LMX2615EVM-CVAL Wideband 15-GHz Synthesizer

User's Guide

Literature Number: SNAU218
November 2018

Contents

1 Evaluation Board Setup and Description 4
2 Setting Up the Software 5
3 Bringing LMX2615 to a Lock State 6
4 Current Loop Filter Configuration 7
5 Typical Phase Noise 8
Appendix A Schematic 10
Appendix B Bill of Materials 11
Appendix C PCB Board Specifications 13
Appendix D Proper Jumper and Switch Positions 18

Copyright © 2018, Texas Instruments Incorporated

LMX2615EVM-CVAL Wideband 15-GHz Synthesizer

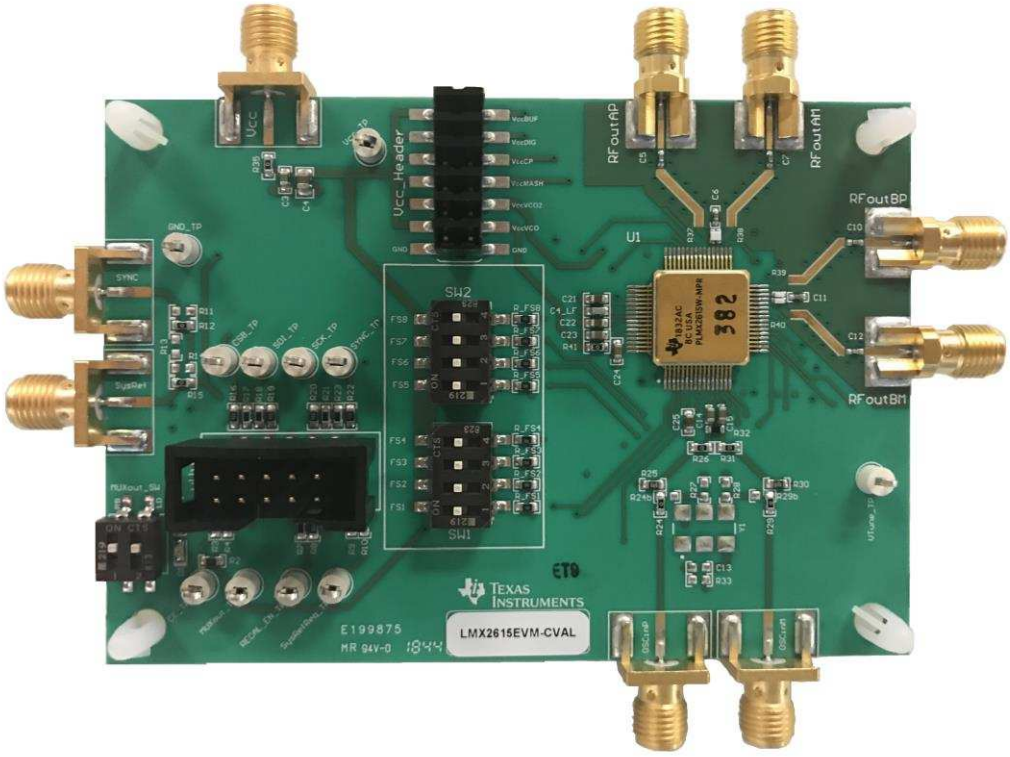


Figure 1. LMX2615EVM-CVAL

Copyright © 2018, Texas Instruments Incorporated

1 Evaluation Board Setup and Description

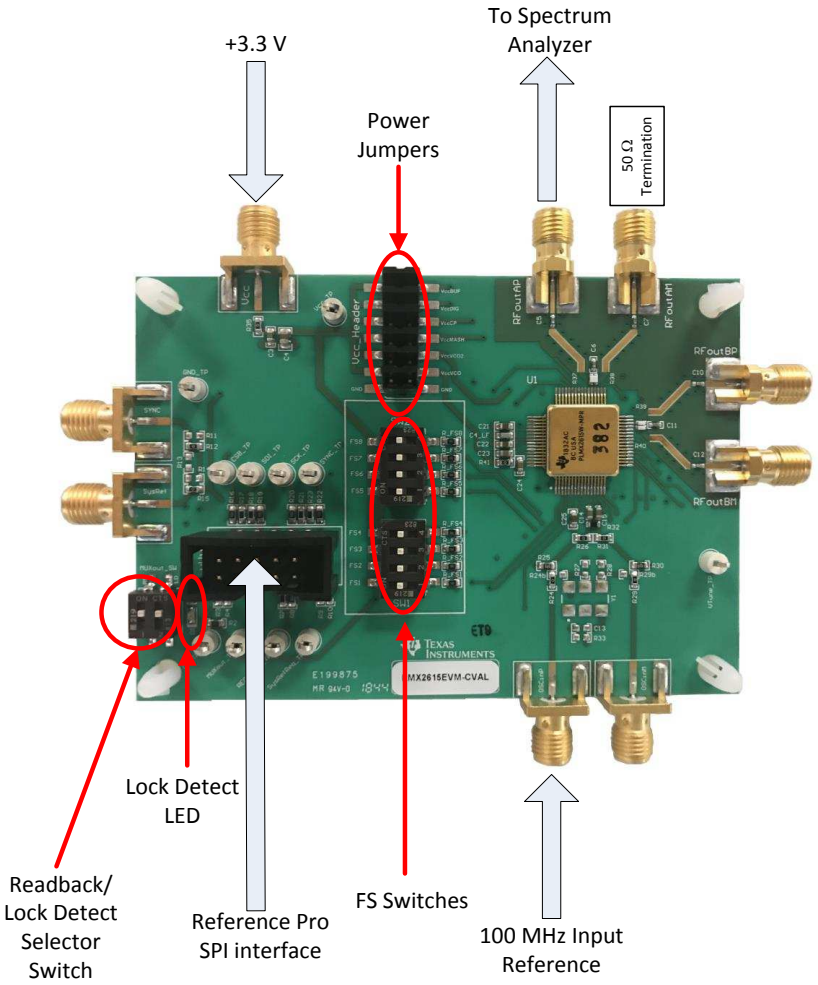


Figure 2. LMX2615EVM Setup and Description

1. Power:
   a. Set power supply to 3.3 V with 600-mA current limit and connect to V_{CC} SMA.
2. Input Signal
   a. The EVM is designed for a 100-MHz input reference that should be connected to the OSCin SMA. Some of the options for this could be a signal generator, the 100 MHz output from the Reference Pro board, or a very clean signal source such as the Wenzel 501-4623G ultra-low phase noise 100 MHz reference
3. Programming Interface:
   - Reference Pro will provide SPI interface to program LMX2615. If using this, Connect USB cable from laptop or PC to USB port in Reference Pro. This provides power to Reference Pro Board and communication with TICS GUI
   - The other option is to use the dip switch on the board to use Pin mode.
4. Output:
   1. Connect RFoutAP to a phase noise analyzer and connect a 50-Ω terminator to RFoutAM.

