Eagle Eye Power Solutions, LLC

Keeping an Eye on Your Critical Power!

iPQMS

Battery Monitoring System

Installation Manual V1.5

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1. Introduction

This manual provides guided steps on how to install the Eagle Eye iPQMS Battery Monitoring System safely and effectively. Please read this manual carefully to fully understand the functionality of the iPQMS.

1.2 Safety Information

Operation methods and safety measures described in this manual are only applicable to the defined purpose and functionality of the iPQMS. If the iPQMS is used in a way not specified in this manual, the safety of the equipment, personnel, and property cannot be assured.

- Please read this manual carefully to avoid accidental injury or misuse of product
- Only qualified personnel with proper tools and equipment should work on batteries
- To avoid damage and injury due to the short circuiting of battery terminals, wrap insulating tape around all metallic parts
- Do not wear metallic items such as jewelry, watches, & rings. Wear insulated gloves and goggles when working around batteries
- Ensure an installation supervisor is on hand when connecting the iPQMS and battery post to avoid fire or personal injury
- Make sure all personnel are fully aware of safety guidelines

2. Product Overview

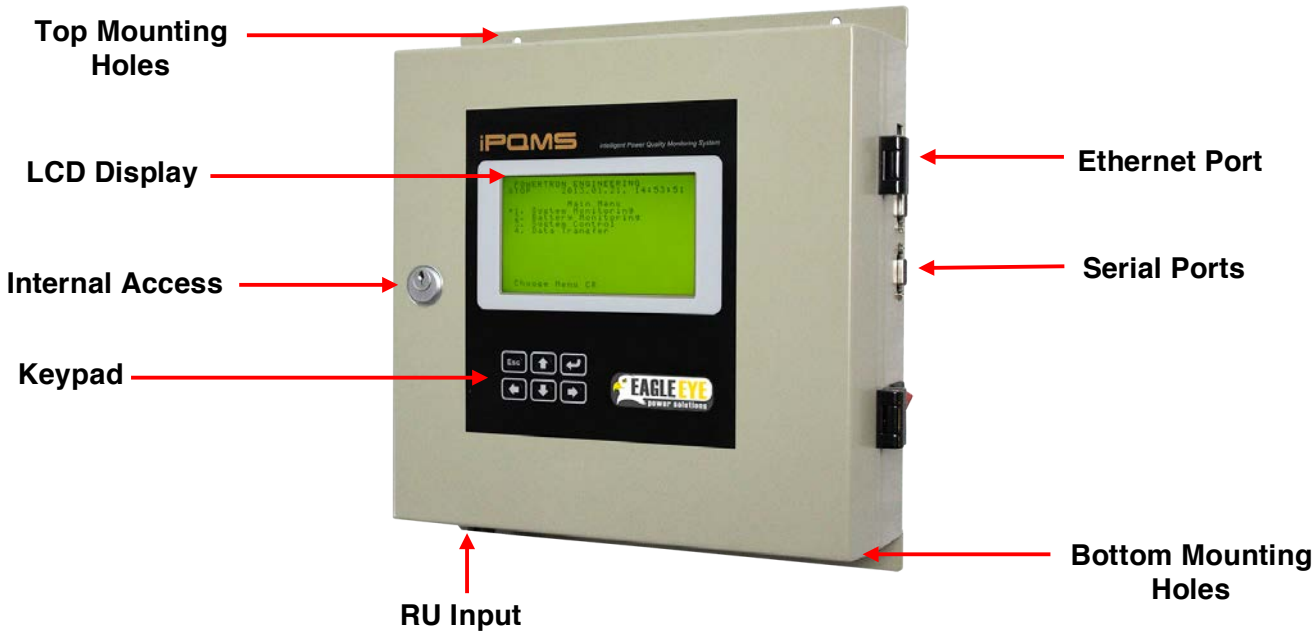
The iPQMS is designed to monitor and analyze the state of health of up to (448) cells by measuring and recording:

String: Voltage & DC Current
Jar/Cell: Voltage, Internal/Connection Resistance, & Temperature

All iPQMS solutions come complete with battery management software which allows all battery systems to be monitored 24 hours a day, 365 days a year via remote computer(s). This software offers comprehensive battery diagnosis and reporting capabilities to ensure the integrity of your critical backup power system.

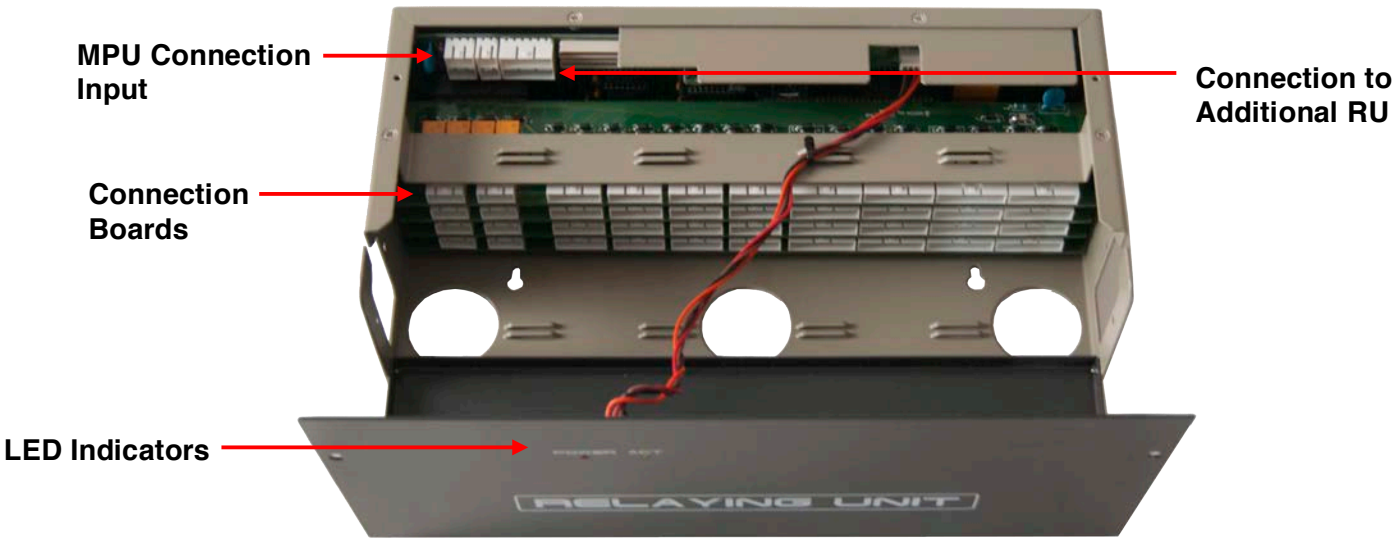
2.1 Main Processing Unit (MPU)

The MPU receives battery data from up to (7) relaying units.



2.2 Relaying Unit (RU)

The RU connects to up to (64) cells. Up to (7) RUs can be connected to the MPU for a total of 448 measured cells.



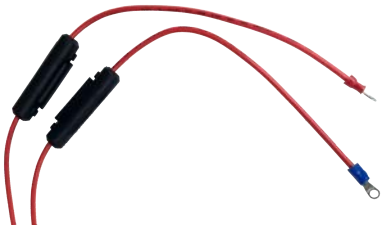
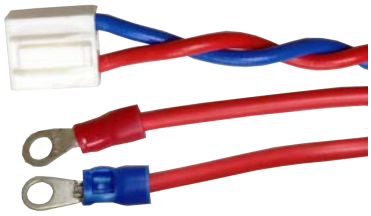
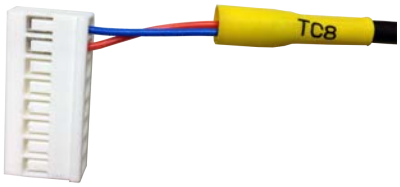
2.3 Technical Specifications

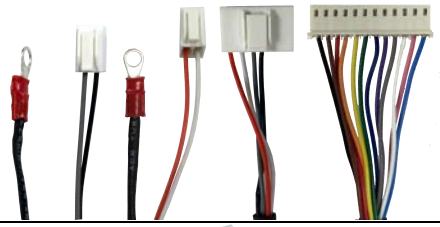
Applications:	Flooded, Sealed, & NiCad battery types Up to 448 jars/cells
Battery Capacity Range:	Up to 6000 Ah
Cell Voltage:	1 – 16 VDC
Accuracy:	DC Voltage / Current: ±0.5% / ±1% Temperature: ±2% Internal Resistance: ±2% Cell Voltage: ±1%
Resolution:	AC Voltage / Current: 0.1 V / 0.1 A DC Voltage / Current: 0.1 V / 0.1 A Cell Voltage: 10 mV Internal Resistance: 0.001 Ω Temperature: 0.5 °C
Test Speed:	3 – 4 seconds per cell
Test Load:	< 2 A per cell
Display:	Backlit LCD
Internal Storage:	On-board memory
Measuring Interval:	Adjustable from 10 min to 24 hours (voltage & resistance)
Data Transfer:	TCP/IP, RS-232 to USB, MODBUS, SMS
Bandwidth Use:	< 10 Kbps
Operating Environment:	Temperature: 0 – 50 °C (32 – 122 °F) Relative Humidity: Under 80% RH
AC Power Requirements:	110 – 220 VAC, 50/60 Hz
DC Power Requirements:	48V: 43 – 72 VDC 125/240V: 100 – 360 VDC 380/480V: 254 – 679 VDC
Power Consumption:	15 W
Connections:	Ethernet, RS-232, RS-485
Dimensions:	MPU: 290 x 280 x 90 mm (11.41 x 11.02 x 3.54 in) Relaying Unit: 310 x 178 x 85 mm (12.2 x 5.78 x 3.34 in)
Weight:	MPU: 4.5 kg (10 lbs) Relaying Unit: 4.5 kg (10 lbs)
Cable Distances:	MPU to RU: 10 m (32 ft) RU to Batteries: 30 m (100 ft)

3. Parts List

The following parts come standard with each iPQMS package. The number and type of connector clamps will depend on the application.

