

Ultralow Noise and Spurious Integer-N Frequency Synthesizer with Integrated VCO

DESCRIPTION

DC1705B features the LTC[®]6946, an ultralow noise and spurious integer-N frequency synthesizer with integrated VCO. The VCO uses no external components and is internally calibrated without external system support.

There are three versions of the DC1705B, one for each version of the LTC6946. The DC1705B-A contains the LTC6946-1, the DC1705B-B incorporates the LTC6946-2 and DC1705B-C uses the LTC6946-3.

Each DC1705B provides 50Ω SMA connectors for the reference frequency input, f_{REF} , the reference output buffer (REF OUT), and the differential RF output (RF⁺ and RF⁻). A DC590 USB serial controller board is used for SPI communication with the LTC6946, controlled by the supplied PLLWizard™ software.

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

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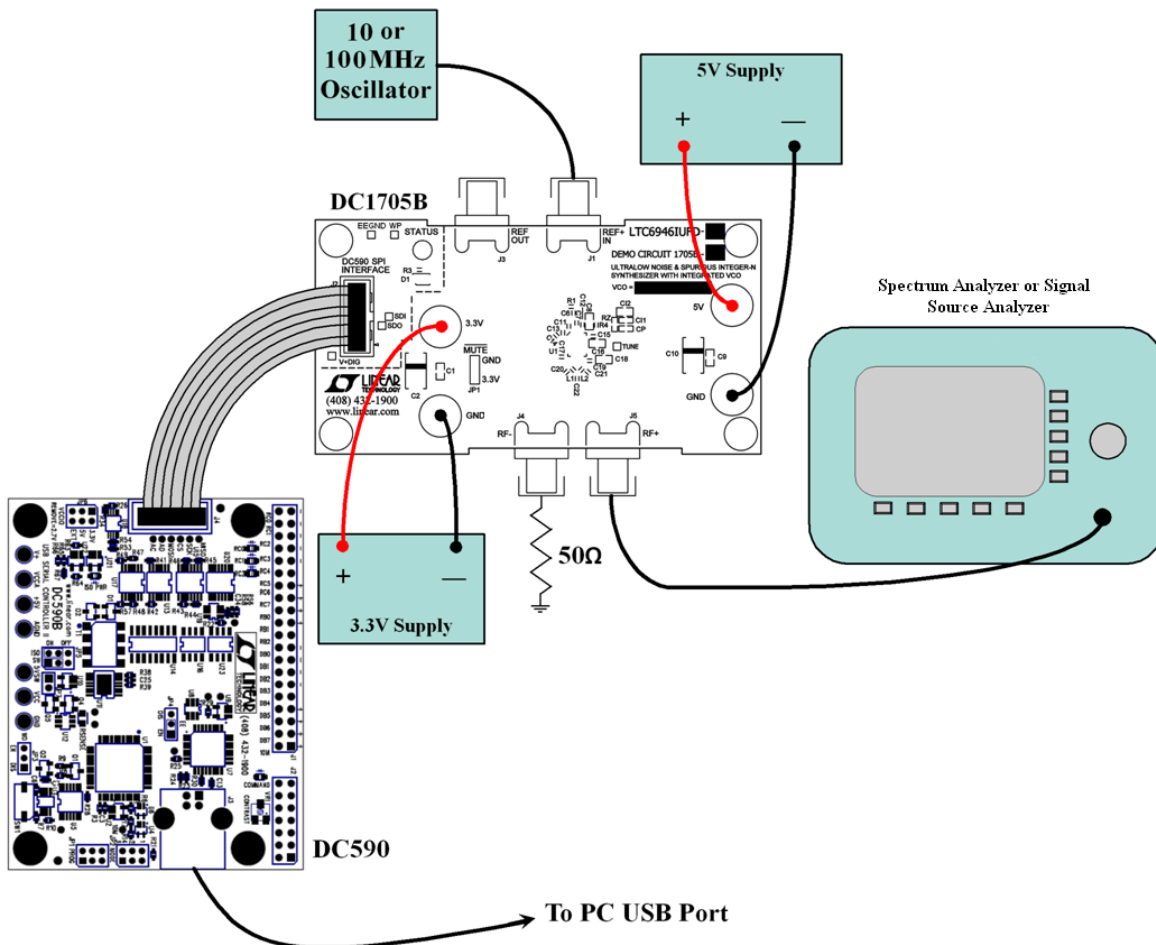


Figure 1. Proper Measurement Equipment Setup

TYPICAL DC1705B REQUIREMENTS AND CHARACTERISTICS

PARAMETER	INPUT OR OUTPUT	PHYSICAL LOCATION	DETAILS
3.3V Power Supply	Input	3.3V and GND Banana Jacks	Low Noise and Spur-Free 3.3V, 115mA
5V Power Supply	Input	5V and GND Banana Jacks	Low Noise and Spur-Free 5V, 45mA
REF ⁺ IN, Reference Frequency	Input	J1 SMA Connector	Low Noise 10MHz or 100MHz*, 6dBm into 50Ω (Note 1)
REF OUT, Buffered Reference	Output	J3 SMA Connector	Frequency = f _{REF} , 0dBm
RF ⁺ and RF ⁻	Two Outputs	J4 and J5 SMA Connectors	Frequency: 900MHz*, Power: 0dBm, Frequency Range: Depends on the version of the LTC6946 device – refer to Table 1, Step Size: 200kHz*
Loop Bandwidth	–	Set by Loop Filter Component Values	47kHz*

* These frequencies are for the DC1705B pllset files included with PLLWizard.

