



Power Innovations  
International, Inc.

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## MS3-EVLR/T

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# Operation and Maintenance Manual



*Power Innovations International – the standard for **perfect, dependable power***

## ***TECHNICAL SUPPORT***

The EVLR/T system is developed by Power Innovations International, Inc. If there is any question or comment about this product, please feel free to contact us.

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# Safety

## Special Instructions

Before working on the EVLR/T system, service and maintenance personnel must take the following steps:

- Complete training and certification on the EVLR/T system
- Be thoroughly familiar with the EVLR/T system and its manuals
- Know and observe all safety warnings and instructions

## Warnings



- Read this manual carefully before operating or performing system maintenance.
- Follow all operating and maintenance instructions.
- For safety, obey all warnings within this manual. Failure to do so may cause physical harm or death and may also void the system warranty.
- To avoid damage, use caution when transporting the system.
- The EVLR/T system should be installed only by qualified service personnel.
- The EVLR/T system contains high voltage power that is potentially dangerous if not handled properly. All repairs should be performed by certified service personnel only.
- The EVLR/T system has its own energy source (batteries). The output receptacles may be energized even when the EVLR/T system is not connected to AC input.
- The EVLR/T system must incorporate an earth ground.
- Ensure correct battery polarity.
- Disconnect the battery before servicing.
- If the EVLR/T system will be stored for long periods of time, the batteries must be charged once every 90 days.
- Maintain the load within the EVLR/T system rating guidelines for proper operation.
- DO NOT insert any object into any of the ventilation holes or any other opening on the system.
- Connecting external batteries without the right termination may result in a hazardous situation.
- Protection of the three-phase circuit relies on the installation of proper over-current devices in the building installation.

## Battery Safety Instructions

This manual contains important instructions that should be followed during installation and for maintenance of the EVLR/T system and batteries.



### **CAUTION**

Batteries can present a risk of electric shock, burns from high short-circuit current, and fire or explosion from vented gases. Observe proper precautions.

- Servicing of batteries should be performed by personnel with battery knowledge.
- The following precautions should be taken when working with batteries:
  - Remove watches, rings, and/or other metal objects.

- Use tools with insulated handles.
  - Wear rubber gloves and boots.
  - Do not lay tools or metal parts on the batteries.
  - Disconnect the charging source before connecting or disconnecting battery terminals.
  - Check that battery terminals are securely connected and insulated. If not, remove connector, insulate, and reconnect.
- When replacing batteries, replace with the same type and number of batteries or battery packs.
  - When replacing the batteries, use the battery specified by the manufacturer.
  - To prevent explosion, do not expose batteries to fire.
  - Do not open or mutilate batteries. The released electrolytes may be harmful to the skin and eyes.
  - Install the EVLR/T system in a temperature-controlled, indoor environment, where it is clean, dry, and free of conductive contaminants.
  - Contact with any part of a grounded battery array can result in electric shock. The possibility of such shock can be reduced by removing unnecessary ground paths or connections.

## Tools and Equipment

The following tools may be necessary during the on-location installation of the EVLR/T system.



### CAUTION

Work on the EVLR/T system should be performed using tools with insulated handles.

- 17MM socket wrench
- 3/8" Flat Head screw driver
- 1/4" Flat Head screw driver
- P2 Phillips screw driver
- Volt Meter

# 1. Introduction

## 1.1 Overview

The EVLR/T is an isolation / filtration / power quality system that was custom developed to provide perfect, quality power for various FlightSafety simulator functions as follows:

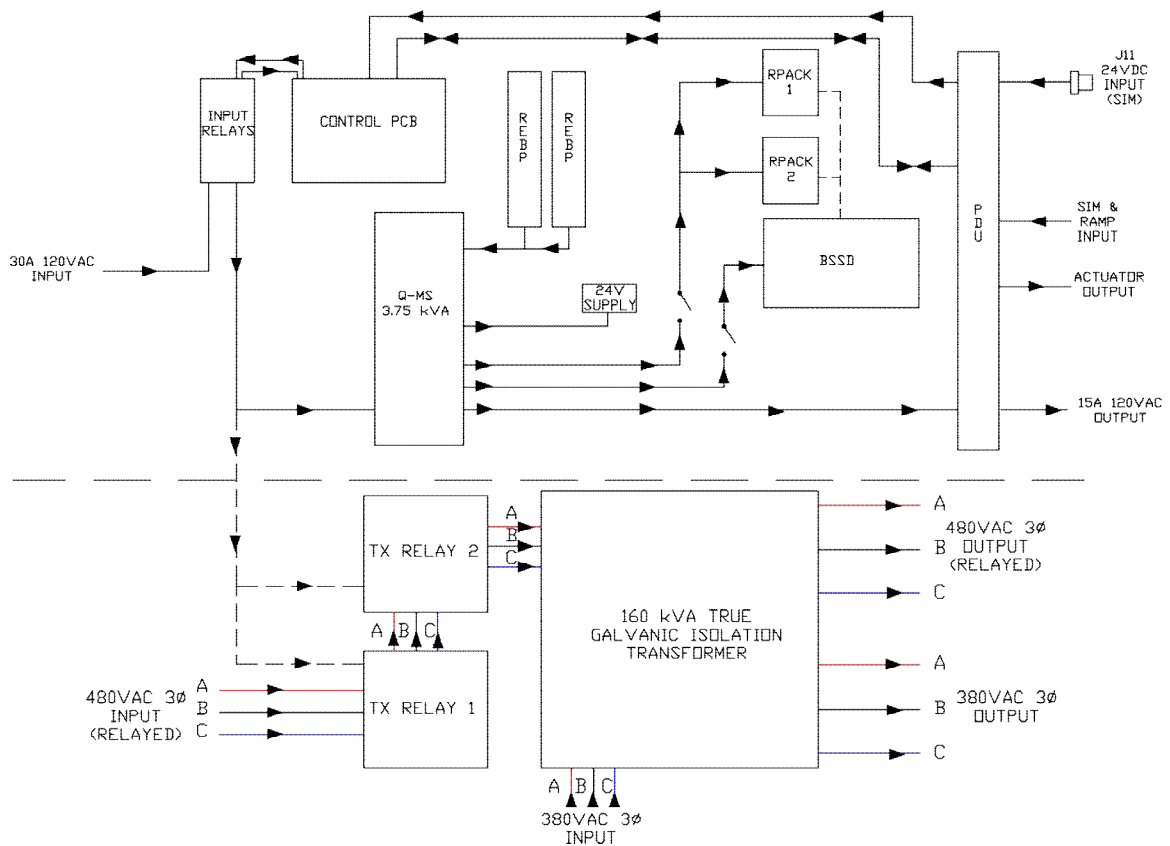
480VAC / 60 Hz “Y” output power for control motion

230 VAC 50/60 Hz “Y” output for control loading

15A, 120 VAC power for lighting, ventilation and ramp control

Battery backup for lighting, ventilation, and ramp control to allow time for personnel to exit the simulator in the event of a power outage

## 1.2 System Topology and Components



### 1.2.1 160 kVA Isolation Transformer

The 160 kVA Isolation Transformer is a high efficiency, high density, multiple input, multiple output, step up - step down transformer. The isolation transformer allows either EU 380 VAC “Delta” or North American 480 VAC “Delta” input. The isolation transformer provides 480 VAC “Y” and 230 VAC “Y” output, regardless of the selected input taps. This feature permits control loading and control motion specified input voltage parameters, in either a domestic or an international installation.

The Isolation Transformer has labeled input taps for 380 VAC and 480 VAC. The systems, unless otherwise specified, are configured from the factory with the 480 VAC taps selected. A field change of this configuration requires only moving of the inputs to the preferred taps. All connections need to be verified prior to installing and energizing the isolation transformer.

**Note: A more detailed description is provided in Section 6.**

### 1.2.2 Built-in Q-MS 3.75 kVA System

The EVLR/T system has a 3.75 kVA Q-MS series inverter built into the unit. This unit controls, manages, and cleans the input and output power supplies. The Q-MS Series UPQ™ system is an advanced, true on-line, uninterruptible power system, which is controlled by an intelligent microprocessor. RS-232 and SNMP advance communication design makes the UPQ system compatible with sophisticated monitoring software. The system offers advanced power security by providing redundant features and an available external SNMP - Web management option (UPQnet-agent II).

During an overload condition, an alarm will sound, and the UPQ system will automatically transfer to Bypass mode (if good power exists) within 4 milliseconds to ensure that the critical load (equipment) continues to operate. The Bypass function uses the AC supply power as its stand-by source. While in Bypass, the connected equipment is still protected by advanced EMI and suppression filters, but will not have isolation, regulation, or battery backup. The UPQ system automatically transfers back to the inverter when an overload condition has been cleared.

**Note: A more detailed description is provided in Section 7.**

### 1.2.3 Q-Series Rechargeable Battery Pack (Q-REBP) system

The EVLR/T is equipped with two Q-REBP battery units, which will provide approximately 12 minutes of back-up power at full capacity. The Q-Series Rechargeable External Battery Pack (REBP) system is an advanced, configurable, UPQ battery pack. Charge status is an important feature of the Q-Series REBP. Two bright multi-state LEDs provide at-a-glance monitoring of charge status. The Q-REBP in junction with a UPQ™ provides safe, dependable back-up power in times of need.

**Note: A more detailed description of the battery modules is found in Section 8.**

## 1.2.4 BSSD (B8000 Series Smart Drives)

Industrial Devices Corporation's (IDC) B8000 Series Smart Drives feature a 5 AMP continuous, 10 AMP peak, digital brushless servo drive using state of the art Digital Signal Processing (DSP) technology to provide high performance closed loop servo control to a wide variety of permanent magnet brushless and brushed servo motors and actuators offered by IDC.

The B8961, one axis Smart Drive, combines a DSP based servo amplifier with a powerful, but easy to use, machine controller. The B8961 incorporates a digital servo amplifier with a motion/machine controller in a single, compact package. Up to 24 digital Input/Output locations are available to control other machine functions. Up to 8 of these can be configured as analog inputs or outputs. (Cited from BSSD manual by IDC, page p.1)

**Note: A more detailed description is provided in Section 3.4**

## 1.2.5 RPACK

The RPACK-1 and RPACK-2 are power dump devices consisting of high voltage power resistors, a heatsink, and cooling fan. These devices were designed to work with the H, S, and B series of drives and controls from IDC. They are typically required in applications involving vertical, ball screw driven loads, or when large, direct driven inertial loads must be decelerated very quickly. The RPACK dissipates the kinetic and potential energy that would otherwise cause the drive to shutdown due to an over-voltage or regen fault. Using an RPACK can help reduce overall cycle time by allowing a higher deceleration rate than would be possible without it. **(Cited from RPACK data sheet by IDC)**

## 1.2.6 Custom Rear PDU

The custom rear distribution panel of the EVLR/T houses various cannon connectors, com connectors, and power connectors for interfacing the EVLR/T with other systems. The rear distribution panel also provides an auxiliary 120VAC 15A output, and indicators for the status of 230, 120, and 24 volt supplies.

**Note: A more detailed description of the Custom Rear PDU is found in Section 3.3.**

## 1.2.7 Real-time Monitoring Module with Web Interface – UPQnet-agent II (Optional)

UPQnet-agent II provides a powerful, Web-based interface to monitor and control any UPQ, EVLR/T, Q-MS, or PRM/ERM system. Through the UPQnet-agent II—via a network, an IP address, or a dial-up connection—a comprehensive, easy-to-understand, and secure Web page provides vital information from the system. For remote monitoring or control of critical power, nothing compares to the flexibility of the UPQnet-agent II connected to any Power Innovations system.

