RM Series Programmable Battery Test Modules with DIN rail mount

Introduction

The RM series of battery test modules by Battery Metric™ are battery analyzers and battery management devices that can be used to test batteries, measure capacity, cycle batteries, perform load tests and a variety of other functions. It can charge, discharge and measure battery Internal Resistance (IR). The form factor is a compact module that mounts on a standard 35mm x 7.5mm DIN rail. The modules are available in several voltage and current configurations.

Each module is a separate channel. The modular DIN rail mount format provides a cost and space saving solution when many channels are required in an industrial setting. DIN rail arrangements can be wall or rack mounted to suit the available space and environment. Each RM system employs a network controller card that provides the interface between the computer USB port and the multi channel RM system. In this fashion a computer can communicate with up to 96 channel using a single USB port.

The RM modules form the basis of a system that you build by adding your own power supplies and rail/rack mounting structure. An RM system is a cost effective way to create multi channel battery solutions for testing, production, research, laboratory, maintenance, recycling, refurbishment or application specific requirements. There are a wide array of charge and discharge termination options that allows the device to execute any number of unique battery management tasks.

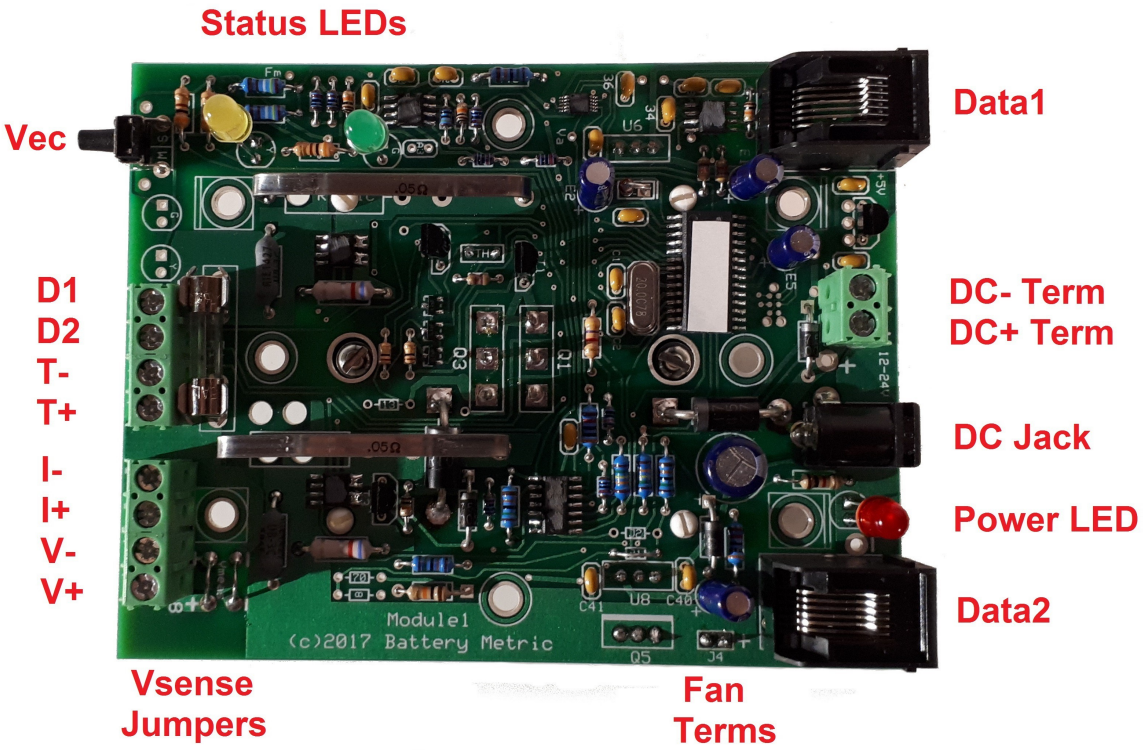
Battery Metric software is used to control the module providing a flexible and feature rich interface to operate, program, collect data and manage the battery under control. Use ***BA500WIN*** with a full features GUI interface or the next generation ***Battery Console*** software for enhance functionality with advanced features.

Features

- Use Battery Metric Windows™ software to program and control the device as well as collect battery performance data
- Fully isolated USB type B computer interface
- Charge, Discharge, Cycle run special custom algorithms
- Measure battery performance & perform special battery management functions
- 3 current and 16 voltage ranges for precision. 12 bit D/A, A/D for 0.25% accuracy
- Integrated board mounted heat sink
- Integrated rear facing variable speed fan
- Programmable LED output indicators
- Short circuit, reverse polarity, overload and fuse protection
- Heavy duty DIN rail mount metallic enclosure
- Factory calibrated with calibration certificate

Network Controller provides interface between computer USB (bottom) and RM data network (top). Mount controller on DIN rail or use controller inline between cables.

