MANZANITA MICRO

MK3 Digital Perl Scanner Software

(Laptop NOT Included)

User's Manual

Rev 0.3

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MANZANITA MICRO MK3 DIGITAL PERL SCANNER SOFTWARE

General Overview

As batteries are used, their voltages and temperature levels tend to change. Sometimes this can be quite dramatic depending on what is being asked of the battery. A standard 12 volt battery will actually vary quite a bit in voltage in the real world. The 12 volt designation is considered the battery's "nominal" voltage. The nominal voltage is essentially what the industry considers the average voltage of that battery. In reality, many 12V batteries get charged up to 14.7 volts and then after charging they tend to sit at a voltage somewhere between 12.8 to 13.2 volts DC. As the temperature changes, these voltage levels may change as well. Additionally, a 12V battery may drop to 10.5 volts as their state of charge is depleted. The voltage might even sag to less than 10 volts when a high current load is placed upon the battery (such as when an electric vehicle accelerates very quickly or goes up a steep hill). With lead-acid batteries common battery pack arrangements often include somewhere between 6 and 30 modules. With newer lithium ion battery packs it is quite common to have from 24 to over 100 cells.

When cells are connected in series their cumulative voltage is the sum of all the cells. The levels of the individual cells themselves are ideally as close to each other as possible but in the real world they may be very different. Being able to visually see the individual voltage levels and temperature levels in a battery pack can allow the user to easily detect imbalances, hot spots and other potential problems before they become bigger problems.

The MK3 line of Manzanita Micro Battery Management System (BMS) components are all based on digital communication instead of just analog. The Perl Scanner software was initially created as an in-house diagnostic tool for Manzanita Micro but was so helpful that it has been made available as a free download for other users of the MK3 family of BMS products.

Since it was first created as a diagnostic tool the graphics are rather simple but they allow the user to view and track changes in the battery voltage and temperature levels. It is a simple, straightforward graphical user interface consisting of vertical voltage columns and horizontal trend lines. The columns in the graph move and change color as fast as the BMS can transmit the information to the scanner. The scanner can also display full battery pack information when connected to the Manzanita Micro SOC Head. This information is displayed at the top of the screen in a horizontal bar graph form.

The Manzanita Micro Perl Scanner allows a new level of battery monitoring and it can be used with any Manzanita Micro Mk3 digital BMS and most Windows based computers, laptops, netbooks, touch screens and other small displays.

System Requirements

Currently, the Manzanita Micro Perl Scanner does not support Macintosh or Linux operating systems. The display device must be running Microsoft Windows.

Operating system: Windows XP or newer

Processor: Anything capable of running XP should run this software

Connectivity: A USB port and the appropriate dongle/terminator box will be required in order for the program to receive the digital data from the regulators.

Mk3 DIGITAL
PERL SCANNER
KEY FEATURES

- Continuously updating bar graph voltage monitoring of up to 255 cells
- Visual cell high and low voltage history depiction makes it easy to detect problem areas without having to watch the screen at all times
- Continuously updating display of BMS dissipation channel heat sink temperatures
- Variable bar colors make it easy to notice cells that are too high or too low.
- Bar graph format allows for quick visual identification of imbalances and anomalies and the cursor “hover-over” feature facilitates very detailed information of any bar when desired.
- Relatively simple design and lean system requirements gives the program the ability to run on almost any Windows based computer system.
- Helpful drop down menus offer a variety of optional features including easy access to the programming commands screen
- From the terminal screen, all commands are easily entered and read in simple ASCII text

Setup

Software Acquisition and Installation

Go to www.manzanitamicro.com

Go to the “Downloads” section and then to the “Software” sub-heading

Then go to “Mk3 Digital Regulators”

There are various software options and documentation available from this sub section.

If the computer is not already equipped with the proper drivers for Manzanita Micro's Dongle Terminator (DT) then start by downloading the DT USB Driver installer program. Click on the green “Download” button to the right of the DT USB Driver line to download and save the file to your computer. This is an .exe file that will automatically install the correct drivers. Find the file in your downloads section and double click to open the file named: USBDriverInstallerV2.04.06

If a warning box pops up asking if you want to let the program make changes to your computer just agree to allow it. When the program starts there may be a small black window that opens up with some white text as the driver files are installed.

Sometimes an error message might pop up saying “This program might not have installed correctly” If this happens, please click on the text that says, “This program installed correctly” and then the error message box should disappear.

Next, from the same Downloads section of the ManzanitaMicro.com website, you will need to download the file named: “BarGraph Scanner”.

Click on the green “Download” button to the right of the BarGraph Scanner line to download and save the file to your computer.

Find the “perlscanner.2.14.zip” file on the computer and unzip it. There should be an option to extract the files. Zipped files are files that have been compressed and must be extracted in order to function.

