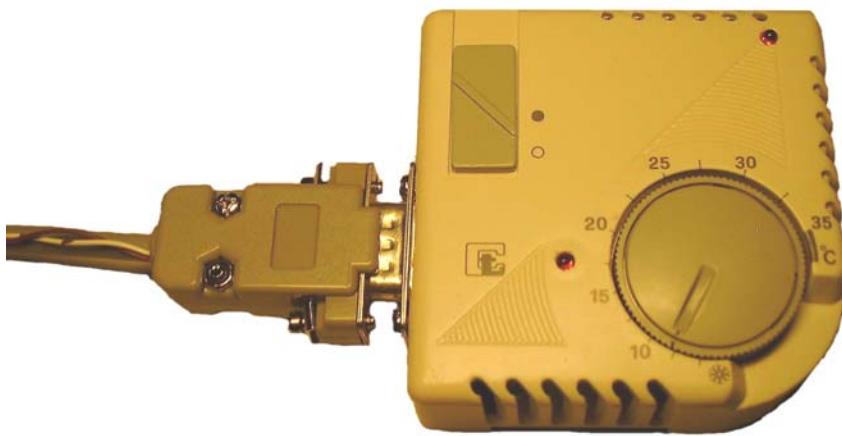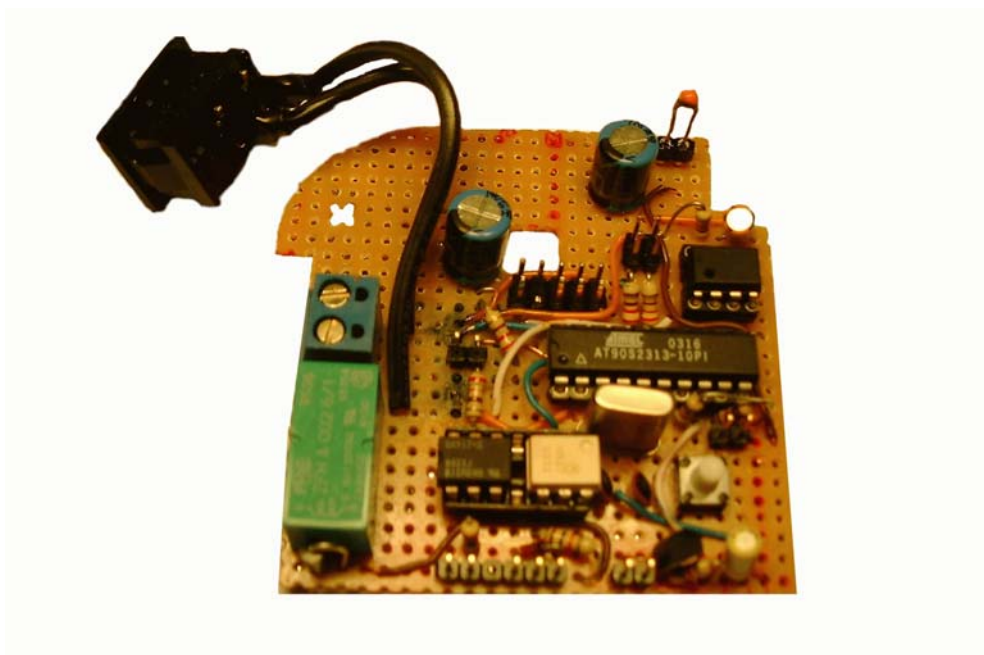# Digital Thermostat with High Accuracy
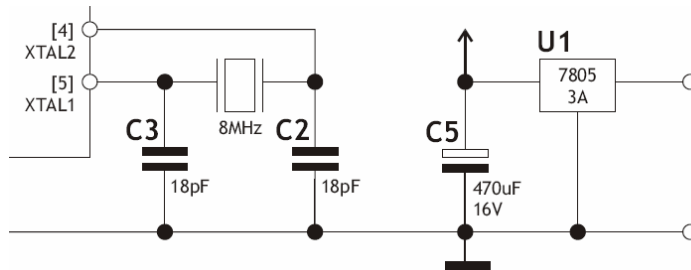# -6,00 to 46,00 °C

Digital Thermostat

We build a digital thermostat for home applications, which controls the room temperature. I used the AT90S2313 microprocessor of ATMEL. The digital thermostat opens the main heating valve of the apartment and the hot water flows in the radiators.