Part Name & Purpose	Picture
iPQMS MPU Main processing unit for iPQMS system	
Relaying Unit(s) Module for relaying measured data from the battery system to the MPU	
C-Type Clamp Clamp used for connection between batteries with busbar inter-cell connections	
O-Type Clamp Clamp used for connection between batteries with cable inter-cell connections	
Clamp Covers: C-Type / O-Type Placed over clamp PCB	
CT Clamp Measures DC current	

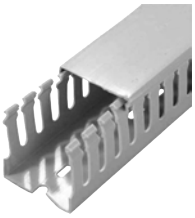
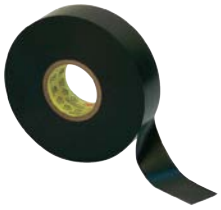
AC / DC Power Cable Power cable for systems utilizing AC power	
Total Voltage / DC Power Fuses Fused lines between the Total Voltage & DC Power cables	
Total Voltage (3-Pin) Used when iPQMS system is powered by DC from the connected battery system	
CT Cable For connection between CT & iPQMS MPU	
Temperature Cable (8-pin) Measures temperature of battery posts	
Voltage Sensing Cable (6-pin) Measures DC voltage (Vs)	
Current Sensing Cable (4-pin) Measures current (Is)	

RU to MPU Cables For connection between the MPU and RU	
RU Crossover Cables For connection from RU to RU	

4. Installation Tools

4.1 Required Tools

Tool Name & Purpose	Picture
Multi-meter Verification of connection voltage & resistance	
#1 Phillips Insulated Screwdriver Tightening of O-Type/C-Type clamp screws	
(2-3 mm) Flathead Screwdriver Tightening of sensing cable	
Wire Cutter Adjustment of cable length	

US or Metric Socket Set For mounting iPQMS	
Wire Stripper Adjustment of cable length	
Shop Snips Adjustment of duct length, cable length	
Zip Ties Cable management	
Cable Duct Cable routing	
Electrical Tape (Scotch Super 33+ Recommended) Cable management	
Cable Wrap Bind multiple cables together	

4.2 Recommended Tools

Tool Name & Purpose	Picture
IBEX Battery Tester Verification of iPQMS measurement readings	
Silicone Sealant Fastening of temperature leads to battery surface	

5. Installation Instructions

This section will provide the correct workflow for installing the iPQMS Battery Monitoring System and all of its components.

All necessary cables and clamps are provided at correct quantities and lengths based on information provided from the Site Survey. Please be sure to have all the necessary tools and parts listed in Section 3 and 4.

NOTE: This guide should be used as an outline for installation, however it does not cover every aspect of installation step-by-step. It is recommended that experienced personnel familiar with electrical work and battery-room environments perform this installation. If a section of this guide is unclear, please contact Eagle Eye Power Solutions directly for further support.

5.1 Overview of Workflow

The following is an overview of the complete workflow of what needs to be done on-site for the iPQMS Installation:

1. **Mount iPQMS MPU (Main Processing Unit) and Relaying Units**
2. **Install clamps to battery connections**
3. **Lay all sensing cables from the Relaying Unit(s) to the clamps**
4. **Install temperature sensors**
5. **Install CT clamp**
6. **Connect total voltage cable and power connections**
7. **Verify all connections**
8. **Configure Parameters on the iPQMS menu screen**
9. **Configure iPQMS MPU IP address**
10. **Connect iPQMS to Network (if applicable)**

5.2 MPU & RU Installation

Parts:	Main Processing Unit, Relaying Units, Mounting Blocks
Tools:	Screwdriver, Socket Set, Drill

(1) Mount MPU & RU

- Identify mounting locations (ex. battery rack, wall behind battery rack)
- The MPU and RU should be installed in a location that provides easy access for maintenance and inspection
- The distance between the MPU and RU should not exceed 10m (33ft)
- Mount each component securely, placing the mounting blocks between the iPQMS/RU and mounting surface

iPQMS & RU Mounted to Concrete Wall

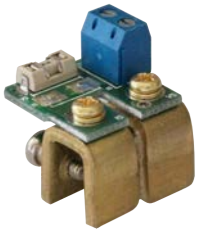
TIP: Ensure that the RU is mounted close enough the battery system so that all sensing cables will reach the connectors inside the RU

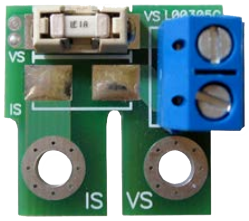
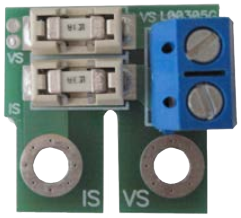
5.3: Clamp Installation

Parts:	C-Type/O-Type Clamps
Tools:	Drill/Phillips Screwdriver

The iPQMS uses two different types of clamps based on the battery connection. C-Type clamps are used for batteries connected by busbar; O-Type clamps for batteries connected via cable. It is not uncommon for both clamp types to be used for an installation. O-Type clamps are commonly used on jumpers between racks.

All clamps house a basic PCB board which is used to fuse the connection between the battery and sensing cables. This manual refers to (2) board types, Voltage (Vs) only and Voltage + Current (Vs+Is). PCB boards of the (Vs) variant have one fuse while (Vs+Is) boards have (2) fuses. These clamps must be installed in the correct sequence as detailed in section 5.4 or in the cable connection map provided with your system.

Connector Type	
	
C-Type for Busbar	O-Type for Cable

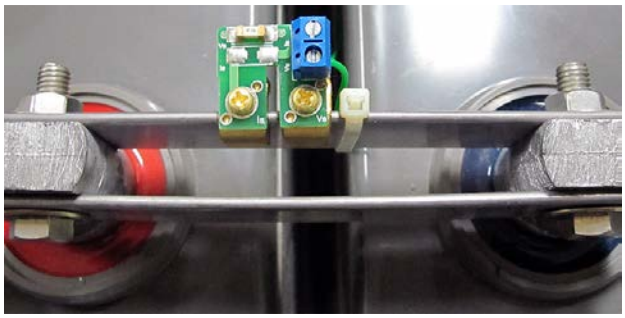
PCB Board Type	
	
Voltage: (Vs) (1 fuse)	Voltage + Current: (Vs+Is) (2 fuse)

(1) Prepare For Connection

1. Organize clamps based on type and verify all clamps are present
2. Using tape and a marker, number the batteries as shown on the provided connection diagram if they are not already numbered

(2) Connection of Clamps (C-Type)

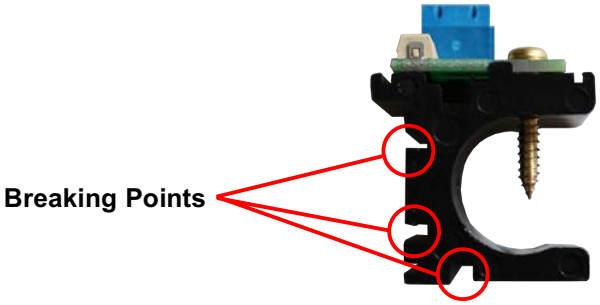
1. Connect clamps according to the provided connection diagram. Clamp 1 will be (Vs+Is). Every 4th clamp afterwards will also be (Vs+Is) (Ex. clamp 1, clamp 5, clamp 9, clamp 13, and so on)
2. Determine how the clamp will be placed. Generally, the cable terminations should be facing the direction the sensing cable(s) will be ran from
3. Place the clamp in the center of the busbar and tighten down using the provided screws
4. If the busbar has a cover, cut out an area so the cover sits snugly against the clamp
5. Attach additional clamps, keep the direction and placement of all clamps consistent

C-Type Clamps Installed to Busbars

(3) Connection of Clamps (O-Type)

1. Connect clamps according to the provided connection diagram. Clamp 1 will be (Vs+Is). Every 4th clamp afterwards will also be (Vs+Is) (Ex. clamp 1, clamp 5, clamp 9, clamp 13, and so on)
2. Determine how the clamp will be placed. Generally, the cable terminations should be facing the direction the sensing cable(s) will come from
3. Place the clamp over the center of the cable and tighten the screws into the cable
   NOTE: If the cable is too large for the clamp it can cut down to accommodate the size
4. Attach additional clamps, keep the direction and placement of all clamps consistent



Customize O-Type Clamp Size

O-Type Clamp Connections

5.4 Sensing Cable Layout & Connection

Parts:	Clamps, clamp covers, voltage sensing cables, current sensing cables
Tools:	Powered driver, 2-3mm flathead, duct, duct tape, cable ties/zip ties, wire cutter, wire stripper, drill

There are two labeled sensing cables which connect to the clamps: voltage sensing (Vs) & current sensing (Is). Both (Vs) and (Is) cables are color coded. During installation, the colored wires will be installed in the below color order, starting at clamp #1 on the main positive bus.

Voltage sensing cable:

Voltage sensing cables measure cell voltage and connect to each clamp in the following order per harness from left to right:

Grey, Green, Blue, Orange, Brown

Example:

Clamp #1 = Grey
Clamp #2 = Green
Clamp #3 = Blue
Clamp #4 = Orange
Clamp #5 = Brown + Grey
Clamp #6 = Green

The last wire (brown) of the harness will always connect to the same (Vs) termination of the first wire (grey) of the next harness.

Current Sensing Cable:

Current sensing cables measure cell resistance and connect to every other 4th clamp in the following order per harness from left to right:

Black, Red, White

Example:

Clamp #1 = Black
Clamp #5 = Red
Clamp #9 = White + Black
Clamp #13 = Red

The last wire (white) of the harness will always connect to the same (Is) termination of the first wire (black) of the next harness.

(1) Prepare Cable Routing/Ducts

1. For a clean installation it is recommended to route cables efficiently using cable ducts that are properly measured for the battery system
2. Mount cable ducts along all areas that sensing cables will be laid out
3. Be sure not to attach the cable ducts in a manner that will not prevent batteries from being removed during replacement (Ex. Laying cable ducts across front facing battery systems)

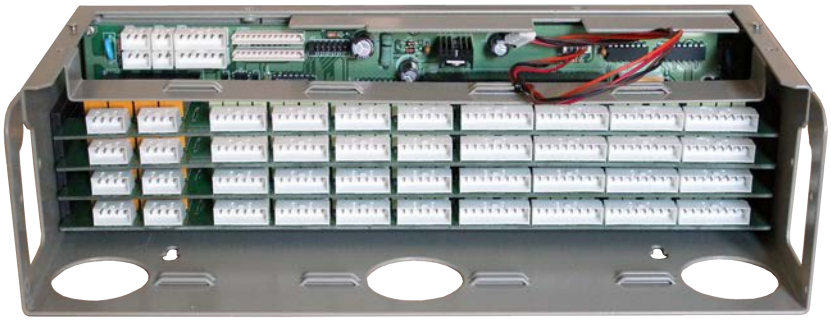
Duct Installation on Rack Mounted Batteries

Duct Installation on Front Facing Batteries

NOTE: Cable ducts are included with Eagle Eye serviced installations. If performing the installation without Eagle Eye, ducts must be obtained separately.

(2) Connect Sensing Cables to Relaying Unit

1. Both (Vs) and (Is) sensing cables are labeled as “V1, V2, V3, etc.” for (Vs) and “I1, I2, etc.” for (Is)
2. Before laying the cables out to each cell, connect the ends of the cables into the correct slot on the RU
    a. The RU is composed of (4) connector boards which the voltage (Vs), current (Is), and temperature sensing cables plug into **Fig. 12**
3. Each numbered cable connects to a corresponding plug in the RU
4. Refer to the diagram on the next page for the connection order of each cable type
5. Connect all (Vs) and (Is) cables in ascending order (I1, then I2, then V1, V2, etc.)



(Fig. 12) Inside of Relaying Unit

7	8	13	14	15	16	13	14	15	16
5	6	9	10	11	12	9	10	11	12
3	4	5	6	7	8	5	6	7	8
1	2	1	2	3	4	1	2	3	4
(Is)		(Vs)				(Temp.)			