Find the new extracted (unzipped) folder which will probably be titled “perlscanner.2.14”

Inside that folder should be four items; “Language.pl”, Ports.pl, a folder named “perl” and a folder named “Scanner”.

Open the folder named “Scanner”. Inside you will find a file titled “runscanner” and it is the file that you will use to open the Manzanita Micro Perlscanner, but first you must get hooked up to the reg bus via the USB DT box and then follow the steps in the “Launching the Perlscanner for the first time” section of this manual.

Hardware

In addition to a Windows based computer, you will need a Manzanita Micro USB Dongle Terminator (DT) box. This small box allows a USB cable to be plugged into it's USB port and there are also two Reg Bus ports so that it can be connected to the Manzanita Micro BMS. It doesn't matter which of the two ports are used in the reg bus or even if both of them are used at the same time.

NOTE: The DT Box and Rudman Bus Display (RBD) MUST NEVER BE PLUGGED INTO THE REG BUS AT THE SAME TIME! If both of them are plugged in, it shouldn't cause any permanent damage but they will not both be able to function at the same time so it must be one or the other.

figure 01. USB Dongle / Terminator Box

It is advisable to start out with the DT box only plugged into one of the BMS units instead of a long string. The reason for this is that the BMS units are each factory programmed with a bus address of “01”. They must first be individually user re-programmed to the correct unique bus address which corresponds to the lowest numbered cell attached to that BMS unit. If more than one unit is connected on the bus with the same bus address, the Perlscanner will not function correctly.

Launching the Perlscanner for the First Time

Make sure that the Reg Bus side of the USB DT box is plugged into one Manzanita Micro BMS unit. Before plugging the USB cable side into the Windows PC, first open your computer's START menu and find the “Control Panel”. Open the control panel and find the program icon called “Device Manager” and click on it to open it.

NOTE: If you do not see the “Device Manager” program from inside your Control Panel, look in the upper right hand portion of the screen for something that says “View by:” and use the drop down arrow menu to find and select “Large Icons”. Now you should see a bunch of program icons and one of them should be the “Device Manager”.

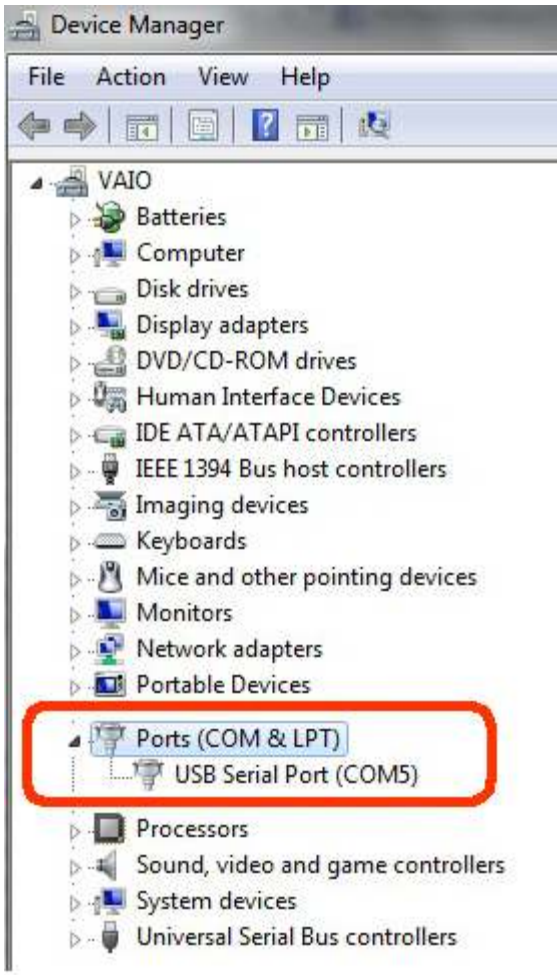

figure 02. Determining the com port

Once the Device Manager window has opened, plug the USB cable from your DT box into an open USB port on your computer. In the Device Manager you should see a list of things and near the bottom of the list will be an option titled, “Ports (COM & LPT)”. To the left of that text is an icon and to the left of the icon is a small triangle arrow. Click once on the triangle arrow and a sub-menu item should appear showing any COM ports that are active. The Manzanita Micro DT box should show up as “USB Serial Port (COM#)” Please make a note of whatever number is shown in parenthesis after the letters “COM” because this is the COM port number which your computer has assigned to that particular DT box. If a different DT Box is used on the same computer it will automatically get a different COM port number. Also if you use the same DT box with a different computer, then it may be assigned a different COM port number . Now that you have the COM number you can open the Perl Scanner program.

Locate your downloaded and un-zipped Perl Scanner folder which should be titled “perlscanner.2.14” (The last few numbers may be different depending on what scanner version you have).