Note 1: A low noise 10MHz or 100MHz reference frequency, such as the Wenzel 501-04608A or 501-04516D OCXO, is recommended. If using a different frequency, make sure to update the f_{REF} and R_DIV boxes under the System tab in PLLWizard so that f_{PDF} is still 1MHz. For example, if a 20MHz clock is used, f_{REF} should be changed to 20MHz and R_DIV to 20. REF BST and FILT under the System tab in PLLWizard might need to be changed if the reference frequency and/or power is different than what is recommended in the table above. More information can be found in the LTC6946 data sheet.

Table 1. DC1705B Options and Frequency Ranges

ASSEMBLY VERSION	PART NUMBER	VCO FREQUENCY RANGE (GHz)	OUTPUT DIVIDER SETTINGS
DC1705B-A	LTC6946IUFD-1	2.240 to 3.740	Integers 1 through 6
DC1705B-B	LTC6946IUFD-2	3.080 to 4.910	Integers 1 through 6
DC1705B-C	LTC6946IUFD-3	3.840 to 5.790	Integers 1 through 6

QUICK START PROCEDURE

The DC590 and PLLWizard application are required to control the DC1705B through a personal computer (PC).

DC590 Configuration

The DC590's QuikEval™ drivers must be installed before the DC590 will be able to communicate with the LTC6946. To configure the DC590, follow the procedure below, starting with step 1. If you have already installed the DC590 software previously, skip to step 5.

Note: Once the QuikEval software is installed, the application does not need to be executed to run PLLWizard or to control the DC1705B.

1. Do Not plug in the DC590 before running the installation program.
2. Download the QuikEval installation program from <http://www.linear.com/software>.

3. Run the QuikEval installation program and follow the on-screen instructions. More detailed installation information may be found in the DC590's Quick Start guide.
4. Exit the QuikEval program once the installation is complete, as it is not needed to run the PLLWizard software.
5. Place the DC590 jumpers in the following positions:
 - JP4** EE Must be in the "EN" position.
 - JP5** ISO "ON" must be selected.
 - JP5** SW "ON" must be selected.
 - JP6** VCCIO "3.3V" must be selected. This sets the SPI port to 3.3V operation.
6. Connect the DC590 to one of your computer's USB ports with the included USB cable.

