Washington Laboratories, Ltd.

CERTIFICATION TEST REPORT

for the

Payload Module

FCC ID: UYXRSK2020-02

REPORT# 16418 -01 REV 0

Prepared for:

ReconRobotics, Inc.

5251 W 73rd Street, Suite A

Edina, Minnesota 55439

Prepared By:

Washington Laboratories, Ltd.

4840 Winchester Blvd

Frederick, MD 21703

Testing Certificate AT-1448

Certification Test Report

for the

ReconRobotics, Inc.

Payload Module

FCC ID: UYXRSK2020-02

MARCH 22, 2020

WLL REPORT# 16418 -01 REV 0

Prepared by:

Michael F. Violette, P.E.
CEO

Reviewed by:

Steve Koster
President

ABSTRACT

This report has been prepared on behalf of ReconRobotics, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Digital Transmission System under Part 15.247 of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy. This Certification Test Report documents the test configuration and test results for the ReconRobotics, Inc. Payload Module.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd 4840 Winchester Blvd, Frederick, MD 21701. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory.

The ReconRobotics, Inc. Payload Module complies with the limits for a Digital Transmission System.

Revision History	Description of Change	Date
Rev 0	Initial Release	March 22, 2020
Rev 1	After ACB comments	March 27, 2020

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1 INTRODUCTION

1.1 COMPLIANCE STATEMENT

The ReconRobotics, Inc. Payload Module complies with the limits for a Digital Transmission System under FCC Part 15.247. It operates using IEEE 802.15.4 protocol.
This device is applying for approval as a **Limited Modular Approval** as the module circuitry does not contain voltage regulating circuitry.

1.2 TEST SCOPE

Tests for radiated and conducted (at antenna terminal) emissions were performed. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 CONTRACT INFORMATION

Customer:	ReconRobotics, Inc.
Address	5251 W 73rd Street, Suite A
	Edina, Minnesota 55439
Purchase Order Number:	8923-1
Quotation Number:	71806

1.4 TEST DATES

Testing was performed on the following date(s): 21 February – 20 March 2020

1.5 TEST AND SUPPORT PERSONNEL

Washington Laboratories, LTD	Mike Violette
Customer Representative	Collin LaFave

2 EQUIPMENT UNDER TEST

2.1 EUT IDENTIFICATION & DESCRIPTION

Table 1: Device Summary

Item	Operational Control Unit 3
Manufacturer:	ReconRobotics, Inc.
FCC ID:	UYXRSK2020-02
Model:	Payload Module
FCC Rule Parts:	§15.247
Frequency Range:	2405-2480 MHz
Maximum Output Power:	123 mW (20.8 dBm)
Modulation:	802.15.4
Occupied Bandwidth (99%):	2.6 MHz
Occupied Bandwidth (6 dB):	1.3 MHz
Keying:	Automatic
Type of Information:	Data
Power Output Level	Fixed
Antenna Connector	UFL
Antenna Type	Trace or monopole
Data Rate	802.15.4
Power Source & Voltage:	Host supplied

The Recon Scout robot is a surveillance robotic device meant to be deployed into settings where useful real time remote information can be transmitted from hazardous locations thereby improving the safety of personnel.

The Recon Scout Operator Control Unit (OCU3) receives video and audio information from the Recon Scout robot and displays that video on a TFT LCD screen on the controller.

The Payload Module is an 802.15.4 protocol radio module that is used to send commands between the controller and the robot. The commands can be used to trigger a response from the robot, such as a 'flashbang' or stun grenade. The module will be used in both the controller and in the robot.

2.2 TEST CONFIGURATION

The Payload Module was configured using a UFL connector to measure conducted output power. Radiated measurements were taken with the two intended antennas, a PCB trace that is used with the controller and a monopole used with the robot.

2.3 TESTING ALGORITHM

The Payload Module was tested was tested using the Texas Instruments Smart RF Suite. Worst cast emission levels are provided in the test results data.

2.4 TEST LOCATION

All measurements herein were performed at Washington Laboratories, Ltd. test center in Frederick, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory.

2.5 MEASUREMENTS

2.5.1 References

ANSI C63.2 (Jan-2016) Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 (Jan 2014) American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

ANSI C63.10 (Jun 2013) American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

2.6 MEASUREMENT UNCERTAINTY

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 (R2002) with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm\sqrt{\frac{a^2}{div_a^2}+\frac{b^2}{div_b^2}+\frac{c^2}{div_c^2}+\ldots\ldots}$$

Where u_c = standard uncertainty

a, b, c,.. = individual uncertainty elements

$Div_{a,\,b,\,c}$ = the individual uncertainty element divisor based on the probability distribution

Divisor = 1.732 for rectangular distribution

Divisor = 2 for normal distribution

Divisor = 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

Where U = expanded uncertainty

k = coverage factor

$k \leq 2$ for 95% coverage (ANSI/NCSL Z540-2 Annex G)

u_c = standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in Table 2 below.

Table 2: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Conducted Emissions	CISPR11, CISPR22, CISPR32, CISPR14, FCC Part 15	±2.63 dB
Radiated Emissions	CISPR11, CISPR22, CISPR32, CISPR14, FCC Part 15	±4.55 dB

3 TEST EQUIPMENT

Table 3 shows a list of the test equipment used for measurements along with the calibration information.

Table 3: Test Equipment List

Test Name:	**Spurious Emissions**	Test Date:	**03/20/2020**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00823	Agilent	EXA Spectrum Analyzer	3/23/2020
00559	HP	8447D	4/3/2020
00837	WLL	RG223	1/21/2018
00644	SUNOL SCIENCES CORPORATION	JB1 925-833-9936	4/16/2020
00004	ARA	DRG-118/A	3/14/2020

4 TEST RESULTS

The following summary of testing results tabulates the final emissions data.

RF Power Output: (FCC Part §2.1046)

To measure the output power the module was tuned to the low, middle and high channels of the device. The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system.

Table 4: RF Power Output

Frequency	Level (dBm)	Limit (dBm)	Pass/Fail
Low Channel: 2405 MHz	20.9	30	Pass
Mid Channel: 2440 MHz	20.1	30	Pass
High Channel: 2480 MHz	19.0	30	Pass

Figure 1: RF Peak Power, Low Channel

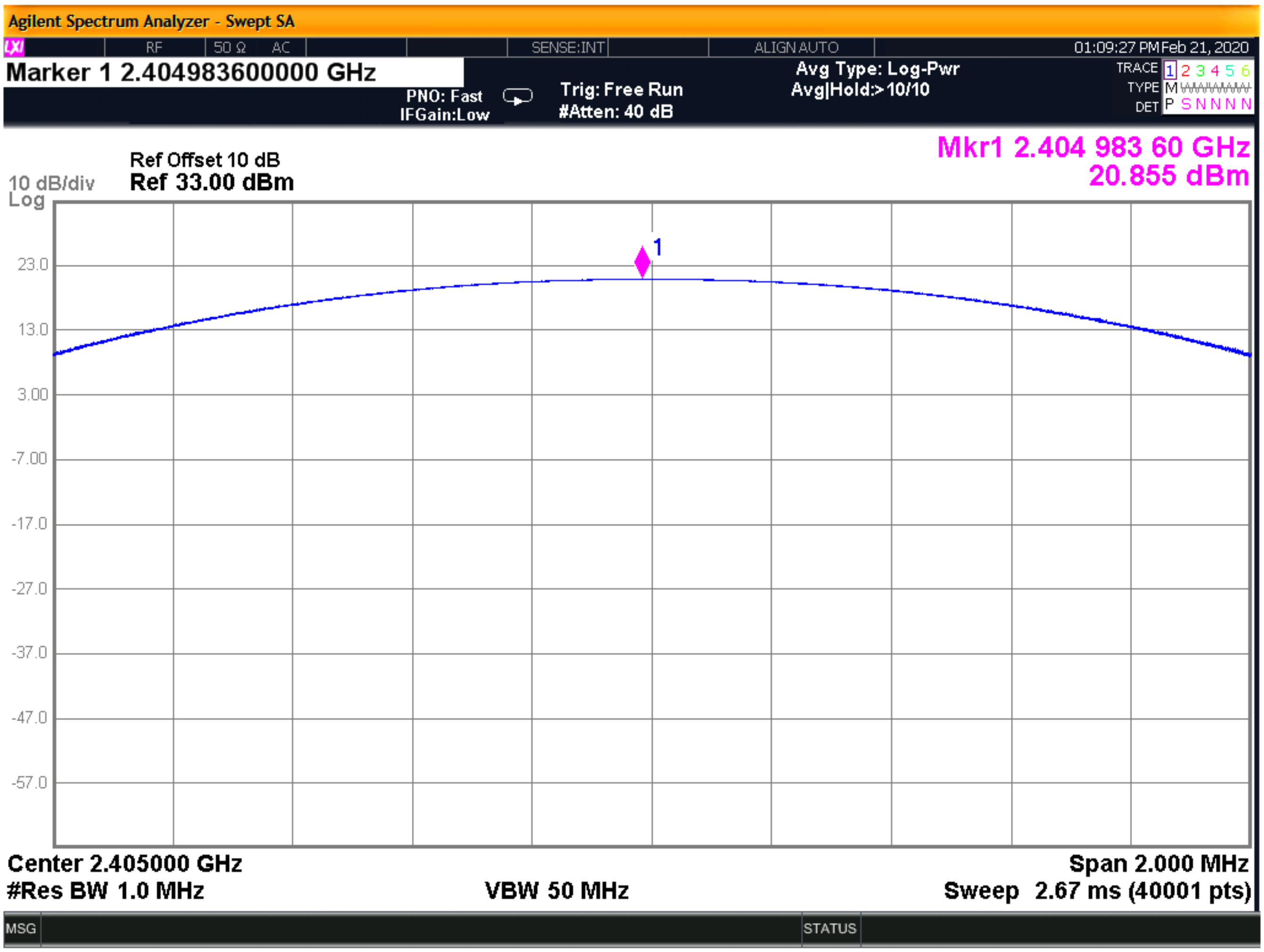


Figure 2. RF Peak Power, Center Channel

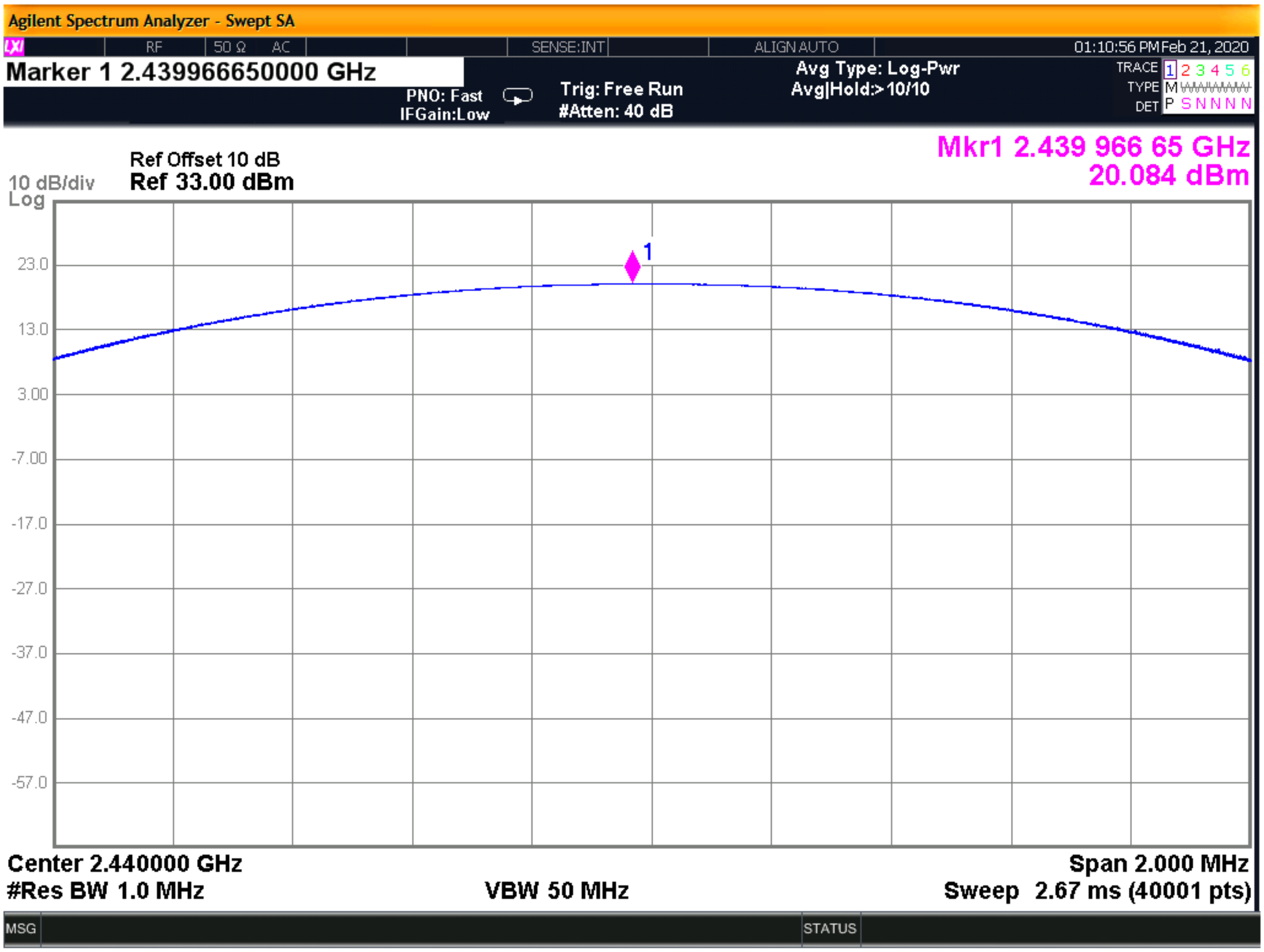
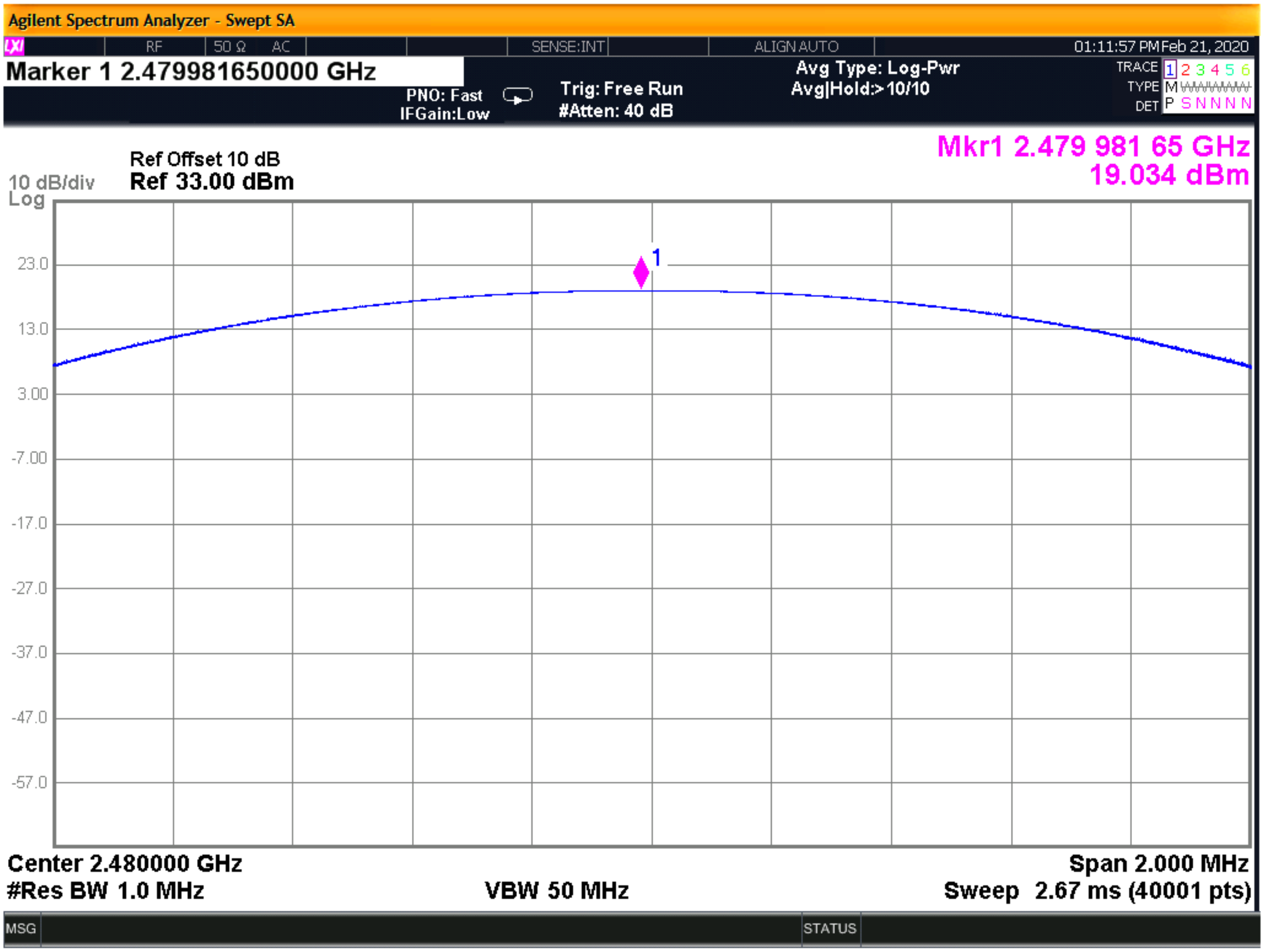


Figure 3. RF Peak Power, High Channel



4.1 OCCUPIED BANDWIDTH: (FCC PART §2.1049)

The measurement was performed by coupling the output of the EUT to the input of a spectrum analyzer.