The UPQnet-agent II uses Simple Network Management Protocol (SNMP) to securely communicate with the system. This universal protocol allows for Internet access of real-time power status and history reports. It also enables remote management and control of connected systems. UPQnet-agent II provides the flexibility to monitor and control power from within a network, from a remote location via any Internet-connected PC, remotely via

direct dial-up, or from handheld devices such as a PDA or a cell phone. An RS-485 to RS-232 adapter is required to modify the signal.

## 2. Installation & Setup

### CAUTION



The EVLR/T system must be installed in a restricted access location. Installation, inspection, and operation must be performed only by individuals with a certified level of competency in relation to all components of the EVLR/T system.

### 2.1 Unpacking the System

Carefully remove all packaging materials from the EVLR/T system and ensure that all items are received with the unit.

### 2.2 Contents of the System

All accessories/options and items included with the unit should be compared with the purchase order and packaging receipt during the unpacking process. Some of these items **may include**, but not be limited to, the following:

- Door key
- Instruction manual
- Q-MS Power Cord
- EVLR/T Remote Cable
- EVLR/T Remote Panel
- Anchoring screws (½ inch diameter)
- Mounting brackets
- Testing Documents

The EVLR/T system should be checked to determine if the specifications of the unit are identical to the specifications of the order. The key items to check include the following:

- Rated power of the EVLR/T isolation transformer
- Proper revision level

### 2.3 Inspection of the System

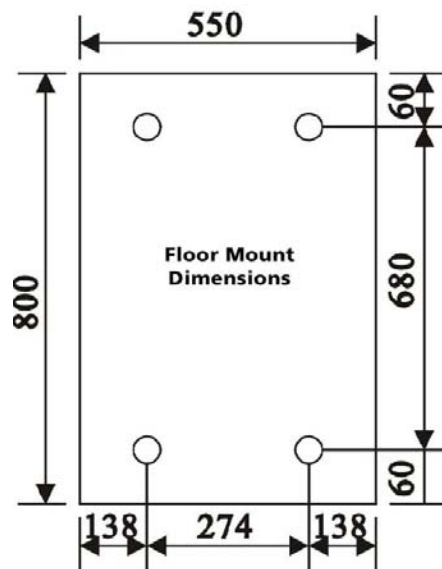
The EVLR/T system has passed detailed production and quality checking procedures of all electrical and mechanical characteristics prior to shipment from the factory. The system has also been packaged so that it should arrive in perfect condition. When the unit is received, the general condition and mechanical structure should be visually checked for any physical damage that may have occurred during shipment.

Note: Special monitoring devices designed to report in-shipment forces sustained by the unit while in transit are also available upon request.

### 2.4 Site and Environmental Considerations

The following precautions and recommendations should be taken into consideration before installing the EVLR/T system.

- The EVLR/T system should be located in a place with adequate ventilation.
- Adequate space at the front and rear of the machine (at least 1M) should be allowed to open panels for operation or maintenance. Adequate space (at least 1M) should also be allowed at the right side of the EVLR/T system for troubleshooting and maintenance.
- To prevent blockage of necessary EVLR/T system airflow, avoid putting objects on the top of the unit.
- Do not locate the EVLR/T system near any of the following:
  - Any heat source
  - Pieces of machinery or equipment that produce metallic coil dust or powder
  - Anything that produces corrosive substances or vapor
  - Below the shower of a fire extinguishing (sprinkler) system. (Abnormal conditions of the EVLR/T system will be controlled by cutting off the power supply to the MS-3 and isolation transformer.)
- The temperature and humidity values of the site into which the EVLR/T system will be installed must be within the specified ranges. The system is capable of continuous normal operation within a temperature range of 0° C (32° F) to 40° C (104° F). For optimal performance and reliability, it is recommended that the temperature of the environment be kept below 25° C (77° F), and the humidity below 80%.
- The floor loading capacity of the installation site should be such that it can handle the weight of the EVLR/T system. The unit should be anchored to the floor with the screws (dia. ½ inch) supplied with the unit, particularly if the unit is located in areas where movement may occur (i.e. earthquake zones, etc.). Locations and dimensions (mm) for the steel foot stands are shown in the following diagram:



### Mounting Bracket Floor Hole Placement

- Walls, ceilings, floors, or anything near the EVLR/T system should be constructed of non-combustible materials, and a portable fire extinguisher should be located near the unit.
- The area surrounding the EVLR/T system should be kept clean. Trash, metallic powders, filings, and other foreign objects can be drawn into the unit and cause damage.

- Access to the room where the EVLR/T system is located should be limited to a minimum number of operation and maintenance personnel. The doors should be kept locked, with keys accessible to authorized personnel only.
- Personnel who operate or maintain the EVLR/T system should be proficient in normal and emergency operational procedures. New personnel should be trained and qualified prior to operating the equipment.
- Although the EVLR/T system has passed the international EMC tests, it is not recommended that it be installed near any equipment that is susceptible to electromagnetic interference, such as computer systems, monitors, radio, etc.

## 2.5 Breakers and Cables

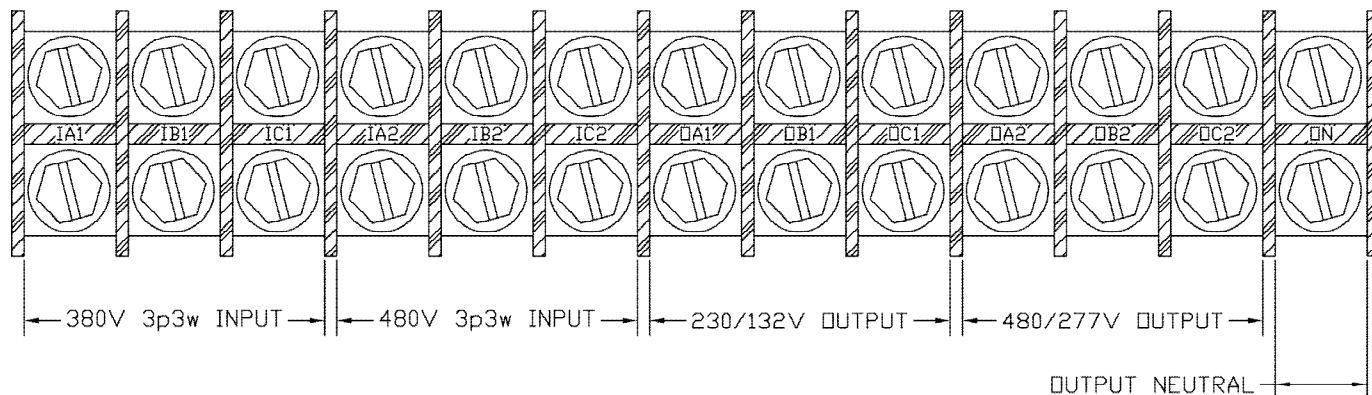
The following table lists specifications for breaker input ratings, and approximate input and output cable sizes. Inadequate cable size or oversized breakers will cause risk of fire or damage. These tables should be used for reference; however, final decision as to the cable and breaker sizes should be made by a qualified electrician and in accordance with local electrical codes and regulations.

**Input Breaker and Input /Output Cable Size for 160 kVA 3-Phase Isolation Transformer**

| kVA | 3Φ<br>Input and/or<br>Output<br>Voltage<br>Phase/Overall | Input          |                         |         |             |       |         |       | Output          |             |      |         |       |  |
|-----|--|----------------|-------------------------|---------|-------------|-------|---------|-------|-----------------|-------------|------|---------|-------|--|
|     |  | Amps           |                         |         | Cable Size  |       |         |       | Amps<br>Current | Cable Size  |      |         |       |  |
|     |  | Max<br>Current | No-<br>Fault<br>Breaker | Current | Phase A/B/C |       | Neutral |       |                 | Phase A/B/C |      | Neutral |       |  |
|     |  |                |                         |         | MM2         | AWG   | MM2     | AWG   |                 | MM2         | AWG  | MM2     | AWG   |  |
| 160 | 120/208V   | 660            | 700                     | 554     | 125*2       | 5/0*2 | 150*2   | 6/0*2 | 464             | 500         | 11/0 | 500     | 11/0  |  |
|     | 230/400V   | 344            | 350                     | 288     | 60*2        | 0*2   | 80*2    | 3/0*2 | 232             | 60*2        | 0*2  | 80*2    | 3/0*2 |  |
|     | 277/480V   | 286            | 300                     | 240     | 100         | 4/0   | 125     | 5/0   | 193             | 80          | 3/0  | 100     | 4/0   |  |
|     | 346/600V   | 225            | 225                     | 192     | 80          | 3/0   | 100     | 4/0   | 154             | 60          | 0    | 80      | 3/0   |  |

## 2.6 Power Connections

The EVLR/T system uses a standard connection terminal for power input and output. Following are the terminal connections for the two power input / output options standard on the EVLR/T:



Note: Throughout this manual, and on the EVLR/T Series system, the power phases are referred to both by the global standard (R, S, T) *and* the North American standard (A, B, C). Therefore, R = A phase, S = B phase, and T = C phase.

## 2.7 Torque Requirements

All electrical components must be tight. The following charts provide the torque values for connections in the EVLR/T system. Use these values unless the equipment is labeled otherwise.

| Nut and Bolt Torque Specifications |          |     |                        |     |
|------------------------------------|----------|-----|------------------------|-----|
| Size                               | Standard |     | Electrical Connections |     |
|                                    | Lb-in    | N-m | Lb-in                  | N-m |
| 1/4                                | 53       | 6   | 46                     | 5.2 |
| 5/16                               | 107      | 12  | 60                     | 3.8 |
| 3/8                                | 192      | 22  | 95                     | 11  |
| 1/2                                | 428      | 48  | 256                    | 29  |

| Circuit Breakers with Compression Lugs Torque Specifications |       |     |
|--|-------|-----|
| Current Rating   | Lb-in | N-m |
| 400 - 1,200<br>Amps  | 300   | 34  |

| Terminal Block with Compression Lugs Torque Specifications |            |            |
|--|------------|------------|
| AWG Wire Size  | Lb-in      | N-m        |
| 22 - 14  | 3.5 to 5.3 | 0.4 to 0.6 |

## 2.8 System Setup

The following steps will enable proper installation of the EVLR/T system. Any deviations in the setup could cause serious harm or death to the User.

**WARNING:** Make sure that the AC input and battery cables are not connected to a live source of power. Make sure all breakers and disconnects are OFF. Failure to heed this warning could cause serious harm or death.

- Place the EVLR/T system (see the Installation section on Site and Environmental Considerations for more information regarding the site and environment of the EVLR/T system).
- Unpack the EVLR/T system (see the Installation section on Unpacking for more information regarding the unpacking to the EVLR/T system). Save the packaging in case the EVLR/T system has to be returned.
- Using the key provided, open the front door of the EVLR/T system.
- If you will be using any type of monitoring software for the built-in Q-MS system, open the control panel door by removing the two (2) securing screws.
- Connect the RS-232 cable to the communication terminal (located just below the Q-MS display board). Once the RS-232 cable is connected, run the cable down through the bottom of the EVLR/T system. (See figure 2.3)
- If the Q-MS system's ON/OFF function is to be controlled via the main relay circuitry, remove one of the quick disconnect wires from SW4 (ON/OFF switch) located to the left of the Q-MS display board. Connect the female disconnect from the main relay PCB [J17-2] to the connector on SW4 previously occupied by the removed quick disconnect. Connect the male disconnect from the main relay PCB [J17-1] to the female disconnect previously removed from SW4 (See figure 2.3).
- Close the control panel and re-secure the control panel using the two (2) securing screws.
- Remove the bottom panel by removing the four (4) lower securing screws.
- Connect the AC input and output to the appropriate terminal block sections (see the Installation sections on Breakers and Cables and Power Connections for more information regarding cable sizes and connections). Run all the cables out of the bottom of the EVLR/T system (See figure 2.1).
- Replace the bottom panel and re-secure it using the (4) securing screws.
- Connect all appropriate J-series connectors to the rear distribution panel.
- Connect the remote control panel to the rear distribution panel [J16] using the supplied remote cable (See figure 2.2).
- Using an appropriate power cord, connect a 120VAC 30A service to J17 (This powers the Q-MS system) (See figure 2.2).
- The unit is ready for operation (see the Operation and Control Panel section).