Board Overview

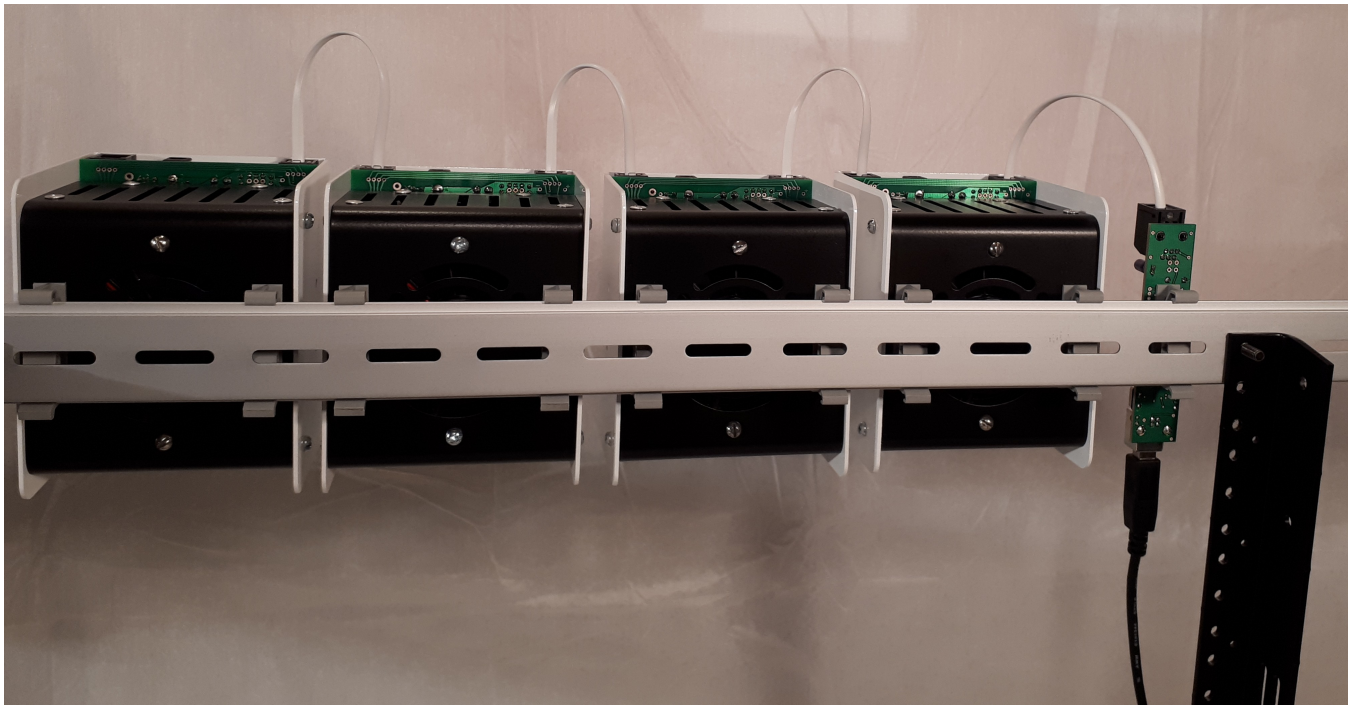


Status LED's	Yellow and green programmable LED indicators.
Data1, Data2	Used to connect to network controller or another RM module. Both network ports are equivalent.
DC Input Terminals	Two screw terminals used to connect DC power supply such as DIN rail mount power supply. Observe proper polarity.
DC Power Jack	Common 2.1 mm jack for connecting generic power supplies. Center positive
Power LED	Power status indicator. RM modules do not have power switches. Power is controlled at the source. Power bar with switch or other switching methods may be employed.
Vector Switch	This momentary push switch is programmable using Battery Console for redirecting the operating program to an alternate step.
D1, D2	Data I/O port. For usage details see: https://www.batterymetric.com/bchelp/#digital-i-o-usage
T+, T-	Connection terminals for optional thermistor. T- is is also ground potential for D1, D2
I+, I-	Battery current carrying terminals. Connect battery here when using two wire connection.(Vsense jumpers installed) Observe proper polarity.
V+, V-	Remote voltage sense. when using 4 wire battery connection. (Vsense jumpers open)
Vsense Jumpers	Used to configure 2-wire (jumpers installed) or 4 wire (jumpers open) battery connection
Fan Terminals	Two wire header on rear side.