Open that extracted (unzipped) folder and inside that folder should be four items; “Language.pl”, Ports.pl, a folder named “perl” and a folder named “Scanner”.

Open the folder named “Scanner”. Inside you will find a file titled “runscanner” and double click on this file to open and start the Perl Scanner.

A black Windows system window should open and shortly after the white Perl Scanner program configuration window should open with 8 lines of text. The default COM number is usually set to 13, so unless that is what your Device Manager said your COM# was then click the cursor in the window and delete the “13” and change it to whatever your COM number is. For example, “COM5”.

On the line below the COM number, is the cell count range. Change this to display the number of cells or group of cells you wish to display. The default is set at “1-8” for eight cells but you can set this for the maximum number of cells that are in the pack you will be monitoring. For example. “1-108”.

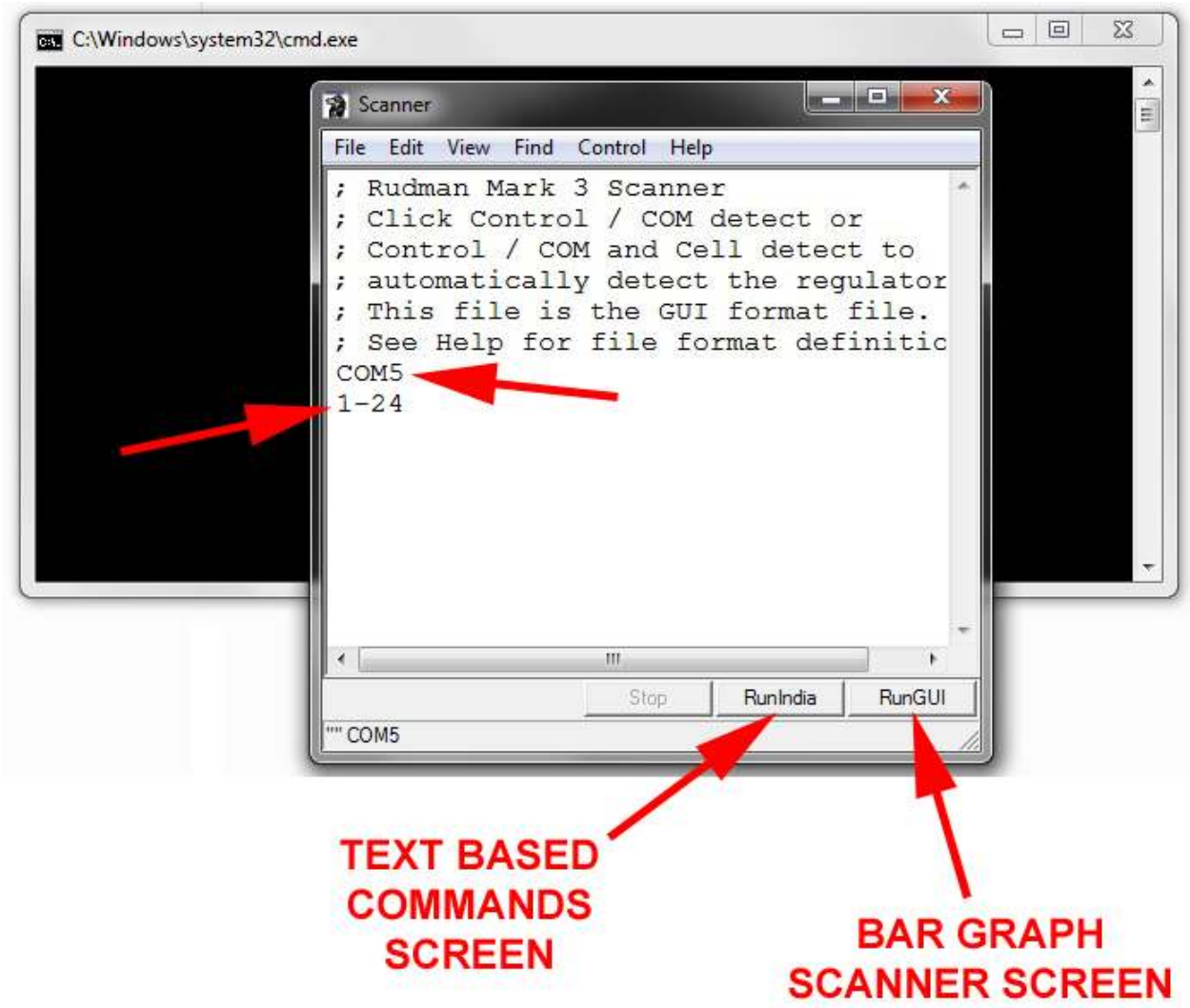

figure 03. Perl Scanner Setup Screen

Once you have made these changes in the Perl Scanner configuration screen you can try running either of the two modes mentioned below in order to get data from the BMS.