Copyright © 2018, Texas Instruments Incorporated

2 Setting Up the Software

1. Download the TICS Pro from the TI Website at www.ti.com/tool/TICSPRO-SW and install.
2. From the menu bar choose *Select Device → PLL + VCO → LMX2615*

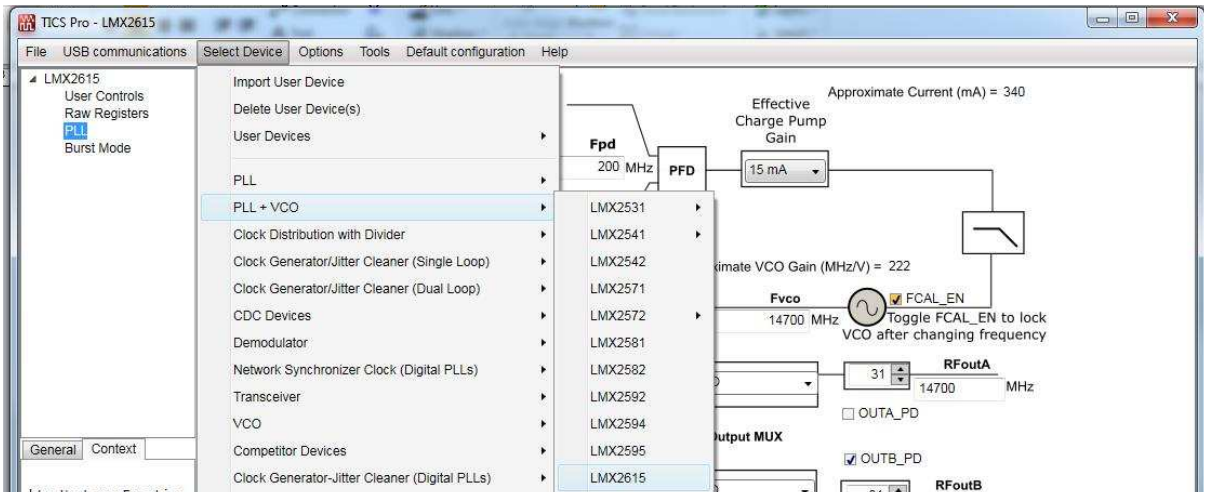


Figure 3. Search for LMX2615 on TICS Pro

3. Verify the communication setup with Reference Pro. To do this, select *USB communications → Interface* . Click on the identify button and the LED on the Reference Pro should blink.

Copyright © 2018, Texas Instruments Incorporated

3 Bringing LMX2615 to a Lock State

Load the default mode as shown in Figure 4 The PLL GUI tab gives useful feedback to the user that is helpful in getting the best performance out of the device

- Items highlighted in orange or red indicate that something may be sub-optimal. To view the comment, simply mouse over the colored item and a tooltip will appear. In this case, the feedback suggests that CAL_CLK_DIV and VCO_SEL can be adjusted to improve the VCO calibration time, SEG1_EN could be disabled for better spurs and lower current, and that FCAL_EN should be toggled to calibrate the VCO.
- Mouse over any item and it will display the field value in the lower left corner including the field name, register location, and description.
- On the bottom is the status bar, which indicates when registers are written to and the status of the USB2ANY/Reference Pro board. In this case, it is indicating that there is no board connected.

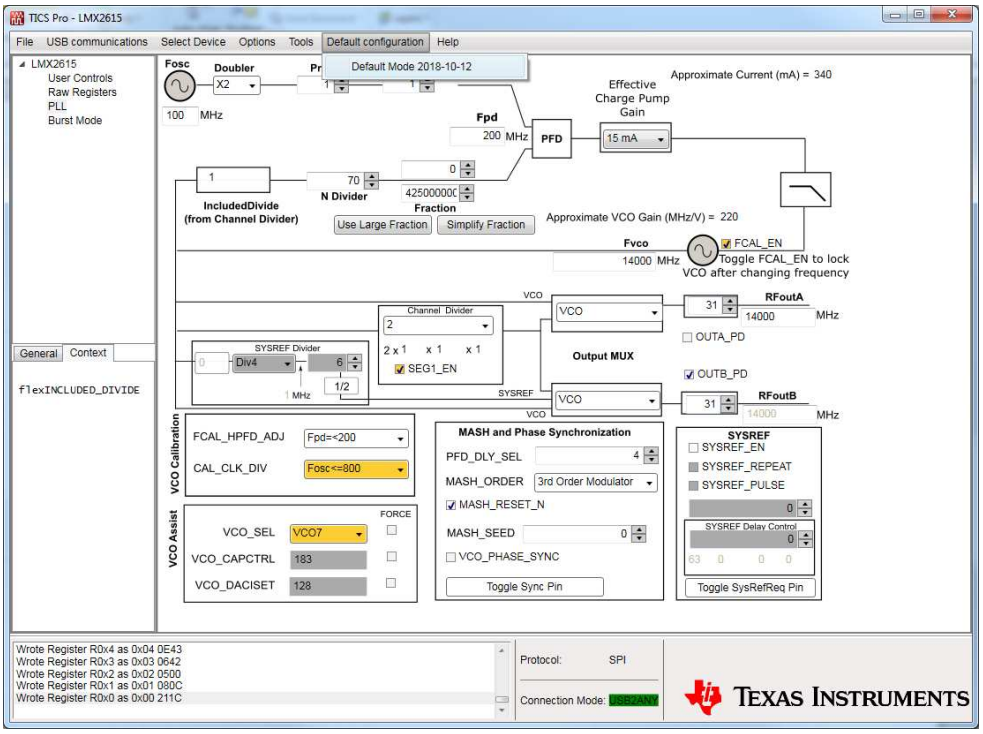


Figure 4. TICS Pro GUI LMX2615 Default Configuration

The GUI gives useful feedback to the user to help understand how to program and get the best performance out of the de

Copyright © 2018, Texas Instruments Incorporated

4 Current Loop Filter Configuration

Note that if the phase detector frequency is changed significantly, the loop filter needs to be redesigned.

Table 1. Current Loop Filter Configuration

PARAMETER	VALUE
VCO Gain	132 MHz/V
Loop Bandwidth	285 kHz
Phase Margin	65 deg
C1_LF	390 pF
C2_LF	68 nF
C3_LF	Open
C4_LF	1800 pF
R2	68 Ω
R3_LF	0 Ω
R4_LF	18 Ω
Effective Charge Pump Gain	15 mA
Phase Detector Frequency (MHz)	200 MHz
VCO Frequency	Designed for 15 GHz, but works over the whole frequency range

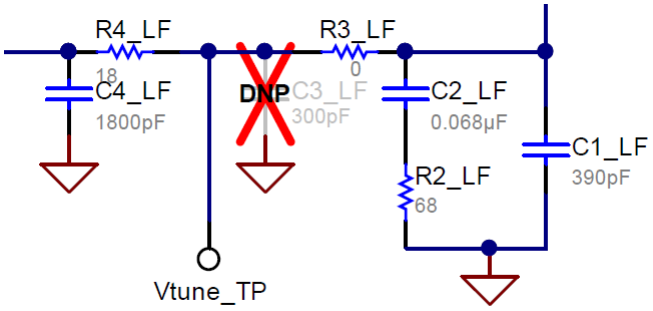


Figure 5. Current Loop Filter Configuration

For detailed design and simulation, see the PLLatinum Sim Tool.

For application notes, videos, and other technical information on TI products, see http://www.ti.com/pll.

