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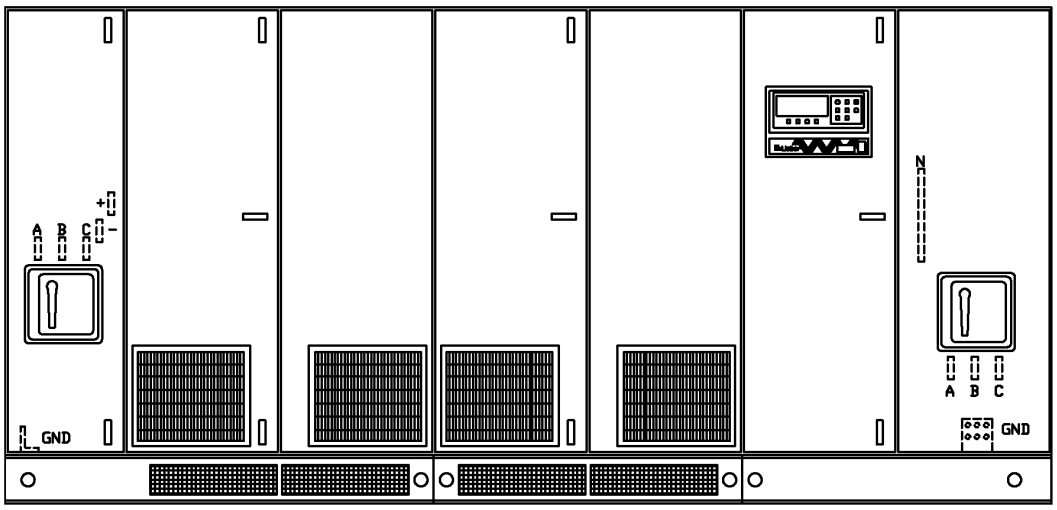
AC Power
For *Business-Critical Continuity™*

Liebert Series 610™ UPS

Installation Manual - 1000kVA, 60Hz, Three Phase Multi-Module



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BATTERY CABINET PRECAUTIONS

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

- **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

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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FIGURES

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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 16,555 to 17,400 lbs. (7509 to 7893kg), including input transformer. The battery cabinets weigh from 3060 to 5300 lbs. (1388 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.

System Control Cabinets (SCCs) have holes intended for rigging bars or chains. Prevent chains or cables from contacting cabinet by using spreader bar and adequate padding.

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 14** 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 modules weigh from 16,555 to 17,400 lbs. (7509 to 7893kg). The battery cabinets weigh from 3060 to 5300 lbs. (1388 to 2404kg). The System Control Cabinets weigh from 1000 to 5850 lbs. (454 to 2653kg). Refer to **Appendix A**. For switchgear weights, refer to your submittal package.

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 cabinets and Transformer Cabinets. **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 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 at least 92-94% 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 SCC bypass input should be high enough to accommodate short-duration overloads. The bypass static switch inside the SCC can draw up to 10 times the system's rated current for up to three cycles.

Figure 1 Multi-Module 500 to 750kVA UPS

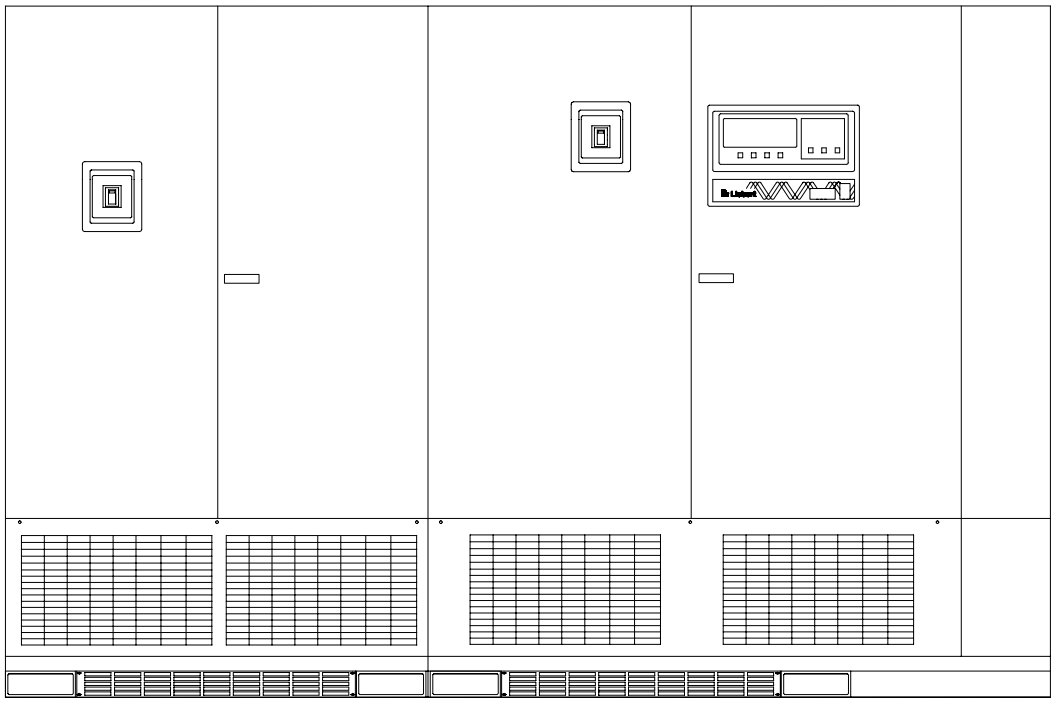
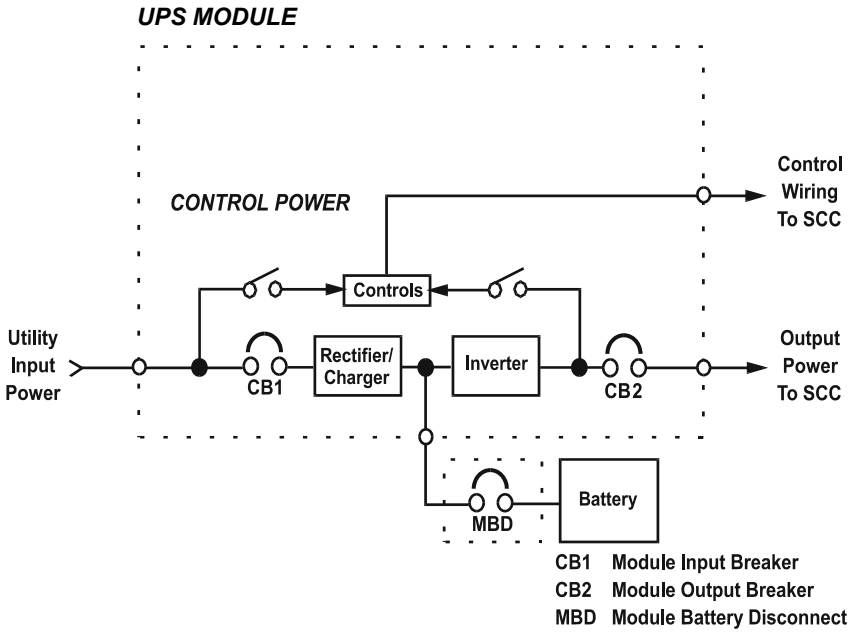


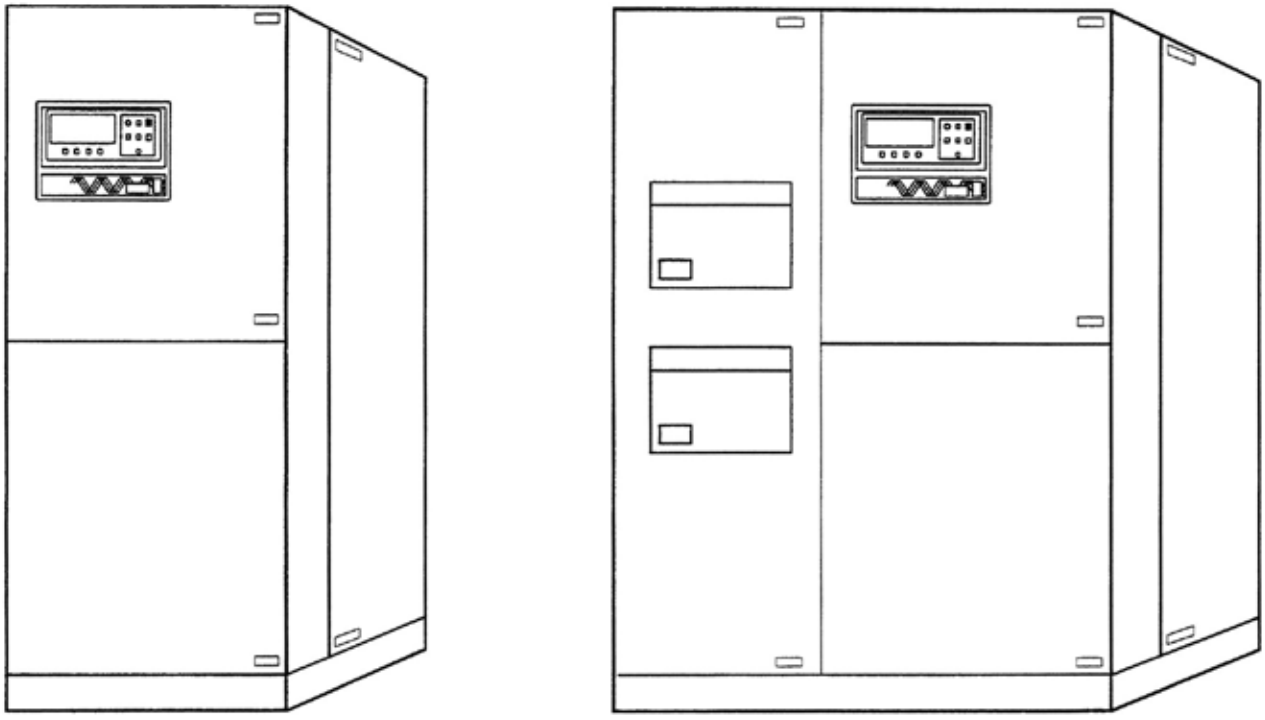
Figure 2 UPS Multi-Module Unit block diagram



1.1 Types of System Control Cabinets

1. **SCCT** is a stand-alone cabinet containing system control logic for up to six UPS modules, static bypass switch, manually operated disconnects for the static bypass switch, and two motor-operated system breakers. The SCCT is painted the same color as the Liebert UPS, but does not match the sheet metal style of the UPS. For SCCT dimensions, refer to **Table 8**.
2. **SCCI** has the system control logic, circuit breakers and static bypass switch integrated into a switchboard cabinet manufactured by others.
3. **SCCC** is an integrated configuration like the SCCI with the static bypass switch rated for continuous duty.

Figure 3 System Control Cabinets



2.0 UNLOADING AND HANDLING

UPS modules are shipped in split cabinets to allow ease of handling. Because the weight distribution in the cabinets is uneven, use extreme care during handling and transport. Your installation may also include battery cabinets and a System Control Cabinet.

NOTE

It is very important that the shipping split sections are matched up to their proper mates, as identified by the shipping split labels.

Integrated SCC/Switchgear will also be shipped in sections, and require proper match up of sections, as identified by labels and drawings.

WARNING

Exercise extreme care when handling UPS cabinets to avoid equipment damage or injury to personnel. The UPS module weight ranges from 16,555 to 17,400 lbs. (7509 to 7893kg). Battery cabinets weigh from 3060 to 5300 lbs. (1388 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 modules and battery cabinets are intended for forklift use. Base slots will support the unit only if the forks are completely beneath the unit.

System Control Cabinets (SCCs)/Switchgear have holes intended for rigging bars or chains (see your submittal package for switchgear drawings). Prevent chains or cables from contacting cabinet by using spreader bar and adequate padding.

To reduce the possibility of shipping damage, cabinets are shored with 2-by-4 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

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. Compare the contents of the shipment with the bill of lading. Report any missing items to the carrier and to Liebert Global Services immediately.
3. Remove equipment from truck using appropriate handling precautions and equipment.
4. Each shipping section will be identified by a label located on the plywood piece that is used to cover the end sections of each shipping split, or on the pallet that the equipment is shipped on. Before removing wood shipping covers, identify the individual pieces and group together the shipping sections of each individual UPS module.
5. Locate cabinet keys. Depending upon equipment type, the keys will either reside in a plastic bag marked “Packing slip enclosed” on a front door of the cabinet, or be taped to a circuit breaker handle protruding through the front of the cabinet.

3.2 Internal Inspections and Shipping Material Removal

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.

8. Remove wood shipping split covers. These covers consist of a 2-by-4 frame covered with plywood. The 2-by-4 frame is attached using lag bolts screwed into the wood from the inside of the cabinet.
9. Check the nameplate/ratings label on the inside of the Module and SCC control section doors to verify that the model numbers correspond with those specified. Record the model numbers and serial numbers in the front of this installation manual. A record of this information is necessary should servicing be required.

4.0 EQUIPMENT LOCATION

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 6
   - **5.0 - Battery Installation**—page 9

   Use a suitable material handling device to move the cabinet to its final location. **Exercise extreme care because of the uneven weight distribution.** Carefully lower the cabinet to the floor.
2. Referring to Shipping Split Detail (**Figure 18**), and any other drawings that are associated with switchgear, set cabinets in final position, preparatory to reconnection of shipping split power and control wiring/bus.
3. Verify that the UPS system is installed in a clean, cool and dry location.
4. 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. SCCT requires front and rear or one-side access for installation and maintenance.
   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 upflow air conditioning systems or any system that blows air down onto the top of the modules.
5. Align the UPS cabinet, battery cabinets (if used) and optional transformer and maintenance bypass cabinets, as shown in the Outline Drawing (**Figure 14**) and your submittal package.
6. Referring to Shipping Split Details (**Figure 18**) and your submittal package for SCC/Switchgear drawings), connect cabinets together mechanically.
7. Referring to Shipping Split Details (**Figure 18**) and your submittal package for SCC/Switchgear drawings), connect intercabinet ground straps, power wiring and bus interconnects. Internal control connections should be left disconnected for later installation by Liebert LGS Customer Engineers.

5.0 BATTERY INSTALLATION

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.

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 electrique. 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 the Battery Cabinet submittal drawings if a battery cabinet is to be used. 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 3060 to 5300 lbs. (1388 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 can be located conveniently next to each 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.
9. **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, if required. No top or bottom entry cables are required, except for remotely located cabinets, which require conduits. Refer to your submittal drawings for instructions on wiring cabinets in parallel**.**

NOTE
The 1000kVA UPS module is approximately 2 to 6 in. (51-152 mm) deeper than the battery cabinet and is not designed to bolt directly to it.

10. **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 modules 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 anything other than a grounded wye system (corner grounded delta or impedance grounded wye), contact your Liebert representative for details about the Isolated Neutral kits for the System Control Cabinet and UPS modules.

WARNING

If the building service feeding the UPS is any configuration other than those mentioned above, contact your Liebert representative or Liebert Global Services immediately.

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.

- What are the UPS input and output voltages? Systems with 480 VAC input and output have significantly different needs from systems with 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 4*** *through* ***10****.*

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

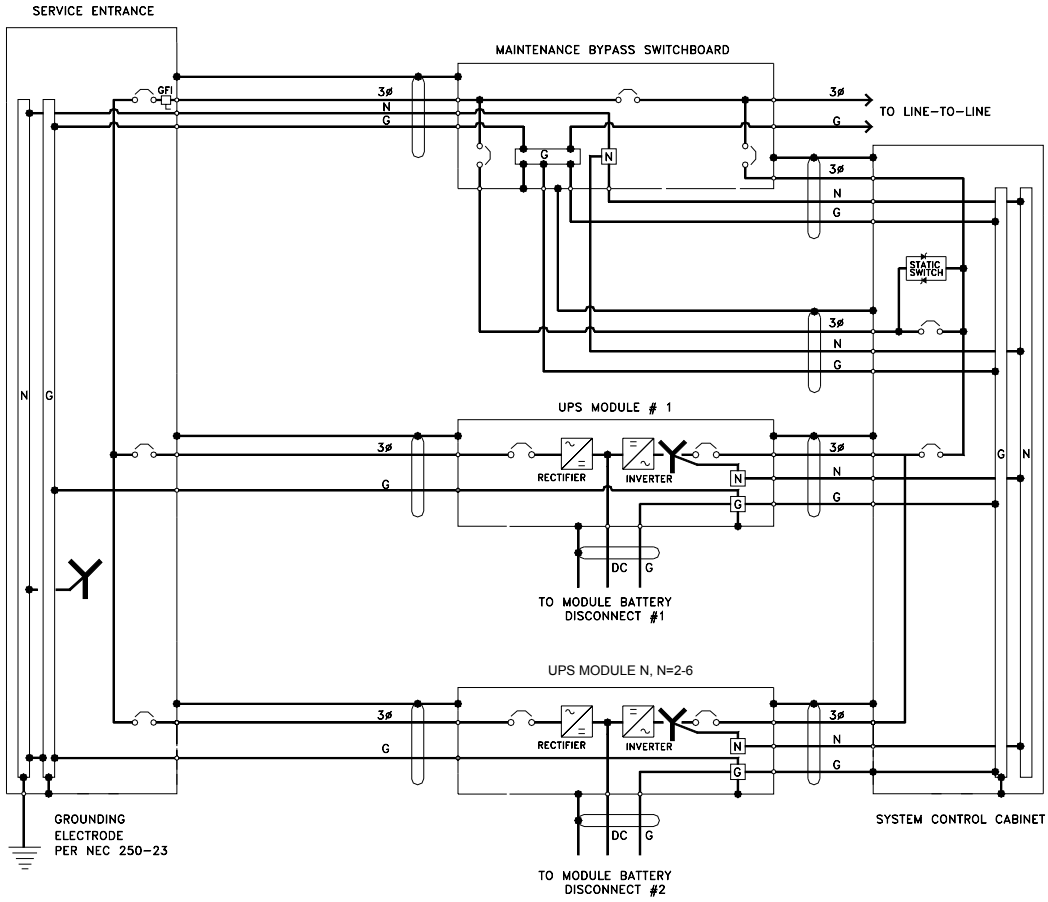
The most common configuration of Series 610 UPS Multi-Module Systems is with 480 VAC input, 480 VAC output and a connected load consisting of multiple Power Distribution Units (PDUs) with isolation transformers in the PDUs to produce 208 VAC. For Canadian customers, the UPS modules usually have 600 VAC input and output. The same principles apply if the connected load is an isolation transformer feeding various loads. **Figure 4** shows a typical installation. The Maintenance Bypass Switchgear is shown separately for clarity, but may be contained within the System Control Cabinet (SCC)/switchgear.

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

All of the UPS module output neutrals are solidly connected to the SCC neutral. A parity-sized neutral is recommended between the UPS module and the SCC for best system performance. The SCC 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. (PDUs are connected to the critical load output of the SCC, but are not shown in **Figure 4** for clarity.)

Figure 4 Preferred grounding configuration, wye-connected service



NOTE

Impedance-grounded wye sources require an Isolated Neutral Kit in addition to the grounding and neutral conductors shown above—see ***6.5 - Grounding Configuration, Corner-Grounded Delta or Impedance-Grounded Wye****.*

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

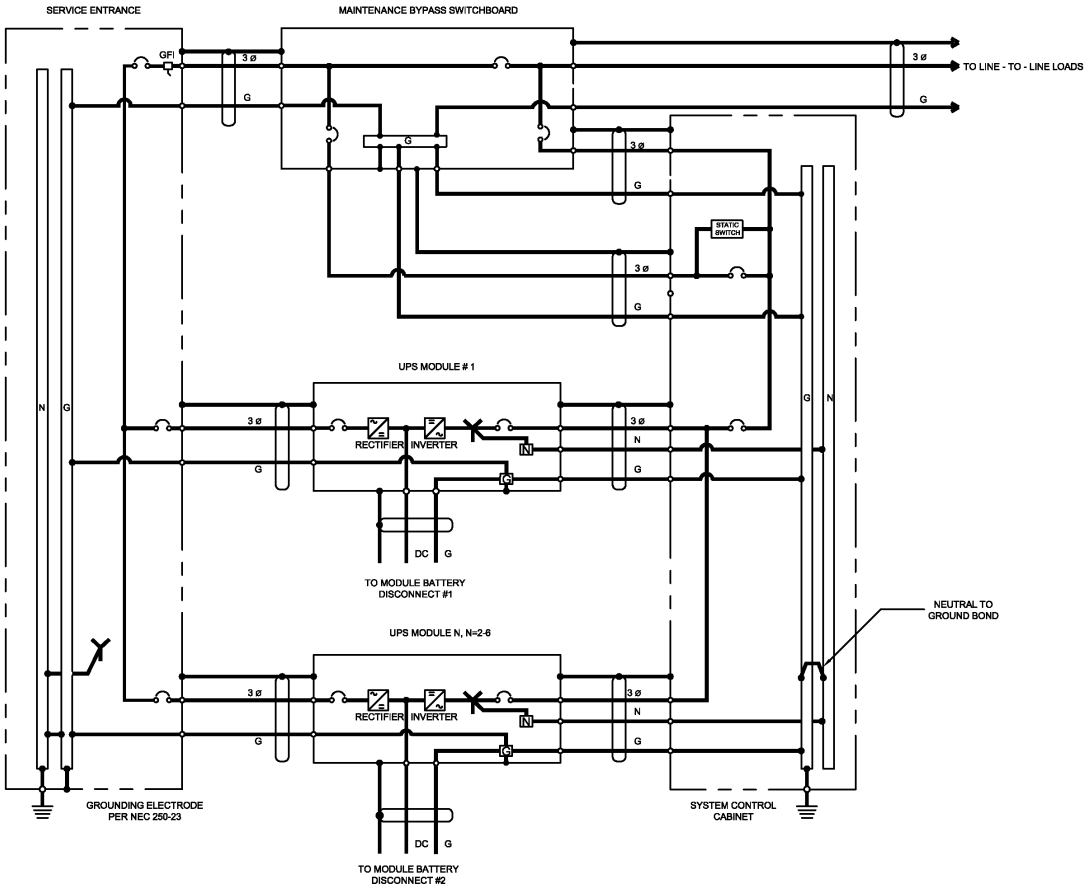
This configuration must NOT be used when single-phase loads are directly connected to the UPS.

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 5 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

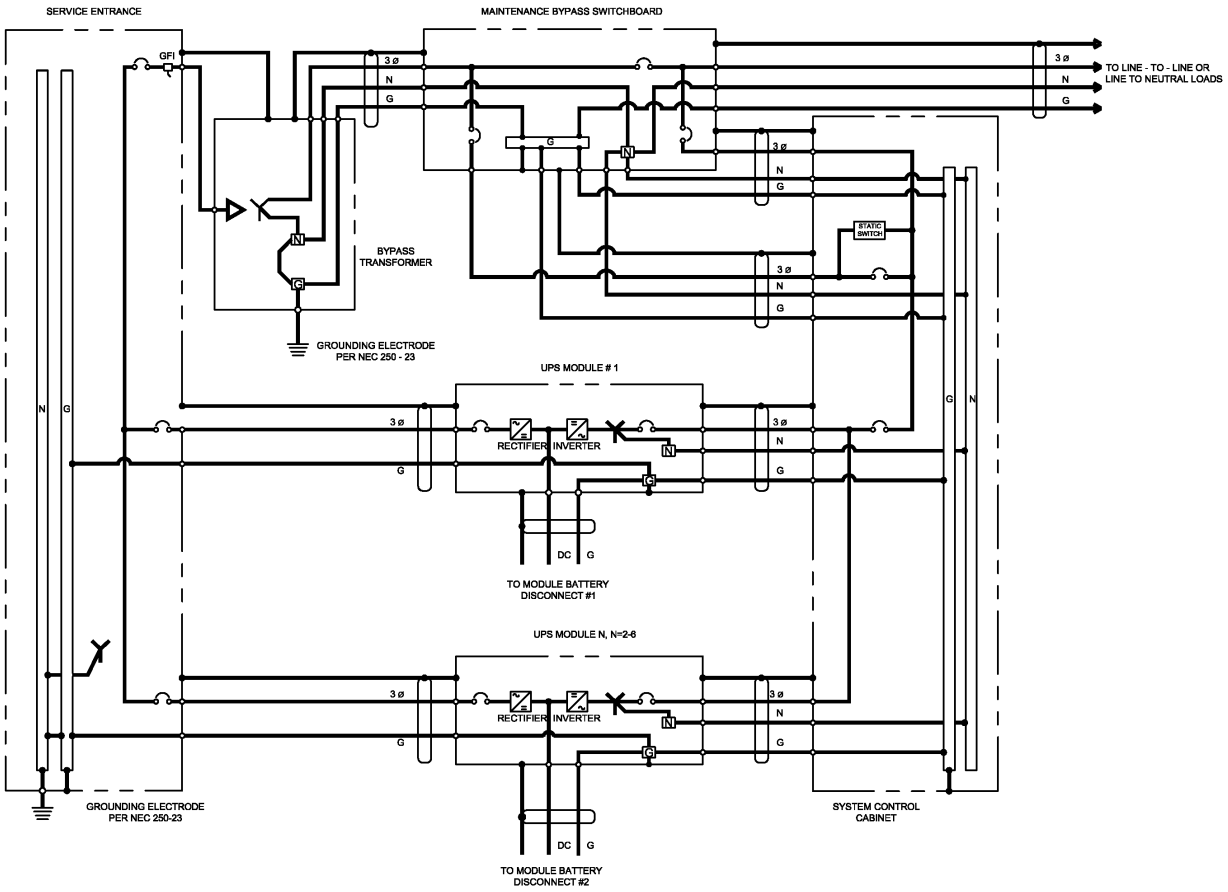
Another configuration in this power range is the Multi-Module System with 480 or 600 VAC input, 208 VAC output, a Bypass Isolation Transformer and a connected load consisting of multiple distribution panelboards or switchboards. **Figure 6** shows a typical installation.

