

## LTC6420 and LTC6421 Low Noise/Distortion Dual Differential ADC Drivers


### DESCRIPTION

Demonstration circuit 1299 features the LTC6420 and LTC6421 Dual ADC Drivers. 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.

The LTC6420/1 is a high-speed dual differential amplifier with superior distortion and noise performance, perfect for demanding communications transceivers, cellular base-stations, and other high-speed signal chain applications. The LTC6420/1 accepts single-ended or differential inputs

with almost no difference in distortion performance. Two standout features of the LTC6420/1 are the ability to independently adjust the output common-mode voltage of both amplifiers independently without any additional components and the ability to shut each amplifier down into a low-power state independently of the other.

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

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### 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 in Figure 1. The power labels of V+ and GND directly correspond to the V+, and V- pins of the LTC6420/1. Jumpers JP1 and JP2 shut down the amplifiers within the LTC6420/1.
2. Apply input signals to J1 and J7. A network analyzer output or RF signal source with an external bandpass filter will yield the best performance. DC1299's input is impedance-matched to 50Ω; no external termination is necessary.
3. Observe the outputs via J3 and J8. The outputs are impedance-matched to 50Ω, suitable for the input of a network or spectrum analyzer. Note that the schematic circuit includes impedance transformers and series resistance that lowers the gain of the overall circuit.
4. The VOCMA and VOCMB turrets may be used to adjust the common-mode output voltages of the LTC6420/1. See the LTC6420/1 datasheet for more information.

**Table 1: DC1299 Board Connector Descriptions**

CONNECTOR	FUNCTION
J1,J7 (+INA,+INB)	Board Inputs. Use this connector to supply an input to the DC1299. Drive from a 50Ω signal source, no external termination necessary.
J2 (-INA)	Differential Input. <b>Not connected by default.</b> Capacitor C25 can be installed and C26 removed to drive this channel differentially.
J3,J8 (+OUTA,+OUTB)	Board Outputs. Impedance-matched to 50Ω, can be used to drive a network/spectrum analyzer input.
J4 (-OUTA)	Differential Output. <b>Not connected by default.</b> Capacitor C24 can be installed and C28 removed to receive this output differentially.
J5 (-INB)	Differential Input. <b>Not connected by default.</b> Capacitor C31 can be installed and C30 removed to drive this channel differentially.
J6 (-OUTB)	Differential Output. <b>Not connected by default.</b> Capacitor C35 can be installed and C33 removed to receive this output differentially.
VOCMA, VOCMB	Turrets can be driven from a DC voltage source to set the input and output common-mode levels of the LTC6420/1. Input impedance is approximately 600Ω

