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X-Microwave Getting Started Plate

XM-RDK-200

User Manual

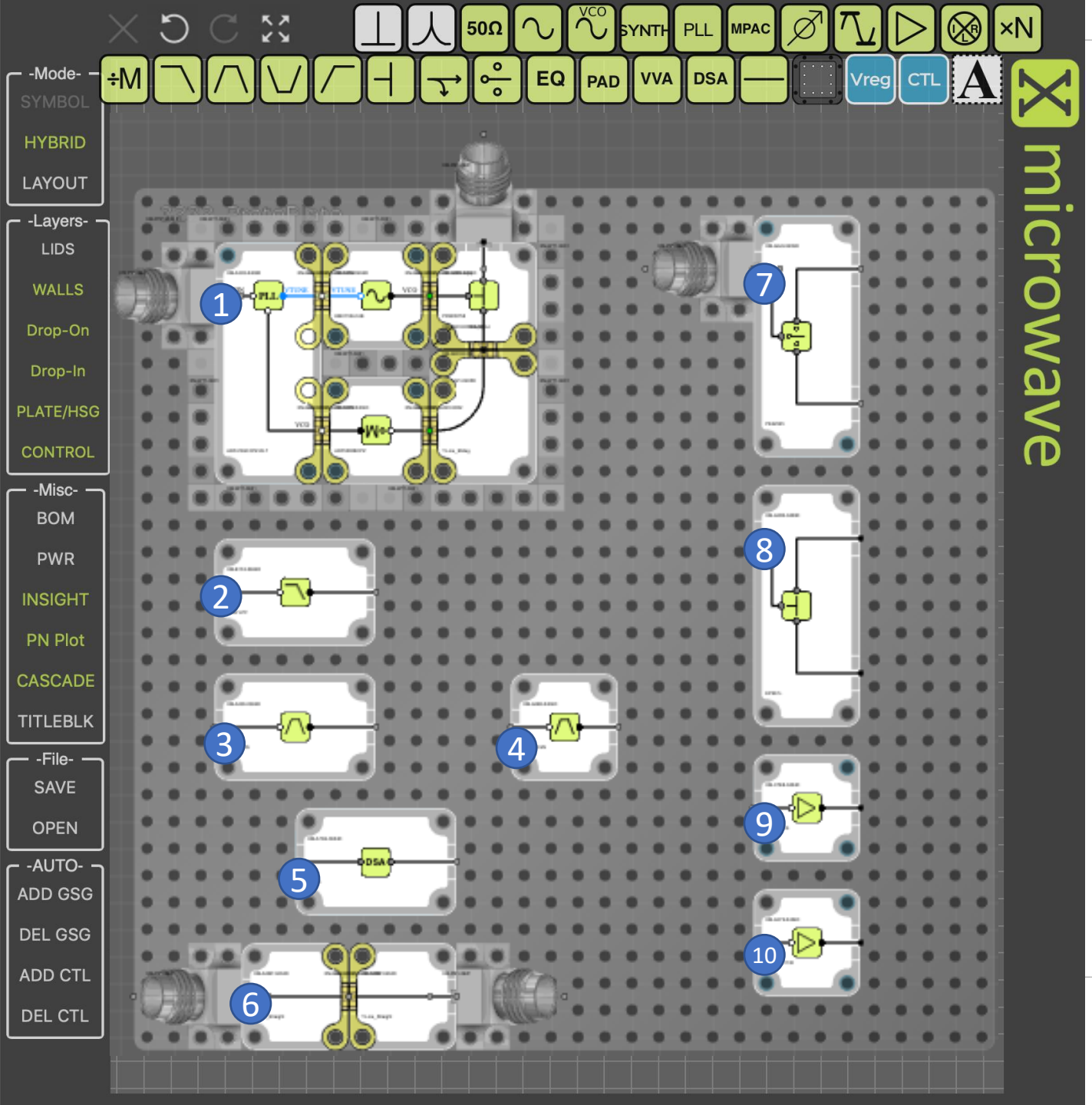
For support contact: sales@quanticxmw.com +1.512.355.7115

This product uses semiconductors that can be damaged by electrostatic discharge (ESD).
When handling, care must be taken so that the devices are not damaged.

- Wear ground foot or wrist straps and use a grounded anti-static mat to cover your work surface
- Always discharge yourself by touching a grounded bare metal surface before picking up the plate

Change Log

Date	Impacted PN	Change (Reason)	By
Sep 1, 2020	XM-RDK-200	Replace (9) 15.5dB Amp, XM-A3A2-0404D, Custom MMIC CMD197C4, [PCB 320], F=1G-24G with With (9) 15.5dB Amp, XM-C7E8-0404D, Custom MMIC CMD317C4 [PCB: 320], F=1G-22G (due to end of life of CMD197C4)	Luther
Sep 1, 2020	XM-RDK-200	Replace (2) Band Pass Filter, XM-A275-1204D, [PCB 044] CF=640MHz BW=39M With (2) Low Pass Filter, XM-B1F4-0604D, [PCB 0976], F=DC-177.5M (Improve lead time of the getting started plate)	Luther
Sep 17, 2021	XM-RDK-200	Corrected voltage levels, OpAmp Voltage = A1=+25.2VDC with changes to PLL(XM-A3X3-0409D-04 version used) and PLL bias board A4G7 changed to A746. Moved Amp(10) to use +9V input. Updated pictures and wiring diagram. Corrected labels on slides. Added A3X3 quick start guide, UXA measurements, and appendix with PLL parameters. Fixed broken hyperlinks on XM Getting Started Guide.	Tillman



Getting Started Proto Plate

(1) Synthesizer
PLL, XM-A3X3-0409D-04, ADI ADF4169CCPZ-RL7, [PCB 0357], F=500M – 13.5G
VCO, XM-A353-0404D, ADI HMC733LC4B, [PCB 0234] F=10G-20G
Divide x2, XM-A5P2-0404D, ADI ADF5000BCPZ, [PCB 0206], F=4G-18G
2-Way Splitter, XM-A2B1-0404D, DLI PDW05758, [PCB 166], F=4.5G-18G

(2) Lumped Element Filter
Low Pass Filter, XM-B1F4-0604D, [PCB 0976], F=DC-177.5M

(3,4) Planar Filters
(3) Band Pass Filter, XM-A265-0604D, DLI AFL05158, [PCB 079], CF=15G BW=7.5G
(4) Band Pass Filter, XM-A2B3-0404D, DLI B096QC2S [PCB 082], CF=10G BW=5.4G

(5) Digital Step Attenuator

DSA, XM-A7D4-0604D, IDT F1956, [PCB 0701], F=1M-6G, 31.75dB, 7bit

(6) Transmission Line w/ Interconnect
0404 Transmission Line, XM-A2M7-0404D, [PCB 306], F=DC-50 GHz

(7) Switch
SPDT Switch, XM-A6J9-0409D, pSemi PE42525, [PCB 0456], F=40M – 60GHz

(8) Splitter
2-Way Splitter, XM-A3R3-0409D, Mini-Circuits EP2K1+, [PCB 364B], F=2G-26.5G

(9,10) Amplifiers
(9) 15.5dB Amp, XM-C7E8-0404D, Custom MMIC CMD317C4 [PCB: 320], F=1G-22G
(10) 20dB Amp, XM-A3Y2-0404D, MACOM MAAL-011130, [PCB 403], F=2.4G-18.5G

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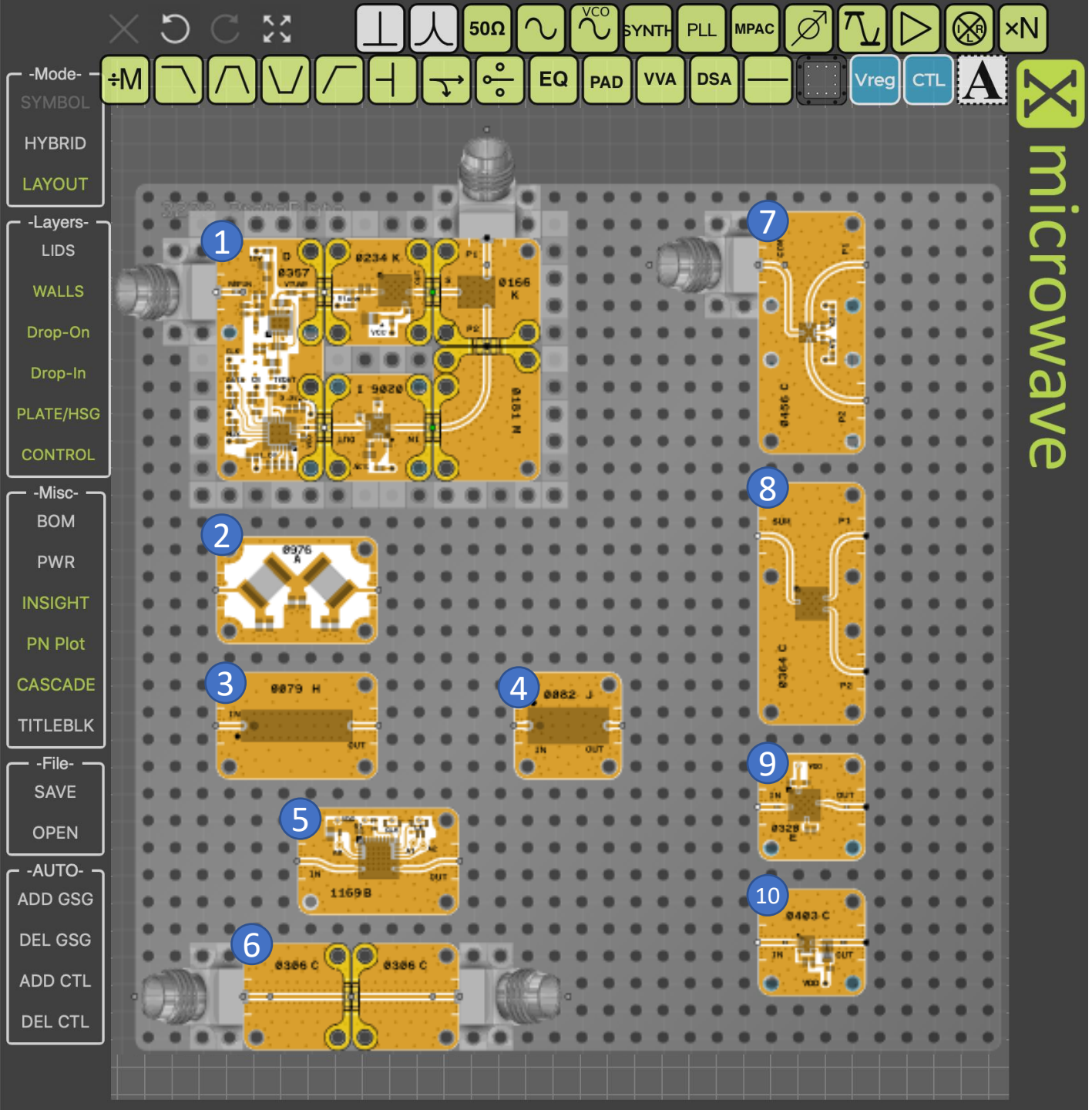
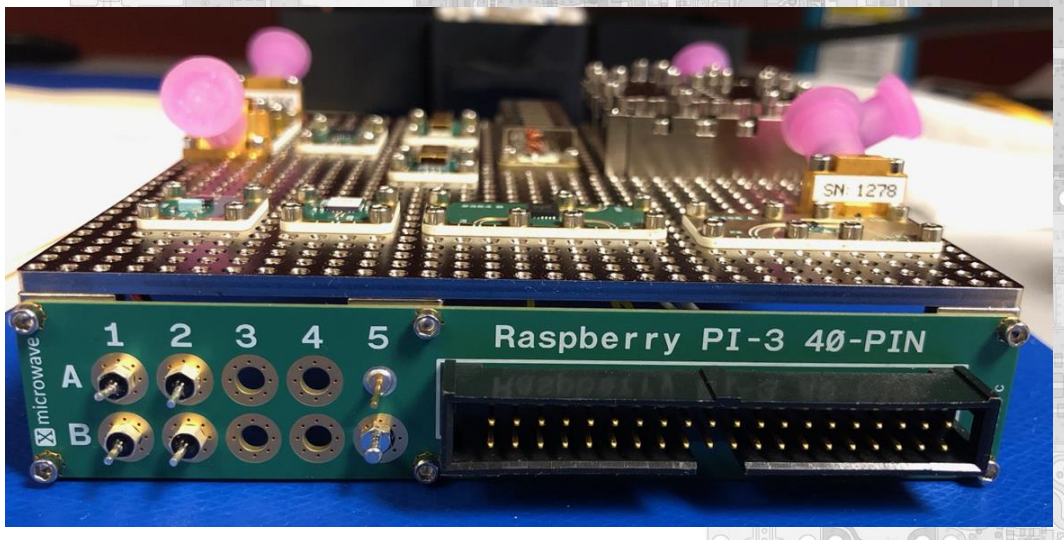




