Application

for

Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, paragraphs 15.207, 15.209 and 15.247

for the

Southern States, LLC

Model: Cap Can Sensor

FCC ID: 2ADWTCCS01

UST Project: 20-0359

Issue Date: January 29, 2021

Total Pages:46

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I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date: January 29, 2021

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Southern States, LLC.
ADDRESS: 30 Georgia Avenue
Hampton, GA 30228 USA
MODEL: Cap Can Sensor
FCC ID: 2ADWTCCS01
DATE: January 29, 2021

This report concerns (check one): ☒ Original ☐ Class II Change

Equipment type: 2.4 GHz Radio Transceiver

Technical: IEEE 802.15.4
Technology: ZigBee
Frequency of Operation: 2405-2480 MHz
Output Power: +3.6 dBm
Type of Modulation: O-QPSK
Data/Bit Rate: 2 Mbps
Antenna Gain: +2.8 dBi
Software used to program EUT: Proprietary test software
EUT firmware: N/A
Power setting: +4.0 dBm

Report prepared by:

US Tech
3505 Francis Circle
Alpharetta, GA30004

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1 General Information

1.1 Purpose of this Report

This report is prepared as a means of conveying test results and information concerning the suitability of this exact product for certification as an intentional transmitter device and public distribution according to FCC Rules and Regulations Part 15, Section 247.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on December 17, 2020 in good operating condition.

1.3 Product Description

The Equipment under Test (EUT) is the Southern States, LLC., Model: Cap Can Sensor. The EUT is placed on high voltage AC powerlines and senses current from the lines. The EUT is in constant listen mode and when addressed, reports back the values from its sensor.

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.10:2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices* for the intentional radiator aspect of the device and *ANSI C63.4:2014, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2014)* for the unintentional radiator aspect of the device as well as FCC subpart B and C of Part 15 and per FCC KDB Publication number 558074 v05r02 for Digital Transmission Systems Operating Under section 15.247.

Digital RF conducted and radiated verification emissions data (FCC 15.107 and 109) below 1 GHz were taken with the measuring receiver (or spectrum analyzer's) resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements performed above 1 GHz were made with a RBW of 1 MHz. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was set to 3 times the RBW or as required per the standard throughout the evaluation process.

A list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions are provided in separate Appendices.

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC. Its designation number is 186022. Additionally, this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1.

1.6 Related Submittal(s)/Grant(s)

The EUT is subject to the following FCC Equipment Authorizations:

a) Certification under section 15.207 and 15.209 as a transmitter.

b) SDoC under 15.101 as a digital device. The results of this test are provided in a separate report; US Tech report number 20-0360.

Table 1. EUT and Peripherals

EUT MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID	CABLES P/D
EUT Southern States, LLC.	Cap Can Sensor	10AA401900 60042	FCC ID: 2ADWTCCS01	P
PERIPHERAL MANUFACTURER	**MODEL NUMBER**	**SERIAL NUMBER**	**FCC/IC ID**	**CABLES P/D**
9V Alkaline Battery Amazon Basics	6LR61	Engineering Sample	N/A	P
ZigBit USB Atmel	A09-1726/05	0200005085	FCC ID: VW4A091731 IC ID: 11019A-091731	N/A
Antenna See antenna details	--	--	--	--

S= Shielded, U= Unshielded, P= Power, D= Data

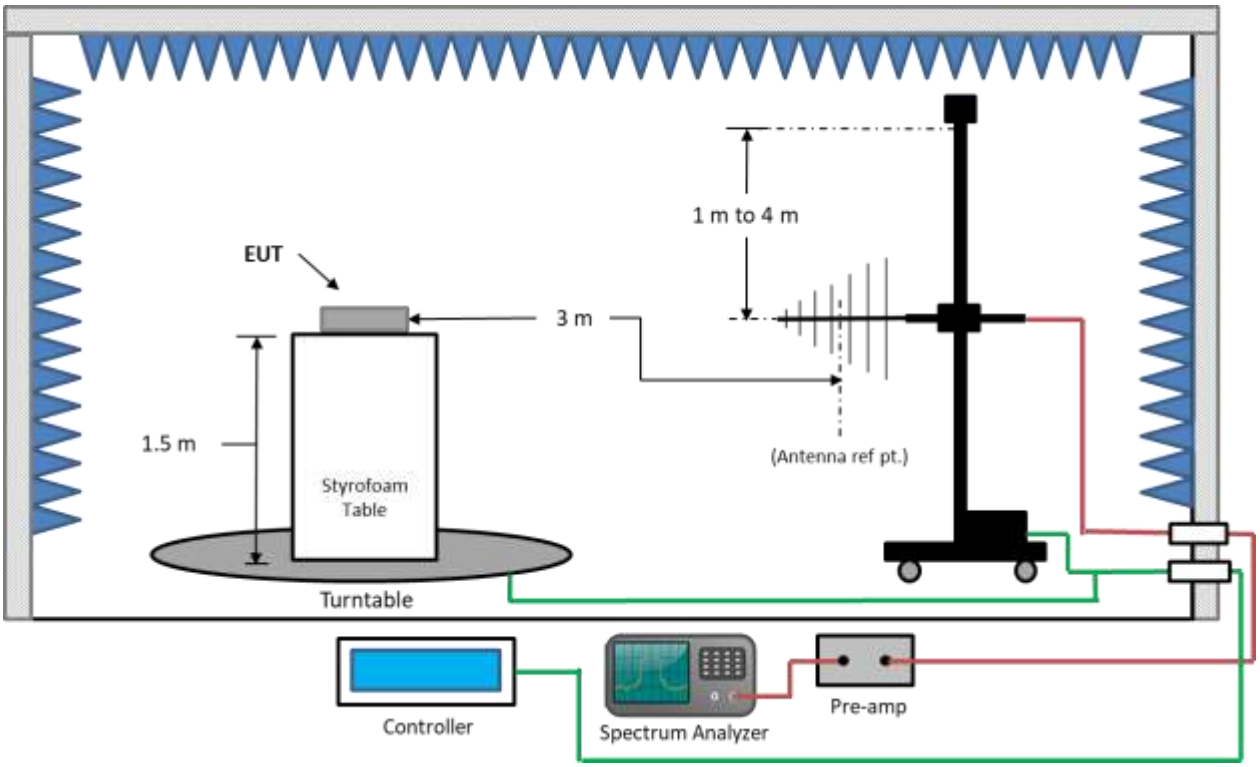


Figure 1. EUT Test Configuration Diagram

2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product.

Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	9/02/2022 2 yr.
SPECTRUM ANALYZER	8593	HEWLETT-PACKARD	3205A00124	1/29/2022 2 yr.
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	1937A02980	5/13/2021
PREAMP 1.0 GHz to 26.0 GHz	8449B	HEWLETT-PACKARD	3008A00480	5/13/2021
LOOP ANTENNA	SAS-200/562	A. H. Systems	142	4/06/2022 2 yr.
BICONICAL ANTENNA	3110B	EMCO	9307-1431	11/11/2022 2 yr.
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	2/1/2021 2 yr
HORN ANTENNA	3115	EMCO	9107-3723	2/28/2021 extended
HIGH PASS FILTER	H3R020G2	MICROWAVE CIRCUITS	001DC9528	5/11/2021
PROGRAMMABLE DC POWER SUPPLY	TP3005T	TEK POWER	218311	Cal not required

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2.2 Modifications to EUT Hardware

No modifications were made by US Tech to bring the EUT into compliance with FCC Part 15.247 requirements.

2.3 Number of Measurements for Intentional Radiators (CFR 15.31(m))

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated, with the device operating at the number of frequencies in each band specified in Table 3 as follows:

Table 3. Number of Test Frequencies for Intentional Radiators

Frequency Range over which the device operates	Number of Frequencies	Location in the Range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

Because the EUT operates over 2405 MHz to 2480 MHz, three test frequencies were used.

2.4 Frequency Range of Radiated Measurements (CFR 15.33)

2.4.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10th harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be 30 MHz to 1000 MHz, or to the range specified in 2.4.1 above, whichever is the higher range of investigation.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35)

The radiated and conducted emissions limits shown herein are based on the parameters listed in the following.

2.5.1 Detector Function and Associated Bandwidth

On frequencies below 1000 MHz, the limits herein are based upon measurement equipment employing a CISPR Quasi-peak detector function and related measurement bandwidths (i.e. 9 kHz from 150 kHz to 30 MHz and 120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the Quasi-peak device are used.

2.5.2 Corresponding Peak and Average Requirements

Above 1000 MHz, radiated limits are based on measuring instrumentation employing an average detector function. When average radiated emissions are specified there is also a corresponding Peak requirement, as measured using a peak detector, of 20 dB greater than the average limit. For all measurements above 1000 MHz the Resolution Bandwidth shall be at least 1 MHz.

2.5.3 Pulsed Transmitter Averaging

When the radiated emissions limit is expressed as an average value, and the transmitter is pulsed, the measured field strength shall be determined by applying a Duty Cycle Correction Factor based upon dividing the total ON time during the first 100 ms period by 100 ms (or by the period if less than 100 ms). The duty cycle may also be expressed logarithmically in dB. In this case, the Duty Cycle Correction Factor was determined from the manufacturer's claim. This data is presented in paragraph 2.6 and Figure 2 below.

2.6 Transmitter Duty Cycle (Part 15.35(c))

When the radiated emissions limit is expressed as an average value, and the transmitter is pulsed, the measured field strength shall be determined by applying a Duty Cycle Correction Factor based upon dividing the total ON time during the first 100 ms period by 100 ms (or by the period if less than 100 ms). The duty cycle may be expressed logarithmically in dB.

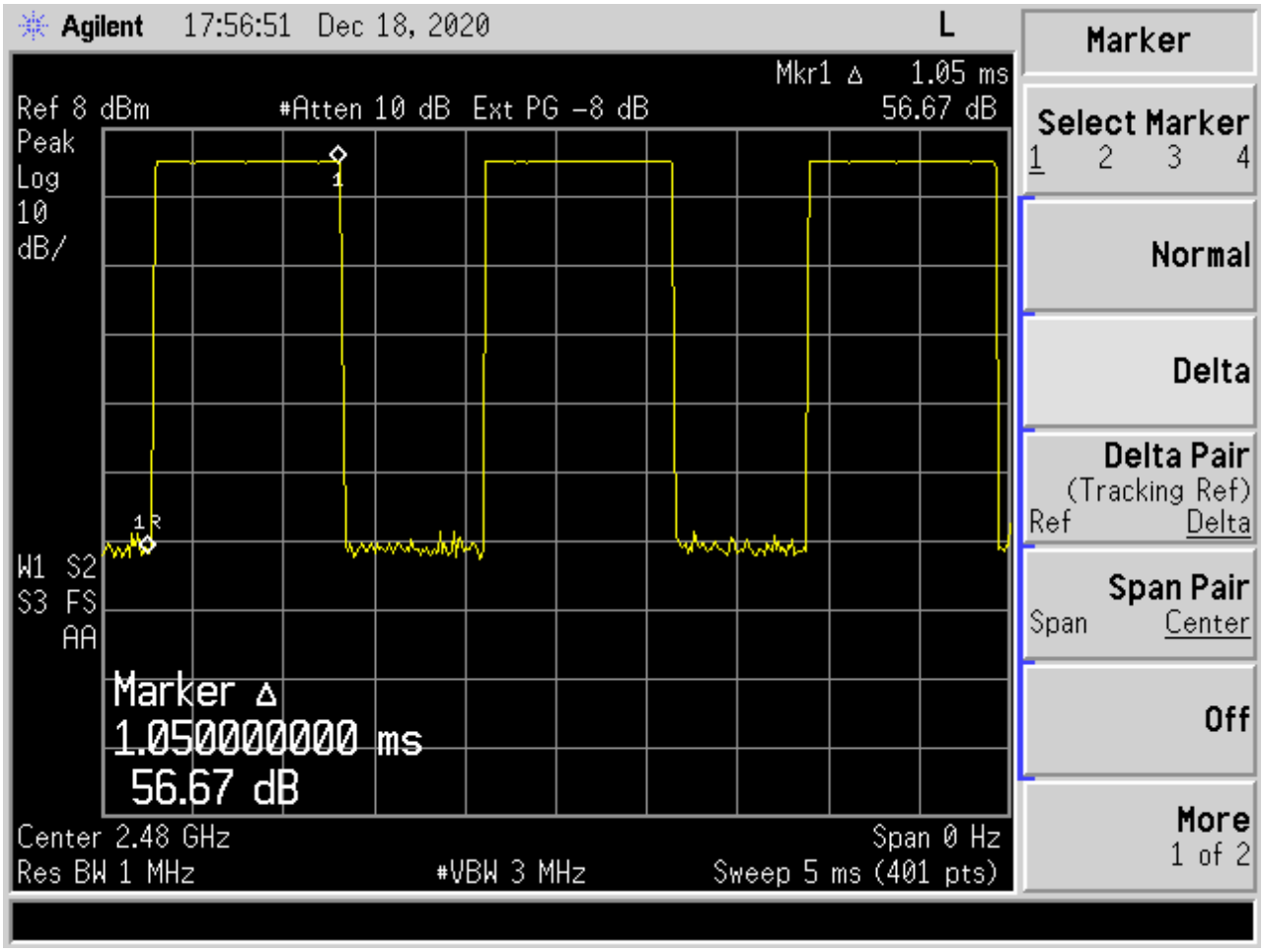


Figure 2. Duty Cycle – ON Time

Total ON = 1.05 ms x 3 x 20 = 63 ms
Duty Cycle = 20log(63/100) = -4.01 dB

2.7 Restricted Bands of Operation (Part 15.205)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these emissions cannot exceed the limits of 15.209. Radiated harmonics and other spurious emissions are examined for this requirement see paragraph 2.10.