# DEMO CIRCUIT DC1299 QUICK START GUIDE

## LOW NOISE/DISTORTION DUAL DIFFERENTIAL ADC DRIVER

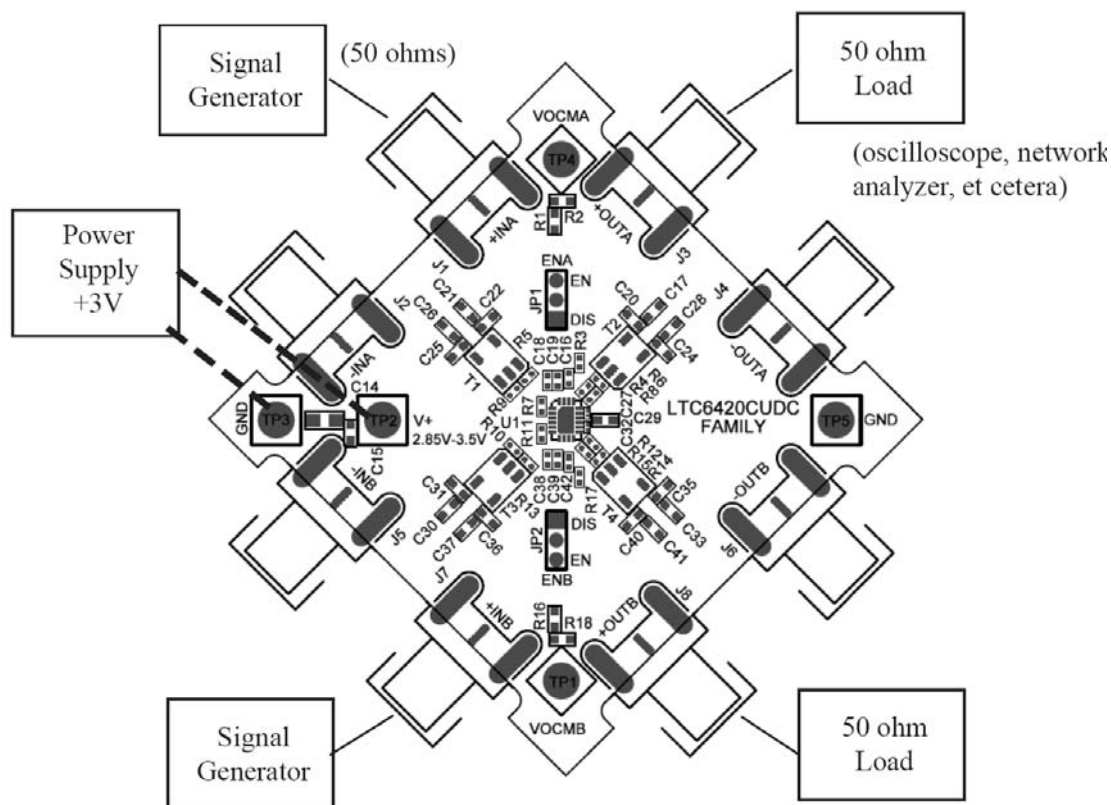


Figure 1: Proper Measurement Equipment Setup

## ADDITIONAL INFORMATION

Although the DC1299 demo board 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.

### DEMO BOARD VERSIONS

DC1299 has versions to support the different options of the LTC6420/1 family. DC1299A-A contains the LTC6420-20, and DC1299A-B contains the LTC6421-20. See the schematic for component differences between the versions.

### DIFFERENTIAL INPUTS

To drive the inputs differentially, remove the capacitors C26/C30 and install them in locations C25/C31. J1/J2 and J7/J5 can now be driven differentially from 50Ω signal sources. The inputs to the DC1299 will still be matched to 50Ω (differentially) when driven in this manner.

### DRIVING THE INPUTS WITH DC COUPLING

It is possible to drive the DC1299 inputs differentially with DC coupling. The input capacitors (C22/C25 and C31/C36) should be shorted or replaced with 0Ω resistors. As a warning, the low input impedance of the LTC6420/1 can cause large input bias currents if DC1299 is driven DC coupled. If transformers T1/T3 are transmission-line transformers (the transformers included on-board are), DC voltages and currents will propagate through. See the LTC6420/1 datasheet for additional information about DC coupling and input bias currents.

### DIFFERENTIAL OUTPUTS

To use the outputs of DC1299 differentially, move capacitors C28/C33 to positions C24/C35. The outputs now appear differentially across J3/J4 and J8/J6. The outputs of

# DEMO CIRCUIT DC1299 QUICK START GUIDE

## LOW NOISE/DISTORTION DUAL DIFFERENTIAL ADC DRIVER

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the DC1299 will still be matched to  $50\Omega$  (differentially) when used in this manner.

### CHANGING THE OUTPUT COMMON-MODE VOLTAGE

The turrets marked VOCMA and VOCMB control the output (and input, if AC-coupled) common-mode voltages of DC1299. This function can be used to level-shift the DC output voltages for optimum system performance. However, if used for this purpose, output capacitors C20/C24 and C40/C35 can be shorted or replaced by  $0\Omega$  resistors to allow the DC bias to reach the output. Transformers T2/T4 are transmission-line type, which means DC voltages will couple from input to output of the transformer. By default, on-board resistors supply 1.25V voltage to the common-mode pins (with  $V_{+}=3.0V$ ). The VOCM voltage of the two amplifiers can be set independently.

### OUTPUT DRIVE

Since the outputs of the LTC6420/1 are low-impedance operational amplifier outputs, performance will degrade when the output is directly driving low impedances such as  $50\Omega$ . That is the reason for the series resistors and 4:1 impedance transformers, which give the outputs a more benign  $400\Omega$  load. See the LTC6420/1 datasheet for more information on distortion performance versus load impedance.

### ENABLE (SHUTDOWN)

Jumpers JP1 and JP2 control the enable function of the LTC6420/1. When set to the EN position, the part will be on

and draw quiescent current. In the DIS position, the part will be in shutdown and draw a very small amount of quiescent current. The two amplifiers can be enabled or shut down independently.

**NOTE.** The  $V_{OCM}$  bias resistors R1/R2 and R16/R18 draw current from  $V_{+}$  to GND, and must be accounted for when measuring the current of the LTC6420/1, especially in shutdown.

### GROUND AND $V_{+}$ CONNECTIONS

DC1299's GND turrets are not only connected to  $V_{-}$  pins of the LTC6420/1, they also serve 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  $V_{+}$  and GND connectors on DC1299 will yield the best performance from the LTC6420/1.

