

LMX2430/33/34 Evaluation Board

User's Guide



November 2013

SNAU049A



LMX2430/33/34

Evaluation Board Instructions

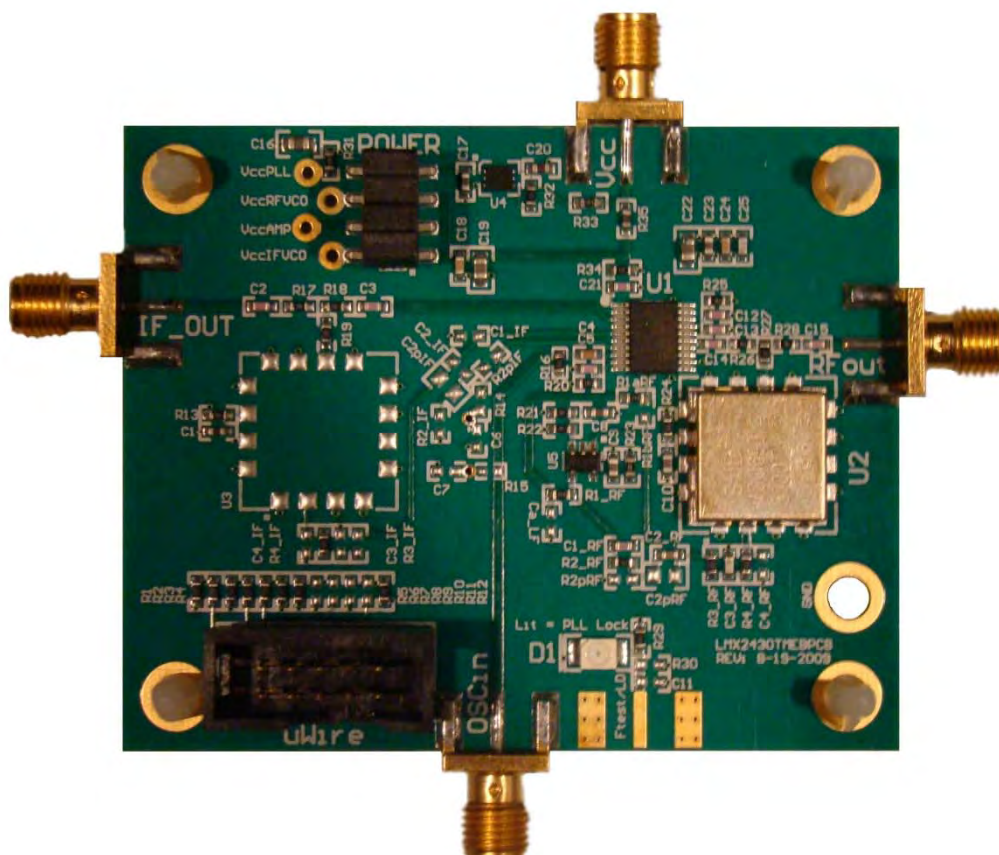


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Equipment

Power Supply

The Power Supply should be a low noise power supply. An Agilent 6623A Triple power supply with LC filters on the output to reduce noise was used in creating these evaluation board instructions.

Signal Generator

The Signal Generator should be capable of frequencies and power level required for the part. A Rohde & Schwarz SML03 was used in creating these evaluation board instructions.

Phase Noise / Spectrum Analyzer

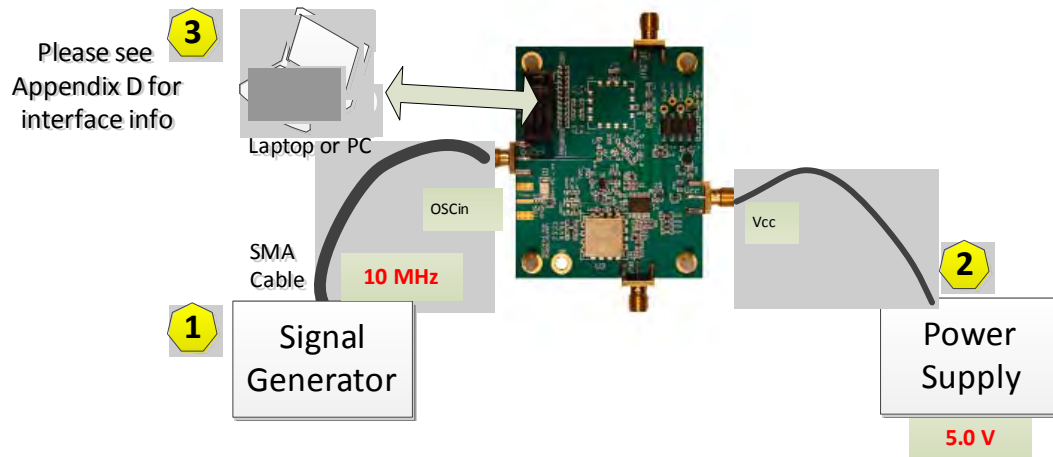
For measuring phase noise an Agilent E5052A is recommended. An Agilent E4445A PSA Spectrum Analyzer with the Phase Noise option is also usable although the architecture of the E5052A is superior for phase noise measurements. At frequencies less than 100 MHz the local oscillator noise of the PSA is too high and measurements will be of the local oscillator, not the device under test.

Oscilloscope

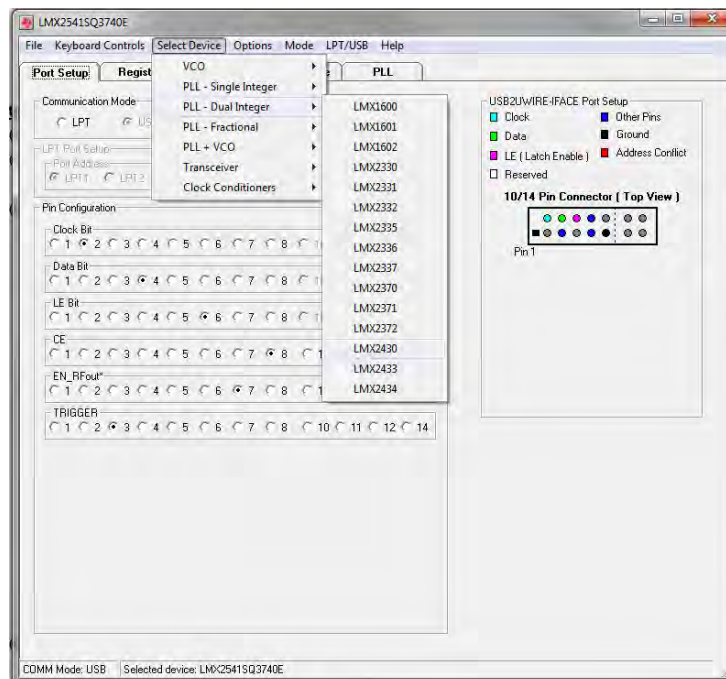
The oscilloscope and probes should be capable of measuring the output frequencies of interest when evaluating this board. The Agilent Infiniium DSO81204A was used in creating these evaluation board instructions.

Basic Operation

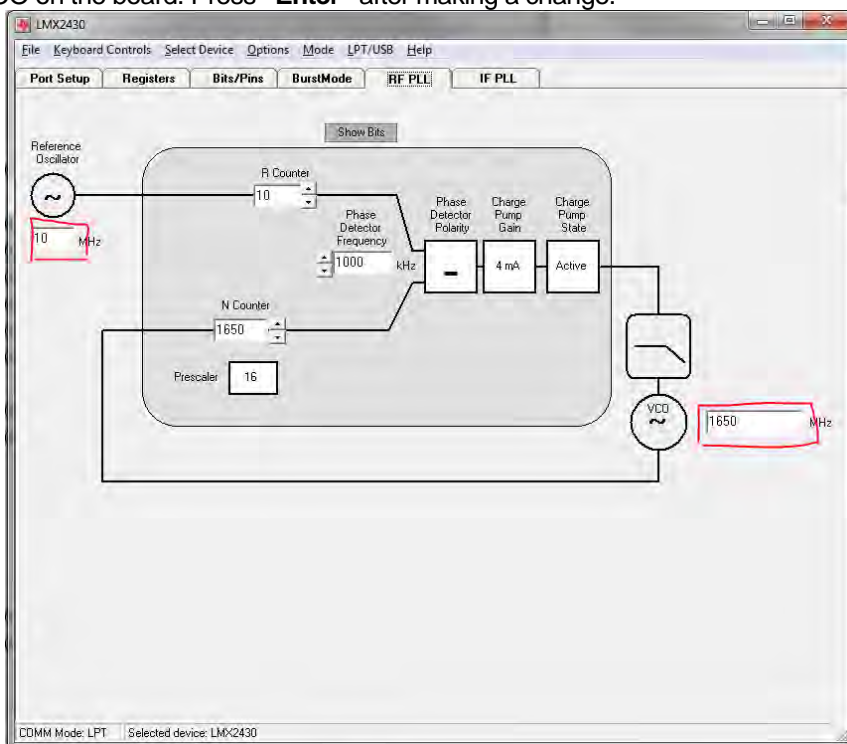
1. Connect the **signal generator output** to the **OSCin** input of the board. For this example we use a 10 MHz sin signal at +5dBm power level.
2. Connect a low noise **5.0 V** power supply to the **Vcc** connector located at the top left of the board.
3. Please see **Appendix C** for quick start on interfacing the board. Connect PC to the **uWire** header.



