User's Guide

LMX2571EPEVM Evaluation Instructions

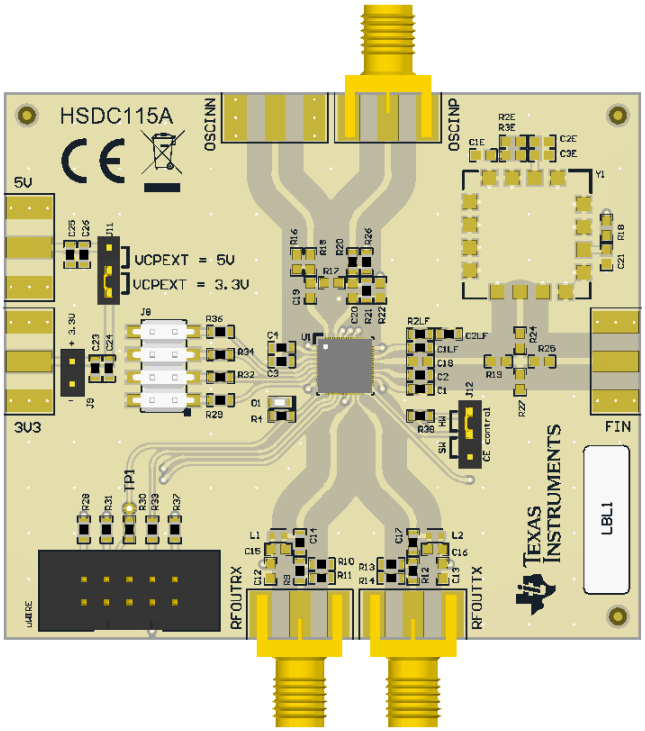
ABSTRACT

The LMX2571EPEVM is designed to evaluate the performance of LMX2571-EP. This board consists of a LMX2571-EP device.

The LMX2571-EP is a low-power, high-performance, wideband RF synthesizer that can generate any frequency from 10 MHz to 1344 MHz. This synthesizer can also be used with an external VCO. The device runs from a single 3.3-V supply and has integrated LDOs that eliminate the need for onboard low noise LDOs.

Except for the following components, this board is able to support extended temperature range testing.

- LED
- uWIRE socket
- Header and short
- Ribbon cable



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1 LMX2571EPEVM Evaluation Module

1.1 Evaluation Module Contents

The following is included in the package:

- One LMX2571EPEVM board (HSDC115-001).
- One Reference PRO board (SV601349).
- One USB cable.
- One 10-pin ribbon cable.

1.2 Evaluation Setup Requirement

The evaluation requires the following hardware and software:

- A DC power supply
- A spectrum analyzer or a signal analyzer
- A PC running Windows 7 or more recent version
- An oscilloscope (optional)
- A high quality signal generator
- Texas Instruments Clocks and Synthesizers TICS Pro software
- Texas Instruments PLLatinum Simulator Tool (optional)

1.3 Resources

Related evaluation and development resources include:

- LMX2571-EP data sheet
- TICS Pro software
- PLLatinum Simulator Tool (PLL Sim)
- Reference PRO design file

2 Setup

2.1 Connection Diagram

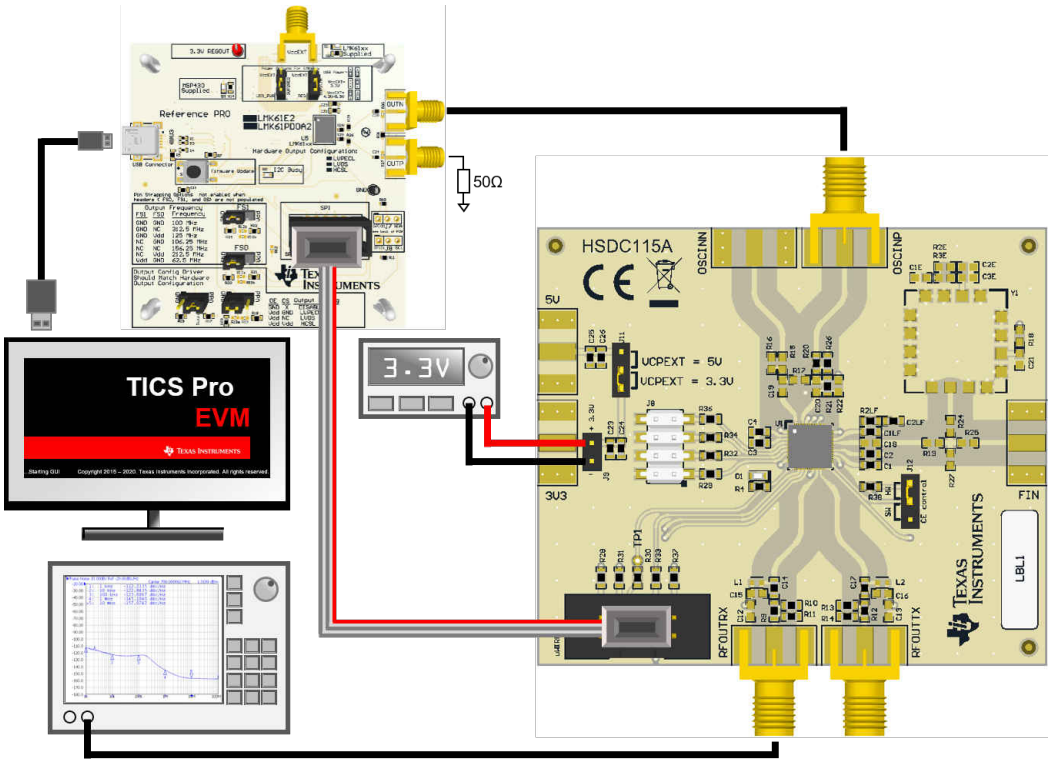

Figure 2-1. Connection Diagram

2.2 Power Supply

Apply 3.3 V to the J9 header. The acceptable supply voltage range is 3.2 V to 3.4 V. The maximum current consumption in the most extreme configuration must not exceed 100 mA.

2.3 Reference Clock

Connect OSCINP SMA connector with one of the outputs from Reference PRO. If required, the EVM can be modified to operate with a different clock source. See Appendix A for details.

