

OEM Documentation Set

FOR EVALUATION & PROJECT ENGINEERS

MPM Mobile Power Manager

BATTERY CHARGER AND INVERTER COMPONENT

FOR POWERED CARTS

Hardware & System Version: 2.0

150/250 watt AC output models.

120V/60Hz || 230V/50/60Hz
Base part numbers & OEM variations



Companion Documents:

A55-00042-00001 MPM RUI & Clinic View (End Users)

A55-00042-00002 MPMView_UM Rev (Technicians)

A55-00049-ManageUPSCIO 2.0-MPM FleetView edition

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CONTENTS:

- 1. UL Required Safety Messages 3
 - IMPORTANT – SAVE THESE INSTRUCTIONS..... 3
- 2. MPM Documentation for End Users 7
 - About the Power and Battery Charger Module 8
 - Plug In for Best Battery Health:..... 8
 - Remote User Interface: On/Off Control, Fuel Gauge & Warning Indicators..... 10
 - Clinic View Dashboard: Time Remaining Fuel Gauge & Warning Indicators 11
- 3. Technical Information for Engineering & Service Personnel 14
 - Before You Start: 14
 - Setup and Operation 15
 - 5-Step Setup 15
 - NOTES ON POWER-UP BEHAVIOR..... 18
 - System Overview & Theory of Operations..... 19
 - System Overview 19
 - Theory of Operation 21
 - Technical Specifications # 87023-06R (82023-07R) 23
 - Physical Dimension Drawings..... 30
 - Remote User Interface (RUI) Description..... 32
 - Diagnostics & Troubleshooting 35
 - Troubleshooting 35
 - Events & Conditions 36
- 4. Warranty & Disclaimers Section..... 38
 - MPM Warranty 38
 - Battery 38
 - Life Support Applications 39

1. UL Required Safety Messages

This section of the Mobile Power Manager (MPM) Documentation Set covers information that should be presented to end users of carts and other work platforms that include the MPM Unit.

IMPORTANT – SAVE THESE INSTRUCTIONS

PLACEMENT



THIS MANUAL CONTAINS IMPORTANT SAFETY INSTRUCTIONS THAT SHOULD BE FOLLOWED DURING INSTALLATION AND MAINTENANCE OF THE MPM. KEEP THIS MANUAL HANDY FOR REFERENCE.



CAUTION: A BATTERY CAN PRESENT A RISK OF ELECTRICAL SHOCK. SHORT-CIRCUIT CURRENTS CAN BE EXTREMELY HIGH AND CAN CREATE SEVERE BURNS AS WELL AS THE RISK OF FIRE OR EXPLOSION FROM VENTED GASES. ALWAYS OBSERVE PROPER PRECAUTIONS.



CAUTION !!

Safe and continuous operation of the MPM depends partially on the care taken by users.

NOTE:

THIS MPM POWER UNIT CONTAINS VOLTAGES WHICH ARE POTENTIALLY HAZARDOUS. ALL REPAIRS SHOULD BE PERFORMED BY QUALIFIED SERVICE PERSONNEL.

TO REDUCE THE RISK OF FIRE, CONNECT ONLY TO A CIRCUIT PROVIDED WITH 20 AMPERES MAXIMUM BRANCH CIRCUIT OVERCURRENT PROTECTION IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE, ANSI/NFPA 70.

PLEASE OBSERVE THE FOLLOWING PRECAUTIONS.

- Do not disassemble the MPM
- Do not attempt to power the MPM from any receptacle except a properly grounded receptacle with the correct input voltage for the unit
- Do not place the MPM near water or in environments of excessive humidity.
- Do not allow liquid or any foreign object to get inside the MPM
- Do not block air vents of the MPM.
- Do not plug appliances such as hair dryers, fans, heaters, etc. into the MPM.
- Do not place the MPM under direct sunshine or close to heat emitting sources
- The battery should be disconnected from the MPM by unplugging at its quick connectors when maintenance or service work inside the MPM is necessary.
- A certified detachable power supply cord is to be used with this equipment. For the 250VA models, a type not lighter than SJT 18AWG should be used.
- This MPM is intended for installation in a controlled environment, indoor area free of conductive contaminants.
- The AC power supply for the MPM should be conveniently near the MPM and easily accessible –avoid extension cords or temporary power strips to power the MPM.

CONDUCTED AND RADIATED RF EMISSIONS – FCC (USA)

Attention:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in both residential and commercial environments.

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio and/or television reception, which can be determined by turning the MPM equipment on and off, the user is encouraged to try to correct the interference by one or more of the following measures:

1. Reorient or relocate the receiving antenna.
2. Increase the separation between the MPM and the receiver.
3. Connect the MPM into an outlet on a circuit that is different from that to which the receiver is connected.
4. Consult the dealer or an experienced radio/TV technician for assistance.

CONDUCTED AND RADIATED RF EMISSIONS DOC (CANADA)

Attention:

This equipment does not exceed Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulation of the Canadian Department of Communications.

Operation in a residential or commercial area may cause unacceptable interference to radio and TV reception requiring the owner or operator to take whatever steps are necessary to correct the interference.

2. MPM Documentation for End Users

This section of the Mobile Power Manager (MPM) Documentation Set covers the essential information that users of workstations and diagnostic instrumentation powered by the MPM should know:

- Plugging-In for best Battery Health
- Turning the output power On and Off
- Understanding the Battery “Fuel Gauge” & “Health” indicator
- Service Indications

About the Power and Battery Charger Module

The mobile work platform includes an integrated power system comprised of two parts:

A. Battery

B. 60601 Isolated Power and Battery Charger Module

- Connected to Wall Power:
 - Manages Battery Recharge
 - Isolates and limits earth leakage current per 60601
- Disconnected from Wall Power:
 - Converts DC power from the Battery to AC power for your workstation or instrument.

The output AC power of the unit is controlled by a Remote User Interface (RUI) mounted near the work surface of the cart.

Battery “fuel gauge” and system warning indicators are presented on the RUI and through an optional software “dashboard” that appears as a small battery on the Windows taskbar of the workstation computer.

Plug In for Best Battery Health:

The battery in your mobile cart is similar to the battery in your laptop computer. If it is not charged from time to time, the battery may not have enough charge remaining when you need it to work. The MPM unit includes an automatic “jump-start” circuit that will attempt to recover a weak battery. Even so, following the advice below will help keep your workstation battery working.

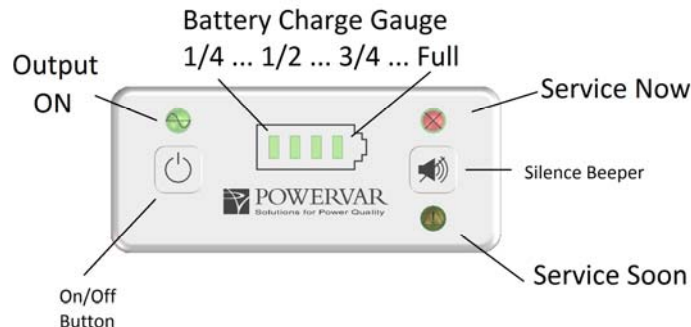
- ✓ Plug in to wall power whenever the battery “fuel gauge” indicates that battery charge is near empty.
- ✓ Never leave a cart sit for more than a day with an “empty” battery. Leaving a battery “empty” for extended periods of time without recharge will damage the battery.
- ✓ Make sure the battery is fully charged before putting the cart into temporary storage (i.e. weeks of non use, disconnected from wall power).
- ✓ If the cart is decommissioned or set aside for more than a few weeks of non-use – smart, Lithium Iron Phosphate Batteries (LiFePO₄) should be

put into extended storage mode by qualified Service technicians per instructions from the battery manufacturer.

