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Test Report for the FCC and ISED Testing of an Raspberry Pi RMC2GW4B52 to FCC Rule 47CFR 15.247 and ISED RSS-247 for Raspberry Pi Ltd

Report number: C15422TR4
Project number: C7894

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Issue	Description						Issue by	Date
4	Copy 1		Copy 2		PDF	√	JB	2nd April 2024

1574

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Test Report Change History

Issue	Date	Modification Details
1	2nd February 2024	First Issue
2	14th February 2024	Customer address updated
3	26th March 2024	Channel list added
4		
5		
6		
7		
8		
9		
10		

Section 1 Test Location

All testing was performed at;

Eurofins E&E UK Ltd	Unit 5
	Speedwell Road
	Castleford
	WF10 5PY
Tel:	01977 731173
Website	http://www.yorkemc.co.uk
UKAS Testing No.	1574

1.1 UKAS Accreditation

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.

Eurofins E&E UK Ltd latest accreditation schedule can be found at:
http://www.ukas.org/testing/lab_detail.asp?lab_id=989&location_id=&vMenuOption=3

Eurofins E&E UK Castleford Laboratory, is an Accredited facility recognised by the Federal Communications Commission (FCC) for certification testing. The appropriate FCC Designation Number is UK2013, dated 1st March 2021.

Eurofins E&E UK Castleford Laboratory is recognised by ISED for certification testing.
ISED Assigned Code: 22959
CAB Identifier: UK0004

Section 2 Customer Information

Company name	Raspberry Pi Ltd
Address	194 Cambridge Science Park
	Milton Road
	Cambridge
	CB4 0AB
	United Kingdom
Contact	Tom Westcott
Email	tom.westcott@raspberrypi.com

Section 3 Equipment Details

3.1 Equipment Under Test (EUT)

Date received:	15th November 2023
EUT name:	Raspberry Pi RMC2GW4B52
PMN:	Raspberry Pi RMC2GW4B52
HVIN:	Raspberry Pi RMC2GW4B52
FCC ID:	2ABCB-RMC2GW4B52
IC:	20953-RMC2GW4B52
EUT description:	The RMC2GW4B52 is a radio module with an on board antenna. The module has 2.4GHz Wi-Fi, Bluetooth classic and Bluetooth Low Energy functionality, which allows the user to connect to a 2.4GHz Wi-Fi network, BT Classic 5 compliant devices and BLE devices.
Antenna	Integral Antenna
Transmission	Digital Transmission System (DTS) Wi-Fi
Modulation schemes	IEEE 802.11b,g,n
Channel Bandwidth	20 MHz
Operating frequency band	2400MHz to 2483.5MHz
No of units tested:	Unit 1: radiated tests Unit 2: conducted tests
EUT power:	3.3V via USB port
Highest internal frequency:	2.462GHz
Mode/s of operation:	Continuous transmit of packetised data at top, middle and bottom channels. Channels used: 2412MHz, 2442MHz and 2462MHz
Test software:	The EUT was tested with picow-wifi-mfg-tester-mar1-2022.uf2 test firmware installed. The radio module was mounted on a representative PCB and the test modes were controlled via USB connection to a Raspberry Pi 400 device.
Modifications incorporated during testing:	N/A

Ports and Cables	Cable Length	Screened/ unscreened	Connected to
USB cable	1m	unscreened	External PC

EUT Monitoring/Auxiliary Equipment

Equipment name	Type no.	Serial no
Raspberry Pi 400	RPI-400	80000290905

Output power Q values

The output power of a specific channel was determined in the test mode software by a parameter referred to as a Q-value. The Q-values for each channel is detailed in the table below.

Modulation scheme	Channel number	Frequency (MHz)	Q value
802.11b	1	2412	68
802.11b	2	2417	68
802.11b	3	2422	73
802.11b	4	2427	73
802.11b	5	2432	73
802.11b	6	2437	73
802.11b	7	2442	73
802.11b	8	2447	73
802.11b	9	2452	73
802.11b	10	2457	73
802.11b	11	2462	73
802.11g	1	2412	64
802.11g	2	2417	64
802.11g	3	2422	64
802.11g	4	2427	64
802.11g	5	2432	64
802.11g	6	2437	64
802.11g	7	2442	64
802.11g	8	2447	64
802.11g	9	2452	64
802.11g	10	2457	64
802.11g	11	2462	64
802.11n	1	2412	64
802.11n	2	2417	64
802.11n	3	2422	64
802.11n	4	2427	64
802.11n	5	2432	64
802.11n	6	2437	64
802.11n	7	2442	64
802.11n	8	2447	64
802.11n	9	2452	64
802.11n	10	2457	64
802.11n	11	2462	64

3.2 EUT Photographs

Photographs are supplied separately.

3.3 Configuration of EUT

The apparatus was supplied in one single possible configuration.

3.4 EUT Monitoring/Auxiliary Equipment

None.

3.5 Monitoring Software

None. The channel required was selected via software prior to the testing.

Section 4Test Specifications

For USA:

Regulation / Test Standard	Regulation: Title 47 of the Code of Federal Regulations (CFR) Part 15 (47CFR15) Subpart C – Intentional Radiators Measurement standard: ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

Requirement	FCC Rule Part	Comments	Result Summary
6 dB Bandwidth	FCC § 15.247(a)(2)	Applies	Pass
Maximum peak conducted power	FCC § 15.247(b)(3)	Applies	Pass
Power spectral density	FCC § 15.247(e)	Applies	Pass
Band edge compliance	FCC § 15.247(d)	Applies	Pass
Conducted spurious emissions	FCC § 15.247(d)	Applies	Pass
Transmitter radiated spurious emissions – restricted bands	FCC § 15.247(d) FCC § 15.209	Applies	Pass

For Canada:

Regulation / Test Standard	RSS-247 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices Issue 3 August 2023 And, RSS-Gen — General Requirements for Compliance of Radio Apparatus Issue 5 April 2018 +A1 March 2019 +A2 February 2021

Requirement	ISED Ragulation	Comments	Results Summary
99% Occupied Bandwidth	RSS-Gen 6.6	Applies	Pass
6 dB Bandwidth	ISED RSS-247 § 5.2	Applies	Pass
Maximum peak conducted power	ISED RSS-247 § 5.4	Applies	Pass
Power spectral density	ISED RSS-247 § 5.2	Applies	Pass
Band edge compliance	ISED RSS-247 § 3.3 and 5.5 RSS-GEN Issue 5 Section 8.10	Applies	Pass
Conducted spurious emissions	ISED RSS-247 § 5.5	Applies	Pass
Transmitter radiated spurious emissions	ISED RSS-GEN § 8.9	Applies	Pass

4.1 Knowledge Database References

The following KDBs were referenced during the testing.
The latest knowledge database references are available via the FCC KDB website at:

https://apps.fcc.gov/kdb

4.1.1 Radiated Emissions (30MHz to 1000MHz)

Publication Number	Keyword	Publication Date
913591	Measurement of radiated emissions at the band-edge for a Part 15 RF Device	04/05/2017

4.1.2 Radiated Emissions (1GHz to 40GHz)

Publication Number	Keyword	Publication Date
414788	Test Site Validation Requirements above 1 GHz.	07/12/2018
414788	Comparison Noise Emitter (CNE), reference noise source, .pdf	07/12/2018
913591	Measurement of radiated emissions at the band-edge for a Part 15 RF Device	04/05/2017
414788	Comparison Noise Emitters (CNE), test equipment, Broadband.pdf	07/12/2018

4.2 Compliance Statement

The Raspberry Pi RMC2GW4B52, as tested, was shown to meet requirements of the standards listed in Section 4 of this report.

Note: Only the Wi-Fi functionality has been testing in this report.

Section 5 Spurious Emission Results – Radiated and Conducted

5.1 Test Specification

FCC Rule Part	47CFR 15.247 (d)
Standard	ANSI C63.10:2013
Measurement Uncertainty Radiated tests	The reported uncertainty of measurement y ± U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95% is +/- 5.01dB for the frequency range from 9kHz to 30MHz +/- 6.26dB for the frequency range 30MHz to 1GHz +/- 5.14dB for the frequency range from 1GHz to 6GHz +/- 5.45dB for the frequency range from 6GHz to 18GHz
Measurement Uncertainty Conducted Power tests	±1.4dB
Measurement Uncertainty Frequency tests	$\pm 9 \times 10^{-8}$

5.2 Procedure and Test Software Version

Radiated tests:- 47CFR15.205 and 47CFR15.209

Eurofins E&E UK test procedure (30MHz to 1GHz)	CEP23 Issue 9
Eurofins E&E UK test procedure (1GHz to 40GHz)	CEP64 Issue 10
Test software	RadiMation Version 2016.2.8

Conducted Tests 47CFR 15.247(d)

ANSi C63.10-2013 Clause reference:	11.11.2 and 11.11.3
Test software	N/A

5.3 Radiated Emissions (30MHz to 1GHz)

Radiated electric field emission measurements are applied as defined in 47CFR15.205 and 47CFR15.209.

5.3.1 Limits at 3m

Frequency (MHz)	Electric Field Strength Limit (dBµV/m) at 3m measurement distance
	Quasi Peak
30 - 88	40.0
88 -216	43.5
216 - 960	46.0
960- 1000	54.0

Note: FCC 47 CFR Part 15 Section 15.209 and 15.205 specifies test limits at 3m

Receiver Settings

Receiver Parameters	Setting
Detector Function	Quasi Peak
Start Frequency	30MHz
Stop Frequency	1000MHz
Resolution Bandwidth	120kHz
Video Bandwidth	Auto

5.3.2 Emissions measurements

5.3.3 Date of Test

24th November 2023

5.3.4 Test Area

LAB 1 (SAC)

5.3.5 Tested by

L Trickett

5.3.6 Test Setup

The EUT was configured in the SAC on an 80cm high polystyrene table.

The measurement was performed with an antenna to EUT separation distance of 3m. The results were maximised in orientation 0-360 degrees and height 1-4m.

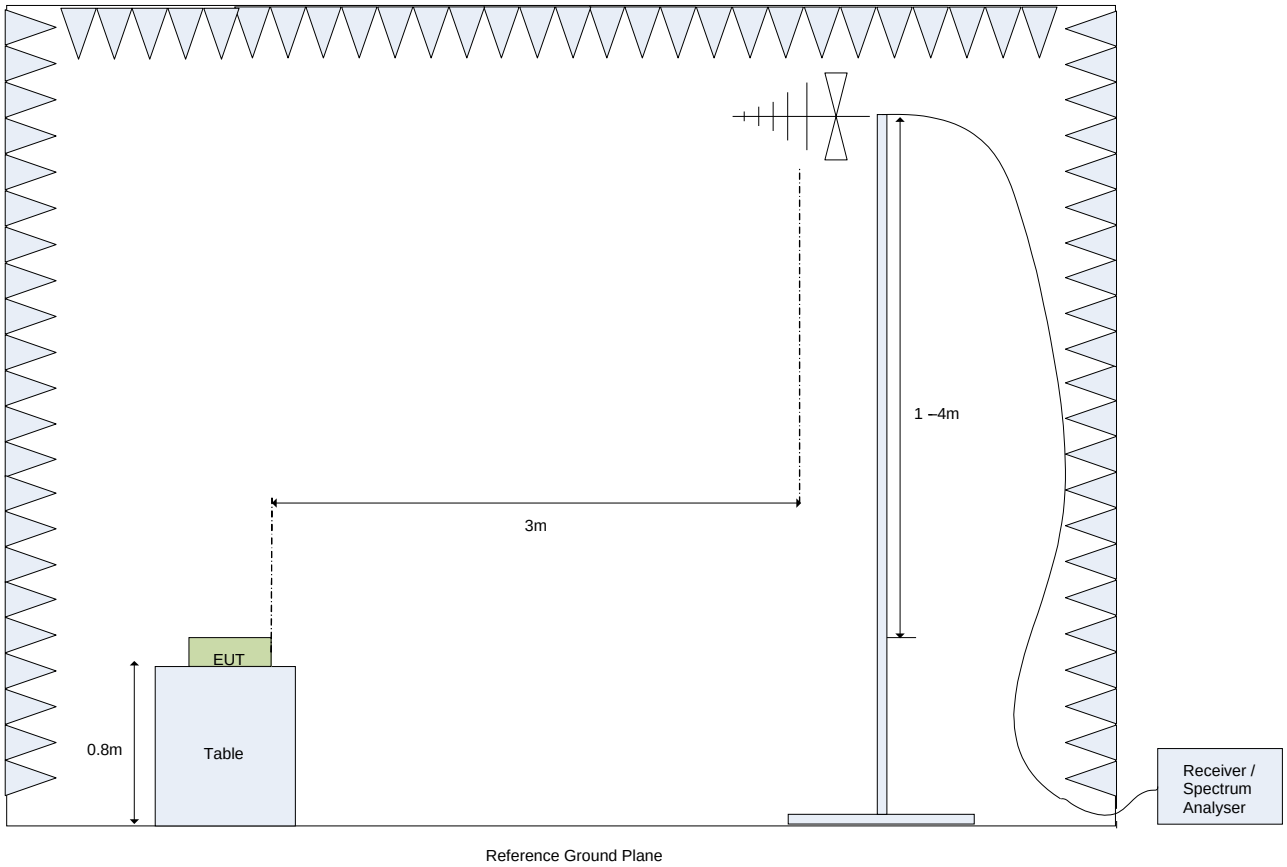


Figure 1 Test Setup for E-Field Measurements from 30MHz to 1GHz

Note 1 : With the EUT de-energized the ambient radio noise and signals met the 6dB peak detection requirement of ANSI C63.10-2013.

Note 2 : There were no significant environmental temperature changes during the test duration and hence it was not considered necessary to consider any variation in cable loss.

Operating Mode During testing

During spurious emission testing the equipment under test was set to transmit at the same frequency on the following channels: 2412MHz, 2442MHz and 2462MHz for each modulation scheme used.

The equipment under test was pre-scanned using peak detection when operating on all three channels for all three modulation schemes. Final measurements were performed for each modulation scheme with the equipment under test operating on the worse case channel identified during the pre-scans.

5.3.7 Electric field emissions IEEE 802.11b, 30MHz to 1GHz

Figure 2 Electric field emissions Plot IEEE 802.11b, 30MHz to 1GHz, 2462MHz Operation

Frequency	Quasi-Peak	Quasi Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height	Polarization
MHz	dBµV/m	dBµV/m	dB		degrees	m	
87.48	23.2	40.0	-16.8	Pass	280	1.6	Vertical
68.64	31.9	40.0	-8.1	Pass	240	1.4	Vertical
52.74	25.2	40.0	-14.8	Pass	20	1.0	Vertical
32.64	29.5	40.0	-10.5	Pass	30	1.0	Vertical
101.10	34.5	43.5	-9.0	Pass	120	1.0	Vertical
132.00	30.3	43.5	-13.2	Pass	220	1.0	Vertical
165.42	9.9	43.5	-33.6	Pass	225	1.0	Vertical
312.72	27.1	46.0	-18.9	Pass	125	1.6	Vertical
480.06	36.0	46.0	-10.0	Pass	155	2.1	Horizontal
902.28	18.0	46.0	-28.0	Pass	55	1.0	Horizontal
120.00	27.7	43.5	-15.8	Pass	5	1.0	Vertical
91.50	32.4	43.5	-11.1	Pass	340	1.1	Vertical
89.28	31.9	43.5	-11.6	Pass	275	1.0	Vertical
148.50	28.9	43.5	-14.6	Pass	130	1.0	Vertical

Table 1 Electric Field Emissions Peaks IEEE 802.11b, 30MHz to 1GHz. 2462MHz Operation

Figure 3 Electric field emissions Plot IEEE 802.11b, 30MHz to 1GHz, Operation on 2412MHz - Peak detector scan

Figure 4 Electric field emissions Plot IEEE 802.11b, 30MHz to 1GHz, Operation on 2442MHz - Peak detector scan

5.3.8 Electric field emissions IEEE 802.11g, 30MHz to 1GHz

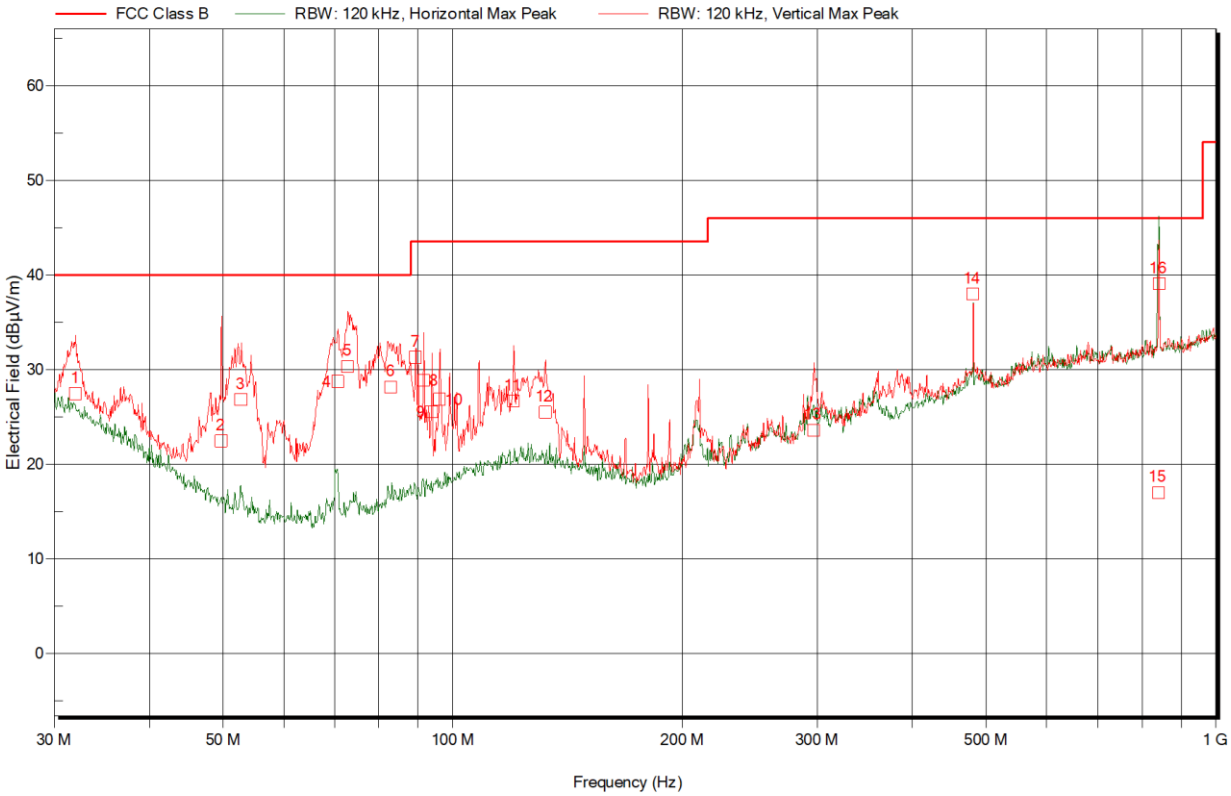


Figure 5 Electric field emissions Plot IEEE 802.11g, 30MHz to 1GHz, 2462MHz Operation

Frequency	Quasi-Peak	Quasi Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height	Polarization
MHz	dBµV/m	dBµV/m	dB		degrees	m	
31.98	27.4	40.0	-12.6	Pass	315	1.0	Vertical
49.68	22.5	40.0	-17.5	Pass	165	1.0	Vertical
52.74	26.8	40.0	-13.2	Pass	45	1.0	Vertical
70.62	28.7	40.0	-11.3	Pass	75	1.6	Vertical
72.72	30.3	40.0	-9.7	Pass	325	1.3	Vertical
82.86	28.1	40.0	-11.9	Pass	360	1.4	Vertical
89.28	31.3	43.5	-12.2	Pass	235	1.5	Vertical
91.50	28.9	43.5	-14.6	Pass	335	1.0	Vertical
93.72	25.5	43.5	-18.0	Pass	5	1.1	Vertical
96.00	26.9	43.5	-16.6	Pass	135	1.1	Vertical
120.06	26.7	43.5	-16.8	Pass	145	1.0	Vertical
132.06	25.5	43.5	-18.0	Pass	335	1.0	Vertical
296.82	23.6	46.0	-22.4	Pass	285	1.0	Vertical
480.06	38.0	46.0	-8.0	Pass	135	1.0	Vertical
840.42	17.0	46.0	-29.0	Pass	245	2.7	Vertical
841.62	39.1	46.0	-6.9	Pass	315	3.6	Horizontal

Table 2 Electric Field Emissions Peaks IEEE 802.11g, 30MHz to 1GHz. 2462MHz Operation

Figure 6 Electric field emissions Plot IEEE 802.11g, 30MHz to 1GHz, Operation on 2412MHz - Peak detector scan

Figure 7 Electric field emissions Plot IEEE 802.11g, 30MHz to 1GHz, Operation on 2442MHz - Peak detector scan

5.3.9 Electric field emissions IEEE 802.11n, 30MHz to 1GHz

Figure 8 Electric field emissions Plot IEEE 802.11n, 30MHz to 1GHz, 2442MHz Operation

Frequency	Quasi-Peak	Quasi Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height	Polarization
MHz	dBµV/m	dBµV/m	dB		degrees	m	
31.68	27.8	40.0	-12.2	Pass	145	1.0	Vertical
51.72	26.5	40.0	-13.5	Pass	80	1.0	Vertical
54.42	23.4	40.0	-16.6	Pass	345	1.0	Vertical
70.44	29.1	40.0	-10.9	Pass	170	1.5	Vertical
73.50	32.7	40.0	-7.3	Pass	135	1.1	Vertical
82.56	28.5	40.0	-11.5	Pass	84	1.3	Vertical
91.50	31.2	43.5	-12.3	Pass	119	1.1	Vertical
93.72	22.2	43.5	-21.3	Pass	185	1.0	Vertical
96.00	26.1	43.5	-17.4	Pass	130	1.0	Vertical
108.06	25.6	43.5	-17.9	Pass	140	1.0	Vertical
120.00	26.2	43.5	-17.3	Pass	125	1.0	Vertical
480.06	34.4	46.0	-11.6	Pass	124	1.0	Vertical
841.62	17.0	46.0	-29.0	Pass	140	1.1	Vertical

Table 3 Electric Field Emissions Peaks IEEE 802.11n, 30MHz to 1GHz. 2442MHz Operation

Figure 9 Electric field emissions Plot IEEE 802.11n, 30MHz to 1GHz, Operation on 2412MHz - Peak detector scan

Figure 10 Electric field emissions Plot IEEE 802.11n, 30MHz to 1GHz, Operation on 2462MHz - Peak detector scan

5.4 Radiated Emissions (1GHz to 18GHz)

5.4.1 Limits

Frequency (GHz)	Limit (dBµV/m)	Limit (dBµV/m)
	Peak	Average
1-18	74.0	54.0

5.4.2 Receiver Settings

Receiver Parameters	Setting
Detector Function	Average and Peak
Start Frequency	1GHz
Stop Frequency	18GHz
Resolution Bandwidth	1MHz
Video Bandwidth	Auto

5.4.3 Emissions measurements

5.4.4 Date of Test

24th November 2023

5.4.5 Test Area

LAB 1 (SAC)

5.4.6 Tested by

L Trickett

5.4.7 Test Setup

The EUT was configured in the SAC on a 1.5m high table Exploratory measurements on the EUT were carried out to identify suspect frequencies and worst case orientations, see Section 5.4.8.

The measurement was then performed with an antenna to EUT separation distance of 3m.

The antenna was kept in the “cone of radiation” from the EUT and pointed at the area both in azimuth and elevation using the tilt mechanism on the antenna mast.

The results were maximised in orientation 0-360 degrees and height 1-4m.

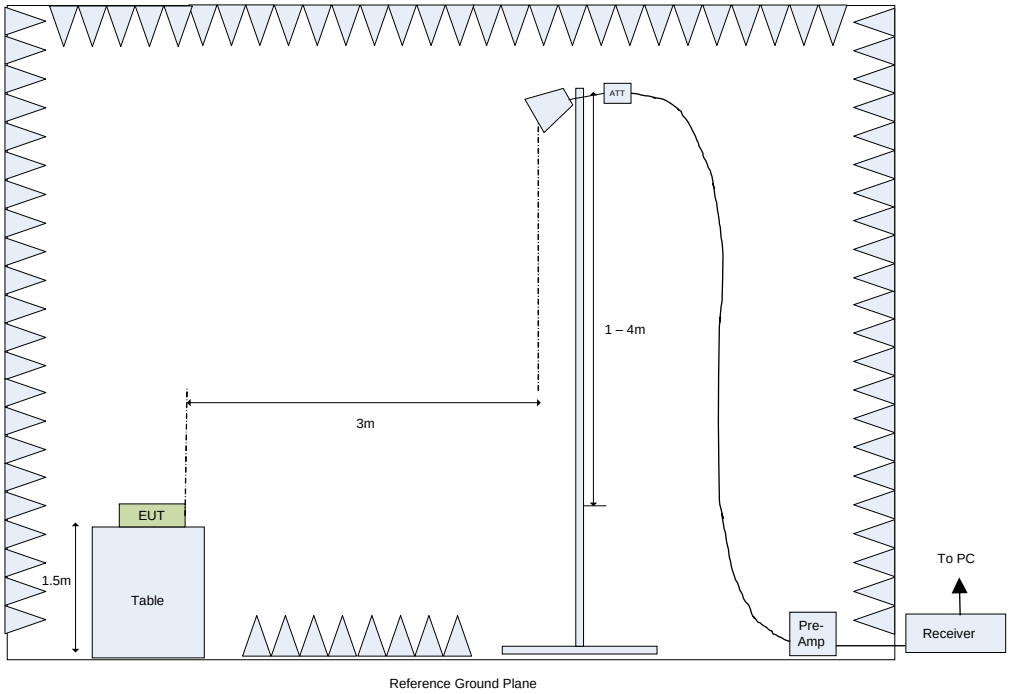


Figure 5.4.7.1: Test Setup for Final E-Field Measurements from 1GHz to 18GHz

Note 1: With the EUT de-energized the ambient radio noise and signals met the 6dB peak detection requirement of ANSI C63.4-2010.

Note 2: There were no significant environmental temperature changes during the test duration and hence it was not considered necessary to consider any variation in cable loss.

Note 3: On all swept and final measurements made between 1GHz and 18GHz a 2.4GHz Microtronics BRM50702 notch filter was placed in the measurement chain between the antenna and pre-amplifier in order to prevent the artificial generation of harmonics within the pre-amplifier.

5.4.8 Exploratory Radiated Emission Maximization

During exploratory testing, suspect emissions from the EUT were identified both in terms of the frequency and directionality. This was achieved by manually positioning the antenna close to the EUT and also by scanning it over all sides of the EUT whilst observing a spectral display. The typical distance between the surface of the EUT and the scanning antenna was circa 30cm.

Frequency (GHz)	Mode of operation	EUT face *	Emissions Angle (w.r.t. turntable)	Height	Polarization
1.0279	Transmitting on channel 2412MHz	front face	0	1.5	H
1.1255	Transmitting on channel 2462MHz	front face	0	1.5	H
1.1277	Transmitting on channel 2412MHz	front face	0	1.5	H
1.1450	Transmitting on channel 2442MHz	front face	0	1.5	H
1.3300	Transmitting on channel 2412MHz	front face	0	1.5	H
1.7245	Transmitting on channel 2462MHz	front face	0	1.5	H
1.7426	Transmitting on channel 2412MHz	front face	0	1.5	H
1.7600	Transmitting on channel 2412MHz	front face	0	1.5	H
1.7607	Transmitting on channel 2462MHz	front face	0	1.5	H
1.7686	Transmitting on channel 2412MHz	front face	0	1.5	H
1.8670	Transmitting on channel 2442MHz	front face	0	1.5	H
1.8952	Transmitting on channel 2412MHz	front face	0	1.5	H
1.8960	Transmitting on channel 2442MHz	front face	0	1.5	H
1.9570	Transmitting on channel 2412MHz	front face	0	1.5	H
3.6184	Transmitting on channel 2412MHz	front face	0	1.5	H
3.6632	Transmitting on channel 2442MHz	front face	0	1.5	H

3.6936	Transmitting on channel 2462MHz	front face	0	1.5	H
4.8234	Transmitting on channel 2412MHz	front face	0	1.5	H
4.8843	Transmitting on channel 2442MHz	front face	0	1.5	H
4.9241	Transmitting on channel 2462MHz	front face	0	1.5	H
7.2361	Transmitting on channel 2412MHz	front face	0	1.5	H
7.3258	Transmitting on channel 2442MHz	front face	0	1.5	H
7.3859	Transmitting on channel 2462MHz	front face	0	1.5	H

Table 4 Frequencies identified during Exploratory Radiated Emission maximization. 802.11b

Frequency (GHz)	Mode of operation	EUT face *	Emissions Angle (w.r.t. turntable)	Height	Polarization
1.0076	Transmitting on channel 2442MHz	front face	0	1.5	H
1.1240	Transmitting on channel 2462MHz	front face	0	1.5	H
1.1306	Transmitting on channel 2412MHz	front face	0	1.5	H
1.1497	Transmitting on channel 2442MHz	front face	0	1.5	H
1.1993	Transmitting on channel 2462MHz	front face	0	1.5	H
1.2094	Transmitting on channel 2442MHz	front face	0	1.5	H
1.6956	Transmitting on channel 2442MHz	front face	0	1.5	H
1.7600	Transmitting on channel 2412MHz	front face	0	1.5	H
1.7006	Transmitting on channel 2462MHz	front face	0	1.5	H
1.7440	Transmitting on channel 2462MHz	front face	0	1.5	H

1.7426	Transmitting on channel 2412MHz	front face	0	1.5	H
1.7599	Transmitting on channel 2462MHz	front face	0	1.5	H
1.7607	Transmitting on channel 2412MHz	front face	0	1.5	H
1.7639	Transmitting on channel 2462MHz	front face	0	1.5	H
1.8055	Transmitting on channel 2462MHz	front face	0	1.5	H
1.8062	Transmitting on channel 2442MHz	front face	0	1.5	H
1.8670	Transmitting on channel 2412MHz	front face	0	1.5	H
1.8793	Transmitting on channel 2462MHz	front face	0	1.5	H
1.9263	Transmitting on channel 2442MHz	front face	0	1.5	H
1.9552	Transmitting on channel 2442MHz	front face	0	1.5	H
3.6184	Transmitting on channel 2412MHz	front face	0	1.5	H
3.6632	Transmitting on channel 2442MHz	front face	0	1.5	H
3.6928	Transmitting on channel 2462MHz	front face	0	1.5	H
4.8720	Transmitting on channel 2442MHz	front face	0	1.5	H
4.9306	Transmitting on channel 2462MHz	front face	0	1.5	H
7.2361	Transmitting on channel 2412MHz	front face	0	1.5	H
7.3258	Transmitting on channel 2442MHz	front face	0	1.5	H
7.3859	Transmitting on channel 2462MHz	front face	0	1.5	H

Table 5 Frequencies identified during Exploratory Radiated Emission maximization. 802.11g

Frequency (GHz)	Mode of operation	EUT face *	Emissions Angle (w.r.t. turntable)	Height	Polarization
1.0350	Transmitting on channel 2412MHz	front face	0	1.5	H
1.0742	Transmitting on channel 2442MHz	front face	0	1.5	H
1.1364	Transmitting on channel 2462MHz	front face	0	1.5	H
1.1436	Transmitting on channel 2412MHz	front face	0	1.5	H
1.1950	Transmitting on channel 2442MHz	front face	0	1.5	H
1.2138	Transmitting on channel 2442MHz	front face	0	1.5	H
1.3035	Transmitting on channel 2442MHz	front face	0	1.5	H
1.7100	Transmitting on channel 2412MHz	front face	0	1.5	H
1.7426	Transmitting on channel 2412MHz & 2442MHz	front face	0	1.5	H
1.7433	Transmitting on channel 2462MHz	front face	0	1.5	H
1.7534	Transmitting on channel 2442MHz	front face	0	1.5	H
1.7549	Transmitting on channel 2412MHz	front face	0	1.5	H
1.7578	Transmitting on channel 2412MHz	front face	0	1.5	H
1.7607	Transmitting on channel 2412MHz & 2442MHz	front face	0	1.5	H
1.8055	Transmitting on channel 2462MHz	front face	0	1.5	H
1.8062	Transmitting on channel 2412MHz	front face	0	1.5	H
1.8974	Transmitting on channel 2412MHz & 2462MHz	front face	0	1.5	H
3.6183	Transmitting on channel 2412MHz	front face	0	1.5	H

3.6632	Transmitting on channel 2442MHz	front face	0	1.5	H
3.6929	Transmitting on channel 2462MHz	front face	0	1.5	H
4.9233	Transmitting on channel 2462MHz	front face	0	1.5	H
7.2358	Transmitting on channel 2442MHz	front face	0	1.5	H
7.2361	Transmitting on channel 2412MHz	front face	0	1.5	H
7.3859	Transmitting on channel 2462MHz	front face	0	1.5	H

Table 6 Frequencies identified during Exploratory Radiated Emission maximization. 802.11n

Note 1: The front face of the EUT is deemed to be 0°, which is then turned in a clockwise direction through 360°.

Note 2: With no emissions observed above 8GHz during the exploratory investigation, final measurements were performed up to 10GHz only.