At full modulation, the occupied bandwidth was measured as shown.

Table 5 provides a summary of the Occupied Bandwidth Results.

Table 5: Occupied Bandwidth Results

Frequency	Bandwidth	Limit (kHz)	Pass/Fail
Low Channel: 2404 MHz	1.6 MHz	> 500 kHz	Pass
Mid Channel: 2440 MHz	1.6 MHz	> 500 kHz	Pass
High Channel: 2480 MHz	1.6 MHz	> 500 kHz	Pass

Figure 4: Occupied Bandwidth, Low Channel

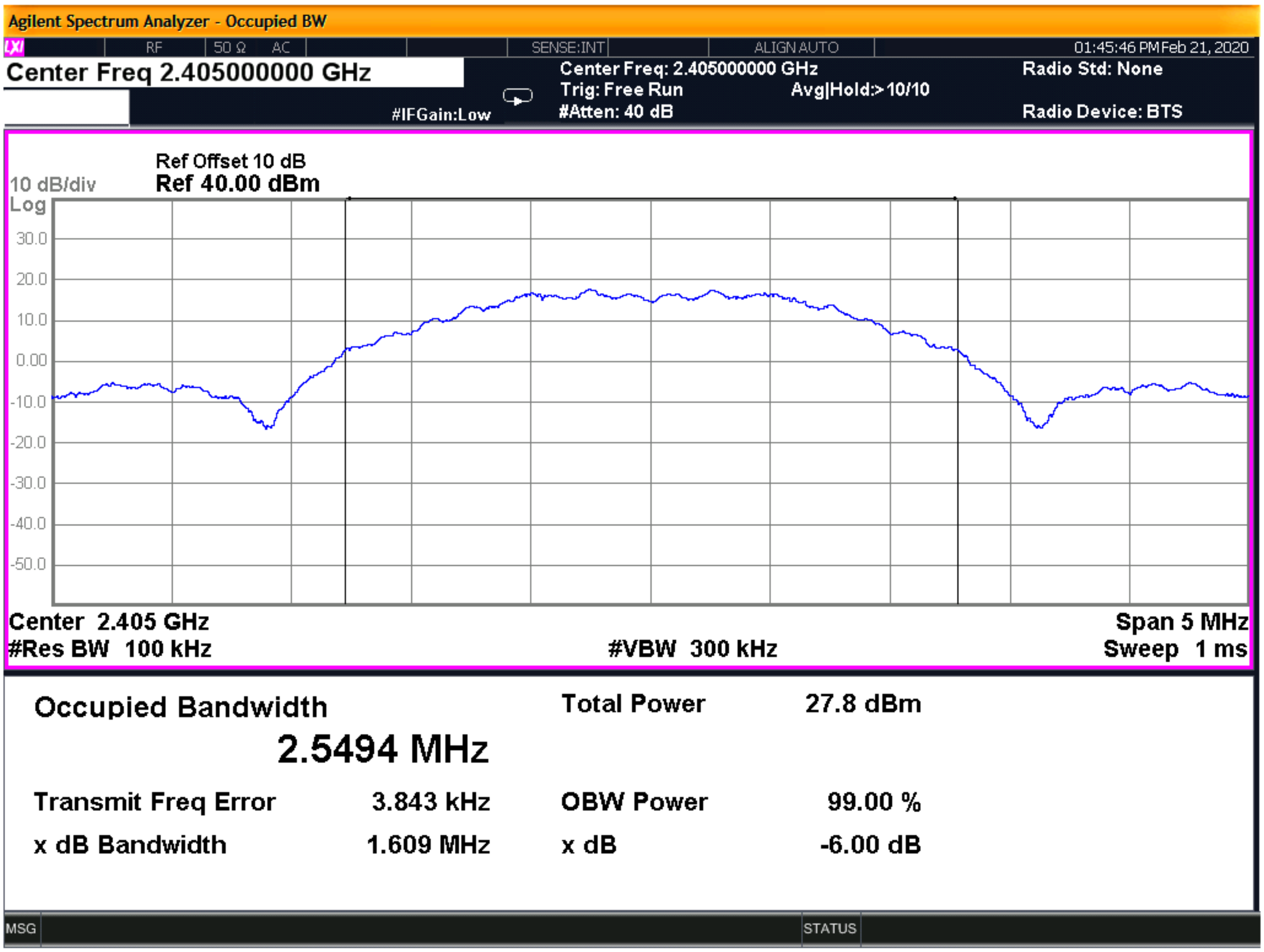


Figure 5: Occupied Bandwidth, Mid Channel

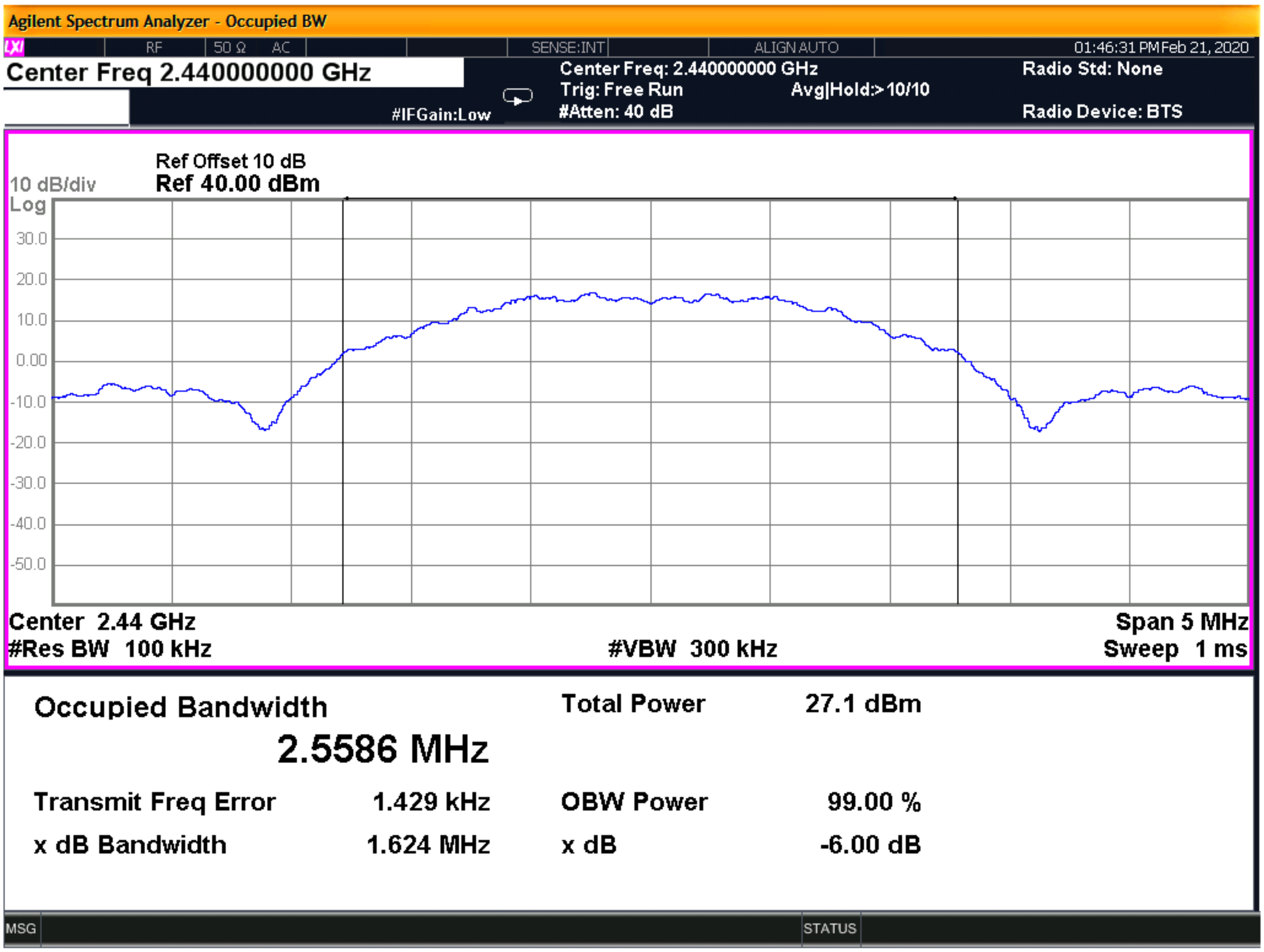
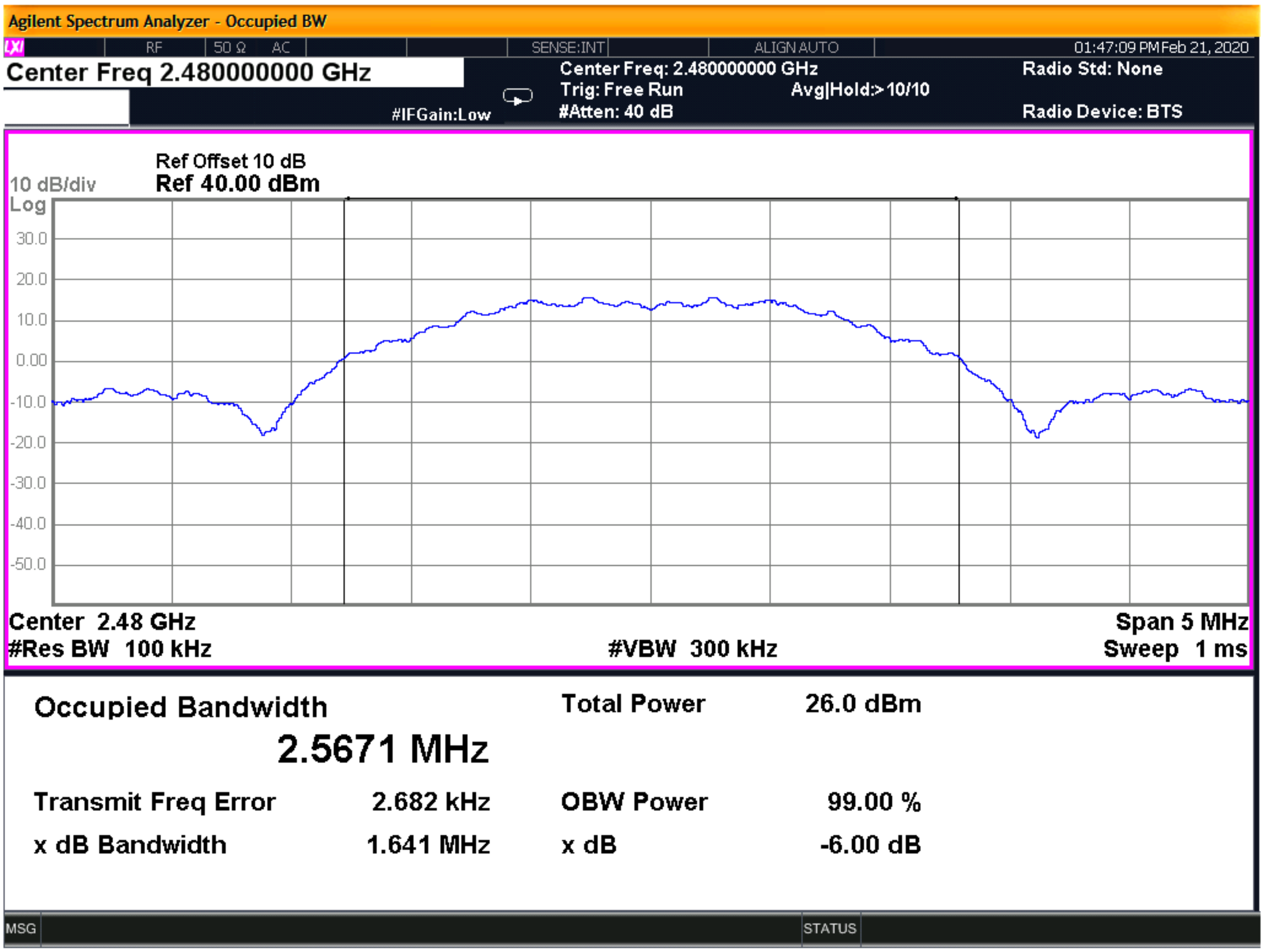


Figure 6: Occupied Bandwidth, High Channel



4.2 CONDUCTED EMISSIONS AC POWER

The device is battery-operated and is not used plugged into a charger. An external battery pack may be used plugged into the USB-C port.

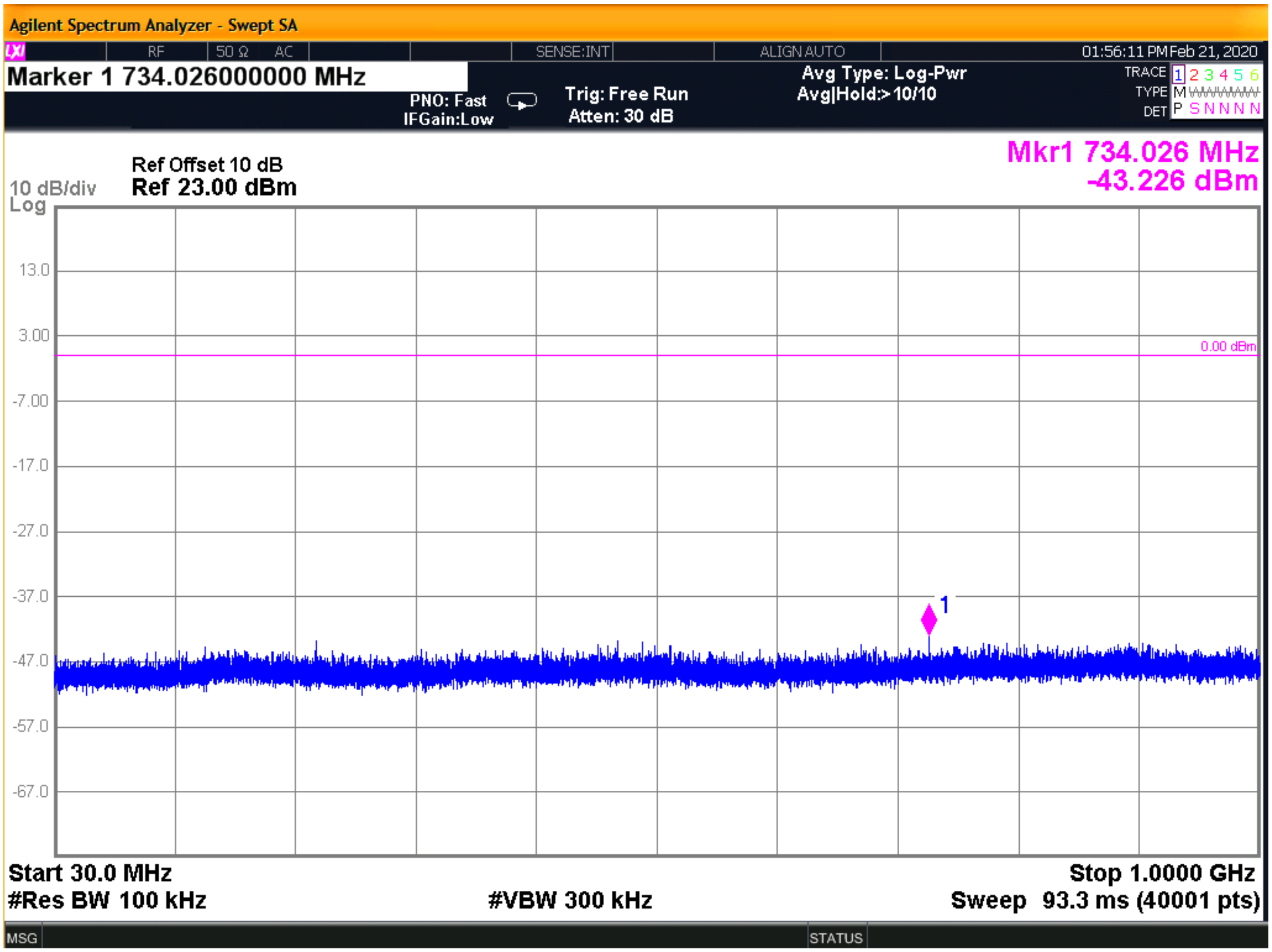
4.3 CONDUCTED SPURIOUS EMISSIONS AT ANTENNA TERMINALS (FCC PART §2.1051)

