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McZD10

MPPT based
Solar Charge Controller For LED Street Light
12V / 42 W LOAD
12V / 125 Wp PANEL / 7.25 A max input

Conforms to IEC 62093

General Information

***McZD10** is a MPPT based based 12V solar charge controller which provides a ready solution for LED solar street lights for loads upto 42W and input rating of 7.25A/125 Wp from solar panel.*

1. The salient features are -

- Microprocessor based MPPT controller employing P&O algorithm.
- Auto Dusk to Dawn Operation
- Built-in High Efficiency (> 92%) LED Driver for constant current output
- Controller available in two different types. .
  McZD10-L: **selectable 12W, 15W, 18W, 24W (Customised output of any other value upto 24W is also possible)**
  McZD10-H: **selectable 30W, 36W, 40W, 42W (Customised output of any other value upto 42W is also possible)**
- 125 Wp panel Input max. Charging current 7.25 Amax.
- User Selectable Multiple Dimming And Timing Options.
- Theatre lighting drive to have no stress on eyes while dimming or brightening.
- User Selectable type of battery- Li Ion or LFP (Lead Acid if customised)
- Automatic selection of charging algorithm for respective type of battery
- Compatible with motion sensor
- Protections against reverse battery and panel connection
- Protections against reverse flow of current from battery to panel during night
- Protection against lightening
- Protection against high-voltage battery than recommended
- Protection against high-current charging due to higher wattage panel
- NO_BATTERY protection with panel connected
- Double side FR4, PTH board with conformal coating
- Low Loss Series Regulation
- Conforms to IEC 62093 for quality assurance

2. It can be used to drive the load upto 24W (McZ10-L) or 42W (McZD10-H) . Custom wattage of any other value upto respective maximum is also possible. The load can be selected simply by selecting pin on the board itself. The same controller can be thus used for any of these wattages by **LOAD** selection pin. See **Customisation** section for details.

3. It has options to dim the load at different timer settings. The built-in user selectable options are available at **MODE** selection as under-

a) **NML**: If link is used here, the load will be on throughout the night (dusk to dawn) with full brightness.
b) **TM1**: If link is used here, light will be full bright (100%) for first 4 hours and then switches to 50% brightness till dawn.
c) **TM2**: If link is used here, light will be full bright (100%) for first 6 hours and then switches to 30% brightness till dawn.
d) **DEFAULT/CUSTOM:** If no link is used, it goes into default mode (if no customisation is required). The load turns on very gradually and reaches 30% light and stays there till 5 min. After this, it increases to 50% light and then stays at this dim position till dawn.
If any customer specific mode of operation is required, it is provided in this NO LINK position. (See **Customisation** section for more details.)

Motion sensor will be operative during dim period in all modes..

4. It has two more unique features being offered for the first time in such controllers.

A) User selectable battery options namely Lead Acid/VRLA/SMF 12V, Lithium Ion 11.1V or Lithium Iron Phosphate (LFP) 12.8V. Charge-discharge algorithm of the battery is automatically selected.

If custom specific values of settings are required, these can be provided in NO LINK position.

5. The controller is compatible to our standard PIR motion sensor for automatic detection of motion to drive the load to full brightness for 30 seconds during any dimming operation.
(See McMS on page 8 for more details)

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Operating Instructions

Please read the following instructions before making connections to the controller.

The controller uses static sensitive components and should be handled by trained technician.

The controller has three terminal block groups.
PV+/ PV-, BT+/ BT-. LD+/ LD-.

PV+/PV- : Solar panel connections with proper polarity. 125Wp/12V/7.25A nominal. Voc of panel upto 25V.
BT+/BT- : Battery connection with polarity.
LD+/LD- : LED PCB.

Four relimate connectors are on the board marked CHRG, BT_STS , MS and MPP. 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, BATTERY and LOAD as per requirement.(See **IMPORTANT** below)
- 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 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:

- **BATTERY Selection:** No link selects 12.8V LFP battery while link connected selects 11.1V Li-ion battery.
- **LOAD selection:** No link is 12W (MczD10-L) or 30W (McZD10-H) . Connect link for other wattages from options as mentioned in CUSTOMISATION page 7.
- If **MODE selection** does not use any link, operation will be in TEST mode in which load gradually increases to 30% light and stays there for 5 min and after this, it increases to 50% light till dawn.
  NML: Load will be on at 100% light..
  TM1: 100%l light for first 4 hours and then 50% light till dawn.
  TM2: 100% light for firstl 6 hours and then 30% light till dawn.
  Motion sensor, if used will be operative during dimming mode.
- Please go through **Customisation** (page7) for selecting different links on the boards.
  LED CONFIGURATION FOR LOAD (**Important Precautions**) page 5 .

