Testing Tomorrow's Technology

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

And

Innovation, Science, and Economic Development Canada
Certification Per
IC RSS-Gen General Requirements for Radio Apparatus
And
RSS-247Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and License-Exempt Local Area Network (LE-LAN) Devices

For the

BoxLock, Inc.

Model Number: BOXLOCK001

FCC ID: 2APA3-BOXLOCK001
IC: 23723-BOXLOCK001

UST Project: 18-0042
Issue Date: May 10, 2018

Total Pages: 113

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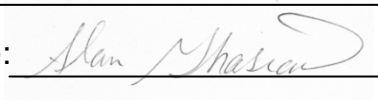
Testing Tomorrow's Technology

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: May 10, 2018

TESTING

NVLAP LAB CODE 200162-0

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: BoxLock, Inc.
MODEL: BOXLOCK001
FCC ID: 2APA3-BOXLOCK001
IC: 23723-BOXLOCK001
DATE: May 10, 2018

This report concerns (check one): Original grant [X]
Class II change

Equipment type: 2400 – 2483.5 MHz Transmitter Module

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until:_____N/A_____
date
agrees to notify the Commission by N/A
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

US Tech
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Phone Number: (770) 740-0717
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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 public distribution according to IC RSS-247 and 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 April 16, 2018 in good operating condition.

1.3 Product Description

The Equipment under Test (EUT) is the BoxLock, Inc. Model BOXLOCK001. The EUT is a lock with wireless application and operates on demand when a barcode is scanned. When a valid barcode is read, a secure channel is used to authenticate the barcode and authorize the lock to open.

The EUT is capable of both Wi-Fi and Bluetooth operation; however under normal use, the radio is not designed to simultaneously broadcast both Wi-Fi and Bluetooth; it will broadcast only one or the other.

This report documents the Wi-Fi radio testing results; a separate report has been prepared to document the Bluetooth Radio testing results

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 v03r05 for Digital Transmission Systems Operating Under section 15.247.

Digital RF conducted and radiated emissions data 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 1.0 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 under designation number US5301. 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 of the transmitter incorporated within the EUT; see test data presented herein.

Table 1.EUT and Supporting Equipment

EUT	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID (pending)	CABLES P/D
BoxLock, Inc. Locking Mechanism	BOXLOCK001	Engineering Sample	FCC ID: 2APA3-BOXLOCK001 IC: 23723-BOXLOCK001	UD
PERIPHERAL Mfg.	**MODEL NUMBER**	**SERIAL NUMBER**	**FCC/IC ID**	**CABLES P/D**
Computer/ GateWay	LT21	LUWH20D006013 1CAD21601	FCC ID: HLZ-AR5B95 IC:1754F-AR5B95	N/A
AC/DC Adapter/ Delta Electronics	ADP-40TH A	AP040010020090 4F57P101	N/A	P
Interface/ Total Phase	TP240141	2238-490510	N/A	D
Battery/ Tenergy Li-ion	N/A	N/A	N/A	P

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

2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are included herein.

Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	6/22/2018
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	1937A02980	3/7/2019
PREAMP 1.0 GHz to 26.0 GHz	8449B	HEWLETT-PACKARD	3008A00480	12/1/2018
LOOP ANTENNA	6502	ETS Lindgren	9810-3246	1/22/2020 2 yr.
BICONICAL ANTENNA	3110B	EMCO	9307-1431	5/2/2019 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	5/1/2019 2 yr
HORN ANTENNA	3115	EMCO	9107-3723	9/22/2018 2 yr
HIGH PASS FILTER	H3R020G2	Microwave Circuits Inc.	001DC9528	3/7/2019
8 dB ATTENUATOR	VAT-8 15542	MINI-CIRCUITS	30519	3/7/2019
20 dB ATTENUATOR	47-20	PASTERNACK	N/A	3/7/2019

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 or IC RSS-210 requirements.

2.3 Number of Measurements for Intentional Radiators (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 2.4 GHz to 2.4835 GHz, 3 test frequencies will be used.

2.4 Frequency Range of Radiated Measurements (Part 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 15.33, 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 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.

2.6 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. Only the antenna(s) listed in Table 4 will be used with this module.

Table 4. Allowed Antenna(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB_i	TYPE OF CONNECTOR
Antenna	N/A	F-type	ATWINC1500	-6.16	soldered

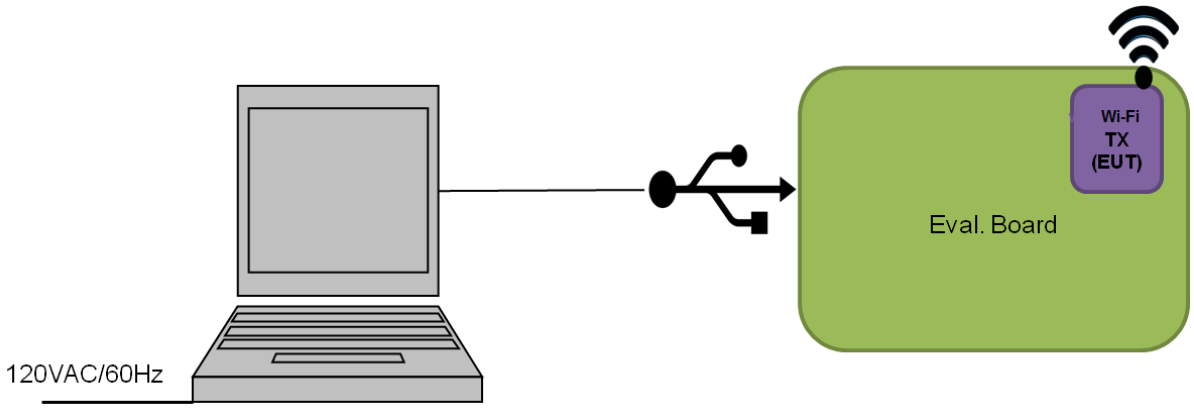


Figure 1.Block Diagram of Test Configuration

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 spurious cannot exceed the limits of 15.209. Radiated harmonics and other Spurious are examined for this requirement see paragraph 2.10.

2.8 Transmitter Duty Cycle (Part15.35 (c))

The EUT employs pulse transmission however for testing purpose the EUT was programmed to transmit at its maximum duty cycle rate.

The Duty Cycle correction factor is based on this.

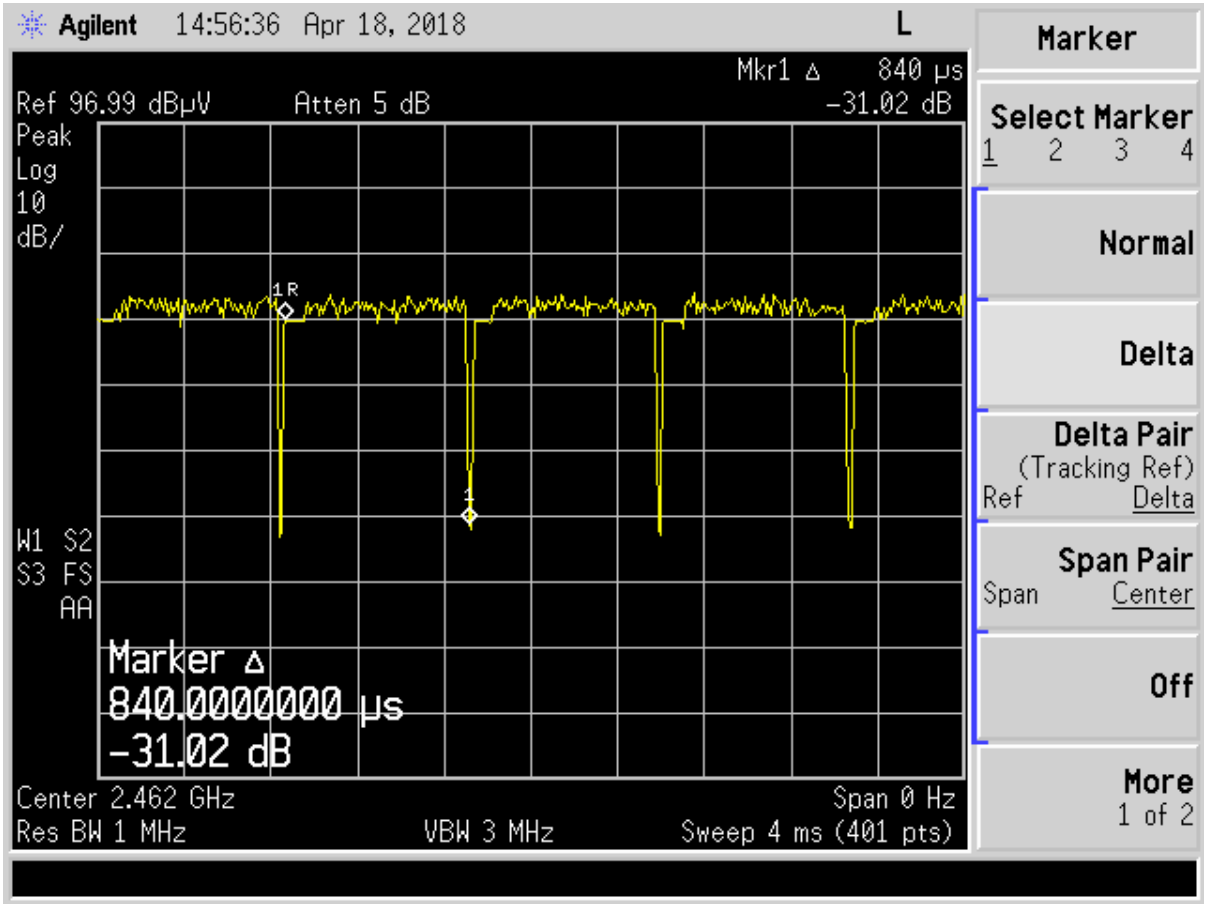


Figure 2. Pulse Width (B mode)

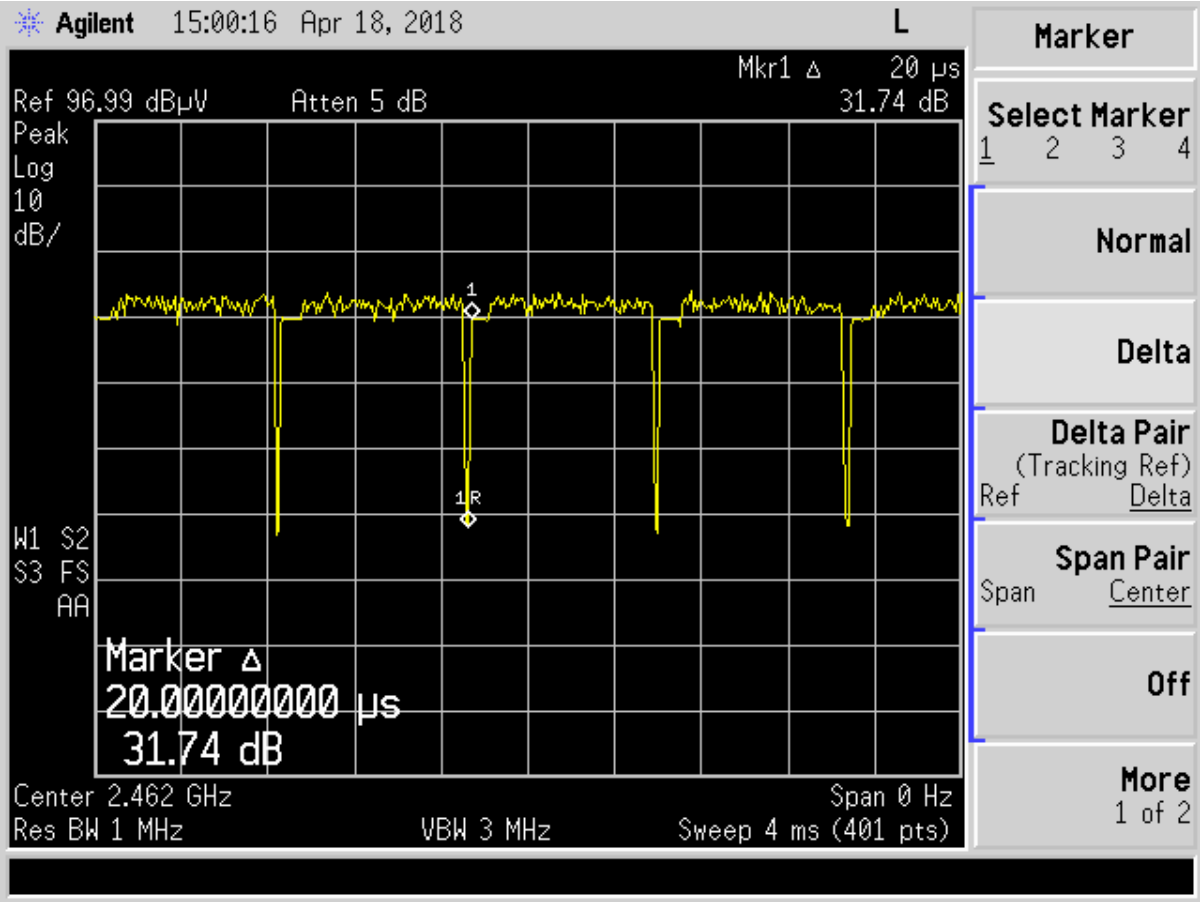


Figure 3. TX Off time (B mode)

The Duty Cycle is 20log(PW/{PW+TXofftime) = 20log(840us/[840+20]us)= 20log(840us/860us) = 20log(.977) = -0.204 dB

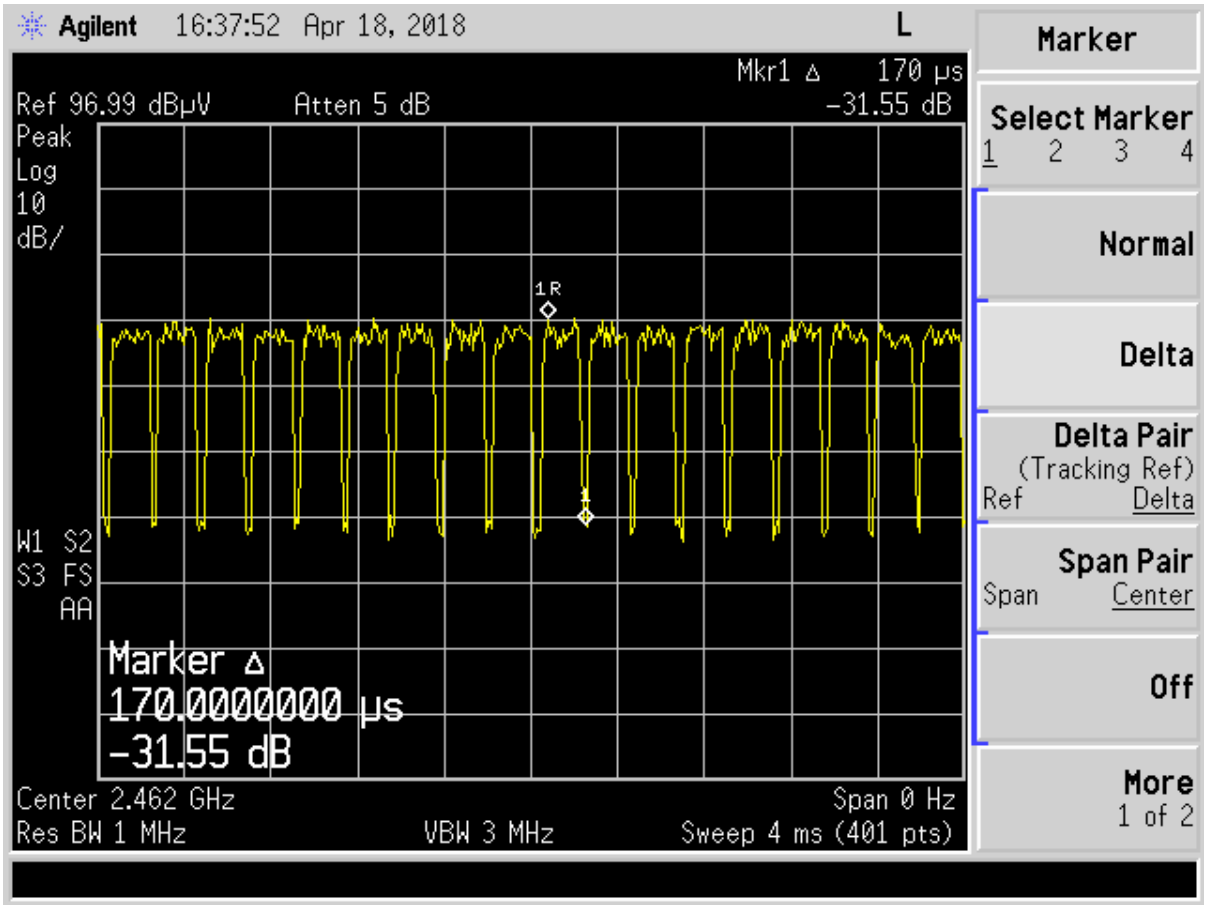


Figure 4. Pulse Width (G mode)

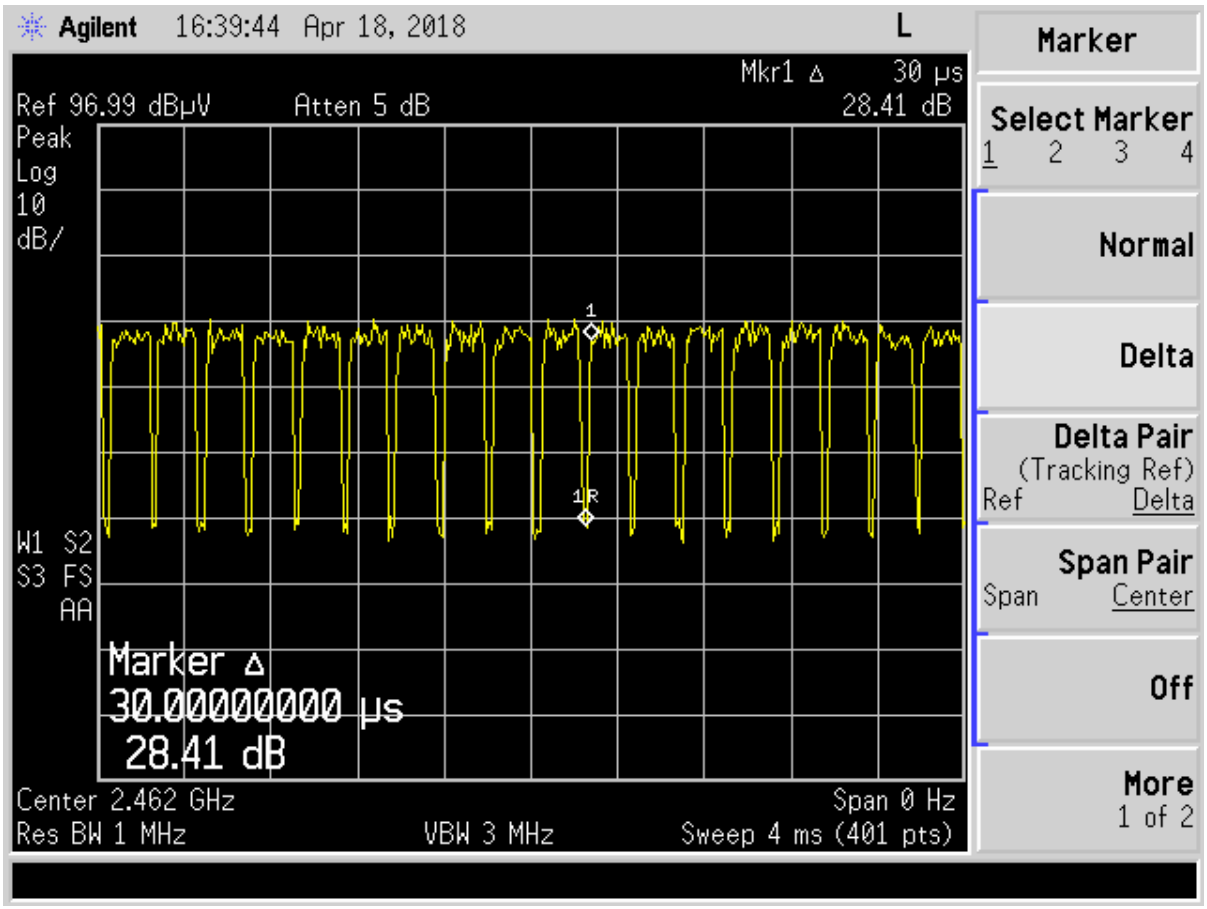


Figure 5. TX Off time (G mode)

The Duty Cycle is 20log(PW/{PW + TX off-time) = 20log(170us/[170+30]us)= 20log(170us/200us) = 20log(.85) = -1.412 dB

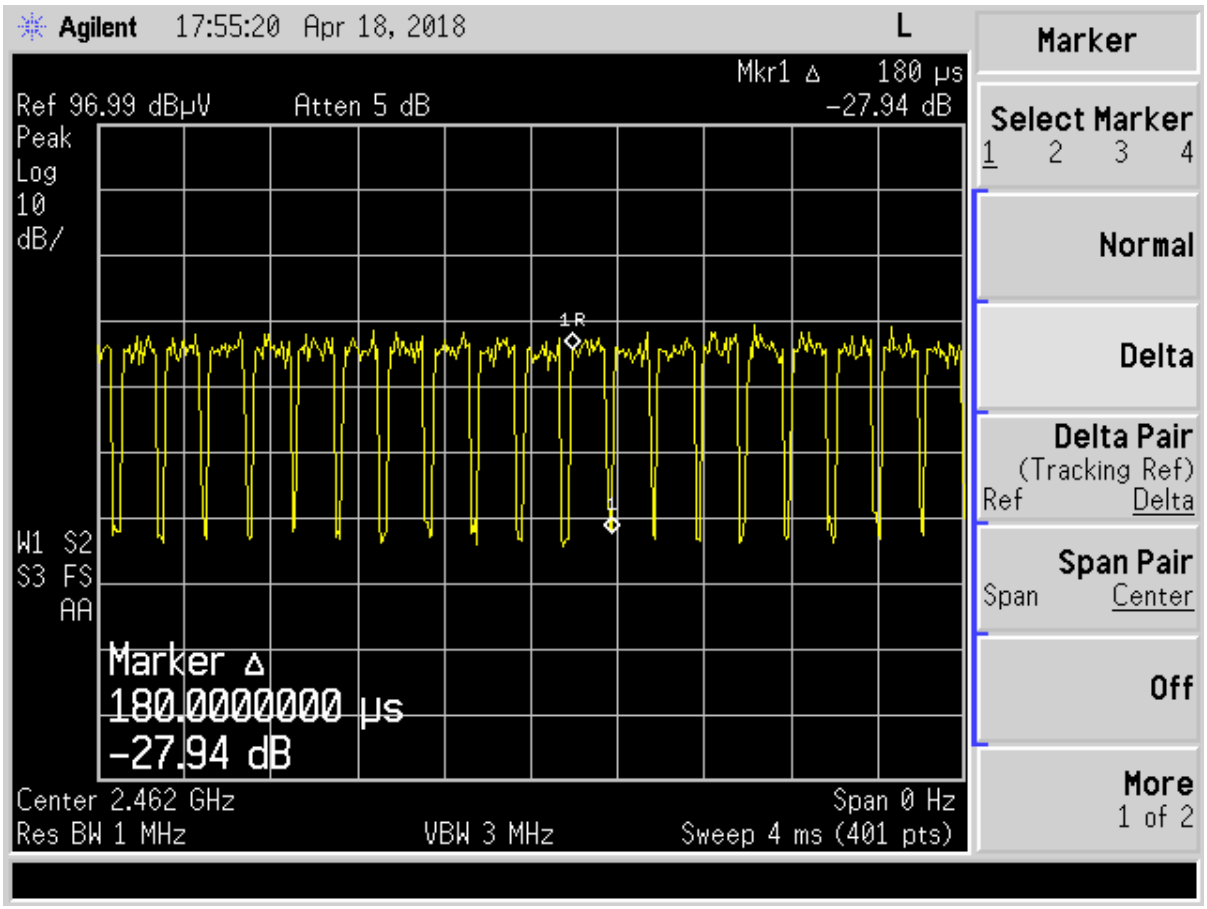


Figure 6. Pulse Width (N mode)

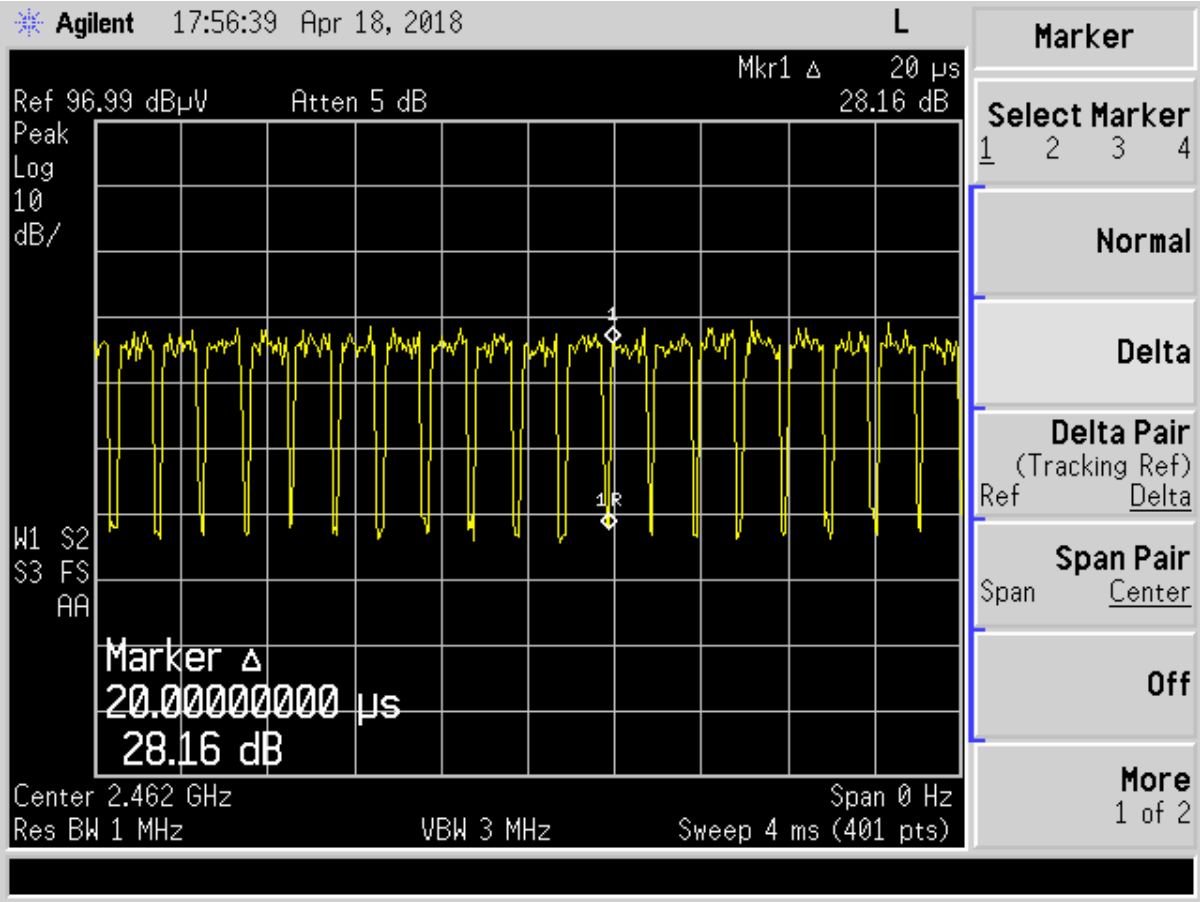


Figure 7. TX Off time (N mode)

The Duty Cycle is 20log(PW/{PW+TX off time) = 20log(180us/[180+20]us)= 20log(180us/200us) = 20log(.90) = -0.046 dB

Note: The transmitter was programmed to transmit at maximum during all testing. Therefore where applicable (when using AVG detection) the duty cycle factor calculated above was applied.

2.9 Antenna Conducted Intentional and Spurious Emissions(CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a), RSS-Gen 8.9)

The EUT was put into a continuous-transmit mode of operation and tested per ANSI C63.10-2013 for conducted out of band emissions emanating from the antenna port over the frequency range of 30 MHz to ten times the highest clock frequency generate 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 on the OATS. The conducted emissions graphs are found in Figures 3through 8below.The limit for antenna conducted power is 1 Watt (30 dBm) per 15.247 (b)(3).

For Conducted RF antenna tests, the RBW was set to 100 kHz, 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.

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 ≥ RBW. The results of peak radiated spurious emissions falling within restricted bands are given inTable 6below.

For Average measurements above 1 GHz, the emissions were measured using RBW = 1 MHz and VBW = 10 Hz or the duty cycle correction factor was applied to the Peak recorded value.

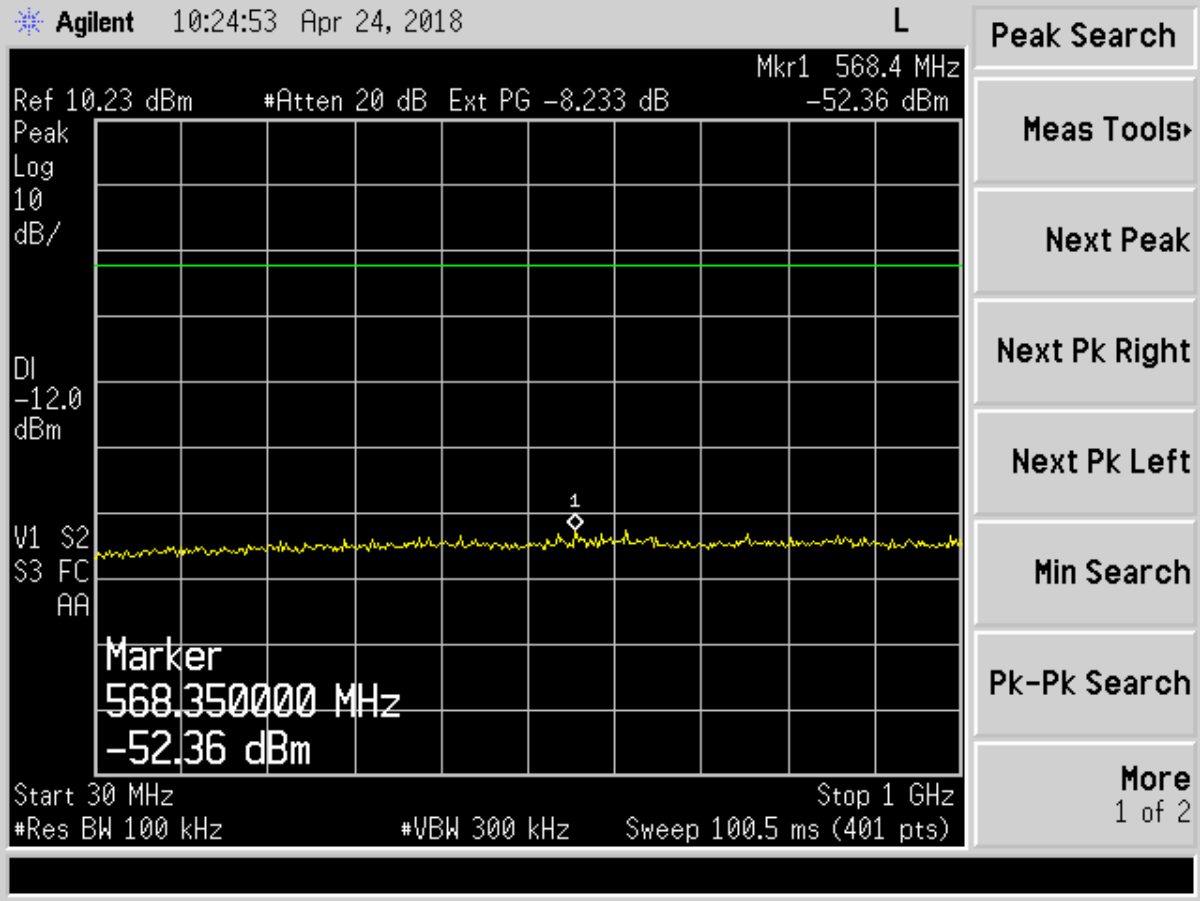


Figure 8. Antenna Conducted Spurious Emissions – B mode Low Channel, 30-1000 MHz

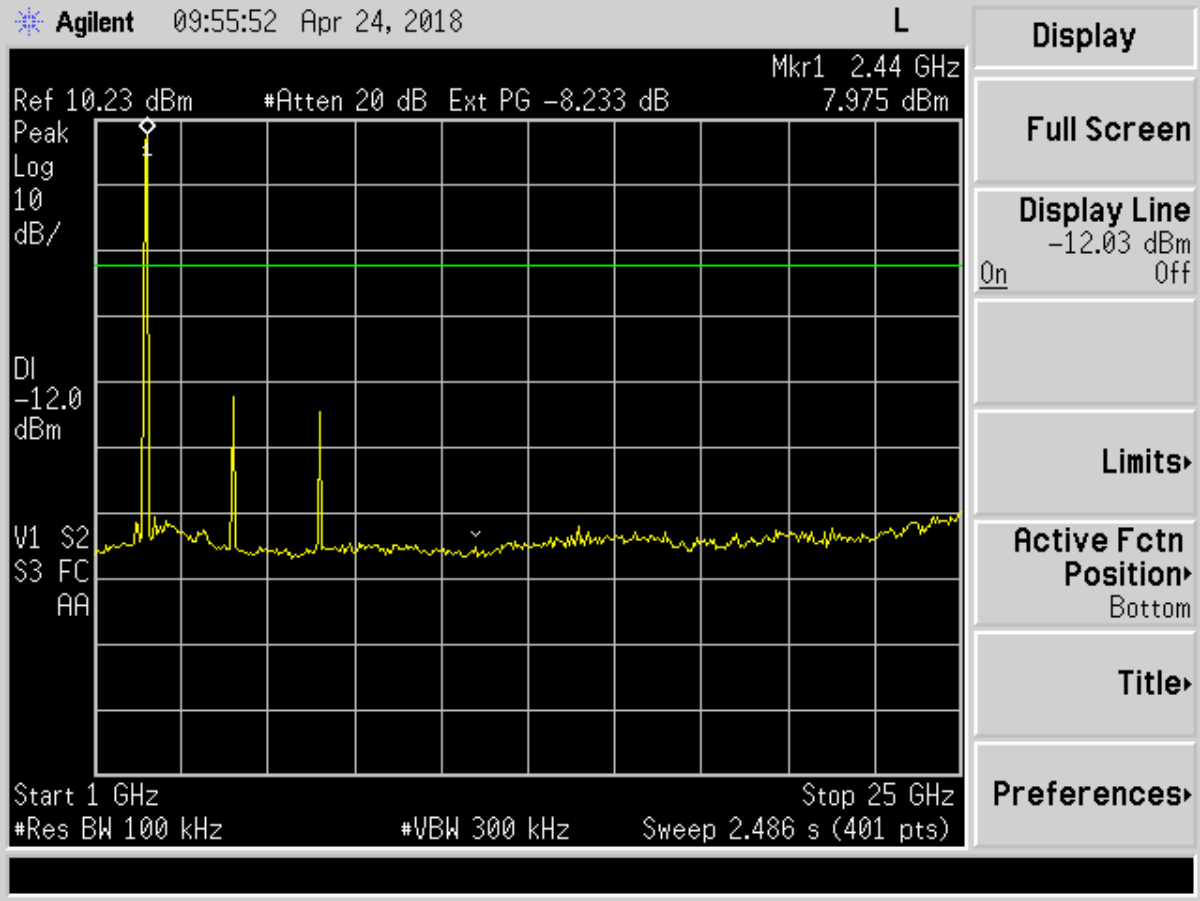


Figure 9. Antenna Conducted Spurious Emissions – B mode Low Channel, 1000-25000 MHz

Note: Large Signal shown is Fundamental Frequency
Note: Green line is limit line.

