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

Aro Technology, Inc.

Model Number: ARO5-001

FCC ID: 2A7ZV-ARO5-001
IC: 28925-ARO5-001

UST Project: 22-0212
Issue Date: August 15, 2022

Total Pages: 117

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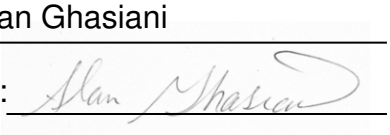
I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date: August 15, 2022

NVLAP LAB CODE 200162-0

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Aro Technology, Inc.
MODEL: ARO5-001
FCC ID: 2A7ZV-ARO5-001
IC: 28925-ARO5-001
DATE: August 15, 2022

This report concerns (check one): ☒Original grant □Class II change

Equipment type: 2.4 GHz Wi-Fi transmitter Device

Technical:
IEEE Std. 802.11 b,g,n (HT20)
2412 MHz - 2462 MHz (Channels 1-11)
Type of modulation:
IEEE 802.11b- DSSS/ IEEE 802.11g- OFDM/ IEEE 802.11n (20MHz)- OFDM
Data/Bit Rate:
802.11b= 1-11 Mbps, 802.11g= 6-54 Mbps, 802.11n= MCS0-7
Antenna Gain: -0.5 dBi (Chip Antenna)
Maximum Output Power: +13.0 dBm
Software used to program EUT: ESP32_RF_TEST
EUT firmware number: version V1.3.9
Power setting: Maximum level

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 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 August 3, 2022 in good operating condition.

1.3 Product Description

The Equipment under Test (EUT) is the Aro Technology, Inc. Model ARO5-001. The ARO5-001 is a smart box which consumers place their mobile devices into to facilitate mindful phone use, family, and focus time away from devices. A consumer would place their iPhone into the box and close the lid. Using Bluetooth Low Energy, the mobile application connects to the Aro smart box to track usage time. Optionally, the consumer can use the USB-C ports available in the box to charge their iPhone while they are away from them.

The EUT incorporates both Bluetooth LE technology and Wi-Fi technology. This report is for the Wi-Fi radio module.

The Wi-Fi radio details include:

Antenna Gain: -0.5 dBi (Chip Antenna)
Bandwidth: 20 MHz bandwidth modulation
Maximum Output Power: +13.0 dBm

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. 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 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 Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID	CABLES P/D
EUT/ Aro Technology, Inc.	ARO5-001	Engineering Sample	Pending FCC ID: 2A7ZV-ARO5-001 IC: 28925-ARO5-001	P
iPhone 7	MN9E2LL/A	F4GT8JJBHG7G	FCC ID: BCG-E3091A	P
iPhone 12 Pro Max	MGCF3LL/A	F2LF9PTE0D3Y	FCC ID: BCG-E3548A	P
iPhone 12 Mini	MG8J3LL/A	F4GDMA8N0GRG	FCC ID: BCG-E3539A	P
iPhone 11	MWGF2LL/A	FK1ZCDYZN10C	FCC ID: BCG-E3309A	P
AC Adaptor Tensility International Corporation	TSAA3601A-1203000US	16-00217	N/A	p
AC Adaptor Channel Well Technology	2AEC054F	Engineering Sample	N/A	P
Laptop Hewlett-Packard	15-da0012dx	CND8397BJW	FCC ID: TX2-RTL8723DE IC: 6317A-RTL8723DE	P/D
Antenna See antenna details	--	--	--	--

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

Note: Two samples were used for testing. One was programmed for normal operating conditions and for intentional Radiated testing. The other was programmed with test mode software for conducted testing on specific radio testing

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	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	CALIBRATION DUE DATE
Spectrum Analyzer	Agilent	E4407B	US41442935	9/2/2022 2 yr.
Spectrum Analyzer	Rigol	DSA815	DSA8A180300138	1/6/2024 2 yr.
Spectrum Analyzer	Hewlett-Packard	8593E	3205A00124	2/28/2024 2 yr.
RF Preamp 100 kHz To 1.3 GHz	Hewlett-Packard	8447D	1937A02980	6/9/2023
Preamp 1.0 GHz To 26.0 GHz	Hewlett-Packard	8449B	3008A00914	2/11/2023
Loop Antenna	ETS Lindgren	6502	9810-3246	Calibrated before use
Biconical Antenna	EMCO	3110B	9306-1708	8/17/2023 2 yr.
Log Periodic Antenna	EMCO	3146	9305-3600	12/13/2023 2 yr.
Horn Antenna	EMCO	SAS-571	605	4/28/2024 2 yr.
High Pass Filter	Microwave Circuits	H3R020G2	001DC9528	8/1/2023
Attenuator 20db SMA	PE	47-20	59078	Calibrated before use
LISN X 2	Solar Electronics	9247-50-TS-50-N	955824 and 955825	2/8/2023

Note 1: 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), RSS-Gen 6.8)

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.

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 2.412 GHz to 2.462 GHz, 3 test frequencies will be used.

2.4 Frequency Range of Radiated Measurements (Part 15.33, RSS-Gen 6.13)

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, RSS-Gen 6.9, 6.13)

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.

2.6 EUT Antenna Requirements (CFR 15.203, RSS-Gen 6.7)

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	Johanson	Chip Antenna	2450AT18A100E	-0.5	solder

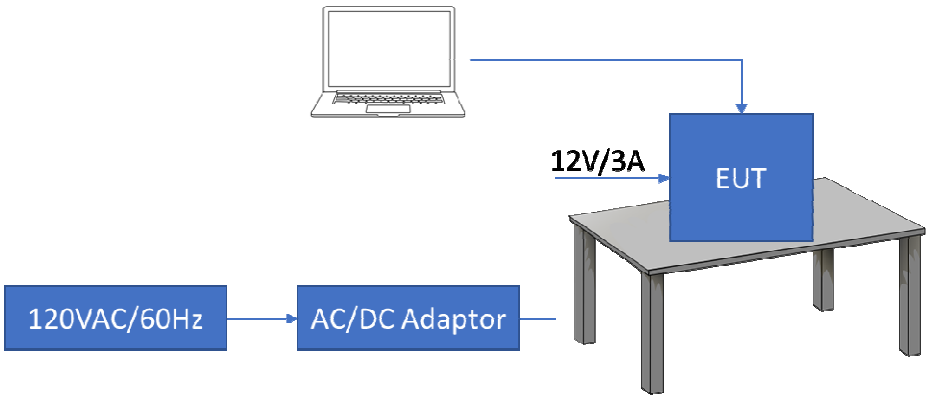


Figure 1. Block Diagram of Test Configuration

Note: PC used to program EUT for intentional spurious emissions only

2.7 Restricted Bands of Operation (Part 15.205, RSS-Gen 8.10)

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), RSS-Gen 6.10)

The EUT employs pulse transmission however for testing purpose the EUT was programmed to transmit at a rate >98%. The pulse transmission requirements of this subpart were acknowledged and considered during testing.

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.

2.9 Antenna Conducted Intentional and Spurious Emissions (CFR 15.209, 15.247(d)) (IC RSS 247, 5.5))

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 in the EMC Chamber. The conducted emissions graphs are found in the figures below. 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.

Figure 2. Bench Test Setup

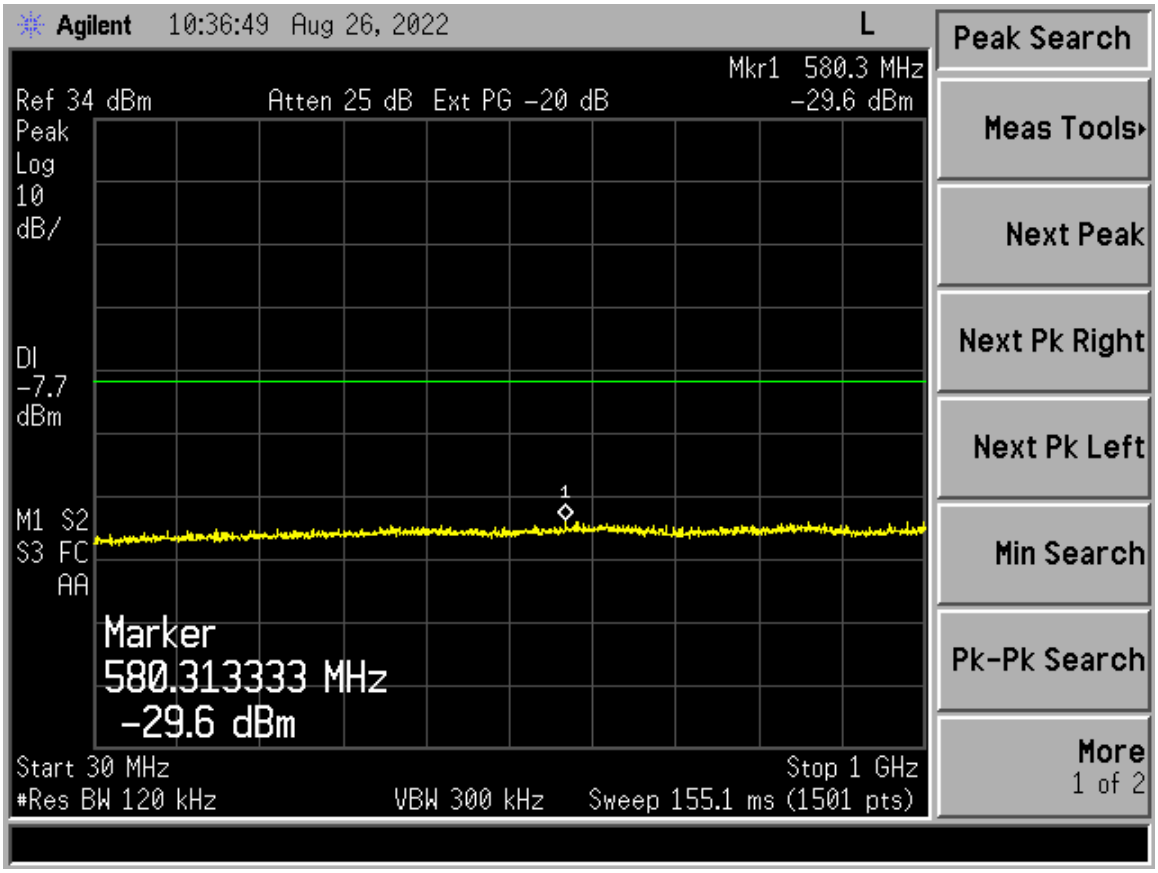


Figure 3. 802.11b, Channel 1, 30-1000 MHz

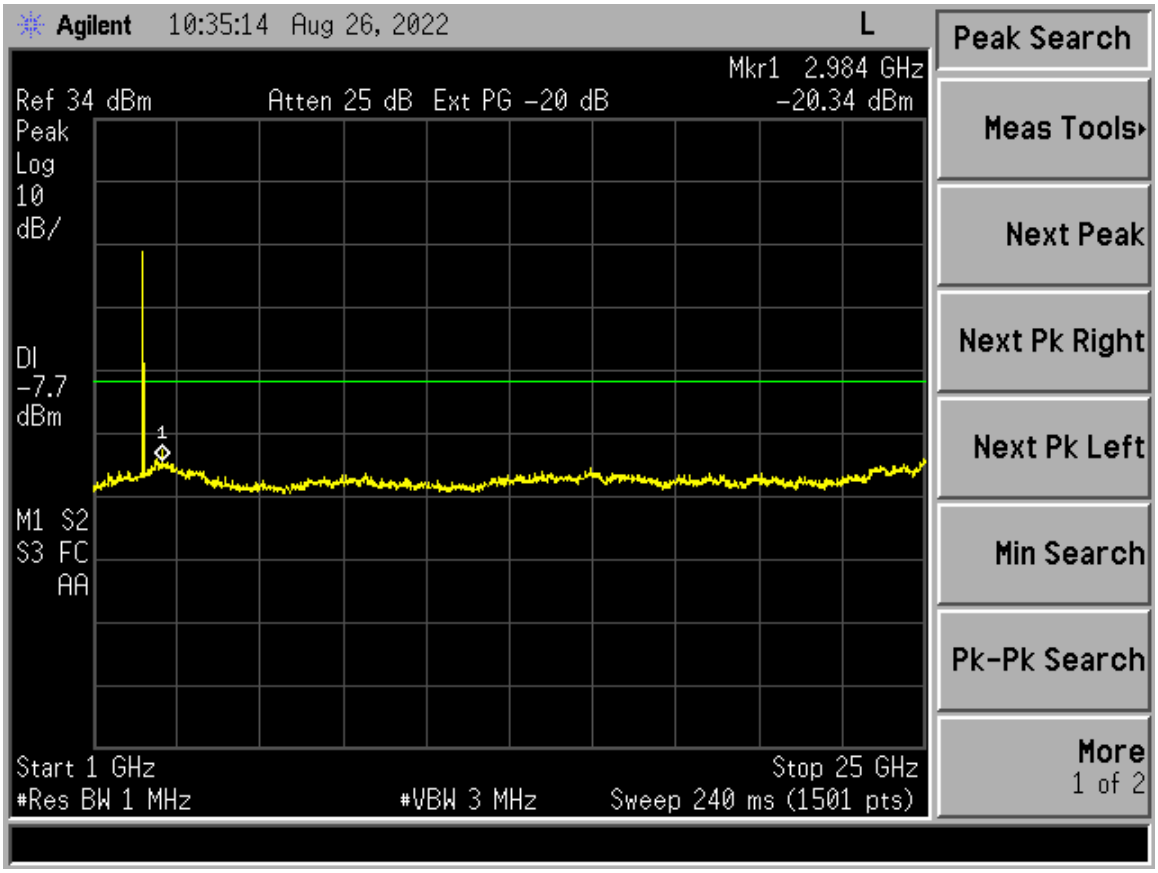


Figure 4. 802.11b, Channel 1, 1 – 25 GHz
(Note: Intentional Emission seen for radio operating at 2412 MHz)

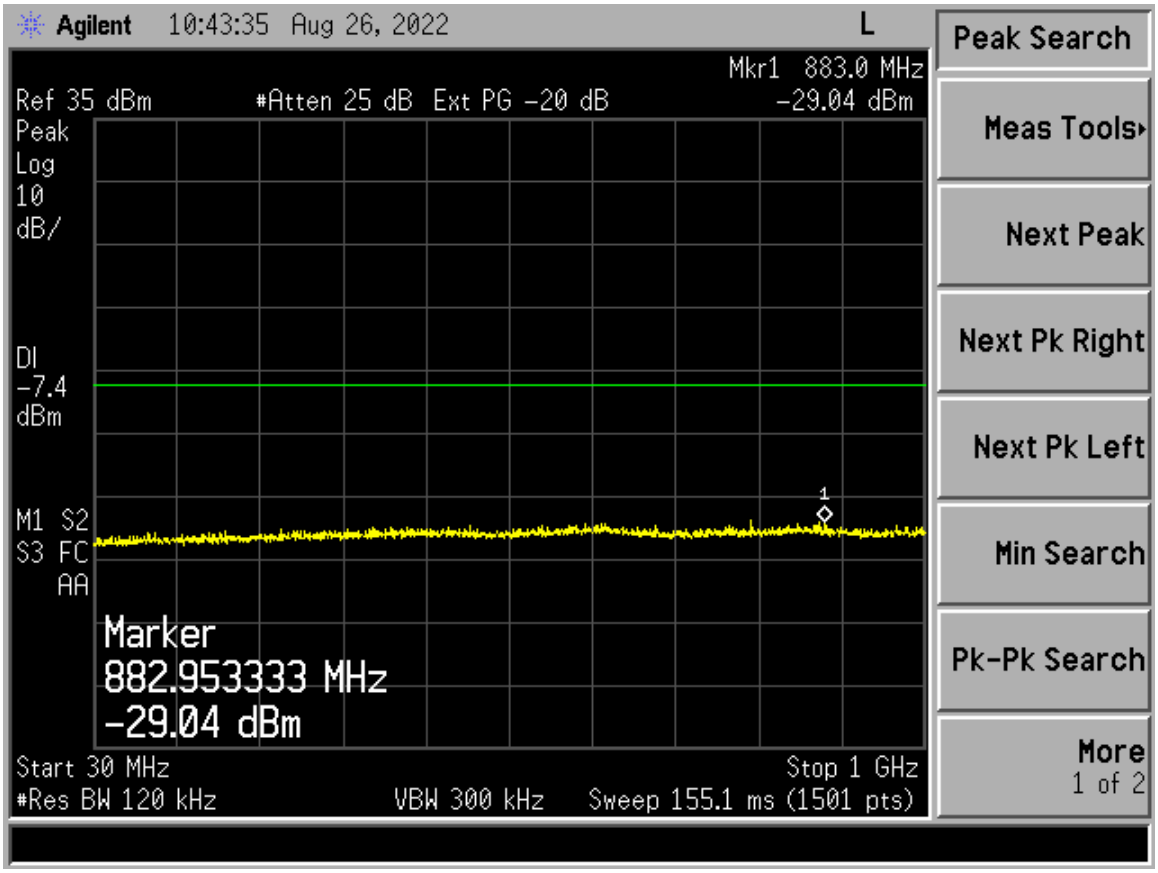


Figure 5. 802.11b, Channel 7, 30-1000 MHz

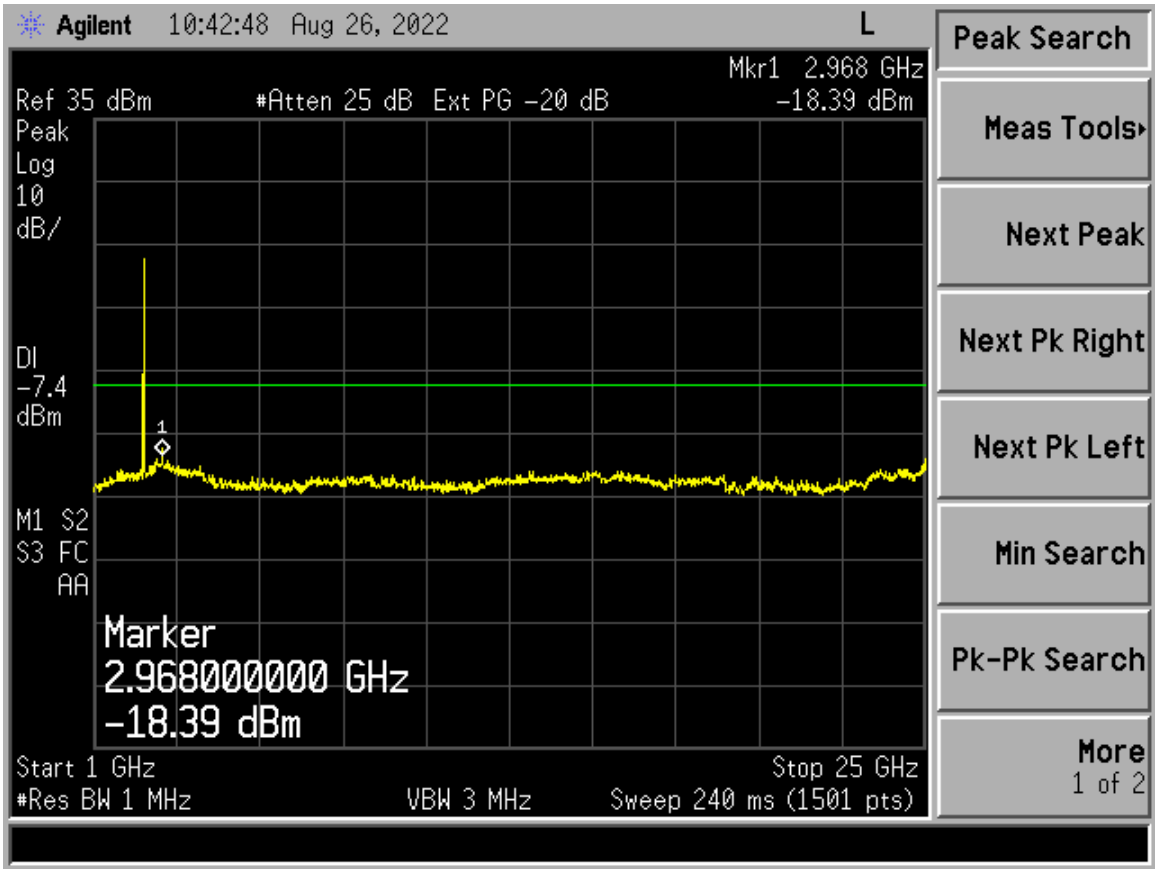


Figure 6. 802.11b, Channel 7, 1 – 25 GHz
(Note: Intentional Emission seen for radio operating at 2442 MHz)

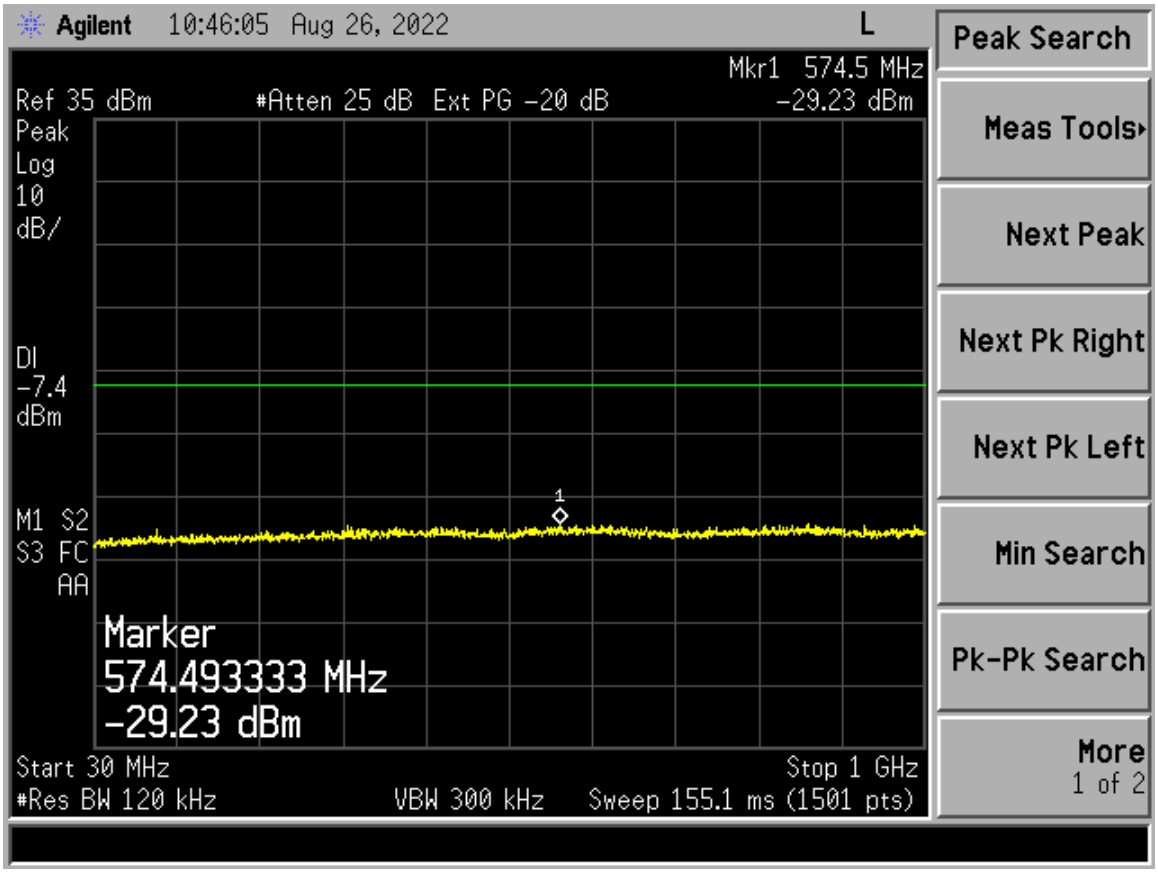


Figure 7. 802.11b, Channel 11, 30-1000 MHz

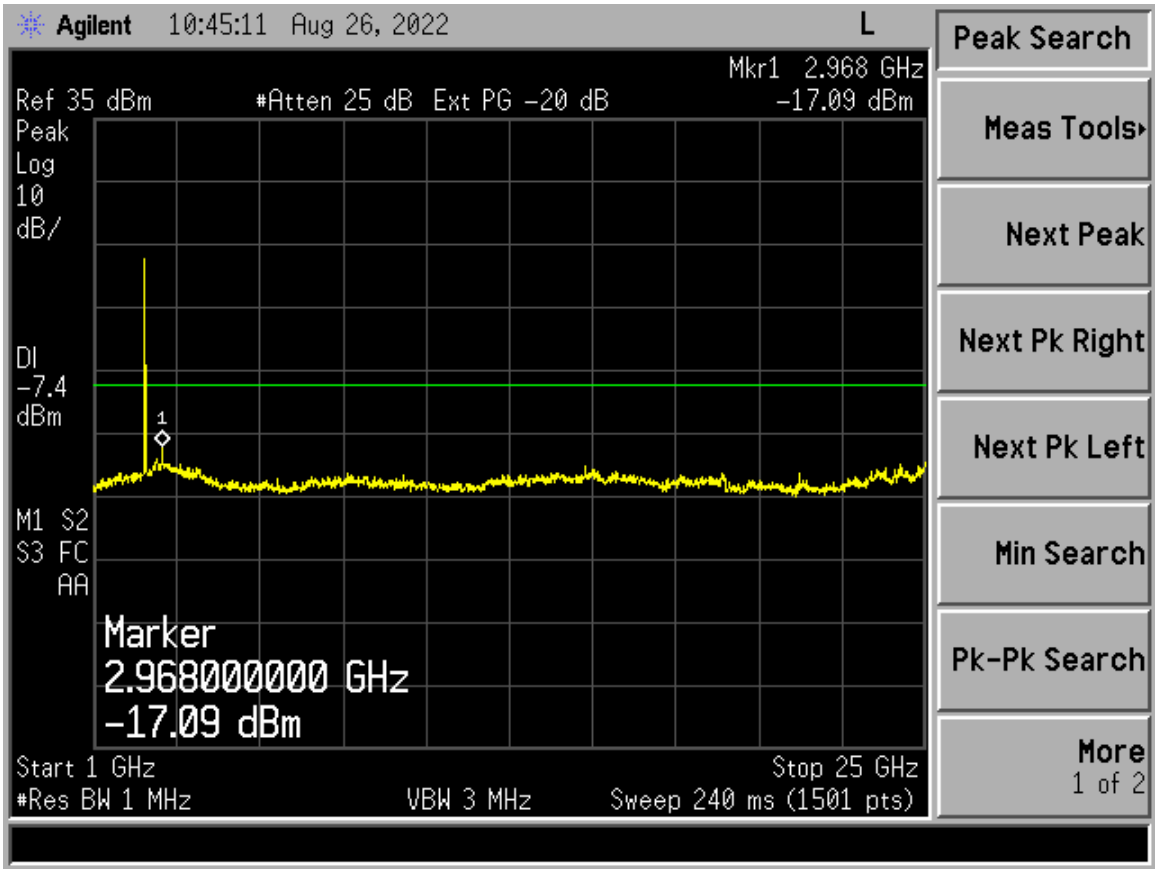


Figure 8. 802.11b, Channel 11, 1 – 25 GHz
(Note: Intentional Emission seen for radio operating at 2462 MHz)

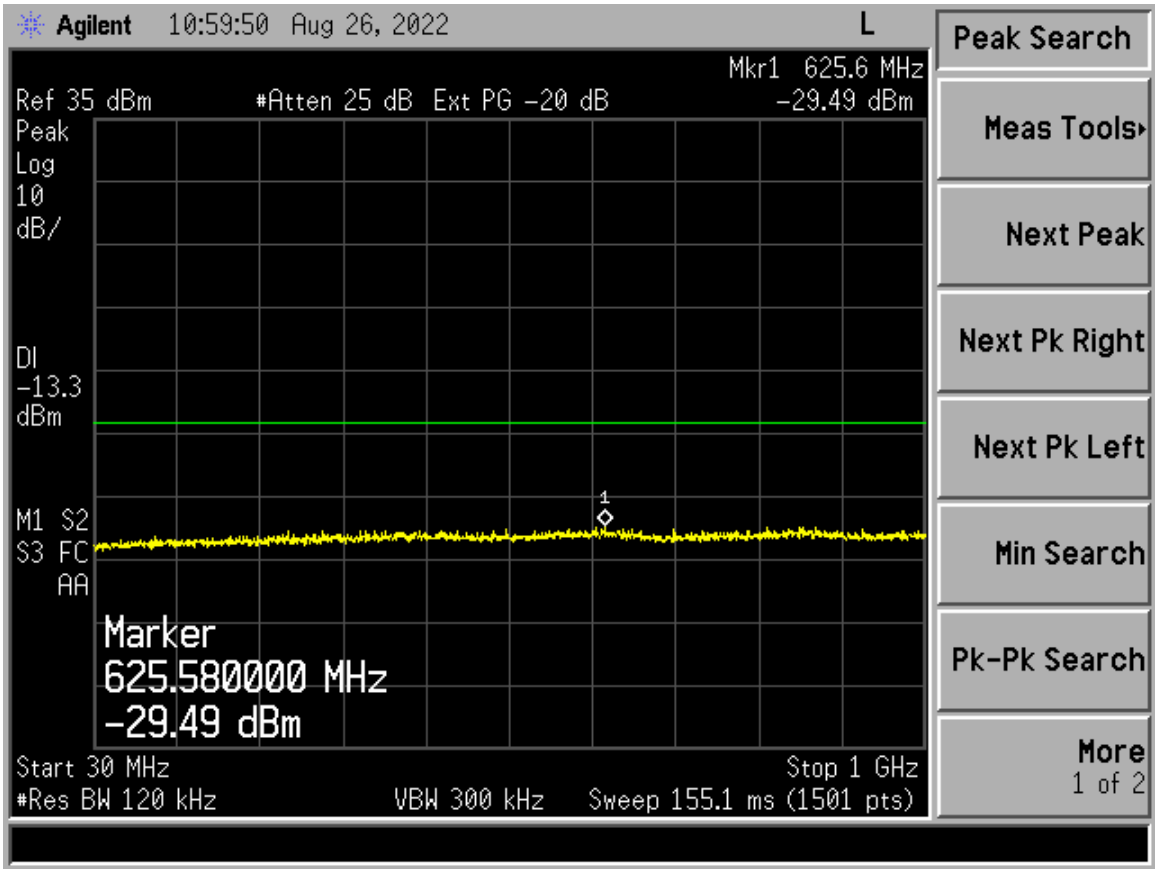


Figure 9. 802.11g, Channel 1, 30-1000 MHz

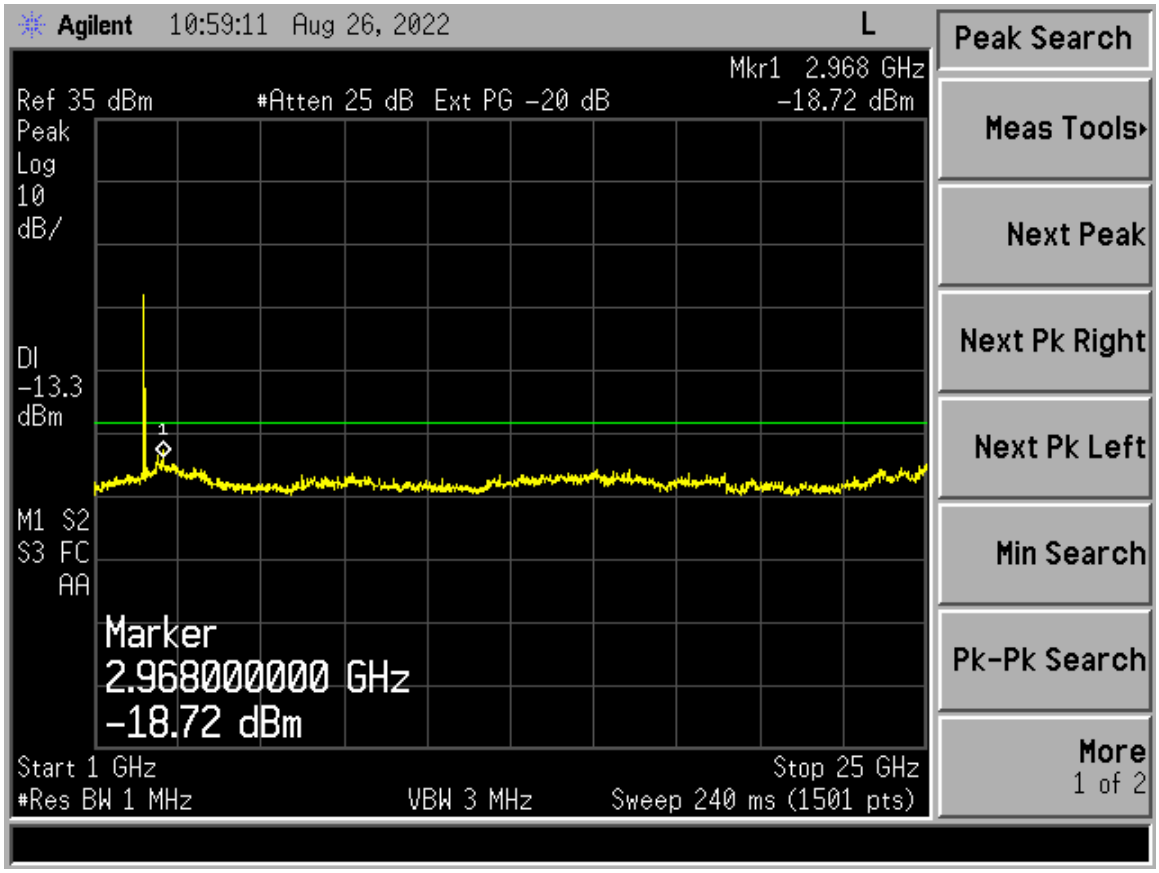


Figure 10. 802.11g, Channel 1, 1 – 25 GHz
(Note: Intentional Emission seen for radio operating at 2412 MHz)

