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APPLICATION NOTE 6184

# USING THE MAX11254EVKIT AS A BUILDING BLOCK PLATFORM FOR INDUSTRIAL APPLICATIONS

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*Abstract: This application note aims to help evaluate the MAX11254/MAX11253 using the MAX11254EVKIT configuration of different analog front ends to achieve higher performance for industrial applications.*

## Introduction

When companies release a new part to the market, the aim is to offer a better solution for today's challenges that is not yet available, or to replace the existing solution with one that is more integrated, and efficient. On the other hand, there is no single solution for the variety of applications and specific requirements that consumers and companies have. This is especially true for industrial process control and automation.

Maxim built an evaluation platform to explore different approaches and evaluate the performance of MAX11254/MAX11253, 6-channel, 24-/16-bit, low-noise, low-power, delta-sigma ADC that can be suitable for different applications when we define and design the MAX11254EVKIT board.

## Front-End Implementations

There are three different front ends implemented in the MAX11254EVKIT:

1. **Each channel is available with direct inputs from terminal blocks (J1-J3, J25, and J26)**. Each channel can be configured with direct input or through the internal programmable gain amplifier (PGA) with the gain options from 1 to 128 selectable in the graphical user interface (GUI). Inputs to ADC channels are selected through J4 to J7 headers.
2. **Channel 2 and 3 have an additional signal conditioning circuit built on the low-noise discrete amplifiers, MAX9632, (U11, U12, U13, and U14 for channel 2, and U15, U16, U17, and U18 for channel 3)**. These amplifiers can be configured either as a) single-ended inverting or non-inverting front-end, or b) differential front-end through the jumper selection of J31 to J36 for the channel 2, and through the jumper selection of J39 to J44 for the channel 3. Refer to the attached MAX11254EVKIT schematic. In addition, the ADC inputs can be biased by $V^{REF}/2$ by placing shunts on J37, J38, J45 or J46.

3. **Channel 4 and 5 have a low-noise front-end build on single MAX44205 (U19 and U20) differential amplifier.** In this case, the ADC inputs are biased by $V_{REF}/2$ by default.

## Reference Options

The MAX11254EVKIT has several voltage reference options to choose for the ADC and its front-end:

1. **3.0V $V_{REF}$ from the MAX6126—**3ppm/°C, 0.02% initial accuracy with 1.3µ$V_{P-P}$ noise-voltage reference in SOIC package (JMP1 shunt 1-2);
2. **3.0V $V_{REF}$ from the MAX6070—**6ppm/°C, 0.04% initial accuracy with 4.8µ$V_{P-P}$ noise-voltage reference in SOT23-6 package (JMP1 shunt 1-3); and,
3. **1.8V $V_{REF}$ from the MAX6070—**6ppm/°C, 0.04% initial accuracy with 4.8µ$V_{P-P}$ noise-voltage reference in SOT23-6 package (JMP1 shunt 1-4).

## Power supply options

The MAX11254/MAX11253 ADC has several power options:

*Note: All supply options are available with jumper selection on the board, using an external supply or their combinations.*

1. Single supply AVDD = +3.3V (J12 shunt 1-2), AVSS = 0V (J17 shunt 1-2);
2. Split supply with AVDD = +1.8V (J12 shunt 2-3), AVSS = -1.8V (J17 shunt 2-3);
3. DVDD = +1.8V (J10 shunt 2-3) or +3.3V (J10 shunt 1-2) with option of +2V (J8 closed), refer to the MAX11254EVKIT data sheet.
4. User defined supplies applied directly to AVDD (TP21), AVSS (TP28), DVDD (TP19), and REFP_F (TP30) referenced to AGND. Keep the external supplies within operation condition limits.

Let's consider a typical application.

## Weight scale (Wheatstone bridge)

For our test we use a load cell from $20 kitchen scale widely available from local hardware stores.