As mentioned in your Manzanita Micro BMS manual, each individual BMS unit must be configured with it's own unique bus address using the “Changead” command before you can hook them all together and view the BMS data at the same time. Since each BMS unit that is shipped from Manzanita Micro has a bus address of “1” you must assign a new bus address. This is most easily done using the terminal or “India” portion of the Perl Scanner program. The Perl Scanner has two modes a “RunIndia” mode, and the “RunGUI” mode.

Using the Perl Scanner's RunIndia Mode

The Perl Scanner's RunIndia mode is a simple text-based operational mode which is best used for changing settings of the BMS unit(s) by sending commands to the BMS unit(s).

To use this mode click on the “RunIndia” button. The screen should change to be a blank white screen with your COM# in the bottom left corner, a “Stop” button in the bottom middle and a text field with a question mark at the top. Click the cursor at the beginning of the first line just above the question mark and then try typing any of the commands listed in your Manzanita Micro BMS Owner's Manual. A full list of commands can also be found in the Appendix at the end of this manual.

Using the Perl Scanner's RunGUI Mode

The Perl Scanner's RunGUI mode is the color graphic user interface operational mode which is most useful for viewing BMS and optionally SOC data. The GUI screen is constantly updating it's displayed data therefore a helper can be sitting in the passenger seat of an electric vehicle and watching the cell voltages change in near real-time! Viewing cell data while the pack is under load or near the end of charging can be very helpful for spotting weak or imbalanced cells.

To start the RunGUI mode, click on the “RunGUI” button. A new screen should open and the bar graph columns should start to appear. It is often helpful to make the screen size bigger to fit your monitor and this can be accomplished by clicking the maximize icon in the upper right-hand side of the window (just like maximizing any other program's window).

At first, it may take awhile for all of the columns to appear and level out correctly. The initial reading of the pack can take a few seconds depending on how many cells there are but once all columns are displayed the scanning goes quicker.

To stop the RunGUI mode, click on the “Control” drop-down menu in the upper left-hand corner of the screen and then select “Stop”. The RunGUI screen will close and the original setup screen will appear. To exit the program completely, first click on the “File” drop-down menu and then click “Exit”. A window will pop up asking if you would like to

save the current file. If you click “Yes” it will allow you to save the settings (NOT THE DATA). The idea is that you can click on that file in the future and it will open the Perl Scanner with the same COM Port and cell numbers that you had programmed in before.