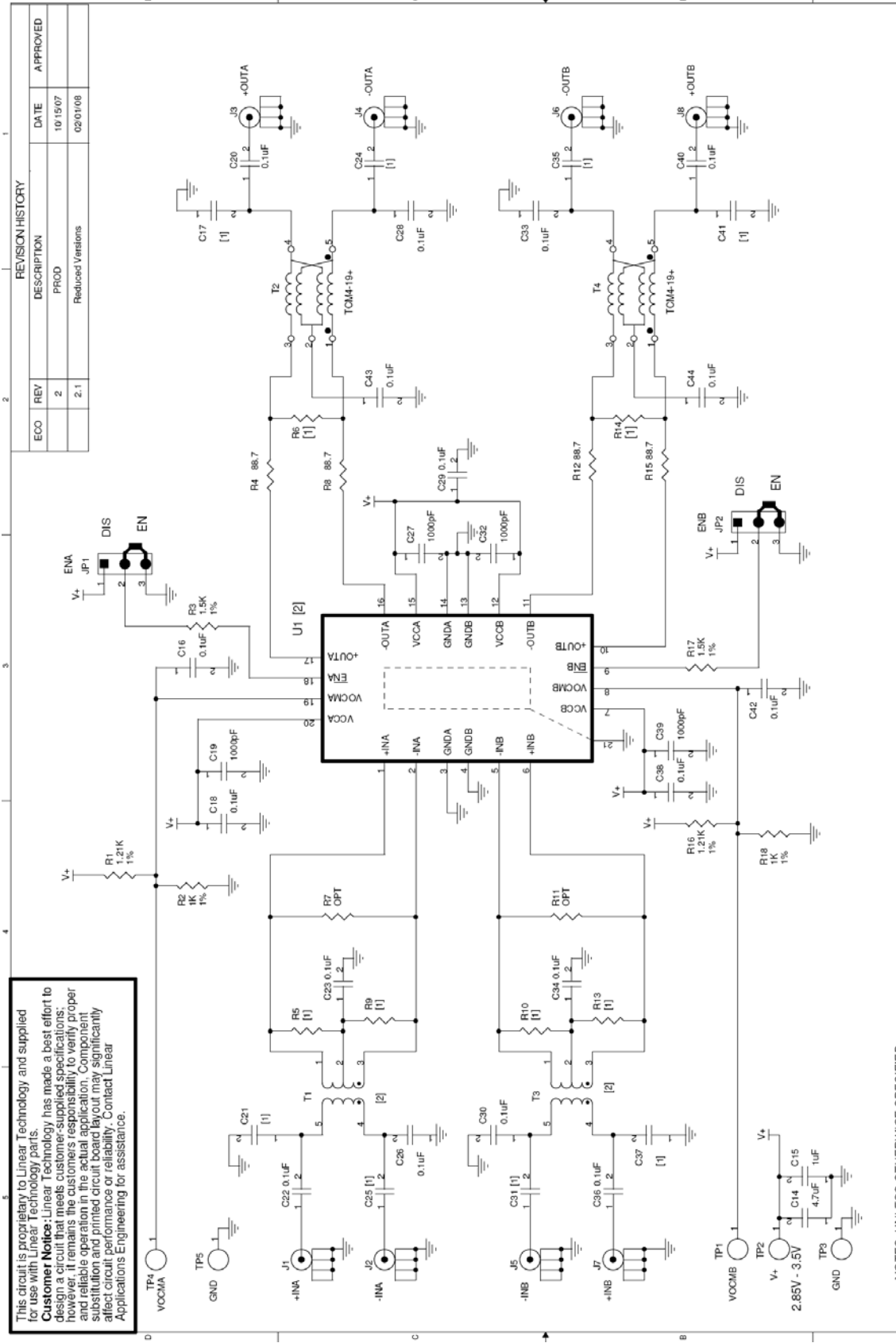
### SCHEMATIC NOTES

Transformers T1/T3 at the inputs of the LTC6420/1 are impedance-matching and/or balun transformers to ensure that the amplifiers see a fully differential input. The transformers will have approximately **1dB** of attenuation that will affect the measured gain of the demo board.

Transformers T2/T4 and the series  $88.7\Omega$  resistors at the LTC6420/1 outputs create a **13dB** attenuation that will affect the measured gain of the demo board. This is done so that the output of DC1299 can plug directly into a  $50\Omega$  analyzer input while the amplifier sees a more benign  $400\Omega$  load resistance.

# DEMO CIRCUIT DC1299 QUICK START GUIDE

## LOW NOISE/DISTORTION DUAL DIFFERENTIAL ADC DRIVER



This circuit is proprietary to Linear Technology and supplied for use with Linear Technology parts.  
**Customer Notice:** Linear Technology has made a best effort to design a circuit that meets customer-specified 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 Applications Engineering for assistance.

REVISION HISTORY				
ECO	REV	DESCRIPTION	DATE	APPROVED
	2	PROD	10/15/07	
	2.1	Reduced Versions	02/01/08	

		1650 McCarthy Blvd Fremont, CA 94538 Phone: (408)420-1000 Fax: (408)424-6507	
CONTRACT NO.		TITLE	
APPROVALS		DATE	
DRAWN MEI	CHECKED	06/28/07	
APPROVED	ENGINEER	SIZE	
DESIGNER	DESIGNER	GAGE CODE	
THIRD ANGLE PROJECTION		DWG NO	
		DC1299A	
DO NOT SCALE DRAWING		SCALE: NONE	FILENAME: 1299A-2.dsn
Friday, February 01, 2008		SHEET 1	OF 1

NOTES: UNLESS OTHERWISE SPECIFIED,  
 [1] DO NOT STUFF.  
 [2]

ASSY LETTER	U1	T1, T3
-A	LTC6420CUDC-20	TCM4-19+
-B	LTC6421CUDC-20	TCM4-19+