Figure 2.1



Figure 2.2

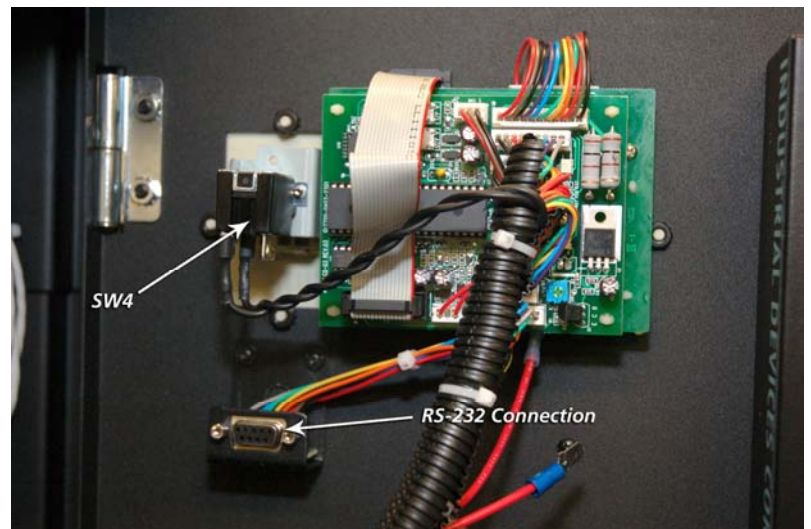


Figure 2.3

## 3. Operation

### CAUTION



The EVLR/T system must be installed in a restricted access location. Installation, inspection, and operation must be performed only by individuals with a certified level of competency in relation to all components of the EVLR/T system.

### 3.1 Pre-start Re-check

After all cables have been connected and the power source is connected to the input terminals, the EVLR/T system is ready to operate. Before turning ON any switches or breakers, re-check the following items:

- Be sure the input voltage conforms to the EVLR/T system's intended input voltage.
- Be sure the input frequency conforms to the EVLR/T system's rated input frequency.
- All loads connected to all outputs should be OFF.
- All breakers and switches should be OFF, and the battery breakers should be OFF.
- Make sure there are no packaging materials, tools, or other foreign materials inside or on top of the unit.
- The bypass feature on the main relay PCB should be OFF.

### 3.2 Operating Procedure

#### Startup Procedure

The following steps should be used to startup the EVLR/T system and initiate normal operating mode:

1. Ensure that all steps in the system setup procedure have been completed
2. Ensure all loads, breakers, and switches are OFF.
3. Plug the J11 cord into the corresponding J11 port on the rear distribution panel (See figure 3.3).
4. Plug the J17 cord into the corresponding twist lock J17 receptacle (See figure 3.3).
5. Switch ON the main power breaker (See figure 3.3).
6. Check the Q-MS control panel. LED readings should be as follows:
  - Bypass LED lit.
  - Input LED lit.
7. Turn ON the Q-MS system by pressing the ON/OFF switch (SW4) (See figure 3.4).
8. Turn ON both REBP systems (See figure 3.2).
9. Check the Q-MS control panel and REBP front panels. LED readings should be as follows:
  - Q-MS input LED lit.
  - Q-MS output LED lit.
  - Battery ON/OFF led lit (blue).
  - Battery Charge status LED lit (red or green).
10. Remove the top right side panel of the EVLR/T. Turn ON the 10A and 1A breakers (See figure 3.1).
11. BSSD and RPACK-1 and 2 should be functional.
12. Isolation transformer should now be operational.

## Shutdown Procedure

To shutdown the EVLR/T system completely, follow these steps:

1. Perform any required steps for a soft shutdown of the BSSD.
2. Turn OFF the 10A and 1A breakers on the right upper side of the EVLR/T (figure 3.1).
3. Turn OFF the REBP systems (figure 3.2).
4. Push the ON/OFF button on the Q-MS control panel (figure 3.4).
5. Turn OFF the main power breaker on the rear distribution panel. (figure 3.3).
6. Disconnect J17 and J11 (figure 3.3).
7. The isolation transformer should be de-energized.
8. All Q-MS outputs should be de-energized.

Check the control panel. All LEDs should be OFF. The EVLR/T system is completely shutdown.

Figure 3.1

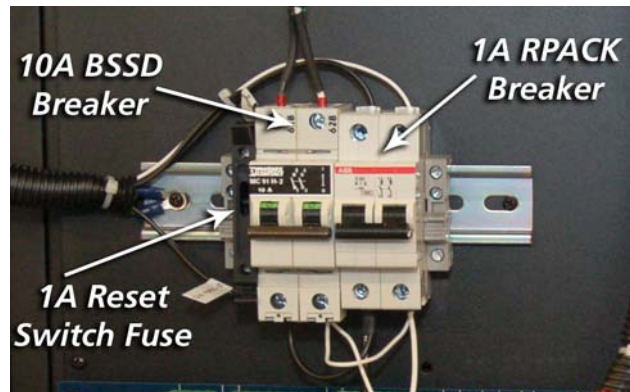
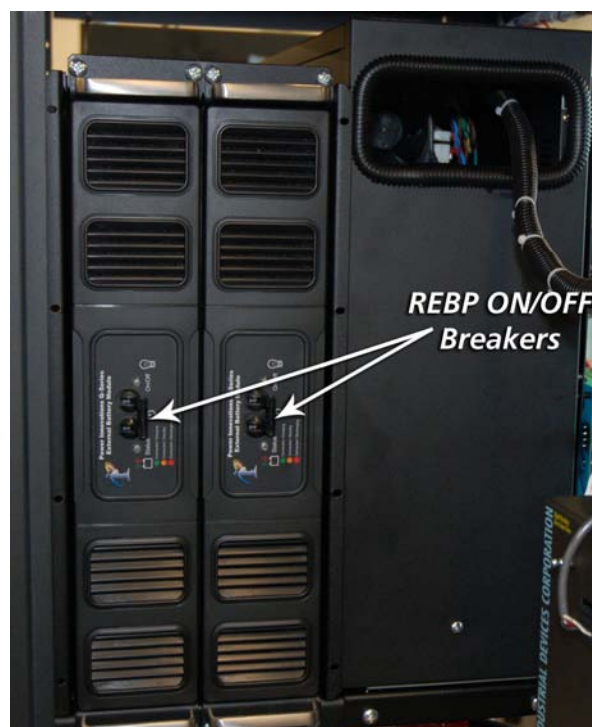
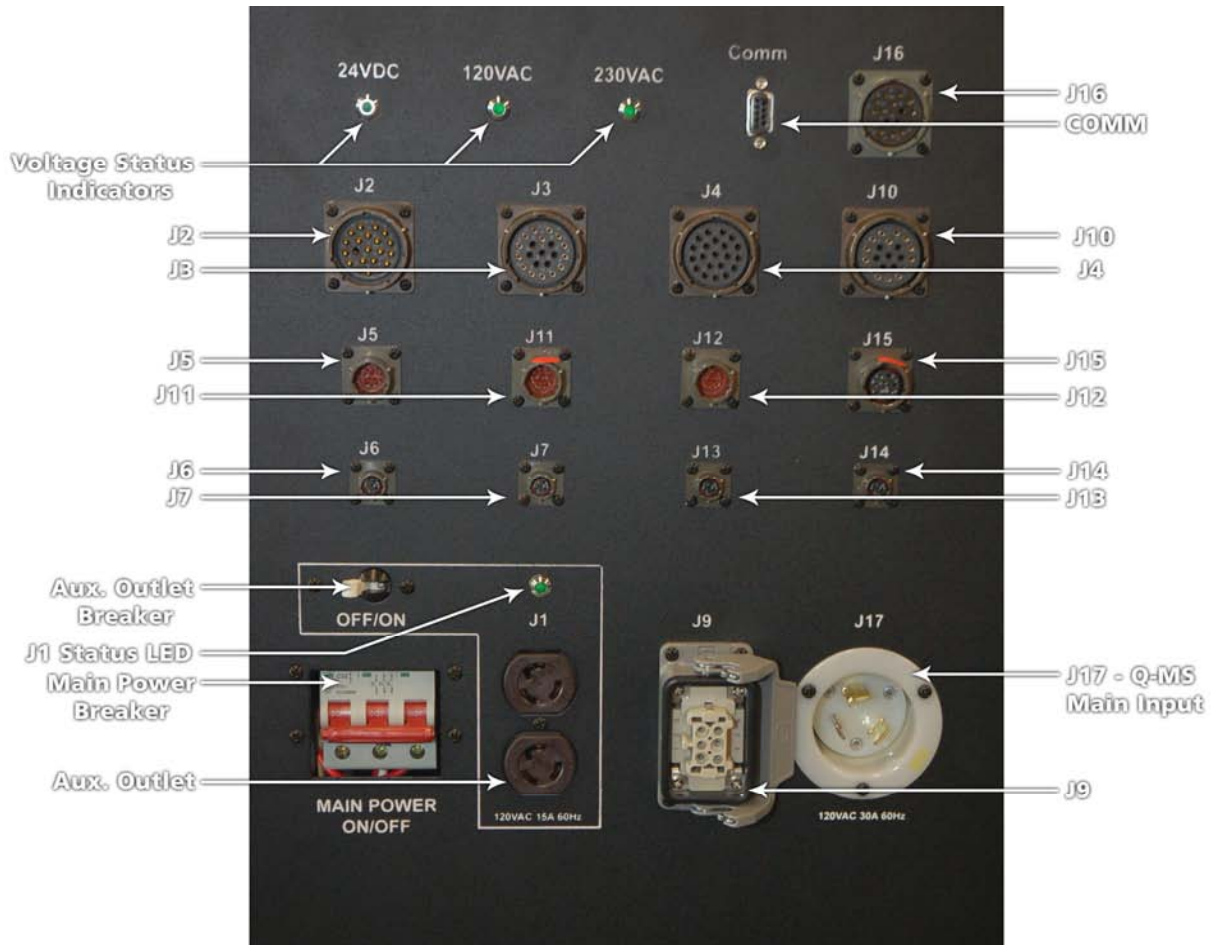


Figure 3.2



### 3.3 Rear PDU


The rear distribution panel of the EVLR/T houses various cannon connectors, com connectors, and power connectors for interfacing the EVLR/T with other systems. The rear distribution panel also provides an auxiliary 120VAC 15A output, and indicators for the status of 230, 120, and 24 volt supplies (See figure 3.3).



### 3.4 BSSD Control


The front panel of the EVLR/T system contains multiple control points for the BSSD, the LCD display for the Q-MS system, and the ON/OFF switch for the Q-MS system. Detailed descriptions of Q-MS LEDs are printed to the left of the Q-MS display, and general power-up instructions are listed below the BSSD key pad.