QUICK START PROCEDURE

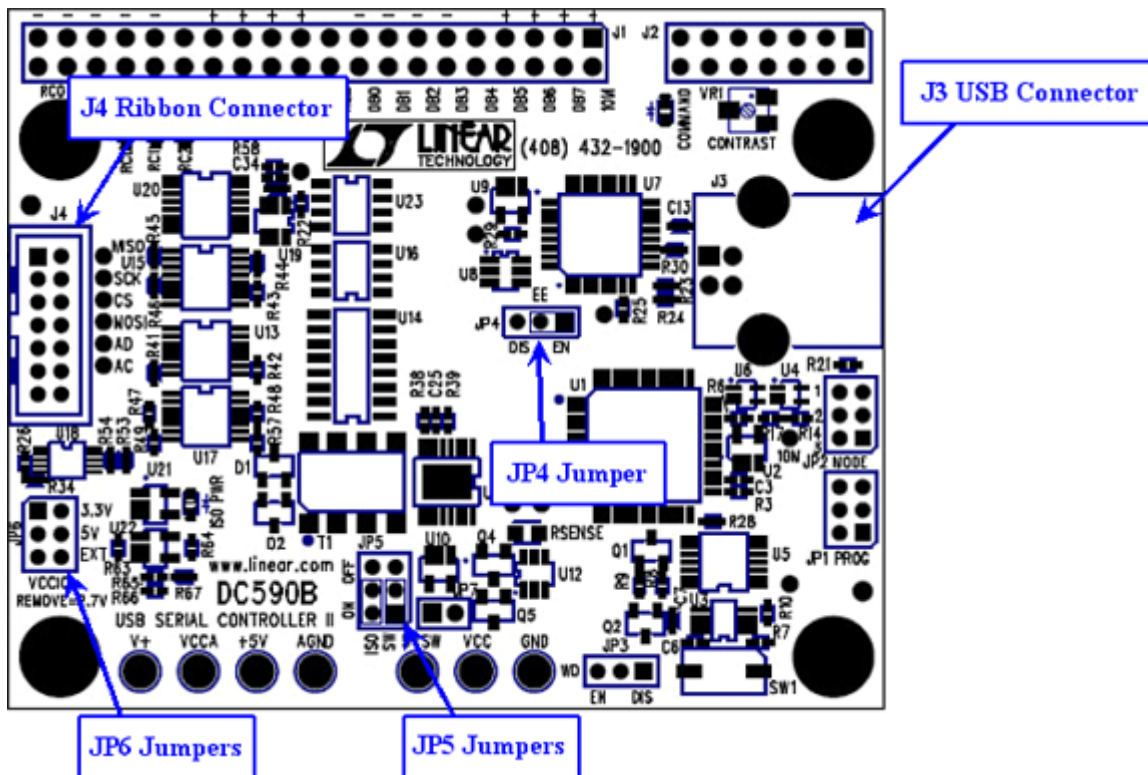


Figure 2. DC590 Jumper Locations

PLLWizard Installation

The PLLWizard software is used to communicate with the LTC6946 synthesizer. It uses the DC590 to translate between USB and SPI-compatible serial communications formats. It also includes advanced PLL design and simulation capabilities. The following are the PLLWizard system requirements:

- Windows Operating System: Windows XP, Windows 2003 Server, Windows Vista, Windows 7
- Microsoft .NET 2.0 or later
- Windows Installer 3.1 or later
- Linear Technology's QuikEval and DC590 hardware

Microsoft .NET

You must have Microsoft .NET 2.0 or later installed on your computer. PLLWizard will not run without it. Note that with Windows Vista and Windows 7 have at least version 3.5 pre-installed.

To manually determine your version of .NET using Windows XP, click *Start Menu* → *Settings* → *Control Panel* → *Add or Remove Programs*.

Depending upon your .NET version, choose one of two PLLWizard setup programs, downloaded from <http://www.linear.com/software>.

QUICK START PROCEDURE

Either setup program will automatically install Microsoft .NET if a compatible .NET version is not found. But, the installation source depends upon which file you downloaded from Linear Technology's website. You should pick one of the following two choices, depending upon your version of .NET.

Table 2. PLLWizard Installation File

FILE	.NET 2.0 SOURCE
PLLWizardSetup.exe	Latest Version Downloaded from Microsoft
PLLWizardSetup_net20.exe	2.0 SP2 Included (Much Larger File Size)

- Choose *PLLWizardSetup* if you have .NET 2.0 or later, have Windows Vista or Windows 7, or if you have less than .NET 2.0 but want the latest .NET installed.
- Choose *PLLWizardSetup_net20* if you have less than .NET 2.0, and want faster installation (no additional Microsoft downloads are needed, but the file size is much larger).

The setup file will verify and/or install Microsoft .NET and install PLLWizard. Refer to the Help menu for software operation.

