DESCRIPTION

Demonstration circuit 1287 is a 2 GHz Low Noise Differential 16-Bit ADC Buffer featuring the LTC6416. It incorporates a variety of passive components to support configurations for varied applications. Both single-ended and differential configurations are supported at the inputs and at the outputs.

The LTC6416 is a high-speed differential buffer amplifier with superior distortion and noise performance. It is intended for driving high speed 14 and 16 bit ADCs. It is perfect in applications such as demanding communications transceivers, cellular base stations, and other high-speed signal chain applications.

Notable features of the LTC6416 include high input impedance, adjustable output voltage limiting and simple output common-mode adjustment. The LTC6416's high input impedance allows it to be used in 50Ω systems with 1:4 and 1:8 input transformers

for additional system gain. The VCLLO and VCLHI pins set lower and upper limits on the output voltages seen at each differential output pin. This feature helps protect the ADC inputs from undervoltage and overvoltage waveforms. The output common-mode voltage of the LTC6416 is determined by the voltage applied to the VCM pin. It is internally buffered then drives the LTC6416's differential inputs through 2kΩ series resistors. For AC-Coupled operation, no external bias network is needed. DC-coupled inputs applied to the LTC6416 can easily override the 2kΩ resistance of the internal bias network. **Design files for this circuit board are available. Call the LTC factory.**

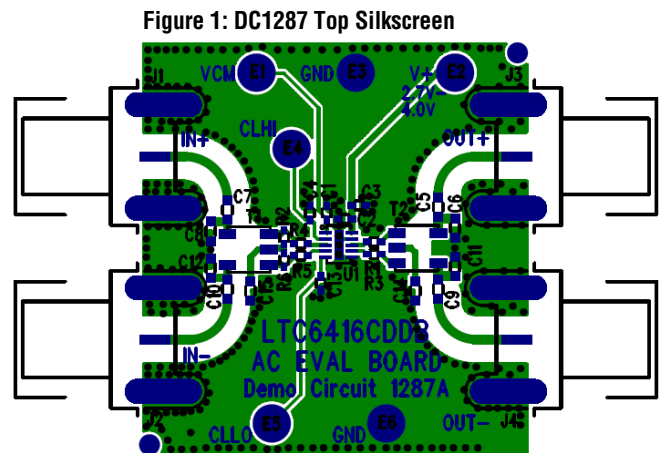# QUICK START PROCEDURE

Table 1 shows the function of each SMA connector on the board.

Table 1: DC1287 SMA Connector Descriptions

J1 (IN+)	Single-Ended/Differential Input. **By default, this is configured as a single-ended input.** Use this connector to supply an input to the DC1287. Drive from a 50ohm signal source, no external termination necessary.
J2 (IN-)	Differential Input. **Not connected by default.** Capacitor C10 can be installed and C12 removed to drive the DC1287 differentially.
J3 (OUT+)	Single-Ended/Differential Output. **By default, this is configured as a single-ended output.** This output is designed to drive 50 ohms, such as a network or spectrum analyzer input.
J4 (OUT-)	Differential Output. **Not connected by default.** Capacitor C9 can be installed and C11 removed for differential output drive.

Figure 1 shows the Top Silkscreen for the DC1287 Demo Board.

Figure 1: DC1287 Top Silkscreen

Refer to Table 1 and Figure 1, and follow the procedure below:

1. Connect ground to both GND turrets and a 3.6V power supply to the V+ turret. VCM, CLLO and CLHI turrets may be left floating.

2. Apply an input signal to J1. It should be >10MHz because of the lower frequency limit of the 1:1 input and output transformers. A good starting point for amplitude is about 0dBm ($0.63V_{PP}$) at the DC1287A's input. A low-distortion, low noise signal source with an external high-order low-pass or band-pass filter will yield the best performance. The DC1287's input is impedance-matched to 50Ω; no external termination is necessary.

3. Observe the output via J3. Although the LTC6416 is intended to drive the high-impedance inputs of an ADC, the DC1287A's output has been designed to drive 50Ω, suitable for the input of a network or spectrum analyzer. A resistive network comprised of R1, R3, 18Ω of internal resistance and the 50Ω load terminates the LTC6416 in a 400Ω differential load. T2, a 1:1 balun, transforms the output signal for single-ended observation. Due to voltage division within the output network, an attenuation of approximately -19dB is observed at the output.

