MICRO CARE®

SOLAR COMPONENTS

LCD MPPT

User Documentation

Contents

1. INTRODUCTION

1.1. General Description

The Microcare Maximum Power Point Tracker Charge Controller is designed to provide maximum power from the panels into the batteries. Using this system up to 30% more power can be extracted from the panels than using shunt or series pass PWM controllers. The Microcare MPPT is able to charge batteries of a lower voltage than the panel system. A Liquid Crystal Display shows the status of the system and the data logging information. The unit has various programmable charge regimes which automatically adjust the charge levels when first starting up or if the battery falls below the minimum voltage. The MPPT will read the battery voltage when first starting up and select whether it is a 12v, 24v, 36v, or 48 volt battery system. It will then read the panel voltage and find the optimum power point. The charging, battery values and charge modes are then adjusted. This series features a durable and continuous 24 hour operation. The compact and modular design makes installations easy and cost effective. It is a high quality product that offers the best price/performance ratio in the industry.

1.2. Key Features

1. 4 X 20 LCD Display.
2. Optional Input and Output circuit breaker protection.
3. RS232 and Ethernet connectivity.
4. Fully programmable.
5. 63 Days logger.
6. High efficiency design with greater than 96% conversion.
7. Low heat dissipation.
8. Variable Fan cooling.
9. Suitable for any battery set between 12 and 48 Volt with 12V increments.
10. Electronically limited charge current 20, 40, 60, 100 Amps. (Dependent on the MPPT type)
11. Maximum open circuit PV Array voltage 150 VOC (Open Circuit Voltage).
12. Manual or Auto Equalise selection.
13. Wall mounted.

1.3. Important Notices

Read the instructions carefully before operating the MPPT.

The unit must only be installed in a clean dry environment.

The unit should only be opened by skilled personnel.

1.4. Recommended Array Sizes:

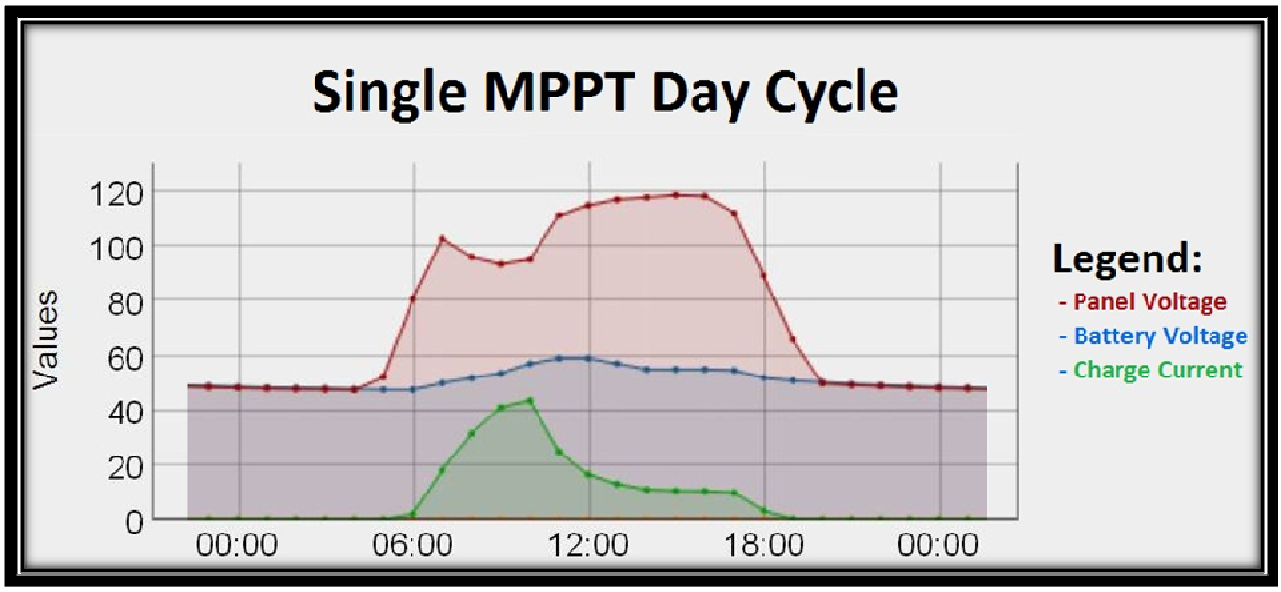
The following should be used as a guide to the maximum array size that can be connected to the MPPT. The current limits to the specified level of the MPPT model so any array larger than these will simply waste power:

Recommended Photovoltaic Array Sizes in Watts				
Battery Set	**20 Amp MPPT**	**40 Amp MPPT**	**60 Amp MPPT**	**100 Amp MPPT**
12V	**250W**	**500W**	**750W**	**1300W**
24V	**500W**	**1000W**	**1500W**	**2500W**
36V	**750W**	**1500W**	**2200W**	**3600W**
48V	**1000W**	**2000W**	**3000W**	**5000W**

1.5. LCD MPPT Description:

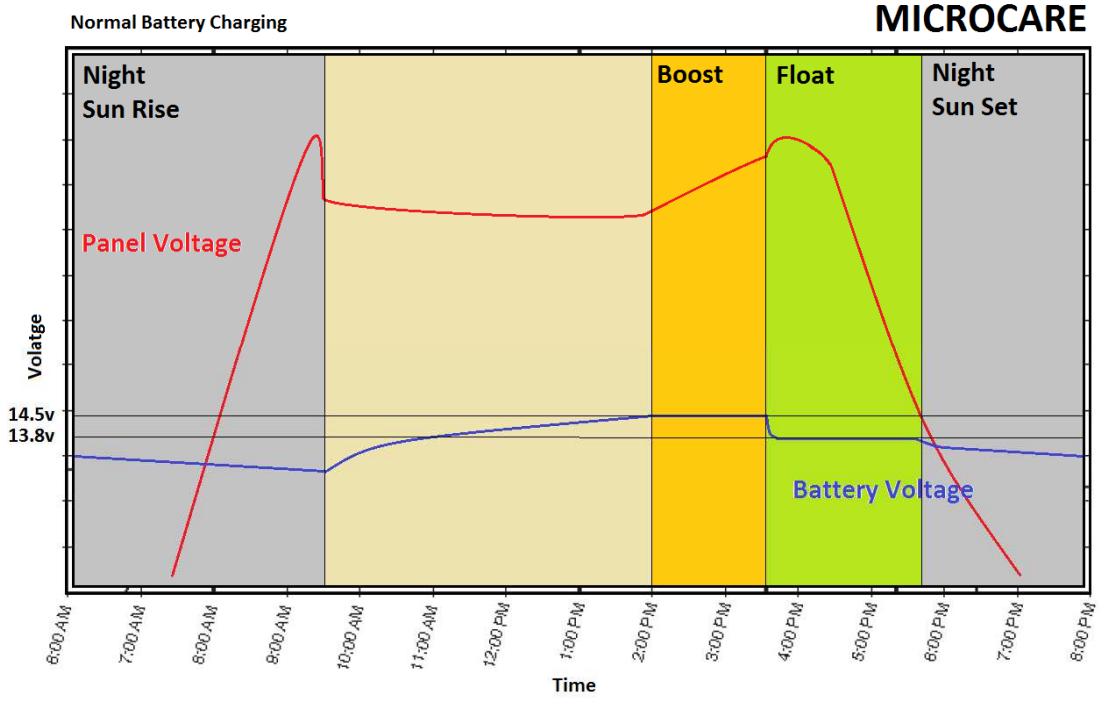
1. LCD Display**:** This indicates the MPPT's operation including Panel voltage, charge condition, charge amps, battery voltage and output power.
2. The **<DATA>**and**<CHARGE>** buttons are used to access the different menus and displays.
3. The Green LED indicates panel power.
4. The Green LED indicates charging.
5. The Green LED indicates battery in float condition.
6. The RJ12 connections at the top of the unit are for programming and RS232 signals.
7. Circuit Breakers (Isolators Installed on 100A MPPT Unit's).

1.6. MPPT Operation Description:



This simple real world illustration (above) shows how an MPPT functions during the course of a day as well as a simple schematic (below). In the morning, as soon as the MPPT detects that the Panel Voltage is at a useable level (MPPT charge entry voltage); it starts to charge the batteries at maximum efficiency in a BOOST mode which has a nominal voltage of 14.5V per 12V battery bank. If however the batteries are detected to not be uniformly discharged, the MPPT will go into EQUALISE mode to restore battery bank balance before switching to BOOST mode as its primary charge mode. The MPPT maintains this mode until the batteries reach the boost voltage and the charge current decreases to a level below a nominal changeable level of 6Amps.

The MPPT then steps down the charge voltage to a nominal voltage of 13.8V per 12V battery bank in FLOAT mode. The MPPT will attempt to maintain FLOAT mode for as long as the panel voltage is present. If no panel voltage is present, the MPPT goes into a sleep state until it detects a rise in panel voltage indicating a new day for charging.