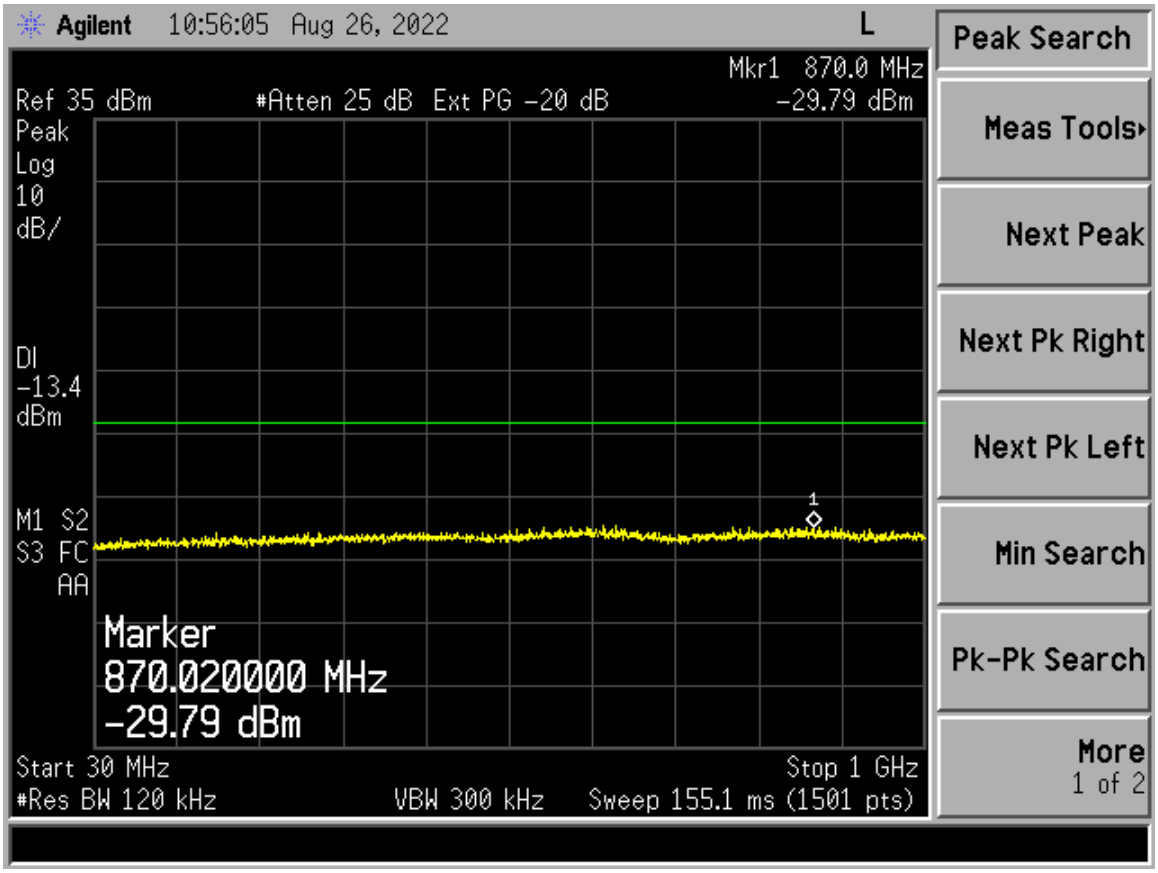


Figure 11. 802.11g, Channel 7, 30-1000 MHz

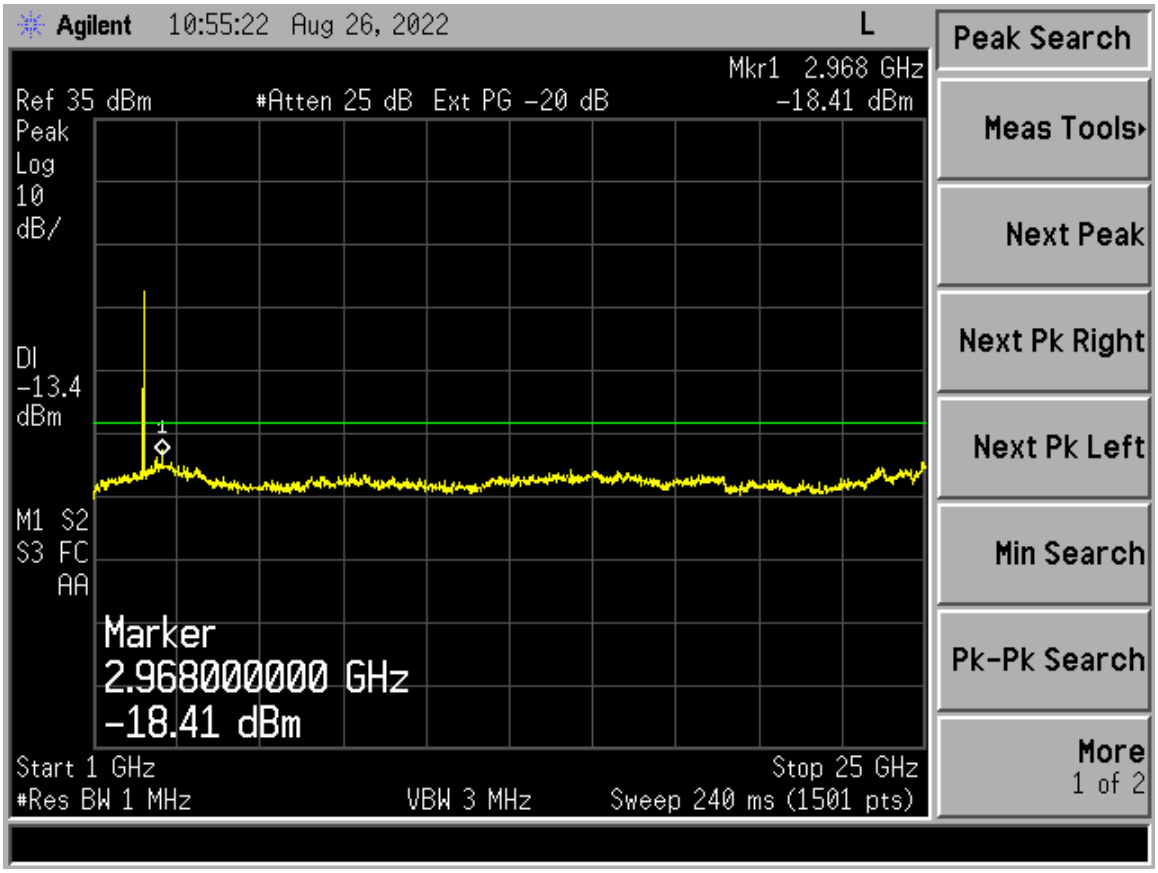


Figure 12. 802.11g, Channel 7, 1 – 25 GHz
(Note: Intentional Emission seen for radio operating at 2442 MHz)

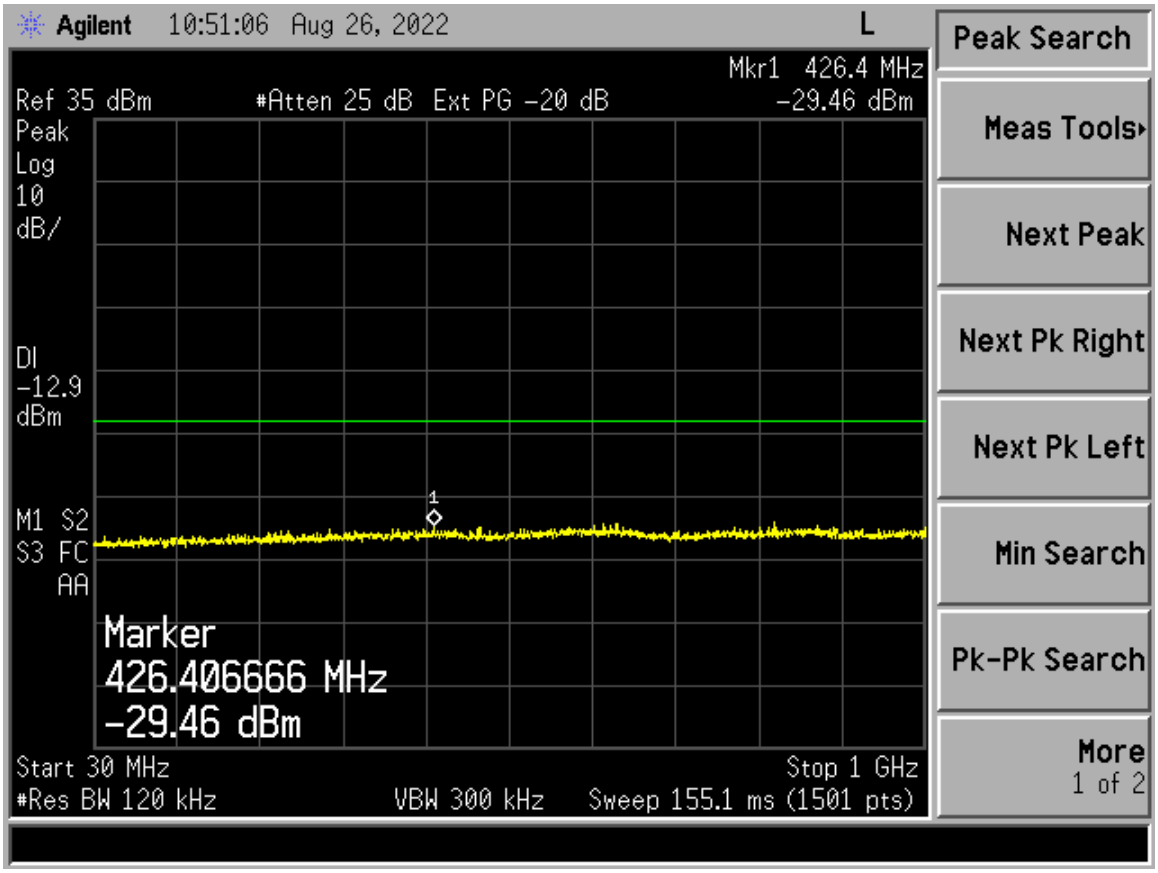


Figure 13. 802.11g, Channel 11, 30-1000 MHz

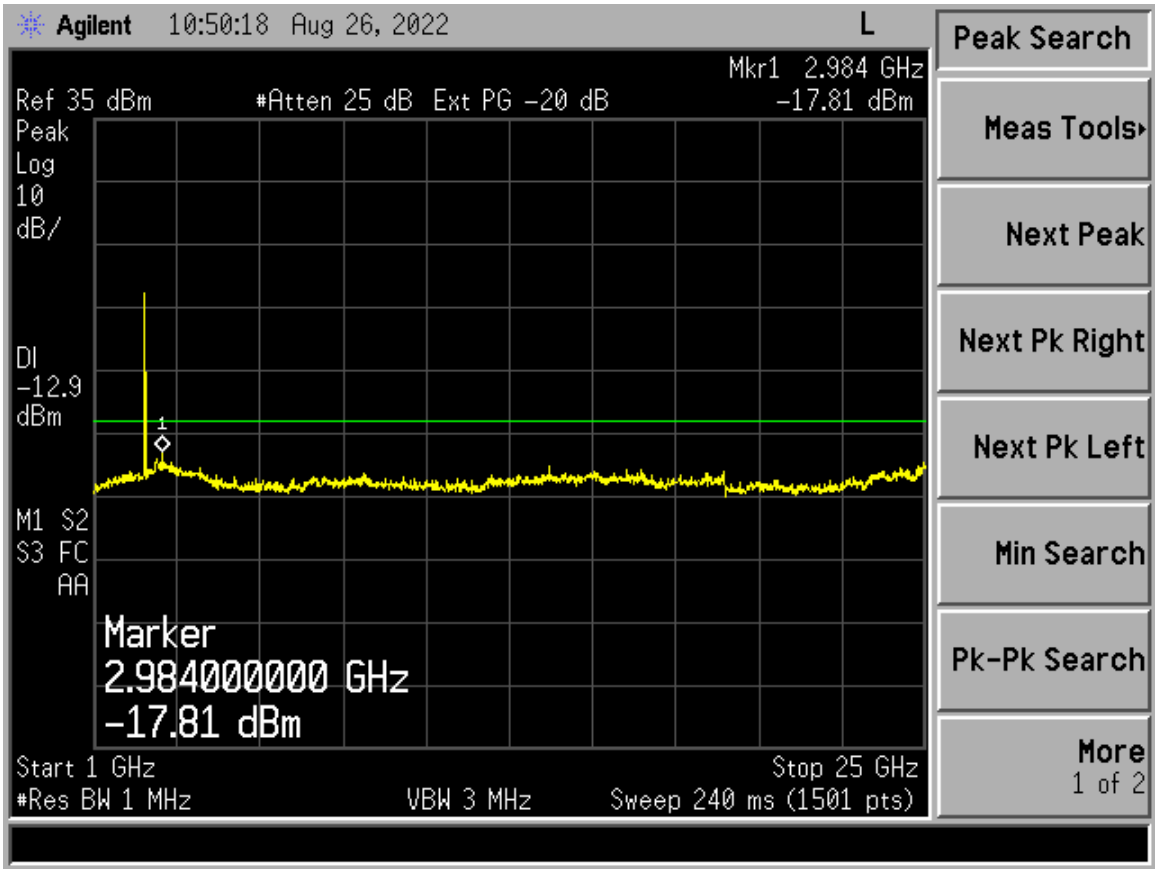


Figure 14. 802.11g, Channel 11, 1- 25 GHz
(Note: Intentional Emission seen for radio operating at 2462 MHz)

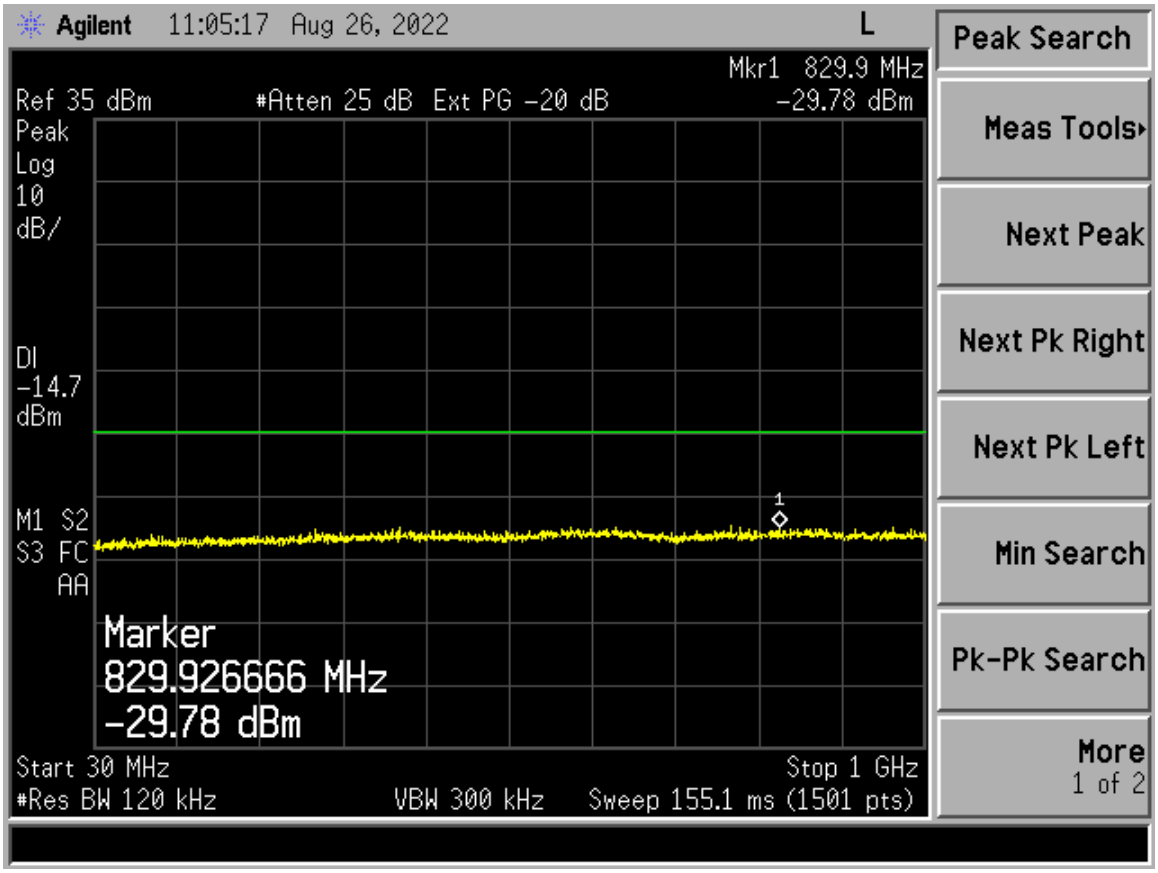


Figure 15. 802.11n, Channel 1, 30-1000 MHz

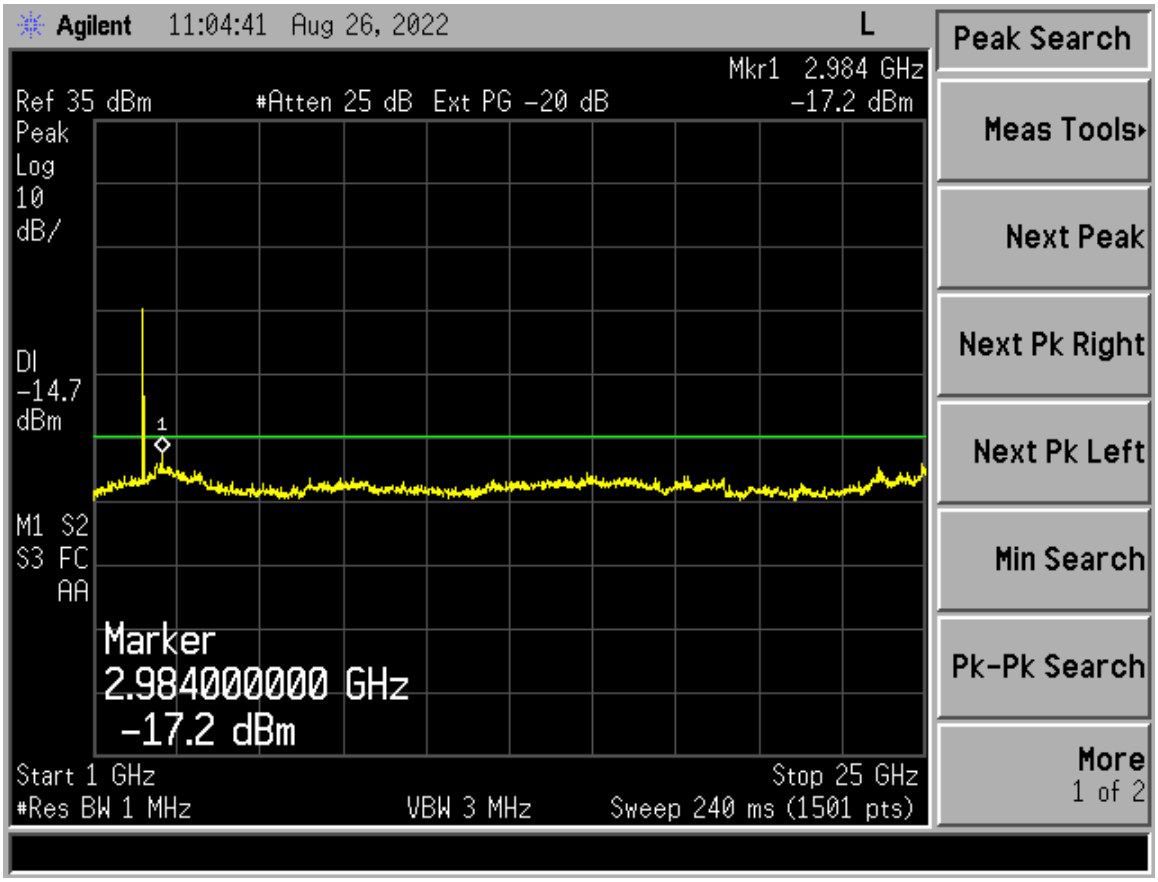


Figure 16. 802.11n, Channel 1, 1 – 25 GHz
(Note: Intentional Emission seen for radio operating at 2412 MHz)

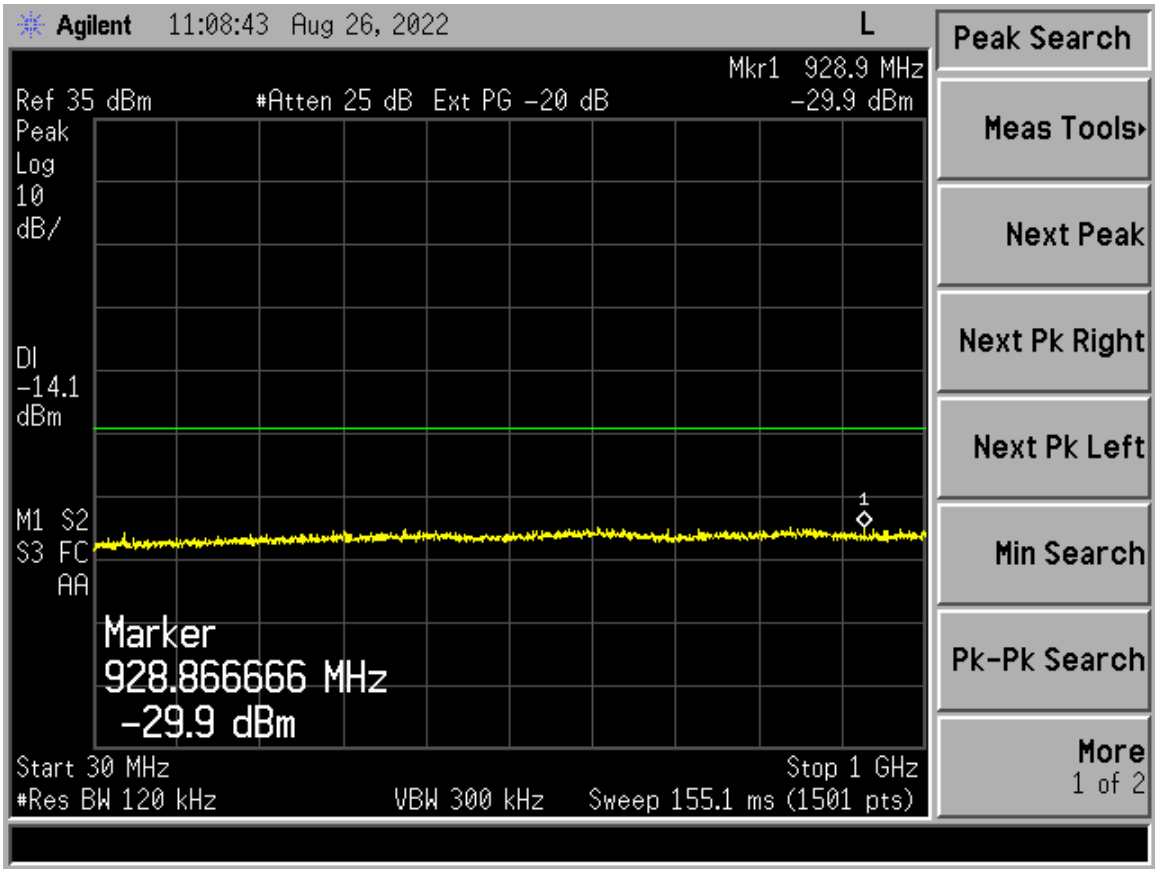


Figure 17. 802.11n, Channel 7, 30-1000 MHz

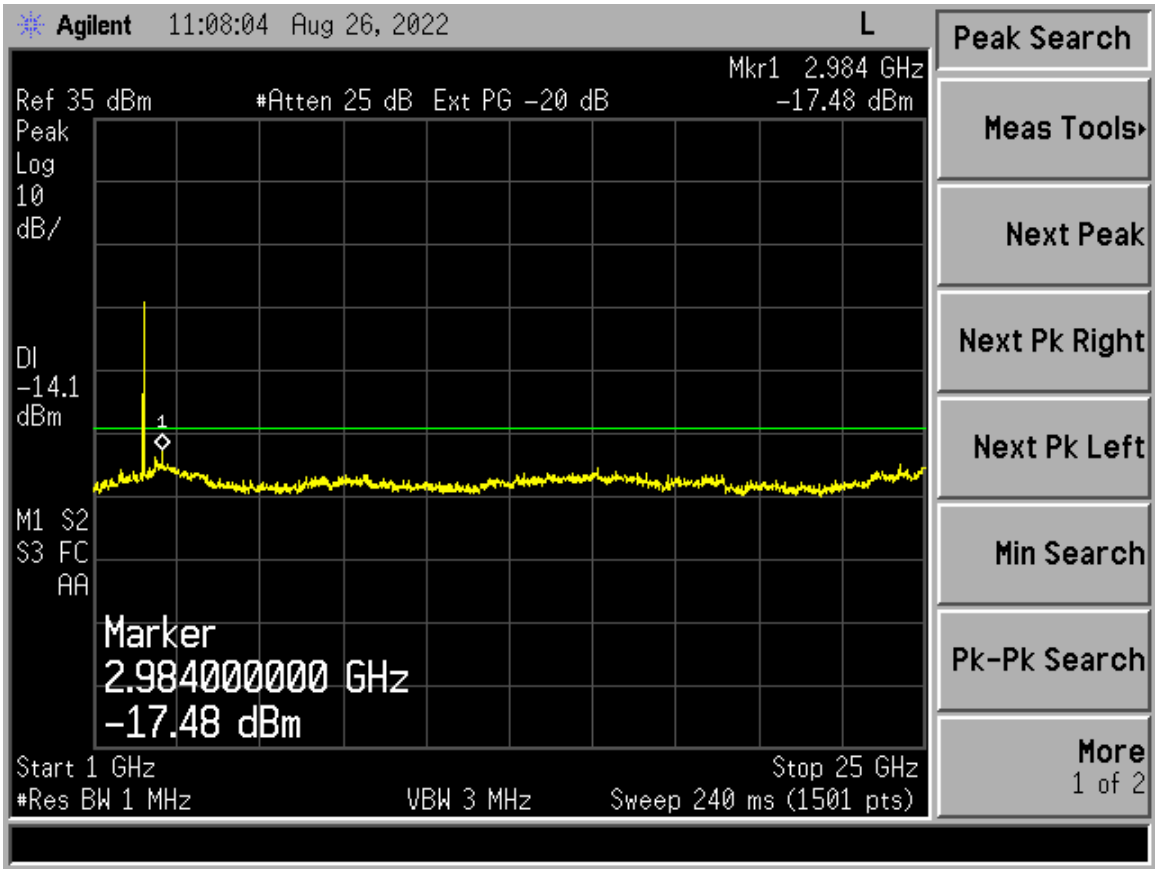


Figure 18. 802.11n, Channel 7, 1 – 25 GHz
(Note: Intentional Emission seen for radio operating at 2442 MHz)

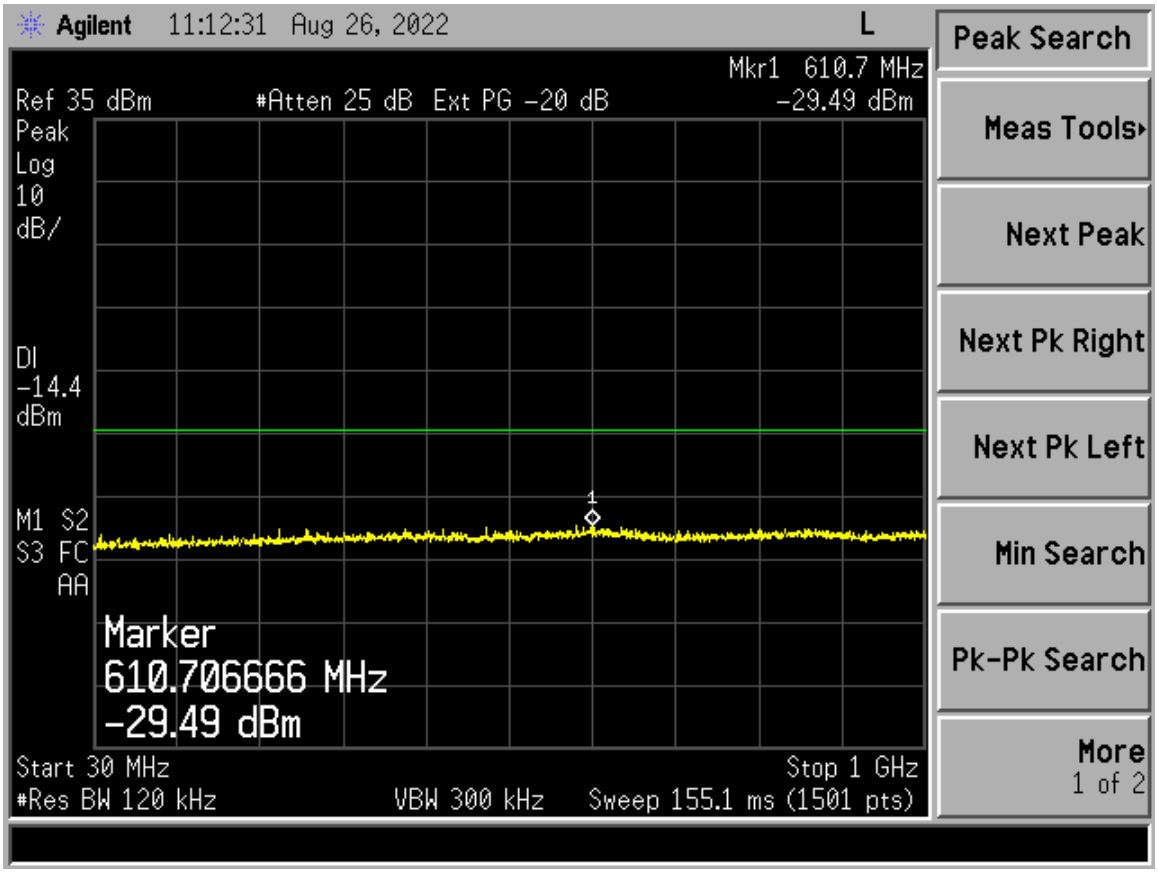


Figure 19. 802.11n, Channel 11, 30-1000 MHz

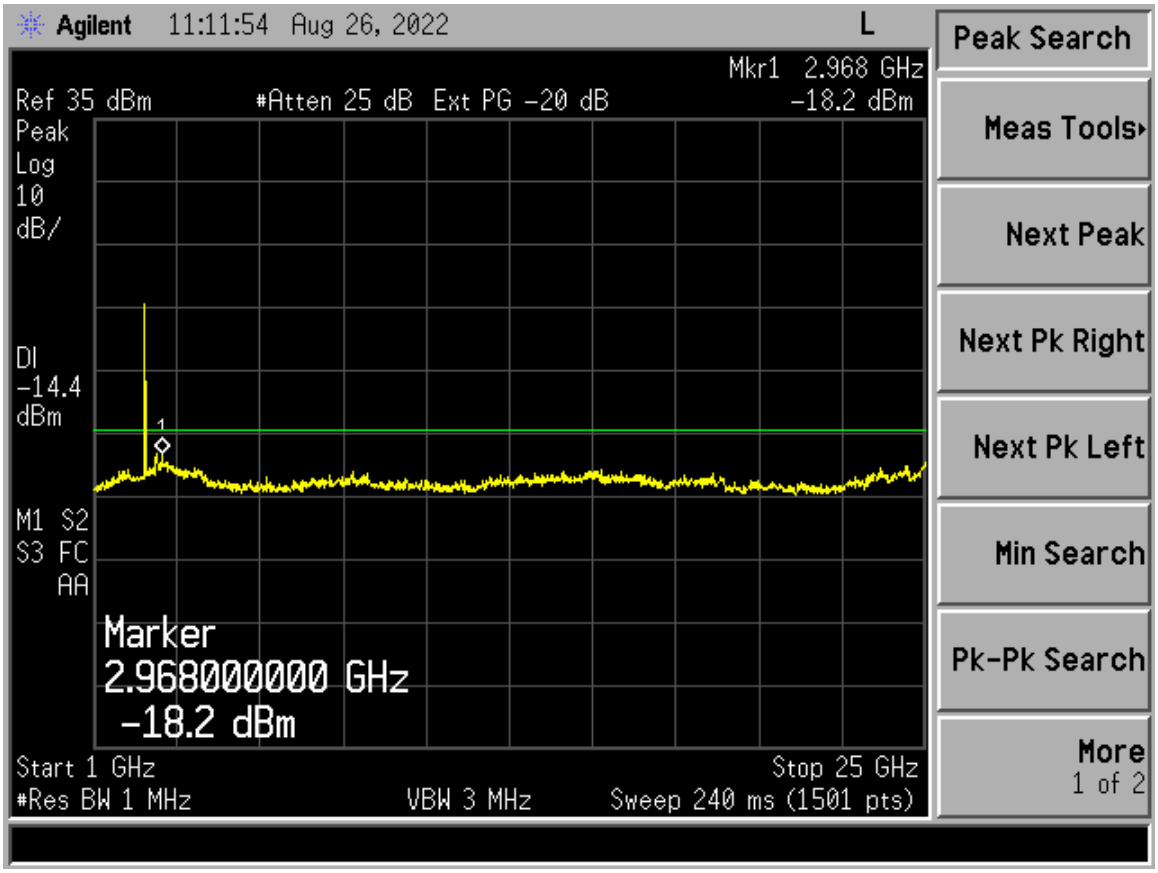


Figure 20. 802.11n, Channel 11, 1 – 25 GHz
(Note: Intentional Emission seen for radio operating at 2462 MHz)

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d), RSS-247, 5.5)

On the test site, the EUT was placed on top of a non-conductive table, 80 cm above the floor for measurements below 1 GHz and 150 cm above the floor for measurements > 1 GHz. The EUT was also evaluated in three orthogonal positions to determine the worst-case position. 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 ≥ RBW. The results of peak radiated spurious emissions falling within restricted bands are given in Table 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.

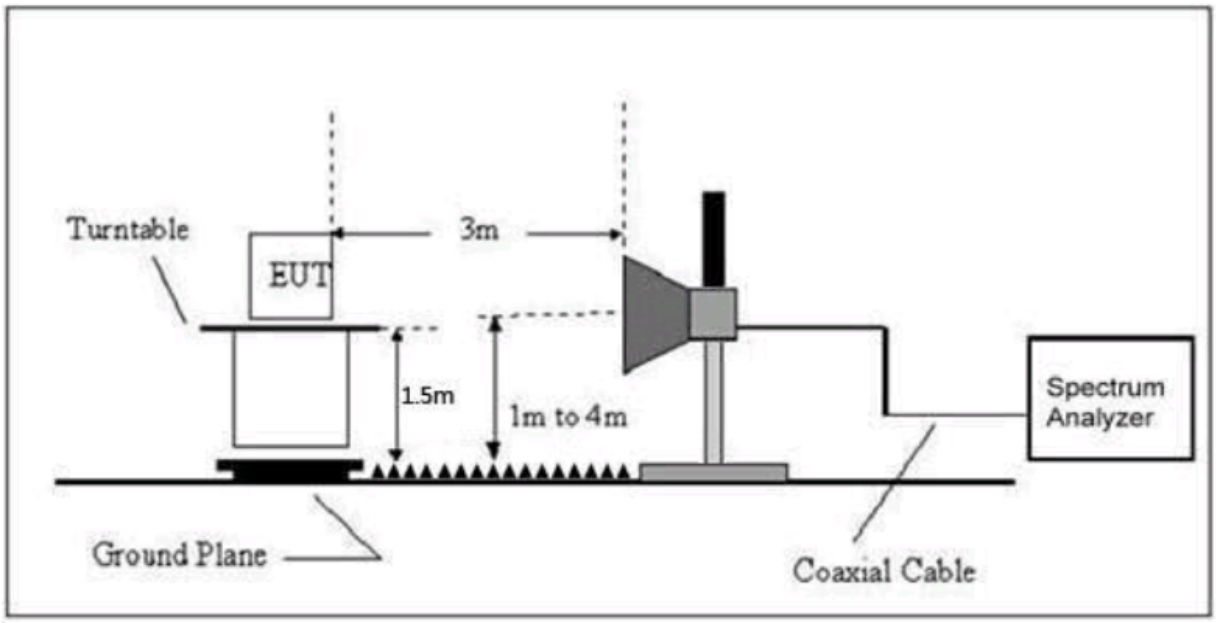


Figure 21. Radiated Emissions Setup (Fundamental and Harmonics)

Table 5. 802.11b-Peak Radiated Fundamental & Harmonic Emissions

Test: FCC Part 15,247(d)								
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								
2413.00	59.58	0.00	32.09	91.67	--	3.0m/HORZ	--	**PK**
*4824.00	52.52	0.00	1.81	54.33	74.0	3.0m./HORZ	19.7	**PK**
*7234.00	50.8	-9.50	7.04	48.34	74.0	1.0m./HORZ	25.7	**PK**
Mid Channel – PEAK								
2443.00	62.01	0.00	32.09	94.10	--	3.0m/HORZ	--	**PK**
*4882.00	50.98	0.00	1.42	52.40	74.0	3.0m./HORZ	21.6	**PK**
*7329.00	50.96	-9.50	7.61	49.07	74.0	1.0m./VERT	24.9	**PK**
High Channel– PEAK								
2461.00	61.91	0.00	32.42	94.33	--	3.0m./HORZ	--	**PK**
*4924.00	51.42	0.00	1.64	53.06	74.0	3.0m./HORZ	20.9	**PK**
*7384.00	51.95	-9.5	7.56	49.71	74.0	1.0m./VERT	24.3	**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
3. The EUT was placed in three orthogonal positions, tested while broadcasting from each antenna, and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.
4. Measurement at 1 meters corrected using inverse extrapolation factor of -9.5 dB to correct the value for 3 meter.

Sample Calculation at 2413.00 MHz:

Magnitude of Measured Frequency	59.58	dBuV
+Additional Factor	0.00	dB
+Antenna Factor + Cable Loss+ Amplifier Gain	32.09	dB/m
Corrected Result	91.67	dBuV/m

Test Date: August 8-9, 2022

Tested By
Signature:  Name: Gabriel Medina

Table 6. 802.11b-Average Radiated Fundamental & Harmonic Emissions

Test: FCC Part 15,247(d)								
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								
2413.00	48.12	0.00	32.09	80.21	--	3.0m./HORZ	--	**AVG**
*4823.00	35.77	0.00	1.72	37.49	54.0	3.0m./VERT	16.5	**AVG**
*7227.00	34.98	-9.50	7.01	32.49	54.0	1.0m./VERT	21.5	**AVG**
Mid Channel–Average								
2443.00	50.04	0.00	32.09	82.13	--	3.0m./HORZ	--	**AVG**
*4882.00	33.78	0.00	1.42	35.20	54.0	3.0m./HORZ	18.8	**AVG**
*7329.00	34.68	-9.50	7.61	32.79	54.0	1.0m./VERT	21.2	**AVG**
High Channel–Average								
2462.00	58.11	0.00	32.36	90.47	--	3.0m./VERT	--	**AVG**
*4924.00	32.90	0.00	1.64	34.54	54.0	3.0m./HORZ	19.5	**AVG**
*7384.00	34.62	-9.50	7.56	32.68	54.0	1.0m./VERT	21.3	**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. The EUT was placed in three orthogonal positions, tested while broadcasting from each antenna, and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.
4. Measurement at 1 meters corrected using inverse extrapolation factor of -9.5 dB to correct the value for 3 meter.

Sample Calculation at 2413.00MHz:

Magnitude of Measured Frequency	48.12	dBuV
+Additional Factor (filter + duty cycle)	0.00	dB
+Antenna Factor + Cable Loss+ Amplifier Gain – Duty Cycle	32.09	dB/m
Corrected Result	80.21	dBuV/m

Test Date: August 8-9, 2022

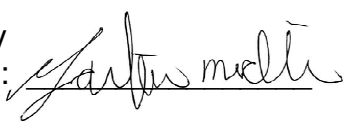
Tested By
Signature:  Name: Gabriel Medina

Table 7. 802.11g-Peak Radiated Fundamental & Harmonic Emissions

Test: FCC Part 15,247(d)								
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								
2413.00	61.23	0.00	32.18	93.41	--	3.0m./VERT	--	**PK**
*4818.00	50.50	0.00	1.81	52.31	74.0	3.0m./HORZ	21.7	**PK**
*7235.00	51.28	-9.50	7.01	48.79	74.0	1.0m./VERT	25.2	**PK**
Mid Channel – PEAK								
2443.00	60.76	0.00	32.18	92.94	--	3.0m./VERT	--	**PK**
*4882.00	50.96	0.00	1.42	52.38	74.0	3.0m./HORZ	21.6	**PK**
*7391.00	52.26	-9.50	7.59	50.35	74.0	1.0m./HORZ	23.7	**PK**
High Channel– PEAK								
2463.00	60.84	0.00	32.36	93.20	--	3.0m./VERT	--	**PK**
*4928.00	50.66	0.00	1.64	52.30	74.0	3.0m./HORZ	21.7	**PK**
*7374.00	51.28	-9.50	7.59	49.37	74.0	1.0m./HORZ	24.6	**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
3. The EUT was placed in three orthogonal positions, tested while broadcasting from each antenna, and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.
4. Measurement at 1 meters corrected using inverse extrapolation factor of -9.5 dB to correct the value for 3 meter.