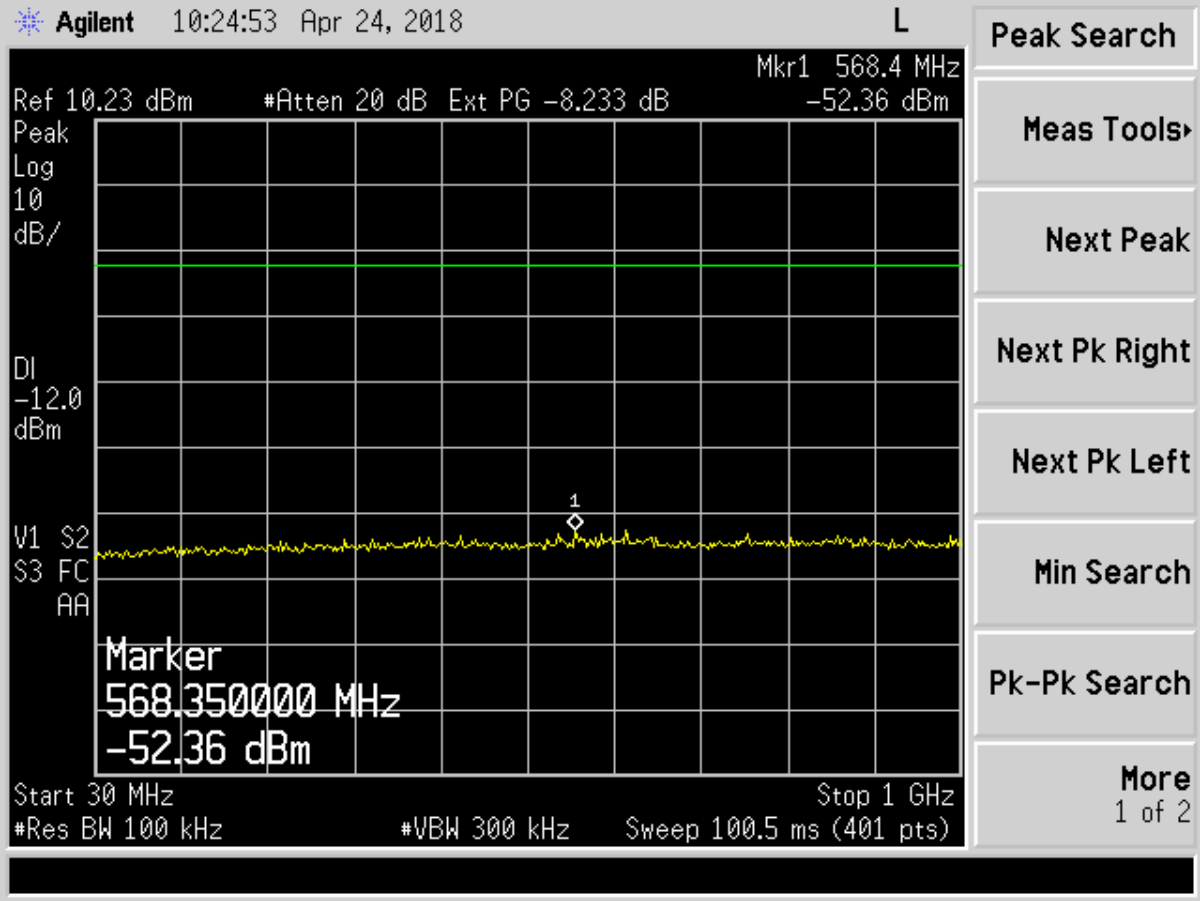


Figure 10. Antenna Conducted Spurious Emissions – B mode Mid Channel, 30-1000 MHz

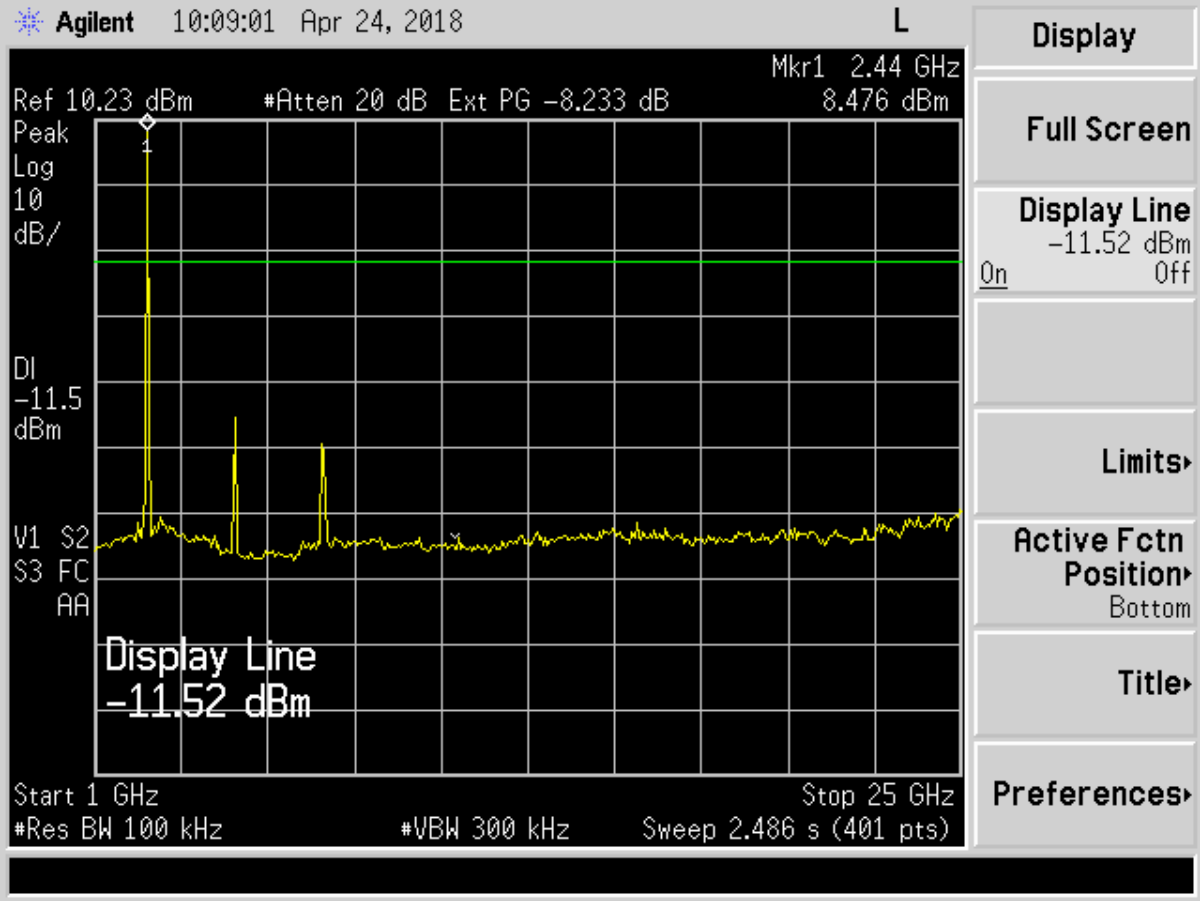


Figure 11. Antenna Conducted Spurious Emissions – B mode Mid Channel, 1000-25000 MHz

Note: Large Signal shown is Fundamental Frequency
Note: Green line is limit line.

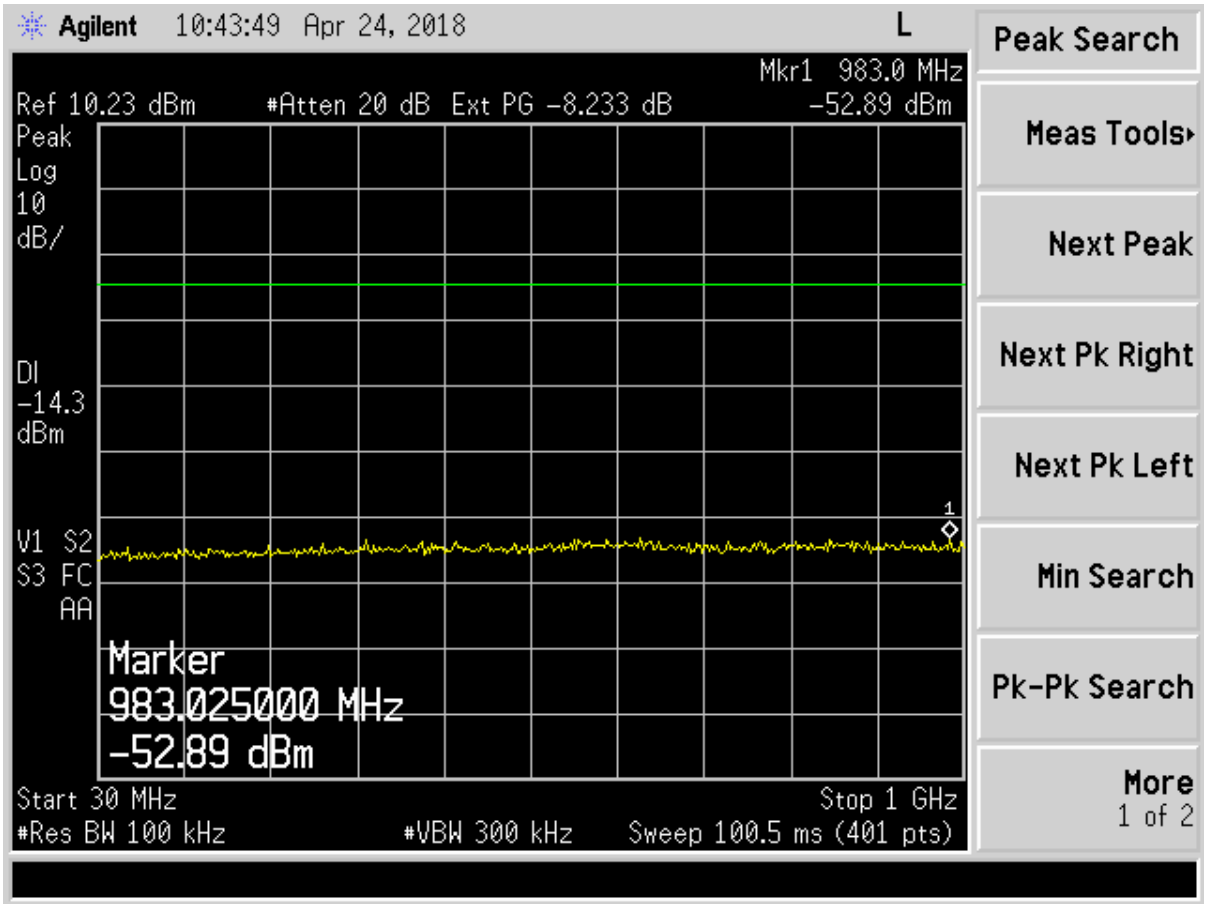


Figure 12. Antenna Conducted Spurious Emissions – B mode High Channel, 30-1000 MHz

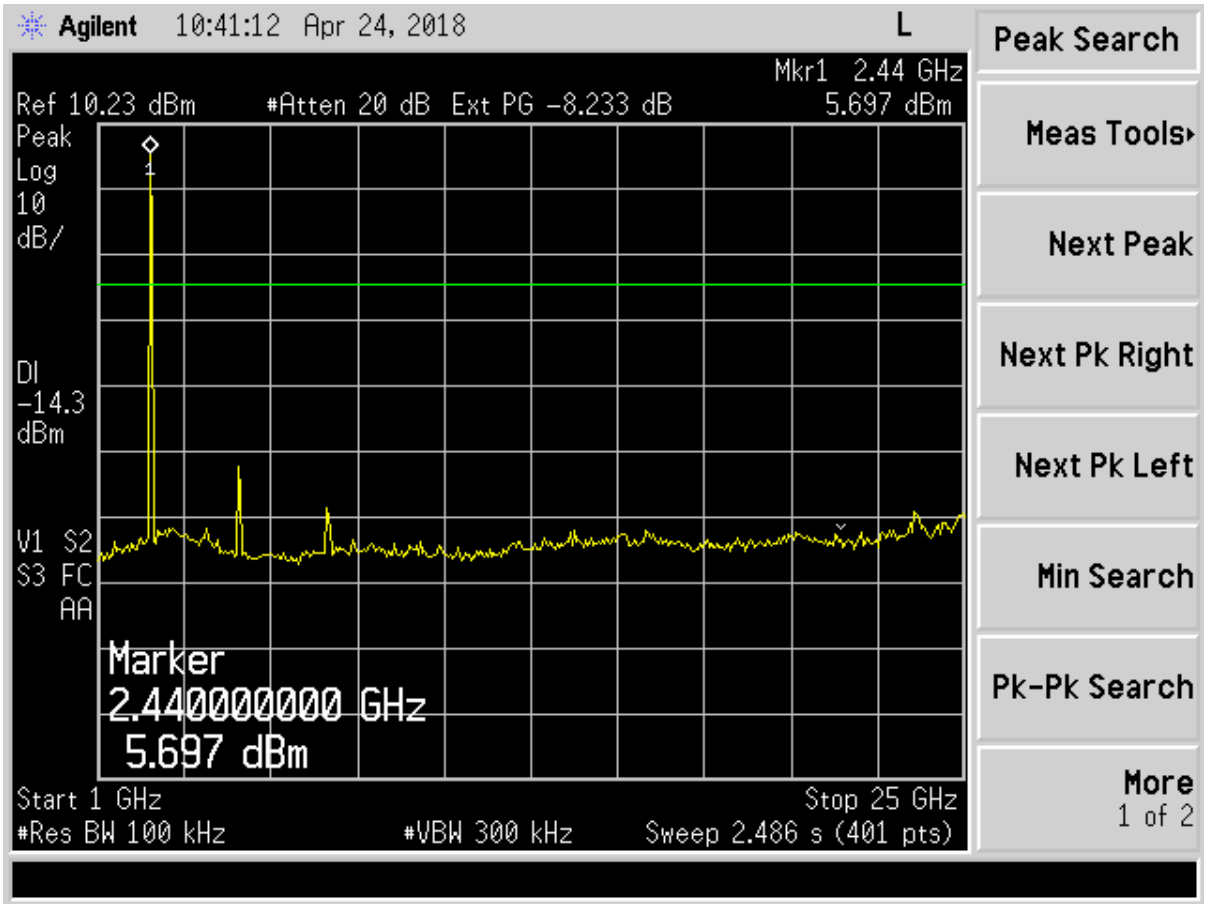


Figure 13. Antenna Conducted Spurious Emissions – B mode High Channel 1000-25000 MHz

Note: Large Signal shown is Fundamental Frequency
Note: Green line is limit line.

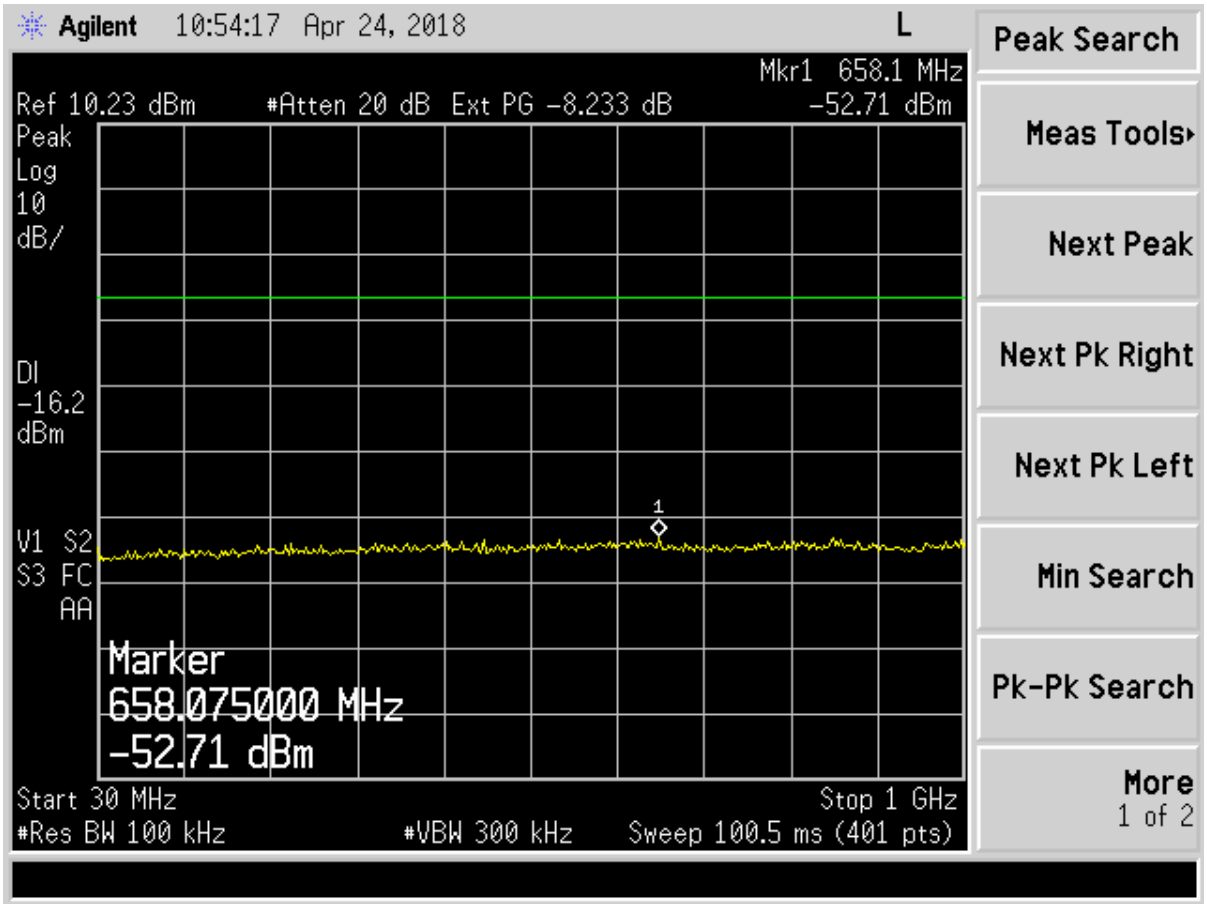


Figure 14. Antenna Conducted Spurious Emissions – G mode Low Channel, 30-1000 MHz

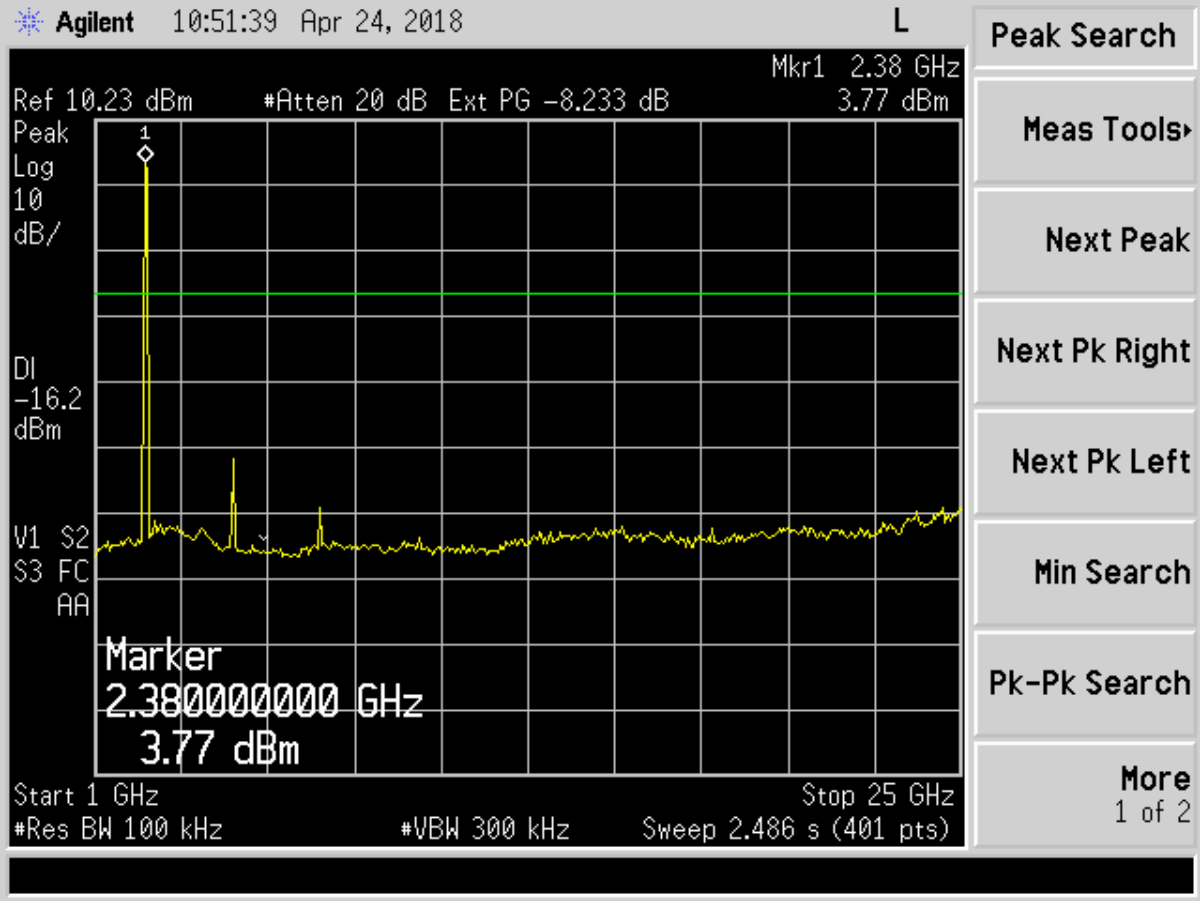


Figure 15. Antenna Conducted Spurious Emissions – G mode Low Channel 1000-25000 MHz

Note: Large Signal shown is Fundamental Frequency
Note: Green line is limit line.

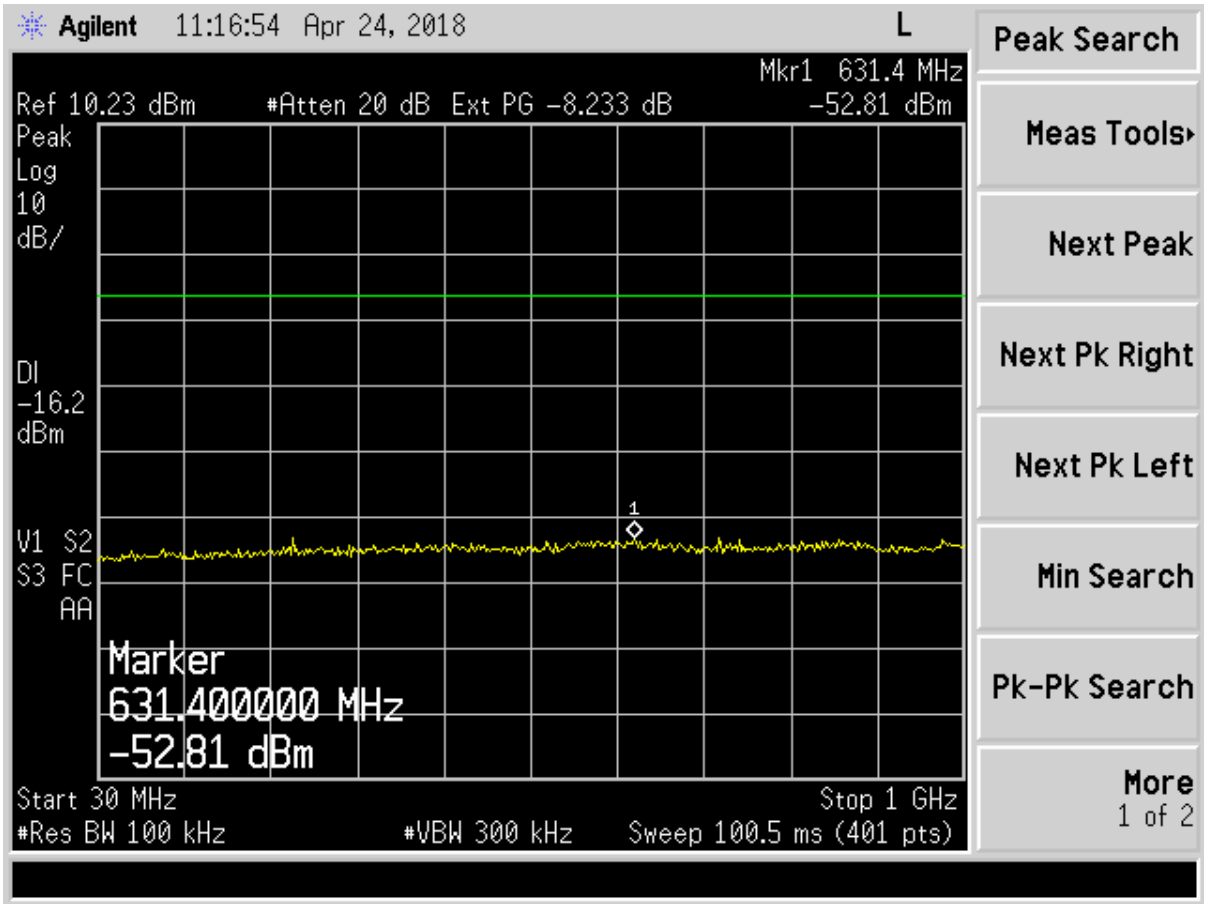


Figure 16. Antenna Conducted Spurious Emissions – G mode Mid Channel, 30-1000 MHz

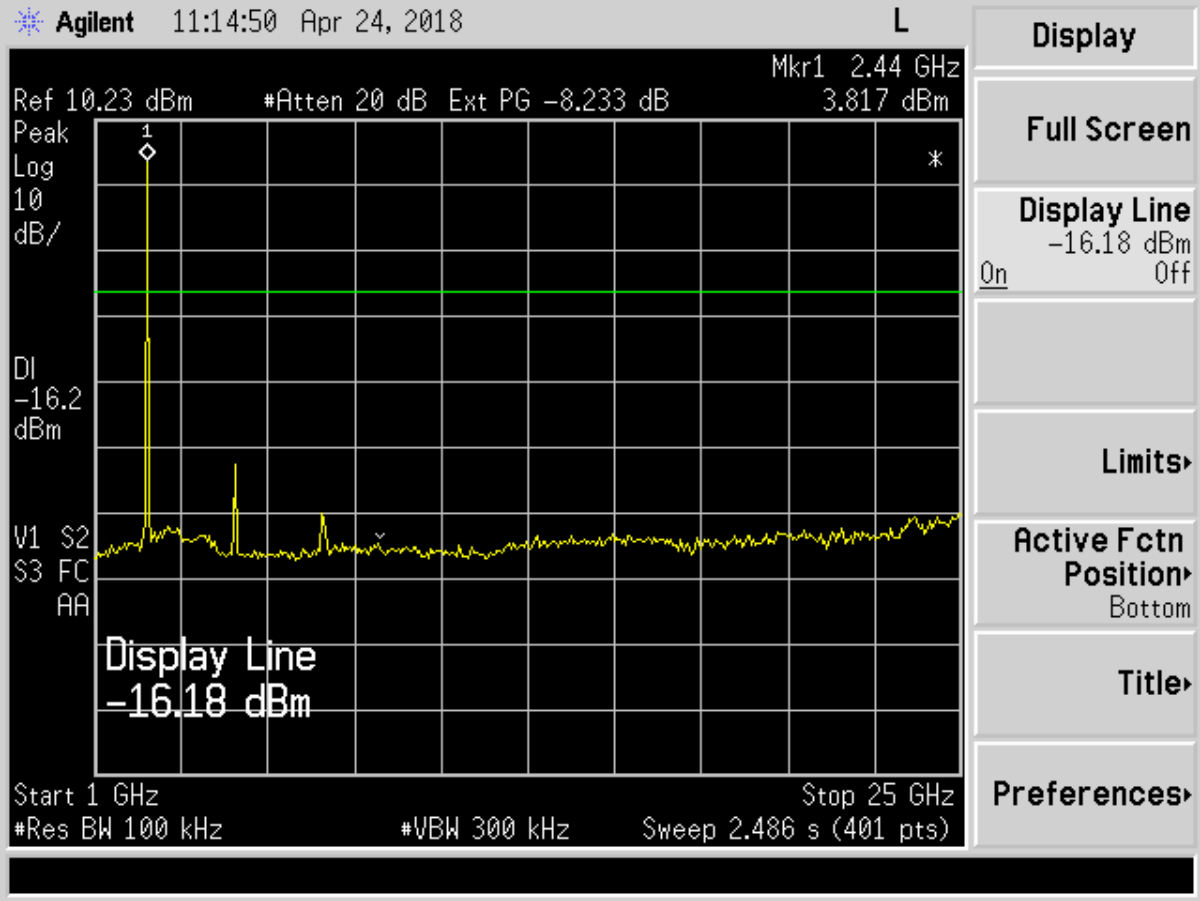


Figure 17. Antenna Conducted Spurious Emissions – G mode Mid Channel 1000-25000 MHz

Note: Large Signal shown is Fundamental Frequency
Note: Green line is limit line.

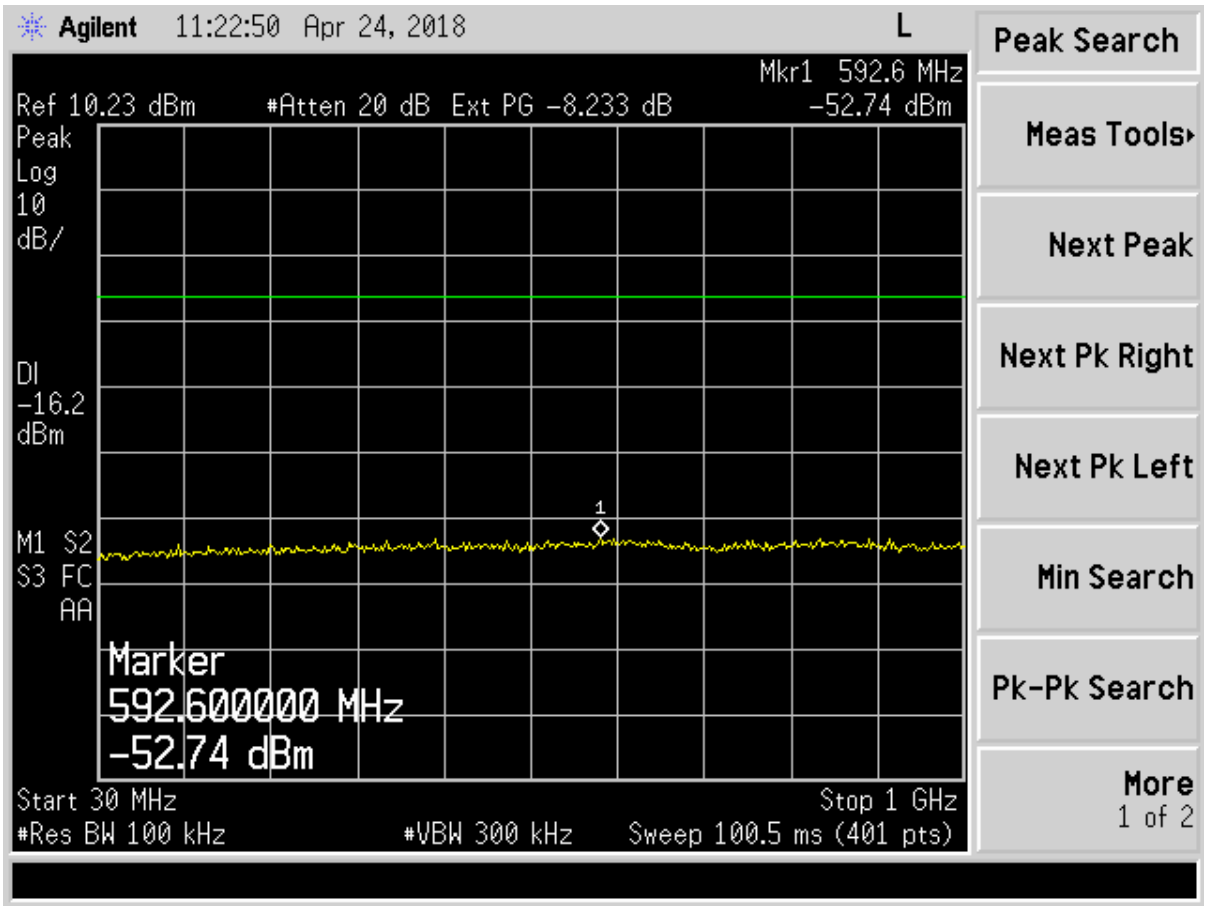


Figure 18. Antenna Conducted Spurious Emissions – G mode High Channel, 30-1000 MHz

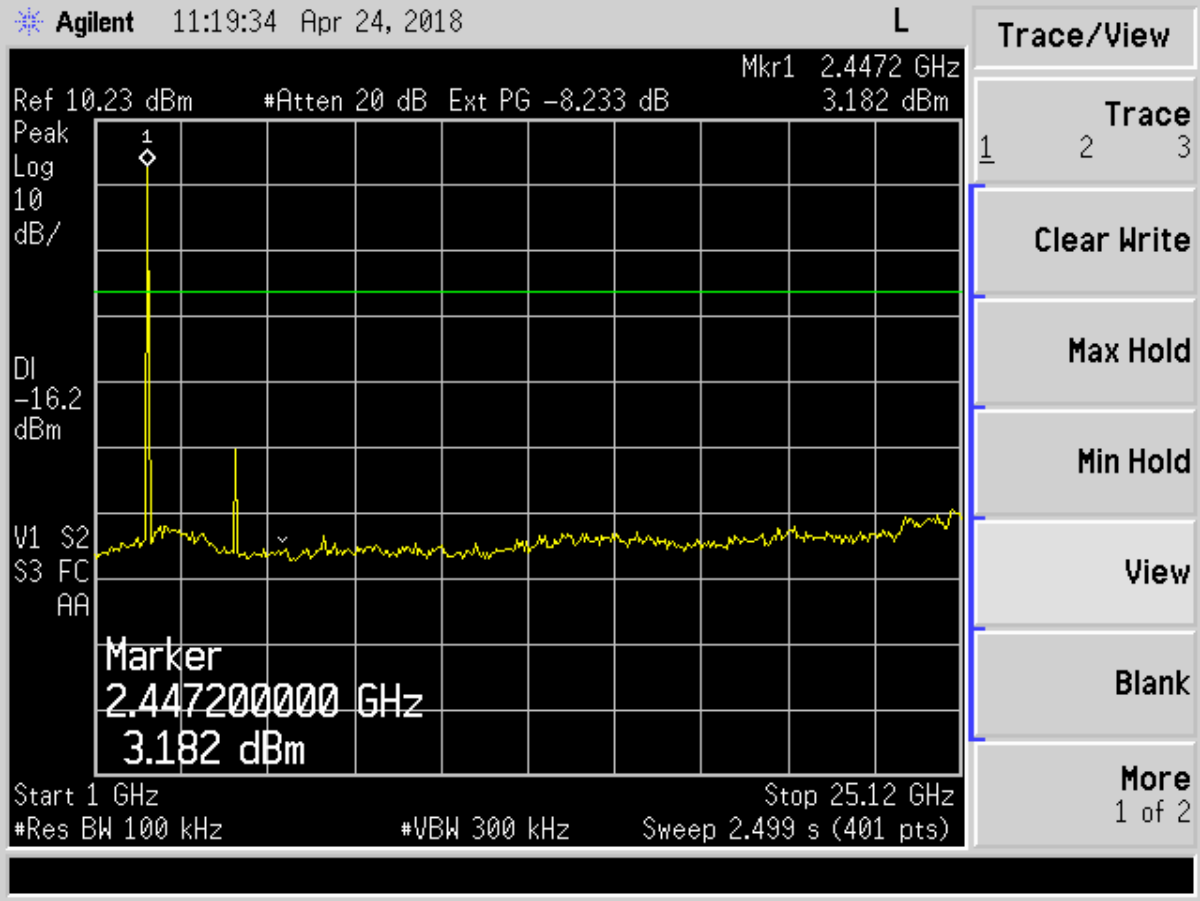


Figure 19. Antenna Conducted Spurious Emissions – G mode High Channel 1000-25000 MHz

Note: Large Signal shown is Fundamental Frequency
Note: Green line is limit line.

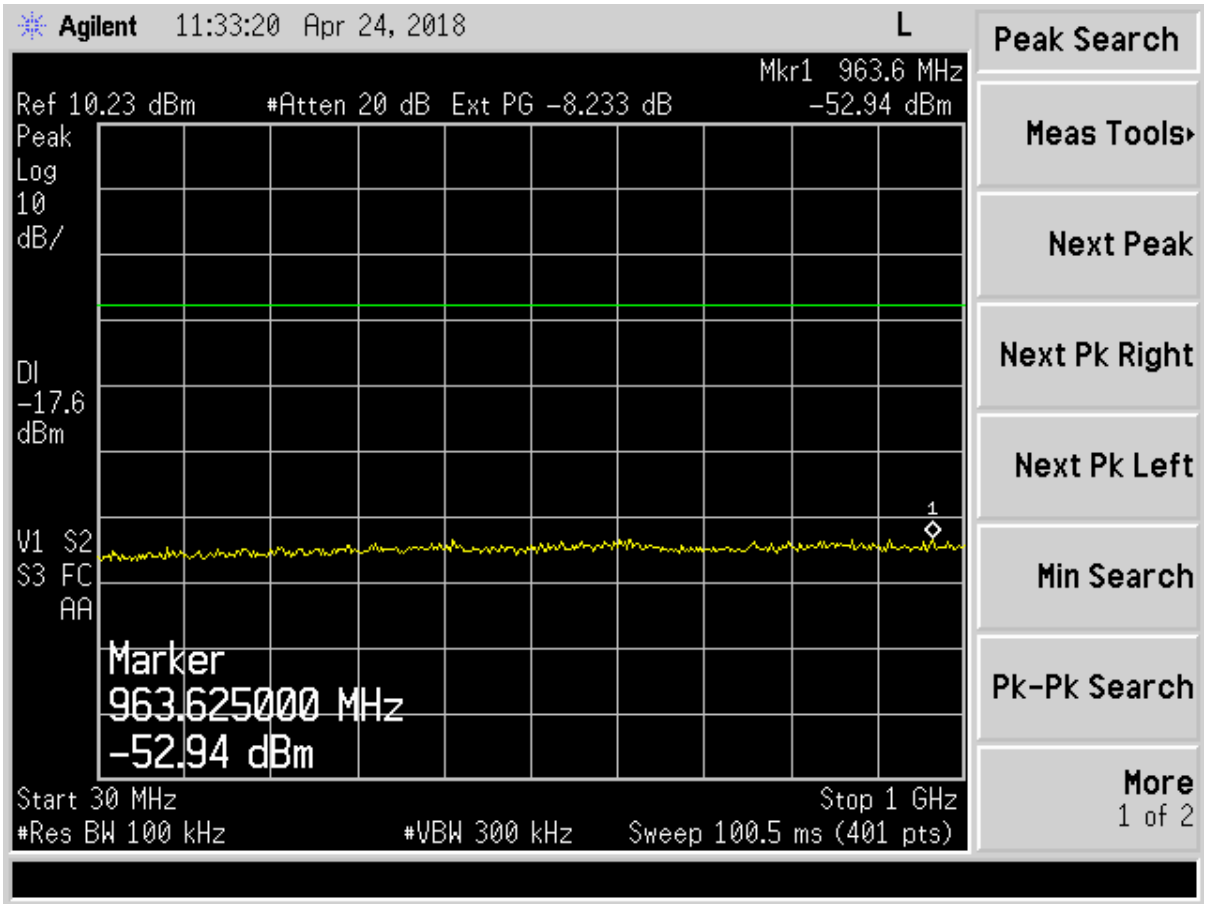


Figure 20. Antenna Conducted Spurious Emissions – N mode Low Channel, 30-1000 MHz

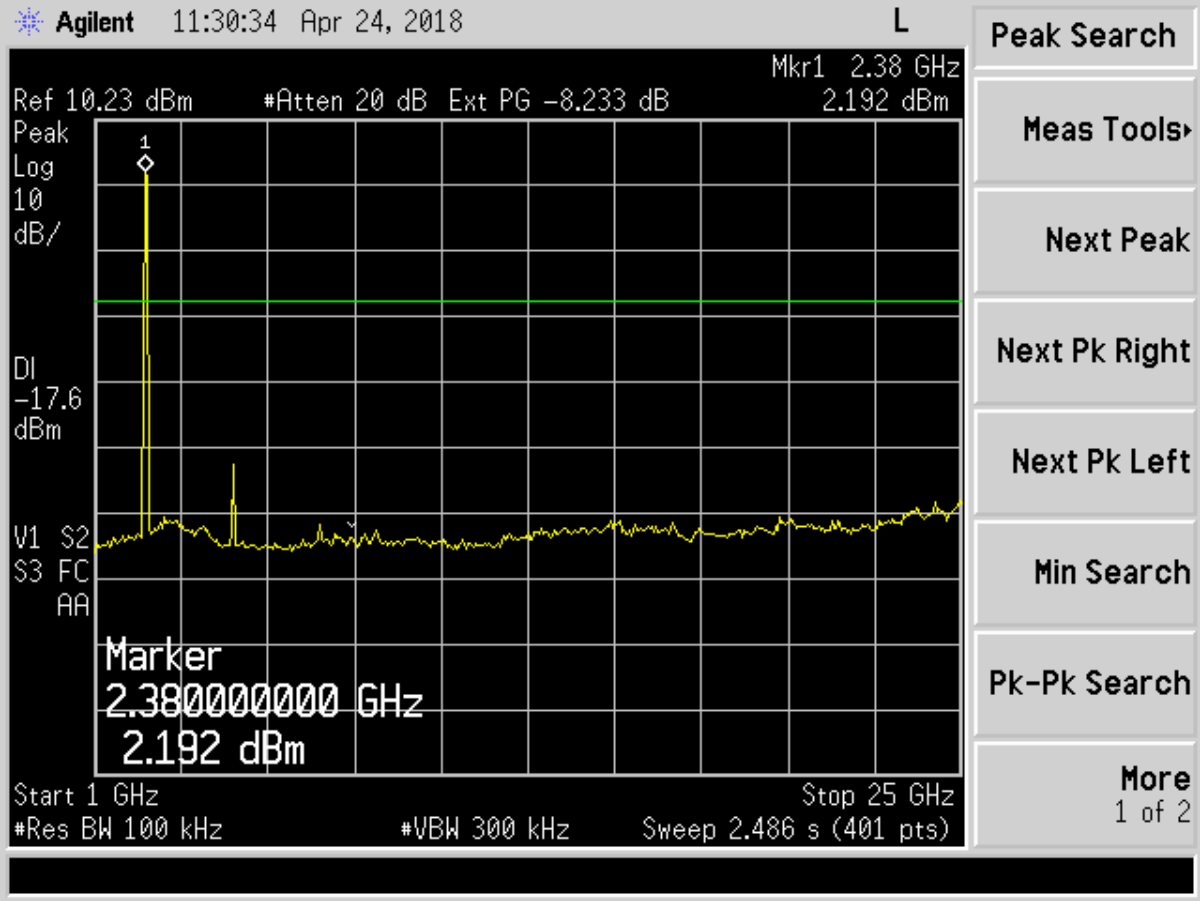


Figure 21. Antenna Conducted Spurious Emissions – N mode Low Channel 1000-25000 MHz

Note: Large Signal shown is Fundamental Frequency
Note: Green line is limit line.