2. MPPT SPECIFICATIONS

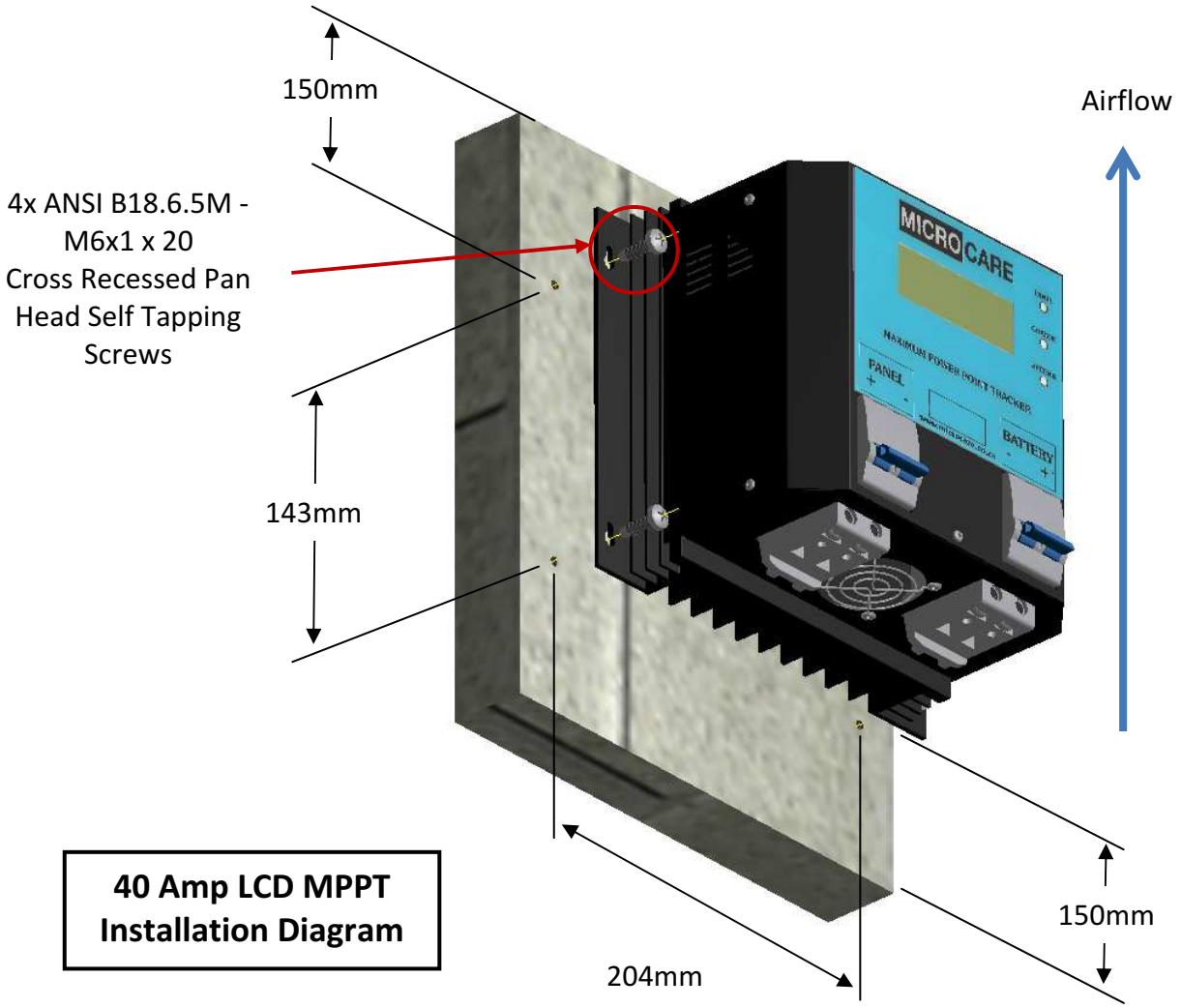
Nominal Battery Voltage	**Multi-Voltage (Automatic/Manual selection of voltage - 12/24/36/48V battery set)**
PV Input Voltage	**Open Circuit Absolute Maximum 150VDC**
Charge Algorithm	**5-stage, 3-level Equalize/Boost/Float**
Equalize Voltage	**Charges12V to 15V per 12V DC battery pack for 1hour**
Boost Voltage	**Charges to 14.5V and switches when charge current is < 10Amps for 1hour**
Float Voltage	**13.8v per battery**
Power Conversion	**DC/DC Switch Mode**
Output Efficiency	**Peak greater than 96% conversion efficiency**
Voltage Step down Capability	**Can charge a lower voltage battery from a higher voltage PV array.**
Status display	**4 Line LCD Screen with Backlight** • **Battery Voltage** • **Charge mode-charge current (Equalize/Boost/Float) and Charge current** • **Panel Voltage** • **Output Power** • **State of charge of battery**
Data Logger	• **24hr Average** • **63 day history**
Power Consumption	**Less than 1 Watt**
Environmental Rating	**0 – 40˚C**
Protection System	• **Lightning Protection** • **Reverse polarity Panel/Battery**
Warranty	**36 months**

Recommended Circuit Breaker sizes:		
MPPT Type	**Input Amp**	**Output Amp**
20 Amp	**20A**	**25A**
40 Amp	**40A**	**50A**
60 Amp	**63A**	**63A**
100 Amp	**100A**	**125A**

3. MPPT SYSTEM INSTALLATION

3.1. MPPT Installation Instructions:

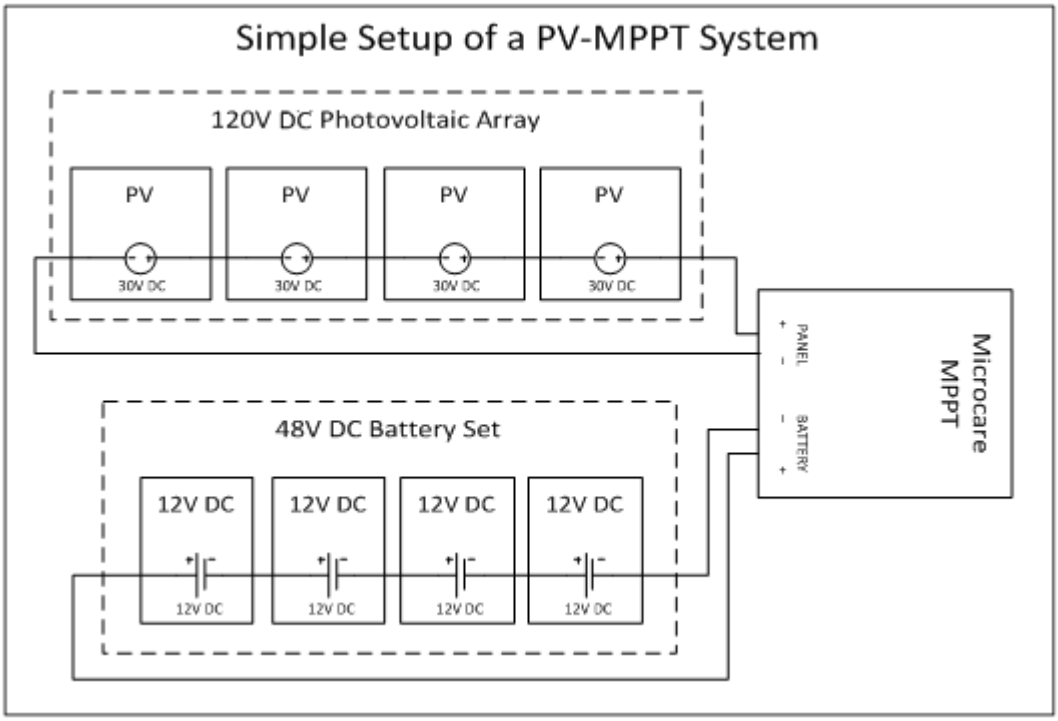
- Do not place the MPPT on a rugged or inclined surface.
- The MPPT must be mounted in a vertical position against a solid wall.
- Do not install the MPPT near water or in damp environments.
- Do not install the MPPT where it would be exposed to direct sunlight or near heat.
- Do not install the MPPT on a wooden surface. Only install the MPPT on flat concrete, stone or metal surfaces.
- Do not block off the aluminium heat sink and don't leave objects on top of the MPPT.
- Do not expose the MPPT to corrosive battery gases.
- MPPT operating environment temperature should not exceed: 0˚C - 40˚C.
- **Ensure that connecting cables are of adequate thickness. Consult the reference table for recommended thicknesses in Cable Connections. Refer to the cable design sheet for correct PV cable thickness.**



40 Amp LCD MPPT Installation Diagram

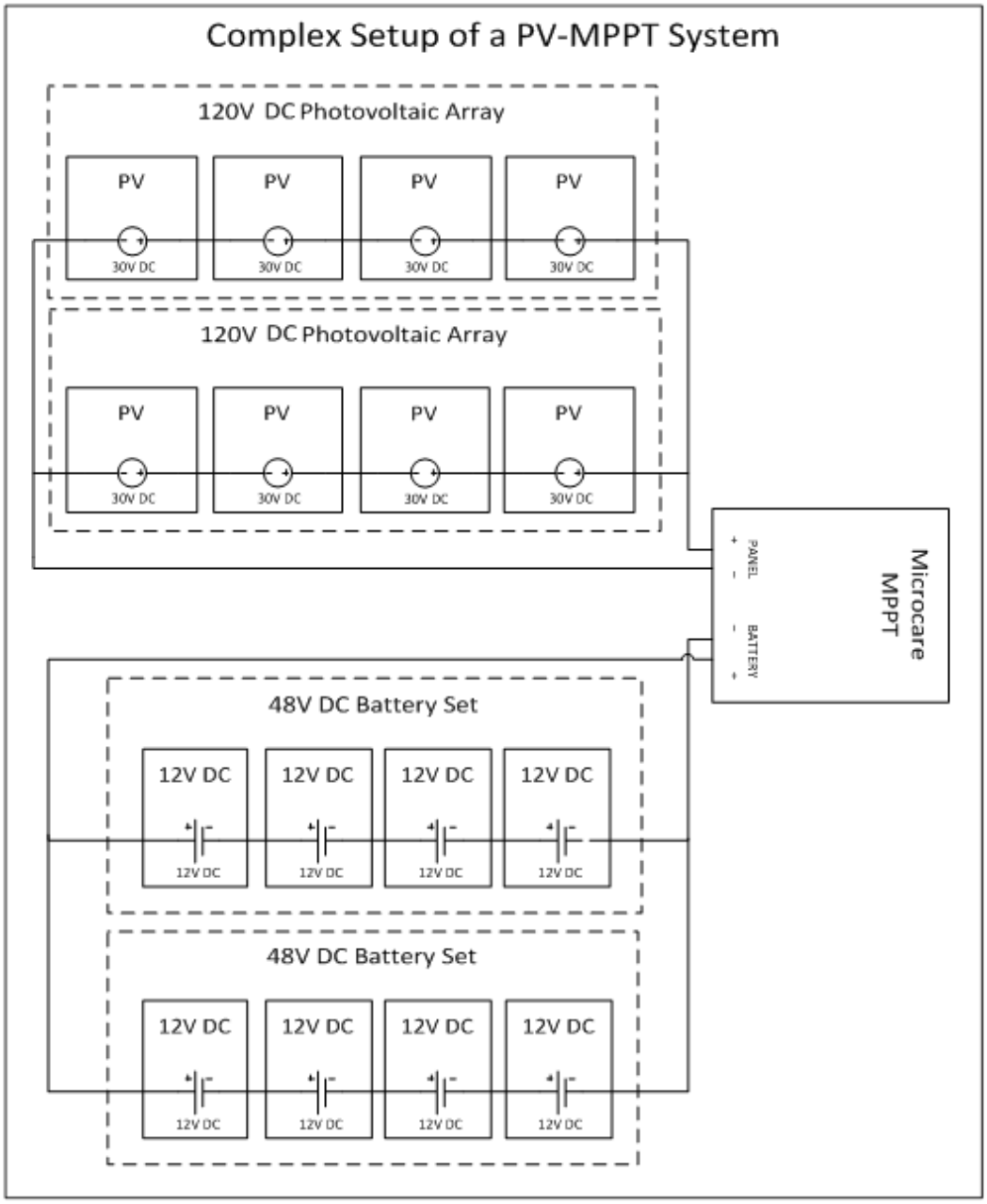
MPPT Mounting Hole Dimensions		
	Height	**Width**
20 Amp LCD MPPT	**143mm**	**204mm**
40 Amp LCD MPPT	**143mm**	**204mm**
60 Amp LCD MPPT	**227mm**	**204mm**
100 Amp LCD MPPT	**278mm**	**204mm**

3.2. MPPT Setup Diagrams



A simple PV system setup is illustrated with 48V DC Battery Set.