Sample Calculation at 2413.00 MHz:

Magnitude of Measured Frequency	61.23	dBuV
+Additional Factor	0.00	dB
+Antenna Factor + Cable Loss+ Amplifier Gain	32.18	dB/m
Corrected Result	93.41	dBuV/m

Test Date: August 9, 2022

Tested By
Signature:  Name: Gabriel Medina

Table 8. 802.11g-Average Radiated Fundamental & Harmonic Emissions

Test: FCC Part 15,247(d)								
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								
2413.00	48.45	0.00	32.18	80.63	--	3.0m./VERT	--	**AVG**
*4825.00	32.10	0.00	1.72	33.82	54.0	3.0m./VERT	20.2	**AVG**
*7236.00	31.65	-9.50	7.04	29.19	54.0	1.0m./HORZ	24.8	**AVG**
Mid Channel –Average								
2443.00	47.63	0.00	32.18	79.81	--	3.0m./VERT	--	**AVG**
*4881.00	31.77	0.00	1.40	33.17	54.0	3.0m./VERT	20.8	**AVG**
*7333.00	32.40	-9.50	7.61	30.51	54.0	1.0m./VERT	23.5	**AVG**
High Channel–Average								
2463.00	60.84	0.00	32.36	80.24	--	3.0m./VERT	--	**AVG**
*4928.00	31.75	0.00	1.64	33.39	54.0	3.0m./HORZ	20.6	**AVG**
*7374.00	31.75	-9.50	7.59	29.84	54.0	1.0m./HORZ	24.2	**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. The EUT was placed in three orthogonal positions, tested while broadcasting from each antenna, and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.
4. Measurement at 1 meters corrected using inverse extrapolation factor of -9.5 dB to correct the value for 3 meter.

Sample Calculation at 2413.00 MHz:

Magnitude of Measured Frequency	48.45	dBuV
+Additional Factor	0.00	dB
+Antenna Factor + Cable Loss+ Amplifier Gain	32.18	dB/m
Corrected Result	80.63	dBuV/m

Test Date: August 9, 2022

Tested By
Signature: Name: Gabriel Medina

Table 9. 802.11n-Peak Radiated Fundamental & Harmonic Emissions

Test: FCC Part 15,247(d)								
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								
2411.00	59.36	0.00	32.18	91.48	--	3.0m./VERT	--	**PK**
*4831.00	51.21	0.00	1.81	53.02	74.0	3.0m./HORZ	21.0	**PK**
*7225.00	51.67	-9.50	7.01	49.18	74.0	1.0m./VERT	24.8	**PK**
Mid Channel – PEAK								
2446.00	60.21	0.00	32.18	92.39	--	3.0m./VERT	--	**PK**
*4833.00	51.13	0.00	1.72	52.85	74.0	3.0m./VERT	21.1	**PK**
*7336.00	51.4	-9.50	7.64	49.54	74.0	1.0m./HORZ	24.5	**PK**
High Channel– PEAK								
2461.00	60.22	0.00	32.36	92.58	--	3.0m./VERT	--	**PK**
*4926.00	50.92	0.00	1.68	52.60	74.0	3.0m./VERT	21.4	**PK**
*7371.00	51.36	-9.50	7.59	50.34	74.0	1.0m./HORZ	23.7	**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
3. The EUT was placed in three orthogonal positions, tested while broadcasting from each antenna, and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.
4. Measurement at 1 meters corrected using inverse extrapolation factor of -9.5 dB to correct the value for 3 meter.

Sample Calculation at 2413.00 MHz:

Magnitude of Measured Frequency	59.36	dBuV
+Additional Factor	0.00	dB
+Antenna Factor + Cable Loss+ Amplifier Gain	32.18	dB/m
Corrected Result	91.48	dBuV/m

Test Date: August 10, 2022

Tested By
Signature: Name: Gabriel Medina

Table 10. 802.11n-Average Radiated Fundamental & Harmonic Emissions

Test: FCC Part 15,247(d)								
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								
2411.00	46.59	0.00	32.18	78.77	--	3.0m./VERT	--	**AVG**
*4831.00	32.06	0.00	1.81	33.87	54.0	3.0m./HORZ	20.1	**AVG**
*7225.00	31.94	-9.50	7.01	29.45	54.0	1.0m./VERT	24.5	**AVG**
Mid Channel –Average								
2446.00	48.11	0.00	32.18	80.29	--	3.0m./VERT	--	**AVG**
*4818.00	32.10	0.00	1.81	33.91	54.0	3.0m./HORZ	20.1	**AVG**
*7336.00	31.98	-9.50	7.64	30.12	54.0	1.0m./HORZ	23.9	**AVG**
High Channel–Average								
2461.00	47.57	0.00	32.36	79.93	--	3.0m./VERT	--	**AVG**
*4926.00	30.91	0.00	1.68	32.59	54.0	3.0m./VERT	21.4	**AVG**
*7389.00	31.96	-9.50	7.56	30.02	54.0	1.0m./VERT	24.0	**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. The EUT was placed in three orthogonal positions, tested while broadcasting from each antenna, and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.
4. Measurement at 1 meters corrected using inverse extrapolation factor of -9.5 dB to correct the value for 3 meter.

Sample Calculation at 2411.00 MHz:

Magnitude of Measured Frequency	46.59	dBuV
+Additional Factor	0.00	dB
+Antenna Factor + Cable Loss+ Amplifier Gain	32.18	dB/m
Corrected Result	78.77	dBuV/m

Test Date: August 10, 2022

Tested By
Signature:  Name: Gabriel Medina

2.11 Band Edge Measurements (CFR 15.247(d), RSS-247, 5.5)

Band Edge measurements are made following the guidelines in ANSI C63.10-2013 Clause 6.10 with the EUT initially operating on the Lowest Channel and then operating on the Highest Channel within its band of operation. Restricted band and band edge test is performed as radiated measurements. The test instrument used for testing has both Peak and Average detection. In consideration of Clause 5.8 of ANSI C63.10-2013, the EUT antenna is connected to its antenna port during testing. The EUT was set to its highest rated output power level during testing. The results are collected and presented below.

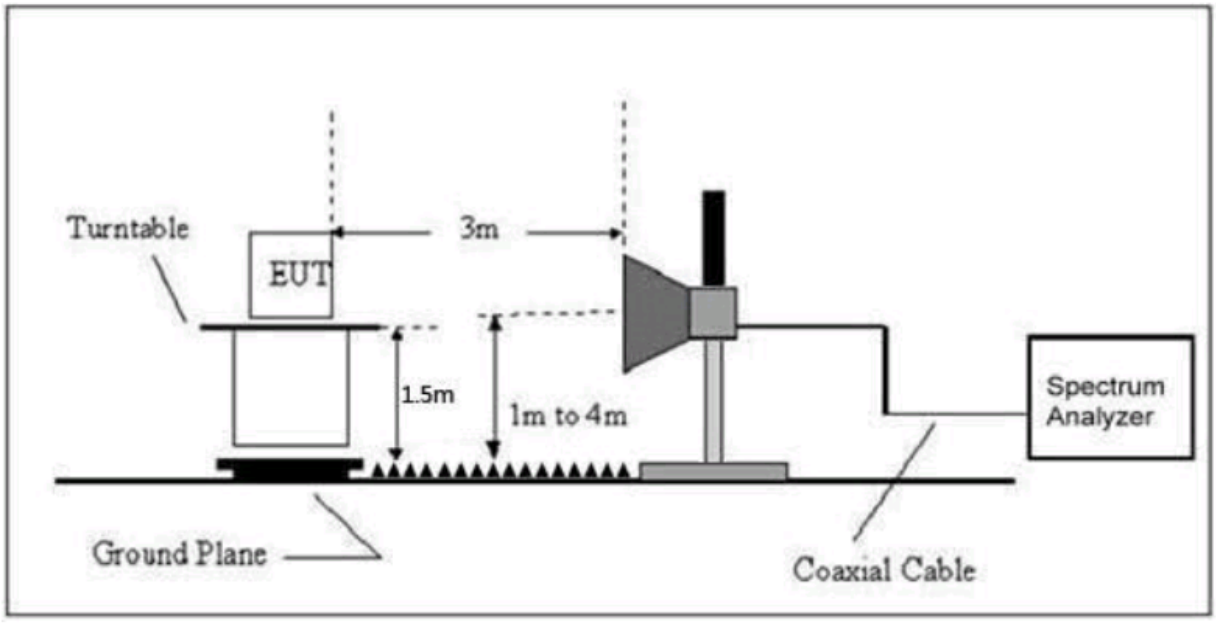


Figure 22. Radiated Bandedge & Restrict Band Test Setup

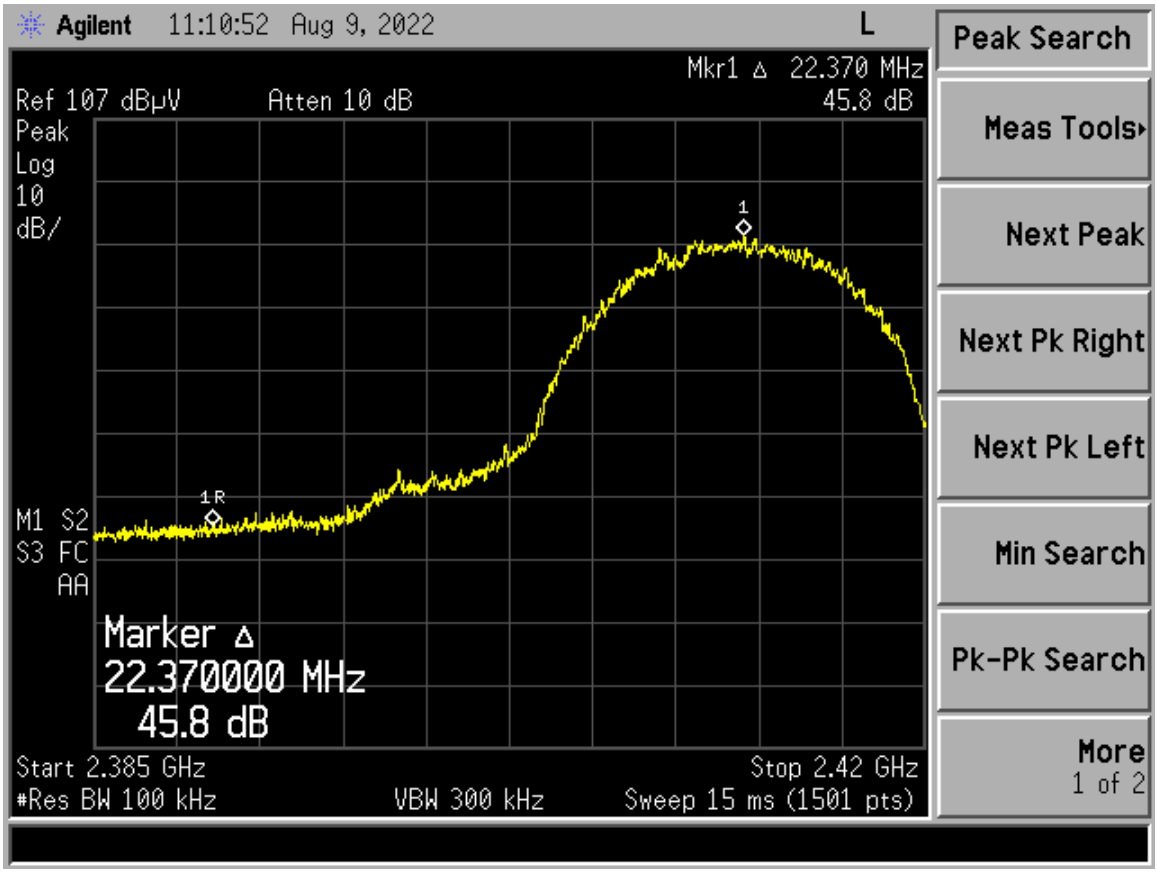


Figure 23. Band Edge Compliance – B mode Low Channel Delta - Peak

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

Measured Result	45.80	dB
Band Edge Limit	20.00	dB
Band Edge Margin	25.80	dB

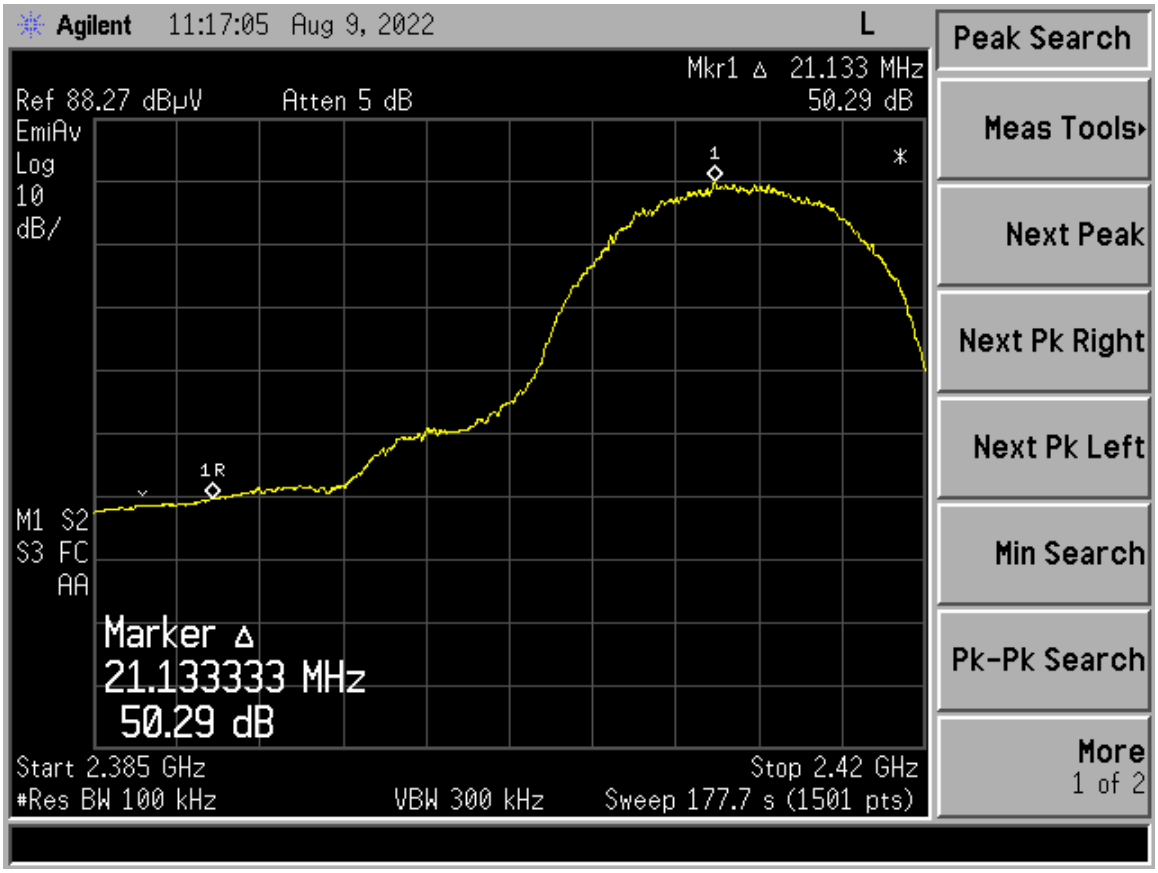


Figure 24. Band Edge Compliance – B mode Low Channel Delta – Average

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

Measured Result	50.29	dB
Band Edge Limit	20.00	dB
Band Edge Margin	30.29	dB

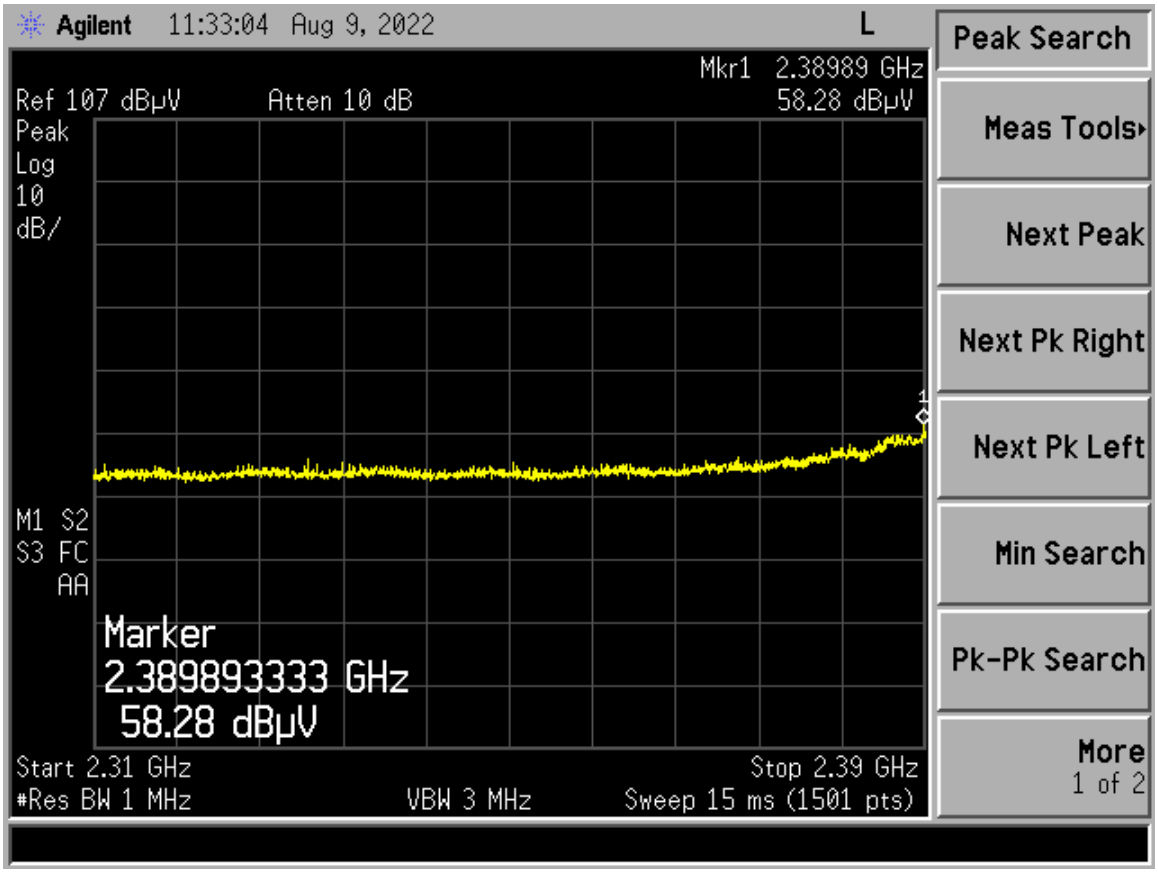


Figure 25. B mode Low Channel Restricted Band - Peak

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
2389.89	58.28	-6.54	51.74	74.0	3.0m./VERT	22.3	**PK**

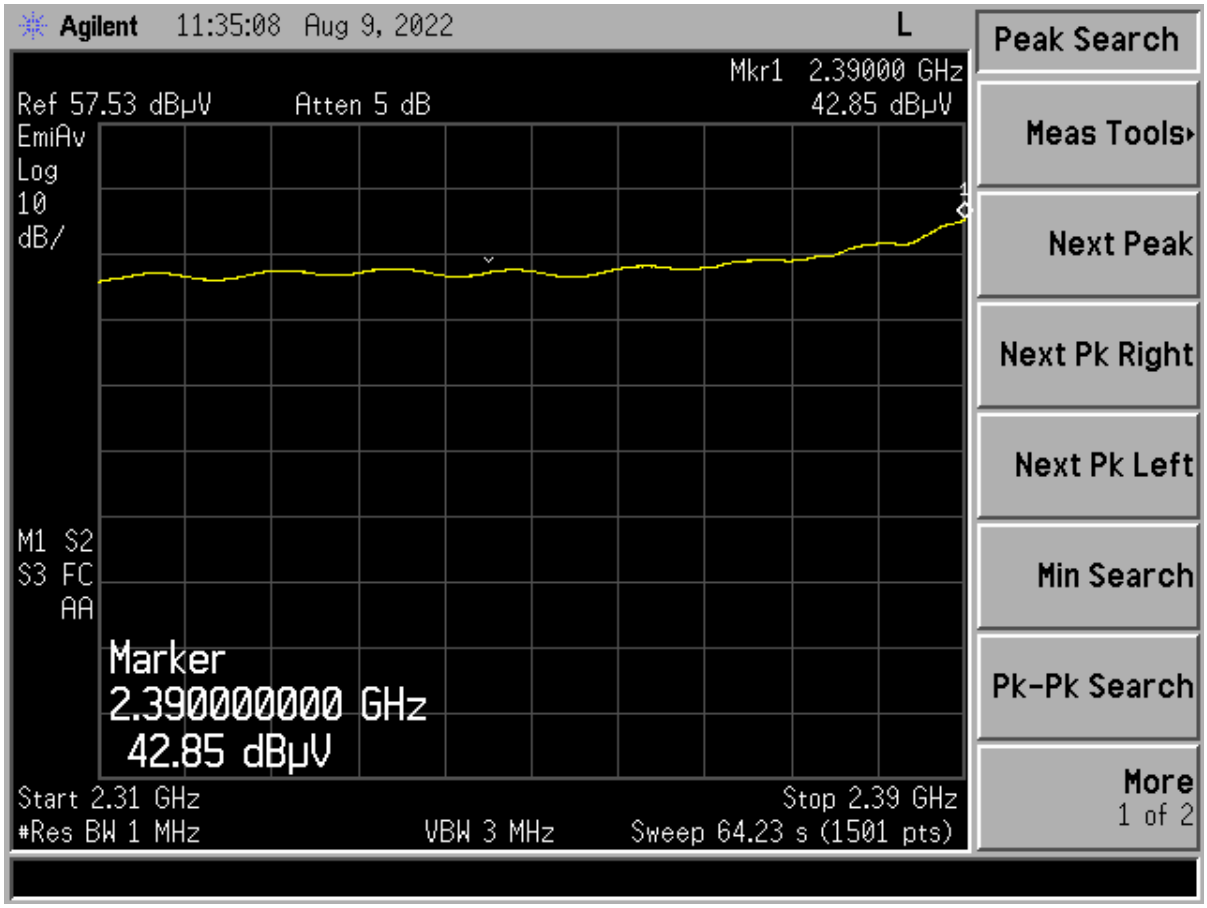


Figure 26. B mode Low Channel Restricted Band – Average

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	42.85	-6.54	36.31	54.0	3.0m./VERT	17.7	**AVG**

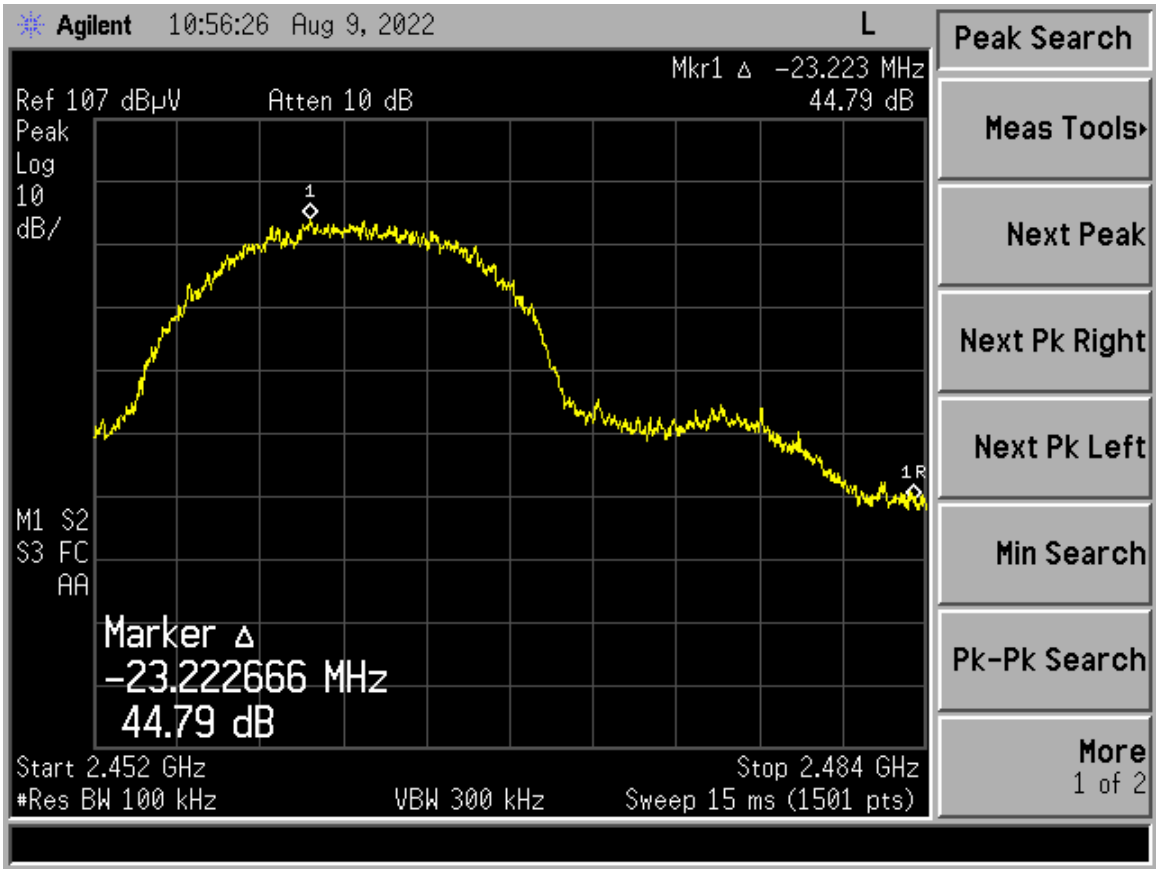


Figure 27. Band Edge Compliance – B mode High Channel Delta - Peak

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

Measured Result	44.79	dB
Band Edge Limit	20.00	dB
Band Edge Margin	24.79	dB

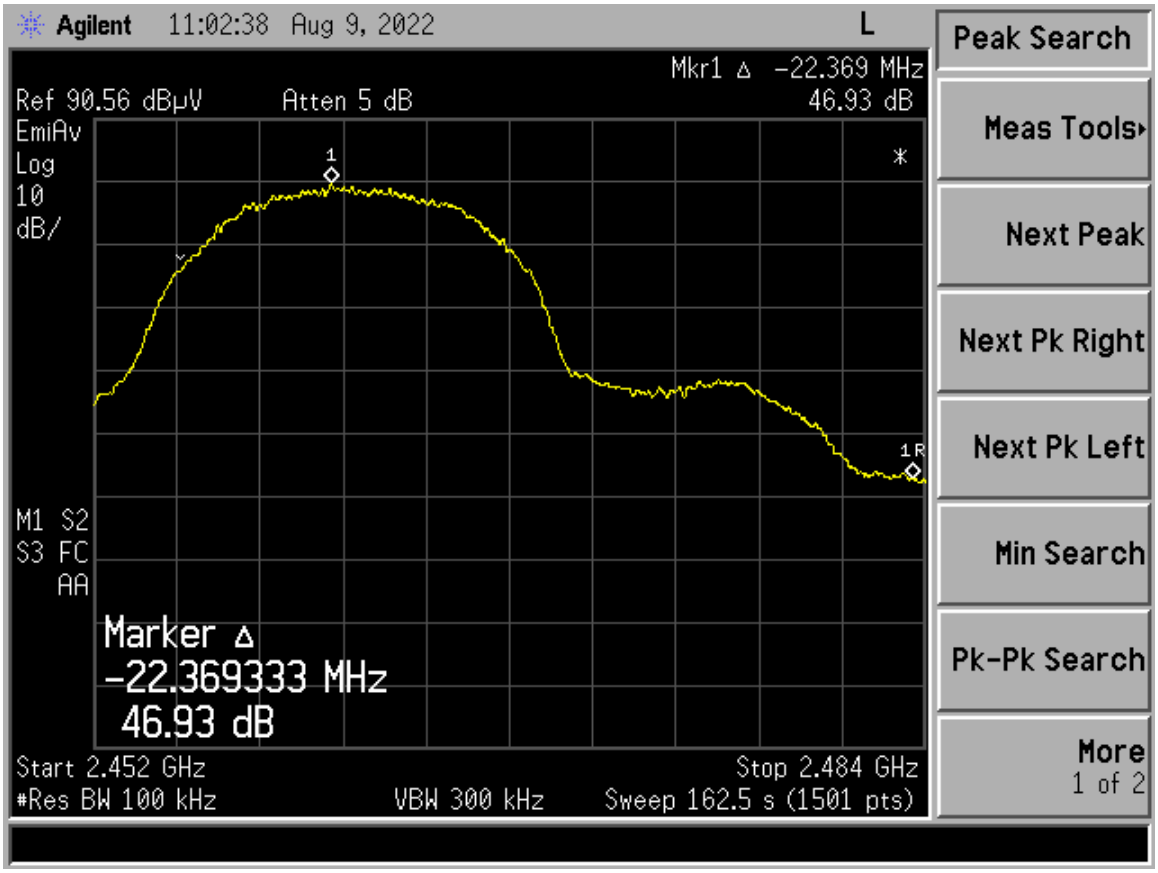


Figure 28. Band Edge Compliance – B mode High Channel Delta - Average

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

Measured Result	46.93	dB
Band Edge Limit	20.00	dB
Band Edge Margin	26.93	dB

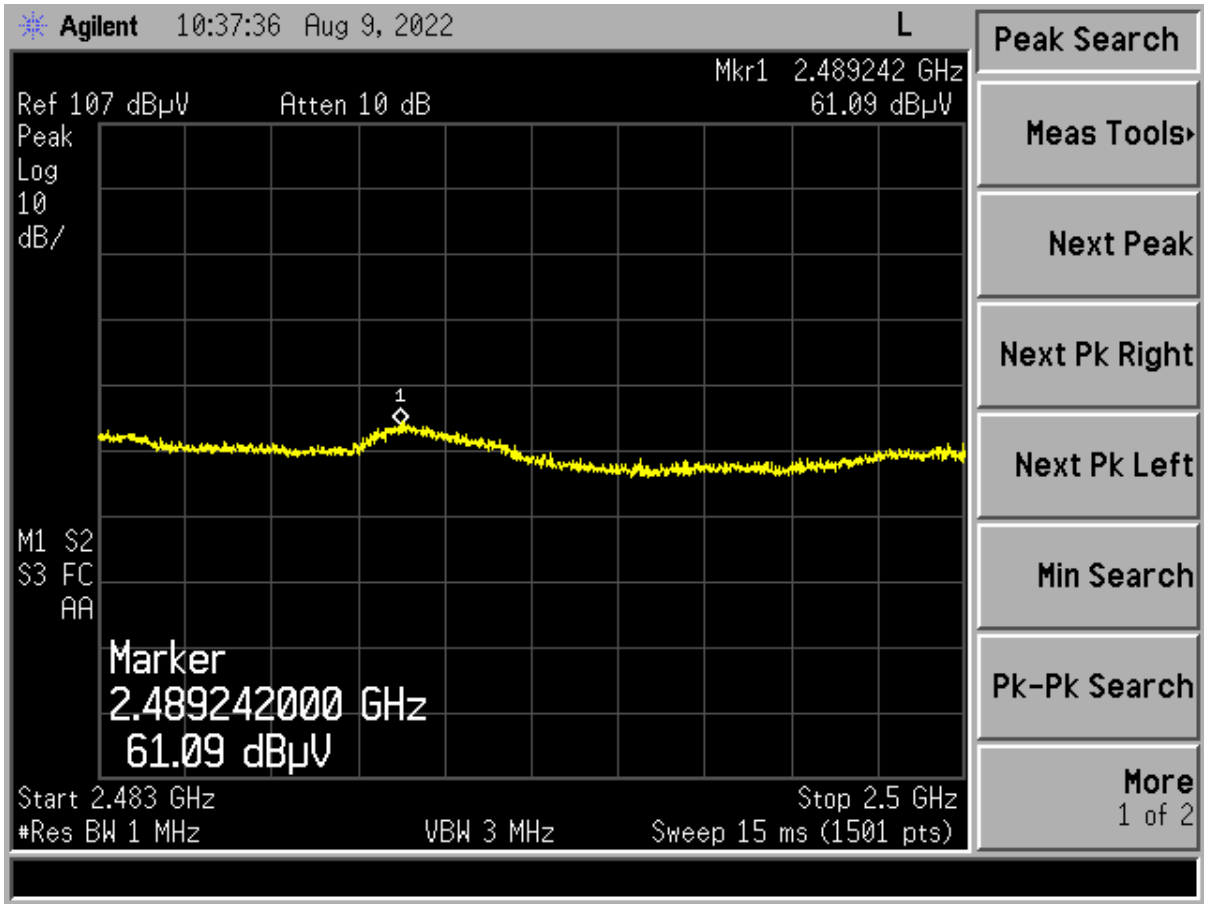


Figure 29. B mode High Channel Restricted Band – Peak

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
2489.24	61.09	-6.14	54.95	74.0	3.0m./VERT	19.1	**PK**

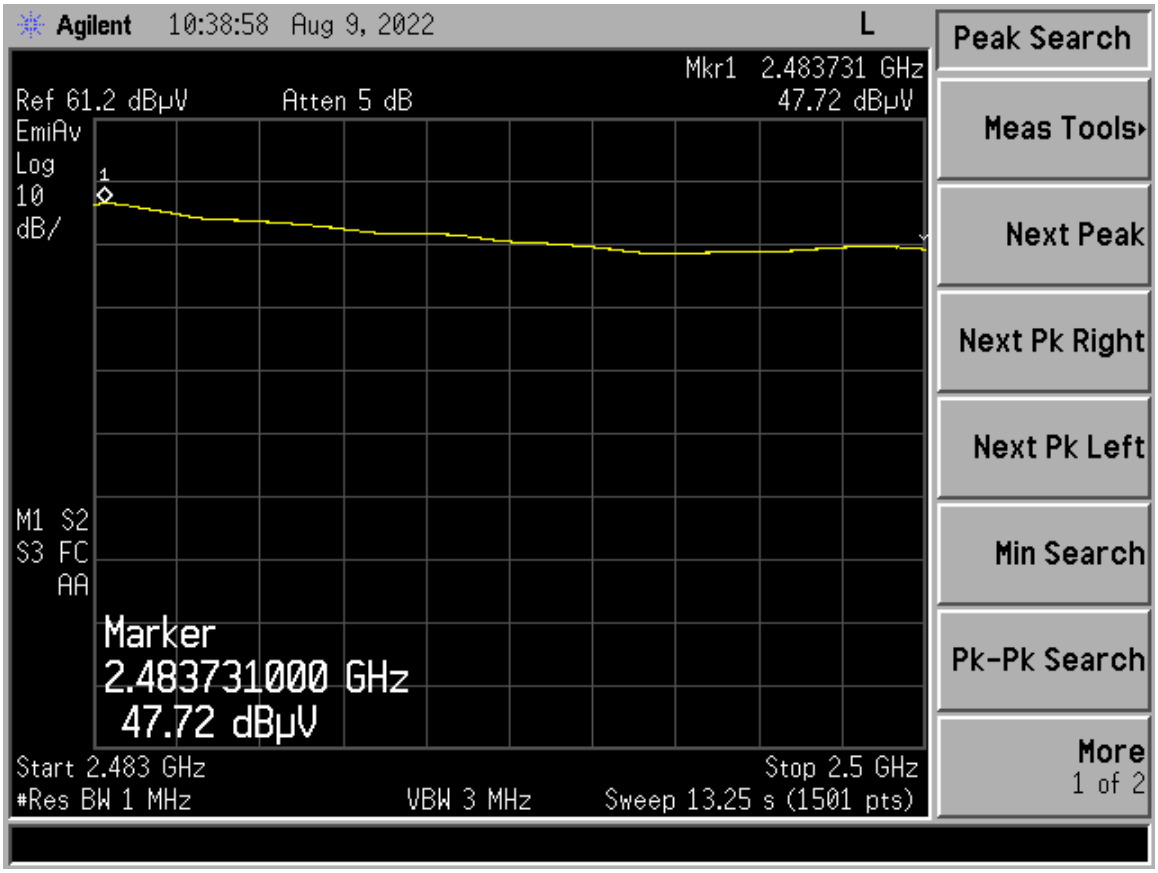


Figure 30. B mode High Channel Restricted Band – Average

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
2483.73	47.72	-6.14	41.58	54.0	3.0m./VERT	12.4	**AVG**

