Workshop Generator

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AVT 3170

ASSEMBLY DIFFICULTY

An indispensable tool for electronics engineers and hobbyists who are looking for an inexpensive and useful equipment for their workshop.
- generates a TTL waveform at the set frequency and fill.

Features

- output signal: rectangular, TTL with a capacity of approx. 300 mA
- frequency range generated: 0...49.9 kHz
- frequency readout on the LED display
- change of fill from 1...99%
- power supply 12 VDC

Circuit description

Schematic diagram of the circuit is shown in Figure 1. Its following functional blocks can be identified:
• ATMEGA8 microcontroller with quartz resonator,
• potentiometric frequency and fill level controllers, supply voltage stabiliser,
•3-digit 7-segment LED display with anode drivers and segment current-limiting resistors,
•5-position frequency range selector switch with LEDs indicating the selected range,
•output circuit with transistor and protection.
The program in the ATMEGA8 microcontroller (US1) is responsible for operating the user interface and generating a signal of the selected frequency and fill. Resistor R1 and capacitor C4 filter the supply voltage, which is used as a reference voltage for the built-in A/D converter, which in turn is used to read the position of the potentiometer shafts. Capacitor C3 is responsible for applying a logical '0' to the Reset pin for a short time after the supply voltage is switched on. The power supply was based on a basic application of the LM7805 linear stabiliser. Connected supply voltage to the POWER connector must be in the range of 8-12 V. Diode D2 protects the generator from incorrect polarity of the input voltage. The supply voltage stabiliser US2, together with capacitances C7...C10, provides a well-filtered +5 VDC voltage. Set frequency and fill value is displayed on the 3-digit 7-segment LED display. Digits share a common anode, so PNP transistors were used to control them. Currents of the individual segments are determined by resistors R2...R9. The control is multiplexed and takes place in the interrupt service routine from the hardware overflow counter Timer0. Set values are displayed in real time. Frequency of the generated rectangular signal is divided into 5 sub-bands. The 5-position switch (SW1) is used to select the range. Selected range is indicated by the lighting of the corresponding LED.

Output circuit uses a BCX51 transistor (T4), operating with a common emitter. Collector load is resistor R21 and the electronic circuit under test attached to the OUTPUT connector. Diode D1 protects against the opposite polarity voltage occurring on the transistor, which could damage it. Resistor R22 is used to limit the output current to a 'safe' value of around 300 mA. This is sufficient to control logic gates, LEDs or small relays. Here it should be remembered that such a solution will give a logic '1' voltage of less than 5 V by the transistor UCEsat voltage, which is typically around 0.5-0.7 V.

