

Real-Time Spectrum Analysis and Mixed Domain Analysis for EMI Diagnostics.

-RSA306 (USB Spectrum Analyzer), MDO Series (Mixed Domain Oscilloscope)-

Jason.cha : Application Engineer

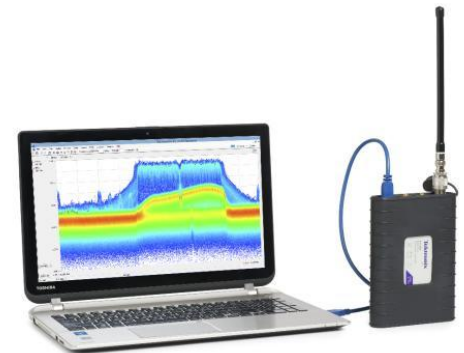
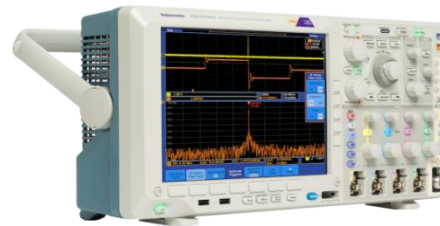


**WIDER
DEEPER**

2015 Tektronix Innovation Forum

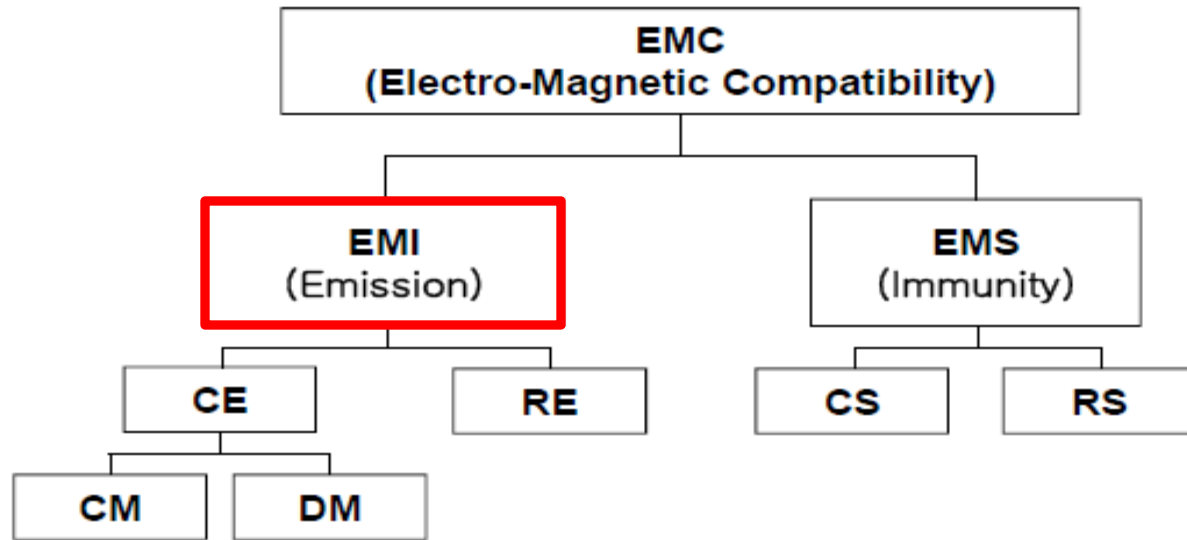
AGENDA

1. The necessity of Pre compliance test for EMI debugging.
2. EMI Debugging Using the RSA306.
 - RSA306 Introduction.
 - Near field solution with DPX and Spectrogram.
3. EMI Debugging Using the MDO4000B Series.
 - MDO(Mixed Domain Oscilloscope) Introduction.
 - EMI Debugging with Mixed Domain.



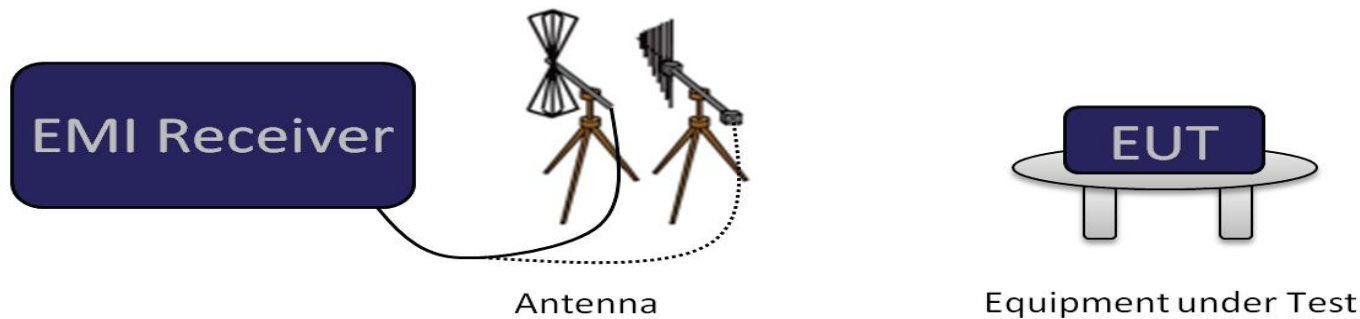
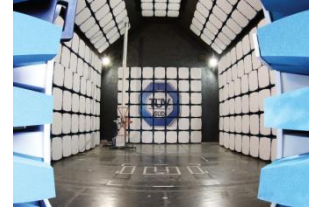
1. The necessity of Pre compliance test for EMI debugging.

EMI Characterization

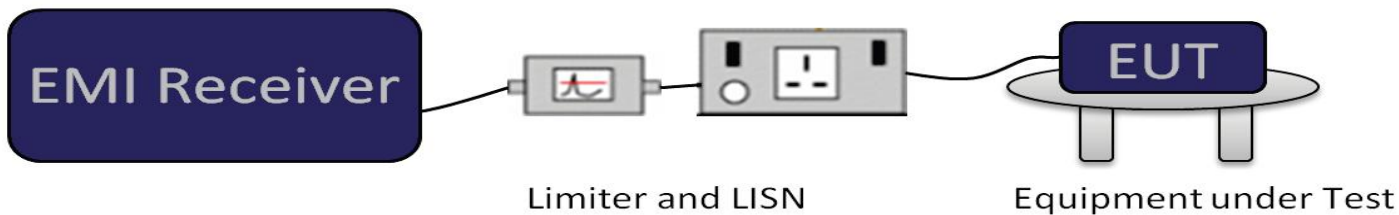


- **EMI** : Electromagnetic Interference
- **EMS** : Electromagnetic Susceptibility
- **CE(RE)** : Conducted(Radiated) Emission
- **CS(RS)** : Conducted(Radiated) Susceptibility
- **CM** : Common-Mode
- **DM** : Differential-Mode

What Is the Difference Between Radiated Emission and Conducted Emission?



Radiated emission Test



Conducted emission Test

Regulations on the frequency and power.

– International EMI standard.

- **CISPR** (International Special Committee on Radio Interference)
- **IEC** (International Electrotechnical Committee)

-> Recommendation & Reference

- **FCC** (Federal Communication Commission)
- **EN** (Europe - including EMS (immunity) in CE.)
- **VCCI** (Voluntary Control Council for Interference)

-> Laws and Regulation by Country or Regulatory Agency.

Standards/ Requirement	Type of Test	Regulatory Agency standard
CISPR11	Industrial, scientific and medical equipment	EN55011(EU), FCC47-Part18(US)
CISPR12	Vehicles, boats and internal combustion engines	JASO(JP), SAE J551/2(US)
CISPR13	Sound and television broadcast receivers	EN55013, FCC-Part15
CISPR14	Household appliances, electric tools	EN55014
CISPR16	Radio disturbance and immunity measuring apparatus	ANSI/IEEE291
CISPR22	Information technology equipment	VCC(JP), EN55022, FCC47-Part15,18
CISPR25	Vehicles, boats and internal combustion engines	EN55012

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Regulations on the frequency and power.

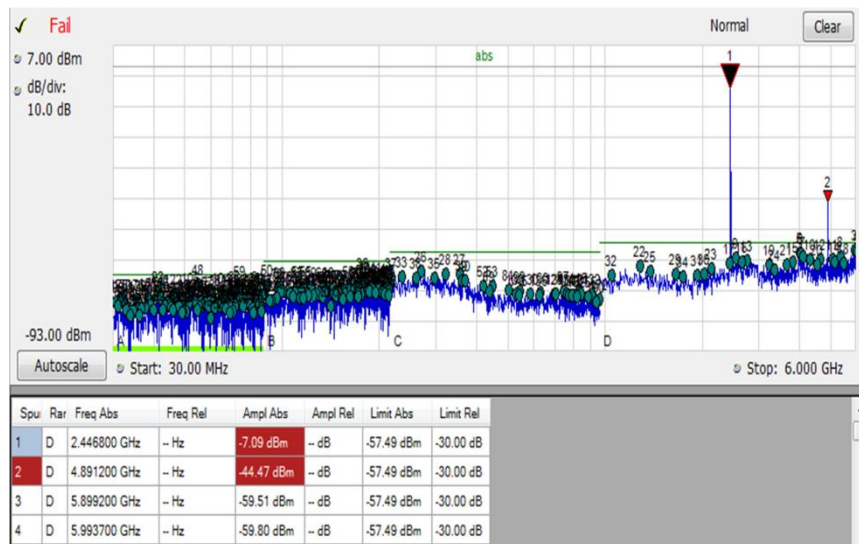
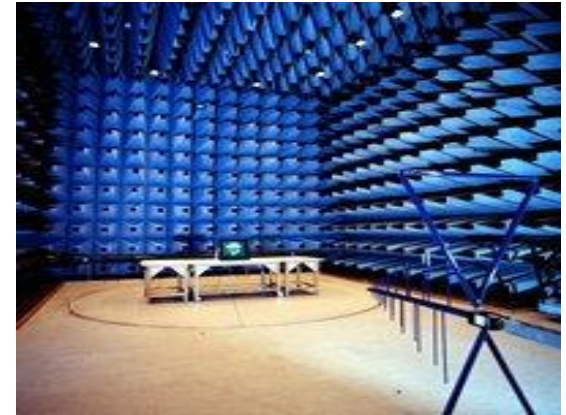
Worldwide Regulatory Agency Requirements.

CISPR 12 (EN 55012, AS/NZS 2557)	
Rad, Average (3m)	30 MHz to 1 GHz
Rad, Average (10m)	30 MHz to 1 GHz
Rad, Peak (3m)	30 MHz to 1 GHz
Rad, Peak (10m)	30 MHz to 1 GHz
Rad, Quasi-Peak (3m)	30 MHz to 1 GHz
Rad, Quasi-Peak (10m)	30 MHz to 1 GHz
CISPR 13 (EN 55013, AS/NZS 1053)	
Conducted, Average	150 kHz to 30 MHz
Conducted, Quasi-Peak	150 kHz to 30 MHz
Disturbance, Average	30 MHz to 300 MHz
Disturbance, Quasi-Peak	30 MHz to 300 MHz
Rad, FM Sound, Rx+PCTuner - Fundamental	30 MHz to 1 GHz
Rad, FM Sound, Rx+PCTuner - Harmonics	30 MHz to 1 GHz
Rad, FM Sound, Rx+PCTuner - Other	30 MHz to 1 GHz
Rad, Indoor Sat TV+Sd Rx,IR Rmt+Headphone	30 MHz to 1 GHz
Rad, Sat Rx Outdoor Unit - EquivRadPW	1 GHz to 18 GHz
Rad, Sat Rx Outdoor Unit - Fundamental	900 MHz to 18 GHz
Rad, Sat TV+Sd Rx, TunerUnit - Fundamental+Harmonics	1 GHz to 3 GHz
Rad, TV, VidRec, PCTuner - Fundamental	30 MHz to 1 GHz
Rad, TV, VidRec, PCTuner - Harmonics	30 MHz to 1 GHz
Rad, TV, VidRec, PCTuner - Other	30 MHz to 1 GHz

Full Compliance test requirements.

1. Compliance Test Facilities.

- 1) An EMC lab with large anechoic test chamber.
- 2) An EMI receiver with Quasi-peak detector.
- 3) Preamplifier, that can test up to the tenth harmonic or to 40 GHz Mast
- 4) 360° Turn table
- 5) EMI software controlling the test equipment like masts, turn tables, EMI Receiver and report generator
- 6) Antennas
- 7) Line impedance stabilization network (LISN) and Transient



2. Test method.

In a full EMI compliance lab, EMI receivers and well-calibrated antennas are used to test the electronic devices over a distance of 3 or 10 meters.

3. Test Result.

the measurements are done in the far field. In essence, the far field test can accurately tell whether the product passes or fails as a whole.

Customer pain points of Full compliance test.

Typical pain points

Test, Cost, Time...

Customer pain points.

Typical pain points

Test, Cost, Time...

Test? In essence, the far field test can accurately tell whether the product passes or fails as a whole but cannot point the source of a problem. Using only the far-field test, one cannot isolate problems down to specific components or locations.



Engineer need to find the root cause of noise source. They are repeating the work of changing components, cutting off the PCB lines and reconnect it to original state until they find the noise source.



The near-field test is the only way to locate such emission sources and is typically performed using a spectrum analyzer and near-field probe.

Customer pain points.

Typical pain points

Test, **Cost**, **Time**...

Cost?

1. The high cost is required for Equipment of EMI test house.
2. If your company hasn't EMI test house, you have to make additional payments whenever you want to use. (outsourcing)

Time?

1. Product introduction delays.
2. The time to perform compliance test is long.
3. EMI test house schedule is always tight.

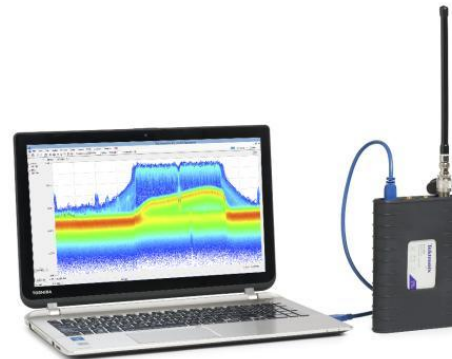
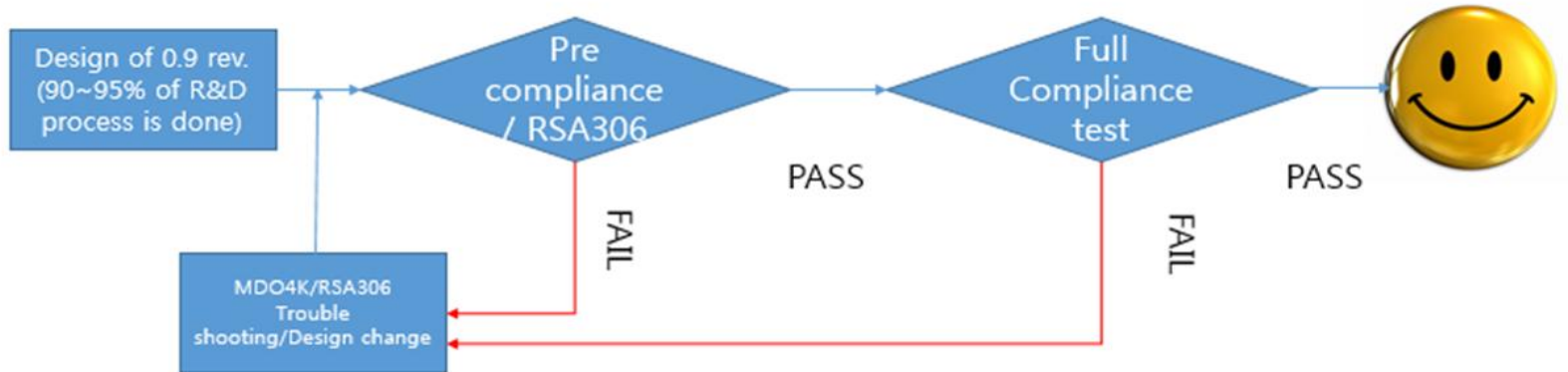


Pre compliance test!!

Using fast measurement techniques intended to give a 'quick look' at problem areas, Uncover potential problems and reduce risk of failure at the expensive compliance test stage.
Not necessarily required to conform to international standards.

Tektronix pre compliance test solution.

EMI/EMC Workflow

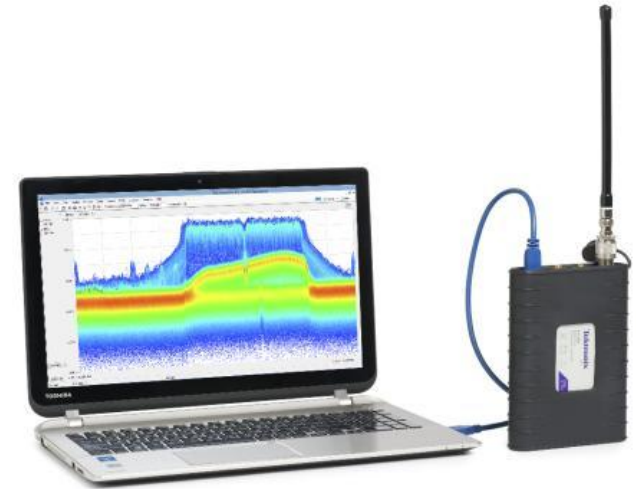


2. EMI Debugging Using the RSA306.

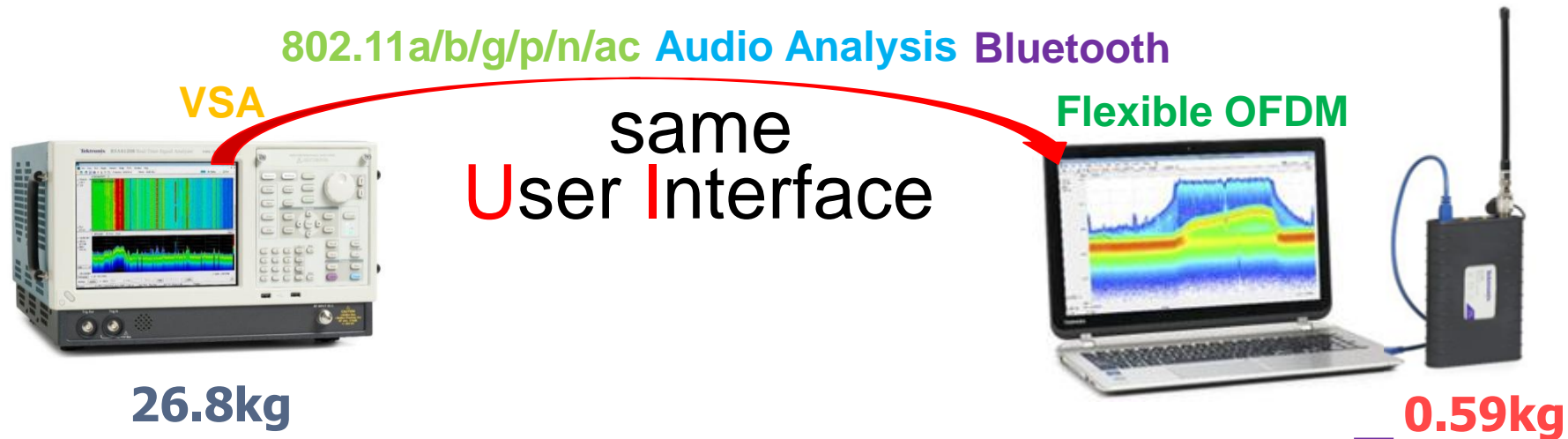
New RSA306 USB Spectrum Analyzer

RF signal analysis in your hands!