2.8 EUT Antenna Requirements (CFR 15.203)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. Following are the antenna details:

Manufacturer	Model	Type/Gain (dBi)	Connector
Molex	1461530150	Patch / +2.8	U.FL

2.9 Maximum Peak Conducted Output Power (CFR 15.247(b)(3))

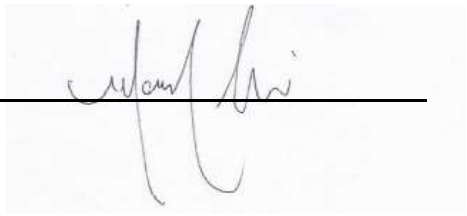
The EUT was programmed to operate at a normal operating output power across the bandwidth. For this test the normal operating output power of the radio was programmed to +4.0 dBm in the radio's test firmware. The short RF cable was connected to the rf port of the EUT. A +8.0 dB attenuator was used to help protect the test measurement equipment. This attenuator factor has been accounted for.

Peak power within the band 2405 MHz to 2480 MHz was measured per FCC KDB Publication 558074v05r02 and ANSI C63.10-2013. Antenna-port RF conducted output power test was performed.

Table 4. Peak Antenna Conducted Output Power per Part 15.247 (b)(3)

Frequency of Fundamental (MHz)	P_{Cond} (dBm)	P_{Cond} (mW)	FCC Limit (mW Maximum)
2405	2.930	1.963	1000
2440	3.207	2.093	1000
2480	3.592	2.287	1000

