Q-LS Series UPQ

180–550 kVA

POWER INNOVATIONS INTERNATIONAL

LITEON GROUP

Installation and Operation Manual

MNL123

Rev 2.2

Q-LS 180+ kVA Double-Wide Cabinet

READ THIS MANUAL CAREFULLY
SAVE ALL INSTRUCTIONS

This manual contains important information needed to operate the Q-LS™ safely and efficiently. Please read all instructions carefully before installing or operating equipment.

Keep this manual handy for easy reference.

ELECTRICAL WARNING

Applying information contained in this manual to any other product, including customized Q-LS systems with nonstandard specifications, may cause injury.

Q-LS™, Q-LS Uninterruptible Power Quality™, UPQ™, MPDU™, and UPQ-NetAgent™ are trademarks of Power Innovations International, Inc.

This manual may accompany other instructional addendums about additional customizations to standard Q-LS™ systems. Please contact Power Innovations if additional manuals are needed and have not been received.

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Building a Safer and Greener Future

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1—Introduction

Congratulations on purchasing the Power Innovations International, Inc. Q-LS Series Uninterruptible Power Quality™ (UPQ™) system. Using the Q-LS™ system will prevent power loss events and equipment wear caused by spikes, sags, and other irregularities in AC power supply. The system provides a source of clean, efficient pure sine wave power and backup battery to keep equipment operating smoothly and consistently even during power outages.

The Q-LS main cabinet features a TouchScreen Display, as well as an easy-to-use LCD display, LED lights, and a status indicator showing the power flow. Depending on its capacity, the system comes in up to four cabinets. The system often includes a matching battery cabinet. An optional computer interface allows the system to be remotely monitored and controlled.

For warranty and customer service information for this product, please refer to the back of this manual.

1.1—Using This Manual

This manual explains how to safely receive, unpack, install, and operate the Power Innovations International, Inc. Q-LS Uninterruptible Power Quality (UPQ™) systems from 180 kVA to 550 kVA.

Read and understand this manual to make installing and operating the system as easy as possible.

1.2—Conventions Used in This Manual

To make this manual easier to read, several formatting conventions have been adopted.

1.2.1—Additional Advice

This manual will occasionally provide additional advice. When it is provided, this information will be enclosed by a set of lines to separate it from the rest of the text:

This text is an example, separated from the rest.

Some of the information is very important, while other information may be good to know. To show the importance of each piece of information, the following safety symbols are used:

ELECTRICAL WARNING

Denotes advice that, if not followed, could cause severe bodily harm due to electrical shock.

WARNING

Denotes advice that, if not followed, could cause severe bodily harm due to other types of injury.

Caution

Offers advice that, if not followed, may harm equipment or indirectly cause physical hazards.

Usually, these symbols will be listed in order of importance. Other information is provided simply to be helpful.

Note

Offers practical advice that may be helpful but can be disregarded.

Manual Help

Provides references to other manual sections or drawings that accompany this manual.

Additional Manuals

Provides references to other manuals that may also be provided with this system.

1.2.2—Breaker Positions

Because some breakers on the front of the Q-LS share names with its subsystems or operation modes, breakers and their positions will be identified using all caps. Additionally, the words OPEN and CLOSED are always capitalized to stress which position is correct.

OPEN is used to identify a breaker that is in the OFF position. CLOSED is used to identify a breaker that is in the ON position.

1.2.3—System Key Identification

The first time a key located on the display is mentioned, both the name of the key and the symbol used on the key is included. In the following references, only the symbol for the key is used.

1.2.4—Type Conventions

Menu options will be printed in uppercase letters and formatted as they appear onscreen.

1.2.5—Cabinet vs. System

In this manual, the word cabinet refers to the actual Q-LS cabinet (or cabinets, for multi-cabinet systems).

The entire power quality system will be referred to as an uninterruptible power quality system (or UPQ™), a Q-LS system, or a Q-LS. These terms do not refer to one cabinet or set of cabinets. They refer to the system and everything that supplies power to it, including the battery cabinet, the cabinet that controls the system, interconnecting cables, and other external controls.

1.2.6—Phase Names

This manual and the Q-LS system use both the global standard (R, S, T) and the North American standard (A, B, C) for the power phases and terminal block identifications.

Labels, documentation and components use the following phase identification interchangeably: R=Phase A; S=Phase B; T=Phase C.

1.3—Safety Warnings and Cautions

This section provides important information that you will need to follow in order to safely operate your system. Read it carefully.

This manual provides very little information about maintaining the system. Such information is provided in a separate manual, for use by trained and qualified technicians only.

All maintenance must be performed by a service technician who has completed a service-level training course on the Q-LS system offered through Power Innovations. During the training course, a separate manual is provided to the technician to use when maintaining or servicing the unit. For more information about becoming a certified service technician, contact Power Innovations International, Inc.

For ease in reading warnings and cautions, they have been divided into sections, **Manual Use**, **Installation and Maintenance**, **Safe Transportation and Storage**, **Batteries,** and **Operation**.

1.3.1—Manual Use

Failure to obey warnings in this manual may cause physical harm and may also void the system warranty.

Handle any unusual events by contacting Power Innovations. Minimal troubleshooting information has been provided in this manual.

All personnel must know and observe all safety warnings and instructions provided in this and other included manuals.

Read this manual and other materials carefully before operating the unit or providing system maintenance.

Before working on the Q-LS systems, all personnel must be thoroughly familiar with this manual and all other manuals provided with this product.

Keep this manual in an accessible location for future reference.

1.3.2—Installation and Maintenance

The Q-LS system must incorporate an earth ground.

The Q-LS should only be installed by qualified service personnel.

The Q-LS system contains high voltage power that is potentially dangerous if not handled properly. All repairs should be performed only by those who have completed a Power Innovations service-level training course.

Work on the Q-LS should only be performed using tools with insulated handles.

Ensure that all individual circuit breakers are OPEN before connecting the facility input to the Q-LS unit. Serious injury may result if any power connection is not turned OFF.

For the warranty to apply, the Q-LS system must be commissioned by personnel who have completed the Power Innovations service-level training course.

No interior parts are serviceable by persons other than qualified technicians. If troubleshooting processes specified in this manual fail to resolve an issue, Q-LS trained and certified technicians should be contacted to service the unit.

For the Q-LS to operate properly, it should be periodically inspected and cleaned. In addition, a periodic preventive maintenance check needs to be performed. (See **12 - Maintenance**)

1.3.3—Safe Transportation and Storage

To avoid accidental worker injury, place this system in an area with limited, controlled access and ensure that all cables are placed to avoid creating potential trip hazards.

To maximize the life of the Q-LS system, it should be stored in a temperature-controlled indoor environment that is clean, dry, and free of flammable liquids, corrosive substances, and hazardous gases.

The Q-LS cabinet should be transported carefully so that the unit is not damaged. Avoid dropping the unit, tipping it upside down, or any other rough handling.

Use caution when transporting the cabinet. To avoid damage, only transport the cabinet in its original packaging.

Damage incurred due to negligent transport or installation will not be covered by the product warranty.

1.3.4—Batteries

Batteries may retain a charge even while the system is not connected to AC input power. Handling batteries incorrectly may result in severe injury.

When working with batteries, always observe proper precautions. Batteries can present the risk of electric shock from high voltage.

If your battery model includes the slide-out tray option, the battery unit MUST be installed on a solid surface. It should be bolted securely to the floor, whenever possible. Doing so will help prevent the cabinet from tipping and causing injury.

Always ensure that only one battery drawer is open at any given time. Opening more than one drawer of the cabinet at a time can cause the cabinet to become unbalanced and tip, even when securely bolted to the floor.

1.3.5—Operation

This manual provides information for safely and correctly operating the Q-LS system.

Retain the load within the Q-LS Series rating guidelines to ensure that the unit will work properly. See **Appendix C — Product Specifications** for more information.

DO NOT insert any foreign objects into the ventilation holes or any other opening on the unit.

2—System Features

2.1—Key Features

2.1.1—Input Surge Protection

The Q-LS system can protect the load from surges caused by utility fluctuations, lightning, or neighboring loads.

2.1.2—Cold Start

The system can be started from battery power using a soft-start function if AC power becomes unavailable.

2.1.3—Harsh Environment Tolerance

Although harsh environments are not recommended, the system can operate efficiently in extreme environments with high or low temperature, high or low humidity, or high or low altitudes.

Q-LS systems are well suited for operating undisturbed, even if poor quality power sources such as generators are connected to the input.

2.1.4—Intelligent Battery Charger

The charger can be programmed to a Low, Medium, or High charging rate. If a battery bank has discharged to 320 VDC, the charger will initiate a charge.

2.1.5—Data Log Capability

The Q-LS unit records and stores system power events. These events are listed under the date and time for the event. Even if all power to the system is interrupted, recent event data will not be erased. Please note that when power is interrupted, the TouchScreen may not capture all information. In that case, refer to the LCD display (located inside the door, behind the TouchScreen Display).

2.1.6—System Auto Restart

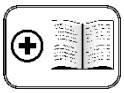
Every 10 seconds, the system will automatically attempt to switch back to normal operating mode after any recoverable faults or shutdowns. While attempting to restart, the system will operate in a reserve mode, continuously providing power to critical loads while input power is available.

In the event of a low-battery shutdown, the system also has the option of auto-restarting upon return of input AC power.

2.2—Interface Options

2.2.1—Q-LS TouchScreen

The Q-LS TouchScreen provides easier access for monitoring and managing the Q-LS system. The TouchScreen provides an easy-to-read, real-time status display for critical Q-LS functions, as well as the ability to control key operational functions.



Additional Manual

For more information about using the TouchScreen display, see ***MNL131 – Q-LS TouchScreen User Manual***.

2.2.2—Emergency Power OFF (EPO) Button

The Emergency Power OFF option is a red button, mounted in a metal box on the top front-right of the Q-LS.

When pressed, the EPO can stop the system output immediately. This feature can be necessary in the case of accidents where personal injury or equipment damage has been or is taking place.

An optional EPO interface can also be provided externally using either Normally Open (NO) or Normally Closed (NC) type circuits.

2.2.3—UPScom

A PC-based software that can monitor up to 99 Q-LS systems at the same time. UPScom requires either a RS-232 or a RS-485 standard cable connection and a compatible client-side interface.

The Q-LS TouchScreen also uses UPScom. To provide system monitoring and TouchScreen management, two UPScom ports can be installed on the main communications (3R) board.

2.2.4—UPQ-NetAgent

The UPQ-NetAgent™ is Power Innovations' latest network interface device for all UPQ products, which supports many different interface options:

- SNMP (all versions)
- HTTP
- HTTPS
- SMS notifications
- Email notifications
- MODBUS over TCP/IP

The UPQ-NetAgent also supports additional environmental sensors.

2.2.5—MODBUS

Aside from the MODBUS provided by the NetAgent, the Q-LS system's MODBUS connection provides a serial-based computer interface for monitoring and managing system operations remotely.

This interface supports varying baud rates up to 19200. For a standard list of MODBUS coils and registers, as well as configuration options, see **Appendix D — MODBUS Information.**

3—Site Preparation

When the Q-LS comes in a capacity higher than 180 kVA, the system consists of multiple cabinets that must be installed immediately beside one another. They will need to be connected to the bus bars and/or cables that are provided with the system. Some systems include a single-wide OUTPUT breaker cabinet that should be installed to the immediate right of the right-most UPQ™ cabinet.

The Q-LS is designed to be connected to one or more Q-LS Battery Module(s) that should be installed near the Q-LS.

This chapter will explain how the site should be prepared to handle the system.

3.1—Facility Readiness

Before installing the system, examine the installation site carefully. Wiring modifications and other changes may need to be made in preparation for attaching the Q-LS to the input source and the load.

Manual Helps

The steps for transport to the site and unpacking will be outlined in **Chapter 5—Installing the System**.

3.1.1—Electrician or Electrical Engineer Approval

It is important that an electrician or electrical engineer examine the site before the Q-LS is installed. The electrician or electrical engineer should:

- Approve the facility's wiring.
- Complete any necessary wiring preparations.
- Ensure that wiring to the Q-LS complies with all local electrical codes.
- Install breakers to protect feed and output lines.
- Approve input and output cable sizes.
- Ensure that the system is grounded before anyone operates it.
- Ensure that all outputs are properly referenced to ground.

ELECTRICAL WARNING

An electrician or electrical engineer should be consulted about any external wiring decisions related to the system. Any facility wiring that may interact with the system should be approved by an electrician or electrical engineer *before* installation.

WARNING

Inadequate cable size or oversized breakers may cause fire or damage. Decisions about electrical cable sizes should be approved by a qualified professional before the system is operated.

3.1.2—Personnel Access

Because the Q-LS controls large amounts of power, any personnel using the Q-LS should know how to use it correctly. To ensure that no unauthorized individuals attempt to operate the system:

- The Q-LS should be placed in a location where access is limited.
- Personnel who operate the Q-LS should be proficient in normal and emergency operation procedures.
- Before operating the Q-LS system, new personnel should be trained to operate it.
- Leave 1 meter (3ft 3.5 in) at the system's rear so that maintenance personnel can assemble the system.

3.1.3—Site Considerations

Ensure that the placement of the Q-LS system complies with all local building codes.

Consider the following when choosing the floor where the system will be placed:

- Pick a site where the floor is strong enough to handle the weight of the Q-LS system. Weights will change, based on customizations requested and number of cabinets.
- Place the system on a level surface.
- Anchor the battery cabinets to the floor with the provided 0.5-inch diameter screws, especially in areas where the floor (or the ground beneath the building) is likely to shift or shake. (NOTE: The Q-LS is not required to be anchored to the floor unless local code requires anchoring.)
- Place the system in a location where the walls, ceilings, and floors are constructed from non-combustible materials.

Power Capacity (kVA)	Cabinet Type	Weight (lb)*	Weight (kg)*
180	2 Cabinet	4,100	1,860
240	2 w/Breaker Cabinet	8,564	3,884
400	2 w/Breaker Cabinet	9,629	4,367
500	3 w/Breaker Cabinet	11,310	5,130
550	4 Cabinet	12,992	5,893

Table 1—Cabinet Weights in Pounds and Kilograms
**All weights are approximate examples and may change based on customizations.*

WARNING

To avoid tipping that might cause damage or injury to personnel, do not place Q-LS or battery cabinets on uneven or unstable surfaces. Always anchor battery cabinets. Anchor Q-LS system if local code requires it.

3.1.4—Space and Ventilation

The Q-LS should be placed and oriented in an adequately ventilated space (see Figure 1) to efficiently disperse heat. The more efficiently the system ventilates, the more efficiently it will operate.

Be sure to measure the location where the system will be placed to ensure that all space requirements can be met.

- Install the system with 1 meter (3 ft 3.5 in) left open at its front for regular startup, shutdown, and operational maintenance.
- Leave at least 1 meter (3 ft 3.5 in) of empty space at the top of the system for ventilation.
- Leave 1-meter (3 ft 3.5 in) maintenance access space to the right side.
- Leave the rear of the Q-LS accessible for installation and maintenance purposes.

See **Appendix A — More about Installation** *for the dimensions of most multi-cabinet systems.*

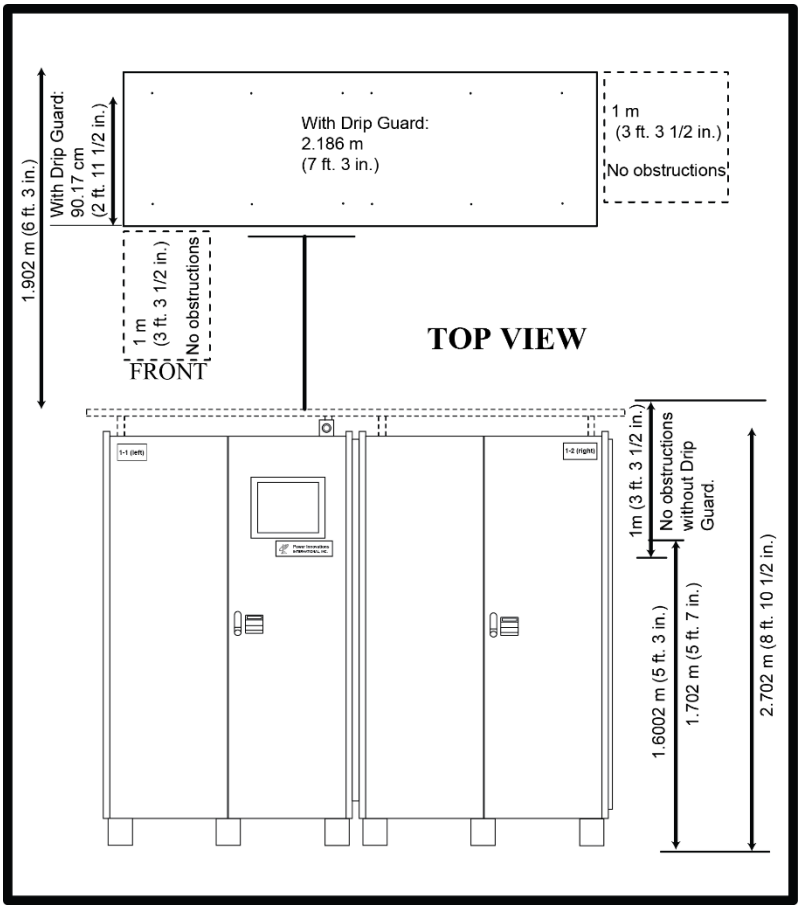


Figure 1—Cabinet Clearances

Caution

Do not put objects directly on top of the Q-LS cabinet. They may block airflow, causing the system to overheat.

Note

It is a good idea to leave 1 meter (3 ft, 3.5 in) of space on the right side of the system for easy technician access during maintenance.

3.1.5—Proximity to Other Q-LS System Cabinets

The Q-LS 180, 240, and 320 are comprised of two double-wide cabinets (labeled 1 & 2) that must be installed immediately beside each other.

The Q-LS 400 is comprised of two double-wide cabinets (labeled 1-1 & 1-2) and will typically also include a single-wide OUTPUT Breaker Cabinet (labeled 1-3) that should be installed to the immediate right of the (1-2) UPQ cabinet.

The Q-LS 450, 500, and 550 are comprised of three double-wide cabinets (labeled 1-1, 1-2, & 1-3) and will also include the Output Breaker Cabinet (labeled 1-4).

The Q-LS is designed to be connected to one or more Q-LS Battery Module(s) that should also be located near the Q-LS, with batteries installed using the cables provided with the battery cabinets.

In the case of redundant Q-LS units, which are two complete sets of the same cabinets, the cabinets are labeled UPS1 (1-1, 1-2, 1-3, etc.) and UPS2 (2-1, 2-2, 2-3, etc.)

3.2—Environmental Conditions

Other environmental factors may influence the lifespan of the system. Q-LS systems can function in extreme environments, but will work more efficiently in clean, dry environments with moderate temperatures.

3.2.1—Weather and Temperature

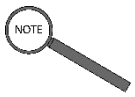
The system will operate better if placed in a controlled environment. An indoor location is generally preferred. If necessary, in temperate climate zones the system can also be installed outdoors in a covered and protected area (such as under a large awning).

For the system to perform most reliably, it should be placed in a location where the following conditions exist:

- The temperature should be between 0 °C (32 °F) and 50 °C (122 °F).
- The nominal operating temperature is between 15 °C (59 °F) and 25 °C (77 °F).
- The humidity is less than 80% noncondensing.
- Avoid exposing the system directly to the elements (sunlight, rain, snow, sand, dust, wind). If a system must be installed in an environment where it will be exposed to the elements, request an enclosing container (see Note below).

Caution

Exposure to extreme conditions such as sunlight, wind, or weather may cause system malfunction.



Note

Power Innovations provides a service in which Q-LS systems can be installed in modular, climate-controlled containers that provide permanent protection.

3.2.2—Proximity to Contaminants

The Q-LS should be placed where nothing near it can interfere with its ability to operate. Keep the area around the cabinet clean. Ensure the area is free of trash and other clutter that could clog the cabinet ventilation openings.

Caution

Trash, metallic powders, filings, sawdust, and other objects can be drawn into the unit and cause damage.

To ensure safety and prevention of damage to the cabinet:

- Place the Q-LS nearer to the power source than the load.
- Put a portable fire extinguisher near the unit. This extinguisher should be appropriate for Class C fires, and may include Halogenated, Carbon Dioxide, or Dry Chemical type extinguishers.
- Place the system in an area far from any combustible materials.

Avoid placing the cabinets near any of the following:

- Heat sources.
- Any machinery or equipment that produces metallic coil dust or powder.
- Anything that produces vapor or corrosive substances.
- Below the shower of a fire extinguishing (sprinkler) system.

Caution

If the system senses that the conditions are abnormal enough to be dangerous, it will turn OFF and drop the load.

3.2.3—Electromagnetic Interference

The system has passed international EMC (Electromagnetic Compatibility) tests, but it is best not to install it near any equipment that may be susceptible to electromagnetic interference.

Such equipment may include (but not be limited to):

- Computerized systems
- Server Equipment
- Monitors
- Radio equipment
- Microwaves

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4—Inspection and Transportation

This chapter will explain precautions to take while unpacking the system and transporting it to its new location.

Steps to follow while unpacking the system:

1. Inspecting the Cabinet
2. Unpacking the Cabinet
3. Checking System Contents
4. Transporting the Cabinet

Each step will be covered in its own section.

4.1—Tools Required

The following tools and machinery are required to unpack, transport, and install the cabinets. For easier unpacking and installation, please ensure that you have them ready.

- Forklift or pallet jack
- Utility knife or scissors
- Screwdrivers—Phillips and straight blade
- Socket wrenches—17 mm and 19 mm
- Box wrenches
- Measuring tape
- Floor-marking tool (e.g., permanent marker, chalk, or construction pencil)

While unpacking the system, be sure to keep the pallet-attaching brackets and hardware sets. They may be used as system anchors on concrete floors.

Note

If the unpacking area is close to the installation site, the transport and installation processes will be easier.

4.2—Inspecting the Cabinets

The system should arrive in perfect condition. When it arrives, look each cabinet over carefully and check the structure of the system for physical damage. If anything seems damaged, file a damage claim with the shipping agency. Contact Power Innovations immediately afterward:

Email: support@power-innovations.com

Web: www.powerinnovations.com/support

The *Q-LS* is packed in a specially designed carton to protect it from damage during shipping. When external battery cabinets are ordered, they are packaged in separate cartons that have also been uniquely designed.

Special packaging considerations may also have been made for shipping. These considerations include full wood crating, as well as shock, damage, and tip indicators.

4.3—Unpacking the Cabinets

Allow 3 meters (10 ft) of space on each side for removing the cabinet from the pallet.

Each cabinet is wrapped multiple times, placed in a carton, and bolted to a wooden pallet. While unpacking the cabinets, be sure to put pallets, cartons, boxes, and securing hardware in a place where they can be kept. They should be saved in case they are needed for future transportation.

Be aware that most systems come with attachable drip guards. Take care while unpacking the system to locate and save the drip guards.

WARNING

Be careful while removing the packaging from the cabinets. Careless handling could cause personal injury or cabinet damage.

Caution

Cabinets are heavy. Follow unpacking instructions closely to avoid tipping or serious injury.

4.3.1—Removing Packaging

Single-wide systems are bolted to the pallet in four places. Double-wide systems are bolted in six places.

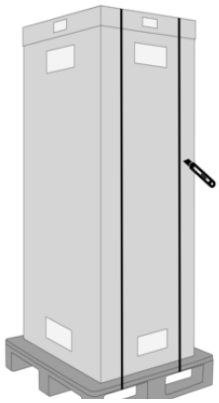


Figure 2—Cutting Packing Straps

1 **Cut through and discard the packing straps (see *Figure 2*) used to secure the packing box or crate to the pallet.**

2 **If the cabinet arrived in a box, lift the box off the top of the cabinet (see *Figure 3*).**
If the system has arrived in a crate, use a Phillips electric screwdriver to disassemble the crate.

3 **Using a knife, carefully cut the shrink wrapping and gently pull it from the cabinet.**

Be aware of the drip guard, to ensure that it is not damaged during this process.

The shrink wrapping and other plastic packaging can be thrown away.

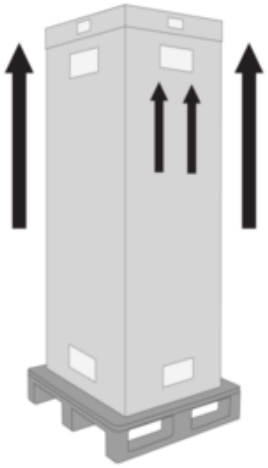


Figure 3—Lifting the Box

4 **Pull the protective bag from the top of the cabinet.**

5 **Remove all nut and bolt sets that secure the fastening brackets to the cabinet's feet and pallet (see** Figure 4**).**

Remove the shipping brackets. Retain the fastening brackets and securing hardware in case they are needed for later use.

6 **Using a forklift, lift the cabinet and transport it from the pallet to a solid flooring location.**

Have at least two people for each cabinet in order to balance the weight. To help prevent tipping, systems may have been ordered with fixed mounted castors, attachable castors, or fixed blocks.

For auto-leveling purposes, all systems can be ordered with attachable castors.

7 **Keep the cabinet upright. Do not tilt it more than 10° or it may tip, causing personal injury and/or system damage. After the cabinet is unpacked, store packaging in a clean, dry place.**
The original packaging may be needed for future system shipping and transport.

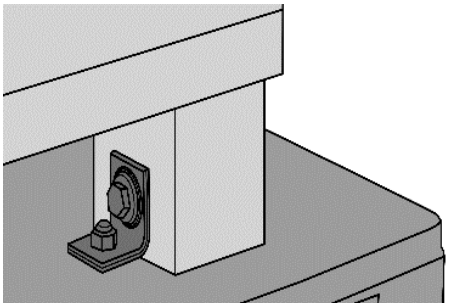


Figure 4—Removing Nut and Bolt Sets

WARNING

While taking systems down inclines, cabinets with castors or on pallet jacks will roll. Use at least two people to remove cabinets from their shipping pallets. Rolling cabinets may cause injury.

Keep the cabinet upright. Do not tilt it more than 10° or it may tip, causing injury.

Caution

Because cartons are especially designed for the size, dimension, and weight of the cabinets, it will be difficult to find other cartons that will accommodate them. Using other boxes or packaging to ship the cabinets may not provide sufficient protection.

4.4—Checking System Contents

Check the system contents against the purchase order and packaging receipt. Some of the standard items shipped with the system include:

- Door key
- Instruction manual
- Battery fuses (if necessary for the system)
- Six pallet-attaching brackets (used for mounting)
- Six nut and bolt sets mounted on pallet-attaching brackets (0.5-inch diameter)
- Attachable drip guard
- Drip guard hardware packet

Notes

Battery cabinets do not come with drip guards or attaching packets.