Remote User Interface: On/Off Control, Fuel Gauge & Warning Indicators

The Remote User Interface (RUI) is your on/off button and output power indicator. Pressing the **ON/OFF** button for more than 1 second will turn the output on or off. The green **Output** indicator will be on when output power is on.

Pressing the **Silence** button when the MPM is in Battery mode will silence the audible alarm (audible alarm may be disabled using MPMView software)



The four “**battery charge gauge**” lights help you know the battery “charge” level:

- All 4 lights on – battery full
- “1/4” light on Green – battery 1/4 full (75% empty).
- “1/4” light on Yellow blinking – 1st Low Battery warning – “minutes remaining”
- “1/4” light on Red, blinking – Critical Low Battery warning – “seconds remaining”.

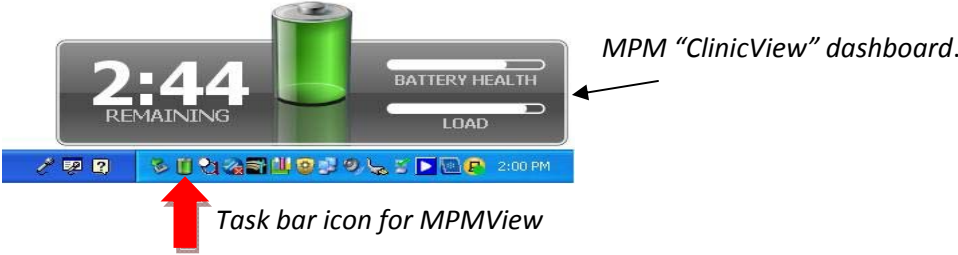
During recharge each light will blink slowly while that portion of the battery is being recharged. (For example, 1st light ON, 2nd light blinking means; battery is between 25% and 50% charged, etc.) Battery is not fully charged until all 4 lights are on without blinking.

Service Required: If either Red or Yellow “**warning**” lights are ON, some type of Service is required.

- **Service NOW:** RED Alert -- power down your workstation and stop using the cart. Turn the cart power OFF and disconnect from the wall.
- **Service SOON:** YELLOW Warning -- power down your workstation as soon as you can. Stop using the cart. Turn the cart power OFF and disconnect from the wall.

Clinic View Dashboard: Time Remaining Fuel Gauge & Warning Indicators

If the optional *MPMView* software is installed on your workstation, a small battery icon will appear in the task bar as shown below by the red arrow. Click the task bar icon (see red arrow) to open the “Clinic View” dashboard.



The software dashboard provides a “fuel gauge” with estimated clock **time remaining** from the battery. The estimated time reported will adjust based on the actual electrical load of your workstation.

For example, if your computer workstation enters a low-power energy-saving mode after some period of inactivity – the estimated time available from the battery system will be recalculated and revised upward based on the reduced energy draw, (allow 10-20 seconds for dashboard information to be updated).

When disk drives and other system activity are reactivated and power consumption increases, the available time estimate from the battery will be reduced based on the increased load on the system.

As the battery ages, the relative health of the battery will be reflected in the **battery health** meter. The battery health meter reflects the calculated capacity of the battery “now”, relative to the original “like new” design capacity of the battery.

The time available from the battery is a function of:

- The capacity of the battery (battery health)
- The energy remaining in the battery (fuel gauge)
- The energy demanded by your workstation (load)

Input power state, battery charge and Alarms conditions will also be reflected on the dashboard as shown below:



Details will also be logged on the local computer by MPMView software for later diagnosis by service Technicians via the advanced option “Tech View”).

3. Technical Information for Engineering & Service Personnel

This section of the OEM documentation is for Test and Compliance Engineers and Service Technicians. It covers correct setup and installation, theory of operations, technical specifications, *MPMView* software and troubleshooting/diagnostics.

Before You Start:

The MPM unit is designed to be installed in a pre-assembled cart with all power and communications cables properly connected and tested prior to delivery to the end use application.

When servicing or testing MPM on a technician bench, make sure that all power and battery communications cables are connected as described in the **Setup and Operation** section (p.18) before powering the unit.

NOTE: For units connected to LiFePO₄ type batteries with “smart battery” communications interface¹, the communications cable between the MPM unit and smart battery communication connection *must be connected before energizing the MPM unit* to prevent possible damage to the protection and management circuits within the battery.

MPM is UL listed under the UL1778 standards specification for Uninterruptible Power Supplies (UPS). However, the operational behavior of the MPM is different than a UPS. Refer to the section System Overview & Theory of Operations for a description of the how the MPM is designed to operate in various conditions.

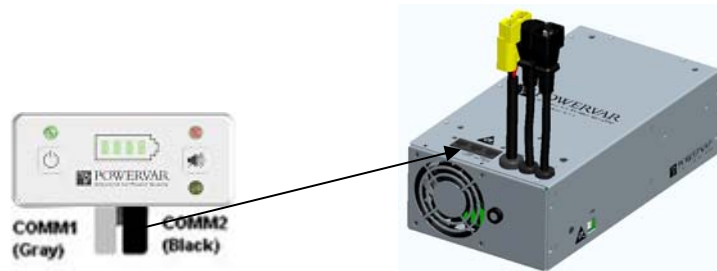
¹ *SMBus protocol is supported for ICC-Nexergy, Powersonic and Micropower-Ironworks battery over I2C. Valence proprietary protocol is supported over RS485 Modbus on the MPM smart battery communications connector.*

Setup and Operation

5-Step Setup

1. **Connect the Remote User Interface (RUI) to the MPM. The MPM will not function without the RUI properly connected.**

Connect one side of each RJ45 cable to the RUI and the other side of the RJ45 cable to the MPM RJ45 ports marked “COMM1” & “COMM2”.



Note that the two cables for RUI must be properly connected for the RUI to operate -- COMM1 (gray) on unit to COMM1 (gray) on RUI, COMM2 (black) to COMM2 (black). Ports and cables are also color coded black and gray for easier tracing from MPM unit in cart base to RUI location on work surface.

The control buttons and LED indicators are described in the **Remote User Interface** section.

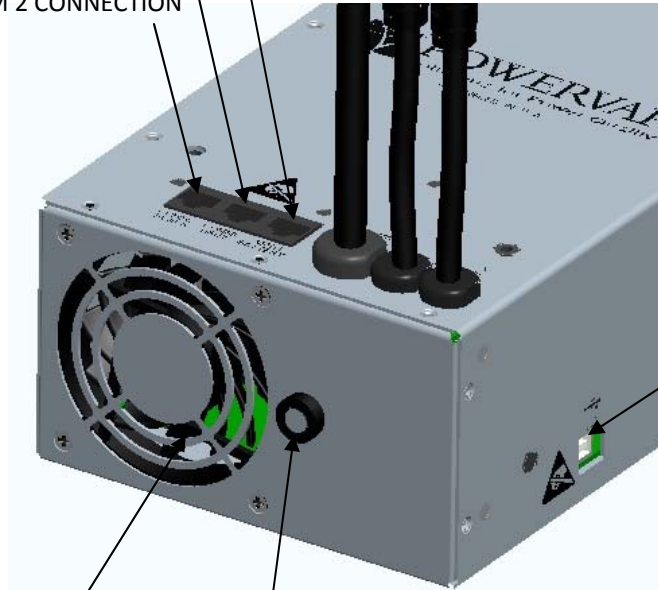


2. Connect the SMBus communications cable between MPM (Smart Battery Connector) and the Smart Battery (Max length is 12”).