(3) Lay Sensing Cables to Each Clamp

1. Lay each sensing cable out across the battery string (through the duct if installed), reference the provided connection diagram for which clamp to lay each cable to
2. **Starting with the (Vs) sensing cables**, lay each colored cable in the correct sequence 4 to 6 inches past each clamp so that there is some slack once the cable is connected (I.e. Grey→Clamp 1, Green→Clamp 2, Blue →Clamp 3, Orange→Clamp 4, Brown+Grey→Clamp 5)
3. **Next lay all (Is) sensing cables** in the correct sequence 4 to 6 inches past each clamp (I.e. Black→Clamp 1, Red→Clamp 5, White+Black→Clamp 9, Red→Clamp 13, White+Black→Clamp 17)
4. For all clamps with multiple cables running to them, twist the cables together to minimize exposed cabling

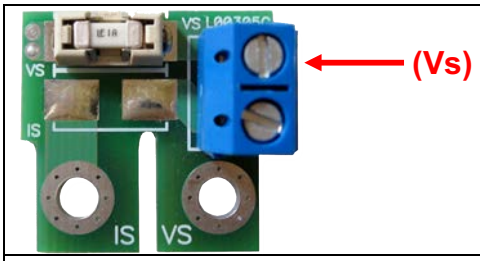
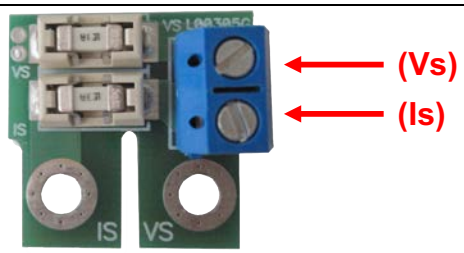
WARNING: Do not connect any cables to clamps yet, wait until all cables are laid out.

5. Fasten/zip tie all sensing cables to the RU then disconnect each cable from the connectors before proceeding

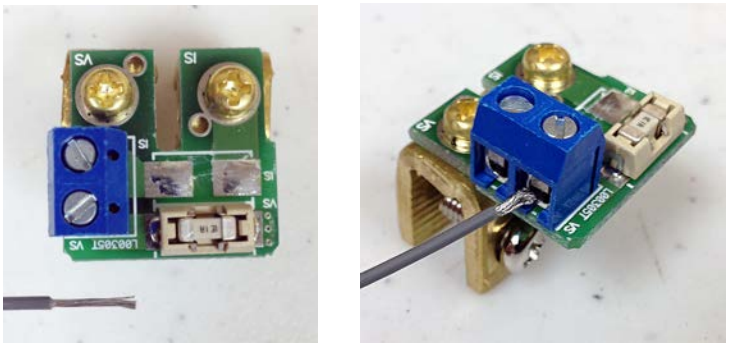
Fasten Disconnected Cables to RU

(4) Connect Sensing Leads to Clamps

1. Observe carefully which slot to is used for each sensing cable

	
(Vs) Board	**(Vs+Is) Board**

2. Using a wire stripper, cut 4 mm of shield away from the wire
3. Twist the exposed wire together, then fold in half and attach to appropriate termination on the clamp
4. Screw the cable tight using a 2-3mm flathead, firmly pull on the cable to ensure the connection is tight



Connection of (Vs) Cable to C-Type Clamp

5.5 Temperature Sensor Connection

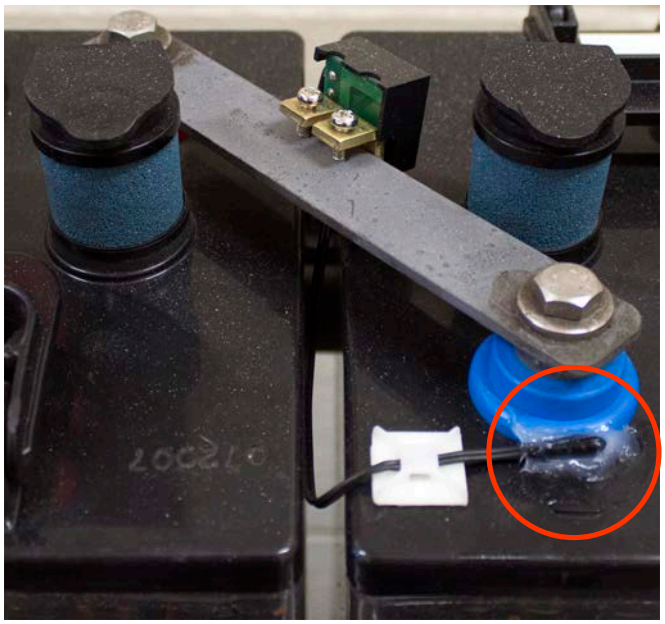
Parts:	Temperature Cable
Tools:	Tape, Hot Glue Gun, or Silicone

Standard iPQMS systems come with temperature thermistors (leads) for connection to 10% of the batteries. By connecting the lead near the post of the battery, temperature can be monitored in real-time.

Temperature sensor leads must be connected to the temperature sensing cable (T) prior to installation. Each T cable has red and black wires which must be paired with the lead. Refer to the provided cable map for recommended locations to mount the temperature sensors.

(1) Place Temperature Leads

1. Place the temperature lead near the negative post of the jar/cell according to the provided connection diagram. Generally, these leads can be placed on any jar/cell
2. Adhere the lead as close to the post as possible using tape to hold the lead in place, then use hot glue or silicone to fasten the lead
3. If possible, place the lead under a cover or in a tight place as close to the post as possible



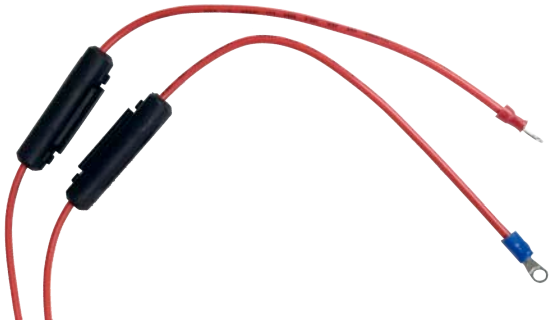
Secured Temperature Lead

5.6 Total Voltage/DC Power Connection

Parts:	Total Voltage Cable, Total Voltage Fuses
Tools:	Phillips Screwdriver, Cable Crimper, Zip Ties

The total voltage cable monitors string voltage in real-time. The total voltage cable connects to the main positive and negative bus of the battery system then back to the iPQMS MPU.

Each cable has a 1A fuse for voltage protection. Be sure to check the fuse before installation.



1A Fuse Leads

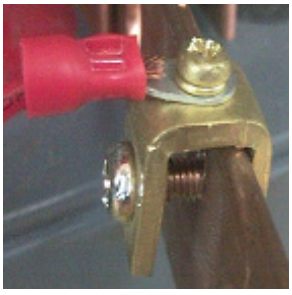
(1) Connect the Fuses to the Total Voltage Cable

1. Crimp the positive fuse to positive total voltage cable
2. Crimp the negative fuse to the negative total voltage cable

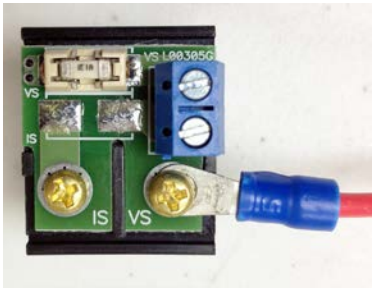
Crimp Fuse to Cable

(2) Connect to Battery System

1. Determine the best place to connect the total voltage cables on the most positive and negative bus of the string
2. If using busbar connections, use the C-Clamp to connect to the busbar
3. If using cable connections, connect directly to the O-type clamp under the (Vs) screw that goes into the cable



Total Volt. C-Clamp



Total Voltage O-Clamp

(3) Run cable to iPQMS MPU

1. The total voltage cables come together into a single Molex connector
2. Run the cable along the sensing cables up past the relaying unit and into the iPQMS MPU
3. Do not plug the connector in, zip tie it in place to connect once all other cables are installed **Fig. 15**

Fig. 15

5.7 Connect CT Clamp

Parts:	CT Clamp, CT cable
Tools:	2-3 mm flat head, zip ties

The CT clamp measures float and discharge current on the battery string.

(1) Attach CT Clamp

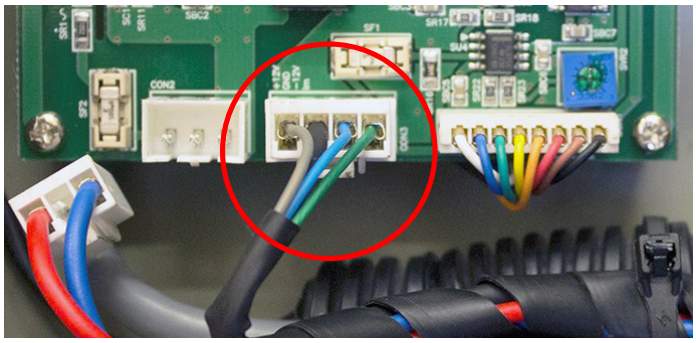
1. Typically the CT clamp is attached to the positive bus of the battery system but it can also be installed to the negative
2. Place the clamp around the positive or negative bus and ensure that the arrow is facing from the positive toward the negative, in the direction of current flow
3. Zip tie the clamp in place so that it is secure **Fig. 16.1**

Fig. 16.1 CT Clamp Secured

(2) Run CT Cable from MPU to CT

1. The CT cable has one end with a Molex connector and the other end has (3) colored cables*
2. Connect the Molex connector to the inside of the MPU as shown below, take note of the color sequence of the cables from left to right. The labels for each connection (Im, -12, +12) are on the PCB.
3. Run the cable to the CT clamp

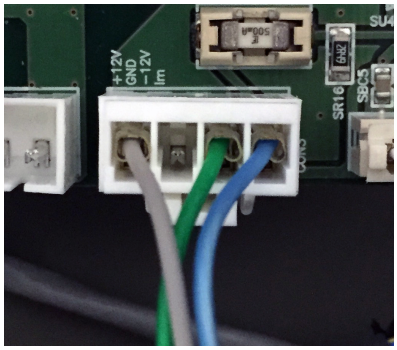
***NOTE:** The cable colors may vary from what is shown in this manual. Always ensure that the cables match the correct termination on both the BDS and the CT.



Connect CT Cable to MPU

(3) Connect CT Cable to CT Clamp

1. Cut excess length from the CT cable if needed
2. Remove shielding to expose roughly 2 inches of the colored wires
3. Cut about 3 mm of shielding from each individual wire
4. Connect the colored wires to each termination labeled [1], [2], and [3] in the order that they are colored from left to right on the Molex connector inside the MPU. (Ex. below the cables are colored as grey, green, blue from left to right. On the CT, connect grey to [1], green to [2], and blue to [3].



