Millennium 2 – Advanced Features Product Manual

Introduction

This manual is intended to supplement the Millennium II Controller J85501P-1 Basic Installation and User's Guide 167-792-181, providing additional details on the use and operation of the Millennium II (M2) controller in the various power system applications it may be found in. Please refer to that Basic Operations manual when necessary for the main product description and general installation procedures.

Below is a summary of the features and operations that are included in this **Advanced Features Product Manual.**

1. LAN Port Access – Craft / Network
2. Serial Communication – Rectifiers, Converters, Bay Interface Cards (BICs), Inverters, Ringers, Power Express, Busway PICs, BDFB VIMs
3. Accurate Load Readings – Shunt Types and System Architecture
4. Rectifier Sequencing / Energy Management / Load Share
5. Rectifier, Converter, Inverter, Ringer Redundancy Loss
6. Low Voltage Disconnect
7. Monitoring Channels / Remote Peripheral Modules / User Defined Events / Derived Channels / Timer Events
8. History Logs / Statistics
9. Slope Thermal Compensation / Temperature Probes
10. Battery Reserve Time Prediction / Battery Discharge Test
11. Battery Recharge Current Limit
12. Battery Boost / Equalize
13. Alarms / Alarm Test
14. Alarm Notification via Email-on-Alarm / SNMP / Modbus
15. Backup / Restore Configuration
16. Upgrade Software
17. T1.317 Command Language
18. Commands requiring super-user or administrator login

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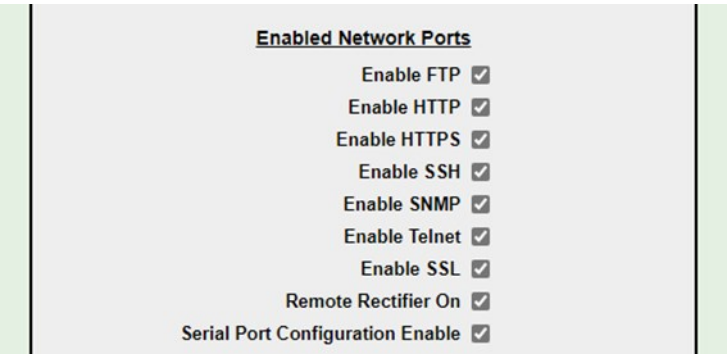
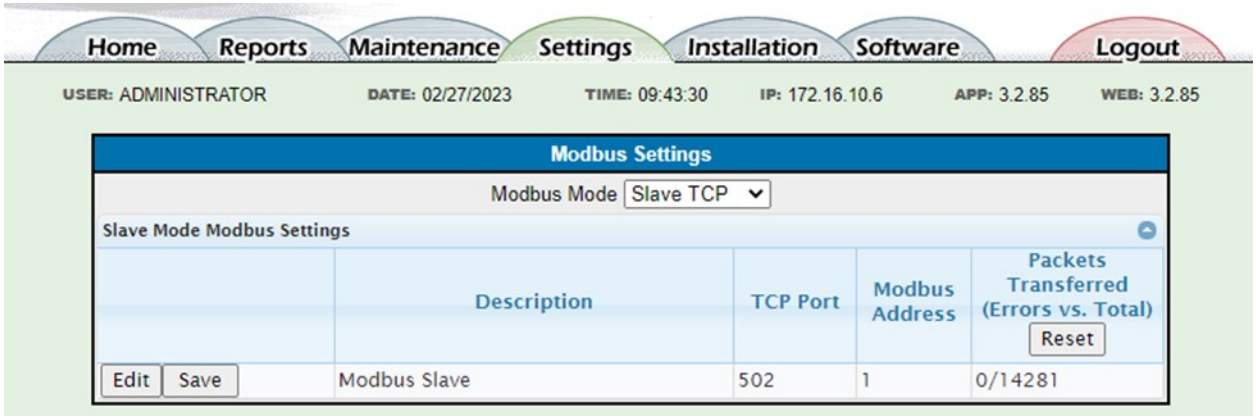
1. LAN Port Access – Craft / Network

M2 offers an Integrated 10/100Base-T Ethernet Network access port via a standard shielded RJ-45 interface that is referenced to chassis ground. This interface supports multiple access protocols, including HTTP (web pages); HTTPS; FTP; Telnet; SNMP; SSH; and SSL, plus Modbus via TCP. Each of these protocols may be individually enabled or disabled on the **Settings – Security** or **Settings – Modbus** web pages, as indicated below.



p/o Settings – Security web page

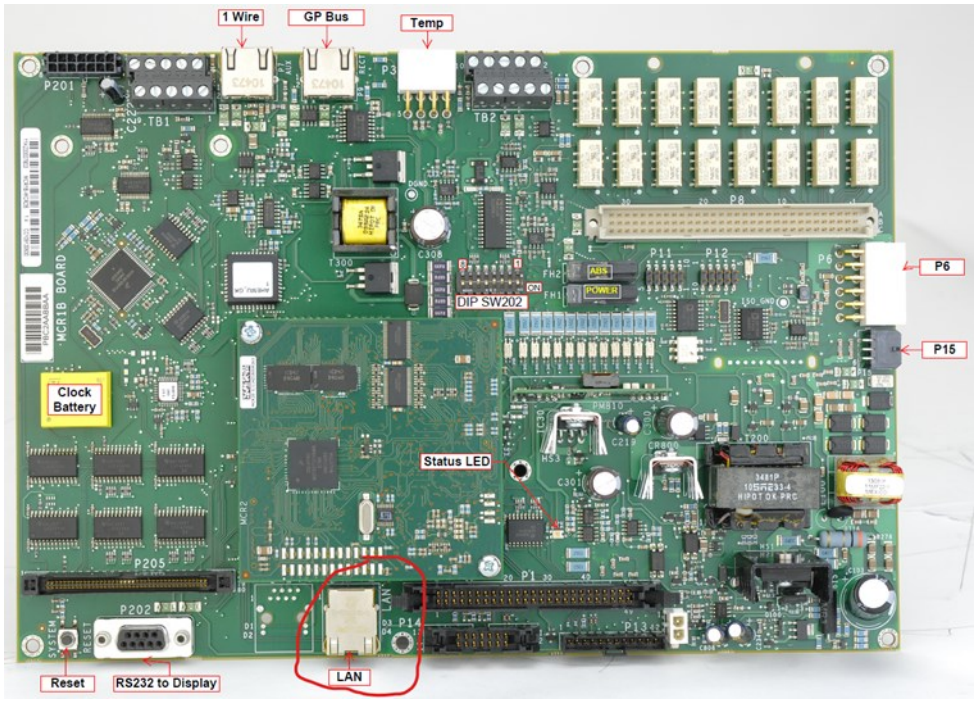


p/o Settings – Modbus web page

Throughout this manual, the HTTP web pages will be provided as examples of the main means of both local craft and remote user access. See the Basic Operations manual for applicable Menu Maps for front display access for those features that are also permitted to be accessed and / or configured through that means.

M2 LAN Port Login

Access to the M2 data via web pages is over its LAN (Local Area Network) port, located along the bottom edge of the M2 main circuit board, using any standard straight-through RJ45 (8-pin) cable set and a web browser. No special GUI software is used for this HTTP web page access. The LAN port location is identified in the following photo of this M2 board:



M2 LAN Port

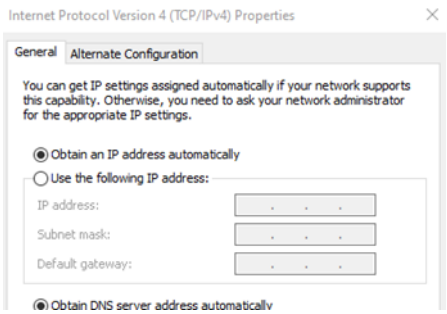
The M2 DHCP (Dynamic Host Configuration Protocol) parameter is used to assign the operation of the LAN port as far as IP Addressing is concerned. 3 configuration settings are available:

DHCP – Client

Client is the default setting for DHCP. This mode of operation is used when the network automatically provides the IP address / parameters to the controller. In many cases, it is necessary to change DHCP from Client mode to another mode to successfully access the controller via the LAN port.

DHCP – Server

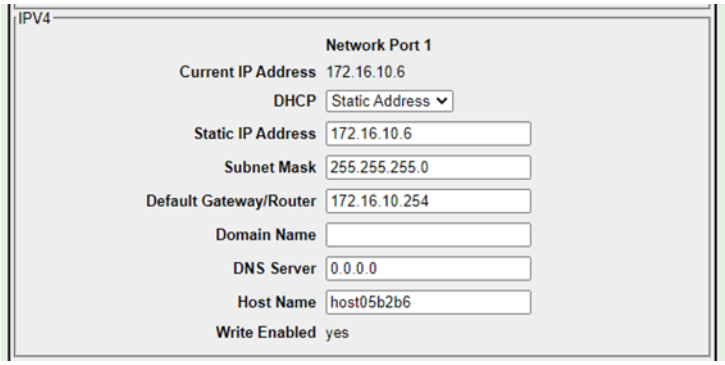
Server mode is used to provide local Craft port functionality for the LAN port for access by a local laptop. In Server mode the controller default IP address is **192.168.2.1** (destination address in a browser) and the controller hands out a compatible address to the laptop or device connected to the port, which must therefore be set to its Client mode, or to "Obtain an IP address automatically", as shown below:



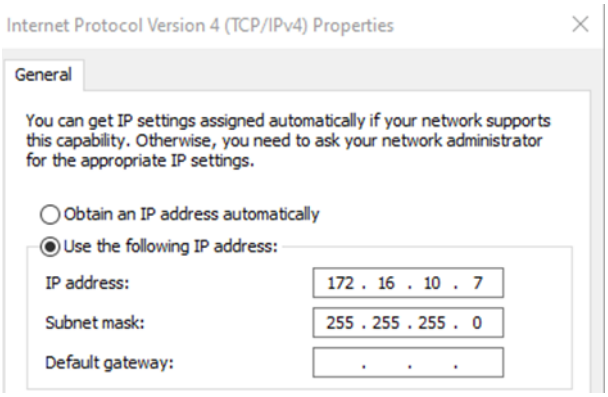
Note: Care should be taken to not connect the M2 LAN port into a customer network whenever the M2 LAN port is set to Server mode.

DHCP - Static

Static mode is used to assign a specific IP Address for the LAN port access when it is to be connected to a customer network. In Static mode, the minimum parameters to be configured for network access are the **IP Address**, **Subnet Mask**, and **Gateway / Router Address**:



Note that use of the LAN port locally as a Craft port is also possible while the M2 DHCP is set to Static mode with an assigned IP Address. It is only necessary to change the settings for the laptop or device that is to be connected to the port to a similar IP Address (change the last octet by one) and the same Subnet Mask, as shown in the example below for use with the M2 example above:



Configuration changes made to any M2 Network parameter will not take effect until the next controller reboot, so the controller will activate a “Reboot Required” alarm when changes are made, to alert the user to this. It is necessary to wait at least 2 minutes after making the last configuration change, to permit those changes to be saved, before completing this reboot (**Maintenance Tab – Reboot Controller** or front display menu path: **Menu – Control/Oper – Reboot Controller**) to start using the new Network settings.

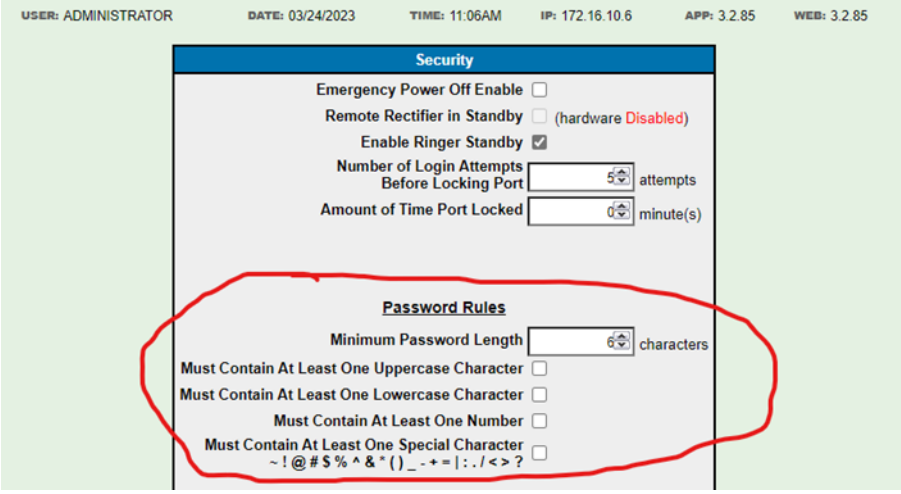
Passwords

There are 3 levels of Password security for the normal HTTP web page access:

Login Level	Access	Default Password
User	Read Only	Lineage
Super-User	Read/Write	super-user
Administrator	Read/ Write/ Upgrade/Change Passwords	Administrator

When logging in, the User, Super-User, or Administrator password may be used, with that level’s access then granted. Passwords may be updated only at the administrator security level on the **Settings – Passwords** web page:

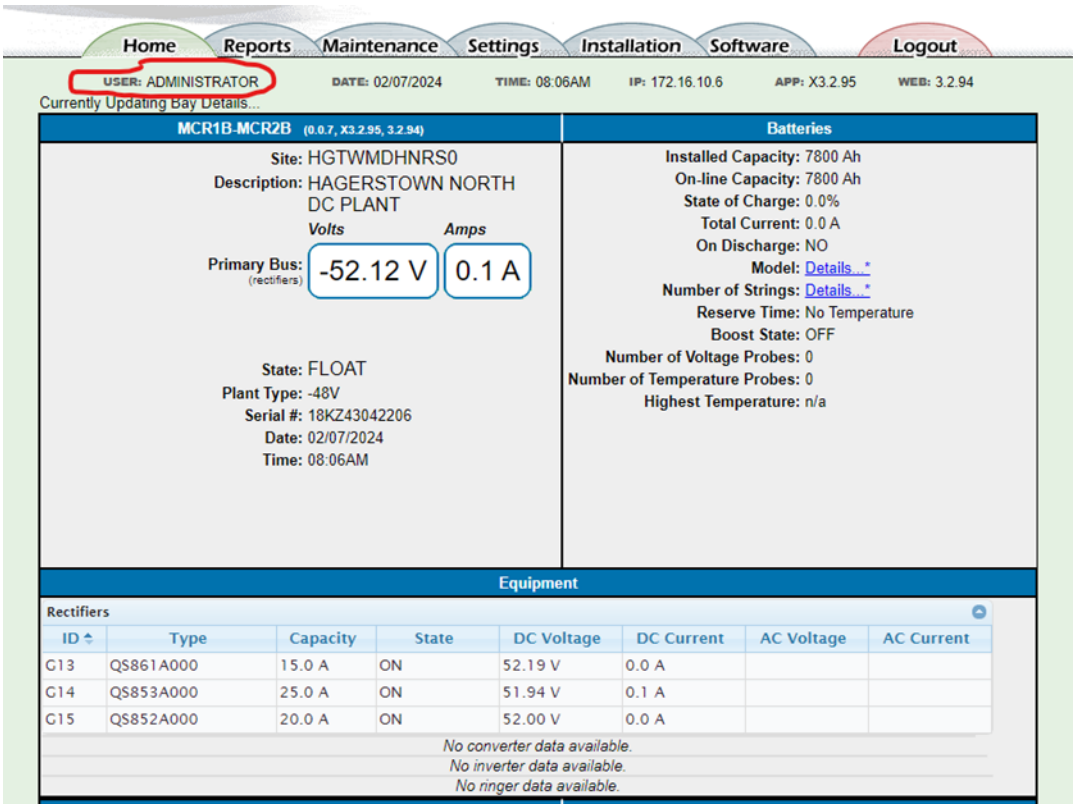
When changing passwords, the parameters necessary may first be established on the **Settings – Security** web page:

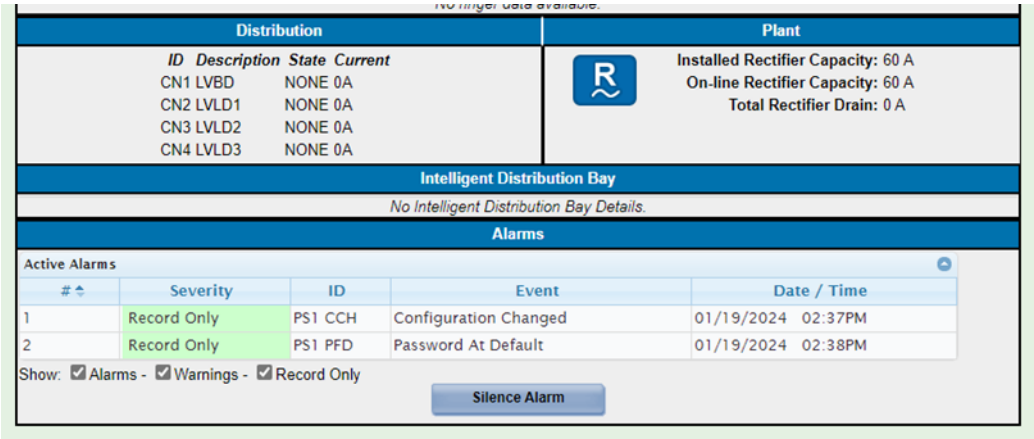


The same password should not be used for different access levels. If this occurs somehow, only the lower access level will be granted upon login with that password.

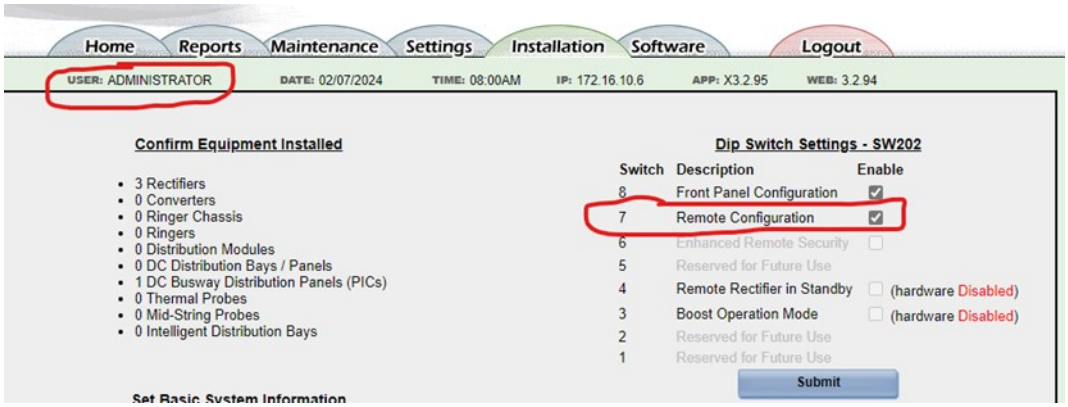
The administrator password can be reset to the default setting by front display menu path:
Control/Oper – Reset Passwords.

Upon a successful web page login, the Home tab will be presented showing basic plant, battery, and rectifier data at the top of the page and alarm information at the bottom:



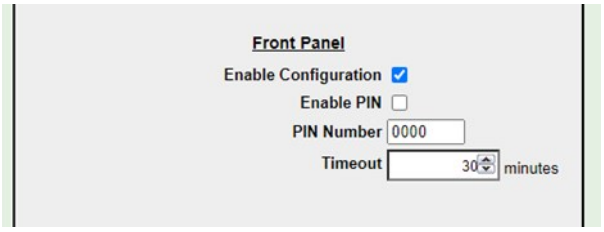


On current web pages, also note that the user's access level for that session is posted immediately under the tabs at the far left, shown as ADMINISTRATOR in the examples shown. If this access level does not coincide with the password level that was used for the login, the security level may be restricted due to hardware and/or software switches that have been set. The Installation tab page shows the security setting for remote logins currently in use via hardware dip-switch 202-7 located immediately to the left of the 2 power fuses on the MCR-1B card itself, as shown here:



The related software security "switches" are at Front Display path: **Menu – Configuration – Communication Ports**, with the Network Port at **Network Port – Write – Enable/Disable**.

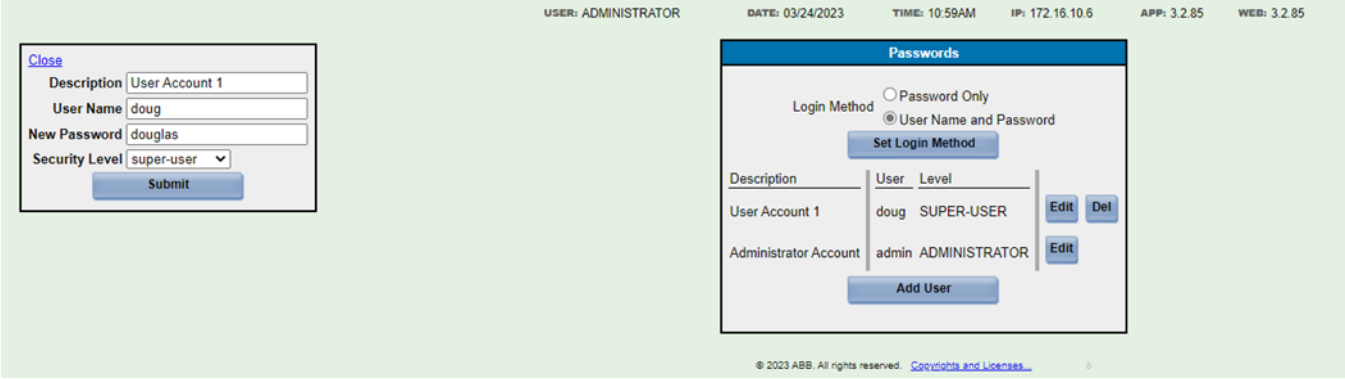
Front Display Read/Write security follows the same pattern but using hardware dip-switch 202-8 to enable/disable front panel configuration, along with a Software switch on the **Settings – Security** web page. There is also an option to require a 4-digit PIN to permit Write access via the front display. This configuration, plus the PIN timeout are configured on the **Settings – Security** web page:



There is a final super-secure remote access security option, called Enhanced Remote Security. It is set via hardware dip-switch 202-6 on the MCR-1B card and at Front Display path: **Menu – Configuration – Communication Ports – Remote Security**. When this feature is enabled, super-user and administrator access permits most configuration changes, except those that will affect the state of the plant. The functions and parameters restricted with the Enhanced Remote Security feature are listed in Table 4-H in the Millennium 2 Basic product manual.

User Names

Additional login security may be implemented in M2 by activating the User Names Login Method feature on the **Settings – Passwords** web page:



Up to 14 User Name Accounts plus an Administrator User Name Account may be established here to limit login access to only these 15 users at their assigned security level. When activated, the initial login web page will require that both the User Name and that User Name's specific password be successfully inputted to gain access and this access will then be limited to that User Name's security access level. So be very careful, if implementing **User Names**, to ensure your organization's procedures for handling User Name assignments is well established.

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2. Serial Communication

The Galaxy Communication Protocol provides a means for many devices in a power system to communicate with the controller over a serial interface. The M2 controller initiates all commands and requests information from other devices over this serial bus. The protocol allows dynamic detection of many devices, automatic configuration, and stable system operation without requiring operator intervention.

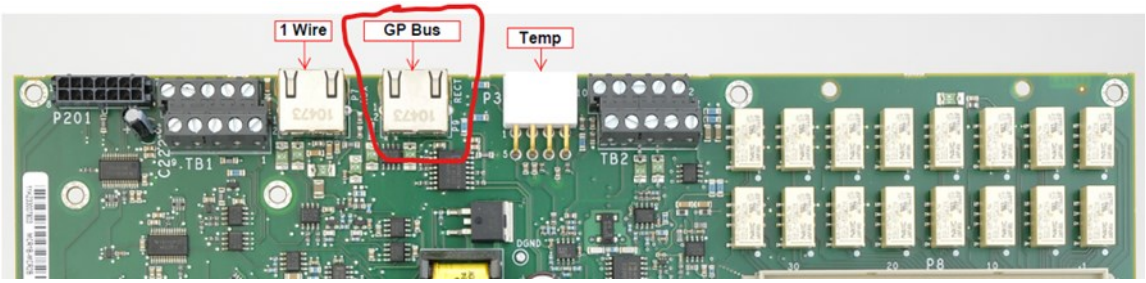
It is this Galaxy Protocol bus (GP bus) that permits many of the features possible with M2 to occur. For example, determining the plant load in a distributed architecture power system as the summation of all rectifier loads and all battery string current readings (obtained via Bay Interface Card (BIC) shunt channels) is only possible because all of these values can be accurately obtained and regularly updated over the GP bus. Features like Battery Recharge Current Limit (BRCL) and Slope Thermal Compensation (STC) depend on the ability of the system controller to adjust rectifier output voltage and recognize battery currents and temperatures on a dynamic basis, all of which happens over the GP bus.

Once devices are detected and established on the GP bus, the controller polls them regularly for updates. When this polling fails to generate a response, a Communications Fail alarm is generated against that device. Therefore, if a device presently recognized on the GP bus is to be permanently removed, it is necessary to notify the controller to clear this alarm. M2 front display path: **Menu – Control/Oper – Uninstall Eqpt** or web pages: **Maintenance – Clear Missing Devices** accomplishes this.

Devices using the GP bus for communication with M2 may include any of the following:

- Rectifiers – 595/595LT Type, 596 Type, Infinity NE Type, CPS 6000 QS Type, & GP100 Type
- The use of other rectifier types may be permitted when used along with the BJC_MSC serial communication cards in the specific Millennium SC controller vintage (J2011-002), but features like BRCL & STC, as discussed previously, will be unavailable when rectifiers are used that the controller cannot adjust the voltage of.
- Converters – 597 Type & Infinity NE Type
- Bay Interface Cards (BICs) – BIC7 to BIC11
- Various Communication / LVD control / Shunt monitoring serial cards – ES, QS, & NE Types
- Inverters – 827E SI Type (when used with a GP bus Bridge Board)
- Ringers – CPS 6000 QS Type
- Busway Panel Interface Cards (PICs) – PIC1 or PIC2
- BDFB VIM Meters – VIM1EC vintages

The GP bus originates at the P9 (RECT) RJ45 type jack at the top edge of the M2 controller MCR1B/2B board:



M2 GP Bus (RECT) Jack

Communication cables to the power system devices are 8-pin straight through RJ45 CAT5/CAT6 type. The communication bus may be split after this point to go in multiple directions, if necessary, or may just travel from device to device. The number of devices and maximum bus length should not be a factor in any practical central office application. The GP bus reference is floating in the M2 itself and is therefore determined by the devices connected to it. GPS, Infinity NE, and GP devices all reference this bus to DG. CPS 6000 QS devices reference to BATT, so there must be no mix between these QS devices and the others within a single power system.

A unique ID for every device on the GP bus is required. IDs can be assigned for the bus devices through various means: switches, jumpers, ID wheels, shelf positions, menu paths, etc. Refer to documentation for the specific equipment or plant used for details regarding device ID assignments. The GPS Installation Guide (167-792-157) is an excellent resource with these assignments for all devices that might be utilized in a GPS power system.

3. Accurate Load Readings – Shunt Types and System Architecture

One of the most fundamentally important tasks performed by the M2 controller in a power system is the accurate recognition and reporting of the plant load reading. And for any plant using battery backup, this load reading cannot be just the sum of the rectifier currents but needs to remain accurate during all three stages of a battery system's operation: Float, Discharge, and Recharge. System features and alarms like Redundancy Loss and Limited Recharge and Energy Management / Efficiency all depend on an accurate recognition of the load current being drawn by equipment fed from the power system.

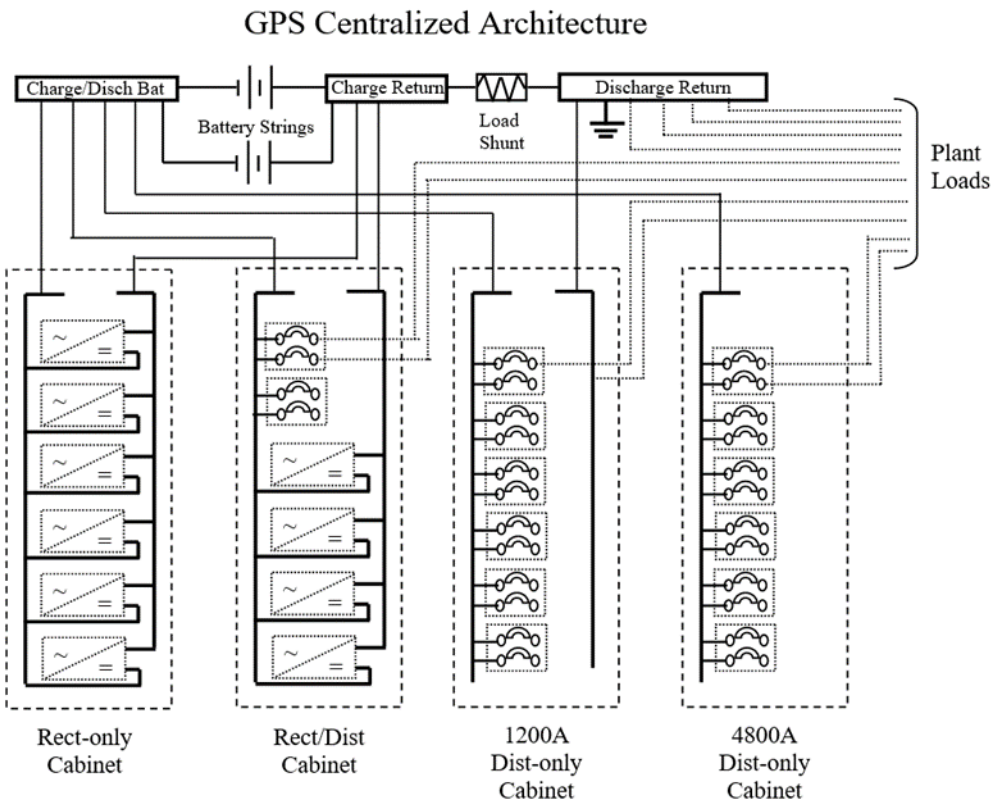
M2 has the flexibility to offer multiple means for determining the power system load. The method selected will depend upon the rectifier type(s) in use and the architecture (or layout) of the power system devices and the current monitoring shunt(s) in use. The two system architectures that may be employed here are Centralized and Distributed.

Centralized Architecture

A centralized architecture system connects all rectifiers and batteries together at a central point prior to engaging the distribution modules for powering the system loads. Monitoring of the plant current is accomplished with the use of one (or more) plant load type shunt(s), located between this central point and the distribution modules, through which all load current (but no battery charge current) must pass. Our older dc plants prior to the CPS line and the introduction of the GPS series (including ECS, MCS, CCS, XCS, 100-type, 300-type, 400-type, 600-type, 700-type, etc.) utilized only centralized architecture.

A current-monitoring shunt can be defined as a calibrated resistor placed into the current path, that will provide a specified voltage drop at a specified current level. Shunts used in dc power systems typically provide either a 25 mV or 50 mV drop at their rated current level. A shunt used in a centralized GPS plant is typically placed into the ground return path of all plant load conductors, although shunts located in the "hot" or non-grounded side are also supported.

Placing the shunt into the ground return path in a GPS system permits distribution modules (fuse or circuit breaker distribution) to be in the same cabinets as rectifiers, if desired. Ground return conductors for all loads in such a system may then only be terminated on an external discharge return bus that connects to the rectifier/battery charge return bus through a plant load shunt. GPS Centralized Architecture is depicted in the following figure:



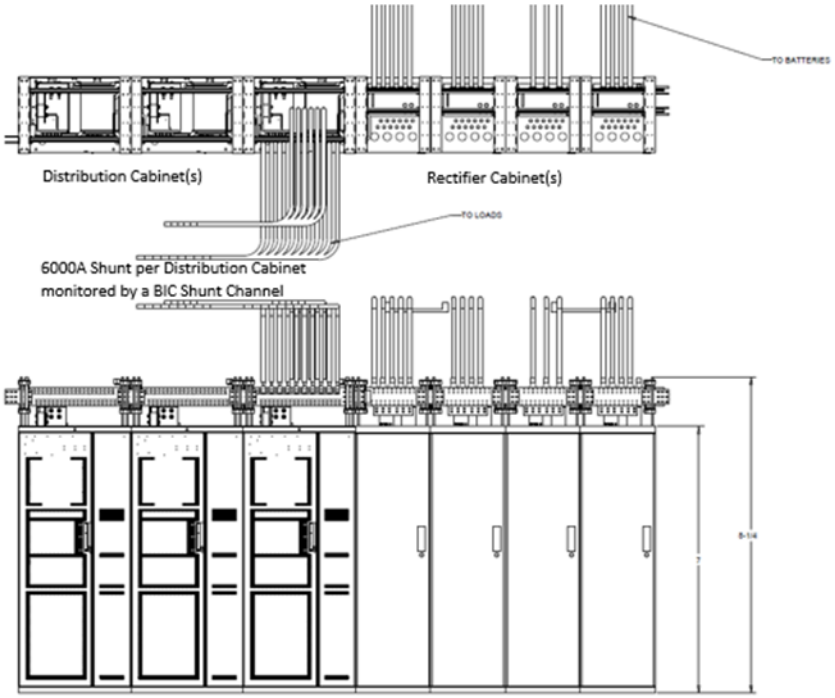
Notice in this figure that all system load return current must pass through this common plant Load Shunt to return to its power source, the plant rectifiers or batteries. The plant load can then be determined by simply monitoring the voltage drop across this plant Load Shunt. Notice also that none of the current used to charge the battery strings is monitored by the plant Load Shunt, only the system load current.

This sketch depicts two types of GPS distribution-only cabinets, a 1200A cabinet with an internal return bus and a 4800A cabinet without a return bus. When the internal ground return bus is utilized, it must be fed only from the discharge return bus (on the load side of the plant Load Shunt). Its feed cannot be common with the charge return bus, or the load returns connected to it would bypass the plant shunt, resulting in an inaccurate plant load measurement.

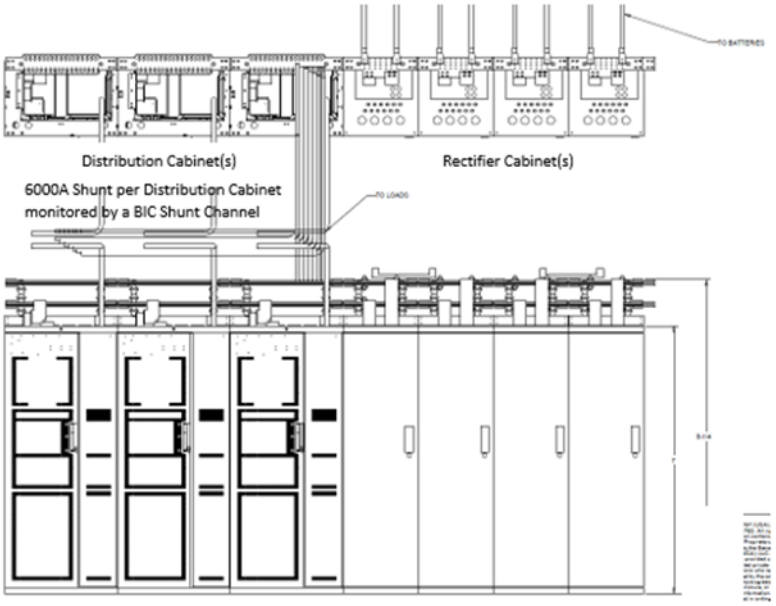
Centralized Architecture is necessary in systems where a mix of our current serial interface rectifiers and older parallel interface rectifiers are used together in the same power plant. Centralized architecture may often also be more convenient and cost effective in retrofit applications where a transition from an existing centralized architecture system to a GPS system is performed.

One disadvantage of Centralized Architecture is that it requires up-front planning and engineering to determine the ultimate system capacity to size the central point external busbars appropriately, where the rectifiers, batteries, plant shunt, and load return conductors all terminate. Any future growth to the system must also be carefully planned so its design can avoid cable congestion at the GPS cabinets and batteries, which can be difficult at larger plant capacities.

A 5,000A or 10,000A busbar system (**ED83311-30** – See sketches that follow) directly over top of the GPS rectifier-only and distribution-only lineup, using a 6,000A load shunt per distribution-only cabinet, can be used to alleviate this potential congestion problem. Regardless of the method used, both the initial and ultimate investment for Centralized Architecture will be greater than that required for an equivalent-sized GPS plant using Distributed Architecture.



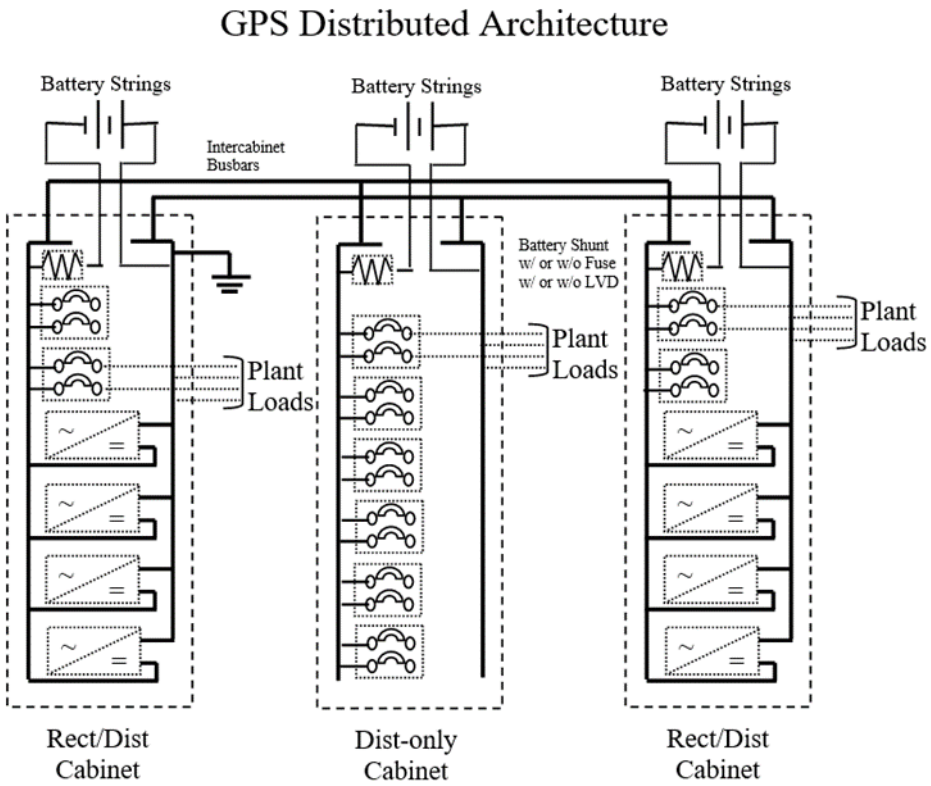
ED83311-30 GPS Overhead Bus System (Vertical Bus Orientation Shown)



ED83311-30 GPS Overhead Bus System (Horizontal Bus Orientation Shown)

Distributed Architecture

GPS Distributed Architecture is depicted in the following figure:



In a GPS Distributed Architecture system, the serial interface rectifiers, combined with battery current measurement shunt(s) in each GPS cabinet, permit the monitoring of the plant load current without the use of a common plant load shunt. The battery charge (-) or discharge (+) current for each GPS cabinet is monitored via one or more battery shunts, and is sent, along with the individual rectifier output currents, over the serial GP Comm bus to the plant controller. There the plant load is calculated and reported as the algebraic sum of all rectifier outputs and all battery charge (-) or discharge (+) currents. In this manner, the plant load is always accurately reported at the plant controller, regardless of whether the batteries are at normal float, charging, or discharging.

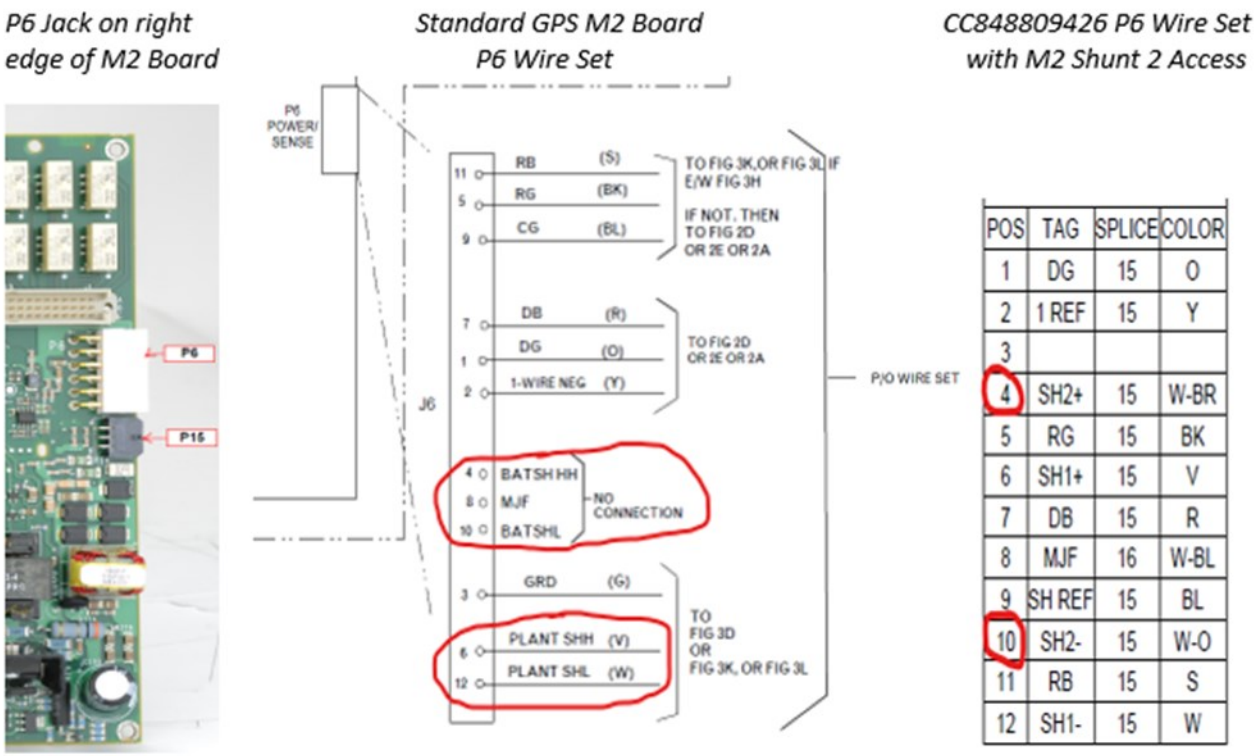
Ideally, each GPS cabinet in Distributed Architecture has its own rectifier modules, battery modules, and distribution modules, sized to support the approximate load connected to that cabinet. 1,800A capacity interconnection busbars permit load to be shared between cabinets when imbalances exist due to rectifier shutdown or failure or battery module failure. A 1,200A distribution-only cabinet is also optional in a distributed architecture system, powered via the 1,800A interconnection busbars. Larger 5,000A capacity interconnection busbars are also available when the necessary balancing of load circuits, rectifiers, and battery reserve capacity between cabinets cannot be maintained to minimize the loading on the interconnection busbars to their 1,800A maximum level.

One thing that becomes evident when comparing the GPS Centralized and Distributed Architecture figures is the tremendous savings in overall cable and bussing costs that Distributed Architecture provides, compared to that necessary with Centralized Architecture. Distributed Architecture also permits growth from initial to maximum plant capacity without significant initial investment in a common point busbar/shunt capacity or a later modification to increase this capacity.

In summary, Distributed Architecture provides the most savings and is best suited to new power plants consisting of all GPS cabinets where growth will be with GPS rectifiers and cabinets. Centralized Architecture is best suited for transitions from older, existing power plants when utilizing GPS cabinets for growth and modernization.