This setup may be extended to suit the needs of the user. 150V is the maximum voltage the MPPT may accept, therefore, PV arrays may not have a voltage greater than 150V else the MPPT will be damaged. Battery Sets may not exceed a voltage of 48V. Ensure that the current strength leading into the MPPT from the PV Array does not exceed that of the maximum allowed by the specific MPPT model that is installed.



A complex PV-MPPT setup can have arrayed PV and Battery Sets all connected in parallel. The voltage of the PV array may not exceed 150V and depending on the MPPT model, a specified current strength. The Battery Set array is however unlimited in size although an increase in Batter Set array length will increase the amount of time needed to fully charge the batteries.

This complex setup diagram of a PV-MPPT System illustrates two 120V DC PV Arrays connected in parallel and two 48V DC Battery Sets connected in parallel.

Try not to exceed a voltage ratio of 1:4. (Battery Bank Voltage – PV Panel Voltage)

Battery Bank Size	PV Panel Voltage (Voc)
12V	48V
24V	96V
36V	135V
48V	135V
Please remember that the Standard MPPT will only support 150Voc per PV Panel String.	

4. SAFETY INSTRUCTION

1. Route cable so that no one can step on them.
2. Batteries may cause electric shock and have a high short-circuit current. Please take the precautionary measures specified below and any other measures necessary when working with batteries.
   - Remove wristwatches, rings and other metal objects.
   - Use only tools with insulated grips and handles.

5. CABLE CONNECTIONS

The PV (Photo Voltaic) panels should always be connected in the highest voltage configuration. The advantage of this is that panel current will always be at its minimum so that thinner connecting wires may be used which reduces voltage drops with loading and improves cost efficiency.

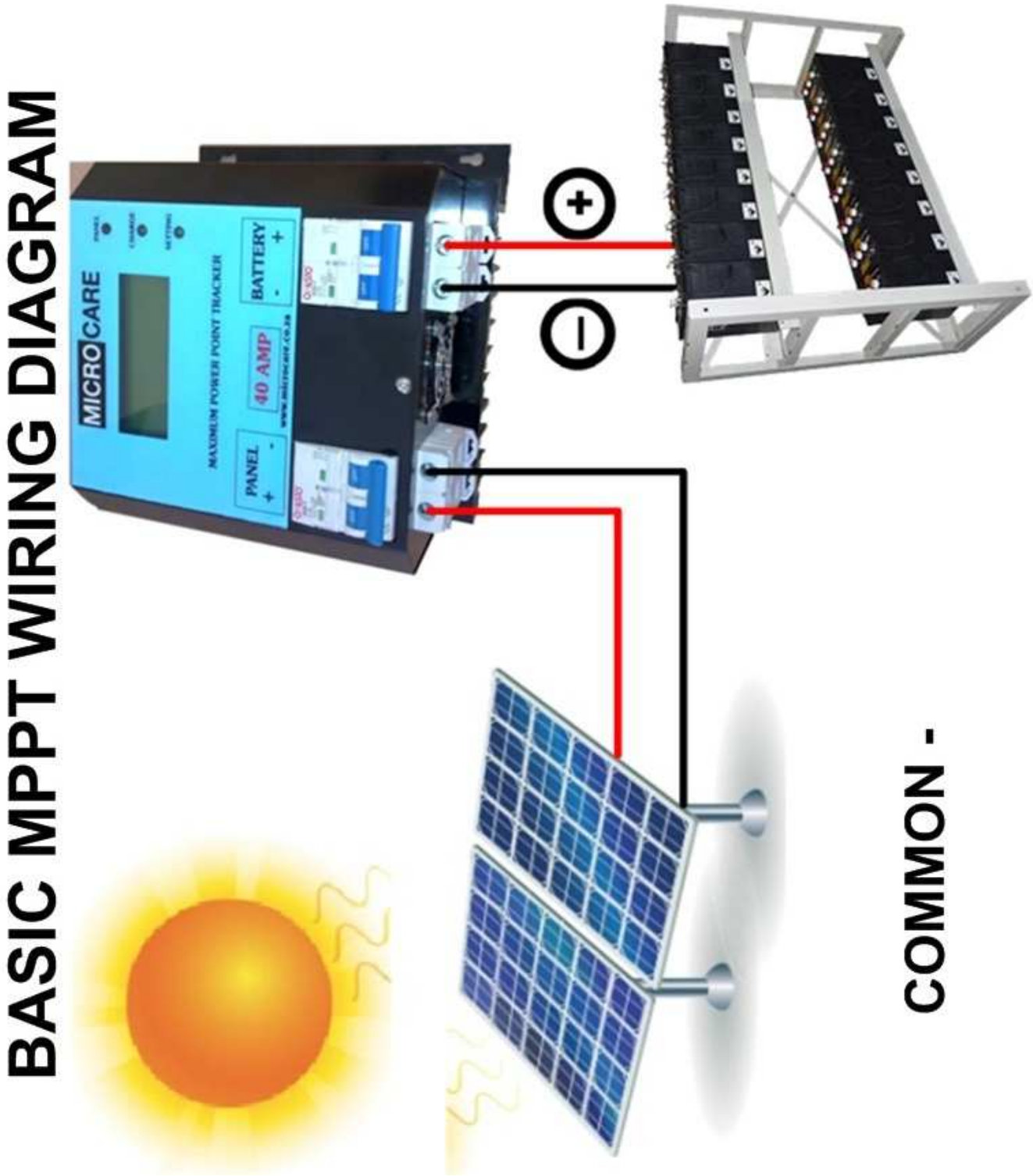
The cable length from the batteries to the MPPT should not exceed 3m. The cable lengths connecting the PV panels to the MPPT should not exceed 30m.

As an example, if there are two 40 volt panels rated at 5 amps each and they are connected in parallel, then the output voltage would be 40 volts at 10 amps. If they were connected in series the output would be 80 volts at 5 amps. In both cases the power would be the same but in the parallel configuration a thicker power cable must be used to reduce the volt drop from the array to the MPPT as well as from the MPPT to the batteries.

Cable thicknesses listed are recommended thicknesses that have voltage drops accounted for up to a distance of 3m for connecting the MPPT and the batteries together and the bottom table lists recommender cable thicknesses for cables connecting the MPPT to the panels up to a distance of 30m.

Recommended Connecting Cables up to 3m from MPPT to batteries (Single Stranded Copper Specifications)		
MPPT Type	**Cable Core Area**	**Overall Cable Diameter**
20 Amp	**6mm²-10mm²**	**5.4mm-6.3mm**
40 Amp	**10mm²-16mm²**	**6.3mm-7.5mm**
60 Amp	**20mm²-30mm²**	**8mm-9.5mm**
100 Amp	**40mm²-55mm²**	**10mm-13mm**
Recommended Connecting Cables up to 30m from MPPT to PV panels (Single Stranded Copper Specifications)		
MPPT Type	**Cable Core Area**	**Cable Core Diameter**
20 Amp	**3mm²-4mm²**	**1.8mm-2.2mm**
40 Amp	**6.8mm²-9mm²**	**2.8mm-3.2mm**
60 Amp	**16mm²-21mm²**	**4.4mm-5mm**
100 Amp	**25mm²-32mm²**	**6mm-6.8mm**

6. BASIC MPPT WIRING DIAGRAM



7. MPPT LCD OPERATION

7.1 Check Prior to Start Up

1. Ensure the MPPT is mounted vertically.
2. Check input output cables are secured.
3. Check the polarity of the panel and battery and they are correct.
4. Check if the Panel Voltage meets the MPPT rating required.

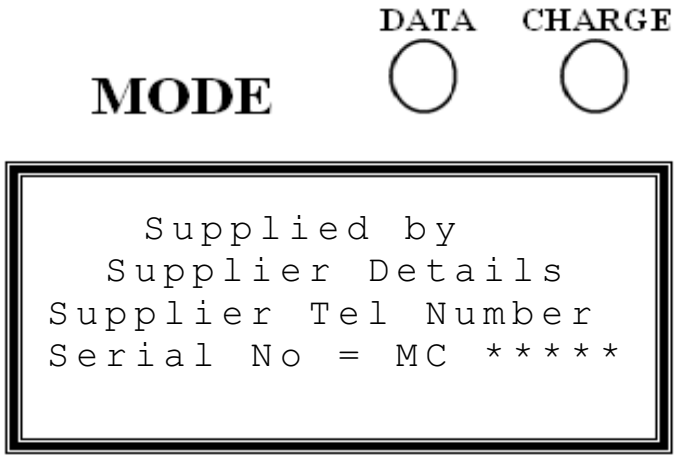
7.2 MPPT Start-up Procedure

1. Always turn on battery breaker first.
2. Wait until MPPT Display states that the MPPT is sleeping.
3. Turn on Panel Breaker.
4. MPPT will track the PV Panels.
5. MPPT will start charging the batteries.

7.3 Basic LCD Operation Procedure

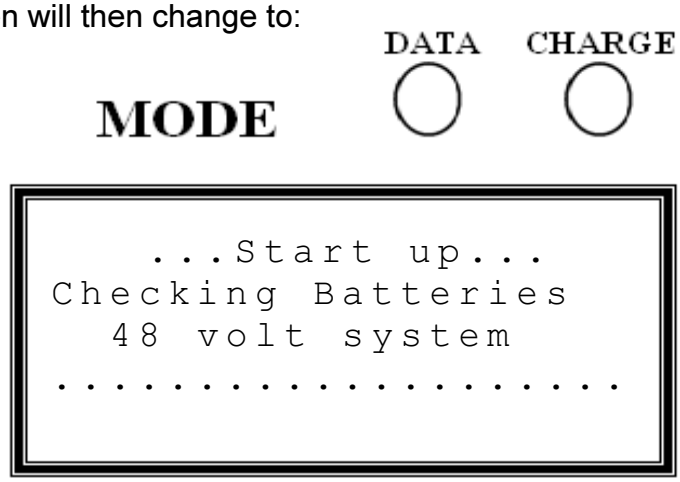
Please follow the instructions below for basic MPPT operation.

1. Turn ON the battery circuit breaker. The following screen should appear:



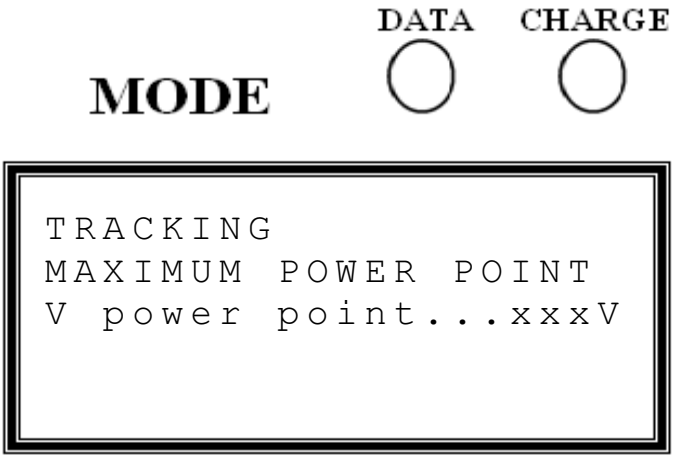
This shows the name of the supplier, contact number and serial number.