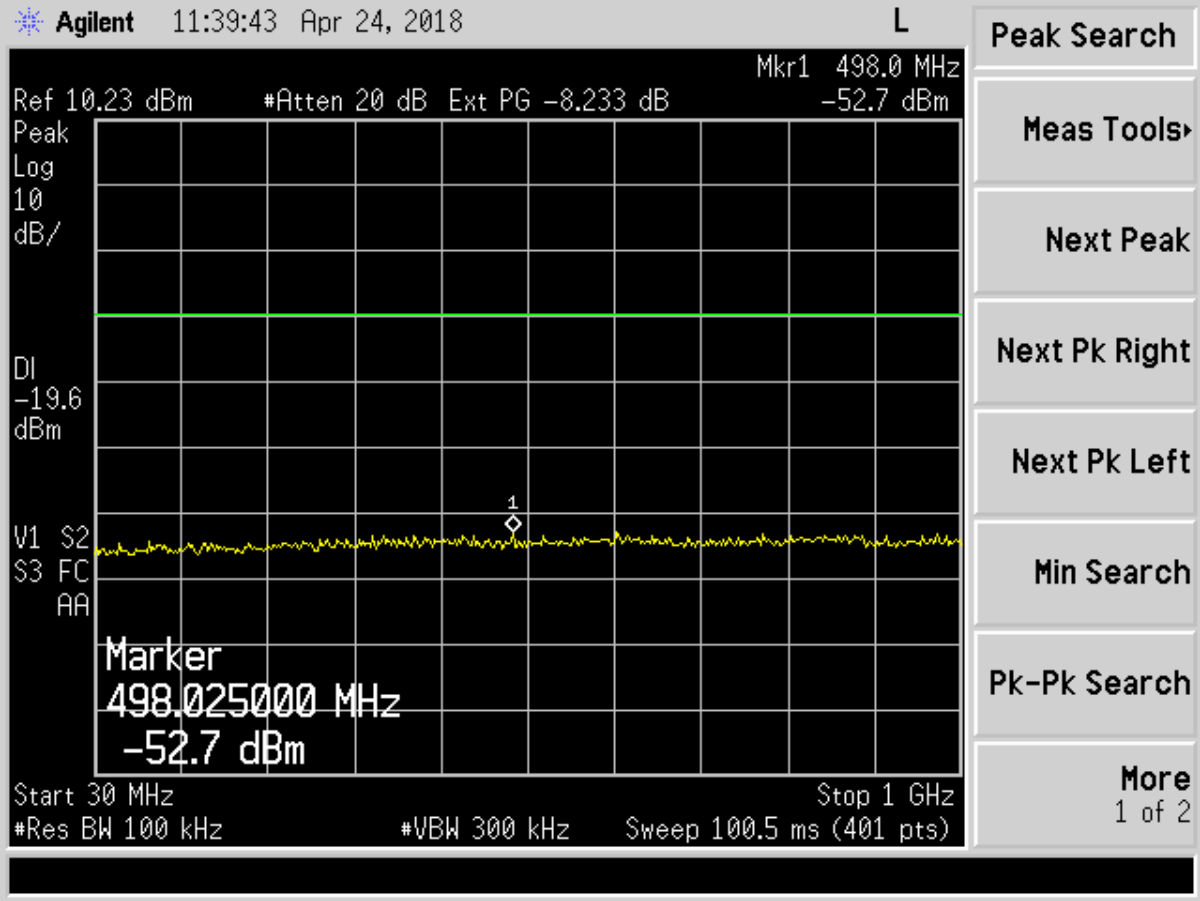


Figure 22. Antenna Conducted Spurious Emissions – N mode Mid Channel, 30-1000 MHz

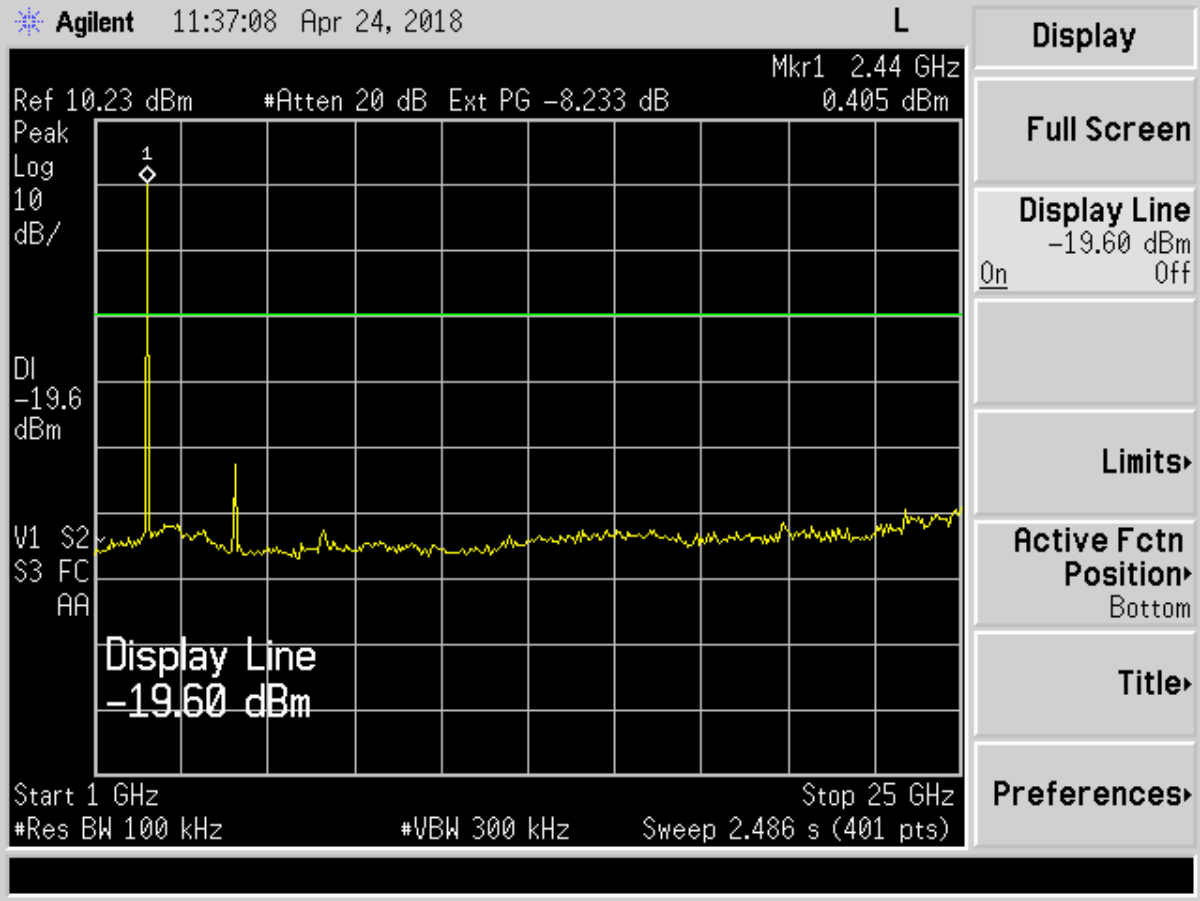


Figure 23. Antenna Conducted Spurious Emissions – N mode Mid Channel 1000-25000 MHz

Note: Large Signal shown is Fundamental Frequency
Note: Green line is limit line

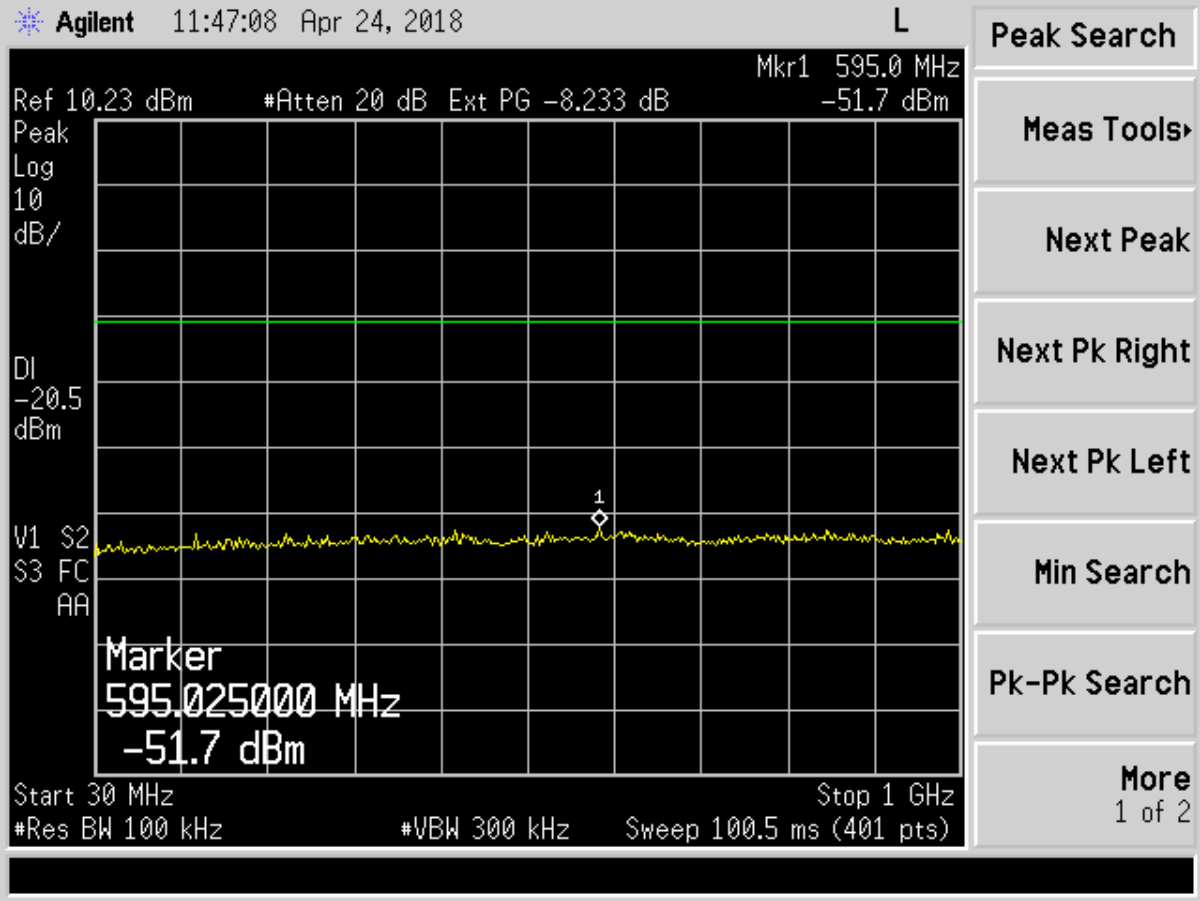


Figure 24. Antenna Conducted Spurious Emissions – N mode High Channel, 30-1000 MHz

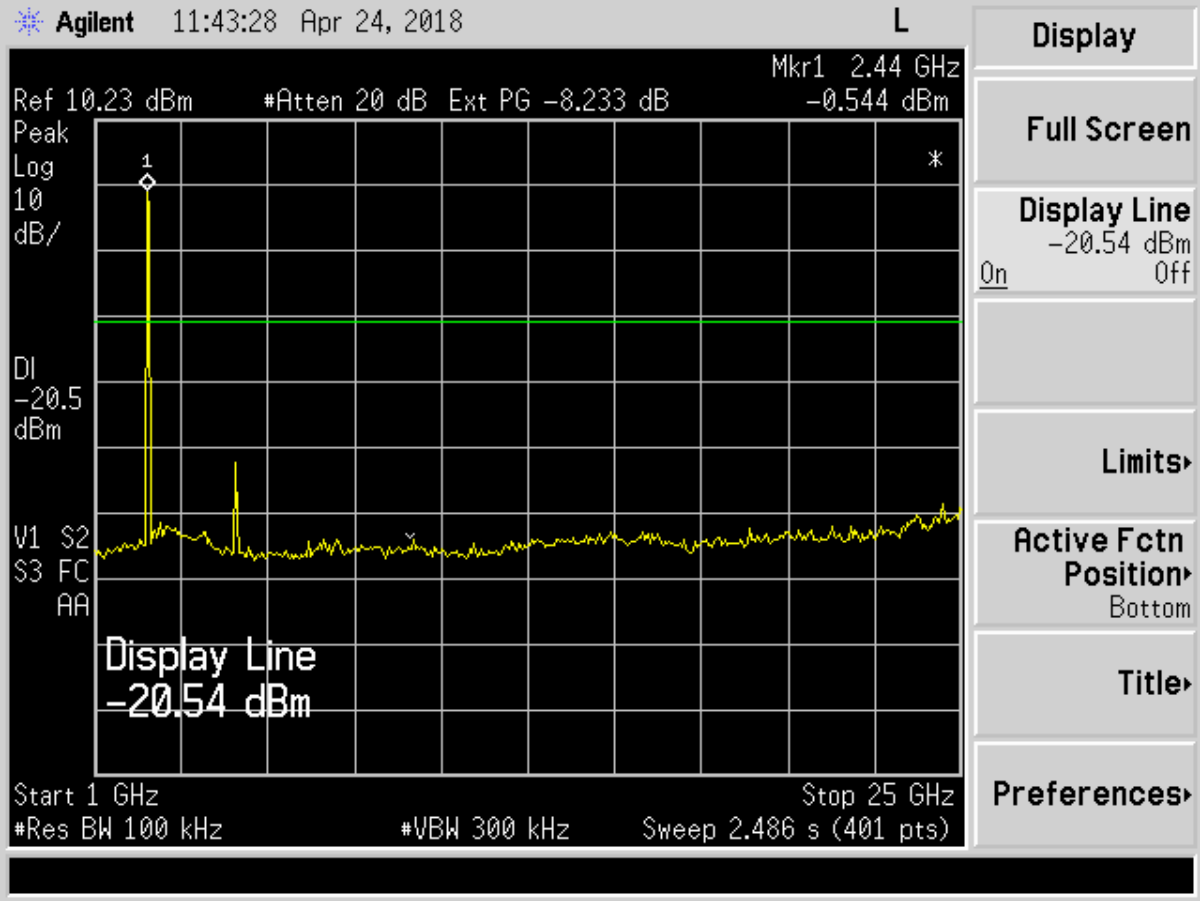


Figure 25. Antenna Conducted Spurious Emissions – N mode High Channel 1000-25000 MHz

Note: Large Signal shown is Fundamental Frequency
Note: Green line is limit line.

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

Radiated Spurious measurements: The EUT was placed into a continuous transmit mode of operation (maximum duty cycle) and tested per ANSI C63.10-2013. The EUT was tested in 3 orthogonal positions because the device is considered portable.

Radiated measurements were conducted between the frequency range of 9 kHz (or lowest frequency used/generated by the device) up to the tenth harmonic of the device (not greater than 40 GHz). In the band below 125 kHz, a resolution bandwidth (RBW) of 200 Hz was used. In the band from 125 kHz to 30 MHz, a RBW of 9 kHz was used; emissions below 1 GHz were tested with a RBW of 100/120 kHz and emissions above 1 GHz were tested with a RBW of 1 MHz. All video bandwidth settings were at least three times the RBW value.

The EUT was investigated per CFR 15.209, General requirements for unwanted spurious emissions. The conducted spurious method as described below was used to investigate all other emissions emanating from the antenna port.

Conducted Spurious measurements: The EUT was put into a continuous-transmit mode of operation (maximum duty cycle) and tested per ANSI C63.10-2013 for conducted out of band emissions emanating from the antenna port over the frequency range of 30 MHz or lowest operating clock frequency to ten times the highest operating clock frequency. A conducted scan was performed on the EUT to identify and record the spurious signals that were related to the transmitter.

Table 5. B mode - Peak Radiated Fundamental & Harmonic Emissions (Single-Band Antenna)

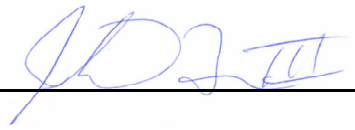
Tested By: JF	Test: FCC Part 15,247(d)		Client: BoxLock, Inc.					
	Project: 18-0042		Model :BOXLOCK001					
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detector**
	Low Channel - PEAK							
2412.00	74.18	-	35.00	109.18		3.0m./VERT		**PK**
*4824.00	45.21	-	9.32	54.53	74.0	3.0m./VERT	19.5	**PK**
7236.00	45.22	-	16.93	62.15	74.0	3.0m./VERT	11.9	**PK**
	Mid Channel – PEAK							
2442.00	72.92	-	34.95	107.87		3.0m./VERT		**PK**
*4884.00	45.82	-	9.32	55.14	74.0	3.0m./VERT	18.9	**PK**
*7326.00	45.67	-	18.29	63.96	74.0	3.0m./VERT	10.0	**PK**
	High Channel – PEAK							
2462.00	71.61	-	34.95	106.56	125.3	3.0m./VERT		**PK**
*4924.00	45.73	-	10.99	56.72	74.0	3.0m./VERT	17.3	**PK**
*7386.00	44.19	-	18.38	62.57	74.0	3.0m./VERT	11.4	**PK**

1.(*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209& 15.247.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic

Sample Calculation at 2412.00 MHz:

Magnitude of Measured Frequency	74.18	dBuV
+Additional Factor	0	dB
+Antenna Factor + Cable Loss+ Amplifier Gain	35.00	dB/m
Corrected Result	109.18	dBuV/m

Test Date: April 18, 2018

Tested By
Signature: 

Name: John Freeman

Table 6. B mode- Average Radiated Fundamental & Harmonic Emissions (Single-Band Antenna)

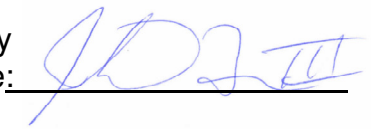
Tested By: JF	Test: FCC Part 15.247(d)				Client: BoxLock, Inc.			
	Project: 18-0042				Model: BOXLOCK001			
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detector**
	Low Channel - Average							
2412.00	63.44	-	35.00	98.44	-	3.0m./VERT	-	**AVG**
*4824.00	45.21	-	9.32	39.90	54.0	3.0m./VERT	14.1	**AVG**
7236.00	45.22	-	16.93	47.51	54.0	3.0m./VERT	6.5	**AVG**
	Mid Channel–Average							
2442.00	62.74	-	34.95	97.69	-	3.0m./VERT	-	**AVG**
*4884.00	31.42	-	9.32	40.74	54.0	3.0m./VERT	13.3	**AVG**
*7326.00	30.82	-	18.29	49.11	54.0	3.0m./VERT	4.9	**AVG**
	High Channel–Average							
2462.00	60.93	-	34.95	95.88	-	3.0m./VERT	-	**AVG**
*4924.00	30.99	-	10.99	41.98	54.0	3.0m./VERT	12.0	**AVG**
*7386.00	30.17	-	18.38	48.55	54.0	3.0m./VERT	5.4	**AVG**

1.(*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. Duty cycle applied where applicable.

Sample Calculation at 2412.00MHz:

Magnitude of Measured Frequency	63.44	dBuV
+Additional Factor (filter + duty cycle)	0	dB
+Antenna Factor + Cable Loss+ Amplifier Gain – Duty Cycle	35.00	dB/m
Corrected Result	98.44	dBuV/m

Test Date: April 18, 2018

Tested By
Signature: 

Name: John Freeman

Table 7. G mode - Peak Radiated Fundamental & Harmonic Emissions (Single-Band Antenna)

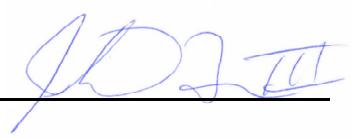
Tested By: JF	Test: FCC Part 15,247(d)		Client: BoxLock, Inc.					
	Project: 18-0042		Model:BOXLOCK001					
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detector**
	Low Channel - PEAK							
2412.00	71.12	-	35.00	106.12	-	3.0m./VERT	-	**PK**
*4824.00	46.00	-	9.32	55.32	74.0	3.0m./VERT	18.7	**PK**
7236.00	45.76	-	16.93	62.69	74.0	3.0m./VERT	11.3	**PK**
	Mid Channel – PEAK							
2442.00	71.75	-	34.95	106.70	-	3.0m./VERT	-	**PK**
*4884.00	45.97	-	9.32	55.29	74.0	3.0m./VERT	18.7	**PK**
*7326.00	44.86	-	18.29	63.15	74.0	3.0m./VERT	10.8	**PK**
	High Channel– PEAK							
2462.00	70.75	-	34.95	105.70	-	3.0m./VERT	-	**PK**
*4924.00	45.51	-	10.99	56.50	74.0	3.0m./VERT	17.5	**PK**
*7386.00	45.01	-	18.38	63.39	74.0	3.0m./VERT	10.6	**PK**

1.(*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209& 15.247.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic

Sample Calculation at 2412.00 MHz:

Magnitude of Measured Frequency	71.12	dBuV
+Additional Factor	0	dB
+Antenna Factor + Cable Loss+ Amplifier Gain	35.00	dB/m
Corrected Result	106.12	dBuV/m

Test Date: April 18, 2018

Tested By
Signature: 

Name: John Freeman

Table 8. G mode - Average Radiated Fundamental & Harmonic Emissions (Single-Band Antenna)

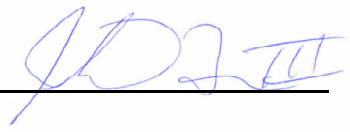
Tested By: JF	Test: FCC Part 15,247(d)			Client: BoxLock, Inc.				
	Project: 18-0042			Model:BOXLOCK001				
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detector**
	Low Channel–Average							
2412.00	52.25	-	35.00	87.25	-	3.0m./VERT	-	**AVG**
*4824.00	31.15	-	9.32	40.47	54.0	3.0m./VERT	13.5	**AVG**
7236.00	30.62	-	16.93	47.55	54.0	1.0m./VERT	6.5	**AVG**
	Mid Channel –Average							
2442.00	54.20	-	34.95	106.70	-	3.0m./VERT	-	**AVG**
*4884.00	30.46	-	9.32	39.78	54.0	3.0m./VERT	14.2	**AVG**
*7326.00	30.61	-	18.29	48.90	54.0	1.0m./HORZ	5.1	**AVG**
	High Channel–Average							
2462.00	52.83	-	34.95	87.78	-	3.0m./VERT	-	**AVG**
*4924.00	31.10	-	10.99	42.09	54.0	3.0m./VERT	11.9	**AVG**
*7386.00	30.30	-	18.38	48.68	54.0	1.0m./VERT	5.3	**AVG**

1.(*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. Duty cycle applied where applicable.

Sample Calculation at 2412.00 MHz:

Magnitude of Measured Frequency	52.25	dBuV
+Additional Factor	0	dB
+Antenna Factor + Cable Loss+ Amplifier Gain	35.00	dB/m
Corrected Result	87.25	dBuV/m

Test Date: April 18, 2018

Tested By
Signature: 

Name: John Freeman

Table 9. N mode – Peak Radiated Fundamental & Harmonic Emissions (Single-Band Antenna)

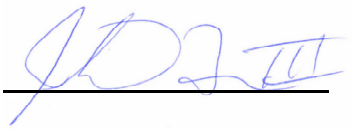
Tested By: JF	Test: FCC Part 15,247(d)			Client: BoxLock, Inc.				
	Project: 18-0042			Model: BOXLOCK001				
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detector**
	Low Channel - PEAK							
2412.00	69.71	-	35.00	104.71		3.0m./VERT		**PK**
*4824.00	45.60	-	9.32	54.92	74.0	3.0m./VERT	19.1	**PK**
7236.00	44.72	-	16.93	61.65	74.0	1.0m./VERT	12.4	**PK**
	Mid Channel – PEAK							
2442.00	69.75	-	34.95	104.70		3.0m./VERT		**PK**
*4884.00	45.15	-	9.32	54.47	74.0	3.0m./VERT	19.5	**PK**
*7326.00	44.81	-	18.29	63.10	74.0	1.0m./HORZ	10.9	**PK**
	High Channel – PEAK							
2462.00	68.62	-	34.95	103.57		3.0m./VERT		**PK**
*4924.00	45.67	-	10.99	56.66	74.0	3.0m./VERT	17.3	**PK**
*7386.00	44.29	-	18.38	62.67	74.0	1.0m./VERT	11.3	**PK**

1.(*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209& 15.247.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic

Sample Calculation at 2412.00 MHz:

Magnitude of Measured Frequency	69.71	dBuV
+Additional Factor	0	dB
+Antenna Factor + Cable Loss+ Amplifier Gain	35.00	dB/m
Corrected Result	104.71	dBuV/m

Test Date: April 18, 2018

Tested By
Signature: 

Name: John Freeman

Table 10. N mode – Average Radiated Fundamental & Harmonic Emissions (Single-Band Antenna)

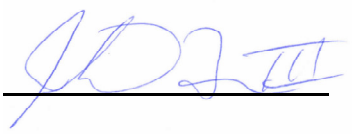
Tested By: JF	Test: FCC Part 15,247(d)			Client: BoxLock, Inc.				
	Project: 18-0042			Model:BOXLOCK001				
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detector**
	Low Channel - Average							
2412.00	51.35	-	35.00	86.35	-	3.0m./VERT	-	**AVG**
*4824.00	30.37	-	9.32	39.69	54.0	3.0m./VERT	14.3	**AVG**
7236.00	30.51	-	16.93	47.44	54.0	1.0m./VERT	6.6	**AVG**
	Mid Channel –Average							
2442.00	51.89	-	34.95	86.84	-	3.0m./VERT	-	**AVG**
*4884.00	30.34	-	9.32	39.66	54.0	3.0m./VERT	14.3	**AVG**
*7326.00	30.15	-	18.29	48.44	54.0	1.0m./HORZ	5.6	**AVG**
	High Channel–Average							
2462.00	50.63	-	34.95	85.58	-	3.0m./VERT	-	**AVG**
*4924.00	30.68	-	10.99	41.67	54.0	3.0m./VERT	12.3	**AVG**
*7386.00	29.97	-	18.38	48.35	54.0	1.0m./VERT	5.6	**AVG**

1.(*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. Duty cycle applied where applicable.

Sample Calculation at 2412.00 MHz:

Magnitude of Measured Frequency	51.35	dBuV
+Additional Factor	0	dB
+Antenna Factor + Cable Loss+ Amplifier Gain	35.00	dB/m
Corrected Result	86.35	dBuV/m

Test Date: April 18, 2018

Tested By
Signature: 

Name: John Freeman

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

Band Edge measurements are made following the guidelines in ANSI C63.10-2013 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). Because these frequencies occur above 1000 MHz they have both a peak and average requirement.

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 ≥ RBW. See figures and calculations below for more detail.

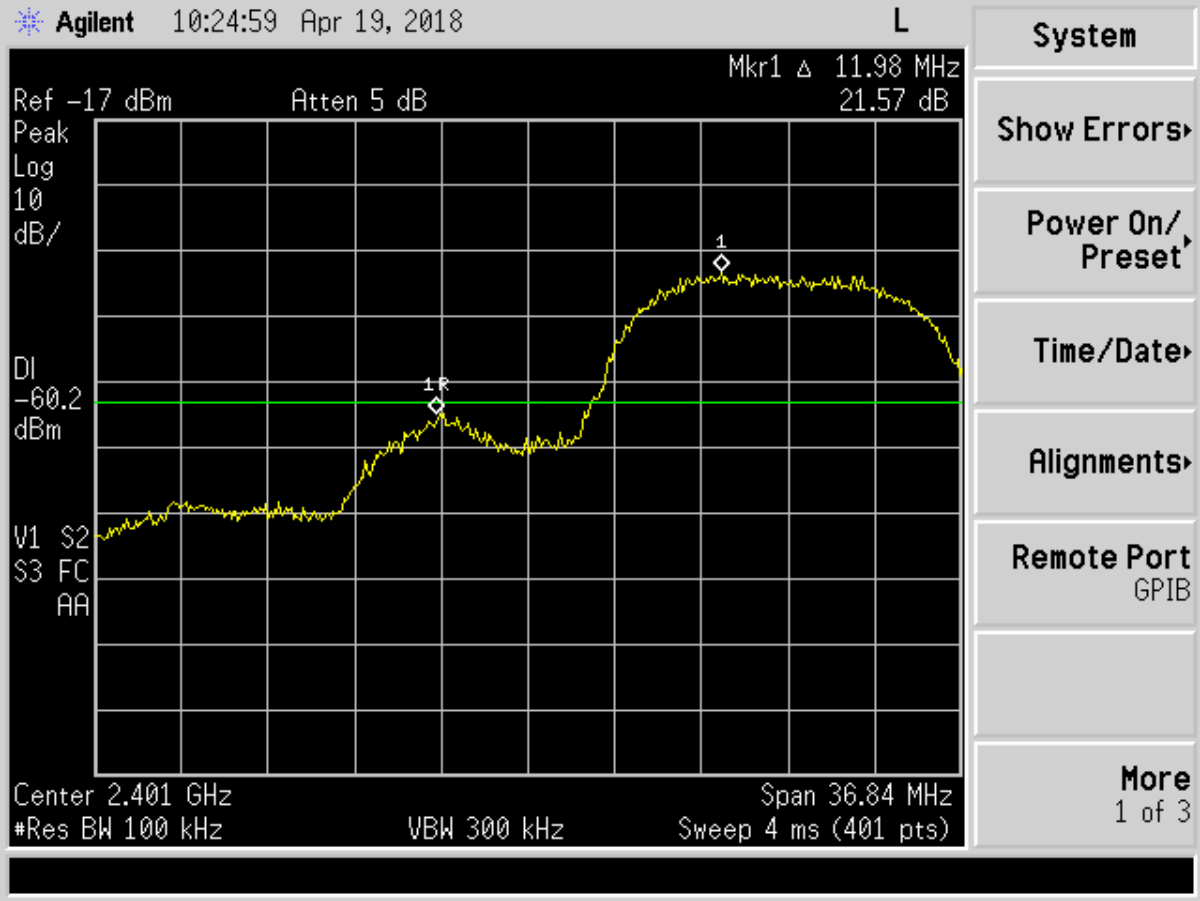


Figure 26. Band Edge Compliance – B mode (Single-Band Antenna) Low Channel Delta – Peak

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

Measured Result	21.57	dB
Band Edge Limit	20.00	dB
Band Edge Margin	1.57	dB

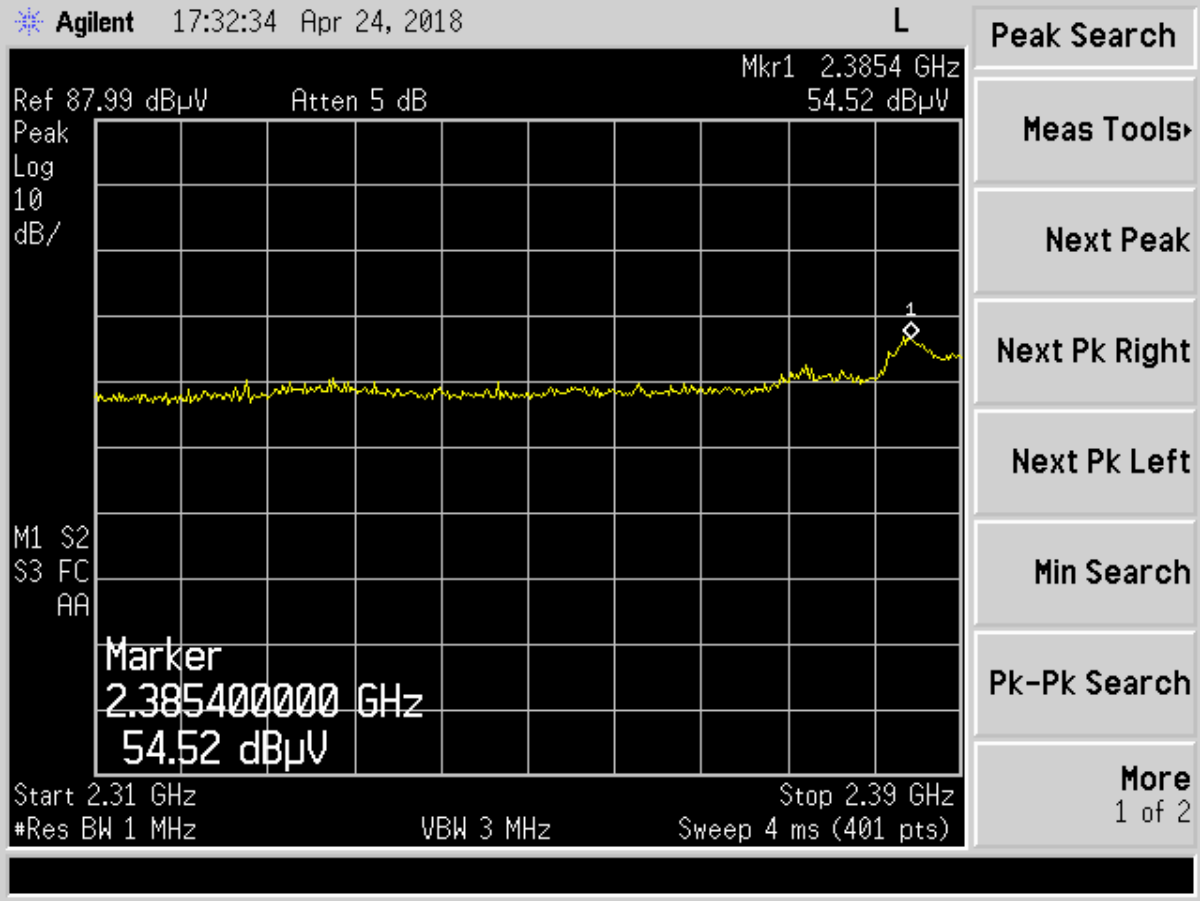


Figure 27. B mode (Single-Band Antenna) Low Channel Restricted Band – Peak

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2385.40	54.52	-1.28	53.24	74.0	3.0m./VERT	20.8	**PK**

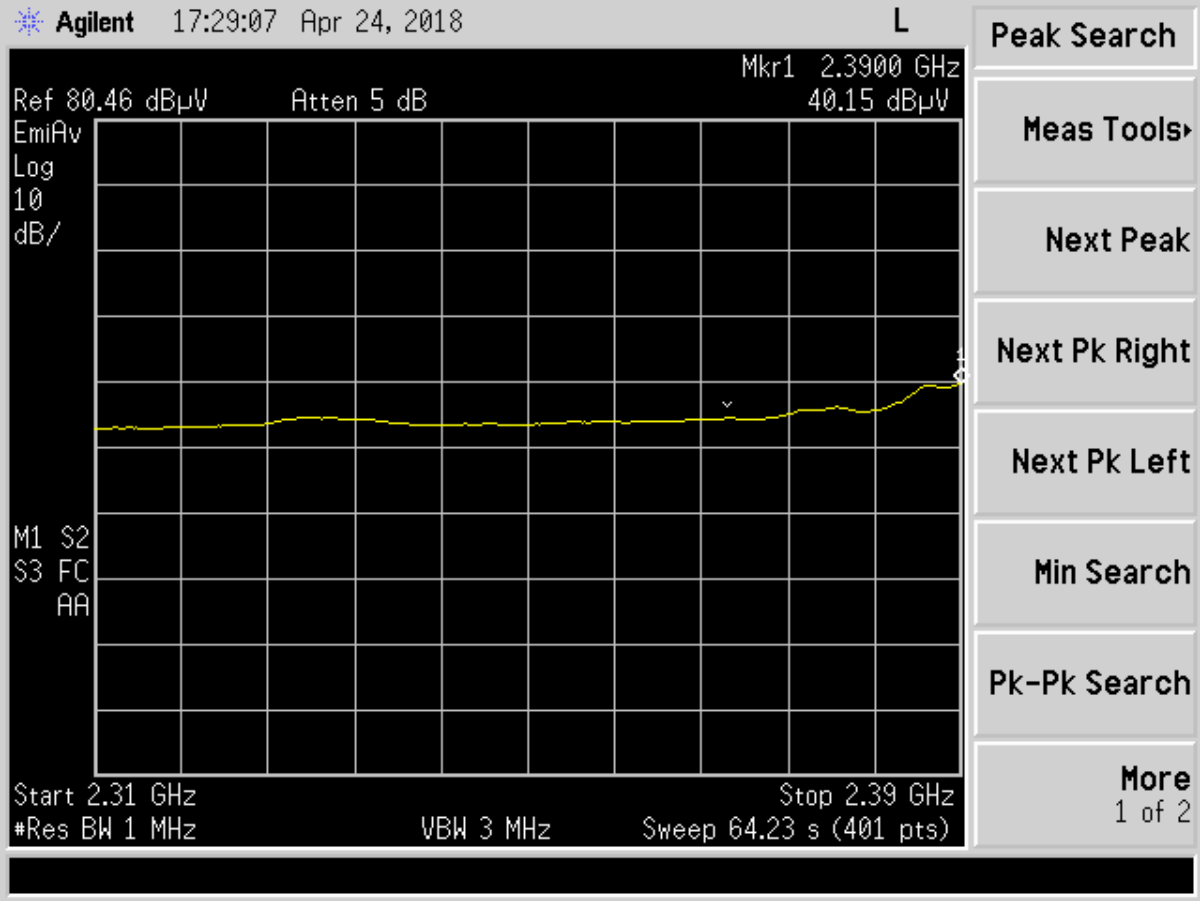


Figure 28. B mode (Single-Band Antenna) Low Channel Restricted Band – Average

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2390.00	40.15	-1.32	38.83	54.0	3.0m./VERT	15.2	**AVG**