Shunt Types

To accommodate these architectures, Shunt monitoring circuits defined in M2 must be configured to match one of the settings identified below. The M2 card itself has 2 shunt circuits available for use off its P6 Input Power/Sense connector. One circuit (P6-6/P6-12) is wired standard on every GPS M2 application. The second one (P6-4/P6-10) requires wire set **CC848809426**, furnished with the stand-alone rack mount vintage of the M2 controller, to access:

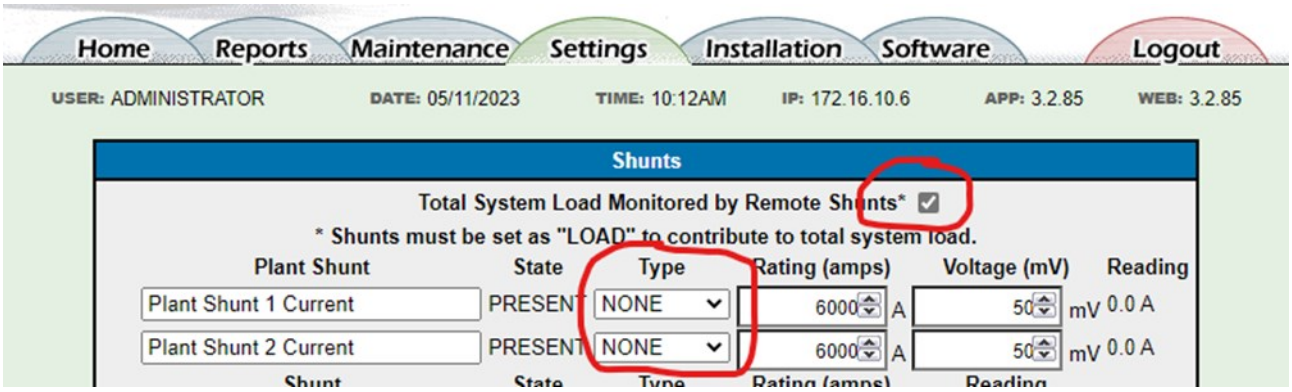


In addition to these M2 board shunt circuits, M2 can instead accept shunt readings from BIC (Bay Interface Card) shunt circuits (used in GPS cabinets) and PIC (Panel Interface Card) shunt circuits (used in DC Busway Plugs) for use in the plant load calculation. (But not from RPM (Remote Peripheral Monitor) shunt circuits.) The correct **Shunt Type** configuration for each of these circuits must be defined in the M2 configuration for them to be included properly in the plant load calculation. And, in all cases, it is imperative that both M2 Shunt circuits be configured to the same **Shunt Type**.

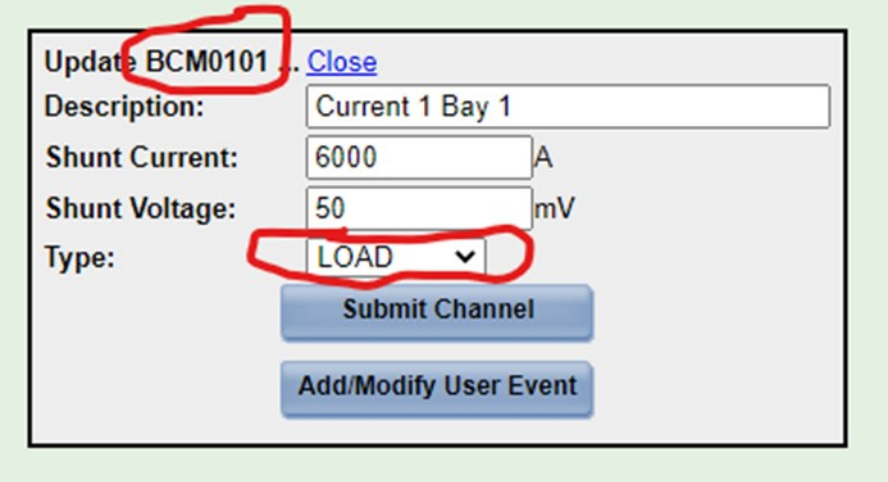
Shunt Type = Load

A Load Type shunt is used when the Shunt input pair is connected to a shunt measuring the **Load** current of equipment fed by the power system. Load Type shunt circuits must always be wired for a positive (+) load reading.

- When the M2 Shunt circuits are configured as **Load Type**, the sum of these two M2 shunt circuits will be recognized as the total plant load for the power system. This is the typical configuration for GPS cabinets with M2 in a standard **Centralized Architecture** plant.
- When BIC or PIC shunt circuit(s) is/are configured as **Load Type** (for BIC9 or BIC10 cards, this requires that the BIC card itself be set to "Software Configured" size), AND the M2 shunt circuits are configured as **Type None**, with the checkbox selected on the top of the M2 **Settings – Shunts** page for "Total System Load Monitored by Remote shunts", then the sum of the BIC or PIC shunt circuits will be recognized as the total plant load for the power system.



Settings – Shunts Configuration for 1 or more BIC or PIC Load Type Shunts



Settings – Remote Monitor Channels – Bay Current Monitor
Configuration for a BIC Current Channel (BCM0101)
For a Load Type 6,000A Shunt

Shunt Type = Battery

A Battery Type shunt is used when the Shunt input is connected to a shunt measuring the **Battery discharge** current (+) or **Battery recharge** current (-). **Battery Type** shunt circuit polarity must be wired as designated here.

- The M2 Shunt circuits will rarely be configured as **Battery Type.** The only "standard" power system where this occurs is a M2 used in Infinity M. When the two M2 shunt circuits are set to **Battery Type**, the plant load will be recognized as the sum of these readings and the outputs of all the system rectifiers.

- When BIC or PIC shunt circuit(s) is/are configured as **Battery Type** AND the M2 shunt circuits are configured as **Type None** (without the checkbox selected on the top of the M2 **Settings – Shunts** page for "Total System Load Monitored by Remote shunts"), then the sum of the BIC or PIC **Battery Type** shunt circuits and the outputs of all the system rectifiers will be recognized as the total plant load for the power system. This is the typical configuration for GPS cabinets with M2 in a standard **Distributed Architecture** plant.

Shunt Type = None

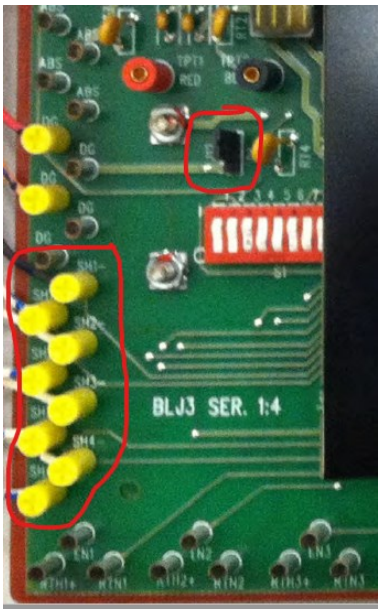
None is used for the M2 Shunt Type whenever the M2 Shunt circuits are not being used. This would be the case for any batteryless plant, where the plant load is just the sum of the rectifiers, and it is also true whenever the system BIC or PIC shunt channels are being used for determining the plant load, as described in the 2nd bullet under both the **Shunt Type = Load** and **Shunt Type = Battery** sections preceding this. Note again however, that in all cases, both M2 Shunt circuits must always be configured to the same **Shunt Type**.

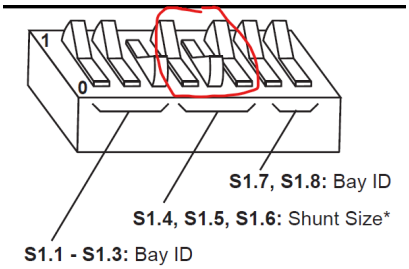
Shunt Wiring

The M2 shunt circuits are designed for a direct connection to the monitored shunt terminals, without the use of any CLRs (Current Limiting Resistors) or fusing. Limit the resistance of this wiring to 1 ohm maximum. Typically, this may be accomplished with 22 AWG conductors 25 ft long (1-way) or 20 AWG conductors 45 ft long (1-way). If the cabling distance to the shunt exceeds these lengths, then 14 AWG conductors may be used. DO NOT use any CLRs in this circuit.

The BIC shunt circuits are designed for connection to the monitored shunt terminals using 100K ohm CLRs (Current Limiting Resistors) installed at the shunt end of the circuit. These CLRs are provided already by the shop when the shunt circuit is pre-wired or may be obtained via part number **847540424** for field wiring applications. Because of these CLRs, wiring length and wire size in the BIC shunt circuit is of little consequence in the monitoring accuracy of these channels.

BIC9 and earlier Bay Interface Cards used in GPS cabinets include a separate BLJ type wiring card, as shown in the views that follow. Landing points for shunt wiring into the 4 available BIC Shunt circuits on BIC9 or earlier cards, are at the bottom left corner as identified here, along with the J12 jumper, common to all 4 channels, that references the card monitoring circuits to the hot (J12-1/2) or return (J12-2/3) bus of the power system, whichever the shunt is located in.





S1.4	S1.5	S1.6	Shunt Size (Amps)*
0	0	0	1000
0	1	0	600 (shown)
1	0	0	150
1	1	0	1500
0	0	1	2000
0	1	1	3000
1	0	1	Invalid
1	1	1	User-Defined

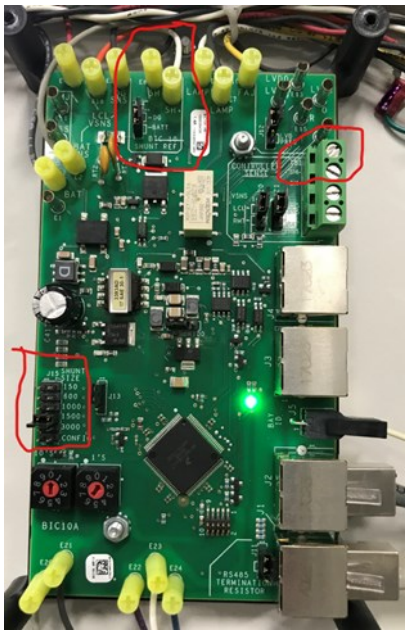
*Shunt size settings for distributed architecture only.

Shunt Amp Size w/ BIC9

BIC9 and Earlier Shunt Circuit Wiring and Programming

Positions **4-5-6** of the S1 8-pos dip switch of the BLJ type card shown here are used for defining the size of the 4 BIC shunt circuits. For the BIC9 card, setting these to the "User-Defined" or "Software Config" setting of 1-1-1 permits each to be individually configured using M2 web pages at **Settings – Remote Monitor Channels – Bay Current Monitor**, as indicted in the previous **Shunt Type = Load** section.

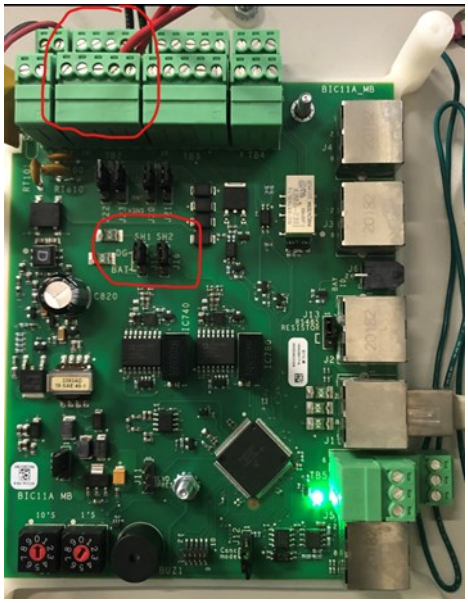
BIC10 Bay Interface Cards used in GPS cabinets only have a single internal shunt circuit, but also include a termination point for the first M2 shunt circuit, when the M2 is located in the cabinet with the BIC10, so it is important to differentiate between these:



The M2 shunt circuit wiring (12 awg max to the top 2 positions of the 4-pos terminal block on the upper right) MUST NOT use any CLR.

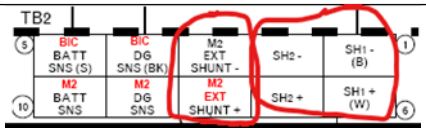
The BIC10 shunt circuit wiring (20 awg max to the E8/E9 insulation displacement terminals at the top center edge) MUST include a 100K ohm CLR. The J14 jumper immediately below E8/E9 references the BIC10 shunt monitoring circuit to the correct bus of the power system that the shunt is located in. The J15 jumper at the bottom left, immediately above the card ID wheels, sets the BIC10 shunt size or the Config position allows it to be configured using M2 web pages.

BIC11 Bay Interface Cards used in GPS cabinets include two internal shunt circuits, plus a termination point for the first M2 shunt circuit, when the M2 is in the cabinet with the BIC11. This wiring connects to TB2 on the top edge of the BIC11 card:



TB2 numbers right to left, as shown in the assignment sketch below. The M2 shunt circuit wiring (14 awg max to positions TB2-3 & TB2-8) MUST NOT use any CLR.

The wiring for the two BIC11 shunt circuits (14 awg max to positions TB2-1 & TB2-6 and TB2-2 & TB2-7 respectively) MUST include a 100K ohm CLR. The J15 (SH1) & J16 (SH2) jumpers circled reference each the BIC11 shunt monitoring circuit individually to the correct bus of the power system that the shunt is located in. The BIC11 shunt sizes are configured using M2 web pages.



4. Rectifier Sequencing / Energy Management / Load Share

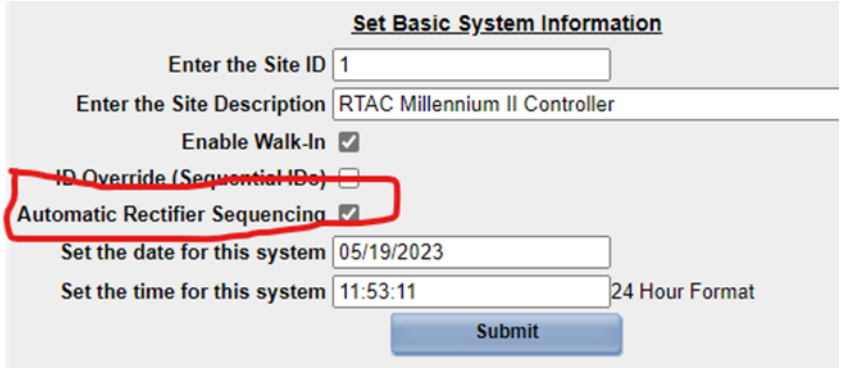
The main job for the Millennium 2 controller in a power system involves the control and monitoring of the system rectifiers. The features described in this section are associated with this work, all made possible with the GP Bus communication explained in Section 2.

Rectifier Sequencing

Rectifier Sequencing is used to ease the rectifier load back onto the AC bus after power has been restored following an AC power interruption, by staggering the starting of plant rectifiers at spaced intervals. Sequencing can be especially valuable when AC power is being supplied by a limited power source such as an emergency generator, allowing it to step gracefully into a loaded condition. Sequencing onto the commercial bus is also easier on components of the AC distribution network, such as breakers and transfer switches, and can help avoid peak demand penalties from power companies.

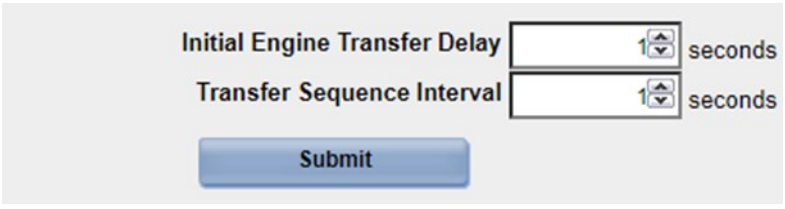
With the M2 **Automatic Rectifier Sequencing (DC1,ASEQ)** parameter enabled, anytime multiple rectifiers recover from a loss of AC input service at the same time, they are restarted one at a time, with both the initial delay **(DC1,ITD)** before any restart (default 1 second), and the interval **(DC1,TSI)** between units restarting (also default 1 second), being configurable.

Automatic Sequencing may be enabled via front display path: **Menu – Config – Plant – Auto Sequencing** or via the **Installation** tab on the web pages, as follows:



Installation Tab – Automatic Internal Sequencing Enable

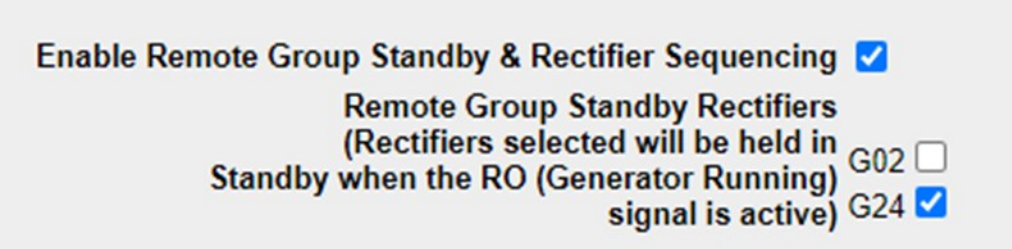
The **ITD** & **TSI** delays for the Auto Sequencer can be adjusted on the **Settings – Rectifiers** web page:



Settings – Rectifiers – ITD & TSI Delays

M2 also includes a **Group Standby** feature **(DC1,RSQ)** that permits rectifiers to be configured to remain off line whenever a **RO (Reserve Operation** or **Engine Run)** Input signal to the controller (closure across **RO/ROR** at BSL-77/78) from an under-sized generator is active. If properly managed, this option can allow an under-sized generator to keep sufficient charging active to support the system load during an extended commercial power outage, effectively extending a discharge event indefinitely.

This Group Standby Sequencing may be enabled via front display path: **Menu – Config – Plant – Group Standby** or via the **Settings – Rectifiers** web page, as follows:



Settings – Rectifiers – Group Standby & Standby Rectifier Selection

Note however that **Group Standby (DC1,RSQ)** takes precedence over **Auto Sequencing (DC1,ASEQ**). If both are enabled, all rectifiers that are not held in standby due to an active RO signal, start up simultaneously when an AC input trouble condition clears, only using their walk-in circuits.

Finally, M2 also permits input **TR (Transfer)** signals from an external sequencing device to hold rectifiers off line, then release them under control of that signal. This same feature was available in previous controller series and therefore provides a simple feature match when retrofitting to a new controller or power plant for an existing system.

M2 can accept up to 4 **TR** input signals (**TR1 to TR4** – ground to hold rectifiers off line) from an external sequencer, each affecting approximately ¼ of the plant rectifiers, as shown in the Table below:

BSL Card Pin #	Signal Name	Rectifier IDs Controlled
73	TR1	G1, G2, G9, G10, G17, G18, G25, G26, G33, G34, G41, G42, etc.
79	TR2	G3, G4, G11, G12, G19, G20, G27, G28, G35, G36, G43, G44, etc.
85	TR3	G5, G6, G13, G14, G21, G22, G29, G30, G37, G38, G45, G46, etc.
80	TR4	G7, G8, G15, G16, G23, G24, G31, G32, G39, G40, G47, G48, etc.

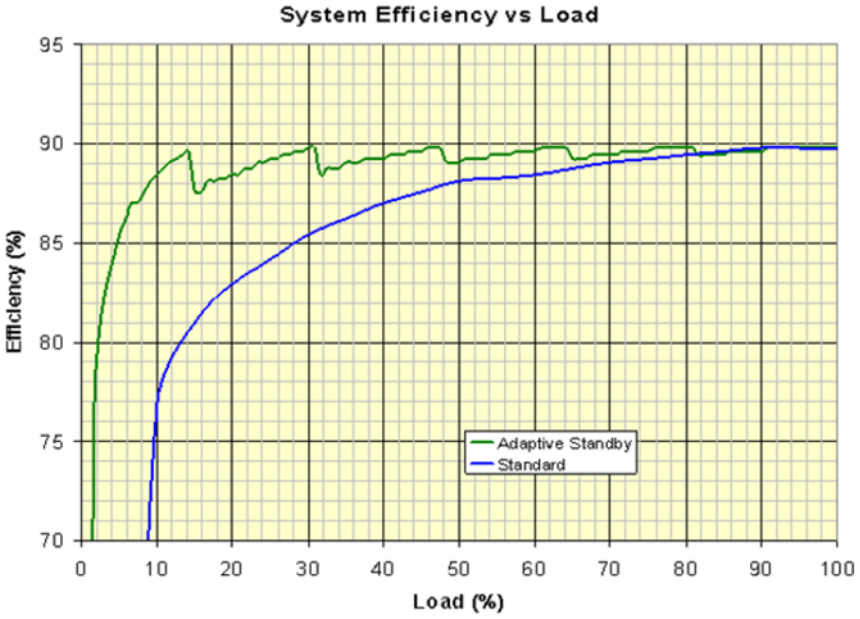
Please note that due to the automatic Rectifier ID assignment method (Bay-Shelf-Pos) for GPS4830 power systems, rectifiers used in GPS 4830 will only be assigned to the TR1 and TR3 groups, making this **External TR** signals a poor sequencing solution for those power systems.

The **External TR** input signals can be enabled or disabled at front display menu path: **Menu – Config – Plant – External TRs**. There is no web page equivalent, just the T1.317 command **CHA DC1 ETE=1** or **0**.

M2 has two safety measures against a malfunction of an external sequencing device. When an input **TR** signal is active, the controller processes an **ETS (External Transfer Shutdown)** alarm, with a default Minor alarm severity. If all 4 **TR** signals are active simultaneously for too long a period (set by the attribute parameter **ETO THR**, 0 to 60 minutes, 0 disables, default 30), the **ETO (Engine Transfer Timeout)** alarm activates (default Minor alarm severity) and all rectifiers are returned to service.

Energy Management

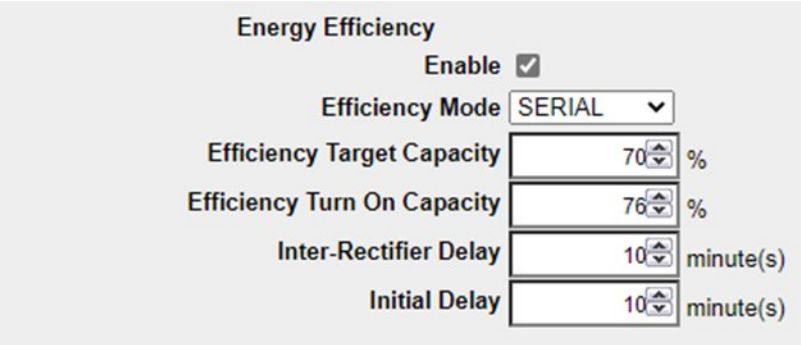
Sometimes referred to as **Efficiency** or **ARM (Active Rectifier Management)**, **Energy Management** has been used in several generations of power system controllers now. Energy Management seeks to match the available rectifier capacity to the actual plant load by placing rectifiers into standby mode when their capacity is not needed, to improve the operating efficiency of the remaining rectifiers. This was particularly beneficial with early generations of rectifiers like ferros, which were much more efficient in the upper half of their output load range.



Energy Management Savings Graph

The M2 Energy Management algorithm works toward loading rectifiers that are in service to 70% - 76% (default) of their capacity, by placing rectifiers that are not required to support the system load into standby mode. Needless shutdown/startup cycles from short-term load changes are reduced by only allowing one rectifier to be placed into standby in any 10-minute interval. On the other hand, large increases in plant load immediately result in the startup of rectifiers, if necessary. The BD (Battery on Discharge) alarm is inhibited for 10 seconds following a rectifier startup to prevent nuisance alarms during the rectifier walk-in period. Turn-on/turn-off stress is limited by permitting only three Energy Management shutdowns within a 24-hour period for any individual rectifier. The rectifier shutdown selection is rotated to keep units to similar runtimes. All rectifiers are exercised for at least 24 hours each month to ensure that they are available when called upon.

Serial, ferro and commercial rectifier types may all be used with Energy Management. The two requirements from a rectifier standpoint are that it can be shut down on a **TR (Terminate Rectifier)** signal from the controller without generating an alarm (and restarts upon release of the **TR** signal) and that its load can be monitored by the controller. If all rectifiers in the system are wired and configured to provide this TR control and load monitoring, Energy Management can be enabled or disabled via front display: **Config – Plant – Efficiency** or on the **Settings – Rectifiers** web page.



Settings – Rectifiers – Energy Efficiency Selections

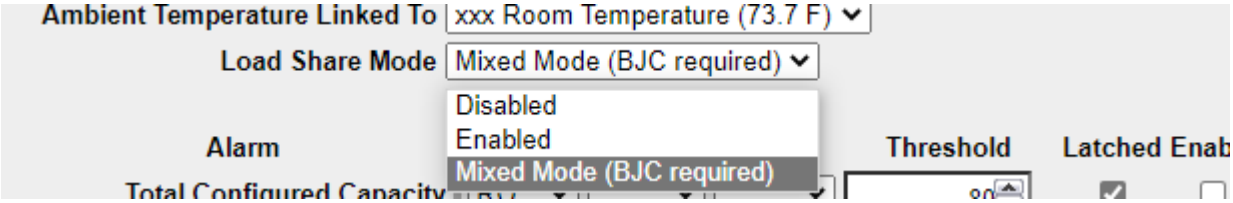
Changes to the **Efficiency Target** and **Turn-on Capacity %** values and to the delays between rectifier changes may be made, but caution should be taken in adjusting any of these fields. The **Efficiency Mode** selection on the web page and at front display: **Config – Plant – Efficiency – Rect Type** should be left at **Serial** unless the controller is a Millennium SC type also using parallel communication control cables to ferros or commercial type rectifiers and it is desired to always place the less efficient ferros into Standby first for Energy Management.

The efficiency curve for today's serial rectifiers is nearly flat from approximately 30% load through full load, so there may be little benefit gained by the Energy Management feature when rectifier loading is above that 30% load level. Energy Management should also be avoided in multi-cabinet GPS Distributed Architecture plants, to avoid the possibility of overloading the inter-cabinet DC busbars sharing load between cabinets, as rectifiers are placed into standby mode by Energy Management. Another situation where Energy Management should not be employed is in any power system used without battery reserve, to ensure that sufficient energy is present to trip any load breaker on a fault condition, without resulting in the bus voltage dropping to an unusable level that causes service risk.

Load Share

Sometimes referred to as **Forced Load Share**, this feature causes all rectifiers that are presently on-line (not in standby mode) to attempt to carry a similar percentage of the plant load. Although not at all critical to plant operation, this feature provides a certain level of confidence regarding rectifier operation when it can be observed that the plant load is evenly distributed. It can also serve to alert one to a potential problem in a charging unit if its output is suddenly higher or lower than the remainder of the rectifiers in a plant while load share is enabled.

Load Share can be Disabled (**None**) or Enabled (**Serial** – Serial Rectifiers only; **Mixed** – Both Serials and Ferros in a Millennium SC plant) via front display path: **Menu – Config – Load Share Mode** or on the **Settings – Plant** web page. When set to **Mixed**, the system float voltage will be determined by the voltage adjustments of the ferros in the plant and the MSC controller will adjust the serial rectifier voltages as needed to accomplish load sharing with the ferros as a group.



Settings – Plant – Load Share Mode Selection

Disabling Load Share completely is rarely beneficial. If the ferro rectifier capacity is needed only for recharge purposes in a mixed plant, it could be helpful to enable just the **Serial** load share mode and turn the voltage adjustments of the ferros down slightly to permit the more efficient serials to carry the system load for the bulk of the system life, until battery recharge is required, and they then automatically carry load to support that.

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5. Rectifier, Converter, Inverter, or Ringer Redundancy Loss

M2 can be configured to generate a “Redundancy Loss” alarm against the various types of power units in the system when changes in the system load and/or power unit capacity causes there to no longer be a spare (redundant) power unit, or a configurable number of spare power units of that type in the system. For converter, inverter, or ringer modules, this can be a serious situation as the failure of a single module during this period would result in dropping service to that bus potential. To alert users to this condition when it is activated during peak loading periods, Redundancy Loss is a latched alarm that must be manually cleared once it occurs. The default threshold for Redundancy Loss is 1 redundant power unit.

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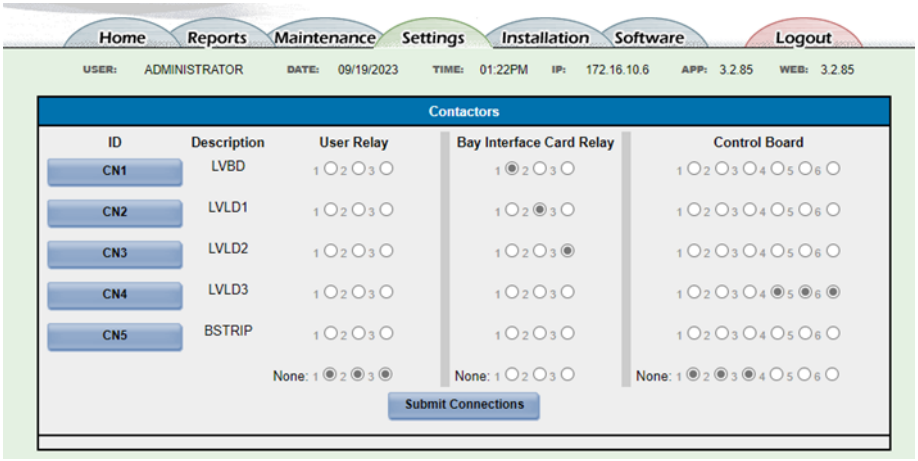
6. Low Voltage Disconnect

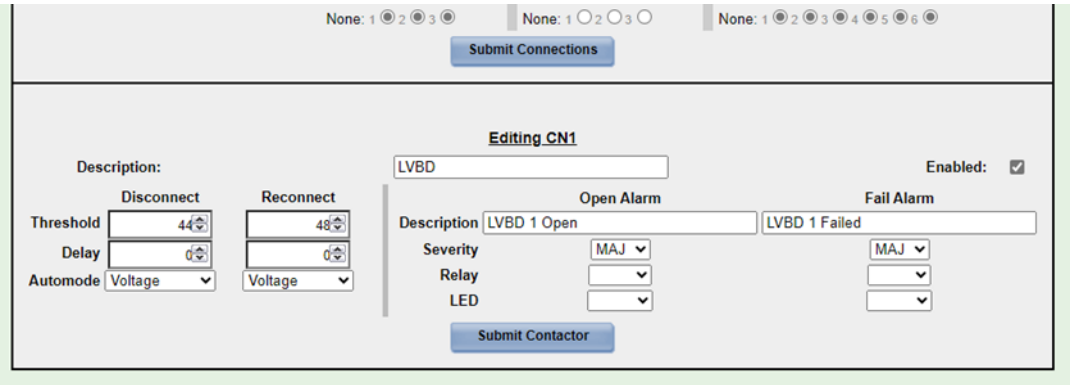
M2 supports **Low Voltage Battery Disconnect** (LVBD) and/or **Low Voltage Load Disconnect** (LVLD) via multiple means. The most common of these, used in GPS cabinets, is using serial data communication between the controller and the system Bay Interface Cards (BICs). Three separately configurable contactor controls may be used, common to all BICs in the GPS system, for control of non-latching type contactors, along with the GPS style BJN (LVBD) and EBV (LVLD) control cards. Infinity plants using the M2 controller can be equipped with up to 6 individually configured NE872 LVD control cards, also using serial bus communication, for control of latching type LVD contactors. For systems using a DC Busway with LVDs in the Busway plugs, the various plug Panel Interface Cards (PICs) may also be used for contactor control with M2. In addition, if there are no BICs or LVD control cards in the power system, User Relays UR1, UR2 and UR3 may optionally be used to control non-latching type contactors. If the User Relays are not used to control contactors, (BICs are present or LVDs are not present), the User Relays may be configured for any purpose. In a power system without a BIC, if a contactor is defined as a battery or load contactor, with a User Relays assigned to control it, the user programmable alarms associated with the User Relay are immediately disabled, and if applicable, a User Relay Conflict Warning is created. The alarm is cleared when all alarms are disassociated with the assigned User Relay.

The M2 controller allows each contactor in the system to be either LVBD or LVLD type. Contactor configuration is completed on the **Settings – System – Contactors** web page, with the default settings for a GPS power system shown here:



Settings – System - Contactors

Note that there are 4 contactor control IDs, **CN1** to **CN4**, each of which can be independently assigned on this page to be wired to and controlled via BICs, NE872 LVD control cards, or M2 User Relays. The **CN5** ID shown on this web page is not currently functional and its use should not be employed. Selecting the desired contactor control ID then expands this window to permit editing of each control's **Description**, **Disconnect & Reconnect** parameters, and **Alarm** settings:



Settings – System – Contactors – Individual Configuration

For the **Disconnect & Reconnect** control parameters, the **Automode** field can be set to either **Voltage** or to **Voltage/Time**, which then uses both the configured **Voltage Thresholds** and **Delay** parameters.

There are no web pages for configuration of the optional busway PIC contactor control settings, so these must be configured using T1.317 command lines as follows:

- ADD DCNPxx — PIC ID 01 to 32 (that is controlling a contactor in the plug)
- CHA DCNPxx,TYP=CNx — Contactor control ID 1 to 5
- CHA DCNPxx,DES=”xxx” — PICxx Contactor Interface (or some other meaningful description)

Note also that many of these parameters can also be set directly from the M2 front display, using menu paths: **Configuration – Contactor Interfaces** and **Configuration – Disconnects**.

7. Monitoring Channels / Remote Peripheral Modules / User Defined Events / Derived Channels / Timer Events

One of the most useful and commonly used features of the Millennium 2 controller is that of monitoring alarms or indications for devices outside of the basic power plant itself. Examples include monitoring alarm conditions, states, or loads for a remote distribution bay, BDFB, inverter plant, converter plant, AC gen-set, or transfer switch. A limited number of binary (on/off) indications for these devices and 2 analog channels (1 voltage and 1 current) can be monitored by the M2 itself. The RPM (Remote Peripheral Monitoring) option adds the ability to monitor not only binary remote indications, but also analog readings of virtually any value that can be accessed as, or converted to, a linear DC voltage value. The readings and values obtained may then be used in program lines of User Defined Events and/or Derived Channels as discussed later in this Section.

M2 Current-limited Battery Voltage Input Signals

The M2 input signals connect to positions on the BSL input / output board as indicated in the following table:

Alarm Signal	Input Assignment	Default Configuration		
		Severity	LED	Alarm Relay
AMJ	BSL-64	Major	None	None
AMN	BSL-66	Minor	None	None
OS	BSL-72	Minor	BATT	None
FAJ	BSL-63	Major	DIST	MJF
FAN	BSL-65	Minor	DIST	MNF

M2 Alarm Input Signals

The 5 different alarm input signals identified in this table, along with their default severity, LED and output alarm relay configurations, all activate against a battery or hot input to the referenced input. In most cases, **FAJ** (Fuse Alarm Major) will already be used for monitoring the power plant distribution alarms, but several, if not all, of the remaining signals will be available for discretionary use. To activate, the incoming signal must be of the same voltage and polarity as the plant voltage and be current-limited by a 1000 ohm, 2-watt resistance. Refer to the Wiring Alarm and Control Inputs section of the Millennium 2 Basic product manual for more info on this input signal wiring.

If the controller is used in a GPS (Galaxy Power System) cabinet, these signals may alternately be terminated on the BLJ/BIC (Bay Interface Card) for any of these cabinets. M2 provides the ability to modify not only the description for any of these signals, but also the default severity, LED and alarm relay activated, to values logical for the alarm event being monitored. For example, if OS (Open String) is not being used by the power plant, there is no reason it cannot be used for monitoring the fuse/circuit breaker alarm status of a remote distribution bay. However, its description should be changed accordingly to “BDFB xxx Alarm” and the severity, LED and alarm relay configuration should then be changed to Major, DIST and MJF respectively.

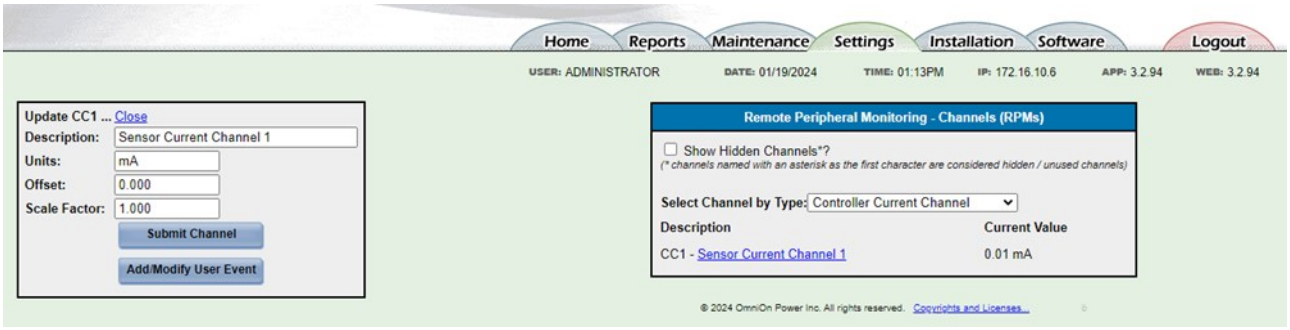
M2 Analog Channels

The M2 Analog Channels also connect to positions on the BSL input / output board as indicated in the following table:

Input Channel	Input Assignments	Default Configuration			
		Units	Offset	Scale Factor	Range
CC1 Sensor Current	BSL-87 (I)	mA	0.00	1.00	-
	BSL-88 (Rtn)				
CV1 Sensor Voltage	BSL-91 (+)	V	0.00	1.00	5
	BSL-92 (-)				

M2 Analog Inputs

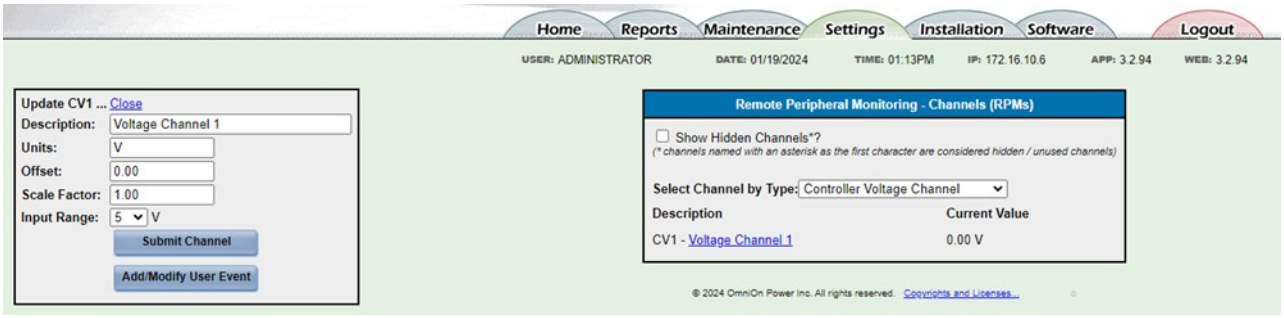
CC1 is a 4-20mA input current channel, intended for use with the 4-20mA output signal used in many monitoring transducers. Configuration for it is completed on the **Settings – Remote Monitor Channels (RPMs) – Controller Current Channel** web page:



M2 CC1 Configuration

The Description and Units parameters are just text fields, for explaining the channel use. The Offset and Scale Factor fields are explained in some detail below and must be applied based on the parameters for the specific transducer being monitored.

CV1 is a 0-5V input channel when paired with a pair of 10.98K ohm resistors, ¼ watt or larger, available as a kit per 150022227, also intended for use with an external monitoring transducer. CV1 may instead be scaled as a 0-30V channel by using a pair of 115.2K ohm resistors, ¼ watt or larger, available as a kit per 150022228, or as a 0-60V channel by using a pair of 242K ohm resistors, ¼ watt or larger, available as a kit per 150022229. When wiring CV1, the connection to BSL-91 must be (+) in respect to the connection to BSL-92. Configuration for CV1 is completed on the **Settings – Remote Monitor Channels (RPMs) – Controller Voltage Channel** web page. As with channel **CC1**, the Description and Units parameters here are just text fields, for explaining the channel use. Range must be selected to match the scaling resistors wired into the **CV1** measurement channel. The Offset and Scale Factor fields must be applied based on the parameters for the specific transducer being monitored.



M2 CV1 Configuration

Offset and Scale Factor

This discussion of the **Offset** and **Scale Factor** parameters used in the **CC1 & CV1** channel configurations also applies to all the Voltage Remote Peripheral Monitor module channels that follow, which also include these parameters to permit their output readings to become a useful value like a temperature or a hydrogen gas % or whatever it is that a transducer being monitored is reporting.

To be compatible with M2 / RPM monitoring, a measurement transducer output signal must be dc (voltage or current) and must be linear. Using a temperature transducer as an example, changes in the transducer output being monitored must be directly proportional to changes in temperature. Scale Factor then is the multiplication constant needed to convert this measured reading to the desired value. Scale Factor is equivalent to the slope (m) of a plotted 2-dimensional line graph, and in that context is equal to $\Delta y / \Delta x$, where x is the measured output of the transducer and y is the value to be reported for the channel.

Some transducers provide a zero output when there is a zero input. One example of this is a 50 mV, 500 A shunt, a simple transducer that will provide 0 mV out for 0A through it. These kinds of transducers are referred to as “zero crossing” and only require a Scale Factor (or multiplication constant) parameter to convert the measured voltage to the proper load value. However, some transducers do not provide a zero output for a zero input. For example, a 4 mA to 20 mA output current loop may correspond to a frequency reading of 0 Hz to 100 Hz, for a particular frequency transducer. To accurately measure the output of non-zero crossing transducers, a transducer Offset parameter is used. This Offset must be calculated and programmed for any non-zero crossing transducer before an accurate output value can be read across the output range of the transducer.

M2 calculates Offset and Scale Factor together as: Reported Value = (Measured Value – Offset) * Scale Factor. Using our plotted 2-dimensional line graph analogy, Offset represents the intersection of the plotted line with the x axis (y = 0).

Transducer specification sheets provide information showing how their input and output are related. This relationship may be shown through equations or sets of points, from which the Scale Factor and Offset parameters are determined. Examples showing these calculations used for Scale Factor and Offset follow:

Calculating Transducer Offsets and Scale Factors

The following examples show typical transducer specifications and general form equations matching those specifications. Calculation examples are then provided for finding both the Scale Factor and the Offset for that example. These equations can be used for any kind of transducer whose input/output specification matches the general form equations shown.

Symbols: These equations use the following symbols: x or v, y, b and m.

- x or v represents the output of the transducer. It is the value actually measured by the channel and is plotted onto the x-axis of a 2- dimensional graph.
- x1 or v1 represents a specific transducer output, such as 4mA, 10V, or 50mV.
- y represents the reading that the transducer is measuring, such as frequency or temperature. It is plotted onto the y-axis of a 2- dimensional graph.
- y1 represents a specific measurement value, such as 100Hz or 500A.
- b is a constant in the equation, representing the y-intercept of the transducer output line when plotted on a 2-dimensional graph. It is often supplied in the transducer sheet or may be calculated.
- m is the slope of a line when plotted on a 2- dimensional graph, defined as Δy / Δx. m is the Scale Factor parameter used in configuring the channel.

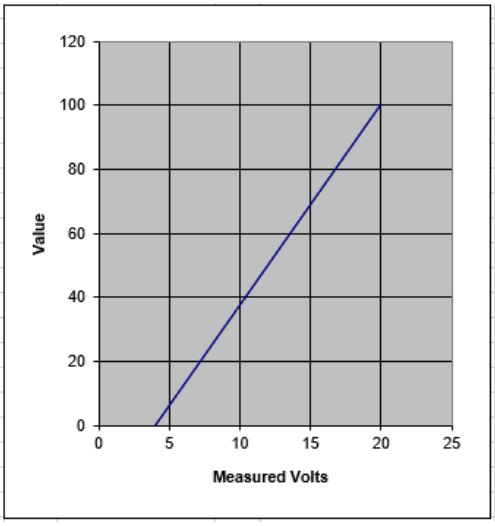
As previously mentioned, one of the common transducer outputs is a 4mA to 20mA current loop. We can choose to monitor this current loop using the M2 CC1 channel.