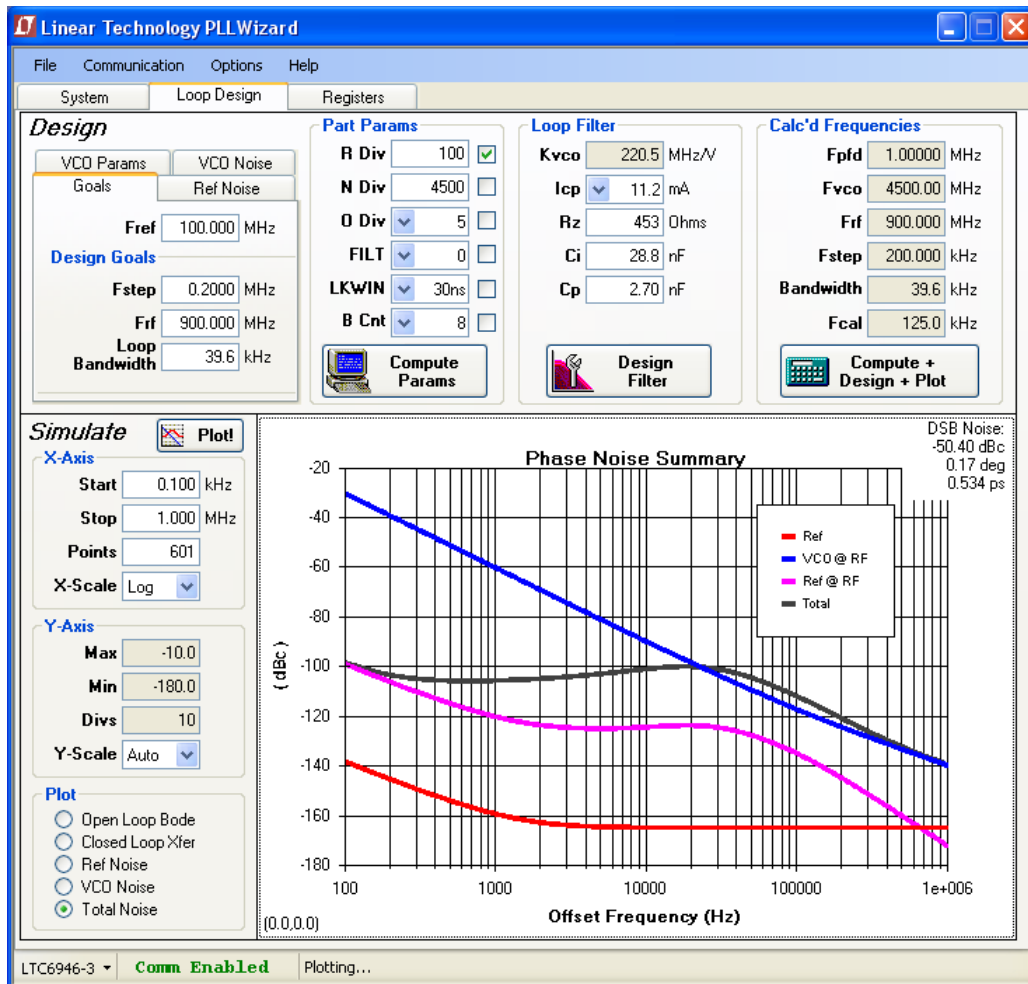


Figure 3. PLLWizard Screenshot

QUICK START PROCEDURE

DC1705B Configuration

1. Connect an appropriate reference frequency source (at J1) and signal analyzers (at J4 and/or J5) using the SMA connectors (see Figure 1 and the Typical DC1705B Requirements and Characteristics table).
2. Choose the $\overline{\text{MUTE}}$ jumper setting: **JP1 - GND/3.3V MUTE** position. Select GND to mute the RF output, 3.3V to un-mute.
3. Connect the GND, 3.3V and 5V banana jacks to a power supply and apply power (see Figure 1 and the Typical DC1705B Requirements and Characteristics table).
4. Connect the DC590 to the DC1705B with the provided ribbon cable.
5. Run the PLLWizard application.
6. In PLLWizard, click File → Load Settings and point to the appropriate pllset file. For example, if you are using a 10MHz reference with a DC1705B-B to evaluate the LTC6946-2, load the “DC1705-B (LTC6946-2) 10MHz.pllset” file found in the PLLWizard installation directory (typically Program Files → LTC → PLLWizard → Set Files).

The red LED on DC1705B should turn on indicating that the loop is locked at 900MHz.

You can then change the values of N_DIV and/or O_DIV in PLLWizard to change the output frequency.

Troubleshooting

If the red LED does not illuminate, follow the instructions below:

1. Verify that you are able to communicate with the DC1705B. The bottom status line in PLLWizard should read “LTC6946” and “Comm Enabled.” Refer to PLLWizard’s Troubleshoot and Help if not.
2. Verify that the 3.3V and 5V have the correct voltages on them and that the reference frequency is applied to the REF+ IN SMA input.

If the red LED is on but you cannot detect an RF output, make sure jumper JP1 is at the 3.3V position. Run Help → Troubleshoot in PLLWizard if the problem is not resolved.

DC1705B Reconfiguration

You can redesign the frequency plan of the DC1705B using PLLWizard. You can change the loop filter components as found using PLLWizard by reinstalling the loop filter components shown in Figure 4.