Copyright © 2018, Texas Instruments Incorporated

5 Typical Phase Noise

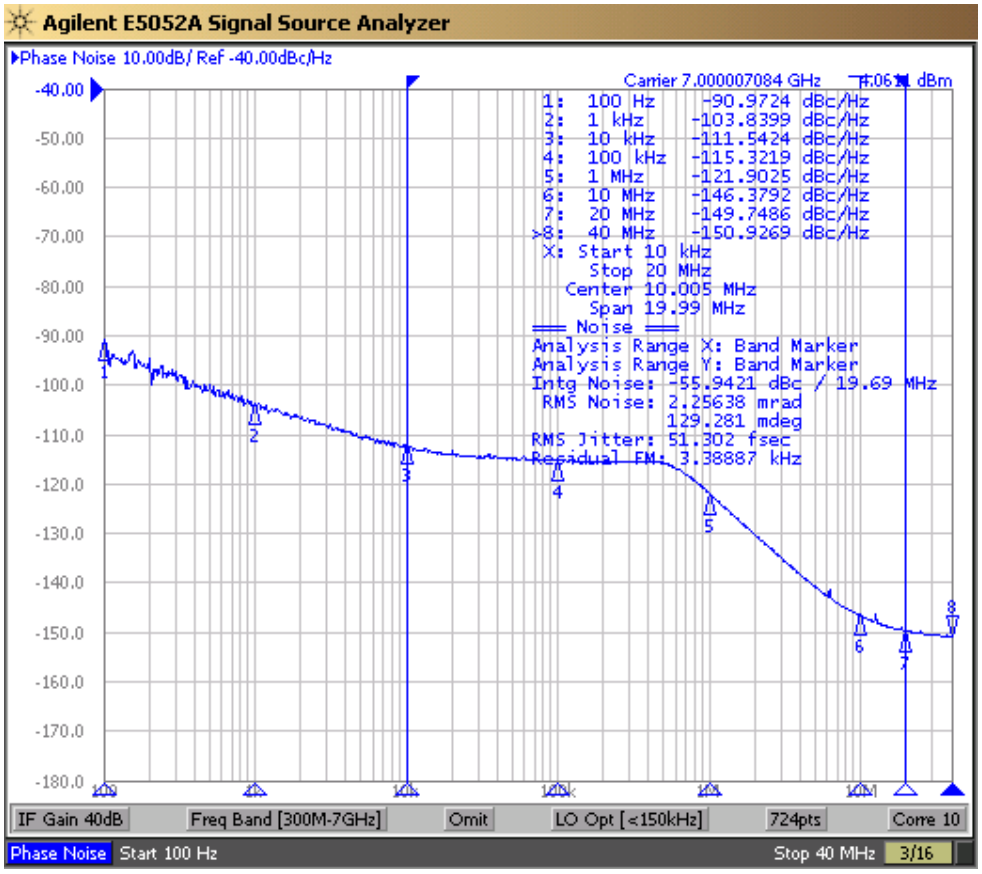


Figure 6. Typical Phase Noise with Wenzel 100 MHz Input

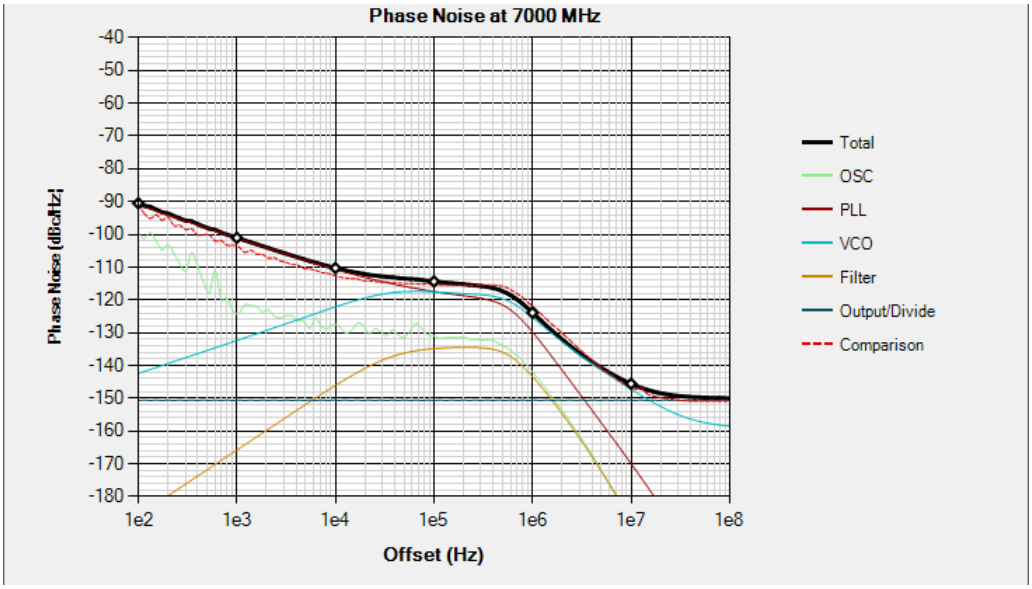


Figure 7. PLLatinum Sim Simulation Result for Phase Noise with Wenzel 100 MHz Input (Total Trace = Simulation, Comparison Trace = Actual Measurement)

