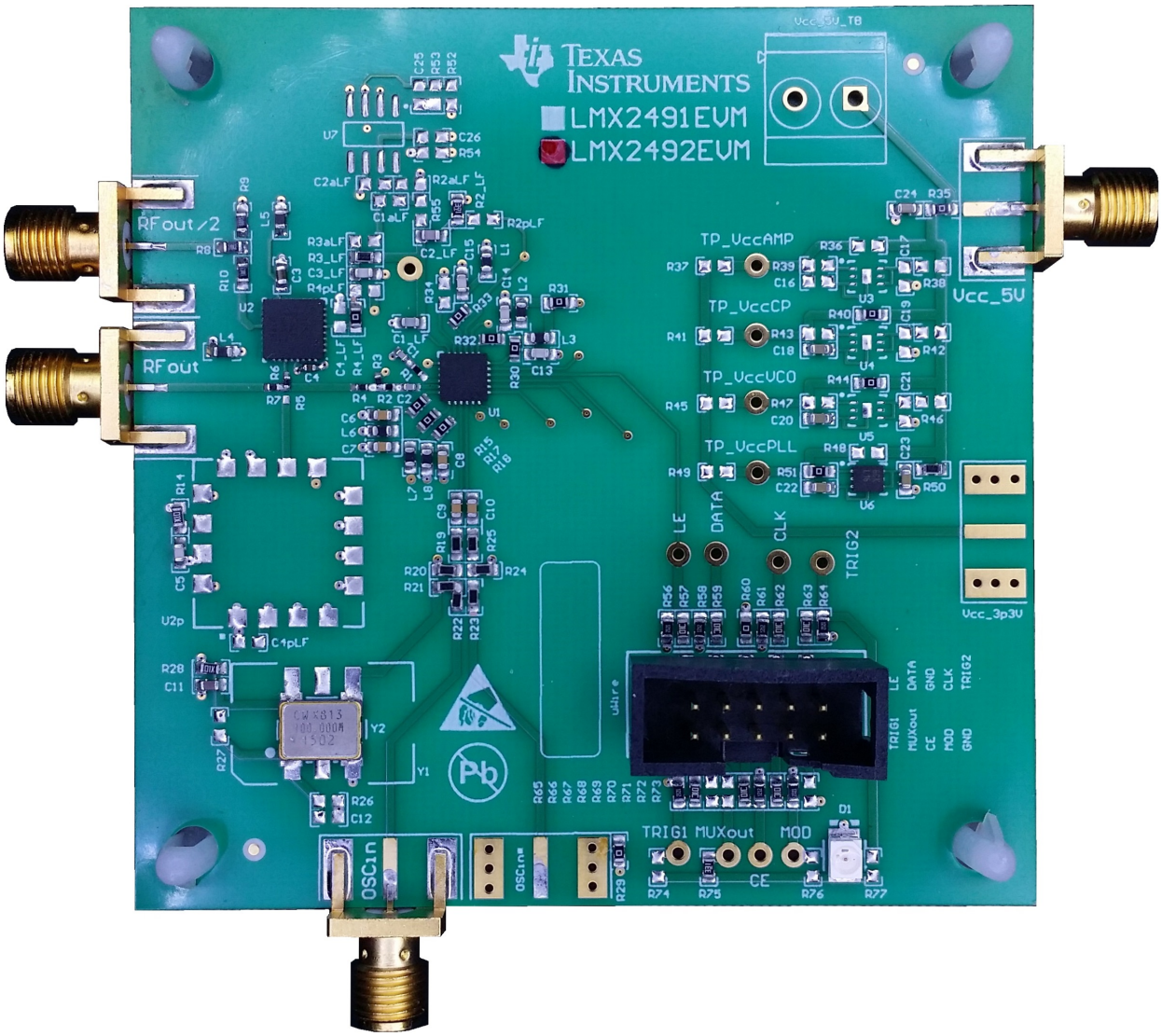
LMX2492EVM Evaluation Module

The LMX2492EVM is design to evaluate the performance of LMX2492. This board consists of a LMX2492 device, a LP5900-3.3V LDO, a 9.4 - 10.8 GHz VCO and a 100 MHz crystal oscillator.

The LMX2492 is a low noise 14 GHz wideband delta-sigma fractional N PLL with ramp and chirp generation. It consists of a phase frequency detector, programmable charge pump, and high frequency input for the external VCO. The LMX2492 supports a broad and flexible class of ramping capabilities, including FSK and configurable piecewise linear FM modulation profiles of up to 8 segments.



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1 LMX2492EVM Evaluation Module

1.1 Evaluation Module Contents

In the box, there are:

- One LMX2492EVM board (SV601040-002).
- One USB2ANY module (HPA665-001).
- One USB cable.
- One 10-pin ribbon cable.

1.2 Evaluation Setup Requirement

The evaluation will require 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 (optional)
- A function waveform generator (optional)
- Texas Instruments Clocks and Synthesizers TICS Pro software
- Texas Instruments PLLatinum Simulator Tool (optional)

1.3 Resources

Related evaluation and development resources are as follows:

- LMX2492 datasheet
- LMX2491 datasheet
- TICS Pro software
- PLLatinum Simulator Tool (PLL Sim)

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2 Setup

2.1 Connection Diagram

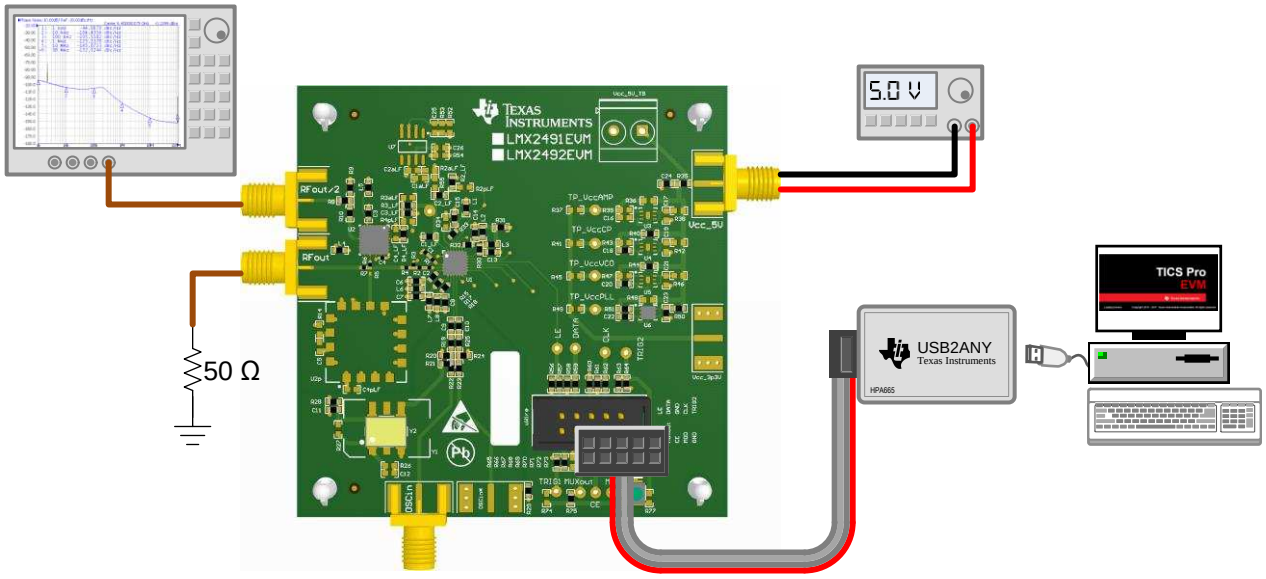


Figure 1. EVM Connection Diagram

2.2 Power Supply

Apply 5-V to Vcc_5V SMA connector. The on-board VCO and the optional op-amp require 5-V supply while the on-board XO and LMX2492 need 3.3-V supply. The on-board LDO regulates 5-V down to 3.3-V. Never apply more than 6-V to Vcc_5V SMA connector or otherwise the LDO will be damaged. The total current consumption of the board is about 240 mA.

2.3 Reference Clock

By default, the board is operated with the on-board 100-MHz CMOS XO. If required, the board can be modified to operate with an external clock source. In this case, apply a single-ended clock to the OSCin SMA connector or apply a differential clock to both OSCin and OSCin* SMA connectors. See Appendix B for details.

2.4 RF Output

Connect RFout/2 SMA connector to a spectrum analyzer or a signal analyzer. By default, the output signal frequency is 4.8 GHz and the amplitude is about –3 dBm. Because the frequency accuracy of the on-board XO is 25 ppm, RF output frequency may also be off by 25 ppm. The phase noise of the XO is not bad but not excellent, as a result, RF output phase noise may not look very good.

2.5 Programming

Connect the uWire header to a PC using the USB2ANY module. The firmware of the USB2ANY may not be up-to-date. In this case, follow the procedures outlined in Appendix A to get it updated.

