QUICK START GUIDE FOR DEMONSTRATION CIRCUIT DC800
LOW DISTORTION, LOW NOISE DIFFERENTIAL AMPLIFIER / ADC DRIVER

LT1993-2/-4/-10

DESCRIPTION

Demonstration circuit 800 features the LT1993-X Differential Amplifier and ADC Driver. It incorporates a variety of passive components to support configurations for varied applications. Single-ended or differential input and output configurations are possible, and there is a calibration circuit to null out the effects of other circuit components. **DC800A-A contains the LT1993-2, DC800A-B contains the LT1993-4, and DC800A-C contains the LT1993-10.**

The LTC1993-X is a high-speed differential amplifier with superior distortion and noise performance, perfect for demanding communications transceiver applications and other high-speed mixed signal applications. The LTC1993-X accepts single-ended or differential inputs with almost no difference in distortion performance. One standout feature of the LTC1993-X is the ability to independently adjust the output common-mode voltage, which allows output level shifting without any additional components. See the LT1993-X datasheet for information on typical performance specifications to expect when using the DC800.

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

LT, LTC and LT are registered trademarks of Linear Technology Corporation.

QUICK START PROCEDURE

Table 1 shows the function of each SMA connector on the board. Refer to Figure 1 for the connection diagram and follow the procedure below:

1. Connect the power supply as shown. The power labels of VCC, EN, and GND directly correspond to the VCC, EN, and VEE pins of the LT1993-X, respectively. Voltages other than +5V may be used as long as the voltage between VCC and GND is between 4V and 5.5V. Switch SW1 enables or shuts down the LT1993-X; to enable the part externally, see the Enable (Shutdown) section of this Quick Start Guide.

2. For network analyzer use, calibrate out board and transformer effects using J6 and J7. There is a 1:1 impedance transfer from J6 to J7, so external termination may be necessary for a 50Ω match.

3. Apply an input signal to J2. A low-distortion, low noise signal source with an external high-order filter will yield the best performance.

    NOTE: DC800's input is impedance-matched to 50Ω. No external termination is necessary.

4. Observe the output via J5. By default, the unfiltered outputs of the LT1993-X are used. The output is impedance-matched to 50Ω, suitable for the input of a network or spectrum analyzer.

Table 1: DC800 SMA Connector Descriptions

| CONNECTOR	FUNCTION
J1 (-IN)	Differential Input. **Connected to GND through resistor R2 by default.** Resistor can be removed to drive the DC800 differentially.
J2 (+IN)	Differential Input. Use this connector to supply an input to the DC800. Drive from a 50ohm signal source, no external termination necessary.
J3 (VOCM)	Output Common-Mode Pin. **By default, 0.44•VCC is supplied to this pin by a 14k resistor and an 11k resistor.** Override this voltage with any low-impedance DC voltage source.
J4 (-OUT)	Differential Output. **Connected to GND through 0Ω resistor R14 by default.** Resistor can be removed for differential output drive.
J5 (+OUT)	Differential Output. Resistively impedance-matched to 50 ohms, can be used to drive a 50ohm network analyzer input.
J6 (TEST IN)	Calibration network input. Use with network analyzer to calibrate out effects of board trace parasitics, transformers, and SMA connectors.
J7 (TEST OUT)	Calibration network output.

