Lead Battery Charger 10...200 Ah

AVT 2715

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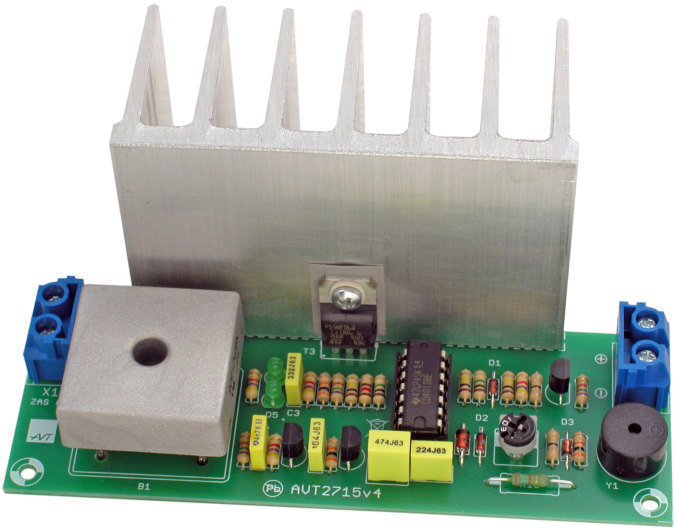


ZOOM

ASSEMBLY DIFFICULTY

The module allows charging of large capacity batteries without the risk of overcharge and damage to them. This circuit operates in a pulsed manner -the battery is charged with current 'pins'. The charger has no charge current limiter only a final voltage control. It features reverse battery connection protection. Any abnormality is indicated by an acoustic signal.

Characteristics

- charging of 12-V lead batteries with capacities 10...200 Ah
- impulse operation
- short circuit protection
- audible indication of faulty connection of poles
- recommended transformer: 17 VAC
- PCB size: 40×117 mm

Circuit description

The system has no current limiter and the maximum charging current (when the transistor is permanently open) is here determined by the transformer and possibly limited by a series resistor and/or by a bulb placed in the primary winding circuit . BUZ11 is recommended as transistor T3 with a permissible continuous current of 26 A, and in the pulse up to 104 A. A key role in the control system is played by D flip-flop from the chip 4013 - U2A. At the end of the full network waveform period, this flip-flop is reset to zero by a short pulse applied to its input R. Then, a low state appears at the Q output. Capacitor C1 charges via diode D1 and the flip-flop output resistance. Positive ramp at CLK input of the U2A flip-flop causes that the output Q takes logical state from the D input. This input is connected to the TL431 - U1 comparator. If the voltage at the REF input of the TL431 chip (relative to ground and terminal A) is less than 2.5 V, there is no current flow through U1, so at the D input of the flip-flop there is a high state.
If the voltage at the REF input reaches a value of threshold voltage of the chip (2.5 V, to be precise 2.495 V ±55 mV), a current will flow through U1 and resistor R7. The voltage at the D input of the flip-flop will drop to values of approximately 2 V, which will be treated as a low state. Potentiometer PR1 adjusts the voltage of the comparator U1 tripping in the range of at least 13.5...15 V.
If the battery voltage is below comparator tripping, then after each resetting of the U2A inverter after additional short delay, the high state is set on the output Q. Capacitor C1 is charged and the voltage at the gate of the transistor becomes at least 10 V higher than the voltage at its source - the transistor

opens. An important characteristic of the circuit is that the described charging cycle C1 is not repeated in each half of the network waveform, only every full period, i.e. every 20 ms. This ensures that the circuit always passes an even number of halves of the sine wave, which is beneficial for the transformer as the current drawn will not contain a constant component. Components R2, D4, D5, R12 are selected so that transistor T1 jams at the end of the positive waveform when the instantaneous value of the voltage from the transformer is approximately 6 V. Transistor T2 jams a little later when the instantaneous voltage falls below 1V. At T1 and T2 there are rising ramps staggered by approximately 1ms. An earlier rising ramp on the T1 due to the presence of a circuit that differentiates R8C3 produces a short (approx. 0.3ms) zeroing pulse at the R input of the U2A flip-flop. The rising ramp that comes a little later on the the clock input sets the current state of the D output on the Q output.