Information from the transducer specification sheet:

4 mA = 0 Hz

20 mA = 100 Hz

The following is a plot of this relationship on a 2D line graph:



General form equations:

at v1 you get y1

at v2 you get y2

and

y = mx + b (2D formula for a non-vertical line)

For this example, measuring the 4mA to 20mA current loop:

v1 = 4 mA

v2 = 20 mA

y1 = 0 Hz

y2 = 100 Hz

Calculations:

Scale Factor = m = slope = Δy / Δv

= (y2-y1) / (v2-v1)

= (100-0) / (20-4)

= 100 / 16

= 6.25

b = y intercept

y = mx + b; so therefore y – mx = b

Solve for b at any point on the line:

At (4,0):	At (20,100):
b = 0 – (6.25 x 4)	b = 100 – (6.25 x 20)
b = -25	b = -25

Offset = x intercept

Use y = mx + b and solve for x with y = 0:

y-b = mx; so therefore y-b / m = x

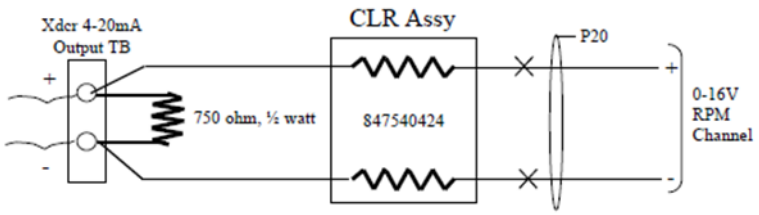
= 0 - (-25) / 6.25

= 25 / 6.25 = 4

With one of our data points (4,0) on the X-axis, an Offset = 4 is obvious.

A Scale Factor of 6.25 and Offset of 4 on our CC1 channel will result in an accurate reading of frequency when using this transducer.

For M2 to monitor this 4 mA to 20 mA output signal with anything other than its single **CC1** channel, it is necessary to add a load resistor in series with this current loop. Current limiting resistor assemblies are then used between the load resistor and a suitably sized Voltage RPM channel (or the **CV1** channel) to measure the voltage drop across this load resistor that is then proportional to the transducer output. The load resistor value cannot exceed the output power specifications for the transducer used and is used for the subsequent Scale Factor and Offset calculations of the channel. The following shows a typical 4 mA to 20 mA measurement and the resulting calculations using this technique:



4-20mA Xdcr Monitoring via 16V RPM Channel using a 750 ohm Load Resistor
4mA = 3V; 20mA = 15V

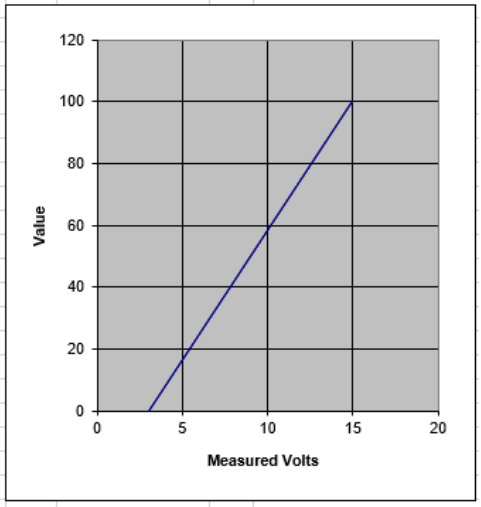
Information from the transducer

specification sheet:

4 mA = 0 Hz

20 mA = 100 Hz

The following is a plot of this relationship on a 2D line graph:



General form equations:

at v1 you get y1

at v2 you get y2

and

y = mx + b (2D formula for a non-vertical line)

For this example, measuring the voltage drop across the 750 ohm load resistor:

v1 = 4 mA x 750 ohms = 3V

v2 = 20 mA x 750 ohms = 15V

y1 = 0 Hz

y2 = 100 Hz

Calculations:

Scale Factor = m = slope = Δy / Δv
= (y2-y1) / (v2-v1)
= (100-0) / (15-3)
= 100 / 12
= 8.33

b = y intercept
y = mx + b; so therefore y – mx = b

Solve for b at any point on the line:

At (3,0):	At (15,100):
b = 0 – (8.33 x 3)	b = 100 – (8.33 x 15)
b = -25	b = -25

Offset = x intercept
Use y = mx + b and solve for x with y = 0:
y-b = mx; so therefore y-b / m = x
= 0 - (-25) / 8.33
= 25 / 8.33 = 3
With one of our data points (3,0) on the X-axis, an Offset = 3 is obvious.

A Scale Factor of 8.33 and Offset of 3 on our **CV1** channel or on a 16V RPM channel will result in an accurate reading of frequency when using this transducer.

A final example, where the transducer provides a 0-2V output signal for the coolant temperature of a gen-set and provides a calculation formula in the line graph format:

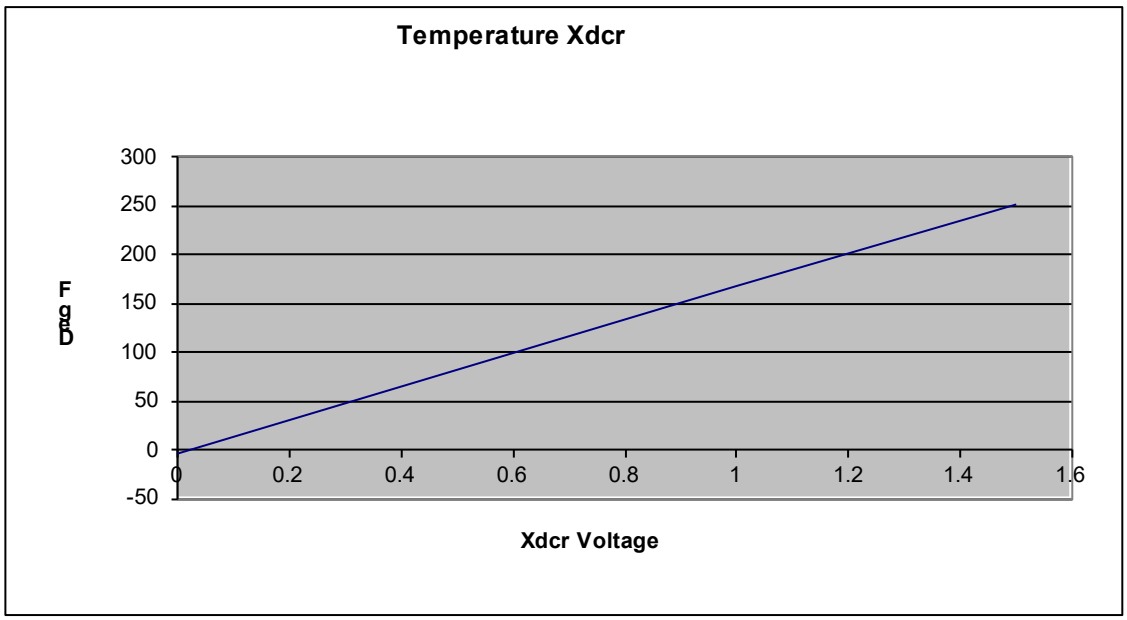
Information from specification sheet:

Deg F = 171v - 4

General form equation:

y = mx + b (2D formula for a non-vertical line)

The following is a plot for this formula on a 2D line graph:



Calculations:

Scale Factor = m = slope = 171

b = y intercept = -4

Offset = x intercept

Use y = mx + b and solve for x with y = 0:

y-b = mx; therefore y-b / m = x

= 0 - (-4) / 171 = 0.0234

A Scale Factor of 171 and Offset of 0.0234 on a 3V RPM channel will result in an accurate reading of temperature when using this transducer.

Remote Peripheral Monitoring

Easily the most popular M2 controller option, Remote Peripheral Monitoring permits the controller to monitor not only binary signals like those described above, but also to report and keep statistics on analog values that are, or can be changed to, linear DC voltages. Monitoring battery voltages, DC loads using shunts, AC loads and voltages using transducers, and external power plant alarms are some of the more popular uses for RPMs. Temperature measurements using 100K ohm nominal NTC (Negative Temperature Coefficient) thermistors and control functions through programmable 0.3 amp capacity form-C relays are also available.

The RPM system consists of one or more RPM modules physically located externally to the M2 controller, daisy-chained back to the controller using a shielded signal bus cable. This “Remote” monitoring feature serves to both reduce cable congestion at the controller and permits the individual channel monitoring wiring to be minimized, reducing the installation effort and cost while increasing monitoring accuracy. The M2 controller comes ready to be equipped with RPM modules, over a single RPM bus of up to 90 RPM modules maximum.

Module types that may be selected are shown in the following table. Note that each DC voltage, shunt and binary module supplies six monitoring circuits of the range and accuracy depicted, plus a temperature channel for use with a 100K ohm NTC thermistor. The temperature module has seven temperature channels and the control relay module contains three independent form-C relay sets.

Module Type	Code	Channel No.	Channel Range	Channel Accuracy
Voltage	221J	6 + 1 Temp	0-100mV DC	0.55mV DC
	221A		0-3V DC	5mV DC
	221B		0-16V DC	25mV DC
	221C		0-70V DC	50mV DC
	221D		0-200V DC	150mV DC
Shunt	221F		-50mV to 150mV DC	0.55mV DC
Binary	222A		5-200V DC	NA
Temperature	223T	7	-40 C to 70 C	1 C
Control Relay	214A	3	0.3A DC max	NA

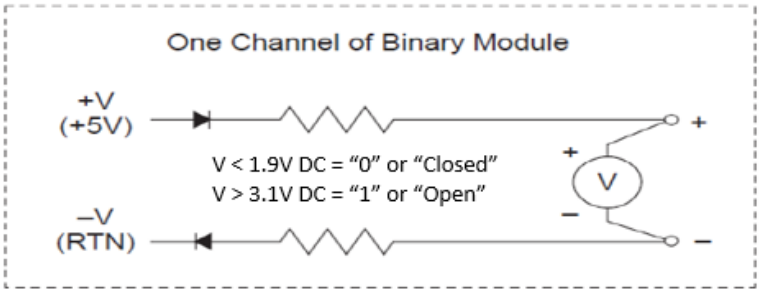
RPM Types

Each voltage, shunt and binary monitoring circuit must be protected by a pair of 100K ohm CLRs (Current Limiting Resistors). These CLRs are provided as pairs within a common assembly per part numbers **847540424** or **847568920** with each RPM that is shipped, except for the 221F Shunt RPM, since these 221F modules are often used in GPS distribution cabinets that include the necessary CLRs already in the GPS distribution panel circuit cards. When the 221F RPMs are being used outside of a GPS application, these CLRs will need to be ordered separately. Temperature channels must not use CLRs, and for control relays, it is the user’s responsibility to limit current passing through their contacts to their 0.3A maximum limit.

It is useful to regard each channel of a voltage, shunt, or binary RPM as a simple analog DC voltmeter. When using this type of meter, it is important to select a range that is greater than the voltage to be measured, yet small enough to move the needle into a portion of the scale where some accuracy can be obtained. Correct polarity must also be observed to allow the needle to read a positive value. Think likewise about selecting and wiring a RPM channel. Choose a RPM channel size to match the actual DC voltage reaching the channel terminals and connect the monitoring pair to provide a positive reading. Software configuration of scale factor (-1 can be used to obtain a negative reading), offset, units, etc. is then completed to permit the channel value to be reported in the desired fashion. AC loads, voltages, and frequency may only be monitored with RPMs if a transducer of some type is first used to change the measured value to a linear DC voltage.

Each Voltage or Shunt RPM channel automatically gets basic statistics associated with it and can be configured for Busy Hour or Trend statistics. Refer to **Section 8** on Statistics for details.

Binary modules are somewhat unique from the other voltage or shunt modules. Each binary channel has its own internal +5V (nominal) bias voltage supply and the "value" reported for a channel is either "Open" or "Closed", as depicted in the following functional schematic.



Functional Schematic for One Channel of a 222A Binary Module

The internal +5V bias supply permits an isolated set of alarm contacts to be monitored by simply wiring it across the channel. As shown here, the necessary CLRs are then internal to the channel itself and no external CLRs are to be used for monitoring a dry set of contacts. Binary channels may also be wired to monitor voltage signals, ground signals, or non-isolated alarm contacts being shared with other alarm or monitoring systems, but both polarity and the proper placement of external CLRs must be observed. Refer to Fig. 5-10 to 5-15 of the RPM product manual, 167-790-063 for wiring these circuits. In short, the voltage measured at the binary channel must range from 0 to +1.9V DC for a "Closed" state to be recognized and from +3.1 to +200V DC for an "Open" state. A voltage outside of these ranges results in an "Unknown" state and a PGI (Program Line Invalid) alarm against any UDE (User-Defined Event) program line using that channel.

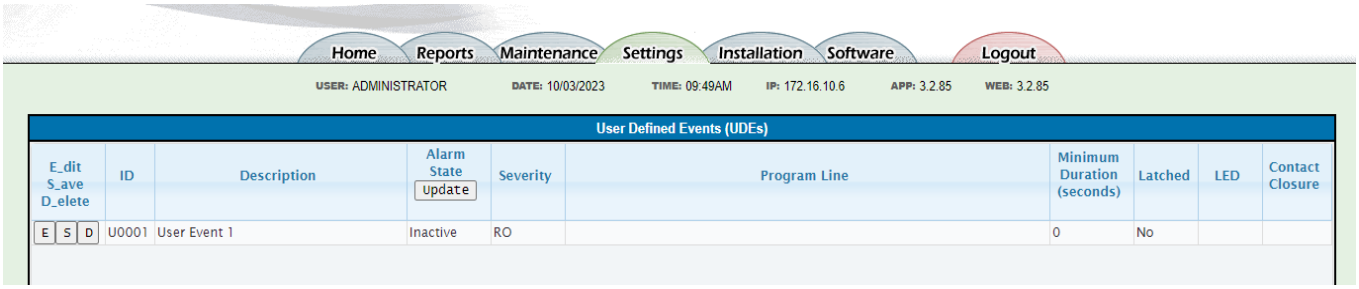
Configuration of RPM channels must be completed via web pages and consists of Channel Descriptions for all types, Amps & mV fields for Shunt channels, Scale Factor, Offset, and Units for Voltage channels (see previous discussion in this section for Offsets and Scale Factors), and a Program Line for Control Relay channel types. Program Lines are discussed under User-Defined Events, which follow.

User-Defined Event (UDE) Programming

Voltage, shunt, binary, and temperature monitoring channels only report values to the controller. For the controller to do anything with this data beyond just keeping statistics for the analog values, it is necessary to place these values into the “program lines” of UDEs, derived channels or control relays.

The strength and flexibility of the M2 controller are most evident in the UDE programing. Up to 1500 of these software devices may be programmed within a controller to customize reactions to monitored events and/or values based on the evaluation of program lines. When the program line for a UDE evaluates to a true condition for a period longer than any delay programmed in the “Minimum Duration” field, the UDE activates. The severity (Critical, Major, Minor, Warning, or Record Only) of the active event, along with which, if any, of the front display LEDS and/or discrete alarm relays activate with it, are programmable fields for the UDE. When the program line is no longer true, the UDE retires, unless the “Latched” field attribute is enabled, whereupon a “Clear Events” command must also be used from the front display or **Maintenance** tab of the web pages for it to retire. A history log of the most recent 256 events is kept for UDEs.

UDEs are added and modified using web pages at the **Settings – User Defined Events (UDEs)** page:



Settings – UDEs

This page lists all existing UDEs when it posts. The **Add UDE** button at the bottom of the page adds a new UDE, using the next available UDE event number that is available. The “E” button then opens all available fields for that event for editing: **Description**, **Severity**, **Program Line**, **Minimum Duration**, **Latched**, **LED**, and **Contact Closure**. The “S” button is then used to save any changes. The “D” button deletes that UDE from the system.

The **Description** field (30 characters max) should be programmed to accurately reflect the condition that results in a true program line and is what appears on the controller display when the alarm is active. “5KVA Inverter Fail PBD001.1” or “BDFB 101 Ld-A > 80%” are much more useful UDE Descriptions than a simple repeat of the program line would be. The object is to lead a user directly to the source of the trouble from the controller display when the UDE activates.

The **Severity** field sets how the UDE alarm event is to be treated by the M2 when the Program Line is true for a longer period than that set by the **Minimum Duration** field. Severity choices are **Critical**, **Major**, **Minor** (all activate the appropriate alarm relay), **Warning** (notification only, no alarm relay), and **Record Only** (no notification on the M2 display). A common source of frustration for users.responding to an active UDE event occurs when a display LED and/or discrete alarm relay (Contact Closure configuration field) is active, but the UDE causing it has been assigned a severity of Record Only. Since Record Only events are not displayed on the front panel, the user must then access the controller via web pages to identify the active event. A UDE assigned Record Only severity, should therefore never be programmed to activate a LED or alarm relay. Use a severity of Warning instead when it is not desirable to process an alarm, but a LED or discrete relay is needed.

Each UDE **Program Line** can have 60 characters max, and a total of 12 **operators** and **operands** combined.

Available **operators** for UDE program lines are:

- Logical operators: &, AND, | (pipe symbol), OR, ^, XOR, !, NOT
- Binary mathematical operators: +, -, *, /
- Unitary mathematical operators: +, -
- Comparator operators: = EQ, < LT, > GT
- Parentheses are accepted.
- The expression has the following precedence (highest first): (), NOT, unary +, negation -, *, /, +, -, <, >, EQ, AND, XOR, OR.

Available **operands** for UDE program lines are:

- **Numbers** are accepted.
- Plant analog attributes: **DC1 VDC** (plant voltage), **DC1 ADC** (plant current), **DC1 TRD** (Total Rectifier Drain, **DC1 UBT** (Universal Battery Temperature)
- Rectifier current attribute: **Gxx ADC**, where xx is the Rectifier ID
- Remote Peripheral Monitor channel value attribute: **Cxyy VAL**, where x is the channel from 1 to 7, and yy is the module address from 01 to FF (Hex number)
- Remote Peripheral Monitor state and alarm attributes: **Cxyy ATR**, where x is the channel from 1 to 7, yy is the module address from 01 to FF (Hex number); and ATR is:
  - **MOR** (Measure Out of Range alarm),
  - **MDF** (Module Fail alarm),
  - **MTC** (Module Type Conflict alarm), or
  - **STT** (for module state, which has a value of 0 if the module is connected and good, or 1 otherwise)
- Derived Channel value attribute: **Dxx VAL**, where xx is from 01 to 32
- Timer Events state as a binary value: **Txx STT**, where xx is 01-32
- User Defined Event alarm state: **Uxxxx AST**, where xxxx is 0001-1500
- All System Alarms state: alarm id **AST**

For example: **(C301 VAL > DC1 VDC) & BDA1 AST** will evaluate to TRUE if channel 3 of module 01 value is greater than the plant voltage AND there is a BD alarm active in the system.

The use of upper or lower case letters have no effect in program lines.

Note: Review the Functional Schematic for a Binary RPM channel in the Remote Peripheral Module section of this chapter and observe the following:

- < 1.9V means the state is OFF or CLOSED or 0. Acceptable program lines to indicate this state are Cxyy=Off; Cxyy=Closed; Cxyy=0; or !Cxyy
- > 3.1V means the state is ON or OPEN or 1. Acceptable program lines to indicate this state are Cxyy=On; Cxyy=Open; Cxyy=1; or Cxyy

A UDE program line can contain system resources that can be added to or removed from the system dynamically (for example rectifiers or remote peripheral monitoring modules). If the expression has an operand that no longer exists in the system, the program line is no longer valid and the **PGI** (Program Line Invalid) alarm activates.

If an object used in a program line has only one attribute that can be used, then the attribute name can be omitted. For example:

- **C105 VAL** or **C105** may be used.
- **BDA1 AST** or **BDA1**, **TE03 STT** or **TE03** may be used.
- **U0012 STT or U0012**, **DR08 VAL** or **DR08** may be used.
- But you must enter **DC1 ADC**, **DC1 VDC**, **DC1 TRD**, **DC1 UBT** because the DC1 object has more than one attribute that can be used in a program line.

The following are additional examples of valid User Defined Event (UDE) program lines:

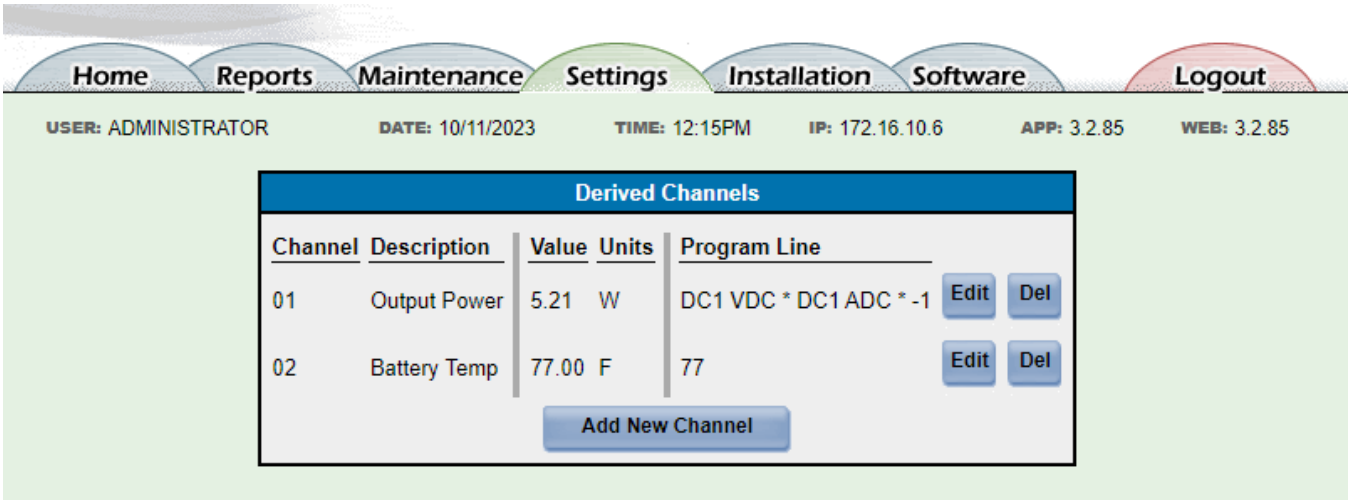
- **(C105 < 20) | (C105 > 60)** Channel 1 of Shunt RPM 05 activates if its reading is out of the 20A to 60A range.
- **MOR1 | MTC1 | MDF1** Activates if any RPM Measurement Out of Range, Module Type Conflict, or Module Fail alarms activate.
- **C103** Here, channel 1 of Binary RPM 03 is wired to an FAJ alarm signal for a distribution panel. Normally there will be 0V at this point. If the reading exceeds 3.1V, the binary channel changes state, activating this UDE.
- **(C102 + C202) > 125** This UDE activates if the sum of two “Diode-ORed” loads, monitored by RPM Shunt channels C102 & C202, is greater than their 125A breaker size.
- **(C507 < 2.12) | (C507 > 2.22)** C507, a 3V RPM channel is used to monitor the “pilot cell” of a battery string. The “pipe” symbol (|) in this example provides the logical “OR” function, so this program line activates when the monitored cell voltage is outside the range of 2.12 to 2.22 volts.
- **((-DC1 VDC – C30A) – C30A) > 0.15** plus a 2nd UDE **((-DC1 VDC – C30A) – C30A) < 0.15**

  Here, C30A is a 70V RPM channel, used to monitor the “mid-string” voltage of a battery string. The program lines for these 2 UDEs compare this mid-string voltage against the total string voltage, activating if the difference exceeds +/- 0.15V of what it should be, to recognize a bad cell in the first or second half of the battery string. Note that 2 UDEs are needed here due to the limitation of max 12 operators and operands combined within a single program line.

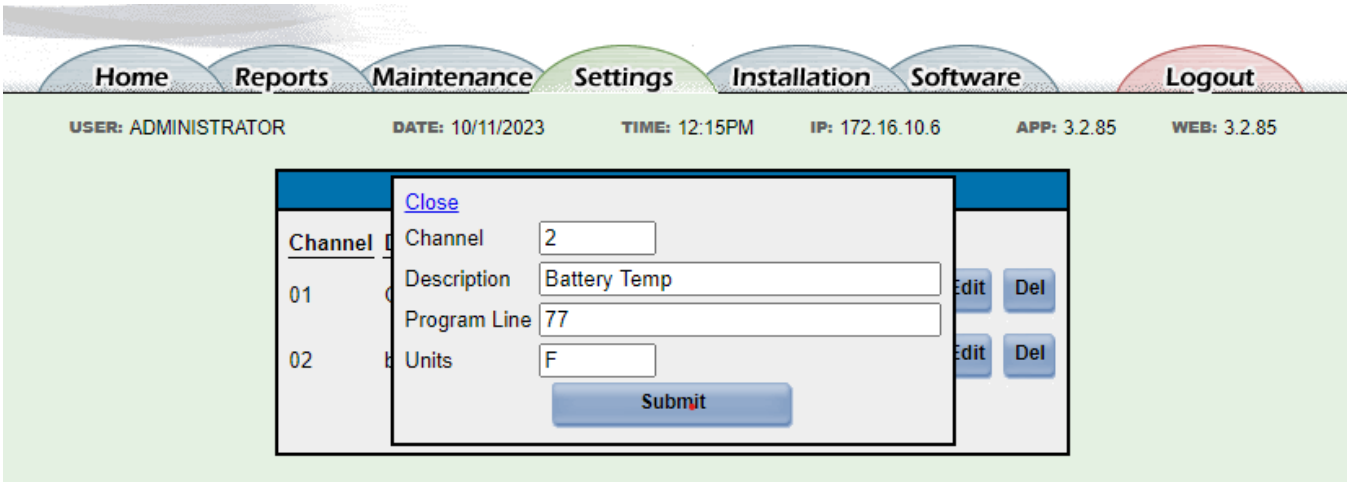
Derived Channels

Derived Channels permit the user to group together a number of system measuring values through the use of an arithmetic program line to develop meaningful data. M2 supports a total of 32 Derived Channels, **D01** to **D32**. Each has a program line as an arithmetic expression which can take the same mathematical operators and operands shown in the User Defined Event section.

Derived Channels are added and modified using web pages at the **Settings – Derived Channels** page:



Use the "Edit" button for a channel to change its Description, Program Line, or Units fields:

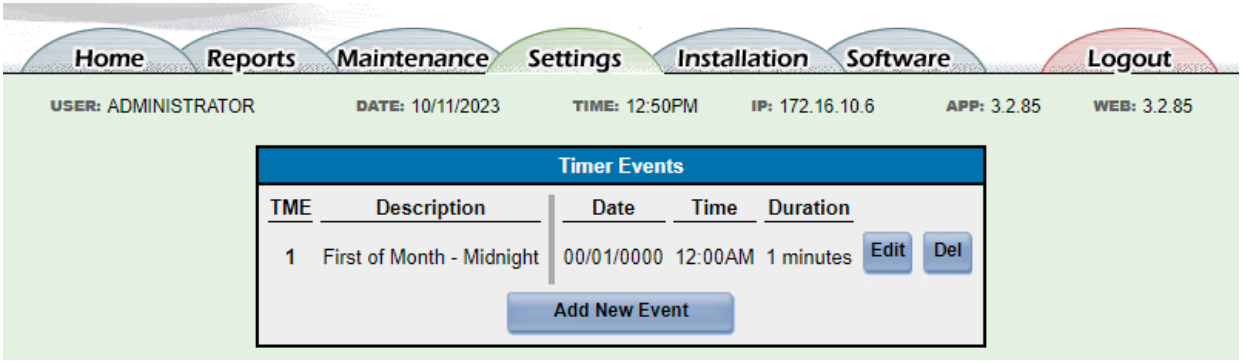


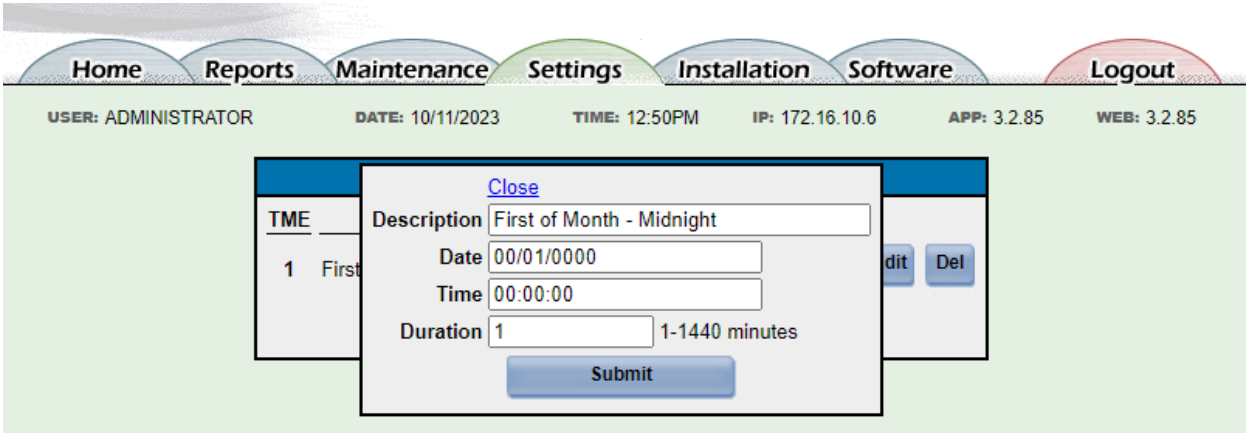
As with UDEs, each Derived Channel program line may have up to 60 characters and the number of operators and operands combined in a program line cannot exceed 12. A program line that contains any invalid operand will activate the Program Line Invalid alarm. For example, if the program line contains C308 (the value for channel 3 of Remote Peripheral Module 08) and the 08 RPM is removed from the system, the program line becomes invalid. Each Derived Channel has basic statistics associated with it, and any of the 32 Derived Channels can be configured for Busy Hour or Trend statistics. Refer to **Section 8** on Statistics for details.

Timer Events

Timer Events may be used to generate a binary signal at a specified time and date that will persist for the duration configured. This binary signal can then be used in a User Defined Event program line to generate time-based alarms. There may be up to 32 Timer Events available in M2, **T01** to **T32**. For each of these events, the **start date**, **start time**, and **duration** in minutes (0 to 1440 minutes (1 day)) must be configured. The default start date (mm/dd/yyyy) is daily (00/00/0000), the default start time (hr:min:sec) is midnight (00:00:00), and the default duration is forever (0). Setting any portion of the date to 0 causes that value to be ignored when deciding if the Timer Event is active. For instance, a Timer Event with a date of 00/01/0000 will occur on the first of every month. Timer Events with invalid values will be rejected and the changes will not be made. If any change is made to the start date, start time, duration, or to the M2 date and time, M2 will re-evaluate these parameters and change the event state as determined to **ON** (1) or **OFF** (0). After evaluating the Timer Event start date, time, duration, and current date, time, if the current M2 time value is outside the calculated Start / End window then the Timer Event state is OFF; if it is inside the Start / End window then the Timer Event state is ON.

TMEs are added, deleted, and modified using web pages at the **Settings – Timer Events** page:

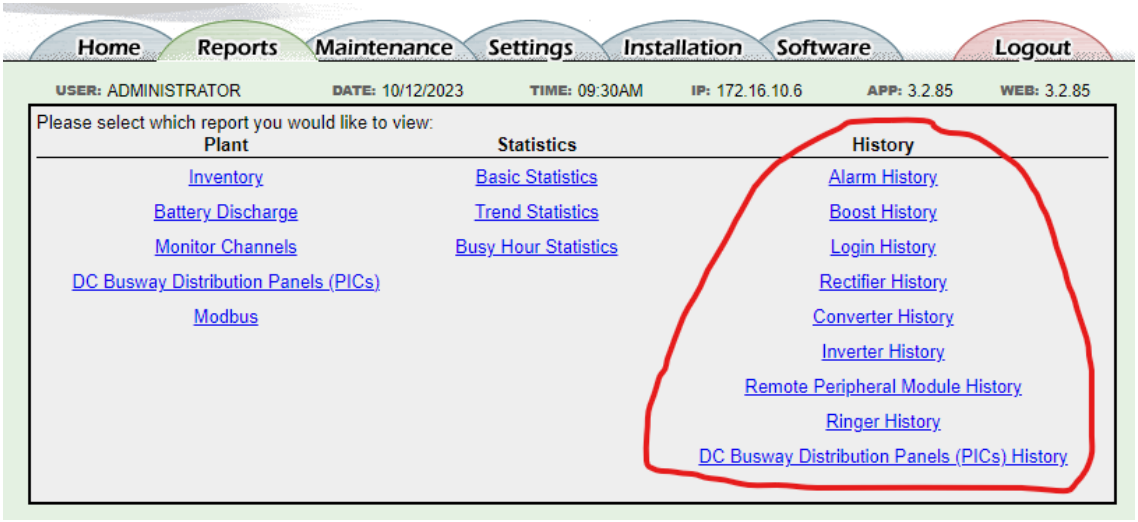




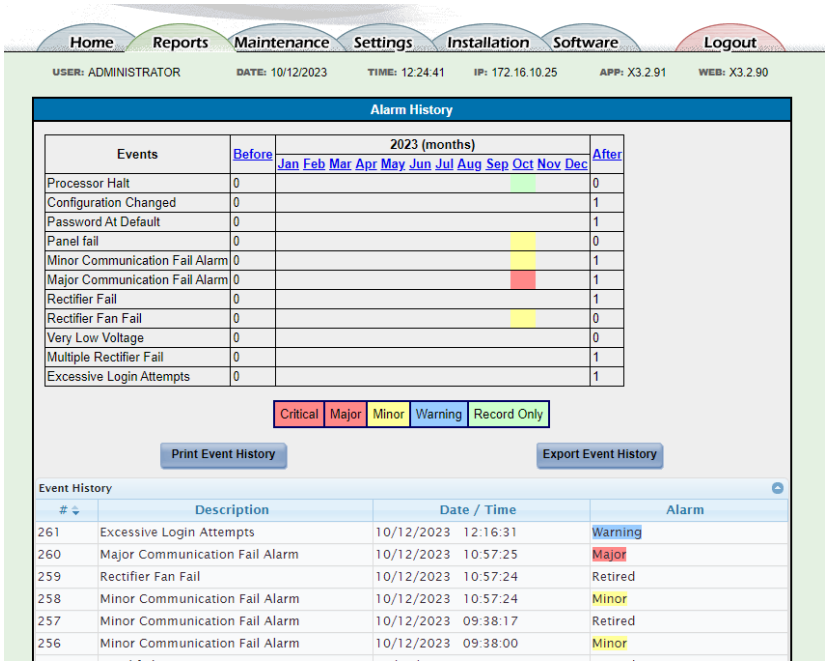
8. History Logs / Statistics

History Logs

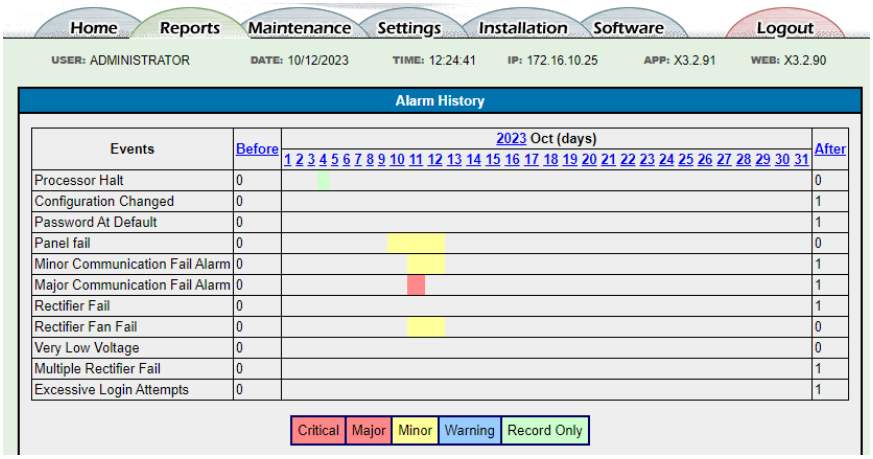
M2 History logs record alarms and events that occur in the system, including Rectifier state history, Boost history, and Login history. M2 History logs may be reviewed from the both the front display (**Menu – History**) and via the various web pages under the **Reports** tab:



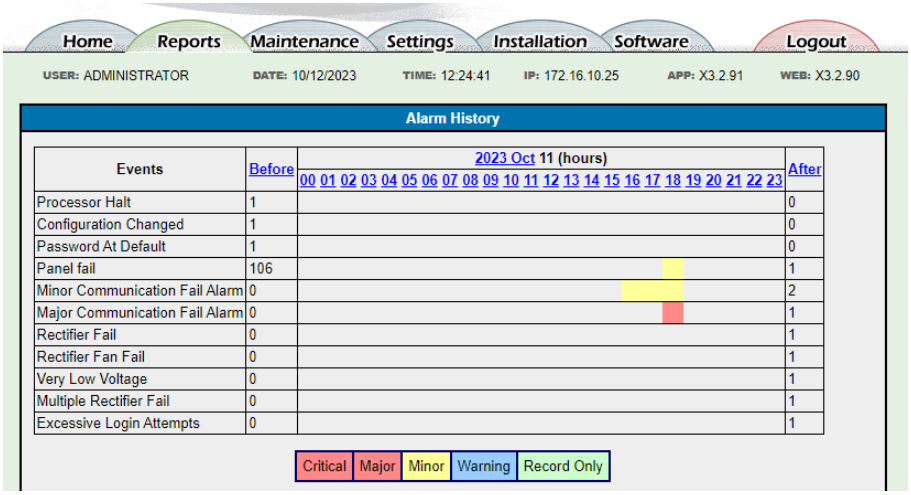
The Alarm History web page provides the report data in both a bar graph format and a detailed listing showing Date & Time for each of the last 1024 events or the last time the History log was cleared. If the log reaches its maximum number of events, the oldest event is replaced by the next event in a first in, first out chronological basis:



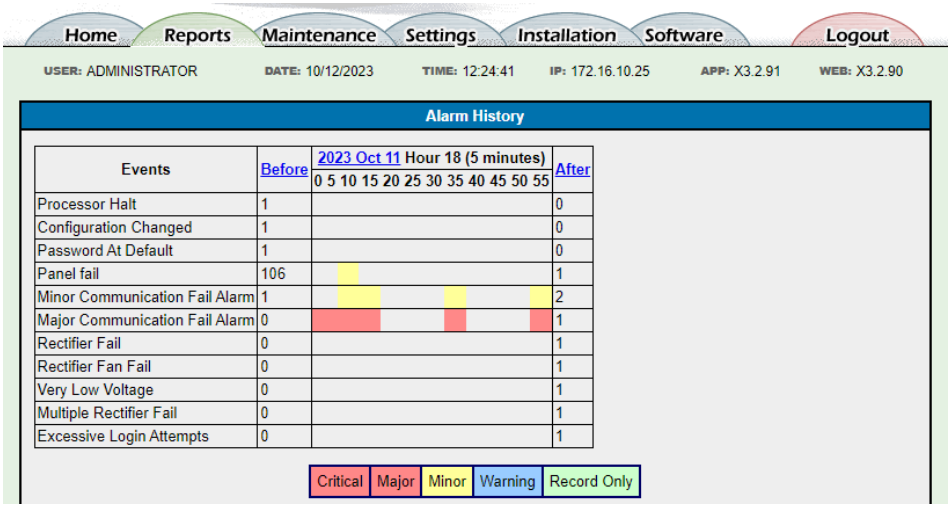
For the bar graph report, additional detail by date & time can be seen by selecting initially the month.



Then the day of that month:

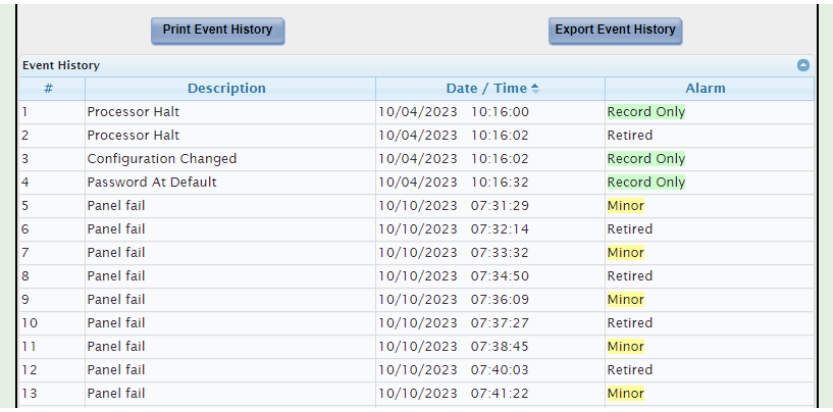


Then the hour of that day:



The Event History list report can be ordered oldest to newest (default) or reverse, or by the Alarm Severity, or by the Alarm Description itself by selecting the appropriate column of the report, one or more times.

