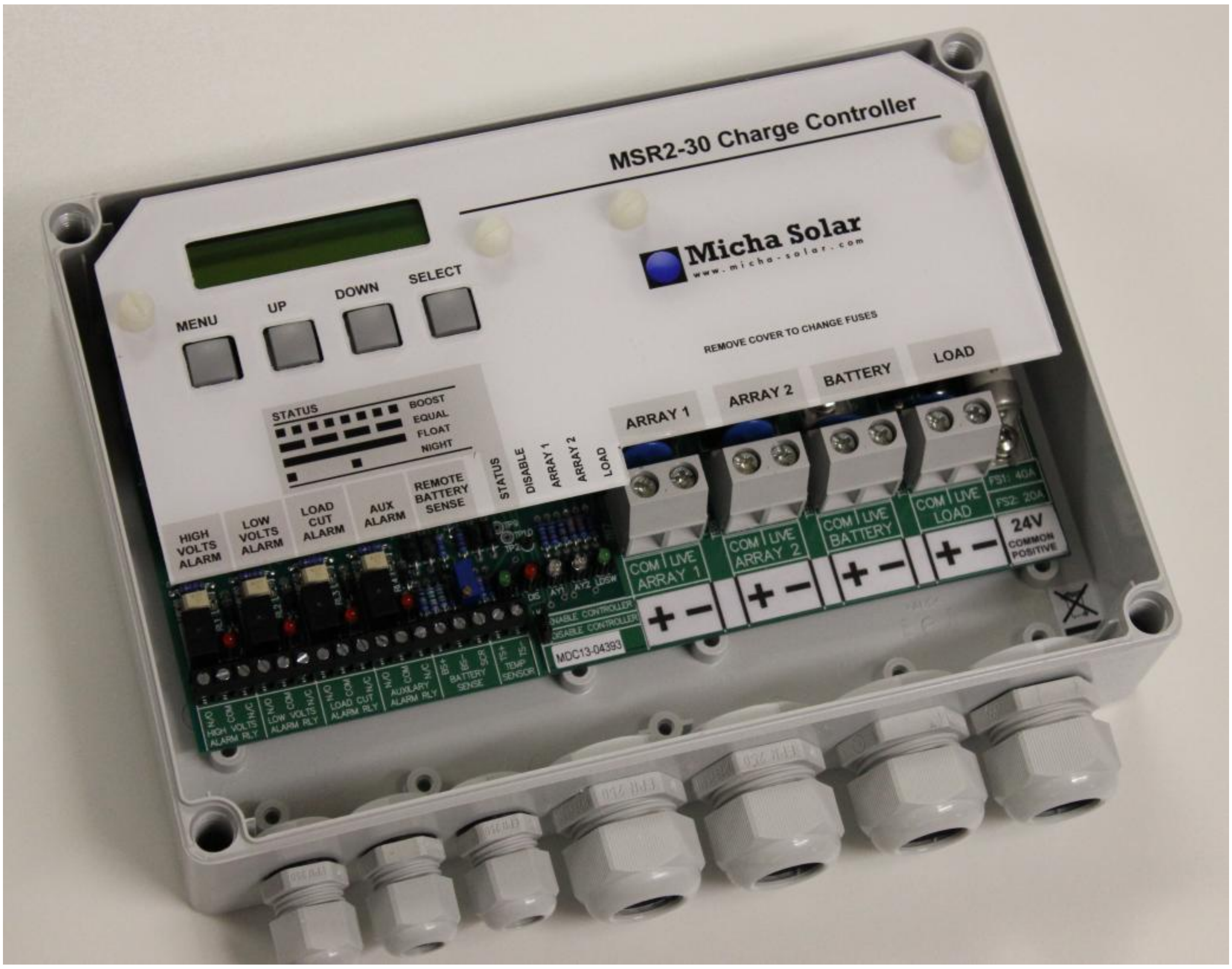
MSR2-30 Charge Controller

Product Manual

Issue 8



1. Introduction

The MSR2-30 Charge Controller provides the charge regulation and supervisory functions necessary in a solar power system. The controller prevents damage to the battery due to excessive charge or discharge and also provides a convenient place to interconnect the solar array, battery bank and load equipment.

The MSR2-30 Charge Controller has connections for two solar arrays, one battery and one load. The basic function of the regulator is to control the transfer of energy from the array to the battery and load. The state of charge of the battery is sensed by monitoring the battery voltage.

The MSR2-30 Charge Controller consits a Control Printed Circuit Board (PCB) Assembly which monitors the battery state of charge and controls the state of the regulation devices and alarms. The optional LCD display PCB Assembly mounts over and plugs into the main control board and enables the user to gain more information on the controller status, and provides some test facilities.

1.1. Standard Features of the MSR2 Charge Controller

System Voltage: 12V, 24V and 48 versions

System Polarity: Positive Earth and Negative Earth versions

Microcontroller (MCU) based control circuit

Solid state switching of two array current inputs up to 15A each (total 30A)

Solid state switching of load current up to 15A

Temperature compensation of the preset levels

LED indication of Status, Disable, Array 1 Charging, Array 2 Charging and Load Connected

40A Battery Fuse and 20A Load Fuse as standard

10mm^2 cable entry for power cables

2.5mm^2 cable entry for signal cables

Protection against induced voltage transients

Small size Polycarbonate IP65 Enclosure (250x175x75mm)

High Volts, Low Volts, Load Cut and Auxiliary Alarm (indication and volt-free relay contact)

1.2. Optional Features of the MSR2 Charge Controller

MSR2-30 Metering: 2x16 Character LCD Display Unit for system parameter indication and control

MSR2-30 RS232 Communications Port to interface to a local PC – Normal or Modbus ASCII Protocols

2. Health & Safety

2.1. General

Read this manual thoroughly BEFORE undertaking any work.

Potentially lethal voltages can be present at the terminals within the Unit. Extreme care MUST be taken when performing any of the actions described in this manual. Remove all metallic personal adornments from the hands, wrists and neck before commencing work on a live unit. Ensure all tools are insulated.

2.2. Earthing

The MSR2-30 Charge Controller can be used with either a Positive Earth (Common Positive) or Negative Earth (Common Negative) solar system.

3. MSR2-30 Control Unit Operation

3.1. Analogue Measurements

The MCU uses an A/D converter to read the battery voltage, the array voltages, the temperature sensor and the array and load current if the metering option is included.

The battery voltage is read every 50ms (20 times a second). Where the unit determines a change of mode or alarm status is necessary, four successive readings will have to be above or below the appropriate setpoint (the exception is the High Volts Alarm) for the change to occur.

To obtain the true array voltages, the MCU needs to first disconnect an array from the battery (if connected) and then read the array voltage. This is done approximately every 60 seconds

The temperature sensor is used to compensate the battery voltage. If faulty or disconnected, then the A/D converter will return a value outside of possible air temperature limits in which case the regulator will operate as if the temperature was sensed as being the Temperature Compensation Null Temperature (i.e. zero compensation applied).

3.2. Battery Regulation

If the compensated battery voltage is less than the Reset-to-Boost voltage, the unit will enter the Boost Mode. During this time the unit will connect the arrays to the battery if the voltage present on each array is greater than the battery voltage by 2V. If the total array current is greater than the load current, the battery will charge and the battery voltage will increase.