5.4.9 Electric field emissions IEEE 802.11b, 1GHz to 18GHz

The equipment under test was pre-scanned using peak detection when operating on all three channels. Final measurements were performed with the equipment under test operating on 2442MHz

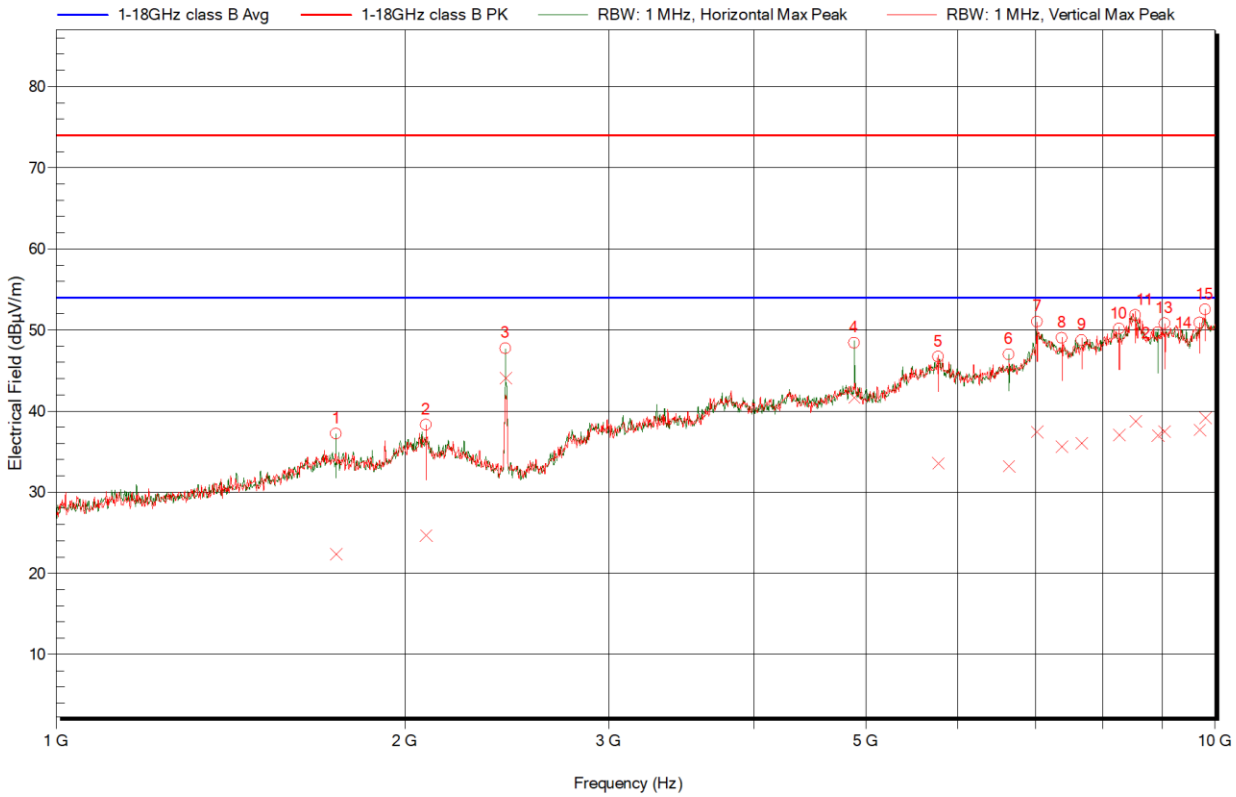


Figure 11 Electric field emissions Plot IEEE 802.11b, 1GHz to 10GHz. Operation on 2442MHz

Frequency	Average	Average Limit	Average Difference	Average Status	Angle	Height	Polarization
GHz	dBµV/m	dBµV/m	dB		degrees	m	
1.745	22.3	54	-31.7	Pass	5	1.5	Horizontal
2.087	24.7	54	-29.4	Pass	285	3.6	Vertical
2.443	44.1	54	-9.9	Pass	135	2.3	Horizontal
4.884	41.7	54	-12.3	Pass	195	2.5	Horizontal
5.773	33.6	54	-20.4	Pass	255	3.4	Vertical
6.641	33.2	54	-20.8	Pass	155	2.3	Horizontal
7.023	37.4	54	-16.6	Pass	280	1.4	Vertical
7.377	35.6	54	-18.4	Pass	290	2.7	Vertical
7.674	36.0	54	-18.0	Pass	155	3.3	Vertical
8.268	37.0	54	-17.0	Pass	120	1.8	Vertical
8.537	38.7	54	-15.3	Pass	55	3.9	Vertical
8.926	37.0	54	-17.0	Pass	40	3.2	Horizontal
9.05	37.5	54	-16.5	Pass	105	3.7	Vertical
9.698	37.7	54	-16.3	Pass	215	2.2	Vertical
9.806	39.2	54	-14.8	Pass	5	3.0	Vertical

Table 7 Electric Field Emissions Peaks IEEE 802.11b, 1GHz to 10GHz – Operation on 2440MHz

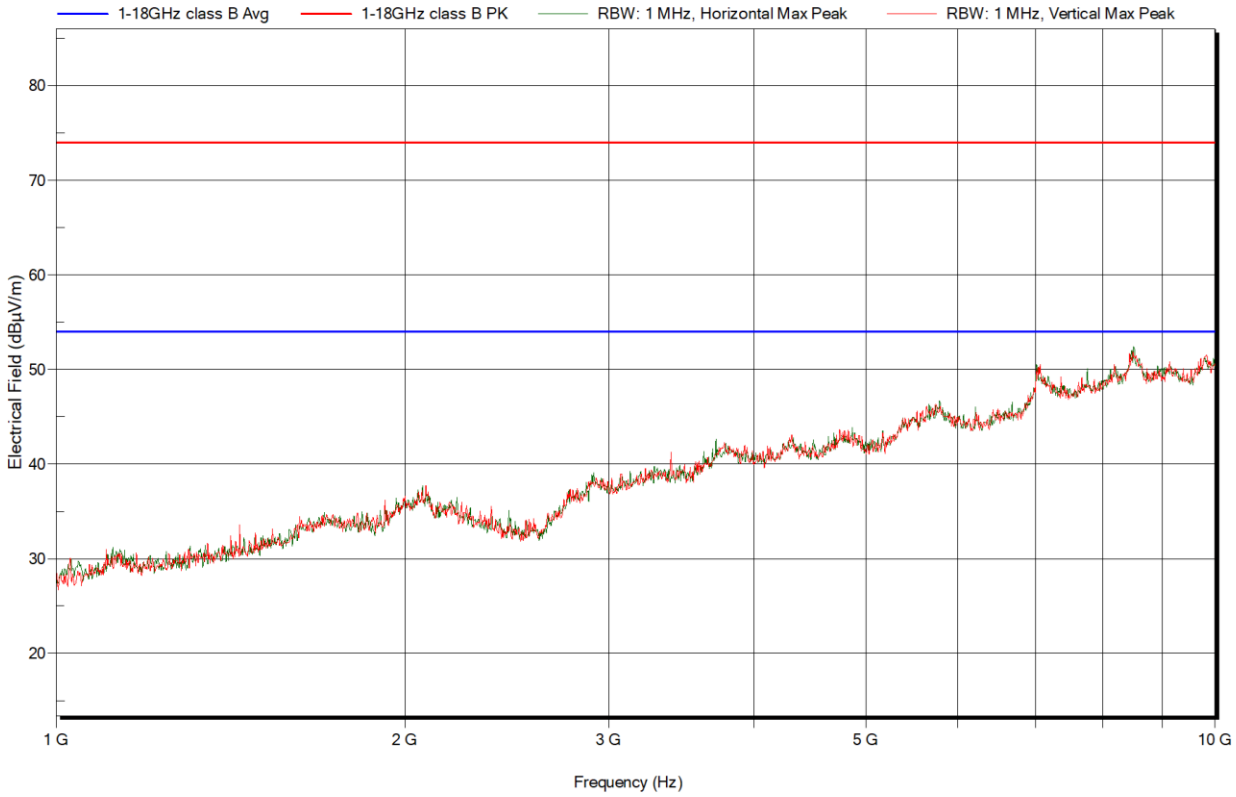


Figure 12 Electric field emissions Plot IEEE 802.11b, 1GHz to 10GHz, Operation on 2412MHz - Peak detector scan

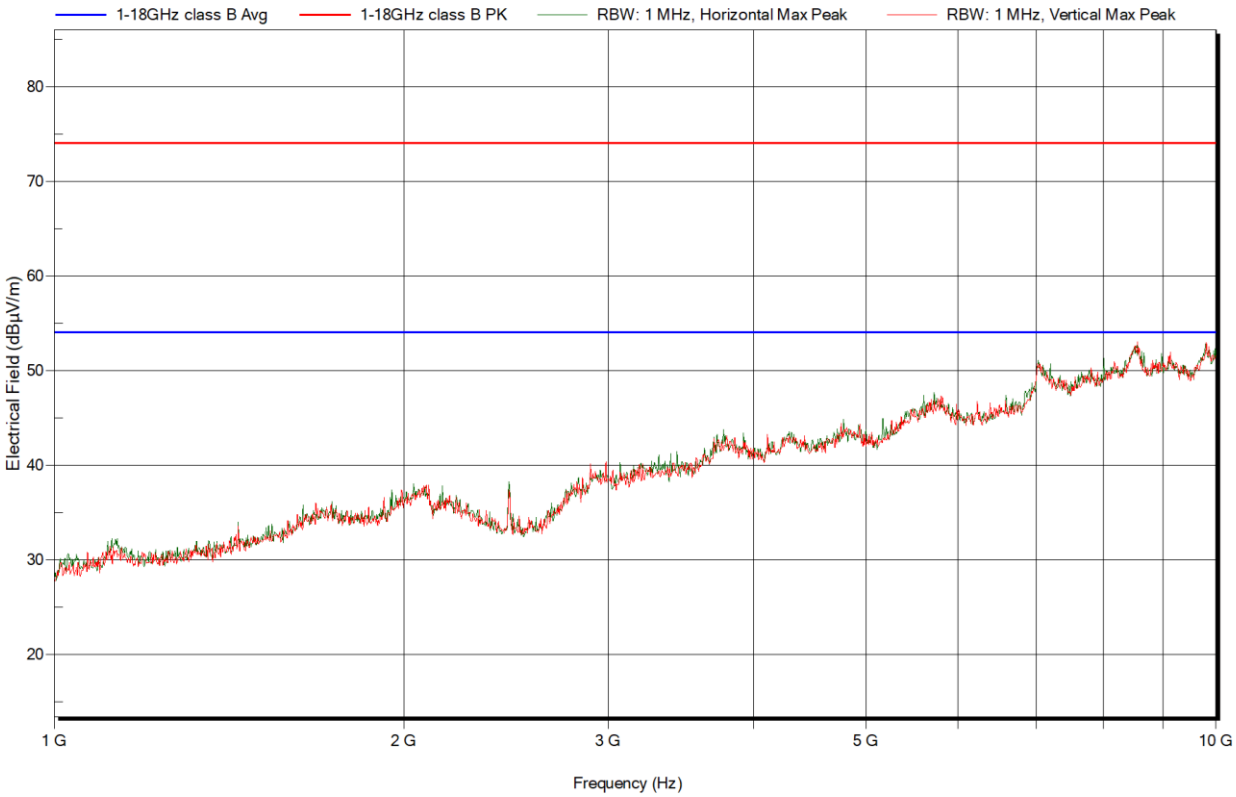


Figure 13 Electric field emissions Plot, 1GHz to 10GHz IEEE 802.11b, Operation on 2462MHz – Peak detector scan

5.4.10 Electric field emissions IEEE 802.11g, 1GHz to 18GHz

The equipment under test was pre-scanned using peak detection when operating on all three channels. Final measurements were performed with the equipment under test operating on 2442MHz

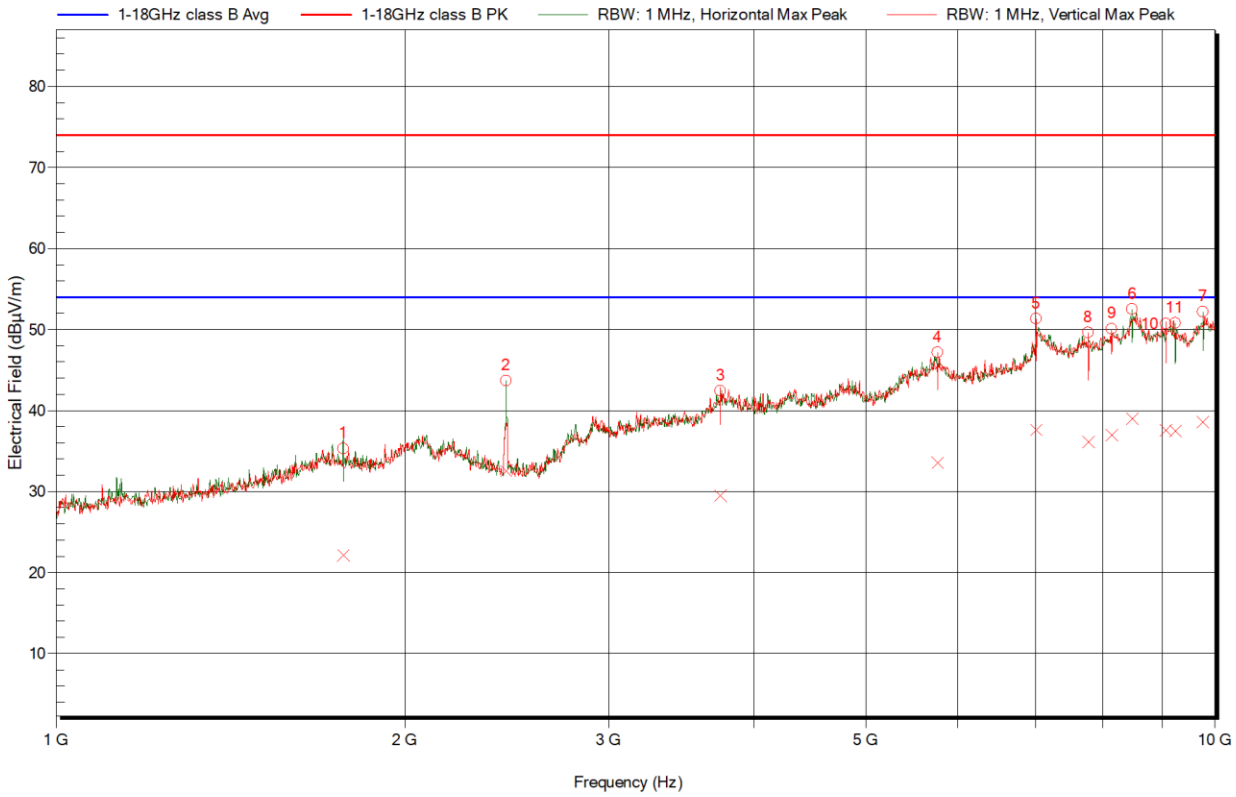


Figure 14 Electric field emissions Plot IEEE 802.11g, 1GHz to 10GHz. Operation on 2442MHz

Frequency	Average	Average Limit	Average Difference	Average Status	Angle	Height	Polarization
GHz	dBµV/m	dBµV/m	dB		degrees	m	
1.770	22.1	54	-31.9	Pass	220	2.4	Horizontal
2.446	32.5	54	-21.5	Pass	145	2.3	Horizontal
3.744	29.5	54	-24.5	Pass	180	3.5	Vertical
5.764	33.5	54	-20.5	Pass	200	2.7	Vertical
7.011	37.6	54	-16.4	Pass	235	2.7	Vertical
8.483	39.0	54	-15.0	Pass	195	1.5	Horizontal
9.765	38.5	54	-15.5	Pass	20	3.7	Horizontal
7.774	36.1	54	-17.9	Pass	160	3	Vertical
8.144	36.9	54	-17.1	Pass	25	4	Vertical
9.071	37.5	54	-16.5	Pass	155	2.3	Vertical
9.241	37.4	54	-16.6	Pass	225	2.4	Horizontal

Table 8 Electric Field Emissions Peaks IEEE 802.11g, 1GHz to 10GHz – Operation on 2442MHz

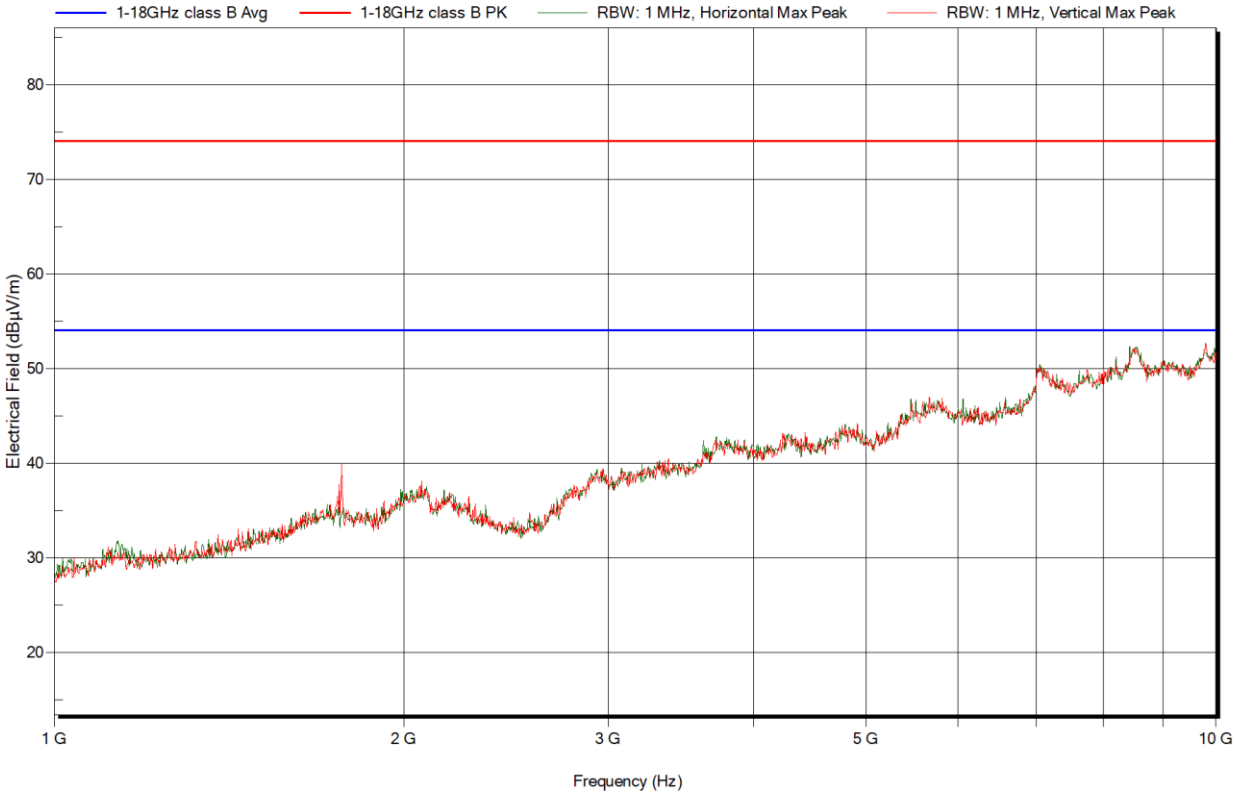


Figure 15 Electric field emissions Plot IEEE 802.11g, 1GHz to 10GHz, Operation on 2412MHz - Peak detector scan

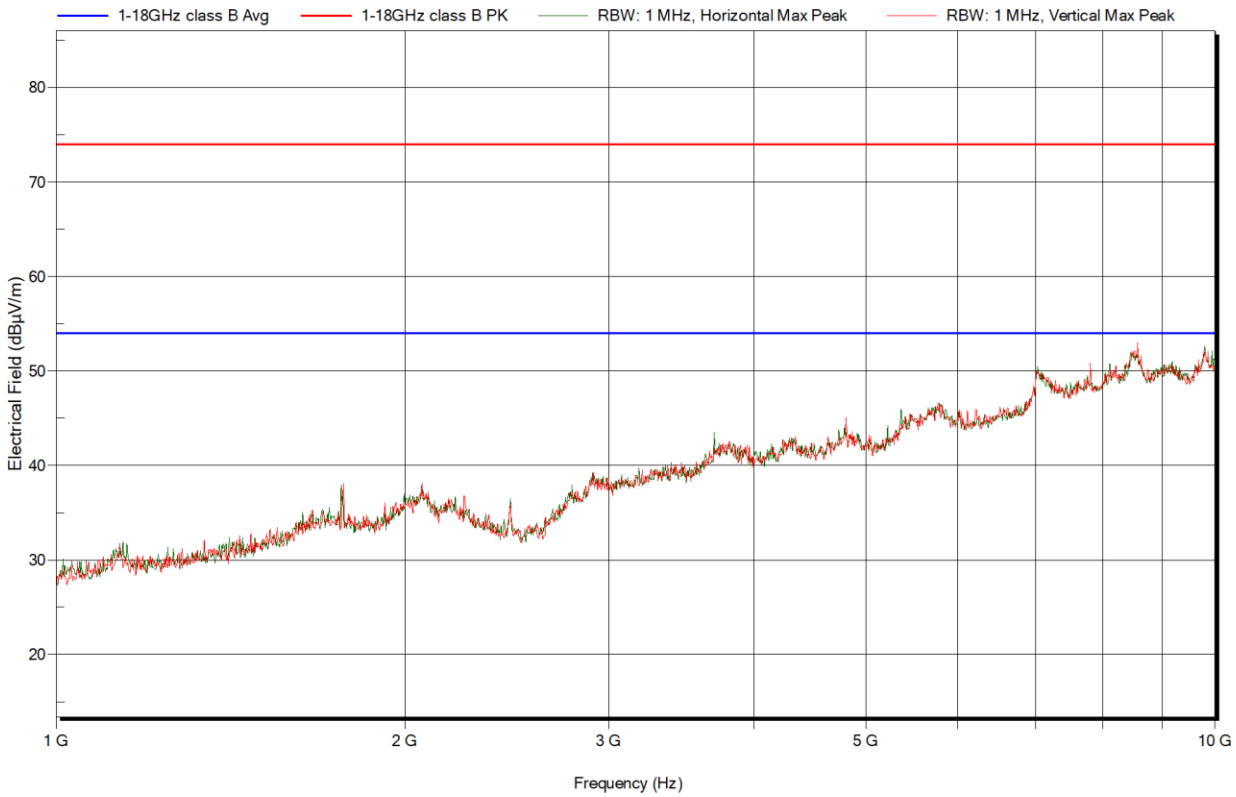


Figure 16 Electric field emissions Plot, 1GHz to 10GHz IEEE 802.11g, Operation on 2462MHz – Peak detector scan

5.4.11 Electric field emissions IEEE 802.11n, 1GHz to 18GHz

The equipment under test was pre-scanned using peak detection when operating on all three channels. Final measurements were performed with the equipment under test operating on 2412MHz

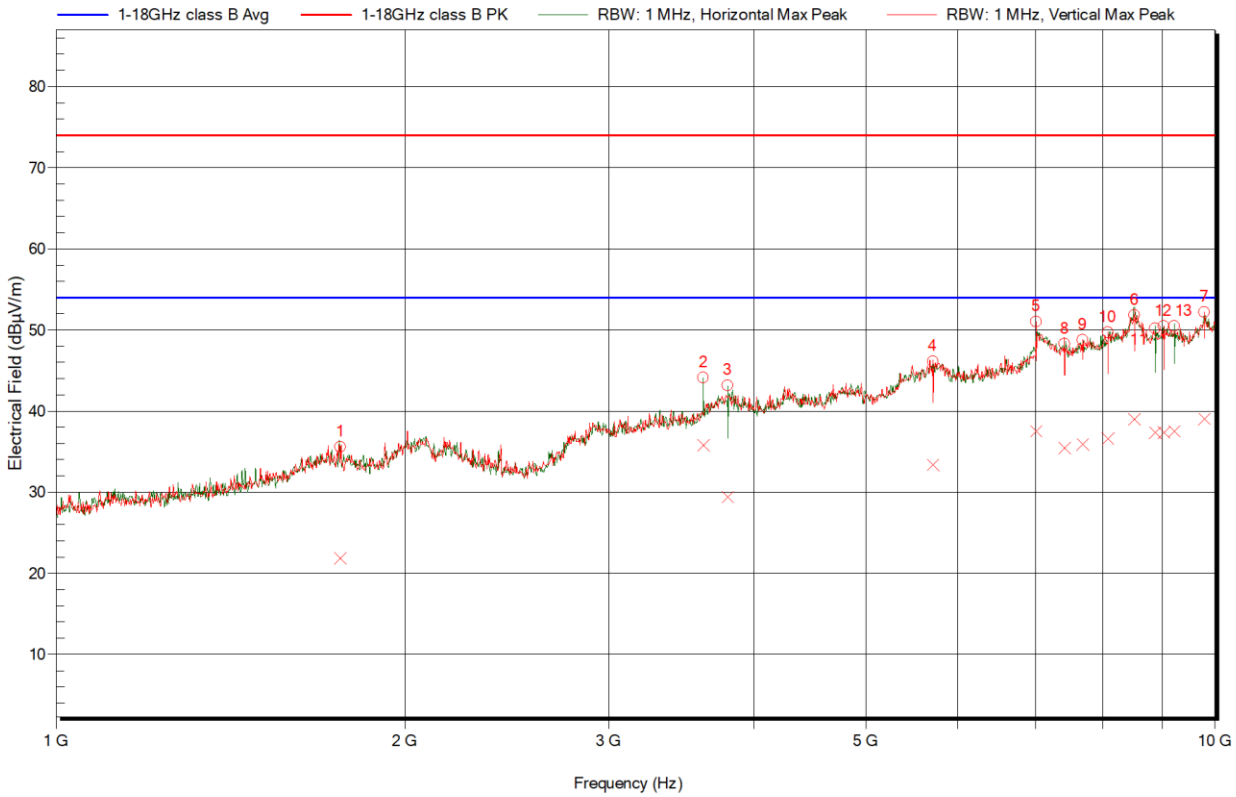


Figure 17 Electric field emissions Plot IEEE 802.11n, 1GHz to 10GHz. Operation on 2412MHz

Frequency	Average	Average Limit	Average Difference	Average Status	Angle	Height	Polarization
GHz	dBµV/m	dBµV/m	dB		degrees	m	
1.760	21.9	54	-32.1	Pass	85	3.6	Horizontal
3.618	35.8	54	-18.2	Pass	200	3.9	Horizontal
3.798	29.4	54	-24.6	Pass	245	1.5	Horizontal
5.711	33.4	54	-20.7	Pass	315	3.6	Vertical
7.008	37.5	54	-16.5	Pass	190	1.6	Vertical
8.521	39.0	54	-15.0	Pass	140	3.5	Vertical
9.787	39.0	54	-15.0	Pass	145	3.1	Vertical
7.415	35.5	54	-18.5	Pass	240	2.7	Vertical
7.690	35.9	54	-18.1	Pass	255	2.9	Vertical
8.084	36.6	54	-17.4	Pass	215	4	Vertical
8.880	37.30	54	-16.7	Pass	160	2.8	Horizontal
9.032	37.3	54	-16.7	Pass	295	3.2	Vertical
9.225	37.5	54	-16.5	Pass	15	1.4	Horizontal

Table 9 Electric Field Emissions Peaks IEEE 802.11n, 1GHz to 10GHz – Operation on 2412MHz

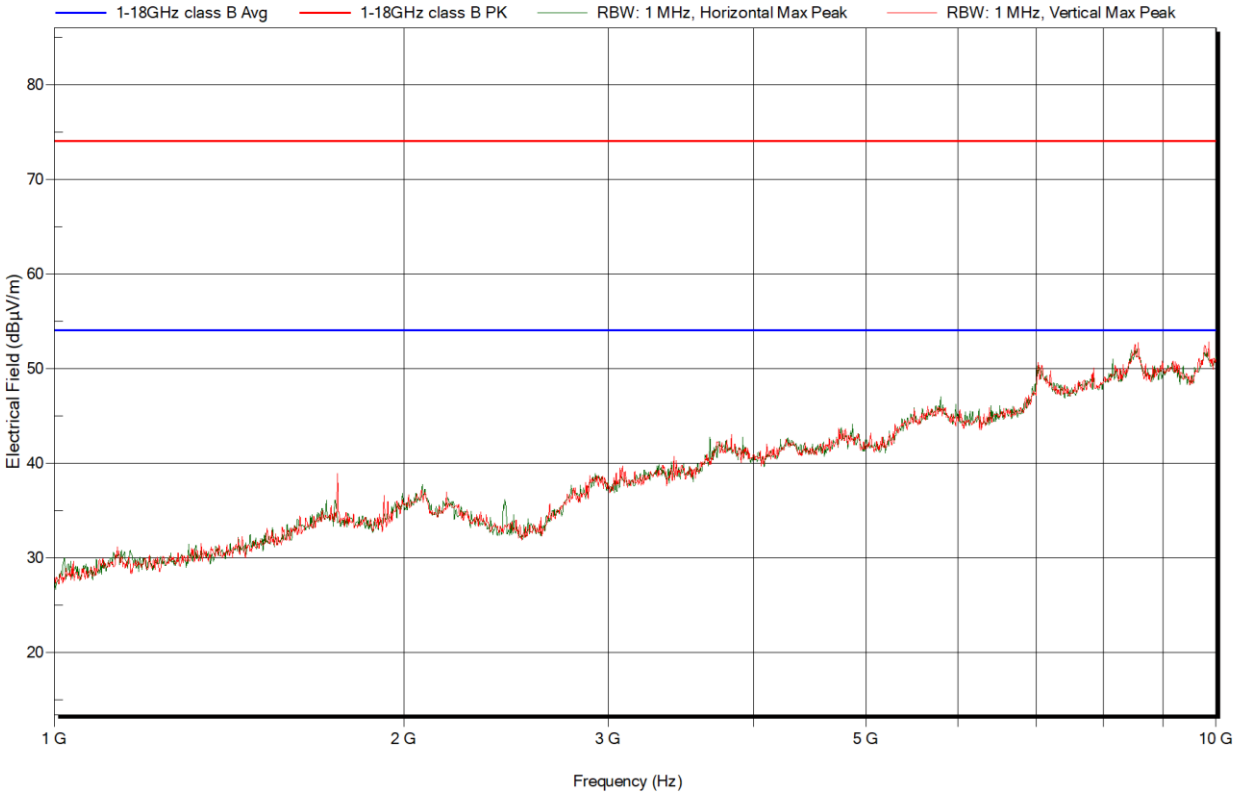


Figure 18 Electric field emissions Plot IEEE 802.11n, 1GHz to 10GHz, Operation on 2442MHz - Peak detector scan

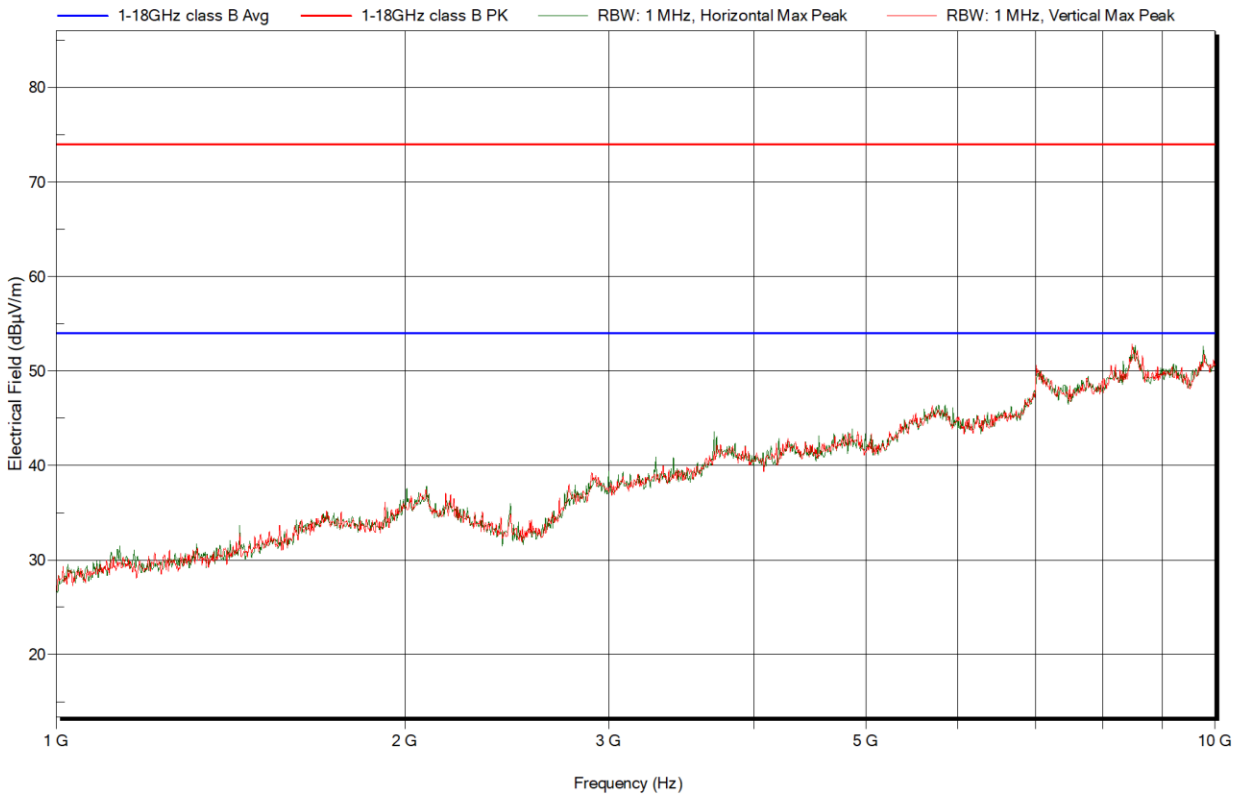


Figure 19 Electric field emissions Plot, 1GHz to 10GHz IEEE 802.11n, Operation on 2462MHz – Peak detector scan

5.4.12 Example field strength calculation

The total average corrections are shown in the above table. This correction figure consists of Preamplifier gain (PG), Antenna factor (AF); and Cable loss (CL), and where necessary distance extrapolation factor (dB).

