

Test Report for the FCC and ISED Testing of an JRD-1171 BLE Module to FCC Rule 47CFR 15.247 and ISED RSS-247 for JR Dynamics Ltd (t/a Transmission Dynamics)

Report number: C15847TR2
Project number: C9235

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Issue	Description						Issue by	Date
2	Copy 1		Copy 2		PDF	√	JB	15 th May 2025

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Test Report Change History

Issue	Date	Modification Details
1	25 th March 2025	First Issue
2	15 th May 2025	Antenna gain added to section 3.1 and EIRP values added to section 7.2.6
3		
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:

[UKAS Scope of accreditation](#)

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	JR Dynamics Ltd (t/a Transmission Dynamics)
Address	1 Innovation Way
	Northumberland Business Park
	Cramlington
	NE23 7FP
	United Kingdom
Contact	Matt Nixon
Email	matt@jrdltd.co.uk

Section 3 Equipment Details

3.1 Equipment Under Test (EUT)

Date received:	3rd February 2025		
EUT name:	JRD-1171 BLE Module		
PMN:	JRD-1171 BLE Module		
HVIN:	V1.0		
FVIN:	V1.0.0		
FCC ID:	2BNX4-JRD1171		
ISED number:	33610-JRD1171		
Serial no:	JRD-1171-0001		
EUT description:	The EUT is a new Bluetooth Low Energy (BLE) module design, based on the Nordic Semiconductor nRF52840 system-on-chip (SoC). The module features a u.FL connector for external antenna support. The EUT is intended for use in a wide range of Transmission Dynamics products.		
Antenna	External - Whip - Fanstel Corp. Ant060 (+6dBi) External - Puck - Poynting Puck-5-V1 (+5dBi)		
Transmission	Digital Transmission System (DTS) Bluetooth Low Energy (BLE)		
Modulation schemes	GFSK		
Operating frequency band	2400MHz to 2483.5MHz		
No of units tested:	One		
EUT power:	3.0V via USB port		
Highest internal frequency:	2.480GHz		
Size of EUT (m)	Width: 40 mm	Depth: 30 mm	Height: 11 mm
Mode/s of operation:	Continuous transmit of packetized data at top, middle and bottom channels. Channels used: 2402MHz, 2440MHz and 2480MHz. Radiated tests were performed with the whip antenna and repeated with the puck antenna.		
Test software:	The EUT was placed in the required test mode by connecting it to a tablet PC via a USB-C to USB cable. The EUT settings were changed by using Python commands. The PC always remained outside of the chamber. The customer requested that power level -16 is used during all tests.		
Modifications incorporated during testing:	N/A		

Ports and Cables	Cable Length	Screened/ unshielded	Connected to
USB cable	5m	Unshielded	Tablet PC

3.2 EUT Photographs

Photographs are supplied separately.

3.3 Configuration of EUT

The apparatus was supplied in one single possible configuration.

BLE Channel Number	Frequency	BLE Channel Number	Frequency
0	2404 MHz	20	2446 MHz
1	2406 MHz	21	2448 MHz
2	2408 MHz	22	2450 MHz
3	2410 MHz	23	2452 MHz
4	2412 MHz	24	2454 MHz
5	2414 MHz	25	2456 MHz
6	2416 MHz	26	2458 MHz
7	2418 MHz	27	2460 MHz
8	2420 MHz	28	2462 MHz
9	2422 MHz	29	2464 MHz
10	2424 MHz	30	2466 MHz
11	2428 MHz	31	2468 MHz
12	2430 MHz	32	2470 MHz
13	2432 MHz	33	2472 MHz
14	2434 MHz	34	2474 MHz
15	2436 MHz	35	2476 MHz
16	2438 MHz	36	2478 MHz
17	2440 MHz	37*	2402 MHz
18	2442 MHz	38*	2426 MHz
19	2444 MHz	39*	2480 MHz

*Advertising channels.

BLE Channelization

Lowest channel	-16
Middle channel	-16
Highest channel	-16

Power settings table

Note: Modulation type GFSK, packet length 37 used for all tests.

3.4 EUT Monitoring/Auxiliary Equipment

Equipment name	Type no.	Serial no
Microsoft Surface Tablet	1724 128GB	000045570153

3.5 Monitoring Software

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

Section 4 Test Specifications**For USA:**

Regulation / Test Standard	<p>Regulation:</p> <p>Title 47 of the Code of Federal Regulations (CFR) Part 15 (47CFR15) Subpart C – Intentional Radiators</p> <p>Measurement standard:</p> <p>ANSI C63.10-2020/Cor1-2023 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices</p>
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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	<p>RSS-247 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices Issue 3 August 2023</p> <p>And,</p> <p>RSS-Gen — General Requirements for Compliance of Radio Apparatus Issue 5 April 2018 +A1 March 2019 +A2 February 2021</p>
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Requirement	ISED Regulation	Comments	Results Summary
99% Occupied Bandwidth	ISED 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	<p>ISED RSS-247 § 3.3 and 5.5</p> <p>ISED RSS-GEN Issue 5 Section 8.10</p>	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 JRD-1171 BLE Module, as tested, was shown to meet requirements of the standards listed in Section 4 of this report.

4.3 Decision Rule Statement

The Decision Rule is applied on the basis of the ILAC-G8:09/2019

This guidance document has been prepared to assist laboratories in the use of decision rules when declaring statements of conformity to a specification or standard as required by ISO/IEC 17025:2017

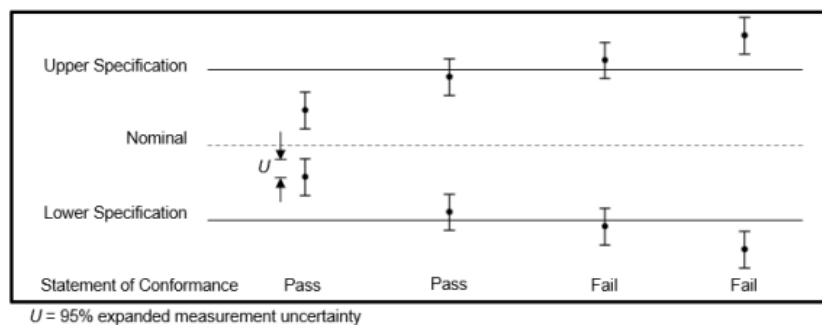
Where a result is considered marginal in respect of its proximity to the limit line, for example, the customer would be made aware of situation so that they can make an informed decision on how to proceed.

A binary decision rule exists when the result is limited to two choices (pass or fail). A non-binary decision rule exists when multiple terms may express the result (pass, conditional pass, conditional fail, fail). These are further explained below.

The laboratory recommends to use Binary Statement for Simple Acceptance Rule ($w = 0$)

Statements of conformity are reported as:

- Pass - the measured value is below the acceptance limit, $AL = TL$.
- Fail - the measured value is above the acceptance limit, $AL = TL$



Section 5 Spurious Emission Results – Radiated and Conducted

5.1 Test Specification

FCC Rule Part	47CFR 15.247 (d)
Standard	ANSIC63.10-2020/Cor1-2023
Measurement Uncertainty Radiated tests	The reported uncertainty of measurement $y \pm U$, 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 tests	± 1.4 dB

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 10
Eurofins E&E UK test procedure (1GHz to 40GHz)	CEP64 Issue 11
Test software	RadiMation Version 2023.1.6

Conducted Tests 47CFR 15.247(d)

ANSIC63.10-2020/Cor1-2023 Clause reference:	11.11
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**

12th February 2025

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.

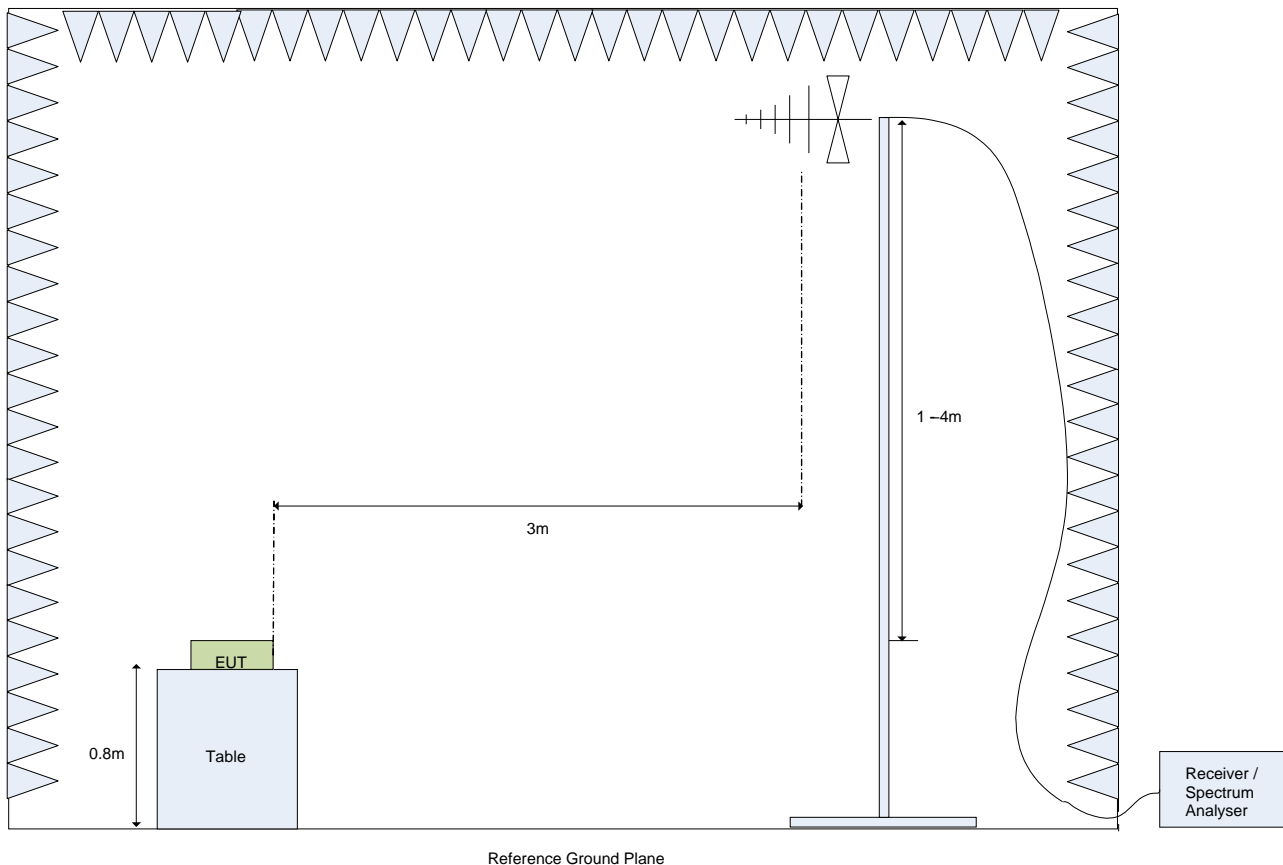


Figure 1 Test Setup for E-Field Measurements from 30MHz to 1GHz

Note 1 : With the EUT de-energized the ambient radio noise and signals met the 6dB peak detection requirement of ANSIC63.10-2020/Cor1-2023.

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 continuously on the following channels: 2402MHz, 2440MHz and 2480MHz.

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 2480MHz.

Note: The customer supplied two different antenna variants, as such radiated tests were performed for both antenna variants.

5.3.7 Electric field emissions, 30MHz to 1GHz – Whip Antenna

RadiMation

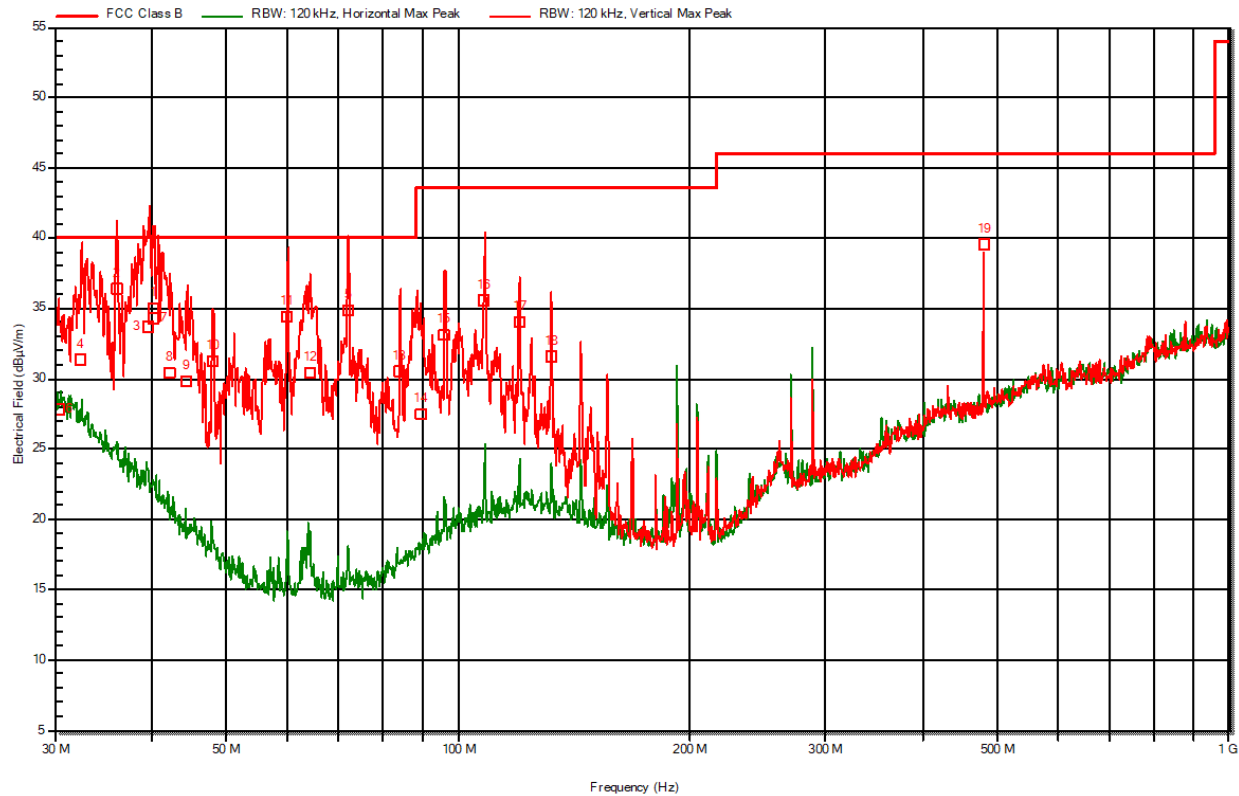


Figure 2 Electric field emissions Plot, 30MHz to 1GHz, 2480MHz Operation – Whip Antenna

Frequency MHz	Quasi- Peak dB μ V/m	Quasi Peak Limit dB μ V/m	Quasi- Peak Difference dB	Quasi- Peak Status	Angle degrees	Height m	Polarization
40.20	35.0	40.0	-5.0	Pass	60	1.0	Vertical
36.06	36.4	40.0	-3.6	Pass	100	1.0	Vertical
39.66	33.7	40.0	-6.3	Pass	225	1.0	Vertical
32.46	31.3	40.0	-8.7	Pass	330	1.0	Vertical
72.00	34.9	40.0	-5.1	Pass	290	2.0	Vertical
30.30	27.8	40.0	-12.2	Pass	60	1.0	Vertical
40.32	34.2	40.0	-5.8	Pass	315	1.0	Vertical
42.24	30.4	40.0	-9.6	Pass	335	1.0	Vertical
44.46	29.8	40.0	-10.2	Pass	35	1.0	Vertical
48.00	31.3	40.0	-8.7	Pass	270	1.0	Vertical
60.06	34.4	40.0	-5.6	Pass	345	1.0	Vertical
64.26	30.4	40.0	-9.6	Pass	70	1.7	Vertical
84.06	30.6	40.0	-9.4	Pass	110	1.4	Vertical
89.34	27.4	43.5	-16.1	Pass	210	1.1	Vertical
96.00	33.1	43.5	-10.4	Pass	180	1.0	Vertical
108.00	35.6	43.5	-7.9	Pass	55	1.0	Vertical
120.00	34.1	43.5	-9.4	Pass	295	1.0	Vertical
132.00	31.6	43.5	-11.9	Pass	330	1.0	Vertical
480.06	39.5	46.0	-6.5	Pass	265	1.1	Vertical

Table 1 Electric Field Emissions Peaks, 30MHz to 1GHz. 2480MHz Operation – Whip Antenna

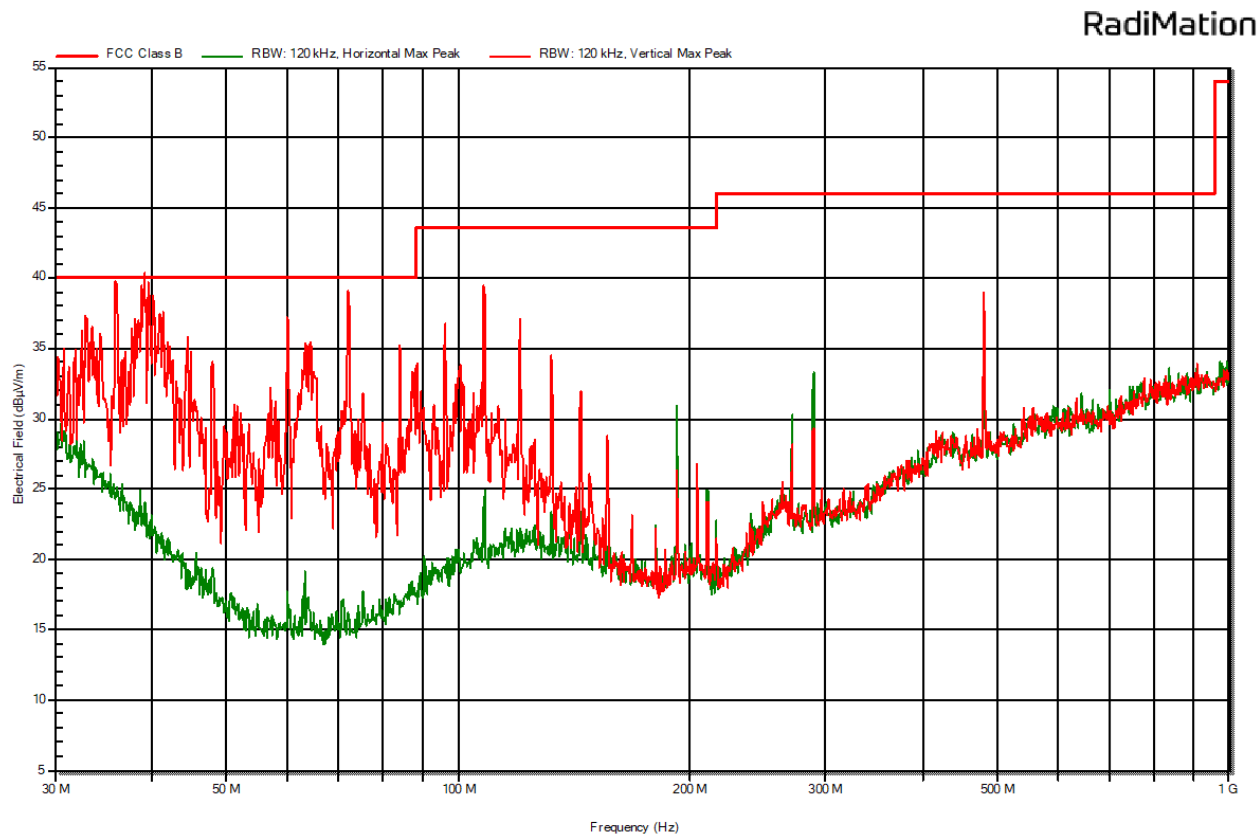


Figure 3 Electric field emissions Plot, 30MHz to 1GHz, Operation on 2402MHz - Peak detector scan – Whip Antenna