Copyright © 2018, Texas Instruments Incorporated

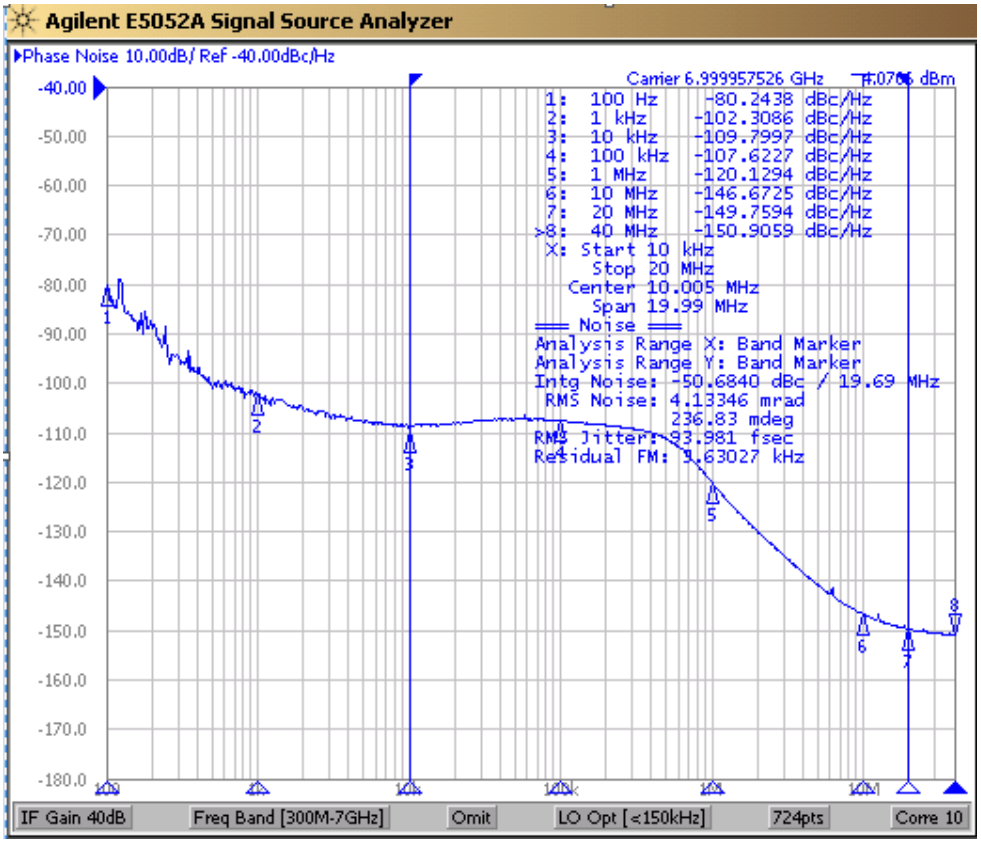


Figure 8. Typical Phase Noise 100 MHz Reference Pro as Input

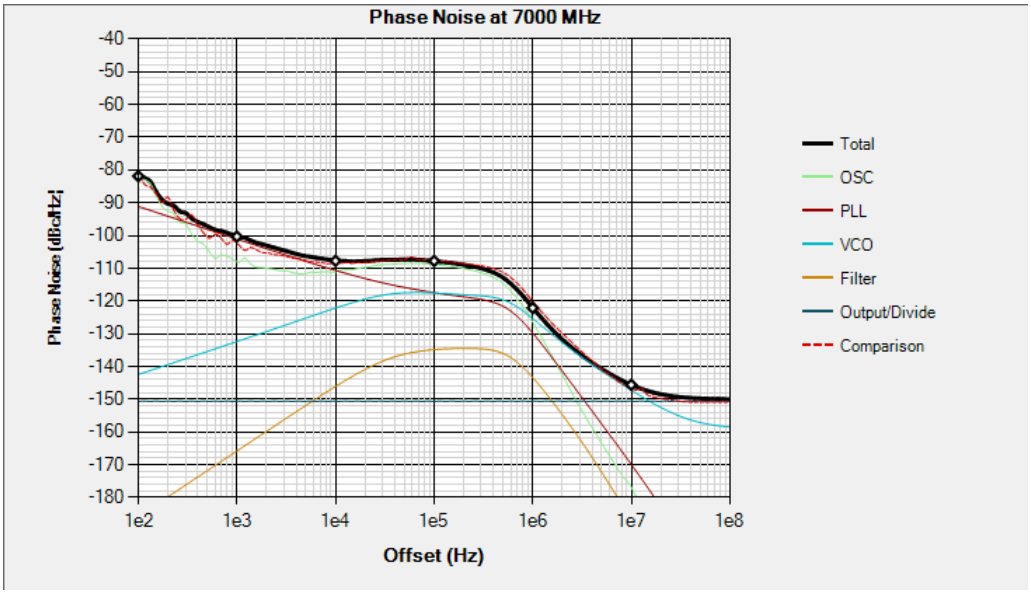


Figure 9. PLLatinum Sim Simulation using 100 MHz Reference Pro as Input (Total Trace = Simulation, Comparison Trace = Actual Measurement)