## FlightSafety International MS3-EVLR/T




1. Input LED: Indicates that AC power is available and that the system is in "Online" mode. This LED should always be illuminated while the UPQ system is in normal operating mode.
2. Bypass LED: Indicates that the Q-MS system is in bypass mode and that the output power is supplied via the bypass line.
3. Output LED: Indicates the Q-MS system power is being supplied from the inverter to the load.
4. Battery Capacity LED: Indicates that the batteries are low.
5. Overload LED: Indicates the load on the Q-MS system exceeds its capabilities. A reduction of the load is required.
6. Fault LED: Indicates a fault condition. The system may need service, the connected load is too large, or there is a short circuit.
7. LCD Display:
  - Q-MS System Status
  - AC: OK (LOSS)    BAT: OK (LOW)
  - NO Output (Bypass, Output, Inverter Output)
  - Input Voltage
  - Output Voltage
  - Input Frequency
  - Output Frequency
  - Battery Voltage
  - Output Power
8. LCD Switch: This switch is pressed to scroll through the Q-MS system status readings on the LCD Display.
9. ON-OFF Switch (SW4): This switch will turn the Q-MS systems ON or OFF.

**POWER MONITORING & CONTROL DISPLAY**




**Q-MS LCD**

**BSSD Key Pad** →




**SERVO DRIVE CONTROL PANEL**

**Reset Switch** →



**CLEAR BUFFER  
SOFT RESET**

Designed and manufactured by:



**Power Innovations**  
www.power-innovations.com  
for:  
**FlightSafety International**  
Simulation

**POWER UP INSTRUCTIONS**

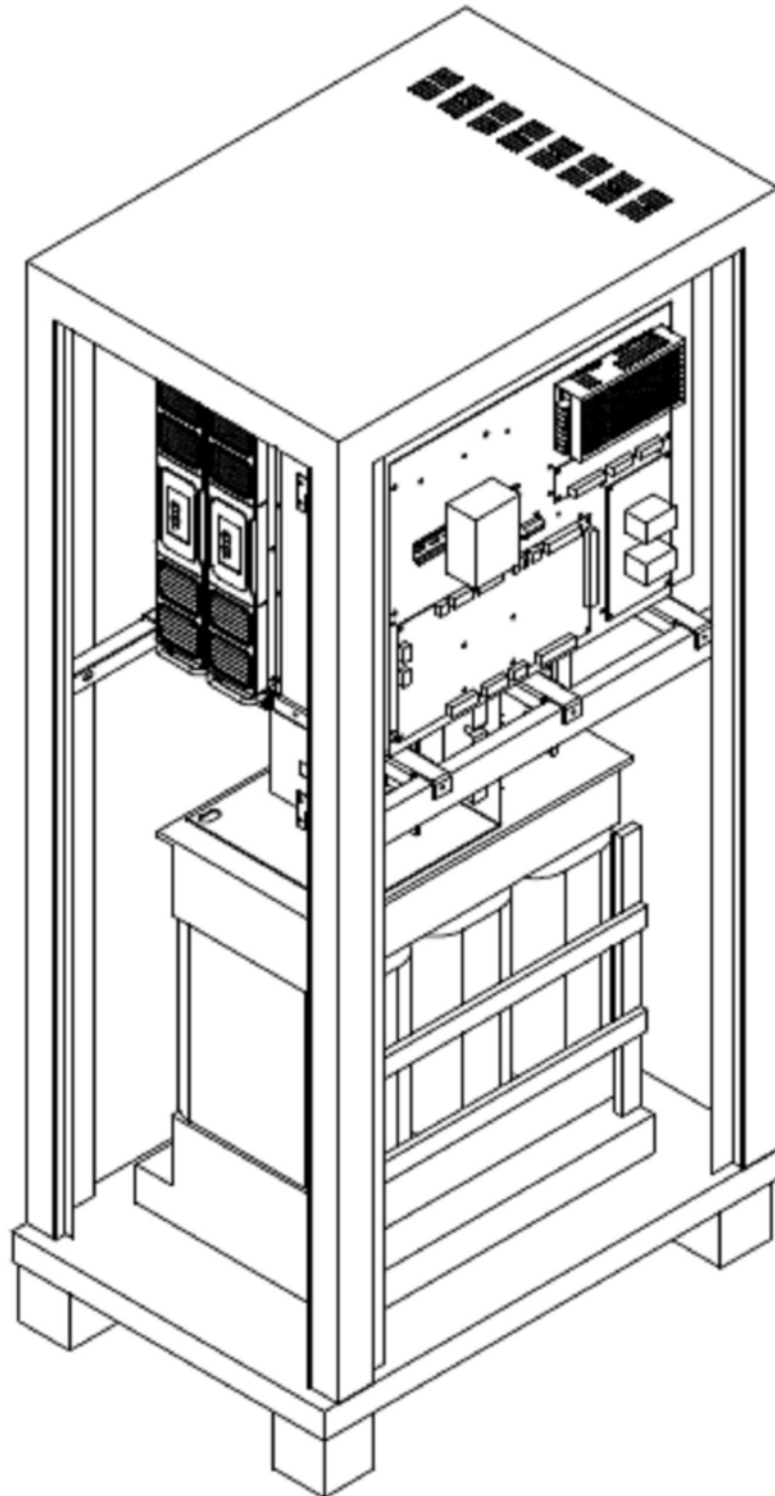
- (a) Switch the "Main Breaker" (NO-FUSE-BREAKER on rear panel) to the "ON" position. Note: The "Input" and "Bypass" LEDs should both light simultaneously.
- (b) Press the "ON-OFF switch" to the ON position. The "LCD Display" will light up immediately to indicate the AC utility power and batteries are normal and the output outlet is supplied via bypass.
- (c) About 20 seconds later, the "Output LED" will illuminate and the "Bypass LED" will turn OFF at the same time, indicating the Q-MS system is operating correctly in inverter mode.

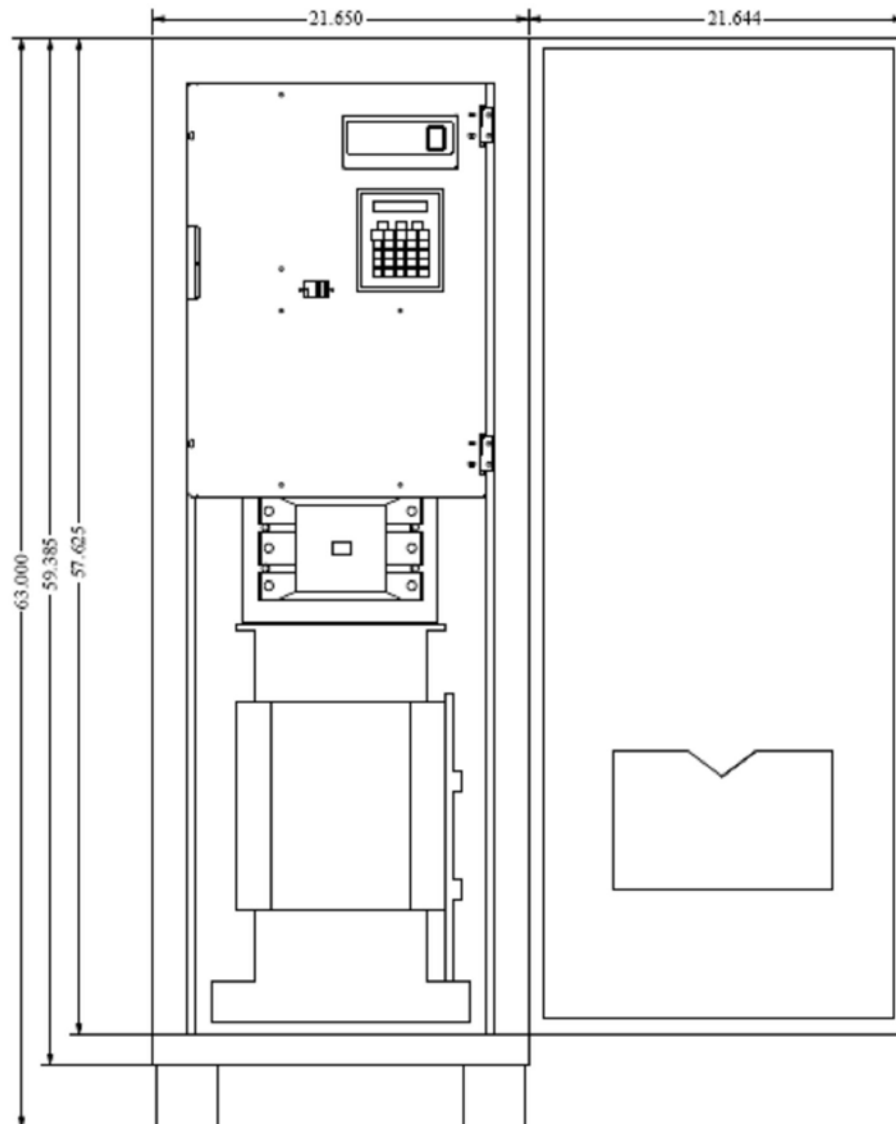
**CAUTION!**  
Install the Q-MS system in a temperature controlled environment (clean and dry and free of conductive contaminants).

**CAUTION!**  
Batteries can present a risk of electric shock, burns from high short-circuit current, and fire or explosion from vented gases. Observe proper precautions.

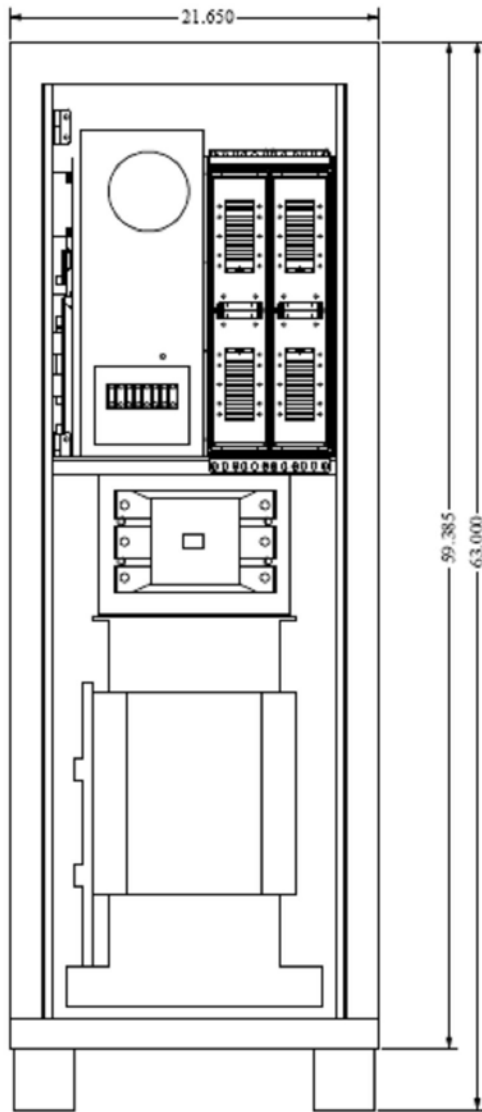
**CAUTION!**  
When replacing the batteries, use the battery specified by the manufacturer.