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" → LMX2492

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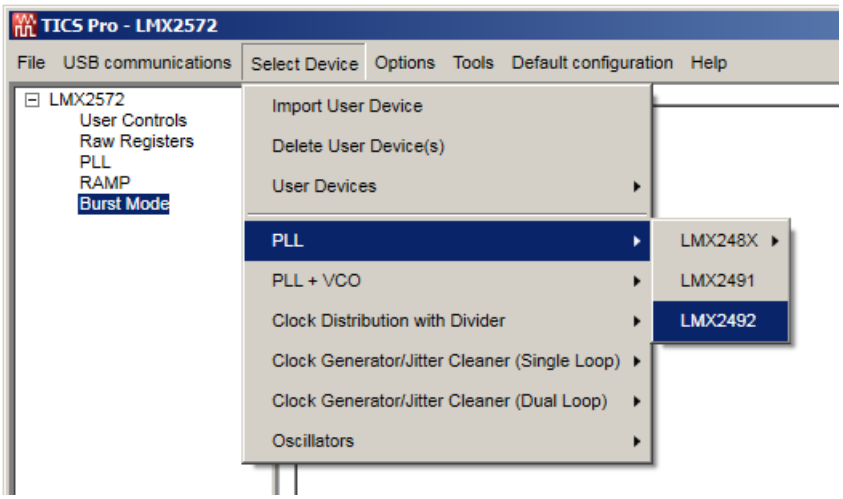


Figure 2. Select Device in TICS Pro

2. Go to "Default configuration" → "Default Mode xxxx-xx-xx"

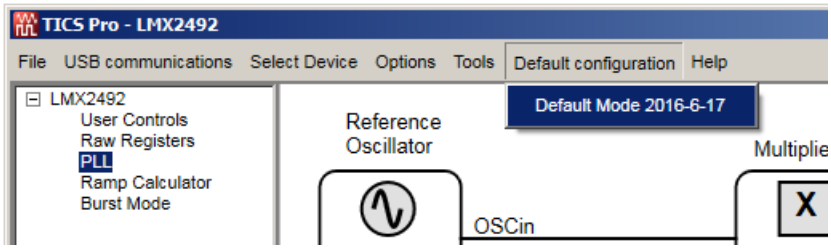


Figure 3. Default Mode

2.7 EVM Strap Options

The MUXout pin is not connected to the uWire header but is used as the lock detect indicator. Other IO pins, such as TRIG1, TRIG2 and MOD are connected to the uWire header. They could be used as the input trigger sources or output flag indicators during frequency ramping.

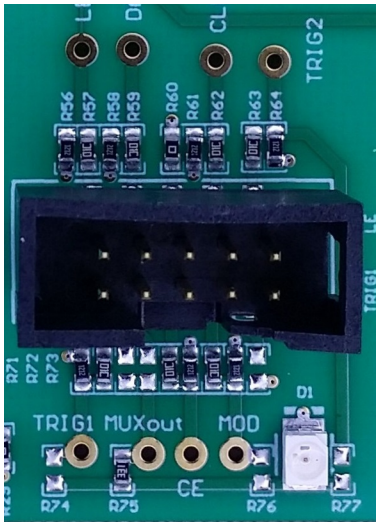


Figure 4. IO Port

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3 Typical Measurement

3.1 Default Configuration

3.1.1 Loop Filter

The parameters for the loop filter are:

Table 1. Loop Filter Configuration

PARAMETER	VALUE
VCO frequency	9.4 - 10.8 GHz
VCO gain	240 MHz/V
Effective charge pump gain	3.1 mA
Phase detector frequency	100 MHz
Loop bandwidth	435 kHz
Phase margin	60.8 degrees
C1_LF	68 pF
C2_LF	3.9 nF
C3_LF	150 pF
C4_LF	Open
R2_LF	390 Ω
R3_LF	150 Ω
R4_LF	0 Ω

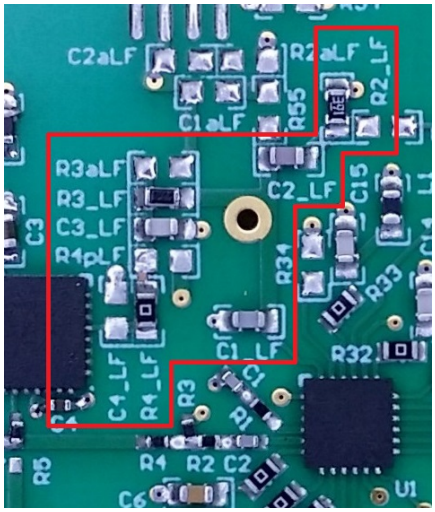


Figure 5. Loop Filter

3.1.2 Typical Output

1. Follow Section 2 to setup the evaluation.
2. Go to "USB communications" → "Write All Registers" to write all the registers to LMX2492.

Default output is 4.8 GHz at RFout/2 SMA connector.

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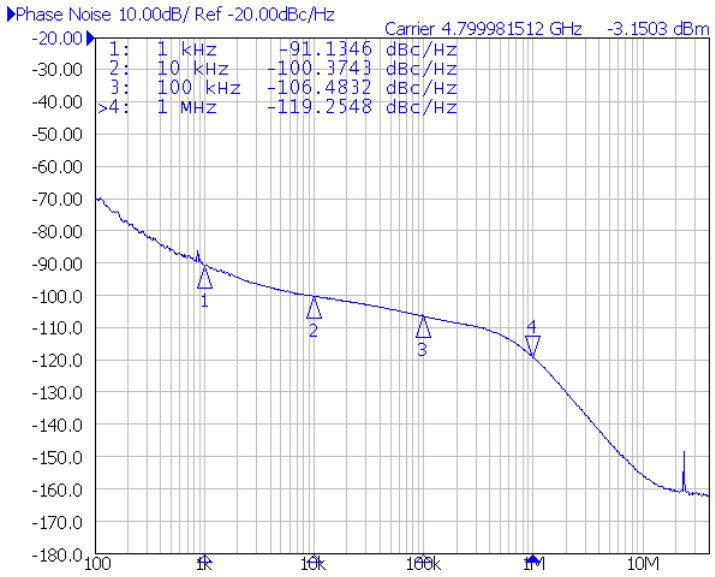


Figure 6. Default Output

3.2 Additional Tests

3.2.1 Frequency Shift Keying (FSK) Example

FSK operation requires an external input trigger signal at either MOD, TRIG1 or TRIG2 pin. In this example, MOD pin is selected as the Trigger A source. A 20 kHz square-wave clock will be applied to MOD pin to toggle the RF output to switch between 9600 MHz and 9604 MHz. That is, FSK deviation is 4 MHz.