- Unmatched Price/Performance
- Unmatched form factor: USB powered and controlled, highly portable
- Unmatched HW features in its class: 6.2 GHz Signal Analyzer with 40 MHz Real Time Bandwidth
- Measurement Range from -160 dBm to +20 dBm
- Unmatched SW features: Benchtop features with a low cost analyzer
 - Runs with SignalVu-PC software
 - Optional capabilities, such as Wi-Fi, P25, and Audio Analysis
 - Long duration signal recording
- Ruggedized and meets Mil-Std 28800 Class 2 specifications



New RSA306 USB Spectrum Analyzer

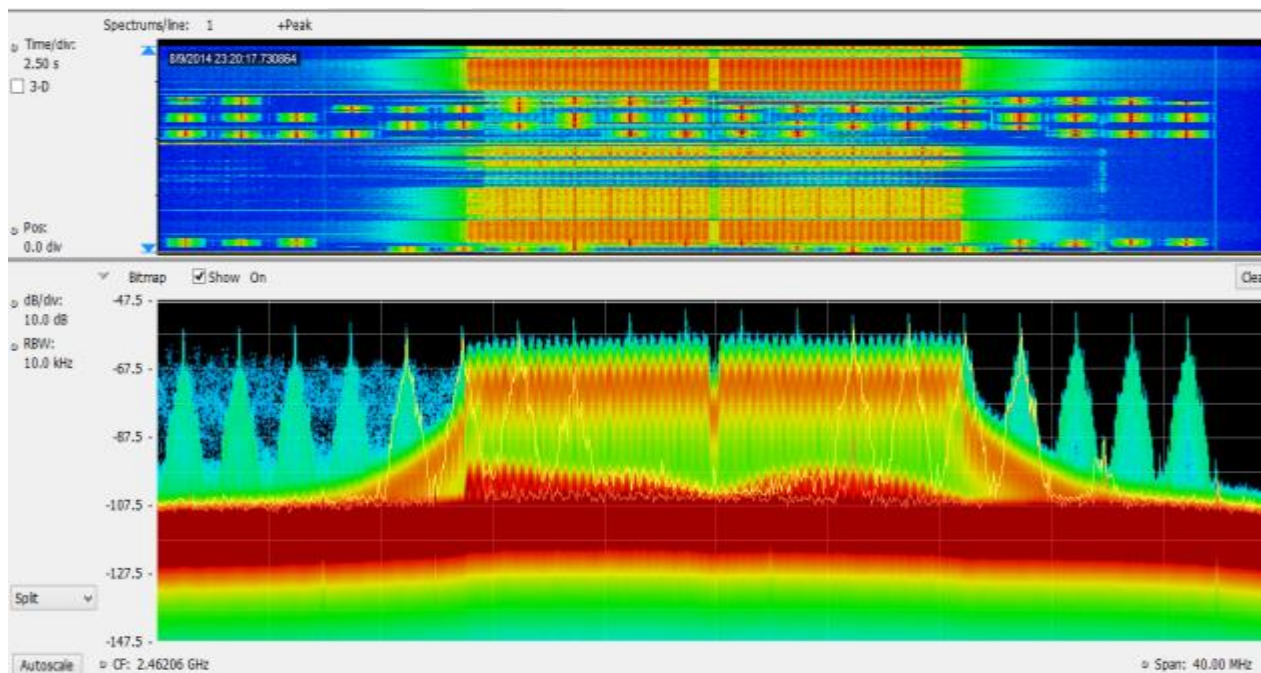


	RSA5KB LAB	RSA306
Frequency Range	1Hz – 3/6.2/15/26.5GHz	9kHz-6.2GHz
Max RF Input	+30dBm	+20dBm
SFDR (dBc)	-75 dBc	-50 dBc

RF signal analysis in your hands!

- Demonstration -

(RSA 306 DPX and Spectrogram.)



EMC 노이즈 국제규격 · 규제 (일례)

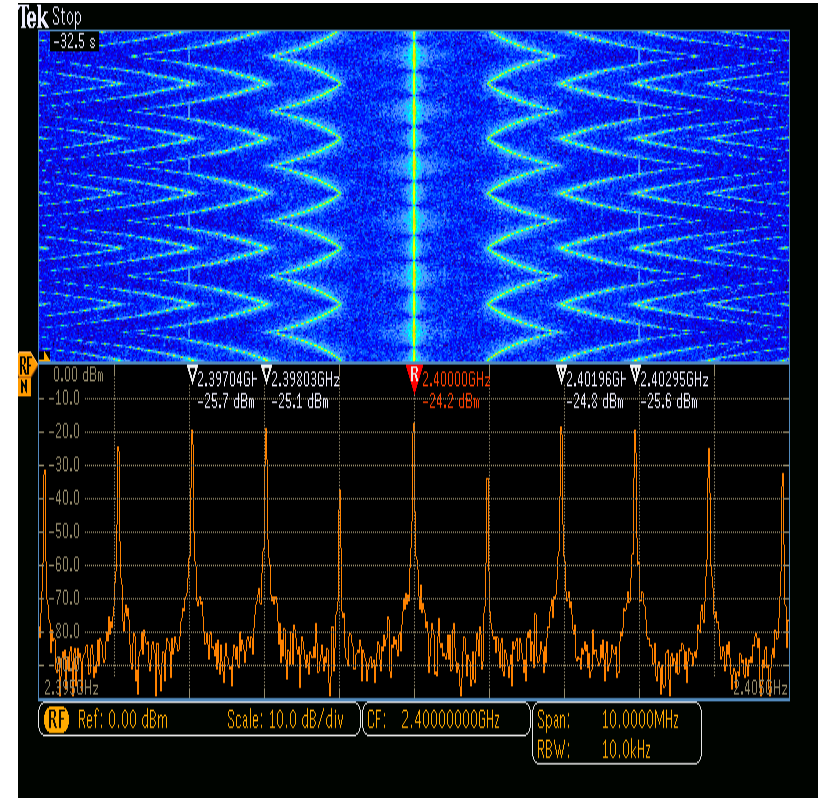
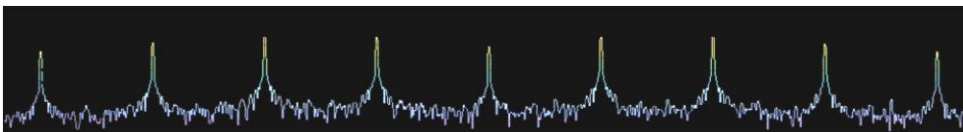
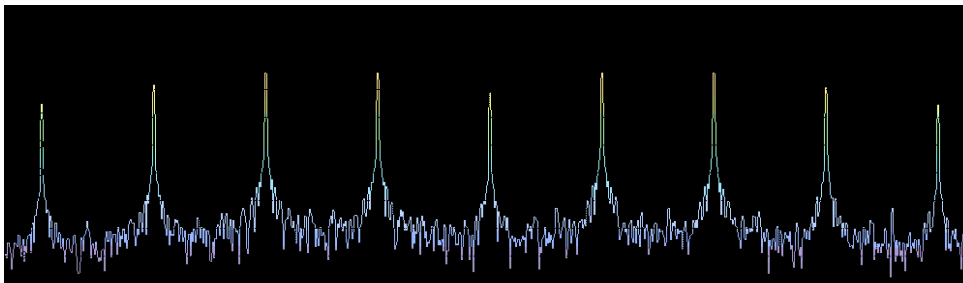
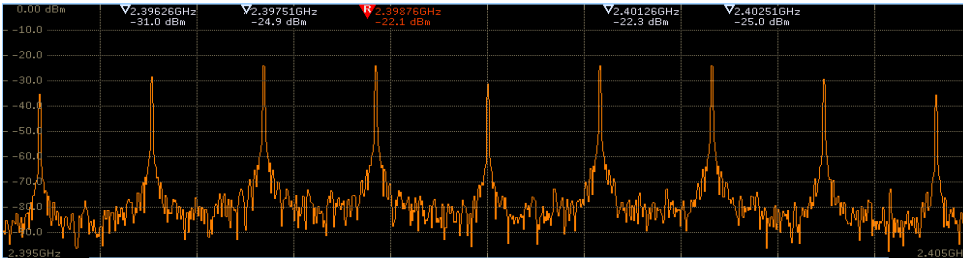
디피엑스를 표현할 가장 좋은 그림 찾아 보기 밀도를 나타낸거와
데모를 통해 펄시스스턴스를 줘서 어떤 느낌인지 (디피엑스와 주파수 도메인을 비교한 데모
추가)

스펙트로 그램을 설명 할 수 있는 그림을 중간에 넣기
와이파이 신호를 4분할 하여 구현 하면서.



Spectrum Analyzer

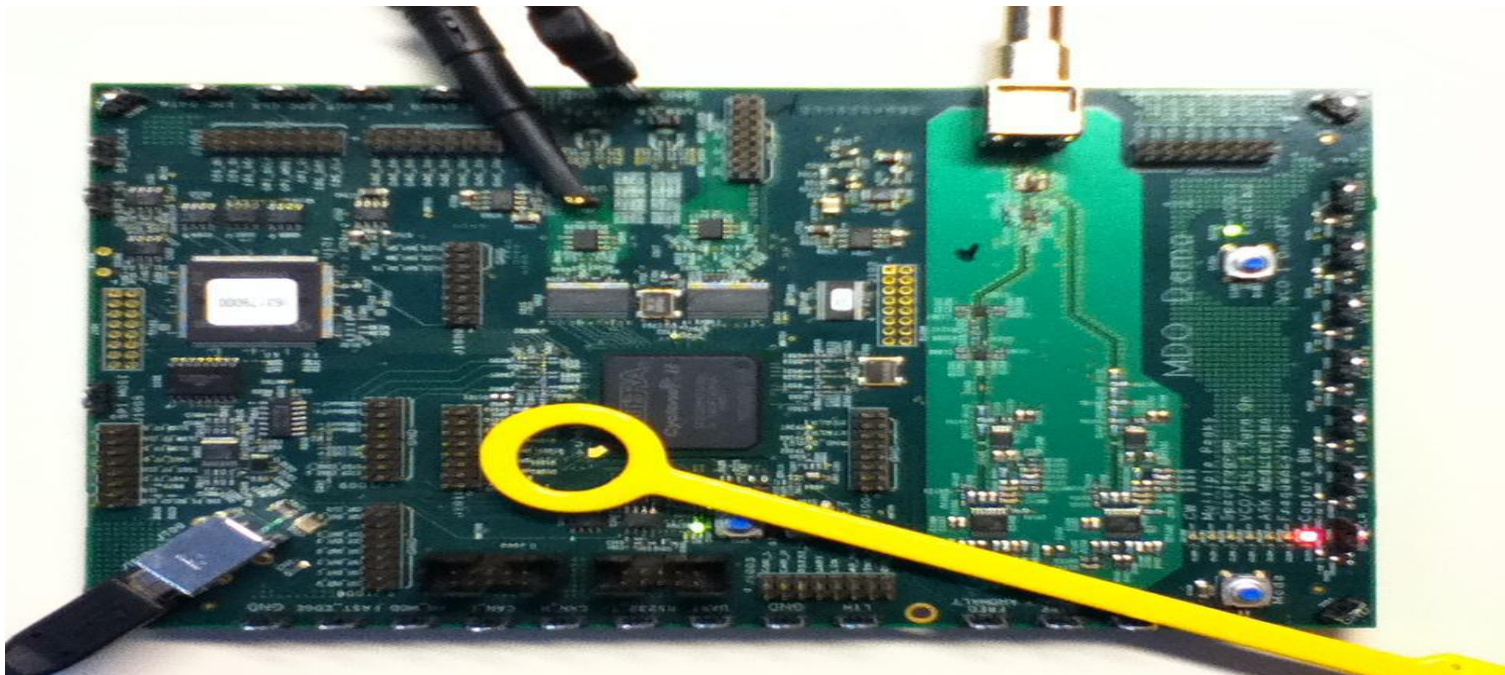
Performance Superior to Scope FFT



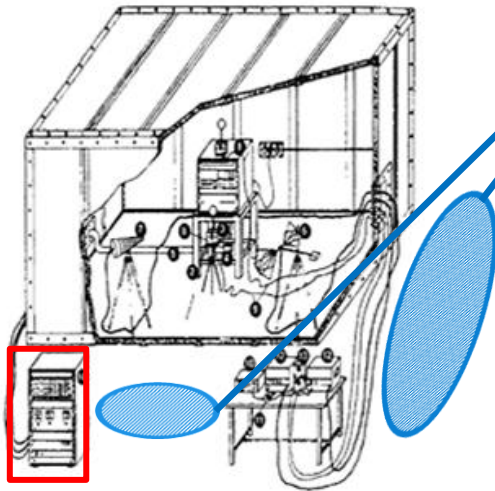
Performance you can't find in any other scope or spectrum analyzer

- Demonstration -

(Near field probe solution with DPX and Spectrogram.)

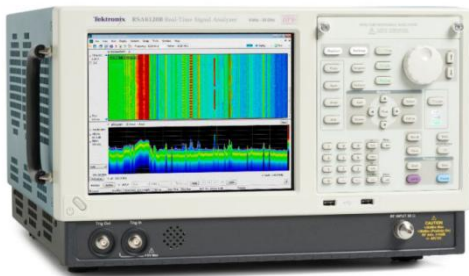


Increasing needs the Portable High performance Spectrum Analyzer.



1. Outside Chamber.

2. Factory Line.



High performance Spectrum Analyzer

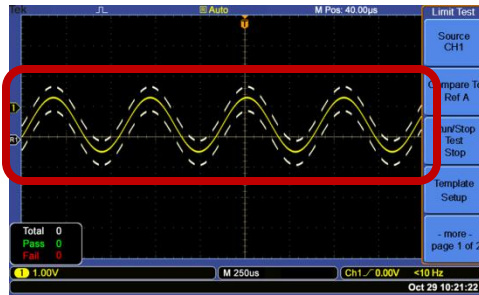


3. In the field.

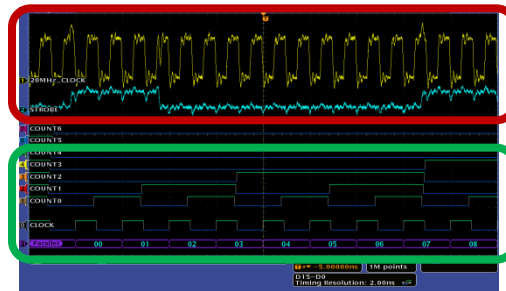
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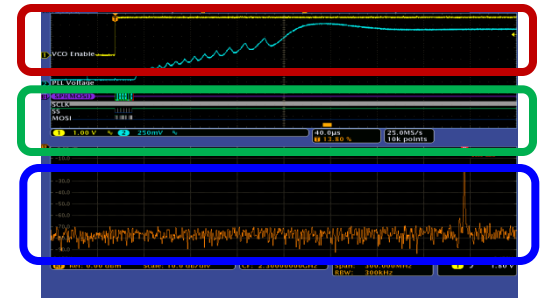
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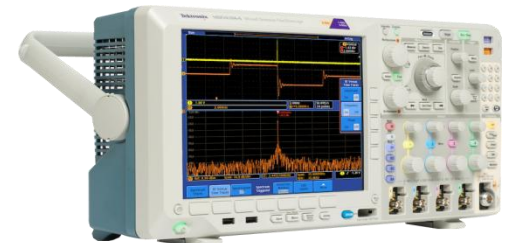
Analog Signal



Analog Signal
+
Digital & Bus Signal



Analog Signal
+
Digital & Bus Signal
+
RF Signal



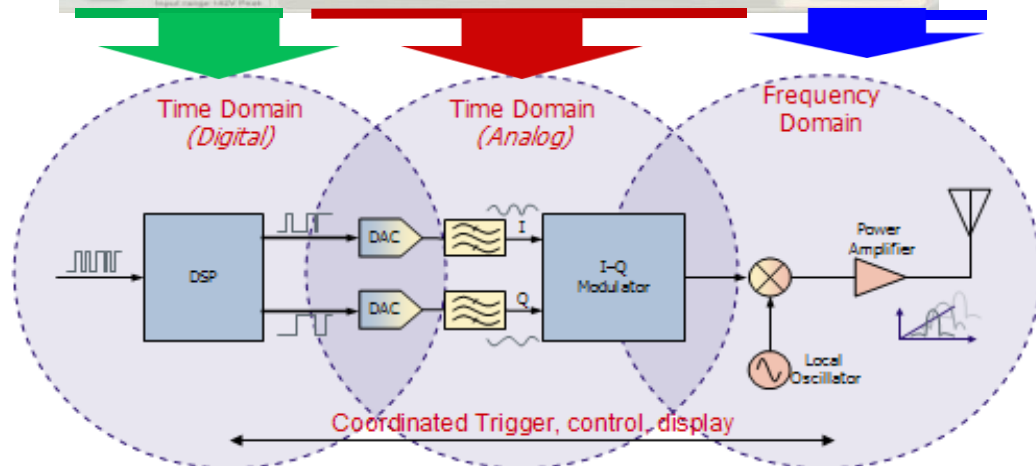




The only *Oscilloscope*
with a built-in *Spectrum Analyzer*

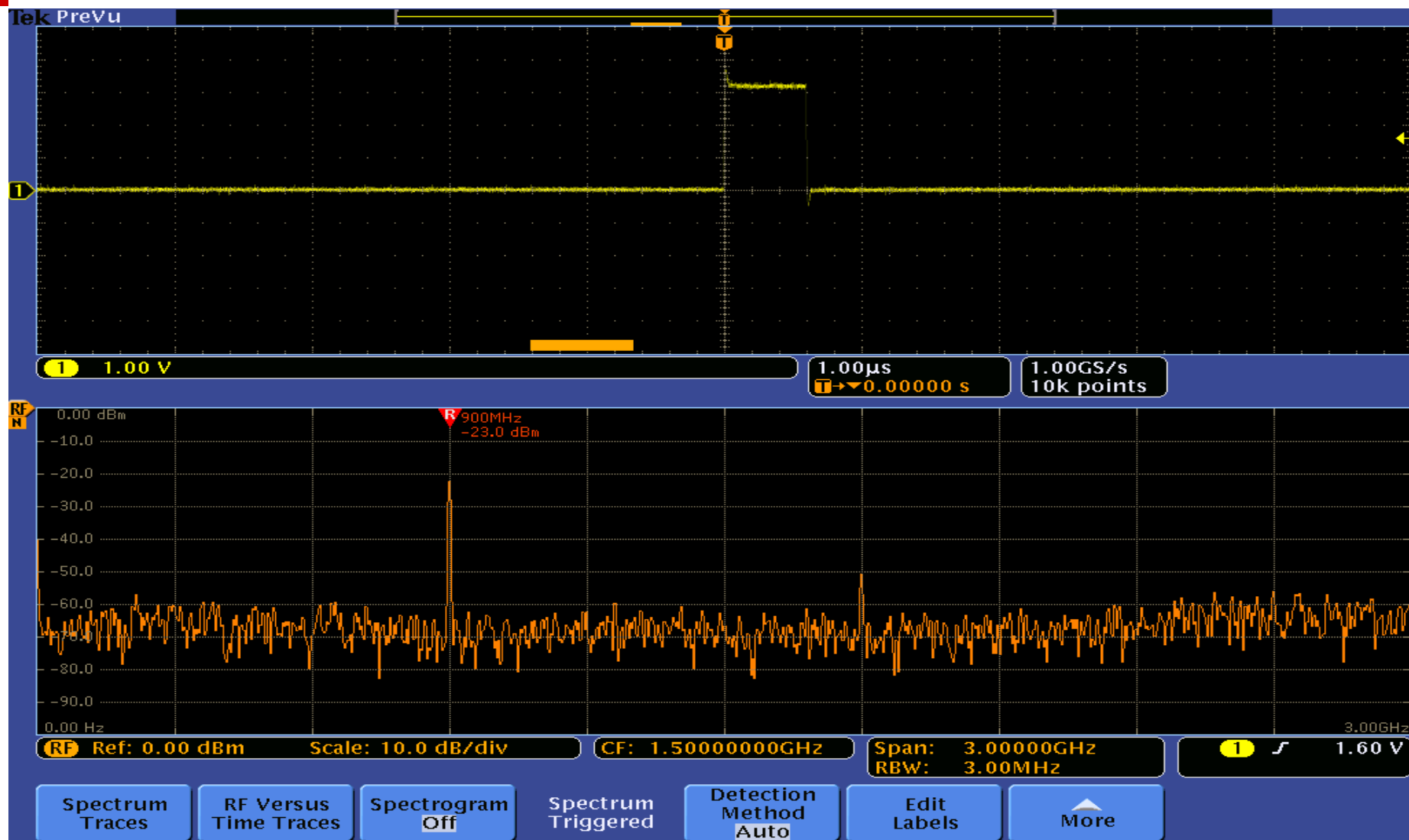
Time correlated acquisition system.