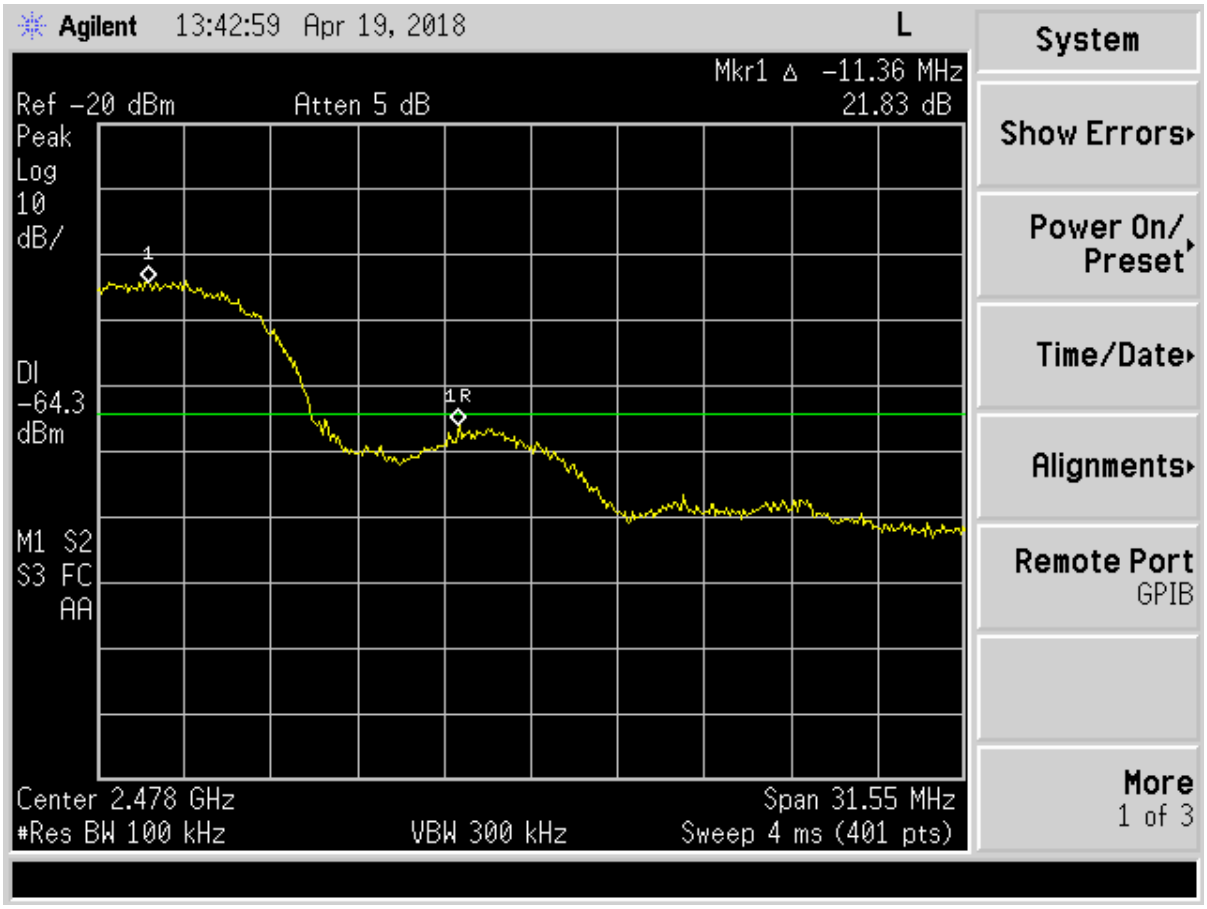


Figure 29. Band Edge Compliance – B mode (Single-Band Antenna) High Channel Delta – Peak

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

Measured Result	21.83	dB
Band Edge Limit	20.00	dB
Band Edge Margin	1.83	dB

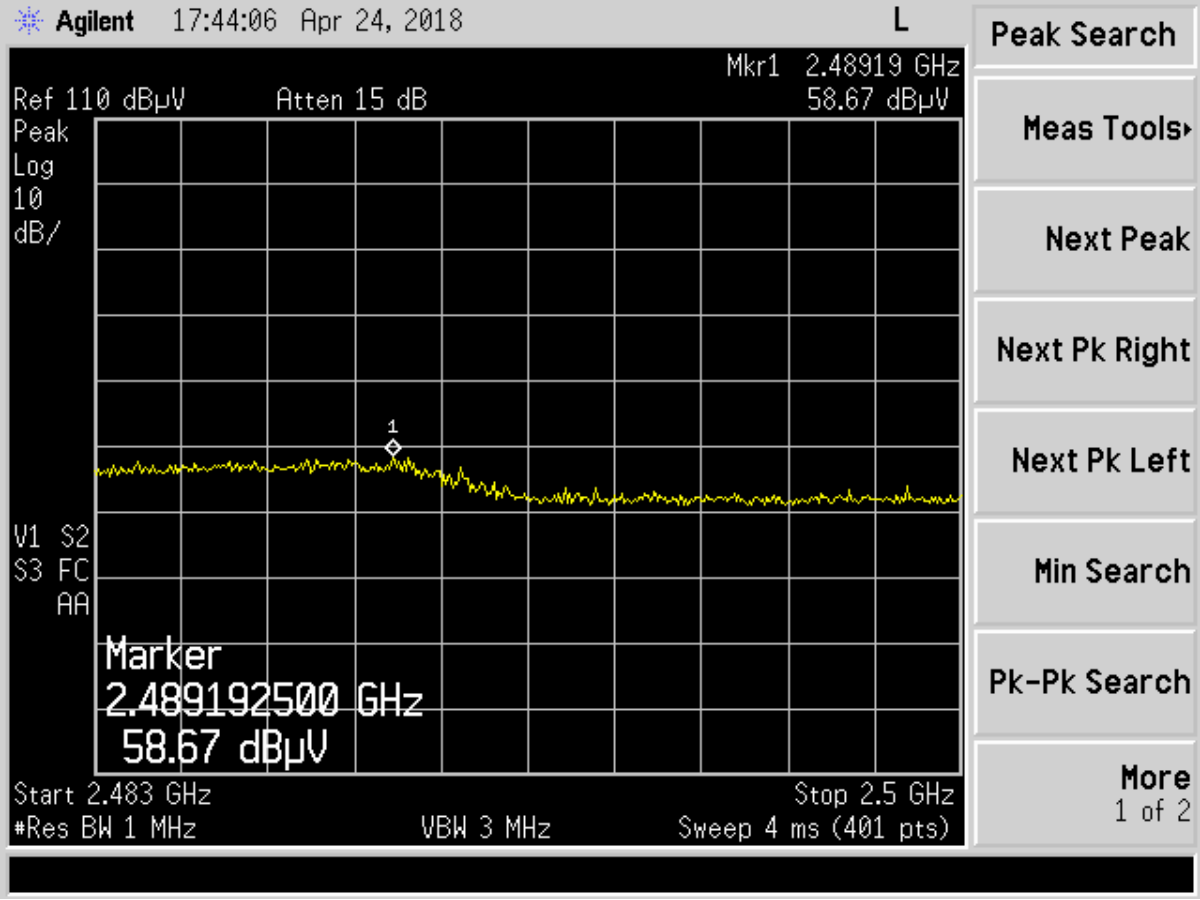


Figure 30. B mode (Single-Band Antenna) High Channel Restricted Band – Peak

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2489.19	58.67	0.48	59.15	74.0	3.0m./VERT	14.9	**PK**

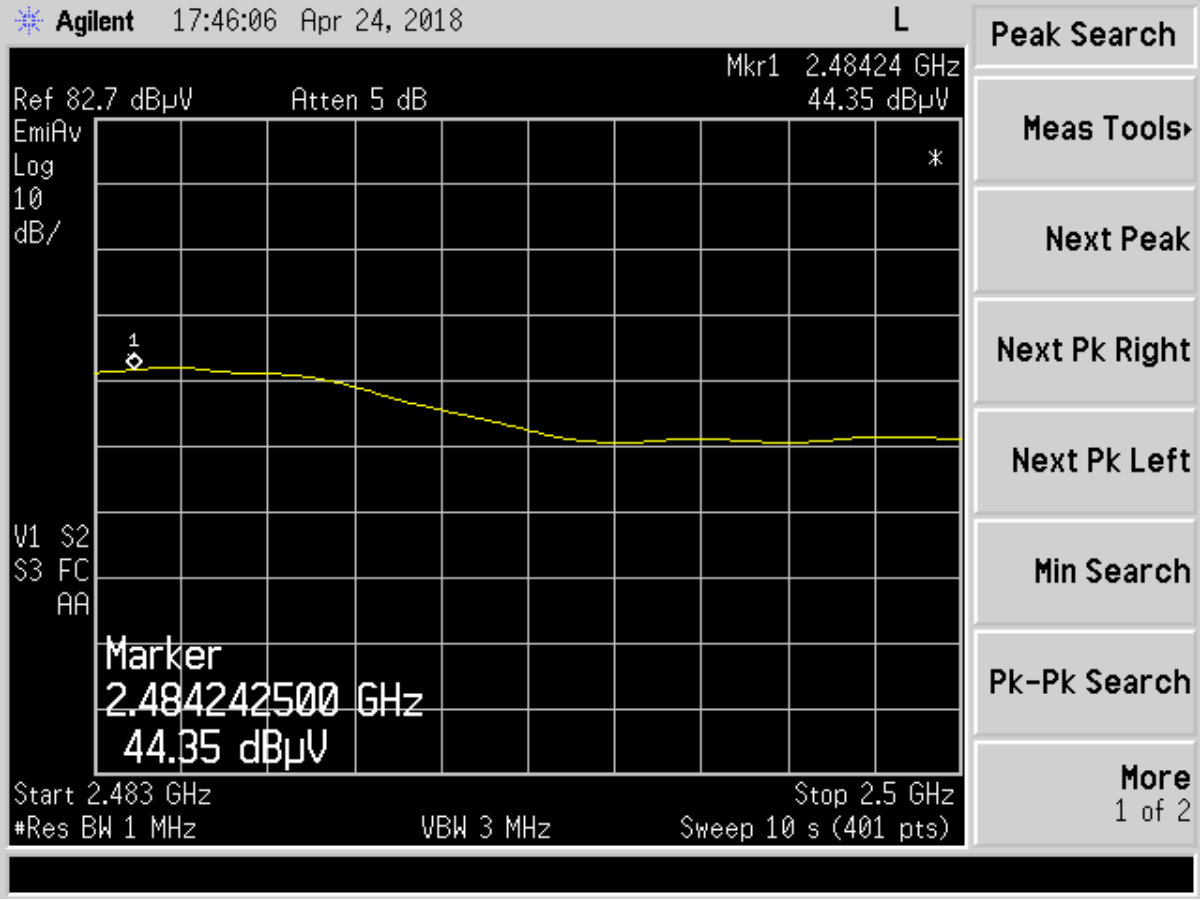


Figure 31. B mode (Single-Band Antenna) High Channel Restricted Band – Average

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2484.24	44.35	0.48	44.83	54.0	3.0m./VERT	9.2	**AVG**

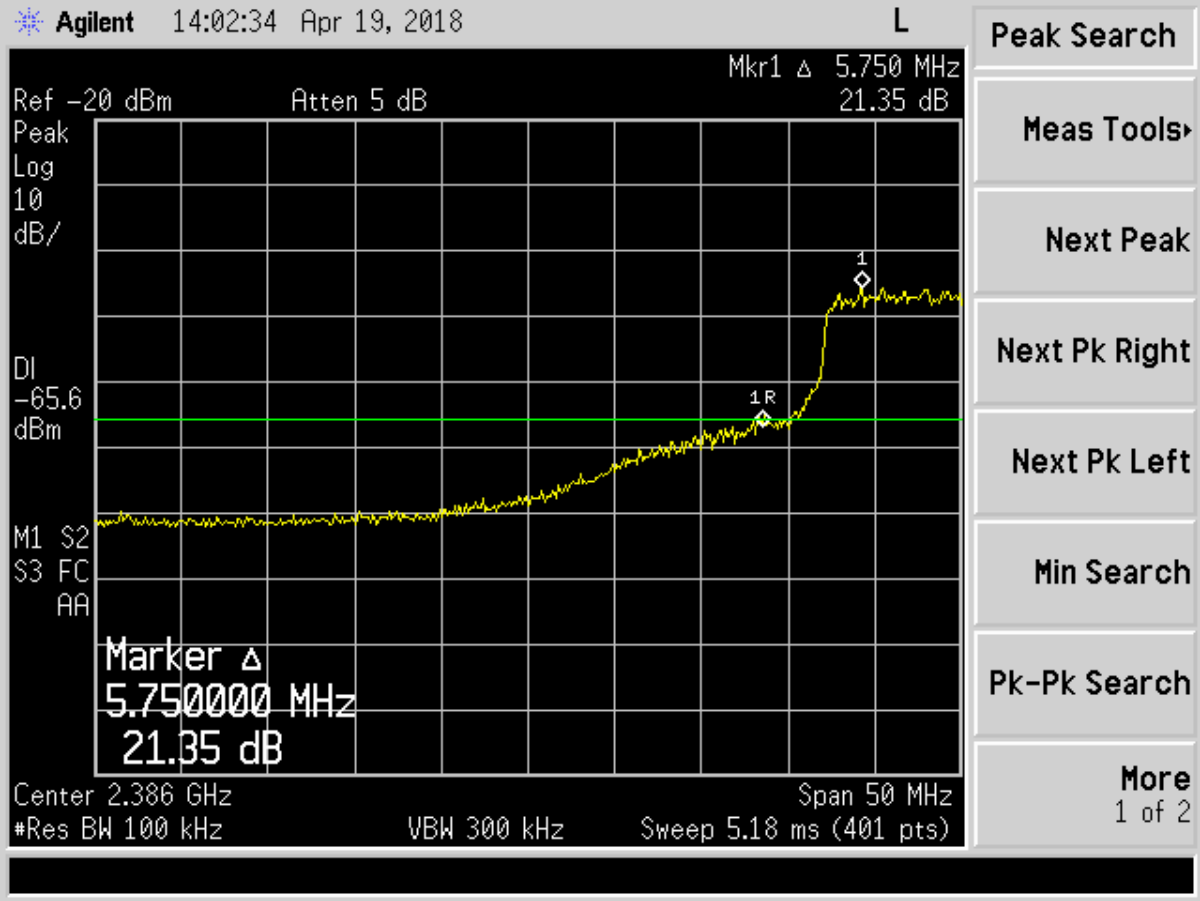


Figure 32. Band Edge Compliance – G mode (Single-Band Antenna) Low Channel Delta – Peak

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

Measured Result	21.35	dB
Band Edge Limit	20.00	dB
Band Edge Margin	1.35	dB

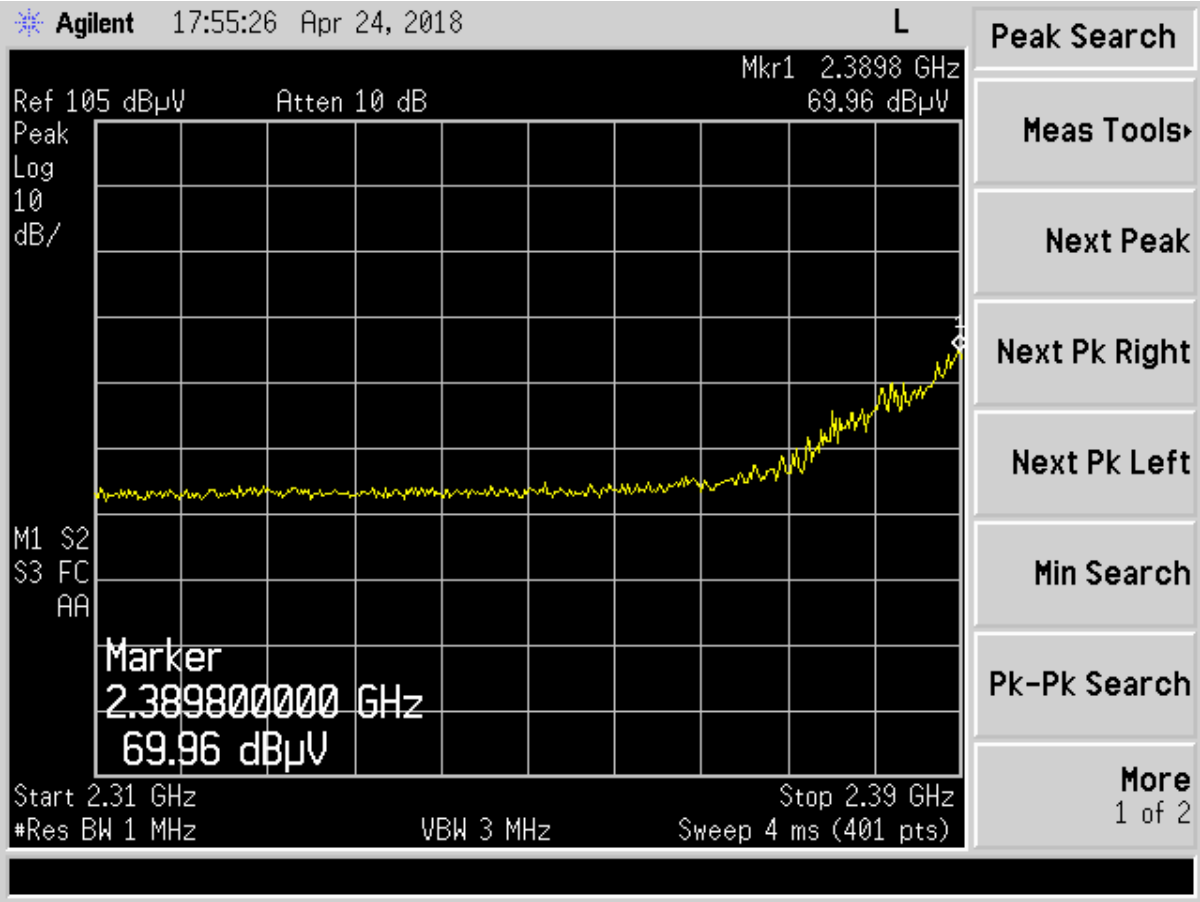


Figure 33. G mode (Single-Band Antenna) Low Channel Restricted Band – Peak

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2389.80	69.96	-1.28	68.68	74.0	3.0m./VERT	5.3	**PK**

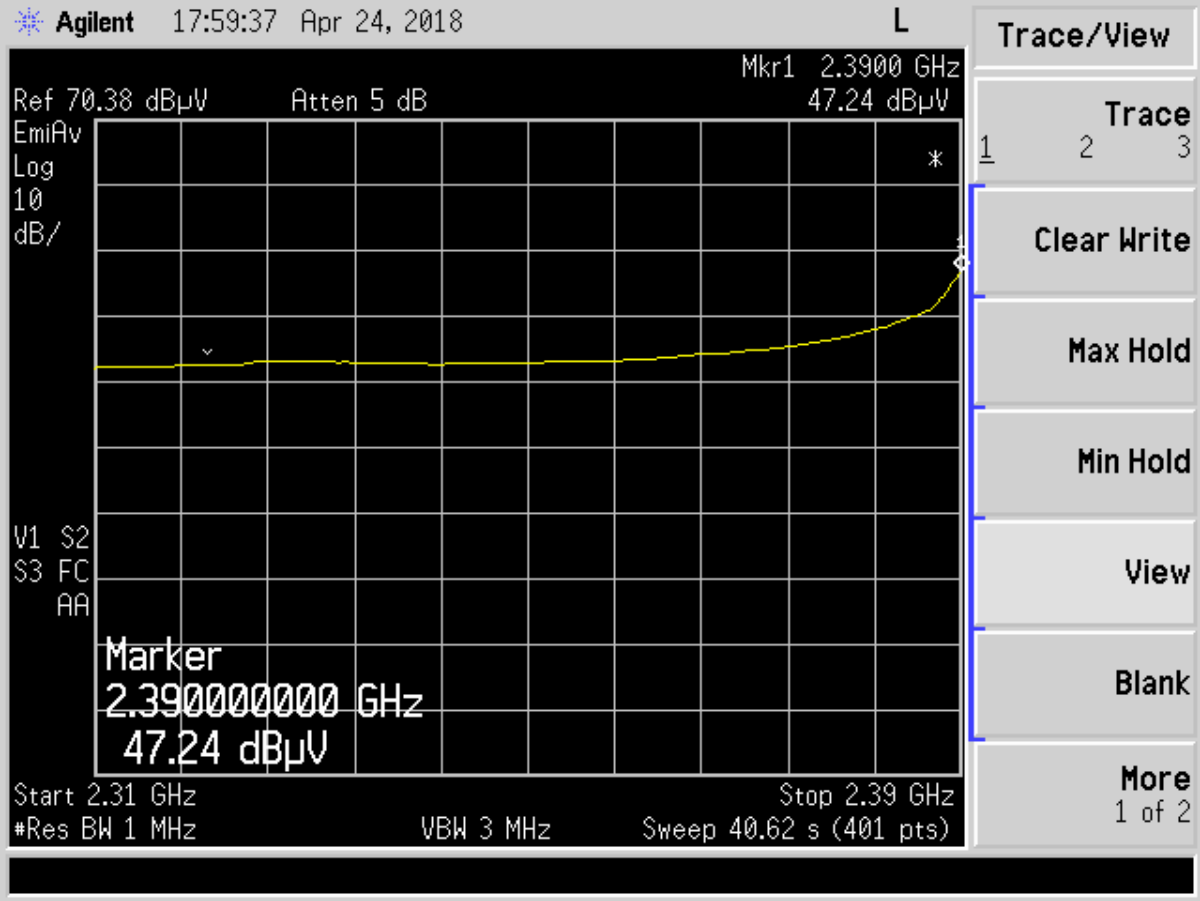


Figure 34. G mode (Single-Band Antenna) Low Channel Restricted Band – Average

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2390.00	47.24	-1.32	45.92	54.0	3.0m./VERT	8.1	**AVG**

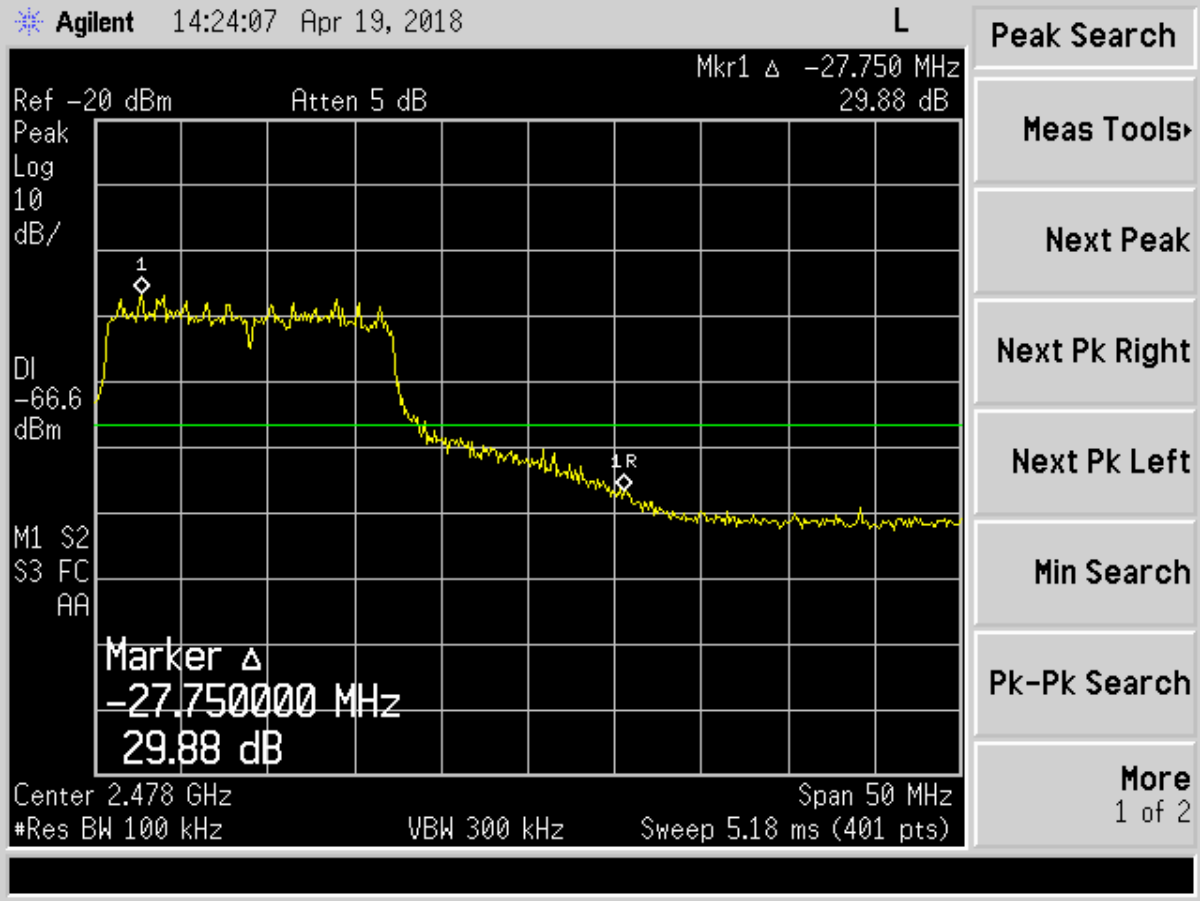


Figure 35. Band Edge Compliance – G mode (Single-Band Antenna) High Channel Delta – Peak

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

Measured Result	29.88	dB
Band Edge Limit	20.00	dB
Band Edge Margin	9.88	dB

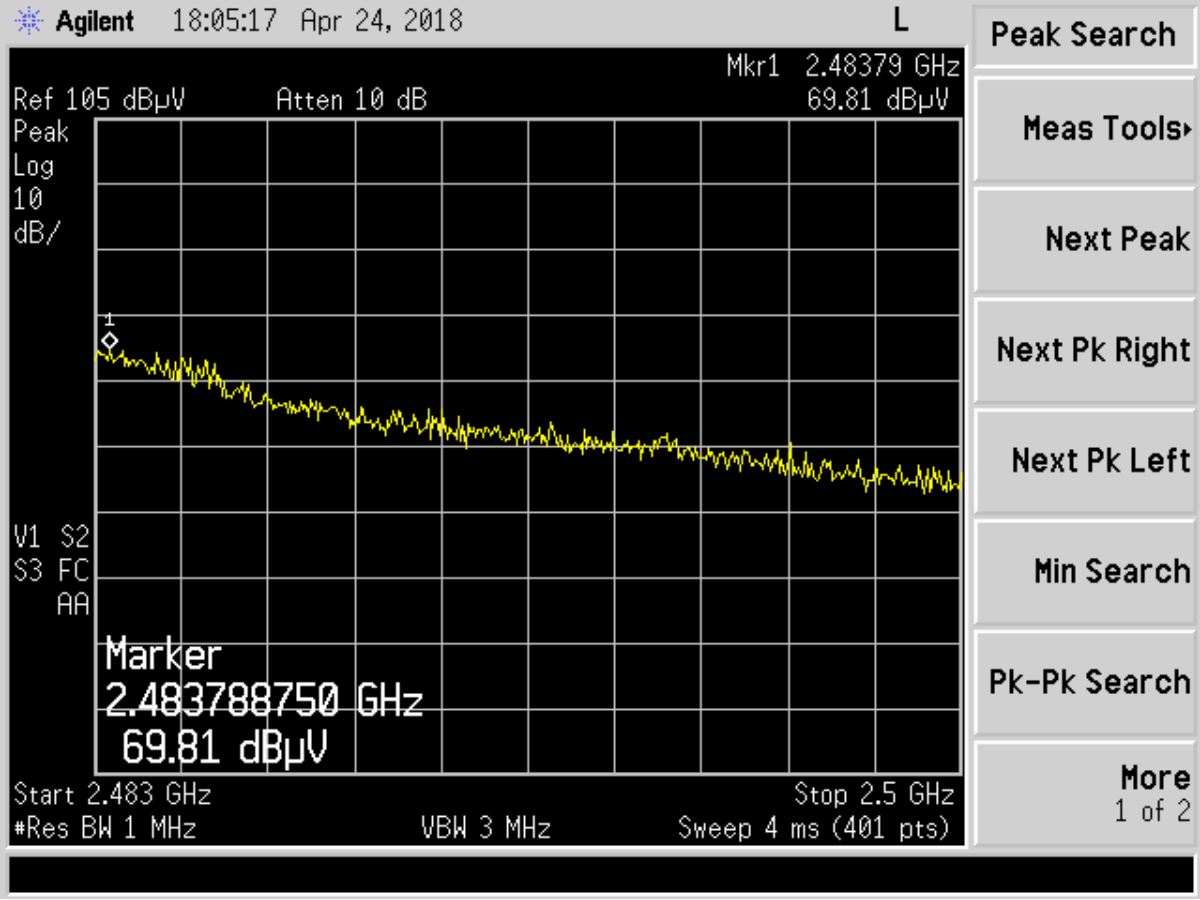


Figure 36. G mode (Single-Band Antenna) High Channel Restricted Band – Peak

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2483.79	69.81	0.48	70.29	74.0	3.0m./VERT	3.7	**PK**

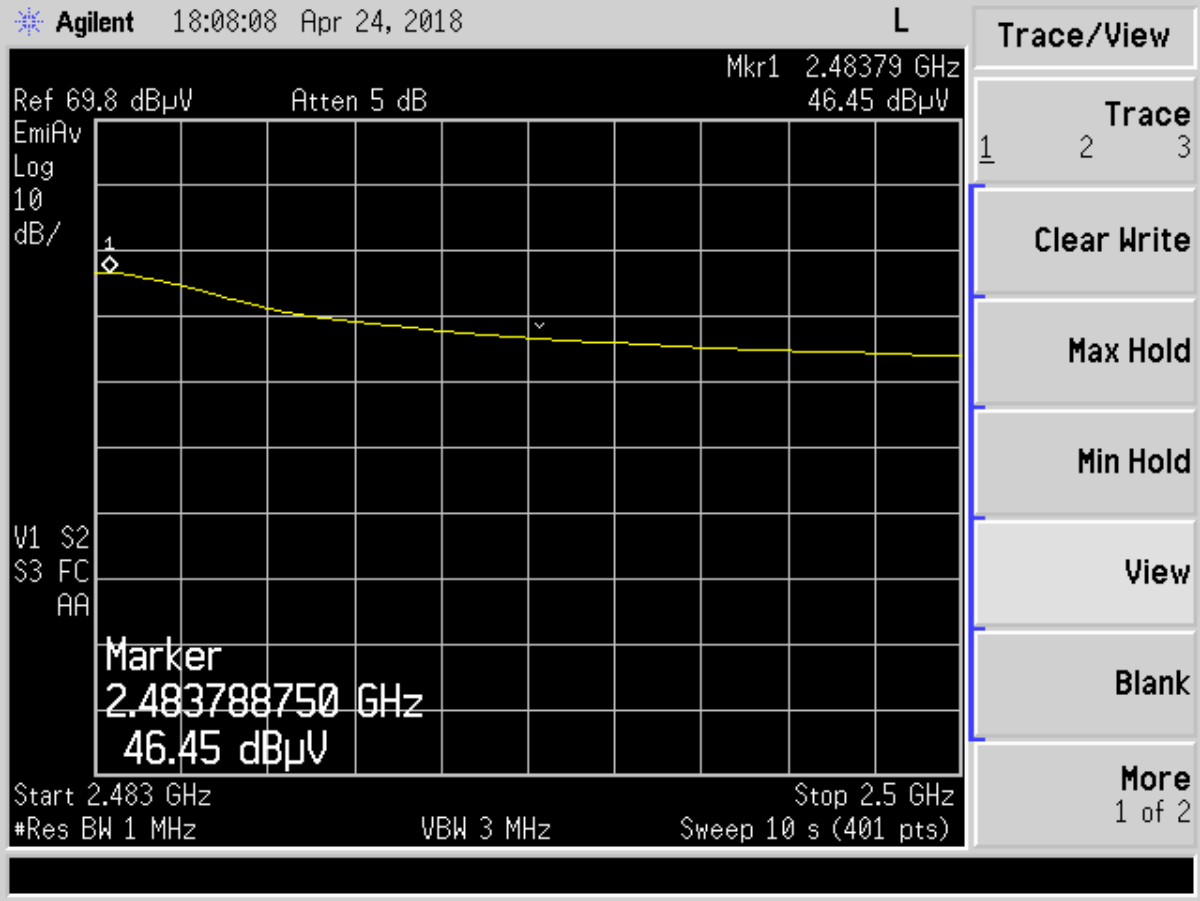


Figure 37. G mode (Single-Band Antenna) High Channel Restricted Band – Average

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2483.79	46.45	0.48	46.93	54.0	3.0m./VERT	7.1	AVG

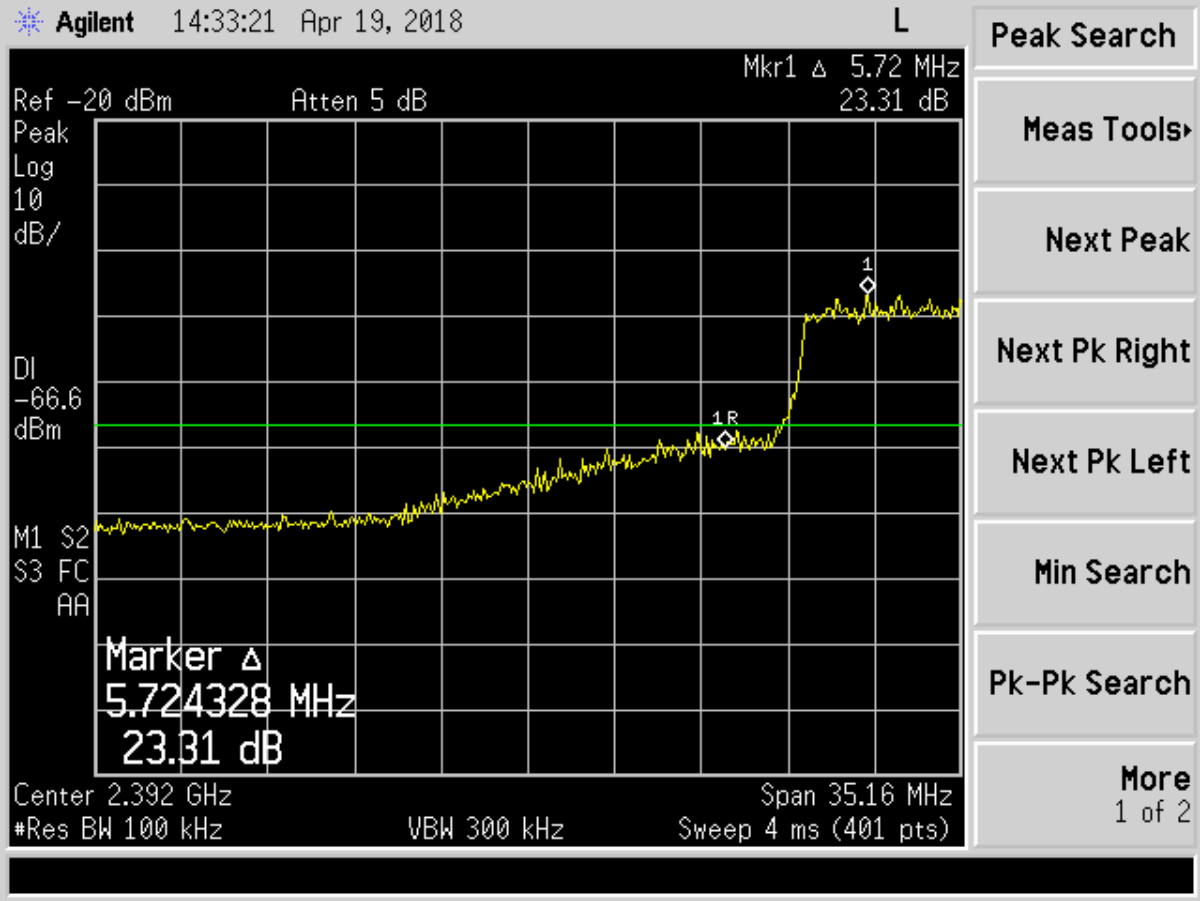


Figure 38. Band Edge Compliance –N mode (Single-Band Antenna) Low Channel Delta – Peak

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

Measured Result	23.31	dB
Band Edge Limit	20.00	dB
Band Edge Margin	3.31	dB

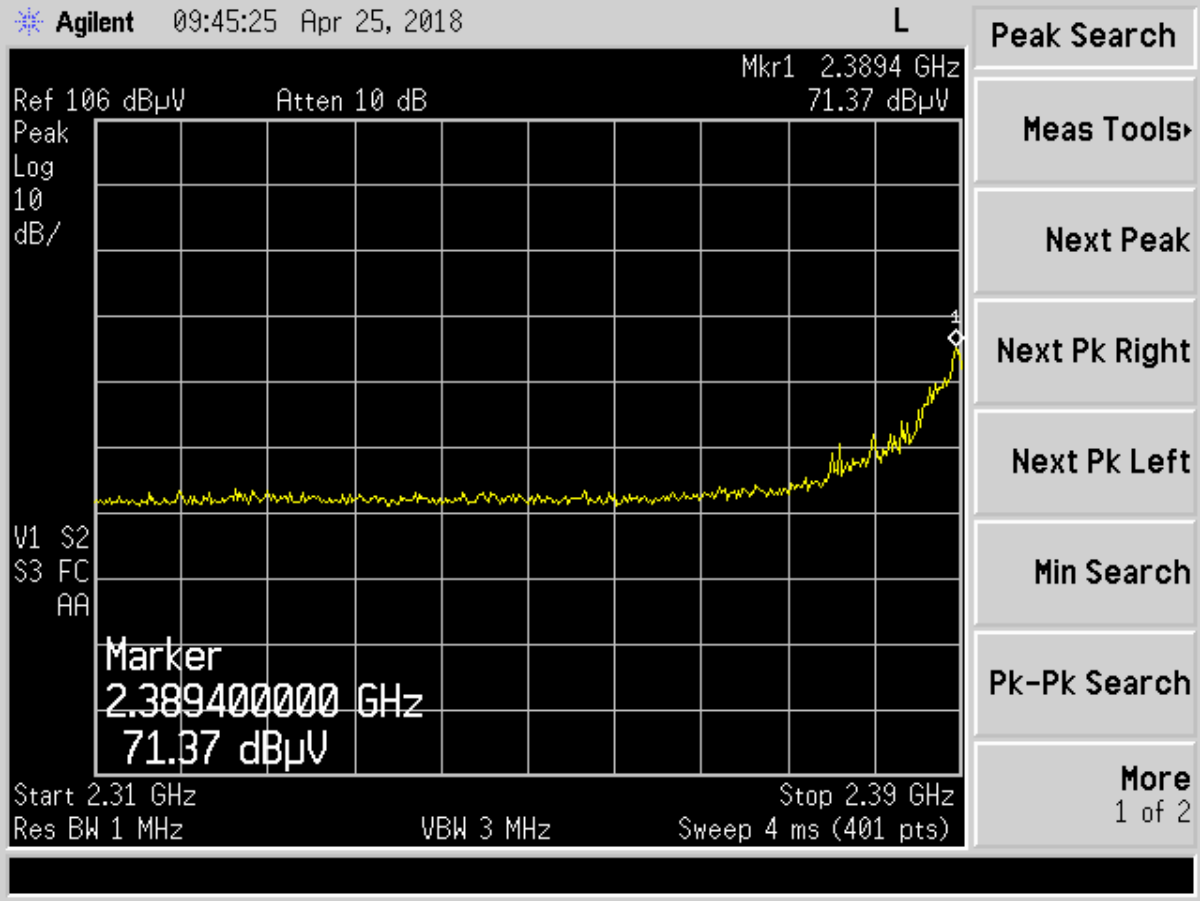


Figure 39. N mode (Single-Band Antenna) Low Channel Restricted Band – Peak

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2389.40	71.37	-1.28	70.09	74.0	3.0m./VERT	3.9	**PK**