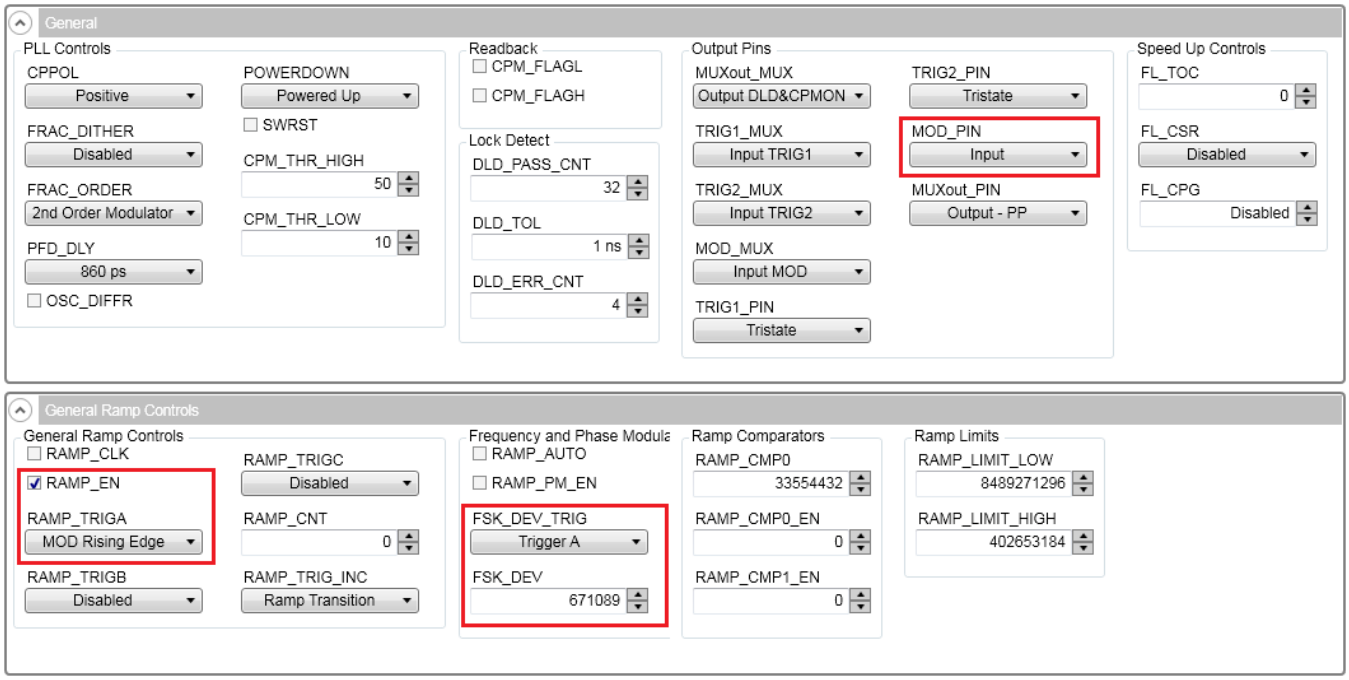


Figure 7. TICS Pro FSK Configuration

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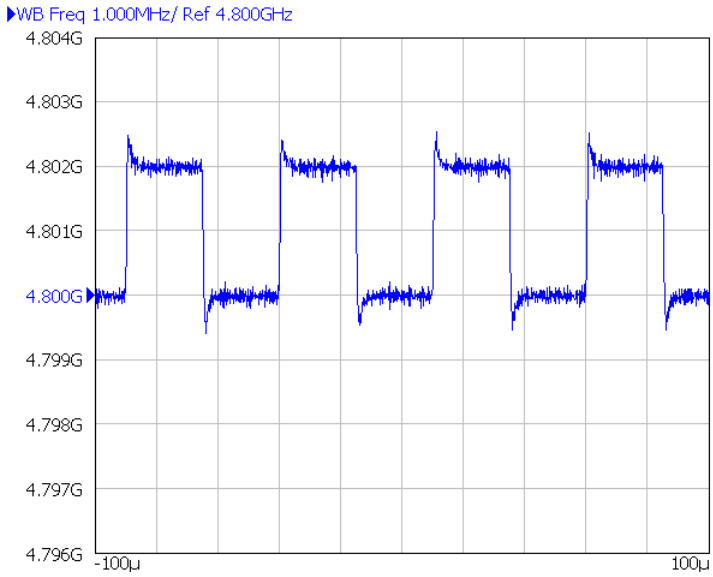


Figure 8. FSK Example

3.2.2 Continuous Sawtooth Ramp Example

This example shows how to generate a continuous sawtooth ramp. Only one ramp segment is necessary as it will loop back to itself.

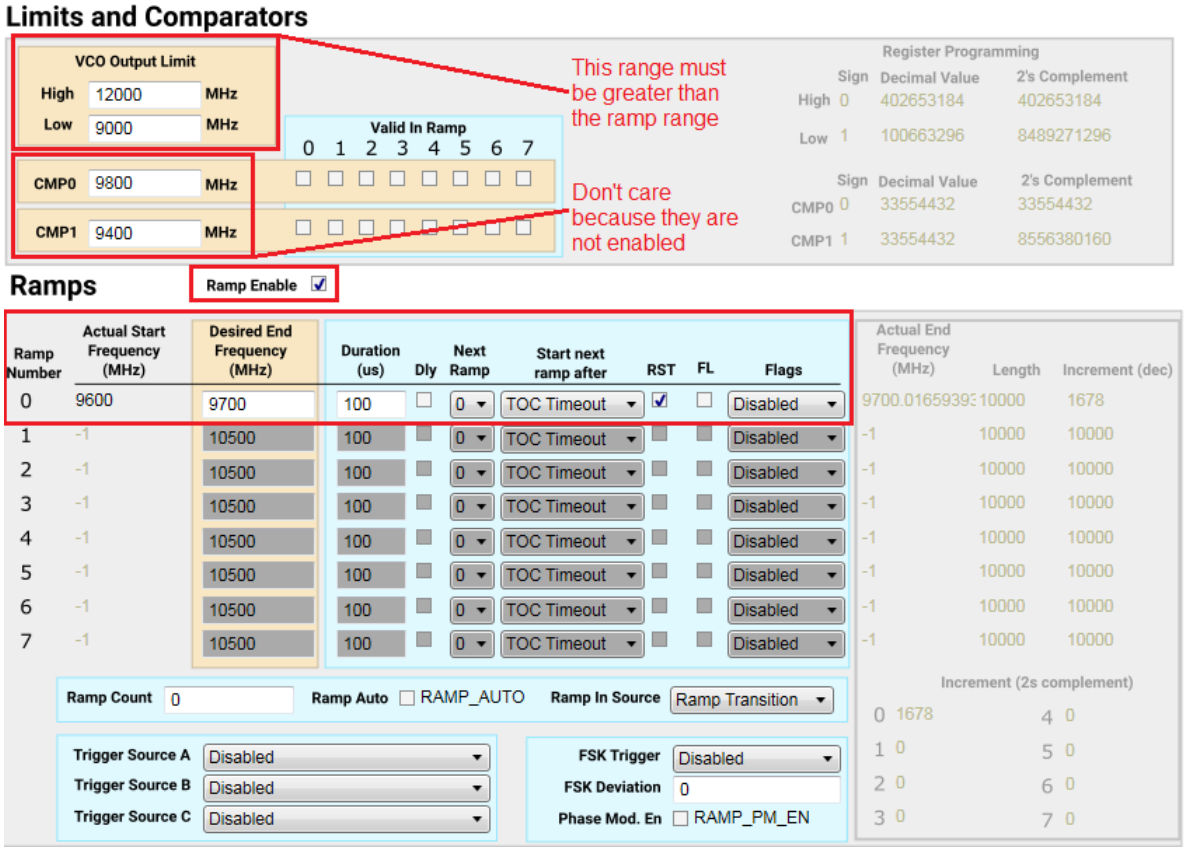


Figure 9. Continuous Sawtooth Ramp Configuration

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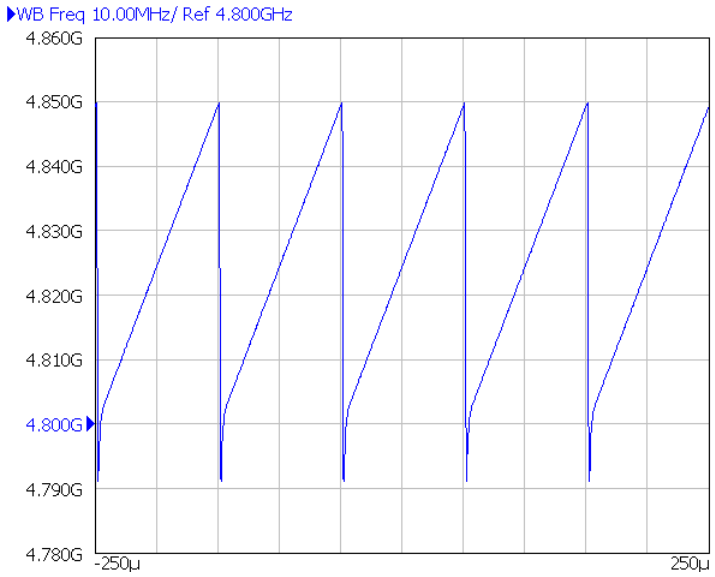


Figure 10. Continuous Sawtooth Ramp Example

3.2.3 Continuous Trapezoid Ramp Example

This is a long-ramp example, the ramp duration is 1 ms. RAMPx_DLY is enabled so that the ramp generator will ramp every 2 phase detector cycles. Output flags are turned on to indicate the start of a ramp.