Setup:

Load cell supply +3.3V from TP14, while the common ground is connected through GPO0 switch. The GPO0 switch can be turned on when you need to take a measurement, or turned off to save power. This feature especially benefits battery-powered applications.

Positive bridge output is connected to J1.3, and negative output is connected to J1.4

Positive reference point is connected to J1.2, and a negative reference point is connected to J1.7 and to

J1.9 by two separate wires, as shown in Figure 1.

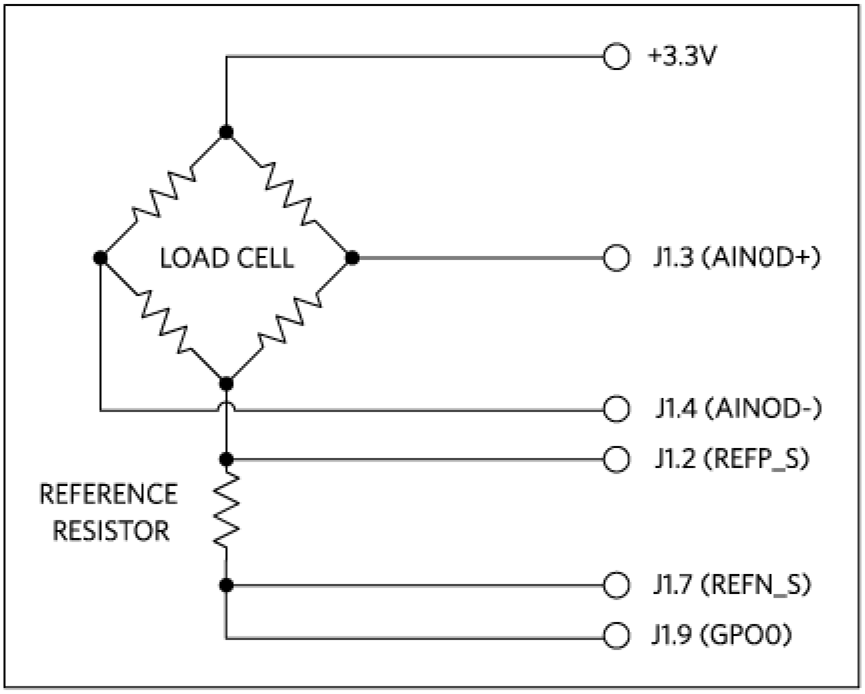

*Figure 1. Weight scale Wheatstone bridge connection.*

In the GUI select channel 0, select Sample Rate, and Number of Samples we are going to take for each conversion from corresponding pull-down menu. Since the load-cell output is very small, from a few micro volt to 2mV with 1kg weight, we use an internal programmable gain amplifier (PGA) with Gain = 128x, and continuous mode. Set GPO0 to 1 to power up the bridge. The GUI setup is shown in **Figure 2**.