Perl Scanner Screen Layout

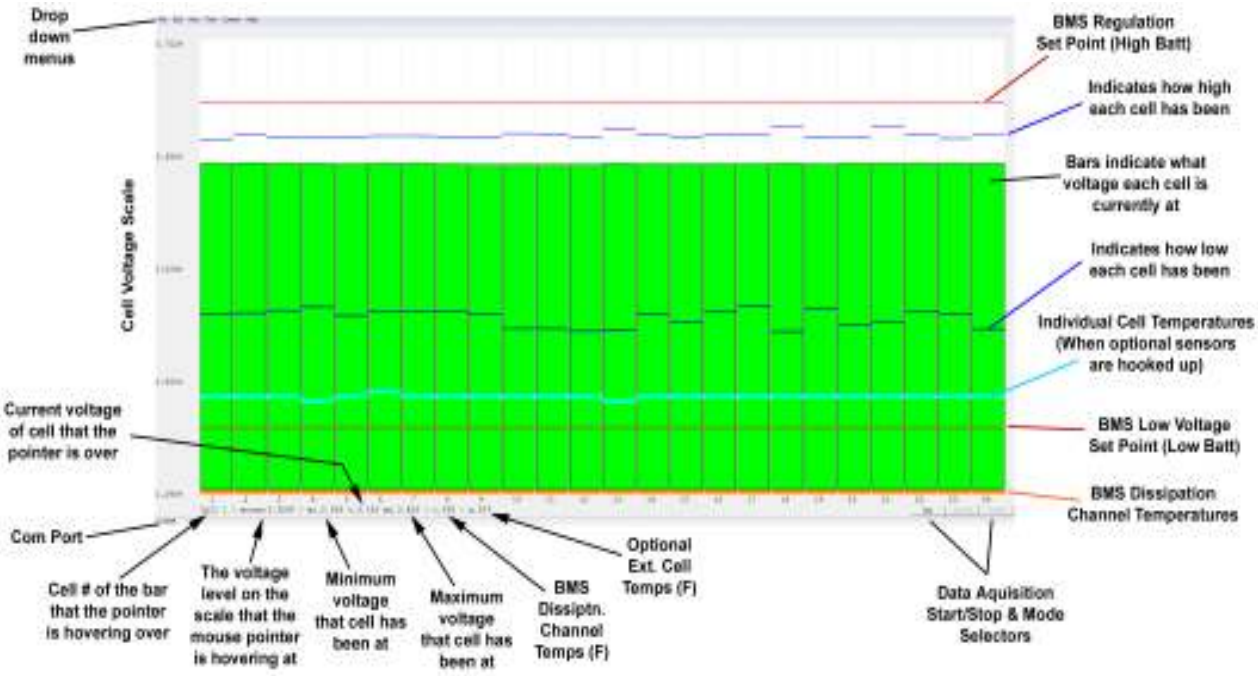

figure 04. RunGUI Screen

Graphic Information

The graphic user interface for the Manzanita Micro Perl Scanner shows a variety of details about the battery pack that the BMS is attached to. Once the proper Com Port for the USB-to-Rudman-Bus connection has been chosen and the proper number of BMS channels (or cells) have been entered, the GUI can be opened. Initially the GUI will open somewhat slowly as it asks for and receives all of the detailed information from the BMS. This takes longer the more BMS units (or channels) there are on the Rudman Bus. After all the bars appear on the screen, the refresh rate will increase and the program will keep polling the BMS unit(s) for information and continuously updating what is displayed.

Bar Graph – “Voltage Columns”

The primary information that is displayed are the tall colored voltage indicator columns on the bar graph. When the program is active, the Manzanita Micro BMS units should be blinking their blue communication LED indicators and the columns will be continuously updating their status. If the columns are observed while driving an EV they

should drop lower as the accelerator is depressed and the load on the pack increases. During regenerative braking or charging, the voltage indicator columns should rise higher as the cell voltages increase.

Green Columns

When a column is green, the voltage of the cell it represents is below the peak voltage limit (high batt) set point on the BMS and above the low voltage limit (low batt) set point. So assuming that these set points have been programmed according to the actual high and low voltage limits prescribed by the battery manufacturer, then when the column is green the battery is in its normal “safe” operational voltage range.

Blue Columns

When a column is blue, the voltage of the cell it represents is at or above the regulation set point (high batt) and the dissipation circuit for that channel should be actively dissipating in order to keep the cell from going over voltage. The columns should begin to turn blue as the cells reach a full state of charge toward the end of the charge cycle. Normally the columns will never be blue during driving unless the pack has a very full charge and the vehicle has regenerative braking or some other way of charging the batteries. In an ideal scenario with a healthy battery pack, all of the columns should change to blue at approximately the same time indicating that they are all closely matched and full at the same time.

Red Columns

When a column is red, the voltage of the cell it represents is at or below the low voltage set point (low batt). This should only occur toward the end of a discharge cycle where the batteries are nearly depleted. It can also occur when the battery pack is subjected to an extreme load such as when an electric vehicle is under heavy acceleration or climbing a steep hill. In the latter cases, the columns should return to green after the load is reduced.

The red columns are a good way of spotting cells that are weaker than others or at a lower state of charge. If a certain cell is the first to go red and also the first to go blue it likely has the least capacity of the group or it may have high resistance due to a loose connection on one or both of its terminals. If the connections to the cell are clean and tight, then it may be time to consider replacing the cell. In an ideal scenario with a healthy battery pack, all of the columns should change to red at approximately the same time. This would indicate that all of the cells are closely matched and are reaching their empty (or “I've had enough”) point at the same time.

By watching how and when the column colors change a user can learn a lot about the performance and overall health of their battery pack.

NOTE: Red bars can also indicate a communication problem with a particular BMS unit

or group of units. If a consecutive group of cells is showing red bars, take actual voltage measurements at the cells and if the cell voltages are above the BMS unit's low voltage set point, then check for an unplugged regbus cable or miss-addressed BMS unit.

BMS Regulation Set Point – “High Batt”

The thin red horizontal lines near the top of the screen above each bar graph column indicate the voltage level at which the BMS is programmed do start regulating. When a cell reaches this level the corresponding column should turn blue and the dissipation channel will be activated in order to prevent the cell from going too far above this voltage.

Normally these thin red lines should actually look like one continuous thin horizontal line across the top of the display screen. In most cases the battery pack will be made up of exactly the same make and model of cells and they should all be programmed for the same “high batt” set point. If some of these thin red lines appear at different levels the BMS units which are attached to them should have their “high batt” set point properly adjusted. If some still do not match, this can indicate a calibration issue with the BMS unit. Small differences generally do not pose any threat but they really should be as close to each other as possible.

BMS Low Voltage Set Point – “Low Batt”

The thin red horizontal lines near the bottom of the screen inside the lower portion of each bar graph column indicate the voltage level at which the BMS has been programmed to initiate the “Low Battery” signal. When a cell reaches this level the corresponding column should turn red.