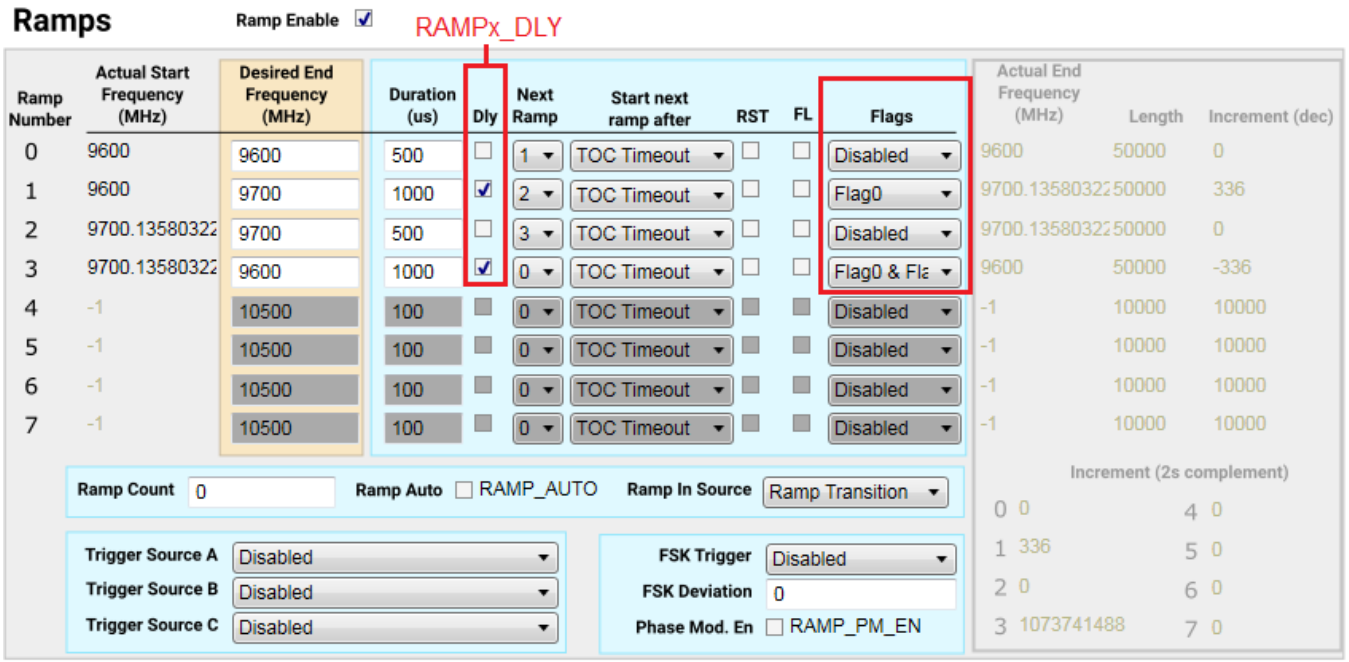


Figure 11. Continuous Trapezoid Ramp Configuration

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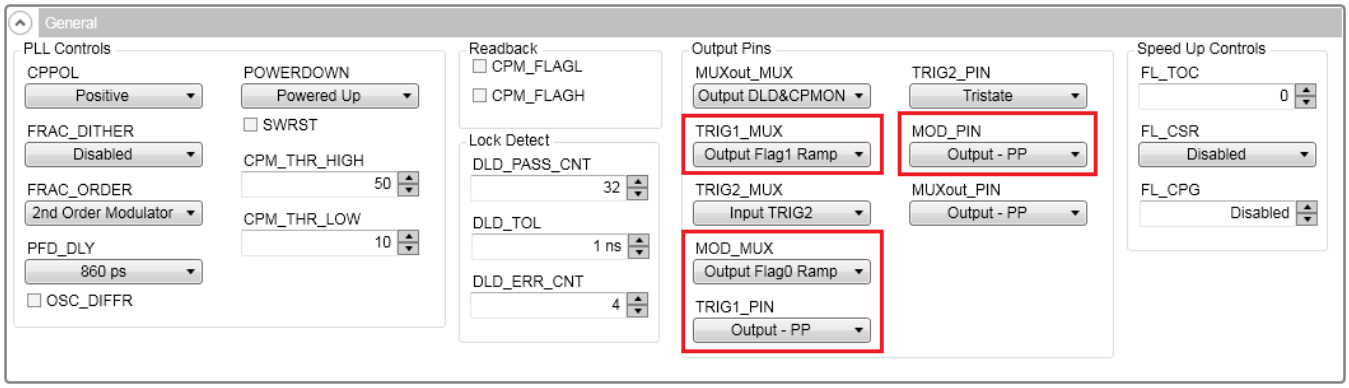


Figure 12. Flag Out Pins Configuration

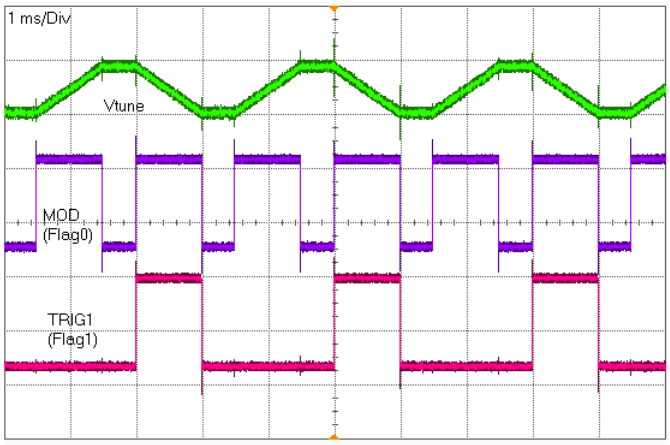


Figure 13. Flags Out Timing

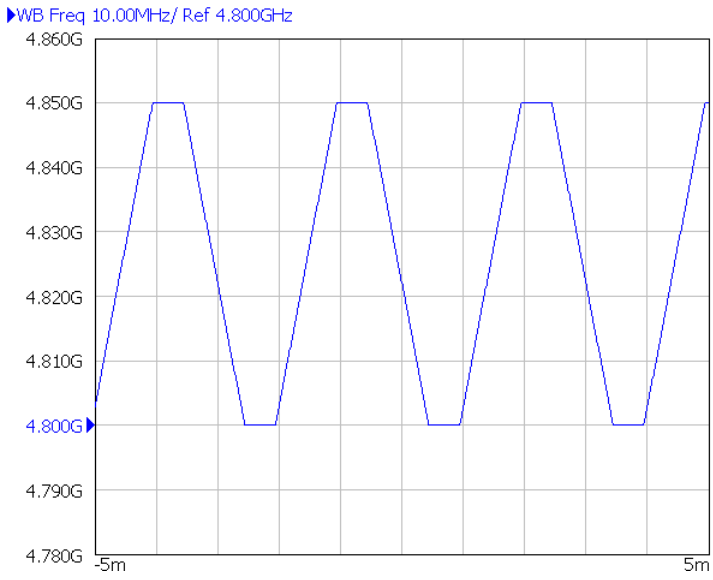


Figure 14. Continuous Trapezoid Ramp Example

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3.2.4 Register Readback

To read back the written register values,

1. Remove R75 so that the MUXout pin is disconnected from the LED.
2. Populate R68 to connect MUXout pin to USB2ANY.
3. In TICS Pro, set MUXout pin to "Output Readback".

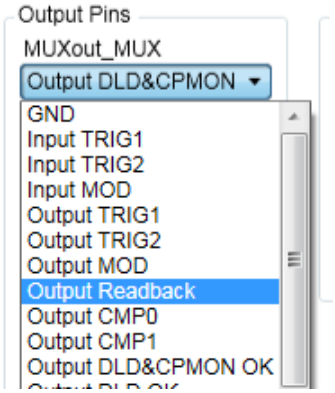


Figure 15. Readback Setting

4. Click on the Register Name that you want to read back.
5. Click the Read Register button to read back the register value.