Powering the Prototyping Plate

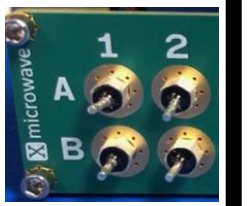
(A1) +25.2 VDC
PLL OpAmp(1)

(A2) +9 VDC
PLL(1), VCO(1), Divider(1), Amps(9,10)

(B1) +5 VDC
DSA(5), Switch-pos(7)

(B2) -5 VDC
Switch-neg(7)

Control Information (X-MWcontroller)



LE0 = XM-A3X3-0409D-04, PLL
LE 1 = XM-A7D4-0604D, DSA
PIN 7 = Switch Control Line (0VDC = P1 | 3.3VDC = P2)

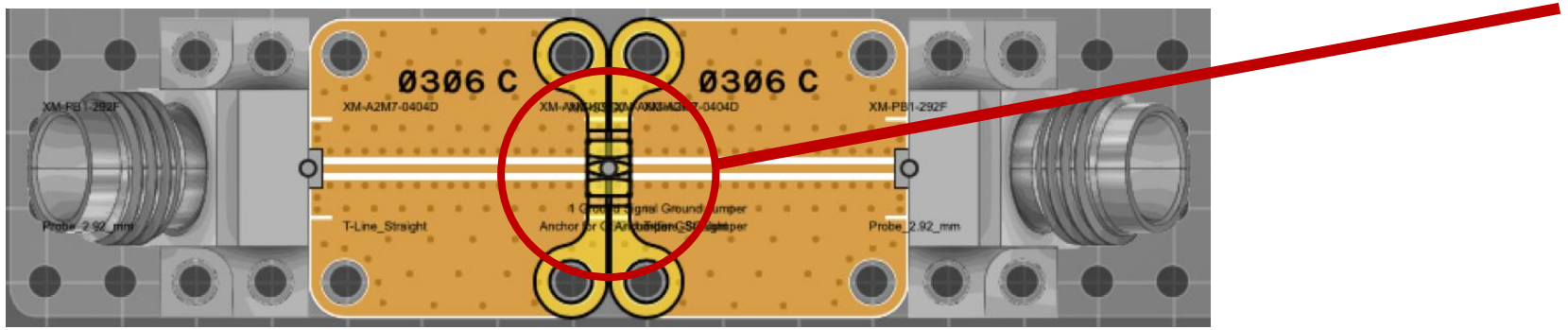
Recommended for your first measurement…

(6) Transmission Line

Note:
The 2.92 mm X-MWprobes provide high performance measurements from DC - 40 GHz. 1.85mm X-MWprobes are also available for measurements to 67 GHz.

Instructions

1. Attach network analyzer to RF ports
2. Set frequency range from DC – 67 GHz
3. Capture S2P of the transmission line



4. Probes can be moved to other devices

   ** Review the getting started guide for best practices. **
5. Repeat measurements as desired for filters (2), (3), (4)
6. Apply power (+9V DC to A2) and move probes to Measure gain of amplifiers (9), (10)

**Download the X-MWsystem Getting Started Guide to learn more about the X-MW System

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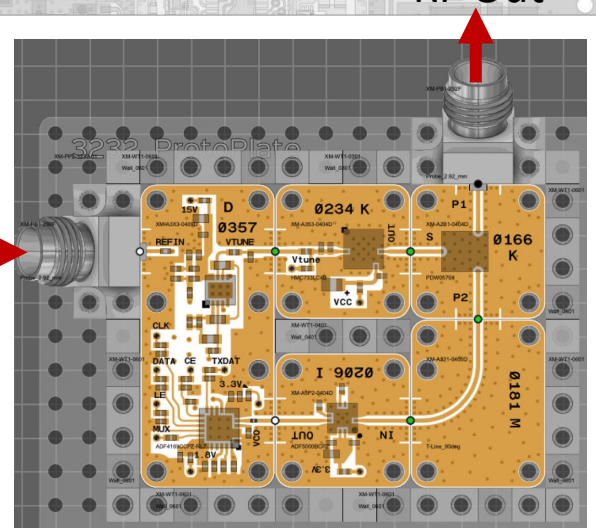
(1) Synthesizer



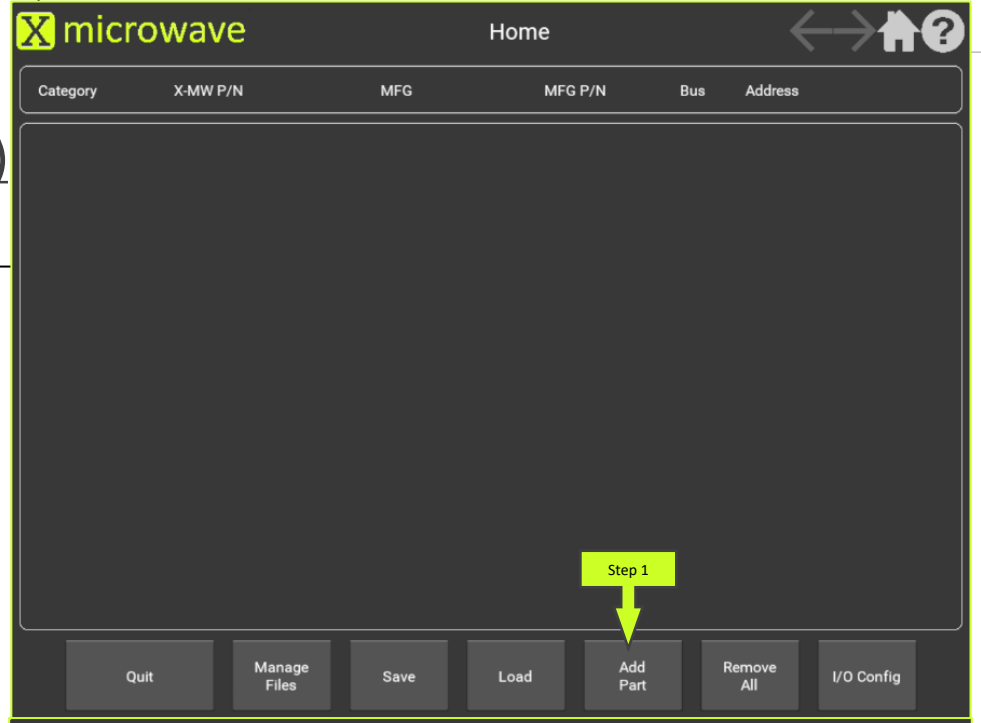
Instructions

1. Attach the X-MWcontroller, 40 pin IDC Cable
2. Prepare to generate a 100 MHz @ 0dBm @ Ref In X-MWprobe
3. Attach spectrum analyzer to splitter output X-MWprobe
4. Power the circuit (A1) +25.2 VDC, (A2) +9V VDC & enable 100 MHz Reference
5. Program the XM-A3X3-0409D-04, ADI ADF4169CCPZ-RL7** using the following slides as a step-by-step guide.

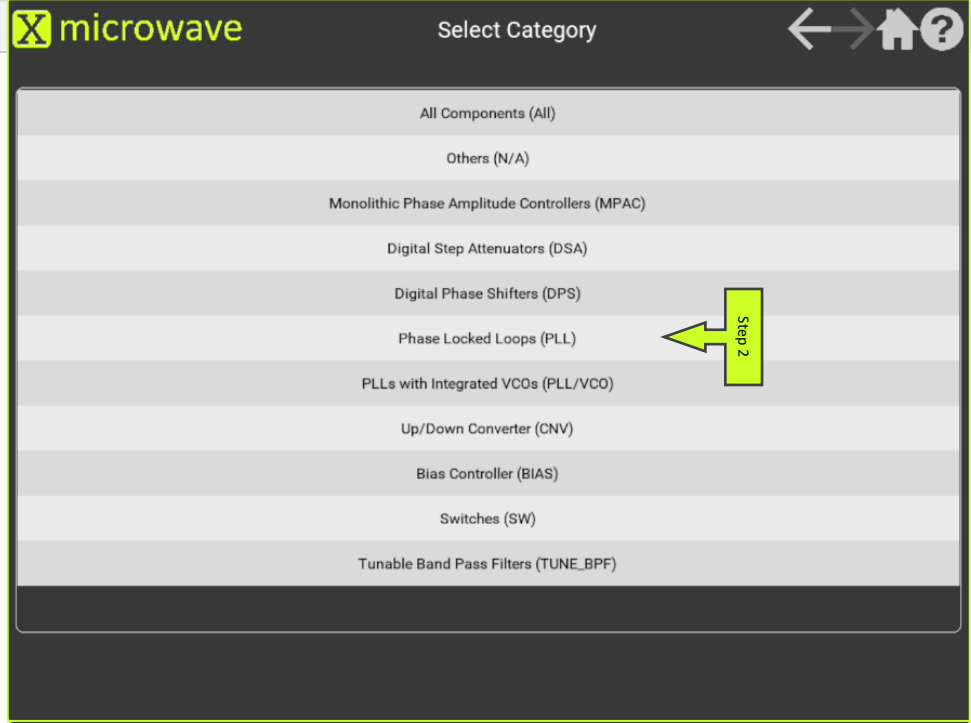
**Download the X-MWsystem Getting Started Guide to learn more about the X-MW System