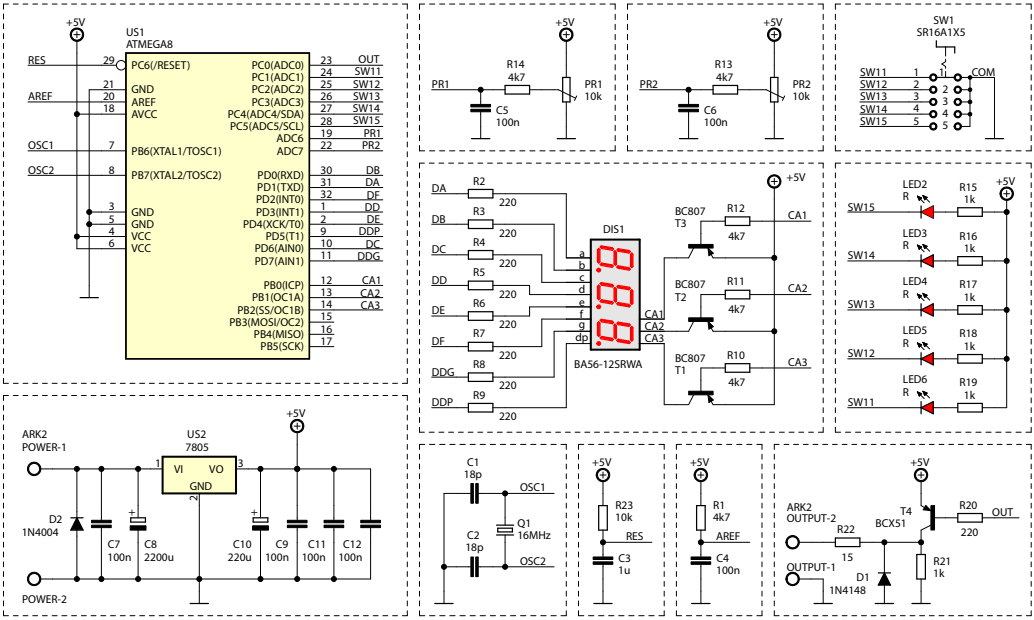


Fig. 1 Schematic diagram

Mounting and start-up

Mounting diagram of the circuit is shown in Figure 2. Photographs will be helpful when mounting. All parts are mounted on a double-sided 60×116 mm PCB. Due to arrangement of the components on both sides of the board, follow this mounting sequence: ATmega8 microcontroller, resistors and capacitors SMD, transistors T1...T3, quartz resonator, diodes D1, D2, resistor R21, R22 a few millimetres from the board. In a further step, capacitors C7, C9, screw connectors, electrolytic capacitors C10, C8 and stabiliser US2 by screwing it to the heat sink beforehand. Before the next step, it is a good idea to wash the plate with isopropanol. On the opposite side of the board: transistor T4, switch SW1 (first cutting off the locator pin) and, without soldering, insert LEDs 2...6. In the next step, screw the banana sockets to the front panel and assemble the two boards together so that the corresponding components are in their places. Now, push the LEDs through the holes around the rotary switch and solder their legs, paying attention to polarity. A broken-out section of the laminate, where the the LED display is to be mounted, will be the ideal distance to mount the potentiometers. Solder straight Goldpins beforehand, removing any unnecessary pins. Before the next step, cut off locator pins in the potentiometers. By bending at right angles the leads of the potentiometers, align them according to the outline on the generator board through the aforementioned piece of laminate and solder their leads to the Goldpins. This will allow them to be accurately positioned relative to the front panel. Now, put the two boards together and move on to mount the display. Put it through the hole in the front panel and cover it with a piece of plate so that its surface is flushed with the front. Solder its two diagonal leads and check the alignment. If it is satisfactory, you can solder the remaining legs. Install the banana sockets with nuts on the main board. Finally, put the knobs on the potentiometers and the switch. Thus assembled, the device will operate when energized without any start-up and adjustment. To test its operation, you can attach a Piezo transducer and listen to the sound change by adjusting the

frequency and fill with respective knobs. The circuit must be supplied from a DC source of not less than 8 V and current capacity of not less than 500 mA. If loads with significant current consumption will be attached to the output, then this capacity should be correspondingly higher. Also, consider the power lost in the stabiliser. The device has a heat sink, which should easily dissipate any heat generated in the stabiliser. To ensure trouble-free operation of the generator, it is recommended to install it in the Z3 enclosure. Front panel dedicated to this enclosure is shown in Photo 1. This avoids short circuits caused by accidental contact with metal objects. Use a standard DC 2.1/5.5 as the power connector, which is mounted in the rear wall of the enclosure. Use two banana-type terminals on the front panel as signal connectors, and in addition, a screw connector on the main PCB for the output of the signal to any other connector, e.g., BNC. During normal operation, the display shows the set frequency value. Adjusting the fill will switch it to display the fill value. Once the fill is adjusted, it will automatically switch to frequency indication.

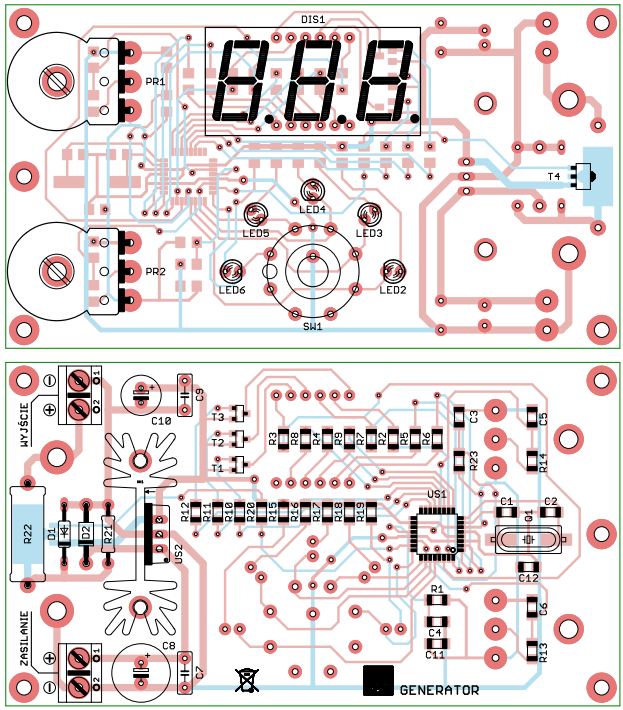
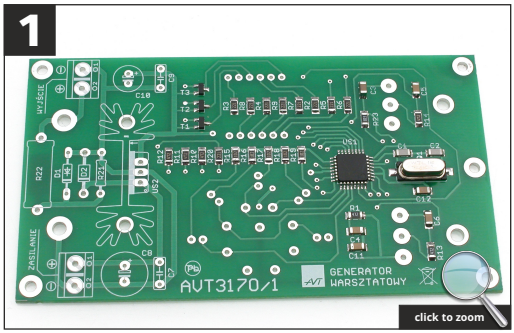
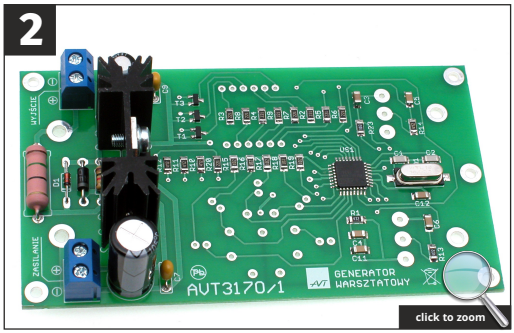
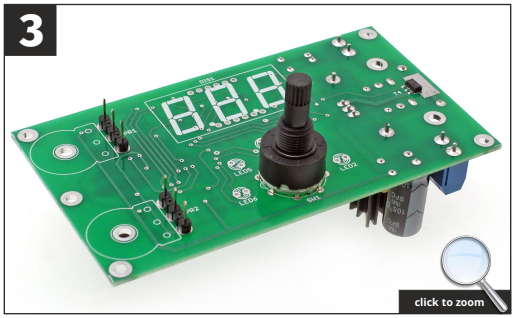
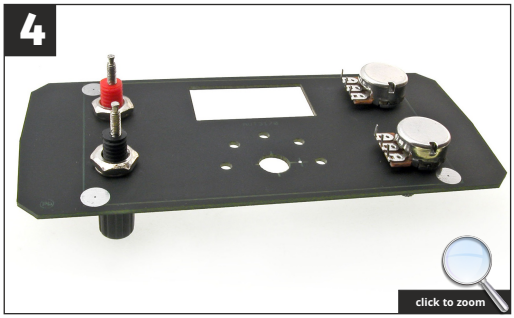


