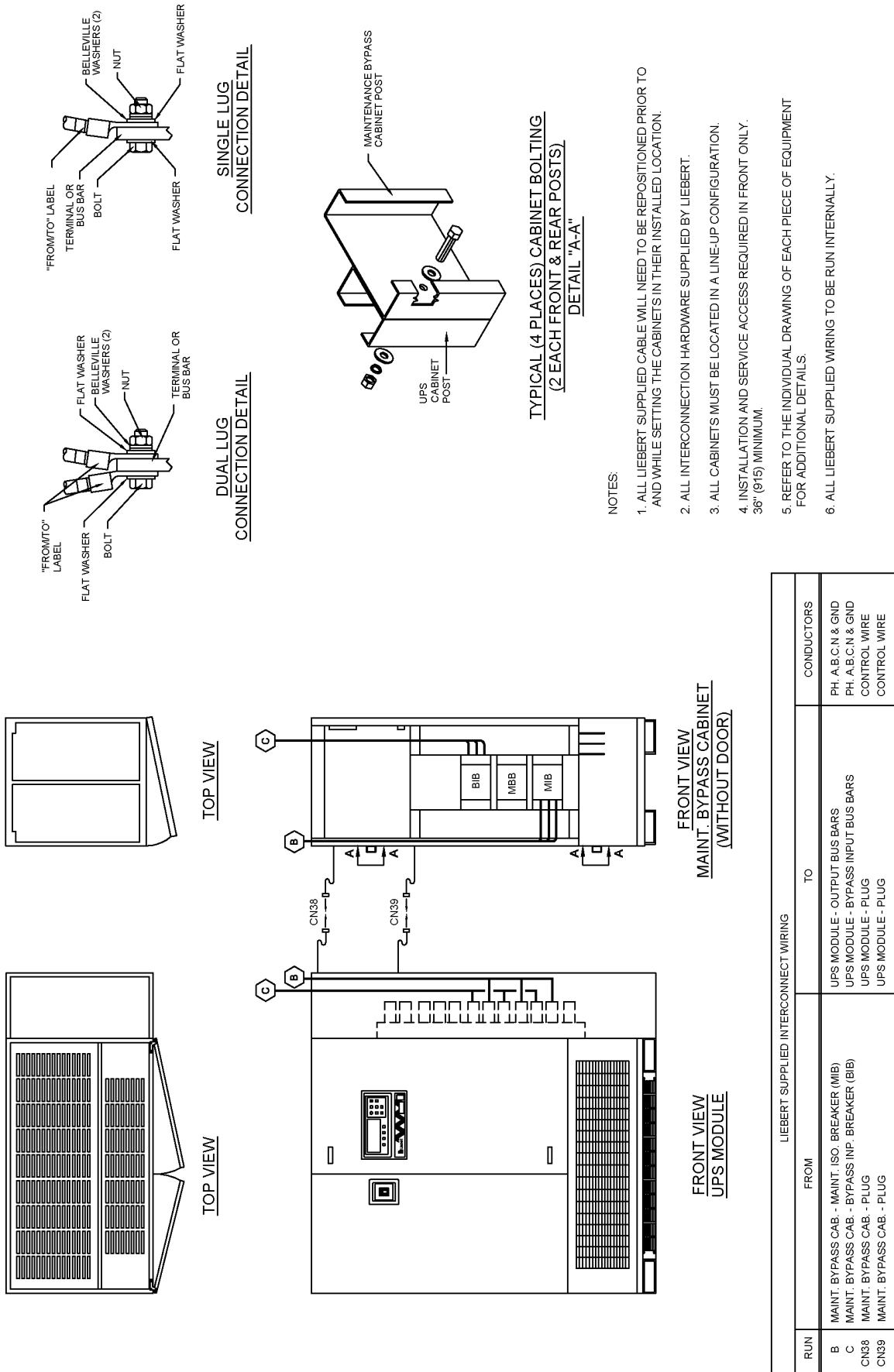
1. ALL LIEBERT SUPPLIED CABLE WILL NEED TO BE REPOSITIONED PRIOR TO AND WHILE SETTING THE CABINETS IN THEIR INSTALLED LOCATION.
2. ALL INTERCONNECTION HARDWARE SUPPLIED BY LIEBERT.
3. ALL CABINETS MUST BE LOCATED IN A LINE-UP CONFIGURATION.
4. INSTALLATION AND SERVICE ACCESS REQUIRED IN FRONT ONLY. 36" (915) MINIMUM.
5. REFER TO THE INDIVIDUAL DRAWING OF EACH PIECE OF EQUIPMENT FOR ADDITIONAL DETAILS.
6. ALL WIRING MUST BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.
7. ALL LIEBERT SUPPLIED WIRING TO BE RUN INTERNALLY.



LIEBERT SUPPLIED INTERCONNECT WIRING		CONDUCTORS
RUN	FROM	TO
B	MAINT. BYPASS CAB. - MAINT. ISO. BREAKER (MIB)	UPS MODULE - OUTPUT TERMINAL BLOCK
C	MAINT. BYPASS CAB. - BYPASS INP. BREAKER (BIB)	UPS MODULE - BYPASS BREAKER
CN38	MAINT. BYPASS CAB. - PLUG	UPS MODULE - PLUG
CN39	MAINT. BYPASS CAB. - PLUG	UPS MODULE - PLUG
		PH. A, B, C, N & GND
		CONTROL WIRE
		CONTROL WIRE

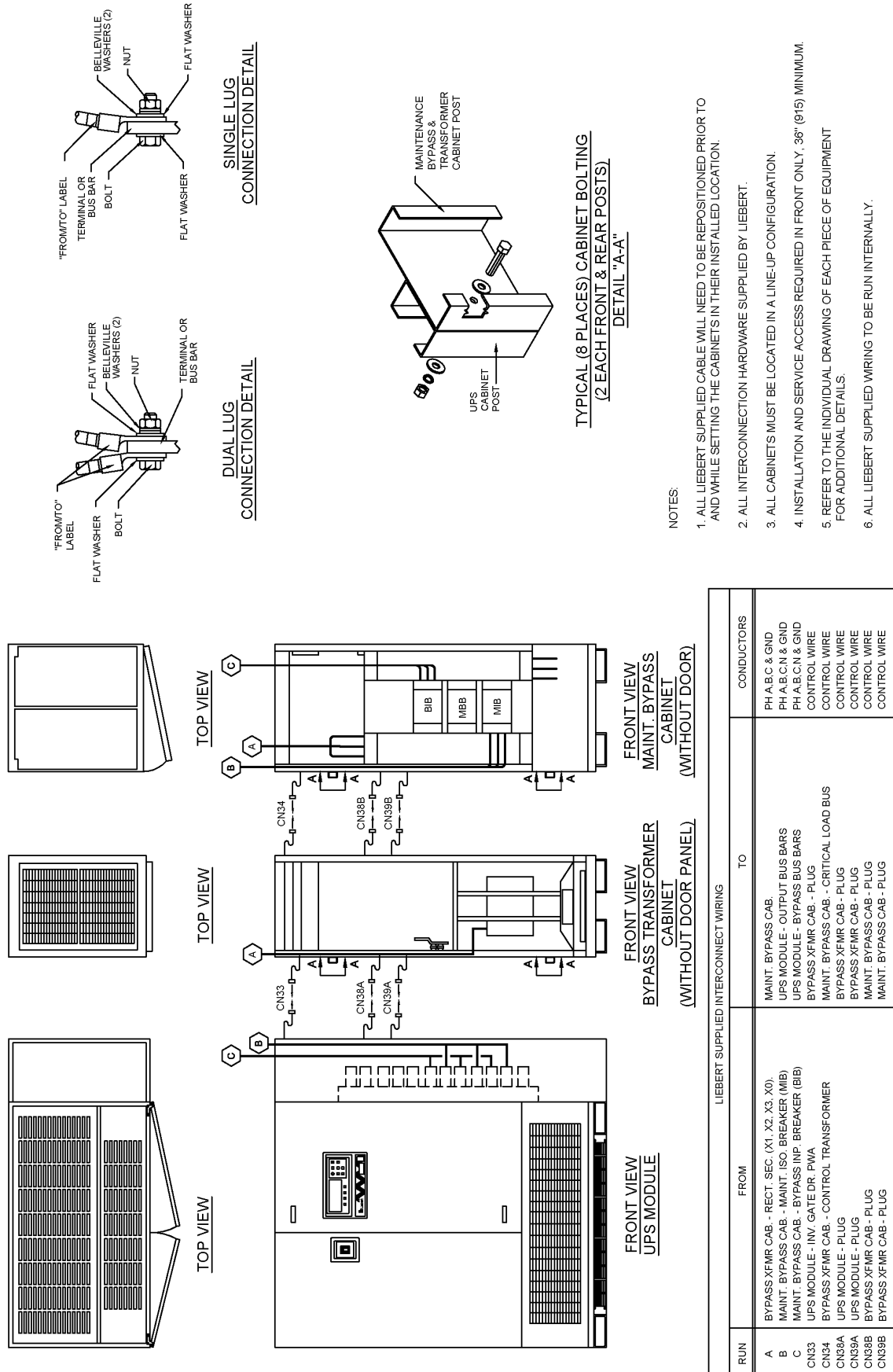
88-797607-13  
Rev. 05

Figure 27 Line-up detail, Single-Module System, with 3-breaker Maintenance Bypass Cabinet