The screen will then change to:



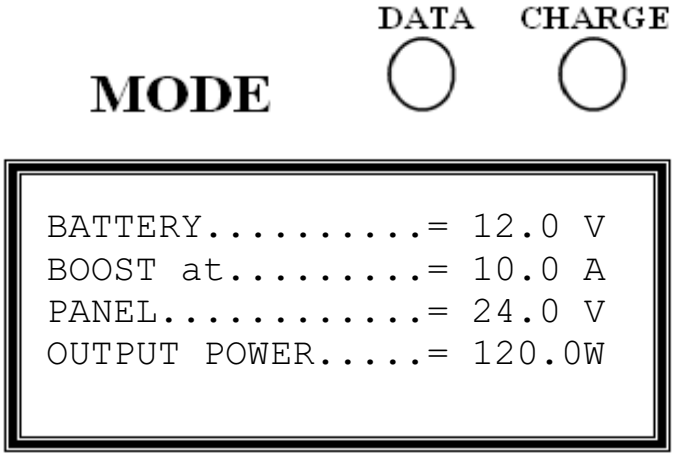
This shows the unit automatically measuring the batteries and displaying the result. Should the battery voltage shown be incorrect it is possible to force the MPPT to accept a new battery value.

Turn ON the Panel Circuit Breaker. The following screen should appear:

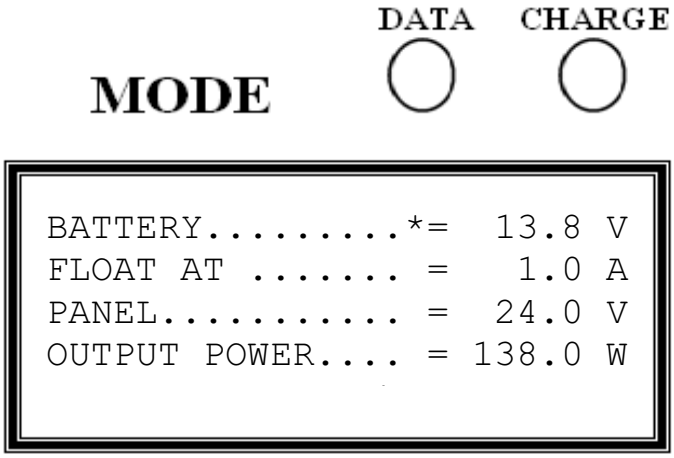


This shows the MPPT measuring the open circuit panel voltage and calculating the initial power point voltage.

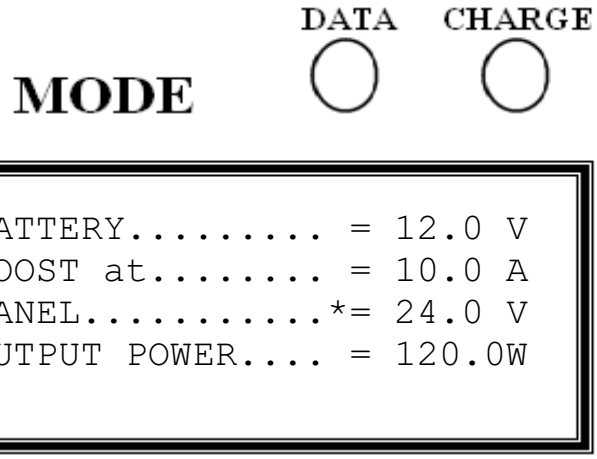
The screen then changes to:



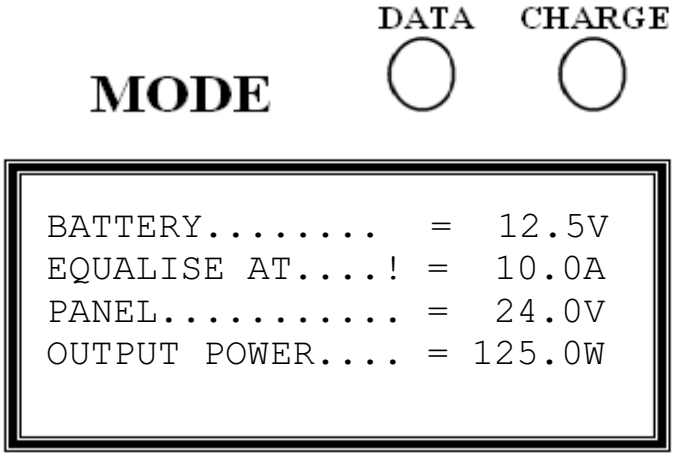
This is the screen that will normally be displayed showing the system operating correctly. There are other details that will appear on the screen that will assist the user to read at what point the MPPT and batteries are:



The * flashing next to the batteries indicates that the **MPPT is in FLOAT mode** and the batteries are full.

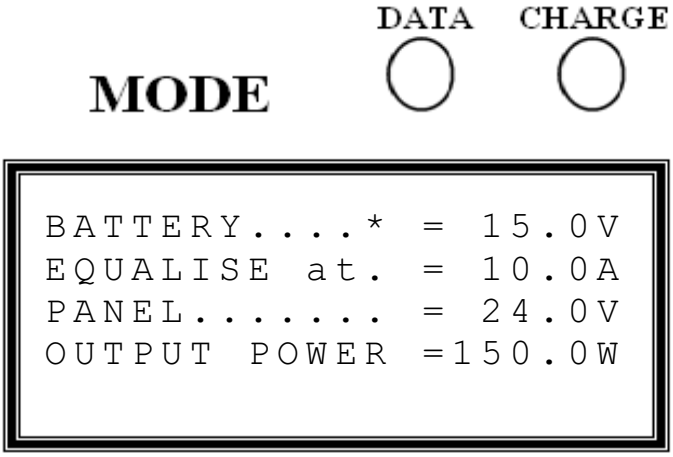


The * flashing next to the PANEL indicates that the PV panels are limiting the amount of energy delivered to the MPPT to charge the batteries.

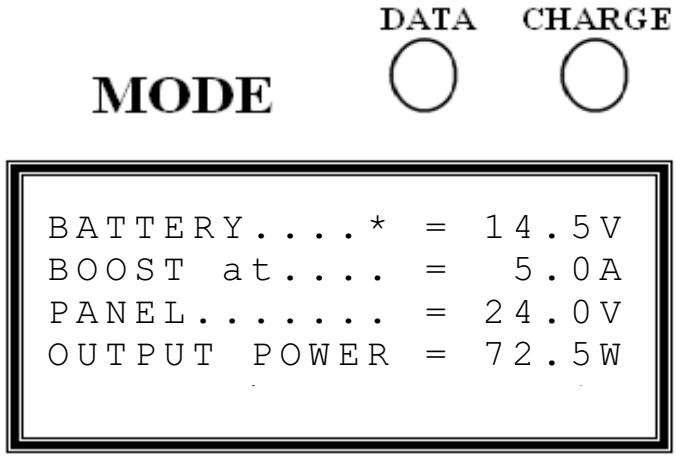


The **'!'** sign next to the **EQUALISE AT** line indicates that the batteries are being charged in the Equalise mode and the batteries have not reached the equalise voltage, for every 12volt in the battery pack, system this would be 15 volts.

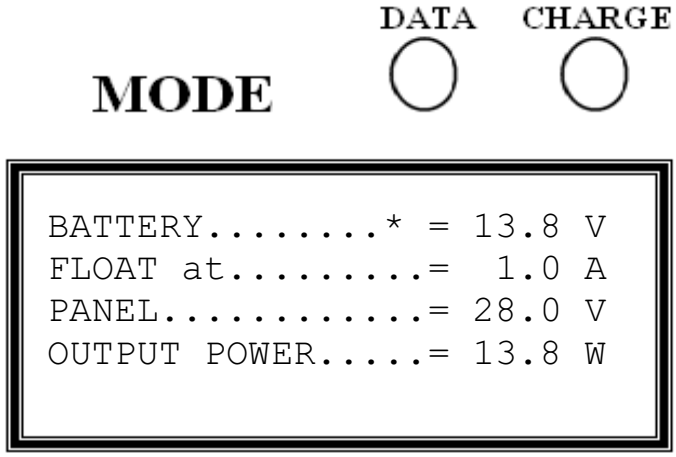
Once the batteries have reached the EQUALISE VOLTAGE then the display will change to:



This shows that the battery is at the **EQUALISE Voltage**, and that the MPPT is in the 1 hour bulk charge mode. When this is complete the charger switches to the **BOOST** mode and will hold the voltage at the programmable value say 14.5 volts until the charge current has fallen below the programmable BOOST amps, say 5.0 amps.



When the charge current falls below the programmed value of say 5.0 amps, the screen will then change to:

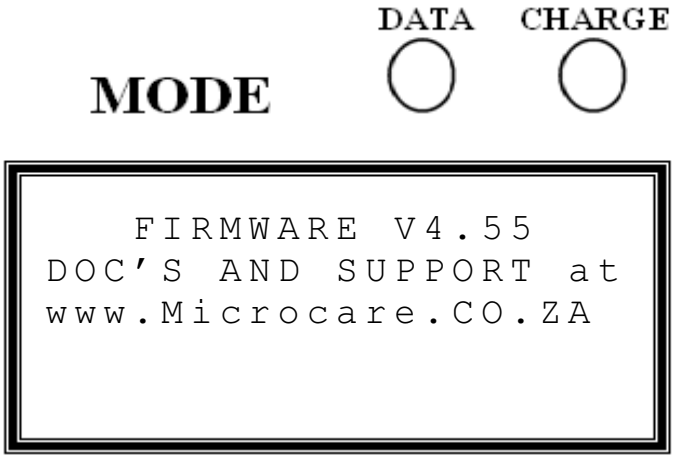


This shows that the **battery is in FLOAT mode** and is indicated by the flashing **'*'**at the end of the BATTERY line.