Specifications

Parameter	RM102	RM202	RM204	RM207	RM402	Units
Maximum battery voltage	10	20	20	20	40	V
Maximum charge current	+ 2	+ 2	+ 4	+ 7.5	+ 2.5	A
Max discharge current	- 2	- 2	- 4	- 7.5	- 2.5	A
Max power (@25°C ambient)	20	401	80	100	100	W
3 current ranges	2• 0.2• 0.02	2• 0.2• 0.02	4• 0.4• 0.04	7.5•0.75•0.075	2.5•0.25• 0.025	A
Current resolution	1• 0.1• 0.01	1• 0.1• 0.01	1• 0.1• 0.01	2• 0.2• 0.02	1• 0.1• 0.01	mA
Voltage measurement res	1	1	1	1	1	mV
Voltage regulation resolution	2.5	5	5	5	10	mV
Accuracy V, I	0.25	0.25	0.25	0.25	0.25	% FS
Input resistance	10M	150K	150K	150K	150K	Ω
Size (w, h, d)	10x12x11	10x12x11	10x12x11	10x12x11	10x12x11	cm
Weight	250	250	250	250	250	g

Other voltage and current configurations available by special order.
Specifications subject to change without notice



RM modules rear view.

Note: Ventilation input top and bottom with rear fan exhaust
Note: All modules and Network Controller are connected to the data network

Mounting and Installation

The RM modules are designed to be mounted on a standard 35mm x 7.5mm DIN rail. Each module is equipped with DIN rail mounting clips on the rear side. For sample DIN rail see Digikey # ADR3575-S2400 This offers the opportunity to mount the modules in a manner that is consistent with many different work environments. The DIN rail can be wall mounted, attached to racks or other support structures.

Another possibility is to use 19" racks using DIN rail brackets. There are a variety of DIN rail to 19" rack brackets on the market. For example Hammond part number RMAD19003BK. See Digikey # HM1259. The mounting and installation can be customized to a specific situation. DIN rail may also be mounted directly to 19" racks provided the racks are securely fastened to the floor.

When designing a rack mount system, consideration should be made with respect to safety. The weight should be considered and precautions such as floor mounting to prevent the system from falling may be required. The mounting system should be designed and inspected by a trained engineer.

The module could also be removed from it's enclosure and mounted directly in a different enclosure. The module could form the basis of a newly designed product. The fact that the module can be programmed to perform a specific task, creates the possibility to produce a custom battery management product.
This way an original OEM product can be designed and marketed. The newly designed product will still require a controller and thermal considerations will be required. The RM module features solder points for all connections that may be required. Contact Battery Metric for assistance with product design.

Network Connection

The RM system requires a network controller to communicate with a Windows™ computer. The Network Controller provides the interface between a computer USB port and each RM module on the network. Only one controller per system is required to control any number of RM modules. The Network Controller features a USB type B input that connects to the computer using a Type A to Type B USB cable. The other side of the Network Controller features a modular connector that allows it to connect to an RM module. Since each RM module also has two similar modular connectors there is provision to connect one RM module to another RM module. In this way many RM models can be interconnect so that they are all on the same network. Each RM module is supplied with a modular connecting cable. Each RM module on the system is assigned a unique network address to manage communications. The Network controller can now communicate with all RM modules on the system. The Network Controller is USB bus powered and as such does not need any power supply connection.

The network Controller is supplied with a DIN rail mounting clip. It can be mounted on the DIN rail together with the RM modules or it can just be used inline between cables.

Power Supply (not included)

Select a power supply that is between 12 and 24V DC. The power supply needs to be able to supply all of the charge current as well as power the board electronics. The board and fan itself will consume about 500mA. If the application does not call for use of the full rated charge current capability then a lower current power supply can be used. For a discharge only application a considerably lower power supply could be used such as 24V / 1A / 24W.

The power supply voltage needs to be at least 12V. Since the power supply is also used to provide the charge current an additional 5V of headroom is required above the maximum battery voltage anticipated. See Thermal Management section in this guide for more information regarding power supply selection. Do not use a Class II type transformer. It will have poor regulation and may introduce noise into the charge circuit. Choose

a switch mode style power supply. For example a wall mount type power supply such as 24V/60W - Meanwell: SGA60U24-P1J Digikey: 1866-4553 might be a typical choice. Several wall type power supplies can be mounted on a power bar equipped with a switch. This provides a convenient total system power switch. The RM modules feature a 2.1mm barrel type DC input jack (center positive+) that can be used to connect many common brick style power supplies.