SMART BATTERY CONNECTION

COMM 1 CONNECTION

COMM 2 CONNECTION



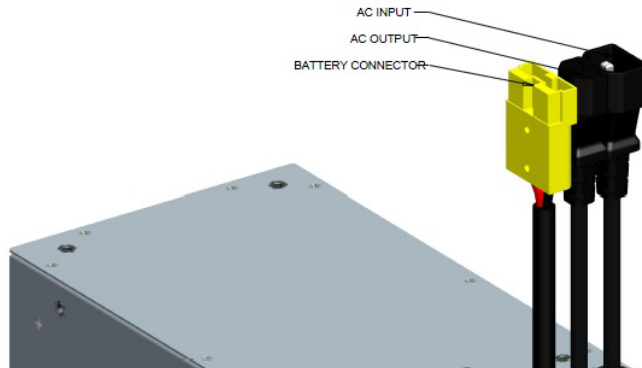
COMMUNICATIONS PORT

FAN EXHAUST

OUTPUT
FUSE

-
- 3. Connect the battery pack to the MPM via the connectors rated for at least 20Amp @ 12VDC to ensure a low resistance and secure connection between the MPM and batteries.**

The MPM should only be used with approved SLA and Lithium (LiFePO₄) batteries. Contact POWERVAR for a list of approved batteries.



- 4. Attach the input AC line cord to the MPM via the IEC320 inlet connector. Connect the input plug to 120V AC wall outlet.**

When the MPM is connected to the AC wall outlet, it will automatically charge the battery pack. It is important to connect the MPM to a live AC outlet for a minimum of 4 hours (LiFePO₄) to 24 hours (SLA) to ensure full charge on the battery packs at initial installation

- 5. Connect the load equipment to the MPM output.**

Ensure the load is not greater than the MPM rating. Refer to MPM rating label to verify maximum ratings of the MPM.

NOTES ON POWER-UP BEHAVIOR

Initial Power-up:

When AC is applied to the input of the unit after the unit has been in a complete OFF state (i.e. output has been turned off and unit not powered by valid AC), the RUI will reflect stages in the boot sequence of the MPM control system:

- Stage 1 – Boot up
one red and one green LED will be illuminated for 4 seconds.
- Stage 2: Normal running -- RUI will behave as documented in the **Remote User Interface** section.

Default Battery Setup:

MPM factory default operation is to power up seeking an active LiFePO₄ smart battery communication connection. If no smart battery is discovered, the MPM will raise a warning and enter Battery Discovery Mode. While in this mode the MPM will continue to look for a smart battery connection and charge the battery at a reduced current and float voltage that is safe for both SLA and LiFePO₄ batteries.

Changing Battery Types:

The MPMView software can be used to reconfigure the unit for a different battery type. The unit must be rebooted after changing the configuration, this can be done from MPMView if the output is turned off and there is AC present on the input.

“Cold” Start – Input AC NOT OK, start from Battery

If there is no input AC present, the MPM output can be “cold started” from the battery by holding the output ON/OFF button for 3-5 seconds.

- ✓ If the battery VDC is too low, cold start is not possible.
- ✓ If the battery health is poor or state of charge is low, the output may turn off shortly after cold start when the battery VDC falls below the discharge cut-off threshold.

“Jump” Start – Input AC OK, start without battery

If the MPM is connected to a valid AC source, the unit will allow output power to be turned on by holding the output ON/OFF button for 3-5 seconds.

- ✓ If the battery VDC is too low, the MPM will attempt to recover the battery using a specific pre-charge recovery profile for battery.

-
- ✓ If there is no battery connected, or the battery is not recoverable (will not accept charge), the MPM will provide output power only as long as the AC input source is valid.

System Overview & Theory of Operations

System Overview

POWERVAR MPM (Mobile Power Manager) is engineered to be source of isolated power for mobile workstations in healthcare applications that require safe grounding and other provisions defined in IEC/UL60601-1 standards.

MPM is designed to provide hours of AC power from battery source during equipment work shifts. When battery charge is “near empty” the MPM unit will provide a “low fuel” alarm. When this occurs, the unit must be connected to AC power so the battery can be recharged. The battery charger will operate whenever the unit is connected to AC power until the battery is fully charged.

MPM vs UPM (UPS) vs Power Supply

Generally, the term “**Power Supply**” is used to describe the part of an electronic system that converts AC power (as delivered via within-building branch circuits - either 120VAC or 230VAC nominal), to low voltage DC power (24VDC-5VDC) for the internal system circuits.

Some power supplies are designed as “universal” power supplies to operate in either North American (120V-208V/60Hz) or European (230V/50Hz) AC power environments. Universal power supplies are designed to provide a steady source of regulated DC output power across a wide range of AC input voltages, typically from 100VAC to 240VAC. Power supplies that are not Universal, typically have narrower operating windows around either 110-120VAC or 208-240VAC nominal voltages. When the AC source falls outside the design operating range, a power supply is not able to provide steady DC output power.

A **UPM/UPS** (Uninterruptible Power Manager, or Uninterruptible Power Supply), is designed to provide a managed source of “within range” AC power to the system when the building VAC supply falls outside the operating range of the power supply. Depending on design, UPM units will use magnetic or electronic components as a first line method to compensate for out-of-range input voltage.

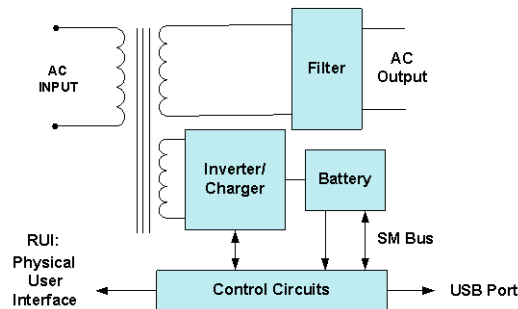
A UPM will provide 5 minutes to 8 hours of “emergency” AC power from battery as the secondary source depending on the size of the battery included in the UPM.

An **MPM** (Mobile Power Manager) uses the same electronic and magnetic elements and basic control system as a UPM – modified to operate from battery as the “normal” or primary power source for day to day activity. MPM is different than a UPM in that it has a powerful charger system to allow faster recovery of battery charge. And, has power electronics designed for “continuous” operation without overheating.

Theory of Operation

When the MPM is connected to an AC source it will switch to battery whenever AC input is out of range or disconnected. The MPM uses battery source to compensate when AC input conditions are out of range.

The **control system** of the MPM includes the embedded microcontroller, a housekeeping power supply and various sense circuits and control circuits that feed information back to the control system regarding temperatures, voltages and currents.



Smart Battery (SMBus or other protocol) communication circuit provides the MPM control system with battery Identity information, internal battery temperature readings as well as battery charge/discharge “flags” and any alarms/conditions from the Smart Battery internal battery management circuits (BMS).

SOC/Fuel Gauge: The MPM uses its own internal algorithms for calculating actual state of charge and full charge capacity of the battery for battery health and fuel gauge reporting. MPM also uses pre-defined maximum and minimum VDC cut-off thresholds to limit battery charge and discharge activities in the event SM Bus communications are not used – or become disconnected or otherwise faulty or unreliable.

Three-stage Charger: Charger current is allowed up to 15.5Amps (avg) for LiFePO₄ type batteries. The charger current is limited to lower values for SLA batteries based on the AH rating of the battery or OEM-specific charge limit parameters.

