Spectrum Analyser

AVT 2864

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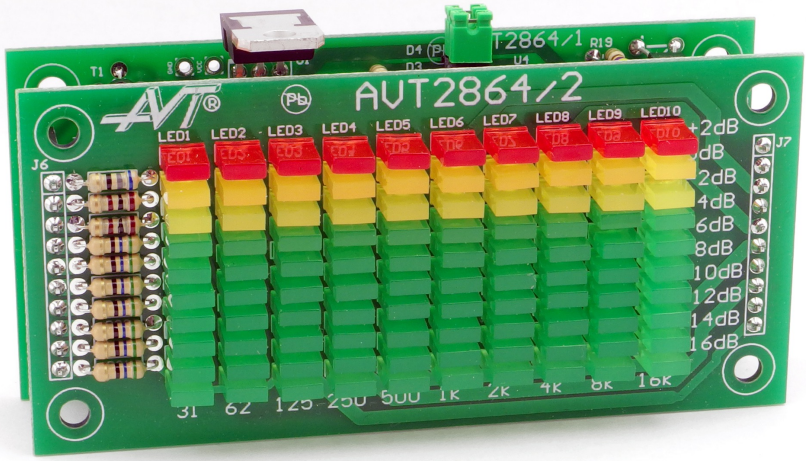

ASSEMBLY DIFFICULTY

Circuit for analysing and displaying the spectrum of an audio signal, very often used (and found) in the audio paths of so-called high-end audiophile equipment. In addition to the analogue part, the kit uses digital signal processing, or DSP. The 'heart' of the analyser is the ATmega8 processor. The A/D converter contained in its structure serves to convert the analogue signal into a digital signal accordingly, and this is routed to a display realised from an array of LEDs.
The filters used to light up relevant 'bars' are provided in the software. This has greatly simplified the design of the analyser, so that even an intermediate electronics technician can build and use this device.

The set is based on the design with the same title published in Electronics for All 05/2008. Full version of the original manual is available to download here: **https://bit.ly/3opZDPH**

Characteristics

- monophonic spectrum analyser - 1 channel
- signal spectrum presented on a 10-bar display
- filter mid frequencies: 31 Hz, 62 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz and 16 kHz
- signal amplitudes that light up subsequent LEDs in the bar: -16 dB to +2 dB in 2 dB steps
- 0 dB indication corresponds to an input signal with an amplitude of 0.2 V
- operation in bar or point display mode
- maximum amplitude display mode
- spectrum presentation on the field from multicoloured LEDs (100 pcs)
- power supply: 9-12 VDC
- board sizes:
  LED board 96×45 mm, main board 96×45 mm

Circuit description

Circuit diagram of the main board is shown in Figure 1, and the display diagram in Figure 2. The supply voltage of 9-12 V is fed to the VCC and GND points. It is filtered through capacitors C1 and C2 and goes to stabiliser U1. Voltage from stabiliser output, blocked with capacitors C3 and C4, powers the microcontroller U3, and the LED display. The audio signal goes to IN point and via capacitor C9 enters the non-inverting input of operational amplifier U2. Resistors R34, R35, R36, R37 and diodes D1, D2 form a amplifier supply voltage limiter U2. Resistors R36 and R37 form a voltage divider that pre-polarises the ADC input with approximately 2.5V. Amplified audio signal from the output of operational amplifier U2 is via the capacitor

C11 fed to this divider and modulates the voltage on it. When too high signal appears, it will be short-circuited by diodes D1 and D2.
Resistor R34 protects against short-circuiting when the signal is limited. The resistor values have been so selected that the voltage at the input of the ADC converter is in the range 0...5 V. Capacitor C12 with resistors R34 and R35 connected in series creates a simple anti-aliasing filter.
Because the ATmega8 chip has too few legs to directly handle a display of 10 columns and 10 rows, receive analogue audio data and read the status of jumpers J4 and J5. It would still be possible to have it somehow realised if it were not for the need to occupy 2 pins by the X1 resonator. Therefore, the decoder 4028 is used, which increases the number of output pins. Transistors T1...T10 and T11...T20 increase the current capacity of these pins. Diodes D3 and D4 provide short-circuit protection when both jumpers J4 and J5 are inserted. Due to the high refresh rate of the display, resistor R39 is required to ensure that the logic states on pin PC.5 are sufficiently fast and stable.