Terminate the unused output of the Reference PRO board with a 50-Ω resistor or SMA load. By default, the output clock from Reference PRO is a 100-MHz LVPECL clock. Appendix B has the details of Reference PRO.

2.4 RF Output

Connect RFOUTRX SMA connector to a signal analyzer. Output frequency is 480 MHz and the amplitude is about +1 dBm.

By default the evaluation software, TICS Pro, has RFOUTTX power down. This SMA connectors could be left open.

2.5 Programming

Connect ribbon cable from Reference PRO to LMX2571EPEVM.

Connect USB cable from a PC to USB port in Reference PRO. This provides power supply to Reference PRO board and communication with TICS Pro. A firmware update may be required. See Appendix B for details.

2.6 Evaluation Software

Download and install TICS Pro to a PC. Run the software and follow the following steps to get started.

1. Go to *Select Device → PLL + VCO → LMX2571 → LMX2571EP.*

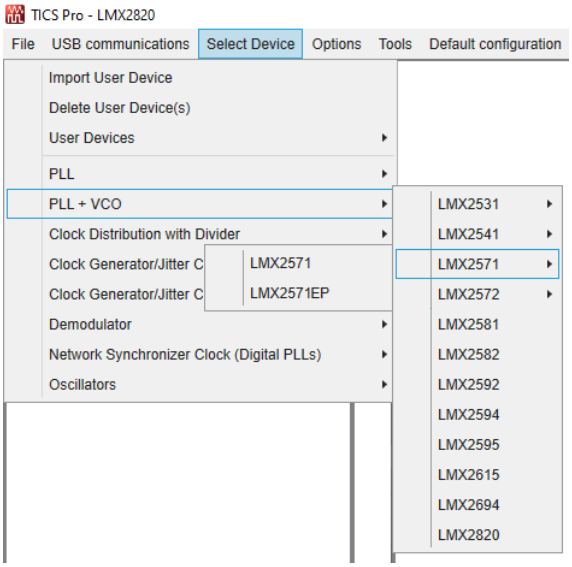

Figure 2-2. Select Device in TICS Pro

2. Go to *Default Configuration → EVM Default Mode.*

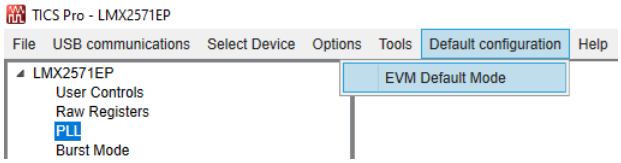

Figure 2-3. EVM Default Mode

2.7 EVM Strap Options

2.7.1 J11 Header

Pin 2 of J11 is connected to the VCPEXT pin. In synthesizer mode, put a short to the 3.3-V position. Put the short to the 5-V position in PLL mode and provide a 5-V supply to the reserved pads for the 5-V SMA connector.

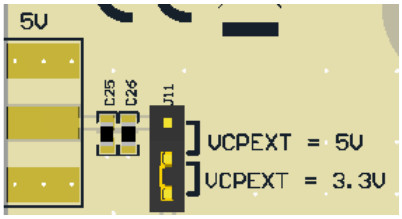

Figure 2-4. J11 Header

2.7.2 J12 Header

Pin 2 of J12 is connected to the CE pin. Put a short to the *HW* position, this will connect the CE pin to 3V3 through resistor R38. If the short is placed in the *SW* position, the status of CE pin is configurable through TICS Pro.

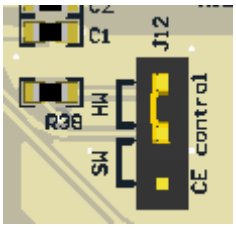

Figure 2-5. J12 Header

3 Typical Measurement

3.1 Default Configuration

3.1.1 Loop Filter

Table 3-1 lists the parameters for the loop filter.

Table 3-1. Loop Filter Configuration

PARAMETER	VALUE
VCO frequency	Designed for 4.8 GHz, but works over the whole frequency range
VCO gain	56 MHz/V
Effective charge pump gain	2500 µA
Phase detector frequency	80 MHz
Loop bandwidth	205 kHz
Phase margin	40 degrees
C1_LF	390 pF
C2_LF	4.7 nF
R2_LF	680 Ω
R3_LF = R4_LF (Internal)	800 Ω
C3_LF (Internal)	50 pF
C4_LF (Internal)	100 pF

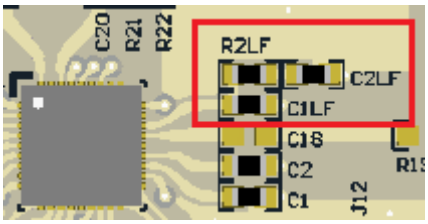

Figure 3-1. Loop Filter

3.1.2 Typical Output

1. Follow Section 2 to set up the evaluation.
2. Click *Write All Registers* to write all the registers to LMX2571-EP. The default output is 480 MHz.

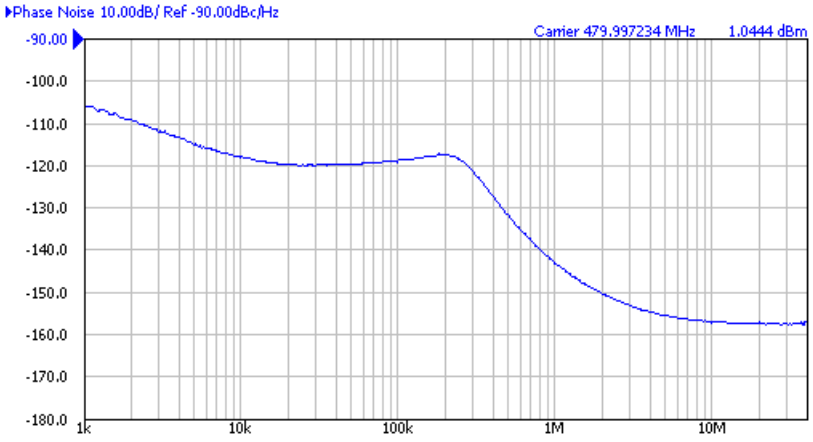

Figure 3-2. Default Output

3.2 Additional Tests

3.2.1 FSK Modulation

Direct digital FSK modulation is supported in LMX2571. FSK PIN mode supports discrete 2-, 4-, or 8-level FSK modulation while other FSK modes support arbitrary level FSK modulation. Table 3-2 is an FSK PIN mode example.