88-797607-23  
Rev. 04

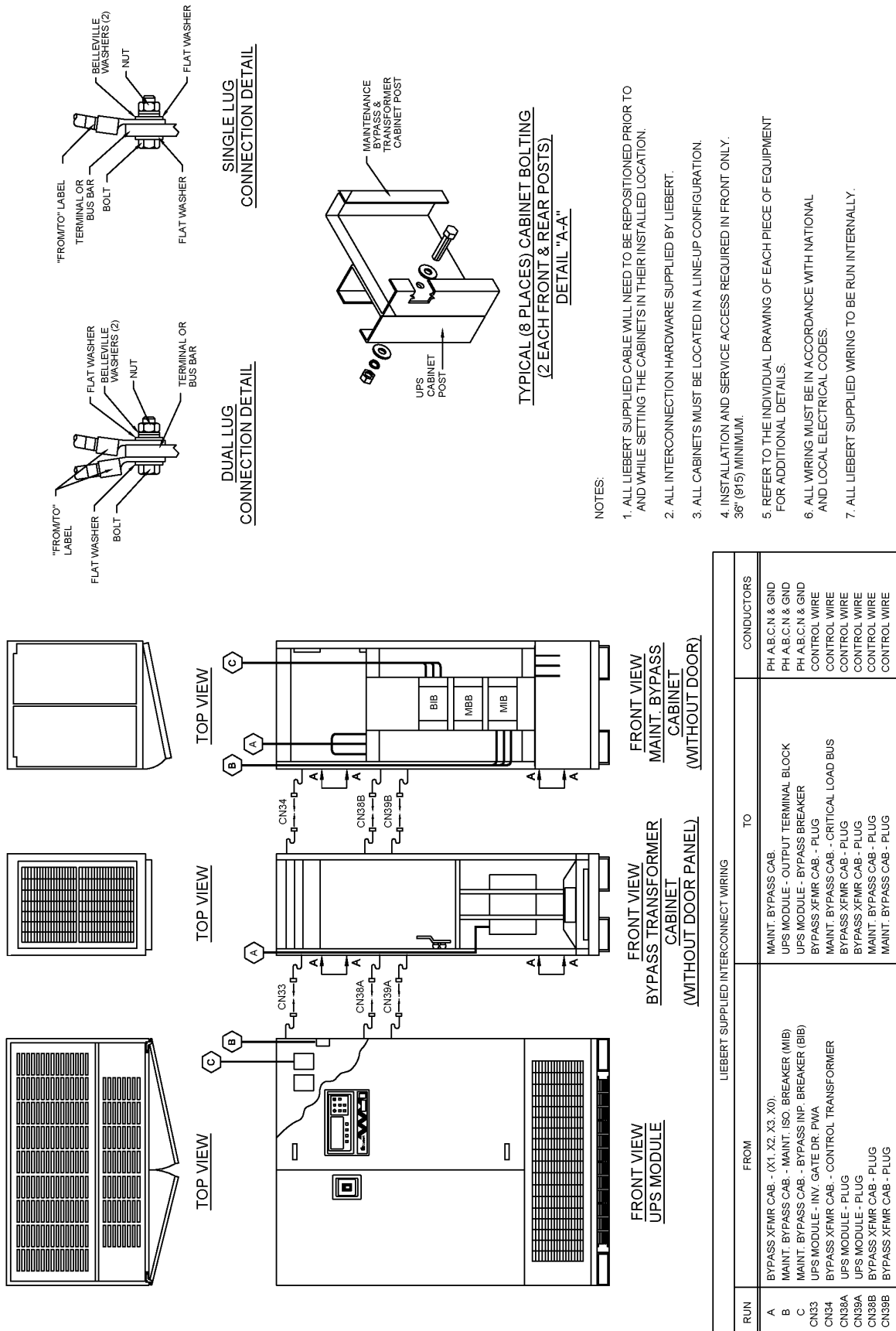
Figure 28 Line-up detail, Single-Module System, with Bypass Transformer Cabinet and 3-breaker Maintenance Bypass Cabinet



LIEBERT SUPPLIED INTERCONNECT WIRING		CONDUCTORS
RUN	FROM	TO
A	BYPASS XFMR CAB. - RECT. SEC. (X1, X2, X3, X0)	PH A,B,C & GND
B	MAINT. BYPASS CAB. - MAINT. ISO. BREAKER (MIB)	PH A,B,C,N & GND
C	MAINT. BYPASS CAB. - BYPASS INP. BREAKER (BIB)	PH A,B,C,N & GND
CN33	UPS MODULE - INV. GATE DR. PWA	CONTROL WIRE
CN34	BYPASS XFMR CAB. - CONTROL TRANSFORMER	CONTROL WIRE
CN38A	UPS MODULE - PLUG	CONTROL WIRE
CN38B	UPS MODULE - PLUG	CONTROL WIRE
CN39A	BYPASS XFMR CAB. - PLUG	CONTROL WIRE
CN39B	BYPASS XFMR CAB. - PLUG	CONTROL WIRE

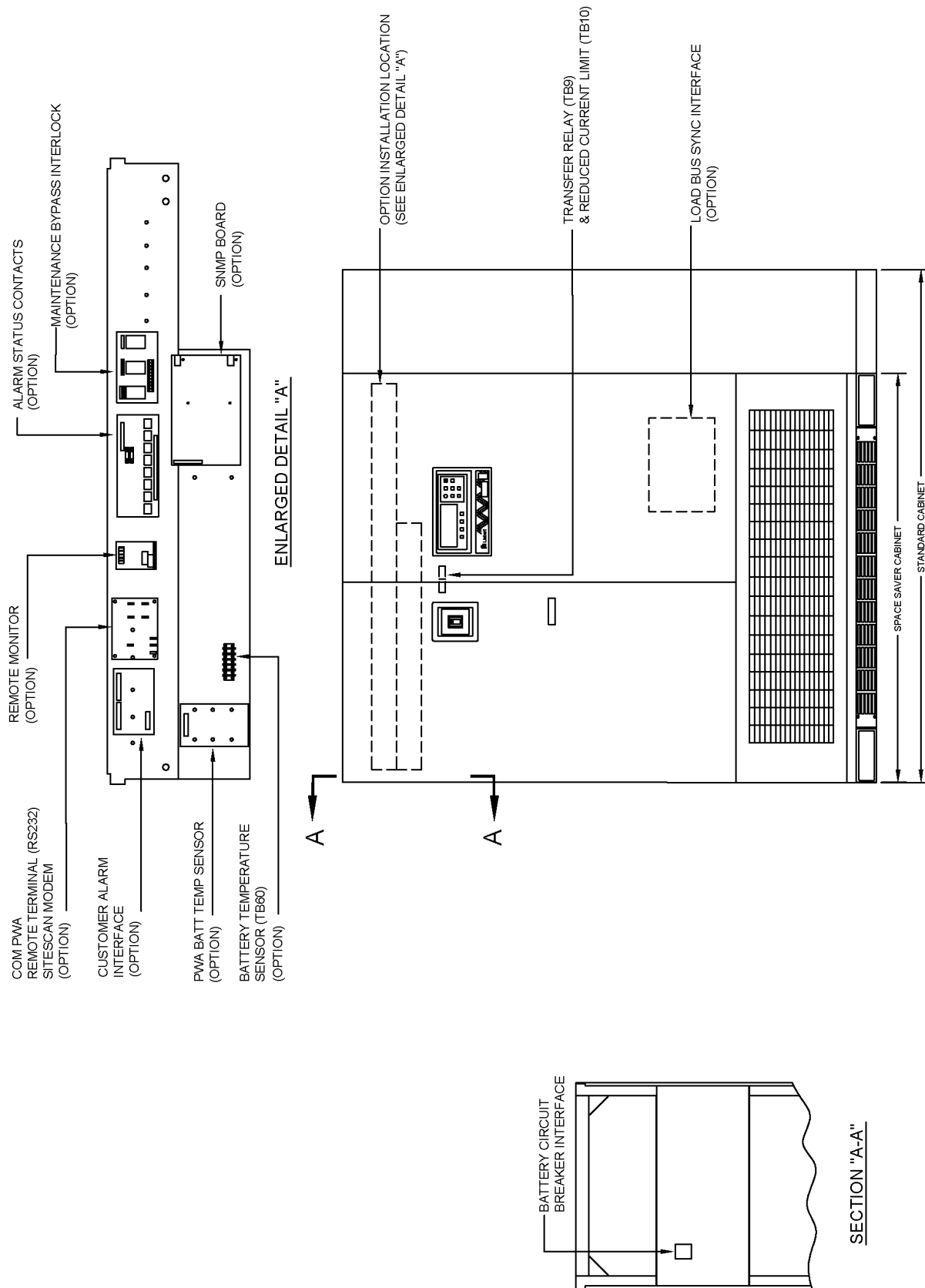
88-797607-26  
Rev. 04

Figure 29 Line-up detail, Single-Module System, SpaceSaver with Bypass Transformer Cabinet and 3-breaker Maintenance Bypass Cabinet



88-797607-16  
Rev. 05

Figure 30 Control connection location diagram, Single-Module System

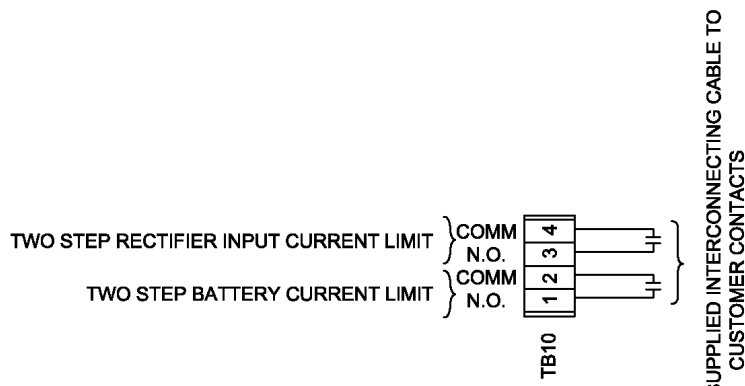


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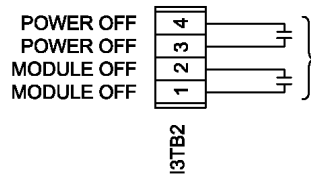
FRONT VIEW

FOR UNITS MANUFACTURED BEFORE 12/31/02, SEE DRAWING 96-797608-03

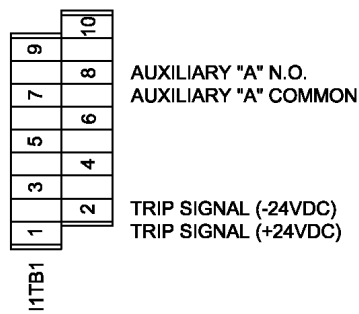
Figure 31 Control wiring, Single-Module System, standard wiring



REDUCED CURRENT LIMIT

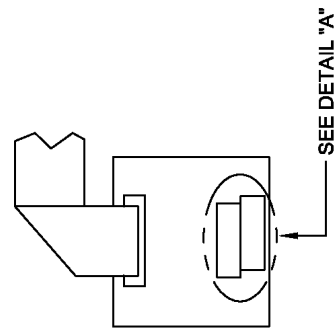


TRANSFER RELAY



CUSTOMER SUPPLIED INTERCONNECTING CABLE TO BATTERY CIRCUIT BREAKER

DETAIL "A"



BATTERY CIRCUIT BREAKER INTERFACE

NOTES:

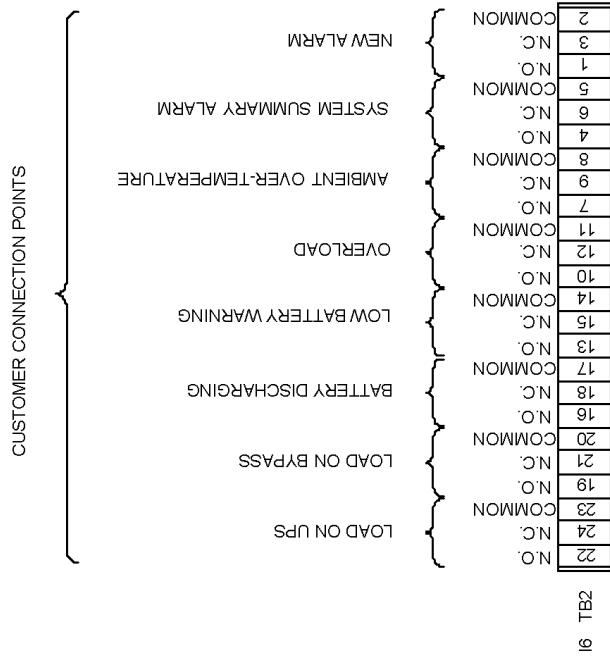
1. ALL CONTROL WIRING (BY OTHERS) MUST BE RUN SEPARATE FROM POWER WIRING. CONTROL WIRING RUNS SHOULD NOT BE COMBINED IN THE SAME CONDUIT.
2. REFER TO UPS MODULE CONTROL CONNECTION LOCATION DIAGRAM FOR LOCATION OF WIRING CONNECTIONS.
3. FOR OPTION WIRING CONNECTIONS, REFER TO INDIVIDUAL CONTROL WIRING DIAGRAM(S).
4. SIGNAL VOLTAGE 24VDC, CURRENT 100mA.
5. MAXIMUM CABLE LENGTH 500 FEET (150 METERS) WITH #14AWG FLEXIBLE STRANDED CABLE.
6. N.O. = NORMALLY OPEN, COMM. = COMMON
7. ALL WIRING MUST BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.

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Rev. 03

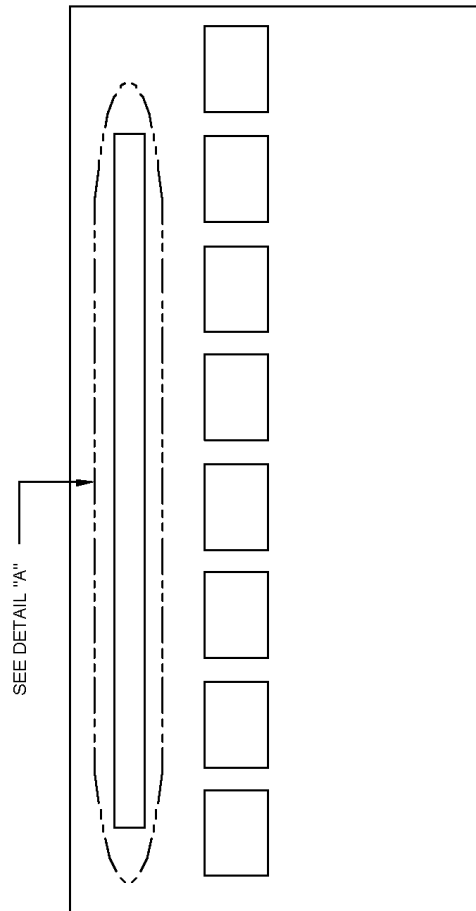


Figure 32 Module control wiring, alarm status contacts option

- NOTES:
1. ALL CONTROL WIRING (BY OTHERS) MUST BE RUN SEPARATE FROM POWER WIRING. CONTROL WIRING RUNS SHOULD NOT BE COMBINED IN THE SAME CONDUIT.
  2. REFER TO UPS MODULE CONTROL CONNECTION LOCATION DIAGRAM FOR LOCATION OF OPTIONAL ALARM STATUS CONTACTS BOARD.
  3. SIGNAL VOLTAGE 120VAC, CURRENT 500mA.
  4. MAXIMUM CABLE LENGTH 500 FEET (150 METERS) WITH #14AWG (2.5 mm<sup>2</sup>) FLEXIBLE STRANDED CABLE.
  5. N.O. = NORMALLY OPEN, N.C. = NORMALLY CLOSED, COMM. = COMMON
  6. ALL WIRING MUST BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.



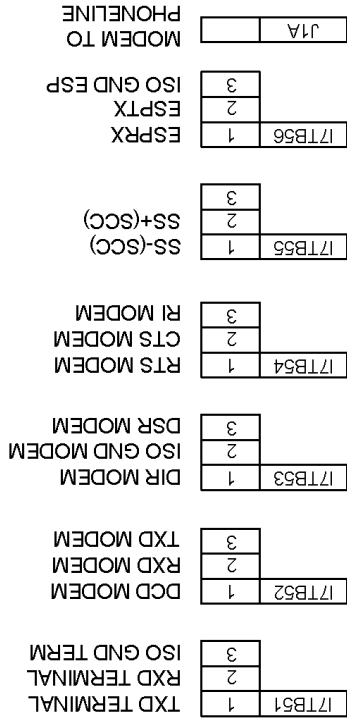
DETAIL "A"



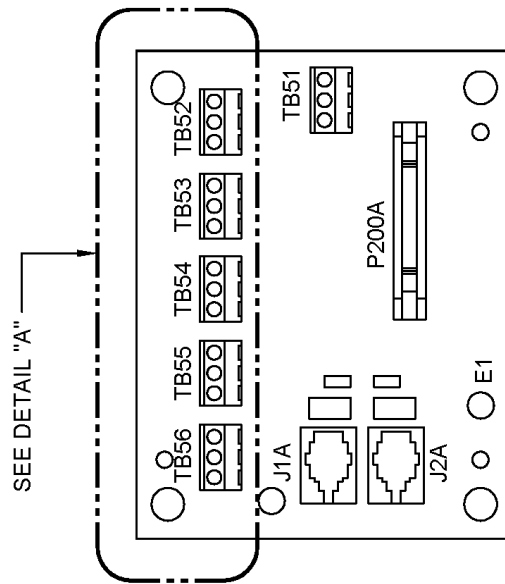
98-797608-04  
Rev. 05

Figure 33 COM PWA, remote terminal (RS232) option, SiteScan option, internal modem option

CUSTOMER SUPPLIED INTERCONNECTING CABLE  
TO COM PWA



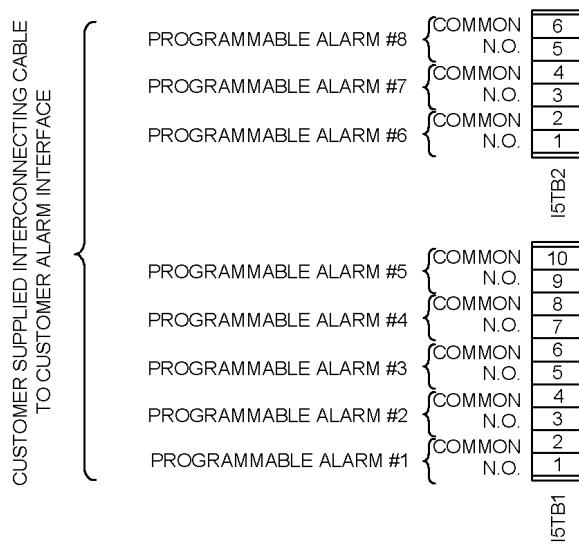
DETAIL "A"



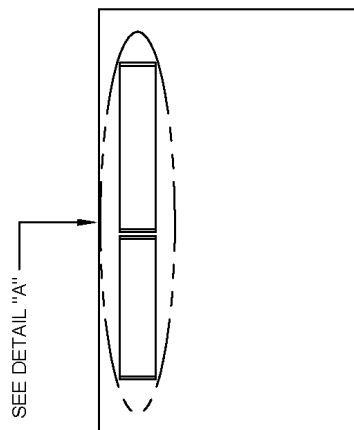
- NOTES:
1. ALL CONTROL WIRING (BY OTHERS) MUST BE RUN SEPARATE FROM POWER WIRING. CONTROL WIRING RUNS SHOULD NOT BE COMBINED IN THE SAME GROUNDED RIGID METAL CONDUIT.
  2. REFER TO UPS MODULE CONTROL CONNECTION LOCATION DIAGRAM FOR LOCATION OF OPTIONAL REMOTE TERMINAL INTERFACE BOARD.
  3. SIGNAL VOLTAGE 24VDC, CURRENT 100ma
  4. MAXIMUM CABLE LENGTH 100 FEET (30 METERS) WITH #22AWG (0.50 mm<sup>sq</sup>) TWISTED SHIELDED CABLE.
  5. ALL WIRING MUST BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.
  6. CONNECT TO J1A WITH STANDARD RJ11 MODULAR CONNECTOR. LENGTH LIMITATIONS ACCORDING TO TELEPHONE COMPANY SPECIFICATIONS.

98-797608-07A  
Rev. 02

Figure 34 Control wiring, customer alarm interface option



DETAIL "A"



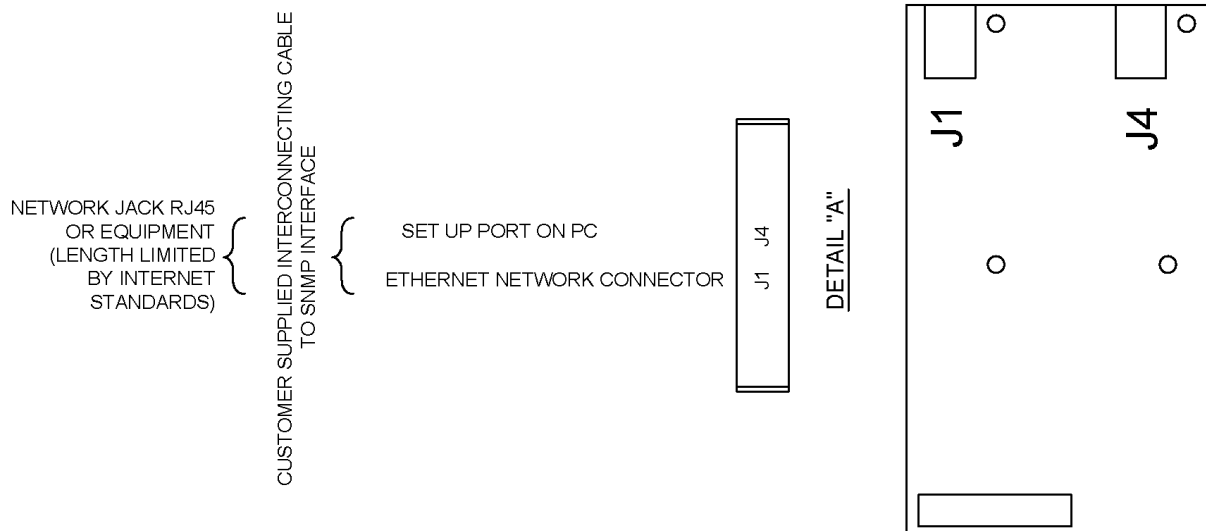
CUSTOMER ALARM INTERFACE BOARD

NOTES:

1. ALL CONTROL WIRING (BY OTHERS) MUST BE RUN SEPARATE FROM POWER WIRING. CONTROL WIRING RUNS SHOULD NOT BE COMBINED IN THE SAME CONDUIT.
2. REFER TO UPS MODULE CONTROL CONNECTION LOCATION DIAGRAM FOR LOCATION OF OPTIONAL CUSTOMER ALARM INTERFACE BOARD.
3. SIGNAL VOLTAGE 24VDC, CURRENT 100mA.
4. MAXIMUM CABLE LENGTH 500 FEET (150 METERS) WITH #14AWG (2.5 mm<sup>2</sup>) FLEXIBLE STRANDED CABLE.
5. N.O. = NORMALLY OPEN, N.C. = NORMALLY CLOSED, COMM. = COMMON
6. ALL WIRING MUST BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.