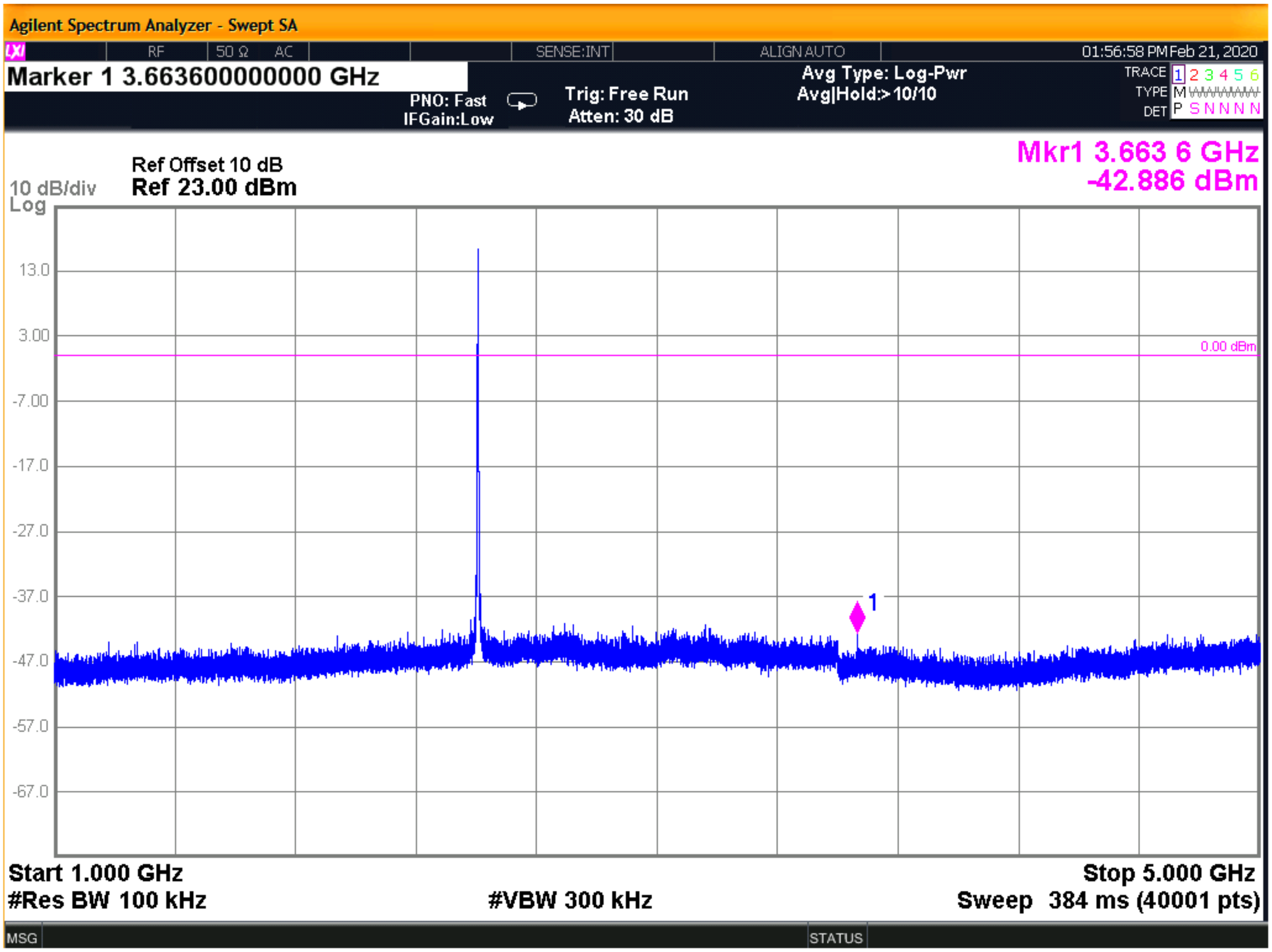
The EUT must comply with requirements for spurious emissions at antenna terminals. Per §15.247(c) all spurious emissions in any 100 kHz bandwidth outside the frequency band in which the spread spectrum device is operating shall be attenuated 20 dB below the highest power level in a 100 kHz bandwidth within the band containing the highest level of the desired power.

The EUT antenna was removed and the cable was connected directly into a spectrum analyzer through a 10 dB attenuator. An offset was programmed into the spectrum analyzer to compensate for the loss of the external attenuator. The spectrum analyzer resolution bandwidth was set to 100 kHz and the video bandwidth was set to 300 kHz. The amplitude of the EUT carrier frequency was measured to determine the emissions limit (20 dB below the carrier frequency amplitude). The emissions outside of the allocated frequency band were then scanned from 30 MHz up to the tenth harmonic of the carrier.

The following are plots of the conducted spurious emissions data.