Table 3-2. FSK PIN Mode Example

PARAMETER	EXAMPLE VALUE
Phase detector frequency	80 MHz
CHDIV1	Divided by 4
CHDIV2	Divided by 1
PLL_DEN	2^{24}
Prescalar	2
Frequency deviation	±600 Hz; ±1800 Hz

Continue to toggle the FSK_D[1:0] and FSK_DV pins, the output is a discrete 4-level FSK modulated signal.

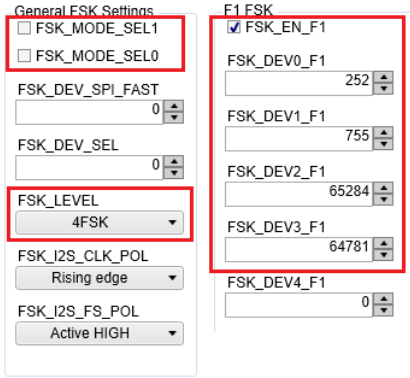

Figure 3-3. FSK PIN Mode Setting

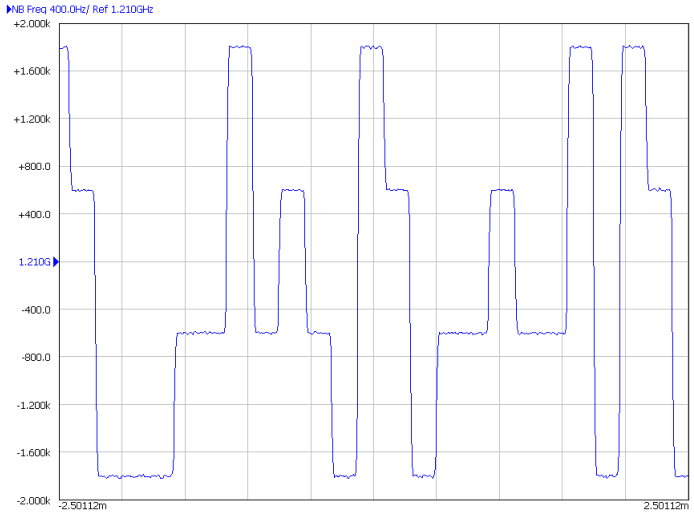

Figure 3-4. FSK PIN Mode

3.2.2 Register Readback

To read back the written register values, use the following steps:

1. From the TICS Pro, set SDO_LD_SEL to *Lock detect output*.

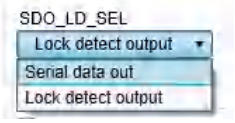

Figure 3-5. Readback Setting

2. Click the Register Name that you want to read back.
3. Click the Read Register button to read back the register value.