The Bypass Transformer provides isolation and may step down the voltage to the bypass input. The Bypass Transformer and the SCC 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 6 *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 SCC 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 6 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.

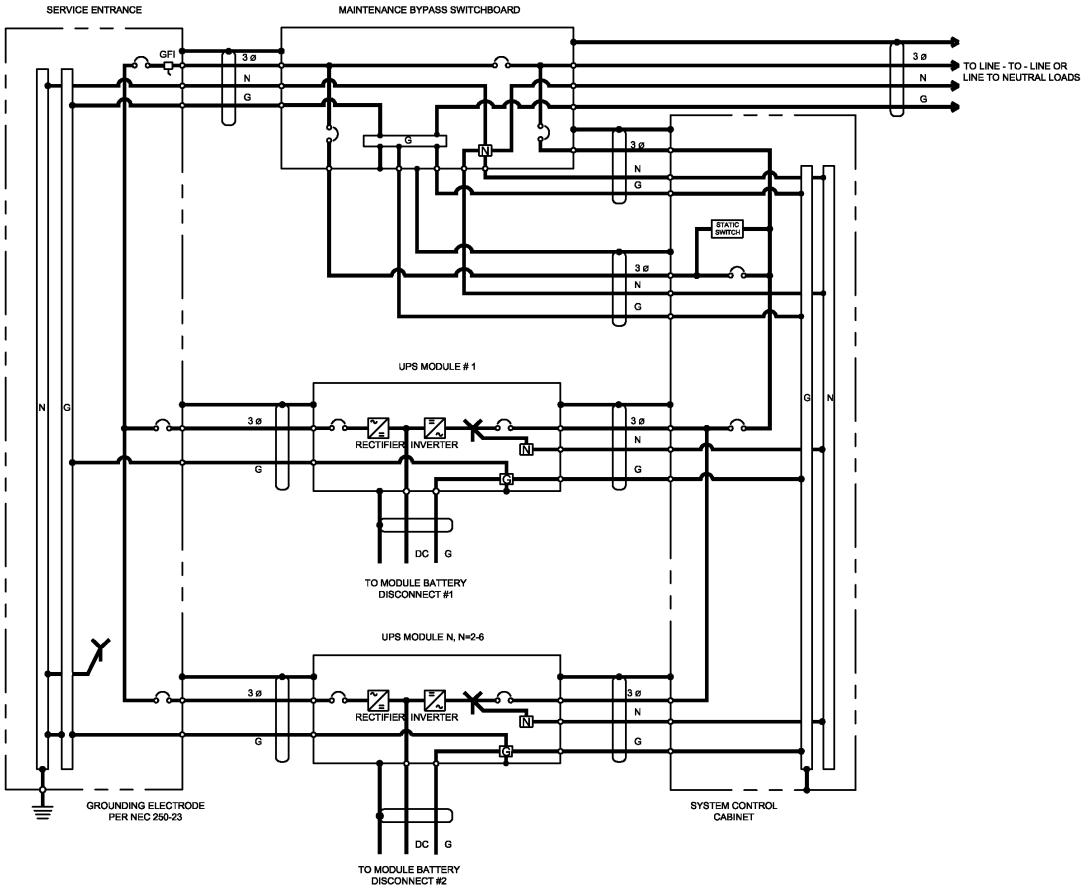
6.4 Alternate Grounding Configuration, Non-Isolated

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 7** that the UPS system main input and bypass input are connected to a grounded-wye service. In this configuration, the UPS system 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 7 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 SCC requires 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 System Control Cabinet (SCC) 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, as do each of the UPS modules. This kit uses control isolation transformers to create a reference point. For this application, the SCC output neutral must **not** be bonded to the SCC ground.

Figure 8 Preferred grounding configuration, corner-grounded delta or impedance-grounded wye

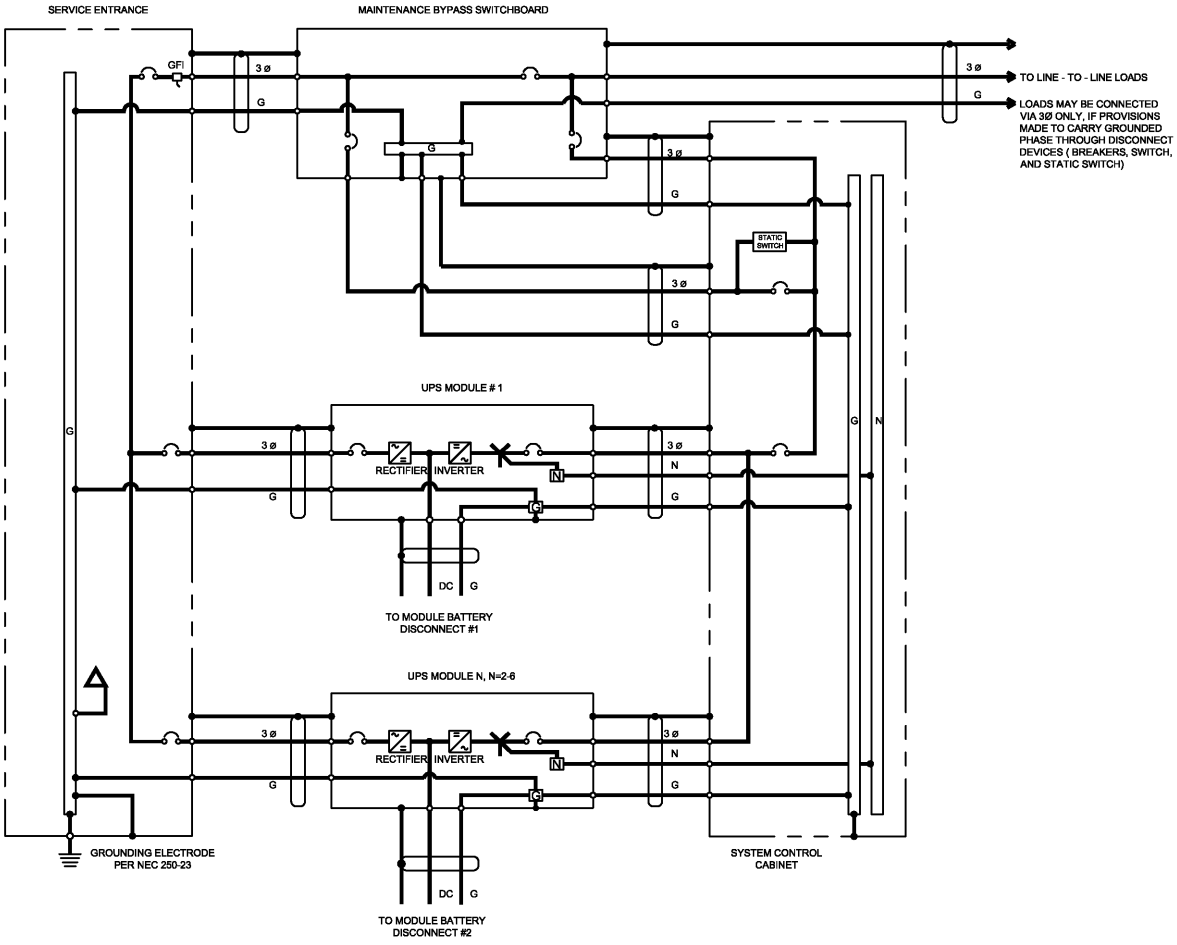
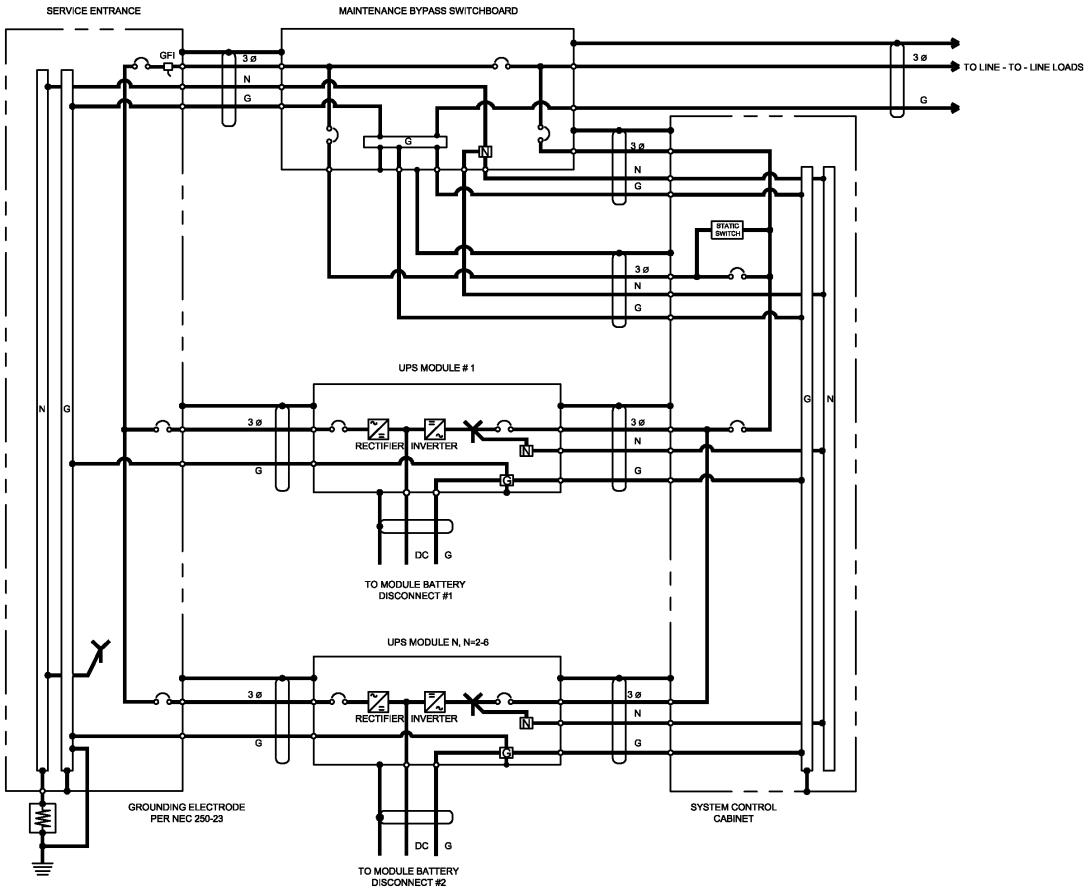


Figure 9 Preferred grounding configuration, impedance-grounded wye



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:

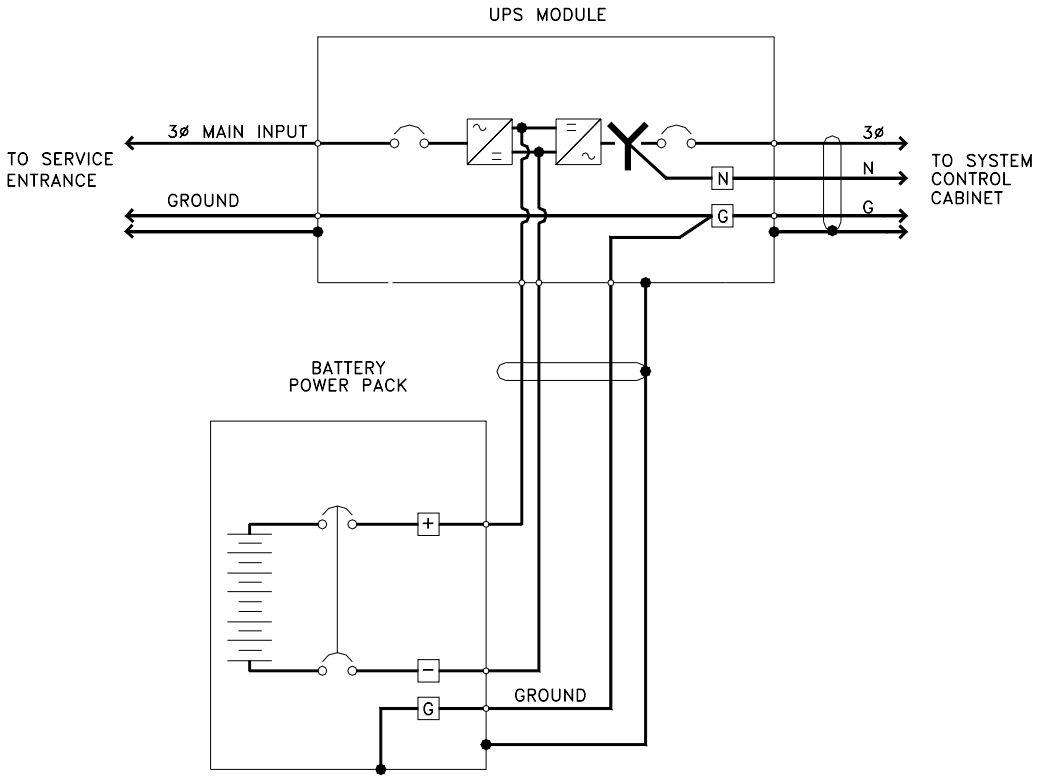
1. Floating (ungrounded),
2. Center-tapped and floating or
3. Center tapped and grounded.

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 10 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 10 Preferred grounding configuration, battery systems



7.0 WIRING CONSIDERATIONS

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**. Consult your facility's breaker coordination study to ensure proper handling of fault currents.

NOTE

The instantaneous trip setting of the bypass feeder breaker should be high enough to accommodate short-duration overloads. The bypass static switch inside the SCC can draw up to 10 times the system's rated current for up to three cycles in the event of a downstream fault.

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 Bussing Details drawings (**Figures 14**, **15**, **19**, **21**, **23**, **25**, **43** and **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.

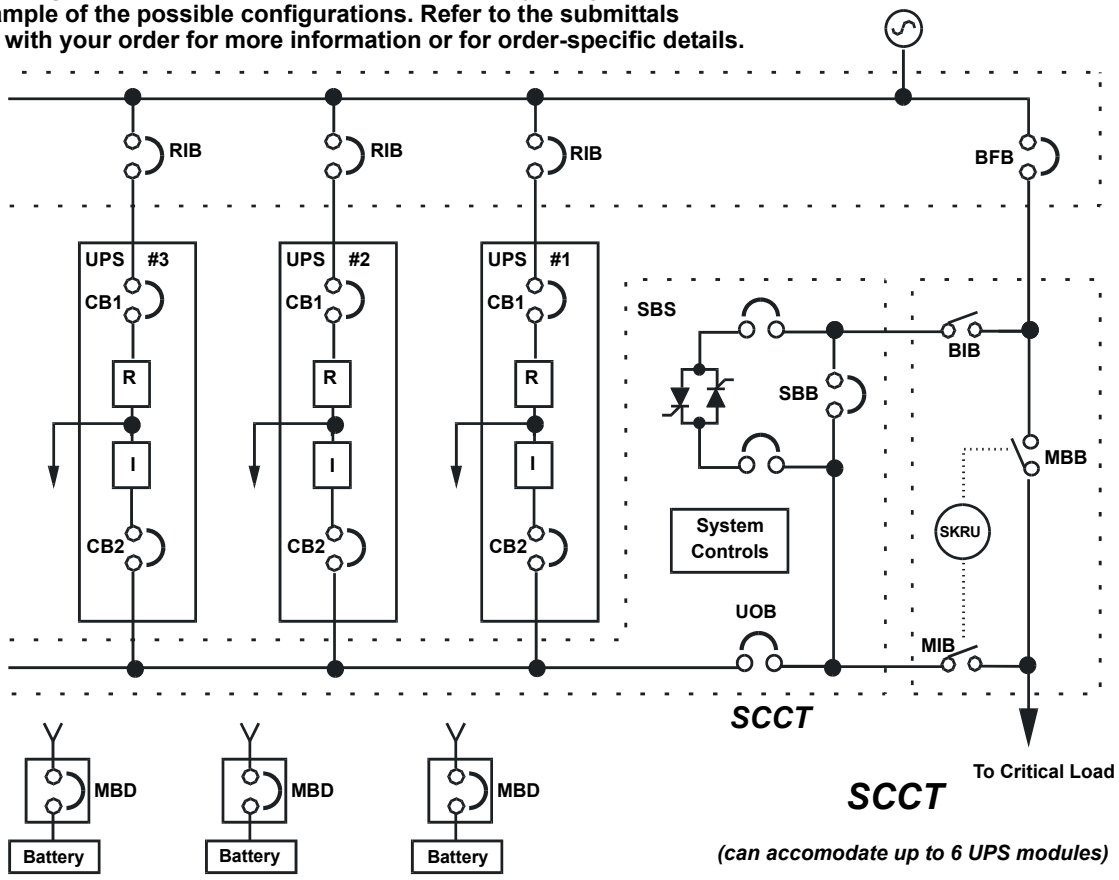
CAUTION
Power and control wiring must be separated!

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 to meet NEC requirements for voltage 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 for your particular model (**Figures 14**, **19**, **21**, **23**, **25**, **43** and **44**).

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.

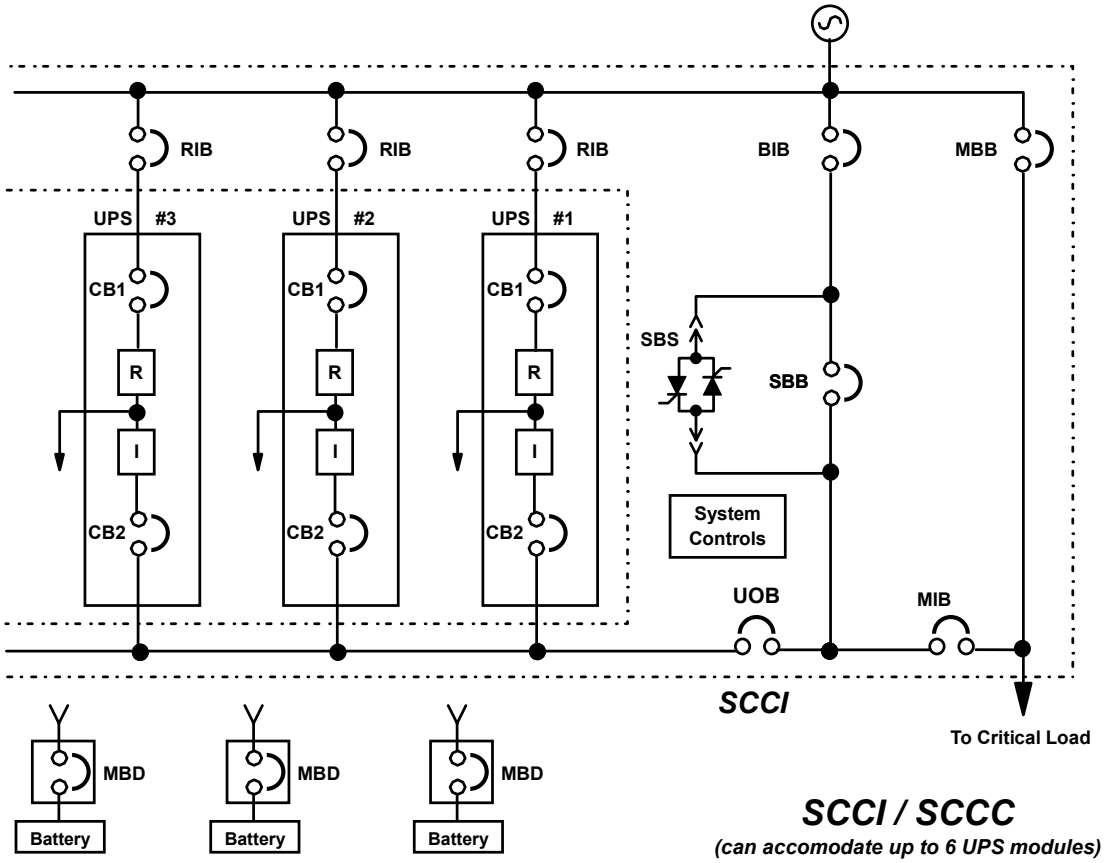
Figure 11 Power single line diagrams, Multi-Module configurations*

*** 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.**



SCCT

(can accomodate up to 6 UPS modules)



SCCI / SCCC

(can accomodate up to 6 UPS modules)

Table 1 Abbreviations for circuit breakers

BFB	Bypass Feeder Breaker
BIB	Bypass Input Breaker
CB1	Module Input Breaker
CB2	Module Output Breaker
MBB	Maintenance Bypass Breaker
MBD	Module Battery Disconnect
MBFB	Maintenance Bypass Feeder Breaker
MIB	Maintenance Isolation Breaker
RIB	Rectifier Input Breaker
SBB	System Bypass Breaker
SSB	Static Bypass Switch
UOB	UPS Output 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.

Refer to the Control Connection Locations and Control Wire Lists, **Figures 27** through **42**. Notice that there are nine cable groups in a typical system:

- Cable group 1 carries signals for the Module Battery Disconnect.
- Cable group 2 is for the remote communications options: modem, remote terminal and remote CRT.
- Cable group 3 carries signals for the Remote Emergency Module Off and Remote Emergency Power Off.
- Cable group 4 carries signals for the optional Remote Monitor Panel.
- Cable group 5 is for the optional SiteScan system.
- Cable group 6 carries signals for the reduced battery charge limit and the reduced input current limit.
- Cable group 7 carries signals to and from the maintenance bypass switchgear.
- Cable groups 20 and 21 carry signals for general housekeeping, modules to SCC.

Other cable groups will be required for other optional equipment. 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.

Figures 27 and **28** show the typical location of control connections inside the UPS and SCC. The position of a particular control connection may be different for your system, 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

The UPS may be supplied with battery cabinets or a rack-mounted battery system.

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. Except for interconnect wiring between multiple battery cabinets, power and control cables are field supplied. Refer to Battery Cabinet submittal drawings.

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 critical part of the UPS system.

8.0 WIRING CONNECTIONS

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.

Make all of the following connections:

1. AC power cables from input power source circuit breaker (RIB) to each UPS Module Input. Observe phase rotation.
2. AC power cables from bypass power source circuit breaker (BIB) to UPS system bypass input at System Control Cabinet (SCC). 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 each UPS module output to SCC or to switchgear for critical load bus. Observe phase rotation.
4. Each UPS module must have its output neutral connected to the SCC for parallel operation. A minimum of a parity-sized neutral wire is recommended on this circuit for optimum system performance, regardless of the load configuration.
5. AC power cables from UPS System Control Cabinet (SCC) Output to critical load or maintenance bypass panelboard or switchgear. Observe phase rotation.

NOTE

If your installation includes a Maintenance Bypass Panelboard or switchgear, some or all power cables will be terminated in that equipment. Make sure all required wiring between the UPS system and this switchgear is completed per the submittal drawings. Observe phase rotation.

6. The UPS System Control Cabinet (SCC) neutral must be connected to one common point and solidly grounded per requirements of the National Electrical Code. The ground connection inside the UPS SCC/switchgear cabinet may be required by the power wiring configuration at your site.

CAUTION

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

7. For battery systems: DC power cables (and ground) from battery to UPS module and between battery cabinets/strings. 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.

8. For remote battery: Install DC power cables (and ground) from battery to Module Battery Disconnect, and then to UPS Module DC bus. Observe polarity.

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.