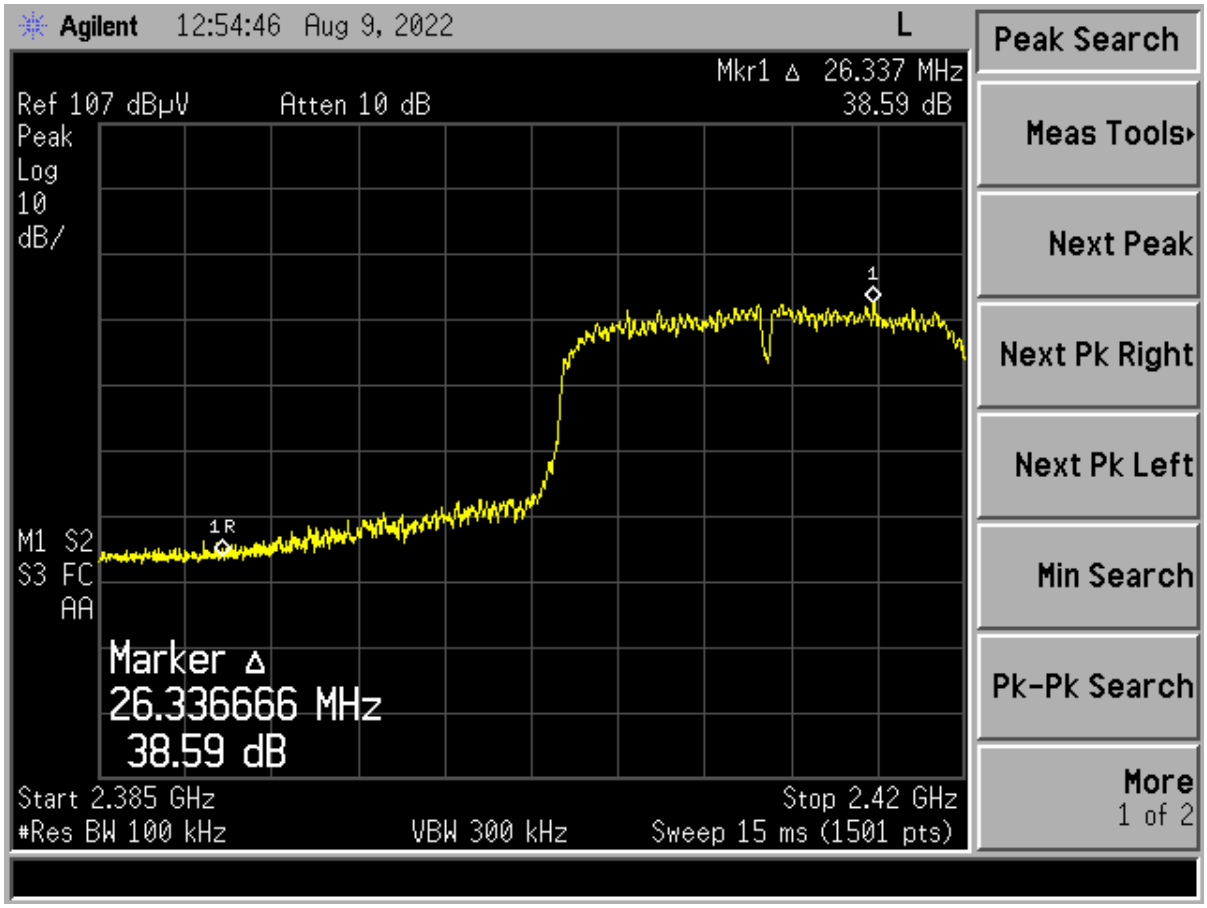


Figure 31. Band Edge Compliance – G mode Low Channel Delta – Peak

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

Measured Result	38.59	dB
Band Edge Limit	20.00	dB
Band Edge Margin	18.59	dB

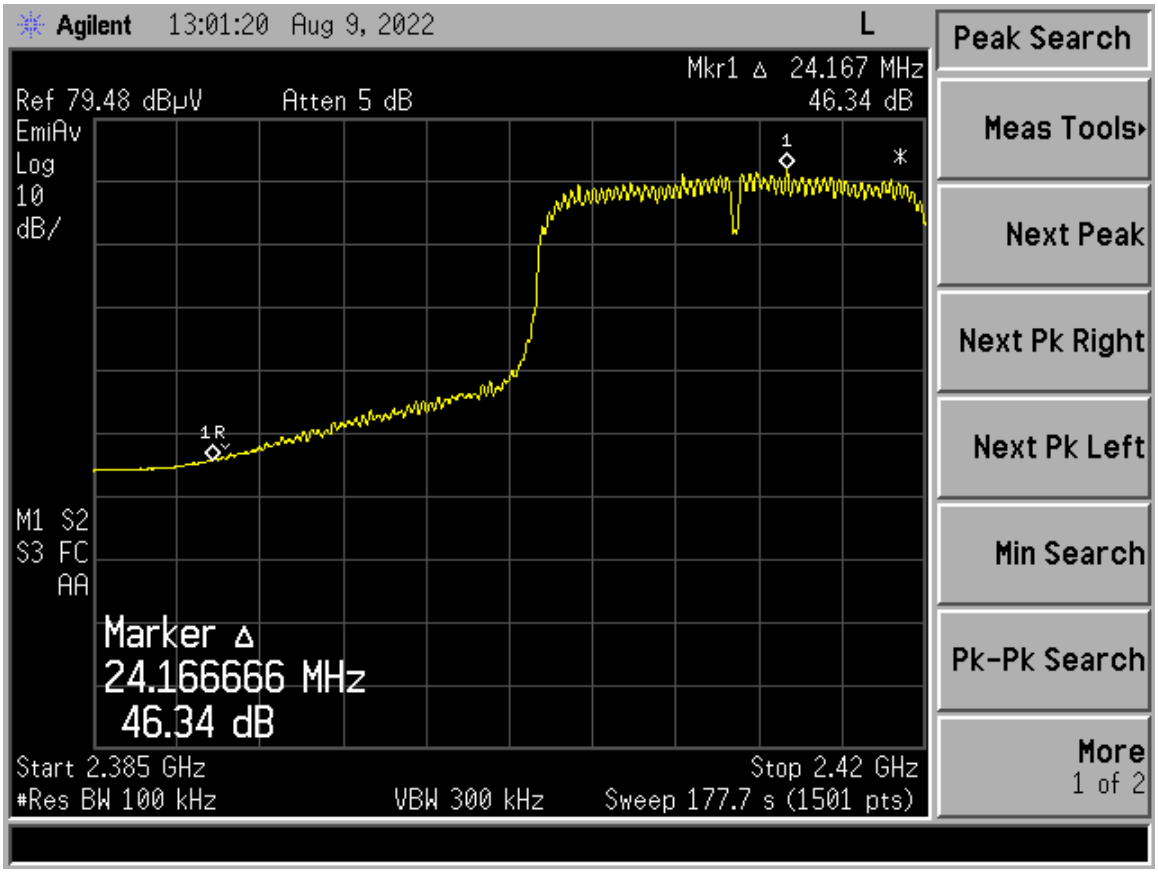


Figure 32. Band Edge Compliance – G mode Low Channel Delta – Average

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

Measured Result	46.34	dB
Band Edge Limit	20.00	dB
Band Edge Margin	26.34	dB

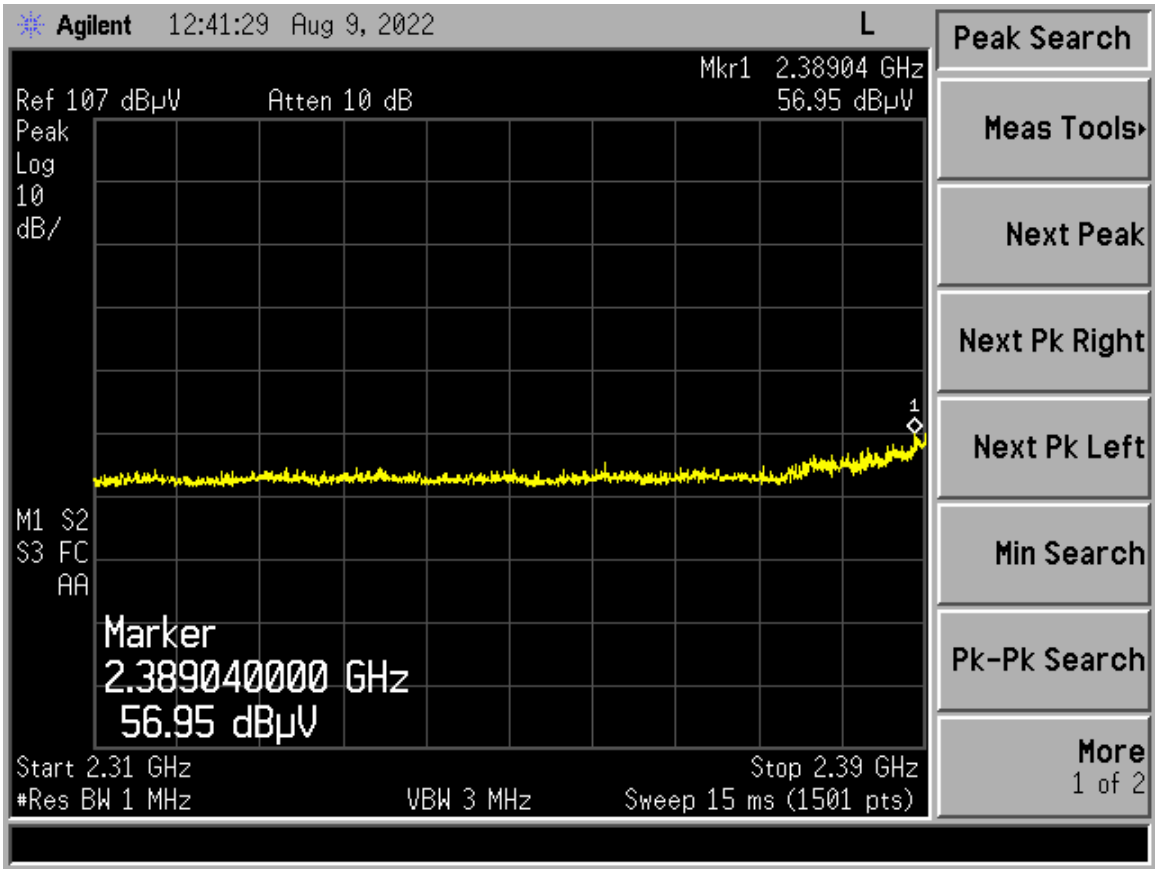


Figure 33. G mode Low Channel Restricted Band – Peak

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
2389.04	56.95	-6.54	50.41	74.0	3.0m./VERT	23.6	**PK**

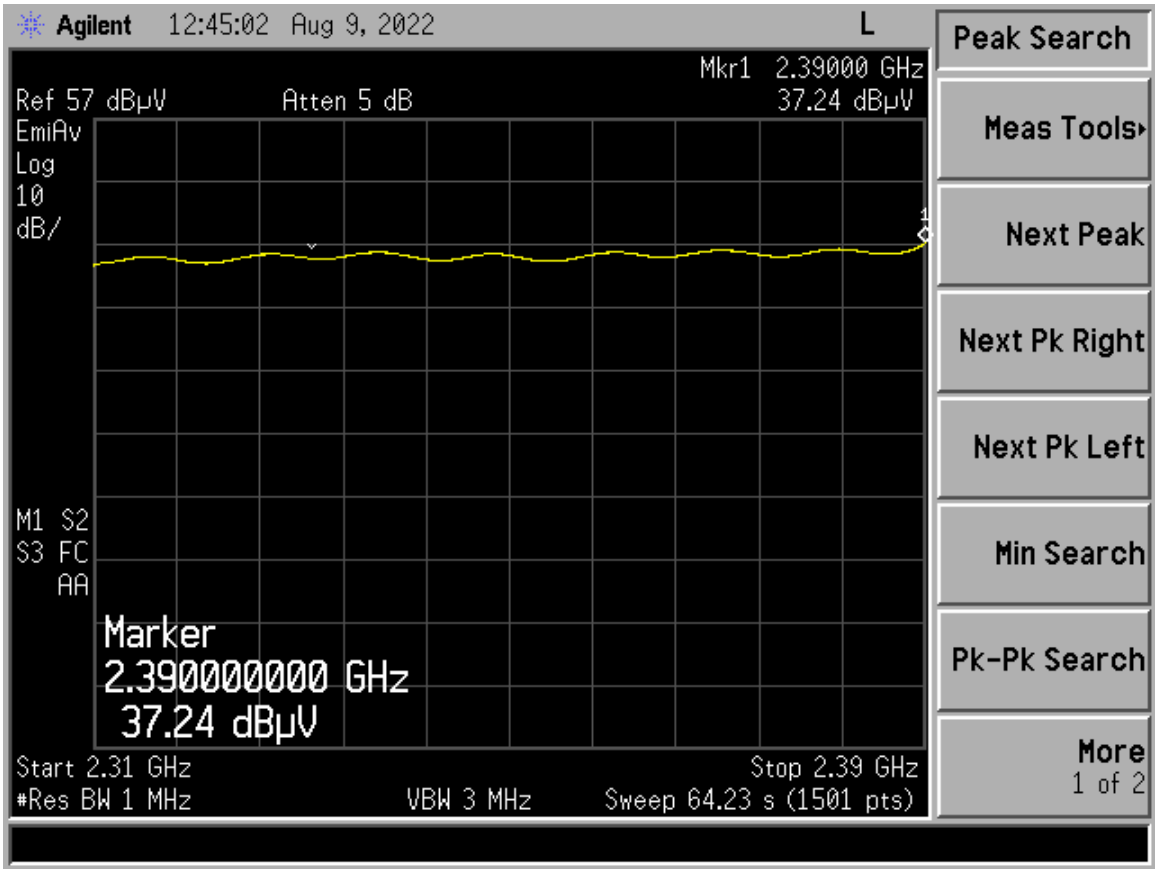


Figure 34. G mode Low Channel Restricted Band – Average

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	37.24	-6.54	30.70	54.0	3.0m./VERT	23.3	**AVG**

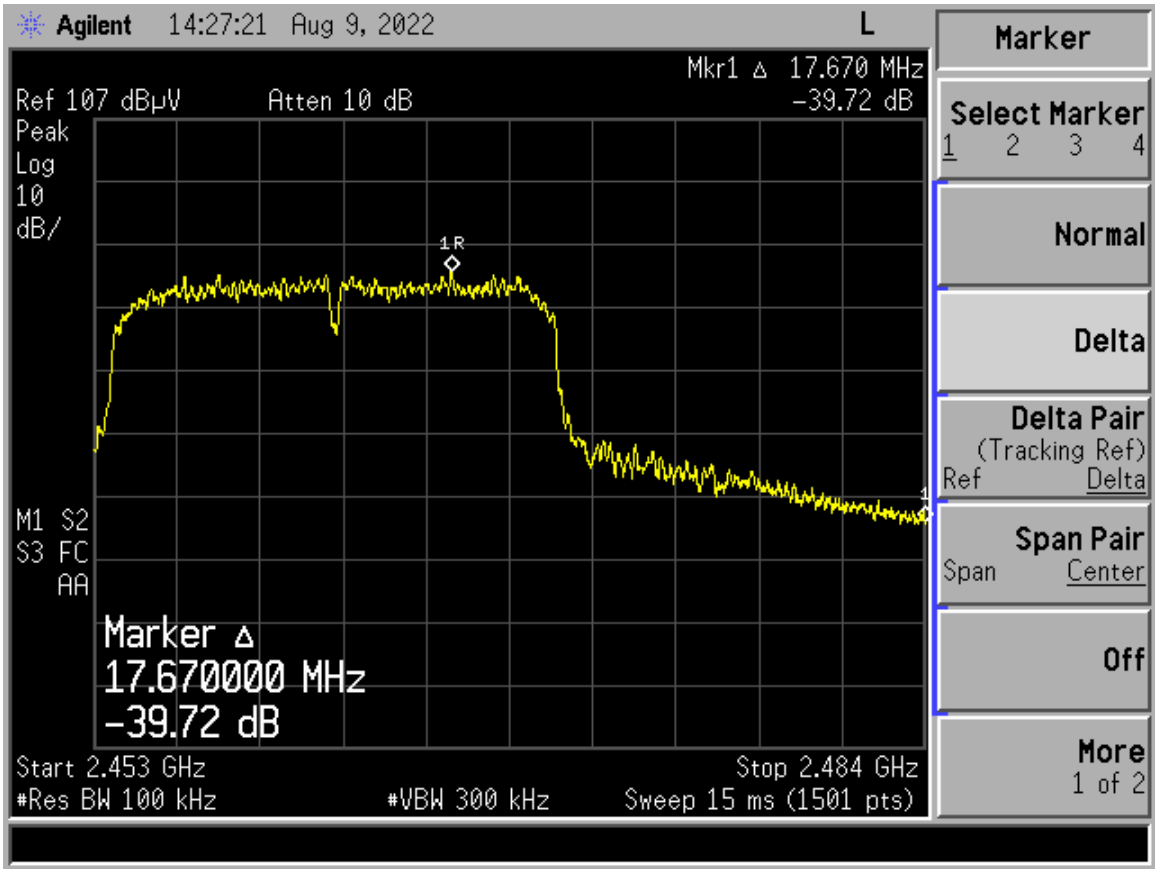


Figure 35. Band Edge Compliance – G mode High Channel Delta – Peak

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

Measured Result	39.72	dB
Band Edge Limit	20.00	dB
Band Edge Margin	19.72	dB

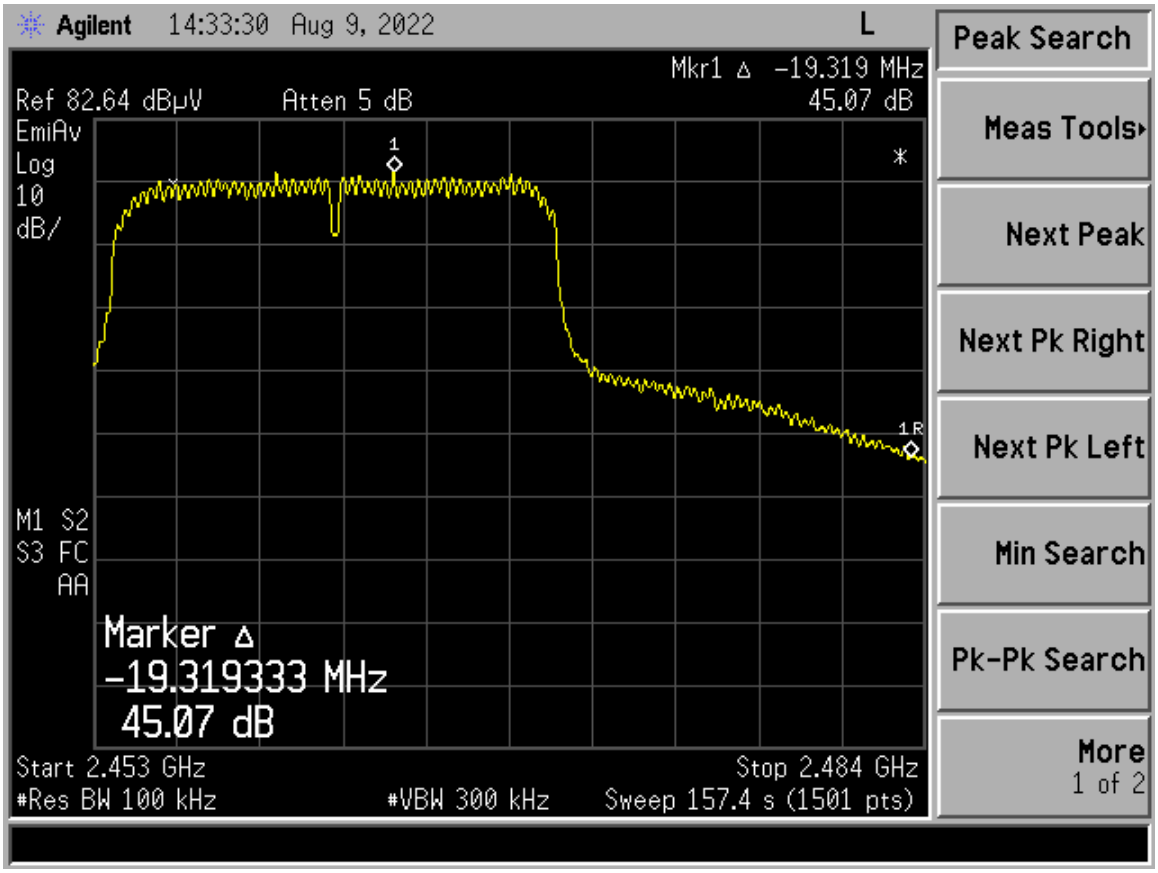


Figure 36. Band Edge Compliance – G mode High Channel Delta – Average

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

Measured Result	45.07	dB
Band Edge Limit	20.00	dB
Band Edge Margin	25.07	dB

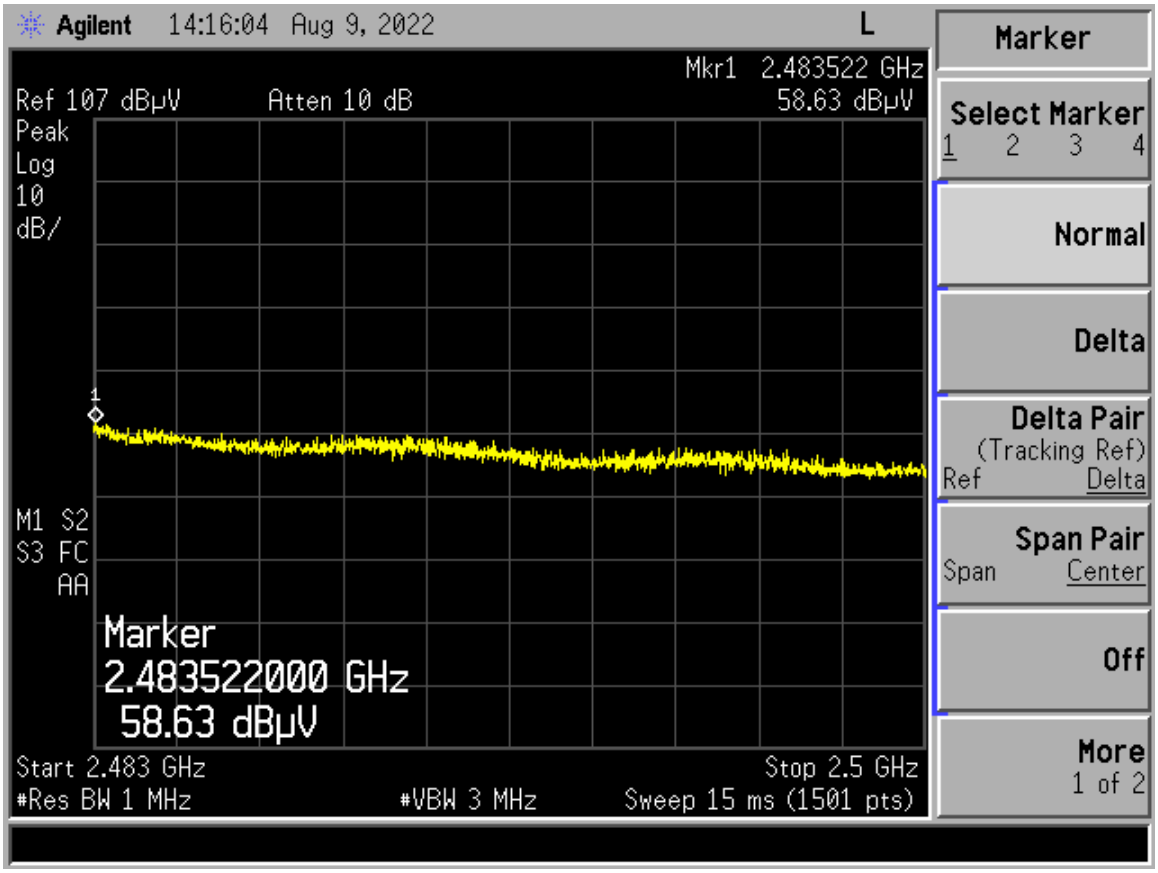


Figure 37. G mode High Channel Restricted Band – Peak

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
2483.52	58.63	-6.14	52.49	74.0	3.0m./VERT	21.5	**PK**

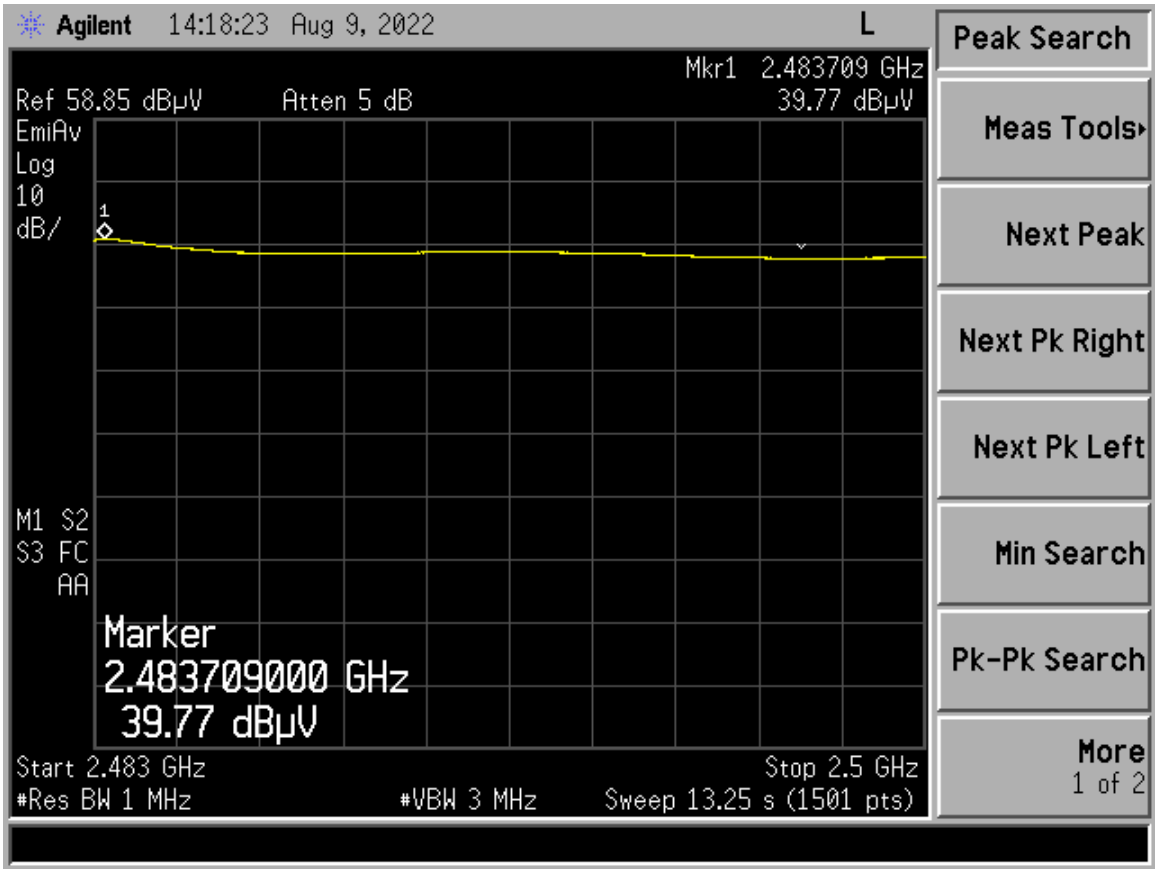


Figure 38. G mode High Channel Restricted Band – Average

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
2483.70	39.77	-6.14	33.63	54.0	3.0m./VERT	20.4	**AVG**

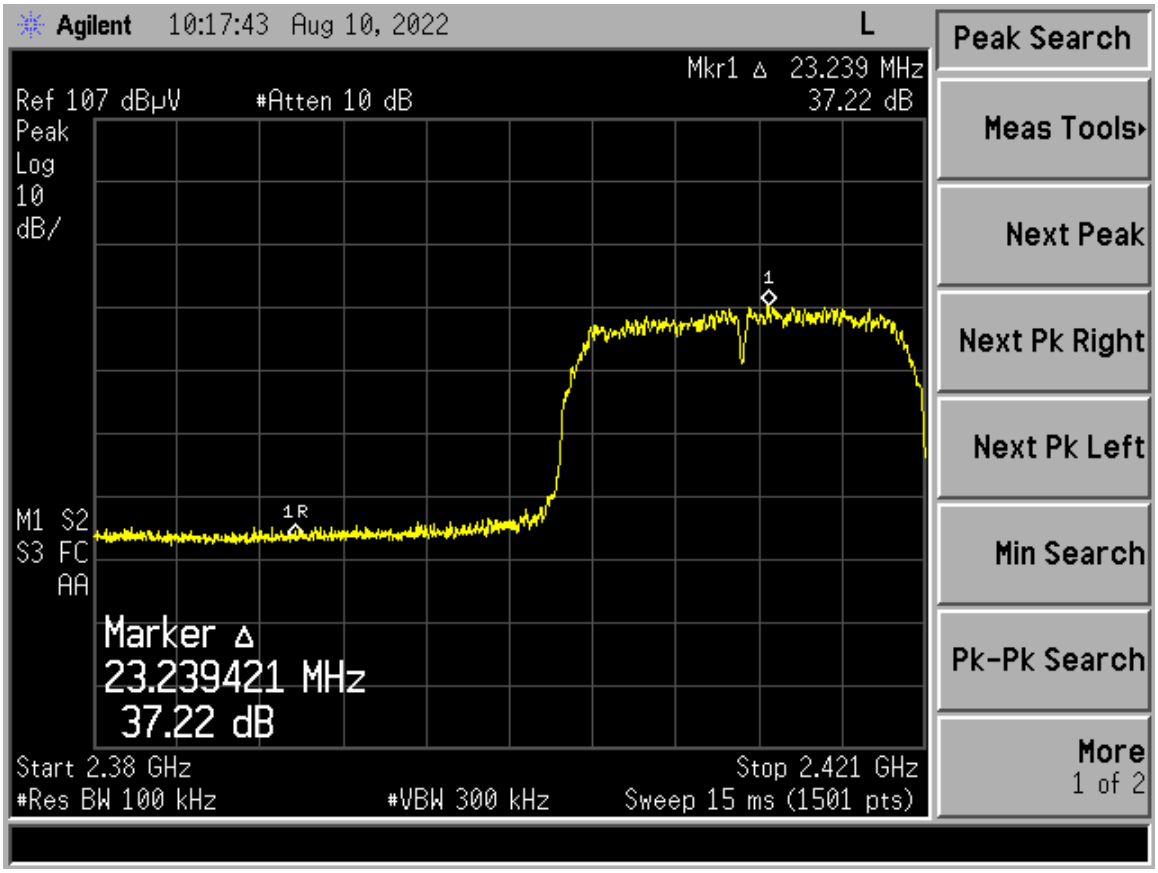


Figure 39. Band Edge Compliance – N mode Low Channel Delta – Peak

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

Measured Result	37.22	dB
Band Edge Limit	20.00	dB
Band Edge Margin	17.22	dB

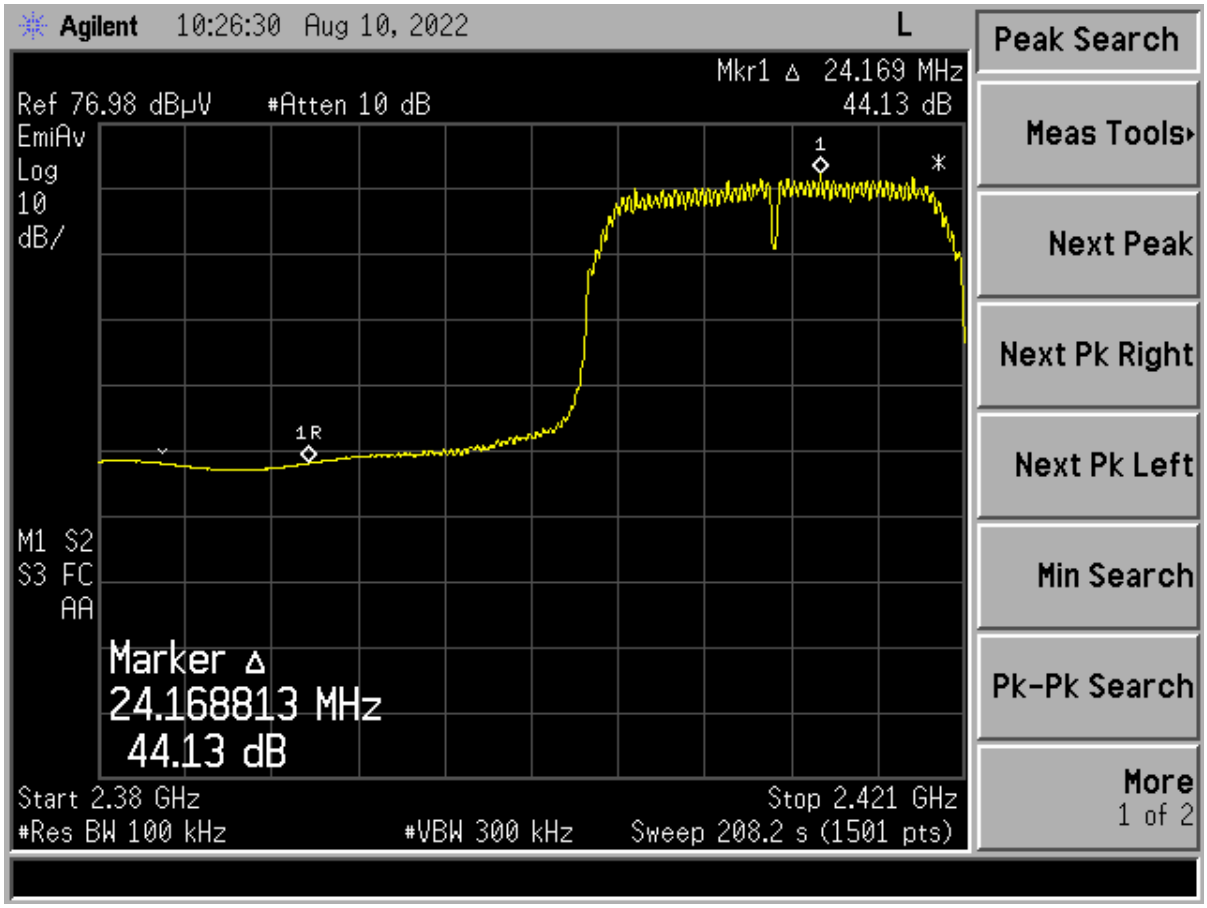


Figure 40. Band Edge Compliance – N mode Low Channel Delta – Average

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

Measured Result	44.13	dB
Band Edge Limit	20.00	dB
Band Edge Margin	24.13	dB

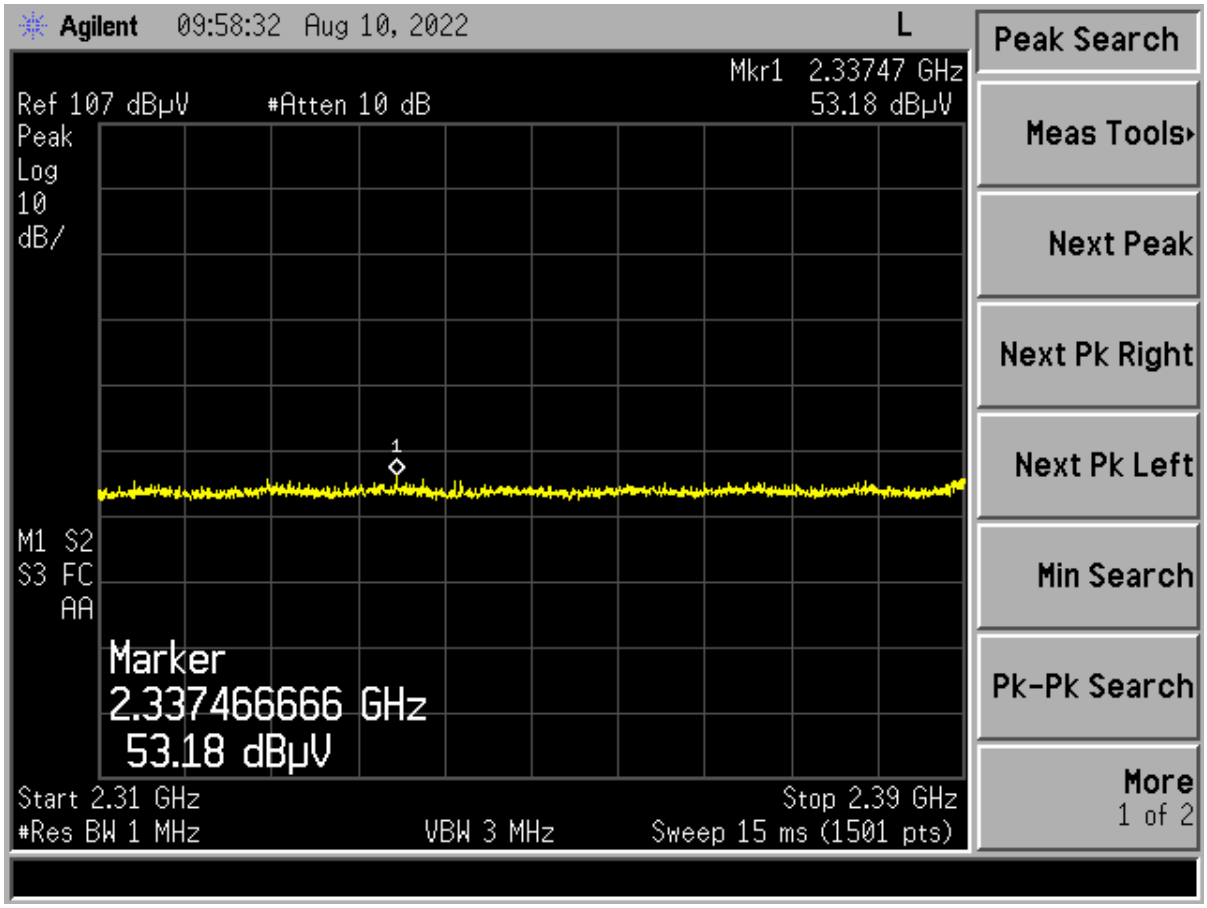


Figure 41. N mode Low Channel Restricted Band – Peak

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
2337.46	53.18	-7.04	46.14	74.0	3.0m./VERT	27.9	**PK**