Compare the system specifications against the purchase order. Along with any other specifications for the system, be sure to verify:

- Rated power capacity of the Q-LS system (in kVA)
- Input voltage and frequency
- Output voltage and frequency
- Number of output phases
- Battery voltage or number of cells
- Any system customizations

If anything is missing, be sure to report any larger missing items (such as missing cabinets) to the carrier. Notify Power Innovations if any item is missing or does not match the purchase order.

Caution

If a cabinet is damaged or does not match the purchase order, call Power Innovations. Do not install the cabinet before calling.

4.5—Transporting the Cabinets

Use a forklift or pallet jack to move the unpackaged cabinet to the installation site.

Note

Before moving a multi-cabinet system to its new location, check the width of any questionable doorways or hallways along the route.

Remember when planning transportation of the system, all weight information is approximate.

It may be necessary to place plywood beneath the pallet jack to distribute the weight more evenly (see **4.5.1—Steps for Transport, Step 1**). Ensure that the flooring is rated for more focused weight beneath the pallet jack wheels.

A narrow style of pallet jack works best with the dimensions of the cabinets.

Caution

Make sure that the forklift or pallet jack is rated to handle each cabinet's weight before loading. Refer to **Table 1—Cabinet Weights in Pounds and Kilograms** for cabinet weight data.

Always consult Power Innovations or a professional rigger prior to lifting the Q-LS system from above using eye bolts and overhead cranes. Improperly lifting the unit from the threaded sockets at the corners of the top of the Q-LS may damage or distort the Q-LS chassis.

4.5.1—Steps for Transport

While loading the cabinet on the pallet jack or forklift:

1. **If using a pallet jack, it may be necessary to place a length of plywood under each side of the pallet jack where it will contact the floor. This step distributes the cabinet weight of large systems more evenly, especially on raised flooring.**
2. **Insert the forks at the bottom of the cabinet.**
3. **Transport the cabinet.**
4. **Set the cabinet on a firm, level floor that can handle its weight.**

WARNING

Keep the cabinet upright. Do not tilt it more than 10° or it may tip, causing injury.

Caution

If not installing the cabinet immediately, store it in its packaging materials. Storing the system packaged will prevent dust, moisture and other environmental contaminants from accumulating within the system. If storing the unpackaged system, be sure to keep it in a clean, dry area free from contaminants.

When storing accompanying battery cabinets for long periods of time, the system's batteries should be fully charged once every 90 days. If stored for long periods of time without charging, batteries will eventually self-discharge and/or degrade, voiding warranties.

5—Installation

Follow seven basic steps when installing a Q-LS system:

1. **Place the Q-LS and battery cabinets at the pre-determined floor location.**
2. **Assemble multi-cabinet systems.**
3. **Attach the drip guard(s).**
4. **Connect all necessary cables and busbars between cabinets.**
5. **Connect monitoring options.**
6. **Connect the batteries to the Q-LS.**
7. **Have the system commissioned (this commissioning check is required to validate the system warranty).**

Each step will be explained in its respective section.

ELECTRICAL WARNING

Before following any steps in the installation process, verify that AC input and battery cables are not connected to a live source of power and that all breakers and disconnects are OFF. Failure to do so could cause serious harm.

WARNING

Any deviations from the steps outlined below may cause serious harm.

Caution

Any deviations from the advice in this chapter may void the warranty.

5.1—Placing and Mounting

Using a pallet jack or forklift, move all cabinets near the locations where they will be installed and operated. Any external battery cabinets will need to be mounted. Mounting of Q-LS cabinets is not necessary unless required by local code. Before mounting system cabinets, be sure all placing recommendations presented in **3—Site Preparation** and **4—Inspection and Transport** (above) have been followed.

WARNING

When installing systems, ensure that the floor can handle system weight. Systems are very heavy and may cause injury if weight concerns are disregarded.

Caution

Placing cabinets unwisely may lead to floor or structural damage.

Do not weld anything to the Q-LS system. The high currents will damage the system and void the warranty.

To place a cabinet:

1 **Make sure the area where the cabinet is to be placed is swept and dust-free.**

2 **Measure the cabinet dimensions on the floor and ensure there is adequate space to operate and perform maintenance on the Q-LS.**

General cabinet dimensions are provided in Figure 5—Mounting Measurements.

3 **Move the cabinet to the location where it will be installed.**

Caution

Mounting a Q-LS cabinet to the floor is NOT recommended in most circumstances because it prohibits the movement of Q-LS cabinets for the purposes of maintenance and operation.

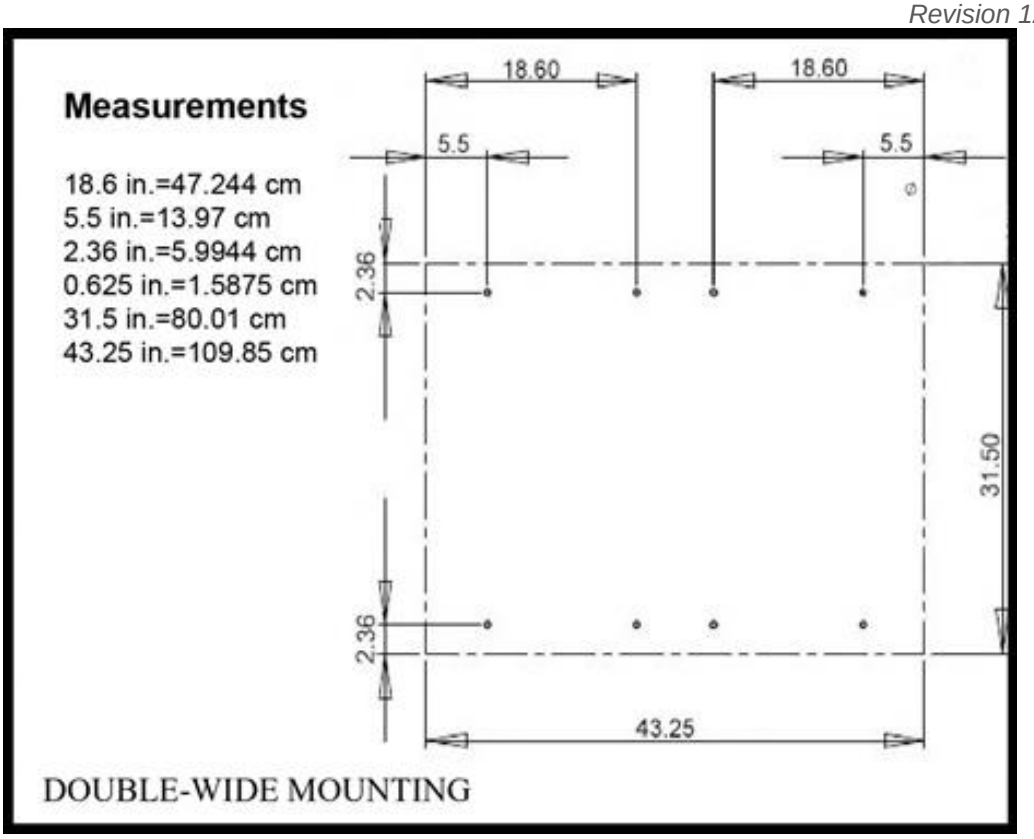


Figure 5—Mounting Measurements

5.1.1—Cabinet Placement

Place the cabinets flush beside one another, ensuring that the bus bars in the rear of the cabinets are aligned. This placement will allow the cabinets to be connected using the bus-bar connectors.

Remove rear access panels from the cabinets before final positioning.

The OUTPUT breaker cabinet (if present) should be installed immediately beside the Q-LS cabinets.

Notes

Align and connect the bus bars before mounting the cabinets.

Make cabinet positioning easier by removing the rear access panels from the cabinets. Removing these access panels before final positioning will allow bus bar alignment to be closely inspected.

5.1.2—Multi-Cabinet Assembly

ELECTRICAL WARNING

Before making any cabinet connections, verify that AC input and battery cables are NOT connected to a live source of power and that all breakers and disconnects are OFF. Failure to do so could cause serious harm.

5.1.2.1—Bus Bar Connections

Note

The instructions below are written with specific reference to the Q-LS 400. Other Q-LS models may have slightly different arrangements. Although the number of bus bars or cabinets to be connected may differ, the same general installation procedures should be followed.

---

1. **Detach the rear panels of cabinets (1-1 and 1-2) by loosening the screws and sliding the panels upward to clear the security slits on the floor of the cabinet.**
2. **Remove the Quick-Disconnect grounding wires located in the bottom-middle of each panel. The wire connector will slide off the anchored tab.**
3. **Remove the panels and set them aside in a safe location.**
4. **Open the front doors of cabinets 1-2.**

5 **Carefully remove the first (left-hand side) inverter Rapid-Replace module, noting the connection points of all wires connected to the module, and set it aside in a safe location (See Figure 6).**

Note

It is important that the wires connected to the module be reconnected to the same pins when the module is re-installed. Failure to reconnect the wires to the correct pins could cause damage to the module.

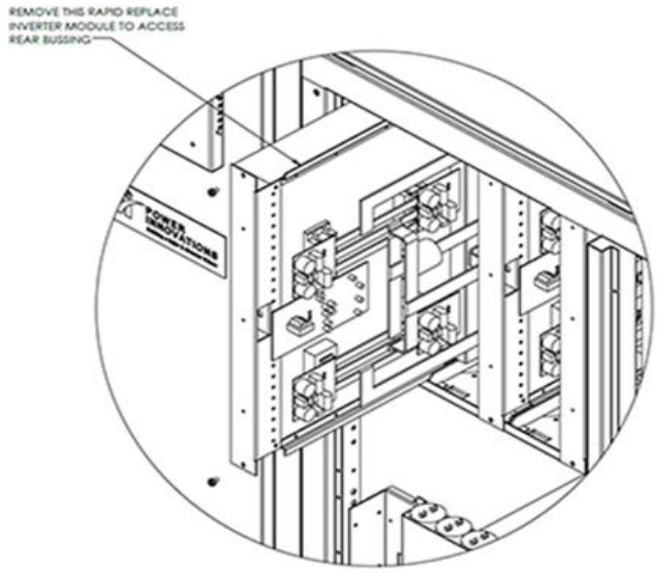
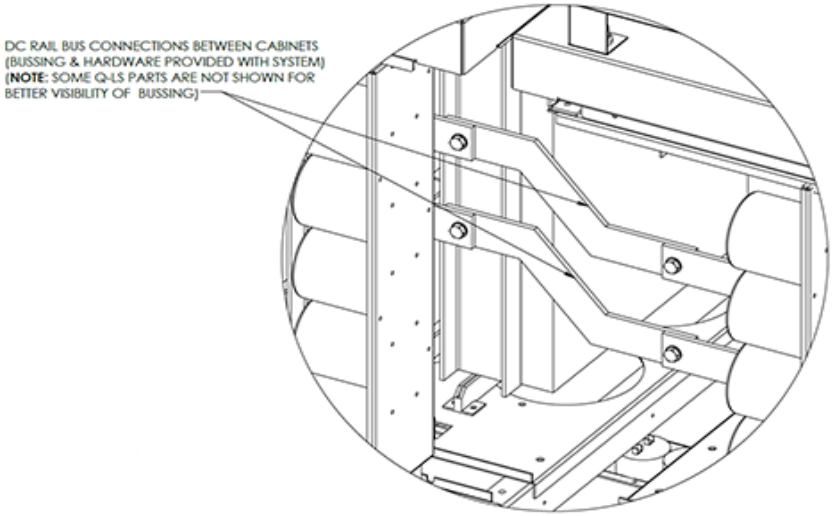


Figure 6 – (Above) Removing the Rapid Replace Inverter Module

Figure 7- (Below) DC Rail Bus Connection Bars



6 **Locate the angled DC Rail bus connection bars located in the rear of the opening where the Rapid-Replace module was removed. Connect them to the bus bar in Cabinet 1-1 (See Figure 7).**

7 **Tighten the DC Rail connector bar bolts.**

8 **Carefully reattach the inverter Rapid-Replace module, making sure to reconnect the wires to the proper connection points. Check the neighboring inverter module to confirm that the wires have been connected properly.**

9 **Install the bus bar connectors on the bus bars near the lower-rear of the cabinet.**

10 **Starting with the bottom bus bar connector and moving up, install and fully tighten each bus bar connector on the lower-rear side of the cabinets before continuing to the next, making sure each bus bar connector is installed. (NOTE: These can be bus bar connectors or cables, depending on the system.)**

5.1.2.2—Connecting the System between Cabinets

1. **Connect the ground bus at the bottom-front-right of Cabinet 1-1 with the ground bus at the bottom-front-left of Cabinet 1-2 using an appropriately sized wire.**
2. **Feed the cabinet bridge wire bundles from the interior-front-right of Cabinet 1-1 into the front-left interior of Cabinet 1-2.**
3. **Connect wires 1–6 to connection points 1–6 in capacitor bank in lower-front-left of Cabinet 1-2.**
4. **Connect wires 7–10 to terminals 7–10 in the terminal block on the lower-front-left of Cabinet 1-2.**
5. **Connect wires 11–12 to the connectors on the connectors labeled 11–12 on the PCB on the lower-front-left of Cabinet 1-2.**
6. **Connect cables 13–18 to the connection points on the Rapid-Replace inverter modules 13–18 in the upper-front of Cabinet 1-2.**
7. **Insert cables 13–18 into the cable guides along the front of Rapid-Replace inverter modules 13–18.**
8. **Snap the cable guide covers in place over cables 13–18.**
9. **Insert the common cable bundle for cables 13–18 into the horizontal cable guide below the Rapid-Replace inverter modules.**
10. **Snap the long cable guide cover in place over the common cable bundle in the horizontal cable guide.**
11. **Feed the wire cables with the cable bundles with the connectors labeled 19–21 from the interior-rear-middle-left of Cabinet 1-1 to the rear-middle-left of Cabinet 1-2.**
12. **Attach the output current sensor wires (19–21) in the rear-middle-left of Cabinet 1-2 to the output current sensors (jacks 19–21) (See** Figure 8**).**

    Note: Numbers may differ. Ensure all cables are correctly connected to their matching connection point.

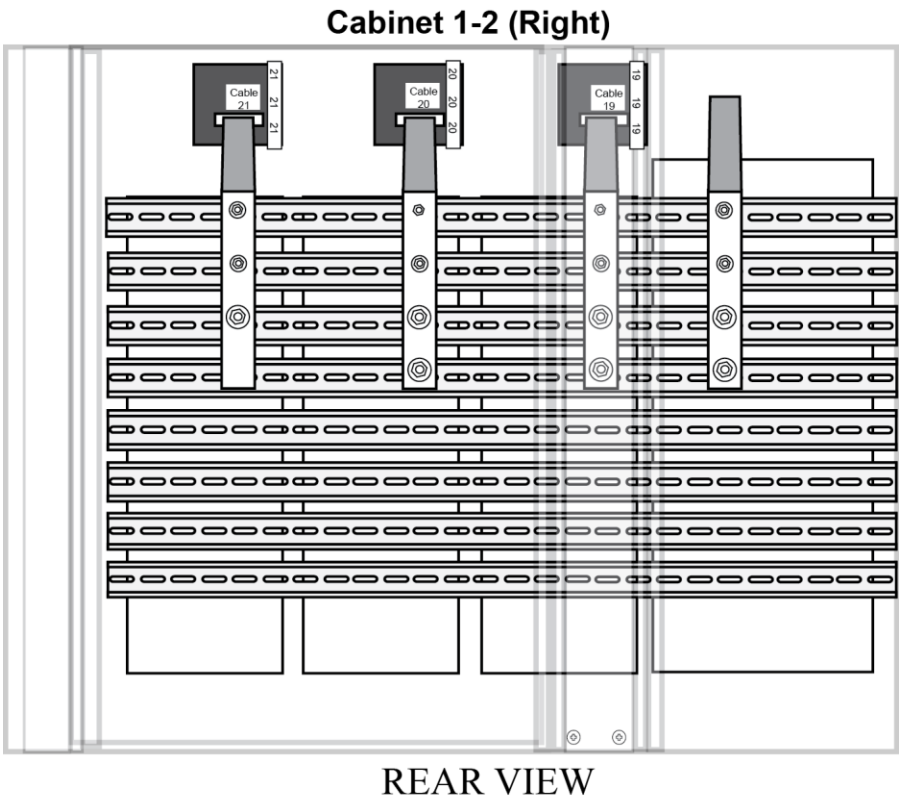


Figure 8—Output Current Sensors

5.1.3—OUTPUT Breaker Cabinet Installation (If Included) / Battery Connection

Q-LS 400, 500, and 550 kVA systems may include an OUTPUT Breaker Cabinet, which contains the OUTPUT breaker and may include the BATTERY breaker.

The breakers in the OUTPUT cabinet must be connected to the bus bars in the back of the Q-LS system, using the cables provided with the battery cabinet.

5.1.3.1—Connecting the Battery Cables to the OUTPUT Breaker Cabinet

1. **Ensure all breakers are set to the OFF position. Failure to do so may result in harm to the operator or system.**
2. **Feed the ends of the battery connector cables through the rubber gland valve at the rear-top-left of Cabinet 1-1 or run the cables through the bump-out section between the UPQ and OUTPUT breaker cabinets.**
3. **Connect the battery cables to the B- and B+ battery bus bars in the rear-top-left of Cabinet 1-1. Note: Orientation may differ.**

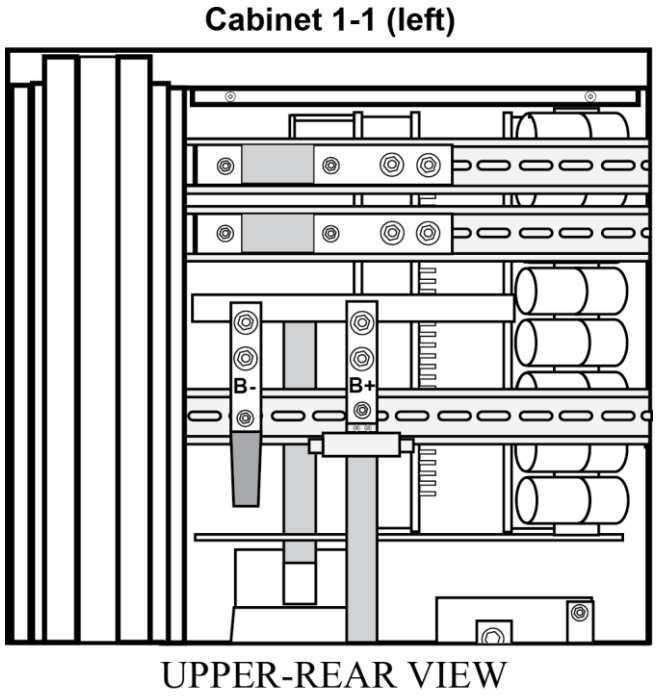


Figure 9—Battery Bus Bars

4. **Connect the other end of the battery cables to the battery bus on the OUTPUT breaker cabinet.**

5.1.3.2—Connecting the Output Cables (Breaker and Q-LS Cabinet)

1 **Feed the output power cables through the rubber gland valves in the rear-top of Cabinet 1-2 or run the cables through the bump-out section between the UPQ and OUTPUT breaker cabinets.**

2 **Connect the output cables to the output bus bars (OA, OB, OC, and ON) in the rear-bottom-left of Cabinet 1-2.**

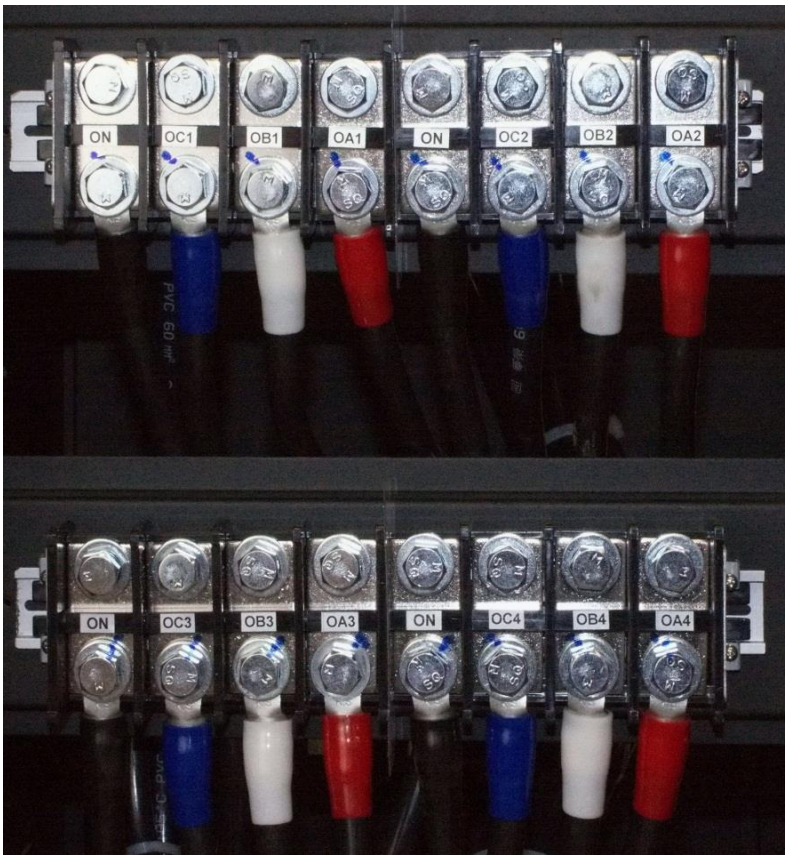


Figure 10—Output Cables

3 **Connect the other end of the output cables to the bus bars in the OUTPUT breaker cabinet.**

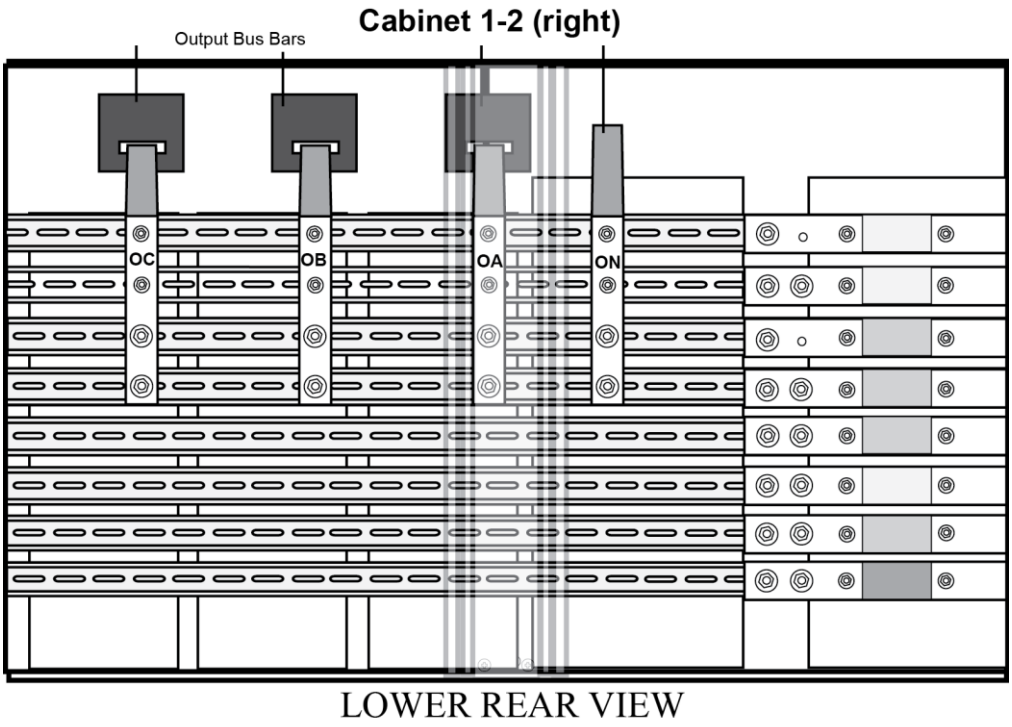


Figure 11—Output Bus Bars

5.1.3.3—Connecting the Ground Wires

Note

All cabinets in a Q-LS system should be grounded together with only a single ground connection to the facility. Grounding with a single connection will prevent the risk of differing ground potentials in different locations. Local codes may also require a Neutral to Ground bonding, which should be done when the system is installed.

1. **Feed one end of the green ground cable through the rubber gland opening in the bottom-front of the Q-LS.**
2. **Connect the green ground cable to one of the ground bus connectors on the bottom of the Q-LS cabinets.**
3. **Feed the other end of the green ground cable through the rubber gland opening in the bottom of the Q-LS Battery Module or PDU cabinet, as applicable.**
4. **Connect the green ground cable to one of the ground bus connectors on the bottom of the Q-LS Battery Module or PDU cabinet, as applicable.**
5. **Repeat this procedure for each battery module or PDU connected to the Q-LS. All cabinets of the QL-S system should have a common ground.**

5.1.3.4—Connecting the Output Cables

1 **Feed one end of the output power cables through the rubber gland closest to the output terminal blocks.**

2 **Connect the output power cables to the output terminals.**
- **a. Connect the red cable to the OA terminal, Phase A.**
- **b. Connect the white cable to the OB terminal, Phase B.**
- **c. Connect the blue cable to the OC terminal, Phase C.**
- **d. Connect the black cable to the ON terminal, Neutral.**

Note: Colors listed here are international color code. Labels take precedent over color of cables.

3 **Connect the other end of the power cables to the load.**

5.1.3.5—Connecting the Battery Module Cables

1 **Feed one end of the battery module cables through the rubber gland closest to the BATTERY breaker. As you proceed, please remember that labels take precedent over the color of cables.**

2 **Connect the battery module cables to the BATTERY breaker terminals.**
- a. Connect the red cable to the B+ battery terminal.
- b. Connect the black cable to the B- battery terminal.
- c. Repeat this process when there are multiple battery cabinets.

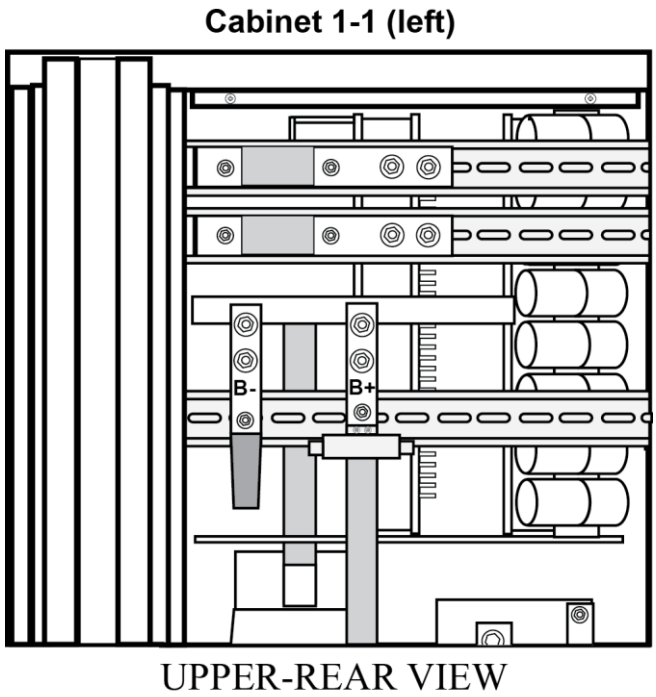


Figure 12—Battery Breaker Terminals

5.1.3.6—Connecting the Input Cables

1 **Feed the input cables through the rubber gland valve at the rear-top-right of Cabinet 1-1.**

2 **Connect the input cables to the input bus bars (IA, IB, and IC) on the rear-top-right of Cabinet 1-1.**

Figure 13—Input Cables

3 **Connect the other end of the cables to the facility power input.**

5.2—Drip Guard Information

When the Q-LS cabinet arrives, the attachable drip guard will be shrink-wrapped to the cabinet. (Drip guard installation is pictured in Figure 14, below.)