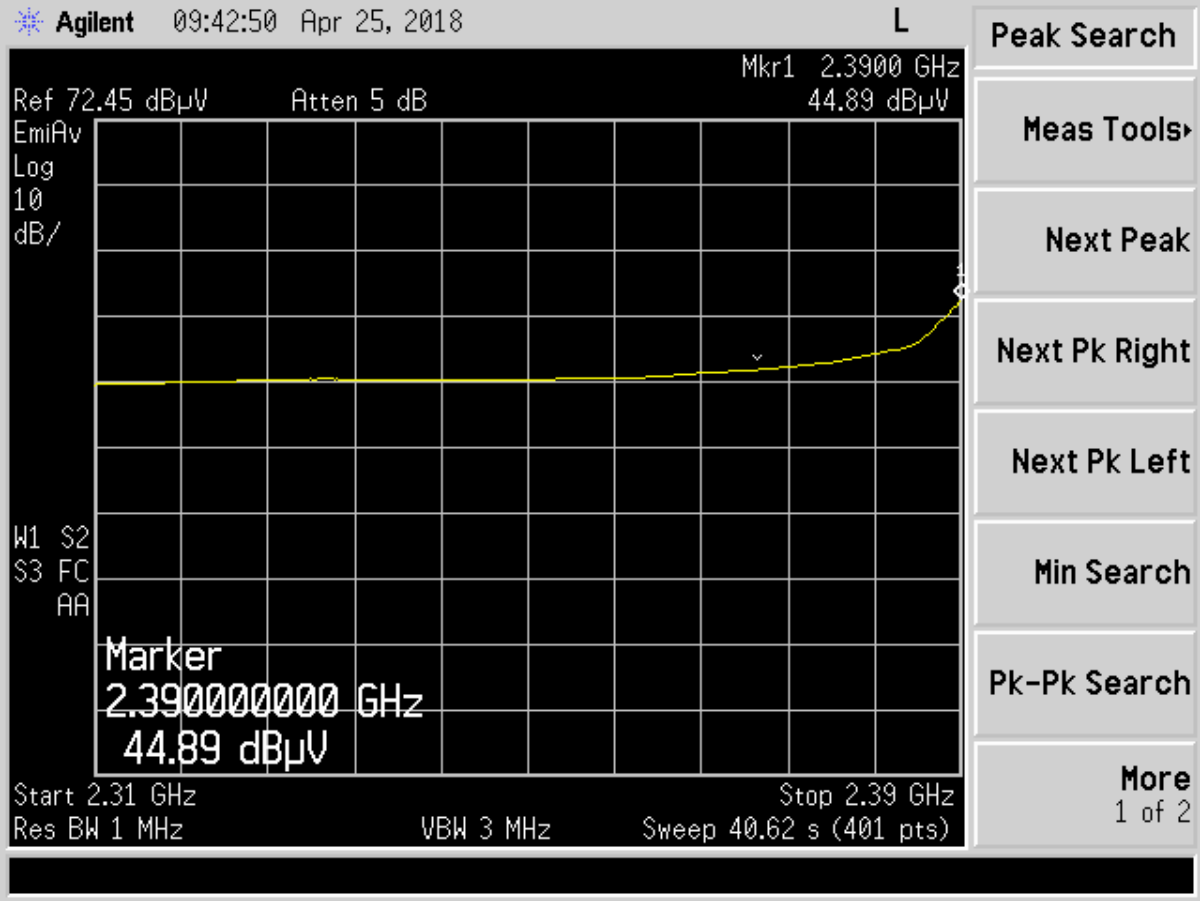


Figure 40. N mode (Single-Band Antenna) Low Channel Restricted Band – Average

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2390.00	44.89	-1.32	43.57	54.0	3.0m./VERT	10.4	**AVG**

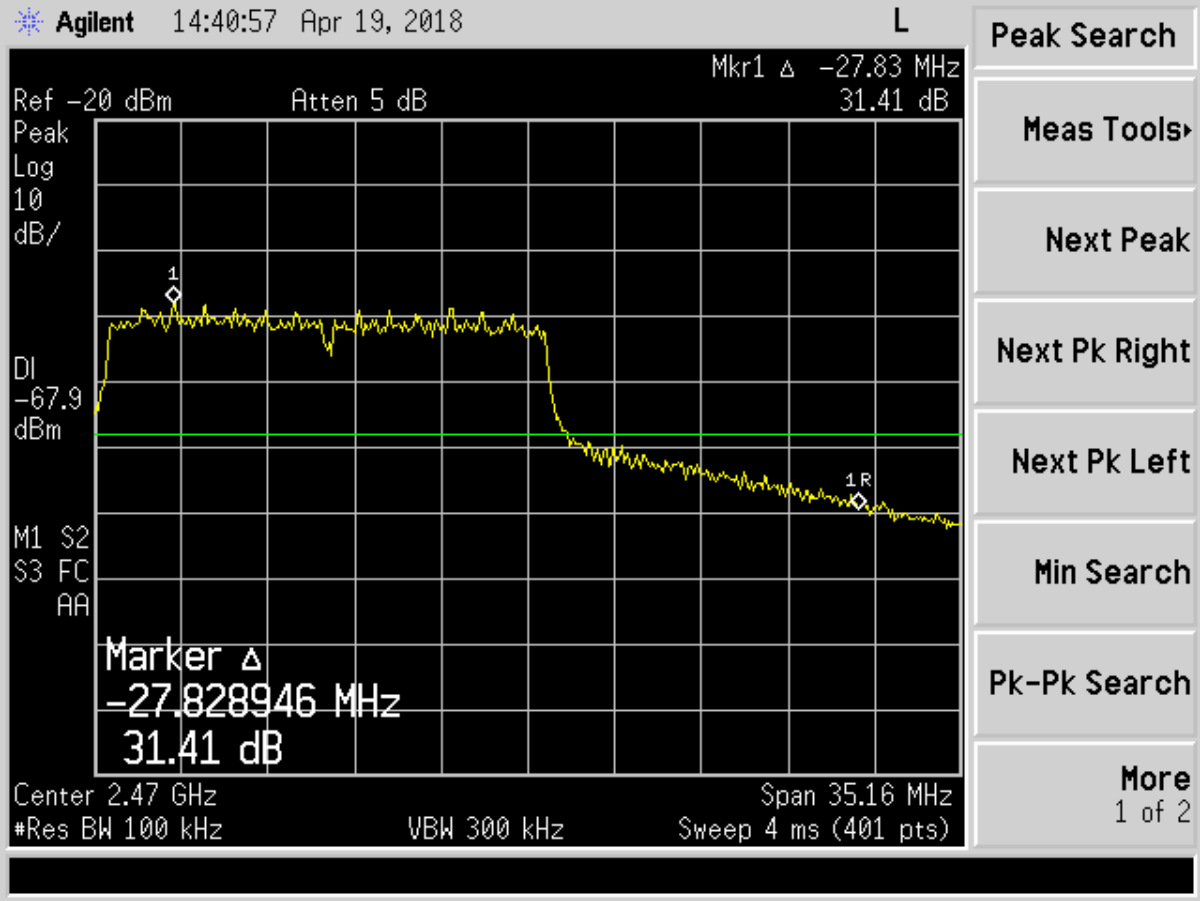


Figure 41. Band Edge Compliance – N mode (Single-Band Antenna) High Channel Delta – Peak

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

Measured Result	31.41	dB
Band Edge Limit	20.00	dB
Band Edge Margin	11.41	dB

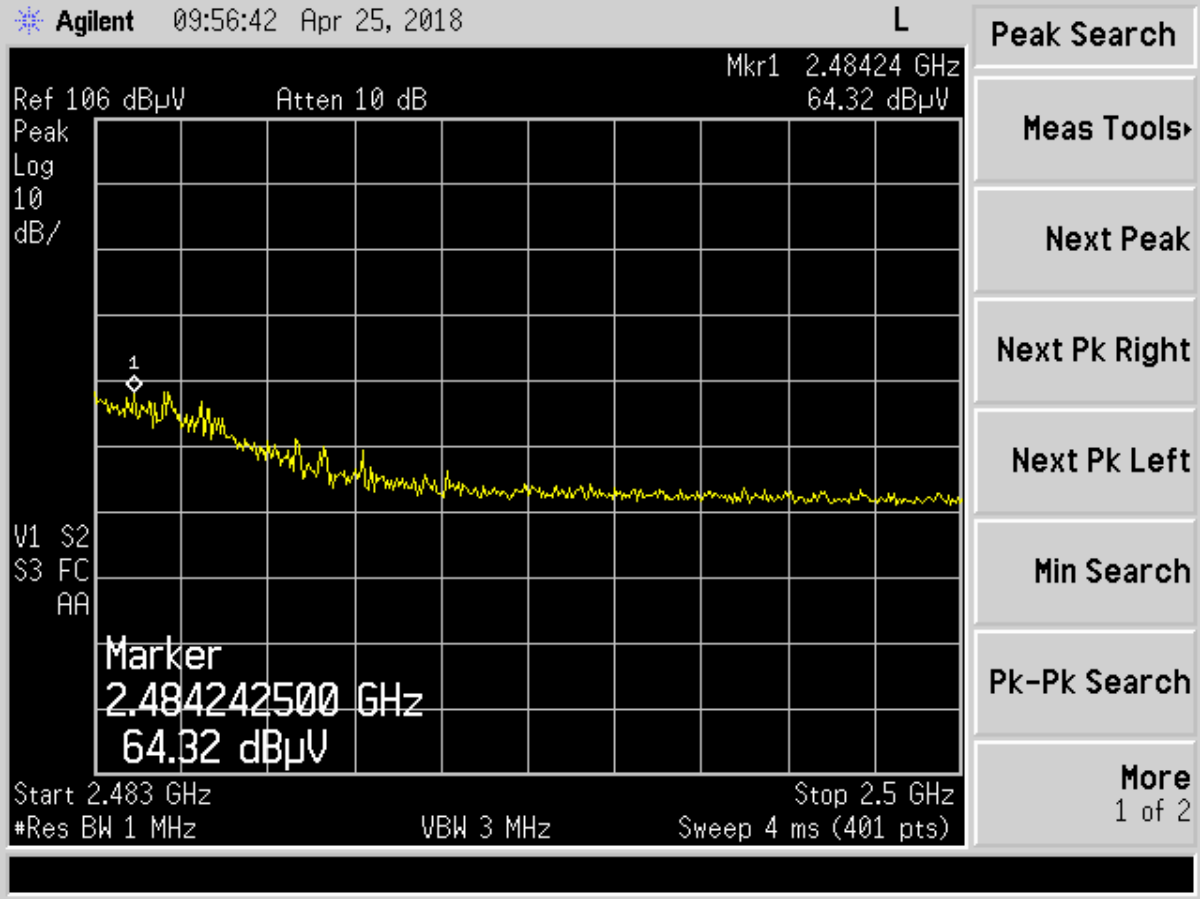


Figure 42. N mode (Single-Band Antenna) High Channel Restricted Band – Peak

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2483.62	64.32	0.48	64.80	74.0	3.0m./VERT	9.2	**PK**

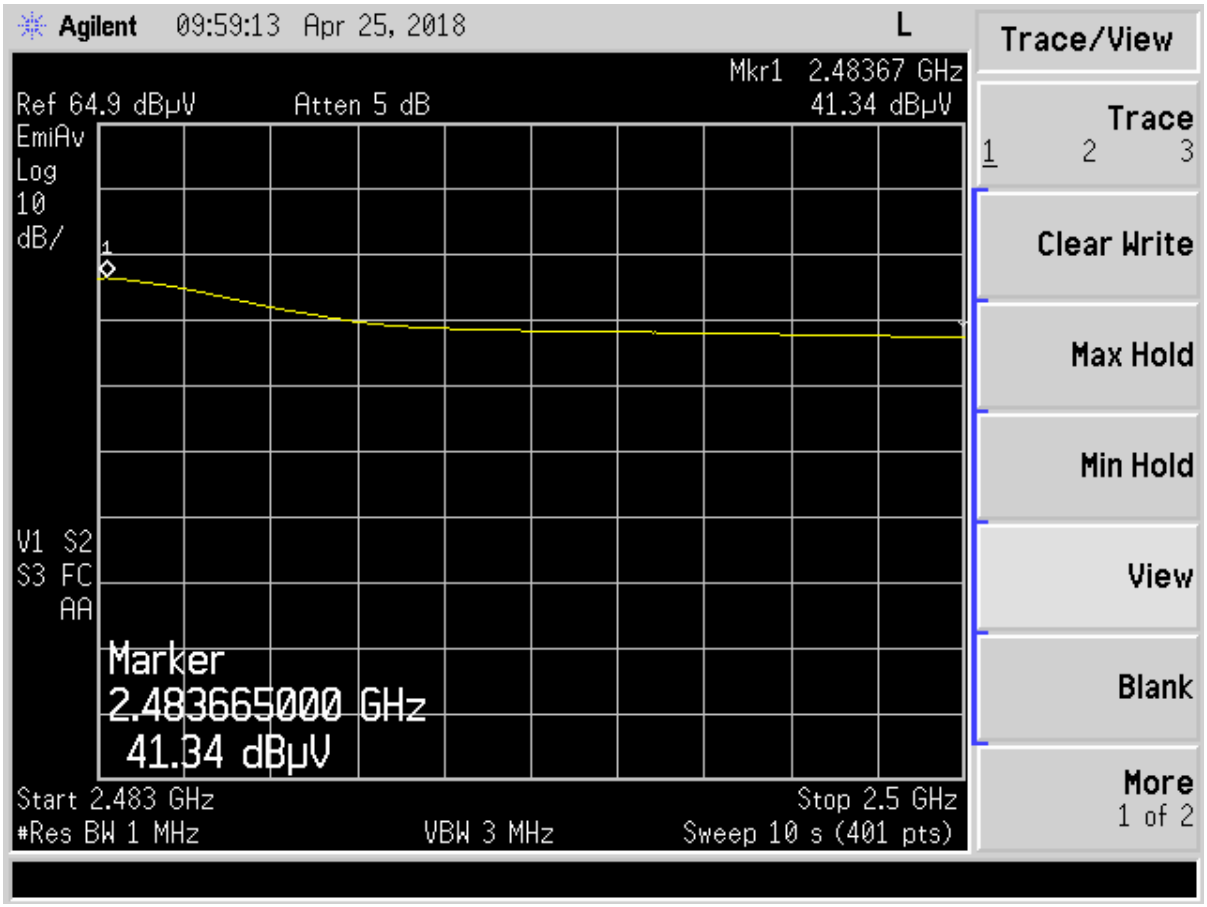


Figure 43. N mode (Single-Band Antenna) High Channel Restricted Band – Average

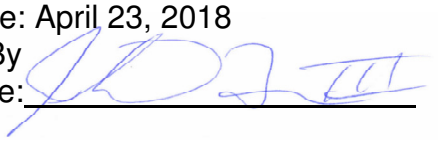
Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2483.66	41.34	0.48	41.82	54.0	3.0m./VERT	12.3	**AVG**

2.12 Six (6) dB Bandwidth per CFR 15.247(a)(2), RSS-247 (5.2(a))

The EUT antenna port was connected to a spectrum analyzer having a 50 Ω input impedance. Measurements were performed per ANSI C63.10-2013, clause 11.8 The RBW was set to 100 kHz and the VBW ≥ RBW. The results of this test are given in the table below and figures below.

Table 11. Six (6) dB Bandwidth

Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum FCC Bandwidth (MHz)	Mode
2412	12.295	0.5	B
2442	11.861	0.5	B
2462	12.225	0.5	B
2412	16.220	0.5	G
2442	16.473	0.5	G
2462	16.185	0.5	G
2412	17.072	0.5	N
2442	16.442	0.5	N
2462	16.480	0.5	N

Test Date: April 23, 2018
Tested By
Signature: 