Programming the Synthesizer(1) (Case 1)

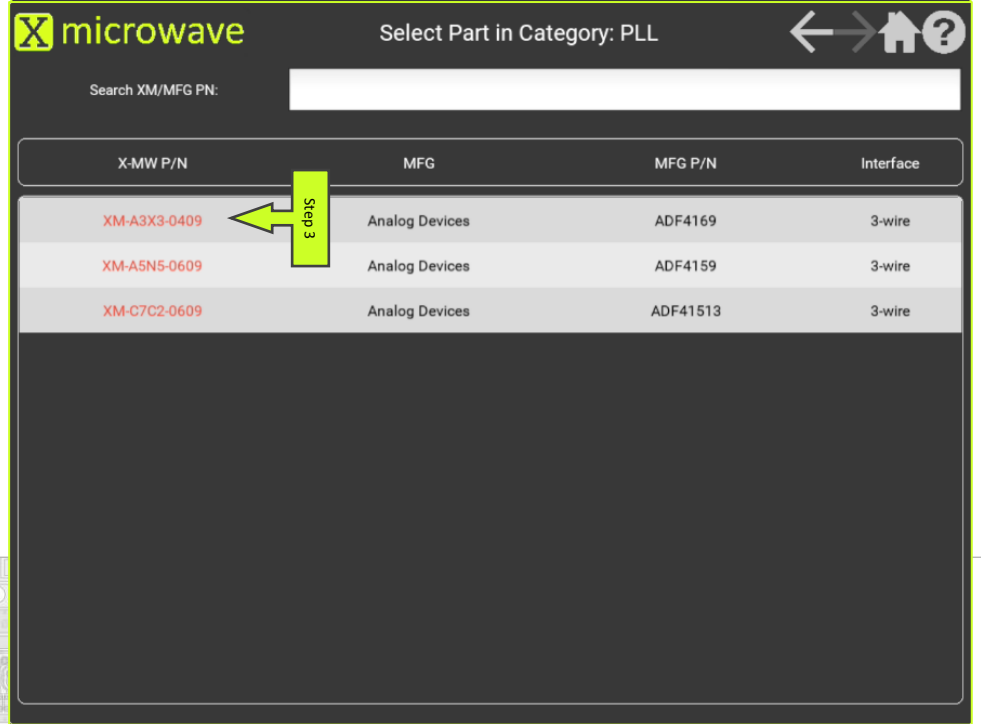
Step 1.)
Once the Raspberry Pi powers up, Select ‘Add Part’.



Step 2.)
Next select ‘Phase Locked Loops (PLL)’.

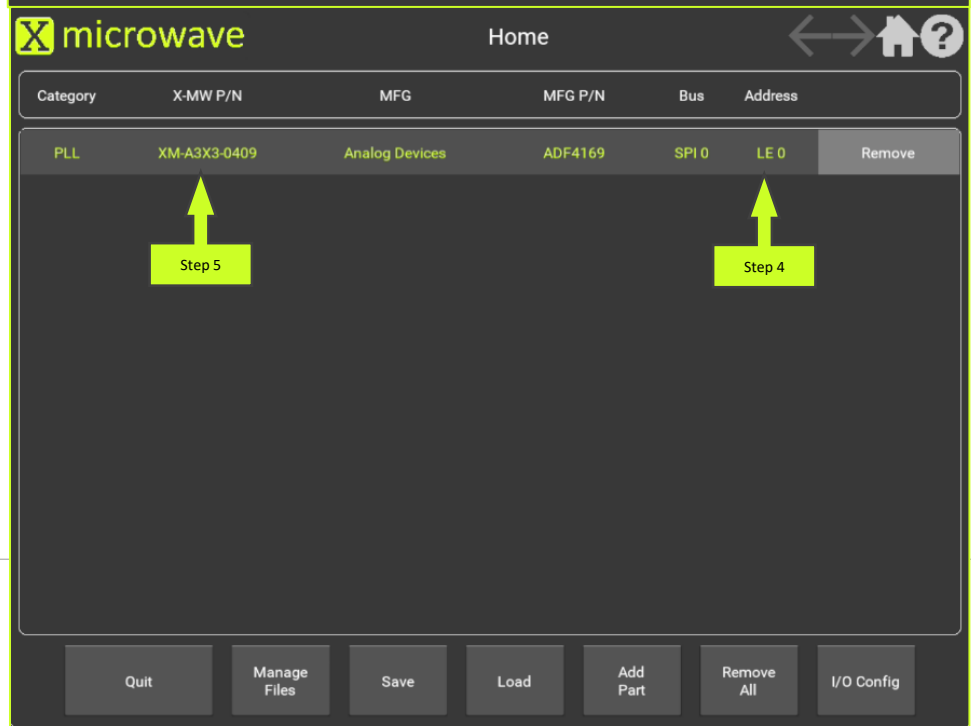


Step 3.)
Next select the PLL being used, ‘XM-A3X3-0409’.

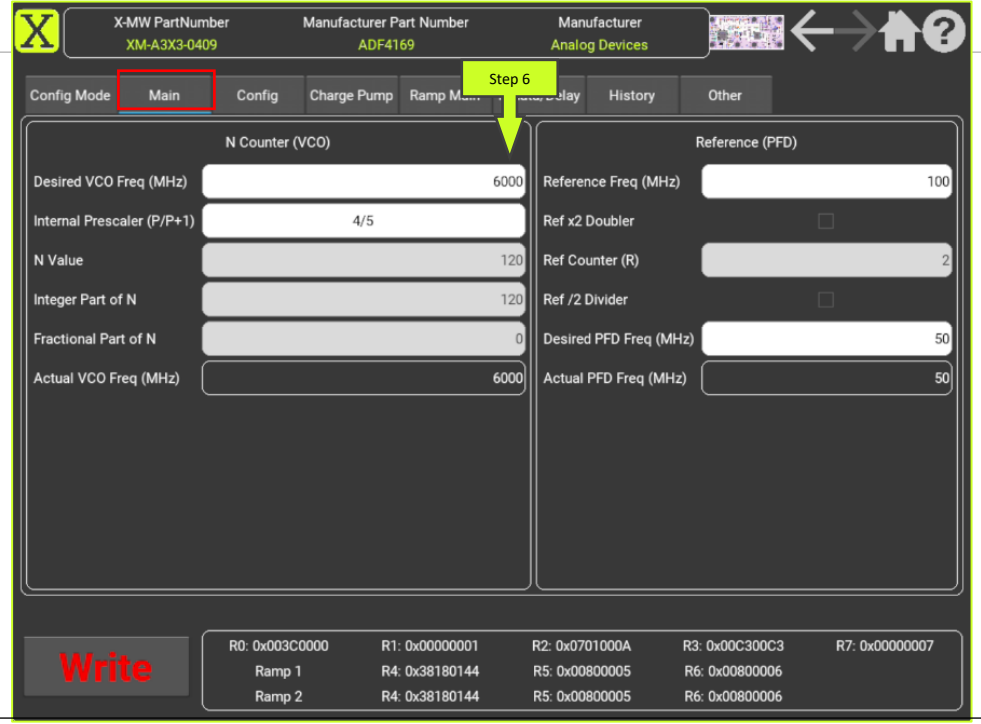


Step 4.)
Ensure that ‘Address’ is set to ‘LE 0’. If this criteria is not met, visit the Appendix to see how to change this setting.

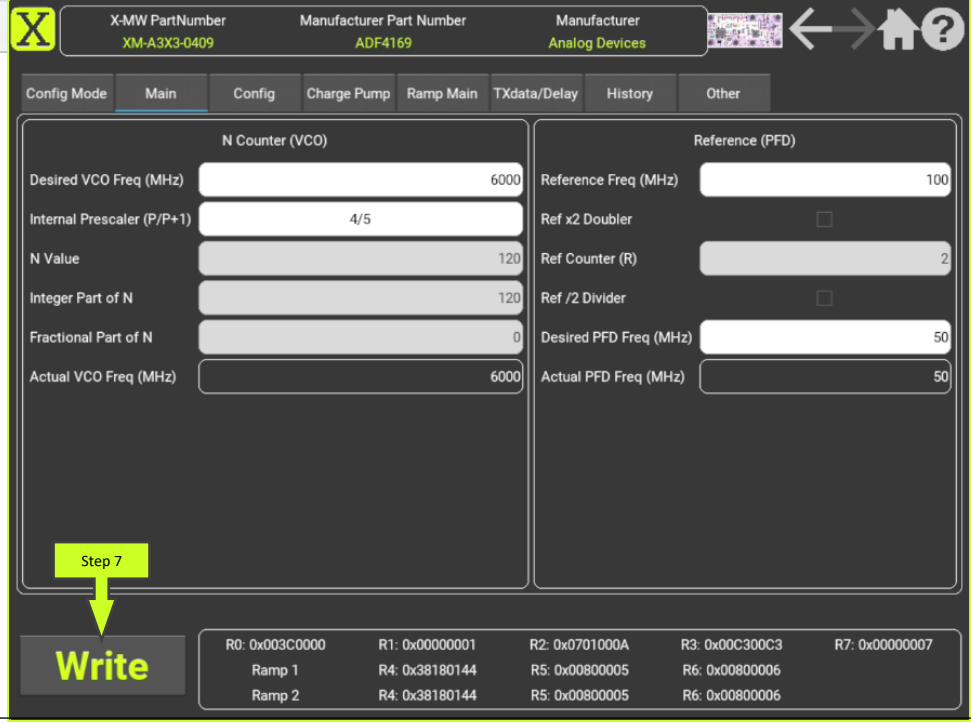
Step 5.)
Click on the PLL that was just added to interact with the settings.



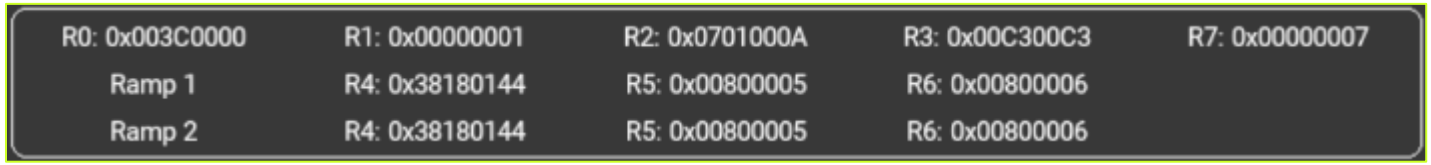
Step 6.)
Navigate to the ‘Main’ tab. The default setting on ‘Desired VCO Freq’ is set to 6000MHz. Sending this command to the synthesizer(1) will lock the output to 12GHz.



Step 7.)
Select the ‘Write’ button. The text should turn green once the command is sent to the device.

