

TMP36 Temperature Sensor Guide for BeagleBone Green

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Last updated: April 06 2022

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1 Introduction

1.1 Purpose

This document is to guide users to connect and setup the BeagleBone and TMP36 temperature sensor, we will provide both Linux commands and Sample C program to explain how to get readings from A2D readings. We will also provide the formula to convert the A2D readings to Celsius degree. This document will be very similar to the other TMP36 Temperature Sensor Guide, but we have update the formula to calculate the Celsius Degree.

(give copyright permission to the instructor.)

2 TMP36 setup guides

2.1 Descriptions

There are three pins on the TMP36 temperature sensor, and it is very important not connect to the wrong pin (it may damage you board and the sensor!).In the board, we are going to use column 16, 17, 18. We take the semi-circular side facing the table, the flat side with words face upside.

(1)The left pin accepts from 2.7V to 5.5V, and we will connect it to the ADD_3V3 pins(Pin 3 or 4) in P9 header.

(2)The centre pin is the analog voltage reading out pin, and we will connect it to the AIN1 pin (Pin 40).

(3) The right pin is the ground pin, we will connect it to the GNDA_ADC pin (Pin34).

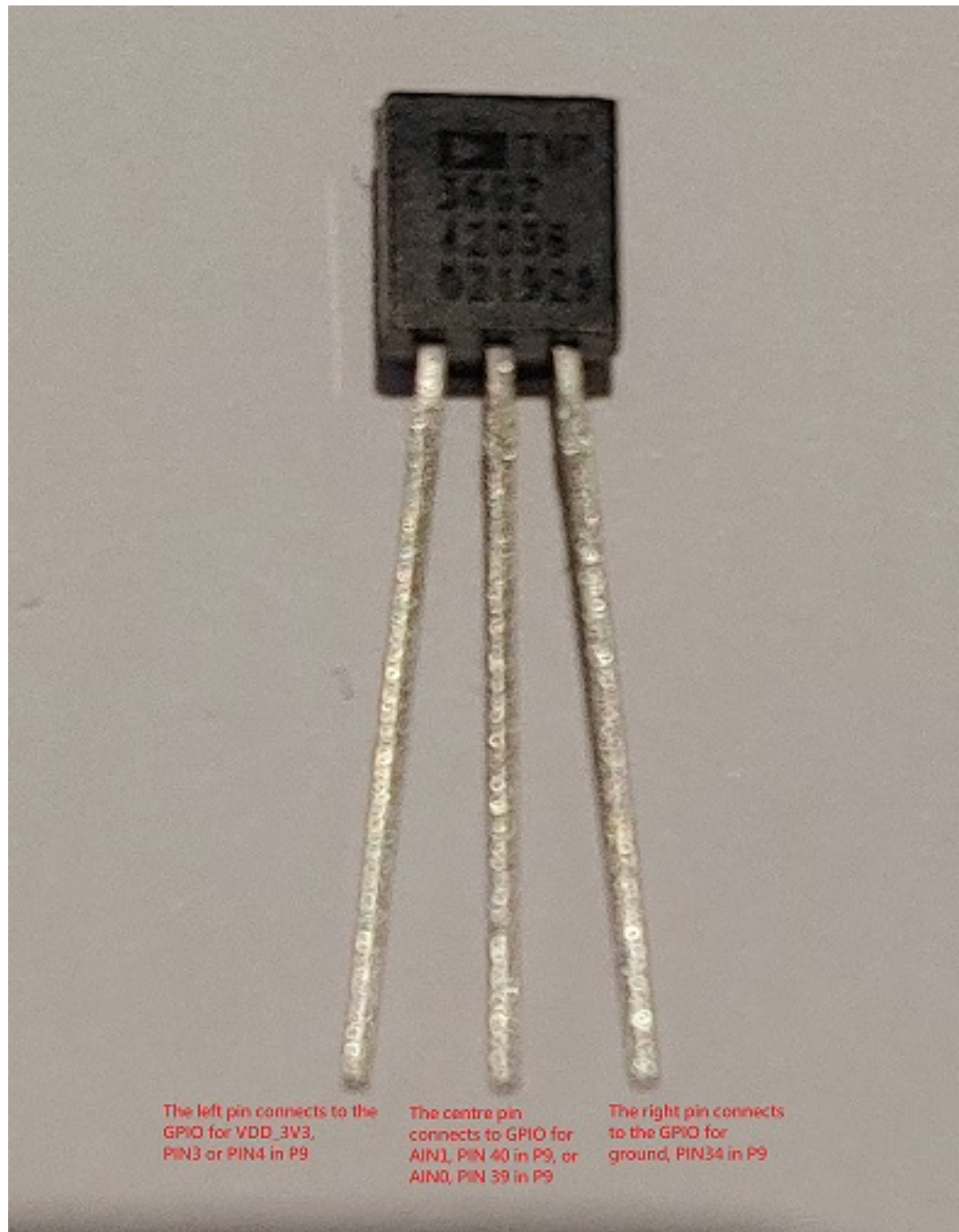
2.2 Images

We will provide some images to help users to check if they connect the correct GPIOs and Pins.