DIN rail mounted power supplies are also quite common and inexpensive. These can be mounted directly on the DIN rail beside the RM modules. A single power supply could power multiple RM modules. The DIN rail power supply DC output can be wired to the + and – DC screw terminals provided on the RM module. When using DIN rail power supplies be sure to use a qualified electrician to connect to the AC mains.

An example of a typical DIN rail mounted power supply is CUI #VDRS-60-24, Digikey # 102-2159

Software

Software to operate the RM modules can be found on the Battery Metric website. Download the software and manuals at: https://www.batterymetric.com/downloads/

Be sure to use the most recent software version. Note the RM modules require BA500WIN version 1.45 or greater. Earlier versions do not support the RM modules.

The ***BA500WIN*** software application is a full featured laboratory style GUI interface with many features. The ***Battery Console*** software takes programming of the device to the next level with sophisticated looping, IF statements, conditional routing & messaging for a high level of control. Routines developed with the ***Battery Console*** software can be downloaded to the module in order to execute routines and programs in stand alone mode. The RM modules can be used by OEM producers to create new products for application specific customer requirements.

Firmware

There may be firmware updates from time to time to add new features, capabilities and fixes. The firmware hex file as well as the ***fwmanger*** program is available from the Battery Metric website at: https://www.batterymetric.com/downloads/

The software program ***fwmanger*** is used to connect and load the firmware into the device. To update the firmware, simply download the latest firmware file from the website. eg. mcfw9_6.hex. Then start ***fwmanager*** and use it to open the firmware hex file and load it into the device. When the ***fwmanger*** program connects to the module it will automatically put the module into update mode. In update mode the green and yellow LED's will alternate. When running ***fwmanger*** make sure that no other Battery Metric software is running otherwise there will be a conflict disrupting communications. Always be sure to use the latest available firmware. When update is complete, power the device OFF/ON to exit update mode and activate the new firmware.

Thermal Management

The RM module has some regulator power limits. If the power limits are exceeded the module will be shut down to avoid over heating. Heat is generated during both charging and discharging as follows:

Charging The analyzer employs a linear charge regulator. As such the heat generated while regulating the charge current can be calculated as: ***P = (Vps-Vbat) x Ireg***
This charge regulator power is how much power the analyzer's internal regulator needs to dissipate to regulate current at the desired value. This dissipated power will appear as heat on the heat sink. It is not a measure of how much power is being delivered to the battery. The charge power limit could become evident when charging low voltage batteries with a higher voltage power supply at high charge currents. In the event you

experience an *Overload* situation while charging you will need to decrease the charge current or use a lower voltage power supply or use a battery with a higher terminal voltage. If you experience an *Overload* situation while performing the charge calibration you will need to use a battery with a higher terminal voltage.

Since the charge regulator heat production is a function of the power supply voltage ***Vps,*** it follows that heating during charge can be reduced by using the minimum power supply voltage required to meet charge voltage requirements. Keep in mind that the regulator will need some voltage headroom above the maximum charge voltage required. A rule of thumb is to provide an extra 5V above the maximum charge voltage required. If the power supply voltage is too low then the charge current may be reduced below the specified value. For example if the device is being used to charge LiIon batteries with a maximum voltage requirement of 4.2V then a 12V power supply will be more than sufficient to provide the required voltage head room. In this example a 12V power supply is a better choice than a 24V power supply because it reduces heating significantly from 19.8W to 7.8W when charging at 1A. This can significantly extend the life of the module.

Discharging: The heat generated during discharge can be calculated as: ***P = Vbat x Ireg***
This is equal to how much power the battery is delivering. All of this power is dissipated as heat using the module's heat sink. In the event you experience an *Overload* situation while discharging you will need to decrease the discharge current.

(***P*** is the power dissipated in Watts, ***Vps*** is the DC voltage of the power supply, ***Vbat*** is the battery voltage at any given time, ***Ireg*** is the current in effect)

Battery Connection

The voltage sense V+ and V− connections are connected to the B+ and B− current carrying terminals on the board. See Vsense jumper. This means only two wires I+ and I− are required to connect to the battery to carry both the current and measure the battery voltage. However, if remote Vsense directly at the battery is required then a 4 wire connection can be employed. Configure this by cutting the Vsense jumpers. In this case then all 4 wires will be required to connect at the battery V+/I+ and V−/I−. A 4 wire connection is only needed when concerned that the resistance of the battery leads is causing voltage measurement/regulation deviation while current is flowing. Usually this is insignificant and a simple two wire battery connection utilizing I+ and I− is perfectly fine. Note that if the Vsense jumpers are "*open"* then a 4 wire connection at the battery will be required.