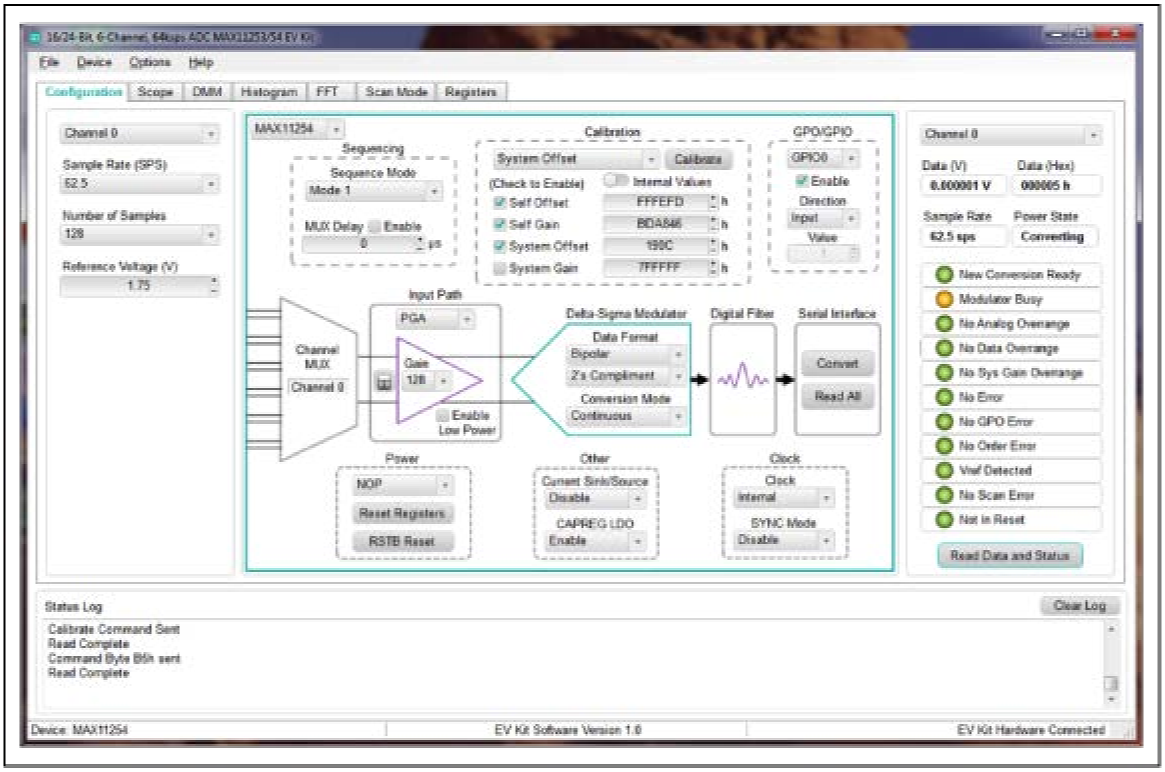


*Figure 2. MAX11254 GUI setup.*

After performing Self Gain and Offset calibration, press Convert button and Read Data and Status button. The load-cell output can be seen on the upper-right corner of the GUI. This data represents offset output of the unloaded Wheatstone bridge in volts. Continuously measuring calibration weights we can plot a transfer function of this load cell. See **Figure 3**.