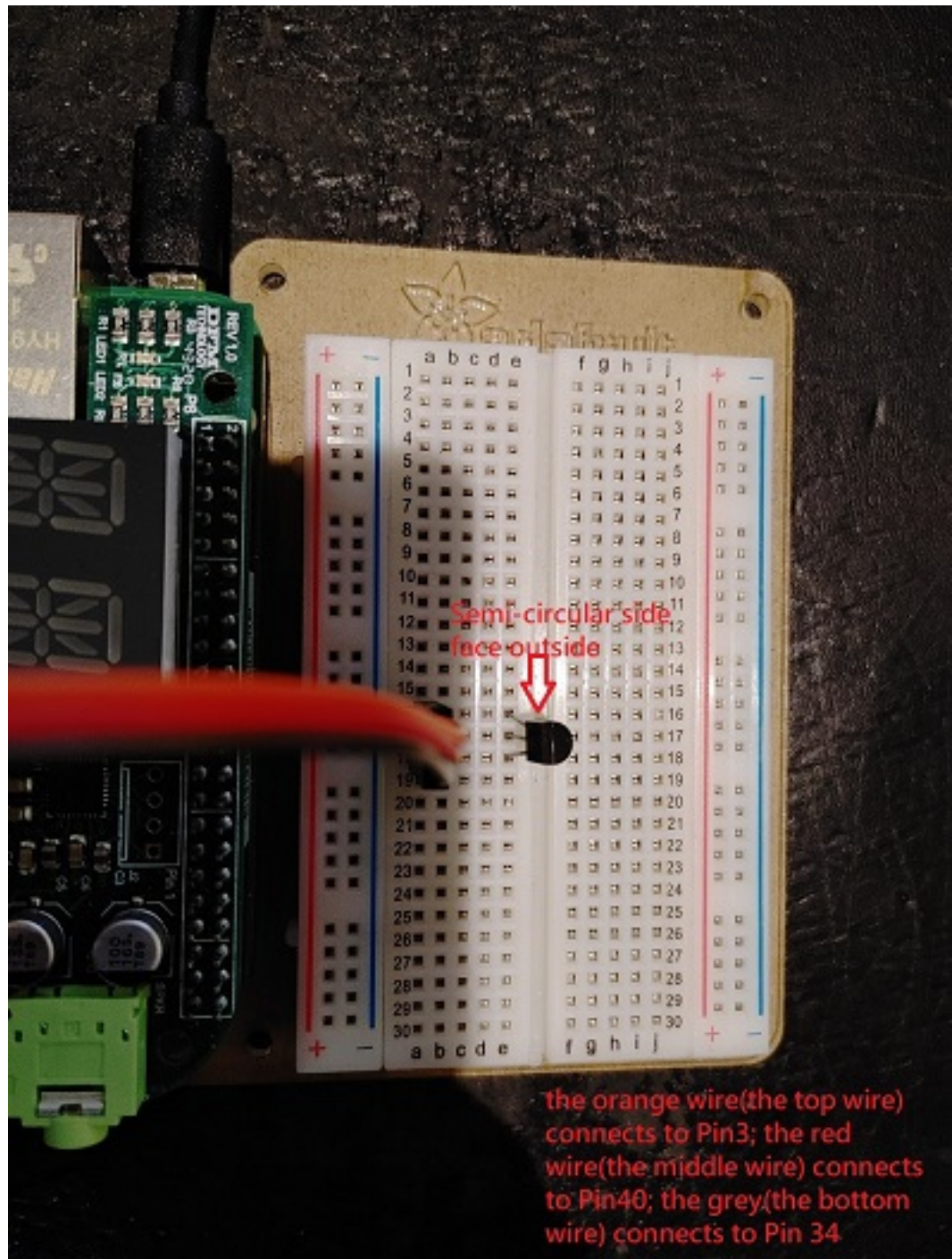
65 possible digital I/Os

P9				P8			
1	2	3	4	1	2	3	4
DGND		DGND		DGND		DGND	
VDD_3V3	3	VDD_3V3		GPIO_38	3	GPIO_39	
VDD_5V	5	VDD_5V		GPIO_34	5	GPIO_35	
SYS_5V	7	SYS_5V		GPIO_66	7	GPIO_67	
PWR_BTN	9	SYS_RESETN		GPIO_69	9	GPIO_68	
GPIO_30	11	GPIO_60		GPIO_45	11	GPIO_44	
GPIO_31	13	GPIO_50		GPIO_23	13	GPIO_26	
GPIO_48	15	GPIO_51		GPIO_47	15	GPIO_46	
GPIO_5	17	GPIO_4		GPIO_27	17	GPIO_65	
	19			GPIO_22	19	GPIO_63	
GPIO_3	21	GPIO_2		GPIO_62	21	GPIO_37	
GPIO_49	23	GPIO_15		GPIO_36	23	GPIO_33	
GPIO_117	25	GPIO_14		GPIO_32	25	GPIO_61	
GPIO_115	27	GPIO_113		GPIO_86	27	GPIO_88	
GPIO_111	29	GPIO_112		GPIO_87	29	GPIO_89	
GPIO_110	31	VDD_ADC		GPIO_10	31	GPIO_11	
AIN4	33	GNDA_ADC		GPIO_9	33	GPIO_81	
AIN6	35	AIN5		GPIO_8	35	GPIO_80	
AIN2	37	AIN3		GPIO_78	37	GPIO_79	
AIN0	39	AIN1		GPIO_76	39	GPIO_77	
GPIO_20	41	GPIO_7		GPIO_74	41	GPIO_75	
DGND	43	DGND		GPIO_72	43	GPIO_73	
DGND	45	DGND		GPIO_70	45	GPIO_71	

The GPIO pins on the BeagleBone Green.



The first image is the details for temperature sensor.



The second image is how to connect the BeagleBone and temperature sensor.

3 Linux command for A2D readings

We can easily get the voltage input from AIN1 if we connect all the component correctly. After we ssh/screen into the BBG, we can start our steps to read the analog voltages. (# represents we are using BBG Linux)

1. (bbg) # cd /sys/bus/iio/devices/iio:device0/
2. (bbg) # cat in_voltage1_raw
3. (bbg) # 1611
4. (bbg) # cat in_voltage1_raw
5. (bbg) # 1613
6. (bbg) # cat in_voltage1_raw
7. (bbg) # 1611

*If you can get the readings like above, it means you are successfully connected your temperature sensor to your BeagleBone.

*If you want to try if the reading is correct, you can try touching the sensor. If the temperature goes up, it is correct.

8. After you get the reading, you can implement the formula to calculate the temperature in Celsius degree.

9. We have to first find the voltage from the readings, for example if we get 1611. We have to use $1.8 * (1611 / 4095) = 0.71V$

