



시험 성적서

TEST REPORT

페이지(page) : (1) / (총(Total) 32)

성적서 번호 Report No.		ICRT-TR-E231115-0A	
신청자 Client	기관명 Name	HANMI MICRONICS INC.	
	주 소 Address	72, Samdo-ro 48beon-gil, Yangchon-eup, Gimpo-si, Gyeonggi-do, Korea.	
시험대상품목 Sample description		Wireless Keyboard	
모델명 Type designation		CaluX	
정 격 Ratings		DC 3.7 V	
시험장소 Place of test		☒ 고정시험(Inside test) ☐ 현장시험(Field test) 주소지(Address): 112, Hwanggeum 3-ro 7beon-gil, Hagun-ri, Yangchon-eup, Gimpo-si, Gyeonggi-do, Korea	
시험기간 Date of test		12. Apr. 2023 ~ 17. May. 2023	
시험방법/항목 Test Method/Item		FCC Part 15 Subpart C §15.247	
시험결과 Test Results		Refer to 3. Test Summary	
확 인 Affirmation	작성자 Tested by	기술책임자 Technical Manager	
	성 명 Name Si-Yeon, Hwang (서 명) (Signature)	성 명 Name Tea-Yang, Yoon (서 명) (Signature)	
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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
ICRT-TR-E231115-0A	2023.05.19	Initial Issue	All



1. Applicant & Manufacturer & Test Laboratory Information

1.1 Applicant information

Applicant	HANMI MICRONICS INC.
Address	72, Samdo-ro 48beon-gil, Yangchon-eup, Gimpo-si, Gyeonggi-do, Korea.
Contact Person	Jin Chul Kim
Telephone No.	82-10-4023-7851
Fax No.	-
E-mail	jckim@micronics.co.kr

1.2 Manufacturer Information

Manufacturer	HANMI MICRONICS INC.
Address	72, Samdo-ro 48beon-gil, Yangchon-eup, Gimpo-si, Gyeonggi-do, Korea.

1.3 Test Laboratory Information

Laboratory	ICR Co., Ltd.
Address	112, Hwanggeum 3-ro 7beon-gil, Hagun-ri, Yangchon-eup, Gimpo-si, Gyeonggi-do, Korea
Telephone No.	+82-2-6351-9002
Fax No.	+82-2-6351-9007
RRA No.	KR0165
KOLAS No.	KT652



2. Equipment under Test(EUT) Information

2.1 General Information

Product Name	Wireless Keyboard
Brand Name	-
Model Name	CaluX
Additional Model Name	-
FCC ID	2A3QW-CALUX
Hardware Version	1.0
Software Version	1.0
Power Supply	DC 3.7 V

2.2 Additional Information

Equipment Class	DTS-Digital Transmission System
Device Type	Stand-alone
Operating Frequency	2 402 MHz ~ 2 480 MHz
RF Output Power	-5.35 dBm
Number of Channel	40
Modulation Type	GFSK
Antenna Type	PCB Antenna
Antenna Gain	1.58 dBi
Antenna Operating Mode	Single Antenna Equipment with only one antenna

2.3 Mode of operation during the test

- The EUT is continuous transmission mode during the test with set at Low Channel, Middle Channel, and High Channel. To get a maximum radiated emission levels from the EUT, the EUT was moved throughout the XY, YZ, XZ planes.

2.4 Modifications of EUT

- None



3. Test Summary

3.1 Test standards and results

FCC Part 15 Subpart C			
Clause	Test items	Applied	Results
§15.247 (a) (2)	6 dB Bandwidth	☒	PASS
§15.247 (b) (3)	Maximum Conducted Output Power	☒	PASS
§15.247 (e)	Power Spectral Density	☒	PASS
§15.247 (d)	Conducted Spurious Emission	☒	PASS
§15.247 (d) & §15.209 & §15.205	Radiated Spurious Emission	☒	PASS
§15.207	Power Line Conducted Emission	☒	PASS
§15.203	Antenna Requirement	☒	PASS

3.2 Purpose of the test

- To determine whether the equipment under test fulfills the requirements of the standards stated in FCC Part 15 Subpart C Section 15.247.

3.3 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013.

Radiated testing was performed at a distance of 3 m from EUT to the antenna.

3.4 Configuration of Test System

3.4.1 Radiated emission test

Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 m Semi Anechoic Chamber. The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

3.4.2 AC power line conducted emission test

The EUT was connected to LISN. All supporting equipment were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions

3.5 Antenna requirement

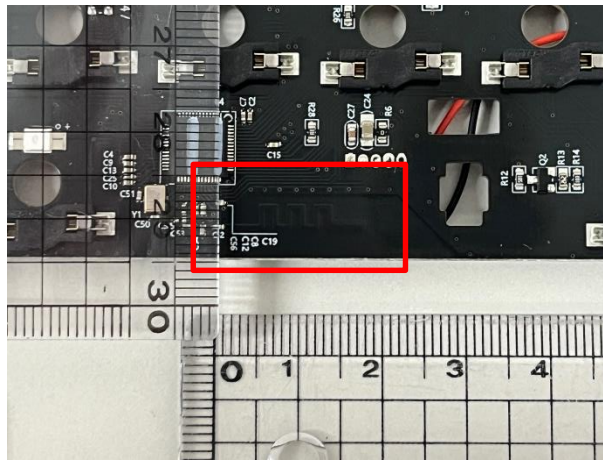
According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

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 use of a standard antenna jack or electrical connector is prohibited.

And according to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



3.5.1 Result: Pass

The transmitter has a **PCB Antenna**. The directional gain of the antenna is **1.58 dBi**.



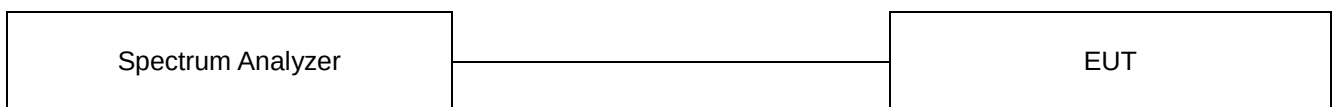
4. 6 dB Bandwidth

4.1 Measurement method

Standard : §15.247 (a) (2)

4.2 Test setup

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, and peak detection was used. The 6 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 6 dB.