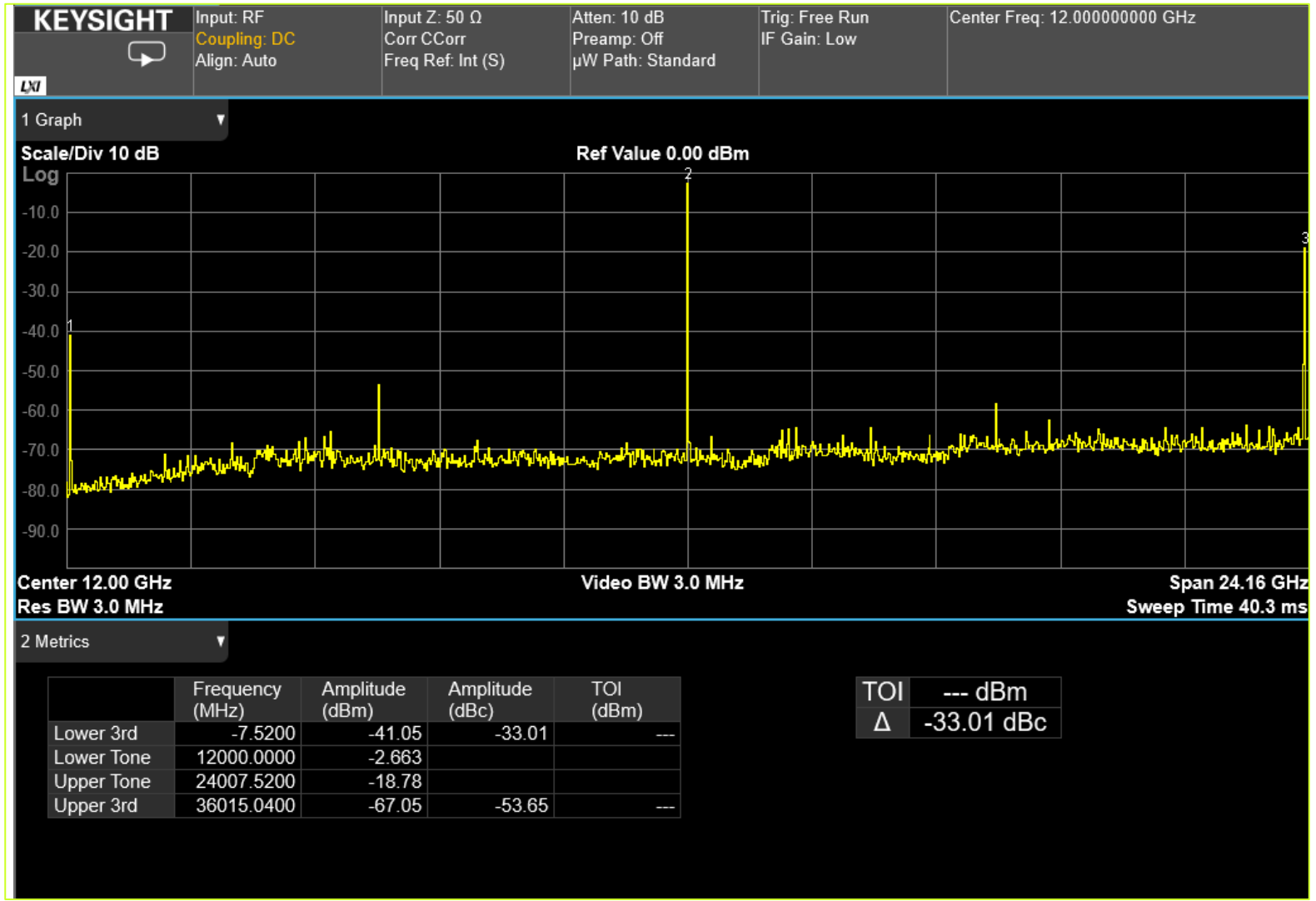


The following registers will be written to the chip:

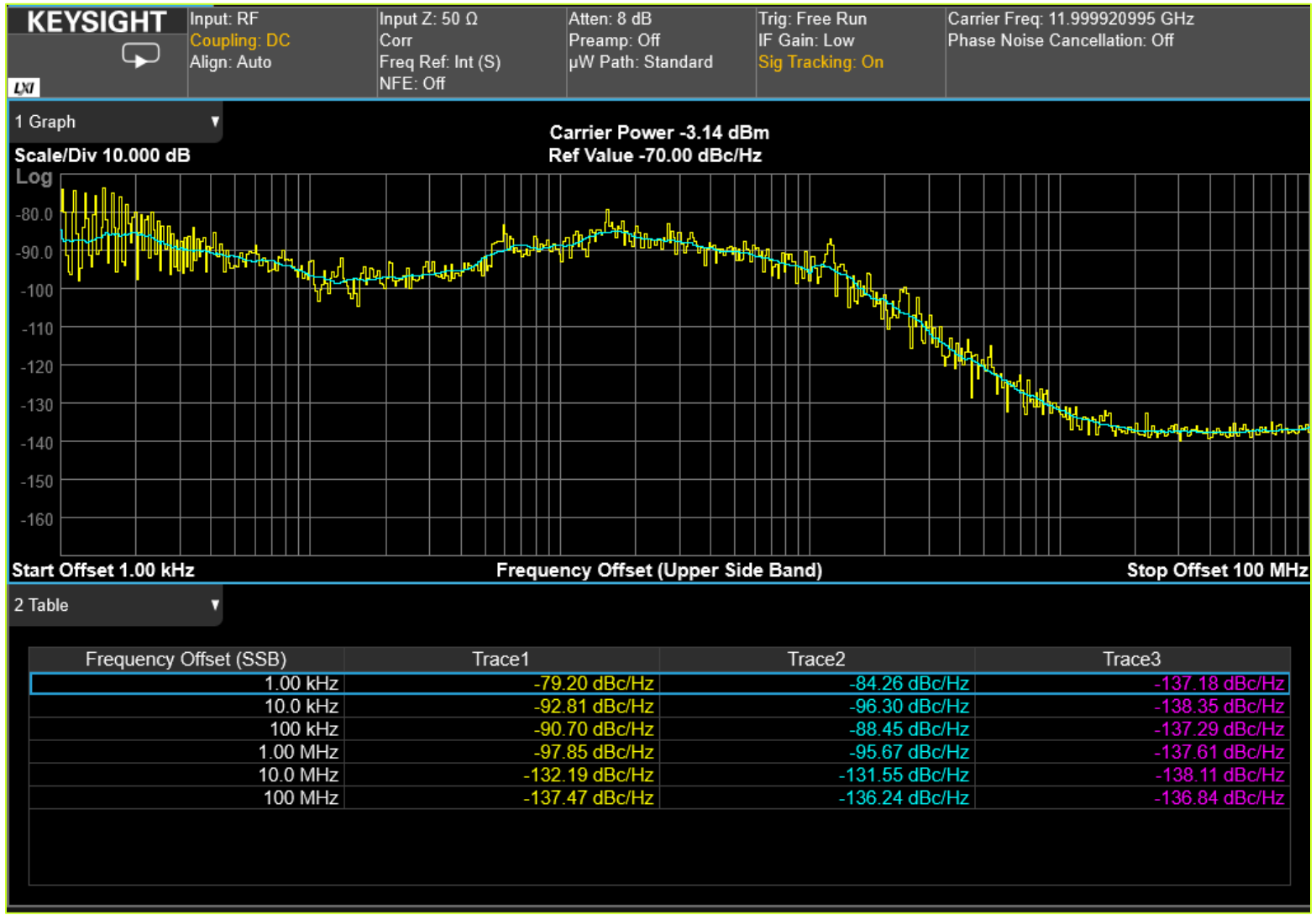


Register	Values
R0	0x003C0000
R1	0x00000001
R2	0x0701000A
R3	0x00C300C3
R4	0x38180144
R5	0x00800005
R6	0x00800006
R7	0x00000007

(1) Synthesizer Output (Case 1) – 12GHz



(1) Synthesizer Phase Noise (Case 1) – 12GHz



Frequency Offset (SSB)	Trace1	Trace2	Trace3
1.00 kHz	-79.20 dBc/Hz	-84.26 dBc/Hz	-137.18 dBc/Hz
10.0 kHz	-92.81 dBc/Hz	-96.30 dBc/Hz	-138.35 dBc/Hz
100 kHz	-90.70 dBc/Hz	-88.45 dBc/Hz	-137.29 dBc/Hz
1.00 MHz	-97.85 dBc/Hz	-95.67 dBc/Hz	-137.61 dBc/Hz
10.0 MHz	-132.19 dBc/Hz	-131.55 dBc/Hz	-138.11 dBc/Hz
100 MHz	-137.47 dBc/Hz	-136.24 dBc/Hz	-136.84 dBc/Hz

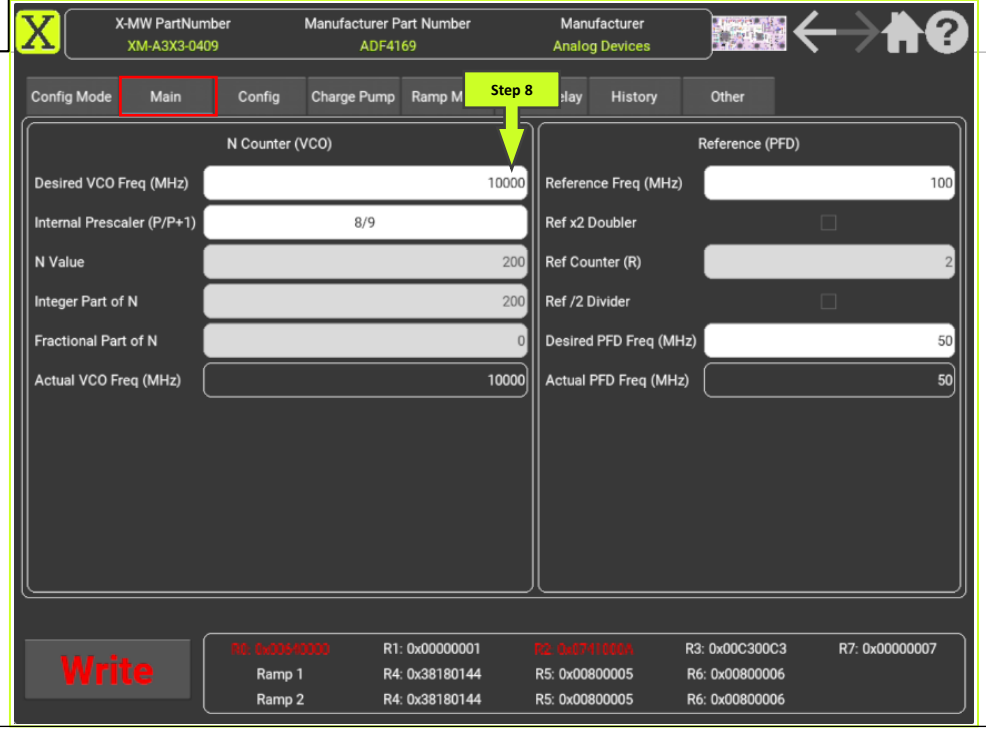
(1) Synthesizer Programming Continued

Instructions continued:

6. To change the output frequency, set the ‘Desired VCO Freq’ to ½ of the actual desired frequency.
   - Case 1: Enter 6000MHz, Read 12000MHz (shown previously)
   - Case 2: Enter 10000MHz, Read 20000MHz
7. If the ‘Desired VCO Freq’ is higher than 8GHz the ‘Internal Prescaler’ must be adjusted to ‘8/9’. Case 2 is shown in the following slides.

