LMX2592EVM High Performance, Wideband PLLatinum™ RF Synthesizer Evaluation Board Operating Instructions

User's Guide

Literature Number: SNAU195
December 2015

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Evaluation Board Setup

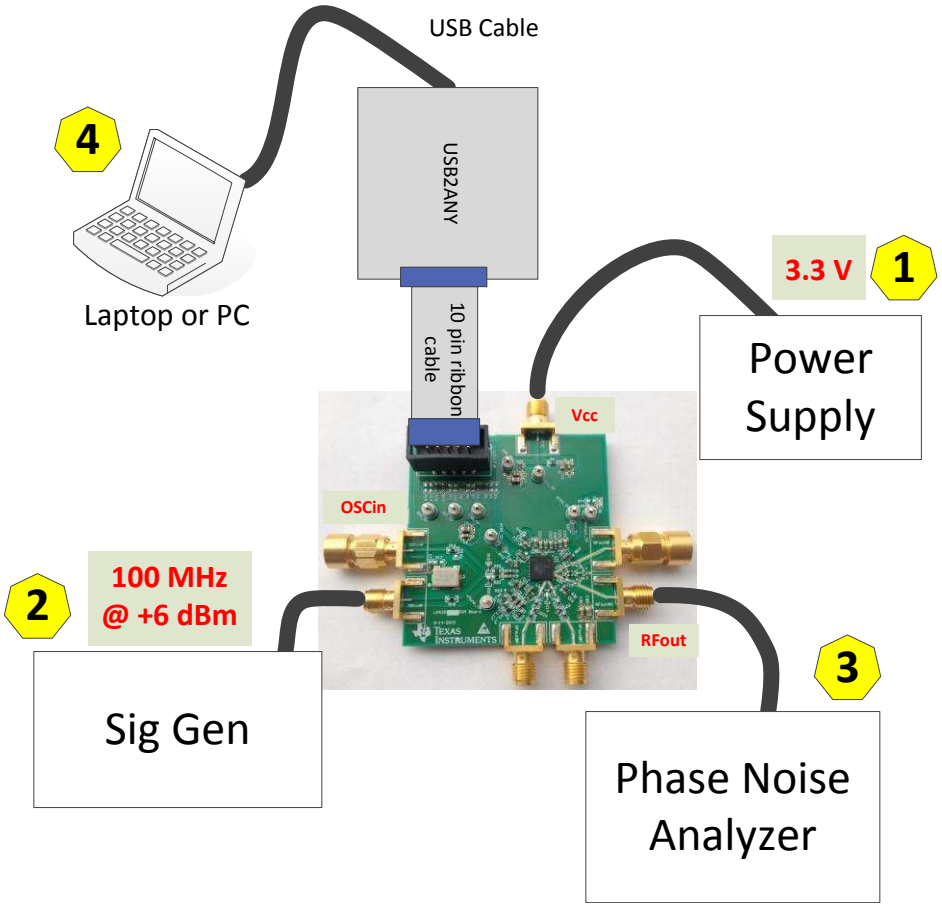


Figure 1-1. Setup Diagram

1. Power:
   (a) Set power supply to 3.3 V with 500-mA current limit.
   (b) Connect V_{CC} with SMA cable or clip to test point Vcc_TP.
2. Input Signal
   (a) Option 1 (default): The on-board Oscillator is powered on and outputs 100-MHz signal to OSCinP (pin 8) of the device input.
   (b) Option 2: Must Switch R14p to R14, which routes the input signal from the OSCinP SMA connector instead of on-board Oscillator. Set a low phase noise signal generator (see note 1) to 100 MHz with 6-dBm power level. Connect to OSCinP or OSCinM if you have a single ended signal. Connect to both if you have a differential signal.
   (c) **IMPORTANT NOTE**: Phase noise of input signal should be below –150 dBc/Hz at 10-kHz offset for 100-MHz signal, otherwise the input reference noise will dominate the in-band phase noise at RF output. The On-board Oscillator is only at –134 dBc/Hz.
3. Output

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(a) Connect RFoutAM or RFoutAP to a phase noise analyzer. Connect a 50-Ω termination on the unused output if you are using only single-end. Use a balan if you are using differential-ended.

4. Programming Interface

(a) Connect your laptop to the EVM as shown with included USB2ANY module.