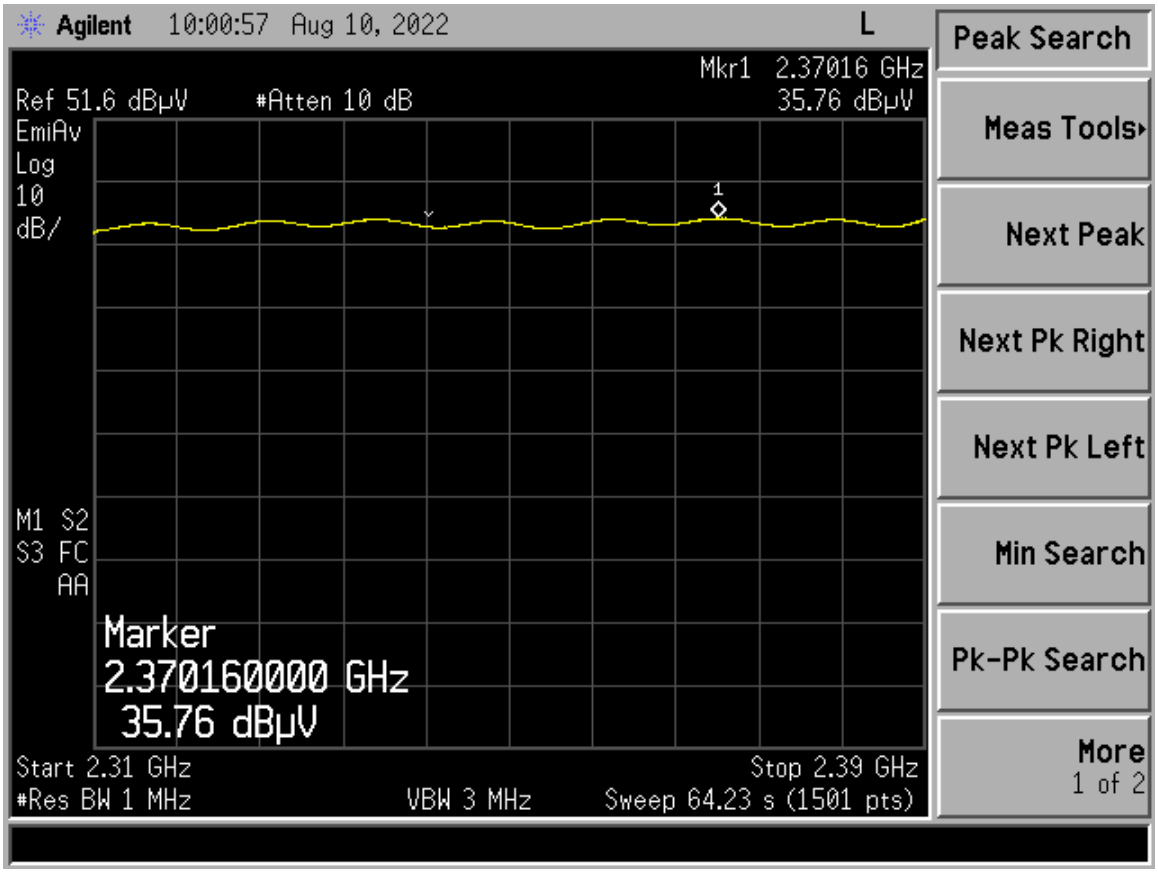


Figure 42. N mode Low Channel Restricted Band – Average

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
2370.16	35.76	-6.57	29.19	54.0	3.0m./VERT	24.8	**AVG**

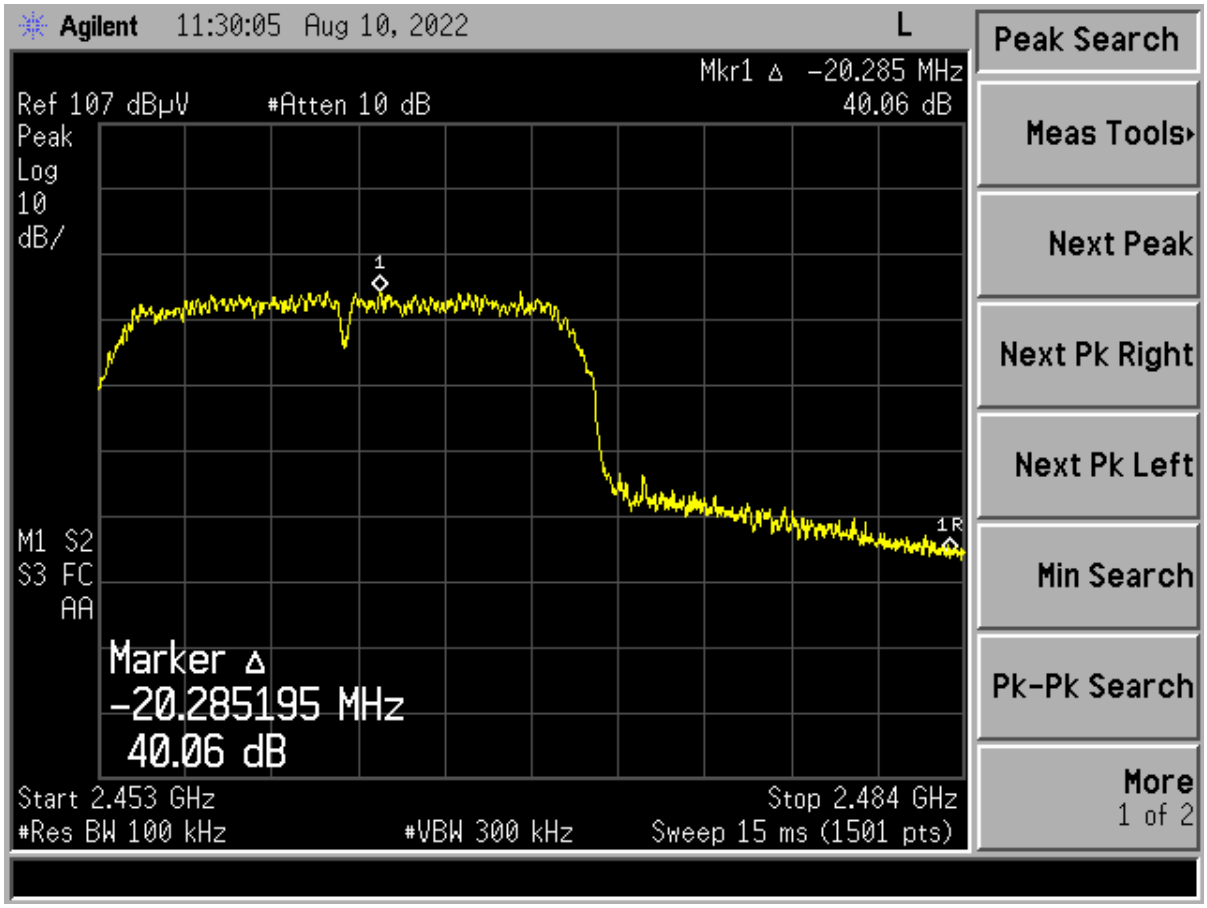


Figure 43. Band Edge Compliance – N mode High Channel Delta – Peak

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

Measured Result	40.06	dB
Band Edge Limit	20.00	dB
Band Edge Margin	20.06	dB

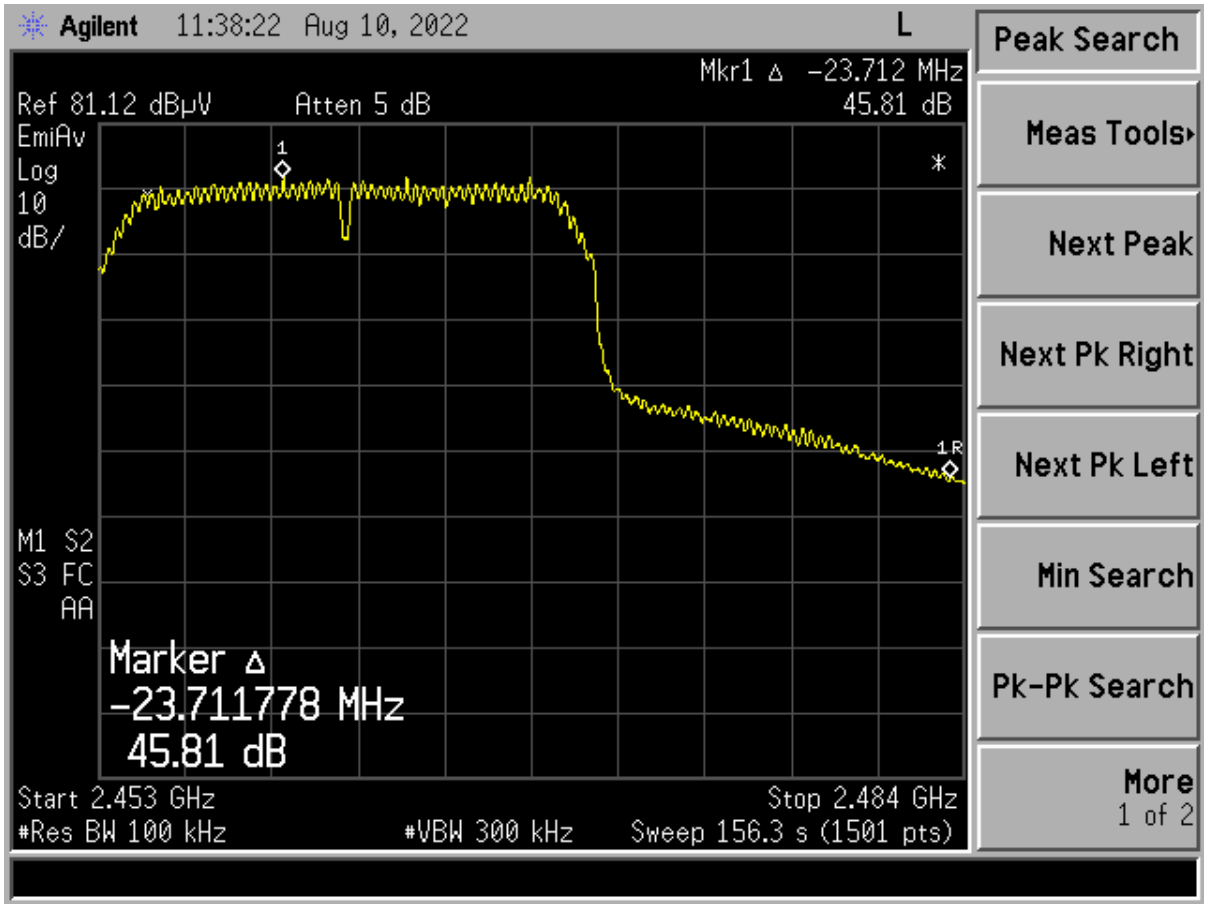


Figure 44. Band Edge Compliance – N mode High Channel Delta - Average

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

Measured Result	45.81	dB
Band Edge Limit	20.00	dB
Band Edge Margin	25.81	dB

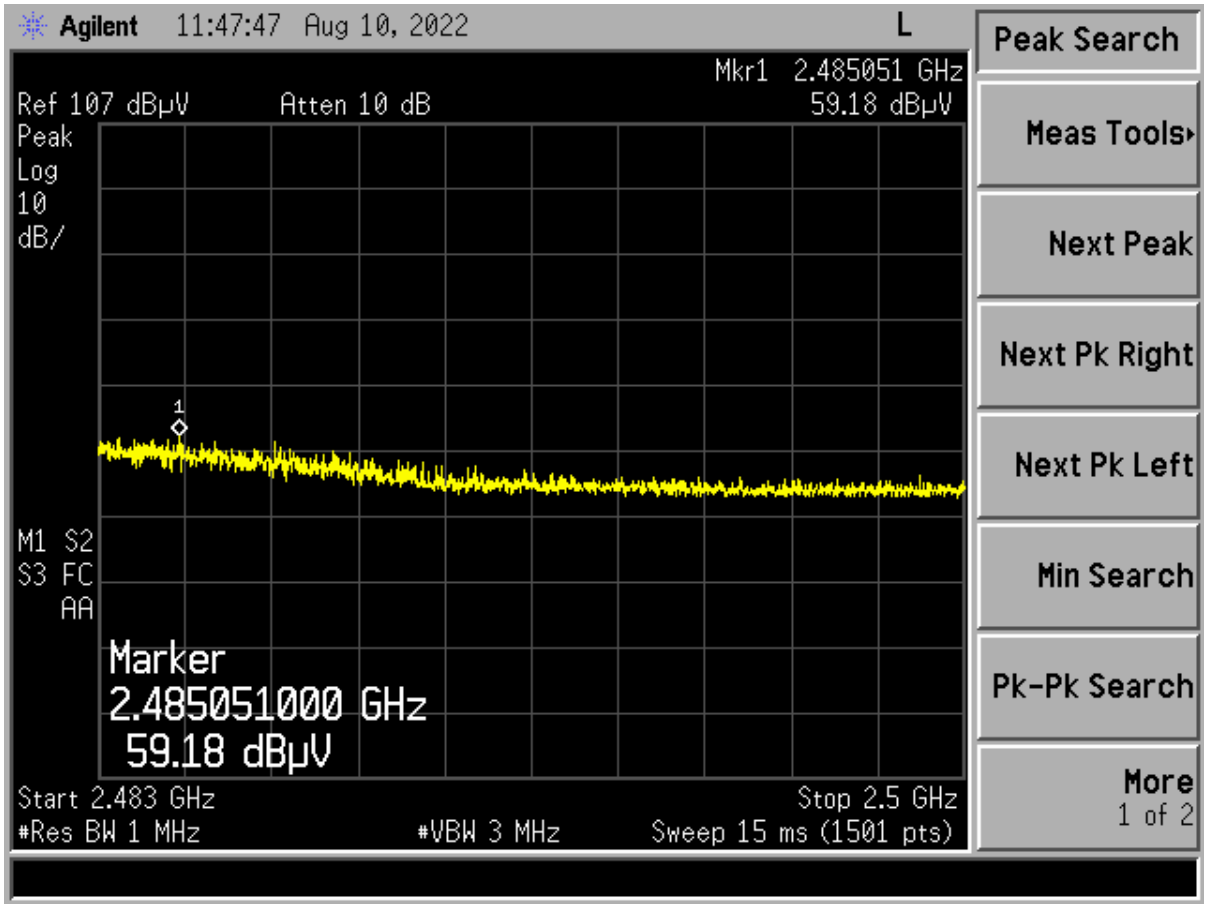


Figure 45. N mode High Channel Restricted Band – Peak

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
2485.05	59.18	-6.14	53.04	74.0	3.0m./VERT	21.0	**PK**

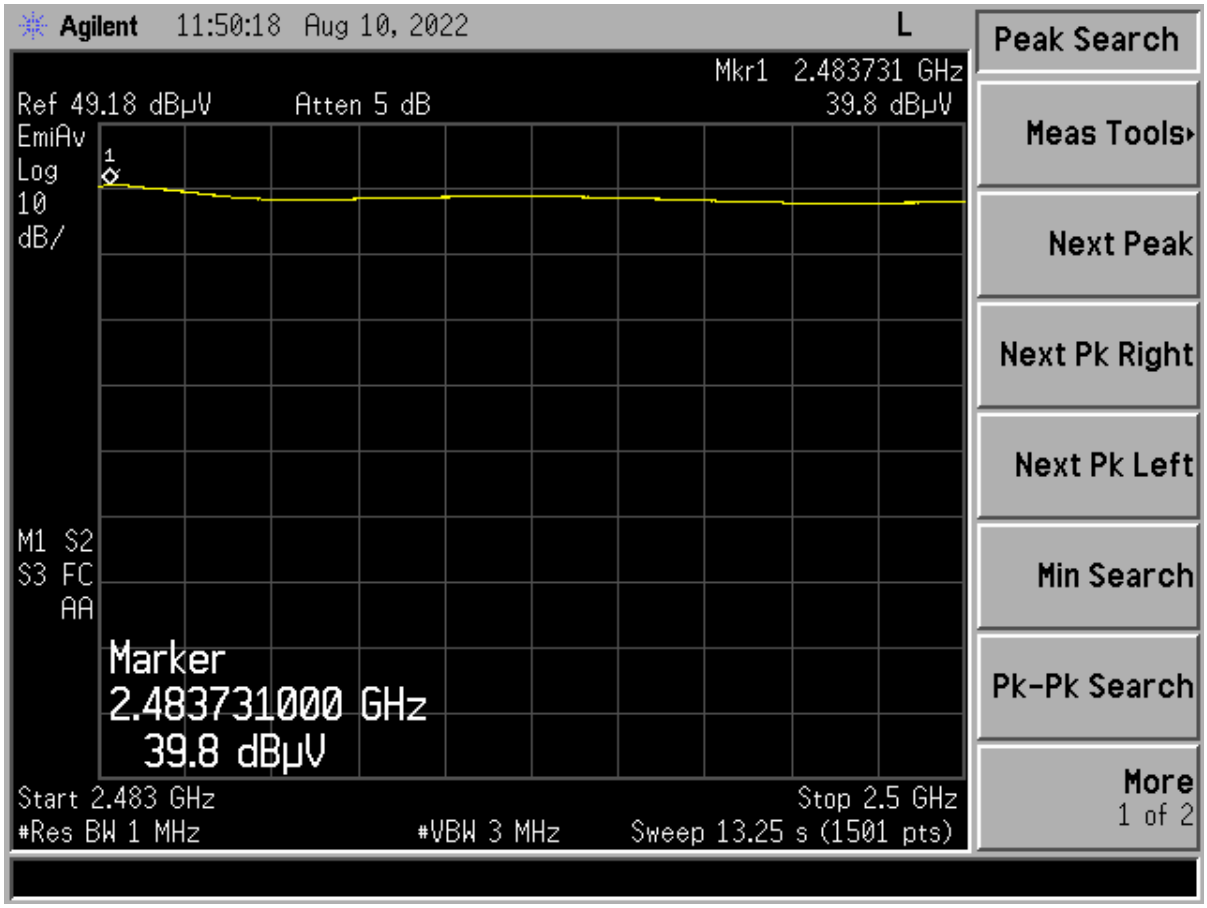


Figure 46. N mode High Channel Restricted Band – Average

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
2483.73	39.80	-6.14	33.66	54.0	3.0m./VERT	20.3	**AVG**

2.12 Six (6) dB Bandwidth (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.

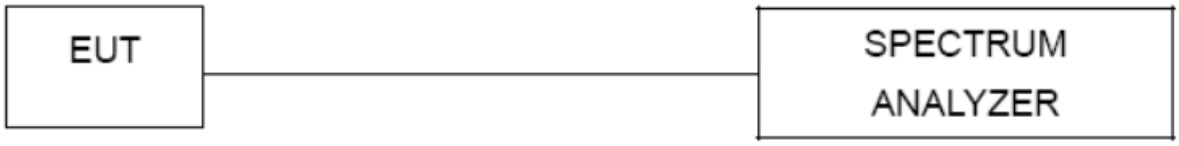


Figure 47. Bandwidth Measurement

Table 11. Six (6) dB Bandwidth

Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum FCC Bandwidth (MHz)	Mode (IEEE 802.11)
2412	9.75	0.5	b
2442	9.30	0.5	b
2462	8.95	0.5	b
2412	16.10	0.5	g
2442	16.05	0.5	g
2462	15.95	0.5	g
2412	16.35	0.5	n
2442	16.40	0.5	n
2462	16.25	0.5	n