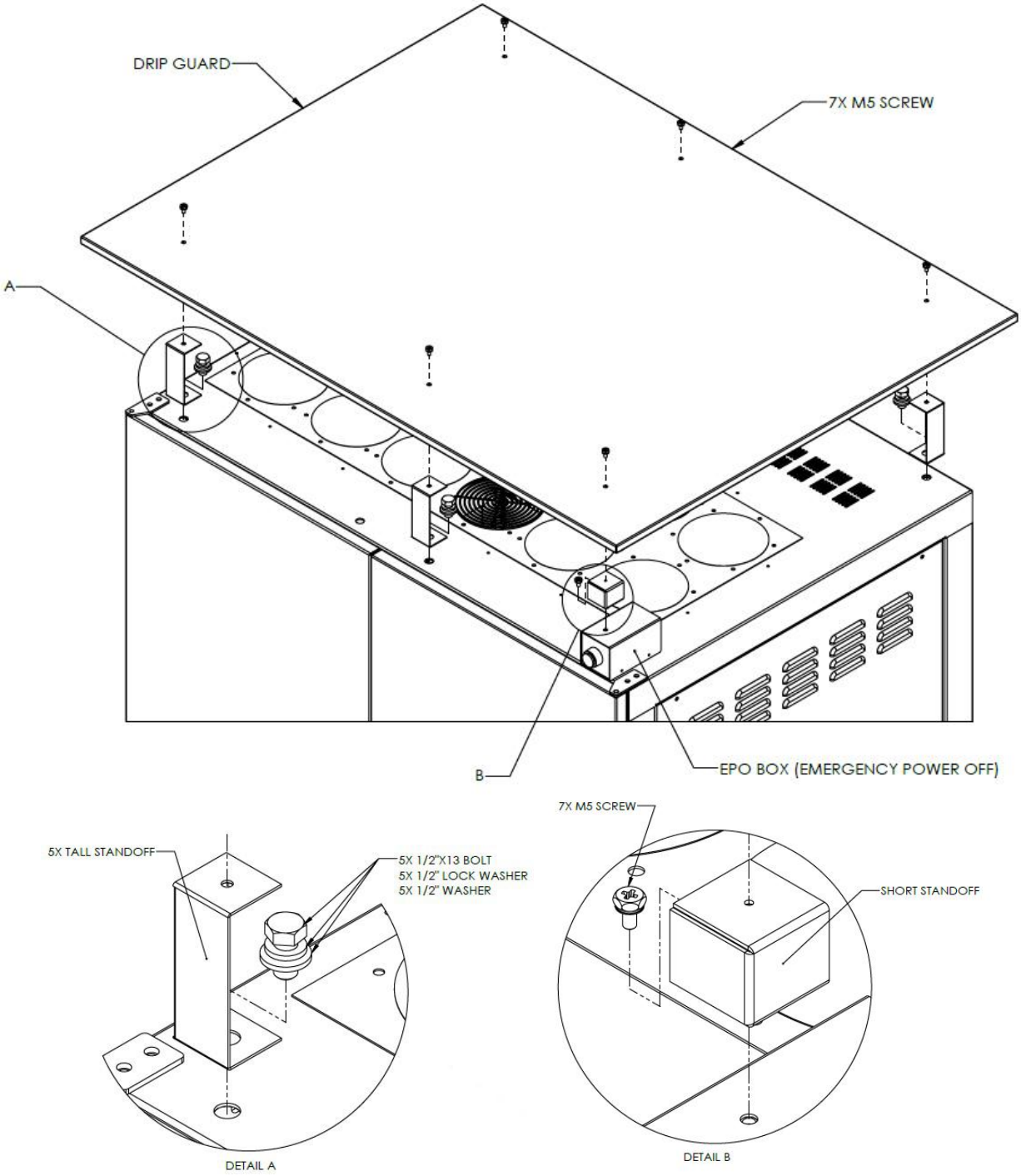


Figure 14 – Drip Guard Installation (Note Detail A, B)

5.2.1—Attaching Drip Guards

To attach the drip guard:

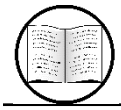
1. **Find the drip guard hardware packet. This packet will be included beneath the cabinet.**
2. **Using one bolt, one nut, and one lock-bottom washer, attach one long standoff leg to the left-front side of the Q-LS cabinet. (See** Figure 14**, Detail A)**

Note

If the cabinet has come with an external Emergency Power OFF (EPO) button, do not attach a long standoff leg to the right-front side of the cabinet.
The shorter leg will connect the Emergency Power OFF (EPO) button housing to the drip guard.

3. **Repeat Step 2 for the rear-side screw holes in the cabinet. For a single-wide cabinet, two each of screws, nuts, and washers will be needed to attach the two standoff legs. For a double-wide cabinet, three each of screws, nuts, and washers will be needed to attach the three standoff legs.**
   If the system did not come with an EPO button: Repeat **Step 2** for the right-front side. Skip **Step 4**.
   If the system came with an EPO button, proceed to **Step 4**.
4. **If the cabinet has come with an external EPO, use one of the M5 screws to attach the short standoff leg to the right-front side of the *Q-LS* cabinet. (See** Figure 14**, Detail B)**
5. **Line up the holes in the drip guard with the holes in the standoff legs. The long side of the cabinet will be lined up with the long side of the drip guard. The drip guard should extend slightly farther to the front of the system. Ensure the orientation of the drip guard is correct to maintain proper IP rating compliance.**
6. **Using the remaining M5 screws, attach each side of the drip guard to each standoff leg. Ensure that they are fastened tightly so that the drip guard will not loosen from vibration or leak liquid into the Q-LS.**

Manual Helps



For torque settings, see **Appendix A — More about Installation**.

This will complete the installation of the drip guard.

5.3—Installing Monitoring Options

The Q-LS system can provide notifications about system status using the MODBUS, UPScom, or NetAgent connections. These monitoring devices will be connected to the main communication board.

Important monitoring connections on the main communication board:

- One connection for NetAgent (RS-232 cable)
- One connection for UPScom (RS-232 cable)
- Two connections for UPScom (RS-485 cables)
- One connection for MODBUS
- Eight dry contact terminals for notifications
- Additional custom interfaces as requested

To attach monitoring options:

1 **Unscrew the control panel located on the top-front side of the *Q-LS* by removing the two securing screws.**

2 **Open the control panel to reveal the circuit boards on the right-hand inside door of the panel.**

3 **Find the board labeled "3R PCB". 3R is the system's main communication board and is located on the bottom of the right-hand inside panel door.**

4 **Connect the appropriate cable to the correct communication port on the 3R board (**Figure 15**).**

5 **Run the cable from the left side of the control panel and down through the bottom of the Q-LS system.**

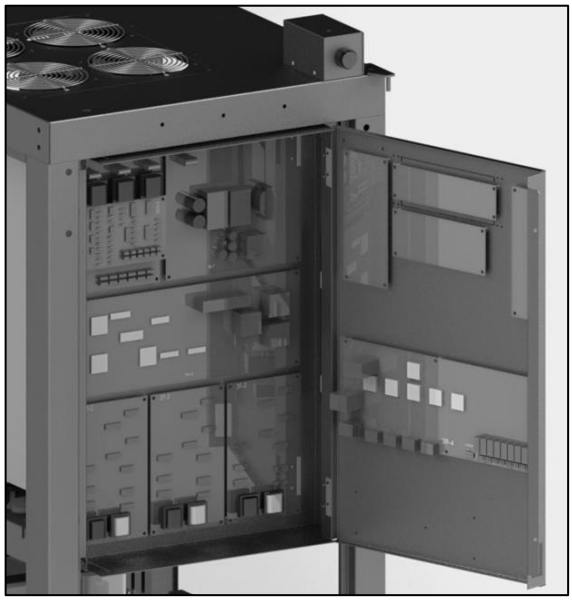


Figure 15—Location of 3R

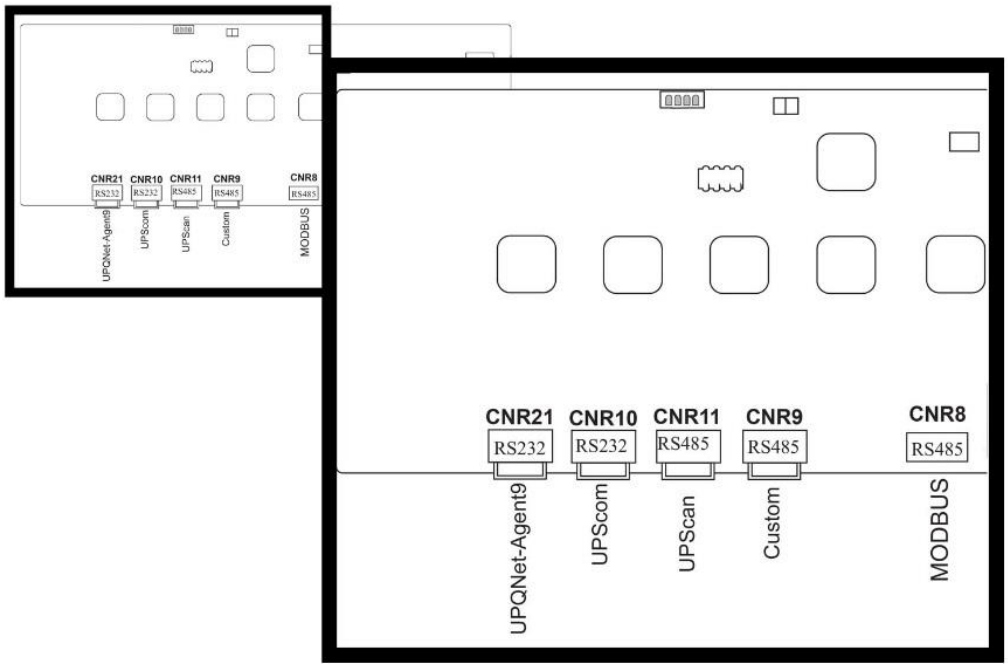


Figure 16—Communication Terminals on Lower-Left Side of the 3R Board

Note: Not all monitoring options will be available, depending on system specifications.

6 Attach wires to the dry contact terminals.

The Dry Contacts are a set of eight normally open relays that will close when the specified condition is active. These conditions include:

COM: Combined notification (user selection of any number of the other dry contact signals)

BATL: Battery at low-battery warning level (320 VDC)

BACK-UP: System running in battery backup mode

BYPASS: Maintenance bypass breaker is CLOSED

SS: The Static Switch Inverter Line is active (this will be closed during Normal Operation Mode)

FAULT: System incurred a fault or multiple faults

(**NOTE:** The fault signal will clear 30 seconds after the fault has been corrected. If clearing the fault without correcting it, reset this contact by turning the inverter OFF and back ON.)

OVL: System overload

INVON: Inverter ON (this will be closed during Normal Operation Mode)

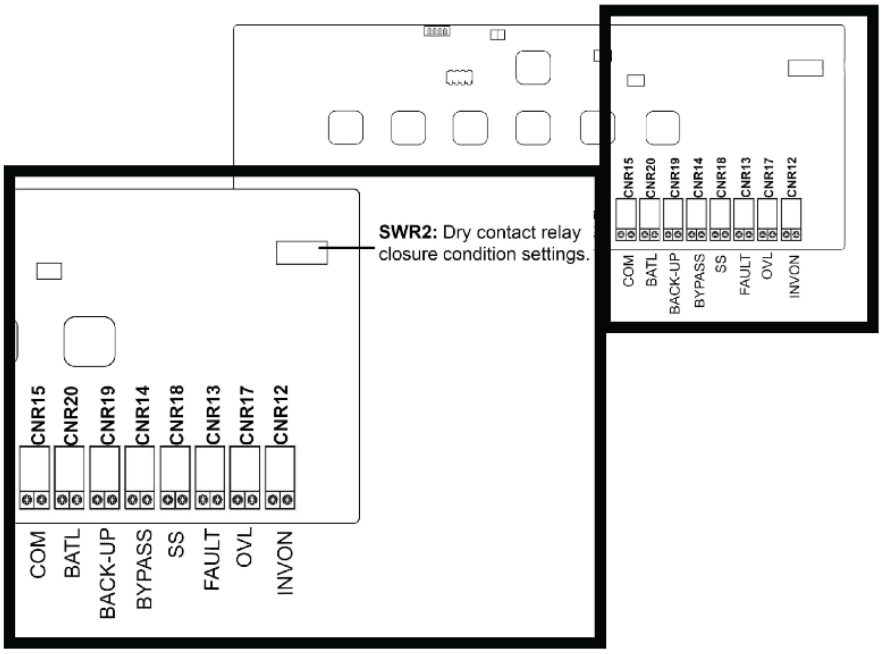


Figure 17— Dry Contact Terminals on Right Side of the 3R Board

The Combined terminal (COM, or CNR 15) allows additional notification for any of the other seven status notifications. If battery power were low and the COM terminal was being used for additional low-battery notification, two signals would be received, one from the BATL terminal and one from the COM terminal. To receive additional notification for any communication terminal, the two terminals will need to be wired together. COM does not have to be wired at all, but it can be wired to any terminal or even all seven of the other terminals. SWR2, a dip switch located on the main communications board, controls which signals are given using the COM terminal. The topology for this notification system is noted in Figure 17.

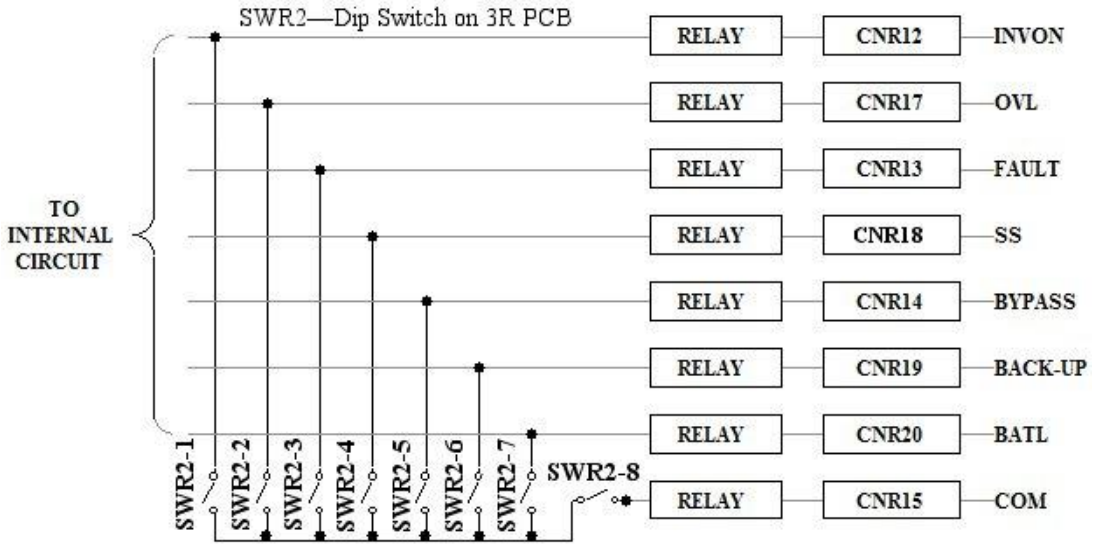


Figure 18—Topology of SWR2 Dip Switch and Combined Notification Relay

7 Close the control panel and re-secure it, using the two securing screws. (For torque settings, see Appendix A—More about Installation.)

5.4—Installing an External EPO Connection

External EPO connections are a custom installation option and will vary in their location. If an external EPO has been ordered, it will need to be attached. The connection is usually made near the input and output connections.

5.5—Connecting Cables

The following section will show how to connect all other cables.

Manual Helps

For suggestions about cable sizes, see **Appendix A—More about Installation**.

Remove the bottom panel by removing the four lower securing screws.

5.5.1—OUTPUT Breaker Cabinet Installation (If Included)

Q-LS 400, 500, and 550 systems may include an OUTPUT Breaker Cabinet, which contains the BATTERY breaker and the OUTPUT breaker(s). The breakers need to be connected to the bus bars in the back of the Q-LS, using the provided cables.

5.5.1.1—Connecting the Battery Cables to the OUTPUT Breaker Cabinet

1 Feed the ends of the battery connector cables through the rubber gland valve at the rear-top-left of Cabinet 1-1 or run the cables through the bump-out section between the UPQ and OUTPUT Breaker cabinets.

2 **Connect the battery cables to the B- and B+ battery bus bars in the rear-top-left of Cabinet 1-4.**

3 **Connect the other end of the battery cables to the battery bus on the OUTPUT breaker cabinet.**

5.5.1.2—Connecting the Output Cables (OUTPUT Breaker Cabinet)

1 **Feed the output power cables through the rubber gland valves in the rear-top of Cabinet 1-2 or run the cables through the bump-out section between the Q-LS and OUTPUT breaker cabinets.**

2 **Connect the output cables to the output bus bars (OA, OB, OC, and ON) in the rear-bottom-left of Cabinet 1-2.**

> **Note: Multiple outputs may be present, depending on customer specification. In case of confusion, remember that labels supersede wire coloration.**

3 **Connect the other end of the output cables to the bus bars in the OUTPUT Breaker Cabinet.**

5.5.2—Cables to Power System and Load

- Connect AC input, output, and battery cables to the terminal block. (See Figure 19—Connections at Terminal Block, below.)
    - The Q-LS uses a standard connection terminal for input and output power.
    - Be sure that the battery polarity is correct before connecting battery cables to the terminal block.

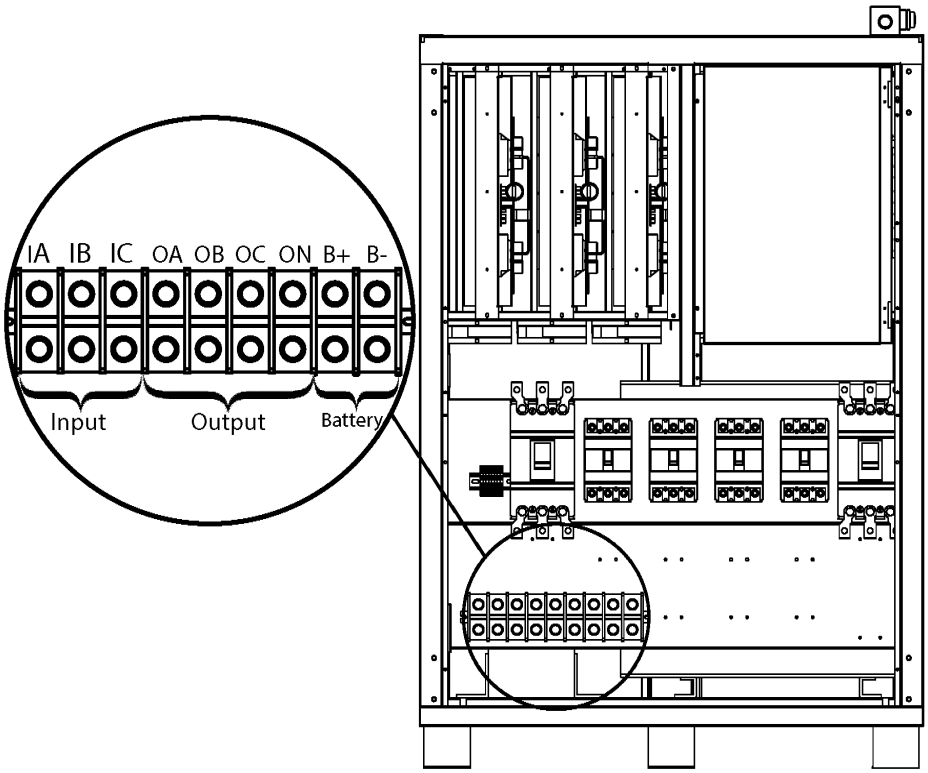


Figure 19—Connections at Terminal Block

NOTE: Actual input and output configurations may vary, depending on requested system specifications. If additional input/output connection instructions are necessary, they will be provided in an addendum.

5.5.3—Grounding Connections

1 **Connect one end of the provided grounding conductor into the grounding bus bar located on the bottom of the Q-LS chassis.**

2 **Run the ground cable out through the rubber gland plate or through the same conduit as the battery conductors.**

3 **Feed the opposite end of the grounding conductor up through the battery gland plate.**

4 **Connect the second end of the provided grounding conductor into the grounding bus bar located on the bottom of the battery chassis.**

5 **If all the connector slots on the bus bar are being used, connect no more than two ground conductor ends into one slot.**

6 **Replace the breaker panel dead front and re-secure it with the securing screws.**

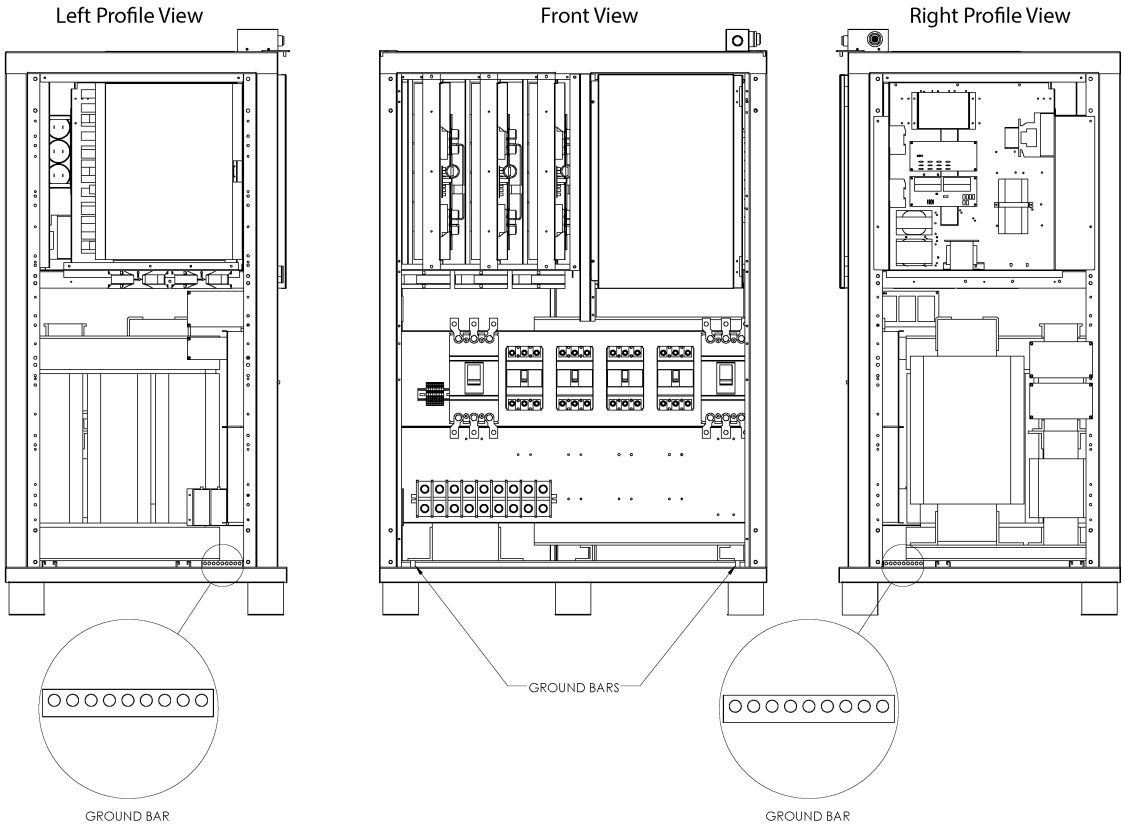


Figure 20—Typical Q-LS and Battery Grounding Connections

ELECTRICAL WARNING

While making grounding connections, check that the terminal block, chassis, and battery have been correctly grounded to the bus bar on the Q-LS. An incorrect grounding connection could cause injury due to electric shock.

Notes

Although more or fewer grounding connections may need to be checked, connections noted in Figure 20are some of the most common.

The bus bar may not be located exactly where it is shown in Figure 20, but the bar will always be grounded to the base of the chassis.

Manual Helps

For torque settings, see **Appendix A—More about Installation**.

5.5.3.1—Additional Connection Options

Occasionally, additional connection options may be necessary for landing cable conduit. One of two methods may be used. The first option provides the simplest solution. If you encounter a situation in which neither of these two options resolve your needs, please contact customer support to seek an alternative.

1 Land cables using an elbow conduit. For this purpose, Power Innovations will replace the rubber cable gland located on the bottom of the Q-LS with an aluminum plate. As noted below, the Q-LS leg supports provide 3.624 inches of clearance (Figure 21**).**

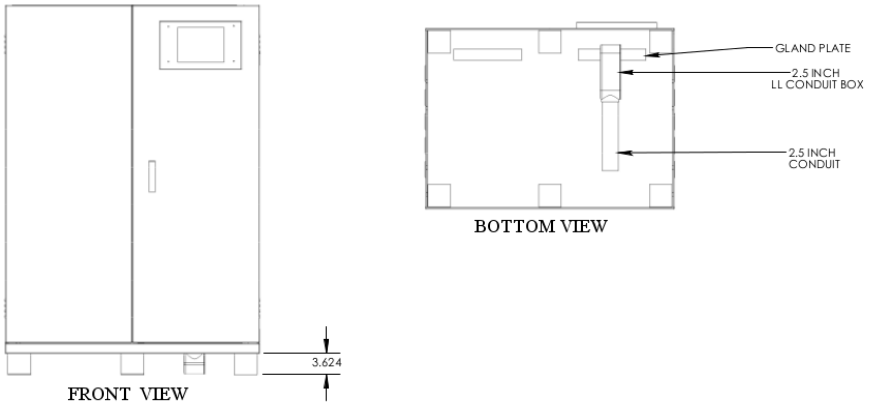


Figure 21—2.5 in Cable Conduit with Aluminum Access Plate

Caution

Secure the elbow joint to the aluminum. Doing so ensures that the Q-LS retains compliance with federal regulations.

Leg extensions can be provided for longer conduits if necessary (*Figure 22*). These extensions provide 6.429 inches of clearance, as noted below.