CT Cable Connection in MPU

Labeled Cable Termination on CT

5.8 Verify Connections

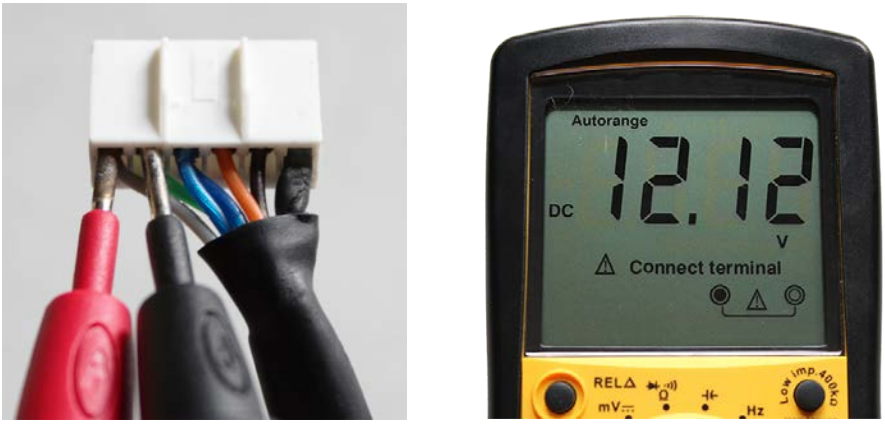
Parts:	Sensing Cables, Total Voltage Cables, Clamps
Tools:	Multimeter

Before plugging cable connectors into the RU, be sure to check each connection using an accurate multimeter to verify the voltages. The purpose of this step is to ensure that the voltage of each connection is as expected. Higher or lower voltages signify that there is an improper connection on the battery system.

WARNING: Failure to perform the below steps may result in permanent damage to the battery monitoring system.

(1) Check Voltage & Current Sensing Connections

1. Always start with the first (Vs) connector cable that will plug into the RU, this will always be cable “V1”
2. With the Molex connector end of the cable in hand, insert the positive lead from the multi-meter into the port with the grey cable
3. Insert the negative test lead into the green port
4. The multi-meter should display the same voltage as jar 1



Test Connection between Clamp 1 & Clamp 2 of 12V Cell

5. Move the negative test lead down the connector and verify each connection’s voltage
6. The final connection should read the total voltage of the batteries it is connected to
7. Repeat the same steps for **all** (Vs) and (Is) connections

Test Connection between Clamp 1 & Clamp 5 of 12V Cells

(2) Check Total Voltage Connection

1. Hold the connector end of the cable in hand
2. Insert the positive test lead into the red port
3. Insert the negative test lead into the blue port
4. The multi-meter should display the same voltage as the string

Test Connection of Total Voltage Cable

(3) Troubleshooting Incorrect Voltage

1. If voltage is incorrect, connections will need to be checked
2. Set the multi-meter to measure resistance and test the connection between the sensing screw and the sensing cable
3. If the multi-meter displays zero resistance (0.00Ω) then the connection is good. If the connection has resistance, replace the fuse (1A)

Check to Verify Fuse

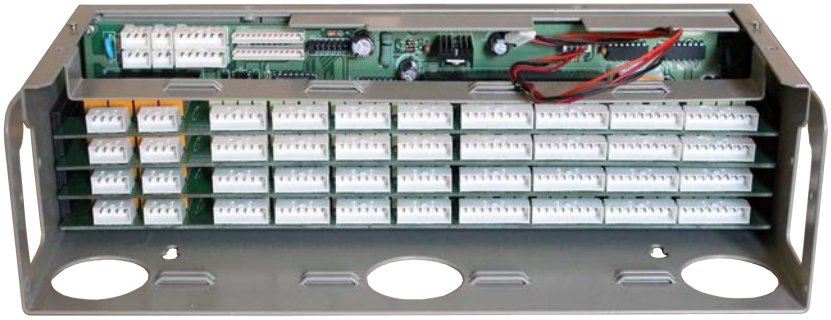
(4) Check Temperature Sensor

1. Temperature sensors can be checked using resistance
2. Check connection resistance between each set of cables
    a. Temp Lead #1: Test between Grey and Green
    b. Temp Lead #1: Test between Blue and Shield
    c. Temp Lead #1: Test between Blue and Orange
    d. Temp Lead #1: Test between Brown and Shield

5.9 Connect Cables to Relaying Unit(s)

Parts:	Relaying Unit(s), Sensing Cables, Total Voltage Cables, Temperature Cables
Tools:	Zip/Cable Ties, Tape

The (Vs) and (Is) sensing cables, total voltage cable, and temperature cables connect directly the Relaying Unit. The RU is used to transmit data from the batteries to the MPU. Each RU can connect to up to 64 cells.



7	8	13	14	15	16	13	14	15	16
5	6	9	10	11	12	9	10	11	12
3	4	5	6	7	8	5	6	7	8
1	2	1	2	3	4	1	2	3	4
(Is)		(Vs)				Temperature			

(1) Connect all Cables to the Relaying Unit

1. Connect each (Is) cable to the corresponding port above in the (Is) column (I.e. Cable I1 connects to port 1 on the (Is) column)
2. Connect each (Vs) cable to the corresponding port above in the (Vs) column (I.e. Cable V1 connects to port 1 on the (Vs) column)
3. Connect each temperature cable in the same fashion
4. Check that all cables are connected well

(2) Cable Management

1. With all cables connected to the RU, begin using cable wrap to clean up the cables
2. For every clamp that has more than one cable running to it, use cable wrap to bind the cables together **Fig. 20**
3. Ensure all cables are tucked in their ducts and that the duct covers are on **Fig. 20.1**
4. Wrap all remaining cables **Fig. 20.2**

Fig. 20

Fig. 20.1

Fig. 20.2

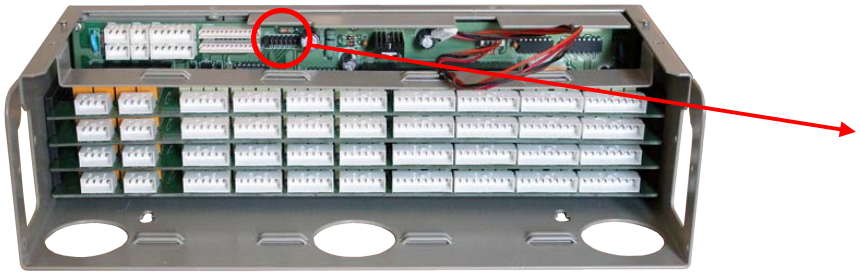
5.10 Connect Relaying Units / iPQMS

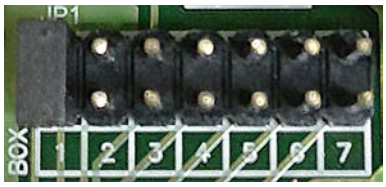
Parts:	Relaying Unit(s), MPU to RU Cable, RU Crossover Cable(s)
Tools:	Zip/Cable Ties, Tape

The iPQMS system can support up to (7) Relaying Units. These units are connected in daisy-chain. Relaying Unit #1 connects to the iPQMS. Before connecting the Relaying Units together and to the iPQMS, all sensing cable connections should be made.

(1) Set Relaying Unit Number

1. Each Relaying Unit must be assigned a number 1 through 7
2. Set the jumper to the number of the RU (Ex. RU#1 has jumper set to the “1” position)
3. If only using one RU, ensure the jumper is in the 1 position as shown below





Set Jumper Position (1-7)

(2) Connect the MPU to RU cable to RU#1

1. The MPU to RU cable is connected to the MPU from the factory
2. Run the cable from the MPU to RU#1
3. Each Relaying Unit has two rows of interface ports for connection between the MPU and RU#1 and to additional RU’s
4. Connect the appropriate cables to each port inside the RU, it does not matter which row of ports the cables are connected to, however if using multiple RU’s, it is recommended to connect the MPU to RU cable to the back row to allow more accessible connection of the RU crossover cable

(4) Interface Ports between iPQMS and Relaying Units

(2) Connect additional RU’s together

1. If using more than one RU, connect additional RU’s together using the RU Crossover cable

5.11 Main Power Connection

Parts:	**For AC -** AC Power Cable, **For DC -** DC Power Cable, 1A Fuses, Single C-Clamps
Tools:	Phillips Screwdriver, Cable Crimper

The iPQMS can be powered by AC 110-220V or DC depending on the system voltage. The label on the lower left front of the MPU will state the correct voltage compatibility for the unit. The DC voltage ranges depend on how the system was configured on the site survey and are as follows:

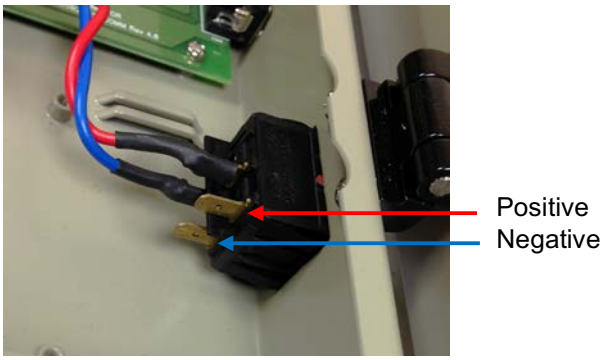
48V: 43 – 72 VDC
125/240V: 100 – 360 VDC
380/480V: 254 – 679 VDC

WARNING: Be sure the MPU power switch is set in the off position before connecting the power.

DC Power Connection

(1) Connect DC Power Cable to iPQMS MPU

1. Connect each end of the DC Power Cable to the iPQMS MPU as shown below



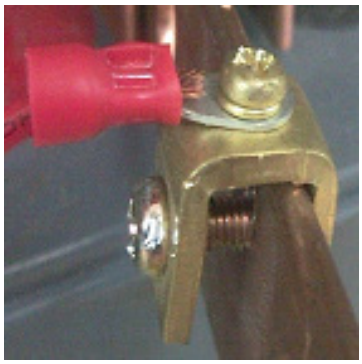
(2) Run Cables to Battery Terminals & Connect Fuses

1. Connect the single C-Clamps to the main positive and negative terminals of the battery system
2. Run the DC power cables from the MPU up to the connections and cut the lengths as needed, the fuses will add about 6-8 inches of length
3. Gather the positive and negative fuse cables
4. Crimp the positive fuse to positive cable
5. Crimp the negative fuse to the negative cable

Crimp Fuse to Cable

(2) Connect DC Power Cable to Battery System

1. Connect the positive and negative DC power cables to the battery system using the single C-Clamp connection.



Single C-Clamp for DC Power Connection

AC Power Connection

1. For connection of AC power, connect the AC power cable to the inside of the iPQMS MPU
2. Be sure to connect the ground as shown below

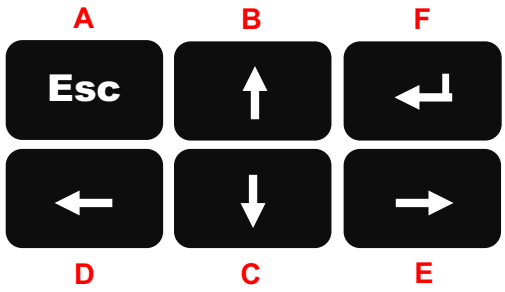
Connection of Provided AC Cable to Switch and Ground

6. Menu Operation

The following steps review functionality of the on screen display of the iPQMS. Using the display, all battery string parameters can be set.