Test Date: August 12, 2022

Tested By
Signature: Name: Gabriel Medina

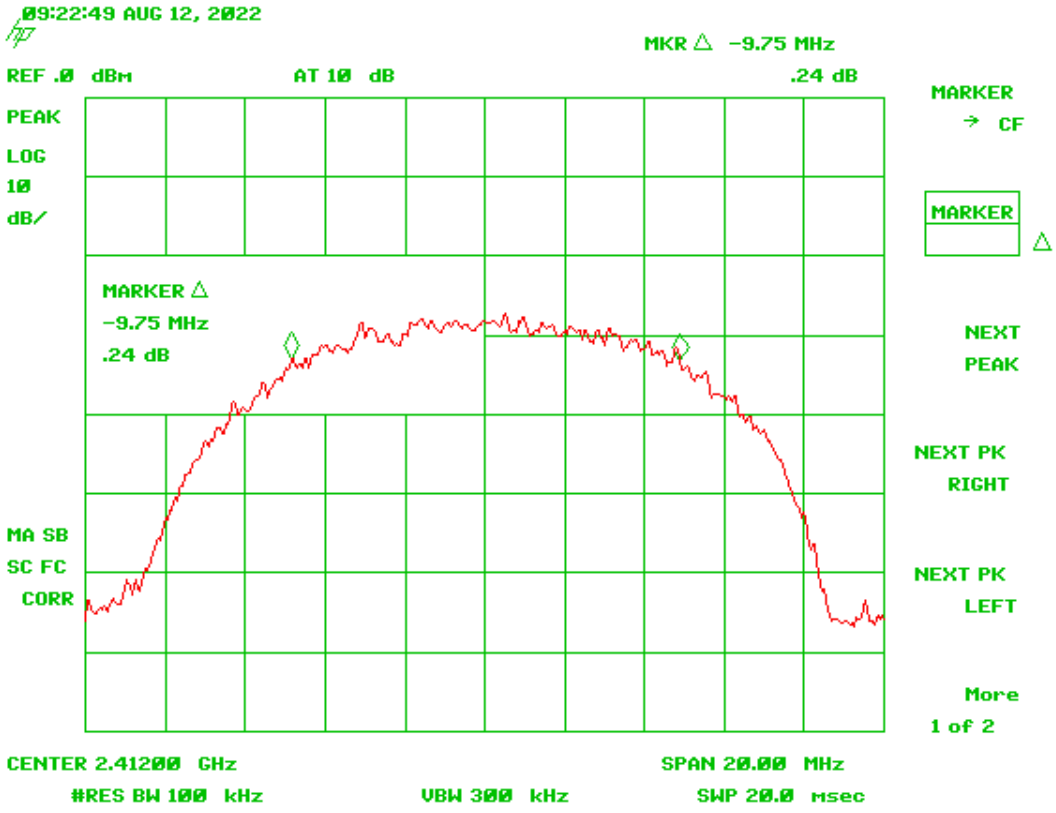


Figure 48. 6 dB Bandwidth b mode Low Channel

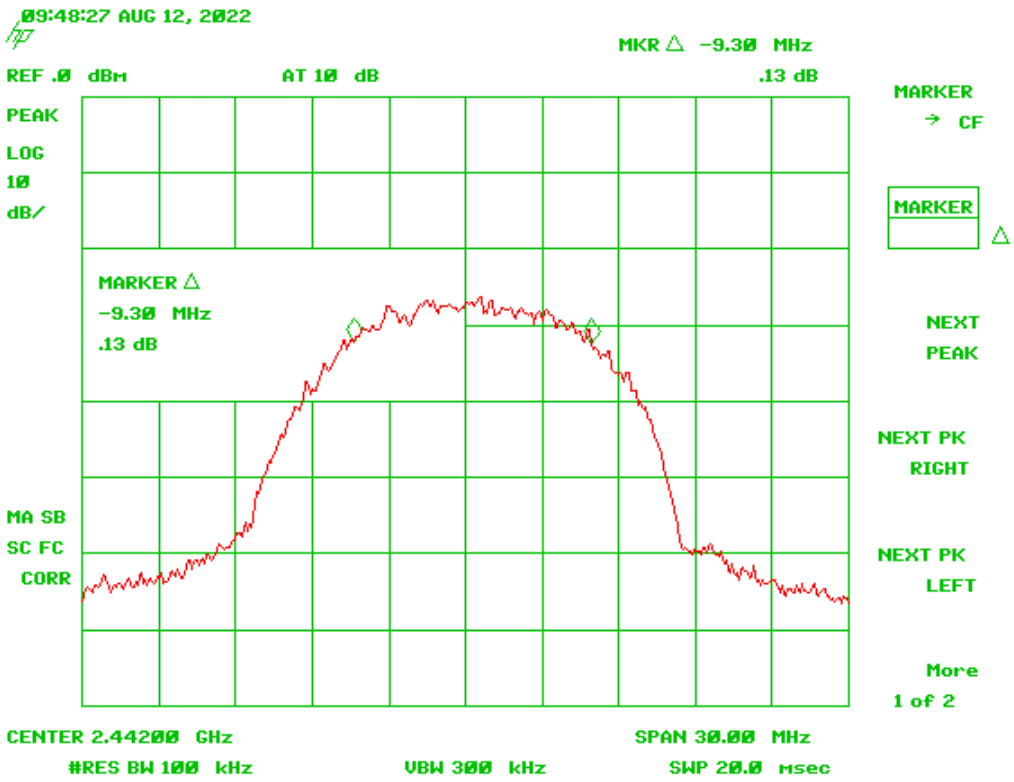


Figure 49. 6 dB Bandwidth b mode Mid Channel

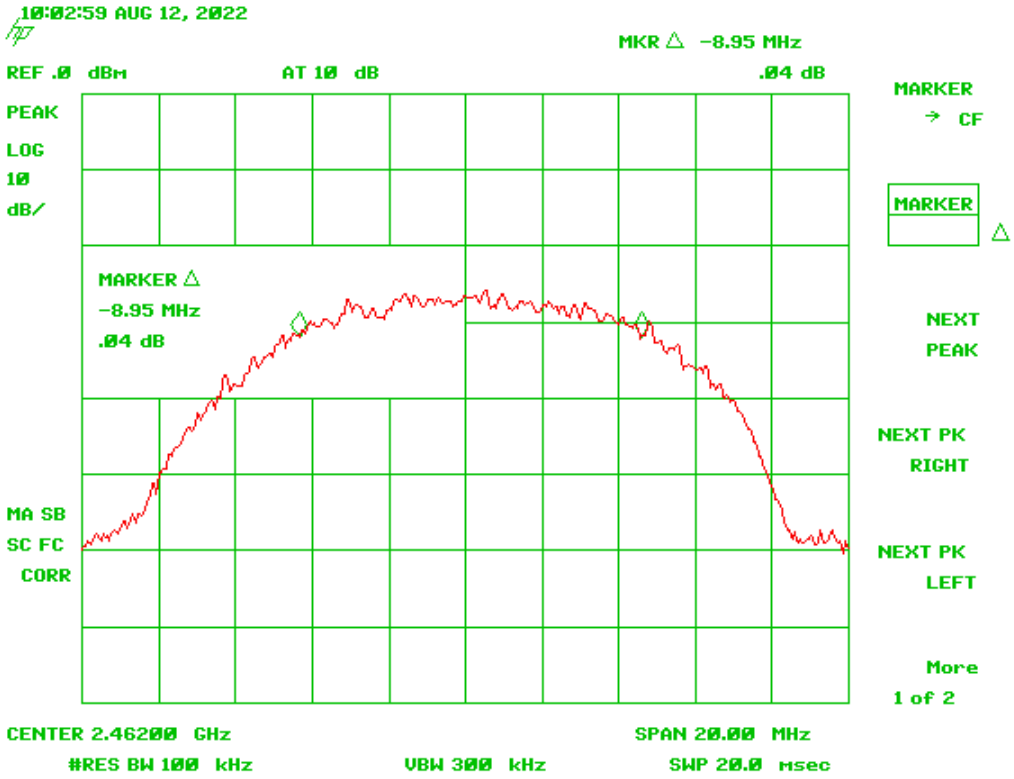


Figure 50. 6 dB Bandwidth b mode High Channel

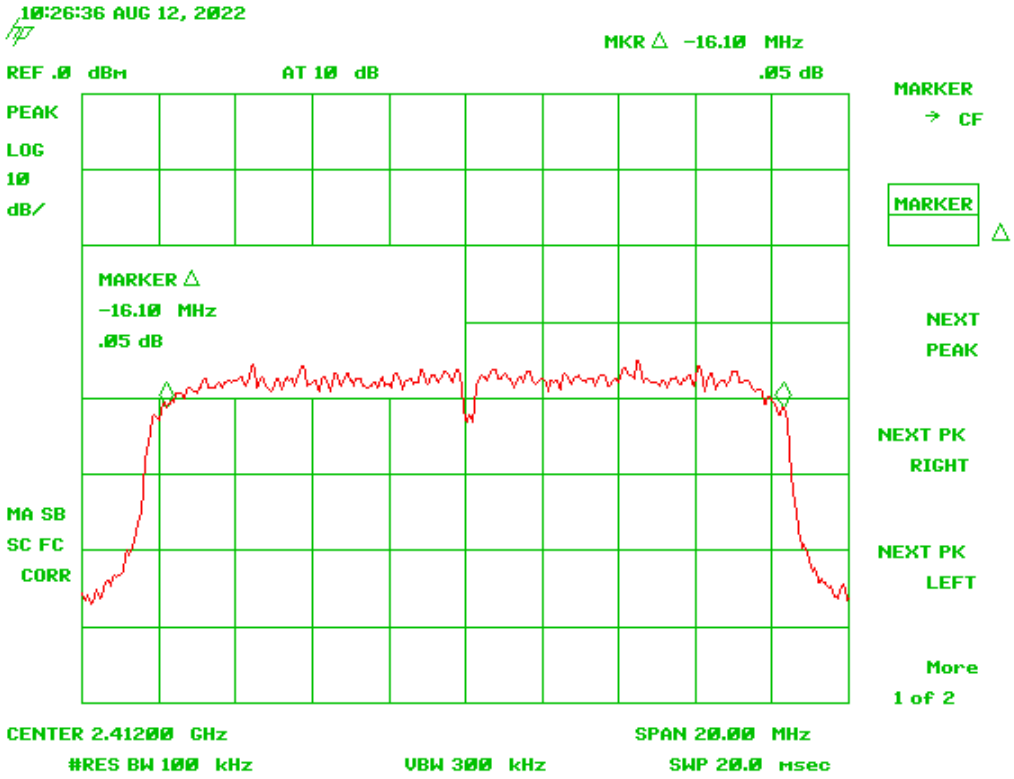


Figure 51. 6 dB Bandwidth g mode Low Channel

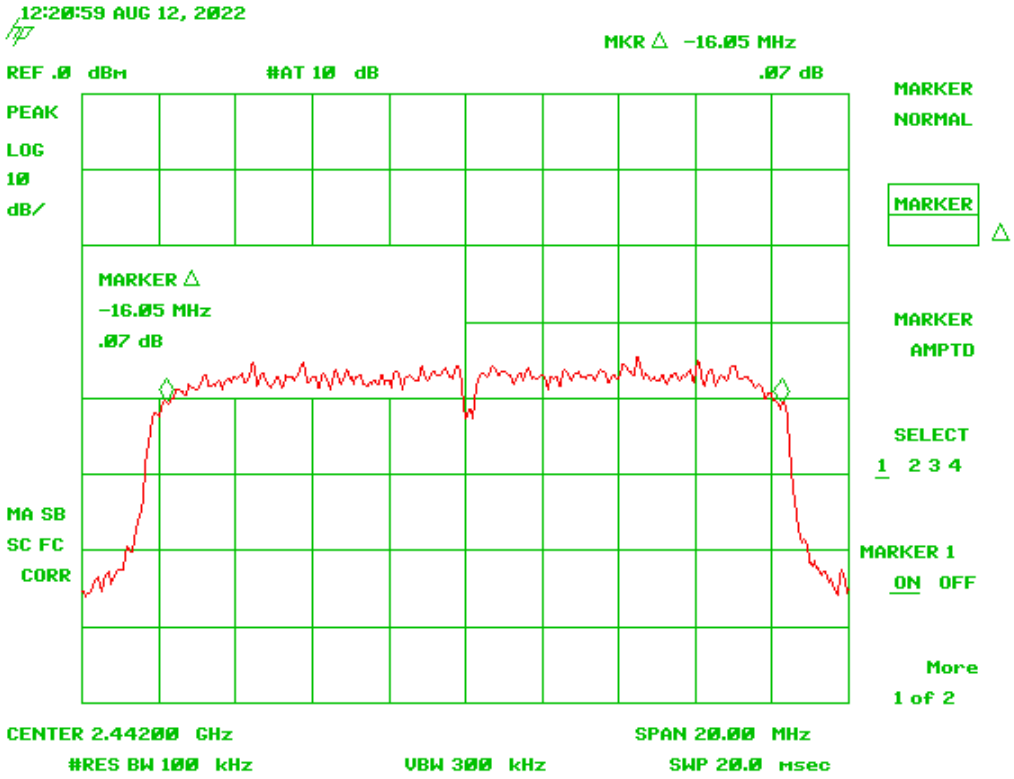


Figure 52.6 dB Bandwidth g mode Mid Channel

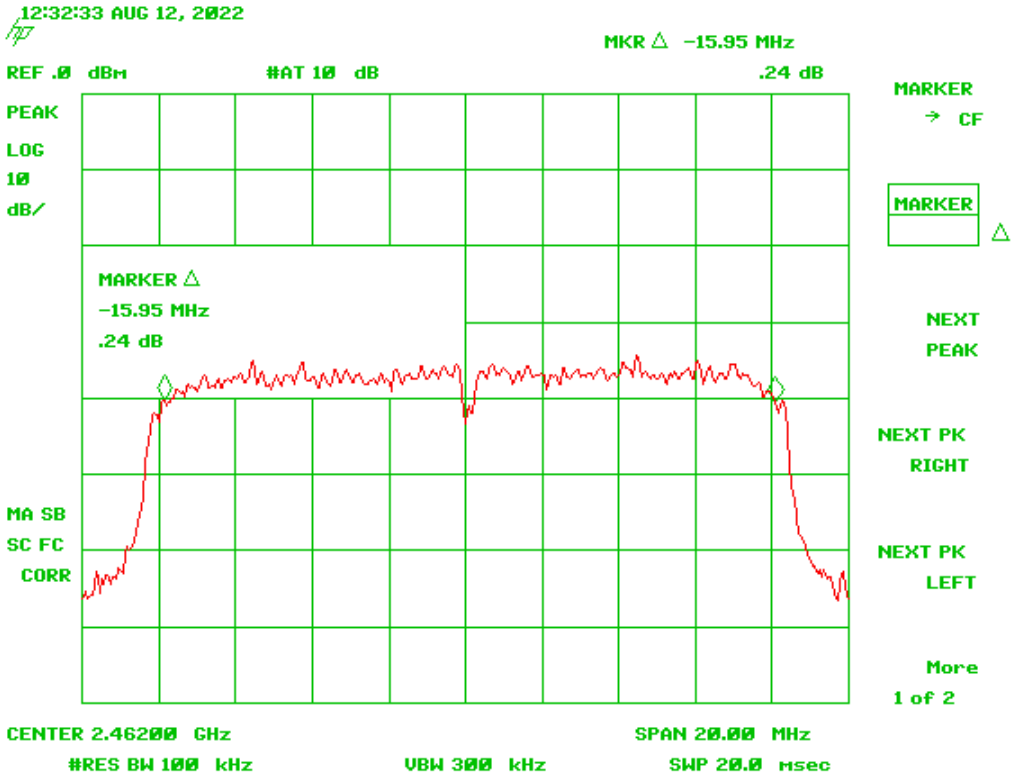


Figure 53. 6 dB Bandwidth g mode High Channel

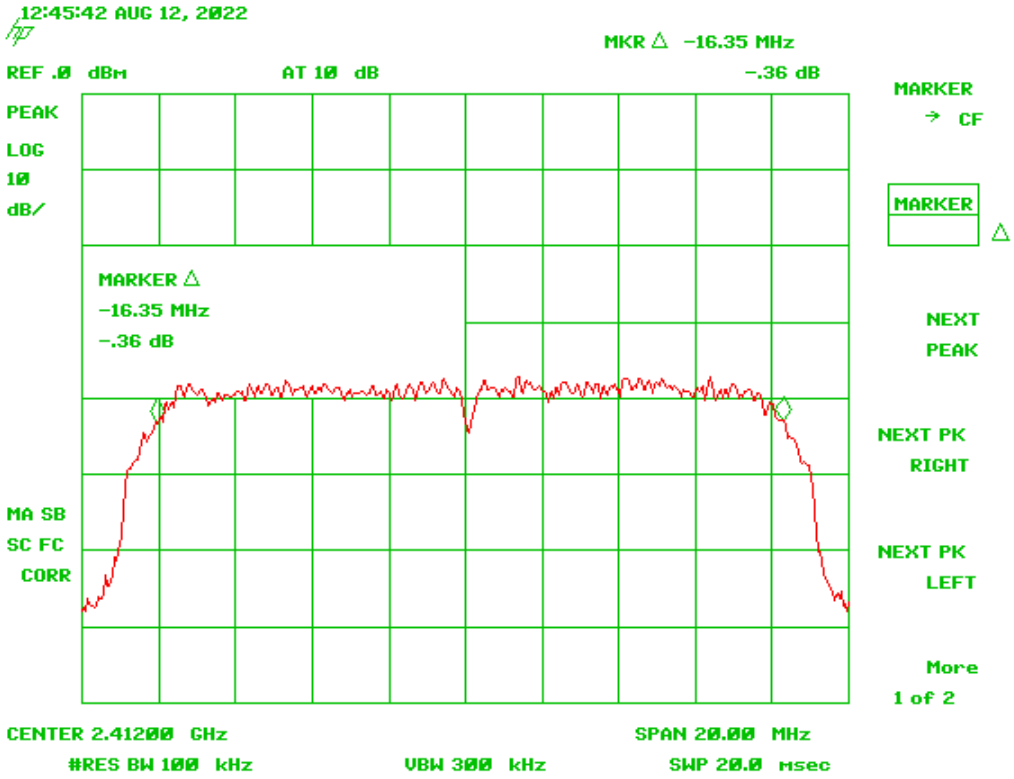


Figure 54. 6 dB Bandwidth n mode Low Channel

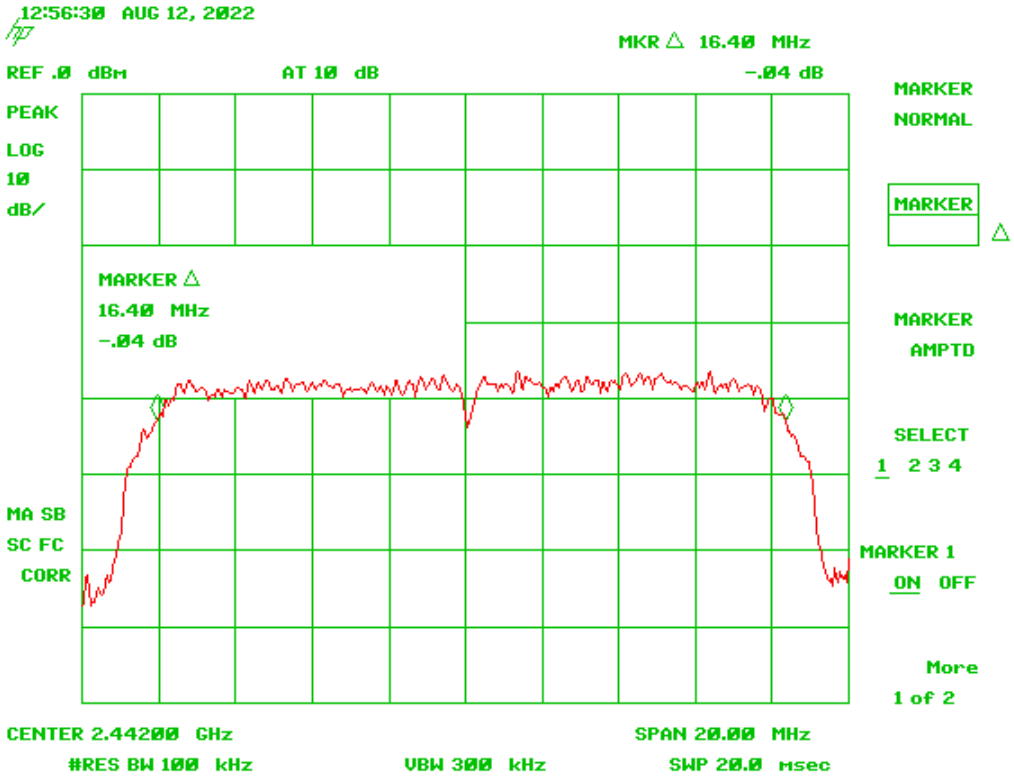


Figure 55. 6 dB Bandwidth n mode Mid Channel

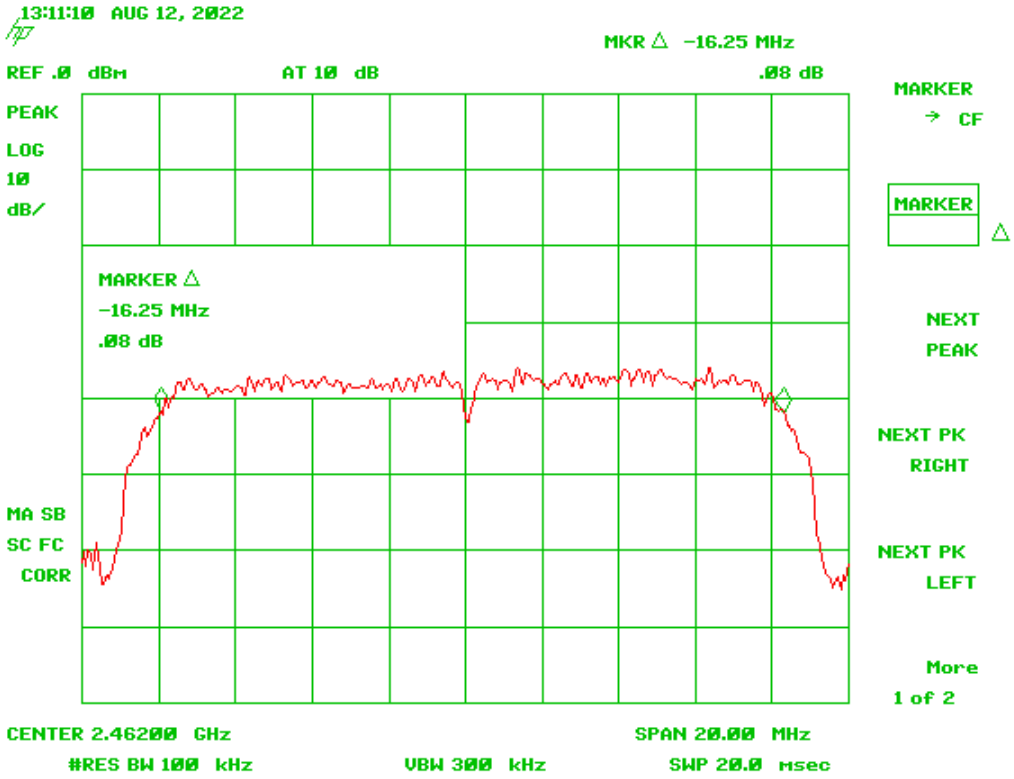


Figure 56. 6 dB Bandwidth n mode High Channel

2.13 Occupied Bandwidth, (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 17 and presented in the figures in section 2.12 above.

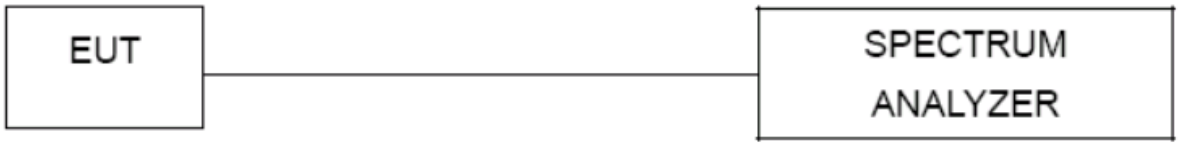


Figure 57. Bandwidth Measurement

Table 12. 99% Occupied Bandwidth

Frequency (MHz)	99% Occupied Bandwidth (MHz)	Mode
2412	13.05	b
2442	13.13	b
2462	13.05	b
2412	16.30	g
2442	16.25	g
2462	16.25	g
2412	16.80	n
2442	16.85	n
2462	16.80	n

Test Date: August 12, 2022

Tested By
Signature: Name: Gabriel Medina

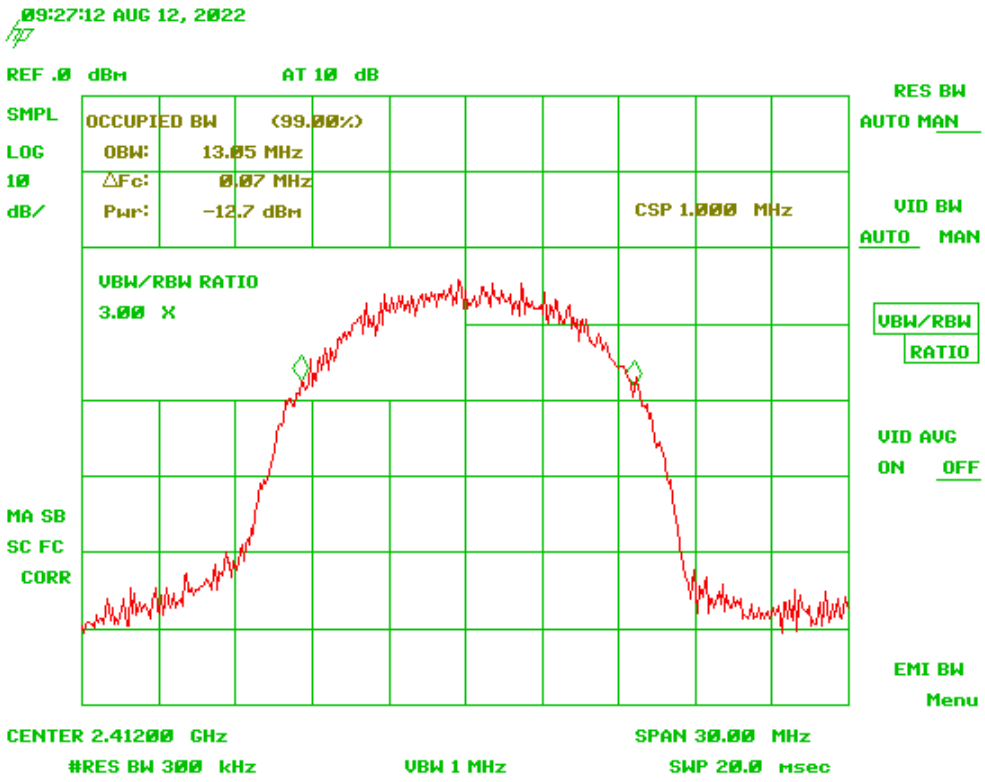


Figure 58. 99% Occupied Bandwidth b mode Low Channel

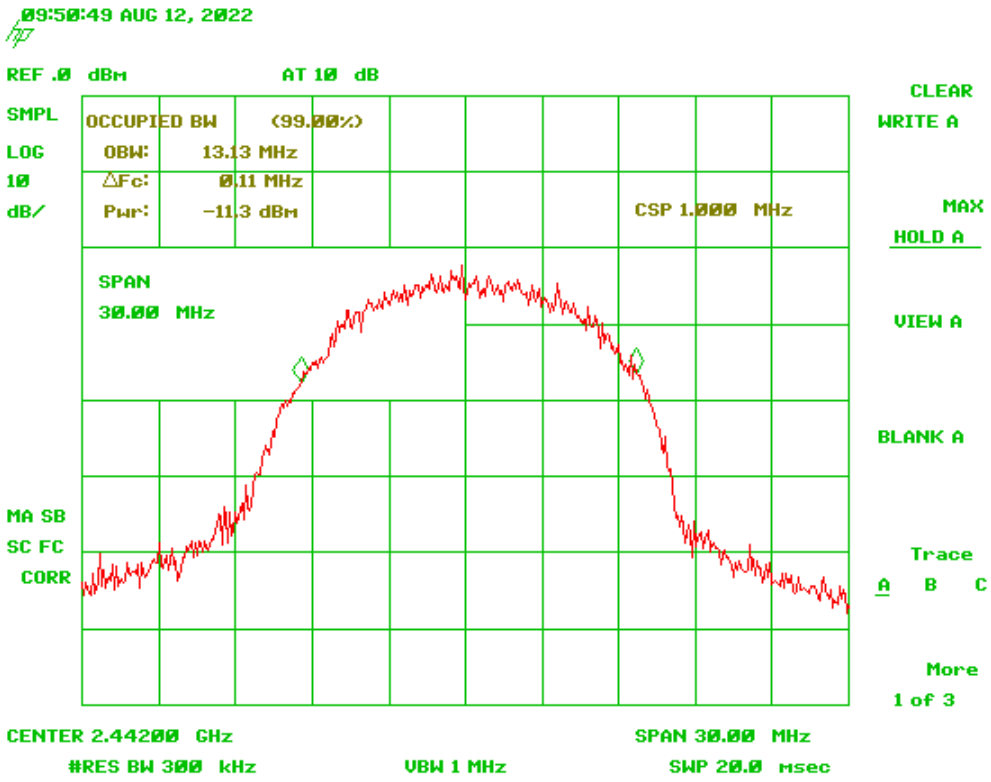


Figure 59. 99% Occupied Bandwidth b mode Mid Channel

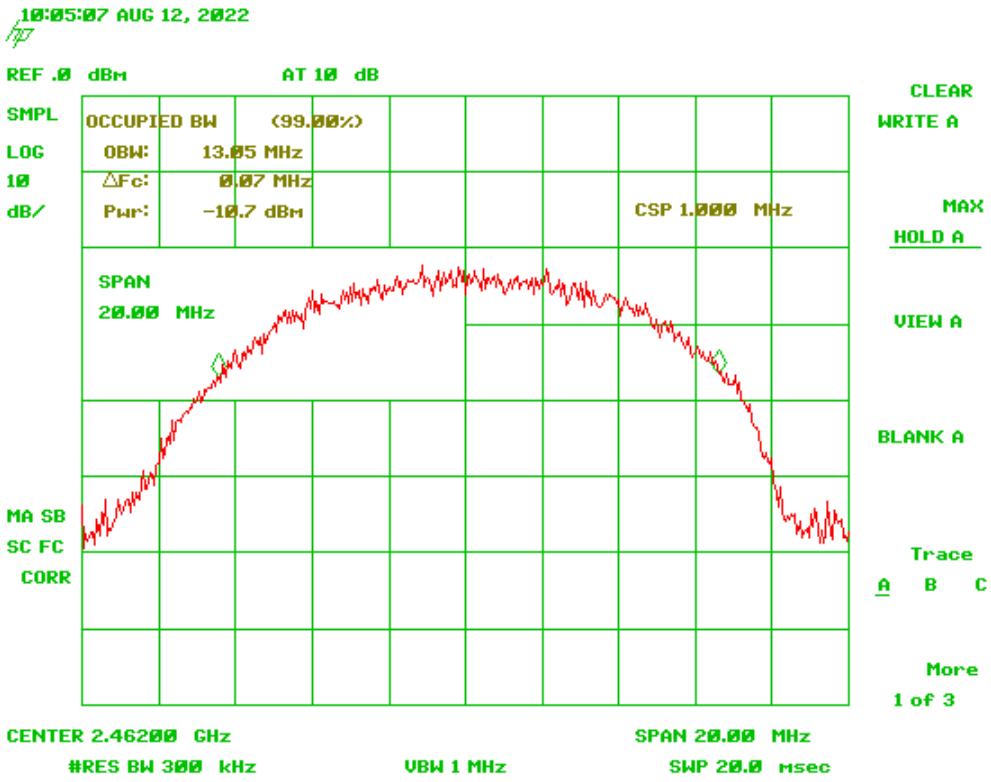


Figure 60. 99% Occupied Bandwidth b mode High Channel

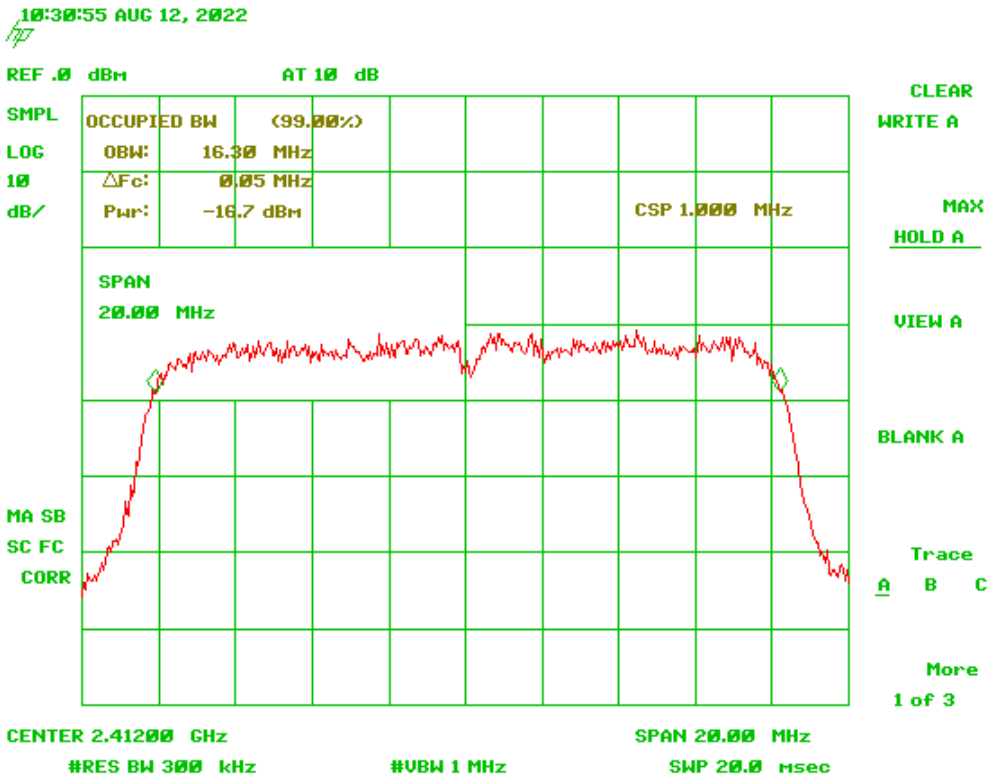


Figure 61. 99% Occupied Bandwidth g mode Low Channel

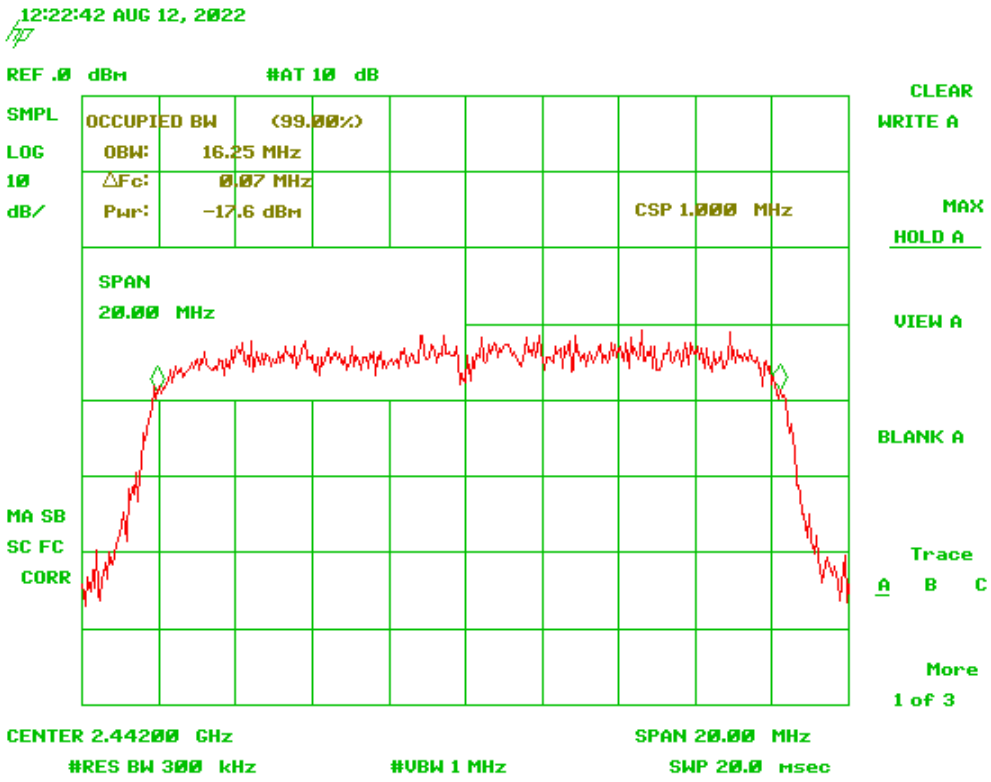


Figure 62. 99% Occupied Bandwidth g mode Mid Channel

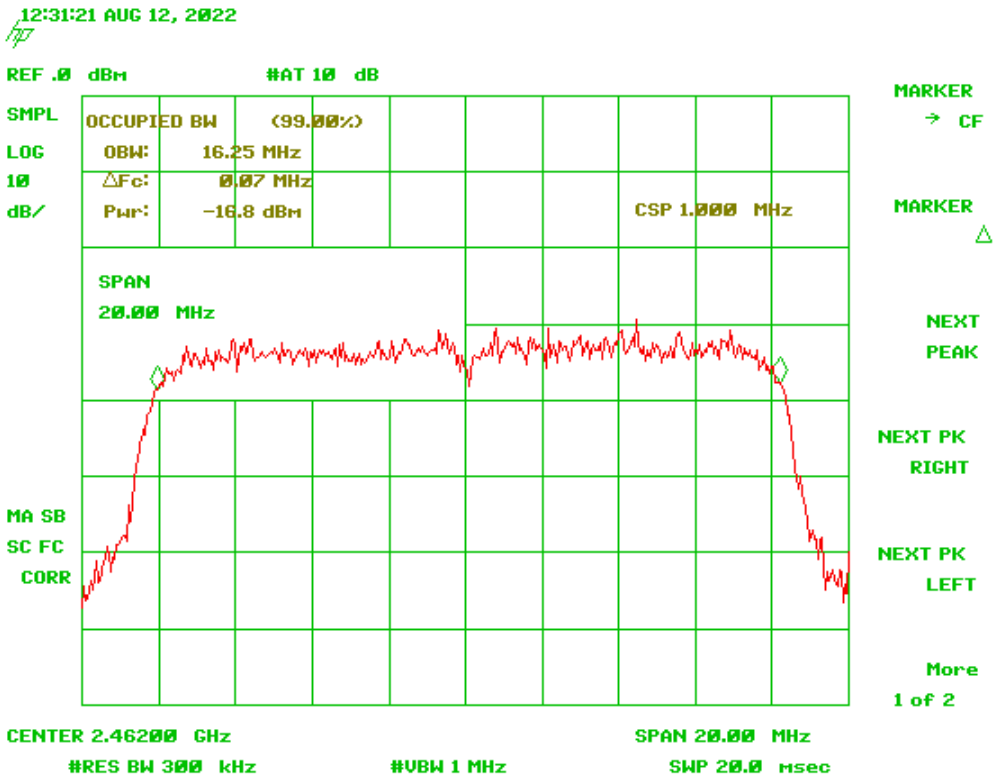


Figure 63. 99% Occupied Bandwidth g mode High Channel

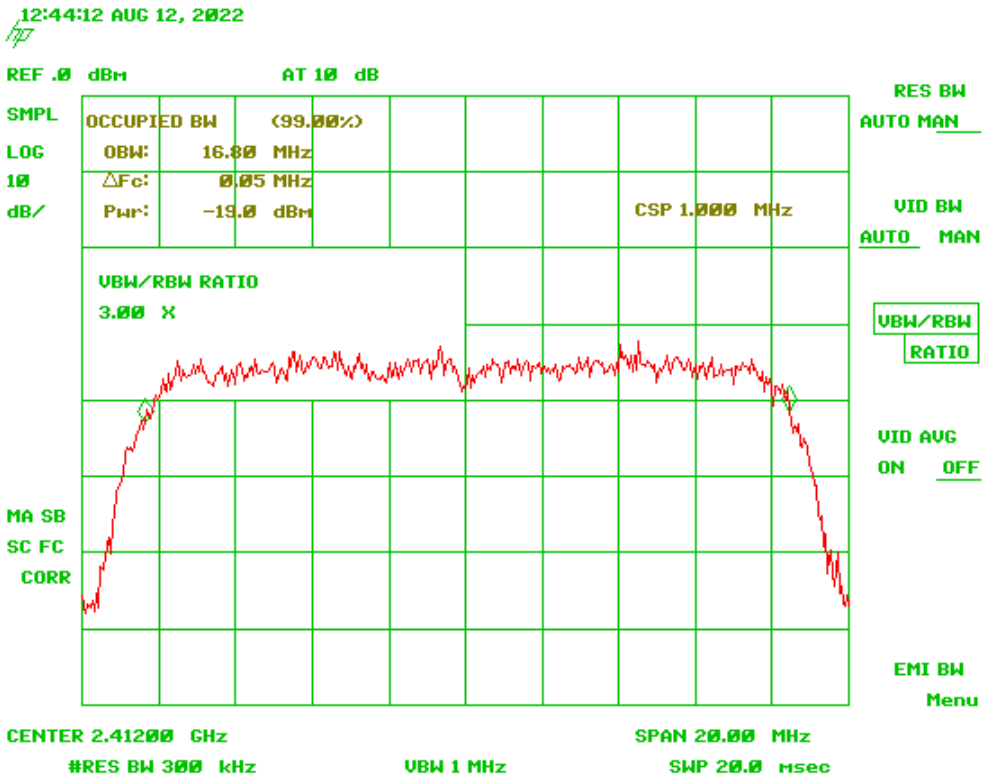


Figure 64. 99% Occupied Bandwidth n mode Low Channel

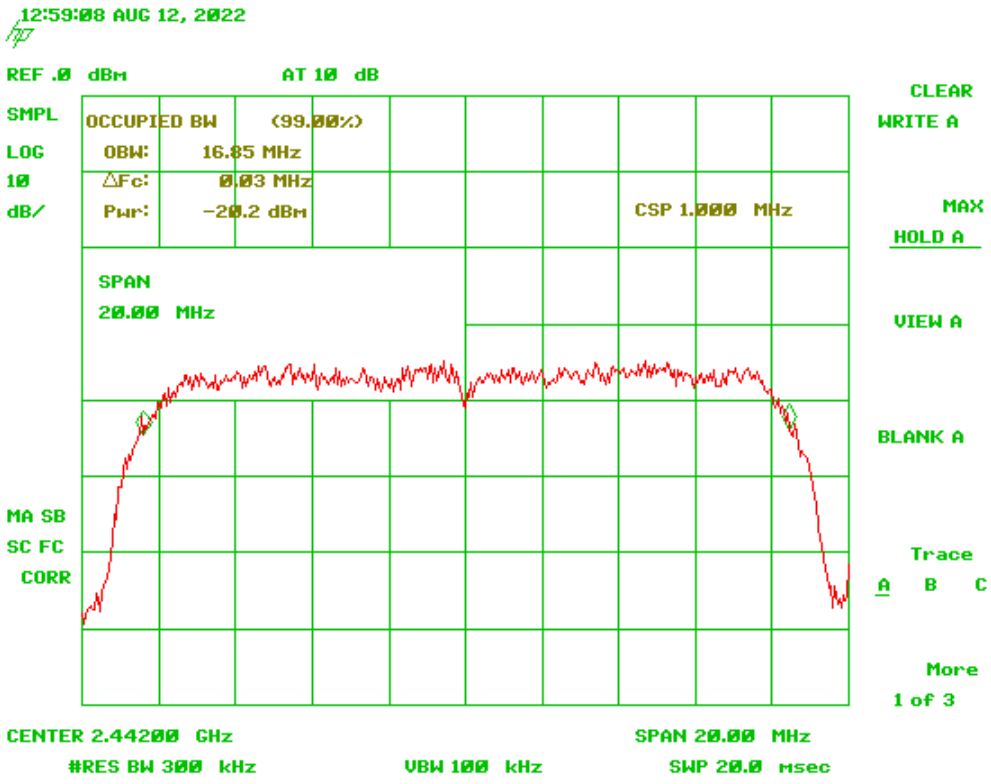


Figure 65. 99% Occupied Bandwidth n mode Mid Channel

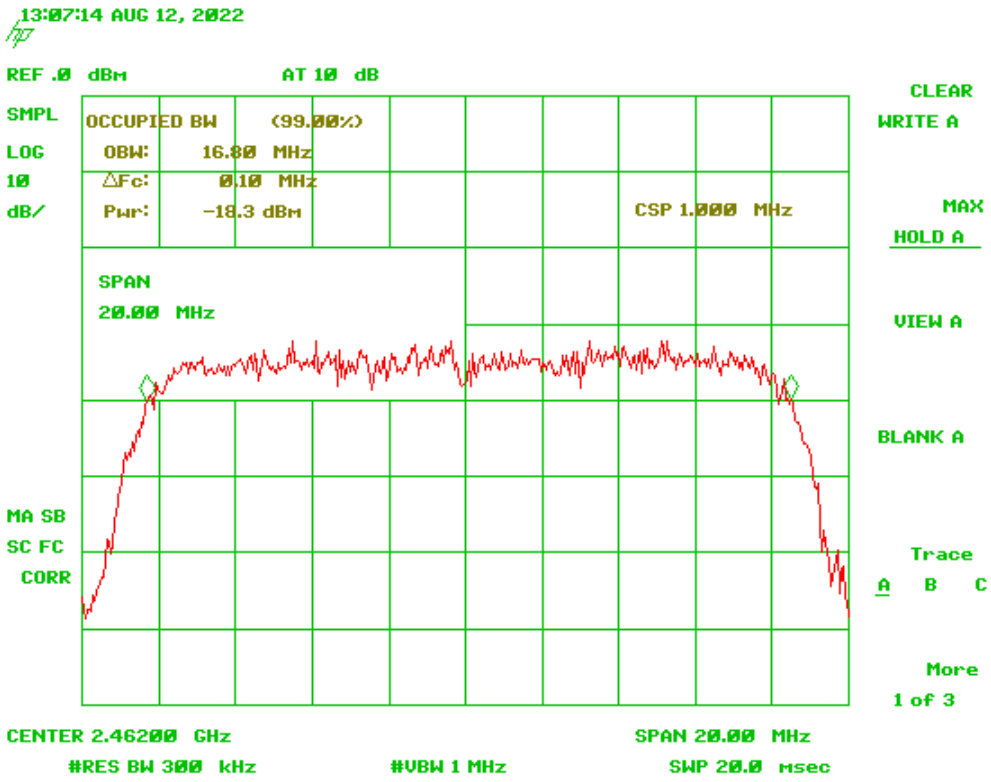


Figure 66. 99% Occupied Bandwidth n mode High Channel

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

The transmitter was programmed to operate at a maximum output power across the bandwidth. For this test the output power of the radio was set to the maximum data rate, with 11Mbps for mode b, 54 Mbps for made g, and MSC-7 for mode n, in order to meet all test requirements.

Peak power within the band 2400 MHz to 2483.5 MHz was measured per 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 of1 MHz, and the VBW ≥ RBW. The integration method was used. Peak antenna conducted output power is tabulated in the table below.

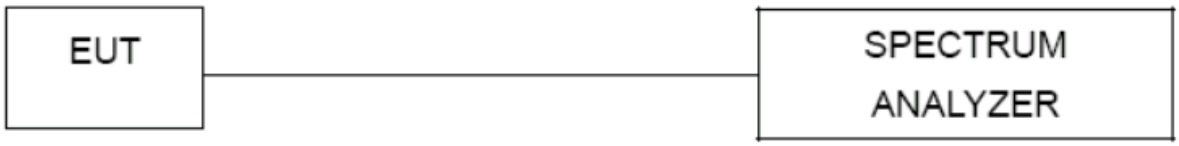


Figure 67. Conducted Output Power Bench measurement

Table 13. Peak 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	12.91	19.54	1000	b
2442	12.85	19.27	1000	b
2462	12.91	19.54	1000	b
2412	7.887	6.14	1000	g
2442	7.837	6.07	1000	g
2462	8.182	6.57	1000	g
2412	6.303	4.26	1000	n
2442	6.37	4.33	1000	n
2462	6.257	4.22	1000	n