98-797608-09  
Rev. 03

Figure 35 Control wiring, SNMP interface option



NOTES:

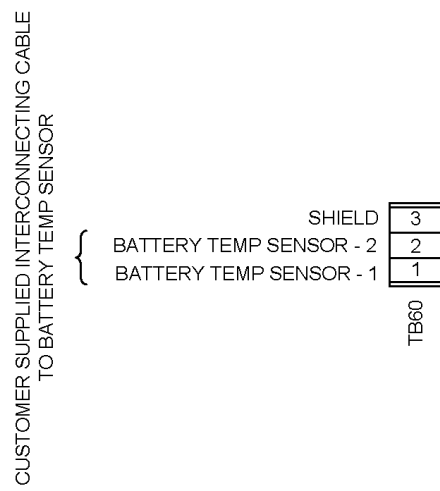
1. ALL CONTROL WIRING (BY OTHERS) MUST BE RUN SEPARATE FROM POWER WIRING. CONTROL WIRING RUNS SHOULD NOT BE COMBINED IN THE SAME GROUNDED RIGID METAL CONDUIT.
2. REFER TO UPS MODULE CONTROL CONNECTION LOCATION DIAGRAM FOR LOCATION OF OPTIONAL SNMP BOARD.
3. WIRE SIZE & TYPE: TELEPHONE CABLE. LENGTH LIMITED BY INTERNET STANDARDS.
4. ALL WIRING MUST BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.

98-797608-11A  
Rev. 02

FOR UNITS MANUFACTURED BEFORE 12/31/02, SEE DRAWING 98-797608-11



Figure 37 Control wiring, battery temperature sensor interface



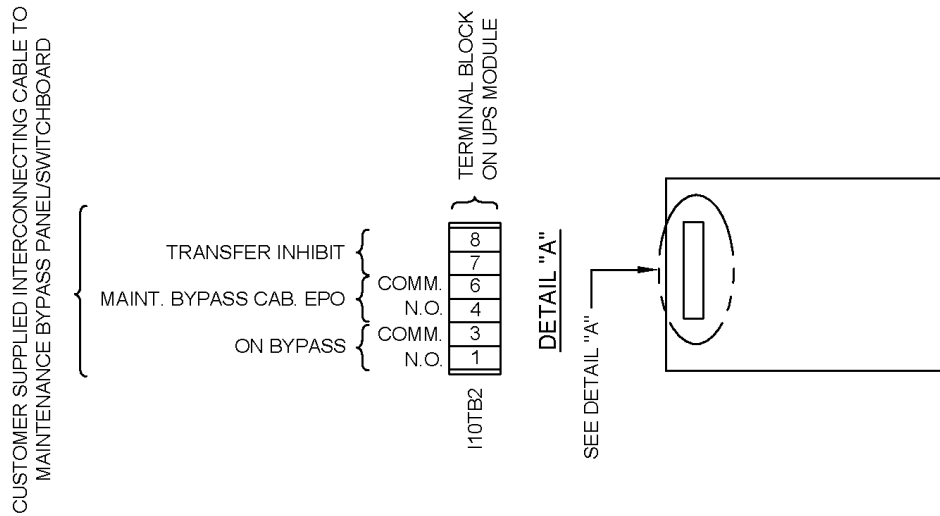
BATTERY TEMPERATURE SENSOR

NOTES:

1. REFER TO UPS MODULE CONTROL CONNECTION LOCATION DIAGRAM FOR LOCATION OF OPTIONAL BATTERY TEMPERATURE SENSOR TERMINAL BLOCK.
2. SIGNAL VOLTAGE 24VDC, CURRENT 100mA.
3. MAXIMUM CABLE LENGTH 100 FEET (30 METERS) WITH #18AWG (1.0 mm<sup>2</sup>) TWISTED PAIR SHIELDED CABLE.
4. ALL WIRING MUST BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.

98-797608-10  
Rev. 04

Figure 38 Control wiring, maintenance bypass interlock option



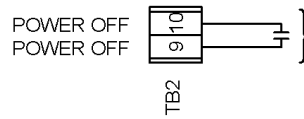
MAINTENANCE BYPASS INTERLOCK BOARD

NOTES:

1. ALL CONTROL WIRING (BY OTHERS) MUST BE RUN SEPARATE FROM POWER WIRING. CONTROL WIRING RUNS SHOULD NOT BE COMBINED IN THE SAME CONDUIT.
2. REFER TO UPS MODULE CONNECTION LOCATION DIAGRAM FOR LOCATION OF OPTIONAL MAINTENANCE BYPASS INTERLOCK BOARD.
3. SIGNAL VOLTAGE 120VAC, CURRENT 5A
4. MAXIMUM CABLE LENGTH 500 FEET (150 METERS) WITH #14AWG (2.5 mm<sup>2</sup>sq) FLEXIBLE STRANDED CABLE.
5. N.O. = NORMALLY OPEN, COMM. = COMMON
6. ALL WIRING MUST BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.

98-797608-05  
Rev. 04

Figure 39 Control wiring, Maintenance Bypass Cabinet option



CUSTOMER SUPPLIED INTERCONNECTING CABLE TO  
EPO/EMO PUSH BUTTON STATIONS

REMOTE EMERGENCY POWER OFF

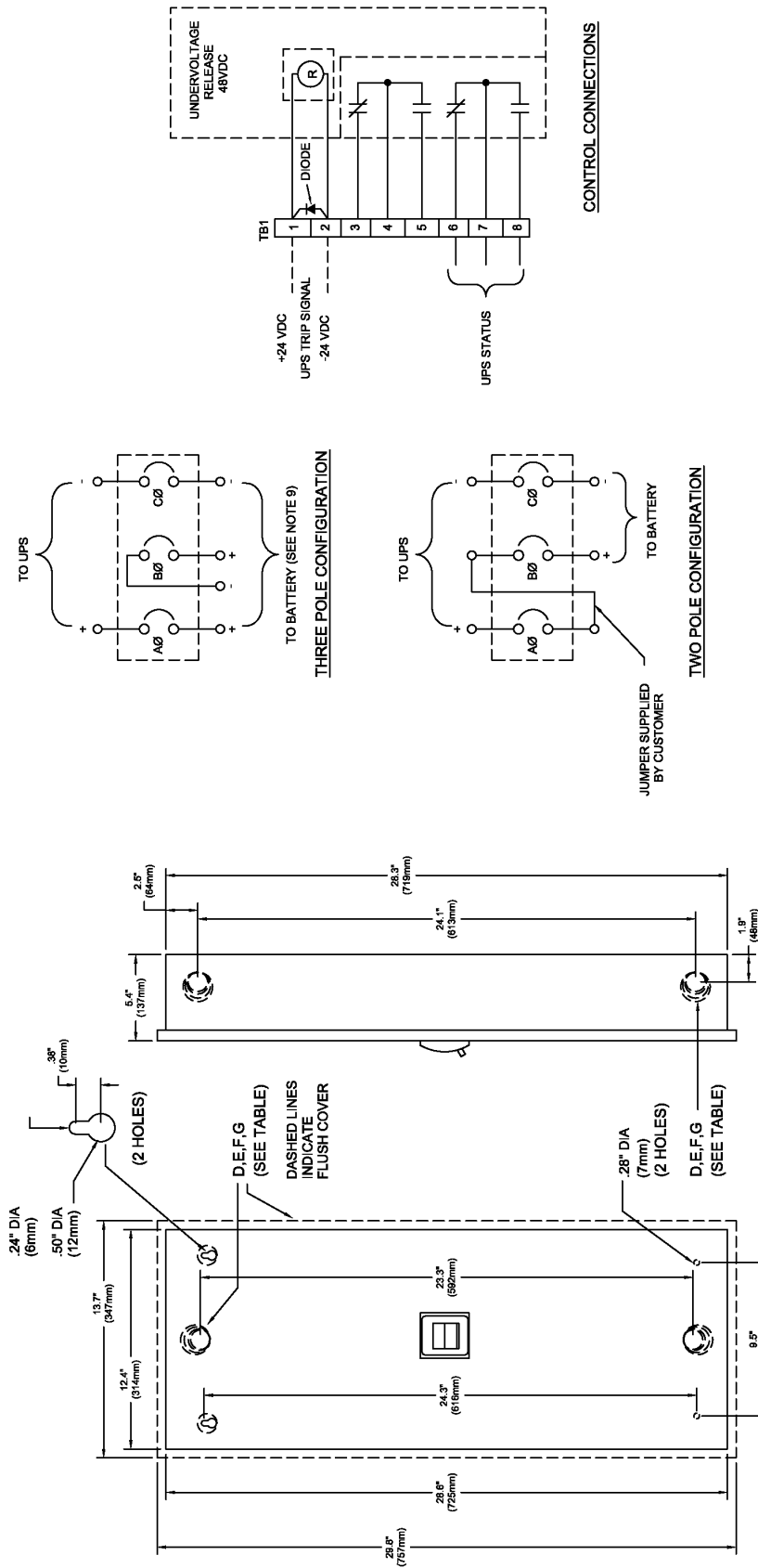
NOTES:

1. ALL CONTROL WIRING (BY OTHERS) MUST BE RUN SEPARATE FROM POWER WIRING. CONTROL WIRING RUNS SHOULD NOT BE COMBINED IN THE SAME CONDUIT.
2. REFER TO MAINTENANCE BYPASS CABINET OUTLINE DRAWING FOR LOCATION OF WIRING CONNECTIONS.
3. SIGNAL VOLTAGE 120VAC, CURRENT 5A.
4. MAXIMUM CABLE LENGTH 500 FEET (150 METERS) WITH #14AWG (2.5 mm<sup>2</sup>) FLEXIBLE STRANDED CABLE.
5. ALL WIRING MUST BE IN ACCORDANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES.