When the compensated battery voltage reaches the Boost voltage, the unit will enter the Equalisation Mode. In this mode, the unit will disconnect and reconnect the arrays to the battery to regulate the battery voltage at the Boost voltage for the Equalisation period. This ensures the battery reaches its optimum state of charge.

After the Equalisation period, the unit will enter the Float Mode. In this mode, the unit will disconnect and reconnect the arrays to the battery to regulate the compensated battery voltage at the Float voltage.

If the compensated battery voltage decreases below the Reset-to Boost voltage, the unit will enter the Boost Mode.

When there is insufficient light to generate current (at night or on a day with poor light conditions), the regulator disconnects the arrays from the battery to avoid the battery discharging back through the array. This is the Night mode.

When the unit is regulating at either the Boost voltage or Float voltage, it will disconnect the arrays from the battery when the battery reaches the required voltage. It will re-connect the array to the battery when the compensated battery voltage falls below the required voltage by 0.15V(12V system), 0.3V (24V system) or 0.6V (48V system).

3.3. Alarms Activation and Reset

If the compensated battery voltage is higher than the High Volts activation voltage, the array will be immediately disconnected from the battery and the High Volts alarm relay and indicator will be activated. If the compensated battery voltage is lower than the High Volts reset voltage, the High Volts alarm relay and indicator will be immediately reset.

If the battery voltage is lower than the Low Volts activation voltage and remains lower for 2 seconds, the Low Volts alarm relay and indicator will be activated. If the battery voltage is higher than the Low Volts reset voltage, the Low Volts alarm relay and indicator will be immediately reset.

If the battery voltage is lower than the Load Cut activation voltage and remains lower for 2 seconds, the Load Cut alarm relay and indicator will be activated. After the Load Cut switch delay period, the Load Cut Switch and indicator will be activated. If the battery voltage is higher than the Load Cut reset voltage, the Load Cut alarm relay and indicator and the Load Cut switch and indicator will be immediately reset.

If the voltage on either array does not exceed 2V above the Battery Voltage for a period of 24 hours then the 24 Hour Alarm will be activated. The Auxiliary Alarm Relay can be programmed to activate for this Alarm.

The Auxiliary Alarm Relay and indicator can be programmed (Menu 3) to activate on 24Hr Alarm, Common Alarm (i.e. any alarm) or System Normal (i.e. active when they is no alarm). System Normal can be used to ensure the charge controller is actually powered and operating correctly.

3.4. Status LED

A status LED is used to provide basic unit status to the user as described in the following table:

Mode	Status LED Operation
Boost Mode	Flash : 0.35 sec on - 0.35 sec off
Equalisation Mode	Flash : 1.05 sec on – 0.35 sec off
Float Mode	Steady
Night Mode	Flash: 0.35 sec on – 2.45 sec off

3.5. Enable/Disable Jumper Link LK2

The Enable/Disable Jumper Link LK2 is used to Disable the Charge Controller. When the unit is Disabled, the Arrays and Load are disconnected from the Battery. The unit must be Disabled inorder to enter the Change Setting Menus (see Section 3.19).

3.6. Default Values 1 Setpoints – Fulmen

The setpoints for Fulmen Battey Cells and the operating parameters of the unit which are held in the Microcontroller are listed in the following table:

Set-points – Fulmen Cells	Volts / Cell	12V System	24V System	48V System
Boost & Equal Regulation Voltage	2.45 V	14.70	29.40	58.80
Float Regulation Voltage	2.30 V	13.80	27.60	55.20
Reset to Boost	2.20 V	13.20	26.40	52.80
High Volts Alarm Trip	2.50 V	15.00	30.00	60.00
High Volts Alarm Reset	2.30 V	13.80	27.60	55.20
Low Volts Alarm Trip	1.95 V	11.70	23.40	46.80
Low Volts Alarm Reset	2.30 V	13.80	27.60	55.20
Load Cut Alarm Trip	1.85 V	11.10	22.20	44.40
Load Cut Alarm Reset	2.10 V	12.60	25.20	50.40
Load Cut Switch Delay	N/A	5 seconds	5 seconds	5 seconds
Equalisation Period	N/A	30 minutes	30 minutes	30 minutes
Temp Compensation Null Temp	N/A	20°C	20°C	20°C
Temp Compensation Rate	N/A	-5mV/ °C /cell	-5mV/ °C /cell	-5mV/ °C /cell

3.7. Default Values 2 Setpoints – Vented

The setpoints for Vented Battey Cells and the operating parameters of the unit which are held in the Microcontroller are listed in the following table:

Set-points – Vented Cells	Volts / Cell	12V System	24V System	48V System
Boost & Equal Regulation Voltage	2.40 V	14.40	28.80	57.60
Float Regulation Voltage	2.35 V	14.10	28.20	56.40
Reset to Boost	2.20 V	13.20	26.40	52.80
High Volts Alarm Trip	2.45 V	14.70	29.40	58.80
High Volts Alarm Reset	2.40 V	14.40	28.80	57.60
Low Volts Alarm Trip	1.90 V	11.40	22.80	45.60
Low Volts Alarm Reset	2.00 V	12.00	24.00	48.00
Load Cut Alarm Trip	1.80 V	10.80	21.60	43.20
Load Cut Alarm Reset	2.00 V	12.00	24.00	48.00
Load Cut Switch Delay	N/A	5 seconds	5 seconds	5 seconds
Equalisation Period	N/A	30 minutes	30 minutes	30 minutes
Temp Compensation Null Temp	N/A	25°C	25°C	25°C
Temp Compensation Rate	N/A	-5.5mV/°C/cell	-5.5mV/°C/cell	-5.5mV/°C/cell

3.8. Default Values 3 Setpoints – VRLA

The setpoints for VRLA Battey Cells and the operating parameters of the unit which are held in the Microcontroller are listed in the following table:

Set-points – VRLA Cells	Volts / Cell	12V System	24V System	48V System
Boost & Equal Regulation Voltage	2.30 V	13.80	27.60	55.20
Float Regulation Voltage	2.25 V	13.50	27.00	54.00
Reset to Boost	2.10 V	12.60	25.20	50.40
High Volts Alarm Trip	2.40 V	14.40	28.80	57.60
High Volts Alarm Reset	2.35 V	14.10	28.20	56.40
Low Volts Alarm Trip	1.90 V	11.40	22.80	45.60
Low Volts Alarm Reset	2.00 V	12.00	24.00	48.00
Load Cut Alarm Trip	1.80 V	10.80	21.60	43.20
Load Cut Alarm Reset	2.00 V	12.00	24.00	48.00
Load Cut Switch Delay	N/A	5 seconds	5 seconds	5 seconds
Equalisation Period	N/A	30 minutes	30 minutes	30 minutes
Temp Compensation Null Temp	N/A	25°C	25°C	25°C
Temp Compensation Rate	N/A	-3.3mV/°C/cell	-3.3mV/°C/cell	-3.3mV/°C/cell

3.9. NiCd Battery Settings

Setpoints for NiCd Battey Cells are listed in the following table and can be adjusted by the user. First set the settings as Default Values 3 (Section 3.20 – Menu A Screen 13) and then manually adjust each setting:

NiCd Set-points	Volts / Cell	12V System	24V System	48V System
Number of Cells / Voltage		10 cells = 12V	20 cells = 24V	40 cells = 48V
Boost & Equal Regulation Voltage	1.50 V	15.00	30.00	60.00
Float Regulation Voltage	1.50 V	15.00	30.00	60.00
Reset to Boost	1.30 V	13.00	26.00	52.00
High Volts Alarm Trip	1.65 V	16.50	33.00	66.00
High Volts Alarm Reset	1.55 V	15.50	31.00	62.00
Low Volts Alarm Trip	1.25 V	12.50	25.00	50.00
Low Volts Alarm Reset	1.30 V	13.00	26.00	52.00
Load Cut Alarm Trip	1.18 V	11.80	23.60	47.20
Load Cut Alarm Reset	1.30 V	13.00	26.00	52.00
Load Cut Switch Delay	5 seconds	5 seconds	5 seconds	5 seconds
Equalisation Period	30 minutes	30 minutes	30 minutes	30 minutes
Temp Compensation Null Temp	25°C	25°C	25°C	25°C
Temp Compensation Rate	-3.3mV/°C/cell	-3.3mV/°C/cell	-3.3mV/°C/cell	-3.3mV/°C/cell

MSR2-30 Metering Option

The MSR2-30 Metering option requires components to be fitted to the MSR2-30 Control PCB Assembly at manufacture and also the fitting of the MSR2 Display PCB Assembly.

3.10. Control PCB Assembly

In order to measure the total array current and the load current, the MSR2-30 Control PCB Assembly is populated with shunt resistors and some signal conditioning hardware if the MSR2-30 Metering option is requested.

3.11. MSR2-30 Display PCB Assembly

The MSR2-30 Display PCB Assembly consists of a 2 x 16 character LCD display module and four user switches (Menu, Up, Down and Select)

3.12. Display Power Down

The MSR2-30 Display PCB Assembly had a power down feature, which operated 4 minutes after the last press of any switch. Software 801454 Verion 1.4 or higher removed this feature so that the display is always active.

3.13. Display Menu Control

The MSR2-30 Display PCB Assembly has multiple menus and information screens as shown in Figure 1.

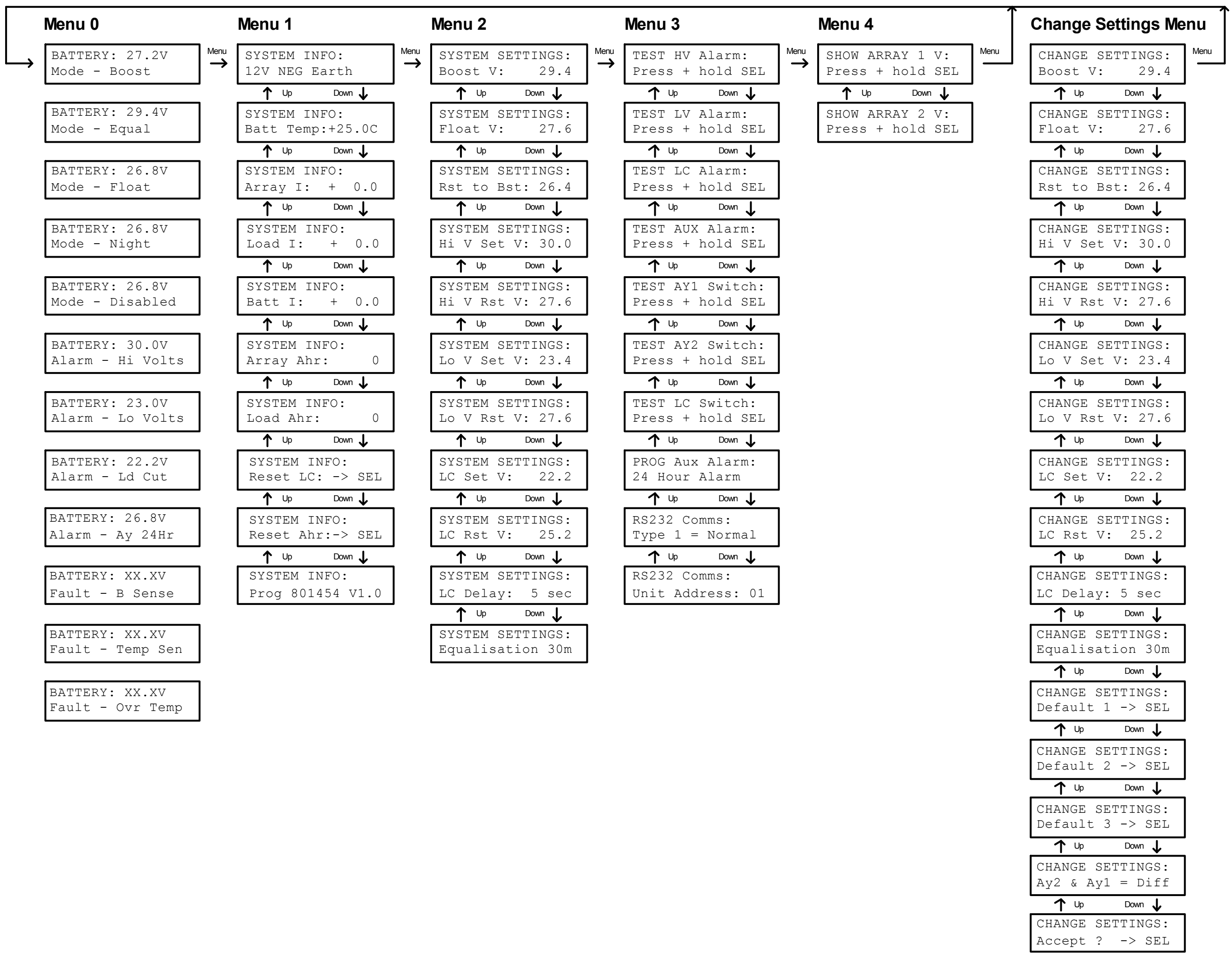


Figure 1

3.14. Menu 0

Menu 0 is the menu for the display of the present Regulation Mode in which the Control Unit is operating: Boost, Equalisation, Float, Night (if inadequate array voltage detected) and Disabled (disabled by jumper link LK2).

If any alarms are present, the display will show the appropriate Alarm mode: High Volts, Low Volts, Load Cut and Aux Alarm (24 Hour).

If any faults are present, the display will show the relevant Fault Mode: Battery Sense (not connected), Temperature Sense (not connected or faulty), Over Temperature (exceeds 55°C).

3.15. Menu 1

Menu 1 is entered from any screen of Menu 0 by pressing the Menu switch.

Menu 1 allows the user to view System Information by pressing the Up and Down switches: System Voltage and System Polarity, Temperature, Array Current, Load Current, Battery Current (by calculation), Array AHrs, Load AHrs, and the software program version number. It is possible to reset a Load Cut condition and to reset the AHrs memory.

3.16. Menu 2

Menu 2 is entered from any screen of Menu 1 by pressing the Menu switch.

Menu 2 allows the user to view System Settings by pressing the Up and Down switches: Boost Voltage, Float Voltage, Reset to Boost Voltage, High Volts Set Voltage, High Volts Reset Voltage, Low Volts Set Voltage, Low Volts Reset Voltage, Load Cut Set Voltage, Load Cut Reset Voltage, Load Cut Delay and Equalisation Period.

3.17. Menu 3

Menu 3 is entered from any screen of Menu 2 by pressing the Menu switch.