Figure 7: Conducted Spurious Emissions Low Channel

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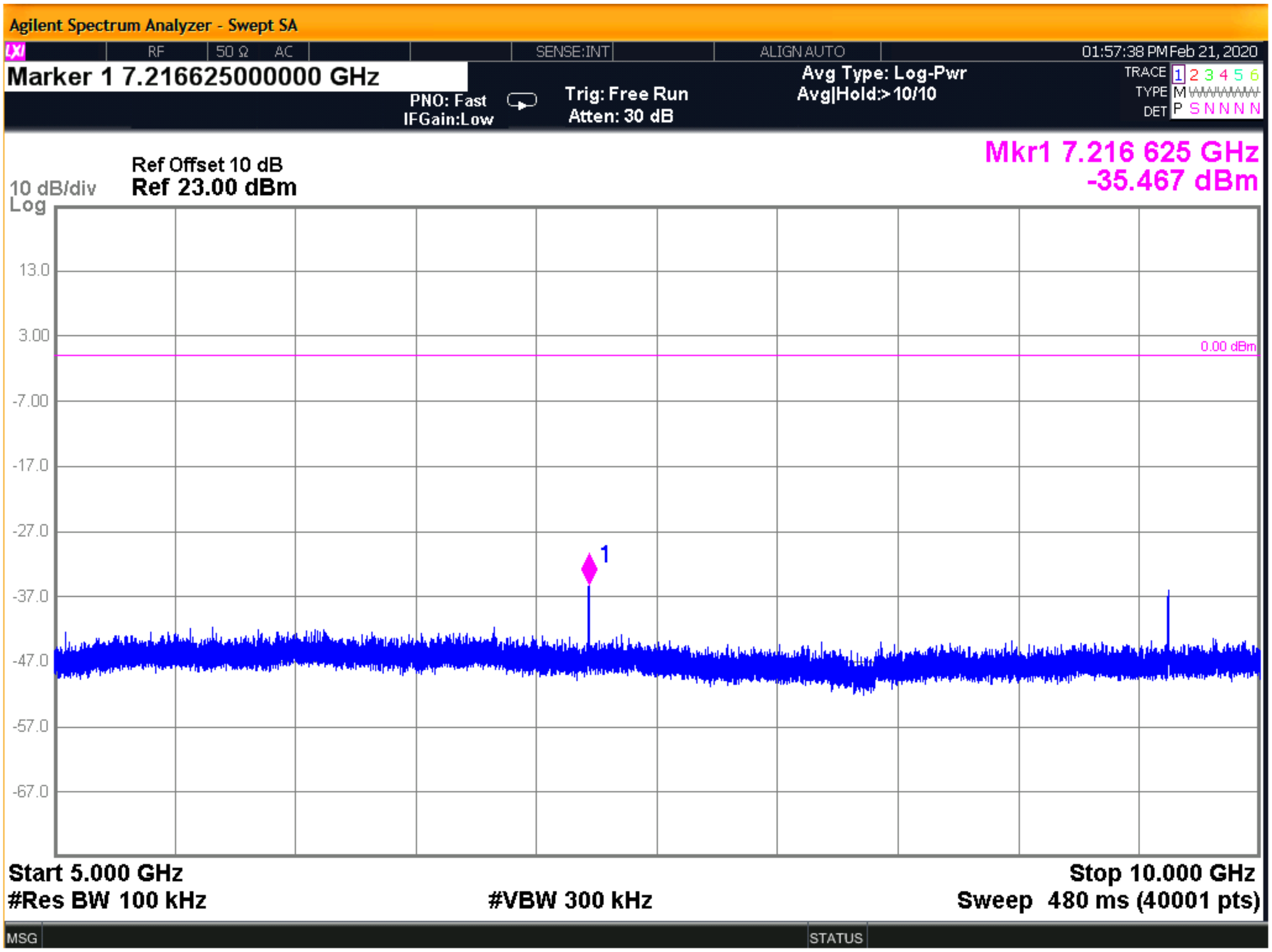
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
01:56:58 PM Feb 21, 2020
Marker 1 3.663600000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P S N N N N
Mkr1 3.663 6 GHz
-42.886 dBm
Ref Offset 10 dB
10 dB/div
Log
Ref 23.00 dBm
13.0
3.00
-7.00
-17.0
-27.0
-37.0
-47.0
-57.0
-67.0
0.00 dBm
1
Start 1.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 5.000 GHz
Sweep 384 ms (40001 pts)
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
RF 50 Ω AC
SENSE:INT
ALIGN AUTO
01:57:38 PM Feb 21, 2020
Marker 1 7.216625000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P S N N N N
Ref Offset 10 dB
10 dB/div
Log
Ref 23.00 dBm
Mkr1 7.216 625 GHz
-35.467 dBm
13.0
3.00
-7.00
-17.0
-27.0
-37.0
-47.0
-57.0
-67.0
0.00 dBm
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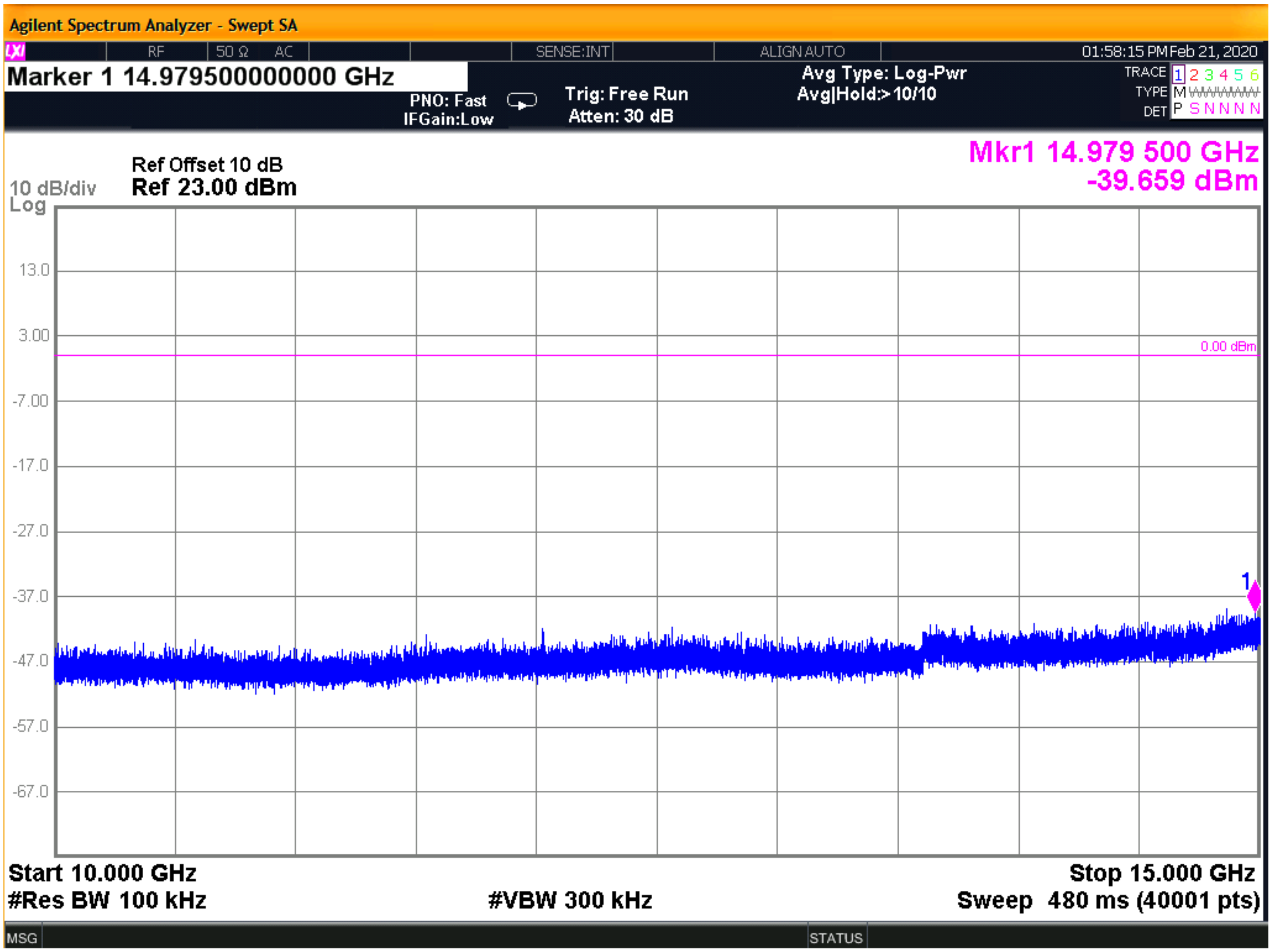
Start 5.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 10.000 GHz
Sweep 480 ms (40001 pts)
MSG
STATUS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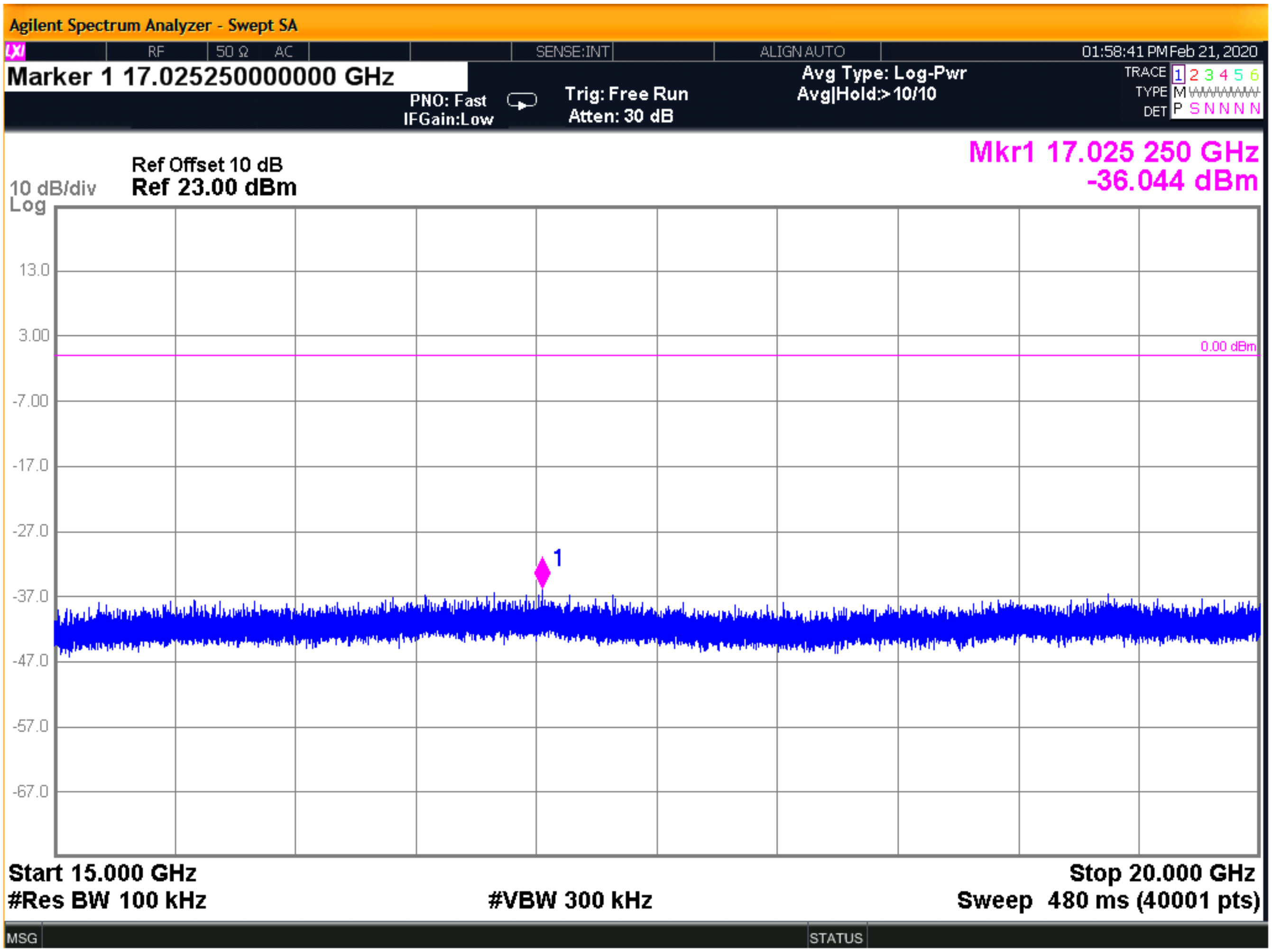
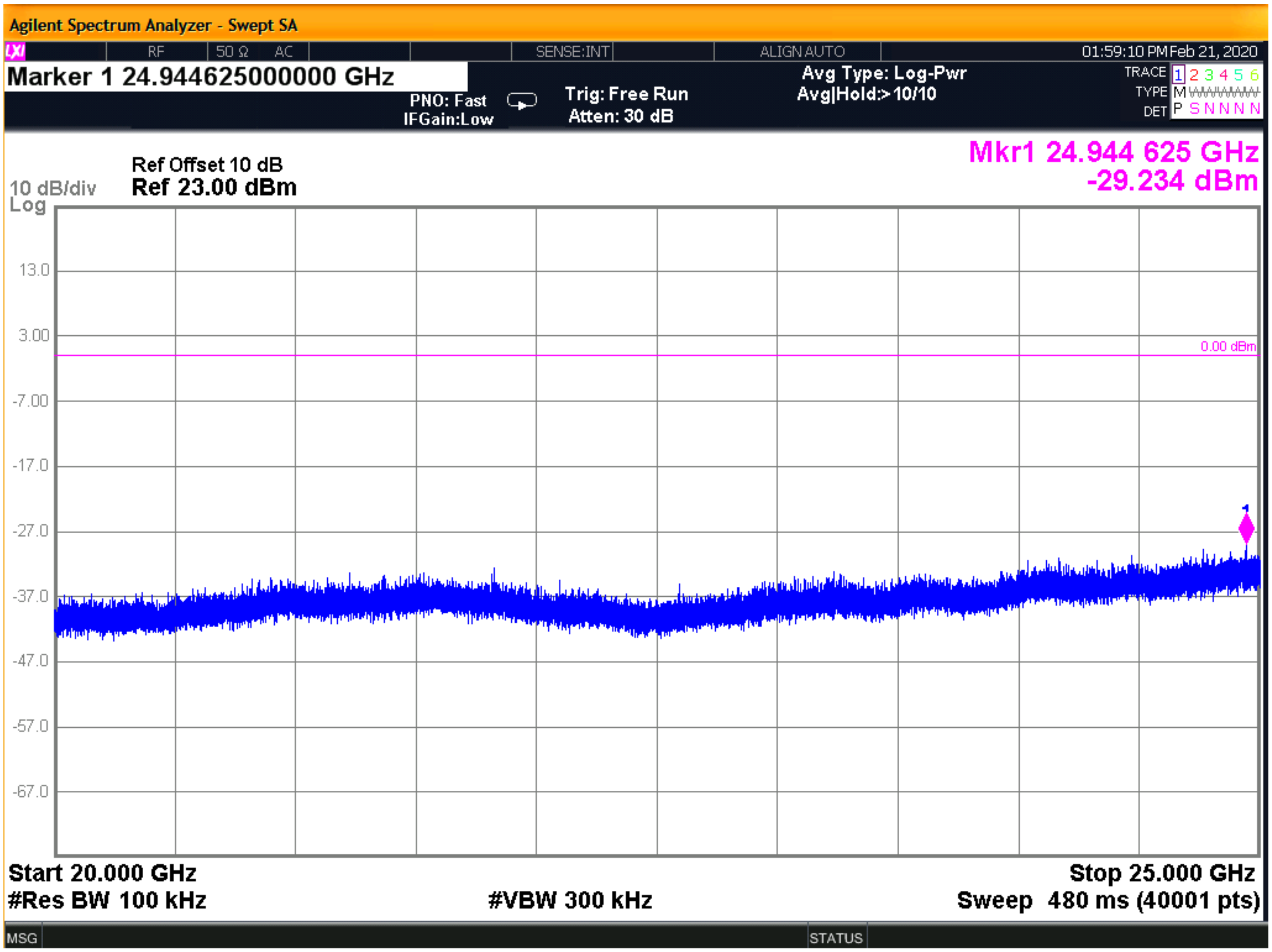
Marker 1 14.979500000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P S N N N N
Ref Offset 10 dB
10 dB/div
Log
Ref 23.00 dBm
Mkr1 14.979 500 GHz
-39.659 dBm
13.0
3.00
0.00 dBm
-7.00
-17.0
-27.0
-37.0
-47.0
-57.0
-67.0
1
Start 10.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 15.000 GHz
Sweep 480 ms (40001 pts)
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
RF
50 Ω
AC
SENSE:INT
ALIGN AUTO
01:58:41 PM Feb 21, 2020
Marker 1 17.025250000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P S N N N N
Ref Offset 10 dB
10 dB/div
Log
Ref 23.00 dBm
Mkr1 17.025 250 GHz
-36.044 dBm
13.0
3.00
-7.00
-17.0
-27.0
-37.0
-47.0
-57.0
-67.0
0.00 dBm
1
Start 15.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 20.000 GHz
Sweep 480 ms (40001 pts)
MSG
STATUS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RF 50 Ω AC
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ALIGN AUTO
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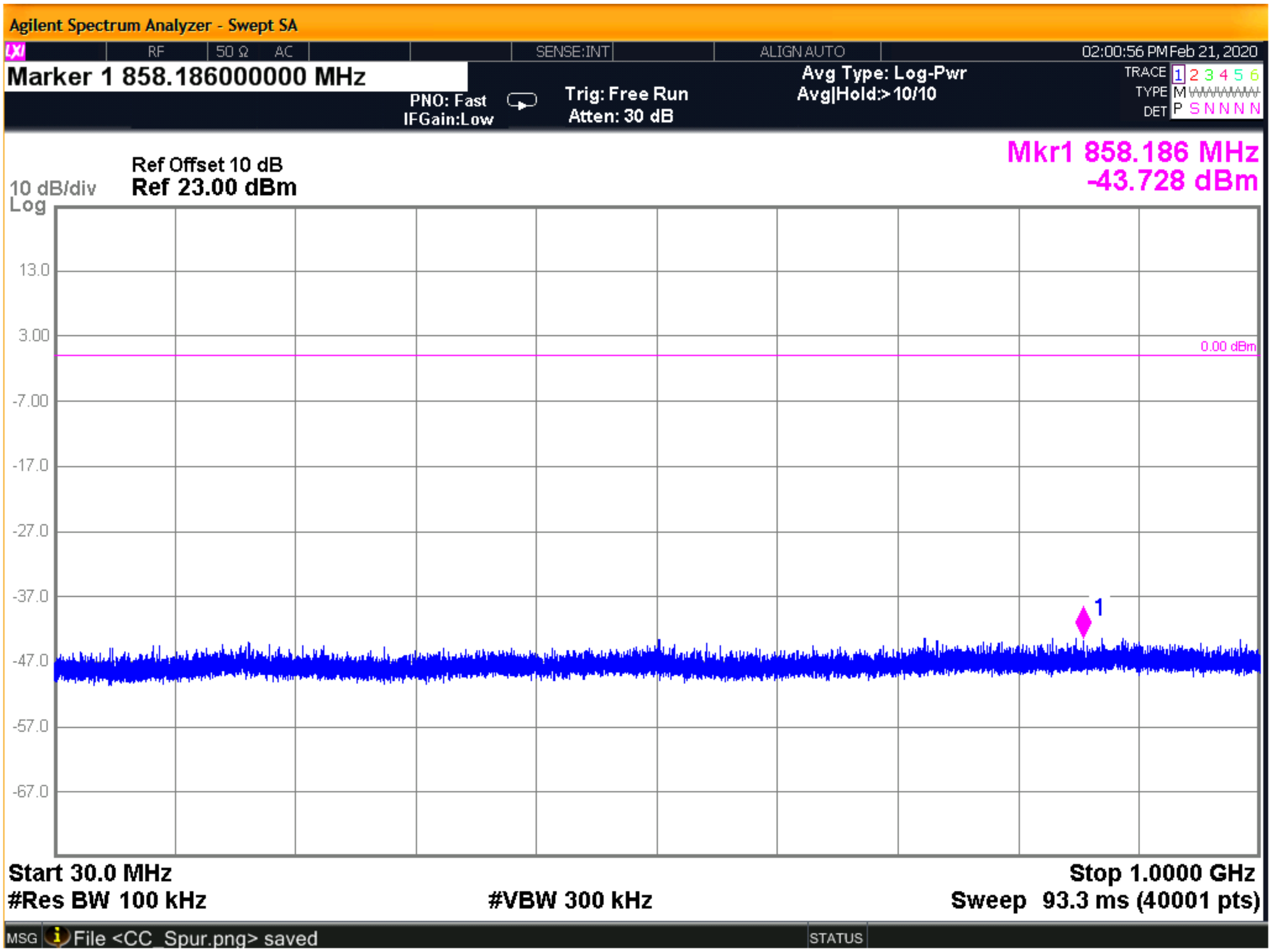
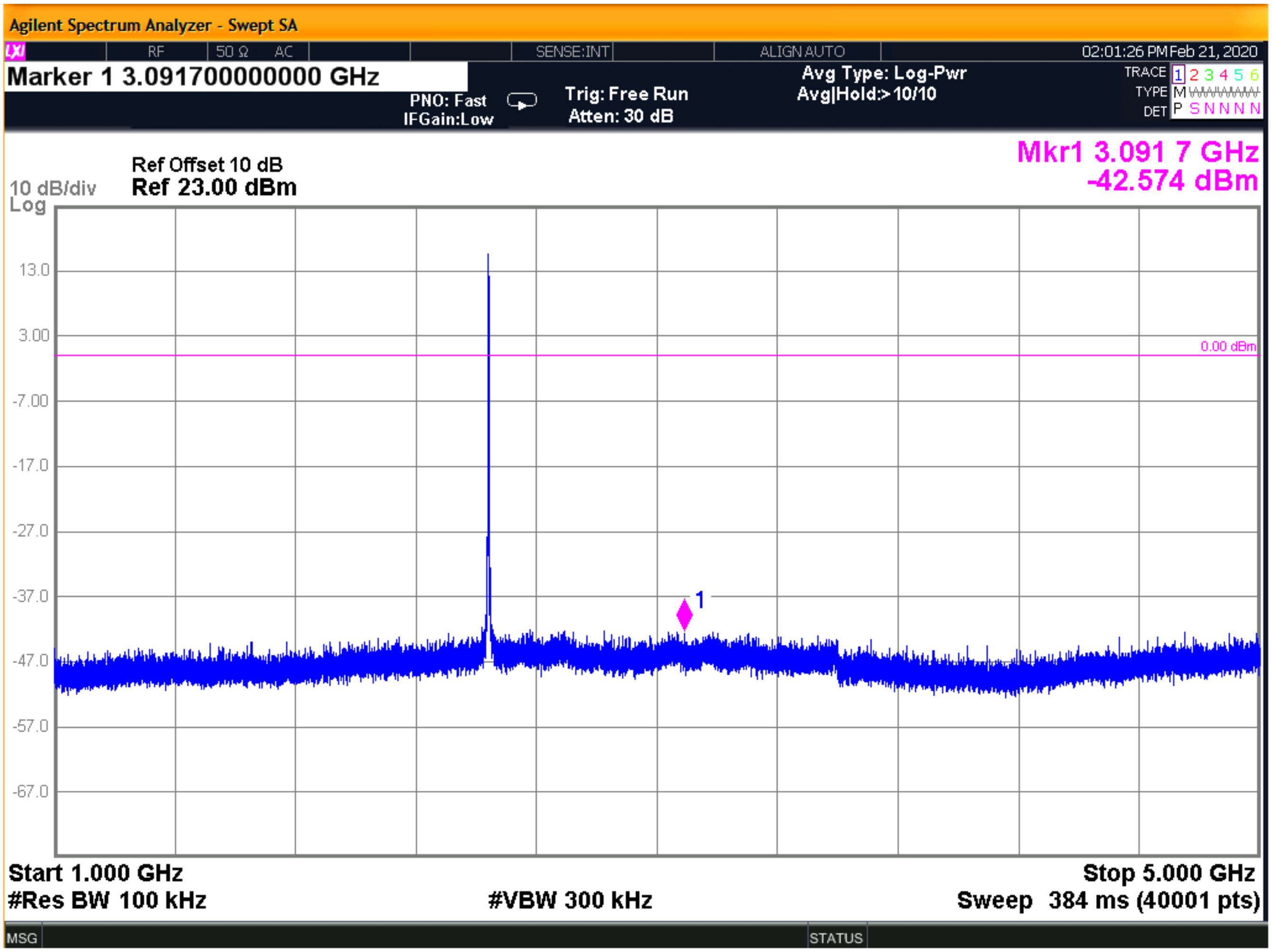
Marker 1 24.944625000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P S N N N N
Ref Offset 10 dB
10 dB/div
Log
Ref 23.00 dBm
Mkr1 24.944 625 GHz
-29.234 dBm
13.0
3.00
-7.00
-17.0
-27.0
-37.0
-47.0
-57.0
-67.0
0.00 dBm
Start 20.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.000 GHz
Sweep 480 ms (40001 pts)
MSG
STATUS

