Application Report
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PGA309 Microcontroller Application

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ABSTRACT

The PGA309 programmable gain amplifier can be used with an external microcontroller. In this type of application, the PGA309 becomes a programmable sensor signal conditioner block that also measures temperature. One key feature of the PGA309 in this application is the test pin, described in detail. This document then discusses two general applications of the PGA309 with an external microcontroller.

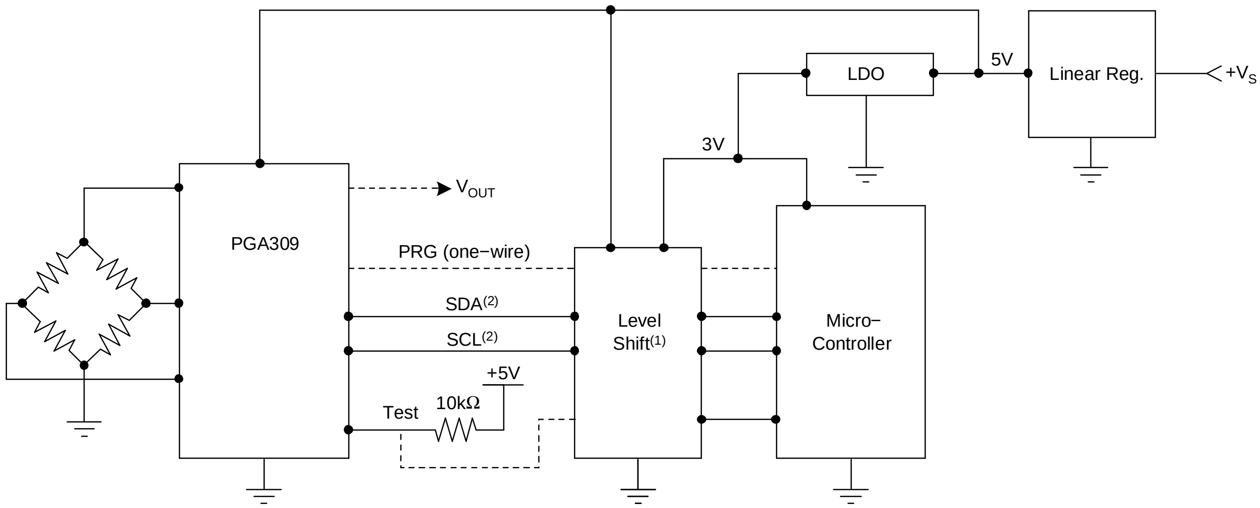
1 Test Pin

The PGA309 has a user-accessible test pin (*Test*, pin 9) that stops the internal state machine cycle and enables the output drive (V_{OUT}) when it is brought high (logic '1'). This mode can be used for simple troubleshooting or initial configuration diagnostics during the system design phase. During normal (stand-alone) operation, the Test pin must be pulled or shorted to GND (logic '0'). If the Test pin is pulled high at any time, the following conditions occur:

- The PGA309 internal state machine is interrupted and reset to its initial state. Any EEPROM transactions are interrupted and the two-wire bus is released.
- The PGA309 output (V_{OUT}) is enabled.
- All internal registers remain at their current values. If the Test pin is high when the supply becomes valid, the registers stay in the initial (POR) state,and output is enabled immediately.
- An external controller can modify any of the writeable PGA309 registers using either a one-wire or two-wire digital interface.
- The Test pin has a 25µA typical pull-down current source.

2 Microcontroller and PGA309 Applications

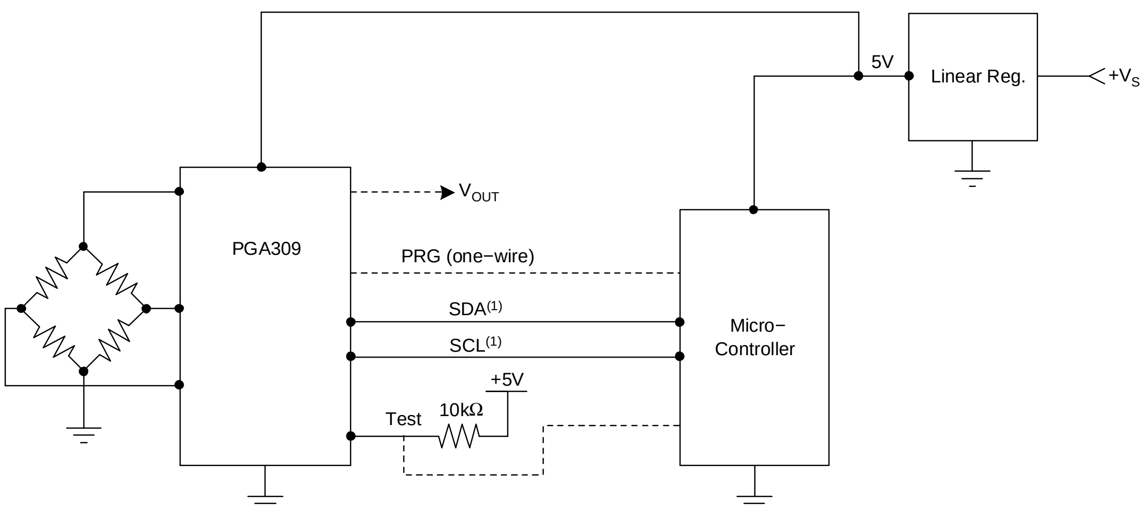
This section reviews two general applications of the PGA309 with an external microcontroller. Application 1 (Figure 1) illustrates a PGA309 that is powered from +5V and a microcontroller powered from +3V. (The +5V power supply is used in this application in order to get the best signal-to-noise ratio from the analog signal conditioning chain.) Application 2 shows both the PGA309 and the microcontroller powered from +5V; see Figure 2.