Name: John Freeman

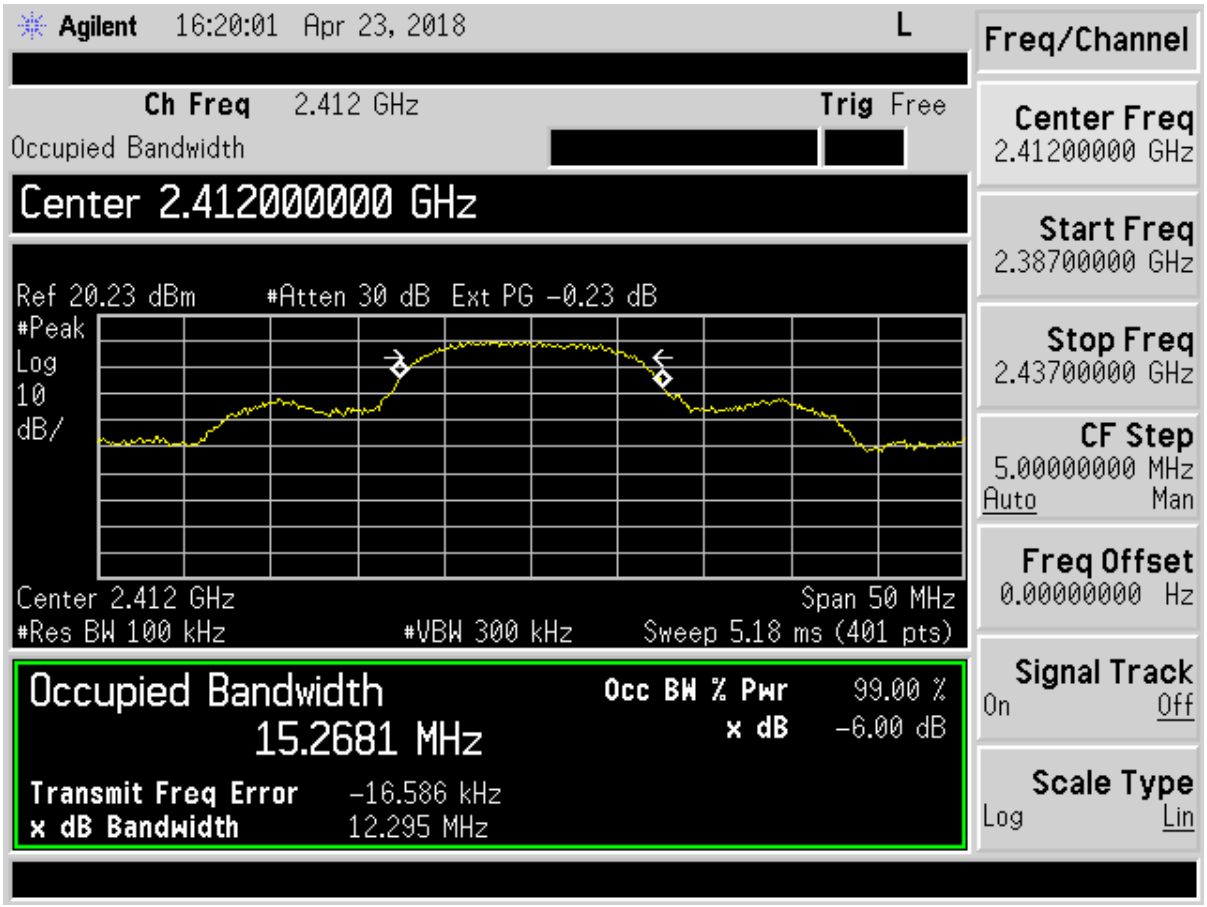


Figure 44. 6 dB Bandwidth B mode Low Channel

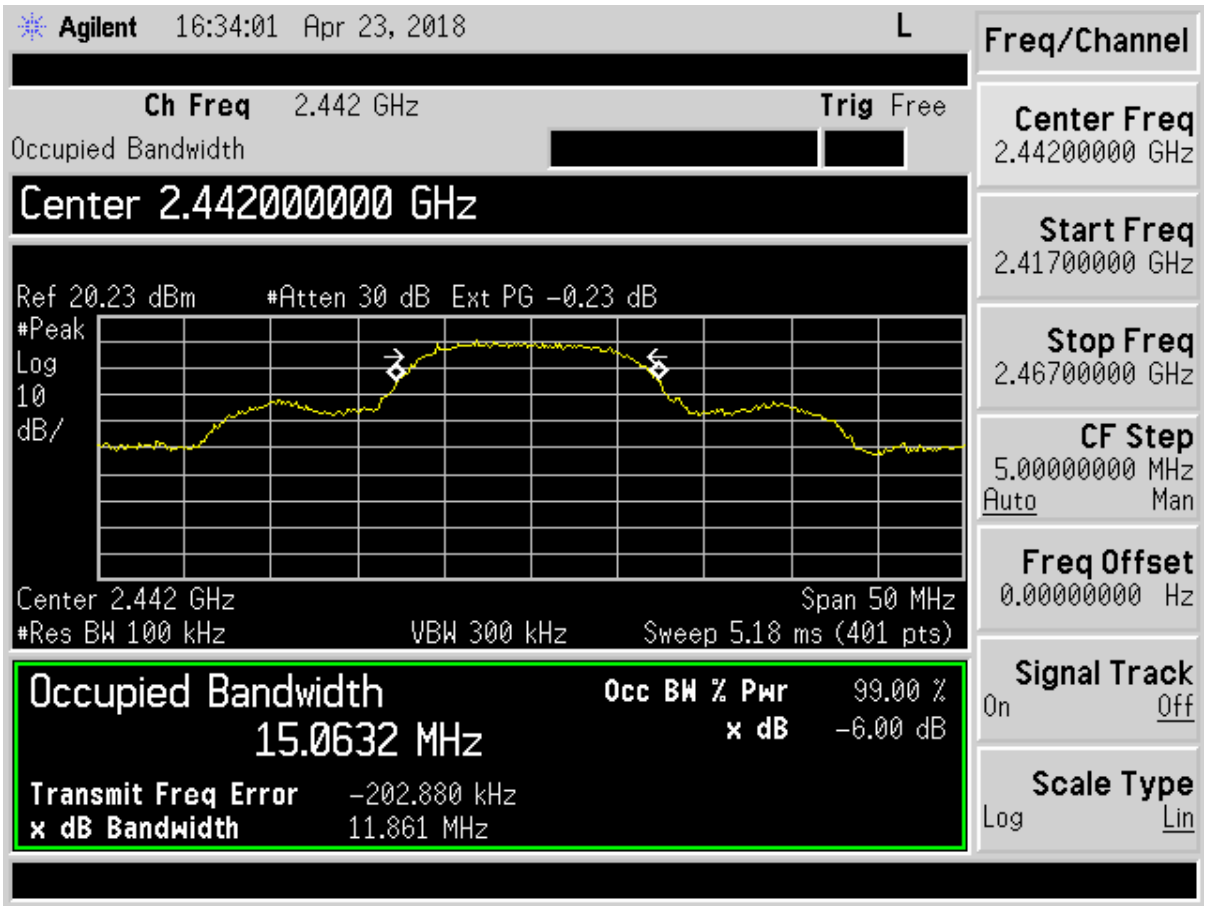


Figure 45. 6 dB Bandwidth B mode Mid Channel

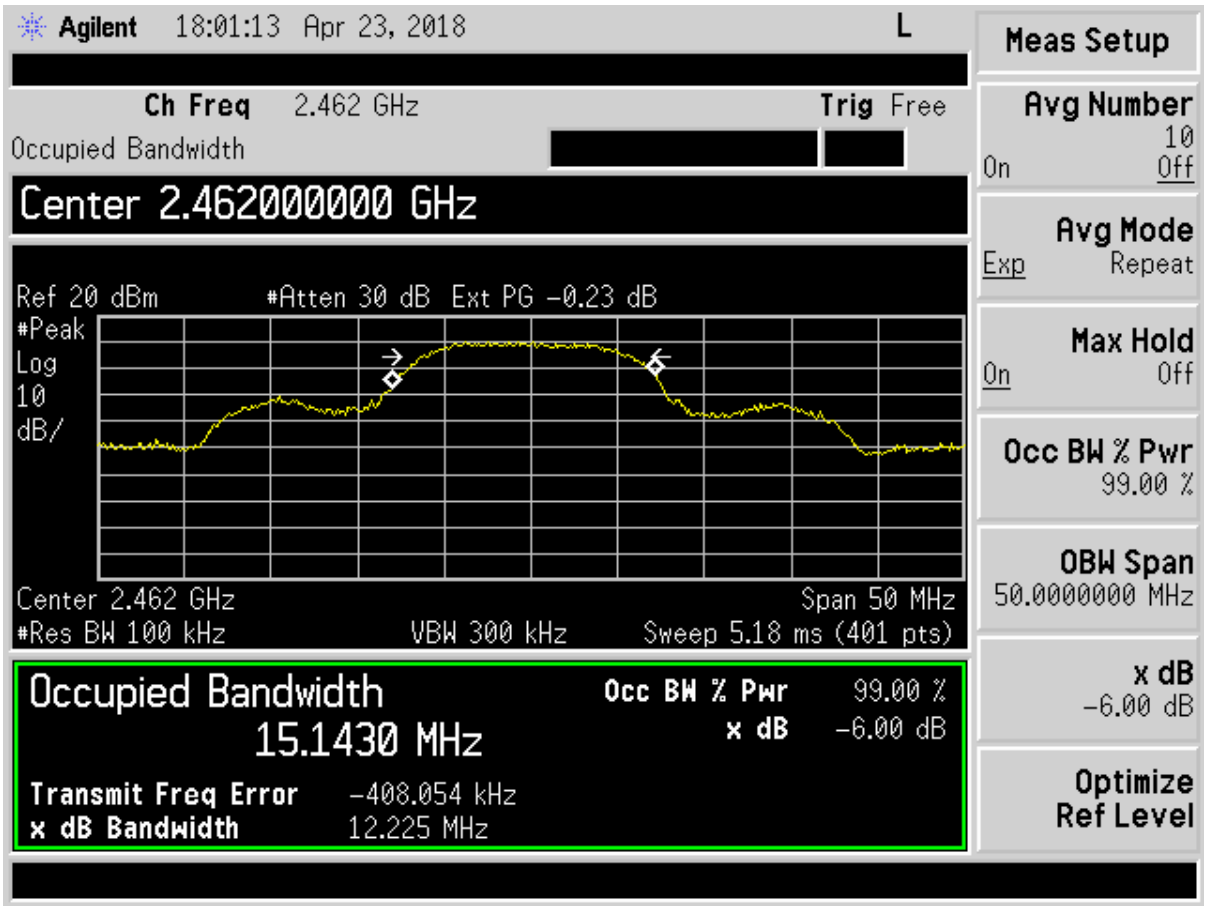


Figure 46. 6 dB Bandwidth B mode High Channel

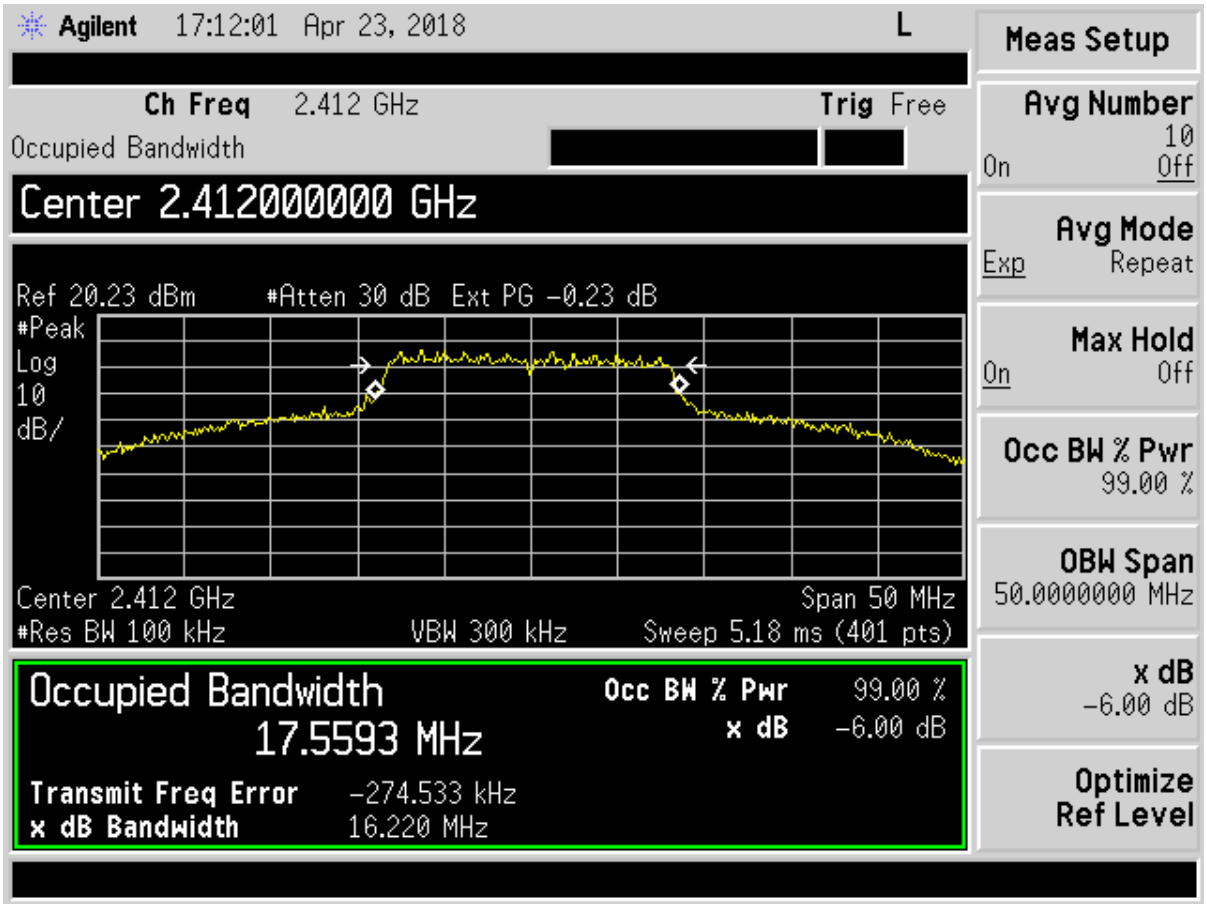


Figure 47. 6 dB Bandwidth G mode Low Channel

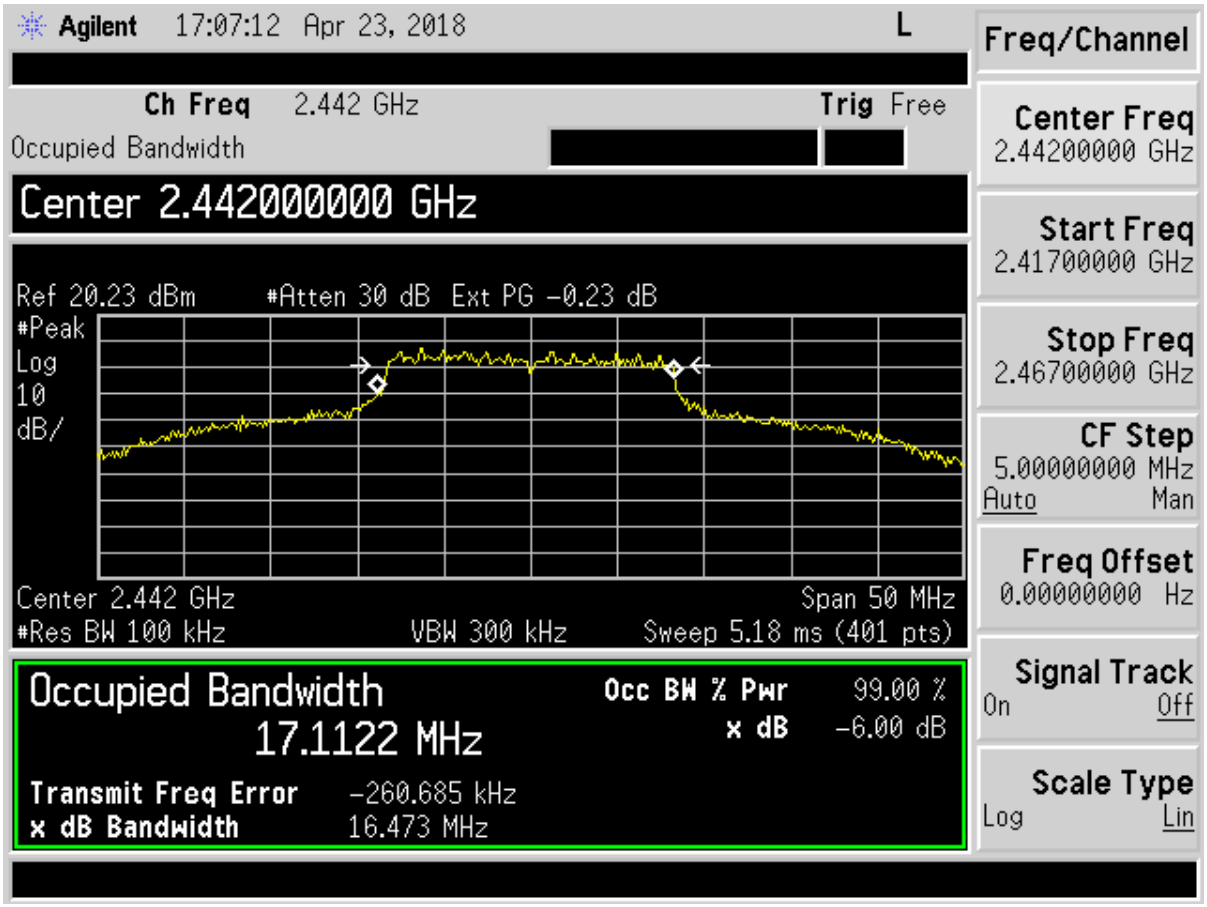


Figure 48. 6 dB Bandwidth G mode Mid Channel

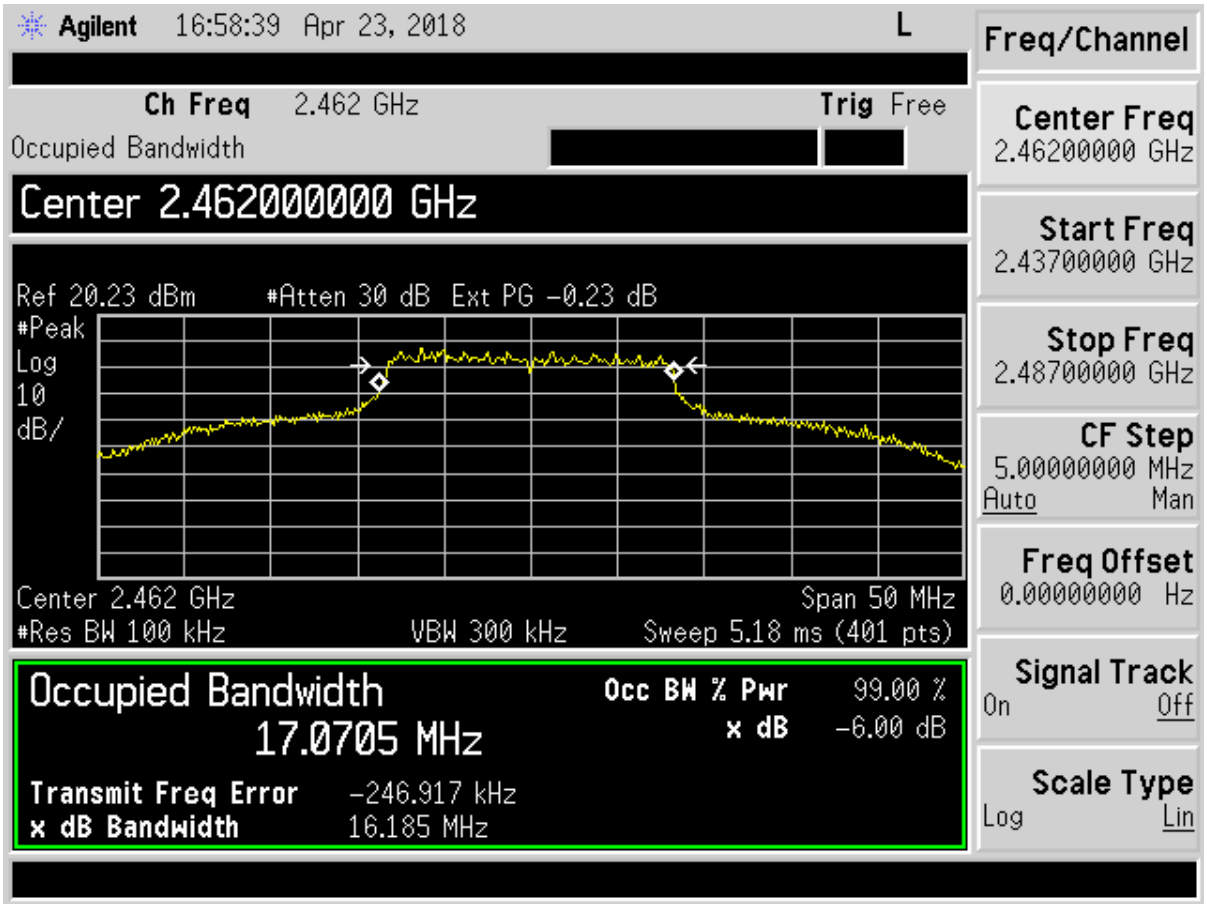


Figure 49. 6 dB Bandwidth G mode High Channel

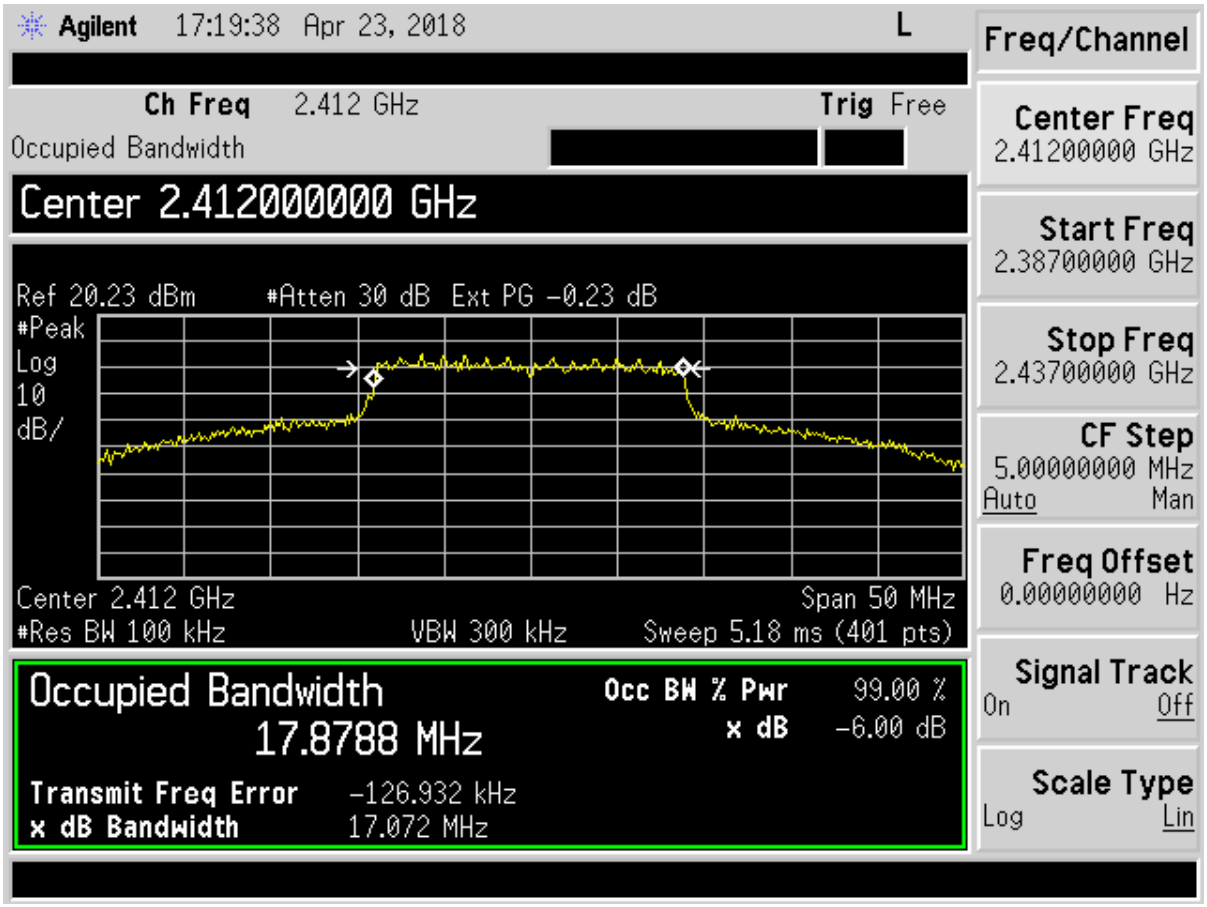


Figure 50. 6 dB Bandwidth N mode Low Channel

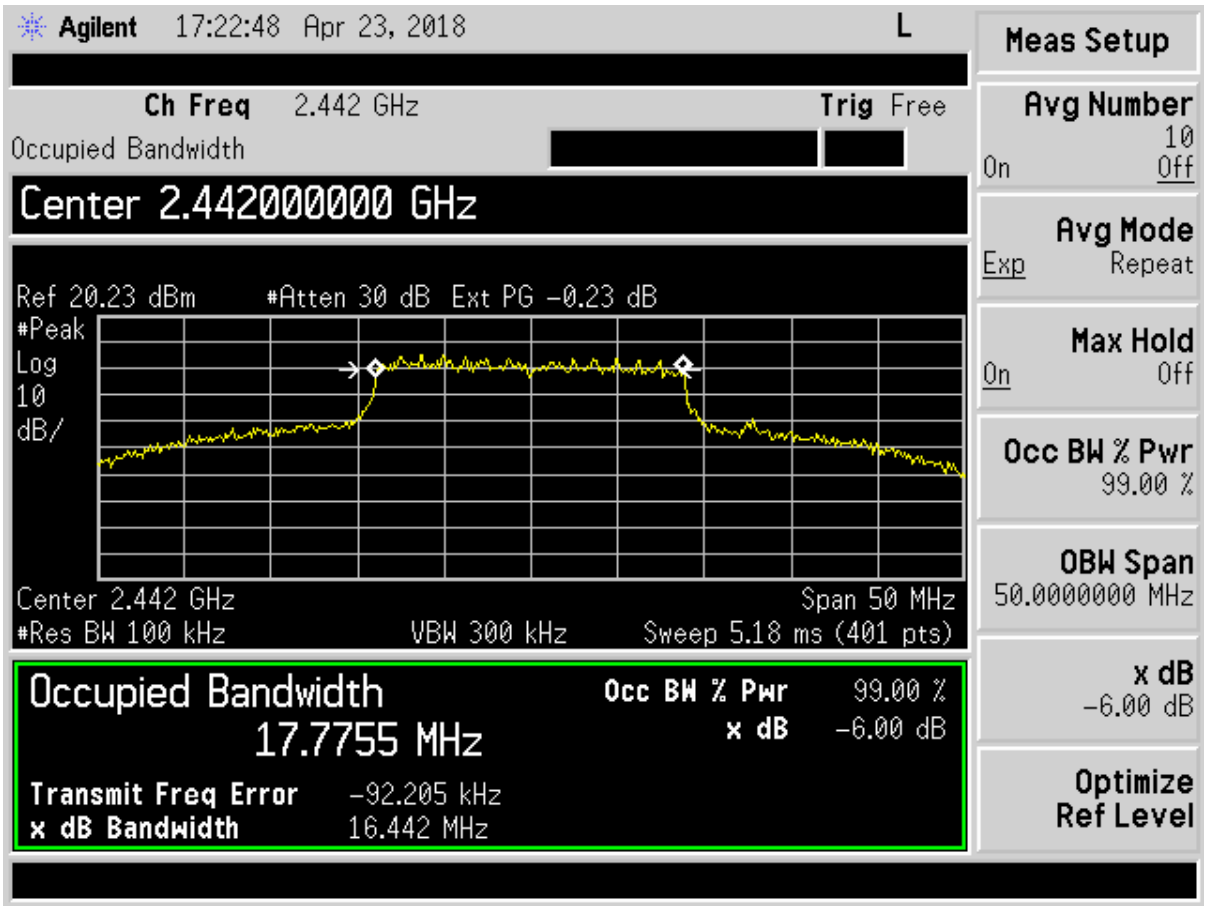


Figure 51. 6 dB Bandwidth N mode Mid Channel

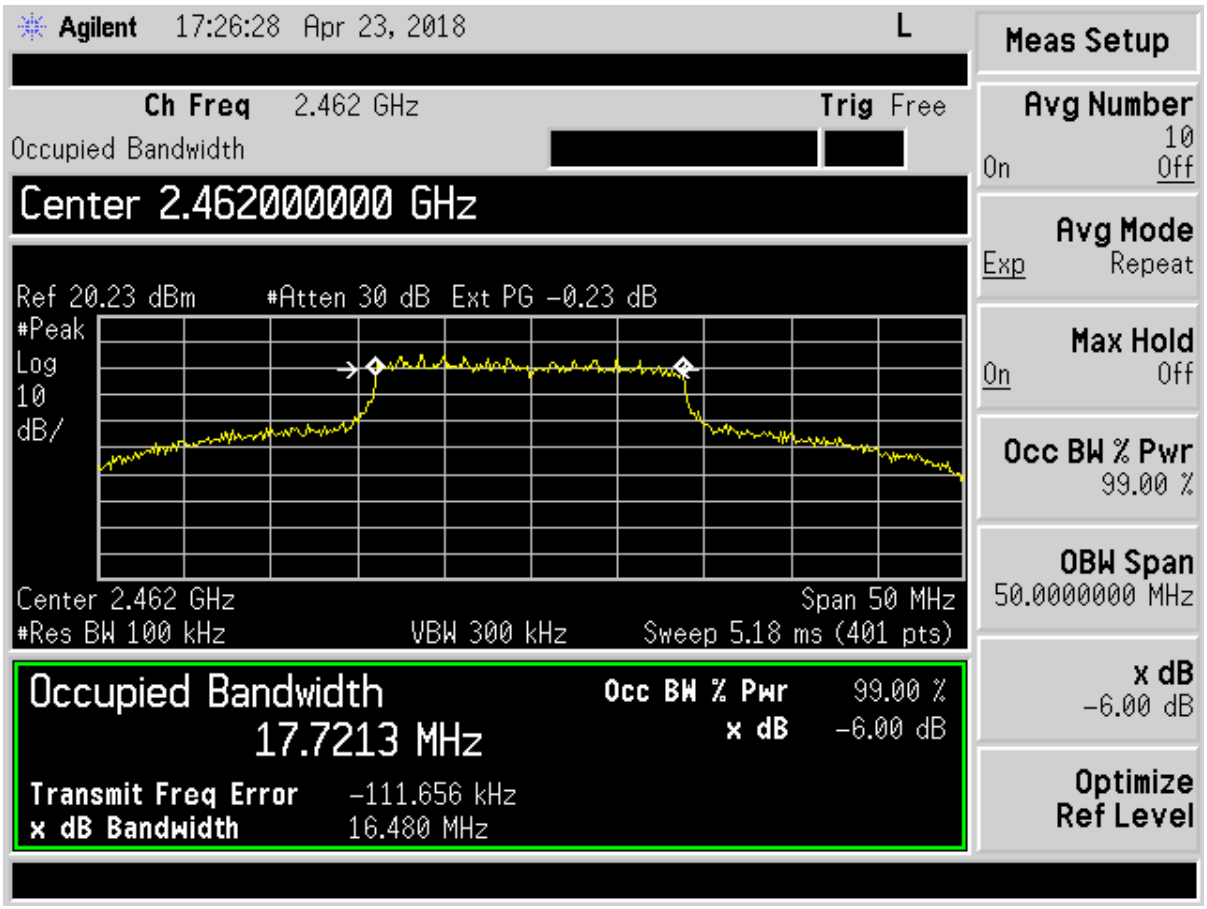


Figure 52. 6 dB Bandwidth N mode High Channel

2.13 Occupied Bandwidth, 20 dB (99% bandwidth)(RSS-GEN (6.6))

The EUT antenna port was connected to a spectrum analyzer having a 50Ω input impedance. Measurements were performed similar to the method of FCC, KDB Publication No. 558074 v03r05 for a bandwidth of 20 dB. The RBW was set to approximately 1/100 of the manufacturers claimed RBW and with the VBW ≥ RBW. The results of this test are given in Table 15 and Figures 29 through 31.

Table 12. 99% Occupied Bandwidth

Frequency (MHz)	99% Occupied Bandwidth (MHz)	20 dB Occupied Bandwidth (MHz)	Mode
2412	13.873	15.393	B
2442	14.025	15.631	B
2462	14.102	15.632	B
2412	16.560	18.224	G
2442	16.575	17.823	G
2462	16.553	17.864	G
2412	17.656	18.522	N
2442	17.627	18.732	N
2462	17.640	18.750	N

Test Date: April 23, 2018
Tested By
Signature: _____ Name: John Freeman

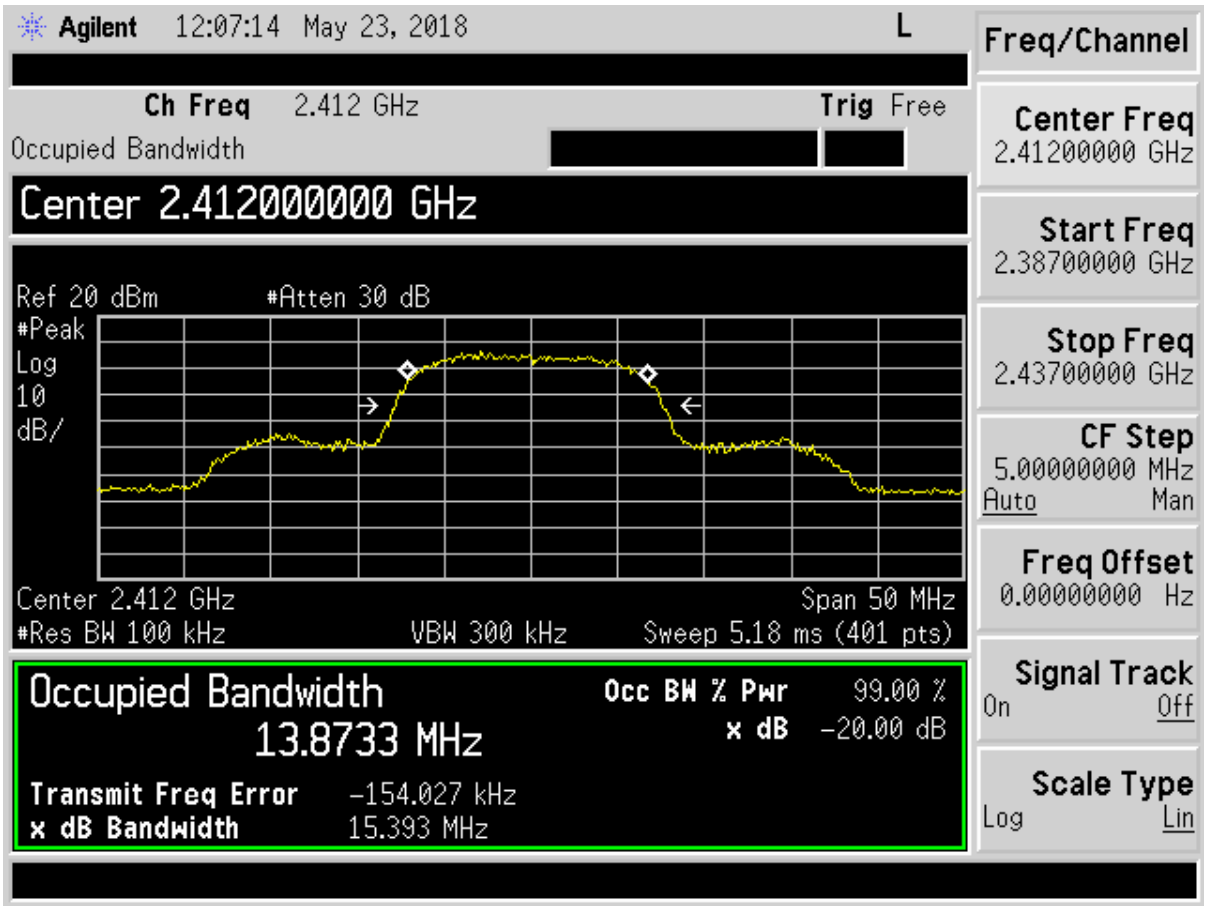


Figure 53. 20 dB Bandwidth–B mode Low Channel

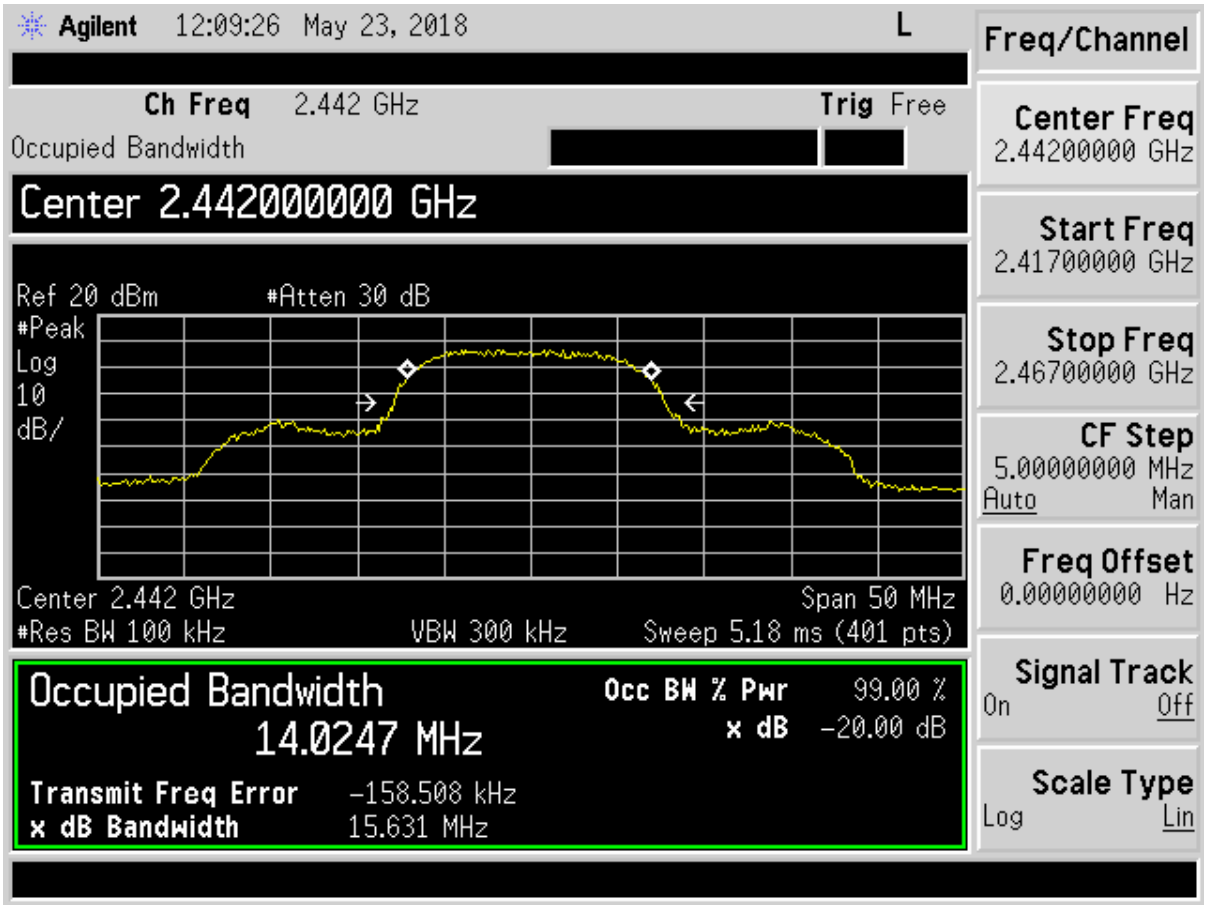


Figure 54. 20 dB Bandwidth – B mode Mid Channel

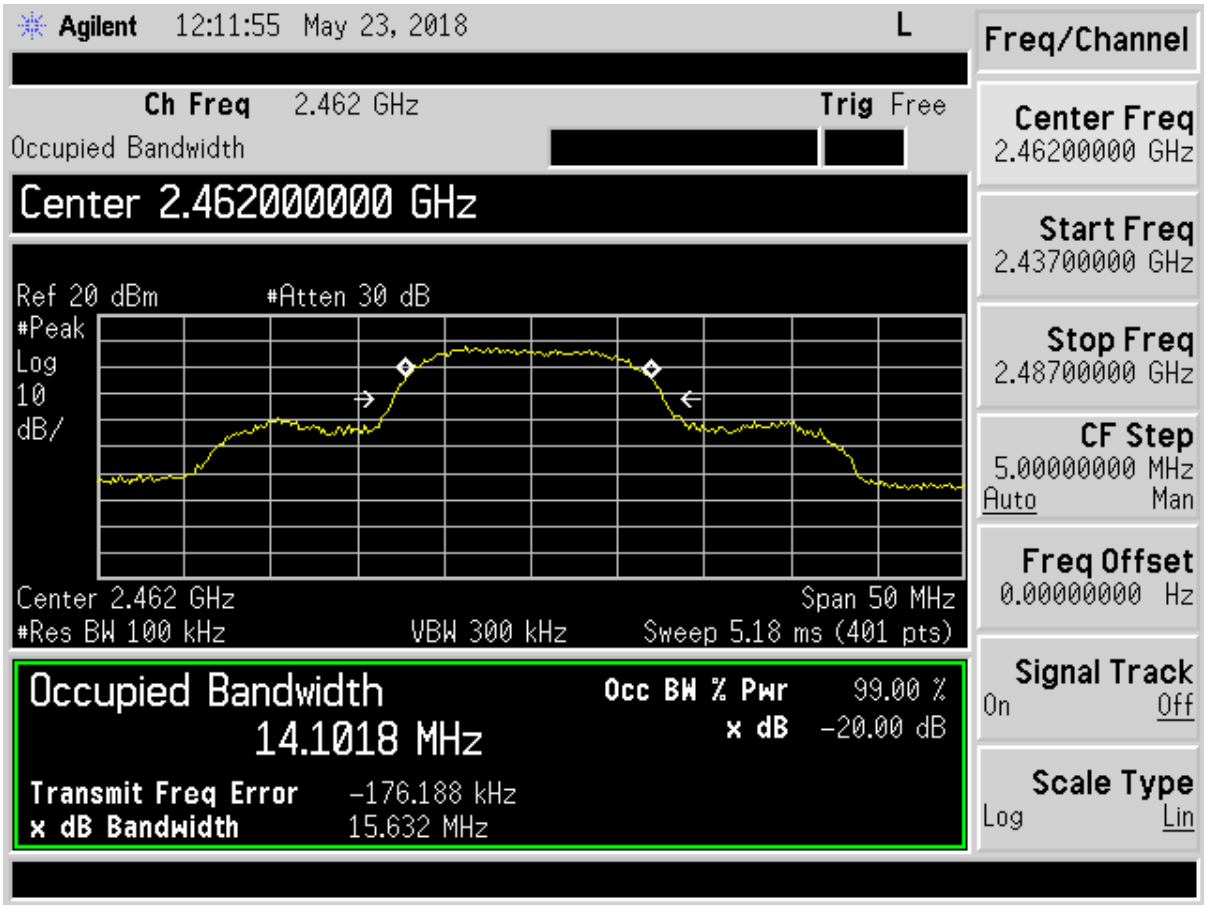


Figure 55. 20 dB Bandwidth – B mode High Channel

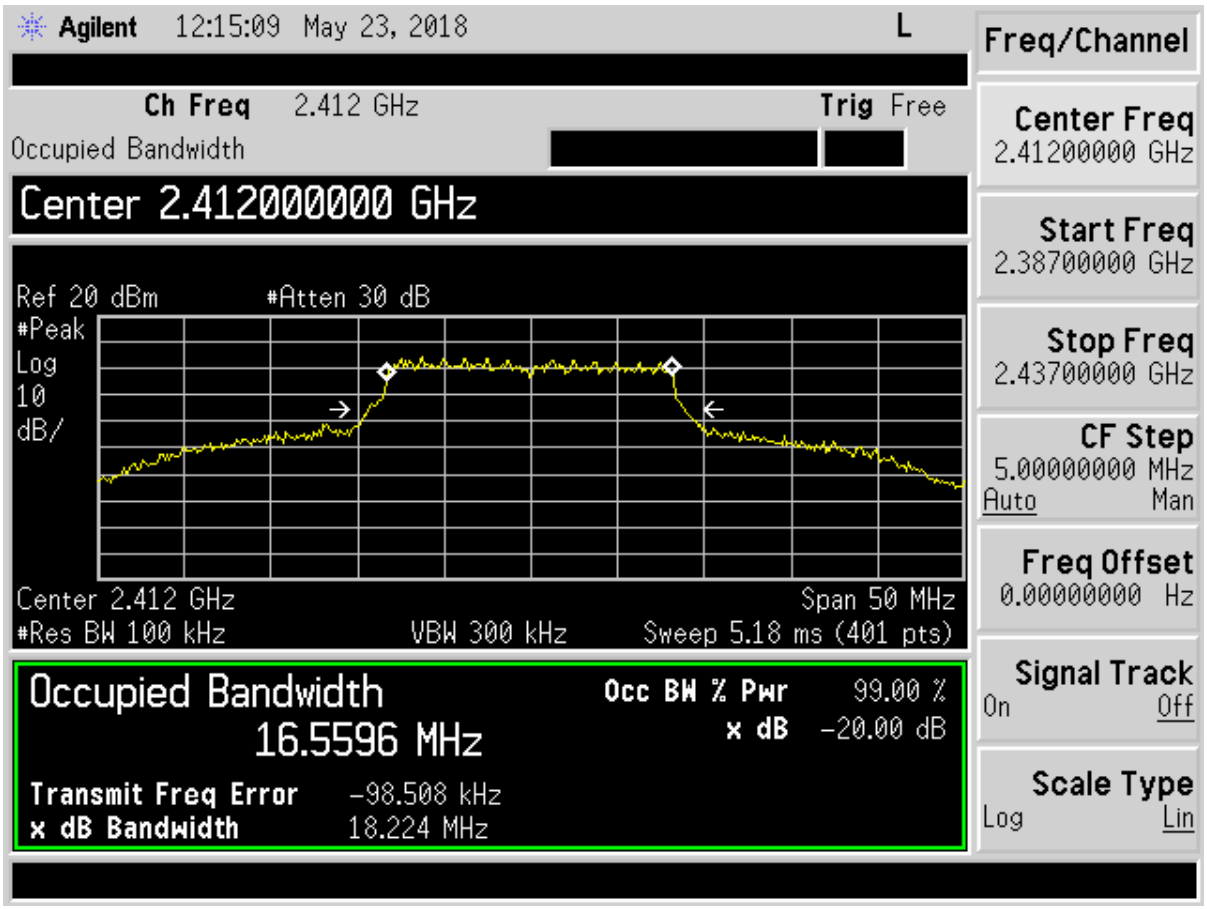


Figure 56. 20 dB Bandwidth – G mode Low Channel

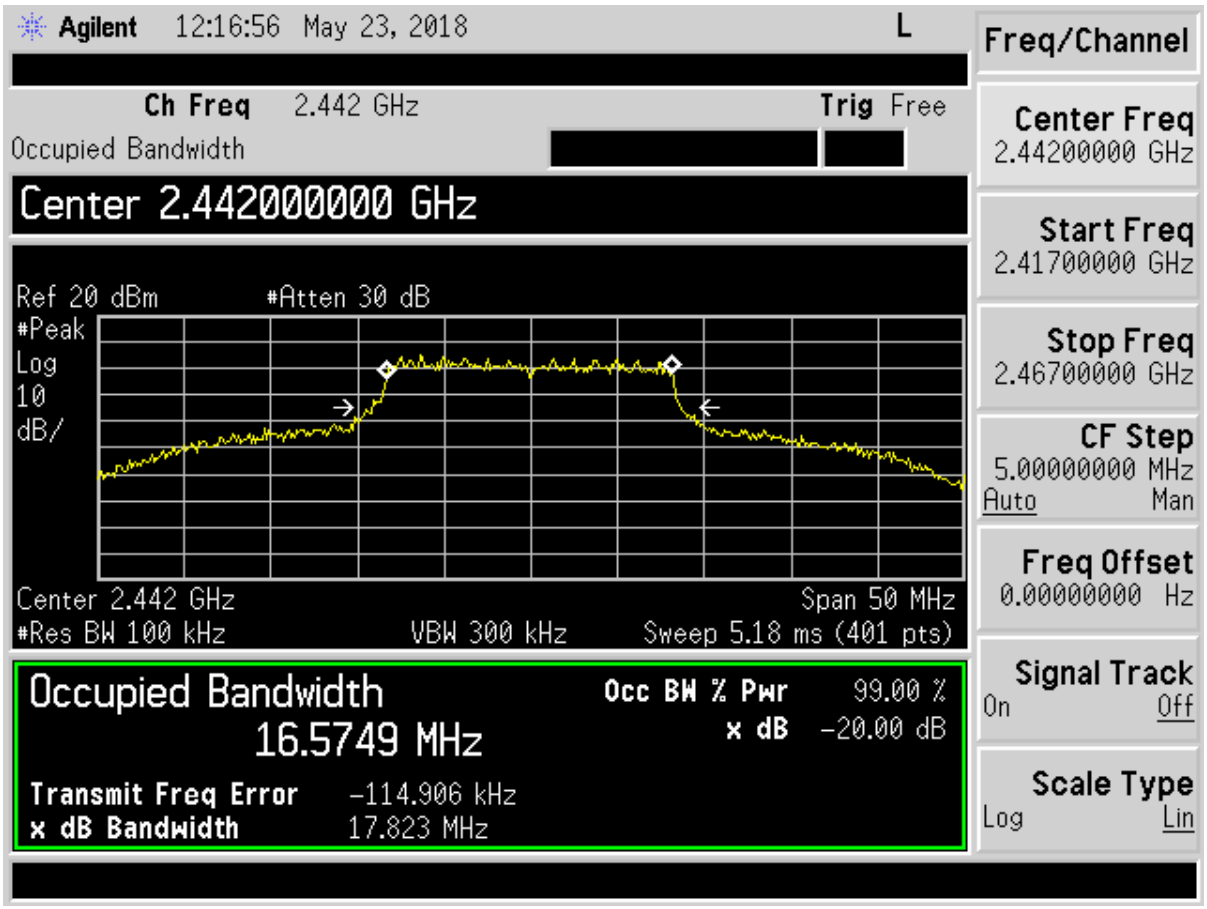


Figure 57. 20 dB Bandwidth – G mode Mid Channel

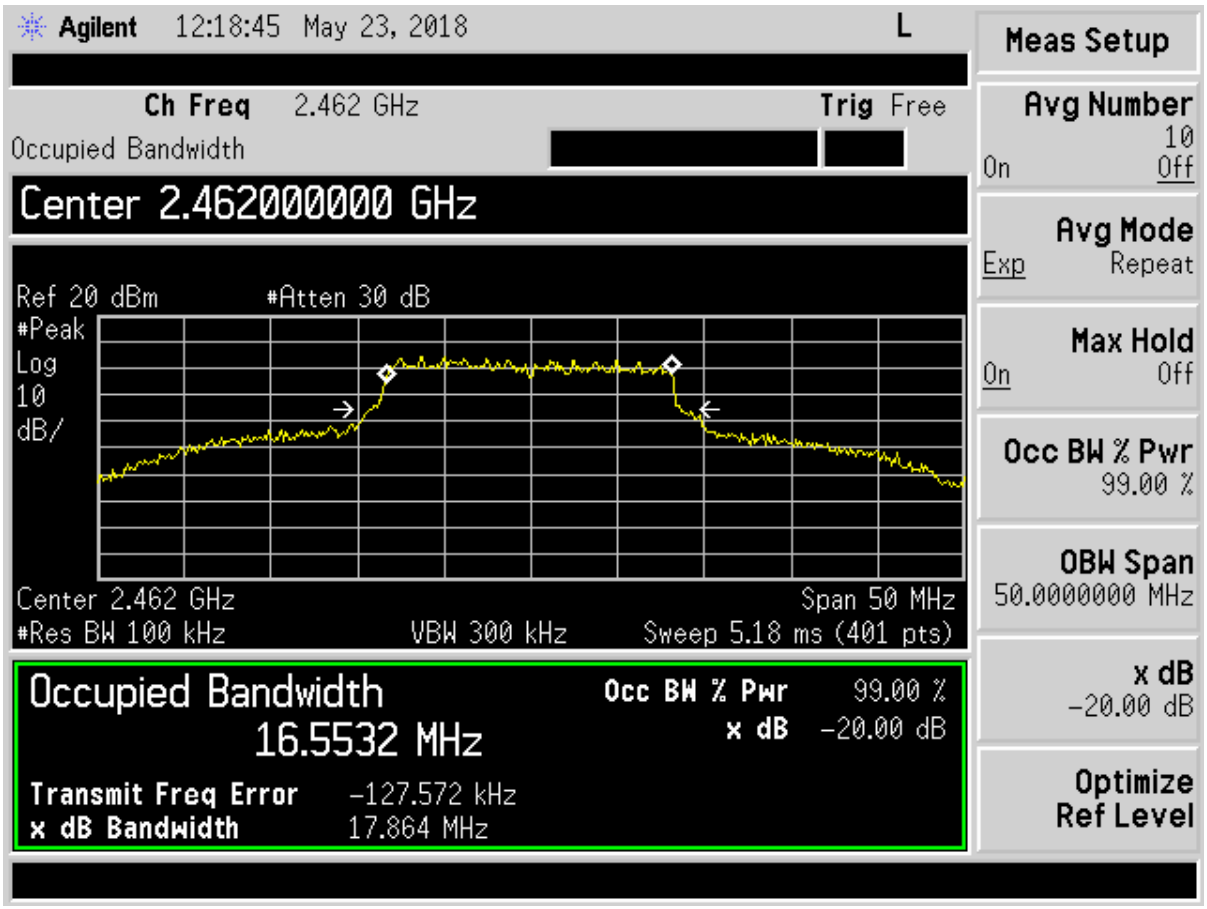


Figure 58. 20 dB Bandwidth – G mode High Channel

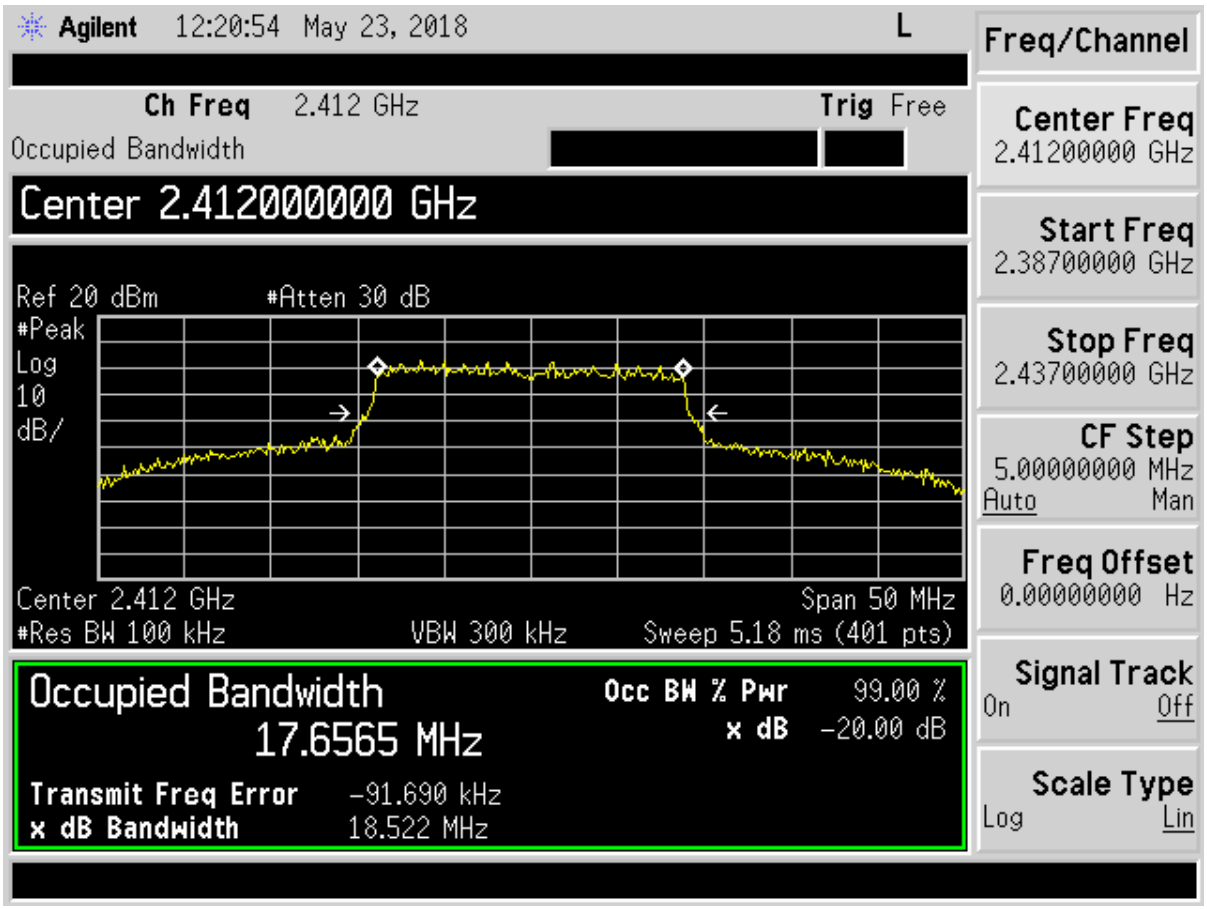


Figure 59. 20 dB Bandwidth – N mode Low Channel

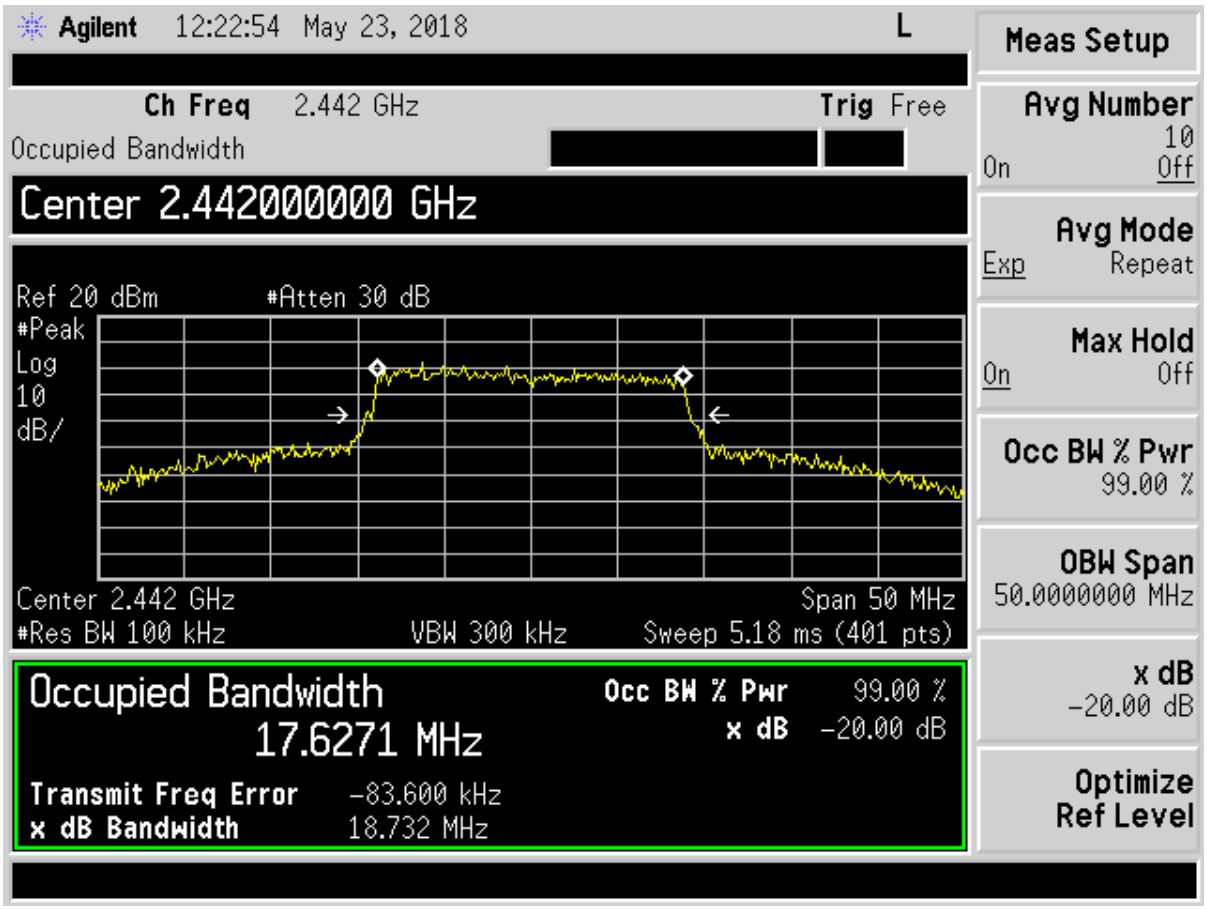


Figure 60. 20 dB Bandwidth – N mode Mid Channel

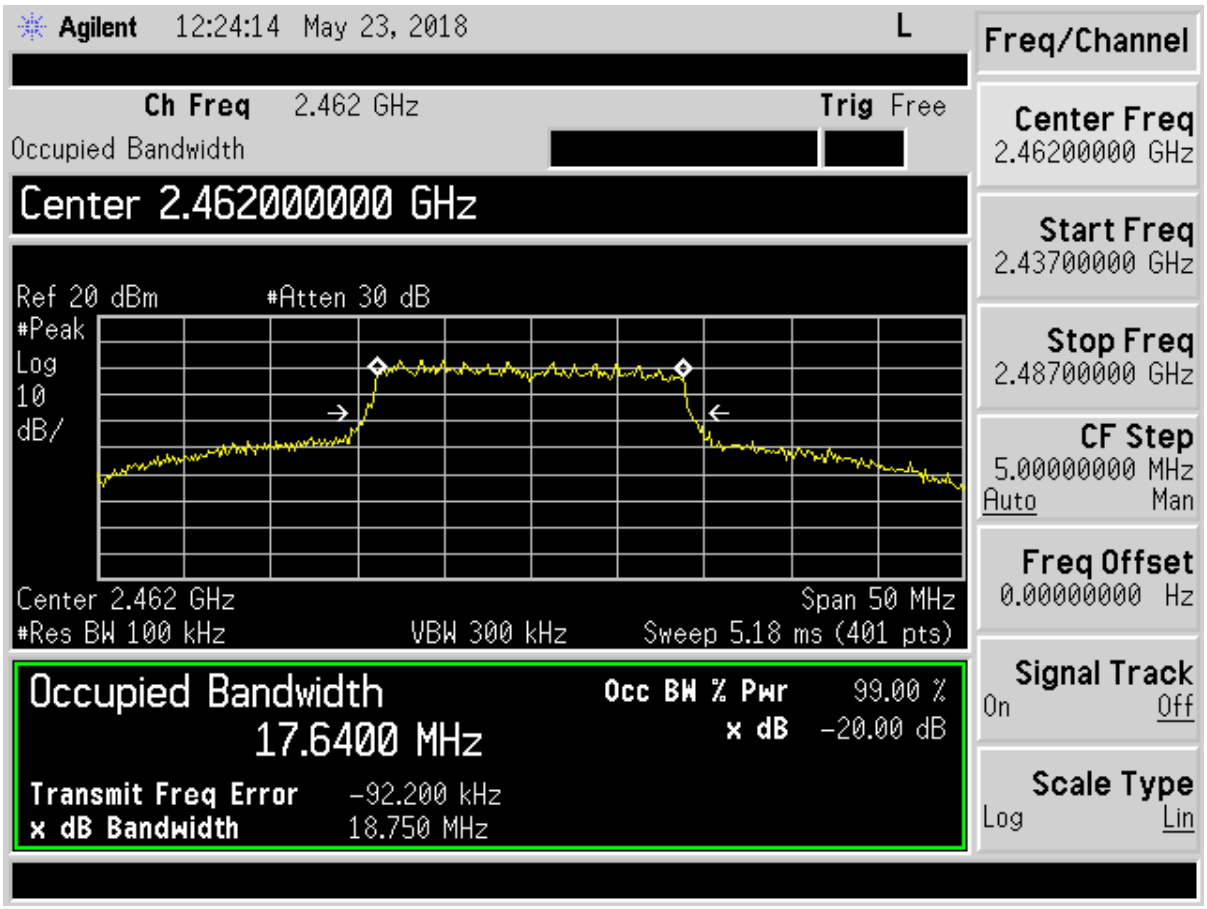


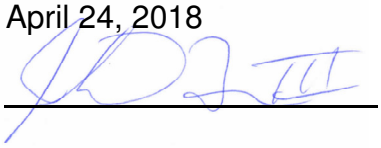
Figure 61. 20 dB Bandwidth – N mode High Channel

2.14 Maximum Conducted Output Power (CFR 15.247 (b) (3)), RSS-247 (5.4(d))

Maximum power within the band 2400 MHz to 2483.5 MHz was measured per KDB 558074 D01 V04 and ANSI C63.10:2013 as an Antenna Conducted test with a spectrum analyzer by connecting the spectrum analyzer directly, via a short RF cable, and attenuators to the antenna output terminals on the EUT. The spectrum analyzer was set to a RBW of 3 MHz, and the VBW ≥ RBW. The integration method was used. AVERAGE antenna conducted output power is tabulated in the table below.