Figure 8: Conducted Spurious Emissions Mid Channel

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RF
50 Ω
AC
SENSE:INT
ALIGN AUTO
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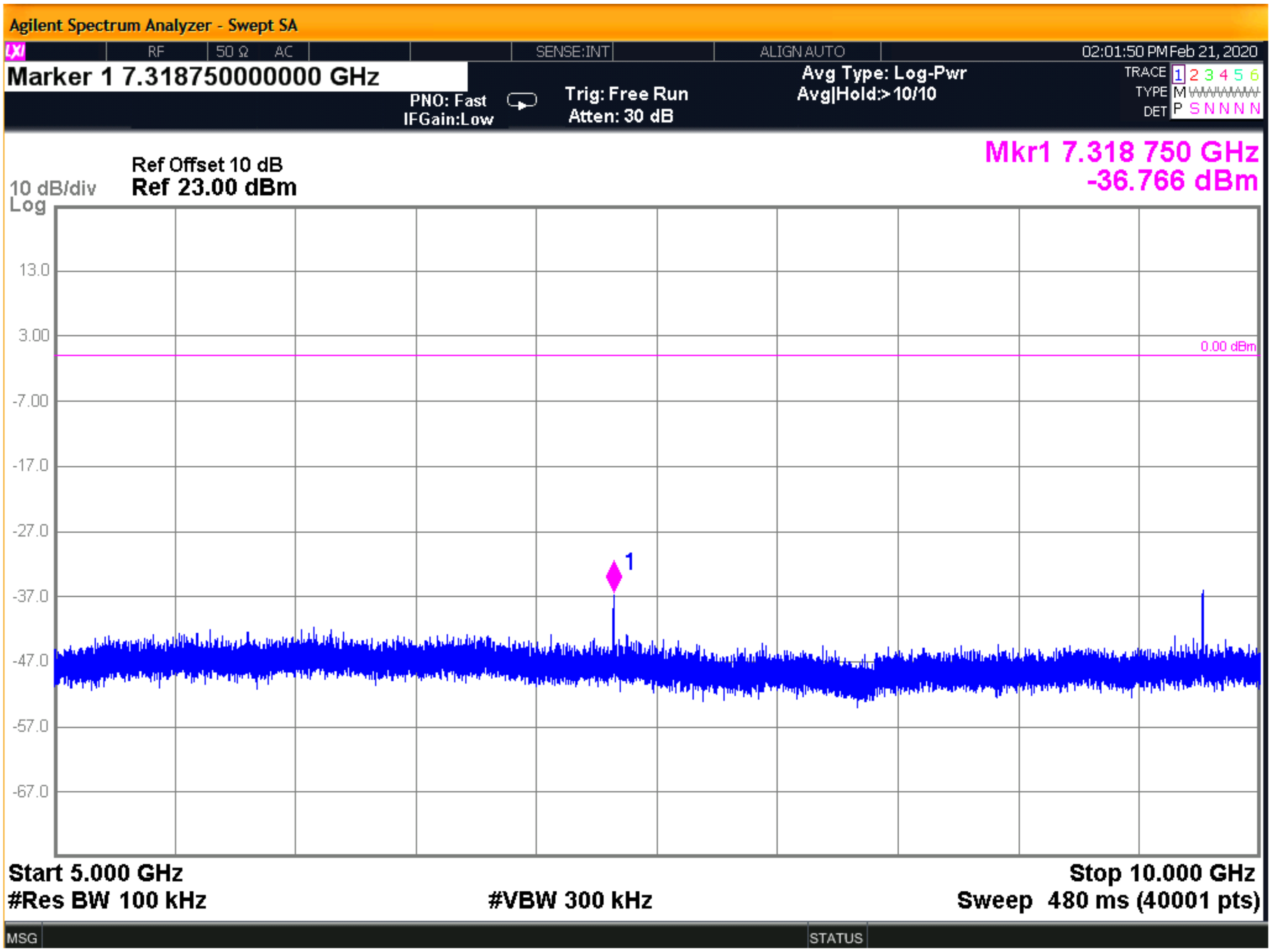
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P S N N N N
Ref Offset 10 dB
10 dB/div
Log
Ref 23.00 dBm
Mkr1 3.091 7 GHz
-42.574 dBm
13.0
3.00
-7.00
-17.0
-27.0
-37.0
-47.0
-57.0
-67.0
0.00 dBm
1
Start 1.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 5.000 GHz
Sweep 384 ms (40001 pts)
MSG
STATUS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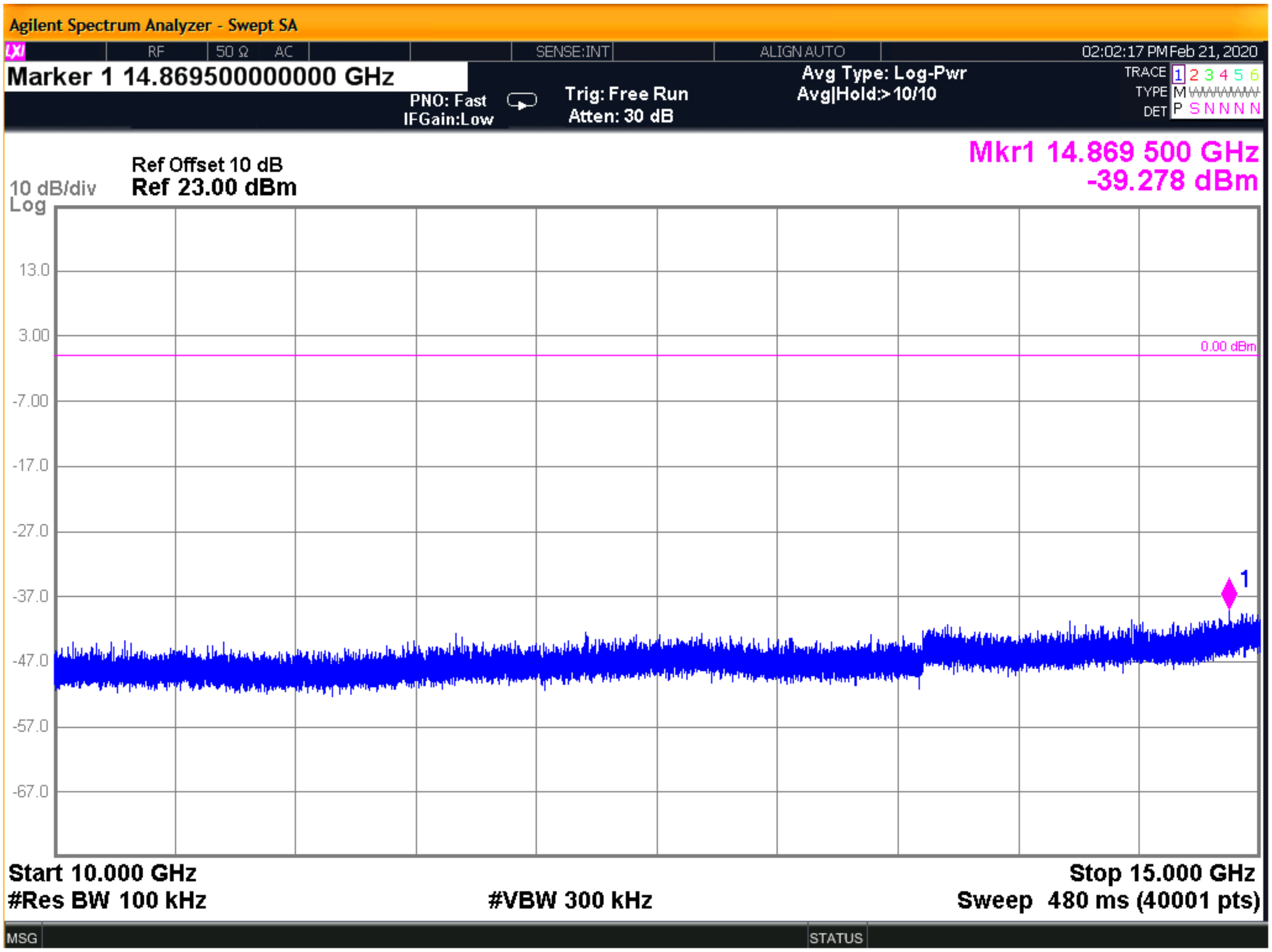
RF 50 Ω AC
SENSE:INT
ALIGN AUTO
02:01:50 PM Feb 21, 2020
Marker 1 7.318750000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P S N N N N
Mkr1 7.318 750 GHz
-36.766 dBm
Ref Offset 10 dB
10 dB/div Ref 23.00 dBm
Log
13.0
3.00
0.00 dBm
-7.00
-17.0
-27.0
-37.0
-47.0
-57.0
-67.0
1
Start 5.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 10.000 GHz
Sweep 480 ms (40001 pts)
MSG
STATUS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RF 50 Ω AC
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ALIGN AUTO
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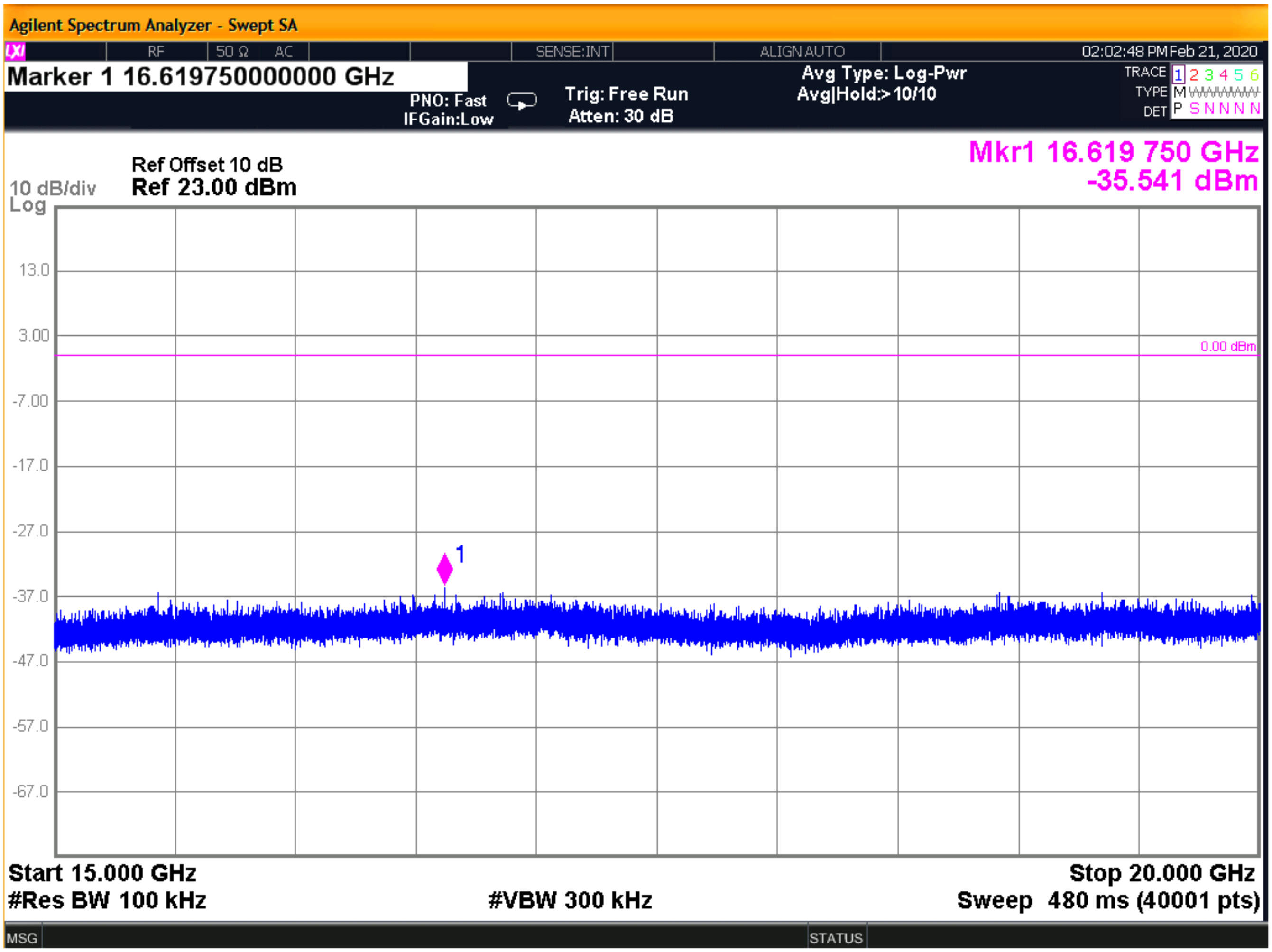
Marker 1 14.869500000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M
DET P S N N N N
Ref Offset 10 dB
10 dB/div
Log
Ref 23.00 dBm
Mkr1 14.869 500 GHz
-39.278 dBm
13.0
3.00
-7.00
-17.0
-27.0
-37.0
-47.0
-57.0
-67.0
0.00 dBm
1
Start 10.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 15.000 GHz
Sweep 480 ms (40001 pts)
MSG
STATUS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RF 50 Ω AC
SENSE:INT
ALIGN AUTO
02:02:48 PM Feb 21, 2020
Marker 1 16.619750000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P S N N N N
Ref Offset 10 dB
10 dB/div
Log
Ref 23.00 dBm
Mkr1 16.619 750 GHz
-35.541 dBm
13.0
3.00
-7.00
-17.0
-27.0
-37.0
-47.0
-57.0
-67.0
0.00 dBm
1
Start 15.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 20.000 GHz
Sweep 480 ms (40001 pts)
MSG
STATUS

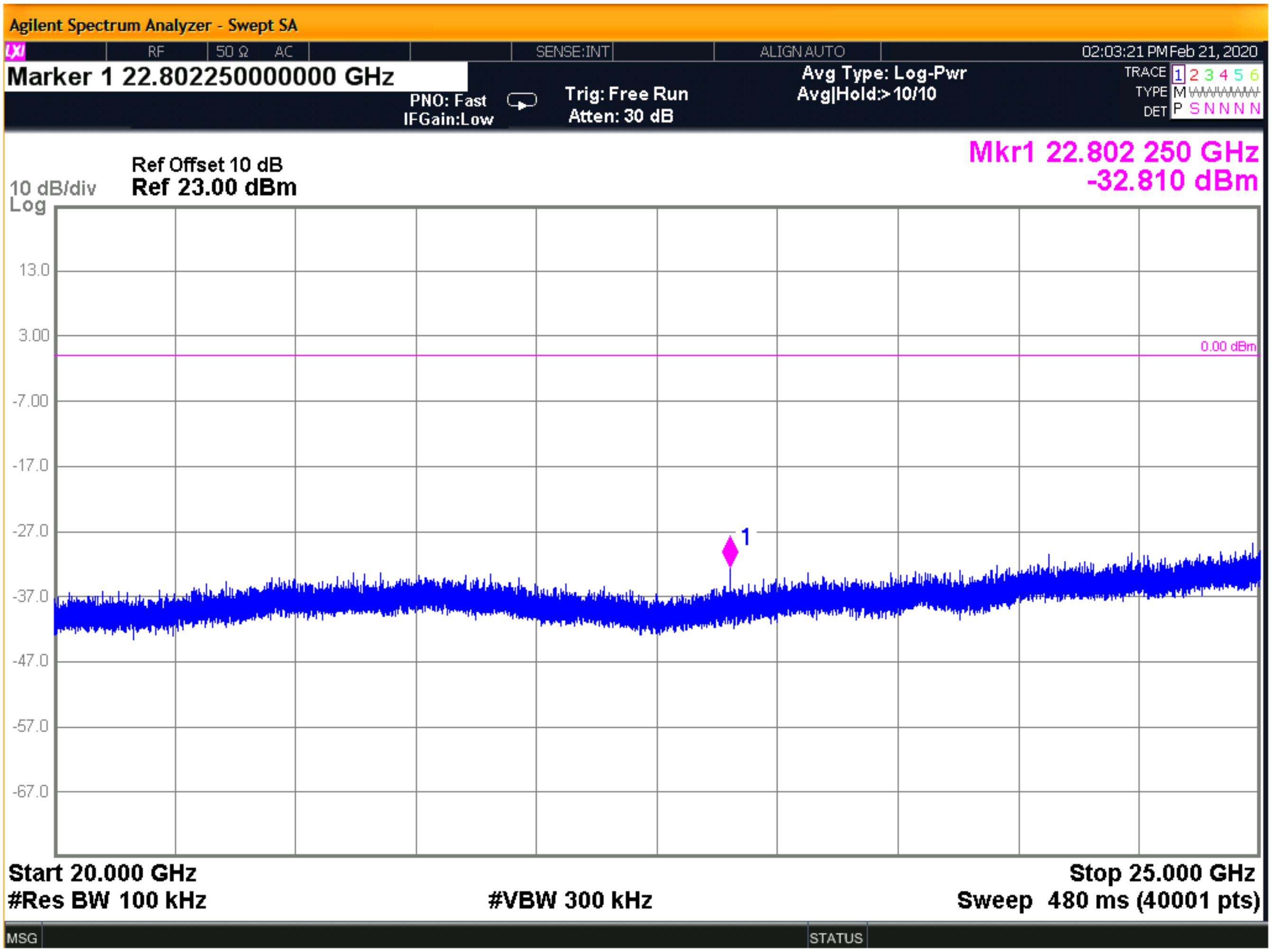
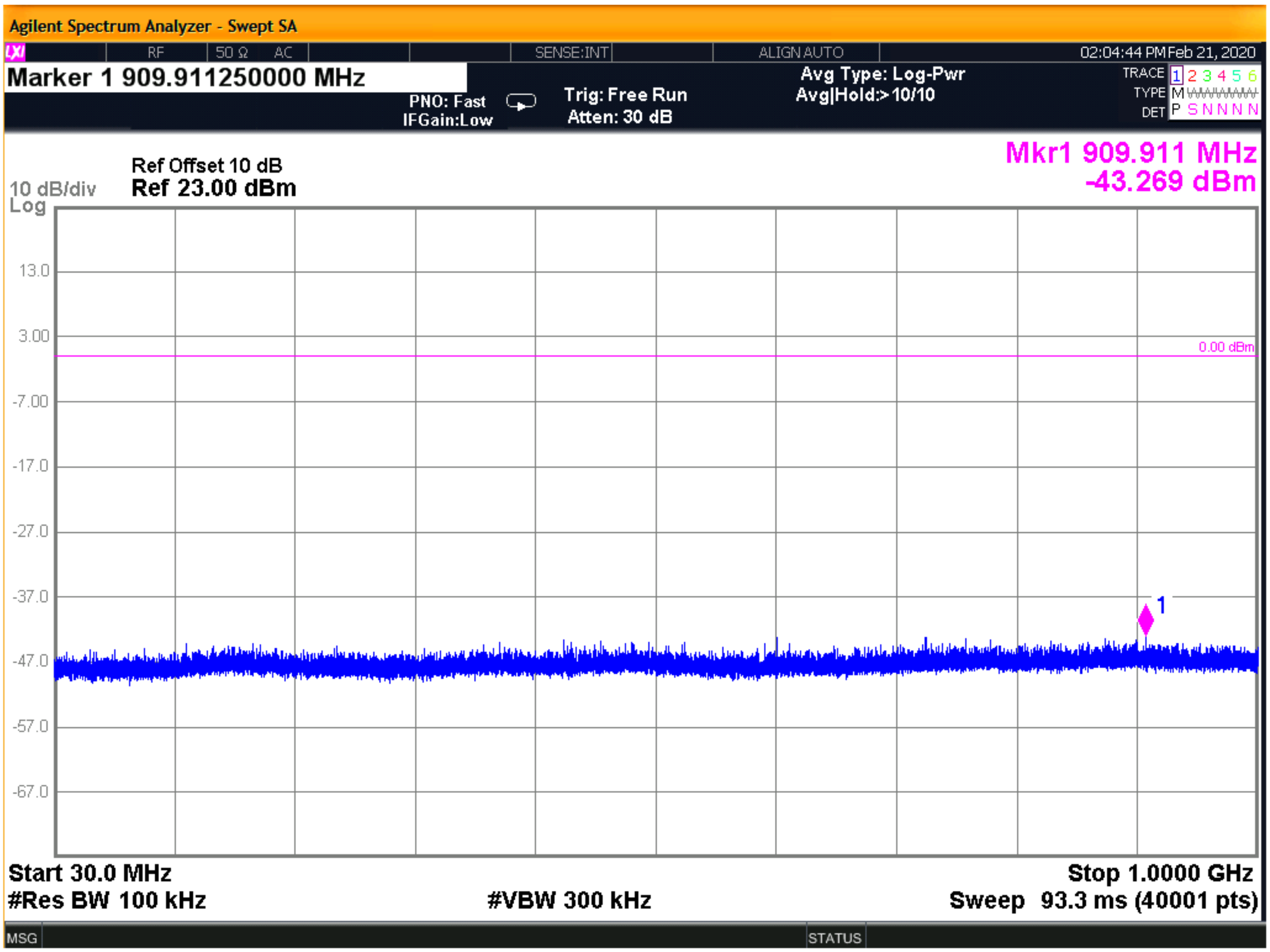
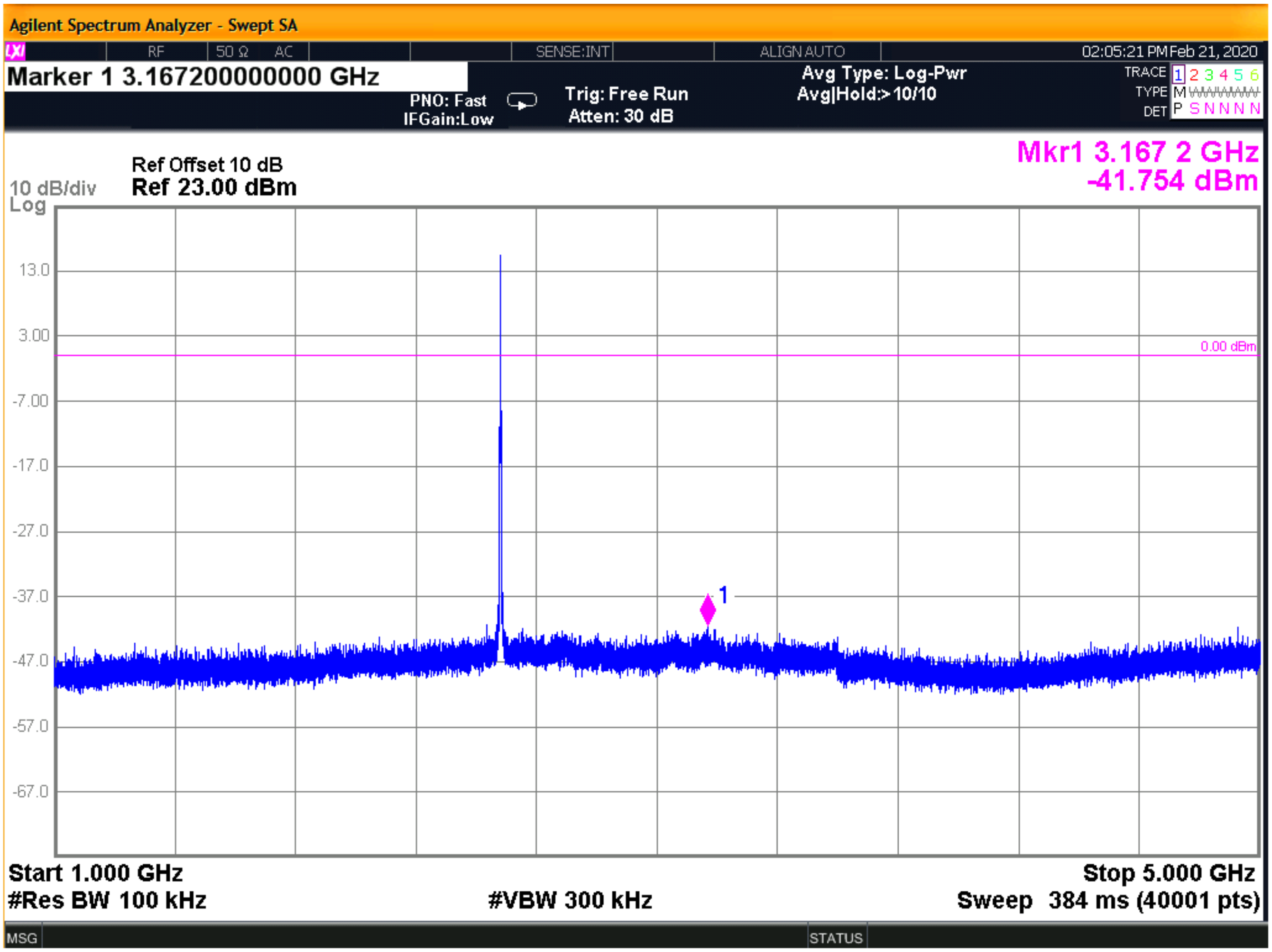