Normally these thin red lines should actually look like one continuous thin horizontal line across the lower part of the of the display. In most cases the battery pack will be made up of exactly the same make and model of cells and they should all be programmed for the same “low batt” set point. If some of these thin red lines appear at different levels the BMS units which are attached to them should have their “high batt” set point properly adjusted. If some still do not match, this can indicate a calibration issue with the BMS unit. Small differences generally do not pose any threat but they should be as close as possible.

Voltage Level History Indicators

The thin dark blue horizontal lines near the tops of each individual column on the bar graph indicate the highest voltage level that each particular bar column has been up to since the last time that the BMS history was cleared. There will be another thin dark blue horizontal line near the middle or lower section of each individual column which indicates the lowest voltage level that each particular bar column has been down to.

In a perfect world with a healthy well-matched battery pack, all of these little horizontal

blue lines would all be at the same level. In the real world, these history indicator lines will vary. These can be used as an early warning system for detecting weak cells and/or loose connections. If you see one cell which has it's lower blue line below the level of most of the others and it's high blue line above the level of most others, then this may indicate a problem. It could be that the particular cell has less capacity than the other cells in the pack and therefore it becomes discharged before the others and its voltage drops lower and it fills up quicker than the other cells so it's voltage goes higher. If this is the case, it may be time to swap that cell for a new one with better capacity. The same bar situation could also be indicative of a loose connection on that cell so before replacing the cell check and make sure that both connections to it's terminals are solid and tight. A loose connection creates more resistance and can be the cause of the differing voltage readings.

NOTICE! Ensure that the REGBUS data cable is fully plugged into the charger whenever the vehicle is charging. The communication data cables are hooked to the regulators in a daisy chain fashion. Make sure that each of the smaller data cables are all plugged in where they should be before charging. If there is an unplugged portion of the REGBUS, the charger cannot communicate with the regs and this could lead to potentially damaging situation if there is an un-matched battery cell in the pack! The RJ connectors are similar to phone cord connectors and they are designed to snap into place and stay connected. If a cable is disconnected insure that it is fully reconnected. An audible *click* should be heard when the RJ plug is fully inserted and it should not be able to be pulled out without first pinching the small plastic tab underneath the plug.

For more information visit: www.manzanitamicro.com

Or for technical questions or other inquiries:

Manzanita Micro
Rich Rudman
PO Box 1774
Kingston, WA 98346

Phone: 360-297-1660

APPENDIX A: Full Commands List with Descriptions

The list of Digital Regulator Commands is included in the following pages.

Commands Document Conventions

Again, ASCII numbers from 000 to 999 are valid device bus addresses. Address 99 is reserved for an all device broadcast, which is only valid for settings such as minvolts, maxvolts, hstclear, etc.

The bus address is a string of decimal digits, and is always in the range 0 to 255 inclusive. Leading zeroes are allowed. When the regulator replies with a bus address, it will always send two or three digits. E.g.: 01, 099, or 200.

A broadcast command is one that responds to the broadcast address. The broadcast address is a single asterisk, i.e.: “*” or “99”.

NOTE: The latest version of the regulator supports the two digit bus address 99 as the broadcast address. To use 99 as a bus address that does not mean broadcast, but instead exactly one bus address, specify at least one leading zero. E.g.: 099.

A broadcast command will not reply with any report or status.
A descriptive word representing one field will be set off in <angle brackets>. The brackets are not included in the actual command. E.g. <addr> may be replaced by 1, 2, 99, etc. An optional field will be set of in [square brackets]. The brackets are not included in the actual command. E.g. [<voltage>] may be replaced by 2.500 or left empty. Commands may be specified using their full syntax, abbreviated to their minimum syntax, or anything in between. An abbreviated command ends with a period “.” A command that takes an argument after the command must end with a single period, whether or not it is abbreviated. All commands must be in lower case letters. E.g. 1e. but not 1E.