Temperature Response: Fan speed is controlled based on temperature readings within the MPM. If internal temperature cannot be managed by the fan, an over temp alarm will be shown on physical RUI and on MPMView software dashboards, charger current will be reduced or stopped, and, if necessary to protect the unit, the output power will be turned off.

The USB port provides a connection to MPM View software. MPMView provides two dashboards; ClinicView and TechView.

ClinicView presents a simple view of system and battery status including estimated time remaining from the battery during discharge.

TechView is used to configure an MPM, update MPM unit firmware, and view system information for analysis by service technicians.

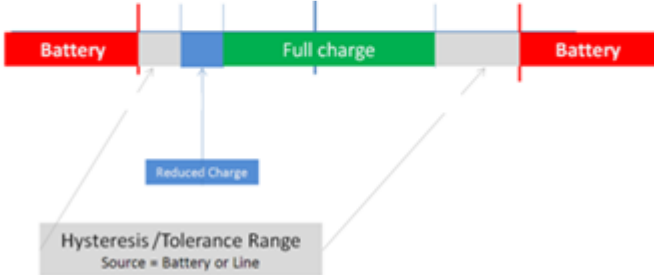
These software products are described further in these companion documents:

- A55-00042-00001 MPM RUI & Clinic View (End Users)
- A55-00042-00002 MPMView_User Manual (Technicians)

These documents and MPMView software can be downloaded from:

<http://connectivity.powervar.com/mpm>

Technical Specifications # 87023-06R (82023-07R)

Feature	Specification														
Output Power	150 VA / 150 Watts (250 VA/250 watts)														
Input Voltage Range	<p>Operating Range</p> <p>Domestic: 120VAC Nominal (100-137* VAC) 60 Hz</p> <p>International: 230VAC Nominal (195-265* VAC) 50/60 Hz</p> <p>* If input VAC is within the range unit will assume valid AC input Operating Range.</p> <div data-bbox="506 667 1328 1260" style="border: 1px solid black; padding: 10px; text-align: center;"> <h3>Operating Voltage Windows</h3> <table style="margin: 0 auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">International:</td> <td style="padding: 5px;">195</td> <td style="padding: 5px;">200</td> <td style="padding: 5px;">215</td> <td style="padding: 5px;">230</td> <td style="padding: 5px;">255</td> <td style="padding: 5px;">265</td> </tr> <tr> <td style="padding: 5px;">Domestic:</td> <td style="padding: 5px;">100</td> <td style="padding: 5px;">105</td> <td style="padding: 5px;">110</td> <td style="padding: 5px;">120</td> <td style="padding: 5px;">132</td> <td style="padding: 5px;">137</td> </tr> </table>  </div>	International:	195	200	215	230	255	265	Domestic:	100	105	110	120	132	137
International:	195	200	215	230	255	265									
Domestic:	100	105	110	120	132	137									
Output Voltage	<p>SOURCE = Battery</p> <p>Domestic: 120VAC/60Hz.</p> <p>International: 230VAC/50/60Hz.</p> <p>SOURCE = AC Input: Output voltage depends on Input VAC.</p> <p>Output will track Input -5% to +6% depending on Load & Charger state:</p> <ul style="list-style-type: none"> • No load, charger idle, VAC may be 6% higher than input. • Full load and charger at full power VAC may be 5% lower than input 														

Feature	Specification																								
Battery Charger Operation	<p>Charger operation is dependent on valid input VAC and internal temperatures</p> <table border="1" data-bbox="574 300 1347 1245"> <thead> <tr> <th colspan="3" data-bbox="574 300 1347 363">Domestic Models – 120VAC/60Hz Nominal</th> </tr> </thead> <tbody> <tr> <td data-bbox="574 363 764 468">#87023-06R (150VA)</td> <td data-bbox="764 363 932 468">#82023-07R (250VA)</td> <td data-bbox="932 363 1347 468">Input Voltage</td> </tr> <tr> <td data-bbox="574 468 764 632">Full power (15.5A)</td> <td data-bbox="764 468 932 632">Full power (10A)</td> <td data-bbox="932 468 1347 632">110VAC-137VAC</td> </tr> <tr> <td data-bbox="574 632 764 772">Partial power (11-15A)</td> <td data-bbox="764 632 932 772">Partial power (6-10A)</td> <td data-bbox="932 632 1347 772">100VAC-109VAC</td> </tr> <tr> <th colspan="3" data-bbox="574 772 1347 835">International Models – 230VAC/50/60Hz Nominal</th> </tr> <tr> <td data-bbox="574 835 764 940">#87023-12R (150VA)</td> <td data-bbox="764 835 932 940">#82023-13R (250VA)</td> <td data-bbox="932 835 1347 940">Input Voltage</td> </tr> <tr> <td data-bbox="574 940 764 1104">Full power (13A)</td> <td data-bbox="764 940 932 1104">Full power (10A)</td> <td data-bbox="932 940 1347 1104">215VAC-265VAC</td> </tr> <tr> <td data-bbox="574 1104 764 1245">Partial power (9-13A)</td> <td data-bbox="764 1104 932 1245">Partial power (6-10A)</td> <td data-bbox="932 1104 1347 1245">195VAC-215VAC</td> </tr> </tbody> </table>	Domestic Models – 120VAC/60Hz Nominal			#87023-06R (150VA)	#82023-07R (250VA)	Input Voltage	Full power (15.5A)	Full power (10A)	110VAC-137VAC	Partial power (11-15A)	Partial power (6-10A)	100VAC-109VAC	International Models – 230VAC/50/60Hz Nominal			#87023-12R (150VA)	#82023-13R (250VA)	Input Voltage	Full power (13A)	Full power (10A)	215VAC-265VAC	Partial power (9-13A)	Partial power (6-10A)	195VAC-215VAC
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Cold Start	<p>Start up from Battery - Output can be enabled from battery with no input AC, if battery voltage is greater than 9.8VDC.</p> <p>Domestic: Factory default inverter output will be 120VAC at 60Hz.</p> <p>International: Factory default inverter output will be 230VAC at 50Hz. The inverter frequency is also configurable and will be set to the last seen input frequency (50Hz or 60Hz).</p>																								
Jump Start	<p>Start up from AC - If Battery VDC is lower than 9.8VDC, and input VAC is valid, unit will power up internal control circuits and enter a battery recovery charge mode.</p> <p>Output power will be provided from AC input until battery VDC has recovered.</p> <p>Output power will not be available from battery until battery has recovered to a value above the cut-off threshold for the specific battery type configured in MPM (see Battery Protection).</p>																								