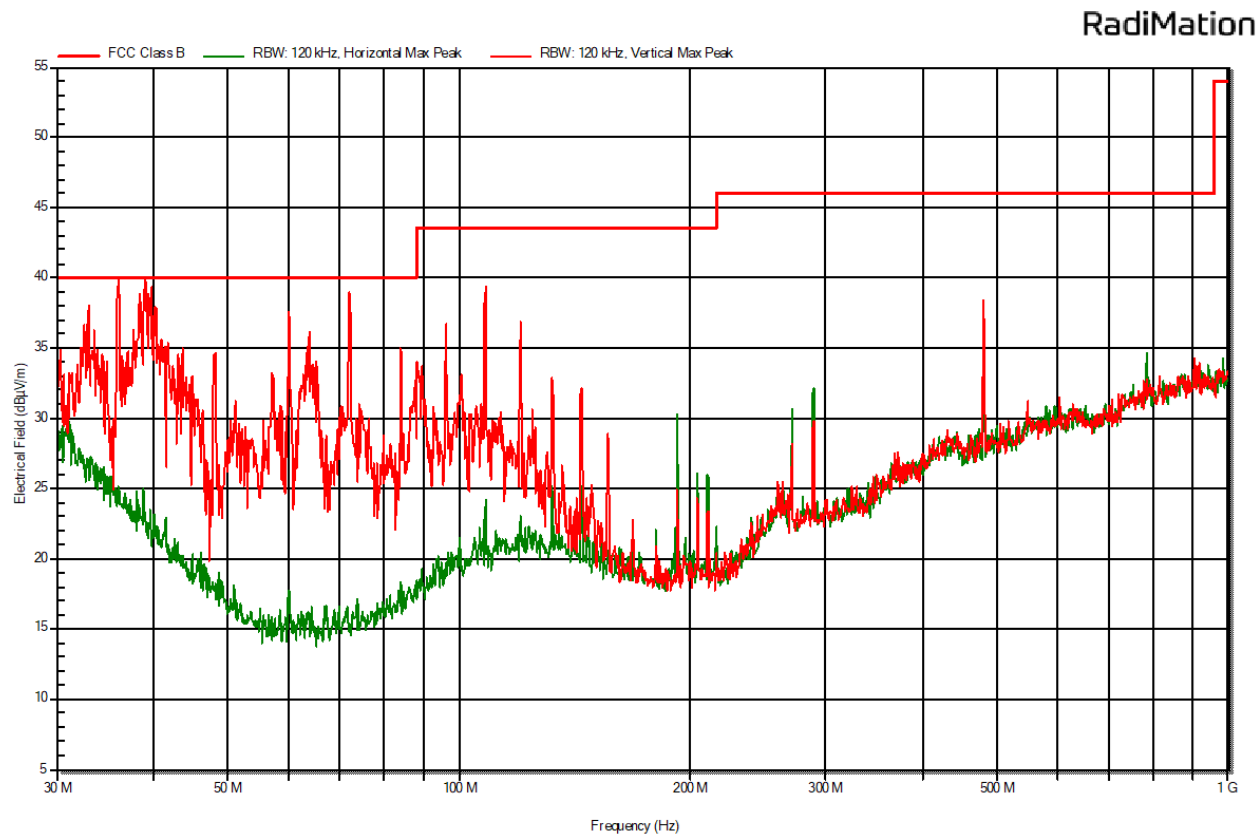


Figure 4 Electric field emissions Plot, 30MHz to 1GHz, Operation on 2440MHz - Peak detector scan – Whip Antenna

5.3.8 Electric field emissions, 30MHz to 1GHz – Puck Antenna

RadiMation

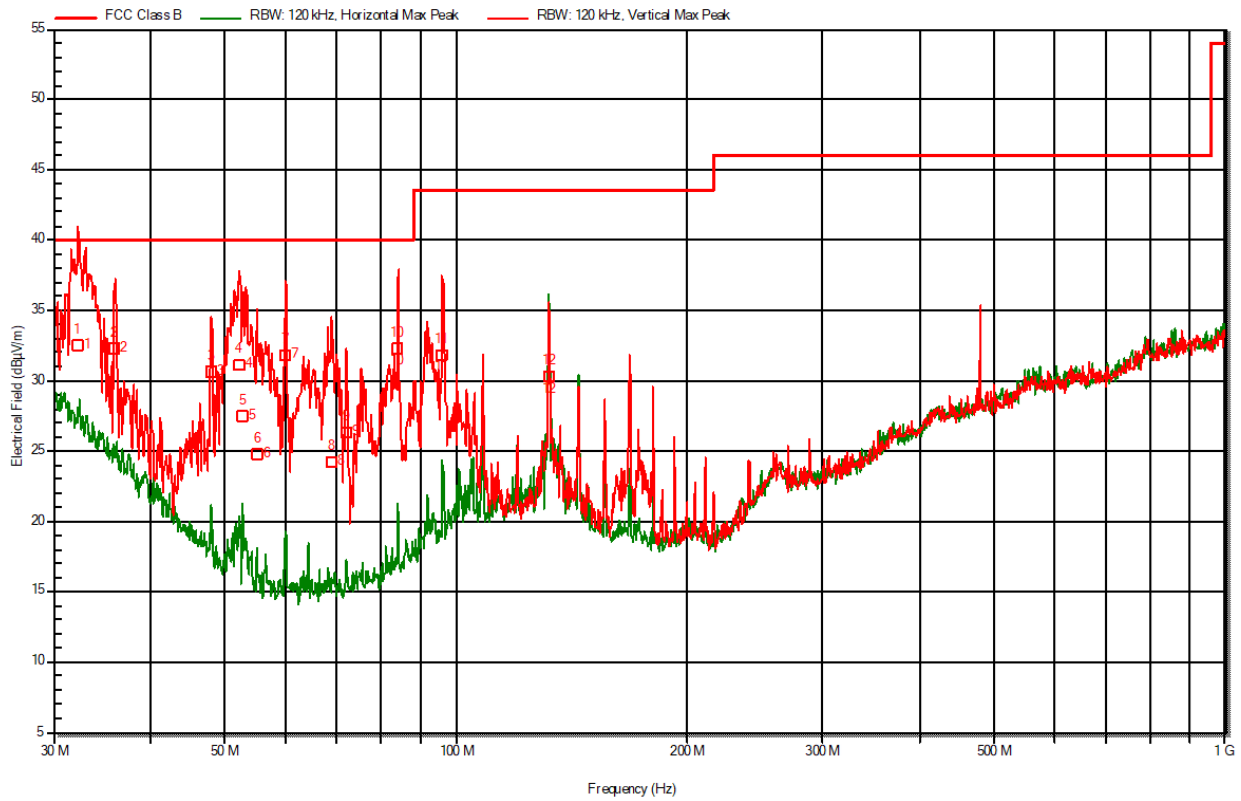


Figure 5 Electric field emissions Plot, 30MHz to 1GHz, 2480MHz Operation – Puck Antenna

Frequency MHz	Quasi- Peak dBμV/m	Quasi Peak Limit dBμV/m	Quasi- Peak Difference dB	Quasi- Peak Status	Angle degrees	Height m	Polarization
32.22	32.6	40.0	-7.4	Pass	79	1.0	Vertical
36.00	32.3	40.0	-7.7	Pass	110	1.0	Vertical
48.06	30.6	40.0	-9.4	Pass	270	1.0	Vertical
52.20	31.2	40.0	-8.8	Pass	359	1.0	Vertical
52.68	27.5	40.0	-12.5	Pass	215	1.0	Vertical
55.08	24.8	40.0	-15.2	Pass	240	1.1	Vertical
60.00	31.8	40.0	-8.2	Pass	225	1.0	Vertical
68.88	24.1	40.0	-15.9	Pass	175	1.4	Vertical
72.00	26.4	40.0	-13.6	Pass	315	1.7	Vertical
84.00	32.3	40.0	-7.7	Pass	95	1.3	Vertical
96.00	31.8	43.5	-11.7	Pass	300	1.0	Vertical
132.00	30.2	43.5	-13.3	Pass	280	1.8	Vertical

Table 2 Electric Field Emissions Peaks, 30MHz to 1GHz. 2480MHz Operation – Puck Antenna

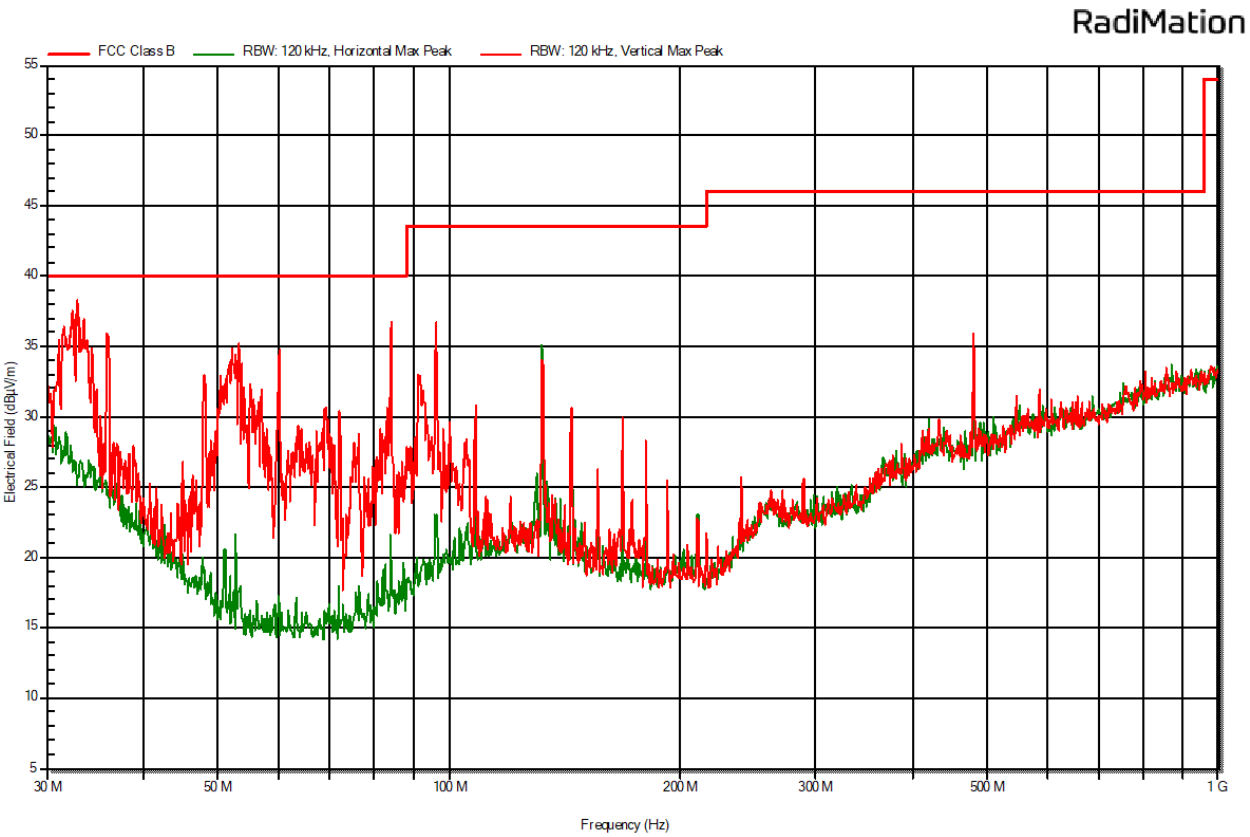


Figure 6 Electric field emissions Plot, 30MHz to 1GHz, Operation on 2402MHz - Peak detector scan – Puck Antenna

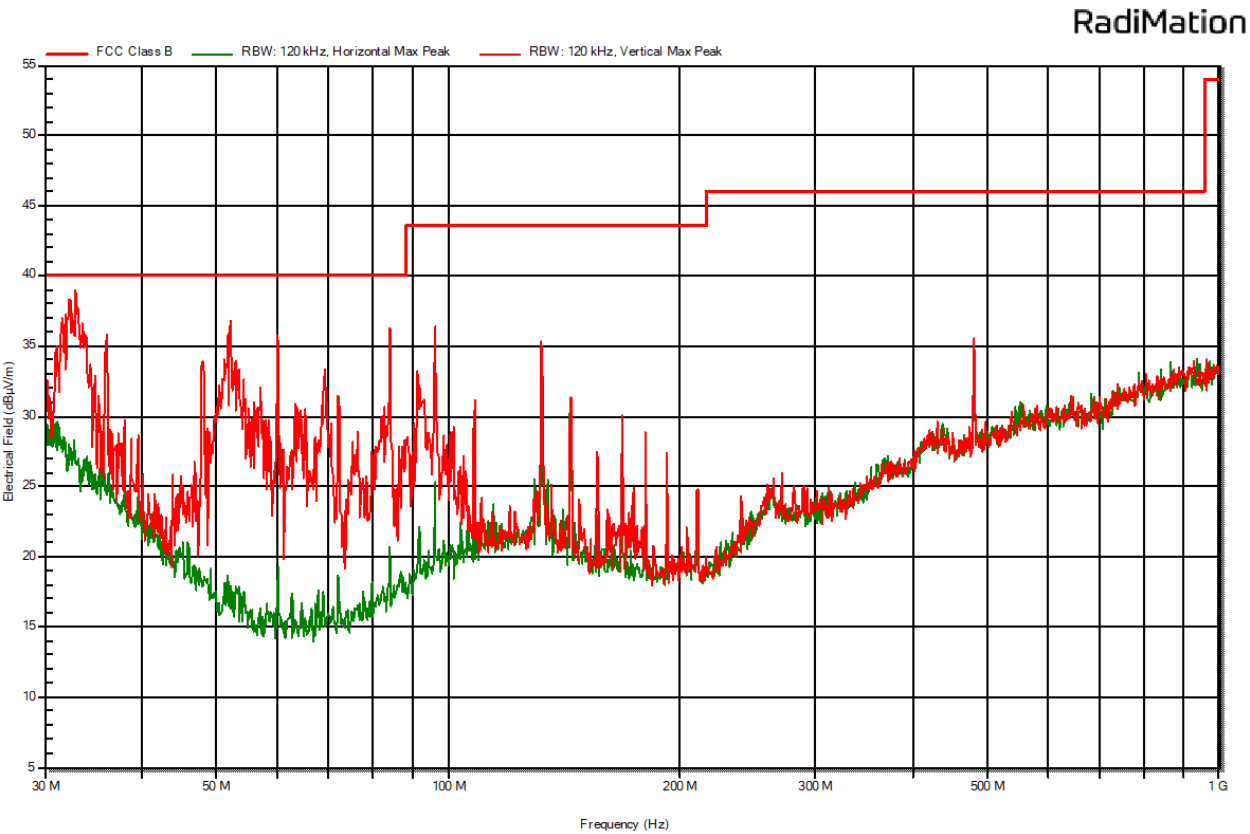


Figure 7 Electric field emissions Plot, 30MHz to 1GHz, Operation on 2440MHz - Peak detector scan – Puck Antenna

5.4 Radiated Emissions (1GHz to 18GHz)**5.4.1 Limits**

Frequency (GHz)	Limit (dB μ V/m)	Limit (dB μ V/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**11th February 2025**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 an 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.

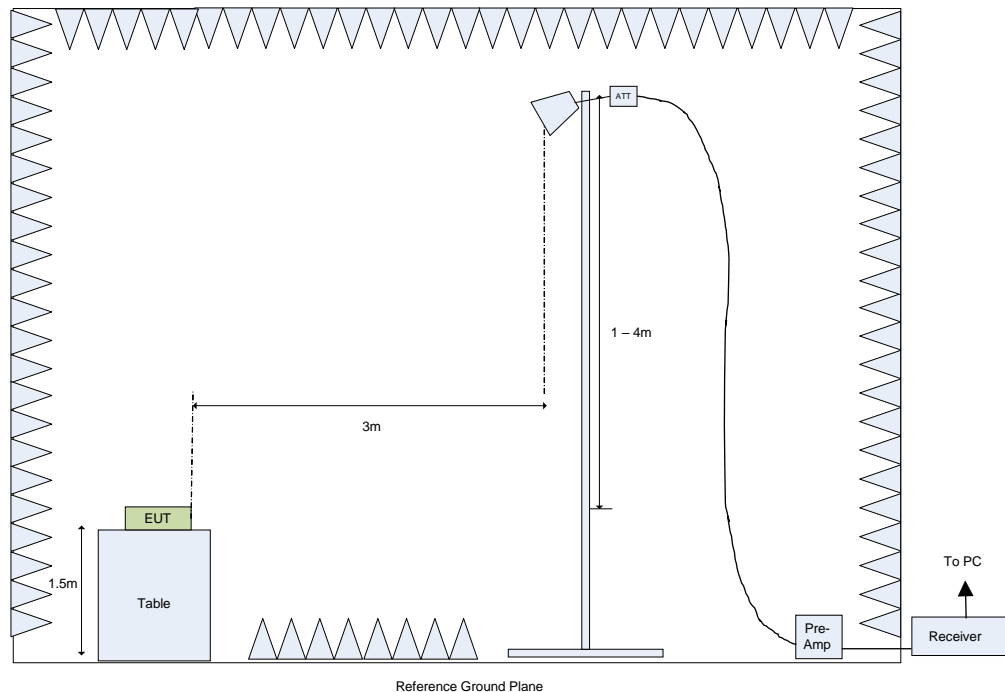


Figure 5.4.7.1: Test Setup for Final E-Field Measurements from 1GHz to 18GHz

Note 1: With the EUT de-energized the ambient radio noise and signals met the 6dB peak detection requirement of ANSIC63.10-2020/Cor1-2023.

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 – Whip Antenna

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
1.069	Transmitting on channel 2480MHz	Front	0	1.5	V
1.171	Transmitting on channel 2440MHz	Front	0	1.5	V
1.545	Transmitting on channel 2480MHz	Front	0	1.5	V
2.114	Transmitting on channel 2402MHz	Front	0	1.5	V
2.152	Transmitting on channel 2440MHz	Front	0	1.5	V
2.172	Transmitting on channel 2440MHz	Front	0	1.5	V
2.182	Transmitting on channel 2402MHz	Front	0	1.5	V
2.188	Transmitting on channel 2440MHz	Front	0	1.5	V
2.193	Transmitting on channel 2480MHz	Front	0	1.5	V
2.194	Transmitting on channel 2402MHz	Front	0	1.5	V
2.215	Transmitting on channel 2402MHz	Front	0	1.5	V
2.217	Transmitting on channel 2440MHz	Front	0	1.5	V
2.232	Transmitting on channel 2440MHz	Front	0	1.5	V
2.913	Transmitting on channel 2440MHz	Front	0	1.5	V
4.804	Transmitting on channel 2440MHz	Front	0	1.5	V
5.849	Transmitting on channel 2440MHz	Front	0	1.5	V
7.208	Transmitting on channel 2440MHz	Front	0	1.5	V
7.441	Transmitting on channel 2480MHz	Front	0	1.5	V

Table 3 Frequencies identified during Exploratory Radiated Emission maximization – Whip Antenna

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 7.5GHz during the exploratory investigation, final measurements were performed up to 10GHz only.

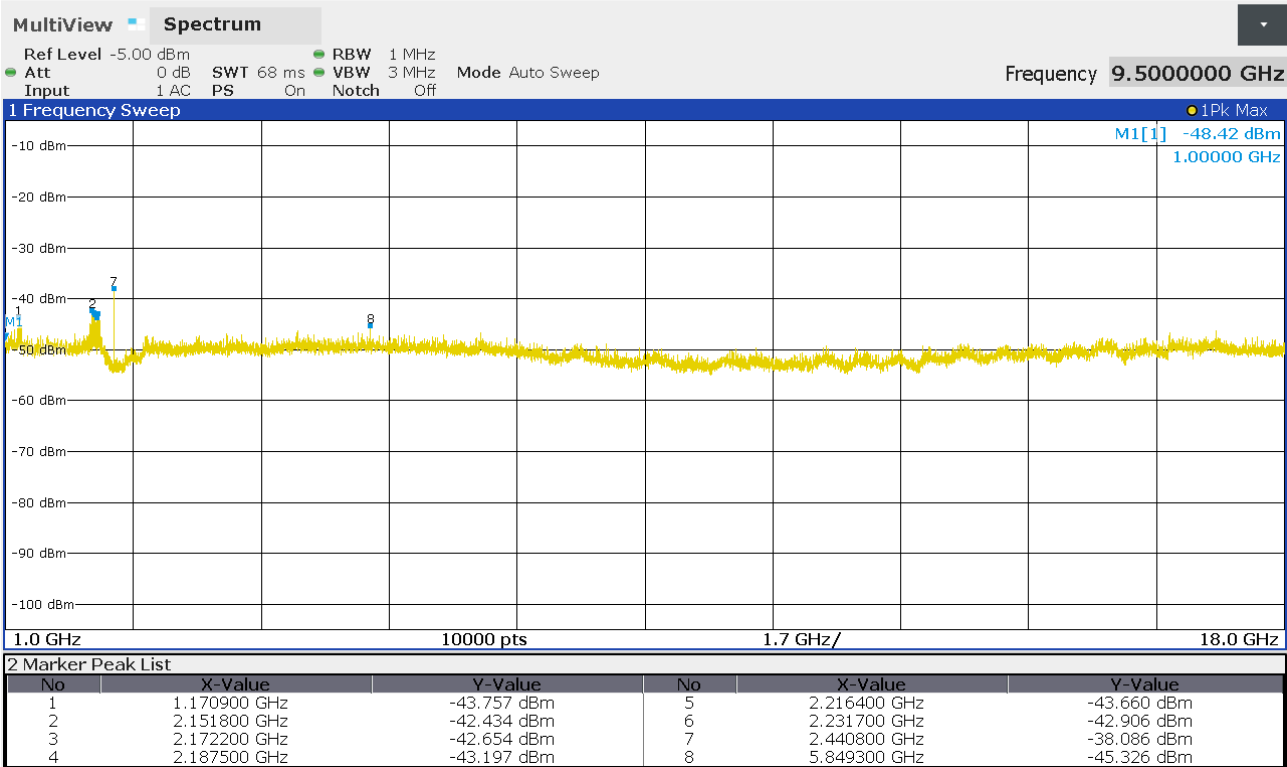


Figure 8 – Manual investigation – Operating on BLE channel 2440MHz – Whip Antenna