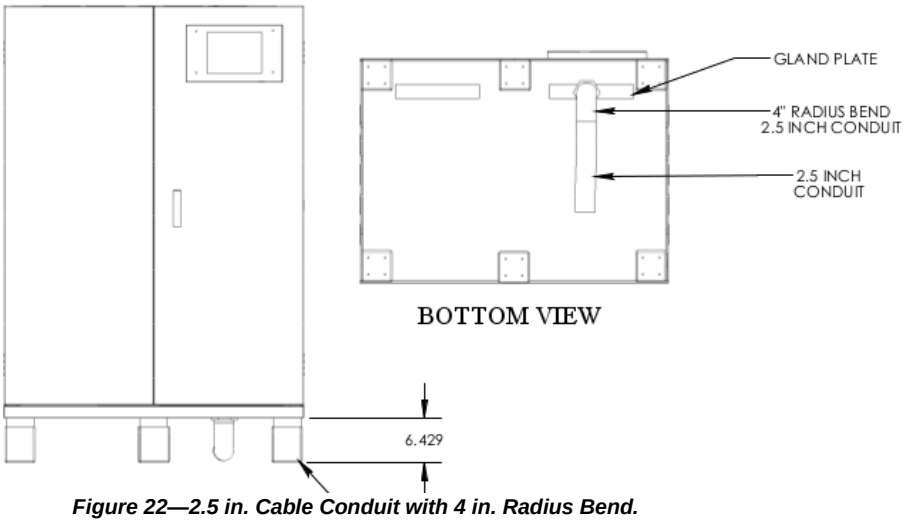


Figure 22—2.5 in. Cable Conduit with 4 in. Radius Bend.

2 **Land cables using a backpack that provides the connections in the rear with larger surface area (*Figure* 23).**

Please note that backpacks are optional equipment and must be ordered or specified by the customer separately.

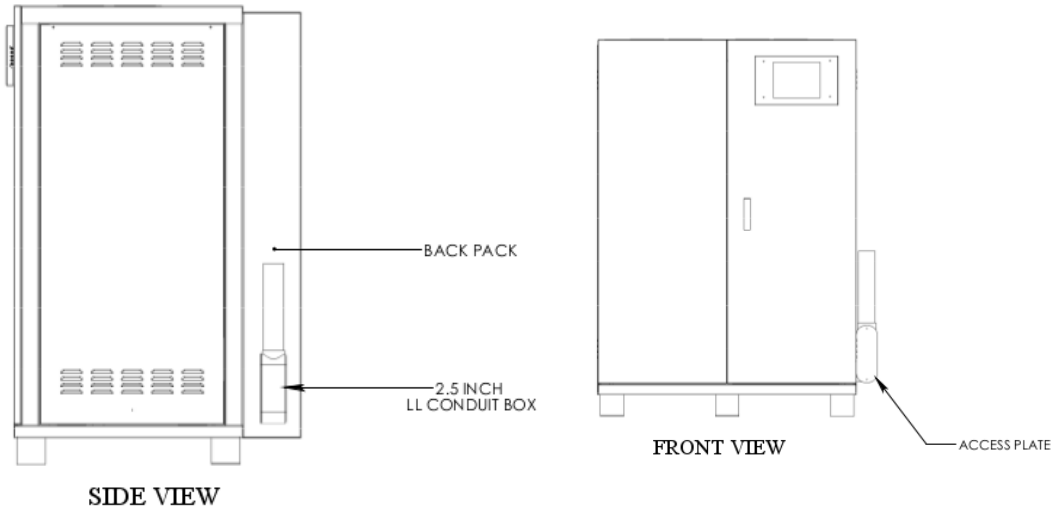


Figure* 23*—Backpack Used to Attach Conduit Box

5.5.4—Electrician Approval

Make sure all external connections are approved by a qualified electrician before the system is operated.

If each of the following items listed has been approved by an electrician before the system has been installed, it is okay to skip this step and move to **5.6—Connecting Batteries**.

Have the electrician verify:

- Downstream and upstream breakers
- Input and output cable sizes
- System grounding cables

5.6—Connecting Batteries

1. **Open the front door of the battery cabinet.**
2. **Unscrew the four screws and remove the battery disconnect panel from the bottom of the *Q-LS* battery cabinet.**
3. **Run the battery cables up through the bottom of the battery cabinet.**
4. **Remove the plastic covers over the battery terminals.**
5. **Connect the battery cables to the battery terminals, ensuring proper torque as outlined in Appendix A.1 — Torque Settings.**
6. **Replace the plastic covers over the battery terminals.**
7. **Replace the battery disconnect panel and re-secure it with the screws.**

Manual Helps

Reminder: For torque settings, see **Appendix A—More about Installation**.

8. **Verify battery polarity on both sides of the battery interconnect cable, both visually and with a meter.**
9. **If fuses are received with the system, place the battery fuses in the battery disconnect.**

ELECTRICAL WARNING

Leave the battery disconnects OFF until instructed to turn them ON during startup procedures. Failure to do so may cause serious harm.

If the system is not being wired in either redundant configuration, the system is now ready to undergo Commissioning Checks.

5.7—Wiring in Redundant Configuration

To wire in redundant configuration, both systems will be wired as normal, with a few exceptions. These exceptions depend on whether the system is being wired in Active (Parallel) Configuration or Serial (Hot Standby) Redundant Configuration.

5.7.1—Wiring in Active (Parallel) Configuration

For systems in active (parallel) configuration, special wiring instructions will be provided in addition to this manual.

5.7.2—Wiring in Serial (Hot Standby) Configuration

To wire in Serial (Hot Standby) Configuration, wire both systems as normal, except for the output for **System One** and the input for **System Two**.

The output for **System One** should be connected to the input for **System Two** (Figure 10).

Attach:

- OA1 (Output A on **System One**) to IA2 (Input A on **System Two**)
- OB1 (Output B on **System One**) to IB2 (Input B on **System Two**)
- OC1 (Output C on **System One**) to IC2 (Input C on **System Two**)

Wiring **System One**'s output to **System Two**'s input will enable **System Two** to start immediately when **System One** ceases to function.

Note

The first machine to start during initial startup will be the primary machine (**System One**). System One will always be the first machine to function during any startup. If **System One** is operating, **System Two** will always be on standby.

To enable systems to run in serial (hot standby) configuration, Power Innovations will have programmed the system as requested.

For any additional adjustments, contact a certified service technician.

5.8—Completing Commissioning Checks

For the factory warranty to apply, the system must be commissioned by a certified Q-LS service technician. This technician must have completed the service-level training course offered by Power Innovations and passed certification testing.

The technician will already possess a current copy of the *Commissioning Checklist*, which will be used for the commissioning process.

This commissioning process ensures that the system will operate safely. As part of the process, the technician may feel it necessary to contact site electricians or ask questions.

WARNING

The commissioning process is necessary to ensure the system is connected and configured properly and can be operated safely.

Cautions

Failure to have a certified service technician commission the system may cause the system harm.

Not completing commissioning for any system will void its Q-LS system warranty.

5.8.1—System Verifications

During the commissioning process, the service technician will verify the following items:

1. **All wiring, mounting, and installation processes have been followed.**
2. **Input and output voltages are correct.**
3. **The system operates smoothly in all operating modes.**
4. **All system specifications match the purchase orders.**
5. **Batteries are working correctly.**

5.8.2—Initial System Startup

The technician will perform the initial system startup. The system should not be powered ON before the system commissioning.

WARNING

Starting up the system before it has been commissioned by a certified service technician may cause serious injury and/or seriously damage the system.

The technician should take a moment with operating personnel after the commissioning to:

1. **Ensure that personnel can safely start and stop the system.**
2. **Explain system components and functions, features, and operating guidelines.**
3. **Review this manual, answering any questions.**
4. **Answer any additional questions.**
5. **Leave their contact information for future maintenance.**

5.8.3—Warranty and Receipt of the Checklist

After completing the *Commissioning Checklist*, the technician will send a copy to Power Innovations.

The warranty will apply after the initial startup and commissioning date. Power Innovations receive the *Commissioning Checklist* to apply the warranty retroactively from the commissioning date noted on the form.

Caution

Ensure that the service technician sends the *Commissioning Checklist* to Power Innovations. If no record shows that the system was commissioned, the system warranty will not apply.

6—System Power Flow

6.1—Q-LS System Power Flow

The Q-LS is a double-conversion, always online UPS system with added isolation and filtration components to ensure high quality output power.

Internal operations of the system are isolated from the input AC source by an input isolation transformer which provides complete galvanic isolation from the input source.

The input AC is converted to DC by the Rectifier subsystem. This DC is used to charge and maintain the DC rail and the system battery bank.

The inverter then converts the DC available on the DC rail to alternating current.

The output isolation transformer then converts the inverter voltage to the specified output voltage for the load. This transformer also provides isolation of the internal system components from the attached load.

In the event of a system fault or emergency, the Reserve line provides an automatic emergency bypass of the main active system components. This automatic switchover is accomplished by the Static Switch.

The Maintenance Bypass line provides a manually activated bypass line allowing the Q-LS to be powered-down for maintenance or service while still providing output to the load.

Note: Q-LS 400, 500, and 550 systems can also be ordered / specified as frequency converters. In this instance the Maintenance Bypass function is disabled to prevent pass-through of dissimilar power.

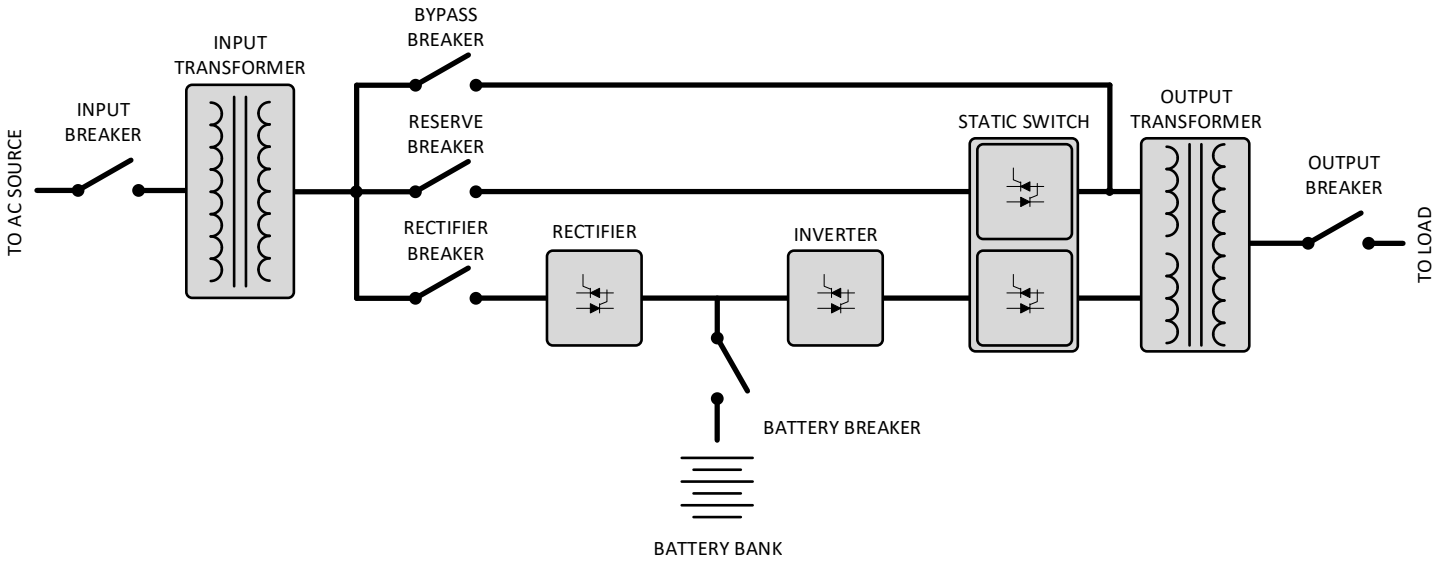


Figure 24—Q-LS System Power Flow Topology

6.2—Q-LS Unit Subsystems

The Q-LS has four main subsystems: the Rectifier, the DC Rail, the Inverter, and the Static Switch. All these subsystems are also labeled on the mimic LED display on the front of the Q-LS cabinet.

6.2.1—Rectifier

The rectifier is the first active subsystem within the Q-LS. The primary purpose of the rectifier is to convert the input alternating current (AC) into a stable direct current (DC) and to maintain the DC rail at a constant voltage. The DC rail is then used to energize the Inverter subsystem and to charge and maintain the system battery bank.

The rectifier will activate as soon as the RECTIFIER breaker is closed. No other action is necessary if the input power is within operating range.

The Q-LS uses an active, full-bridge rectifier and high-current SCR switching transistors to convert AC to DC.

Q-LS systems covered in this manual will include parallel rectifiers in a 12-pulse configuration for optimized efficiency.

6.2.2—DC Rail

The output of the rectifier charges and maintains the DC rail. This is a common bus used to provide direct current for both the Inverter subsystem and the system battery bank. In the event of input power failure, the DC rail will be energized by the system battery bank.

The rectifier charges the batteries using a constant current / constant voltage charge cycle. The rectifier also prevents higher voltage charging functions when ambient temperature is abnormally high.

The external battery bank is kept at a constant float voltage of 390 VDC to maintain charge. Once per month, the Q-LS will initiate a boost charge to maintain battery health and ensure optimal charge. A similar boost charge, called a low battery boost charge, will be initiated if the battery bank is ever discharged to a low battery state.

A battery test is conducted daily at midnight. This battery test reduces the rectifier DC output, allowing the batteries to power the load for a short period of time to ensure that the battery bank is ready for use. This test does not interrupt power to the load and will not degrade the lifespan of the batteries.

Manual Helps

For more information about controlling a boost charge, see 9.2.4-Parameter Setting Menu

Turning the BATTERY breaker ON connects the batteries to the DC rail and allows charging (or discharging) as part of the Q-LS system.

6.2.3—Inverter

The inverter is the second active subsystem within the Q-LS. The primary purpose of the inverter is to convert the direct current of the DC rail to alternating current for the system output.

The Q-LS uses an active switching, H-bridge inverter configuration, employing high-current and high-frequency IGBT switching transistors to convert DC to AC. Output feedback logic and output power filter components ensure that the Inverter output maintains a high-resolution sinewave.

The inverter draws operating current from the DC rail. During normal operations (Normal Operation Mode), the source of current is the rectifier. If AC input power is lost, the inverter draws current from the external battery bank (Backup Mode). Switchover between Normal and Backup modes is seamless and does not result in loss of output power fidelity.

The Q-LS has a separate inverter for each output phase. Because each inverter acts separately, there can be a complete load imbalance between the phases without causing issues with the Q-LS system. Even when the system switches from input power to backup power, the inverter keeps the AC power flow constant.

When the inverter is operating, it receives power as long as either the RECTIFIER or the BATTERY breaker is CLOSED. There is no inverter breaker for Inverter overcurrent protection; however, each inverter is protected by an input fuse and active overcurrent monitoring and protection.

The Inverter may be activated by simultaneously pressing the left and center inverter buttons on the control panel.

Manual Helps

For more information about these keys, see **Inverter Control Panel**.

6.2.4—Static Switch

The Static Switch is the final active subsystem in the Q-LS. This is the main active component for the Reserve line and can be considered the automatic emergency bypass of the Q-LS. The static switch allows the output of the Q-LS to be energized by either the Inverter output or the Reserve line. It also has the ability to shut off the output entirely.

The Reserve line is selected as the active output in the case of an internal component failure or emergency fault condition.

During normal operations, the inverter deliberately shadows the waveform available on the Reserve line. In the event that a switchover from the Inverter to the Reserve line becomes necessary, the two waveforms are synchronous.

The static switch is designed to switch sources at zero-cross in a break-before-make action.

The static switch begins functioning when the RESERVE breaker is CLOSED. Turning on the Inverter causes the static switch to select the Inverter line within 7 seconds as long as no fault conditions are present. Turning the inverter off causes the static switch to select the Reserve line.

6.3—Operation Modes

The Q-LS system has five modes of operation:

- Normal Operation Mode
- Battery Backup Mode
- Reserve Mode
- Maintenance Bypass Mode
- Economy Mode

Manual Help

For more information about operating procedures, see **Operating Procedures**.

6.3.1—Normal Operation Mode

In Normal Operation Mode, input power enters the input isolation transformer and is converted to the internal operation voltage. This input AC power is then converted to DC by the Rectifier subsystem and used to charge and maintain the DC rail and the system battery bank. The Inverter subsystem then converts the DC power to AC. The output of the Inverter is then converted to the specified output voltage through the output isolation transformer (**Figure 25**).

The input power goes through five separate stages of isolation and filtration: input isolation and filtration, AC/DC rectification, DC/DC regulation, DC/AC conversion, and output isolation and filtration. These stages ensure a clean, well-regulated, high-resolution sinewave output free of interference and line noise.

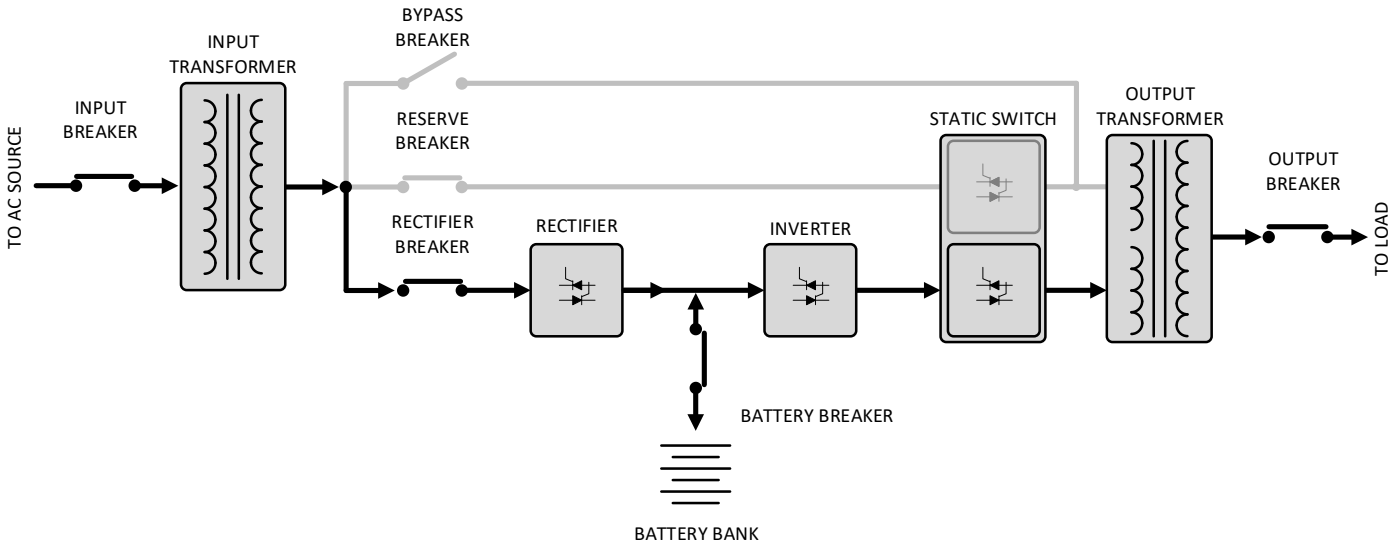


Figure 25—Power Flow in Normal Operation Mode

6.3.2—Battery Backup Mode

The Q-LS only enters Battery Backup Mode if the system is not receiving input power or in the event of a rectifier failure. If input power is lost, the Q-LS automatically switches to Backup Mode.

In Battery Backup Mode, the DC rail is energized exclusively from the system battery bank. Battery power is converted from DC to AC by the Inverter and used to energize the load (**Figure 26**). When the system changes to Backup Mode, the AC output is not interrupted, and the connected load continues to operate normally.

The Inverter subsystem is always be powered by the DC rail, whether it is energized by the Rectifier or the battery bank. The inverter continues to output AC power without interruption as long as the battery bank is connected and remains above the low-battery shutdown level.

The system continues to run on the battery until input power is restored or it must shut down due to low battery status. In the event of battery power depletion, the static switch is set to transfer to Reserve Mode.

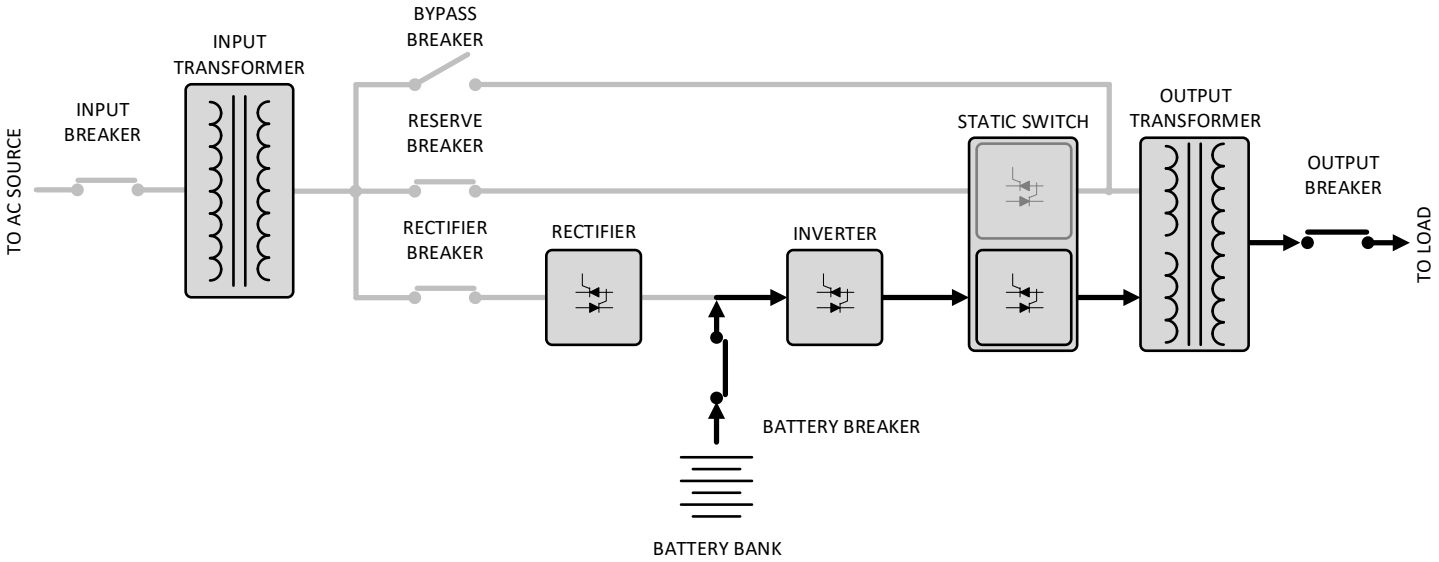


Figure 26—Power Flow in Battery Backup Mode

6.3.3—Reserve Mode

Under some conditions, the inverter shuts down to protect itself or protect the attached load due to unreliable output conditions. Operation during any of these situations may harm the inverter or the load. In these instances, the static switch selects the Reserve line as the output source of the system. This is referred to as Reserve Mode. Any one of the following conditions triggers the Q-LS to shut down the Inverter and activate Reserve Mode:

- Abnormally high DC Rail voltage
- Inverter output short circuit
- Inverter fuse failure
- Abnormal inverter output
- Subsystem modules exceeding temperature limits
- Output overload (above 110%)
- Bypass Breaker Closed

In Reserve Mode, the static switch routes the power flow around all other active subsystems until the fault or warning is cleared. Reserve power from AC input is isolated, but no active filtration is available. Any changes to power on the input are reflected on the system's output (**Figure 27**). Additionally, the Q-LS will not switch to Battery Backup mode if there is a loss of AC input power. This condition would result in loss of output power to the load.

Switchover to the Reserve line is initiated by system logic if the input waveform goes outside of the operating parameters set by the system firmware. This is intended to protect the load from abnormal voltages or frequencies.

The Rectifier still operates while the Q-LS is in Reserve Mode. This allows the system to charge and maintain the battery bank even while the Inverter is inactive.

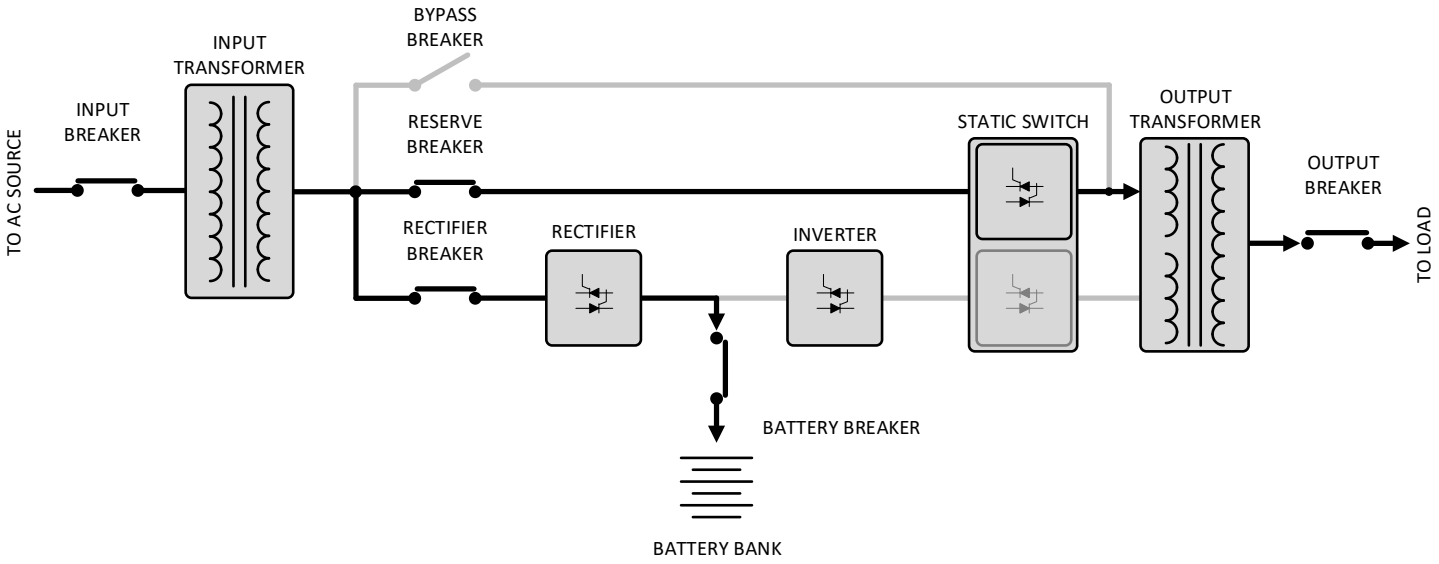


Figure 27—Power Flow in Reserve Mode

6.3.4—Maintenance Bypass Mode

Maintenance Bypass Mode is similar to Reserve Mode. This mode allows for output operation in the event of scheduled maintenance or a malfunction with the Normal and Reserve modes. If a certified service technician needs to perform maintenance on the system, it can be partially powered down using this mode. Maintenance Bypass Mode must be activated manually.

