

# LTC6953

## Ultralow Jitter, 4.5GHz Clock Distributor with 11 Outputs and JESD204B Support

### DESCRIPTION

Demonstration circuit 2610A features the [LTC6953](#), an Ultralow Jitter, 4.5GHz Clock Distributor with 11 Outputs and JESD204B Support.

By default, the DC2610A is powered from a single 3.3V supply. An option is provided to power to the DC2610A from dual supplies, allowing for the LTC6953's output supply pins to connect to an LTC Silent Switcher® and the LTC6953 input supply pin to connect to a low noise LDO.

All differential inputs and seven of the differential outputs are populated with 0.5" spaced SMA connectors. These outputs are AC-coupled with 50Ω transmission lines making them suitable to drive 50Ω impedance instruments. The remaining four differential outputs are terminated with 100Ω.

The LTC6953's EZSync™ and SYSREF request functions are made available via the LTC6953 SPI interface or the EZS\_SRQ SMA/turret connectors. The DC2609A, DC2610A, and DC2611A SMA placement was designed for ease of connection for all multi-part synchronization and SYSREF request modes.

A calibration path is provided to aid in accurate LTC6953 propagation delay measurements.

A DC2026 USB serial controller board is used for SPI communication with the LTC6953, controlled by the supplied LTC6952Wizard™ software.

**DC2610 Design files are available.**

All registered trademarks and trademarks are the property of their respective owners.

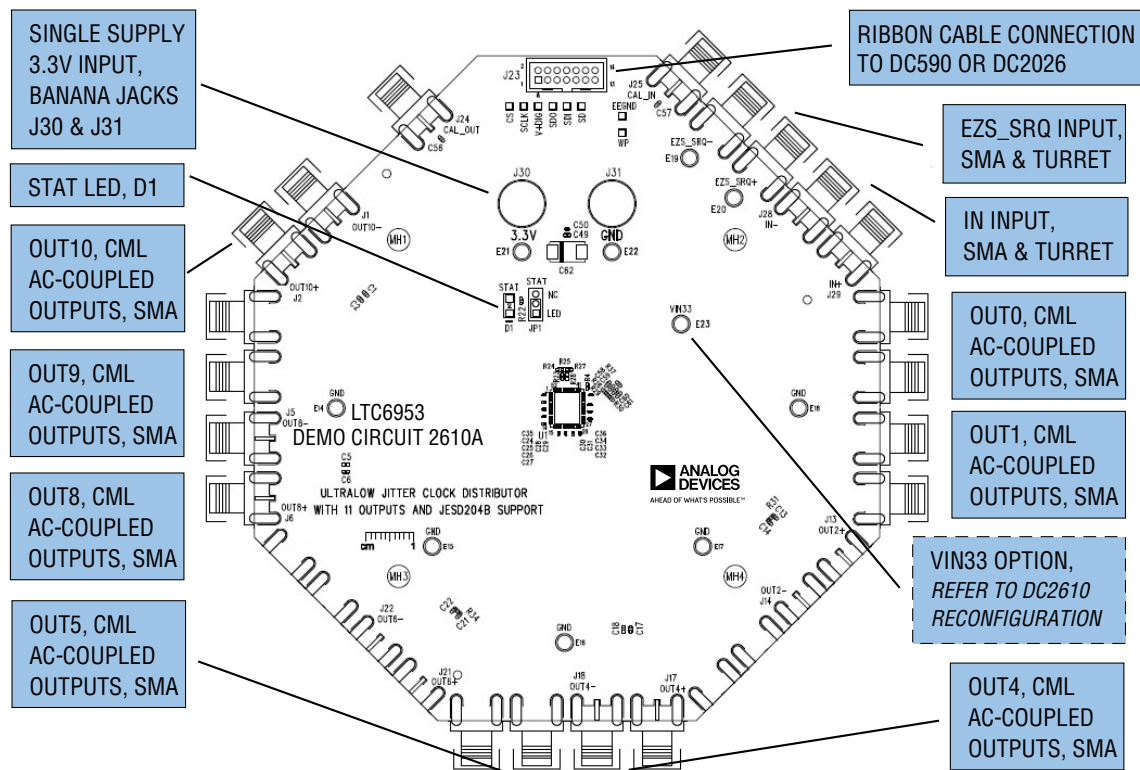


Figure 1. DC2610A Connections

## QUICK START PROCEDURE

The DC2610A is easy to set up to evaluate the performance of the [LTC6953](#). Follow the procedure below.

The LTC6952Wizard and the DC2026 are required to control the DC2610A through a personal computer (PC).

### DC2026 CONFIGURATION

Refer to Figure 2. Set the JP3 jumper to the 3.3V (preferred) or 5V position.