7.4 Checking MPPT Firmware

To determine the MPPT's firmware, make sure the LCD display is at the main screen:

Now hold in the **<CHARGE>** button for 3 seconds and the following screen will appear for 2 seconds and then automatically revert to the main screen:



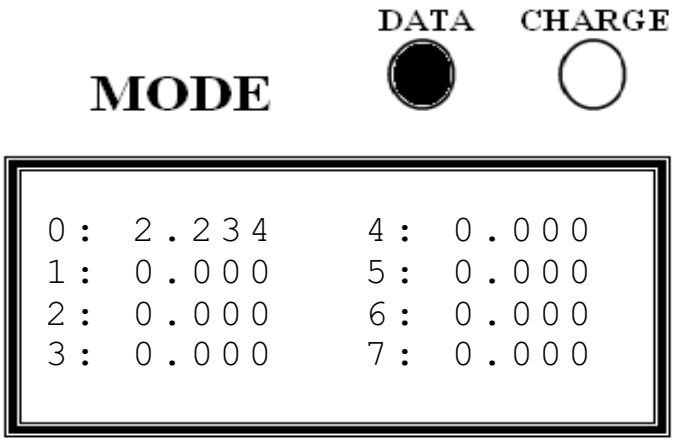
Check the Microcare website for the latest firmware available for your specific MPPT. To request a firmware upgrade for the MPPT, visit Microcare at **www.microcare.co.za** and contact them via the online email.

7.5 Turning the MPPT Off.

1. Turn off the panel breaker first. **(Never Turn Off The Battery Breaker First.)**
2. Wait until MPPT Display states that the MPPT is sleeping.
3. Turn off the battery breaker.
4. This will allow the MPPT to discharge any remaining power in the coil into the batteries and will eliminate the possibility of damage to the MPPT.

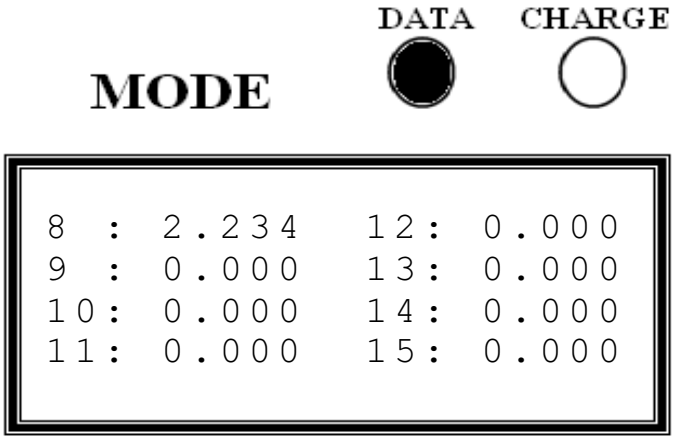
8. DATA LOGGING OPERATION

By pushing the **DATA** button the following screen will appear:



This shows the energy accumulated since the charger started. The 24Hr is the daily average for the no of days shown. Should you wish to CLEAR the DATA then hold the **<CHARGE>** button in for 6 seconds and the values will reset to **0.**

To view the next 8 days of DATA LOGGING push the **<DATA>** button and the screen will change to:



Day 0 shows the power accumulated for the current day. Up to 31 days of data is stored and may be viewed by pushing the **<DATA>** button. To clear the screen, hold in the **<CHARGE>** button in for 10 seconds or until the data has been cleared.

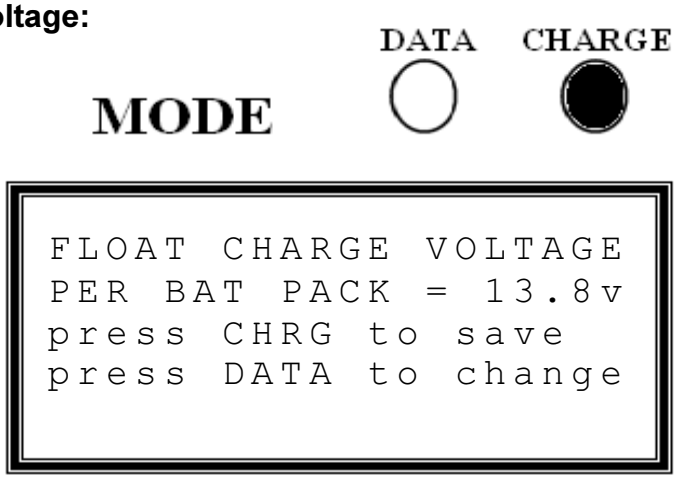
To return to the main screen, the **<DATA>** button must be pressed until the end of the Data Log Menu has been reached. Alternatively, the MPPT will automatically revert to the normal charge display after 1minute.

If a **Battery Temperature and Battery Voltage Sensor** is connected to the MPPT, the **<DATA>**button needs to be repeatedly pressed to return to the main screen.

9. PROGRAMMABLE OPERATION

To enter the programming mode the panel circuit breaker must be turned OFF and the MPPT must be in the SLEEP MODE.
Hold in the <**CHARGE>** button for 6 seconds and the following screen will appear:

9.1 Float Voltage:



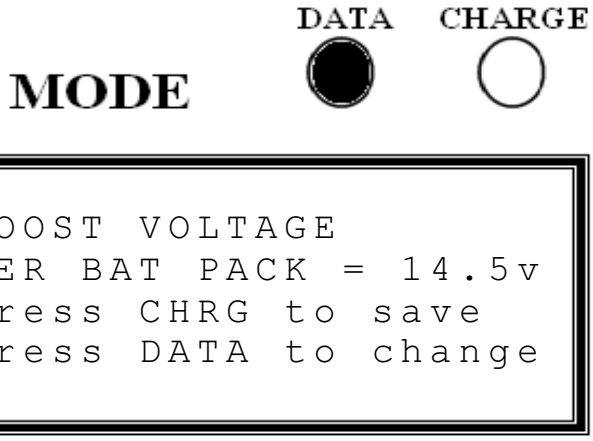
To change the battery pack FLOAT VOLTAGE push the **<DATA>** button and the voltage can be changed from 13.2 to 14.5 volts with 0.1 volt increments.

Default Value is 13.8V.

Press **<CHARGE>** button to save the changed voltage.

The screen will now change to:

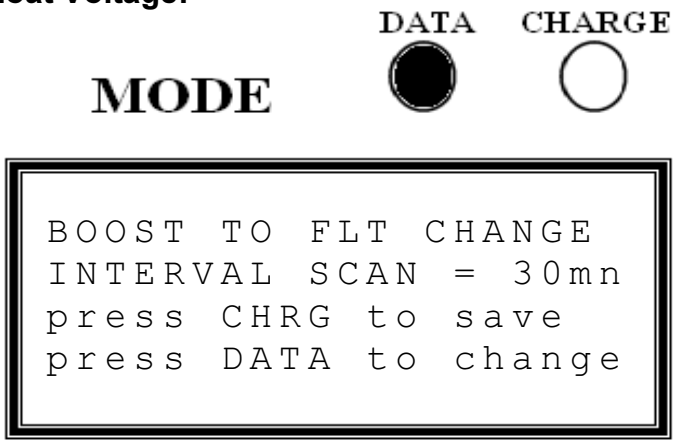
9.2 Boost Voltage:



The Boost voltage can be changed between 13.5 and 16.0 volts with 0.1 volt increments. Press **<CHARGE>** to save. The screen will now change to:

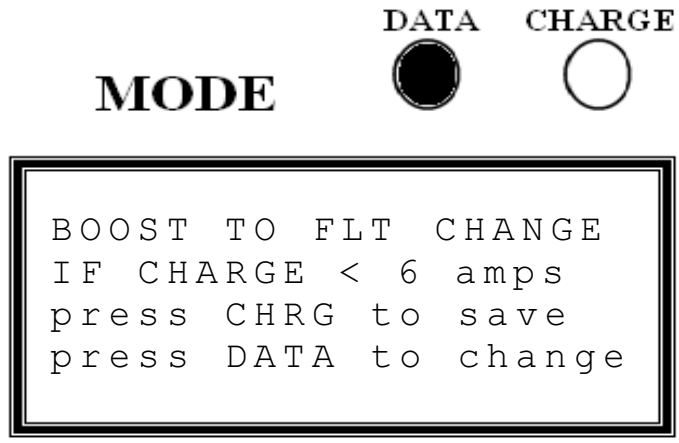
Default Value is 14.5V.

9.3 Boost to Float Voltage:



This screen changes the time that the BOOST mode takes to switch to FLOAT mode once the batteries have reached the BOOST voltage level. The time can be 30minutes – 1 hour – 2 hours. Press **<CHARGE>** to save. The screen will then change to:

Default Value is 1 Hr.



This changes the charge current at which the BOOST mode after timing out changes to FLOAT. This can be 3 – 6 – 15 - 30 amps or Disabled. Press **<CHARGE>** to save. The screen will then change to:

Default Value is < 6 Amps.

9.4 Equalise Voltage:


```
EQUALISE CHARGE MODE
AUTO          ENABLED
press CHRG to save
press DATA to change
```

In this mode the Regulator will automatically go into EQUALISE mode if the battery pack voltage falls below 10.8 volts. This enables or disables the EQUALISE Charge mode. The screen will now change to:

Default Value is AUTO.

9.5 Battery Set Voltage:


```
BATTERY  PACK SELECT
12 - 48  AUTO SELECT
press CHRG to save
press DATA to change
```

This allows the user to leave the battery system selection to the MPPT or the selection can be PRESET. Pushing the <**CHARGE**> button will change the battery selection from AUTO to 6 cells 12 volts through to 24 cell 48 volt battery pack. The screen will now change to:

Default Value is 12 – 48 AUTO SELECT.

9.6 Charge Limit:


```
Charge LIMIT IS    @
=   95%
press CHRG to save
press DATA to change
```

This allows the user to limit the MPPT current. 100 % will be 20 amps or if the limit must be 18 amps then set the % to 90 % for a 20Amp MPPT as an example. This can be extended to any LCD MPPT type accordingly.

Default Value is 95%.

9.7 External Output Connections:


```
EXTERNAL OUTPUT IS A
UNUSED OUTPUT     N/C
press CHARGE to save
press DATA to change
```

Please refer to **Section 10** on **External Output Connections**.

9.8 Set Operation Mode:


```
SET OPERATION MODE
F MODE0
press CHRG to save
press DATA to change
```

MODE 0 is the Low Frequency Setting – 34MHz.
MODE 1 is the High Frequency Setting – 77MHz.
MODE 2 – 5 Is Currently Not Used.

Default Value is MODE 0.