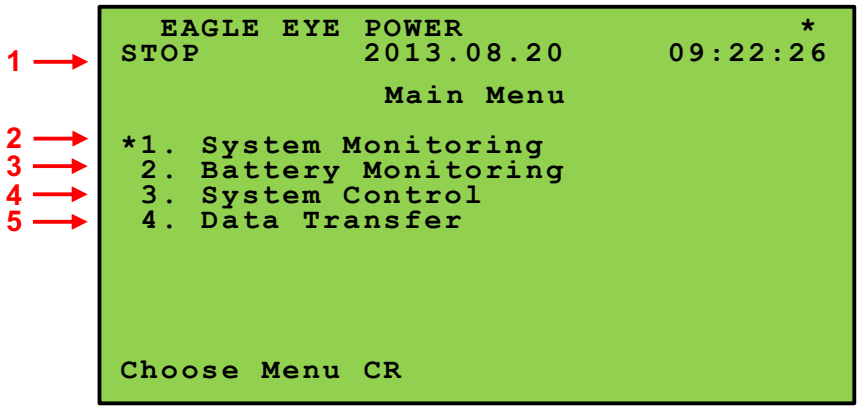
6.1 Keypad Layout

1. The iPQMS has 6 buttons as illustrated below
    A. **ESC:** Move to previous menu screen
    B. **UP:** Move selection up
    C. **DOWN:** Move selection down
    D. **LEFT:** Decrease selected value
    E. **RIGHT:** Increase selected value (hold to start battery monitoring)
    F. **ENTER:** Enter selected menu/save parameter and move position down



6.2 Main Menu

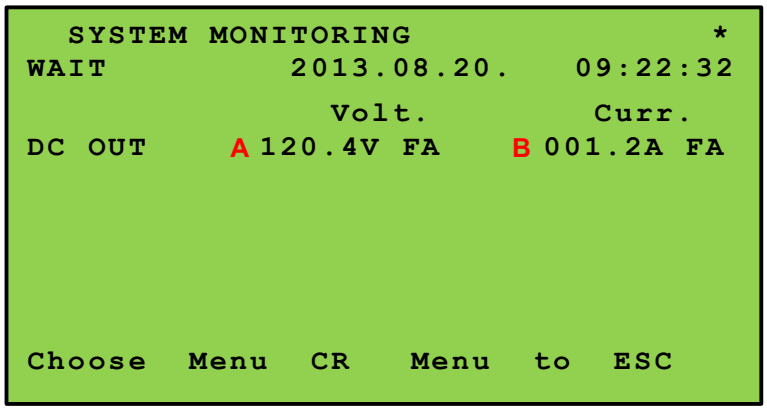
The main menu is used to access all of the features available on the iPQMS unit. It also displays the measuring status, data, and time. Refer to the numbers below for an explanation of each menu function and associated submenus.



Main Menu Screen

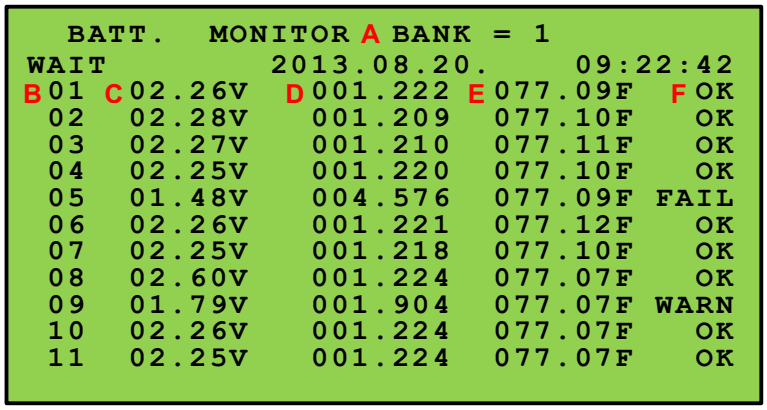
1. **Measuring Status:** The iPQMS has three status modes that will display
    A. STOP: System is not monitoring or measuring
    B. RUN: System is currently monitoring and measuring
    C. WAIT: System is monitoring but is between measuring intervals

2. **System Monitoring:** Real-time display of string voltage and current.
   A. **String Voltage:** Total string voltage measured in real-time
   B. **DC Current:** Measured DC current in real-time



System Monitoring

3. **Battery Monitoring:** Display of most recent measured cell voltage, resistance, & temperature. Also displays cell status (OK, WARN, FAIL) based on set alarm parameters.
   A. **Bank Number:** Indicates RU number, press UP or DOWN arrow to cycle through RU's (cell numbering starts at "1" for each RU)
   B. **Cell Number:** Numerical value of cell
   C. **Cell Voltage:** Most recent measured cell voltage value
   D. **Resistance:** Most recent measured resistance value in milliohms
   E. **Temperature:** Measured temperature value in Fahrenheit or Celsius
   F. **Status:** Cell status based on set alarm parameters

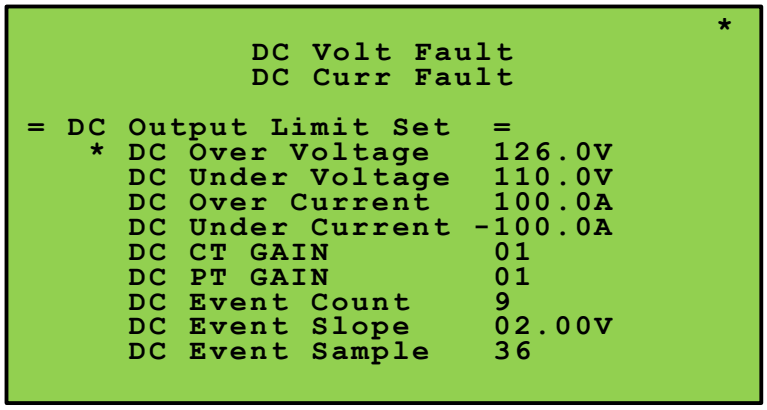


Battery Cell Monitoring

4. System Control: This menu contains seven submenus that are used to set various parameters on the iPQMS. Please see below for a description of these menus.

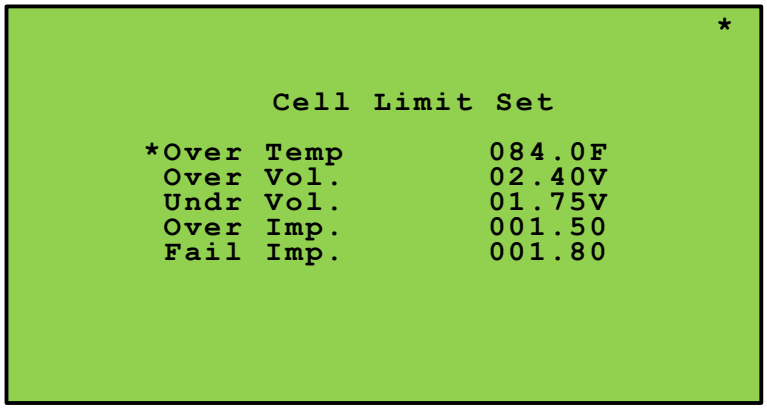
   a. **AC Input Limit Set:** These parameters do not apply to DC battery systems and are not covered in this manual. If installing the iPQMS to an AC power system, please request the AC version of this installation manual

b. **DC Output Limit Set:** Sets the string over and under thresholds for total voltage and current. Only edit the first four parameters as listed below.
   A. **DC Over Voltage:** Sets the over voltage alarm value for the battery string
   B. **DC Under Voltage:** Sets the under voltage alarm value for the battery string
   C. **DC Over Current:** Sets up threshold for measured DC current
   D. **DC Under Current:** Sets lower threshold for measured DC current
   E. **DC CT Gain, DC PT Gain, DC Event Count, DC Event Slope, DC Event Sample:** **These settings are preconfigured at the factory and should not be adjusted during the installation and setup of the system.**



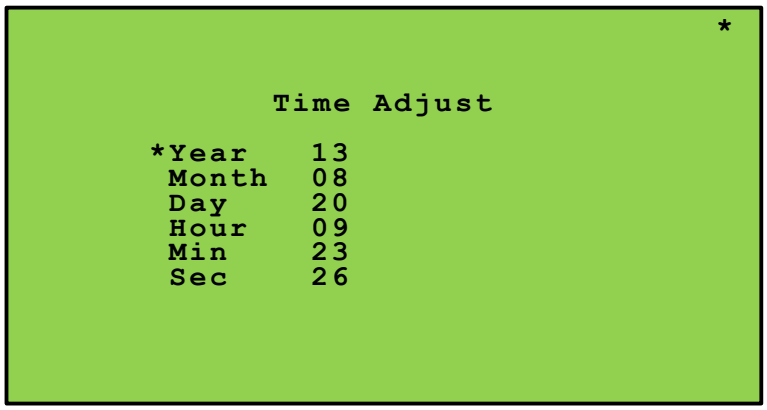
DC Output Limit Set

c. **Cell Limit Set:** Sets the cell over and under thresholds for voltage, impedance, & temperature.
   A. **Over Temp:** Sets the upper temperature limit
   B. **Over Vol:** Sets the cell over voltage alarm value
   C. **Undr Vol:** Sets the cell under voltage alarm value
   D. **Over Imp:** Sets the cell over (warning) resistance value
   E. **Fail Imp:** Sets the cell fail resistance value



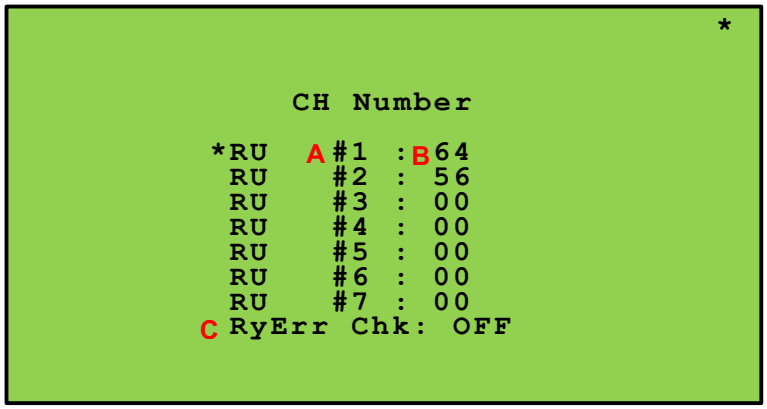
Cell Limit Set

d. **Date & Time Set:** Used to set the year, month, day, hour, min, and second value for the most accurate time adjustment



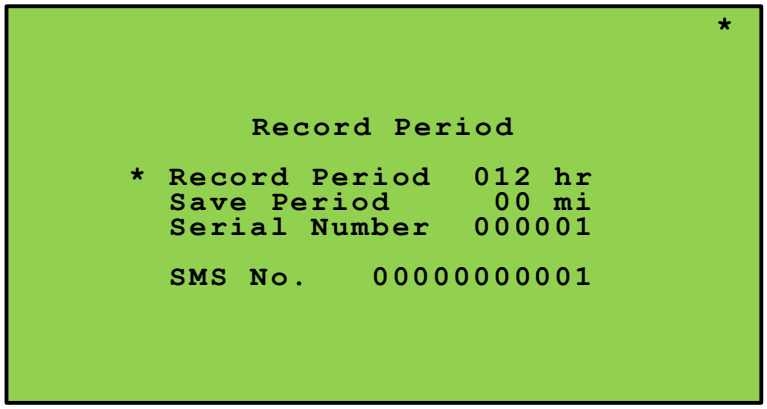
Time Adjust

e. **Channel Number:** Used to set the number of cells per Relaying unit. Each RU can have a maximum of 64 cells. Set the number of cells per RU with this menu.
   A. **RU Number:** Number of the RU
   B. **Cell Number:** Number of cells per selected RU
   C. **RyErr Chk:** Relaying unit error check, set to “ON” if there is an error with one of the RU’s



Channel Number

f. **Record Period:** Used to set the measuring interval for cell voltage & resistance, set the save interval, and set the serial number.
   A. **Record Period:** Set the time interval in hours for how often the iPQMS will inject sensing current to measure the cell voltage & resistance values
   B. **Save Period:** Set the time interval in minutes for how often the iPQMS will save measured data to its internal memory
   C. **Serial Number:** Set the serial number of the unit



Record Period

g. **Data Transfer:** Used for system diagnostics.