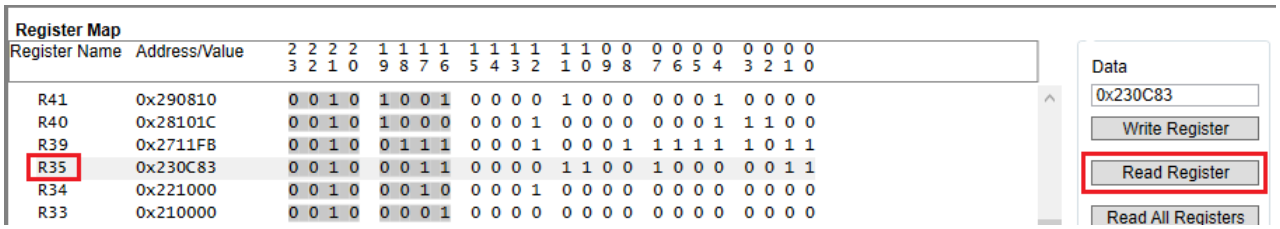

Figure 3-6. Register Readback

4 Schematic

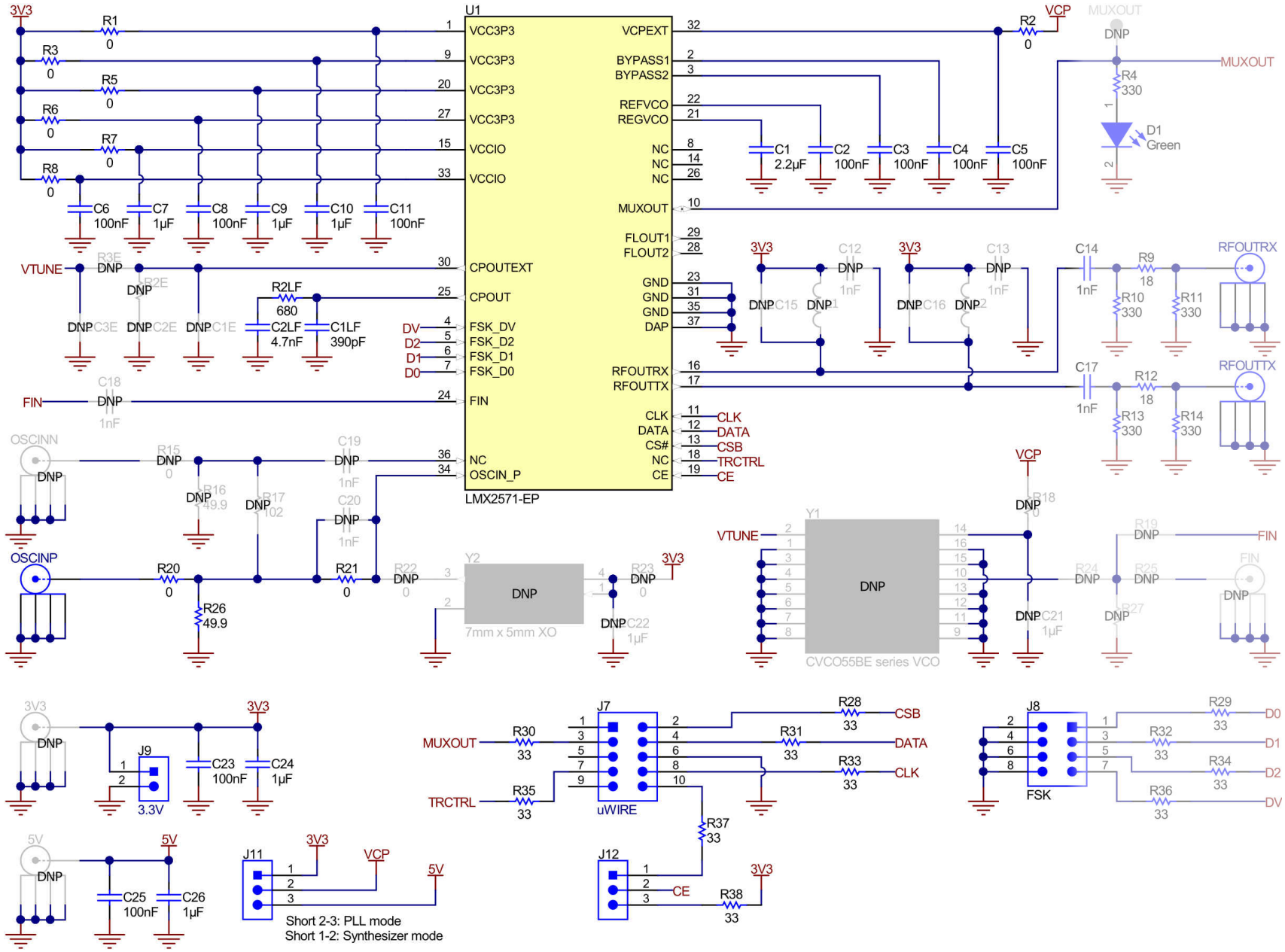

Figure 4-1. LMX2571EPEVM Schematic

5 Board Construction

5.1 PCB Layer Stack-Up

The board is made on FR4 for the Prepreg and Core Layers. The top layer is 1 oz copper.

