Thermometer with Thermocouple and Alarm

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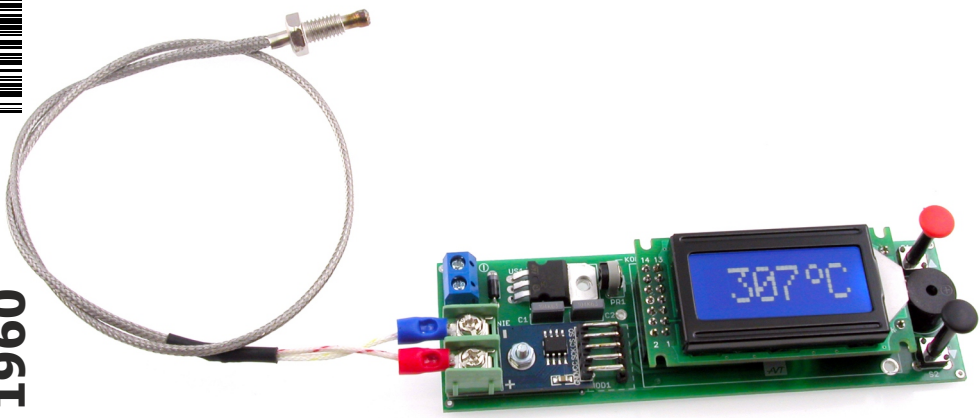
AVT 1960



ASSEMBLY DIFFICULTY

Thermocouples are used to measure temperature over a wide range. They are used in industry, laboratories, transport, measuring and control instrumentation, etc. It also happens that the measurement should activate an alarm signal if the temperature is not within the set range, which is an additional advantage of this thermometer.

Specifications

- 1×6 LCD display
- accuracy of measurement: ±1...2°C
- temperature measuring range: 0...1024°C **(included probe allows a maximum temperature of 400 °C to be measured)**
- alarm for set measuring range
- board size 35×116 mm

Circuit description

Schematic diagram of the thermometer is shown in Figure 1. Depending on the abilities and needs, the circuit can be supplied with a DC voltage in the 8...15 V range. The voltage supplied to connector X1 via D1 diode is fed to stabiliser US1, which supplies +5 V. The operation of the module is controlled by the ATtiny2313 microcontroller, timed by an internal clock signal, or more precisely by the program contained therein. To ensure error-free temperature measurement, a specialised IC module with integrated cold-end compensation from Maxim-Dallas MAX6675 is used, which has an SPI interface through which it communicates with the microcontroller. Due to the module used, the construction of the thermometer is extremely simple. The temperature measurement module can measure temperature in the range 0...1024 °C. It is designed to work with a K-type thermocouple sensor (chromel-alumel), which is most commonly used in multimeters.
Probe included with this unit can measure up to 400°C, its cable length is 50 cm and the metal cap has an M6 thread. Typical measurement accuracy for thermocouples is ±1...2°C, which exceeds the required accuracy for most applications. Visualisation of the result is realised on a 1x6 LCD display. In practice, for this type of application, a display with such a small number of characters is ideal. Communication of the display with the microcontroller is in 4-bit mode. The PR1 potentiometer is used to adjust the contrast of the displayed characters, while the R2 resistor limits the current flowing through the backlight diodes. For alarm settings, the thermometer is equipped with buttons S1 and S2. The alarm is set pressing either button, with the upper button increasing the temperature and the lower button decreasing it. Alarm signal is a modulated sound generated by a buzzer.

