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MA13H

Hybrid Solar Charge Controller
For Uninterrupted Operation of LED Street Light
(with dual output for CCTV, blinker)

12V / 75 W LOAD

12V / 350 Wp PANEL / 20A max

DC From Mains Utility



Conforms to IEC 62093

ALL PRODUCTS, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.



It is common observation, during cloudy atmosphere power generated from solar panel may not be sufficient to fully charge the battery thereby resulting in the premature shut down of the street light in the midnight.

MA13H, a 12V based hybrid system is entirely designed, developed and manufactured in-house is a solution to this problem. It accepts dc from mains to keep load on if battery power is found insufficient during operation.

Why Hybrid Solar?

Many a time, even if the system is conservatively designed with autonomy, the batteries loose the power over a period of time or insolation is insufficient for days together to charge the batteries optimally and light is off prematurely. If the system is of critical nature, mains power can be automatically switched to drive the load during such emergencies. And the load will be on throughout the night uninterruptedly.

What is Ideal solution?

1. Hybrid solution involving the mains power should not interfere in the normal charging and discharging of the battery bank.
2. Mains power should not charge the battery but simply provide power to the load during night if battery fails to provide it. The very purpose of harnessing solar power will be lost if mains power charges battery.
3. Mains power should not disturb the operation settings of the load. Obviously, during day time, mains power should just stay in standby mode without interfering the solar generation/charging.
4. User must know if the system is running on mains power during such emergencies.
5. Mains operation should not be possible if battery is not present. Else, it will be simply a mains-operated system.
6. If battery is dead or absent, user should immediately come to know that system needs battery replacement. So the system should be off all the time if battery is dead or absent.
7. If mains supply is not available, it should work in normal operation mode as a stand alone solar street light.

Why MA13H?

MA13H is designed with the view to providing such a solution and more.

The controller is accompanied with specially designed mains power pack compatible to the controller.

The controller has auxiliary output terminal where battery voltage is available during night to drive additional gadgets like IP camera, blinkers etc. if needed.

OPERATION:

It has on board selection for type of battery to be used either Lilon (11.1V) or LFP (12.8V).

It can work in different modes like normal mode (full light from dusk to dawn), 50% dimming after 4 hours, 70% dimming after 6 hours or any other customised operation for dimming and timer settings.

User can select the desired load between 40W, 48W, 55W, 60W or 75W. Customised output load other than these values is also possible.

Motion sensor operates during dimming mode.

If for any reason, battery goes low during operation in the night, mains/grid supply is instantly and automatically switched to drive the load without charging battery. If mains supply fails during this operation, it will switch to battery operation till battery level of low voltage disconnect(LVD) is reached. If mains supply is back, it will switch to mains supply again. This automatic change over is possible as long as battery is above LVD. During these transitions, working of the controller as regards the drive of the load is unaffected i.e. dimming, timer and motion sensing operation will be unaffected whether it is on battery or mains mode. There is indication to the user if the controller is operating on mains- in addition to regular indications for charging, battery normal and low.

Any DC operated gadget can be connected to AUX terminals on the board with max output current of 2A at these terminals.



Operating Instructions

Please read these instructions before making connections to the controller.

The controller uses static sensitive components. It needs trained technician to handle it. The controller has three terminal block groups.

One set with six terminals are marked PV+, PV-, BT+, BT-, DC+, DC-.

Second set with two terminals are marked LD+, LD-.

Third set (small) with two terminals is marked AUX +, -.

PV+/PV- : Solar panel connections. Solar panel can be upto 350Wp/12V nominal. Voc of panel 30V max.

BT+/BT- : Connections for nominal 12V (Lead Acid 12V or Li Ion 11.1V or LFP 12.8V) battery.

LD+/LD- : Connections for LED load.

AUX terminals are marked + and - for getting battery voltage at these points which has 2A capacity and is available day and night as long as battery voltage is in the acceptable limits. If desired, this output can be made available only during dusk to dawn period.

Please confirm the gadget to be connected to AUX terminals work within battery limits of LVD and HVD of the battery type used and its current requirement is not more than 2000mA (unprotected). The connected gadget will be on day and night (default) or during night only (if requested) as long as battery voltage is within these limits.

Three relimate connectors are on the board marked CHRg, BT_STS and MS. The relimate MS is meant for connecting motion sensor assembly if needed and provided by us as optional attachment.