Digital Thermostat Board

Power and Oscillator

The system is supplied a 6 Volts DC current, we use a 7805 to stabile the voltage to 5 Volts DC. The microprocessor is running on an 8MHz crystal so the pulse measurement is in microseconds (us).

Watchdog Timer

The AT90S2313 enables the watchdog timer in a period of 2 seconds the microprocessor runs the program and finally goes to power down sleep mode. It can wake up only from the RESET of watchdog. The CPU is mainly in sleep mode and the actual current is very low (0,04mA).

NE555 – Pulse measurement
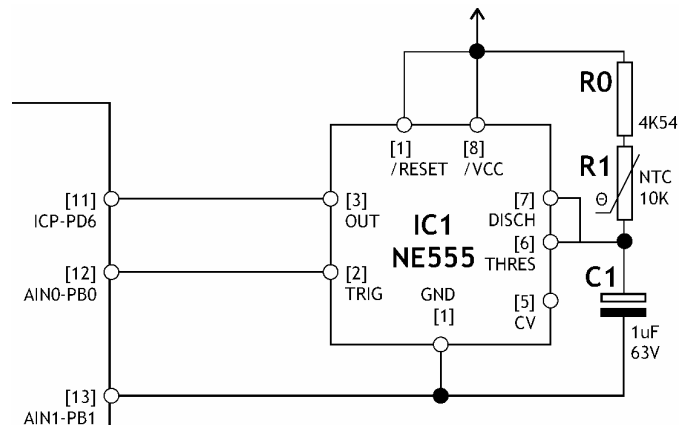
The temperature is measured using the NE555. In order to reduce the power consumption the PB1 pin gives the ground to the NE555, in normal operation it consume up to 3mA. The resistor R0 reduces the current of the NTC Thermistor in order not to influent the real resistor of the thermistor. In the AT90S2313 we store in the eeprom memory the NTC thermistor curve. Using the ICP pin in the AT90S2313 we measure the pulse duration of the NE55 output. The AT90S2313 calculates the actual temperature using the NTC thermistor curve and also an average temperature of four measurements is also performed. The temperature measurement is performed every a specified period of time, by default every 1 minute.
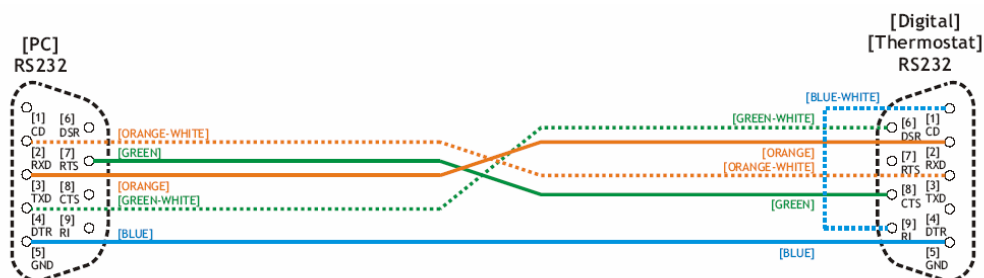
Communication (RS232)