4.3 Test data

Operating mode : Transmit mode

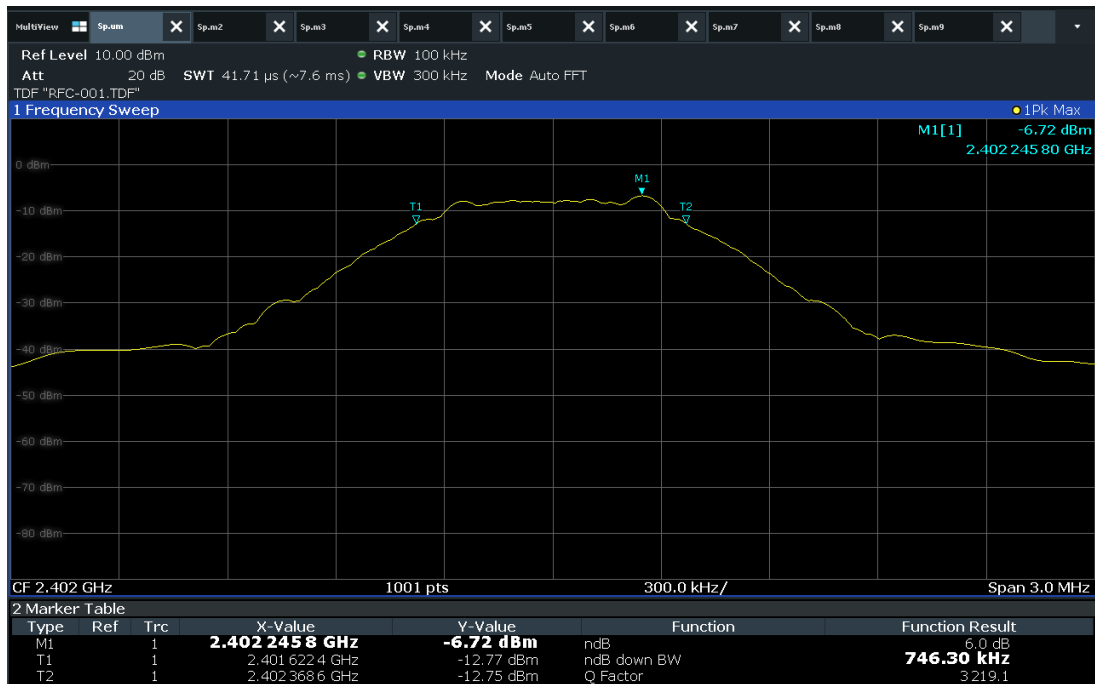
Test Result : Pass

4.3.1 Measured Results

Modulation Type	Channel (Frequency)	Measured Value (kHz)	Limit (kHz)
Bluetooth LE	0 (2 402 MHz)	746.3	at least 500
	19 (2 440 MHz)	779.2	
	39 (2 480 MHz)	773.2	



4.3.2 Measured Graph (6 dB Bandwidth)



Low CH



Mid CH



High CH



5. Maximum Conducted Output Power

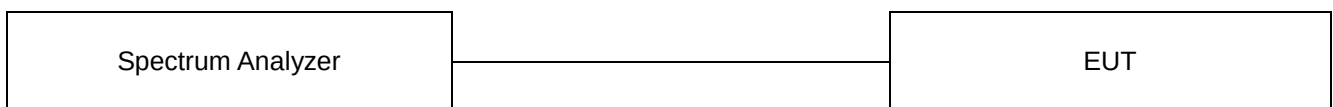
5.1 Measurement method

Standard : §15.247 (b) (3)

5.2 Test setup

The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT. The spectrum analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99 % bandwidth. The EUT was operating in transmit mode at the appropriate center frequency.

And e.i.r.p. is added antenna maximum gain with the Maximum Conducted Output Power.



5.3 Test data

Operating mode : Transmit mode

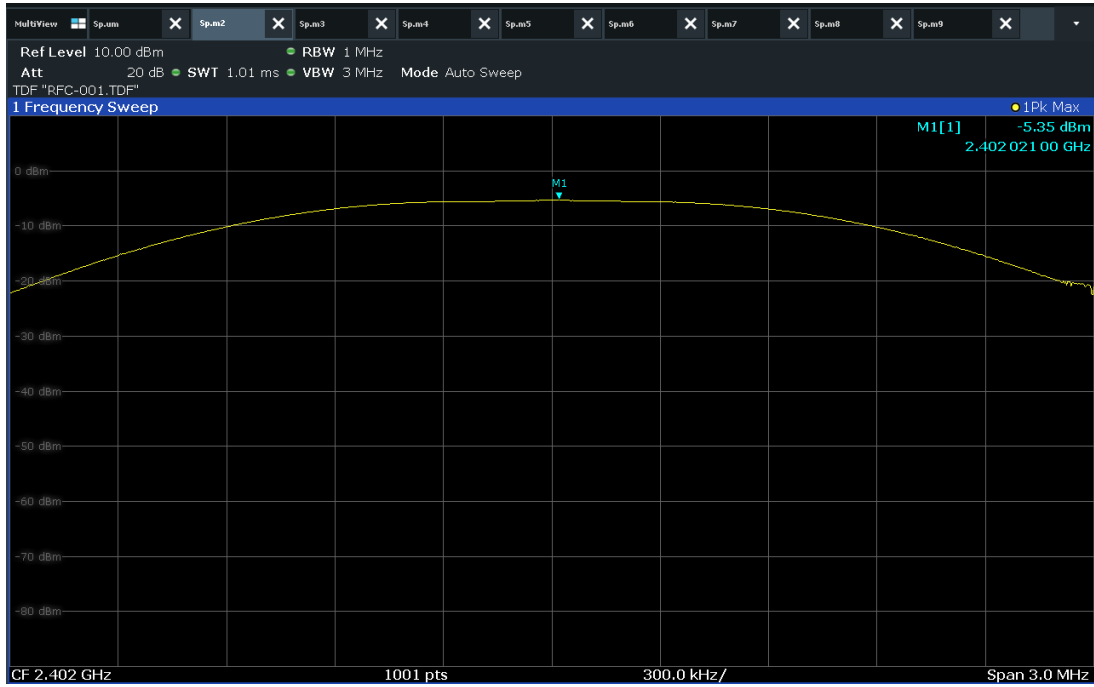
Test Result : Pass

5.3.1 Measured Results

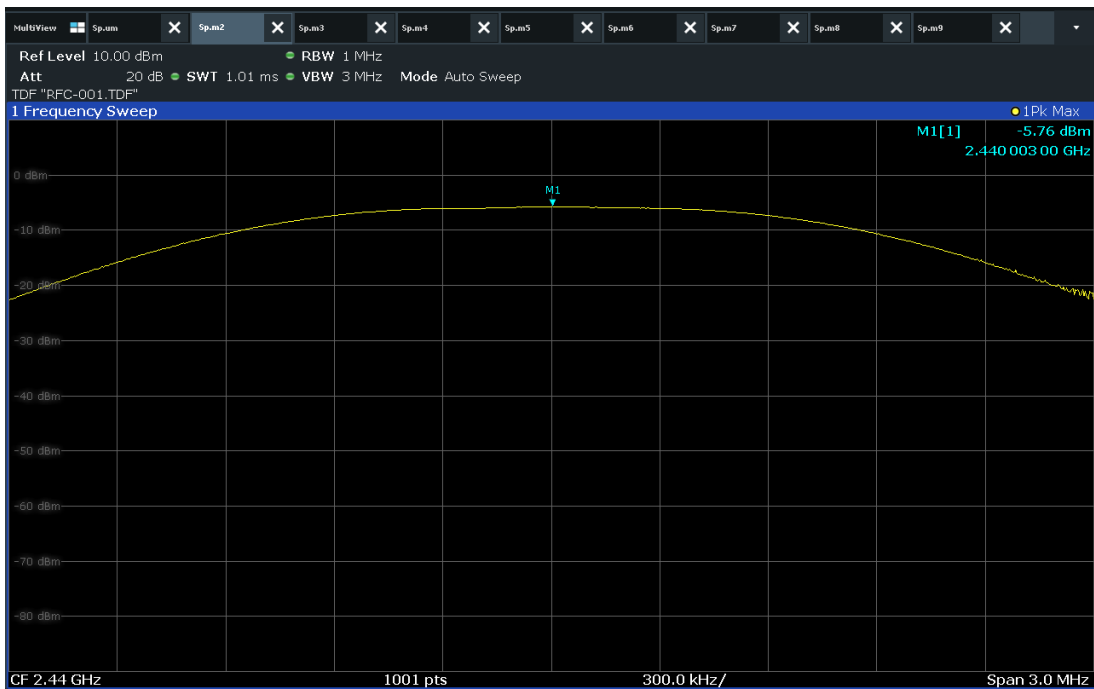
Modulation Type	Channel (Frequency)	Highest signal level (dBm)	Limit (dBm)
Bluetooth LE	0 (2 402 MHz)	-5.35	30 (1 Watt)
	19 (2 440 MHz)	-5.76	
	39 (2 480 MHz)	-5.74	