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EVM Software Startup Instructions

1. Download TICS software from TI.com: http://www.ti.com/tool/TICSPRO-SW
2. To start the EVM software, open TICS.exe from Installed directory.

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EVM Software Navigation

1. The software should be opened as shown in Figure 3-1:

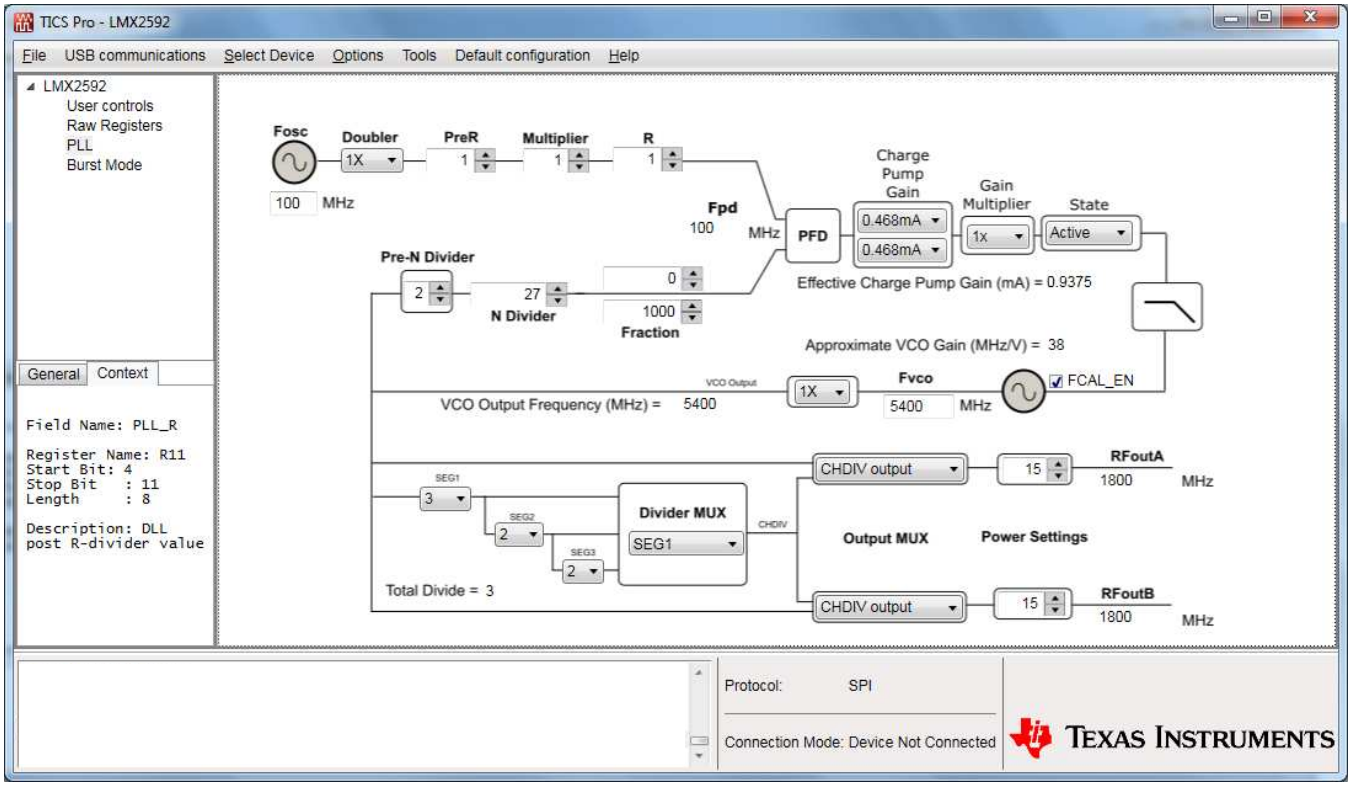


Figure 3-1. Software Screenshot

2. Top Menu
   - File: Allows you to load or save a setting, export or import the registers in HEX values.
   - USB Communications: Check your connection with the USB2ANY module (if there is new software follow the on-screen instructions to upgrade). Load the device (the keyboard shortcut is CTRL+L), which programs all the registers into the device.
   - Default configuration: Load a pre-set setting file given to start from a known state.
   - To select the LMX2592: Click *Select Device* on top menu. Then click *PLL + VCO* and select *LMX2592*.
3. Left Panel
   - User Controls: Here you can configure registers, organized by function. Hover your mouse over the register and its information will appear in the *Context* tab on the left panel.
   - Raw Registers: See the entire register map. Enter a HEX value in the *Data* cell then click *Write Register* to program that value. To read registers, you must have MUXout pin (pin 20) connected to the USB2ANY (by default it is connected to the LED, switch R40 to R39 for readback). Also set MUXOUT_SEL=0 for readback. You can also read a register by the name of the register in *Register/Field Name* section.
4. PLL

