

DAH Checkpoint 5: Temperature Sensors

1. What is the interface between the DS18B20 temperature sensor and the Raspberry Pi? Explain how it works.

(Note: both the sensors I had were DS18S20's not DS18B20's, as the serial numbers both started with 10-... which is the code for DS18S20)

The temperature sensor interfaced with the Raspberry Pi with a single wire connecting the DQ pin on the sensor to a GPIO pin on the Raspberry Pi. The DQ pin acts as a serial input and output line. A 1-wire master can communicate with one or more slave devices by using a device's unique serial number in its commands to act as an address.

2. What is the smallest change in temperature that a single sensor can report? Explain this with reference to the temperature data encoding described on the sensor datasheet.

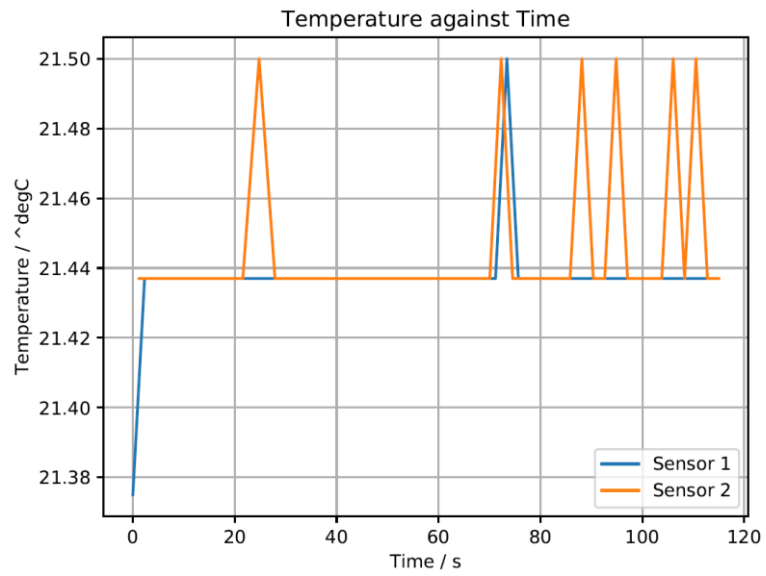
Had the DS18S20 temperature sensor had fixed 9-bit resolution (unlike the DS18S20) with the 8 least significant bits determining the value of the temperature and a 9th bit giving the sign (with 7 other duplicate sign bits) as shown in figure 1. The least significant bit corresponds to $2^{-1} = 0.5^{\circ}\text{C}$ so this is the smallest temperature change a sensor could report.

	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
LS BYTE	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^{-1}
	BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	BIT 8
MS BYTE	S	S	S	S	S	S	S	S
S = SIGN								

Figure 1: 'Temperature Register Format' for DS18S20 temperature sensor from datasheet at <https://datasheets.maximintegrated.com/en/ds/DS18S20.pdf>

In practice, the sensor reported changes in temperature as small as $\sim 0.062^{\circ}\text{C}$. Both the Linux commands and the webiopi method reported these 0.062°C changes which is smaller than expected for the 9-bit resolution measurement. Perhaps they were interpreting an underlying 12-bit resolution (as if it were the DS18B20 instead) which would have a least significant bit corresponding to $2^{-4} = 0.0625^{\circ}\text{C}$. However, there is only ' $\pm 0.5^{\circ}\text{C}$ accuracy from -10°C to $+85^{\circ}\text{C}$ ' according to the datasheet so these smaller changes are not necessarily accurate anyway.

3. How do your two temperature sensors' readings compare with each other? Is this what you would expect from the datasheet?



From the graph taken in the lab, the maximum difference in temperature between the two sensors could be $\sim 0.12^{\circ}\text{C}$. The datasheet states they should each have ' $\pm 0.5^{\circ}\text{C}$ accuracy from -10°C to $+85^{\circ}\text{C}$ ' so the temperature differences measured in the lab are acceptable as the difference is less than 1°C .