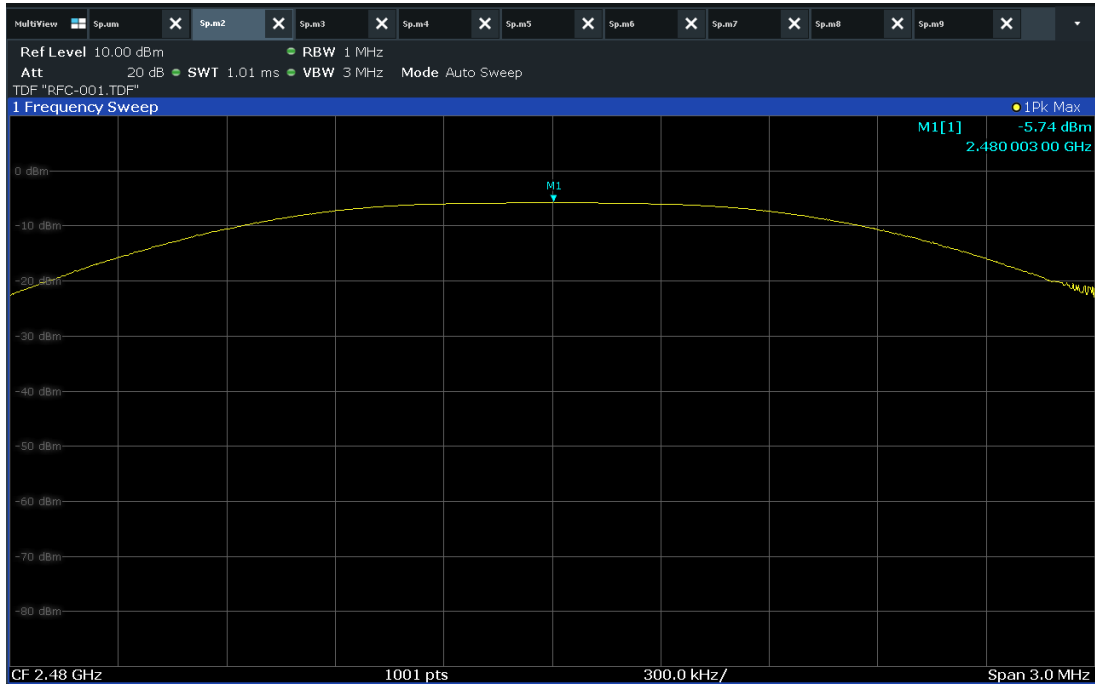
5.3.2 Measured Graph



Low CH



Mid CH



High CH



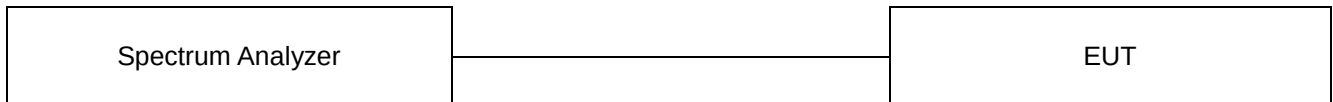
6. Power Spectral Density

6.1 Measurement method

Standard : §15.247 (e)

6.2 Test setup

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 3 kHz, the video bandwidth is set to 3 times the resolution bandwidth.