Oldest to Newest (default):

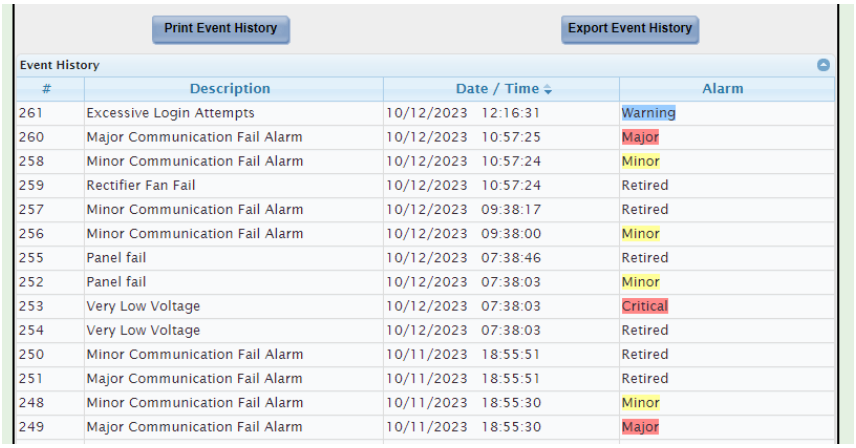


Print Event History | Export Event History

Event History

#	Description	Date / Time	Alarm
1	Processor Halt	10/04/2023 10:16:00	Record Only
2	Processor Halt	10/04/2023 10:16:02	Retired
3	Configuration Changed	10/04/2023 10:16:02	Record Only
4	Password At Default	10/04/2023 10:16:32	Record Only
5	Panel fail	10/10/2023 07:31:29	Minor
6	Panel fail	10/10/2023 07:32:14	Retired
7	Panel fail	10/10/2023 07:33:32	Minor
8	Panel fail	10/10/2023 07:34:50	Retired
9	Panel fail	10/10/2023 07:36:09	Minor
10	Panel fail	10/10/2023 07:37:27	Retired
11	Panel fail	10/10/2023 07:38:45	Minor
12	Panel fail	10/10/2023 07:40:03	Retired
13	Panel fail	10/10/2023 07:41:22	Minor

Newest first (Date / Time or Event # selected):

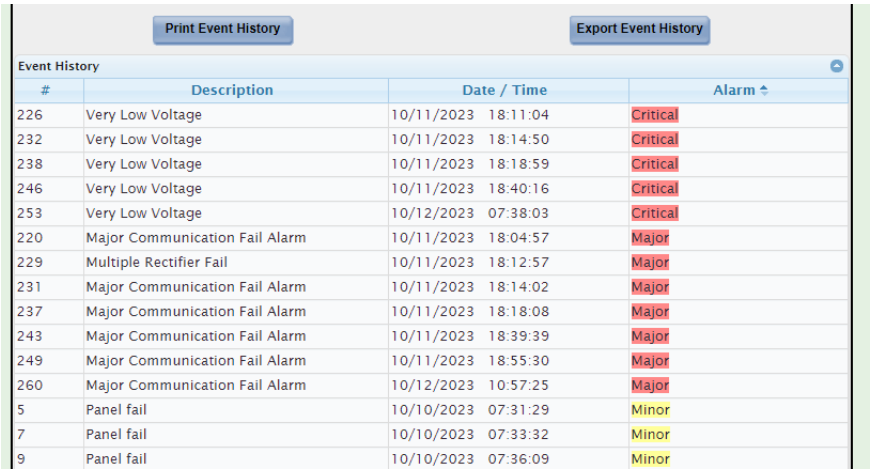


Print Event History | Export Event History

Event History

#	Description	Date / Time	Alarm
261	Excessive Login Attempts	10/12/2023 12:16:31	Warning
260	Major Communication Fail Alarm	10/12/2023 10:57:25	Major
258	Minor Communication Fail Alarm	10/12/2023 10:57:24	Minor
259	Rectifier Fan Fail	10/12/2023 10:57:24	Retired
257	Minor Communication Fail Alarm	10/12/2023 09:38:17	Retired
256	Minor Communication Fail Alarm	10/12/2023 09:38:00	Minor
255	Panel fail	10/12/2023 07:38:46	Retired
252	Panel fail	10/12/2023 07:38:03	Minor
253	Very Low Voltage	10/12/2023 07:38:03	Critical
254	Very Low Voltage	10/12/2023 07:38:03	Retired
250	Minor Communication Fail Alarm	10/11/2023 18:55:51	Retired
251	Major Communication Fail Alarm	10/11/2023 18:55:51	Retired
248	Minor Communication Fail Alarm	10/11/2023 18:55:30	Minor
249	Major Communication Fail Alarm	10/11/2023 18:55:30	Major

By Alarm Severity (Alarm selected):

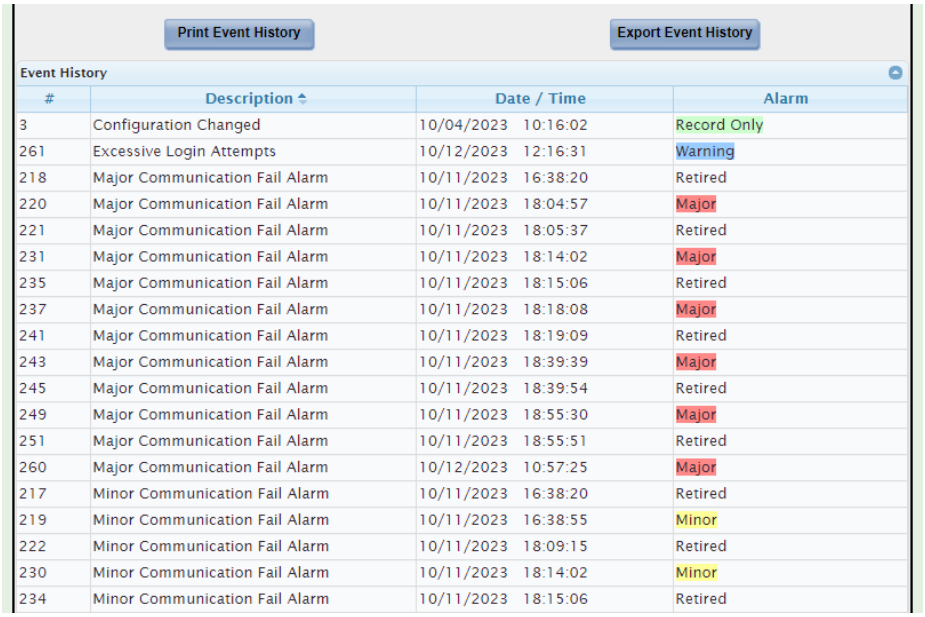


Print Event History | Export Event History

Event History

#	Description	Date / Time	Alarm
226	Very Low Voltage	10/11/2023 18:11:04	Critical
232	Very Low Voltage	10/11/2023 18:14:50	Critical
238	Very Low Voltage	10/11/2023 18:18:59	Critical
246	Very Low Voltage	10/11/2023 18:40:16	Critical
253	Very Low Voltage	10/12/2023 07:38:03	Critical
220	Major Communication Fail Alarm	10/11/2023 18:04:57	Major
229	Multiple Rectifier Fail	10/11/2023 18:12:57	Major
231	Major Communication Fail Alarm	10/11/2023 18:14:02	Major
237	Major Communication Fail Alarm	10/11/2023 18:18:08	Major
243	Major Communication Fail Alarm	10/11/2023 18:39:39	Major
249	Major Communication Fail Alarm	10/11/2023 18:55:30	Major
260	Major Communication Fail Alarm	10/12/2023 10:57:25	Major
5	Panel fail	10/10/2023 07:31:29	Minor
7	Panel fail	10/10/2023 07:33:32	Minor
9	Panel fail	10/10/2023 07:36:09	Minor

By Alarm Description (Description selected):



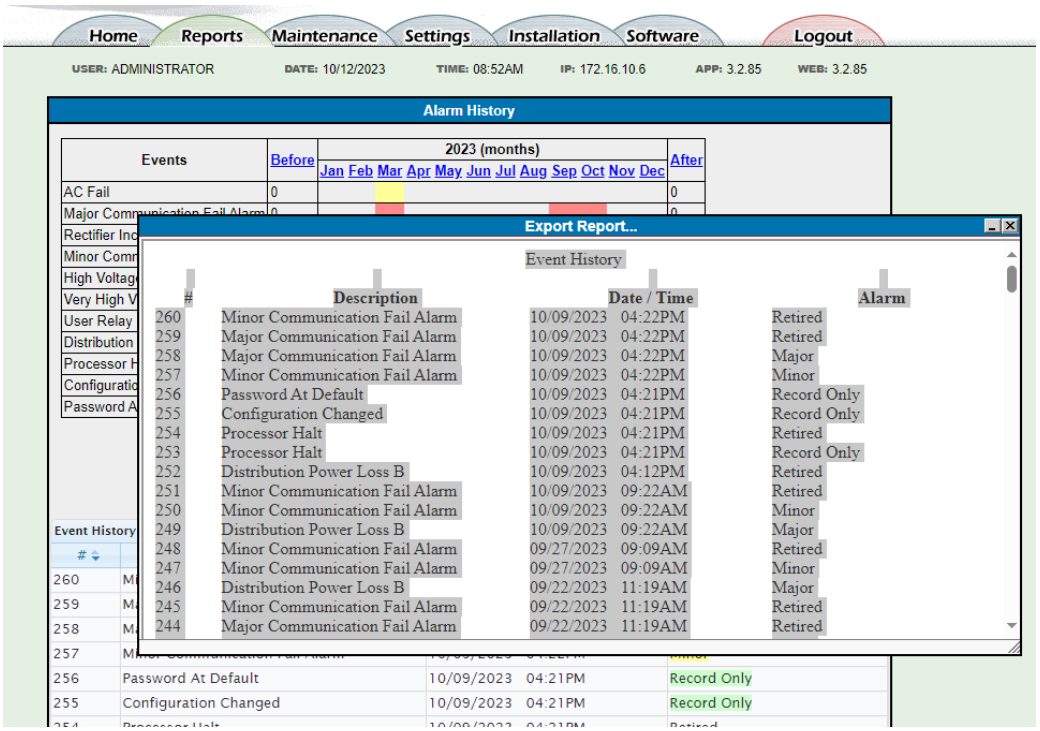
Print Event History | Export Event History

Event History

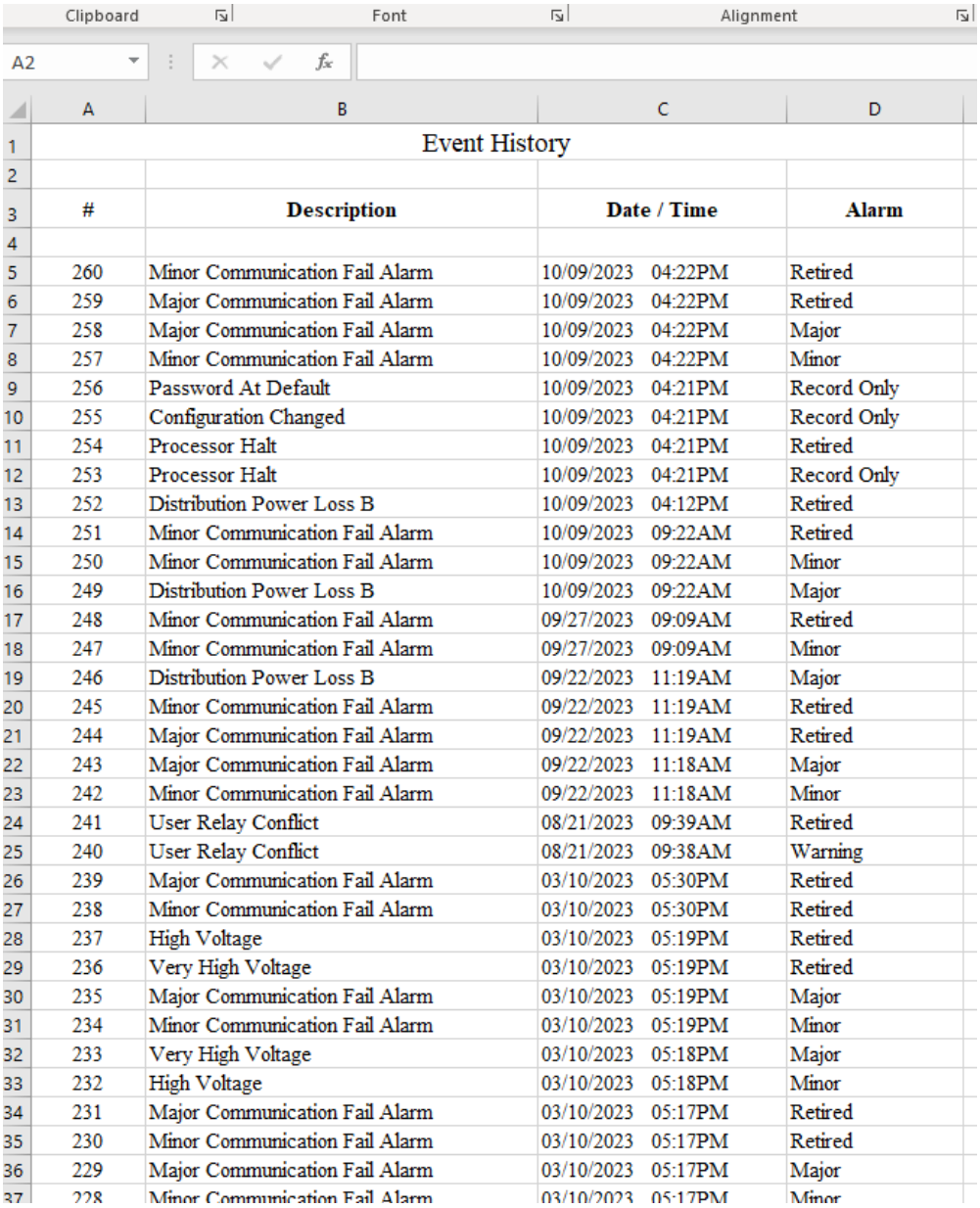
#	Description	Date / Time	Alarm
3	Configuration Changed	10/04/2023 10:16:02	Record Only
261	Excessive Login Attempts	10/12/2023 12:16:31	Warning
218	Major Communication Fail Alarm	10/11/2023 16:38:20	Retired
220	Major Communication Fail Alarm	10/11/2023 18:04:57	Major
221	Major Communication Fail Alarm	10/11/2023 18:05:37	Retired
231	Major Communication Fail Alarm	10/11/2023 18:14:02	Major
235	Major Communication Fail Alarm	10/11/2023 18:15:06	Retired
237	Major Communication Fail Alarm	10/11/2023 18:18:08	Major
241	Major Communication Fail Alarm	10/11/2023 18:19:09	Retired
243	Major Communication Fail Alarm	10/11/2023 18:39:39	Major
245	Major Communication Fail Alarm	10/11/2023 18:39:54	Retired
249	Major Communication Fail Alarm	10/11/2023 18:55:30	Major
251	Major Communication Fail Alarm	10/11/2023 18:55:51	Retired
260	Major Communication Fail Alarm	10/12/2023 10:57:25	Major
217	Minor Communication Fail Alarm	10/11/2023 16:38:20	Retired
219	Minor Communication Fail Alarm	10/11/2023 16:38:55	Minor
222	Minor Communication Fail Alarm	10/11/2023 18:09:15	Retired
230	Minor Communication Fail Alarm	10/11/2023 18:14:02	Minor
234	Minor Communication Fail Alarm	10/11/2023 18:15:06	Retired

Either the Print Event History or Export Event History buttons may be used to save the selected report from the M2. Copy / paste with the Export Event History button permits the data to populate a spreadsheet:

Export:



Spreadsheet:



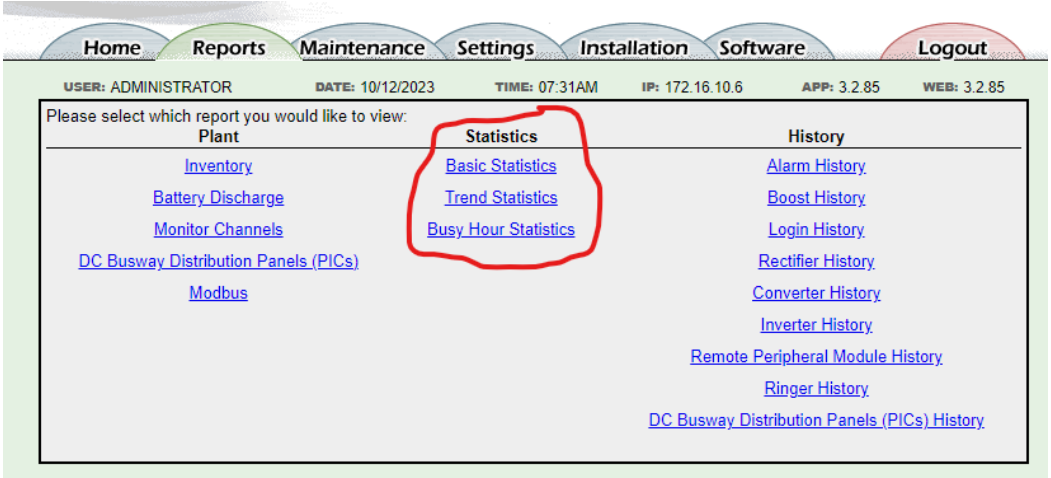
Event History

#	Description	Date / Time	Alarm
260	Minor Communication Fail Alarm	10/09/2023 04:22PM	Retired
259	Major Communication Fail Alarm	10/09/2023 04:22PM	Retired
258	Major Communication Fail Alarm	10/09/2023 04:22PM	Major
257	Minor Communication Fail Alarm	10/09/2023 04:22PM	Minor
256	Password At Default	10/09/2023 04:21PM	Record Only
255	Configuration Changed	10/09/2023 04:21PM	Record Only
254	Processor Halt	10/09/2023 04:21PM	Retired
253	Processor Halt	10/09/2023 04:21PM	Record Only
252	Distribution Power Loss B	10/09/2023 04:12PM	Retired
251	Minor Communication Fail Alarm	10/09/2023 09:22AM	Retired
250	Minor Communication Fail Alarm	10/09/2023 09:22AM	Minor
249	Distribution Power Loss B	10/09/2023 09:22AM	Major
248	Minor Communication Fail Alarm	09/27/2023 09:09AM	Retired
247	Minor Communication Fail Alarm	09/27/2023 09:09AM	Minor
246	Distribution Power Loss B	09/22/2023 11:19AM	Major
245	Minor Communication Fail Alarm	09/22/2023 11:19AM	Retired
244	Major Communication Fail Alarm	09/22/2023 11:19AM	Retired
243	Major Communication Fail Alarm	09/22/2023 11:18AM	Major
242	Minor Communication Fail Alarm	09/22/2023 11:18AM	Minor
241	User Relay Conflict	08/21/2023 09:39AM	Retired
240	User Relay Conflict	08/21/2023 09:38AM	Warning
239	Major Communication Fail Alarm	03/10/2023 05:30PM	Retired
238	Minor Communication Fail Alarm	03/10/2023 05:30PM	Retired
237	High Voltage	03/10/2023 05:19PM	Retired
236	Very High Voltage	03/10/2023 05:19PM	Retired
235	Major Communication Fail Alarm	03/10/2023 05:19PM	Major
234	Minor Communication Fail Alarm	03/10/2023 05:19PM	Minor
233	Very High Voltage	03/10/2023 05:18PM	Major
232	High Voltage	03/10/2023 05:18PM	Minor
231	Major Communication Fail Alarm	03/10/2023 05:17PM	Retired
230	Minor Communication Fail Alarm	03/10/2023 05:17PM	Retired
229	Major Communication Fail Alarm	03/10/2023 05:17PM	Major
228	Minor Communication Fail Alarm	03/10/2023 05:17PM	Minor

The remaining History logs work similarly to the main Alarm History log examples shown here, but without the bar graph and with more details regarding the specific rectifier, converter, etc. that is involved.

Statistics

M2 provides a wealth of data in the form of statistics of measured analog values over various time periods. Much of this gathering of statistics happens automatically within the controller and requires no setup or configuration. Only **Busy Hour** and certain **Trend** statistics require any configuration work to enable them. M2 statistics may be obtained from both the front display (**Menu – Statistics**) and via the various web pages under the **Reports** tab:



General Information on Statistics

Statistics data is held in battery-backed RAM within M2 to protect against data loss during a power failure. Loss of DC power to the controller or powering down or rebooting the M2 will affect the computation of statistics only during the period the processor is not functioning. Complete statistics logging will resume at the next change of hour or day, depending on the data type, after the processor is rebooted. Where a time change results in an incomplete entry, no data will be reported for that period.

Two basic values are used throughout the statistics logs, **Instantaneous Values** and **Hourly Average Values**, defined as follows:

- **Instantaneous Values** –
  - Plant and Rectifier readings are sampled every 5 seconds.
  - Analog RPM (Remote Peripheral Monitor) and Derived channel readings are sampled every minute.
- **Hourly Average Values** –
  - Sampling of instantaneous values starts over at the change of every hour. A minimum of 10 instantaneous values are required before an hourly average will be recorded.

Please note that absolute values are NOT used. This means that -52.08 is recognized and logged as LESS than -48.00 from a statistics standpoint. Where this is a problem for voltage values, Derived Channels can be established for those readings, using a (–1) multiplier to create positive values.

The controller keeps four types of Statistics logs: **Basic**, **Battery Discharge**, **Trend**, and **Busy Hour**. Each is described below.

Basic Statistics

Basic Statistics are recorded for every measured value. This happens automatically, with no programming required. Voltages, loads, temperatures, derived channels, RPM channels, and anything else the controller keeps track of that offers a measurable analog value, are included in Basic Statistics. This does not include alarms or control relay or binary RPMs since their values can only be either ON or OFF, OPEN or CLOSED. Each Basic Statistic log includes the following:

- 3 Highest Hourly Instantaneous – This log is updated each hour. Only the highest instantaneous value of the previous hour is compared and reported if greater than any of the values previously reported.
- 3 Lowest Hourly Instantaneous – This log is updated each hour. Only the lowest instantaneous value of the previous hour is compared and reported if less than any of the values previously reported.
- 3 Highest Hourly Average Values – This log is updated each hour.

Battery Discharge Statistics

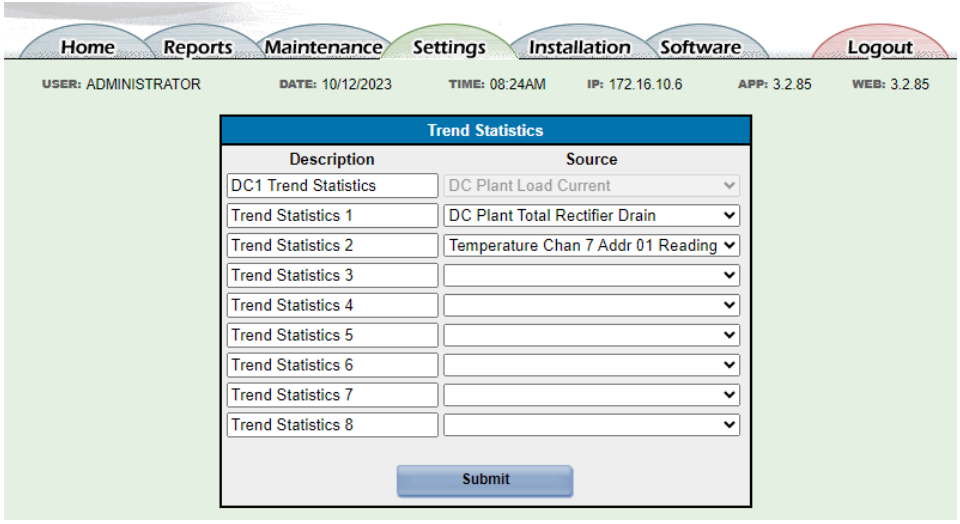
One of the most valuable pieces of statistics data, Battery Discharge Stats are designed to provide data showing the health of the plant batteries during the discharge and recharge cycles. Once again, no programming is required to generate these statistics.

- Sampling begins 1 minute after a BD (Battery on Discharge alarm) activates.
- Plant voltage and plant load are then sampled every 5 seconds.
- A log of voltage, load, and time stamp is recorded whenever the voltage sampling differs by more than 250 mV (48V plant) or 125 mV (24V plant) from the previous entry log or every 15 minutes maximum, until the BD retires.
- 120 entries maximum are kept in Battery Discharge Statistics. The 121st entry results in dropping the oldest entry.
- Each BD activate / retire cycle that adds entries to the Battery Discharge Statistics file is accompanied with a start and end time stamp, duration report, and average load record.

Trend Statistics

Designed primarily for load statistics, nine Trend Statistics channels are supported. Channel **DCT1** is automatically configured against the plant load (DC1 ADC) attribute. User-configured channels **TR1** to **TR8** activate when a measurement value for the specified channel is selected.

Trend Statistic channels are configured on the **Settings – Trend Statistics** web page:



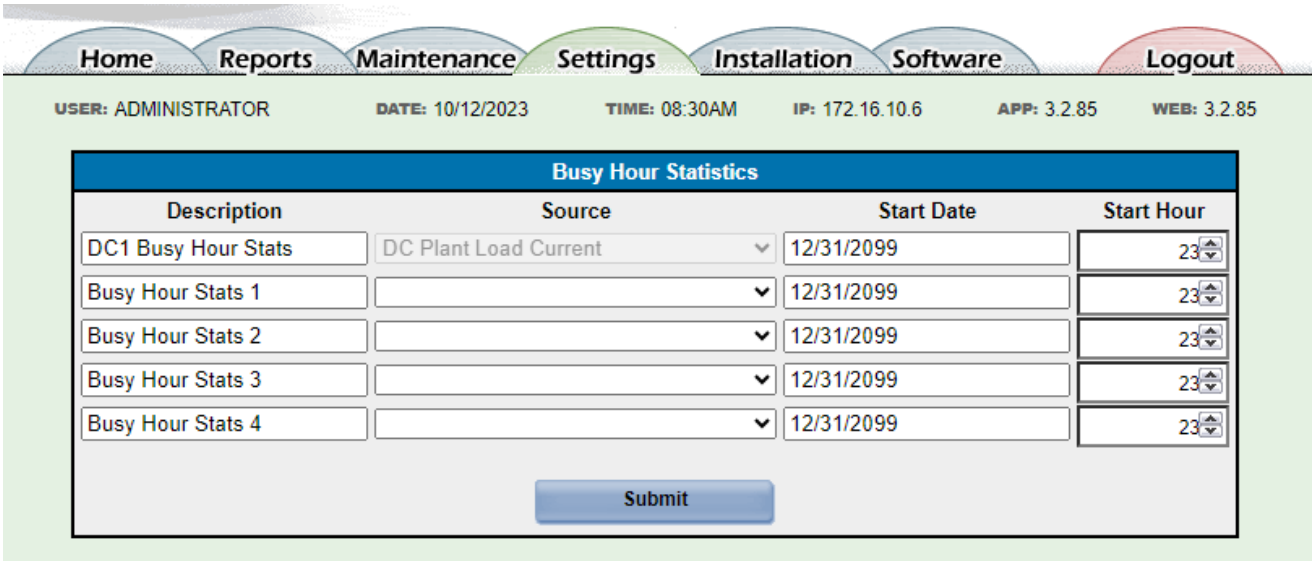
Trend Statistic channels provide the following logs:

- Daily Highest Instantaneous – This record is kept for the previous 16 days with a time stamp.
- Daily Lowest Instantaneous – This record is kept for the previous 16 days with a time stamp.
- Daily Maximum Hourly Average – The highest hourly average value and time stamp are kept for each day. This record is kept for each of the previous 32 days.
- Monthly Average of Daily Maximum Hourly Averages – This record is kept for each of the previous 13 months.

Busy Hour Statistics

Designed primarily for load statistics, each of the five Busy Hour Statistics channels that are supported provides 24 consecutive hourly averages and the highest instantaneous value reported for its channel, within the 24-hour period following a start date and time. Each channel requires that a start date and hour be configured before data gathering begins. Channel **DCBH1** is automatically configured against the plant load (DC1 ADC) attribute. User-configured channels **BH1** to **BH4** activate when a measurement value for the specified channel is selected in addition to the start date and hour. Note that five consecutive days of plant load data can be gathered by simply selecting DC1 ADC as the measured attribute for channels BH1 to BH4 and setting five consecutive start dates for channels DCBH1 through BH4.

Busy Hour Statistic channels are configured on the **Settings – Busy Hour Statistics** web page:

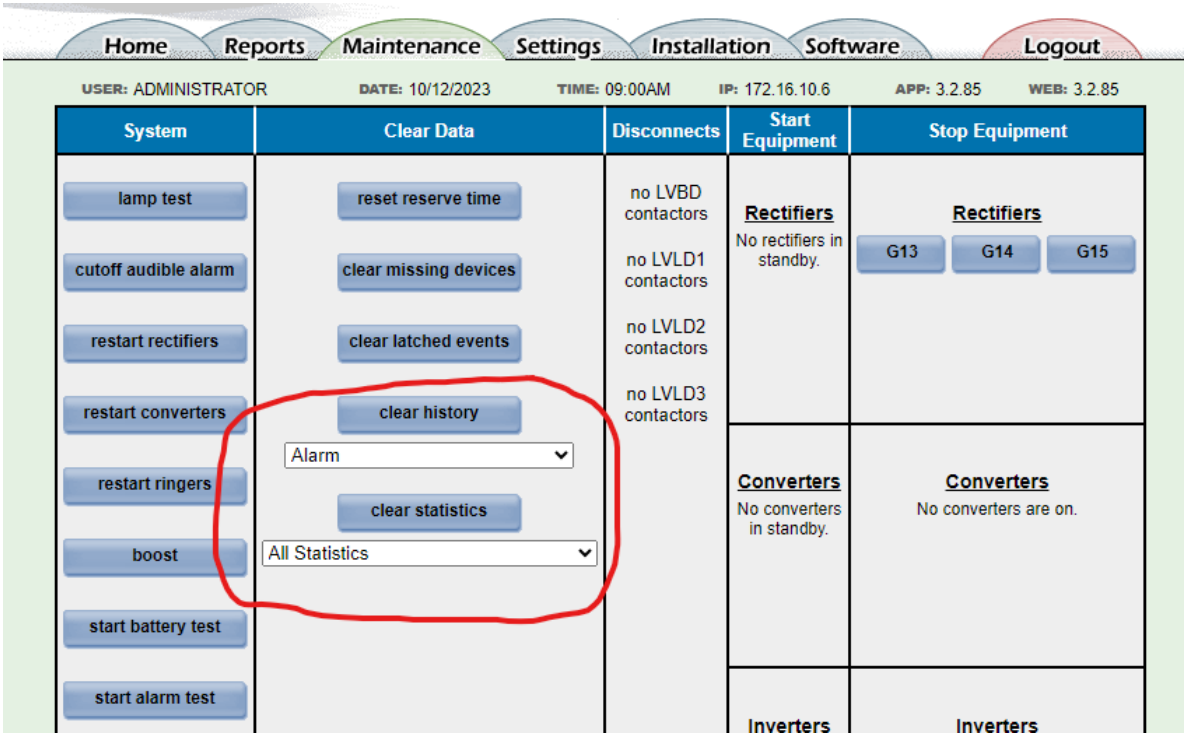


Busy Hour Statistic channels provide the following logs:

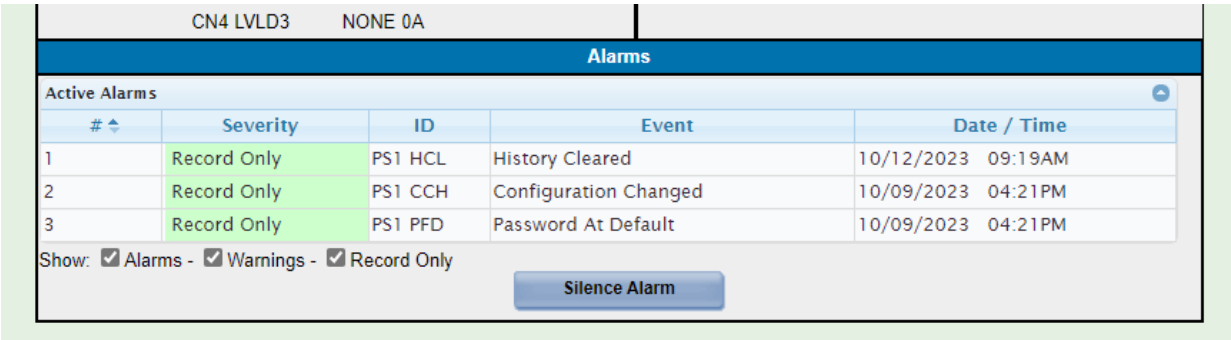
- Highest Instantaneous – This field reports the highest value recorded within the selected 24-hour period.
- Hourly Averages – Each of the 24 hourly averages for the specified measurement are recorded and stored.

Clearing History and Statistics

All History and Statistic records can be cleared out of M2 on the **Maintenance** web page, either individually or as a group:



This can be useful following any significant testing that is performed or to start statistics over at a specific time. Clearing any History log activates the HCL History Cleared alarm in the system. The HCL alarm has a default alarm severity of RO (Record Only):



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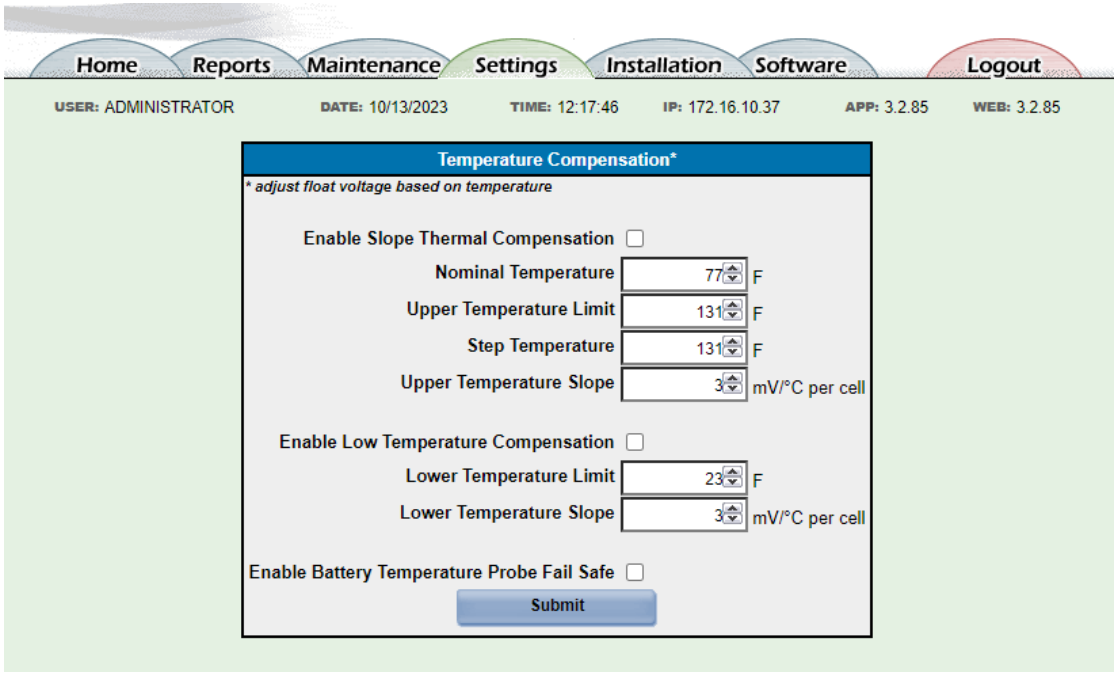
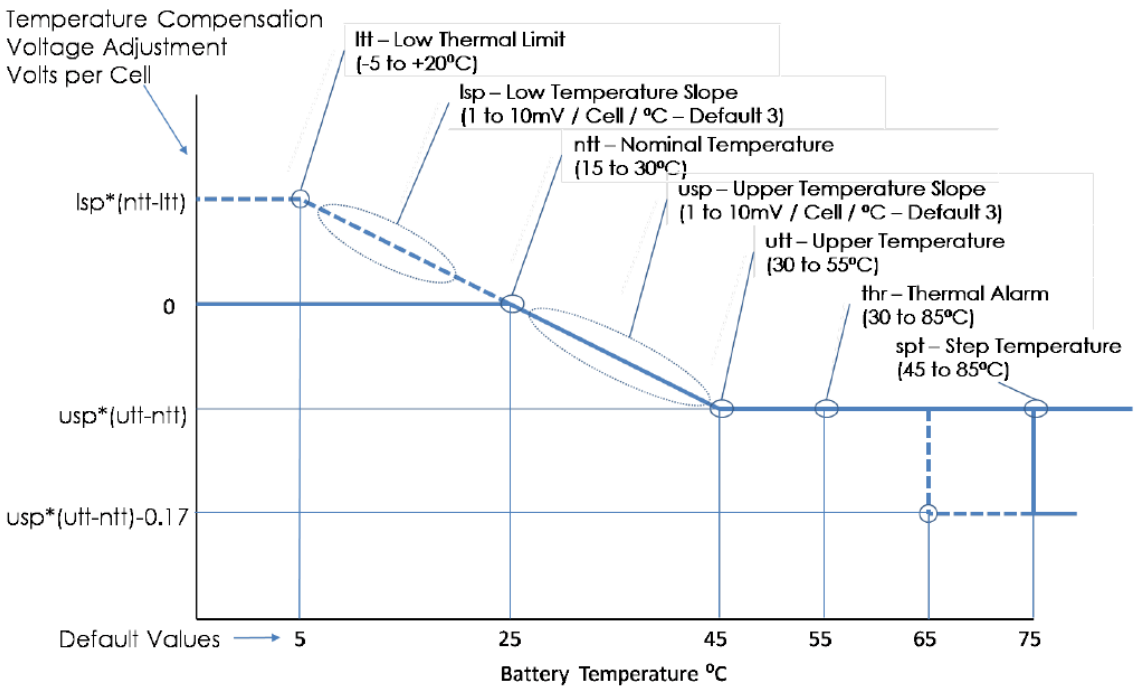
9. Slope Thermal Compensation / Temperature Probes

Slope Thermal Compensation (STC) is a feature available in M2 when all rectifiers in use are serial communication type (595/595LT Type, 596 Type, Infinity NE Type, CPS 6000 QS Type, & GP100 Type). STC provides protection against "thermal runaway" in "sealed" or "valve regulated" battery strings and provides a means to keep these batteries at their ideal float voltage dependent on their measured temperature. As the temperature of a monitored battery increases above a configured nominal value (default 25C or 77F), STC steadily decreases the plant voltage (at the configured Upper Temperature Slope – default 3mV per degree C per cell) to limit the level of charge current accepted by the battery. STC also provides a thermal alarm and a final "step" reduction in voltage should a thermal runaway condition become evident. M2 also provides an option for raising plant voltage in a similar fashion on low temperature conditions. STC configuration is completed on the **Settings – Temperature Compensation** web page:



STC parameters are fully explained on the following graph of Voltage Adjustment vs. Temperature:



In general, STC should only be activated in plants with “sealed” or “valve regulated” battery types and is not meant for use with “flooded” batteries.

Temperature Monitoring Methods

Multiple methods are available for permitting M2 to monitor Battery Temps for STC and other features needing these values to perform.

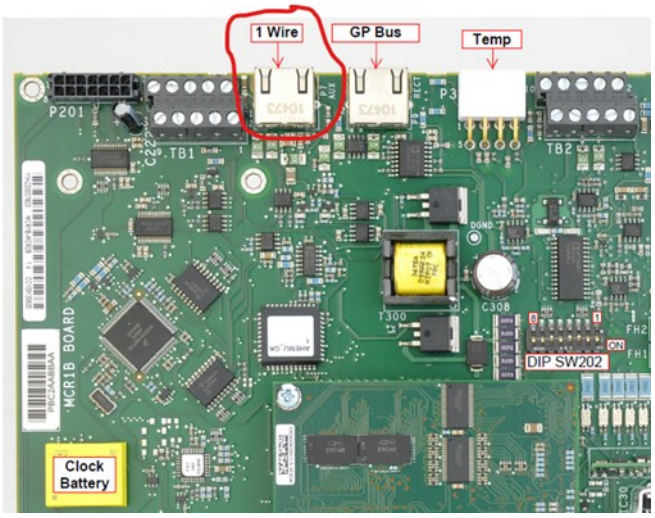
Battery temperatures may be monitored in M2 using negative temperature coefficient (NTC) thermistors. A NTC thermistor is a resistor whose value varies inversely with temperature. They are referred to by their resistance at room temperature (77F / 25°C). Three distinct sizes of these thermistors (or probes) have been developed and can be used with M2:

- 10K – One of the early temperature probe types, these 10K ohm probes were available in 2 styles; paddle-type, used with battery modules that physically touch each other, allowing the probe to be inserted between the battery cases; and ring-type, available with inside diameters ranging from ¼ to ½ inch, which are then secured to the battery posts themselves. 10K probes may be connected to the M2 controller P3 UBT (Universal Battery Temperature) port, to a connected a GPS BIC (Bay Interface Card) temperature channel (one per BIC), or could be connected up to eight at a time into a 210E Thermal Probe Multiplexer module. The 210E module (now discontinued) was then connected to either the P3 UBT port or to a GPS BIC temperature channel.
- 30K – The first temperature probe available, the 30K ohm probe was a single cylinder style probe, 5/16 diameter x 1¼ long, that was designed to mount in an unused connector bolt hole of a KS20472 round cell battery post. When used with other types of batteries, it must be sewed, wire-tied, or otherwise mounted onto a battery post as necessary to allow it to sense the battery temperature. The 30K probe may be connected only to the M2 P3 UBT port.

- 100K – The most common probe used, the 100K ohm probe is available in 5/16 and ½ inch diameter ring-type probes for mounting directly to a battery post. This probe connects to a temperature channel of a RPM (Remote Peripheral Module) that is then monitored by M2. All RPMs except the 214A control relay module have a 100K temperature channel in position 7 for use with this probe, and all 7 channels of the 223T RPM are 100K temperature channels.

It should be noted that the thermistor circuits used with all of these probes are electrically isolated from the probe potential, allowing the probes to be connected to any battery post on any battery cell in a string. Placement can therefore be determined solely based on obtaining a representative temperature for the cells being monitored, and should be out of the direct path of a heating or cooling duct, sunlight, etc.

The most current style of temperature probe now available for use with M2 is a QS873 type and differs from the others in that it is not a NTC thermistor, but instead contains an integrated circuit that reads the temperature and converts it to a digital format that is then transmitted over a 1-Wire data bus to the M2 controller. The M2 can have up to 16 of these probes daisy-chained on this 1-Wire bus, reporting temperatures to the controller. M2 only reports the highest and lowest temperatures of all attached 1-Wire bus probes and has no means to identify which probe is reporting the specific high or low temperature, but these shortcomings may be offset by the ease and convenience provided when adding these 1-Wire probes. The connection point for the 1-Wire bus is at P7 at the top left edge of the M2 board, as shown below:



There are also varieties of temperature monitoring transducers available from commercial sources. As long as these transducers can be arranged to provide a linear DC output voltage signal that corresponds to the battery temperature range, these units can be used with appropriately sized RPM channels for a M2 controller to provide temperature inputs to the GPS system. These RPM channels must be programmed with scale factor and offset values as required for the transducer used, to provide a temperature measurement in Deg. C.

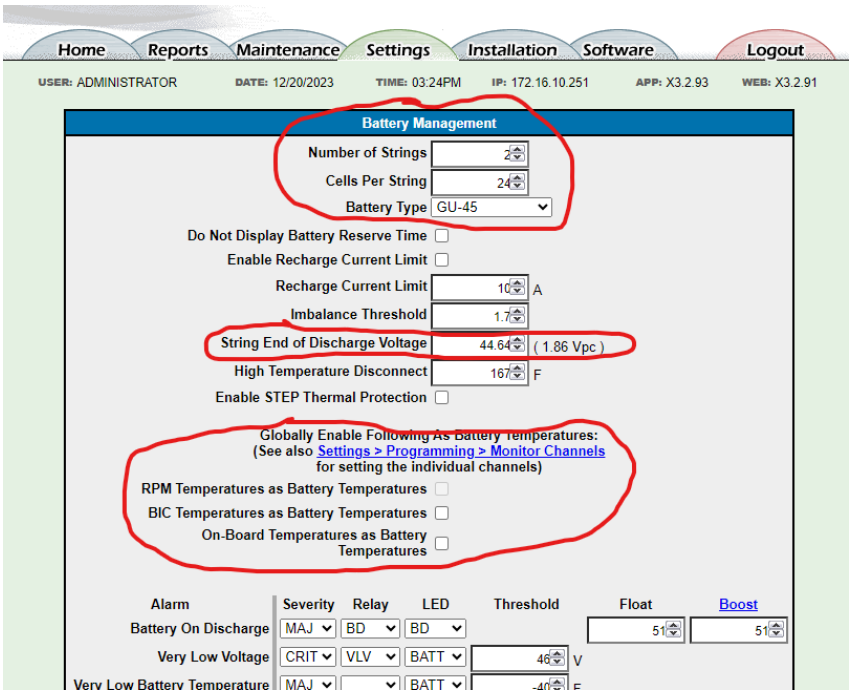
A common question regards the number of probes that should be used. Obviously, we need at least one probe to use STC and it is logical that the more probes, the better the protection against a thermal condition in a battery cell. The controller performs temperature compensation against the highest “valid” temperature value received. Generally, the minimum number of probes that should be considered for adequate temperature compensation protection is 1 per string, or, in the case of the larger Unigy II model sizes, 1 per stack. At the opposite extreme, there is little benefit in using more than 1 probe per row within a stack of batteries.

10. Battery Reserve Time Prediction / Battery Discharge Test

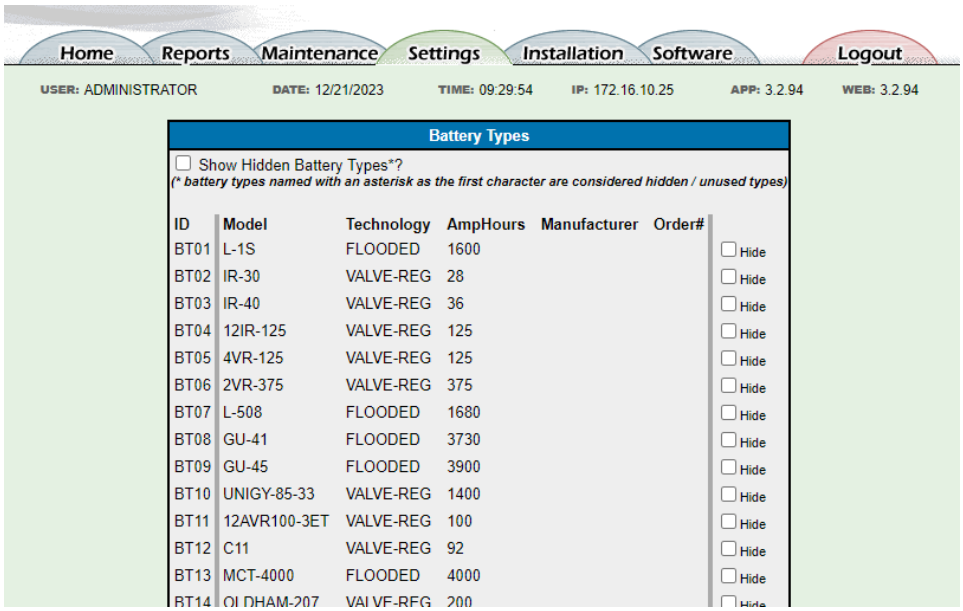
Battery Reserve Time Prediction (BRTP) is perhaps the battery test feature most familiar to users, based loosely on the Round Cell Reserve Time Prediction option that first came into use with our MCS controller. With Millennium 2 it has been significantly updated, now providing predictions for a variety of commercial battery types in addition to Round Cells, and permitting battery types to be manually configured, using coulomb counting as the test method, for measuring the energy discharged from and recharged back into the power system battery strings. Another important improvement is that BRTP continuously updates the prediction for changing load conditions during each of the battery states recognized by the controller.