Entering Bypass Mode does not interrupt power to the load or change output voltage. The output continues to function normally.

Bypass Mode is similar to Reserve Mode in that all active subsystems are bypassed. The Bypass line also bypasses the Static Switch (**Figure 28**).

While in Bypass Mode, power from the AC input is isolated, but no active filtration is available. Any changes to input power are reflected on the system's output. Additionally, the Q-LS does not switch to Battery Backup mode if there is a loss of AC input power. This condition would result in loss of output power to the load. To prevent loss of output power to the load, when in Bypass Mode, the Q-LS does not switch to Battery Backup Mode if there is a loss of AC input power.

Components above the lower fan shelf in the Q-LS are de-energized. This allows a technician to repair or replace components within the Q-LS. Components below the lower fan shelf are still energized.

Note: Q-LS 400, 500, and 550kVA systems can also be ordered / specified as frequency converters. In this instance the Maintenance Bypass function is disabled to prevent pass-through of dissimilar power.

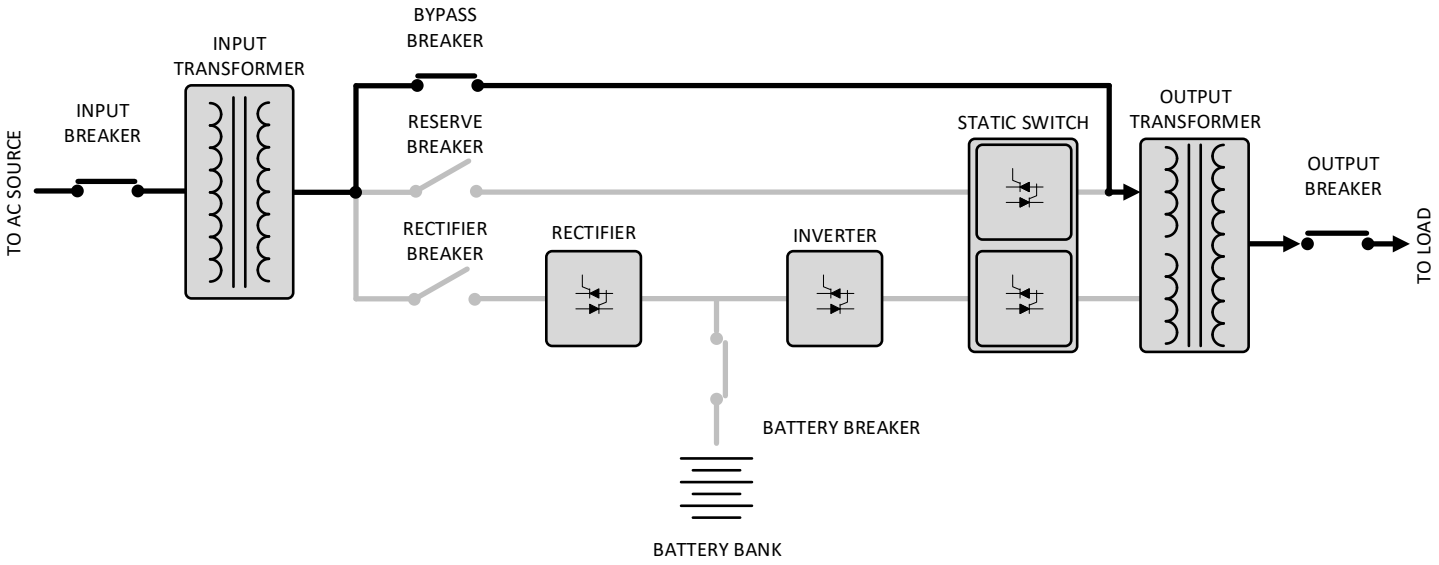


Figure 28—Power Flow in Internal Bypass Mode

6.4—System Auto Restart

The Q-LS system automatically enters auto restart (or auto-recover) mode if the inverter is automatically shut down by the system logic.

The system will not auto-restart under any circumstances when the system is manually removed from Normal Operation Mode.

6.4.1—Low-Voltage Battery Standby

If the inverter shuts down due to a low battery status, the system logic continues to operate in a low battery standby mode for ten (10) minutes. If input power is restored within this 10-minute period, the system restarts the inverter and resumes operation.

If power is not restored within 10 minutes, the system completely shuts down and must be manually restarted.

This feature is enabled when the daily battery test feature is turned ON.

6.4.2—Normal Operation Auto-Resume

When the system is forced into Reserve Mode as a result of an unexpected overload or fault condition, the auto-restart function also operates. In such cases, the inverter automatically attempts to resume Normal Operation Mode.

If more than three auto-restart attempts occur with a 10-minute window, the auto-resume function ceases, and the inverter must be manually restarted.

7—Operating Procedures

For easy reference, operating procedures are shown on a label just above the breakers on the front panel of the Q-LS unit. These labels also provide breaker ID numbers customized to the various systems. (Note: If your Q-LS is a Frequency Converter, operating procedures may differ slightly from the instructions below. Always refer to the Operating Procedure label on the unit.)

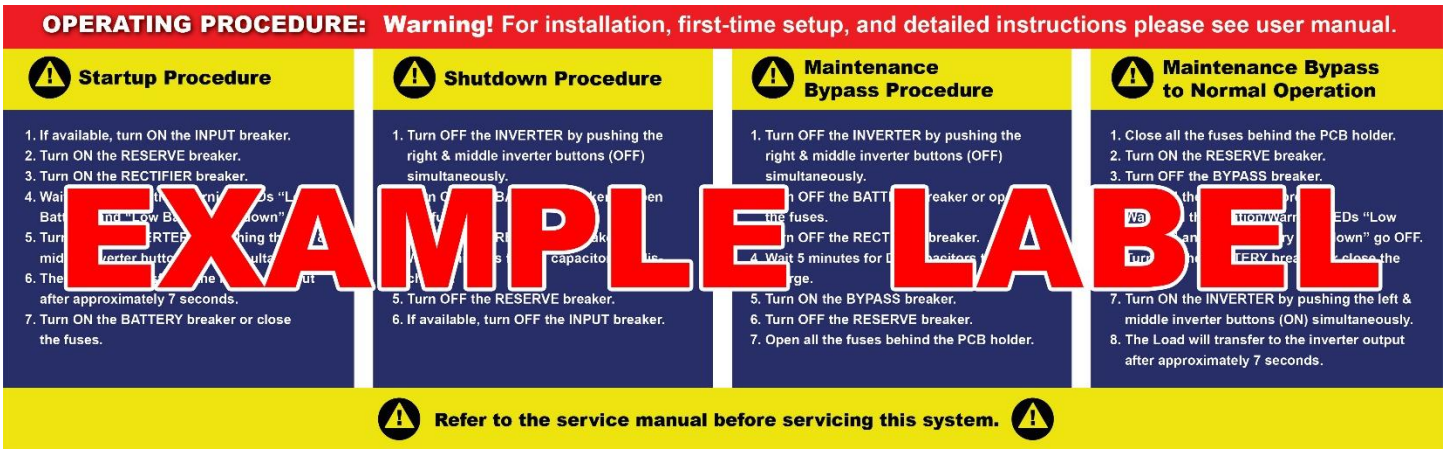


Figure 29 -- Example Operating Procedure Label

For more information about operation modes, see **Operation Modes**.

7.1—Prestart Check

Once all cables are properly connected and the power source is connected to the input terminals, the Q-LS system is ready to operate.

If the system is being operated for the first time, a Q-LS certified technician should startup the system and perform a full system commissioning.

At any other time the system has been turned OFF, it will be necessary to go through a *prestart check* before startup.

Check the following items before beginning the startup procedures:

- Verify that batteries are connected using the correct polarity.
- Verify that the input voltage conforms to the system's rated input voltage.
- Verify that the supplied input frequency conforms to the Q-LS system's rated input frequency.
- All connected loads should be OPEN.
- All breakers, including the battery breaker, should be OPEN.
- Ensure that there are no packaging materials, tools, or other foreign materials inside or on top of the cabinet.

7.2—Startup/Shutdown Procedures

Following the proper procedures for activating and deactivating the Q-LS is essential to safe system operations. Failure to follow the startup or shutdown procedures as described here may result in damage to the system.

7.2.1—Startup Procedure

To start the Q-LS system in Normal Operation Mode,

1 **CLOSE the INPUT breaker.**

2 **CLOSE the RESERVE breaker.**

The Reserve LED light (B) on the front panel mimic display of the Q-LS unit will illuminate. The internal housekeeping power supply and system logic are now active.

3 **CLOSE the RECTIFIER breaker.**

The Rectifier will activate and begin to energize the DC Rail as long as the input power is within operating range and there are no system errors. The rectifier will only start if the system is connected to the correct input power source.

4 **Wait until *System Status* LEDs 15 and 16 (“Low Battery” and “Low Battery Shutdown”) turn OFF.**

DC voltage will gradually rise until the DC Rail reaches the designated voltage level. Once the DC Rail reaches the designated voltage, the inverter can be turned ON.

5 **Turn ON the inverter by pressing the left and center inverter buttons (ON) simultaneously (see also Inverter Control Panel).**

If the system is being powered up from a fully OFF state, the inverter will immediately power the output (or output breaker, if present).

If the inverter is being started when the system is in reserve mode, the inverter will synchronize with the reserve for seven seconds before the static switch activates the Inverter output.

6 **CLOSE the BATTERY breaker on the Q-LS unit.**

The battery is now ready to supply power if necessary.

7 **CLOSE the OUTPUT breaker on the Q-LS unit**.

7.2.2—Shutdown Procedure

To shut down the Q-LS:

1. **Turn OFF the inverter by pressing the right and center inverter buttons (OFF) simultaneously (see also Inverter Control Panel on the Q-LS unit.)**

   This process will automatically transfer the load to Reserve without interrupting the output.

2. **OPEN the BATTERY breaker on the Q-LS unit.**

3. **OPEN the RECTIFIER breaker on the Q-LS unit.**

   DC Rail will slowly discharge.

4. **Completely discharge the DC rail by pressing the left and right inverter buttons simultaneously on the Q-LS unit. Monitor the DC Rail voltage until it reaches 0 VDC.**

   Voltage is displayed in Real Time Data > Other Data on the LCD screen. See 9.2.2 -- Real Time Data Menu.

5. **Ensure that no critical equipment is connected to the output, then OPEN the RESERVE breaker on the Q-LS unit. If the load is connected to the output, OPENING the RESERVE breaker will drop the load.**

6. **OPEN the OUTPUT breaker.**

7. **OPEN the INPUT breaker.**

7.3—Maintenance Bypass Procedures

Maintenance Bypass Mode will allow shutdown of the Q-LS for maintenance without interrupting output to the load. Note: Maintenance Bypass Mode is not present or is deactivated in a Frequency Converter since input power and output power are not compatible.

7.3.1—Entering Maintenance Bypass Mode

To initiate Maintenance Bypass Mode:

1. **Transfer the load to reserve by turning OFF the inverter.**

   Press the right and center inverter buttons (OFF) simultaneously. The output to the load will not be interrupted.

2. **OPEN the BATTERY breaker to disconnect the battery bank.**

3. **OPEN the BATTERY breaker(s) on the external battery cabinet(s).**

4. **OPEN the RECTIFIER breaker.**

   The DC voltage will slowly decrease.

5. **Completely discharge the DC rail by pressing the left and right inverter buttons simultaneously. Monitor the DC Rail voltage until it reaches 0 VDC.**

   DC Rail Voltage is displayed in [Real Time Data > Other Data] on the LCD screen. See Error! Reference source not found..

6. **CLOSE the BYPASS breaker on the Q-LS unit.**

   The RESERVE breaker and reserve static switch LEDs will still be illuminated.
   (**NOTE:** When the BYPASS breaker is CLOSED, power will flow through both the Bypass and Reserve lines in parallel.)

7. **OPEN the RESERVE breaker on the Q-LS unit.**

8. **Open the bottom row of fuse cartridges located behind the Q-LS LCD control panel.**

If performing immediate, internal maintenance, open both rows of fuses. This will deactivate the fan banks as well as the internal power supplies.

If the Q-LS is to remain in Bypass mode for extended periods of time, the AC PS, UPPER FAN, and LOWER FAN fuses should be left in place to maintain airflow for transformer cooling.

ELECTRICAL WARNING

IMPORTANT: Before touching anything or proceeding, verify with a meter that there is no voltage.

Check the control panel and verify that all LEDs are OFF. If no power is going to the control panel, the Q-LS system is ready to be serviced.

7.3.2—Returning to Normal Q-LS Operation Mode after Internal Bypass

The system can be returned to Normal Operation Mode from Internal Bypass Mode without interrupting output power.

To return the system to Normal Operation Mode:

1. **Close all the fuse cartridges behind the Q-LS LCD control panel.**

2. **CLOSE the RESERVE breaker on the Q-LS unit.**

   The Reserve LED light (*B*) on the front panel mimic display of the Q-LS unit will illuminate. The internal housekeeping power supply and system logic are now active. Power is available on the Reserve Line.

3. **Wait about 5 seconds for the Static Switch LED on the mimic display to illuminate.**

   This LED indicates that the Static Switch has initialized and is providing output. Continuing to the next step before the Static Switch initializes will cause the load to be dropped.

4. **After the LED lights up, OPEN the BYPASS breaker on the Q-LS unit.**

   NOTE: The inverter cannot be switched ON when the BYPASS breaker is ON. This safeguard exists to prevent harm to the inverter and to the load.

5. **CLOSE the RECTIFIER breaker.**

   The Rectifier will start automatically if it is connected to a compatible power source.

6. **Wait until *System Status* LEDs 15 and 16 ("Low Battery" and "Low Battery Shutdown") turn OFF.** DC voltage will gradually rise until the DC Rail reaches the designated voltage level. Once the DC Rail reaches the designated voltage, the inverter can be turned ON.

7. **Turn ON the inverter by pressing the left and center inverter buttons (ON) simultaneously.**

   The Static Switch will transfer to the Inverter output after about 7 seconds.

8. **CLOSE the BATTERY breaker on the Q-LS unit.**

9. **CLOSE the BATTERY breaker on the battery cabinet.**

Check the control panel. If the system is operating normally:

1. All Caution/Warning LEDs (on the right side of the panel) should be OFF.
2. System Status LED lights “Inverter ON” and “Static Switch Normal” should be illuminated.
3. If the load is over 70%, one of the System Status “Load” LED lights (*9–12*) will also be illuminated.

Note

If the battery is charging, System Status LED light “Battery Charging” (*21)* will also be illuminated.

8—Control Panel Operation

The control panel provides notification and status lights for easier operation and troubleshooting. The menus can be used to set and configure the system. To use the panel for troubleshooting, see Troubleshooting the System. For an in-depth explanation of each status light, alarm and menu feature, see **System Status Key**.

8.1—Q-LS Cabinet Control Panel Features

The control panel is located on the top front side of the Q-LS cabinet. Through a small display window built into the top of the cabinet, the most commonly used parts of the panel display can be seen.

During normal operation, the troubleshooting sections of the panel are hidden behind the Q-LS cabinet's front door. The sections of the Control Panel that can be seen through the display window are explained below **(Figure 30)**.

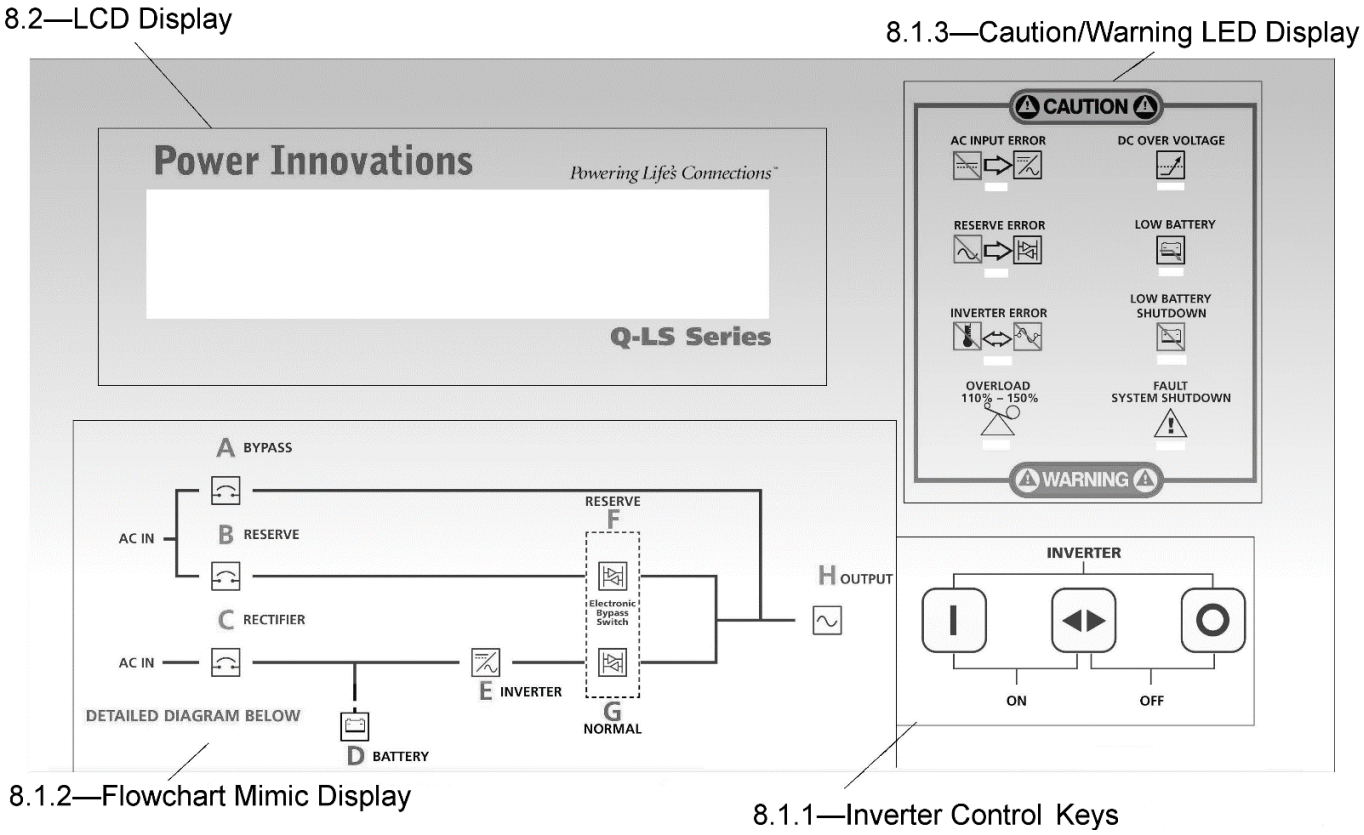


Figure 30—Q-LS Control Panel

8.1.1—Inverter Control Panel

The Inverter is controlled using three tactile switches located below the Caution/Warning LEDs on the Control Panel (see **Figure 31**). All Inverter functions are activated by pressing two of these simultaneously.

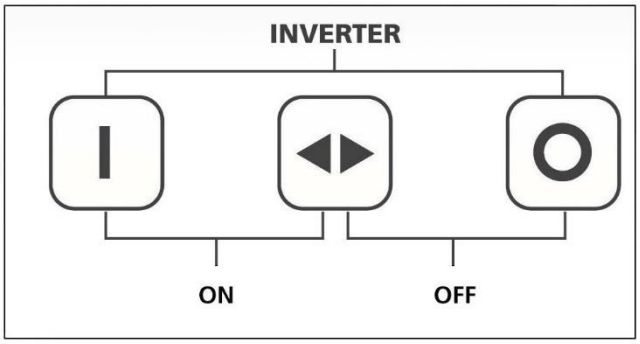


Figure 31—Inverter Control Buttons

INVERTER ON (Left and Center)—The Inverter can be manually activated by pressing the left and center Inverter buttons simultaneously.

INVERTER OFF (Right and Center)—The Inverter can be manually deactivated by pressing the right and center Inverter buttons simultaneously.

The Inverter OFF control is also used to reset emergency conditions. Holding down the Inverter OFF keys for two seconds will reset any alarms. The Inverter will need to be manually restarted after an alarm is reset.

INVERTER SIMULATE (Right and Left)—The Inverter can be placed into Simulate Mode by pressing the left and right Inverter buttons simultaneously. This locks the Static Switch to Reserve Mode and activates the Inverter with all input voltage limits disabled. Simulate Mode allows service and calibrations to be safely performed on the Inverter Subsystem without placing a load on the Inverter.

This mode is also used to safely discharge the DC Rail during shutdown.

When the inverter is turned ON or OFF, the status alarm (located behind the display window) sounds once to indicate that the system has registered the change.

8.1.2—Flow Chart Mimic Display

The power Flow Chart Mimic Display is located just beneath the LCD display screen. It provides an overview of the current power flow states (see **Figure 32**).

A more detailed flowchart diagram is located below the 24 status symbol lights inside the system front door.

For an explanation of the more detailed diagram located below the Flow Chart Mimic Display, see System Status Key.

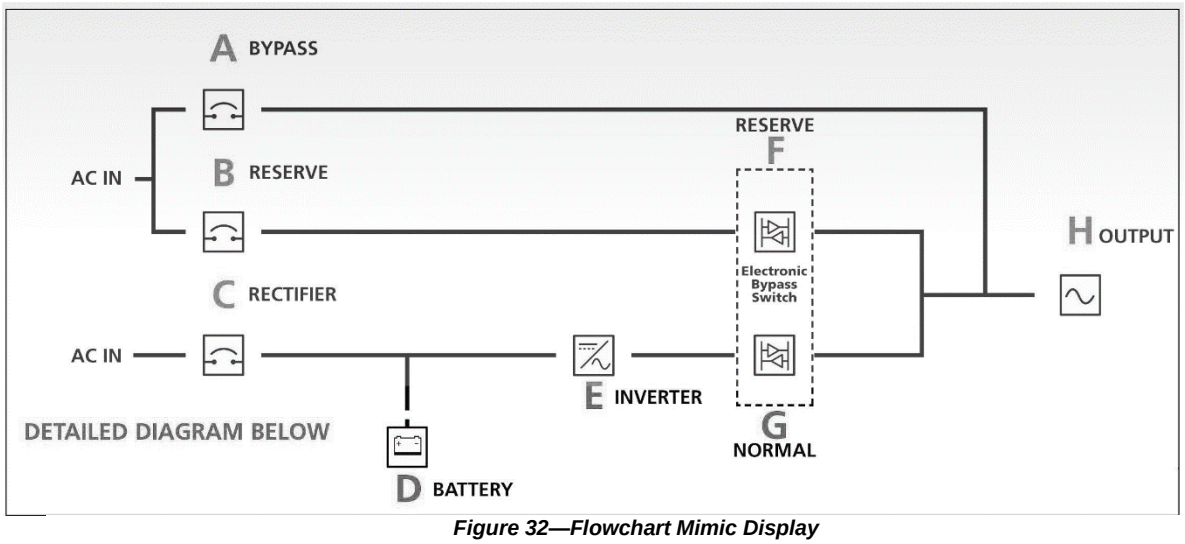


Figure 32—Flowchart Mimic Display

Additional Manual

For more information about reading the flow chart mimic display via the Q-LS TouchScreen, see the ***MNL131 – Q-LS TouchScreen User Manual***.

During normal operation, the **C–RECTIFIER** light, the **E–INVERTER** light, the **G–NORMAL Electronic Bypass Switch** light, and the **H–OUTPUT** light should be illuminated.

A **Bypass LED**—Lights when BYPASS Breaker has been closed.

B **Reserve LED**—Lights when power is available on the Reserve Line.

C **Rectifier LED**—Lights when the Rectifier is operating normally.

D **Battery LED**—Lights when the Battery is discharging.

E **Inverter LED**—Lights when the Inverter is operating normally.

F **Reserve (Electronic Bypass Switch) LED** — Lights to indicate that the Reserve output is active on the Static Switch and the Inverter output is inactive.

G **Normal (Electronic Bypass Switch) LED**— Lights to indicate that the Inverter output is active on the Static Switch and the Bypass output is inactive. Typically, this LED will light up seven (7) seconds after the inverter is switched ON.

H **Output LED**—Lights when the system supplies AC power to the output. Flashes when the output is abnormal. Goes out when output power has been lost.

8.1.3—Caution/Warning LED Display

This LED Display is the only troubleshooting display visible through the Q-LS front window. It provides summary light alarms during abnormal conditions.

For more information about how to use lights on this panel, see Figure 50—Caution/Warning LEDs. For information about the meanings of each light, see **Control Panel Operation**.

8.2—LCD Display

Real-time status, data, or historical events can be displayed using the LCD screen **(**Figure 33**)**.

The LCD is backlit by LEDs that will shut OFF after 3 minutes of inactivity. The LCD will illuminate again when the Up (↑), Down (↓), or Enter (↵) key is pressed.

The display is operated with a set of three keys accessed on or near the screen.

The real-time clock, inverter, and status alarm can be set using the LCD screen and keys. See LCD Menu Navigation.

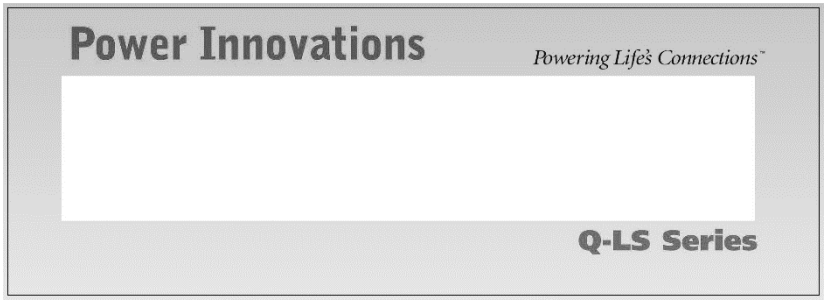


Figure 33—LCD Display Screen

8.3—Caution/Warning LED Display

Although most of the meanings for LED Display lights are intuitive, some may require additional explanation.

These LED warning lights indicate that the system is operating abnormally (Figure 34). When the system is operating normally, none of these LEDs should be illuminated.

Because the Caution/Warning LEDs provide an overview of system malfunction, the door to the system will need to be open to fully view the Control Panel window.

If all the correct breakers are turned ON and basic troubleshooting (**10.5—Troubleshooting Tables**) has failed, record which of these lights are illuminated and contact a service technician.

AC INPUT ERROR: The rectifier AC input is abnormal. This may indicate that AC input voltage is out of range, input AC frequency is out of range, a phase rotation error has occurred, or the rectifier has shut down.

RESERVE ERROR: Power available on the Reserve line is abnormal. This may indicate that AC input voltage of the system is out of range, input AC frequency is out of range, or no power is present at the input.

This may also indicate that the system phase lock is improperly set, or that the system parameter number is improperly set for the current configuration.