6.3 Test data

Operating mode : Transmit mode

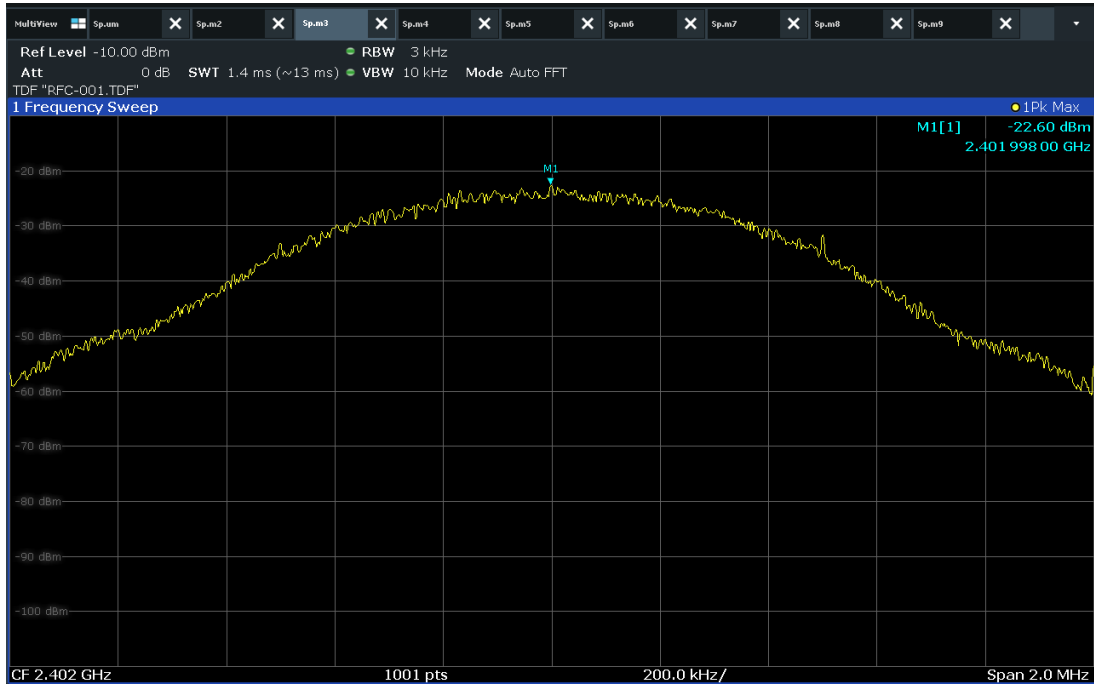
Test Result : Pass

6.3.1 Measured Results

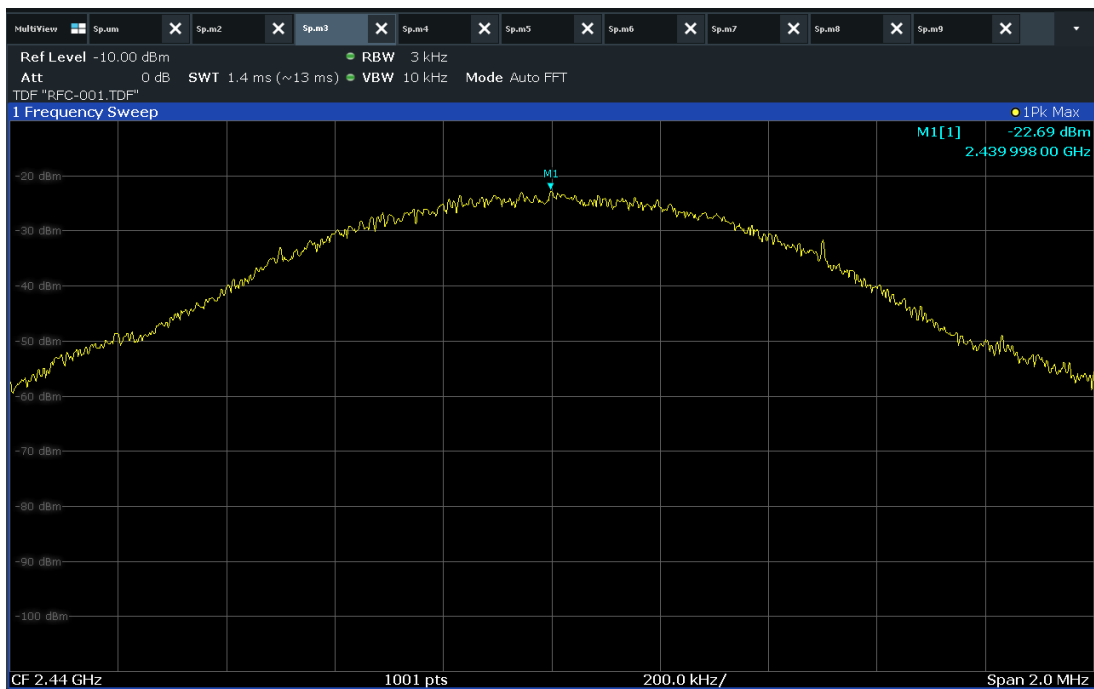
Modulation Type	Channel (Frequency)	Highest signal level (dBm/3 kHz)	Limit (dBm/3kHz)
Bluetooth LE	0 (2 402 MHz)	-22.60	8
	19 (2 440 MHz)	-22.69	
	39 (2 480 MHz)	-23.08	



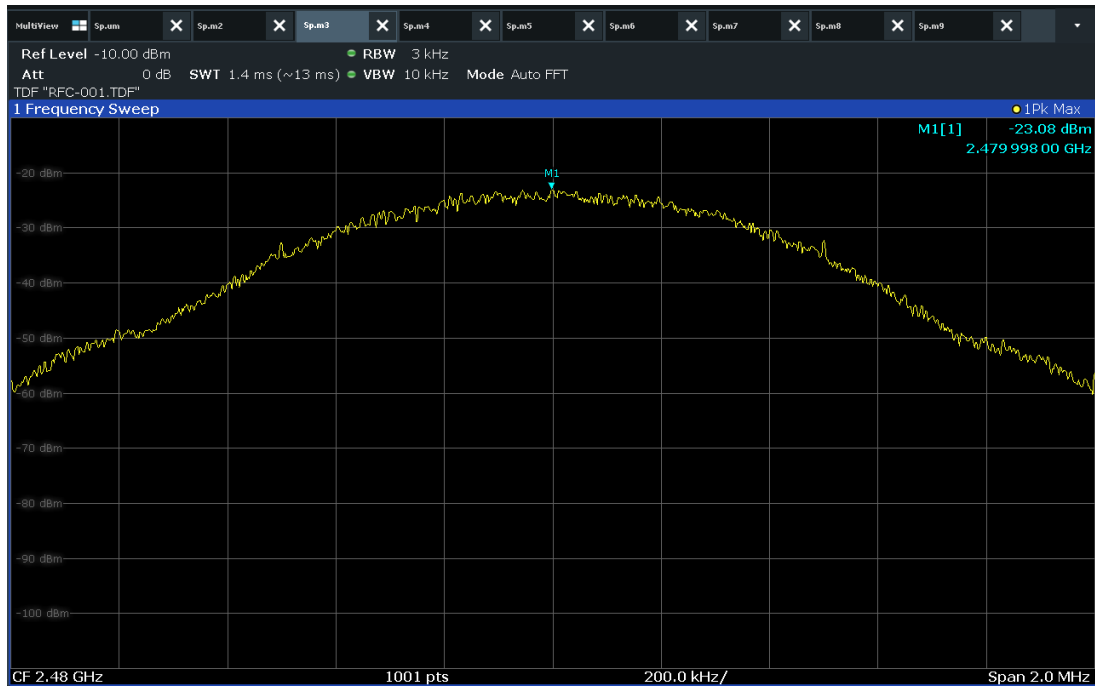
6.3.2 Measured Graph



Low CH



Mid CH



High CH



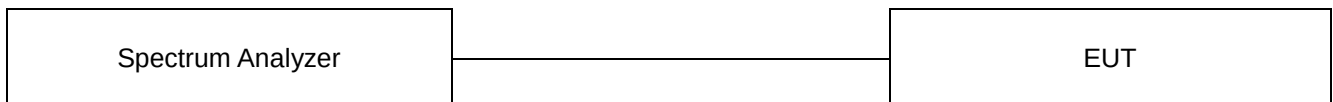
7. Conducted Spurious Emission

7.1 Measurement method

Standard : §15.247 (d)

7.2 Test setup

The antenna output of the EUT was connected to the spectrum analyzer. The resolution and video bandwidth is set to 100 kHz, and peak detection was used.



