FCC Part 15.247

TEST REPORT

For

IOTTECH CORPORATION

No. 10-1, Shijian Rd., Hukou Township, Hsinchu County 303, Taiwan (R.O.C.)

FCC ID: 2AWP5WMD566

Report Type:	**Product Name:**
Original Report	2.4GHz Wi-Fi/BLE IoT Module

Report Producer : Coco Lin

Report Number : RXZ231129147RF02

Report Date : 2024-03-11

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Revision History

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
0.0	RXZ231129147	RXZ231129147RF02	2024-03-11	Original Report	Coco Lin

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1 General Information

1.1 Product Description for Equipment under Test (EUT)

Applicant	IOTTECH CORPORATION
	No. 10-1, Shijian Rd., Hukou Township, Hsinchu County 303, Taiwan (R.O.C.)
Brand(Trade) Name	IOTTECH Corp.
Product (Equipment)	2.4GHz Wi-Fi/BLE IoT Module
Main Model Name	ITM-D566
Frequency Range	IEEE 802.11b Mode: 2412 ~ 2462 MHz BLE(1M): 2402 ~ 2480 MHz
Conducted Peak Output Power	IEEE 802.11b Mode: 11.05 dBm BLE(1M) Mode : 0.49 dBm
Modulation Technique	IEEE 802.11b Mode: DSSS BLE(1M) Mode: GFSK
Power Operation (Voltage Range)	☐ AC Type ☐ Adapter ☐ By AC Power Cord ☐ PoE
	☒ DC 3.3V ☐ Battery ☐ DC Power Supply ☐ External from USB Cable ☐ External DC Adapter
	☐ Host System
Received Date	2023/11/29
Date of Test	2024/01/13 ~ 2024/03/06

*All measurement and test data in this report was gathered from production sample serial number: RXZ231129147-4 (Assigned by BACL (New Taipei Laboratory).

1.2 Objective

This report is prepared on behalf of *IOTTECH CORPORATION* in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commission's rules.

1.3 Related Submittal(s)/Grant(s)

N/A

1.4 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
KDB 558074 D01 15.247 Meas Guidance v05r02

1.5 Statement

Decision Rule: No, (The test results do not include MU judgment)

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.
The determination of the test results does not require consideration of the uncertainty of the measurement, unless the assessment is required by customer agreement, regulation or standard document specification.
Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) is not responsible for the authenticity of the information provided by the applicant that affects the test results.

1.6 Measurement Uncertainty

Parameter		Uncertainty
AC Mains		+/- 2.53 dB
RF output power, conducted		+/- 3.74 dB
Power Spectral Density, conducted		+/- 0.58 dBm
Occupied Bandwidth		+/- 0.09 %
Unwanted Emissions, conducted		+/- 1.13 dBm
Emissions, radiated	9 kHz~30 MHz	+/- 3.54 dB
	30 MHz~1 GHz	+/- 4.99 dB
	1 GHz~18 GHz	+/- 7.56 dB
	18 GHz~40 GHz	+/- 5.06 dB
Temperature		+/- 0.79 °C
Humidity		+/- 0.44 %

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

1.7 Environmental Conditions

Test Site	Test Date	Temperature (℃)	Relative Humidity (%)	ATM Pressure (hPa)	Test Engineer
AC Line Conducted Emissions	2024/01/18	19.4	69	1010	Aaron Pan
Radiation Spurious Emissions	2024/01/13~2024/03/06	19.6~21.5	56~67	1010	Aaron Pan
Conducted Spurious Emissions	2024/01/16	20.3	55	1010	Anson Lu
6 dB Emission Bandwidth	2024/01/16	20.3	55	1010	Anson Lu
Maximum Output Power	2024/01/16	20.3	55	1010	Anson Lu
100 kHz Bandwidth of Frequency Band Edge	2024/01/16	20.3	55	1010	Anson Lu
Power Spectral Density	2024/01/16	20.3	55	1010	Anson Lu

1.8 Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) to collect test data is located on

☒70, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3732) and the FCC designation No.TW3732 under the Mutual Recognition Agreement (MRA) in FCC Test.

2 System Test Configuration

2.1 Description of Test Configuration

For WIFI 2.4G mode, there are totally 11 channels.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437	/	/

For 802.11 b Modes were tested with channel 1, 6 and 11.

For BLE mode, there are totally 40 channels.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	--	--
2	2406	--	--
3	2408	37	2476
--	--	38	2478
19	2440	39	2480

For BLE Modes were tested with channel 0, 19 and 39.

2.2 Equipment Modifications

No modification was made to the EUT.

2.3 EUT Exercise Software

The test software was used “Tera Term V4.71”

The system was configured for testing in engineering mode, which was provided by manufacturer.

Test Frequency		Low	Middle	High
Power Level Setting	802.11 b Mode	default	default	default
	BLE 1M	default	default	default

The worst case data rates are as follows:

802.11b : 1Mbps

BLE 1M : 1 Mbps

2.4 Test Mode

Model: ITM-D566 for all test item.

2.5 Support Equipment List and Details

Description	Manufacturer	Model Number
NB	DELL	E6410
Adapter	DELL	DA130PE1-00
Fixture	iot Tech	EVB_D566_V1.0

2.6 External Cable List and Details

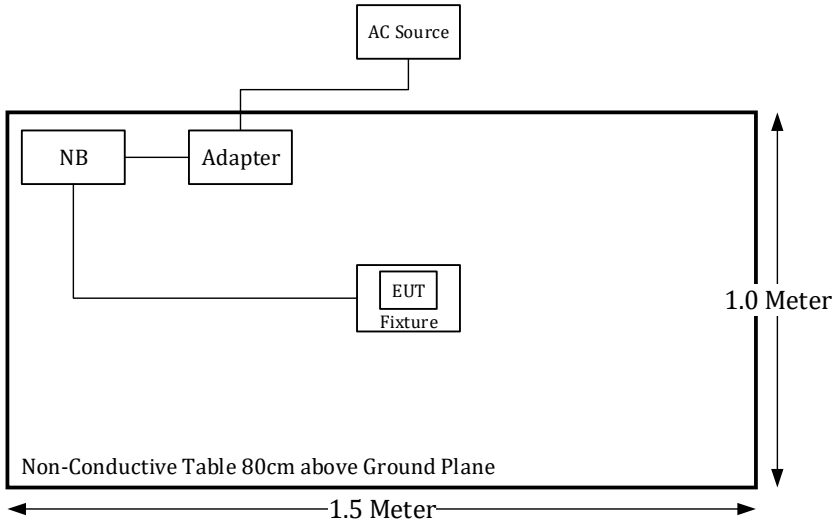
Cable Description	Length (m)	From	To
Micro USB cable	1	NB	Fixture

2.7 Block Diagram of Test Setup

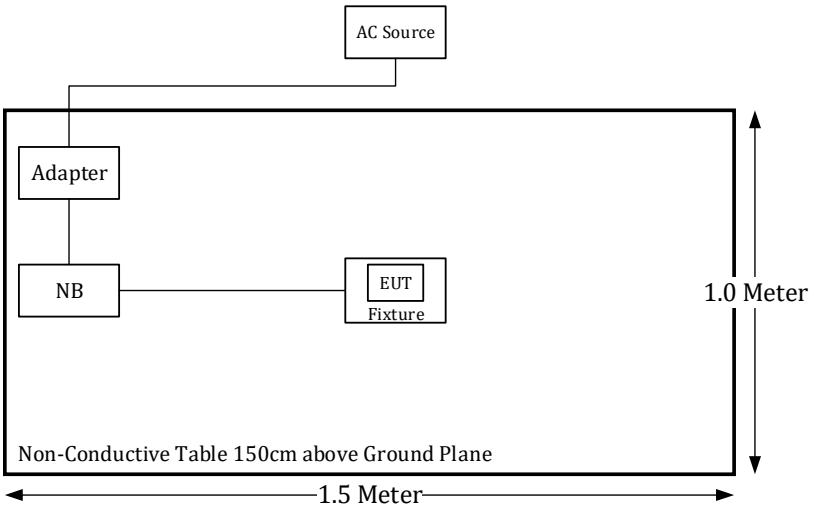
See test photographs attached in setup photos for the actual connections between EUT and support equipment.

Radiation:

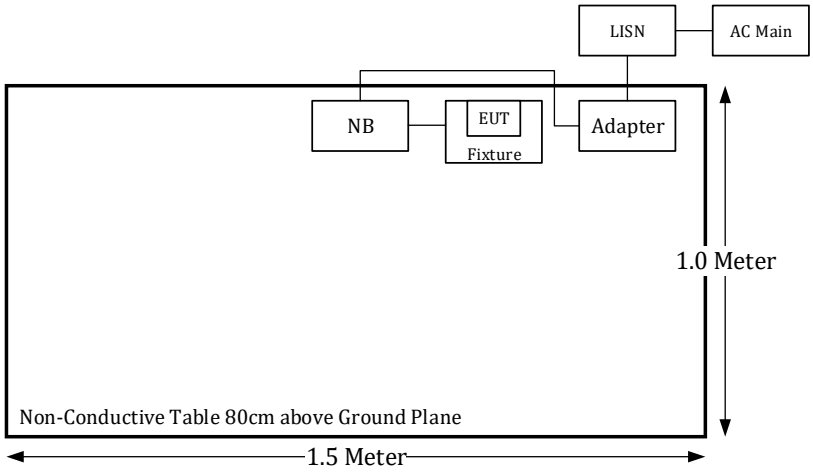
Below 1GHz:



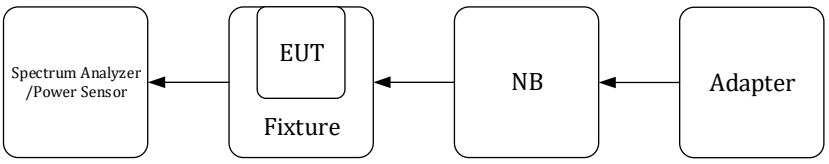
Above 1GHz:



Conduction:



Conducted:



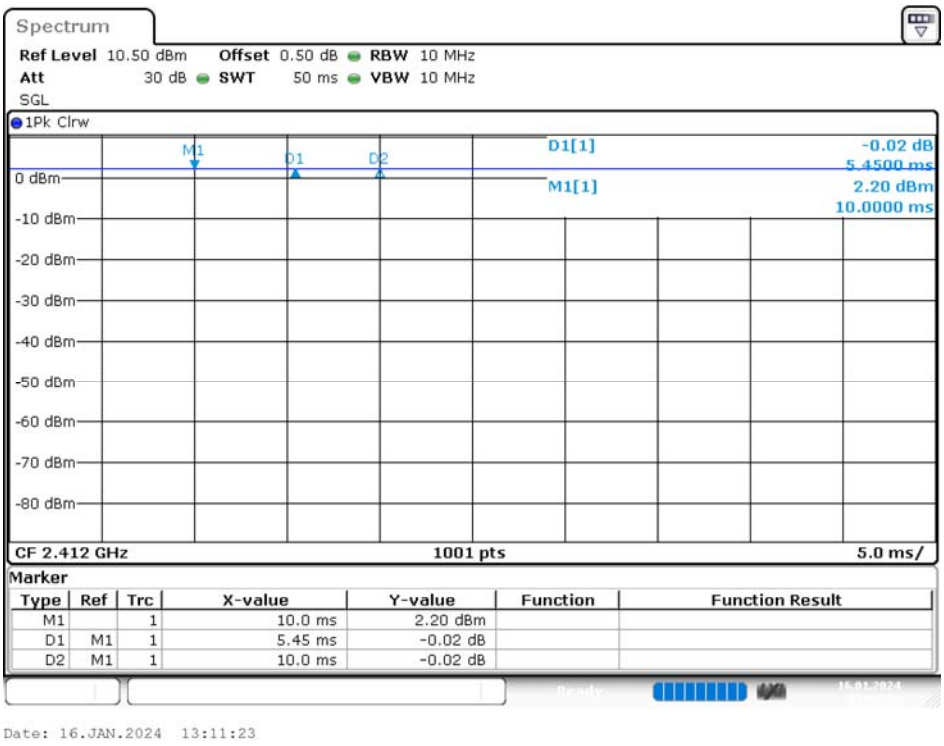
2.8 Duty Cycle

The duty cycle as below:

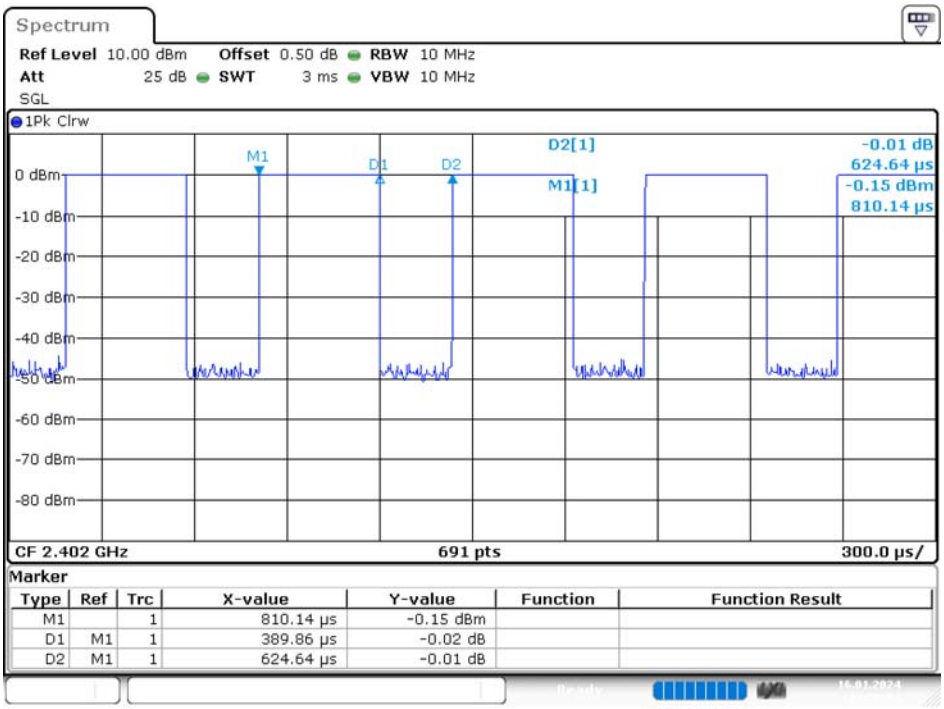
Radio Mode	On Time (ms)	Off Time (ms)	Duty Cycle (%)	1/T (kHz)	VBW Setting (kHz)
802.11b	100	100	100	0.01	0.01
BLE(1M)	0.38986	0.23478	62	2.57	3

Please refer to the following plots.

B Mode



BLE(1M) Mode



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3 Summary of Test Results

FCC Rules	Description of Test	Results
§1.1307(b)(3)(i)	RF Exposure	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247(a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum Peak Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

4 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
AC Line Conduction Room (CON-A)					
LISN	Rohde & Schwarz	ENV216	101612	2023/2/2	2024/2/1
EMI Test Receiver	Rohde & Schwarz	ESW8	100947	2023/5/22	2024/5/20
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM104	2023/5/18	2024/5/16
RF Cable	EMEC	EM-CB5D	1	2023/6/6	2024/6/4
Software	AUDIX	E3	V9.150826k	N.C.R	N.C.R
Radiation 3M Room (966-A)					
Active Loop Antenna	ETS-Lindgren	6502	35796	2023/3/23	2024/3/24
Bilog Antenna with 6 dB Attenuator	SUNOL SCIENCES & MINI-CIRCUITS	JB6/UNAT-6+	A050115/15542_01	2023/1/31	2024/1/30
				2024/1/19	2025/1/20
Horn Antenna	EMCO	SAS-571	1020	2023/5/18	2024/5/17
Horn Antenna	ETS-Lindgren	3116	62638	2023/8/25	2024/8/24
Preamplifier	Sonoma	310N	130602	2023/6/16	2024/6/15
Preamplifier	Channel	ERA-100M-18G-01D1748	EC2300051	2023/4/1	2024/3/31
Preamplifier	A.H. Systems	PAM-1840VH	174	2023/3/24	2024/3/23
Spectrum Analyzer	Rohde & Schwarz	FSV40	101435	2023/1/31	2024/1/30
				2024/2/7	2025/2/5
EMI Test Receiver	Rohde & Schwarz	ESR3	102099	2023/6/16	2024/6/15
Micro flex Cable	UTIFLEX	UFB197C-1-2362-70U-70U	225757-001	2023/1/24	2024/1/23
				2024/1/23	2025/1/23
Coaxial Cable	COMMATE	PEWC	8Dr	2023/12/23	2024/12/22
Coaxial Cable	UTIFLEX	UFB311A-Q-1440-300300	220490-006	2023/1/24	2024/1/23
				2024/1/23	2025/1/23
Coaxial Cable	JUNFLON	J12J102248-00-B-5	AUG-07-15-044	2023/12/23	2024/12/22
Cable	EMC	EMC105-SM-SM-10000	201003	2023/1/24	2024/1/23
				2024/1/23	2025/1/21
Coaxial Cable	ROSNOL	K1K50-UP0264-K1K50-450CM	160309-1	2023/1/24	2024/1/23
				2024/1/23	2025/1/21
Coaxial Cable	ROSNOL	K1K50-UP0264-K1K50-50CM	15120-1	2023/2/1	2024/1/31
				2024/1/23	2025/1/21
Software	AUDIX	E3	18621a	N.C.R	N.C.R
Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSV40	101140	2023/2/9	2024/2/8
Cable	UTIFLEX	UFA210A	9435	2023/10/2	2024/10/1
Power Sensor	Boonton	RTP5006	11037	2023/5/23	2024/5/22

***Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to the SI System of Units via the R.O.C. Center for Measurement Standards of the Electronics Testing Center, Taiwan (ETC) or to another internationally recognized National Metrology Institute (NMI), and were compliant with the current Taiwan Accreditation Foundation (TAF) requirements.