4. Run CodeLoader4.exe
5. Select the Device on board by “Select Device” → “PLL-Dual integer” → LMX24xx



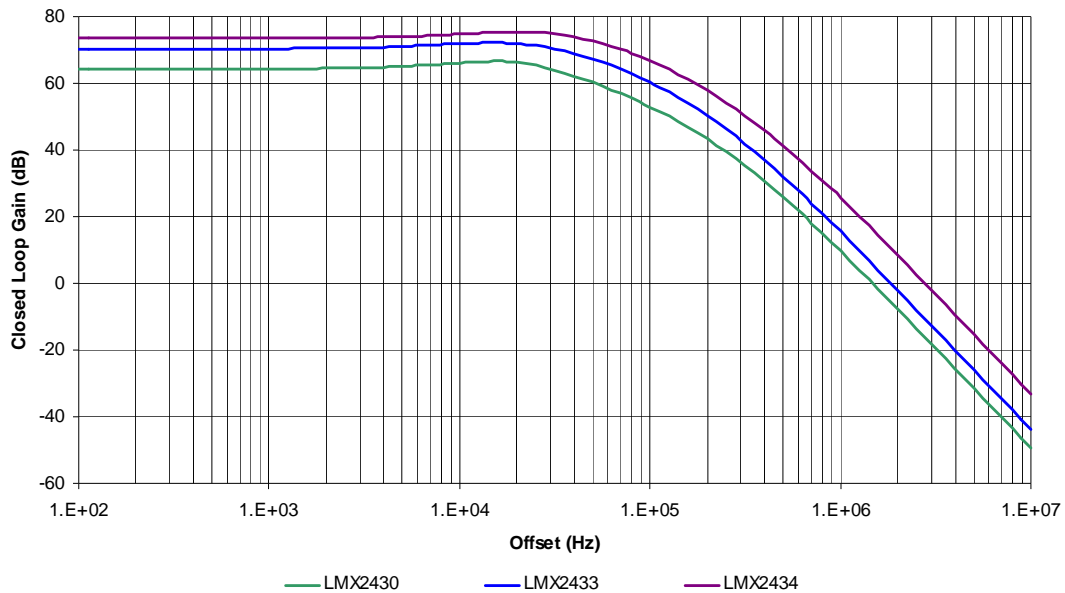
6. On the “RF PLL” Tab, make sure Reference Oscillator is 10 MHz and output frequency is set to within the range of the VCO on the board. Press “Enter” after making a change.