7.3 Test data

Operating mode : Transmit mode

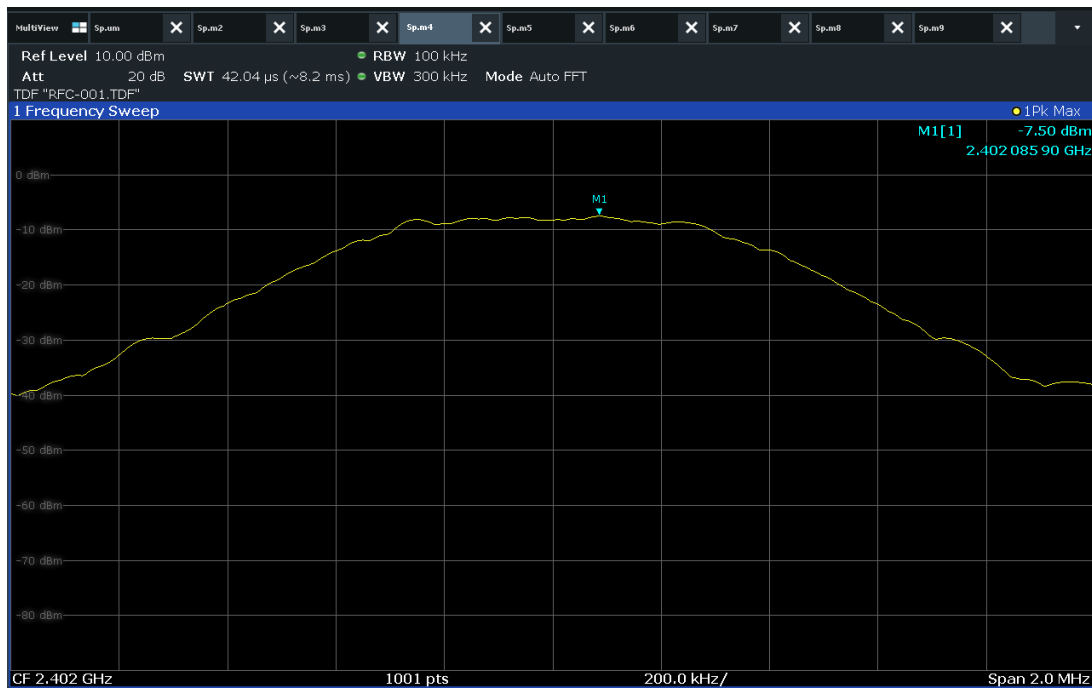
Test Result : Pass

7.3.1 Measured Results

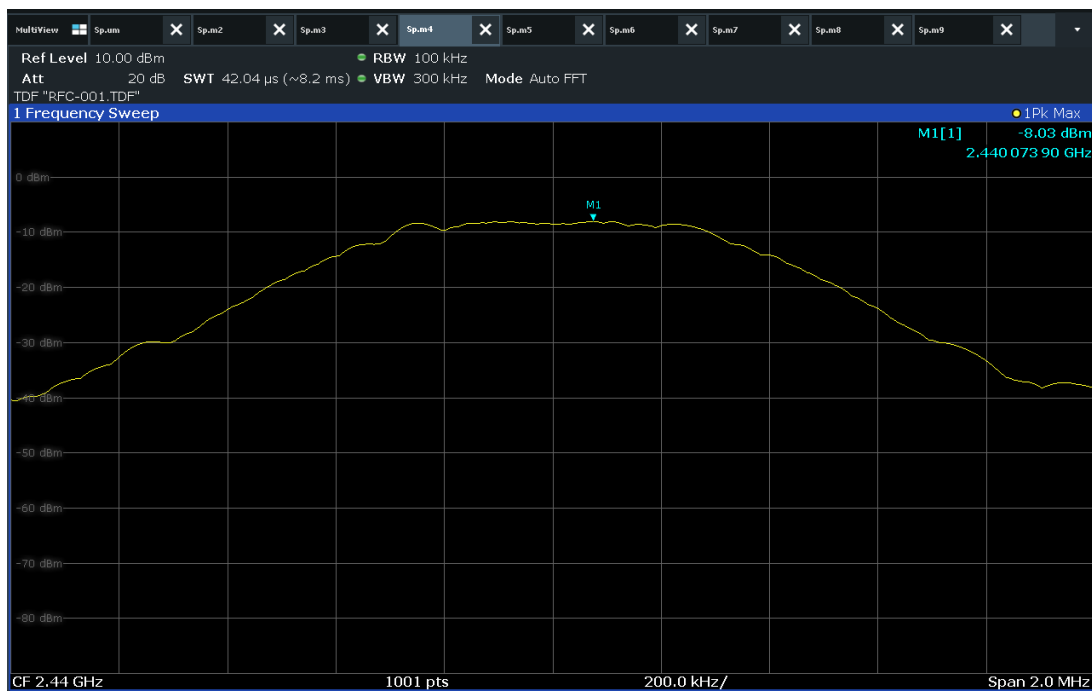
Modulation Type	Channel (Frequency)	Measurement band	Result
Bluetooth LE	0 (2 402 MHz)	Band Edge	Pass
		30 MHz to 1 GHz	Pass
		1 GHz to 26 GHz	Pass
	19 (2 440 MHz)	30 MHz to 1 GHz	Pass
		1 GHz to 26 GHz	Pass
	39 (2 480 MHz)	Band Edge	Pass
		30 MHz to 1 GHz	Pass
		1 GHz to 26 GHz	Pass



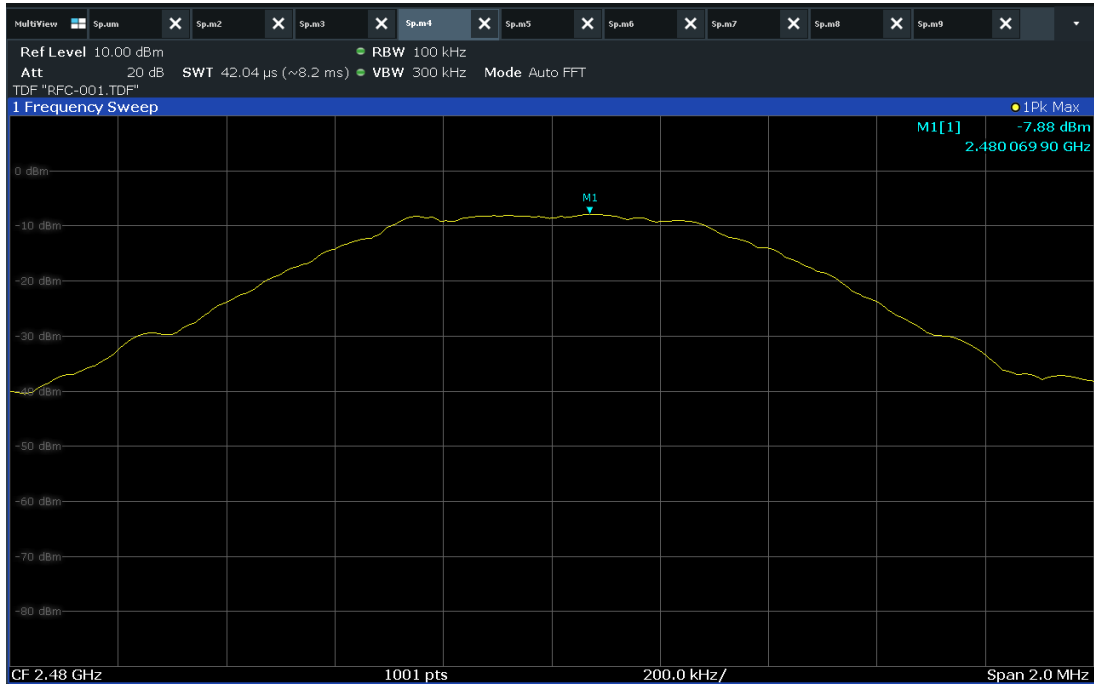
7.3.1.1 Signal level (dB m)