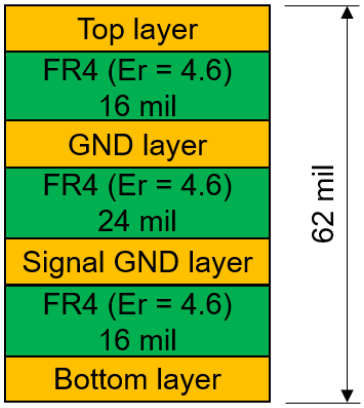

Figure 5-1. PCB Layer Stack-Up

5.2 PCB Layout

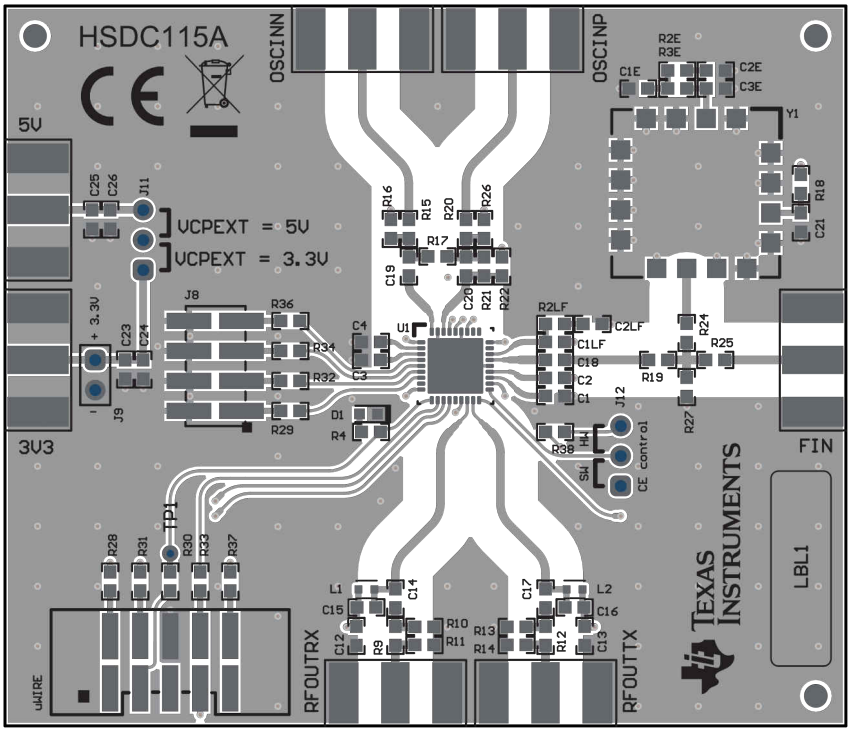

Figure 5-2. Top Layer

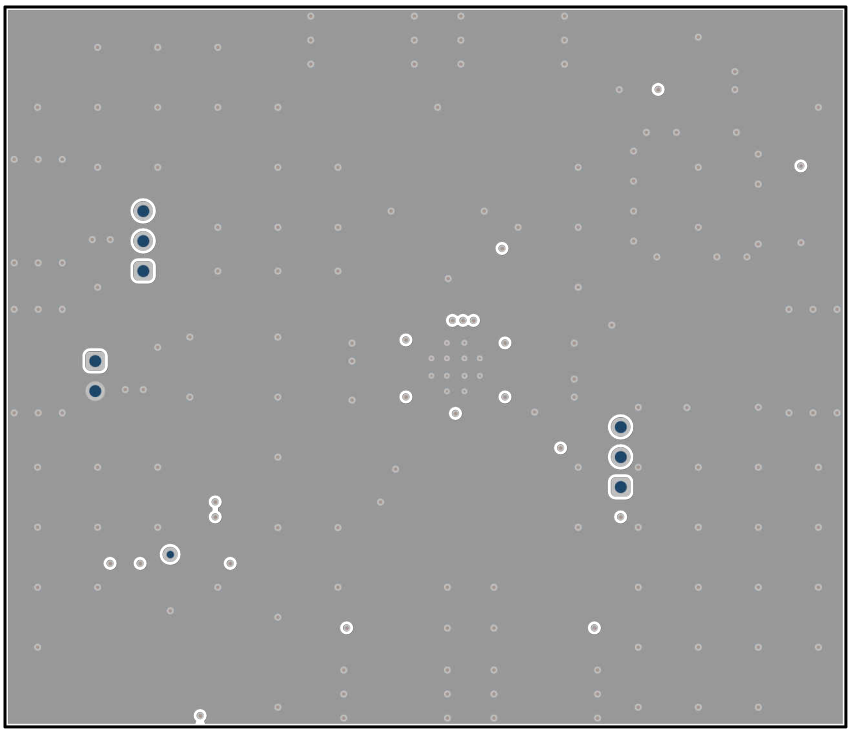

Figure 5-3. GND Layer

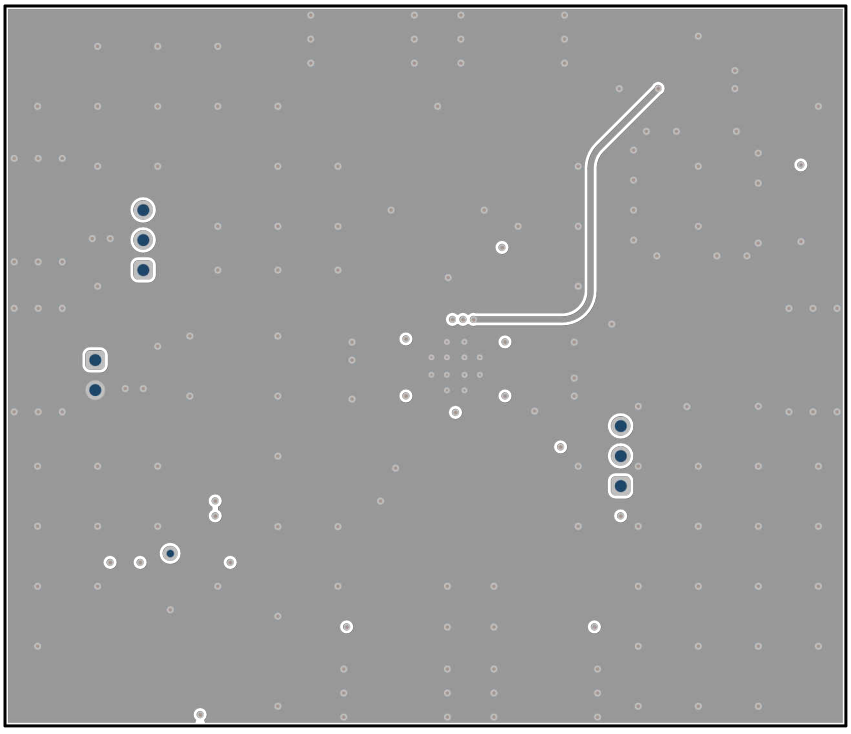

Figure 5-4. Signal GND Layer

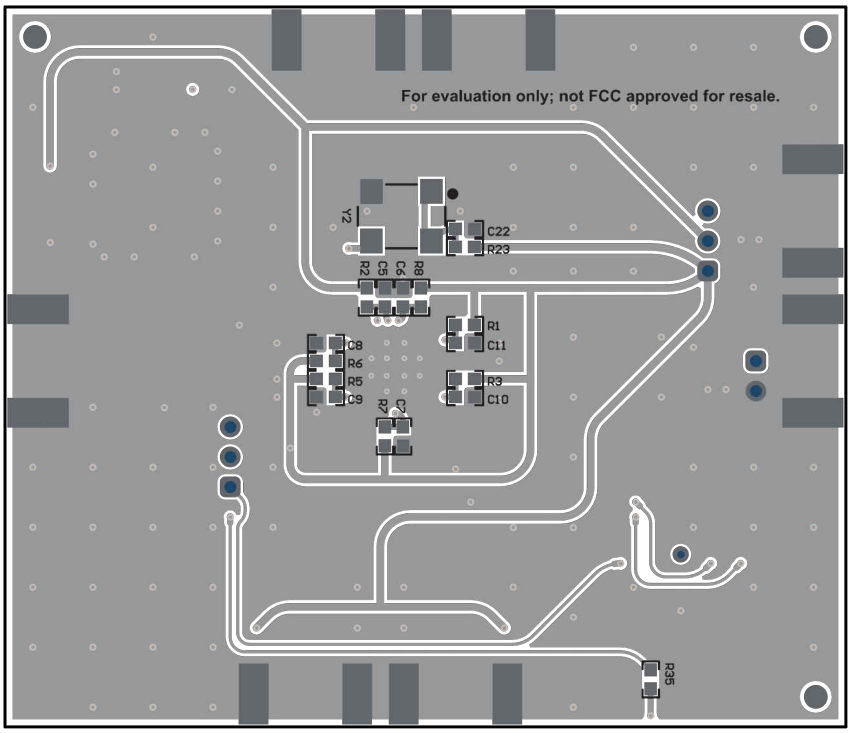

Figure 5-5. Bottom Layer

6 Bill of Materials

Table 6-1. LMX2571EPEVM Bill of Materials

DESIGNATOR	QTY	DESCRIPTION	PART NUMBER	MANUFACTURER
C1	1	CAP, CERM, 2.2 µF, 10 V, +/- 10%, X5R, 0603	C0603C225K8PACTU	Kemet
C1LF	1	CAP, CERM, 390 pF, 50 V, +/- 5%, C0G/NP0, 0603	C0603C391J5GACTU	Kemet
C2, C3, C4, C5, C6, C8, C11, C23, C25	9	CAP, CERM, 0.1 µF, 16 V, +/- 10%, X7R, 0603	885012206046	Wurth Elektronik
C2LF	1	CAP, CERM, 4700 pF, 50 V, +/- 10%, X7R, 0603	885012206087	Wurth Elektronik
C7, C9, C10, C24, C26	5	CAP, CERM, 1 µF, 16 V, +/- 10%, X7R, 0603	885012206052	Wurth Elektronik
C14, C17	2	CAP, CERM, 1000 pF, 50 V,+/- 10%, X7R, 0603	885012206083	Wurth Elektronik
D1	1	LED, Green, SMD	LTST-C190GKT	Lite-On
J1, J2, J4	3	Connector, End launch SMA, 50 ohm, SMT	142-0701-851	Cinch Connectivity
J7	1	Header (shrouded), 100mil, 5x2, Gold, SMT	52601-S10-8LF	FCI
J8	1	Header, 100mil, 4x2, Gold, SMT	0015910080	Molex
J9	1	Header, 100mil, 2x1, Gold, TH	TSW-102-07-G-S	Samtec
J11, J12	2	Header, 100mil, 3x1, Gold, TH	TSW-103-07-G-S	Samtec
R1, R2, R3, R5, R6, R7, R8, R20, R21	9	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW06030000Z0EA	Vishay-Dale
R2LF	1	RES, 680, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW0603680RJNEA	Vishay-Dale
R4, R10, R11, R13, R14	5	RES, 330, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW0603330RJNEA	Vishay-Dale
R9, R12	2	RES, 18, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW060318R0JNEA	Vishay-Dale
R26	1	RES, 49.9, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW060349R9FKEA	Vishay-Dale
R28, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38	11	RES, 33, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW060333R0JNEA	Vishay-Dale
U1	1	LMX2571-EP Low Power Synthesizer with FSK Modulation	LMX2571-EP	Texas Instruments