Connect the DC2026 to one of your computer's USB ports with the included USB cable.

The DC2026 has the ability to run Linduino code, refer to [Linduino Design Center](#) and the Frequently Asked Question section (Question #2) for more details.

### LTC6952WIZARD INSTALLATION

The LTC6952Wizard software is used to communicate with the LTC6953. It uses the DC2026 to translate between USB and SPI-compatible serial communications formats. It also includes advanced design and simulation capabilities. The following are the LTC6952Wizard system requirements:

- Windows Operating System: Windows XP, Windows 2003 Server, Windows Vista, Windows 7
- Microsoft .NET 3.5 SP1 or later
- Windows Installer 3.1 or later
- Linear Technology's DC2026 (with the DC590B emulator sketch loaded)

The DC2026 arrives from the factory with the DC590B Emulator sketch loaded. If this is not the case refer to the troubleshooting section.

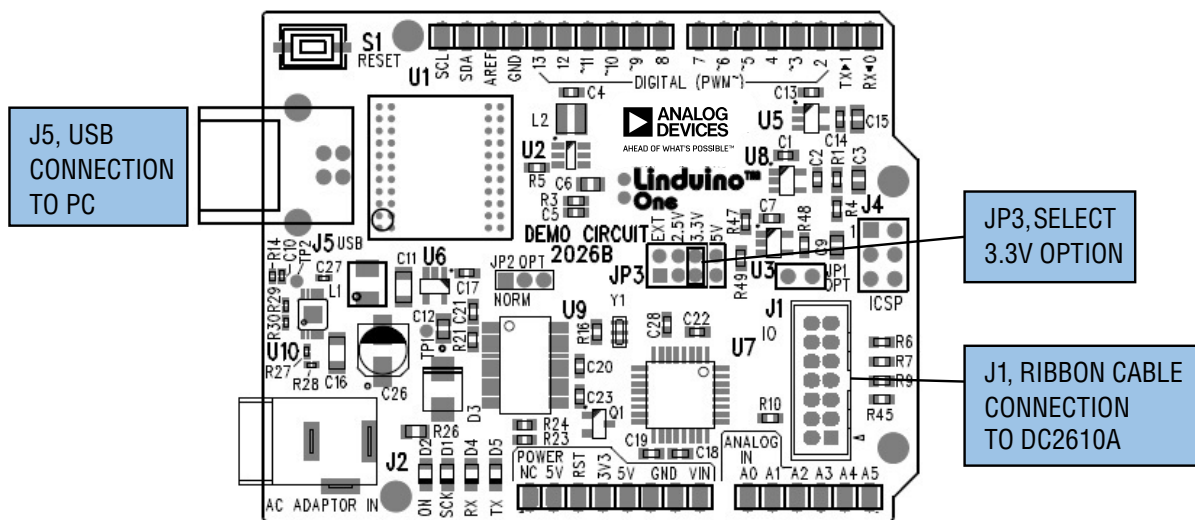


Figure 2. DC2026 Connector Location

## QUICK START PROCEDURE

[Download the LTC6952Wizard setup file.](#)

Run the LTC6952Wizard setup file and follow the instructions given on the screen. The setup file will verify and/or install Microsoft .NET and install the LTC6952Wizard. Refer to the LTC6952Wizard Help menu for software operation.

## DC2610A CONFIGURATION

1. Connect J30 and J31 to a power supply and apply power (see Figure 1 and the Typical DC2610A Requirements and Characteristics).
2. Connect the DC2026 to the DC2610A with the provided ribbon cable.
3. Connect a low phase-noise (low jitter) single-ended signal to IN<sup>-</sup> (J28). Refer to the LTC6953 data sheet for acceptable input frequencies and amplitudes.

4. Run the LTC6952Wizard application.
5. In LTC6952Wizard, click File → Load Settings and select file “LTC6953 EZSync StandAlone.6952set”. The DC2610A’s red STAT LED (D1) should illuminate.
6. From the LTC6952Wizard, update Fin to the frequency of the input signal in step 3. This will update the LTC6952Wizard with the correct output frequencies.
7. Synchronize outputs by toggling the LTC6953 SSYNC bit on then off from the LTC6952Wizard.
8. Connect desired output (OUT10, OUT9, OUT8, OUT5, OUT4, OUT1 or OUT0) to a test instrument or other demo board to evaluate performance.

Be sure to power down or terminate any unused RF output with 50Ω, or poor spurious performance may result.