Battery Temperature Measurement

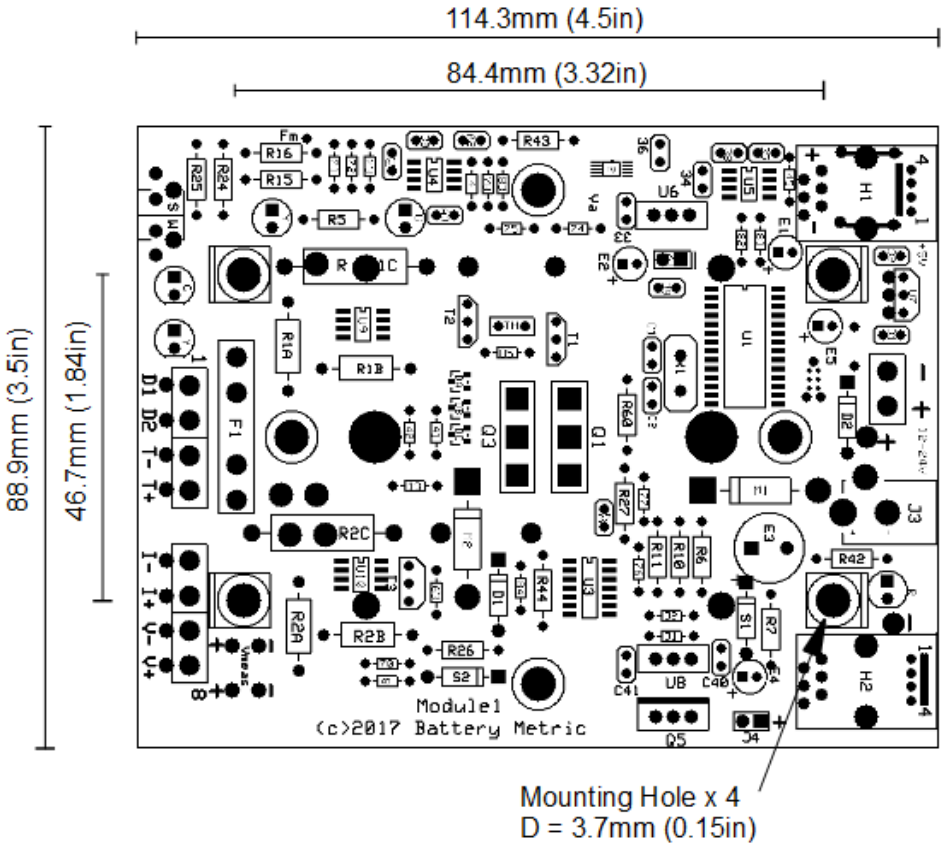
The RM module has provision to measure battery temperature by using a thermistor. This can be done by making a two wire cable terminated with a thermistor. The module has provision for connecting the thermistor cable to the T+ and T- terminals. The recommended thermistor is:

10K - NTC Thermistor Vishay NTCLE100E3103HB0, Digikey: BC2311, Mouser: 594-2381-640-66103

This thermistor can then be affixed externally to the battery under test with tape. It is possible to use a single wire to connect the module T+ terminal to the T contact of a battery. However this method will require a good knowledge of the internal wiring of the battery. Also be aware that the thermistor inside a battery often share the Bat(-) terminal. This can cause temperature measurement deviations while charging because the B- connection moves up above ground due to current flowing through the cable to B- and then through the ground side current sense resistor. In this case compensation will be required when programming the module to account for this offset. This T offset is only seen during charge, not discharge. Also, any deviation between the battery internal thermistor and the recommended 10KΩ thermistor will cause additional Temperature measurement error requiring additional compensation.

Mechanical

- Dimensions: 10w x 12h x 11d cm
- Mount: Standard 35mm x 7.5mm DIN rail.
- Weight: 150g
- Enclosure: Two part Aluminum 1.6 mm thick
- Cooling: Ventilated enclosure with rear facing fan
- Screw terminals wire size: max 14 AWG, min 26 AWG
- Battery connection: Screw terminals or direct solder
- DC Power Input: 2.1mm ID / 5.5mm OD barrel plug or screw terminals or direct solder
- Data Cable: 4 conductor modular cable with 6P4C modular connectors (e.g. Molex:90075-0035 Digikey:WM16856)



PCB front side – Note power transistors and heat sink are mounted on rear side