Time correlated acquisition.



- Mixed-domain analysis
 - Time-correlated analog, digital, and RF signal acquisitions in a single instrument.
 - Amplitude, frequency, and phase vs. time waveforms derived from spectrum analyzer input
 - Selectable spectrum time to discover and analyze how RF
 - spectrum changes over time - even on a stopped acquisition

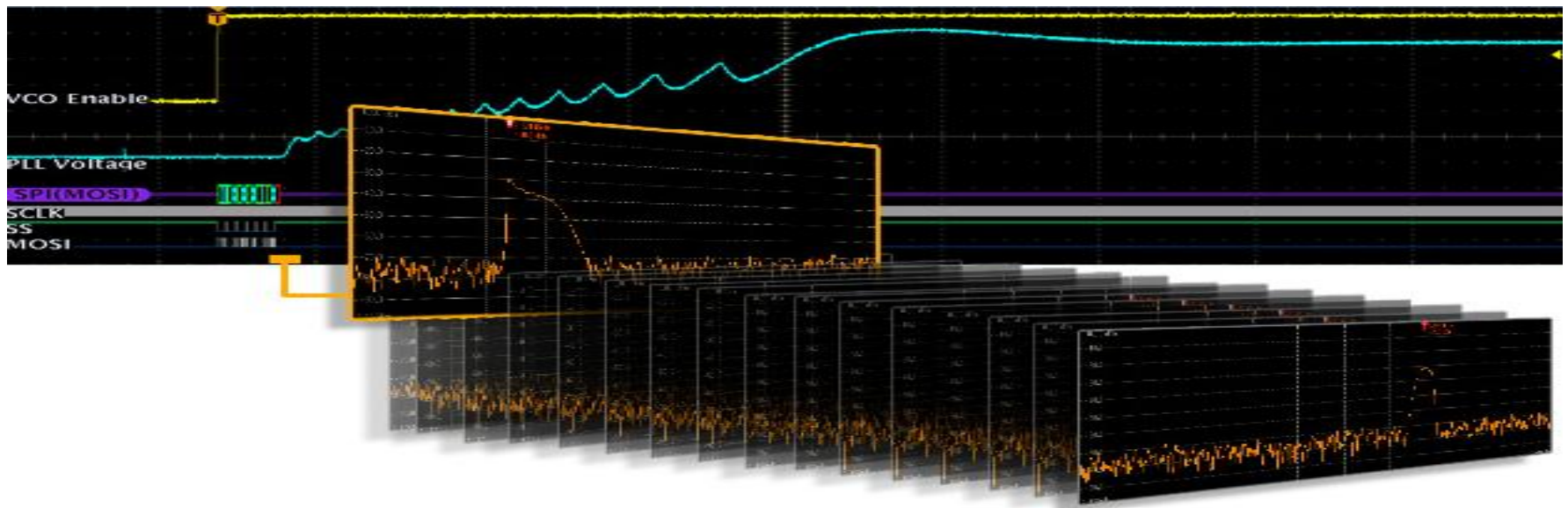
Time correlated acquisition system with wide capture bandwidth.



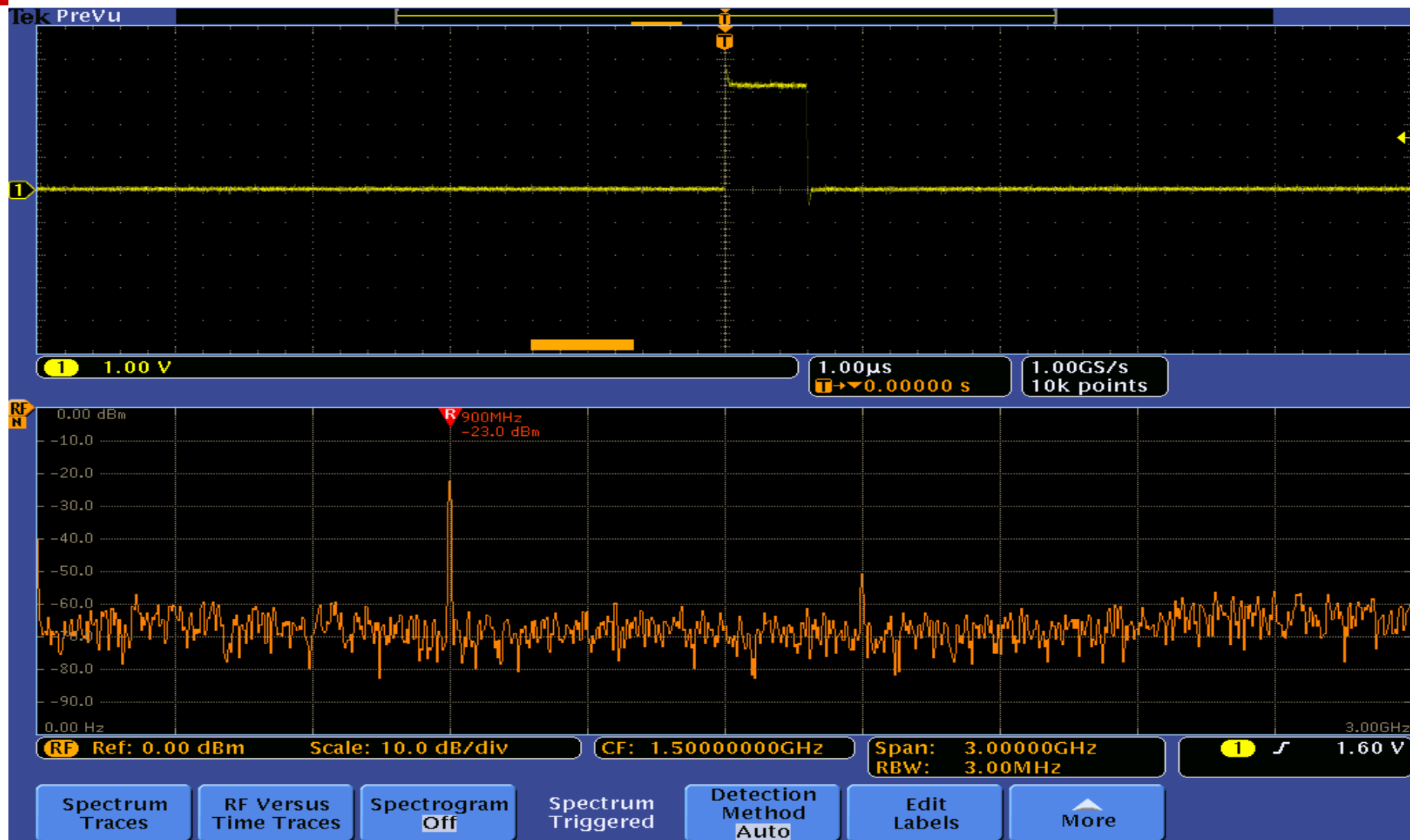
Time correlated acquisition system with wide capture bandwidth.

Time and Frequency Domains

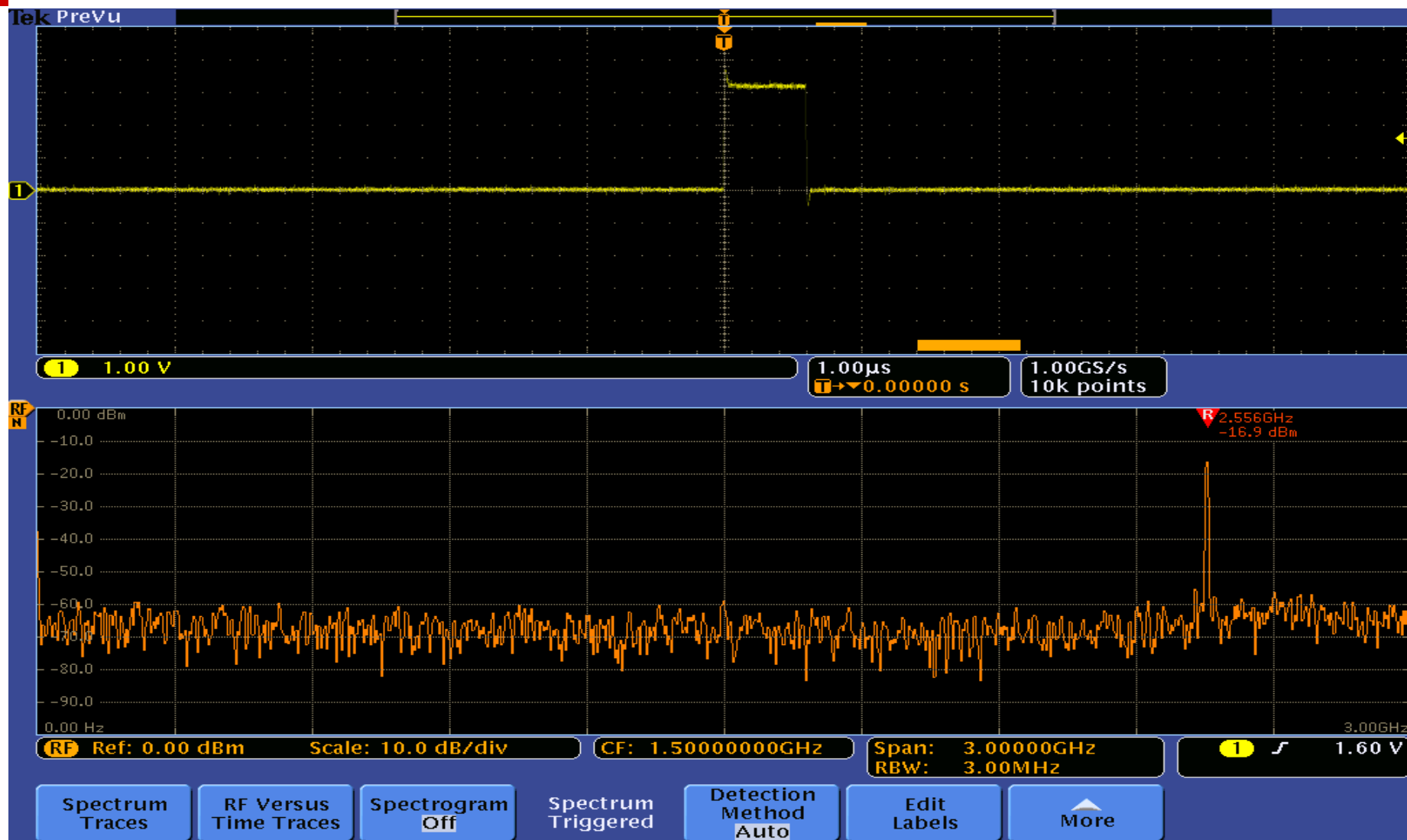
The real power of the MDO4000B comes from its universal trigger and acquisition system. All channels are fully integrated, so you can trigger on any of your signals and the oscilloscope will capture all channels simultaneously. As a result, all signals—analogue, digital and RF—are time-correlated for accurate analysis



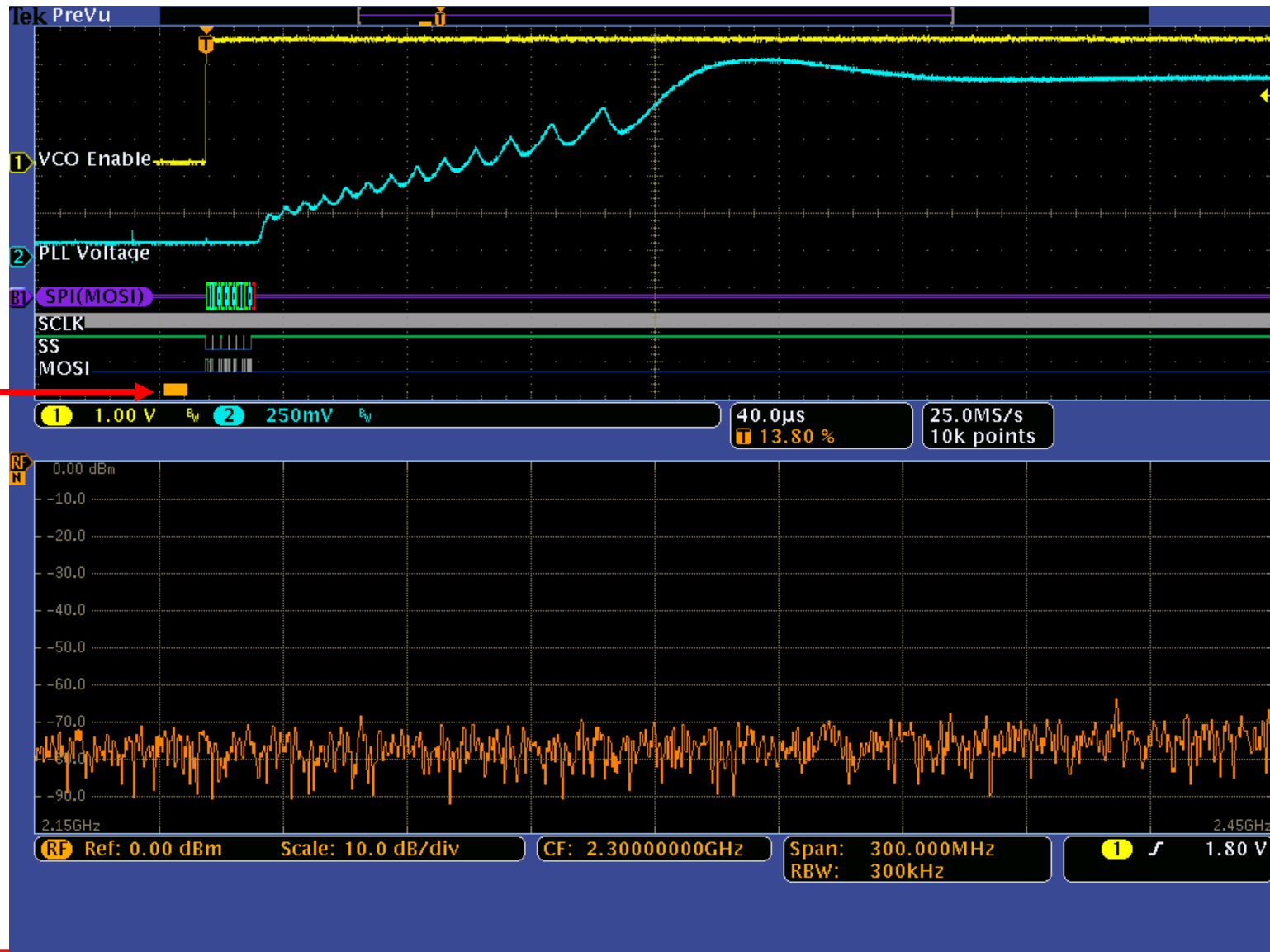
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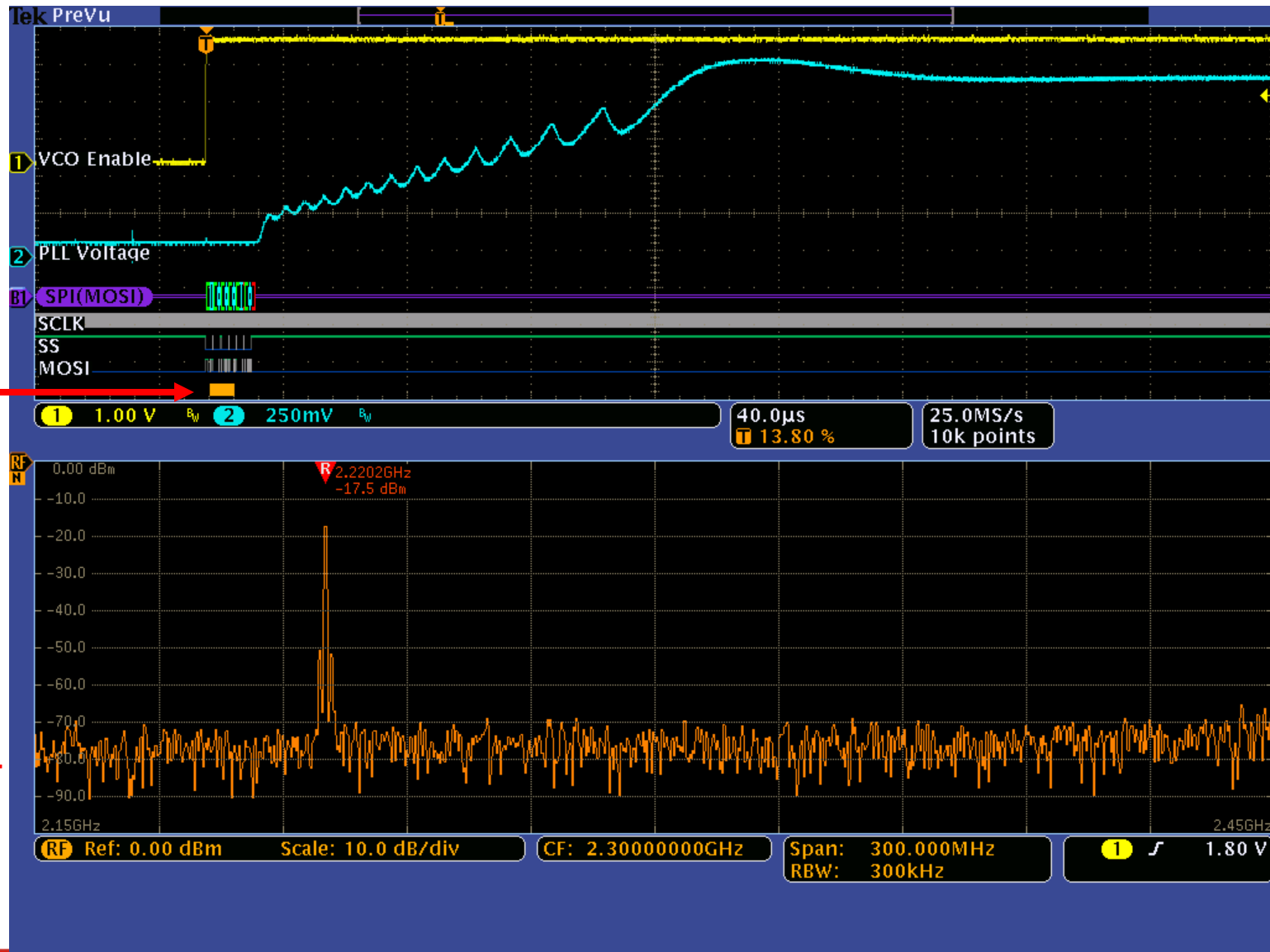
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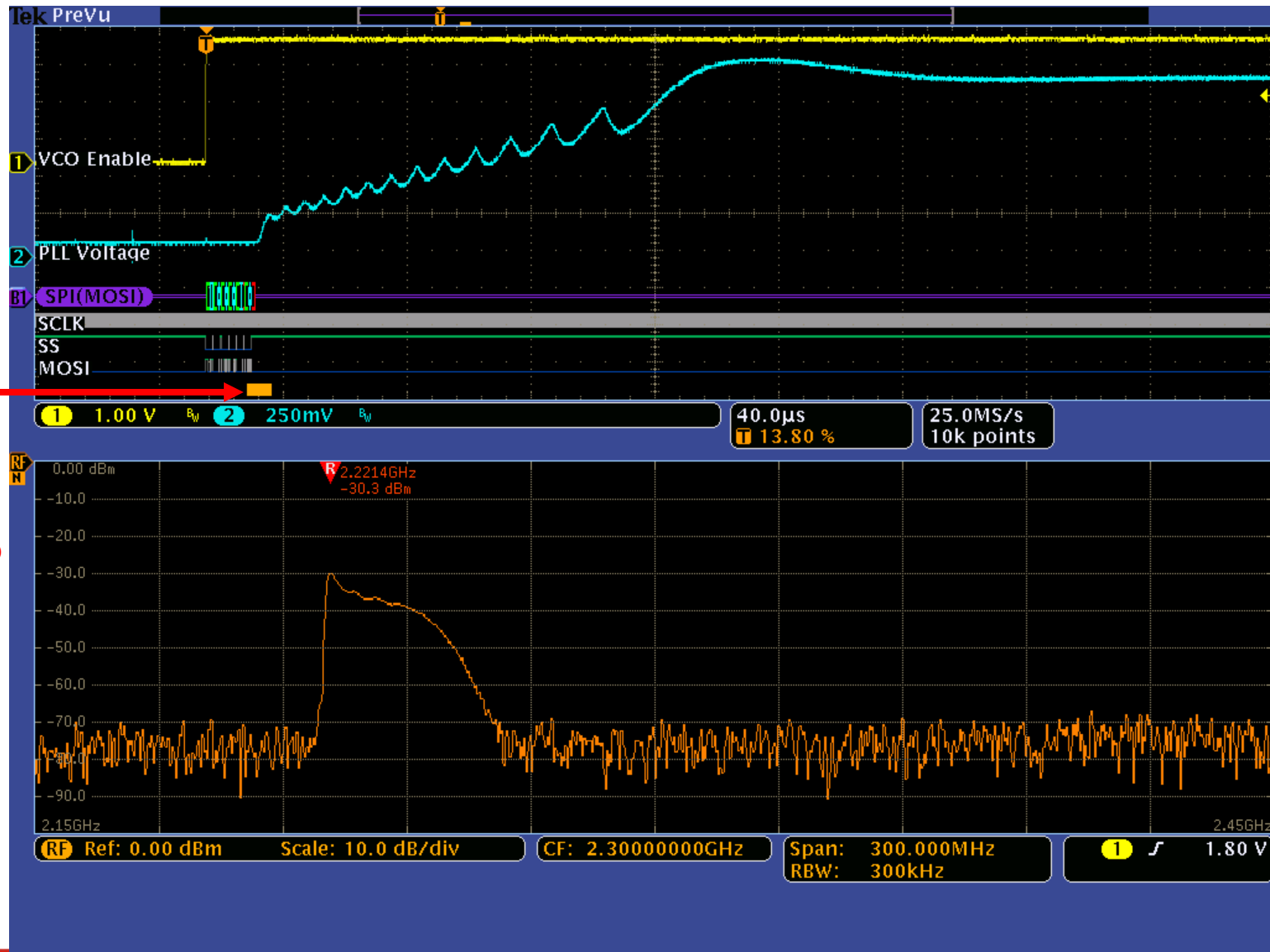
VCO/PLL Circuit Turn-on