(Case 2)

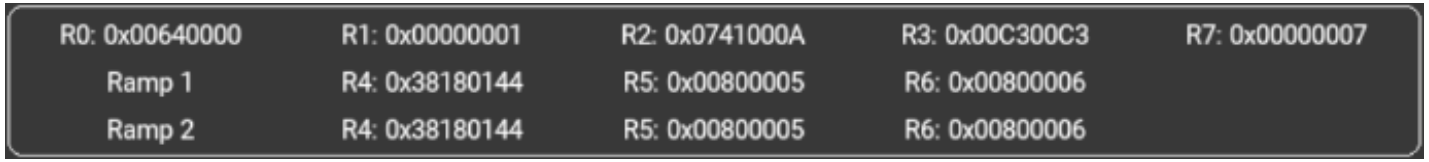
Step 8.)
Navigate to the ‘Main’ tab. Change the ‘Desired VCO Freq’ to ‘10000MHz’ which will output ‘20000MHz’.



Step 9.)
When changing the ‘Desired VCO Freq’ above 8GHz, Change the ‘Internal Prescaler’ to ‘8/9’.

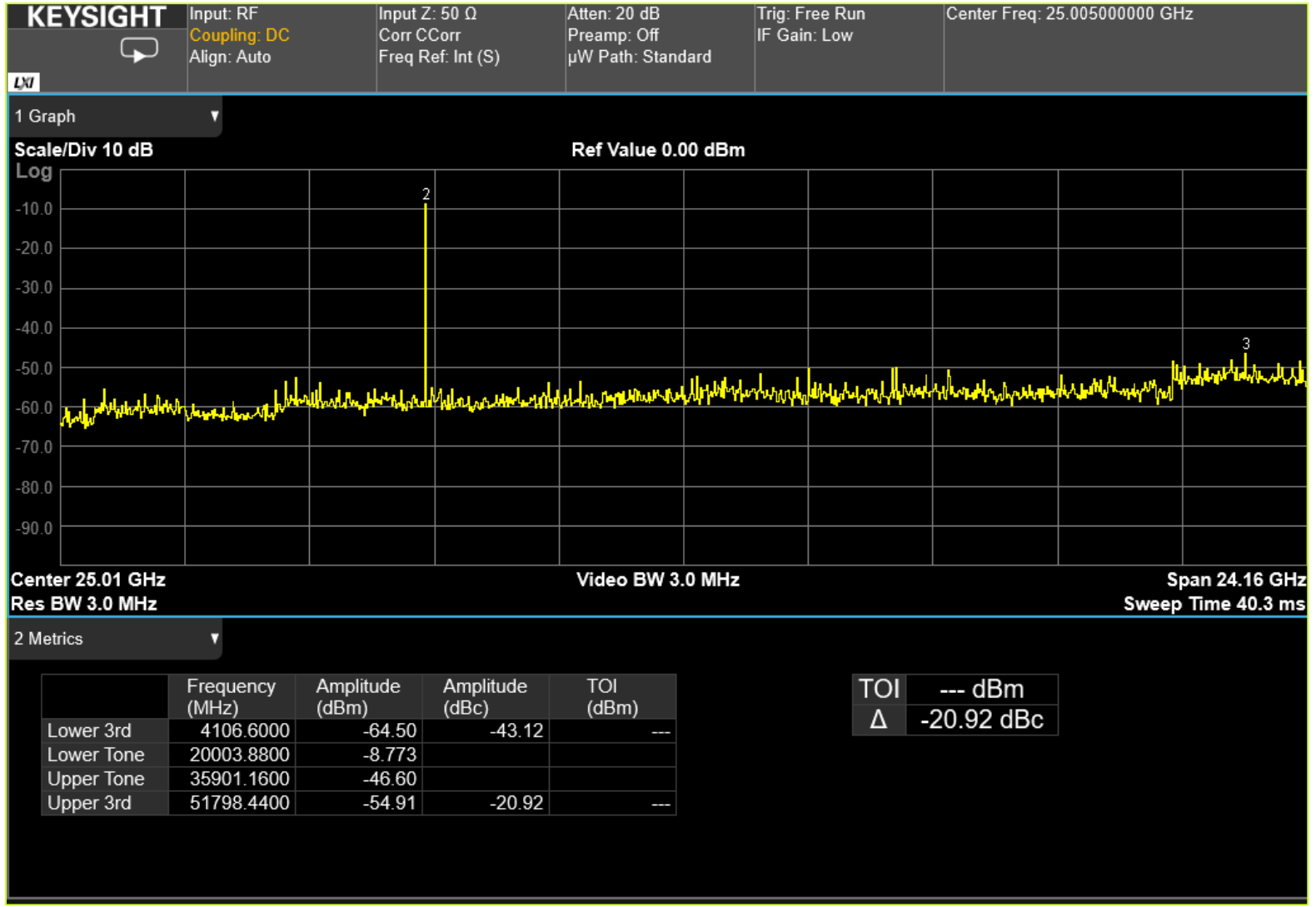
Step 10.) Press ‘Write’ to send the command to the synthesizer.

The following registers will be written to the chip:

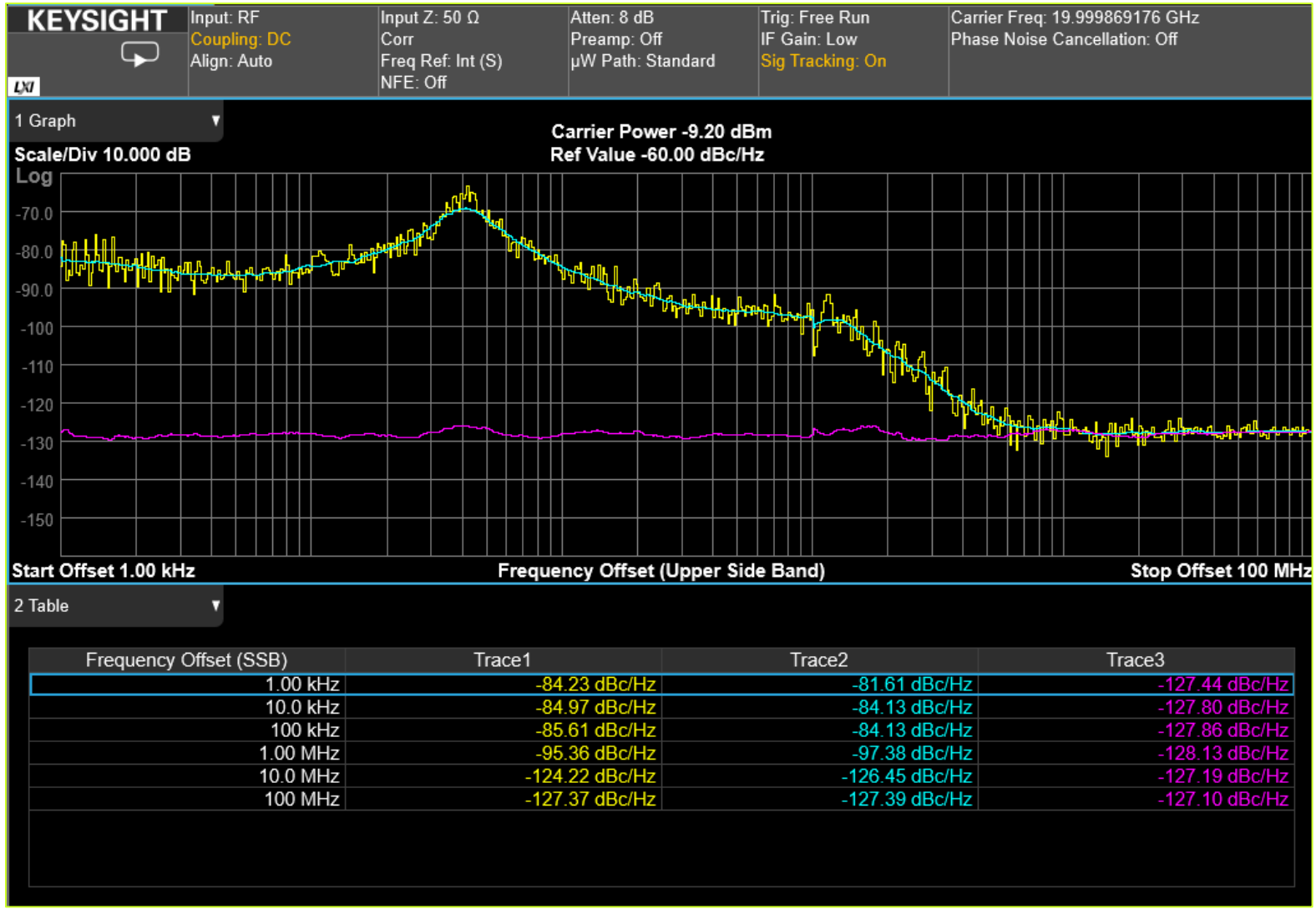


Register	Values
R0	0x00640000
R1	0x00000001
R2	0x0741000A
R3	0x00C300C3
R4	0x38180144
R5	0x00800005
R6	0x00800006
R7	0x00000007

(1) Synthesizer Output (Case 2) – 20GHz



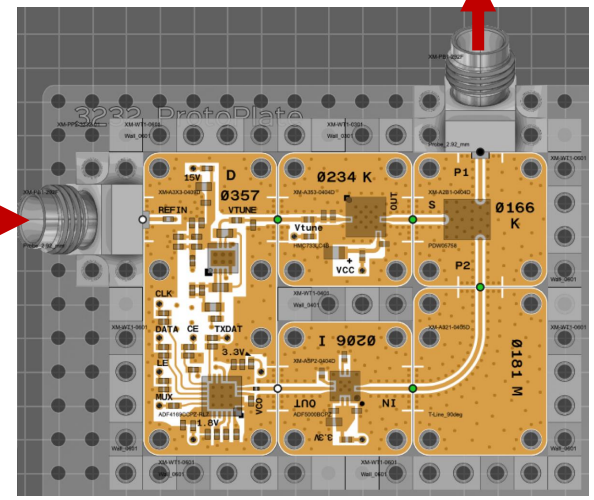
(1) Synthesizer Phase Noise (Case 2) – 20GHz