98-797608-14  
Rev. 03



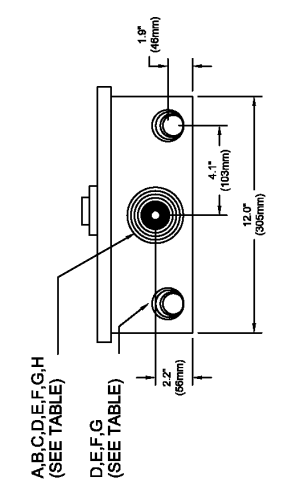
Figure 40 Outline drawing, single-breaker module battery disconnect, 175-250A, 600VDC circuit breaker



NOTES:

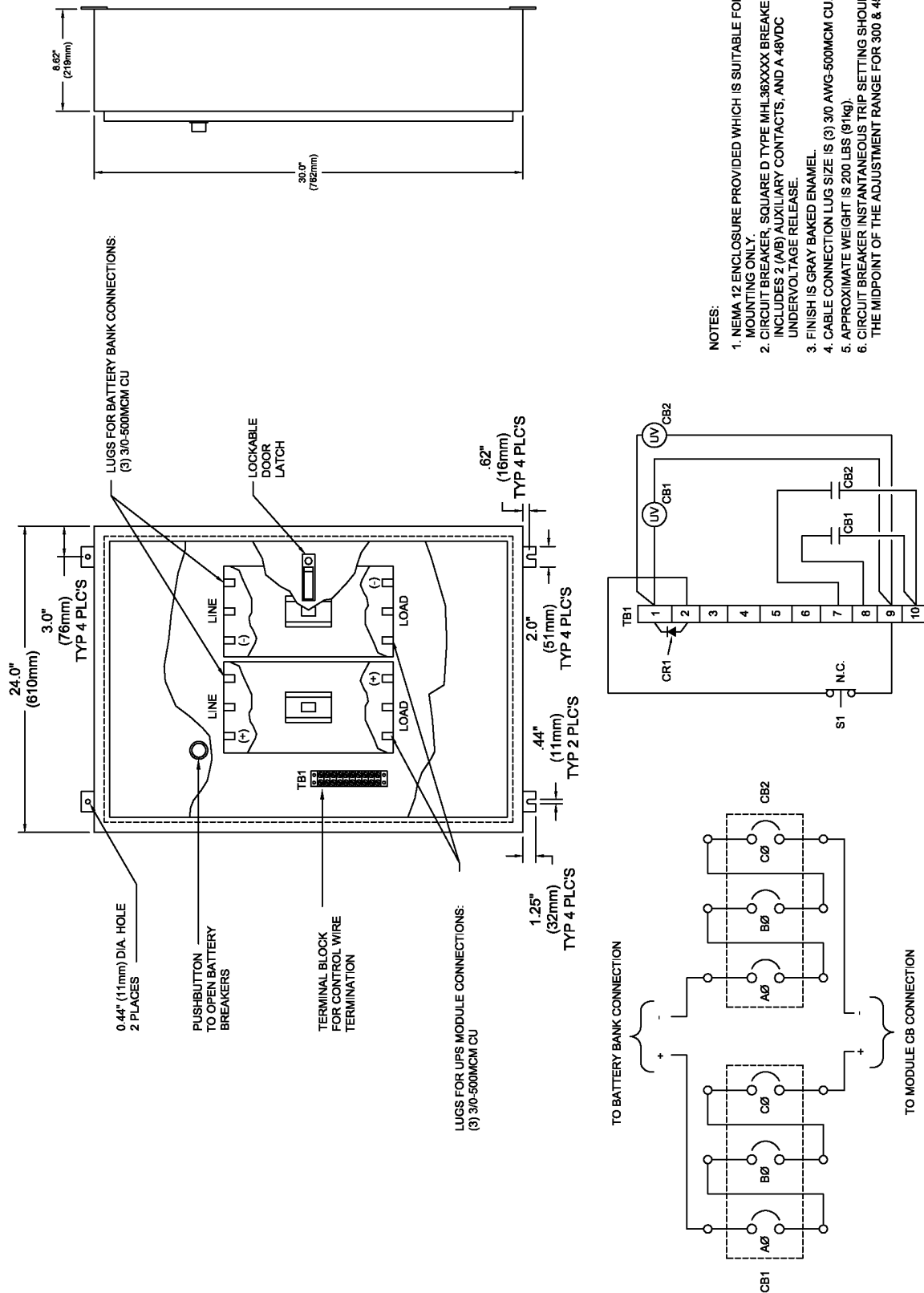
1. NEMA 1 ENCLOSURE PROVIDED WHICH IS SUITABLE FOR WALL MOUNTING ONLY.
2. CIRCUIT BREAKER IS SQUARE D TYPE KHL38XXX. BREAKER INCLUDES 2(A/B) AUXILIARY CONTACTS, AND A 48VDC UNDERVOLTAGE RELEASE.
3. KNOCKOUTS PROVIDED FOR FIELD WIRING CONNECTIONS.
4. FINISH IS GRAY BAKED ENAMEL.
5. FOR APPLICATIONS WHERE A TWO POLE CONFIGURATION IS REQUIRED THE CUSTOMER MUST ADD A CABLE JUMPER OF EQUAL AMPACITY TO THE BATTERY CIRCUIT CONDUCTORS AS SHOWN ON THIS DRAWING.
6. CENTER POLE USED TO BREAK MIDPOINT OF BATTERY STRING.
7. CABLE CONNECTION LUG SIZE IS (1) 6 AWG-350KCMIL CU (16-185mm<sup>2</sup>).
8. APPROXIMATE WEIGHT IS 150 LBS (68 kg).
9. CIRCUIT BREAKER INSTANTANEOUS TRIP SETTING SHOULD BE SET AT THE MINIMUM OF THE ADJUSTMENT RANGE.
10. GROUND LUGS ARE PROVIDED FOR (2) #10-20 AWG CU (6-70mm<sup>2</sup>) CONDUCTORS.

SYMBOL	CONDUIT SIZE		DIAMETER	
	IN	mm	IN	mm
A	.50	13	.88	22
B	.75	19	1.13	29
C	1.00	25	1.38	35
D	1.25	32	1.75	45
E	1.50	38	2.00	51
F	2.00	51	2.50	64
G	2.50	54	3.00	76
H	3.00	76	3.63	92



88-797606-17  
Rev. 05

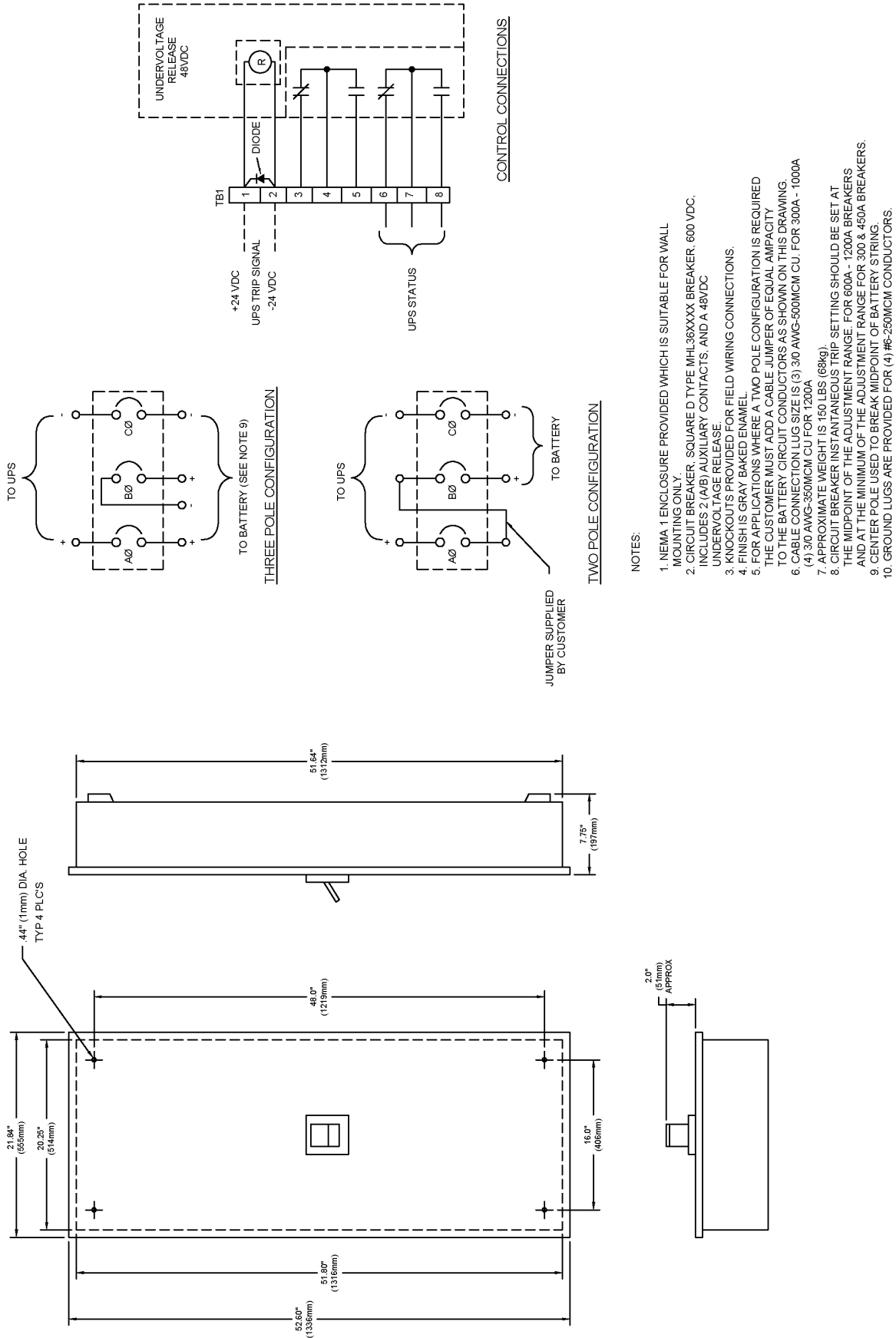
Figure 41 Outline drawing, dual-breaker module battery disconnect, 175-250A, 600VDC circuit breaker



- NOTES:
1. NEMA 12 ENCLOSURE PROVIDED WHICH IS SUITABLE FOR WALL MOUNTING ONLY.
  2. CIRCUIT BREAKER, SQUARE D TYPE MHL36XXXX BREAKER, 600 VDC, INCLUDES 2 (A/B) AUXILIARY CONTACTS, AND A 48VDC UNDERVOLTAGE RELEASE.
  3. FINISH IS GRAY BAKED ENAMEL.
  4. CABLE CONNECTION LUG SIZE IS (3) 3/0 AWG-500MCM CU. FOR 300 & 450A.
  5. APPROXIMATE WEIGHT IS 200 LBS (91kg).
  6. CIRCUIT BREAKER INSTANTANEOUS TRIP SETTING SHOULD BE SET AT THE MIDPOINT OF THE ADJUSTMENT RANGE FOR 300 & 450A BREAKERS.