LT LINEAR TECHNOLOGY
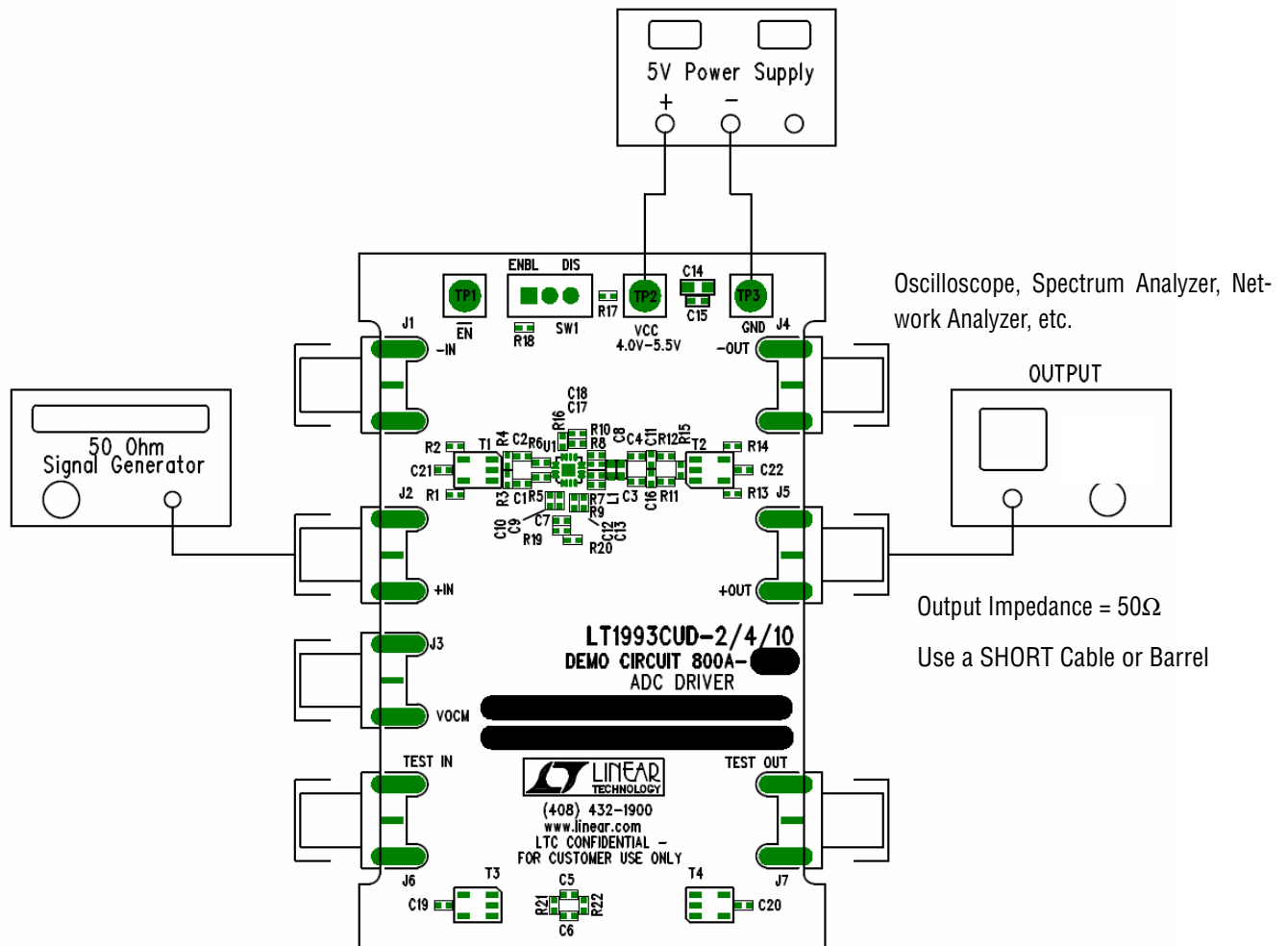
Figure 1.   Proper Measurement Equipment Setup

ADDITIONAL INFORMATION

Although the DC800 demo board is ready to use out of the box (See "Quick Start Procedure" above), it has features that you can access by adding, removing or changing components on the board. Here are some ways that you can change the configuration to take advantage of these features.

DIFFERENTIAL INPUTS

To drive the inputs differentially, remove resistor R2. J1 and J2 can now be driven differentially from a 50Ω signal source. The input to the DC800 will still be matched to 50Ω (differential) when driven in this manner.