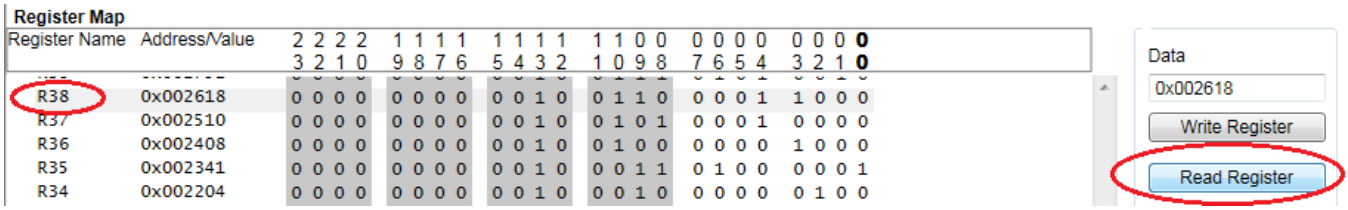


Figure 16. Register Readback

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4 Schematic

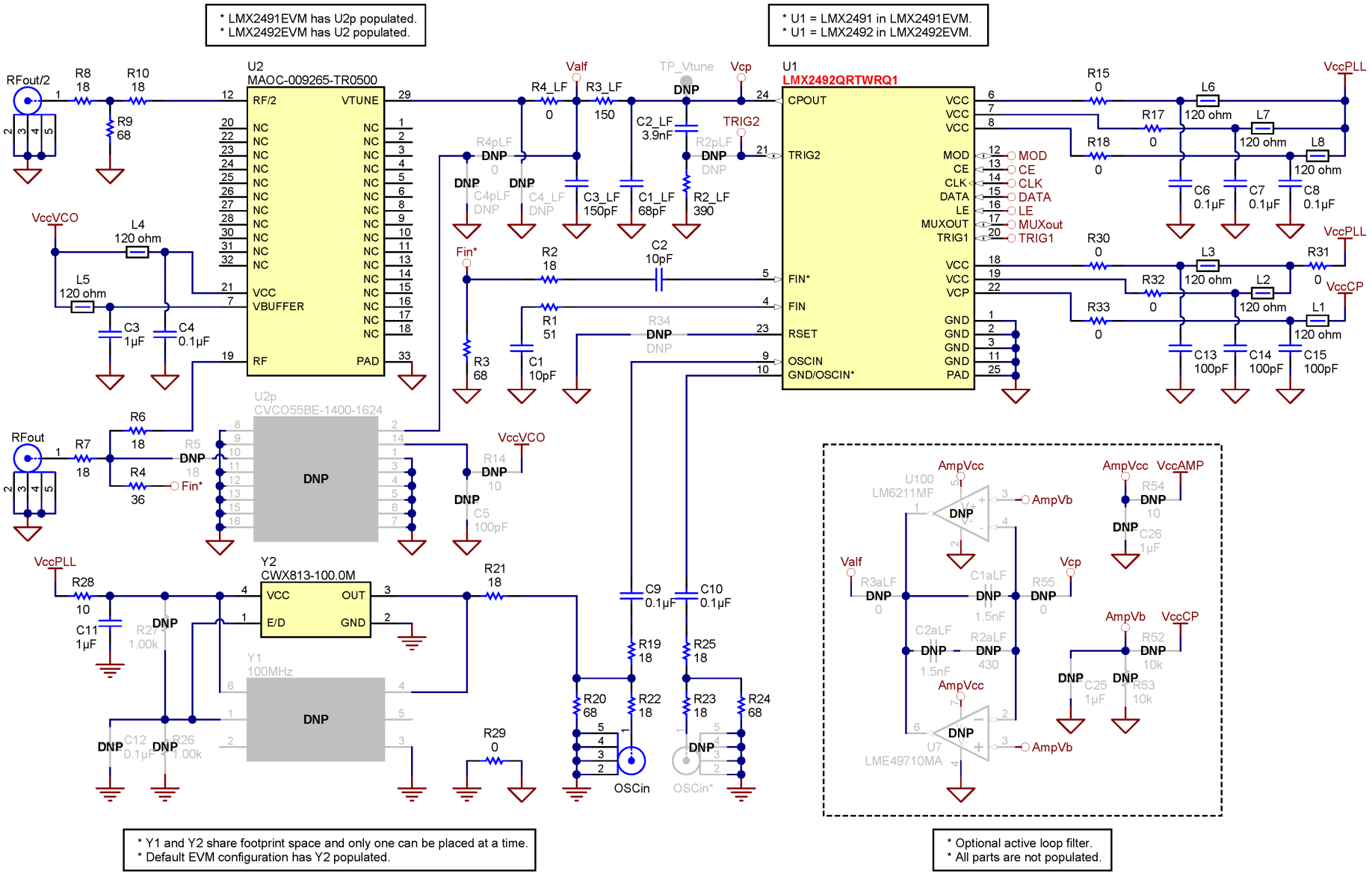


Figure 17. LMX2492EVM Schematic (Page 1)

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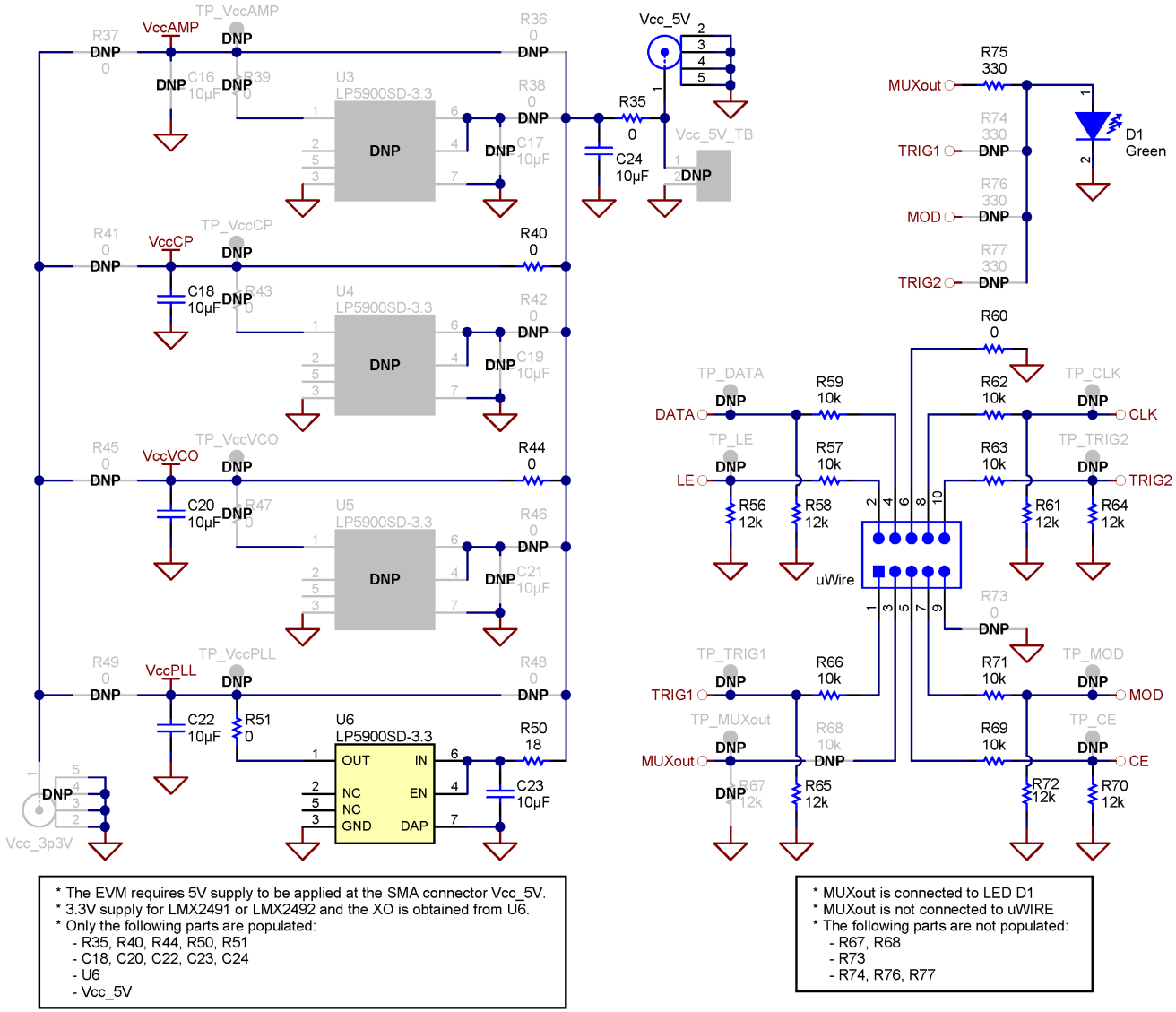


Figure 18. LMX2492EVM Schematic (Page 2)

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5 PCB Layout and Layer Stack-up

5.1 PCB Layer Stack-up

The top layer is 1 oz copper.

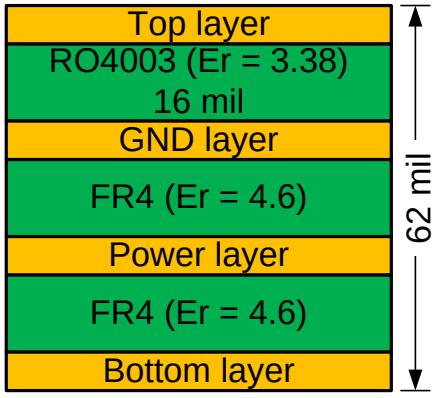


Figure 19. PCB Layer Stack-up

5.2 PCB Layout

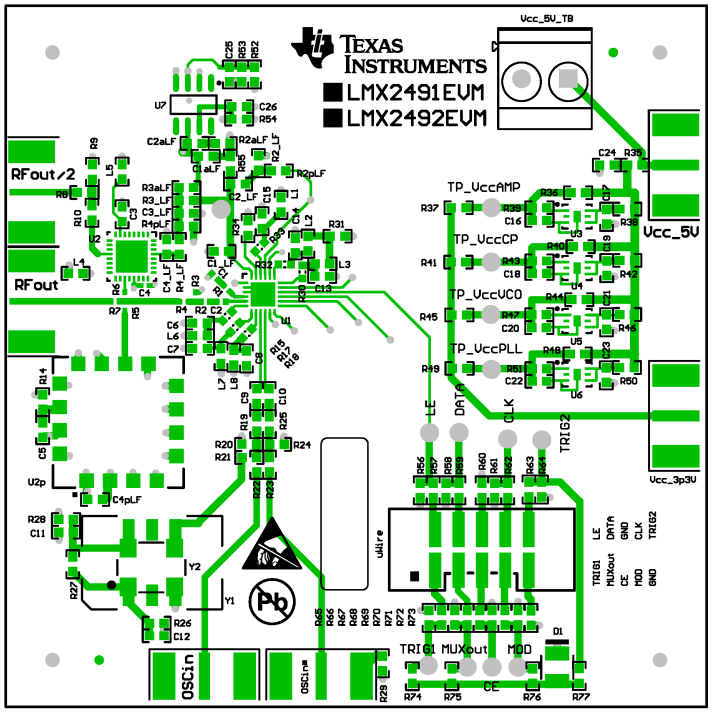


Figure 20. Top Layer

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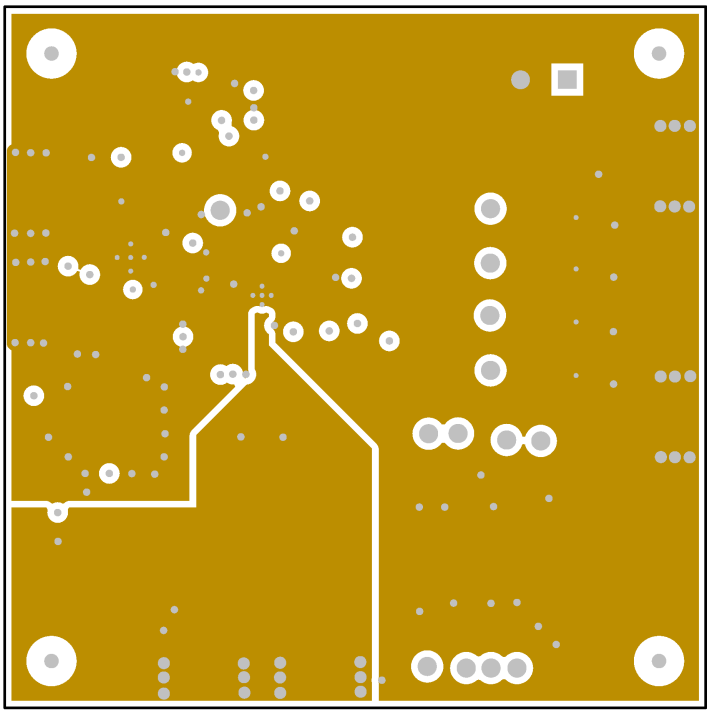


