martybugs.net Electronics Projects

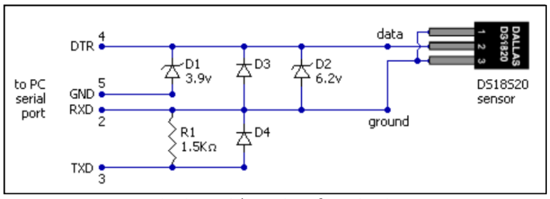
Serial Port Temperature Sensors - Hardware Interface

This page describes the electronic circuitry required to interface to the temperature sensors via a PC's serial port.

Schematic

The serial port interface circuit was taken from page 21 of (an older revision of) the Maxim Application Note 74: Reading and Writing iButtons via Serial Interfaces, and redrawn by Martin using Circad'98 for Windows.

This circuit is a generic circuit for communicating to any 1-wire device via a serial port, and works reliably with the DS18S20 temperature sensors.



1-wire serial port interface circuit

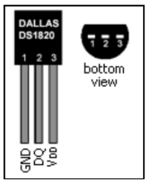
The circuit consists of four connections to the PC's serial port, two connections to the temperature sensor, two zener diodes, two Schottky diodes and a resistor. Due to the small number of components, it is possible to build a circuit that is small enough to fit inside a plastic DB9 serial port shell.

Note that commercial versions of this circuit are readily available - Maxim and various other vendors sell serial port and USB versions.

Sensor Pinout

For the DS18S20 sensor in a TO-92 package, the pins are, from left to right:

- GND - ground
- DQ - data in/out
- V_{DD} - power supply voltage (unused)



temperature sensor pinout

The V_{DD} terminal is not used (but needs to be grounded), as the circuit allows the sensor to operate in parasitic mode, sourcing required power from the data terminal.

Apparently the wiring between the circuitry and the temperature sensor(s) can be extended upto 100 metres without any issues. For distances greater than this, you cannot use the sensor in parasitic mode, but you will need to provide power to the V_{DD} pin (+5v).

Note that running the sensor in parasitic mode reduces the maximum temperature it can report is decreased from 125 degrees Celcius to approximately 70-75 degrees Celcius, but this should be ample for most applications.

Note that real-world testing indicates the maximum temperature in parasitic mode may be lower than 70-75 degrees. A sensor (in parasitic mode) was installed to monitor the air temperature inside a metal cabinet housing a PC, UPS, various power supplies for one of the WAFreeNet access points. The cabinet is exposed to full sun each afternoon, and in the heat of a Western Australian summer, the contents of the cabinet get very hot.

On Friday 26 January 2007, the DS18S20 stopped responding, with the last reported temperature inside the cabinet being 63.4 degrees (the maximum temperature reported by the Bureau of Meteorology for that day was just over 41 degrees). Several hours later, when the temperature had cooled to approx 59 degrees, the sensor started responding again.

A graph of the cabinet temperature for that day is available here.

Note that it may not have been the temperature sensor itself that stopped functioning at those temperatures, but it could have been the serial interface circuitry or the PC motherboard.

Component List

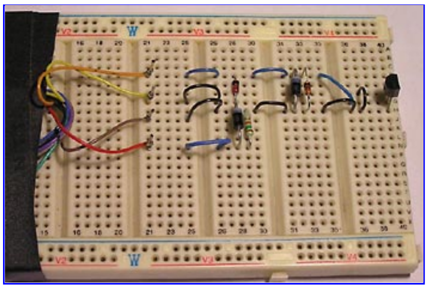
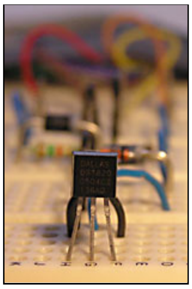
The following components are required for the serial port interface circuit:

- DS18S20 1-Wire Parasite-Power Digital Thermometer
- D1 1N5228 3.9v zener diode
- D2 1N5234 6.2v zener diode
- D3,D4 1N5818 Schottky diode
- R1 1.5kohm
- female DB9 serial cable

Note that D1 can be substituted with a 3.6v zener diode if necessary.

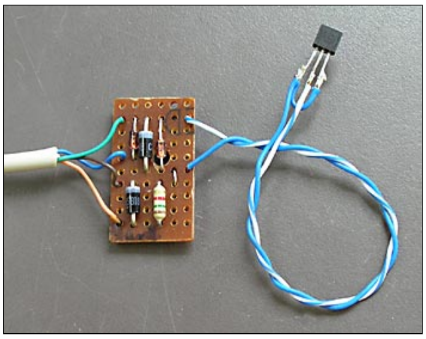
Construction Details

The serial port interface circuit can be prototyped on breadboard, allowing you to confirm correct operation of the temperature sensor and circuit before constructing a more permanent version.

interface circuit assembled on breadboard

Once the operation of the circuit has been confirmed, it can be constructed on some vero board, as shown in the photo below. Vero board is ideal for this simple circuit, and allows for a relatively compact layout.