DRIVING THE INPUTS WITH DC COUPLING

It is possible to drive the DC800 inputs differentially with DC coupling. Capacitors C1 and C2 should be shorted or replaced with 0Ω resistors. As a warning, the low input impedance of the LT1993-X can cause large input bias currents if DC800 is driven DC coupled. Since transformer T1 is a transmission-line transformer, DC voltages (and currents) will propagate through. Removing T1 would delete the simple impedance transformation, but free up space to place extra components on T1's pads. See the LT1993-X datasheet for additional information about DC coupling and input bias currents.

DIFFERENTIAL OUTPUTS

To use the both outputs of the DC800, remove resistor R14. The output now appears differentially across J4 and J5. The output of the DC800 will still be matched to 50Ω (differential) when used in this manner.

CHANGING THE OUTPUT COMMON-MODE VOLTAGE

Driving connector J3 controls the output common-mode voltage of DC800. This function can be used to level-shift the DC output voltage for optimum system performance. However, if used for this purpose, AC-coupling capacitors C3 and C4 should be shorted or replaced by 0Ω resistors to allow the DC bias to reach the output. Transformer T2 is a transmission-line type, which means DC voltages will couple from input to output of the transformer.

DISCRETE OUTPUT FILTERING

DC800 provides some additional component pads for building discrete output filters. In addition to the internal output low-pass filters built into the LT1993-X, a simple LC bandpass filter can be placed on pads L1 and C8 to filter a narrow-band signal. Other types of discrete filters can be built by replacing components on the output of the LT1993-X: R7-R15, C3-C4, C11, C16, and T2. For best performance, care must be taken to maintain proper impedance matching on the DC800 output. Also, since the output of the LT1993-X is a low-impedance operational amplifier output, performance will degrade when the output is directly driving low impedances such as 50Ω. See the LT1993-X datasheet for more information.

ENABLE (SHUTDOWN)

To drive the EN function of the LT1993-X with an external voltage source, switch S1 must be disabled by removing resistors R17 and R18. The LT1993-X will now be controlled via the EN pin. To enable the part, pull the pin low to within 0.8V of the GND pin on the DC800.

NOTE: The output common-mode bias resistors R19 and R20 draw current from VCC to GND, and must be accounted for when measuring the current of the LT1993-X in shutdown.

GROUND AND VCC CONNECTIONS

DC800's GND connector is not only connected to VEE of the LT1993-X, 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 DC800 will yield the best performance from the LT1993-X.