9. Module Battery Disconnect control wiring to UPS module and between battery cabinets, if applicable. Wiring must be run in individual separate steel conduit.
10. Control wiring from System Control Cabinet (SCC) to UPS modules. Wiring must be run in individual separate steel conduit. Refer to **Figures 30**, **31** and **38** through **42** or your submittal drawings.
11. Control connections between the System Control Cabinet (SCC) and the Maintenance Bypass panelboard or switchgear. Refer to your submittal drawings.
12. 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.
13. Emergency Power Off control wiring (to SCC) must be run in separate steel conduit.
14. Optional communications wiring (to SCC) for terminals, site monitoring or modem must be run in separate steel conduit.
15. Any additional special wiring required at your site. Refer to **Figures 29** through **42** or your submittal drawings.

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
1000/1100kVA	Busbars for connecting hardware (with 3/8" holes on 1.75" centers) are provided for bypass input, critical load output and DC wiring terminations. DC busbars for 1000/1100kVA modules are designed for top or bottom entry and are located adjacent to the input circuit breaker. Rectifier input wiring is top or bottom entry, directly to busbars on top of the input circuit breaker. UPS module output wiring is top or bottom entry, directly to busbars above the circuit breakers (left side of unit). Field-supplied lugs are required for all input and output terminations.

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				
	Grade 2 Standard		Electrical Connections with Belleville Washers	
Bolt Shaft Size	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[1] Lug Style	**Wire Size**	**Bolt Size (in.)**	**Tongue Width (in.)**	**T & B[1] 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) [1]

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 12 One-line diagram, two-module system with two-breaker maintenance bypass

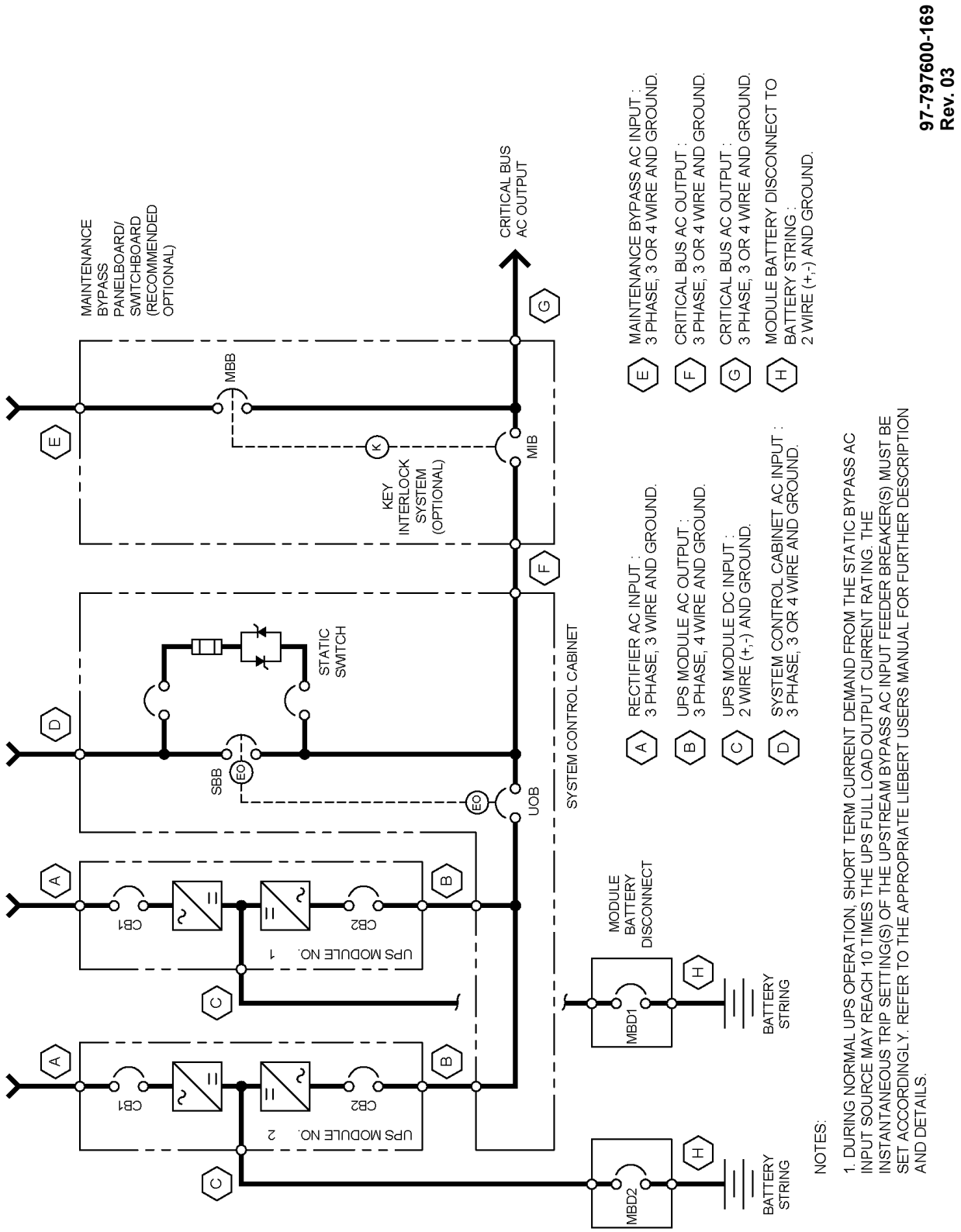


Figure 13 One-line diagram, four-module parallel system with three-breaker maintenance bypass

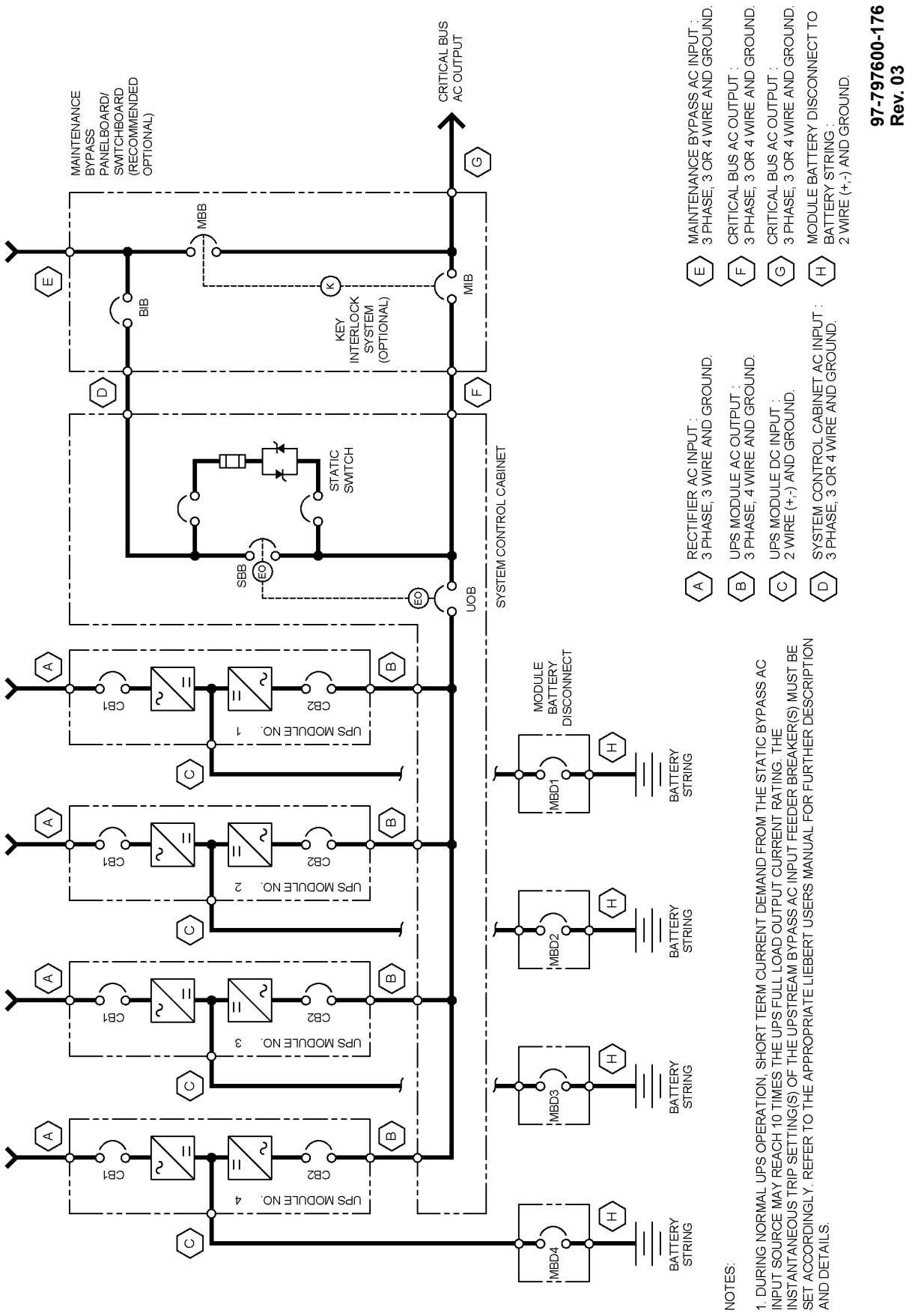


Figure 14 Outline drawing, 1000kVA, front-access Multi-Module UPS, 480V and 600V

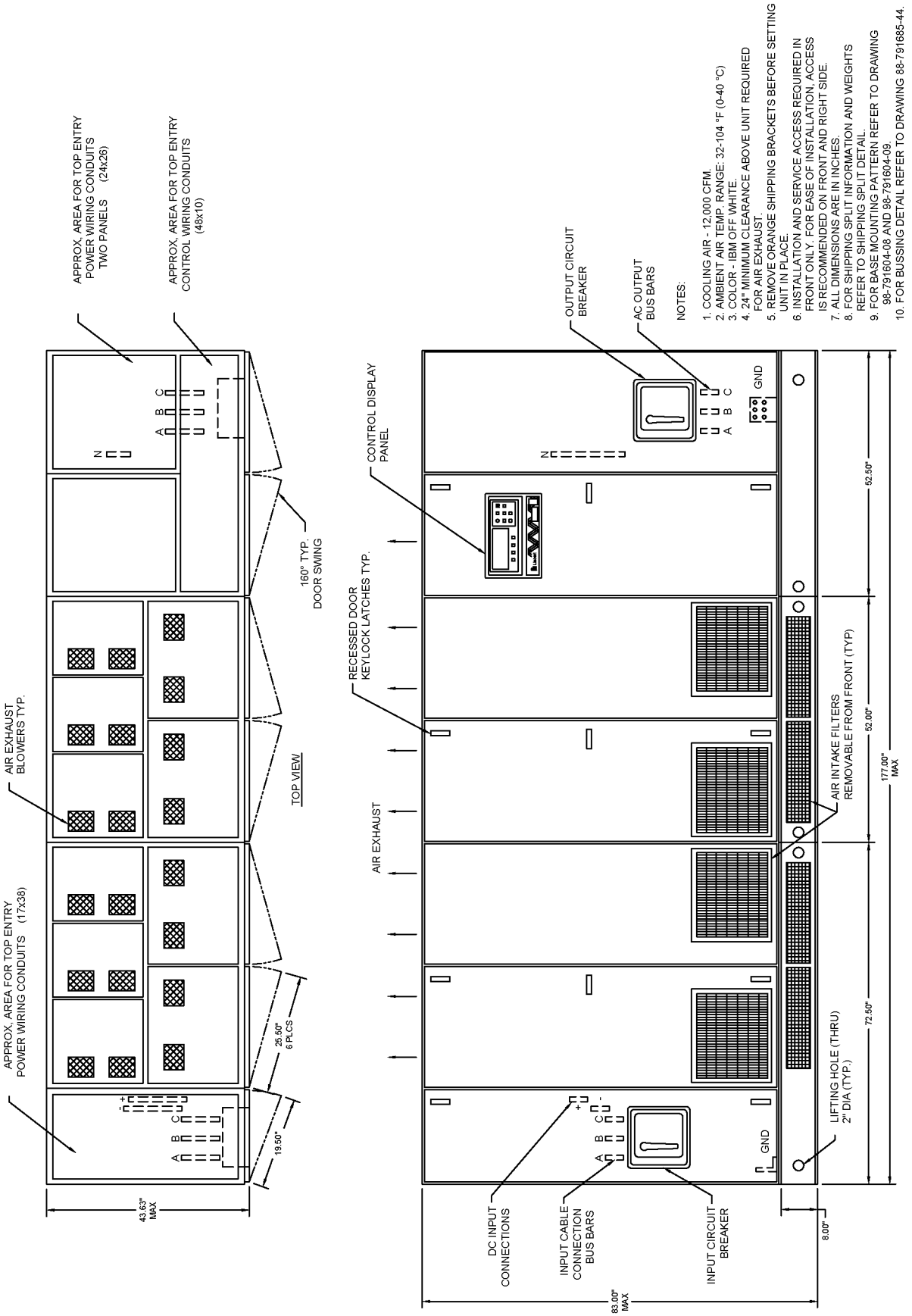


Figure 15 Bussing details, 1000kVA, front-access Multi-Module UPS, 480V and 600V

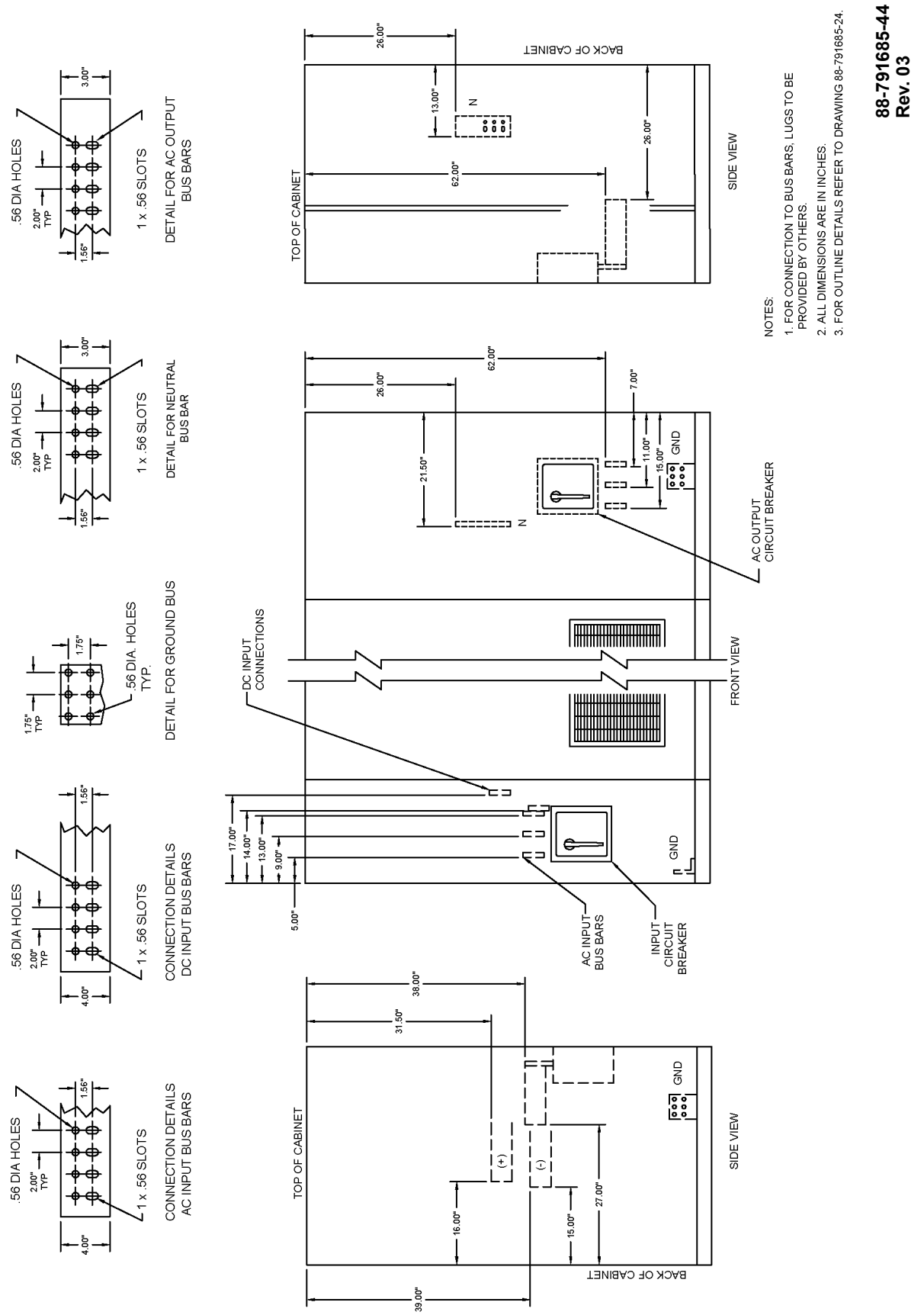


Figure 16 Base mounting details, 1000kVA, Single- and Multi-Module, rectifier and inverter sections

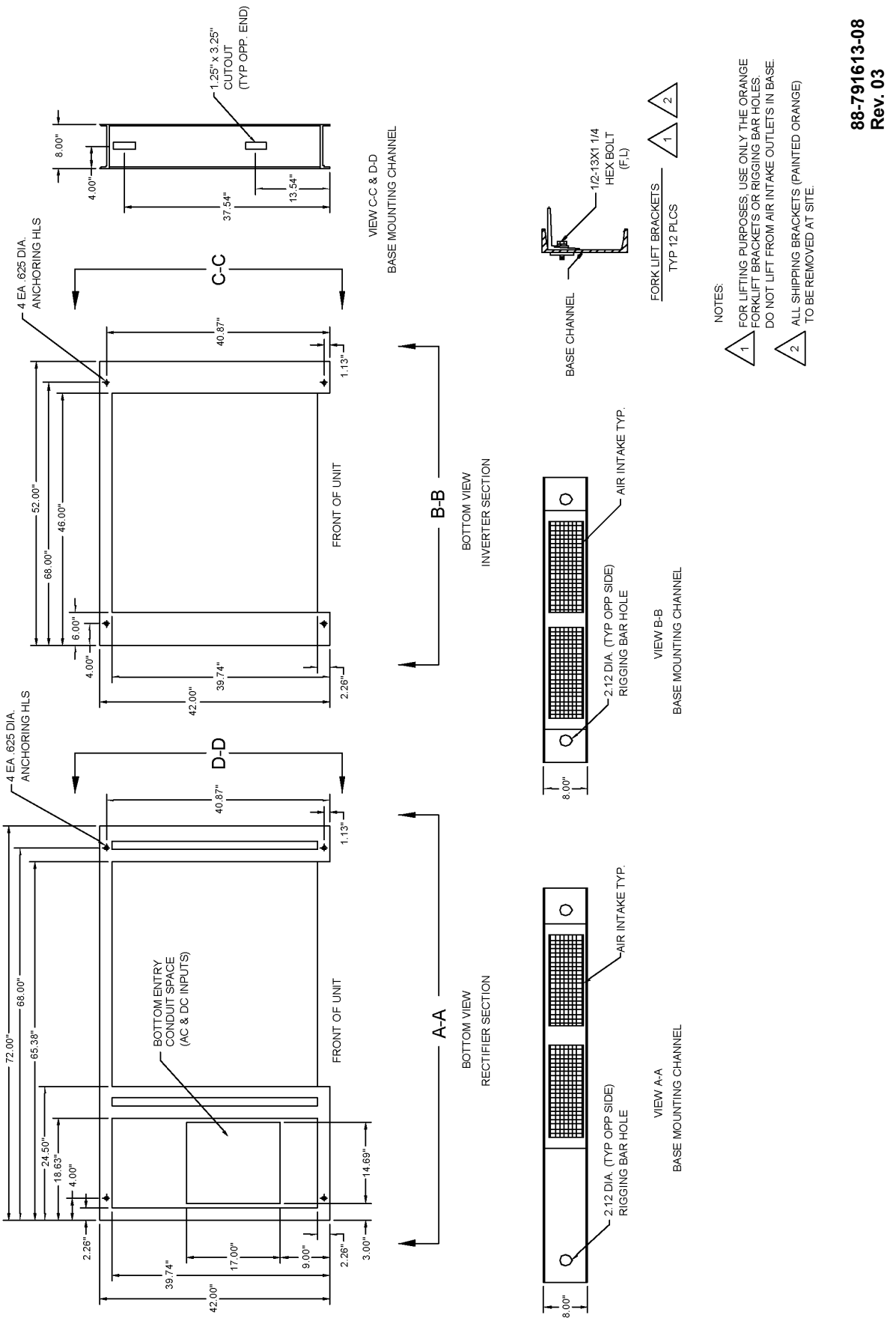


Figure 17 Base mounting details, 1000kVA, Single- and Multi-Module, control section

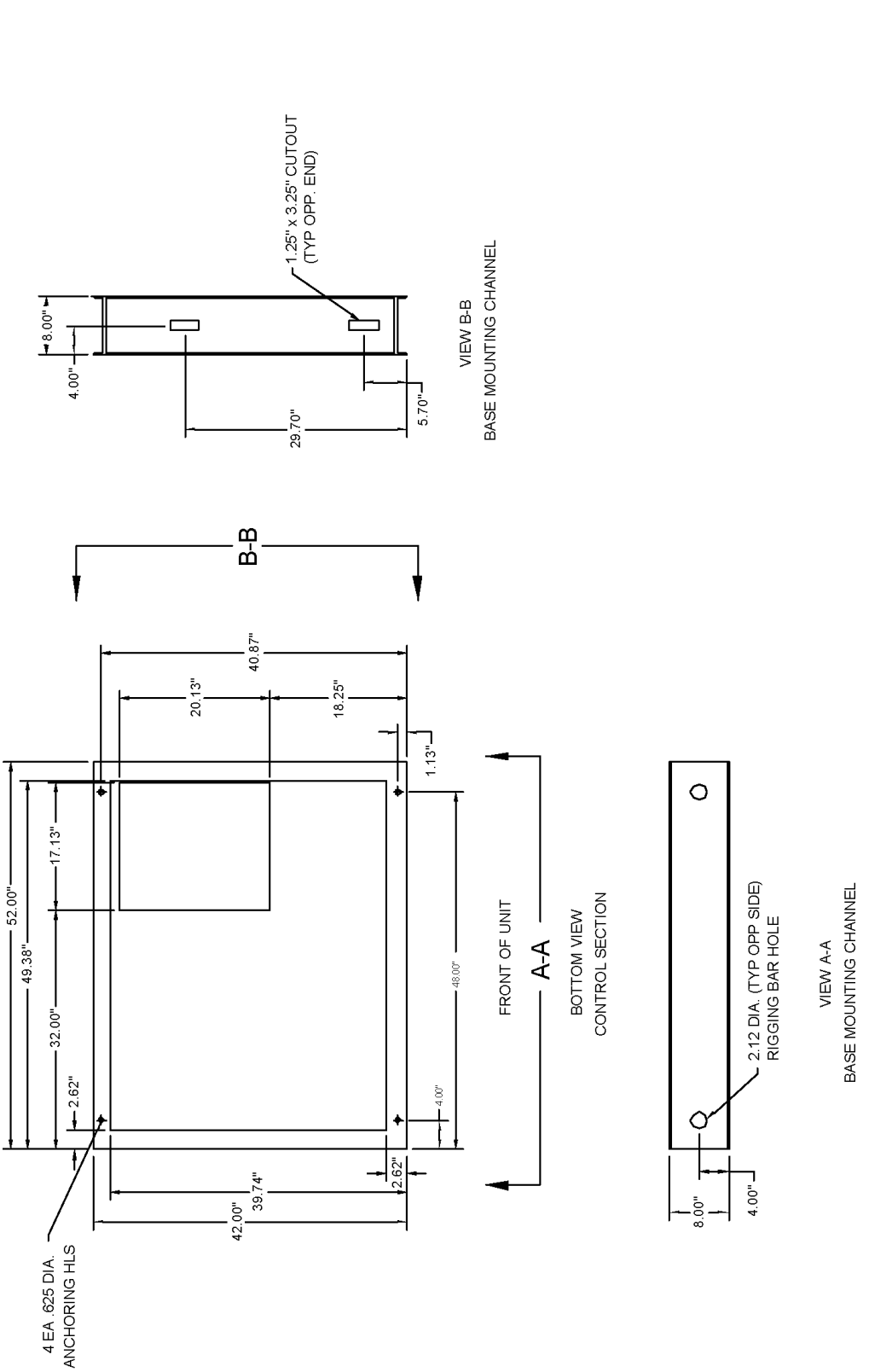
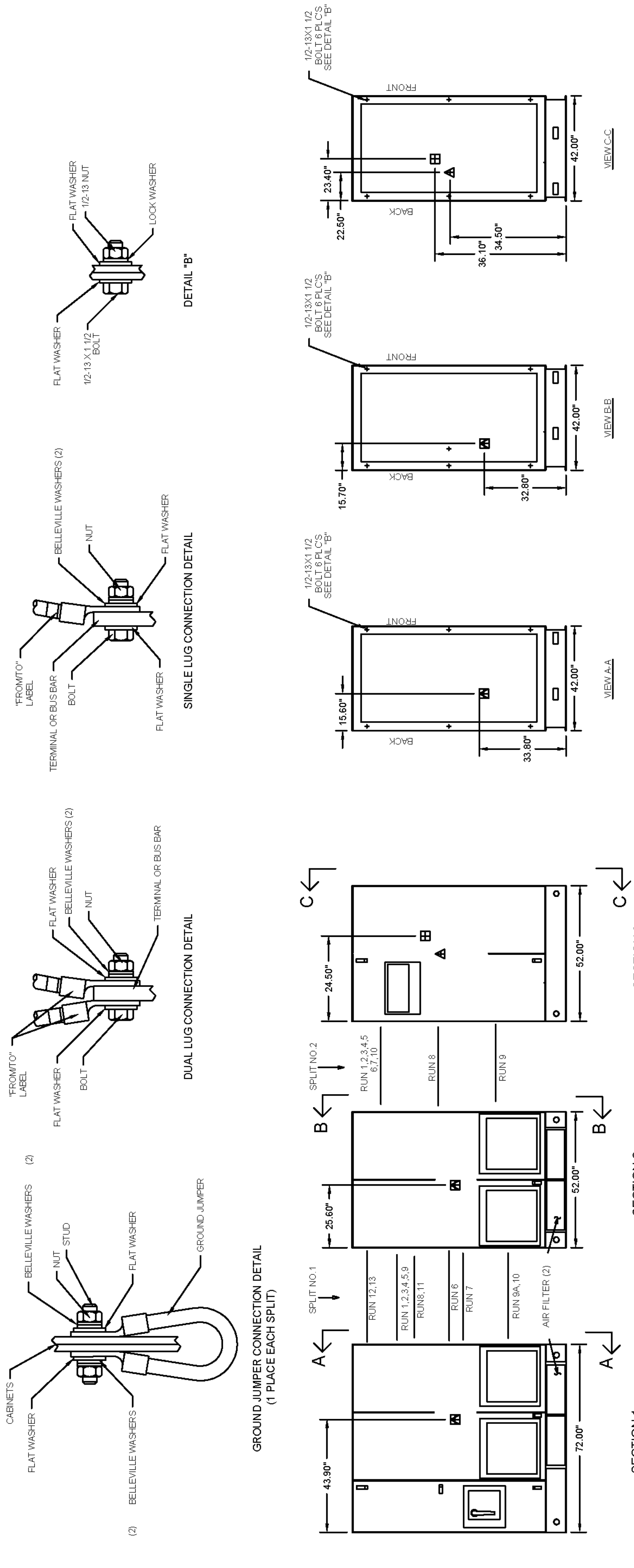