Agilent Spectrum Analyzer - Swept SA
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
02:03:21 PM Feb 21, 2020
Marker 1 22.802250000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P S N N N N
Mkr1 22.802 250 GHz
-32.810 dBm
Ref Offset 10 dB
Ref 23.00 dBm
10 dB/div
Log
13.0
3.00
-7.00
-17.0
-27.0
-37.0
-47.0
-57.0
-67.0
0.00 dBm
1
Start 20.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.000 GHz
Sweep 480 ms (40001 pts)
MSG
STATUS

Figure 9: Conducted Spurious Emissions Upper Channel

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RF 50 Ω AC
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ALIGN AUTO
02:05:21 PM Feb 21, 2020
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PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P S N N N N
Ref Offset 10 dB
10 dB/div
Log
Ref 23.00 dBm
Mkr1 3.167 2 GHz
-41.754 dBm
13.0
3.00
-7.00
-17.0
-27.0
-37.0
-47.0
-57.0
-67.0
0.00 dBm
1
Start 1.000 GHz
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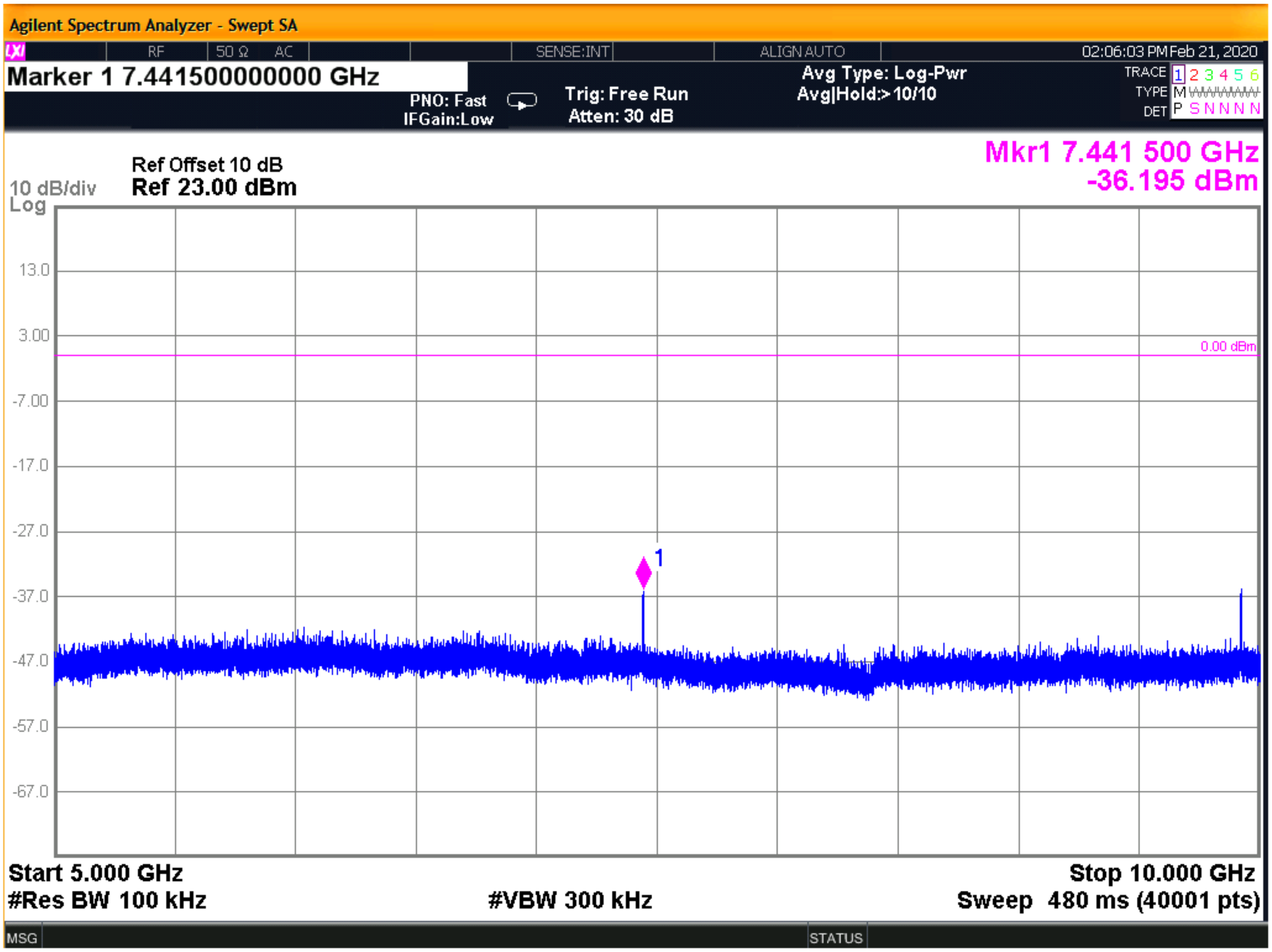
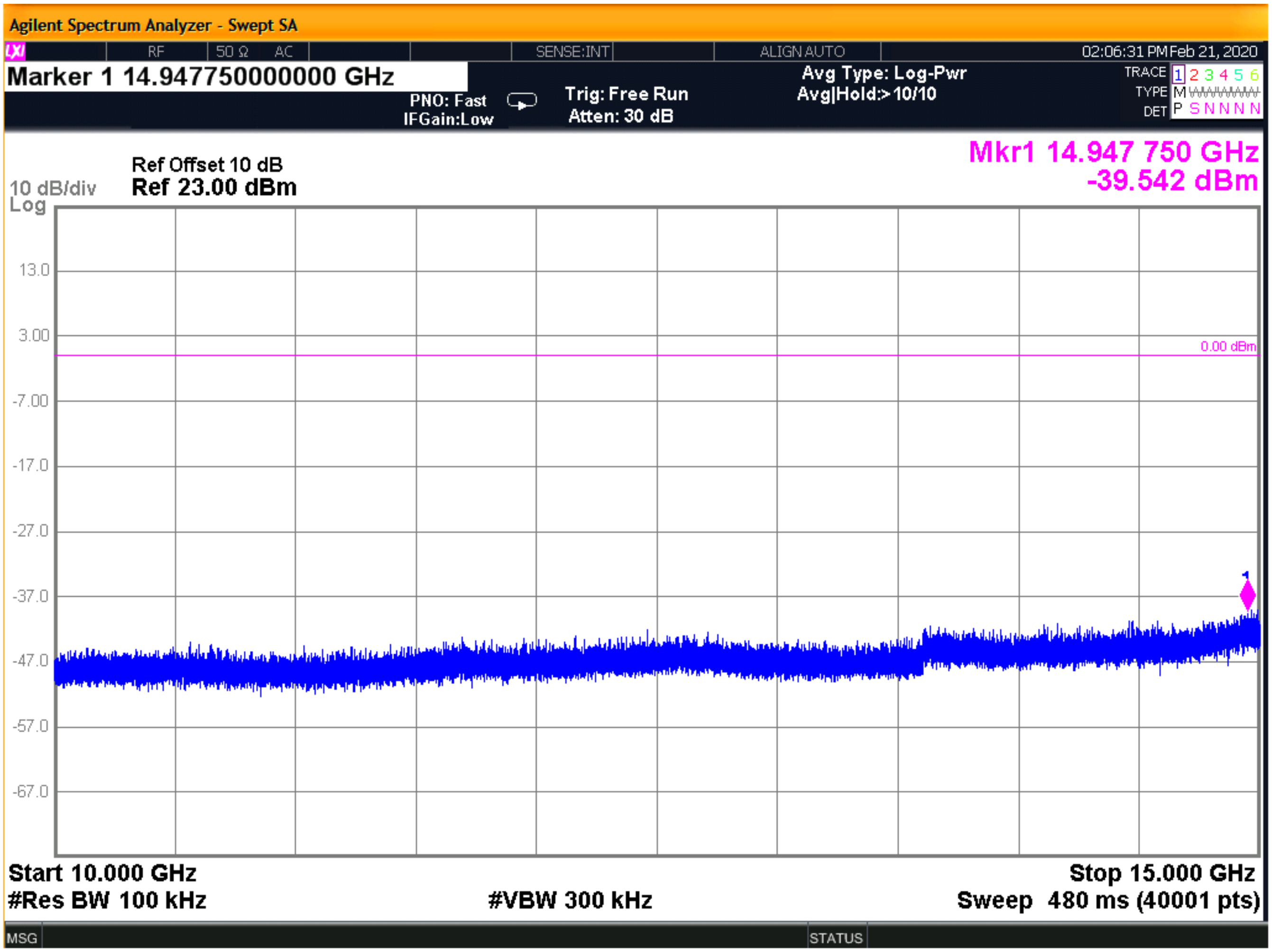
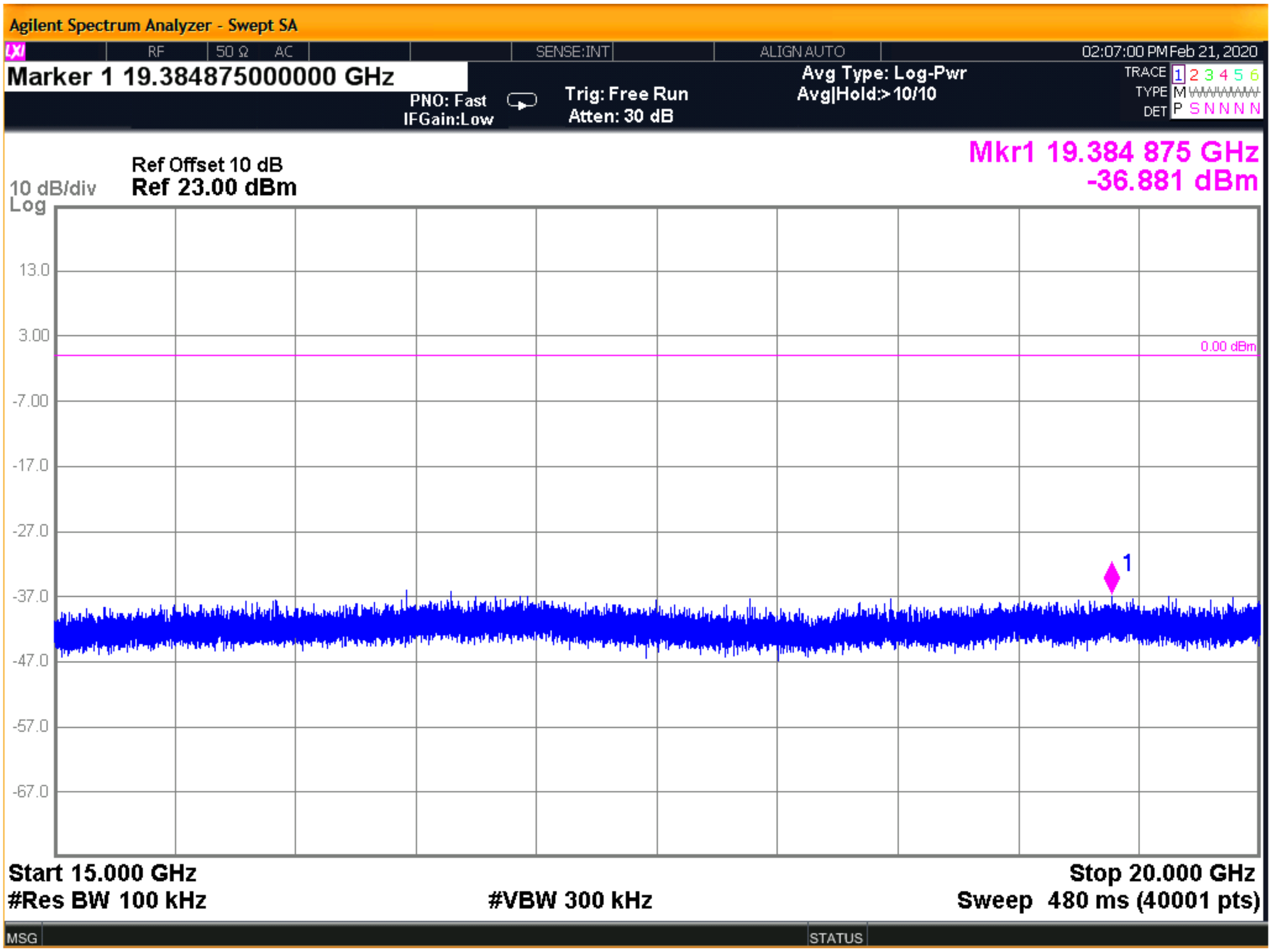
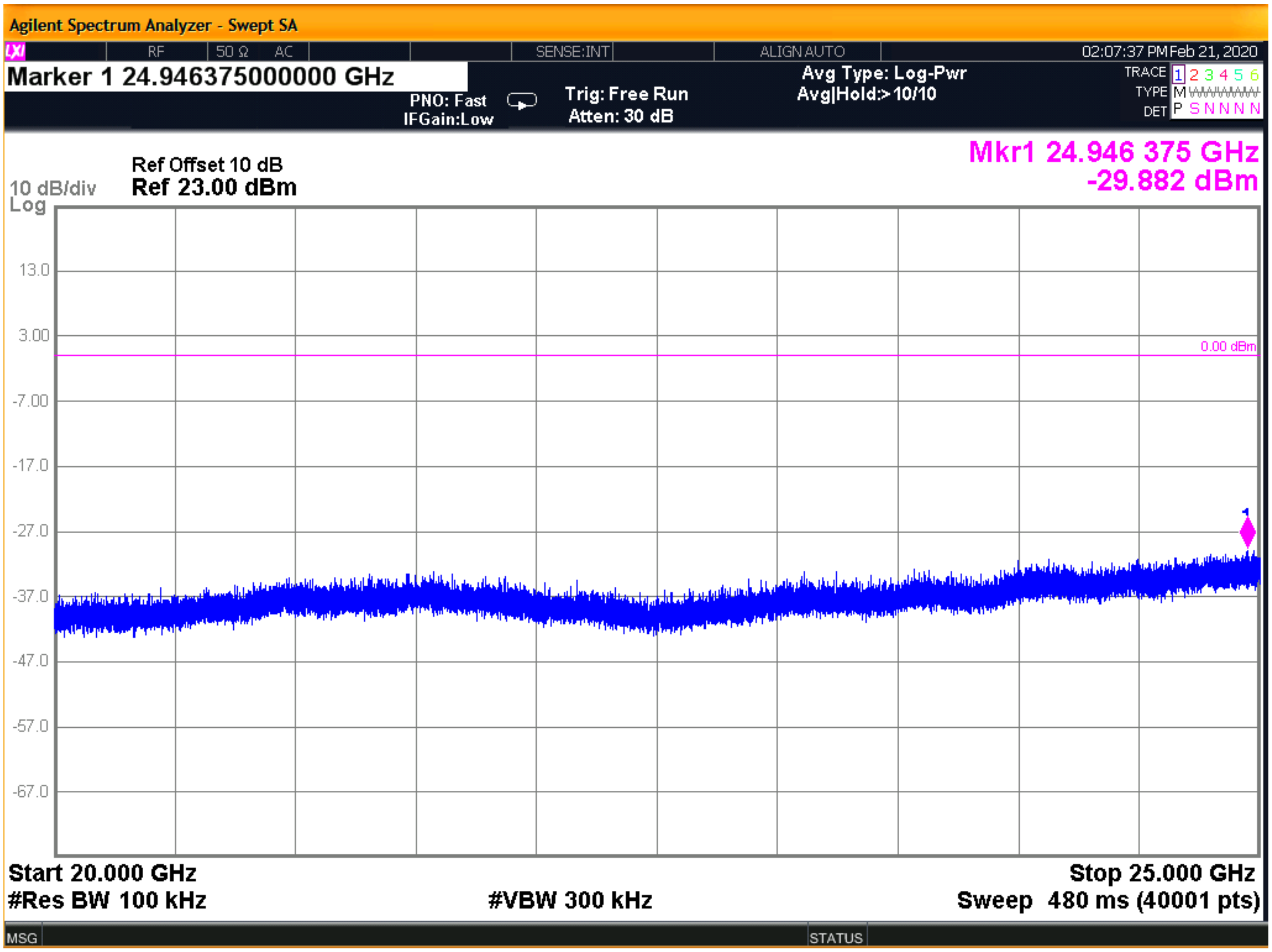
#VBW 300 kHz
Stop 5.000 GHz
Sweep 384 ms (40001 pts)
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
02:06:03 PM Feb 21, 2020
Marker 1 7.441500000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P S N N N N
Ref Offset 10 dB
10 dB/div
Ref 23.00 dBm
Log
Mkr1 7.441 500 GHz
-36.195 dBm
13.0
3.00
0.00 dBm
-7.00
-17.0
-27.0
-37.0
-47.0
-57.0
-67.0
1
Start 5.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 10.000 GHz
Sweep 480 ms (40001 pts)
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
02:06:31 PM Feb 21, 2020
Marker 1 14.947750000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P S N N N N
Ref Offset 10 dB
10 dB/div
Log
Ref 23.00 dBm
Mkr1 14.947 750 GHz
-39.542 dBm
13.0
3.00
-7.00
-17.0
-27.0
-37.0
-47.0
-57.0
-67.0
0.00 dBm
Start 10.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 15.000 GHz
Sweep 480 ms (40001 pts)
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
RF
50 Ω
AC
SENSE:INT
ALIGN AUTO
02:07:00 PM Feb 21, 2020
Marker 1 19.384875000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P S N N N N
Ref Offset 10 dB
10 dB/div
Log
Ref 23.00 dBm
Mkr1 19.384 875 GHz
-36.881 dBm
13.0
3.00
-7.00
-17.0
-27.0
-37.0
-47.0
-57.0
-67.0
0.00 dBm
1
Start 15.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 20.000 GHz
Sweep 480 ms (40001 pts)
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
RF
50 Ω
AC
SENSE:INT
ALIGN AUTO
02:07:37 PM Feb 21, 2020
Marker 1 24.946375000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P S N N N N
Ref Offset 10 dB
Ref 23.00 dBm
10 dB/div
Log
Mkr1 24.946 375 GHz
-29.882 dBm
13.0
3.00
-7.00
-17.0
-27.0
-37.0
-47.0
-57.0
-67.0
0.00 dBm
Start 20.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.000 GHz
Sweep 480 ms (40001 pts)
MSG
STATUS