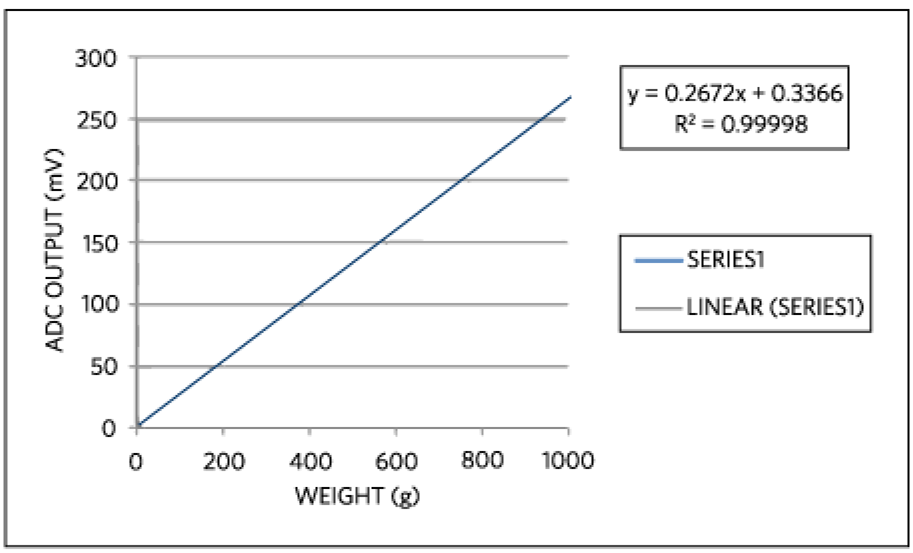


*Figure 3. Transfer function of load cell.*

As can be seen in Figure 3, the transfer function is perfectly linear. Refer to the trend-line equation and R-squared value. The only drawback of this configuration is a small dynamic range and compromised weight resolution. Let's say we need to achieve a better dynamic range, in volts, not in millivolts. For this purpose we are going to use another channel, channel 4, which has an external differential amplifier MAX44205 (U19). We changed its gain from original 1x to 10x by replacing resistors R101 and R103 with 10k 0.1%. Since the input impedance of this amplifier is small, about 1kΩ, we need to add an additional buffer in front of it for correct measurement. We are going to use two MAX9632 op-amps (U15 and U16) as buffers for differential amplifiers. Removing R62/R66 and R64/R67, we change their original differential configuration to high impedance input buffers. Using jump-wires from J43.1 to J49.4 and J44.1 to J49.2, and connecting load cell output to J26.2 and J26.6, we complete our modification. Conducting the same measurement, we can plot a new transfer function as shown in **Figure 4**.

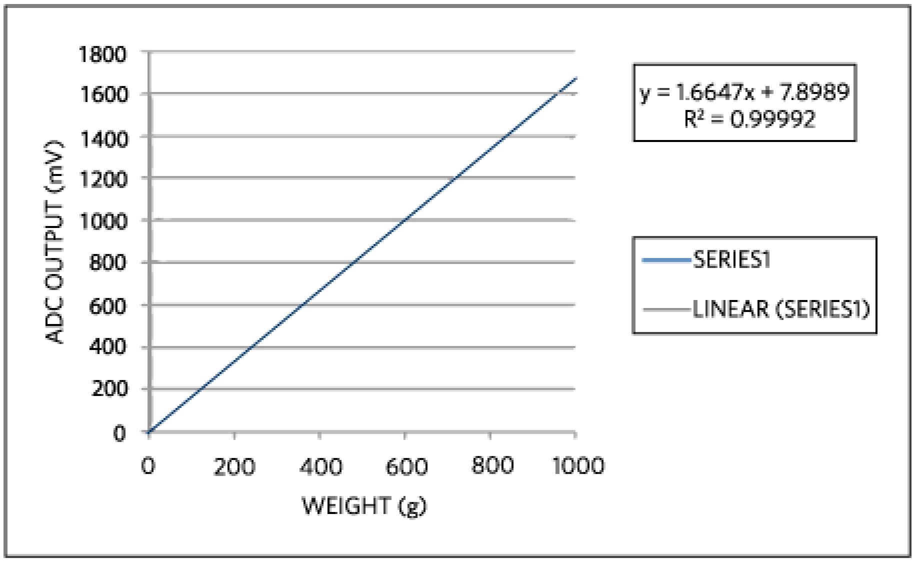


*Figure 4. Load cell transferfunction with a higher dynamic range.*

Now the output dynamic range and weight resolution become much higher with very little nonlinearity added. This Maxim evaluation platform is suitable for different applications, getting us closer to having a single solution for the variety of applications and specific requirements of consumers and companies in industrial process control and automation—the MAX11254EVKIT board IS the better solution for today's challenges.

| Related Parts | | |
|---|---|---|
| MAX11253 | 16-Bit, 6-Channel, 64ksps, 6.2nV/ÃHz PGA, Delta-Sigma ADC with SPI Interface | Free Samples |
| MAX11254 | 24-Bit, 6-Channel, 64ksps, 6.2nV/ÃHz PGA, Delta-Sigma ADC with SPI Interface | Free Samples |

| | | |
|---|---|---|
| MAX44205 | 180MHz, Low-Noise Fully Differential SAR ADC Driver | Free Samples |
| MAX6070 | Low-Noise, High-Precision Series Voltage References | Free Samples |
| MAX6126 | Ultra-High-Precision, Ultra-Low-Noise, Series Voltage Reference | Free Samples |
| MAX9632 | 36V, Precision, Low-Noise, Wide-Band Amplifier | Free Samples |

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