The cables used for making connections to the panel, battery and load should be suitably rated for the current passing through the same. Undersized cables or loose connections to the terminals will result in malfunctioning of the controller due to drop in the voltage.

How to use:

- Connect indicator LED assemblies to the respective relimate connectors on board.
- Select the pins for MODE, BAT_SEL and LOAD as per requirement. (See **CUSTOMISATION**)
- Sequence of connections should preferably be first battery, then load and lastly panel.
- When battery is connected, BT_STS should turn Green. If panel is not connected or if it is in dark, load will be on.
- If panel is connected and its voltage is above dawn level, load will be off after 10 seconds.
- When panel voltage goes below dusk level, load will be on after 10 sec. (See DUSK_SENSE and DAWN_SENSE in **Technical Specifications**.)

IMPORTANT:

LEDs used as load on the MCPCB should be configured as outlined in section **LED CONFIGURATION FOR LOAD (Important Precautions)** . Use of other configuration may lead to improper operation.



Technical Specifications

The controller comes with selectable battery option of Li Ion 11.1V and Li Ferro Phosphate 12.8V. If Lead Acid battery (12V) is to be used, it can be provided as customised option. See CUSTOMISATION. The settings for LVD, LVR etc. will be automatically selected as mentioned in the chart below.
Before using the controller, ensure BAT_SEL is done properly.

SYSTEM:	12V Nominal		
CAPACITY:	Input Panel 350Wp/ 20A max, Voc 30V max		
	Output 40W, 48W, 55W, 60W, 75W (or any other value upto 75W as customised)		
REGULATION:	Low Loss, Series Type		
OUTPUT VOLTAGE DROP:	<320mV at 6A (OVD)		
INPUT VOLTAGE DROP:	<330mV at 20A (IVD)		
BATTERY OPERATION (Based on selection of Link)	BATTERY TYPE		
	Lead Acid 12V	Li Ion 11.1V	LFP 12.8
LOW VOLTAGE PROTECT:	9.5 V	8 V	10 V
LOW VOLTAGE DISCONNECT:	10.7 V	9.6 V	11.2 V
LOW VOLTAGE RECONNECT:	12.3 V	11.2V	13.2 V
HIGH VOLTAGE DISCONNECT:	14.4 V	12.6 V	14.4 V
HIGH VOLTAGE RECONNECT:	14.3 V	12.3 V	13.8 V
HIGH VOLTAGE PROTECT:	15V	13.5 V	15 V
DUSK_SENSE	Panel Voltage <2V, 10sec delay		
DAWN_SENSE	Panel Voltage > 4V, 10sec delay		
MAINS BATTERY CHANGEOVER	When battery nears LVD		
PROTECTIONS:	*Short Circuit / Overload		
	*Reverse Battery *Reverse Panel		
	*Reverse flow of current from Battery to Panel during night		
	*Lightening		
	*No battery but panel connected. System disabled.		
AUX out	Battery voltage, 2A, unprotected		
APPLICATION;	In Fixture Use Only		
OPERATING TEMP RANGE;	0 to 50° C		
DIMENSIONS:	135 L x 75 W x 25 H (all in mm)		



Important Precautions

Important precautions before using the controller.

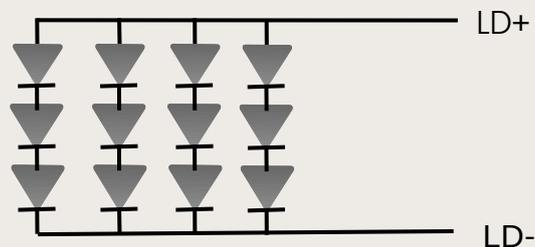
- Only trained technician should handle the controller as it houses many static sensitive devices.
- No soldering / desoldering should be carried out on the board.
- The system voltage of the controller is nominal 12V. The type of battery suitable for the controller is any of the three types- Lead Acid 12V, Li Ion 11.1V or LFP 12.8V.
- Panel suitable for the controller is of nominal 12V. Its Voc should be 25V max and capacity should be 350Wh max with desired Vmp 16 to 18V for best results. **Higher wattage panel, if connected, will result in irreparable damage of the controller.**
- While selecting the load, **if links are placed at two or more places, it will result in damage of the controller.**
- MODE selection can be done for different modes of operation. It has positions marked NML, TM1, TM2, DIM and UNQ.
- If the controller comes with our motion sensor McMS (see **Motion Sensor Add_On Module**), it should be connected at the relimate on the board marked MS.
- Use of other motion sensor may result in the damage of controller and/or sensor. The controller is designed to accept our own motion sensor only.