Figure 21. GND Layer

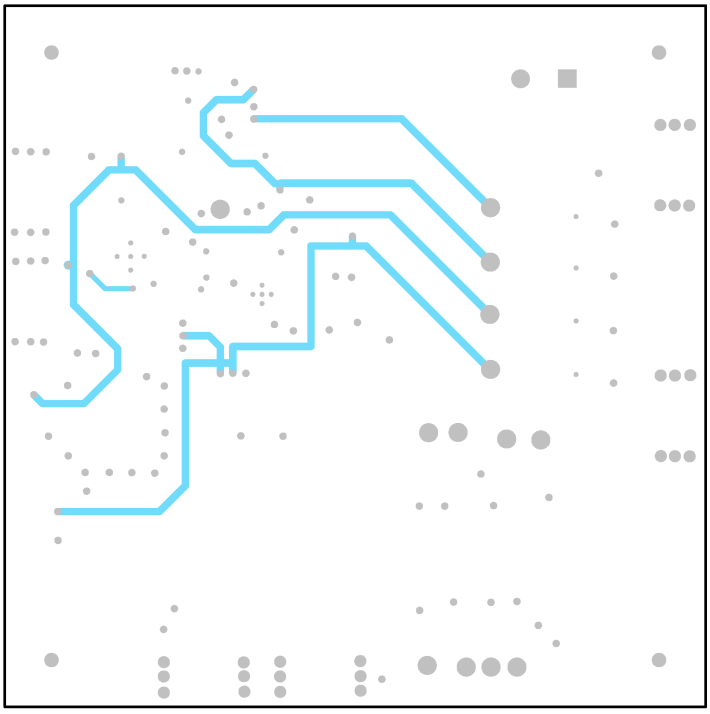


Figure 22. Power Layer

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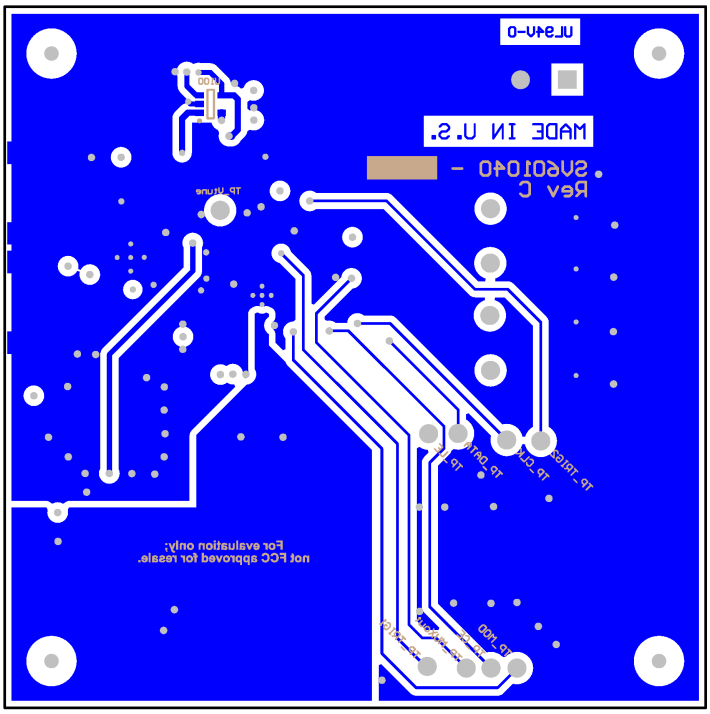


Figure 23. Bottom Layer

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6 Bill of Materials

Table 2. Bill of Materials

DESIGNATOR	QUANTITY	DESCRIPTION	PART NUMBER	MANUFACTURER
C1, C2	2	CAP, CERM, 10 pF, 50 V, ±5%, C0G/NP0, 0402	500R07S100JV4T	Johanson Technology
C1_LF	1	CAP, CERM, 68 pF, 50 V, ±5%, C0G/NP0, 0603	C0603C680J5GACTU	Kemet
C2_LF	1	CAP, CERM, 3900 pF, 50 V, ±5%, C0G/NP0, 0603	GRM1885C1H392JA01D	MuRata
C3, C11	2	CAP, CERM, 1 µF, 16 V, ±10%, X7R, 0603	C1608X7R1C105K	TDK
C3_LF	1	CAP, CERM, 150 pF, 50 V, ±5%, C0G/NP0, 0603	C0603C151J5GACTU	Kemet
C4	1	CAP, CERM, 0.1 µF, 50 V, ±10%, C0G/NP0, 0402	C1005X7R1H104K	TDK
C6, C7, C8, C9, C10	5	CAP, CERM, 0.1 µF, 16 V, ±5%, X7R, 0603	0603YC104JAT2A	AVX
C13, C14, C15	3	CAP, CERM, 100 pF, 50 V, ±5%, C0G/NP0, 0603	C0603C101J5GACTU	Kemet
C18, C20, C22, C23, C24	5	CAP, CERM, 10 µF, 6.3 V, ±20%, X5R, 0603	C0603C106M9PACTU	Kemet
D1	1	LED, Green, SMD	SML-LX2832GC-TR	Lumex
L1, L2, L3, L4, L5, L6, L7, L8	8	3 A Ferrite Bead, 120 Ω @ 100 MHz, SMD	BLM18SG121TN1D	MuRata
OSCin, Vcc_5V	2	Connector, SMT, End launch SMA 50 Ω	142-0701-851	Emerson Network Power Connectivity
R1	1	RES, 51 Ω, 5%, 0.063 W, 0402	CRCW040251R0JNED	Vishay-Dale
R2, R6, R7	3	RES, 18 Ω, 5%, 0.063 W, 0402	CRCW040218R0JNED	Vishay-Dale
R2_LF	1	RES, 390 Ω, 5%, 0.1 W, 0603	CRCW0603390RJNEA	Vishay-Dale
R3	1	RES, 68 Ω, 5%, 0.063 W, 0402	CRCW040268R0JNED	Vishay-Dale
R3_LF	1	RES, 150 Ω, 5%, 0.1 W, 0603	CRCW0603150RJNEA	Vishay-Dale
R4	1	RES, 36 Ω, 5%, 0.063 W, 0402	CRCW040236R0JNED	Vishay-Dale
R4_LF, R15, R17, R18, R29, R30, R31, R32, R33, R35, R40, R44, R51, R60	14	RES, 0 Ω, 5%, 0.1 W, 0603	CRCW06030000Z0EA	Vishay-Dale
R8, R10, R19, R21, R22, R23, R25, R50	8	RES, 18 Ω, 5%, 0.1 W, 0603	CRCW060318R0JNEA	Vishay-Dale
R9, R20, R24	3	RES, 68 Ω, 5%, 0.1 W, 0603	CRCW060368R0JNEA	Vishay-Dale
R28	1	RES, 10 Ω, 5%, 0.1 W, 0603	CRCW060310R0JNEA	Vishay-Dale
R56, R58, R61, R64, R65, R70, R72	7	RES, 12k Ω, 5%, 0.1 W, 0603	CRCW060312K0JNEA	Vishay-Dale
R57, R59, R62, R63, R66, R69, R71	7	RES, 10k Ω, 5%, 0.1 W, 0603	CRCW060310K0JNEA	Vishay-Dale
R75	1	RES, 330 Ω, 5%, 0.1 W, 0603	RC0603JR-07330RL	Yageo America
RFout, RFout/2	2	Connector, SMT, End launch SMA 50 Ω	142-0701-851	Emerson Network Power
U1	1	500 MHz to 14 GHz Wideband, Low Noise Fractional N PLL With Ramp/Chirp Generation	LMX2492QRTWRQ1	Texas Instruments
U2	1	Voltage Controlled Oscillator 9.4 - 10.8 GHz	MAOC-009265-TR0500	MACOM
U6	1	Ultra Low Noise, 150 mA Linear Regulator for RF/Analog Circuits Requires No Bypass Capacitor	LP5900SD-3.3	Texas Instruments
uWire	1	Header (shrouded), 100mil, 5x2, Gold plated, SMD	52601-S10-8LF	FCI
Y2	1	OSC 100.0000 MHz 3.3 V ±25 PPM SMD	CWX813-100.0M	Connor-Winfield

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7 Troubleshooting Guide

If the EVM does not work as expected, use the following chart to identify potential root causes. Couples of thing to note:

- Make modifications to the EVM or change the default settings until AFTER it is verified to be working.
- Register readback requires the correct hardware and software setup. See Section 3.2.4 for details.
- The POR current of the LMX2492EVM is approximately 175 mA.
- The powerdown current of the LMX2492EVM is approximately 175 mA.