Figure 18 Shipping split detail, 1000kVA, Single- and Multi-Module UPS



SHIPPING SPLIT NO. 1

RUN	FROM (CONNECTED)	TO (DISCONNECTED)	QTY
1	CN24	CN24	1
2	INTERFACE PWA TB3	DC SENSOR PWA TB2	2
3	INTERFACE PWA J1	FRONT END MONITOR J1	1
4	INTERFACE PWA J3	FRONT END MONITOR J3	1
5	DC REGULATOR PWA J2	FRONT END MONITOR J5	1
6	DC BUS (+)	DC BUS (+)	1
7	DC BUS (-)	DC BUS (-)	1
8	OUTPUT XFMR H1	LEAD INVERTER • A	3
9	LOGIC PWA J5	LEAD INVERTER GATE DRIVE J1	1
9A	LOGIC PWA J6	LAG INVERTER GATE DRIVE J1	1
10	DC FUSE MON(LAG INV • B)J1	DC FUSE MON(LAG INV • A)J1	1
11	INVERTER LAG • A	SERIES INDUCTOR L1	3
12	BLOWER ASSY(RECTIFIER)CN4	BLOWER ASSY(INVERTER)CN5	1
13	OUTPUT XFMR X4,X5,X6,X0	BLOWER ASSY(RECT)TB1-1,-2,-3,-4	4

SHIPPING SPLIT NO. 2

RUN	FROM (CONNECTED)	TO (DISCONNECTED)	QTY
1	CN25	CN25	1
2	DC SENSOR PWA TB2	INTERFACE PWA TB3	2
3	FRONT END MONITOR J1	INTERFACE PWA J1	1
4	FRONT END MONITOR J3	INTERFACE PWA J3	1
5	FRONT END MONITOR J5	DC REGULATOR J2	1
6	INVERTER GATE DRIVE PWA J1	LOGIC PWA J1-J6	6
7	DC FUSE MON(LAG INV • C)J1	INTERFACE PWA J2	1
8	OUTPUT CB(• A,B,C,NEUTRAL)	OUTPUT XFMR(• A,B,C,NEUTRAL)	4
9	OUTPUT TRAP ASSY	AC INDUCTOR	6
10	DC CONDITIONER J1	DC REGULATOR J3	1

CENTER OF GRAVITY KEY

⊞ – 1000 KVA SINGLE MODULE

▲ – 1000 KVA MULTI-MODULE

WEIGHTS IN LBS

1000 KVA FRONT ACCESS		SECTION 1	SECTION 2	SECTION 3	TOTAL
SMS	WITH 5% INPUT FLTR	8,150	7,900	1,500	17,550
	WITHOUT 5% INPUT FLTR	7,300	7,900	1,500	16,700
MMM	WITH 5% INPUT FLTR	8,150	7,900	1,350	17,400
	WITHOUT 5% INPUT FLTR	7,300	7,900	1,350	16,550

NOTES:

1. RUN 8 AND 11 MUST PASS THROUGH THE SAME OPENING AT THE SPLIT.
2. REMOVE BASE AIR FILTER ASSY TO PREVENT DAMAGE WHILE HANDLING; REINSTALL AFTER UNIT IS INSTALLED AT SITE.
3. FOR BASE MOUNTING DETAILS AND LIFTING INSTRUCTIONS, SEE DWG 88-791613-08.

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Figure 19 Outline drawing, System Control Cabinet (SCCT) 200-1200A

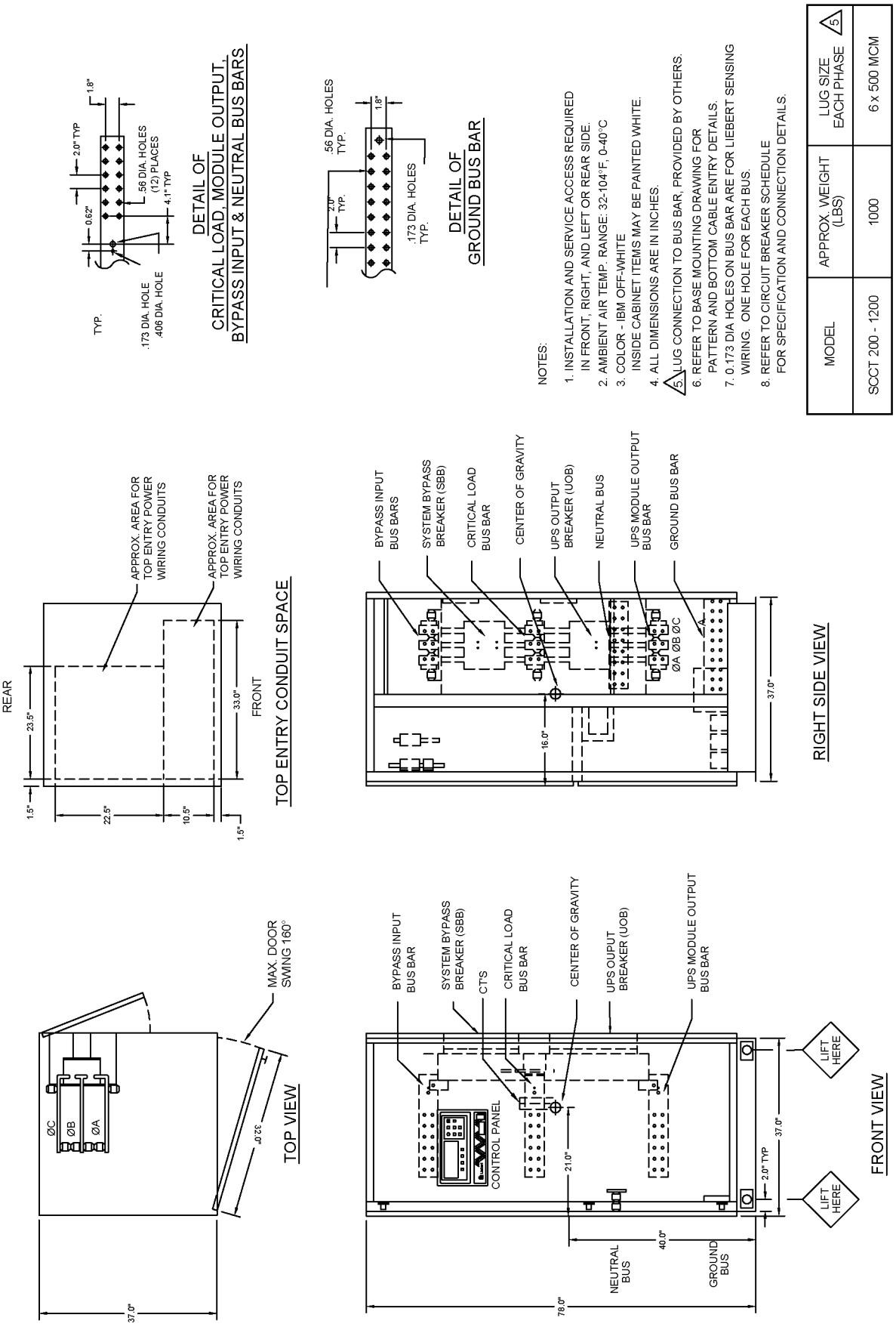

Figure 20 Base mounting pattern, System Control Cabinet (SCCT), 200-1200A

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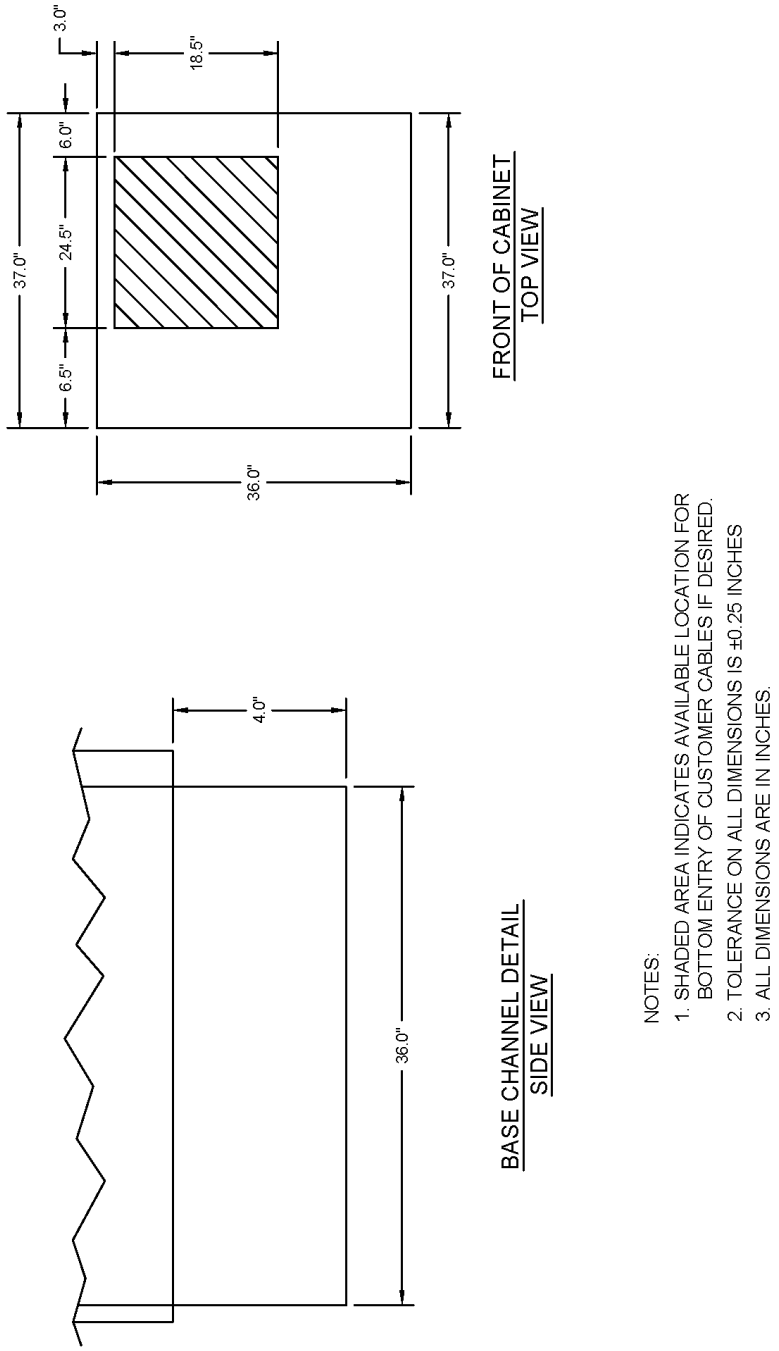
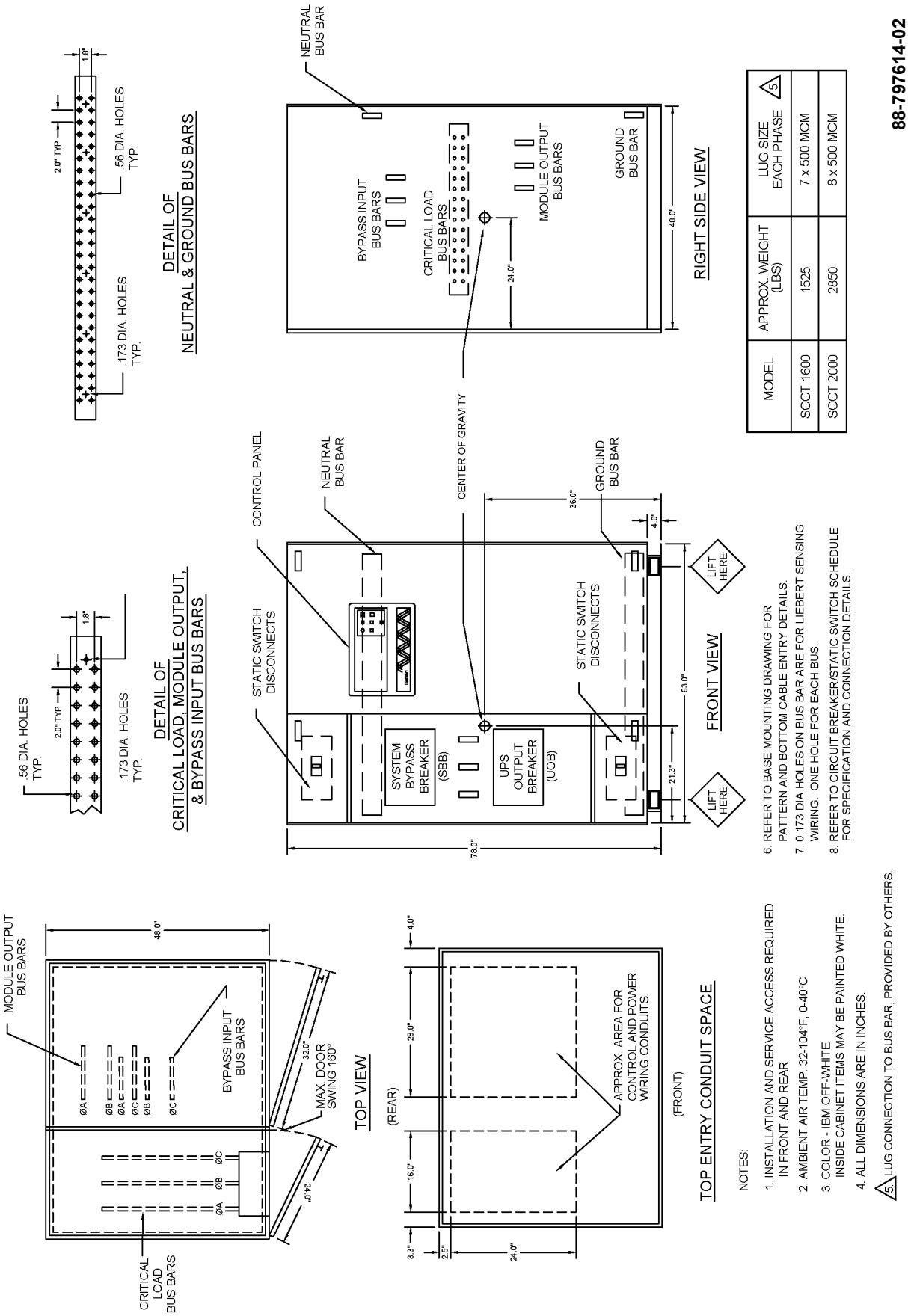


Figure 21 Outline drawing, System Control Cabinet (SCCT), 1600-2000A



MODEL	APPROX. WEIGHT (LBS)	LUG SIZE EACH PHASE ⚠5
SCCT 1600	1525	7 x 500 MCM
SCCT 2000	2850	8 x 500 MCM

NOTES:

1. INSTALLATION AND SERVICE ACCESS REQUIRED IN FRONT AND REAR
2. AMBIENT AIR TEMP. 32-104°F, 0-40°C
3. COLOR - IBM OFF-WHITE INSIDE CABINET ITEMS MAY BE PAINTED WHITE.
4. ALL DIMENSIONS ARE IN INCHES.
5. ⚠5 LUG CONNECTION TO BUS BAR, PROVIDED BY OTHERS.
6. REFER TO BASE MOUNTING DRAWING FOR PATTERN AND BOTTOM CABLE ENTRY DETAILS.
7. 0.173 DIA HOLES ON BUS BAR ARE FOR LIEBERT SENSING WIRING. ONE HOLE FOR EACH BUS.
8. REFER TO CIRCUIT BREAKER/STATIC SWITCH SCHEDULE FOR SPECIFICATION AND CONNECTION DETAILS.

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Figure 22 Base mounting patterns, System Control Cabinet (SCCT), 1600-2000A