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Technical Specifications

SYSTEM:	12V Nominal		
CHARGING REGIME:	TRUE MPPT, P&O BASED 30% more power extracted		
CAPACITY:	Input Panel 125Wp,7.25A max, Voc 25V typ		
	Output 12W, 15W, 18W, 24W (McZD10-L) 30W, 36W, 40W, 42W (McZD10-H) (or any other value upto respective maximum as customised)		
REGULATION:	MPPT for bulk charging to full capacity. Then switches to replenish the charge in float region.		
OUTPUT VOLTAGE DROP:	<150mV at 3A (OVD)		
INPUT VOLTAGE DROP:	<200mV at 7A (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	11.2 V	13 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 PROTECTION:	15V	13.5 V	15 V
DUSK_SENSE	Panel Voltage < 1.5V		
DAWN_SENSE	Panel Voltage > 3.5V, 10sec delay		
PROTECTIONS:	*Short Circuit / Overload		
	*Reverse Battery and Panel		
	*Reverse flow of current from Battery to Panel during night		
	*Lightening		
	*Charging disabled if current >7.25A		
	*No battery but panel connected. System disabled.		
APPLICATION;	In Fixture Use Only		
OPERATING TEMP RANGE;	0 to 50^0 C		
DIMENSIONS:	75Lx60Wx20H		

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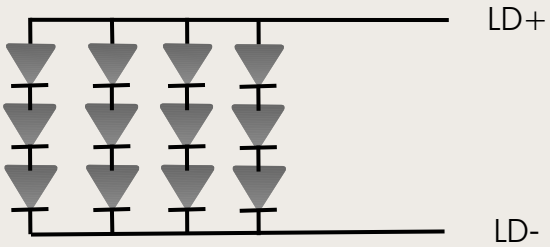
Important precautions for using the solar charge controller

- Panel suitable for the controller is of nominal 12V. Its Voc should not be more than 25V and capacity should not be more than 125Wp (7.25A max capacity). **Higher input current (>7.25A) will result in disabling MPPT operation .**
- While selecting the load, care should be taken that link is put at one place only. **If links are placed at two or more places, it will result in damage of the controller**.
- **No other motion sensor should be used**. Such use 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 to10 V)



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

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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. If battery selection is done correctly, the battery needs to be charged at least upto LVR.

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 permissible limit LVD and load is off. Unless battery is again charged at least upto LVR, load will not be on.

HVD (High Voltage Disconnect)
When the 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 HVR, MPPT mode will stop and MPP indicator will be off. Lower current will pump in the battery upto HVD. Current will totally stop at this point.

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 to refresh upto HVD. Please note MPPT will not come into action in this refresh mode.

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.

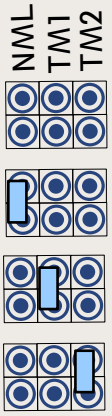
High Charging current protection
If panel connected is of bigger capacity, very high current will pass through the battery. To protect such a situation, BT_STS bicolour indicator will be blinking alternately and CHRG indicator will be continuously on until the panel is disconnected. Connect the proper capacity panel to avoid over current.

Customisation

EASY SELECTION TABLES:

MODE SELECTION:

The controller has multiple user selectable dimming options. A short link is provided with each unit for this operation as mentioned here:



No Short link : Default/Custom mode. Very slowly turns on and stays at 30% light upto 5 min. Then it increases to 50% and stays there until dawn. Motion sensor operates during the entire operation. If any custom operation is requested, it will be available here.

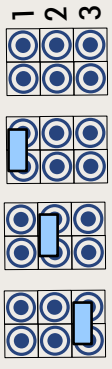
Short link placed at NML position. 100% light right from dusk to dawn. Motion sensor disabled.

Short link placed at TM1. 100% light for first 4 hours. Then 50% light till dawn. Motion sensor enabled during dim mode.

Short link placed at TM2. 100% light for first 6 hours. Then 30% light till dawn. Motion sensor enabled during dim mode.

