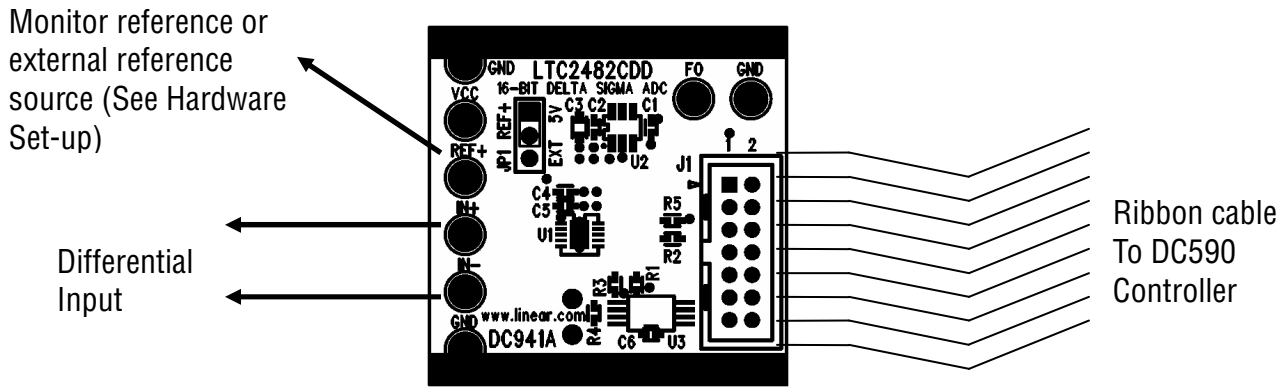
DESCRIPTION

Demonstration circuit 941 features the LTC2482, a 16-bit high performance ΔΣ analog-to-digital converter (ADC). The LTC2482 features 2ppm linearity, 0.5μV offset, and 600nV RMS noise. The input is fully differential, with input common mode rejection of 140 dB. The LTC2482 is available in a 10 pin DFN package and has an easy to use SPI interface.

DC941 is a member of Linear Technology's QuickEval™ family of demonstration boards. It is designed to allow easy evaluation of the LTC2482 and may be connected directly to the target application's analog signals while using the DC590 USB Serial Controller board and supplied software to measure performance. The exposed ground planes allow proper grounding to prototype circuitry. After evaluating with Linear Technology's software, the digital signals can be connected to the end application's processor / controller for development of the serial interface.

Design files for this circuit board are available. Call the LTC factory.