The only hardware requirement for BRTP in M2 is a battery temperature measurement. See previous Section 9 for a review of the various battery temperature measurement methods available.

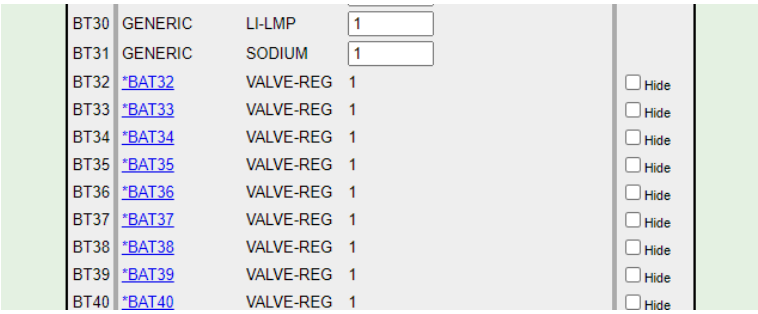
BRTP recognizes four states of battery condition: float, Coup de Fouet, discharge, and recharge. The prediction algorithm continuously calculates the remaining reserve time using a combination of available plant measurements and user configurable parameters. Measured parameters include battery temperature (**DC1 UBT**), plant current (**DC1 ADC**), total rectifier drain (**DC1 TRD**), and plant voltage (**DC1 VDC**). Software parameters that must be configured by the user include battery type (**DC1 BTY**), number of strings (**DC1 NST**), cells per string (**DC1 CPS**), and end volts per cell (**BR1 CEV**). These parameters may be configured on the **Settings – Battery Mgmt** web page:

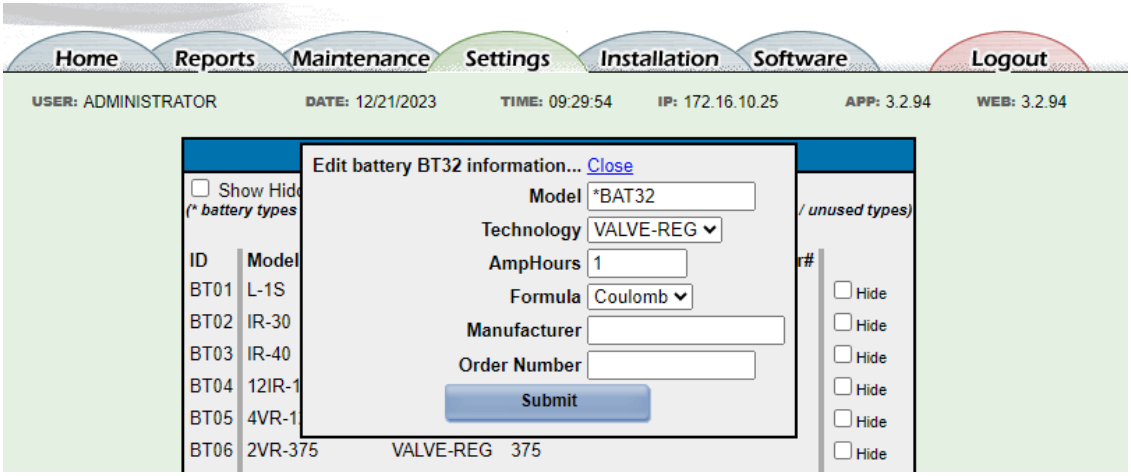


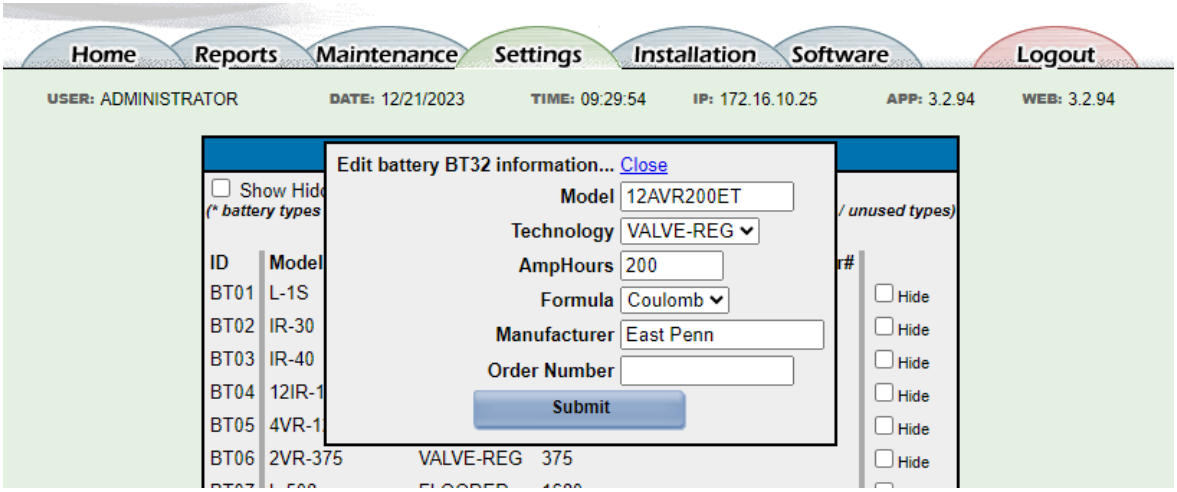
The Battery Type drop-down list here can be reviewed or edited for an unlisted battery model on the **Settings – Battery Types** web page:



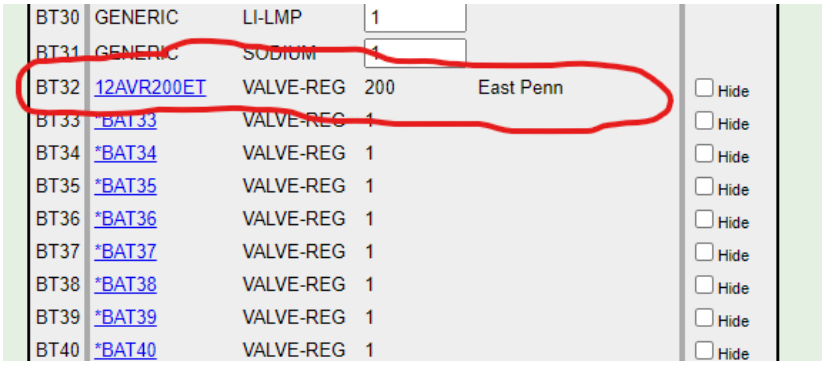
If the battery model in use is not one of the pre-defined ones on this list, scroll down to any of the BT32 or higher ones that can be edited and select and edit the fields for that model:







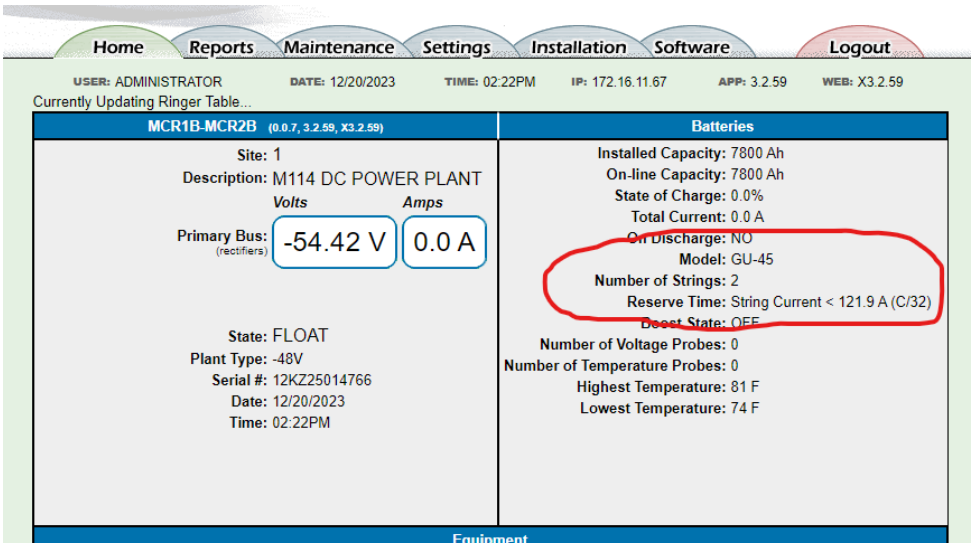
The Technology, Amp-Hours, and Formula (choose Coulomb) fields here are necessary. The others are just text fields for information only to the user.



The Model name will then be one that can be selected on the **Settings – Battery Mgmt** web page.

For power systems using more than one battery string model, it will be necessary to select just one Battery Type on the **Battery Mgmt** web page, but the important thing is to get the total system Amp-Hour capacity as close as possible to being accurate, by adjusting the number of strings, if necessary, or by creating your own “fake” Battery Type that is the average A-H size for all battery strings in use. For example, a system with 3, 180 A-H strings and 2, 200 A-H strings has a total A-H capacity of 940 A-H. So, the average per string is then 188 A-H. Create a new 188 A-H Battery Type and show 5 strings.

BRTP starts reporting reserve time as soon as the required hardware is installed and the plant load is in the range of C/2 to C/32, where C is the total A-H capacity of all battery strings. The prediction (**DC1 RTM**) is provided in hours on the bottom line of the default front panel display and is reported in the Batteries section of the **Home** web page. If the plant load is > C/2, the prediction report is “String Current > C/2”; or if the load is < C/32, “String Current < C/32”, as the accuracy of any prediction outside of these battery capacity to load ratios would be poor.



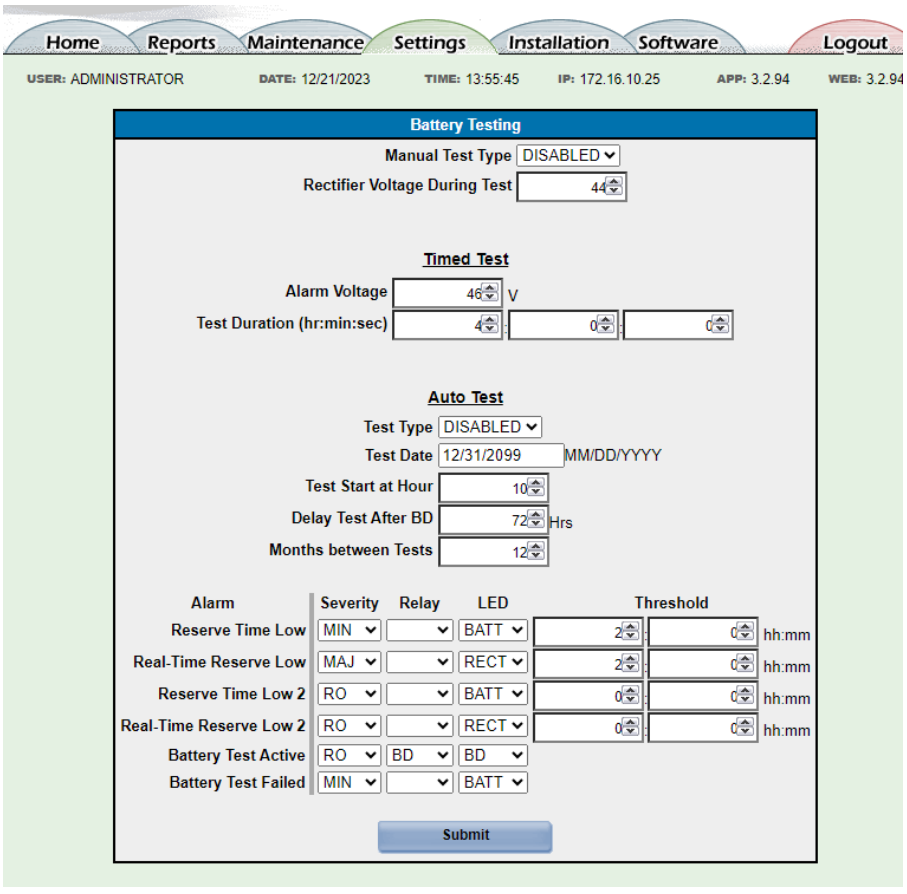
The initial prediction at float is based on the battery manufacturer's data for the battery type and will therefore only be accurate for a fully charged battery. During the Coup de Fouet period at the beginning of a discharge, the predictor continuously subtracts the A-H being removed from the battery off the reserve time predicted prior to the discharge. When the Coup de Fouet is completed, the prediction for the discharge period is based on a patented prediction algorithm. In addition, during this period, the algorithm "learns" the characteristics of the battery string(s) in the plant. During the recharge period, the prediction is updated as A-H are added back into the battery. After the plant is back at float state and the battery is fully charged, the algorithm uses the "learned" battery characteristics for all subsequent predictions.

The reserve time prediction for a discharge event is also stored in the plant **Battery On Discharge** history file. This report can be accessed on the **Reports - Battery On Discharge** web page. On it is a graph of the discharge event(s), a listing of their dates and times of each BD event, and the peak load. This report can be particularly useful for determining the health of the batteries in a plant.

A final benefit of BRTP is that it enables the use of the threshold alarm Reserve Time Low (RTL1) to warn against a possible service affecting condition anytime the predicted reserve time drops below the configurable threshold RTL1 THR (default 2 hours). The RTL alarm can activate either during a discharge event or if the plant load increases to a level where the calculated reserve time is less than its threshold with a fully charged battery.

Battery Discharge Test

Battery Discharge Test (BDT) is a M2 feature that is available in any plant using only serial rectifiers (595/595LT Type, 596 Type, Infinity NE Type, CPS 6000 QS Type, & GP100 Type). When activated, BDT lowers the rectifier voltage set point to a configurable setting, so that the battery discharges into the plant load, but with the rectifiers still available, should the batteries fail to support the load. BDT can be configured to run for a specific length of time or can be set to terminate the test when approximately 20% of the anticipated battery capacity has been removed. BDT can also be configured to operate automatically at a specific future date and time, or at a time after that (default 72 hours), if there has been a recent Battery Discharge event. If Battery Discharge Test is activated while BRTP is active, a reserve time prediction is provided throughout the test, as it would during any discharge event. BDT configurations are made on the **Settings – Battery Testing** web page:



There are several safety features provided with BDT. Battery Test Enable software switch **BR1 BTE** must be active and the plant must be in Float mode with no active alarms, in order to initiate a test. BDT can then be started manually, either from the front display or through the **Maintenance** tab on the web pages. During a test, the plant status field changes from “Float” to “Bat Test” and both the NORM and BD front display LEDs, along with the BD external alarm relay, are activated. BD and VLV alarm thresholds are inhibited throughout the test and for 3 minutes following the test and a record only event, Battery Test Active (**BTA1**) is asserted. Any alarm with a power major severity that occurs during the test causes it to abort and results in a latched power minor alarm, Battery Test Failed (**BFA1**).

If any of the following conditions occur during the test, it is aborted and the **BFA1** alarm is asserted:

- 100 minutes elapses and the Coup de Fouet portion of the discharge has not been recognized.
- Battery voltage falls to within a safety level of 1.2 volts (48V plant) or 0.6 volts (24V plant) of the highest of the following:
    1. End Cell Voltage (**BR1 CEV**) multiplied by No. Cells (**DC1 CPS**)
    2. Highest LVD Disconnect Threshold (**CN1/CN2/CN3/CN4 DTH**)
    3. Converter Plant Disconnect Threshold (**CP1 DTH**)
- A rectifier fail alarm (**RFA1**) activates.
- A serial bus communication failure alarm (**CMA1, MCM1**) activates.
- A voltage sense fuse alarm (**VSF1**) activates.

A **BFA1** alarm can be cleared using the “Clear Latched Events” command from the front display or from the web page **Maintenance – Clear Latched Events** button.

11. Battery Recharge Current Limit

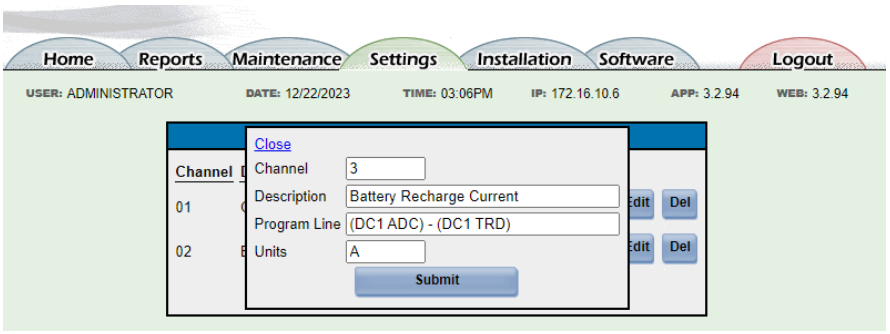
Battery Recharge Current Limit (BRCL) is a M2 feature that is available in plants using all serial rectifiers (595/595LT Type, 596 Type, Infinity NE Type, CPS 6000 QS Type, & GP100 Type) when a measurement of battery charge current is available or can be calculated. BRCL is a means to limit the rectifier current permitted to recharge battery strings following a discharge event.

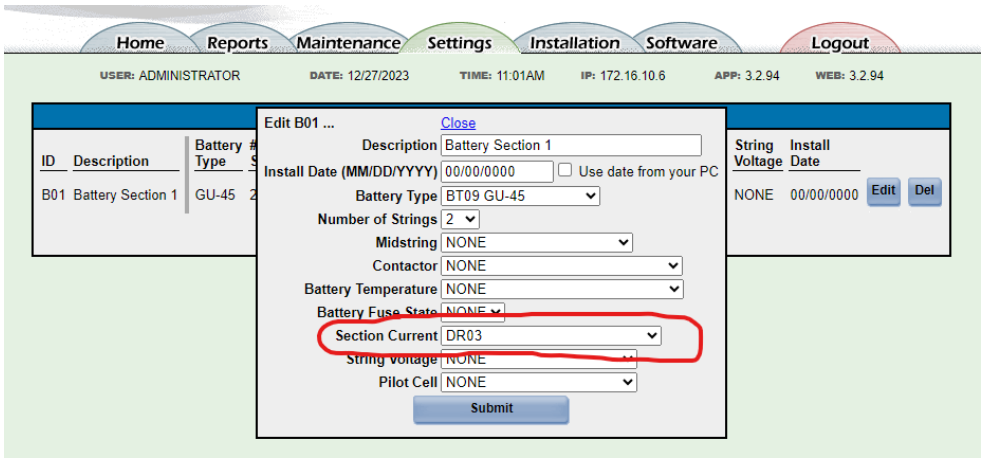
Battery manufacturers, particularly for “sealed” or “valve regulated” batteries, typically specify a maximum recharge current recommendation of 0.1C to 0.2C, where C represents the 8 or 10 hour A-H capacity of the battery. This level of recharge current permits the electrochemical recombination within the battery to occur during recharge without the build-up of internal pressure that might otherwise cause the safety valves to vent, resulting in water loss and capacity or life degradation.

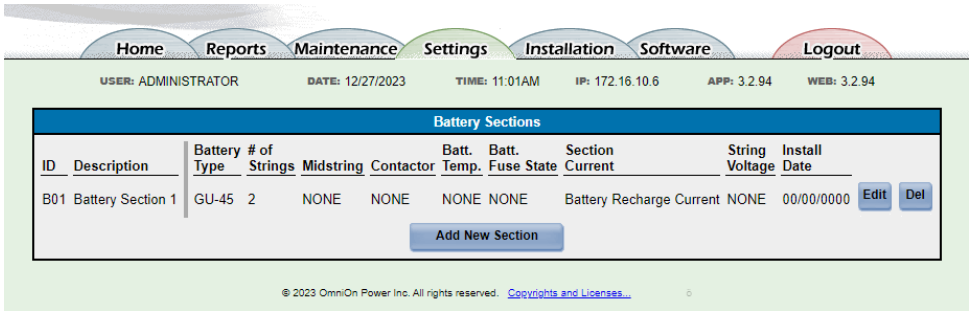
For example, the ideal maximum recharge current for a string of 12IR125 batteries (125 AH) is between 0.1 x 125 or 12.5 amps and 0.2 x 125 or 25 amps. For a string of Unigy II Model 3A-85-33 batteries (1400 AH), the ideal maximum recharge current is between 0.1 x 1400 or 140 amps and 0.2 x 1400 or 280 amps. BRCL is designed to permit the restriction of recharge current to levels that match the battery capacity in the system.

Another, less common, use of BRCL is to limit the stress placed onto the AC power system by the plant rectifiers following a discharge event. Since the rectifiers must both support the plant load and supply battery recharge current following a discharge event, BRCL may be used to limit the maximum power required during this recharge period. This can be particularly useful where reserve AC generator power availability is marginal. Battery recharge still occurs, but at a slower rate and over a longer period than it would without BRCL enabled.

M2 provides multiple methods of obtaining the necessary battery string current parameter(s) for BRCL. The most common means in a GPS power system is through the battery shunt(s) and BIC current channel(s) of a BIC card within each GPS cabinet of a distributed architecture setup. M2 will use all BIC current channels configured as Battery type for BRCL. In an Infinity M plant, where the M2 shunt itself measures battery current and is programmed as Battery type, it is the M2 shunt that BRCL uses. For a centralized architecture plant, where battery current is not directly measured, recharge current can be calculated in a Derived Channel (program line “(DC1 ADC) – (DC1 TRD)” – see Section 7 for Derived Channel details) and then “linked” to the **Section Current** field of a single Battery Section that can be created on the **Settings – Battery Sections** web page, as shown below. Please note that in each of these options, battery recharge current is recognized as a (-) current value:

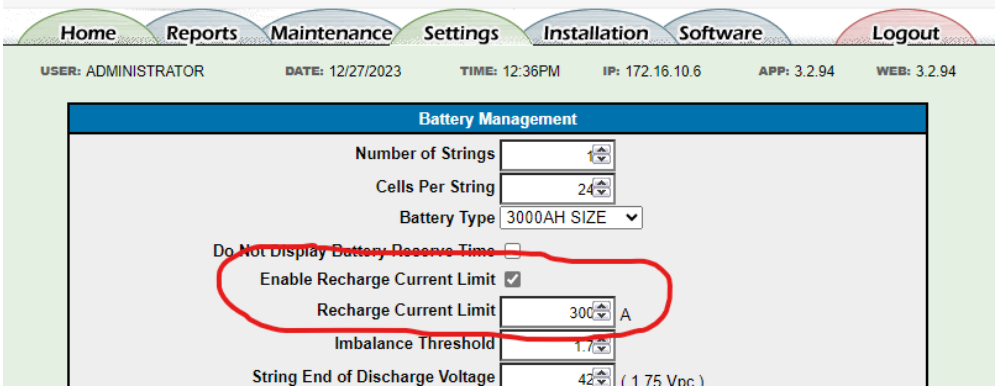






If the web pages in use for the M2 do not show Derived Channels (DRxx) in the drop-down list for linking to the **Section Current** field on the **Settings - Battery Sections** page, it will be necessary to complete this linking using a T1.317 command line as follows: **LIN B01 ADS,DRxx** where xx is the Derived Channel ID, 03 in this example.

Note that when there is more than one battery shunt, as may be the case in GPS Distributed Architecture (see Section 3), M2 performs BRCL against the highest of the recharge currents recognized against any of its battery shunts that may be present. The recharge current limit threshold attribute (**BR1 CLT**) therefore needs to be set to the maximum allowed for any one of the battery shunt(s) (range 10 to 1,000 amps). Refer to the following **Settings – Battery Mgmt** web page example:

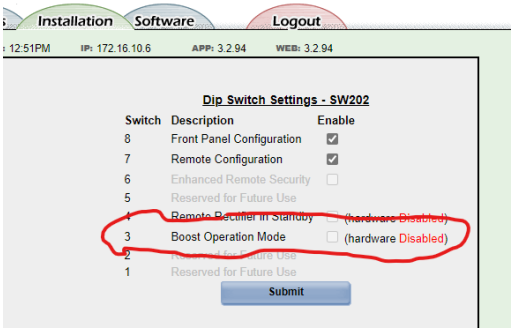


12. Battery Boost / Equalize

For the purposes of this manual, Battery Boost and Battery Equalize are identical terms and refer to the operation of the battery plant at a defined voltage other than the normal float voltage. The battery plant voltage in boost mode is typically adjusted higher to rapidly charge lead-acid flooded (or wet cell) batteries to a higher-than-normal voltage, in an effort to cause some bubbling in their electrolyte to chemically mix it among the battery plates, resulting in an evening out or equalizing of the cell voltages after the string is returned once again to its normal float voltage. Boost mode is rarely advised for use with valve-regulated (or sealed) batteries.

Boost is performed in M2 by sending signals to the rectifiers to switch them from float mode to boost mode, this second voltage level. All rectifiers must be serial type rectifiers (595/595LT Type, 596 Type, Infinity NE Type, CPS 6000 QS Type, & GP100 Type), or must be capable of switching automatically to a second, pre-set voltage level under command of the M2.

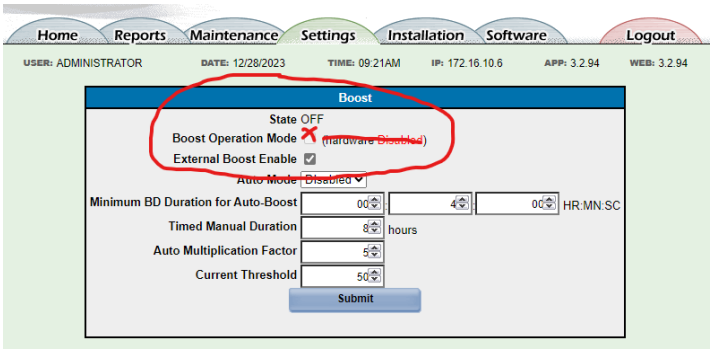
Boost mode is default disabled in M2, with both a hardware dip switch (MCR1B SW202-3) and a software switch (front display path: **Menu – Configure – Rectifier Boost Settings – Enable** or web pages **Installation – Boost Operation Mode**) needing to be enabled before it is functional:



With the feature enabled, Boost mode may be initiated and terminated several ways:

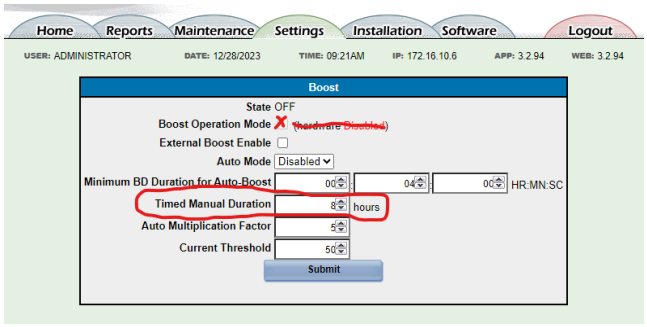
External Boost:

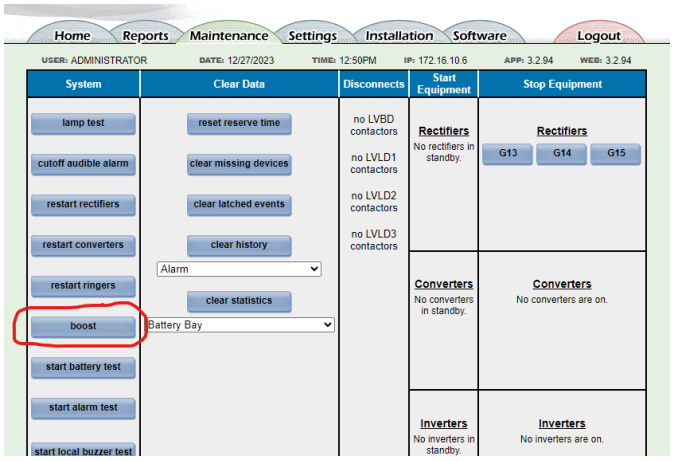
With both Boost Mode and External Boost enabled (**Settings – Boost** web page), M2 can accept input signals into its BSL alarm card terminals 67 (TFLT), 68 (TBST), & 69 (TRTN) to control switching between Float and Boost operation. This provides compatibility with external boost timer devices that provided contact closure inputs for earlier vintage controllers for Boost operation control:



Manual Timed Boost:

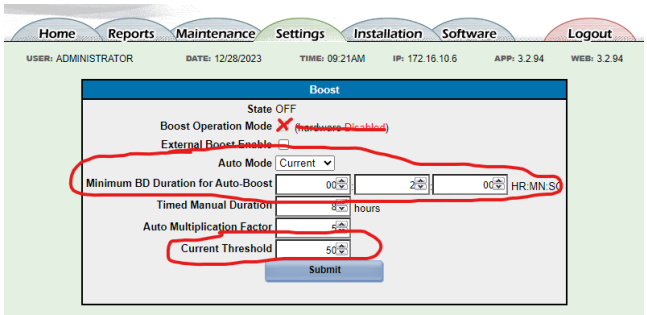
With Boost Mode enabled (**Settings – Boost** web page), M2 can be manually switched to Boost operation for a specific period (1 to 80 hours) by the **boost** button on the **Maintenance** page (or front display path: **Menu – Control/ Oper – Enter Boost Mode**).





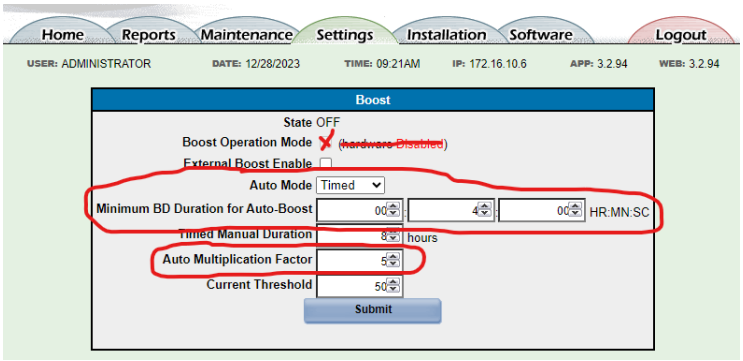
Auto Current (or QRCT) Boost:

An automatic Boost initiation mode is known as **Auto Current** or **QRCT** (**Quiescent Recharge Current Terminated**) Boost. With Boost mode enabled, select **Current** from the **Auto Mode** drop-down of the **Settings – Boost** web page and a **Minimum BD Duration** (in HR:MIN:SEC) plus a **Current Threshold** (1 to 999A) for terminating the Boost charge. Boost mode will then be initiated automatically whenever a BD event retires that exceeded the configured duration and will continue until the highest battery shunt recharge current drops below the configured current value.



Auto Timed Boost:

Another automatic Boost initiation mode is known as **Auto Timed** Boost. With Boost mode enabled, select **Timed** from the **Auto Mode** drop-down of the **Settings – Boost** web page and a **Minimum BD Duration** (in HR:MIN:SEC) plus an **Auto Multiplication Factor** (0.1 to 9.0) for terminating the Boost charge. Boost mode will then be initiated whenever a BD event retires that exceeded the configured duration and will continue for a period equal to the assigned factor x the length of the BD event. Thus, for the configuration in the example below, a BD event lasting 1.5 hours will result in a Boost period lasting (1.5 x 5) 7.5 hours.



Because the plant voltage is typically increased during boost mode, M2 provides separately configured alarm thresholds for the float and boost modes. Alarm thresholds that change going from float to boost modes are the battery on discharge (BD), the high float voltage (HFV), and the high voltage (HV) alarms. By default, the float and boost mode alarm thresholds are identical, and each alarm threshold must be changed prior to entering boost to avoid creating any of these alarms.

If the plant is in boost mode, and a rectifier fail alarm (RFA), HFV, or HV alarm occurs, boost mode is terminated. In addition, if an RFA, HFV, or HV alarm is currently active, the only method of entering boost is from the front panel. Boost mode is generally prevented during these alarms, to protect the rectifiers.

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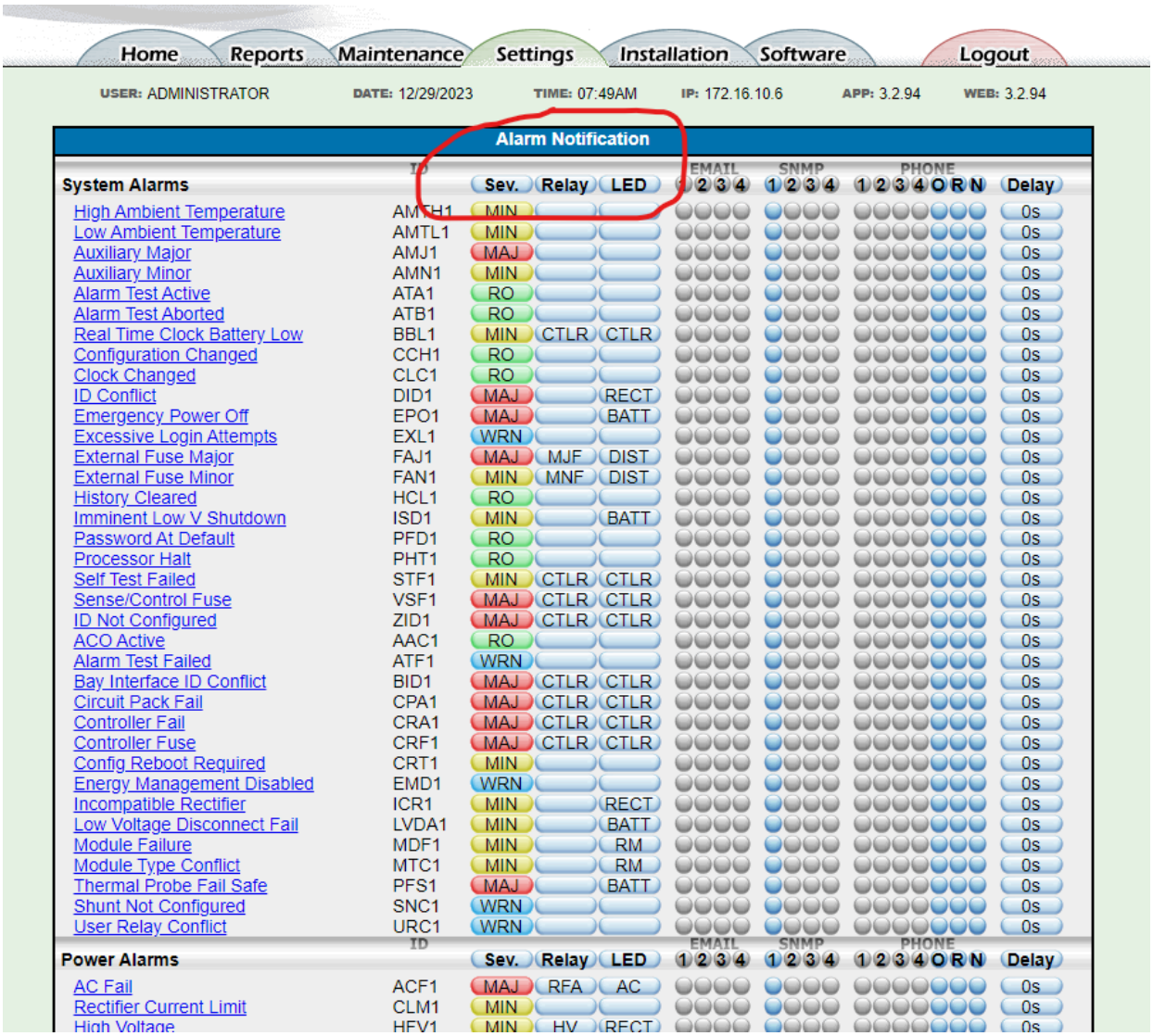
13. Alarms / Alarm Test

One of the most important functions performed by any battery plant controller is compiling and transmitting alarms for the various components of the power system to one or more external alarm systems. One of the main means that M2 uses for this functionality is via “Form-C” alarm relay contacts off its BSL alarm card, all rated at 60V DC and 0.3 amps maximum. These alarm sets provide an extremely flexible power plant alarm monitoring scheme in M2, especially when coupled with the programming capability afforded against their assignments.

M2 monitors nearly 200 standard alarm events that can be recognized, plus up to 1500 additional UDEs (User Defined Events – See Section 7). Each of these alarm or user defined events is assigned a severity level and may or may not be assigned to activate a distinct front display LED and/or distinct output alarm relay in the controller programming. The default assignments for all alarm events can be found in Section 17 tables at the end of this manual. The assignments used in any M2 can be reviewed and changed on the **Settings – Alarm Notification** or **Settings – UDE Alarm Notification** web pages.



Alarm Severity Attributes

Each M2 alarm event must be assigned to one of five available severity levels, discussed here in decreasing severity:

Critical – Critical Severity is meant to indicate the presence of a severe, service-affecting trouble and that all service may potentially soon be lost, if the condition is not immediately acted upon. The only default alarm events assigned as Critical severity are VLA1, Very Low Voltage and RTL1, Reserve Time Low. A Critical severity event lights the CRIT alarm LED on the front display and turns off any less severe alarm LED and/or the NORM LED. An active event with this severity activates external alarm relays PCR-A (Power Critical Audible), PCR-V (Power Critical Visual), and PCR-E (Power Critical External). Since this is a new alarm severity that some customers may not have the ability to monitor, a software provision is made (default enabled) to also activate the controller's major external alarm relays along with these critical relays for active events assigned Critical severity.

Major – Events assigned a severity of Major are potentially service-affecting and also require immediate action. BDA1 (Battery on Discharge), FAJ1 (Discharge Fuse Alarm), and MFA1 (Multiple Rectifier Fail) are examples of events that are assigned Major severity by default. A Major severity event lights the MAJ alarm LED on the front display, unless a CRIT event is also active, and turns off any less severe alarm LED and/or the NORM LED. An active event with this severity activates external alarm relays PMJ-A (Power Major Audible), PMJ-V (Power Major Visual), and PMJ-E (Power Major External).

Minor – Minor severity events require a response, but without the urgency of a Critical or Major severity event. ACF1 (AC Fail), MDF1 (Module Fail), and RFA1 (Rectifier Fail) are examples of events that are assigned Minor severity by default. A Minor severity event lights the MIN alarm LED on the front display, unless a more severe event is active, and turns off the NORM LED. An active event with this severity activates external alarm relays PMN-A (Power Minor Audible), PMN-V (Power Minor Visual), and PMN-E (Power Minor External).

Warning – Events are assigned a severity of Warning when it is desirable to recognize that these events are active from the controller's display, but there is no need to notify an external alarm monitoring system. The Normal LED of the controller's front display does not change state for events assigned a Warning severity. BBL1 (Memory Backup Battery Low and RPI1 (Rectifier / Plant Drain Inconsistency) are examples of events that are assigned Warning severity by default. No external severity alarm relays activate on a Warning.

Record Only – Events given a RO severity are not detectable from the front display and can only be seen from the **Home** tab of the web pages or in the appropriate **Reports - History** logs. Like Warnings, the Normal LED of the controller's front display does not change state for events assigned RO severity and no external severity alarm relays activate. AAC1 (Alarm Cutoff Active), ATA1 (Alarm Test Active), and HCL1 (History Cleared) are all events with a RO severity by default.

Alarm and User Defined Event Programming Options

In addition to a severity level, each alarm or user defined event can also be programmed to activate one of seven distinct front display LEDs and/or one of ten distinct external alarm relays. In this fashion, each event can be programmed to identify itself in quite specific detail, even without requiring interrogation through the controller menu structure or web page access.

Distinct LEDs that may be assigned are AC, BATT, BD (Battery on Discharge), CTLR (Controller), DIST (Distribution), RECT, and RM (Remote Module). Distinct external alarm relays that may be assigned are ACF (AC Fail), BD, CTLR, HV (High Voltage), MJF (Major Fuse), MNF (Minor Fuse), RFA (Rectifier Fail), UR1 (User Relay 1), UR2 (User Relay 2), and UR3/VLV (User Relay 3 / Very Low Voltage). Except for the earliest GPS plants that were not equipped with BICs (Bay Interface Cards) but had LVDs (Low Voltage Disconnects), UR1 & UR2 are not assigned by default to any event (see Section 6). UR3 is assigned by default to the VLA1 (Very Low Voltage) alarm event and the UR3 alarm contact set is in fact shown as VLV in the Millennium 2 basic product manual.

Note that in M2, it is possible to activate any of the distinct front display LEDs and/or distinct external alarm relays for an event assigned to any severity. This practice should be discouraged however for events assigned with a RO severity because it will not be possible to determine why the LED or distinct relay has activated from the controller display. Assign at least a Warning severity instead, if LEDs and/or relays are to be active without any associated severity alarm relays, so that the event can be interrogated through the controller menu structure.

Alarm Wiring

Alarm transmission from the controller to an alarm monitoring system may be made through assignments to the M2 alarm relays at its BSL alarm interface board located under the rear cover of the controller. Two styles of this card are available. BSL4 utilizes wire wrap connections, 24 to 30 AWG. A wire wrap tool/gun is required to make these assignments. BSL3 (standard) utilizes convenient insulation displacement terminations, like those found on the BIC (Bay Interface Card) of GPS cabinets, accommodating wire sizes 18 to 28 AWG.

The M2 BSL alarm assignments are shown on a label located on the controller rear cover. Note that not all the assignments on these cards are alarm outputs. Controller input and control signals make up all assignments above Pin-60 in M2, so it is important to consult the assignment stamping/table when wiring the alarms for the controller. Assignments for wiring these alarms is covered in Section 4 of the M2 Basic Operations product manual.

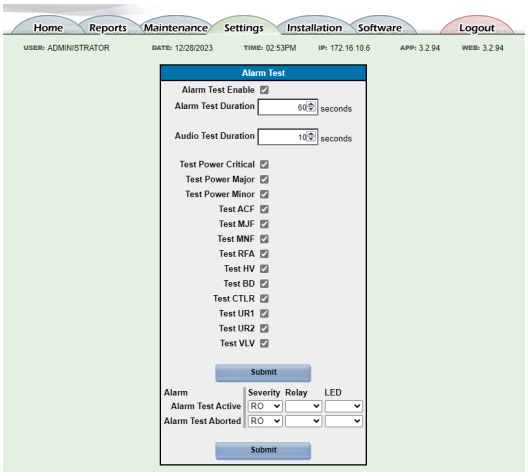
Each alarm output is a clean “Form-C” transfer type contact set, consisting of a combination of normally-open (closed-on-alarm) and normally-closed (open-on-alarm) contacts, with one side of each “common” with the “return” contact. Both sides of the Form-C contact set change state when the associated relay activates or deactivates. These isolated Form-C contact sets are not referenced to ground and have no voltage potential on them until wiring into an alarm system is completed.

When determining which alarm sets to monitor for use with an alarm system that has limited capacity, it is important to recognize that events given a severity of Critical, Major or Minor always activate their associated severity alarm relays. These same events may or may not have a distinct external alarm relay assigned. Therefore, to avoid missing an alarm event, the Major and Minor severity relays should always be monitored at minimum. Any or all distinct external relay sets may then also be monitored, as the alarm system allows, to provide additional detail regarding the active alarm event(s).

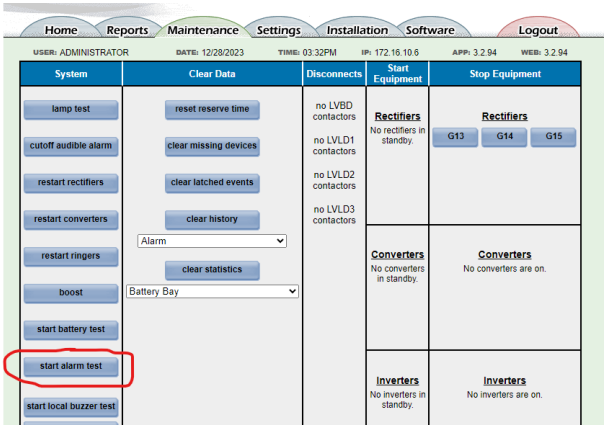
Alarm Test

The M2 Alarm Test feature provides a means to sequentially assert selected alarm relays, as a means of testing and verifying the complete alarm system interfacing with M2.