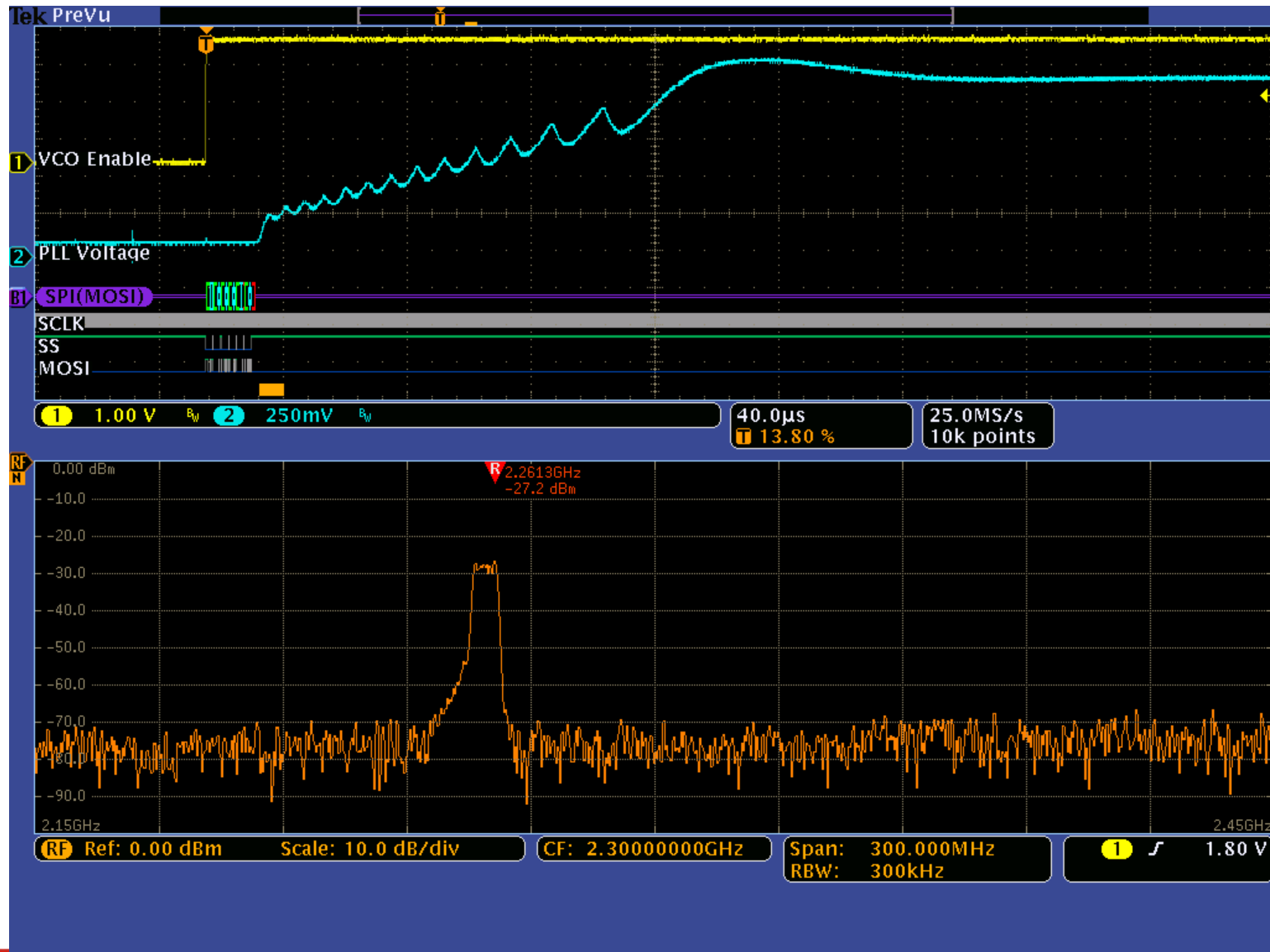
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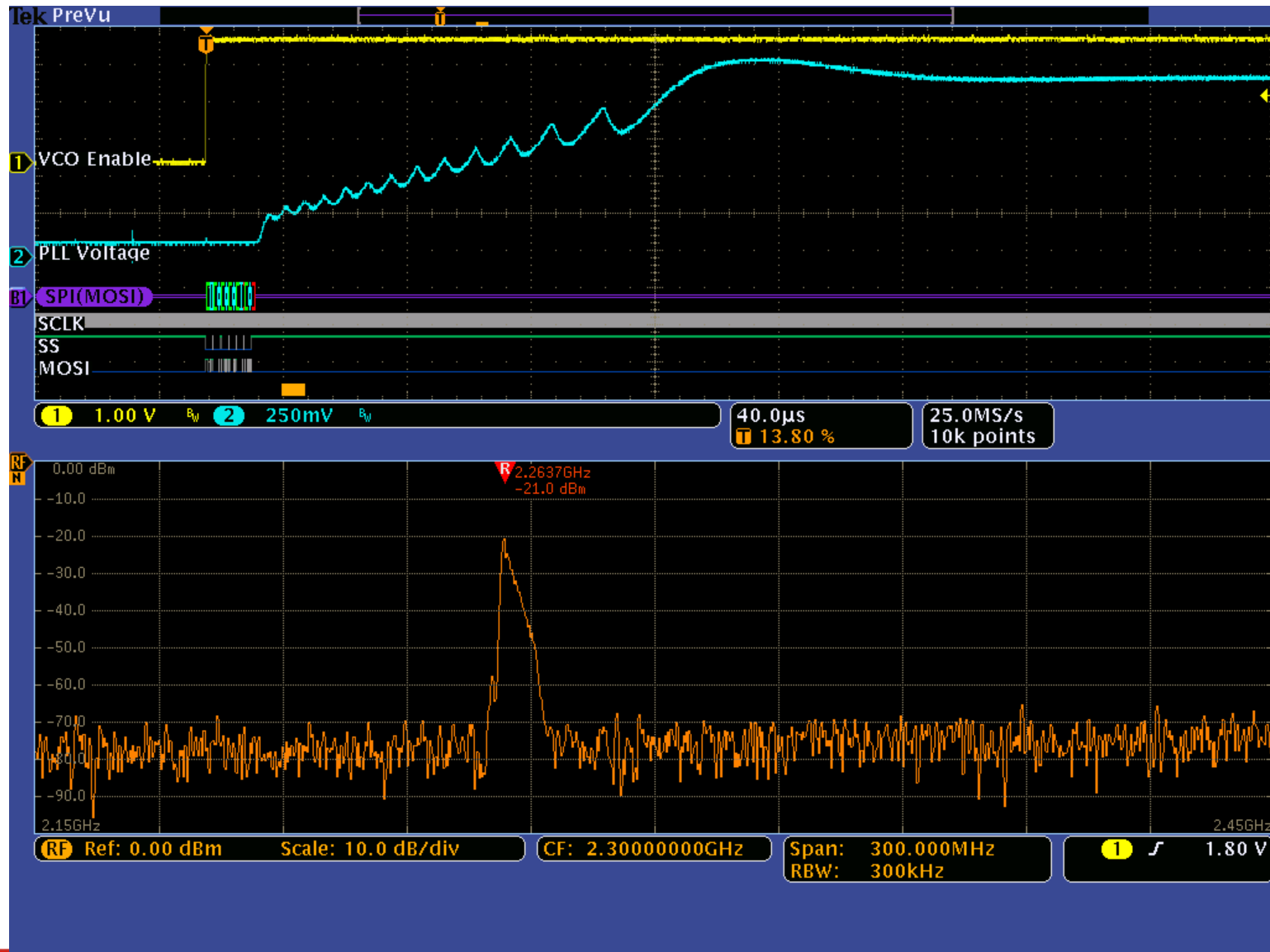
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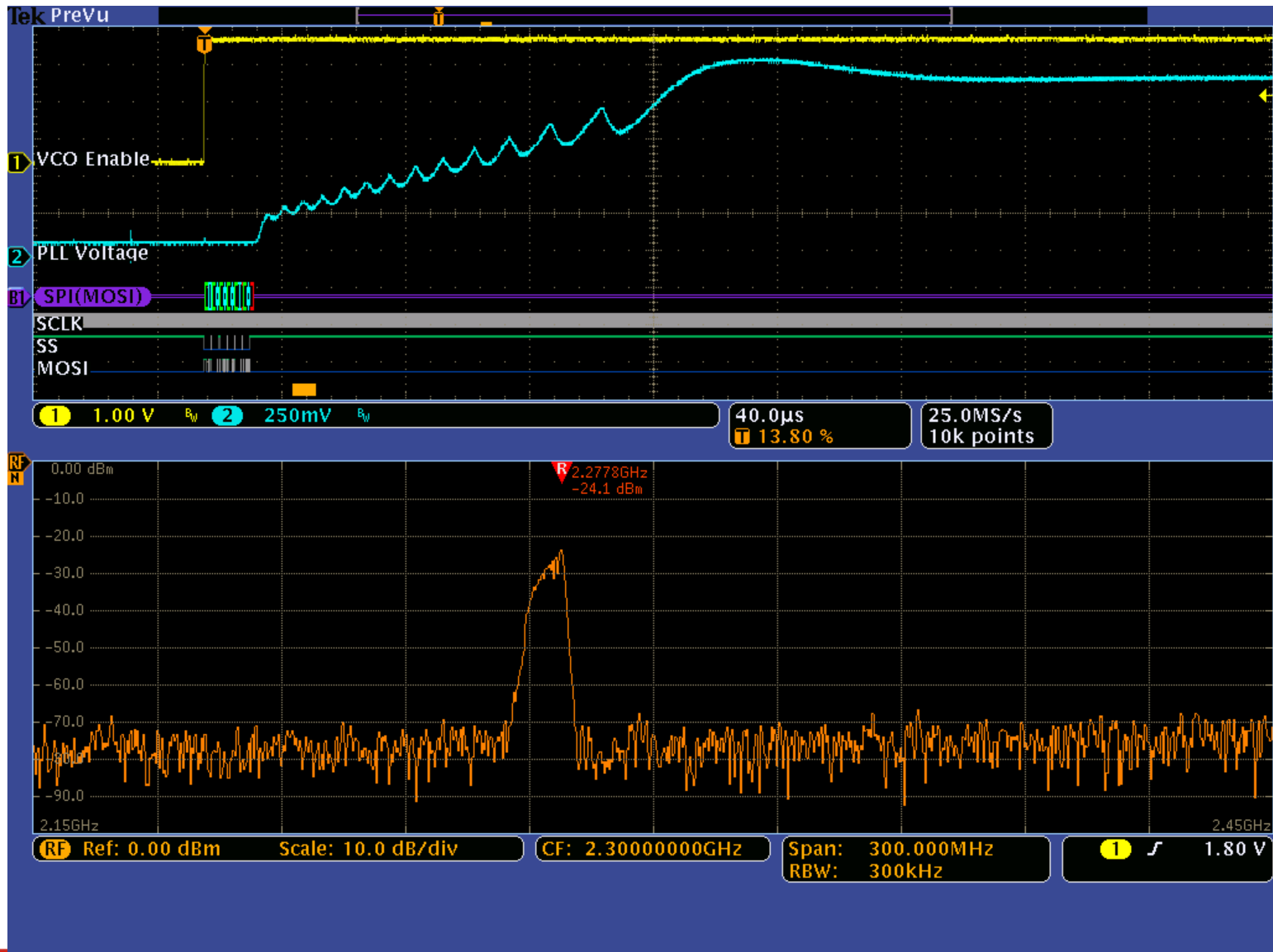
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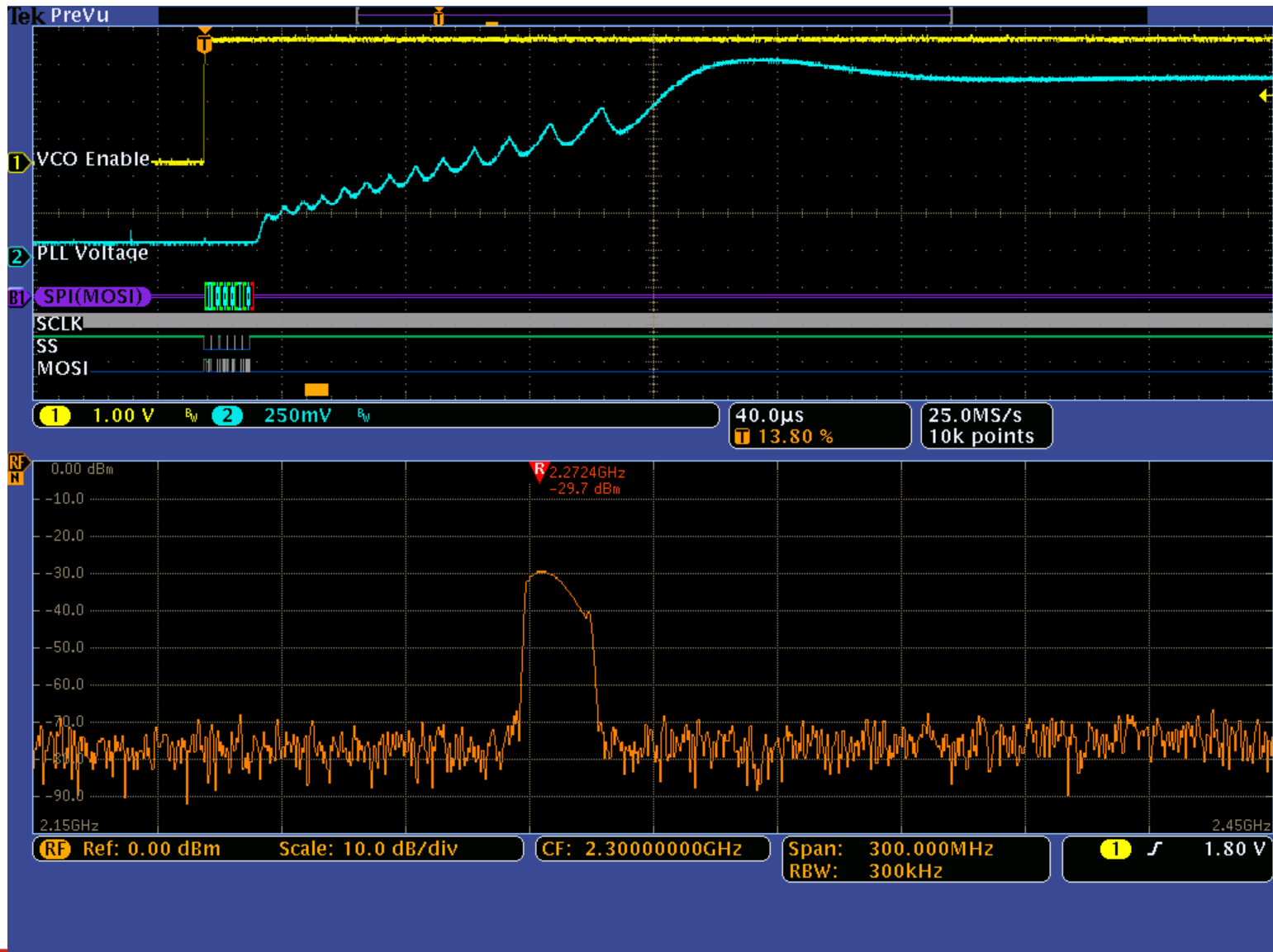
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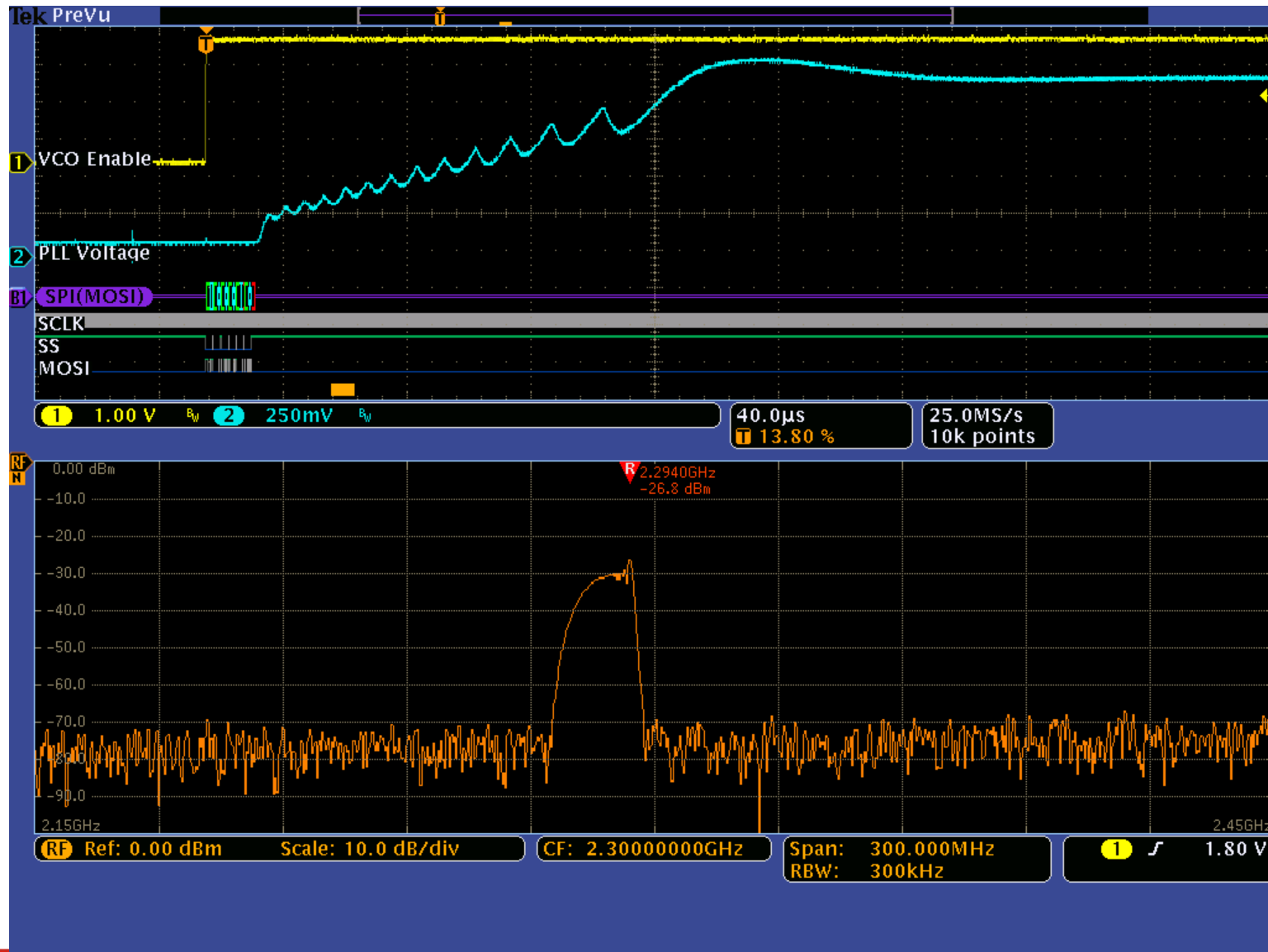