Test Date: December 18, 2020

Tested By
Signature:  Name: Mark Afroozi

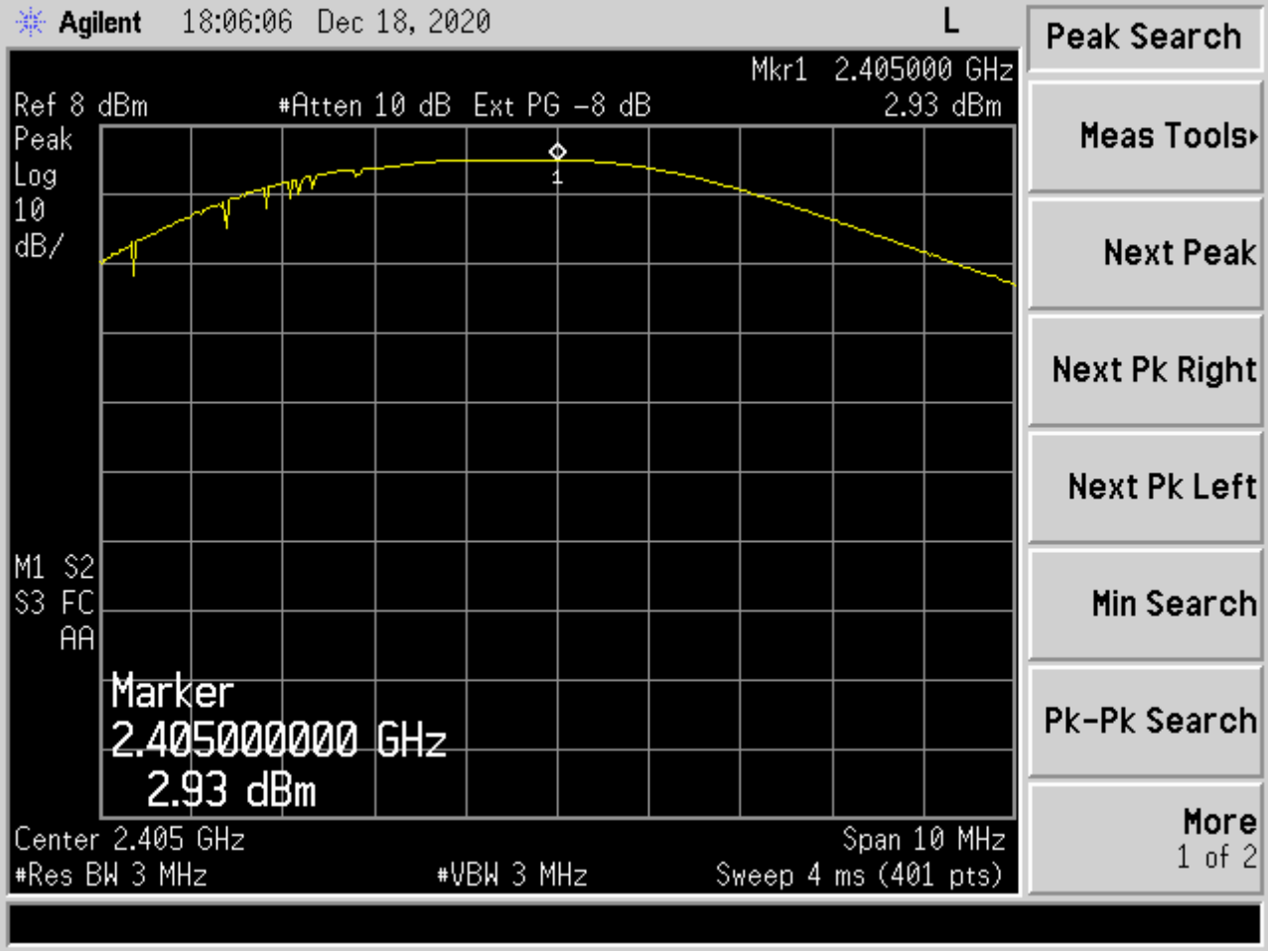


Figure 3. Peak Output Power – Low Channel

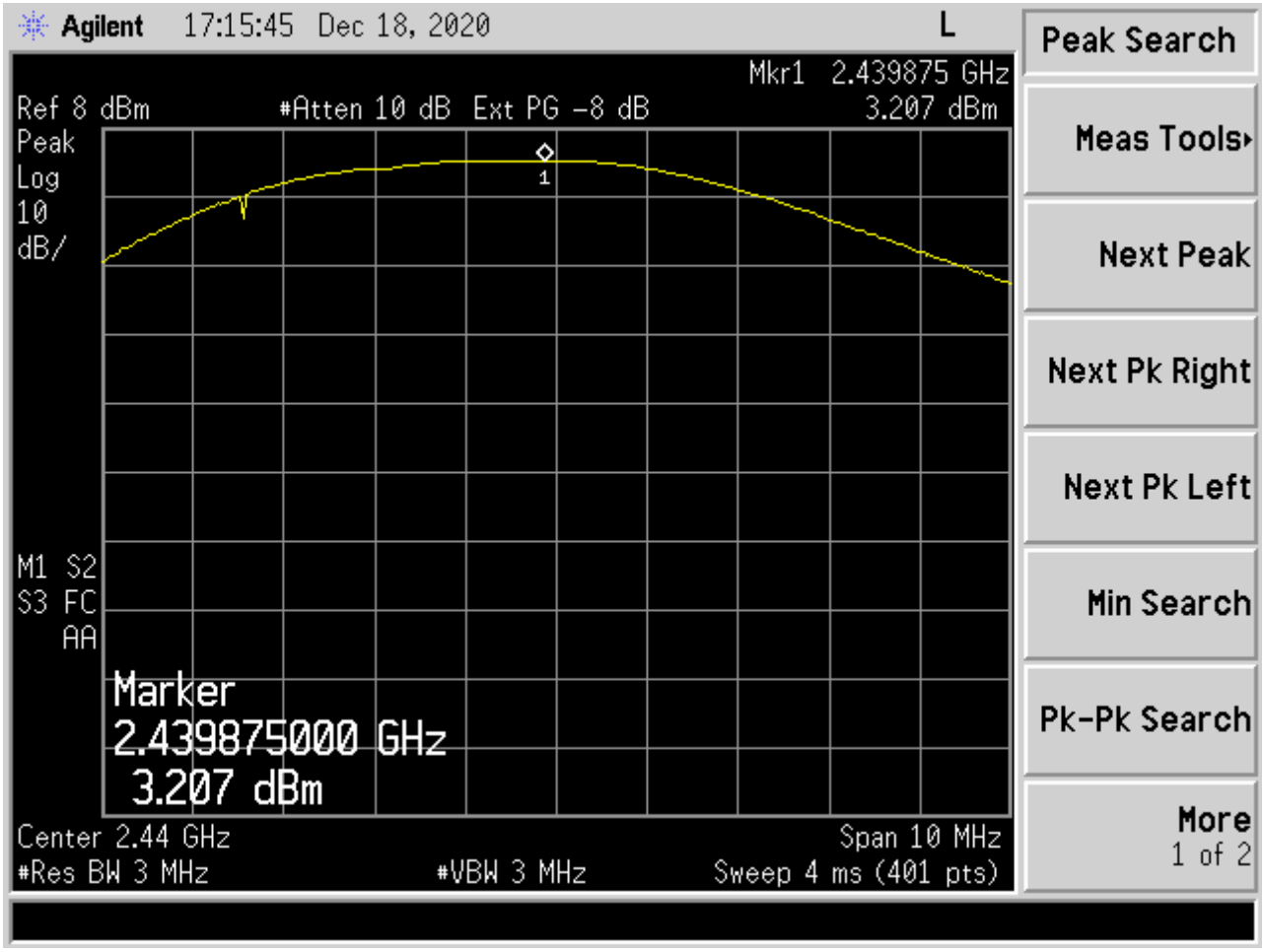


Figure 4. Peak Output Power - Mid Channel

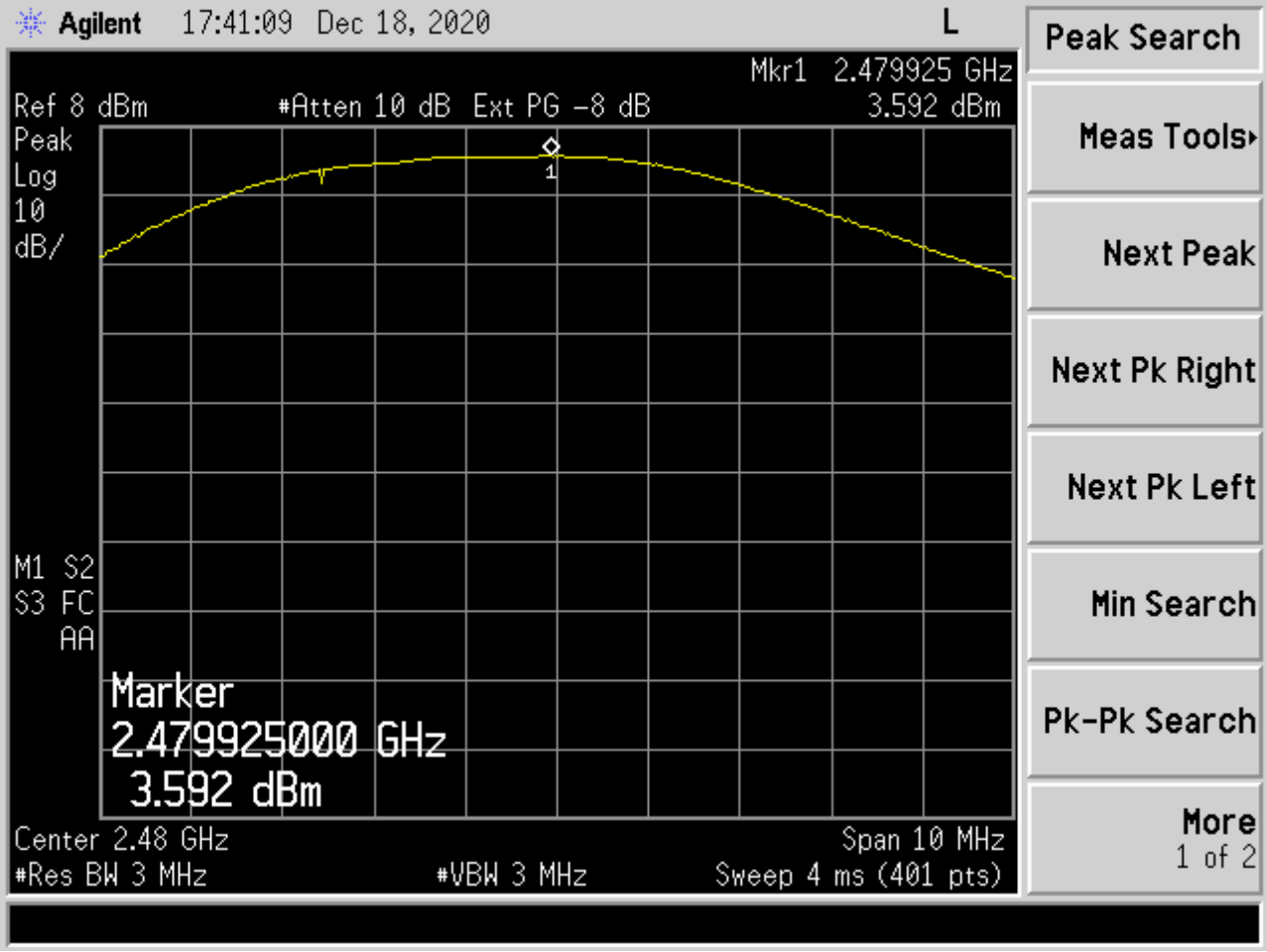


Figure 5. Peak Output Power - High Channel

2.10 Power Spectral Density (CFR 15.247(e), RSS-247 (5.2(b)))

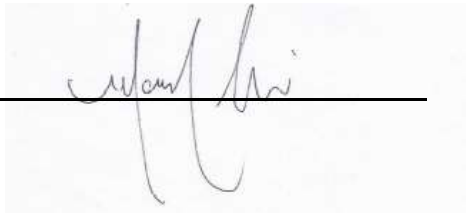
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission. The same method of determining the conducted output power shall be used to determine the power spectral density.

Per ANSI C63.10-2013, 11.10.1, if the measured peak conducted output power complies with the regulatory requirement for PSD, then measurement of PSD is not required. In this case the maximum peak conducted output power of the EUT is lower than +8 dBm therefore PSD measurements were not made. The PSD levels are reported as being equal to the measured output power.

Table 5. Power Spectral Density

Frequency (MHz)	Results (dBm/3kHz)	FCC Limit (dBm/3 kHz)
2405.00	2.93	8.0
2440.00	3.21	8.0
2480.00	3.59	8.0

Test Date: December 18, 2020

Tested By
Signature:  Name: Mark Afroozi

2.11 Antenna Conducted Intentional and Spurious Emissions (CFR 15.209, 15.247(d)) (RSS-247 (5.5), RSS-Gen 8.9)

The EUT was put into a continuous-transmit mode of operation and tested per FCC KDB Publication 558074v05r02 for conducted out of band emissions radiating from the antenna port over the frequency range of 30 MHz to ten times the highest clock frequency generated or used in this case, 25 GHz. A conducted scan was performed on the EUT to identify and record spurious signals that were related to the transmitter. Antenna conducted emissions of a significant magnitude that fell within restricted bands were then measured as radiated emissions in the semi-anechoic chamber. The conducted emissions graphs are found in figures below. All spurious emissions must be at least 20 dB below the fundamental signal.

For RF antenna conducted tests, the RBW was set to 1 MHz, video bandwidth (VBW)> RBW, scan up through the 10^{th} harmonic of the fundamental frequency. All harmonics/spurs must be at least 20 dB down from the highest emission level within the authorized band.

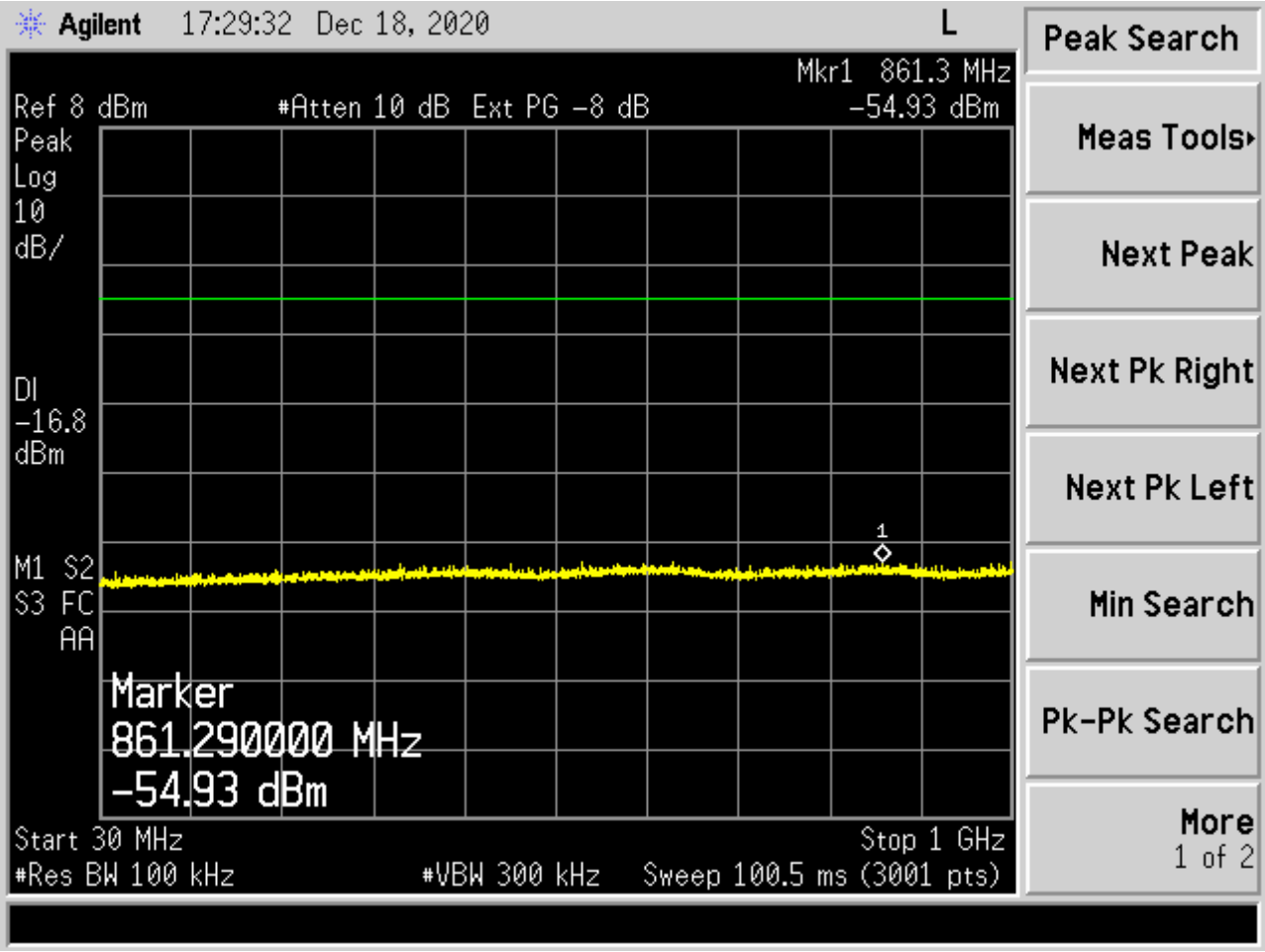


Figure 6. Conducted Spurious Emissions – Low Channel, 30 MHz – 1 GHz

Display line represents 20 dB below peak of fundamental frequency.

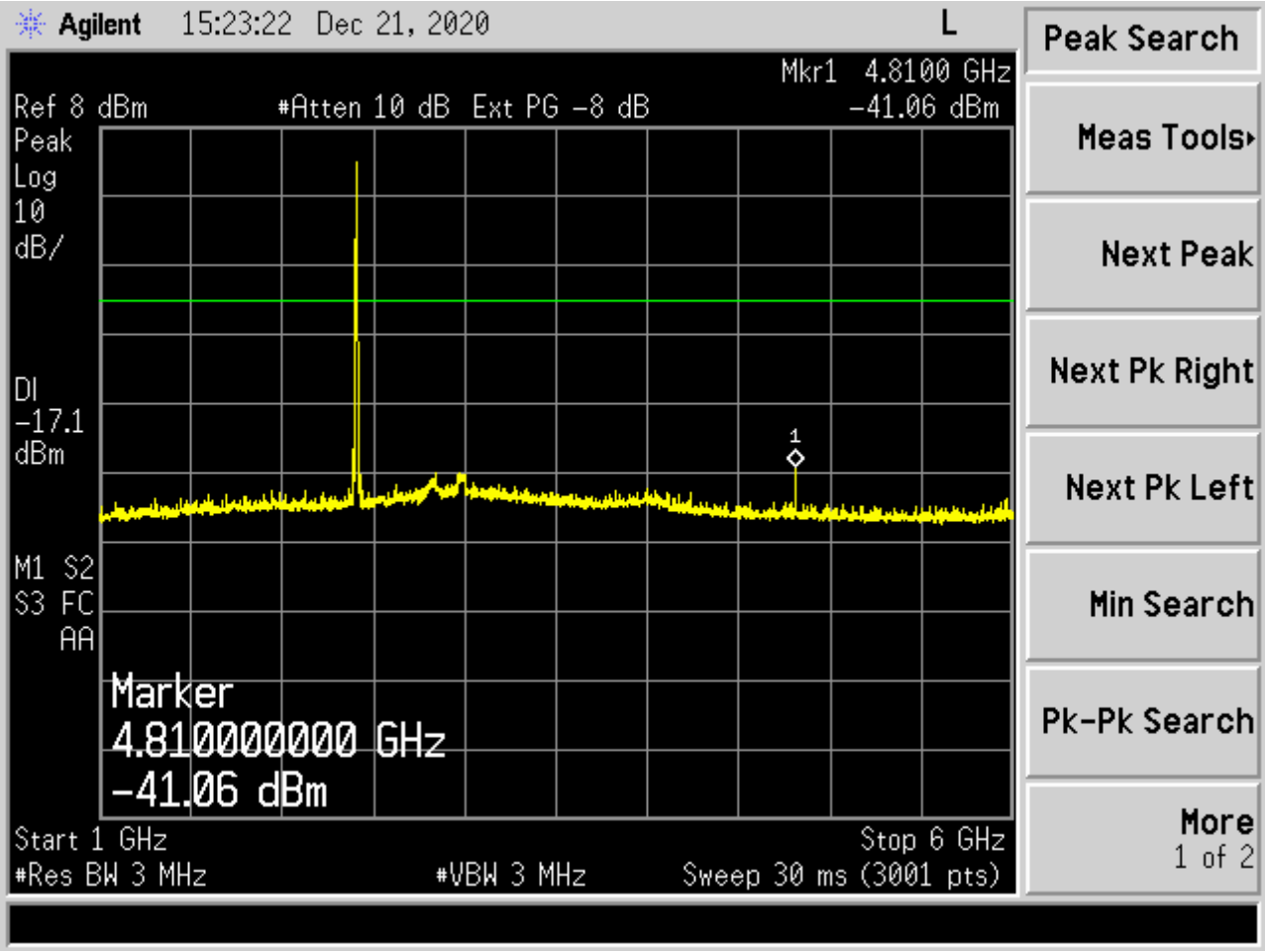


Figure 7. Conducted Spurious Emissions – Low Channel, 1 GHz – 6 GHz

Large Signal shown is fundamental frequency
Display Line represents 20 dB below peak of fundamental frequency