7 Troubleshooting Guide

If the EVM does not work as expected, use the Figure 7-1 to identify potential root causes. Consider the following:

- Do not make modifications to the EVM or change the default settings until AFTER it is verified to be working.
- Register read back requires the correct software setup, See Section 3.2.2 for details.
- The POR current of the LMX2571EPEVM is approximately 30 mA.
- The power-down current of the LMX2571EPEVM is approximately 3 mA.

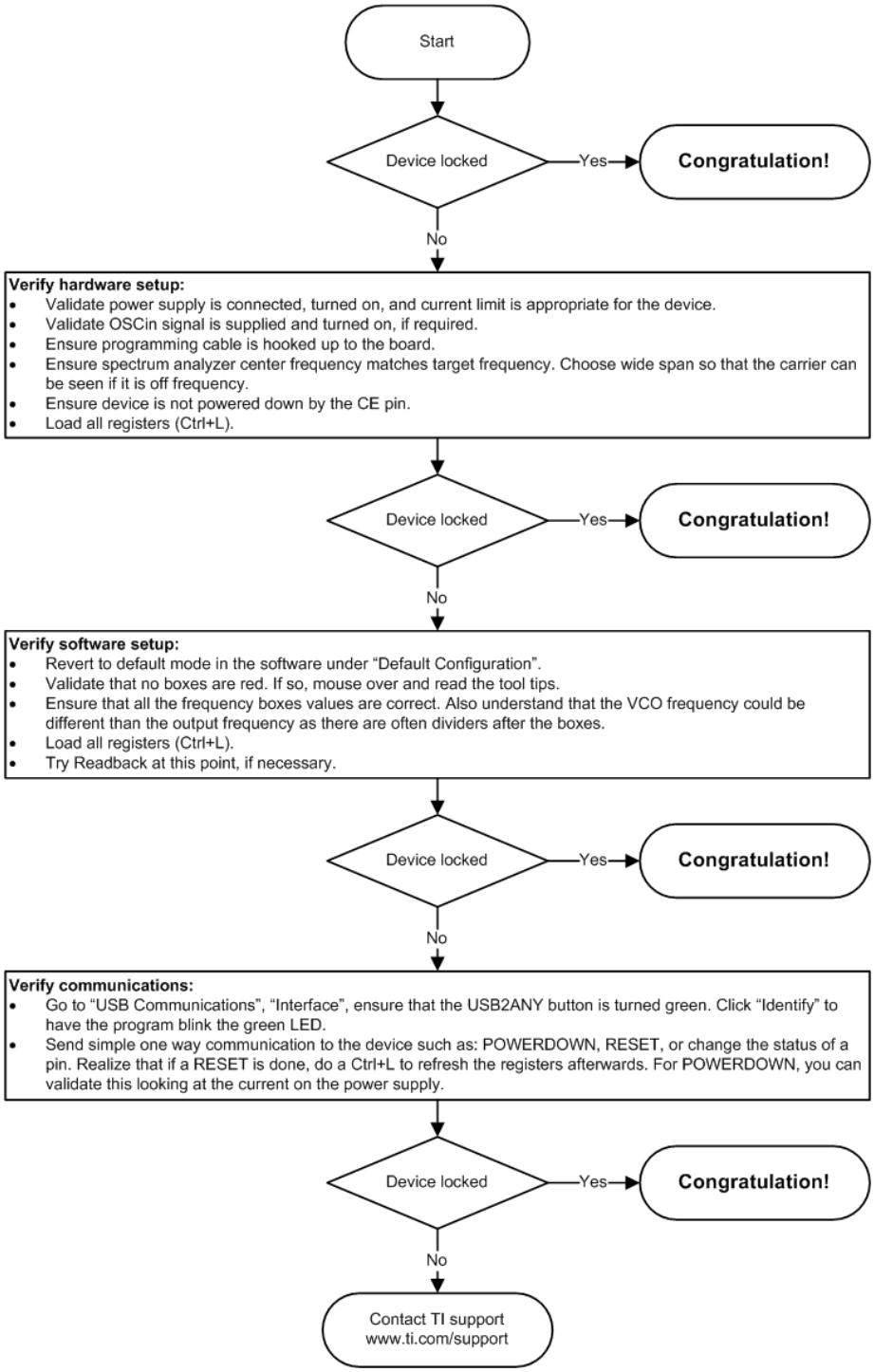

Figure 7-1. Troubleshooting Guide

A Using Different Reference Clock

There are different options to provide a reference clock to LMX2571EPEVM. By default, the EVM is configured for an external single-ended clock.