Copyright © 2018, Texas Instruments Incorporated

Schematic

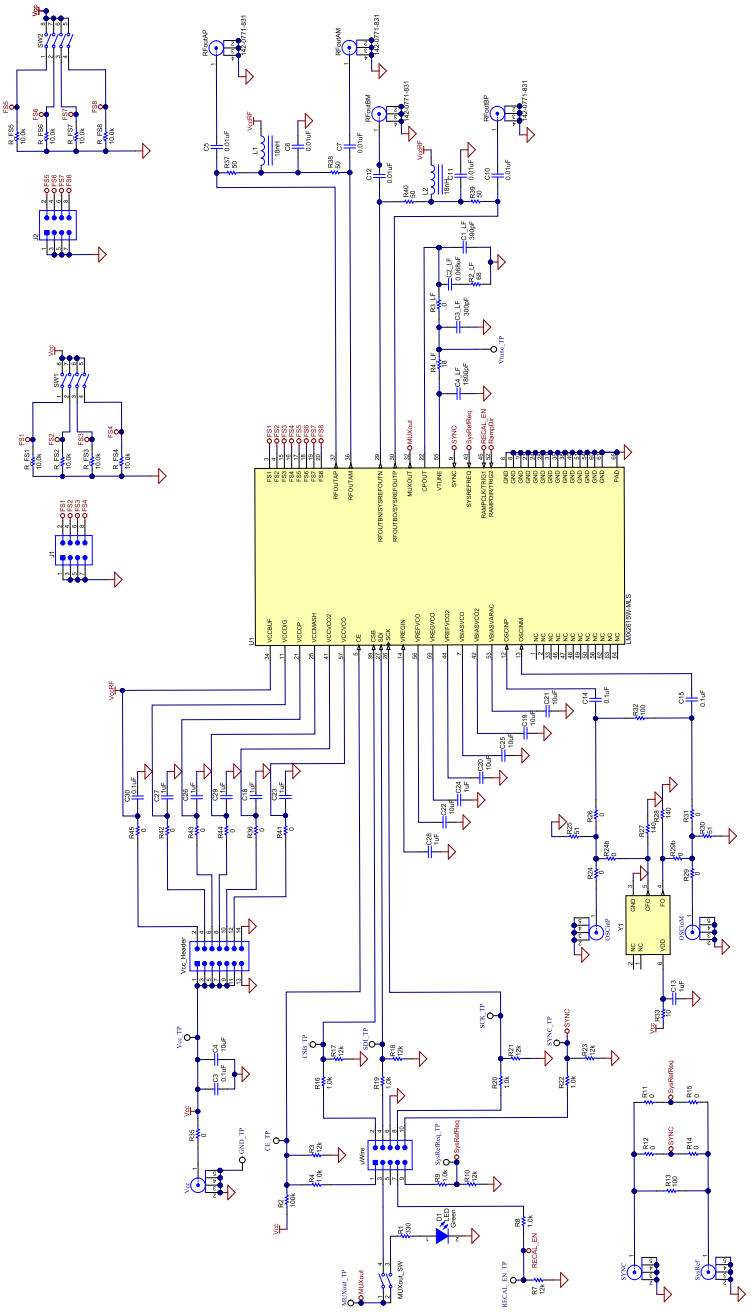


Figure 10. Schematic

Copyright © 2018, Texas Instruments Incorporated

Bill of Materials

Table 2. Bill of Materials

Item	Designator	Description	Manufacturer	Part Number	Qty
1	!PCB	Printed Circuit Board	Any	SV601368	1
2	C1_LF	CAP, CERM, 390 pF, 50 V, +/- 5%, C0G/NP0, 0603	Kemet	C0603C391J5GACTU	1
3	C2_LF	CAP, CERM, 0.068 uF, 50 V, +/- 10%, X7R, 0603	MuRata	GRM188R71H683KA93D	1
4	C3, C14, C15, C30	CAP, CERM, 0.1 uF, 16 V, +/- 5%, X7R, 0603	AVX	0603YC104JAT2A	4
5	C4	CAP, CERM, 10 uF, 10 V, +/- 10%, X5R, 0805	Kemet	C0805C106K8PACTU	1
6	C4_LF	CAP, CERM, 1800 pF, 50 V, +/- 5%, C0G/NP0, 0603	MuRata	GRM1885C1H182JA01D	1
7	C5, C6, C7, C10, C11, C12	CAP, CERM, 0.01 uF, 16 V, +/- 10%, X7R, 0402	AT Ceramics	520L103KT16T	6
8	C18, C23, C24, C26, C27, C28, C29	CAP, CERM, 1 uF, 16 V, +/- 10%, X7R, 0603	TDK	C1608X7R1C105K080AC	7
9	C19, C20, C21, C22, C25	CAP, CERM, 10 uF, 10 V, +/- 20%, X5R, 0603	TDK	C1608X5R1A106M080AC	5
10	CE_TP, CSB_TP, GND_TP, MUXout_TP, RECAL_EN_TP, SCK_TP, SDI_TP, SYNC_TP, SysRefReq_TP, Vcc_TP, Vtune_TP	Test Point, Compact, White, TH	Keystone	5007	11
11	D1	LED, Green, SMD	Lite-On	LTST-C190GKT	1
12	K1	Reference Pro - SV601349 (Kitting only) - EDGE #: 6607586	Texas Instruments	SV601349	1
13	K2	Cable USB A - Mini (Kitting only)	Qualtek	Q362-ND	1
14	K3	10 Pin Ribbon Cable (Kitting only)	3M	M3DDA-1006J	1
15	K4, K5	SMA - SMA (Kitting only)	Amphenol-RF Division	132168	2
16	L1, L2	Inductor, Multilayer, Air Core, 18 nH, 0.3 A, 0.36 ohm, SMD	MuRata	LQG15HS18NJ02D	2
17	LBL1	Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	Brady	THT-14-423-10	1
18	MUXout_SW	Switch, SPST, Slide, Off-On, 2 Pos, 0.1A, 20V, SMD	CTS Electrocomponents	219-2MST	1
19	OSCinM, OSCinP, SYNC, SysRef, Vcc	Connector, End launch SMA, 50 ohm, SMT	Cinch Connectivity	142-0701-851	5
20	R1	RES, 330, 5%, 0.1 W, 0603	Yageo America	RC0603JR-07330RL	1
21	R2	RES, 100 k, 5%, 0.1 W, 0603	Vishay-Dale	CRCW0603100KJNEA	1
22	R2_LF	RES, 68, 5%, 0.1 W, 0603	Vishay-Dale	CRCW060368R0JNEA	1
23	R3_LF, R12, R15, R24, R26, R29, R31, R35, R36, R41, R42, R43, R44, R45	RES, 0, 5%, 0.1 W, 0603	Vishay-Dale	CRCW06030000Z0EA	14
24	R4_LF	RES, 18, 5%, 0.1 W, 0603	Vishay-Dale	CRCW060318R0JNEA	1
25	R7, R10, R17, R18, R21, R23	RES, 12 k, 5%, 0.1 W, 0603	Vishay-Dale	CRCW060312K0JNEA	6
26	R8, R9, R16, R19, R20, R22	RES, 1.0 k, 5%, 0.1 W, 0603	Vishay-Dale	CRCW06031K00JNEA	6
27	R25, R30	RES, 51, 5%, 0.1 W, 0603	Vishay-Dale	CRCW060351R0JNEA	2

Copyright © 2018, Texas Instruments Incorporated

Table 2. Bill of Materials (continued)

Item	Designator	Description	Manufacturer	Part Number	Qty
28	R32	RES, 100, 1%, 0.1 W, 0603	Vishay-Dale	CRCW0603100RFKEA	1
29	R37, R38, R39, R40	RES, 50, 0.1%, 0.05 W, 0402	Vishay-Dale	FC0402E50R0BST1	4
30	RFoutAM, RFoutAP, RFoutBM, RFoutBP	JACK, SMA, 50 Ohm, Gold, Edge Mount	Cinch Connectivity	142-0771-831	4
31	R_FS1, R_FS2, R_FS3, R_FS4, R_FS5, R_FS6, R_FS7, R_FS8	RES, 10.0 k, 1%, 0.1 W, 0603	Vishay-Dale	CRCW060310K0FKEA	8
32	S1, S2, S3, S4	HEX STANDOFF SPACER, 9.53 mm	Richco Plastics	TCBS-6-01	4
33	SW1, SW2	Switch, SPST, Slide, Off-On, 4 Pos, 0.1A, 20V, SMD	CTS Electrocomponents	219-4MST	2
34	uWire	Header (shrouded), 100mil, 5x2, Gold, SMT	FCI	52601-S10-8LF	1
35	Vcc_Header	Header, 2.54mm, 7x2, Gold, Black, SMT	Sullins Connector Solutions	GBC07DABN-M30	1
36	U1	LMX2615HBD, HBD0064A (CFP-64)	Texas Instruments	LMX2615HBD	1
Components of Quantity 0 are DNP					
37	C3_LF	CAP, CERM, 300 pF, 100 V, +/- 5%, C0G/NP0, 0603	MuRata	GRM1885C2A301JA01D	0
38	C13	CAP, CERM, 1 uF, 16 V, +/- 10%, X7R, 0603	TDK	C1608X7R1C105K080AC	0
39	FID5, FID6, FID7, FID10, FID11, FID12	Fiducial mark. There is nothing to buy or mount.	N/A	N/A	0
40	J1, J2	Header, 2.54mm, 4x2, Gold, SMT	Samtec	TSM-104-01-L-DV	0
41	R3	RES, 12 k, 5%, 0.1 W, 0603	Vishay-Dale	CRCW060312K0JNEA	0
42	R4	RES, 1.0 k, 5%, 0.1 W, 0603	Vishay-Dale	CRCW06031K00JNEA	0
43	R11, R14, R24b, R29b	RES, 0, 5%, 0.1 W, 0603	Vishay-Dale	CRCW06030000Z0EA	0
44	R13	RES, 100, 5%, 0.1 W, 0603	Vishay-Dale	CRCW0603100RJNEA	0
45	R27, R28	RES, 140, 1%, 0.1 W, 0603	Vishay-Dale	CRCW0603140RFKEA	0
46	R33	RES, 10, 5%, 0.1 W, 0603	Vishay-Dale	CRCW060310R0JNEA	0
47	U2	Socket, QFN-64, 0.5 mm	Ironwood Electronics	C16420	0
48	Y1	Crystal Oscillator, 100 MHz, LVDS, 3.3V, SMD	Vectron	VC-708-EDE-FNXN-100M000000	0