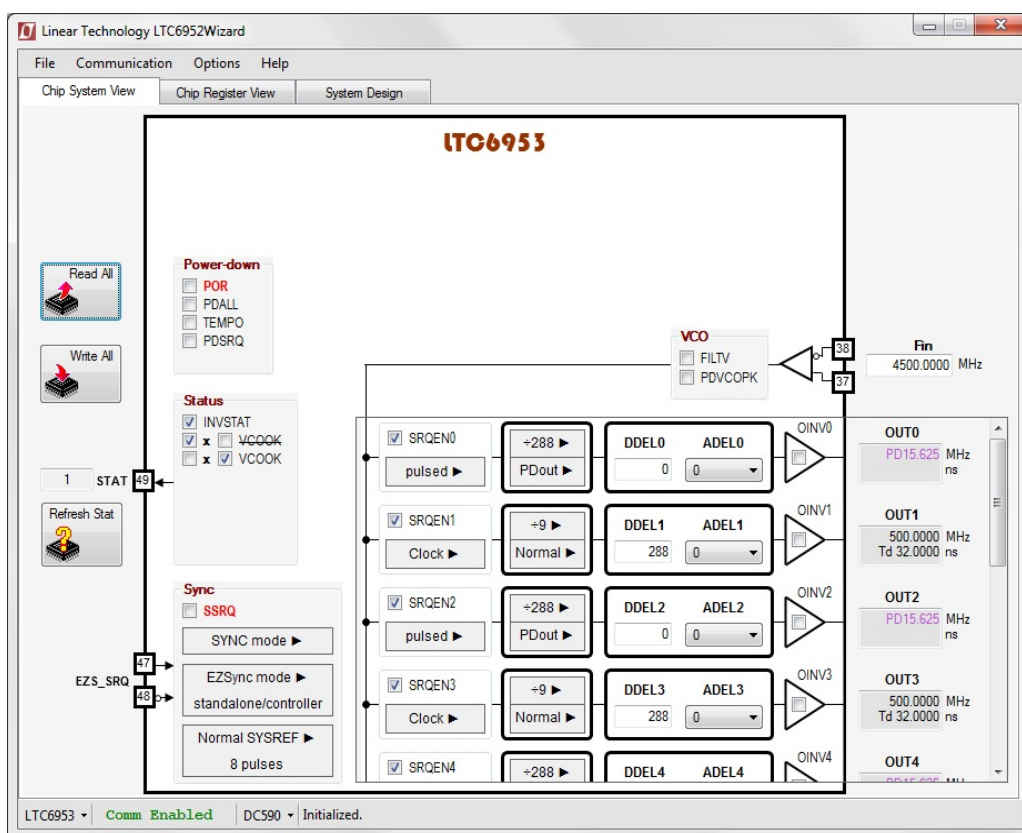


Figure 3. LTC6952Wizard Screenshot

## TROUBLESHOOTING GUIDE

### If the red LED (D1) does not illuminate:

1. Ensure LTC6953 input signal is at the LTC6953 IN<sup>-</sup> pin.
2. In LTC6952Wizard's System tab click 'Read All'. LTC6952Wizard should match Figure 3. If not, see 'Verify DC2610A and LTC6952Wizard Communication'

### Verify DC2610A and LTC6952Wizard Communication:

To verify communication with the DC2610A. The bottom status line in LTC6952Wizard should read "LTC6953" and "Comm Enabled" as shown in Figure 3. If not, then perform the following steps:

1. Ensure the DC2026 is connected to PC
2. Disconnect and Reconnect DC2026 to PC
3. Ensure DC2026 is connected to DC2610A
4. Close LTC6952Wizard and restart
5. Verify the DC2026 has the DC590B Emulator sketch loaded by contacting the factory or following these steps.
  - a. Download [QuikEval™](#).
  - b. Run QuikEval (Linduino connected to the PC)

If QuikEval does not find a DC590B, reload the DC590 Linduino sketch. To use the LTSketchbook refer to the [Linduino Design Center](#) for instructions on how to start using Linduino.

If DC2610A performance is less than the LTC6953 data sheet specifications:

1. For unexpected spurious response, verify power supplies are low noise and spurious free power supplies. Power supplies that are based off a switching regulator architecture are known to generate spurs on low jitter clock outputs.
2. For poor phase noise results, verify the phase noise specifications of the input signal and the phase noise measurement instrument. Traditional signal sources and spectrum analyzers have higher phase noise than the LTC6953 and will degrade measurement results. To measure phase noise performance it is recommended to use a low jitter oscillator and a signal source analyzer, such as Keysight's (previously Agilent/HP) E5052.
3. Contact the factory for further troubleshooting.

## DC2610A RECONFIGURATION

The following covers the hardware reconfiguration of the DC2610A. Refer to LTC6952Wizard and the LTC6953 data sheet to better understand how to change programmed parameters on the DC2610A.