5 FCC §1.1307(b)(3)(i) – RF Exposure

5.1 Applicable Standard

According to subpart 15.247(i)and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

For single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

(B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold Pth (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). Pth is given by:

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^x & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

(C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least λ/2π, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of λ/4 or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

5.2 RF Exposure Evaluation Result

Project info

Band	Freq (MHz)	Tune-up Power (dBm)	Ant Gain (dBi)	Distances (mm)	Tune-up Power (mW)	ERP (dBm)	ERP (mW)
802.11b	2412	11.5	-0.27	200	14.13	9.08	8.09
BLE	2402	0.5	-0.27	200	1.12	-1.92	0.64

§ 1.1307(b)(3)(i)(A) method is not applicable.

§ 1.1307(b)(3)(i)(C)

Band	Freq (MHz)	λ/2π (mm)	Distances applies	ERP Limit (mW)	Result Option C
802.11b	2412	19.8	apply	768.00	exempt
BLE	2402	19.88	apply	768.00	exempt

The minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates

ERP (watts) is no more than the calculated value prescribed for that frequency

R must be at least $\lambda/2\pi$

λ is the free-space operating wavelength in meters

Result: The device compliant the MPE-Based Exemption at 20cm distances.

6 FCC §15.203 – Antenna Requirements

6.1 Applicable Standard

According to § 15.203,

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna does not exceed 6dBi.

6.2 Antenna List and Details

Manufacturer	Model	Type	Antenna Gain
iot Tech	ANT-D566	PCB	-0.27 dBi

The antenna is permanently attached to the device.

Result: Compliance

7 FCC §15.207(a) – AC Line Conducted Emissions

7.1 Applicable Standard

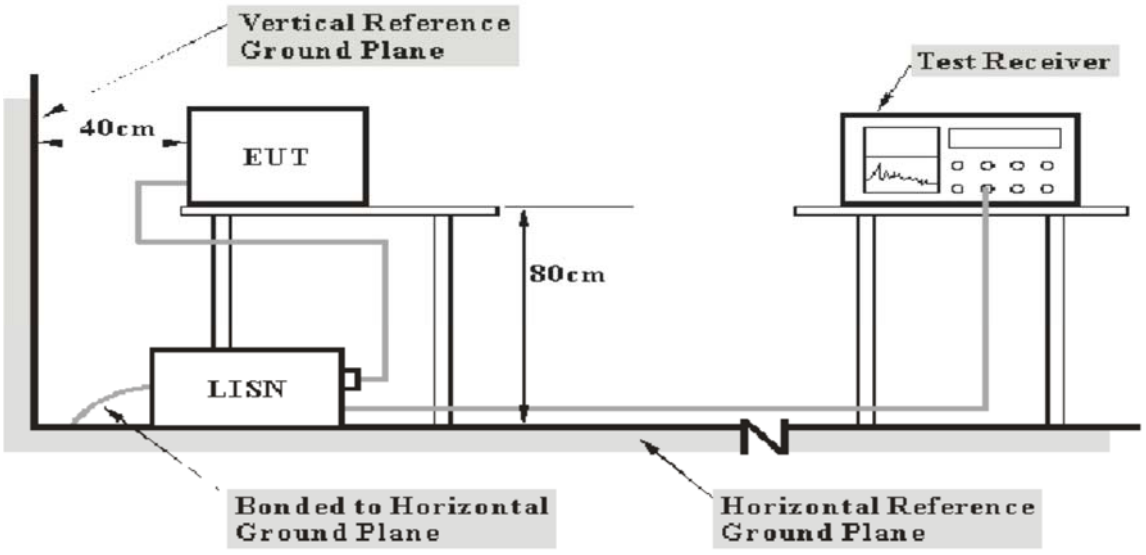
According to §15.207

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 (Note 1)	56 to 46 (Note 1)
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency.

7.2 EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

7.3 EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150kHz to 30MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations

Frequency Range	IF B/W
150kHz – 30MHz	9kHz

7.4 Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

7.5 Corrected Factor & Margin Calculation

The factor is calculated by adding LISN/ISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

The “Over Limit” column of the following data tables indicates the degree of compliance with the applicable limit. For example, an over limit of -7 dB means the emission is 7 dB below the limit. The equation for Over Limit calculation is as follows:

Over Limit = Result – Limit

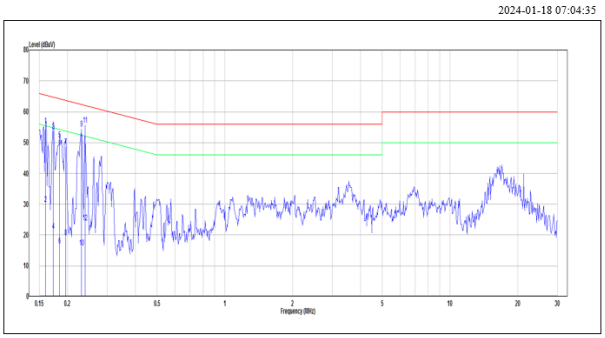
7.6 Test Results

Test Mode: Transmitting

Main: AC120 V, 60 Hz

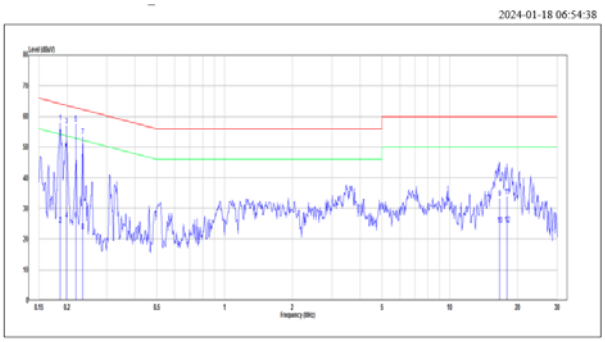
WIFI Mode (Worst case is 802.11b mode, High Channel)

Line



No.	Frequency	Reading	Correct	Result	Limit	Over limit	Remark	Phase
	(MHz)	dBuV	Factor(dB)	dBuV	dBuV	(dB)		
1	0.160	36.01	19.50	55.51	65.47	-9.96	QP	Line
2	0.160	10.54	19.50	30.04	55.47	-25.43	Average	Line
3	0.173	34.21	19.50	53.71	64.81	-11.10	QP	Line
4	0.173	1.92	19.50	21.41	54.81	-33.40	Average	Line
5	0.184	31.41	19.49	50.91	64.28	-13.38	QP	Line
6	0.184	-2.86	19.49	16.63	54.28	-37.65	Average	Line
7	0.197	29.31	19.49	48.80	63.76	-14.95	QP	Line
8	0.197	-0.26	19.49	19.23	53.76	-34.53	Average	Line
9	0.230	35.02	19.50	54.52	62.44	-7.91	QP	Line
10	0.230	-3.59	19.50	15.91	52.44	-36.52	Average	Line
11	0.239	36.14	19.51	55.65	62.13	-6.48	QP	Line
12	0.239	4.56	19.51	24.07	52.13	-28.06	Average	Line

Neutral



No.	Frequency	Reading	Correct	Result	Limit	Over limit	Remark	Phase
	(MHz)	dBuV	Factor(dB)	dBuV	dBuV	(dB)		
1	0.186	38.57	19.50	58.07	64.20	-6.13	QP	Neutral
2	0.186	5.06	19.50	24.56	54.20	-29.63	Average	Neutral
3	0.199	37.59	19.50	57.09	63.67	-6.58	QP	Neutral
4	0.199	6.78	19.50	26.28	53.67	-27.38	Average	Neutral
5	0.219	38.13	19.51	57.64	62.88	-5.24	QP	Neutral
6	0.219	6.75	19.51	26.25	52.88	-26.62	Average	Neutral
7	0.234	33.95	19.51	53.46	62.30	-8.84	QP	Neutral
8	0.234	3.07	19.51	22.59	52.30	-29.71	Average	Neutral
9	16.661	12.88	20.39	33.28	60.00	-26.72	QP	Neutral
10	16.661	4.21	20.39	24.61	50.00	-25.39	Average	Neutral
11	17.944	13.60	20.45	34.05	60.00	-25.95	QP	Neutral
12	17.944	4.52	20.45	24.97	50.00	-25.03	Average	Neutral

Note:

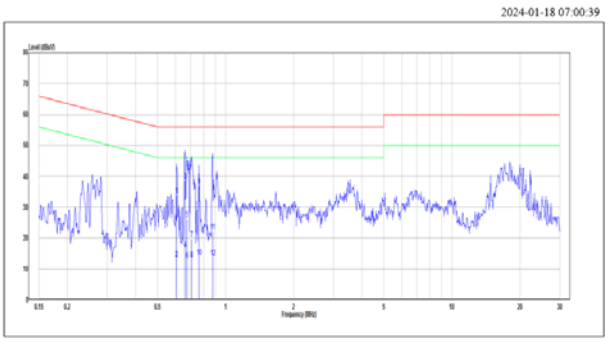
Level = Read Level + Factor

Over Limit = Result – Limit

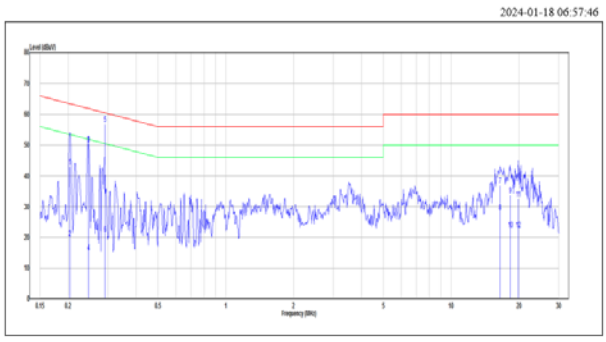
Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

BLE Mode (Worst case is Middle Channel)

Line	Neutral



No.	Frequency (MHz)	Reading dBuV	Correct Factor(dB)	Result dBuV	Limit dBuV	Over limit (dB)	Remark	Phase
1	0.608	14.05	19.68	33.72	56.00	-22.28	QP	Line
2	0.608	-6.39	19.68	13.29	46.00	-32.71	Average	Line
3	0.661	18.81	19.70	38.51	56.00	-17.49	QP	Line
4	0.661	-3.34	19.70	16.37	46.00	-29.63	Average	Line
5	0.675	6.44	19.71	26.15	56.00	-29.85	QP	Line
6	0.675	-6.86	19.71	12.85	46.00	-33.15	Average	Line
7	0.708	0.04	19.73	19.77	56.00	-36.23	QP	Line
8	0.708	-6.69	19.73	13.04	46.00	-32.96	Average	Line
9	0.763	17.17	19.75	36.92	56.00	-19.08	QP	Line
10	0.763	-5.90	19.75	13.86	46.00	-32.14	Average	Line
11	0.876	2.32	19.81	22.13	56.00	-33.87	QP	Line
12	0.876	-6.18	19.81	13.62	46.00	-32.38	Average	Line



No.	Frequency (MHz)	Reading dBuV	Correct Factor(dB)	Result dBuV	Limit dBuV	Over limit (dB)	Remark	Phase
1	0.203	23.47	19.50	42.98	63.49	-20.52	QP	Neutral
2	0.203	0.11	19.50	19.61	53.49	-33.88	Average	Neutral
3	0.246	30.74	19.52	50.26	61.91	-11.65	QP	Neutral
4	0.246	-4.46	19.52	15.06	51.91	-36.84	Average	Neutral
5	0.291	37.22	19.54	56.76	60.50	-3.74	QP	Neutral
6	0.291	1.57	19.54	21.11	50.50	-29.39	Average	Neutral
7	16.486	16.50	20.39	36.88	60.00	-23.12	QP	Neutral
8	16.486	7.77	20.39	28.15	50.00	-21.85	Average	Neutral
9	18.328	13.23	20.47	33.70	60.00	-26.30	QP	Neutral
10	18.328	2.20	20.47	22.67	50.00	-27.33	Average	Neutral
11	19.845	12.07	20.53	32.61	60.00	-27.39	QP	Neutral
12	19.845	2.11	20.53	22.64	50.00	-27.36	Average	Neutral

Note:

Level = Read Level + Factor

Over Limit = Result – Limit

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

8 FCC §15.209, §15.205 , §15.247(d) – Spurious Emissions

8.1 Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1MHz.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	608 – 614	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	960 – 1240	5. 35 – 5. 46
2.1735 – 2.1905	16.80425 – 16.80475	1300 – 1427	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1435 – 1626.5	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1645.5 – 1646.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1660 – 1710	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1718.8 – 1722.2	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	2200 – 2300	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2310 – 2390	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2483.5 – 2500	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2690 – 2900	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	3260 – 3267	22.01 – 23.12
8.41425 – 8.41475	162.0125 –167.17	3.332 – 3.339	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3 3458 – 3 358	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3.600 – 4.400	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4		Above 38.6
13.36 – 13.41	399.9 – 410		

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

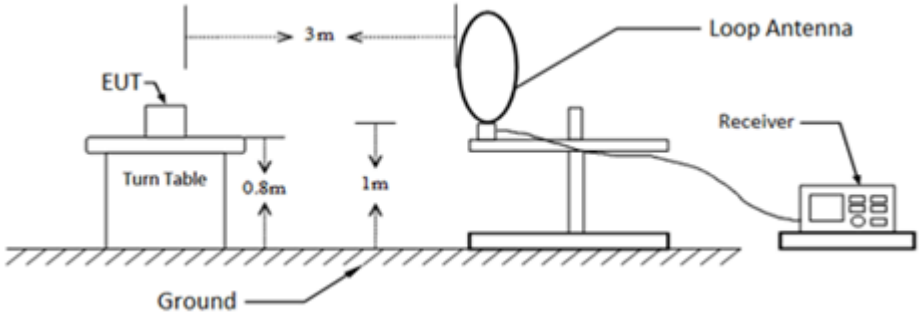
According to ANSI C63.10-2013, section 5.3.3 Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field, and the emissions to be measured can be

detected by the measurement equipment (see 4.3.4). Measurements shall not be performed at a distance greater than 30 m for frequencies above 30 MHz, unless it can be further demonstrated that measurements at a distance of 30 m or less are impractical. Measurements from 18 GHz to 40 GHz are typically made at distances significantly less than 3 m from the EUT. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade of distance (inverse of linear distance for field-strength measurements or inverse of linear distance-squared for power-density measurements).