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- Fosc: Enter the input signal frequency between 5 to 1400 MHz.
- Doubler: Can double input signal frequency (input must be 50% duty cycle to use this).
- Pre-R divider: Divides frequencies up to 1400 MHz.
- Multiplier: Multiplies frequencies between 40 to 70 MHz and outputs between 180 to 250 MHz.
- R divider: Used for dividing frequencies below 5 MHz for very low PFD
- Charge Pump Gain: This tab will auto-update UP and DN to be equal. Go to bits/pins section if you want to force different values.
- Gain multiplier: Multiplies Charge Pump Gain by a factor
- State: Changes the charge pump output state
- FCAL_EN: Every time you change the output frequency, toggle this off and on to calibrate the device to the frequency.
- Fvco: Sets the VCO frequency between 3550 to 7100 MHz
- 1X or 2X: Enables the VCO doubler from 3550 to 4900 MHz for frequencies up to 9800 MHz
- Divider MUX: This determines which of the 3 segments are included for a total division between 2 to 192.
- Output MUX: Selects the signal from the VCO output or the Divider
- Power Settings: Changes the output power (increase 0 to 31, then additional boost with 49 to 63)

5. Burst Mode
   - Enter a register in *Load Register"*or delay in seconds.
   - You can run and stop the commands in a single burst or continuous loop.