Table 13. AVERAGE Antenna Conducted Output Power per Part 15.247 (b)(3)

Frequency of Fundamental (MHz)	Raw Test Data dBm	Converted Data (mW)	FCC Limit (mW Maximum)	Mode
2412	13.80	23.99	1000	B
2442	15.15	32.73	1000	B
2462	14.56	28.57	1000	B
2412	11.82	15.20	1000	G
2442	11.82	15.20	1000	G
2462	11.44	13.93	1000	G
2412	10.04	10.09	1000	N
2442	10.13	10.30	1000	N
2462	10.20	10.47	1000	N

Test Date: April 24, 2018
Tested By
Signature:  Name: John Freeman

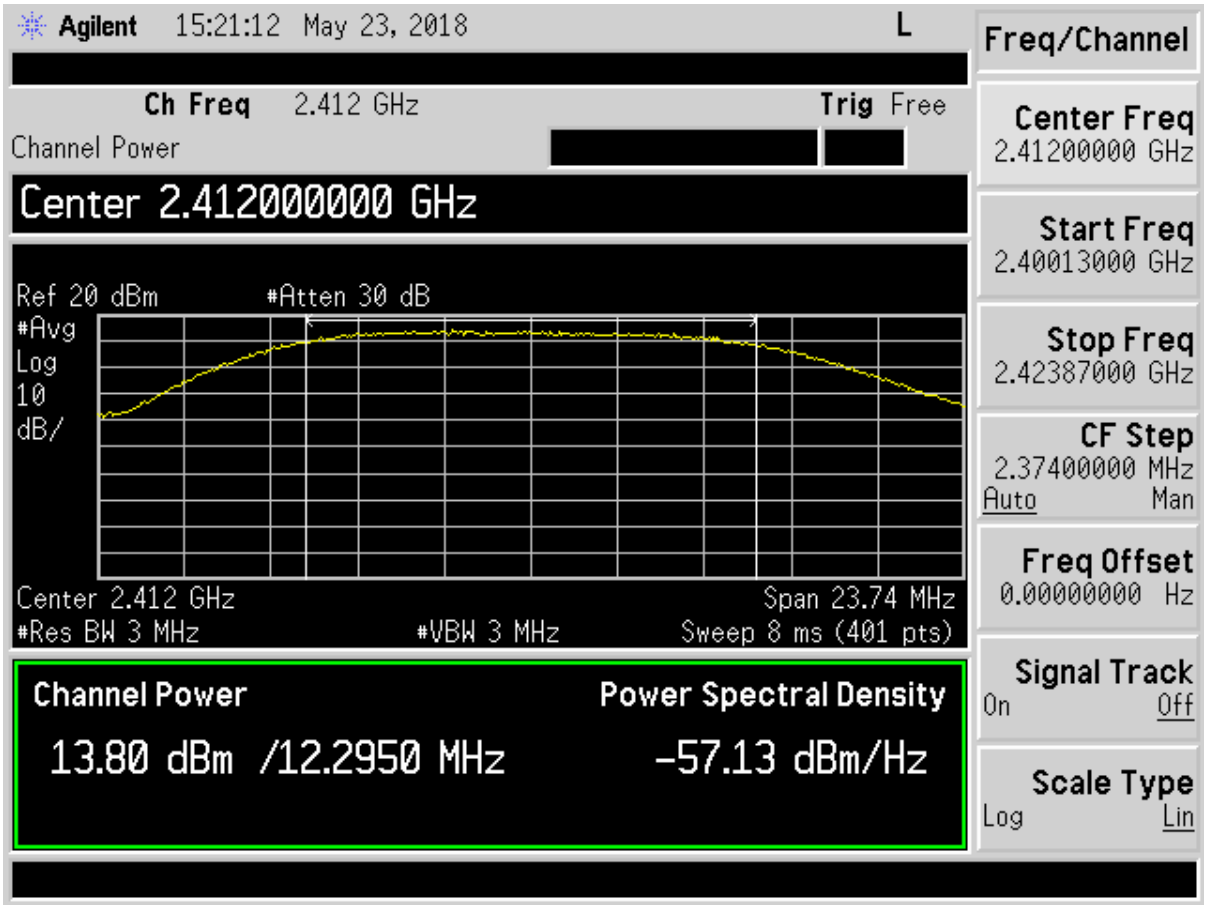


Figure 62. Peak Antenna Conducted Output Power, B mode Low Channel

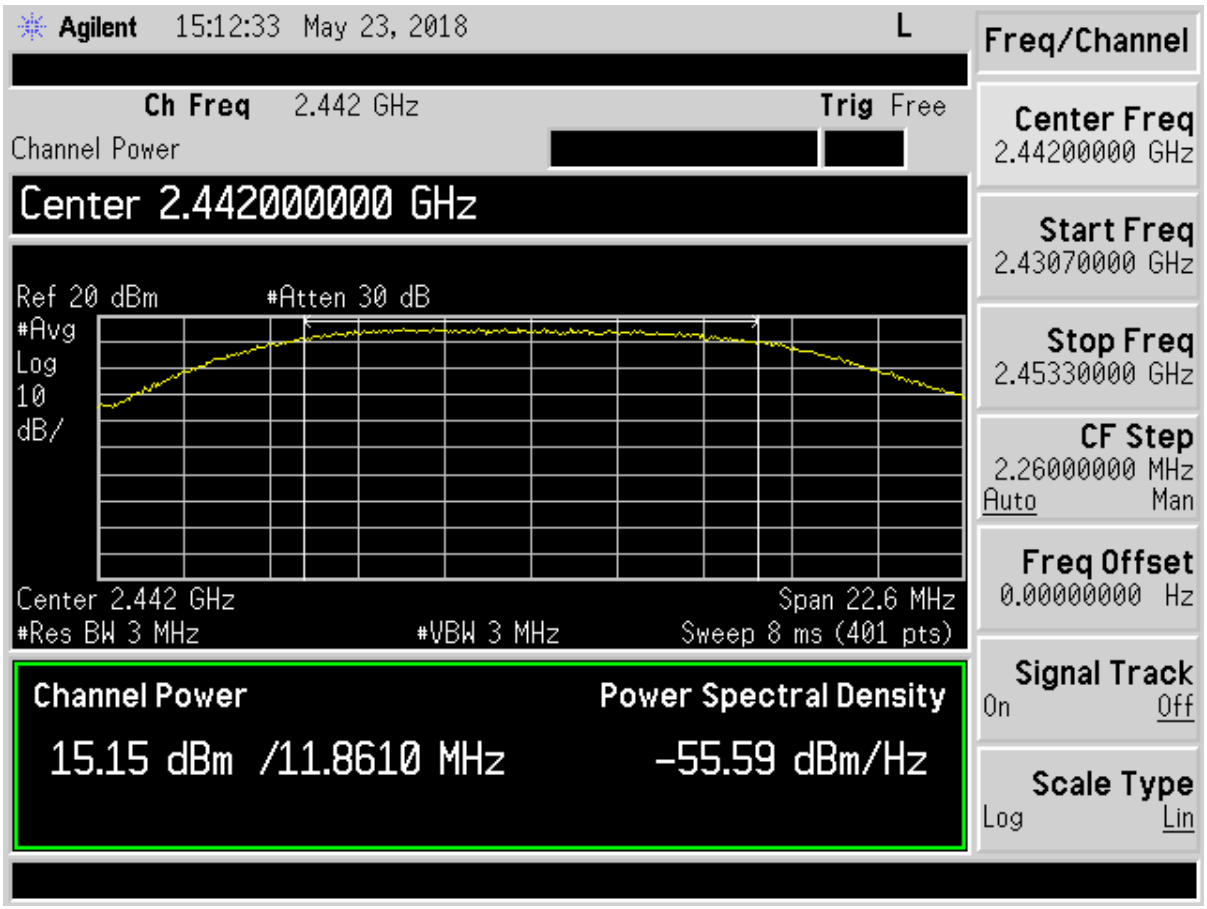


Figure 63. Peak Antenna Conducted Output Power, B mode Mid Channel

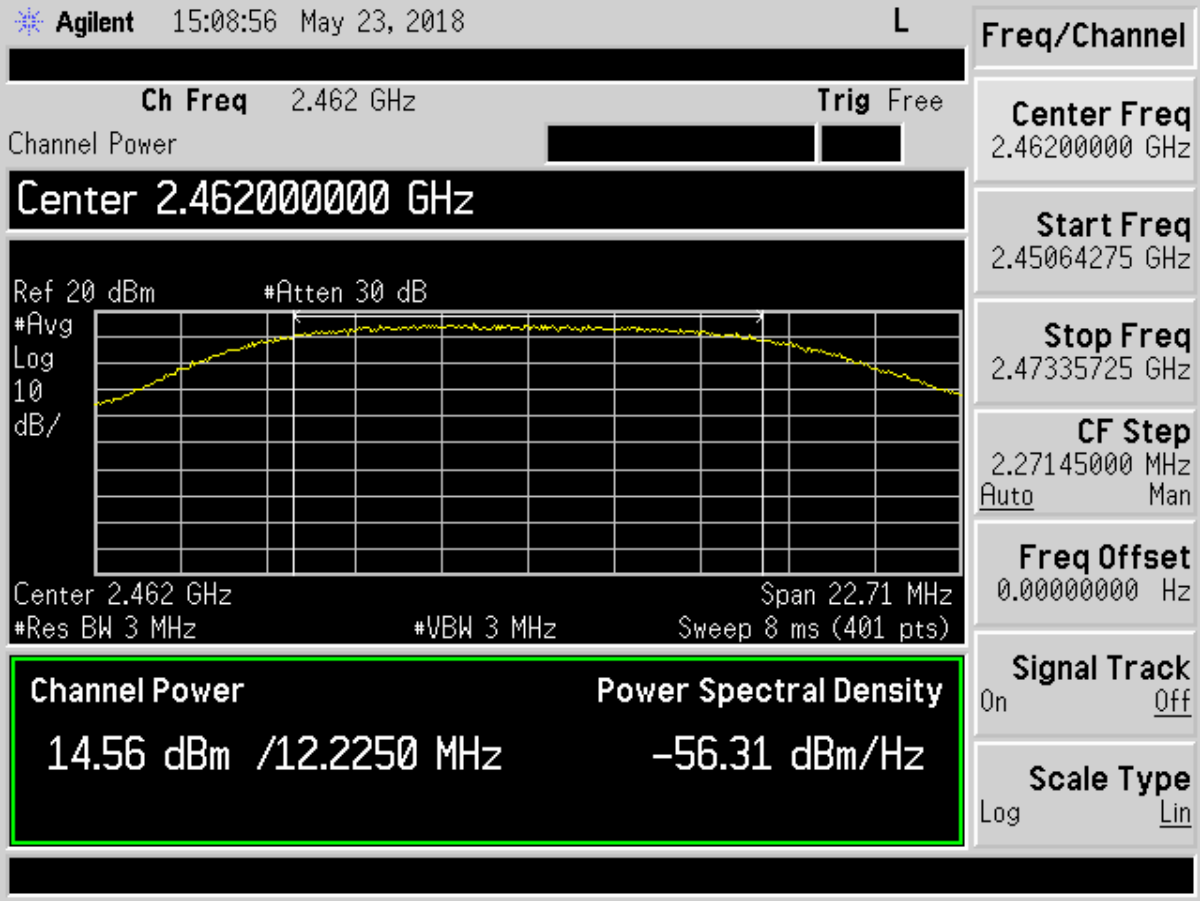


Figure 64. Peak Antenna Conducted Output Power, B mode High Channel

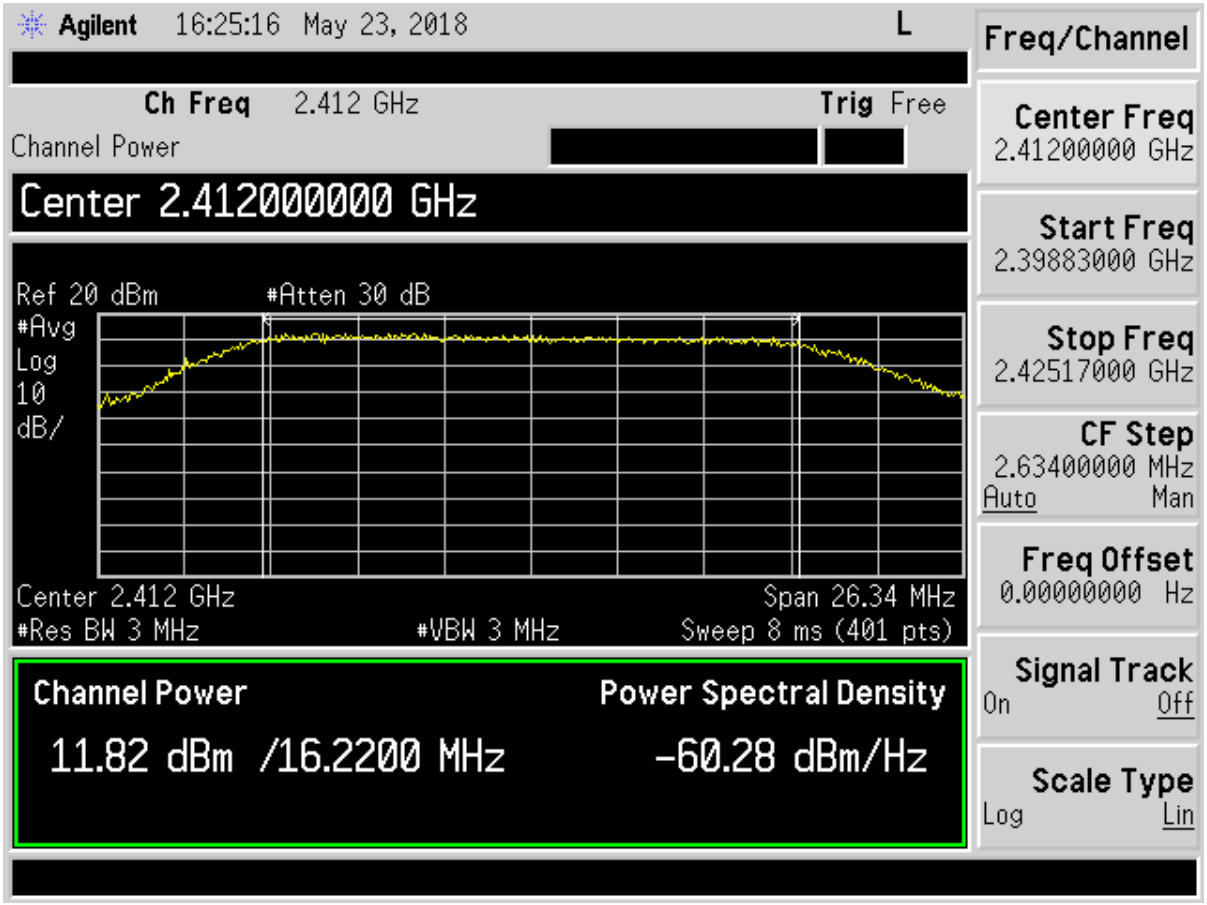


Figure 65. Peak Antenna Conducted Output Power, G mode Low Channel

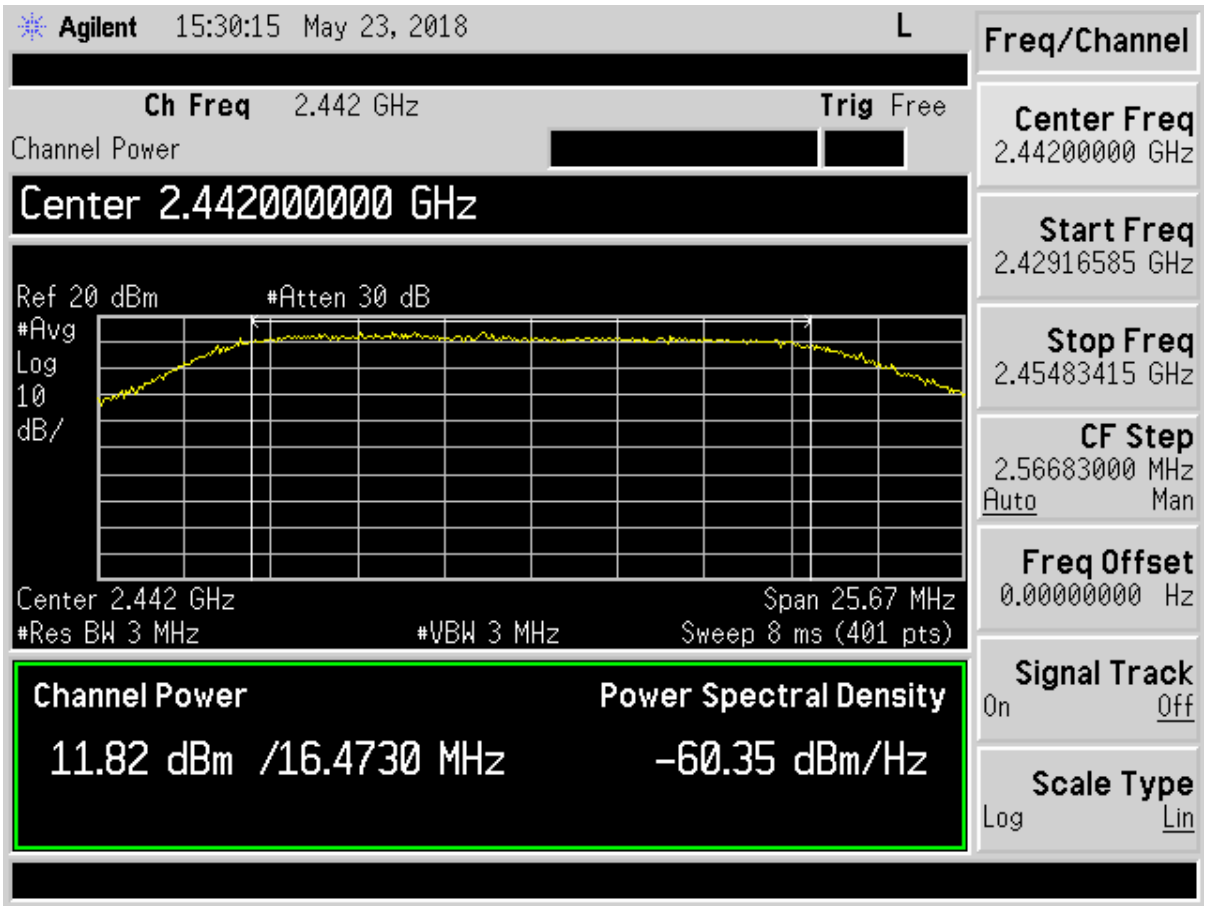


Figure 66. Peak Antenna Conducted Output Power, G mode Mid Channel

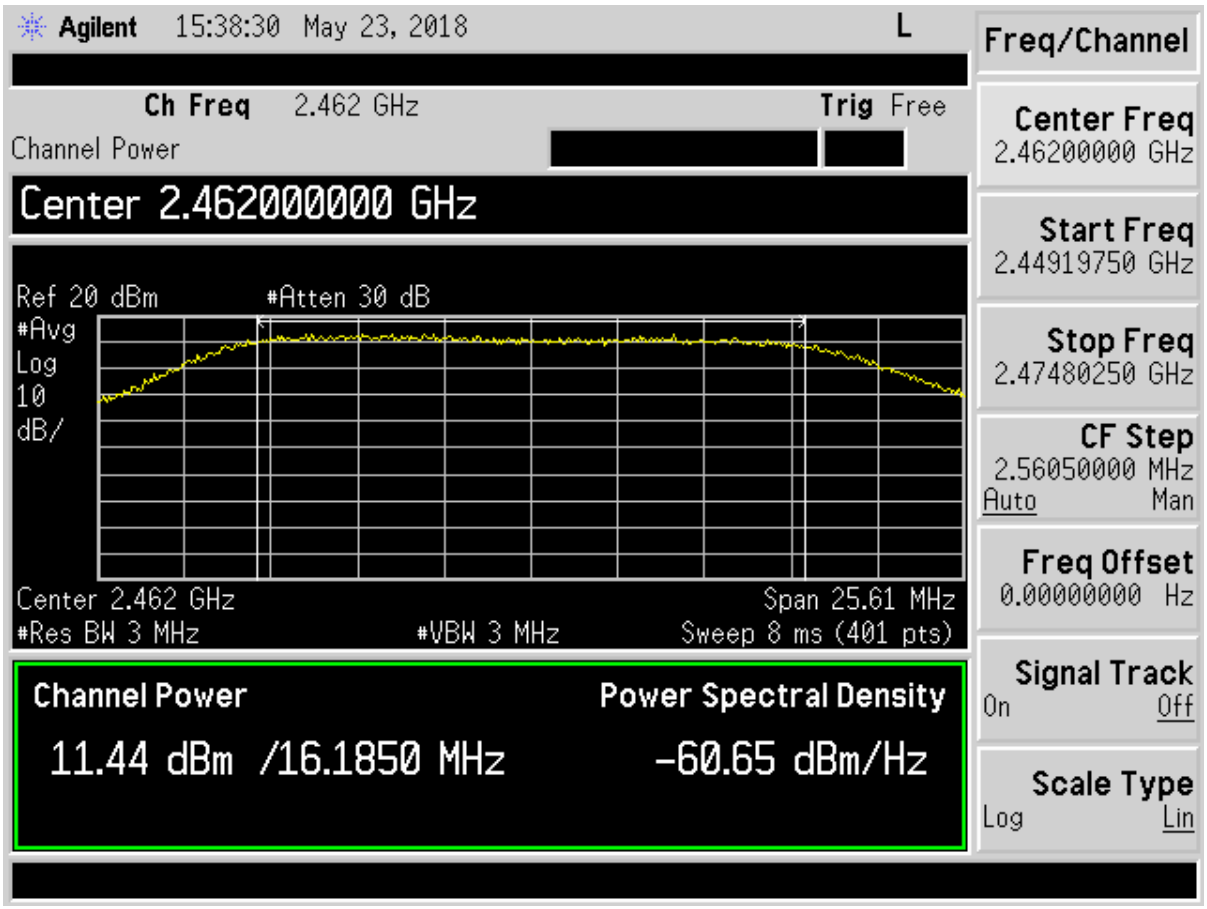


Figure 67. Peak Antenna Conducted Output Power, G mode High Channel

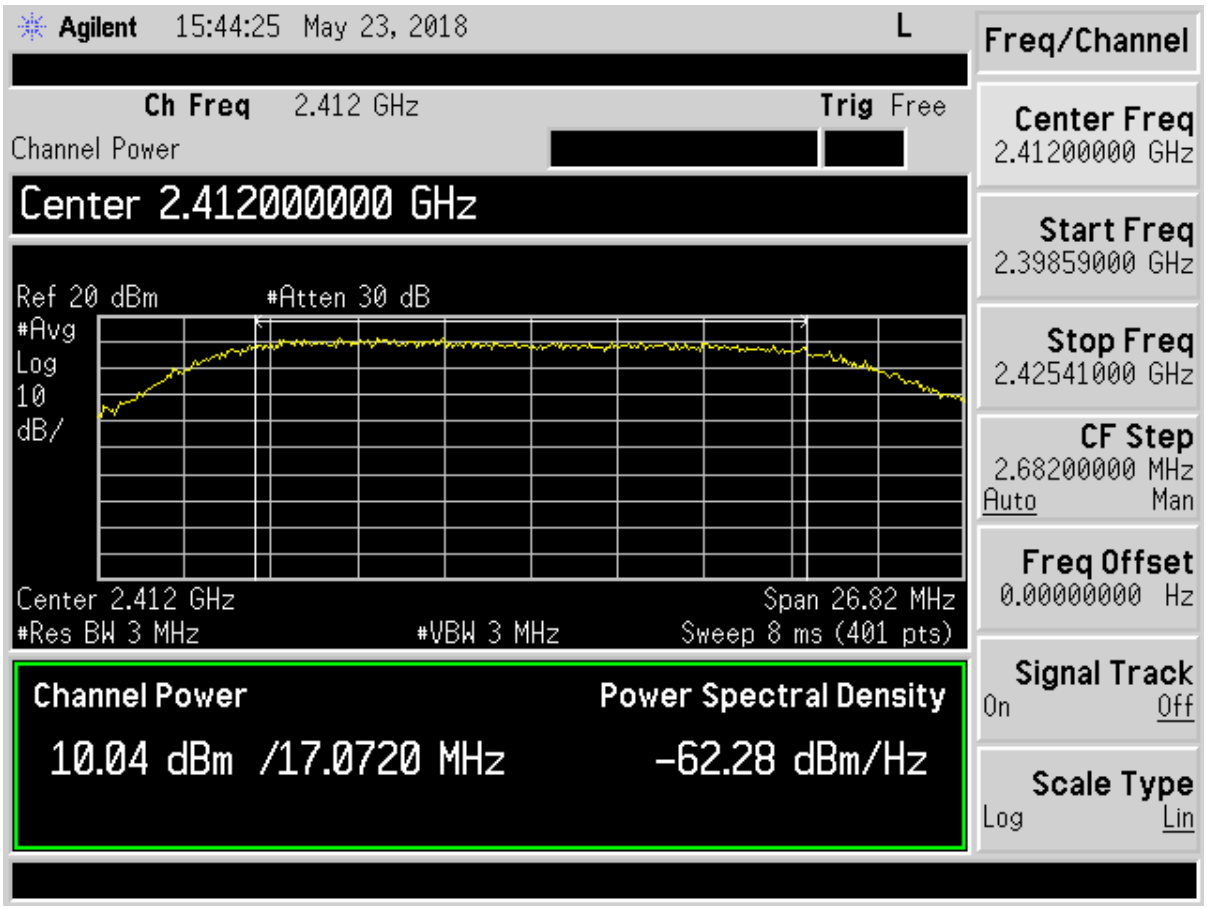


Figure 68. Peak Antenna Conducted Output Power, N mode Low Channel

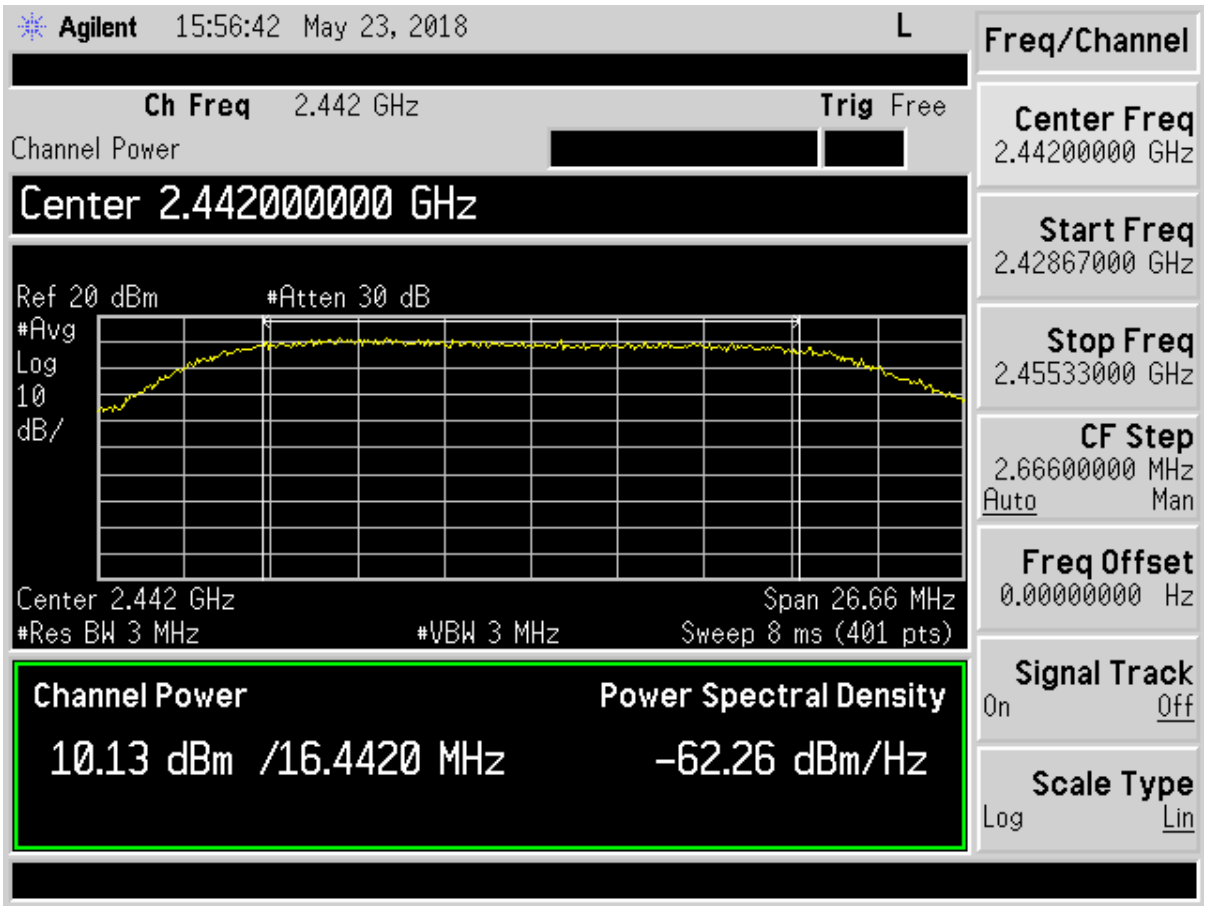


Figure 69. Peak Antenna Conducted Output Power, N mode Mid Channel

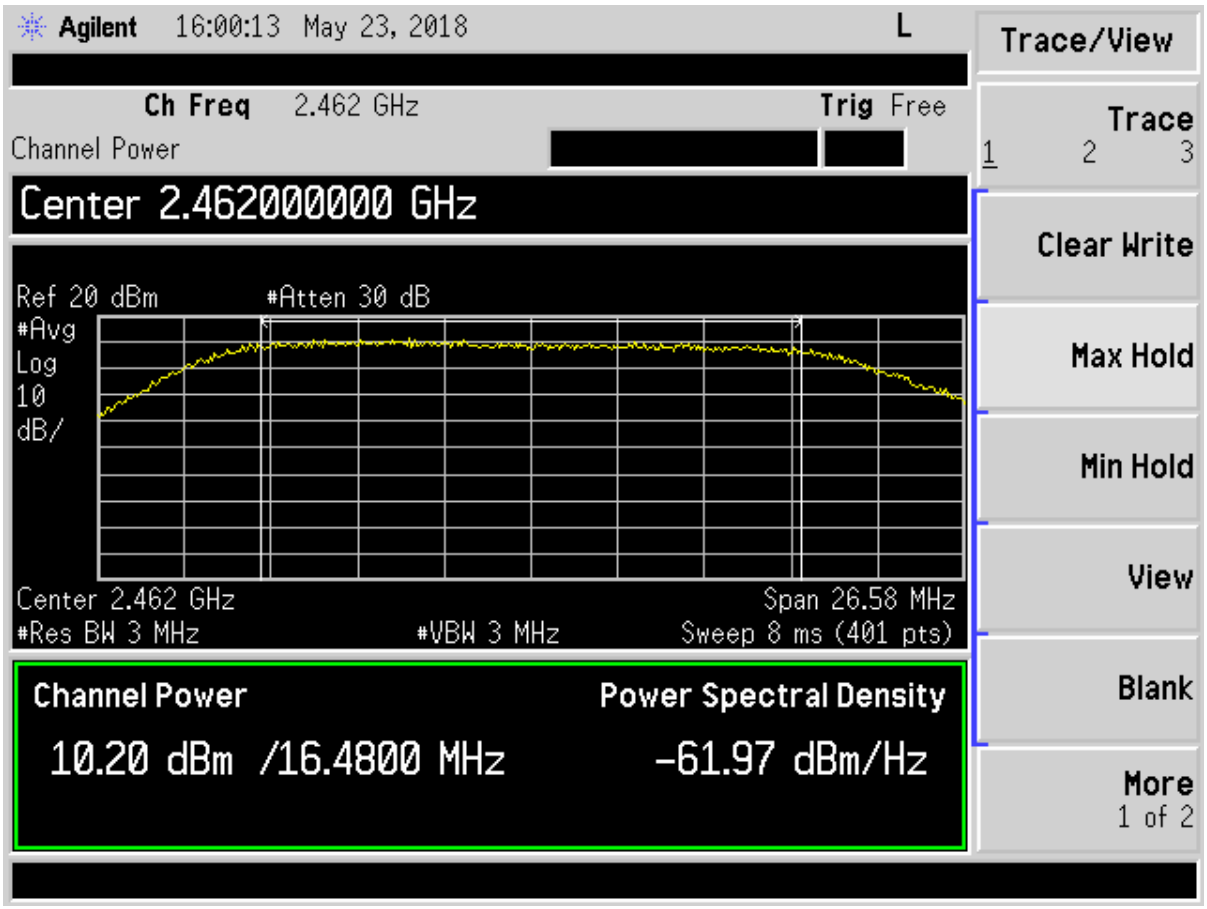


Figure 70. Peak Antenna Conducted Output Power, N mode High Channel

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

The transmitter was placed into a continuous mode of operation at all applicable frequencies. The measurements were performed per the procedures of ANSI C63.10-2013. The RBW was set to 3 kHz and the Video Bandwidth was set to ≥ RBW. The trace capture time was set to (Span/3 kHz).

In accordance with 15.247 (e), the power spectral density shall be no greater than +8 dBm per any 3 kHz band.

Results are shown in the table below and figures below. All are less than +8 dBm per 3 kHz band.