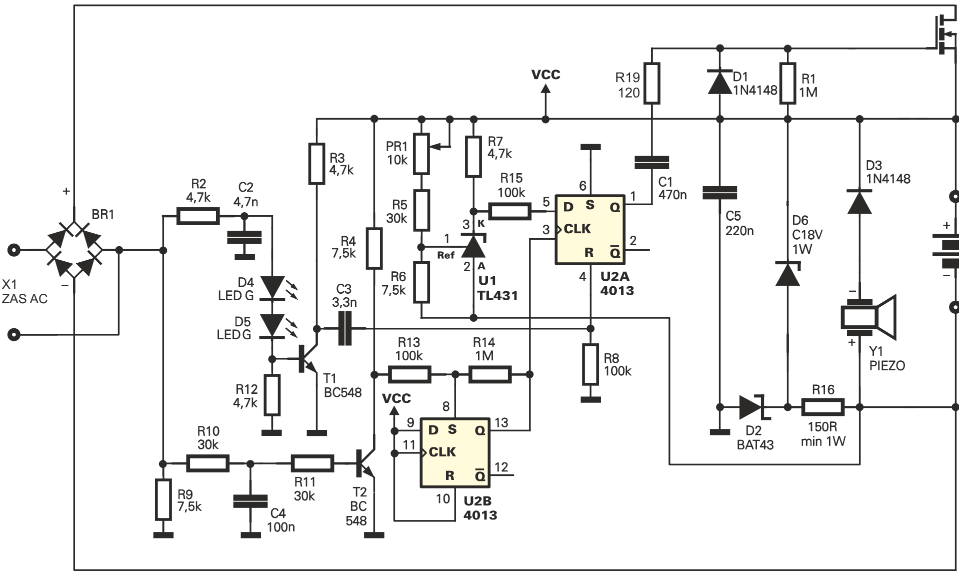


Fig. 1. Schematic diagram

Note that the charger's electronic circuitry (including U2) is supplied with voltage from the charged battery. If the battery is not connected, the serial transistor T3 will not open. Such solution, among other things, protects against damage in the event of short-circuiting terminals X2 and reverse battery connection. If the transistor T3 remains jammed, accidental short-circuit or reverse battery connection will not damage the rectifier bridge diodes. During normal operation, Zener diode D6 is not conductive.

The electronic circuit is powered by a small value resistor R16 and Schottky diode D2. The D6 diode is needed to limit the supply voltage of the integrated circuit U2 to safe value. This diode also protects the circuit in case of reverse battery connection. At the time of reverse connection of the battery, resistor R16 and diode D6 have a current flow not exceeding 0.1A. Actually, resistor R16 can have lower resistance and lower power, because at reverse battery connection the Y1 buzzer immediately sounds loudly.

Mounting and start-up

Circuit assembled correctly from efficient components will work straight away. Because, currents of several or even over a dozen amperes flow in it, it is required to use wires with a suitable cross-section. Main current circuit, i.e.: connection of the module to the transformer and battery should be made with a minimum cross-section of 2.5 mm^2. It is also advisable to tin the exposed tracks on the board. The used BUZ11 transistor has a permissible continuous current of 26 A, and in practice maximum (effective) charging current should not exceed 12...15 A. When charging batteries with very large capacities it may be needed to individually select the heatsink and to replace transistor T3 with for a component of greater conduction current and also to place the bridge BR1 on a heatsink.

When adjusting the circuit, using the potentiometer PR1, set the final charging voltage.

According to the instructions of the battery manufacturers, at cycling operation it will be approximately 15V (recommended value is 14.4 V...15 V) and in buffer operation approx 13.8 V (13.5 V...13.8 V). Due to the significant charging current pulses, it is recommended that adjustment is carried out after connecting a battery, under real operating conditions. Final voltage set too low (voltage switching off the current) can significantly increase the time needed to fully charge the battery.

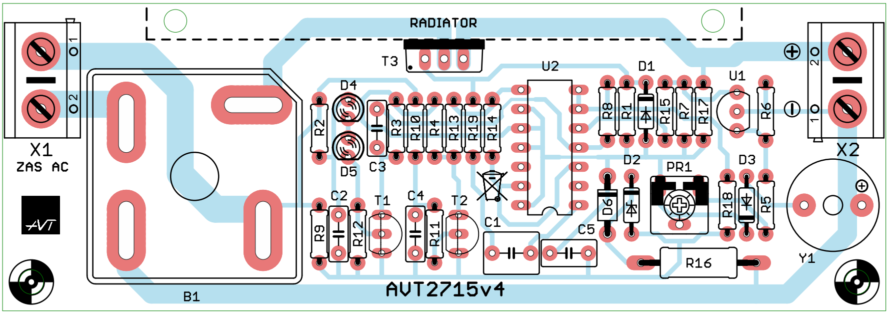


Fig. 2. Arrangement of components on the PCB.