5.4.9 Electric field emissions, 1GHz to 18GHz – Whip Antenna

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 2480MHz

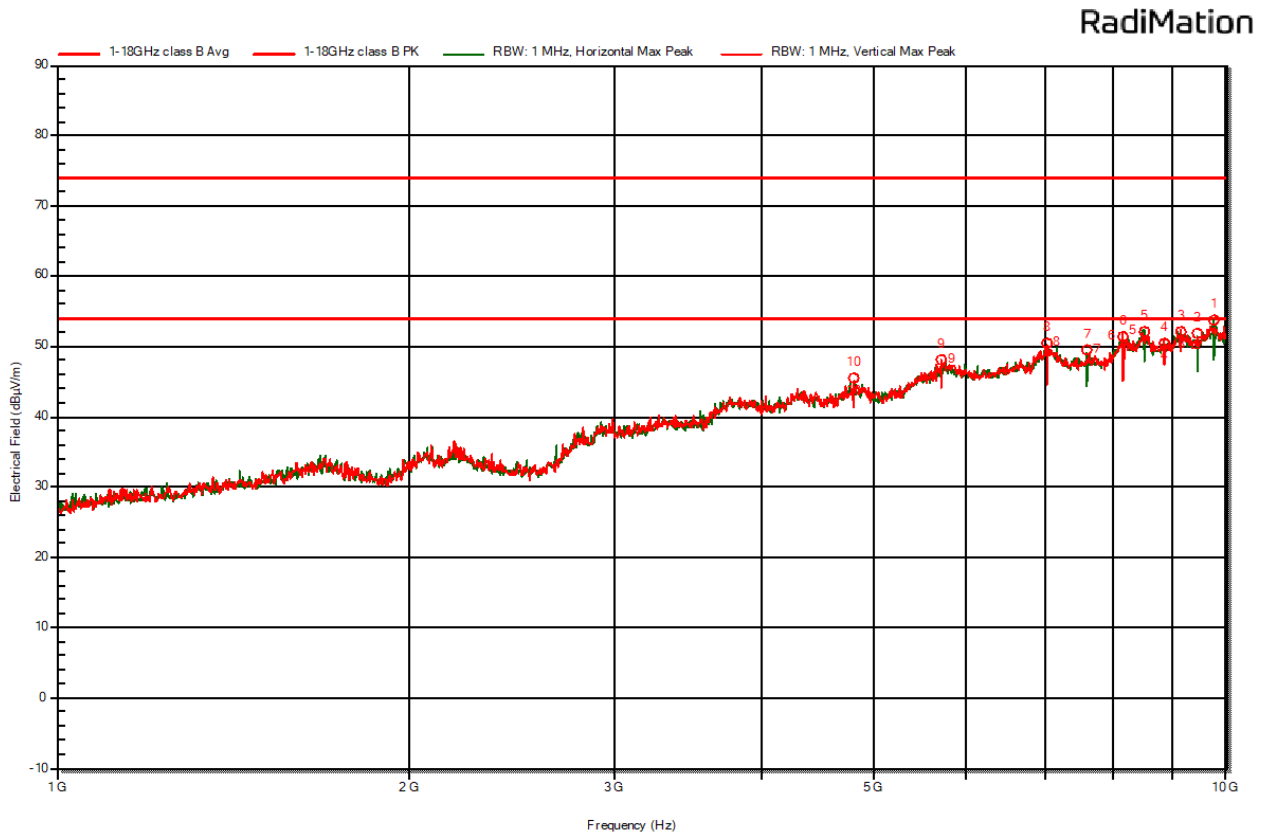


Figure 9 Electric field emissions Plot, 1GHz to 10GHz. Operation on 2480MHz – Whip Antenna

Frequency GHz	Average dBμV/m	Average Limit dBμV/m	Average Difference dB	Average Status	Angle degrees	Height m	Polarization
9.769	40.4	54.0	-13.6	Pass	335	3.7	Horizontal
9.440	38.3	54.0	-15.7	Pass	275	1.2	Horizontal
9.132	39.2	54.0	-14.8	Pass	10	1.2	Vertical
8.854	37.8	54.0	-16.2	Pass	115	1.3	Vertical
8.500	39.3	54.0	-14.7	Pass	325	3.6	Horizontal
8.163	38.3	54.0	-15.7	Pass	105	2.8	Vertical
7.608	36.0	54.0	-18.0	Pass	80	3.9	Horizontal
7.017	37.1	54.0	-16.9	Pass	105	1.8	Vertical
5.702	34.9	54.0	-19.1	Pass	25	2.2	Vertical
4.801	31.8	54.0	-22.2	Pass	345	3.6	Vertical

Table 4 Electric Field Emissions Peaks, 1GHz to 10GHz – Operation on 2480MHz – Whip Antenna

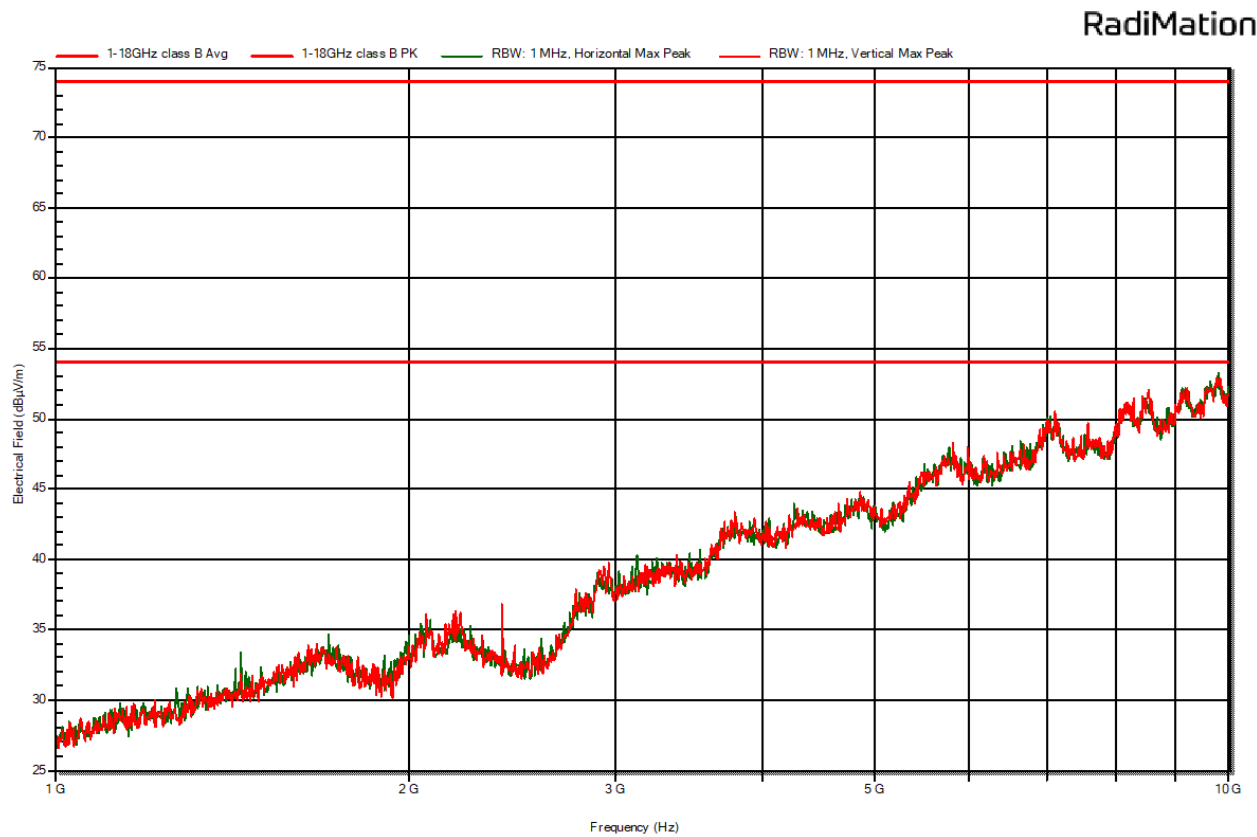


Figure 10 Electric field emissions Plot, 1GHz to 10GHz, Operation on 2402MHz - Peak detector scan – Whip Antenna

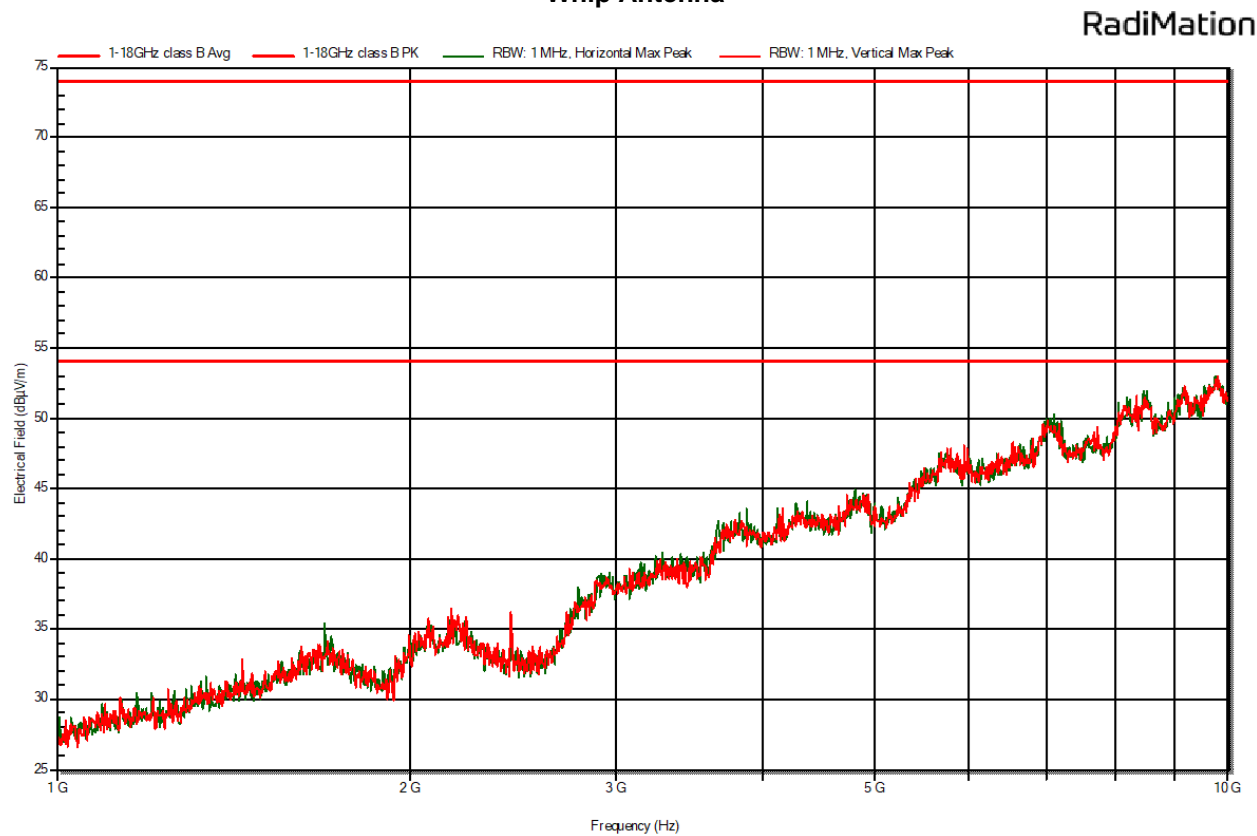


Figure 11 Electric field emissions Plot, 1GHz to 10GHz, Operation on 2440MHz – Peak detector scan – Whip Antenna

5.4.10 Exploratory Radiated Emission Maximization – Puck Antenna

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
1.008	Transmitting on channel 2402MHz	Front	0	1.5	V
1.060	Transmitting on channel 2402MHz	Front	0	1.5	V
1.088	Transmitting on channel 2480MHz	Front	0	1.5	V
1.200	Transmitting on channel 2480MHz	Front	0	1.5	V
1.365	Transmitting on channel 2402MHz	Front	0	1.5	V
2.152	Transmitting on channel 2440MHz	Front	0	1.5	V
2.160	Transmitting on channel 2480MHz	Front	0	1.5	V
2.172	Transmitting on channel 2440MHz	Front	0	1.5	V
2.176	Transmitting on channel 2480MHz	Front	0	1.5	V
2.177	Transmitting on channel 2402MHz	Front	0	1.5	V
2.188	Transmitting on channel 2440MHz	Front	0	1.5	V
2.193	Transmitting on channel 2480MHz	Front	0	1.5	V
2.194	Transmitting on channel 2402MHz	Front	0	1.5	V
2.198	Transmitting on channel 2402MHz	Front	0	1.5	V
2.201	Transmitting on channel 2440MHz	Front	0	1.5	V
2.210	Transmitting on channel 2402MHz	Front	0	1.5	V
2.216	Transmitting on channel 2440MHz	Front	0	1.5	V
2.228	Transmitting on channel 2480MHz	Front	0	1.5	V
2.232	Transmitting on channel 2440MHz	Front	0	1.5	V
2.252	Transmitting on channel 2440MHz	Front	0	1.5	V
2.256	Transmitting on channel 2480MHz	Front	0	1.5	V
7.441	Transmitting on channel 2480MHz	Front	0	1.5	V

Table 5 Frequencies identified during Exploratory Radiated Emission maximization – Puck Antenna

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 7.5GHz during the exploratory investigation, final measurements were performed up to 10GHz only.

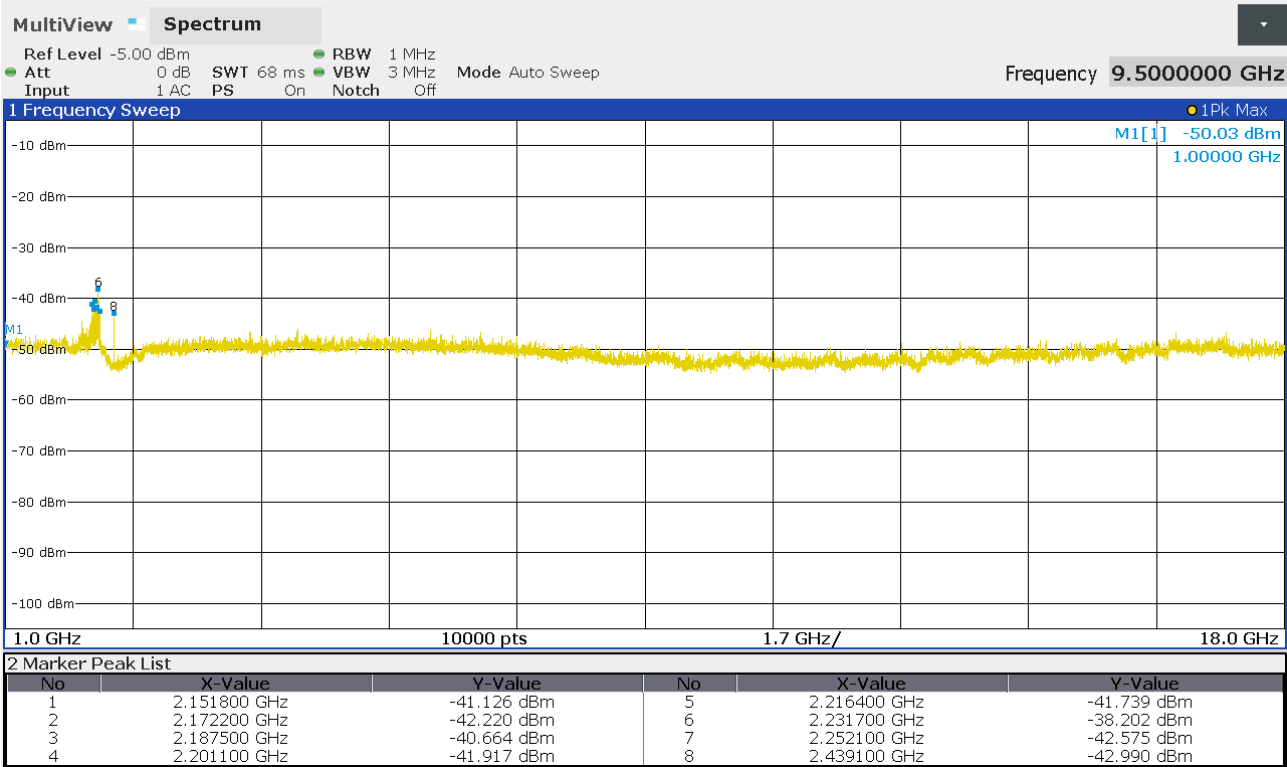


Figure 12 – Manual investigation – Operating on BLE channel 2440MHz – Puck Antenna

5.4.11 Electric field emissions, 1GHz to 18GHz – Puck Antenna

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 2480MHz

RadiMation

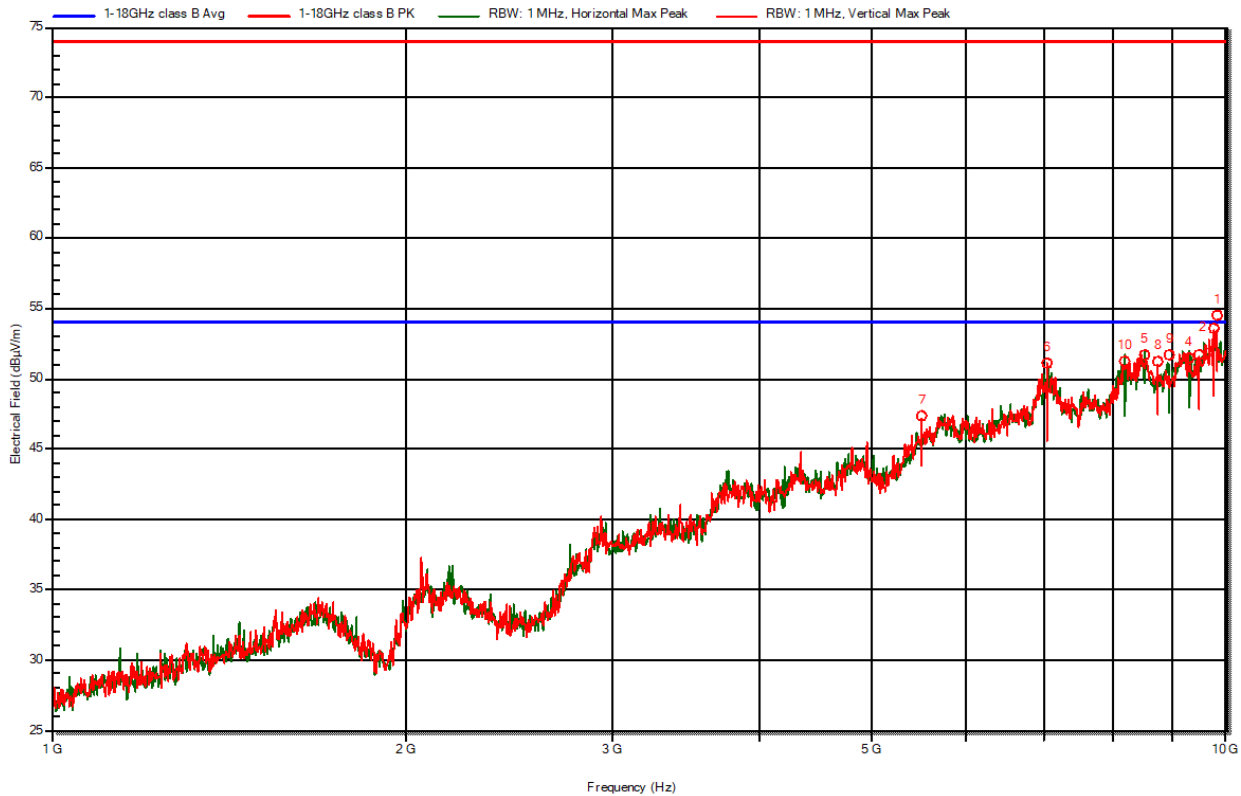


Figure 13 Electric field emissions Plot, 1GHz to 10GHz. Operation on 2480MHz – Puck Antenna

Frequency GHz	Average dBμV/m	Average Limit dBμV/m	Average Difference dB	Average Status	Angle degrees	Height m	Polarization
9.821	40.7	54.0	-13.3	Pass	55	1.0	Vertical
9.744	40.4	54.0	-13.6	Pass	355	2.2	Vertical
9.465	38.5	54.0	-15.5	Pass	265	1.0	Vertical
9.308	38.6	54.0	-15.4	Pass	205	2.5	Horizontal
8.509	38.9	54.0	-15.1	Pass	165	1.3	Horizontal
7.027	37.7	54.0	-16.3	Pass	225	3.9	Vertical
5.501	34.0	54.0	-20.0	Pass	55	1.4	Vertical
8.744	37.8	54.0	-16.2	Pass	240	2.3	Vertical
8.930	38.1	54.0	-15.9	Pass	55	3.9	Horizontal
8.204	38.6	54.0	-15.5	Pass	250	1.2	Horizontal

Table 6 Electric Field Emissions Peaks, 1GHz to 10GHz – Operation on 2480MHz – Puck Antenna



Figure 14 Electric field emissions Plot, 1GHz to 10GHz, Operation on 2402MHz - Peak detector scan – Puck Antenna