Frequency Offset (SSB)	Trace1	Trace2	Trace3
1.00 kHz	-84.23 dBc/Hz	-81.61 dBc/Hz	-127.44 dBc/Hz
10.0 kHz	-84.97 dBc/Hz	-84.13 dBc/Hz	-127.80 dBc/Hz
100 kHz	-85.61 dBc/Hz	-84.13 dBc/Hz	-127.86 dBc/Hz
1.00 MHz	-95.36 dBc/Hz	-97.38 dBc/Hz	-128.13 dBc/Hz
10.0 MHz	-124.22 dBc/Hz	-126.45 dBc/Hz	-127.19 dBc/Hz
100 MHz	-127.37 dBc/Hz	-127.39 dBc/Hz	-127.10 dBc/Hz

(1) Synthesizer

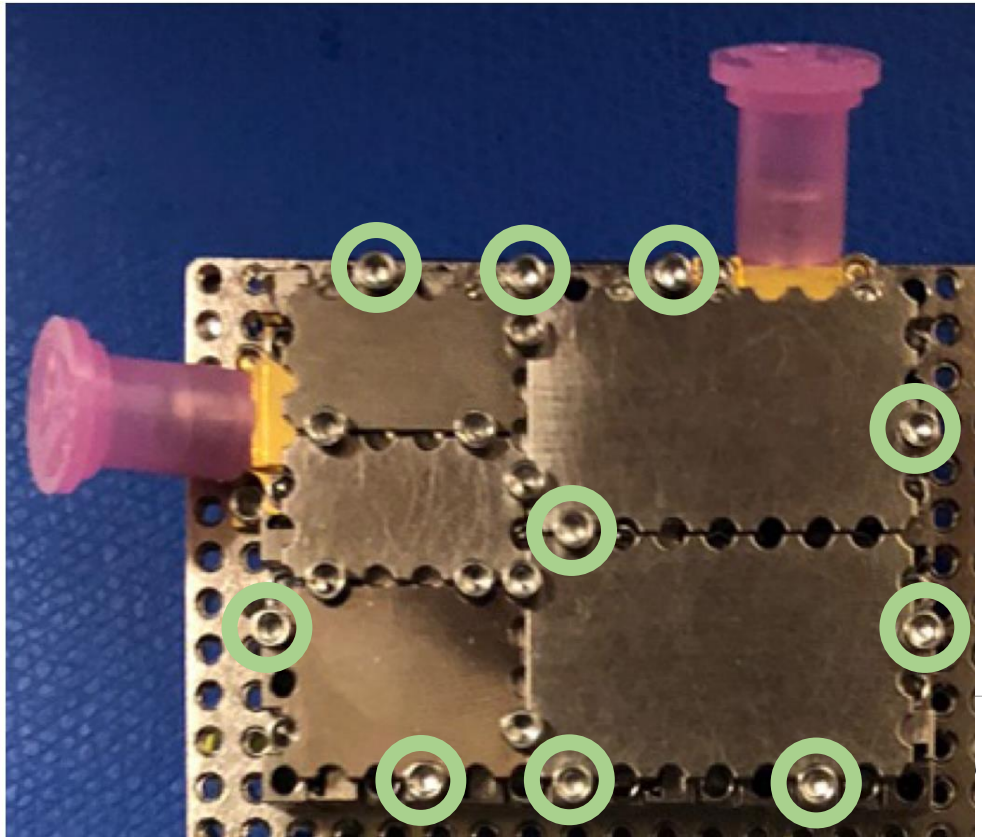
RF Out



Look Under the Lid

- Only 10 screws are holding the lid in place.
- Remove the ○ screws to see inside.
- Please replace them when finished.

(Note: All screws can be removed without damaging anything)



(1) Synthesizer

Synthesizer

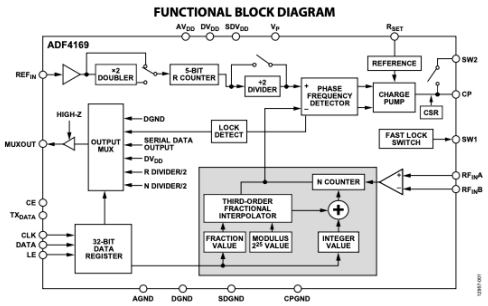
- **PLL**, XM-A3X3-0409D-04, ADI ADF4169CCPZ-RL7, [PCB 0357], F=500M – 13.5G
- **VCO**, XM-A353-0404D, ADI HMC733LC4B, [PCB 0234] F=10G-20G
- **Divide x2**, XM-A5P2-0404D, ADI ADF5000BCPZ, [PCB 0206], F=4G-18G
- **2-Way Splitter**, XM-A2B1-0404D, DLI PDW05758, [PCB 166], F=4.5G-18G

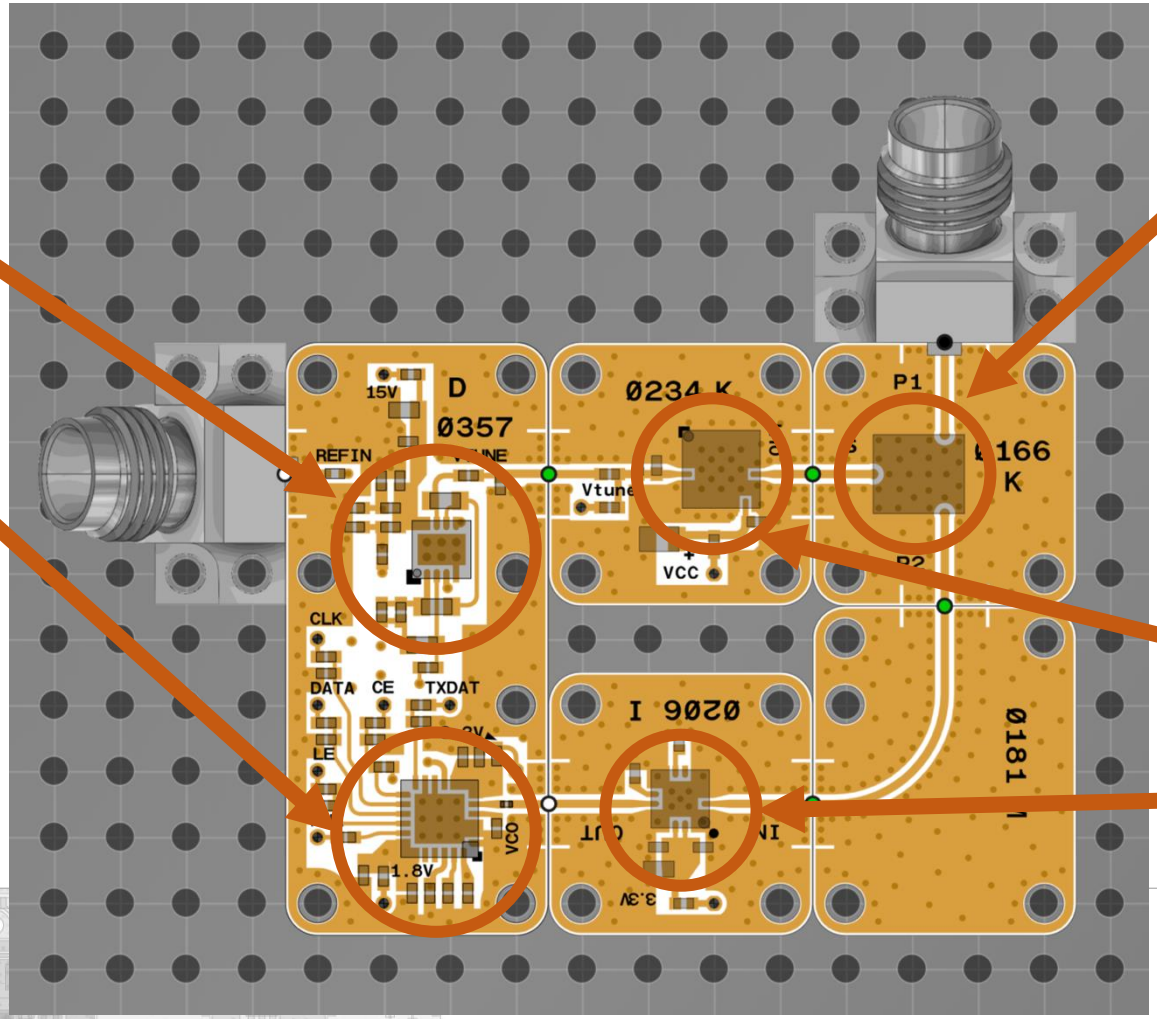
Loop Filter + Gain

- OpAmp

PLL

- ADF4169CCPZ
- F=500M – 13.5G





Splitter

- PDW05758
- F=4.5G-18G

VCO

- HMC733LC4B
- F=10G-20G

Divider

- ADF5000BCPZ
- F=4G-18G

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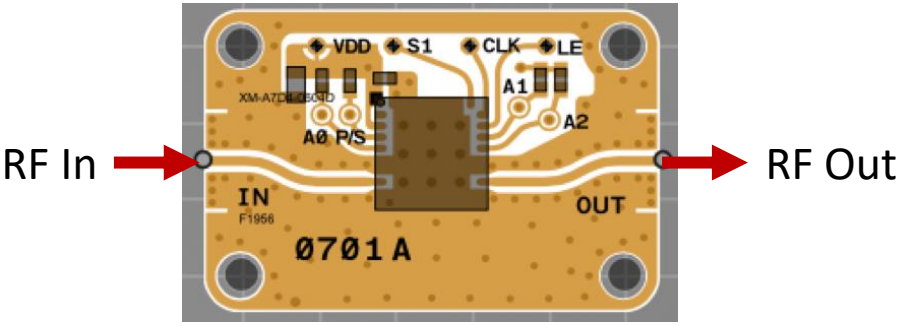
(5) Digital Step Attenuator

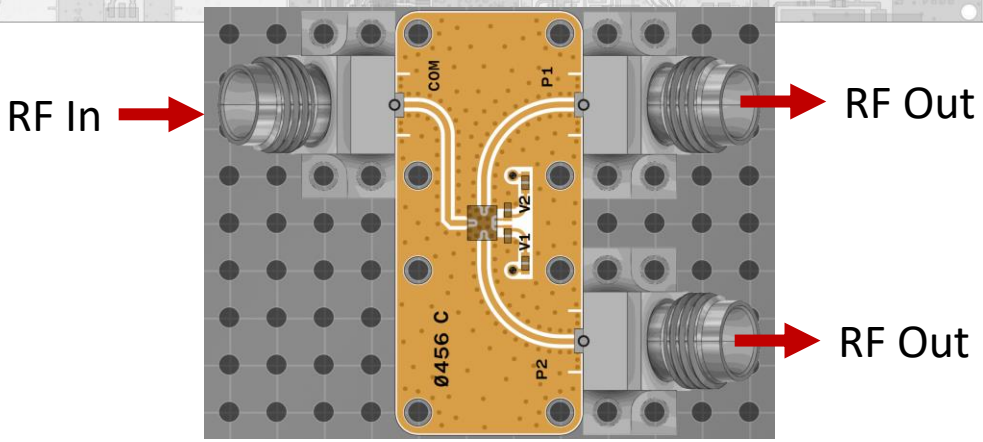


Instructions

1. Attach the X-MWcontroller, 40 pin IDC Cable
2. Attach X-MWprobes to the input and output ports
3. Attach a network analyzer to the X-MWprobes
4. Power the circuit (B1) +5 VDC
5. Program the XM-A7D4-0604D, IDT F1956**
   a. Add X-MWblock to home screen of the X-MWcontroller (set line enable to LE1)
   b. Set desired attenuation level
   c. Press ‘Write’ to program
6. Measure S2P of the device (DC – 10G)