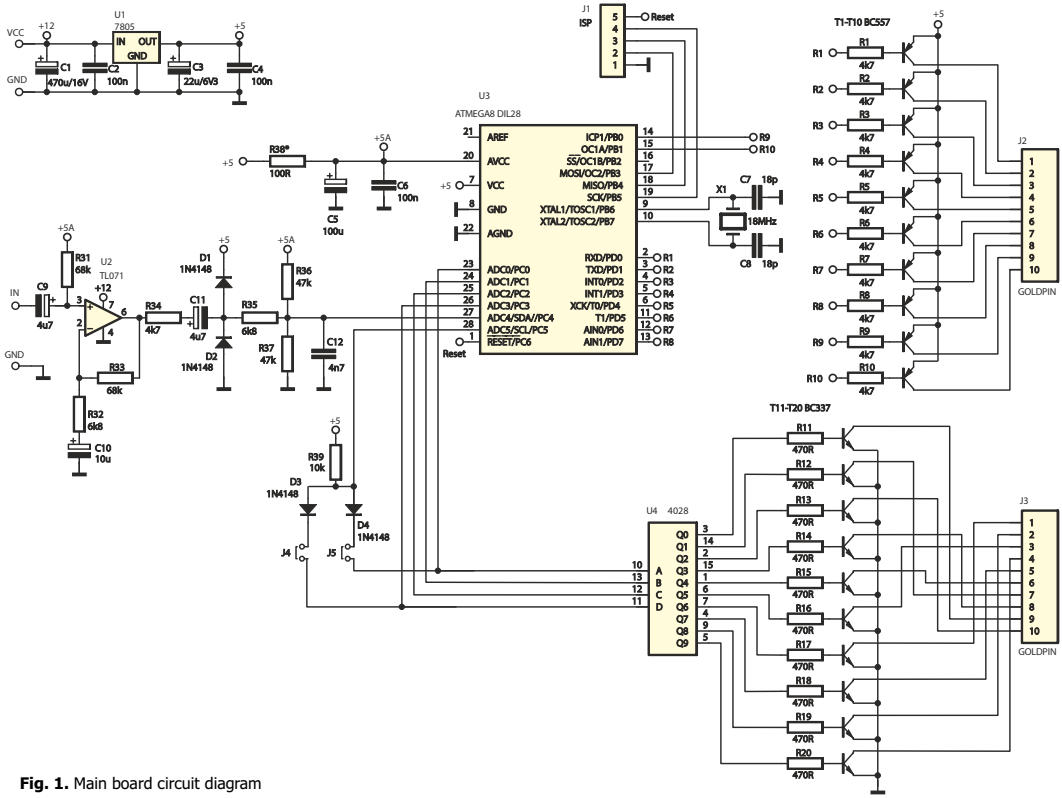

Fig. 1. Main board circuit diagram

Mounting and start-up

The circuit is mounted on 2 PCBs shown in Figure 3. Boards are assembled in the so-called 'sandwich'. The mounting, apart from the fact that the components are fairly tightly spaced, is rather classic.
Start mounting from the smallest components. Use socket under the U3 chip. The X1 resonator is mounted standing only if its height is not greater than 8mm. If it is going to be the most common type of resonator, i.e. one that is 12mm high, it should be mounted lying, tilting it by 90° towards resistors R1...R10, as drawn on the board. Electrolytic capacitors C1, C3, C9, C10 and C11 vertically may also not fit, so they too should be mounted lying. Before mounting the U2 chip, cut off or bent upwards legs no. 1, 5 and 8, as the PCB has no holes for them. Goldpin strips (J2 and J3) on the display board and the goldpin sockets (J6 and J7) on the other board is best soldered after they are joined in pairs (strip inserted in the socket)