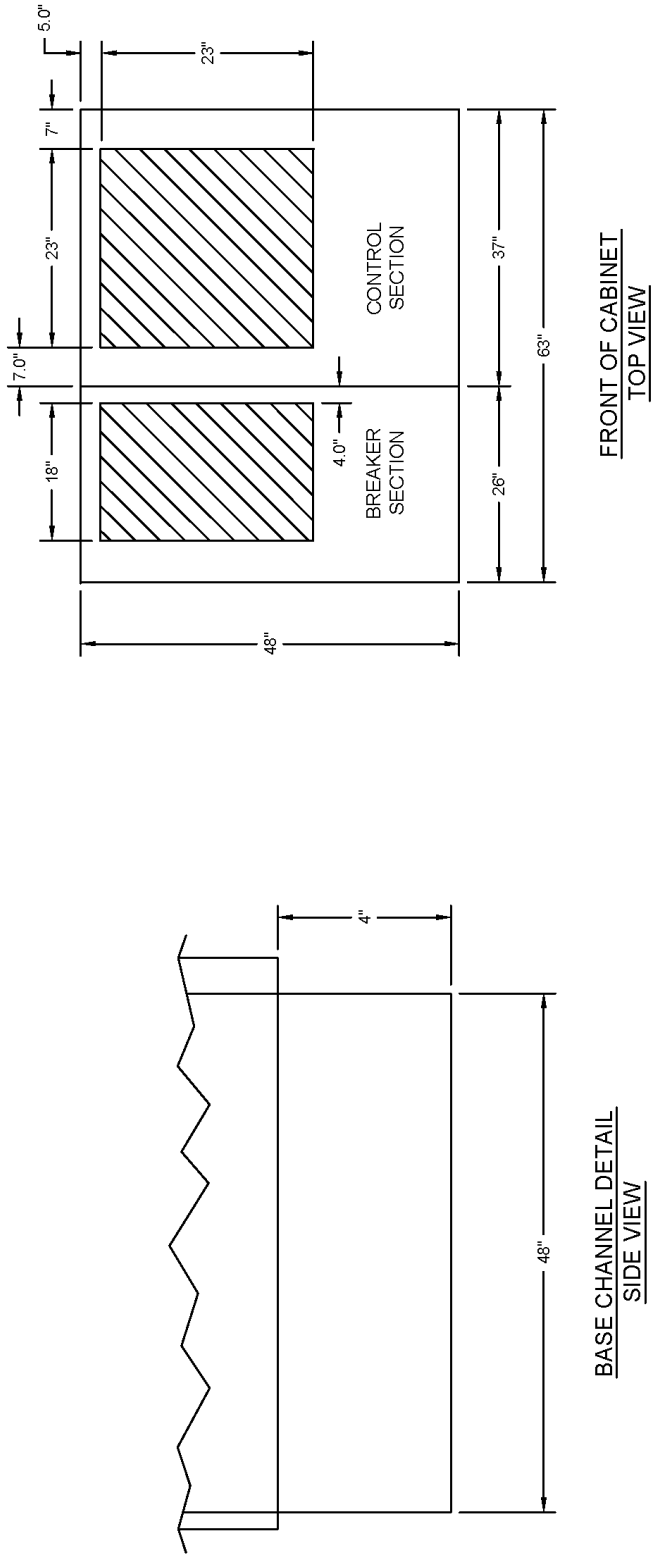

Figure 23 Outline drawing, System Control Cabinet (SCCT), 2500-3000A

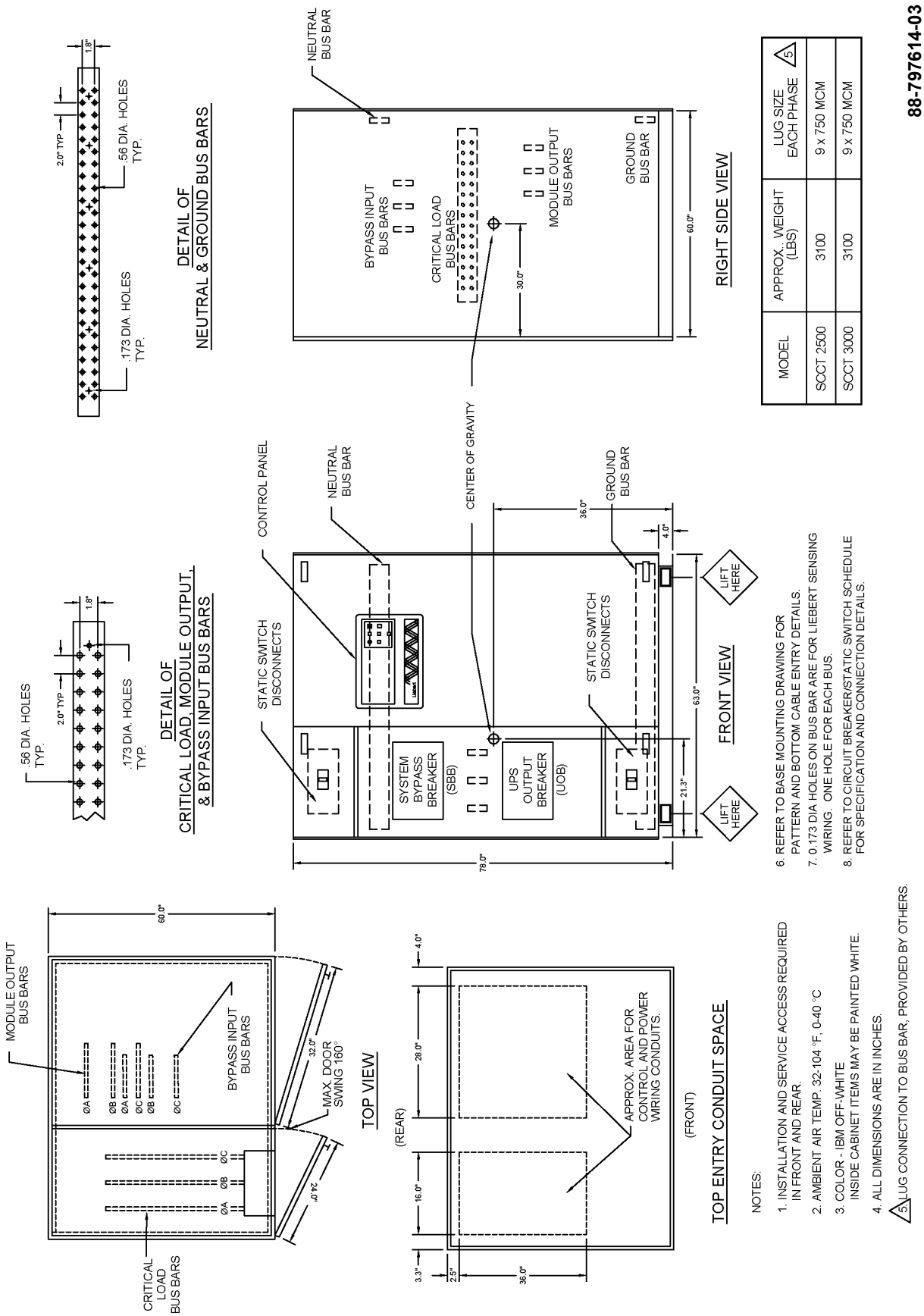

Figure 24 Base mounting patterns, System Control Cabinet (SCCT), 2500-3000A

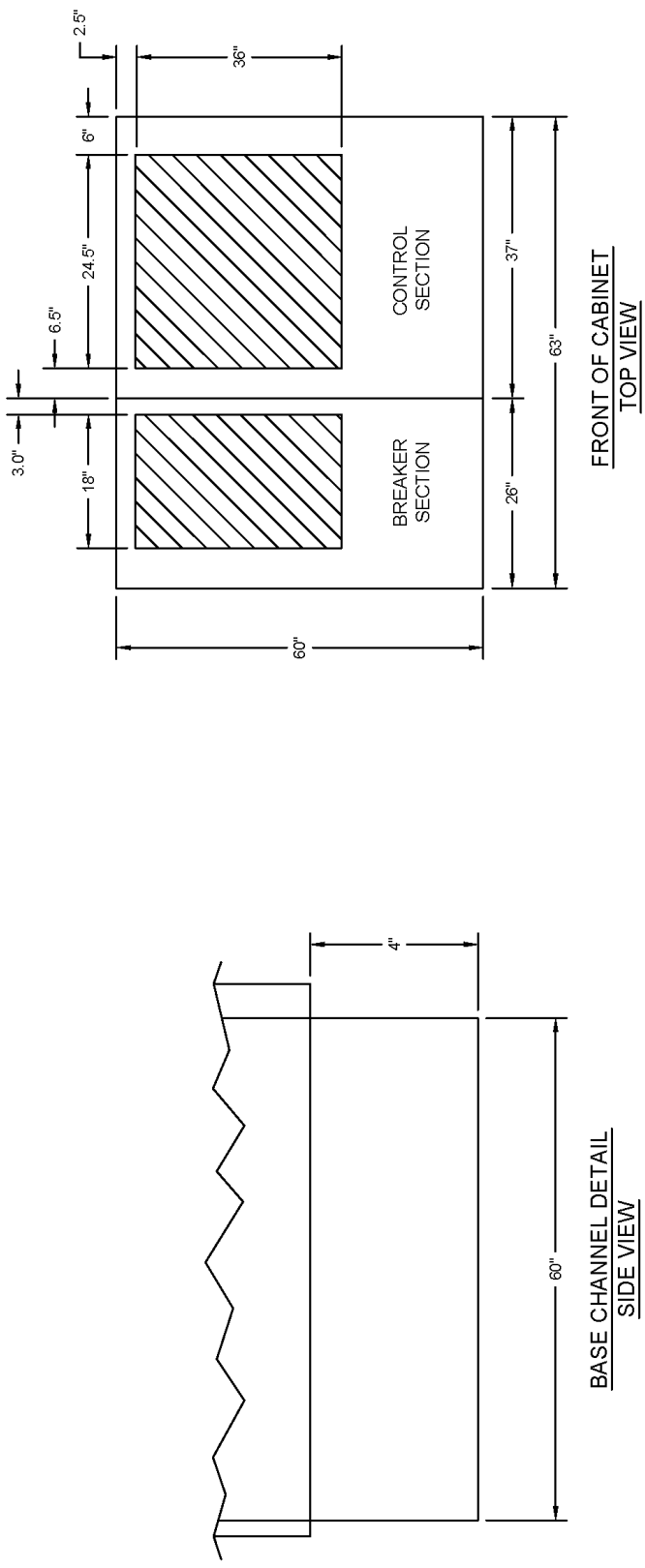

Figure 25 Outline drawing, System Control Cabinet (SCCT), 4000A

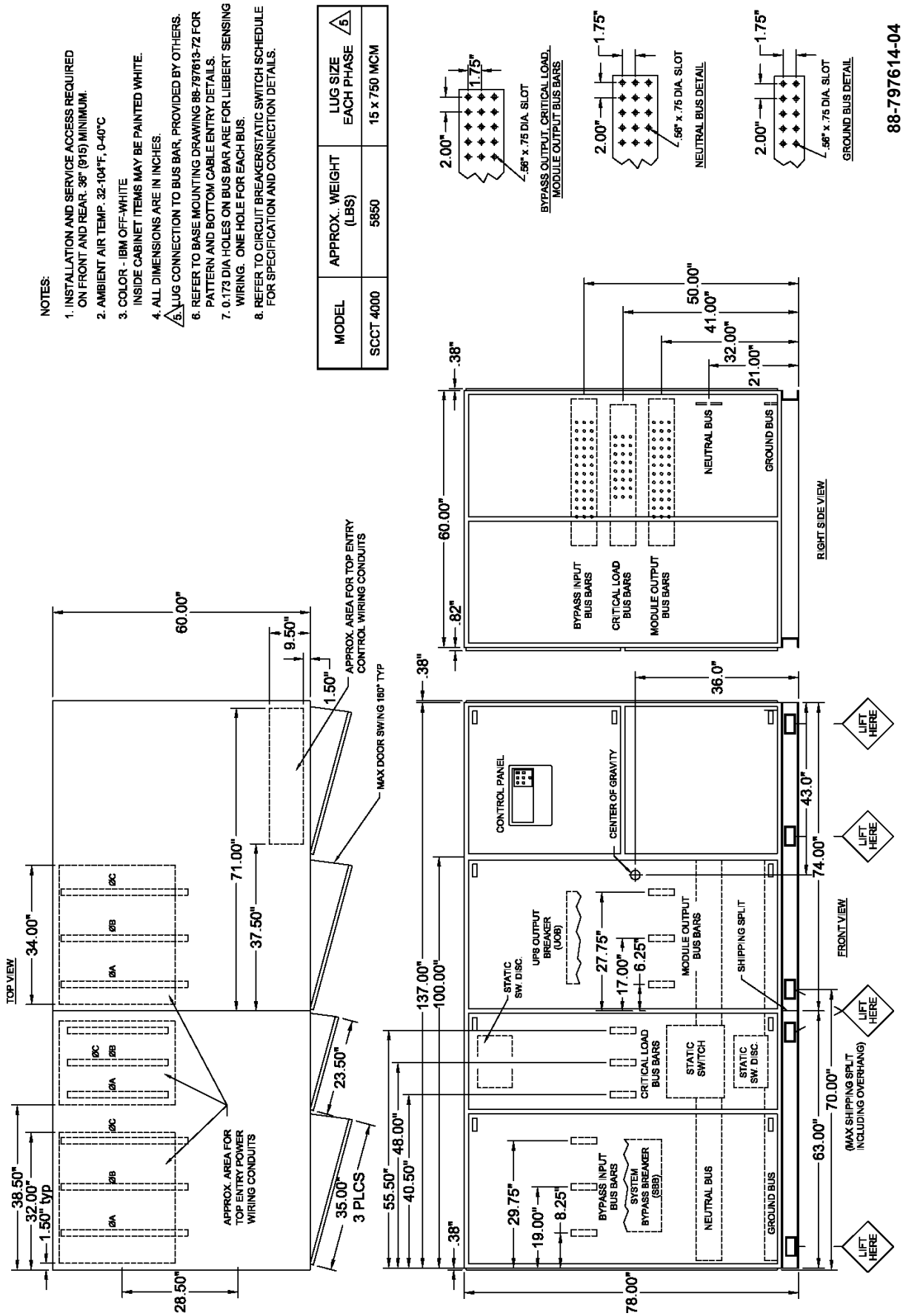

Figure 26 Base mounting patterns, System Control Cabinet (SCCT), 4000A

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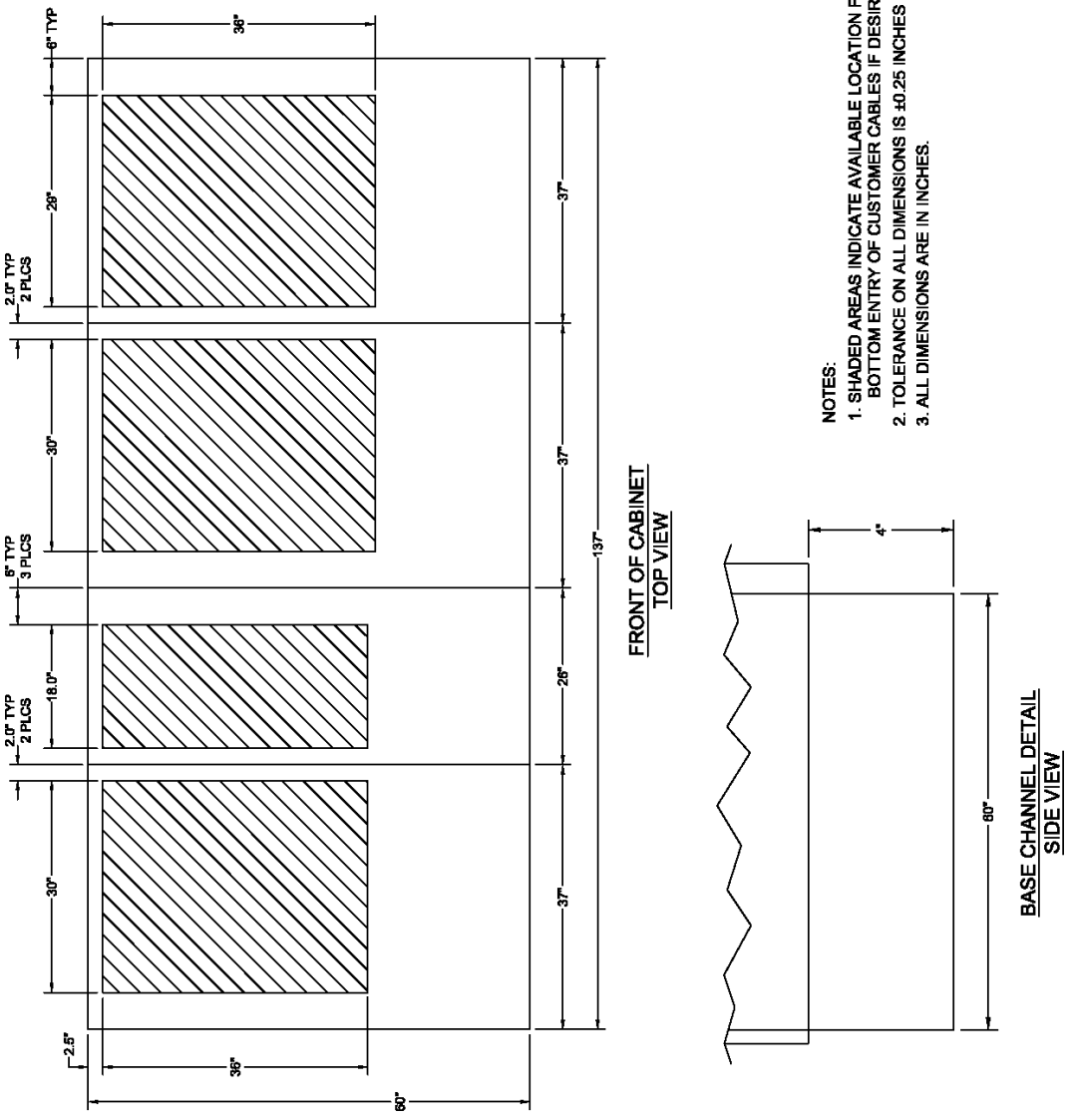

Figure 27 Control connection location diagram, 750 (low-link) - 1000kVA, Multi-Module System

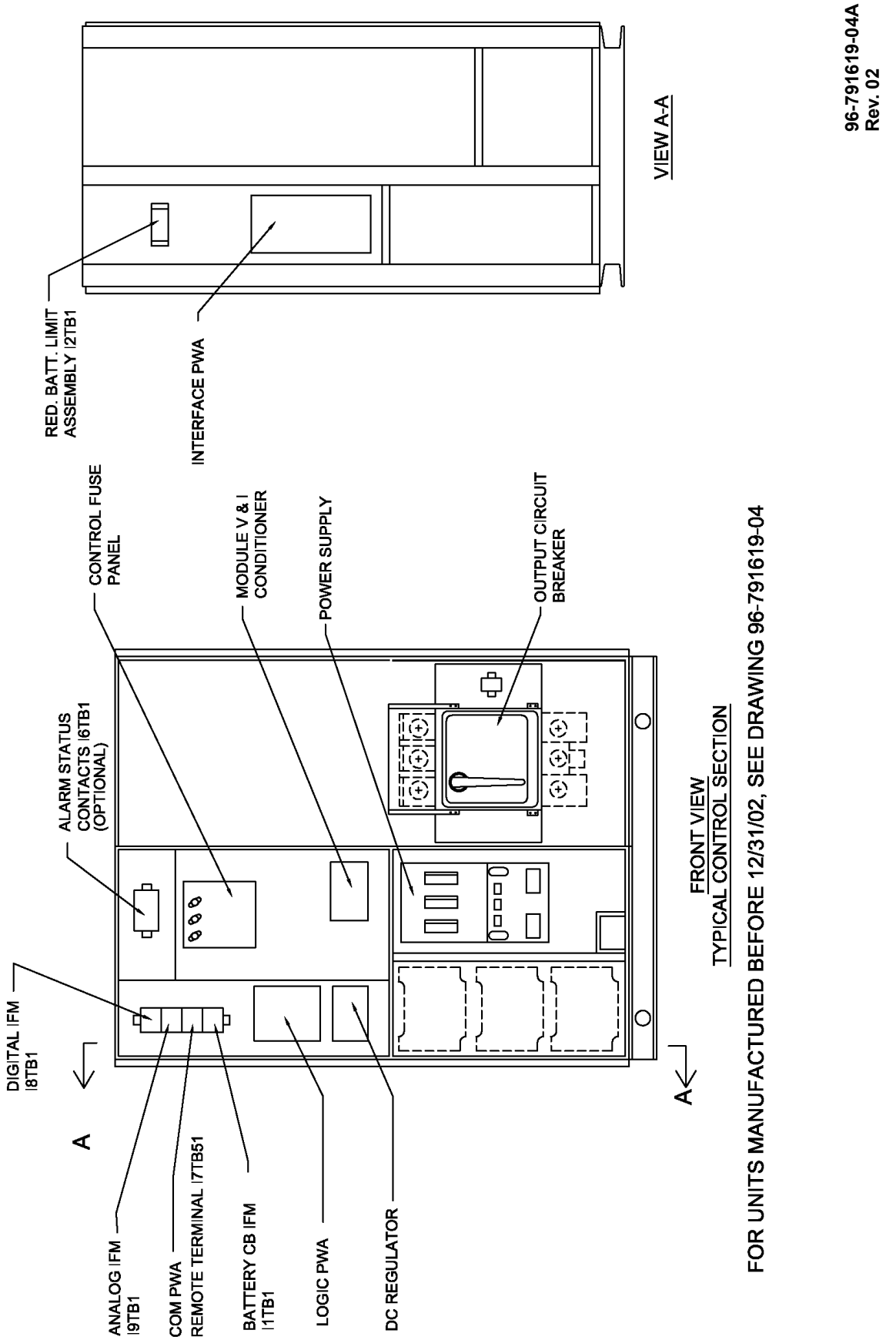

Figure 28 Control connection location diagram, Multi-Module System, System Control Cabinet - SCCT

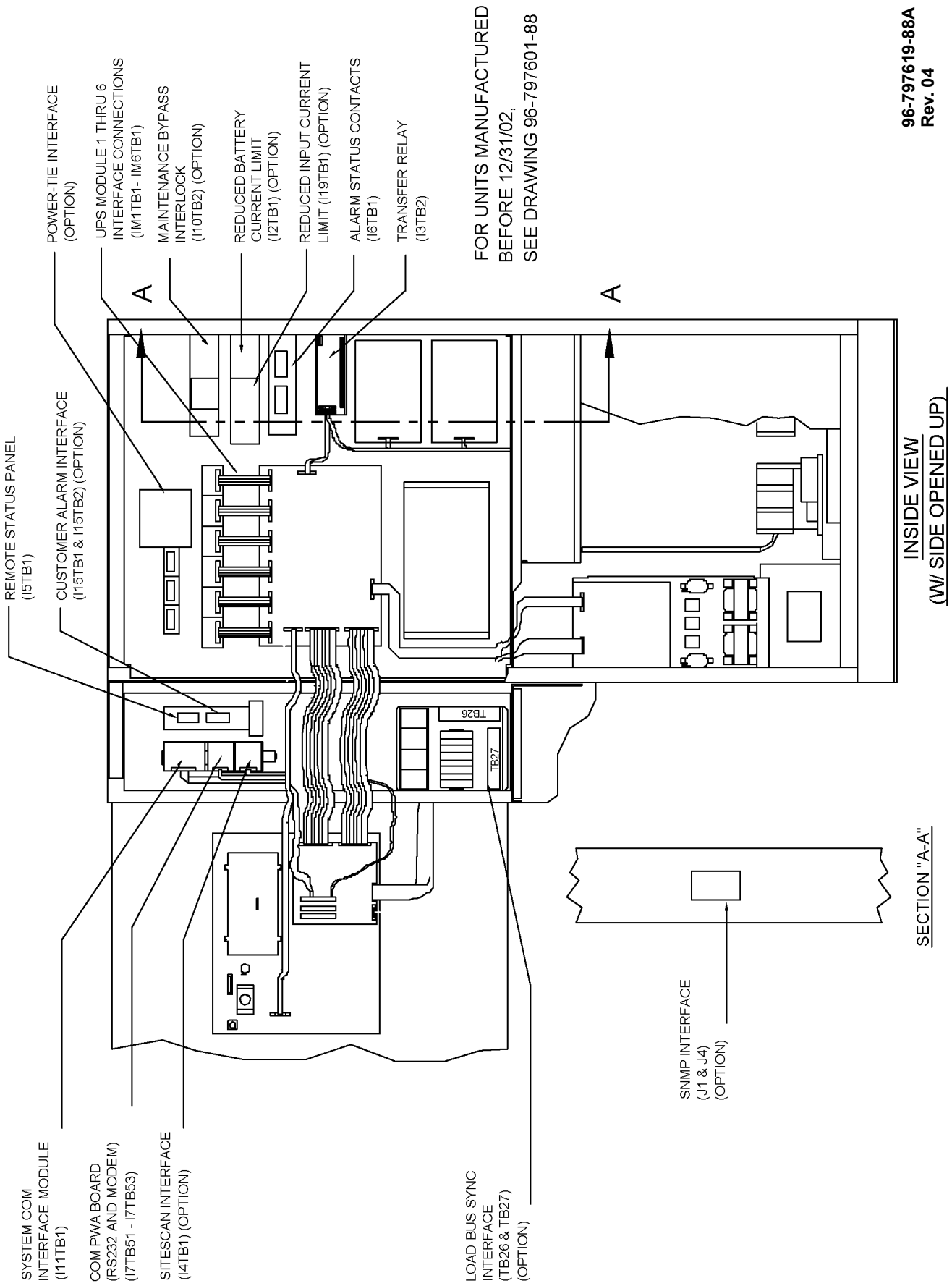

Figure 29 Control wire list, interconnect diagram, Multi-Module System

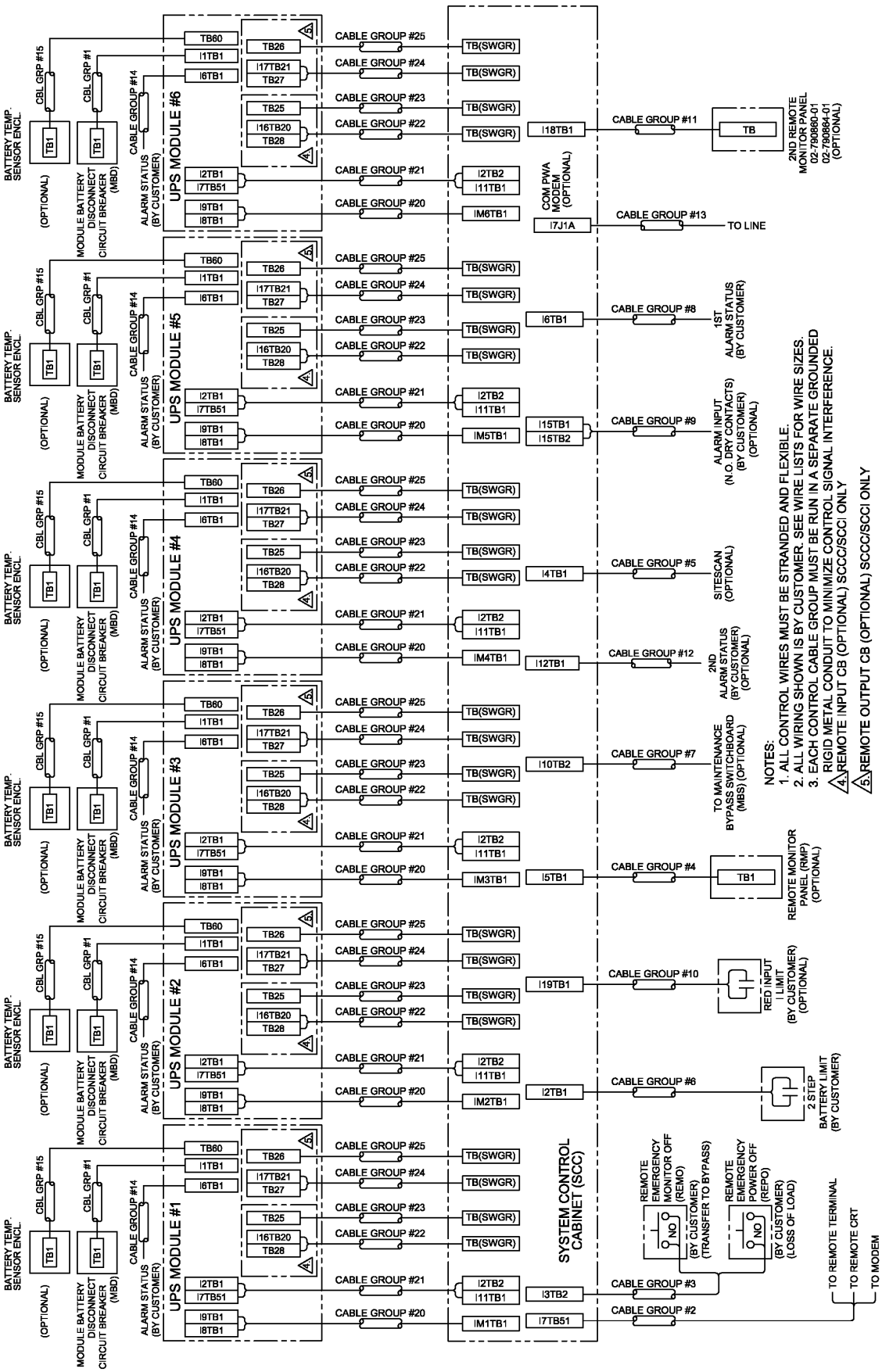

Figure 30 Control wire list, Multi-Module System, UPS module, external interconnections

