Honeywell Pressure Sensor DAQ on a USB Stick with Renesas R5F10JBC

Introduction

This cookbook shows the operation of Intersil’s precision products in a pressure sensor application. The application uses Intersil’s Data Acquisition (DAQ) on a Stick reference design with Honeywell’s NBP Series-Uncompensated/Unamplified 0psi to 30psi basic board mount pressure sensor.

The reference design is a self contained demo showing a complete signal chain solution from the Honeywell sensor, signal conditioning using Intersil’s precision parts and a Renesas microcontroller. The complete reference design is conveniently housed in a USB stick form factor with a plug in sensor board. This compact design draws power through the USB port and uses a Graphical User Interface (GUI) to display the real time voltage readings from the pressure sensor. Figure 1 shows the DAQ on a Stick connected to an external pressure sensor. Pressure is applied to the Honeywell sensor via a syringe. Figure 2 shows a simplified schematic of the pressure sensor design. The design uses Honeywell’s NBPLLNN030PGUNV 0psi to 30psi basic board mount pressure sensor, Intersil’s ISL28134 chopper amplifier, ISL22316 Digitally Controlled Potentiometer (DCP), ISL43741 differential mux, ISL21010 4.096 voltage reference, the ISL26102 24-bit delta sigma converter, and Renesas R5F10JBC microcontroller.

Graphical User Interface (GUI) Software

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-BDGSTKEVAL2Z /ISLSTKDB-HWPEV1Z evaluation boards to the USB port.

The software 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-honeywell-pressure-reference-design.html.

Measuring Pressure with the Honeywell Sensor Board

The DAQ on a Stick reference design has the ability to measure two types of sensors, reference Figure 3. The input pins labeled “s”, “s” are for resistive changes in a bridge configuration and are not used for the Honeywell demo. Reference Application note AN1834 for bridge measurements using these inputs.

The inputs labeled GND, 5V, IN+, IN- are used to power the Honeywell pressure sensor board and measure the pressure applied. The selection between which sensor is measured by the GUI is determined by clicking the appropriate radial button (“Sensor Supplied with the Demo” or the “Customer Supplied”) at the bottom of Figure 4a. The “Sensor Supplied with the Demo” is the default value.
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in the GUI with a gain of 115V/V. When the user selects “Customer Supplied” sensor, the ISL43741 differential mux connects the IN+ and IN- inputs to the differential amplifier constructed with two ISL28134 zero drift amplifiers. The user will now have the option of changing the amplifiers’ gain for the best measurement.

Figure 4b shows the Measurement Display screen. From this screen, the user can stop and start data collection, adjust the minimum and maximum X & Y axis and go back to the set-up screen by clicking on the Show Main button. A calibrate button is provided to zero out the voltage reading when the Honeywell sensor is not under pressure. This helps to give an accurate reading from time zero.

Design Considerations

**ISL28134**

The ISL28134 is an ideal choice for the input amplifier for a pressure gauge design. The ISL28134 uses auto-correction circuitry to provide ultra low offset voltage (2.5μV), and low offset temperature drift (<0.1μV/°C). The very low 1/f noise corner at 100Hz of the amplifier makes it ideal for low frequency precision applications requiring very high gain and low noise. Other attributes of the ISL28134 are the wide gain bandwidth and rail-to-rail input/output swing.

**ISL26102 24-bit ADC**

The ISL26102 is a complete analog front-end with dual differential multiplexed inputs for high resolution measurements. ISL26102 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 (ISL28134), the high input impedance of the ISL26102 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 R2 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 ISL21010 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.

**ISL22316 DCP**

The ISL22316 is a low noise, low power I2C® bus, 128 tap DCP. The DCP can be used as a three-terminal potentiometer or as a two-terminal variable resistor in a wide variety of applications including control, parameter adjustments, and signal processing.

**ISL43741 Diff 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 Vsupply = ±5V.

Reference Documents

- Intersil App Note “DAQ on a Stick, with Honeywell Pressure Sensor” AN1865
- Intersil ISL28134 Data Sheet “5V Ultra Low Noise, Zero Drift Rail-to-Rail Precision Op Amp.” FN6957
- Intersil ISL21010 Data Sheet “Micropower Voltage Reference,” FN7608
- Intersil ISL26102 Data Sheet “Low-Noise 24-bit Delta Sigma ADC,” FN7608
- Intersil ISL43741 Data Sheet “Low-Voltage, Single and Dual Supply, 8 to 1 Multiplexer and Differential 4 to 1 Multiplexer,” FN6053
- Intersil ISL22316 Data Sheet “Low Noise, Low Power I2C® Bus, 128 Taps,” FN6186
- Renesas R5F10JBC Data Sheet
- Honeywell pressure sensor Link to Honeywell web page.

**Sensor:** Foil strain gauge, bridge sensor, tension, load cell, force, torque, weight, compression, flow sensor, absolute, gage, pressure, barometric, psi

**Applications:** Sensor signal conditioning, process control, industrial control, medical, small signal gain, precision analog, mixed signal analog to digital, USB, HVAC, Alternative Energy, Wind Power, energy meters, patient monitors, data acquisition, smart metering, automotive, aerospace, pneumatic controls, air compressor, hydraulic controls, VAV controls, clogged filter detection, presence/absence of flow.

**Performance:** 16-bit to 24-bit sensor signal conditioning, low noise, low offset drift, less than <1%, RL78/G1C, Gecko series, ARM Cortex-M3, ARM Cortex-M0, 32-bit controller, chopper stabilized, 21.6 noise-free bits, ENOB, USB 2.0, DMIPS, true low power MCU, 16-bit CISC architecture, USB BC 1.2 standard for Fast Battery Charging