LED CONFIGURATION FOR LOAD:

The controller has buck type of high efficiency driver. Since the system is of 12V nominal system, the maximum voltage in series should be max 10v. For LED having Vf of 9V, all should be connected in parallel.



(Forward voltage of LEDs: 8.2V to 10 V)



(Forward voltage of LEDs: 2.7 V to 3.4 V)



INDICATORS AND CONNECTORS:

- The controller comes complete with two LED indicator assemblies. One with Green LED another with Bicolour LED for indication of charging and status of battery respectively. Connect these assemblies to the relimate connectors marked CHRG and BT_STS respectively. See operation in VOLTAGE SETTINGS below.
- Connector marked BAT_SEL is provided on the board. If short link is placed here, battery selection is done for Li Ion 11.1V. If link is not placed, LFP (12.8V) will be selected. These are the default settings. (If customised VOLTAGE SETTINGS are requested, these will be operative when no link is used here.)
- Connector marked LOAD has NO PIN / CUSTOM 40W, 48W, 55W, 60W and 75W. If no link is used, it will result in 40W operation (default). Link put on any one of 48 to 75 will result in selecting the respective wattage. Link should not be placed at more than one place which may result in damage to the controller.
- Connector marked MODE is for selecting the mode of operation. It has 4 different positions.
- One relimate marked MS is meant for connecting Motion Sensor. MS pins provide the power supply to motion sensor and accepts signal output from it. Motion sensor operates only during the dimming period of operation. When motion is sensed, load will be full bright for 30 seconds and then reverts to dimming mode.

VOLTAGE SETTINGS:

LVR (Low Voltage Reconnect)

After selecting the type of battery, mode of operation and load, connect the battery to the controller and connect the load to the respective terminals with proper polarity. If battery voltage is at least equal to LVR, BT_STS will turn Green and load will be on as per mode setting. If BT_STS is Red or blinking Red, battery voltage is less than LVR. Battery needs to charge above LVR. When operation is on Mains supply during night, the Green part will be blinking to show the battery is in reserve mode and load is driven by Mains power/grid.

LVD (Low Voltage Disconnect)

When battery voltage is less than LVR, BT_STS will be blinking Red. When it turns continuous Red, battery has reached its lowest voltage level (LVD) and load is off. Load will be on only after battery voltage is above LVR.

HVD (High Voltage Disconnect)

When solar panel is connected and insolation is sufficient, load will be off after 10 seconds and charging will start. CHRG will blink when battery is sufficiently charged. When battery reaches HVD, charging will stop.

HVR (High Voltage Reconnect)

After battery reaches HVD, charging is stopped and battery voltage will start reducing gradually, due to *Relaxation* of battery which is inherent characteristic of Lithium type of batteries. Depending upon SOC of battery, it will take time to drop to HVR at which point, charging will again start. In Lead Acid based type of battery, charging will be in PWM mode which is automatically selected by the controller.

LVP /HVP (Low and High Voltage Protection)

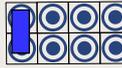
If battery voltage is less than LVP or more than HVP, the controller is disabled and no action takes place.

EASY SELECTION TABLES:

MODE selection

Select how controller should work in different dimming options. Extra connections other than suggested at these pins will result in unpredictable performance. **If link is not placed at any of the positions, load will be off.**

UNQ
DIM
NML
TMR



LINK PUT AT UNQ. FIRST 5 HRS 100% LIGHT, NEXT FIVE HRS 30% LIGHT AND THEN 100% LIGHT TILL DAWN



LINK PUT AT DIM. 50% LIGHT RIGHT FROM DUSK TO DAWN



LINKS PUT AT BOTH DIM AND TMR. FIRST 6 HRS 100% LIGHT, THEN 50% LIGHT TILL DAWN



LINK PUT AT TMR. FIRST 6 HRS 100% LIGHT, THEN LOAD IS OFF TILL DAWN



LINK PUT AT NML. 100% LIGHT RIGHT FROM DUSK TO DAWN

MODE

LOAD selection

Depending upon the load to be driven, you can select the short link at the connector marked LOAD