### POWER SUPPLY OPTIONS

Table 1 provides the power supply options for DC2610A. By default the DC2610A is setup to use the single supply option. However, a dual supply option is available to power the higher current supply from an LTC Silent Switcher, such as the LT8609S. The LTC Silent Switcher improves the power efficiency over the low noise LDO. A low noise LDO is required on the LTC6953's  $V_{IN}^+$  supply pin.

**Table 1. Power Supply Options**

Default	Option	R4	Power Supply Voltage/Current (Recommended Supply)	
			J30 (3.3V)	E23 (VIN33)
X	Single Supply	Installed	3.3V/1.5A (Low Noise LDO)	NA
	Dual Supply	Do Not Install	3.3V/1.5A (LTC Silent Switcher)	3.3V/150mA (Low Noise LDO)

### INPUT TERMINATION OPTIONS

Table 2 provides the single-ended and differential input termination options. By default the DC2610A is setup for a single-ended input on the  $IN^-$  SMA (J28).

**Table 2: Input Termination Options (\*)**

Default	Termination	R26 $\Omega$	R30 $\Omega$	R29 $\Omega$	R37 $\Omega$	C59 $\mu F$	C60 $\mu F$
X	SE, $IN^-$	75	30	DNI	DNI	0.1	DNI
	SE, $IN^+$	30	75	DNI	DNI	DNI	0.1
	DIFF, CML or PECL	DNI	DNI	160	DNI	0.1	0.1
	DIFF, LVDS	DNI	DNI	DNI	160	0.1	0.1

\* SE = Single-Ended, DIFF = Differential, DNI = Do Not Install

### LTC6953 6952SET FILES

The LTC6952Wizard provides a 6952set file for all LTC6953 data sheet application examples and typical application circuits. After loading a 6952set file a pop-up window will detail any user actions and board modifications required for the selected file.

### SYNC OPTIONS

The LTC6953 data sheet describes several synchronization modes. After selecting the desired synchronization mode, refer to Table 3 to identify the required DC2610A board modifications. Refer to the LTC6953 data sheet for SYNC timing and level requirements.

### CML OUTPUTS, OUT[10:0]

The DC2610A has 11 CML outputs. Seven of these outputs are AC-coupled and brought out to SMAs (OUT10, OUT9, OUT8, OUT5, OUT4, OUT1, and OUT0). To drive 50 $\Omega$  impedance instruments connect  $OUTx^+$  to the instrument and  $OUTx^-$  to a 50 $\Omega$  termination, or vice versa.

The remaining four outputs (OUT7, OUT6, OUT3, and OUT2) are terminated with a 100 $\Omega$  resistor on board. To connect these outputs to a 50 $\Omega$  instrument, remove the 100 $\Omega$  termination, and install the appropriate SMAs and AC blocking capacitors.

Refer to LTC6953 data sheet for differential termination options.

## DC2610A RECONFIGURATION

Table 3. LTC6953 Sync Mode Programming Options

SYNC/SYSREF Method	EZS_SRQ Pins State	Board Modifications (DNI = Do Not Install)						
		R27 ( $\Omega$ )	R24 ( $\Omega$ )	R25 ( $\Omega$ )	R28 ( $\Omega$ )	R23 ( $\Omega$ )	R39 ( $\Omega$ )	R38 ( $\Omega$ )
EZS_SRQ Pin	Differential, CML or LVPECL	DNI	DNI	100	0	0	DNI	DNI
	Differential LVDS	100	100	750	50	50	130	130
	EZS_SRQ+: CMOS EZS_SRQ-: GND	200k	0	DNI	0	0	DNI	DNI
SSRQ Register Bit	EZS_SRQ+: GND EZS_SRQ-: GND	200k	0	DNI	0	0	DNI	DNI

---

## FREQUENTLY ASKED QUESTIONS

### 1. Can the LTC6952Wizard control a LTC6953 on a board other than the DC2610A?

Yes, follow these steps.

Step 1: Configure the DC2026 for 3.3V SPI as shown in Figure 2

Step 2: Connect the DC2026 J1 connector SPI pins to the LTC6953 SPI pins. Refer to page two of the DC2610A schematic for pin assignments.

### 2. Does the LTC6953 have Linduino Code available?

Yes, download the LTC6953 sketch in the LTSketchbook. To use the LTSketchbook and for instructions on how to start using Linduino refer to the [Linduino Design Center](#). This will give programmers a head start in writing code for the LTC6953. It is recommended to use LTC6952Wizard to create the best possible register settings for all conditions. These LTC6953 register settings from LTC6952Wizard can be programmed in a lookup table.