7. To program the settings into the device, Click “Keyboard Controls” → “Load Device”, or Press **CTRL + L**

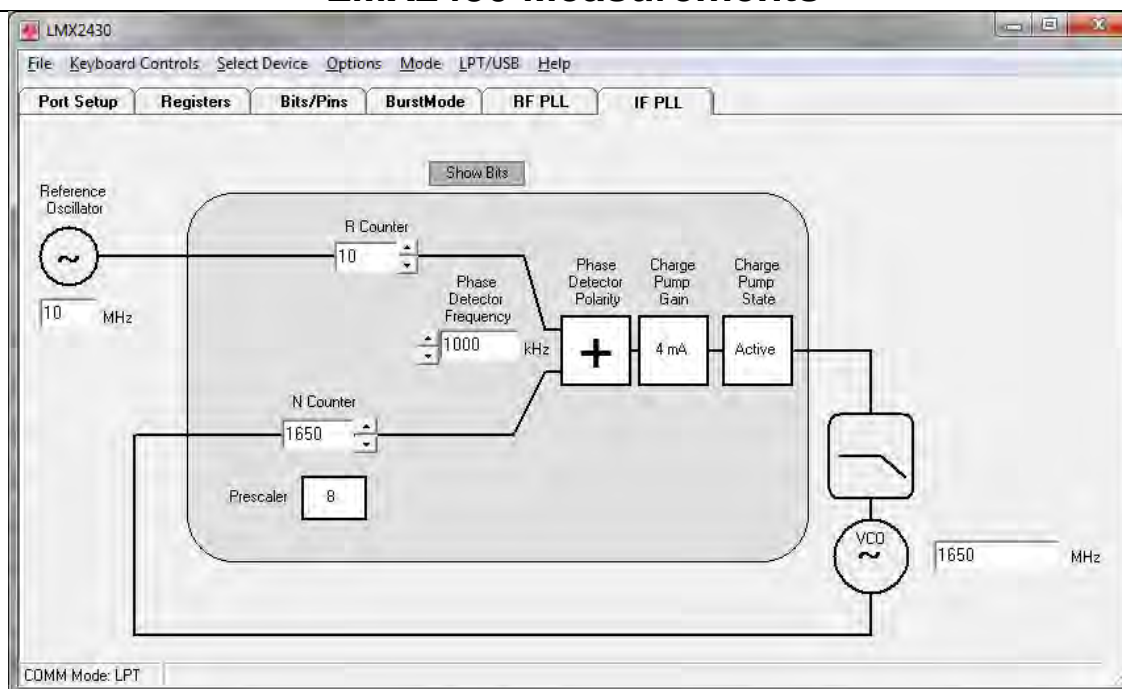
LMX243x Board Information

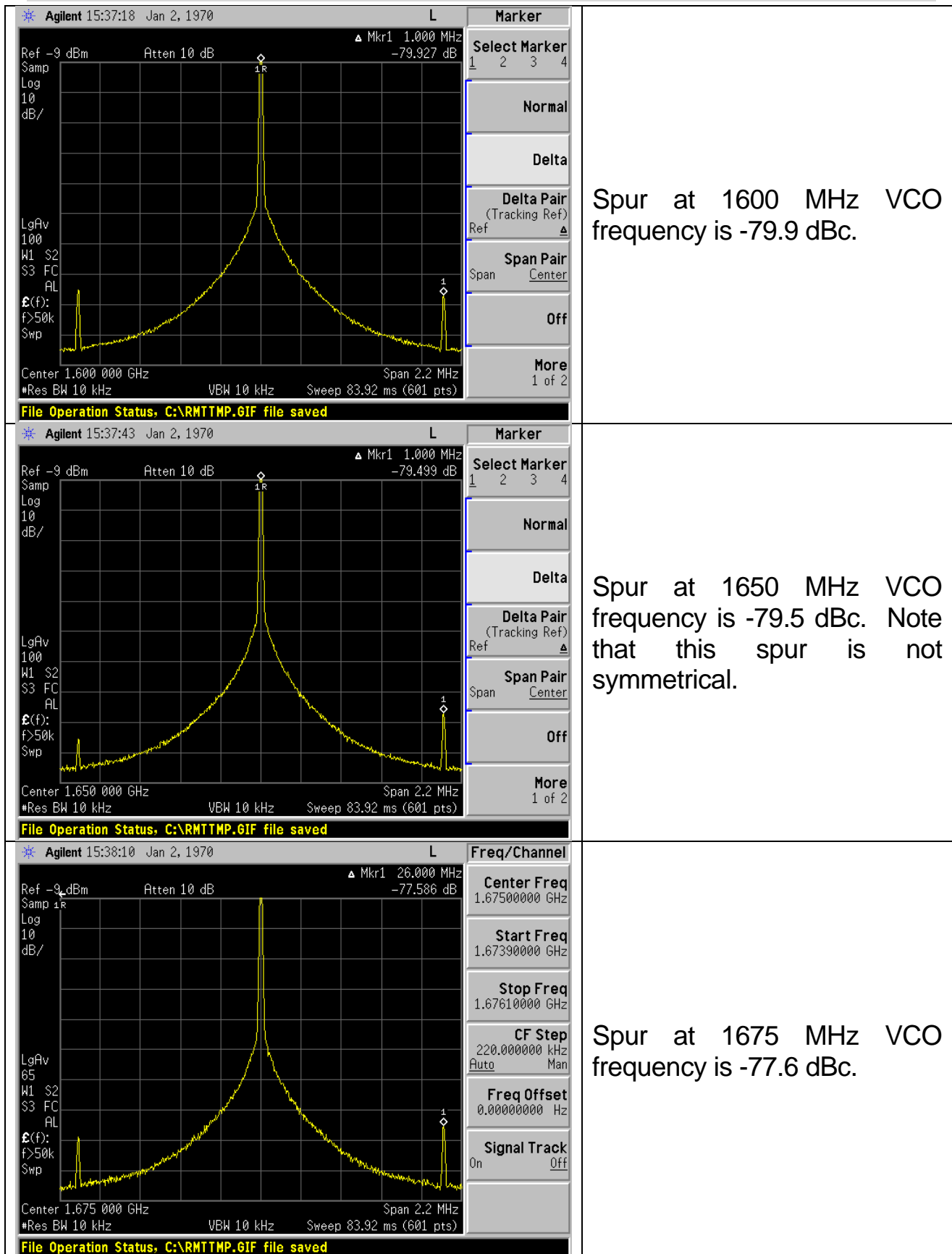
Closed Loop Transfer Function



Parameter	LMX2430	LMX2433	LMX2434
VCO Frequency (MHz)	1600 – 1675	3200 - 3400	4690 - 4890
VCO Gain (MHz/V)	32	90	94
Charge Pump Gain (mA)	4	4	4
VCO Input Capacitance	39	22	12
Phase Detector Frequency (MHz)	1	1	1
OSCin Frequency (MHz)	100	100	100
Loop Bandwidth (kHz)	27.9	31.1	41.2
Phase Margin (deg)	56.8	59.6	58.4
Gamma	0.57	0.90	0.87
T3/T1 Ratio (%)	220.8	177.1	213.9
C1_LF (nF)	0.18	0.27	0.1
C2_LF (nF)	6.8	10	3.9
C3_LF (nF)	1	1	1
C4_LF (nF)	Open	Open	Open
R2_LF (Kohm)	2.2	1.8	3.3
R3_LF (Kohm)	0.82	0.82	0.68
R4_LF (Kohm)	0	0	0

LMX2430 Measurements



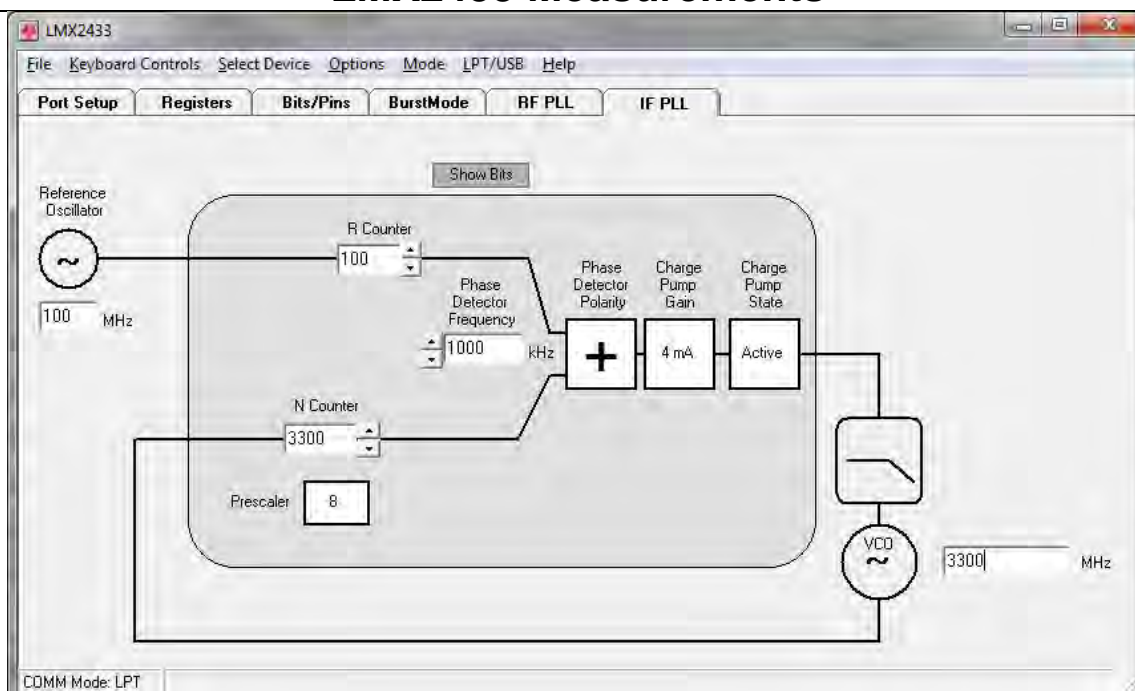


Spur at 1600 MHz VCO frequency is -79.9 dBc.

Spur at 1650 MHz VCO frequency is -79.5 dBc. Note that this spur is not symmetrical.

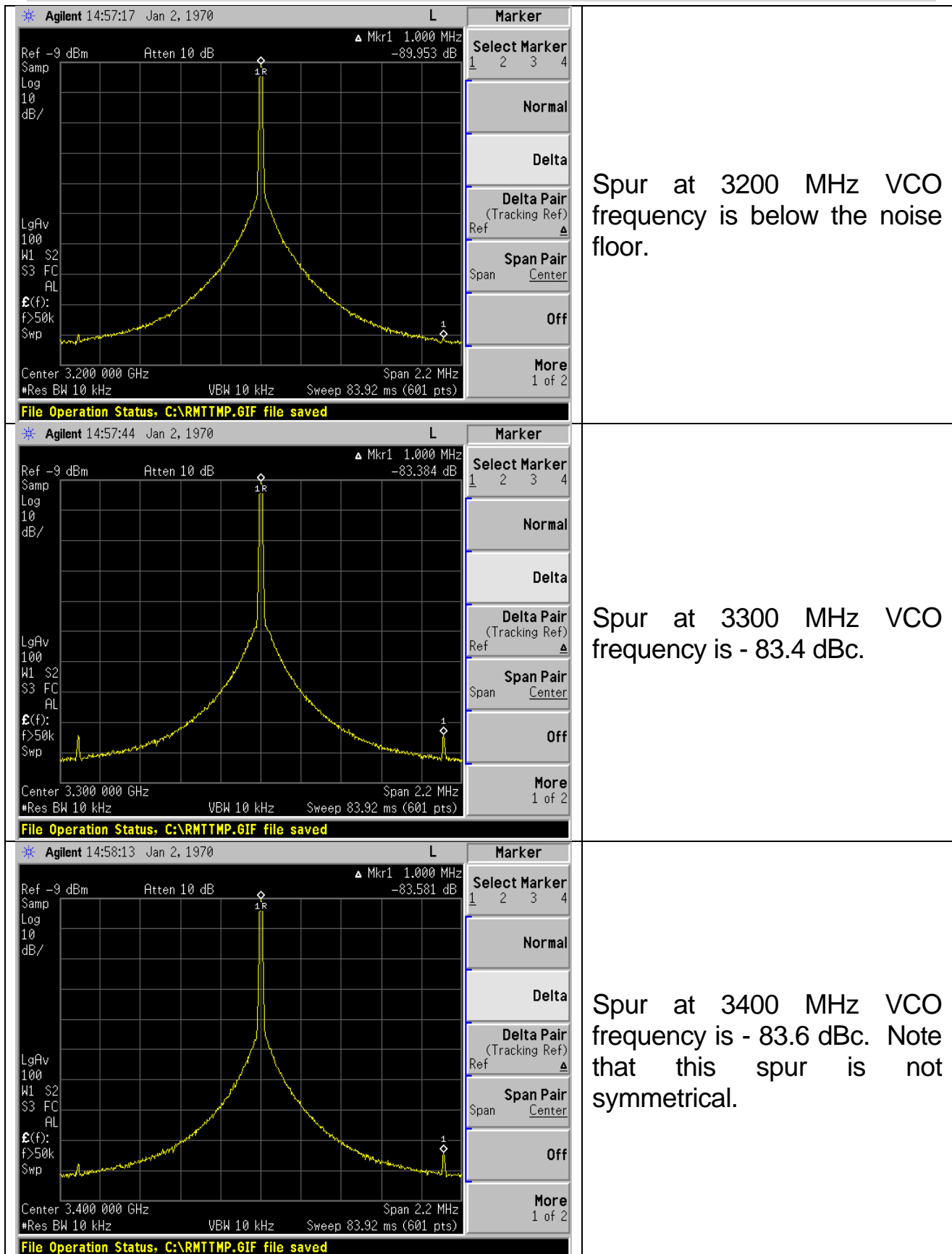
Spur at 1675 MHz VCO frequency is -77.6 dBc.