***If Customised wattage upto 75W is requested, all other wattage settings are disabled.**

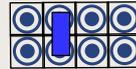
48 55 60 75



NO LINK USED. LOAD SELECTED 40W (DEFAULT) OR CUSTOM VALUE IF REQUESTED



LINK PUT ON 48. LOAD SELECTED 48W



LINK PUT ON 55. LOAD SELECTED 55W

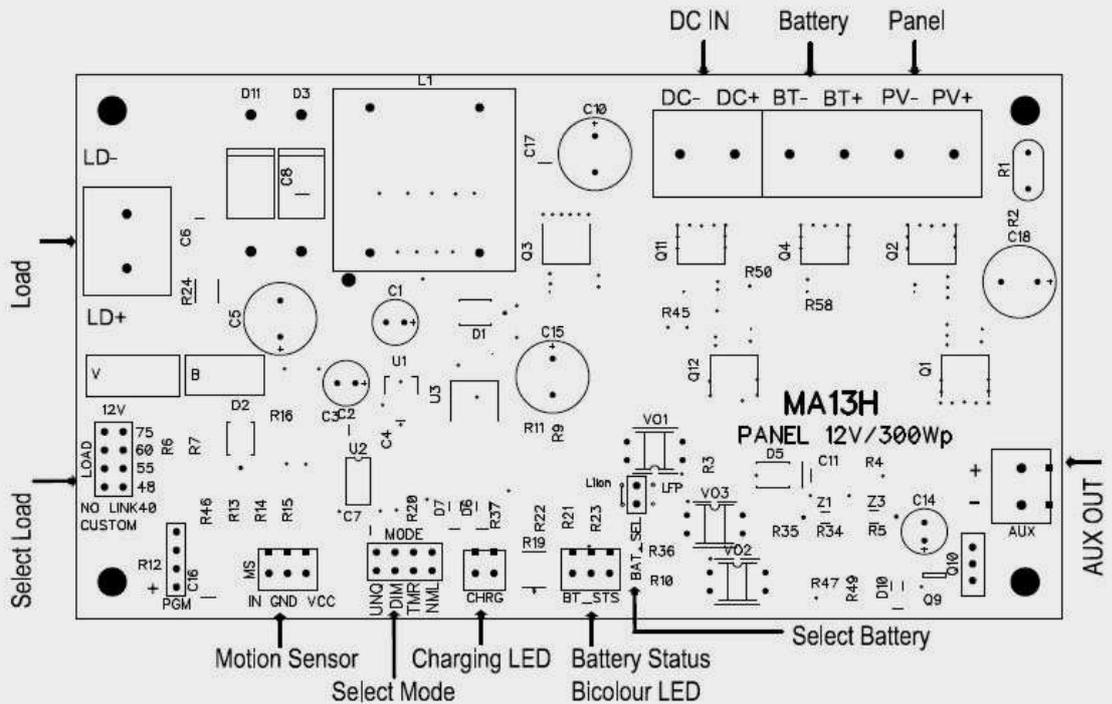


LINK PUT ON 60. LOAD SELECTED 60W



LINK PUT ON 75. LOAD SELECTED 75W

LOAD



BAT_SEL (battery type selector)



NO LINK WILL SELECT LFP BAT 12.8V Nominal. .



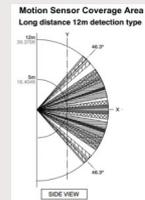
LINK PUT HERE WILL SELECT Li Ion BAT 11.1V Nominal

BAT_SEL



Motion Sensor Add_On Module

McMS



McMS is available as add_on module for connecting to the main charge controller unit. It is available in different sense-ranges, right from 6 mtr to 17 mtr depending upon the height of the pole.

It comes with 3 way relimate connector to be directly plugged in the main unit which has 3-way base provided exclusively for this module.

The software for the operation of motion sensor is pre-installed in the main controller. Required supply for this module is also provided by main controller.

Technical Specifications:

- Operating voltage: 5 to 15V
- Quiescent current: <math>< 9\mu\text{A}</math>
- Level output: 3.3V Hi, 0V Lo
- Block time: 5sec
- Sensor Angle : 110°
- Sensing range: 6 mtr to 17 mtr (depending upon the type)
- Operating temp: -15 to 70°C

Precautions:

In some versions the module has user accessible settings like, selection of single pulse or multiple pulse, delay time and sensitivity, it has been configured optimally to be compatible with the software installed on the main controller unit. And we strongly recommend not to disturb the factory settings done.