Manzanita Micro MK3 Digital Regulator Command List

Command Name	Full Syntax	Minimum Syntax	Broadcast Command	Example Command	Example Reply
btemp (bt.)	<addr>btemp<temp>	<addr>bt.<temp>	YES	1bt.120	01BT 120F
	FUNCTION: Sets cell temperature that will activate the STOP CHARGE LINE when a cell is above this temperature. The temperature must be set between 32F and 180F. If <temp> is not present then the stored setting is displayed. If btdisable has been activated, btemp will reset the regulator to activate the STOP CHARGE LINE if a cell exceeds the designated temperature - Factory default is 120F.				
btdisable (btd.)	<addr>btdisable	<addr>btd.	YES	1btd.	01BT DISABLE
	FUNCTION: Disables the ability to activate the STOP CHARGE LINE if a cell is over temperature.				
changead (ch.)	<addr>changead.<newaddr>	<addr>ch.<newaddr>	NO	1ch.9	01 Now:09
	FUNCTION: Changes the current bus address <addr> to the new address <newaddr>. The other bus addresses on the same regulator are adjusted respectively. The new address must always be from 0 to 255. Additionally, the new address must not force any other bus address on the same regulator to exceed 0 to 255. Factory default is bus address 1, this will need to be changed if more than one regulator is in the series.				
commandl (.)	<addr>commandl	<addr>.	NO	1.	--Rudman MK3x8 Regulator --V0.17 Unit:01-08 S/N: 00001 commandl changead disable enable fan gethighv hstclear hmaclear hmiclear lights minvolts maxvolts querytot readlowv status sethigh setlow setover temperat tempwarm temphot tempoff voltage xtrntemp commandl btemp btdisable
	FUNCTION: Lists regulator model, software version, bus address range, serial number and valid commands				
disable (d.)	<addr>disable	<addr>d.	YES	1d.	01Disable
	FUNCTION: Disables the regulators ability to shunt - Factory default has shunting enabled for cell protection and equalization				
enable (e.)	<addr>enable	<addr>e.	YES	1e.	01Enable
	FUNCTION: Enables the regulators ability to shunt - Factory default has shunting enabled for cell protection and equalization				
fan (f.)	<addr>fan[.<level>]	<addr>f.[<level>]	YES	1f.4	01F 4
	FUNCTION: Forces the fan to be ON at set <level> - Factory default automatically controls the fan by the heat sink temperature. The <level> must be 0 to 8. A fan <level> of 1 or more will force the fan to run, with 8 being at full power. Fan <level> 0 is the default automatic mode (controlled by the temperature.)				
firstpos (fi.)	<addr>firstpos[.<enable>]	<addr>fi.[<enable>]	YES	1fi.1	01FP 1
	FUNCTION: If <enable> is 1 it switches the cell # order in the EEPROM so that BMS will display the most positive cell as Cell #1. <enable> must be 0 or 1, if <enable> is not present, <addr>fi. reports the active mode - Factory default is 0 indicating the most negative cell is Cell #1.				
gethighv (g.)	<addr>gethighv	<addr>g.	NO	1g.	01G 3.792V
	FUNCTION: Replies with high voltage set point. There is only one set point per regulator, so all bus addresses on one regulator will give the same response. The high voltage set point can be adjusted with the sethigh command, this set point adjusts the cell voltage level at which shunting will turn on.				

Manzanita Micro MK3 Digital Regulator Command List

Command Name	Full Syntax	Minimum Syntax	Broadcast Command	Example Command	Example Reply
hmaclear (hma.)	<addr>hmaclear	<addr>hma.	YES	1hma.	NO RESPONSE
	FUNCTION: Clears the history for the maximum sensed voltage for the given bus address.				
hmiclear (hmi.)	<addr>hmiclear	<addr>hmi.	YES	1hmi.	NO RESPONSE
	FUNCTION: Clears the history for the minimum sensed voltage for the given bus address.				
hstclear (h.)	<addr>hstclear	<addr>h.	YES	1h.	NO RESPONSE
	FUNCTION: Clears history for both minimum and maximum sensed voltages for the given bus address.				
lights (l.)	<addr>lights	<addr>l.	NO	1l.	--Rudman MK3x8 Regulator --V0.17 Unit:01 S/N: 00001
	FUNCTION: LED indicators will flash on regulator with given bus address and reply with the sign on message including, model, software version, bus address range and serial number				
maxvolts (ma.)	<addr>maxvolts	<addr>ma.	NO	1ma.	01MA 3.917V
	FUNCTION: Replys with maximum sensed voltage for given bus address				
minvolts (mi.)	<addr>minvolts	<addr>mi.	NO	1mi.	01MA 1.510V
	FUNCTION: Replys with minimum sensed voltage for given bus address				
phev (p.)	<addr>phev[.<enable>]	<addr>p.[<enable>]	YES	1p.	01P 0
	FUNCTION: Activates PHEV mode. The PHEV mode will be applied to all bus addresses per regulator. <enable> must be 0 or 1, 0 indicateds PHEV is disabled, 1 indicates PHEV is enabled. If <enable> is not present, <addr>phev reports the active mode. If enabled (1), the STOP CHARGE LINE is activated whenever the UNDERVOLTAGE LINE is activated. The PHEV command can be used to trigger something to cut back when a cell gets below the low set point the same way the charger is normally notified when a cell gets too high. The low set point can be changed with the setlow command. The sethigh set point will still activate the STOP CHARGE LINE during charging.				
querytot (q.)	<addr>querytot	<addr>q.	NO	1q.	01Q 12.19V
	FUNCTION: Replies with the total realt time sensed voltage for the regulators with the given bus address				
readlowv (r.)	<addr>readlowv	<addr>r.	NO	1r.	01R 2.496V
	FUNCTION: Replies with the low voltage set point. There is only one low voltage set point per regulator, so all bus addresses on one regulator will give the same response. When a cell falls below the low voltage set point the UNDERVOLTAGE LINE is activated.				
sethigh (seth.)	<addr>sethigh[.<voltage>]	<addr>seth.[<voltage>]	YES	01seth.3.792	01H 3.792V
	FUNCTION: Sets the high voltage set point. There is only one high voltage set point per regulator, so all bus addresses on one regulator are affected by the command. <voltage> must be from 0.000 to 9.999 and must contain exactly four digits. If <voltage> is not present, <addr>sethigh will give you the same result as the gethighv command. - Factory Default is 3.600V				
setlow (setl.)	<addr>setlow[.<voltage>]	<addr>setl.[<voltage>]	YES	01setl.2.496	01H 2.496
	FUNCTION: Sets the low voltage set point. There is only one low set point per regulator, so all bus addresses on one regulator are affected by the command. <voltage> must be from 0.000 to 9.999 and must contain exactly four digits. If <voltage> is not present, <addr>setlow will give you the same result as the readlowv command. If a cell falls below the low voltage set point the UNDERVOLTAGE LINE is activated. - Factory Default is 2.496				