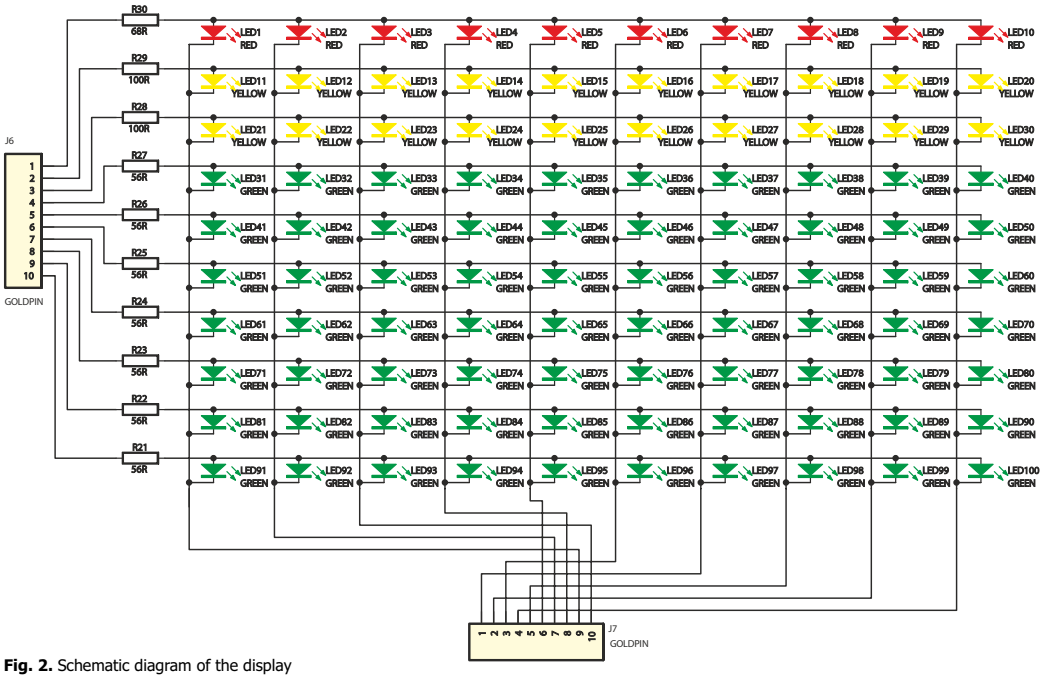

Fig. 2. Schematic diagram of the display

and after they are inserted into the holes in the boards. Mount the transistors T1...T20 possibly close to the board. Mount the stabiliser U1 as shown in the photos. Such mounting will enable easy screwing on the heatsink. Just a few more sentences about the diodes LED1... LED100. In order to install them in a relatively simple manner you have to use a well-known trick. It involves inserting the legs of the diodes into the appropriate holes, turning the board upside down (diodes down, soldering points up) and positioning so inverted plate on some flat surface, for example, on a table (of course, when turning protect the diodes from falling out, as a piece of paper that you take out once the board is laid). In this way, the diodes will be in constant distance from the board. Now, solder one leg of each diode at a time. It is best to shorten at once the legs that are soldered first, to make easier soldering of further legs. After soldering all legs needed, turn the board over and set the diodes straight, because they will certainly be a little twisted and tilted. Once you have this done, you can solder the "second" legs of each diode. Once assembled, the circuit will not require any start-up procedure and should immediately work correctly. The analyser should be controlled during normal operation by an audio signal with an amplitude of up to approximately 0.2 Vpp. Insert or not jumpers J3 and J4 to activate the corresponding operating mode.