Low CH

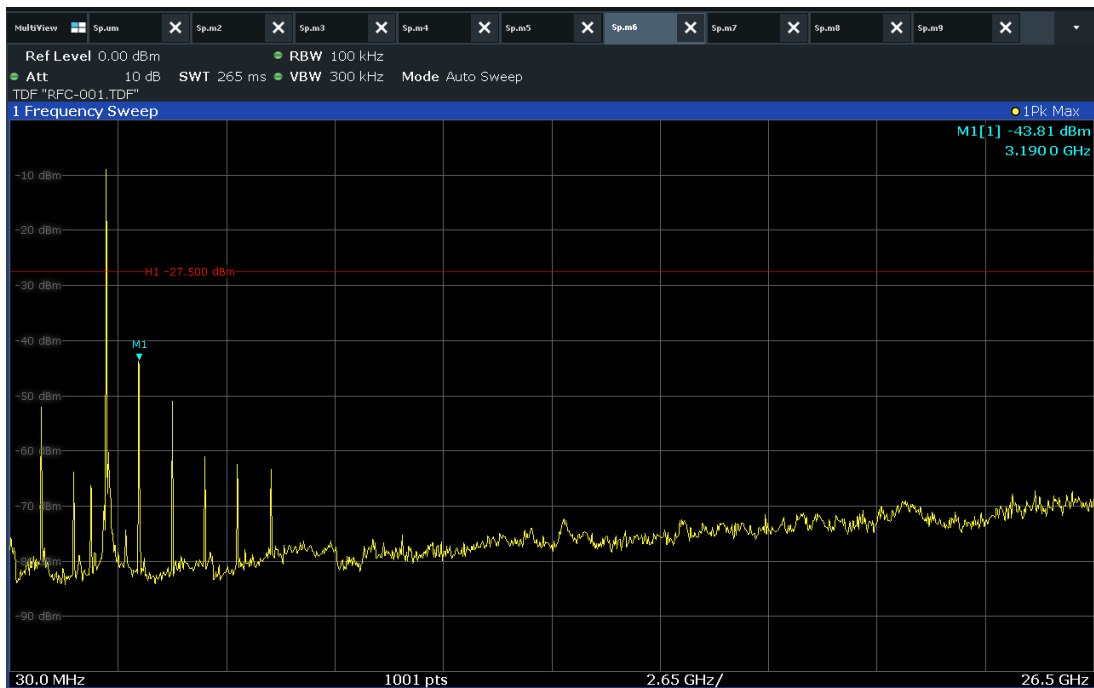


Mid CH

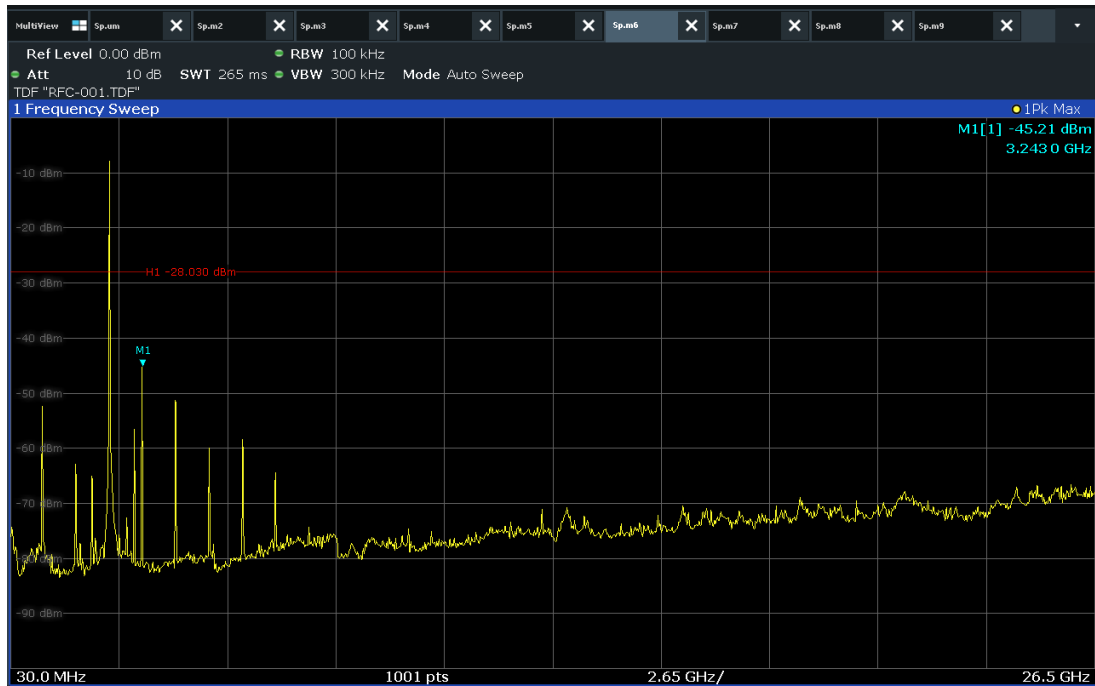


High CH

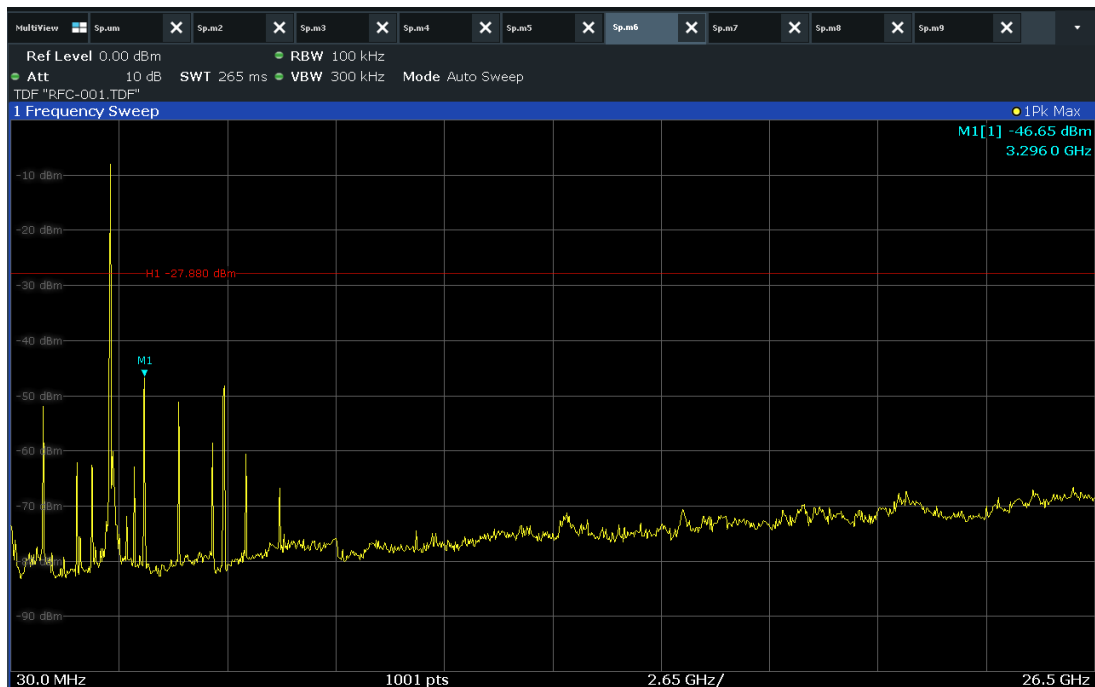
7.3.1.2 Unwanted Emissions In Non-Restricted Frequency Bands