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.
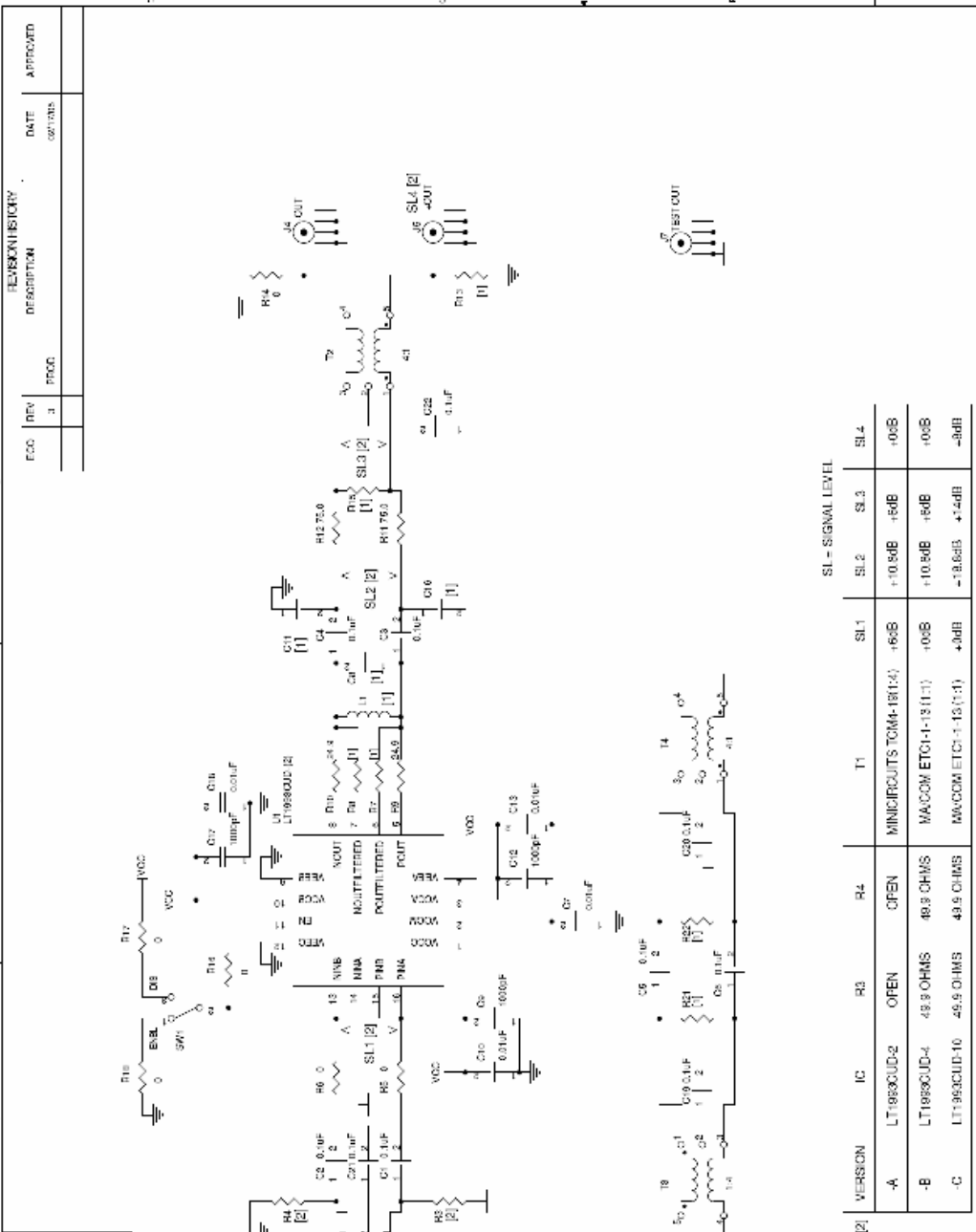
SCHEMATIC NOTES

The schematic included at the end of this Quick Start Guide includes approximate signal levels seen at various points along DC800's signal chain. The signal levels shown (SL1-SL4) assume that the signal level at the input(s) is 0dB, and that there is a 50Ω load at the output(s), from an oscilloscope, analyzer, or another circuit component. If the output load is a high-impedance load, the signal levels at SL2-SL4 will vary from the schematic.

The calibration circuit, as shown in the schematic, contains two extra resistors R21-R22. These resistors are included for added circuit flexibility, as well as for RF scattering parameter calibration purposes.

S1 – SIGNAL LEVEL				
	SL1	SL2	SL3	SL4
MINICIRCUIT'S TCM4-19(1:4)	+6dB	+10.5dB	+6dB	+0dB
MA/COM ETC1-1-13(1:1)	+0dB	+10.5dB	+6dB	+0dB
M/A-COM ETC1-1-13(1:1)	+0dB	–19.6dB	+4dB	–9dB

VERSION	IC	R3	R4	T1
-A	LT1993CUD-2	OPEN	OPEN	MINICIRCUIT'S TCM4-19(1:4)
-B	LT1993CUD-4	49.9 OHMS	49.9 OHMS	MA/COM ETC1-1-13(1:1)
-C	LT1993CUD-10	49.9 OHMS	49.9 OHMS	M/A-COM ETC1-1-13(1:1)

NOTES: UNLESS OTHERWISE SPECIFIED,

[1] DO NOT STUFF

SCH. LT1993CUD-X, ADC DRIVER

DWG NO DC800A

REV 3

SHEET 1 OF 1