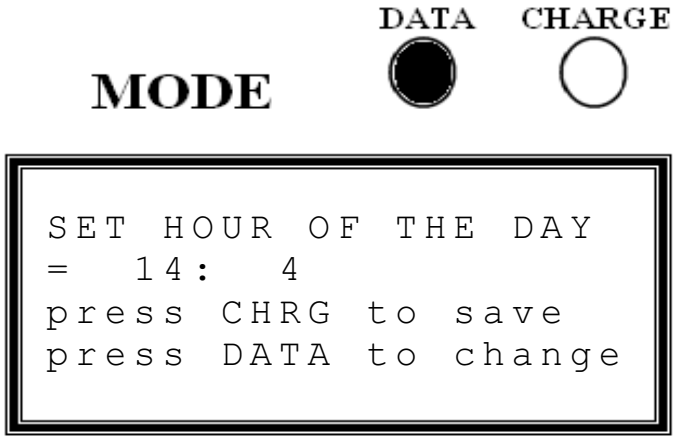
9.9 Solar or Wind Settings:


```
SOLAR OR WIND MPPT ?
MODE = SOLAR
press CHRG to save
press DATA to change
```

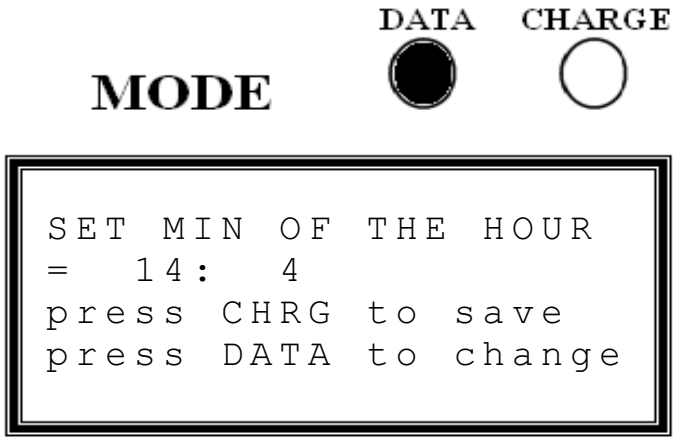
This Setting allows the MPPT to be changed between a solar MPPT and a Wind Turbine MPPT. Please confirm that these settings are not adjusted as a standard.
Confirm with support before adjusting these settings.

Default Value is SOLAR.

9.10 Change Time Settings:



This allows the user to change the time settings of the MPPT. The Hour of the day is changed in this screen through a 24hour time format with 1 hour increments. By pressing the **<DATA>** button, the display wills then change to change the minute's settings of the MPPT:

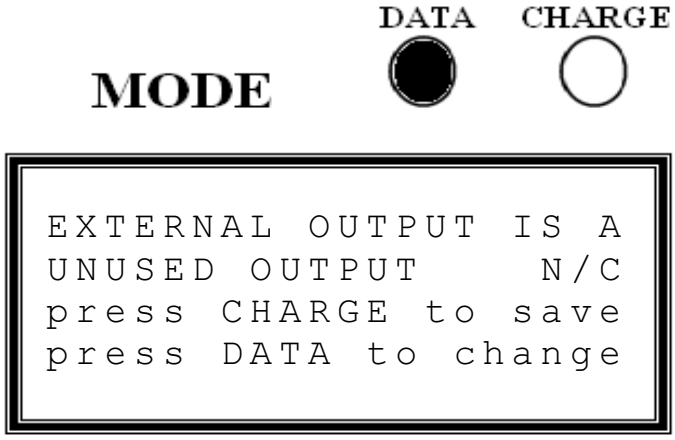


In this screen, the clock's minutes are adjusted in a similar fashion to that of the hour settings. Pressing the <DATA> button again will exit the settings menu and the MPPT will then reset itself with all adjusted settings loaded and normal MPPT operation will continue as soon as the PANEL breaker is reset.

Note: Time settings do not affect any MPPT operations and are purely for user convenience. Time settings are lost when the batteries are disconnected from the MPPT.

10. EXTERNAL CONNECTIONS

This allows the user to program the external output to operate the RELAY INTERFACE. This is plugged into the RJ12 port.



Pushing the **<CHARGE>** button will change the external output from being an UNUSED output to a:

- SOLAR ASSIST SIGNAL
- DAY NIGHT SIGNAL
- LOAD SHED SIGNAL (also known as a Low Battery Disconnect)
- SOLAR ASSIST SIGNAL V2
- SOLAR AST UPS CNTR1
- WIND TURBINE BRAKE

Note: The external output is **only** to be used with MICROCARE MPPT CHARGER accessories.

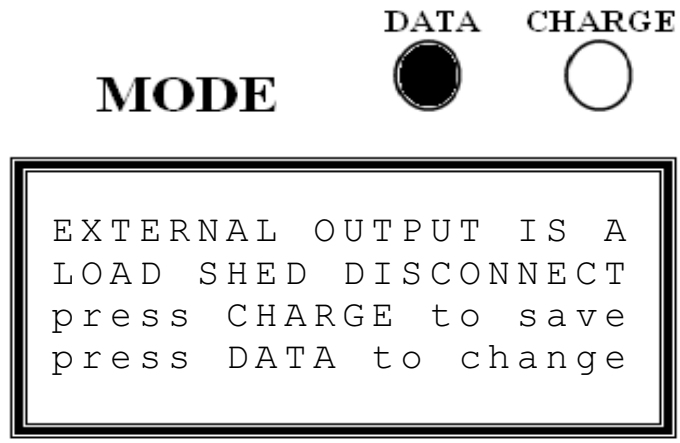
Finally:

Pressing the **<CHARGE>** button twice (pressing it once will display the time settings) will save the changes made to the MPPT. The MPPT will then reset itself and normal operation will continue as soon as the user resets the PANEL breaker.

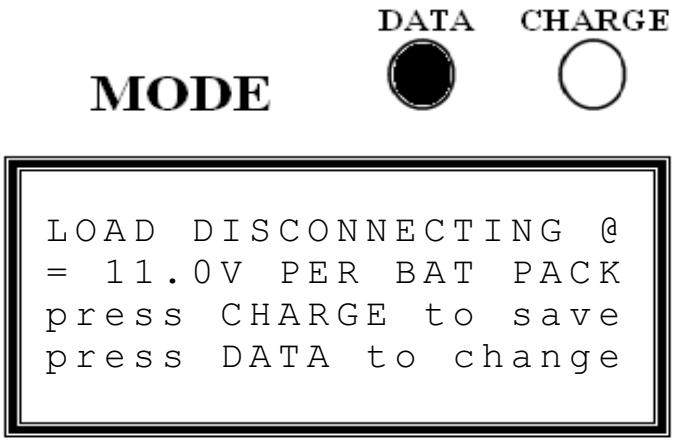
10.1 The **SOLAR ASSIST SIGNAL** switches the relay for 10 seconds when the regulator switches from BOOST to FLOAT.

10.2 If **DAY NIGHT SIGNAL** mode is selected, it switches the relay when the panel power is LOW and stays ON until the panel reconnects.

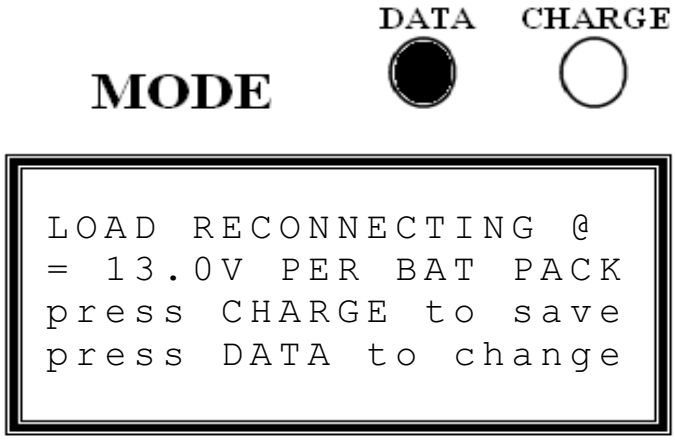
10.3 If **LOAD SHED DISCONNECT** is selected (by pressing **<CHARGE>**to save)



The following screen will appear:

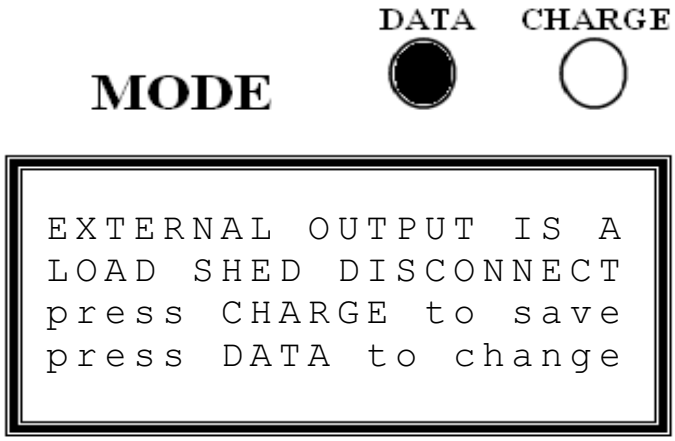


The user can program the Voltage at which the RELAY operates. This is between 10-12 volts per pack and increments in steps of 0.1 volts. If the system is 48 volts, multiply the settings by 4. If this is complete then the LOAD SHED RECONNECT voltage can be programmed which can be between 12-14 volts per pack:

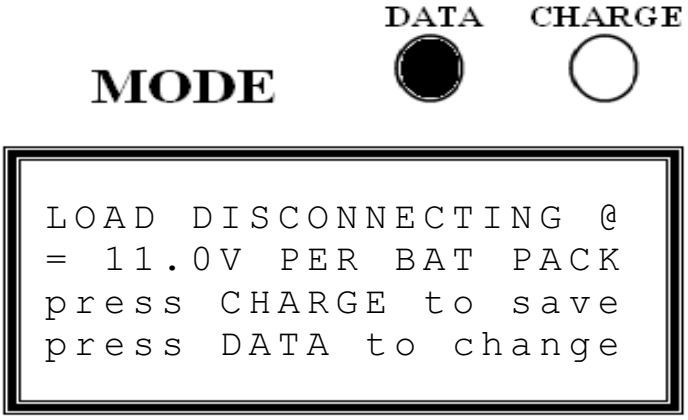


10.4 The **SOLAR ASSIST SIGNAL V2** switches the relay for 10 seconds when the battery voltage is limiting the current into the system. This is when the * is flashing next to the Battery display.