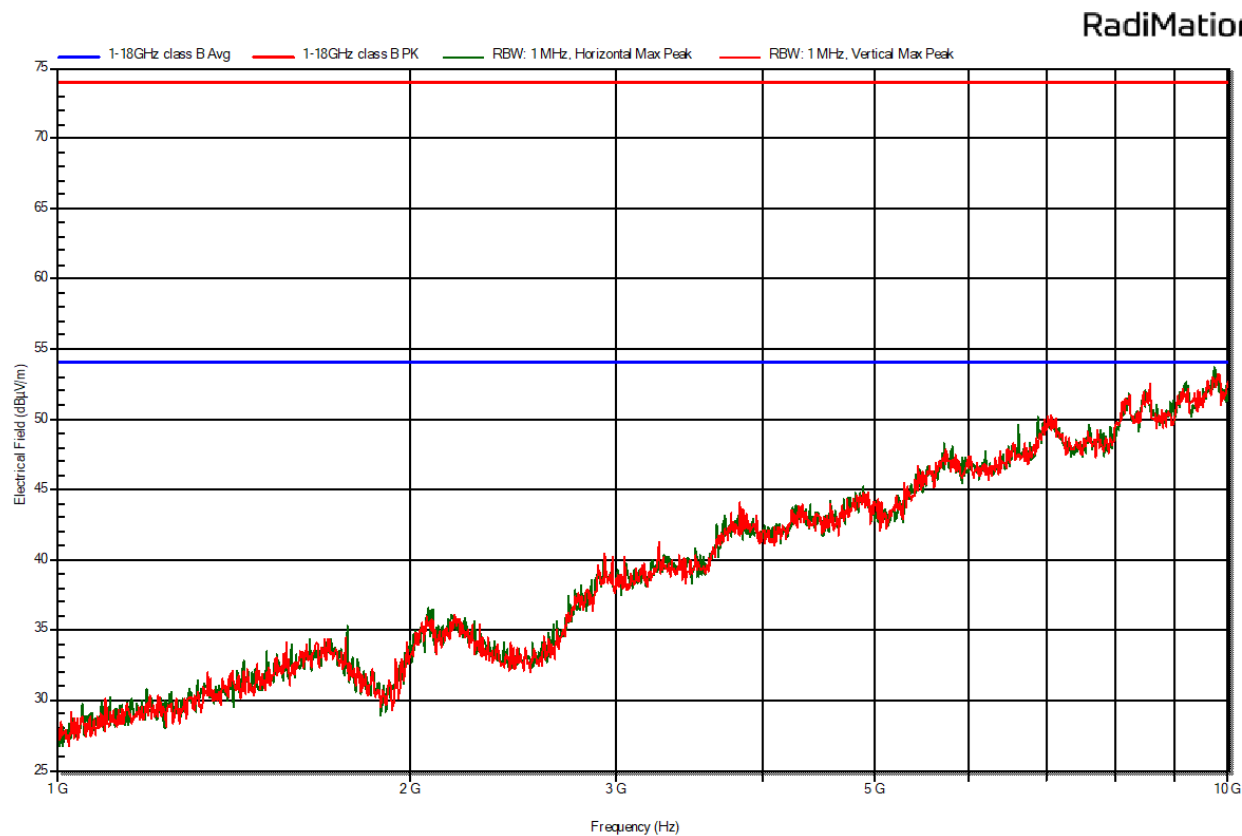


Figure 15 Electric field emissions Plot, 1GHz to 10GHz, Operation on 2440MHz – Peak detector scan – Puck Antenna

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:

$$\text{FS (dB}\mu\text{V/m)} = \text{Indicated Signal Level (dB}\mu\text{V)} - \text{PG (dB)} + \text{AF (dB)} + \text{CL (dB)}$$

5.4.13 Sample Data

From Figure 13 and table 6, The Average level at 8.204GHz is calculated as follows:

$$\text{FS (dB}\mu\text{V/m)} = 44.9(\text{dB}\mu\text{V}) - 54.5(\text{dB}) + 40.4(\text{dB/m}) + 7.8(\text{dB}) = 38.6\text{dB}\mu\text{V/m}$$

5.5 Radiated Emissions (18GHz to 26GHz)**5.5.1 Limits**

Frequency (GHz)	Limit (dB μ V/m)	Limit (dB μ V/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**11th February 2025**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 – Whip Antenna

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 7 Frequencies identified during Exploratory Radiated Emission maximization – Whip Antenna

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

No emissions were identified for further investigation above 18GHz.

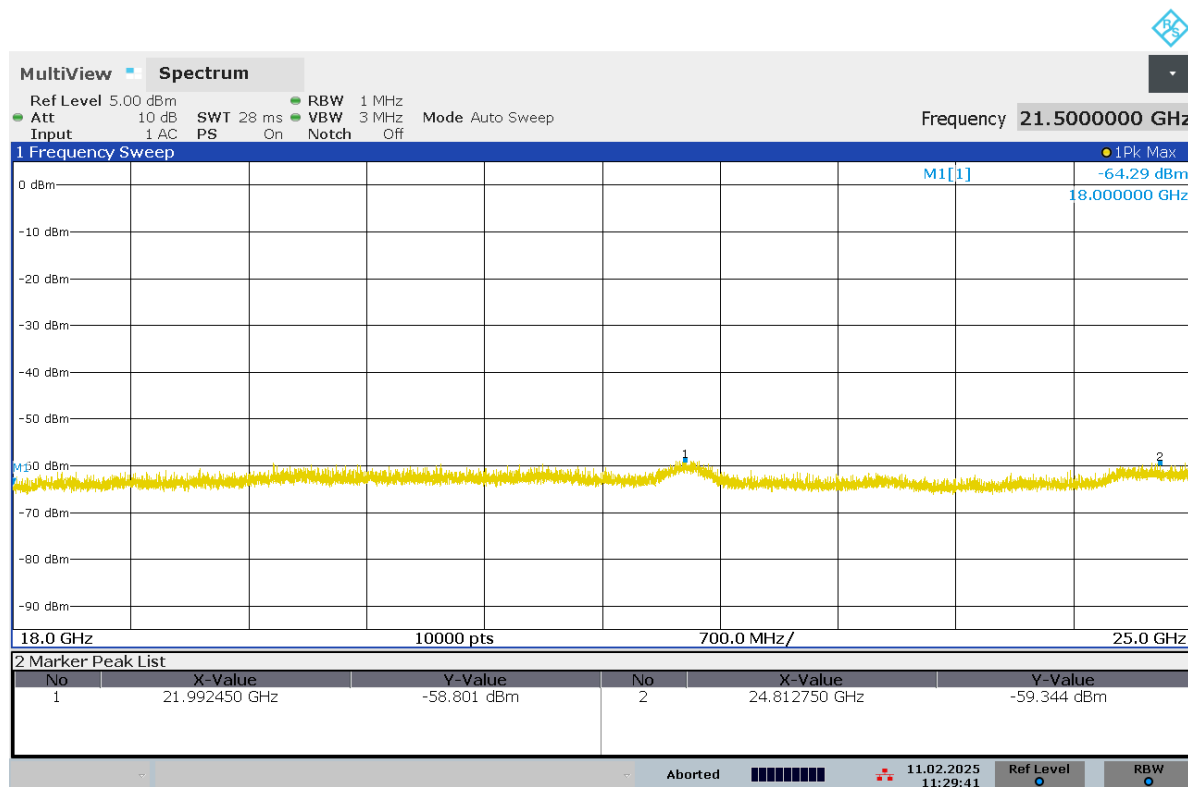


Figure 16 – Manual investigation – Operating on channel 2402MHz – Whip Antenna

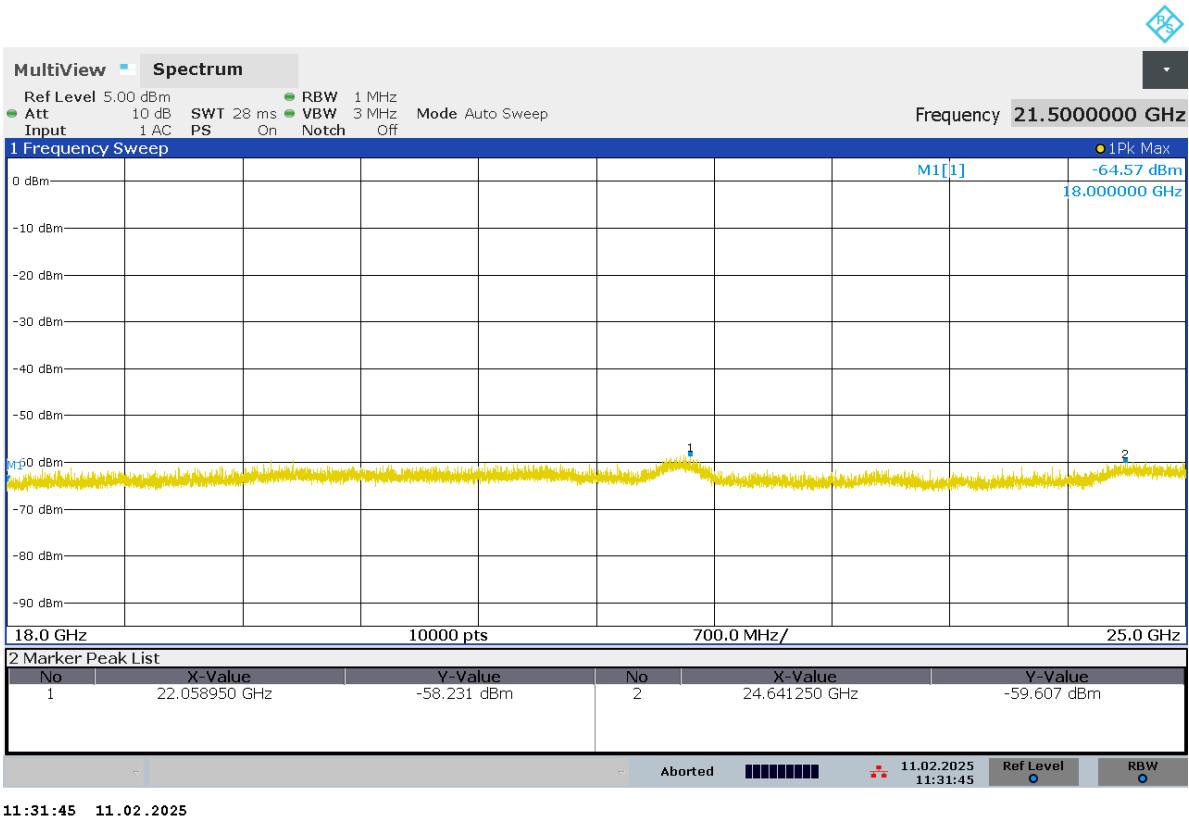


Figure 17 – Manual investigation – Operating on channel 2440MHz – Whip Antenna

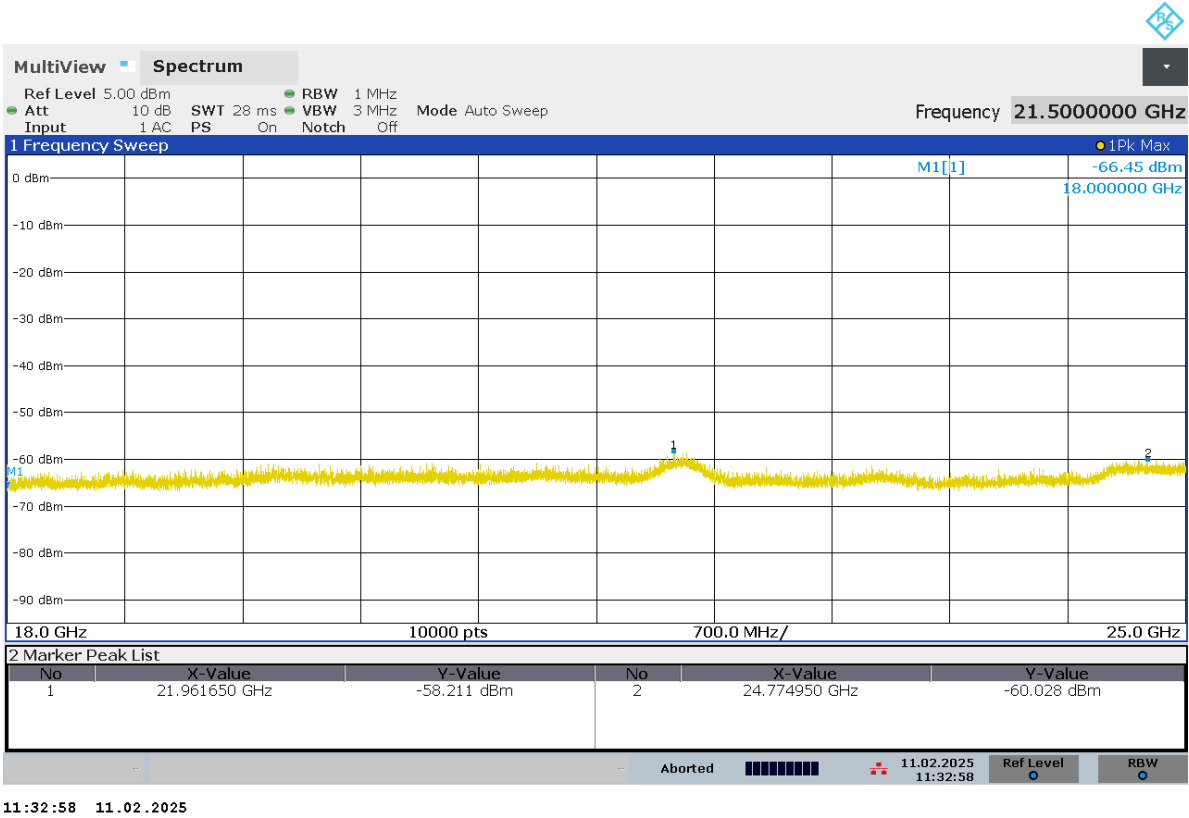


Figure 18 – Manual investigation – Operating on channel 2480MHz – Whip Antenna

5.5.9 Exploratory Radiated Emission Maximization – Puck Antenna

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 8 Frequencies identified during Exploratory Radiated Emission maximization – Puck Antenna

Note 2 : The front face of the EUT is deemed to be 0°, which is then turned in a clockwise direction through 360°.

No emissions were identified for further investigation above 18GHz.

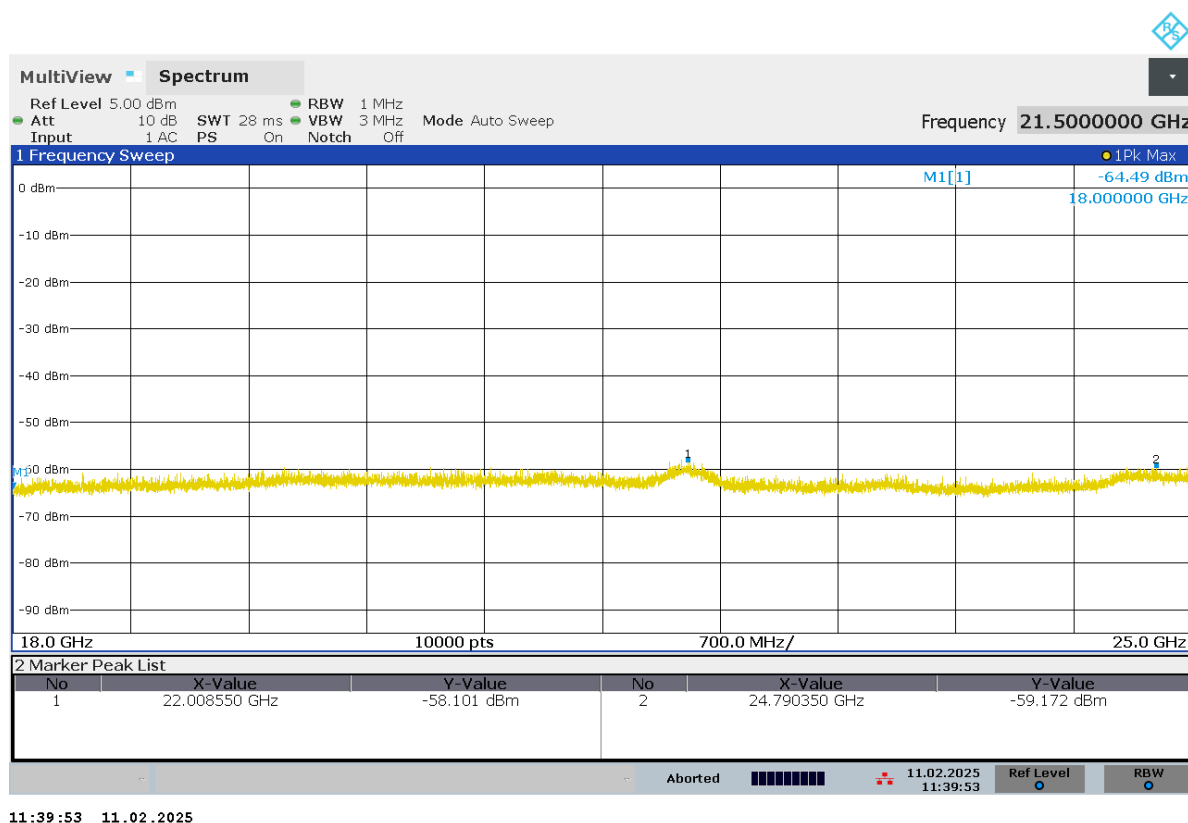


Figure 19 – Manual investigation – Operating on channel 2402MHz – Puck Antenna

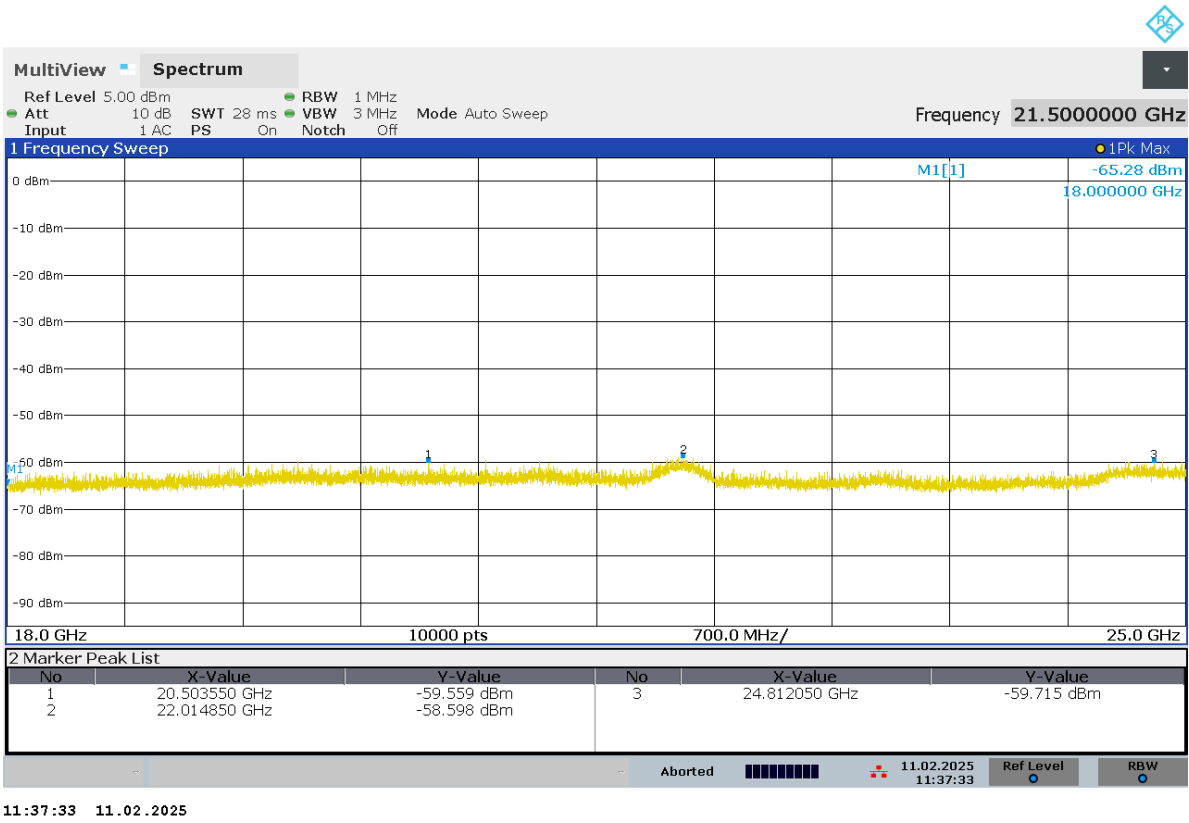


Figure 20 – Manual investigation – Operating on channel 2440MHz – Puck Antenna

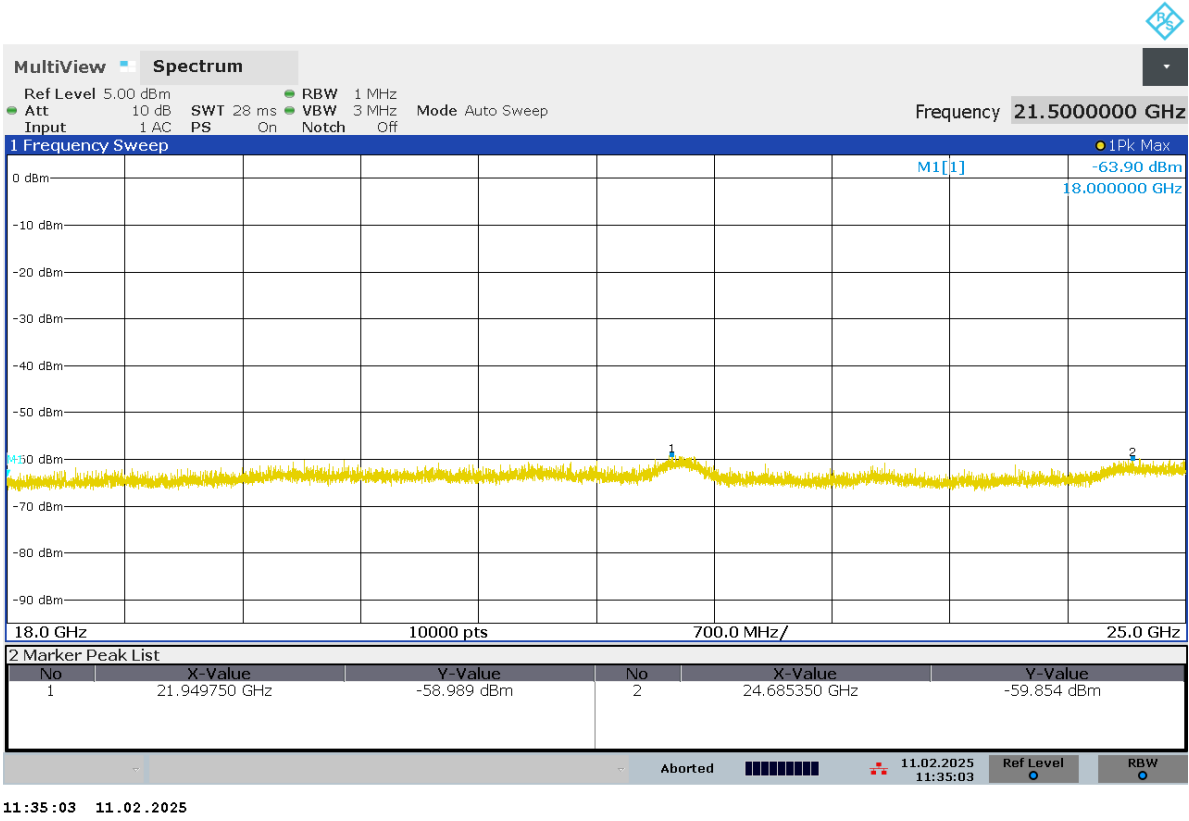


Figure 21 – Manual investigation – Operating on channel 2480MHz – Puck Antenna

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 ANSIC63.10-2020/Cor1-2023 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