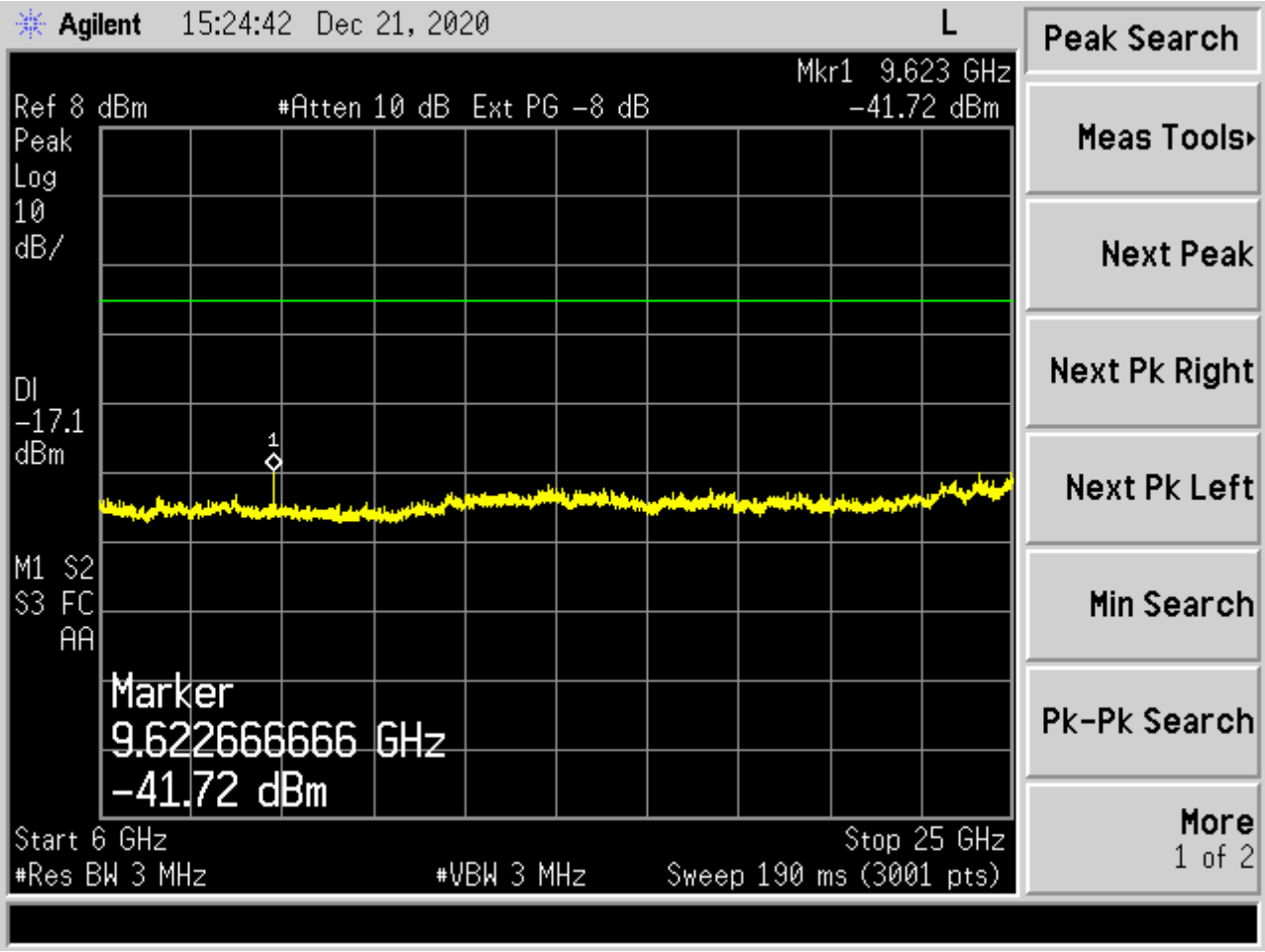


Figure 8. Conducted Spurious Emissions – Low Channel, 6 GHz - 25 GHz

Display Line represents 20 dB below peak of fundamental frequency

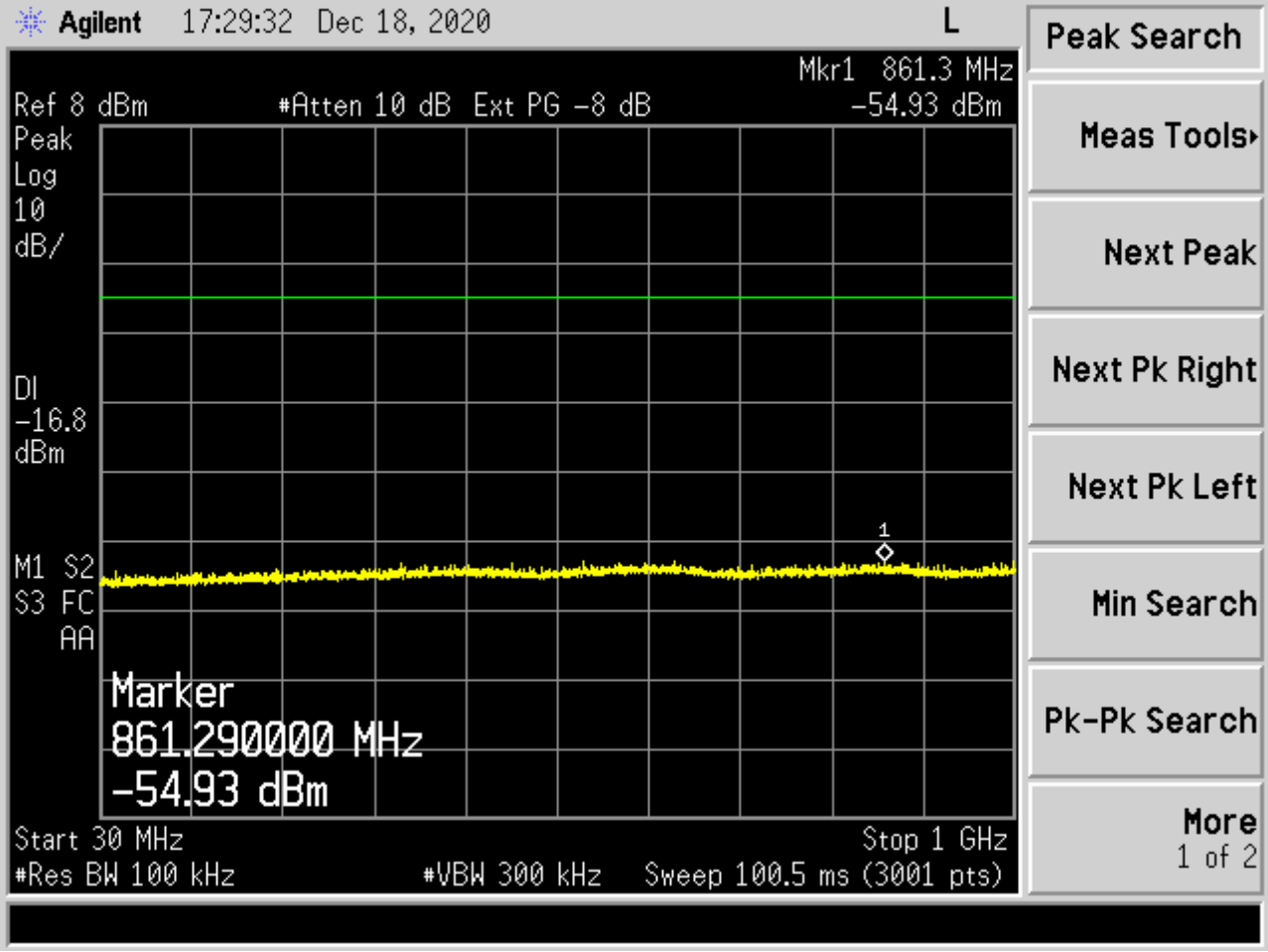


Figure 9. Conducted Spurious Emissions – Mid Channel, 30 MHz – 1 GHz

Display Line represents 20 dB below peak of fundamental frequency.

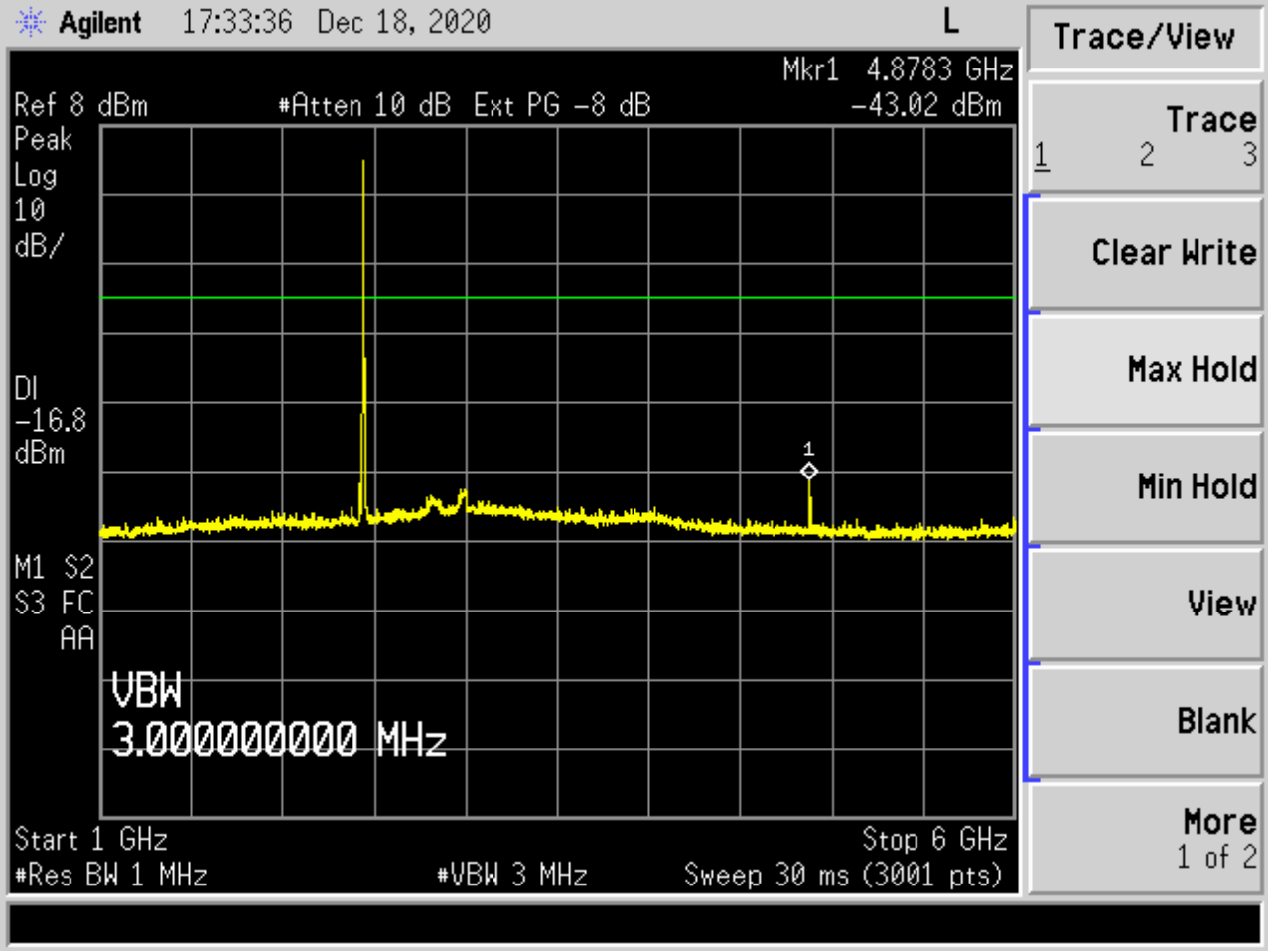


Figure 10. Conducted Spurious Emissions – Mid Channel, 1 GHz – 6 GHz

Large Signal shown is fundamental frequency.
Display Line represents 20 dB below peak of fundamental frequency.