INVERTER ERROR: This indicates that the Inverter protection fuse has blown on one or more of the inverter Rapid Replacement Module(s), the Inverter is not being supplied with sufficient DC voltage, or Inverter output is not within operating range.

OVERLOAD 110%–150%: The current draw of the load is between 110% and 150%. The system will switch to Reserve mode shortly.

DC OVER VOLTAGE: DC (battery) voltage exceeds 430 VDC and the Inverter has been shut down.

LOW BATTERY: DC voltage is lower than 320 VDC. System shutdown will occur shortly.

LOW BATTERY SHUTDOWN: DC voltage is lower than 296 VDC and the system has shut down to avoid high current draw.

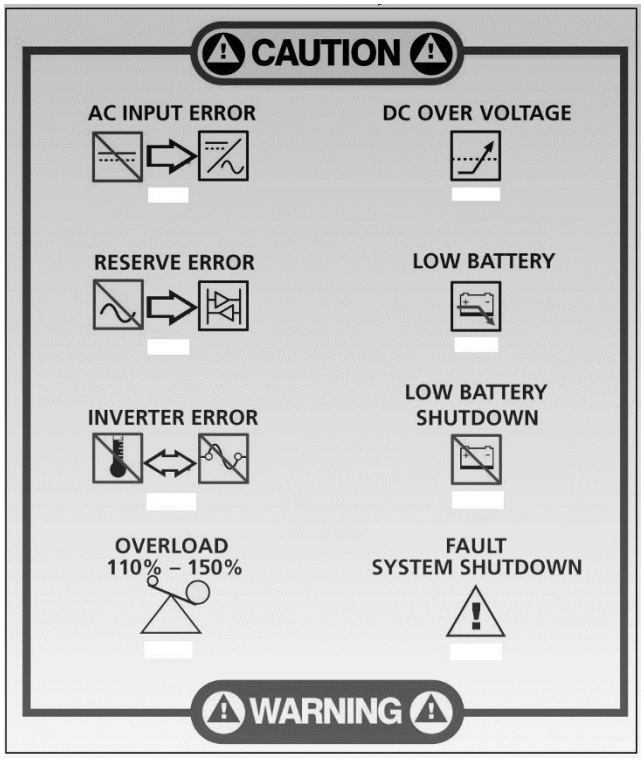


Figure 34—Caution/Warning LED Display

The inverter cannot be turned ON because DC voltage is too low.

FAULT SYSTEM SHUTDOWN: The inverter has shut down due to an abnormal condition. This abnormal event could be an overload, short circuit, high DC voltage, fuse, over-temperature event, or the BYPASS breaker is CLOSED.

8.4—System Status Key

When the Q-LS front door is open, a set of System Status icons will be visible (Figure 35). These icons are overlaid on a bank of LED lights. These lights will illuminate to indicate the system's status and may be especially helpful during routine troubleshooting.

The LED display is located to the left of the LCD display and flow chart mimic display. Unless noted otherwise, the lights will light up rather than blink.

A key is located beneath these system status lights. This key provides help to interpret the icons, but additional clarification for each status light is provided in Figure 35 below.

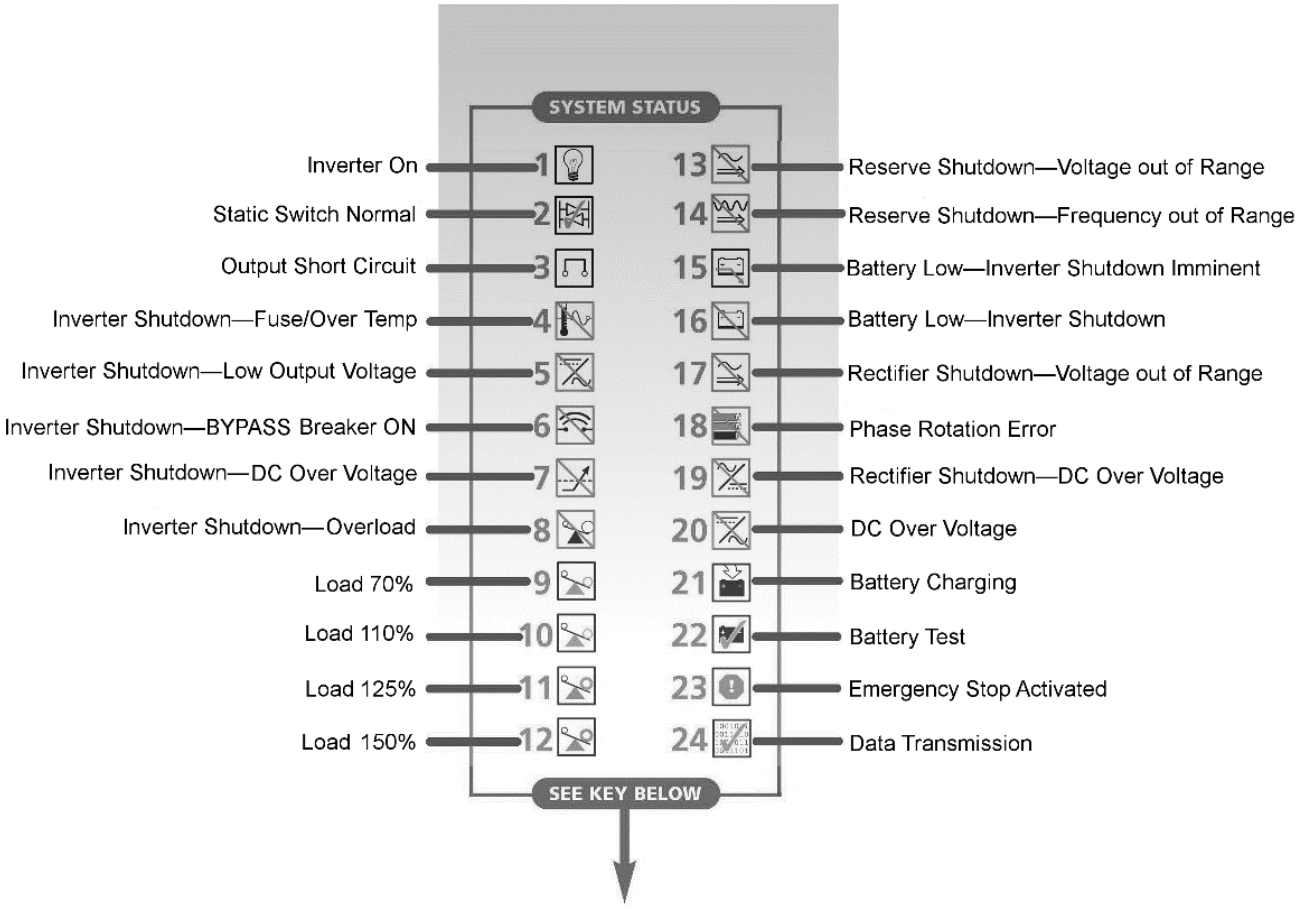


Figure 35—System Status Lights and Key

8.4.1— Inverter Icons

Eight Inverter icons supply information about Inverter and output status.

Lights 4–8 may be especially useful for routine and intensive troubleshooting, since they specify a cause for inverter shutdown.

1 

Inverter ON: Inverter is running. This icon will be illuminated if the system is in Normal Operating Mode.

2 

Static Switch Normal: The system output is being energized by the Inverter output. This icon will be illuminated during Normal Operating Mode and in Battery (Backup) Mode.

3 

Output Short Circuit: A short circuit event has occurred on the output and the Inverter has shutdown. An overload is anything greater than 200% load.

4 

Inverter Shutdown–Fuse/Over Temp: This indicates a blown Inverter input fuse or overheating has caused the Inverter to shut down.

5 

Inverter Shutdown–Low Output Voltage: Inverter output voltage is too low and has caused the Inverter to shut down.

6 

Inverter Shutdown–Bypass Breaker On: The Inverter has shut down because the BYPASS breaker has been CLOSED while the inverter was running.

7 

Inverter Shutdown–DC Over Voltage: The DC rail voltage is too high and the Inverter has shut down to protect itself.

8 

Inverter Shutdown–Overload: The Inverter is overloaded and has shut down. It will attempt to restart itself after 7 seconds.

8.4.2—Load Percentage Icons

Four load percentage icons provide details about percentage of system capacity being supplied to the load. Icons 10–12 will illuminate when the system is overloaded in the indicated states.

Icons 10–12 also specify an approximate run time under overload conditions. Run times are maximum operating time within each state. The actual running time may be less in cases where the system has already been operating in another overload state.

9 

Load 70%: Any single output phase is drawing more than 70% of the system's rated output capacity. The fans will be boosted to a higher speed to compensate for the additional heat generated. The Q-LS may run in this state indefinitely, up to 110% rated load.

NOTE: Operating in this state for longer than 15 minutes will reduce the run time of any other overload state by half.

NOTE: This is not considered a warning indicator and does not necessarily represent an abnormal state. This is considered a cautionary indicator. If this indicator is lit, technicians should monitor and be aware of the actual output load being placed on the system.

10 

Load 110%: Any single output phase is drawing between 110% and 125% of the system's rated output capacity. The Inverter will shut down after 15 minutes of continuous use in this state and the system will enter Reserve mode.

11 

Load 125%: Any single output phase is drawing between 125% and 150% of the system's rated output capacity. The Inverter will shut down after 5 minutes of continuous use in this state and the system will enter Reserve mode.

12 

Load 150%: Any single output phase is drawing between 150% and 170% of the system's rated output capacity. The Inverter will shut down after 30 seconds of continuous use in this state and the system will enter Reserve mode.

NOTE: No indicator exists for loading beyond 170% of rated output capacity. The Q-LS will operate for a *maximum* of 5 seconds in states above 170%.

NOTE: Loading states at or above 200% are considered output short circuit events and the Q-LS will shut down within five to ten cycles.

8.4.3—Reserve Line Icons

The following two icons signify abnormal states present on the Reserve Line.

In Normal Operating Mode, the Inverter will match its output to what is available on the Reserve Line. If these icons are lit, the waveform present on the Reserve line is incorrect and the Inverter will be using internal timing circuitry to output the correct waveform.

13 

Reserve Shutdown–Voltage Out of Range: The AC supply to the Reserve line is not within +/-20% of the system's rated output voltage.

This icon will be continuously illuminated if the QLS is being used as a Frequency Converter.

14 

Reserve Shutdown–Frequency Out of Range: The AC supply to the Reserve line is not within +/-2.5 Hz of the system's rated output frequency.

The Q-LS is designed to protect the load in the event that the Reserve frequency is not within the operating window. If the Reserve supply is outside the tolerable frequency window, the Static Switch will inhibit transfer to the Reserve line.

This icon will be continuously illuminated if the Q-LS is being used as a Frequency Converter.

8.4.4—Rectifier and Battery Operation Icons

The following eight icons provide information about the Rectifier and the DC Rail.

15 

Battery Low–Inverter Shutdown Imminent: DC Rail voltage is less than 320 VDC and shutdown is imminent if AC input is not restored.

16 

Battery Low–Inverter Shutdown: The Inverter has already shut down because DC Rail voltage has dropped below 296 VDC. DC voltage is too low to support Inverter operation.

The system will attempt to transfer to Reserve Mode before shutdown. This is in case Backup Mode was initiated due to an unidentified Rectifier Failure, and not a loss of input power.

17 

Rectifier Shutdown–Voltage Out of Range: The AC supply to the Rectifier is not within +/-16% of the system's rated input voltage.

18 

Phase Rotation Error: For three-phase input systems, input phase rotation is incorrect. This could mean that the system has been wired incorrectly.

19 

Rectifier Shutdown–DC Over Voltage: Voltage on the DC Rail is in excess of 445 VDC. The Rectifier will attempt an automatic restart 30 seconds after DC Rail has discharged to 430 VDC.

20 

DC Over Voltage: Voltage on the DC Rail exceeds 430 VDC.

21 

Battery Charging: Rectifier is currently charging the battery in a boost charge state. This icon will not be illuminated when the batteries are being maintained at a float charge state (390 VDC). This icon may be illuminated while the Q-LS is in Normal Operating Mode.

22 

Battery Test: System is currently testing the battery. This icon will blink if the battery has failed the test.

8.4.5—Communication Icon

This icon provides information about the communications systems associated with the Q-LS.

23 

Data Transmission: This light blinks when data is being transmitted to or from the communications port.

9—LCD Menu Navigation

This chapter will explain how to navigate through the options in the Q-LS menu by using the LCD Display.
(Note: For more information on the TouchScreen's menu navigation options, see ***MNL 131 – QLS TouchScreen User Manual***.)

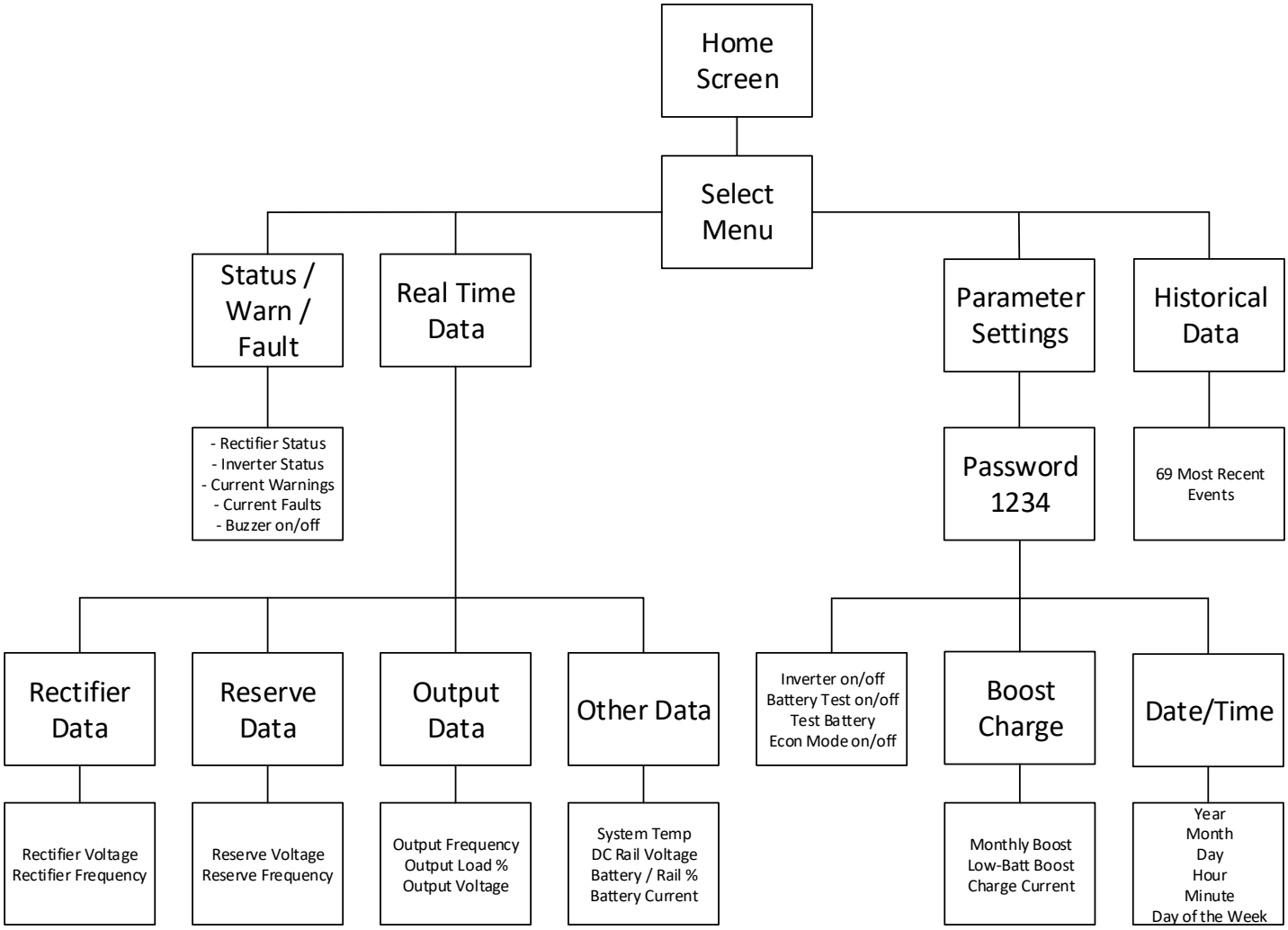


Figure 36—LCD Display Menu Tree

To navigate through the menus, use the Up (↑), Down (↓), and Enter (↵) keys. When the cursor points to the desired option, select it by pressing the Enter (↵) key.

9.1—Home Screen

The home screen is the default display for the Q-LS system. All menus will default to the home screen after 2 minutes of inactivity.

This screen lists basic information about the system, including part number, serial number, identification number, system description, date and time, and sometimes a run-time meter.

First Line: Displays the name of the unit or a short greeting message. It will come set as “Power Innovations UPQ,” but can be changed by a service technician using Parameter Setting **(**Figure 46**)**.

Second Line: Displays the model number (P/N), serial number (S/N), and identification number (ID). The system comes with the serial number preset by the manufacturer. Each *Q-LS* system has its own identification number, which can be set during system installation.

Figure 37—Home Screen

Third Line: Displays the kVA, input, and output ratings for the *Q-LS* system.

Caution

The model number on this menu should never be changed. Changing the model number will also change the rating displayed on the third line because the system automatically generates inputs and outputs based on the model number. The actual system capacities will not change, and the system may malfunction.

Fourth Line: Displays date and time from the internal clock. The date and time are used to record historical events.

9.2—Select Menu

After any control button is pushed from the home screen, the Select Menu will appear. It is the root menu for all other system options.

To select any item on this menu, press the Up (↑) and Down (↓) keys to scroll between the menu options. Press Enter (↵) to select a submenu.

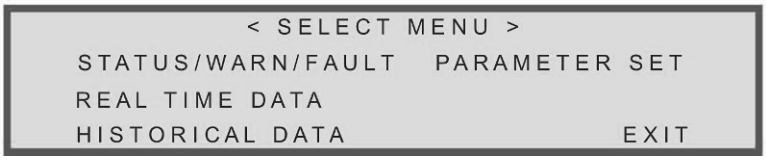


Figure 38—Select Menu

9.2.1—Status/Warn/Fault Menu

Pressing Enter (↵) on this menu will cause the screen to revert to the Select Menu.

Disabling the Buzzer: Pressing the Down (↓) key will disable or enable the warning/fault buzzer. Push the Down (↓) key until the number following BUZ is 0 to turn OFF the warning buzzer. To enable the buzzer, push the Down (↓) key. When the number following BUZ is 1, the buzzer has been enabled.

Figure 39—Status/Warn/Fault Menu

Faults and Warnings: This menu only shows real-time faults and warnings. For event logs, use Historical Data.

Left Side: Current status of rectifier, inverter, and static switch.

Right side: Any Warning or Fault condition. <Fault> messages indicate system emergencies, while <Warning> messages are less urgent.

Warnings indicate system problems that may lead to faults.

Note

Figure 39 shows a <Fault> message (Short Circuit!) on the right-hand side. If the right-hand side displays a warning, it will appear under a <Warning> heading. If disregarded, <Warning> messages will be replaced by more urgent <Fault> messages.

The following Fault messages may be displayed on the Status/Warn/Fault menu:

- High DC Shutdown
- Short Circuit!
- Fuse/Overheat
- Overload Shutdown
- Emergency
- Inverter Abnormal
- Bypass on Shutdown

The following Warning messages can be displayed:

- Bypass ON
- Rectifier AC Fail
- Rectifier Phase Error
- Reserve Frequency Error
- 170% Overload
- 150% Overload
- 125% Overload
- 110% Overload
- Battery Low Stop
- Battery Low
- Battery Bad
- Battery Ground Fault
- Battery Testing

This menu will inform about system status but will not provide any additional troubleshooting options. After checking this menu, press Enter (↵) to return to Select Menu.

9.2.2—Real Time Data Menu

To access this menu, select Real Time Data from the Select Menu screen. To select options within the menu, press the Up (↑) and Down (↓) arrow keys and press Enter (↵) when the cursor points to the desired option.

Figure 40—Real-Time Data Menu

9.2.2.1—Rectifier Data

To view real-time rectifier data, select RECTIFIER DATA from the REAL TIME DATA screen. The rectifier data screen displays information such as rectifier frequency (measured in Hertz) and A-N, B-N, C-N voltage.

Figure 41—Rectifier Data Menu

Phase-to-phase voltage display is also available, provided input is a delta-connected (Δ) source.

This menu shows information about the rectifier input. This information will be approximate, not exact.

9.2.2.2—Reserve Data

To view real-time reserve input data, select RESERVE DATA from the REAL TIME DATA screen.

This screen displays information such as reserve frequency (measured in Hertz) and A-N, B-N, and C-N voltage.

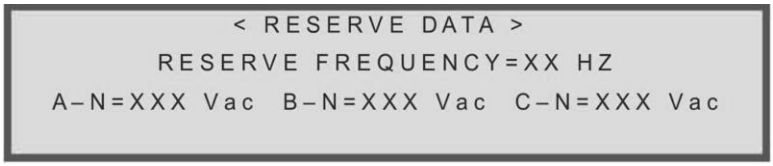


Figure 42—Reserve Data

Phase-to-phase voltage is also available, provided that the input is a delta-connected (Δ) source.

This screen will only show phase information based upon the output phase configuration of the system. For example, if the input is three-phase, but the output is single phase; only a single phase will show in the reserve input data screen.

9.2.2.3—Output Data

Select this item on the REAL TIME DATA screen to view system output information such as output frequency and load percentage of phases A/B/C, and output voltage of A-N, B-N, and C-N.

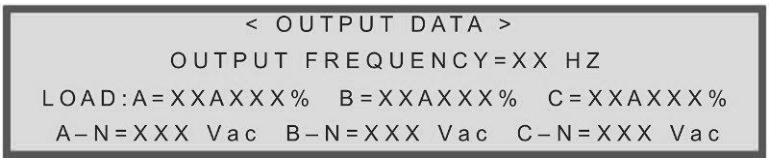


Figure 43—Output Data

This menu will generally show the output as a percentage of the load per phase, although firmware is available that will show this information in amps.

9.2.2.4—Other Data

Select this item on the REAL TIME DATA screen to view general system statistics, such as the system's interior temperature in Celsius, the DC voltage, current battery charge, and battery current (measured in amps).

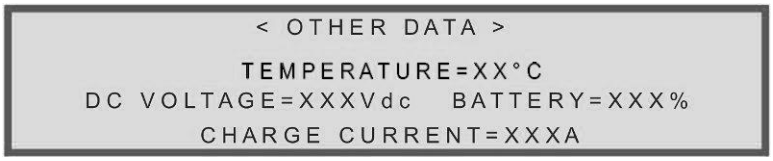


Figure 44—Other Data Menu

If the Q-LS is in normal operating mode, the data in the last row of Other Data is the charging current of the battery. If the Q-LS system Is in backup mode, the data shown in the last row will be the battery discharge current.

In certain instances, the battery percentage may show as NIL. This reading is normal and provides an indication that the battery voltage is currently outside the operating window of the inverter.

Note

Battery percentages and currents are calculated based upon the DC voltage being stored on the DC rail, whether or not a battery string is currently attached.

9.2.3—Historical Events Menu

To view real-time historical data, including system run time in years and months, select Historical Data from the Select Menu screen.

Figure 45—Historical Events Menu

This menu also displays power event records. The record display begins with the date and time of the event. Three records can be displayed at a time, with the most recent three listed first.

This data listing comes from a chip in the system. This chip is called an EEPROM (Electronically Erasable Programmable Read Only Memory). Up to 69 records can be stored on one EEPROM. Some systems may have two EEPROMs, which means 146 events can be accessed using the Historical Data menu.

Even a list of 146 events will be displayed from most recent to least recent.

These records will be retained even if the system loses power.

Recorded events may include:

- High DC Shutdown
- Short Circuit!
- Fuse-Overheat
- Overload Shutdown
- Emergency Stop
- Inverter Abnormal
- Bypass on Shutdown
- AC Fail
- Normal Recovered
- Low Battery
- Low Battery Stop
- Battery Test Fail

9.2.4—Parameter Setting Menu

To adjust or set the *Q-LS*, select Parameter Set from the Select Menu screen. The Parameter Setting screen allows additional setting options, including turning the inverter ON/OFF, turning Auto-Start ON/OFF (see “3.3—System Auto Restart”), resetting Boost Charge rates, and manually correcting the date and time.

A password screen will appear before Parameter Settings can be accessed.

9.2.4.1—Entering the Password

The four-digit default password for Parameter Settings is 1234. Enter the numbers by pressing the Up (↑) or Down (↓) key to reach each correct number. Once the correct number has been selected, confirm the number by pressing Enter (↵).

When the correct password has been entered, the Parameter Setting screen will be displayed. If after three attempts, the correct password is not entered, the LCD will return to the Home Screen.

9.2.4.2—Parameter Setting

After a password has been accepted by the system, the Parameter Setting screen will appear.

Figure 46—Parameter Setting Menu

Once all desired modifications have been made, select Exit and press **Enter** (↵) to return to the Select Menu screen.

Inverter ON/OFF: When Inverter ON/OFF is selected, ON will blink if the inverter status is ON, or OFF will blink if the inverter status is OFF. Use the **Down** (↓) key to switch the selection between ON and OFF. As each is selected, it will blink. Press **Enter** (↵), and the inverter will switch.

After the inverter switches over, a buzzer will beep once, announcing the change.

Battery Test ON/OFF: The system will run a daily battery test that can be manually unselected using this option. If the automatic battery test is disabled, Auto-Start ON/OFF will also be disabled.

When Battery Test ON/OFF is selected, ON will blink if the Battery Test/Auto-Start features are turned ON (the default setting is ON). OFF will blink if the features are turned OFF. To select ON or OFF, use the **Down** (↓) key to scroll between the two options. When the correct option is blinking, press **Enter** (↵).

If the Auto-Start is OFF, the Q-LS system will cut off power 10 minutes after a low-battery shutdown and will not restart automatically when utility power has been restored. With Auto-Start ON, the system will restart automatically when utility power has been restored.

Boost Charge Setting: When Boost Charge is selected from the Parameter Setting Menu, a Boost Charge screen will appear.

Using the **Down** (↓) key, select the desired boost charge time for the monthly or battery-low boost charge and press **Enter** (↵).

Figure 47—Boost Charge Setting Menu

The same charge current will be used for both types of boost charge and can be selected using **Down** (↓) and **Enter** (↵). Choose from three options for the charge current, Low, Medium, and High.

The current rate settings for LO, ME, and HI depend on the size of the system. Before shipping, the charging currents for these rate settings will be preset, based on the type and size of the battery bank.

Once all desired modifications have been made, select **Exit** and press **Enter** (↵) to return to the Parameter Setting Menu.

Date/Time Setting: The settings on this screen are used to timestamp system events. The internal clock is also used to conduct boost charges on the first of every month and run daily battery tests every midnight.

Select Date Time Setting on the Parameter Setting Menu to change the system date and time. The real-time settings clock will appear after Date Time Setting is selected.