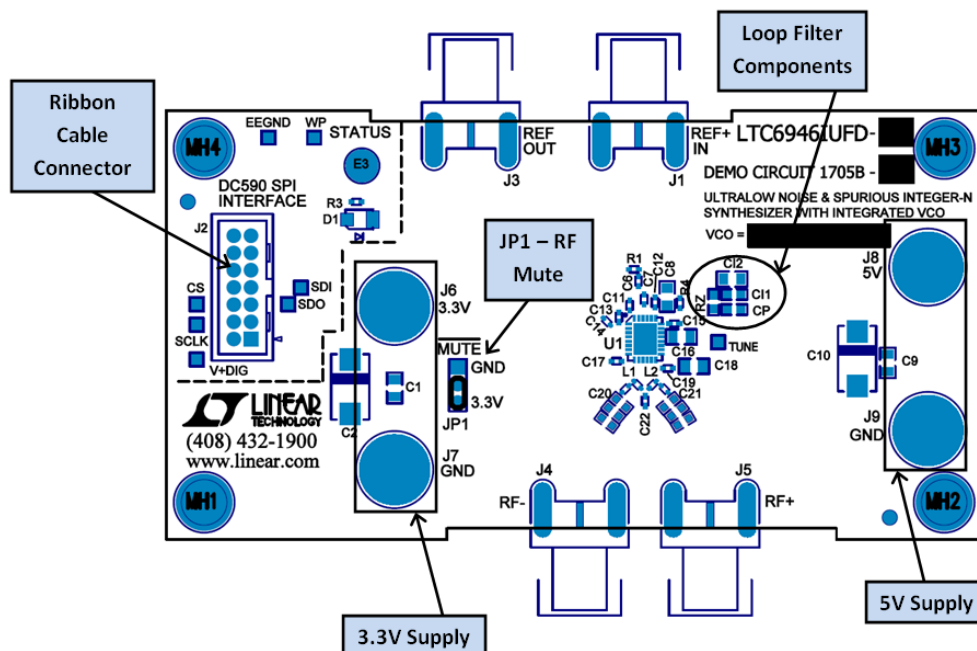


Figure 4. DC1705B Components and Connections

DEMO MANUAL DC1705B

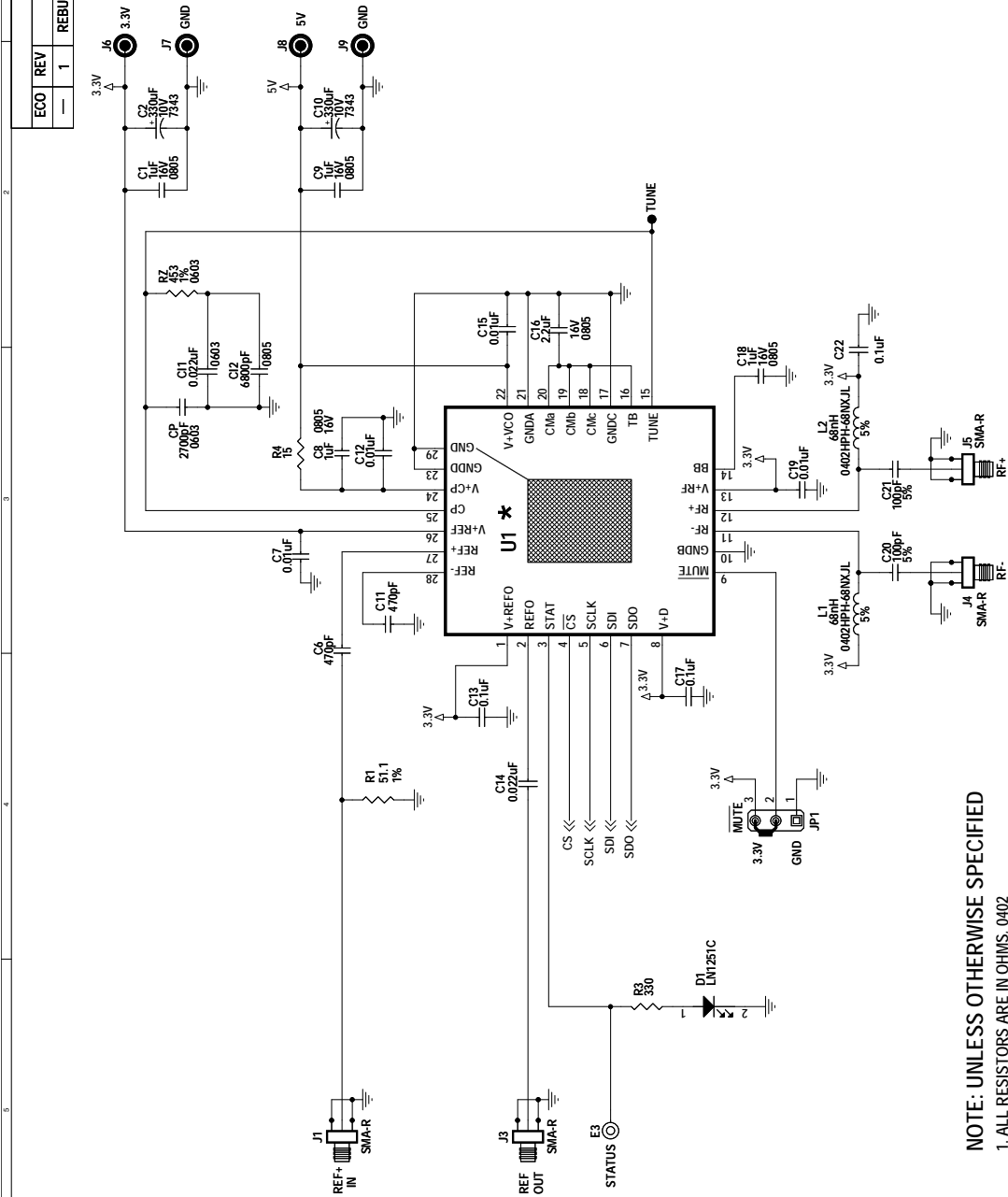
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
DC1705B General BOM				
1	1	C11	CAP, X7R 0.022µF 50V 5% 0603	AVX 06035C223JAT2A
2	1	C12	CAP, COG 6800pF 50V 5% 0805	MURATA GRM2195C1H682JA01D
3	1	CP	CAP, COG 2700pF 50V 5% 0603	MURATA GRM1885C1H272JA01D
4	4	C1, C8, C9, C18	CAP, X7R, 1.0µF, 16V, 10%, 0805	TDK, C2012X7R1C105K
5	2	C2, C10	CAP, Tantalum, 330µF, 10V, 10%, 7343	AVX, TPME337K010R0035
6	8	C3, C13, C17, C22-C26	CAP, X5R, 0.1µF, 10V, 10%, 0402	TDK, C1005X5R1A104K
7	2	C6, C11	CAP, X7R, 470pF, 50V, 10%, 0402	AVX, 04025C471KAT2A
8	4	C7, C12, C15, C19	CAP, X7R, 0.01µF, 16V, 10%, 0402	AVX, 0402YC103KAT2A
9	1	C14	CAP, X7R 0.022µF 16V, 10%, 0402	AVX 0402YC223KAT2A
10	1	C16	CAP, X7R, 2.2µF, 16V, 10%, 0805	TDK, C2012X7R1C225K
11	2	C20, C21	CAP, NPO, 100pF, 50V, 5%, 0402	TDK, C1005C0G1H101J
12	1	D1	LED, RED	PANASONIC, LN1251C-TR
13	1	E3	TURRET, Testpoint, 2501	MILL-MAX, 2501-2-00-80-00-00-07-0
14	1	JP1	HEADERS, 3 Pins 2mm Ctrs.	SAMTEC TMM-103-02-L-S
15	4	J1, J3, J4, J5	CON., SMA 50-OHM EDGE-LAUNCH	E.F. JOHNSON, 142-0701-851
16	1	J2	CON., Header, 14 Pin, 2mm	MOLEX, 87831-1420
17	4	J6, J7, J8, J9	JACK, BANANA	KEYSTONE, 575-4
18	2	L1, L2	IND, 68nH 5%, 0402	COILCRAFT, 0402HPH-68NXJLW
19	1	RZ	RES., CHIP, 453 1/10W 1%, 0603	NIC, NRC06F4530TRF