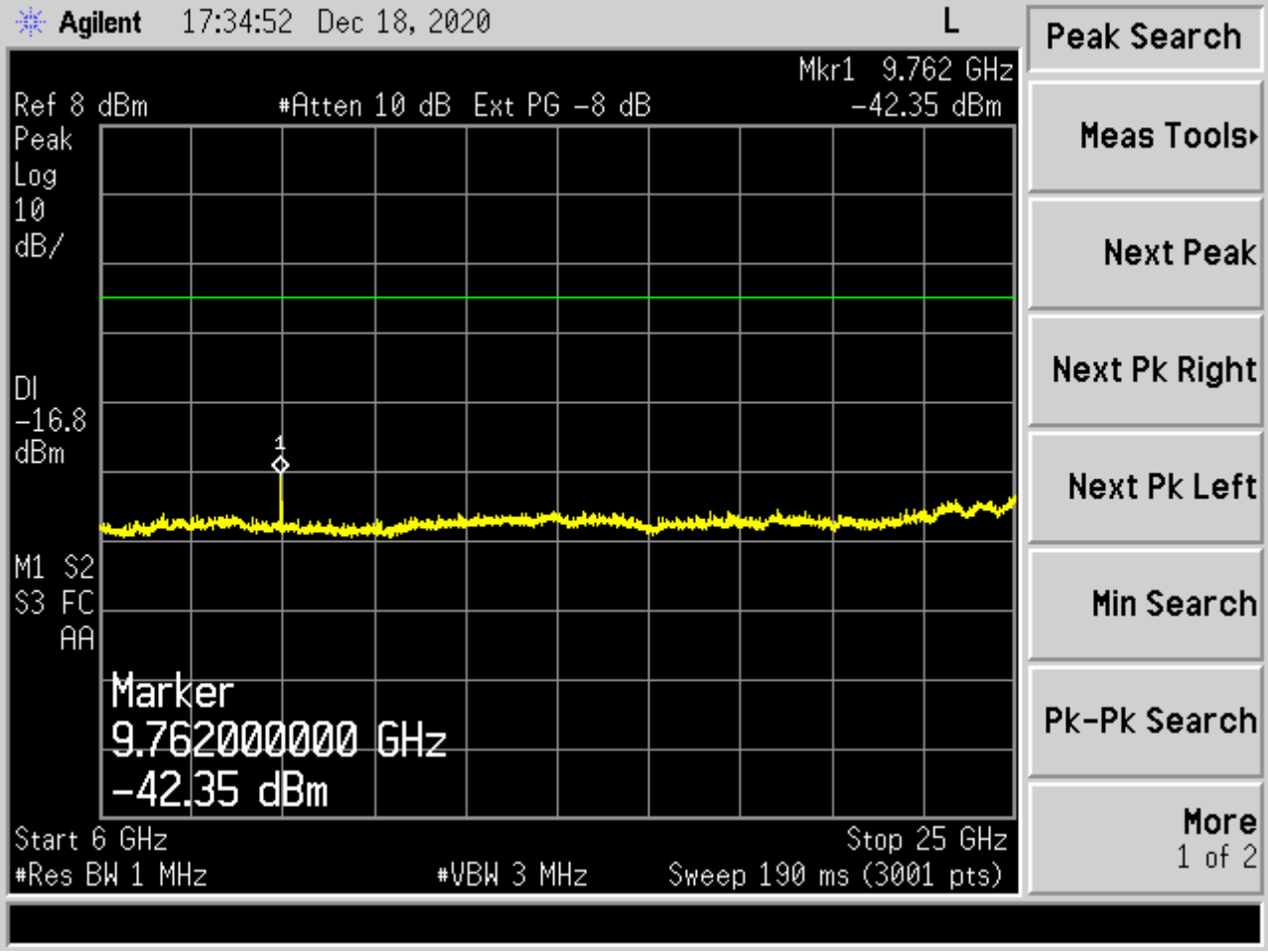


Figure 11. Conducted Spurious Emissions – Mid Channel, 6 GHz – 25 GHz

Display Line represents 20 dB below peak of fundamental frequency.

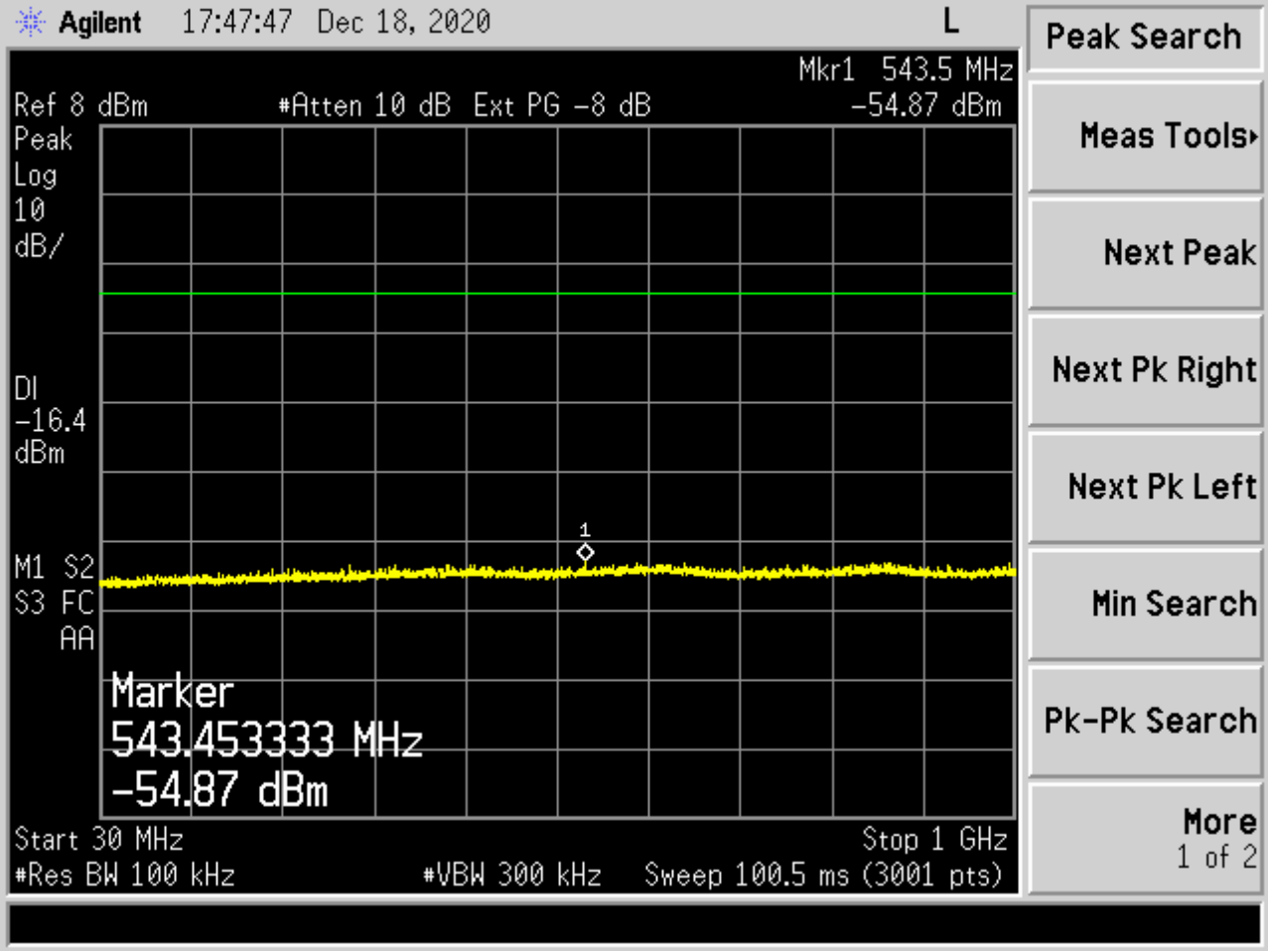


Figure 12. Conducted Spurious Emissions – High Channel, 30 MHz - 1 GHz

Display line represents 20 dB below peak of fundamental frequency.

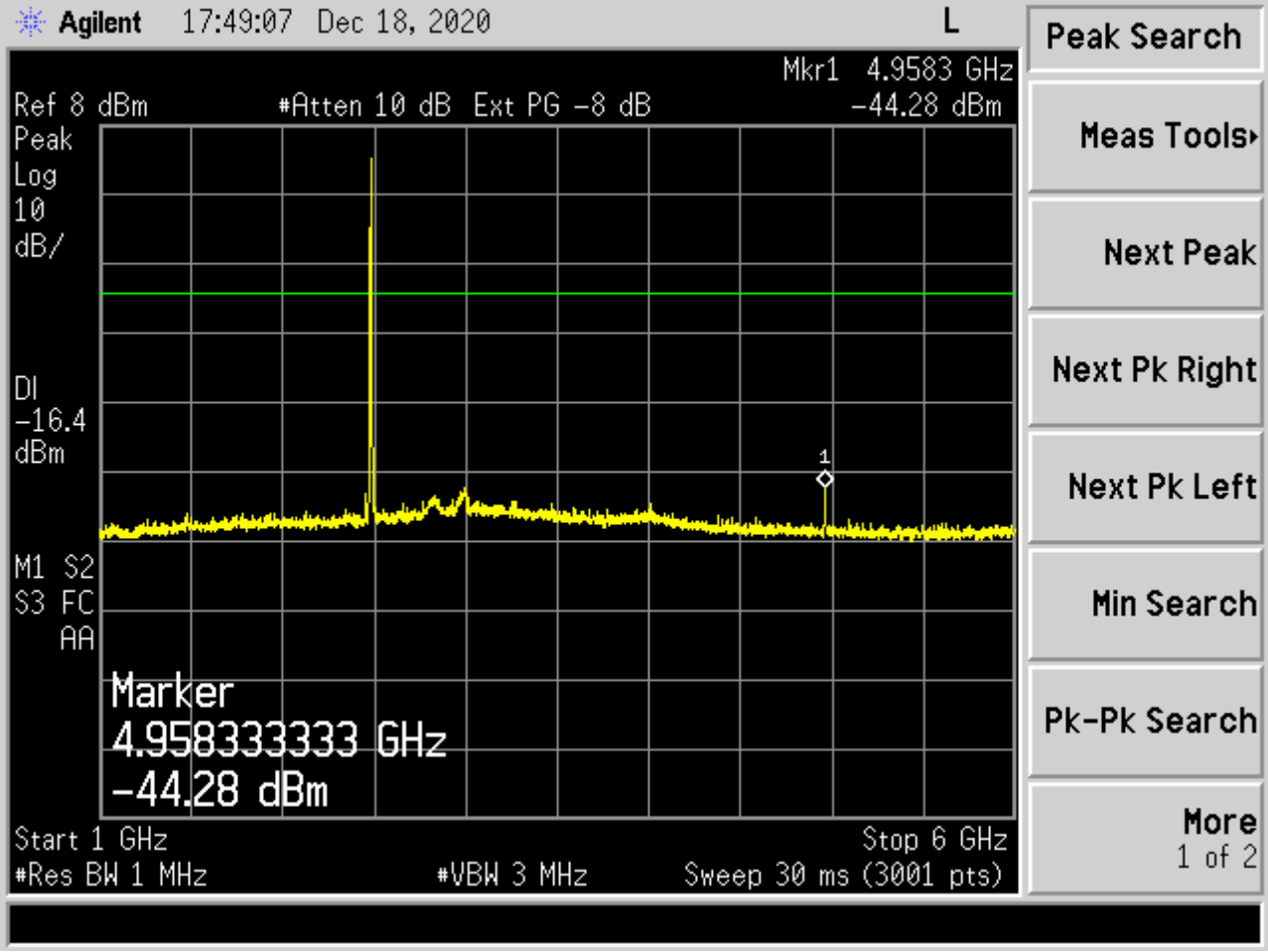


Figure 13. Conducted Spurious Emissions – High Channel, 1 GHz – 6 GHz

Large Signal shown is fundamental frequency.
Display line represents 20 dB below peak of fundamental frequency.