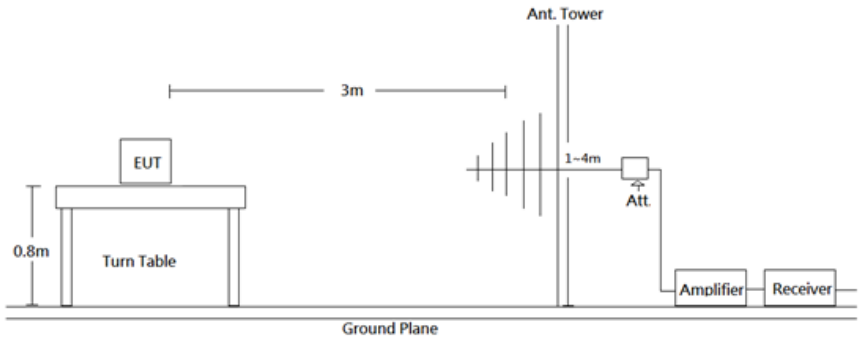
As per FCC §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c).

8.2 EUT Setup

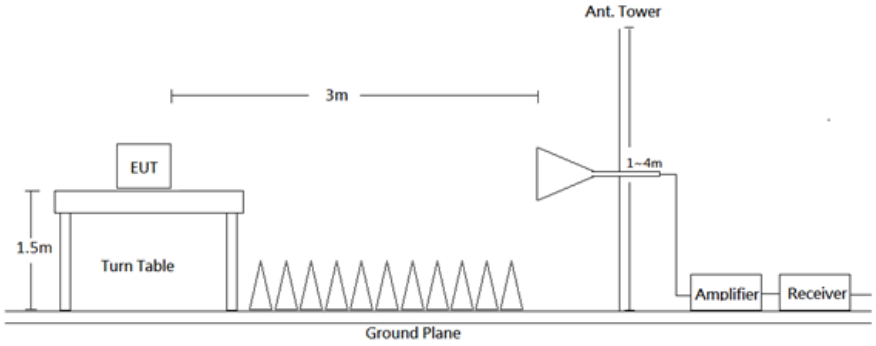
9kHz-30MHz:



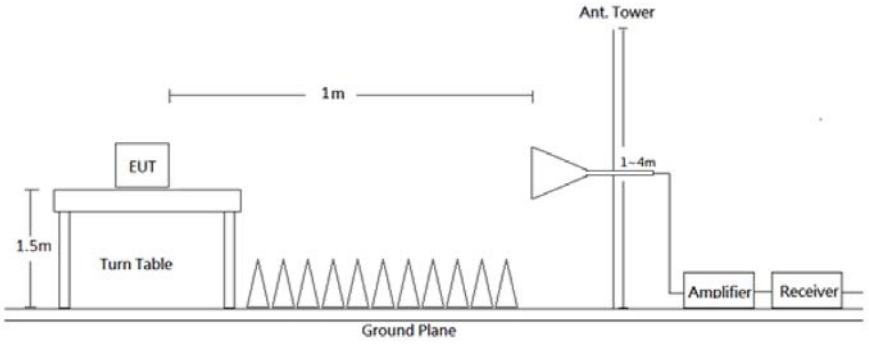
30MHz-1GHz:



1-18 GHz:



18-26.5 GHz:



Radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC Part 15.209 and FCC 15.247 Limits.

8.3 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 9 kHz to 26.5 GHz. During the radiated emission test, the EMI test receiver was set with the following configurations measurement method 6.3 in ANSI C63.10.

Frequency Range	RBW	VBW	Duty cycle	Measurement method
9 kHz - 150 kHz	300 Hz	1 kHz	/	QP/AV
150 kHz - 30 MHz	10 kHz	30 kHz	/	QP/AV
30-1000 MHz	120 kHz	300 kHz	/	QP
Above 1 GHz	1 MHz	3 MHz	/	PK
	1 MHz	10 Hz	>98%	Ave
	1 MHz	1/T	<98%	Ave

Note: T is minimum transmission duration.

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

8.4 Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All data was recorded in the Quasi-peak detector mode from 30 MHz to 1 GHz and PK and average detector modes for frequencies above 1 GHz.

8.5 Corrected Factor & Margin Calculation

The Correct Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Margin = Level – Limit

8.6 Test Results

Test Mode: Transmitting

(Pre-scan with three orthogonal axis, and worse case as Y axis.)

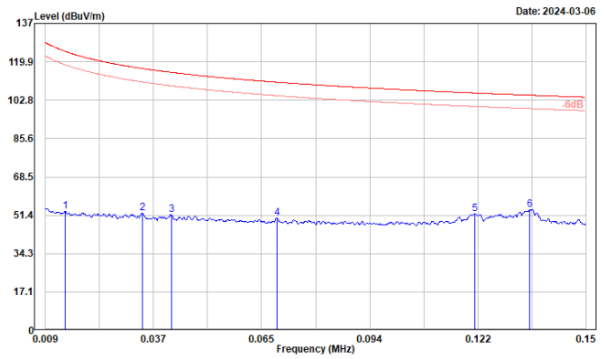
WIFI Mode

9kHz-30MHz:

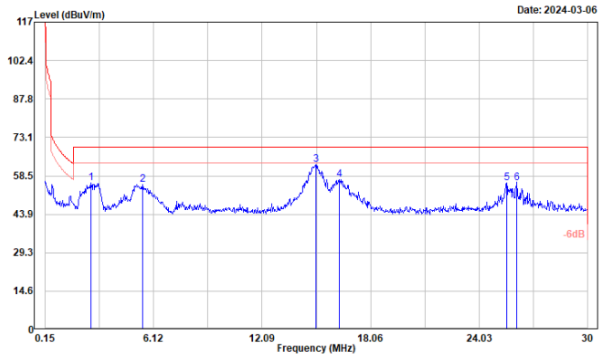
(worst case is high channel)

(Pre-scan using three directional polarities, worst case as parallel)

9kHz-150kHz	150kHz-30MHz



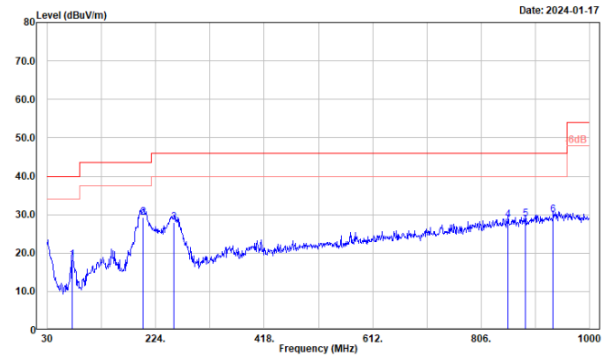
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
0.014	37.20	16.01	53.21	124.55	-71.34	100	312	Average
0.034	39.03	13.29	52.32	116.91	-64.59	100	225	Average
0.042	38.94	12.70	51.64	115.17	-63.53	100	141	Average
0.069	38.63	11.53	50.16	110.78	-60.62	100	39	Average
0.121	40.81	11.32	52.13	105.95	-53.82	100	103	Average
0.135	42.57	11.40	53.97	104.98	-51.01	100	105	Average



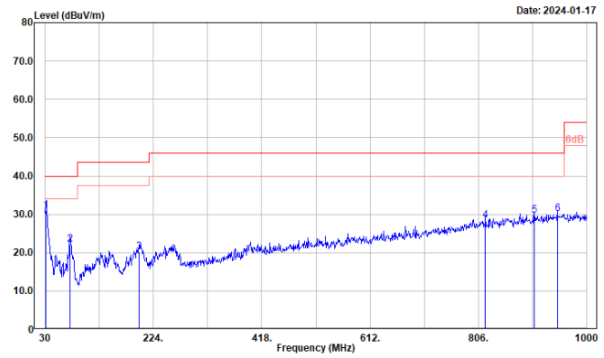
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2.657	45.27	10.55	55.82	69.54	-13.72	100	58	QP
5.523	43.87	11.29	55.16	69.54	-14.38	100	96	QP
15.045	51.34	11.52	62.86	69.54	-6.68	100	145	QP
16.329	45.46	11.54	57.00	69.54	-12.54	100	220	QP
25.552	44.02	11.70	55.72	69.54	-13.82	100	168	QP
26.120	44.25	11.71	55.96	69.54	-13.58	100	311	QP

30MHz-1GHz:

Low channel	
Horizontal	Vertical



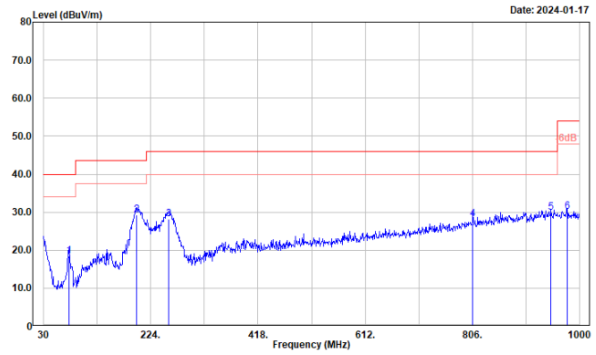
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
74.620	33.81	-15.70	18.11	40.00	-21.89	100	339	QP
200.720	39.76	-10.41	29.35	43.50	-14.15	100	94	QP
256.980	38.77	-10.89	27.88	46.00	-18.12	100	132	QP
854.500	27.42	1.24	28.66	46.00	-17.34	100	199	QP
885.540	27.26	1.67	28.93	46.00	-17.07	100	216	QP
935.010	27.55	2.43	29.98	46.00	-16.02	100	316	QP



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
31.940	35.50	-4.45	31.05	40.00	-8.95	100	65	QP
74.620	37.88	-15.70	22.18	40.00	-17.82	100	107	QP
197.810	30.65	-10.47	20.18	43.50	-23.32	100	169	QP
818.610	27.88	0.43	28.31	46.00	-17.69	100	249	QP
906.880	27.76	1.89	29.65	46.00	-16.35	100	234	QP
947.620	27.32	2.72	30.04	46.00	-15.96	100	126	QP

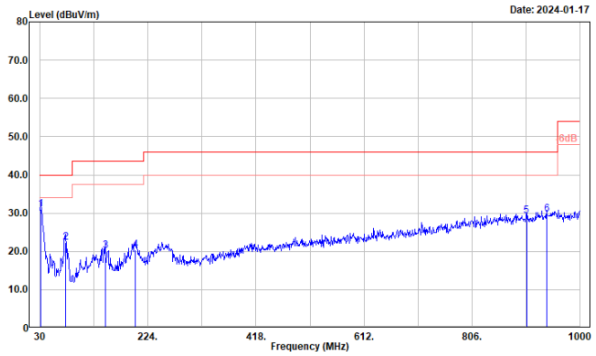
Middle channel

Horizontal



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
75.590	34.16	-15.68	18.48	40.00	-21.52	100	317	QP
197.810	39.74	-10.47	29.27	43.50	-14.23	100	94	QP
256.980	39.18	-10.89	28.29	46.00	-17.71	100	144	QP
806.970	27.85	0.29	28.14	46.00	-17.86	100	136	QP
948.590	27.12	2.74	29.86	46.00	-16.14	100	289	QP
977.690	27.55	2.51	30.06	54.00	-23.94	100	83	QP

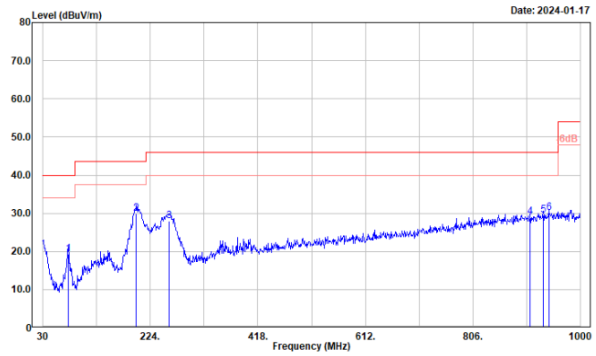
Vertical



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
31.940	35.44	-4.45	30.99	40.00	-9.01	100	185	QP
75.590	38.09	-15.68	22.41	40.00	-17.59	100	48	QP
147.370	30.59	-10.34	20.25	43.50	-23.25	100	201	QP
200.720	30.75	-10.41	20.34	43.50	-23.16	100	208	QP
903.970	27.37	1.87	29.24	46.00	-16.76	100	357	QP
939.860	27.19	2.55	29.74	46.00	-16.26	100	41	QP

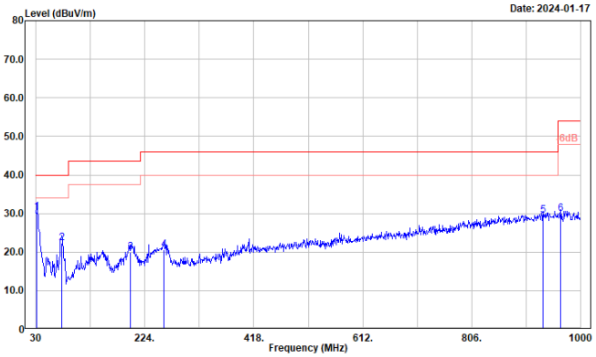
High channel

Horizontal



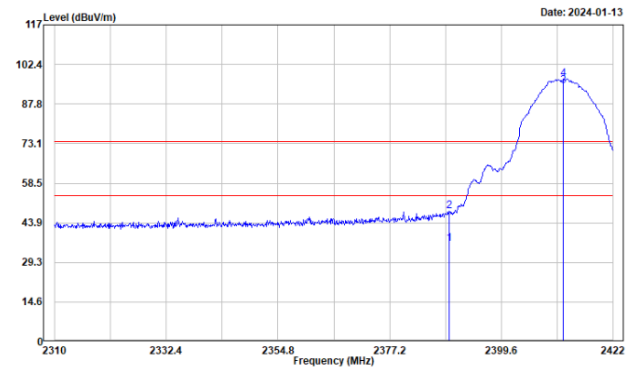
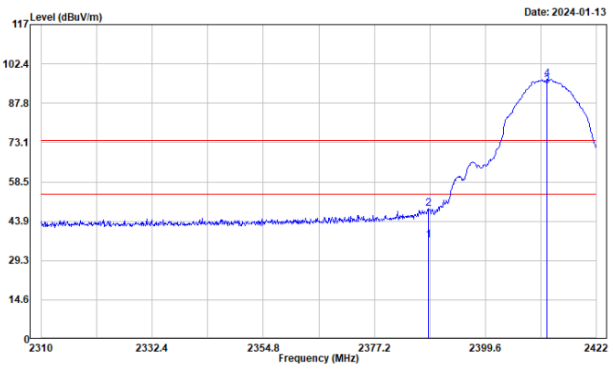
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
76.560	35.06	-15.77	19.29	40.00	-20.71	100	353	QP
198.780	40.27	-10.27	30.00	43.50	-13.50	100	82	QP
257.950	38.64	-10.76	27.88	46.00	-18.12	100	143	QP
909.790	27.02	1.97	28.99	46.00	-17.01	100	13	QP
933.070	27.05	2.43	29.48	46.00	-16.52	100	17	QP
942.770	27.48	2.62	30.10	46.00	-15.90	100	284	QP

Vertical



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
31.940	34.89	-4.45	30.44	40.00	-9.56	100	159	QP
75.590	37.98	-15.68	22.30	40.00	-17.70	100	73	QP
197.810	30.45	-10.47	19.98	43.50	-23.52	100	203	QP
257.950	31.29	-10.76	20.53	46.00	-25.47	100	148	QP
933.070	27.11	2.43	29.54	46.00	-16.46	100	35	QP
964.110	27.27	2.66	29.93	54.00	-24.07	100	104	QP

Band-Edge: (worst case is low channel)

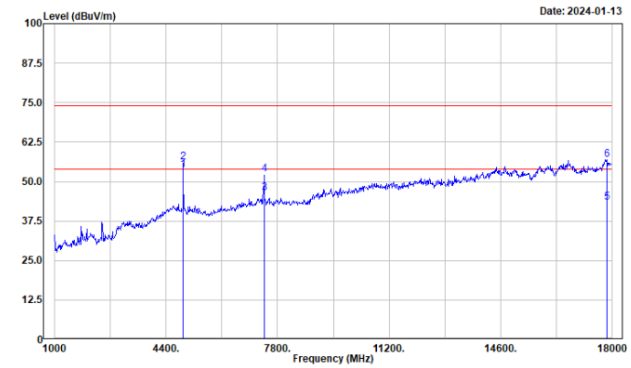
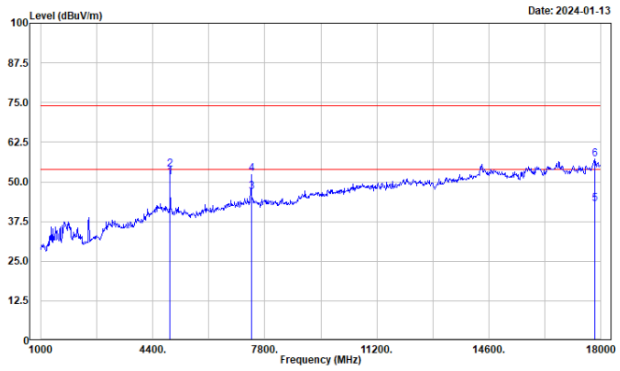
Horizontal	Vertical
	