Correct and fault-free use of the charger requires the following sequence of connection to be observed:

1. With the charger's power supply disconnected, connect the battery to the AKU + and - terminals.
2. The buzzer activation indicates any incorrect battery connection - the terminals must be swapped.
3. If the buzzer is not activated, you can connect the mains supply to the charger.

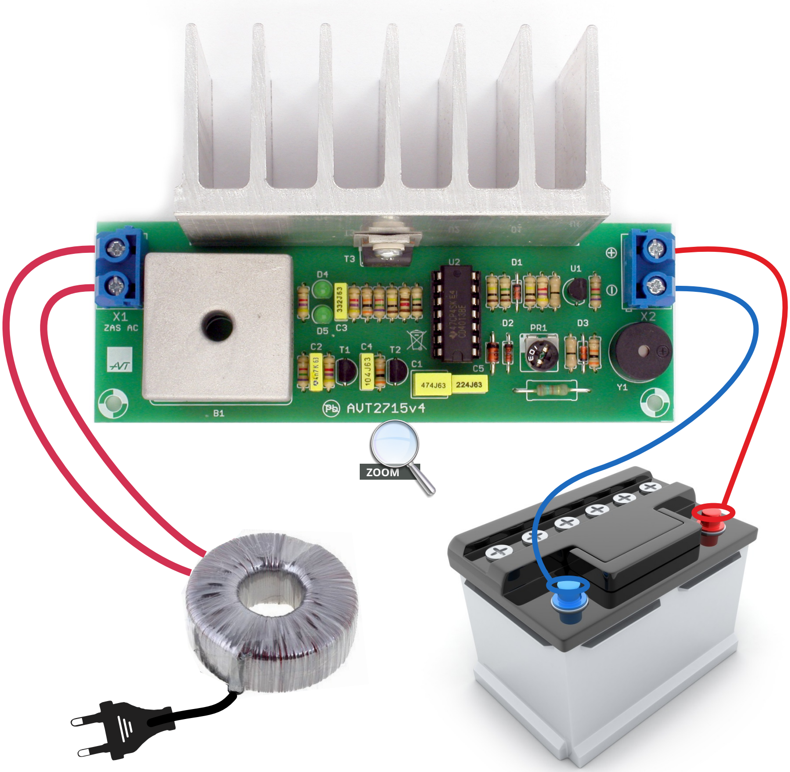
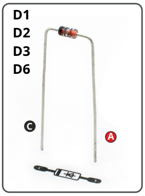
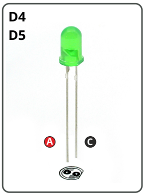


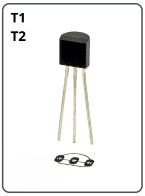
Fig. 3 Connection of the charger

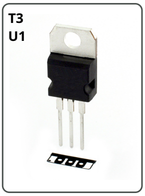
List of components

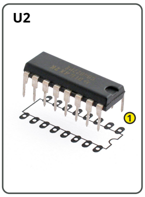
Resistors:
R1, R14:........................1 MΩ (brown-black-green-gold)
R2, R3, R7, R12: ....4.7 kΩ (yellow-violet-red-gold)
R4, R6, R9:..................7.5 kΩ (violet-green-red-gold)
R5, R10, R11: ....30 kΩ (orange-black-orange-gold)
R8, R13, R15: ....100 kΩ (brown-black-yellow-gold)
R17, R18:.....................0 Ω (JUMPER) (black)
R16: ....150 Ω / 1W (brown-green-brown-gold)
R19: ....120 Ω (brown-red-brown-gold)
PR1: ....mounting potentiometer 10 kΩ
Capacitors:
C1:................................470 nF (may be designated 474)
C2:................................4.7 nF (may be designated 472)
C3:................................3.3 nF (may be designated 332)
C4:................................100 nF (may be designated 104)
C5:................................220 nF (may be designated 224)
Semiconductors:
B1:................................rectifier bridge
D1,D3:..........................1N4148 !
D2: ....BAT43 !
D4, D5: ....LED G 3mm !
D6: ....Zener diode C18 V / 1 W !
T1,T2: ....BC548 !
T3:................................BUZ11 !
U1: ....TL431 !
U2: ....CMOS 4013 !
Other:
Y1:................................piezo transducer with generator
X1, X2: ....screw connectors
Heatsink











Start mounting from soldering the components onto the board in order of size from smallest to largest.
When mounting components marked with an exclamation mark, pay attention to their polarity.
Wiring diagrams and symbols of the components on the PCB and photographs of the assembled kit may be helpful.
To access the high-resolution images as links, download the PDF.

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