Menu 3 allows the user to test the alarm relays and the solid-state switches of the unit. The Up and Down switches allow the user to choose the test, and the Select switch changes the present state of the alarm or solid-state switch.

The Auxiliary Alarm can be programmed for a variety of uses: 24Hr Alarm / Common Alarm / System Normal

RS232 Communication can be set as Type 1 = Normal (Micha Protocol) or Type 2 = Modbus (Modbus Protocol).

The RS232 Communications Uint Address can be set from 1 to 247

3.18. Menu 4

Menu 4 is entered from any screen of Menu 3 by pressing the Menu switch.

Menu 4 allows the user to view the present voltage on Array 1 and Array 2. The Up and Down switches allow the user to select between Array 1 and Array 2, and the Select switch displays the voltage.

3.19. Change Settings Menu Instructions

A Change Settings Menu (see below) exists to allow an authorised user to change the settings of the unit in the field. The Change Settings Menu can only be entered by doing the following: insert the jumper link on LK2 in the Disable position, hold the Menu, Up and Down switches pressed and press the Select switch.

The Up and Down switches are used to select the setting to be changed. Then the Select switch is pressed and the parameter will flash. The Up and Down switches are used to vary the parameter value. The Select switch is pressed to allow the selection of another parameter.

Inorder to remember the new settings, the user must navigate to the “Accept ?” screen and press the Select switch. Escape from this menu without remembering the changes can be done by pressing the Menu switch. To change the settings back to the default (factory) settings, the user can navigate to one of the “Default” screens and press the Select switch.

3.20. Change Settings Menu List

Menu A	Screen	Description
CHANGE SETTINGS: Boost V: 29.4	Screen 0	Boost Regulation Voltage Set-point
CHANGE SETTINGS: Float V: 27.6	Screen 1	Float Regulation Voltage Set-point
CHANGE SETTINGS: Rst to Bst: 26.4	Screen 2	Reset to Boost Voltage Set-point
CHANGE SETTINGS: Hi V Set V: 30.0	Screen 3	High Volts Alarm Trip Voltage Set-point
CHANGE SETTINGS: Hi V Rst V: 27.6	Screen 4	High Volts Alarm Reset Voltage Set-point
CHANGE SETTINGS: Lo V Set V: 23.4	Screen 5	Low Volts Alarm Trip Voltage Set-point
CHANGE SETTINGS: Lo V Rst V: 27.6	Screen 6	Low Volts Alarm Reset Voltage Set-point
CHANGE SETTINGS: LC Set V: 22.2	Screen 7	Load Cut Alarm Trip Voltage Set-point
CHANGE SETTINGS: LC Rst V: 25.2	Screen 8	Load Cut Alarm Reset Voltage Set-point
CHANGE SETTINGS: LC Delay: 5 sec	Screen 9	Load Cut Delay Period (1 to 9 seconds) (Time between the alarm being activated and the load being cut)
CHANGE SETTINGS: Equalisation:30m	Screen 10	Equalisation Period (1 to 90 minutes)
CHANGE SETTINGS: Default 1 -> SEL	Screen 11	Program Unit to Default 1 Settings – Fulmen Batteries (Section 3.5)
CHANGE SETTINGS: Default 2 -> SEL	Screen 12	Program Unit to Default 2 Settings – Vented Batteries (Section 3.7)
CHANGE SETTINGS: Default 3 -> SEL	Screen 13	Program Unit to Default 3 Settings – VRLA Batteries (Section 3.8)
CHANGE SETTINGS: Ay2 & Ay1 = Diff	Screen 14	Array 2 & Array 1 Operation = Diff = Independent Operation Array 2 & Array 1 Operation = Same = Operate together as Array 1
CHANGE SETTINGS: Accept ? -> SEL	Screen 15	To remember the programmed settings the SELECT switch must be pressed at this screen

4. MSR2-30 RS232 Communications (Type 1 = Normal - Micha Protocol)

The MSR2-30 RS232 option consists of an add-on MSR2-30 RS232 PCB Assembly which plugs into the MSR2-30 Control PCB Assembly. The RS232 option allows a PC to interrogate the MSR2-30. The MSR2-30 will respond with data in a specified format.

For Normal RS232 Communications (Micha Protocol) ensure Menu 3 Screen 8 is set to Type 1 = Normal. The Unit Address (Menu 3 Screen 9) can be set to 1 but this is not used.

4.1. RS232 Connection

The RS232 PCB Assembly has a 3-way terminal block to terminate the Transmit (TX), Receive (RX) and Ground (GND) connections from the PC.

4.2. RS232 Set-up

The RS232 communications require the following format: 9600 Baud, 1 Start Bit, 1 Stop Bit, No Parity.

4.3. PC Commands

The MSR2-30 will respond to two ASCII commands:

“D” followed by a carriage return (Hex’0D’) will return the system Data of the MSR2-30 unit.

“S” followed by a carriage return (Hex’0D’) will return the system Settings of the MSR2-30 unit.

4.4. Data Format

The format for the system data ASCII string is given in the following table

PC String: “D” followed by carriage return		
MSR2-30 Data String: “A,B,CC.C,DD.D,EE.E,FF.F,GG.G,HHH.H,I,J,K,L,M,N,O,P,Q,R,S,END”		
Ref	**Parameter Description**	**Parameter code**
A	System Voltage	1=12V, 2=24V, 4=48V
B	System Polarity	0=Negative, 1=Positive
CC.C	Battery Voltage	Volts
DD.D	Array 1 Voltage	Volts
EE.E	Array 2 Voltage	Volts
FF.F	Array Current	Amps
GG.G	Load Current	Amps
HHH.H	Temperature Sensor	+HH.H °C or –HH.H°C
I	Regulation Mode	B=Boost, E=Equal, F=Float, N=Night
J	High Volts Alarm	0=Inactive, 1=Active
K	Low Volts Alarm	0=Inactive, 1=Active
L	Load Cut Alarm	0=Inactive, 1=Active
M	Auxilary Alarm	0=Inactive, 1=Active
N	Array 1 Switch	0=Inactive, 1=Active
O	Array 2 Switch	0=Inactive, 1=Active
P	Load Switch	0=Inactive, 1=Active
Q	Battery Sense Fault	0=Inactive, 1=Active
R	Temperature Sensor Fault	0=Inactive, 1=Active
S	Controller Enable/Disable	E=Enable, D=Disable
END	End of String	

4.5. Settings Format

The format for the system settings ASCII string is given in the following tables:

PC String: "S" followed by carriage return		
MSR2-30 Settings String: "AA.A,BB.B,CC.C,DD.D,EE.E,FF.F,GG.G,HH.H,II.I,J,KK,END"		
Ref	**Parameter Description**	**Parameter code**
AA.A	Boost Regulation Voltage	Volts
BB.B	Float Regulation Voltage	Volts
CC.C	Reset to Boost Voltage	Volts
DD.D	High Volts Set Voltage	Volts
EE.E	High Volts Reset Voltage	Volts
FF.F	Low Volts Set Voltage	Volts
GG.G	Low Volts Reset Voltage	Volts
HH.H	Load Cut Set Voltage	Volts
II.I	Load Cut Reset Voltage	Volts
J	Load Cut Delay	Seconds
KK	Equalisation Period	Minutes
END	End of String	

5. MSR2-30 RS232 Communications (Type 2 = Modbus ASCII Protocol)

The RS232 Port PCB Assembly has a 3-way terminal block to terminate the Transmit (TX), Receive (RX) and Ground (GND) connections from the PC. The RS232 Communications requires the following format: 9600 Baud, 1 Start Bit, 1 Stop Bit, No Parity.