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2389.072	47.29	-11.03	36.26	54.00	-17.74	102	100	Average
2389.072	59.21	-11.03	48.18	74.00	-25.82	102	100	Peak
2412.000	105.40	-10.94	94.46			102	100	Average
2412.000	107.95	-10.94	97.01			102	100	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2388.064	47.82	-11.04	36.78	54.00	-17.22	102	238	Average
2388.064	59.61	-11.04	48.57	74.00	-25.43	102	238	Peak
2412.000	105.03	-10.94	94.09			102	238	Average
2412.000	107.57	-10.94	96.63			102	238	Peak

(worst case is High channel)

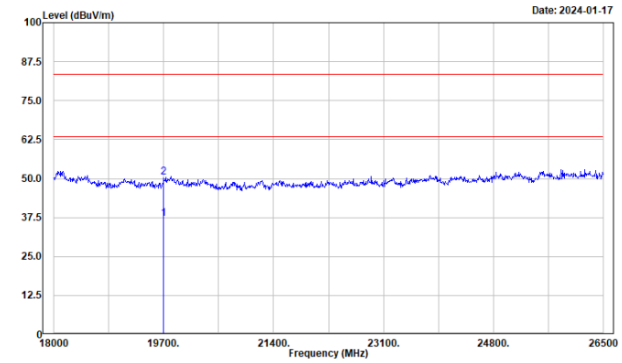
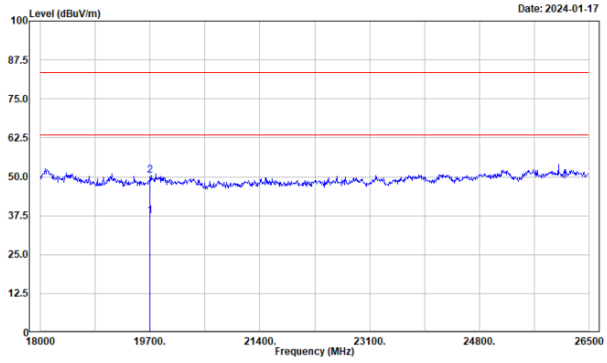
1GHz-18GHz:

Horizontal	Vertical
	

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4924.000	57.56	-3.84	53.72	54.00	-0.28	102	143	Average
4924.000	59.90	-3.84	56.06	74.00	-17.94	102	143	Peak
7386.000	46.00	0.45	46.45	54.00	-7.55	104	236	Average
7386.000	51.97	0.45	52.42	74.00	-21.58	104	236	Peak
17847.000	30.26	13.05	43.31	54.00	-10.69	150	209	Average
17847.000	43.95	13.05	57.00	74.00	-17.00	150	209	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4924.000	55.34	-3.84	51.50	54.00	-2.50	101	293	Average
4924.000	57.64	-3.84	53.80	74.00	-20.20	101	293	Peak
7386.000	46.34	0.45	46.79	54.00	-7.21	104	320	Average
7386.000	52.02	0.45	52.47	74.00	-21.53	104	320	Peak
17830.000	30.13	12.99	43.12	54.00	-10.88	150	219	Average
17830.000	44.22	12.99	57.21	74.00	-16.79	150	219	Peak

18GHz-26.5GHz:

Horizontal	Vertical
	

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
19696.000	19.64	17.55	37.19	63.50	-26.31	151	83	Average
19696.000	32.92	17.55	50.47	83.50	-33.03	151	83	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
19696.000	19.83	17.55	37.38	63.50	-26.12	155	289	Average
19696.000	32.77	17.55	50.32	83.50	-33.18	155	289	Peak

Level = Reading + Factor.

Margin = Level – Limit.

Factor = Antenna Factor + Cable Loss – Amplifier Gain.

Above 1GHz

Low channel

Horizontal

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2389.072	47.29	-11.03	36.26	54.00	-17.74	102	100	Average
2389.072	59.21	-11.03	48.18	74.00	-25.82	102	100	Peak
2412.000	105.40	-10.94	94.46			102	100	Average
2412.000	107.95	-10.94	97.01			102	100	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4824.000	56.91	-3.75	53.16	54.00	-0.84	107	155	Average
4824.000	58.38	-3.75	54.63	74.00	-19.37	107	155	Peak
7236.000	47.17	0.29	47.46	54.00	-6.54	106	108	Average
7236.000	52.06	0.29	52.35	74.00	-21.65	106	108	Peak

Vertical

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2388.064	47.82	-11.04	36.78	54.00	-17.22	102	238	Average
2388.064	59.61	-11.04	48.57	74.00	-25.43	102	238	Peak
2412.000	105.03	-10.94	94.09			102	238	Average
2412.000	107.57	-10.94	96.63			102	238	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4824.000	52.37	-3.75	48.62	54.00	-5.38	119	331	Average
4824.000	54.63	-3.75	50.88	74.00	-23.12	119	331	Peak
7236.000	47.28	0.29	47.57	54.00	-6.43	142	354	Average
7236.000	52.57	0.29	52.86	74.00	-21.14	142	354	Peak

Middle channel

Horizontal

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2437.000	105.49	-10.92	94.57			120	102	Average
2437.000	108.03	-10.92	97.11			120	102	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4874.000	57.21	-3.86	53.35	54.00	-0.65	105	36	Average
4874.000	59.93	-3.86	56.07	74.00	-17.93	105	36	Peak
7311.000	45.23	0.18	45.41	54.00	-8.59	111	234	Average
7311.000	51.27	0.18	51.45	74.00	-22.55	111	234	Peak

Vertical

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2437.000	105.33	-10.92	94.41			115	236	Average
2437.000	107.89	-10.92	96.97			115	236	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4874.000	52.86	-3.86	49.00	54.00	-5.00	120	305	Average
4874.000	55.57	-3.86	51.71	74.00	-22.29	120	305	Peak
7311.000	46.86	0.18	47.04	54.00	-6.96	136	350	Average
7311.000	52.67	0.18	52.85	74.00	-21.15	136	350	Peak

High channel

Horizontal

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2462.000	104.44	-10.76	93.68			114	99	Average
2462.000	107.09	-10.76	96.33			114	99	Peak
2484.064	46.33	-10.47	35.86	54.00	-18.14	114	99	Average
2484.064	61.16	-10.47	50.69	74.00	-23.31	114	99	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4924.000	57.56	-3.84	53.72	54.00	-0.28	102	143	Average
4924.000	59.90	-3.84	56.06	74.00	-17.94	102	143	Peak
7386.000	46.00	0.45	46.45	54.00	-7.55	104	236	Average
7386.000	51.97	0.45	52.42	74.00	-21.58	104	236	Peak
17847.000	30.26	13.05	43.31	54.00	-10.69	150	209	Average
17847.000	43.95	13.05	57.00	74.00	-17.00	150	209	Peak

Vertical

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2462.000	104.33	-10.76	93.57			130	234	Average
2462.000	106.96	-10.76	96.20			130	234	Peak
2483.968	45.37	-10.47	34.90	54.00	-19.10	130	234	Average
2483.968	59.22	-10.47	48.75	74.00	-25.25	130	234	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4924.000	55.34	-3.84	51.50	54.00	-2.50	101	293	Average
4924.000	57.64	-3.84	53.80	74.00	-20.20	101	293	Peak
7386.000	46.34	0.45	46.79	54.00	-7.21	104	320	Average
7386.000	52.02	0.45	52.47	74.00	-21.53	104	320	Peak
17830.000	30.13	12.99	43.12	54.00	-10.88	150	219	Average
17830.000	44.22	12.99	57.21	74.00	-16.79	150	219	Peak

Level = Reading + Factor.

Margin = Level – Limit.

Factor = Antenna Factor + Cable Loss – Amplifier Gain.

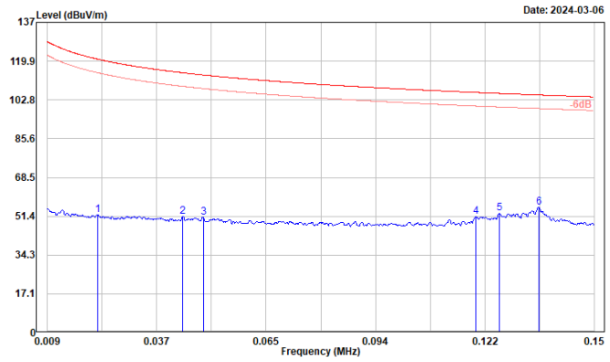
BLE(1M) Mode

9kHz-30MHz:

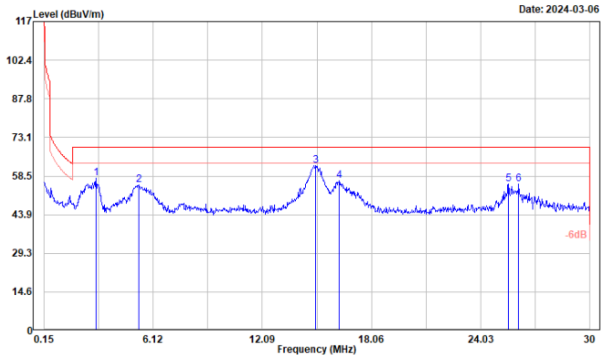
(worst case is low channel)

(Pre-scan using three directional polarities, worst case as parallel)

9kHz-150kHz	150kHz-30MHz



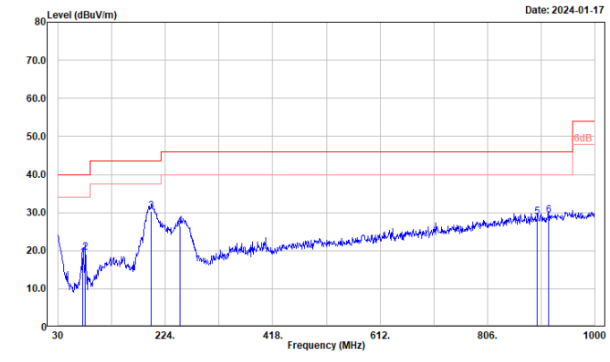
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
0.022	37.41	14.67	52.08	120.77	-68.69	100	228	Average
0.044	38.57	12.68	51.25	114.74	-63.49	100	144	Average
0.049	38.32	12.62	50.94	113.77	-62.83	100	315	Average
0.120	39.78	11.32	51.10	106.05	-54.95	100	207	Average
0.126	41.26	11.35	52.61	105.62	-53.01	100	9	Average
0.136	43.86	11.40	55.26	104.96	-49.70	100	152	Average



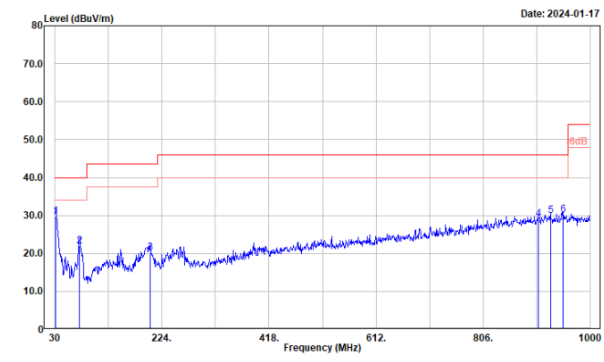
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2.986	47.23	10.46	57.69	69.54	-11.85	100	142	QP
5.344	44.17	11.08	55.25	69.54	-14.29	100	19	QP
15.015	50.96	11.52	62.48	69.54	-7.06	100	325	QP
16.299	45.30	11.54	56.84	69.54	-12.70	100	228	QP
25.552	43.83	11.70	55.53	69.54	-14.01	100	174	QP
26.120	43.80	11.71	55.51	69.54	-14.03	100	241	QP

30MHz-1GHz:

Low channel	
Horizontal	**Vertical**



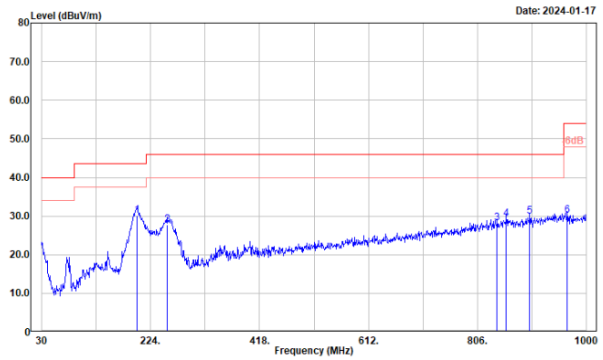
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
74.620	33.81	-15.70	18.11	40.00	-21.89	100	347	QP
79.470	35.55	-15.93	19.62	40.00	-20.38	100	5	QP
198.780	40.62	-10.27	30.35	43.50	-13.15	100	83	QP
251.160	37.79	-11.28	26.51	46.00	-19.49	100	140	QP
896.210	27.05	1.89	28.94	46.00	-17.06	100	232	QP
916.580	27.27	2.01	29.28	46.00	-16.72	100	68	QP



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
31.940	34.07	-4.45	29.62	40.00	-10.38	100	127	QP
74.620	37.69	-15.70	21.99	40.00	-18.01	100	108	QP
202.660	31.41	-11.17	20.24	43.50	-23.26	100	163	QP
905.910	27.27	1.87	29.14	46.00	-16.86	100	273	QP
928.220	27.45	2.38	29.83	46.00	-16.17	100	322	QP
951.500	27.29	2.78	30.07	46.00	-15.93	100	243	QP

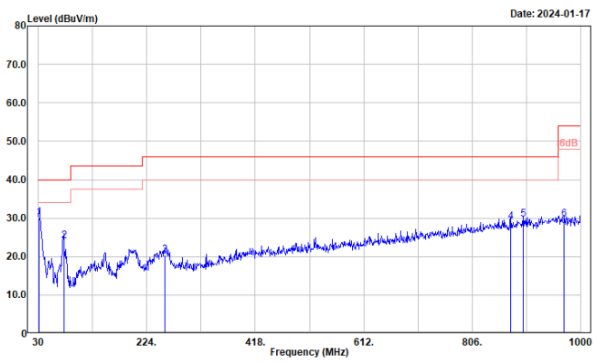
Middle channel

Horizontal



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
199.750	40.31	-10.14	30.17	43.50	-13.33	100	88	QP
253.100	39.02	-11.23	27.79	46.00	-18.21	100	141	QP
840.920	27.34	0.88	28.22	46.00	-17.78	100	141	QP
857.410	27.95	1.32	29.27	46.00	-16.73	100	163	QP
899.120	27.89	1.93	29.82	46.00	-16.18	100	43	QP
966.050	27.52	2.63	30.15	54.00	-23.85	100	303	QP

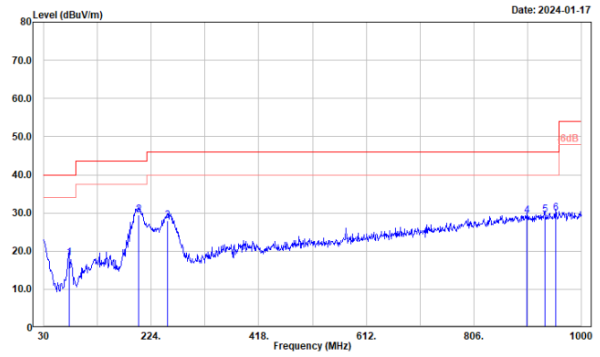
Vertical



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
30.970	33.94	-3.87	30.07	40.00	-9.93	100	128	QP
75.590	39.64	-15.68	23.96	40.00	-16.04	100	110	QP
256.010	31.32	-11.04	20.28	46.00	-25.72	100	128	QP
874.870	27.73	1.36	29.09	46.00	-16.91	100	16	QP
897.180	27.70	1.91	29.61	46.00	-16.39	100	360	QP
970.900	27.17	2.60	29.77	54.00	-24.23	100	184	QP