4.4 BAND EDGE COMPLIANCE

In accordance with FCC Public Notice DA-00-705 close-up plots of the upper and lower channels with respect to the nearest authorized band-edges are provided below. The tests were performed in the same manner as the above conducted spurious emissions tests.

Figure 10: Low Channel, Lower Band-edge

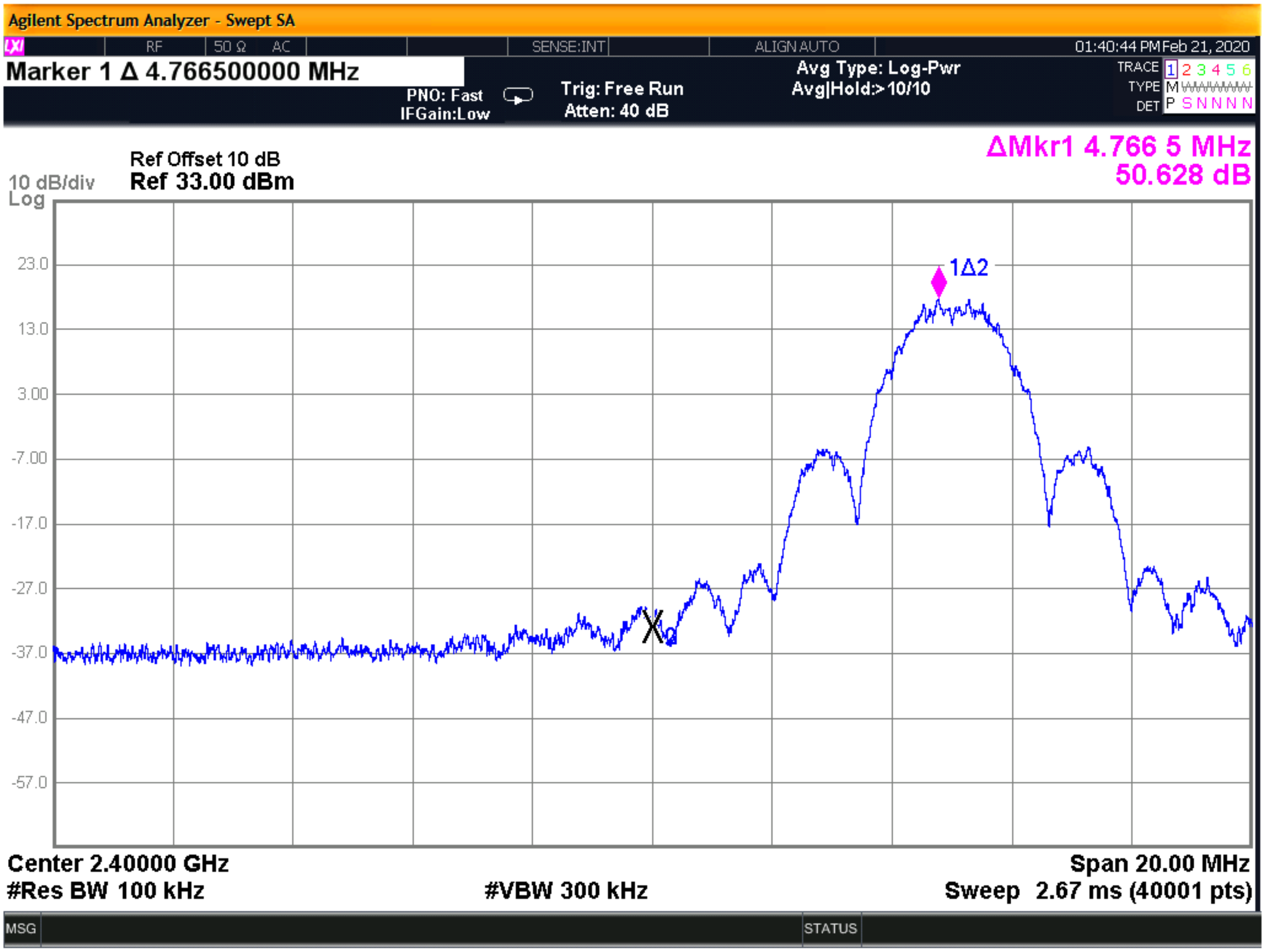
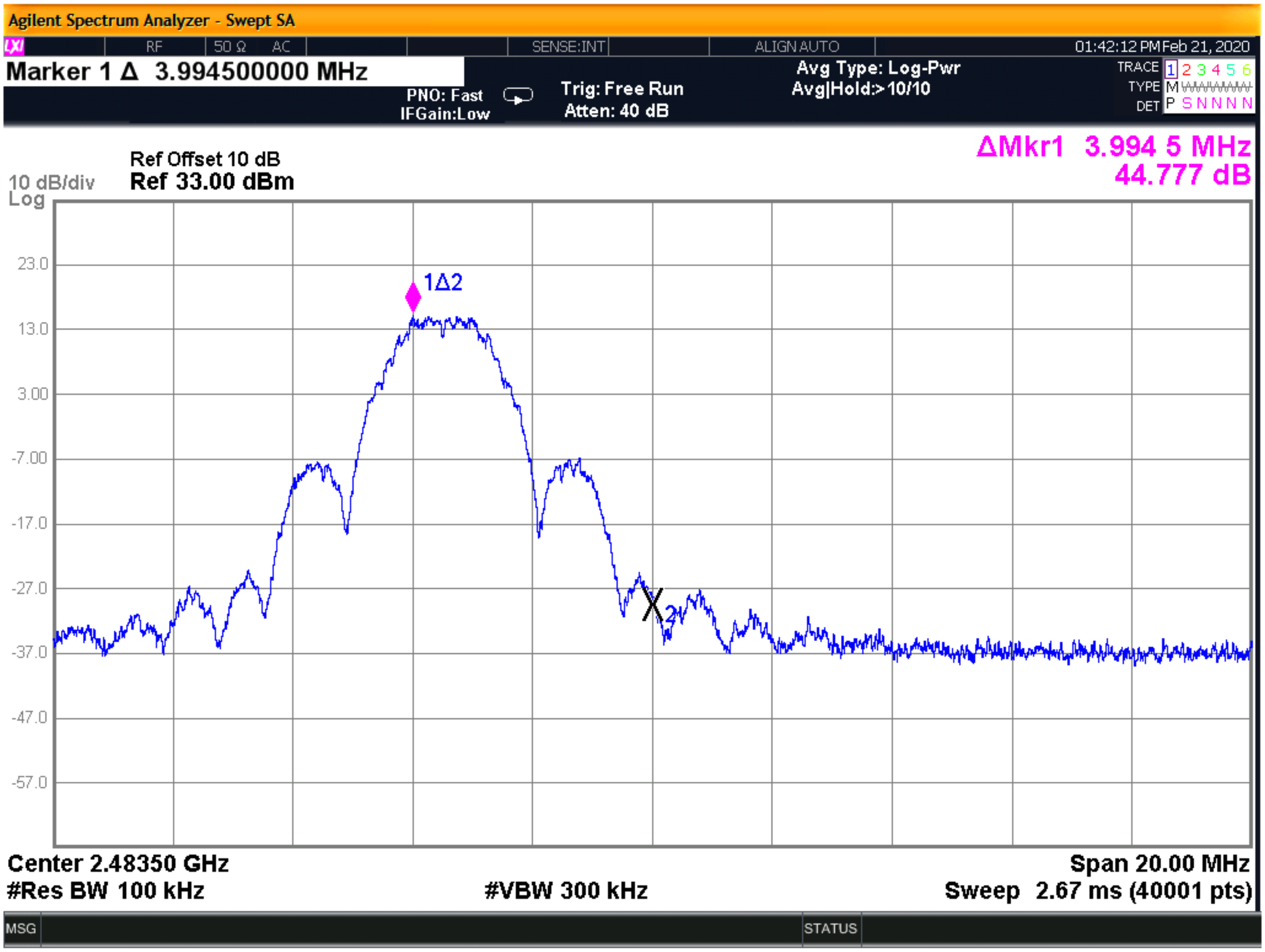


Figure 11: High Channel, Upper Band-edge



4.6 POWER SPECTRAL DENSITY

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.
The measurement was performed by coupling the output of the EUT to the input of a spectrum analyzer.

Following are plots showing the PSD measurements.