Field strength (FS) is calculated as follows:

FS (dBµV/m) = Indicated Signal Level (dBµV) - PG (dB) + AF (dB) + CL (dB)

5.4.13 Sample Data

From Figure 17 and table 9, The Average level at 9.225GHz is calculated as follows:

FS (dBµV/m) = 42.93(dBµV) – 53.43(dB) + 40.11(dB) + 7.89 (dB) = 37.5dBµV/m

5.5 Radiated Emissions (18GHz to 26GHz)

5.5.1 Limits

Frequency (GHz)	Limit (dBµV/m)	Limit (dBµV/m)
	Peak	Average
18-25	74.0	54.0

5.5.2 Receiver Settings

Receiver Parameters	Setting
Detector Function	Average and Peak
Start Frequency	18GHz
Stop Frequency	25GHz
Resolution Bandwidth	1MHz
Video Bandwidth	Auto

5.5.3 Emissions measurements

5.5.4 Date of Test

8th November 2023

5.5.5 Test Area

LAB 1 (SAC)

5.5.6 Tested by

L Trickett

5.5.7 Test Setup

This is the same as for the 1-18GHz range for final measurements, except with a measurement distance of 1m.

5.5.8 Exploratory Radiated Emission Maximization

During exploratory testing, suspect emissions from the EUT were identified both in terms of the frequency and directionality. This was achieved by manually positioning the antenna close to the EUT and also by scanning it over all sides of the EUT whilst observing a spectral display. The typical distance between the surface of the EUT and the scanning antenna was circa 30cm.

Frequency (GHz)	Mode of operation	EUT face *	Emissions Angle (w.r.t. turntable)	Height	Polarization
-	Tx on channels 2402MHz, 2440MHz and 2480MHz.	-	-	-	-

Table 10 Frequencies identified during Exploratory Radiated Emission maximization

Note 1: The front face of the EUT is deemed to be 0°, which is then turned in a clockwise direction through 360°.

Note 2: No emissions were identified for further investigation above 18GHz.

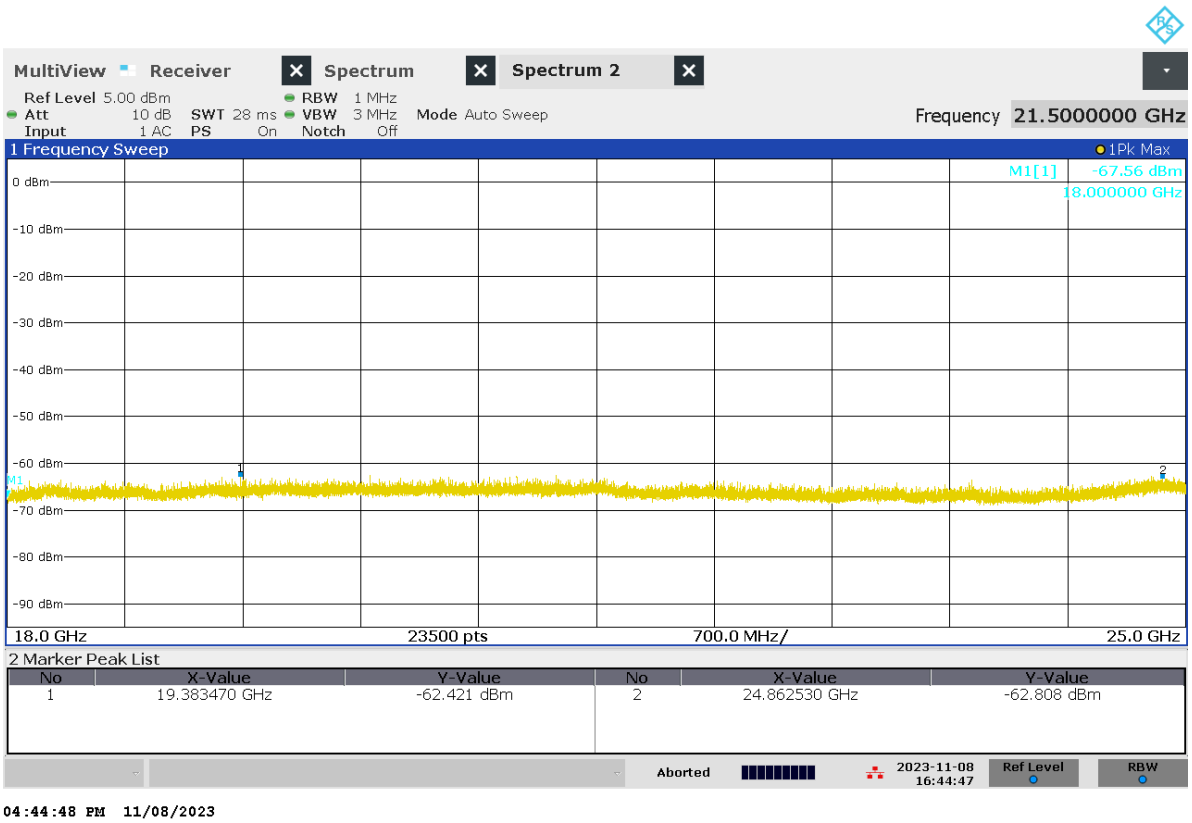


Figure 20 – manual investigation – Operating on IEEE 802.11b channel 2412MHz

Figure 21 – manual investigation – Operating on IEEE 802.11b channel 2442MHz

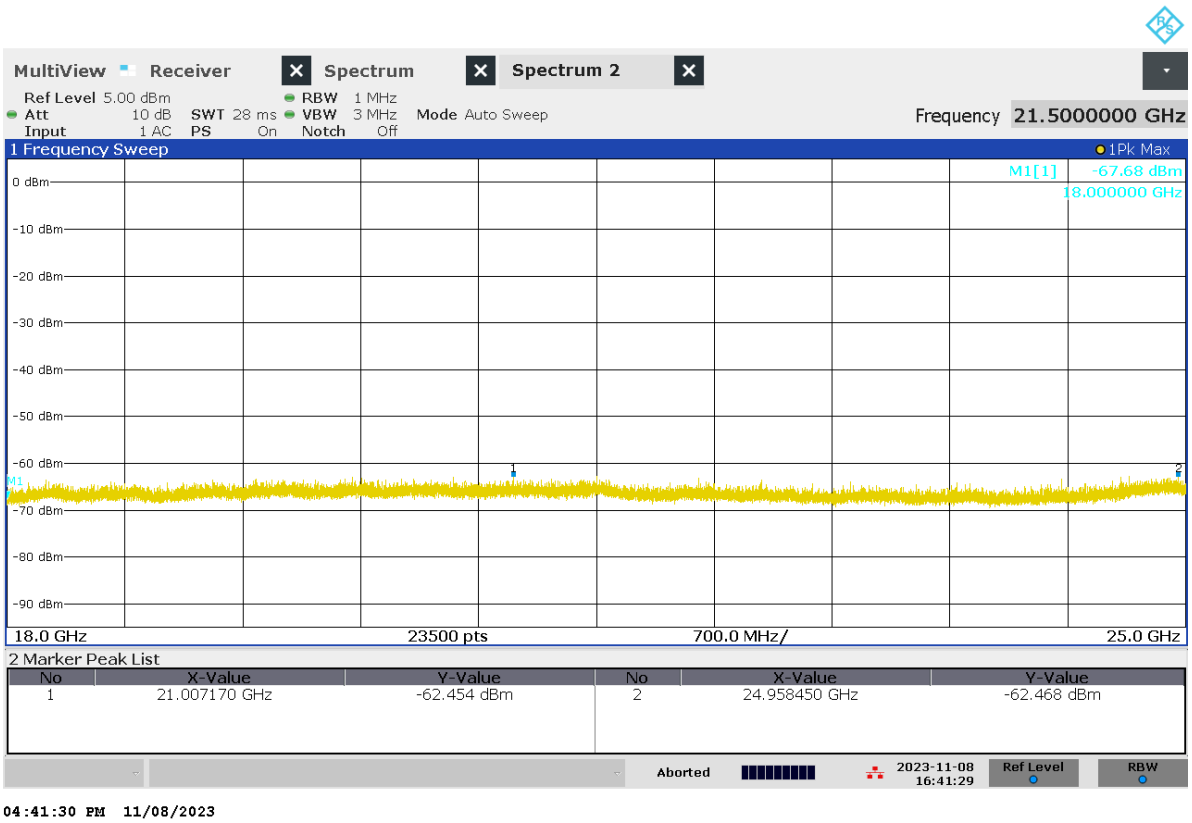


Figure 22 – manual investigation – Operating on IEEE 802.11b channel 2462MHz

Figure 23 – manual investigation – Operating on IEEE 802.11g channel 2412GHz

Figure 24 – manual investigation – Operating on IEEE 802.11g channel 2442MHz

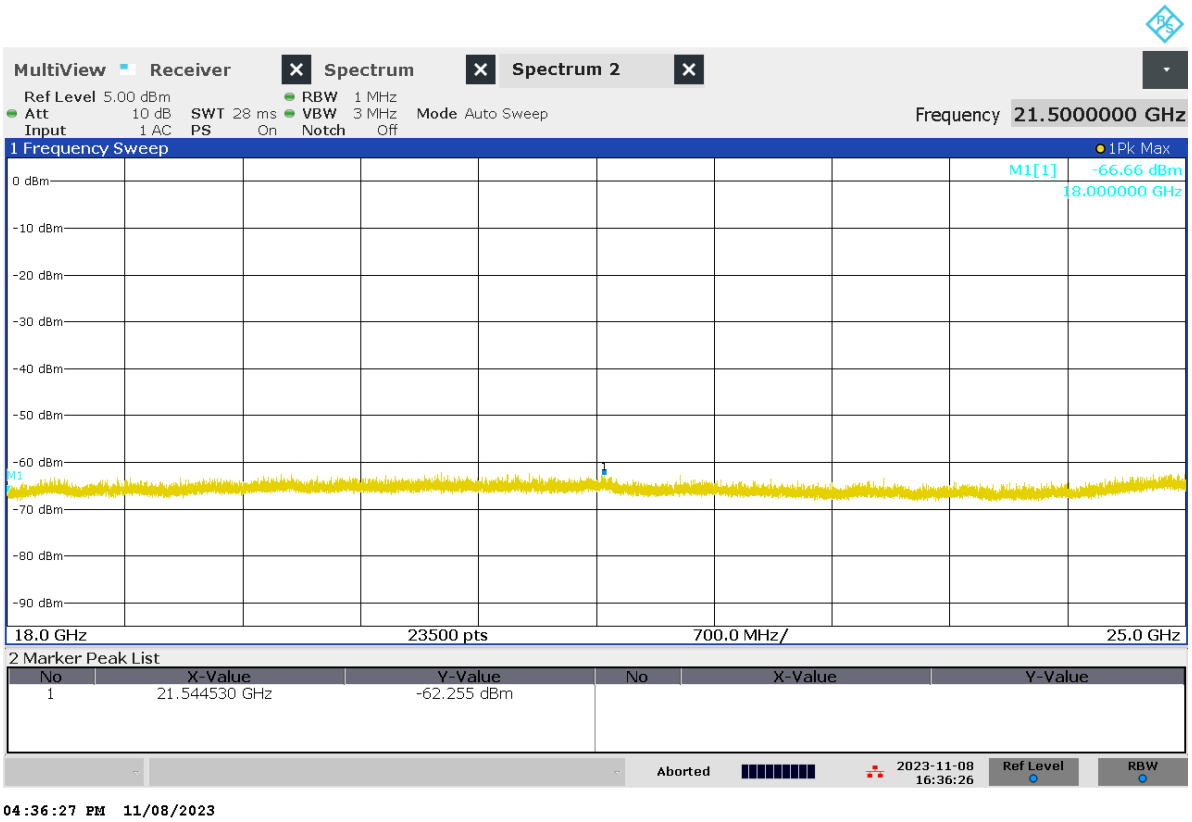


Figure 25 – manual investigation – Operating on IEEE 802.11g channel 2462MHz

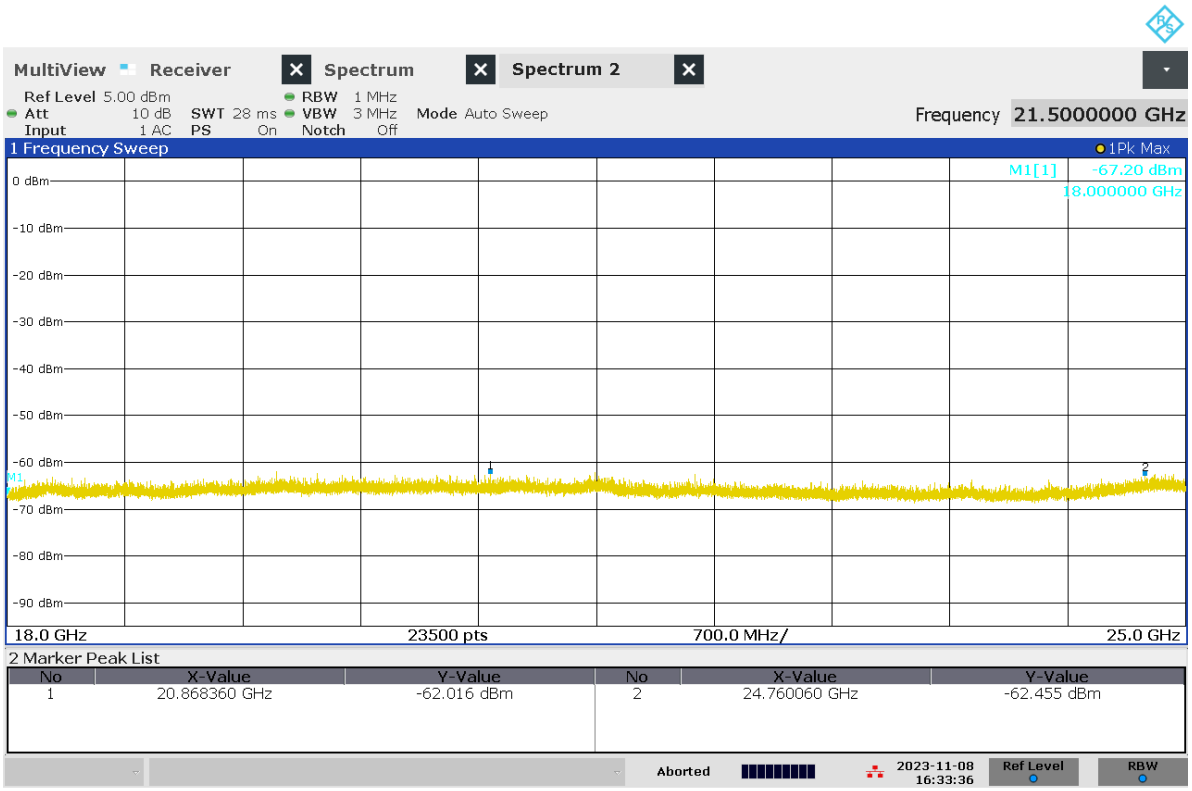


Figure 26 – manual investigation – Operating on IEEE 802.11n channel 2412MHz

Figure 27 – manual investigation – Operating on IEEE 802.11n channel 2442MHz

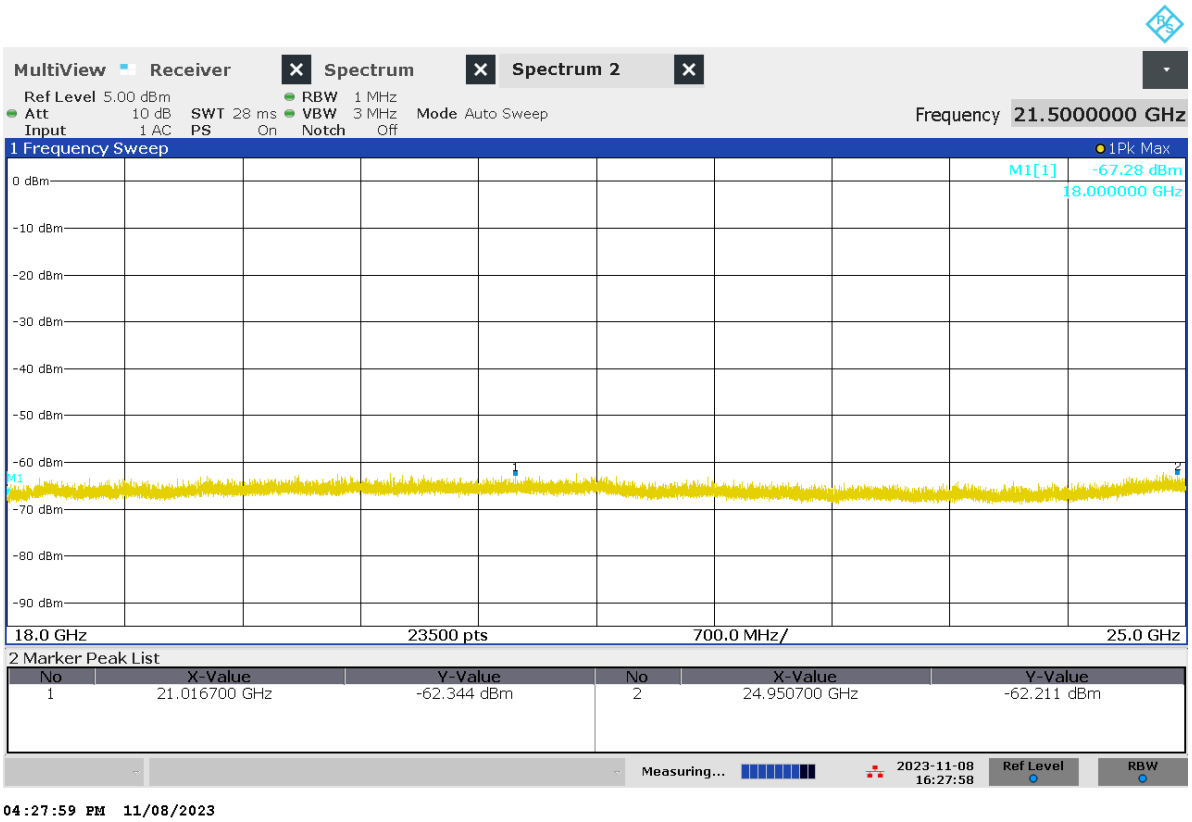


Figure 28 – manual investigation – Operating on IEEE 802.11n channel 2462MHz

5.6 Conducted Spurious Emissions 30MHz to 25GHz

5.6.1 Limits

Frequency (MHz)	Limit, 47CFR 15.247(d)
	Peak
30 – 25000	-20dBc

Spectrum analyser settings as specified by ANSI C63.10-2013 Clause 11.11.2

Receiver Parameters	Setting
Detector Function	Peak
Start Frequency	30MHz
Stop Frequency	25000MHz
Resolution Bandwidth	100kHz
Video Bandwidth	300kHz
Sweep rate	Auto couple
Trace mode	Max hold

5.6.2 Emissions measurements

5.6.3 Date of Test

28th November 2023

5.6.4 Test Area

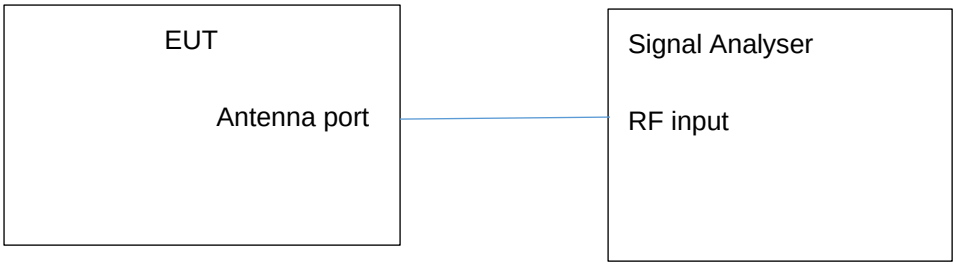
LAB 5

5.6.5 Tested by

L Trickett

5.6.6 Test Setup

The antenna port was connected directly to the signal analyser.



5.6.7 Test Results

The results of the conducted spurious emissions are stated below and by the signal analyser images.

All disturbances detected were > 20dB below the carrier.

5.6.8 Antenna port conducted emissions IEEE 802.11b, 30MHz to 25GHz

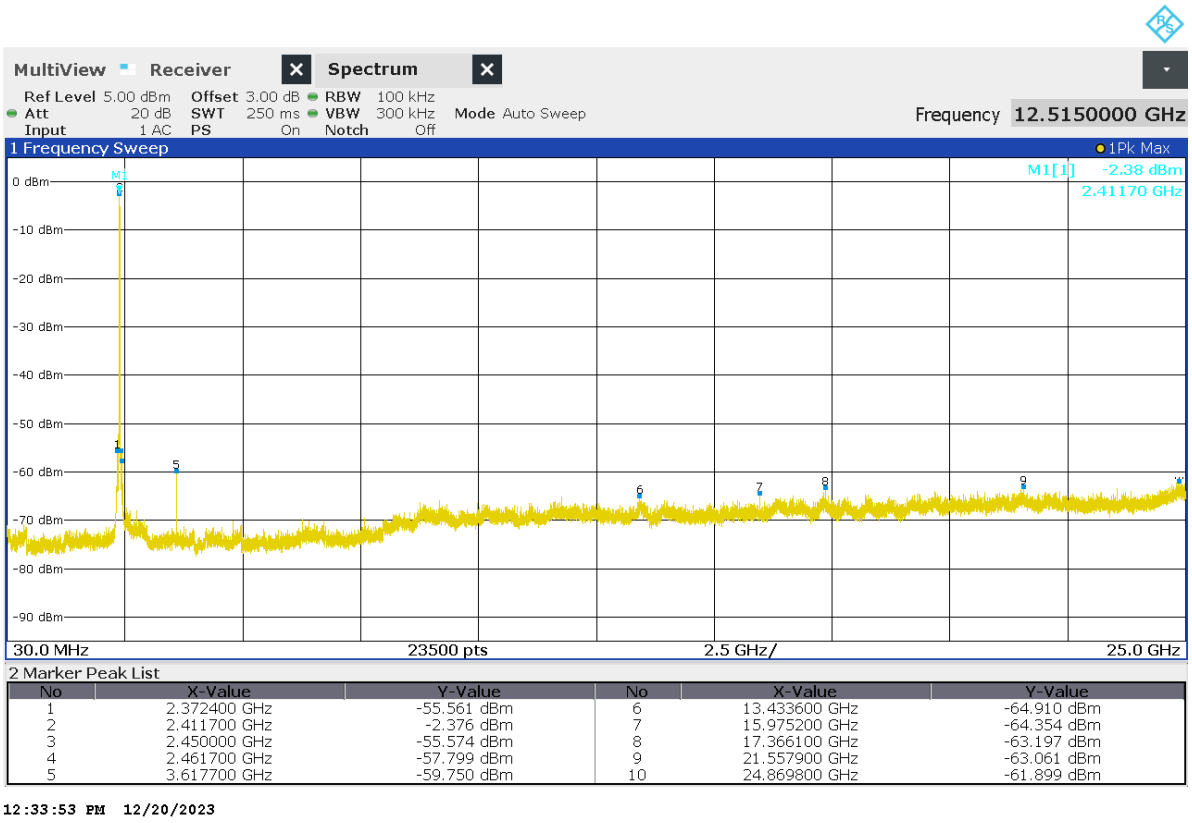


Figure 29 Conducted emissions 30MHz to 25GHz. Operation on IEEE 802.11b channel 2412MHz.

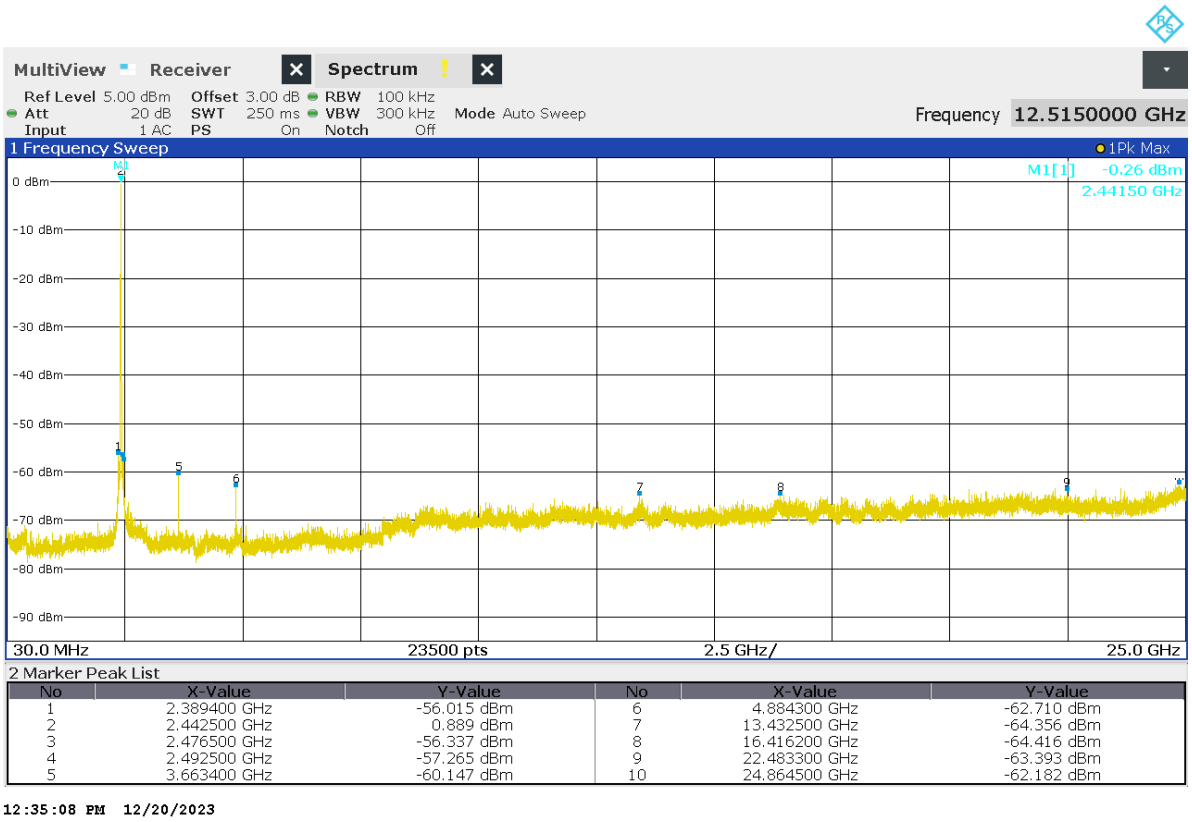


Figure 30 Conducted emissions 30MHz to 25GHz. Operation on IEEE 802.11b channel 2442MHz.

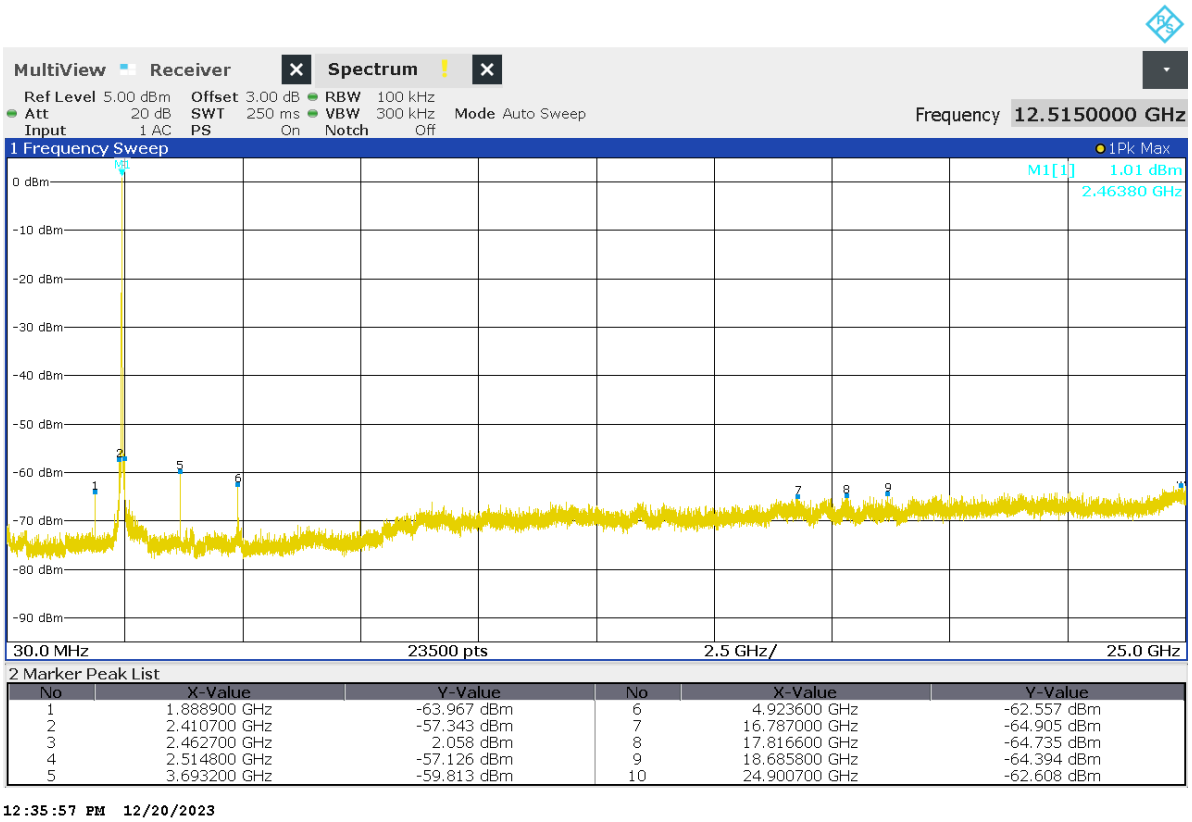


Figure 31 Conducted emissions 30MHz to 25GHz. Operation on IEEE 802.11b channel 2462MHz.

5.6.9 Antenna port conducted emissions IEEE 802.11g, 30MHz to 25GHz

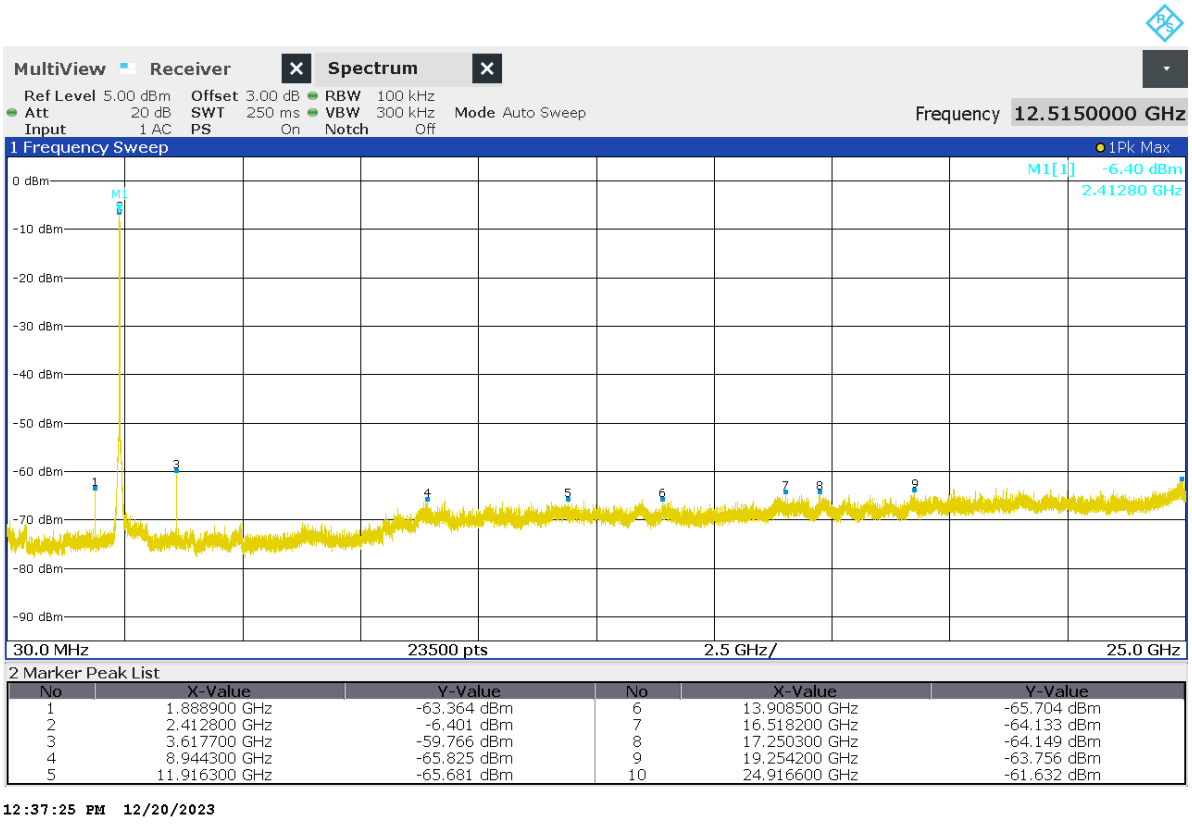


Figure 32 Conducted emissions 30MHz to 25GHz. Operation on IEEE 802.11g channel 2412MHz.