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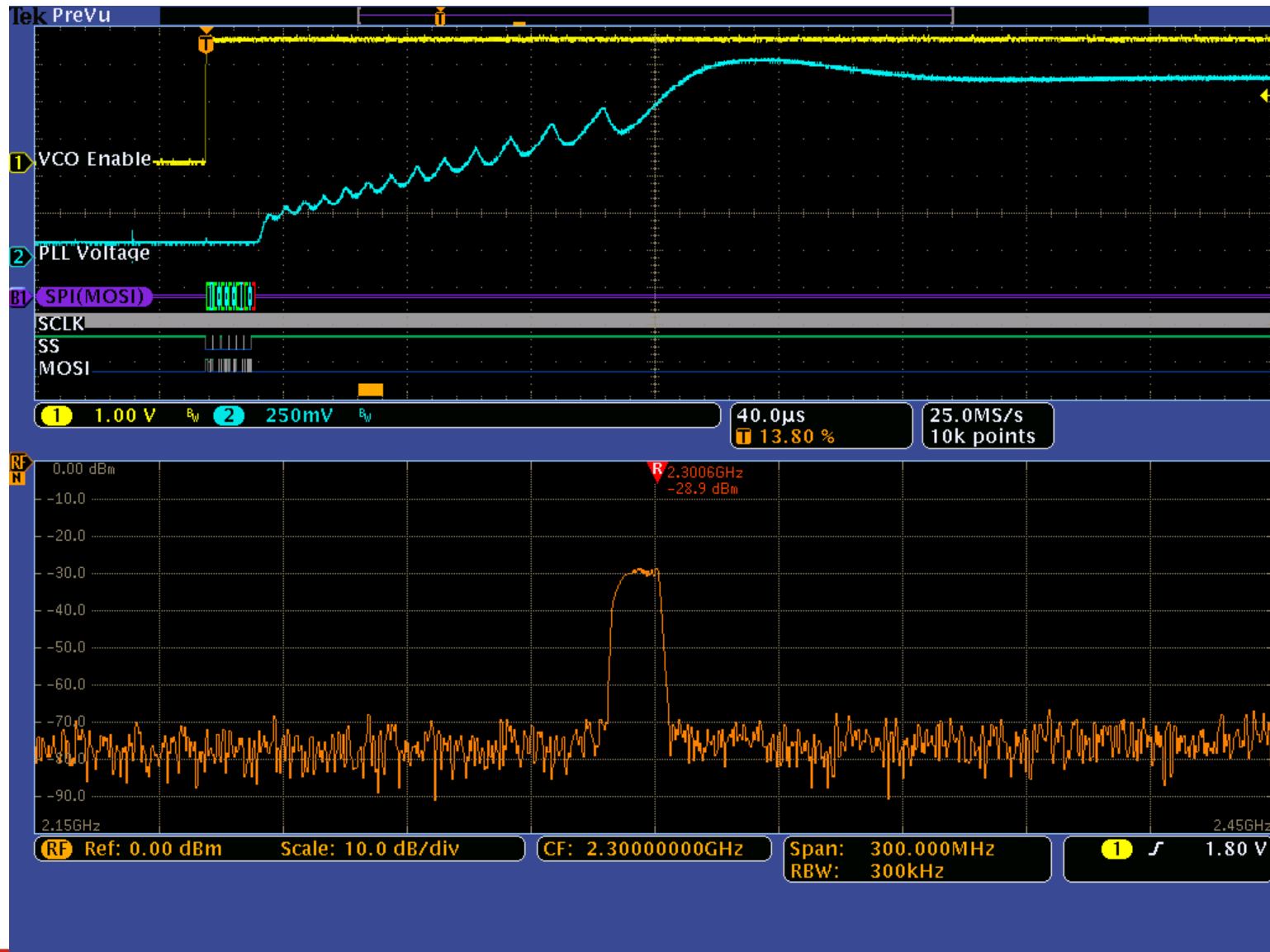
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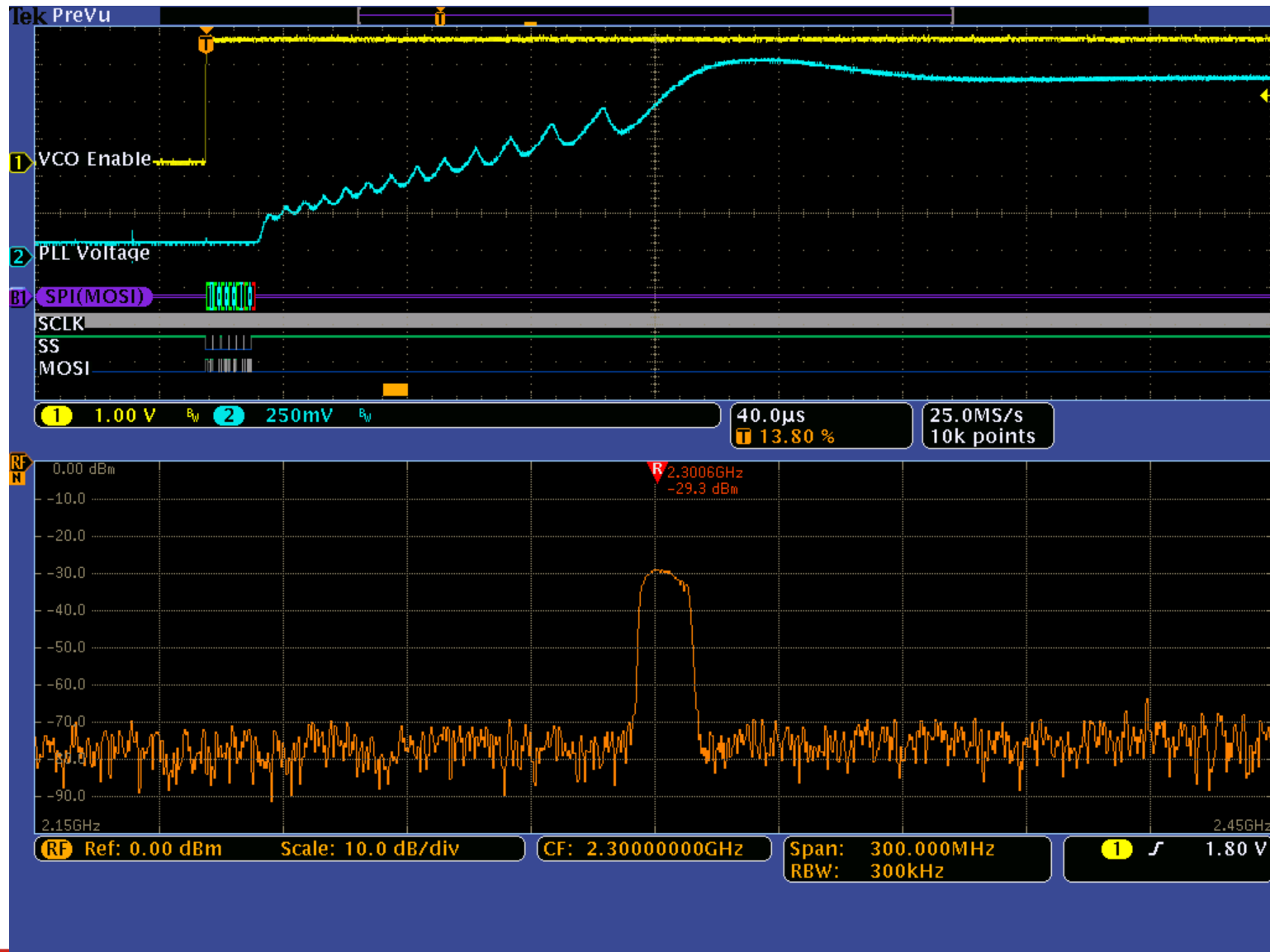
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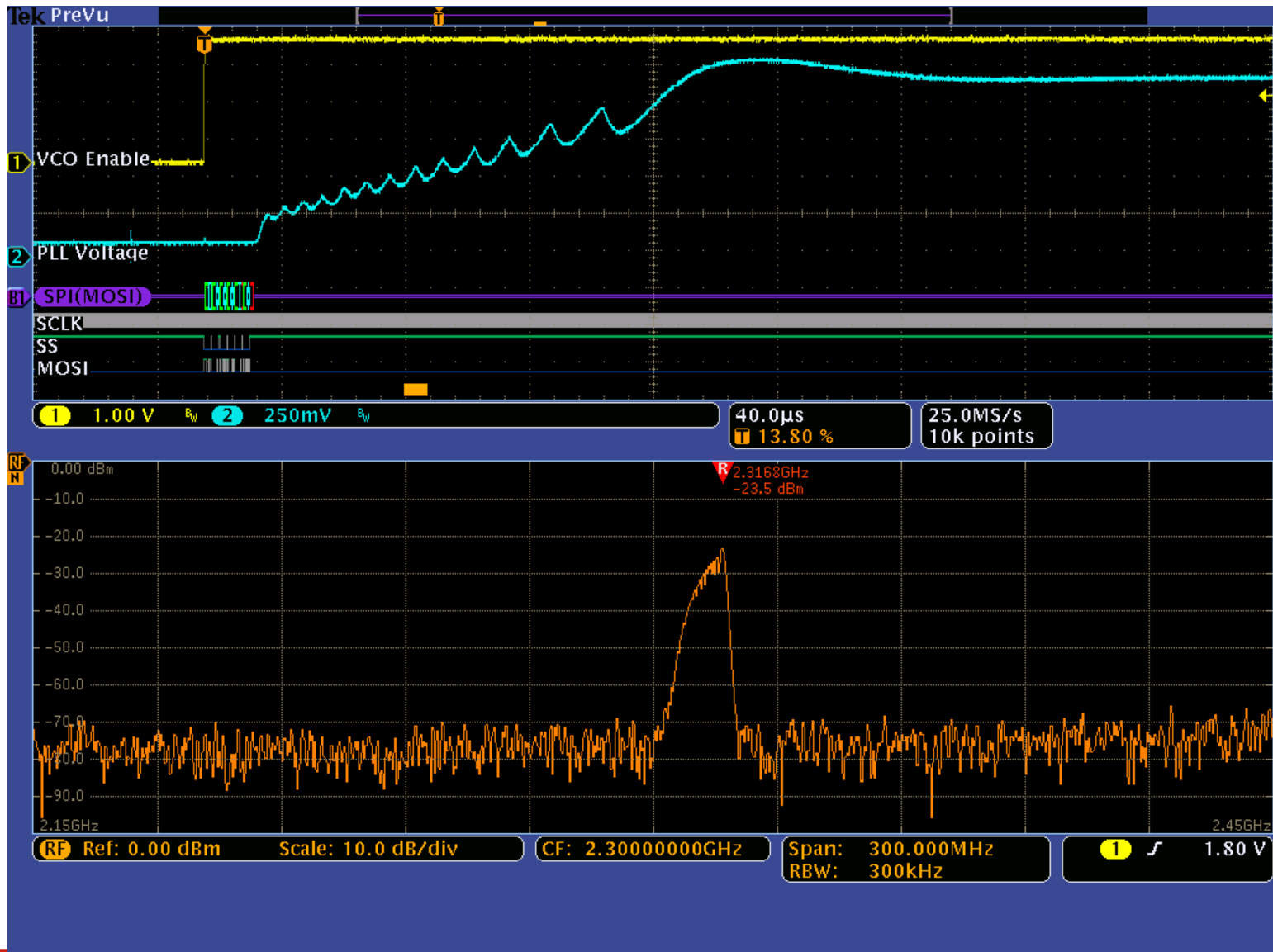
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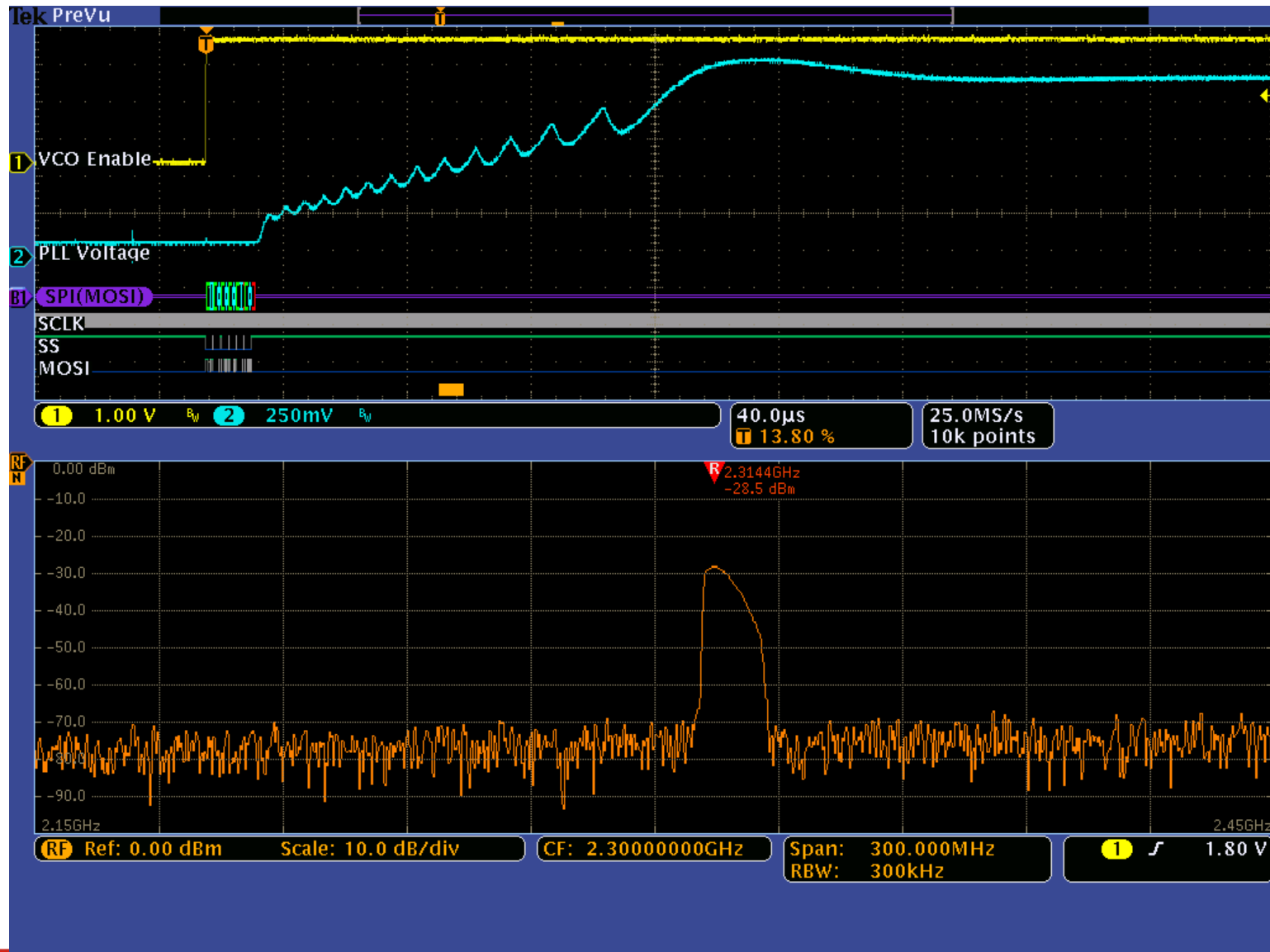
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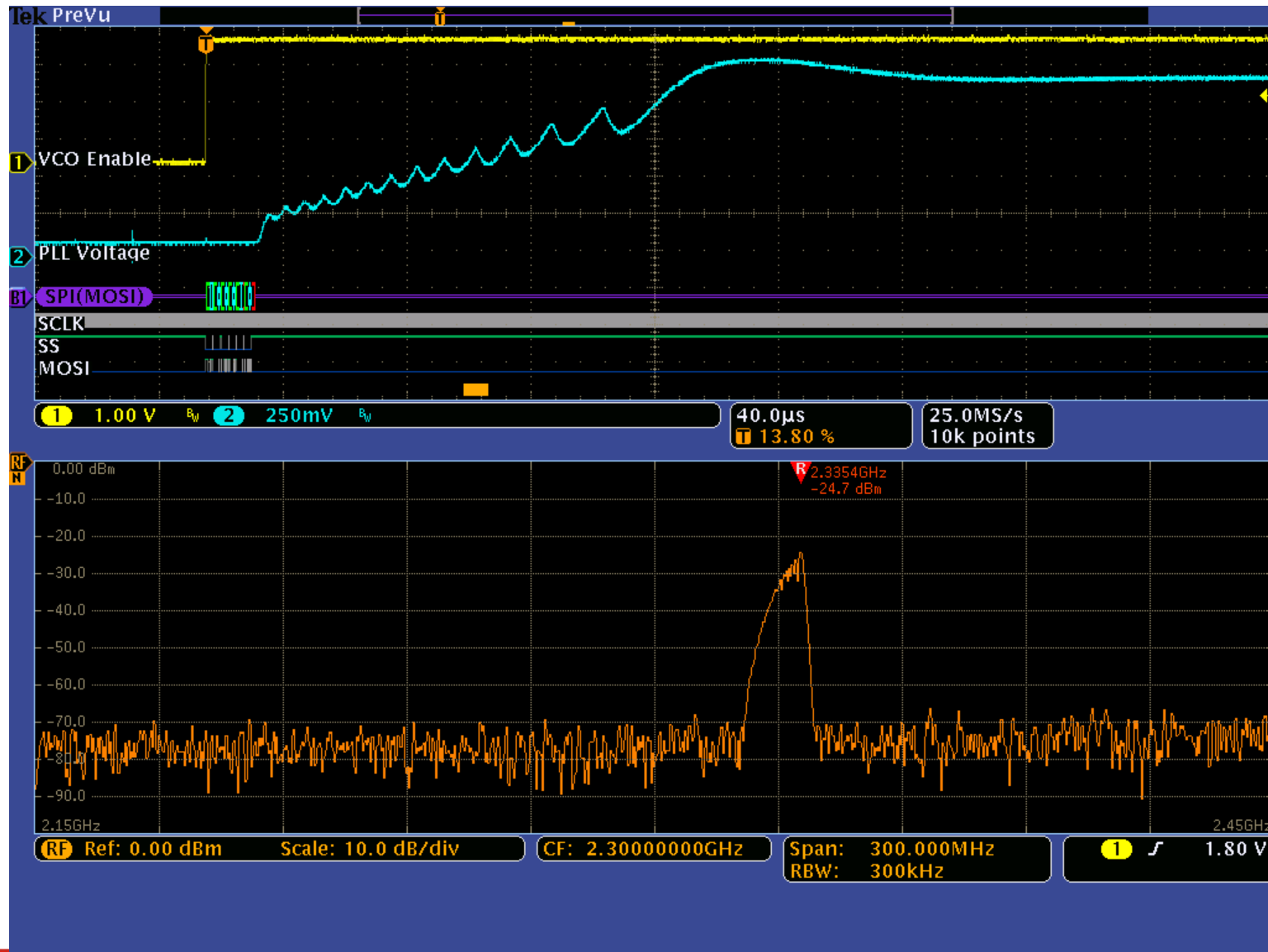