Feature	Specification																		
Battery Protection / Sleep Mode / Auto Restart	<p>Battery Protection -- MPM shuts down when battery VDC is below a cut-off threshold defined for a specific battery type (SLA vs LiFePO₄)</p> <p>The output and internal power supply is turned OFF and the MPM goes into a very low power state (sleep mode) where the drain current on the battery is < 50 uA.</p> <p>When AC returns, the internal power supply is enabled and the unit starts up. If the output was on prior to shut down it will automatically be turned on.</p> <p>(See also: MPM post-shutdown Auto Recovery section)</p>																		
Overload Protection	<table border="1" data-bbox="570 667 1224 1327"> <thead> <tr> <th data-bbox="570 667 761 884">MPM OVERLOAD TABLE</th> <th data-bbox="761 667 976 884">Line Mode (Running on AC) protection shut down delay</th> <th data-bbox="976 667 1224 884">Battery Mode (Running on DC) protection shut down delay</th> </tr> </thead> <tbody> <tr> <td data-bbox="570 884 761 984">110% - 120%*</td> <td data-bbox="761 884 976 984">5 minutes</td> <td data-bbox="976 884 1224 984">30 seconds</td> </tr> <tr> <td data-bbox="570 984 761 1052">121% - 140%*</td> <td data-bbox="761 984 976 1052">5 seconds</td> <td data-bbox="976 984 1224 1052">5 seconds</td> </tr> <tr> <td data-bbox="570 1052 761 1119">141% - 200%</td> <td data-bbox="761 1052 976 1119">1 second</td> <td data-bbox="976 1052 1224 1119">500 ms</td> </tr> <tr> <td data-bbox="570 1119 761 1186">201%+</td> <td data-bbox="761 1119 976 1186">100 ms</td> <td data-bbox="976 1119 1224 1186">100 ms</td> </tr> <tr> <td data-bbox="570 1186 761 1327">Output Recovery in Line Mode</td> <td data-bbox="761 1186 976 1327">NO</td> <td data-bbox="976 1186 1224 1327">YES</td> </tr> </tbody> </table> <p>(Output short circuit protection in both modes) Overload conditions are signaled on the RUI and presented in MPMView software.</p> <p>* Audible alarm sounds within 3 seconds.</p>	MPM OVERLOAD TABLE	Line Mode (Running on AC) protection shut down delay	Battery Mode (Running on DC) protection shut down delay	110% - 120%*	5 minutes	30 seconds	121% - 140%*	5 seconds	5 seconds	141% - 200%	1 second	500 ms	201%+	100 ms	100 ms	Output Recovery in Line Mode	NO	YES
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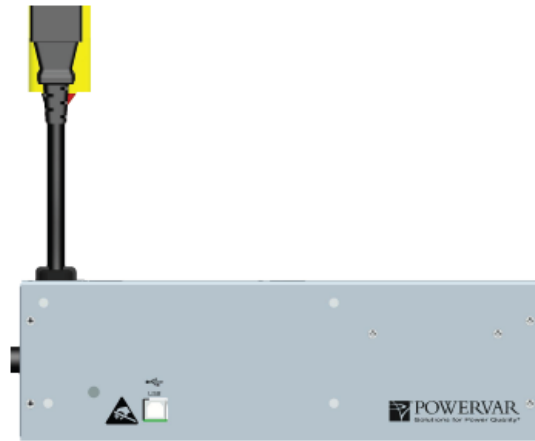
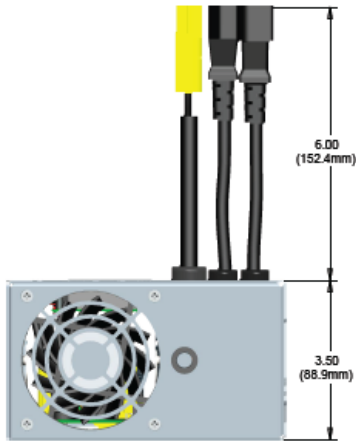
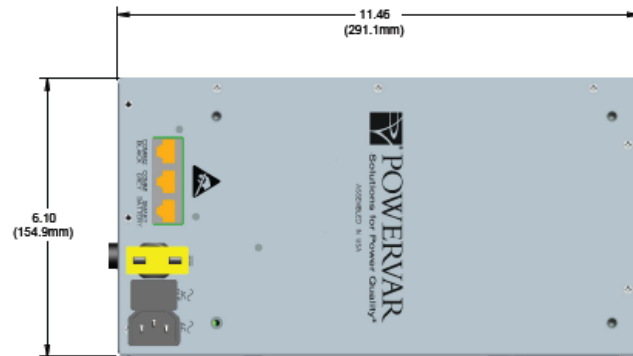
Feature	Specification	
Temperature Protection	<p>The unit Environmental specifications allow for operation within an ambient temperature range between 0C and 40C. If the unit is installed within a confined compartment at the base of a cart, the compartment must allow for adequate ventilation of outside air such that the compartment temperature remains at or below 40C.</p> <p>Over Temp operation: Internal Temperature as measured on Bridge FET Heat Sink</p> <ol style="list-style-type: none"> 1. DC mode: MPM shuts down if $T \geq 90C$; 2. AC mode: MPM turns off charger if $T \geq 80C$. MPM shuts down if $T \geq 90C$; 	
MPM Auto Recovery operation after auto/protective shutdowns	Operating Mode before auto-shutdown	Restart Behavior
	Source – Input AC line (AC mode); Auto/Protective Shutdown due to over-load or over-temp.	MPM remains shutdown; No automatic output restart. Press output On/Off button for 3 seconds to restart. If condition persists, MPM will auto shutdown.
	Source – Input AC (AC mode) Abnormal line condition causes MPM to switch to battery source:	MPM automatically transfers back to AC source if the abnormal input line condition clears.