CABLE GROUP	WIRE NO.	FROM	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	TO	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	SIGNAL NAME	MAX VOLTAGE	MAX CURRENT	WIRE COLOR	WIRE SIZE & TYPE	MAX. LENGTH	REMARKS
CBL GRP. #1	901	UPM	I1TB1- 1	#14 - #22	MBD	TB1- 1	#10 - #22	TRIP SIGNAL (+)	+ 24 VDC	100 mA		1/C #14	500 FT	
CBL GRP. #1	902	UPM	I1TB1- 2	#14 - #22	MBD	TB1- 2	#10 - #22	TRIP SIGNAL (-)	- 24 VDC	100 mA		1/C #14	500 FT	
CBL GRP. #1	903	UPM	I1TB1- 7	#14 - #22	MBD	TB1- 7	#10 - #22	AUX COM	24 VDC	100 mA		1/C #14	500 FT	
CBL GRP. #1	904	UPM	I1TB1- 8	#14 - #22	MBD	TB1- 8	#10 - #22	AUX N.O.	24 VDC	100 mA		1/C #14	500 FT	
CABLE GROUP #14	910	UPM	I6TB1- 1	#14 - #22	F.B.O.	N.O.	F.B.O.	OUTPUT CB OPEN	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	911	UPM	I6TB1- 3	#14 - #22	F.B.O.	N.C.	F.B.O.	OUTPUT CB OPEN	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	912	UPM	I6TB1- 5	#14 - #22	F.B.O.	COMM	F.B.O.	OUTPUT CB OPEN	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	913	UPM	I6TB1- 7	#14 - #22	F.B.O.	N.O.	F.B.O.	BATTERY CB OPEN	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	914	UPM	I6TB1- 9	#14 - #22	F.B.O.	N.C.	F.B.O.	BATTERY CB OPEN	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	915	UPM	I6TB1- 11	#14 - #22	F.B.O.	COMM	F.B.O.	BATTERY CB OPEN	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	916	UPM	I6TB1- 13	#14 - #22	F.B.O.	N.O.	F.B.O.	BATTERY DISCHARGING	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	917	UPM	I6TB1- 15	#14 - #22	F.B.O.	N.C.	F.B.O.	BATTERY DISCHARGING	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	918	UPM	I6TB1- 17	#14 - #22	F.B.O.	COMM	F.B.O.	BATTERY DISCHARGING	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	919	UPM	I6TB1- 19	#14 - #22	F.B.O.	N.O.	F.B.O.	LOW BATTERY WARNING	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	920	UPM	I6TB1- 21	#14 - #22	F.B.O.	N.C.	F.B.O.	LOW BATTERY WARNING	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	921	UPM	I6TB1- 23	#14 - #22	F.B.O.	COMM	F.B.O.	LOW BATTERY WARNING	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	922	UPM	I6TB1- 25	#14 - #22	F.B.O.	N.O.	F.B.O.	CONTROL FAILURE	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	923	UPM	I6TB1- 27	#14 - #22	F.B.O.	N.C.	F.B.O.	CONTROL FAILURE	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	924	UPM	I6TB1- 29	#14 - #22	F.B.O.	COMM	F.B.O.	CONTROL FAILURE	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	925	UPM	I6TB1- 31	#14 - #22	F.B.O.	N.O.	F.B.O.	AMBIENT OVERTEMP	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	926	UPM	I6TB1- 33	#14 - #22	F.B.O.	N.C.	F.B.O.	AMBIENT OVERTEMP	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	927	UPM	I6TB1- 35	#14 - #22	F.B.O.	COMM	F.B.O.	AMBIENT OVERTEMP	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	928	UPM	I6TB1- 37	#14 - #22	F.B.O.	N.O.	F.B.O.	MODULE SUMMARY ALARM	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	929	UPM	I6TB1- 39	#14 - #22	F.B.O.	N.C.	F.B.O.	MODULE SUMMARY ALARM	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	930	UPM	I6TB1- 41	#14 - #22	F.B.O.	COMM	F.B.O.	MODULE SUMMARY ALARM	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	931	UPM	I6TB1- 43	#14 - #22	F.B.O.	N.O.	F.B.O.	NEW ALARM	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	932	UPM	I6TB1- 45	#14 - #22	F.B.O.	N.C.	F.B.O.	NEW ALARM	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4
CABLE GROUP #14	933	UPM	I6TB1- 47	#14 - #22	F.B.O.	COMM	F.B.O.	NEW ALARM	125 VAC	500 mA		1/C #14		SEE NOTE 3, 4

NOTES:

1. F.B.O. - FURNISHED BY OTHERS
2. EACH CABLE GROUP MUST BE RUN IN A SEPARATE STEEL RACEWAY TO MINIMIZE CONTROL SIGNAL INTERFERENCE.
3. CABLE GROUP #8 AND #14 MAY BE RUN IN THE SAME CONDUIT.
4. THE CONTACTS ARE ALSO RATED 2A MAX. AT 30 VDC MAX.

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Figure 31 Control wire list, Single- and Multi-Module System, external interconnection, optional battery temperature sensor

	WIRE NO.	FROM	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	TO	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	SIGNAL NAME	MAX VOLTAGE	MAX CURRENT	WIRE COLOR	WIRE SIZE & TYPE	MAX. LENGTH	REMARKS
CABLE GROUP #15	940	UPM	TB6O - 1	#14 - #22	RMP	TB1-1	#14 - #22	BATTERY TEMP. SENSOR	24 VDC	100A	WHITE	2/C TW	100 FT	2/C TWISTED PAIR
	941	UPM	TB6O - 2	#14 - #22	RMP	TB1-2	#14 - #22	BATTERY TEMP. SENSOR	24 VDC	100A	BLACK	PR SHD	100 FT	SHIELDED #18 BELDON
	942	UPM	TB6O - 3	#14 - #22	RMP			SHIELD	24 VDC	100A	SHD		100 FT	8760 OR EQUAL.

NOTES:

1. F.B.O. - FURNISHED BY OTHERS.
2. EACH CABLE GROUP MUST BE RUN IN A SEPARATE STEEL RACEWAY TO MINIMIZE CONTROL SIGNAL INTERFERENCE

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Figure 32 Control wire list, Multi-Module System, System Control Cabinet/Module 1 interconnection

CABLE GROUP	WIRE NO.	FROM	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	TO	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	SIGNAL NAME	MAX VOLTAGE	MAX CURRENT	WIRE COLOR	WIRE SIZE & TYPE	MAX. LENGTH	REMARKS
CABLE GROUP #20	101	UPM1	I8TB1- 1	#14 - #22	SCC	IM1TB1- 1	#14 - #22	OSC. SYNC.	24 VDC	100 mA	WHITE	2/C TW	100 FT	18/C TW PR SHIELDED #18 BELDEN 9390 OR 7-2/C #18 TW. PR. SHIELDED BELDON 8760 OR EQUAL
	102	UPM1	I8TB1- 2	#14 - #22	SCC	IM1TB1- 2	#14 - #22	OSC. SYNC.	24 VDC	100 mA	BLACK	PR SHD	100 FT	
	-	UPM1	I8TB1- 3	#14 - #22	SCC	IM1TB1- 3	#14 - #22	OSC. SYNC.	24 VDC	100 mA	SHD		100 FT	
	-	UPM1	I8TB1- 4	#14 - #22	SCC	IM1TB1- 4	#14 - #22	PHASE SYNC.	24 VDC	100 mA	SHD		100 FT	
	103	UPM1	I8TB1- 5	#14 - #22	SCC	IM1TB1- 5	#14 - #22	PHASE SYNC.	24 VDC	100 mA	BLACK	2/C TW	100 FT	
	104	UPM1	I8TB1- 6	#14 - #22	SCC	IM1TB1- 6	#14 - #22	PHASE SYNC.	24 VDC	100 mA	WHITE	PR SHD	100 FT	
	105	UPM1	I8TB1- 7	#14 - #22	SCC	IM1TB1- 7	#14 - #22	FREQ. CONTROL	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM1	I8TB1- 8	#14 - #22	SCC	IM1TB1- 8	#14 - #22	FREQ. CONTROL	24 VDC	100 mA	SHD		100 FT	
	106	UPM1	I8TB1- 9	#14 - #22	SCC	IM1TB1- 9	#14 - #22	GROUND	24 VDC	100 mA		1/C #14	100 FT	
	107	UPM1	I8TB1- 10	#14 - #22	SCC	IM1TB1- 10	#14 - #22	EMO SUPPLY	24 VDC	100 mA		1/C #14	100 FT	
	108	UPM1	I8TB1- 11	#14 - #22	SCC	IM1TB1- 11	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	WHITE	2/C TW	100 FT	
	109	UPM1	I8TB1- 12	#14 - #22	SCC	IM1TB1- 12	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	BLACK	PR SHD	100 FT	
	-	UPM1	I8TB1- 13	#14 - #22	SCC	IM1TB1- 13	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	SHD		100 FT	
	-	UPM1	I9TB1- 3	#14 - #22	SCC	IM1TB1- 19	#14 - #22	LINE DROP COMP.	24 VDC	100 mA	SHD		100 FT	
	110	UPM1	I9TB1- 4	#14 - #22	SCC	IM1TB1- 20	#14 - #22	LINE DROP COMP.	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM1	I9TB1- 5	#14 - #22	SCC	IM1TB1- 21	#14 - #22	VOLT CONTROL	24 VDC	100 mA	SHD		100 FT	
	111	UPM1	I9TB1- 6	#14 - #22	SCC	IM1TB1- 22	#14 - #22	VOLT CONTROL	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM1	I9TB1- 8	#14 - #22	SCC	IM1TB1- 24	#14 - #22	CURRENT SHARE	24 VDC	100 mA	SHD		100 FT	
	112	UPM1	I9TB1- 9	#14 - #22	SCC	IM1TB1- 25	#14 - #22	CURRENT SHARE	24 VDC	100 mA	WHITE	2/C TW	100 FT	
	113	UPM1	I9TB1- 10	#14 - #22	SCC	IM1TB1- 26	#14 - #22	CURRENT SHARE	24 VDC	100 mA	BLACK	PR SHD	100 FT	
CBL GRP. #21	114	UPM1	I7TB51- 1	#14 - #22	SCC	I11TB1- 7	#14 - #22	COMMUNICATIONS	24 VDC	100 mA		3/C	100 FT	3/C #22 SHIELDED BELDON 9939 OR EQUAL
	115	UPM1	I7TB51- 2	#14 - #22	SCC	I11TB1- 6	#14 - #22	COMMUNICATIONS	24 VDC	100 mA		SHIELDED	100 FT	
	116	UPM1	I7TB51- 3	#14 - #22	SCC	I11TB1- 8	#14 - #22	COMMUNICATIONS	24 VDC	100 mA			100 FT	
	-	UPM1	I7E1	#14 - #22	SCC	I11TB1- 9	#14 - #22	COMMUNICATIONS	24 VDC	100 mA	SHD		100 FT	
	117	UPM1	I2TB1- 4	#14 - #22	SCC	I21TB2- 1	#14 - #22	2 STEP BATTERY LIMIT	24 VDC	100 mA		1/C #14	100 FT	
	118	UPM1	I2TB1- 3	#14 - #22	SCC	I21TB2- 2	#14 - #22	2 STEP BATTERY LIMIT	24 VDC	100 mA		1/C #14	100 FT	

FOR UNITS MANUFACTURED BEFORE 12/31/02, SEE DRAWING 96-791619-22

NOTES:

1. F.B.O. - FURNISHED BY OTHERS
2. EACH CABLE GROUP MUST BE RUN IN A SEPARATE GROUNDED RIGID METAL CONDUIT TO MINIMIZE CONTROL SIGNAL INTERFERENCE.

96-791619-22A
Rev. 02

Figure 33 Control wire list, Multi-Module System, System Control Cabinet/Module 2 interconnection

CABLE GROUP	WIRE NO.	FROM	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	TO	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	SIGNAL NAME	MAX VOLTAGE	MAX CURRENT	WIRE COLOR	WIRE SIZE & TYPE	MAX. LENGTH	REMARKS
CABLE GROUP #20	201	UPM2	I8TB1- 1	#14 - #22	SCC	IM2TB1- 1	#14 - #22	OSC. SYNC.	24 VDC	100 mA	WHITE	2/C TW	100 FT	18/C TW PR SHIELDED
	202	UPM2	I8TB1- 2	#14 - #22	SCC	IM2TB1- 2	#14 - #22	OSC. SYNC.	24 VDC	100 mA	BLACK	PR SHD	100 FT	#18 BELDEN 9390 OR
	-	UPM2	I8TB1- 3	#14 - #22	SCC	IM2TB1- 3	#14 - #22	OSC. SYNC.	24 VDC	100 mA	SHD		100 FT	7-2/C #18 TW. PR.
	-	UPM2	I8TB1- 4	#14 - #22	SCC	IM2TB1- 4	#14 - #22	PHASE SYNC.	24 VDC	100 mA	SHD		100 FT	SHIELDED BELDON 8760
	203	UPM2	I8TB1- 5	#14 - #22	SCC	IM2TB1- 5	#14 - #22	PHASE SYNC.	24 VDC	100 mA	BLACK	2/C TW	100 FT	OR EQUAL
	204	UPM2	I8TB1- 6	#14 - #22	SCC	IM2TB1- 6	#14 - #22	PHASE SYNC.	24 VDC	100 mA	WHITE	PR SHD	100 FT	
	205	UPM2	I8TB1- 7	#14 - #22	SCC	IM2TB1- 7	#14 - #22	FREQ. CONTROL	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM2	I8TB1- 8	#14 - #22	SCC	IM2TB1- 8	#14 - #22	FREQ. CONTROL	24 VDC	100 mA	SHD		100 FT	
	206	UPM2	I8TB1- 9	#14 - #22	SCC	IM2TB1- 9	#14 - #22	GROUND	24 VDC	100 mA		1/C #14	100 FT	
	207	UPM2	I8TB1- 10	#14 - #22	SCC	IM2TB1- 10	#14 - #22	EMO SUPPLY	24 VDC	100 mA		1/C #14	100 FT	
	208	UPM2	I8TB1- 11	#14 - #22	SCC	IM2TB1- 11	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	WHITE	2/C TW	100 FT	
	209	UPM2	I8TB1- 12	#14 - #22	SCC	IM2TB1- 12	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	BLACK	PR SHD	100 FT	
	-	UPM2	I8TB1- 13	#14 - #22	SCC	IM2TB1- 13	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	SHD		100 FT	
	-	UPM2	I9TB1- 3	#14 - #22	SCC	IM2TB1- 19	#14 - #22	LINE DROP COMP.	24 VDC	100 mA	SHD		100 FT	
	210	UPM2	I9TB1- 4	#14 - #22	SCC	IM2TB1- 20	#14 - #22	LINE DROP COMP.	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM2	I9TB1- 5	#14 - #22	SCC	IM2TB1- 21	#14 - #22	VOLT CONTROL	24 VDC	100 mA	SHD		100 FT	
	211	UPM2	I9TB1- 6	#14 - #22	SCC	IM2TB1- 22	#14 - #22	VOLT CONTROL	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM2	I9TB1- 8	#14 - #22	SCC	IM2TB1- 24	#14 - #22	CURRENT SHARE	24 VDC	100 mA	SHD		100 FT	
	212	UPM2	I9TB1- 9	#14 - #22	SCC	IM2TB1- 25	#14 - #22	CURRENT SHARE	24 VDC	100 mA	WHITE	2/C TW	100 FT	
	213	UPM2	I9TB1- 10	#14 - #22	SCC	IM2TB1- 26	#14 - #22	CURRENT SHARE	24 VDC	100 mA	BLACK	PR SHD	100 FT	
CBL GRP. #21	214	UPM2	I7TB51- 1	#14 - #22	SCC	I11TB1- 11	#14 - #22	COMMUNICATIONS	24 VDC	100 mA		3/C	100 FT	3/C #22
	215	UPM2	I7TB51- 2	#14 - #22	SCC	I11TB1- 10	#14 - #22	COMMUNICATIONS	24 VDC	100 mA		SHIELDED	100 FT	SHIELDED BELDON
	216	UPM2	I7TB51- 3	#14 - #22	SCC	I11TB1- 12	#14 - #22	COMMUNICATIONS	24 VDC	100 mA			100 FT	9939 OR EQUAL
	-	UPM2	I7E1	#14 - #22	SCC	I11TB1- 13	#14 - #22	COMMUNICATIONS	24 VDC	100 mA	SHD		100 FT	
	217	UPM2	I2TB1- 4	#14 - #22	SCC	I2TB2- 3	#14 - #22	2 STEP BATTERY LIMIT	24 VDC	100 mA		1/C #14	100 FT	
	218	UPM2	I2TB1- 3	#14 - #22	SCC	I2TB2- 4	#14 - #22	2 STEP BATTERY LIMIT	24 VDC	100 mA		1/C #14	100 FT	

FOR UNITS MANUFACTURED BEFORE 12/31/02, SEE DRAWING 96-791619-23

NOTES:
1. F.B.O. - FURNISHED BY OTHERS
2. EACH CABLE GROUP MUST BE RUN IN A SEPARATE GROUNDED RIGID METAL CONDUIT TO MINIMIZE CONTROL SIGNAL INTERFERENCE.

96-791619-23A
Rev. 02

Figure 34 Control wire list, Multi-Module System, System Control Cabinet/Module 3 interconnection

CABLE GROUP	WIRE NO.	FROM	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	TO	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	SIGNAL NAME	MAX VOLTAGE	MAX CURRENT	WIRE COLOR	WIRE SIZE & TYPE	MAX. LENGTH	REMARKS
CABLE GROUP #20	301	UPM3	I8TB1- 1	#14 - #22	SCC	IM3TB1- 1	#14 - #22	OSC. SYNC.	24 VDC	100 mA	WHITE	2/C TW	100 FT	18/C TW PR SHIELDED
	302	UPM3	I8TB1- 2	#14 - #22	SCC	IM3TB1- 2	#14 - #22	OSC. SYNC.	24 VDC	100 mA	BLACK	PR SHD	100 FT	#18 BELDEN 9390 OR
	-	UPM3	I8TB1- 3	#14 - #22	SCC	IM3TB1- 3	#14 - #22	OSC. SYNC.	24 VDC	100 mA	SHD		100 FT	7-2/C #18 TW. PR.
	-	UPM3	I8TB1- 4	#14 - #22	SCC	IM3TB1- 4	#14 - #22	PHASE SYNC.	24 VDC	100 mA	SHD		100 FT	SHIELDED BELDON 8760
	303	UPM3	I8TB1- 5	#14 - #22	SCC	IM3TB1- 5	#14 - #22	PHASE SYNC.	24 VDC	100 mA	BLACK	2/C TW	100 FT	OR EQUAL
	304	UPM3	I8TB1- 6	#14 - #22	SCC	IM3TB1- 6	#14 - #22	PHASE SYNC.	24 VDC	100 mA	WHITE	PR SHD	100 FT	
	305	UPM3	I8TB1- 7	#14 - #22	SCC	IM3TB1- 7	#14 - #22	FREQ. CONTROL	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM3	I8TB1- 8	#14 - #22	SCC	IM3TB1- 8	#14 - #22	FREQ. CONTROL	24 VDC	100 mA	SHD		100 FT	
	306	UPM3	I8TB1- 9	#14 - #22	SCC	IM3TB1- 9	#14 - #22	GROUND	24 VDC	100 mA		1/C #14	100 FT	
	307	UPM3	I8TB1- 10	#14 - #22	SCC	IM3TB1- 10	#14 - #22	EMO SUPPLY	24 VDC	100 mA		1/C #14	100 FT	
	308	UPM3	I8TB1- 11	#14 - #22	SCC	IM3TB1- 11	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	WHITE	2/C TW	100 FT	
	309	UPM3	I8TB1- 12	#14 - #22	SCC	IM3TB1- 12	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	BLACK	PR SHD	100 FT	
	-	UPM3	I8TB1- 13	#14 - #22	SCC	IM3TB1- 13	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	SHD		100 FT	
	-	UPM3	I9TB1- 3	#14 - #22	SCC	IM3TB1- 19	#14 - #22	LINE DROP COMP.	24 VDC	100 mA	SHD		100 FT	
	310	UPM3	I9TB1- 4	#14 - #22	SCC	IM3TB1- 20	#14 - #22	LINE DROP COMP.	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM3	I9TB1- 5	#14 - #22	SCC	IM3TB1- 21	#14 - #22	VOLT CONTROL	24 VDC	100 mA	SHD		100 FT	
	311	UPM3	I9TB1- 6	#14 - #22	SCC	IM3TB1- 22	#14 - #22	VOLT CONTROL	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM3	I9TB1- 8	#14 - #22	SCC	IM3TB1- 24	#14 - #22	CURRENT SHARE	24 VDC	100 mA	SHD		100 FT	
	312	UPM3	I9TB1- 9	#14 - #22	SCC	IM3TB1- 25	#14 - #22	CURRENT SHARE	24 VDC	100 mA	WHITE	2/C TW	100 FT	
	313	UPM3	I9TB1- 10	#14 - #22	SCC	IM3TB1- 26	#14 - #22	CURRENT SHARE	24 VDC	100 mA	BLACK	PR SHD	100 FT	
CBL GRP. #21	314	UPM3	I7TB51- 1	#14 - #22	SCC	I11TB1- 15	#14 - #22	COMMUNICATIONS	24 VDC	100 mA		3/C	100 FT	3/C #22
	315	UPM3	I7TB51- 2	#14 - #22	SCC	I11TB1- 14	#14 - #22	COMMUNICATIONS	24 VDC	100 mA		SHIELDED	100 FT	SHIELDED BELDON
	316	UPM3	I7TB51- 3	#14 - #22	SCC	I11TB1- 16	#14 - #22	COMMUNICATIONS	24 VDC	100 mA			100 FT	9939 OR EQUAL
	-	UPM3	I7E1	#14 - #22	SCC	I11TB1- 17	#14 - #22	COMMUNICATIONS	24 VDC	100 mA	SHD		100 FT	
	317	UPM3	I2TB1- 4	#14 - #22	SCC	I2TB2- 5	#14 - #22	2 STEP BATTERY LIMIT	24 VDC	100 mA		1/C #14	100 FT	
	318	UPM3	I2TB1- 3	#14 - #22	SCC	I2TB2- 6	#14 - #22	2 STEP BATTERY LIMIT	24 VDC	100 mA		1/C #14	100 FT	

FOR UNITS MANUFACTURED BEFORE 12/31/02, SEE DRAWING 96-791619-24

NOTES:

1. F.B.O. - FURNISHED BY OTHERS
2. EACH CABLE GROUP MUST BE RUN IN A SEPARATE GROUNDED RIGID METAL CONDUIT TO MINIMIZE CONTROL SIGNAL INTERFERENCE.

