Solar Battery Charger 12 V

AVT 5598

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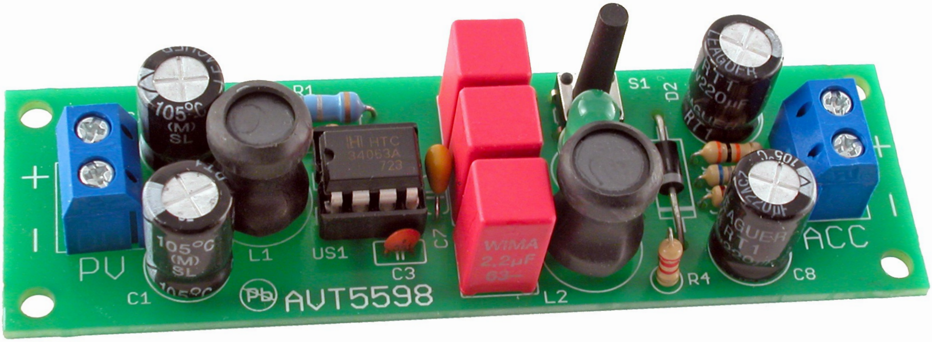


ASSEMBLY DIFFICULTY

This unit is a charge controller designed to operate at input voltages varying over a very wide range from 4 to 25 V. This controller can come in handy at the garden plot, campsite, or camping.

Features

- designed for operation with a voltage source of 4-25 VDC
- can operate with a photovoltaic panel with a nominal voltage of 12 V
- used for charging a 12 V lead battery
- battery charging current 0.05-0.6 A
- PCB size: 89×27 mm

Circuit description

The circuit is used to charge an acid battery (e.g., a gel battery) in buffer mode, i.e., the charging current starts to decrease when the set voltage is reached. This always keeps the battery ready. The charger supply voltage can vary between 4-25 V. Ability to take advantage of both strong and weak sunlight significantly increases time of charging during a day. Charging current strongly depends on the input voltage, but this solution still has advantages over simply limiting the excess voltage from the solar module. Schematic diagram of the charger is shown in Figure 1. The constant-voltage energy source is a converter made in SEPIC topology based on the low-cost and well-known MC34063A chip. It works in its typical role of a keying circuit. If the voltage applied to the comparator (leg 5) is too low, the built-in transistor key starts operating at a constant fill and frequency. Operation ceases if this voltage exceeds the reference voltage (typically 1.25 V). Controllers that can vary the keying signal fill are definitely used more often in converters with SEPIC topologies that can both step up and step down the output voltage. The use of the MC34063A in this role is an uncommon solution, but - as tests of the prototype showed - sufficient for this application. Price was also a certain criterion, which in the case of the MC34063A is significantly lower than PWM controllers. To reduce internal impedance of the power source, which is the photovoltaic module, the two capacitors C1 and C2 connected in parallel are used*-. Parallel connection reduces the resultant parasitic parameters, such as resistance and inductance. Resistor R1 serves to limit the current of this process to approximately 0.44 A. A higher current may cause the IC to overheat. Capacitor C3 sets the operating frequency to approximately 80 kHz. Chokes L1 and L2, as well as the resultant capacitance of capacitors C4-C6, have been selected so that operation of the converter is possible over a very wide voltage range. Parallel connection of capacitors was intended to reduce the resultant ESR and ESL. The LED1 is used to check that the controller is working. If so, an alternating component of the voltage is deposited on coil L2, which is indicated by switching on the LED. It is switched on by pressing the S1 button so that it will not be pointlessly on all the time. Resistor R3 limits its current to approximately 2 mA, and D1 protects the LED from breakdown caused by excessive reverse voltage. Resistor R4 was added for better stability of the inverter at low current consumption and low supply voltage. It absorbs some of the energy that the L2 coil puts into the load. It has an effect on efficiency, but a small one - the value of the current flowing through it is only a few milliamperes. Capacitors C8 and C9 smooth the ripple of the current supplied via diode D2. The resistor divider R5-R7 sets the output voltage to approximately 13.5 V, which is the correct voltage at the terminals of a 12 V gel battery in buffer operation. This voltage should change slightly with temperature, but this fact has been omitted so as not to complicate the circuit. This resistor divider loads the attached battery all the time, so it should have as high a resistance as possible. Capacitor C7 reduces the ripple of the voltage seen by the comparator and reduces the response rate of the feedback loop. Without it, with the battery disconnected, the output voltage can exceed the safe value for electrolytic capacitors, because each time the keying is switched on (even for a short while), a considerable amount of energy is injected into them, which has no outlet. Adding this capacitor causes the circuit to stop switching the key every now and then.