For Modbus RS232 Communications (Modbus ASCII Protocol) ensure Menu 3 Screen 8 is set to Type 2 - Modbus. The Unit Address (Menu 3 Screen 9) is the Modbus Slave Address (1-247).

5.1. Modbus Memory Map - Discrete Coils (Outputs)

Coil Register Numbers = 1 to 9999 / Data Address = 0 to 9998

Function 01 – Read Coils (Read Digital Outputs)

Function 05 – Write Single Coil (Write Single Digital Output)

Data Addr	Parameter	Value Range	Data Bytes	Register Type
0	Not used	0	1 bit	1 Digital Output
1	Not used	0	1 bit	1 Digital Output
2	Not used	0	1 bit	1 Digital Output
3	Not used	0	1 bit	1 Digital Output
4	Not used	0	1 bit	1 Digital Output
5	Not used	0	1 bit	1 Digital Output
6	Not used	0	1 bit	1 Digital Output
7	Not used	0	1 bit	1 Digital Output
8	Not used	0	1 bit	1 Digital Output
9	Not used	0	1 bit	1 Digital Output
10	Not used	0	1 bit	1 Digital Output

5.2. Modbus Memory Map - Discrete Inputs (Digital Inputs)

Input Register Numbers = 10001 to 19999 / Data Address = 0 to 9998

Function 02 – Read Discrete Inputs (Read Digital Inputs)

Data Addr	Parameter	Value Range	Data Bytes	Register Type
0	Array 1 Switch	0 = Inactive / 1 = Active	1 bit	1 Digital Input
1	Array 2 Switch	0 = Inactive / 1 = Active	1 bit	1 Digital Input
2	Not used	0	1 bit	1 Digital Input
3	Not used	0	1 bit	1 Digital Input
4	Not used	0	1 bit	1 Digital Input
5	Not used	0	1 bit	1 Digital Input
6	Not used	0	1 bit	1 Digital Input
7	Not used	0	1 bit	1 Digital Input
8	Load 1 Switch	0 = Inactive / 1 = Active	1 bit	1 Digital Input
9	Not used	0	1 bit	1 Digital Input
10	Load Disconnect 1 Alarm	0 = Inactive / 1 = Active	1 bit	1 Digital Input
11	Not used	0	1 bit	1 Digital Input
12	Disable Input	0 = Inactive / 1 = Active	1 bit	1 Digital Input
13	Not used	0	1 bit	1 Digital Input
14	Not used	0	1 bit	1 Digital Input
15	Not used	0	1 bit	1 Digital Input
16	Common Alarm	0 = Inactive / 1 = Active	1 bit	1 Digital Input
17	High Voltage 1 Alarm	0 = Inactive / 1 = Active	1 bit	1 Digital Input
18	Not used	0	1 bit	1 Digital Input
19	Low Voltage 1 Alarm	0 = Inactive / 1 = Active	1 bit	1 Digital Input
20	Not used	0	1 bit	1 Digital Input
21	Battery 1 Sense Alarm	0 = Inactive / 1 = Active	1 bit	1 Digital Input
22	Temp 1 Sense Alarm	0 = Inactive / 1 = Active	1 bit	1 Digital Input
23	Not used	0	1 bit	1 Digital Input
24	Not used	0	1 bit	1 Digital Input
25	Not used	0	1 bit	1 Digital Input
26	Not used	0	1 bit	1 Digital Input
27	Not used	0	1 bit	1 Digital Input
28	Not used	0	1 bit	1 Digital Input
29	Not used	0	1 bit	1 Digital Input
30	Not used	0	1 bit	1 Digital Input
31	Not used	0	1 bit	1 Digital Input
32	Not used	0	1 bit	1 Digital Input
33	Not used	0	1 bit	1 Digital Input

5.3. Modbus Memory Map - Analog Input Registers (Analogue Inputs)

Input Register Numbers = 30001 to 39999 / Data Address = 0 to 9998

Function 04 – Read Input Registers (Read Analogue Inputs)

Data Addr	Parameter	Value Range	Data Bytes	Register Type
0	Controller Type	Byte 1: 02 Byte 2: 30	2 bytes	1 Analog Input
1	System Voltage / Polarity	Byte 1: 01=12V, 02=24V, 04=48V Byte 2: 00=Com Negative, 01=Com Pos	2 bytes	1 Analog Input
2	Software High Digits	Hex: Byte 1=Digits 87 Byte 2=Digits 65	2 bytes	1 Analog Input
3	Software Low Digits	Hex: Byte 1=Digits 43 Byte 2=Digits 21	2 bytes	1 Analog Input
4	Battery Voltage	0-1000 => 0.0-100.0V	2 bytes	1 Analog Input
5	Array 1 Voltage	0-1000 => 0.0-100.0V	2 bytes	1 Analog Input
6	Array 2 Voltage	0-1000 => 0.0-100.0V	2 bytes	1 Analog Input
7	Not used	0	2 bytes	1 Analog Input
8	Not used	0	2 bytes	1 Analog Input
9	Not used	0	2 bytes	1 Analog Input
10	Not used	0	2 bytes	1 Analog Input
11	Not used	0	2 bytes	1 Analog Input
12	Not used	0	2 bytes	1 Analog Input
13	Not used	0	2 bytes	1 Analog Input
14	Battery Current	0-1000 => 0-1000A	2 bytes	1 Analog Input
15	Array Current	0-1000 => 0-1000A	2 bytes	1 Analog Input
16	Load Current	0-1000 => 0-1000A	2 bytes	1 Analog Input
17	Temperature 1	2000-3500 => 200.0-350.0K	2 bytes	1 Analog Input
18	Not used	0	2 bytes	1 Analog Input
19	Not used	0	2 bytes	1 Analog Input
20	Array Ahr High Digits	Hex: Byte 1=Digits 87 Byte 2=Digits 65	2 bytes	1 Analog Input
21	Array Ahr Low Digits	Hex: Byte 1=Digits 43 Byte 2=Digits 21	2 bytes	1 Analog Input
22	Load Ahr High Digits	Hex: Byte 1=Digits 87 Byte 2=Digits 65	2 bytes	1 Analog Input
23	Load Ahr Low Digits	Hex: Byte 1=Digits 43 Byte 2=Digits 21	2 bytes	1 Analog Input
24	Not used	0	2 bytes	1 Analog Input
25	Not used	0	2 bytes	1 Analog Input
26	Not used	0	2 bytes	1 Analog Input
27	Not used	0	2 bytes	1 Analog Input

5.4. Modbus Memory Map - Analog Output Holding Registers (Analogue Outputs)

Input Register Numbers = 40001 to 49999 / Data Address = 0 to 9998

Function 03 – Read Holding Registers (Read Analogue Outputs)

Function 06 – Write Single Register (Write Single Analogue Output)

Note: Voltage parameters are passed as if for a 48V system (i.e. 24V system parameters x 2)