Figure 1. Proper Measurement Equipment Setup

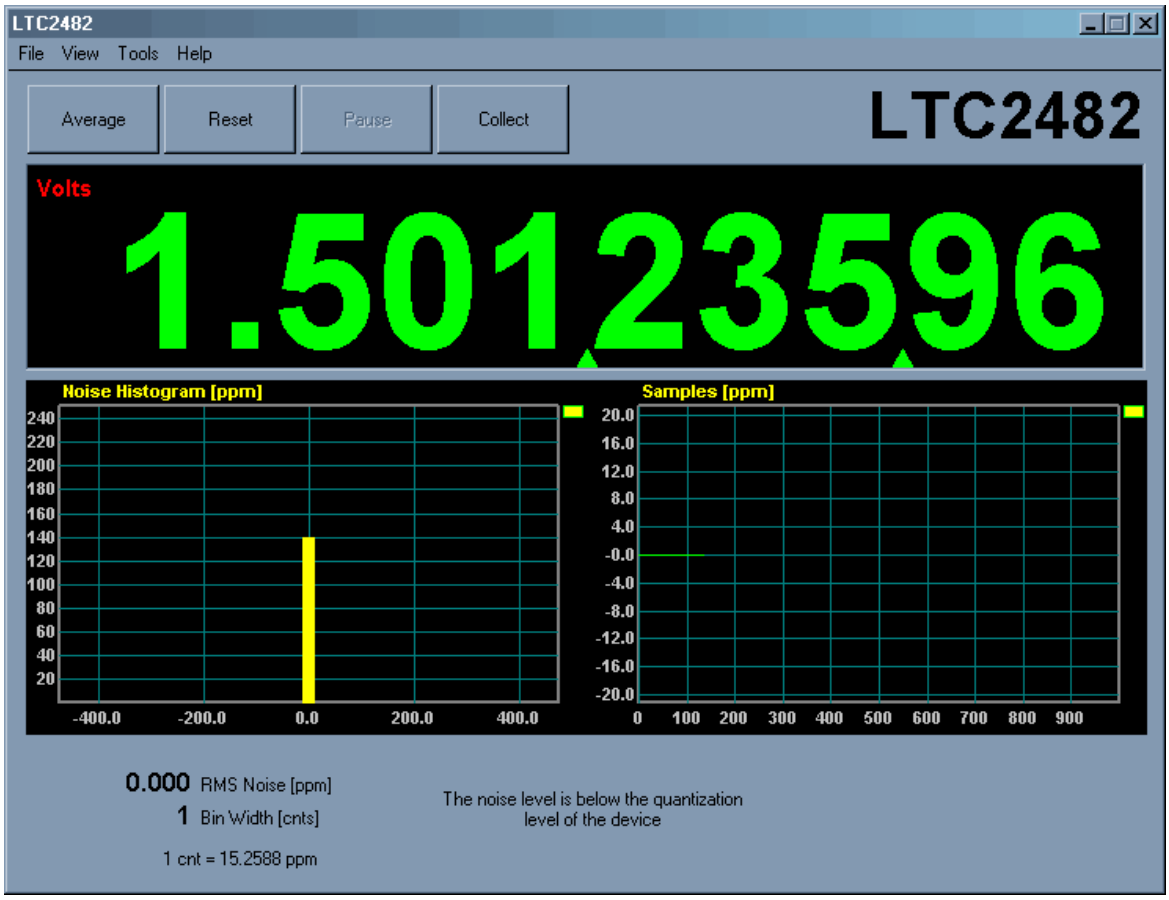


QUICK START PROCEDURE

Connect DC941 to a DC590 USB Serial Controller using the supplied 14-conductor ribbon cable. Connect DC590 to host PC with a standard USB A/B cable. Run the evaluation software supplied with DC590 or downloaded from http://www.linear.com/software. The correct program will be loaded automatically. Click the COLLECT button to start reading the input voltage. Details on software features are documented in the control panel's help menu.

Tools are available for logging data, changing reference voltage, changing the number of points in the strip chart and histogram, and changing the number of points averaged for the DVM display.

Figure 2. Software Screenshot



HARDWARE SET-UP

CONNECTION TO DC590 SERIAL CONTROLLER

J1 is the power and digital interface connector. Connect to DC590 serial controller with supplied 14 conductor ribbon cable.

JUMPERS

JP1 – Select the source for REF+, either an LT1790A-5 or externally supplied.

ANALOG CONNECTIONS

Analog signal connections are made via the row of turret posts along the edge of the board. Also, when connecting the board to an existing circuit the exposed ground planes along the edges of the board may be used to form a solid connection between grounds.

GND – Three ground turrets are connected directly to the internal ground planes.

VCC – This is the supply for the ADC. Do not draw any power from this point.

REF+ - Connected to the LTC2482 reference pin. If one of the onboard references is being used, the reference voltage may be monitored from this point. An external reference may be connected to these terminals if JP1 is removed.

IN+, IN- – These are the differential inputs to the LTC2482.

Fo - An external conversion clock may be applied to the Fo turret to modify the frequency rejection characteristics or data output rate of the LTC2482. This should be a square wave with a low level equal to ground and a high level equal to Vcc. While up to a 2MHz clock can be used, performance may be compromised. Refer to the LTC2482 data sheet. This terminal has a 5k pulldown resistor to keep it from floating when no signal is applied.

EXPERIMENTS

INPUT NOISE

One of the characteristics of the LTC2482 is that the 600nV input noise floor is far below the quantization level of 38uV when a 5-volt reference is used. This means that the output will be stable if the input noise level is significantly below 38uV. In this sense, the LTC2482 is a true 17 effective bit part, whereas many 16-bit SAR converters have several LSBs of noise.