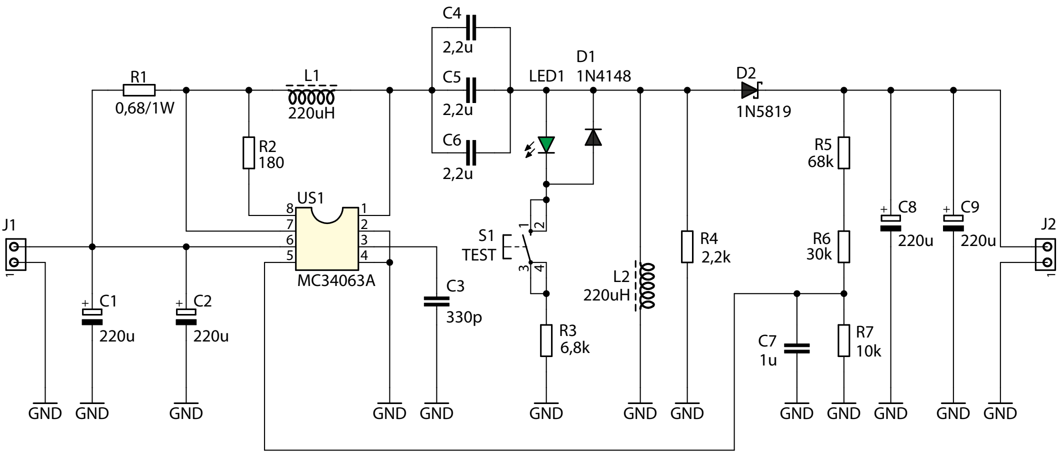


Fig. 1 Schematic diagram of the solar charger

Mounting and start-up

The charger was assembled on a single-sided 89 mm×27 mm PCB, the assembly diagram of which is shown in Figure 2. All components are in enclosures for through-hole technology, which is a great convenience even for those who are not very proficient with a soldering iron. Under the IC, it is suggested not to use a socket, as it will increase the resistance of the connections to the keying transistor. When correctly assembled, the unit is immediately ready for operation and will not require any start-up steps. To test the device, you can apply DC voltage to its input and regulate within a given range 4-20 V and observe reading of the voltmeter connected to the output. It should vary sawtooth in the range of approx. 18-13.5 V. The former value is due to capacitor charging and is not critical, but at 13.5 V the inverter should resume operation. Charging current depends on the current input voltage, as the input current is limited to approximately 0.44 A. As the measurements indicated, the battery charging current varies from about 50 mA (4 V) to about 0.6 A at 20 V. This value can be reduced by increasing the resistance of R1, which may be advisable for batteries with a small (as 2 Ah) capacity. The charger is suitable for use with a photovoltaic module with a nominal voltage of 12 V. Its terminals can carry voltages of up to 20...22 V at low current consumption, which is why capacitors suitable for 25 V are used at the converter input. In contrast, with a voltage of less than 4 V, the losses are so high that charging of the battery practically will not take place. To make the most of the charger, a module of 10 W or more must be connected. In the case of lower power, charging of the battery will also take place, but more slowly.

