



TI Designs: TIDA-00150

Automotive Resistive Pressure Sensor Interface - Test Data

This document shares the tests results of the PGA400-Q1 EVM using variable resistors as inputs. The output will be very linear since the test procedure utilizes variable resistors (and not a true sense element). Therefore, linearization firmware is not necessary and the data is extracted after the ADC.

The data is structured into two main categories:

1. Test set up
2.
 - a. PGA400-Q1 EVM GUI Settings
 - b. PGA400-Q1 EVM GUI Procedure
3. PGA400-Q1 EVM ADC results

Equipment used to create this data:

1. 12V power supply
2. PGA400-Q1 EVM GUI installed on PC
3. PGA400-Q1 EVM + board that interfaces with PC (TI-ger board)

Section 1: Test set up

- Before the system is powered up, please make sure all hardware is configured properly. Check that all jumpers and headers are connected appropriately. For a detailed description of configurations, see EVM user's guide.
- To power the board:
 - The PGA400-Q1 EVM is shipped with a TI-ger USB communication board that provides a link from the PC controlled GUI to the EVM. Connect the TI-ger board to the PGA400-Q1 EVM.
 - Connect 12V from a power supply to the EVM. The 12V bucks down to 5V to power the PGA400-Q1.
 - Connect the TI-ger board to the PC. See Image 1 below.

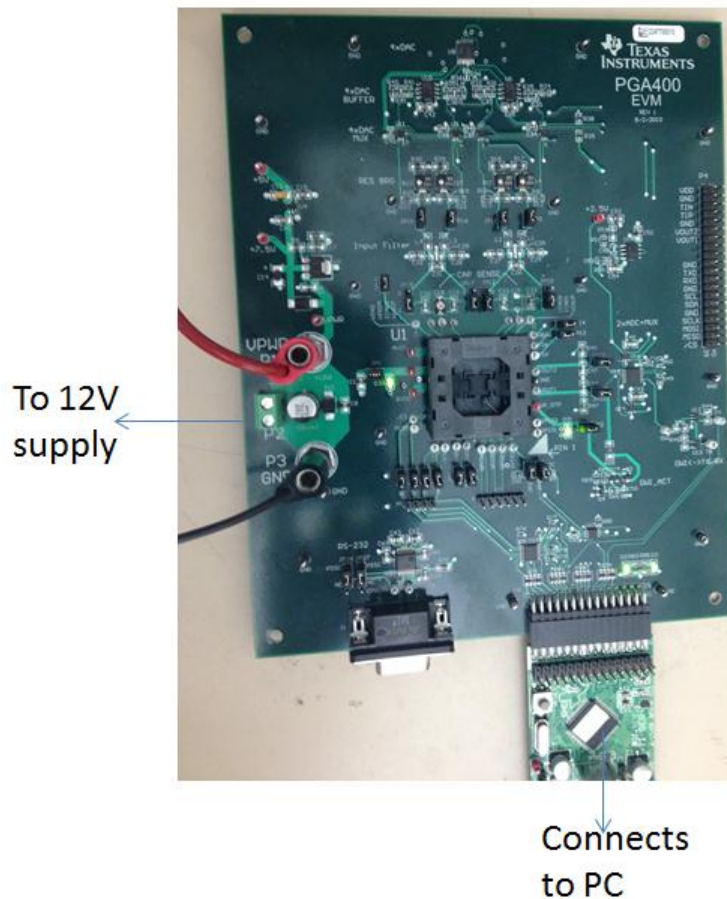


Image 1: PGA400EVM Connections and TI-ger Board

Section 2a: PGA400-Q1 EVM GUI settings

- To re-create the data, open up the EVM GUI and enter the following settings. Notice this is under the “Resistive” tab.