Solder a short wire from the IN- turret post to the IN+ turret post. Noise should be below the quantization level of the LTC2482. This will result in a noise reading of zero on the control software, unless the offset is such that the display flickers between two codes in which case the RMS noise reading will be incorrect.

Select EXT for the source for Vref on JP1 and apply a 100mV source between a GND turret post and the Vref turret post. A precision, adjustable voltage source such as a Data Precision 8200 or Fluke 332A is ideal. Another option for this experiment is a 50k / 1k divider from the LT1790A-5 output to ground, giving a 98mV output. The resulting LSB size is 0.1/217, or 763nV. This is small enough to “see” the noise floor of the LTC2482 inputs, and the RMS noise display should read approximately 6 to 7ppm (of the 100mV reference).

COMMON MODE REJECTION

Tie the two inputs (still connected together) to ground through a short wire and note the indicated voltage. Tie the inputs to REF+; the difference should be less than 0.5µV due to the 140dB minimum CMRR of the LTC2482.

BIPOLAR SYMMETRY

To demonstrate the symmetry of the ADCs transfer function, connect a stable, low noise, floating voltage source (with a voltage less than Vref/2) from IN+ to IN- and note the indicated voltage. Reverse the polarity; the indicated voltage will typically be within one LSB of the first reading multiplied by –1.

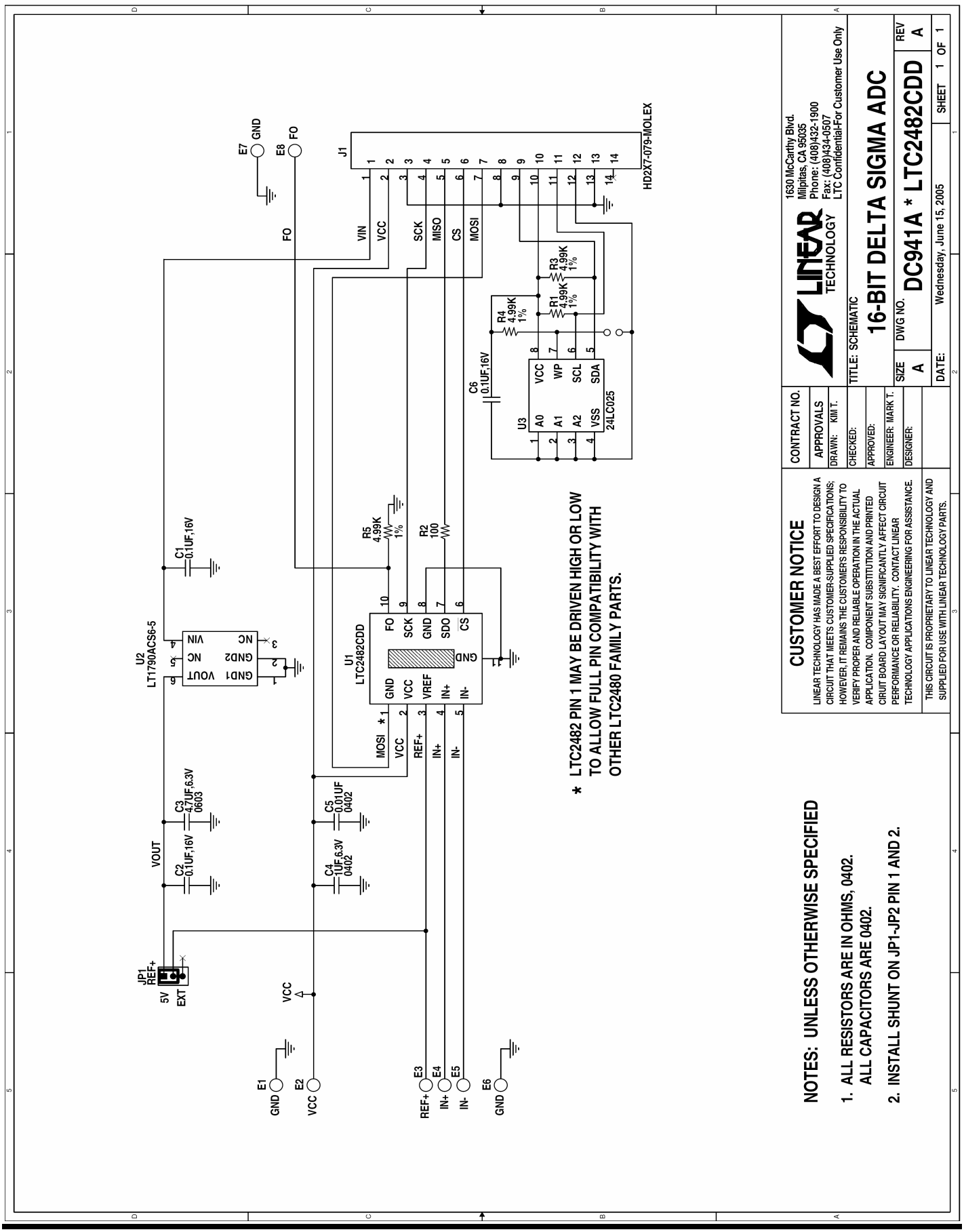
One convenient voltage source for this experiment is a single alkaline battery. While a battery has fairly low noise, it is sensitive to temperature drift. It is best to use a large (D-size) battery that is insulated from air currents. A better source is a battery powered series reference such as the LT1790. This part is available with output voltages of 1.25V, 2.048V, 2.5V, 3V, 3.3V, 4.096V and 5V.

