1 ACD - Analog to Digital Conversion

An ACD converter is needed to translate analog data (temperature) from the thermistor to digital data (voltage) that the RaspberryPi can understand. If I were using an Arduino I would not need such a converter as an Arduino has an ADC converter built in where as the RaspberryPi is a digital only microcontroller. Using the MCP3008 for ADC, its pin out:

- VDD - power
- DGND - Digital ground

used to power the converter

- DOUT - data out of the coverter (the covnerted data we desire)
- CLK - clock pin
- DIN - data in from raspberry pi
- CS - Chip select

These 4 pins are used for the SPI (Serial Peripheral Interface) of the raspberry pi. Section 2 gives more on this.

- AGND - analog ground (used for precision which is optional and so can merely be connected to GND)
- Vref - analog reference voltage (used as a scale for the ADC)

Everything above comes from Analog Inputs for Raspberry Pi Using the MCP3008. Discussed below is how we can use this digital data from the ADC converter to translate the data into what we expect, see Analog to Digital Conversion by Adapfruit for more.

Consider a microcontroller is powered with 5v, it understands 0v as a binary 0 and 5v as a binary 1. Now we have a problem when the voltage is anything between 0 and 5 volts (what will be binary 0 and what is binary 1) - this is analog data and is why micocontrollers have difficult time translating what analog data means, this is why we need an ADC converter, to understand analog data in a form it understands (digital data). The MCP3008 ADC converter is a 10-bit converter, meaning it can detect $2^{10} = 1024$ discrete analog levels. The ADC is a ratio value given as $\frac{Resolution of the ADC converter}{System Voltage} = \frac{ADC Reading}{Analog Voltage Measured}$. This means the converter will use the value 1023 to depict the system voltage and value between 0 and 1024 will be a ratio between the 5V and the ADC value 1023. The system voltage of the raspberry pi is either 3.3V or 5V dependending on the voltage pin used to power the converter. Thus we can get the *analog voltage* from this equation that uses ADC values. As an example, imagine we are measuring a voltage with our Pi and the system voltage we are using is 5V, lets assume the ADC value measured on the Pi is 434 and we are using a 10-bit ADC converter. Now to get the analog voltage from this we do the following

$$\begin{aligned} \frac{1023}{5} &= \frac{434}{Analog Voltage Measured} \\ Analog Voltage Measured &= 2.12V \end{aligned} \tag{1}$$

2 SPI - Serial Peripheral Interface