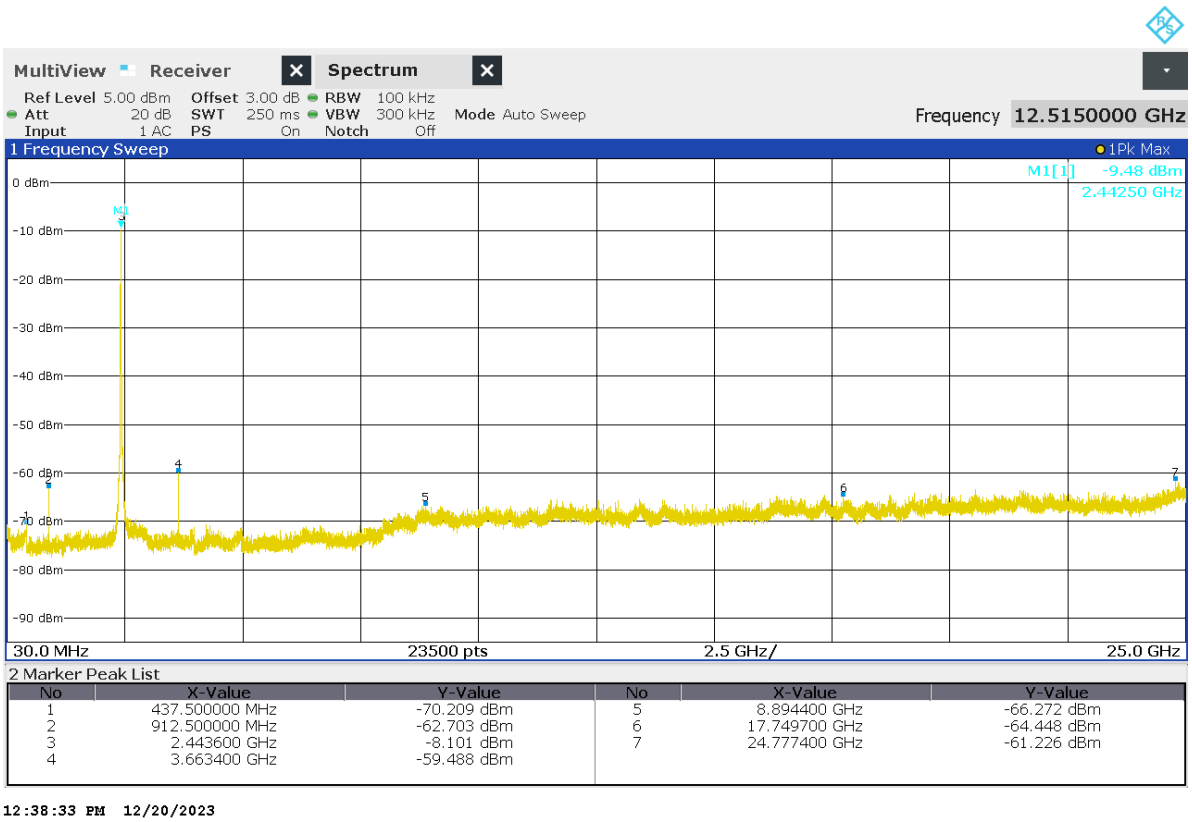


Figure 33 Conducted emissions 30MHz to 25GHz. Operation on IEEE 802.11g channel 2442MHz.

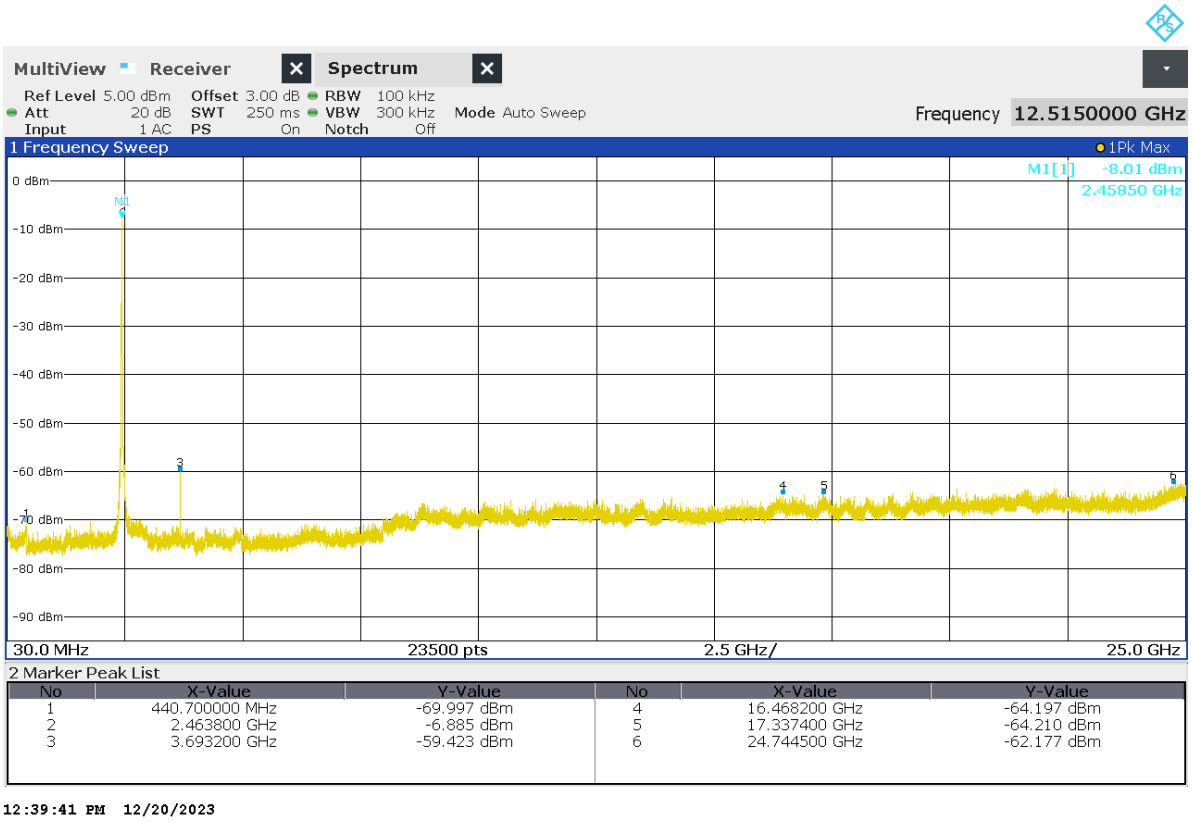


Figure 34 Conducted emissions 30MHz to 25GHz. Operation on IEEE 802.11g channel 2462MHz.

5.6.10 Antenna port conducted emissions IEEE 802.11n, 30MHz to 25GHz

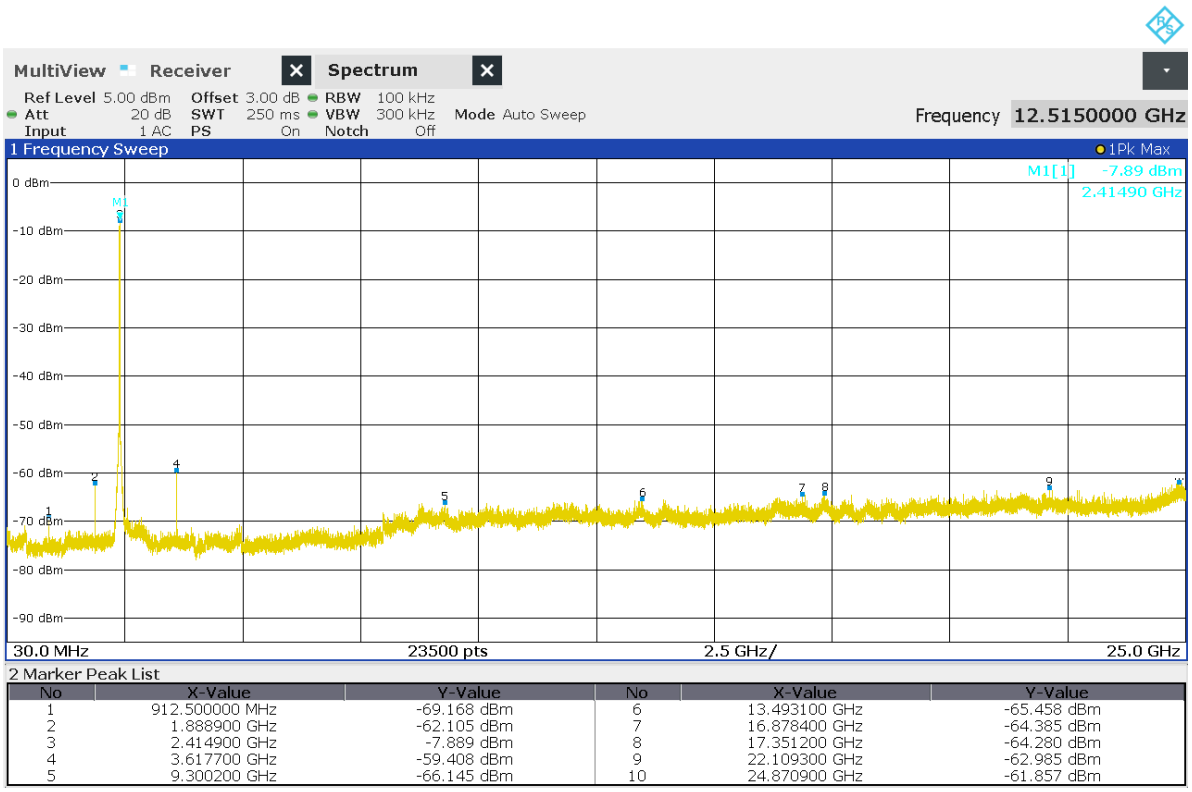


Figure 35 Conducted emissions 30MHz to 25GHz. Operation on IEEE 802.11n channel 2412MHz.

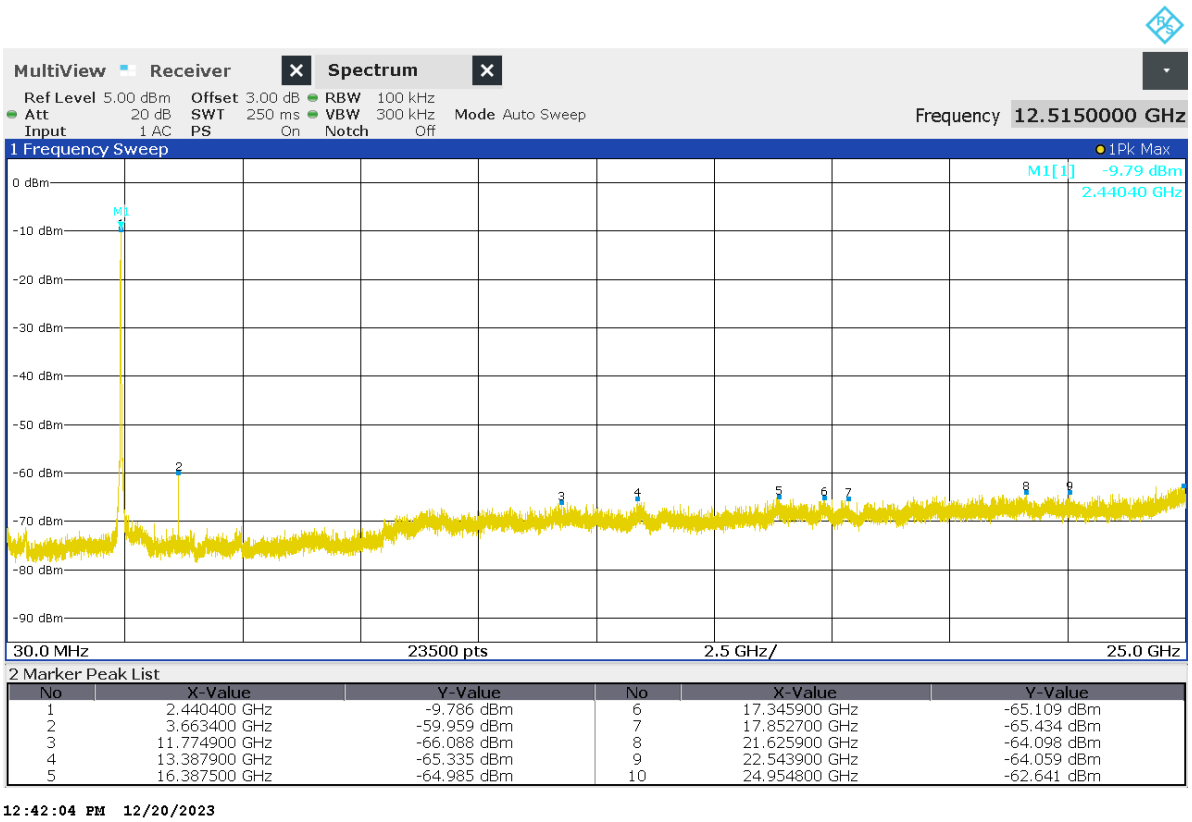


Figure 36 Conducted emissions 30MHz to 25GHz. Operation on IEEE 802.11n channel 2442MHz.

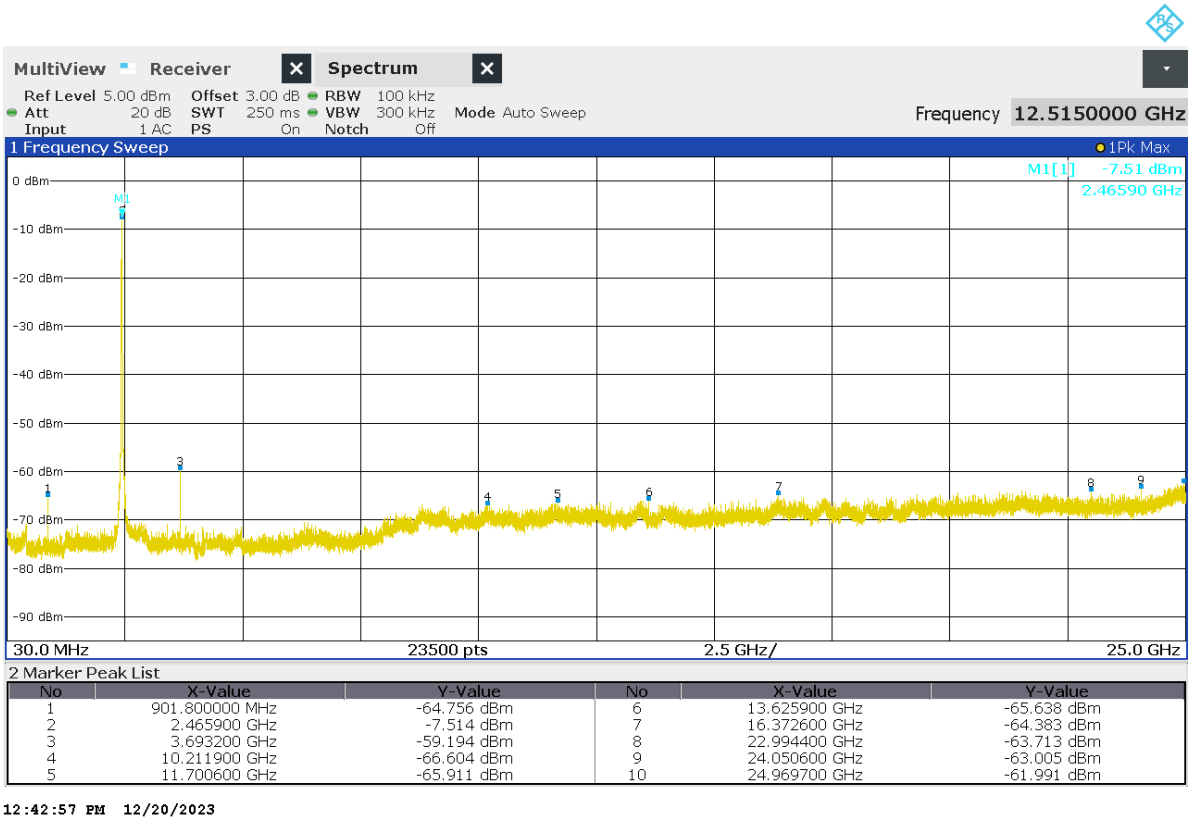


Figure 37 Conducted emissions 30MHz to 25GHz. Operation on IEEE 802.11n channel 2462MHz.

Section 6 6dB Bandwidth and 99% Occupied Bandwidth

6.1 Test Specification

FCC Rule Part	46CFR 15.247 (b)(2)
Standard	ANSI C63.10:2013
Measurement Uncertainty Frequency tests	$\pm 9x10^{-8}$

6.2 Procedure and Test Software Version

Conducted Tests

ANSi C63.10-2013 Clause reference:	11.9.1.1 (RBW>DTS bandwidth)
Test software	N/A

Frequency (MHz)	Limit, 47CFR 15.247(a)(2) 6dB bandwidth
	Peak
2400MHz to 2483.5MHz	At least 500kHz

Spectrum analyser settings as specified by ANSI C63.10-2013 Clause 11.8.1

Receiver Parameters	Setting
Detector Function	Peak
Span	30MHz
Resolution Bandwidth	100kHz
Video Bandwidth	300kHz
Sweep rate	Auto couple
Trace mode	Max hold

6.2.1 Emissions measurements

6.2.2 Date of Test

28th November 2023

6.2.3 Test Area

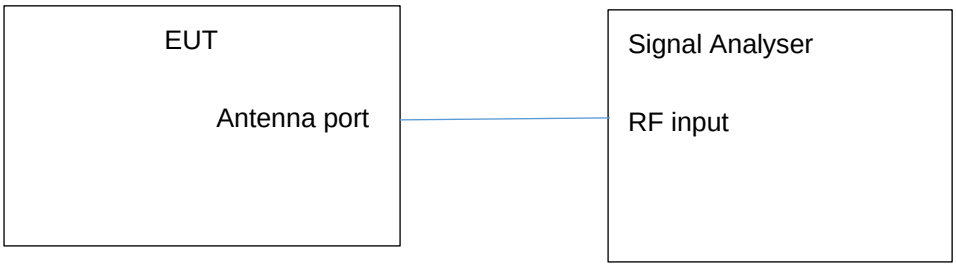
LAB 5

6.2.4 Tested by

L Trickett

6.2.5 Test Setup

The antenna port was connected directly to the signal analyser.



6.2.6 Test Results

The results of the 6dB bandwidth measurements are stated in the table below and by the signal analyser images.

Channel (MHz)	99% Occupied Bandwidth (MHz)	Measured 6dB bandwidth (kHz)	Minimum requirement (kHz)	Figure	Result
2412.0	14.066	9023	500.0	38 & 41	Pass
2442.0	14.171	9068	500.0	39 & 42	Pass
2462.0	14.164	9052	500.0	40 & 43	Pass

Table 11 IEEE 802.11b Bandwidth Measurements

Channel (MHz)	99% Occupied Bandwidth (MHz)	Measured 6dB bandwidth (kHz)	Minimum requirement (kHz)	Figure	Result
2412.0	16.499	16307	500.0	44 & 47	Pass
2442.0	16.424	15288	500.0	45 & 48	Pass
2462.0	16.537	15529	500.0	46 & 49	Pass

Table 12 IEEE 802.11g Bandwidth Measurements

Channel (MHz)	99% Occupied Bandwidth (MHz)	Measured 6dB bandwidth (kHz)	Minimum requirement (kHz)	Figure	Result
2412.0	17.514	15068	500.0	50 & 53	Pass
2442.0	17.805	15648	500.0	51 & 54	Pass
2462.0	17.486	15061	500.0	52 & 55	Pass