## TYPICAL DC2610A REQUIREMENTS AND CHARACTERISTICS

PARAMETER	INPUT OR OUTPUT	PHYSICAL LOCATION	DETAILS
3.3V Power Supply	Input	J30 and J31 BNC Banana Jacks	<b>If R4 Populated</b> , Default Option, Single Supply: 3.3V Low-noise and spur-free supply, 1.5A; <b>If R4 Depopulated</b> , Dual Supply Option, allows for experiments with more efficient power supply evaluation (LTC Silent Switcher). See 3.3V Power Supply #2 (VIN33)
3.3V Power Supply #2 (VIN33)	Input	E23 turret (VIN33)	<b>If R4 Depopulated</b> , Dual Supply Option, 3.3V Low-noise and spur-free supply, 150mA;
OUT10 <sup>+</sup> ; OUT10 <sup>-</sup>	Two Outputs	J1 and J2 SMA Connectors*	CML, AC-Coupled, 800mVpk Differential
OUT9 <sup>+</sup> ; OUT9 <sup>-</sup>		J3 and J4 SMA Connectors*	
OUT8 <sup>+</sup> ; OUT8 <sup>-</sup>		J5 and J6 SMA Connectors*	
OUT5 <sup>+</sup> ; OUT5 <sup>-</sup>		J19 and J20 SMA Connectors*	
OUT4 <sup>+</sup> ; OUT4 <sup>-</sup>		J17 and J18 SMA Connectors*	
OUT1 <sup>+</sup> ; OUT1 <sup>-</sup>		J11 and J12 SMA Connectors*	
OUT0 <sup>+</sup> ; OUT0 <sup>-</sup>		J9 and J10 SMA Connectors*	
OUT7 <sup>+</sup> ; OUT7 <sup>-</sup>	Two Outputs (Not Connected)	J7 and J8 (SMA Not Populated)	Onboard Differential 100Ω termination
OUT6 <sup>+</sup> ; OUT6 <sup>-</sup>		J21 and J22 (SMA Not Populated)	
OUT3 <sup>+</sup> ; OUT3 <sup>-</sup>		J15 and J16 (SMA Not Populated)	
OUT2 <sup>+</sup> ; OUT2 <sup>-</sup>		J13 and J14 (SMA Not Populated)	
IN <sup>+</sup>	Input (Not connected)	J29 SMA Connector	Default: Not Connected (see Table 2, for correct input termination options)
IN <sup>-</sup>	Input	J28 SMA Connector	Default: Preferred Single Ended Input (see Table 2, for correct input termination options)
EZS_SRQ <sup>+</sup>	Input	J27 SMA Connector/E20 Turret	Default: Preferred Single Ended Input
EZS_SRQ <sup>-</sup>	Input	J26 SMA Connector/E19 Turret	Default: Shorted to GND
ISD	Input	Test Point	3.3V(Default): Device Active, set by pull-up resistor GND: Shut Down Device
STAT	Output	STATUS Turret	Red LED D1 illuminates when STAT pin in high state

\*Any unused RF output must be powered down or terminated with 50Ω, or poor spurious performance may result.