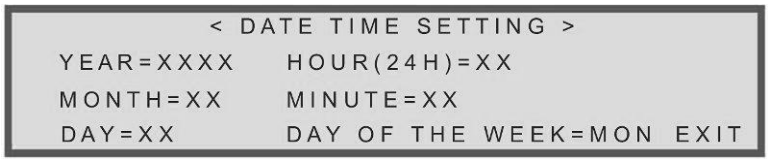


Figure 48—Date Time Setting Menu (Accessed from Parameter Setting Menu)

Use the Up (↑) and Down (↓) keys to select the desired date, time, and weekday. All values but the day of the week will show in numbers. The day of the week will be displayed using its first three letters.

When selected, each of these values will blink. Confirm a selection by pressing Enter (↵).

The system will disregard some entries as invalid. Valid entries for each category include:

Year: 1998–2097

Month: 01–12

Day: 01–31 (31 changes to 30 if entered for a 30-day month)

Hour: 0–23

Minute: 0–59

Day of the Week: Mon, Tue, Wed, Thu, Fri, Sat, Sun

Once the times and dates have been set, select Exit and press Enter (↵) to return to Parameter Setting Menu.

Battery Test: Select Battery Test on the Date Time Setting to run an unscheduled battery test. The battery test icon will light during the test. The battery icon on the Flowchart Mimic Display will blink if the battery fails the test.

10—Troubleshooting the System

This chapter will explain what should be done if the system malfunctions. It will also explain when a certified service technician should be called.

Some malfunctions can be fixed by following a simple troubleshooting process. It is possible, however, that other malfunctions could be caused by problems with logic boards in the system. Only service technicians are trained to fix board-level malfunctions.

If simple troubleshooting fails to fix any problem with the system, do not hesitate to call a service technician.

10.1—What to Know When Calling a Technician

Before calling a service technician following an unusual event, be sure to have the following information ready:

- Serial number and date of commissioning.
- Any unusual system sights or sounds associated with the event.

  (Did it clank? Did something buzz? Did electricity arc?)
- Any LED lights that were lit before, during, or after the event.

  (When were normal indicators lit? What other LEDs went on, and when?)
- Buzzer notifications that occurred before, during, or after the event.

  (What buzzers sounded, and how long and frequently did they sound?)

The service technician will need to know the answers to these questions to correctly diagnose system problems.

10.2—Flowchart Mimic Display during Abnormal Events

A. Bypass LED — Lights when the MAINTENANCE BYPASS breaker is ON. If the breaker is turned ON, the system will be operating in maintenance bypass mode, and the inverter will not be turned ON.

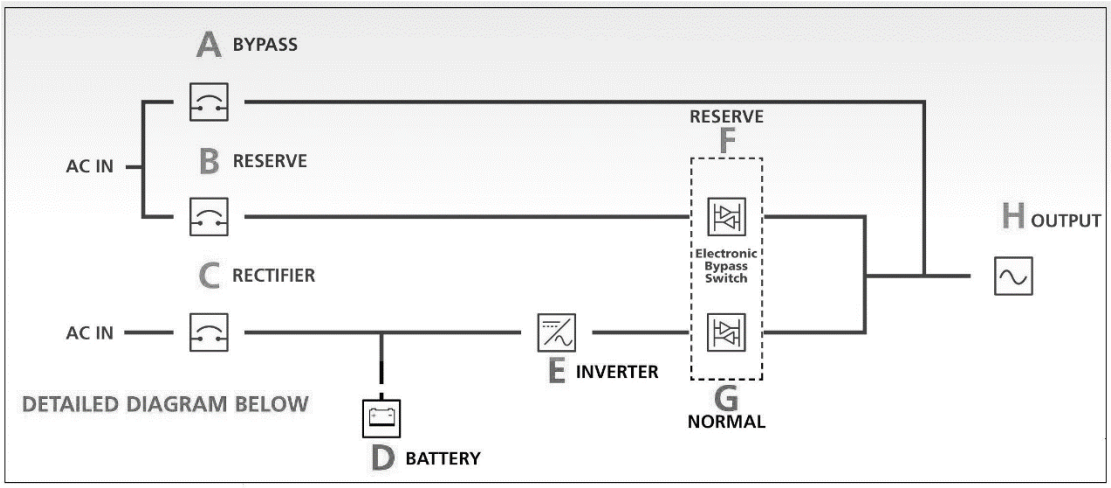


Figure 49—Flowchart Mimic Display

When the MAINTENANCE BYPASS breaker is turned ON, the inverter cannot be switched ON. If the inverter is running, it will stop immediately if the BYPASS breaker is turned ON.

B **Reserve LED** — Lights when the RESERVE breaker is ON, and AC power is available through the reserve input. May also light if the procedure for entering maintenance bypass mode has not been followed completely.

D **Battery (Backup) LED** — This LED serves two purposes.

1) Lights to indicate when the *Q-LS* is operating in backup mode.

2) Flashes as an indication that a battery test has failed. Even if the system is not in backup mode, the Battery LED will flash, indicating that batteries should be replaced.

F **Reserve (Electronic Bypass Switch) LED** — Lights when the reserve static switch is turned ON, the inverter static switch is turned OFF, and the load is supplied from the reserve input line.

Since the reserve static switch and inverter static switch will never turn ON together, the inverter static switch LED and the reserve static switch LED will not be lit at the same time.

H **Output LED** — Flashes to indicate that output power is abnormal. Either the voltage is out of range, or one of the phases is not present.

10.3—Troubleshooting Portions of the Panel

Two additional sections of the Control Panel are used only for troubleshooting. This section will show how these parts of the Control Panel can help in performing basic or routine troubleshooting on the Q-LS.

This section will only cover the practical purposes of each section of the control panel.

Manual Helps

For more in-depth information, see 10.5—**Troubleshooting Tables**.

If basic troubleshooting fails to fix the problem, call a certified service technician.

10.3.1—Caution/Warning LEDs

The Caution/Warning LEDs are located directly behind the TouchScreen Display (the door to the Q-LS system must be opened to view the display.) **(Figure 50)**.

They consist of eight backlit icons that light when the system is experiencing abnormal operating conditions.

Rather than provide a detailed description of alarm conditions, these LED icons provide a summary of the system's current condition.

No icons on this LED Display should be lit during normal system operation. If any of these lights appear, conduct the troubleshooting operations listed below.

Use the twenty-four system status LEDs in conjunction with these eight summary LED icons to perform basic troubleshooting.

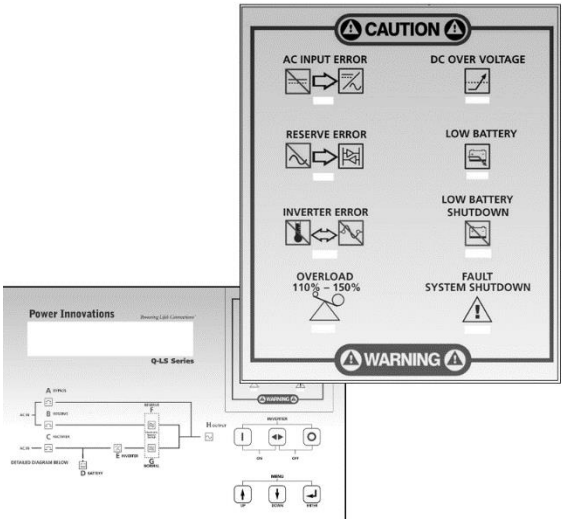


Figure 50—Caution/Warning LEDs

Manual Helps

For more information about what each light indicates, see **8.3 –** Caution/Warning LED Display.

10.3.2—System Status LEDs

Twenty-four system status LEDs are visible with the system's front doors open.

Each of these lights will light up under specific operating conditions. Reading these lights will provide specific information about system malfunctions.

A key to reading these lights is located beneath the System Status LED section on the control panel **(A.,** Figure 51**)**.

The icon key (located beneath the system status lights on the front of the cabinet) provides the meaning for each symbol. (**B.,** Figure 51).

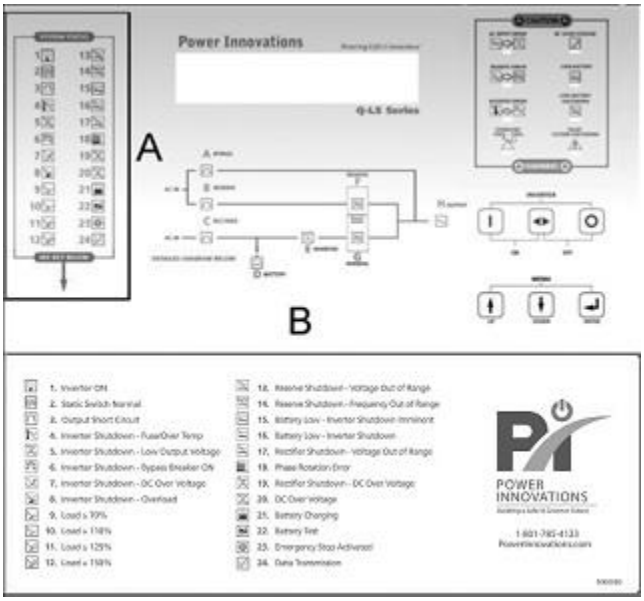


Figure 51—A. System Status LEDs; B. Icon Key

10.4—Buzzer Notifications

The buzzer speaker is located below the system status LEDs. The buzzer will sound with varying frequencies, depending on the problem that the system is experiencing.

Buzzer Frequency	Operating Mode	Possible Causes
No beep	Any	System is operating normally
	Battery (Backup)	Battery charge is <295 VDC
One beep	Any	Inverter switched ON or OFF
Beeps every three seconds	Normal Battery (Backup)	Inverter 110% overloaded
	Battery (Backup)	Battery <320 VDC
Beeps once per second	Normal Battery (Backup)	Inverter 125% overloaded
Beeps twice per second	Normal Battery (Backup)	Inverter 150% overloaded
	Battery (Backup)	Battery <320 VDC
Beeps continuously	Any	Output Short Circuit Fuse Blown Over Temperature Emergency Stop Activated
	Normal Battery (Backup)	DC Over Voltage
	Maintenance Bypass	BYPASS Breaker ON

Table 2—Buzzer Notification Types, Listed by Frequency

10.5—Troubleshooting Tables

To solve problems or system malfunctions, refer to the tables below. If troubleshooting steps listed in the tables fail to produce a result, contact a trained Q-LS service technician.

10.5.1—Inverter/Output

Symptom	Possible LEDs	Possible Problem	Possible Solution
Inverter will not start	Inverter Abnormal – 15,16	Rectifier not turned ON	Turn ON the RECTIFIER breaker
		Inverter feed fuse blown	Contact a certified technician
		Damaged inverter module	Contact a certified technician
	6	BYPASS breaker is ON	Turn OFF the BYPASS breaker
	4	System has overheated	Allow system to cool and investigate operating environment. System will restart upon normal temperature
			Inspect fans for proper operation
	18,17	Incorrect input power to rectifier	Contact a certified technician
	7,17,20	Malfunctioning rectifier	Contact a certified technician
		Incorrect battery configuration	Contact a certified technician
Abnormal output power	Output MIMIC LED flashing	Maintenance Bypass Procedure not properly followed	Recheck steps for coming out of maintenance bypass
		Blown sense fuse	Contact a certified technician
	5	3T board malfunctioning / needs calibration	Contact a certified technician
No output power	Fault System Shutdown, 23	EPO button has been pressed	Check for emergency, turn OFF inverter, and turn ON inverter
System running in reserve mode	Fault System Shutdown, 3, 8, 10, 11, 12	An overload condition, high in-rush condition, or a short-circuit condition has occurred	If overloaded, inverter will attempt to restart once overload has cleared
			If in-rush, inverter will attempt to restart immediately
			If short-circuit, check for fault on loads before attempting to manually restart inverter
		Inverter needs to be manually turned ON	Turn ON the inverter
Inverter makes abnormal noise and shuts down		Possible damaged inverter module	Contact a certified technician
System is in overload and only a fraction of the total capacity of the system is being used	8,10,11,12	Output loads are not properly balanced across output phases	The *Q-LS* is capable of 100% load imbalance; however, each phase is only capable of supplying 1/3 of the overall system capability; rebalance output loads

10.5.2—Rectifier

Symptom	Possible LEDs Lit	Possible Problem	Possible Solution
Rectifier will not start or provide DC voltage	17, 18	Incorrect input power configuration (voltage or phase rotation)	Contact a certified technician
	19, 20	Rectifier 3CC, 3CD problem	Contact a certified technician
		Incorrect voltage from battery	Contact a certified technician
	4	System has overheated	Allow system to cool and investigate operating environment. System will restart upon normal temperature
Rectifier makes loud noise and then RECTIFIER breaker trips		Damaged rectifier module	Contact a certified technician

10.5.3—Static Switch

Symptom	Possible LEDs Lit	Possible Problem	Possible Solution
Frequency converter *Q-LS* system switches to reserve when inverter is turned OFF and incorrect power appears on the output		System not properly configured for frequency conversion	Contact a certified technician
Output voltage changes slightly when switching between reserve and inverter modes		This can occur when inverter output voltage is calibrated to a slightly different voltage from the natural voltage provided on the reserve by the transformer magnetics. This is a normal situation	None. If disparity is large, contact a certified technician
The static switch will not switch to reserve mode	13,14	The reserve power (voltage or frequency) source has gone outside tolerable range	Check input power characteristics (voltage and frequency)

10.5.4—Bypass

Symptom	Possible LEDs Lit	Possible Problem	Possible Solution
Control panel still functional after entering bypass mode		System fuses behind the control panel not opened —Maintenance Bypass Procedure not properly followed	Open fuses behind the control panel
Reserve LED on MIMIC display still lit when RESERVE breaker is open	RESERVE breaker MIMIC LED	This is a normal condition	Complete the procedure to enter maintenance bypass mode
When exiting maintenance bypass mode, my load is dropped	Reserve static switch MIMIC LED not lit	The static switch has not yet initialized, and the BYPASS breaker was opened too soon	Wait for the reserve static switch MIMIC LED to light before opening the BYPASS breaker

10.5.5—Battery/Backup

Symptom	Possible LEDs Lit	Possible Problem	Possible Solution
System shuts down immediately upon loss of input power	15, 16	Battery is not connected to the *Q-LS* system	Make sure battery is properly connected
	15,16	BATTERY breaker is open	Make sure the BATTERY breakers on both the *Q-LS* cabinet and the battery cabinets are all ON
	13,14,17,18	System was not operating in inverter mode	Ensure that the system is operating in normal (inverter) mode at all times
	8, 10, 11, 12	System is in an overload state	Backup mode will only occur if output load is below 110% capacity on any individual phase—reduce output load
System does not last long while running in backup mode	15,16	Batteries are aged	Contact a certified technician
		Batteries are not fully charged	Allow the batteries to charge for 8–12 hours
System beeps every three seconds		The *Q-LS* BATTERY breaker is OFF	Turn the BATTERY breaker ON
			If the BATTERY breaker is ON, turn it OFF and then ON again
	Battery MIMIC LED flashes	The battery bank has failed a battery test	Contact a certified technician
Batteries are not recharging quickly		Incorrect charger settings	Consult a certified technician on the proper battery settings
Status LEDs 21 or 22 are lit	21, 22	This is an indication that the batteries are either being tested or boost-charged temporarily	
System will not start on DC only		The DC rail was not properly discharged prior to the previous shutdown	Turn OFF all breakers and allow the DC rail to self-discharge for 15–45 minutes, depending on system size

10.5.6—Display

Symptom	Possible LEDs Lit	Possible Problem	Possible Solution
Incorrect voltages are being displayed for rectifier and reserve		Incorrect system part number has been entered	Contact a certified technician
Incorrect output voltages are being displayed		The output voltage display needs calibration	Contact a certified technician
Incorrect battery voltage readings		The battery voltage display needs to be calibrated	Contact a certified technician
Display shows battery capacity and voltage when no battery is connected		No problem—Calculations are made based on internal DC rail voltages, regardless of battery connectivity	
Display is non-functional		Startup procedure not followed properly	Turn on RESERVE breaker (after INPUT) or BATTERY breaker first
		Damaged 3R board	Contact a certified technician
Buzzer does not sound when conditions occur		Buzzer is disabled in the Status/Warn/Fault menu	Enable the buzzer

10.5.7—Other

Symptom	Possible LEDs Lit	Possible Problem	Possible Solution
Fans are not operating	4	Fans have failed	Contact a certified technician
		Exiting Maintenance Bypass Procedure not properly followed	Ensure that all fuses behind the control panel are closed
Communication options are not functioning		Incorrect system ID	Change the system ID in the parameter settings menu, using password 7777
		Connections and chips are not properly configured	Contact a certified technician
		3R board is malfunctioning	Contact a certified technician

11—Battery Information

Additional Manuals

For more information about the Q-LS Battery Modules, see ***MNL129 – Q-LSA/B/C/D(-ST) Battery Module User's Manual***.

11.1—System Operation and Storage

11.1.1—Battery Tests

The Q-LS system will conduct an automatic battery test once every day. This battery test will be conducted at midnight.

Run manual battery tests whenever desired by using the Parameter Setting menu (Parameter Setting Menu) on the LCD Display.

Notes

It may be helpful to run manual battery tests any time the system display is checked.

Regular battery inspection and maintenance will extend the life of the battery bank. Running routine manual tests can identify issues with the battery bank before they cause system failure.

11.1.2—Battery Charges and Control Panel Functions

Battery levels can be checked using the manual Battery Test function from the Parameter Setting menu (see Error! Reference source not found.). Additionally, approximate DC voltages in the Q-LS cabinet can be checked using the Real Time Data menu.

The results shown via the LCD Displays show only the Q-LS cabinet's current voltages based on breaker states. These voltages may not represent actual battery voltage.

To see if the batteries are operating normally at any voltage, refer to the table below.

Battery Charge	Battery Status	Visible Signs	Auditory Signs	Automatic System Function
390-408 VDC	Charge Mode	CHARGE LED	None	Can switch to Battery Mode
370-390 VDC	Good Charge	None	None	Can switch to Battery Mode
320-370 VDC	Poor Charge	None	Beeps every three seconds	Can switch to Battery Mode
295-320 VDC	Low Battery	LOW BATTERY LEDs	Beeps twice per second	Automatic boost charge
295 VDC	Low Battery Shutdown	LOW BATTERY SHUTDOWN LEDs	None	Inverter will not start Automatic boost charge

Table 3—Battery Charge Levels and System Function

11.2—Cable Cautions

Any time the system is rewired or a new battery is connected, the battery polarity should be checked again.

ELECTRICAL WARNING

Never start the system without checking the battery polarity. Serious harm may result if prestart polarity checks are neglected.

Any time the system is rewired, the grounding connections should be checked again.

ELECTRICAL WARNING

Never start the system without checking the battery grounding. Serious harm may result if prestart grounding checks are neglected.

11.2.1—Storing Q-LS Batteries

If the Q-LS Battery Module will be stored for long periods of time, the batteries must be charged once every 90 days to maintain optimal battery life. If stored for long periods of time without charging, batteries may self-discharge to low levels that will no longer provide backup.

WARNING

To prevent tipping injuries, open only one cabinet drawer at a time.

Caution

DO NOT insert any object into any of the ventilation holes or any other opening in the battery cabinet.

12—Maintenance

12.1—Monthly Maintenance Check

Routine cleaning and inspections should be completed by technicians every 30 days.

To maintain the system in an optimal working condition, perform the following tasks on a monthly basis:

- Clear the operating area of clutter that could be pulled into the air vents.
- Check that no foreign materials are on top of the Q-LS or battery cabinets. If anything has been set on top of the cabinet, move the items away from the system operating area.
- Use a dry cloth to wipe any accumulated dust off external air vents, the top, and sides of all cabinets.
- A diluted cleaning detergent may be used to clean the cabinet exterior only if precautions are taken to prevent the cleaning agents from entering the exhaust or air inlet vents.
- Check phase loading and percentages, output voltage, and rectifier settings using the Real Time Data menu.
- Check the historical events menu for any recent warnings, faults, or errors that have not been addressed.
- Inspect all breakers to ensure that the system is in the correct operational configuration.
- Note any abnormalities. If the system is operating outside of specified parameters, have a Q-LS Certified Technician address these issues or contact Power Innovations.

12.2—Monthly Battery Bank Inspection

The Q-LS system automatically runs a battery test once per day. The indication of a failed test is shown by:

- An alarm sounds once every 3 seconds
- The Status / Warning / Fault Screen displays BATTERY BAD
- The Low Battery Shutdown LED and the Battery Charging LED alternately illuminate.

These are indications that a full battery inspection and possibly replacement should take place.

A visual inspection of the battery cabinets, cables, and their surrounding area should be conducted in a manner similar to that given for the Q-LS.

The battery string voltage should be checked to verify that it is within the nominal string voltage of 390 VDC.

A spot check of any number of battery drawers should be conducted to check for leaking, bulging, warping, or discoloration of the batteries.

12.3—Quarterly Preventive Maintenance

A certified Q-LS technician should periodically perform a full preventive maintenance check. For the manufacturer's warranty to stay in effect, a full PM check is *required* once every six months. However, it is highly recommended that these checks take place once every 90 days, or quarterly. A PM check must be performed by a Certified Q-LS Technician. The full PM Checklist may be found as an addendum to the Q-LS Service Manual.

WARNING

If twice-yearly maintenance checks are not completed by qualified service technicians within the warranty period, the warranty on the system will be voided. Additionally, any system malfunction or liability that results from neglecting maintenance is strictly the responsibility of Q-LS owners.

12.4—Other Maintenance and Repairs

The technicians who have completed Power Innovations' Q-LS training course have been trained to safely handle internal system parts and batteries as well as techniques for repair and troubleshooting of the system. These certified technicians serve as the first point of contact for any questions about Q-LS systems.

For more information about becoming a certified service technician, contact Power Innovations International, Inc. (See 20 - Error! Reference source not found.).

These trained service technicians should perform routine maintenance checks at least once every 90 days. For any repairs or troubleshooting questions, the service technician should be also contacted.

Before calling a service technician, please have the following information on hand:

- Serial number
- Date of commissioning
- Date of last preventive maintenance check
- A description of any unusual events associated with the system failure.

  (Did the system make any unusual noises? Were there unusual environmental conditions? Were there personnel on site that can give a *first-hand* account of what happened?)
- A list of any Caution / Waring / Fault LED indicators that were lit before, during, or after the event.
- Auditory notifications that occurred before, during, or after the event.

  (What alarms sounded? How long and frequently did they sound?)

The service technician will need to know the answers to these questions to correctly diagnose system problems.

12.4.1—System Operational Life

The estimated life expectancy of the Q-LS is roughly 15 years. Depending on various operating conditions, and with regular service, the Q-LS may remain in service for over 20 years. Improper or irregular maintenance will shorten the estimated service life.

12.4.2—Refurbishment

The overall Q-LS system contains several parts that are considered consumables. These parts, listed below, have short lifespans in comparison to the rest of the system:

- Batteries
- Input Filter Capacitors
- DC Filter Capacitors
- Inverter Filter Capacitors
- Output Filter Capacitors
- Ventilation Fans

The Q-LS is designed so that all consumable components may be replaced within the same timeframe. This is referred to as a refurbishment. A full refurbishment should take place during the seventh year of continuous service since commissioning, or since the last refurbishment.

Power Innovations offers full refurbishment services that include parts and complete system inspection and re-commissioning.

A refurbishment kit is also available for Q-LS operators who wish to perform the refurbishment themselves.

Contact Power Innovations for more information on these services.

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13—Appendix A — More about Installation

13.1—A.1 — Torque Settings

All electrical components must be fastened tightly for electrical operation. These charts provide torque values for Q-LS connections. Use these values unless the equipment is otherwise labeled.