Manzanita Micro MK3 Digital Regulator Command List

Command Name	Full Syntax	Minimum Syntax	Broadcast Command	Example Command	Example Reply
setover (seto.)	<addr>setover[.<voltage>]	<addr>seto.[<voltage>]	YES	01seto.3.984	01H 3.984V
	FUNCTION: Sets the over voltage set point. This set point must be higher than the high voltage set point designated with the sethigh command. The sethigh voltage set point will enable dissipation where as the setover voltage set point is when the BMS will tell the charger to cut back. There is only one over voltage set point per regulator, so all bus addresses on one regulator are affected by the command. <voltage> must be from 0.000 to 9.999 and must contain exactly four digits. If <voltage> is not present, <addr>setover reports the current set point. - Factory Default is 3.648V				
status (s.)	<addr>status	<addr>s.	NO	1s.	01S 28
	FUNCTION: Replies with real time status bits of the regulator with the given bus address as two hexadecimal digits. These digits are a sum of the hexadecimal digits from the immediate condition. For example if you have an over temp cell all of the bus addresses for that regulator will display a status bit of 01, but the bus address associated with the specific over temp cell will also have 02, therefore displays 03 because 01+02=03. Or if the shunt is disabled, status bit 80, and a cell is below the low voltage set point, status bit 20 then the reported status would be A0, following hexadecimal summation. Below is a table of the status bits and their meaning:				
	STATUS BIT	**LED INDICATORS**	**MEANING**		
	0x01	Blue ON, Yellow FLASHING	Regulator heat sink or a cell on the regulator is over temperature		
	0x02	Blue ON, Yellow FLASHING	Designates the exact bus address with an over temp cell		
	0x04	NONE	Reserved for future features		
	0x08	Red ON	The bus address has been below the low voltage set point		
	0x10	Green ON	The bus address is above the high voltage set point		
	0x20	Yellow ON, Red ON	The bus address is below the low voltage set point		
	0x40	Green ON, Cell Green ON	The shunt is enabled and the bus address is above the high voltage set point		
	0x80	NONE	The shunt is disabled		
temperat (t.)	<addr>temperat	<addr>t.	NO	1t.	01T 064F
	FUNCTION: Replies with the real time temperature of the heat sink or unit if there is no heatsink like the MK3x12. There is only one heat sink temperature per regulator, so all bus addresses on one regulator will give the same response.				
temphot (temph.)	<addr>temphot.<temp>	<addr>temph.<temp>	YES	1temph.151	01TH 151F
	FUNCTION: Sets the heatsink temperature that will make the fan run at full speed. The fan speed scales up from tempwarm to temphot. <temp> must be from 32 to 181 and between the tempwarm and tempoff set points.				
tempoff (tempo.)	<addr>tempoff.<temp>	<addr>tempo.<temp>	YES	1tempo.171	01TO 171F
	FUNCTION: Sets the heatsink temperature that forces the regulator to stop dissipating in order to avoid internal heat damage. <temp> must be from 32 to 181 and greater than temphot.				
tempwarm (tempw.)	<addr>tempwarm.<temp>	<addr>tempw.<temp>	YES	1tempw.120	01TW 120F
	FUNCTION: Sets the heatsink temperature that starts the fan. The fan speed scales up from tempwarm to temphot. tempwarm must be from 32 to 181 and less than temphot.				
xtrntemp (x.)	<addr>xtrntemp	<addr>x.	NO	1x.	01X Cold
	FUNCTION: Replies with the real time temperature of the given bus address cell's external temperature sensor if the optional sensors have been installed. The MK3x12 has only 6 sensors so temp sensor 1 reports as bus address 1 & 2, temp sensor 2 reports as 3 & 4 etc.				