LTC2607
16-Bit Dual Rail-to-Rail DAC with I²C Interface

DESCRIPTION

Demonstration circuit 934A features the LTC®2607 dual 16-bit DAC. This device establishes a new board-density benchmark for 16-bit DACs and advances performance standards for output drive, load regulation, and crosstalk in single supply, voltage-output DACs.

DC934A has many features for evaluating the performance of the LTC2607. Onboard 5V, 4.096V, and 2.5V precision references are provided, and the LTC2607 may be powered by the 5V reference for evaluating rail-to-rail operation.

Another feature of this board is the onboard LTC2422 20-bit ADC for monitoring DAC output voltage. The 16ppm total error of this device is adequate for taking meaningful measurements of various LTC2607 parameters.

Design files for this circuit board are available at http://www.linear.com/demo

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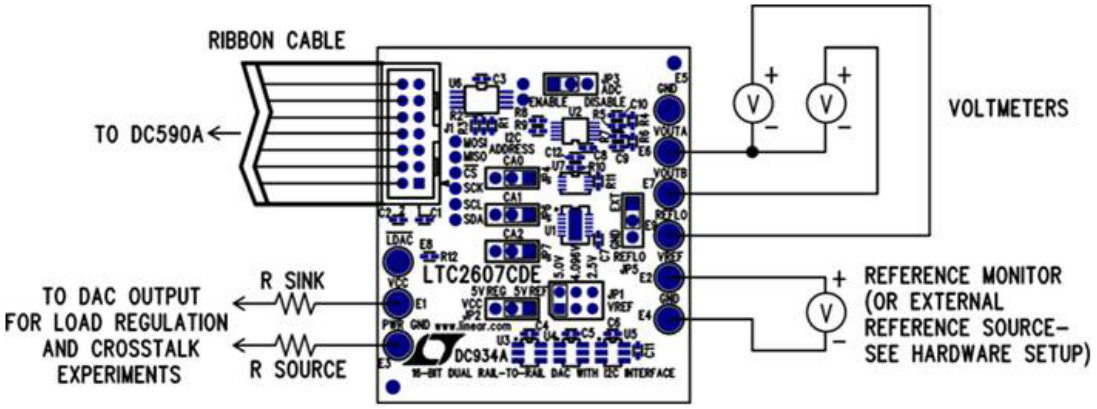


Figure 1. Proper Measurement Equipment Setup

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITION	VALUE
Resolution		16 Bits
Monotonicity	V_{CC} = 5V, V_{REF} = 4.096V	16 Bits
Differential Nonlinearity	V_{CC} = 5V, V_{REF} = 4.096V	±1LSB
Integral Nonlinearity	V_{CC} = 5V, V_{REF} = 4.096V	±19LSB Typical
Load Regulation	V_{CC} = V_{REF} = 5V, Mid-scale I_{OUT} = ±15 mA	2LSB/mA Max
DC Crosstalk	Due to Load Current Change on Any Other Channel	3µV/mA

QUICK START PROCEDURE

Connect DC934A to a DC590 USB serial controller using the supplied 14-conductor ribbon cable. Connect DC590 to a host PC with a standard USB A/B cable. Run the evaluation software supplied with DC590 or download it from www.linear.com/software. The correct control panel will be loaded automatically. Click the COLLECT button to begin outputting codes to the DAC and reading back the resulting output voltage.

Complete software documentation is available from the Help menu item, as features may be added periodically.