LMX2433 Measurements

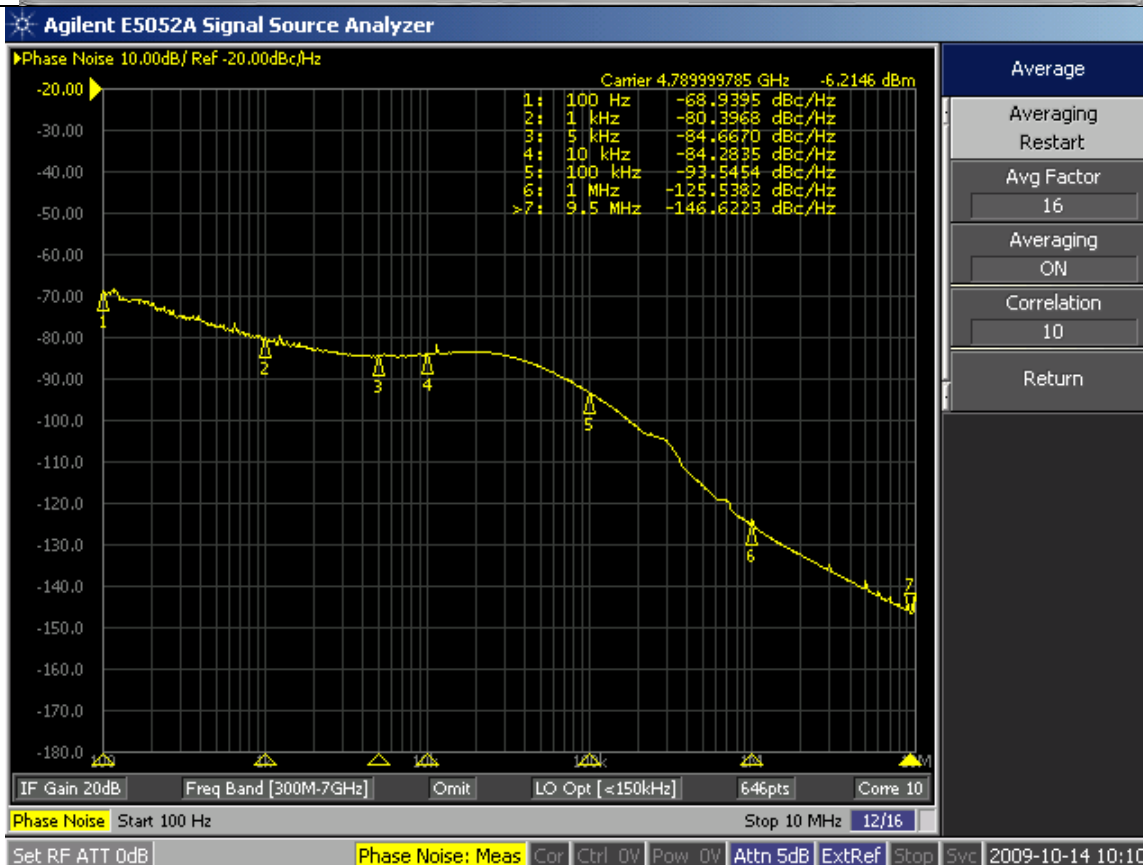
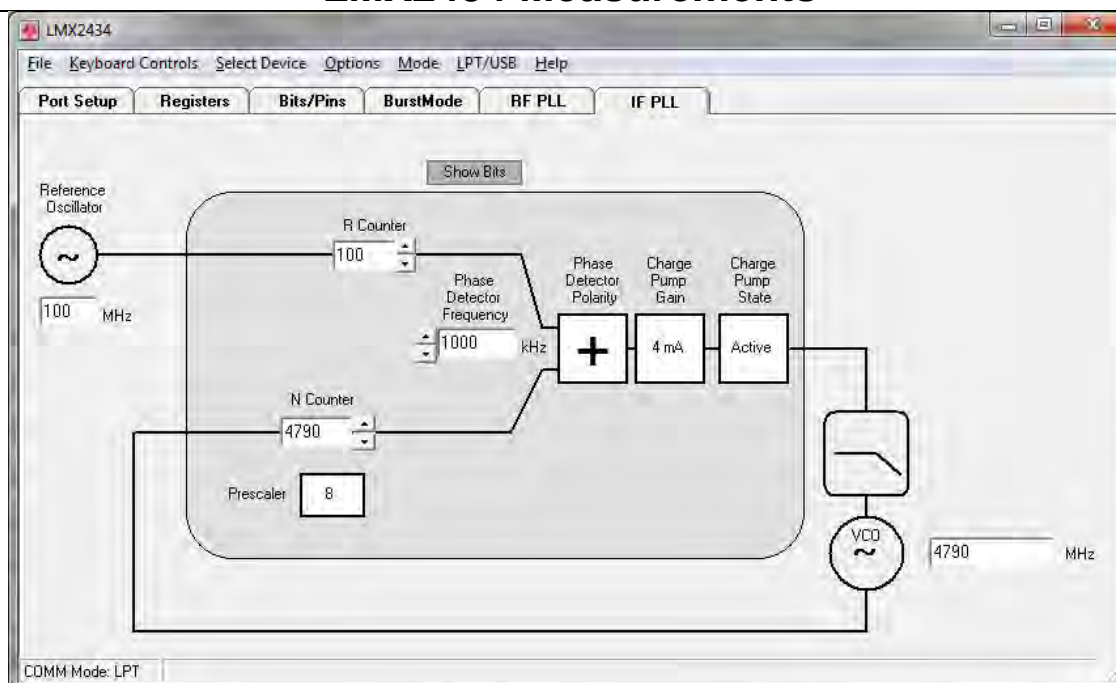