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Schematic

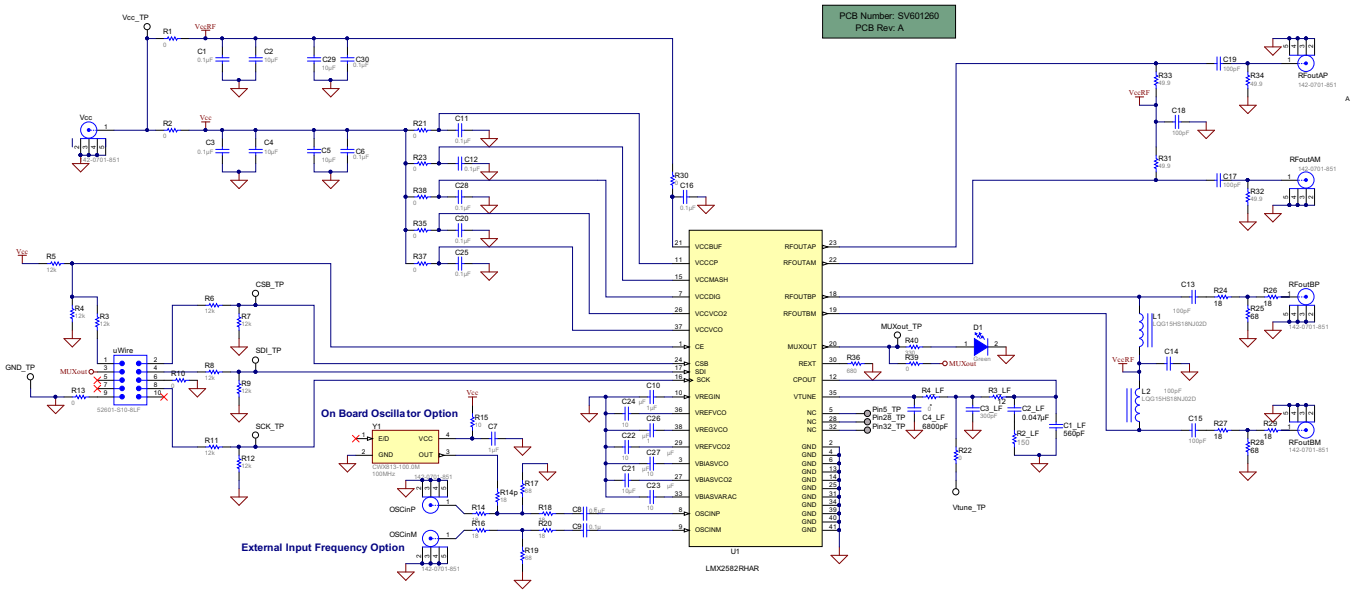


Figure 4-1. Schematic

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BOM

DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
!PCB	Printed Circuit Board	Any	SV601260	1
C1, C3, C6, C8, C9, C11, C12, C16, C20, C25, C28, C30	CAP, CERM, 0.1 µF, 16 V, ±5%, X7R, 0603	AVX	0603YC104JAT2A	12
C1_LF	CAP, CERM, 560 pF, 50 V, ±10%, X7R, 0603	Kemet	C0603C561K5RACTU	1
C2, C4, C5, C29	CAP, CERM, 10 µF, 10 V, ±10%, X5R, 0805	Kemet	C0805C106K8PACTU	4
C2_LF	CAP, CERM, 0.047 µF, 50 V, ±10%, X7R, 0603	MuRata	GRM188R71H473KA61D	1
C4_LF	CAP, CERM, 6800 pF, 50 V, ±10%, X7R, 0603	MuRata	GRM188R71H682KA01D	1
C7, C10	CAP, CERM, 1 µF, 16 V, ±10%, X7R, 0603	TDK	C1608X7R1C105K	2
C13, C14, C15, C17, C18, C19	CAP, CERM, 100 pF, 50 V, ±5%, C0G/NP0, 0402	MuRata	GRM1535C1H101JDD5D	6
C21, C22, C23, C24, C27	CAP, CERM, 10 µF, 10 V, ±10%, C0G/NP0, 0603	TDK	C1608X5R1A106M	5
C26	CAP, CERM, 1 µF, 6.3 V, ±10%, X5R, 0603	TDK	C1608X5R0J105K	1
CSB_TP, GND_TP, MUXout_TP, SCK_TP, SDI_TP, Vcc_TP, Vtune_TP	Test Point, Compact, White, TH	Keystone	5007	7
D1	LED, Green, SMD	Lite-On	LTST-C190GKT	1
L1, L2	Inductor, Multilayer, Air Core, 18 nH, 0.3 A, 0.36 Ω, SMD	MuRata	LQG15HS18NJ02D	2
OSCinM, OSCinP, RFoutAM, RFoutAP, RFoutBM, RFoutBP, V_{CC}	Connector, SMT, End launch SMA 50 ohm	Emerson Network Power Connectivity	142-0701-851	7
R1, R2, R4_LF, R10, R13, R21, R22, R23, R30, R35, R37, R38	RES, 0 Ω, 5%, 0.1W, 0603	Vishay-Dale	CRCW06030000Z0EA	12
R2_LF	RES, 150, 5%, 0.1 W, 0603	Vishay-Dale	CRCW0603150RJNEA	1
R3_LF	RES, 12, 5%, 0.1 W, 0603	Vishay-Dale	CRCW060312R0JNEA	1
R5, R6, R8, R11	RES, 12k Ω, 5%, 0.1 W, 0603	Vishay-Dale	CRCW060312K0JNEA	4
R14p, R16, R18, R20	RES, 18 Ω, 5%, 0.1 W, 0603	Vishay-Dale	CRCW060318R0JNEA	4
R15	RES, 10 Ω, 5%, 0.1 W, 0603	Vishay-Dale	CRCW060310R0JNEA	1
R17, R19	RES, 68 Ω, 5%, 0.1 W, 0603	Vishay-Dale	CRCW060368R0JNEA	2
R24, R26, R27, R29	RES, 18, 5%, 0.063 W, 0402	Vishay-Dale	CRCW040218R0JNED	4
R25, R28	RES, 68, 5%, 0.063 W, 0402	Vishay-Dale	CRCW040268R0JNED	2
R31, R33	RES, 49.9, 1%, 0.063 W, 0402	Vishay-Dale	CRCW040249R9FKED	2
R36	RES, 680, 1%, 0.1 W, 0603	Yageo America	RC0603FR-07680RL	1
R40	RES, 330 Ω, 5%, 0.1 W, 0603	Yageo America	RC0603JR-07330RL	1