Data Addr	Parameter	Value Range	Data Bytes	Register Type
0	Boost Regulation Voltage	0-1000 => 0.0-100.0V (as for 48V system)	2 bytes	1 Analog Output
1	Float Regulation Voltage	0-1000 => 0.0-100.0V (as for 48V system)	2 bytes	1 Analog Output
2	Reset to Boost Voltage	0-1000 => 0.0-100.0V (as for 48V system)	2 bytes	1 Analog Output
3	Equalisation Period	1-90 minutes	2 bytes	1 Analog Output
4	Temp Comp Null Temp	1-40 degrees C	2 bytes	1 Analog Output
5	Temp Comp Rate	1-99 => -0.1 to 9.9mV / Cell / deg C	2 bytes	1 Analog Output
6	High Volts 1 Trip Voltage	0-1000 => 0.0-100.0V (as for 48V system)	2 bytes	1 Analog Output
7	High Volts 1 Reset Voltage	0-1000 => 0.0-100.0V (as for 48V system)	2 bytes	1 Analog Output
8	Not used	0	2 bytes	1 Analog Output
9	Not used	0	2 bytes	1 Analog Output
10	Low Volts 1 Trip Voltage	0-1000 => 0.0-100.0V (as for 48V system)	2 bytes	1 Analog Output
11	Low Volts 1 Reset Voltage	0-1000 => 0.0-100.0V (as for 48V system)	2 bytes	1 Analog Output
12	Not used	0	2 bytes	1 Analog Output
13	Not used	0	2 bytes	1 Analog Output
14	Load Cut 1 Trip Voltage	0-1000 => 0.0-100.0V (as for 48V system)	2 bytes	1 Analog Output
15	Load Cut 1 Reset Voltage	0-1000 => 0.0-100.0V (as for 48V system)	2 bytes	1 Analog Output
16	Not used	0	2 bytes	1 Analog Output
17	Not used	0	2 bytes	1 Analog Output
18	Not used	0	2 bytes	1 Analog Output
19	Not used	0	2 bytes	1 Analog Output
20	Not used	0	2 bytes	1 Analog Output
21	Not used	0	2 bytes	1 Analog Output
22	Not used	0	2 bytes	1 Analog Output
23	Not used	0	2 bytes	1 Analog Output
24	Not used	0	2 bytes	1 Analog Output
25	Not used	0	2 bytes	1 Analog Output
26	Not used	0	2 bytes	1 Analog Output
27	Not used	0	2 bytes	1 Analog Output
28	Not used	0	2 bytes	1 Analog Output
29	Not used	0	2 bytes	1 Analog Output
30	Not used	0	2 bytes	1 Analog Output
31	Not used	0	2 bytes	1 Analog Output

5.5. Example Query: Function 01 - Read Coils 0-10

Start Colon	Slave Addr	Func-tion	Start Address		No of Coils		LRC	Carr-Retrn	Line Feed	Description of Characters
			High	Low	High	Low				
:	01	01	00	00	00	0B	F3	CR	LF	ASCII

Response

Start Colon	Slave Addr	Func-tion	Byte Count	Data		LRC	Carr-Retrn	Line Feed
				15-8	7-0			
:	01	01	02	07	0F	E6	CR	LF

5.6. Example Query: Function 02 - Read Discrete Inputs 10-30

Start Colon	Slave Addr	Func-tion	Start Address		No of Inputs		LRC	Carr-Retrn	Line Feed
			High	Low	High	Low			
:	01	02	00	00	00	22	DB	CR	LF

Response

Start Colon	Slave Addr	Func-tion	Byte Count	Data			LRC	Carr-Retrn	Line Feed
				33-26	25-18	17-10			
:	01	02	03	07	80	11	62	CR	LF

5.7. Example Query: Function 03 - Read Holding Registers 0-2

Start Colon	Slave Addr	Func-tion	Start Address		No of Regs		LRC	Carr-Retrn	Line Feed
			High	Low	High	Low			
:	01	03	00	00	00	03	F9	CR	LF

Response

Start Colon	Slave Addr	Func-tion	Byte Count	Data		Data		Data		LRC	Carr-Retrn	Line Feed
				High	Low	High	Low	High	Low			
:	01	03	06	02	4C	02	28	02	10	6C	CR	LF

5.8. Example Query: Function 04 - Read Input Registers 1-2

Start Colon	Slave Addr	Func-tion	Start Address		No of Regs		LRC	Carr-Retrn	Line Feed
			High	Low	High	Low			
:	01	04	00	01	00	02	F8	CR	LF

Response

Start Colon	Slave Addr	Func-tion	Byte Count	Data		Data		LRC	Carr-Retrn	Line Feed
				High	Low	High	Low			
:	01	04	04	02	01	01	E0	13	CR	LF

5.9. Example Query: Function 05 - Write Single Coil: 10 = ON (Write Data must be FF 00)

Start Colon	Slave Addr	Func-tion	Coil Address		Write Data		LRC	Carr-Retrn	Line Feed
			High	Low	High	Low			
:	01	05	00	0A	FF	00	F1	CR	LF

Response = same as Query

5.10. Example Query: Function 05 – Write Single Coil: 05 = OFF (Write Data must be 00 00)

Start Colon	Slave Addr	Func-tion	Coil Address		Write Data		LRC	Carr-Retrn	Line Feed
			High	Low	High	Low			
:	01	05	00	05	00	00	F5	CR	LF

Response = same as Query

5.11. Example Query: Function 06 - Write Single Register

Start Colon	Slave Addr	Func-tion	Reg Address		Write Data		LRC	Carr-Retrn	Line Feed
			High	Low	High	Low			
:	01	06	00	00	02	4C	AB	CR	LF

Response = same as Query

6. Installation

6.1. Mounting and Position

6.1.1. The MSR2-30 Charge Controller should be installed using either the two mounting feet or using the four fixing points which are hidden by the cover fixing screws (see Figure 3). Ensure that the fixing method employed is sturdy enough to support the weight of the Unit. Position the unit so that it is shaded from direct sunlight, sheltered from extreme weather conditions and oriented so that the cable glands are pointing downwards.