6.3 On-Screen Measurement Data & Resistance Compensation

The iPQMS LCD can be used to view the string voltage, DC current, as well as the cell voltage, resistance, & temperature.

After configuring all the test parameters, it is strongly recommended to review the cell internal resistance readings.

Depending on the configuration of the battery system, some resistance readings might be considerably higher than the surrounding readings. This is likely caused by increased resistance from clamps which are installed to longer jumper cables, such as those found between racks.

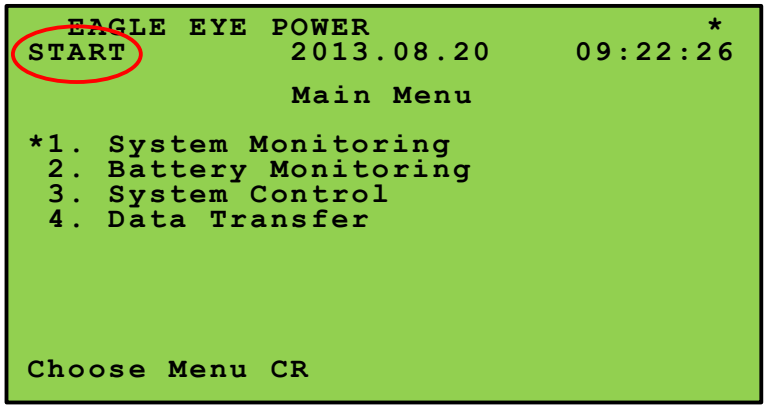
If the battery system utilizes long jumpers, then the resistance of these jars/cells will need to be compensated.

TIP: Before attempting to compensate internal resistance readings, a standard resistance baseline or average should be determined.

NOTE: The following steps assume that all hardware installation steps have been completed and that the system successfully measured all of the battery jars/cells.

(1) Start Measurement of Battery System

1. From the main menu, press and hold the right arrow key until the measuring status changes to “START”

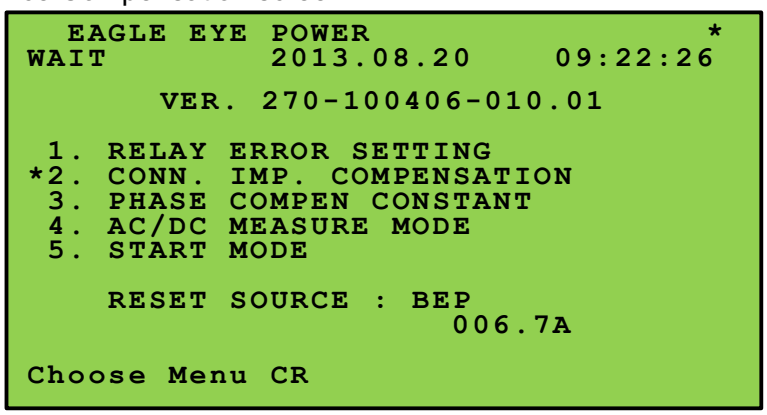


Start Monitoring from Main Menu Screen

2. At this time the iPQMS will begin gathering cell measurement data, do not proceed until the measuring status changes from “START” to “WAIT”
3. After the measuring status has changed to “WAIT” open the Battery Monitoring menu and check to ensure all jars/cells have a resistance measurement value.

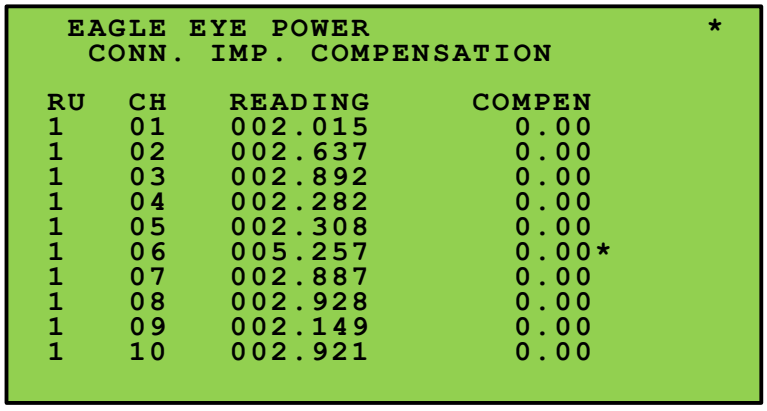
(2) Configure Connection Resistance Compensation

1. Press and hold the left button until the screen changes to display the following options shown below. Select CONN. IMP. COMPENSATION to open the Connection Resistance Compensation screen.



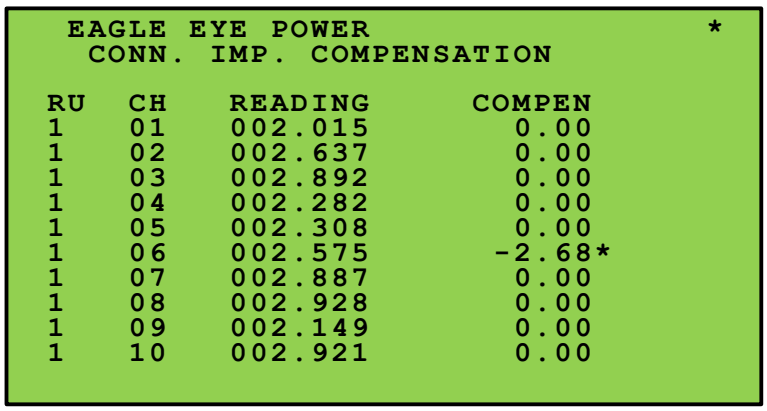
Advanced Menu Options

2. The Connection Resistance Compensation screen displays the measured resistance from each connection/channel. Identify which readings need to be compensated and adjust accordingly. As shown below, connection 5 has a much higher resistance than the surrounding readings because it is on a jumper.



Resistance of Connection 5 before Compensation

3. To calculate the compensation value, subtract the determined standard or average resistance value from the measured value. In the example below, the average value is 2.575, this value will be subtracted from the measured resistance to provide a compensation value of -2.68.



Resistance of Connection 5 after Compensation

4. Alternatively, a more accurate compensation value can be determined with use of the IBEX Battery Tester. The IBEX utilizes the same measurement technology of the iPQMS. Using the IBEX, the internal resistance of connection 5 can be measured directly from the battery. The measured value can be used to calculate the compensation value using the same methodology of step 3.
5. After the compensation value has been entered, press the ENT button on each connection to exit and save the results.

NOTE: The compensated internal resistance readings will not be updated until the next measurement cycle starts. To update the measured values immediately, press and old the right arrow button on the main screen to manually initiate the next measurement cycle.

7. Network Communication Setup

The iPQMS Battery Monitoring System comes standard with Centroid battery management software. This software is used to manage all of the battery monitoring systems on the network. Alternatively, the iPQMS can be ordered with Modbus protocol for communication to a third party BMS or SCADA system.

The following steps will outline how to set the IP address of the iPQMS for use with Centroid software or Modbus protocol.

7.1 Configure MPU IP Address

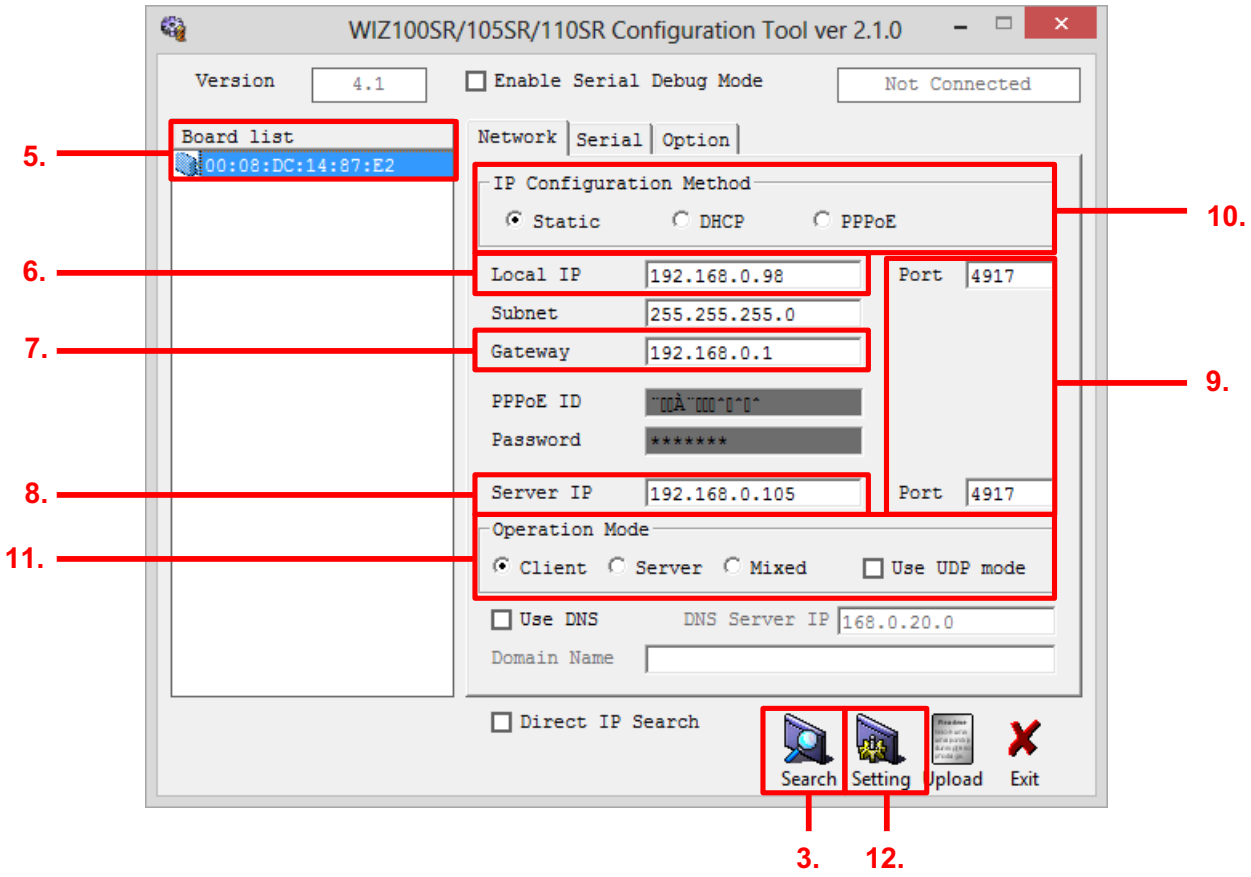
Parts:	iPQMS Installed, Ethernet Cable, Laptop Computer with WIZ100SR Config Tool
Tools:	IBwatch Installation Document, Laptop Computer with WIZ100SR Config Tool

For communication, the iPQMS MPU needs to be assigned an IP address. Use the provided WIZ100SR configuration utility to set the IP address. This configuration tool can be found on the provided USB drive or downloaded from the link below.