In order to communicate with the PC with the RS232, AT90S2313 checks the PD5 pin, if the pin is LOW then a PC is connected in the RS232. The user program must supply on the CTS signal +10 Volts and on the DSR signal -10 Volts in order for the Rx signal to work. The Rx on the AT90S2313 is enabled using the PB2 pin in order to reduce the power consumption (20mA in normal operation). The settings of the communication is 38400,n,8,1.
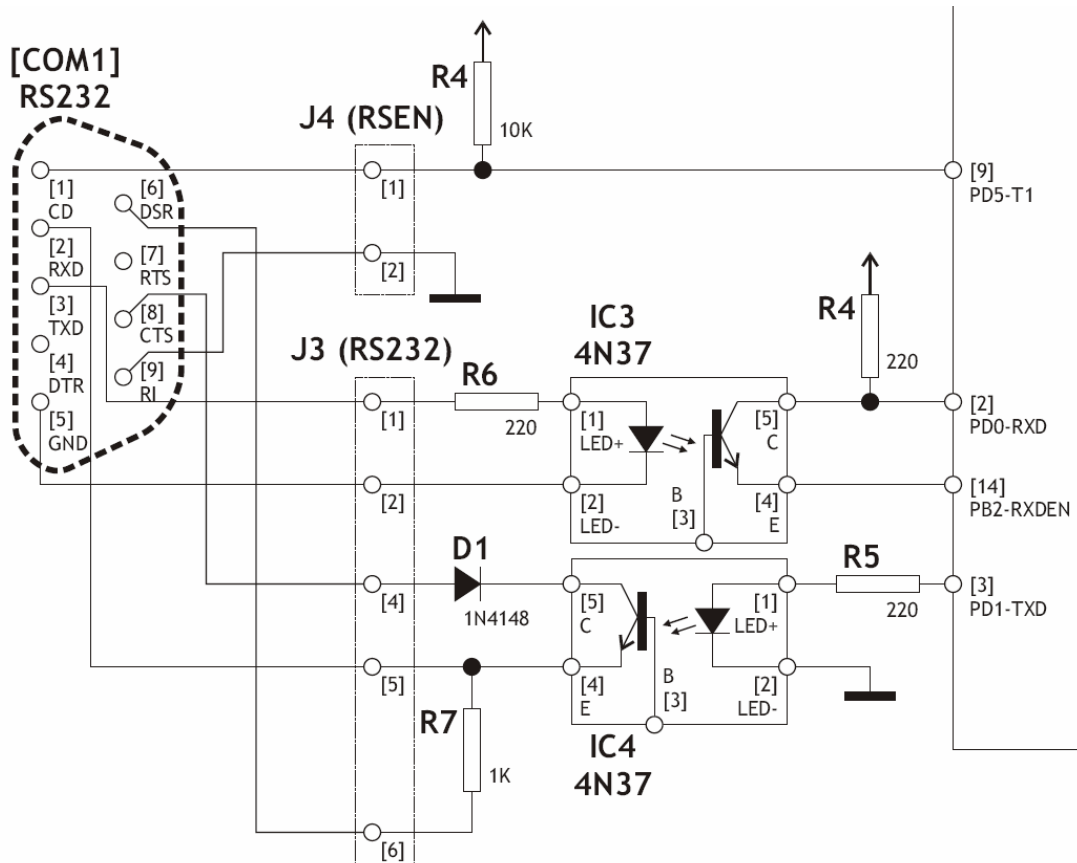
Now the AT90S2313 sends the 'Q' character on RESET that means every 2 seconds. The PC can send an 'R' Read or 'W' Write character command. On Read command the response is 'B' character and 40 bytes or 20 integers of the Parameters inside the AT90S2313. On Write command the response is 'S' character and now the AT90S2313 waits for the following information.
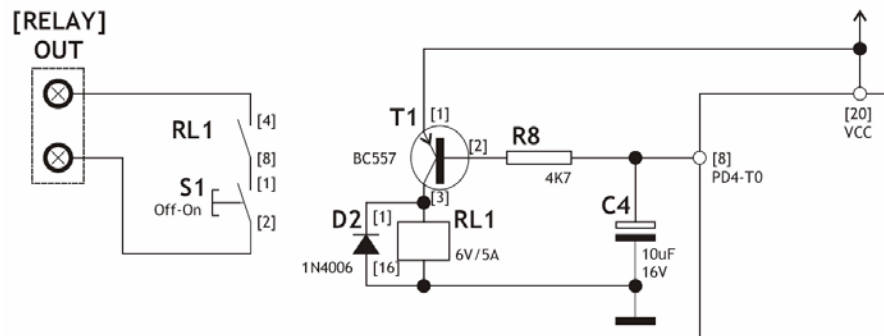
Byte 1 = Memory address of Parameter
Byte 2 = E2prom address of Parameter
Byte 3 = Low byte of Parameter
Byte 4 = High byte of Parameter

Communication Cable (RS232)

The communication cable for the connection between PC and Digital Thermostat is as in the picture above.

Relay Contact

The output of the thermostat is a relay contact that's used to activate the heating system. The PD4 pin is used to energize the transistor T1 and drive the relay. The relay is a 6 Volt and the contact is 250V AC / 5A. We use the C4 capacitor because when the system RESET from the watchdog the PD4 pin is HIGH. So in the period of RESET until the beginning of the program the relay should be disabled but the capacitor maintains the command of the relay until the RESET passes. In series with the relay contact there is a switch for manual switch on and off the system. The operation modes of the Relay are three, off, pulse, continues. In Pulse mode the relay switch on and off using specified times. In Continues mode the relay is always switches on is the user set point is bigger than the average actual temperature until the hysterisis set point is reached.

Avr_ISP (Programming connection)

We also use the PB5, 6, 7 pins and the RESET for the AVR_ISP socket, in order to be able to program the AT90S2313.