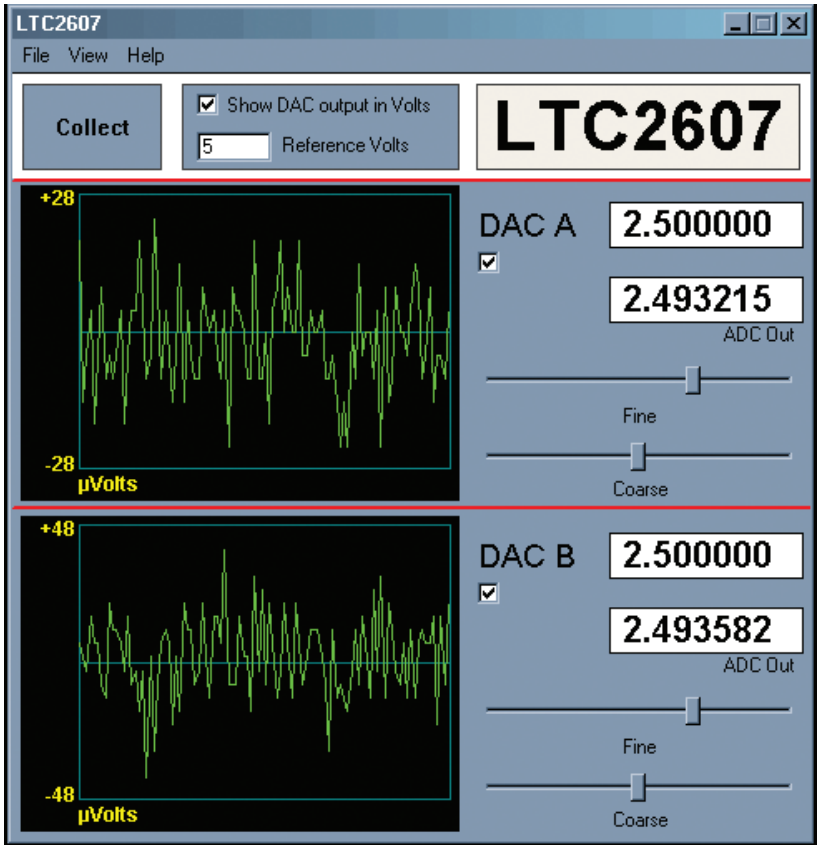


Figure 2. Software Screenshot

HARDWARE SETUP

JUMPERS

JP1: V_{REF} Select. Select 5V, 4.096V, or 2.5V reference. To apply an external reference through the V_{REF} turret, remove this jumper.

JP2: V_{CC} Select. V_{CC} is taken either from the onboard 5V reference or the 5V regulated supply from the controller board. Selecting the 5V reference for V_{CC} and V_{REF} allows characterization of rail to rail operation of the LTC2607.

JP3: ADC Disable. Set to ON for operation with DC590 serial controller. When using in customer's end application, the ADC can be completely disabled by setting jumper to DISABLE.

For very sensitive noise measurements when using LTC supplied software, set the output voltage and stop reading voltage via the collect button on the control panel.

JP5: REFLO connection – either grounded or externally supplied. Refer to the LTC2607 data sheet for REFLO details.

HARDWARE SETUP

JP4,6,7: I^2C Address Selection. These are connected to the CA0, CA1, CA2 pins. The demo software uses the global I^2C address, so these pins have no effect when used with the QuikEval™ software. They can be used in prototyping to set the I^2C address of the LTC2607 – refer to the data sheet for the mapping of CA0,1,2 levels to I^2C addresses.

ANALOG CONNECTIONS

V_{OUTA}, V_{OUTB}: LTC2607 Outputs

V_{REF}: The V_{REF} turret is connected directly to the reference terminals of the LTC2607 and LTC2422 ADC. When one of the onboard references is being used, the reference voltage may be monitored at this point. An external reference may also be applied to this turret after removing JP1.

Grounding and Power Connections

Power (V_{CC}): Normally DC934A is powered by the DC590 controller. V_{CC} can be supplied to this turret, however the power supply on DC590 must be disabled! Refer to DC590 Quick Start Guide for more details on this mode of operation.

Grounding: Separate power and signal grounds are provided. Any large currents drawn from the DAC outputs should be returned to power ground. Also, if an external power supply is connected, power ground should be used. Signal ground is connected to the exposed ground planes at the top and bottom edges of the board, and to the two turrets labeled GND. Use signal ground as the reference point for measurements and connections to external circuits.

EXPERIMENTS

The following experiments are intended to demonstrate some of the outstanding features of the LTC2607. All can be performed using the onboard LTC2422 to monitor the DAC output voltage. The indicated output voltage will typically agree with an HP3458A voltmeter to 5 digits. If a DAC will be sinking or sourcing a significant current, then the output voltage should be measured as close to the DAC as possible.

Most of the data sheet specifications use a 4.096V reference, so this is the preferred reference to use for these experiments. Using the 5V regulator as the source for V_{CC} has the limitation that V_{CC} may be slightly lower than V_{REF}, which may affect the full-scale error. Selecting the 5V reference as the source for V_{CC} overcomes this, however the total current that the LTC2607 can source will be limited to approximately 5mA.