20	1	R1	RES., CHIP, 51.1Ω, 1/16W, 1%, 0402	NIC, NRC04F51R1TRF
21	1	R3	RES., CHIP, 330Ω, 1/16W, 1%, 0402	NIC, NRC04F3300TRF
22	1	R4	RES., CHIP, 15Ω, 1/16W, 1%, 0402	NIC, NRC04F15R0TRF
23	4	R5, R6, R7, R13	RES., CHIP, 200k, 1/16W, 1%, 0402	NIC, NRC04F2003TRF
24	3	R8, R9, R14	RES., CHIP, 4.99k, 1/16W, 1%, 0402	NIC, NRC04F4991TRF
25	3	R10, R11, R12	RES., CHIP, 100 1/16W, 5%, 0402	NIC, NRC04J101TRF
26	1	R15	RES., CHIP, 0Ω, 0603	VISHAY, CRCW06030000Z0EA
27	2	U2, U3	I.C., Dual Buffer, SC70	FAIRCHILD SEMI., NC7WZ17P6X
28	1	U4	I.C., Dual Transceiver, SOT363	NXP, 74LVC1T45GW
29	1	U5	I.C., Serial EEPROM, TSSOP8	MICROCHIP, 24LC025-I/ST
30	1	SHUNT ON JP1 (2&3)	SHUNT, 2mm Ctrs.	SAMTEC 2SN-BK-G
31	4	MH1-MH4	STANDOFF, NYLON, 0.5, 1/2"	KEYSTONE, 8833 (SNAP ON)
DC1705B-A				
1	1		DC1705B General BOM	DC1705B
2	1	U1	IC Synthesizer QFN-28 4mm × 5mm	Linear Technology Corporation, LTC6946IUFD-1
DC1705B-B				
1	1		DC1705B General BOM	DC1705B
2	1	U1	IC Synthesizer QFN-28 4mm × 5mm	Linear Technology Corporation, LTC6946IUFD-2
DC1705B-C				
1	1		DC1705B General BOM	DC1705B
2	1	U1	IC Synthesizer QFN-28 4mm × 5mm	Linear Technology Corporation, LTC6946IUFD-3

Note: The DC1705B has an additional identification EEPROM on it

SCHEMATIC DIAGRAM

REVISION HISTORY				
ECO	REV	DESCRIPTION	APPROVED	DATE
—	1	REBUILD WITH CHANGE	MICHEL.A.	11-15-11



NOTE: UNLESS OTHERWISE SPECIFIED

- 1. ALL RESISTORS ARE IN OHMS, 0402
- ALL CAPACITORS ARE IN MICROFARADS, 0402.