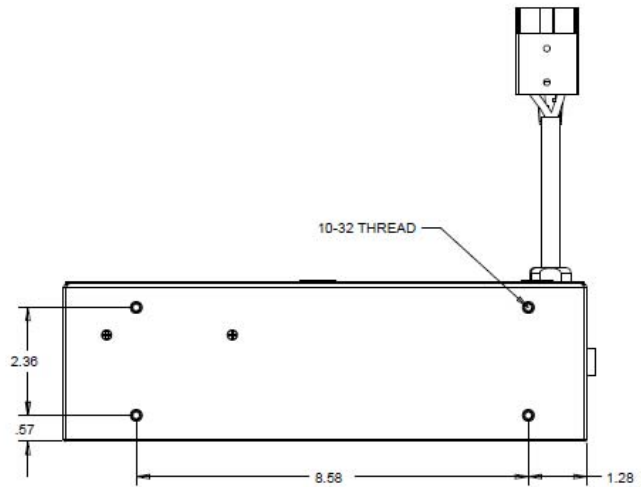
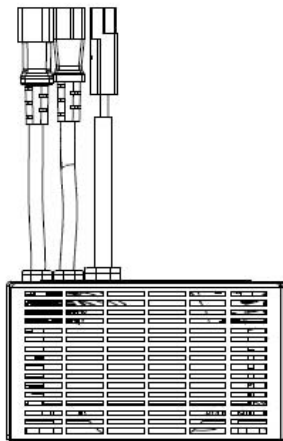
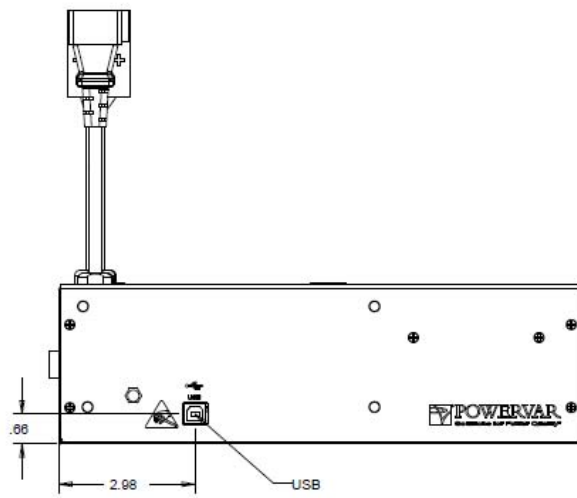
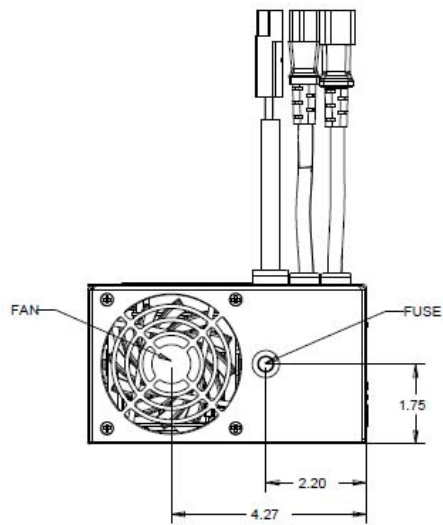
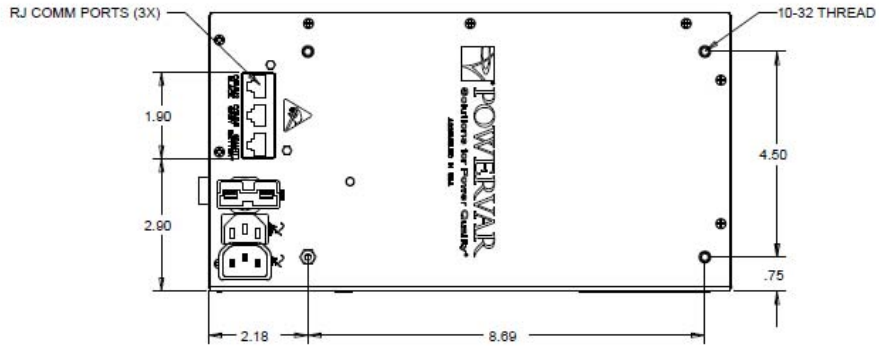
Feature	Specification	
	<p>Source - Battery (DC mode)</p> <p>Auto/Protective Shutdown due to any condition: overload, over-temp, fully discharged battery or Smart Battery shutdown.</p>	<p>MPM remains shutdown until user intervention.</p> <p>If MPM is connected to valid AC input, MPM re-starts as a normal internal power-up and battery pre-charge stage.</p> <p>Press output On/Off button for 3 seconds to start output power.</p> <p>If the shutdown was caused due to a fully discharged battery, then the output will return to the state it was in prior to auto shutdown.</p> <p>If the shutdown was caused for any other reason, then the MPM will not automatically turn on the AC output. It must be manually turned on using the output On/Off button after the condition has been cleared. If the output still does not turn on then there may be a hardware fault or output fuse failure, and Service may be required.</p>
Over Current Protections	<p>Input AC: 8A 250V SLOW RESPONSE FUSE, NON-RESETTABLE /INPUT LINE AND NEUTRAL, I/O PCB (Return to Factory)</p> <p>Output AC : 1.6A TIME-DELAYED FUSE, NON-RESETTABLE BUT REPLACEABLE /OUTPUT LINE, FRONT PANEL FUSEHOLDER (Disconnect Load, replace fuse and test)</p> <p>Battery DC: 2X30A AUTOMOTIVE FUSES, NON-RESETTABLE /BATTERY RETURN, MAIN PCB (Return to factory).</p> <p>All units have firmware that protects for multilevel overload conditions. Overload conditions are also time delayed dependent on level of overload. Unit will provide specific warnings before unit shuts off. (See also Overload Protection)</p>	
Input / Output AC connections	Single IEC-320 input and output connectors	
On/Off switch	<p>Part of Remote User Interface (RUI)</p> <p>Press 3 seconds to enable/disable output</p> <p>MPM continues to power internal controls when connected to valid input AC.</p> <p>MPM charges battery when valid input AC is present regardless of state of output power switch.</p> <p>Note: The Output On/Off button is standard factory configuration. Unit can also be configured for fixed position ON/OFF control as factory build time option.</p>	

Feature	Specification
Charge Time	<p>At nominal line voltage input +/- 10%</p> <p>LiFePO₄ type batteries up to 600Wh < 4 hours max</p> <p>SLA Batteries – depends on battery size</p>
Approvals	<p>UL 60601 3rd Edition</p> <p>UL 1778 4th edition</p> <p>FCC Part 15J Class B</p>
Earth Leakage Current	Less than 300 uA
Communication	USB interface provided for communications with MPMView software
Battery Type	<p>The MPM will adapt to various sizes of SLA or LiFePO₄ type batteries.</p> <p>On power up, Unit will try to detect a Smart Battery (LD mode). If a compliant Smart Battery is detected, the unit will operate in LS (Smart LIFEP0) mode. If no SMBus battery is detected, the unit will operate in Discovery Mode. While in this mode the MPM will continue to look for a SMBus connection and charge the battery at a reduced current and float voltage that is safe for both SLA and LiFePO₄ batteries. It will also raise an alarm that the battery parameters need to be confirmed or changed.</p> <p>Use MPMView software (Advanced tab) to set the battery type as either: LiFePO₄ without SMBus (LP mode) or SLA (SE mode)</p> <p>Then select the manufacturer, and battery size in Ah. Also enter the date* the battery is “new” (use install date) and any serial number for identifying the battery.</p> <p><i>*MPMView software will compare Battery date to PC system date and raise a reminder when the battery “age” is beyond the configured threshold (default 18 months).</i></p>
Maximum Number Of Battery Cycles	Depends on battery type and model
Remote User Interface (RUI)	<p>4 Green LED’s to indicate battery level</p> <p>1 Green LED to indicate AC output enabled.</p> <p>Fault Indications:</p> <ul style="list-style-type: none"> • For POWERVAR RUI, two separate LEDs indicate Yellow or Red fault conditions • For 3rd party T-Type RUI: two of the 4 battery charge level LEDs are tri-color and are used to indicate alarm status. <p>Alarm Silence Push Button</p>

Feature	Specification
Audible Alarm	<p>Factory default configuration is “enabled” but can be silenced when active via the RUI.</p> <p>Configuration option via MPMView can disable the audible alarm so that it will never sound during operation. Warning indications will be visible via RUI LEDs or MPMView software dashboard only.</p>
Audible noise (Fan operation)	45 dBA at 1 meter
Mechanical	<p>Electronics Enclosure</p> <p>3.5” high x 6.1” W x 11.46” D</p> <p>(adequate clearance for input and output airflow required)</p> <p>Battery Enclosure – none</p>
Weight	15.0 lbs. / 6.8 kg. (15.5 lbs. / 7.0 kg.)

Physical Dimension Drawings



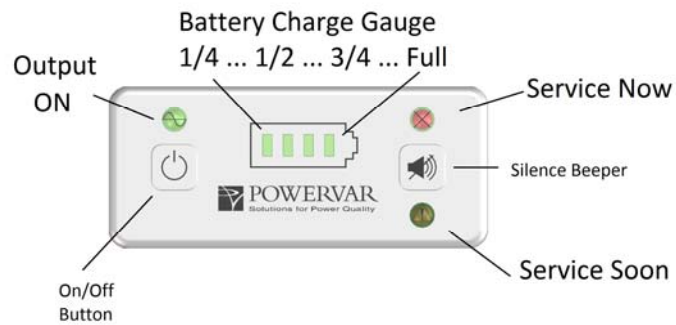


Remote User Interface (RUI) Description

The MPM unit drives two types of RUI implementations – POWERVAR and 3rd Party (T Type).