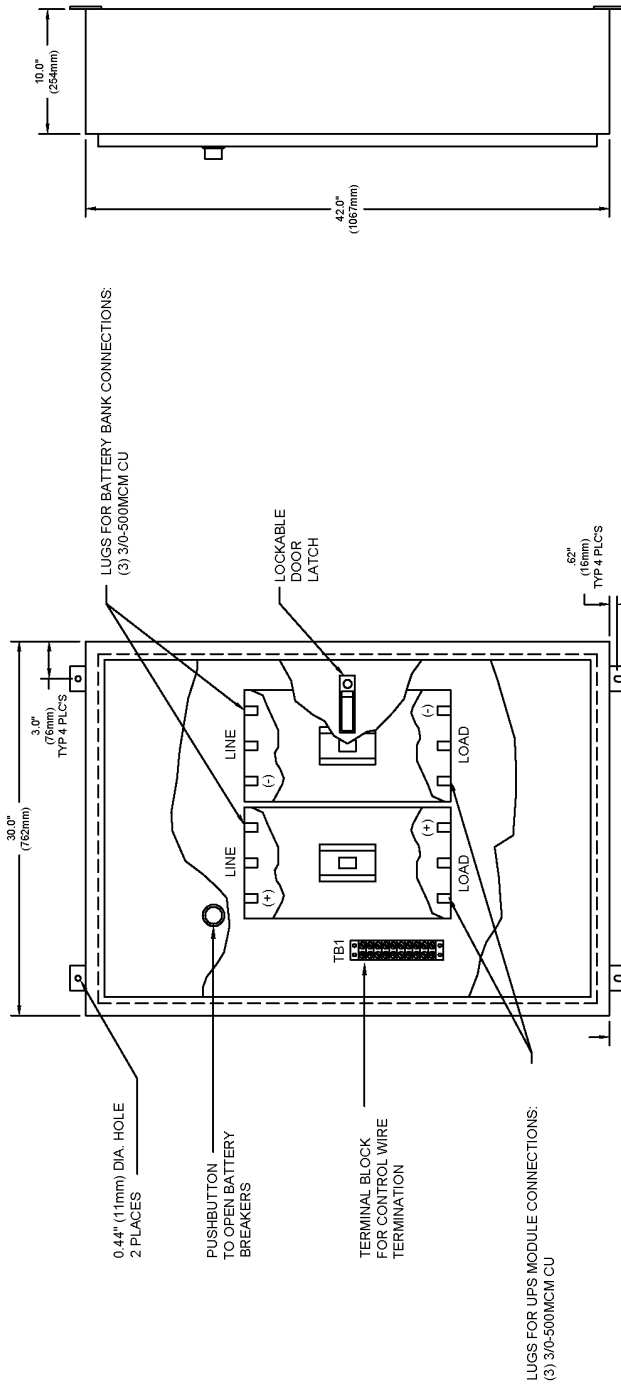
88-797616-17  
Rev. 03

Figure 42 Outline drawing, single-breaker module battery disconnect, 300, 450, 600, 800, 1000, 1200A



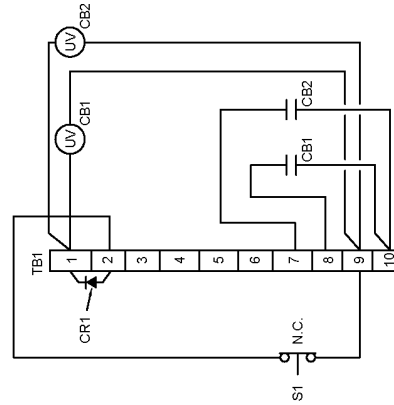
88-797616-09  
Rev. 08

Figure 43 Outline drawing, dual-breaker module battery disconnect, 300 & 450A

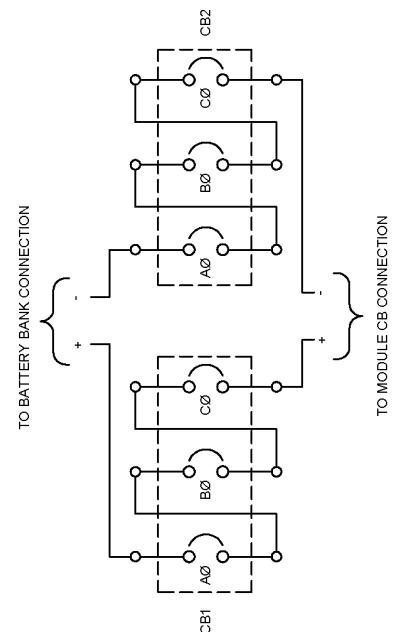


NOTES:

1. NEMA 12 ENCLOSURE PROVIDED WHICH IS SUITABLE FOR WALL MOUNTING ONLY.
2. CIRCUIT BREAKER, SQUARE D TYPE MHL36XXXX BREAKER, 600 VDC, INCLUDES 2 (A/B) AUXILIARY CONTACTS, AND A 48VDC UNDERVOLTAGE RELEASE.
3. FINISH IS GRAY BAKED ENAMEL.
4. CABLE CONNECTION LUG SIZE IS (3) 3/0 AWG-500MCM CU. FOR 300 & 450A.
5. APPROXIMATE WEIGHT IS 200 LBS (91kg).
6. CIRCUIT BREAKER INSTANTANEOUS TRIP SETTING SHOULD BE SET AT THE MIDPOINT OF THE ADJUSTMENT RANGE FOR 300 & 450A BREAKERS.