Instructions for use:

- The module is electrostatically sensitive. Only technically competent person should handle it.
- It is provided with relimate cable with standard length of 12".
- It directly fits into connector marked MS on the main controller. Power is provided to the module and signal is received from the module from the same connector.
- The module needs about 60 sec to stabilize for operation. During this initialization, it will toggle output for 3 times. Once stabilized, it will go into normal mode of working.
- Module has dual probe sensor placed at rectangular window. If movement is along this length, the sensitivity is excellent. Place the module such that movement is along its length i.e. human movement should be parallel to its length for best results.
- If the movement is facing the sensor, or from its width, sensitivity is reduced.
- In the optimal direction, sense distance is 3 to 12 mtr depending upon the type used.
- Avoid direct sunlight or heavy winds on the module which will result in malfunction.



LOAD IS NOT ON:

1. BT_STS is off.
Check the battery connections. Battery might be reverse connected or no connections to the terminals BT+/BT-.
2. BT_STS is blinking Red and Green alternately.
Battery selection link is not done properly. Battery voltage is more than acceptable.
3. BT_STS is Red or blinking Red.
If battery selection is correct, battery voltage is less than LVR. Battery needs charging till indicator turns Green.
4. BT_STS is green and steady,
 - a) Panel might be connected with some light on it. Remove panel. Wait for 10 sec.
 - b) Load might be connected in the reverse direction at LD+/LD- terminals. Correct the polarity.
 - c) No link is put at MODE selection. Select the mode.

BATTERY NOT CHARGING:

1. CHRG LED is not on.
 - a) Panel is not connected properly or connected in reverse direction.
 - b) Panel is without sufficient insolation. Check voltage at PV+/PV- . It needs to be more than 12V.
2. CHRG LED is on.
Panel is not giving power sufficient to charge battery. Battery voltage will increase very slowly. Panel and battery combination is not matched properly.
3. CHRG LED is on and BT_STS blinking Red and Green.
Battery is damaged or wrong selection of battery or panel is very over sized for battery capacity.

LOAD TURNS OFF AFTER SOME TIME IN THE NIGHT:

1. If Mode selection is NML or UNQ, battery capacity is reduced to give full back up till dawn, or panel is not charging the battery to desired SOC. If battery goes to full charge (CHRG blinks during day time), battery capacity is drastically gone down. Replace battery.
2. If Mode selection is TMR please confirm you used DIM link also. If DIM link is not used with TMR, load will be off after timer setting irrespective of available capacity of battery.

OUR GADGET NEEDS DIFFERENT VOLTAGE AT AUX OUT:

1. AUX out gives the instantaneous battery voltage (Vbat-0.9V). If selected battery is Li Ion 11.1V, voltage available at the terminals will be any where between 9 V and 12 V depending upon the status of the battery. Similarly, for other types of batteries selected as per the details on page 4. If your gadget needs lower than this voltage, you need to have a regulator between this output and your gadget. If higher voltage is needed, a boost type converter is needed .
2. AUX output has a rated capacity of 2000mA continuous. This output is not protected against short or overload. If current requirement is more than this continuously, please contact us.

EXCESSIVE HEATING WHILE CHARGING:

Please confirm the panel connected is not more than 350Wp. Current passing should be less than 20A.

CHANGE OVER TO MAINS NOT TAKING PLACE:

1. Check if the SMPS supply is giving 25V.
2. If you are using any other supply than the standard one supplied by us, it will not accept the voltage.

WHAT ARE THE THINGS THAT CAN BE CUSTOMISED:

1. Voltage settings different from factory defaults.
2. Load wattage different from the factory default at NO LINK position
3. Profile at UNQ pin in MODE selection which can be different from factory defaults
4. Contact us for any other customisation.

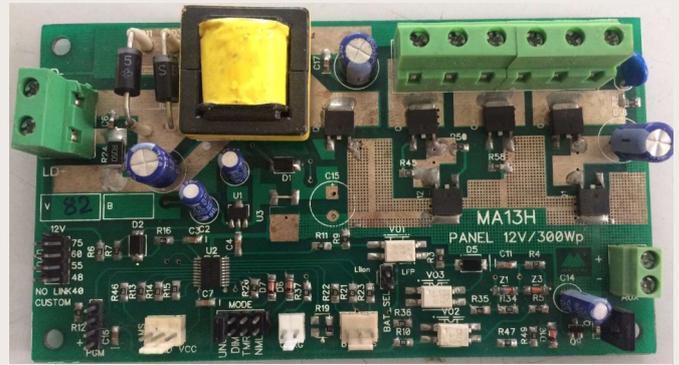


Product Test Specifications

You can check the performance of controller with the procedure outlined below.