Using an external power supply is highly recommended for these experiments, especially those that draw significant current. Refer to the DC590 quick start guide for details.

RESOLUTION

The onboard LTC2422 ADC has an input resolution of 6µV. This will easily resolve a 1LSB (76µV for V_{REF} = 5V, 62.5µV for V_{REF} = 4.096V) change in the LTC2607 output. Set the DAC output to a voltage close to mid-scale. Select the FINE slider on the control panel with the mouse and use the right and left arrow keys to step the output by single LSBs. The change should be clearly visible in the output graph. (It may be necessary to wait for the graph to clear if a large step has just occurred.)

INTEGRAL NONLINEARITY

A rough measurement of INL can be taken using the onboard ADC. Measure one of the LTC2607 outputs at code 256 and 65,535 and calculate the slope and intercept using a spreadsheet. Next, take several readings at intermediate points. The readings should not deviate from the calculated line by more than 64LSBs, and they will typically be within 12LSBs.

LOAD REGULATION/DC OUTPUT IMPEDANCE

Select 5V REG for V_{CC} source. Set one of the outputs to mid-scale (code 32768). Source or sink 15mA from one of the DAC outputs by pulling it to power ground or V_{CC} with an appropriate value resistor. The voltage change

EXPERIMENTS

should be less than 2.25mV, corresponding to an output impedance of 0.15Ω. Output impedance is typically less than 0.030Ω. (measure DAC voltage at the output pin if using a voltmeter.)

ZERO SCALE ERROR

Set one of the DACs to code 0. The measured output should be less than 9mV and will typically be less than 1mV.

OFFSET ERROR

Set one of the DACs to code 256. The output voltage should be within 9mV of the correct value, or V_{REF} • 256/65535.

GAIN ERROR

Set one of the DACs to code 65,535. The output voltage should be within 0.7% of V_{REF}, and will typically be within 0.2%.