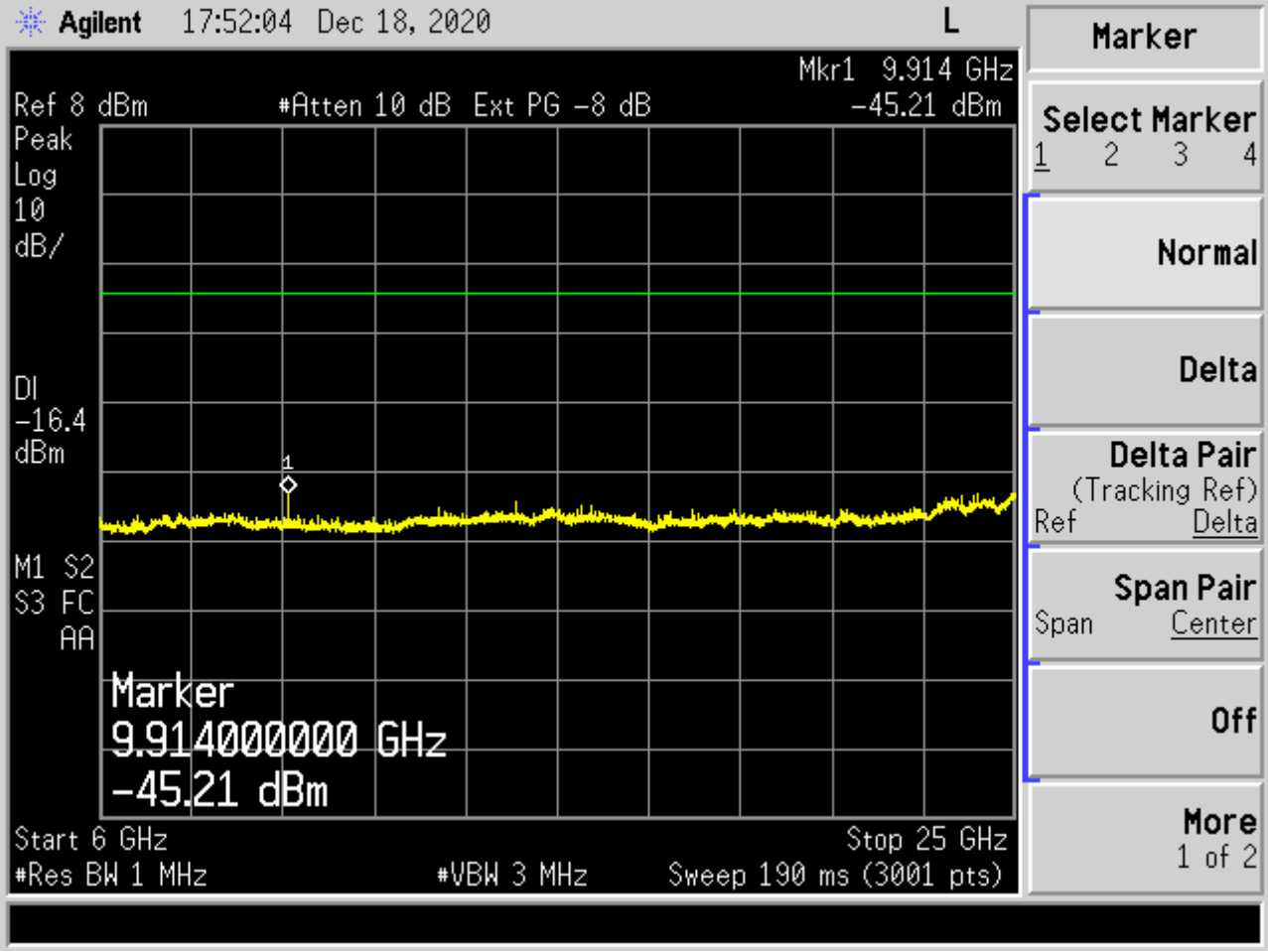


Figure 14. Conducted Spurious Emissions – High Channel, 6 GHz – 25 GHz

Display line represents 20 dB below peak of fundamental frequency.

2.12 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d))

On the test site, the EUT was mounted on top of a non-conductive table, 80 cm above the floor, by placing it in the X-Z plane along the Z axis with its bottom cover in parallel with the ground. The front of the EUT faced the measurement antenna located 3 meters away. Each signal measured was maximized by raising and lowering the receive antenna between 1 and 4 meters in height while monitoring the ever changing spectrum analyzer display (with channel A in the Clear-Write mode and channel B in the Max-Hold mode) for the largest signal visible. That exact antenna height where the signal was maximized was recorded for reproducibility purposes. Also, the EUT was rotated about its Y-axis while monitoring the Spectrum Analyzer display for maximum. The EUT azimuth was recorded for reproducibility purposes. The EUT was measured when both maxima were simultaneously satisfied.

For radiated measurements, the EUT was set into a continuous transmission mode. Below 1 GHz, the RBW of the measuring instrument was set equal to 120 kHz. Peak measurements above 1 GHz were measured using a RBW = 1 MHz, with a VBW ≥ 3 x RBW. The results of peak radiated spurious emissions falling within restricted bands are given in Table 5 below. For average measurements above 1 GHz, the emissions were measured using an average detector.

Table 6. Peak Radiated Fundamental, Harmonic Emissions & Restricted Band Edges

Frequency (MHz)	Test Data (dBuV)	Additional Factor	AF+CL-PA (dB/m)	Corrected Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector
Low Channel								
2405	62.55	--	28.83	91.38	--	3.0m./HORZ		**PK**
*4810	50.84	--	3.55	54.39	74.0	3.0m./HORZ	19.6	**PK**
9620	51.46	-9.50	8.88	50.84	74.0	1.0m./HORZ	23.2	**PK**
14430	52.30	-9.50	14.79	57.59	74.0	1.0m./HORZ	16.4	**PK**
16835	51.61	-9.50	15.66	57.77	74.0	1.0m./HORZ	16.2	**PK**
Middle Channel								
2440	61.33	--	28.98	90.31		3.0m./HORZ		**PK**
*4880	52.05	--	3.61	55.66	74.0	3.0m./HORZ	18.3	**PK**
*7320	52.19	-9.50	9.35	52.04	74.0	1.0m./HORZ	22.0	**PK**
9760	52.68	-9.50	8.92	52.10	74.0	1.0m./HORZ	21.9	**PK**
14640	52.63	-9.50	14.21	57.34	74.0	1.0m./HORZ	16.7	**PK**
High Channel								
2480	86.18	--	31.47	117.65	--	3.0m./VERT	--	**PK**
4960	51.13	--	8.52	59.65	74.0	3.0m./HORZ	14.4	**PK**
7440	51.89	-9.50	9.64	52.03	74.0	1.0m./HORZ	22.0	**PK**
9920	53.62	-9.50	8.77	52.89	74.0	1.0m./HORZ	21.1	**PK**
Restricted Band Edge – Lower								
2389.58	50.07	--	-6.46	43.61	74.0	3.0m./HORZ	30.4	**PK**
Restricted Band Edge – Upper								
2483.52	59.78	--	-5.73	54.05	74.0	3.0m./HORZ	19.9	**PK**

1. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
2. A correction factor of -9.5 dB was applied to measurements made at a distance of 1 m.
3. (*) Falls within restricted band.

Sample Calculation at 2405 MHz:

Magnitude of Measured Frequency	62.55	dBuV
+Additional Factor	0.00	dB
+Antenna Factor + Cable Loss - Amplifier Gain	28.83	dB/m
Corrected Result	91.38	dBuV/m

Test Date: December 22, 2020

Tested By
Signature: 

Name: Mark Afroozi

Table 7. Average Radiated Fundamental, Harmonic Emissions & Restricted Band Edges

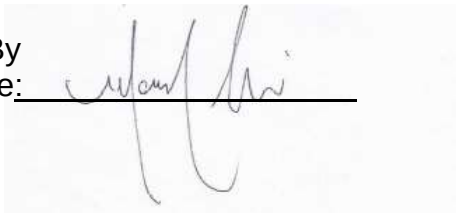
Frequency (MHz)	Test Data (dBuV)	Additional Factor	AF+CL-PA (dB/m)	Corrected Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector
Low Channel								
2405	44.40	--	28.83	73.23	--	3.0m./HORZ	--	**AVG**
* 4810	31.30	--	3.55	34.85	54.0	3.0m./HORZ	19.2	**AVG**
9620	31.12	-9.50	8.88	30.50	54.0	1.0m./HORZ	23.5	**AVG**
14430	29.93	-9.50	14.79	35.22	54.0	1.0m./HORZ	18.8	**AVG**
16835	30.38	-9.50	15.66	36.54	54.0	1.0m./HORZ	17.5	**AVG**
Middle Channel								
2440	42.84	--	28.98	71.82	--	3.0m./HORZ	--	**AVG**
*4880	30.78	--	3.61	34.39	54.0	3.0m./HORZ	19.6	**AVG**
*7320	30.60	-9.50	9.35	30.45	54.0	1.0m./HORZ	23.5	**AVG**
9760	33.68	-9.50	8.92	33.10	54.0	1.0m./HORZ	20.9	**AVG**
14640	29.78	-9.50	14.21	34.49	54.0	1.0m./HORZ	19.5	**AVG**
High Channel								
2480	41.14	--	28.99	70.13	--	3.0m./HORZ	--	**AVG**
4960	29.94	--	4.26	34.20	54.0	3.0m./HORZ	19.8	**AVG**
7440	30.41	-9.50	9.64	30.55	54.0	1.0m./HORZ	23.4	**AVG**
9920	34.98	-9.50	8.77	34.25	54.0	1.0m./HORZ	19.7	**AVG**
Restricted Band Edge – Lower								
2349.77	19.81	--	-6.52	13.29	54.0	3.0m./HORZ	40.7	**AVG**
Restricted Band Edge – Upper								
2483.64	43.92	--	-5.73	38.19	54.0	3.0m./HORZ	15.8	**AVG**

1. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
2. A correction factor of -9.5 dB was applied to measurements made at a distance of 1 m.
3. (*) Falls within restricted band.

Sample Calculation at 2405 MHz:

Magnitude of Measured Frequency	44.40	dBuV
+Additional Factor (Duty cycle correction)	0.00	dB
+Antenna Factor + Cable Loss - Amplifier Gain	28.83	dB/m
Corrected Result	73.23	dBuV/m

Test Date: December 22, 2020

Tested By
Signature: 

Name: Mark Afroozi

2.13 Band Edge Measurements – (CFR 15.247(d))

Band Edge measurements are made following the guidelines in FCC KDB Publication No. 558074 v05r02 with the EUT initially operating on the Lowest Channel and then operating on the Highest Channel within its band of operation. Antenna port conducted measurements are performed to demonstrate compliance with the requirement of 15.247(d) that all emissions outside of the band edges be attenuated by at least 20 dB when compared to its highest in-band value (contained in a 100 kHz band).

To capture the band edge set the Spectrum Analyzer frequency span large enough (usually around 10 MHz) to capture the peak level of the emission operating on the channel closest to the band edge as well as any modulation products falling outside of the authorized band of operation. Conducted measurements are performed with RBW ≥1% of the frequency span. In all cases, the VBW is set ≥3 x RBW. See figures and calculations below for more detail.