## 4. Dimensions & Views

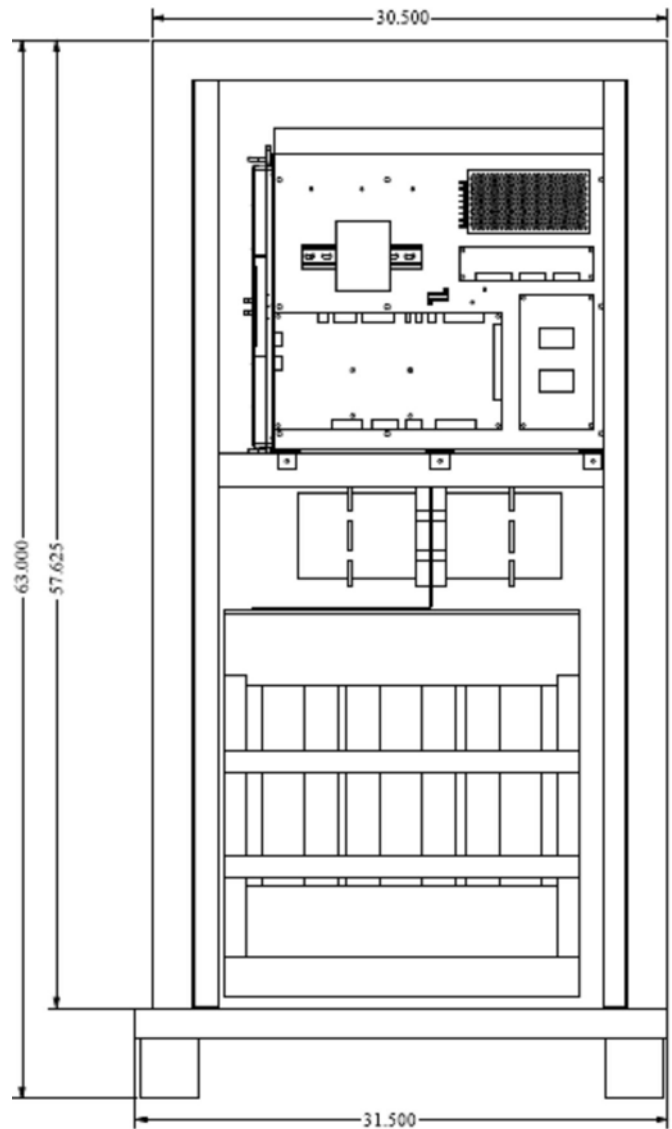




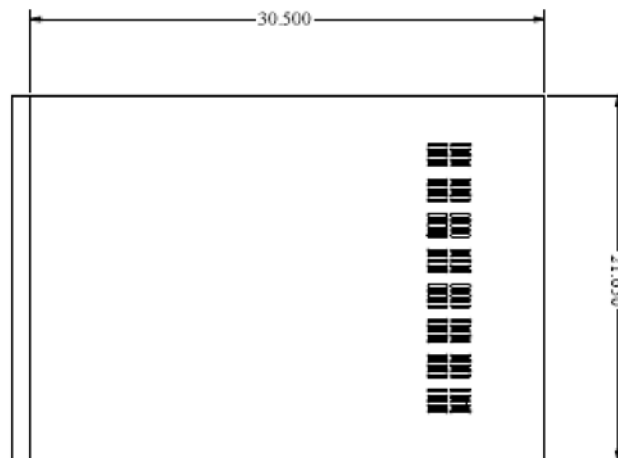
**Front View**



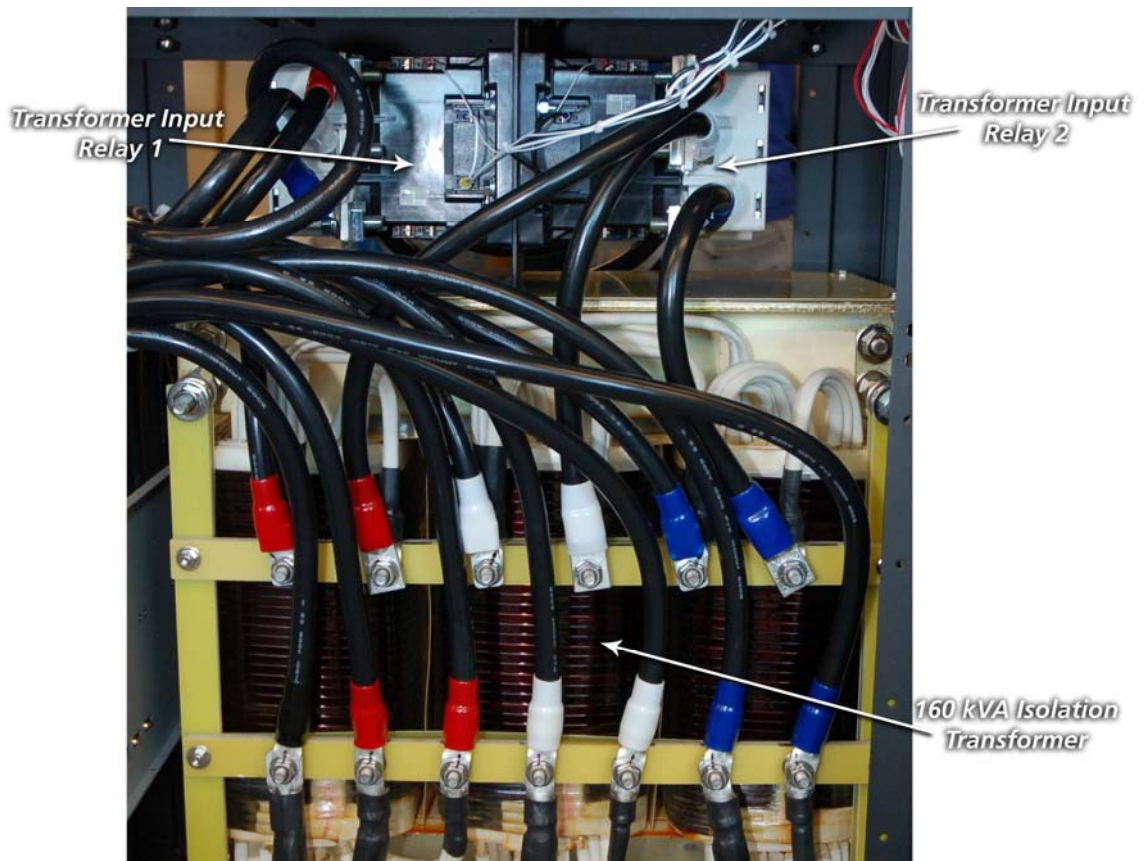
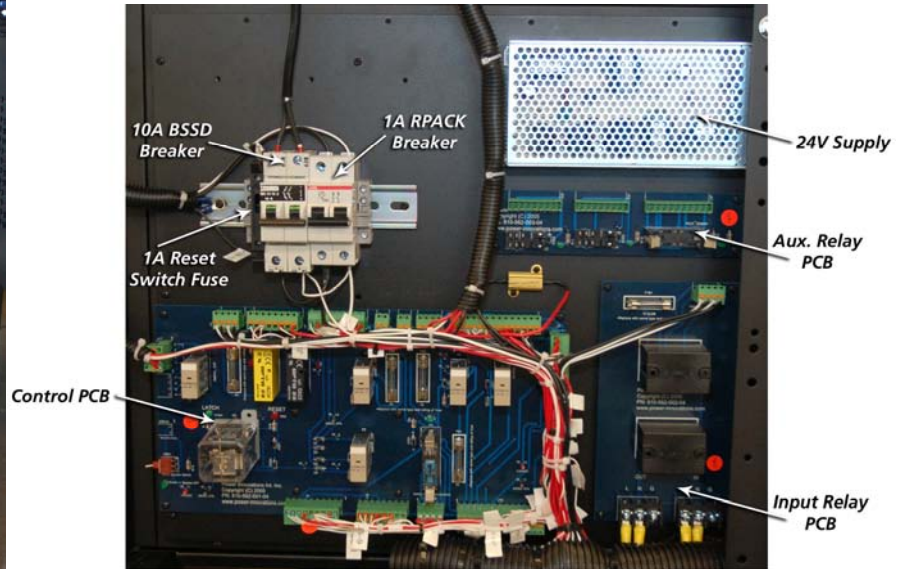
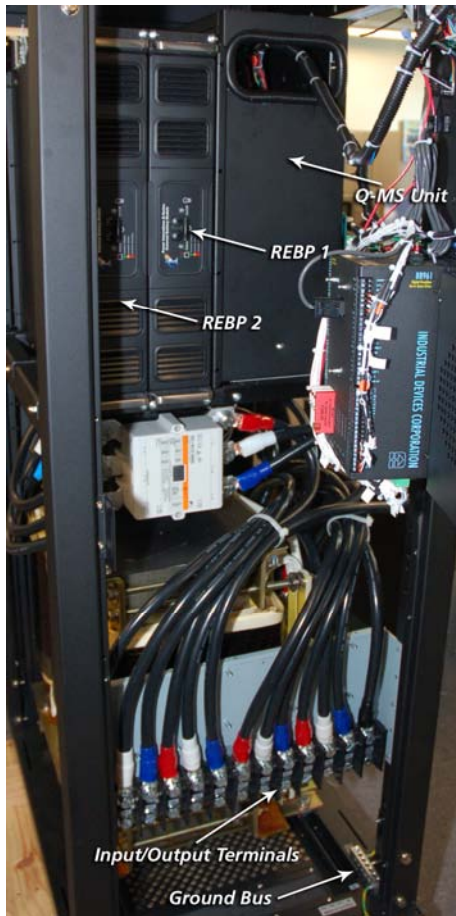
**Rear View**



**Right Side View**



**Top View**



## 5. System Maintenance

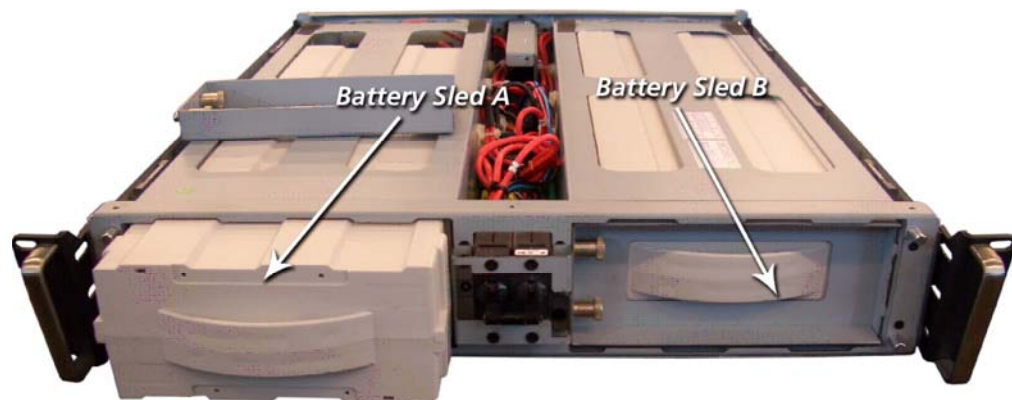
The Maintenance section provides information on proper maintenance of the EVLR/T system and its components. Service should be performed by authorized service personnel only.

### 5.1 Preventive Maintenance

The following service steps are designed to ensure that the EVLR/T system is functioning properly and that it will continue to function properly and provide quality power for years to come. These steps should be performed at least twice per year:

- Inspect electronic components.
- Verify that the system is operating within specification.
- Test each battery sled. Record individual voltages and maintain a history of each battery sled.