96-791619-24A
Rev. 02

Figure 35 Control wire list, Multi-Module System, System Control Cabinet/Module 4 interconnection

	WIRE NO.	FROM	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	TO	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	SIGNAL NAME	MAX VOLTAGE	MAX CURRENT	WIRE COLOR	WIRE SIZE & TYPE	MAX. LENGTH	REMARKS
CABLE GROUP #20	401	UPM4	I8TB1- 1	#14 - #22	SCC	IM4TB1- 1	#14 - #22	OSC. SYNC.	24 VDC	100 mA	WHITE	2/C TW	100 FT	18/C TW PR SHIELDED
	402	UPM4	I8TB1- 2	#14 - #22	SCC	IM4TB1- 2	#14 - #22	OSC. SYNC.	24 VDC	100 mA	BLACK	PR SHD	100 FT	#18 BELDEN 9390 OR
	-	UPM4	I8TB1- 3	#14 - #22	SCC	IM4TB1- 3	#14 - #22	OSC. SYNC.	24 VDC	100 mA	SHD		100 FT	7-2/C #18 TW. PR.
	-	UPM4	I8TB1- 4	#14 - #22	SCC	IM4TB1- 4	#14 - #22	PHASE SYNC.	24 VDC	100 mA	SHD		100 FT	SHIELDED BELDON 8760
	403	UPM4	I8TB1- 5	#14 - #22	SCC	IM4TB1- 5	#14 - #22	PHASE SYNC.	24 VDC	100 mA	BLACK	2/C TW	100 FT	OR EQUAL
	404	UPM4	I8TB1- 6	#14 - #22	SCC	IM4TB1- 6	#14 - #22	PHASE SYNC.	24 VDC	100 mA	WHITE	PR SHD	100 FT	
	405	UPM4	I8TB1- 7	#14 - #22	SCC	IM4TB1- 7	#14 - #22	FREQ. CONTROL	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM4	I8TB1- 8	#14 - #22	SCC	IM4TB1- 8	#14 - #22	FREQ. CONTROL	24 VDC	100 mA	SHD		100 FT	
	406	UPM4	I8TB1- 9	#14 - #22	SCC	IM4TB1- 9	#14 - #22	GROUND	24 VDC	100 mA		1/C #14	100 FT	
	407	UPM4	I8TB1- 10	#14 - #22	SCC	IM4TB1- 10	#14 - #22	EMO SUPPLY	24 VDC	100 mA		1/C #14	100 FT	
	408	UPM4	I8TB1- 11	#14 - #22	SCC	IM4TB1- 11	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	WHITE	2/C TW	100 FT	
	409	UPM4	I8TB1- 12	#14 - #22	SCC	IM4TB1- 12	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	BLACK	PR SHD	100 FT	
	-	UPM4	I8TB1- 13	#14 - #22	SCC	IM4TB1- 13	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	SHD		100 FT	
	-	UPM4	I9TB1- 3	#14 - #22	SCC	IM4TB1- 19	#14 - #22	LINE DROP COMP.	24 VDC	100 mA	SHD		100 FT	
	410	UPM4	I9TB1- 4	#14 - #22	SCC	IM4TB1- 20	#14 - #22	LINE DROP COMP.	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM4	I9TB1- 5	#14 - #22	SCC	IM4TB1- 21	#14 - #22	VOLT CONTROL	24 VDC	100 mA	SHD		100 FT	
	411	UPM4	I9TB1- 6	#14 - #22	SCC	IM4TB1- 22	#14 - #22	VOLT CONTROL	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM4	I9TB1- 8	#14 - #22	SCC	IM4TB1- 24	#14 - #22	CURRENT SHARE	24 VDC	100 mA	SHD		100 FT	
	412	UPM4	I9TB1- 9	#14 - #22	SCC	IM4TB1- 25	#14 - #22	CURRENT SHARE	24 VDC	100 mA	WHITE	2/C TW	100 FT	
	413	UPM4	I9TB1- 10	#14 - #22	SCC	IM4TB1- 26	#14 - #22	CURRENT SHARE	24 VDC	100 mA	BLACK	PR SHD	100 FT	
CBL GRP. #21	414	UPM4	I7TB51- 1	#14 - #22	SCC	I11TB1- 19	#14 - #22	COMMUNICATIONS	24 VDC	100 mA		3/C	100 FT	3/C #22
	415	UPM4	I7TB51- 2	#14 - #22	SCC	I11TB1- 18	#14 - #22	COMMUNICATIONS	24 VDC	100 mA		SHIELDED	100 FT	SHIELDED BELDON
	416	UPM4	I7TB51- 3	#14 - #22	SCC	I11TB1- 20	#14 - #22	COMMUNICATIONS	24 VDC	100 mA			100 FT	9939 OR EQUAL
	-	UPM4	I7E1	#14 - #22	SCC	I11TB1- 21	#14 - #22	COMMUNICATIONS	24 VDC	100 mA	SHD		100 FT	
	417	UPM4	I2TB1- 4	#14 - #22	SCC	I2TB2- 7	#14 - #22	2 STEP BATTERY LIMIT	24 VDC	100 mA		1/C #14	100 FT	
	418	UPM4	I2TB1- 3	#14 - #22	SCC	I2TB2- 8	#14 - #22	2 STEP BATTERY LIMIT	24 VDC	100 mA		1/C #14	100 FT	

FOR UNITS MANUFACTURED BEFORE 12/31/02, SEE DRAWING 96-791619-25

NOTES:

1. F.B.O. - FURNISHED BY OTHERS
2. EACH CABLE GROUP MUST BE RUN IN A SEPARATE GROUNDED RIGID METAL CONDUIT TO MINIMIZE CONTROL SIGNAL INTERFERENCE.

96-791619-25A
Rev. 02

Figure 36 Control wire list, Multi-Module System, System Control Cabinet/Module 5 interconnection

	WIRE NO.	FROM	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	TO	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	SIGNAL NAME	MAX VOLTAGE	MAX CURRENT	WIRE COLOR	WIRE SIZE & TYPE	MAX. LENGTH	REMARKS
CABLE GROUP #20	501	UPM5	I8TB1- 1	#14 - #22	SCC	IM5TB1- 1	#14 - #22	OSC. SYNC.	24 VDC	100 mA	WHITE	2/C TW	100 FT	18/C TW PR SHIELDED #18 BELDEN 9390 OR 7-2/C #18 TW. PR. SHIELDED BELDON 8760 OR EQUAL
	502	UPM5	I8TB1- 2	#14 - #22	SCC	IM5TB1- 2	#14 - #22	OSC. SYNC.	24 VDC	100 mA	BLACK	PR SHD	100 FT	
	-	UPM5	I8TB1- 3	#14 - #22	SCC	IM5TB1- 3	#14 - #22	OSC. SYNC.	24 VDC	100 mA	SHD		100 FT	
	-	UPM5	I8TB1- 4	#14 - #22	SCC	IM5TB1- 4	#14 - #22	PHASE SYNC.	24 VDC	100 mA	SHD		100 FT	
	503	UPM5	I8TB1- 5	#14 - #22	SCC	IM5TB1- 5	#14 - #22	PHASE SYNC.	24 VDC	100 mA	BLACK	2/C TW	100 FT	
	504	UPM5	I8TB1- 6	#14 - #22	SCC	IM5TB1- 6	#14 - #22	PHASE SYNC.	24 VDC	100 mA	WHITE	PR SHD	100 FT	
	505	UPM5	I8TB1- 7	#14 - #22	SCC	IM5TB1- 7	#14 - #22	FREQ. CONTROL	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM5	I8TB1- 8	#14 - #22	SCC	IM5TB1- 8	#14 - #22	FREQ. CONTROL	24 VDC	100 mA	SHD		100 FT	
	506	UPM5	I8TB1- 9	#14 - #22	SCC	IM5TB1- 9	#14 - #22	GROUND	24 VDC	100 mA		1/C #14	100 FT	
	507	UPM5	I8TB1- 10	#14 - #22	SCC	IM5TB1- 10	#14 - #22	EMO SUPPLY	24 VDC	100 mA		1/C #14	100 FT	
	508	UPM5	I8TB1- 11	#14 - #22	SCC	IM5TB1- 11	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	WHITE	2/C TW	100 FT	
	509	UPM5	I8TB1- 12	#14 - #22	SCC	IM5TB1- 12	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	BLACK	PR SHD	100 FT	
	-	UPM5	I8TB1- 13	#14 - #22	SCC	IM5TB1- 13	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	SHD		100 FT	
	-	UPM5	I9TB1- 3	#14 - #22	SCC	IM5TB1- 19	#14 - #22	LINE DROP COMP.	24 VDC	100 mA	SHD		100 FT	
	510	UPM5	I9TB1- 4	#14 - #22	SCC	IM5TB1- 20	#14 - #22	LINE DROP COMP.	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM5	I9TB1- 5	#14 - #22	SCC	IM5TB1- 21	#14 - #22	VOLT CONTROL	24 VDC	100 mA	SHD		100 FT	
	511	UPM5	I9TB1- 6	#14 - #22	SCC	IM5TB1- 22	#14 - #22	VOLT CONTROL	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM5	I9TB1- 8	#14 - #22	SCC	IM5TB1- 24	#14 - #22	CURRENT SHARE	24 VDC	100 mA	SHD		100 FT	
	512	UPM5	I9TB1- 9	#14 - #22	SCC	IM5TB1- 25	#14 - #22	CURRENT SHARE	24 VDC	100 mA	WHITE	2/C TW	100 FT	
	513	UPM5	I9TB1- 10	#14 - #22	SCC	IM5TB1- 26	#14 - #22	CURRENT SHARE	24 VDC	100 mA	BLACK	PR SHD	100 FT	
CBL GRP. #21	514	UPM5	I7TB51- 1	#14 - #22	SCC	I11TB1- 23	#14 - #22	COMMUNICATIONS	24 VDC	100 mA		3/C	100 FT	3/C #22 SHIELDED BELDON 9939 OR EQUAL
	515	UPM5	I7TB51- 2	#14 - #22	SCC	I11TB1- 22	#14 - #22	COMMUNICATIONS	24 VDC	100 mA		SHIELDED	100 FT	
	516	UPM5	I7TB51- 3	#14 - #22	SCC	I11TB1- 24	#14 - #22	COMMUNICATIONS	24 VDC	100 mA			100 FT	
	-	UPM5	I7E1	#14 - #22	SCC	I11TB1- 25	#14 - #22	COMMUNICATIONS	24 VDC	100 mA	SHD		100 FT	
	517	UPM5	I2TB1- 4	#14 - #22	SCC	I2TB2- 9	#14 - #22	2 STEP BATTERY LIMIT	24 VDC	100 mA		1/C #14	100 FT	
	518	UPM5	I2TB1- 3	#14 - #22	SCC	I2TB2- 10	#14 - #22	2 STEP BATTERY LIMIT	24 VDC	100 mA		1/C #14	100 FT	

FOR UNITS MANUFACTURED BEFORE 12/31/02, SEE DRAWING 96-791619-26

NOTES:
1. F.B.O. - FURNISHED BY OTHERS
2. EACH CABLE GROUP MUST BE RUN IN A SEPARATE GROUNDED RIGID METAL CONDUIT TO MINIMIZE CONTROL SIGNAL INTERFERENCE.

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Figure 37 Control wire list, Multi-Module System, System Control Cabinet/Module 6 interconnection

	WIRE NO.	FROM	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	TO	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	SIGNAL NAME	MAX VOLTAGE	MAX CURRENT	WIRE COLOR	WIRE SIZE & TYPE	MAX. LENGTH	REMARKS
CABLE GROUP #20	601	UPM6	I8TB1- 1	#14 - #22	SCC	IM6TB1- 1	#14 - #22	OSC. SYNC.	24 VDC	100 mA	WHITE	2/C TW	100 FT	18/C TW PR SHIELDED
	602	UPM6	I8TB1- 2	#14 - #22	SCC	IM6TB1- 2	#14 - #22	OSC. SYNC.	24 VDC	100 mA	BLACK	PR SHD	100 FT	#18 BELDEN 9390 OR
	-	UPM6	I8TB1- 3	#14 - #22	SCC	IM6TB1- 3	#14 - #22	OSC. SYNC.	24 VDC	100 mA	SHD		100 FT	7-2/C #18 TW. PR.
	-	UPM6	I8TB1- 4	#14 - #22	SCC	IM6TB1- 4	#14 - #22	PHASE SYNC.	24 VDC	100 mA	SHD		100 FT	SHIELDED BELDON 8760
	603	UPM6	I8TB1- 5	#14 - #22	SCC	IM6TB1- 5	#14 - #22	PHASE SYNC.	24 VDC	100 mA	BLACK	2/C TW	100 FT	OR EQUAL
	604	UPM6	I8TB1- 6	#14 - #22	SCC	IM6TB1- 6	#14 - #22	PHASE SYNC.	24 VDC	100 mA	WHITE	PR SHD	100 FT	
	605	UPM6	I8TB1- 7	#14 - #22	SCC	IM6TB1- 7	#14 - #22	FREQ. CONTROL	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM6	I8TB1- 8	#14 - #22	SCC	IM6TB1- 8	#14 - #22	FREQ. CONTROL	24 VDC	100 mA	SHD		100 FT	
	606	UPM6	I8TB1- 9	#14 - #22	SCC	IM6TB1- 9	#14 - #22	GROUND	24 VDC	100 mA		1/C #14	100 FT	
	607	UPM6	I8TB1- 10	#14 - #22	SCC	IM6TB1- 10	#14 - #22	EMO SUPPLY	24 VDC	100 mA		1/C #14	100 FT	
	608	UPM6	I8TB1- 11	#14 - #22	SCC	IM6TB1- 11	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	WHITE	2/C TW	100 FT	
	609	UPM6	I8TB1- 12	#14 - #22	SCC	IM6TB1- 12	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	BLACK	PR SHD	100 FT	
	-	UPM6	I8TB1- 13	#14 - #22	SCC	IM6TB1- 13	#14 - #22	MAJORITY FAIL	24 VDC	100 mA	SHD		100 FT	
	-	UPM6	I9TB1- 3	#14 - #22	SCC	IM6TB1- 19	#14 - #22	LINE DROP COMP.	24 VDC	100 mA	SHD		100 FT	
	610	UPM6	I9TB1- 4	#14 - #22	SCC	IM6TB1- 20	#14 - #22	LINE DROP COMP.	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM6	I9TB1- 5	#14 - #22	SCC	IM6TB1- 21	#14 - #22	VOLT CONTROL	24 VDC	100 mA	SHD		100 FT	
	611	UPM6	I9TB1- 6	#14 - #22	SCC	IM6TB1- 22	#14 - #22	VOLT CONTROL	24 VDC	100 mA	BLK/WHT	2/C TW PR SHD	100 FT	
	-	UPM6	I9TB1- 8	#14 - #22	SCC	IM6TB1- 24	#14 - #22	CURRENT SHARE	24 VDC	100 mA	SHD		100 FT	
	612	UPM6	I9TB1- 9	#14 - #22	SCC	IM6TB1- 25	#14 - #22	CURRENT SHARE	24 VDC	100 mA	WHITE	2/C TW	100 FT	
	613	UPM6	I9TB1- 10	#14 - #22	SCC	IM6TB1- 26	#14 - #22	CURRENT SHARE	24 VDC	100 mA	BLACK	PR SHD	100 FT	
CBL GRP. #21	614	UPM6	I7TB51- 1	#14 - #22	SCC	I11TB1- 27	#14 - #22	COMMUNICATIONS	24 VDC	100 mA		3/C	100 FT	3/C #22
	615	UPM6	I7TB51- 2	#14 - #22	SCC	I11TB1- 26	#14 - #22	COMMUNICATIONS	24 VDC	100 mA		SHIELDED	100 FT	SHIELDED BELDON
	616	UPM6	I7TB51- 3	#14 - #22	SCC	I11TB1- 28	#14 - #22	COMMUNICATIONS	24 VDC	100 mA			100 FT	9939 OR EQUAL
	-	UPM6	I7E1	#14 - #22	SCC	I11TB1- 29	#14 - #22	COMMUNICATIONS	24 VDC	100 mA	SHD		100 FT	
	617	UPM6	I2TB1- 4	#14 - #22	SCC	I2TB2- 11	#14 - #22	2 STEP BATTERY LIMIT	24 VDC	100 mA		1/C #14	100 FT	
	618	UPM6	I2TB1- 3	#14 - #22	SCC	I2TB2- 12	#14 - #22	2 STEP BATTERY LIMIT	24 VDC	100 mA		1/C #14	100 FT	

FOR UNITS MANUFACTURED BEFORE 12/31/02, SEE DRAWING 96-791619-27

NOTES:
1. F.B.O. - FURNISHED BY OTHERS
2. EACH CABLE GROUP MUST BE RUN IN A SEPARATE GROUNDED RIGID METAL CONDUIT TO MINIMIZE CONTROL SIGNAL INTERFERENCE.

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Figure 38 Control wire list, Multi-Module System, System Control Cabinet, external interconnections, Part 1

CABLE GROUP	WIRE NO.	FROM	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	TO	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	SIGNAL NAME	MAX VOLTAGE	MAX CURRENT	WIRE COLOR	WIRE SIZE & TYPE	MAX. LENGTH	REMARKS
CABLE GROUP #2	700	SCC	I7TB51- 1	#14 - #22	REM. TERM.	F.B.O.	F.B.O.	REM. TERM. TXD	24 VDC	100 mA		#22 SHIELDED	50-100 FT	BELDEN 9939
	701	SCC	I7TB51- 2	#14 - #22	REM. TERM.	F.B.O.	F.B.O.	REM. RERM. RXD	24 VDC	100 mA		#22 SHIELDED	50-100 FT	OR EQUAL
	702	SCC	I7TB51- 3	#14 - #22	REM. TERM.	F.B.O.	F.B.O.	REM. TERM. GND	24 VDC	100 mA		#22 SHIELDED	50-100 FT	SEE NOTE 3
	-	SCC	I7E1	#14 - #22	REM. TERM.	F.B.O.	F.B.O.	REM. TERM. SHD	24 VDC	100 mA		SHD	50-100 FT	
	703	SCC	I7TB52- 1	#14 - #22	MODEM	F.B.O.	F.B.O.	MODEM DCD	24 VDC	100 mA		#22 SHIELDED	50-100 FT	
	704	SCC	I7TB52- 3	#14 - #22	MODEM	F.B.O.	F.B.O.	MODEM TXD	24 VDC	100 mA		#22 SHIELDED	50-100 FT	
	705	SCC	I7TB52- 2	#14 - #22	MODEM	F.B.O.	F.B.O.	MODEM RXD	24 VDC	100 mA		#22 SHIELDED	50-100 FT	
	706	SCC	I7TB53- 2	#14 - #22	MODEM	F.B.O.	F.B.O.	MODEM GND	24 VDC	100 mA		#22 SHIELDED	50-100 FT	
	-	SCC	I7E1	#14 - #22	MODEM	F.B.O.	F.B.O.	MODEM SHD	24 VDC	100 mA		SHD	50-100 FT	
	707	SCC	I7TB51- 1	#14 - #22	REM. CRT	F.B.O.	F.B.O.	REM. CRT TXD	24 VDC	100 mA		#22 SHIELDED	50-100 FT	
	708	SCC	I7TB51- 3	#14 - #22	REM. CRT	F.B.O.	F.B.O.	REM. CRT GND	24 VDC	100 mA		#22 SHIELDED	50-100 FT	
	-	SCC	I7E1	#14 - #22	REM. CRT	F.B.O.	F.B.O.	REM. CRT SHD	24 VDC	100 mA		SHD	50-100 FT	
CBL GRP #3	711	SCC	I3TB2- 1	#14 - #22	REMO	N.O.	F.B.O.	REMOTE EMER. MOD. OFF	24 VDC	1 A		1/C #14	500 FT	
	712	SCC	I3TB2- 2	#14 - #22	REMO	COMM.	F.B.O.	REMOTE EMER. MOD. OFF	24 VDC	1 A		1/C #14	500 FT	
	713	SCC	I3TB2- 3	#14 - #22	REPO	N.O.	F.B.O.	REMOTE EMER. POWER OFF	24 VDC	1 A		1/C #14	500 FT	
	714	SCC	I3TB2- 4	#14 - #22	REPO	COMM.	F.B.O.	REMOTE EMER. POWER OFF	24 VDC	1 A		1/C #14	500 FT	
CABLE GROUP #4	721	SCC	I5TB1- 1	#14 - #22	RMP	TB1- 1	#12 - #22	LOAD ON UPS	24 VDC	100 mA		1/C #14	500 FT	
	722	SCC	I5TB1- 2	#14 - #22	RMP	TB1- 2	#12 - #22	LOAD ON BYPASS	24 VDC	100 mA		1/C #14	500 FT	
	723	SCC	I5TB1- 3	#14 - #22	RMP	TB1- 3	#12 - #22	BATTERY DISCHARGING	24 VDC	100 mA		1/C #14	500 FT	
	724	SCC	I5TB1- 4	#14 - #22	RMP	TB1- 4	#12 - #22	LOW BATTERY WARNING	24 VDC	100 mA		1/C #14	500 FT	
	725	SCC	I5TB1- 5	#14 - #22	RMP	TB1- 5	#12 - #22	OVERLOAD	24 VDC	100 mA		1/C #14	500 FT	
	726	SCC	I5TB1- 6	#14 - #22	RMP	TB1- 6	#12 - #22	AMBIENT OVERTEMP	24 VDC	100 mA		1/C #14	500 FT	
	727	SCC	I5TB1- 7	#14 - #22	RMP	TB1- 7	#12 - #22	SYSTEM SUMMARY ALARM	24 VDC	100 mA		1/C #14	500 FT	
	728	SCC	I5TB1- 8	#14 - #22	RMP	TB1- 8	#12 - #22	NEW ALARM	24 VDC	100 mA		1/C #14	500 FT	
	729	SCC	I5TB1- 9	#14 - #22	RMP	TB1- 9	#12 - #22	+ 24 VDC	24 VDC	100 mA		1/C #14	500 FT	
	730	SCC	I5TB1- 10	#14 - #22	RMP	TB1- 10	#12 - #22	GROUND	24 VDC	100 mA		1/C #14	500 FT	
CABLE GROUP #5	741	SCC	I4TB1- 1	#14 - #22	MUX BD		#16 - #22	SC/SM SCC (+)	5 VDC	10 mA	BLACK	2/C #22	1000 FT	BELDON 8761
	742	SCC	I4TB1- 2	#14 - #22	MUX BD		#16 - #22	SC/SM SCC (-)	5 VDC	10 mA	CLEAR	TWISTED PAIR	1000 FT	OR EQUAL
	743	SCC	I4TB1- 3	#14 - #22	MUX BD		#16 - #22	SC/SM MOD1 (+)	5 VDC	10 mA	BLACK	2/C #22	1000 FT	SEE NOTE 3
	744	SCC	I4TB1- 4	#14 - #22	MUX BD		#16 - #22	SC/SM MOD1 (-)	5 VDC	10 mA	CLEAR	TWISTED PAIR	1000 FT	
	745	SCC	I4TB1- 5	#14 - #22	MUX BD		#16 - #22	SC/SM MOD2 (+)	5 VDC	10 mA	BLACK	2/C #22	1000 FT	
	746	SCC	I4TB1- 6	#14 - #22	MUX BD		#16 - #22	SC/SM MOD2 (-)	5 VDC	10 mA	CLEAR	TWISTED PAIR	1000 FT	
	747	SCC	I4TB1- 7	#14 - #22	MUX BD		#16 - #22	SC/SM MOD3 (+)	5 VDC	10 mA	BLACK	2/C #22	1000 FT	
	748	SCC	I4TB1- 8	#14 - #22	MUX BD		#16 - #22	SC/SM MOD3 (-)	5 VDC	10 mA	CLEAR	TWISTED PAIR	1000 FT	
	749	SCC	I4TB1- 9	#14 - #22	MUX BD		#16 - #22	SC/SM MOD4 (+)	5 VDC	10 mA	BLACK	2/C #22	1000 FT	
	750	SCC	I4TB1- 10	#14 - #22	MUX BD		#16 - #22	SC/SM MOD4 (-)	5 VDC	10 mA	CLEAR	TWISTED PAIR	1000 FT	
	751	SCC	I4TB1- 11	#14 - #22	MUX BD		#16 - #22	SC/SM MOD5 (+)	5 VDC	10 mA	BLACK	2/C #22	1000 FT	
	752	SCC	I4TB1- 12	#14 - #22	MUX BD		#16 - #22	SC/SM MOD5 (-)	5 VDC	10 mA	CLEAR	TWISTED PAIR	1000 FT	
	753	SCC	I4TB1- 13	#14 - #22	MUX BD		#16 - #22	SC/SM MOD6 (+)	5 VDC	10 mA	BLACK	2/C #22	1000 FT	
	754	SCC	I4TB1- 14	#14 - #22	MUX BD		#16 - #22	SC/SM MOD6 (-)	5 VDC	10 mA	CLEAR	TWISTED PAIR	1000 FT	

FOR UNITS MANUFACTURED BEFORE 12/31/02, SEE DRAWING 96-791619-19

NOTES:

1. F.B.O. - FURNISHED BY OTHERS
2. EACH CABLE GROUP MUST BE RUN IN A SEPARATE GROUNDED RIGID METAL CONDUIT TO MINIMIZE CONTROL SIGNAL INTERFERENCE.
3. CABLE GROUP #2 AND #5 MAY BE RUN IN THE SAME GROUNDED RIGID METAL CONDUIT.