Table 13 IEEE 802.11n Bandwidth Measurements

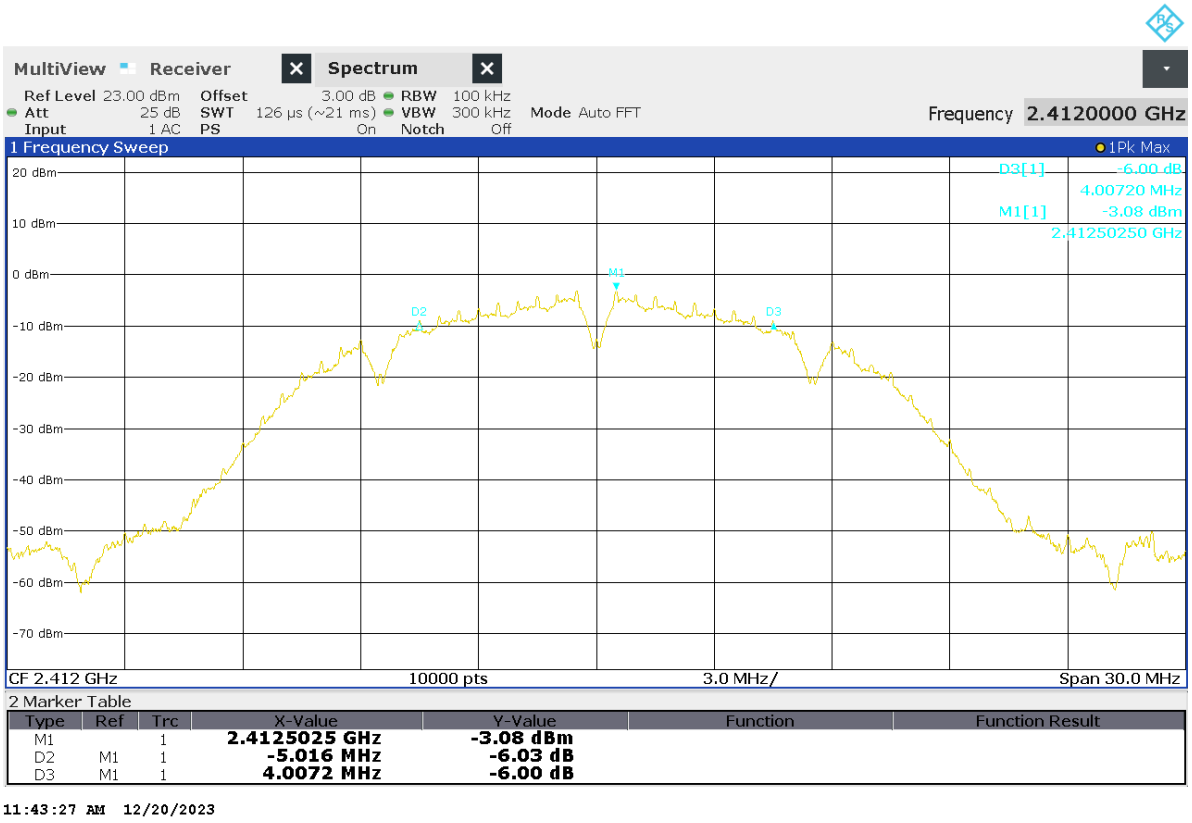


Figure 38 Bandwidth at 6dB Point. Operation on IEEE 802.11b channel 2412MHz

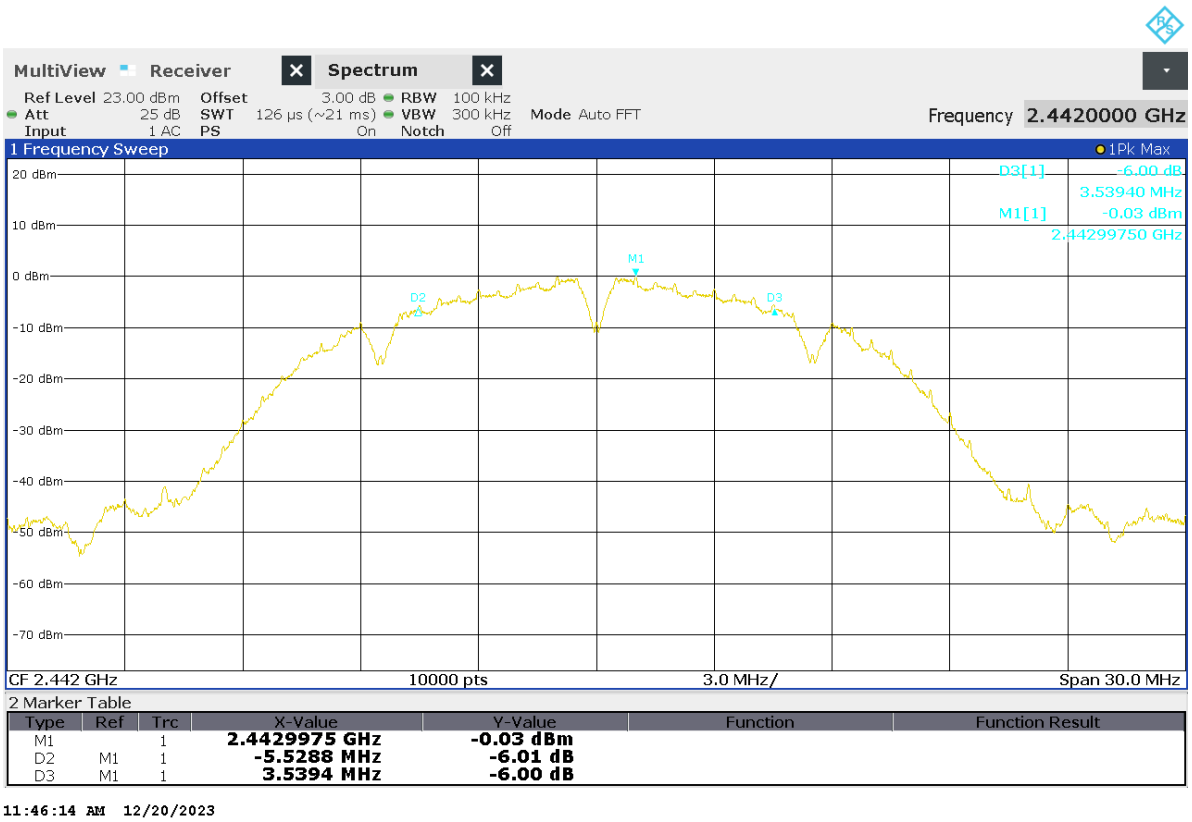


Figure 39 Bandwidth at 6dB Point. Operation on IEEE 802.11b channel 2442MHz

Figure 40 Bandwidth at 6dB Point. Operation on IEEE 802.11b channel 2462MHz

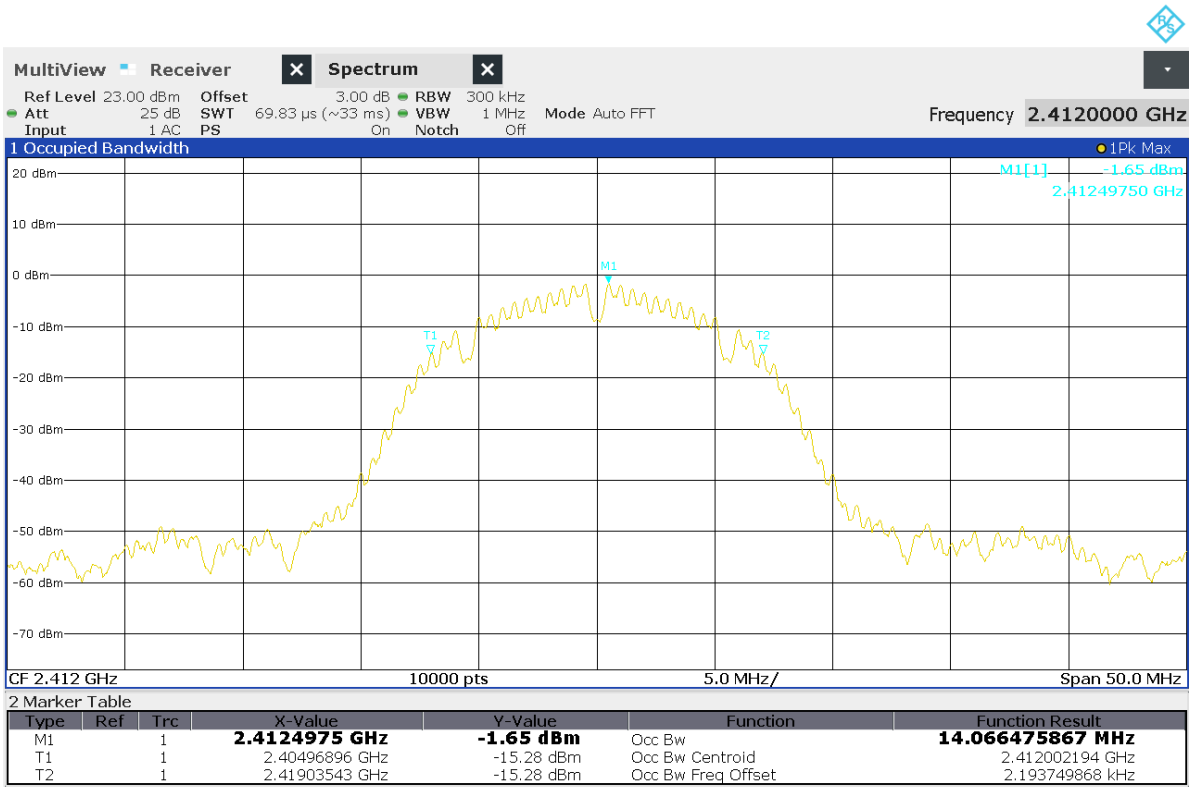


Figure 41 99% Occupied Bandwidth. Operation on IEEE 802.11b channel 2412MHz

Figure 42 99% Occupied Bandwidth. Operation on IEEE 802.11b channel 2442MHz

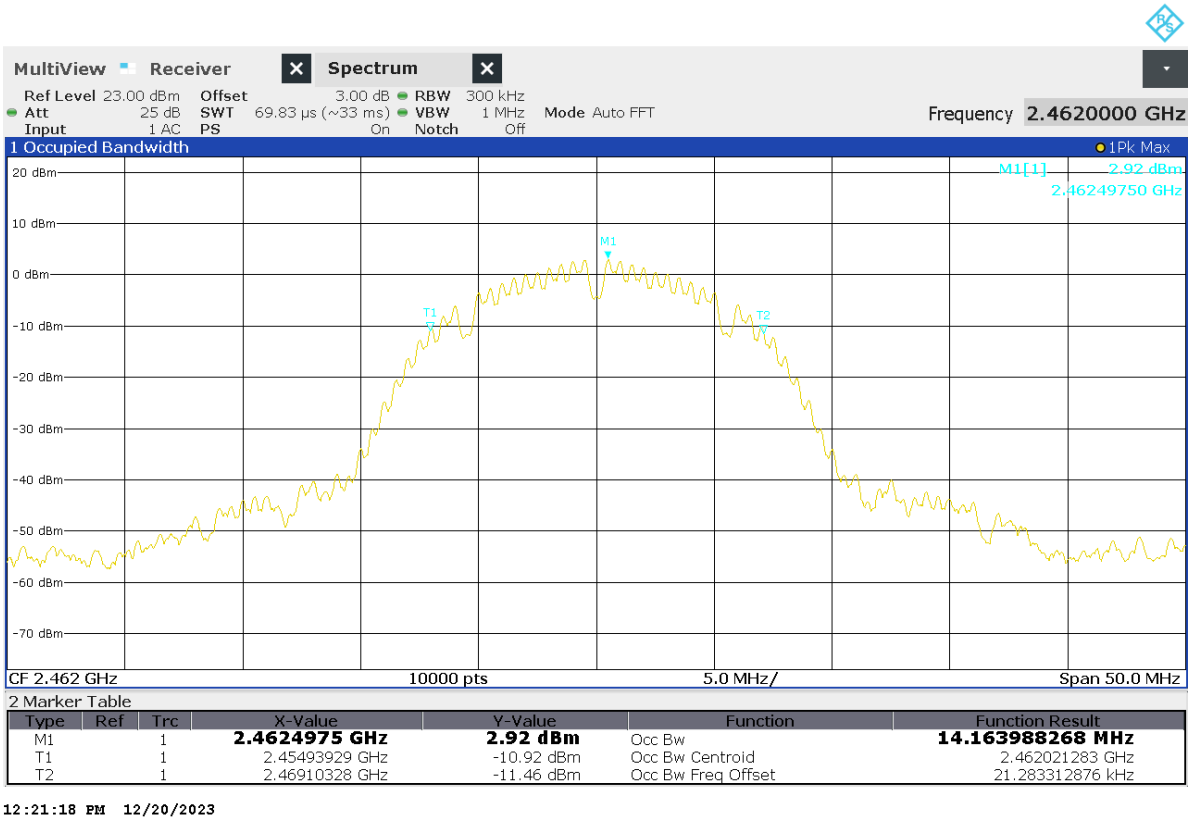


Figure 43 99% Occupied Bandwidth. Operation on IEEE 802.11b channel 2462MHz

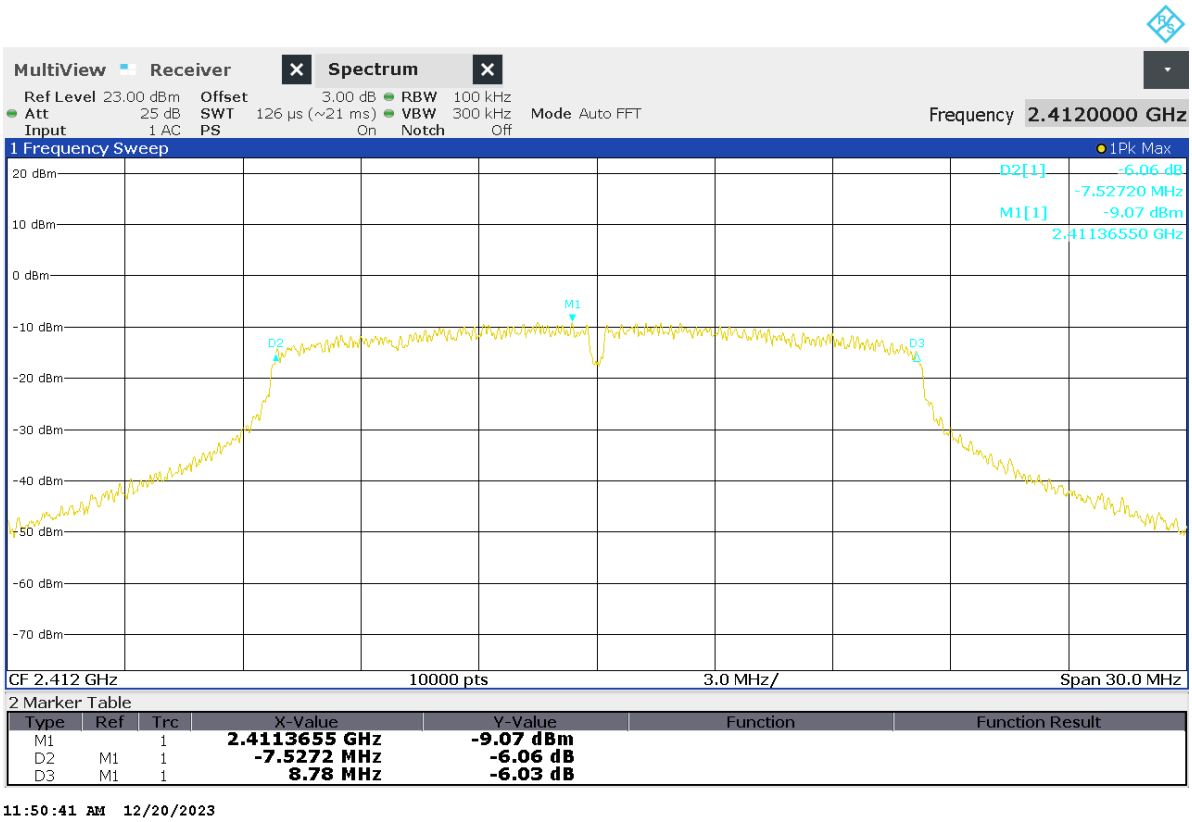


Figure 44 Bandwidth at 6dB Point. Operation on IEEE 802.11g channel 2412MHz

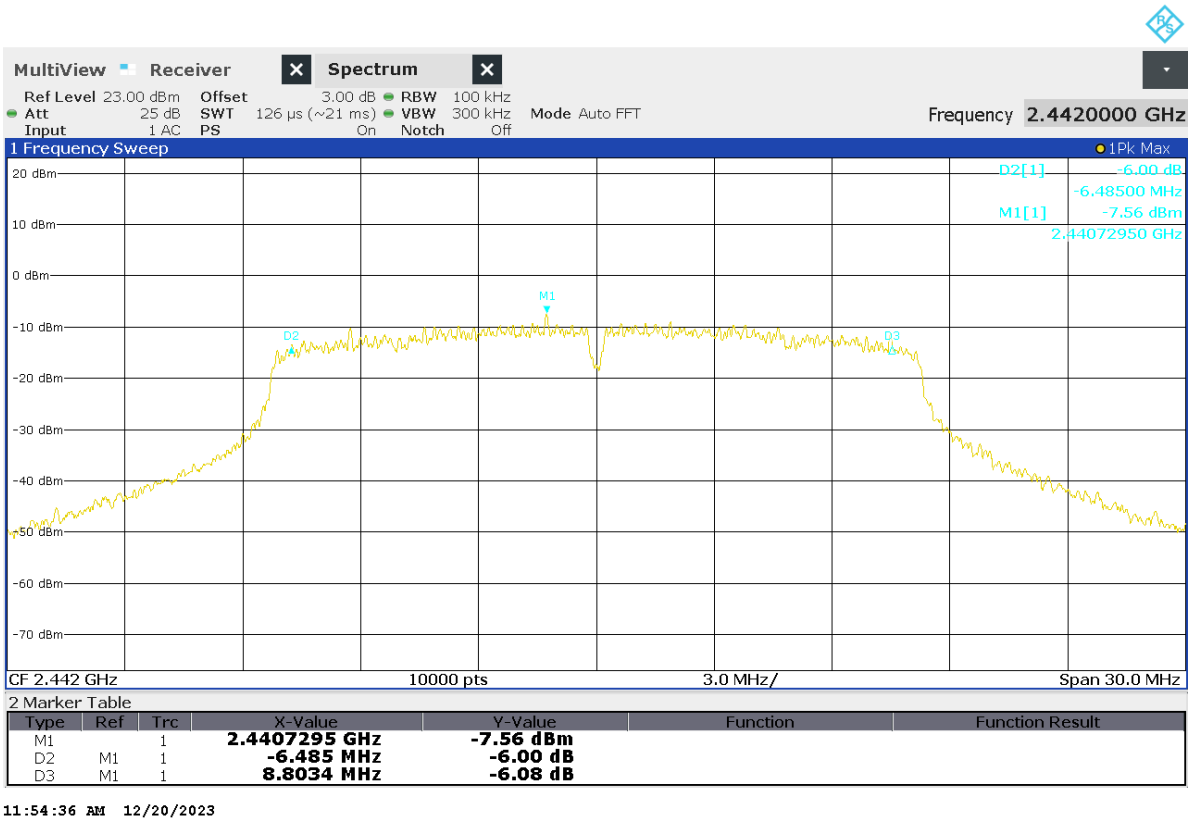


Figure 45 Bandwidth at 6dB Point. Operation on IEEE 802.11g channel 2442MHz

Figure 46 Bandwidth at 6dB Point. Operation on IEEE 802.11g channel 2462MHz

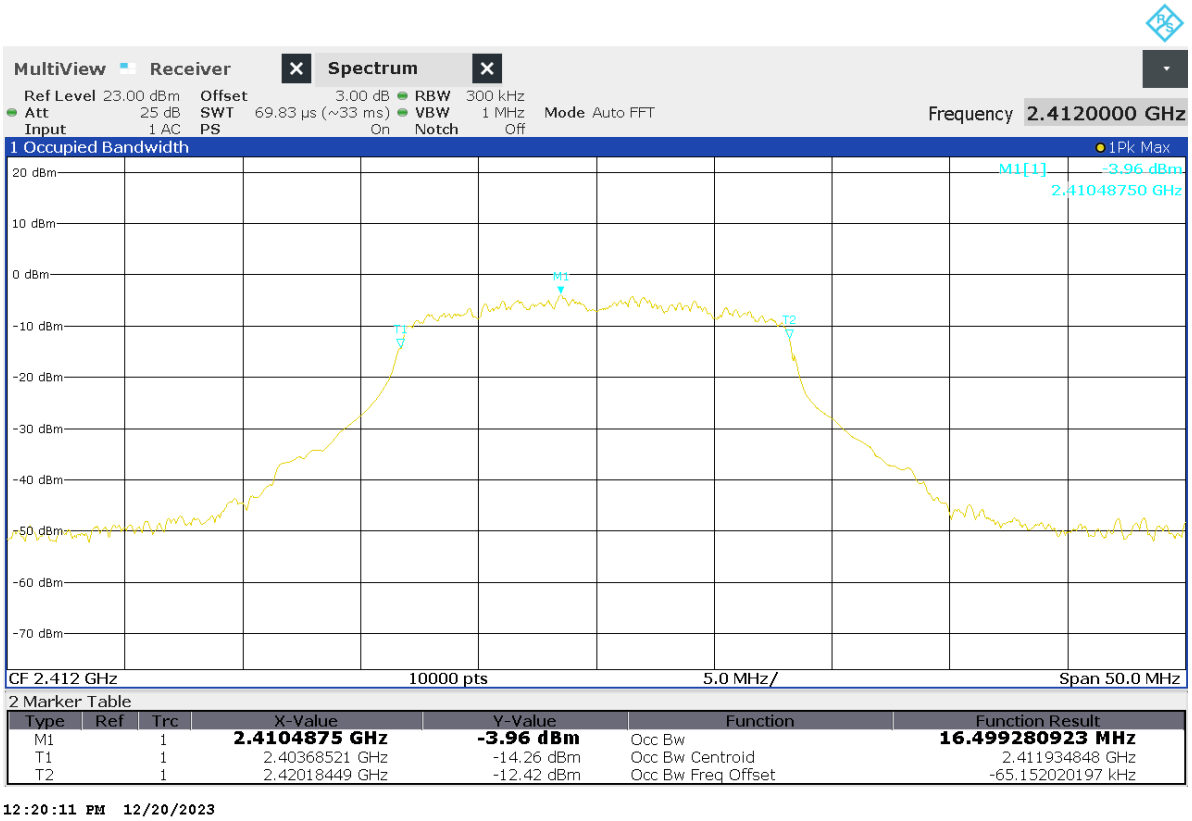


Figure 47 99% Occupied Bandwidth. Operation on IEEE 802.11g channel 2412MHz

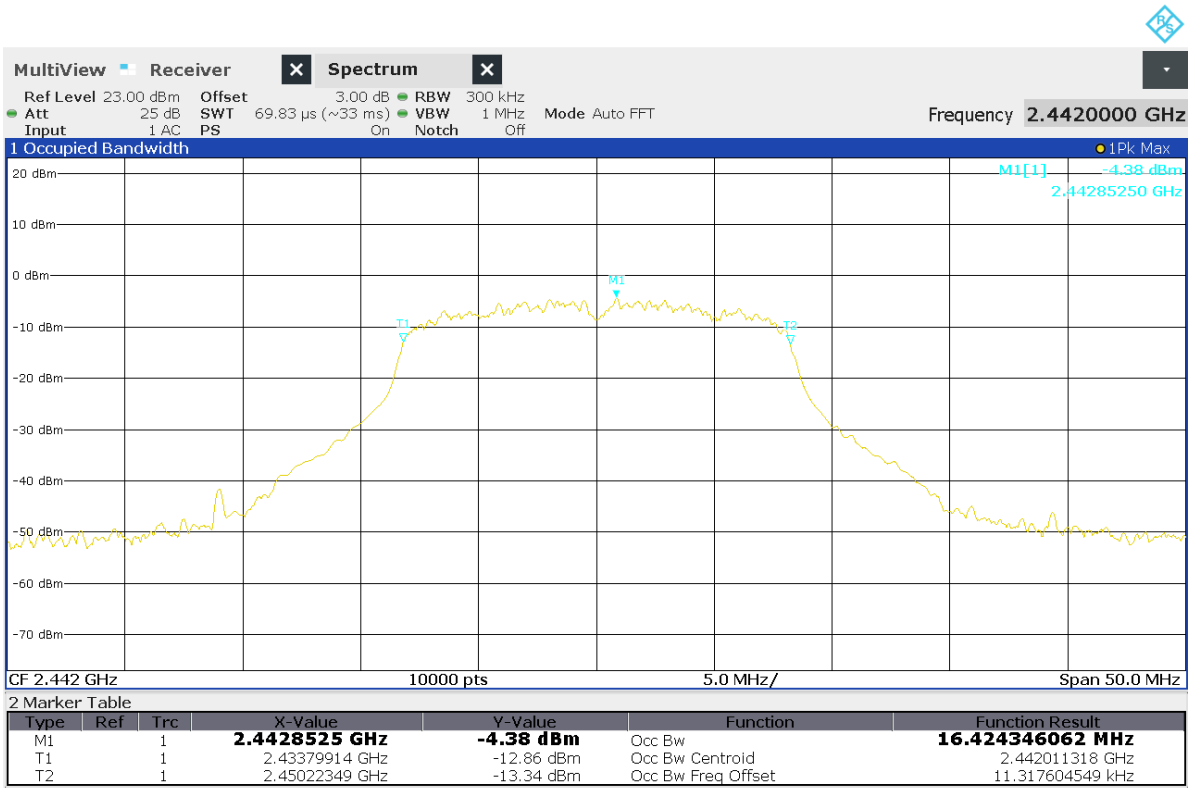


Figure 48 99% Occupied Bandwidth. Operation on IEEE 802.11g channel 2442MHz

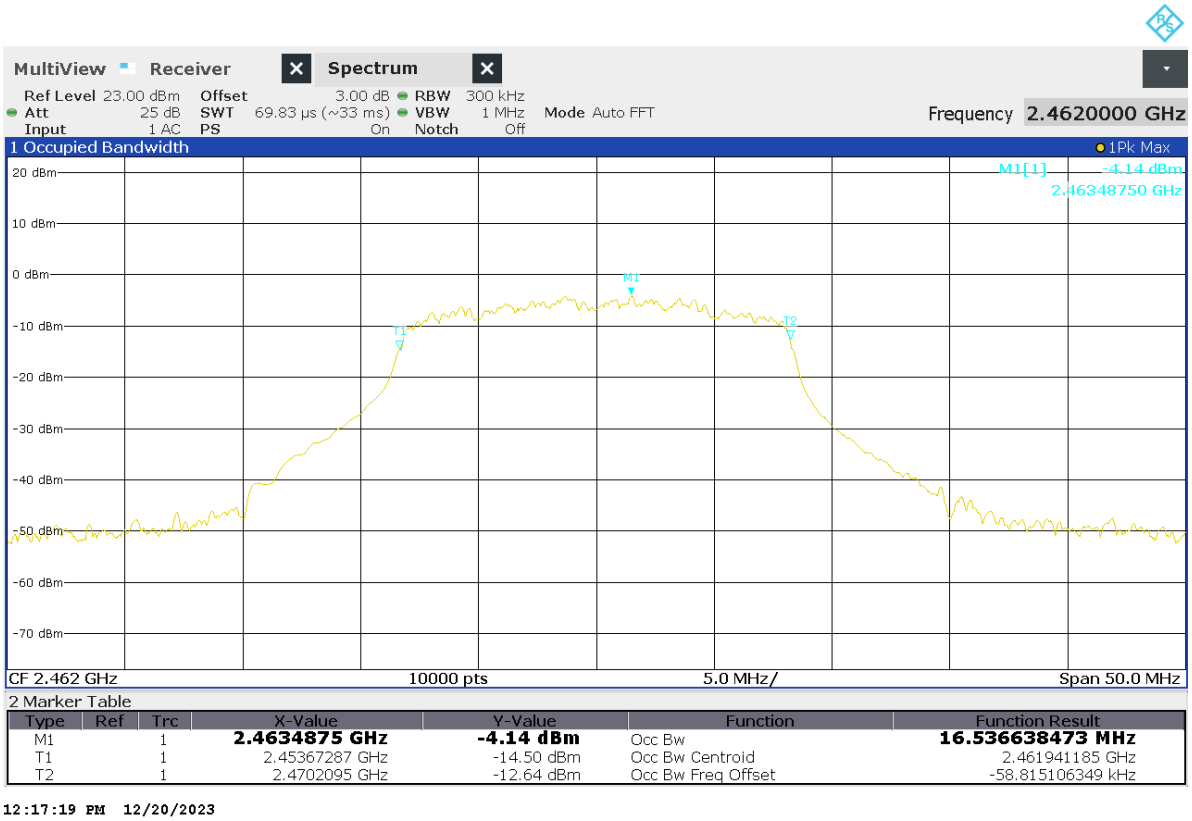


Figure 49 99% Occupied Bandwidth. Operation on IEEE 802.11g channel 2462MHz

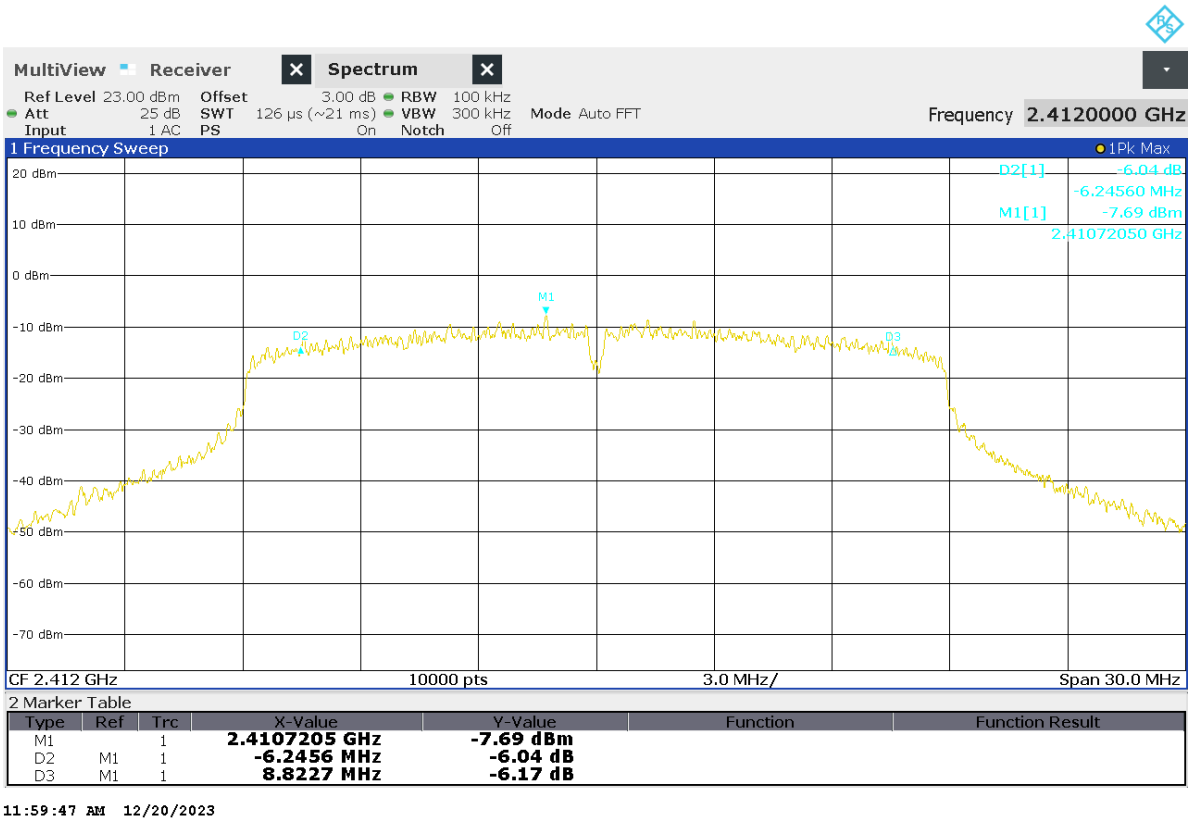


Figure 50 Bandwidth at 6dB Point. Operation on IEEE 802.11n channel 2412MHz

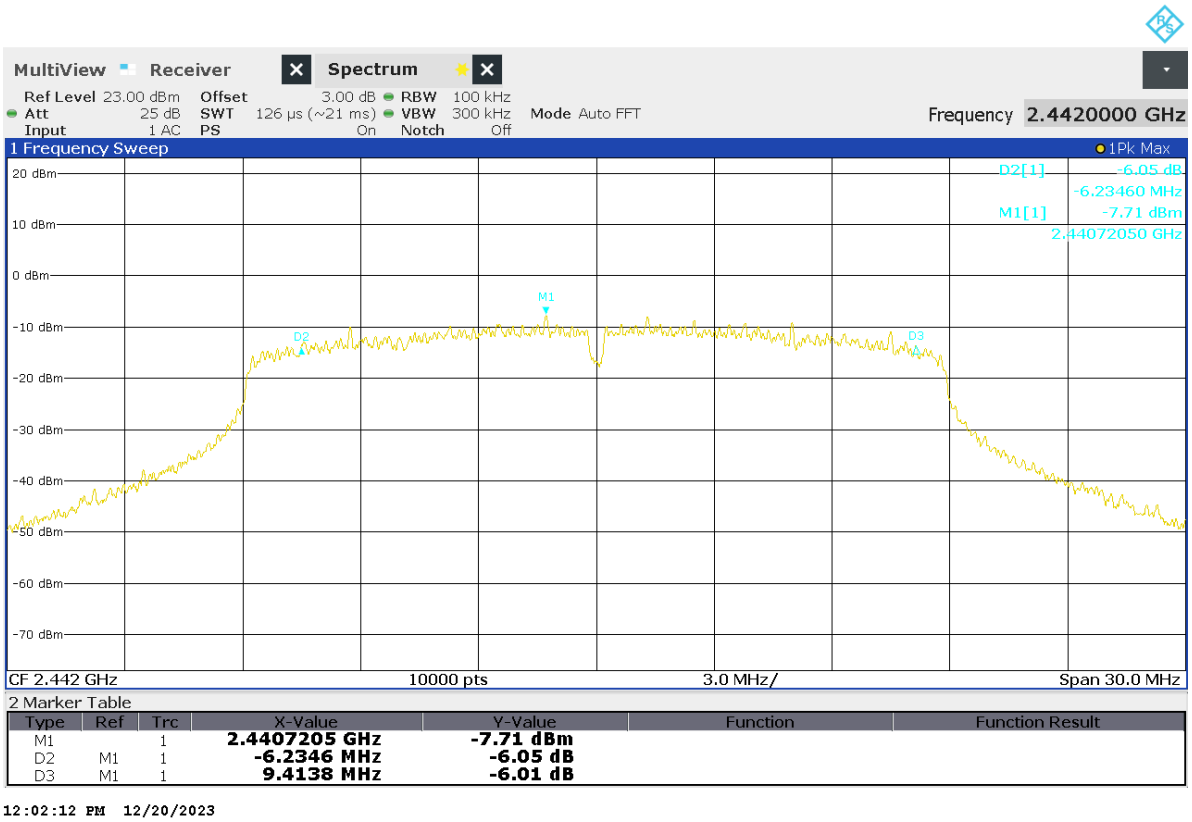


Figure 51 Bandwidth at 6dB Point. Operation on IEEE 802.11n channel 2442MHz

Figure 52 Bandwidth at 6dB Point. Operation on IEEE 802.11n channel 2462MHz

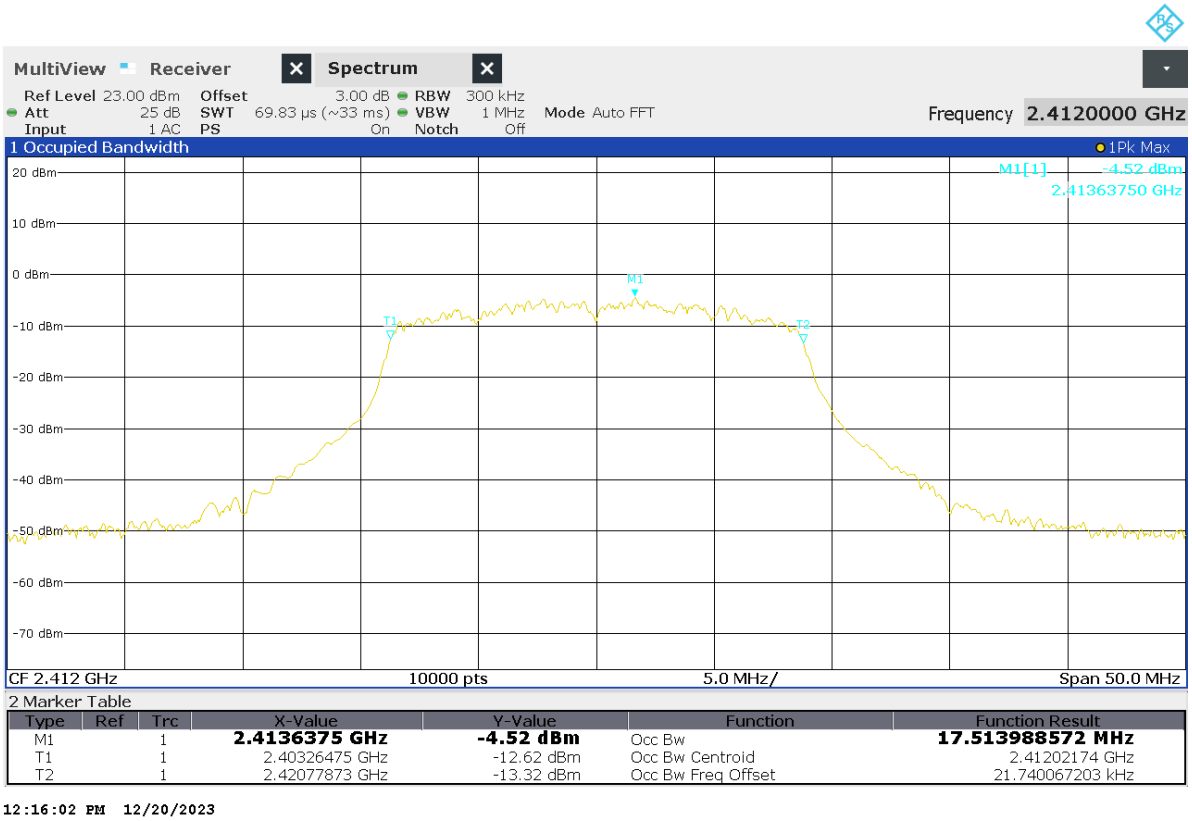


Figure 53 99% Occupied Bandwidth. Operation on IEEE 802.11n channel 2412MHz

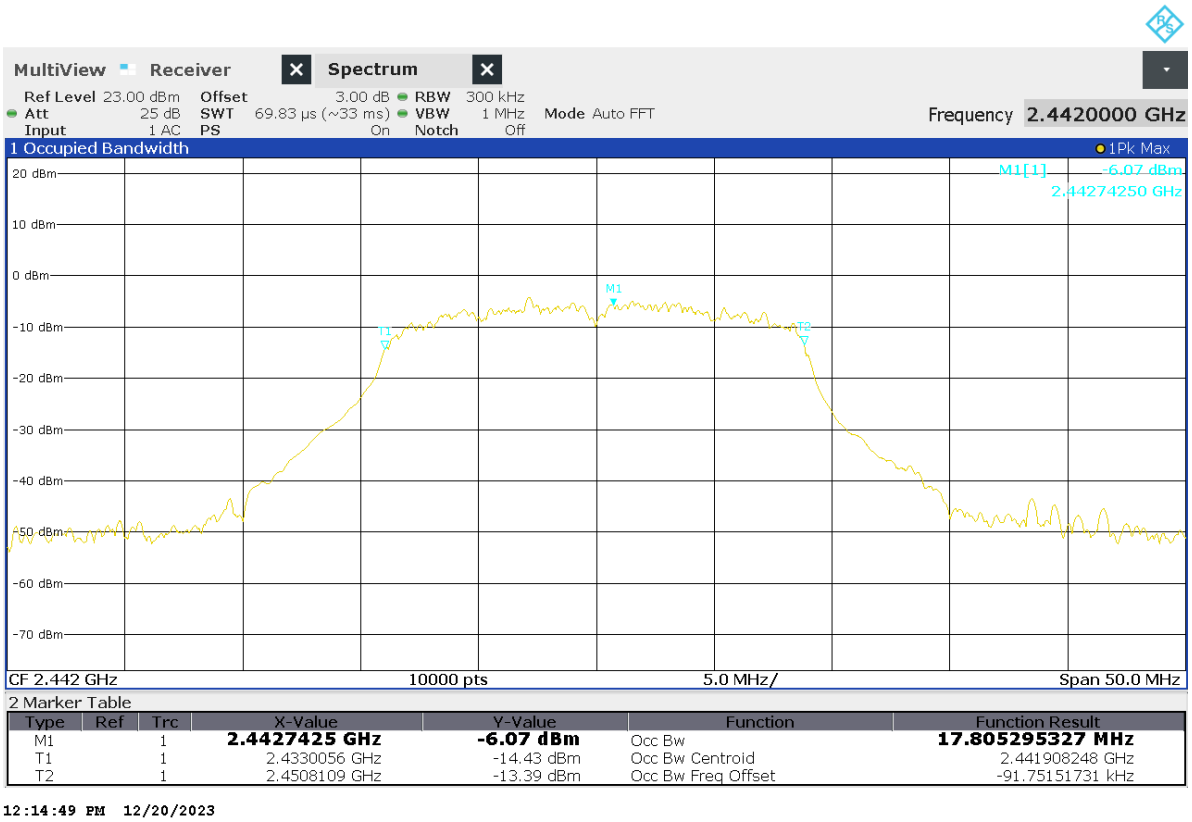


Figure 54 99% Occupied Bandwidth. Operation on IEEE 802.11n channel 2442MHz

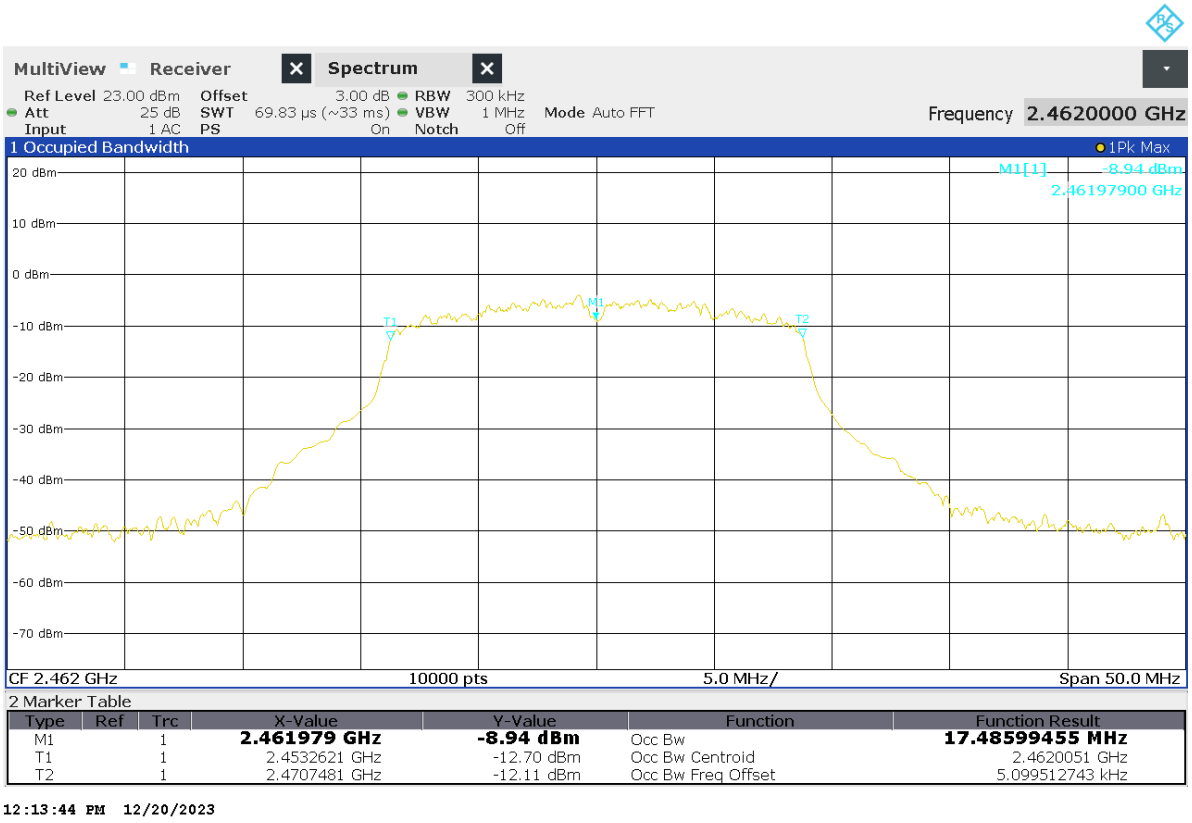


Figure 55 99% Occupied Bandwidth. Operation on IEEE 802.11n channel 2462MHz

Section 7 Peak Output Power

7.1 Test Specification

FCC Rule Part	46CFR 15.247 (b)(3)
Standard	ANSI C63.10:2013
Measurement Uncertainty Conducted Power tests	±1.4dB

7.2 Procedure and Test Software Version

Conducted Tests

ANSi C63.10-2013 Clause reference:	11.9.1.1 (RBS>DTS bandwidth)
Test software	N/A

Frequency (MHz)	Limit, 47CFR 15.247(b)(2)
	Peak
2400MHz to 2483.5MHz	1 watt

Spectrum analyser settings as specified by ANSI C63.10-2013 Clause 11.11.2

Receiver Parameters	Setting
Detector Function	Peak
Span	100MHz
Resolution Bandwidth	20MHz
Video Bandwidth	80MHz
Sweep rate	Auto couple
Trace mode	Max hold

7.2.1 Emissions measurements

7.2.2 Date of Test

28th November 2023

7.2.3 Test Area

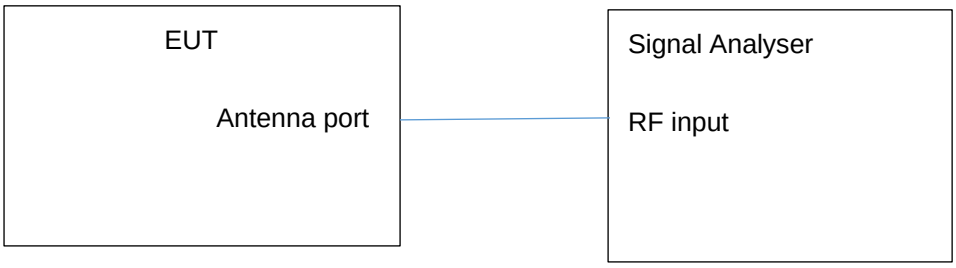
LAB 5

7.2.4 Tested by

L Trickett

7.2.5 Test Setup

The antenna port was connected directly to the signal analyser.



7.2.6 Test Result

The results of the peak output power measurements are stated in the table below and by the signal analyser images.

Modulation scheme	Channel (MHz)	Peak Power (dBm)	Peak Power (Watts)	Limit (Watts)	Figure
IEEE 802.11b	2412	8.56	0.0072	1	56
IEEE 802.11b	2442	14.60	0.0288	1	57
IEEE 802.11b	2462	14.06	0.0255	1	58
IEEE 802.11g	2412	17.03	0.0505	1	59
IEEE 802.11g	2442	15.00	0.0316	1	60
IEEE 802.11g	2462	15.98	0.0396	1	61
IEEE 802.11n	2412	15.34	0.0342	1	62
IEEE 802.11n	2442	15.11	0.0324	1	63
IEEE 802.11n	2462	15.41	0.0348	1	64

Table 14 Peak Output Power Measurements

Note: An offset was applied to the spectrum analyser prior to measurement to account for cable loss.

The MAX antenna gain is 4.2 dBi, MAX EIRP=MAX peak power *MAX antenna gain=17.03+4.2=21.23 dBm. The Max EIRP is 21.23 dBm (0.1327W) and does not exceed 4W, which meets the EIRP requirement of RSS-247 section 5.4.