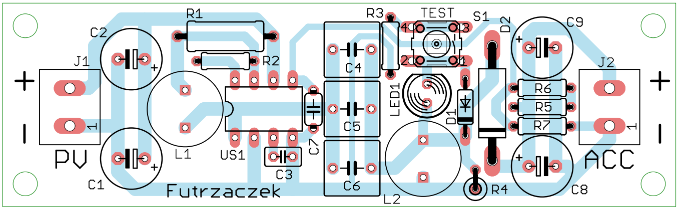
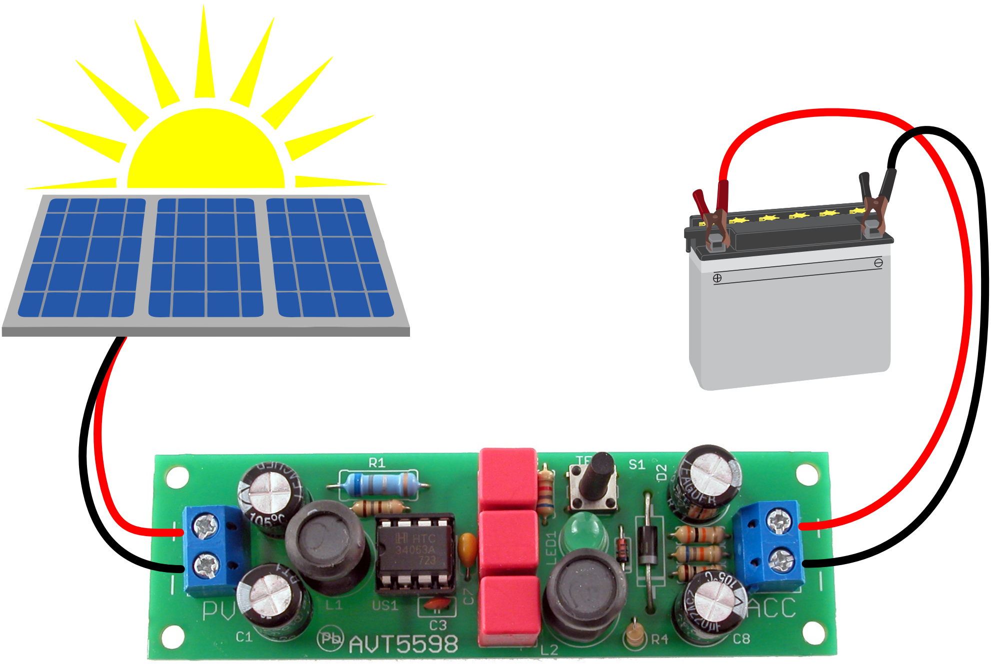


Fig. 2 Arrangement of components on the PCB

List of components

Resistors:
R1: ....0,68 Ω / 1 W
R2: ....180 Ω
R3: ....6,8 kΩ
R4: ....2,2 kΩ
R5: ....68 kΩ
R6: ....30 kΩ
R7: ....10 kΩ
Capacitors:
C1, C2, C8, C9:.......220 uF / 25 V
C3: ....330 pF (ceramic)
C4...C6:....................2,2 uF / 50 V (MKT R=5 mm)
C7: ....1 uF / 50 V ((monolithicy)

Semiconductors:
D1:............................1N4148
D2:............................1N5819
LED1: ....LED 5 mm e.g. green
US1: MC34063A (DIP8)
Other:
J1, J2:.......................connector ARK2/5 mm
L1, L2: ....choke 220 mH (vertical)
S1:.............................microswitch 6×6/13 mm



Notes

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Produktu nie wolno wyrzucać do zwykłych pojemników na odpady. Obowiązkiem użytkownika jest przekazanie zużytego sprzętu do wyznaczonego punktu zbiórki w celu recyklingu odpadów powstałych ze sprzętu elektrycznego i elektronicznego.