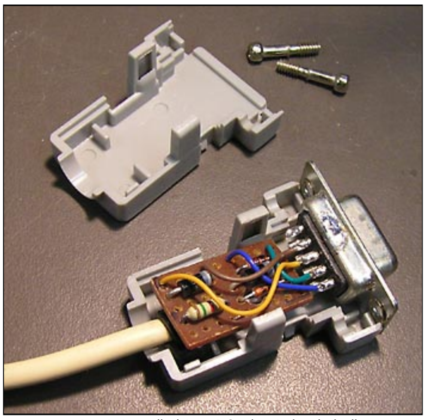


completed circuit on vero board

Circuit Inside A D9 Plastic Backshell

With some careful trimming of the vero board, it can be made small enough to fit inside a D9 plastic backshell, thus providing a very compact temperature sensor circuit.

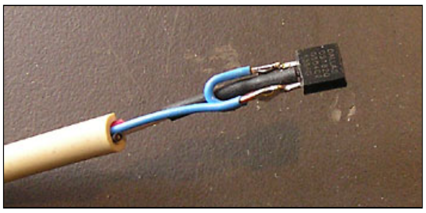
A cable tie on the sensor wiring is used to provide strain relief, to prevent the sensor wiring connections to the vero board being pulled off the board.



circuit installed in a D9 plastic backshell

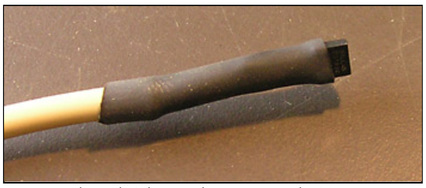
Note that a small piece of tape was added to the end of the vero board, to prevent it from shorting out on the exposed pins on the serial port connector.

The sensor was soldered to the other end of the length of wire, with pins 1 and 3 of the sensor being connected together. A short length of heatshrink is used to insulate pin 2 from the other pins on the temperature sensor.



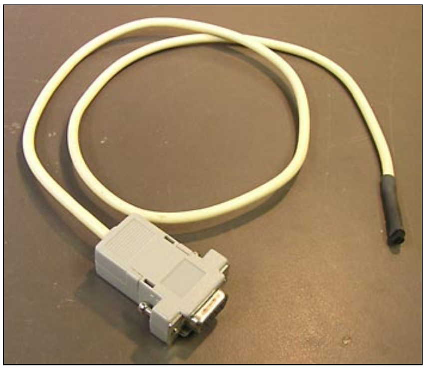
heatshrink over the sensor's centre lead

Another length of heatshrink is used to cover the wiring to the temperature sensor, leaving the sensor protruding from the end of the heatshrink to ensure adequate exposure to ambient air for temperature monitoring.



heatshrink over the sensor and wiring

Installing the circuit inside the D9 plastic backshell provides for a very compact and robust serial port temperature sensor.



completed serial port sensor

If desired, additional temperature sensors can be added in parallel, using longer lengths of wire to attach them to the interface circuit. This will allow multiple temperatures to be monitored at varying locations, with a single serial port interface circuit.

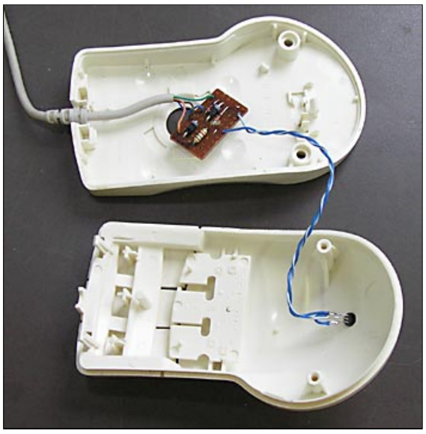
Circuit Inside A Mouse

When looking through my junk box for a serial cable to use for the interface circuit, I found several serial mice. Not only could a serial mouse provide a serial cable, but the mouse itself could also be used to house the interface circuit, thus providing a robust "case" for the circuit.

donor serial mouse

After opening the mouse, and discarding the ball and mouse circuitry, a 3/16" hole was drilled in the upper half of the mouse case, and provided a snug fit for the temperature sensor.

The interface circuit was installed in the mouse case, and the case was closed.



circuit and sensor installed inside the mouse

With the sensor protruding through the top of the mouse case, the sensor will be exposed to ambient air, and will thus provide an accurate temperature reading wherever it is located.

temperature sensor protruding from the mouse

If desired, the sensor and the circuit can be fixed in place using some hot melt glue, to prevent any movement.

The mouse provides a robust "case" for the circuit, and allows the temperature sensor to be placed a distance away from the PC it is connected to, due to the reasonably long serial cable.

next page: linux software

last updated 22 Jan 2010