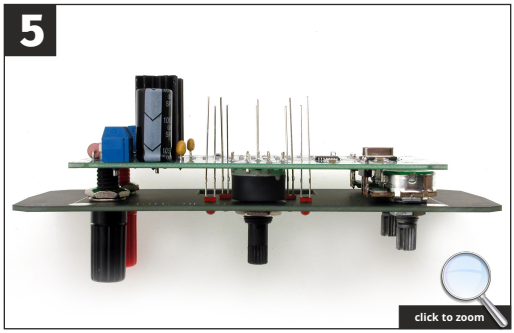
Fig. 2 Arrangement of components on the PCB.

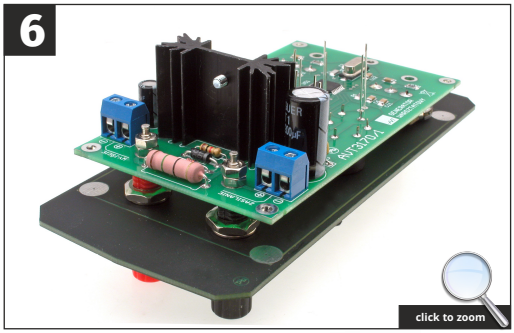


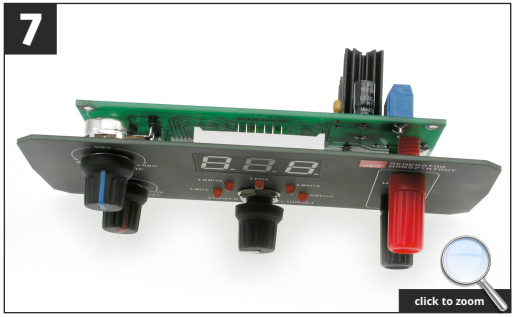


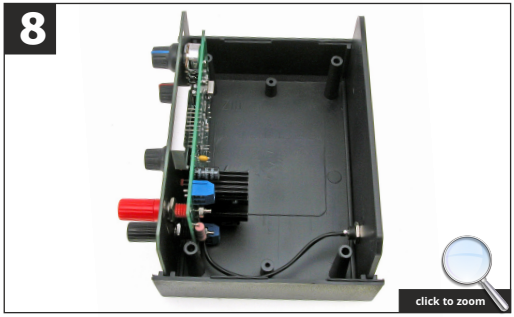












List of components

Resistors:

R1, R10-R14:.....4.7 kΩ (1206)
R2-R9, R20:.....220 Ω (1206)
R15-R19: .....1 kΩ (1206)
R21: .....1 kΩ
R22: .....15 Ω / 3 W
R23: .....10 kΩ (1206)
PR1, PR2: .....10 kΩ

Capacitors:

C1, C2: .....15-22 pF (1206)
C3:.....10 µF (1206)
C4-C6, C11, C12: .....100 nF (1206)
C8: .....2200 µF
C7, C9: .....100 nF
C10: .....220 µF

Semiconductors:

D1: 1N4148
D2: 1N4007
DIS1:.....display AT5636BMR
LED2-LED6: .....any LED 3mm
US1:.....ATMEGA8
US2:.....7805
T1-T3: BC857
T4:.....BCX51

Other:

Q1: 16MHz
SW1:.....5-position rotary switch SR-16
POWER, OUTPUT: ARK2/500
Heat sink
Banana sockets
Z3 enclosure

AVT SPV Sp. z o.o.

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