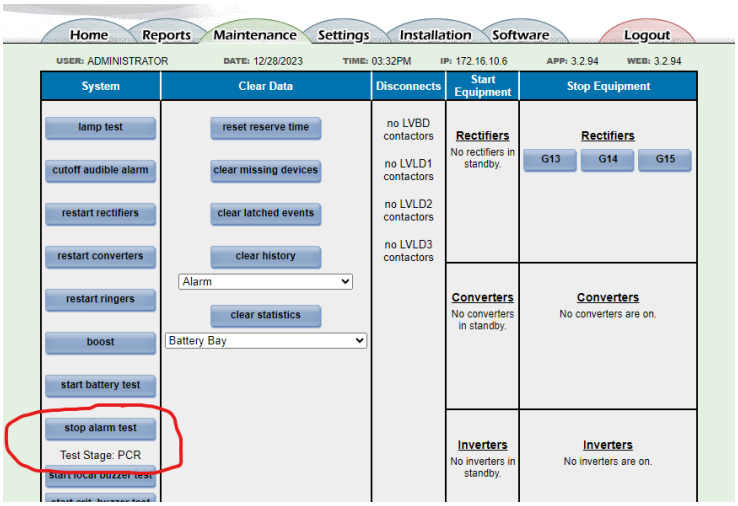
Alarm test is available when the M2 has no active Critical, Major, or Minor alarms active and its **Alarm Test Enable** software switch on the **Settings – Alarm Test** web page is selected. Note that this web page also has fields for the desired **Alarm Test Duration** (per Alarm) and **Audio Test Duration** (5 – 300 seconds each) and checkboxes for which of the 13 relays to include in the test:



Any real alarm in the power system with a Critical, Major, or Minor alarm severity that activates during the test aborts Alarm Test. So be sure not to choose any of those severities for the **Alarm Test Active** or **Alarm Test Aborted** alarm events at the bottom of the **Settings – Alarm Test** web page:



Alarm Test is then initiated on the **Maintenance** web page or at front display path: **Menu – Control/Oper – Alarm Test**. The test begins with the top-most alarm relay selected on the web page, runs for the duration selected, then moves to the next lower selected alarm relay. Each alarm relay being tested is displayed on the **Alarm Test** screen of the main menu and on the **Maintenance** web page:



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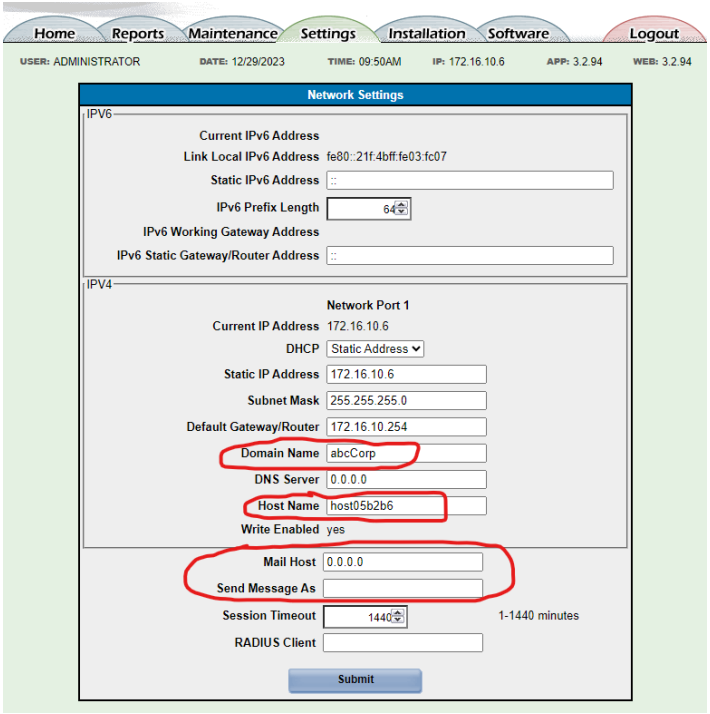
14. Alarm Notification via Email-on-Alarm / SNMP / Modbus

With HTTP or HTTPS access established to M2 via its LAN port (see Section 1), several additional means become available for monitoring M2 alarms, apart from the Alarm Relays covered in Section 13.

Email-on-Alarm

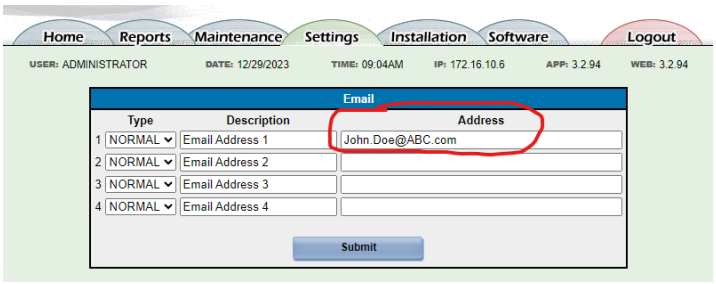
SMTP (Simple Mail Transfer Protocol) provides a basic electronic email facility. It is a mechanism for transferring messages among separate hosts and browser applications. The protocol may be used in M2 for sending alarm messages and alerts through email. Up to 4 email addresses may be configured for M2 to send the alarm messages to, but in general, they all need to utilize a common email server (or Mail Host) and some configuration may be necessary at that Mail Host by its administrator.

M2 configuration for Email-on-Alarm begins on the **Settings – Network** web page:

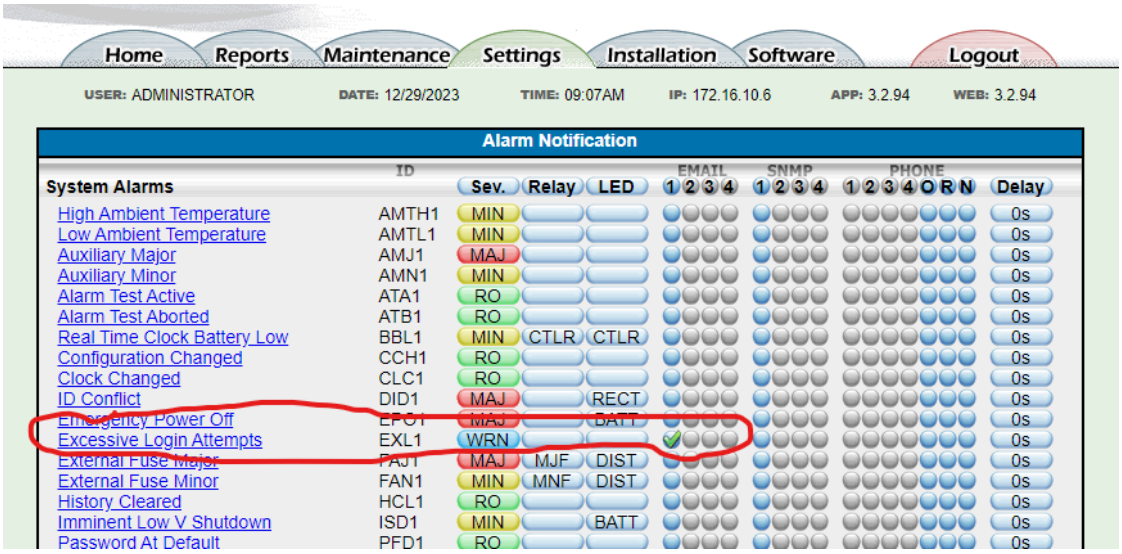


1. **Domain Name** is the name assigned to the network as a whole.
2. **Mail Host** is the IP Address of the SMTP server to be used by the M2. (xxx.xxx.xxx.xxx format)
3. **Send Message As** is the email address for the M2, or another site identifier as designated by the Mail Host administrator.
4. **Host Name** is provided by the Mail Host administrator for the M2. It must be registered or authenticated with the SMTP server, to permit the mail server to validate the controller as a valid sender of email messages, based on the **Domain Name** & **Host Name** that are configured.
5. Finally, verify that the M2 IP Address has unblocked access for port 25. Basic SMTP messages require port 25 to be open to allow the controller to send email messages.

Then go to the **Settings – Email** web page and add 1 to 4 valid email address(es) to receive the emailed alarm message:



Finally, go to the **Settings – Alarm Notification** or **Settings – UDE Alarm Notification** web page. The email columns represent the four email address recipients chosen in the previous step. Check any of the bubbles, 1-4, against all alarm events that the controller should email a notification to when that alarm is active. Here, Email Address 1 is selected against the Excessive Login Attempts alarm event:



Example Emails (against a Rectifier Fail Alarm that occurred at 16:17:27 & retired 10 seconds later)

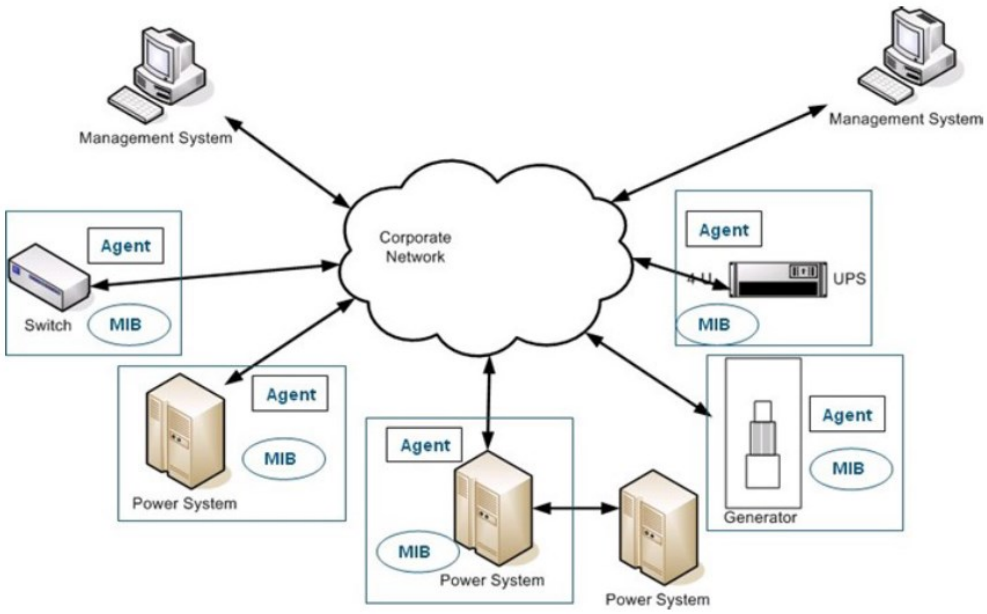
-----Original Message-----
From: Millennium II Controller [mailto:alarm@acmeCorp.com]
Sent: Wednesday, March 12, 2023 4:17 PM
Subject: 1: Alarm Report
Alarm report from 1 http://theM2PowerCtrl.acmeCorp.com/
DC1 RFA,03/12/2023,16:17:27,MIN,Rectifier Fail
End of report

-----Original Message-----
From: Millennium II Controller [mailto:alarm@acmeCorp.com]
Sent: Wednesday, March 12, 2023 4:17 PM
Subject: 1: Alarm Report
Alarm report from 1 http://theM2PowerCtrl.acmeCorp.com/
DC1 RFA,03/12/2023,16:17:37,RET,Rectifier Fail
End of report

SNMP

SNMP (Simple Network Management Protocol) is likely the most dominant network management standard. SNMP is an application-layer protocol designed to facilitate the exchange of management information between network devices. There have been several releases of SNMP in its history and M2 implements both SNMPv3 and SNMPv2C Agents. SNMPv2C is backwards compatible with SNMPv1.

SNMP allows communication and control via open standards host systems for centralized management by a SNMP Host of multiple plants (SNMP Agents). A key part of the SNMP protocol is the detailed Management Information Base (MIB) that describes all Agent variables that can be accessed. For M2, this includes all the objects controlled or monitored in the system such as: rectifiers, converters, distribution monitoring cards, alarms, RPMs, etc. Essentially, all the elements described in the T1.317 protocol (see Section 17) are available in SNMP. The M2 MIB needs to be loaded into any SNMP Host that wishes to communicate with M2. The MIB then permits the Host to interpret SNMP alarm Traps from M2 and to make some configuration changes to it, dependent on the access level SNMP Community String used.



SNMP Network Example

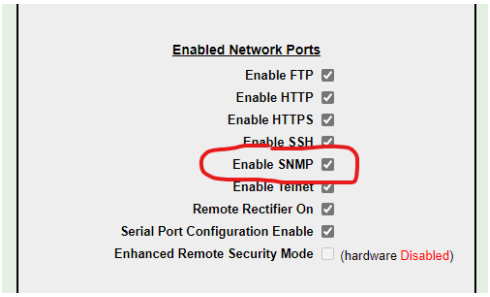
SNMP Operations

Interactions between the SNMP Host and the SNMP Agent (M2) can be any of four different types of commands: Reads, Writes, Traversal operations, and Traps. SNMP utilizes six operations to respond to the various SNMP Hosts: Get, GetNext, GetBulk, Set, Trap, and Inform. M2 implements the Get, GetNext, Set, and Trap operations.

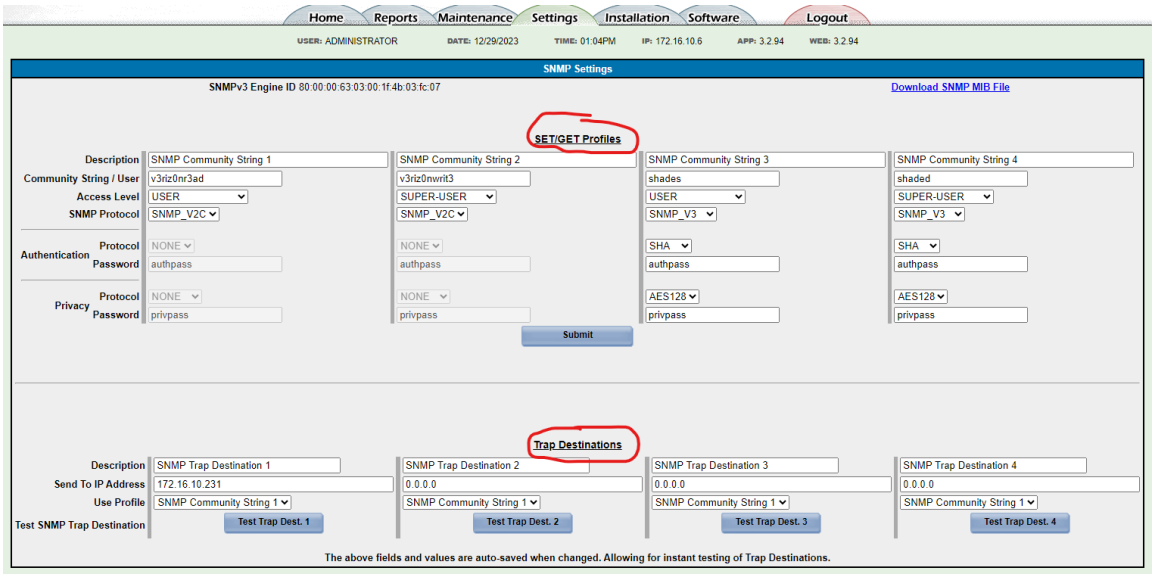
- Get - Allows the SNMP Host to retrieve a value from M2.
- GetNext - Allows the SNMP Host to retrieve the next value in sequence from a table or list of variables in M2.
- Set - Allows the SNMP Host to set a value within M2.
- Trap - Used by the SNMP Agent (M2) to asynchronously inform the SNMP Host of an event such as an alarm notification. Unlike the other operations, the trap does not require a response from the host. M2 must be configured with appropriate addresses of the SNMP Host(s) for Traps to be delivered.

M2 SNMP Configuration

SNMP functionality is available whenever the checkbox against the SNMP port is selected on the **Settings – Security** web page:



Configuration of the IP addresses for Trap destinations and the necessary Set/Get access profiles is performed on the **Settings – SNMP** web page. The controller supports up to four different destinations for SNMP messages. Each destination (1 through 4) is configured with an IP address for the SNMP Host that Traps are to be sent to, plus the SET/GET Profile to use. The sample screen for this configuration follows:

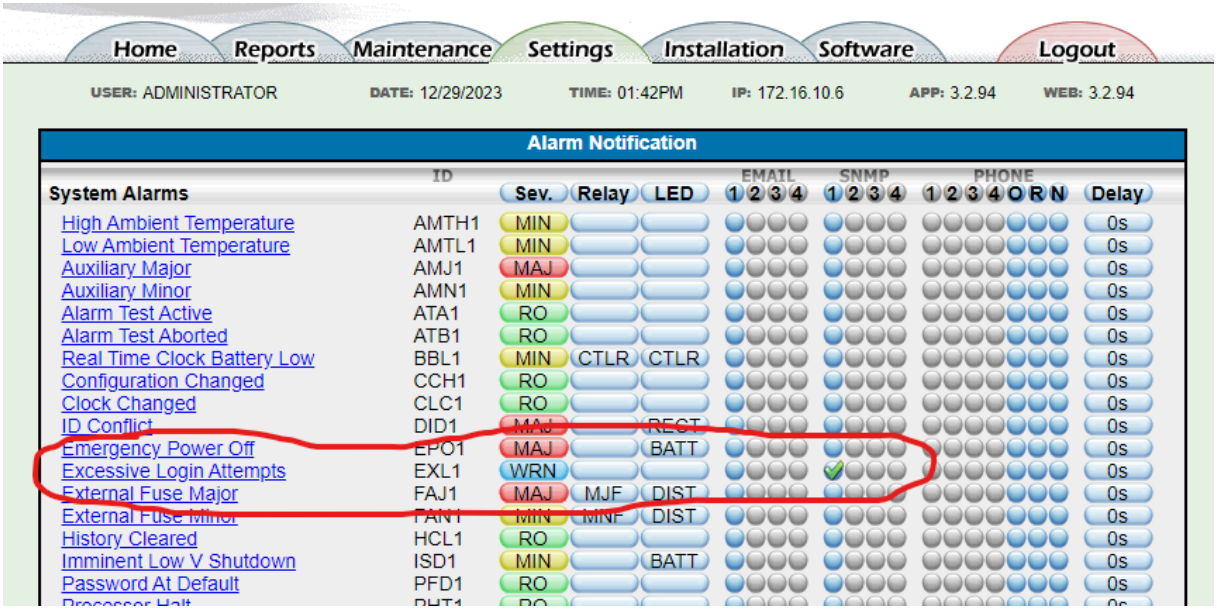


This page permits up to 4 independent SET/GET profiles to be configured, allowing for Read-only (User) and Read/ Write (Super-user) profiles for both SNMP v2C and SNMP v3 protocols, if desired. As shown, the v3 protocol increases security beyond just the Community String of v2C, adding an additional password in either SHA or MD5 Authentication Protocols and Privacy passwords in either DES or AES128 encryption standards.

SNMP Traps

SNMP traps are considered a read-only event. SNMP traps are unsolicited alert messages sent from a SNMP-enabled device to the SNMP Host. For the M2, this means that if a customer wants to be notified of an alarm or event, the controller can automatically send that alert to the SNMP Host. A trap is simply a packetized message that includes a date and time stamp and basic alarm information. When the alarm clears, an additional trap is sent indicating that the alarm condition has retired. SNMP Host managers can then program various things to happen upon the receipt of a trap: sending an email, lighting a lamp, rolling a technician to the site, etc.

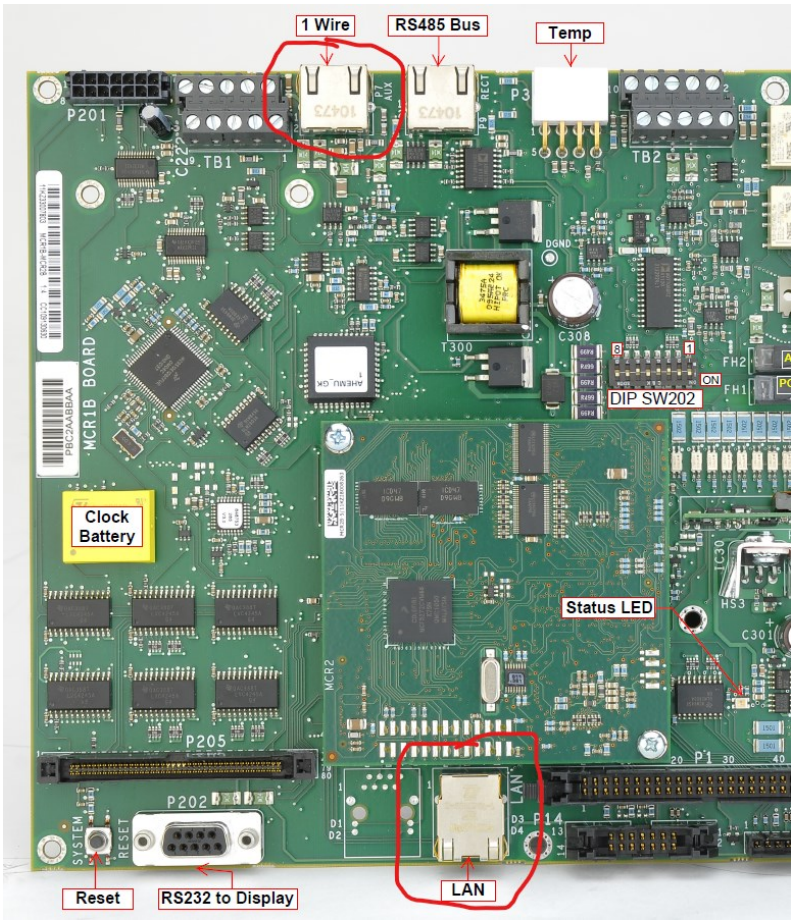
Once the Trap Destinations have been configured and successfully tested, the next step is to choose which alarm events need to send a trap out when the alarm condition is asserted and retired. Complete this on the **Settings – Alarm Notification** or **Settings – UDE Alarm Notification** web page. The SNMP columns represent the four Trap Destinations configured in the previous step. Check any of the bubbles, 1-4, against all alarm events that M2 is to send a Trap to when that alarm is active. Here, SNMP Trap Address 1 is selected against the Excessive Login Attempts alarm event. Therefore, if that alarm activates, a trap will be sent to the programmed destination. Any alarm requiring a trap to be sent can be selected on this page:



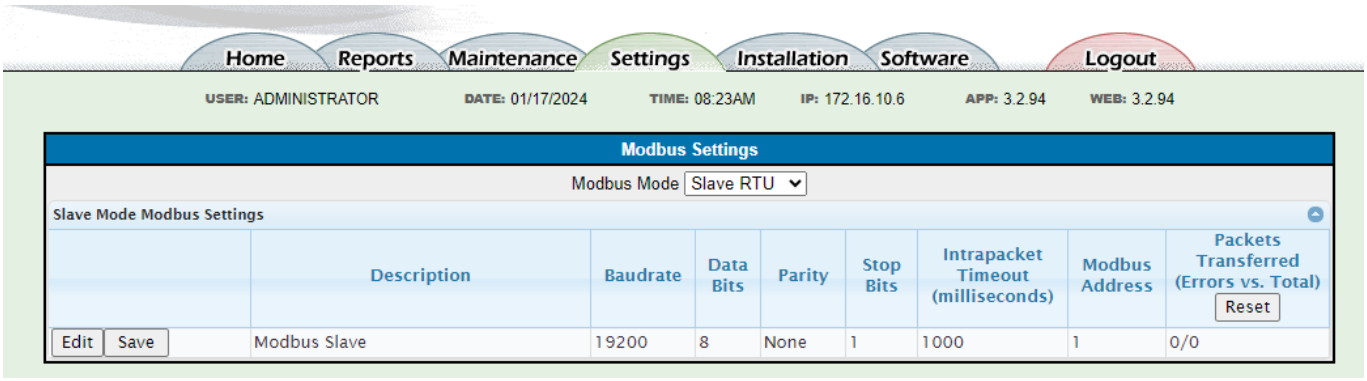
To test the specific traps that are checked on the Alarm Notification page, use the **start snmp trap test** button on the **Maintenance** web page.

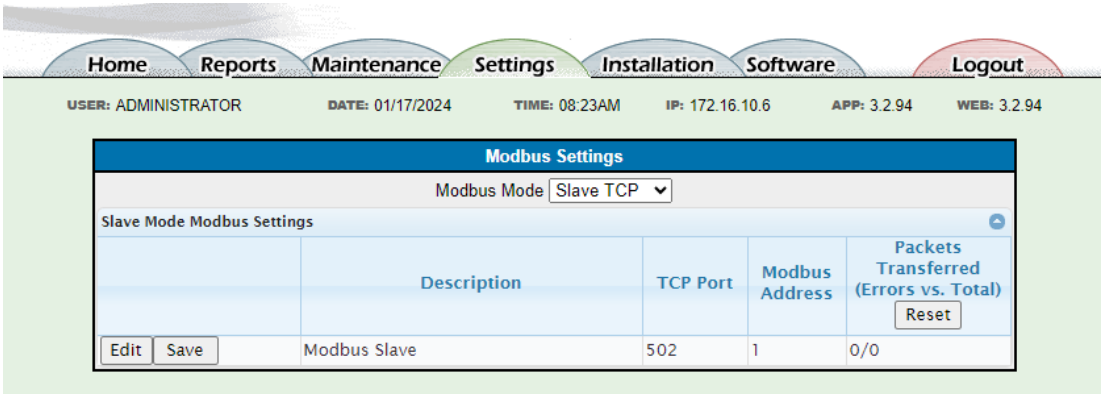
Modbus

MODBUS© Protocol is a messaging structure, widely used to establish master-slave (server-client) communication between intelligent devices. A MODBUS message sent from a master to a slave contains the address of the slave, the 'command' (e.g. 'read register' or 'write register'), the data, and a check sum (LRC or CRC). Since Modbus protocol is just a messaging structure, it is independent of the underlying physical layer. M2 permits Modbus communication to be implemented using RS485 / RTU transmission at pins 1 & 2 of its P7 Aux jack or using TCP over port 502 of its P2 LAN jack:



Configuration for Modbus in M2 is completed on the **Settings – Modbus** web page and is primarily just the selection of **Modbus Mode** as **Slave RTU** or **Slave TCP** and the **Modbus Address** assignment in the network:





The master (or server) device for this Modbus communication will need to be loaded with the appropriate Modbus Mapping tables of Coil and Holding Registers for M2. These can be obtained via a request into the OmniOn Power technical support team at 877-Lineage (877-546-3243) Opt-1, 1 or TechSupport@OmniOnPower.com .

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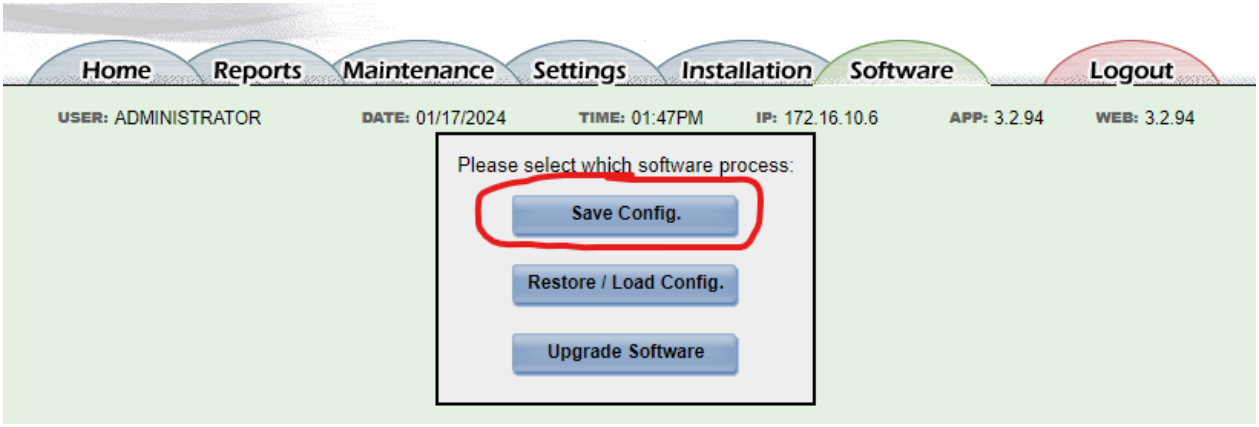
15. Backup / Restore Configuration

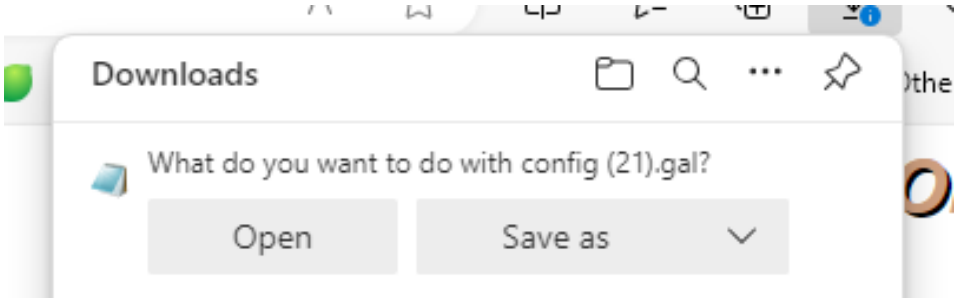
The M2 controller configuration is stored internally in a file named **config.gal**. This file then can be used to restore the controller to its present configuration in the event of a board failure or a configuration reset. This capability is of particular importance when the M2 has been configured with a host of unique items like RPM channels and UDE alarm events, to avoid having to reestablish all of their settings back into the controller individually again. The **config.gal** file is a text editable file. Items in it can be eliminated or changed to allow an upload into other sites to allow their controller to be restored to a similar configuration. Preserve the **.gal** file extension when editing a backup file name to permit this editing of it and to allow it to be easily located by the **Backup** or **Restore** web page **Browse** button.

Backup

To make a backup of the M2's current configuration, select the **Software** tab and the **Save Config** button:



Using this button provides a self-explanatory path to perform a backup of the controller's configuration to a **config.gal** file. Depending on the web browser in use, you should then get prompted regarding a location and/or name to be used for the downloaded file. As previously mentioned, keep the **.gal** file extension on whatever filename and location you select.



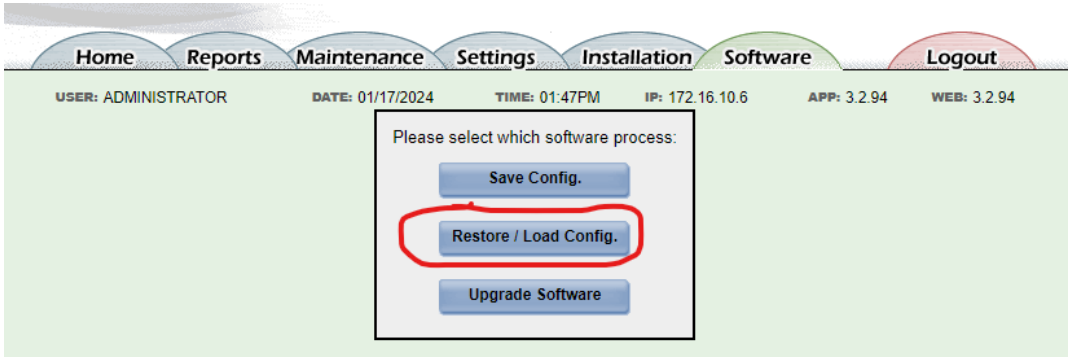
If reviewed using a simple text editor program like Notepad or Wordpad (don't use any app that adds formatting characteristics), the resulting backup can be viewed and edited as just a string of primarily REM (Remark), ADD, LIN (Link), and CHA (Change) T1.317 command lines, all specific to that controller's configuration:

REM 08/01/2017 11:49PM	Date & Time of the backup
ADD RPM,M01,"SHM"	Add a Shunt Module addressed as M01
ADD RPM,M02,"SHM"	
ADD RPM,M03,"SHM"	
ADD RPM,M04,"SHM"	
ADD UDE,U0001	Add a UDE with ID U0001
ADD UDE,U0002	
LIN PS1 AMT,C701	Link channel C701 to be the ambient temperature
CHA PS1,DTF="MM/DD/YYYY"	Date Format to use
CHA PS1,TMF=12	12 Hour Time format (am / pm)
CHA PS1,DLS=1	Daylight Savings Time is enabled
CHA PS1,LNG="ENGLISH"	Language is English
CHA PS1,TUN="F"	Temperature units is Deg F
Etc.	

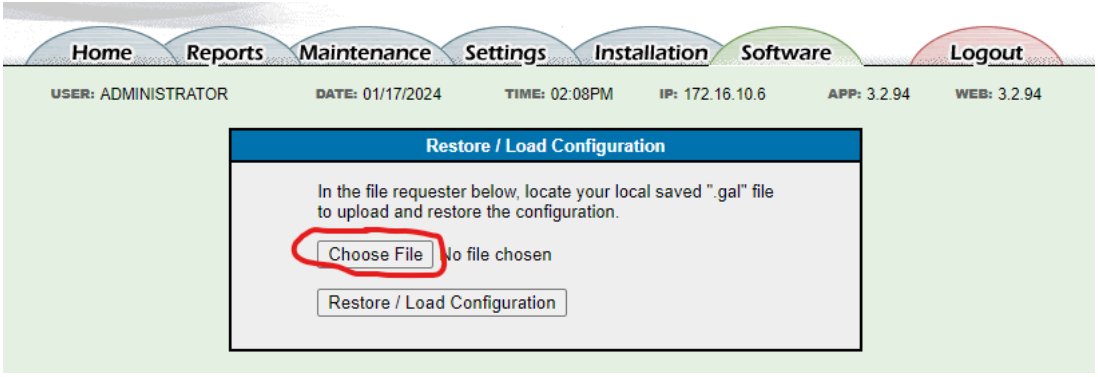
Interpretation of these command lines is covered in Section 17 on the T1.317 Interface.

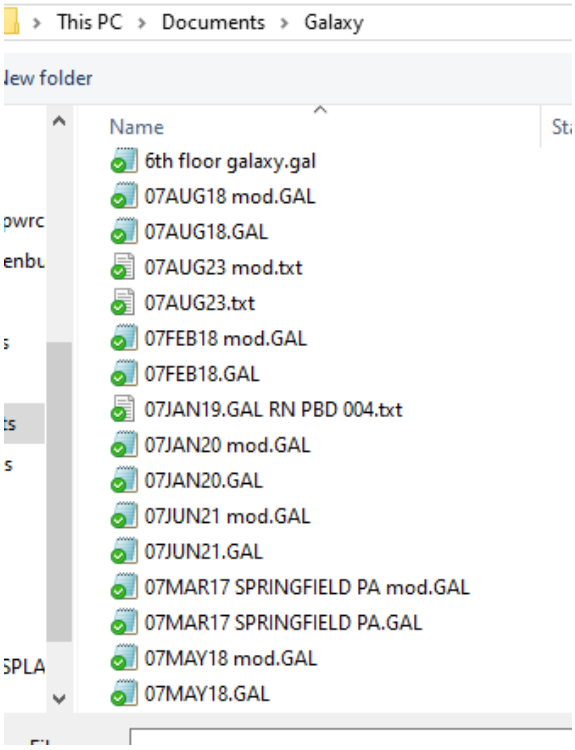
Restore

To load a backup file into a M2's current configuration, select the **Software** tab and the **Restore / Load Config** button:



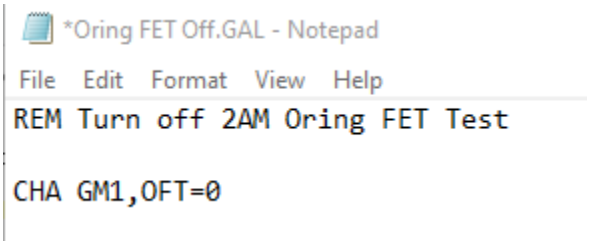
Using this button and then the Choose File button on the subsequent page provides a self-explanatory path to locate the specific **.gal** controller backup that is to be loaded:





An important distinction to note when working with backup files, is that the **Restore** operation Adds or Overwrites Objects and Attributes into the existing controller configuration it is restored into. The existing configuration is not completely replaced by just the Objects and Attributes and their settings of the backup file that is loaded. It only adds to or changes those Objects and Attributes that are in the backup file.

As an example, the following **ORing FET Off.gal** file may be loaded into a M2 to disable the Oring FET Test that occurs at 2am every night against some of our rectifier types:



Loading this file into a M2 using the **Restore** function just turns off this single OFT attribute of the GM1 object. Note also that when trying to load a backup file into a reused M2 circuit board that is not sitting with a default configuration, it is best to first edit it to delete all configured items from the previous use, then load the backup file needed for the new application.

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16. Upgrade Software

Millennium 2 controller software (application code and/or web pages) is best upgraded via web pages, as discussed here. If FTP (File Transfer Protocol) access is enabled on the Settings – Security web page and can be established into M2, the software upgrades can also be performed using that protocol. If upgrading from a very early set of code, FTP may be preferred. Contact the OmniOn Power technical support team for the FTP Upgrade Instructions if these are needed.

A Backup of the existing M2 configuration should always be on hand when performing an Upgrade, in the event that the process fails and the M2 board requires replacement. Refer to Section 15 for obtaining a Backup Configuration file.

The files necessary to complete an upgrade will be typically furnished in a zip file. Extract the files from the zip file and place them into a folder where you will be able to easily locate them, perhaps your My Documents folder. The upgrade files will be named as follows:

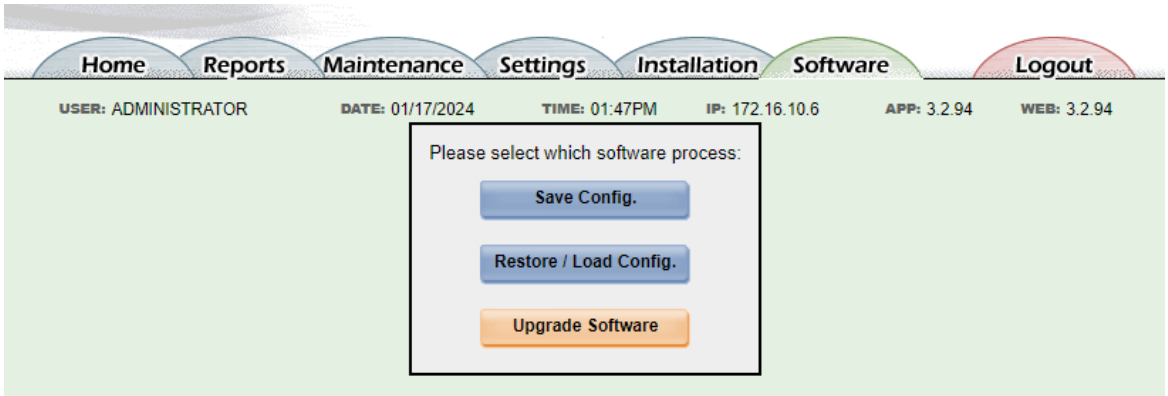
- m2-app.bin Application Code
- m2-pages.web Web Pages

Upgrade Steps:

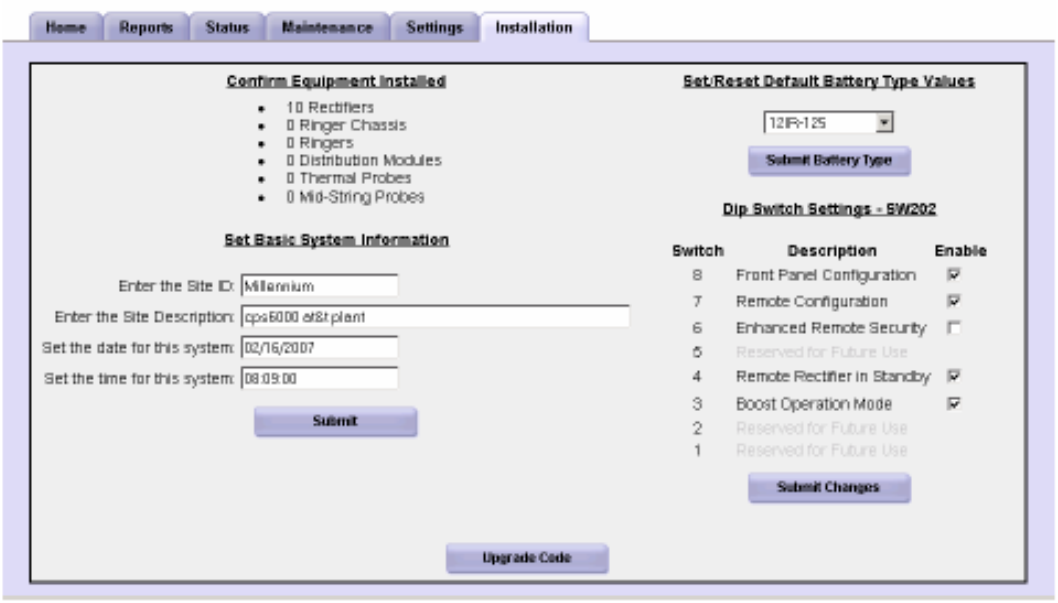
1. Login to the M2 controller through the web pages at the **administrator** security level.

2. Depending on the web pages being used, the access screen for updating software can be at two different web page locations:

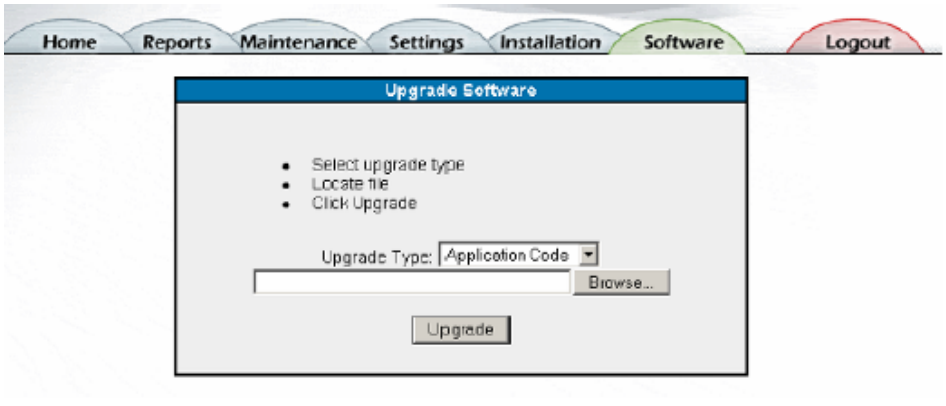
   a. If there is a **Software** tab, go to that page and select the **Upgrade Software** button located at the bottom of the page:



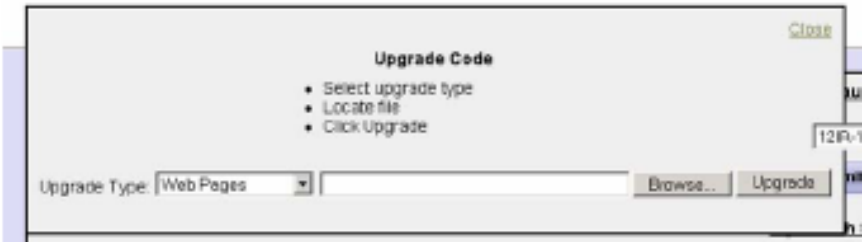
b. With older web pages without a **Software** tab, go to the **Installation** tab and select the **Upgrade Code** button located at the bottom of the page:



3. Selecting the **Upgrade Software** or **Upgrade Code** button provides a drop-down interface to select the type of upgrade to be completed as well as a Browse tool to help select the file to load:



or



4. Select **Web Pages** first in the **Upgrade Type** drop-down and **Browse** to locate and select the **m2-pages.web** file that was previously extracted from the zip file. The **Upgrade** button then begins the upgrade process for the web pages. When it has completed, the M2 should automatically log you off and then perform a processor reset. If it does not reboot within about 2 minutes, then log off and initiate a processor reset yourself, using front display path: **Menu – Control/Oper – Reboot Controller** or the **Reboot** button on the **Maintenance** web page.