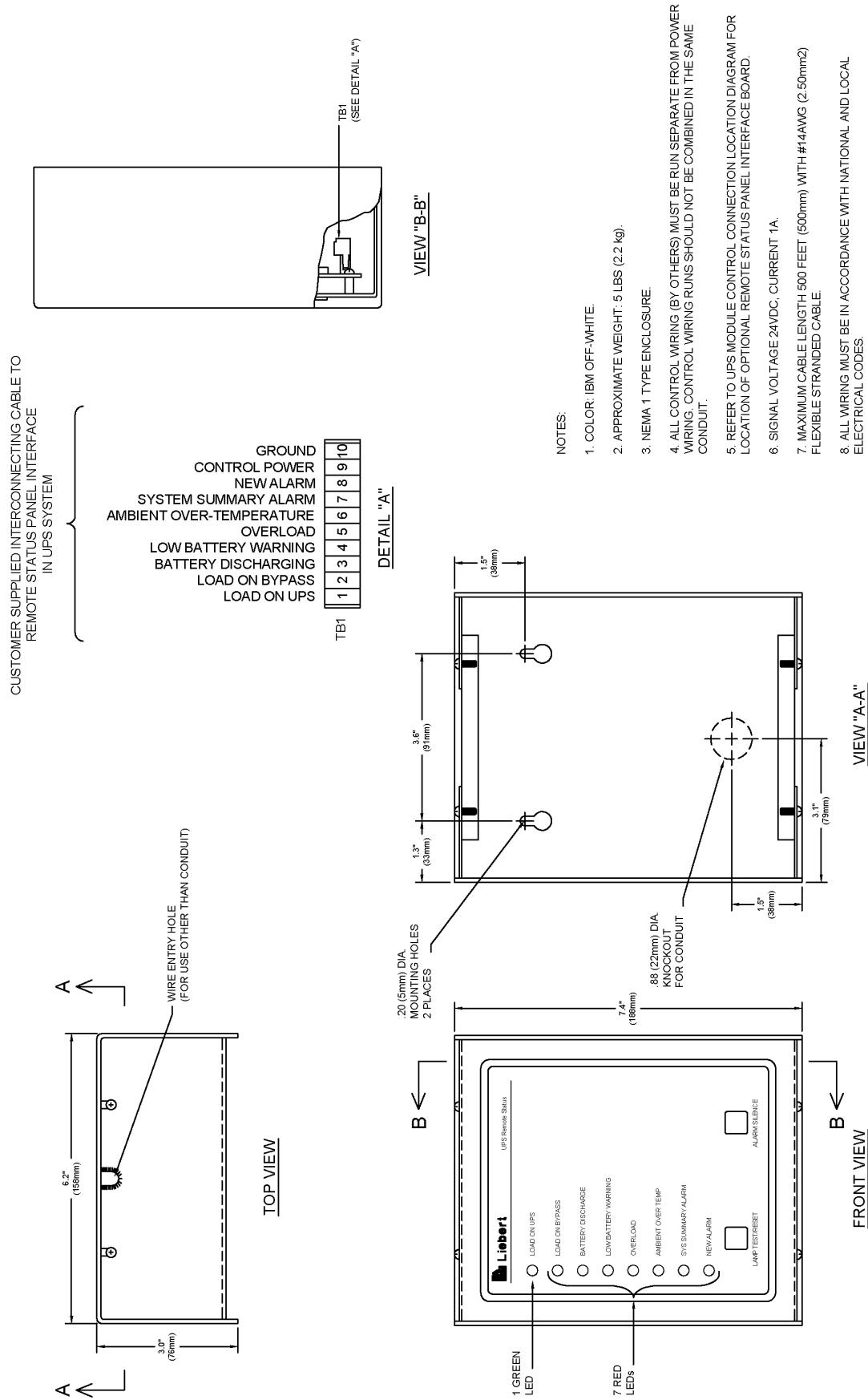
CONTROL TERMINALS



ONE-LINE  
STANDARD CONNECTIONS

88-797616-08  
Rev. 05

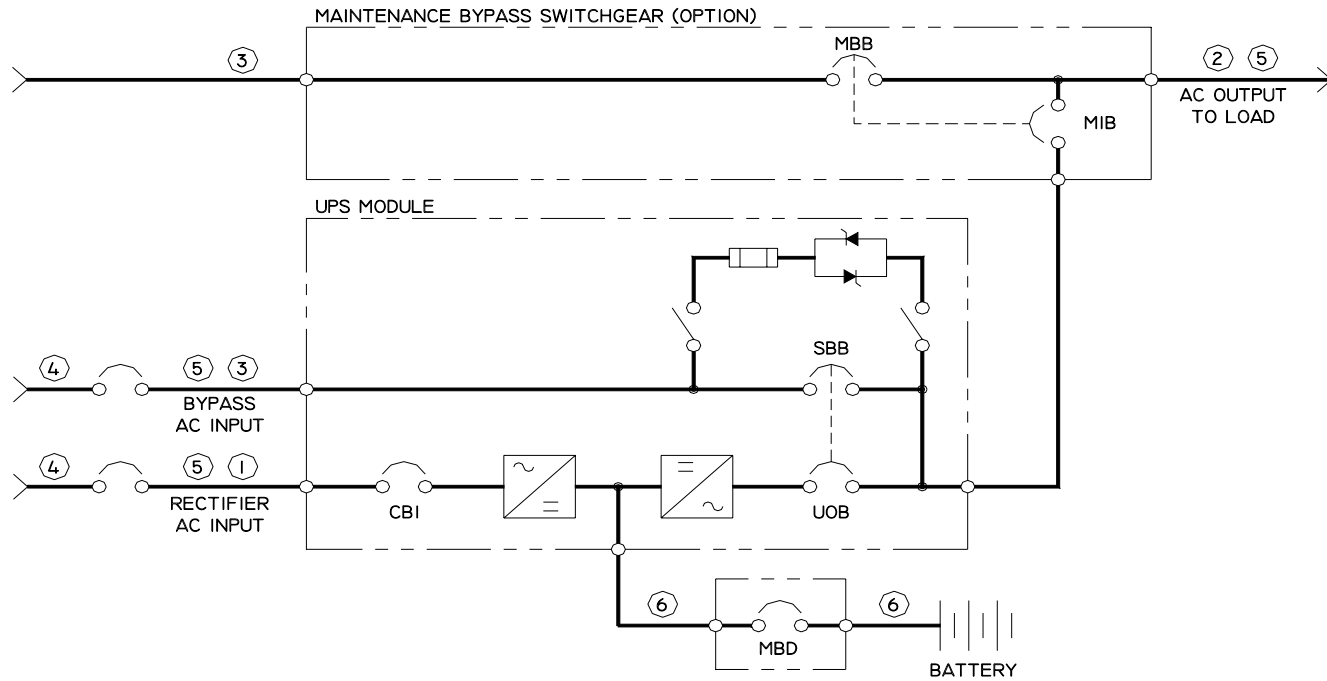
Figure 44 Outline drawing, remote status panel, surface mount



88-791617-01  
Rev. 05



## APPENDIX A - SITE PLANNING DATA, SERIES 610, 100-225kVA, SINGLE-MODULE SYSTEMS



### Notes for Tables 6 - 8

- Nominal rectifier AC input current (considered continuous) is based on full rated output load. Maximum current includes nominal input current and maximum battery recharge current (considered noncontinuous). Continuous and noncontinuous current limits are defined in NEC 100. Maximum input current is controlled by current limit setting which is adjustable. Values shown for maximum setting are 125% of nominal input current. Standard factory setting is 115%.
- Nominal AC output current (considered continuous) is based on full rated output load. Maximum current includes nominal output current and overload current for 10 minutes.
- Bypass AC input current (considered continuous) is based on full rated output load.
- Feeder protection (by others in external equipment) for rectifier AC input and bypass AC input is recommended to be provided by separate overcurrent protection devices.
- UPS output load cables must be run in separate conduit from input cables.
- Power cable from module DC bus to battery should be sized for a total maximum 2.0 volt line drop (power cable drop plus return cable drop as measured at the module) at maximum discharge current.
- Grounding conductors to be sized per NEC 250-122. Neutral conductors to be sized for full capacity—per NEC 310-15 (b)(4)—for systems with 4-wire loads and half capacity for systems with 3-wire loads.
- Rectifier AC Input: 3-phase, 3-wire, plus ground  
AC Output to Load: 3-phase, 3- or 4-wire, plus ground  
Bypass AC Input: 3-phase, 3- or 4-wire, plus ground  
Module DC Input from Battery: 2-wire (positive and negative), plus ground
- All wiring is to be in accordance with National and Local Electrical Codes.
- Minimum overhead clearance is 2 ft. (0.6m) above the UPS.
- Top and bottom cable entry through removable access plates on standard size cabinets only. Top cable entry only on SpaceSaver cabinets, which are 8" (20cm) narrower than standard size cabinets. SpaceSaver cabinets are available on all 100-125kVA units and on 150-225kVA units that have either 600 or 480VAC output. Cut access plates to suit conduit size.
- Control wiring and power cables must be run in separate conduits. Control wiring must be stranded tinned conductors.
- 7% maximum reflected input harmonic current and 0.92 lagging input power factor at full load with optional input filter.

Table 6 Site planning data—600V input

UPS Rating		AC Output Voltage	Options		Rectifier AC Input Current		Inverter or Bypass AC Output Current		Required Battery Disconnect Rating (A)	Max. Battery Current at End of Discharge (A)	Max. Heat Dissipation Full Load BTU/h (kW)	Dimensions WxDxH: in. (mm)	Approx. Weight Unpacked lb. (kg)		Floor Loading Concentrated Loading lb./ft. <sup>2</sup> (kg/m <sup>2</sup> )	
kVA	kW	VAC	Input Filter	Input Xformer	Nom	Max	Nom	Max				Standard Model/SpaceSaver	Standard Model	Space-Saver	Standard Model	Space-Saver
100	80	600	No	No	97	122	96	120	250	217	20,550 (6.0)	<b>Standard:</b> 56x33x78 (1422x838x1981) <b>SpaceSaver:</b> 48x33x78 (1219x838x1981)	2650 (1202)	2450 (1111)	206 (1008)	223 (1087)
100	80	600	Yes	No	90	113	96	120	250	217	21,500 (6.3)		2720 (1234)	2520 (1143)	212 (1035)	229 (1119)
100	80	600	No	Yes	99	124	96	120	250	217	25,350 (7.4)		3275 (1486)	3075 (1395)	255 (1246)	280 (1365)
100	80	600	Yes	Yes	92	115	96	120	250	217	26,350 (7.7)		3345 (1517)	3145 (1427)	261 (1273)	286 (1396)
100	80	208	No	No	98	122	278	347	250	218	22,150 (6.5)		2950 (1338)	2750 (1247)	230 (1122)	250 (1221)
100	80	208	Yes	No	91	113	278	347	250	218	23,100 (6.8)		3020 (1370)	2820 (1279)	235 (1149)	256 (1252)
100	80	208	No	Yes	100	124	278	347	250	218	27,000 (7.9)		3575 (1622)	3375 (1531)	279 (1360)	307 (1498)
100	80	208	Yes	Yes	92	115	278	347	250	218	28,000 (8.2)		3645 (1653)	3445 (1563)	284 (1387)	313 (1529)
125	100	600	No	No	122	152	120	150	250	271	25,700 (7.5)	<b>Standard:</b> 56x33x78 (1422x838x1981) <b>SpaceSaver:</b> 48x33x78 (1219x838x1981)	2800 (1270)	2600 (1179)	218 (1065)	236 (1154)
125	100	600	Yes	No	113	141	120	150	250	271	26,900 (7.9)		2870 (1302)	2670 (1211)	224 (1092)	243 (1185)
125	100	600	No	Yes	124	155	120	150	250	271	31,700 (9.3)		3400 (1542)	3200 (1451)	265 (1294)	291 (1420)
125	100	600	Yes	Yes	115	143	120	150	250	271	32,950 (9.6)		3470 (1574)	3270 (1483)	270 (1320)	297 (1451)
125	100	208	No	No	122	153	347	434	250	273	27,650 (8.1)		3100 (1406)	2900 (1315)	242 (1179)	264 (1287)
125	100	208	Yes	No	113	142	347	434	250	271	28,850 (8.4)		3170 (1438)	2970 (1347)	247 (1206)	270 (1318)
125	100	208	No	Yes	124	156	347	434	250	271	33,750 (9.9)		3700 (1678)	3500 (1588)	288 (1408)	318 (1553)
125	100	208	Yes	Yes	115	144	347	434	250	271	35,000 (10.2)		3770 (1710)	3570 (1619)	294 (1434)	325 (1585)
150	120	600	No	No	145	182	144	180	300	324	28,450 (8.3)	<b>Standard:</b> 56x33x78 (1422x838x1981) <b>SpaceSaver:</b> 48x33x78 (1219x838x1981)	3120 (1415)	2920 (1324)	243 (1187)	265 (1296)
150	120	600	Yes	No	135	168	144	180	300	324	29,900 (8.8)		3250 (1474)	3050 (1383)	253 (1236)	277 (1354)
150	120	600	No	Yes	148	185	144	180	300	324	35,600 (10.4)		3770 (1710)	3570 (1619)	294 (1434)	325 (1585)
150	120	600	Yes	Yes	137	171	144	180	300	324	37,050 (10.8)		3900 (1769)	3700 (1678)	304 (1484)	336 (1642)
150	120	208	No	No	146	183	416	520	300	326	30,850 (9.0)	<b>Standard:</b> 56x33x78 (1422x838x1981)	3270 (1483)	—	255 (1244)	—
150	120	208	Yes	No	135	169	416	520	300	326	32,250 (9.4)		3400 (1542)	—	265 (1294)	—
150	120	208	No	Yes	148	186	416	520	300	326	38,050 (11.1)		3920 (1778)	—	305 (1491)	—
150	120	208	Yes	Yes	138	172	416	520	300	326	39,500 (11.6)		4050 (1837)	—	316 (1541)	—
225	180	600	No	No	218	272	217	271	450	486	42,700 (12.5)	<b>Standard:</b> 56x33x78 (1422x838x1981) <b>SpaceSaver:</b> 48x33x78 (1219x838x1981)	3460 (1569)	3260 (1479)	270 (1316)	296 (1447)
225	180	600	Yes	No	202	253	217	271	450	486	44,800 (13.1)		3590 (1628)	3390 (1538)	280 (1366)	308 (1505)
225	180	600	No	Yes	221	277	217	271	450	486	53,400 (15.6)		4410 (2000)	4210 (1910)	344 (1678)	383 (1869)
225	180	600	Yes	Yes	205	257	217	271	450	486	55,600 (16.3)		4540 (2059)	4340 (1969)	354 (1727)	395 (1926)
225	180	208	No	No	219	274	625	781	450	488	46,250 (13.5)	<b>Standard:</b> 56x33x78 (1422x838x1981)	3660 (1660)	—	285 (1392)	—
225	180	208	Yes	No	203	254	625	781	450	488	48,400 (14.2)		3790 (1719)	—	295 (1442)	—
225	180	208	No	Yes	223	278	625	781	450	488	57,050 (16.7)		4610 (2091)	—	359 (1754)	—
225	180	208	Yes	Yes	206	258	625	781	450	488	59,300 (17.4)		4740 (2150)	—	369 (1803)	—
<b>See Notes (p. 65):</b>			13	—	1,4,5,7,8,9,12		2,3,5,7,8,9,12		6	6,8,9,12		—	—	—	—	—