Copyright © 2018, Texas Instruments Incorporated

PCB Board Specifications

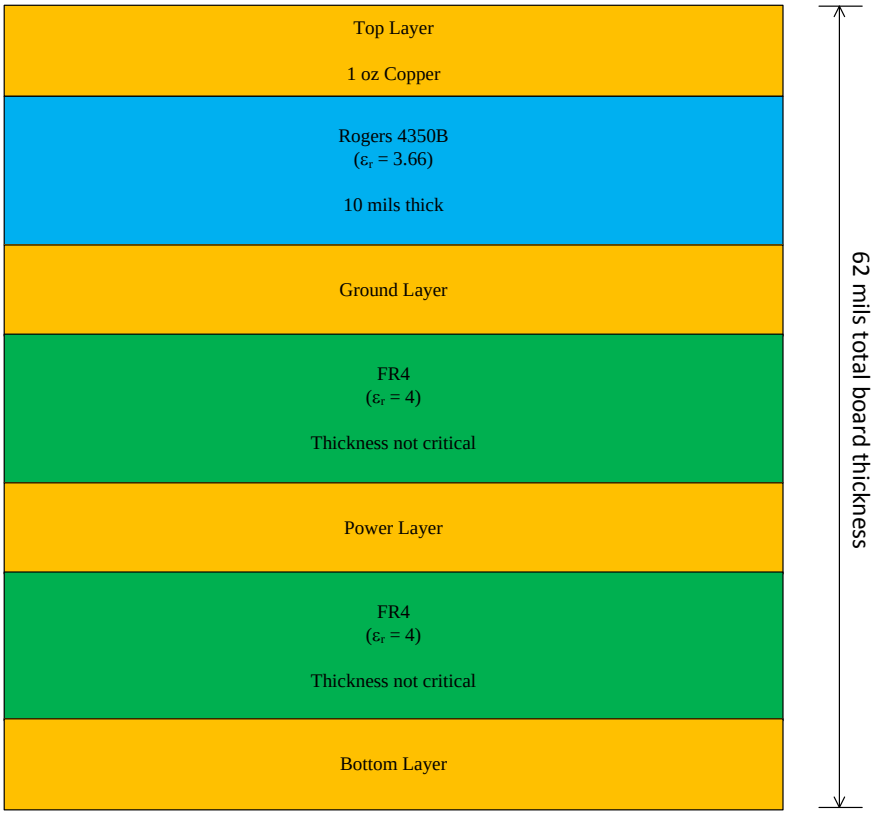


Figure 11. Board Layer Stack-Up

Copyright © 2018, Texas Instruments Incorporated

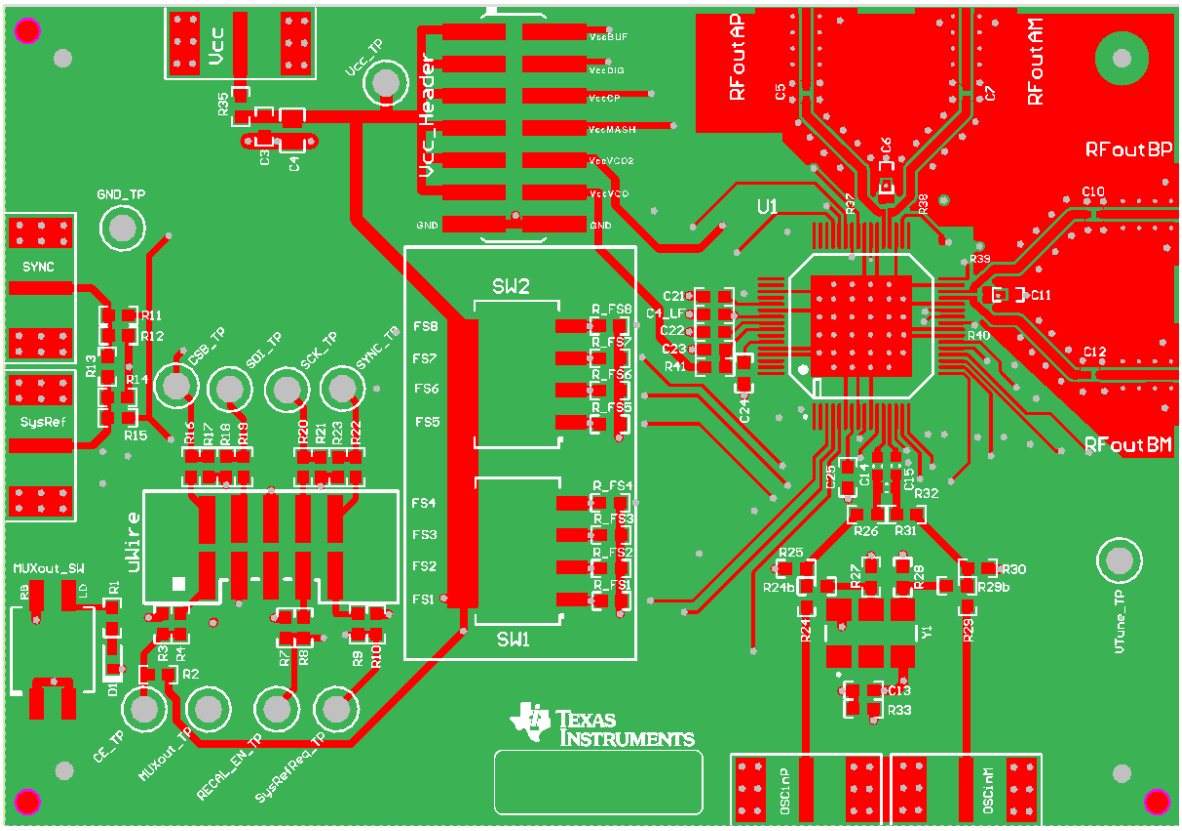


Figure 12. Top Layer

Copyright © 2018, Texas Instruments Incorporated

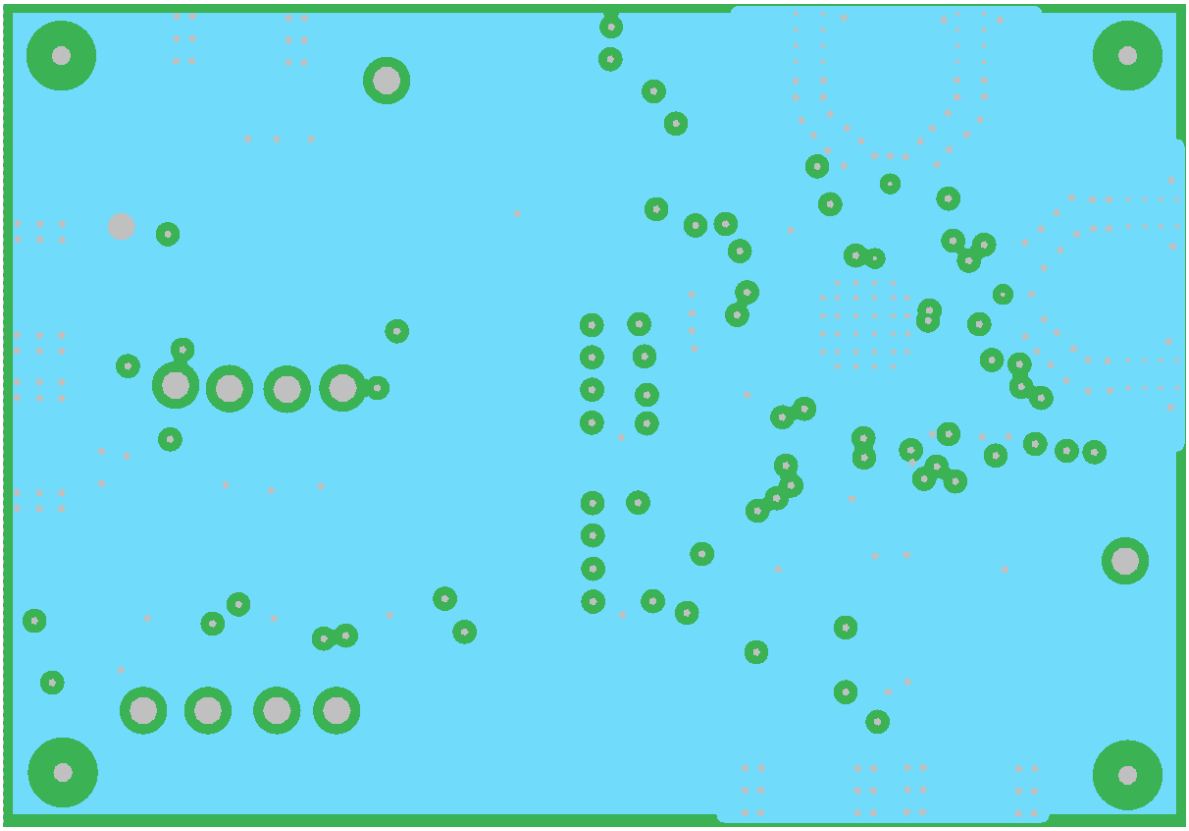


Figure 13. Ground Layer