## ASSEMBLY OPTIONS

Table 5. DC2610A Options

Assembly Version	Part Number
DC2610A-A	LTC6953IUUG

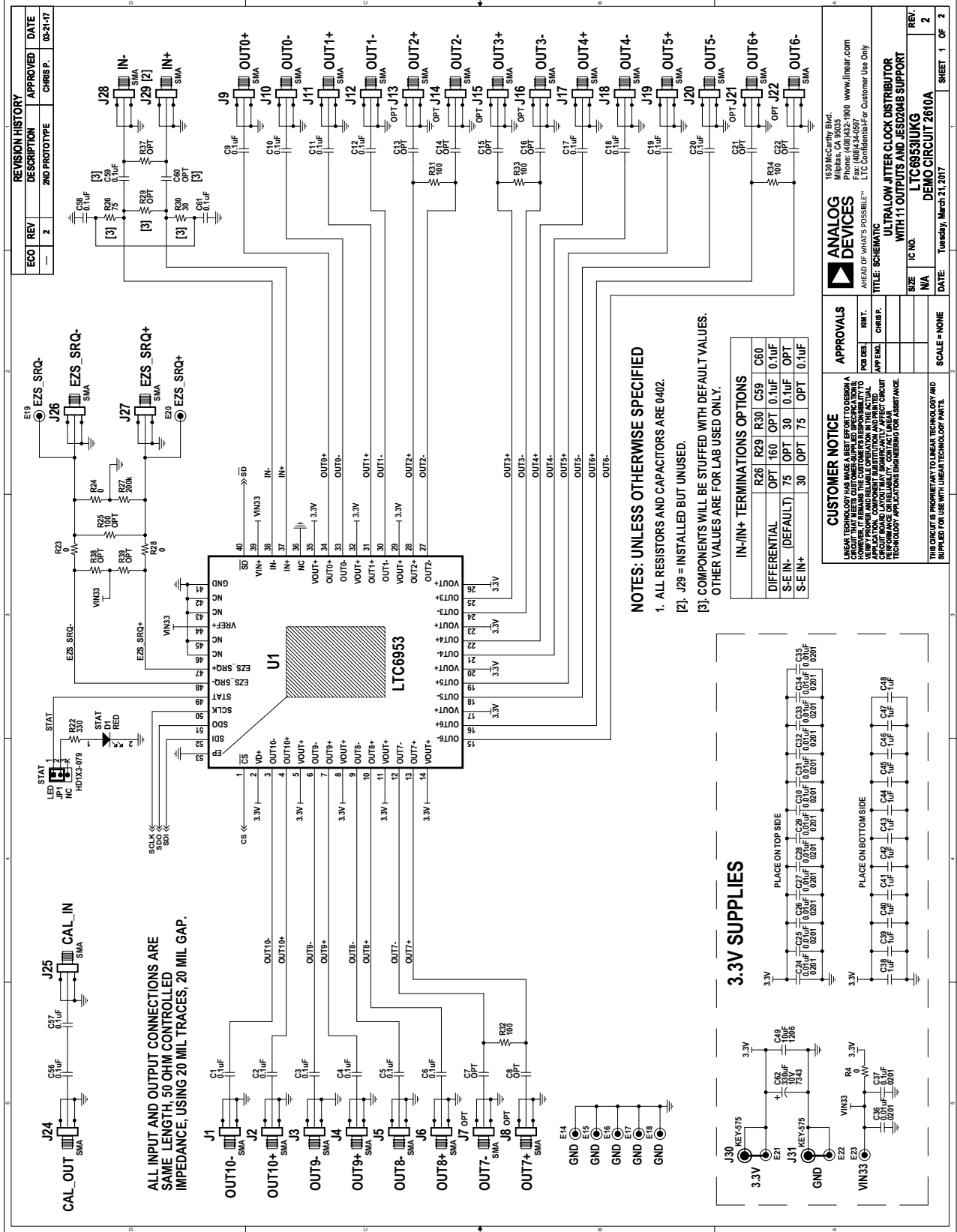
# DEMO MANUAL DC2610A

## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	24	C1-C12, C17-C20, C51-C59, C61	CAP, X7R, 0.1µF, 10V, 10%, 0402	MURATA, GRM155R71A104KA01D
2	0	C7, C8, C13-C16, C21, C22, C60	CAP, 0402	OPT
3	13	C24-C36	CAP, X7R, 0.01µF, 6.3V, 10%, 0201	MURATA, GRM033R70J103KA01D
4	1	C37	CAP, X5R, 0.1µF, 16V, 10%, 0201	MURATA, GRM033R61C104KE14D
5	11	C38-C48	CAP, X5R, 1µF, 16V, 10%, 0402	MURATA, GRM155R61C105KE01D
6	1	C49	CAP, X7R, 10µF, 25V, 10%, 1206	MURATA, GRM31CR71E106KA12L
7	1	C62	CAP,TANT., 330µF,10V, 10%, 7343	AVX, TPME337K010R0035
8	1	D1	LED, RED, LED-ROHM-SML-01	ROHM, SML-012V8TT86
9	10	E14-E23	TURRET, TESTPOINT 0.064"	MILL-MAX, 2308-2-00-80-00-00-07-0
10	1	JP1	CONN., HEADER, MALE, 1 × 3, 2mm, THT	Würth Elektronik, 62000311121
11	20	J1-J6, J9-J12, J17-J20, J24-J29	CONN., SMA 50Ω EDGE-LAUNCH	CCSJ, 142-0701-851
12	0	J7, J8, J13-J16, J21, J22	CONN., SMA 50Ω EDGE-LAUNCH	OPT
13	1	J23	CONN., HEADER, 14-PIN, 2mm	MOLEX, 87831-1420
14	2	J30, J31	CONN, JACK, BANANA	KEYSTONE, 575-4
15	5	R4, R19, R23, R24, R28	RES., CHIP, 0, 1/10W, 0402	VISHAY, CRCW04020000Z0ED
16	6	R6, R10, R11, R21, R27, R36	RES., CHIP, 200K, 1/10W, 1% 0402	VISHAY, CRCW0402200KFKED
17	9	R7-R9, R18, R31-R35	RES., CHIP, 100, 1/16W, 1% 0402	VISHAY, CRCW0402100RFKED
18	3	R12, R13, R14	RES., CHIP, 4.99K, 1/10W, 1% 0402	VISHAY, CRCW04024K99FKED
19	0	R15, R29, R37, R38, R39	RES., 0402	OPT
20	1	R20	RES., CHIP, 0, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
21	1	R22	RES., CHIP, 330, 1/16W, 1% 0402	VISHAY, CRCW0402330RFKED
22	0	R25	RES., CHIP, 100, 1/16W, 1% 0402	OPT
23	1	R26	RES., CHIP, 75, 1/16W, 1% 0402	VISHAY, CRCW040275R0FKED
24	1	R30	RES., CHIP, 30, 1/16W, 1% 0402	VISHAY, CRCW040230R0FKED
25	1	U1	I.C., QFN52UKG-7 × 8	LINEAR TECH., LTC6953IUKG#PBF
26	1	U2	I.C., Serial EEPROM, TSSOP8	MICROCHIP, 24LC025-I /ST
27	2	U3,U4	I.C., Dual Buffer, SC70-6	FAIRCHILD SEMI., NC7WZ17P6X
28	1	U5	I.C., Single Bit, Dual Supply, 3-State Output, SOT363	NXP SEMI., 74LVC1T45GW,125
29	1	SHUNT ON JP1 (1&2)	SHUNT, 2mm	Würth Elektronik, 60800213421
30	4	MH1-MH4	STANDOFF, NYLON, 0.5, 1/2"	Würth Elektronik, 702935000
31	1	DUST CAP FOR J29	WYHP DUST CAP FOR SMA FEMALE RF CONN	AMAZON,