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DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
U1	High Performance, Wideband PLLatinum RF Synthesizer, RHA0040C	Texas Instruments	LMX2592RHAR	1
uWire	Header (shrouded), 100mil, 5x2, Gold plated, SMD	FCI	52601-S10-8LF	1
Y1	OSC 100.0000 MHZ 3.3 V ±25 PPM SMD	Connor-Winfield	CWX813-100.0M	1

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Layout

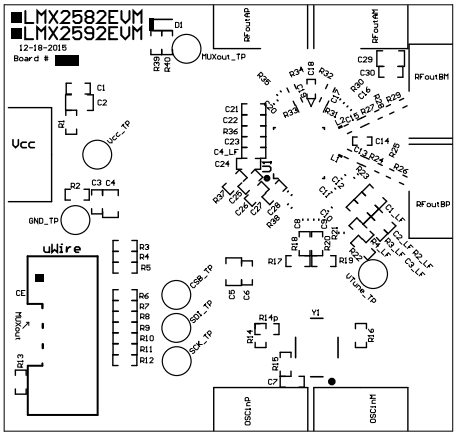


Figure 6-1. Top Overlay

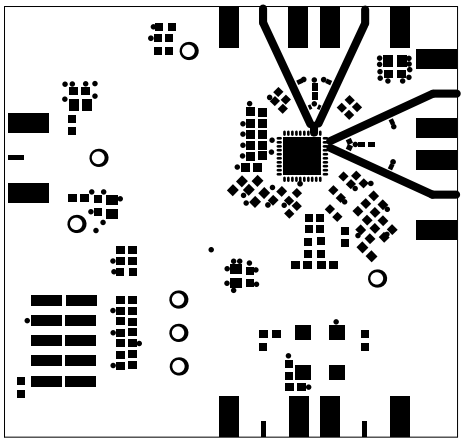


Figure 6-2. Top Solder

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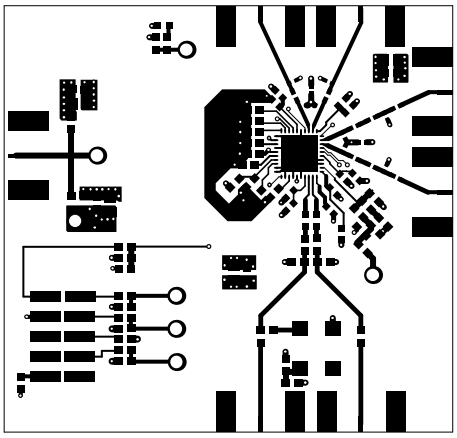


Figure 6-3. Top Layer

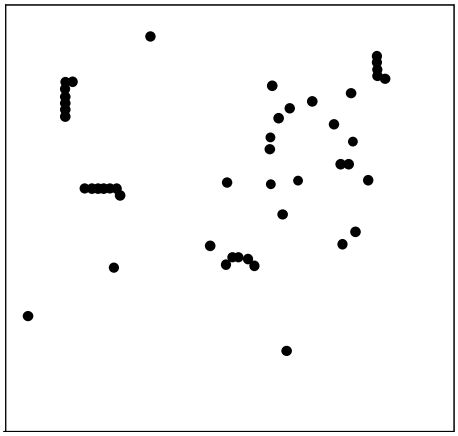


Figure 6-4. Ground Layer

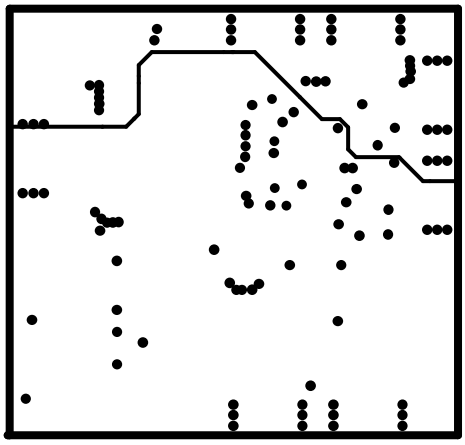


Figure 6-5. Power Layer

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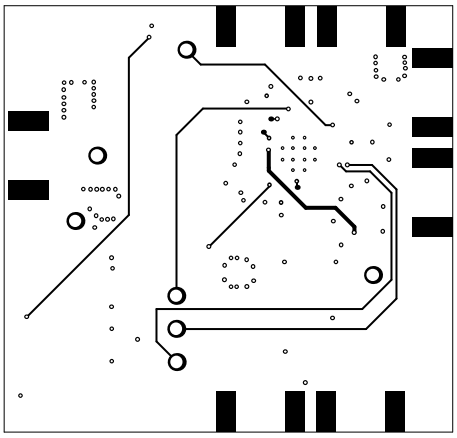