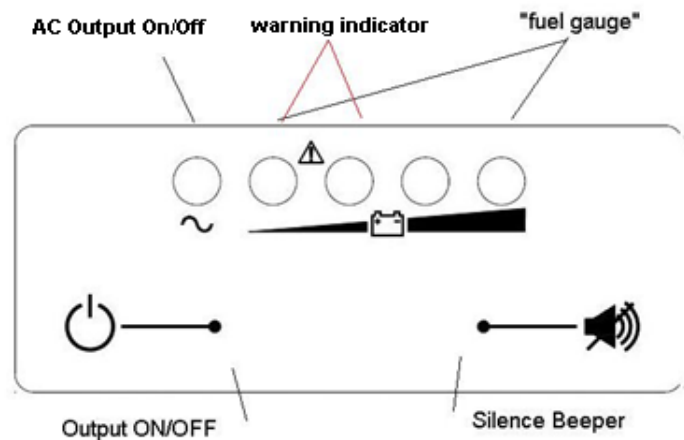
POWERVAR RUI

In the POWERVAR design, the warning indicator LEDs is separated from the “Battery Charge Gauge”.



3rd Party “T-type” RUI

In the 3rd party RUI design, the warning indicator LEDs are typically placed within the “fuel gauge” and shared with the lower two charge level LED indicators.



The tables on the next two pages outline the function of the LED indicators for both RUI implementations. (See the *Events and Conditions* section for a list of specific alarm conditions and what they mean)

POWERVAR RUI Description

MPM Mode	Output	Warnings			Fuel Gauge				Buz	Notes
	LED1	LED2	LED3	LED4	LED5	LED6	LED7			
	GRN	YEL	RED	GRN	GRN	GRN	GRN			
BATTERY DISCHARGING										
76%-100%	***	OFF	OFF	ON	ON	ON	ON	OFF		
51%-75%	***	OFF	OFF	ON	ON	ON	OFF	OFF		
26%-50%	***	OFF	OFF	ON	ON	OFF	OFF	OFF		
11%-25%	***	OFF	OFF	ON	OFF	OFF	OFF	OFF		
Low Battery Warning	***	OFF	OFF	YEL*	OFF	OFF	OFF	ON*	6-10% Default, User Settable	
Low Battery Critical	***	OFF	OFF	RED*	OFF	OFF	OFF	ON**	0-5% SOC	
BATTERY CHARGING										
100%	***	OFF	OFF	ON	ON	ON	ON	OFF		
76%-99%	***	OFF	OFF	ON	ON	ON	ON#	OFF		
51%-75%	***	OFF	OFF	ON	ON	ON#	OFF	OFF		
26%-50%	***	OFF	OFF	ON	ON#	OFF	OFF	OFF		
0%-25%	***	OFF	OFF	ON#	OFF	OFF	OFF	OFF		
Bootup - First 4 seconds	OFF	OFF	OFF	RED	OFF	OFF	ON	OFF	ON/OFF Button can be pressed at any time during this period to turn unit on.	
Warning Alarms	***	YEL	OFF	OFF	OFF	OFF	OFF	OFF	Flash LED2 1x per sec.	
Severe Alarms	***	OFF	RED	OFF	OFF	OFF	OFF	ON	Flash LED3 1x per sec. Buzzer beeps 2x per second. Mute button silences.	
Informational Alarms	***								Informational alarms do not require special handling.	

NOTES:

* Battery Low

LED 4 Flashing Yellow ON for 1 second, OFF for 1 second

Buzzer should beep once per second, until silenced by pressing the "Alarm Mute" button.

** Battery Low Critical

When the SOC charge level falls below 6%, LED4 will flash RED ½ second ON , 1/2 second OFF.

Buzzer will beep 2x ea Second – until silenced by pressing the "Alarm Mute" button.

*** Output On LED Behavior

LED1 is on when output is on and off when output is off.

Battery Charging LED Behavior

LED will flash at a rate of once per second.

3rd Party “T-Type” RUI Description

MPM Mode	LED1	LED2	LED3	LED4	LED5	Buz	Notes
	GRN	BiColor	BiColor	GRN	GRN		
BATTERY DISCHARGING							
76%-100%	***	GRN	GRN	ON	ON	OFF	
51%-75%	***	GRN	GRN	ON	OFF	OFF	
26%-50%	***	GRN	GRN	OFF	OFF	OFF	
11%-25%	***	GRN	OFF	OFF	OFF	OFF	
Low Battery Warning	***	YEL*	OFF	OFF	OFF	ON*	6-10% Default, User Settable
Low Battery Critical	***	RED**	OFF	OFF	OFF	ON**	0-5% SOC
BATTERY CHARGING							
100%	***	GRN	GRN	ON	ON	OFF	
76%-99%	***	GRN	GRN	ON	ON#	OFF	
51%-75%	***	GRN	GRN	ON#	OFF	OFF	
26%-50%	***	GRN	ON#	OFF	OFF	OFF	
6%-25%	***	ON#	OFF	OFF	OFF	OFF	
Low Battery Critical	***	RED**	OFF	OFF	OFF	OFF	0-5% SOC
Bootup - first 4 seconds		RED	OFF	OFF	ON	OFF	ON/OFF Button can be pressed at any time during this period to turn unit on.
Warning Alarms	***	YEL	YEL	OFF	OFF	OFF	Flash LED2 and LED3 1x per second.
Severe Alarms	***	RED	RED	OFF	OFF	ON	Flash LED2 and LED3 1x per second. Buzzer beeps 2x per second. Mute button silences.
Informational Alarms	***						Informational alarms do not require special handling.

NOTES:

* Battery Low

LED 2 Flashing Yellow ON for 1 second, OFF for 1 second

Buzzer should beep once per second, until silenced by pressing the "Alarm Mute" button.

** Battery Low Critical

When the SOC charge level falls below 6%, LED2 will flash RED ½ second ON , 1/2 second OFF.

Buzzer will beep 2x ea second – until silenced by pressing the "Alarm Mute" button.

*** Output On LED Behavior

LED1 is on when output is on and off when output is off.

Battery Charging LED Behavior

LED will flash at a rate of once per second.

Diagnostics & Troubleshooting

This section includes a brief troubleshooting table and the complete list of Events and condition codes that are logged and displayed in *MPMView*

Troubleshooting

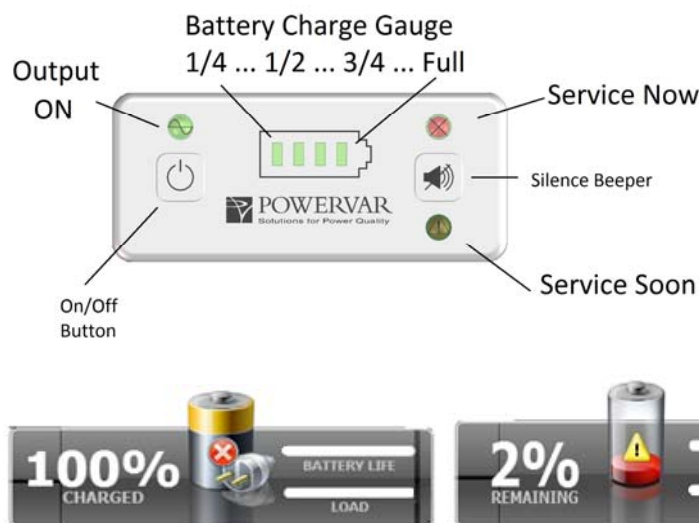
The troubleshooting information provided in this section should help you discover the cause of most commonly encountered difficulties. Before following the troubleshooting steps provided, be certain that

- the MPM is connected to a properly working outlet,
- the line voltage to the MPM is within specified boundaries

Problem	Possible Cause	Action you should take
MPM does not power up and has no audible alarm	On/Off button is not pressed long enough	Press and hold the On/Off switch for at least 3 seconds.
	Invalid Battery and Invalid Input AC.	Check wall socket and test for proper line voltage.
	MPM input power cord is not plugged in	Plug in input power cord
	Output fuse is open	Reduce load replace fuse and test
Backup time is less than expected	Battery is not fully charged or battery is dead.	Recharge battery for at least 24 hours and retest backup time.
MPM is normal, but the load will not turn on.	Load input power cord is loose or not connected.	Connect computer input power cord.