**Table 7 Site planning data—480V input**

UPS Rating		AC Output Voltage	Options		Rectifier AC Input Current		Inverter or Bypass AC Output Current		Required Battery Disconnect Rating (A)	Max. Battery Current at End of Discharge (A)	Max. Heat Dissipation Full Load BTU/h (kW/h)	Dimensions WxDxH: in. (mm)	Approx. Weight Unpacked lb. (kg)		Floor Loading Concentrated Loading lb./ft. <sup>2</sup> (kg/m <sup>2</sup> )	
kVA	kW	VAC	Input Filter	Input Xformer	Nom	Max	Nom	Max				Standard Model/ SpaceSaver	Standard Model	Space-Saver	Standard Model	Space-Saver
100	80	480	No	No	121	151	120	150	250	217	19,000 (5.6)	<b>Standard:</b> 56x33x78 (1422x838x1981) <b>SpaceSaver:</b> 48x33x78 (1219x838x1981)	2500 (1134)	2300 (1043)	195 (951)	209 (1021)
100	80	480	Yes	No	112	140	120	150	250	217	19,900 (5.8)		2570 (1166)	2370 (1075)	200 (978)	215 (1052)
100	80	480	No	Yes	123	154	120	150	250	217	23,750 (7.0)		3275 (1486)	3075 (1395)	255 (1246)	280 (1365)
100	80	480	Yes	Yes	114	143	120	150	250	217	24,700 (7.2)		3345 (1517)	3145 (1427)	261 (1273)	286 (1396)
100	80	208	No	No	122	152	278	347	250	218	20,550 (6.0)		2800 (1270)	2600 (1179)	218 (1065)	236 (1154)
100	80	208	Yes	No	113	141	278	347	250	218	21,500 (6.3)		2870 (1302)	2670 (1211)	224 (1092)	243 (1185)
100	80	208	No	Yes	124	155	278	347	250	218	25,350 (7.4)		3575 (1622)	3375 (1531)	279 (1360)	307 (1498)
100	80	208	Yes	Yes	115	143	278	347	250	218	26,350 (7.7)		3645 (1653)	3445 (1563)	284 (1387)	313 (1529)
125	100	480	No	No	151	189	150	188	250	271	23,750 (7.0)	<b>Standard:</b> 56x33x78 (1422x838x1981) <b>SpaceSaver:</b> 48x33x78 (1219x838x1981)	2600 (1179)	2400 (1089)	203 (989)	218 (1065)
125	100	480	Yes	No	140	175	150	188	250	271	24,900 (7.3)		2670 (1211)	2470 (1120)	208 (1016)	225 (1096)
125	100	480	No	Yes	154	192	150	188	250	271	29,700 (8.7)		3400 (1542)	3200 (1451)	265 (1294)	291 (1420)
125	100	480	Yes	Yes	143	178	150	188	250	271	30,900 (9.0)		3470 (1574)	3270 (1483)	270 (1320)	297 (1451)
125	100	208	No	No	152	190	347	434	250	273	25,700 (7.5)		2900 (1315)	2700 (1225)	226 (1103)	245 (1198)
125	100	208	Yes	No	141	176	347	434	250	273	26,900 (7.9)		2970 (1347)	2770 (1256)	231 (1130)	252 (1229)
125	100	208	No	Yes	155	193	347	434	250	273	31,700 (9.3)		3700 (1678)	3500 (1588)	288 (1408)	318 (1553)
125	100	208	Yes	Yes	143	179	347	434	250	273	32,950 (9.6)		3770 (1710)	3570 (1619)	294 (1434)	325 (1585)
150	120	480	No	No	181	226	180	226	300	324	26,150 (7.7)	<b>Standard:</b> 56x33x78 (1422x838x1981) <b>SpaceSaver:</b> 48x33x78 (1219x838x1981)	2850 (1293)	2650 (1202)	222 (1084)	241 (1176)
150	120	480	Yes	No	167	209	180	226	300	324	27,550 (8.1)		2980 (1352)	2780 (1261)	232 (1134)	253 (1234)
150	120	480	No	Yes	184	229	180	226	300	324	33,200 (9.7)		3750 (1701)	3550 (1610)	292 (1427)	323 (1576)
150	120	480	Yes	Yes	170	213	180	226	300	324	34,650 (10.1)		3880 (1760)	3680 (1669)	302 (1476)	335 (1633)
150	120	208	No	No	182	227	416	520	300	326	28,450 (8.3)	<b>Standard:</b> 56x33x78 (1422x838x1981)	3050 (1383)	—	238 (1160)	—
150	120	208	Yes	No	168	210	416	520	300	326	29,900 (8.8)		3180 (1442)	—	248 (1210)	—
150	120	208	No	Yes	185	231	416	520	300	326	35,600 (10.4)		3950 (1792)	—	308 (1503)	—
150	120	208	Yes	Yes	171	214	416	520	300	326	37,050 (10.8)		4080 (1851)	—	318 (1552)	—
225	180	480	No	No	271	339	271	338	450	486	39,200 (11.5)	<b>Standard:</b> 56x33x78 (1422x838x1981) <b>SpaceSaver:</b> 48x33x78 (1219x838x1981)	3190 (1447)	2990 (1356)	249 (1214)	272 (1327)
225	180	480	Yes	No	251	314	271	338	450	486	41,300 (12.1)		3320 (1506)	3120 (1415)	259 (1263)	284 (1385)
225	180	480	No	Yes	275	344	271	338	450	486	49,800 (14.6)		4390 (1991)	4190 (1901)	342 (1670)	381 (1860)
225	180	480	Yes	Yes	255	319	271	338	450	486	51,950 (15.2)		4520 (2050)	4320 (1960)	352 (1720)	393 (1917)
225	180	208	No	No	272	341	625	781	450	488	42,700 (12.5)	<b>Standard:</b> 56x33x78 (1422x838x1981)	3475 (1576)	—	271 (1322)	—
225	180	208	Yes	No	253	316	625	781	450	488	44,800 (13.1)		3605 (1635)	—	281 (1372)	—
225	180	208	No	Yes	277	346	625	781	450	488	53,400 (15.6)		4675 (2121)	—	364 (1779)	—
225	180	208	Yes	Yes	257	321	625	781	450	488	55,600 (16.3)		4805 (2180)	—	374 (1828)	—
<b>See Notes (p. 65):</b>			13	—	1,4,5,7,8,9,12		2,3,5,7,8,9,12		6	6,8,9,12		—	—	—	—	—

Table 8 Site planning data—208V input

UPS Rating		AC Output Voltage	Options		Rectifier AC Input Current		Inverter or Bypass AC Output Current		Required Battery Disconnect Rating (A)	Max. Battery Current at End of Discharge (A)	Max. Heat Dissipation Full Load BTU/h (kWH)	Dimensions WxDxH: in. (mm)	Approx. Weight Unpacked lb. (kg)		Floor Loading Concentrated Loading lb./ft. <sup>2</sup> (kg/m <sup>2</sup> )	
kVA	kW	VAC	Input Filter	Input Xformer	Nom	Max	Nom	Max				Standard Model/SpaceSaver	Standard Model	Space-Saver	Standard Model	Space-Saver
100	80	208	No	No	284	355	278	347	250	218	23,750 (7.0)	<b>Standard:</b> 56x33x78 (1422x838x1981) <b>SpaceSaver:</b> 48x33x78 (1219x838x1981)	3100 (1406)	2900 (1315)	242 (1179)	264 (1287)
100	80	208	Yes	No	263	329	278	347	250	218	24,700 (7.2)		3150 (1429)	2950 (1338)	245 (1198)	268 (1309)
100	80	208	No	Yes	287	359	278	347	250	218	27,000 (7.9)		3470 (1574)	3270 (1483)	270 (1320)	297 (1451)
100	80	208	Yes	Yes	266	333	278	347	250	218	28,000 (8.2)		3520 (1597)	3320 (1506)	274 (1339)	302 (1474)
125	100	208	No	No	355	444	347	434	250	273	29,700 (8.7)	<b>Standard:</b> 56x33x78 (1422x838x1981) <b>SpaceSaver:</b> 48x33x78 (1219x838x1981)	3250 (1474)	3050 (1383)	253 (1236)	277 (1354)
125	100	208	Yes	No	329	449	347	434	250	273	30,900 (9.0)		3300 (1497)	3100 (1406)	257 (1255)	282 (1376)
125	100	208	No	Yes	359	449	347	434	250	273	33,750 (9.9)		3650 (1656)	3450 (1565)	284 (1389)	314 (1531)
125	100	208	Yes	Yes	333	416	347	434	250	273	35,000 (10.2)		3700 (1678)	3500 (1588)	288 (1408)	318 (1553)
150	120	208	No	No	424	530	416	520	300	326	33,200 (9.7)	<b>Standard:</b> 56x33x78 (1422x838x1981)	3320 (1506)	—	259 (1263)	—
150	120	208	Yes	No	393	491	416	520	300	326	34,650 (10.1)		3450 (1565)	—	269 (1313)	—
150	120	208	No	Yes	431	538	416	520	300	326	40,500 (11.9)		4020 (1823)	—	313 (1529)	—
150	120	208	Yes	Yes	399	499	416	520	300	326	42,000 (12.3)		4150 (1882)	—	323 (1579)	—
225	180	208	No	No	635	794	625	781	450	488	49,800 (14.6)	<b>Standard:</b> 56x33x78 (1422x838x1981)	3870 (1755)	—	302 (1472)	—
225	180	208	Yes	No	589	736	625	781	450	488	51,950 (15.2)		4000 (1814)	—	312 (1522)	—
225	180	208	No	Yes	646	807	625	781	450	488	60,750 (17.8)		4510 (2046)	—	351 (1716)	—
225	180	208	Yes	Yes	599	748	625	781	450	488	63,000 (18.4)		4640 (2105)	—	362 (1765)	—
<b>See Notes (p. 65):</b>			13	—	1,4,5,7,8,9,12		2,3,5,7,8,9,12		6	6,8,9,12		—	—	—	—	—



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