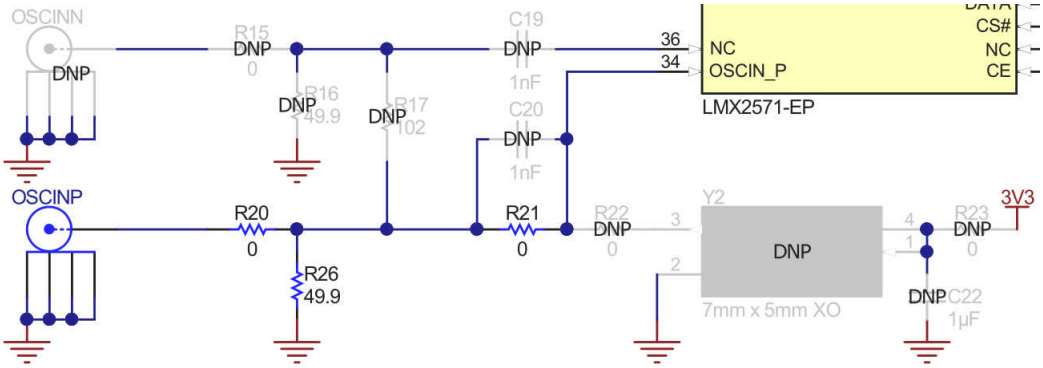

Figure A-1. Single-ended Input

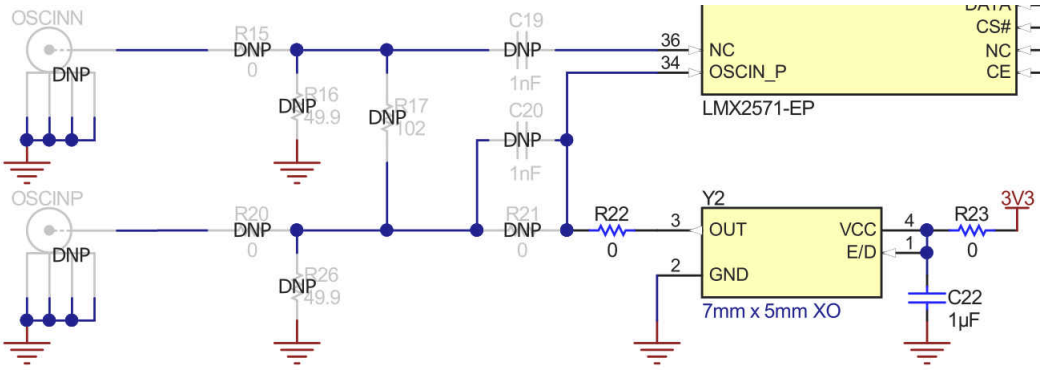

Figure A-2. Crystal Oscillator Input

B Reference PRO

The Reference PRO board is used to program the LMX2571EPEVM and at the same time, provide a clean reference clock to LMX2571EPEVM. The board has several control pins dedicated for control of output format, output frequency, and output enable control. These control pins are configurable through the jumpers by strapping the center pin to Vdd position or GND position. Connections from the Vdd position to the device supply or from the GND position to the ground plane are connected by 1.5-kΩ resistors. By default, the board is configured for 100-MHz LVPECL output. The power supply to Reference PRO is obtained from the PC that is connecting to Reference PRO through the USB interface.

B.1 Output Frequency Selection

Jumpers FS1 and FS0 are used to set the output frequency.

Table B-1. Reference PRO Output Frequency Selection

FS1	FS0	OUTPUT FREQUENCY (MHz)
GND	GND	100
GND	NC	312.5
GND	Vdd	125
NC	GND	106.25
NC	NC	156.25
NC	Vdd	212.5
Vdd	GND	62.5

B.2 Output Format Selection

The OE pin is used to enable or disable the output.

The OS pin is used to bias internal drivers and change the output format.

Table B-2. Reference PRO Output Format Selection

OE	OS	OUTPUT FORMAT
GND	Don't Care	Disabled
Vdd	GND	LVPECL
Vdd	NC	LVDS
Vdd	Vdd	HCSL

It is imperative to match the output termination passive components as shown in Table B-3.

Table B-3. Output Termination Configuration

OUTPUT FORMAT	COUPLING	COMPONENT	VALUE
LVPECL	AC (Default configuration)	R15, R28	0 Ω
		R26, R29	150 Ω
		C24, C25	0.01 µF
		R27, R30, R31	DNP
	DC[1]	R15, R28, C24, C25	0 Ω
		R26, R27, R29, R30, R31	DNP
LVDS[2]	AC	R25, R27, R28, R30	0 Ω
		R31	100 Ω
		C24, C25	0.01 µF
		R26, R29	DNP
	DC	R25, R27, R28, R30, C24, C25	0 Ω
		R31	100 Ω
		R26, R29	DNP

Table B-3. Output Termination Configuration (continued)

OUTPUT FORMAT	COUPLING	COMPONENT	VALUE
HCSL	AC	R25, R28	0 Ω
		R26, R29	50 Ω
		C24, C25	0.01 µF
		R27, R30, R31	DNP
	DC	R25, R28, C24, C25	0 Ω
		R26, R29	50 Ω
		R27, R30, R31	DNP

(1) 50-Ω to V_{CC} – 2-V termination is required on receiver.
(2) 100-Ω differential termination (R31) is provided onboard. Removing this termination is possible if the differential termination is available on the receiver.