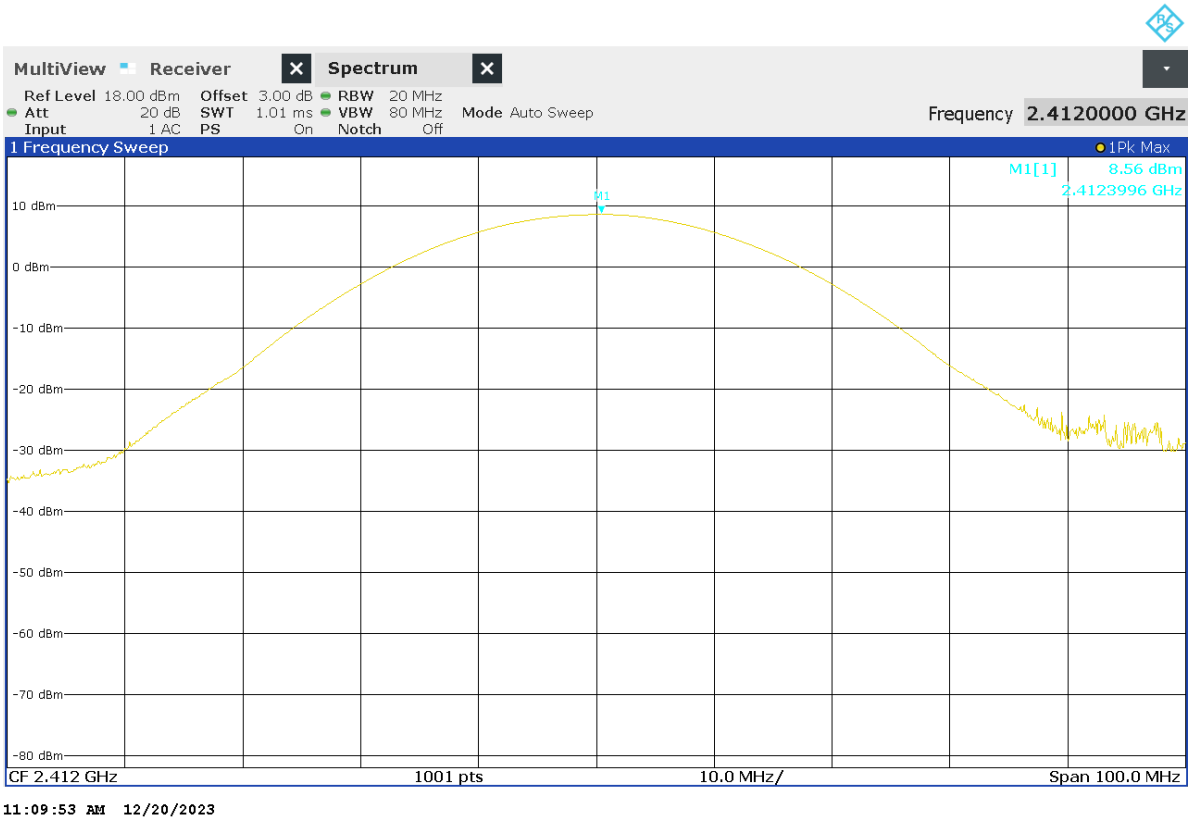


Figure 56 Peak output power, Operation on IEEE 802.11b channel 2412MHz

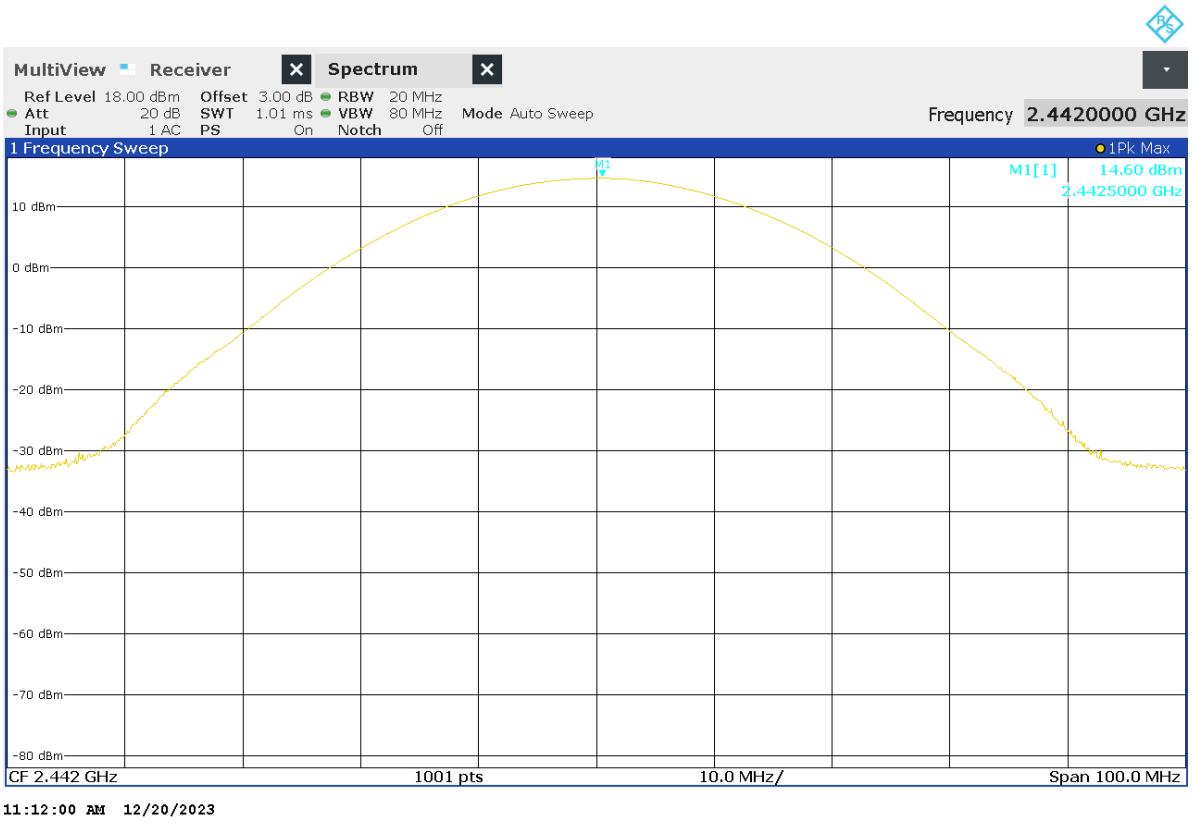


Figure 57 Peak output power, Operation on IEEE 802.11b channel 2442MHz

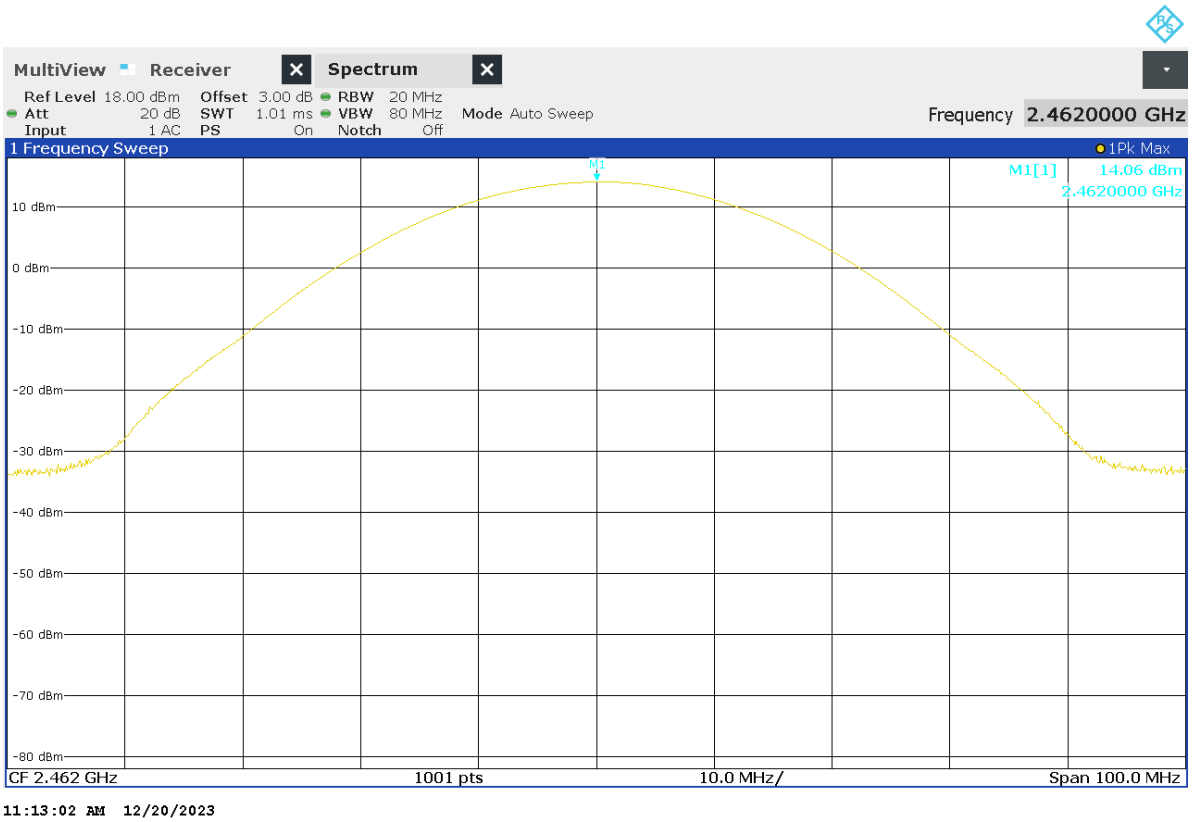


Figure 58 Peak output power, Operation on IEEE 802.11b channel 2462MHz

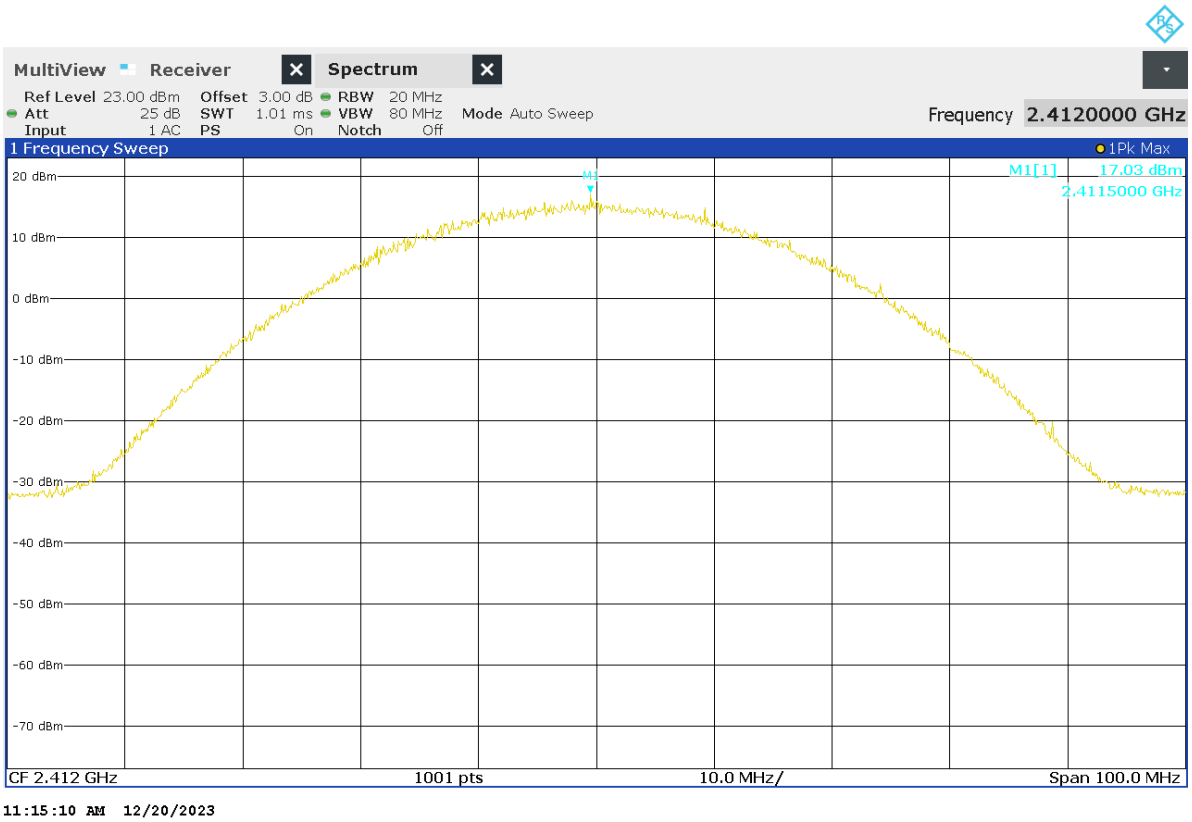


Figure 59 Peak output power, Operation on IEEE 802.11g channel 2412MHz

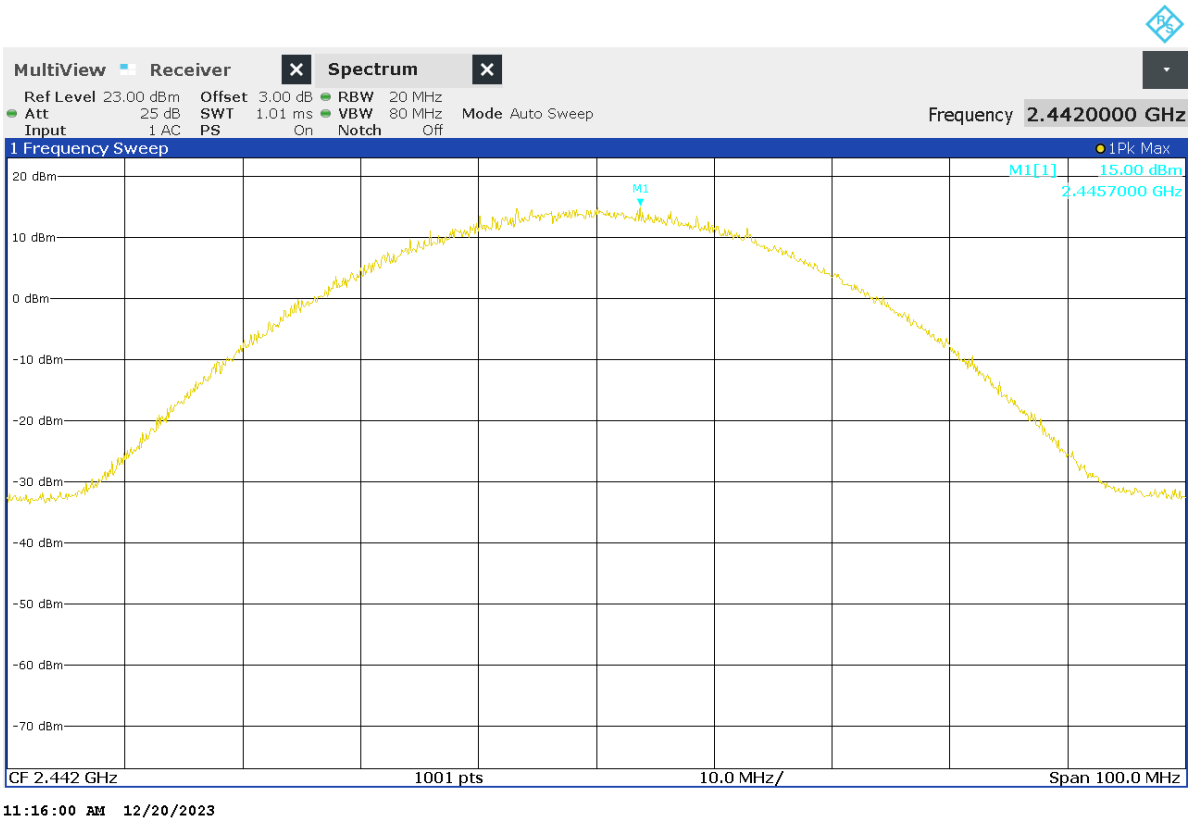


Figure 60 Peak output power, Operation on IEEE 802.11g channel 2442MHz

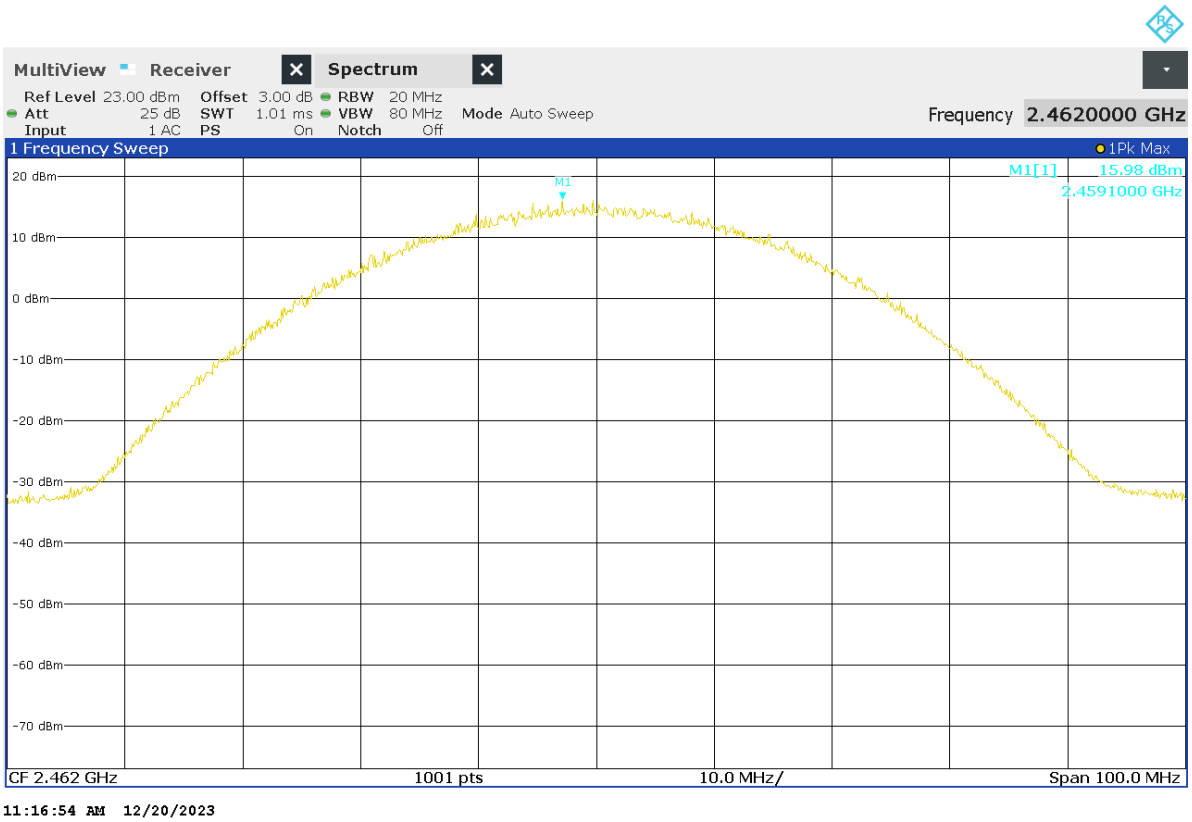


Figure 61 Peak output power, Operation on IEEE 802.11g channel 2462MHz

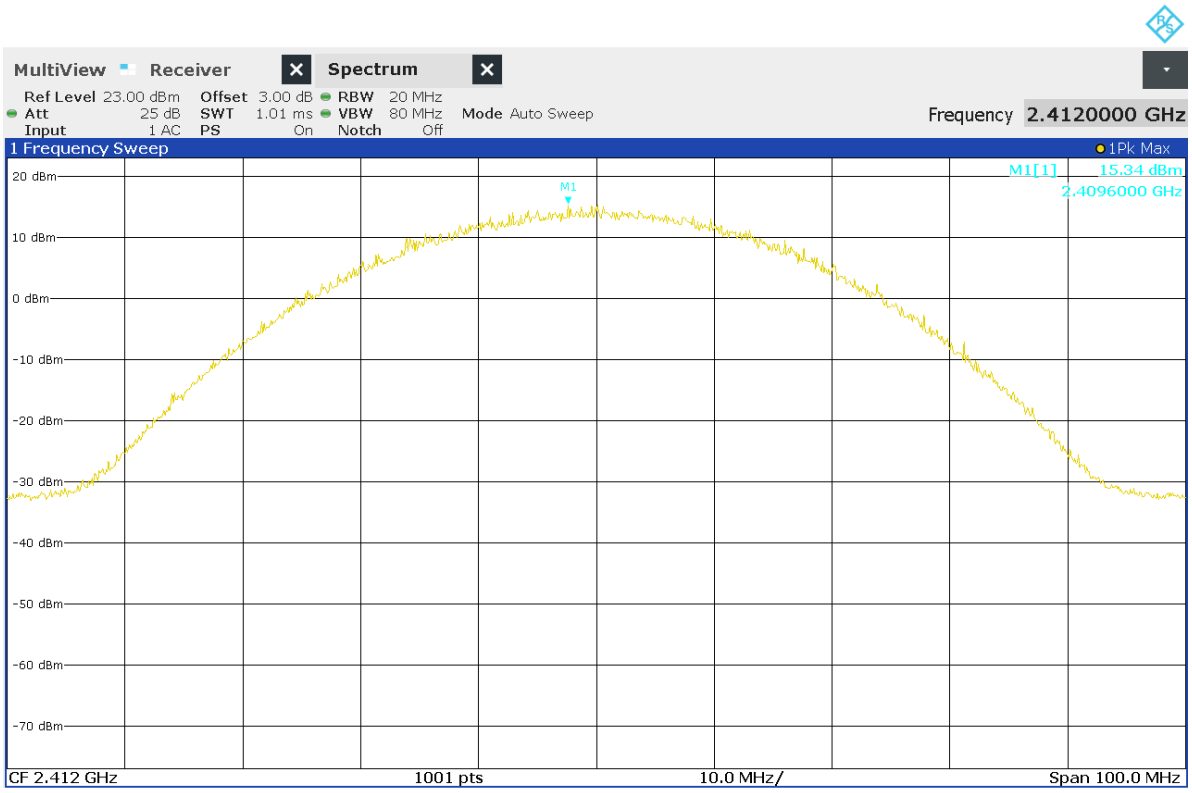


Figure 62 Peak output power, Operation on IEEE 802.11n channel 2412MHz

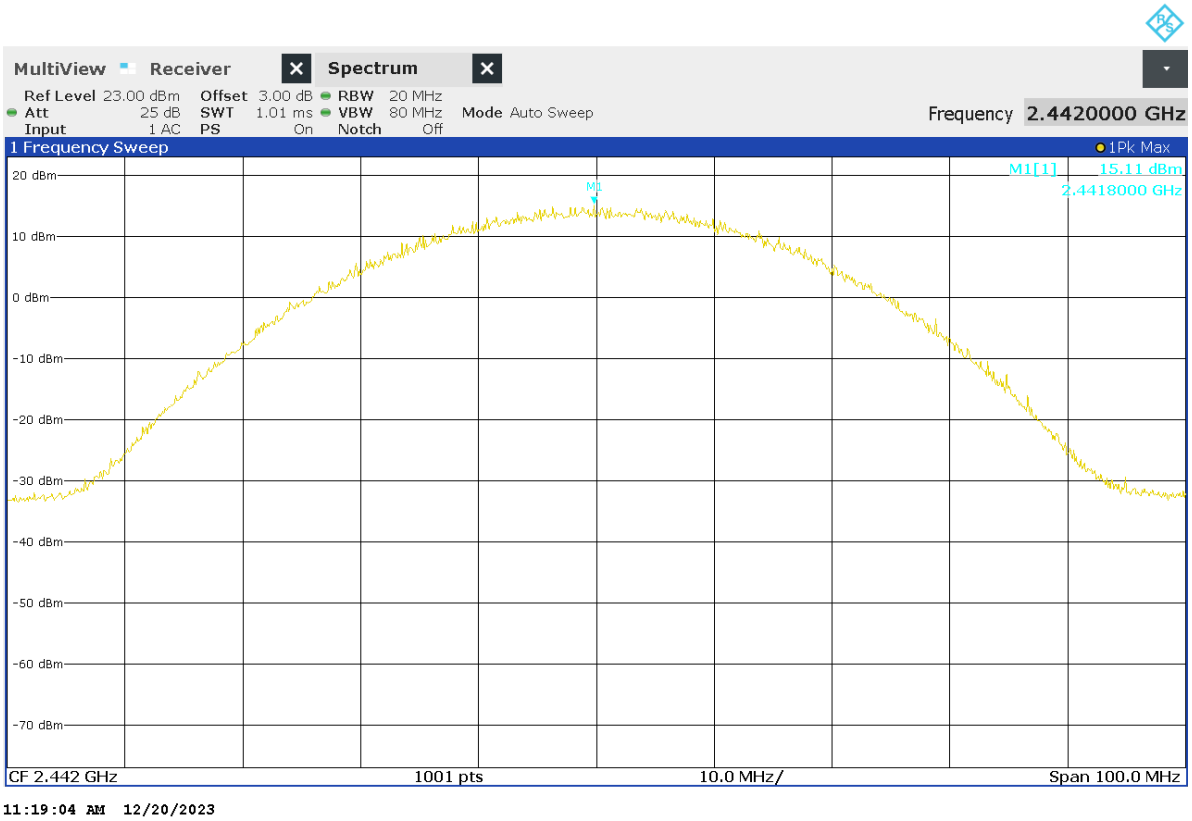


Figure 63 Peak output power, Operation on IEEE 802.11n channel 2442MHz

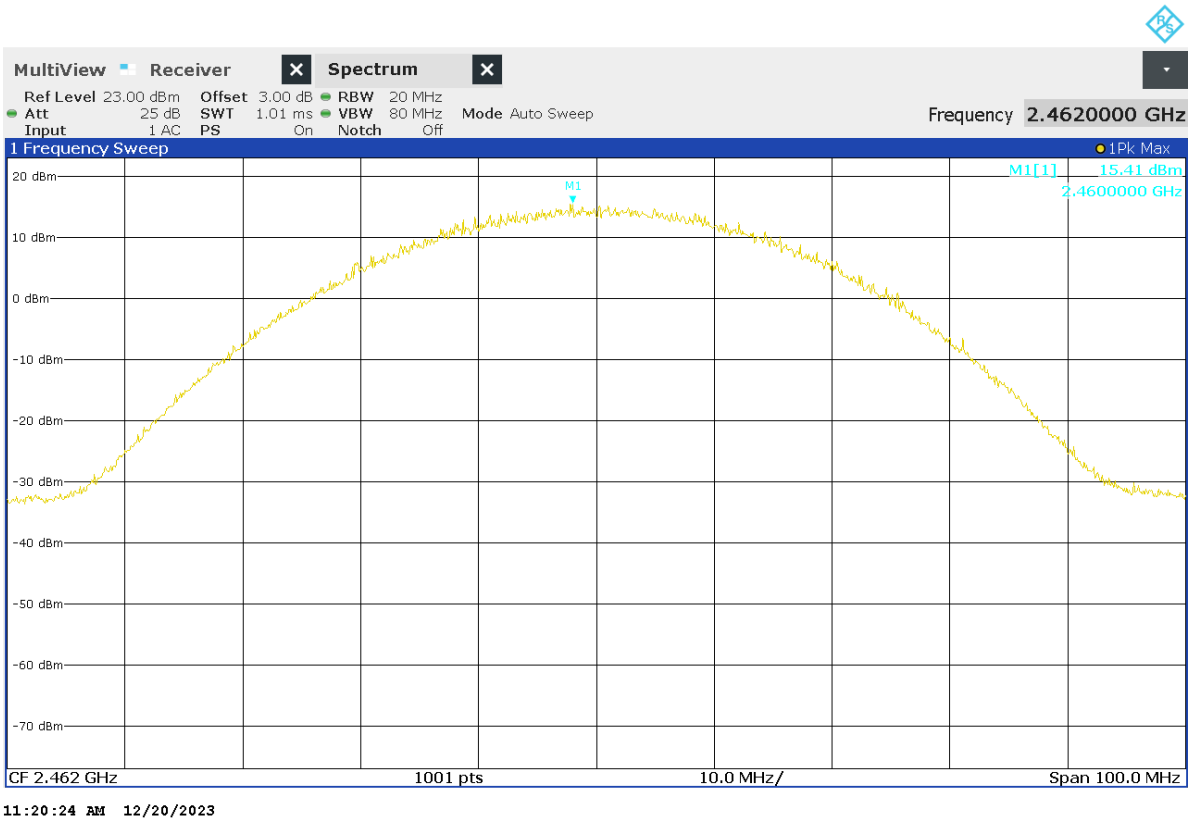


Figure 64 Peak output power, Operation on IEEE 802.11n channel 2462MHz

Section 8 Power Spectral Density

8.1 Test Specification

FCC Rule Part	46CFR 15.247 (e)
Standard	ANSI C63.10:2013
Measurement Uncertainty Conducted Power tests	±1.4dB

8.2 Procedure and Test Software Version

Conducted Tests

ANSi C63.10-2013 Clause reference:	Clause 11.10.2
Test software	N/A

Frequency (MHz)	Limit, 47CFR 15.247(e)
	Peak
2400MHz to 2483.5MHz	<8dBm in any 3kHz band during any time interval of complete transmission

Spectrum analyser settings as specified by ANSI C63.10-2013 Clause 11.10.2

Receiver Parameters	Setting
Detector Function	Peak
Span	1.5xDTS bandwidth
Resolution Bandwidth	3kHz ≤RBW ≤100kHz
Video Bandwidth	3 x RBW
Sweep rate	Auto couple
Trace mode	Max hold

8.2.1 Emissions measurements

8.2.2 Date of Test

28th November 2023

8.2.3 Test Area

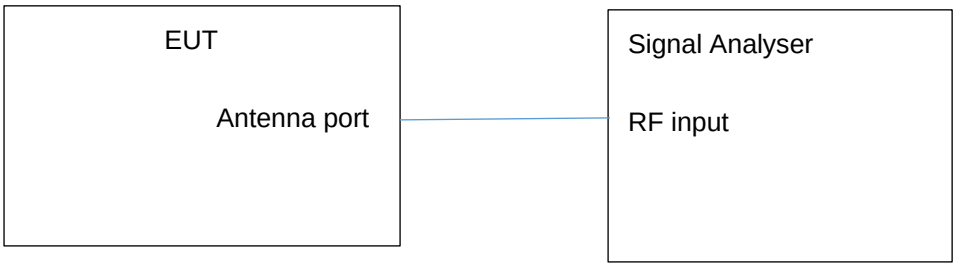
LAB 5

8.2.4 Tested by

L Trickett

8.2.5 Test Setup

The antenna port was connected directly to the signal analyser.