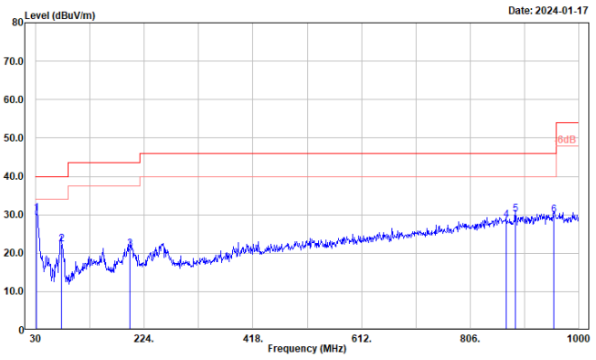
High channel

Horizontal



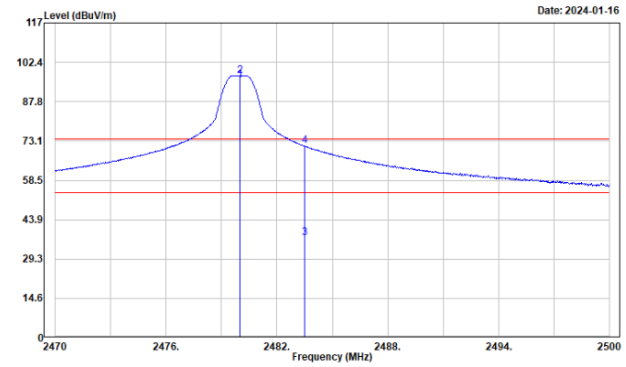
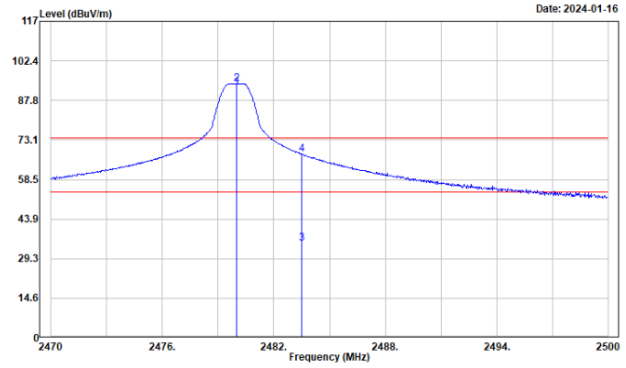
Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
75.590	33.87	-15.68	18.19	40.00	-21.81	100	347	QP
201.690	40.36	-10.79	29.57	43.50	-13.93	100	81	QP
253.100	39.25	-11.23	28.02	46.00	-17.98	100	130	QP
902.030	27.27	1.90	29.17	46.00	-16.83	100	188	QP
934.040	27.06	2.43	29.49	46.00	-16.51	100	107	QP
954.410	27.23	2.79	30.02	46.00	-15.98	100	103	QP

Vertical



Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
31.940	34.72	-4.45	30.27	40.00	-9.73	100	150	QP
75.590	38.08	-15.68	22.40	40.00	-17.60	100	33	QP
198.780	31.40	-10.27	21.13	43.50	-22.37	100	325	QP
870.020	27.24	1.31	28.55	46.00	-17.45	100	360	QP
886.510	28.46	1.66	30.12	46.00	-15.88	100	310	QP
955.380	27.16	2.79	29.95	46.00	-16.05	100	271	QP

Band-Edge: (worst case is high channel)

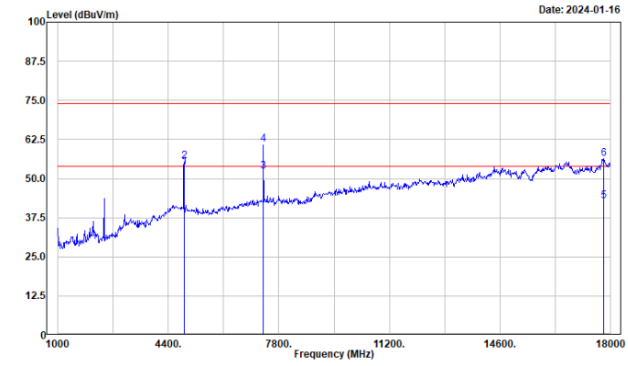
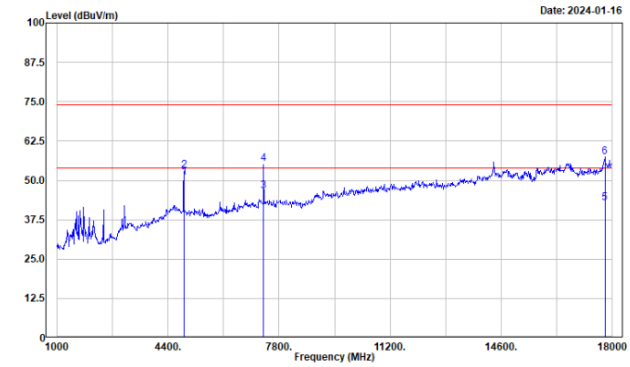
Horizontal	Vertical
	

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2480.000	106.41	-10.53	95.88			142	168	Average
2480.000	107.90	-10.53	97.37			142	168	Peak
2483.500	47.61	-10.48	37.13	54.00	-16.87	142	168	Average
2483.500	81.73	-10.48	71.25	74.00	-2.75	142	168	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2480.000	102.96	-10.53	92.43			113	300	Average
2480.000	104.45	-10.53	93.92			113	300	Peak
2483.500	45.50	-10.48	35.02	54.00	-18.98	113	300	Average
2483.500	78.39	-10.48	67.91	74.00	-6.09	113	300	Peak

(worst case is Middle channel)

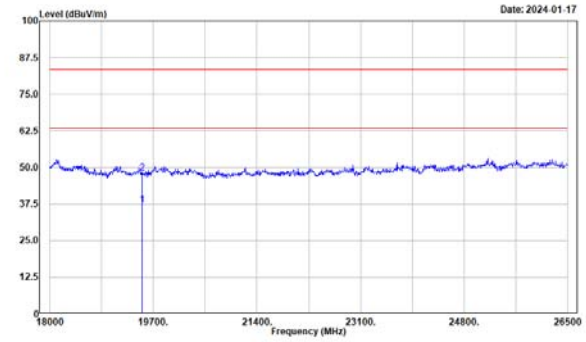
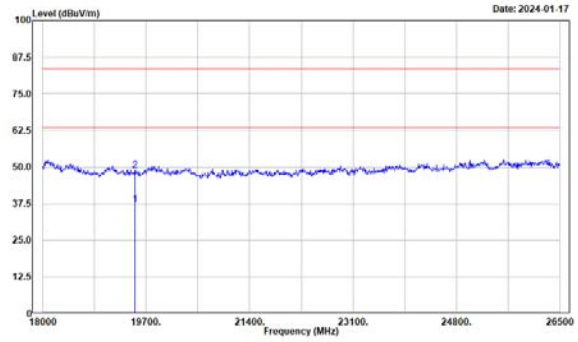
1GHz-18GHz:

Horizontal	Vertical
	

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4880.000	57.50	-3.88	53.62	54.00	-0.38	136	273	Average
4880.000	59.45	-3.88	55.57	74.00	-18.43	136	273	Peak
7320.000	52.13	0.22	52.35	54.00	-1.65	115	296	Average
7320.000	60.66	0.22	60.88	74.00	-13.12	115	296	Peak
17796.000	30.07	12.85	42.92	54.00	-11.08	150	147	Average
17796.000	43.38	12.85	56.23	74.00	-17.77	150	147	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4880.000	54.69	-3.88	50.81	54.00	-3.19	102	261	Average
4880.000	57.02	-3.88	53.14	74.00	-20.86	102	261	Peak
7320.000	46.46	0.22	46.68	54.00	-7.32	112	281	Average
7320.000	55.15	0.22	55.37	74.00	-18.63	112	281	Peak
17779.000	30.10	12.79	42.89	54.00	-11.11	150	285	Average
17779.000	44.59	12.79	57.38	74.00	-16.62	150	285	Peak

18GHz-26.5GHz:

Horizontal	Vertical
	

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
19520.000	20.33	16.69	37.02	63.50	-26.48	155	105	Average
19520.000	31.24	16.69	47.93	83.50	-35.57	155	105	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
19520.000	20.34	16.69	37.03	63.50	-26.47	151	360	Average
19520.000	32.11	16.69	48.80	83.50	-34.70	151	360	Peak

Level = Reading + Factor.

Margin = Level – Limit.

Factor = Antenna Factor + Cable Loss – Amplifier Gain.

Above 1GHz

Low channel

Horizontal

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2390.000	45.24	-11.02	34.22	54.00	-19.78	114	174	Average
2390.000	71.86	-11.02	60.84	74.00	-13.16	114	174	Peak
2402.000	107.34	-10.96	96.38			114	174	Average
2402.000	108.83	-10.96	97.87			114	174	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4804.000	57.27	-3.70	53.57	54.00	-0.43	108	267	Average
4804.000	58.99	-3.70	55.29	74.00	-18.71	108	267	Peak
7206.000	52.38	0.23	52.61	54.00	-1.39	102	308	Average
7206.000	60.91	0.23	61.14	74.00	-12.86	102	308	Peak

Vertical

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2390.000	43.51	-11.02	32.49	54.00	-21.51	151	291	Average
2390.000	67.11	-11.02	56.09	74.00	-17.91	151	291	Peak
2402.000	103.12	-10.96	92.16			151	291	Average
2402.000	104.61	-10.96	93.65			151	291	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4804.000	51.23	-3.70	47.53	54.00	-6.47	108	288	Average
4804.000	54.27	-3.70	50.57	74.00	-23.43	108	288	Peak
7206.000	45.95	0.23	46.18	54.00	-7.82	105	109	Average
7206.000	54.54	0.23	54.77	74.00	-19.23	105	109	Peak

Middle channel

Horizontal

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2440.000	107.55	-10.93	96.62			113	172	Average
2440.000	108.89	-10.93	97.96			113	172	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4880.000	57.50	-3.88	53.62	54.00	-0.38	136	273	Average
4880.000	59.45	-3.88	55.57	74.00	-18.43	136	273	Peak
7320.000	52.13	0.22	52.35	54.00	-1.65	115	296	Average
7320.000	60.66	0.22	60.88	74.00	-13.12	115	296	Peak
17796.000	30.07	12.85	42.92	54.00	-11.08	150	147	Average
17796.000	43.38	12.85	56.23	74.00	-17.77	150	147	Peak

Vertical

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2440.000	104.25	-10.93	93.32			174	293	Average
2440.000	105.64	-10.93	94.71			174	293	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4880.000	54.69	-3.88	50.81	54.00	-3.19	102	261	Average
4880.000	57.02	-3.88	53.14	74.00	-20.86	102	261	Peak
7320.000	46.46	0.22	46.68	54.00	-7.32	112	281	Average
7320.000	55.15	0.22	55.37	74.00	-18.63	112	281	Peak
17779.000	30.10	12.79	42.89	54.00	-11.11	150	285	Average
17779.000	44.59	12.79	57.38	74.00	-16.62	150	285	Peak

High channel

Horizontal

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2480.000	106.41	-10.53	95.88			142	168	Average
2480.000	107.90	-10.53	97.37			142	168	Peak
2483.500	47.61	-10.48	37.13	54.00	-16.87	142	168	Average
2483.500	81.73	-10.48	71.25	74.00	-2.75	142	168	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4960.000	56.19	-3.77	52.42	54.00	-1.58	145	253	Average
4960.000	58.13	-3.77	54.36	74.00	-19.64	145	253	Peak
7440.000	48.92	0.61	49.53	54.00	-4.47	115	287	Average
7440.000	57.72	0.61	58.33	74.00	-15.67	115	287	Peak

Vertical

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
2480.000	102.96	-10.53	92.43			113	300	Average
2480.000	104.45	-10.53	93.92			113	300	Peak
2483.500	45.50	-10.48	35.02	54.00	-18.98	113	300	Average
2483.500	78.39	-10.48	67.91	74.00	-6.09	113	300	Peak

Freq.	Reading	Factor	Level	Limit	Margin	Height	Degree	Remark
MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	(cm)	(°)	
4960.000	53.96	-3.77	50.19	54.00	-3.81	113	277	Average
4960.000	56.89	-3.77	53.12	74.00	-20.88	113	277	Peak
7440.000	43.73	0.61	44.34	54.00	-9.66	137	269	Average
7440.000	52.71	0.61	53.32	74.00	-20.68	137	269	Peak

Level = Reading + Factor.

Margin = Level – Limit.

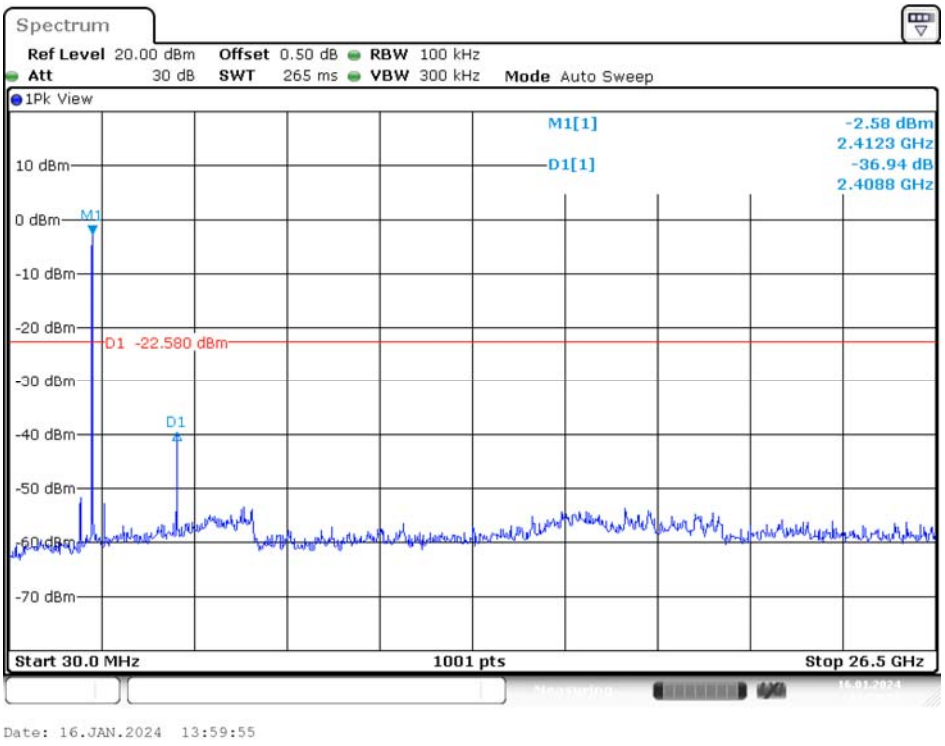
Factor = Antenna Factor + Cable Loss – Amplifier Gain.