10.5 If **SOLAR AST UPS CNTR1** is selected (by pressing **<CHARGE>** to save).

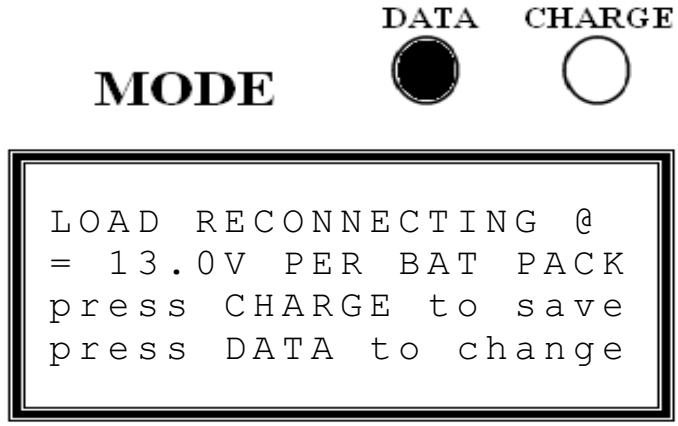


The following screen will appear:



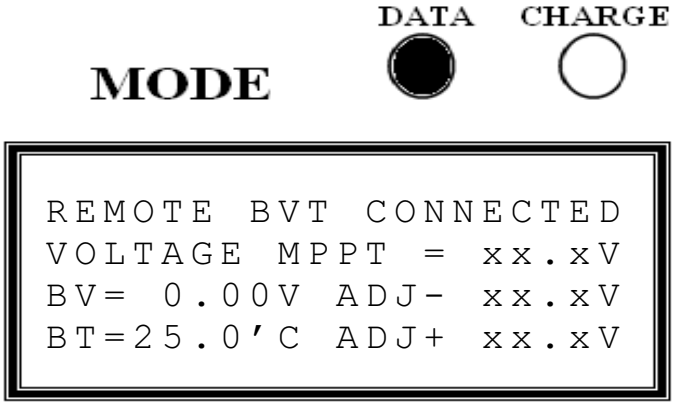
The user can program the Voltage at which the RELAY operates. This is between 10-12 volts per pack, in 0.1 volt steps. If the system is 48 volts multiply the settings by 4.

If this is complete then the **LOAD RELAY RECONNECT** voltage may be programmed which can be between 12-14 volts per pack.



10.6 **Wind Turbine Brake** is not used in the solar MPPT.

10.7 If the **Battery Temperature and Battery Voltage Sensor** is plugged into the RJ12 connector then the following screen will show:



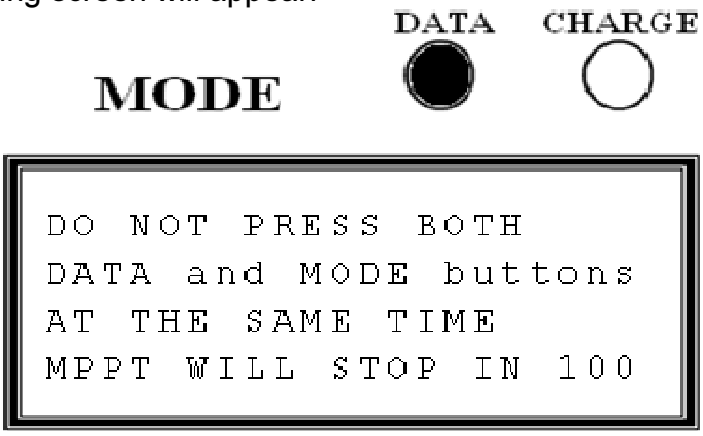
This shows the battery temperature and voltage. Should there be a problem with the cable or a poor connection then the screen will flash ERROR.

- **Voltage MPPT** shows the battery voltage at the output of the MPPT.
- The **BV** shows the voltage at the battery terminals. The correction is shown as either **+/-**.
- The Battery Temperature (**BT**) is then shown with the **ADJ** compensation.

If the Battery Voltage Temperature is disconnected, the MPPT will revert back to stand alone readings.

11. TO RESET THE MPPT TO FACTORY SETTINGS

11.1. To reset the MPPT to factory defaults you need to make sure the MPPT Battery and Panel Breaker is off.
11.2. Push and hold the DATA and CHARGE Button and turn on the battery breaker.
11.3. The Following screen will appear:



11.4. Once the countdown completes then the MPPT will have been reset to the default values.
11.5. Switch off the battery breaker and restart the MPPT as described under step 7.2 in the manual.

12. CLARIFICATION AROUND THE PURPOSE AND CONNECTION OF AN MPPT.

What is the main Idea of an MPPT:
A MPPT allows you to take advantage of the mathematics behind power conversion and allows maximum power delivery from the panel.

Let's look at a typical solar panel (the values will be adjusted to make reading/maths easier).
Open circuit voltage = 22v (Voc)
Power point voltage = 17v (Vmp)
Short Circuit current = 10.1 Amp (Icc)
Max Charge current = 10.0 Amp (Imp)
Max Power = 170w

What do these values mean?
Open circuit voltage:
If the panel is exposed to sunlight while the panel is not connected to anything the voltage will be 22v.
Power point voltage:
If we connect the panel to an MPPT the panel will be kept around 17v (depending on temperature of panel, angle of sun…) as long as the MPPT has a flat battery to charge. This is the point at which panel voltage multiplied by panel current = max wattage (not max amps or max voltage but the combination of the two).
Short Circuit current:
If the panel + and panel – touch this current will flow. The panel will be at 10amp when panel voltage is at 17v, if the panel voltage is forced lower the current will increase as voltage decreases, when the panel voltage reaches 0v then the current will = 10.1amps.
Max Charge current:
As long as the sun gives you 1000wm2 and the panel is kept at 25° C (P.S. panel temp rises when current is flowing) and the panel voltage is kept at Vmp then the Imp will = 10amps.

Max Power:
Vmp x Imp = 170w

What Happens When You Charge a Battery.
Remember that power cannot be created out of nothing and cannot be destroyed so input = output so Vbat x Ibat must = Vpan x Ipan.
With the MPPT the panel voltage is controlled independently from battery voltage and the panel voltage is kept at Vmp allowing Imp to flow, with PWM the panel is connected to the Battery while charging, forcing Vpan to = Vbat, a current slightly higher than Imp will flow, because the panel is directly connected to battery the current must be equal in both, if the current is limited to Imp then the power is limited to Vpan (or Vbat) x Imp.

MPPT				
Vbat	Ibat	Vpan	Ipan	Power
10v	17 Amp	17v	10 Amp	170w
12v	14.2 Amp	17v	10 Amp	170w
14v	12.2 Amp	17v	10 Amp	170w

PWM				
Vbat	Ibat	Vpan	Ipan	Power
10v	10.05 Amp	10v	10.05 Amp	100w
12v	10.05 Amp	12v	10.05 Amp	120w
14v	10.05 Amp	14v	10.05 Amp	140w

So here you can see that the PWM can give you as low as 100w from a 170w panel under full sunlight condition and a max of about 140w in ideal conditions (battery V, temp, radiation …). The MPPT will always give you 170w in ideal conditions (temp, radiation …) no matter what the battery voltage is.

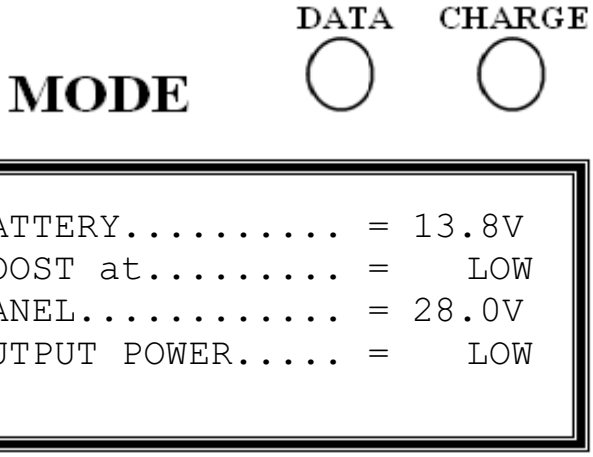
So now that you know the 1st and foremost importance of an MPPT we can discuss some added advantages.
It is true that a MPPT helps to improve system efficiency by allowing a higher panel voltage to be used, because power stays the same and power = V x I it means that the panel array current will decrease, resulting in less volt drop in the cable, resulting in les power loss in cable. What is important here is that this is only true if you keep the cable / conductor diameter the same when or as you increase the voltage, if you use thinner cable because the current is less then you're only saving on system installation cost and not gaining any efficiency. This gain in efficiency in any ways is normally almost insignificant when compared to the 1st most important reason for using an MPPT gain of **up to 70%** increase in power (normally around 30% because battery voltage does not always stay at 10v).
So my point here is, do not use an MPPT to increase panel voltage, increase panels voltage to make your installation easier and more economical but what is very important to note is that there is a limit to how much you can increase the panel voltage on the MPPT.

Why is this so?
A MPPT (all step down MPPT battery chargers) uses a Buck regulator circuit to do the power conversion, these circuits do not operate at max efficiency when the input output voltage ratio is very high, try to not exceed a ratio of 1:4, this is especially true on 12v systems. For examples is you charge a 12v battery do not connect 120v of panels to the MPPT, the ratio = 1:10 the MPPT will give you a **"High Panel voltage" Warning** meaning that the MPPT is now operated out of speck. For a 12v system your max Charge is 15v so use a panel array with a power point voltage **(Vmp not Voc)** between 15v and 60v (1:4 = 15v x 4 = 60v), then your MPPT will be happy and you will get maximum power transfer efficiency from your MPPT. In essence your MPPT has 2 paths where the power flow, 1 path steps down and divides the voltage and the other increases and multiplies the current, if your ratio is 1:10 then each circuit has to work 10 times harder then what it would have worked if the ratio was 1:1, having too dived the voltage by 10 and boosting the current 10 fold (turn 1 amp from panel into 10 amps into the battery), the difference in efficiency between 1:1 and 1:4 is minuscule and not worth stressing about but when the ratio becomes greater than 1:6 then the efficiency is notably lower.

13. Fault Finding Support:

When Problems are experienced with the MPPT's please refer to this section to confirm the procedure to follow in order to correct the fault.

13.1. When the display is showing the following:



This would be the general error experienced when connecting the MPPT.

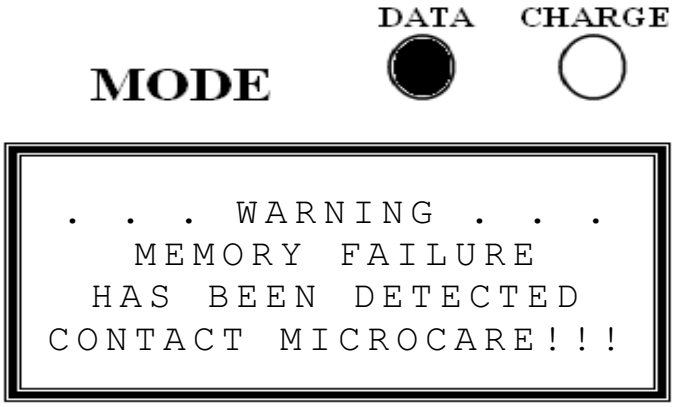
This fault can be checked through any of the following tests on the MPPT:

13.1.1. Turn off the MPPT Panel breaker and measure the voltage using a multi-meter. Turn on the Panel circuit breaker and confirm if the voltage is immediately dropping to the battery voltage or if the voltage is slowly decreasing. (If the voltage is immediately dropping to the battery voltage then the MPPT needs to be sent to Microcare for repair.)

13.1.2. If the voltage is not adjusting then you need to open up the MPPT and check the internal cables to confirm if the circuit breaker attachments are tight. Tighten the circuit breaker internally and externally.