8.2.6 Test Results

Modulation scheme	Channel (MHz)	Power in 3kHz RBW (dBm)	Limit (dBm)	Figure	Result
IEEE 802.11b	2412	-16.11	8.0	65	Pass
IEEE 802.11b	2442	-11.58	8.0	66	Pass
IEEE 802.11b	2462	-12.09	8.0	67	Pass
IEEE 802.11g	2412	-20.43	8.0	68	Pass
IEEE 802.11g	2442	-20.31	8.0	69	Pass
IEEE 802.11g	2462	-19.98	8.0	70	Pass
IEEE 802.11n	2412	-20.61	8.0	71	Pass
IEEE 802.11n	2442	-20.48	8.0	72	Pass
IEEE 802.11n	2462	-20.02	8.0	73	Pass

Table 15 Peak Spectral Density Measurements

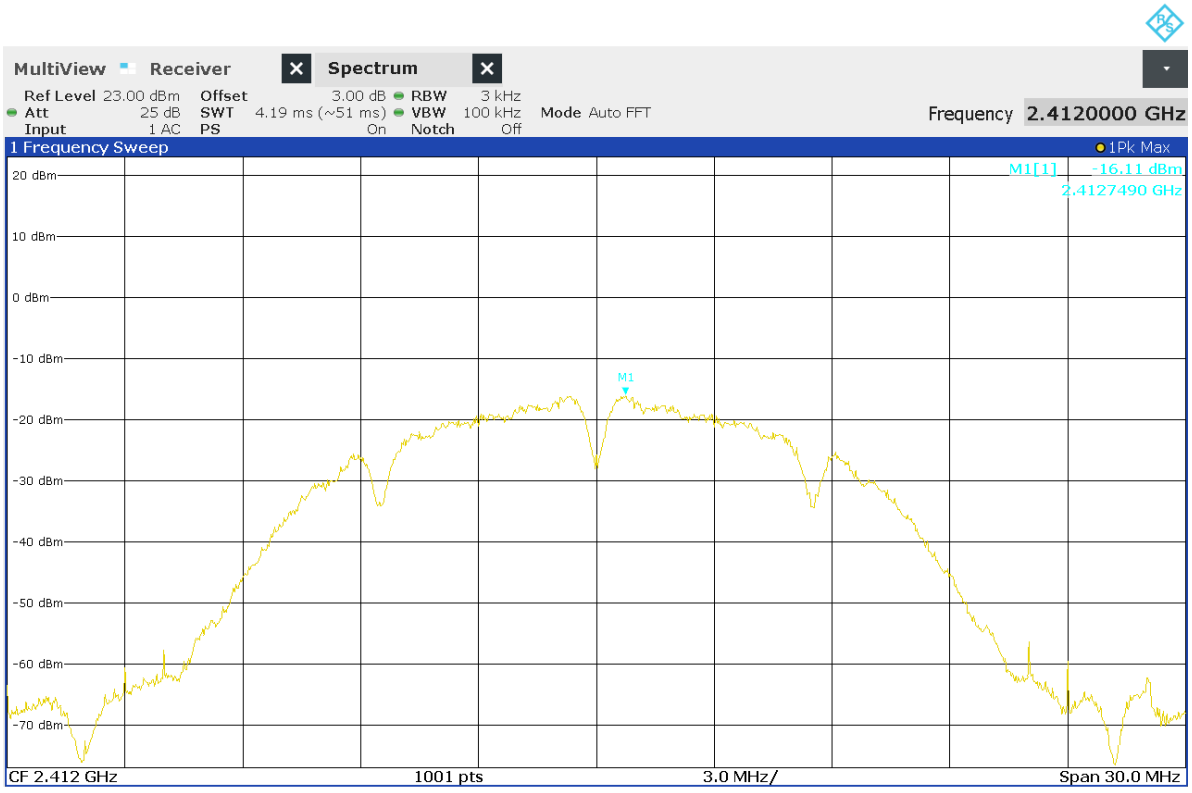


Figure 65 Power spectral density, Operation on IEEE 802.11b channel 2412MHz

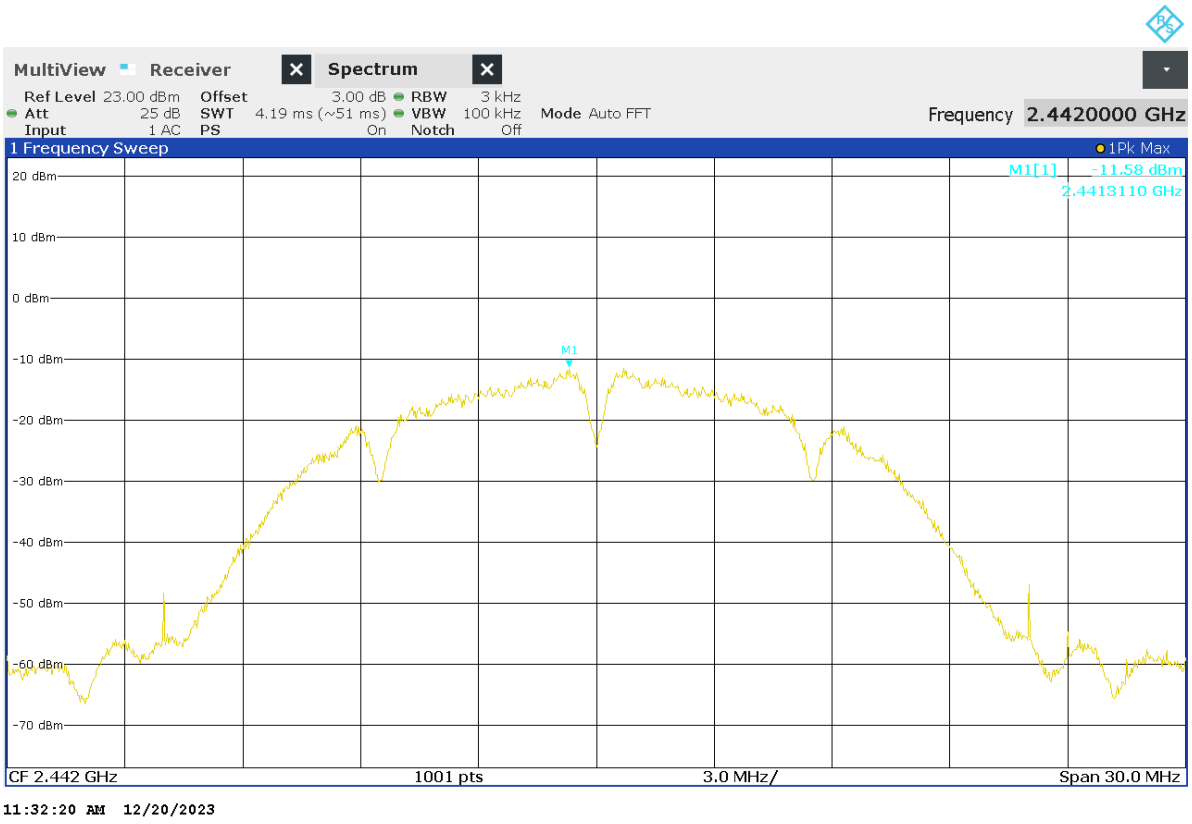


Figure 66 Power spectral density, Operation on IEEE 802.11b channel 2442MHz

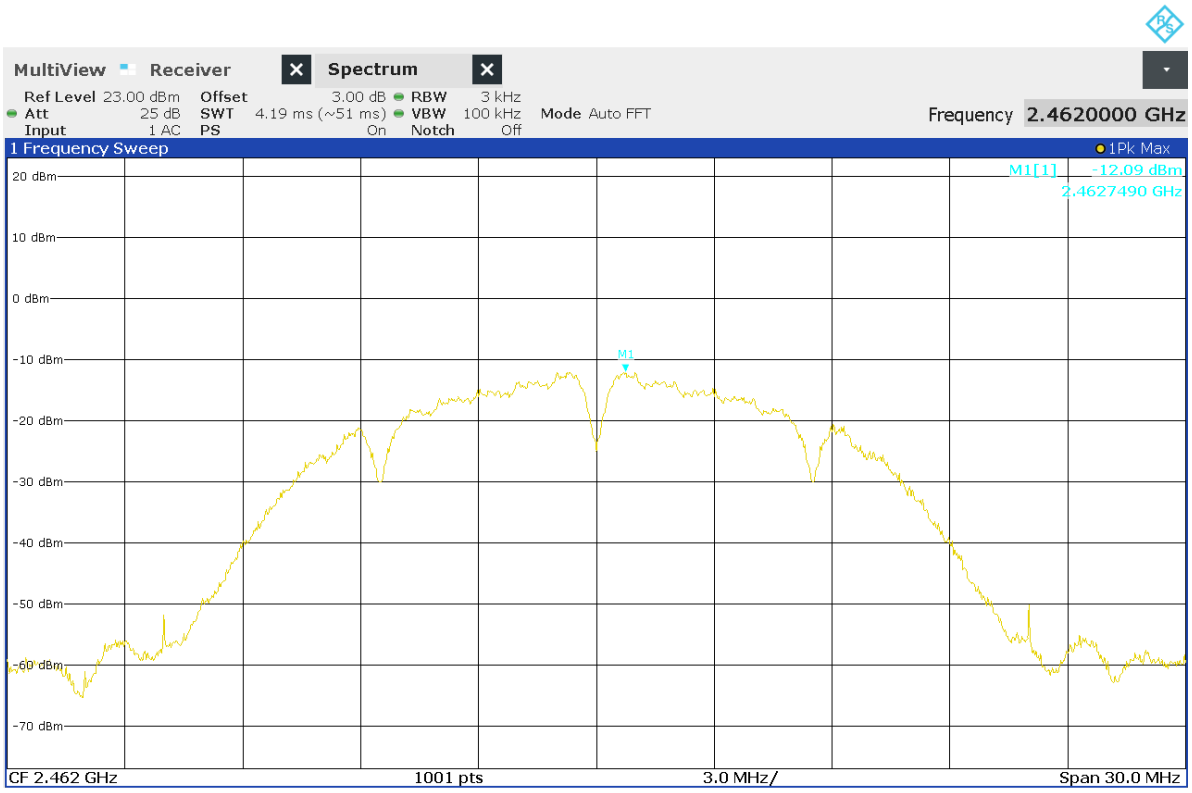


Figure 67 Power spectral density, Operation on IEEE 802.11b channel 2462MHz

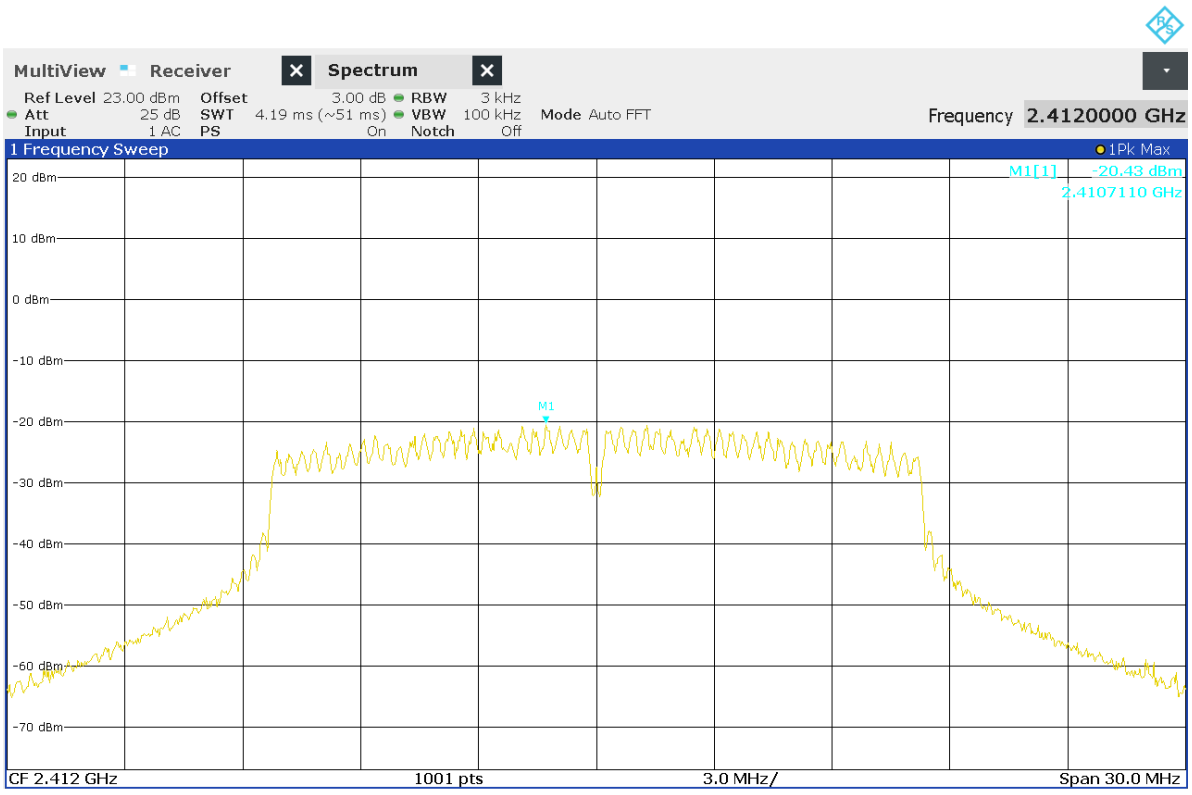


Figure 68 Power spectral density, Operation on IEEE 802.11g channel 2412MHz

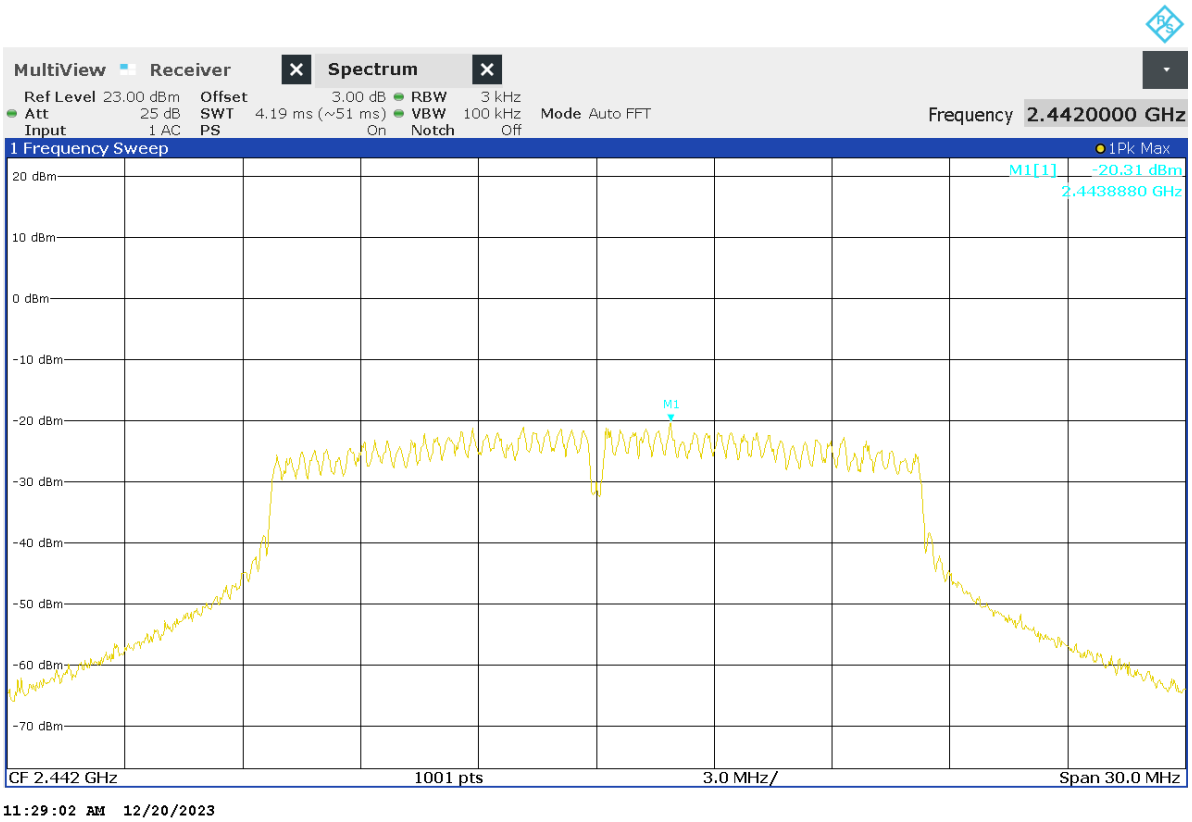


Figure 69 Power spectral density, Operation on IEEE 802.11g channel 2442MHz

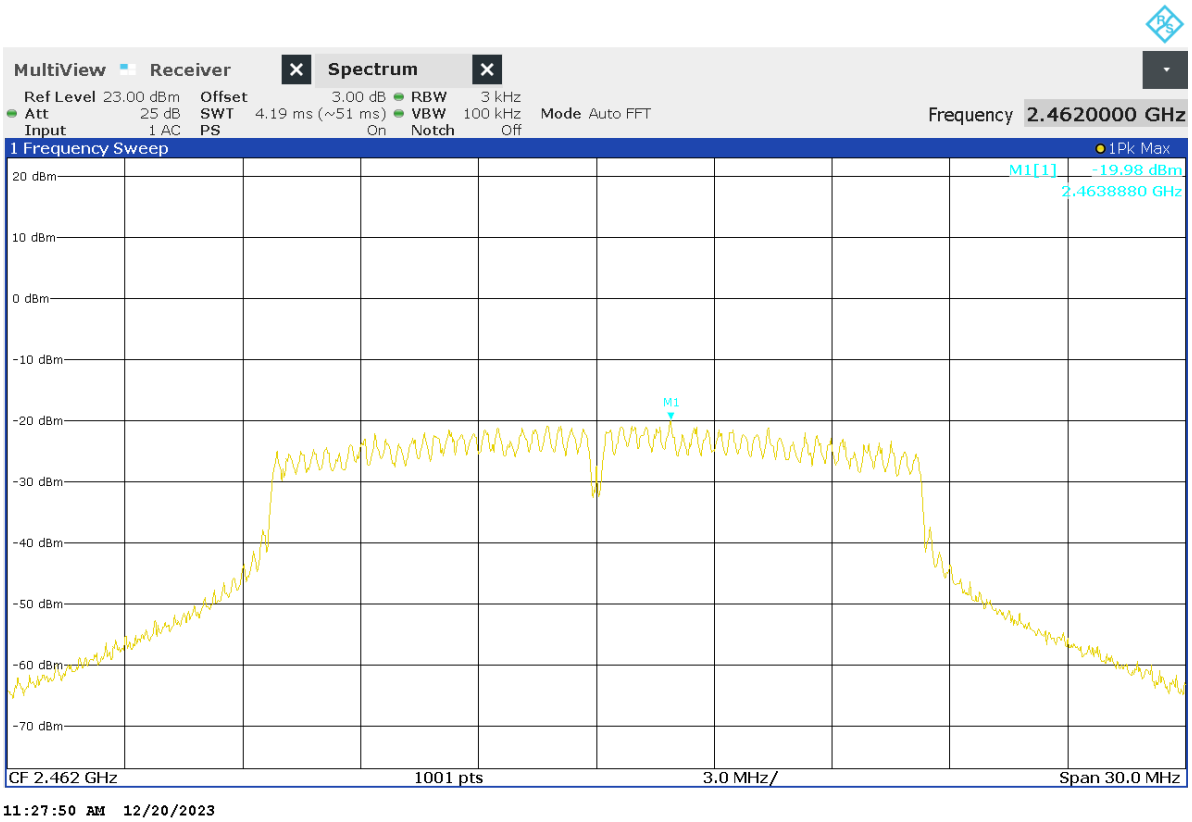


Figure 70 Power spectral density, Operation on IEEE 802.11g channel 2462MHz

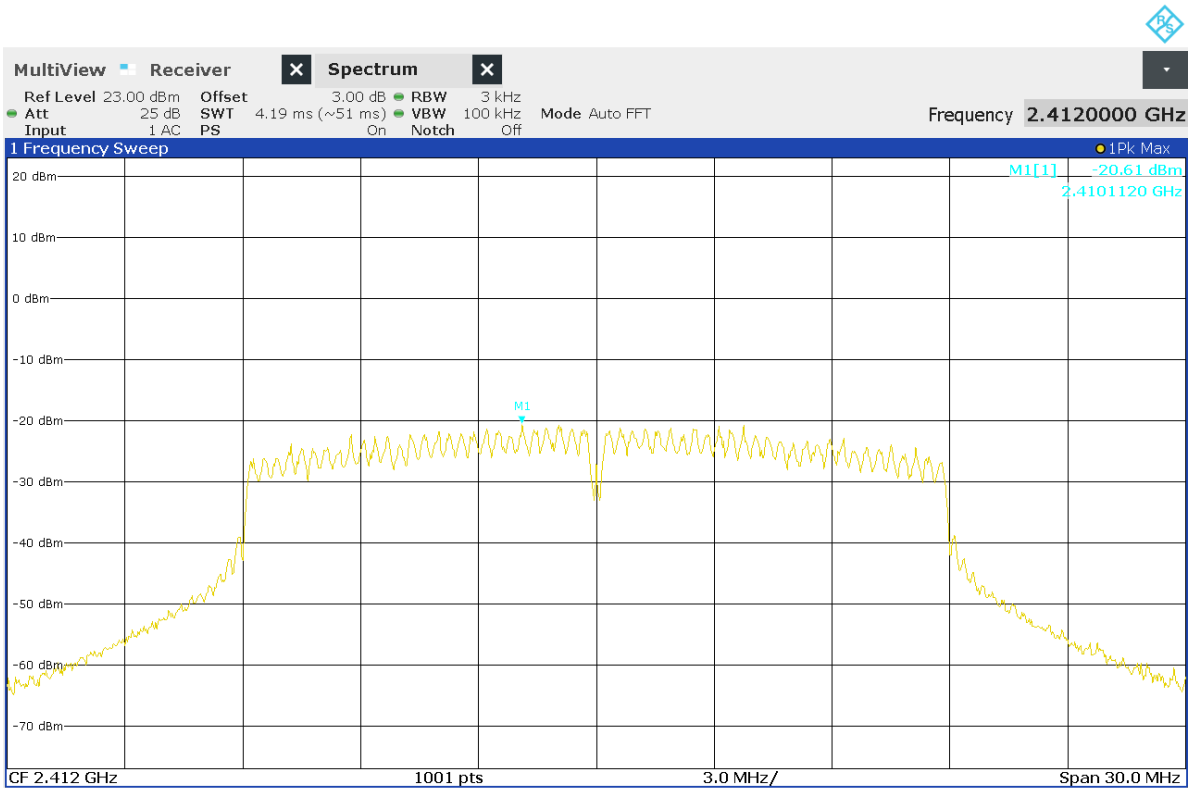


Figure 71 Power spectral density, Operation on IEEE 802.11n channel 2412MHz

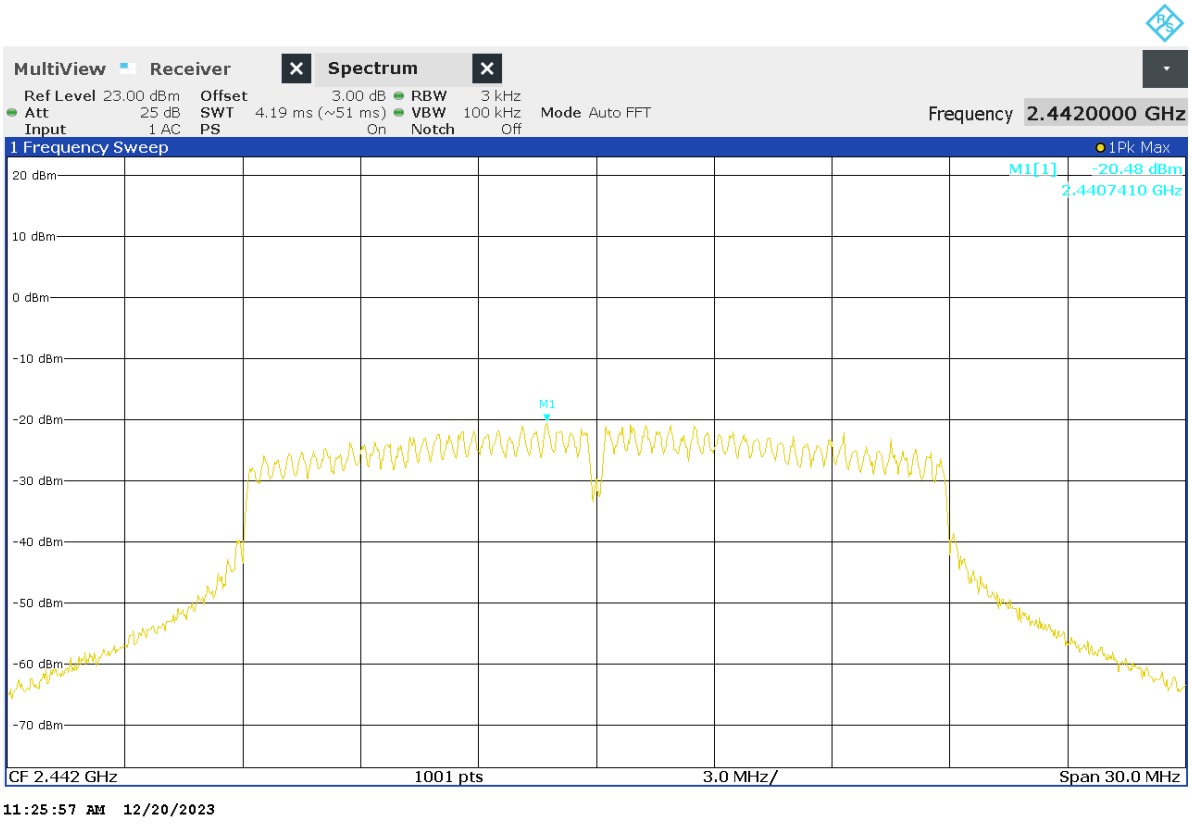


Figure 72 Power spectral density, Operation on IEEE 802.11n channel 2442MHz

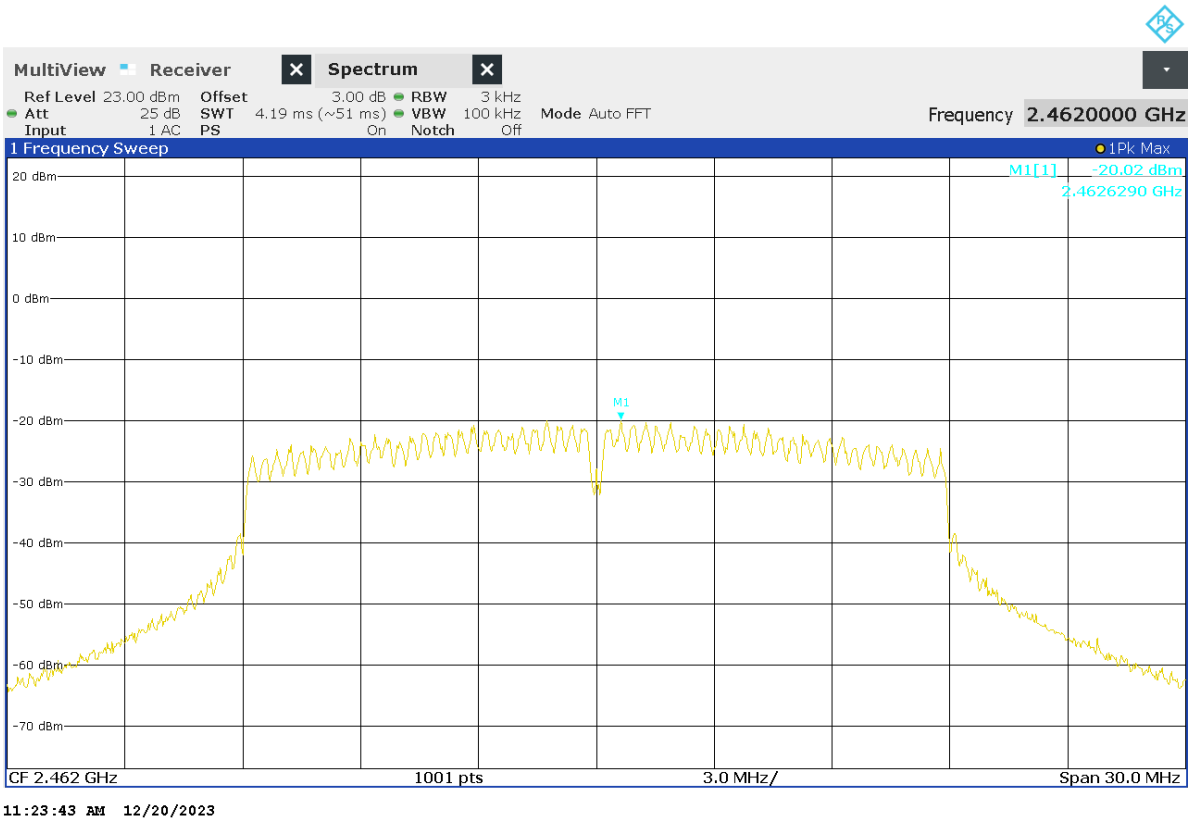


Figure 73 Power spectral density, Operation on IEEE 802.11n channel 2462MHz

Section 9 Band Edge Compliance

9.1 Test Specification

FCC Rule Part	46CFR 15.205 and 47CFR15.209
Standard	ANSI C63.10:2013
Measurement Uncertainty Radiated tests	The reported uncertainty of measurement y ± U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95% is +/- 5.14dB for the frequency range from 1GHz to 6GHz

9.2 Procedure and Test Software Version

Conducted Tests

ANSi C63.10-2013 Clause reference:	Clause 6.10.4 Authorised band-edge measurements
Test software	N/A

Frequency (MHz)	Limit, 47CFR 15.247(e)
	Peak
2400MHz to 2483.5MHz	Measured signal at the band edge must be below the radiated emission limits of 47CFR15.209

Spectrum analyser settings as specified by ANSI C63.10-2013 Clause 6.10.5 “Restricted band-edge measurements”

Receiver Parameters	Setting
Detector Function	Peak
Span	As necessary
Resolution Bandwidth	100kHz
Video Bandwidth	3 x RBW
Sweep rate	Auto couple
Trace mode	Max hold

9.2.1 Emissions measurements

9.2.2 Date of Test

24th November 2023

9.2.3 Test Area

LAB 1

9.2.4 Tested by

L Trickett

9.2.5 Test Setup

The test setup was identical to radiated emissions testing 1-18GHz.

9.2.6 Test Results

Results are presented in two formats:

Tabular results of measurements at the band edges. Manual measurements were performed to measure the maximum value of signal at the band edge. The tabular data includes the following:

1. Polarity of the measurement antenna
2. Frequency at the band edge
3. Amplitude of signal at the input of the test receiver
4. Pre-amplifier gain
5. Cable loss
6. Antenna factor
7. Resultant Electric field strength = 3-4+5+6

Spectrum analyser screen displays are also included. Please note that the screen displays do not include losses or antenna factor.

Tabular Data IEEE 802.11b modulation

The following radiated measurements were made at the band edges:

Upper band edge

Polarity	frequency (MHz)	Amplitude (dBuV)	Preamp (dB)	Cable loss (dB)	AF(dB/m)	E (dBuV/m)	Limit (dBuV/m)	Margin (dB)
H	2483.5	73.30	54.03	2.59	30.55	52.41	74.00	21.59
V	2483.5	69.50	54.03	2.59	30.55	48.61	74.00	25.39

Table 16 Operation on IEEE 802.11b 2462MHz Channel, Peak detector measurements

Polarity	frequency (MHz)	Amplitude (dBuV)	Preamp (dB)	Cable loss (dB)	AF(dB/m)	E (dBuV/m)	Limit (dBuV/m)	Margin (dB)
H	2483.5	56.60	54.03	2.59	30.55	35.71	54.00	18.29
V	2483.5	50.30	54.03	2.59	30.55	29.41	54.00	24.59

Table 17 Operation on IEEE 802.11b Channel 2462MHz, average detector measurements

Lower band edge

Polarity	frequency (MHz)	Amplitude (dBuV)	Preamp (dB)	Cable loss (dB)	AF(dB/m)	E (dBuV/m)	Limit (dBuV/m)	Margin (dB)
H	2400	81.40	54.02	2.54	30.01	59.93	74.00	14.07
V	2400	68.40	54.02	2.54	30.01	46.93	74.00	27.07

Table 18 Operation on IEEE 802.11b channel 2412MHz Peak detector measurements

Polarity	frequency (MHz)	Amplitude (dBuV)	Preamp (dB)	Cable loss (dB)	AF(dB/m)	E (dBuV/m)	Limit (dBuV/m)	Margin (dB)
H	2400	69.00	54.02	2.54	30.01	47.53	54.00	6.47
V	2400	61.60	54.02	2.54	30.01	40.13	54.00	13.87

Table 19 Operation on IEEE 802.11b channel 2412MHz average detector measurements

Spectrum analyser displays IEEE 802.11b modulation

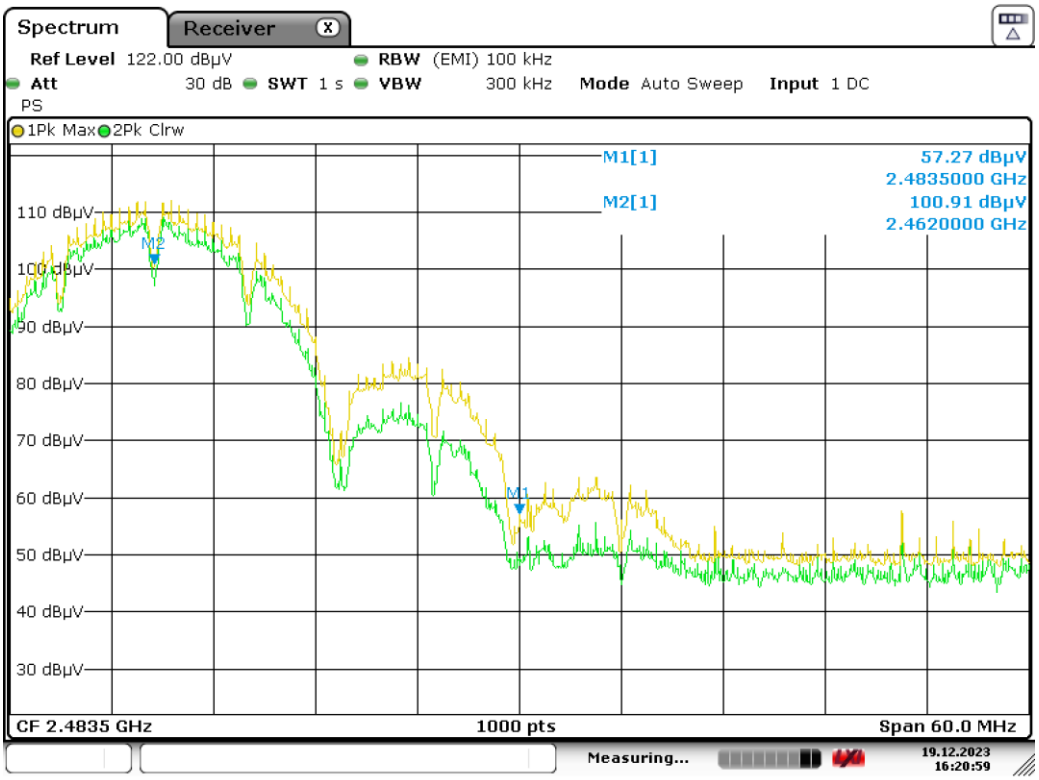


Figure 74 Band Edge Measurement IEEE 802.11b – upper band edge - horizontal polarity

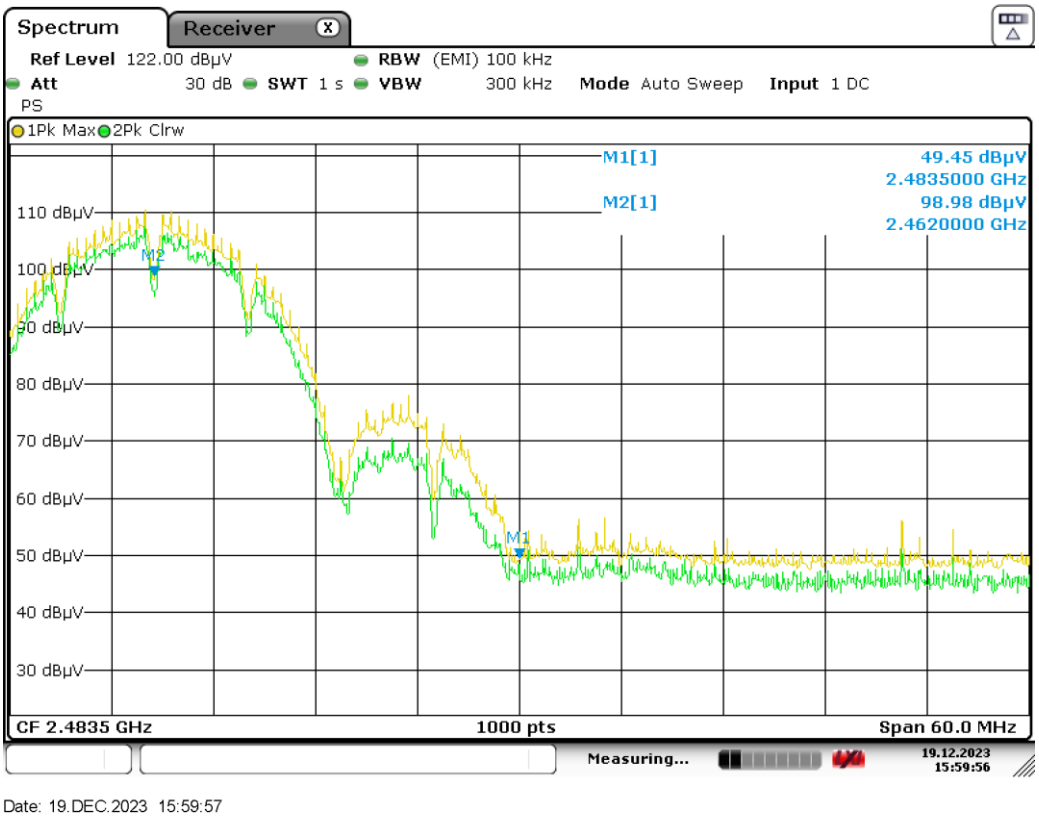


Figure 75 Band Edge Measurement IEEE 802.11b – upper band edge - vertical polarity