MODE

LOAD SELECTION:



No Short link :
12W (McZD10-L), 30W(McZD10-H)

Pin 1:
15W (McZD10_L), 36W (McZD10-H)

Pin 2:
20W (McZD10-L), 40W (McZD10-H)

Pin 3:
24W (McZD10-L), 42W McZD10-H)

LOAD

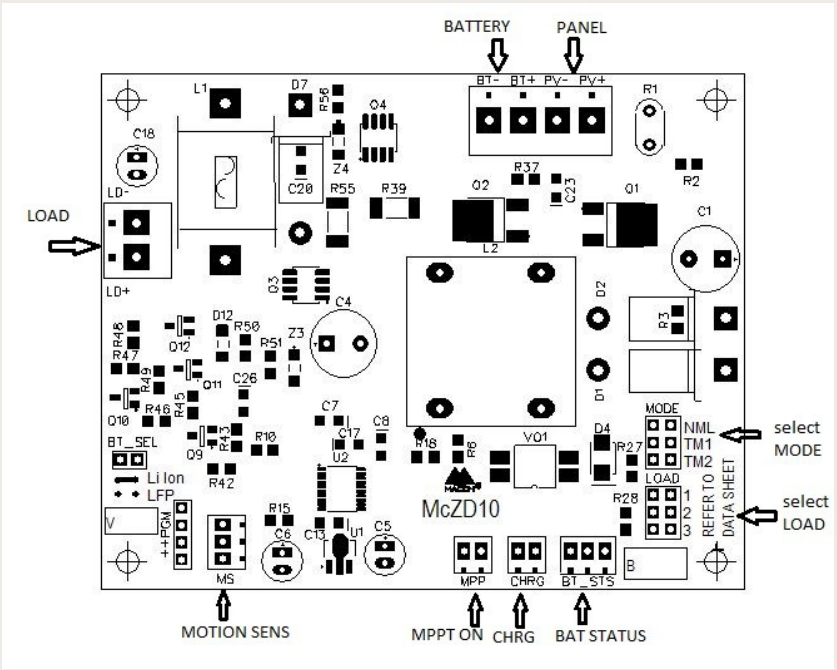
BAT_SEL (battery selection)

With Link :
Li Ion battery 11.1V

No Link :
LFP battery 12.8V

BAT_SEL

Please note
USING MORE THAN ONE LINK AT LOAD / MODE SELECT MAY RESULT IN UNPREDICTABLE OPERATION.



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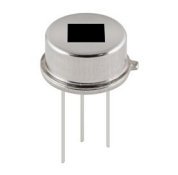
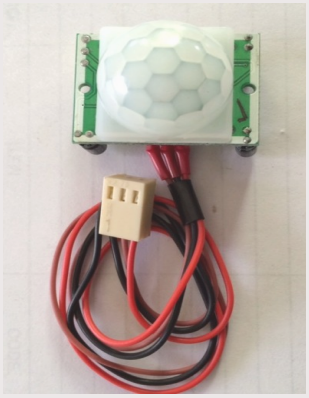
Motion Sensor
Add_On Module

McMS

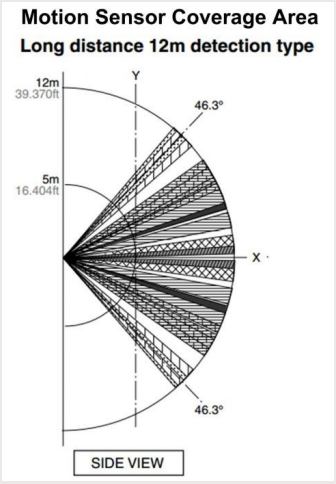


McMS is available as add_on module for connecting to the main charge controller unit. It is available in different sense-ranges from 6m to 17m.



Technical Specifications:

- Operating voltage: 5 to 15V
- Quiescent current: <9uA
- Level output: 3.3V Hi, 0V Lo
- Block time: 5sec
- Sensor Angle : 110 ^{0}
- Sensing range: 6m to 17m (depending upon the type)
- Operating temp: -15 to 70^{0}C



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FAQ

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 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.

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 insloation. Check voltage at PV+/PV- . It needs to be more than13V.

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.

