Introduction
The "Strain Gauge DAQ on a USB Stick with Programmable Gain INAMP with Renesas R5F10JBC" is one of a series of reference designs highlighting Intersil’s precision products with different microcontrollers. This reference design is a self contained demo showing a complete signal chain solution using Intersil parts and a Renesas microcontroller. The complete reference design is conveniently housed in a USB stick form factor. This compact design draws power through the USB port and uses a Graphical User Interface (GUI) to display the real time voltage readings from a bridge strain gauge or a user supplied sensor. Figure 1 shows the Data Acquisition (DAQ) on a Stick connected to an external foil strain gauge.

Installation of the Graphical User Interface (GUI) Software and USB Drivers
The GUI Software and USB drivers have to be installed on a PC running Windows NT/2000/XP/Vista/Win7/Win 8 operating system before connecting the ISLRE-BDGSTKEV1Z evaluation board to the USB port.

The software (Figure 3) and a quick video on the operation of this application demo can be downloaded or viewed from the Intersil website at: http://www.intersil.com/en/tools/reference-designs/Renesas-ISL28634-strain-gauge-reference-design.html.

Figure 2 shows a simplified schematic of the Strain Gauge design. The design uses Intersil’s ISL28634 Programmable gain INAMP, ISL28233 Operational Amplifiers, ISL43741 Differential Mux, ISL21010 4.096 Voltage Reference, the ISL26104 24-bit Delta Sigma Converter and Renesas R5F10JBC Microcontroller.
Pressure Strain Gauge Signal Conditioning

The strain gauge design is a bridge solution that is able to extract a small sensor signal from a high voltage common mode signal of 10V or higher. Figure 2 shows a simplified schematic of the strain gauge design. The strain gauge design enables the user to measure the strain from an onboard foil strain gauge, or disconnect the onboard foil strain gauge via logic command to the ISL43741 differential MUX, and connect their own external signal to the IN1+ and IN1- inputs. Depending upon the sensor, the gain of the amplifier might need to be adjusted.

Design Considerations

ISL28634

The ISL28634 is an ideal choice for the input amplifier for a strain gauge design. The 5V Zero-Drift Rail-to-Rail Input/Output programmable gain Instrumentation Amplifier has the following features: low input offset, low input bias current, low input noise, low high CMRR. The zero drift circuitry achieves low offset and gain error drift. The logic interface allows up to 9 selectable gain settings. The differential output amplifier includes a reference pin to set the common mode output voltage to interface with differential input ADC.

ISL28233 Dual Micropower, Zero-Drift, RRIO Operational Amplifier

The ISL28233 is a dual micropower, zero-drift operational amplifier that is optimized for single supply operation from 1.65V to 5.5V. The low supply current of 18μA and wide input range enable the ISL28233 to be an excellent general purpose op amp for a variety of applications.

ISL26104 24-bit ADC

The ISL26104 is a complete analog front-end with quad differential multiplexed inputs for high resolution measurements. ISL26104 features a third order modulator providing up to 21.4-bit noise-free performance (10Sps). The 24-bit delta-sigma analog-to-digital converter includes a very low-noise amplifier with programmable gain. Although this application demo uses an input buffer amplifier (ISL28634), the high input impedance of the ISL26104 allows direct connection of sensors, such as load cell bridges to ensure the specified measurement accuracy without a buffer amplifier.

In order to initiate a correct power-up reset, diode D1, resistor R3 and capacitor C8 implement a simple RC delay to ensure the PDWN transitions from low to high after both power supplies have settled to specified levels.

ISL21010 (4.096V)

The ISL21010CFH341 is a precision 4.096V, low dropout micropower bandgap voltage reference. It provides a ±0.2% accurate reference. The ISL21010 provides up to 25mA output current sourcing with low 150mV dropout voltage. The low supply current and low dropout voltage combined with high accuracy make the ISL21010 ideal for precision low powered applications.

ISL43741 Differential 4 to 1 Multiplexer

The ISL43741 is a precision, bidirectional, differential 4-channel multiplexer/demultiplexer. The mux is designed to operate from a single ±2V to +12V supply or from ±2V to ±6V supplies. The ISL43741 has low charge injection with 1pC (Max) at Vc = ±5V.

Reference Documents

- ISL28634 Data Sheet “5V Zero-Drift Rail-to-Rail Input/Output programmable gain Instrumentation Amplifier features,” FN8364
- ISL28233 Data Sheet “Dual Micropower, Zero-Drift, RRIO Operational Amplifier,” FN7692
- ISL21010 Data Sheet “Micropower Voltage Reference,” FN7896
- ISL26104 Data Sheet “Low-Noise 24-bit Delta Sigma ADC,” FN7608
- ISL43741 Data Sheet “Low-Voltage, Single and Dual Supply, 8 to 1 Multiplexer and Differential 4 to 1 Multiplexer,” FN6053
- App Note “DAQ on a Stick, Strain Gauge with Programmable Chopper Stabilized IN-Amp,” AN1853
- Renesas R5F10JBC Data Sheet