Copyright © 2018, Texas Instruments Incorporated

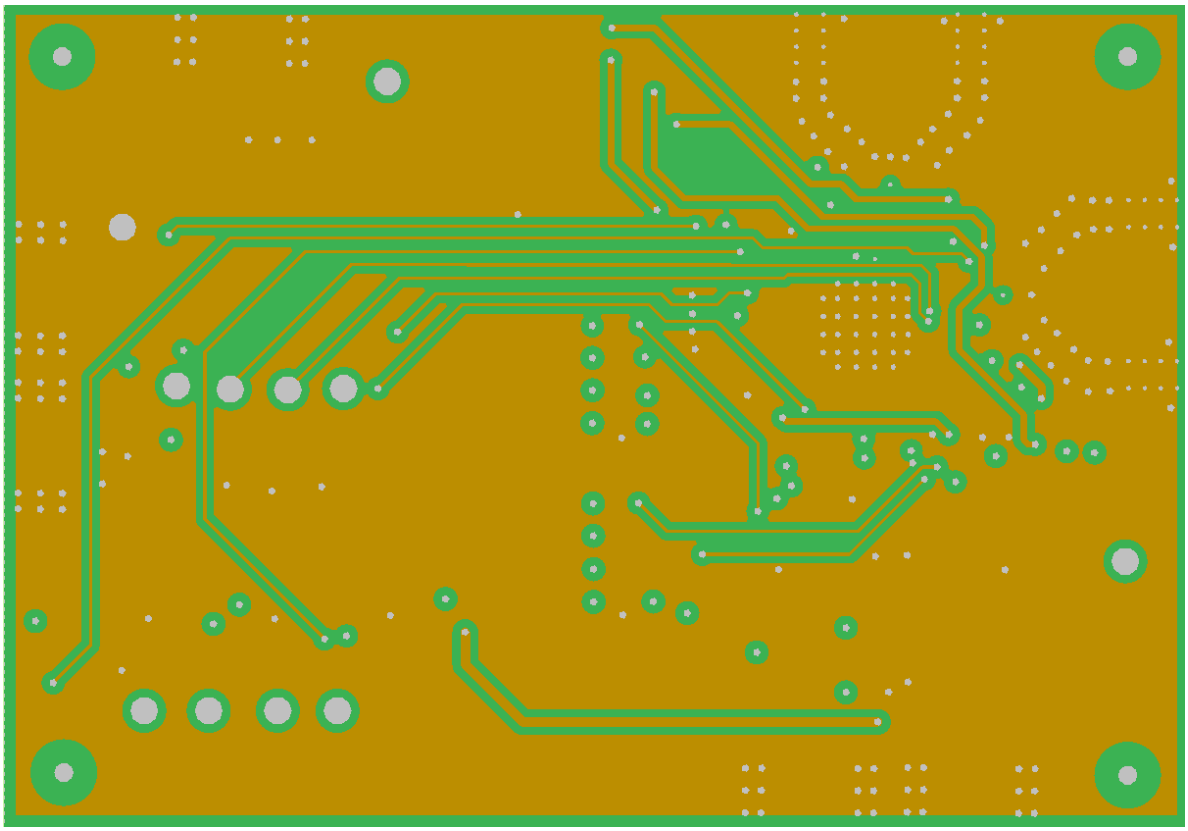


Figure 14. Power Layer

Copyright © 2018, Texas Instruments Incorporated

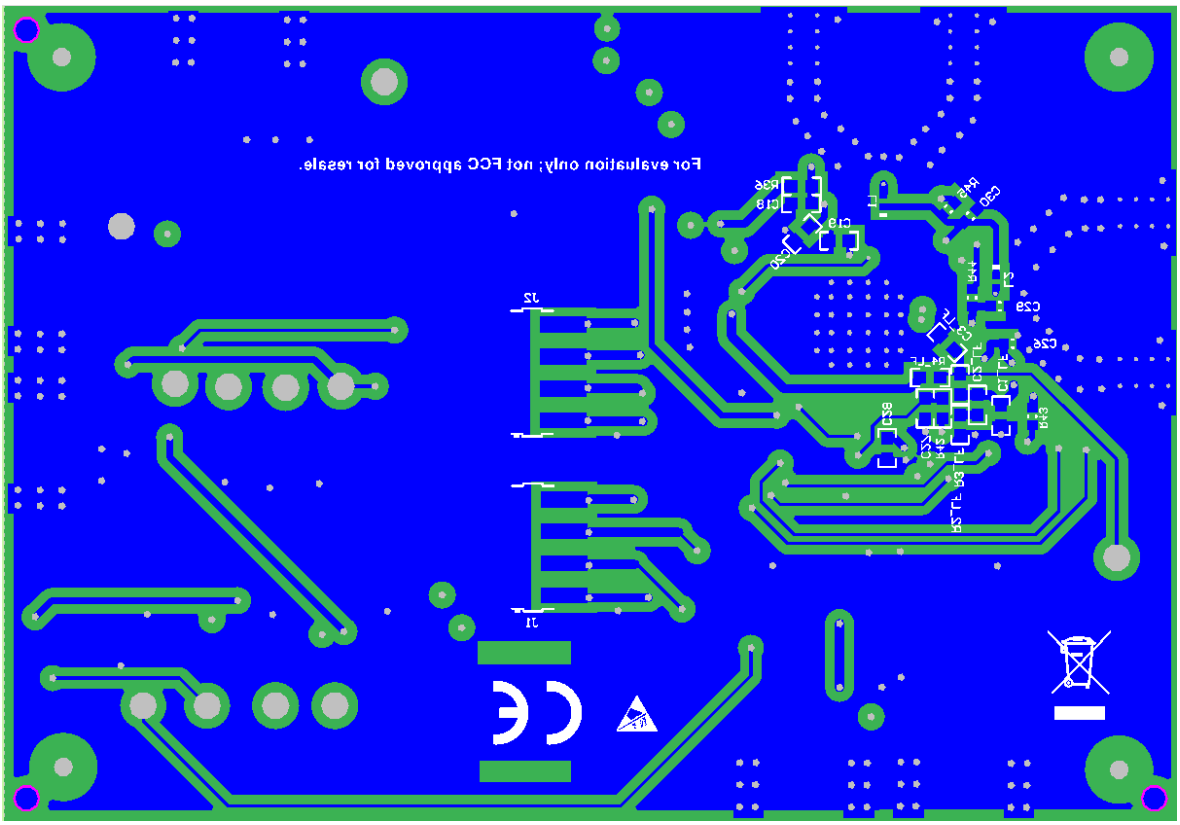


Figure 15. Bottom Layer

Copyright © 2018, Texas Instruments Incorporated

Proper Jumper and Switch Positions

Reference Pro Board

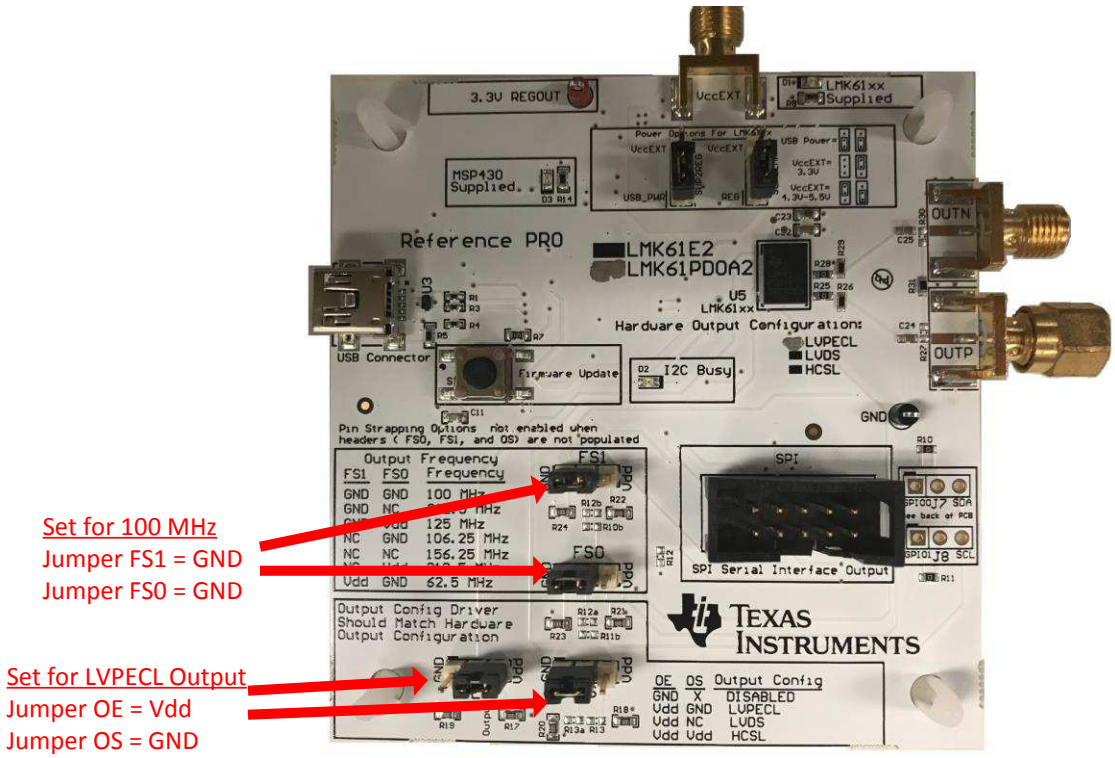