6th February 2025

5.6.4 Test Area

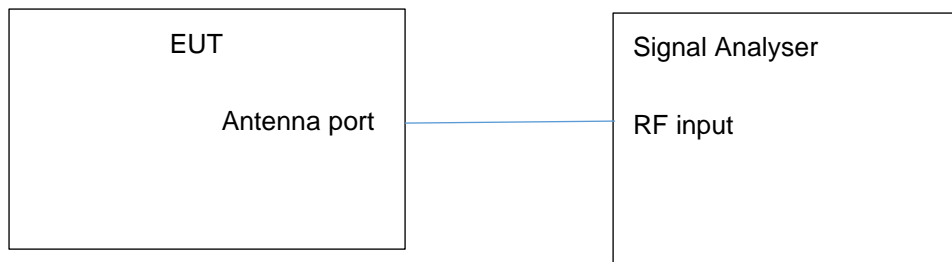
LAB 8

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.

Date: 15th May 2025

Report Number: C15847TR2

5.6.8 Antenna port conducted emissions, 30MHz to 25GHz

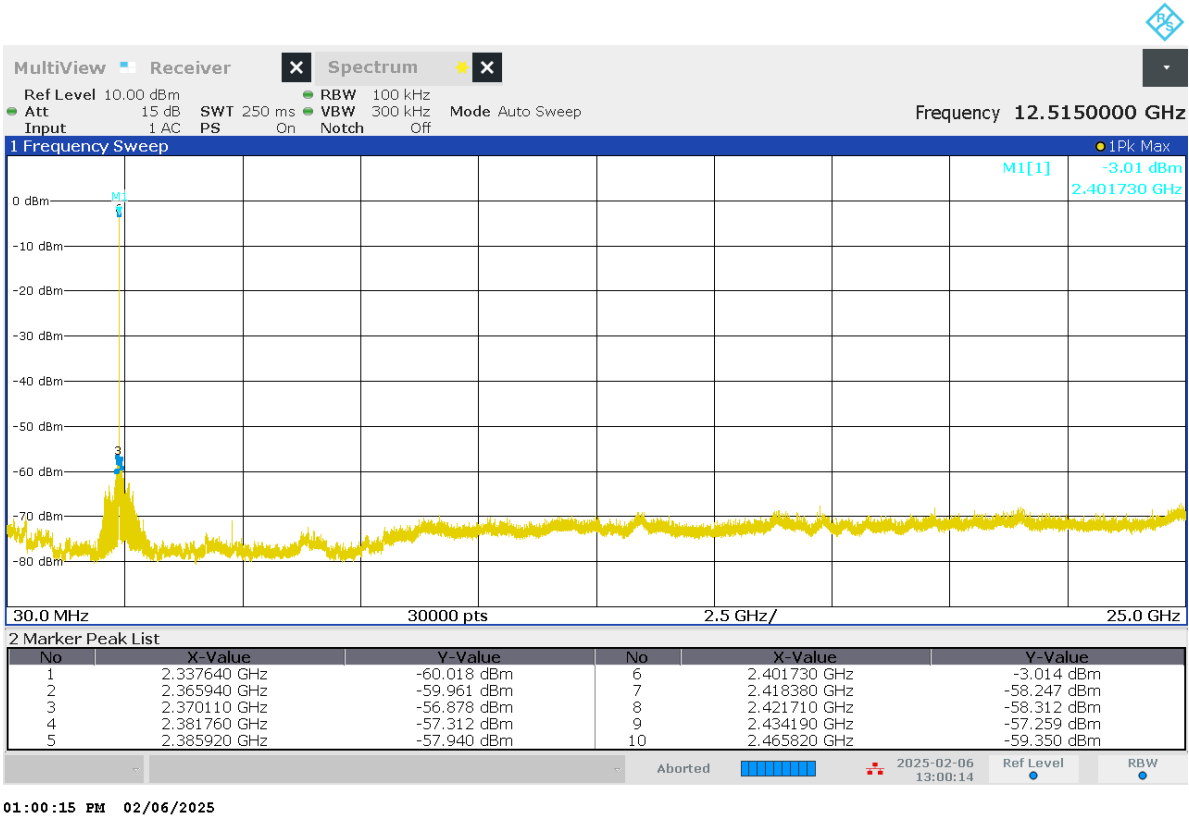


Figure 22 Conducted emissions 30MHz to 25GHz. Operation on channel 2402MHz.

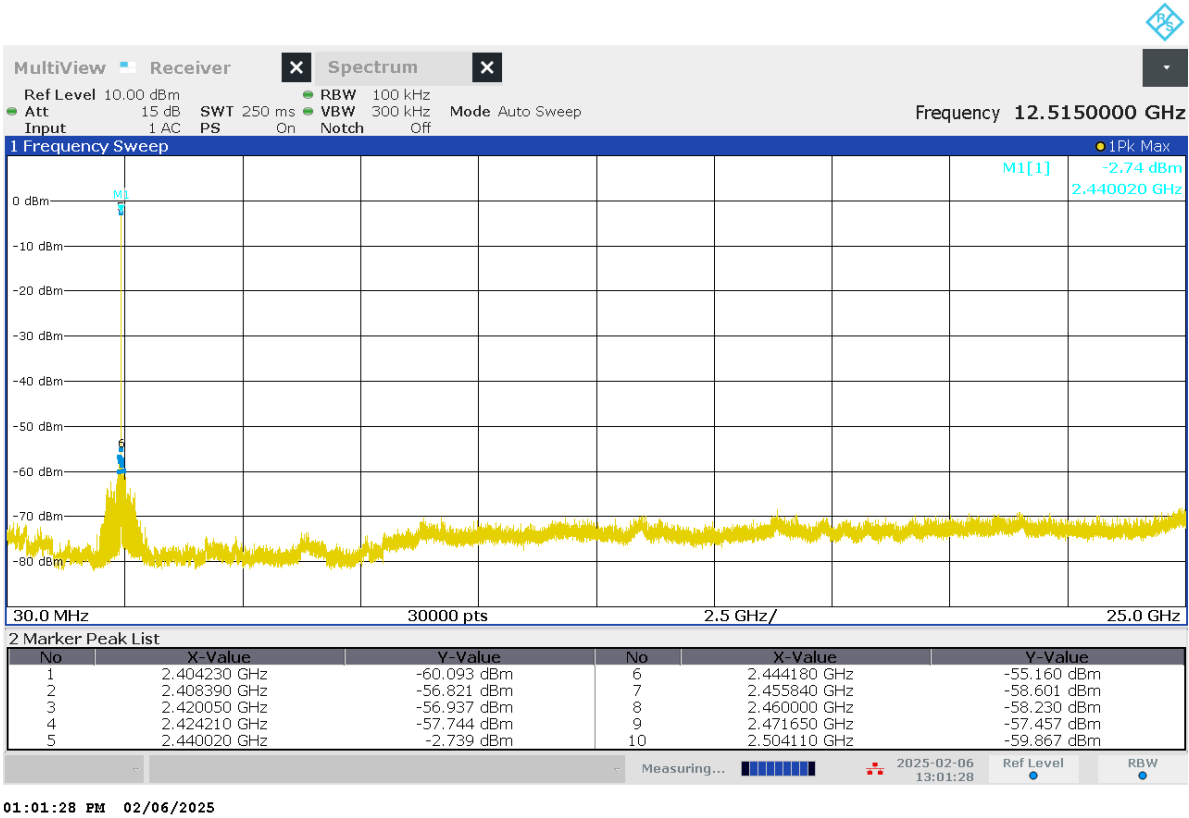


Figure 23 Conducted emissions 30MHz to 25GHz. Operation on channel 2440MHz.

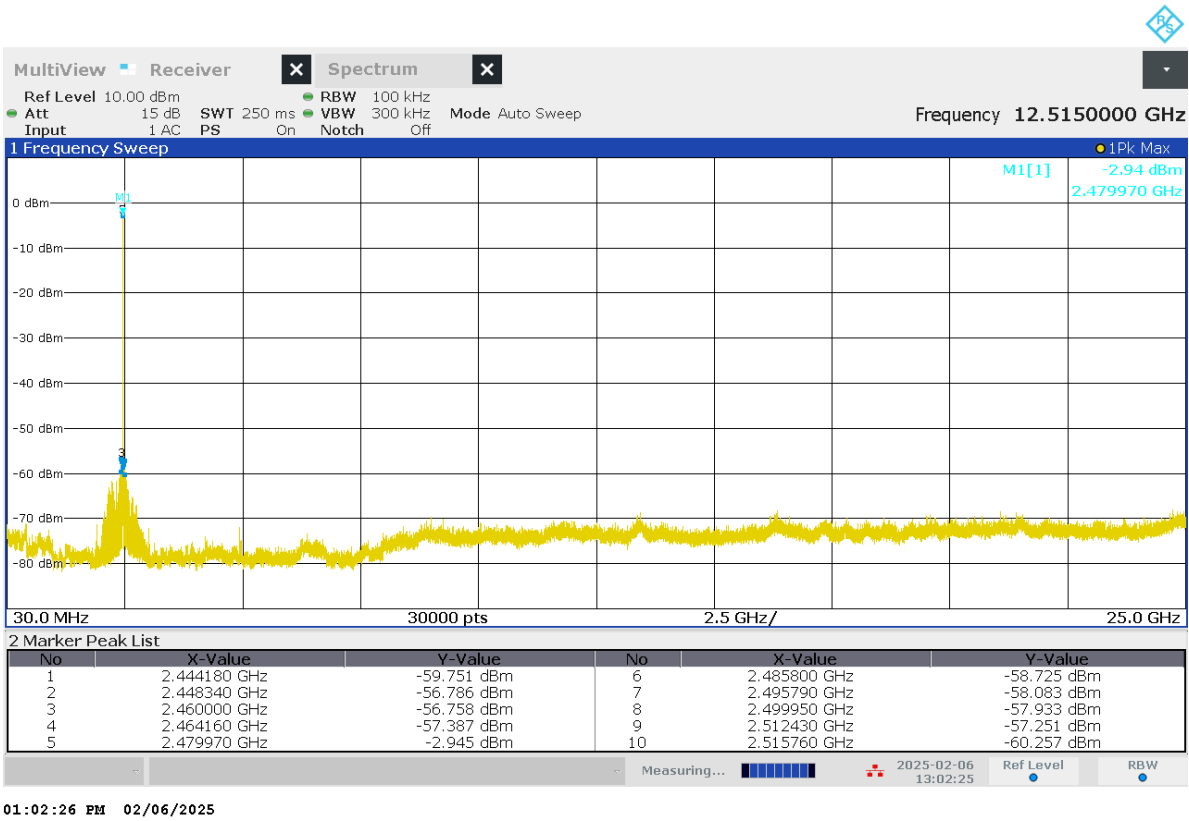


Figure 24 Conducted emissions 30MHz to 25GHz. Operation on channel 2480MHz.

Section 6 6dB Bandwidth and 99% Occupied Bandwidth

6.1 Test Specification

FCC Rule Part	46CFR 15.247 (b)(2)
Standard	ANSIC63.10-2020/Cor1-2023
Measurement Uncertainty	The reported uncertainty of measurement $y \pm U$, 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 $\pm 1.4\text{dB}$

6.2 Procedure and Test Software Version

Conducted Tests

ANSIC63.10-2020/Cor1-2023 Clause reference:	11.8
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 ANSIC63.10-2020/Cor1-2023 Clause 11.8.1

Receiver Parameters	Setting
Detector Function	Peak
Span	3MHz
Resolution Bandwidth	100kHz/20kHz
Video Bandwidth	300kHz/100kHz
Sweep rate	Auto couple
Trace mode	Max hold

6.2.1 Emissions measurements

6.2.2 Date of Test

6th February 2025

6.2.3 Test Area

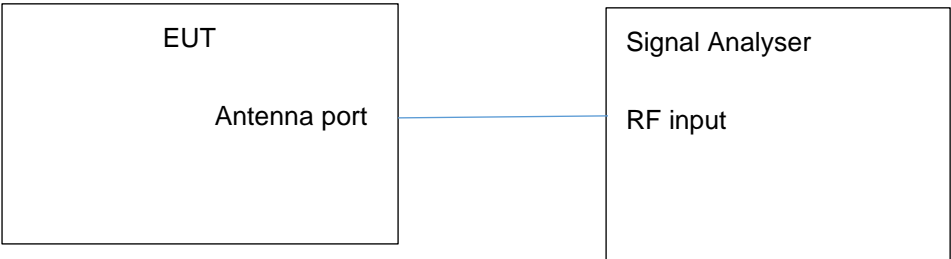
LAB 8

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 6dB bandwidth requirement (kHz)	Figures	Result
2402.0	1.053	673.2	500.0	25 & 28	Pass
2440.0	1.051	685.8	500.0	26 & 29	Pass
2480.0	1.053	690.9	500.0	27 & 30	Pass