MPP (Amber/Yellow) LED NOT ON:

1. Panel insolation is not sufficient to enable MPPT mode.
2. Battery might be fully charged and bulk charge is stopped and only refreshing is in operation.
3. Check if panel is oversized

BT_STS blinking alternately

The battery connected is of wrong type (higher voltage than permissible)

BT_STS blinking alternately+CHRG is continuous on

The charging current passing into battery is dangerously high. Panel should be of rated capacity. Disconnect the panel and connect right sized one.

WHAT ARE THE THINGS THAT CAN BE CUSTOMISED:

1.Battery Voltage settings different from factory defaults.

2.Load wattage different from the factory default

3.Light dimming percentage

4.Dimming time selection

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Performance of controller can be seen 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).

COLD TESTS:

- **Select the BATTERY type first from on board selector BAT_SEL.**
- 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. CHRG indicator will now turn on. Increase PV till battery voltage reaches HVD. Now CHRG 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, TM1 or TM2 at MODE connector.
- Keep battery voltage to at least LVR and panel voltage to 0. Load will gradually turn 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, battery 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 see the current. It will be half the previous value (when system is on for more than 5 min)
- TM1/TM2 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 1V. Wait for 10 sec and load will be off. Now gradually reduce panel voltage to slightly less than .5V and load will be on again. This completes DUSK_SENSE and DAWN_SENSE settings.

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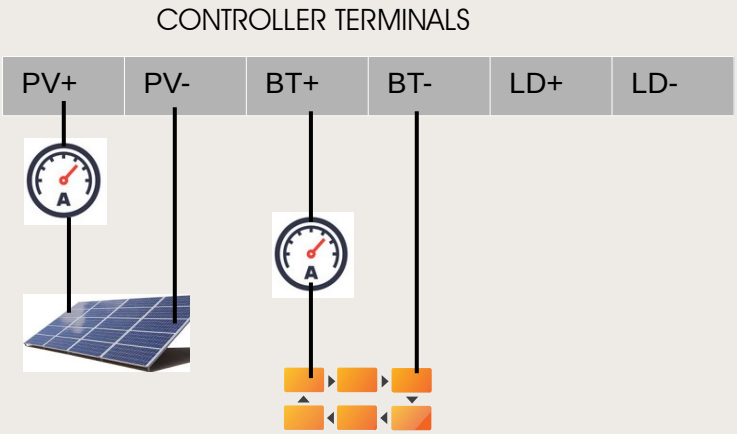
Efficiency Calculations

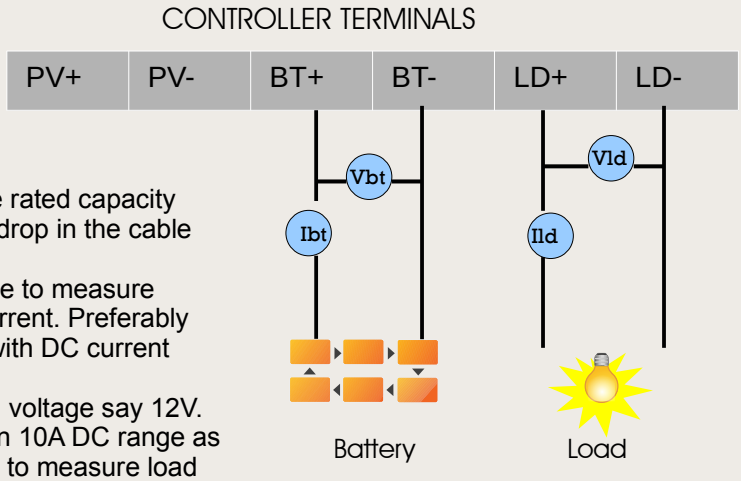
MPPT BOOST CALCULATIONS:

To know the percentage boosting of charging current by MPPT action, connect two digital current meters in panel and battery circuits as shown here.



When insolation is sufficient to enable MPPT mode, MPP LED of controller will be on. Monitor Amperage in battery circuit and panel circuit. Increase in battery circuit current will be seen.
If Panel current is Ipv and battery current at the same instant is Ibt, instantaneous percentage boost is Ibt/Ipv x100. This will be continuously varying over a period as insolation changes and/or battery voltage changes.

DRIVER EFFICIENCY CALCULATIONS:



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 the Output power.

Without disturbing the set up, connect the multimeters at battery terminals in the same way. This will give the 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 may go wrong.

EFF=(Vld*Ild)/(Vbat*Ibat)x100

Use thick wires to minimise cable loss

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