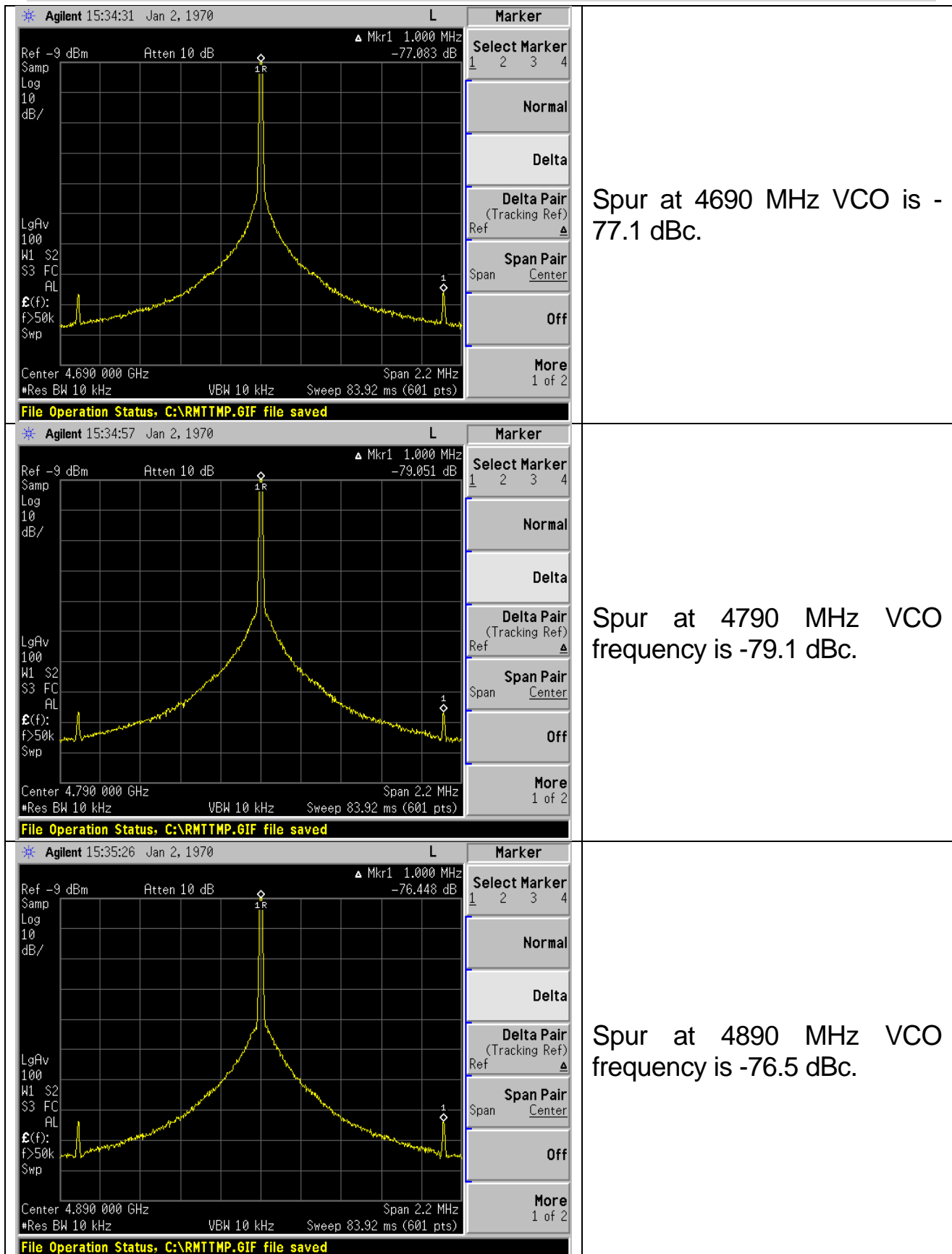
Agilent E5052A Signal Source Analyzer





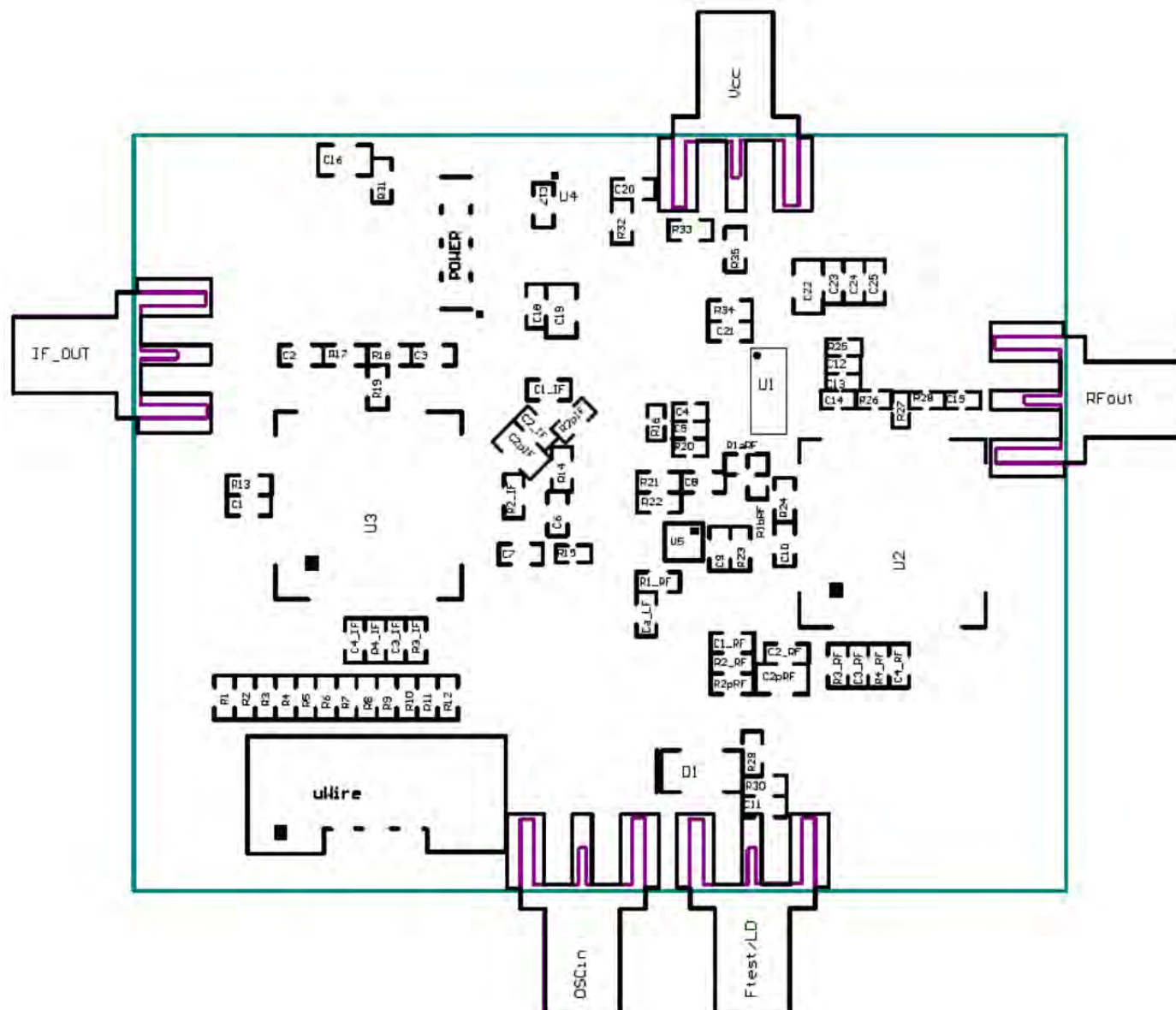
LMX2434 Measurements



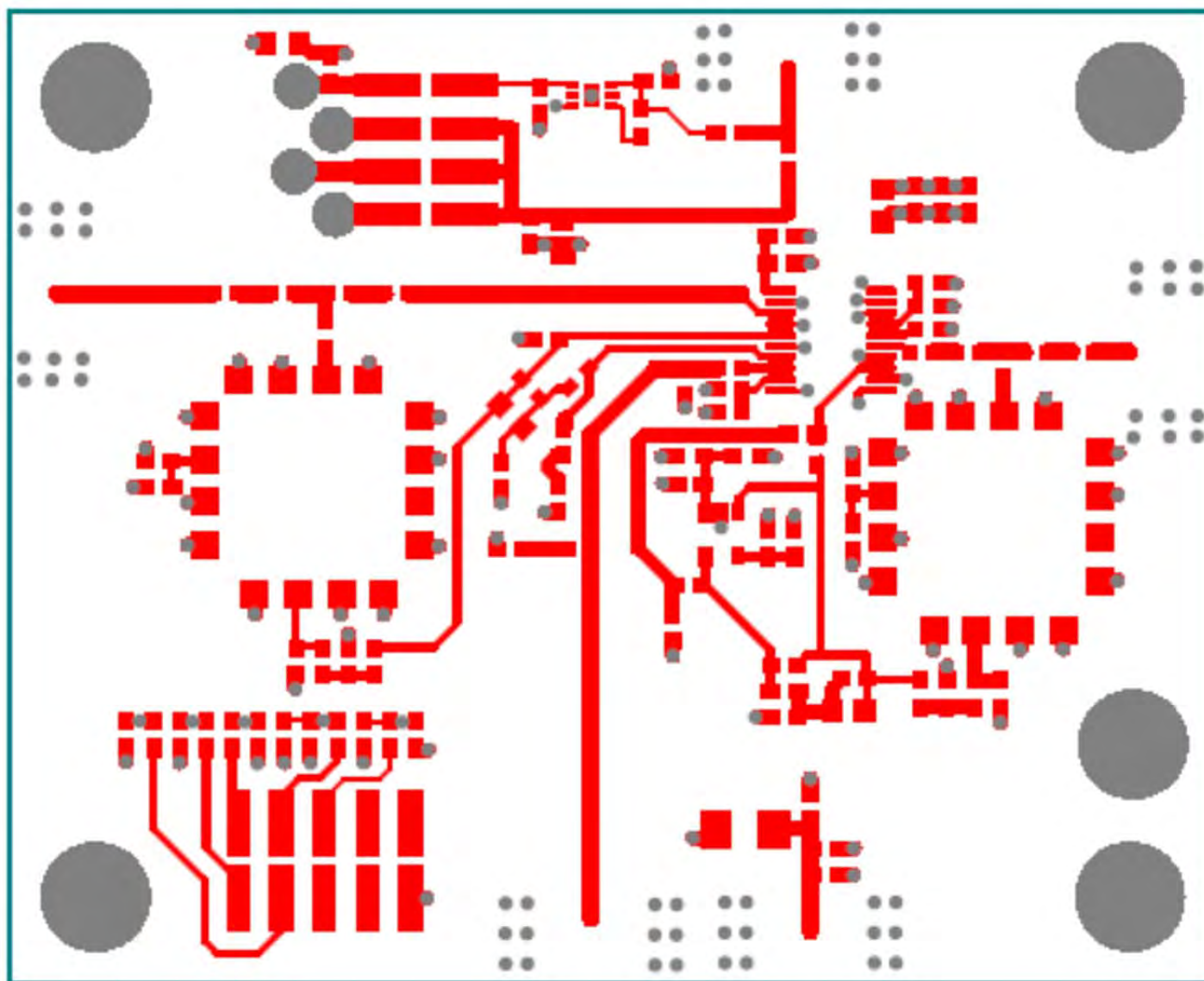




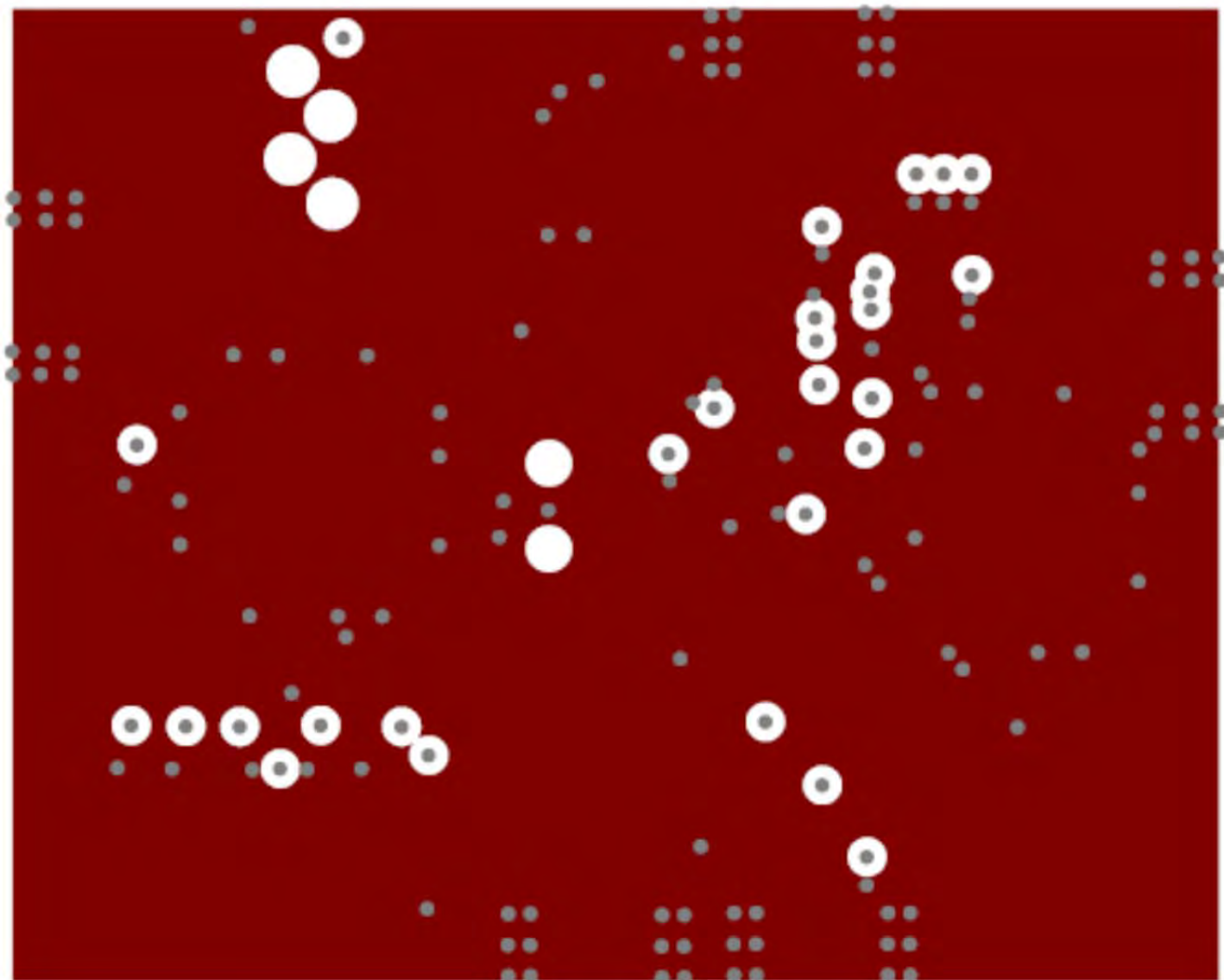