Table 9 Bandwidth Measurements



Figure 25 Bandwidth at 6dB Point. Operation on channel 2402MHz

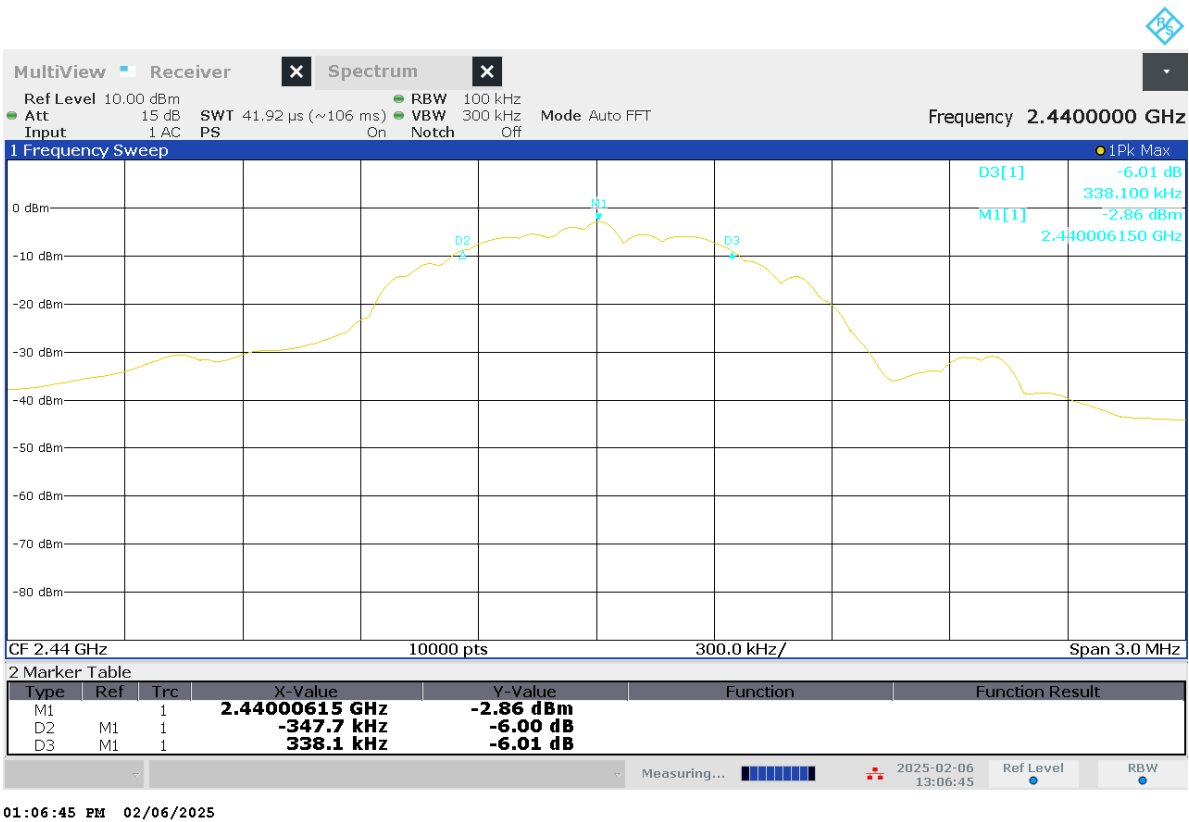


Figure 26 Bandwidth at 6dB Point. Operation on channel 2440MHz

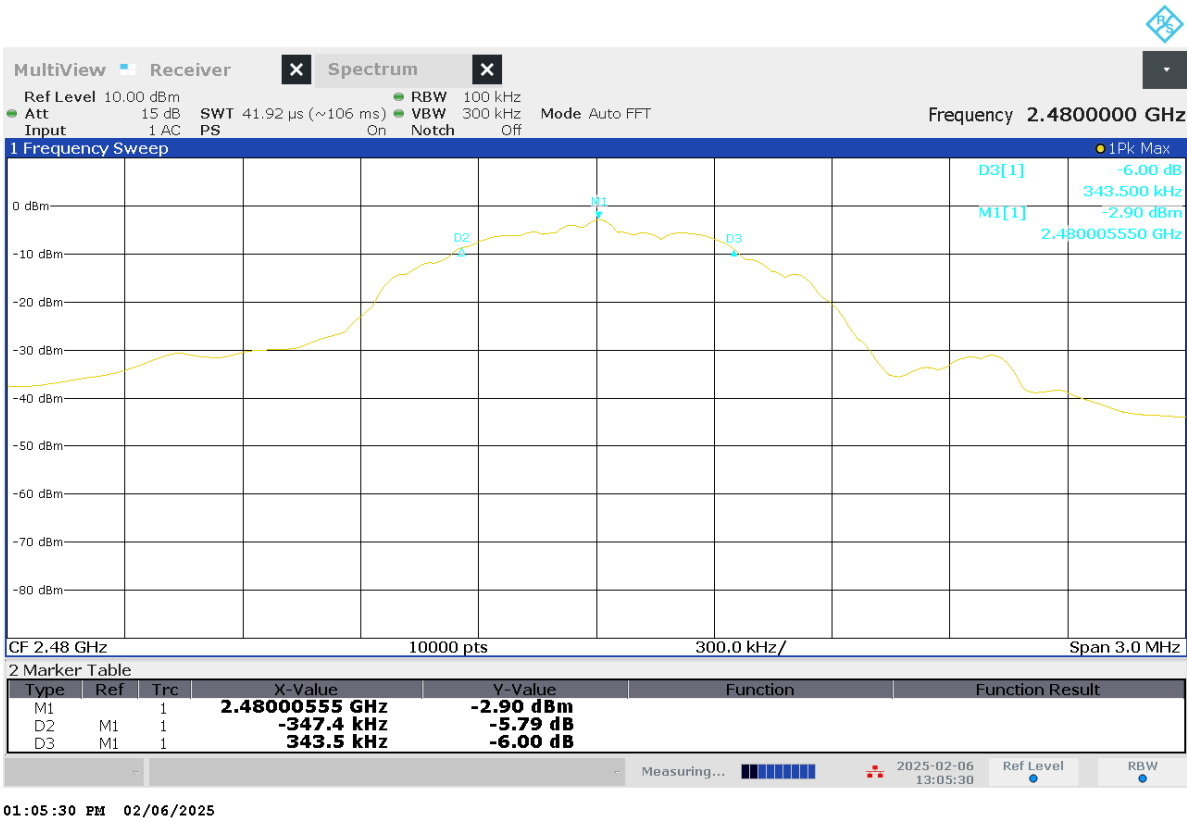


Figure 27 Bandwidth at 6dB Point. Operation on channel 2480MHz

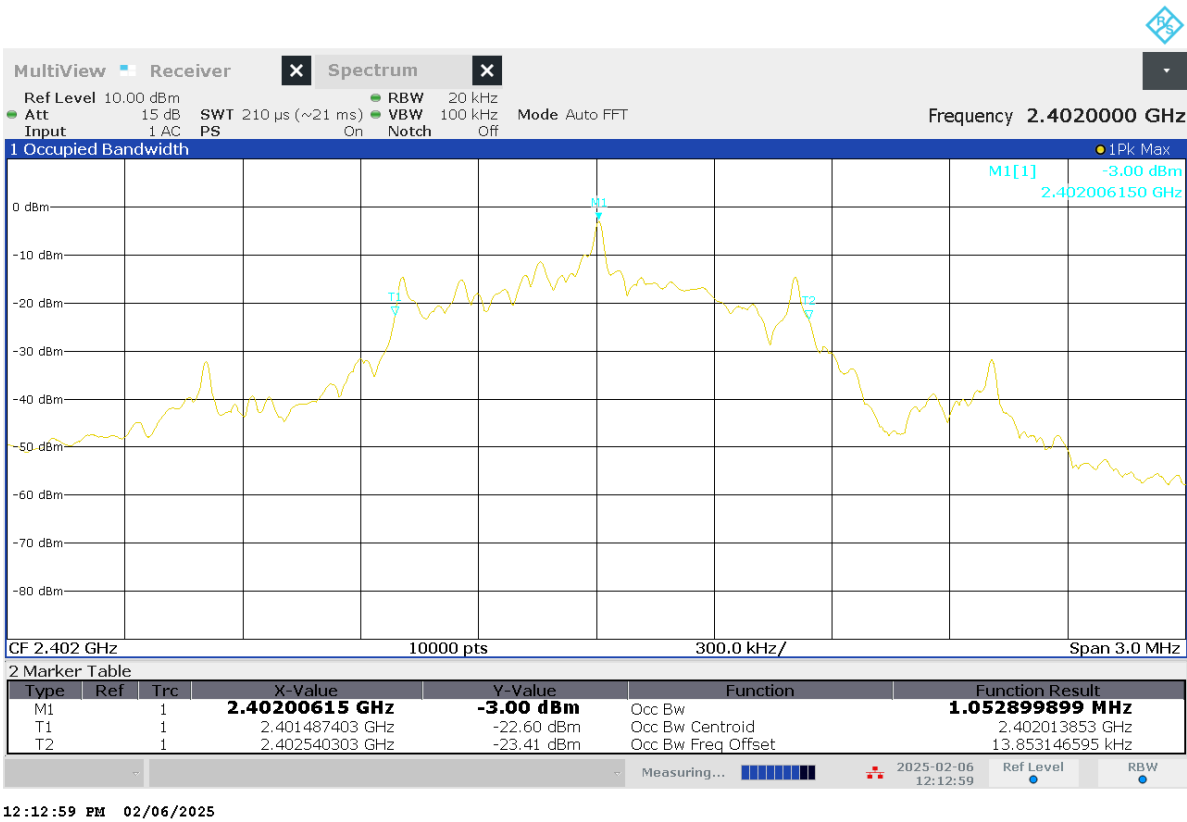


Figure 28 99% Occupied Bandwidth. Operation on channel 2402MHz

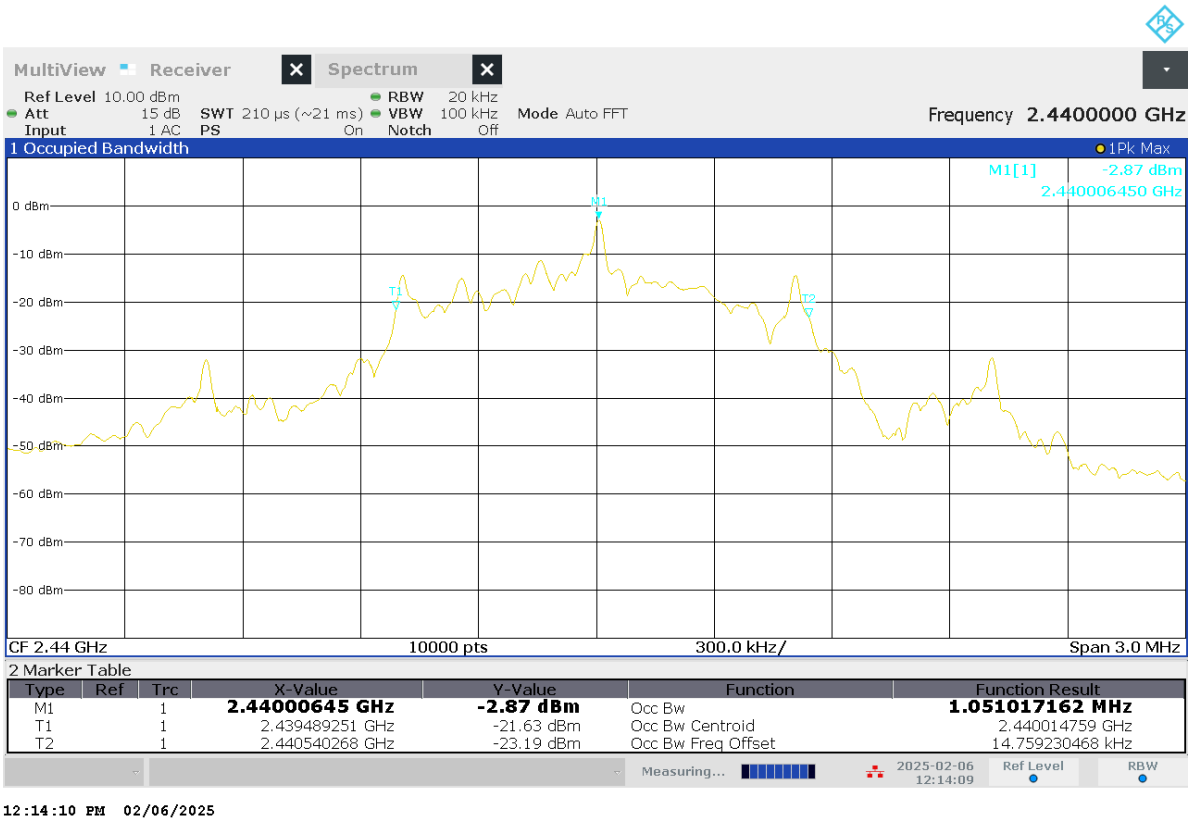


Figure 29 99% Occupied Bandwidth. Operation on channel 2440MHz

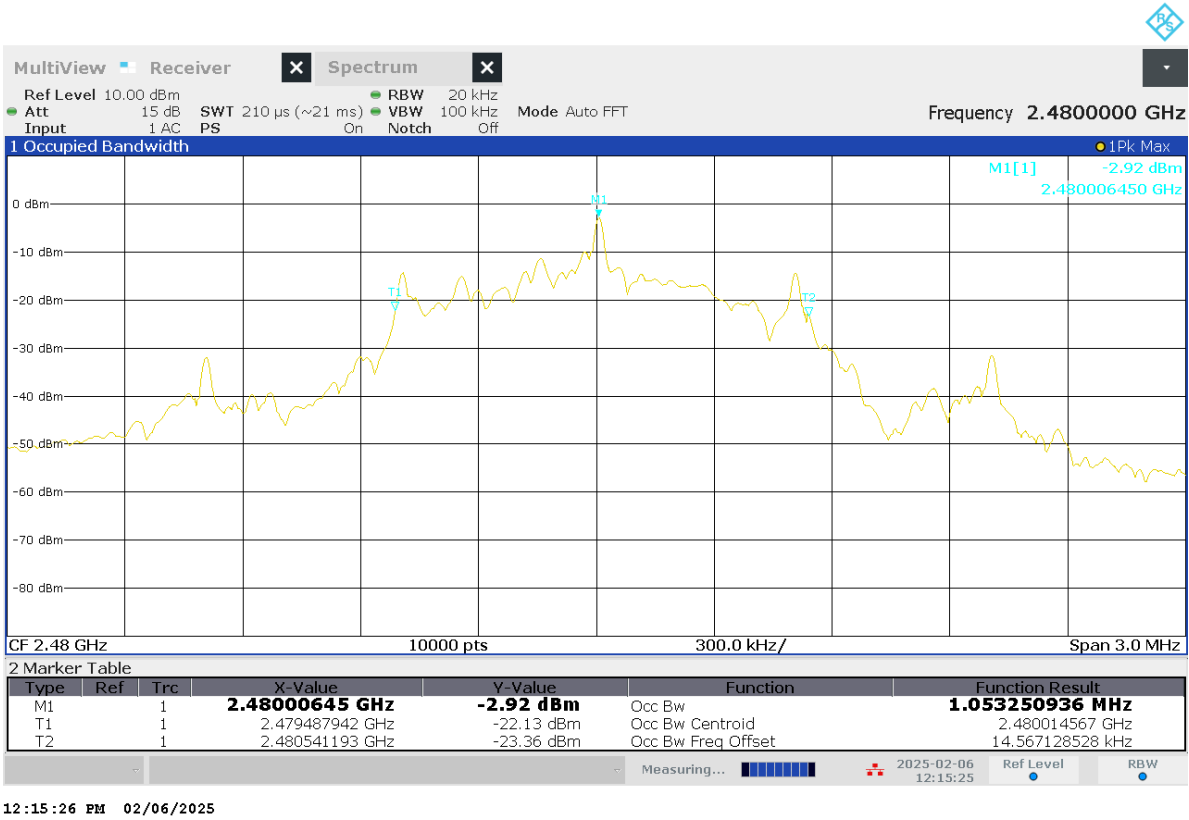


Figure 30 99% Occupied Bandwidth. Operation on channel 2480MHz

Section 7 Peak Output Power

7.1 Test Specification

FCC Rule Part	46CFR 15.247 (b)(3)
Standard	ANSIC63.10-2020/Cor1-2023
Measurement Uncertainty	The reported uncertainty of measurement $y \pm U$, 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 $\pm 1.4\text{dB}$

7.2 Procedure and Test Software Version

Conducted Tests

ANSIC63.10-2020/Cor1-2023 Clause reference:	11.9.1.1 (RBS>DTS bandwidth)
Test software	N/A

Frequency (MHz)	Limit, 47CFR 15.247(b)(3)
	Peak
2400MHz to 2483.5MHz	1 watt

Spectrum analyser settings as specified by ANSIC63.10-2020/Cor1-2023 Clause 11.9.1.1

Receiver Parameters	Setting
Detector Function	Peak
Span	10MHz
Resolution Bandwidth	2MHz (>DTS Bandwidth)
Video Bandwidth	10MHz
Sweep rate	Auto couple
Trace mode	Max hold

7.2.1 Emissions measurements**7.2.2 Date of Test**6th February 2025**7.2.3 Test Area**

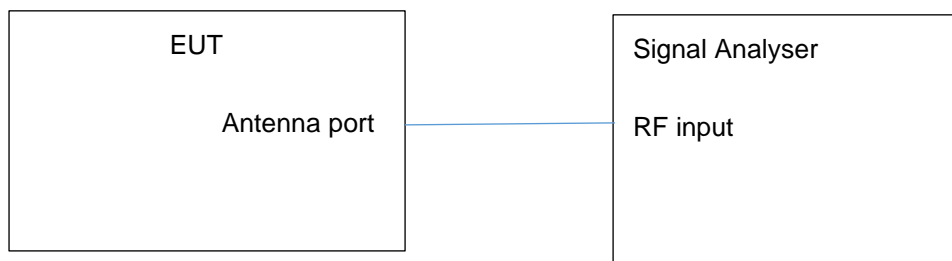
LAB 8

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. Note: EIRP values are based on a worst case antenna gain of +6dBi.

Channel (MHz)	Peak Power (dBm)	Peak Power (Watts)	EIRP (Watts)	Limit (Watts)	Figure
2402	-2.37	0.00058	0.0023	1	31
2440	-2.26	0.00059	0.0024	1	32
2480	-2.20	0.00060	0.0024	1	33

Table 10 Peak Output Power Measurements

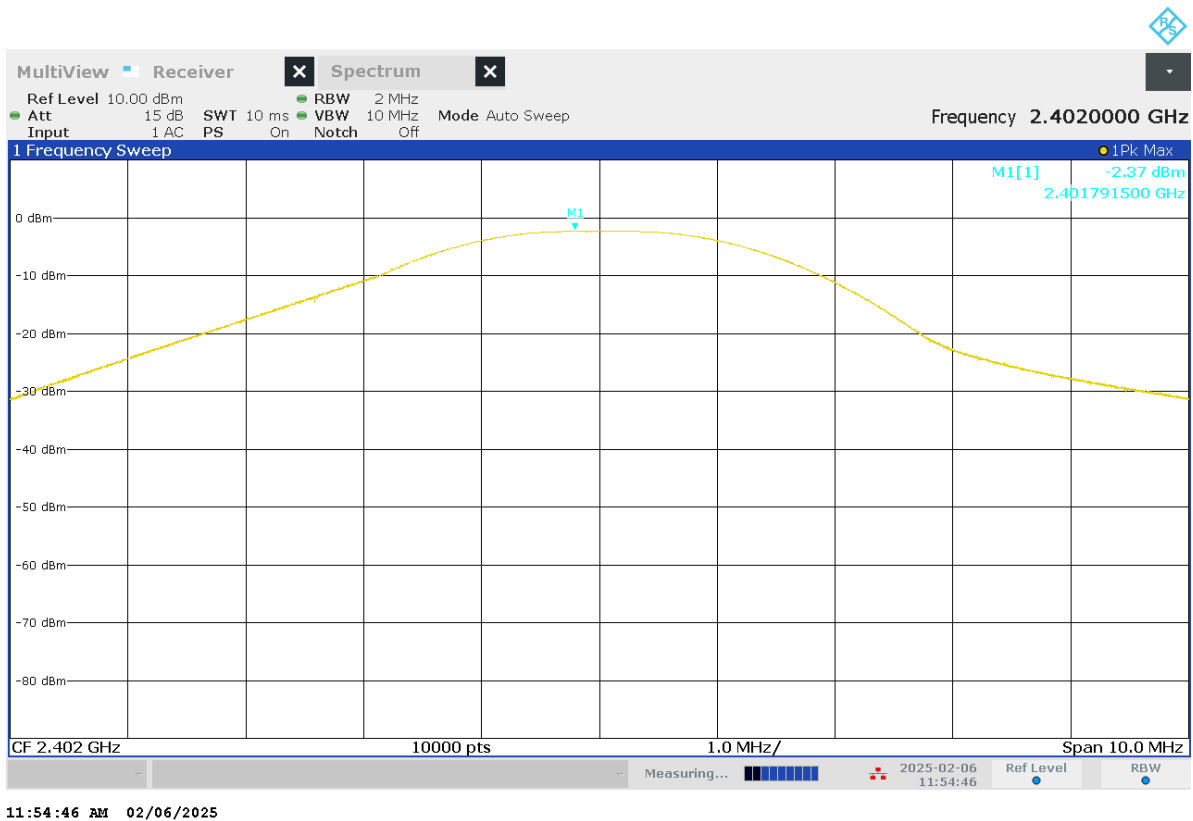


Figure 31 Peak output power, Operation on channel 2402MHz

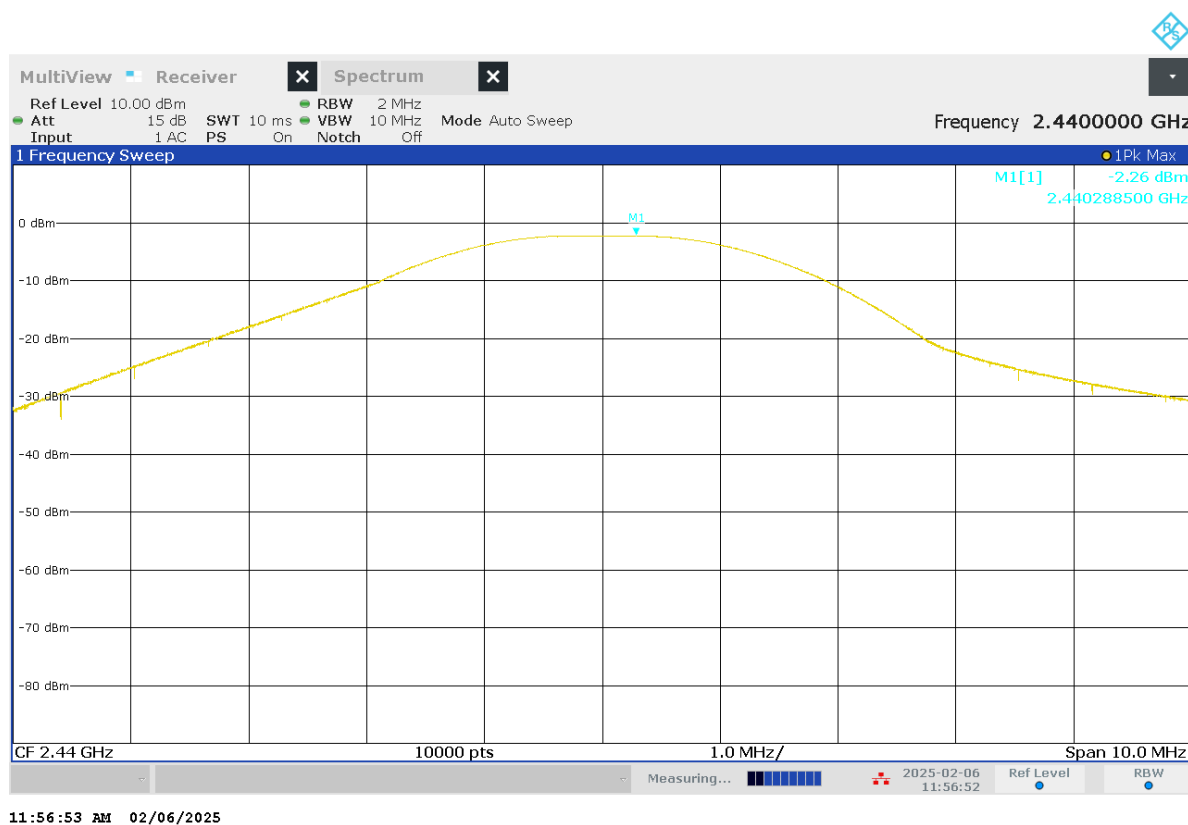


Figure 32 Peak output power, Operation on channel 2440MHz

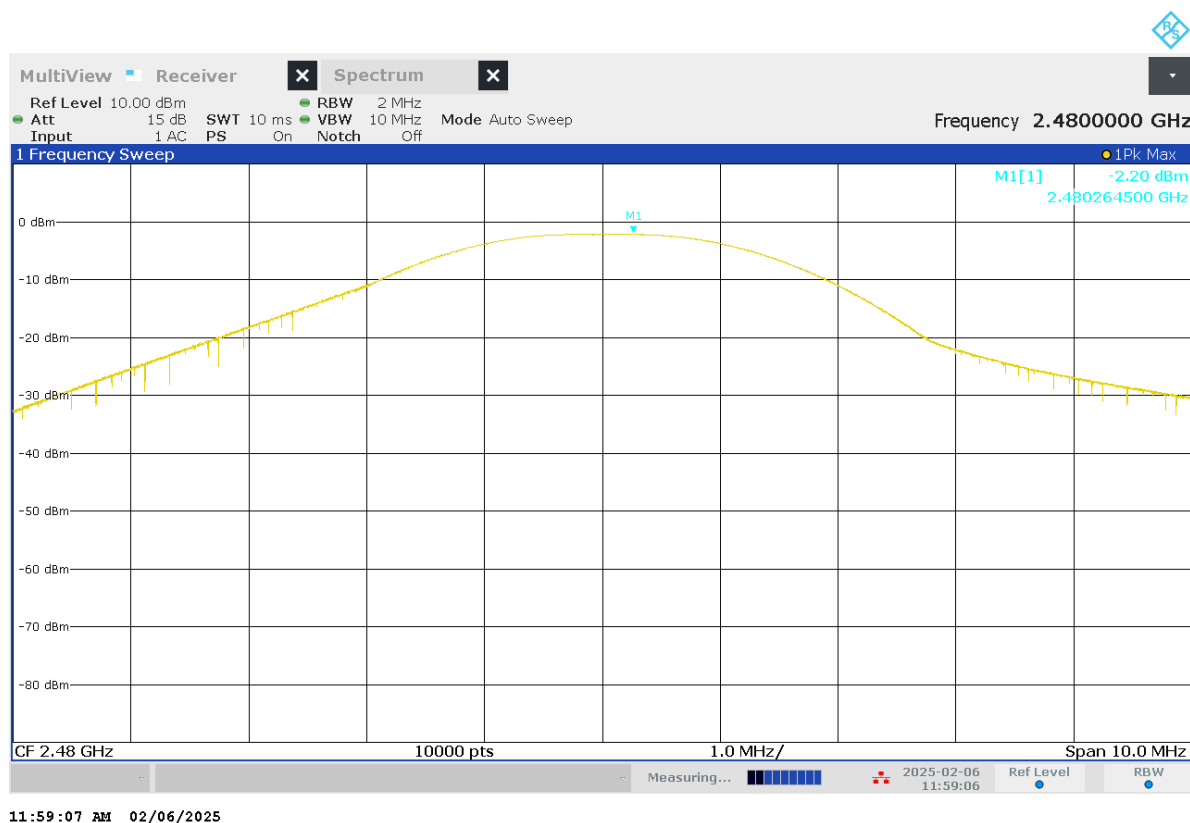


Figure 33 Peak output power, Operation on channel 2480MHz

Section 8 Power Spectral Density

8.1 Test Specification

FCC Rule Part	46CFR 15.247 (e)
Standard	ANSIC63.10-2020/Cor1-2023
Measurement Uncertainty	The reported uncertainty of measurement $y \pm U$, 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 $\pm 1.4\text{dB}$