**(For more details please refer to Section 7.10)**

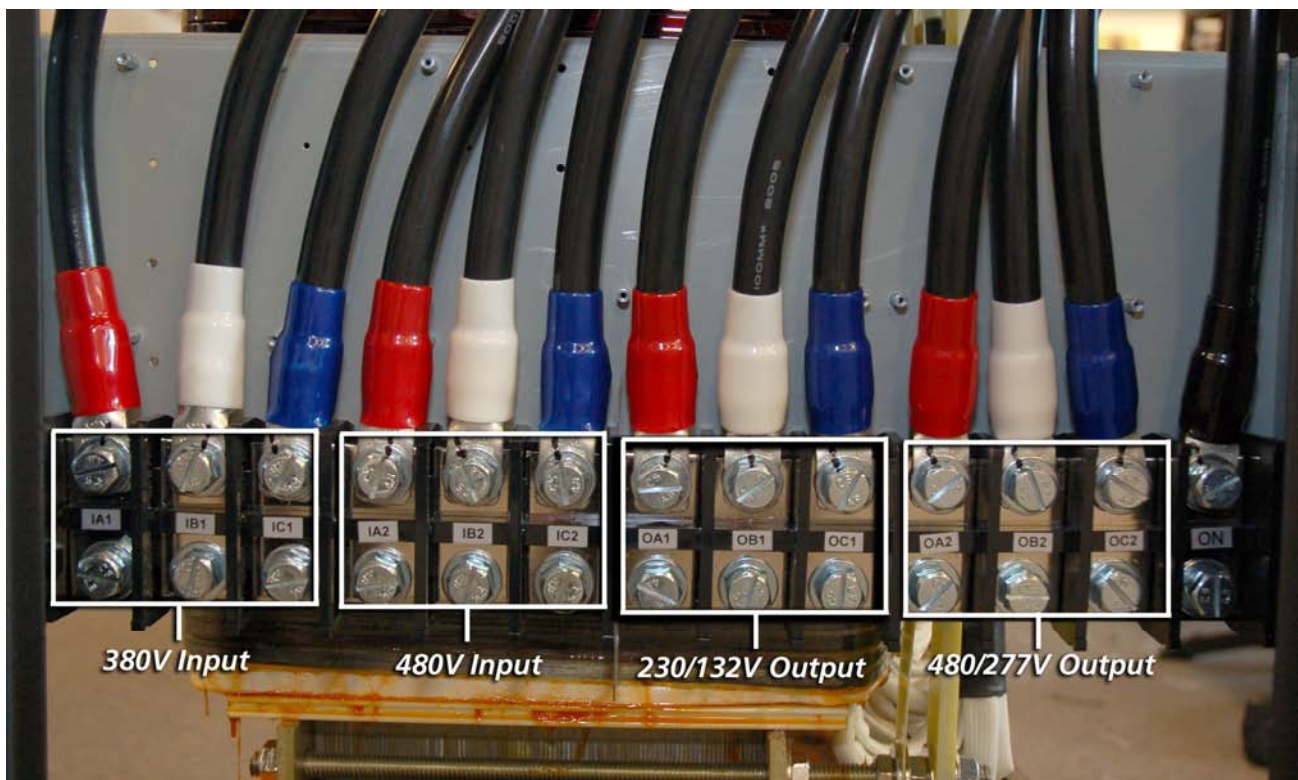


- Clean the system of dust, shavings, and any other foreign objects.
- Inspect torque levels.
- Inspect fuses.
- Check connection integrities.
- Check LEDs.

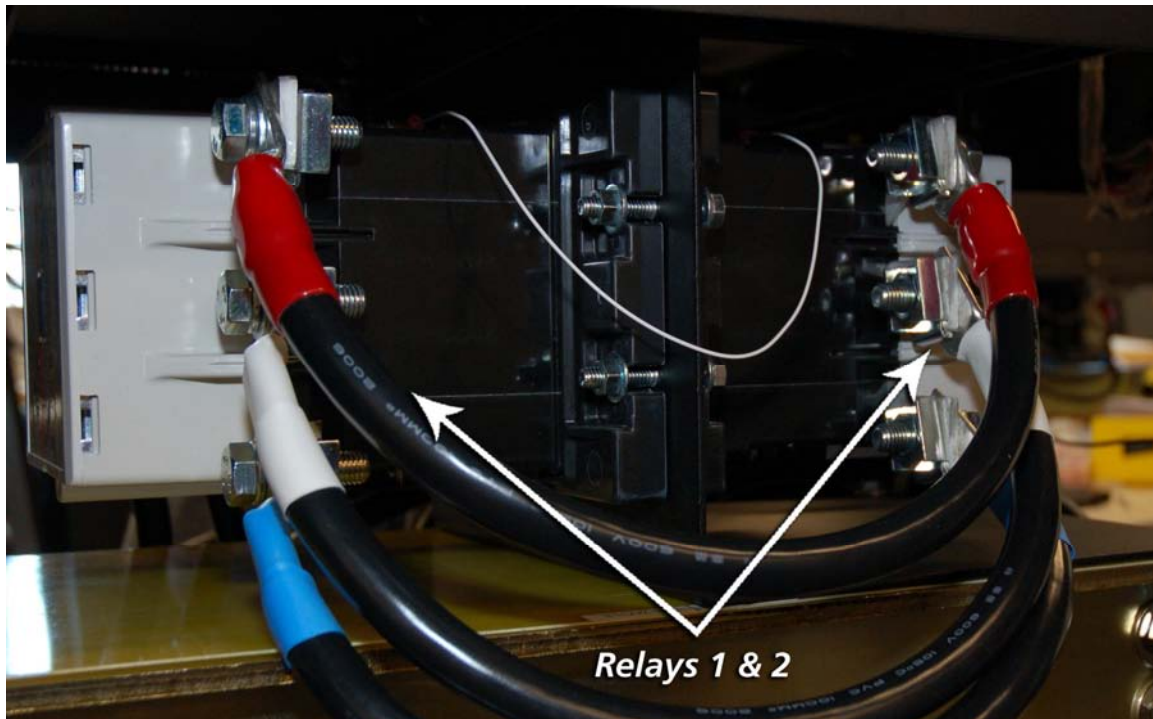
## 6. Built In 160 kVA Isolation Transformer

The 160 kVA Isolation Transformer is a high efficiency, high density, multiple input, multiple output, step up - step down transformer. The isolation transformer allows either EU 380 VAC “Delta” or North American 480 VAC “Delta” input. The isolation transformer provides 480 VAC “Y” and 230 VAC “Y” output, regardless of the selected input taps. This feature permits control loading and control motion specified input voltage parameters, in either a domestic or an international installation.

The Isolation Transformer has labeled input taps for 380 VAC and 480 VAC. The systems, unless otherwise specified, are configured from the factory with the 480 VAC taps selected. A field change of this configuration requires only moving of the inputs to the preferred taps. All connections need to be verified prior to installing and energizing the isolation transformer.



Per CE standards, the input to the transformer is channeled through two (2) safety relays. These safety relays are energized through a SIM control signal to the EVLR/T. If the 120 VAC control signal is not present, there will be no input power to the transformer.



Because of the “Delta” input and “Y” output design of this Isolation Transformer, common mode noise is eliminated, allowing clean power to the control loading and control motion leads.

**For system setup instructions, refer to Section 2.8**

**For operating procedure instructions, refer to Section 3.2**

## 7. Built In Q-MS3 – Mid-Scale UPQ™



### 7.1 Description – Built-In Q-MS3.75 for EVLR/T

The Q-MS Series UPQ™ system is an advanced, true on-line, uninterruptible power system, which is controlled by an intelligent microprocessor. RS-232 and SNMP advance communication design makes the UPQ system compatible with sophisticated monitoring software. All models offer advanced power security by providing redundant features and an available external SNMP - Web management option (UPQnet-agent II).

During an overload condition, an alarm will sound, and the UPQ system will automatically transfer to Bypass mode (if good power exists) within 4 milliseconds to ensure that the critical load (equipment) continues to operate. The Bypass function uses the AC supply power as its stand-by source. While in Bypass, the connected equipment is still protected by advanced EMI and suppression filters, but will not have isolation, regulation, or battery backup. The UPQ system automatically transfers back to the inverter when an overload condition has been cleared.

### 7.2 Q-MS 3.75 Features

#### *Wide Input Range*

The Q-MS Series system is designed to accept extra wide input ranges ( $\pm 25\%$ ), so that it can work efficiently under poor AC power conditions. The Q-MS Series uses special input components that can handle extremely high-voltage and high-current conditions.

### *Branch Circuit Input Protection*

The Q-MS Series system has an independent branch circuit for each input loop. In the event of a breaker trip or a short circuit on one of the input loops, the other input loops will continue to function normally, avoiding a total system shutdown.

### *Input Surge Protection*

The Q-MS Series system has additional surge protection on the input. This feature provides additional protection to both the Q-MS Series system and the ancillary equipment from any damage that might be caused by lightning or by neighboring loads.

### *EMI Suppression*

The Q-MS Series system provides Electromagnetic Interference (EMI) filtering. EMI filtering eliminates noise that could interfere with the equipment attached to the system. The Q-MS Series meets all the international EMC requirements.

### *Cold Start Function*

The Q-MS Series system can be started using its batteries without an AC power source connected. The special current limit circuitry provides the Q-MS Series unit protection from high inrush currents associated with DC battery connections on a dry DC bus. Ordinary on-line UPS solutions will suffer damage to battery fuses and DC capacitors when batteries are connected to an empty DC bus for cold start applications.

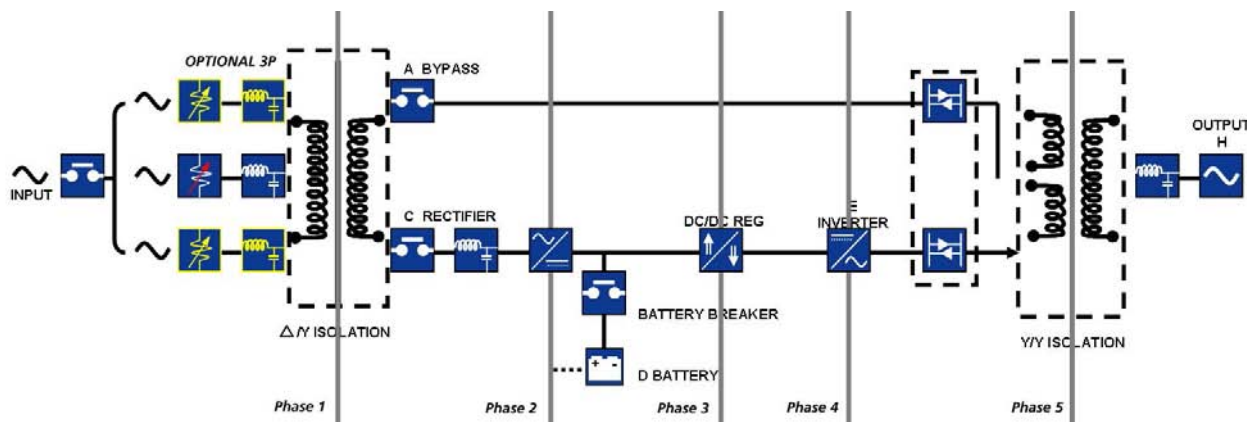
### *Protection from User Error*

The Q-MS Series' advanced circuitry prohibits damage to the Q-MS Series system when an operational mistake is made by the User.

### *Harsh Environment Tolerance*

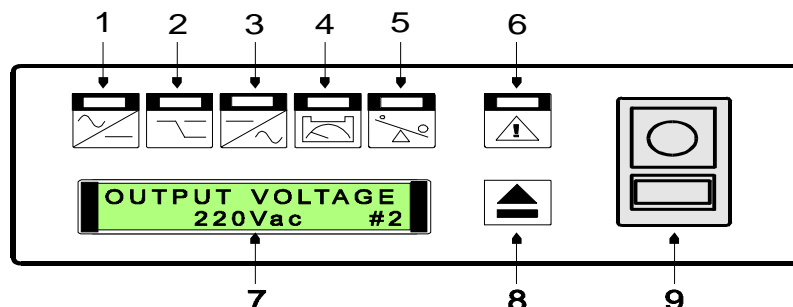
Each component that goes into the Q-MS Series system has been selected based on its high margin of safety and reliability. This careful attention to detail allows the Q-MS Series to run efficiently in extreme environments. Environmental considerations include temperature, humidity, altitude, shock, or contamination.

The Q-MS Series UPQ system provides complete power quality and power assurance through isolation of contaminated input, continual efficient regeneration of the output, and resource management and control.