**Download the X-MWcontroller Getting Started Guide

(7) SPDT Switch



Instructions

1. Attach the X-MWcontroller, 40 pin IDC Cable
2. Attach X-MWprobes to the input and output ports of the switch
3. Attach a network analyzer to the X-MWprobes
4. Power the circuit (B1) +5 VDC and (B2) -5 VDC
5. Control the XM-A6J9-0409D, pSemi PE42525**
   a. Add X-MWblock to home screen of the X-MWcontroller (choose Pin 7 to Control)
   b. Set desired switch value
   c. Press ‘Write’ to program
6. Measure S3P of the device (DC – 50GHz)

**Download the X-MWcontroller Getting Started Guide

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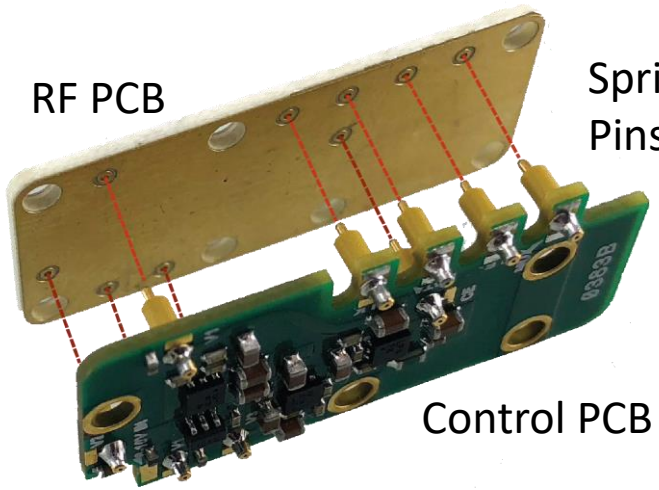
Appendix

X-Microwave Essentials



X-MWsystem Vocabulary

X-MW**block** RF

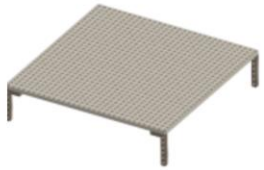
X-MW**probe**

Anchor

gsg Jumper

X-MW**block** Bias and Control

X-MW**protoplate**



X-MW**wall**

X-MW**lid**

X-MWblocks (bottom of plate)

1-72 x 1/8” (0.125”)

X-MWblocks (top) X-MWprobe (short)

1-72 x 5/32” (0.156”)

Lid (top)

1-72 x 3/16” (0.187”)

X-MWanchor Pinbridge

1-72 x 1/4” (0.25”)

X-MWProbe (tall) X-MWwall (short)

1-72 x 3/8” (0.375”)

X-MWwall (tall)

1-72 x 1/2” (0.5”)

X-MWwall Edge with Lid

1-72 x 5/8” (0.625”)

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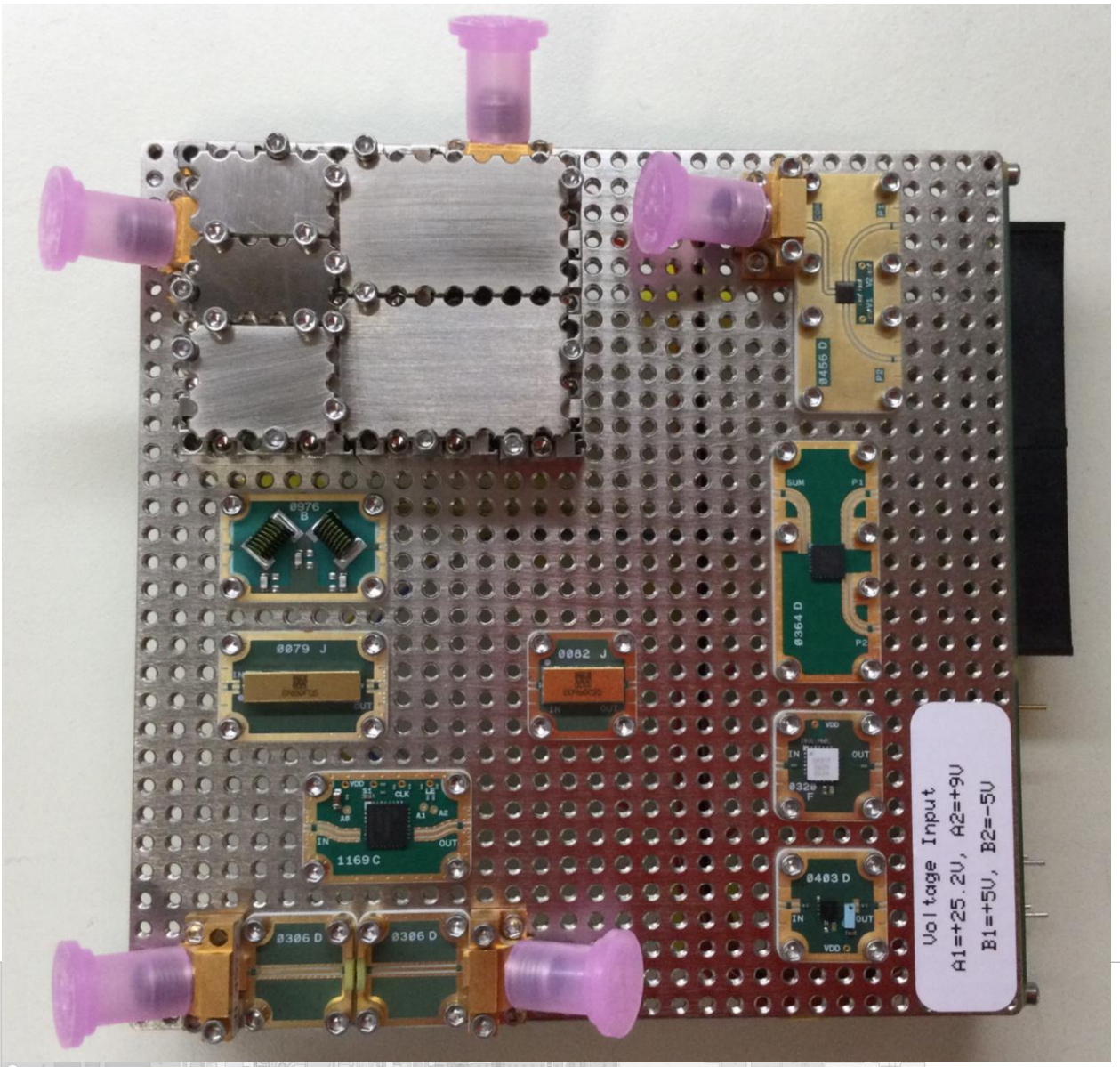
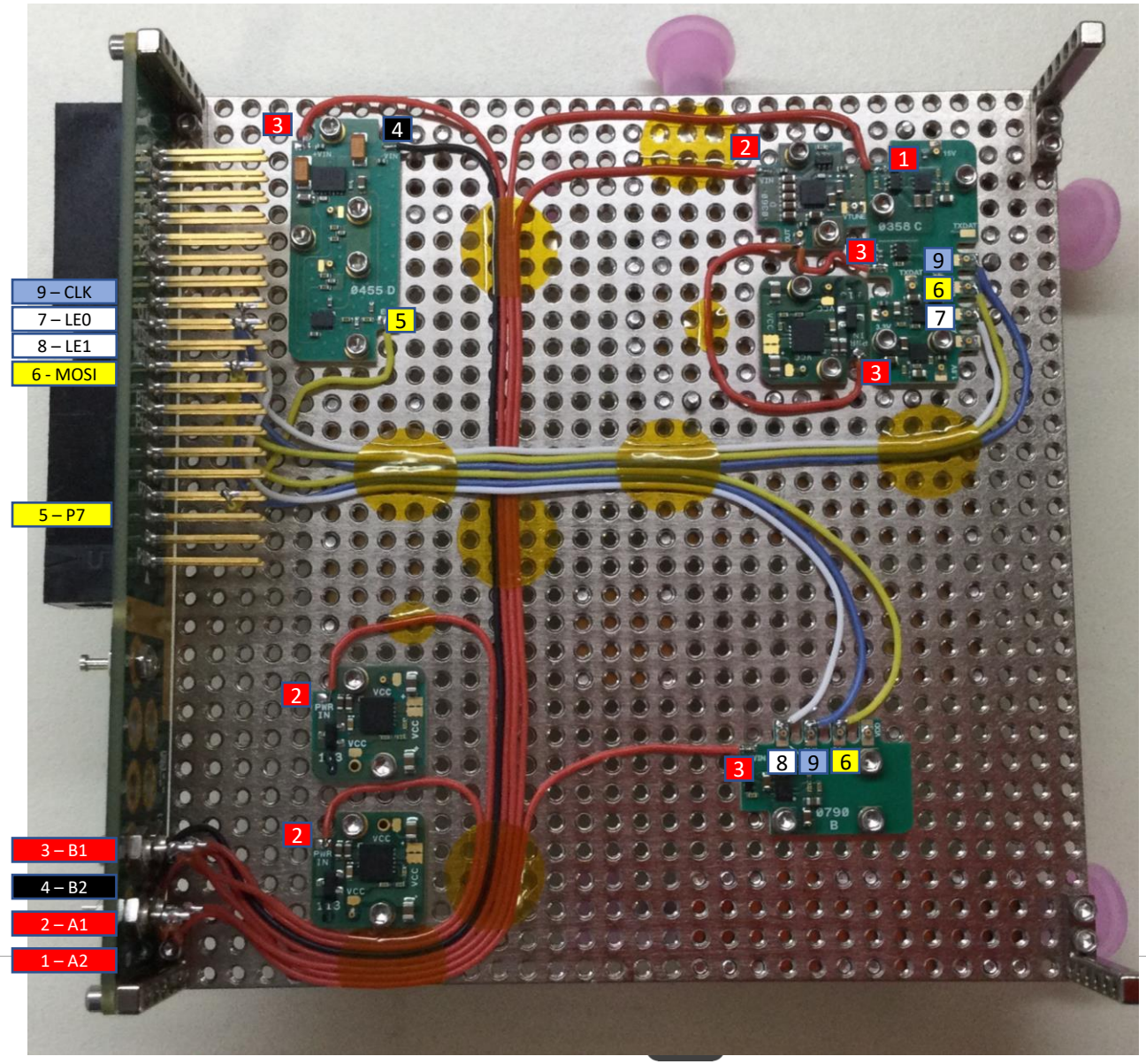
Reference Photos