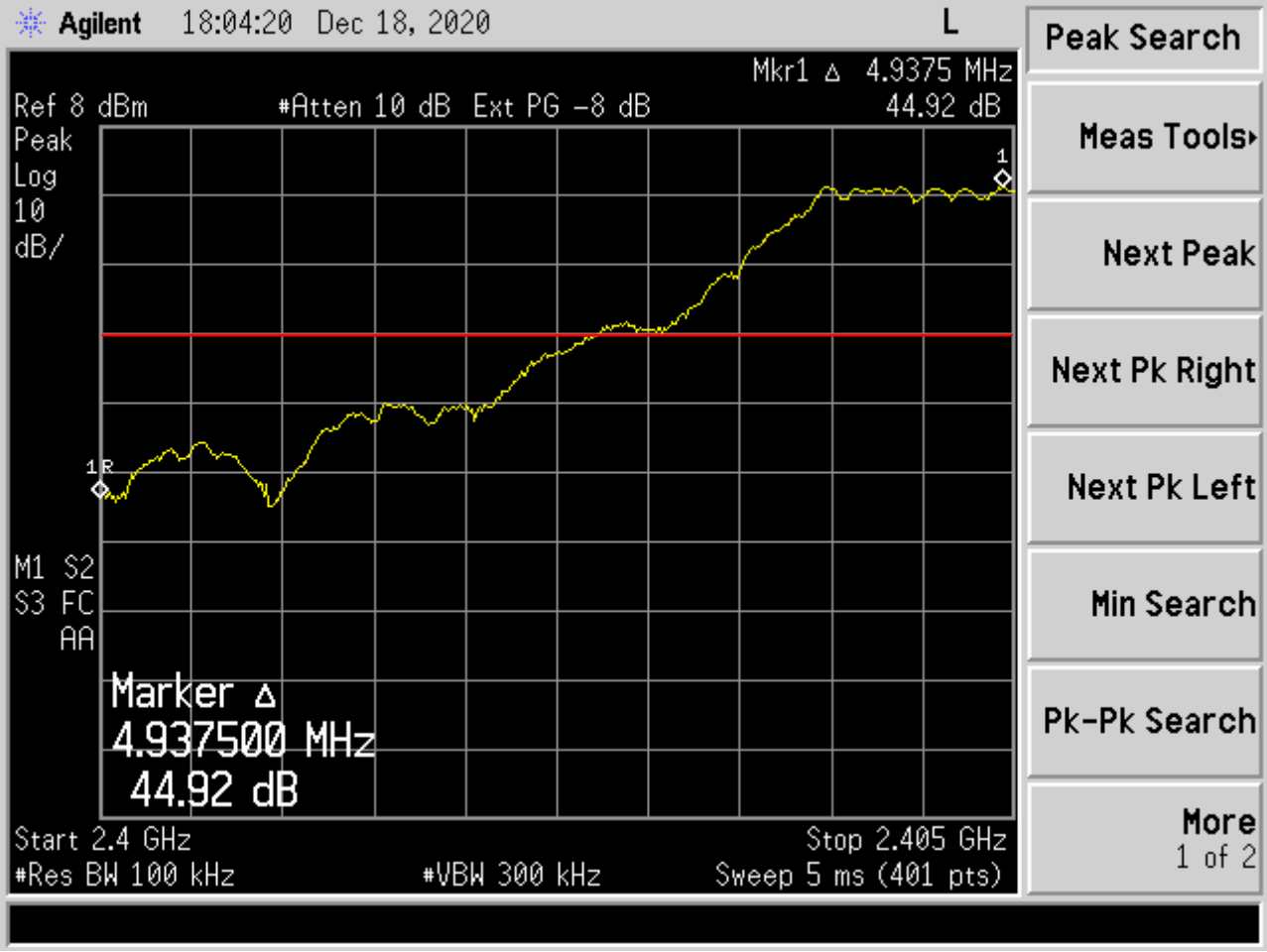


Figure 15. Band Edge Compliance – Low Channel Delta - Peak

Lower band edge must be 20 dB below the fundamental. This requirement is met.

Measured Result	44.92	dB
Band Edge Limit	20.00	dB
Band Edge Margin	24.92	dB

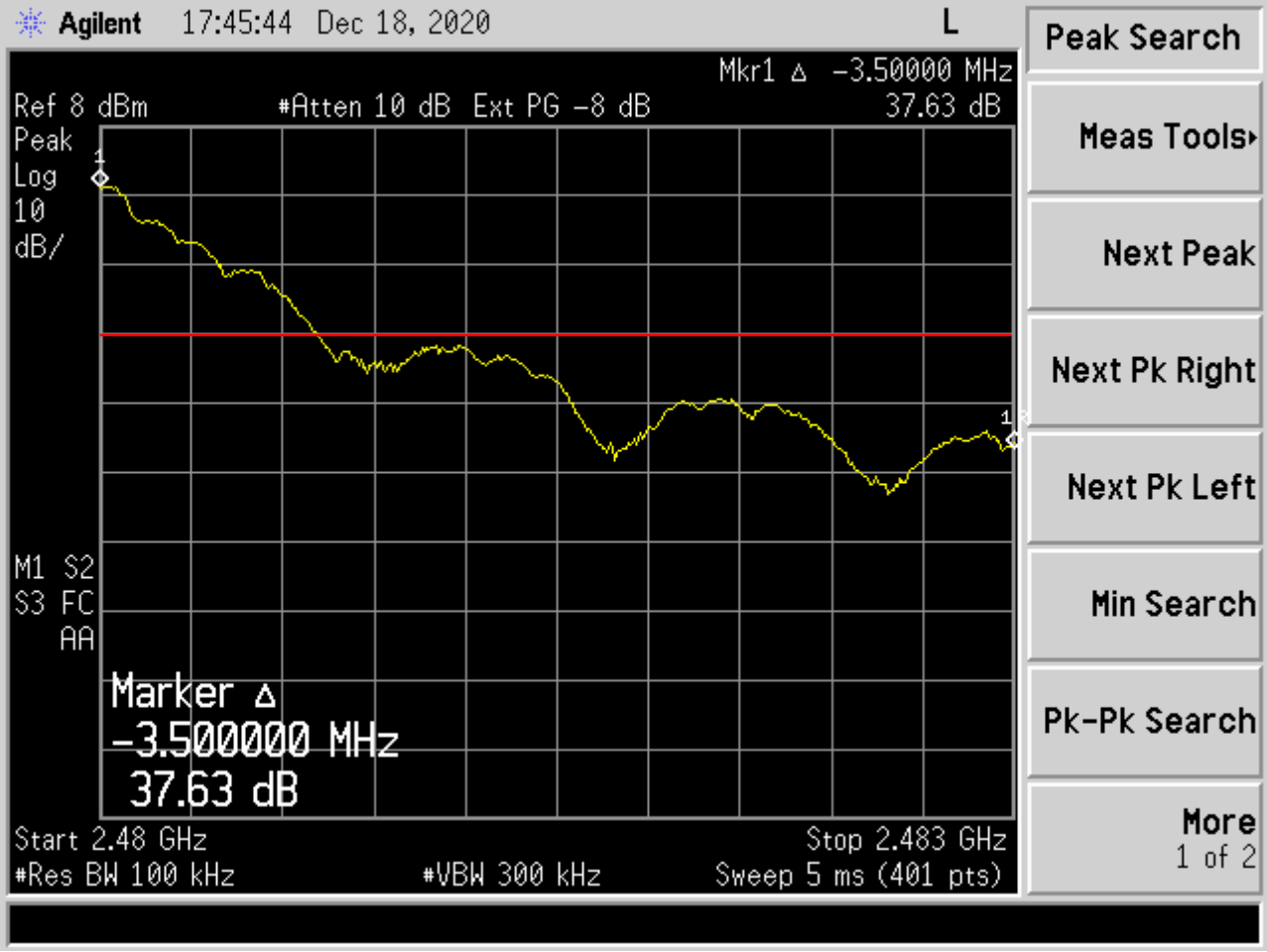


Figure 16. Band Edge Compliance – High Channel Delta - Peak

Higher band edge must be 20 dB below the fundamental. This requirement is met.

Measured Result	37.63	dB
Band Edge Limit	20.00	dB
Band Edge Margin	17.63	dB

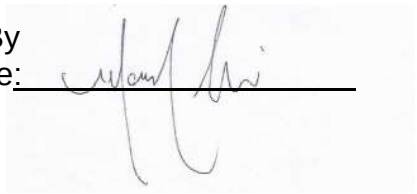
2.14 DTS Bandwidth (CFR 15.247(a)(2))

The EUT antenna port was connected to a spectrum analyzer having a 50 Ω input impedance. Measurements were performed similar to the method of FCC, KDB Publication No. 558074 v05r02 and ANSI C63.10-2013 Option 1. The RBW was set to 100 kHz and the VBW was set to ≥ [3 X RBW]. The detector was set to PEAK and trace was Max Hold. The measurement was taken at 6 dB down from the peak fundamental emission. The results of this test are given in the table below and figures below.

Table 8. Six (6) dB Bandwidth

Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum FCC Bandwidth (MHz)
2405	1.48	0.5
2440	1.54	0.5
2480	1.44	0.5