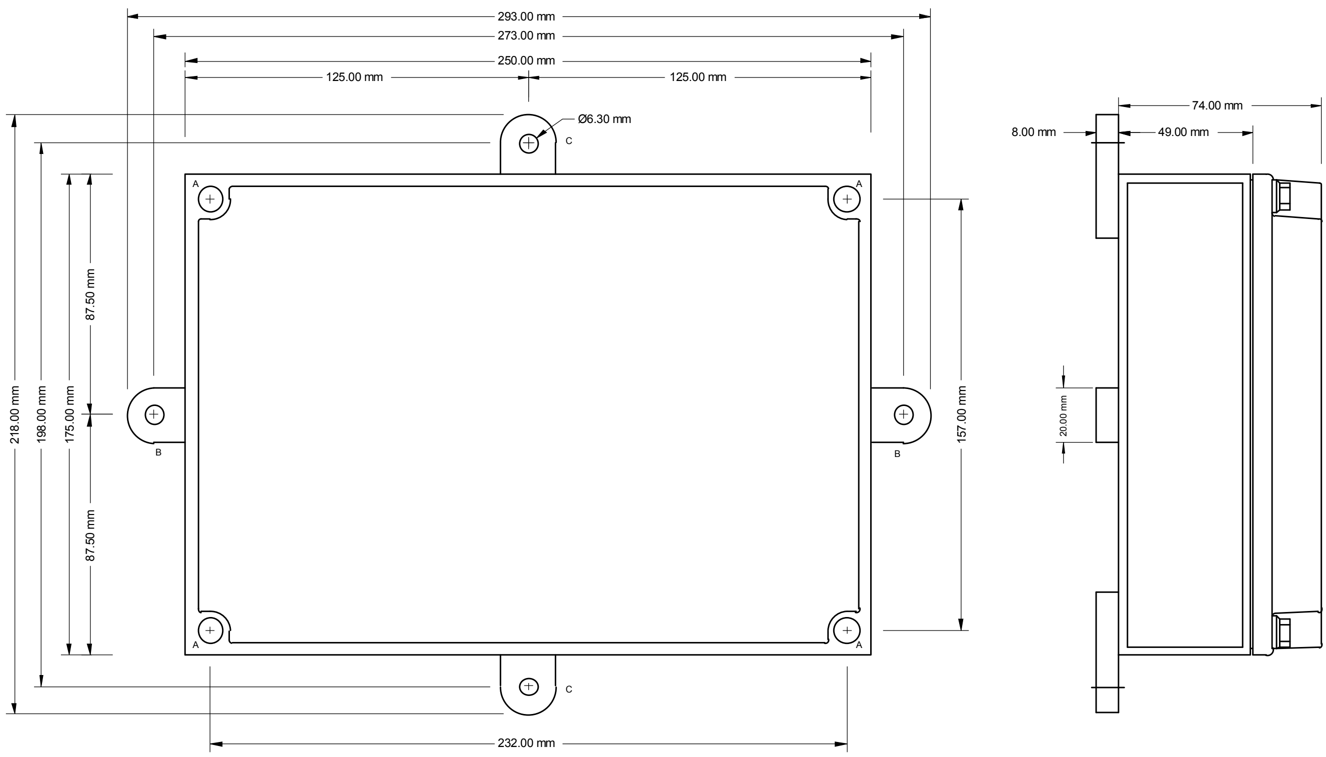


Figure 3

6.2. Equipment Suitability

6.2.1. Confirm that the system voltage shown on the Control PCB Assembly is as required.

6.2.2. Confirm that the unit is Common Positive (for Positive Earth systems) or Common Negative (for Negative Earth systems) as required.

6.2.3. Do not proceed unless 6.2.1 and 6.2.2 have been confirmed.

6.3. Electrical Connections

Ensure the Jumper Link LK2 on the MSR2-30 Control PCB Assembly is fitted in the DISABLE position.

Make the electrical connections in the following order:

6.3.1. Connect the terminal BATTERY +VE to the Battery positive.

6.3.2. Connect the terminal BATTERY -VE to the Battery negative.

6.3.3. Connect the terminal BATTERY SENSE +VE to the Battery positive.

6.3.4. Connect the terminal BATTERY SENSE -VE to the Battery negative.

6.3.5. Connect the terminal ARRAY 1 +VE to the Array 1 positive.

6.3.6. Connect the terminal ARRAY 1 -VE to the Array 1 negative.

6.3.7. Connect the terminal ARRAY 2 +VE to the Array 2 positive.

6.3.8. Connect the terminal ARRAY 2 -VE to the Array 2 negative.

6.3.9. Connect the terminal LOAD +VE to the Load positive.

6.3.10. Connect the terminal LOAD –VE to the Load negative.

6.3.11. Connect an MSRx Temperature Sensor as follows:

Red wire to terminal TEMP SENSOR +VE, Black wire to terminal TEMP SENSOR –VE.

6.3.12. High Volts Alarm relay contacts: connect to external telemetry system as required

6.3.13. Low Volts Alarm relay contacts: connect to external telemetry system as required

6.3.14. Load Cut Alarm relay contacts: connect to external telemetry system as required

6.3.15. Aux Alarm relay contacts: connect to external telemetry system as required

6.4. MSR2-30 Charge Controller Enable

To enable the MSR2-30 Charge Controller, ensure Jumper Link LK2 on the MSR2-30 Control PCB Assembly is fitted in the ENABLE position.

6.5. Battery Temperature

To ensure the Battery Temperature Compensation is as accurate as possible, follow the instructions below after the temperature of the batteries has stabilised:

6.5.1. Use the switches on the MSR2-30 Display PCB Assembly to navigate to the Battery Temperature screen (Menu 1).

6.5.2. Use a small flat screwdriver to adjust the potentiometer beside LED4 on the MSR2-30 Control PCB Assembly (just above the Temp Sensor connection terminals).

6.5.3. Adjust the potentiometer so that the temperature shown on the MSR2-30 Display PCB Assembly is the same as the actual temperature as measured at the battery.

7. Re-Configuring the MSR2-30 Charge Controller

The MSR2-30 Charge Controller is factory configured for System Voltage (12V, 24V or 48V) and System Polarity (Positive Earth (common positive) or Negative Earth (common negative)). If the factory configured controller voltage or polarity does not match the intended system voltage or polarity then the unit must be re-configured before installation.

7.1. System Voltage Configuration

The Controller Voltage can only be re-configured within the capability of the DC-DC converter.

Note: it may be necessary to obtain and replace the appropriate DC-DC converter inorder to allow the controller to work with the system voltage.

Links LP1, LP2 and LP3 must be fitted to the appropriate position marked on the PCB:

System Voltage	Link LP1 Marking	Link LP2 Marking	Link LP3 Marking
12V	12V	12V	12V
24V	24V	24V	24V
48V	48V	48V	48V

The following tables describe the system voltages that may be configured depending on the part number of the DC-DC converter (IC13) fitted.

IC13 – DC-DC Converter	System Voltage
TEN3-1222	12V – TEN3-1222 can only be used with a 12V system
TEN3-2422	24V – TEN3-2422 can only be used with a 24V system
TEN3-4822	48V – TEN3-4822 can only be used with a 48V system
REC3-2412 or REC5-2412	12-24V – can be used with a 12V or 24V system
REC3-4812 or REC5-4812	24-48V – can be used with a 24V or 48V system