13.1.1—A.1.1 — Circuit Breakers

Circuit Breaker Torque Settings										
Product	Manufacturer	Breaker Series / Part No.	Current Rating (Amps)	Pole	Ring Terminal to Breaker			Bare Wire to Breaker (Lug)		
					Nm	ft lb	in lb	Nm	ft lb	in lb
Q-LS A/B Bat	Fuji	BW250EAG	125	3	10	7	92	9	6	80
Q-LS C/D Bat	ABB SACE	Tmax T3N	175	3	18	13	159	13	10	119
Q-LS C/D Parallel	ABB SACE	Tmax T5N	400	3	28	20	247	31	23	275
Q-LS/MPDU	Cutler Hammer	BW EAG	All sizes	3	28	20	250	42	31	375
Q-LS/MPDU	Fuji	EAG63C	63	3	5	4	51	9	6	80
Q-LS/MPDU	Fuji	EAG53C	53	3	2	1	20	4	3	35
Q-LS/MPDU	Fuji	BW 250EAG	200	3	10	7	93	9	6	79
Q-LS/MPDU	Fuji	BW 400EAG	300	3	45	33	298	40	29	354
Q-LS/MPDU	Fuji	BW 630RAG	500	3	47	34	416	42	31	375
Q-LS/MPDU	Eaton	NZM	All	3	9	6	80	15	11	132
Q-LS/MPDU	General Electric	SFLA, wire size 8-4	225	3	10	7	90	16	12	150
Q-LS/MPDU	General Electric	SFLA, wire size 3-1	225	3	10	7	90	22	16	200
Q-LS/MPDU	General Electric	SFLA, wire size 1/0-350MCM	225	3	10	7	90	31	22	275
Q-LS/MPDU	General Electric	THED CS-N3	150	3	3	2	30	6	4	55
Q-LS/MPDU	Square D	QO/QOB	15-30	1-3	2	1	20	4	3	36
Q-LS/MPDU	Square D	QO/QOB	35-50	1-3	2	1	20	5	3	45
Q-LS/MPDU	Square D	QO/QOB	60-70	1-3	2	1	20	5	3	45
Q-LS/MPDU	Square D	QO/QOB	80-150	1-3	2	1	20	5	4	50
Q-LS/MPDU	Square D	L Frame	285	3	9	7	85	5	4	50

Table 4—Torque Settings: Circuit Breakers

13.1.2—A.1.2 — Terminal Blocks

Terminal Block (TB) Torque Settings							
TB Mounting Style	TB Description	TB Current Rating	Wire Size	Connection	Torque		
					Nm	ft lb	in lb
Din Rail	Yellow Expandable 1 to 1	41 Amp	24–6 AWG	Wire (Lug)	1	1	14
Screw Mount	Black Expandable Terminal Block w/13mm Bolt	150 Amp	16–0 AWG	Ring Terminal	11	8	104
Screw Mount	White Terminal Block #1 flat blade	15 Amp	≤ 14 AWG	Wire (Lug)	1	1	9
Screw Mount	White Terminal Block #1 flat blade	40 Amp	≤14 AWG	Wire (Lug)	1	1	9
Screw Mount	Chair lug 2-barrel	175 Amp	14–2/0 AWG	Wire (Lug)	16	12	144
Screw Mount	Chair lug 1-barrel 1/4 stud	175 Amp	14–2/0 AWG	Wire (Lug)	13	10	120
Din Rail	Black Expandable Terminal Block w/13mm Bolt	100 Amp	2 AWG	Ring Terminal	6	4	53
Screw Mount	Black Terminal Block w/17mm Nut	200 Amp	1/0–4/0 AWG	Ring Terminal	24	18	216
Screw Mount	Black Expandable Terminal Block w/17mm Bolt	200 Amp	3/0 AWG	Ring Terminal	10	7	88
Screw Mount	Chair lug 2-barrel 3/8 stud	200 Amp	6–250 kcmil	Wire (Lug)	31	23	275
Screw Mount	Chair lug 1-barrel 1/4 stud	300 Amp	6–250 kcmil	Wire (Lug)	31	23	275
Screw Mount	Black Expandable Terminal Block w/17mm Bolt	300 Amp	350 kcmil	Ring Terminal	10	7	88
Screw Mount	Black Terminal Block w/17mm Nut	350 Amp	350 kcmil	Ring Terminal	10	7	88

Table 5—Torque Settings: Terminal Blocks

13.1.3—A.1.3 — Bus Bars and Nut-Bolt Sets

SAE Standard Bus Bar and Nut-Bolt Set Torque Settings								
Size (in.)			Nm/ft lb/in lb					
Bolt Thread Size	Socket Size	Hex Head Size	Grade 0-2	Grade 3	Grade 5	Grade 6	Grade 7	Grade 8
1/4	7/16	7/32	8/6/70	12/9/108	13/10/120	17/12/150	17/13/156	19/14/168
5/16	1/2	17/64	16 / 12 / 144	23/17/204	26/19/228	33/24/288	34/25/300	40/29/348
3/8	9/16	21/64	27/20/240	41/30/360	45/33/396	59/43/516	60/44/528	64/47/564
7/16	11/16	3/8	43/32/384	64/47/564	74/54/648	94/69/828	98/71/852	106/78/936
1/2	3/4	7/16	64/47/564	94/69/828	106/78/936	145/106/1272	150/110/1320	163/119/1428

Table 6—Torque Settings: SAE Standard Bus Bars and Nut-Bolt Sets

Metric Standard Bus Bar and Nut-Bolt Set Torque Settings					
Size (mm)			Nm/ft lb/in lb		
Bolt Thread Size	Socket Size	Hex Head Size	Grade 8.8	Grade 10.9	Grade 12.9
M5	8	3	6/4/54	6/4/54	10/7/91
M6	10	5	10/7/92	10/7/92	17/13/156
M7	11	5 or 6	17/13/156	17/13/156	29/22/260
M8	13	6	25/19/225	25/19/225	43/31/377
M10	17	8	50/37/444	50/37/444	84/62/744
M12	19	10	89/65/780	89/65/780	148/108/1296

Table 7—Torque Settings: Metric Standard Bus Bars and Nut-Bolt Sets

13.1.4—A.1.4 — Neutral and Ground Bars

Neutral and Ground Bar Torque Settings			
Wire Gauge (AWG)	Nm	ft lb	in lb
Small Bar Openings			
14-12	2	1	19
10	2	1	19
8	2	2	25
6	4	3	35
Large Bar Openings			
14-10	35	25	309
8	40	29	354
6-4	45	33	398
3-1/0	50	27	442

Table 8—Torque Settings: Neutral and Ground Bars

13.2—A.2 — Additional Dry Contact Information

13.2.1—A.2.1 — Maximum Contact Ratings

Each terminal has a dry contact rating of 16 A / 250 VAC (16 A / 30 VDC).

13.2.2—A.2.2 — Normally Open/Closed

Each dry contact is normally open.

The dry contact terminals operate using relays from corresponding parts of the system. When an event occurs, the relay for the event will close, and the terminal on the dry contacts board will send a signal. *

	RELAY OPEN (No signal)	RELAY CLOSED (Signal)
INVON	Inverter OFF	Inverter ON
OVL	System normal	System overload
FAULT*	No current faults	Fault incurred
SS	Reserve output active	Inverter output active
BYPASS	Bypass breaker OPEN	Bypass breaker CLOSED
BACK-UP	System running in any other mode	System running on backup (batteries)
BATL	Battery normal	Battery low
COM	No selected relays closed	selected relays closed
	No relays selected	

Table 9—Dry Contact Terminal NO/NC Position

*The fault contact relay will remain closed so long as the fault condition exists or until the fault is acknowledged. Fault acknowledgement is done by manually turning the inverter OFF (even if the inverter is already in the OFF state).

13.2.3—A.2.3 — Additional NO/NC Contacts

Additional sets of form A, B or C contacts can be provided to indicate various system conditions upon request.

Power Innovations welcomes requests for custom system configurations.

14—Appendix B — Redundant Configuration Wiring

To wire in redundant configuration, both systems will be wired as normal, with a few exceptions. These exceptions depend on whether the system is being wired in Active (Parallel) Configuration or Serial (Hot Standby) Redundant Configuration.

14.1—B.1 — Active (Parallel) Configuration

For systems in active (parallel) configuration, specific wiring instructions will be provided in addition to this manual. A pair of Q-LS systems must be manufactured as active standby systems and may not be field converted to this configuration.

14.2—B.2 — Serial (Hot Standby) Configuration

To wire in Serial (Hot Standby) Configuration the output of **System One** will need to be wired into the input of **System Two**.

The output for **System Two** should be connected to the load (Figure 52—

Make the following connections:

- OA1 (Output A on **System One**) to IA2 (Input A on **System Two**)
- OB1 (Output B on **System One**) to IB2 (Input B on **System Two**)
- OC1 (Output C on **System One**) to IC2 (Input C on **System Two**)
- ON1 (Neutral on **System One**) to IN2 (Input Neutral on **System Two**), if using a Wye system

Wiring **System One**'s output to **System Two**'s input will enable **System Two** to start immediately when **System One** depletes its battery or is forced to go into Reserve Mode.

NOTE: The first machine to start during initial startup will be the primary machine (**System One**). It will always be the first machine to function during any startup. If **System One** is operating, **System Two** will always be placed on standby.

To enable systems to run in serial (hot standby) configuration, Power Innovations will have programmed the system as required.

For any additional adjustments, contact a certified service technician.

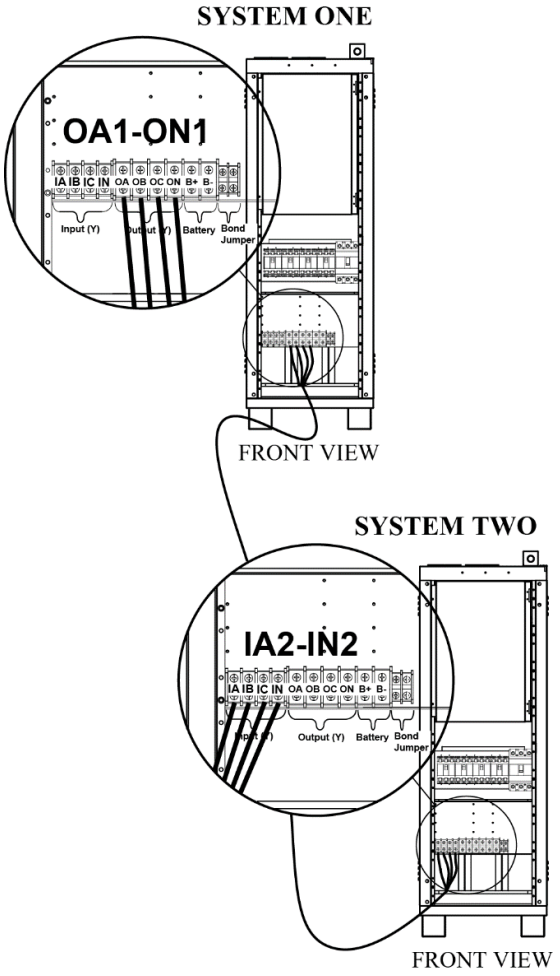

Figure 52—Cables for Serial (Hot Standby) Configuration

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15—Appendix C — Product Specifications

Q-LS Version:	**Q-LS 180**	**Q-LS 200**	**Q-LS 240**	**Q-LS 320**	**Q-LS 400**	**Q-LS 450**	**Q-LS 500**	**Q-LS 550**
Output								
Capacity (VA)	180,000	200,000	240,000	320,000	400,000	450,000	500,000	550,000
Capacity (watts)	144,**000**	160,000	192,000	256,000	320,000	360,000	400,000	440,000
Nominal voltage range (3-phase)*	+/- 20% (>20% available upon request)							
Nominal voltage range (1-phase)*	+/- 20% (>20% available upon request)							
Frequency*	50, 60Hz (400Hz special order)							
Frequency tracking	1%							
Maximum output frequency deviation	2%							
Power factor	.8							
Waveform	SINUSOIDAL							
Single phase output	Customizable, per customer specifications							
3-phase output	Customizable, per customer specifications							
Input								
Current (amp) (208VAC)	624	693	832	1110	1388	1561	1735	1908
Current (amp) (380 VAC)	324	380	456	608	760	855	950	1045
Current (amp) (415 VAC)	313	348	417	556	696	783	870	956
Current (amp) (480 VAC)	271	301	361	481	601	677	752	827
Current (max amp) (208/120 VAC)	743	825	990	1321	1,652	1,858	2065	2271
Current (max amp) (415/380 VAC)	407	452	543	724	904	1,017	1131	1244
Current (amp) (415/380 VAC)	373	414	497	662	828	931	1035	1138
Current (max amp) (480/277 VAC)	322	358	429	573	716	805	895	984
Frequency*	50/ 60 Hz +/- 7%							
Power factor (12-pulse rectifier)	0.8							
General								

UPQ power conditioning topology	True galvanic, UPQ 5-Stage isolation and online conversion
Remote power management	Monitoring 1~99 UPS simultaneously / Dry contact / RS232 / RS485 Modbus

Q-LS Version:	**Q-LS 180**	**Q-LS 200**	**Q-LS 240**	**Q-LS 320**	**Q-LS 400**	**Q-LS 450**	**Q-LS 500**	**Q-LS 550**
High Frequency On-line Inverter								
Inverter design	Active Switching H-bridge							
Inverter driver frequency	16.5 kHz							
Inverter regulation	+/- 1%							
Overload capacity	110% continuous / 125% 7.5~15 min / 150% 2.5 – 5 min / >150% 15~30 sec							
Crest factor	3:1							
Transfer time	Zero							
Overall system efficiency	95%							
Efficiency	>93%							
Q-LS to bypass/bypass to Q-LS	Zero							
Rectifier (12-Pulse)								
Efficiency	99%							
Current limit (amp) (208/120 VAC)	817	907	1089	1453	1817	2043	2271	2498
Current limit (amp) (380 VAC)	448	497	597	796	995	1119	1244	1368
Current limit (amp) (415/380 VAC)	420	455	546	728	911	1024	1138	1252
Current limit (amp) (480/277 VAC)	308	428	513	684	855	962	1069	1176
Static Switch								
Voltage range	20%							
Frequency range	50Hz:45~55Hz / 60Hz:55~65Hz							
Efficiency	99.5%							
Transfer time—main to inverter	0.2 mS							
Transfer time—inverter to main	0.3 mS							
Battery Information								
DC Voltage	348 VDC (nominal), 390 VDC (float)							
Maximum recharge current (amps)	54	60	72	96	120	435	150	165
Boost charge	Selectable							

Q-LS Version:	Q-LS 180	Q-LS 200	Q-LS 240	Q-LS 320	Q-LS 400	Q-LS 450	Q-LS 500	Q-LS 550
Voltage Regulation								
Input voltage range*	208 to 690 VAC							
-Full load with backup	±15%							
-Full load without backup	±20%							
Half load without battery	±25%							
Output voltage regulation (normal mode)	±1%							
Isolation								
Input to output isolation	Dielectric strength 5 kV, 120 dB common mode attenuation							
Common-mode noise rejection	Yes							
Normal-mode noise rejection	Yes							
Suppression								
IEEE 587 / ANSI 62.41 (North America)	Yes							
IEEE 587 / ANSI 62.41 (International)	Yes							
Joules (energy absorption)	1530 per phase							
TVSS MOV joule rating	768 joules per phase							
TVSS low pass filter	750 Hz							
Peak surge current (amps)	19,500 per phase							
Multi-stage protection	Yes							
Reverse inverter impulse protection	54 joules without batteries							
IEC	62040-2							
FCC	Class A							
EN500091-1	Yes							
EN500091-2	Yes							
EN 60610 (leakage current)	< 1 mA							
CE approval	Yes							
Conditioning	Yes							
Output THD (linear load)	< 2%							
Current THD (12-pulse rectifier)	Maximum of 9%							
Input frequency range	50/60 Hz ± 10 Hz							

Q-LS Version:	Q-LS 180	Q-LS 200	Q-LS 240	Q-LS 320	Q-LS 400	Q-LS 450	Q-LS 500	Q-LS 550
Battery, continued								
Battery low voltage	320 VDC							
Battery low stop voltage	295 VDC							
Environmental								
Maximum heat dissipation kW	13	14.4	17.3	23	28.8	32.4	36	39.6
Maximum heat dissipation BTU/hr	44,220	49,133	58,959	78,612	98,266	110,549	122,832	135,115
Operating temperature	32 to 113 °F (0 to 45 °C)							
Humidity	0%–95% non-condensing							
Audible noise	< 65 dBA at 1 meter				< 67 dBA at 1 meter			
Altitude	Less than 6,600 ft (2,000 m) above sea level							
De-rating temperature to altitude	39 °F / 3,281 ft (4 °C / 1,000 m)							
Physical								
Width			87 in (220 cm)	87 in (220 cm)	87 in (220 cm)	87 in (220 cm)	133 in (338 cm)	
Depth			32 in (81 cm)	32 in (81 cm)	38 in (96 cm)	38 in (96 cm)	38 in (96 cm)	
Height	63 in (160 cm)							
Weight in lb (no battery)	4,620	5,500	8,250	8,800	9,350	9,900	12,540	13,200
Weight in kg (no battery)	2,100	2,500	3,750	4,000	4,250	4,500	5,700	6,000

*Customizable

16—Appendix D — MODBUS Information

16.1—D.1 — Hardware Settings

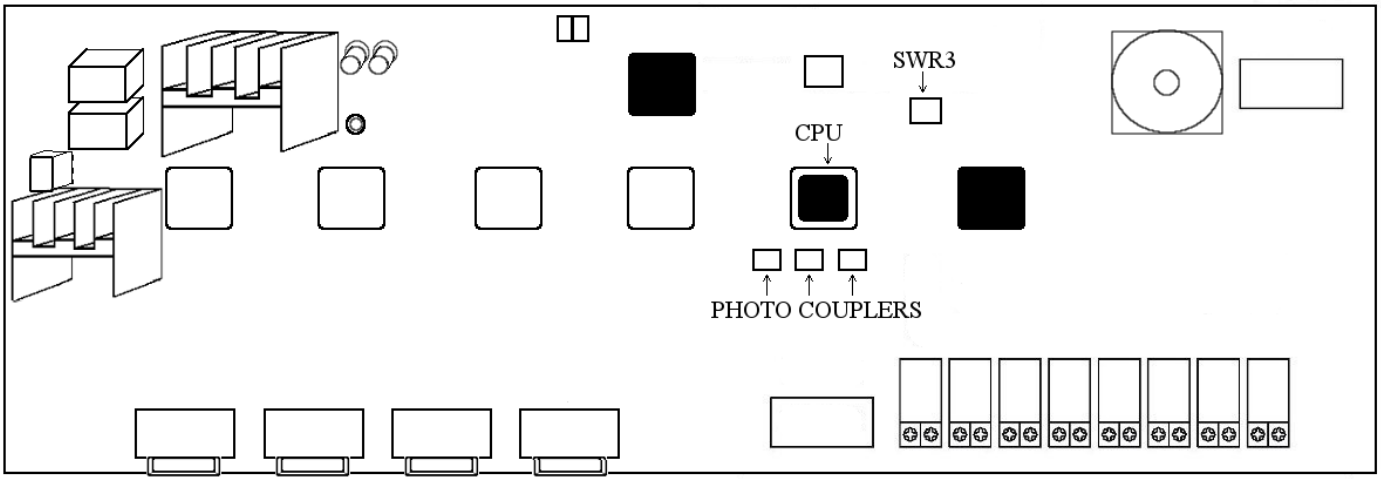

Figure 53—Location of Hardware Components on 3R Board

16.2—D.2 — SWR3–1~3: BAUD RATE

1	• 2	• 3	• BINARY	• BAUD RATE
OFF	OFF	OFF	000	1200
ON	OFF	OFF	001	2400
OFF	ON	OFF	010	4800
ON	ON	OFF	011	9600
OFF	OFF	ON	100	14400
ON	OFF	ON	101	19200

16.3—D.3 — SWR3 – 4, Set Data Format

ON=HEX **OFF**=DECIMAL

16.4—D.4 — 01: Coils (Read-Only):

Data Length: 32 Max.

NO	IMPL	STATUS	LOGIC
1	YES	UPS OUPUT OK	1
2	YES	INVERTER ON	1
3	YES	LOAD ON INVERTER	1
4	YES	LOAD ON RESERVE	1
5	YES	LOAD ON BYPASS	1
6	YES	RESERVE AC OK	1
7	YES	RECTIFIER ON	1
8	YES	BACK-UP	1
9	YES	INVERTER ON	1
10	YES	LOAD ON INVERTER	1
11	YES	SHORT CIRCUIT	1
12	YES	FUSE / OVER TEMPERATURE	1
13	YES	INVERTER FAIL SHUTDOWN	1
14	YES	BYPASS ON SHUTDOWN	1
15	YES	HIGH DC SHUTDOWN	1
16	YES	OVERLOAD SHUTDOWN	1
17	YES	70% LOAD	1
18	YES	110% LOAD	1
19	YES	125% LOAD	1
20	YES	150% LOAD	1
21	YES	RESERVE AC FAIL	1
22	YES	RESERVE FREQUENCY FAIL	1
23	YES	BATTERY LOW	1
24	YES	BATTERY LOW SHUTDOWN	1
25	YES	RECTIFIER AC FAIL	1
26	YES	ROTATION ERROR	1
27	YES	RECTIFIER SHUTDOWN	1
28	YES	HIGH DC	1
29	YES	BOOST CHARGE	1
30	YES	BATTERY TEST	1
31	YES	EMERGENCY STOP	1
32	YES	DATA LINE	1

16.5—D.5 — Holding Register (Read-Only):

Data Length: 36 Max.

ADDR	IMPL	DATA
1	YES	RECTIFIER R PHASE VOLTAGE
2	YES	RECTIFIER S PHASE VOLTAGE
3	YES	RECTIFIER T PHASE VOLTAGE
4	YES	RECTIFIER INPUT FREQUENCY
5	YES	RESERVE R PHASE VOLTAGE
6	YES	RESERVE S PHASE VOLTAGE
7	YES	RESERVE T PHASE VOLTAGE
8	YES	RESERVE INPUT FREQUENCY
9	YES	UPS OUTPUT R PHASE VOLTAGE
10	YES	UPS OUTPUT S PHASE VOLTAGE
11	YES	UPS OUTPUT T PHASE VOLTAGE
12	YES	UPS OUTPUT FREQUENCY
13	YES	UPS OUTPUT R PHASE LOAD PERCENTAGE
14	YES	UPS OUTPUT S PHASE LOAD PERCENTAGE
15	YES	UPS OUTPUT T PHASE LOAD PERCENTAGE
16	YES	BATTERY VOLTAGE
17	YES	BATTERY CURRENT
18	YES	AMBIENT TEMPERATURE
19	YES	DC VOLTAGE
20	YES	STATUS 1
21	YES	STATUS 2
22	YES	YEAR, MONTH
23	YES	DATE, DAY OF WEEK
24	YES	HOUR, MINUTE
25	NO	RESERVED
26	NO	RESERVED
27	NO	RESERVED
28	NO	RESERVED
29	NO	RESERVED
30	NO	RESERVED
31	NO	RESERVED
32	NO	RESERVED
33	NO	RESERVED
34	NO	RESERVED
35	NO	RESERVED
36	NO	RESERVED

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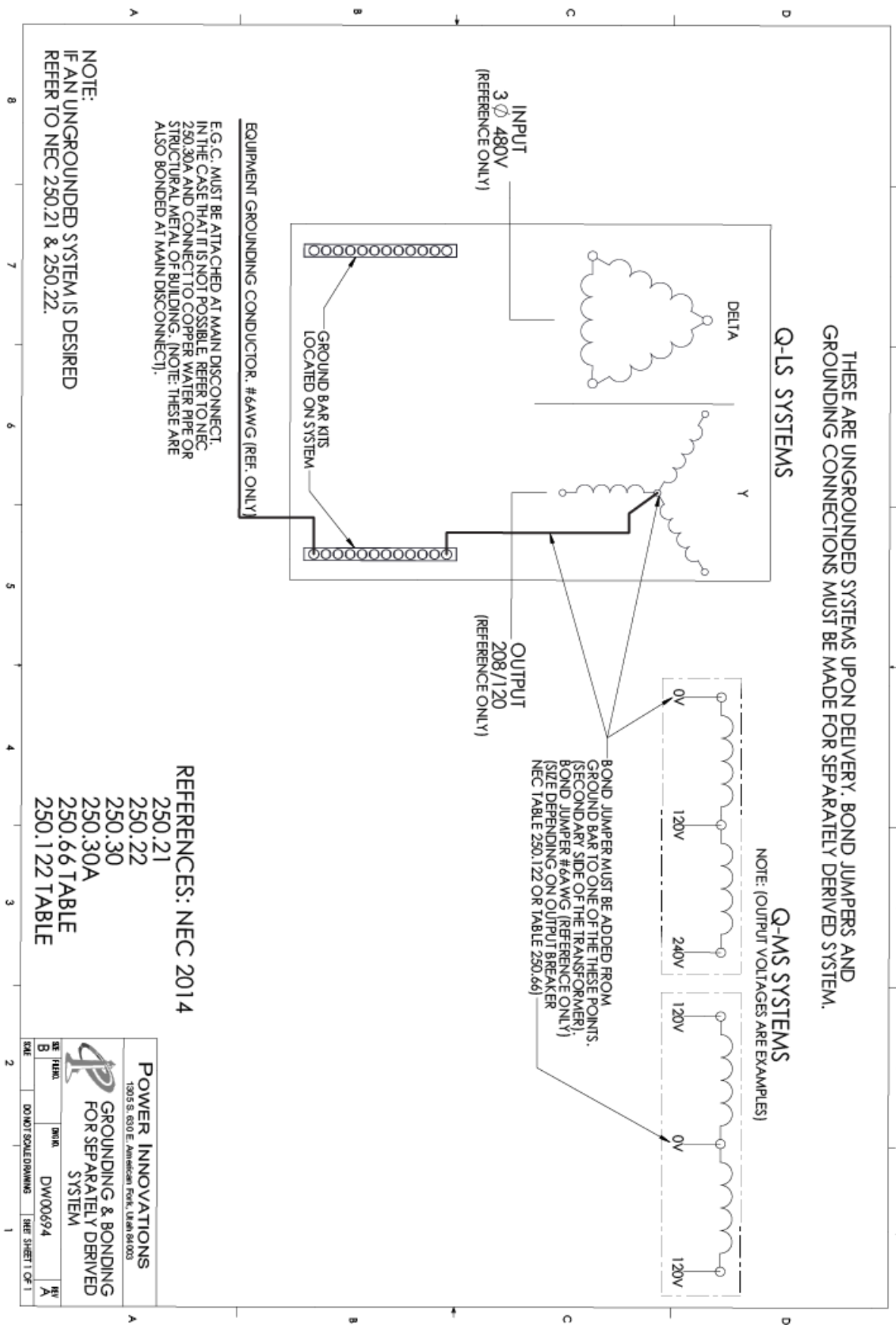
17—Appendix E — Grounding and Bonding Details



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18—Appendix F — Warranty

Limited Warranty

Power Innovations International, Inc. (hereinafter “PI”), warrants this product to be free from defects in material and workmanship for a period of one year from the startup date, provided initial power-up is performed by a PI certified technician. The initial power-up must be performed within six (6) months of the PI shipping date, and the product must be stored in a suitable environment prior to power-up, with batteries being charged as recommend. The warranty includes twelve-month (12) coverage of parts only. Various service contracts that cover parts, labor, and travel are sold separately.

This Warranty does not cover any product that has been misused, operated, or handled in a way that conflicts with the instructions contained in the User’s Manual, and/or which has been installed or serviced by an unauthorized technician.

Repair or Replacement

If any part or portion on the PI product fails to conform to the Warranty within the Warranty period, PI, will repair or provide a refurbished or new replacement within a reasonable turnaround time. Replacement parts will meet specifications of the original part or unit.

Proof of Purchase

Proof of purchase will be required by Power Innovations to substantiate date of purchase and to verify the Warranty period. Such proof of purchase must be an original bill of sale or receipt containing name and address of seller, purchaser, and the serial number of the product.

Legal Rights and Restrictions

This Warranty gives you specific legal rights. You may also have other rights which vary from state to state. This warranty is limited to the original end user of the product and is not transferrable. This warranty covers only PI supplied components. Any damage or service required because of third-party components is not covered under this warranty.

Limitation of Remedies

PI’s entire liability and the User’s exclusive remedy will be repair or replacement of the unit if all conditions described under Limited Warranty have been met.

18.1—Warranty Claims

18.1.1—Claim Restrictions

The product must not have been altered, repaired, or serviced by anyone other than a certified technician. The serial number of the product must not have been altered or removed. To be covered by this warranty, the product will not have been subjected to accident, misuse or abuse, or operated contrary to the instructions in the User's Manual.

18.1.2—Making a Claim

For any Warranty Claims, customers shall contact PI at 801-785-4123 or http://powerinnovations.com/support. It is the obligation of the customer to have the product or part shipped freight prepaid, to PI. All parts or products returned to PI for service and repair MUST have prior approval, which can be obtained by contacting http://powerinnovations.com/support. All products must be returned using original packaging.

18.1.3—Replacement of Parts/Components

It is often unnecessary to return a failed piece of equipment/components since this equipment uses plug-in type assemblies throughout. Replacement assemblies for the system covered by this manual are custom made and will be provided as soon as possible.

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20—Contacting Power Innovations

20.1—Customer Support

Questions concerning the operation, repair, or maintenance of this equipment should be directed to the Customer Support Department of Power Innovations. When making such an inquiry, please provide the model number, serial number, and detailed description of the issue. To service or repair any product, the customer must obtain a Customer Support Ticket number from Customer Support.

20.2—Contacting Power Innovations

For any questions or comments about this product, please feel free to contact us.

Power Innovations International, Inc.

Tel: (801) 785-4123
Fax: (801) 785-6999
Email: support@power-innovations.com

Building a Safer and Greener Future