WIZ100SR Download:
www.eepowersolutions.com/downloads/software/wiz1x0_105sr_install.zip

Refer to the steps on the next page to configure the iPQMS.

1. Connect the computer (with the WIZ100SR tool installed) directly to the Ethernet port on the iPQMS using an Ethernet or Crossover cable and power on the iPQMS
2. On the computer, open “WIZ1x0SR_105SR_CFG.exe”
3. Click the “Search” button
4. Edit only the fields listed below and outlined in red
5. **Board List:** The MAC address of the iPQMS will appear on the left column “Board List”. Record the MAC address under the MAC Address column in the IBwatch Installation Document
6. **Local IP:** The Local IP field represent the IP of the iPQMS. Edit only the last quartet of the IP address. Record the set IP under the IP Address column of the IBwatch Installation Doc
7. **Gateway:** Enter the network/router IP in this field
8. **Server IP:** Enter the IP address of the Server PC in this field, this is the computer that Centroid Snet is installed on. (Note, this field can be modified later if the Server IP is not yet determined)
9. Make sure the port is set to 4917
10. Make sure IP Configuration Method is set to “Static” and that Operation Mode is set to “Client”
11. Click “Setting” to save all changes



7.4 Connect iPQMS to Network

Parts:	iPQMS Installed, Ethernet Cable
Tools:	N/A

With the iPQMS installed and the IP configured, it can be connected to the company network.

1. Run the Ethernet directly into the TCP/IP port on the side of the iPQMS
2. Check that both lights (green & orange) are blinking

The iPQMS is now connected.

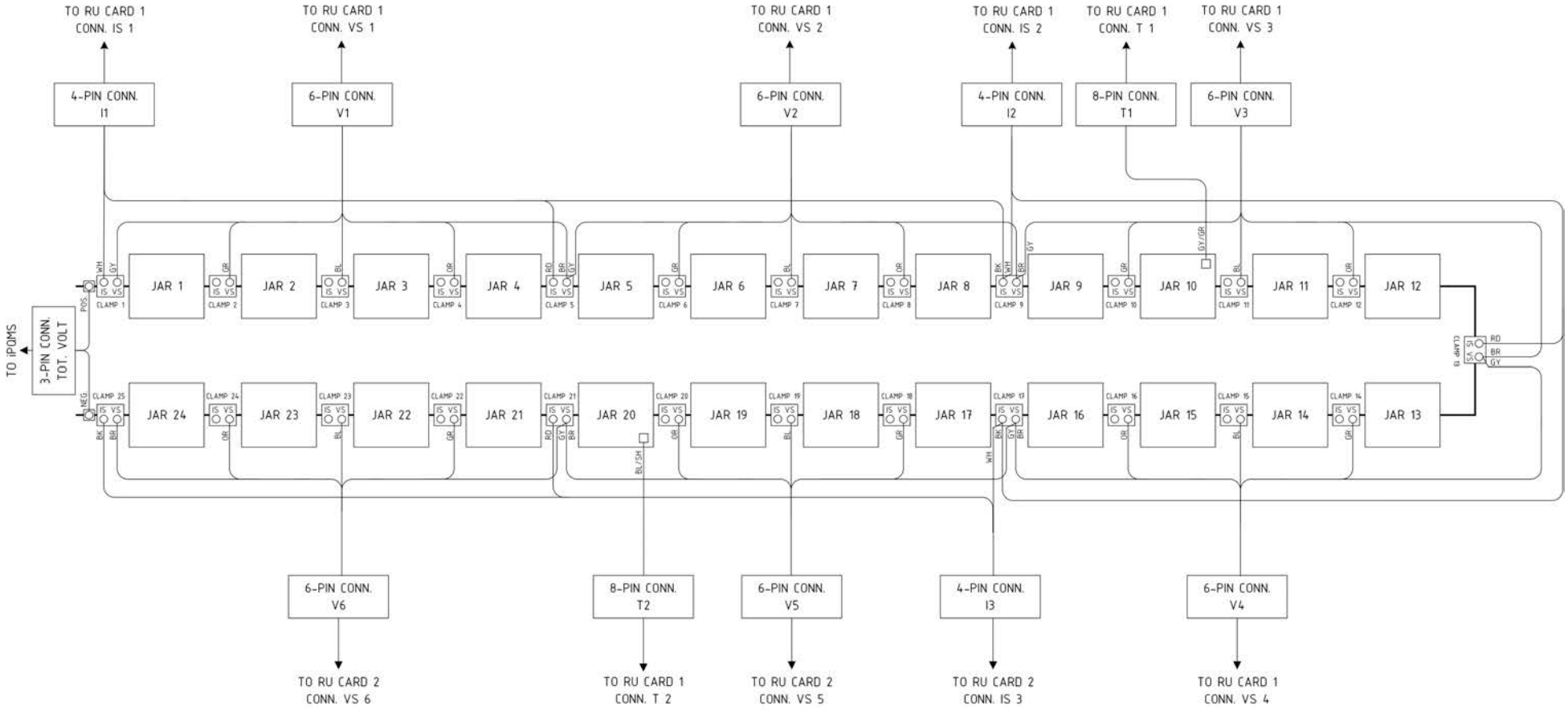
8. Example Connection Diagrams

The following pages contain example connection drawings for common iPQMS systems. These drawings can be used as guide on how to connect the iPQMS clamps and wires to the battery system.

Custom connection diagrams can be made available upon request.