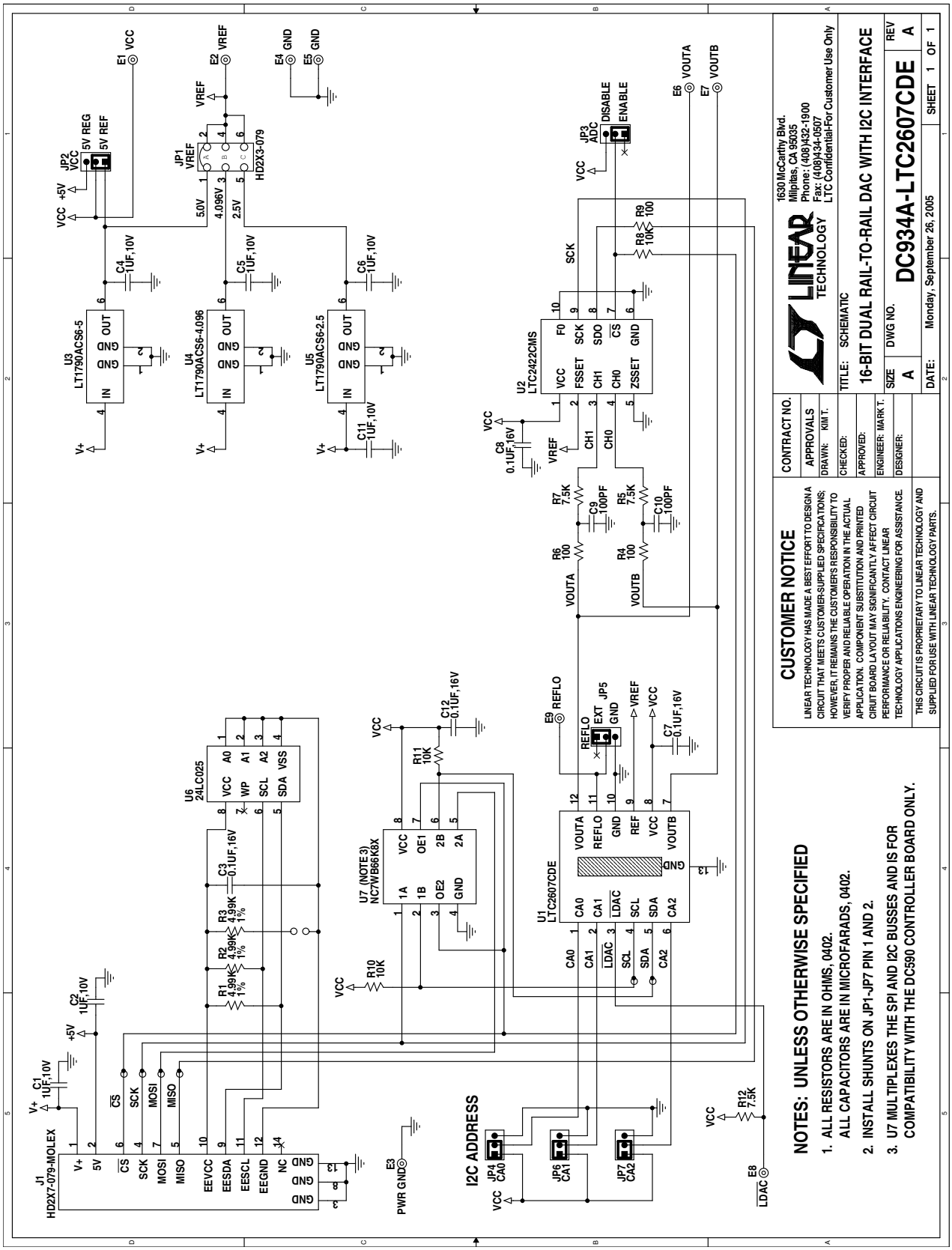
DC CROSSTALK

Set one of the DACs to mid-scale. Connect a 250Ω resistor from the output to V_{CC} or power ground (to sink or source 10mA, respectively, when the 5V reference is being used.) The other output should not change by more than 3.5µV per milliamp of load current.

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	6	C1, C2, C4, C5, C6, C11	CAP., X5R, 1µF 10V, 0402	TDK, C1005X5R1A105MT
2	4	C3, C7, C8, C12	CAP., X7R, 0.1µF 16V, 0402	TDK, C1005X7R1C104MT
3	2	C9, C10	CAP., NPO, 100pF 50V, 0402	AVX, 04025A101JAT
4	9	E1-E9	TESTPOINT, TURRET, 0.064"	MILL-MAX, 2308-2
5	1	JP1	JMP, 2X3, 0.079CC	SAMTEC, TMM-103-02-L-D
6	6	JP2-JP7	JMP, 3 PIN 1 ROW 0.079CC	SAMTEC, TMM-103-02-L-S
7	7	SHUNTS FOR JP1-JP7 PIN 1 AND 2	SHUNT, 0.079" CENTER	SAMTEC, 2SN-BK-G
8	1	J1	HEADER, 2X7 PIN, 0.079CC	MOLEX, 87331-1420
9	3	R1, R2, R3	RES., CHIP 4.99k 1/16W 1%, 0402	AAC, CR05-4991FM
10	3	R4, R6, R9	RES., CHIP 100Ω 1/16W 5%, 0402	VISHAY, CRCW0402101J
11	3	R5, R7, R12	RES., CHIP 7.5k 1/16W 5%, 0402	AAC, CR05-752JM
12	3	R8, R10, R11	RES., CHIP 10k 1/16W 5%, 0402	AAC, CR05-103JM
13	1	U1	I.C., LTC2607CDE, DFN12DE	LINEAR TECH., LTC2607CDE
14	1	U2	I.C., LTC2422CMS, MSOP10	LINEAR TECH., LTC2422CMS
15	1	U3	I.C., LT1790ACS6-5, SOT23-6	LINEAR TECH., LT1790ACS6-5 *
16	1	U4	I.C., LT1790ACS6-4.096, SOT23-6	LINEAR TECH., LT1790ACS6-4.096 **
17	1	U5	I.C., LT1790ACS6-2.5, SOT23-6	LINEAR TECH., LT1790ACS6-2.5
18	1	U6	I.C., 24LC025, TSSOP8	MICROCHIP, 24LC025-I/ST
19	1	U7	I.C., NC7WB66K8X, US8	FAIRCHILD, NC7WB66K8X

SCHEMATIC DIAGRAM



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This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

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