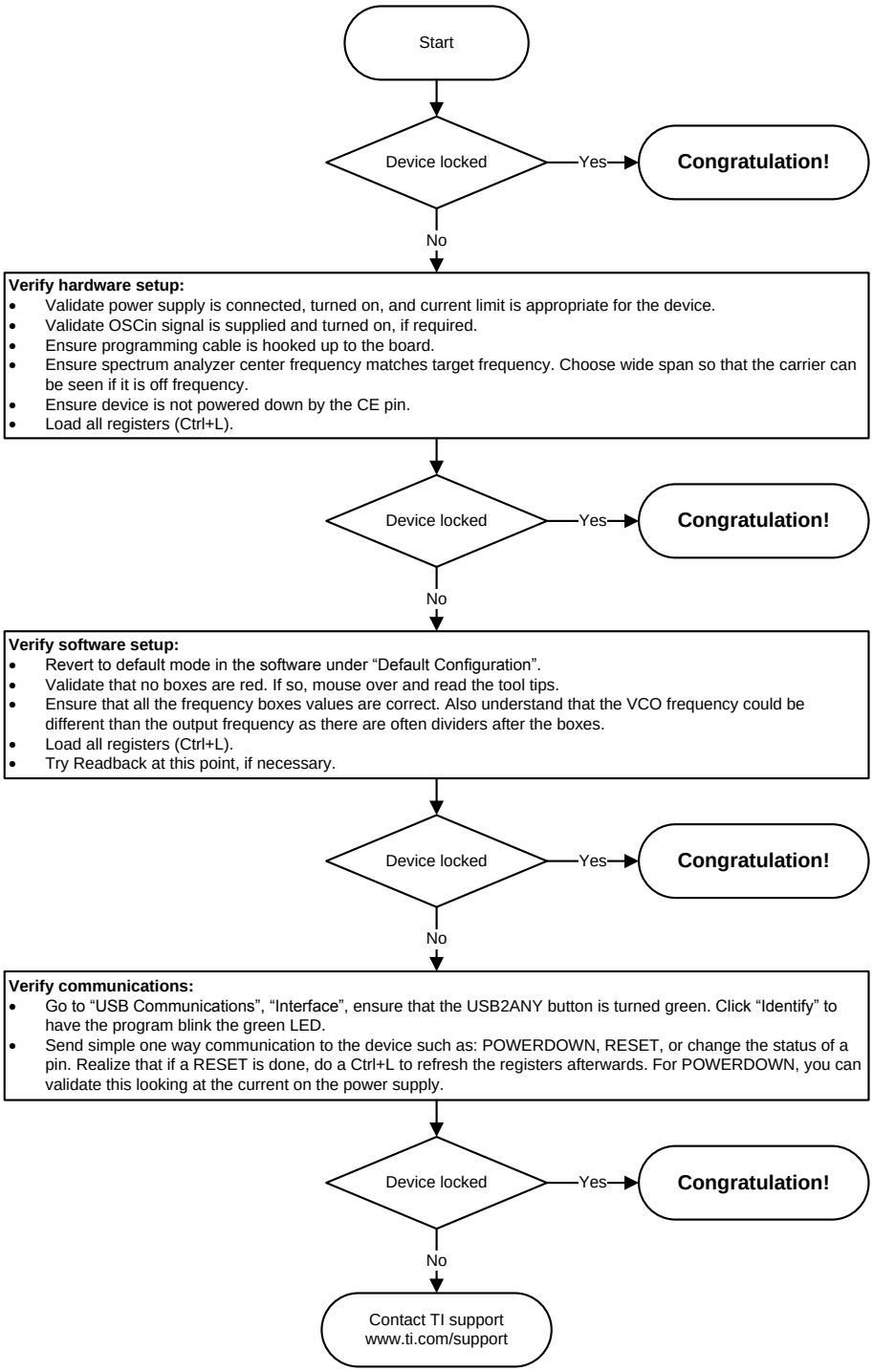


Figure 24. Troubleshooting Guide

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USB2ANY Firmware Upgrade

Usually when the USB2ANY module 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 USB2ANY module is properly setup, otherwise the programming to LMX2492EVM will not be successful.

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

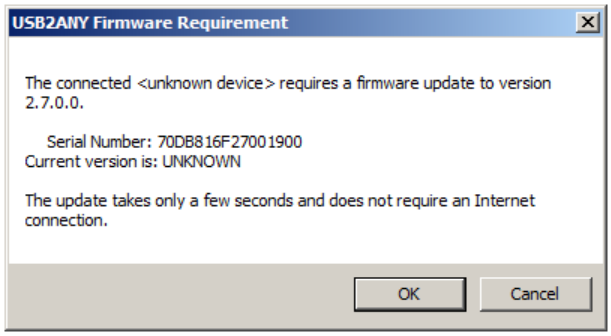


Figure 25. Firmware Requirement

2. Next, follow the on-screen procedure.

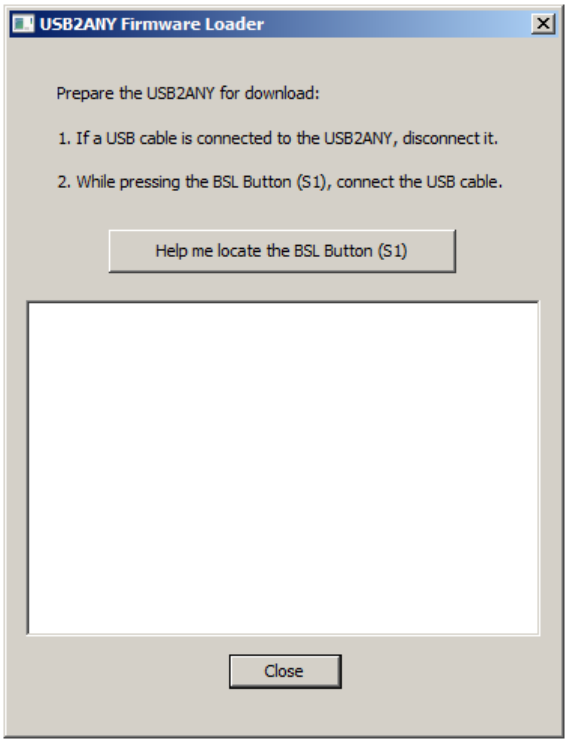


Figure 26. Firmware Loader

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3. If you don't know the location of the BSL button, click the long button in the middle of the screen.