7.2. System Polarity Configuration

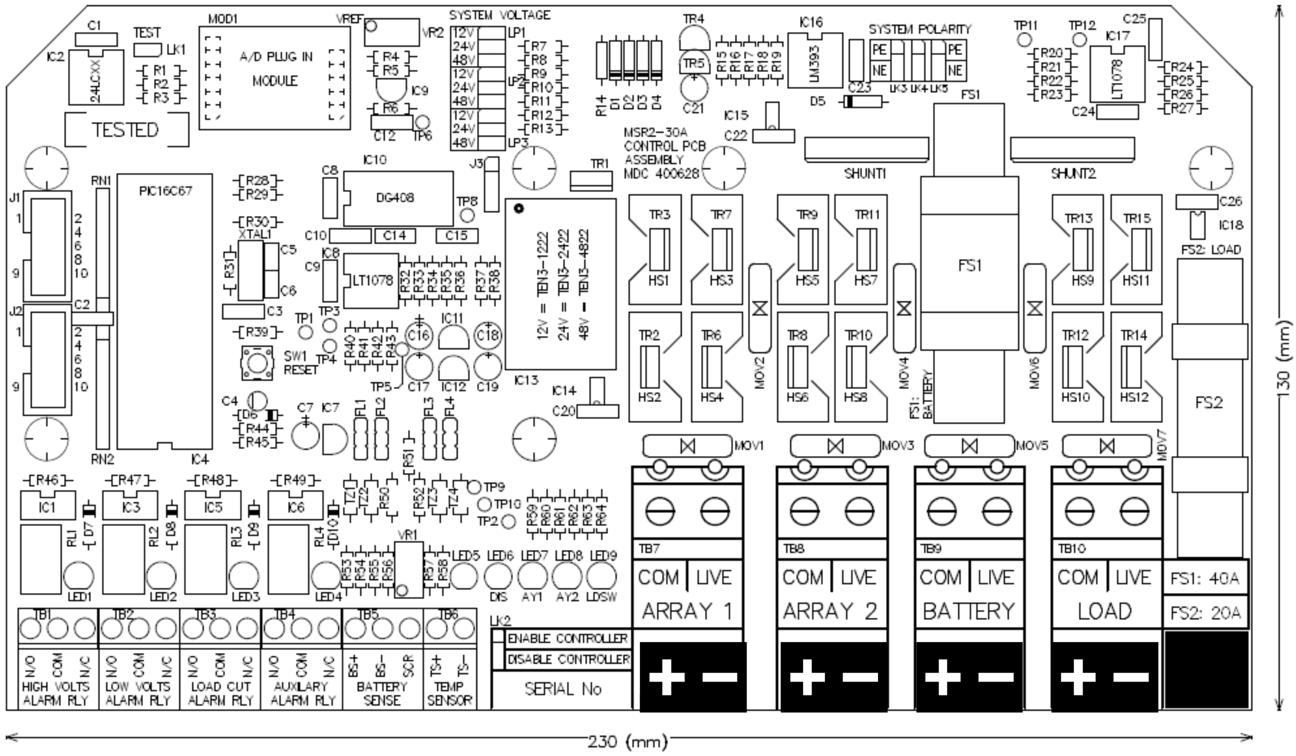
The Controller Polarity is set by the position of the jumper links on LK3, LK4 & LK5.

Note: If changing the Controller Polarity the connections to the Arrays, Battery and Load must be changed and the connection label must be changed.

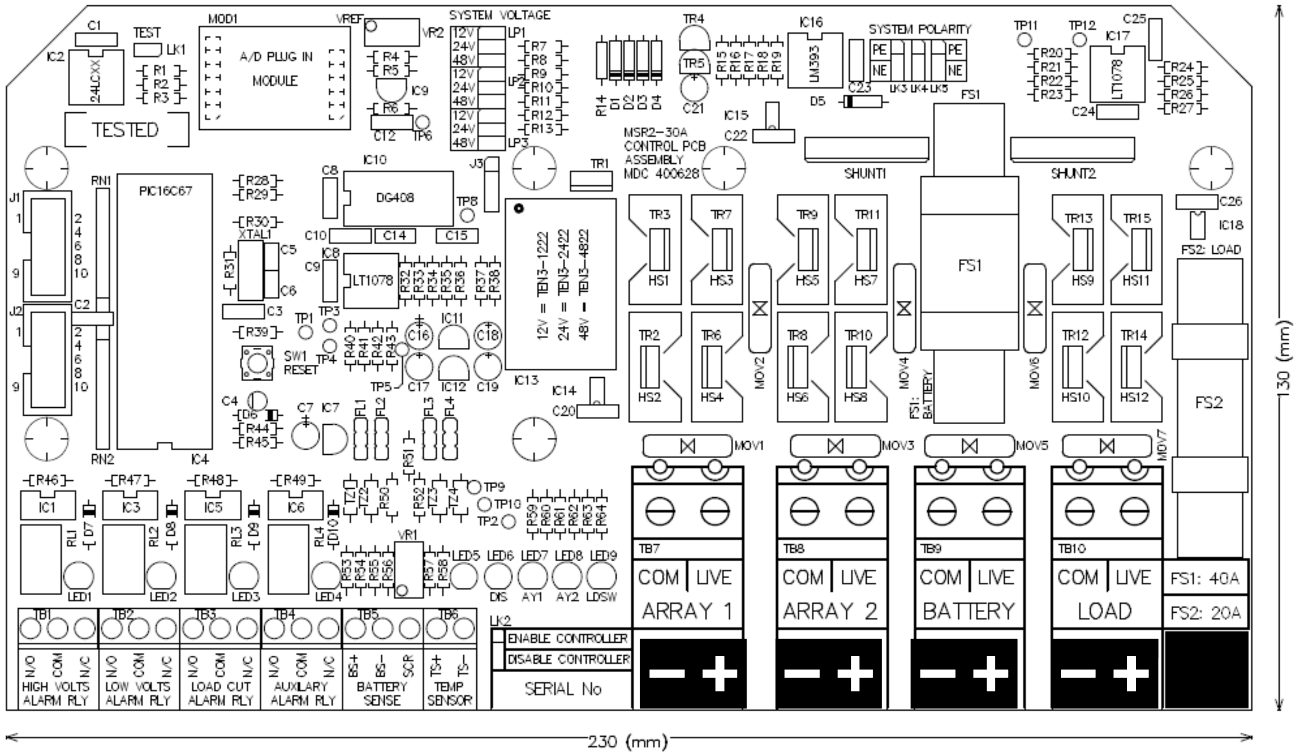
The jumper links and connections are described in the following table.

System Polarity	Link LK3 Marking	Link LK4 Marking	Link LK5 Marking	Array, Battery and Load Connections	
				COM Connections	LIVE Connections
Positive Earth (Common Positive)	PE	PE	PE	Positive	Negative
Negative Earth (Common Negative)	NE	NE	NE	Negative	Positive

7.3. MSR2-30 Control PCB Assembly Layout Diagram– Positive Earth / Common Positive Connection Label



7.4. MSR2-30 Control PCB Assembly Layout Diagram – Negative Earth / Common Negative Connection Label



8. Software

8.1. Software History

Software Version	Date Released	Comments
801 454 Ver 1.0	16th Nov 2007	Production Issue
801 454 Ver 1.1	5th Dec 2008	Added Array 1 & Array 2 Switches can operate together
801 454 Ver 1.2	17th July 2009	Added Programming of Auxiliary Alarm Relay to Menu 3 24Hr Alarm / Common Alarm / System Normal
801 454 Ver 1.3	2nd June 2011	Added Modbus ASCII Protocol to RS232 Communications Added RS232 Communications selection screens in Menu 3
801 454 Ver 1.4	17th Dec 2013	The Display does not power down after a few minutes – it is always active

8.2. Installation / Replacement of the MCU

Ensure that anti-static precautions are taken to avoid damage to the Micro-controller when handling (i.e. touch a conductor that is connected to earth before carrying out the following):

Turn off all power to the Controller.

Remove the Control PCB Fascia Cover. Identify the Microcontroller – IC4 (40 pin integrated circuit) on the PCB Assembly. Carefully lever out the Microcontroller presently located there by using a small flat screwdriver on both ends equally. Do this carefully.

Identify the device to be installed. Carefully handle the device without touching the legs of the device. NOTE the orientation of the semi-circular notch out of one end of the device. NOTE which end of IC4 has a notch in the PCB socket. Now insert the Microcontroller into the IC4 socket so that the notch in the device is at the same end as the notch in the socket. Before pressing down on the device to mate it fully in its socket, check that all pins are properly lined up with the pins in the PCB socket. Press the device fully into the socket and check that no leg has been bent or missed its socket.

Replace the Control PCB Fascia Cover.

Restore power to the Controller.