Test Date: August 12, 2022

Tested By
Signature:  Name: Gabriel Medina

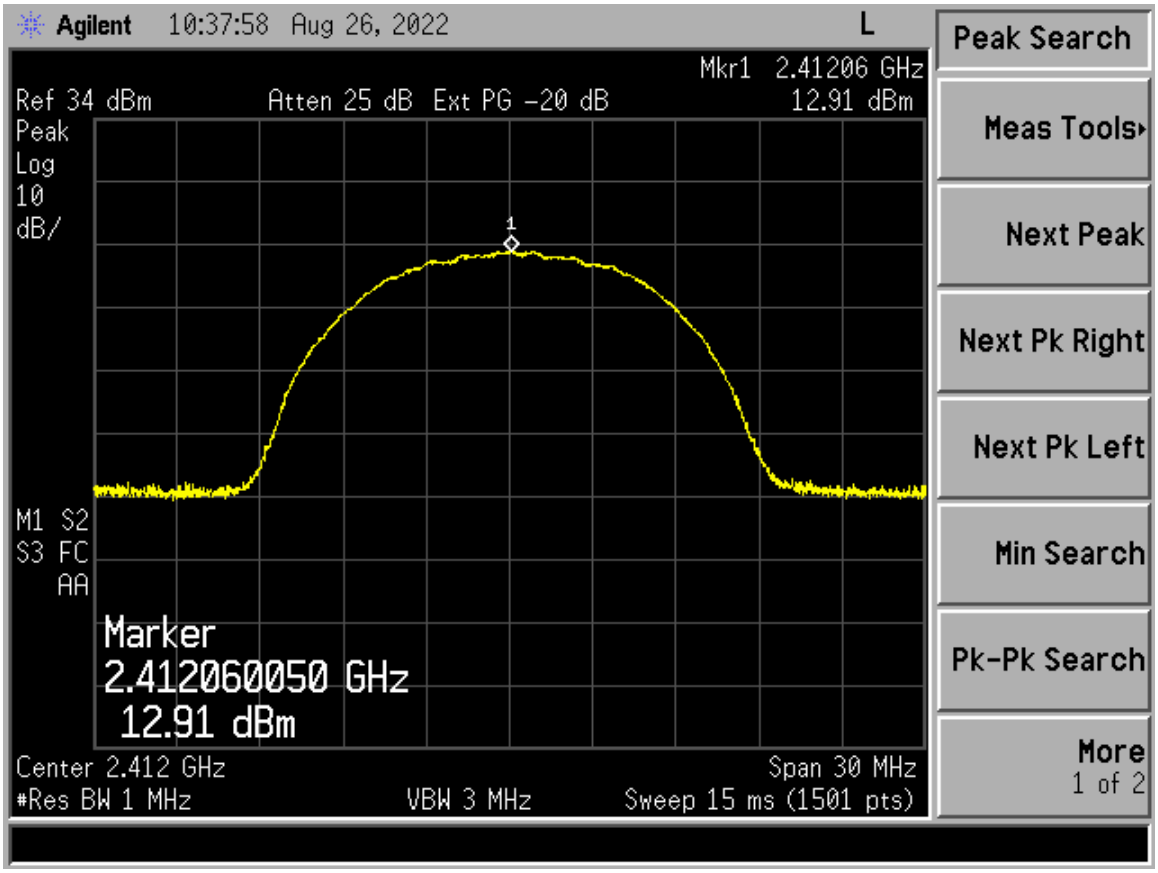


Figure 68. Peak Antenna Conducted Output Power, b mode Low Channel

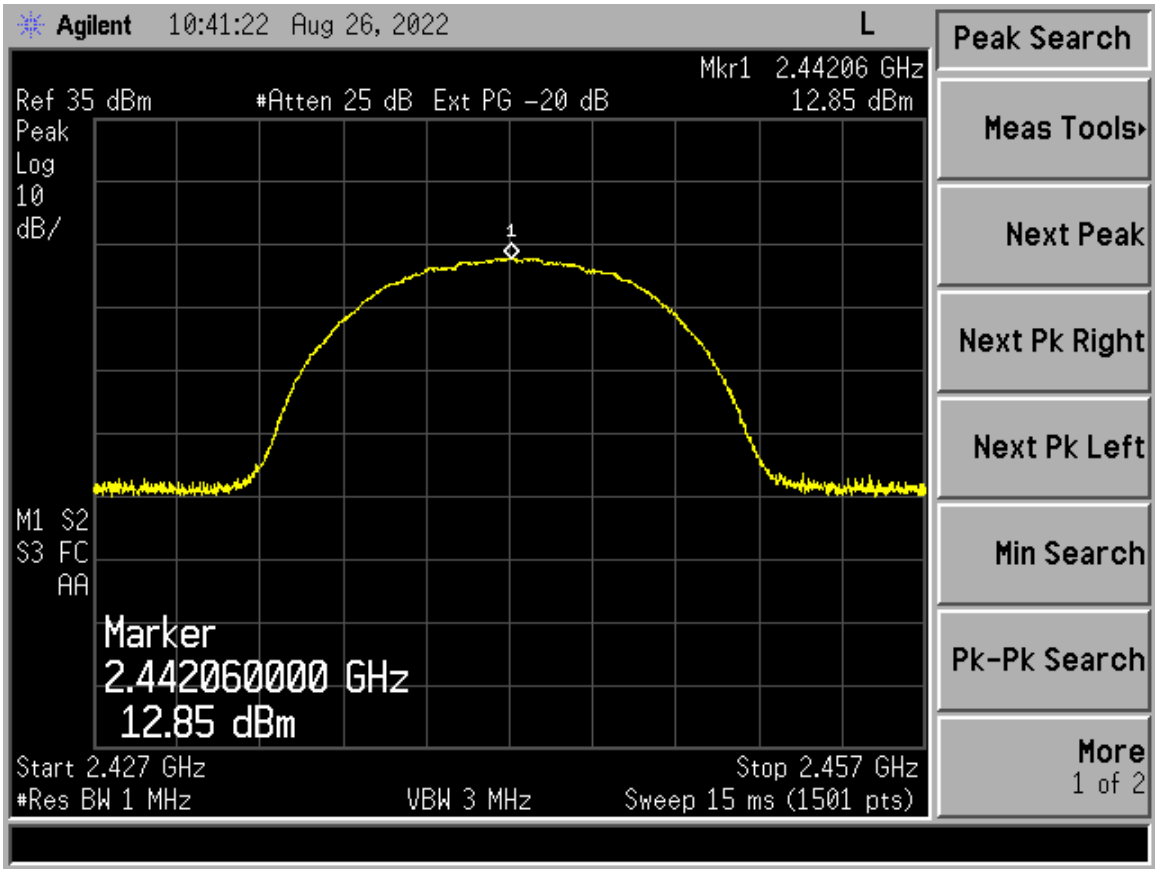


Figure 69. Peak Antenna Conducted Output Power, b mode Mid Channel

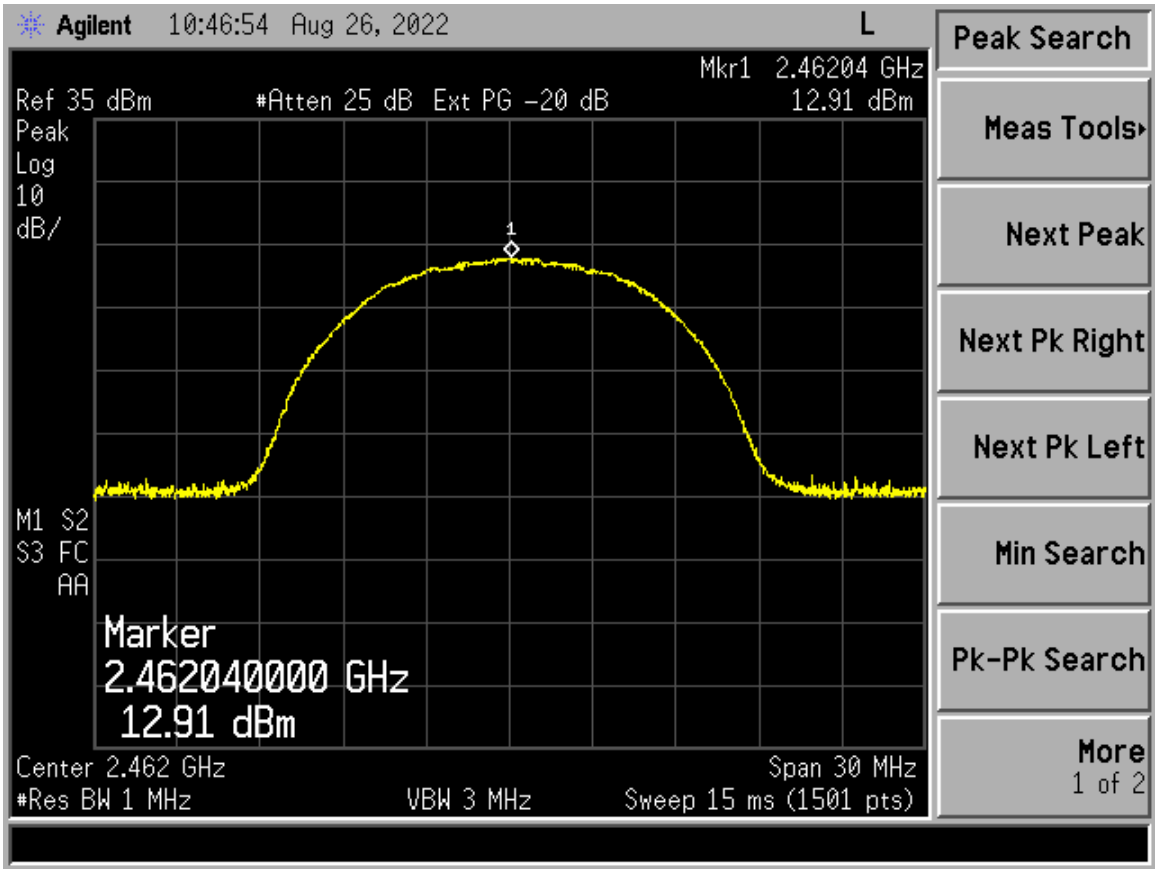


Figure 70. Peak Antenna Conducted Output Power, b mode High Channel

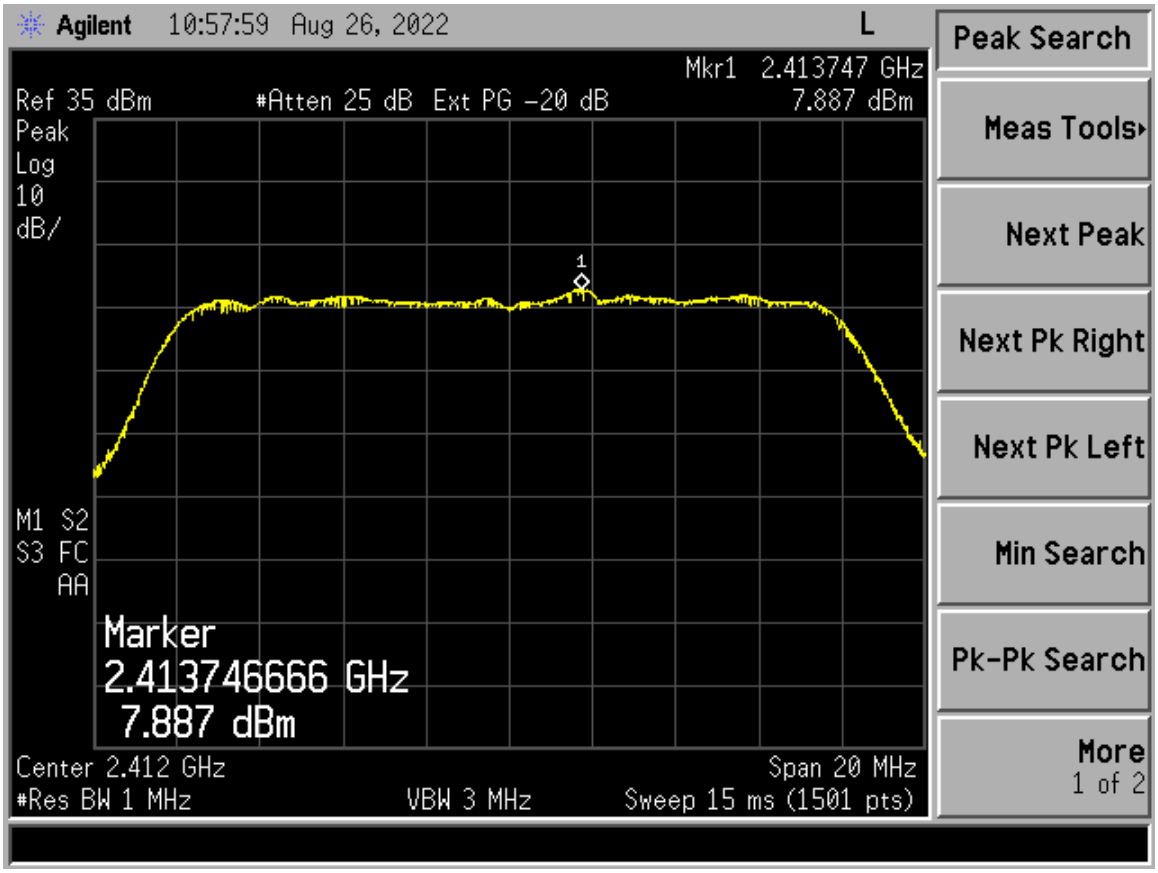


Figure 71. Peak Antenna Conducted Output Power, g mode Low Channel

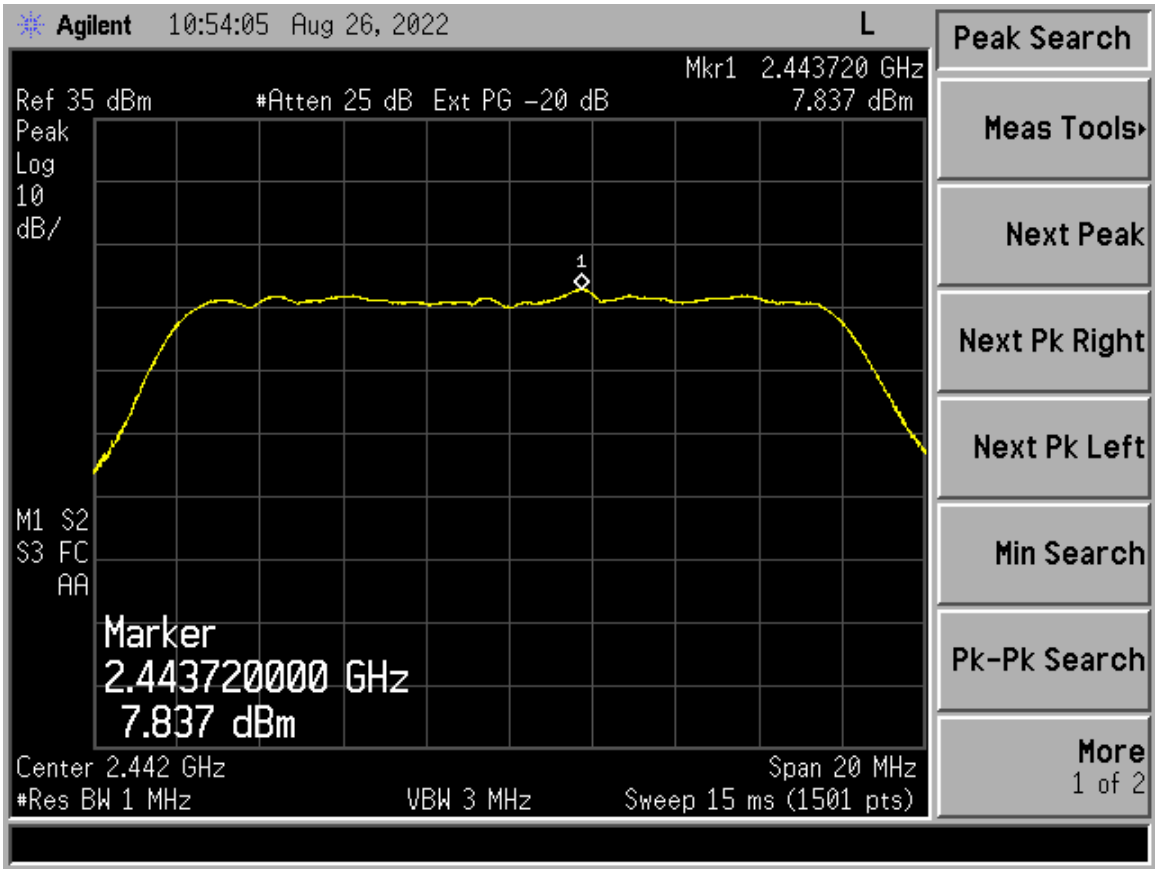


Figure 72. Peak Antenna Conducted Output Power, g mode Mid Channel

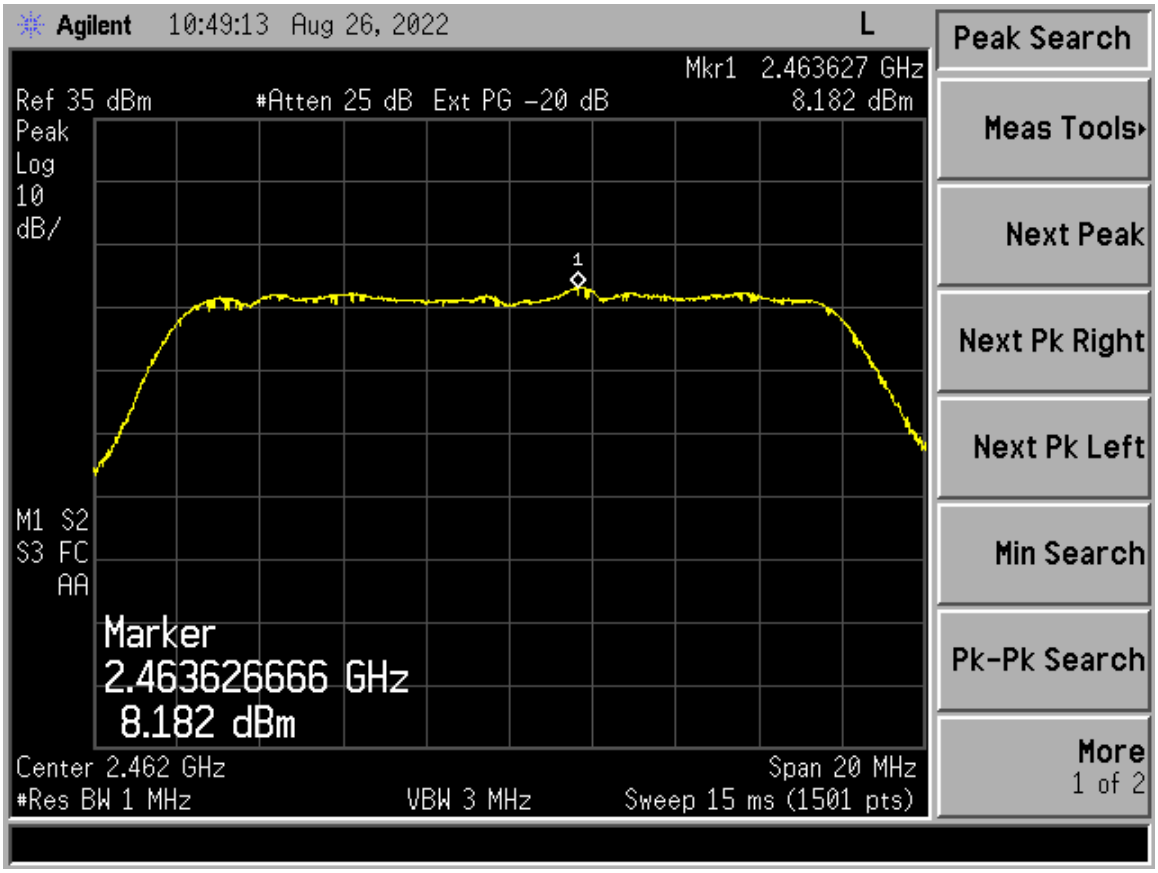


Figure 73. Peak Antenna Conducted Output Power, g mode High Channel

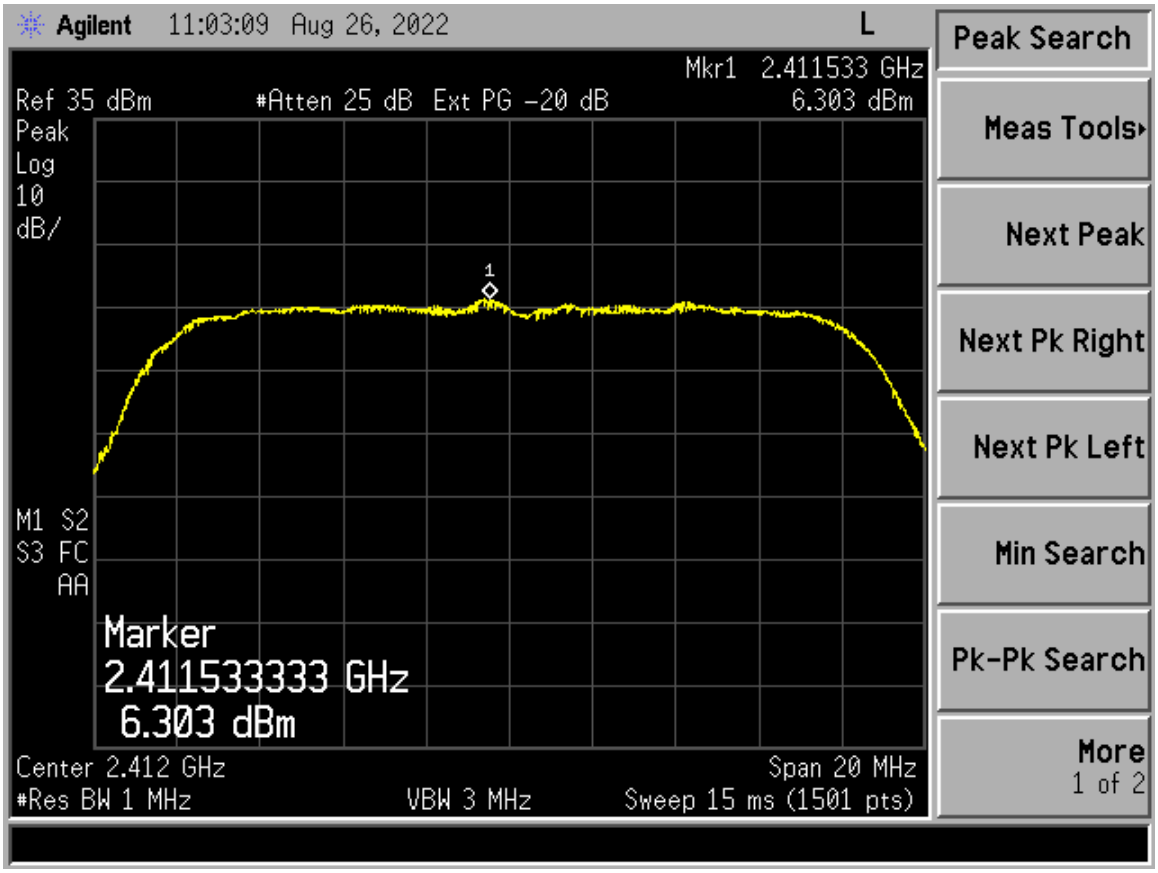


Figure 74. Peak Antenna Conducted Output Power, n mode Low Channel

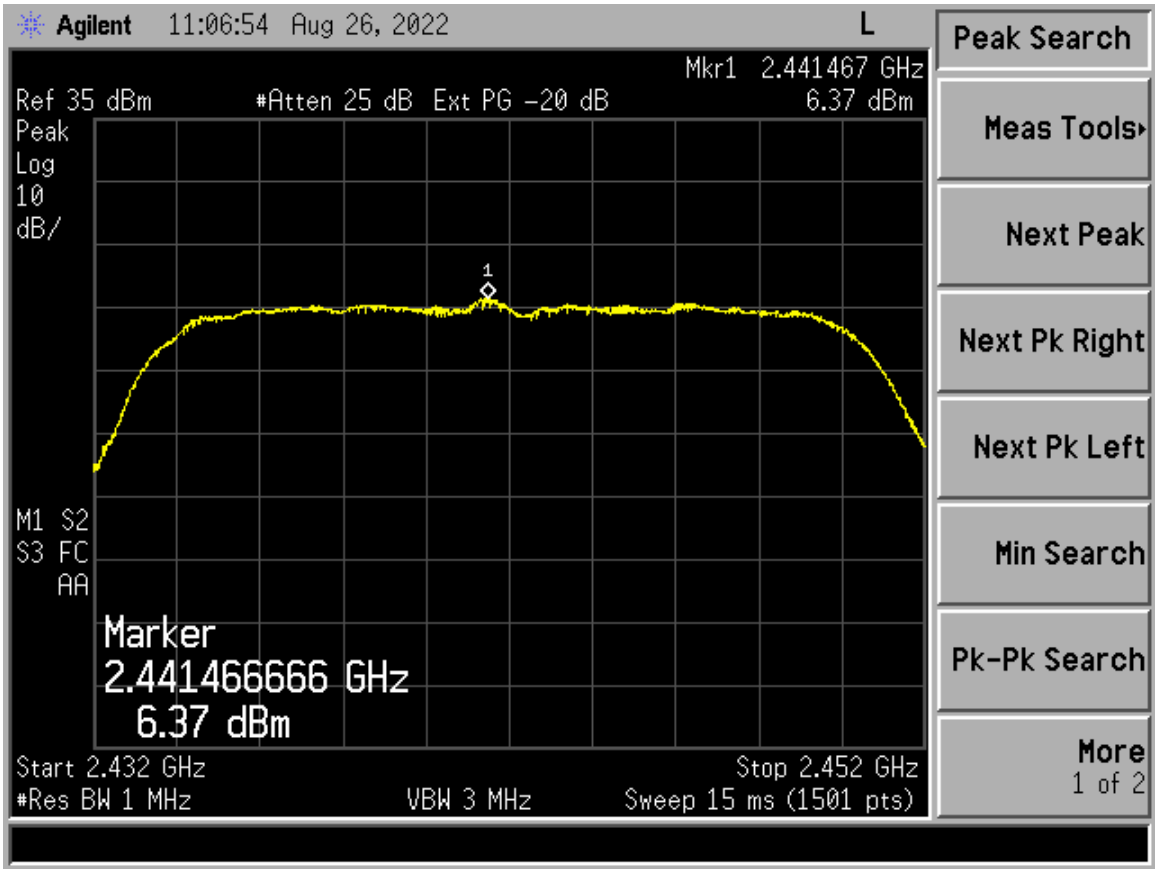


Figure 75. Peak Antenna Conducted Output Power, n mode Mid Channel

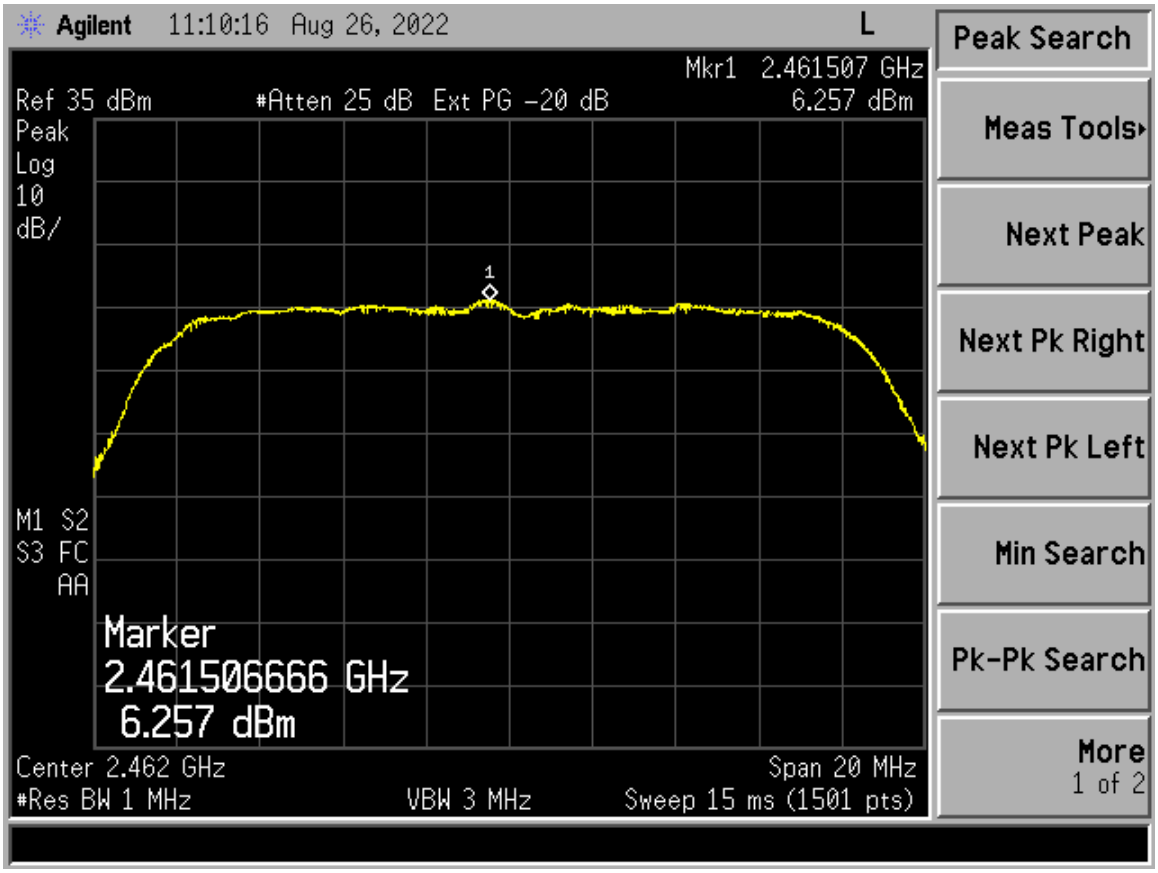


Figure 76. Peak Antenna Conducted Output Power, n mode High Channel

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.

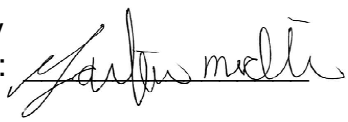
Results are shown in the table below and figures below. All are less than +8 dBm per 3 kHz band. See figures below.

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

Frequency (MHz)	Measured Result (dBm/30kHz)	Corrected Results (dBm/3kHz)	FCC Limit (dBm/3 kHz)	Mode
2412	0.72	-9.28	+8.0	b
2442	0.48	-9.51	+8.0	b
2462	0.41	-9.59	+8.0	b
2412	-6.48	-16.48	+8.0	g
2442	-6.37	-16.37	+8.0	g
2462	-6.86	-16.86	+8.0	g
2412	-7.04	-17.04	+8.0	n
2442	-7.95	-17.95	+8.0	n
2462	-7.89	-17.89	+8.0	n

Note: dBm/Hz correct to dBm/kHz using the following formula, 10 log RBW ref/RBW measured.

