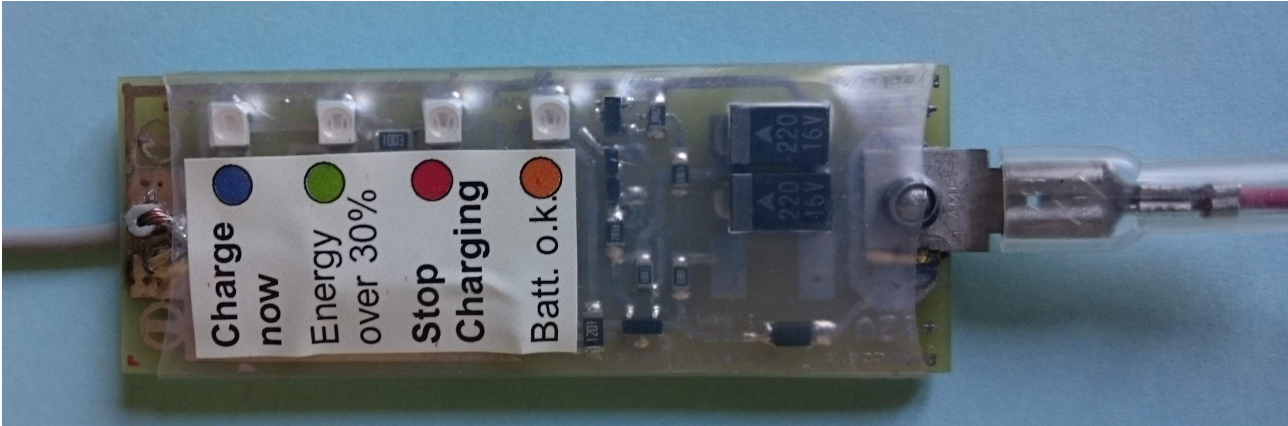


CMB Charging Monitor Circuit for 12 Volt Lead-Acid Battery

General

The monitoring circuit CMB shows the state of a lead-acid battery by measurement of the actual voltage. Four flashing colored LEDs give information about charging and using, fully charged and empty. The circuit needs a little current from the battery. The flashing method enables to reduce the measurement current down to only 1.5 mA. For example a 12 Volt lead battery with 50 Ah (Ampere hours) would lose 1% of the energy by the CMB after two weeks uninterrupted running. A 100 Ah battery would lose 0.5 % after two weeks or 1% after four weeks and so on.



Monitoring Table

Circuit LEDs	Battery voltage	Battery situation	To do
all LEDs off	lower than 10.5 Volts	deeply uncharged	Charge battery as soon as possible to prevent battery damage
blue alone	between 10.5 and 11.5 Volts	deeply uncharged	Charge battery as soon as possible to prevent battery damage
amber alone	between 11.5 and 12.4 Volts	30% or less energy remaining	Battery okay. Use remaining energy. Charging soon is recommended
green and amber	between 12.4 and 13.5 Volts	more than 30% energy remaining	Battery okay. Energy > 30%. Use it or charge it to reach 100 % energy again
green and red	13.5 Volts or more	fully charged	Stop charging to prevent gas producing and danger of damage

Specific Properties of Lead-Acid Batteries

- each cell delivers about 2 Volts, so that a 12V car batterie does have 6 cells
- the battery tolerates high charging currents
- a fully charged batterie shows about 12.8 Volts
- below 12 to 11.5 Volts the battery becomes empty
- below 11 Volts the battery goes to be deeply discharged and has to be regenerated soon
- over 13.8 Volts the charging process generates gas from battery fluid, additionally the chemic consistence of the battery may get damage. With generating gas there grows pressure in the battery that comes out of the battery by built in valves.

Description of the CMB Circuit Functions

The LEDs on the CMB always shine like flashlight and not uninterrupted so that the circuit saves energy. Additionally as more energy stays in the battery as faster is the flashing of the LEDs.

When charging the battery the voltage grows up to maximum 14.4 Volts, but to prevent gas producing and the possibility of chemical damage charging should stop at about 13.8 Volts. The CMB shows the red light while the amber light has gone off when 13.5 Volts are reached and therefore charging should stop next.

When using the batterie to deliver courant for some device (lights, TV, motors, ...) the voltage of the full charged battery does start at about 12.8 Volts slowly decreasing down to 12 Volts when going to be empty. But there is a small rest energy on it, that could be used down to about 11.5 Volts. The CMB shows all the time the green light as long as the battery energy state is more then 30%. Below 30% only the amber light flashes.

With the use of the rest energy the amber light switches off when the voltage is down at 11.5 Volts. When it comes to 11.4 Volts or below the blue light begins to flash. Showing the amber light alone charging is recommended. Showing the blue light charging is required as soon as possible.

Connecting to the Battery

The CMB has two connecting pads, one on each side. The pad with the pattern +12 has to be connected with the red wire to the plus pole of the battery. The pad on the opposite side with the minus sign has to be connected to the battery minus pole with the grey wire.

After connecting the CMB with the batterie it will take about 3 seconds until it will work. Because of the low current the circuit takes from the battery (1,5 mA) small wires can be used for connecting. The CMB can be placed far away from the battery when using long wires to connect.

The CMB is protected against mechanical contact and voltage connection by using plastic tube round it. It is not waterproofed so it can only be placed in dry rooms.

When no battery usage and no charging is given for a lot of weeks it would be better to disconnect the monitoring circuit to provide loosing some battery energy. The red wire can be pulled off the CMB. Within 4 weeks uninterrupted running the circuit will take about 1 Ah (Ampere hour). For example a fully loaded 12Volt 30 Ah Battery does remain 29 Ah after 4 weeks, 28 Ah after 8 weeks and so on.

But attention! A battery may have little self discharging that will additionally reduce the battery energy when idle standing long time. Informations in the internet tell about 4 to 6% self discharge of lead batteries during one month. The battery manufactor may give more specific information about that.

Technical Information about the CMB

Waterproof	no
Working temperature	+5 to +40 Celsius (at lower temperature CMB voltage measurement is lower)
Current	1.5 mA
Maximum Voltage	16 Volts
Protection	against false polarity (red and grey wire exchanged)

Error Table

Error	Possible Reasons	Remedy
No shining of the CMB LEDs after connecting to the battery	1) Very low voltage on the empty battery 2) Battery status low, the amber LED is off and the blue LED does not yet shine 3) Bad connection to the battery, broken wire	1) charge immediately 2) charge immediately 3) repair connection, replace wire
One or more LEDs shine very little without flashing	May be some humidity did come into the CMB circuit (condensate)	Dry the CMB circuit by putting it to a warm dry sunny place for some hours

Abbreviations LED Light Emitting Diodes (a good replacement for old light bulb)
 CMB Charging Monitor for Batteries
 mA milli ampere, 1000 mA = 1 A

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