Test Date: December 18 and 21, 2020

Tested By
Signature:  Name: Mark Afroozi

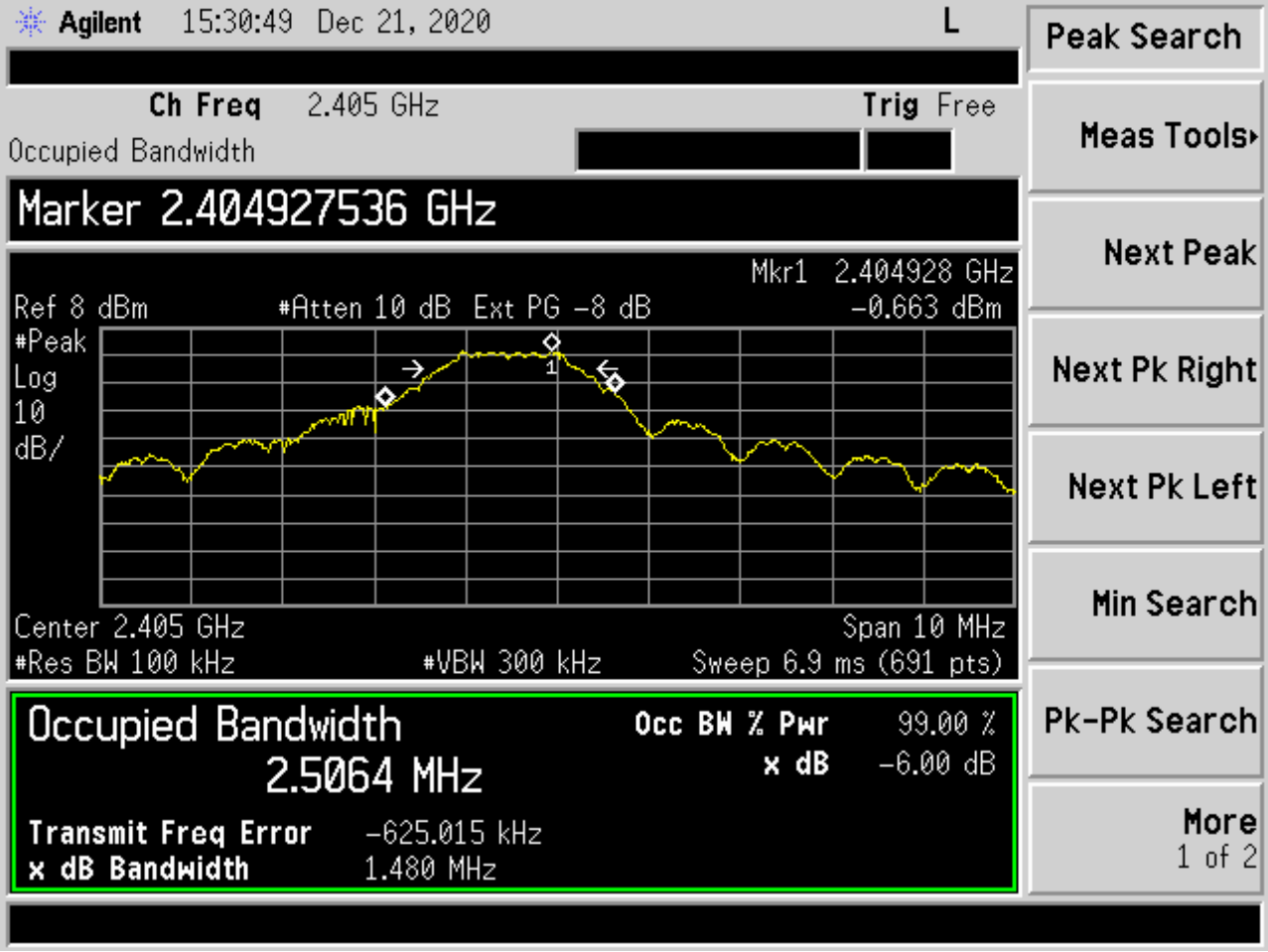


Figure 17. 6 dB Bandwidth Low Channel

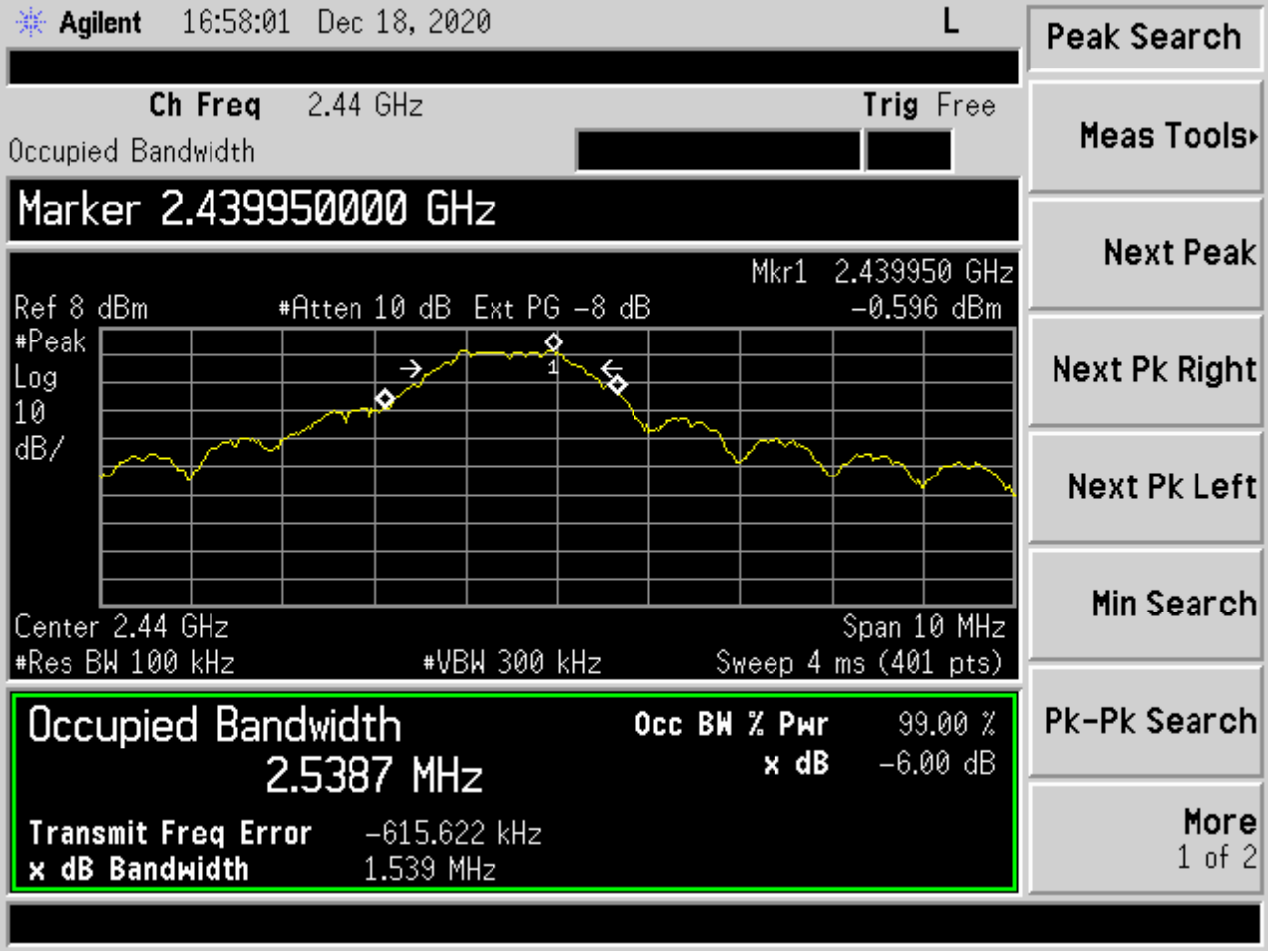


Figure 18. 6 dB Bandwidth Mid Channel

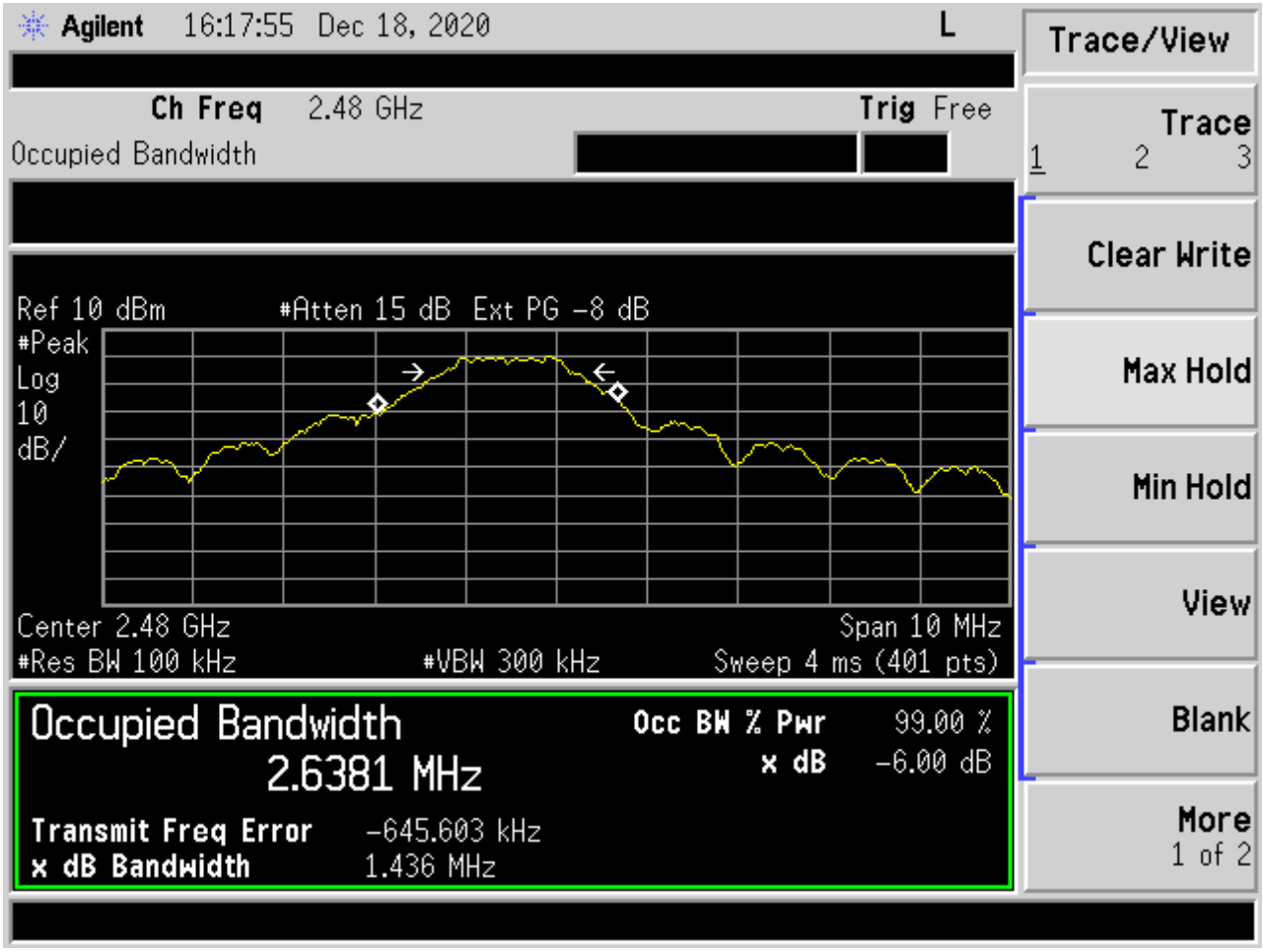


Figure 19. 6 dB Bandwidth High Channel

2.15 Intentional Radiator Power Line Conducted Emissions (CFR 15.207)

The power line conducted voltage emission measurements have been carried out in accordance with CFR 15.207, per ANSI C63.10:2013, Clause 6.2, with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmission. The worst-case results for conducted emissions were determined to be produced when the EUT was operating under continuous transmission

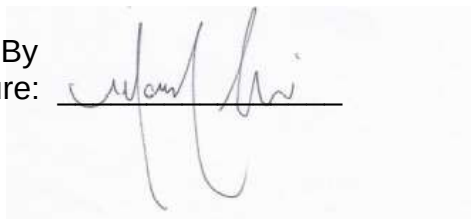
Table 9. Power Line Conducted Emissions 150 kHz to 30 MHz (CFR 15.107/207)

Frequency (MHz)	Test Data (dBuV)	LISN+CL (dB)	Corrected Results (dBuV)	Limits (dBuV)	Margin (dB)	Detector
Phase @ 120 Vac/60Hz						
0.1579	25.78	0.08	25.86	55.6	29.7	**PK**
0.5425	21.70	0.23	21.93	46.0	24.1	**PK**
1.5000	25.38	0.34	25.72	46.0	20.3	**PK**
8.4250	20.33	0.34	20.67	50.0	29.3	**PK**
12.1300	23.14	0.67	23.81	50.0	26.2	**PK**
20.6800	14.27	0.92	15.19	50.0	34.8	**PK**
Neutral @ 120 Vac/60Hz						
0.1588	25.78	0.08	25.86	55.6	29.7	**PK**
0.7138	21.70	0.23	21.93	46.0	24.1	**PK**
1.5000	25.38	0.34	25.72	46.0	20.3	**PK**
8.4250	20.33	0.34	20.67	50.0	29.3	**PK**
16.0300	23.14	0.67	23.81	50.0	26.2	**PK**
24.5800	14.27	0.92	15.19	50.0	34.8	**PK**

SAMPLE CALCULATION AT: 0.1579 MHz

Magnitude of Measured Frequency	25.78	dBuV
+ LISN + Cable Loss	0.08	dB
Corrected Result	25.86	dBuV/m

Test Date: January 8, 2021

Tested By
Signature:  Name: Mark Afroozi

2.16 Unintentional Radiator and Intentional Radiator, Radiated Emissions (CFR 15.109, 15.209)

The test data provided herein is to support the verification requirement for radiated emissions coming from the EUT in a transmitting state per 15.209 and were investigated from 9kHz or the lowest operating clock frequency to 12.5 GHz and tested as detailed in ANSI C63.10:2013, Clause 6.4-6.6. Data is presented in the table below.

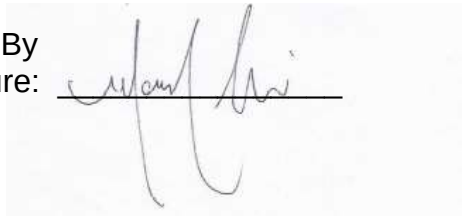
Radiated emissions within the band of 9 kHz to 30 MHz were investigated using a calibrated loop antenna and per the requirements of ANSI C63.10:2013.

Measurements were made with the analyzer's resolution bandwidth set to 120 kHz for measurements made below 1 GHz and 1 MHz for measurements made above 1 GHz. The video bandwidth was set to three times the resolution bandwidth (1 MHz RBW and 3 MHz VBW). The magnitude of each emission was maximized by rotating the turn-table 360 degrees clockwise and counterclockwise then raising and lowering the receiving antenna between 1 to 4 meters in height as part of the measurement procedure.

Table 10. Spurious Radiated Emissions (9 kHz – 30 MHz)

Tested By: MA	Test: FCC Part 15.109/15.209			Client: Southern States, LLC.				
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detector**
All emissions were more than 20 dB below the applicable limit.								

Test Date: December 31, 2020

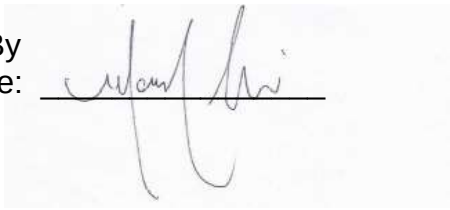
Tested By
Signature: 

Name: Mark Afroozi

Table 11. Spurious Radiated Emissions (30 MHz – 1 GHz)

Tested By: MA	Test: FCC Part 15.109/15.209				Client: Southern States, LLC.			
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factors**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**DETECTOR PK / QP/AVG**
All emissions were more than 20 dB below the applicable limit.								

Test Date: December 22, 2020

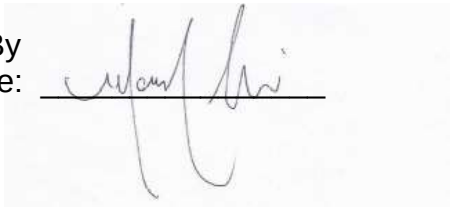
Tested By
Signature: 

Name: Mark Afroozi

Table 12. Spurious Radiated Emissions (above 1 GHz)

Tested By: MA	Test: FCC Part 15.109/15.209				Client: Southern States, LLC.			
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factors**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**DETECTOR PK / QP/AVG**
No emissions other than fundamental and harmonics were detected.								

Test Date: December 22, 2020

Tested By
Signature: 

Name: Mark Afroozi

2.17 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4-2:2011. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.17.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ±2.78 dB.

2.17.2 Radiated Emissions Measurement Uncertainty

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ±5.3 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ±5.1 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna (Above 1000 MHz) is ±5.1 dB.

3 Test Results

The EUT is deemed to have met the requirements of the standards cited within the test report when tested as detailed in the test report.