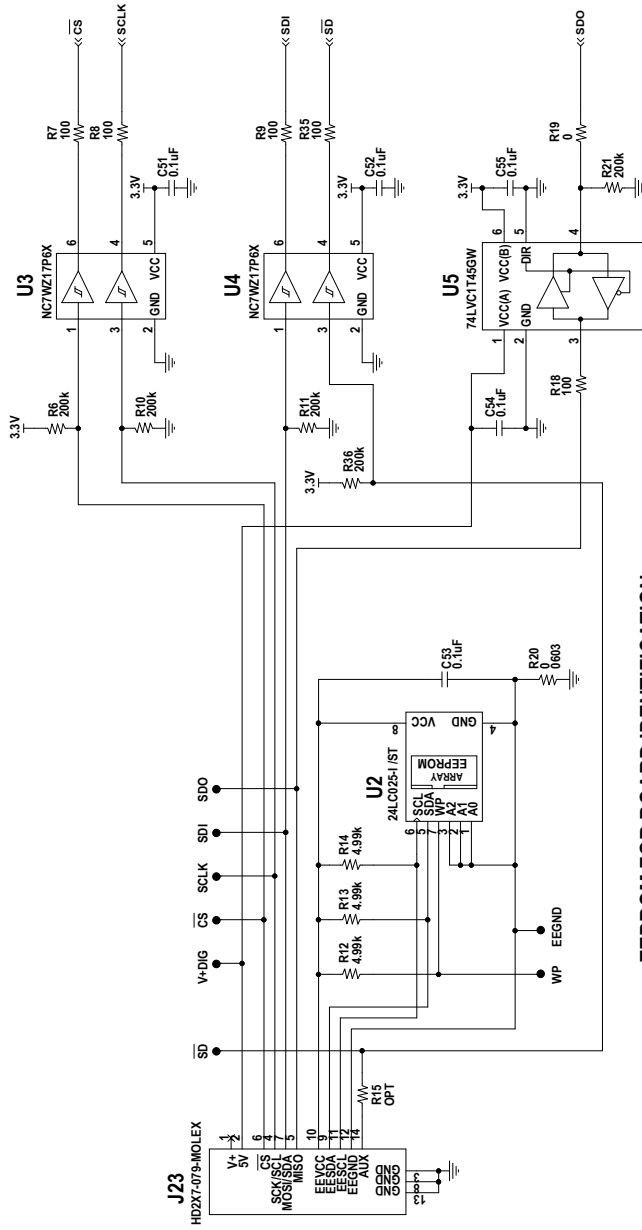


**SCHEMATIC DIAGRAM**



## SCHEMATIC DIAGRAM

### DC2026 (DC590) SPI INTERFACE

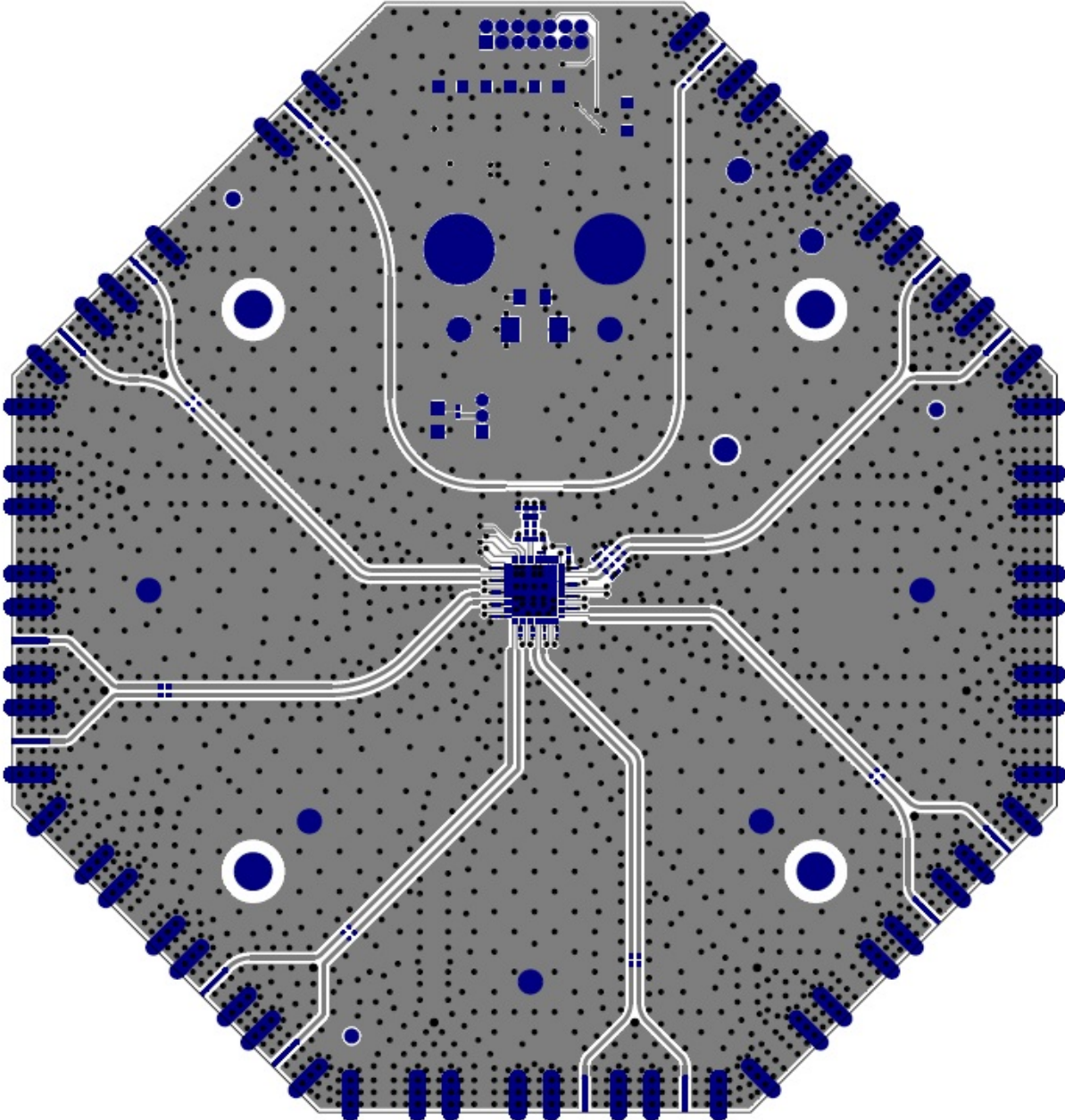


### EEPROM FOR BOARD IDENTIFICATION

<b>CUSTOMER NOTICE</b> 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 THAT THE CIRCUIT MEETS THE CUSTOMER'S APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRCUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE. CONTACT YOUR LOCAL LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.		<b>APPROVALS</b> PCB DES. KIM T. APP ENG. CHRIS P.		1630 McCarty Blvd. Folsom, CA 95632-9900 www.linear.com Tel: (916) 434-4507 Fax: (916) 434-4507 LTC Confidential-For Customer Use Only	
<b>CUSTOMER NOTICE</b> THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.		SCALE = NONE		DATE: Tuesday, March 21, 2017	
TITLE: SCHEMATIC ULTRALOW JITTER CLOCK DISTRIBUTOR WITH 11 OUTPUTS AND JESD204B SUPPORT		SIZE: N/A		REV. 2	
IC NO. LTC6953IUUKG		DEMO CIRCUIT 2610A		SHEET 2 OF 2	

Note: The buffers shown on sheet 2 of 2 of the schematic are used to protect the LTC6953 when connected to the DC2026 before the LTC6953 is powered up. There is no need for such circuitry if the SPI bus is not active before powering up the LTC6953. The EEPROM is for identification and is not needed to program the LTC6953.

LAYOUT TOP LAYER





## ESD Caution

**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

## Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.