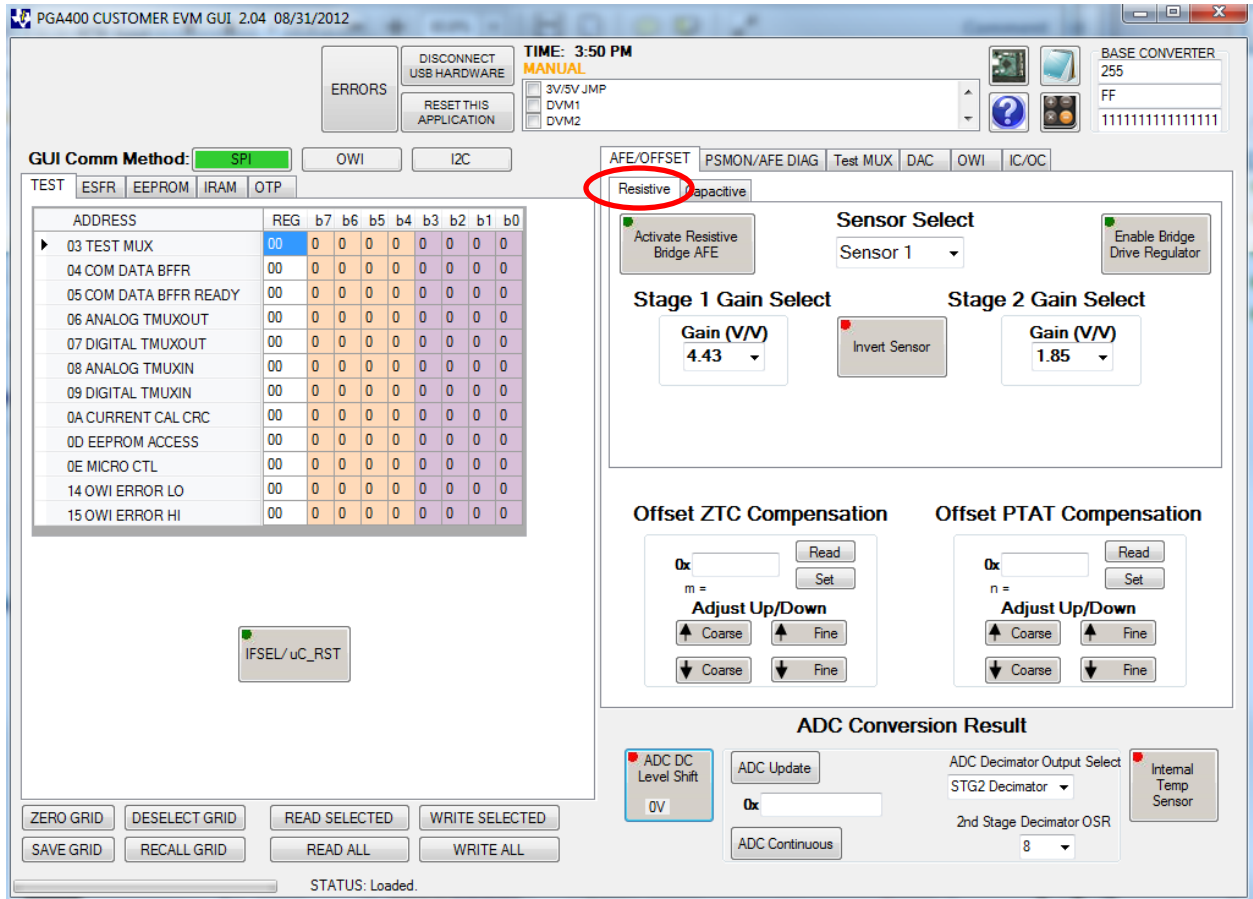


Image 2: PGA400-Q1 EVM GUI Settings



Section 2b: PGA400-Q1 EVM GUI Procedure

- Put in reset to do SPI communication. That is found under the “Test” tab, then click “If Select/UC_RST”. When the PGA400's MCU is in reset, SPI can be used to write to the registers that control the MUXes, gains, and offsets of the AFE.
- Put in settings as shown in the figures in section 2a under the “AFE/OFFSET” tab.
 - Note: Many buttons need to be toggled to be enabled. The input does not re-enable itself each time the input is changed and must be re-enabled again each time.
 - Under Sensor Select, select “Sensor 1”
 - Stage 1 gain: 4.43
 - Stage 2 gain: 1.85
 - Toggle “Enable Bridge Drive Regulator” (to disable, then enable)
 - Toggle “Activate Resistive Bridge AFE”
 - Under Sensor Select, select “Sensor 2”. Repeat steps for “Sensor 2”.
 - ZTC: 200 (hit “set” to program value, then “read” to verify and read back value)
 - PTAT: 20 (hit “set” to program value, then “read” to verify and read back value)
 - Note: These values are reflected in the grid under the “Test” tab. The values can be saved by saving the grid.
 - Press “ADC Update” to read back the ADC value. As the input resistance changes, so should the ADC value.

Section 3: PGA400-Q1 EVM ADC results