Table 14. Power Spectral Density for Low, Mid and High Bands

Frequency (MHz)	Results (dBm/kHz)	FCC Limit (dBm/3 kHz)	Mode
2412	-7.75	+8.0	B
2442	--5.13	+8.0	B
2462	-6.49	+8.0	B
2412	-8.14	+8.0	G
2442	-9.81	+8.0	G
2462	-8.54	+8.0	G
2412	-8.86	+8.0	N
2442	-8.16	+8.0	N
2462	-8.39	+8.0	N

Test Date: April 24, 2018
Tested By
Signature: _____ Name: John Freeman

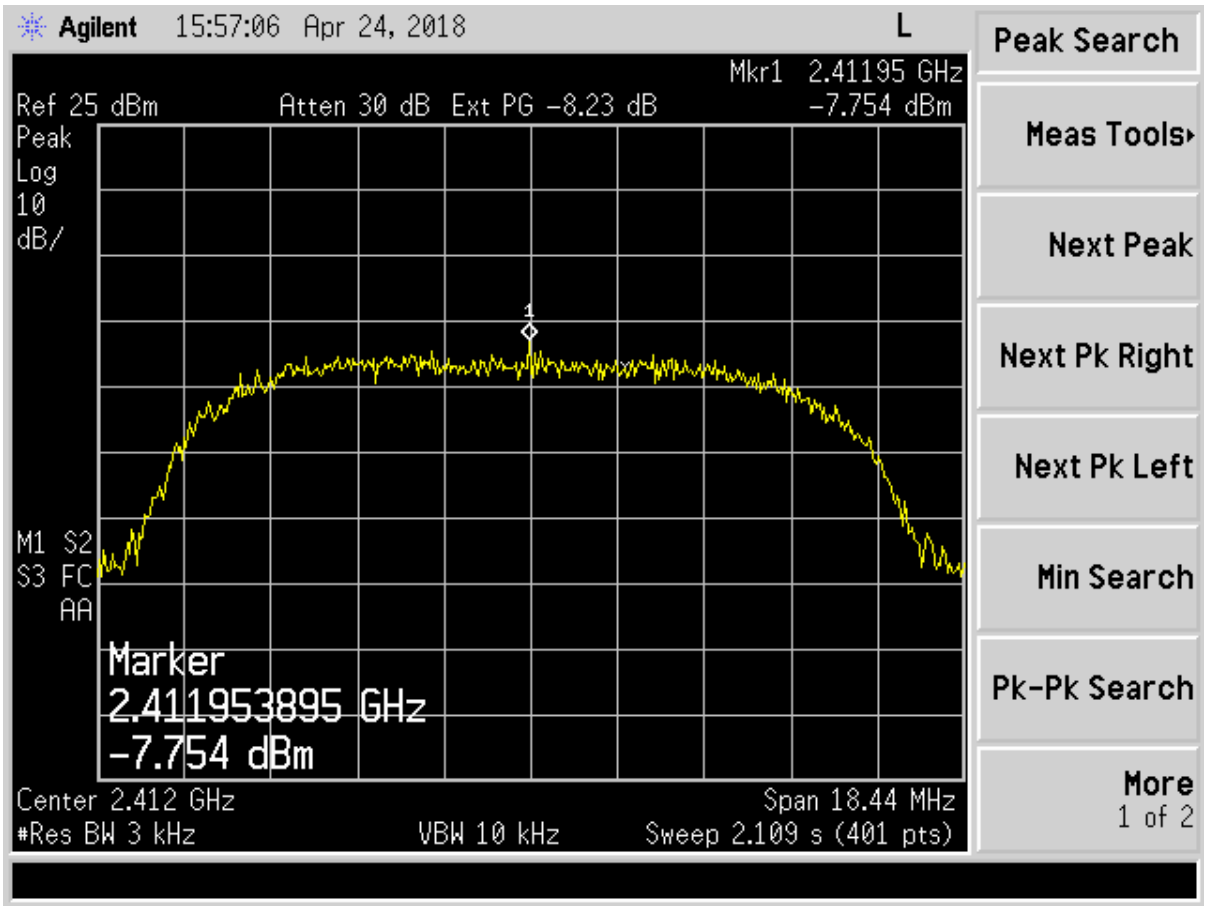


Figure 71. Peak Power Spectral Density - Part 15.247 (e) –B mode Low Channel

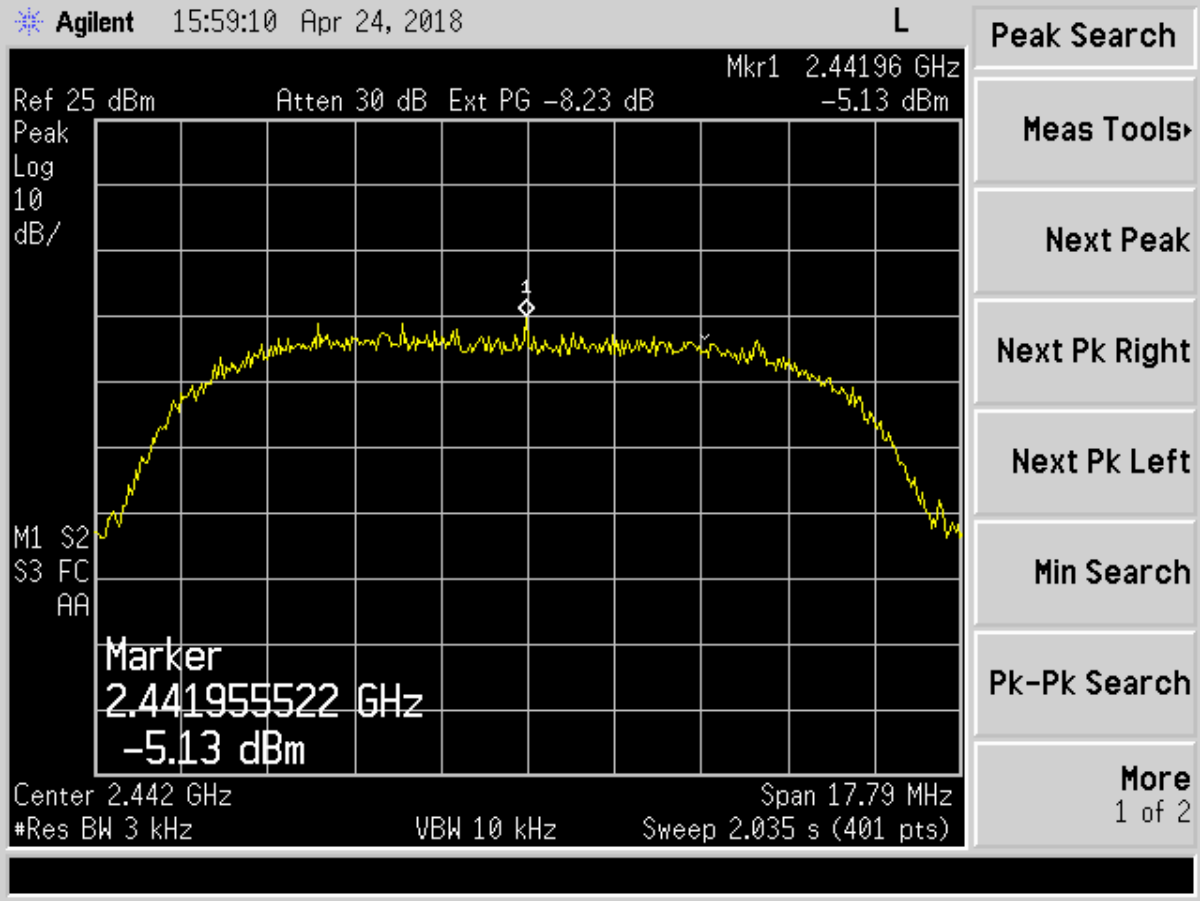


Figure 72. Power Spectral Density - Part 15.247 (e) – B mode Mid Channel

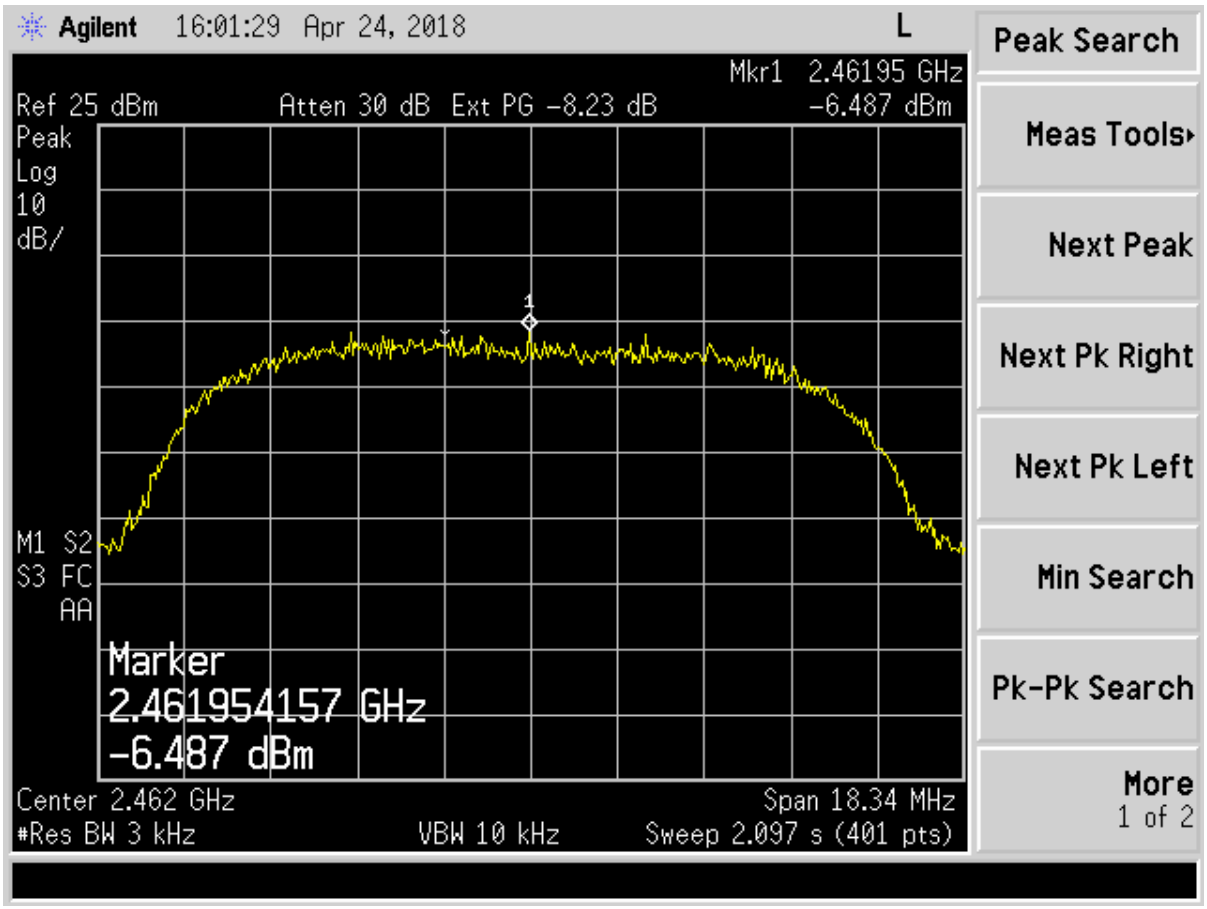


Figure 73. Peak Power Spectral Density - Part 15.247 (e) – B mode High Channel

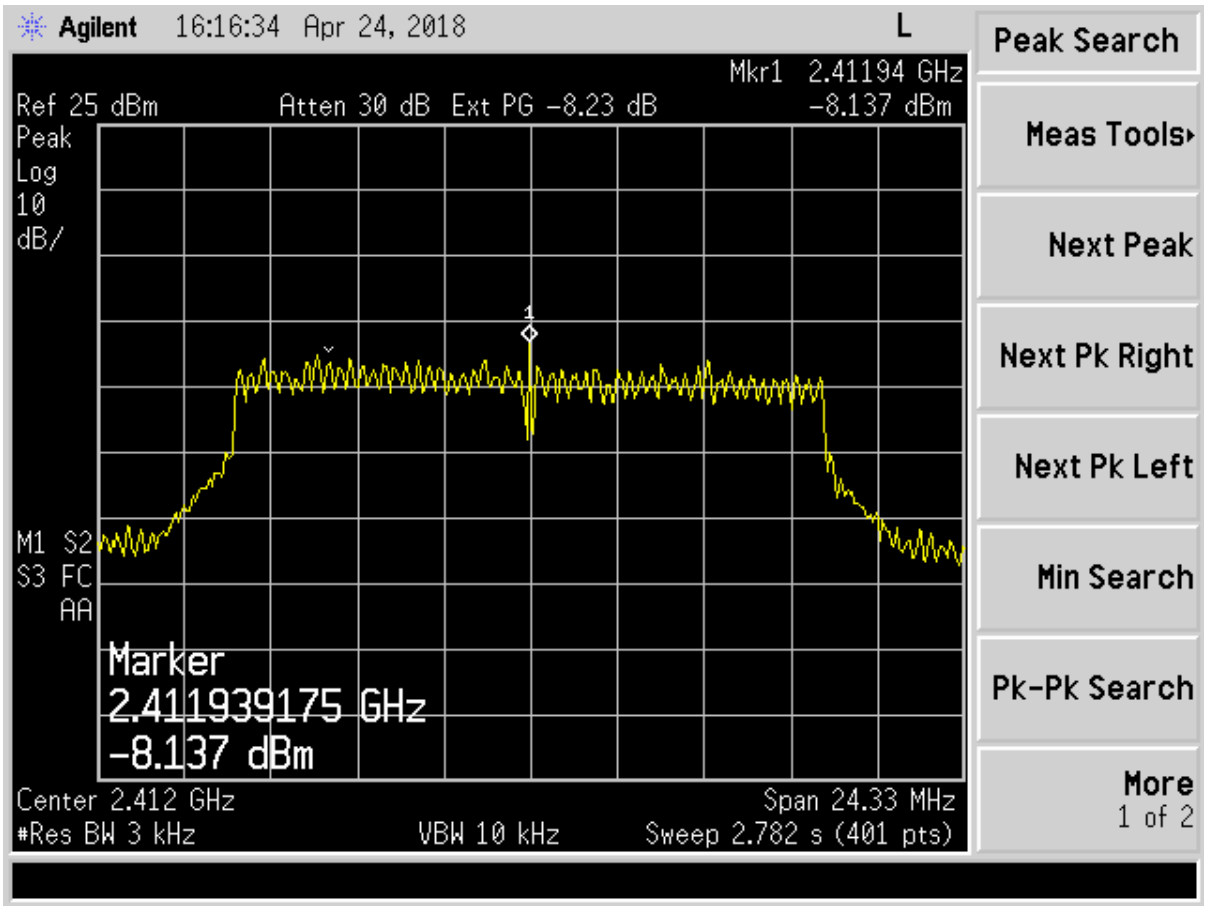


Figure 74. Peak Power Spectral Density – Part 15.247 (e) – G mode Low Channel

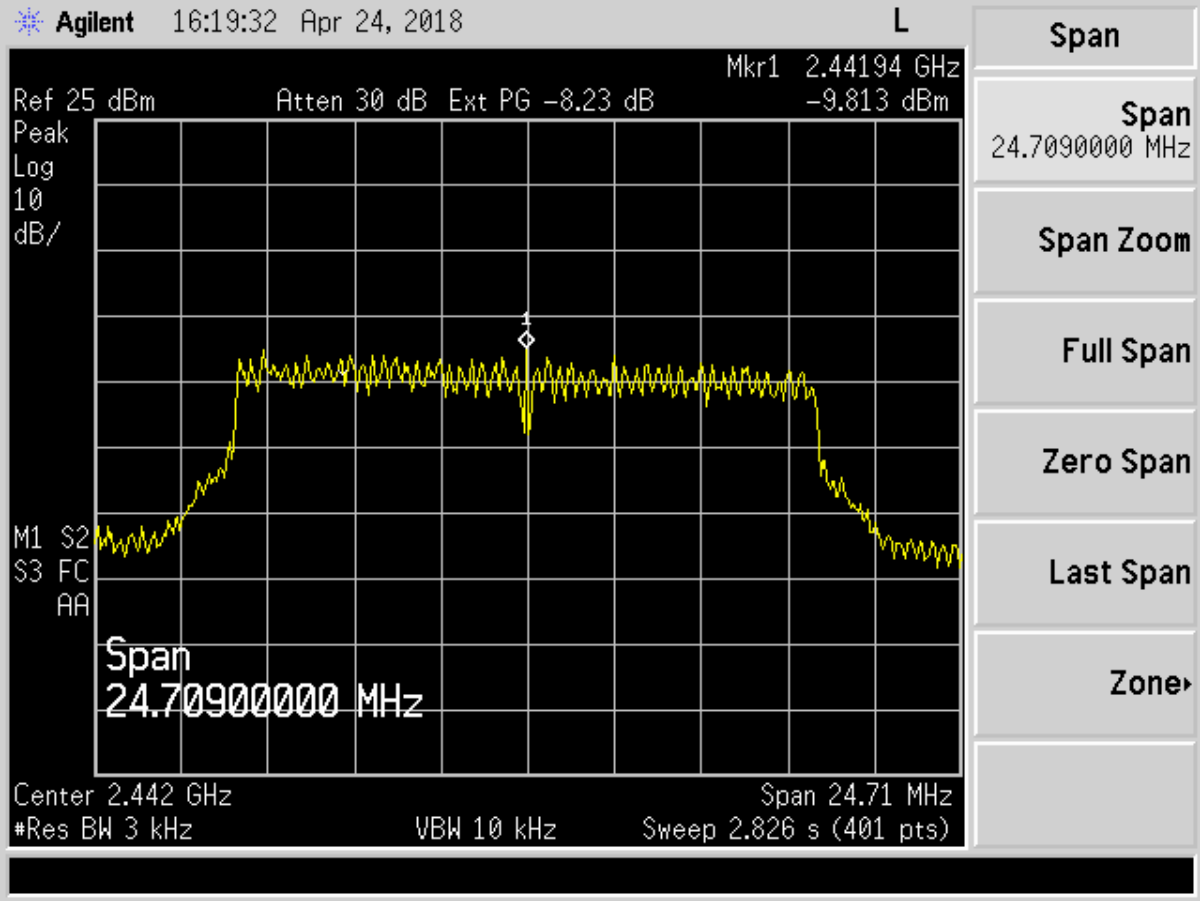


Figure 75. Peak Power Spectral Density – Part 15.247 (e) – G mode Mid Channel

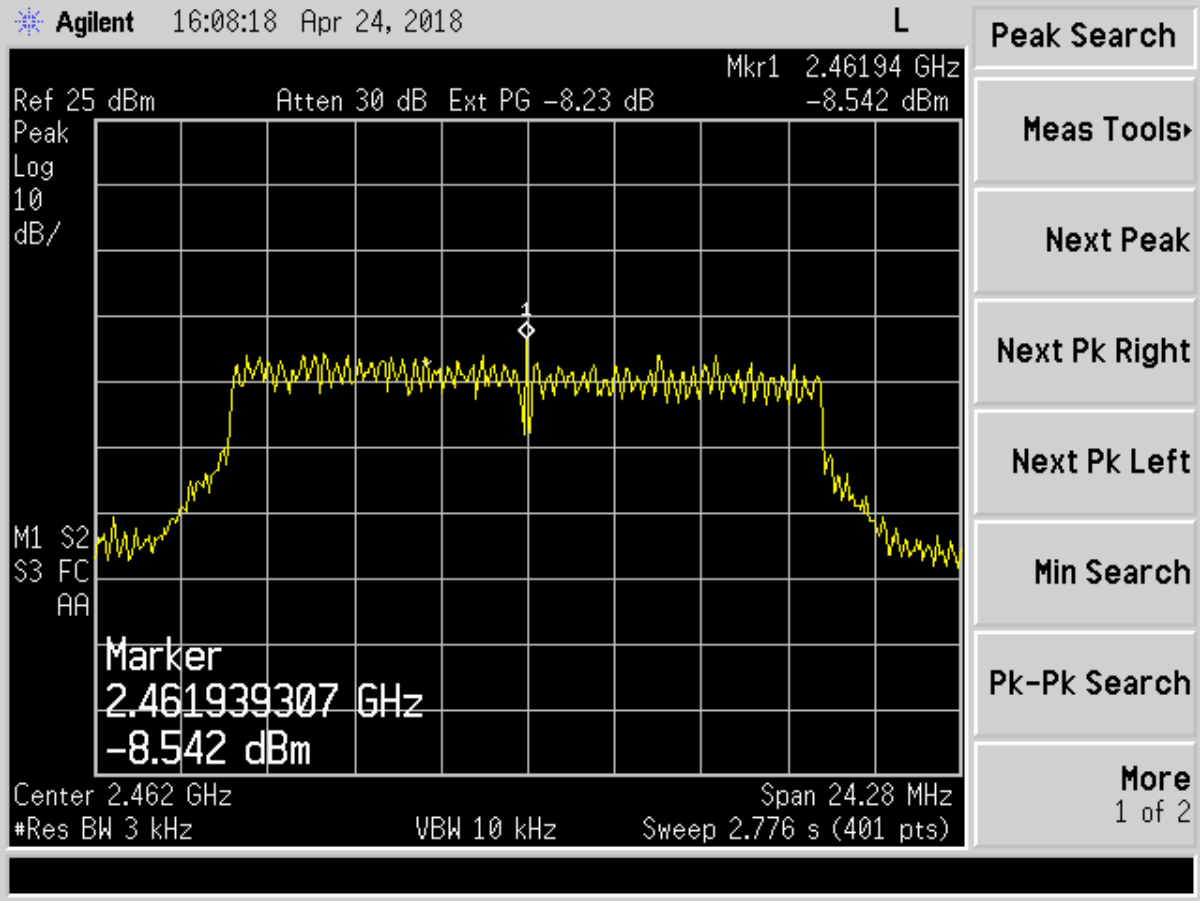


Figure 76. Peak Power Spectral Density – Part 15.247 (e) – G mode High Channel

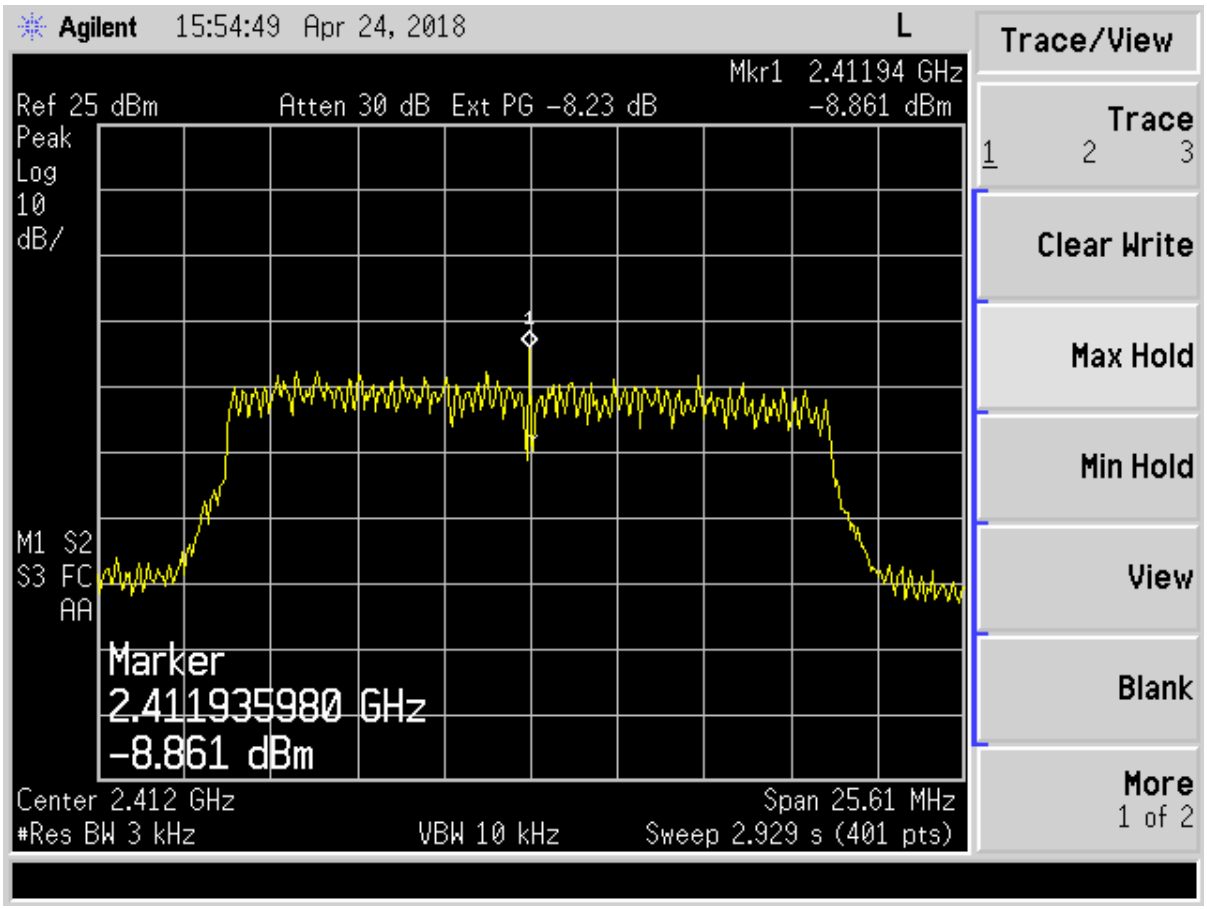


Figure 77. Peak Power Spectral Density – Part 15.247 (e) – N mode Low Channel

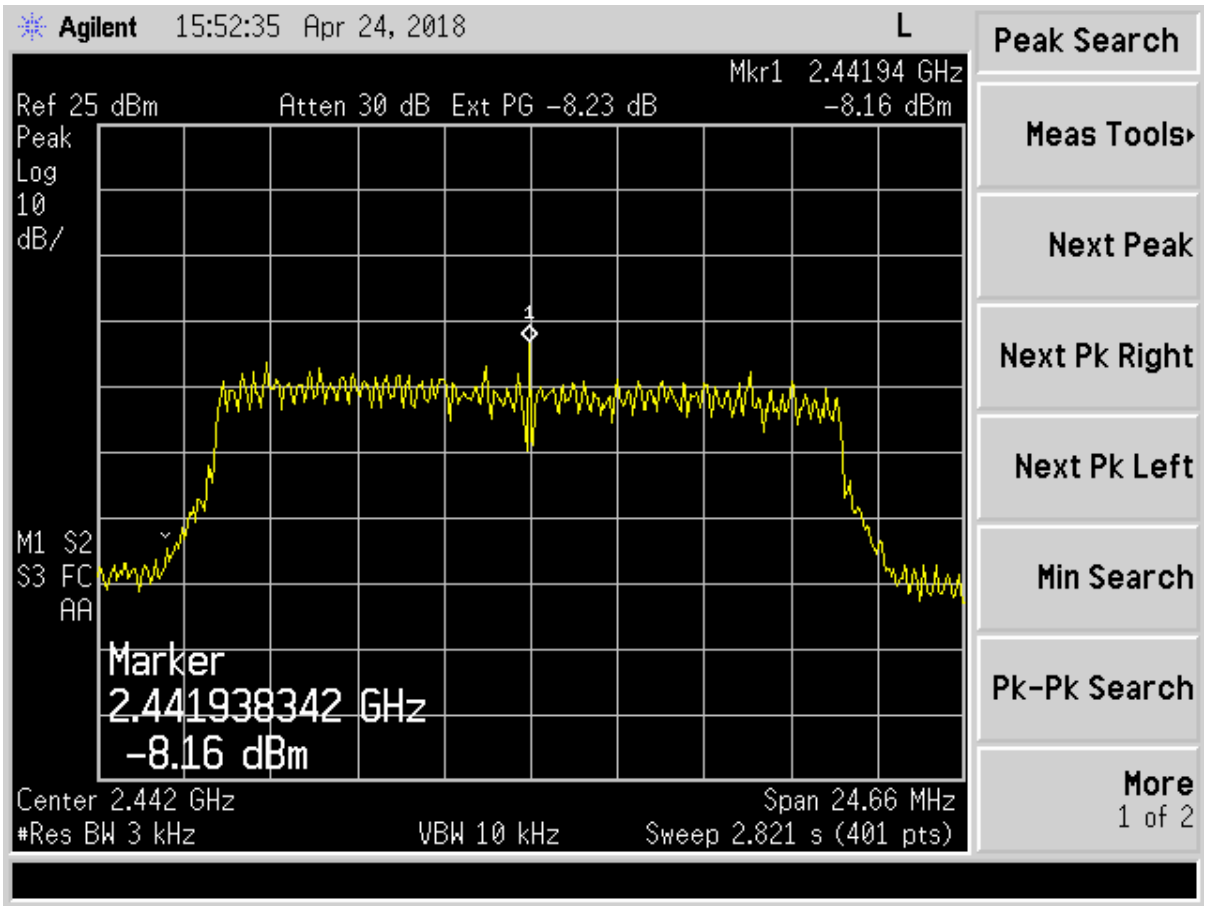


Figure 78. Peak Power Spectral Density – Part 15.247 (e) – N mode Mid Channel

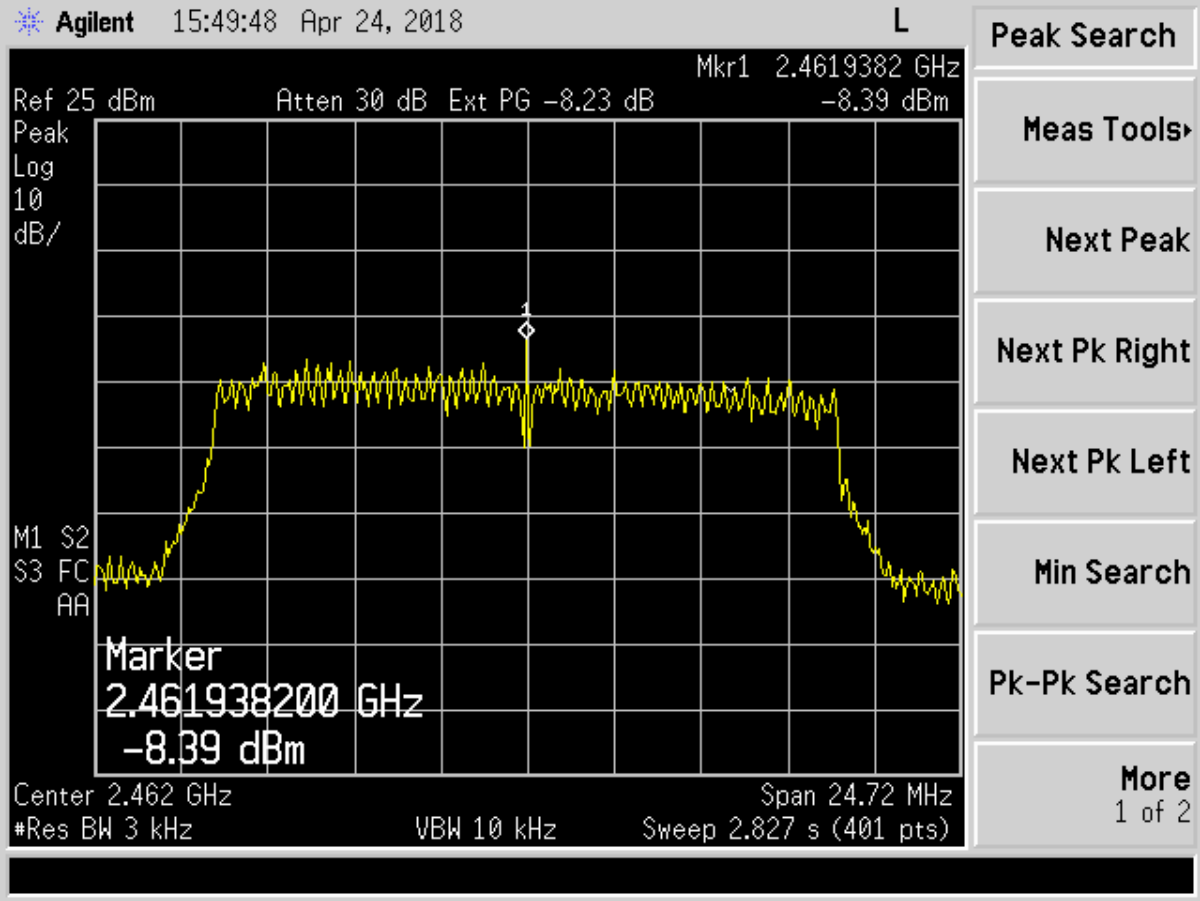


Figure 79. Peak Power Spectral Density – Part 15.247 (e) – N mode High Channel

2.16 Unintentional and Intentional Radiator Power Lines Conducted Emissions (CFR 15.107/15.207, RSS-Gen 8.8)

The test data provided in this section is to support the Verification requirement for the digital apparatus. The power line conducted voltage measurements for Receiver and Digital Devices have been carried out in accordance with CFR 15.107 and ANSI C63.4:2014, Paragraph 7, with a spectrum analyzer connected to an LISN and the EUT placed into an idle condition or a continuous mode of receive (non-transmitting).

Additionally 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 an 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. The worst case measurement was 7.9 dB from the applicable limit. All other emissions were at least 8.6 dB from the limit. Those results are given in the table below.

Table 15. Power Line Conducted Emissions

CONDUCTED EMISSIONS 150 kHz to 30 MHz						
Tested By: JF	Specification Requirement: FCC Part 15.107 &207		Project No.: 18-0042	Manufacturer: BoxLock, Inc. Model: BOXLOCK001		
Frequency (MHz)	**Test Data (dBuV)**	**LISN+CL (dB)**	**Corrected Results (dBuV)**	**Avg Limits (dBuV)**	**Margin (dB)**	**Detector**
Phase @ 120VAC/60Hz						
0.1506	46.83	0.50	47.33	56.0	8.6	**PK**
0.6370	38.01	0.14	38.15	46.0	7.9	**PK**
1.6670	35.63	0.15	35.78	46.0	10.2	**PK**
5.8000	33.79	0.26	34.05	50.0	16.0	**PK**
15.1830	32.83	0.71	33.54	50.0	16.5	**PK**
21.0000	24.81	0.65	25.46	50.0	24.5	**PK**
Neutral @ 120VAC/60Hz						
0.1500	45.68	0.61	46.29	56.0	9.7	**PK**
0.5850	33.93	0.29	34.22	46.0	11.8	**PK**
1.4330	34.25	0.30	34.55	46.0	11.5	**PK**
7.4920	30.87	0.45	31.32	50.0	18.7	**PK**
15.7500	31.65	0.66	32.31	50.0	17.7	**PK**
20.9000	24.76	0.74	25.50	50.0	24.5	**PK**

Test Date: April 25, 2018
Tested By
Signature: _____ Name: John Freeman

2.17 Unintentional and Intentional Radiator, Radiated Emissions (CFR 15.109/15.209, RSS-Gen 8.9)

The test data provided herein is to support the verification requirement for digital devices. Radiated emissions coming from the EUT in a non-transmit state per15.109 were evaluated from 30 MHz to 12.5 GHz as well as radiated emissions coming for the EUT in a transmitting state per 15.209 and were investigated from 9kHz or the lowest operating clock frequency to 25 GHz and tested as detailed in ANSI C63.10:2013, Clause 6.4-6.6. Data is presented in the table below. The data presented is with the EUT and all transmitters ON and transmitting. This is intended to satisfy the requirements for co-location transmitter testing.

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 120kHz 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 test data were maximized for magnitude by rotating the turn-table through 360 degrees and raising and lowering the receiving antenna between 1 to 4 meters in height as a part of the measurement procedure.

The worst-case radiated emission was 11.1dB below the specification limit at 686.58 MHz. All other measured signals were at least 12.8 dB below the specification limit. The results are shown in the table below. These results are meant to show that this EUT’s digital device portion has met the verification requirements for an unintentional radiator under CFR Part 15.109 as well as the intentional transmitter requirements of CFR Part 15.209.

NOTE: FOR TESTING PURPOSES, THE EUT WAS PROGRAMMED AND TESTING WAS PERFORMED WITH BOTH WI-FI AND BLUETOOTH RADIOS ON AND ACTIVE TO COVER CO-LOCATION.

Table 16. Antenna Spurious Radiated Emissions Below 30 MHz

150 kHz to 30 MHz, 15.209 limits							
Test: Radiated Emissions				**Client:** BoxLock, Inc.			
Project: 18-0042				**Model:** BOXLOCK001			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**QP Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
X Position							
0.16	47.39	11.94	59.33	87.4	m./meters.	28.1	**PK**
0.55	36.29	11.82	48.11	85.5	m./meters.	37.4	**PK**
1.85	24.32	11.77	36.09	49.5	m./meters.	13.5	**PK**
Y Position							
0.16	45.79	11.94	57.73	86.7	m./meters.	28.9	**PK**
0.49	35.16	11.54	46.70	87.6	m./meters.	40.9	**PK**
1.99	24.61	11.77	36.38	49.5	m./meters.	13.1	**PK**
Z Position							
0.16	44.70	11.94	56.64	86.8	m./meters.	30.2	**PK**
0.55	35.19	11.82	47.01	85.5	m./meters.	38.5	**PK**
1.78	24.89	11.77	36.66	49.5	m./meters.	12.8	**PK**

Sample Calculation at: 0.16 MHz

Magnitude of Measured Frequency	47.39	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	11.94	dB/m
Duty Cycle Correction Factor	0.00	dB
Corrected Result	59.33	dBuV/m

Test Date: April 18, 2018
Tested By

Signature: _____ Name: John Freeman

Table 17. Antenna Spurious Radiated Emissions (30 MHz – 1 GHz)

Test: FCC Part 15, Paragraph 15.209, 15.249(a)					**Client:** BoxLock, Inc.			
Project: 18-0042					**Model:** BOXLOCK001			
Frequency (MHz)	**Test Data (dBuV)**	**Factor (dB)**	**AF+CA -AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector Mode**
33.33	37.56	-	-13.40	24.16	40.0	3m./HORZ	15.8	**PK**
83.07	39.72	-	-17.47	22.25	40.0	3m./VERT	17.8	**PK**
159.68	37.24	-	-12.62	24.62	43.5	3m./VERT	18.9	**PK**
178.72	38.53	-	-12.85	25.68	43.5	3m./HORZ	17.8	**PK**
205.12	38.12	-	-13.69	24.43	43.5	3m./HORZ	19.1	**PK**
210.76	37.54	-	-14.52	23.02	43.5	3m./VERT	20.5	**PK**
500.58	38.72	-	-6.22	32.50	46.0	3m./VERT	13.5	**PK**
686.58	38.13	-	-3.25	34.88	46.0	3m./HORZ	11.1	**PK**
994.00	37.86	-	-2.19	35.67	54.0	3m./VERT	18.3	**PK**
999.10	37.86	-	-1.59	36.27	54.0	3m./HORZ	17.7	**PK**

Notes:
1. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with the duty cycle programmed for maximum ON time in continuous transmit mode.
2. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at: 33.33 MHz

Magnitude of Measured Frequency	37.56	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	-13.40	dB/m
Duty Cycle Correction Factor	0.00	dB
Corrected Result	24.16	dBuV/m

Test Date: April 17, 2018

Tested By
Signature: _____ Name: John Freeman

NOTE: FOR TESTING PURPOSES, THE EUT WAS PROGRAMMED AND TESTING WAS PERFORMED WITH BOTH WI-FI AND BLUETOOTH RADIOS ON AND ACTIVE TO COVER CO-LOCATION.

Table 18. Antenna Spurious Radiated Emissions (1 GHz – 25 GHz)

Test By: JF		Test: FCC Part 15.109/15.209			Client: BoxLock, Inc.			
		Project: 18-0042 Class B			Model: BOXLOCK001			
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**
3103.75	33.50	-	3.95	37.45	54.0	3.0m./HORZ	16.6	**AVG**
3278.75	33.32	-	4.23	37.55	54.0	3.0m./VERT	16.5	**AVG**

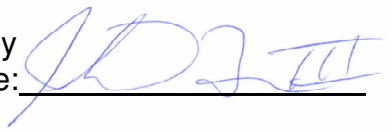
No other emissions detected other than those presented in this table and the tables in section 2.10 above.

AF is antenna factor. CL is cable loss. PA is preamplifier gain.

Sample Calculation at: 3103.75 MHz

Magnitude of Measured Frequency	47.79	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	3.95	dB/m
Duty Cycle Correction Factor	0.00	dB
Corrected Result	51.74	dBuV/m

Test Date: April 23, 2018

Tested By
Signature: 

Name: John Freeman

NOTE: FOR TESTING PURPOSES, THE EUT WAS PROGRAMMED AND TESTING WAS PERFORMED WITH BOTH WI-FI AND BLUETOOTH RADIOS ON AND ACTIVE TO COVER CO-LOCATION.

2.18 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%.

2.18.1 Conducted Emissions Measurement Uncertainty

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

2.18.2 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 is ±5.1 dB.

3 Conclusions

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