Components needed to carry out these tests are Digital Multimeter, Dual Output (Independent) Variable Power Supply (CVCC) with volt/ampere display, Electronic load, 2 sq mm cable lengths for connections, DSO to see waveforms (not needed for routine check).

ONLY TECHNICALLY COMPETENT PERSON SHOULD CARRY OUT THE FOLLOWING TESTS



COLD TESTS:

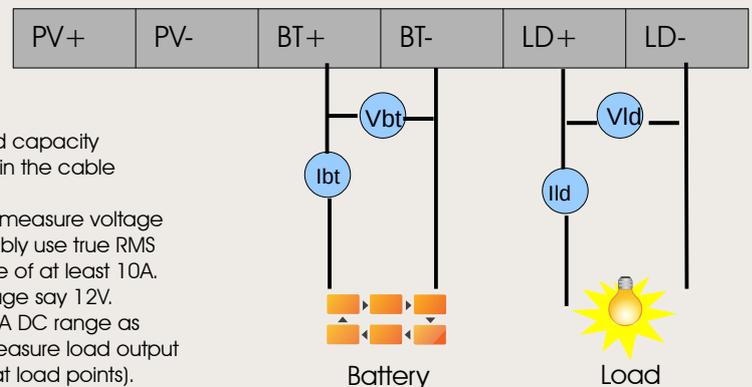
- **Select the BATTERY type first from on board selector.**
- First connect the cables to BT+ and BT- securely to the respective terminals of power supply.
- Gradually increase the supply such that voltage is just above LVR. BT_STS will turn Green. Reduce the voltage slightly and BT_STS will show Green plus blinking Red both together. Reduce voltage further to LVD. BT_STS will now be fully Red.
- Increase voltage slightly, BT_STS will show blinking Red only. This completes LVR and LVD check.
- Increase voltage to more than HVDD. BT_STS will alternately turn Red and Green. This indicates the system is disabled and voltage will not be available to the load.
- Switch off the supply and now connect with other pair of cables PV+ and PV- to respective terminals of other part of power supply.
- Put battery voltage to LVR and gradually increase voltage to PV terminals. Battery voltage will track the PV voltage when battery voltage is more than LVD. CHRГ indicator will now turn on. Increase PV till battery voltage reaches HVD. Now CHRГ will turn on and off alternately. This will continue till voltage is HVDD Afterwards, system is disabled.

LOAD TESTS:

- Above tests in the same sequence can be carried with load connected to the controller.
- If electronic DC load is not available, connect your assembled power LED cluster to respective terminals of LD output.
- Depending upon the load used, select LOAD select pin to match output current.
- Put the link on NML or TMR or UNQ on MODE connector.
- Keep battery voltage to at least LVR and panel voltage to 0. Load will be on. You can check the output current of battery. *Please note this is not the actual current passing through the power LED cluster. This is the battery current at the instantaneous battery voltage. If battery voltage is increased, this current will be reduced and vice-a-versa. This indicates the proper working of SMPS driver.*
- If you connect a precision current meter in series with LED load, the current indicated will be constant even if battery voltage is varied up and down.
- Remove link and put it on DIM. Load current indicated will be half of previous reading.
- UNQ or TMR operations can be checked only in real time environment.
- When battery voltage is above LVR and load is on, increase panel voltage gradually to slightly above 3.5V. Wait for 10 sec and load will be off. Now gradually reduce panel voltage to slightly less than 1.8V and load will be on again in. This completes DUSK_SENSE and DAWN_SENSE settings.

EFFICIENCY CALCULATIONS:

CONTROLLER TERMINALS



Precautions should be taken to use rated capacity wires to make connections so that drop in the cable is minimised.

At least two meters are needed, one to measure voltage and another to measure current. Preferably use true RMS quality multimeters with DC current range of at least 10A. Set the power supply to some fixed voltage say 12V. Connect the load with multimeter on 10A DC range as shown in red. Use other multimeter to measure load output voltage at the controller terminals (not at load points). This will give you Output power.

Without disturbing the set up, connect the multimeters at battery terminals in the same way. This will give you input power.

Since meters in series always have some mV drop across it, voltage at load terminals on the controller and actual at load

pins are different. This results in error in calculations. Input and output power of controller must be calculated at controller points only. Else drop in the cable and current meter are not taken into account and calculations go wrong.

$$EFF = (Vld * Ild) / (Vbat * Ibat)$$

Use thick wires to minimise cable loss