iPQMS-24C

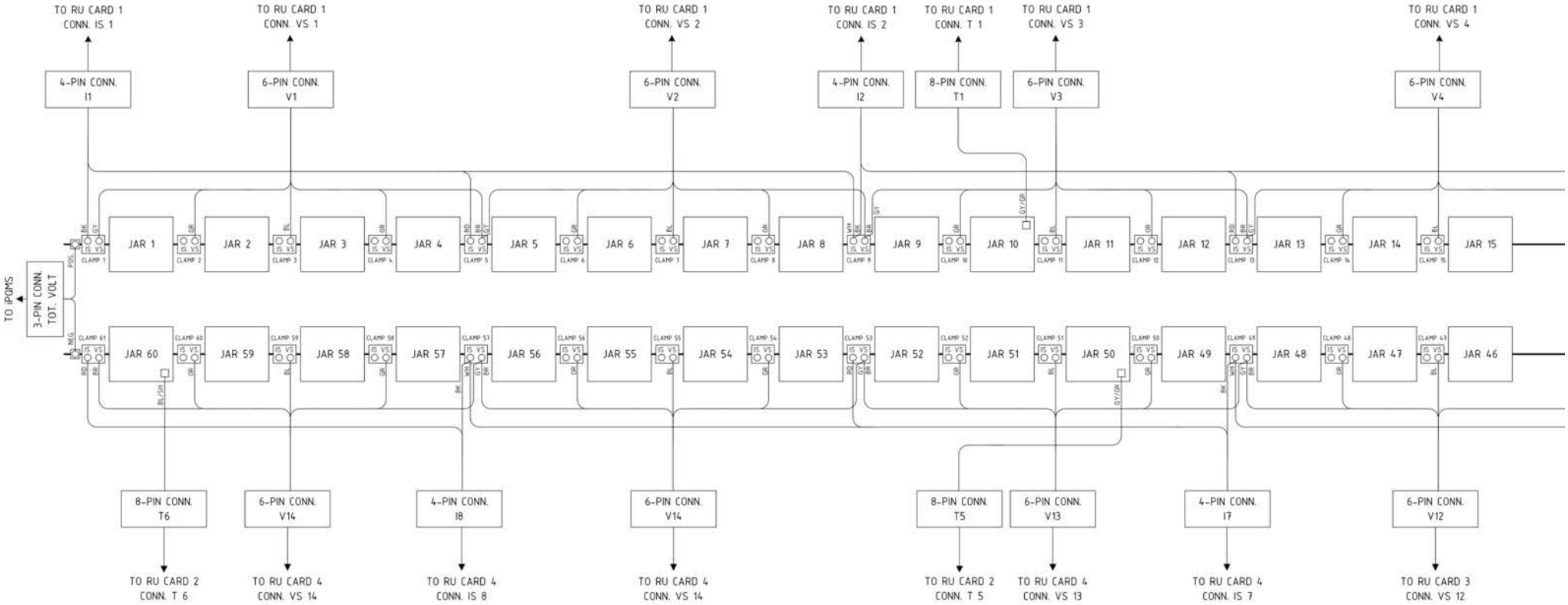
48V Battery Bank, 2V Jars



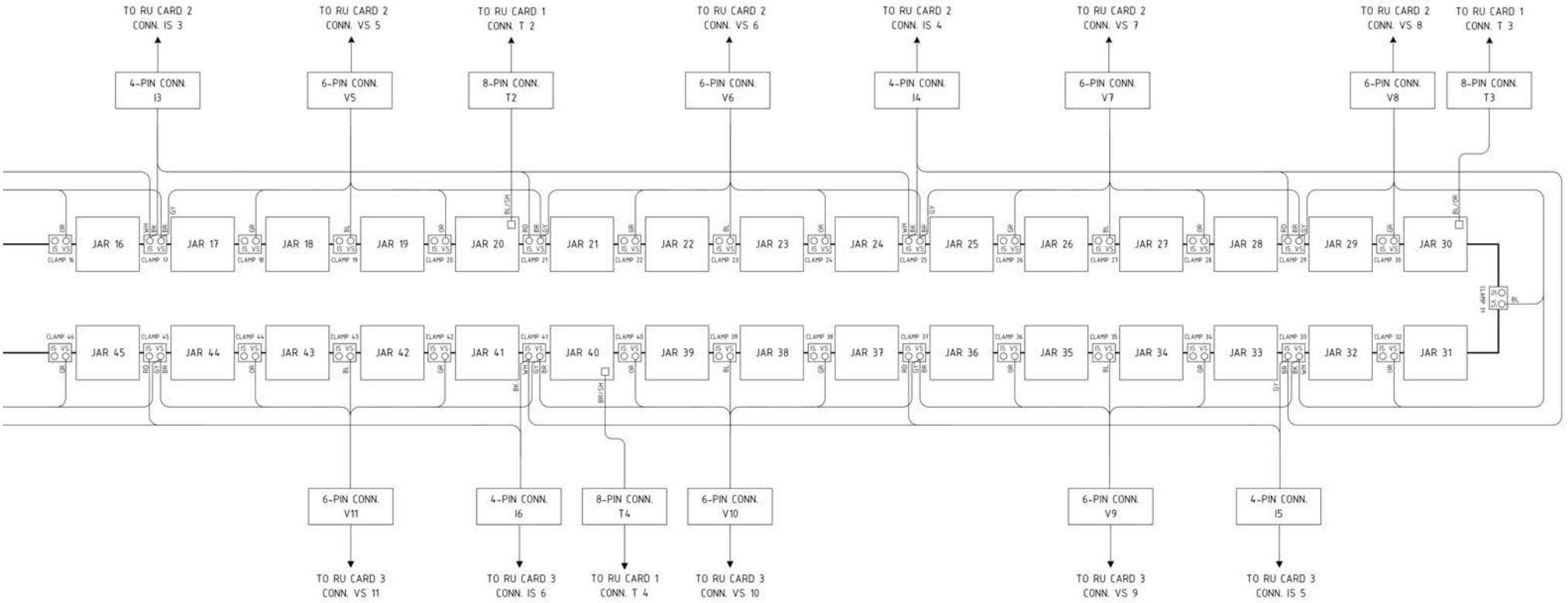
PDF Download Link: www.eepowersolutions.com/downloads/drawings/iPQMS-24C%2048VDC%20String-2V%20Jar%20V1.1.pdf

iPQMS-60C

125V Battery Bank, 2V Jars

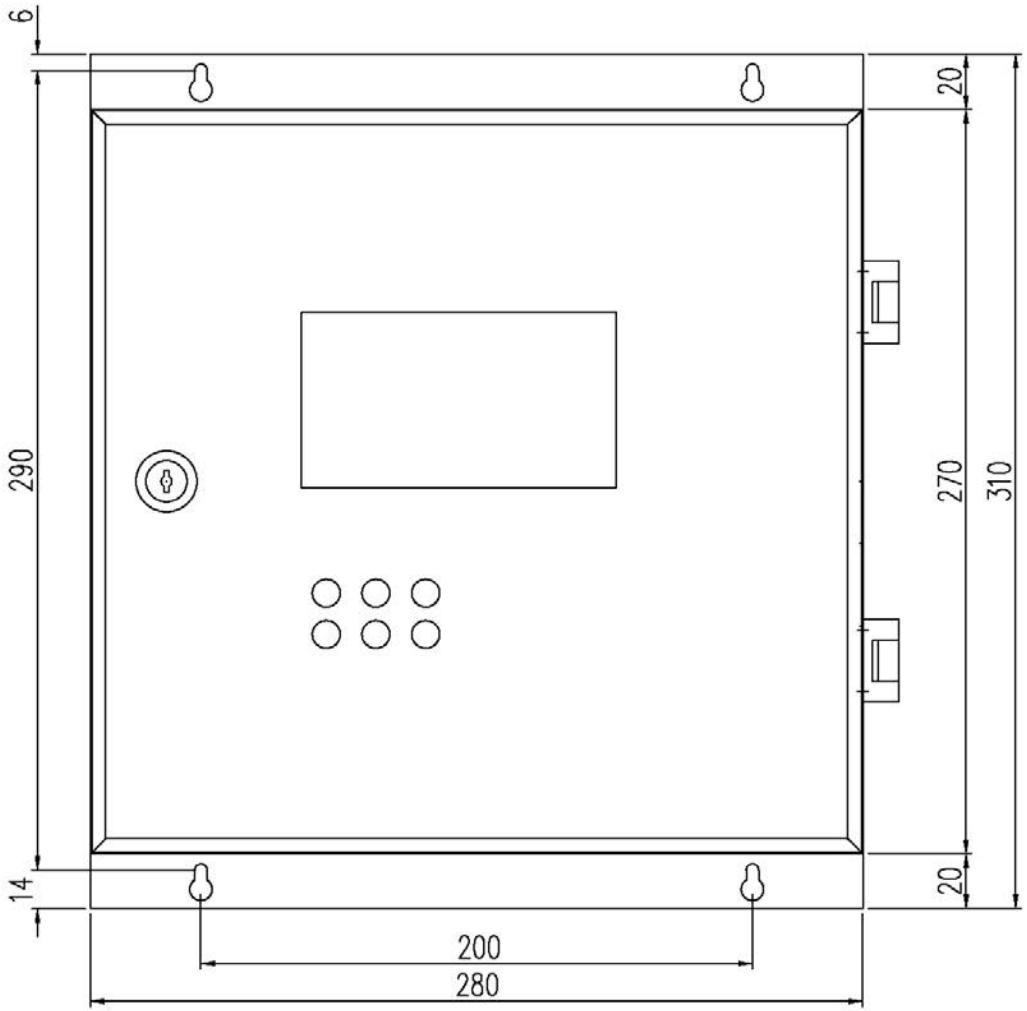


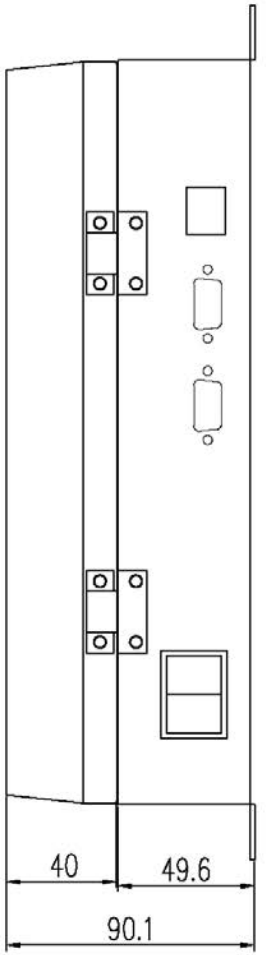
PDF Download Link: www.eepowersolutions.com/downloads/drawings/iPQMS-60C%20125VDC%20String-12V%20Jar%20V1.1.pdf


TO RU CARD 2
CONN. IS 3
TO RU CARD 2
CONN. VS 5
TO RU CARD 1
CONN. T 2
TO RU CARD 2
CONN. VS 6
TO RU CARD 2
CONN. IS 4
TO RU CARD 2
CONN. VS 7
TO RU CARD 2
CONN. VS 8
TO RU CARD 1
CONN. T 3
4-PIN CONN.
I3
6-PIN CONN.
V5
8-PIN CONN.
T2
6-PIN CONN.
V6
4-PIN CONN.
I4
6-PIN CONN.
V7
6-PIN CONN.
V8
8-PIN CONN.
T3
JAR 16
JAR 17
JAR 18
JAR 19
JAR 20
JAR 21
JAR 22
JAR 23
JAR 24
JAR 25
JAR 26
JAR 27
JAR 28
JAR 29
JAR 30
JAR 45
JAR 44
JAR 43
JAR 42
JAR 41
JAR 40
JAR 39
JAR 38
JAR 37
JAR 36
JAR 35
JAR 34
JAR 33
JAR 32
JAR 31
6-PIN CONN.
V11
4-PIN CONN.
I6
8-PIN CONN.
T4
6-PIN CONN.
V10
6-PIN CONN.
V9
4-PIN CONN.
I5
TO RU CARD 3
CONN. VS 11
TO RU CARD 3
CONN. IS 6
TO RU CARD 1
CONN. T 4
TO RU CARD 3
CONN. VS 10
TO RU CARD 3
CONN. VS 9
TO RU CARD 3
CONN. IS 5

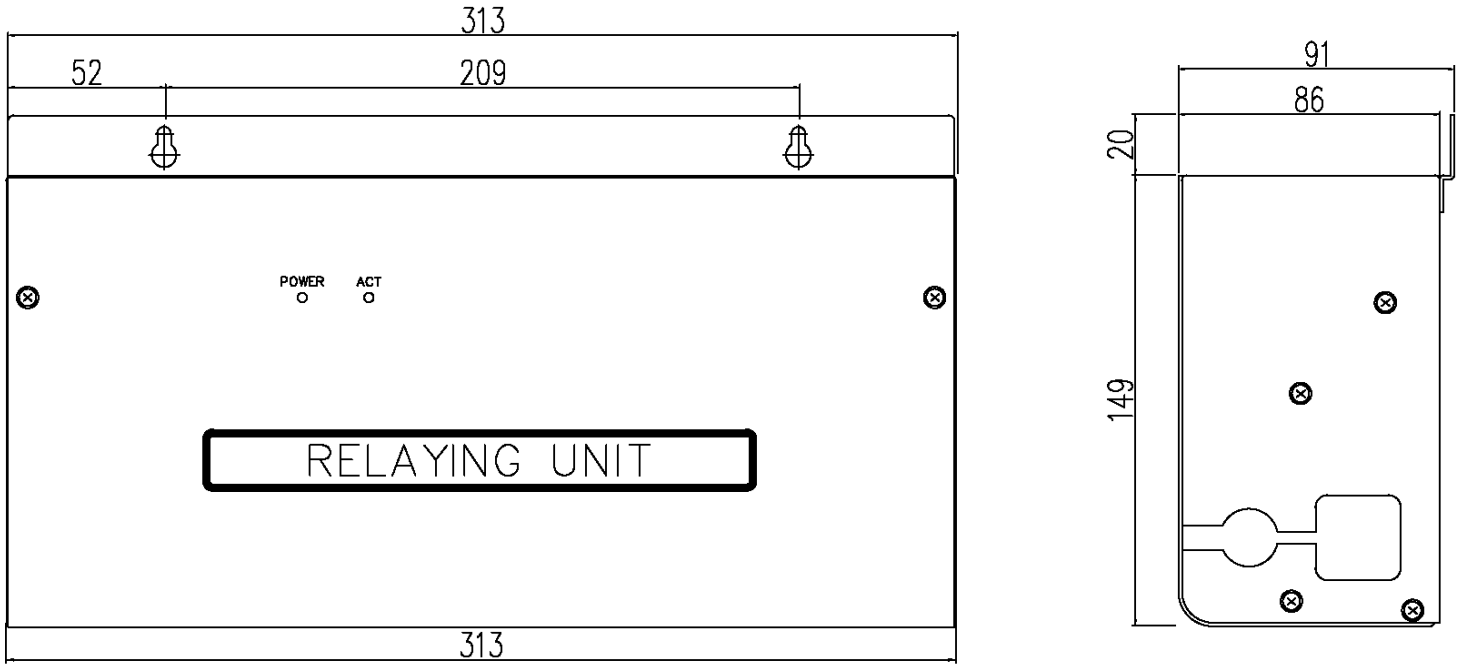
9. iPQMS Hardware Drawings

(1) iPQMS Main Processing Unit (MPU)





(2) iPQMS Relaying Unit (RU)



(3) iPQMS Block Diagram