5. Wait 2-5 minutes for the controller reboot to finish and for communication to be reestablished with the plant rectifiers. When all alarms have retired, repeat steps 1-3 again and then select **Application Code** in the **Upgrade Type** drop-down and **Browse** to locate and select the **m2-app.bin** file that was previously extracted from the zip file. The **Upgrade** button then begins the upgrade process for the app code. Once again, when it has completed, the M2 should automatically log you off and then perform a processor reset. If it does not reboot within about 2 minutes, then log off and initiate a processor reset yourself, using front display path: **Menu – Control/Oper – Reboot Controller** or the **Reboot** button on the **Maintenance** web page.

6. Wait 2-5 minutes for the controller reboot to finish and for communication to be reestablished with the plant rectifiers. When all alarms have retired, login again and go to the **Reports – Inventory** web page. The resulting report should list both the Application Code and Web Pages that were upgraded under the **Controller Information** column. A successful upgrade may also be confirmed from front display path: **Menu – Status – System Info – Controller Info**.

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17. T1.317 Command Language

The M2 controller user to machine command language is based on the T1.317 standard. This section describes the commands, objects and attributes used to access measurements, configuration, and control parameters in the M2 controller.

The T1.317 standard organizes system parameters called attributes into groups called objects. All commands, objects, attributes and ranges for their respective parameters for the M2 are provided in the tables that follow.

An object-attribute pair uniquely identifies a measurement, configuration, or control parameter. For example, the object-attribute pair **dc1,vdc** identifies the plant voltage while the object-attribute pair **dc1,adc** identifies the plant load current. In each of these examples **dc1** identifies the plant object and **vdc** and **adc** identify DC voltage and DC current, respectively.

There are three main commands involved with plant operations in the system controller command set. The command **sta** is used to get the status of the object-attribute, the command **cha** is used to change a parameter, and the command **ope** is used to initiate a plant function. A login at the **user** level can only perform the **sta** operations. A login at the **super-user** and **administrator** level can also perform the **cha** and **ope** operations.

Instructions in the T1.317 command set take the following form:

command object,attribute[=parameter]

Certain commands do not require a value for parameter, while others do. Note that text parameters are to be enclosed in quotation marks while numeric parameters are not to be enclosed in quotation marks.

For example, to obtain the plant voltage, use in the following command: **sta dc1,vdc**

To enable low-temperature slope thermal compensation, use the following command: **cha sc1,rve=1**

To change the voltage at which the LVD contactor disconnects the batteries from the load to 40V, use following: **cha cn1,dth=40**

Note: all IP addresses and their associated descriptions are required to be in quotes “ ” when using the cha command. To initiate a manual boost charging, i.e., place the plant into boost charging mode, use the following command: **ope dc1,stt=“boost”**

The tables that follow summarize the object-attribute pairs in the system along with the commands that can be used with the pair and the valid range that the attribute may have. The values in bold text are the default settings for the attributes.

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18. Commands requiring super-user or administrator login:

Command	Description	Security level	Notes
ADD	Add object or attribute	super-user	
BACKUP	Backup configuration	super-user	
CHA	Change attribute	super-user	Exceptions noted in tables below
CLE	Clear event	super-user	
CLH	Clear history	super-user	
CLS	Clear statistics	super-user	
DEL	Delete object or attribute	super-user	
LIN	Link object	super-user	Reporting links requires only user level login
OPE	Operate	User	Exceptions noted in tables below
PAS	Changed password	administrator	
RESTORE	Restore configuration	super-user	
STA	Reports state of attributes	User	Exceptions noted in tables below
UNL	Unlink object	super-user	
UPGRADE	Upgrade software	administrator	

Power System		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
ps1,ide	Identifier	✓			text	PS1
ps1,des	Power system description	✓			text	“Millennium II Controller”
ps1,sid	Site ID	✓	✓[1]		text	Up to 20 characters
ps1,sde	Site Description	✓	✓[1]		text	Up to 55 characters
ps1,sys	System Description	✓			text	Up to 55 characters
ps1,swv	Software version	✓			text	d.d
ps1,verw	Web pages version	✓			text	d.d
ps1,verb	Boot block version	✓			text	d.d
ps1,dflt	Defaults version	✓			text	d.d
ps1,brc	Board code	✓			text	“”
ps1,sn	Serial number	✓			text	YYLLddddddddd
ps1,cc	comcode	✓			text	“”
ps1,clei	CLEI code	✓			text	“”
ps1,ser	Series number	✓			text	“”
ps1,cty	Controller type	✓			number	
ps1,dow	Day of week	✓			Text	Sunday…Saturday
ps1,dat	Date	✓	✓[1]		date	format matching ps1,dtf
ps1,dtf	Date format	✓	✓[1]		text	mm-dd-yyyy, dd-mm-yyyy, yyyy-mm-dd
ps1,tim	Time	✓	✓[1]		time	hh:mm
ps1,tmf	Time format	✓	✓[1]		number	12, 24
ps1,dls	Daylight savings enable	✓	✓[1]		number	0=disabled 1=enabled
ps1,tzo	Timezone offset in minutes	✓	✓		number	-14*60 (or 840) to 14*60 (or 840)
ps1,lng	Language	✓	✓	✓	text	see ps1,lngl OPE changes the descriptions
ps1,lngl	Language list	✓				Comma separated list of available languages
ps1,tun	Temperature units	✓	✓[1]		text	C, F
Ps1,cem	Critical equals major	✓	✓		number	0=disable, 1=enable
ps1,fpc	Front panel configuration	✓	✓		number	0=disable, 1=enable
ps1,spc	Serial port configuration	✓	✓		number	0=disable, 1=enable
ps1,rrn	Remote rectifier on	✓	✓		number	0=disable, 1=enable
ps1,rrf	Remote rectifier off	✓	✓		number	0=disable, 1=enable
ps1,lma	Remote security	✓	✓		number	0=disable, 1=enable

Power System		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
ps1,poe	Power off enable	✓	✓		number	0=disable, 1=enable
ps1,usl	Uninstall missing equipment	✓		✓	number	1
ps1,usr	Username enable	✓	✓[2]		number	0=disable, 1=enable
ps1,dct	Display contrast	✓	✓[1]		number	0 – 100 %
ps1,por	Shutdown reset (cancel)	✓		✓	number	1
ps1,ptt	Communication port type	✓	✓		text	“LOCAL”, “MODEM”
ps1,hamt	Highest ambient temperature	✓				In degrees C or F
ps1,lamt	Lowest ambient temperature	✓				In degrees C or F
ps1,nat	Number of 1-wire ambient probes present	✓				0-18
ps1,fst	Factory defaults	✓		✓[1]	text	See ps1,fstl
ps1,fstl	Factory defaults list	✓			text	Comma deliminated list of defaults
ps1,rap	Reset Passwords	✓		✓	number	1 = reset passwords (OPE only valid from local display) will restore passwords.gal
ps1,fpe	Front Panel Pin enable	✓	✓[2]		number	0=disable, 1=enable
ps1,fpt	Front Panel Pin Time-out	✓	✓[2]		Number	1-120 minutes
ps1,fpp	Front Panel Pin	✓	✓[2]		Number	4 digit Pin (only viewable as admin)
ps1,rss	Restart all	✓		✓	number	1=restart rectifiers and ringers
ps1,ltt	Lamp test	✓		✓	number	1 = do lamptest
ps1,ast	System alarm state	✓			Text	"NORM", "RO", "WRN", "MIN", "MAJ", "CRIT"
ps1,slv	Port security level	✓			text	
ps1,dss	Daylight saving start	✓	✓		d:d:d:d	mon:wk:dow:min mon:-1:dom:min
ps1,dse	Daylight saving end	✓	✓		d:d:d:d	mon:wk:dow:min mon:-1:dom:min
ps1,uet	Uninstall Timeout	✓	✓		Number	0-60 seconds
ps1,nal	Number of total alarms active	✓			Number	
ps1,ncr	Number of total critical alarms active	✓			Number	
ps1,nmj	Number of total major alarms active	✓			Number	
ps1,nmn	Number of total minor alarms active	✓			Number	
ps1,nwa	Number of total warnings active	✓			Number	
ps1,nre	Number of total record only events active	✓			Number	
ps1,cra					Attrl	CRA1
ps1,cpa					Attrl	CPA1
ps1,epr					Attrl	EPR1
ps1,pfd					Attrl	PFD1
ps1,exl					Attrl	EXL1
ps1,bbl					Attrl	BBL1
ps1,pht					Attrl	PHT1
ps1,clc					Attrl	CLC1
ps1,stf					Attrl	STF1
ps1,pgi					Attrl	PGI1
ps1,cch					Attrl	CCH1

Power System		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
ps1,hcl					Attrl	HCL1
ps1,mor					Attrl	MOR1
ps1,mtc					Attrl	MTC1
ps1,mdf					Attrl	MDF1
ps1,ats					Attrl	AT1
ps1,amtl					Attrl	AMTL1
ps1,amth					Attrl	AMTH1
ps1,ax1					Attrl	AUX1
ps1,ax2					Attrl	AUX2
ps1,ax3					Attrl	AUX3
ps1,ax4					Attrl	AUX4
ps1,ax5					Attrl	AUX5
ps1,ax6					Attrl	AUX6
ps1,amt					Attrl	
ps1,mrm					Attrl	MR01 – MR12
ps1,cid	Controller assigns IDs	✓	✓		number	0=disable, 1=enable

* Must have administrator privileges to change.
[1] User for craft port only.
[2] Administrators only.

User		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
x,ide	Identifier	✓			text	USR01-USR14, ADM1
x,des	Description	✓	✓		text	User Account 1-14 Administrator Account
x,pwd	Password	✓[1]	✓[1]		text	15 characters
x,usr	User name	✓[1]	✓[1]		text	15 characters
x,lvl	Security level	✓[1]	✓[1]		text	“USER”, “SUPER-USER”, “ADMINISTRATOR”

[1] Administrator only.

AC Distribution		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
acd1,ide	Identifier	✓			text	ACD1
acd1,des	Description	✓	✓		text	AC Distribution
acd1,prv					Attrl	
acd1,psv					Attrl	
acd1,ptv					Attrl	
acd1,rsv					Attrl	
acd1,stv					Attrl	
acd1,trv					Attrl	
acd1,pra					Attrl	
acd1,psa					Attrl	
acd1,pta					Attrl	
acd1,prf					Attrl	
acd1,psf					Attrl	
acd1,ptf					Attrl	
acd1,msa					Attrl	

DC Plant		related commands				
obj,attr	description	sta	cha	ope	type	range
dc1,ide	Identifier	✓			text	DC1
dc1,des	Description	✓	✓		text	DC Plant 1
dc1,typ	Plant Type	✓	✓	✓[1]	number	48V, 24V
dc1,vdc	Plant voltage	✓		✓	number	dd.dd V
dc1,adc	Plant load current	✓		✓	number	ddd.d A
dc1,cap	Total installed rectifier capacity	✓			number	ddd.d A
dc1,olcap	Total on-line rectifier capacity	✓			number	ddd.d A
dc1,trd	Plant total rectifier drain	✓			number	ddd.d A
dc1,sht	Centralized plant shunt type	✓	✓		Text	“NONE”, ”BATTERY”, ”LOAD”
dc1,sha	Centralized plant shunt size	✓	✓		Number	0=disabled 1-9999
dc1,shv	Centralized plant shunt mV	✓	✓		Number	1 – 150 mV
dc1,stt	Plant state	✓		✓[2]	text	“FLOAT”, “BOOST”
dc1,bod	Battery on discharge	✓			number	0= not on discharge 1= on discharge
dc1,rss	Rectifier restart	✓		✓	number	0=no action 1=restart
dc1,rse	Remote security	✓	✓		number	0=disable 1=enable
dc1,rsq	Rectifier sequencing	✓	✓		number	0=disable 1=enable
dc1,aseq	Automatic sequencing	✓	✓		number	0=disable 1=enable
dc1,ete	External ETR	✓	✓		number	0=disable 1=enable
dc1,ron	User Group TR request	✓		✓[2]	Number	0-3 LSB = User, MSB=PBT
dc1,rot	All Rectifier On Threshold	✓	✓		number	20-25or 40-50 volts
dc1,rod	Coup de fouet delay	✓	✓		number	0 – 60 minutes
dc1,trf	External TR status	✓			number	s,s,s,s where s = 1 or 0
dc1,itd	Engine transfer rectifier on initial delay	✓	✓		number	1 – 600 seconds
dc1,tsi	Engine transfer rectifier on subsequent delay	✓	✓		number	0.1 – 600 seconds
dc1,nst	Number of battery strings	✓	✓		number	1-100
dc1,cps	Number of Cells per String	✓	✓		number	1-75 (24V plant) or 24 (48V plant)
dc1,bty	Battery type	✓	✓[1]	✓[1]	Text	See battery type definitions default (OPE causes battery defaults to be loaded)
dc1,isd	Imminent shutdown enable	✓	✓		number	0=disable 1=enable
dc1,isy	Imminent shutdown delay	✓	✓		number	2 – 300 seconds
dc1,rtm	Actual reserve time	✓			time	hh:mm:ss
dc1,res	Reserve time error	✓			text	Error string or blank
dc1,hrt	Hide reserve time	✓	✓		number	0=disable 1=enable
dc1,scap	String capacity	✓	✓[1]		number	
dc1,mls	All load shunts monitored	✓	✓		number	0=disable 1=enable
dc1,ems	Efficiency management status	✓			Number	0=off, 1=on
dc1,eme	Efficiency management enable	✓	✓		Number	0=disable, 1=enable
dc1,emm	Efficiency mode	✓	✓		text	“SERIAL”, “PARALLEL”
dc1,emt	Efficiency target	✓	✓		Number	20 to 95 %
dc1,emo	Efficiency turn on rectifier threshold	✓	✓		Number	25 to 100 %
dc1,emi	Efficiency initial delay	✓	✓		Number	1 to 30 minutes
dc1,emw	Efficiency delay	✓	✓		Number	1 to 30 minutes
dc1,poc	Battery charge percentage	✓			Text	0 to 100 % (with percent character)
dc1,bdt	Time on BD	✓			Text	HH:MM:SS
dc1,nvac	Nominal AC voltage	✓	✓		Number	85 – 530 volts AC
dc1,ccap	Configured Capacity	✓	✓		Number	>= 0 A

dc1,tccl	Total Configured Capacity Latch	✓	✓		number	0=disable 1=enable
dc1,ticl	Total Installed Capacity Latch	✓	✓		number	0=disable 1=enable
dc1,tcce	Total Configured Capacity Enable	✓	✓		number	0=disable 1=enable
dc1,tice	Total Installed Capacity Enable	✓	✓		number	0=disable 1=enable
dc1,btj					Attrl	BTJ1
dc1,amj					Attrl	AMJ1
dc1,amn					Attrl	AMN1
dc1,faj					Attrl	FAJ1
dc1,fan					Attrl	FAN1
dc1,abs					Attrl	ABS1
dc1,vsf					Attrl	VSF1
dc1,lvda					Attrl	LVDA1
dc1,lvd					Attrl	LVD1
dc1,osa					Attrl	OSA1
dc1,emd					Attrl	EMD1
dc1,epd					Attrl	EPD1
dc1,src					Attrl	SRC1
dc1,zid					Attrl	ZID1
dc1,tpa					Attrl	TPA1
dc1,vmf					Attrl	VMF1
dc1,cma					Attrl	CMA1
dc1,mcm					Attrl	MCM1
dc1,epo					Attrl	EPO1
dc1,icr					Attrl	ICR1
dc1,faj2					Attrl	FAJ2
dc1,bid					Attrl	BID1
dc1,rfa					Attrl	RFA1
dc1,acf					Attrl	ACF1
dc1,pha					Attrl	PHA1
dc1,lca					Attrl	LCA1
dc1,lsf					Attrl	LSF1
dc1,man					Attrl	MAN1
dc1,ets					Attrl	ETS1
dc1,ric					Attrl	RIC1
dc1,hpa					Attrl	HPA1
dc1,did					Attrl	DID1
dc1,clm					Attrl	CLM1
dc1,rfn					Attrl	RFN1
dc1,vla					Attrl	VLA1
dc1,mfa					Attrl	MFA1
dc1,lmr					Attrl	LMR1
dc1,erd					Attrl	ERD1
dc1,eto					Attrl	ETO1
dc1,rpi					Attrl	RPI1
dc1,rtl					Attrl	RTL1
dc1,rrtl					Attrl	RRTL1
dc1,rls					Attrl	RLS1
dc1,mman					Attrl	MMAN1
dc1,macf					Attrl	MACF1
dc1,bda					Attrl	BDA1
dc1,hva					Attrl	HVA1
dc1,hfv					Attrl	HFV1
dc1,bst					Attrl	BS1
dc1,ubt					Attrl	CT1

dc1,vhav					Attrl	VHAV1
dc1,hav					Attrl	HAV1
dc1,vlav					Attrl	VLAV1
dc1,lav					Attrl	LAV1
dc1,tic					Attrl	TIC1
dc1,tcc					Attrl	TCC1

[1] User for craft port only
[2] Super-user login required

Alarms With Two Thresholds		**related command**				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
objid,ide	Identifier	✓			text	see below
objid,des	Description	✓	✓		text	see below
objid,ast	Alarm state	✓			number	0=not active 1=active
objid,led	LED	✓	✓		text	BATT, BD, DIST, RECT, AC, RM, CTLR, ""
objid,sev	Alarm severity	✓	✓		text	CRIT, MAJ, MIN, WRN, RO
objid,fth	Alarm boost threshold	✓	✓		number	see below
objid,bth	Alarm float threshold	✓	✓		number	see below
objid,acc	Contact Closure	✓	✓		text	ACF, MJF, MNF, RFA, HV, BD, CTLR, UR1, UR2, VLV, ""
objid,dly	Notify Delay	✓	✓		number	0-540 seconds
objid,noo	Notify On Occur	✓	✓		number	0=no 1=yes
objid,nor	Notify On Retire	✓	✓		number	0=no 1=yes
objid,nag	NAG On Occur	✓	✓		number	0=no 1=yes
objid,dst	Notify Destination	✓	✓		text	"", P1, P2, P3, P4, E1, E2, E3, E4, S1, S2, S3, S4

obj	**description**	**fth**	**bth**
bda1	Battery On Discharge	23-28 V or 40-55 V	23-28 V or 40-55 V
hfv1	High voltage	24.75-31.75 V or 50-60 V	25.75-31.75 V or 52-60 V
hva1	Very high voltage	24.75-31.75 V or 50-60 V	25.75-31.75 V or 52-60 V

Alarms With One Threshold		**related command**				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
objid,ide	Identifier	✓			text	see below
objid,des	Description	✓	✓		text	see below
objid,ast	Alarm state	✓			number	0=not active 1=active
objid,sev	Alarm severity	✓	✓		text	CRIT, MAJ, MIN, WRN, RO
objid,thr	Alarm threshold	✓	✓		number	number
objid,led	LED	✓	✓		text	BATT, BD, DIST, RECT, AC, RM, CTLR, ""
objid,acc	Contact Closure	✓	✓		text	ACF, MJF, MNF, RFA, HV, BD, CTLR, UR1, UR2, VLV, ""
objid,dly	Notify Delay	✓	✓		number	**0**-540 seconds
objid,noo	Notify On Occur	✓	✓		number	**0=no** 1=yes
objid,nor	Notify On Retire	✓	✓		number	**0=no** 1=yes
objid,nag	NAG On Occur	✓	✓		number	**0=no** 1=yes
objid,dst	Notify Destination	✓	✓		text	"", P1, P2, P3, P4, E1, E2, E3, E4, S1, S2, S3, S4

obj	description	Thr
amth1	High ambient temp	30-75C
amtl1	Low ambient temp	-40-10C
btvh1	Very high battery temperature	30-85C
btha1	High battery temperature	30-85C
btla1	Low battery temperature	-40-10C
btvl1	Very low battery temperature	-40-10C
Gnm1	Generator Requires Maintenance	0-8544 hours (1 year) 0 = disabled
ICF1	Inverter High Crest Factor	0-3.2
IIPK1	Inverter High Peak Current	0-28A
IIRM1	Inverter High RMS Current	0-15A
mfa1	Multiple Rectifier Fail	2-90
mman1	Multiple Manual Off	2-90
rrtl1	Real-time reserve low	0-100hrs
rtl1	Reserve time low	0-100hrs
macf1	Multiple AC Fail	2-90
rls1	Redundancy Loss	1-89
cmfa1	Multiple Converter Fail	2-16
chva1	Converter Very High Output Voltage	25-30V 50-60V

obj	description	Thr
chfv1	Converter High Output Voltage	24-30V 48-60V
cvla1	Converter Very Low Output Voltage	20 - 27V 40 - 54V
crl1	Converter redundancy loss	1-16
vla1	Very low voltage	20-25.5 V or 40-57 V
lmr1	Limited Recharge	0.5 – 1.0
erd1	Excess Rectifier Drain	1.0 – 2.0
eto1	Engine Transfer Timeout	0 – 60 minutes
rpi1	Rect/Plant Inconsistency	1.0-2.0
vhav1	Very high AC voltage	0.0-200.0
hav1	High AC voltage	0.0-200.0
vlav1	Very low AC voltage	0.0-200.0
lav1	Low AC voltage	0.0-200.0

Alarms With No Threshold		related command				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
objid,ide	Identifier	✓			text	see below
objid,des	Description	✓	✓		text	see below
objid,ast	Alarm state	✓			number	0=not active 1=active
objid,sev	Alarm severity	✓	✓		text	CRIT, MAJ, MIN, WRN, RO
objid,led	LED	✓	✓		text	BATT, BD, DIST, RECT, AC, RM, CTLR, ""
objid,acc	Contact Closure	✓	✓		text	ACF, MJF, MNF, RFA, HV, BD, CTLR, UR1, UR2, VLV, ""
objid,dly	Notify Delay	✓	✓		number	0-540 seconds
objid,noo	Notify On Occur	✓	✓		number	0=no 1=yes
objid,nor	Notify On Retire	✓	✓		number	0=no 1=yes
objid,nag	NAG On Occur	✓	✓		number	0=no 1=yes
objid,dst	Notify Destination	✓	✓		text	"", P1, P2, P3, P4, E1, E2, E3, E4, S1, S2, S3, S4

Object	Description
AAC1	ACO Active
ABS1	Alarm Battery Supply
ACF1	AC Fail
AMJ1	Auxiliary Major
AMN1	Auxiliary Minor
ATA1	Alarm Test Active
ATB1	Alarm Test Aborted
ATF1	Alarm Test Failed
AUX1	Auxiliary 1
AUX2	Auxiliary 2
AUX3	Auxiliary 3
AUX4	Auxiliary 4
AUX5	Auxiliary 5
AUX6	Auxiliary 6
BBL1	Real Time Clock Battery Low
BFA1	Battery Test Failed
BID1	Bay Interface ID Conflict
BTA1	Battery Test Active
BTJ1	Battery Thermal Major
CCH1	Configuration Changed
CDFA1	Converter Distribution Fuse
CDID1	Converter ID Conflict
CFA1	Converter Fail
CFJ1	Converter Fan Major
CFN1	Converter Fan Minor
CLC1	Clock Changed
CLM1	Rectifier Current Limit
CMA1	Minor Communication Fail Alarm
CNF1	LVBD 1 Failed
CNF2	LVLD 1 Failed
CNF3	LVLD 2 Failed
CNF4	LVLD 3 Failed
CNF5	Battery Shunt Trip 1 Failed
CNO1	LVBD 1 Open
CNO2	LVLD 1 Open
CNO3	LVLD 2 Open
CNO4	LVLD 3 Open
CNO5	Battery Shunt Trip 1 Open
COF1	Queue Overflow
COR1	No Call-Out Response
CPA1	Circuit Pack Fail
CRA1	Controller Fail
DID1	ID Conflict
EMD1	Energy Management Disabled
EPD1	Excess Plant Drain
EPO1	Emergency Power Off
EPR1	External Password Reset
ETS1	External Transfer Shutdown
EXL1	Excessive Login Attempts
FAJ1	External Fuse Major 1
FAJ2	External Fuse Major 2
FAN1	External Fuse Minor 1
HCL1	History Cleared
HPA1	Half Power
ICC1	Incompatible Converter
IDA1	Inverter Distribution Alarm
IF1	Inverter Fail
IFA1	Inverter Freq Lock

Object	Description
IHV1	Inverter High Output
IHVI1	Inverter High Input
ILV1	Inverter Low Output
ILVI1	Inverter Low Input
IMAN1	Inverter Manual Off
IOF1	Inverter Output Fuse
MDF1	Module Failure
MOR1	Measurement Out Of Range
MTC1	Module Type Conflict
MZD1	Voltage ID Not Configured
NNC1	Unconfigured Alarm Destination
OSA1	Open String
PCM	PIC Current Measurement
PFD1	Password At Default
PGI1	Program Line Invalid
PHA1	Phase Or Low Output
PHT1	Processor Halt
PIC	Panel Interface Card
POR1	No Dial-Out Response
PFS1	Thermal Protection Fail Safe
PTM	PIC Temperature Measurements
PVM	PIC Voltage Measurement
RCDP1	Ringer ID Conflict
RF1	Ringer Fail
RFA1	Rectifier Fail
RFN1	Rectifier Fan Fail
RIC1	Rectifier Incomplete Config
RIF1	Rectifier Internal Fault
RPFF1	Ringer Fan Fail
RPFJ1	Ringer Fail Major
RPRL1	Ringer Redundancy Loss
RPXJ1	Ringer Major External Fault
RPXN1	Ringer Minor External Fault
SCD1	Battery Voltage Imbalance
SNC1	Shunt Not Configured
STF1	Self Test Failed
TPA1	Thermal Probe Failure
URC1	User Relay Conflict
VMF1	Voltage Channel Failure
VSF1	Sense/Control Fuse
ZID1	ID Not Configured

Rectifier Management		related commands				
obj,attr	description	sta	cha	ope	type	range
gm1,ide	Identifier	✓			Text	GM1
gm1,des	Description	✓	✓		Text	Rectifier Manager 1
gm1,lse	Load Share Enable	✓	✓		number	0=disable 1=enable
gm1,rme	Redundancy monitor enable	✓	✓		number	0=disable,1=enable
gm1,fsd	Float High Voltage Shutdown	✓	✓		number	25-30 or 50-60 V
gm1,bsd	Boost High Voltage Shutdown	✓	✓		number	26-30 or 52-60 V
gm1,fsp	Float Set-Point	✓	✓		number	21-28 or 42-56.5 V
gm1,bsp	Boost Set-Point	✓	✓		number	21-30 or 48-60 V
gm1,fcl	Float Current Limit	✓	✓		number	30-110%
gm1,bcl	Boost Current Limit	✓	✓		number	30-110%
gm1,oft	Oring Fet Test Enable	✓	✓		number	0=disable 1=enable
gm1,wie	Walkin Enable	✓	✓		number	0=disable 1=enable
gm1,nri	Number of Rectifiers Installed	✓			number	>=0

Rectifiers		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**Range**
gsr,ide	Identifier	✓			Text	Gsr
gsr,des	Description	✓	✓		text	Rectifier sr
gsr,typ	Rectifier Type	✓	✓		text	12 char
gsr,sn	Serial number	✓			text	Up to 18 characters
gsr,cc	Comcode	✓			text	
gsr,clei	Clei code	✓			text	
gsr,ser	Series Number	✓			text	
gsr,verp	Primary Software Version	✓			text	
gsr,vers	Secondary Software Version	✓			text	
gsr,adc	DC Current (VI, VIR)	✓			number	number A
gsr,vdc	DC Voltage	✓			number	number V
gsr,stt	Individual rectifier state	✓		✓[1]	text	ON, OFF, STANDBY, VACANT, MISSING
gsr,cap	Capacity	✓			number	number A
gsr,vac	AC Voltage	✓			number	number V
gsr,vac1	Phase 1 AC Voltage	✓			number	number V
gsr,vac2	Phase 2 AC Voltage	✓			number	number V
gsr,vac3	Phase 3 AC Voltage	✓			number	number V
gsr,aac	AC Current	✓			number	number A
gsr,aac1	Phase 1 AC Current	✓			number	number A
gsr,aac2	Phase 2 AC Current	✓			number	number A
gsr,aac3	Phase 3 AC Current	✓			number	number A
gsr,tmp	Temperature	✓			number	number F or C
gsr,rtm	Run time	✓			number	
gsr,mnt	MAN signal type	✓	✓		text	None, CC, CO
gsr,seq	Use In Sequence Enable	✓	✓		number	0=no 1=yes
gsr,ocb	Output circuit breaker	✓			number	open, closed
gsr,rfa	Rectifier Fail	✓			number	0=inactive 1=active
gsr,acf	AC Fail	✓			number	0=inactive 1=active
obj,pha	Phase fail	✓			number	0=inactive 1=active
obj,lca	Low current output	✓			number	0=inactive 1=active
gsr,man	Standby or Manual Off	✓			number	0=inactive 1=active
obj,erd	Excessive rectifier drain	✓			number	0=inactive 1=active
obj,ets	External transfer shutdown	✓			number	0=inactive 1=active
obj,ric	Type warning	✓			number	0=inactive 1=active
obj,hpa	Half power	✓			number	0=inactive 1=active
gsr,did	ID Conflict	✓			number	0=inactive 1=active
gsr,clm	Current Limit	✓			number	0=inactive 1=active
gsr,rif	Internal fault	✓			number	0=inactive 1=active
gsr,rcf	Communication Fail	✓			number	0=inactive 1=active
gsr,rfn	Fan fail	✓			number	0=inactive 1=active
gsr,lsf	Load share fail	✓			number	0=inactive 1=active
gsr,vhav	Very high AC voltage	✓			number	0=inactive 1=active
gsr,hav	High AC voltage	✓			number	0=inactive 1=active
gsr,vlav	Very low AC voltage	✓			number	0=inactive 1=active
gsr,lav	Low AC voltage	✓			number	0=inactive 1=active

[1] Super-user login required to place in standby. User login can turn on.

For shelf-based systems:
s stands for shelf number (1 to 16); r stands for rectifier number (1 to 7)

For bay-based systems: id will be gbsr (6 digit ids) Where:
b stands for bay number (1 to 99)
s stands for shelf number (1 to 99)
r stands for rectifier number (1 to 10)

Ferro Rectifier Bridge		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
fbx,ide	Identifier	✓			Text	FB1, FB2
fbx,des	Description	✓	✓		Text	Bridge board *x*
fbx,stt	State	✓			Text	Present, Missing
fbx,sn	Serial Number	✓			Text	Up to 18 characters
fbx,typ	Board Type	✓			Text	BJC1, BJC2

x is 1 or 2

Converter Plant		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
cp1,ide	Identifier	✓			Text	CP1
cp1,des	Description	✓	✓		Text	Converter Plant 1
cp1,typ	Converter output type	✓			Text	24V or 48V
cp1,vdc	DC Voltage	✓		✓	Number	Number in volts
cp1,adc	DC Current	✓			Number	Number in amps
cp1,cap	Installed capacity	✓			Number	Number in amps
cp1,olcap	Online capacity	✓			Number	Number in amps
cp1,vsp	Voltage Set-Point	✓	✓		Number	23-28V or 46-57V
cp1,vsd	Internal high voltage shutdown	✓	✓		Number	25-30V or 50-60V
Cp1,clm	Current Limit	✓	✓		Number	30% to 100%
cp1,dth	Low Voltage Discon Threshold	✓	✓		Number	20-25V or 40-50V
cp1,rth	Low Voltage Recon Threshold	✓	✓		Number	22-27V or 44-54V
cp1,lvd	Low Voltage Disconnect Enable	✓	✓		Number	0=disabled 1=enabled
Cp1,rof	Remote standby enable	✓	✓		number	0=disable,1=enable
cp1,rme	Redundancy monitor enable	✓	✓		number	0=disable,1=enable
cp1,rss	Converter restart	✓		✓	number	1=restart
cp1,nci	Number of Converters Installed	✓			number	>=0
cp1,cfa					Attrl	CFA1
cp1,cfn					Attrl	CFN1
cp1,cfj					Attrl	CFJ1
cp1,dfa					Attrl	CDFA1
cp1,did					Attrl	CDID1
cp1,icc					Attrl	ICC1
cp1,mfa					Attrl	CMFA1
cp1,hva					Attrl	CHVA1
cp1,hfv					Attrl	CHFV1
cp1,vla					Attrl	CVLA1
cp1,rl					Attrl	CRL1

DC Converter		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
csr,ide	Identifier	✓			Text	Csr
csr,des	Description	✓	✓		Text	DC Converter sr
csr,typ	Type	✓	✓		Text	1410 chars
csr,sn	Serial number	✓			Text	Serial number
csr,adc	DC Current	✓			Number	Number in amps
csr,cap	Capacity	✓			Number	Number in amps
csr,stt	State	✓		✓[1]	Text	ON, OFF, STANDBY, MISSING, VACANT ON qualifiers –LIM OFF qualifiers –LVD, -INF, -TA, -HVSD, -FAN
csr,cfa	Converter Fail	✓			Number	0=inactive 1=active
csr,dfa	Distribution fuse fail	✓			Number	0=inactive 1=active
csr,did	ID Conflict	✓			Number	0=inactive 1=active
csr,ccf	Communication Fail	✓			Number	0=inactive 1=active
csr,cfn	Minor fan fail	✓			Number	0=inactive 1=active
csr,cfj	Major fan fail	✓			Number	0=inactive 1=active

[1] Super-user login required to place in standby. User login can turn on.
s stands for shelf number (0 or 1)
r stands for converter number (1 thru 6)

Battery Reserve Management		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
Br1,ide	Identifier	✓			Text	BR1
br1,des	Description	✓	✓		Text	Battery Reserve 1
br1,adc	Total battery current	✓			number	*d* A (+ for discharge, - for charge)
br1,hbt	Highest battery temperature	✓			number	*dd* °C
br1,lbt	Lowest battery temperature	✓			number	*dd* °C
br1,cap	Installed battery capacity	✓			number	ddddd AH

Battery Reserve Management		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
brl,olcap	On-line battery capacity	✓			number	ddddd AH
brl,btr	Discharge test results	✓		✓	text	result,reserve,load result is one of the following: COMPLETED CHECK BATTERY INTERRUPTED ACTIVE NOT RUN reserve is hours calculate by last complete test load is load at beginning of test
brl,tth	High Temperature Threshold	✓	✓		Number	30-90°C or 86-194°C
brl,cle	Current Limit Enable	✓	✓		number	0=disable 1=enable
brl,clt	Current Limit Threshold	✓	✓		number	5-1000A
brl,cev	Battery string end of discharge V	✓	✓[1]		Number	19.25-25.35V or 40.25-48.75V
brl,epe	Process reserve time	✓	✓		number	0=disable 1=enable
brl,bts	Battery Test State	✓		✓[1]	number	0=inactive 1=active
brl,mtt	Manual test type	✓	✓[1]		text	DISABLED, 20%, TIMED
brl,tev	Manual test alarm voltage	✓	✓[1]		number	21-27V or 36-48 V
brl,tmd	Manual test duration	✓	✓[1]		time	00:00:00 to 23:59:59 (hh:mm:ss)
brl,bte	Auto test type	✓	✓		text	DISABLED, 20%, TIMED
brl,btv	Battery test rectifier voltage	✓	✓[1]		number	21-26 V or 42-52 V
brl,ath	Auto test start hour	✓	✓		number	0-23
brl,tin	Auto test interval	✓	✓		number	1-18 months
brl,atw	Auto test min hours after BD	✓	✓		number	0-240 hours
brl,atd	Auto test date	✓	✓		date	dd-mmm-yy
brl,atc	“At” current	✓	✓		number	> 0
brl,atr	“At” reserve time	✓			time	
brl,ate	“At” reserve time error	✓				Error string
brl,nvm	Number of mid-cell V present	✓				d
brl,ntm	Number of temperatures present	✓				d
brl,scd	Battery voltage imbalance detection enable	✓			number	0=disable,1=enable (Automatically enabled when mid cell V monitor present)
brl,scv	Battery imbalance threshold	✓	✓		number	1.5-3.0V
brl,bta					Attrl	BTA1
brl,bfa					Attrl	BFA1
brl,scda					Attrl	SCD1
brl,isda					Attrl	ISD1
brl,mdp					Attrl	MDP1
brl,mzd					Attrl	MZD1
brl,btha					Attrl	BTHA1

[1] User level for craft port only

Battery String		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
Bnn,ide	Identifier	✓			Text	Bnn
Bnn,des	Description	✓	✓		Text	Battery String 1 to 70
Bnn,con	Battery Contactor	✓	✓		Text	DCN01 to DCN06, DCNP1-32, DCNU1-3
bnn,stt	State	✓			text	NONE, MISSING, OPEN, CLOSED
bnn,nst	Number of strings	✓	✓		number	1 to 100
bnn,bty	Battery type	✓	✓		text	See battery type definitions
bnn,cap	Capacity	✓			number	dddd
bnn,rtm	Reserve time	✓			time	
bnn,adc	Current	✓			number	Current

Battery strings are addable.

Battery Type Definition		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
btnn,ide	Identifier	✓			Text	BTnn
btnn,des	Description	✓	✓		Text	Battery Configuration 1 to 25
btnn,bty	Battery Type	✓	✓		Text	Up to 14 characters
btnn,btc	Battery Class	✓	✓		Text	FLOODED, SEALED, NICD, LI_LMP, LI_ELITE
btnn,cap	Capacity	✓	✓		Number	dddd
obj,d01		✓	✓		Number	
obj,d02		✓	✓		Number	
obj,d03		✓	✓		Number	
obj,d04		✓	✓		Number	
obj,d05		✓	✓		Number	
obj,d06		✓	✓		Number	
obj,d07		✓	✓		Number	
obj,d08		✓	✓		Number	
obj,d09		✓	✓		Number	
obj,d10		✓	✓		Number	
obj,d11		✓	✓		Number	
obj,d12		✓	✓		Number	
obj,d13		✓	✓		Number	
obj,d14		✓	✓		Number	
obj,d15		✓	✓		Number	
obj,d16		✓	✓		Number	
obj,d17		✓	✓		Number	
obj,frm	Formula	✓	✓		Number	

Ringer Plant		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
rp1,ide	Identifier	✓			number	RP1
rp1,des	Description	✓	✓		number	Ringer Plant 1
rp1,frq	Ringer output frequency	✓	✓		number	15-50Hz
rp1,vsp	Ringer voltage set-point	✓	✓		number	65-100V
rp1,ofe	Ringer offset enable	✓	✓		number	0=disable,1=enable
rp1,rme	Redundancy monitor enable	✓	✓		number	0=disable,1=enable
rp1,rss	Ringer restart	✓		✓	number	1=restart
rp1,va	Ringer VA	✓			number	
rp1,cap	Ringer capacity	✓			number	
rp1,olcap	Ringer online capacity	✓			number	
rp1,rrf	Ringer standby enable	✓	✓		number	0=disable 1=enable
rp1,rf					Attrl	RF1
rp1,rpff					Attrl	RPFF1
rp1,rprl					Attrl	RPRL1
rp1,rpfj					Attrl	RPFJ1
rp1,rpxj					Attrl	RPXJ1
rp1,rpxn					Attrl	RPXN1
rp1,rcdp					Attrl	RCDP1

Ringer Chassis		related commands				
attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
rcn,ide	Identifier	✓			number	RC1-RC8
rcn,des	Description	✓	✓		number	Ringer Chassis 1-8
rcn,stt	Ringer group state	✓		✓	number	ON –FAN, -REDUN OFF –FAIL, -EXT, -TA, -RET, -FAN STANDBY MISSING The ope command supports the ON and STANDBY states
rcn,va	Ringer output va	✓			number	dd.d VA
rcn,pri	Primary ringer	✓			text	sr where s is the shelf number r is the ringer position 1=first primary ringer 3=second primary ringer First ringers are in the odd shelf slot. Second ringers are in the even shelf slot
rcn,sec	Secondary ringer	✓			text	sr where s is the shelf number r is the ringer position 2=first secondary ringer 4=second secondary ringer First ringers are in the odd shelf slot. Second ringers are in the even shelf slot
rcn,ptyp	Primary type	✓				
rcn,psn	Primary serial number	✓				
rcn,pstt	Primary state	✓				
rcn,styp	Secondary type	✓				
rcn,ssn	Secondary serial number	✓				
rcn,sst	Secondary state	✓				
rcn,cap	Capacity	✓				
rcn,rf	Ringer Fail	✓				0=inactive 1=active
rcn,rpff	Ringer Fan Fail	✓				0=inactive 1=active
rcn,rpxj	Ringer External Minor Fault	✓				0=inactive 1=active
rcn,rpxn	Ringer External Major Fault	✓				0=inactive 1=active
rcn,rprl	Ringer Redundancy Loss	✓				0=inactive 1=active
rcn,rpfj	Ringer major Fail	✓				0=inactive 1=active
rcn,rcdp	Ringer ID Conflict	✓				0=inactive 1=active

Where n stands for ringer chassis number (1 thru 8)

Boost Management		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
bs1,ide	Identifier	✓			Text	BS1
bs1,des	Description	✓	✓		Text	Boost Control 1
bs1,stt	State	✓	✓		Text	QRCT, MANUAL, BTP, TIMED AUTO, OFF
bs1,bse	Boost enable	✓	✓			0=disable,1=enable
bs1,tbe	External boost enable	✓	✓			0=disable,1=enable
bs1,btp	Battery temp. protection mode	✓	✓			0=disable,1=enable
bs1,atm	Auto Mode	✓	✓		Text	DISABLED, CURRENT, TIMED
bs1,tmd	Timed Manual Duration	✓	✓		Number	1-80 hours
bs1,amf	Auto Multiplication Factor	✓	✓		Number	0.1-9
bs1,cta	Current Term Current Thresh	✓	✓		Number	1-999A
bs1,btd	Minimum BD duration for auto boost	✓	✓		Time	0 – 5 minutes (HH:MM:SS format)
bs1,bsa	Boost alarm				Attrl	

Disconnect Contactor Control		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
cn*x*,ide	Identifier	✓			number	CN1, CN2, CN3, CN4, CN5
cn*x*,des	Description	✓	✓		number	Contactor 1
cn*x*,stt	Status	✓		✓ [1]	text	NONE, DISCON, CONNECT, FAILED
cn*x*,ena	Control enable	✓	✓			0=disable,1=enable
cn*x*,dth	Disconnect threshold	✓	✓		number	19-25V or 39-50V
cn*x*,ddy	Disconnect delay	✓	✓		number	0-300 minutes
cn*x*,dam	Disconnect automode	✓	✓		text	0="NONE" 1="VOLTAGE" 2= "VOLTAGE+TIME"
cn*x*,dtm	Disconnect remaining time	✓			number	>0 means going to disconnect
cn*x*,rth	Reconnect threshold	✓	✓		number	19.5-27V or 39-55V
cn*x*,rdy	Reconnect delay	✓	✓		number	0-300 seconds
cn*x*,ram	Reconnect automode	✓	✓		text	0="NONE" 1="VOLTAGE" 2="VOLTAGE+TIME"
cn*x*,rtm	Reconnect remaining time	✓			number	>0 means going to reconnect
cn*x*,cno					Attrl	CNOx
cn*x*,cnf					Attrl	CNFx

[1] Super-user login only

The contactors are identified as follows:
CN1 = Battery Disconnect (LVBD1)
CN2 = Load 1 Disconnect (LVLD1)
CN3 = Load 2 Disconnect (LVLD2)
CN4 = Load 3 Disconnect (LVLD3)
CN5 = Battery Shunt Trip Disconnect 1 (BSTRIP)

Distribution Current Monitor		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
dcmxx,ide	Identifier	✓			number	DCMC1 is the plant shunt DCM01-DCM08
dcmxx,des	Description	✓	✓		number	Contactor 1
dcmxx,sn	Serial Number	✓			text	Serial number
dcmxx,brc	Board Code	✓			text	Board code
dcmxx,stt	State	✓			text	NONE, MISSING, PRESENT
dcmxx,typ	Shunt Type	✓	✓		text	NONE, LOAD, BATTERY
dcmxx,val	Reading	✓			number	ddd.d Amps
dcmxx,sha	Shunt amp rating	✓	✓		number	0-9999 Amps
dcmxx,shv	Shunt mV	✓	✓		number	mV

The shunt type defaults are as follows:

DCMC1 = Battery

DCM01 = Battery

DCM02-DCM08 = Load

Distribution Contactor Interface		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
dcn*xx*,ide	Identifier	✓			number	DCN01-DCN06, DCNP01-32, DCN1-3
dcn*xx*,des	Description	✓	✓		number	Contactor 1
dcn*xx*,sn	Serial Number	✓			text	Serial number
dcn*xx*,brc	Board Code	✓			text	Board code
dcn*xx*,stt	State	✓		✓[1]	text	NONE, MISSING, OPEN, CLOSED
dcn*xx*,typ	Contactor interface type	✓	✓		text	NONE, CN1, CN2, CN3, CN4, or CN5

[1] Super-user login required

The contactor interface type defaults are as follows:
DCN01 = CN1
DCN02 = CN2
DCN03 = CN3
DCN04-DCN06 = CN4
DCNP01-P32 = CN4
DCNU1-3 = CN4

Slope Thermal Compensation		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
sc1,ide	Identifier	✓			Text	SC1
sc1,des	Description	✓	✓		Text	Slope Thermal Comp
sc1,stt	State	✓	✓		number	0=disable 1=enable
sc1,rve	Raise Voltage Enable	✓	✓		number	0=disable 1=enable
sc1,fse	Fail Safe Enable	✓	✓		number	0=disable 1=enable
sc1,ltt	Lower Temperature Threshold	✓	✓		number	-5-20°C or 23-68°F
sc1,ntt	Nominal Temperature Threshold	✓	✓		number	15-30°C or 59-86°F
sc1,utt	Upper Temperature Threshold	✓	✓		number	30-55°C or 86-131°F
sc1,spt	Step Temperature	✓	✓		number	45-85°C or 113-185°F
sc1,lsp	Low temperature slope	✓	✓		number	1-10mV/°C per cell
sc1,usp	Upper temperature slope	✓	✓		number	1-10mV/°C per cell

Input Management		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
inmnn,ide	Identifier	✓			number	m=module; nn=input number Examples: IN001=input 1 on controller IN103=input 3 on module with ID 1
inmnn,des	Description	✓			text	See table below
inmnn,,sn	Serial Number	✓			text	Serial number
inmnn,stt	State	✓			Number	
inmnn,,brc	Board Code	✓			text	Board code
inmnn,typ	Input alarm type	✓	✓		text	“”,FAN1, FAJ1, OSA1, AUX1, AUX2, AUX3, AUX4, AUX5, AUX6, REMLVD
inmnn,pol	Input alarming state	✓	✓		text	CLOSED, OPEN

where: m is the distribution interface module ID from 1 to 4
nn is the input number from 01 to the number of inputs supported by the distribution interface module

Built-in plant inputs

Object	**Signal**	**Default Description**
In001	???	???
In002	???	???
In003	???	???
In004	???	???
In005	???	???
In006	???	???