8.2 Procedure and Test Software Version

Conducted Tests

ANSIC63.10-2020/Cor1-2023 Clause reference:	Clause 11.10.2 (peak PSD)
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 ANSIC63.10-2020/Cor1-2023 Clause 11.10.2

Receiver Parameters	Setting
Detector Function	Peak
Span	1.5xDTS bandwidth
Resolution Bandwidth	3kHz \leq RBW \leq 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

6th February 2025

8.2.3 Test Area

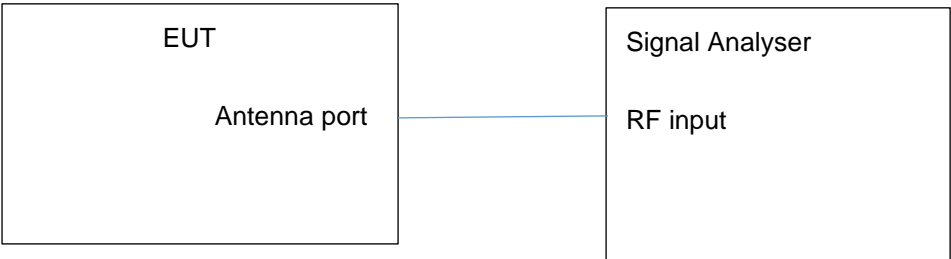
LAB 8

8.2.4 Tested by

L Trickett

8.2.5 Test Setup

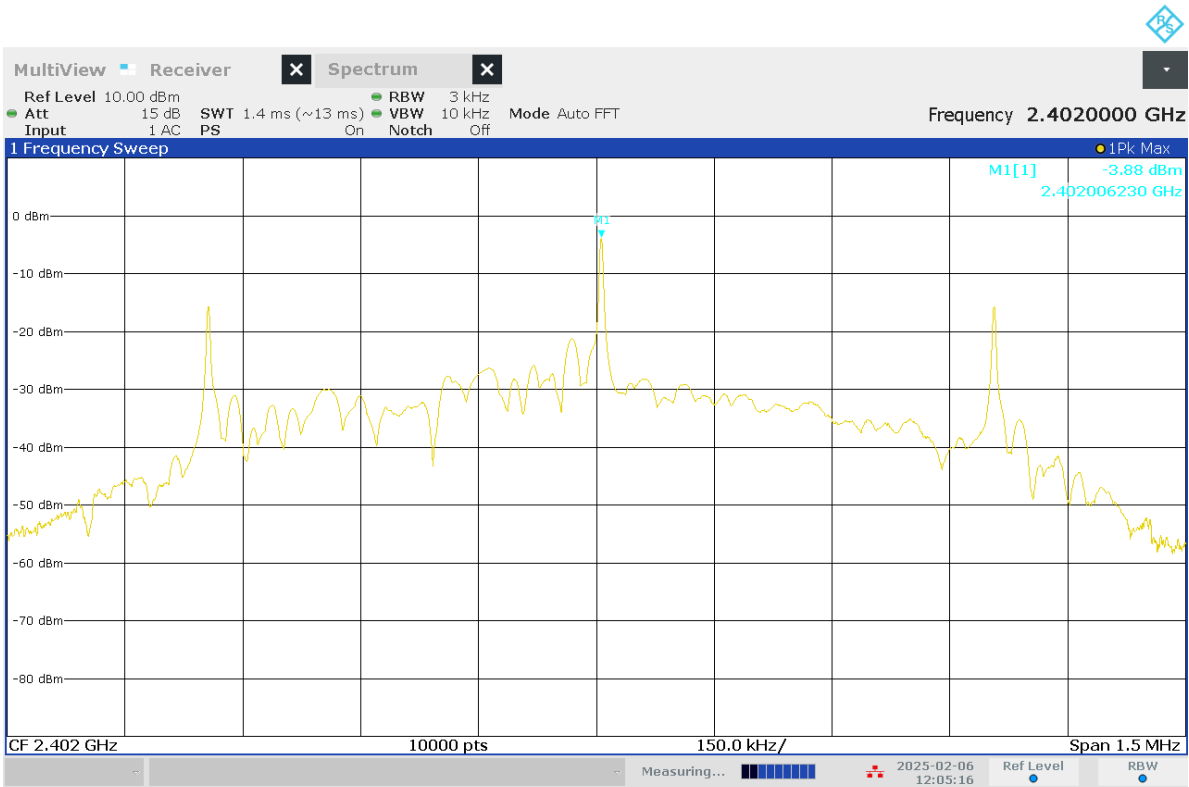
The antenna port was connected directly to the signal analyser.



8.2.6 Test Results

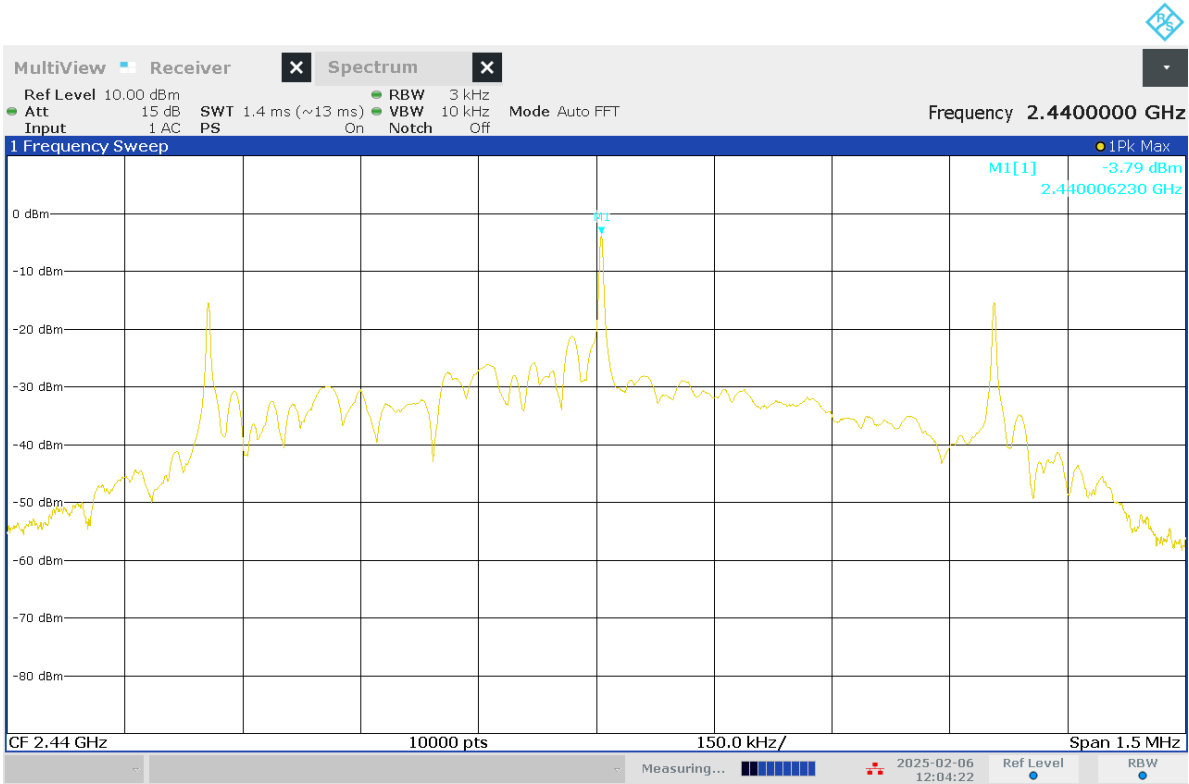
Channel (MHz)	Power in 3kHz RBW (dBm)	Limit (dBm)	Figure	Result
2402	-3.88	8.0	34	Pass
2440	-3.79	8.0	35	Pass
2480	-3.87	8.0	36	Pass

Table 11 Peak Spectral Density Measurements



12:05:16 PM 02/06/2025

Figure 34 Power spectral density, Operation on channel 2402MHz



12:04:22 PM 02/06/2025

Figure 35 Power spectral density, Operation on channel 2440MHz

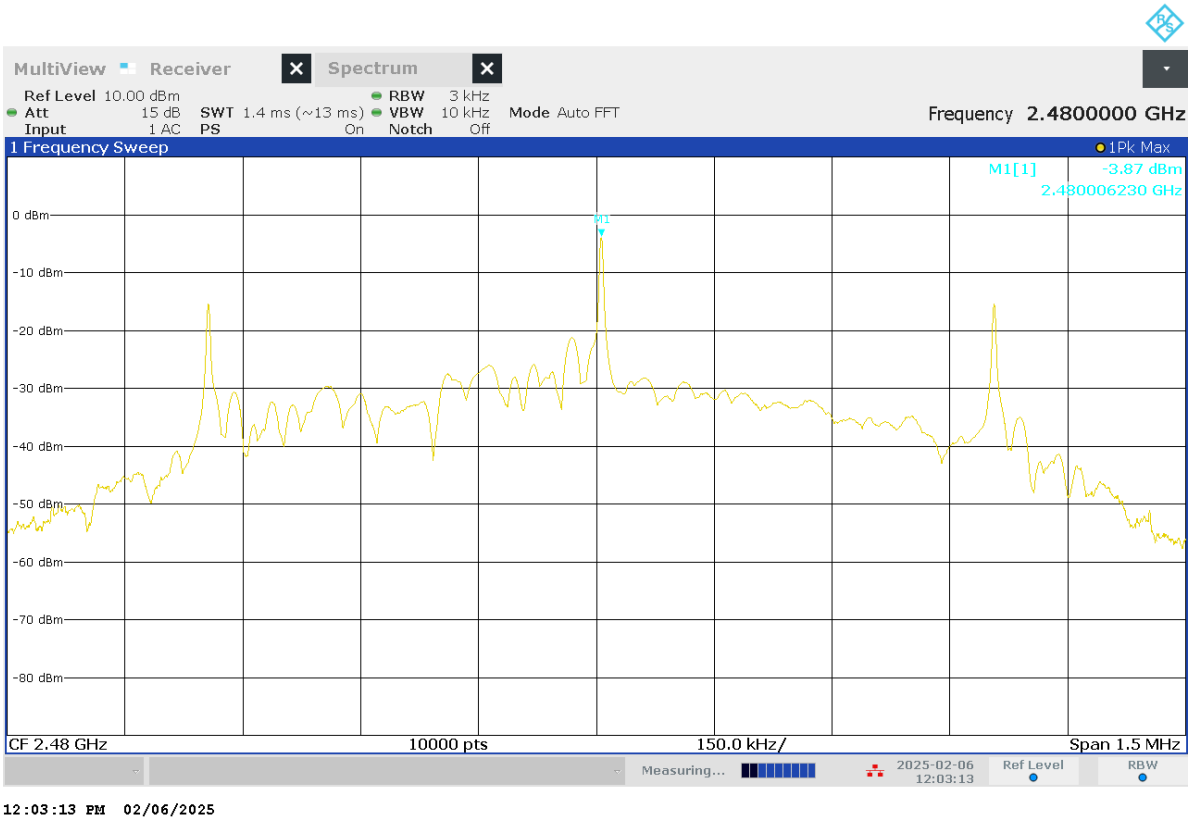


Figure 36 Power spectral density, Operation on channel 2480MHz

Section 9 Band Edge Compliance

9.1 Test Specification

FCC Rule Part	46CFR 15.205 and 47CFR15.209
Standard	ANSIC63.10-2020/Cor1-2023
Measurement Uncertainty	The reported uncertainty of measurement $y \pm U$, 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 $\pm 5.14\text{dB}$

9.2 Procedure and Test Software Version

Radiated Tests

ANSIC63.10-2020/Cor1-2023 Clause reference:	Clause 6.10.5 "Restricted 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 ANSIC63.10-2020/Cor1-2023 Clause 6.10.5 "Restricted band-edge measurements"

Receiver Parameters	Setting
Detector Function	Peak
Span	As necessary
Resolution Bandwidth	1MHz
Video Bandwidth	3 x RBW
Sweep rate	Auto couple
Trace mode	Max hold

9.2.1 Emissions measurements**9.2.2 Date of Test**

13th February 2025

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.

Test Results – Whip Antenna**Tabular Data**

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	70.5	54.3	3.8	30.6	50.6	74.0	23.4
V	2483.5	81.9	54.3	3.8	30.6	62.0	74.0	12.0

Table 12 Operation on Channel 2480MHz, 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	44.5	54.3	3.8	30.6	24.6	54.0	29.4
V	2483.5	50.1	54.3	3.8	30.6	30.2	54.0	23.8

Table 13 Operation on Channel 2480MHz, 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	85.0	54.2	3.7	30.0	64.5	74.0	9.5
V	2400	94.3	54.2	3.7	30.0	73.8	74.0	0.2

Table 14 Operation on Channel 2402MHz 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	51.1	54.2	3.7	30.0	30.6	54.0	23.4
V	2400	59.0	54.2	3.7	30.0	38.5	54.0	15.5