Conducted Spurious Emissions:

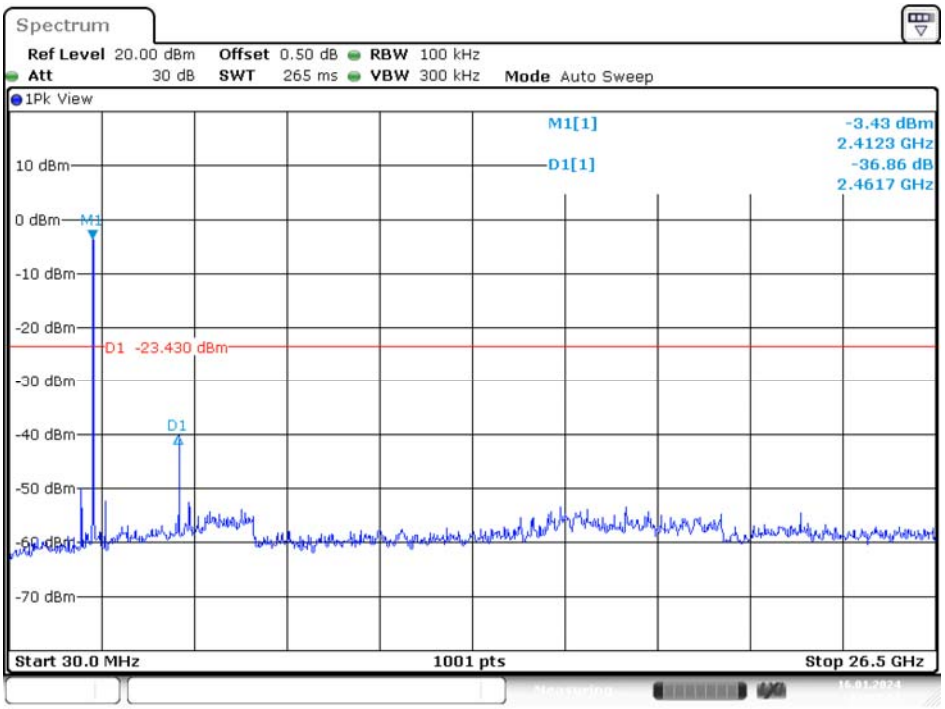
Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
B Mode				
Low	2412	36.94	≥ 20	PASS
Middle	2437	36.86	≥ 20	PASS
High	2462	37.88	≥ 20	PASS
BLE(1M) Mode				
Low	2402	50.67	≥ 20	PASS
Middle	2440	52.28	≥ 20	PASS
High	2480	52.02	≥ 20	PASS

B Mode

Low Channel

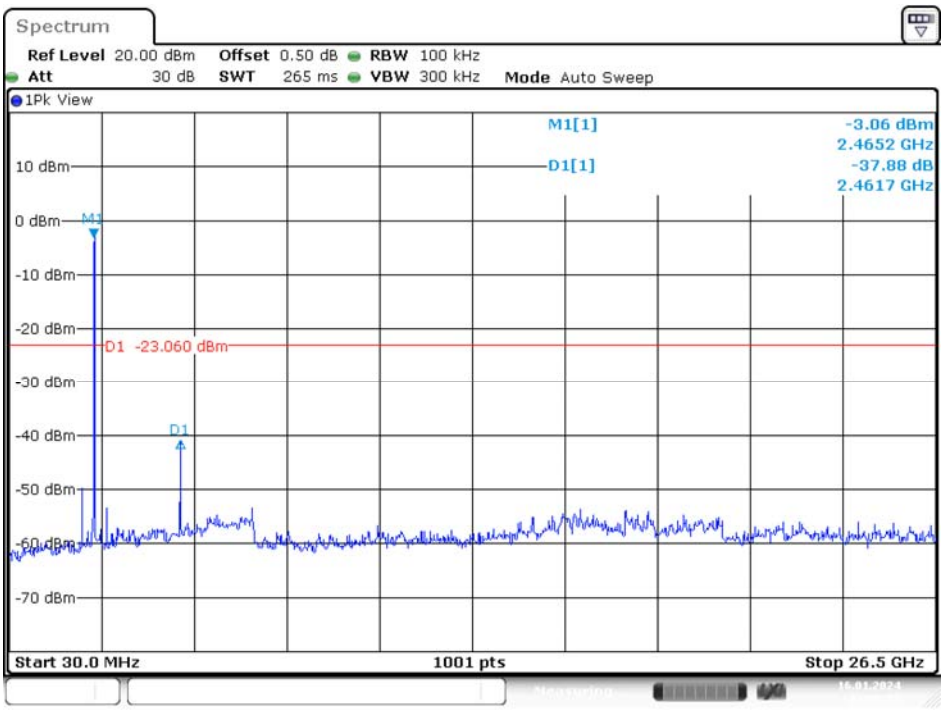


Middle Channel



Date: 16.JAN.2024 14:03:07

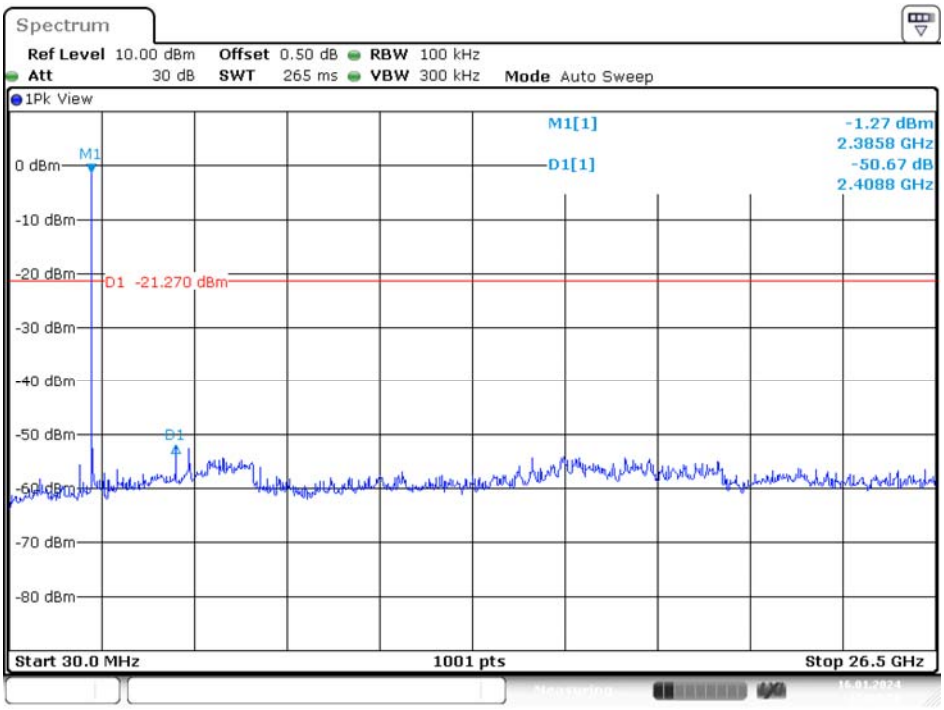
High Channel



Date: 16.JAN.2024 14:06:25

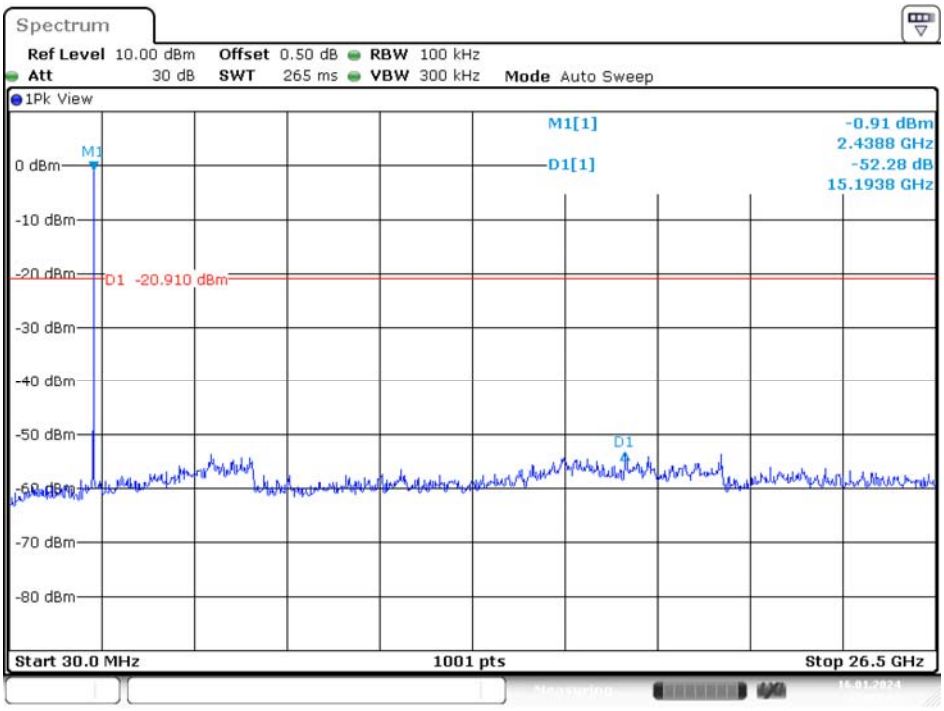
BLE(1M) Mode

Low Channel



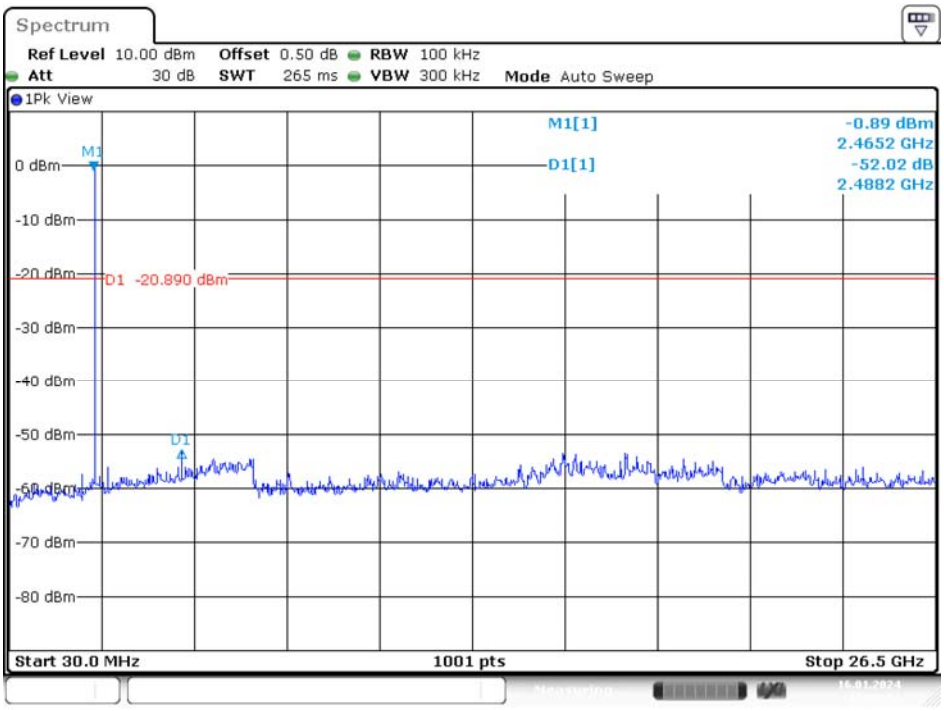
Date: 16.JAN.2024 15:00:56

Middle Channel



Date: 16.JAN.2024 15:03:43

High Channel



Date: 16.JAN.2024 15:06:21

9 FCC §15.247(a)(2) – 6 dB Emission Bandwidth

9.1 Applicable Standard

According to FCC §15.247(a)(2).

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

9.2 Test Procedure

According to ANSI C63.10-2013, section 11.8

The steps for the first option are as follows:

a) Set RBW = 100 kHz.

b) Set the VBW ≥ [3 × RBW].

c) Detector = peak.

d) Trace mode = max hold.

e) Sweep = auto couple.

f) Allow the trace to stabilize.

g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

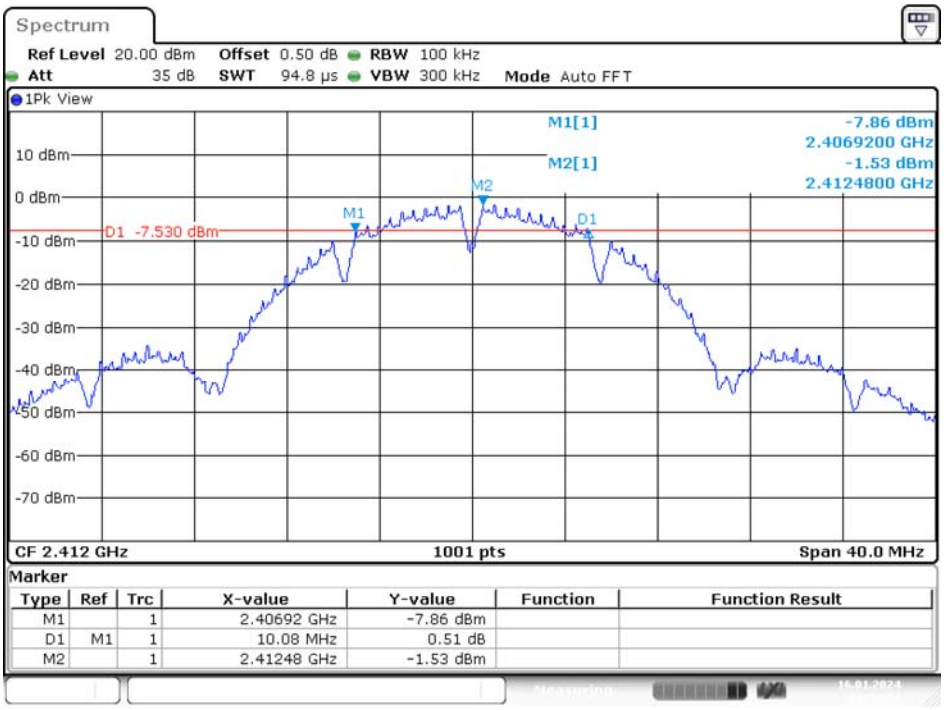
9.3 Test Results

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (kHz)	Result
B Mode				
Low	2412	10.08	> 500	PASS
Middle	2437	10.08	> 500	PASS
High	2462	10.08	> 500	PASS
BLE(1M) Mode				
Low	2402	0.708	> 500	PASS
Middle	2440	0.768	> 500	PASS
High	2480	0.783	> 500	PASS