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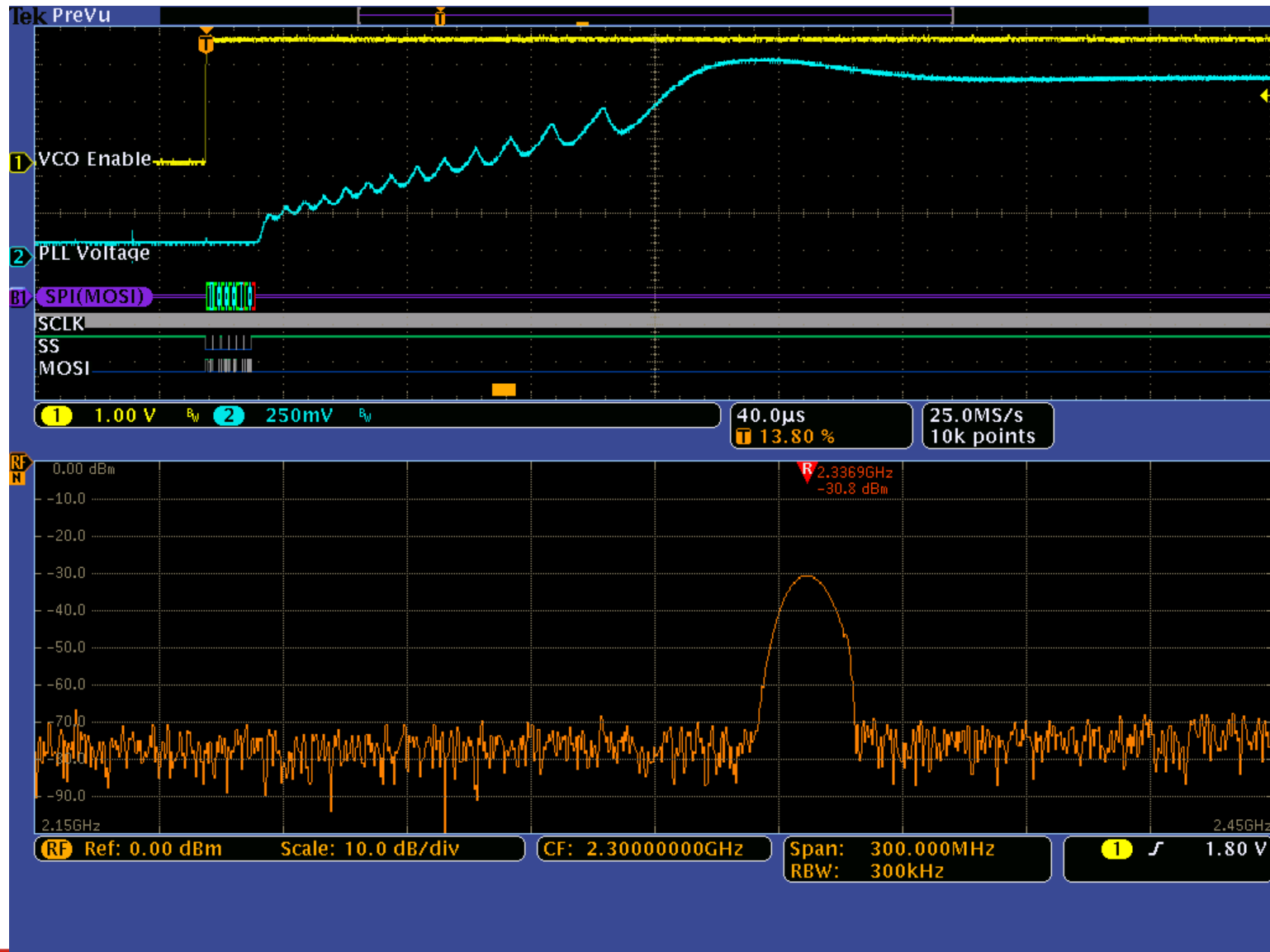
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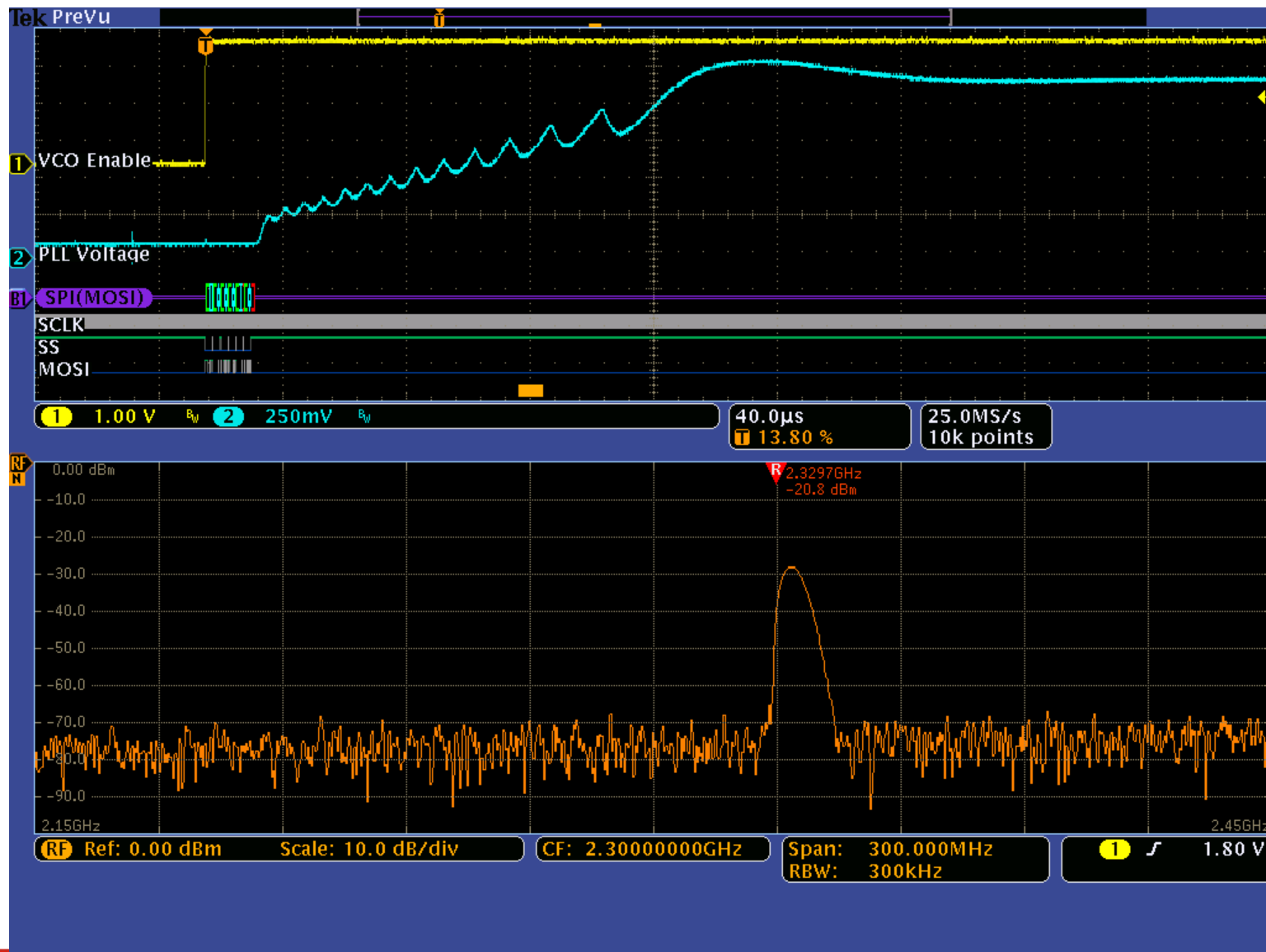
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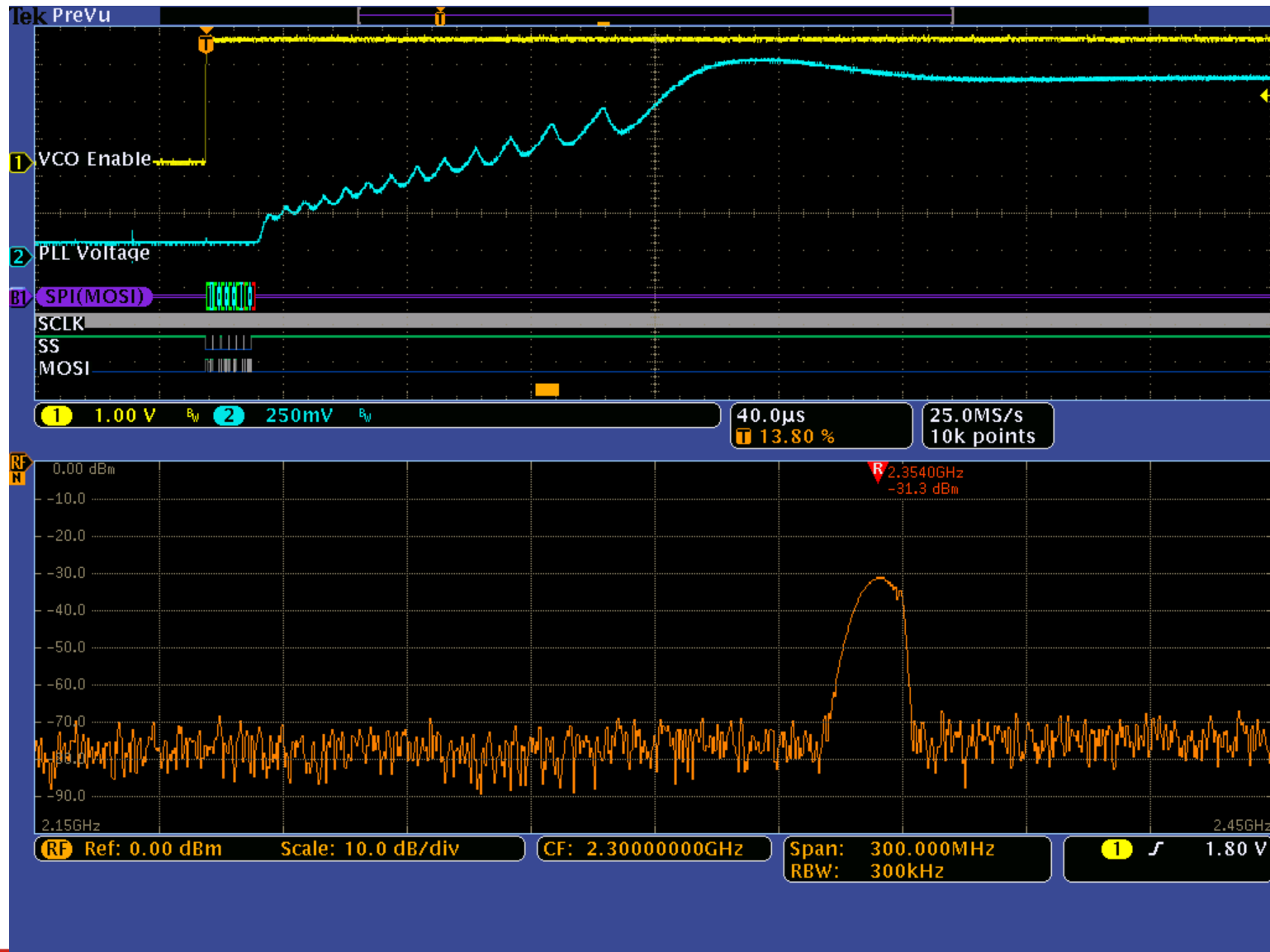
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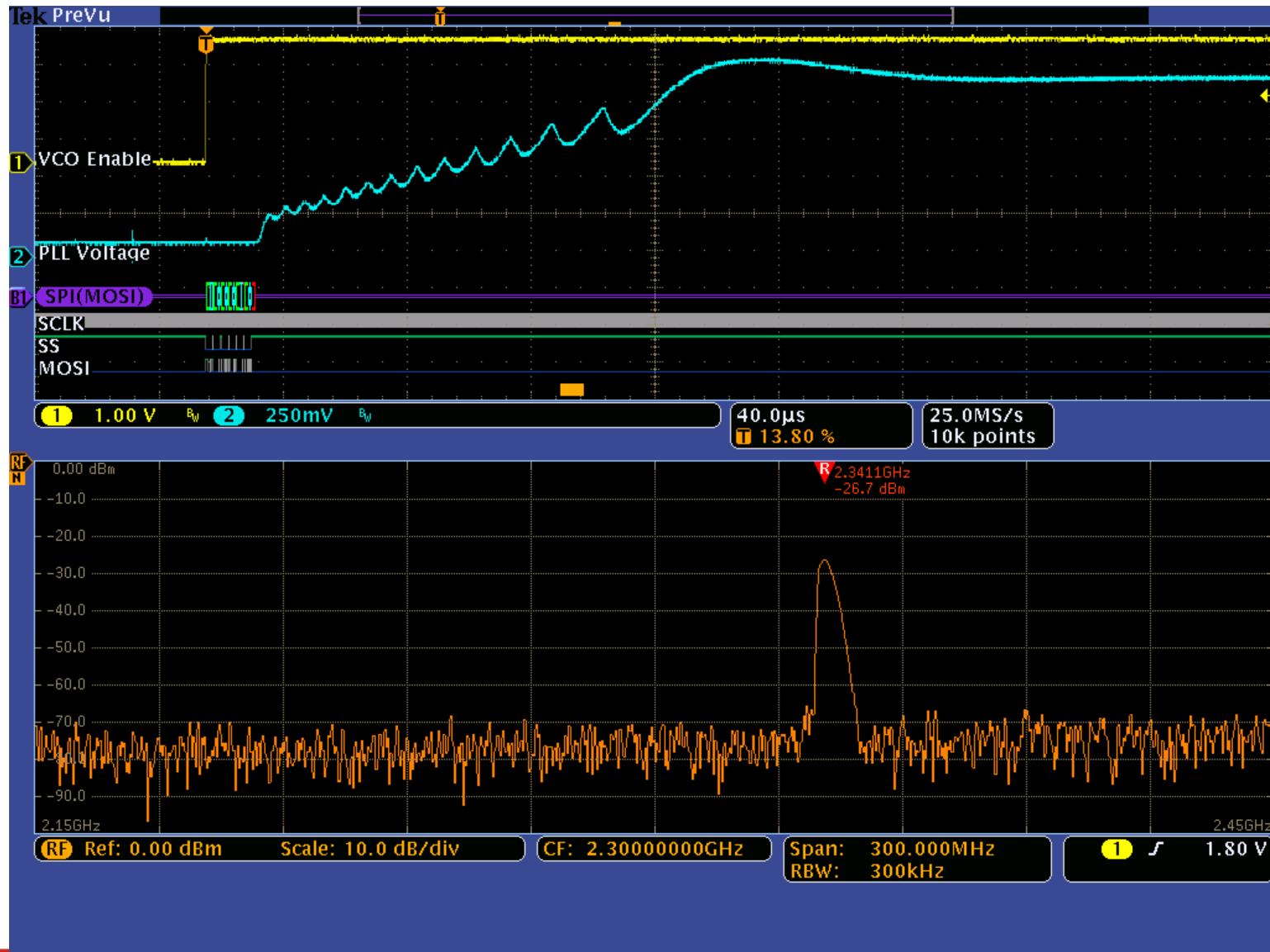