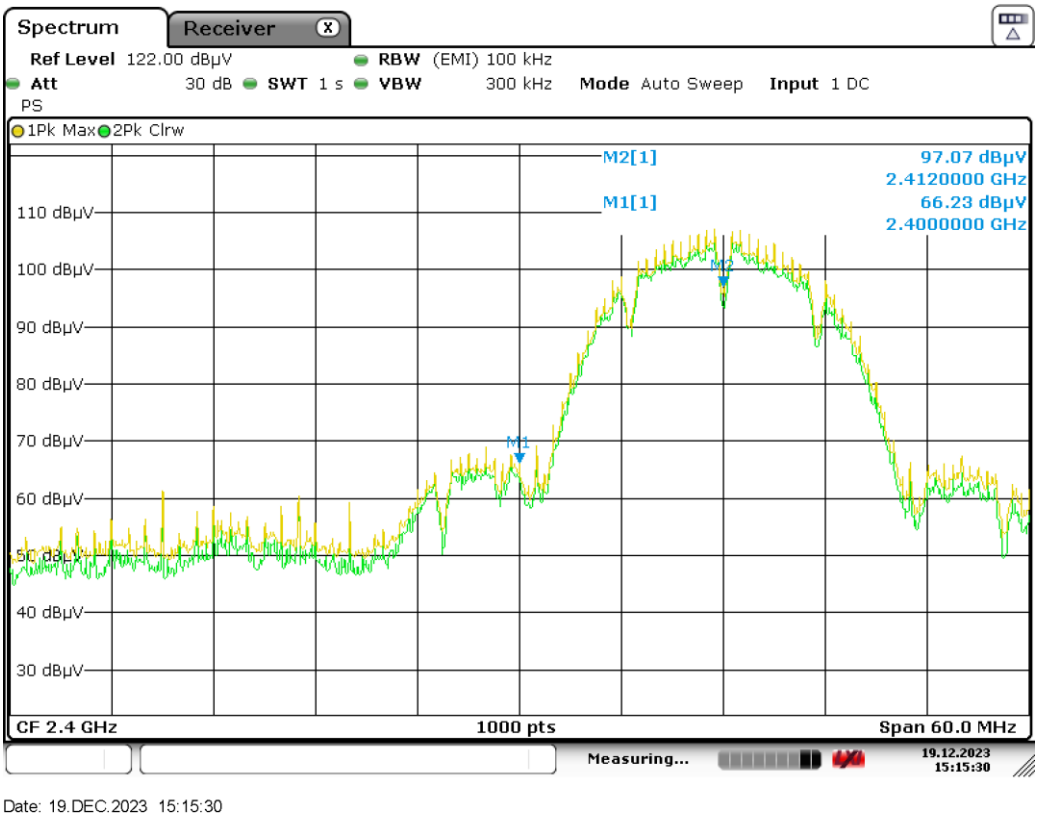


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Figure 76 Band Edge Measurement IEEE 802.11b – lower band edge - horizontal polarity

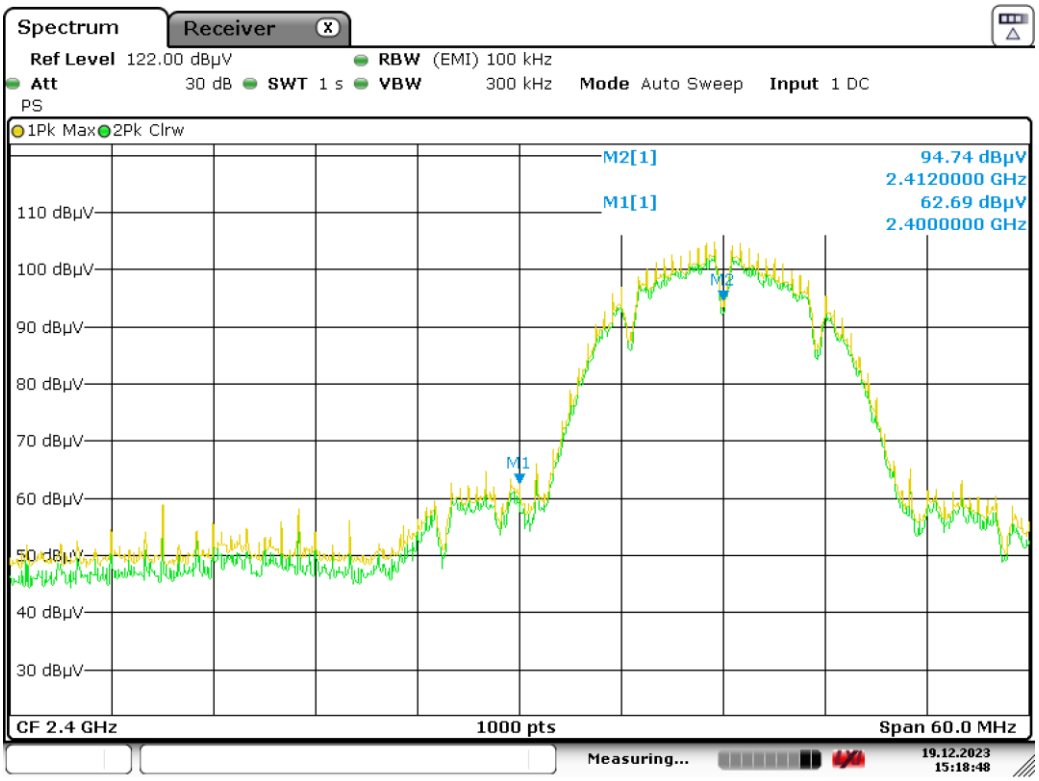

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Figure 77 Band Edge Measurement IEEE 802.11b – lower band edge - vertical polarity

Tabular Data IEEE 802.11g modulation

The following radiated measurements were made at the band edges:

Upper band edge

Polarity	frequency (MHz)	Amplitude (dBuV)	Preamp (dB)	Cable loss (dB)	AF(dB/m)	E (dBuV/m)	Limit (dBuV/m)	Margin (dB)
H	2483.5	63.70	54.03	2.59	30.55	42.81	74.00	31.19
V	2483.5	61.20	54.03	2.59	30.55	40.31	74.00	33.69

Table 20 Operation on IEEE 802.11g 2462MHz Channel, Peak detector measurements

Polarity	frequency (MHz)	Amplitude (dBuV)	Preamp (dB)	Cable loss (dB)	AF(dB/m)	E (dBuV/m)	Limit (dBuV/m)	Margin (dB)
H	2483.5	49.80	54.03	2.59	30.55	28.91	54.00	25.09
V	2483.5	47.80	54.03	2.59	30.55	26.91	54.00	27.09

Table 21 Operation on IEEE 802.11g Channel 2462MHz, average detector measurements

Lower band edge

Polarity	frequency (MHz)	Amplitude (dBuV)	Preamp (dB)	Cable loss (dB)	AF(dB/m)	E (dBuV/m)	Limit (dBuV/m)	Margin (dB)
H	2400	81.70	54.02	2.54	30.01	60.23	74.00	13.77
V	2400	78.50	54.02	2.54	30.01	57.03	74.00	16.97

Table 22 Operation on IEEE 802.11g channel 2412MHz Peak detector measurements

Polarity	frequency (MHz)	Amplitude (dBuV)	Preamp (dB)	Cable loss (dB)	AF(dB/m)	E (dBuV/m)	Limit (dBuV/m)	Margin (dB)
H	2400	61.90	54.02	2.54	30.01	40.43	54.00	13.57
V	2400	57.40	54.02	2.54	30.01	35.93	54.00	18.07

Table 23 Operation on IEEE 802.11g channel 2412MHz average detector measurements

Spectrum analyser displays IEEE 802.11g modulation

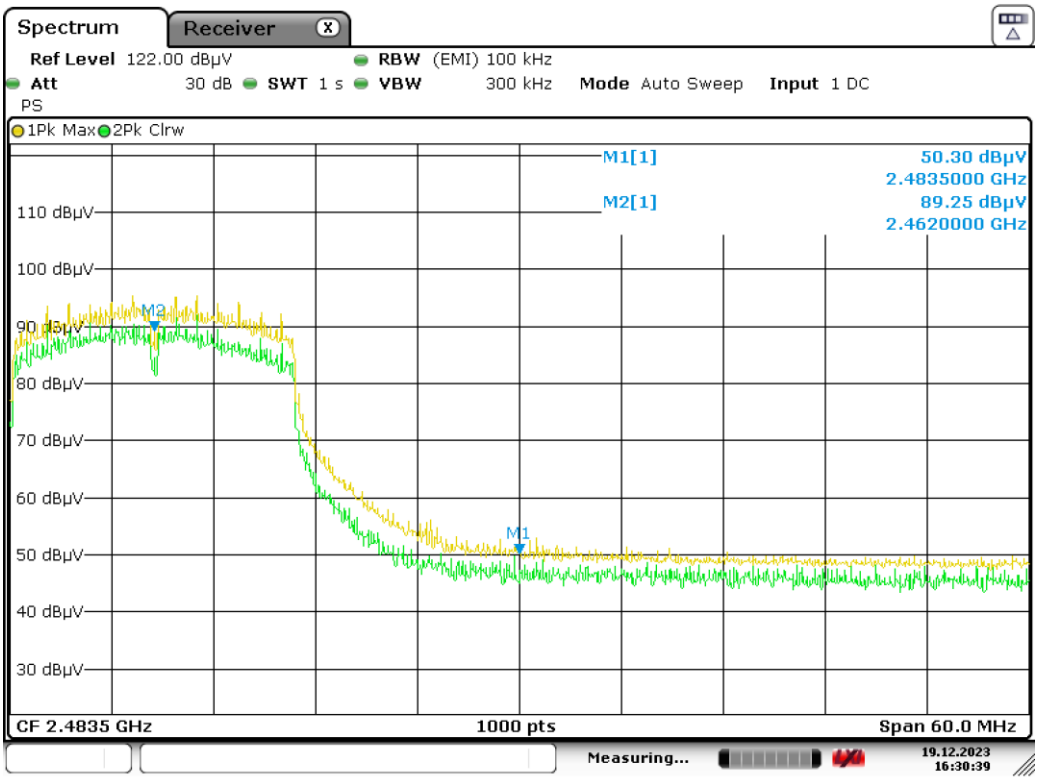

Figure 78 Band Edge Measurement IEEE 802.11g – upper band edge - horizontal polarity

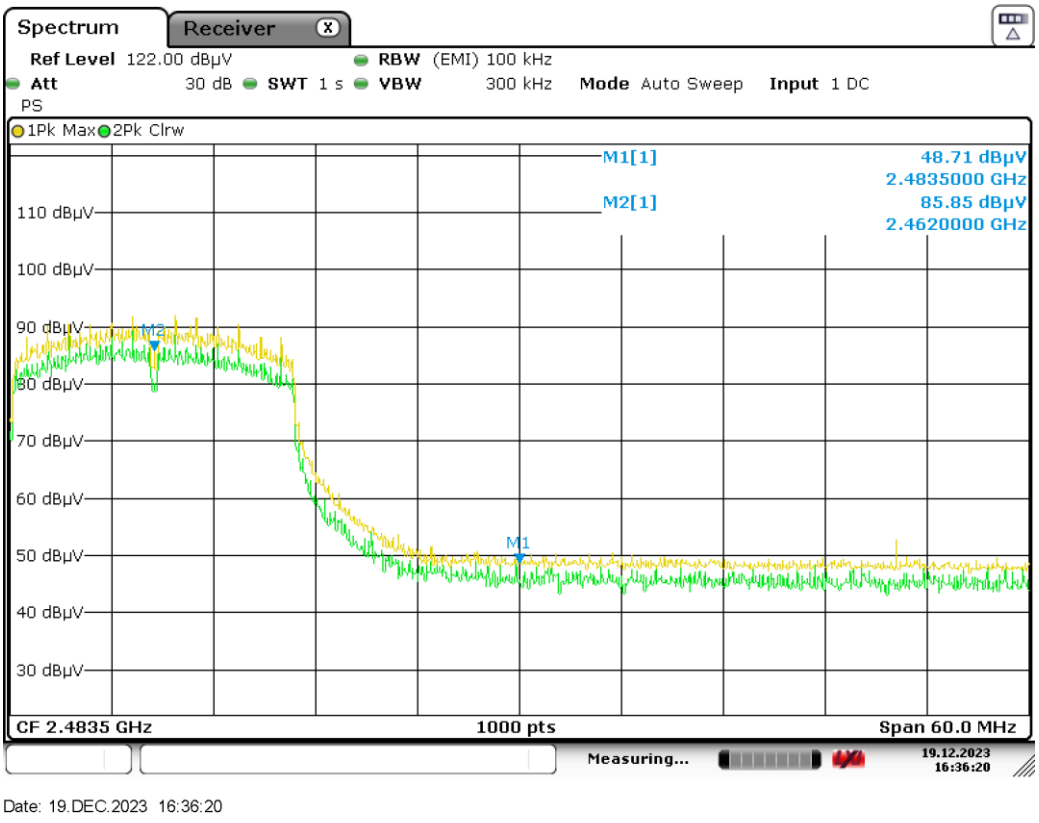

Figure 79 Band Edge Measurement IEEE 802.11g – upper band edge - vertical polarity

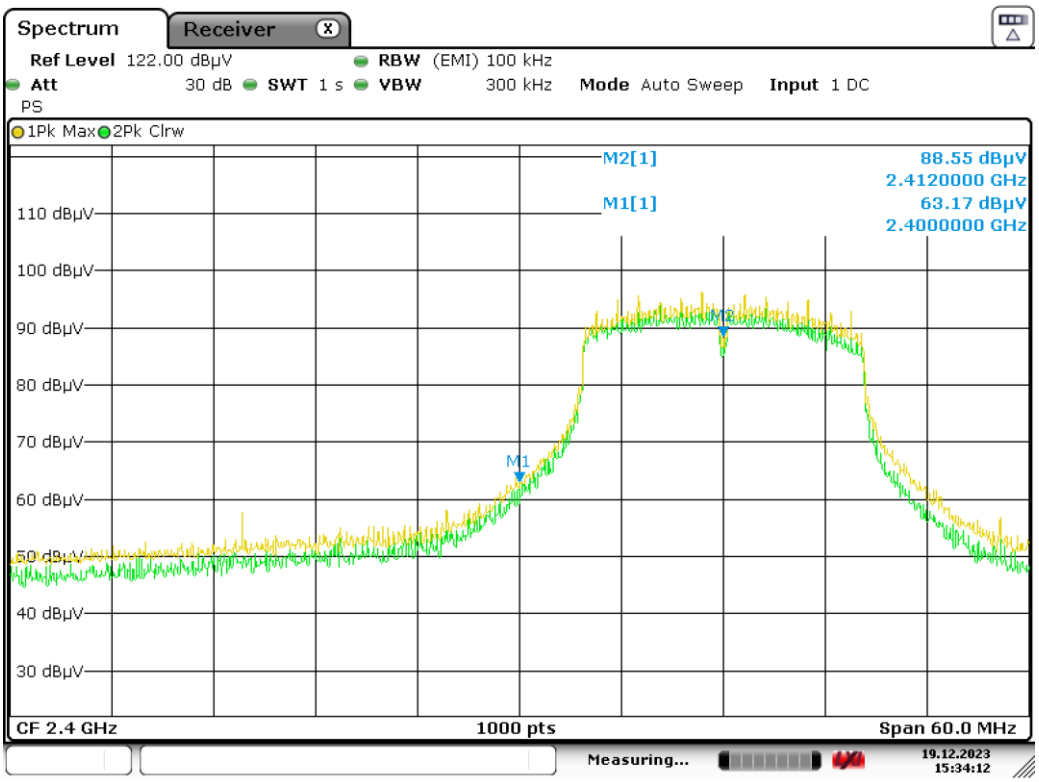

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Figure 80 Band Edge Measurement IEEE 802.11g – lower band edge - horizontal polarity

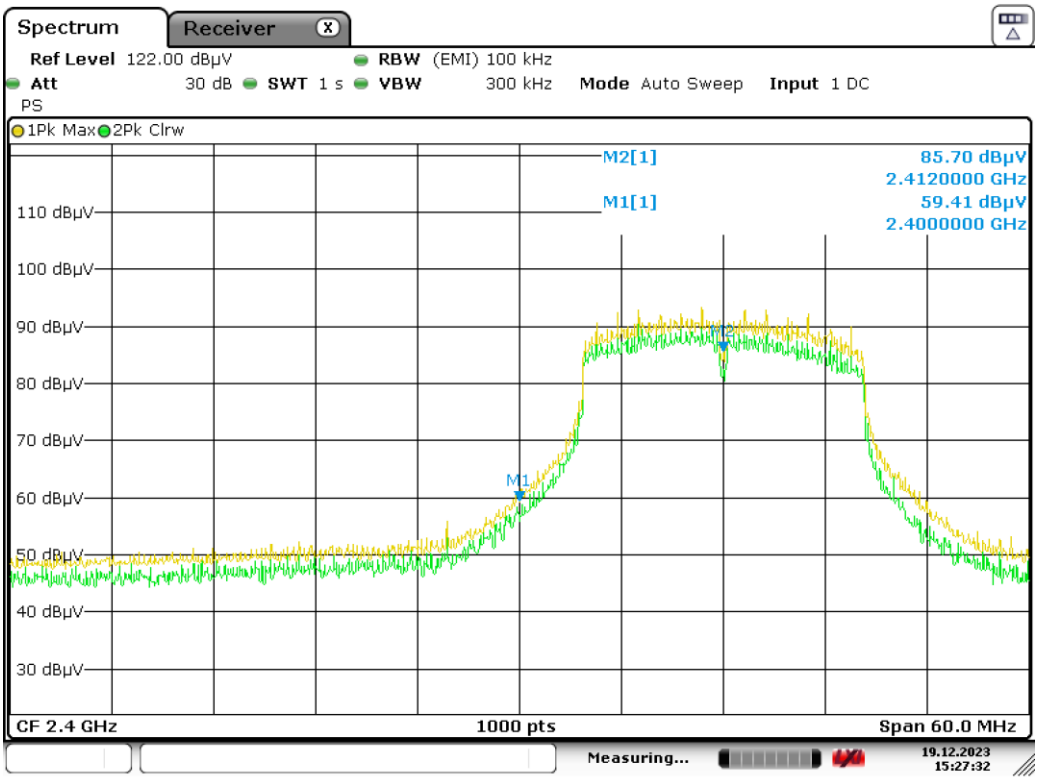

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Figure 81 Band Edge Measurement IEEE 802.11g – lower band edge - vertical polarity

Tabular Data IEEE 802.11n modulation

The following radiated measurements were made at the band edges:

Upper band edge

Polarity	frequency (MHz)	Amplitude (dBuV)	Preamp (dB)	Cable loss (dB)	AF(dB/m)	E (dBuV/m)	Limit (dBuV/m)	Margin (dB)
H	2483.5	63.40	54.03	2.59	30.55	42.51	74.00	31.49
V	2483.5	61.80	54.03	2.59	30.55	40.91	74.00	33.09

Table 24 Operation on IEEE 802.11n 2462MHz Channel, Peak detector measurements

Polarity	frequency (MHz)	Amplitude (dBuV)	Preamp (dB)	Cable loss (dB)	AF(dB/m)	E (dBuV/m)	Limit (dBuV/m)	Margin (dB)
H	2483.5	49.70	54.03	2.59	30.55	28.81	54.00	25.19
V	2483.5	47.80	54.03	2.59	30.55	26.91	54.00	27.09

Table 25 Operation on IEEE 802.11n Channel 2462MHz, average detector measurements

Lower band edge

Polarity	frequency (MHz)	Amplitude (dBuV)	Preamp (dB)	Cable loss (dB)	AF(dB/m)	E (dBuV/m)	Limit (dBuV/m)	Margin (dB)
H	2400	81.70	54.02	2.54	30.01	60.23	74.00	13.77
V	2400	78.20	54.02	2.54	30.01	56.73	74.00	17.27

Table 26 Operation on IEEE 802.11n channel 2412MHz Peak detector measurements

Polarity	frequency (MHz)	Amplitude (dBuV)	Preamp (dB)	Cable loss (dB)	AF(dB/m)	E (dBuV/m)	Limit (dBuV/m)	Margin (dB)
H	2400	60.50	54.02	2.54	30.01	39.03	54.00	14.97
V	2400	56.70	54.02	2.54	30.01	35.23	54.00	18.77

Table 27 Operation on IEEE 802.11n channel 2412MHz average detector measurements

Spectrum analyser displays IEEE 802.11n modulation

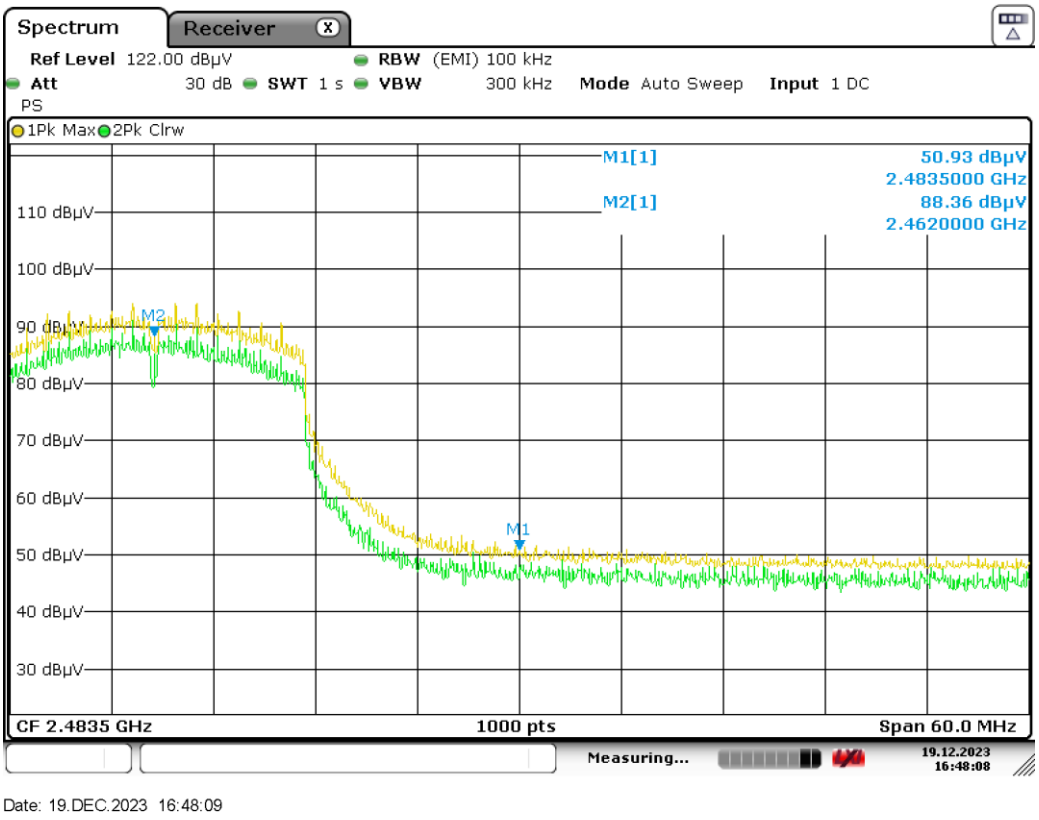

Figure 82 Band Edge Measurement IEEE 802.11n – upper band edge - horizontal polarity

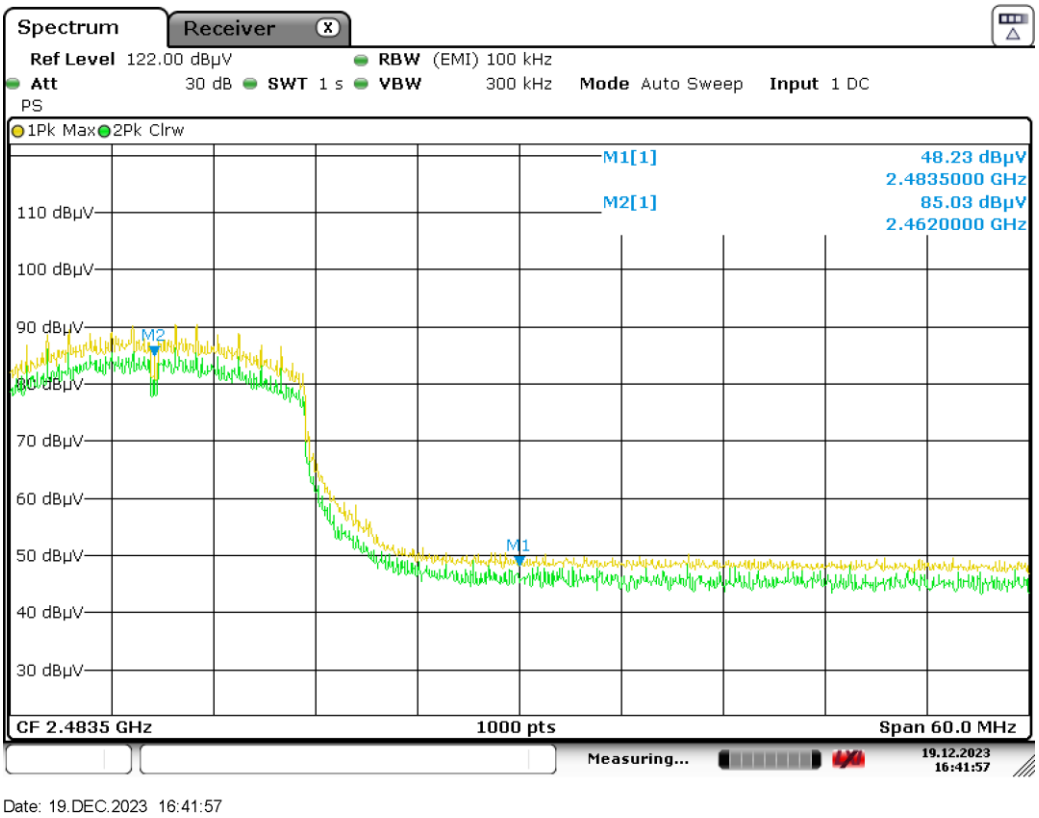

Figure 83 Band Edge Measurement IEEE 802.11n – upper band edge - vertical polarity

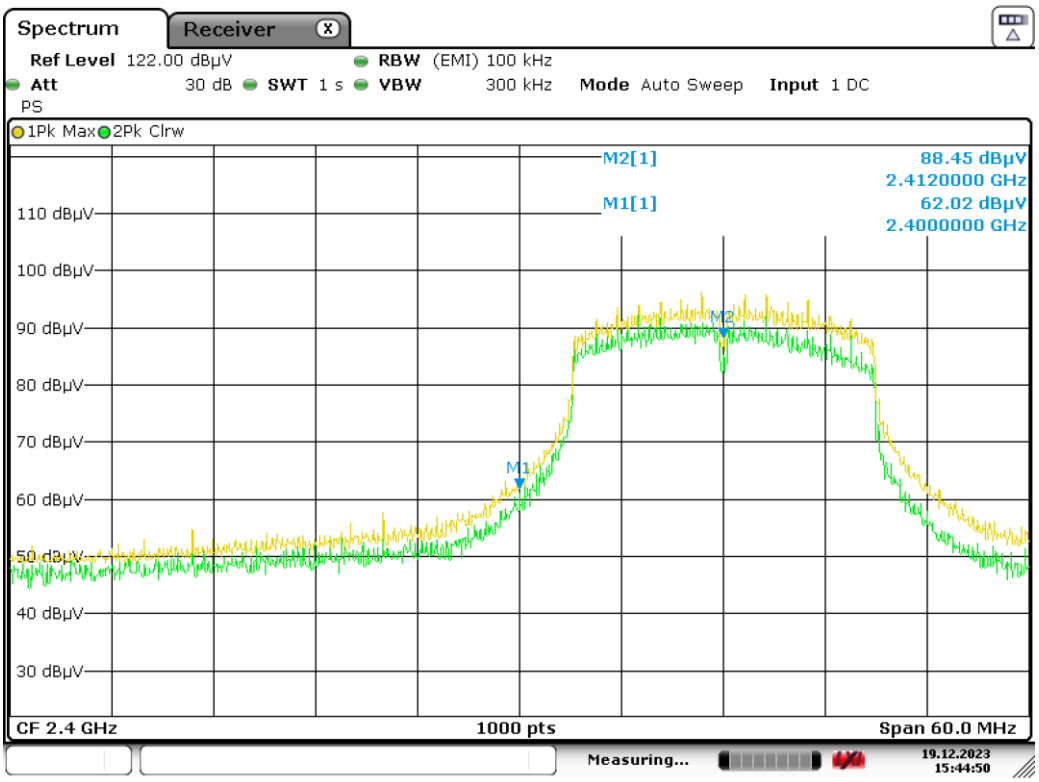

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Figure 84 Band Edge Measurement IEEE 802.11n – lower band edge - horizontal polarity

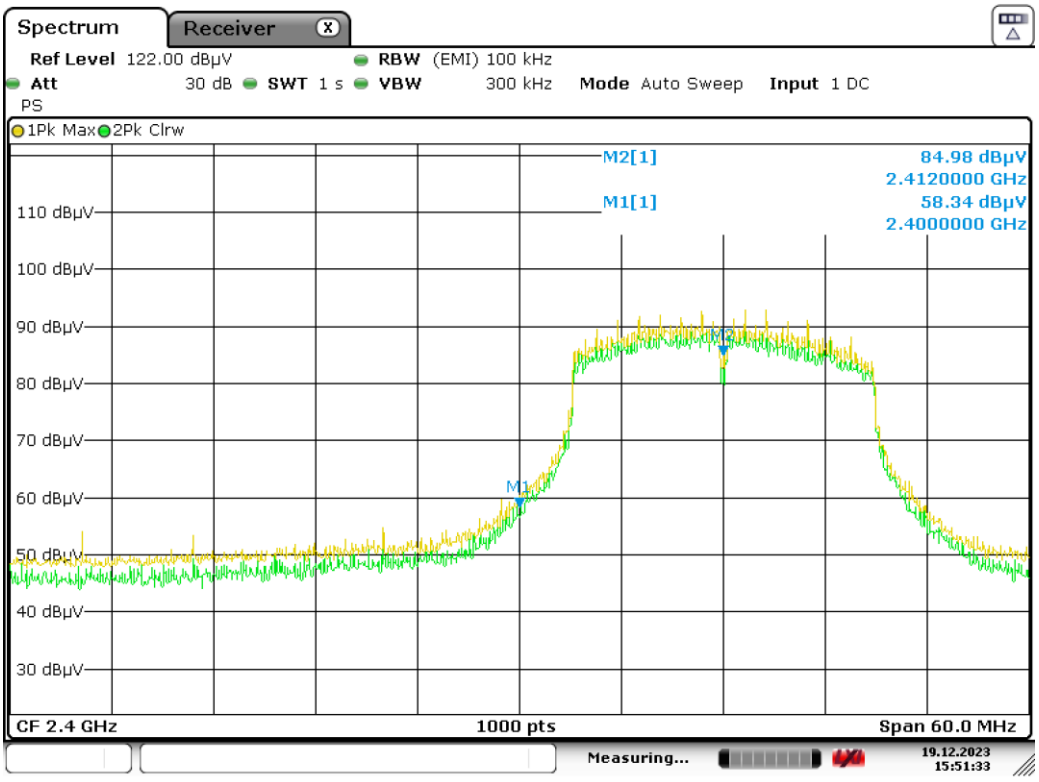

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Figure 85 Band Edge Measurement IEEE 802.11n – lower band edge - vertical polarity

Appendix A EUT Test Photos

Test set up photographs are supplied separately.

Appendix B Test Equipment List

Conducted Emissions from Antenna Port

Item	Serial No.	Last Calibration Date	Calibration Interval
RF Cable	Cable 23	30th November 2022	15 Months
R&S ESW44 EMI Receiver	C0751	10th July 2023	12 Months
Kikusui PCR200M	C0198	-	-

Radiated Emissions Equipment

Item	Serial No.	Last Calibration Date	Calibration Interval
Laboratory 1 Semi-Anechoic Chamber	C0471	6th December 2022	36 Months
ETS Lindgren 2017B Mast (1 – 4m) with tilting mechanism	--	N/A	N/A
R & S ESR26	C0502	8th August 2023	12 Months
Kikusui PCR200M	C0198	-	-
Teseq CBL6112D Bilog Antenna	C0506	12th January 2023	36 Months
HF29 Cable	20147.01.09.001	30th November 2022	15 Months
HF31 Cable	19148.06.13.002	30th November 2022	15 Months
HF35 Cable	19149.02.13.003	30th November 2022	15 Months
HF27 Cable	19149.03.13.004	30th November 2022	15 Months
Schwarzbeck STLP 9148 Antenna 1-18GHz	C0626	12th April 2022	24 Months
2.4GHz Microtronics BRM50702 notch filter	79178	7th December 2023	12 Months
BONN BLMA 0118-M Preamplifier	C0702	7th July 2023	12 Months
ETS Lingren 3116C-PA Horn Antenna 18-40GHz	C0433	28th September 2023	36 Months

----------END OF REPORT----------