Please refer to the following plots

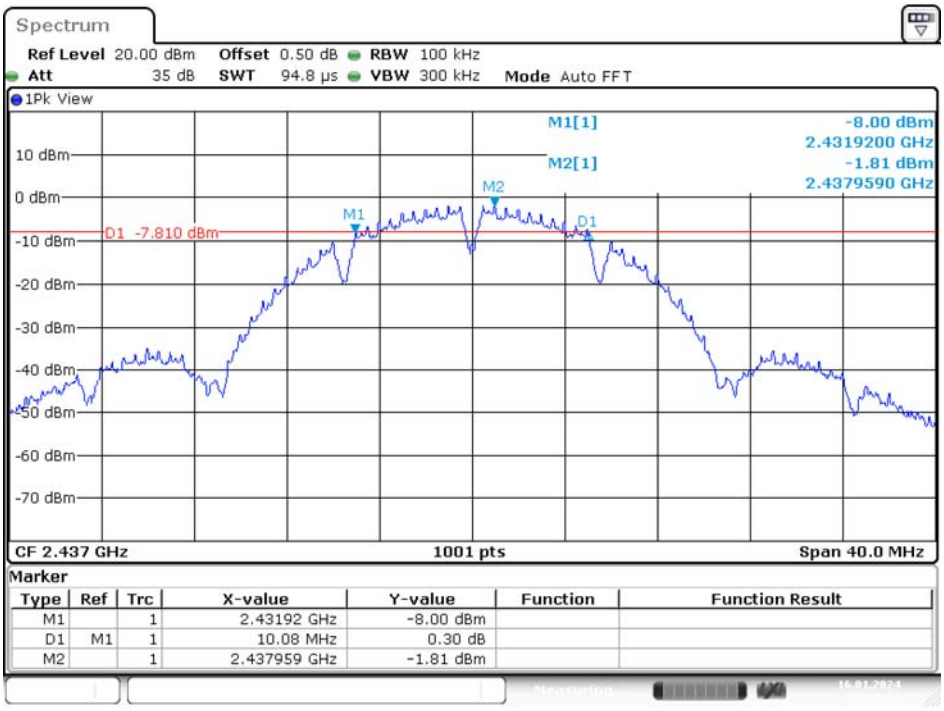
B Mode

Low Channel



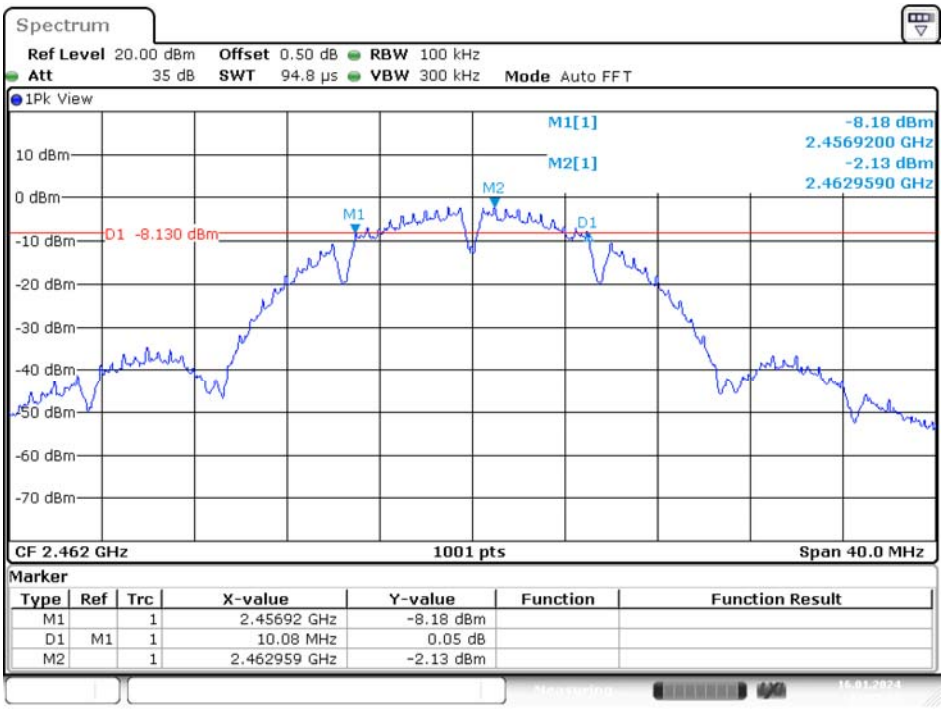
Date: 16.JAN.2024 13:59:14

Middle Channel



Date: 16.JAN.2024 14:02:42

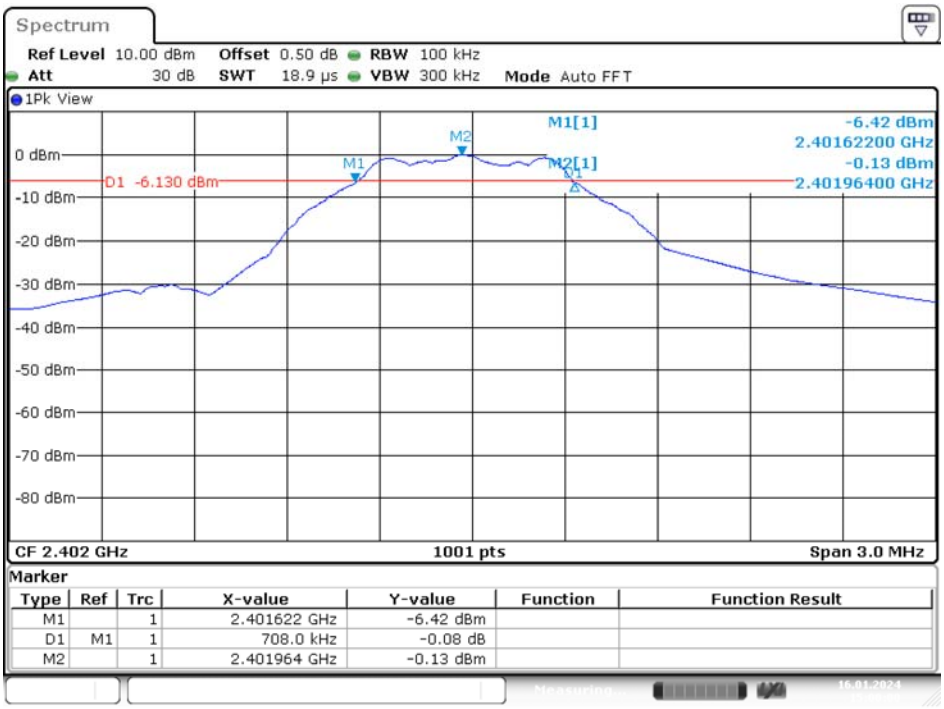
High Channel



Date: 16.JAN.2024 14:05:45

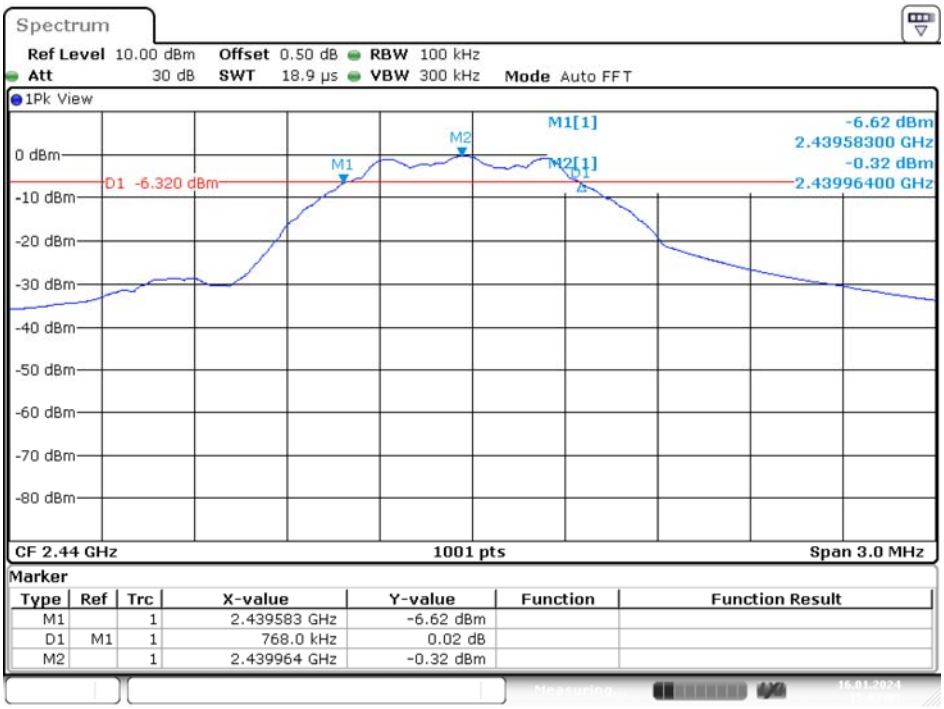
BLE(1M) Mode

Low Channel



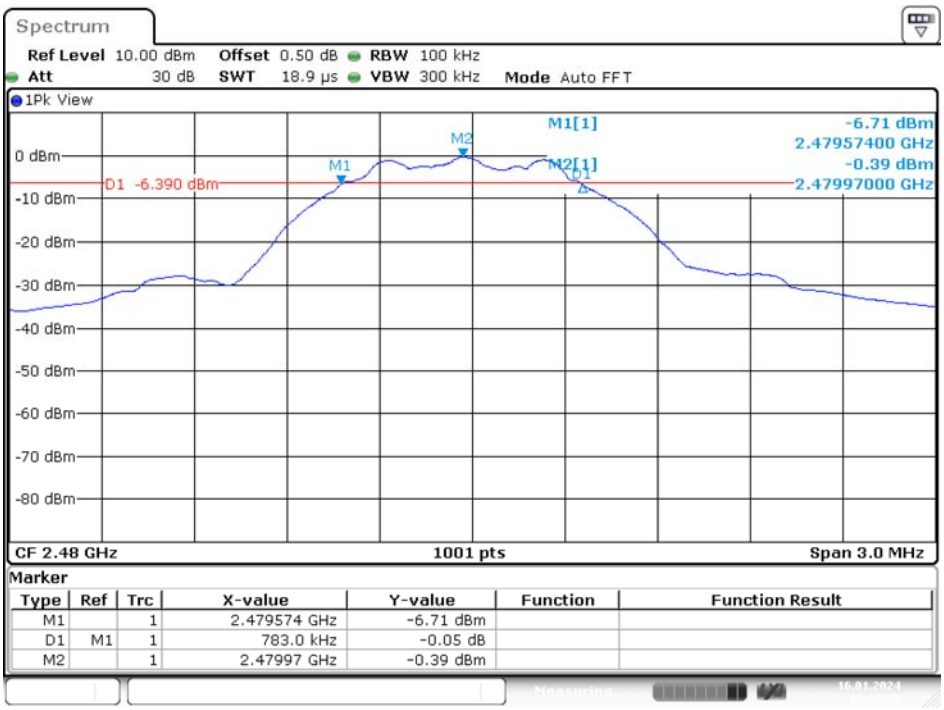
Date: 16.JAN.2024 15:00:00

Middle Channel



Date: 16.JAN.2024 15:03:03

High Channel



Date: 16.JAN.2024 15:05:25

10 FCC §15.247(b)(3) – Maximum Output Power

10.1 Applicable Standard

According to FCC §15.247(b) (3).

Systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

10.2 Test Procedure

According to ANSI C63.10-2013, section 11.9.1.3

1. Place the EUT on a bench and set it in transmitting mode.

2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to measuring equipment.

10.3 Test Results

Conducted Peak Output Power

Channel	Frequency (MHz)	Conducted Peak Output Power (dBm)	Power (W)	Limit (W)	Result
802.11b Mode					
Low	2412	11.05	0.013	1	PASS
Middle	2437	10.72	0.012	1	PASS
High	2462	10.35	0.011	1	PASS
BLE(1M) Mode					
Low	2402	0.49	0.001	1	PASS
Middle	2440	0.40	0.001	1	PASS
High	2480	0.28	0.001	1	PASS

11 FCC§15.247(d) – 100 kHz Bandwidth of Frequency Band Edge

11.1 Applicable Standard

According to FCC §15.247(d).

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

11.2 Test Procedure

According to ANSI C63.10-2013 Section 11.11

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

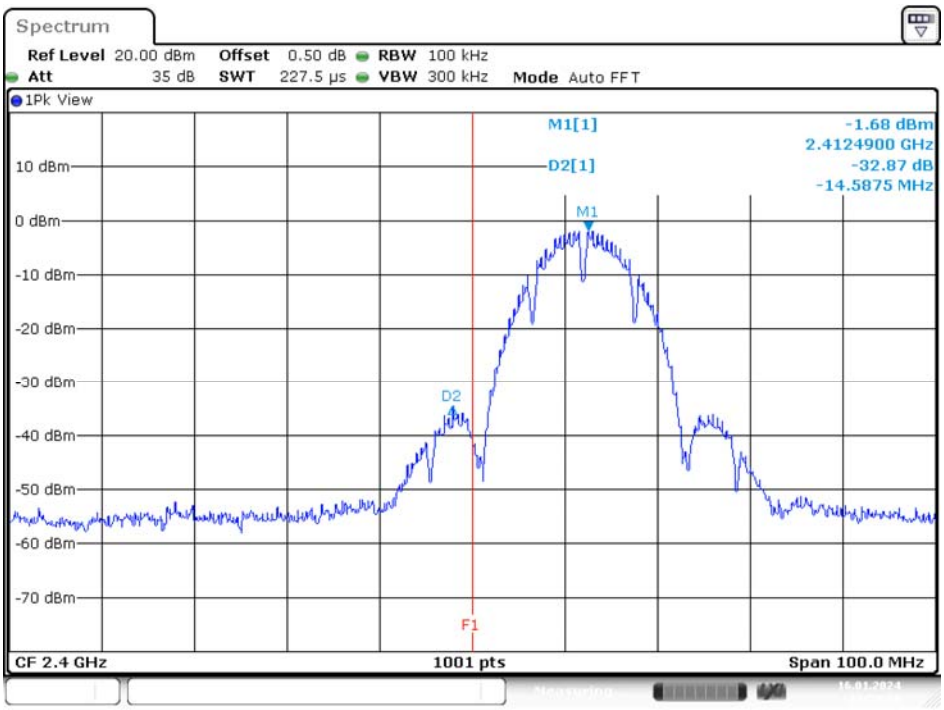
11.3 Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
B Mode				
Low	2412	32.87	≥ 20	PASS
High	2462	48.61	≥ 20	PASS
BLE(1M) Mode				
Low	2402	39.25	≥ 20	PASS
High	2480	43.83	≥ 20	PASS

Please refer to the following plots.

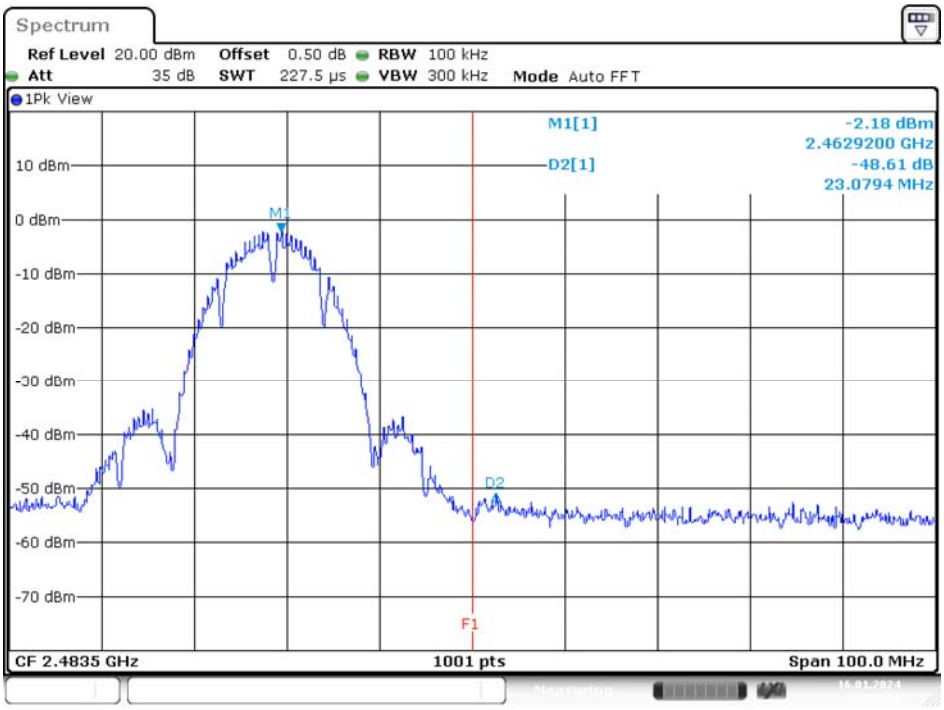
B Mode

Band Edge, Left Side



Date: 16.JAN.2024 13:59:39

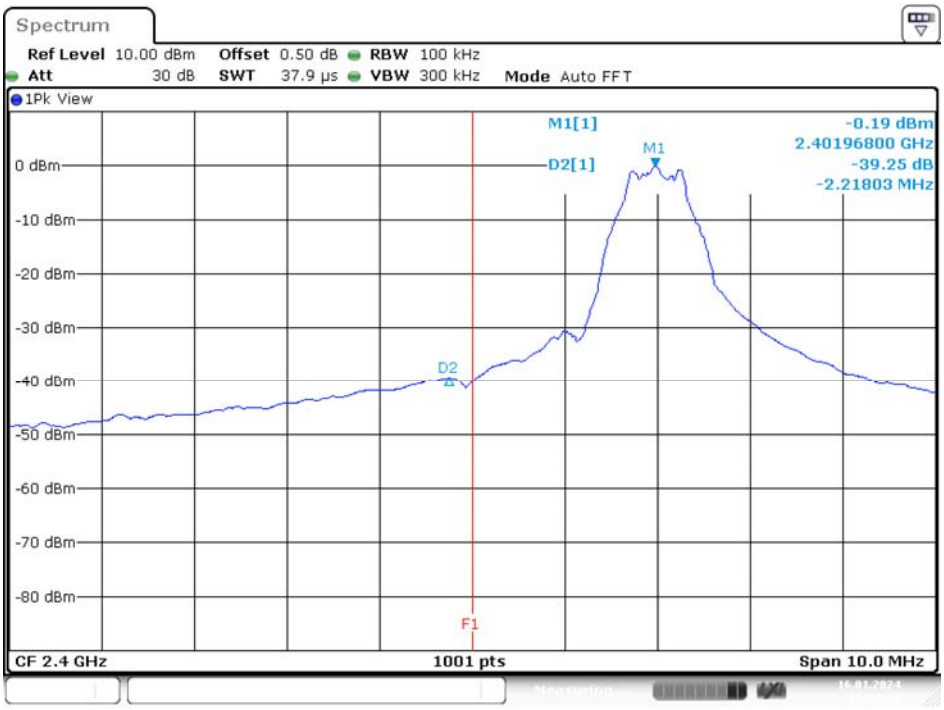
Band Edge, Right Side



Date: 16.JAN.2024 14:06:10

BLE(1M) Mode

Band Edge, Low Channel



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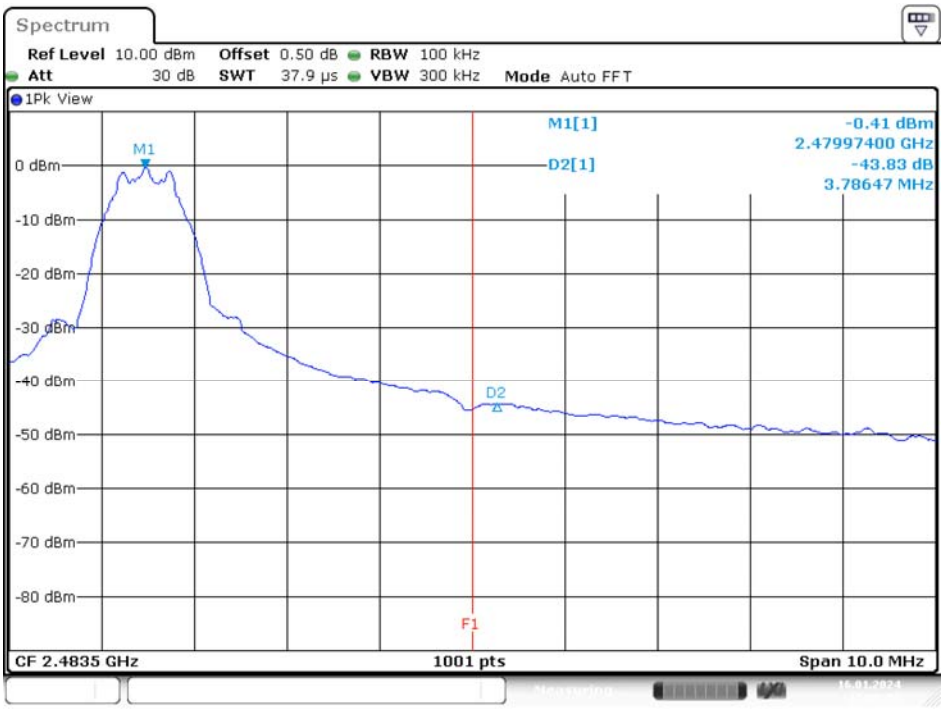
Band Edge, High Channel



Date: 16.JAN.2024 15:06:05

12 FCC §15.247(e) – Power Spectral Density

12.1 Applicable Standard

According to FCC §15.247(e).