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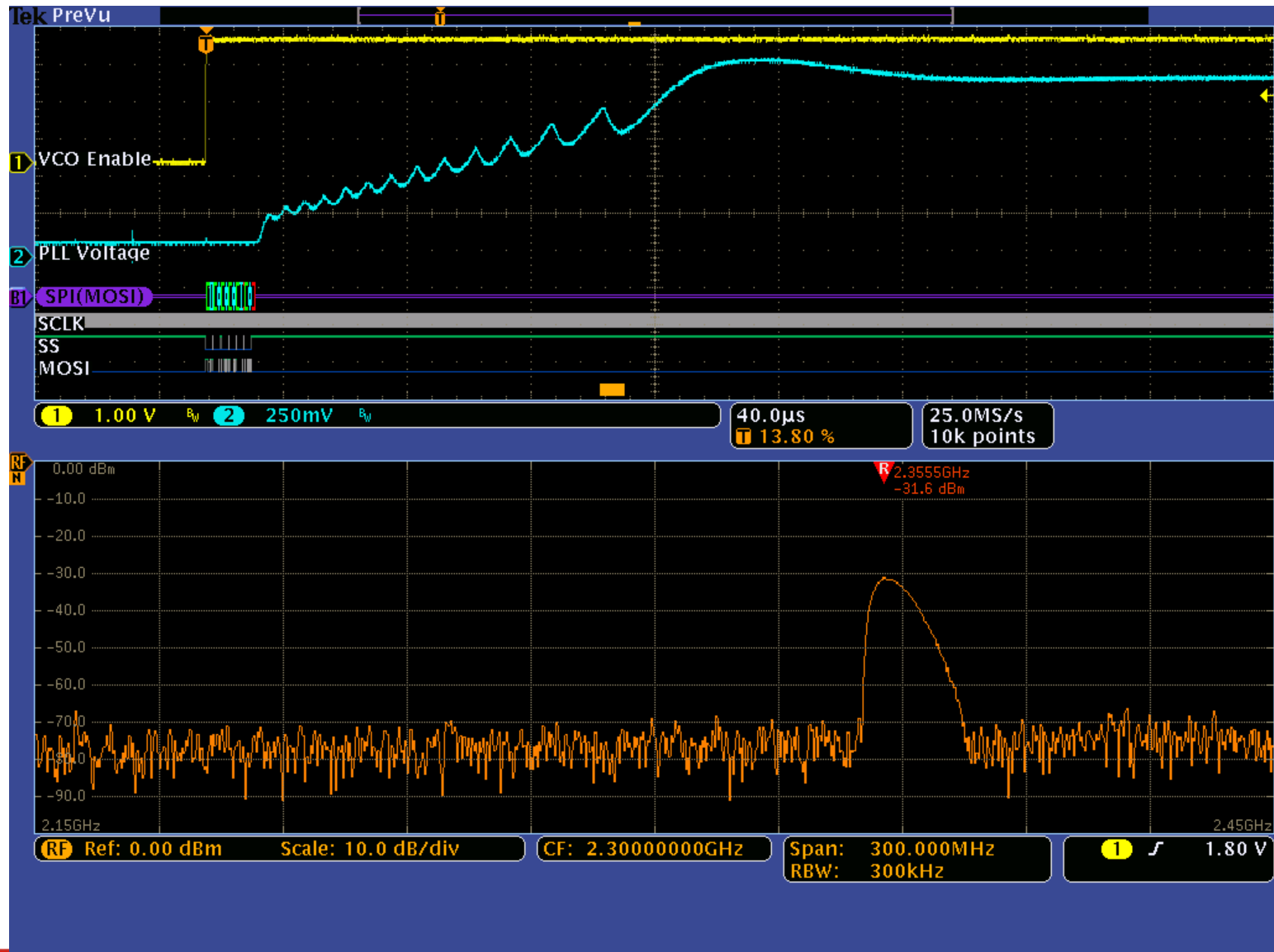
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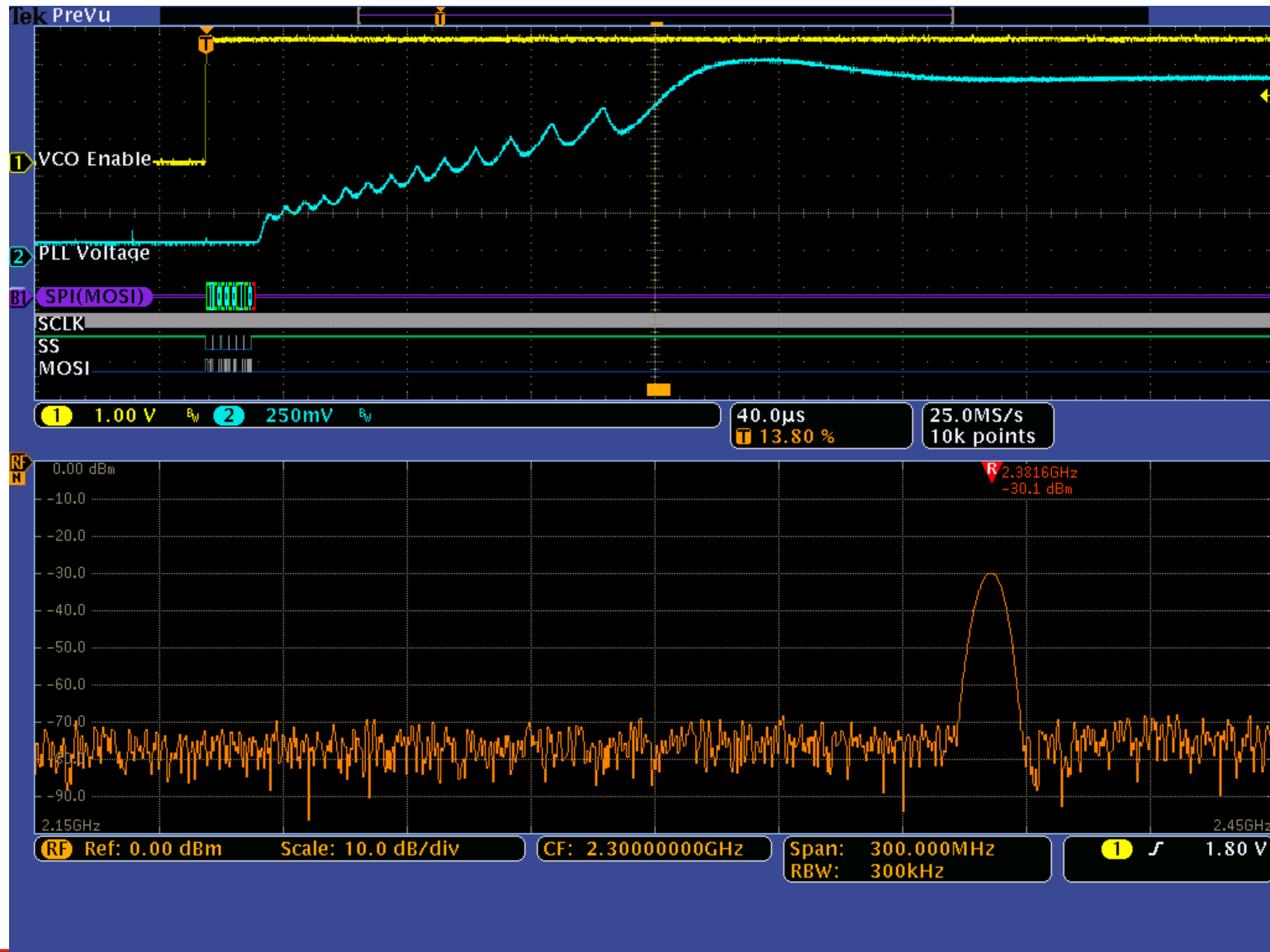
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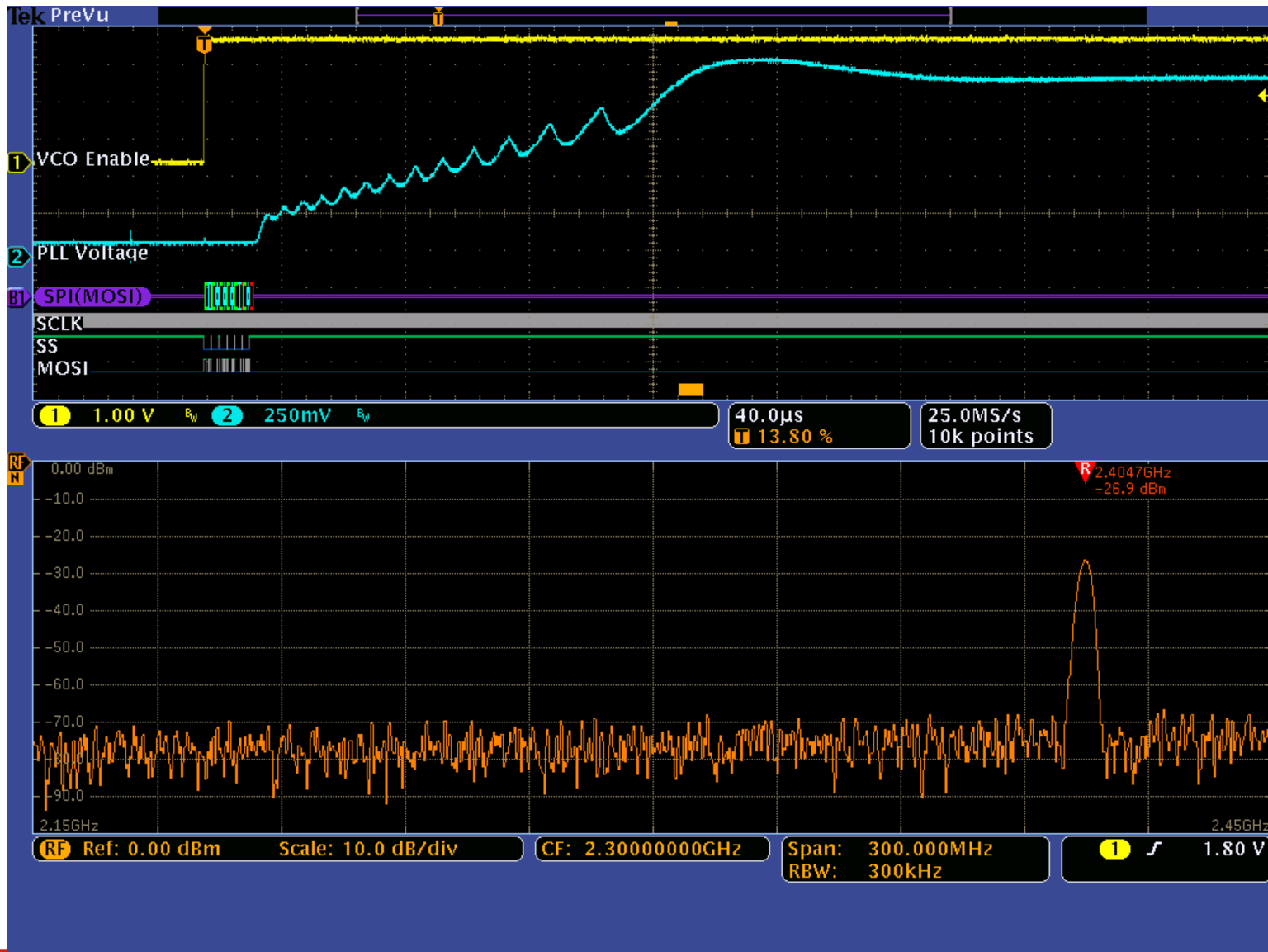
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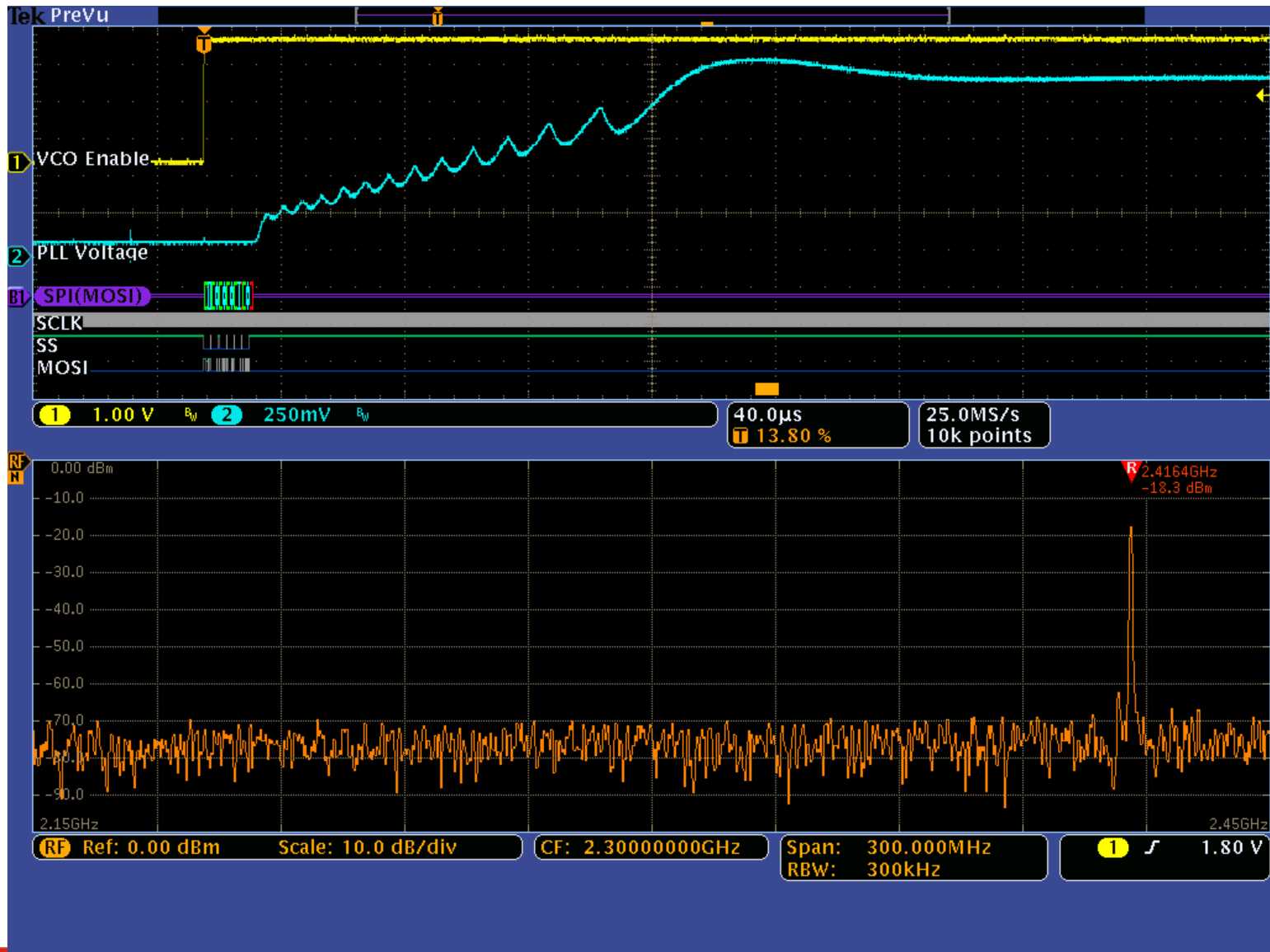
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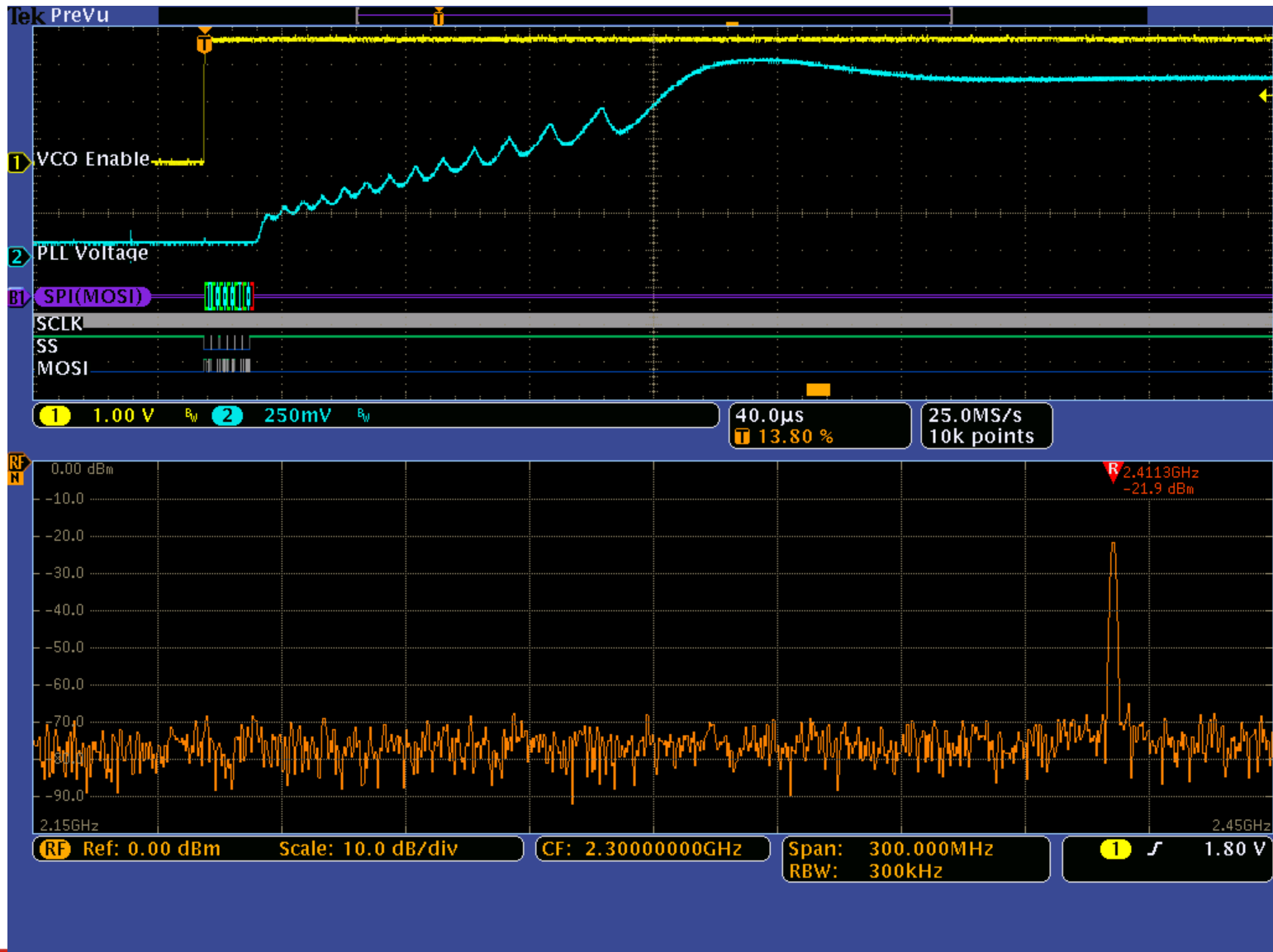