ADDITIONAL INFORMATION

Although the DC1287A is ready to use out of the box, it has features that you can access by adding, removing or changing components on the board. These are described below.

DIFFERENTIAL INPUTS

To drive the DC1287A differentially, remove capacitor C12 and install capacitor C10. J1 and J2 can now be driven differentially from a 50Ω signal source. The input to the DC1287A will still be matched to 50Ω (differential) when driven in this manner.

DIFFERENTIAL OUTPUTS

To use the both outputs of the DC1287A, remove capacitor C11 and install capacitor C9. The output now appears differentially across J3 and J4. The output of the DC1287A will still be matched to 50Ω (differentially) when used in this manner.

CHANGING THE OUTPUT COMMON-MODE VOLTAGE

Turret E1 (labeled VCM) controls the output common-mode voltage of the DC1287A. This function can be used to level-shift the DC output voltage for optimum system performance. Normally, capacitors C8 and C9 prevent the output common mode voltage from reaching the output. However, if the common mode voltage is desired, C8 and C9 can be shorted or replaced by 0Ω resistors to allow the DC bias to reach the output. Transformer T2 is a 1:1 transmission line type, which means DC voltages will couple from input to output of the transformer. By default, the LTC6416 will self-bias the VCM pin to 1.36V (with V+=3.6V). For a different common-mode voltage, simply apply a voltage source to Turret E1.

ADJUSTING THE CLLO AND CLHI VOLTAGES

The LTC6416 features high speed voltage limiting at each of the output pins. This feature is important to help protect the inputs of the ADC. The output voltage at either of the differential outputs will not exceed the voltage set at the LTC6416's CLHI pin. Similarly, it will not go below the voltage set at the LTC6416's CLLO pin. See the LTC6416 datasheet for more information.

Turret E4 (labeled CLHI) drives the CLHI pin of the LTC6416 directly. If left floating, the CLHI pin will self-

bias to 2.45V (with V+=3.6V). For a different CLHI voltage, simply apply a voltage source to Turret E4.

Turret E5 (labeled CLLO) drives the CLLO pin of the LTC6416 directly. If left floating, the CLLO pin will self-bias to 0.265V (with V+=3.6V). For a different CLLO voltage, simply apply a voltage source to Turret E5.

OUTPUT DRIVE

Because the output of the LTC6416 is a low-impedance voltage output, performance will degrade when the output is directly driving low impedances such as 50Ω. See the LTC6416 datasheet for more information.

GROUND AND V+ CONNECTIONS

DC1287A's GND connector is not only connected to GND of the LTC6416, it also serves as the board ground. For best performance, a low-impedance return path to the power supply from GND is crucial. Short, low impedance wires to the VCC and GND connectors of DC1287A will yield the best performance from the LTC6416.

CABLES AND CONNECTORS

Long BNC or SMA cables are transmission lines, and for best circuit performance should be kept as short as possible. BNC or SMA cables or barrels should be characterized (or nulled out through calibration) for good high-frequency performance. Connectors also fall under the category of circuit elements, and must be of good quality and well characterized to ensure predictable results.

SIGNAL LEVELS

If we examine the schematic included with this Quick Start Guide, we can determine approximate signal levels seen at various points along DC1287A's signal chain. These signal levels assume that we start with 0dB at J1, and that there is a 50Ω load at the output(s). If the output load is a high-impedance load, the signal levels will vary from the schematic.

With 0dB at J1, 1:1 transformer T1 performs a single-ended to differential conversion. There is about 0.5dB of attenuation in the transformer, so the differential signal level at the inputs of the LTC6416 is about -0.5dB. The differential signal level at the outputs of the LTC6416 is about -1dB. The output resistor network results in an additional 17.5dB of attenuation at the input of 1:1 transformer T2 (-18.5dB total). Transformer T2 performs a differential to single-ended conversion and adds a final 0.5dB of attenuation bringing the total attenuation to -19dB.

The external series resistors at the LTC6416's output have been included so that the output of the DC1287A can plug directly into a 50Ω analyzer input, but the LTC6416 sees a more benign 400Ω load resistance.

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 CIRCUIT 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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TITLE: LTC6416CDDB, AC EVAL BOARD

SIZE | CAGE CODE | DWG NO: DC1287A | REV A

SHEET 1 OF 1