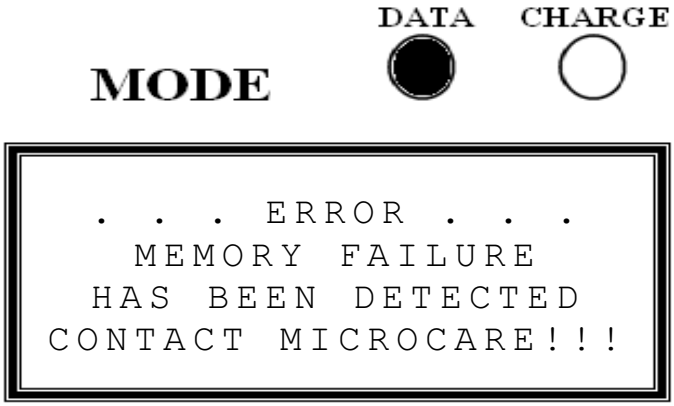
13.1.3. If this does not solve the error then you would be required to test your PV Panels independently to confirm if you have a Panel short circuit that is causing the PV voltage to be low.

13.2. When the display is showing the following:



The Internal PIC (Memory Chip) in the MPPT is becoming full and is starting to detect that it is full. This warning can be overcome by restarting the MPPT, however the problem will start occurring more often.

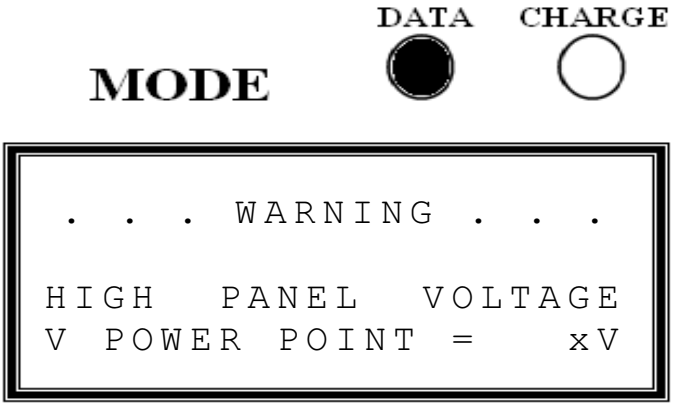
When the screen below is seen:



This means that the PIC has become saturated and will no longer be able to store information.

The MPPT needs to be sent in to the Microcare offices in order to get replaced with a new PIC to gather the information for the MPPT LOG's.

13.3. When the display is showing the following:



This error will display when the PV Voltage is exceeding the 4:1 Ratio between the battery voltage and the PV Panel Voltage used to charge the batteries.
(Refer to List Below)

Battery Bank Size	PV Panel Voltage (Voc)
12V	48V
24V	96V
36V	135V
48V	135V
Please remember that the Standard MPPT will only support 150Voc per PV Panel String.	

13.4. When the display is showing the following and all LED Lights are flashing:


```
ERR DETECTED!  PANEL
OPEN CIRCUIT VOLTAGE
GREATER THAN 100vDC
MPPT CHARGE DISABLED
```

Your PV Panel array is connected in series and is exceeding the 150Voc capacity of the MPPT

13.5. When the display is showing the following:


```
ERR DETECTED!BATTERY
OPEN CIRCUIT VOLTAGE
GREATER THAN 60vDC
MPPT CHARGE DISABLED
```

The Battery Voltage is exceeding the supported Voltage range of the MPPT.

13.6. When the display is showing the following:


```
ERR DETECTED!
MPPT OUTPUT
SHORT CIRCUIT
MPPT CHARGE DISABLED
```

This error message will be displayed if the load being drawn from the batteries is exceeding the amount of power that the MPPT is capable of supplying.

If the load being drawn from the batteries is 63A and you only have a 40A MPPT then this error will display on the MPPT.

If this error is detected, open up the MPPT and check the left ribbon cable and confirm that the ribbon cable is securely fastened between the Display and the power card.

If the Ribbon Cable is secure then reduce the Load being drawn from the battery bank to clear the error. (Restart the MPPT once the load has been reduced.)

J & J ELECTRONICS LIMITED WARRANTY

J&J Electronics warrants its full range of products against defects in workmanship and materials, fair wear and tear accepted, for a period of three (3) years from the date of delivery/collection for all equipment and are based on a bring-in-basis. Where the installation of the product makes it impractical to bring-in to our workshops, J&J Electronics reserves the right to charge for travel time and kilometres travelled to and from the site where the product is installed.

During this warranty year period, J&J Electronics will, at its own discretion, repair or replace the defective product free of charge. This warranty will be considered void if the unit has suffered any physical damage or alteration, either internally or externally, and does not cover damages arising from improper use such as, but not exclusive to:

- Reverse of battery polarity.
- Inadequate or incorrect connection of the product and/or of its accessories.
- Mechanical shock or deformation.
- Contact with liquid or oxidation by condensation.
- Use in an inappropriate environment (dust, corrosive vapour, humidity, high temperature, biological infestation).
- Breakage or damage due to lightning, surges, spikes or other electrical events.
- Connection terminals and screws destroyed or other damage such as overheating due to insufficient tightening of terminals.
- When considering any electronic breakage except due to lightning, reverse polarity, over-voltage, etc. the state of the internal control circuitry determines the warranty.

This warranty will not apply where the product has been misused, neglected, improperly installed, or repaired by anyone else than J&J Electronics or one of its authorised Qualified Service Partners. In order to qualify for the warranty, the product must not be disassembled or modified. Repair or replacement are our sole remedies and J&J Electronics shall not be liable for damages, whether direct, incidental, special, or consequential, even caused by negligence or fault. J&J Electronics owns all parts removed from repaired products. J&J Electronics uses new or re-conditioned parts made by various manufacturers in performing warranty repairs and building replacement products. If J&J Electronics repairs or replaces a part of a product, its warranty term is not extended. Removal of serial nos. may void the warranty.

All remedies and the measure for damages are limited to the above. J&J Electronics shall in no event be liable for consequential, incidental, contingent or special damages, even if having been advised of the probability of such damages. Any and all other warranties expressed or implied arising by law, course of dealing, course of performance, usage of trade or otherwise, including but not limited to implied warranties of merchantability and fitness for a particular purpose, are limited in duration to a period of three (3) years from the date of purchase.

Life Support Policy:
As a general policy, J&J Electronics does not recommend the use of any of its products in life support applications where failure or malfunction of the J&J Electronics product can be reasonably expected to cause failure of the life support device or to significantly affect its safety or effectiveness. J&J Electronics does not recommend the use of any of its products indirect patient care. J&J Electronics will not knowingly sell its products for use in such applications unless it receives in writing assurances satisfactory to J&J Electronics that the risks of injury or damage have been minimised, the customer assumes all such risks, and the Liability of J&J electronics is adequately protected under the circumstances.

Caution:
Our products are sensitive. While all care is taken by us to dispatch goods with adequate packaging, J&J Electronics is not responsible for any damage caused to products after they have left our premises. Semi-sealed batteries have to be transported upright and must not be put on their side. Please ensure that your transport company or delivery team is aware of the sensitivity of the products they are collecting.

Goods return policy
The following terms apply to return of items purchased from J&J Electronics, and we require the following information:

1. Details of the item(s) you would like to return.
2. Our invoice number.
3. The reason for the return.
4. J&J Electronics must be notified within 7 days of your intention to return the goods which were purchased.
5. All items returned will be inspected prior to refund. If our technicians are not immediately available, the goods will have to be left with us until such time as a technician is available to check the items.
6. Proof of purchase is required for all returns.
7. The price paid by the customers is the price on which the refund is based.
8. Items purchased can be returned for a refund, replacement or exchange, provided proof of purchase is provided and subject to all other conditions as set down here.
9. All returns may be subject to an administration and handling fee of 10% of purchase price plus VAT.
10. Returns are based on a bring-in basis; all return shipment costs are for customer's account.
11. Returns will be refused in the following circumstances:
    a. Where an item has been tampered with, altered or damaged in any way, or
    b. Where a return is deemed unreasonable, this will be referred to management.

Severability:
If a part of the terms and conditions set out above is held invalid, void, or unenforceable due to any particular national or international legislation, it shall not affect other parts of the terms and conditions remaining.

J&J ELECTRONICS' TERMS AND CONDITIONS OF SALE

- **Payment Terms:**
    - On placing an order your unit/s is/are booked on the production line, and a Pro Forma invoice is sent to you with our banking details.
    - A 50% deposit is required to secure the order, with the balance payable prior to despatch of the goods.
    - **Payment is accepted in South African Rands (ZAR) only, and by Electronic Funds Transfer (EFT) into J&J Electronics' bank account.**
    - The issuing of a quotation or a Pro Forma invoice issued as a quotation represents no obligation by J&J Electronics until such time that the customer's official purchase order has been accepted.

- **Pricing:**
    - Prices are quoted ex-works Port Elizabeth, and do not include delivery.
    - Prices are quoted excluding VAT. VAT is payable on all invoices except on exports where J&J Electronics is arranging the export transport.
    - Prices are valid for 30 calendar days from the date of quotation.
    - Prices quoted are based on the quantities specified in the quotation and J&J Electronics reserves the right to revise prices quoted in the event of the quantities being reduced or increased.

- **Delivery/Packaging:**
    - Delivery times where specified are estimated. J&J Electronics will endeavour to adhere to estimated delivery times; however, should any delays which are beyond J&J Electronics control occur, J&J Electronics will not be liable for any costs or losses incurred by the customer through such a delay.
    - J&J Electronics requires all customers to arrange their own shipping/courier when orders are placed as all orders are Ex-Port Elizabeth; when repairs as per the J&J Electronics Carry In Warranty are sent to J&J Electronics, the onus on the return of the goods to the customers lays with the customer in terms of arranging shipping/courier services.
    - Goods are packaged in corrugated packaging; if the customer requires any specific type of packaging such as crates or pallets, this will be an additional cost for the customer.
    - Where the goods are not delivered by J&J Electronics or are collected by the customer, but are collected or delivered by and independent carrier, the collection/delivery by the carrier shall be deemed to be delivery to the customer. Where the goods have been delivered by the carrier, J&J Electronics is not responsible for goods lost or damaged in transit.

- **Carry-In Warranty and Returns:**
    - Carry-In Warranty is 36 months (three years).
    - Goods are warranted against faulty workmanship and components for a period of thirty six months (three years) from the date of supply. A copy of our full warranty policy and returns policy is available on request or from our home page on our website.
    - While J&J Electronics provides professional advice regarding the usage of goods supplied, the suitability of the goods supplied for the use contemplated by the customer is the sole responsibility of the customer.
    - J&J Electronics shall in no way be responsible for the suitability of the goods sold on for any particular end use.

- **General:**
    - Any item not specified is excluded from the quotation. Delivery, commissioning, installation and electrical work are excluded unless specifically quoted.