Appendix B: Build Diagram



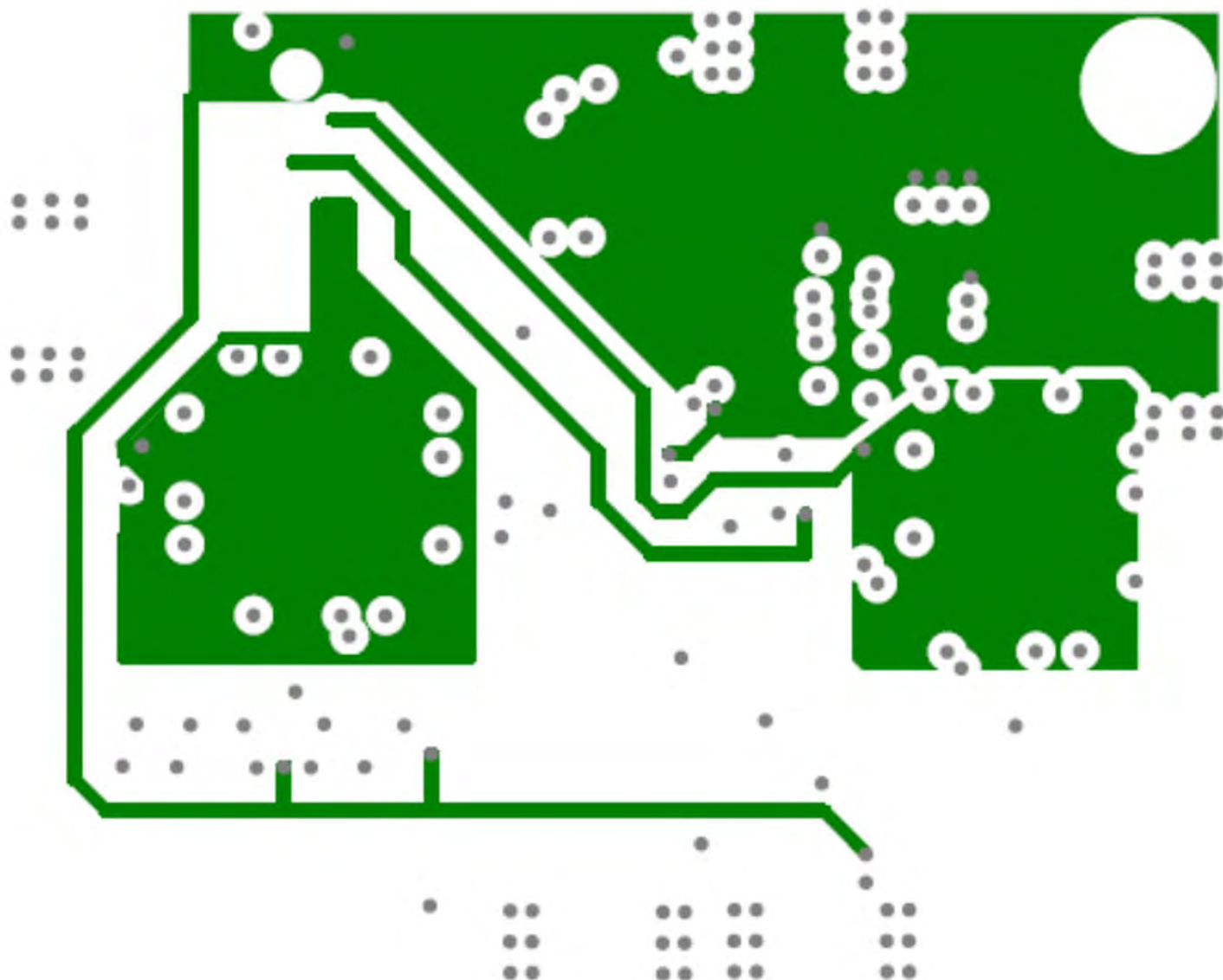
Top Layer



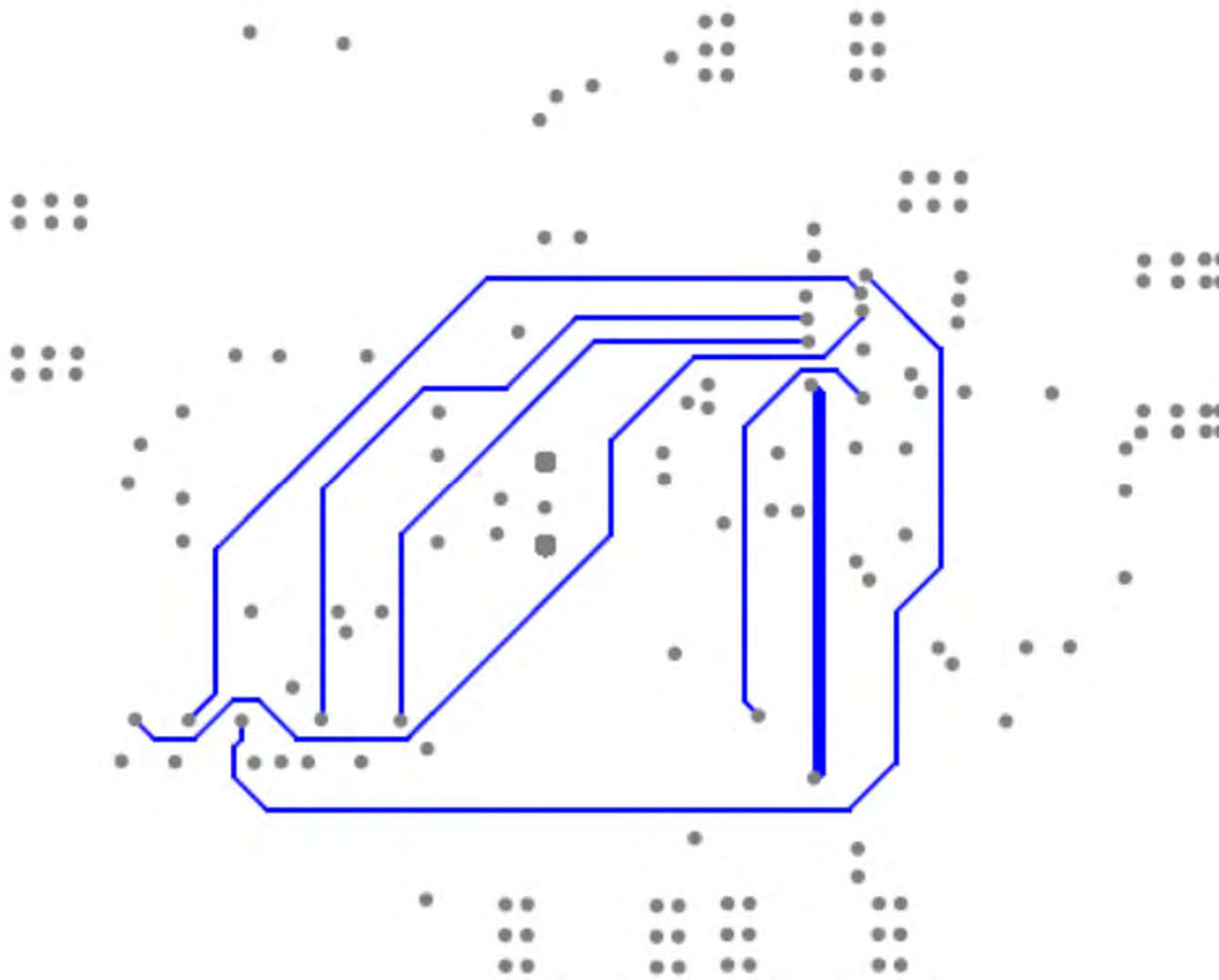
GND Layer



POWER Layer



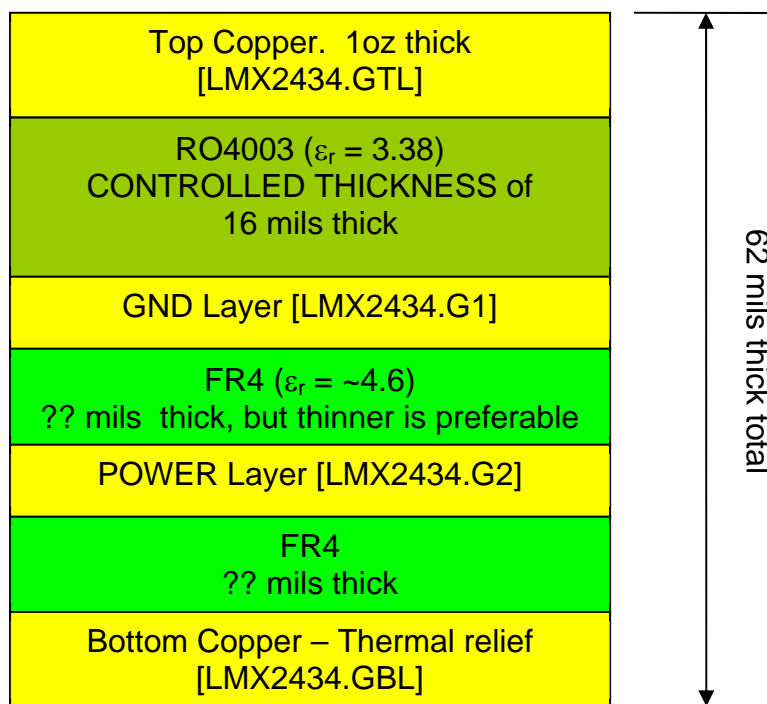
Bottom Copper



Appendix C: Fabrication and Assembly

Board Material	Rogers RO4003 (Top Layer to Ground Plane (.G1)) Remaining layers - FR4
Number of Layers	4
Board Thickness	0.062"
Copper Weight	1 oz Finished
Finish	Immersion Gold
Solder Mask Color	Green/Gloss
Testing	100% Electrical Testing