Test Date: August 12, 2022

Tested By
Signature:  Name: Gabriel Medina

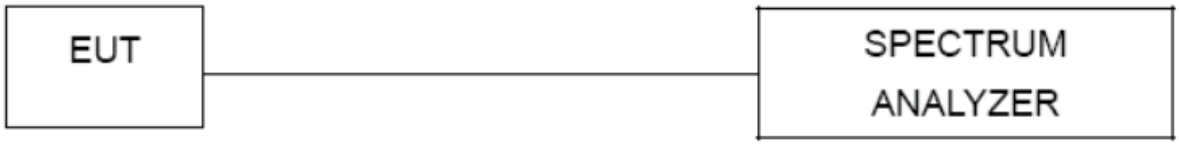


Figure 77. PSD Bench measurement

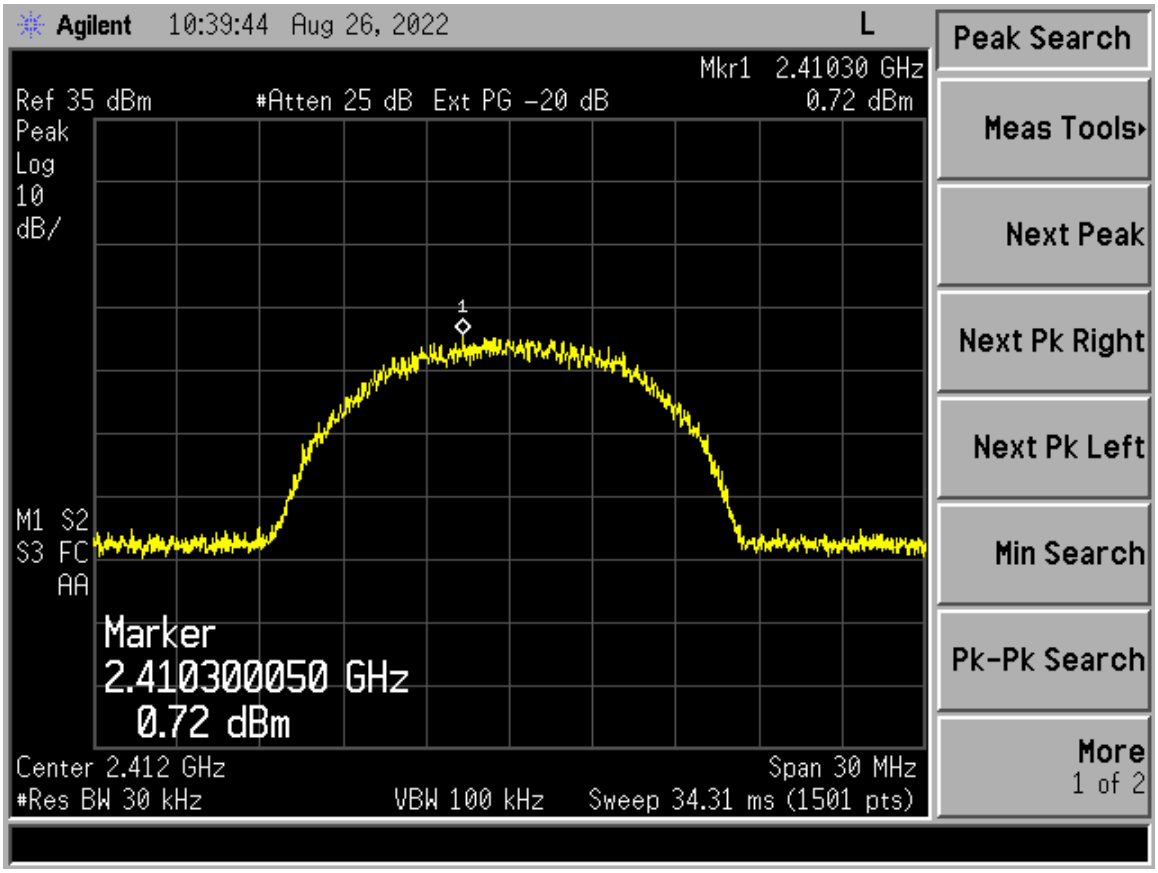


Figure 78. Power Spectral Density, b mode Low Channel

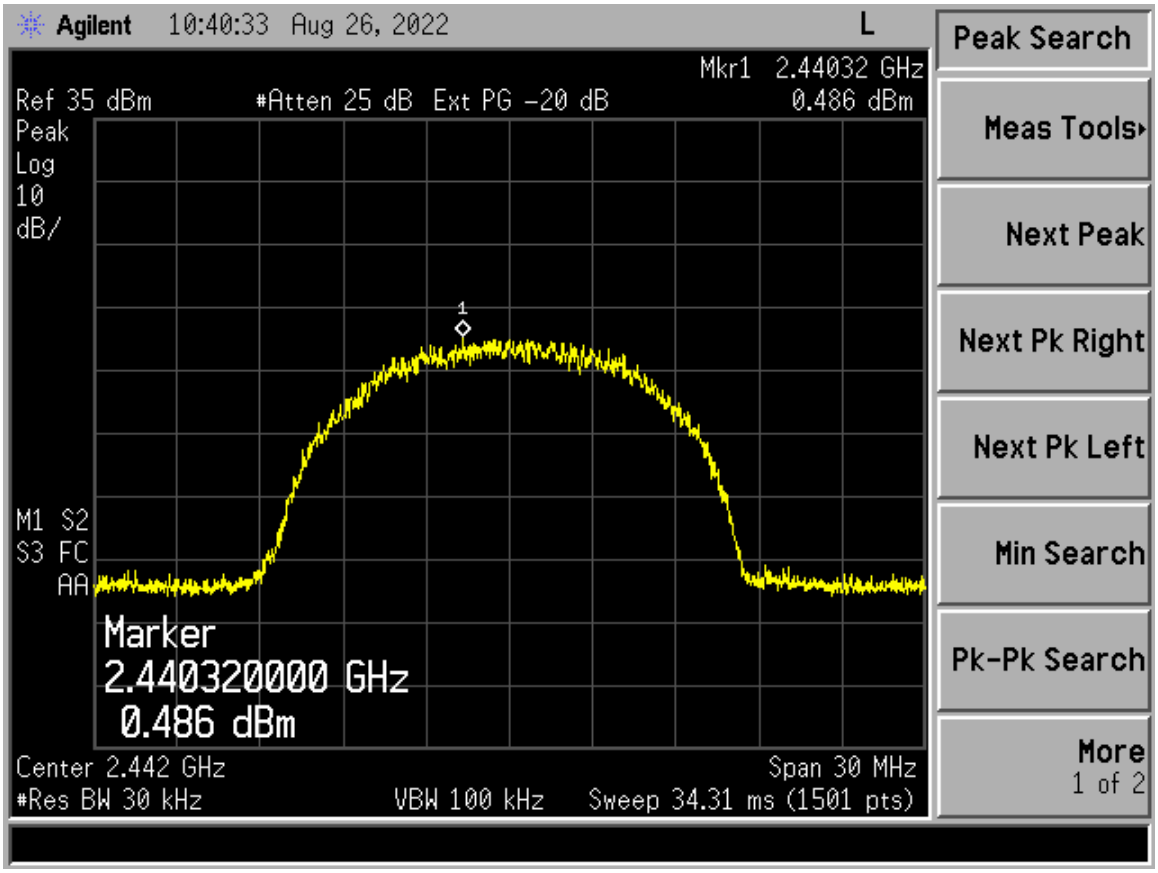


Figure 79. Power Spectral Density, b mode Mid Channel

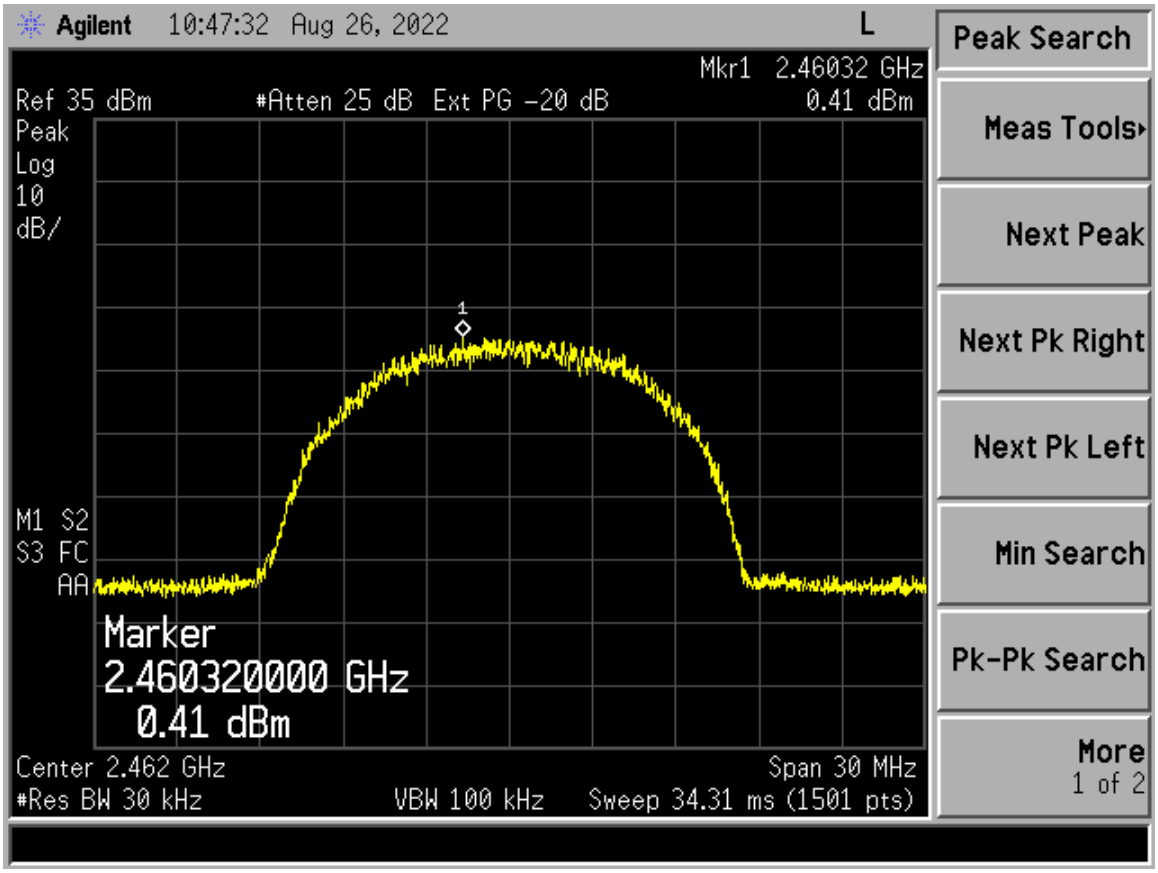


Figure 80. Power Spectral Density, b mode High Channel

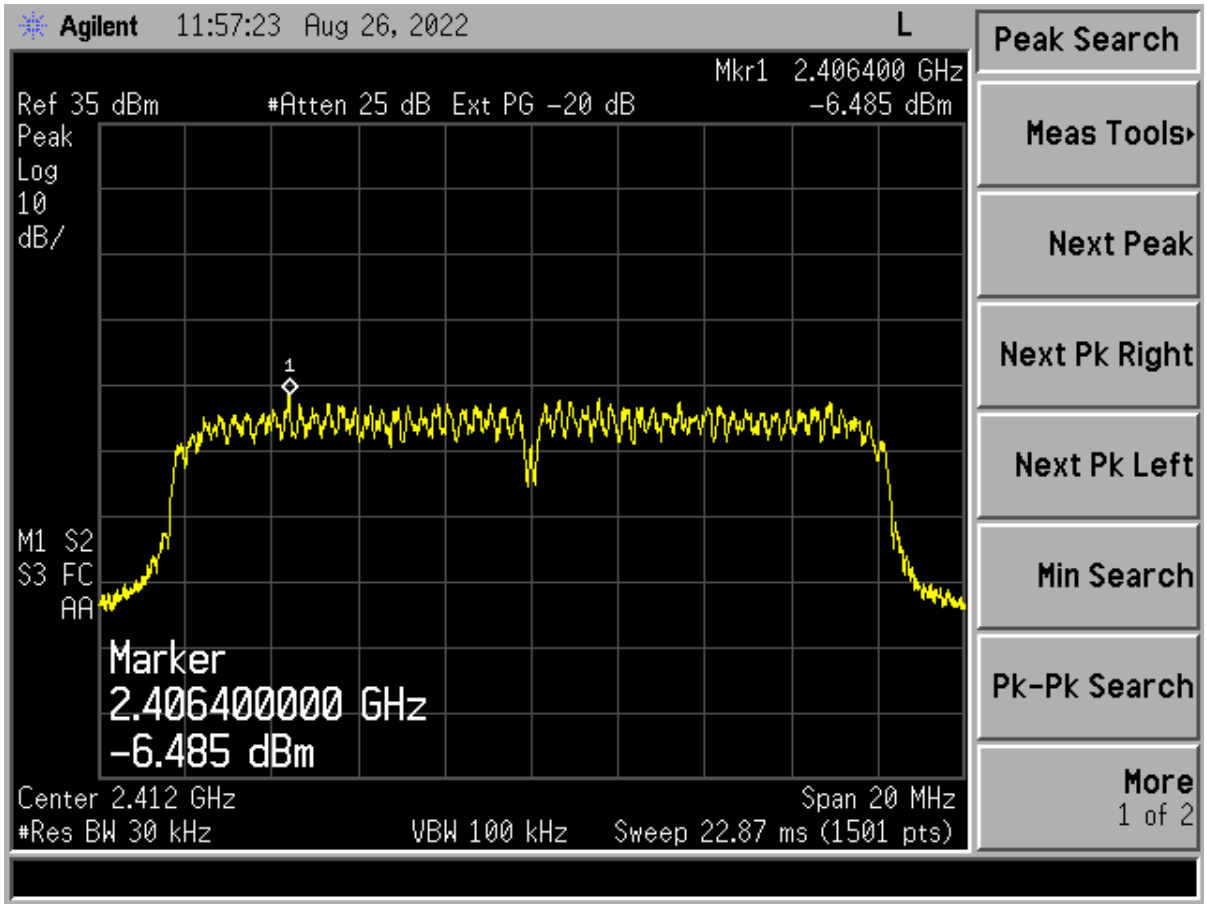


Figure 81. Power Spectral Density, g mode Low Channel

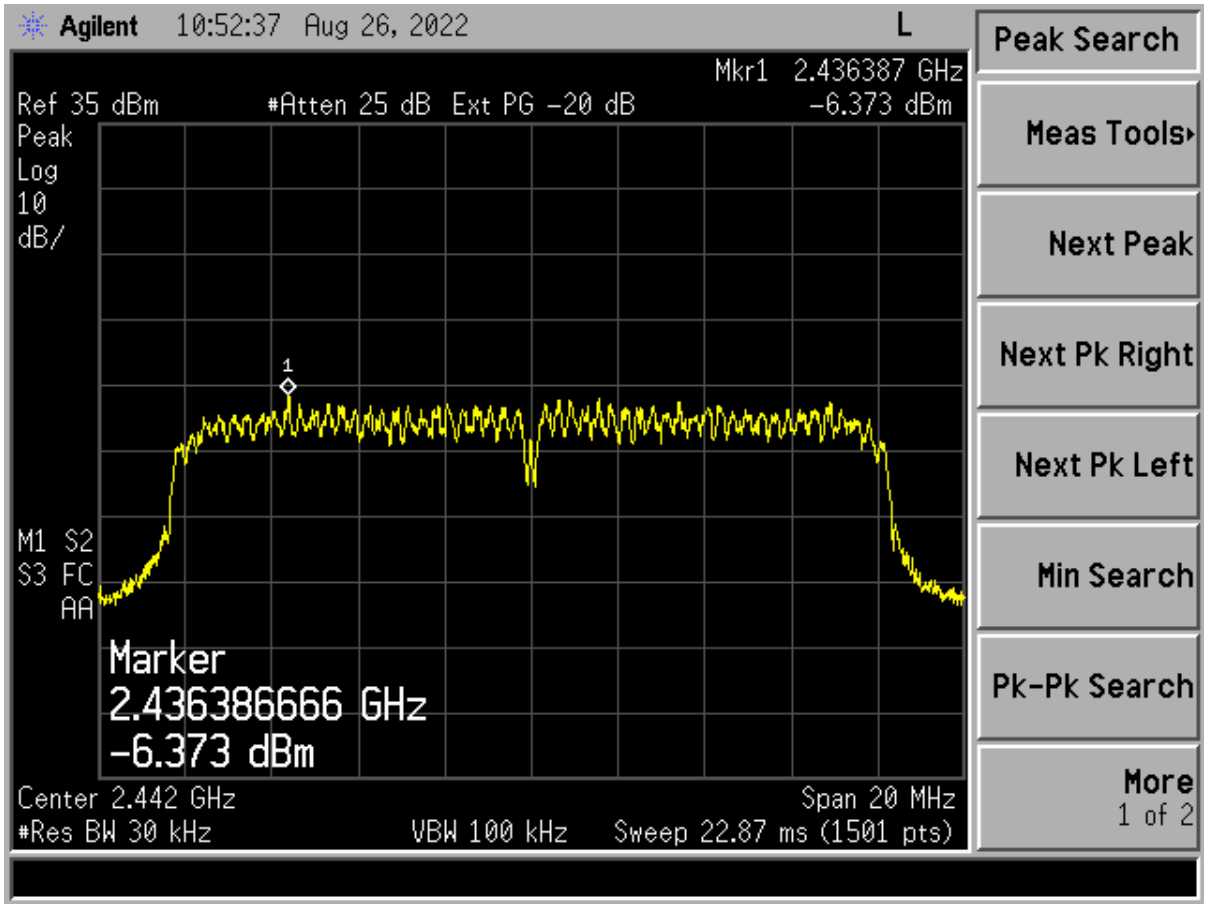


Figure 82. Power Spectral Density, g mode Mid Channel

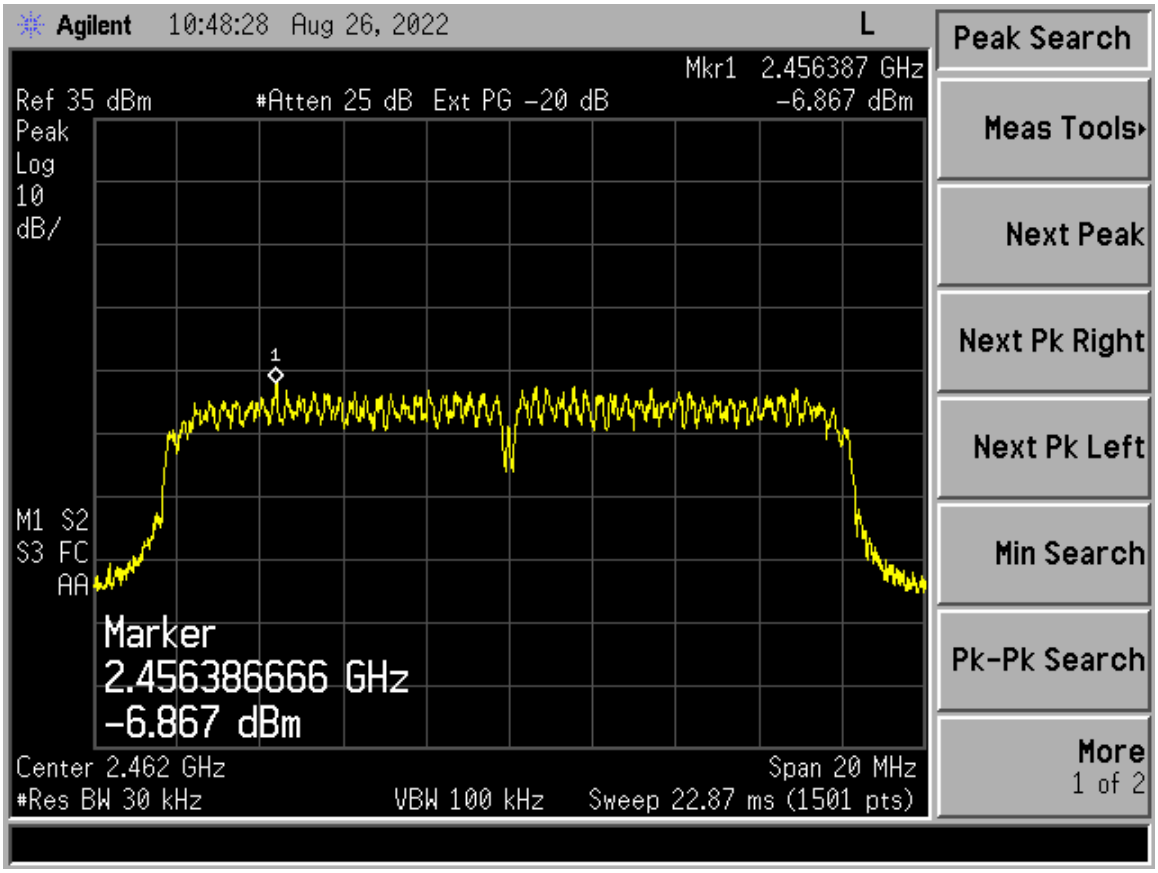


Figure 83. Power Spectral Density, g mode High Channel

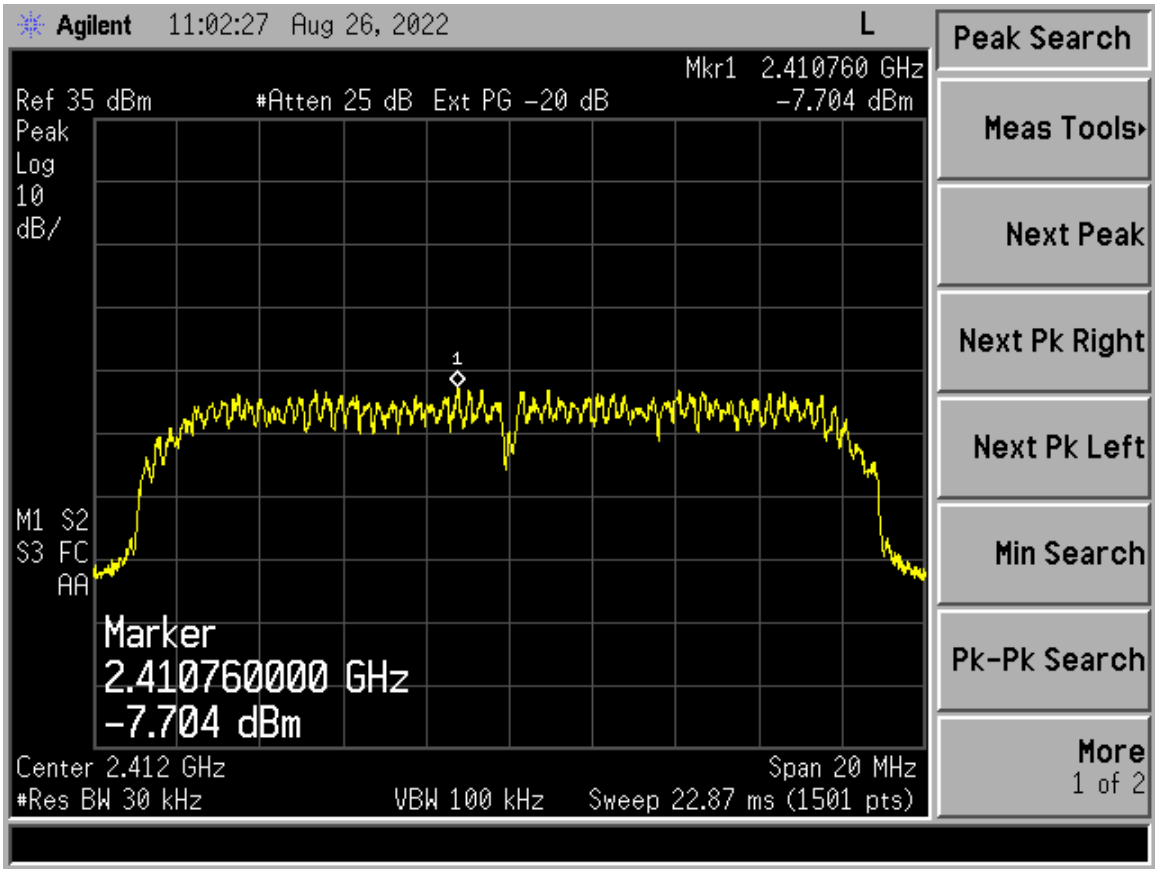


Figure 84. Power Spectral Density, n mode Low Channel

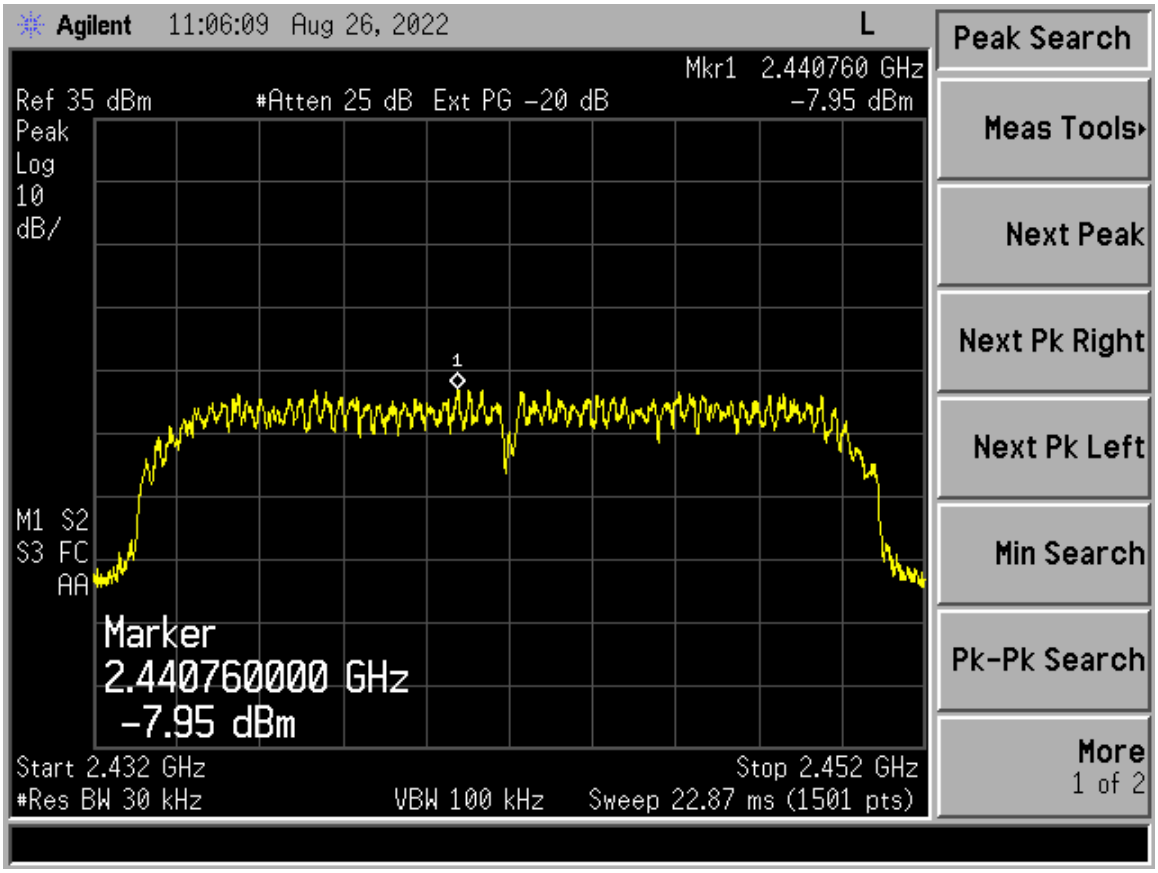


Figure 85. Power Spectral Density, n mode Mid Channel

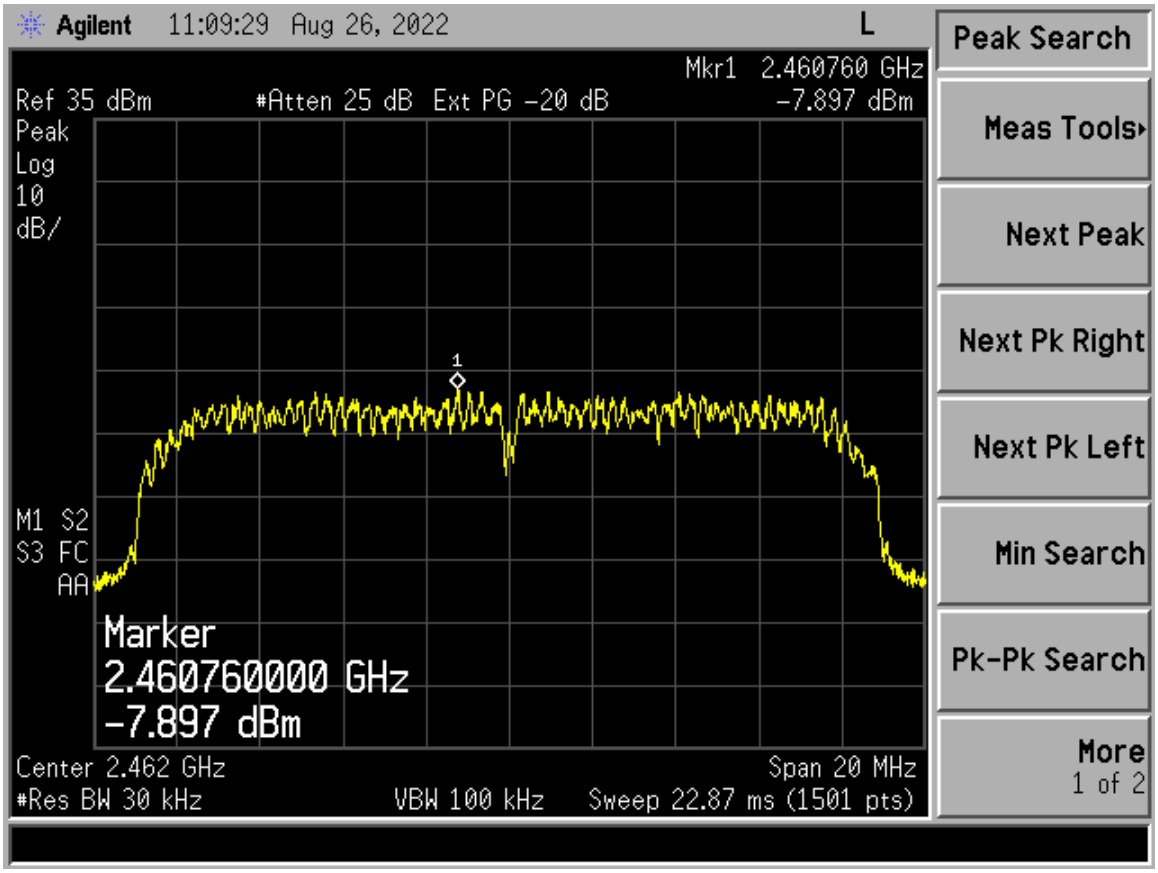


Figure 86. Power Spectral Density, n mode High Channel

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

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 6.0 dB from the applicable limit. All other emissions were at least 6.2 dB from the limit. Those results are given in the table following.

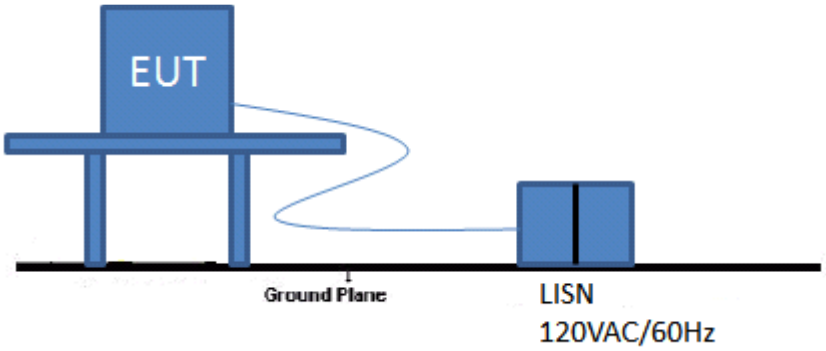


Figure 87. Powerline conducted Test Setup

Table 15. Power Line Conducted Emissions

CONDUCTED EMISSIONS 150 kHz to 30 MHz						
Frequency (MHz)	**Test Data (dBuV)**	**LISN+CL (dB)**	**Corrected Results (dBuV)**	**AVG Limits (dBuV)**	**Margin (dB)**	**Detector**
Phase @ 120 Vac / 60Hz						
0.1500	58.35	0.08	58.43	66.0*	7.6	**PK**
0.1500	38.32	0.08	38.40	56.0	17.6	**AVG**
2.4430	51.07	0.07	51.14	56.0*	4.9	**PK**
2.4430	24.38	0.07	24.45	46.0	21.6	**AVG**
10.2080	44.71	0.55	45.26	50.0	4.7	**PK**
Neutral @ 120 Vac / 60Hz						
0.1523	57.90	0.13	58.03	65.9*	7.8	**PK**
0.1523	38.75	0.13	38.88	55.9	17.0	**AVG**
0.5975	41.81	0.51	42.32	56.0*	13.7	**PK**
0.5975	30.29	0.51	30.80	46.0	15.2	**AVG**
9.7500	40.83	0.61	41.44	50.0	8.6	**PK**

Note: (*) Indicates that the limit used is Quasi-Peak (QP)

Sample Calculation at 0.1500 MHz:

Magnitude of Measured Frequency	58.35	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	0.08	dB/m
Corrected Result	58.43	dBuV/m

Test Date: August 5-8, 2022

Tested By
Signature:  Name: Gabriel Medina

2.17 Intentional Radiator, Radiated Emissions (CFR 15.209, RSS-Gen, 8.9)

The test data provided herein is to support the verification requirement for 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.

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 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 greater than 20.0 dB below the specification limit. The results are shown in the table following. These results are meant to show that this EUT has met the intentional transmitter requirements of CFR Part 15.209.

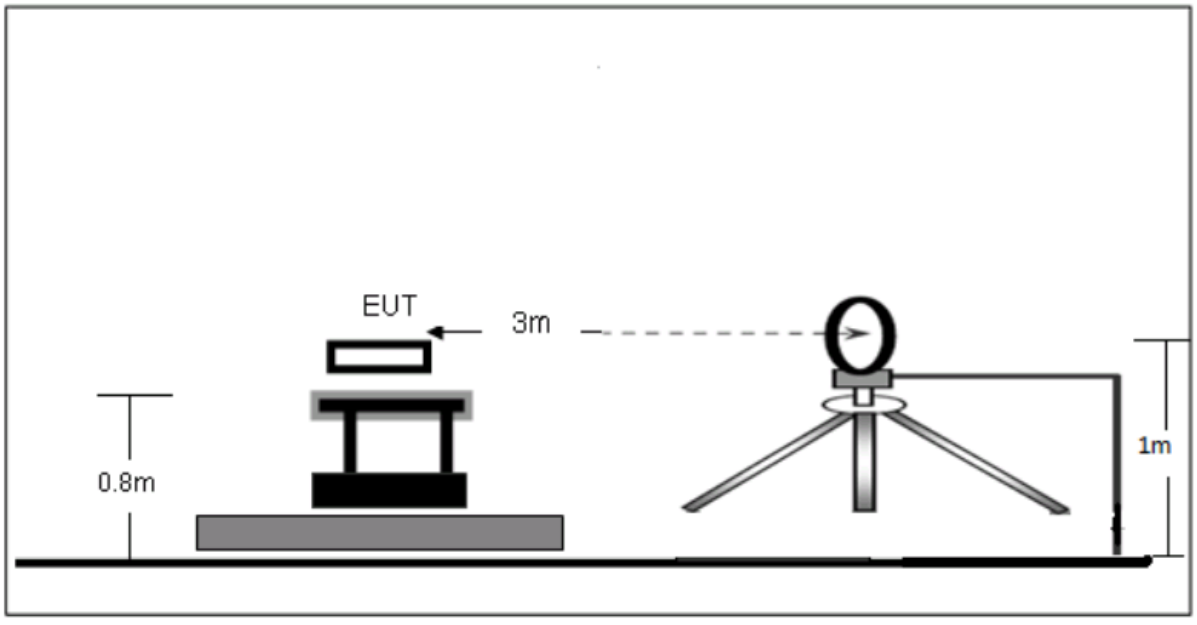


Figure 88. Test Configuration below 30 MHz

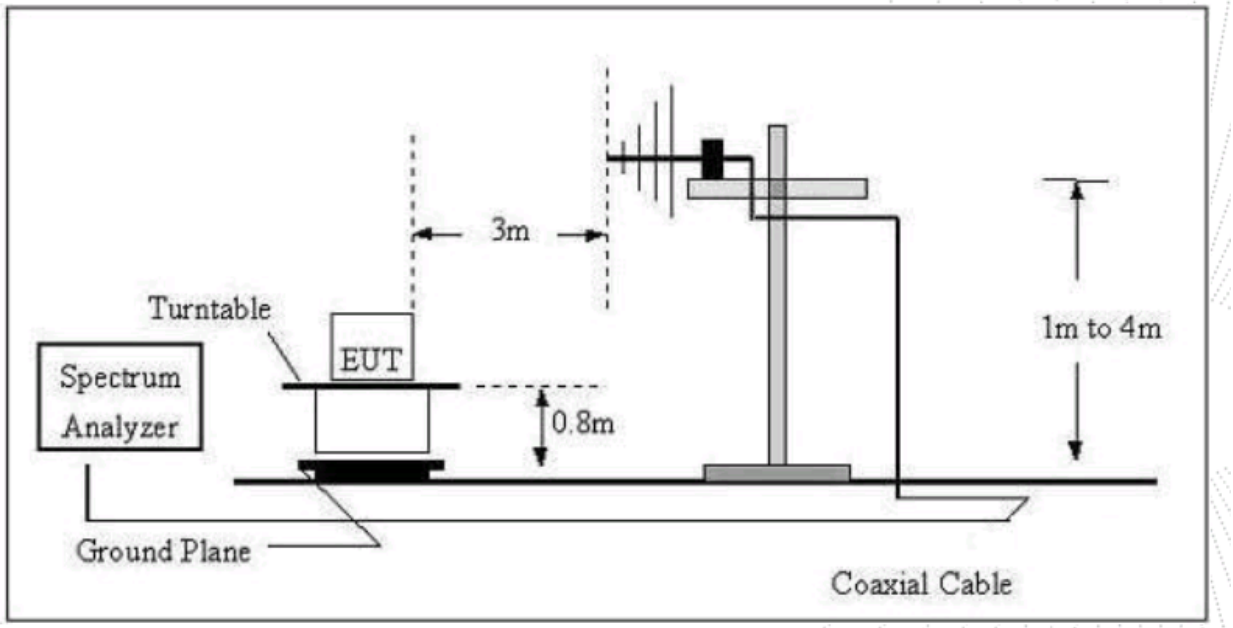


Figure 89. Test Configuration below 1000 MHz

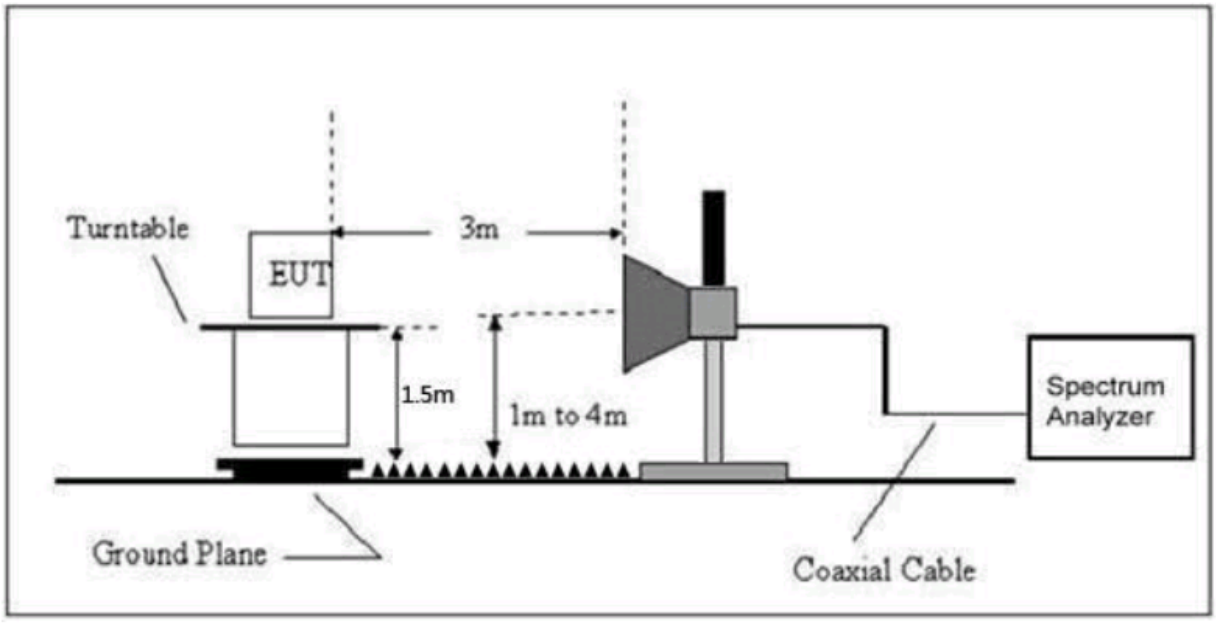


Figure 90. Test Configuration above 1000 MHz

Table 16. Spurious Radiated Emissions (9kHz-30MHz)

Test: FCC Part 15.209							
Frequency (MHz)	**Test Data (dBuV)**	**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.							

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

Sample Calculation: N/A

Test Date: August 11, 2022

Tested By
Signature:  Name: Gabriel Medina

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

Test: FCC Part 15.209							
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**DETECTOR PK / QP/AVG**
85.38	45.42	-18.15	27.27	40.0	3m./HORZ	12.7	**PK**
195.36	40.96	-11.25	29.71	43.5	3m./HORZ	13.8	**PK**
220.58	44.79	-14.54	30.25	46.0	3m./HORZ	15.8	**PK**
671.66	41.57	-4.87	36.70	46.0	3m./HORZ	9.3	**PK**
857.56	41.23	-2.93	38.30	46.0	3m./HORZ	7.7	**PK**
82.68	50.13	-18.51	31.62	40.0	3m./VERT	8.4	**PK**
190.03	41.34	-11.19	30.15	43.5	3m./VERT	13.4	**PK**
351.98	41.71	-11.75	29.96	46.0	3m./VERT	16.0	**PK**
623.90	41.89	-6.91	34.98	46.0	3m./VERT	11.0	**PK**
871.28	42.25	-4.53	37.72	46.0	3m./VERT	8.3	**PK**

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

Sample Calculation at 85.38 MHz:

Magnitude of Measured Frequency	45.42	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	-18.15	dB/m
Corrected Result	27.27	dBuV/m

Test Date: August 11, 2022

Tested By
Signature:  Name: Gabriel Medina

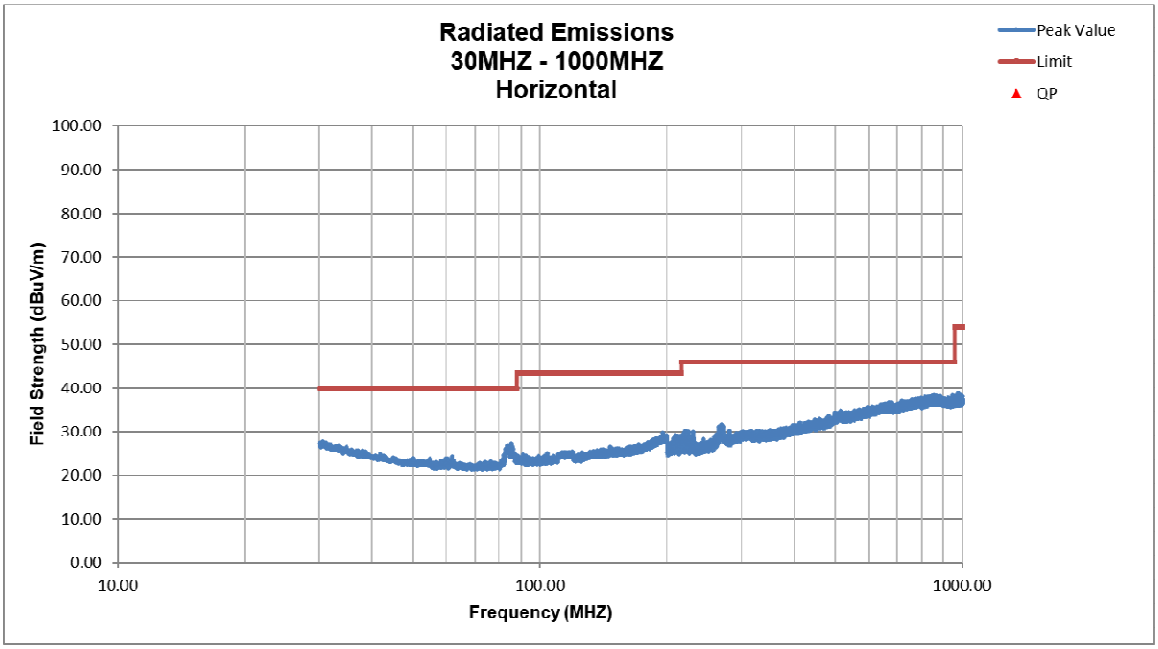


Figure 91. Radiated Emissions, Horizontal 30 – 1000 MHz

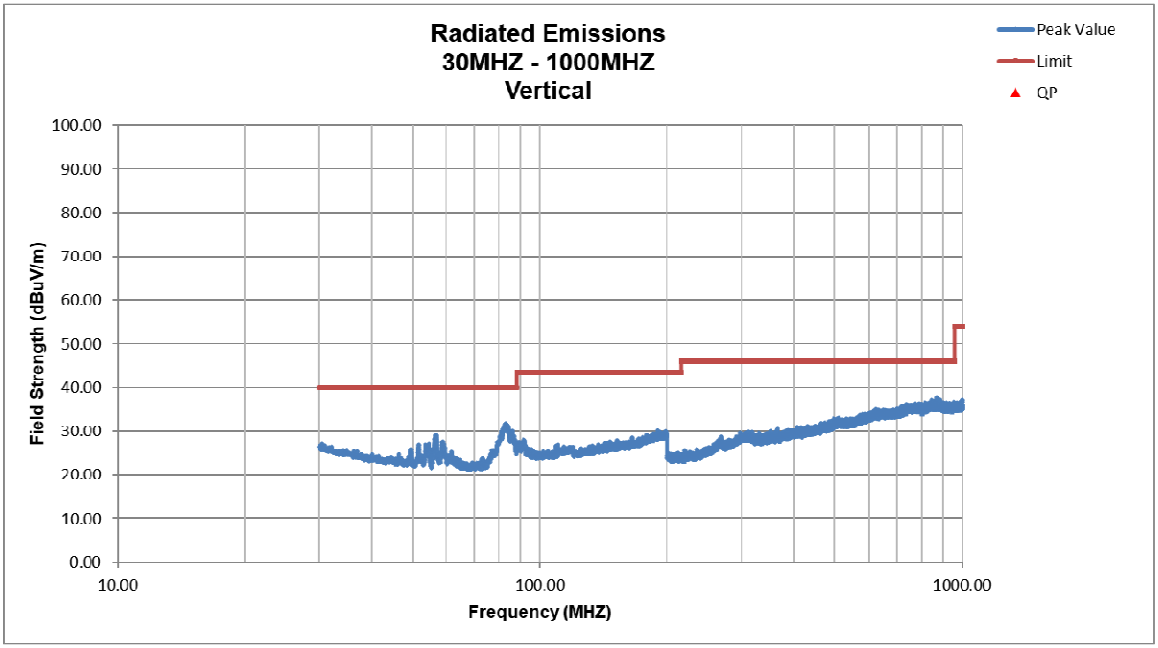


Figure 92. Radiated Emissions, Vertical 30 – 1000 MHz

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

Test: FCC Part 15.209							
Frequency (MHz)	**Test Data (dBuV)**	**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.							

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

Sample Calculation: N/A

Test Date: August 11, 2022

Tested By
Signature:  Name: Gabriel Medina

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 ±2.85 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 ±5.2 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 ±5.2 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ±5.2 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.