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

12.2 Test Procedure

According to ANSI C63.10-2013, section 11.10.2

a) Set analyzer center frequency to DTS channel center frequency.

b) Set the span to 1.5 times the DTS bandwidth.

c) Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz.

d) Set the VBW ≥ [3 × RBW].

e) Detector = peak.

f) Sweep time = auto couple.

g) Trace mode = max hold.

h) Allow trace to fully stabilize.

i) Use the peak marker function to determine the maximum amplitude level within the RBW.

j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat

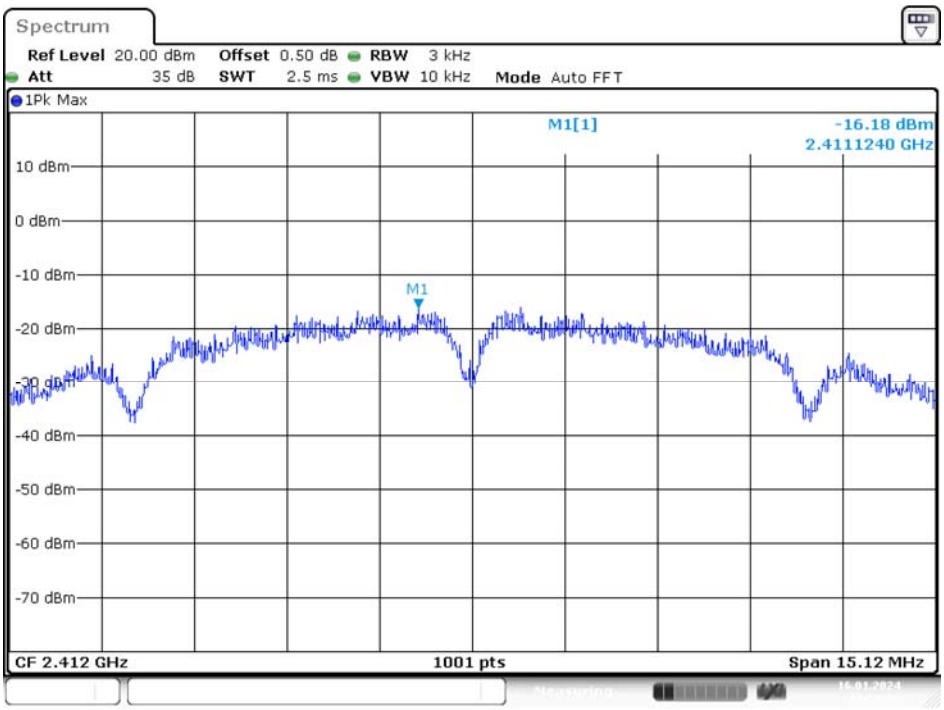
12.3 Test Results

Channel	Frequency (MHz)	Power Spectral Density (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
B Mode				
Low	2412	-16.18	8	PASS
Middle	2437	-16.40	8	PASS
High	2462	-16.72	8	PASS
BLE(1M) Mode				
Low	2402	-13.45	8	PASS
Middle	2440	-13.96	8	PASS
High	2480	-14.33	8	PASS

Please refer to the following plots

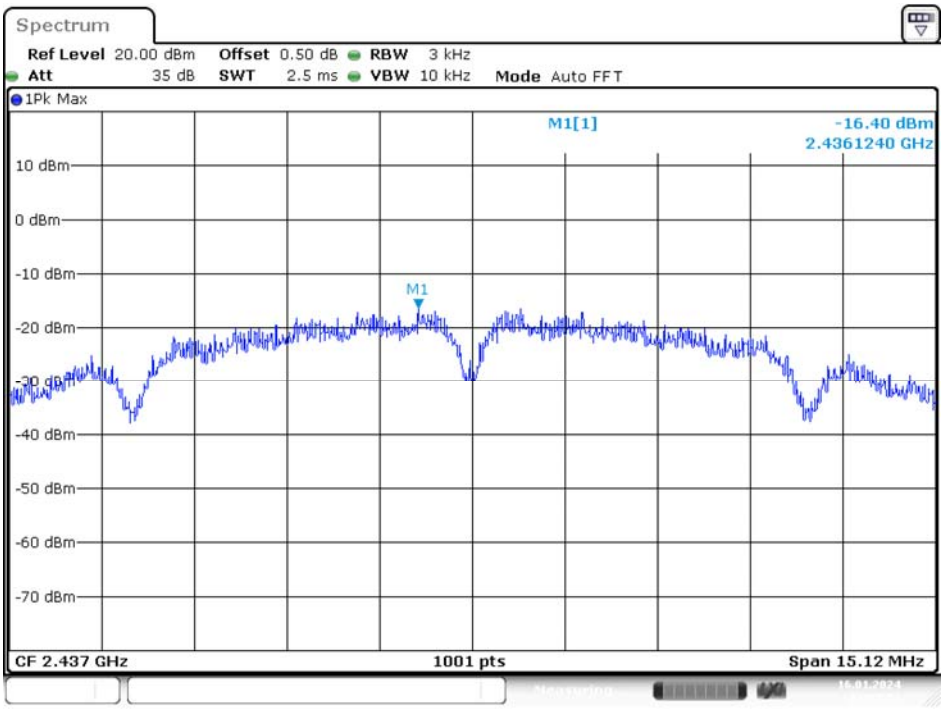
B Mode

Low Channel



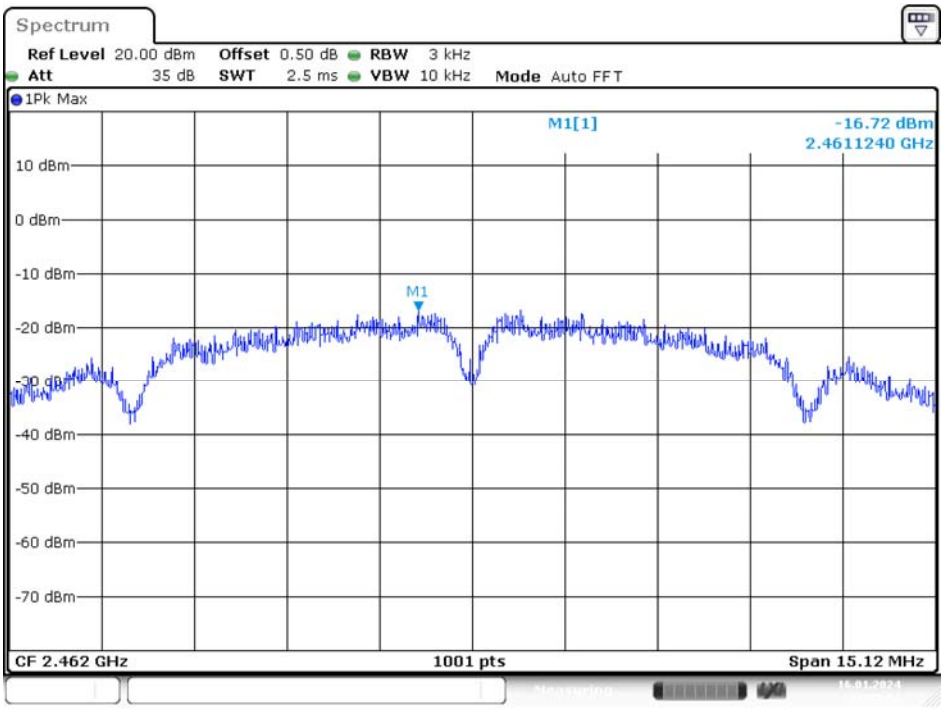
Date: 16.JAN.2024 13:59:23

Middle Channel



Date: 16.JAN.2024 14:02:51

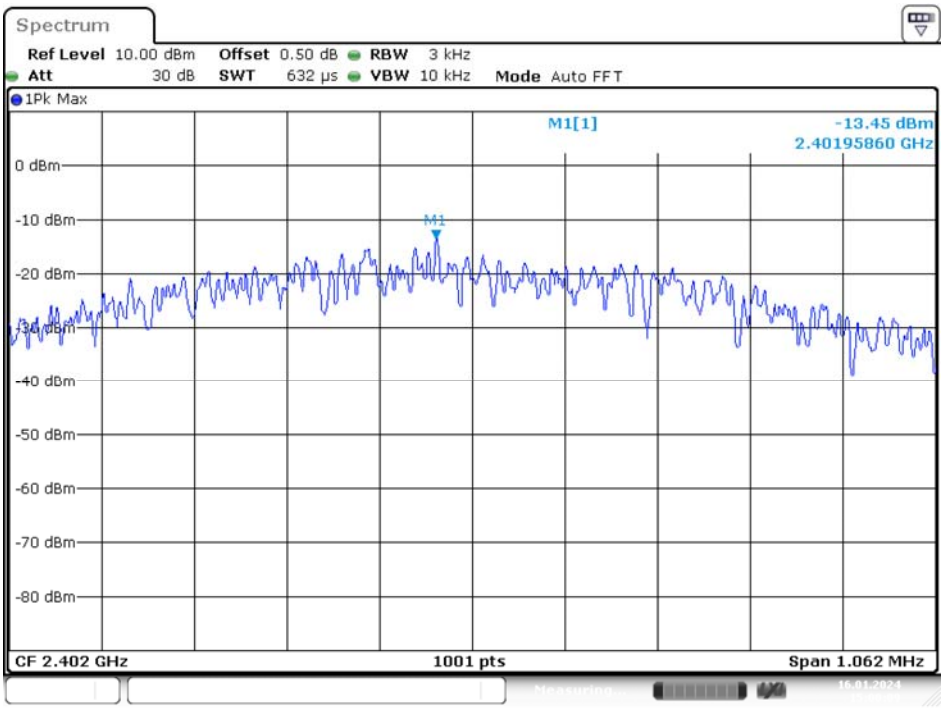
High Channel



Date: 16.JAN.2024 14:05:54

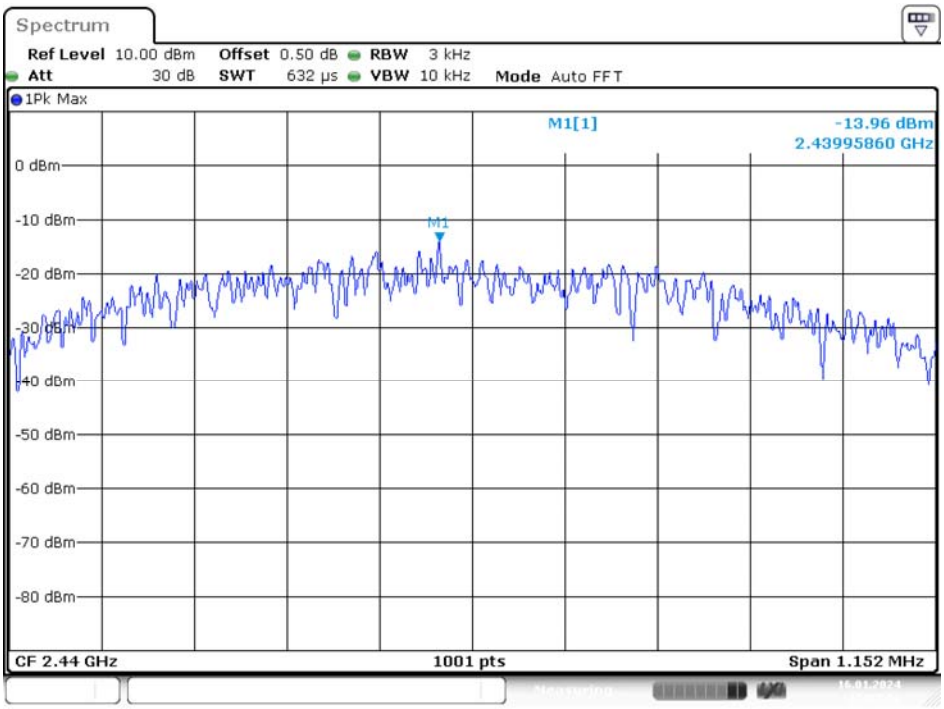
BLE(1M) Mode

Low Channel

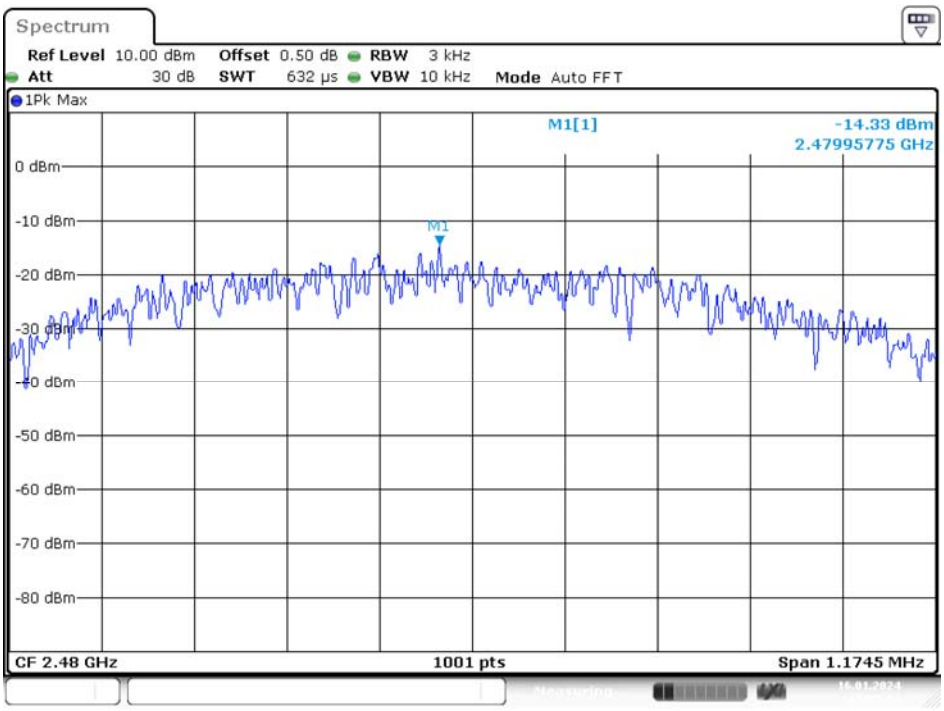


Date: 16.JAN.2024 15:00:09

Middle Channel



High Channel



******* END OF REPORT *******