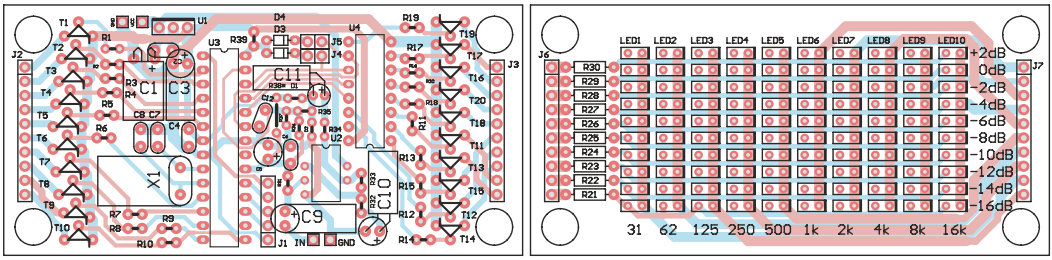

Fig. 3. Arrangement of components on the PCBs

List of components

MAIN BOARD:

Resistors:
R1-R10, R34: ....4.7 kΩ
R11-R20: ....470 Ω
R31, R33: ....68 kΩ
R32, R35: ....6.8 kΩ
R36, R37: ....47 kΩ
R38: ....(do not mount)
R39: ....10 kΩ

Capacitors:
C1: ....220 uF / 16 V
C2, C4, C6: ....100 nF ceramic
C3: ....22 uF
C5: ....100 uF
C7, C8: ....18 pF
C9, C11: ....4,7 uF
C10: ....10 uF
C12: ....4,7 nF ceramic

Semiconductors:
D1-D4: 1N4148
T1-T10: BC557
T11-T20: BC337
U1: 7805
U2: TL071
U3: ATmega8
U4: 4028

Other:
Q1: .... quartz 18 MHZ
J1: ....goldpin strip 1×5
J2,J3: ....goldpin socket 1×10
J4 and J5: ....goldpin angle strip 2×2 + jumpers

DISPLAY:

Resistors:
R21-R27: ....56 Ω
R28, R29: ....100 Ω
R30: ....68 Ω

Semiconductors:
D1-D10: ....LED 2×5mm red
D11-D30: ....LED 2×5mm yellow
D31-D100: ....LED 2×5mm green

Other:
J6, J7: ....goldpin strip 18mm 1×10

Start mounting from soldering the components onto the board in order of size from smallest to largest. Photographs of the mounted kit may be helpful. To access the high-resolution images as links, download the PDF.

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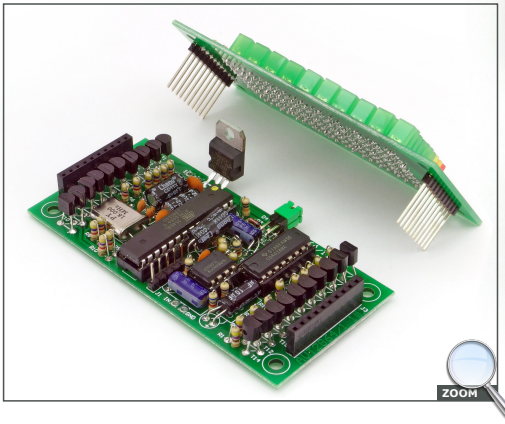

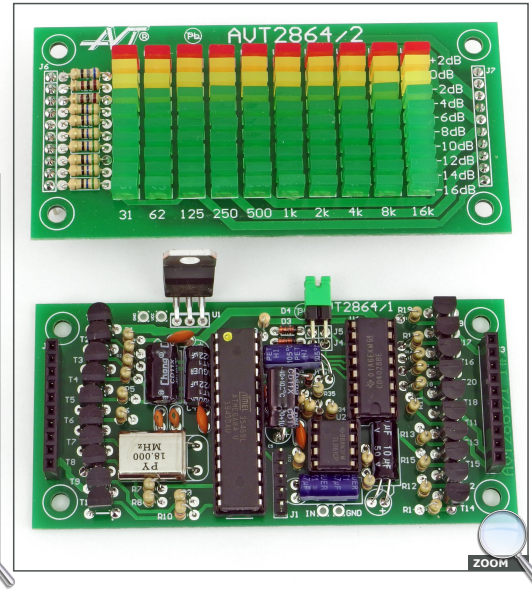

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