INPUT NORMAL MODE REJECTION

The LTC2482's SINC4 digital filter is trimmed to reject 50 or 60 Hz line noise when operated with the internal conversion clock. To measure input normal mode rejection, connect IN- to a 2.5 volt source such as an LT1790-2.5 reference or 1k – 1k divider from the onboard 5V reference to ground. Apply a 10 Hz, 2V peak-to-peak sine wave to IN+ through a 1uF capacitor. No DC bias is required because the 2-3MΩ input impedance of the LTC2482 tends to self-bias the input to mid-reference (see datasheet applications information for details.)

Start taking data. The input noise will be quite large, and the graph of output vs. time should show large variations.

Next, slowly increase the frequency to 60 Hz (or 50Hz or 55Hz, depending on the selected rejection frequency.) The noise should be almost undetectable in the graph. Note that the indicated noise in ppm may still be above that of the datasheet specification because the inputs are not connected to a DC source.


E7 GND
E8 FO
J1
HD2X7-079-MOLEX
FO
VIN
VCC
SCK
MISO
CS
MOSI
U2
LT1790ACS6-5
GND1 VOUT
GND2 NC
NC VIN
C1 0.1UF,16V
R5 4.99K 1%
R2 100
U1
LTC2482CDD
FO SCK GND SDO CS GND
GND VCC VREF IN+ IN- IN-
MOSI * 1
VCC 2
REF+ 3
IN+ 4
IN- 5
C6 0.1UF,16V
U3
24LC025
A0 A1 A2 VSS VCC WP SCL SDA
R4 4.99K 1%
R1 4.99K 1%
R3 4.99K 1%
VOUT
C3 4.7UF,6.3V 0603
C2 0.1UF,16V
C5 0.01UF 0402
C4 1UF,6.3V 0402
JP1
REF+
5V
EXT
VCC
E1 GND
E2 VCC
E3 REF+
E4 IN+
E5 IN-
E6 GND
* LTC2482 PIN 1 MAY BE DRIVEN HIGH OR LOW TO ALLOW FULL PIN COMPATIBILITY WITH OTHER LTC2480 FAMILY PARTS.
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE IN OHMS, 0402.
ALL CAPACITORS ARE 0402.
2. INSTALL SHUNT ON JP1-JP2 PIN 1 AND 2.
CUSTOMER NOTICE
LINEAR TECHNOLOGY HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT MEETS CUSTOMER-SUPPLIED SPECIFICATIONS; HOWEVER, IT REMAINS THE CUSTOMER'S RESPONSIBILITY TO VERIFY PROPER AND RELIABLE OPERATION IN THE ACTUAL APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.
THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.
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16-BIT DELTA SIGMA ADC
SIZE A
DWG NO. DC941A * LTC2482CDD
REV A
DATE: Wednesday, June 15, 2005
SHEET 1 OF 1