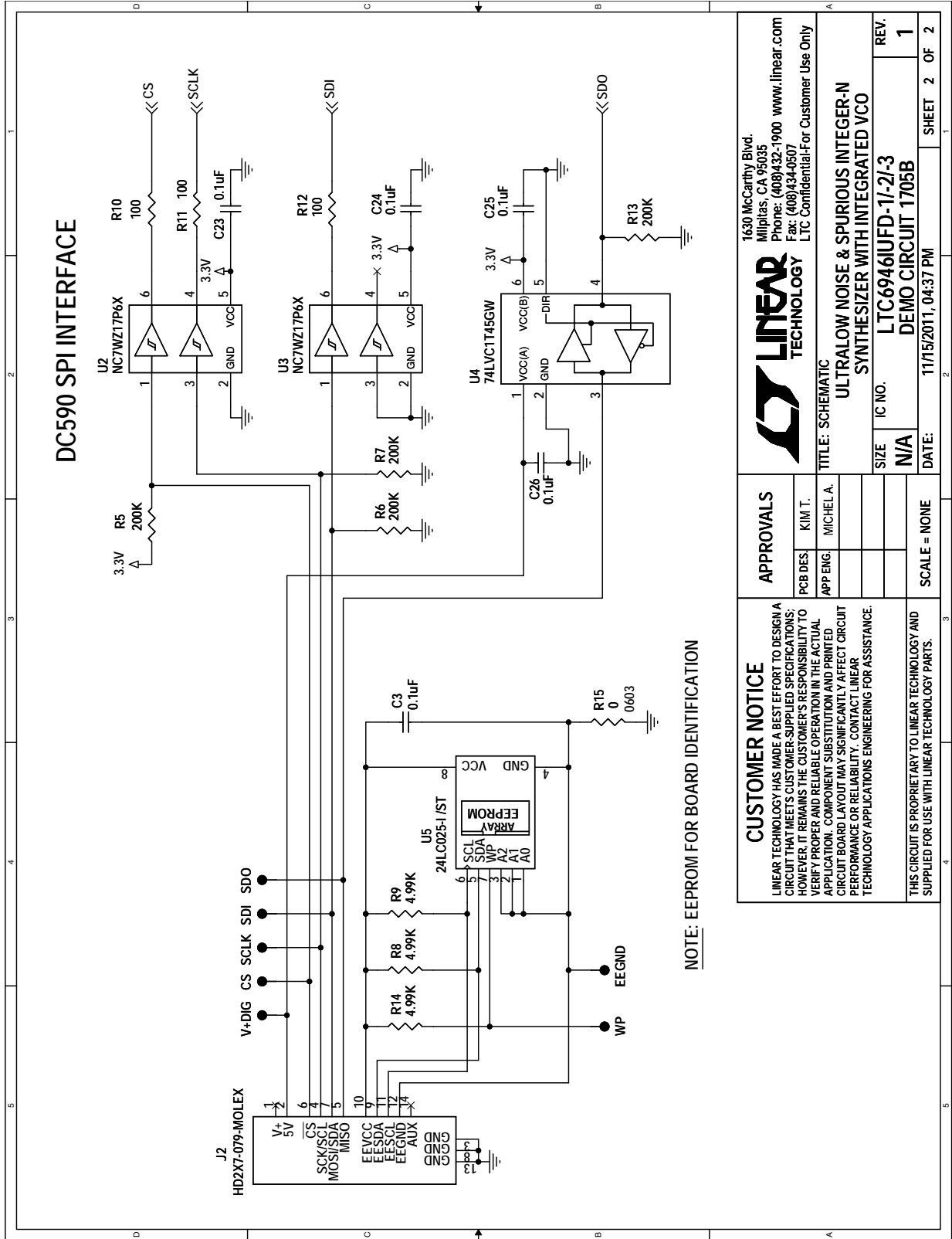
ASSY	U1	VCO
-A	LTC6946IUFD-1	2.24 TO 3.74 GHZ
-B	LTC6946IUFD-2	3.08 TO 4.91 GHZ
-C	LTC6946IUFD-3	3.84 TO 5.79 GHZ

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APPROVALS		TITLE: SCHEMATIC	
PCB DES	KIM.T.	ULTRALOW NOISE & SPURIOUS INTEGER-N SYNTHESIZER WITH INTEGRATED VCO	
APP'G	MICHEL.A.	SIZE	LTC6946IUFD-1/2/3
		IC NO.	DEMO CIRCUIT 1705B
		SCALE	NONE
		DATE	11/15/2011, 04:37 PM
		SHEET	1 OF 2