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Figure 39 Control wire list, Multi-Module UPS System, System Control Cabinet, external interconnections, Part 2, Cable Groups 6-8

CABLE GROUP	WIRE NO.	FROM	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	TO	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	SIGNAL NAME	MAX VOLTAGE	MAX CURRENT	WIRE COLOR	WIRE SIZE & TYPE	MAX. LENGTH	REMARKS
CG 6	761	SCC	I2TB1- 3	#14 - #22	GENERATOR	N.O.	F.B.O.	2 STEP BATTERY LIMIT	24 VDC	100 mA		1/C #14	500 FT	
CG 6	762	SCC	I2TB1- 4	#14 - #22	GENERATOR	COMM.	F.B.O.	2 STEP BATTERY LIMIT	24 VDC	100 mA		1/C #14	500 FT	
CABLE GROUP #7	771	SCC	I10TB2-1	#14 - #22	MBS	1	#10 - #22	ON BYPASS COM	120 VAC	5 A		1/C #14	500 FT	
CABLE GROUP #7	772	SCC	I10TB2-3	#14 - #22	MBS	2	#10 - #22	ON BYPASS N.O.	120 VAC	5 A		1/C #14	500 FT	
CABLE GROUP #7	773	SCC	I10TB2-7	#14 - #22	MBS	3	#10 - #22	TRANSFER INHIBIT	120 VAC	5 A		1/C #14	500 FT	
CABLE GROUP #7	774	SCC	I10TB2-8	#14 - #22	MBS	4	#10 - #22	TRANSFER INHIBIT	120 VAC	5 A		1/C #14	500 FT	
CABLE GROUP #7	775	SCC	I10TB2-4	#14 - #22	MBS	5	#10 - #22	MBB EPO N.O.	120 VAC	10 A		1/C #14	500 FT	
CABLE GROUP #7	776	SCC	I10TB2-5	#14 - #22	MBS		#10 - #22	MBB EPO N.C.	120 VAC	10 A		1/C #14	500 FT	
CABLE GROUP #7	777	SCC	I10TB2-6	#14 - #22	MBS	6	#10 - #22	MBB EPO COM	120 VAC	10 A		1/C #14	500 FT	
CABLE GROUP #8	801	SCC	I6TB1- 1	#14 - #22	F.B.O.	N.O.	F.B.O.	LOAD ON UPS	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	802	SCC	I6TB1- 3	#14 - #22	F.B.O.	N.C.	F.B.O.	LOAD ON UPS	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	803	SCC	I6TB1- 5	#14 - #22	F.B.O.	COMM	F.B.O.	LOAD ON UPS	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	804	SCC	I6TB1- 7	#14 - #22	F.B.O.	N.O.	F.B.O.	LOAD ON BYPASS	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	805	SCC	I6TB1- 9	#14 - #22	F.B.O.	N.C.	F.B.O.	LOAD ON BYPASS	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	806	SCC	I6TB1- 11	#14 - #22	F.B.O.	COMM	F.B.O.	LOAD ON BYPASS	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	807	SCC	I6TB1- 13	#14 - #22	F.B.O.	N.O.	F.B.O.	BATTERY DISCHARGING	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	808	SCC	I6TB1- 15	#14 - #22	F.B.O.	N.C.	F.B.O.	BATTERY DISCHARGING	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	809	SCC	I6TB1- 17	#14 - #22	F.B.O.	COMM	F.B.O.	BATTERY DISCHARGING	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	810	SCC	I6TB1- 19	#14 - #22	F.B.O.	N.O.	F.B.O.	LOW BATTERY WARNING	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	811	SCC	I6TB1- 21	#14 - #22	F.B.O.	N.C.	F.B.O.	LOW BATTERY WARNING	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	812	SCC	I6TB1- 23	#14 - #22	F.B.O.	COMM	F.B.O.	LOW BATTERY WARNING	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	813	SCC	I6TB1- 25	#14 - #22	F.B.O.	N.O.	F.B.O.	OVERLOAD	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	814	SCC	I6TB1- 27	#14 - #22	F.B.O.	N.C.	F.B.O.	OVERLOAD	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	815	SCC	I6TB1- 29	#14 - #22	F.B.O.	COMM	F.B.O.	OVERLOAD	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	816	SCC	I6TB1- 31	#14 - #22	F.B.O.	N.O.	F.B.O.	AMBIENT OVERTEMP	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	817	SCC	I6TB1- 33	#14 - #22	F.B.O.	N.C.	F.B.O.	AMBIENT OVERTEMP	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	818	SCC	I6TB1- 35	#14 - #22	F.B.O.	COMM	F.B.O.	AMBIENT OVERTEMP	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	819	SCC	I6TB1- 37	#14 - #22	F.B.O.	N.O.	F.B.O.	SYSTEM SUMMARY ALARM	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	820	SCC	I6TB1- 39	#14 - #22	F.B.O.	N.C.	F.B.O.	SYSTEM SUMMARY ALARM	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	821	SCC	I6TB1- 41	#14 - #22	F.B.O.	COMM	F.B.O.	SYSTEM SUMMARY ALARM	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	822	SCC	I6TB1- 43	#14 - #22	F.B.O.	N.O.	F.B.O.	NEW ALARM	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	823	SCC	I6TB1- 45	#14 - #22	F.B.O.	N.C.	F.B.O.	NEW ALARM	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5
CABLE GROUP #8	824	SCC	I6TB1- 47	#14 - #22	F.B.O.	COMM	F.B.O.	NEW ALARM	125 VAC	500 mA		1/C #14		SEE NOTE 4, 5

NOTES:

1. F.B.O. - FURNISHED BY OTHERS
2. EACH CABLE GROUP MUST BE RUN IN A SEPARATE STEEL RACEWAY TO MINIMIZE CONTROL SIGNAL INTERFERENCE.
3. CABLE GROUP #2 AND #5 MAY BE RUN IN THE SAME CONDUIT.
4. CABLE GROUP #8 AND #14 MAY BE RUN IN THE SAME CONDUIT.
5. THE CONTACTS ARE ALSO RATED 2A MAX. AT 30 VDC MAX.

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Figure 40 Control wire list, Multi-Module System, external interconnection, optional customer alarm interface 1, Cable Group 9

	WIRE NO.	FROM	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	TO	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	SIGNAL NAME	MAX VOLTAGE	MAX CURRENT	WIRE COLOR	WIRE SIZE & TYPE	MAX. LENGTH	REMARKS
CABLE GROUP #9	781	SCC	I15TB1- 1	#14 - #22	F.B.O.	N.O.	F.B.O.	(PROGRAMMABLE) ALARM #1	24 VDC	100 mA		1/C #14	500 FT	
	782	SCC	I15TB1- 2	#14 - #22	F.B.O.	COMM.	F.B.O.	(PROGRAMMABLE) ALARM #1	24 VDC	100 mA		1/C #14	500 FT	
	783	SCC	I15TB1- 3	#14 - #22	F.B.O.	N.O.	F.B.O.	(PROGRAMMABLE) ALARM #2	24 VDC	100 mA		1/C #14	500 FT	
	784	SCC	I15TB1- 4	#14 - #22	F.B.O.	COMM.	F.B.O.	(PROGRAMMABLE) ALARM #2	24 VDC	100 mA		1/C #14	500 FT	
	785	SCC	I15TB1- 5	#14 - #22	F.B.O.	N.O.	F.B.O.	(PROGRAMMABLE) ALARM #3	24 VDC	100 mA		1/C #14	500 FT	
	786	SCC	I15TB1- 6	#14 - #22	F.B.O.	COMM.	F.B.O.	(PROGRAMMABLE) ALARM #3	24 VDC	100 mA		1/C #14	500 FT	
	787	SCC	I15TB1- 7	#14 - #22	F.B.O.	N.O.	F.B.O.	(PROGRAMMABLE) ALARM #4	24 VDC	100 mA		1/C #14	500 FT	
	788	SCC	I15TB1- 8	#14 - #22	F.B.O.	COMM.	F.B.O.	(PROGRAMMABLE) ALARM #4	24 VDC	100 mA		1/C #14	500 FT	
	789	SCC	I15TB1- 9	#14 - #22	F.B.O.	N.O.	F.B.O.	(PROGRAMMABLE) ALARM #5	24 VDC	100 mA		1/C #14	500 FT	
	790	SCC	I15TB1- 10	#14 - #22	F.B.O.	COMM.	F.B.O.	(PROGRAMMABLE) ALARM #5	24 VDC	100 mA		1/C #14	500 FT	
	791	SCC	I15TB2- 1	#14 - #22	F.B.O.	N.O.	F.B.O.	(PROGRAMMABLE) ALARM #6	24 VDC	100 mA		1/C #14	500 FT	
	792	SCC	I15TB2- 2	#14 - #22	F.B.O.	COMM.	F.B.O.	(PROGRAMMABLE) ALARM #6	24 VDC	100 mA		1/C #14	500 FT	
	793	SCC	I15TB2- 3	#14 - #22	F.B.O.	N.O.	F.B.O.	(PROGRAMMABLE) ALARM #7	24 VDC	100 mA		1/C #14	500 FT	
	794	SCC	I15TB2- 4	#14 - #22	F.B.O.	COMM.	F.B.O.	(PROGRAMMABLE) ALARM #7	24 VDC	100 mA		1/C #14	500 FT	
	795	SCC	I15TB2- 5	#14 - #22	F.B.O.	N.O.	F.B.O.	(PROGRAMMABLE) ALARM #8	24 VDC	100 mA		1/C #14	500 FT	
	796	SCC	I15TB2- 6	#14 - #22	F.B.O.	COMM.	F.B.O.	(PROGRAMMABLE) ALARM #8	24 VDC	100 mA		1/C #14	500 FT	

NOTES:

1. F.B.O. - FURNISHED BY OTHERS.
2. EACH CABLE GROUP MUST BE RUN IN A SEPARATE STEEL RACEWAY TO MINIMIZE CONTROL SIGNAL INTERFACE.

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Figure 41 Control wire list, Multi-Module System, external interconnection, optional reduced input current limit, Cable Group 10

	WIRE NO.	FROM	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	TO	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	SIGNAL NAME	MAX VOLTAGE	MAX CURRENT	WIRE COLOR	WIRE SIZE & TYPE	MAX. LENGTH	REMARKS
CG 10	763	SCC	I19TB1-3	#14 - #22	F.B.O.	F.B.O.	F.B.O.	2 STEP INPUT LIMIT	24 DC	100 mA		1/C #14	500 FT	
	764	SCC	I19TB1-4	#14 - #22	F.B.O.	F.B.O.	F.B.O.	2 STEP INPUT LIMIT	24 DC	100 mA		1/C #14	500 FT	

NOTES:

1. F.B.O. - FURNISHED BY OTHERS.
2. EACH CABLE GROUP MUST BE RUN IN A SEPARATE STEEL RACEWAY TO MINIMIZE CONTROL SIGNAL INTERFACE.

96-791619-29
Rev. 03

Figure 42 Control wire list, Multi-Module System, external interconnection, optional internal modem

	WIRE NO.	FROM	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	TO	TERMINAL DESIGNATION	TERMINAL WIRE RANGE	SIGNAL NAME	MAX VOLTAGE	MAX CURRENT	WIRE COLOR	WIRE SIZE & TYPE	MAX. LENGTH	REMARKS
CG 13	871	SCC	SCC COM PWA I7 J1A	N/A	F.B.O.	F.B.O.	N/A	MODEM LINE COMM.	N/A	N/A		TELEPHONE		

FOR UNITS MANUFACTURED BEFORE 12/31/02, SEE DRAWING 96-791619-32

NOTES:
1. F.B.O. - FURNISHED BY OTHERS
2. EACH CABLE GROUP MUST BE RUN IN A SEPARATE GROUNDED RIGID METAL CONDUIT TO MINIMIZE CONTROL SIGNAL INTERFERENCE.

96-791619-32A
Rev. 02

Figure 43 Outline drawing, single-breaker module battery disconnect, 1400AT/1600AT/2000AT/2500AT, 600VDC circuit breaker

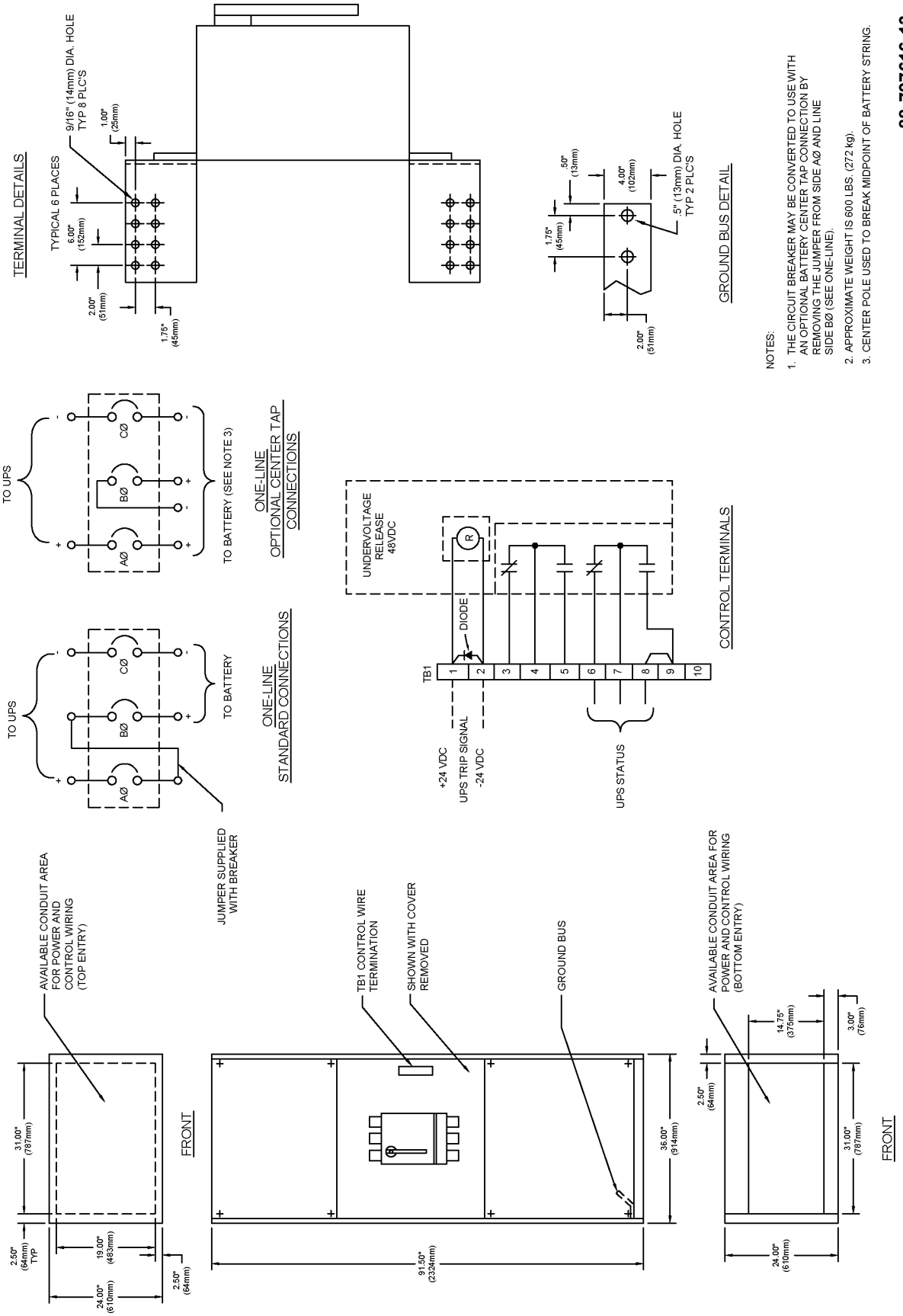
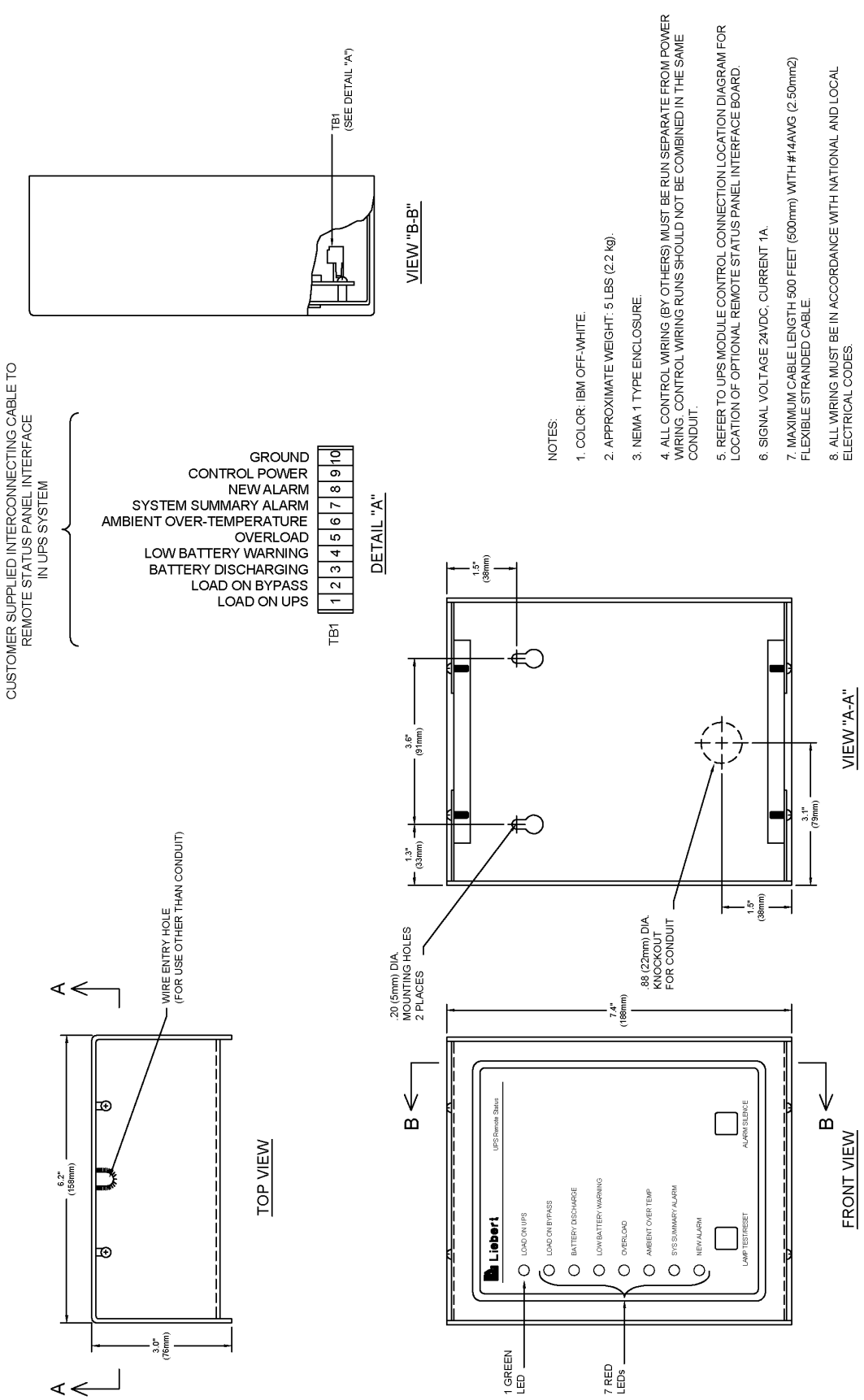
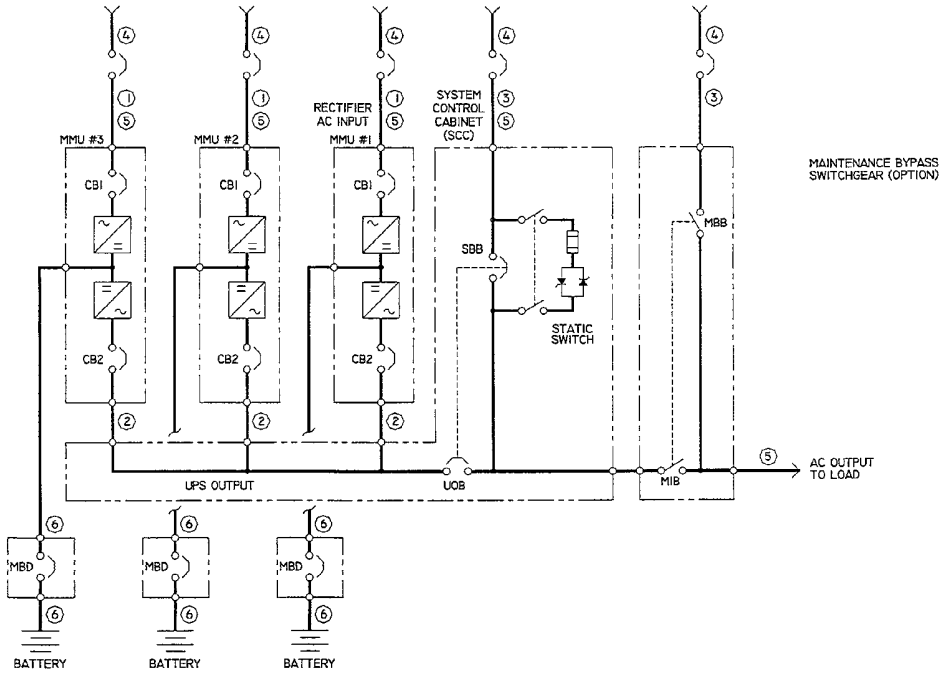


Figure 44 Outline drawing, remote status panel, surface mount





Notes for Tables 6 and 7

1. 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 settings are 125% of nominal input current. Standard factory setting is 115%.
2. 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.
3. Bypass AC input current (considered continuous) is based on full rated output load.
4. 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.
5. UPS output load cables must be run in separate conduit from input cables.
6. 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.
7. 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.

(7 continued)

NOTE: A neutral conductor is required from each Multi-Module Unit output to the System Control Cabinet and from each SCC to the Power-Tie™ cabinet, if applicable. See grounding diagrams in the Installation Manual.

8. Rectifier AC Input: 3-phase, 3-wire, plus ground
   AC Output to Load: 3-phase, 3- or 4-wire, plus ground
   Bypass AC Input to SCC: 3-phase, 4-wire, plus ground (3-wire plus ground in certain circumstances)
   Module DC Input from Battery: 2-wire (positive and negative), plus ground
   Module Input to SCC: 3-phase, 4-wire, plus ground
9. All wiring is to be in accordance with National and Local Electrical Codes.
10. Minimum overhead clearance is 2 ft. (0.6m) above the UPS.
11. Top or bottom cable entry through removable access plates. Cut plate to suit conduit size.
12. Control wiring and power cables must be run in separate conduits. Control wiring must be stranded tinned conductors.
13. 4% maximum reflected input harmonic current and 0.92 lagging input power factor at full load with optional 12-pulse rectifier and optional input filter.
14. UPS module will be shipped in sections. Reconnect shipping splits according to drawings supplied with the equipment.
15. Dimensions and weights do not include the System Control Cabinet required for Multi-Module Systems.

Table 6 Site planning data—600V input

UPS Rating		AC Output Voltage	Options	Rectifier AC Input Current		Inverter AC Output Current		Required Battery Disconnect Rating (A)	Max. Battery Current at End of Discharge (A)	% Efficiency at Full Load	Max. Heat Dissipation Full Load BTU/h (kWH)	Dimensions	Approx. Weight Unpacked	Floor Loading Distributed Loading
kVA	kW	VAC	Input Filter	Nom	Max	Nom	Max					WxDxH: in. (mm)	lb. (kg)	lb./ft.^{2} (kg/m^2)
1000	900	600	No	1096 *	1369	962	1203	2500	2440	93	231,203 (67.7)	177x44x82 (4496x1118x2083)	16555 (7509)	306 (1494)
1000	900	600	Yes	1012 **	1265	962	1203	2500	2440	93	231,203 (67.7)		17400 (7893)	322 (1572)
See Notes (p. 65):			13	1,4,5,7,8,9,11,12		2,5,7,8,9,11,12		6	6,8,9,11,12	—	—	14,15	14,15	—

* Nominal Input Power Factor 0.85 lagging at full load; 0.09 Maximum Total Input Harmonic Current Distortion (THD) at full load.
** Nominal Input Power Factor 0.92 lagging at full load; 0.04 Maximum Total Input Harmonic Current Distortion (THD) at full load.

Table 7 Site planning data—480V input

UPS Rating		AC Output Voltage	Options	Rectifier AC Input Current		Inverter AC Output Current		Required Battery Disconnect Rating (A)	Max. Battery Current at End of Discharge (A)	% Efficiency at Full Load	Max. Heat Dissipation Full Load BTU/h (kWH)	Dimensions	Approx. Weight Unpacked	Floor Loading Distributed Loading
kVA	kW	VAC	Input Filter	Nom	Max	Nom	Max					WxDxH: in. (mm)	lb. (kg)	lb./ft.^{2} (kg/m^2)
1000	900	480	No	1369 *	1712	1203	1504	2500	2440	93	231,203 (67.7)	177x44x82 (4496x1118x2083)	16555 (7509)	306 (1494)
1000	900	480	Yes	1265 **	1582	1203	1504	2500	2440	93	231,203 (67.7)		17400 (7893)	322 (1572)
See Notes (p. 65):			13	1,4,5,7,8,9,11,12		2,5,7,8,9,11,12		6	6,8,9,11,12	—	—	14,15	14,15	—

* Nominal Input Power Factor 0.85 lagging at full load; 9% Maximum Total Input Harmonic Current Distortion (THD) at full load.
** Nominal Input Power Factor 0.92 lagging at full load; 4% Maximum Total Input Harmonic Current Distortion (THD) at full load.

System Control Cabinets

Multi-Module Systems are provided with a System Control Cabinet. Cabinets are available to match load current. **Table 8** shows dimensions and weights for SCCT cabinets.

Table 8 System Control Cabinet data - SCCT

Type	Amps	Overall dimensions - WxDxH: in. (mm)	Weight - lb. (kg)
SCCT	1200	37x37x78 (940x940x1981)	1000 (454)
SCCT	1600	62x48x78 (1575x1219x1981)	1525 (692)
SCCT	2000	62x48x78 (1575x1219x1981)	2850 (1293)
SCCT	2500-3000	62x60x78 (1575x1524x1981)	3100 (1406)
SCCT	4000	138x60x78 (3505x1524x1981)	5850 (2653)

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