Figure 16. Reference Pro Board Jumper Positions

Copyright © 2018, Texas Instruments Incorporated

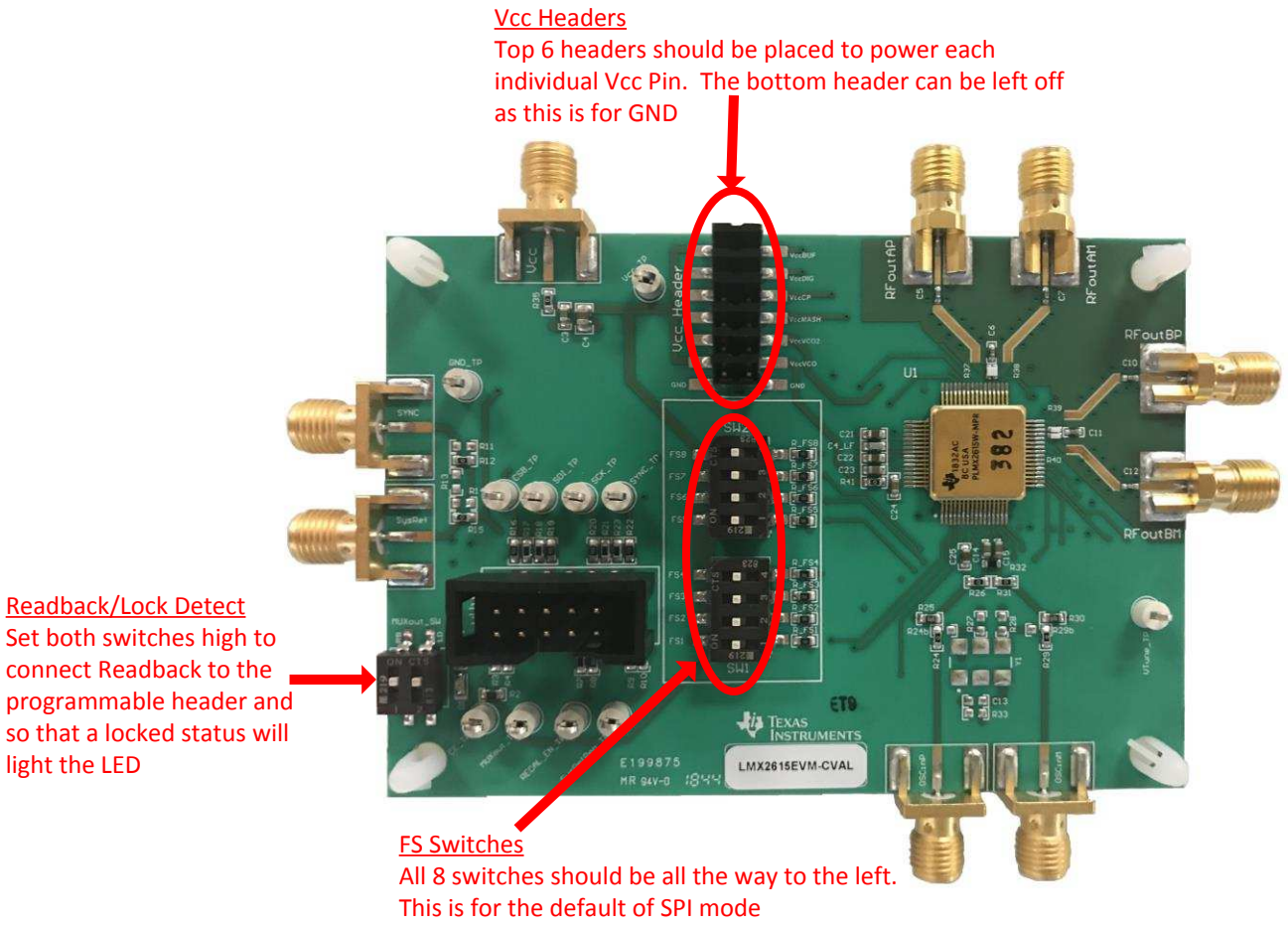


Figure 17. EVM Jumper and Switch Positions

Copyright © 2018, Texas Instruments Incorporated

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale (www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2018, Texas Instruments Incorporated