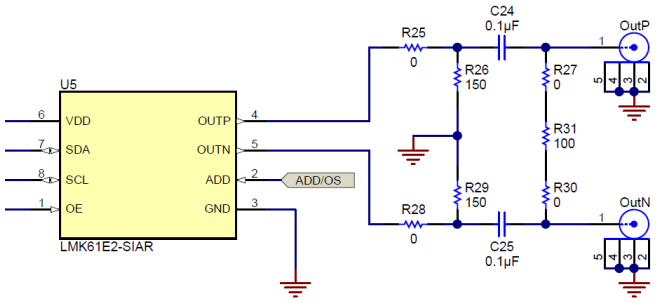

Figure B-1. Output Termination Schematic

B.3 Typical Output Characteristics

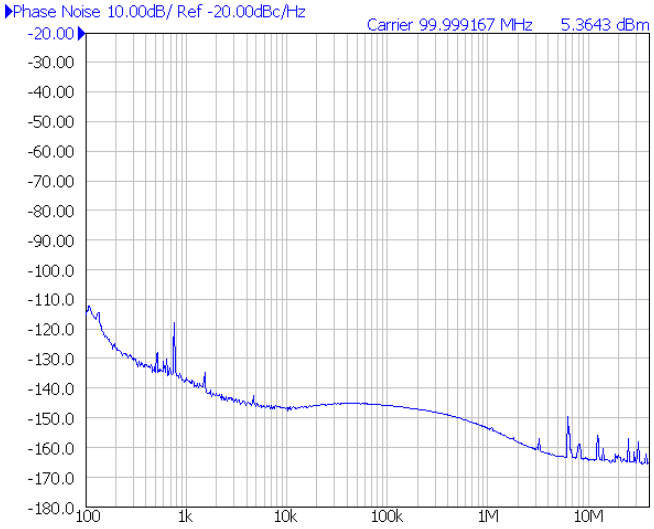

Figure B-2. Default Output Phase Nosie

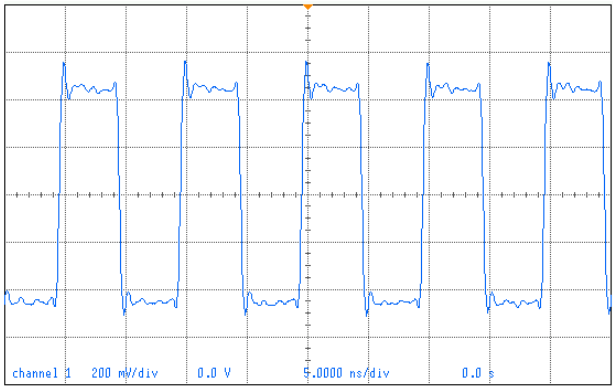

Figure B-3. Default Output Waveform

B.4 Firmware Update

Usually when the Reference PRO board is used at the first time, TICS Pro will request for a firmware update. Simply follow the pop-up instructions to complete the update. This is necessary to ensure that the USB connection between the PC and the Reference PRO board is properly setup, otherwise the programming to LMX2571EPEVM will not be successful.

1. When you see this message, click the *OK* button.

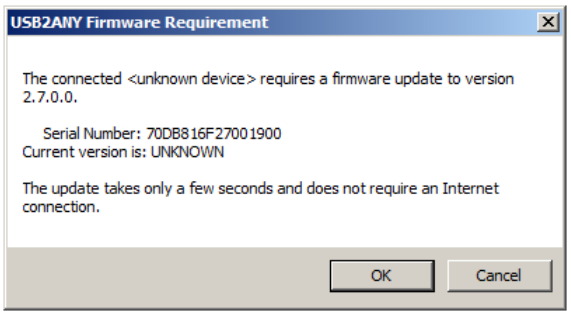

Figure B-4. Firmware Requirement

2. Next, follow the on-screen procedure.

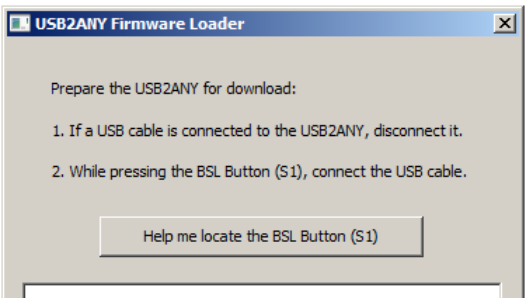

Figure B-5. Firmware Loader

3. The BSL button is located next to the USB connector.

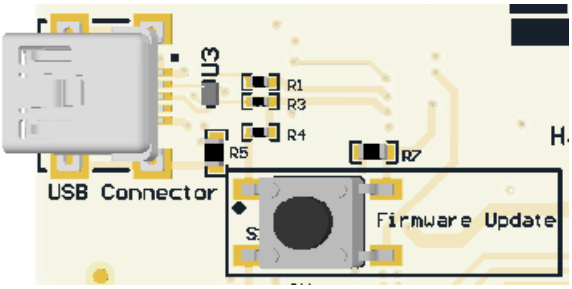

Figure B-6. BSL Button

4. Follow the on-screen procedure until the below screen is pop-up.

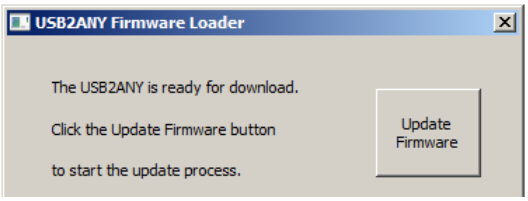

Figure B-7. Update Firmware

5. Click the *Upgrade Firmware* button, the firmware will be upgrading. Click the *Close* button after the upgrade is complete.

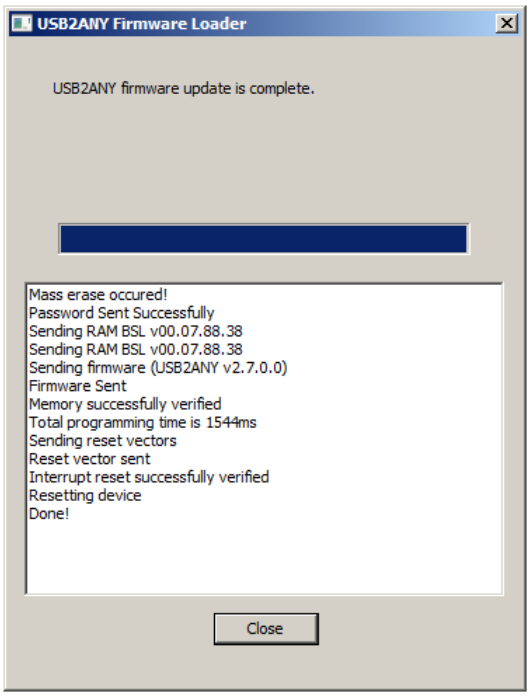

Figure B-8. Firmware Update Completed

6. Check the USB connection in TICS Pro by clicking USB communications → Interface. Make sure the USB Connected button is now green.

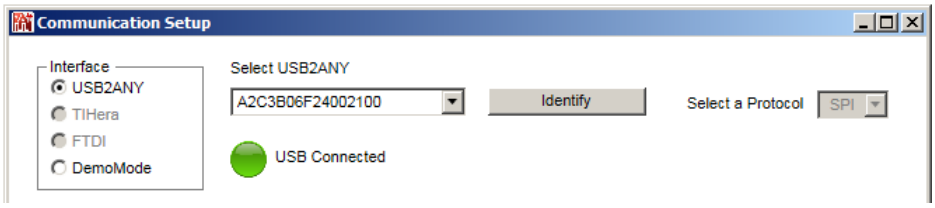

Figure B-9. USB Communications

C Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision * (March 2021) to Revision A (May 2022)	Page
• Changed LMX2571-EP pin names from: OSCIN_N and TRCTRL to: NC	9
• Removed the Differential Input option	15

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