Figure 6-6. Bottom Layer

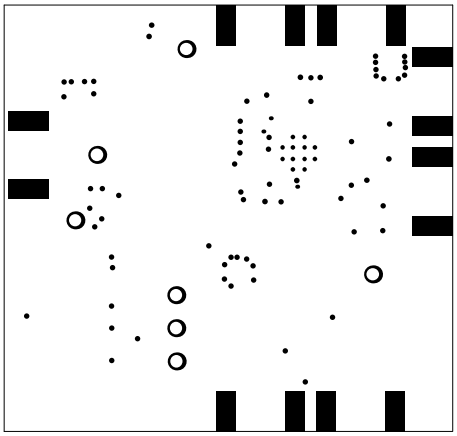


Figure 6-7. Bottom Solder

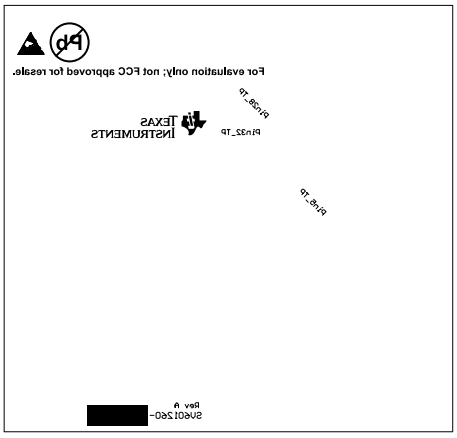
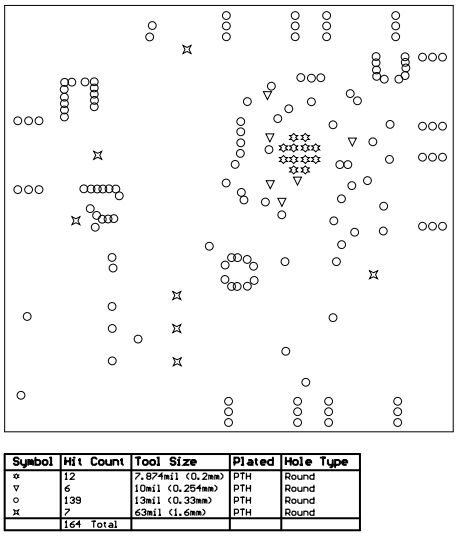


Figure 6-8. Bottom Overlay

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Symbol	Hit Count	Tool Size	Plated	Hole Type
¤	12	7.874mil (0.2mm)	PTH	Round
▽	6	10mil (0.254mm)	PTH	Round
○	139	13mil (0.33mm)	PTH	Round
⌑	7	63mil (1.6mm)	PTH	Round
	164 Total			

Figure 6-9. Drill Drawing

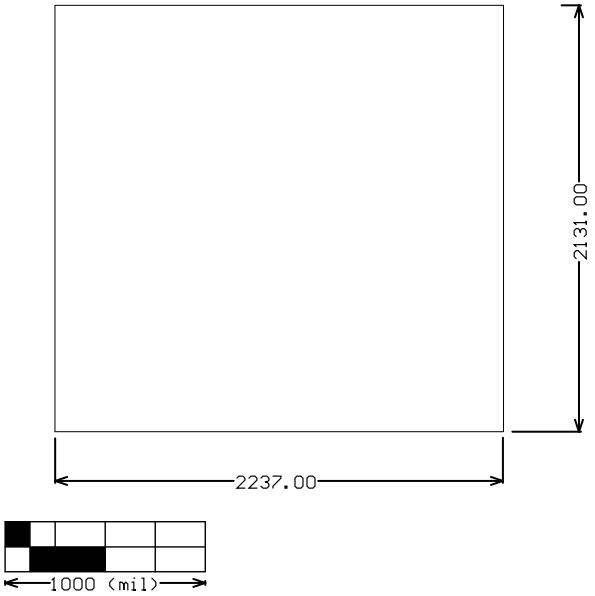


Figure 6-10. Board Dimensions

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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/lsds/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/lsds/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.

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2. 実験局の免許を取得後ご使用いただく。
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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:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

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