Below are the test results. As expected, the ADC value increases as the differential voltage increases. The output is very linear. If the input were a true resistive bridge sense element, the pressure vs. differential voltage would not be linear.

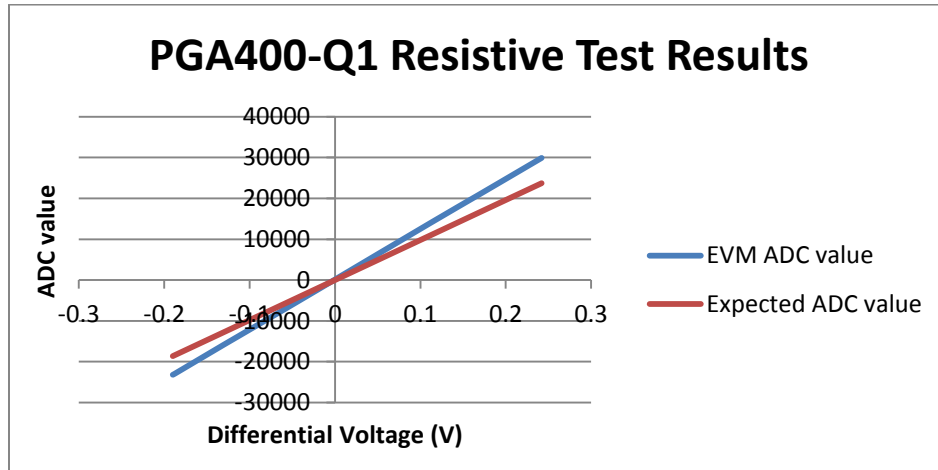


Figure 1: PGA400-Q1 Resistive Bridge Test Results ADC value vs. Differential Voltage

VIN2N	VIN2P	Gain1	Gain2	EVM ADC value	Expected ADC value
1.405	1.647	4.43	1.35	29898	23712.2519
1.478	1.647	4.43	1.35	20954	16559.38253
1.536	1.647	4.43	1.35	13886	10876.28083
1.649	1.647	4.43	1.35	-106	-195.969024
1.724	1.647	4.43	1.35	-9344	-7544.807424
1.777	1.647	4.43	1.35	-15797	-12737.98656
1.835	1.647	4.43	1.35	-22973	-18421.08826
1.837	1.647	4.43	1.35	-23180	-18617.05728
1.837	1.647	4.43	1.85	-31642	-25512.26368

Table 1: PGA400-Q1 Resistive Test Results

The blue line is the EVM ADC value that was read out in the GUI with the given inputs (VIN2N, VIN2P, Gain1, Gain2). The red line is the calculated ADC value. The red line equation is below. The results of both lines are similar.

$$\text{Expected ADC value} = \frac{(VIN2P - VIN2N) * Gain1 * Gain2}{2} * 32768$$

Note: The last data point is not included in the graph. It's listed to show that changing the gain values can increase the full scale output and/or prevent saturation.

In this set up, one variable resistor's value is varied. The other variable resistor is left in the middle position @1.65V. Then, the voltage differential is measured.

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