## 7.3 Safety Features

1. Overload bypass function
2. Short-circuit protection
3. Over-temperature protection



## 7.4 Status Indicators

Figure 1 : Front View LCD Indicators

1. **Input LED** : indicates that AC power is available and that the system is in “Online” mode. This LED should always be illuminated while the UPQ system is in normal operating mode.
2. **Bypass LED** : indicates that the Q-MS system is in bypass mode, and that the output power is supplied via the bypass line.
3. **Output LED** : indicates the Q-MS system power is being supplied from the inverter to the load.
4. **Battery Capacity LED** : indicates that the batteries are low.
5. **Overload LED** : indicates the load on the Q-MS system exceeds its capabilities. A reduction of the load is required.
6. **Fault LED** : indicates a fault condition. The system may need service, or the connected load is too large, or there is a short circuit.
7. **LCD Display:**
  - Q-MS System Status
  - AC: Loss (OK)    BAT: OK (LOW)
  - No Output (Bypass, Output, Inverter Output)
  - Input Voltage
  - Output Voltage
  - Input Frequency
  - Output Frequency
  - Battery Voltage
  - Output Power
8. **LCD Switch** : this switch is pressed to scroll through the Q-MS system status readings on the LCD Display.

9. **ON/OFF Switch (SW4):** this switch will turn the Q-MS system ON or OFF.
10. **DB-9 Interface:** communication port between the Q-MS system and the computer.
11. **Main Breaker (NO-FUSE-BREAKER):** controls the AC input/output and the external battery power.
12. **Terminal Block:** the input/output and external battery's power cords will be wired to the terminal block.

### 7.5 Audible Beep/Alarm Status

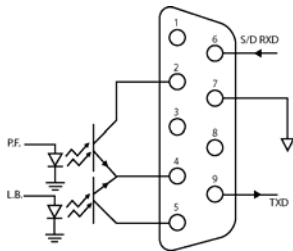
1. If normal AC supply power fails, the beep/alarm sounds two short beeps twice every 4 seconds.
2. When the battery voltage level is low, the beep/alarm beeps once every second.
3. When the UPQ system is in fault status, overloaded, or there is a short circuit condition on the output of the UPQ system, the beep will sound continuously.

### 7.6 Interface Specifications

The UPQ system provides communication signals for power failure, low battery, external shutdown, etc. via an RS-232 cable connection to the user's computer. The communication protocol is as follows:

Baud rate : 2400  
 Data : 8  
 Stop : 1  
 Parity : None

### 7.7 DB-9 Connector



### 7.8 DB-9 PIN Assignment

| <u>RS232</u> | <u>Signal</u> | <u>Contact Closure</u> |
|--------------|---------------|------------------------|
| PIN 7        | PIN 1         | PIN 2                  |
| PIN 6        | PIN 3         | PIN 4                  |
| PIN 9        | PIN 4         | PIN 5                  |
|              | PIN 8         |                        |

- PIN 1: Q-MS System Fault  
 PIN 2: AC POWER Failure  
 PIN 3: Inverter Power ON  
 PIN 4: Common GND of Pin 1,2,3,5,8

PIN 5: Q-MS System Battery Low  
 PIN 6: Turn OFF Q-MS System  
 PIN 7: GND of PIN6  
 PIN 8: Inverter Output  
 PIN 9: RS232 TXD

## 7.9 Q-MS STARTUP GUIDE

The Quick Setup Guide has been prepared to guide the User through proper installation of the Q-MS Series system. Any deviations in the setup could cause serious harm or death.

### 7.9.1 Check Prior to Start Up

1. The Main Breaker and ON/OFF switch should be in the OFF position.
2. Ensure that the Q-MS system is in a suitable location.
3. Be sure the input power cord is connected.
4. Make sure the load is disconnected or in the OFF position.
5. Check if input voltage meets the Q-MS system requirement (208VAC – 240 VAC).

### 7.9.2 Start-Up Procedure

Following are the instructions for system startup.

1. The Main Breaker AND the ON/OFF switch must BOTH be OFF, and no load should be connected to the output terminal of Q-MS system.
2. Switch the Main Breaker (NO-FUSE-BREAKER in rear panel) to the ON position. Note: The Input and Bypass LEDs should both light simultaneously (Figure 1).

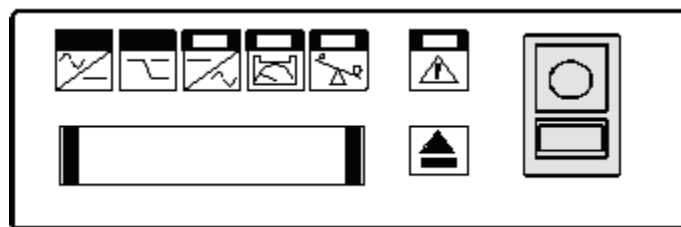


Figure 1

3. Press the ON/OFF switch to the ON position. The LCD display will light up immediately to indicate that AC utility power and batteries are normal and that the output outlet is supplied via bypass (Figure 2).



Figure 2

4. After approximately 20 seconds, the Output LED will illuminate and the Bypass LED will turn OFF at the same time, indicating the Q-MS system is operating correctly and that Q-MS system power is traveling from the inverter to the load (Figure 3).

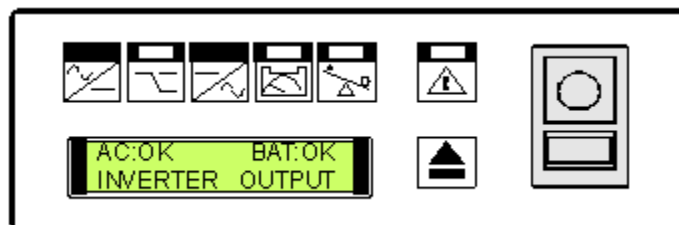


Figure 3

5. Disconnect the AC input of the Q-MS system for blackout simulation. The Input LED will go out, and the Q-MS system will beep every 4 seconds to indicate AC failure and that the Q-MS system is using battery power. The beep will stop automatically after 90 seconds. When the battery level is getting low, the Q-MS system will beep every second (Figure 4).

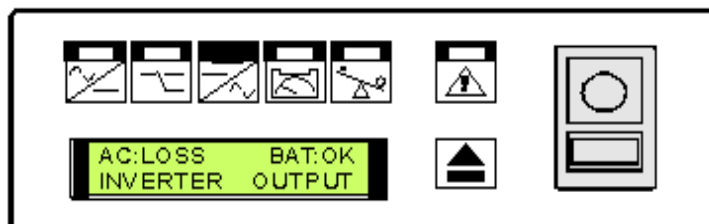


Figure 4

6. When the AC power is restored, the Input LED will light up again. The initial setup is complete. The Q-MS system is now ready to have the load connected to the output terminal block.

## 7.10. Q-MS OPERATION

### 7.10.1 Normal Operations Mode

**Daily operating procedure:** Press the ON/OFF Switch (SW4) to turn the Q-MS system ON or OFF.

**IMPORTANT POINTS TO NOTE ABOUT THE OPERATION OF THE Q-MS SYSTEM:**

1. When operating the Q-MS system, please contact Power Innovations immediately if anything different occurs from what has been outlined in the installation section of the manual. If the overload LED indicator is illuminated and the beep sounds continuously, switch OFF the least critical piece of equipment connected to the unit. Continue to switch OFF less critical items until the alarm stops. The overload LED and beep indicate an overload condition. Shutting-down pieces of connected equipment (one at a time) will reduce the load until it can be determined what can be connected safely.
2. During production and testing the batteries are fully charged. After the initial start up, keep the power applied continuously to the Q-MS system for at least 8 hours to ensure that the batteries are fully charged.
3. Be sure to test the operation of the Q-MS system regularly to ensure it is functioning correctly and to ensure the longevity of the batteries. This process should occur every 90 days.
  - a. Make certain to save all data is saved on any equipment (i.e. computers) being protected by the Q-MS system.
  - b. Switch off the AC utility supply to the Q-MS system and allow it to run from its batteries until the battery low alarm occurs.
  - c. Restore AC supply and recharge batteries.

**FAILURE TO CHECK AND RECHARGE BATTERIES AS INSTRUCTED ABOVE MAY VOID THE BATTERY WARRANTY!**

**7.10.2 Regular Q-MS Maintenance**

1. The environment in which the Q-MS system is located must be kept dry and relatively dust free.
2. Exterior panels can be cleaned with a mild cleaning solution.
3. All power connections at the input, battery, output terminals, and circuit breaker should be checked periodically. **Warning:** Make sure all power to the Q-MS system has been disconnected when performing these checks. Failure to do so could be fatal.
4. The battery cells used are sealed and maintenance free. The factory adjusts both charging voltage and current according to battery specifications.

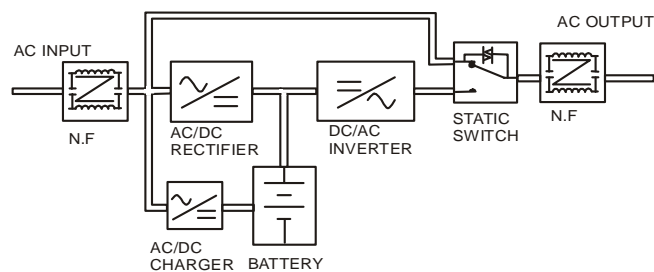
**7.10.3 Storage Instructions**

1. Turn OFF the Q-MS system and the Main Breaker if the Q-MS system will not be used for a long period of time.
2. If the Q-MS system has not been used for over 90 days, follow initial start-up procedure

and supply power to the Q-MS system for at least 24 hours to ensure that the batteries are fully recharged.

## 7.11 OPERATION MODES OF THE Q-MS SYSTEM

### 7.11.1 Q-MS System Block Diagram



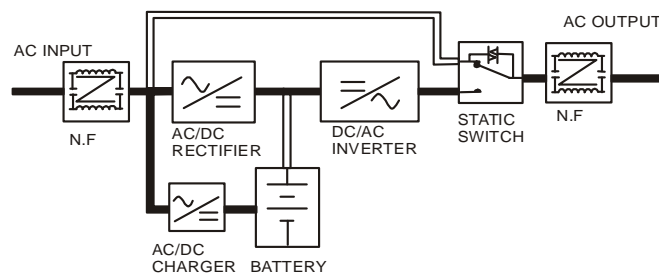
**Q-MS System Block Diagram**

### 7.11.2 Normal Operation

There are two main loops when AC utility power is normal:

- The AC loop
- The battery charging loop.

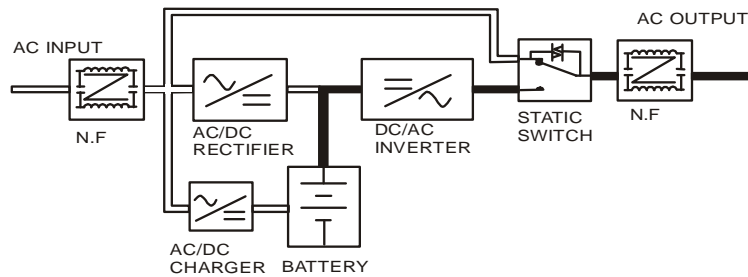
The AC output power comes from the AC utility input and passes through the AC/DC rectifier, DC/DC booster, DC/AC inverter, and static switch to support power to the load. The battery charging voltage comes from the AC utility power input and is converted by the AC/DC charger to support battery-charging power.



**Shows how the Q-MS System works with AC utility power**

### 7.11.3 AC Utility Failure

The AC output comes from the battery, passes through the DC/DC converter, the DC/AC inverter, and the static switch within the battery backup time.