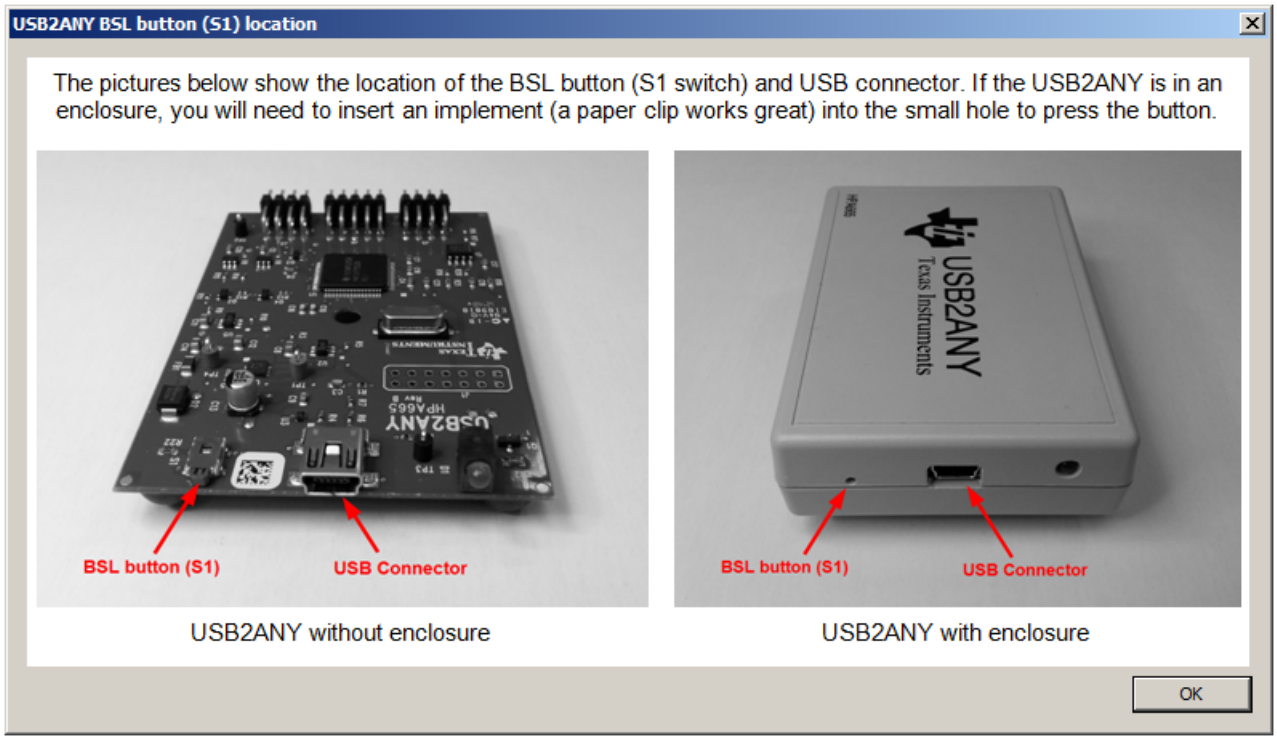


Figure 27. BSL Button

4. Click the "OK" button to go back to the previous screen. Follow the on-screen procedure until the below screen is pop-up.

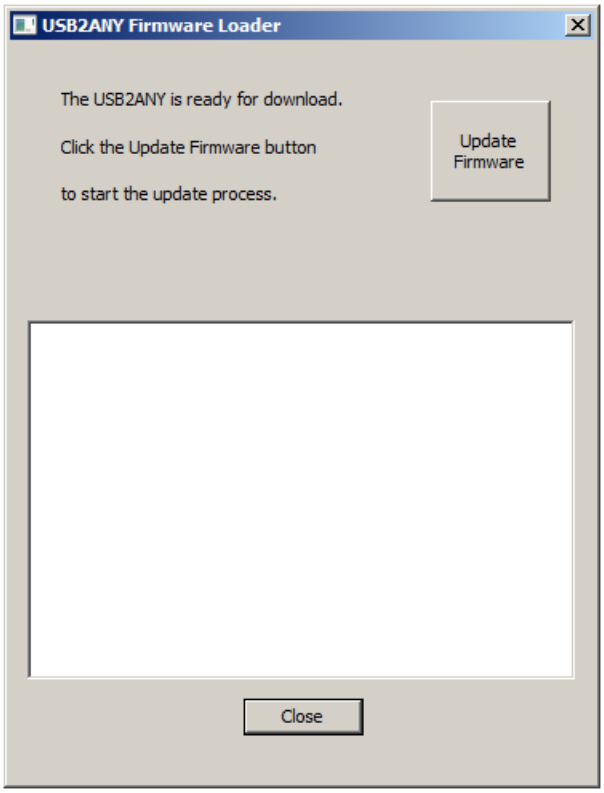


Figure 28. Update Firmware

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5. Click the "Upgrade Firmware" button, the firmware will be upgrading. Click the "Close" button after it is done.

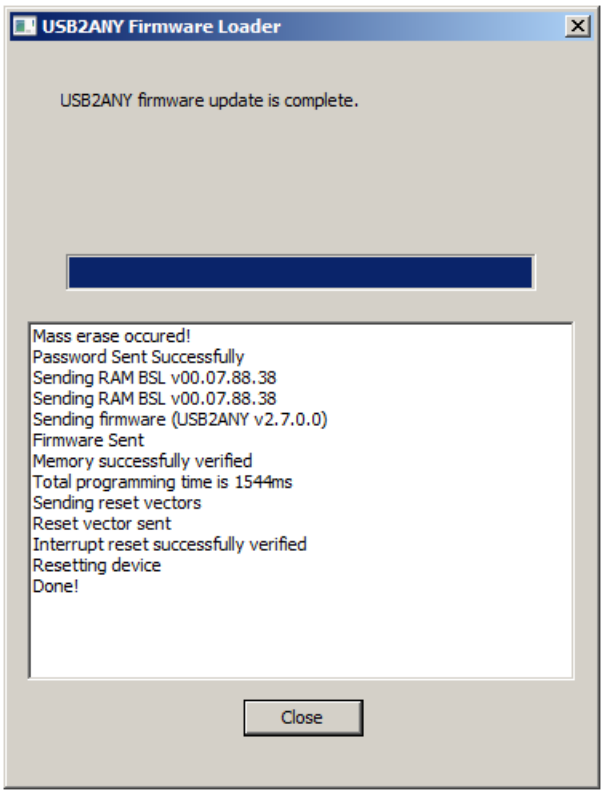


Figure 29. Firmware Update Completed

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

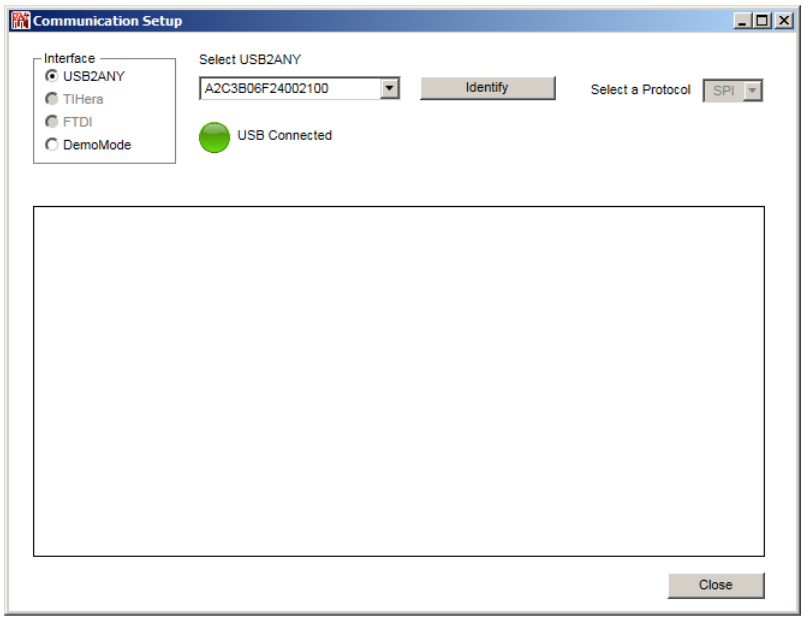


Figure 30. USB Communications

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Using Different Reference Clock

There are different options to provide a reference clock to LMX2492EVM. By default, the EVM is configured for the on-board single-ended XO clock. To use external clock, R21 and R28 must be removed. If external differential clock is desired, OSCin* SMA connector is required.

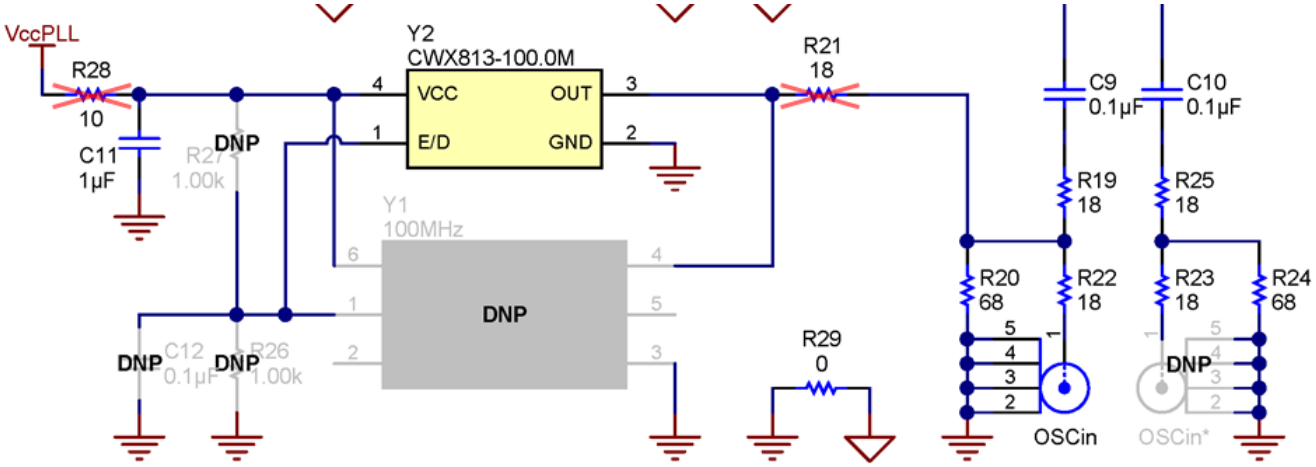


Figure 31. Reference Clock Input Configuration

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Revision History

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

Changes from D Revision (September 2015) to E Revision	Page
• Changed to use on-board XO	4
• Changed to use TICS Pro to program the device	4
• Changed VCO frequency and VCO gain	6
• Changed U2 part number	17
• Added Appendix A	19
• Added Appendix B	22

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- *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.*
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