Name	K	Tand
RO4003 (16 mil)	3.38	0.0022



Appendix D: Bill of Materials

Revision	8.19.2009	LMX243X
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Part	Manufacturer	Part Number	Qty	Identifier
Capacitors				
100 pF	Kemet	C0603C101J5GAC	8	C2, C3, C5, C12, C13, C14, C15, C21
1 nF	Kemet	C0603C102J5GAC	1	C25
0.1 uF	Kemet	C0603C104K5RAC	3	C4, C18, C24
1 uF	Kemet	C0603C105K8VAC	6	C1, C8, C9, C10, C17, C20, C23
10 uF	Kemet	C0805C106K9PAC	3	C16, C19, C22
Resistors				
0 ohm	Vishay/Dale	CRCW06030000Z0EA	4	R1_RF, R1aRF, R4_IF, R4_RF
3.3 ohm	Vishay/Dale	CRCW06033R3JNEA	3	R20, R25, R34
5.6 ohm	Vishay/Dale	CRCW06035R6JNEA	2	R13, R24
10 ohm	Vishay/Dale	CRCW060310R0JNEA	3	R23, R31, R33
18 ohm	Vishay/Dale	CRCW060318R0JNEA	3	R17, R18, R19, R26, R27, R28
51 ohm	Vishay/Dale	CRCW060351R0JNEA	2	R16, R29
8.2 k	Vishay/Dale	CRCW06038K20JNEA	3	R2, R4, R5
10 k	Vishay/Dale	CRCW060310K0JNEA	6	R1, R3, R6, R7, R12, R32
100 k	Vishay/Dale	CRCW0603100KJNEA	2	R21, R22
Other				
Ferrite	Digikey	490-1015-1-ND	1	R35
HEADER_2X4	Comm Con Connectors	HTSM3203-8G2	1	POWER
HEADER_2X5 (POLARIZED)	FCI Electronics	52601-S10-8	1	uWire
Red LED	Lumex	SML-LX2832IC-TR	1	D1
SMA	Johnson Components	142-0701-851	4	IF_OUT, OSCin, RFout, Vcc
Op AMP	Texas Instruments	LM6211	1	U5
LDO	Texas Instruments	LP5900-2.5	1	U4
Standoff	SPC Technology	SPCS-6	4	Place in 4 holes in corners of board
Jumper	Sullins Electronics Corp.	S9000	4	Place on the POWER header
Open				
Open Capacitors	Open	Open	6	C4_RF, C6, C7, C11, Ca_LF, C2pRF
Open Resistors	Open	Open	9	R1bRF, R2pRF, R8, R9, R10, R11, R14, R15, R30
Open IF Loop Filter			10	C1_IF, C2_IF, C2pIF, C3_IF, C4_IF, R2_IF, R2pIF, R3_IF, R4_IF, U3
Open Other	-	Open	2	Y1, Ftest/LD

LMX2430 Build Only				
PLL	Texas Instruments	LMX2430TM	1	U1
VCO	RF Microdevices/VARIL	VCO190-1650T(Y)	1	U2
180 pF	Kemet	C0603C181J5GAC	1	C1_RF
6.8 nF	Kemet	C0603C682J5GAC	1	C2_RF
1 nF	Kemet	C0603C102J5GAC	1	C3_RF
2.2 k	Vishay/Dale	CRCW06032K20JNEA	1	R2_RF
820 ohm	Vishay/Dale	CRCW0603820RJNEA	1	R3_RF

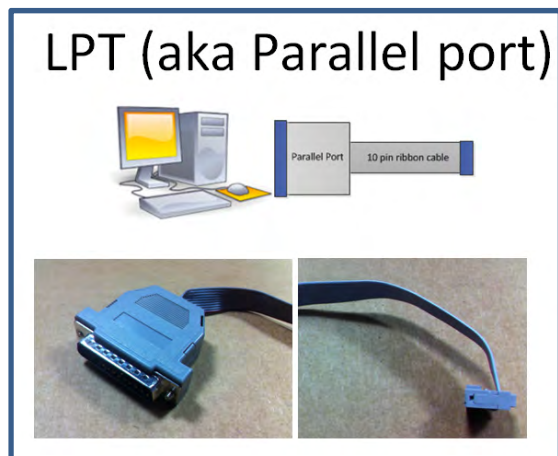
LMX2433 Build Only				
PLL	Texas Instruments	LMX2433TM	1	U1
VCO	RF Microdevices/VARIL	VCO690-3300T	1	U2
270 pF	Kemet	C0603C271J5GAC	1	C1_RF
10 nF	Kemet	C0603C103J3GAC	1	C2_RF
1 nF	Kemet	C0603C102J5GAC	1	C3_RF
1.8 k	Vishay/Dale	CRCW06031K80JNEA	1	R2_RF
820 ohm	Vishay/Dale	CRCW0603820RJNEA	1	R3_RF

LMX2434 Build Only				
PLL	Texas Instruments	LMX2434TM	1	U1
VCO	RF Microdevices/VARIL	VCO690-4790T	1	U2
100 pF	Kemet	C0603C101J5GAC	1	C1_RF
3.9 nF	Kemet	C0603C392J5GAC	1	C2_RF
1 nF	Kemet	C0603C102J5GAC	1	C3_RF
3.3 k	Vishay/Dale	CRCW06033K30JNEA	1	R2_RF
680 ohm	Vishay/Dale	CRCW0603680RJNEA	1	R3_RF

Appendix E: Quick Start for EVM Communications

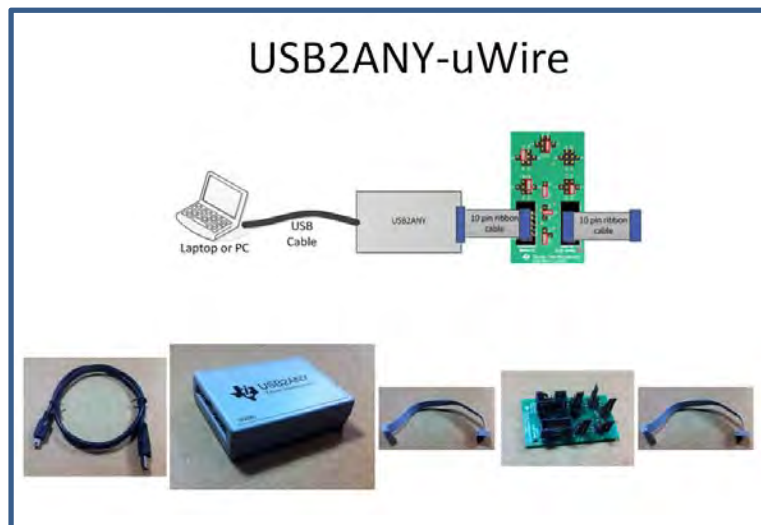
Codeloader is the software used to communicate with the EVM (Please download the latest version from TI.com - <http://www.ti.com/tool/codeloader>). This EVM can be controlled through the uWire interface on board. There are two options in communicating with the uWire interface from the computer.

OPTION 1



Open Codeloader.exe → Click “Select Device” → Click “Port Setup” tab → Click “LPT” (in Communication Mode)

OPTION 2



The Adapter Board

This table describes the pins configuration on the adapter board for each EVM board (See examples below table)

EVM	Jumper Bank								Code Loader Configuration
	A	B	C	D	E	F	G	H	
LMX2581	A4	B1	C2		E5	F1	G1	H1	BUFEN (pin 1), Trigger (pin 7)
LMX2541	A4		C3		E4	F1	G1	H1	CE (pin 1), Trigger (pin 10)
LMK0400x	A0		C3		E5	F1	G1	H1	GOE (pin 7)
LMK01000	A0		C1		E5	F1	G1	H1	GOE (pin 7)
LMK030xx	A0		C1		E5	F1	G1	H1	SYNC (pin 7)
LMK02000	A0		C1		E5	F1	G1	H1	SYNC (pin 7)
LMK0480x	A0	B2	C3		E5	F0	G0	H1	Status_CLKin1 (pin 3)
LMK04816/4906	A0	B2	C3		E5	F0	G0	H1	Status_CLKin1 (pin 3)
LMK01801	A0	B4	C5		E2	F0	G0	H1	Test (pin 3), SYNC0 (pin 10)
LMK0482x (prelease)	A0	B5	C3	D2	E4	F0	G0	H1	CLKin1_SEL (pin 6), Reset (pin 10)
LMX2531	A0				E5	F2	G1	H2	Trigger (pin 1)
LMX2485/7	A0		C1		E5	F2	G1	H0	ENOSC (pin 7), CE (pin 10)
LMK03200	A0				E5	F0	G0	H1	SYNC (pin 7)
LMK03806	A0		C1		E5	F0	G0	H1	
LMK04100	A0		C1		E5	F1	G1	H1	

Example adapter configuration (LMK01801)

Open Codeloader.exe → Click “Select Device” → Click “Port Setup” Tab → Click “USB” (in Communication Mode)

**Remember to also make modifications in “Pin Configuration” Section according to Table above.*

STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.

- 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms and conditions that accompany such Software
- 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

- 2 *Limited Warranty and Related Remedies/Disclaimers:*

- 2.1 These terms and conditions do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
- 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.
- 2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

- 3 *Regulatory Notices:*

- 3.1 *United States*

- 3.1.1 *Notice applicable to EVMs not FCC-Approved:*

This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

- 3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/llds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/llds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。日本テキサス・インスツルメンツ株式会社
東京都新宿区西新宿 6 丁目 2 4 番 1 号
西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page
電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

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