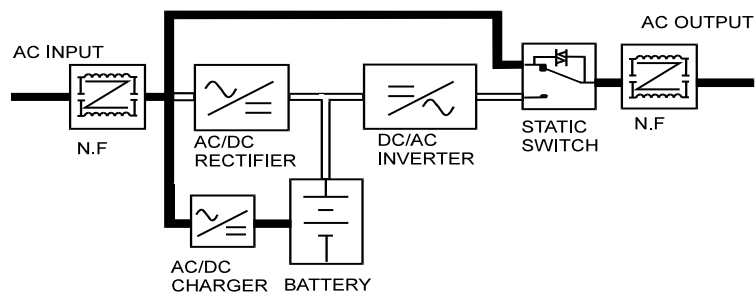


Shows how Q-MS System works when the AC utility fails

### 7.11.4 Bypass Enable

The bypass will be enabled under the following conditions:

1. Overload
2. Inverter failure
3. Initial inverter startup (about 20 seconds).
4. SW4 has been turned OFF
5. Over temperature condition



Shows how Q-MS System works in bypass mode

### 7.11.5 Recharging the Batteries

The batteries will automatically charge when the input breaker (Main Power ON/OFF) and the battery module breakers are in the ON position.

NOTE: Batteries can be recharged in approximately 8-10 hours to 90% capacity. Keeping the battery fully charged will extend battery life.

**WARNING:** There are no customer serviceable components inside, do not open the cover or attempt to service the unit as high voltage may remain when the unit shuts down.

## 8. Q-Series REBP (96VDC)



### Uninterruptible Power Quality System for the EVLR/T

#### 8.1 Description

The Q-Series Rechargeable Battery Pack (REBP) system is an advanced, configurable, UPQ battery pack. Charge status is an important feature of the Q-Series REBP. Two bright multi-state LEDs provide at a glance monitoring of charge status. RS-232 and Simple Network Management Protocol (SNMP) advanced communications design makes the REBP system compatible with sophisticated monitoring software. All models offer advanced power security by providing *multiple trip point* features and an available internal SNMP - Web management option (UPQnet-agent II). The Q-Series REBP also comes standard with a versatile, universal mounting system.

During an overload condition, the UPQ system will automatically transfer to “Bypass” mode (if good power exists) within 4 milliseconds to ensure that the critical load (equipment) continues to operate. The Bypass function uses the AC supply power as its stand-by source. While in Bypass, the connected equipment is still protected by advanced Electromagnetic Interference (EMI) and suppression filters, but will not have isolation, regulation, or battery backup.

The UPQ system automatically transfers back to the inverter when an overload condition has been cleared and backup will again be available.

#### 8.2 Safety Features

- Redundant breaker system
- Short circuit protection

## 8.3 Status Indicators

The control panel allows control of the UPQ system, while providing a visual status of the functions. For the layout of the display, refer to the figure found in 1.11.

- 1 **Charge Level (located on UPQ system)** — depending on the type of UPQ system connected, charge level indicators may vary. Consult your specific UPQ system manual for further information.
- 2 **ON/OFF Breaker** — to turn the system ON or OFF, switch the breaker to the position where the ON/OFF LED lights.
- 3 **ON/OFF LED** — indicates current status of the REBP. When the blue LED is lit, the individual REBP is supplying DC voltage.
- 4 **Charge Status LED (red)** — indicates batteries are connected, are not at full capacity, and are currently being charged.
- 5 **Charge Status (yellow/amber)** — indicates that the batteries may or may not be connected and are neither being charged nor discharged (floating).
- 6 **Charge Status (green)** — indicates that batteries are connected, charged, and ready for discharge.

## 8.4 Installation

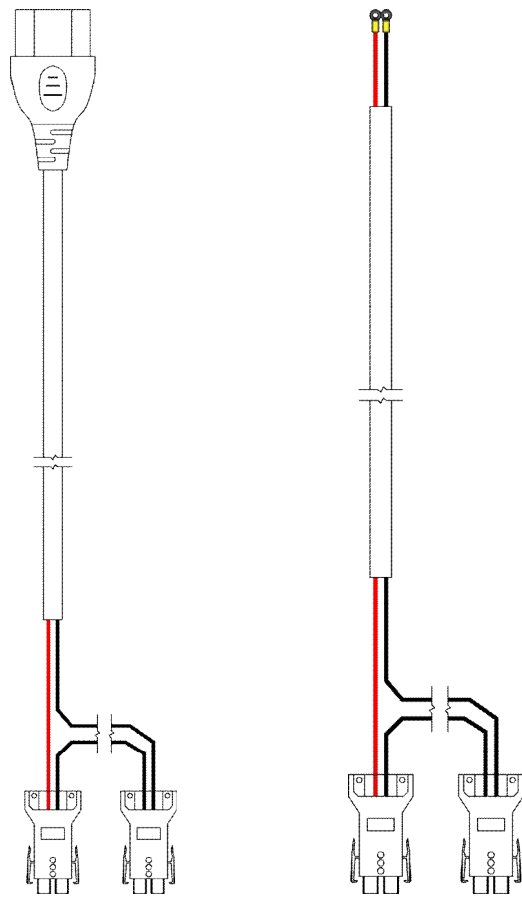
### 8.4.1 Inverter – Battery Connection

When using the battery backup modules, the appropriate interconnecting cable is necessary and is pre-installed in the EVLR/T system. Follow these guidelines when connecting the battery backup modules:

1. The output connector and cables of the inverter and battery modules must be tightly connected.
2. Do not touch the pins of the connectors. Always have installation performed by qualified service personnel.
3. To avoid electric shock and/or damage to the UPQ system, always install flying leads prior to connecting directly to the REBP.
4. Always ensure proper polarity configuration. Failure to do so WILL result in severe damage to the UPQ system.
5. Always ensure proper DC rail voltage. Failure to do so may result in severe damage to the UPQ system or the REBPs.
6. Inspect all flying lead connections and ensure no possibilities for a short circuit are in existence.

**In any REBP configuration, all Anderson Connectors are active and any connector can be used. The additional ports are required for use with multiple REBP systems, allowing the module to be used as a dual external battery module. In the Q500 / Q700 / and Q 1000 configuration, the side which contains the removeable module would be active. If both removeable modules are installed, both sides would be active.**

### 8.4.2 External Battery Cable Diagram for EVLR/T



## 8.5 Dimensions & Views



Top View



Front View



Rear View



Side View

## 8.6 Maintenance

There are no user serviceable parts inside the Q-MS System. DO NOT remove the cover or attempt to service the UPQ system. High voltage inside the system is always present even when it has been shutdown and unplugged. Unauthorized service will VOID the warranty.

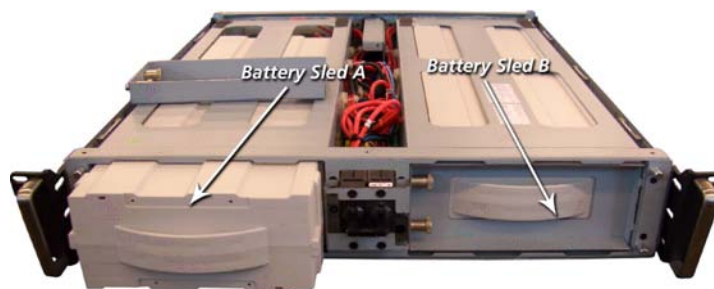
The unit is designed for maintenance-free operation, thus requiring very little attention from the User. The minimal service requirements to ensure trouble free operation are as follows:

1. Vacuum dust buildup that may gather on the vents.
2. Wipe the cover with a damp cloth.
3. Periodically switch off the AC supply to the UPQ system to check the operation of the unit and the battery condition. Before testing, be sure to save any data by closing all open files on computer(s) being protected by the UPQ system and shutdown any other equipment which is sensitive to sudden power failure. Follow the instructions for the application software as well as the computer manufacturer's instructions for saving data and turning off the computer.
4. After a power failure, keep power applied continuously to the UPQ system for at least 8 hours to ensure the batteries remain charged. The UPQ system will automatically shutdown to protect the batteries from over discharge. When the incoming AC utility recovers the UPQ system will reset automatically.
5. When storing the REBP system for any period of time, be sure to:
  - a) Leave the UPQ and REBP system plugged in for 24 hours prior to storage.
  - b) Store the REBP system in a cool, dry environment (below 80 degrees F/ 27 degrees C).
  - c) Remove from storage and repeat step a) every 90 days.
  - d) Disconnect the interconnect cord from the REBP DC outlet during storage.

## 8.7 Battery Maintenance

Due to the unique design, the Rack Front Load (RFL) batteries may be serviced while the system is active. Please refer to the following diagrams and follow these steps:

1. Remove the magnetic front bezel
2. Remove sled retainer brackets
3. Slide battery sled out
4. Replace batteries
5. Slide sled back into system
6. Seat sled completely into the DC connections
7. replace sled retainer brackets
8. replace the magnetic front bezel



(EVLR/T — Battery Module)

## 9. WARRANTY AND COPYRIGHT

### ***LIMITED WARRANTY***

Power Innovations International, Inc. (hereinafter “Power Innovations”), warrants this product to be free from defects in material and workmanship for a period of ninety (90) days from the start-up date, provided that initial power-up is performed by Power Innovations personnel (or authorized representative), occurs within six (6) months of the Power Innovations shipping date, and the product has been stored in a suitable environment prior to power-up. The power-up date will be determined only from the completed inspection and power-up sheet provided by Power Innovations. The product shipment date will be determined only from the Power Innovations bill of lading. An authorized power-up is required for systems that are 8 kVA and larger. The warranty also includes twelve-month coverage on parts only. Various service contracts are available which include parts, labor, and travel.

If any part or portion of the Power Innovations product fails to conform to the Warranty within the Warranty period, Power Innovations, at its option, will furnish new or factory remanufactured products for repair or replacement of that portion or part. Replacement parts or unit may be new or refurbished and will meet specifications of the original parts or unit.

This warranty gives you specific legal rights, and you may also have other rights, which vary from state to state. This warranty is limited to the original purchaser of the product and is not transferable. This warranty covers only Power Innovations-supplied components. Service required as a result of third-party components is not covered under this warranty. Proof of purchase will be required by Power Innovations to substantiate date of purchase. 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.

### ***WARRANTY CLAIMS***

Within a reasonable time, but in no case to exceed thirty (30) days, after discovery of a defect, the purchaser shall contact Power Innovations at 801-785-4123. Subject to the limitations specified herein, a Power Innovations service representative will determine the appropriate course of action to repair the non-conforming product warranted hereunder. If it is determined that an on-site visit is needed to resolve the issue, Power Innovations will provide and pay the expenses of a field service representative. If it is determined that the product must be shipped back to the manufacturer for repair, the purchaser will assume liability and pay for shipping to Power Innovations or an authorized service center. Power Innovations or an authorized service center will pay for shipping to return the repaired product to the customer. All products returned for service MUST have prior approval.

The product must not have been previously altered, repaired, or serviced by anyone other than a service facility authorized by Power Innovations to render such service, and the serial number of the product must not have been altered or removed. In order to be covered by this warranty, the product will not have been subjected to accident, misuse or abuse, or operated contrary to the instructions contained in the User’s Manual. Any such conditions will void this warranty and the purchaser assumes all the expenses associated with the on-site visit, including travel expenses, parts and labor.

### ***LIMITATION OF REMEDIES***

Power Innovations International, Inc.’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. In no event will Power Innovations International, Inc. be liable for indirect, special, incidental, consequential, or exemplary damages of any kind whatsoever arising out of the use of this unit, including without limitation, lost profits, business interruption, or loss of data, whether any claim is based upon theories of contract, negligence, strict liability, tort, or otherwise.