Figure 12. Power Spectral Density Low Channel

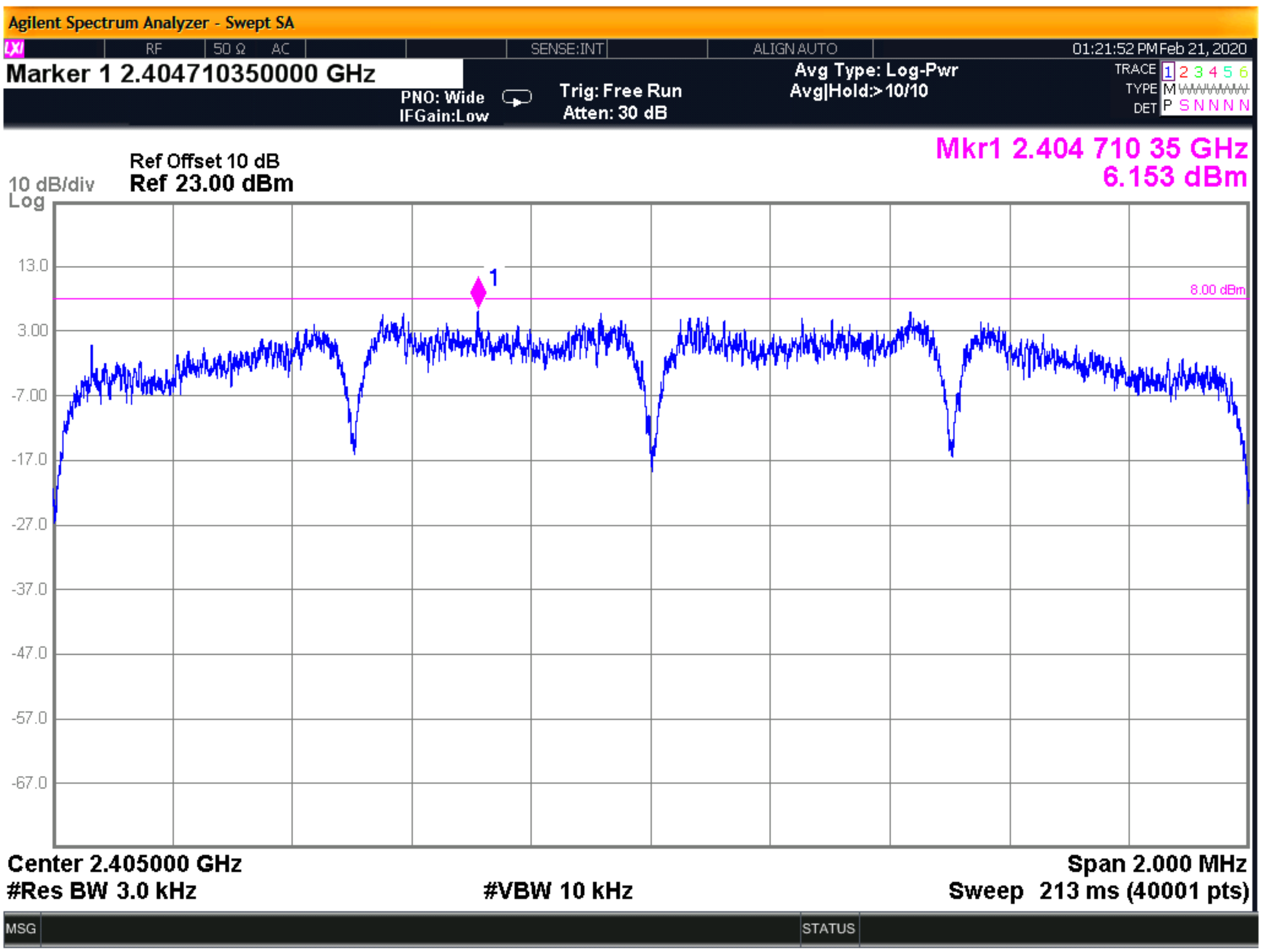


Figure 13. Power Spectral Density Mid Channel

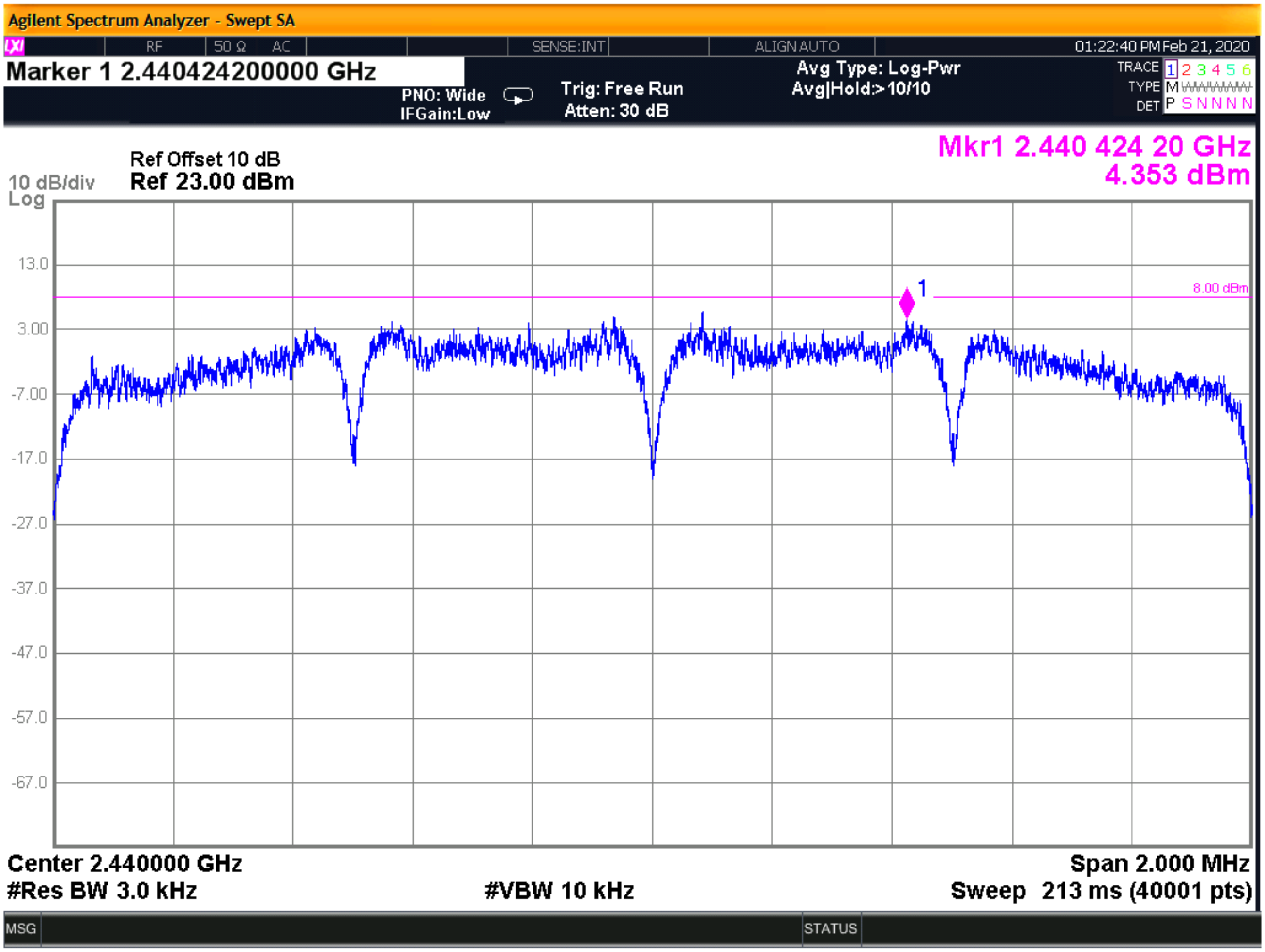
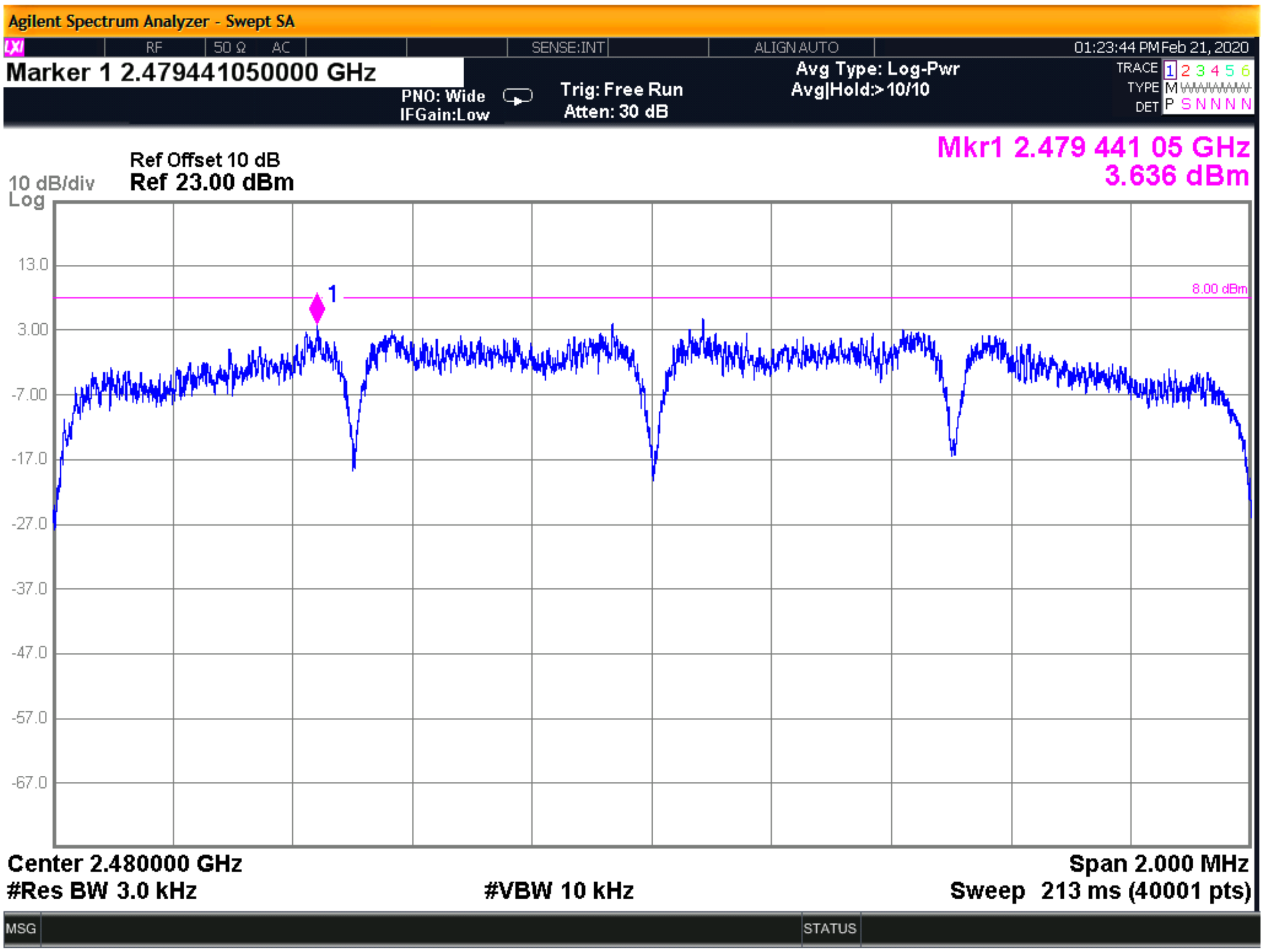


Figure 14. Power Spectral Density High Channel



4.7 RADIATED SPURIOUS EMISSIONS: (FCC PART §2.1053)

The EUT must comply with the requirements for radiated spurious emissions that fall within the restricted bands. These emissions must meet the limits specified in §15.209 and §15.35(b) for peak and average limits.

4.7.1 Test Procedure

The EUT was tested in a fully-functional OCU3 and placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions.

The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-2014. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The emissions were measured using the following resolution bandwidths:

Table 6: Spectrum Analyzer Settings

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	<10 Hz (Avg.), 1MHz (Peak)

Worst-case results are reported in the table.

Three orthogonal positions were investigated. Worst-case emissions are reported below for the unit placed flat on the foam.

Table 7: Spurious Radiated Emission Test Data-Average Unit Flat

CH	Frequency (MHz)	Pol H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	DET
2405	4810.00	V	180.0	1.2	28.0	5.9	49.6	500.0	-20.1	AVG
2405	12025.00	V	0.0	1.2	26.0	18.6	170.4	500.0	-9.4	AVG
2440	4880.00	V	0.0	1.2	28.9	6.1	56.3	500.0	-19.0	AVG
2440	7320.00	V	90.0	1.2	38.0	10.3	261.3	500.0	-5.6	AVG
2440	12200.00	V	0.0	1.2	25.0	18.9	156.9	500.0	-10.1	AVG
2480	2483.5	V	0.0	0.19	37.6	5.1	42.7	500.00	-21.4	AVG
2480	4960.00	V	0.0	1.2	29.2	6.4	60.4	500.0	-18.4	AVG
2480	7440.00	V	0.0	1.2	41.0	10.2	365.1	500.0	-2.7	AVG
2480	12400.00	V	0.0	1.2	25.0	19.1	160.9	500.0	-9.8	AVG
2405	4810.00	H	180.0	1.2	29.0	5.9	55.7	500.0	-19.1	AVG
2405	12025.00	H	0.0	1.2	25.0	18.6	151.8	500.0	-10.4	AVG
2440	4880.00	H	0.0	1.2	26.2	6.1	41.3	500.0	-21.7	AVG
2440	7320.00	H	90.0	1.2	25.0	10.3	58.5	500.0	-18.6	AVG
2440	12200.00	H	0.0	1.2	25.5	18.9	166.2	500.0	-9.6	AVG
2480	2483.5	H	240	1.2	34.4	5.1	39.5	500.0	-10.5	AVG
2480	4960.00	H	0.0	1.2	29.5	6.4	62.5	500.0	-18.1	AVG
2480	7440.00	H	0.0	1.2	37.2	10.2	235.7	500.0	-6.5	AVG
2480	12400.00	H	0.0	1.2	25.0	19.1	160.9	500.0	-9.8	AVG

Table 8: Spurious Radiated Emission Test Data-Peak Unit Flat

CH	Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2405	4810.00	V	180.0	1.2	39.0	5.9	176.0	5000.0	-14.5	PK
2405	12025.00	V	0.0	1.2	37.0	18.6	604.5	5000.0	-9.2	PK
2440	4880.00	V	0.0	1.2	39.9	6.1	199.8	5000.0	-14.0	PK
2440	7320.00	V	90.0	1.2	49.0	10.3	927.3	5000.0	-7.3	PK
2440	12200.00	V	0.0	1.2	36.0	18.9	556.7	5000.0	-9.5	PK
2480	2483.5	V	180	1.2	47.4	5.1	421.7	5000.0	-20.0	PK
2480	4960.00	V	0.0	1.2	40.2	6.4	214.3	5000.0	-13.7	PK
2480	7440.00	V	0.0	1.2	57.0	10.2	2303.7	5000.0	-3.4	PK
2480	7440.00	V	0.0	1.2	52.0	10.2	1295.5	5000.0	-5.9	PK
2480	12400.00	V	0.0	1.2	36.0	19.1	570.9	5000.0	-9.4	PK
2405	4810.00	H	180.0	1.2	40.0	5.9	197.5	5000.0	-14.0	PK
2405	12025.00	H	0.0	1.2	36.0	18.6	538.8	5000.0	-9.7	PK
2440	4880.00	H	0.0	1.2	37.2	6.1	146.4	5000.0	-15.3	PK
2440	7320.00	H	90.0	1.2	36.0	10.3	207.6	5000.0	-13.8	PK
2440	12200.00	H	0.0	1.2	36.5	18.9	589.7	5000.0	-9.3	PK
2480	2483.5	H	90.0	1.2	46.0	5.1	359.0	5000.0	-22.9	PK
2480	4960.00	H	0.0	1.2	40.5	6.4	221.9	5000.0	-13.5	PK
2480	7440.00	H	0.0	1.2	48.2	10.2	836.4	5000.0	-7.8	PK
2480	12400.00	H	0.0	1.2	36.0	19.1	570.9	5000.0	-9.4	PK

The unit was installed in a payload module housing with a monopole antenna and tested as above. Radiated spurious results are found in the following table.

Table 9. Spurious Emissions Payload Module with Monopole

Frequency (MHz)	Pol (H/V)	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Peak or Average
2483.50	V	0.0	1.2	34.2	5.1	39.3	54.0	-14.7	AVG
4880.00	V	0.0	1.2	33.1	6.9	40.0	54.0	-14.0	AVG
7320.00	V	0.0	1.0	40.5	10.8	51.3	54.0	-2.7	AVG
12200.00	V	0.0	1.2	21.0	19.6	40.6	54.0	-13.4	AVG
2483.50	H	180.0	1.2	33.2	5.1	38.3	54.0	-15.7	AVG
4880.00	H	0.0	1.0	37.0	6.9	43.9	54.0	-10.1	AVG
7320.00	H	0.0	1.0	42.9	10.8	53.7	54.0	-0.3	AVG
12200.00	H	0.0	1.0	20.6	19.6	40.2	54.0	-13.8	AVG

Co-location was assessed as a radiated test in an operational OCU3. The 75 MHz transmitter was set to maximum permissible power and the Payload Module was set to center channel and set to transmit a CW signal.

Measurements were performed of the 2440 MHz +/- 75 MHz up to 3 harmonics of the 75 MHz signal. Results are in the following table.

Table 10. Co-Location Results

Frequency (MHz)	Pol (H/V)	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Peak or Average
FLAT									
2028.45	V	90.0	1.8	44.8	3.0	47.8	54.0	-6.2	Peak
2179.87	V	0.0	1.8	26.2	3.8	30.0	54.0	-24.0	Peak
2331.29	V	45.0	1.6	31.9	3.8	35.7	54.0	-18.3	Peak
2482.71	V	45.0	2.1	43.0	5.1	48.2	54.0	-5.8	Peak
2634.13	V	90.0	1.7	41.7	6.4	48.1	54.0	-5.9	Peak
2028.45	H	90.0	2.0	49.2	3.0	52.2	54.0	-1.8	Peak
2179.87	H	90.0	2.0	47.9	3.8	51.6	54.0	-2.4	Peak
2331.29	H	0.0	2.0	42.8	3.8	46.6	54.0	-7.4	Peak
2482.71	H	90.0	1.5	40.5	5.1	45.6	54.0	-8.4	Peak
2634.13	H	45.0	2.0	44.0	6.4	50.4	54.0	-3.6	Peak
VERTICAL									
2028.45	H	45.0	1.5	45.0	3.0	48.0	54.0	-6.0	Peak
2179.87	H	0.0	1.8	33.1	3.8	36.8	54.0	-17.2	Peak
2331.29	H	90.0	2.0	40.0	3.8	43.8	54.0	-10.2	Peak
2482.71	H	180.0	2.0	38.5	5.1	43.7	54.0	-10.3	Peak
2634.13	H	90.0	2.0	43.0	6.4	49.4	54.0	-4.6	Peak
2028.45	V	0.0	2.2	48.5	3.0	51.4	54.0	-2.6	Peak
2179.87	V	45.0	1.9	47.8	3.8	51.6	54.0	-2.4	Peak
2331.29	V	180.0	2.3	45.7	3.8	49.5	54.0	-4.5	Peak
2482.71	V	0.0	1.8	38.7	5.1	43.9	54.0	-10.1	Peak
2634.13	V	0.0	2.7	33.5	6.4	40.0	54.0	-14.0	Peak