Low CH



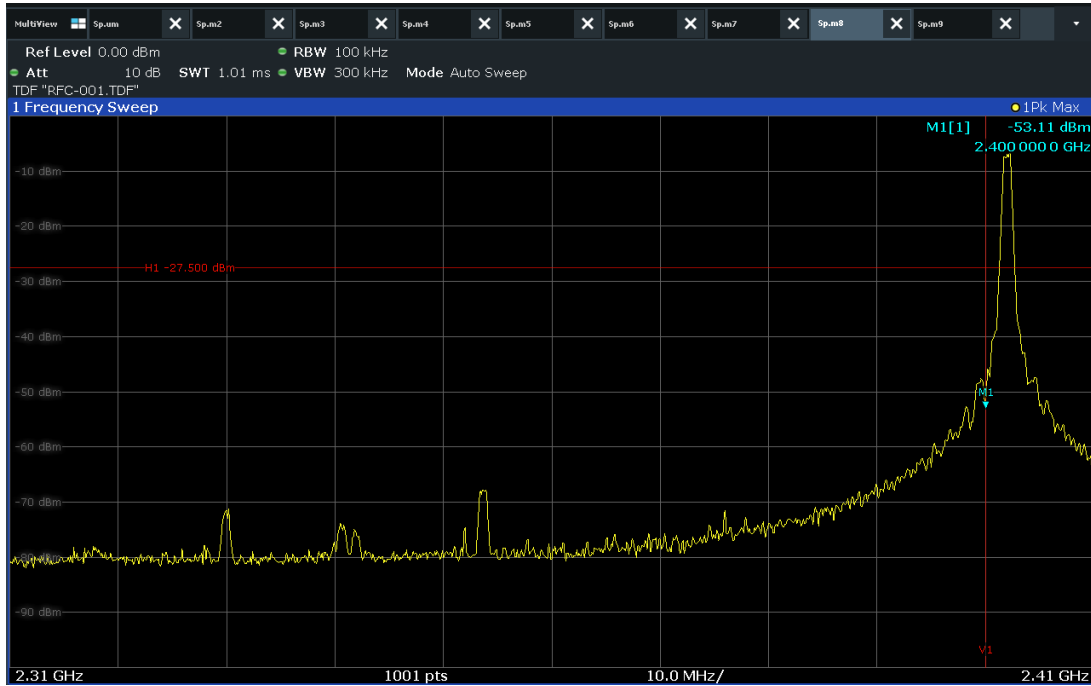
Mid CH



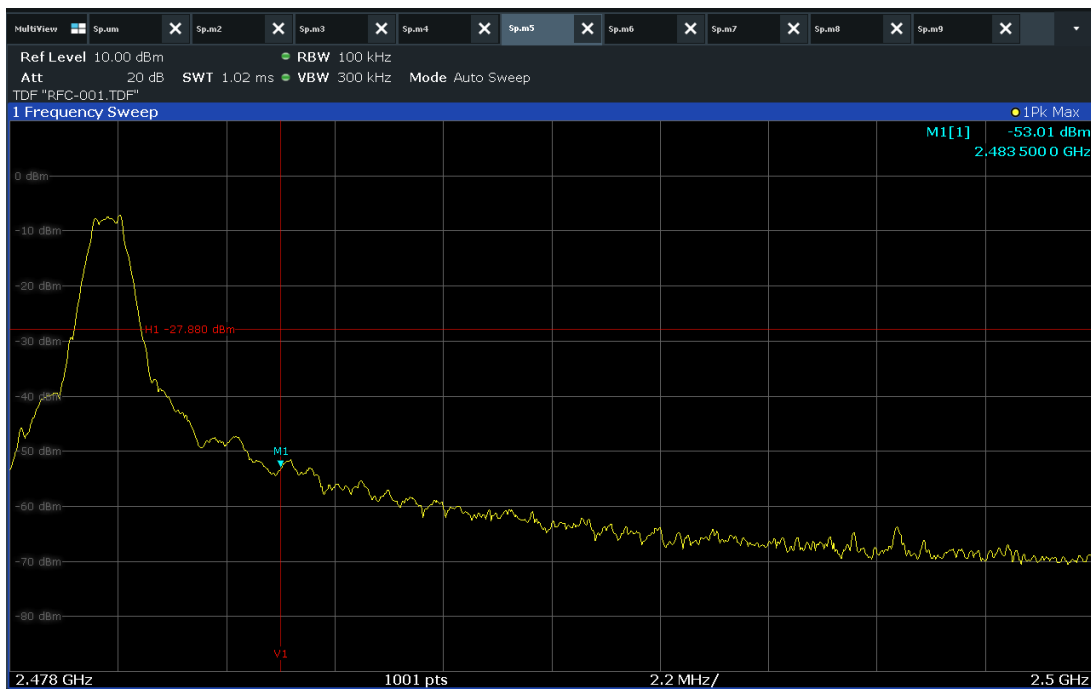
High CH



7.3.1.3 Band Edge



Low CH



High CH

8. Radiated Spurious Emission

8.1 Measurement method

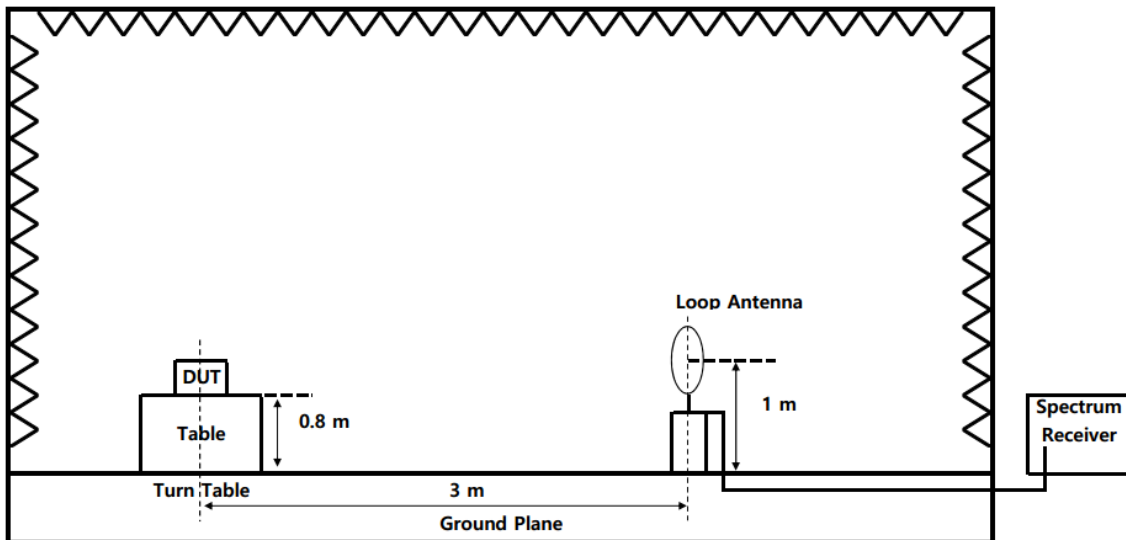
Standard : §15.247 (d), §15.209, §15.205

8.2 Test setup

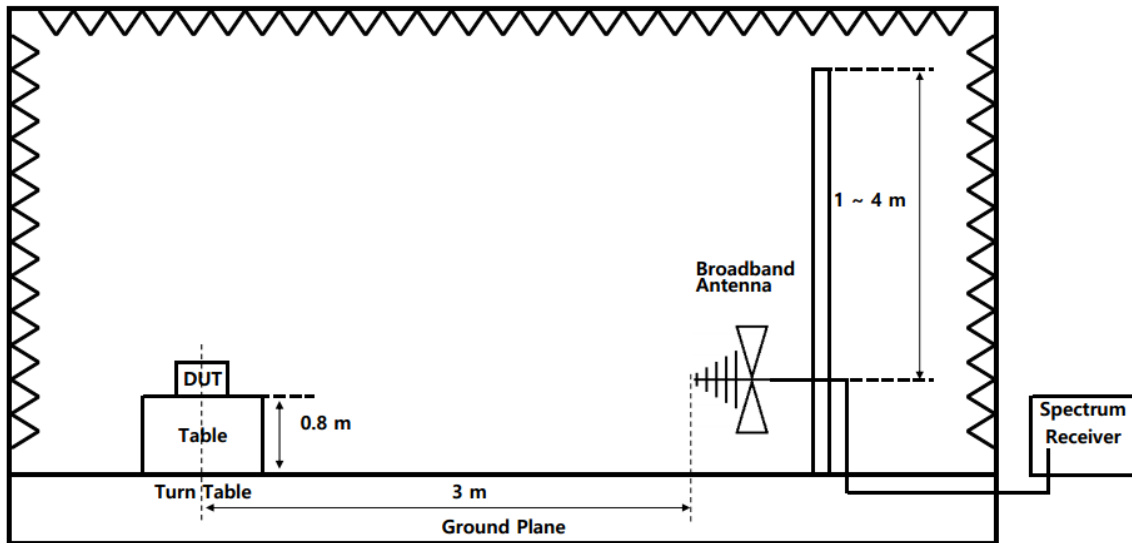
The radiated emissions measurements were performed on the 3 m, Semi-Anechoic Chamber. The EUT was placed on a non-conductive turntable above the ground plane.