Table 15 Operation on Channel 2402MHz Average detector measurements

Spectrum analyser displays

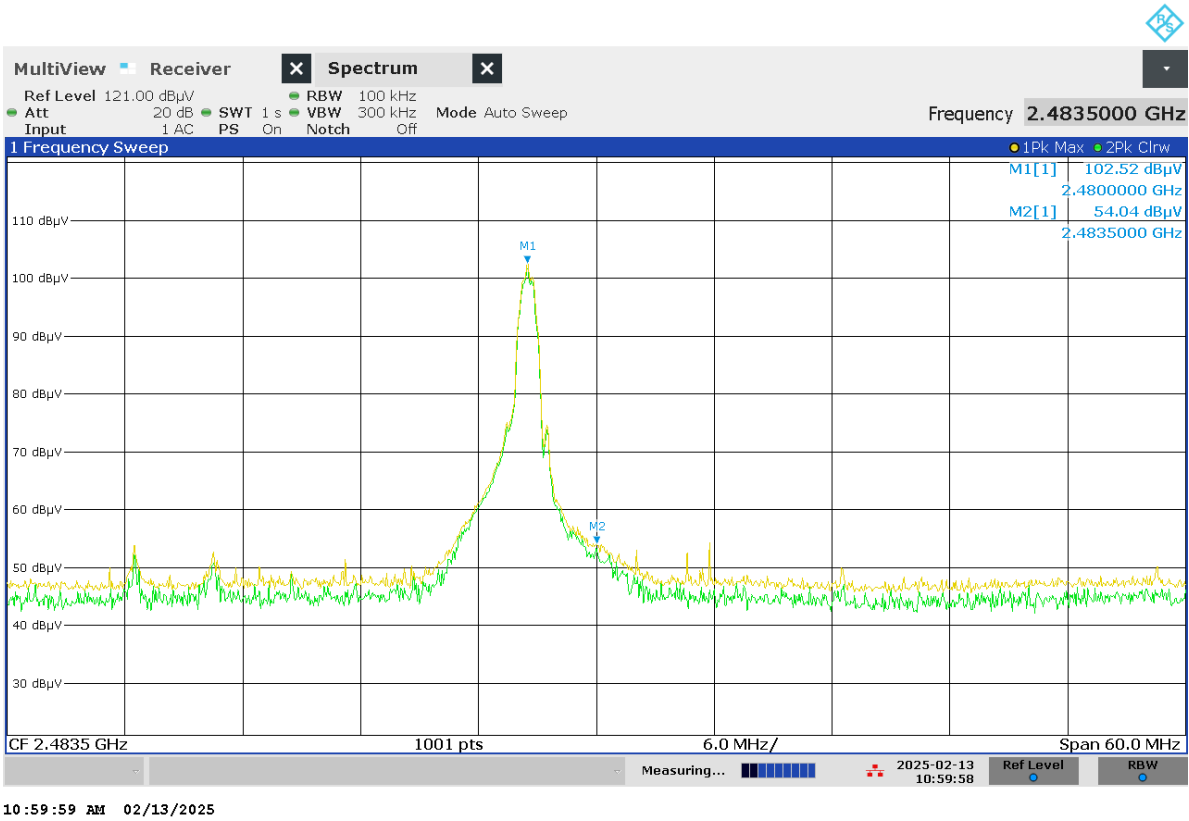


Figure 37 Band Edge Measurement – Upper band edge - Horizontal polarity

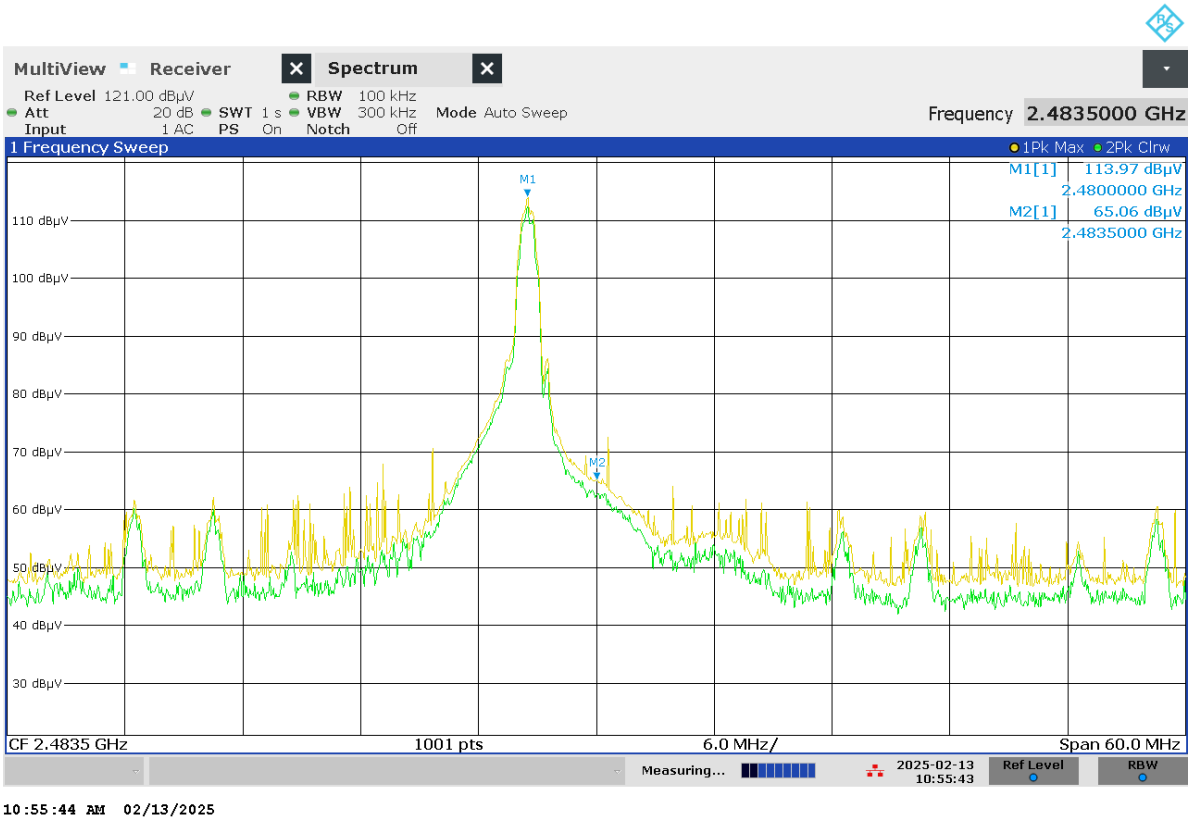


Figure 38 Band Edge Measurement – Upper band edge - Vertical polarity

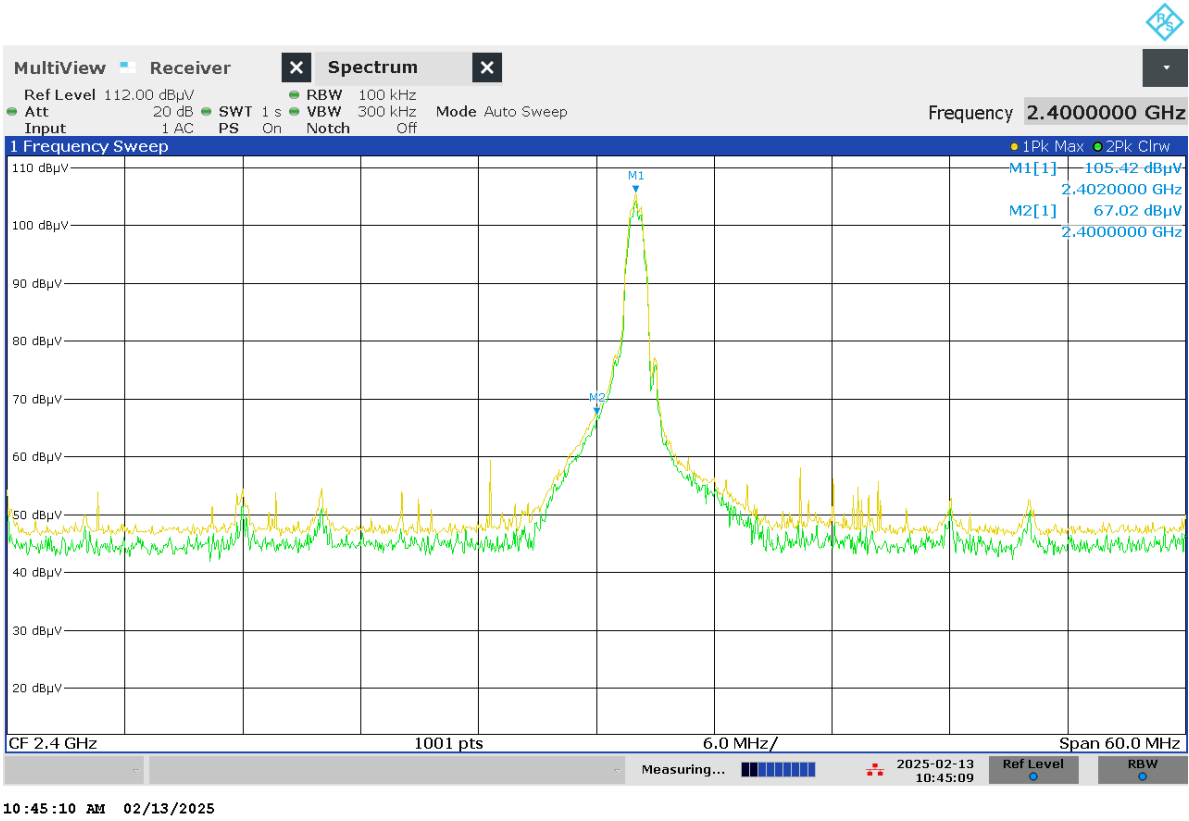


Figure 39 Band Edge Measurement – Lower band edge - Horizontal polarity

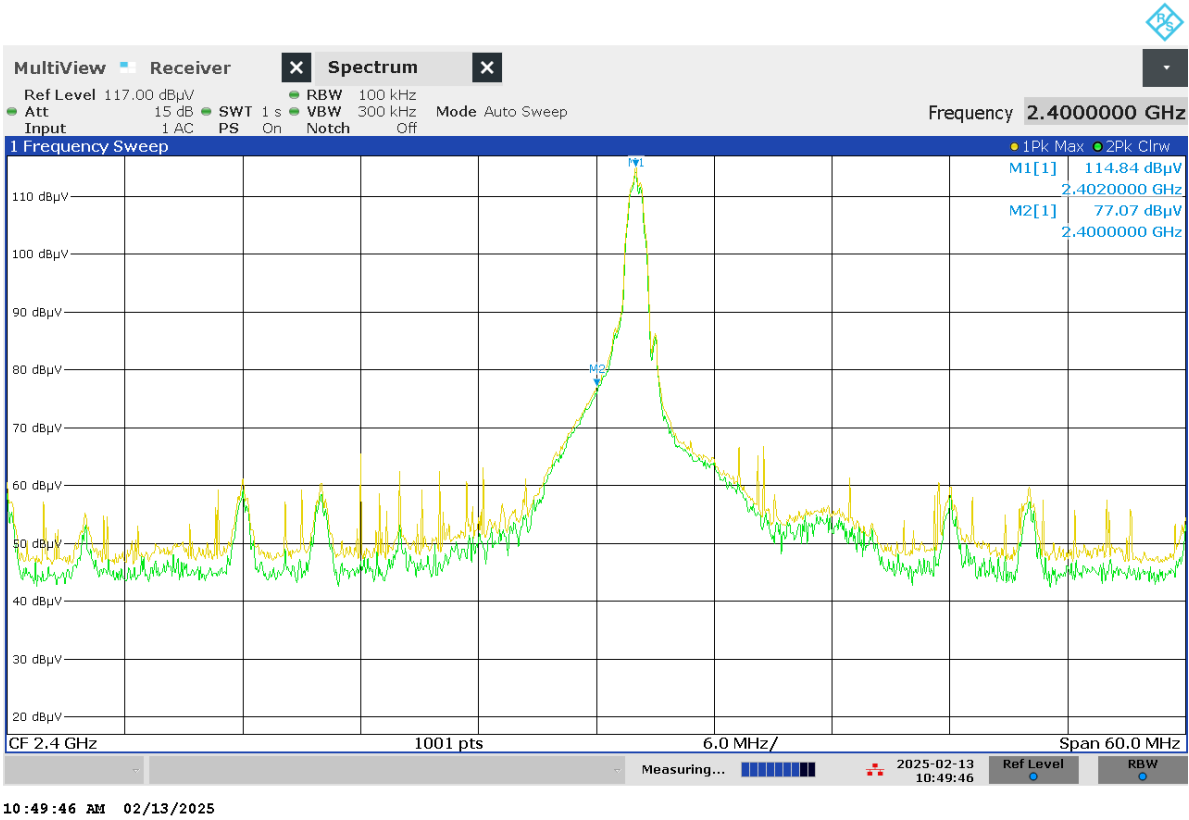


Figure 40 Band Edge Measurement – Lower band edge - Vertical polarity

Test Results – Puck Antenna**Tabular Data**

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	71.4	54.3	3.8	30.6	51.5	74.0	22.5
V	2483.5	70.4	54.3	3.8	30.6	50.5	74.0	23.5

Table 16 Operation on Channel 2480MHz, 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	44.7	54.3	3.8	30.6	24.8	54.0	29.2
V	2483.5	44.4	54.3	3.8	30.6	24.5	54.0	29.5

Table 17 Operation on Channel 2480MHz, 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	91.5	54.2	3.7	30.0	71.0	74.0	3.0
V	2400	88.6	54.2	3.7	30.0	68.1	74.0	5.9

Table 18 Operation on Channel 2402MHz 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	56.5	54.2	3.7	30.0	36.0	54.0	18.0
V	2400	54.2	54.2	3.7	30.0	33.7	54.0	20.3

Table 19 Operation on Channel 2402MHz Average detector measurements

Date: 15th May 2025

Report Number: C15847TR2

Spectrum analyser displays

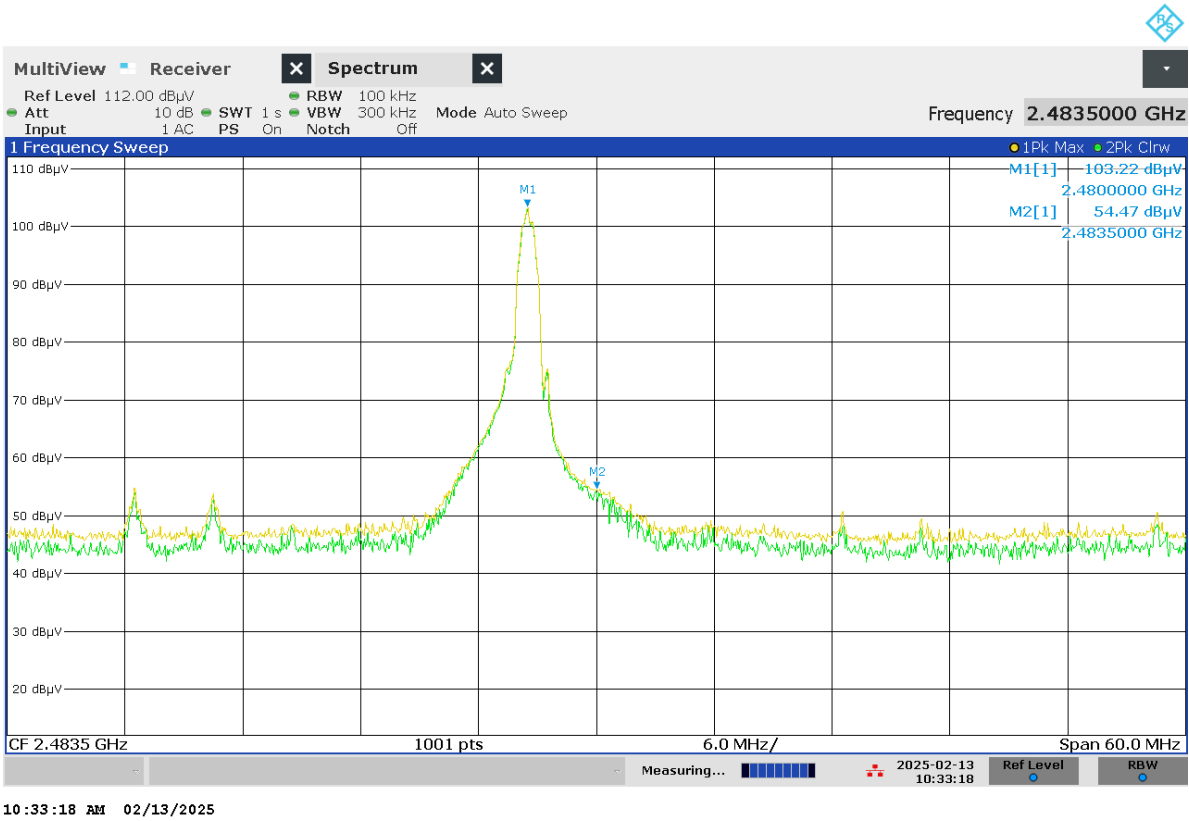


Figure 41 Band Edge Measurement – Upper band edge - Horizontal polarity

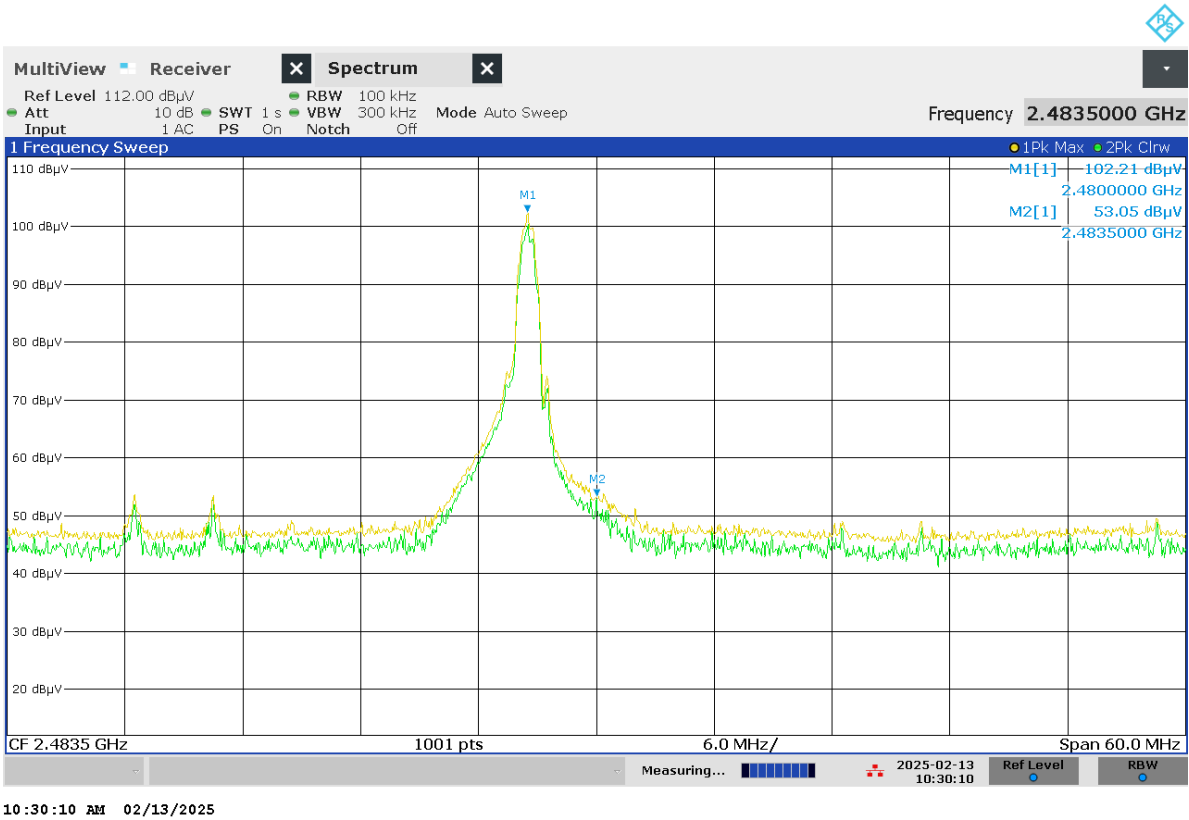


Figure 42 Band Edge Measurement – Upper band edge - Vertical polarity

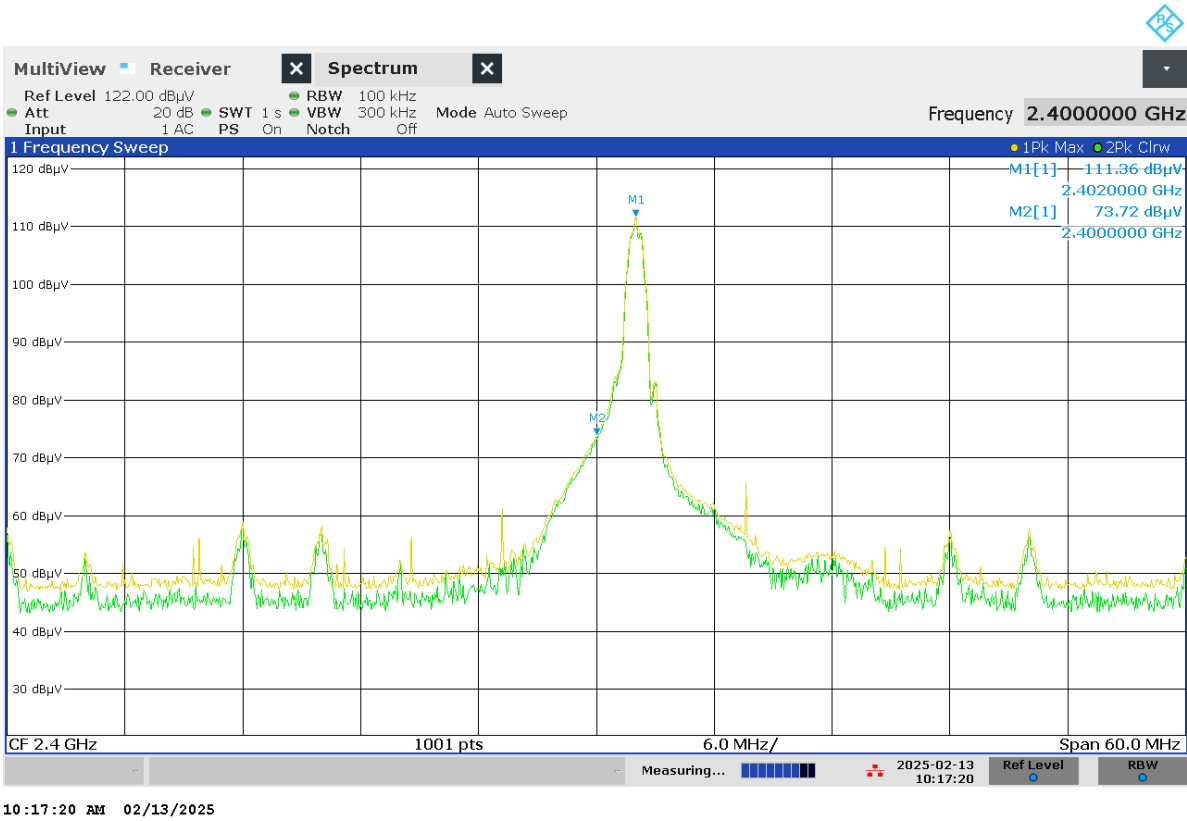


Figure 43 Band Edge Measurement – Lower band edge - Horizontal polarity

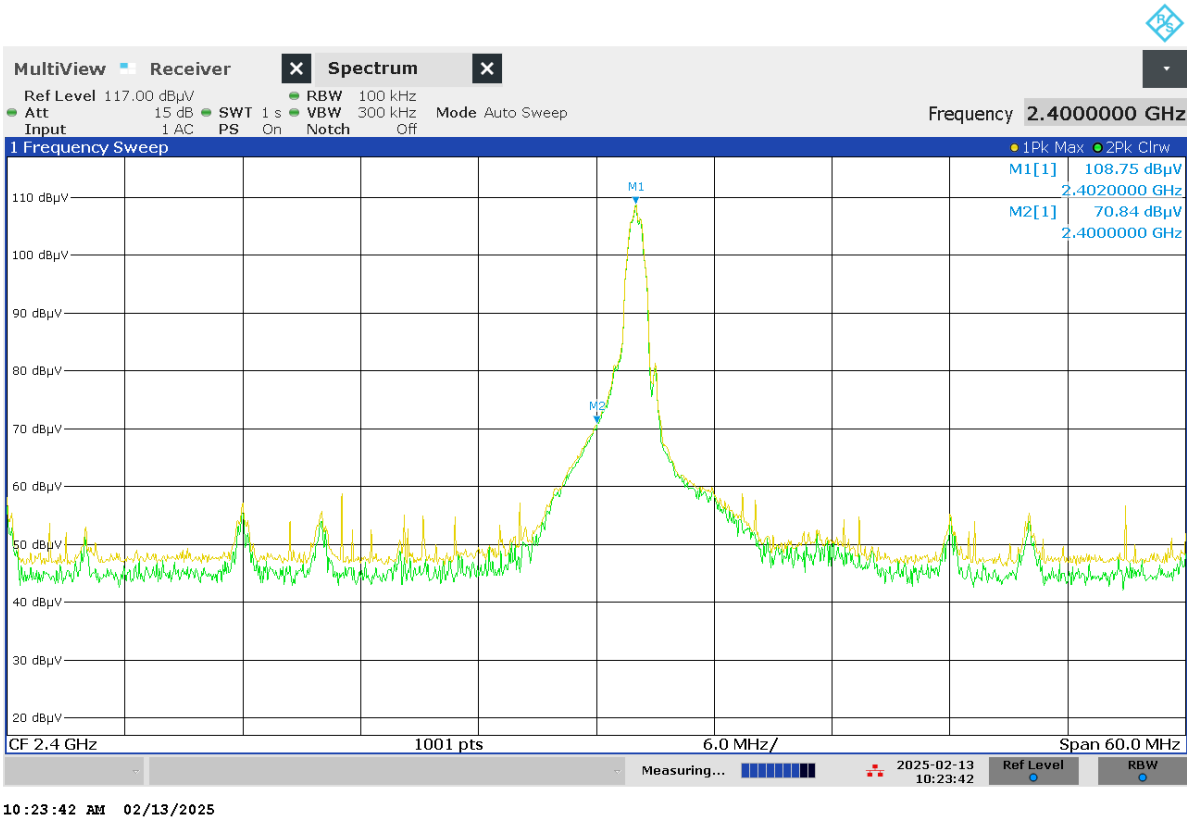


Figure 44 Band Edge Measurement – Lower band edge - Vertical polarity

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
R&S ESW44 EMI Receiver	C0751	5 th August 2024	12 Months

Radiated Emissions Equipment

Item	Serial No.	Last Calibration Date	Calibration Interval
Laboratory 1 Semi-Anechoic Chamber	C0471	6 th December 2022	36 Months
Lab 5 Fully-Anechoic Room	C0578	10 th July 2024	36 Months
ETS Lindgren 2017B Mast (1 – 4m) with tilting mechanism	--	N/A	N/A
R&S ESW44 EMI Receiver	C0751	5 th August 2024	12 Months
R&S ESW44 EMI Receiver	C0658	30 th October 2023	18 Months
Teseq CBL6112D Bilog Antenna	C0506	22 nd August 2024	36 Months
HF27 Cable	19149.03.13.004	3 rd October 2024	12 Months
HF29 Cable	20147.01.09.001	3 rd October 2024	12 Months
HF32 Cable	19149.01.09.003	3 rd October 2024	12 Months
HF35 Cable	19149.02.13.003	3 rd October 2024	12 Months
HF47 Cable	E44808	3 rd October 2024	12 Months
Cable 24	20748.03.14.002	3 rd October 2024	12 Months
Cable 25	20748.03.14.001	3 rd October 2024	12 Months
Schwarzbeck STLP 9148 Antenna 1-18GHz	C0626	26 th March 2024	24 Months
2.4GHz Microtronics BRM50702 notch filter	79178	25 th October 2024	12 Months
2.4GHz Microtronics BRM50702 notch filter	C0473	25 th October 2024	12 Months
BONN BLMA 0118-M Preamplifier	C0702	1 st August 2024	12 Months
ETS Lingren 3116C-PA Horn Antenna 18-40GHz	C0433	29 th September 2022	36 Months

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