Object	Signal	Default Description
In007	???	???
In008	???	???
In009	???	???
In010	???	???

Call-Out Manager		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
cm1,ide	Identifier	✓			Text	CM1
cm1,des	Description	✓	✓		text	30 char (Call-Out Manager)
cm1,ngi	NAG Interval	✓	✓		Number	**15** to 60 minutes
cm1,cof					Attrl	COF1
cm1,cor					Attrl	COR1
cm1,nnc					Attrl	NNC1
cm1,cop	Phone number				Attrl	P1, P2, P3, P4, A1

Call-Out Phone Number		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
x,ide	Identifier	✓			Text	x
x,des	Description	✓	✓		text	(Alternate) Call-Out Number
x,typ	Type	✓	✓		text	DATA, PAGER
x,phn	Phone Number	✓	✓		text	Digit ( ) * # - , up to 25 characters
x,bdr	Connect Baudrate	✓	✓		Number	300, 1200, 2400, 4800, 9600, 14400
x,dbt	Data Bits	✓	✓		Number	7, 8
x,pry	Parity	✓	✓		Text	O, E, N
x,sbt	Stop Bits	✓	✓		Number	1, 2
x,dly	Pager ID Delay	✓	✓		Number	0-9 seconds
x,pgr	Pager ID (Pin #)	✓	✓		Text	Digit ( ) * # - , up to 25 characters
x,msg	Pager Message	✓	✓		Text	up to 25 characters

Where x is P1, P2, P3, P4, A1

Call-Out Email Address		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
x,ide	Identifier	✓			text	E1, E2, E3, E4
x,des	Description	✓	✓		text	Email Address
x,adr	Address	✓	✓		text	40 characters
x,typ	Type	✓	✓		text	**NORMAL**, PAGER

Where x is E1 – E4

SNMP Destination		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
x,ide	Identifier	✓			text	S1, S2, S3, S4
x,des	Description	✓	✓		text	SNMP Trap Destination
x,ip	IP Address	✓	✓		text	d.d.d.d
x,v1t	Send v1 traps	✓	✓		Number	0 (v2 traps), 1(v1 traps)
x,cs	Community string	✓	✓		text	20 characters
x,snt	Enable Trap Test	✓	✓			0=disable,1=enable

Where x is S1 – S4

Periodic Call-Out		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
po1,ide	Identifier	✓			Text	POL1
po1,des	Description	✓	✓		text	Periodic Call-Out 1
po1,phn	Phone Number	✓	✓		text	Digit ( ) * # - , up to 25 characters
po1,bdr	Connect Baudrate	✓	✓		Number	300, 1200, 2400, 4800, 9600, 14400
po1,dbt	Data Bits	✓	✓		Number	7, 8
po1,pry	Parity	✓	✓		Text	O, E, N
po1,sbt	Stop Bits	✓	✓		Number	1, 2
po1,int	Interval	✓	✓		Text	Sunday...Saturday, Daily, Monthly, Quarterly, Never
po1,tim	Time	✓	✓		Time	Hh:mm
po1,e1-4	Email address 1-4	✓	✓		Text	Up to 40 characters each
po1,cl01-10	Command Line 1-10	✓	✓		Text	Up to 40 characters each
po1,d01-10	Description for Command Line 1-10	✓	✓		Text	Up to 30 characters each

Modem		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
mp1,ide	Identifier	✓			Text	MP1
mp1,des	Description	✓	✓		Text	Modem Port 1
mp1,stt	State	✓			Text	USER, SUPER-USER, ADMINISTRATOR, TL1, LOGOUT
mp1,dbt	Data Bits	✓	✓		Number	7, 8
mp1,pry	Parity	✓	✓		text	O, E, N
mp1,sbt	Stop Bits	✓	✓		Number	1, 2
mp1,tmo	Time-Out	✓	✓		Number	0(disabled) – 45 minutes
mp1,hsh	Handshaking	✓	✓		text	NO, SW
mp1,nrg	Number of Rings Before Answer	✓	✓		number	2-15
mp1,wre	Write Enable	✓	✓		Number	0=disable 1=enable (HW,SW)
mp1,ins	Modem Initialization String	✓	✓		text	Up to 40 characters “” assigns the default string

Local RS-232 Port		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
lp1,ide	Identifier	✓			Text	LP1
lp1,des	Description	✓	✓		text	Local Port 1
lp1,stt	State	✓			text	USER, SUPER-USER, ADMINISTRATOR, TL1, LOGOUT
lp1,bdr	Baud Rate	✓	✓		text	AUTO, 300, 1200, 2400, 4800, 9600, 19200
lp1,dbt	Data Bits	✓	✓		Number	7, 8
lp1,pry	Parity	✓	✓		text	O, E, N
lp1,sbt	Stop Bits	✓	✓		Number	1, 2
lp1,tmo	Time-Out	✓	✓		Number	0(disabled) – 45 minutes
lp1,hsh	Handshaking	✓	✓		text	NO, HW, SW
lp1,app	Application	✓	✓		Text	TERMINAL, TL1, EVENT LOG
lp1,wre	Write Enable	✓	✓		Number	0=disable 1=enable (HW,SW)

Auxiliary RS-232/485 Port		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
au1,ide	Identifier	✓			Text	AU1
au1,des	Description	✓	✓		text	Local Port 1
au1,stt	State	✓			text	USER, SUPER-USER, ADMINISTRATOR, TL1, LOGOUT

Auxiliary RS-232/485 Port		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
au1,bdr	Baud Rate	✓	✓		text	AUTO, 300, 1200, 2400, 4800, 9600, 19200
au1,dbt	Data Bits	✓	✓		Number	7, 8
au1,pry	Parity	✓	✓		text	O, E, N
au1,sbt	Stop Bits	✓	✓		Number	1, 2
au1,tmo	Time-Out	✓	✓		Number	0(disabled) – 45 minutes
au1,hsh	Handshaking	✓	✓		text	NO, HW, SW
au1,app	Application	✓	✓		Text	TERMINAL, TL1, EVENT LOG
au1,wre	Write Enable	✓	✓		Number	0=disable 1=enable (HW,SW)
au1,ptt	Port tyep	✓	✓		Text	RS232, RS485

Front Panel		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
fp1,ide	Identifier	✓			Text	FP1
fp1,des	Description	✓	✓		text	Local Port 1

Alarm Test		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
at1,ide	Identifier	✓			Text	AT1
at1,des	Description	✓	✓		Text	Alarm Test 1
at1,stt	Alarm Test State	✓		✓[1]	Number	0=inactive 1=active
at1,stg	Alarm Test Stage	✓			text	“”, HVSD, RFAT, PCR, PMJ, PMN, MJF, MNF, BD, ACF, RFA, VLV, HV, CTLR, UR1, UR2
at1,rtf	Rectifier fail list	✓			text	
at1,lte	Alarm Test Enable	✓	✓[1]		Number	0=disable 1=enable (HW,SW)
at1,hvs	Simulate HV	✓	✓[1]		Number	0=no 1=yes
at1,dur	Duration	✓	✓[1]		Number	5-300 seconds
at1,pcr	Test Power Critical	✓	✓[1]		Number	0=no 1=yes
at1,pmj	Test Power Major	✓	✓[1]		Number	0=no 1=yes
at1,pmn	Test Power Minor	✓	✓[1]		Number	0=no 1=yes
at1,mjf	Test Major Fuse	✓	✓[1]		Number	0=no 1=yes
at1,mnf	Test Minor Fuse	✓	✓[1]		Number	0=no 1=yes
at1,bd	Test BD	✓	✓[1]		Number	0=no 1=yes
at1,acf	Test ACF	✓	✓[1]		Number	0=no 1=yes
at1,rfa	Test RFA	✓	✓[1]		Number	0=no 1=yes
at1,ur1	Test User Relay 1	✓	✓[1]		Number	0=no 1=yes
at1,ur2	Test User Relay 2	✓	✓[1]		Number	0=no 1=yes
at1,ur3	Test User Relay 3	✓	✓[1]		Number	0=no 1=yes
at1,hv	Test HV	✓	✓[1]		Number	0=no 1=yes
at1,ctlr	Test CTRL	✓	✓[1]		Number	0=no 1=yes
at1,ets	Email Test	✓		✓	number	1=do test (sets and clears ATA1)
at1,ems	Email Results	✓			text	
at1,irt	Individual Relay Test State	✓		✓	Number	“”=Stop Test, HVSD, RFAT, PCR, PMJ, PMN, MJF, MNF, BD, ACF, RFA, VLV, HV, CTLR, UR1, UR2
at1,snt	SNMP Test	✓		✓	Number	1=do test
at1,bzi	Audio Test Duration	✓	✓[1]		Number	5-300 seconds
at1,bzt	Audio Test State	✓		✓	Number	“”=Stop Test, Local=local buzzer
at1,ata					Attrl	ATA1
at1,atf					Attrl	ATF1
at1,atb					Attrl	ATB1

[1] User level for craft port only

Alarm Cut-off		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
aco1,ide	Identifier	✓			Text	ACO1
aco1,des	Description	✓	✓		Text	Alarm Cut-off 1
aco1,stt	Alarm Cut-off State	✓		✓	Number	0=inactive 1=active
aco1,cst	Critical Alarm Cut-off State	✓			Number	0=inactive 1=active
aco1,cae	Critical Alarm Cut-off Enable	✓	✓		Number	0=disable 1=enable
aco1,cto	Critical Alarm Cut-off Time-Out	✓	✓		Number	1 to 8 hours
aco1,jst	Major Alarm Cut-off State	✓			Number	0=inactive 1=active
aco1,jae	Major Alarm Cut-off Enable	✓	✓		Number	0=disable 1=enable
aco1,jto	Major Alarm Cut-off Time-Out	✓	✓		Number	1 to 8 hours
aco1,nst	Minor Alarm Cut-off State	✓			Number	0=inactive 1=active
aco1,nae	Minor Alarm Cut-off Enable	✓	✓		Number	0=disable 1=enable
aco1,nto	Minor Alarm Cut-off Time-Out	✓	✓		Number	1 to 72 hours
aco1,lbe	Local Buzzer Enable	✓	✓		Number	0=disable 1=enable
aco1,aac	ACO active				Attrl	AAC1

User Defined Events		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
unnnn,ide	Identifier	✓			Text	Unnnn
unnnn,des	Description	✓	✓		Text	30 char
unnnn,ast	Alarm State	✓			Number	0=inactive 1=active
unnnn,sev	Severity	✓	✓		Text	CRIT, MAJ, MIN, WRN, RO
unnnn,prg	Program Line	✓	✓		Text	60 char
unnnn,dur	Minimum Duration	✓	✓		Number	> 0 seconds
unnnn,lat	Latched	✓	✓		Number	0=no 1=yes
unnnn,led	LED	✓	✓		text	BATT, BD, DIST, RECT, AC, RM, CTLR, ""
unnnn,acc	Contact Closure	✓	✓		text	ACF, MJF, MNF, RFA, HV, BD, CTLR, UR1, UR2, VLV, ""
unnnn,dly	Notify Delay	✓	✓		Number	0-540 seconds
unnnn,noo	Notify On Occur	✓	✓		Number	0=no 1=yes
unnnn,nor	Notify On Retire	✓	✓		Number	0=no 1=yes
unnnn,nag	NAG On Occur	✓	✓		Number	0=no 1=yes
unnnn,dst	Notify Destination	✓	✓		text	"", P1, P2, P3, P4, E1, E2, E3, E4, S1, S2, S3, S4

where nnnn = 1 thru 1500

Derived Channels		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
drnn,ide	Identifier	✓			Text	DRnn
drnn,des	Description	✓	✓		Text	30 char (Derived Chan nn)
drnn,val	Value	✓			Number	Number units
drnn,prg	Program line	✓	✓		Text	60 char
drnn,uni	Unit	✓	✓		Text	5 chars

Where nn is from 01 thru 32

Trend		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
dct1,ide	Identifier	✓				DCT1 for DC plant load TR1 – TR8
dct1,des	Description	✓	✓		Text	DC1 Trend Statistics CP1 Trend Statistics
dct1,src	Source	✓	✓		Text	DC1 ADC

TL1 Manager		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
tlm1,ide	Identifier	✓			Text	TLM1
tlm1,des	Description	✓	✓		text	30 char (TL1 Manager)
tlm1,aue	Activate-User Enable	✓	✓		number	0=disable 1=enable
tlm1,cts	CTS Connect Detection	✓	✓		number	0=disable 1=enable
tlm1,dsr	DSR Connect Detection	✓	✓		number	0=disable 1=enable
tlm1,prt	Port	✓	✓		number	2020
tlm1,tmo	Timeout	✓	✓		number	0-60 minutes

TL1 Object		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
tl1,ide	Identifier	✓			Text	TL1
tln,des	Description	✓	✓		text	30 char (TL1 Object n)
tln,cds	Condition Description	✓	✓		text	60 char
tln,aid	Aid	✓	✓		text	20 char
tln,cnd	Condition Type	✓	✓		text	20 char
tln,saf	Service Affecting	✓	✓		Number	0=no 1=yes
tln,rpt	Reporting	✓	✓		text	EQUIPMENT, ENVIRONMENT, PRESENCE

Where n is the TL object number from 001 thru 128

Call-Back Security		related commands				
obj,attr	**description**	**sta**	**cha**	**Ope**	**type**	**range**
cb1,ide	Identifier	✓			Text	CB1
cb1,des	Description	✓	✓		text	Call-Back Security 1
cb1,stt	State	✓	✓		number	0=off 1=on
cb1,ph1-5	Call-Back Phone Number	✓	✓		Text	Digit () * # - , space
cb1,br1-5	Connect Baudrate	✓	✓		number	300, 1200, 2400, 4800, 9600, 14400

Mid-String Voltage		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
msnc,des	Description	✓	✓		text	30 char (Mid-String Voltage Module n Channel c)
msnc,stt	State	✓		✓	text	None, Present, Missing
msnc,val	Value	✓			Number	Mid-String voltage
msnc,did	Duplicate Id	✓			Number	0=no 1=yes

Where n is the Mid-String module number from 1 to 7, and c is the Mid-String channel number form 1 to 3

Network Settings		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
net1,ide	Identifier	✓			Text	NET1
net1,des	Description	✓	✓		text	30 char (Mid-String Voltage Module n Channel c)
net1,ead	Ethernet (MAC) Address	✓			text	hh:hh:hh:hh:hh:hh
net1,dhcp	DHCP	✓	✓	✓[1]	number	0=static IP, 1=DHCP Client, 2=DHCP Server (OPE causes system reboot)
net1,ip	Static IP address	✓	✓		IP address	xxx.xxx.xxx.xxx (not used if DHCP enabled)
net1,sub	Static Subnet Mask	✓	✓		IP address	xxx.xxx.xxx.xxx (not used if DHCP enabled)
net1,gtwy	Static Gateway (Router) IP	✓	✓		IP address	xxx.xxx.xxx.xxx (not used if DHCP enabled)
net1,host	Hostname	✓	✓		text	
net1,wip	Working IP address	✓				xxx.xxx.xxx.xxx (shows DHCP assigned or static IP address)
net1,dom	Static Domain Name	✓	✓		text	(not used if DHCP enabled)

Network Settings		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
net1,dns	Static DNS IP	✓	✓		IP address	xxx.xxx.xxx.xxx (not used if DHCP enabled)
net1,ntp	NTP provider IP address	✓	✓		IP address	xxx.xxx.xxx.xxx
net1,wre	Write Enable	✓	✓			0=disabled, 1=enabled
net1,tmo	Session Timeout	✓	✓			Minutes
net1,msrv	Mailhost IP	✓	✓		IP address	xxx.xxx.xxx.xxx (0.0.0.0 will force a DNS lookup of “mailhost”)
net1,sma	Send Mail As	✓	✓		text	40 characters (email address)
net1,sid	SNMPv3 Engine ID	✓			number	
net1,fpe	FTP enable	✓	✓		number	0=disable 1=enable
net1,hpe	HTTP enable	✓	✓		number	0=disable 1=enable
net1,hse	HTTPS enable	✓	✓		number	
net1,she	SSH enable	✓	✓		number	
net1,sne	SNMP enable	✓	✓		number	
net1,tle	Telnet enable	✓	✓		number	
net1,ip6	IPv6 Address	✓	✓		text	
net1,gtwy6	IPv6 Gateway	✓	✓		text	
net1,wip6	Working IPv6 Address	✓			number	
net1,ll6	Link local address	✓			number	
net1,pl6	Prefix length	✓	✓		number	
net1,wgtwy6	IPv6 Router Address	✓			number	

Battery Section		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
bnn,ide	Identifier	✓			Text	B*nn*
bnn,des	Description	✓	✓		text	30 char
bnn,con	Contactor	✓	✓			
bnn,stt	State	✓				
bnn,nst	Number of strings	✓	✓			
bnn,bty	Battery Type	✓	✓			
bnn,cap	Capacity	✓				
bnn,dat	Installed Date	✓	✓			0/0/0 = not set yet
bnn,mpv	Mid-string voltage	✓				
bnn,rtm	Actual reserve time	✓			time	hh:mm:ss
bnn,res	Reserve time error	✓			text	Error string or blank
bnn,adc	Current	✓				

where nn is 01 - 70

Rectifier Bay		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
rbnn,ide	Identifier	✓			Text	RBnn
rbnn,des	Description	✓	✓		text	30 char
rbnn,tmp	Temperature	✓			Attrl	
rbnn,icb	Input circuit breaker	✓			Attrl	
rbnn,rec	Rectifiers	✓			Attrl	
rbnn,dcc	Converters	✓			Attrl	
rbnn,rch	Ringer chassis	✓			Attrl	
rbnn,dat	Installed Date	✓			Attrl	
rbnn,mpv	Mid-string voltage	✓			Attrl	
rbnn,adc	Current	✓			Attrl	

where nn is 01 -32

Battery Bay		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
bbnn,ide	Identifier	✓			Text	BBnn
bbnn,des	Description	✓	✓		text	30 char
bbnn,tmp	Temperature	✓			Attrl	
bbnn,bat	Battery sections	✓			Attrl	

where nn is 01 -32

Bay Interface Card (BIC)		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
bicnn,ide	Identifier	✓			Text	BICnn
bicnn,des	Description	✓	✓		text	30 char
bicnn,stt	State	✓			text	
bicnn,sn	Serial number	✓			text	
bicnn,bid	Duplicate ID	✓			Number	0=no 1=yes
bicnn,bcf	Communication fail	✓			Number	0=no 1=yes

where nn is 01 -32

Bay Current Monitor		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
bcmccnn,ide	Identifier	✓			Text	BCMccnn
bcmccnn,des	Description	✓	✓		text	30 char
bcmccnn,val	Current	✓			Number	
bcmccnn,sha	Shunt current rating	✓	✓		Number	
bcmccnn,shv	Shunt mV	✓	✓		Number	
bcmccnn,sht	Shunt type	✓	✓		Text	“NONE”, “BATTERY”, “LOAD”

where nn is BIC 01 – 32, and cc is channel 01 – 04

Bay Voltage Monitor		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
bvmccnn,ide	Identifier	✓			Text	BVMccnn
bvmccnn,des	Description	✓	✓		text	30 char
bvmccnn,val	Voltage	✓			Number	

where nn is BIC 01 – 32, and cc is channel 01 – 04

Bay Temperature Monitor		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
btm01nn,ide	Identifier	✓			Text	BTM01*nn*
btm01nn,des	Description	✓	✓		text	30 char
btm01nn,val	Temperature	✓			Number	
btm01nn,ibt	Is Battery Temperature	✓	✓		Number	0=disable, 1=enable

where nn is BIC 01 – 32

Panel Interface Card (PIC)		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
picnn,ide	Identifier	✓			Text	PICnn
picnn,des	Description	✓	✓		text	30 char
picnn,stt	State	✓			text	
picnn,sn	Serial number	✓			text	
picnn,ncc	No Cable Connected	✓	✓		Number	0= Cable returning status connected, 1= no cable connected returning status
picnn,trp	Shunt Trip Disconnect	✓	✓		Number	0=normal disconnect 1=shunt trip disconnect
picnn,vera	Application software version	✓			text	
picnn,pid	Duplicate ID	✓			Number	0=no 1=yes
picnn,pcf	Communication fail	✓			Number	0=no 1=yes

where nn is 01 -32

Panel Current Monitor		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
pcmccnn,ide	Identifier	✓			Text	PCMccnn
pcmccnn,des	Description	✓	✓		text	30 char
pcmccnn,val	Current	✓			Number	
pcmccnn,sha	Shunt current rating	✓	✓		Number	
pcmccnn,shv	Shunt mV	✓	✓		Number	
pcmccnn,sht	Shunt type	✓	✓		Text	“NONE”, ”BATTERY”, ”LOAD”

where nn is PIC 01 – 32, and cc is channel 01 – 02

Panel Voltage Monitor		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
pvmccnn,ide	Identifier	✓			Text	PVMccnn
pvmccnn,des	Description	✓	✓		text	30 char
pvmccnn,val	Voltage	✓			Number	

where nn is PIC 01 – 32, and cc is channel 01 – 02

Panel Temperature Monitor		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
ptm01nn,ide	Identifier	✓			Text	PTM01nn
ptm01nn,des	Description	✓	✓		text	30 char
ptm01nn,bamt	Board Ambient Temperature	✓			Number	
ptm01nn,nat	Number of Ambient Temperature Probes	✓			Number	
ptm01nn,hamt	Highest Ambient Temperature (Probe)	✓			Number	
ptm01nn,lamt	Lowest Ambient Temperature (Probe)	✓			Number	
ptm01nn,ntm	Number of Battery Probes	✓			Number	
ptm01nn,hbt	Highest Battery Temperature	✓			Number	
ptm01nn,lbt	Lowest Battery Temperature	✓			Number	
ptm01nn,nbut	Number of Bus Temperature Probes	✓			Number	
ptm01nn,hbut	Highest Bus Temperature	✓			Number	
ptm01nn,lbut	Lowest Bus Temperature	✓			Number	

where nn is PIC 01 – 32

Controller Current Channel		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
cc1,ide	Identifier	✓			Text	CC1
cc1,des	Description	✓	✓		text	30 char
cc1,val	Current	✓			Number	
cc1,uni	Units	✓	✓		text	
cc1,ofs	Offset	✓	✓		Number	
cc1,scf	Scale factor	✓	✓		Number	

Controller Voltage Channel		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
cv1,ide	Identifier	✓			Text	CV1
cv1,des	Description	✓	✓		text	30 char
cv1,val	Voltage	✓			Number	
cv1,uni	Units	✓	✓		text	
cv1,ofs	Offset	✓	✓		Number	
cv1,scf	Scale factor	✓	✓		Number	
cv1,rng	Input voltage range	✓	✓		Number	5, 30, 60 Must correspond to the external scaling resistors used: 10.98K, 115.2K, or 242K ohms respectively

Controller Temperature Channel		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
ctn,ide	Identifier	✓			Text	CTn
ctn,des	Description	✓	✓		text	30 char
ctn,val	Temperature	✓			Number	
ctn,ibt	Is Battery Temperature	✓	✓		Number	0=disable, 1=enable

where n = 1 – 4

DC Distribution		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
lda,ide	Identifier	✓			Text	LDA1
lda,des	Description	✓	✓		text	30 char
lda,dfa	Distribution fuse alarm	✓			Attrl	

RPM Module		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
mhh,ide	Identifier	✓			Text	Mhh
mhh,des	Description	✓	✓		text	30 char
mhh,stt	State	✓			text	ATTACHED, DETACHED, TYPE CONFLICT, FAIL, INVALID, OUT OF RANGE, VALID
mhh,ser	Serial number	✓			text	
mhh,typ	Type	✓			text	BIM, CRM, SHM, VTM, TPM
mhh,tlk	Type lock	✓	✓		Number	0=no 1=yes
mhh,mor	Measurement out of range	✓			Number	0=no 1=yes
mhh,mdf	Module fail	✓			Number	0=no 1=yes
mhh,mtc	Module type conflict	✓				0=no 1=yes

where hh = 01 – ff

Binary Input Channel		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
cnhh,ide	Identifier	✓			Text	Cnhh
cnhh,des	Description	✓	✓		text	30 char
cnhh,stt	State	✓			text	
cnhh,typ	Type	✓			text	BIM
cnhh,val	Value	✓			Number	
cnhh,mor	Measurement out of range	✓			Number	0=no 1=yes

Where n is channel 1 - 6, and hh is module 01 – ff

Control Relay Channel		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
cnhh,ide	Identifier	✓			Text	Cnhh
cnhh,des	Description	✓	✓		text	30 char
cnhh,stt	State	✓			text	
cnhh,typ	Type	✓			text	CRM
cnhh,val	Value	✓			Number	
cnhh,prg	Program	✓	✓		text	
cnhh,mor	Measurement out of range	✓			Number	0=no 1=yes

Where n is channel 1 - 6, and hh is module 01 – ff

Shunt Monitor Channel		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
cnhh,ide	Identifier	✓			Text	Cnhh
cnhh,des	Description	✓	✓		text	30 char
cnhh,stt	State	✓			text	
cnhh,typ	Type	✓			text	SHM
cnhh,rng	Range	✓			text	
cnhh,val	Value	✓			Number	
cnhh,sha	Shunt rating	✓	✓		Number	
cnhh,shv	Shunt mV	✓	✓		Number	
cnhh,mor	Measurement out of range	✓			Number	0=no 1=yes

Where n is channel 1 - 6, and hh is module 01 – ff

Voltage Monitor Channel		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
cnhh,ide	Identifier	✓			Text	Cnhh
cnhh,des	Description	✓	✓		text	30 char
cnhh,stt	State	✓			text	
cnhh,typ	Type	✓			text	VTM
cnhh,rng	Range	✓			text	
cnhh,val	Value	✓			Number	
cnhh,uni	Units	✓	✓		text	
cnhh,ofs	Offset	✓	✓		Number	
cnhh,scf	Scale factor	✓	✓		Number	
cnhh,mor	Measurement out of range	✓			Number	0=no 1=yes

Where n is channel 1 - 6, and hh is module 01 – ff

Temperature Monitor Channel		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
cnhh,ide	Identifier	✓			Text	Cnhh
cnhh,des	Description	✓	✓		text	30 char
cnhh,stt	State	✓			text	
cnhh,typ	Type	✓			text	TPM
cnhh,val	Value	✓			Number	
cnhh,ibt	Is Battery Temperature	✓	✓		Number	0=disable, 1=enable
cnhh,mor	Measurement out of range	✓			Number	0=no 1=yes

Where n is channel 1 - 6, and hh is module 01 – ff

User Defined Object		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**Range**
xxx,ide	Identifier	✓			Text	*xxx*
xxx,des	Description	✓	✓		text	30 char

Up to 100

Data Switch Port		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
obj,ide	Identifier	✓			Text	DS1, DS2, DS3, DS4, DS5, and DS6
obj,des	Description	✓	✓		text	30 char
obj,cid	Controller ID	✓	✓		text	GALAXY, OMNI, ECS, MCS, RAS, XCS
obj,stt	State	✓			text	N/A, IDLE, REPORTING, PASS-THRU
obj,ren		✓			Number	VTM
obj,bdr	Baudrate	✓			Text	300, 1200, 2400, 4800, 9600, 19200
obj,dbt	Data bits	✓			Number	7, 8
obj,pry	Parity	✓	✓		Text	o, e, n
obj,sbt	Stop bits	✓	✓		Number	1, 2
obj,hsh	Handshaking	✓	✓		Text	HW, SW, NONE
obj,dsr	DSR signal required	✓	✓		Number	0=no 1=yes
obj,hdr	Header length	✓	✓		Number	
obj,apr	Attention	✓	✓		Text	
obj,pwd	Password	✓	✓		Text	LINEAGE\r
obj,acm	Alarms command	✓	✓		Text	ALM\r
obj,huc	Hangup command	✓	✓		Text	BYE\r
obj,cea		✓	✓		Attrl	CEA1 – CEA6

obj = ds1 – ds6

Connected Equipment Alarm		related command				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
objid,ide	Identifier	✓			Text	CEA1, CEA2, CEA3, CEA4. CEA5, CEA6
objid,des	Description	✓	✓		text	
objid,ast	Alarm state	✓			number	0=not active 1=active
objid,sev	Alarm severity	✓	✓		text	CRIT, MAJ, MIN, WRN, RO
objid,dly	Notify Delay	✓	✓		number	0-540 seconds
objid,noo	Notify On Occur	✓	✓		number	0=no 1=yes
objid,nor	Notify On Retire	✓	✓		number	0=no 1=yes
objid,nag	NAG On Occur	✓	✓		number	0=no 1=yes
objid,dst	Notify Destination	✓	✓		text	“”, P1, P2, P3, P4, E1, E2, E3, E4, S1, S2, S3, S4

objid = cea1 – cea6

Time Event		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
obj,ide	Identifier	✓			Text	T01-T32
obj,des	Description	✓	✓		text	30 char
obj,stt	State	✓			text	
obj,dat	Date	✓	✓		date	
obj,tim	Time	✓	✓		time	
obj,dur	Duration	✓	✓		Number	0 – 1440 hours (1 day)

obj = t01 – t32

Busy Hour Statistics		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
obj,ide	Identifier	✓			Text	DCBH1, BH1, BH2, BH3, BH4
obj,des	Description	✓	✓		text	30 char
obj,src	State	✓	✓		text	T1.317 object, attribute
obj,sdt	Start date	✓	✓		date	
obj,shr	Start hour	✓	✓		Number	0 - 23

obj = DCBH1 DC1 plant current busy hour stats
BH1 - BH4

Maintenance Reminder		related command				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
objid,des	Description	✓	✓		text	
objid,ast	Alarm state	✓			number	0=not active 1=active
objid,sev	Alarm severity	✓	✓		text	CRIT, MAJ, MIN, WRN, RO
objid,noo	Notify On Occur	✓	✓		number	0=no 1=yes
objid,nor	Notify On Retire	✓	✓		number	0=no 1=yes
objid,nag	NAG On Occur	✓	✓		number	0=no 1=yes
objid,dst	Notify Destination	✓	✓		text	“”, P1, P2, P3, P4, E1, E2, E3, E4, S1, S2, S3, S4
obj,dat	Date	✓	✓		date	
obj,tim	Time	✓	✓		time	
obj,txt	Message text	✓	✓		text	

objid = MR01 – MR12

Notepad		related command				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
objid,ide	Identifier	✓			Text	UNP, SNP, ENP
objid,des	Description	✓	✓		text	
objid,stt	Alarm state	✓			number	0=not active 1=active
objid,cl01 – cl15	Notepad text	✓	✓		text	

objid = UNP User Notepad, SNP Super-User Notepad, ENP Easy View Notepad

CS Community String		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
csn,ide	Identifier	✓			Text	CSn
csn,des	Description	✓	✓		text	30 char
csn,str	Community string	✓	✓		text	20 characters
csn,ip	IP address to match	✓	✓		IP address	xxx.xxx.xxx.xxx (0.0.0.0 → no match required)
csn,ipm	IP address mask	✓	✓		IP address	xxx.xxx.xxx.xxx (255.255.255.255 → compare entire IP address)
csn,wre	Write enable	✓	✓		number	0=disable 1=enable SETs

where n is 1 - 4

As a MODBus Slave		related commands				
mod1,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
mod1,ide	Identifier	✓			Text	MOD1
mod1,des	Description	✓	✓		Text	30 char
mod1,mod	Mode	✓	✓		Text	MASTER RTU, SLAVE RTU, SLAVE TCP, None, Slave (Slave is kept for backwards compatibility)
mod1,bdr	Baudrate	✓	✓		Text	2400, 4800, 9600, 19200, 38400
mod1,dbt	Data bits	✓	✓		Number	7, 8
mod1,pry	Parity	✓	✓		Text	o, e, n
mod1,sbt	Stop bits	✓	✓		Number	1, 2
mod1,tmo	Intrapacket Timeout	✓	✓		Number	1 to 20000 milliseconds
mod1,id	Modbus Address	✓	✓		Number	1 to 255
mod1,prt	Modbus TCP port number	✓	✓		Number	Defaulted: 502
mod1,ver	Modbus register version	✓			Text	
mod1,err	Communication errors	✓		✓	Number	Num Error Packets/Total Packets

Remote Polled Slave MODBus Devices		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
obj,ide	Identifier	✓			Text	D01, D02, D03, D04, D05
obj,des	Description	✓	✓		Text	30 char
obj,bdr	Baudrate	✓	✓		Text	2400, 4800, 9600, 19200, 38400
obj,dbt	Data bits	✓	✓		Number	7, 8
obj,pry	Parity	✓	✓		Text	o, e, n
obj,sbt	Stop bits	✓	✓		Number	1, 2
obj,tmo	Round-trip timeout	✓	✓		Number	1 to 20000 milliseconds
obj,id	Modbus Address	✓	✓		Number	1 to 255
obj,err	Communication errors	✓		✓	Number	Num Error Packets/Total Packets

obj = d01 – d05

Polled MODBus Registers		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
obj,ide	Identifier	✓			Text	D01, D02, D03, D04, D05
obj,des	Description	✓	✓		text	30 char
obj,dev	Device Object Number	✓	✓		Number	1-5
obj,reg	Remote MODbus Register	✓	✓		Number	0-65536 (0x10000)
obj,num	Number of Registers to poll	✓	✓		Number	1-4
obj,typ	Command Type	✓	✓		Number	0=(Read/Write) Coil, 1=(Read/Write) Discrete Input, 2=(Read/Write) Holding Register, 3=(Read/Write) Input Register
obj,wre	Write Access	✓	✓		Number	0,1
obj,val	Value	✓		✓	Number	Value Read/to be written
obj,uni	Units	✓	✓		Text	Units
obj,stt	Status	✓	✓		Number	Bit field 0x01 Ready 0x02 Timeout 0x04 Received message
obj,ofs	Offset	✓	✓		Number	Offset Applied to value read
obj,scf	Scale factor	✓	✓		Number	Scale Factor Applied to value read
obj,dft	Display Format	✓	✓		Number	0=hex, 1=decimal, 2=float
obj,tft	Transfer Format via Modbus	✓	✓		Number	0=signed, 1=unsigned, 2=float
obj,int	Poll interval	✓	✓		Number	1-60 seconds
obj,err	Communication errors	✓		✓	Number	Num Error Packets/Total Packets

obj = r001 – r200

Distribution Bay (DBY)		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
dbnn,des	Description	✓	✓		text	30 char
dbnn,sn	Serial number	✓			text	18 characters
dbnn,stt	State	✓			text	Missing, Present
dbnn,sha	Shunt Capacity	✓	✓		Number	0 – 4000 Amps
dbnn,npl	Number of Panels	✓	✓		Number	1 - 8
dbnn,pmt	Measurement Type	✓	✓		text	I, IV, V (Current, Current and Voltage, Voltage)
dbnn,ids	Identification Style	✓	✓		text	AN (A1,B1...A4,B4), A (A...H), N (1...8)
dbnn,bze	Buzzer Enable	✓	✓		Number	0=disable 1=enable
dbnn,ole	Overload Latch Enable	✓	✓		Number	0=disable 1=enable
dbnn,ori	Panel Orientation	✓	✓		Text	TL (Top Left), BL (Bottom Left), TR (Top Right), BR (Bottom Right)
dbnn,cmb	Combine Panels	✓	✓		Number	0=disable 1=enable
dbnn,smw	Shunt Mis-wired	✓			Number	0=no shunt mis-wired,1=shunt mis-wired
dbnn,cca	Circuit Assignment	✓			Number	0=no circuit assignment,1=circuit assignment
dbnn,ovl	Clear Latched Overload	✓		✓	Number	0=do not clear,1=clear latched alarm
dbnn,faja	Distribution fuse A	✓			Number	0=no fuse fail,1=fuse fail
dbnn,fajb	Distribution fuse B	✓			Number	0=no fuse fail,1=fuse fail
dbnn,vid	BDFB/BDCBB ID Conflict	✓			Number	0=no conflict,1=conflict

Where nn is distribution bay 01 – 16

Distribution Panel (DPN)		related commands				
obj,attr	**Description**	**sta**	**cha**	**ope**	**type**	**range**
dpbbp,des	Description	✓	✓		text	30 char
dpbbp,adc	Current	✓			text	Measured current
dpbbp,vdc	Voltage	✓			text	Measured voltage
dpbbp,stt	State	✓			Number	Missing, Present
dpbbp,pid	Panel ID	✓			Number	1 - 8
dpbbp,ena	Enable	✓	✓		Number	0=disable 1=enable
dpbbp,old	Overload Delay	✓	✓		Number	0 – 300 seconds
dpbbp,olt	Overload Threshold	✓	✓		Number	0 – 4000 Amps
dpbbp,olr	Redundant Overload	✓	✓		Number	0=disable 1=enable
dpbbp,plt	Power Loss Threshold	✓	✓		Number	40 – 60 Volts
dpbbp,cct	Input Circuit	✓	✓		Number	1 - 8
dpbbp,vlv	Power Loss	✓			Number	0=power ok,1=power loss
dpbbp,ovl	Overload	✓			Number	0=no overload,1=overload

Where bb is distribution bay 01 – 16, p is panel 1 - 8

Inverter Plant		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
ip1,des	Description	✓	✓		Text	Inverter Plant 1
ip1,cap	Installed capacity	✓			Number	Number in amps
ip1,irm	RMS current	✓			Number	Number in amps
ip1,vac	AC output voltage	✓			Number	Number in volts
ip1,adc	Input DC current	✓			Number	Number in amps
ip1,vdc	Input DC voltage	✓			Number	Number in volts
ip1,frq	Output frequency	✓			Number	Number in Hertz
ip1,lst	Load share target percentage	✓			Number	0-100%
ip1,dth	Disconnect input voltage threshold	✓			Number	20.00 - 25.00, 40.00 - 50.00
ip1,rth	Reconnect input voltage threshold	✓			Number	22.00 - 27.00, 44.00 - 54.00
ip1,lvd	LVD enabled	✓	✓		Number	0=DISABLED, 1=ENABLED

Inverter Plant		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
ip1,hce	High Crest Factor enabled	✓	✓		Number	0=DISABLED, 1=ENABLED
ip1,hipe	High Ipeak enabled	✓	✓		Number	0=DISABLED, 1=ENABLED
ip1,hrme	High RMS enabled	✓	✓		Number	0=DISABLED, 1=ENABLED
ip1,ste	Standby enabled	✓	✓		Number	0=DISABLED, 1=ENABLED
ip1,rlse	Redundancy Loss enabled	✓	✓		Number	0=DISABLED, 1=ENABLED

Inverter		related commands				
obj,attr	**description**	**sta**	**cha**	**ope**	**type**	**range**
nsr,ide	Identifier	✓			Text	Inverter Module N*sr*
nsr,des	Description	✓	✓		Text	Inverter *sr*
nsr,stt	State	✓			Text	24V or 48V
nsr,typ	type	✓			Text	Type
nsr,sn	Serial number	✓			Text	Serial number
nsr,ipk	Peak current	✓			Number	Number in amps
nsr,irm	RMS current	✓			Number	Number in amps
nsr,frq	Output frequency	✓			Number	Number in Hertz
nsr,cf	Crest factor	✓			Number	Number
nsr,pwr	Output power	✓			Number	23-28V or 46-57V
nsr,vnom	Nominal output voltage	✓			Number	25-30V or 50-60V
nsr,cap	Capacity	✓			Number	Number in amps
nsr,cva	Capacity in VA	✓			Number	Number in volt amps
nsr,vac	Output voltage	✓			Number	Number in volts
nsr,adc	Input DC current	✓			Number	Number in amps
nsr,vdc	Input DC voltage	✓			Number	Number in volts
nsr,ncl	Non-critical load for LVD	✓	✓		Number	0=not placed in standby 1=place in standby
nsr,ilvi	Low Voltage Input	✓			Number	0=inactive 1=active
nsr,ita	Temperature alarm	✓			number	0=inactive,1=active
nsr,if	Inverter fail	✓			number	0=inactive,1=active
nsr,ilv	Low output voltage	✓			number	0=inactive,1=active
nsr,ifa	Inverter frequency lock fail	✓			number	0=inactive,1=active
nsr,ihvi	High input DC	✓			number	0=inactive,1=active
nsr,ihv	High output	✓			number	0=inactive,1=active
nsr,iirm	High Irms	✓			number	0=inactive,1=active
nsr,iipk	High Ipeak	✓			number	0=inactive,1=active
nsr,icf	High crest factor	✓			number	0=inactive,1=active
nsr,ida	Distribution alarm	✓			number	0=inactive,1=active
nsr,iof	Output fuse	✓			number	0=inactive,1=active
nsr,did	Duplicate Id	✓			number	0=inactive,1=active
nsr,icmf	Communication Failure	✓			number	0=inactive,1=active
isrnsr,vera	Module Software Version	✓			text	Format: xxxxxxxx
isrnsr,verb	Bridge board Software Version	✓			text	Format x.y

s stands for shelf number (1 thru 4) and r stands for inverter number (1 thru 7)

OmniOn Power Inc.
601 Shiloh Rd.
Plano, TX USA

omnionpower.com

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