10. Then we have to use the following formula to calculate the temperature:

$$temperature = (voltage * 1000 - 500) / 10$$

$$temperature = (710 - 500) / 10$$

$$temperature = 21c$$

4 Sample C Program to read from A2D and convert the readings to Celsius degree

```
1 // Demo application to read analog input voltage 1 on the BeagleBone; Assumes ADC cape al
2 //Modified from Dr. Fraser's file
3
4 #include <stdlib.h>
5 #include <stdbool.h>
6 #include <stdio.h>
7 #include <time.h>
8 #include <unistd.h>
9
10 #define A2D_FILE_VOLTAGE1 "/sys/bus/iio/devices/iio:device0/in_voltage1_raw"
11 #define A2D_VOLTAGE_REF_V 1.8
12 #define A2D_MAX_READING 4095
13
14 int getVoltage1Reading() //get the voltage1 input reading
15 {
16     // Open file
17     FILE *f = fopen(A2D_FILE_VOLTAGE1, "r");
18     if (!f) {
19         printf("ERROR: Unable to open voltage input file. Cape loaded?\n");
20         printf("        Check /boot/uEnv.txt for correct options.\n");
21         exit(-1);
22     }
23     // Get reading
24     int a2dReading = 0;
25     // int itemsRead = fgets();
26     int itemsRead = fscanf(f, "%d", &a2dReading);
27     if (itemsRead <= 0) {
28         printf("ERROR: Unable to read values from voltage input file.\n");
29         exit(-1);
30     }
31     // Close file
32     fclose(f);
33     return a2dReading;
34 }
35
36 double calVoltageReading(int voltage) //compute the int voltage reading to double (from 0
37 {
38     double result = (A2D_VOLTAGE_REF_V)*((double)voltage/(double)A2D_MAX_READING);
39     double temperature = (double)(1000*result - 500)/(double)10
40     return temperature;
41 }
```

5 Reference

Temperature Sensor Guide for Python

<https://cdn-learn.adafruit.com/downloads/pdf/measuring-temperature-with-a-beaglebone-black.pdf>

Previous Students' Temperature Sensor Guide

https://opencoursehub.cs.sfu.ca/bfraser/grav-cms/cmpt433/links/files/2017-student-howtos/TMP36_SensorGuide.pdf

GPIO guides

<https://opencoursehub.cs.sfu.ca/bfraser/grav-cms/cmpt433/guides/files/GPIOGuide.pdf>