Events & Conditions

The MPM will indicate the presence of Warning (yellow) and Severe (red) Alarms and Conditions via the RUI and via the ClinicView taskbar application as shown below.



The specific alarm that is raising the Yellow or Red indicator will be logged and displayed locally in the *TechView* application (taskbar app, right click, Advanced) or over the network (LAN) via CIO/FleetView application.

The table below lists the specific alarms and what they mean. (See the “RUI Description” section to know how these alarms appear on the supported RUI’s)

Code	As displayed in MPMView	What it means
24-034	Battery Charge Threshold: Low	1 st level warning for low battery charge level. Is triggered when either threshold for % charge or estimated minutes is reached. Default thresholds are 7% or 5 minutes. These can be modified using MPM TechView.
20-147	Lost Device Communications	MPMView is unable to communicate with MPM unit. This could be caused by the USB cable being disconnected, the USB port on the computer has failed or the MPM is off. It is not likely that the MPM will be off in normal usage, however it is possible in lab settings when PC running MPMView is not powered by MPM.
24-050	Service Check: Battery Parameters not Initialized	Alarm raised when the MPM is configured to detect a smart battery but is unable to establish communications to the battery. The MPM would then be operating in Smart Discovery Mode at reduced charger current. Remedy: Configure the unit for the actual battery attached using MPM Techview software.
24-051	Service Check: Replace Battery – Health Threshold	This alarm is raised when the measured battery capacity is less than 50% of original design capacity (measure of state of health). The default is 50%, this value can be modified using MPMView.

Code	As displayed in MPMView	What it means
24-063	Service Check: Replace Battery – Date Threshold	This alarm is raised when the comparison of MPMView system date to Battery Replace Date indicates that the battery Age is older than the Battery Age Threshold. Default is 18 Months, configure via MPMView.
24-064	Service Check: Smart Batteries - Configuration	This alarm is raised when the number of Smart Batteries detected is different than expected by MPM configuration.
24-066	Service Check: Smart Batteries - Communication	This alarm is raised when MPM unit has lost communication with a SmartBattery. Could indicate Smart Battery has entered a Safe/Protect Mode from being left depleted and without charge for too long. The alarm may clear if the MPM unit is able to recover the battery. If the alarm persists, check SmartBattery cable connections.
20-134	Service Check: Temperature Warning	This is the 1 st level warning that the MPM internal temperatures are nearing a level where immediate thermal shutdown could occur if temperatures continue to increase. Check that MPM ventilation is unobstructed. If no visible obstruction, MPM unit may need cleaning or other Service.
24-032	Service Check: Battery Connection	The MPM unit detects no voltage across the battery terminals. Battery may be disconnected, or there may be a blown fuse. The MPM can still power up when connected to AC input line
30-189	Input Frequency Out Of Range	This alarm is raised if the frequency of the input AC power to the MPM unit is out of range and the output can only be supplied from battery power.
34-053	Battery Charge Threshold: Low-Critical	Final warning to recharge battery – shutdown imminent. Hard coded within MPM to be raised when charge level is less than 5%.
36-080	Output Overload	This alarm is raised if MPM detects its VA output is over 110%.
36-081	Output Overload	This alarm is raised if MPM detects its Watt output is over 110%.
33-037	Service Required: Charger	This alarm is raised if MPM charger delivers more than 110% of max charge current for more than 60 seconds.
33-038	Service Required: Charger	This alarm is raised when MPM is attached to a Smart battery and battery indicates an “OverCharged” alarm.
34-055	Service Warning: Smart Battery Over Temp	This alarm is raised when MPM is attached to a Smart battery and battery indicates its internal temperature has exceeded internal threshold.
30-190	Service Required: Output Bad	MPM detects a problem in inverter or output circuits; output relay is shorted, inverter voltage too high or too low, inverter failure or output fuse open.
30-192	Service Required: EEPROM failure	MPM detects a serious internal error. Return for Service.

4. Warranty & Disclaimers Section

MPM Warranty

POWERVAR warrants its mobile power managers or MPM (known hereafter as the "product") to be free from defects in materials or workmanship for a period of two years from the date of shipment.

The product will be repaired or (at POWERVAR' option) replaced at no charge during this warranty period. Product must be returned prepaid to the factory.

POWERVAR makes no warranties, expressed or implied, of merchantability, fitness for a particular purpose, performance, condition, capacity or otherwise. POWERVAR is not liable for incidental or consequential damages, monetary loss, loss of sales, or loss of business resulting from the failure or malfunction of the product. Warranty is void on any product that is misused, misapplied, abused, altered or repaired by any unauthorized personnel or where evidence of tampering exists. The foregoing constitutes the sole and exclusive remedy of the purchaser and is in lieu of all other warranties. No greater degree of liability is imposed on POWERVAR.

Battery

If batteries are included as part of the system delivered from POWERVAR;

SLA batteries are warranted to be free from defects in materials or workmanship for a period of 90-days from the date of shipment.

LiFePO₄ type batteries are warranted for 90-days, or for the period defined in battery manufacturer's warranty.

Note that LiFePO₄ battery manufacturers have certain usage and non-usage provisions that will void the battery warranty. Generally, these "warranty voiding events" relate to operating temperatures, storage temperatures, maximum periods of storage without use (charged or discharged), tampering with battery communications/internal electronics circuits and operation of the charger.

The MPM charger system has been verified to meet the charger specifications of the following LiFePO₄ battery manufacturers: Valence, Micropower, ICC/Nexergy and Powersonic.

Life Support Applications

POWERVAR products are not designed for use in any application intended to support or sustain life, or with any healthcare system where the failure of the product might result in circumstances causing injury or death.

Examples of such healthcare systems include (but are not limited to) neonatal oxygen analyzers, auto transfusion devices, blood pumps, nerve stimulators, arrhythmia detectors and/or alarms, defibrillators, pacemakers, haemodialysis and peritoneal dialysis systems, ventilators for either adults or infants, anesthesia ventilators, infusion pumps or any other healthcare device that the United States Food and Drug Administration designates as “critical”.

POWERVAR products are not for use in the presence of a flammable anesthetic mixture with air, oxygen, or nitrous oxide.

POWERVAR specifically discourages the use of its products in these applications and under no conditions will POWERVAR knowingly sell any of its products for such uses.

Any use in such applications is purely without the knowledge or consent of POWERVAR who disavows any liability for such use. Any buyer who uses a POWERVAR product for such applications acknowledges that POWERVAR has provided buyer with this disclaimer and that buyer voluntarily assumes sole responsibility for any and all consequences and agrees to fully indemnify and hold harmless POWERVAR, its officers, employees, subsidiaries, sales representatives, distributors, suppliers, and any other affiliates against any and all claims, costs, damages, expenses, and attorney’s fees arising, either directly or indirectly, from any claim of injury or death associated with use of the product in the applications, even though said claim alleges negligence in design or manufacture on the part of POWERVAR.

This disclaimer includes POWERVAR products equipped with hospital grade plugs and receptacles, and with UL544, UL2601, UL60601, cUL 22.2 No. 60601, and IEC60601 safety agency listings.

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