Notes: (1) May be one resistor and internal port pin ESD diode.
(2) SDA, SCL need open drain outputs.

Also, be sure to analyze speed limitations.

Figure 1. Application 1: PGA309 at +5V, Microcontroller at +3V



Note: (1) SDA, SCL need open drain outputs.

Figure 2. Application 2: PGA309 and Microcontroller at +5V

3 Common Design Guidelines for Application 1 and Application 2

The following design guidelines are relevant to both applications.

- If the PGA309 V_{OUT} is to be used in the system, it may be optimal for the microcontroller to control the Test pin in order to keep V_{OUT} at high impedance until the microcontroller has configured the PGA309 for the desired settings.
- If the user desires to have the internal Temperature Analog-to-Digital Converter (Temp ADC) on the PGA309 read the analog V_{OUT} of the PGA309, this configuration can be accomplished by using an algorithm similar to that depicted in Figure 3. The Temp ADC conversion time is denoted by ***tconv_uc***. This time is user-selectable, depending upon the desired Temp ADC resolution. In addition, if the internal temperature sense mode is to be used on the PGA309, then one can calibrate out the Temp ADC offset before reading the PGA309 V_{OUT} by connecting the TEMPIN pin to ground and then configuring the Temp ADC to read the TEMPIN pin. This result can be stored and subtracted from all PGA309 V_{OUT} readings. The offset of the Temp ADC is its dominant error.
- In both example applications, the PGA309 operates as a programmable sensor signal conditioner. Its internal state machine for compensation is not active. Therefore, all computations for setting the Gain and Zero Digital-to-Analog Converters (DACs) while the temperature changes must be performed by the microcontroller.
- Either the one-wire interface or the two-wire interface may be used by the microcontroller to communicate with the PGA309. The two-wire interface is compatible with microcontrollers that have a dedicated I^2C™ port.
- If using either the two-wire or one-wire interface, the port pins must be open drain to allow either the PGA309 or the microcontroller to pull down.
- Application 1 may have some level-shifting considerations, depending on the microcontroller port pin capabilities. The SCL and SDA lines of the PGA309 have 85µA (typical) pull-up current sources to the PGA309 V_{SD} supply pin.
- The internal pull-up current sources on the PGA309 SCL and SDA (85µA, typical) will need to be evaluated in the specific application. External pull-up resistors may need to be added, depending on capacitive loading and bus speed.

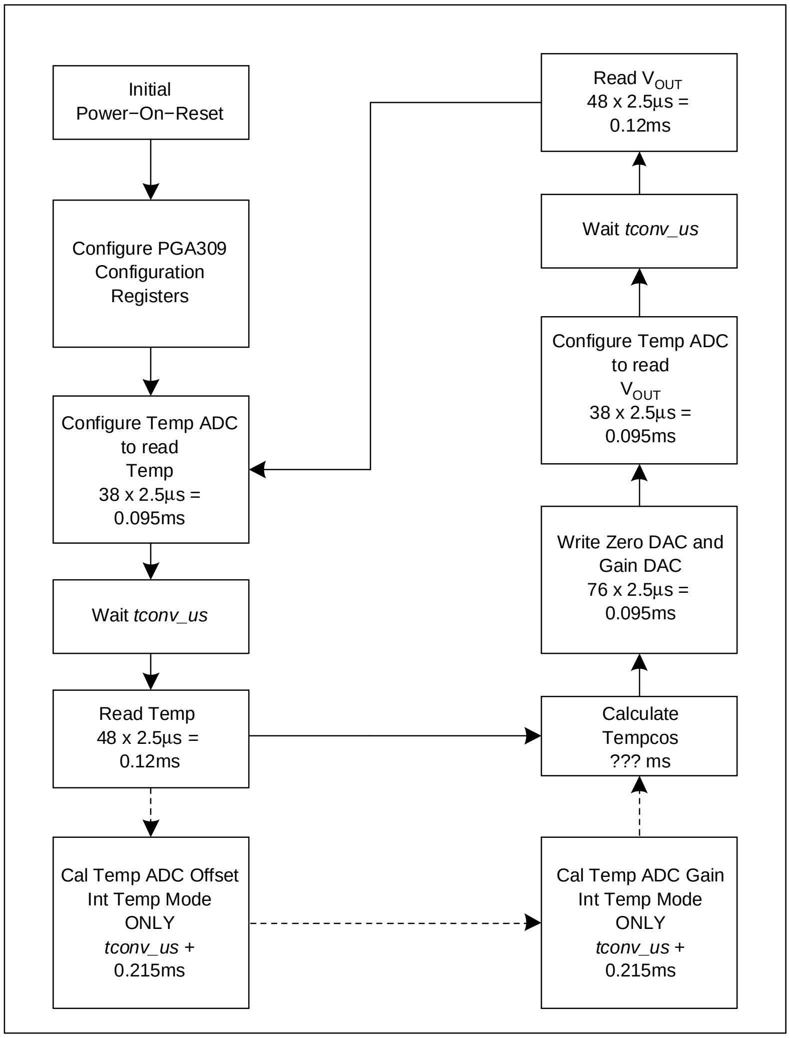


Figure 3. Typical Flowchart for External Microcontroller and PGA309 Application