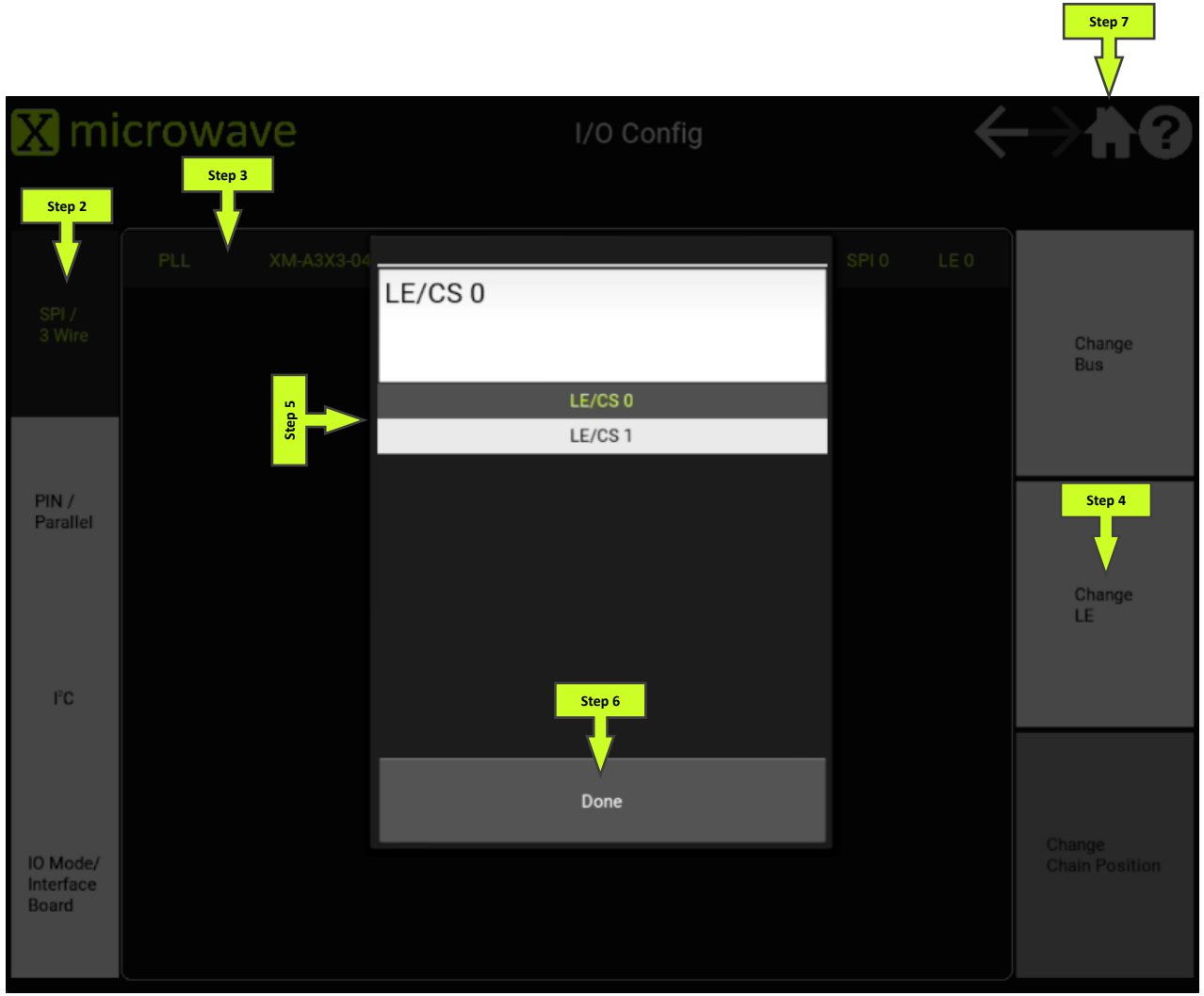




Part Address Configuration

After adding the XM parts that are to be programmed and returning to the home screen:

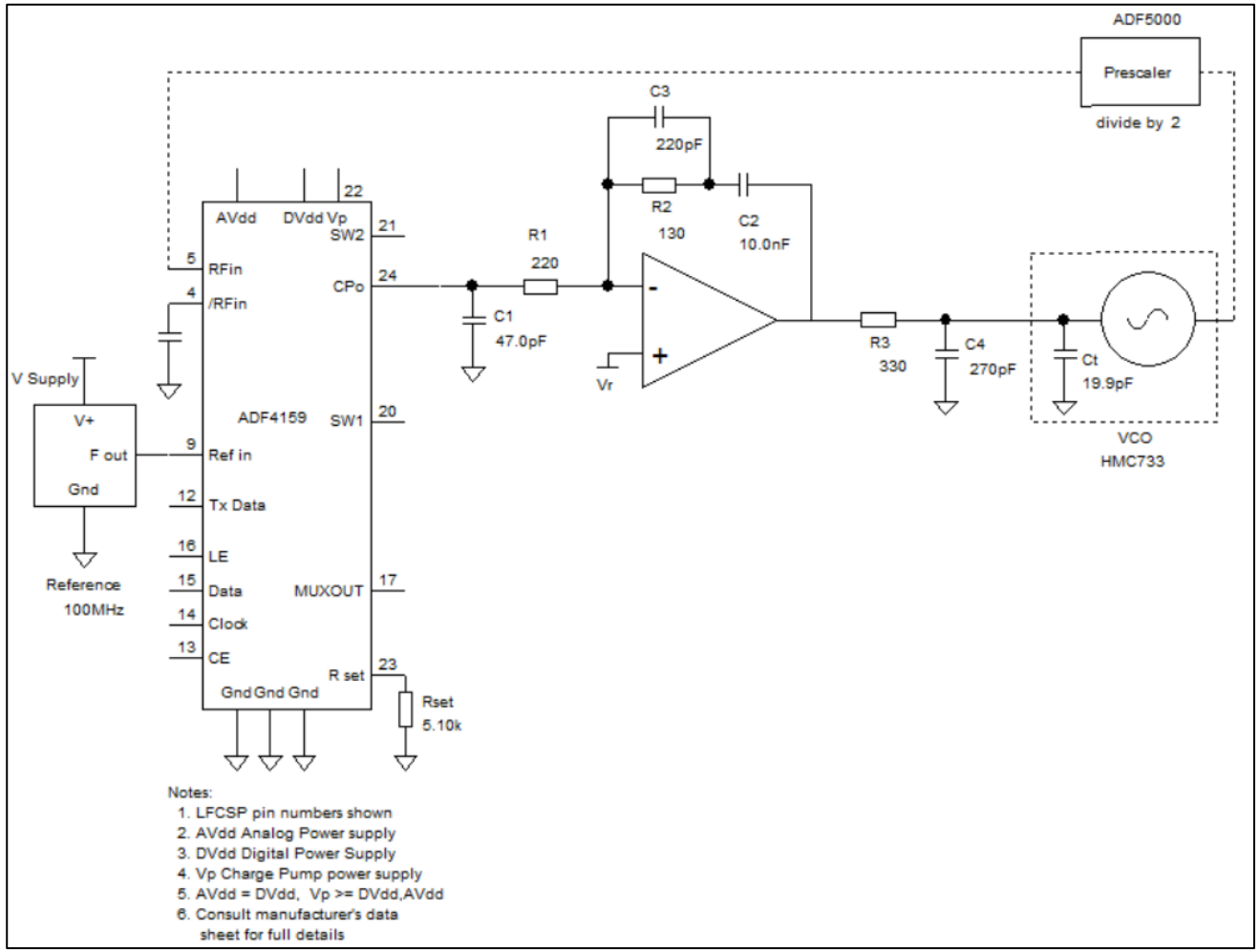
- Step 1: Tap ‘I/O Config’. The screen will redirect.
- Step 2: Tap ‘SPI/ 3 Wire.’
- Step 3: Tap the part that needs the LE address to change.
- Step 4: Tap ‘Change LE.’
- Step 5: Tap the appropriate LE pin the part is attached to.
- Step 6: Tap ‘Done.’
- Step 7: Tap the home icon to return to the home screen.



PLL Parameters

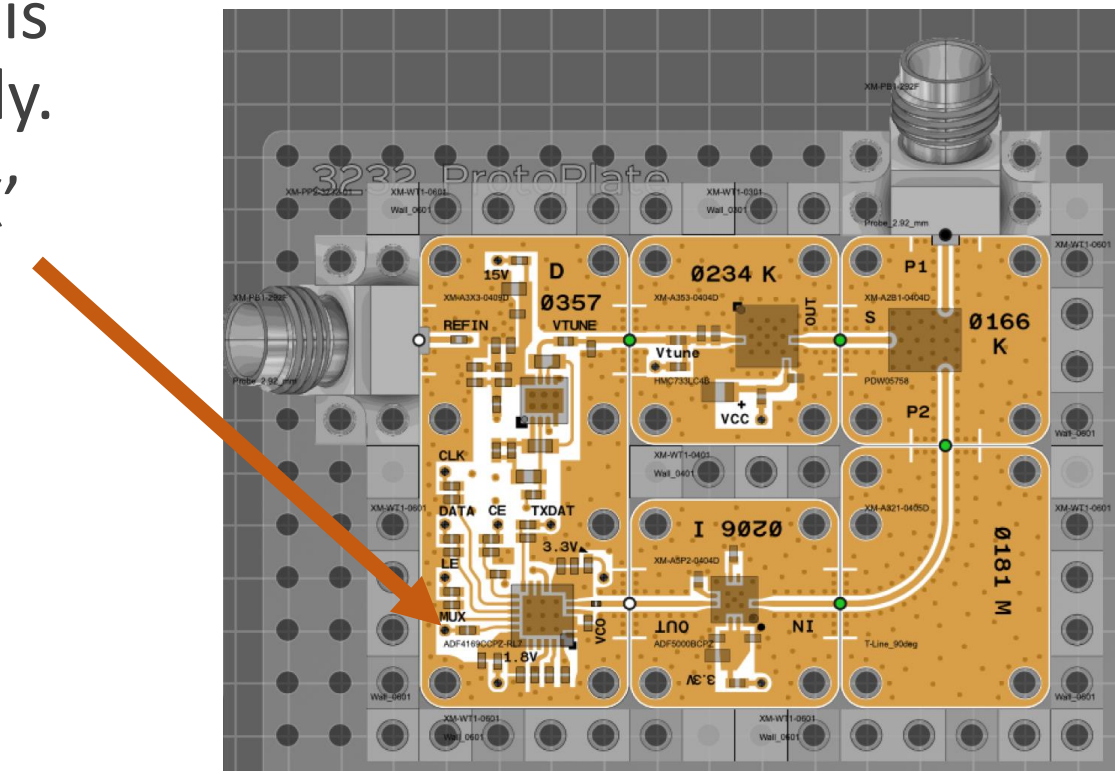
Loop Filter

- Loop Bandwidth: 234kHz
- Phase Margin: 52.1 deg
- VCO Range: 10-20GHz



Verifying Synthesizer Lock

- A locked state can be verified if the lid is removed from the synthesizer assembly.
- Measure with a voltmeter at the ‘MUX’ via. (Shown at the arrow’s tip)
- A locked state will output 1.8V.
- An unlocked state will output 0V.



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