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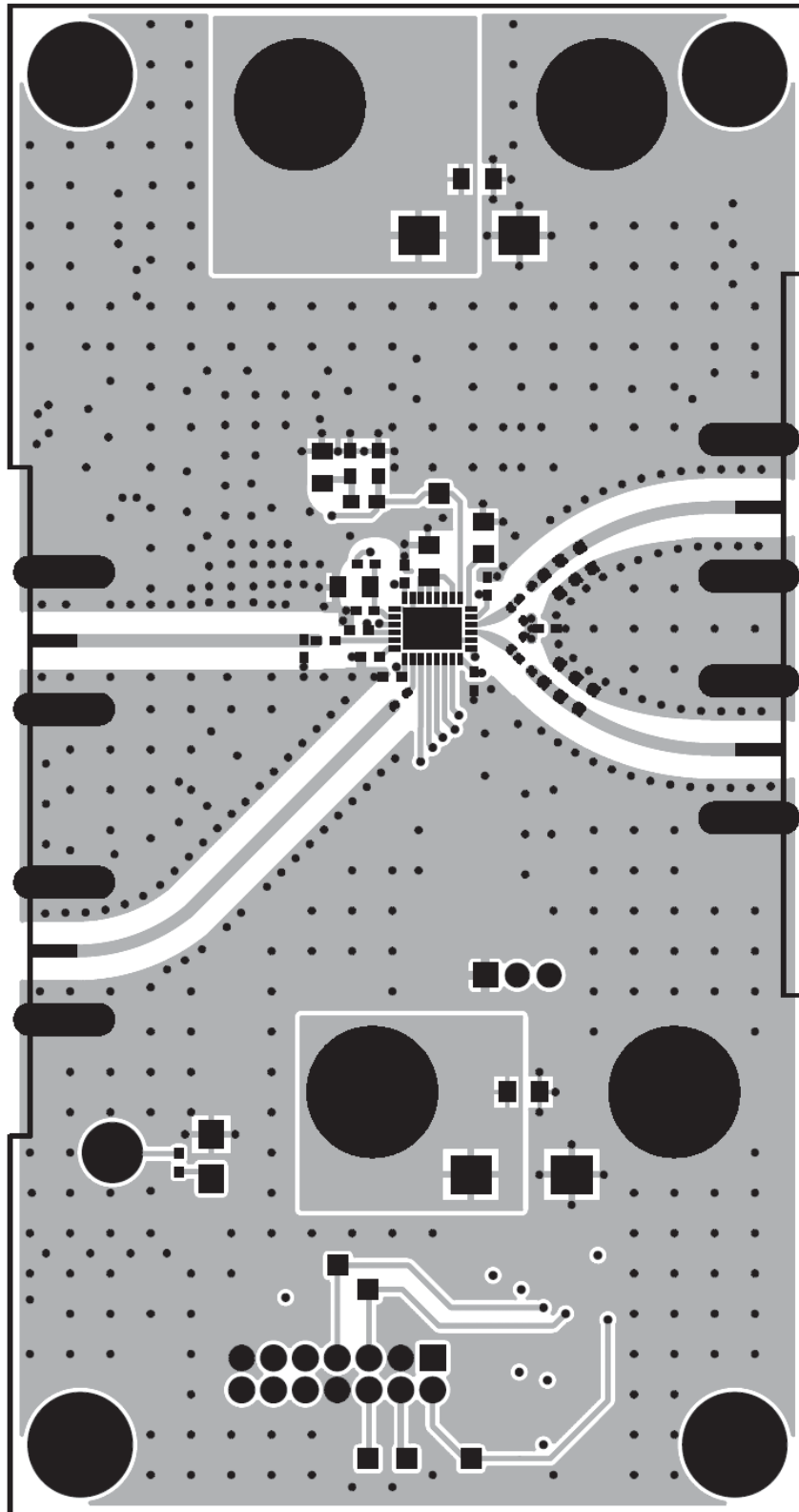


APPROVALS PCB DES: KIM T. APP ENG: MICHEL A.		1630 McCarthy Blvd. Milpitas, CA 95035 Phone: (408)432-1900 www.linear.com Fax: (408)434-0507 LTC Confidential-For Customer Use Only	
		LINEAR TECHNOLOGY	
TITLE: SCHEMATIC ULTRALOW NOISE & SPURIOUS INTEGER-N SYNTHESIZER WITH INTEGRATED VCO			
SIZE	IC NO.	REV.	
N/A	LTC6946IUF-1/-2/-3	1	
DATE: 11/15/2011, 04:37 PM		SHEET 2 OF 2	
SCALE = NONE			
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THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.			

Note: The buffers shown on sheet 2 of 2 of the schematic are used to protect the LTC6946 when communicating to it starts before powering it up. There is no need for such circuitry if the SPI bus is not active before powering up the LTC6946. The EEPROM is for identification and is not needed to program the LTC6946.

LAYOUT

The top metal layer of the DC1705B is shown here as an example of good PCB layout for the LTC6946.



DEMO MANUAL DC1705B

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