VCO/PLL Circuit Turn-on

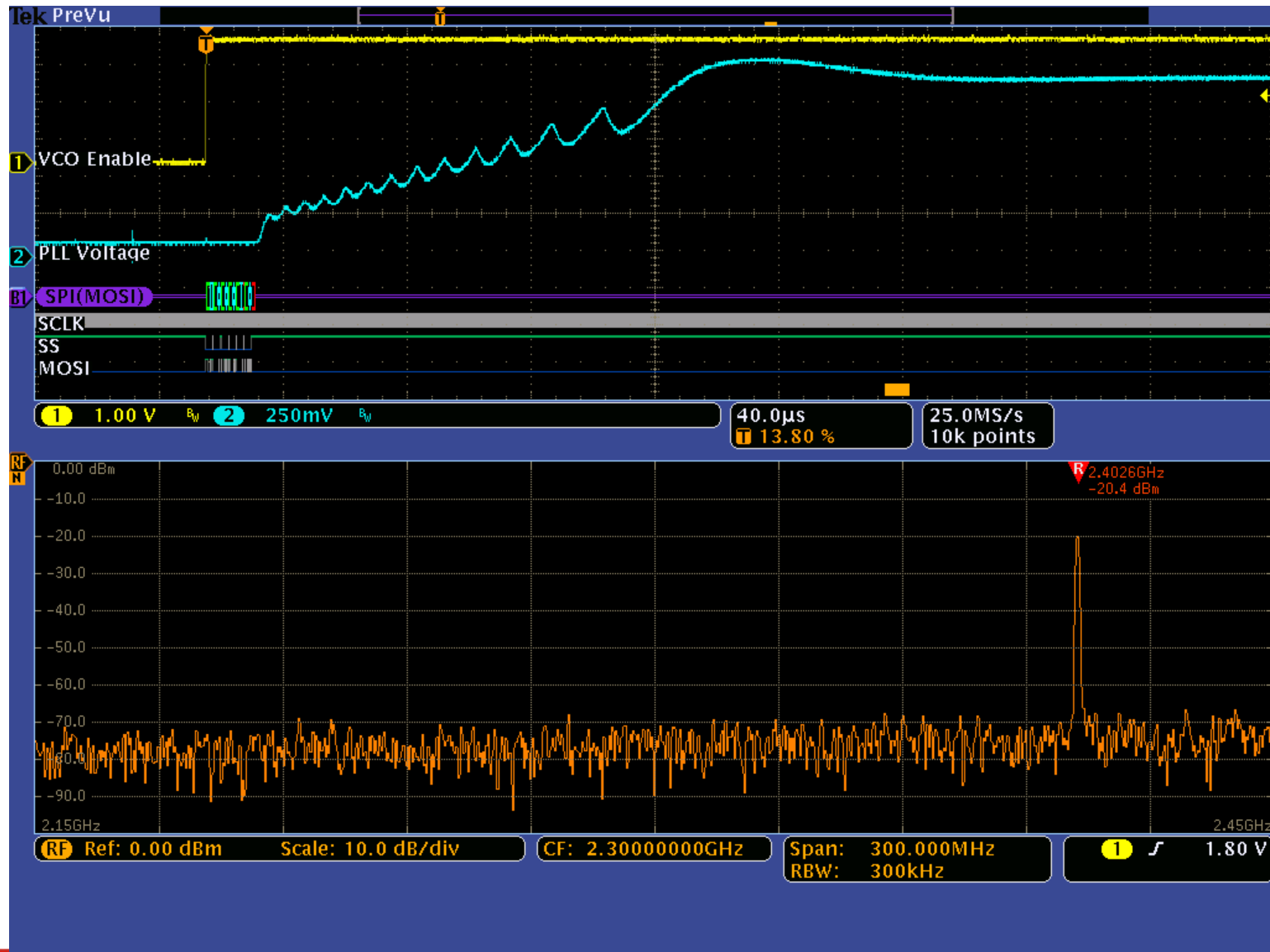


**RF over-
shoots
2.416
GHz**

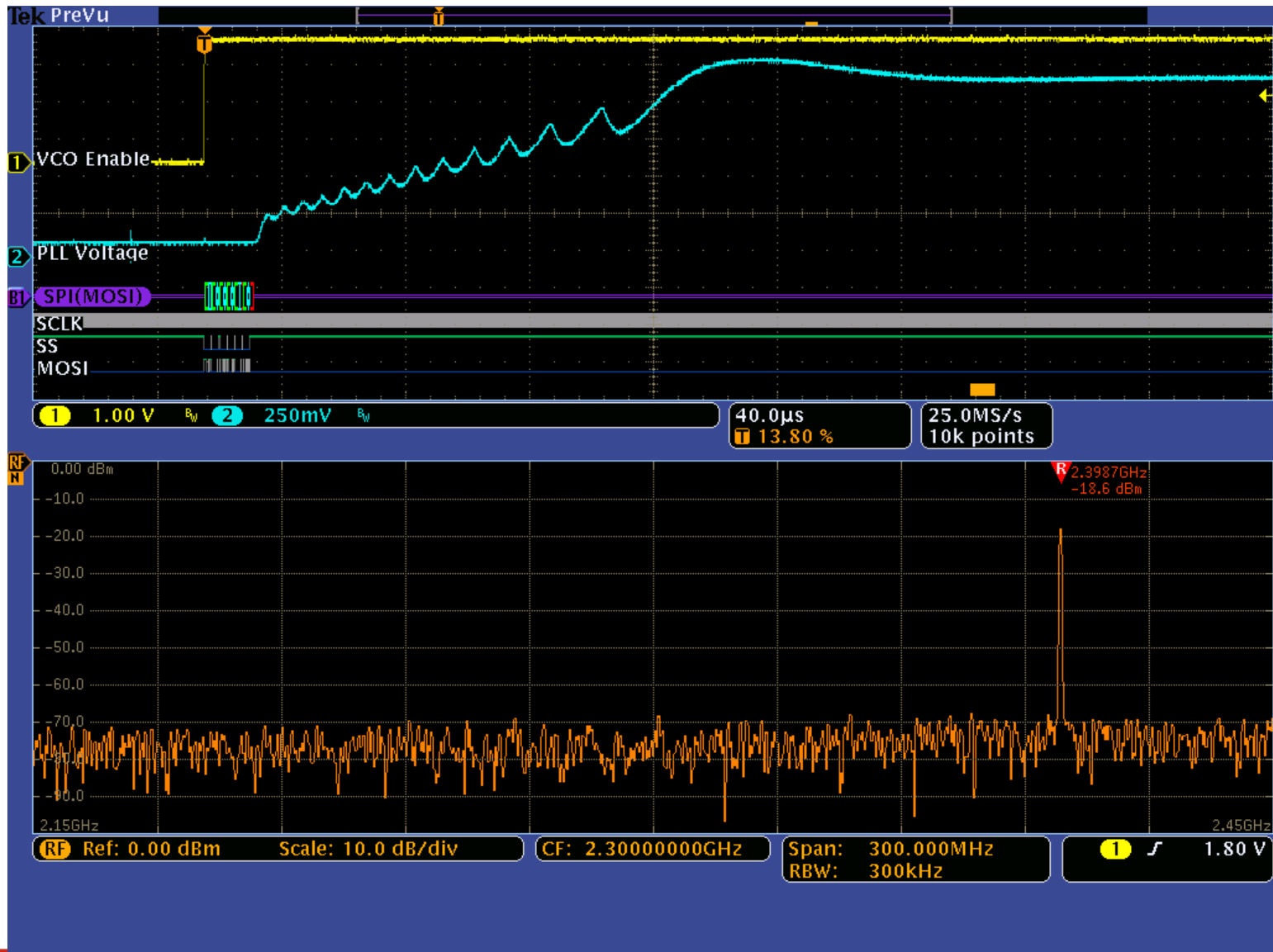
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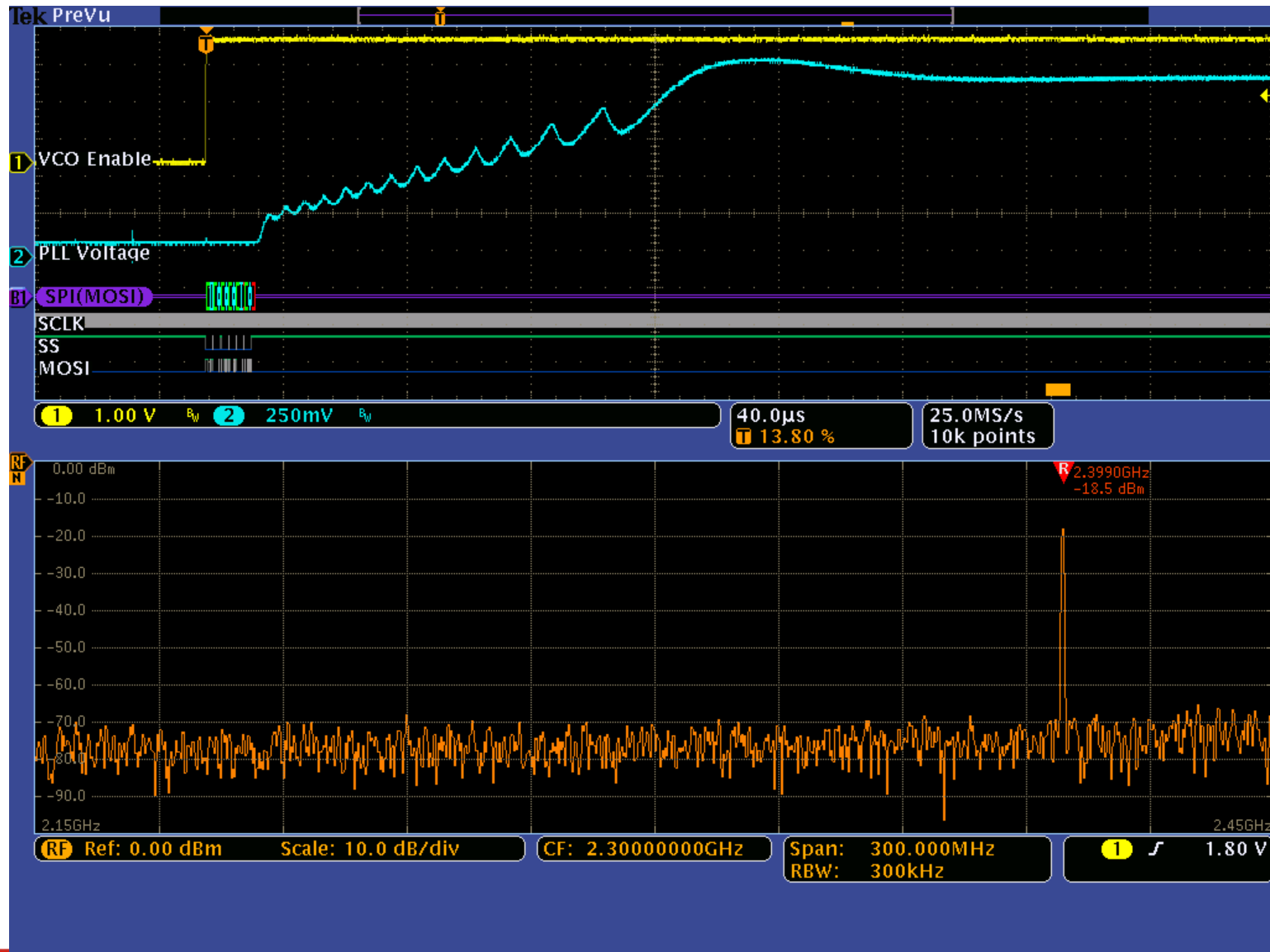
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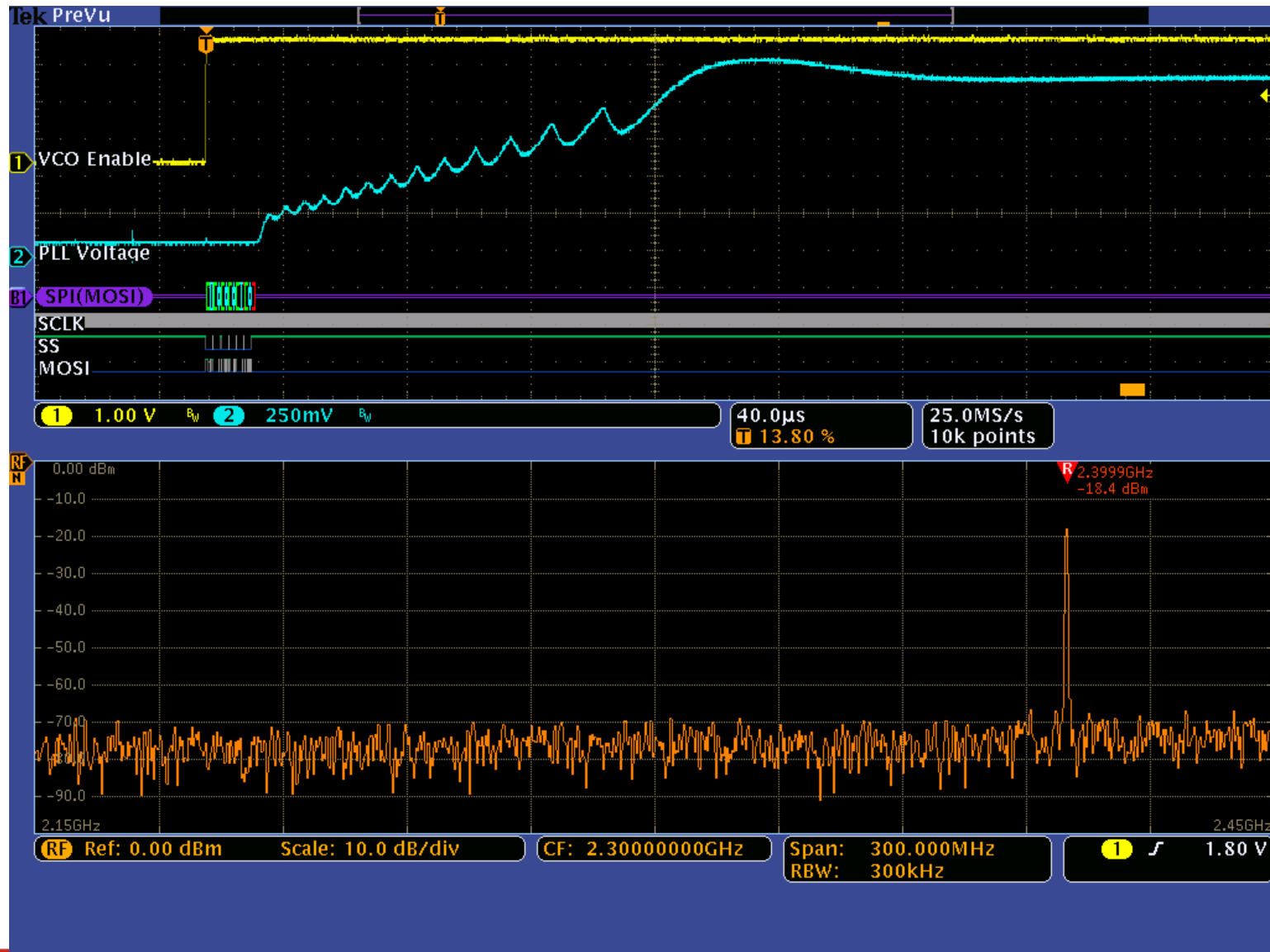
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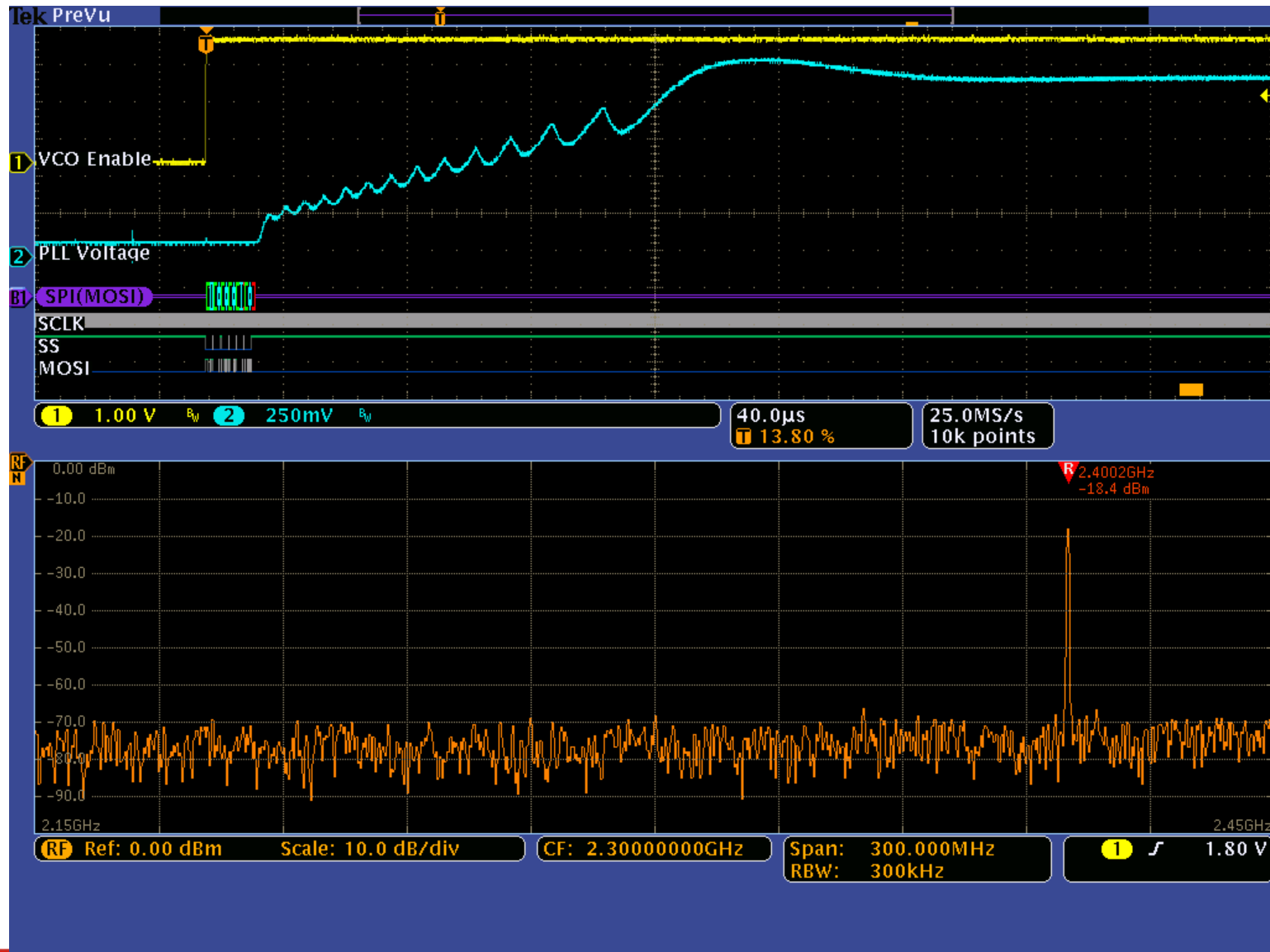
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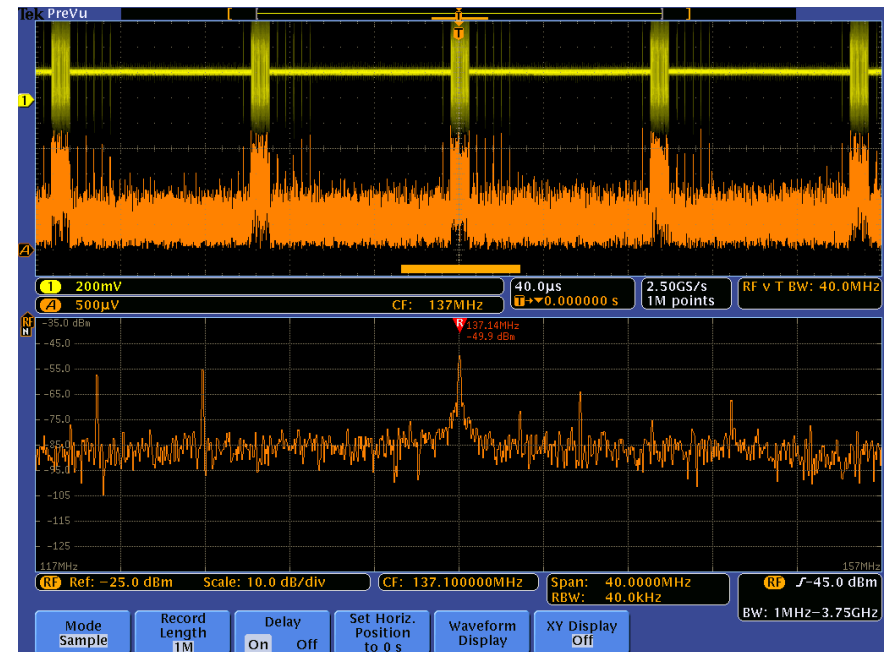
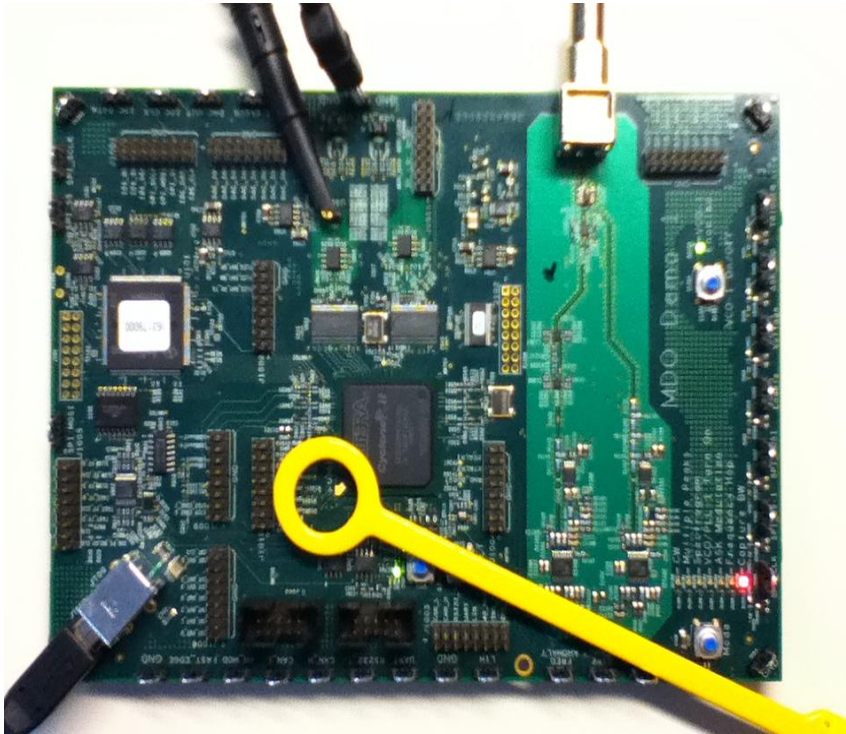


VCO/PLL Circuit Turn-on



**RF at
2.400
GHz
~304μs
after
turn on**

- Switching noise EMI debugging -





Tektronix®