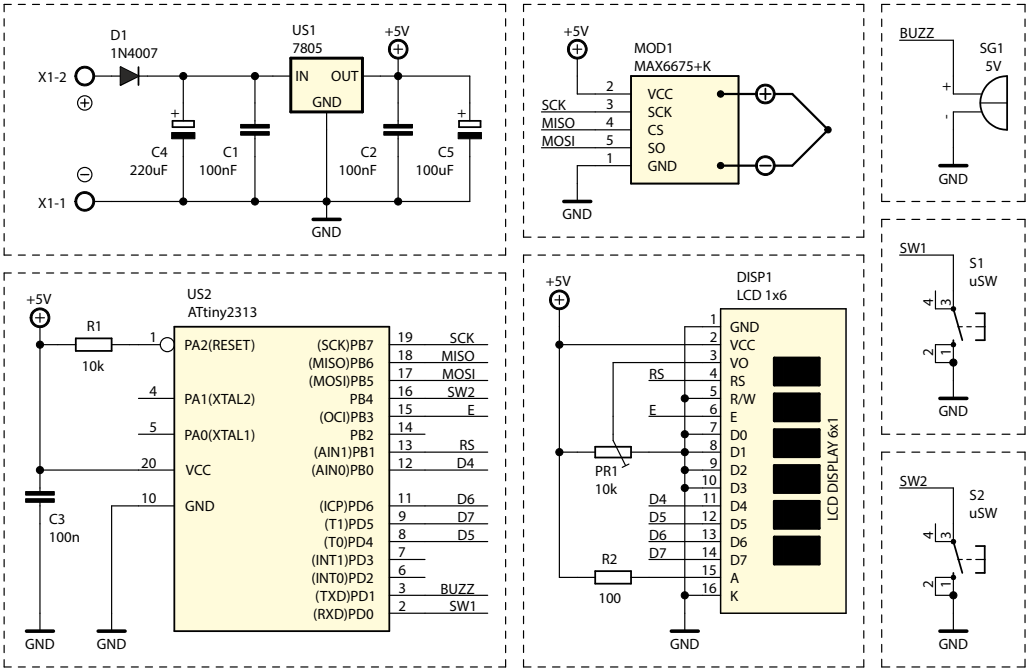


Fig.1 Schematic diagram

Mounting and start-up

The module must be mounted on the double-sided PCB shown in Figure 2. Photograph showing the details of the components arrangement under the display and the module with the MAX6675 and thermocouple will facilitate assembly. Begin mounting by soldering resistors and other small components onto the board. The next step will be to mount the thermocouple module, which is fastened with an M2.5 screw with the nut between boards. This mounting aligns the heights of the angled goldpins of the module and the main board, thus allowing to sold them together. The display will be installed as the last component. Device mounted without any errors, with efficient components and using a programmed microcontroller, will work as soon as energized. You must only adjust the display contrast with the PR1 potentiometer. Each time it is activated, the display shows the screen as in Figure 3. The same screen and alarm signal will appear when a sensor is disconnected from the measuring module or becomes damaged. During normal operation, the screen in Figure 4 will be displayed with the measured temperature, while when one of the buttons is pressed, the screen will switch to the set limit temperature value which triggers an alarm (Figure 5).

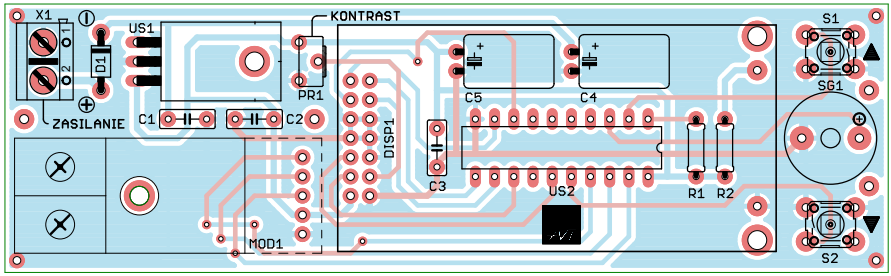


Fig.2 Arrangement of components on the PCB

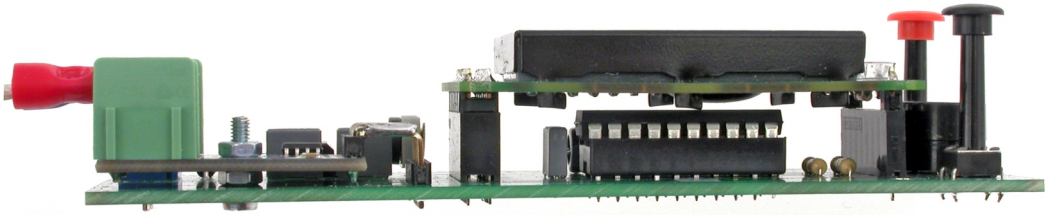


Photo 1

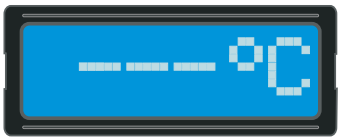


Fig. 3 Thermometer start screen

Fig. 4 Thermometer operating screen

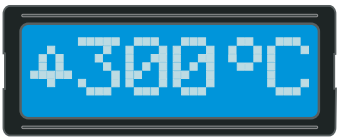


Fig. 5 Thermometer settings screen

List of components

Resistors:
R1:.....10 kΩ
R2:.....100 Ω
PR1: .....mounting potentiometer 10 kΩ
Capacitors:
C1-C3:.....100 µF
C4:.....220 µF
C5:.....100 µF
Semiconductors:
D1:.....1N4007
DISP1:.....LCD 1×6
US1:.....7805
US2:.....ATtiny2313

Other:
MOD1:.....MAX6675 + thermocouple K
S1, S2:.....Microswitch
SG1:.....Buzzer 5V
X1:.....ARK2/500
Mounting elements

AVT SPV Sp. z o.o.

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Notes