The frequency spectrum from 9 kHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

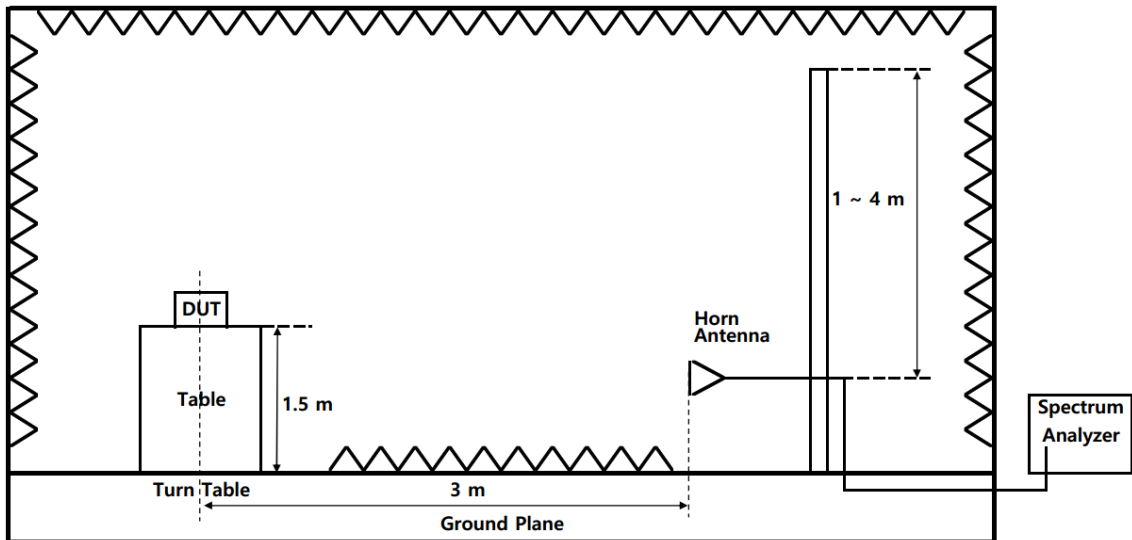
8.2.1 Below 30 MHz



8.2.2 30 MHz to 1 GHz



8.2.3 Above 1 GHz



**8.3 Test data**

Operating mode : Transmit mode

Test Result : Pass

8.3.1 Test data for Restricted band

Frequency	Reading	Detector	Ant. Pol.	Corr. Factor	Result	Limit	Margin
(MHz)	(dBμV)		(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
Low CH							
2 326.27	47.63	Peak	V	-10.30	37.33	73.98	36.65
	34.45	Average	V		24.15	53.98	29.83
High CH							
2 497.34	46.30	Peak	H	-9.70	36.60	73.98	37.38
	32.27	Average	H		22.57	53.98	31.41

※ Ant. Pol. : Antenna Polarization

※ Corr. Factor. : Antenna Factor + Cable Loss - Amplifier Gain

※ Result = Reading + Corr. Factor

※ Margin = Limit - Result

8.3.2 Test data for Spurious & Harmonic**8.3.2.1 Measurement Results for below 30 MHz**

Frequency	Reading	Detector	Ant. Pol.	Corr. Factor	Result	Limit	Margin
(MHz)	(dBμV)		(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
Low CH							
It was not found any emissions peaks found from the EUT.							
Mid CH							
It was not found any emissions peaks found from the EUT.							
High CH							
It was not found any emissions peaks found from the EUT.							

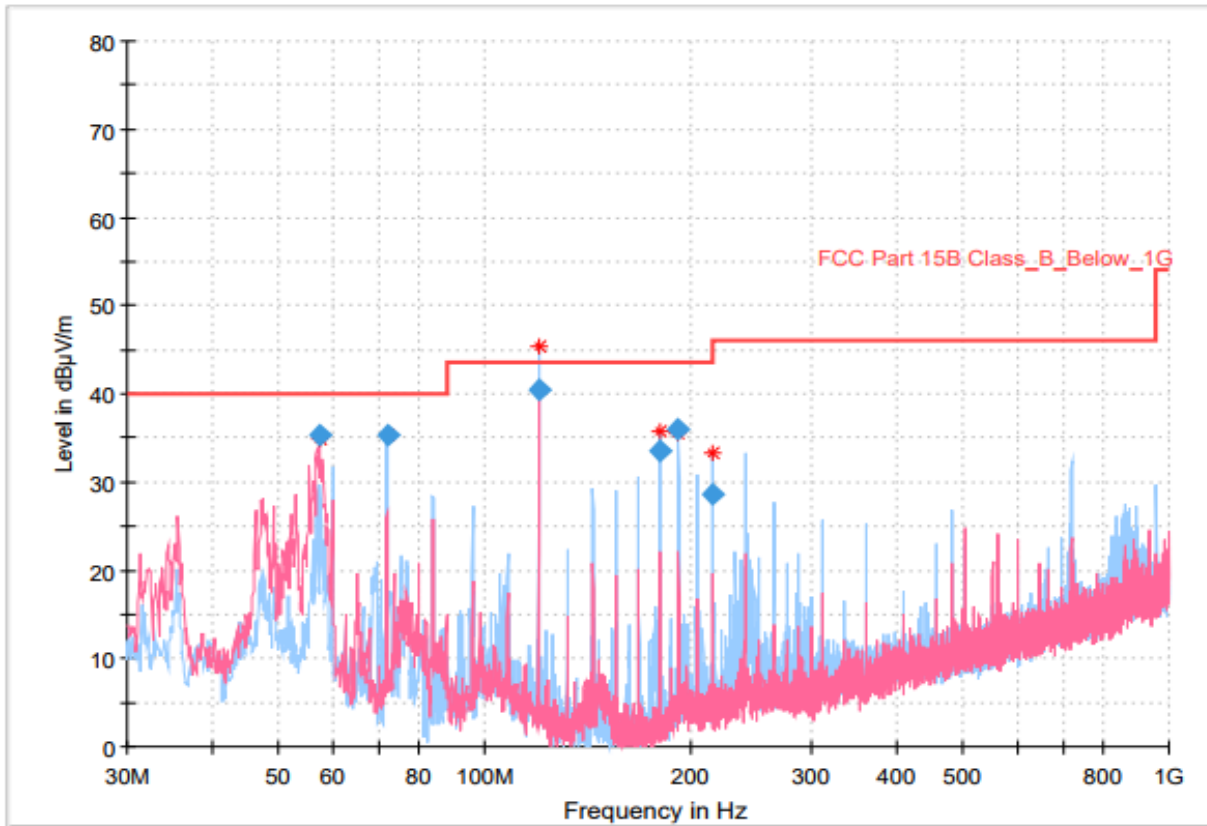
※ Ant. Pol. : Antenna Polarization

※ Corr. Factor. : Antenna Factor + Cable Loss - Amplifier Gain

※ Result = Reading + Corr. Factor

※ Margin = Limit - Result

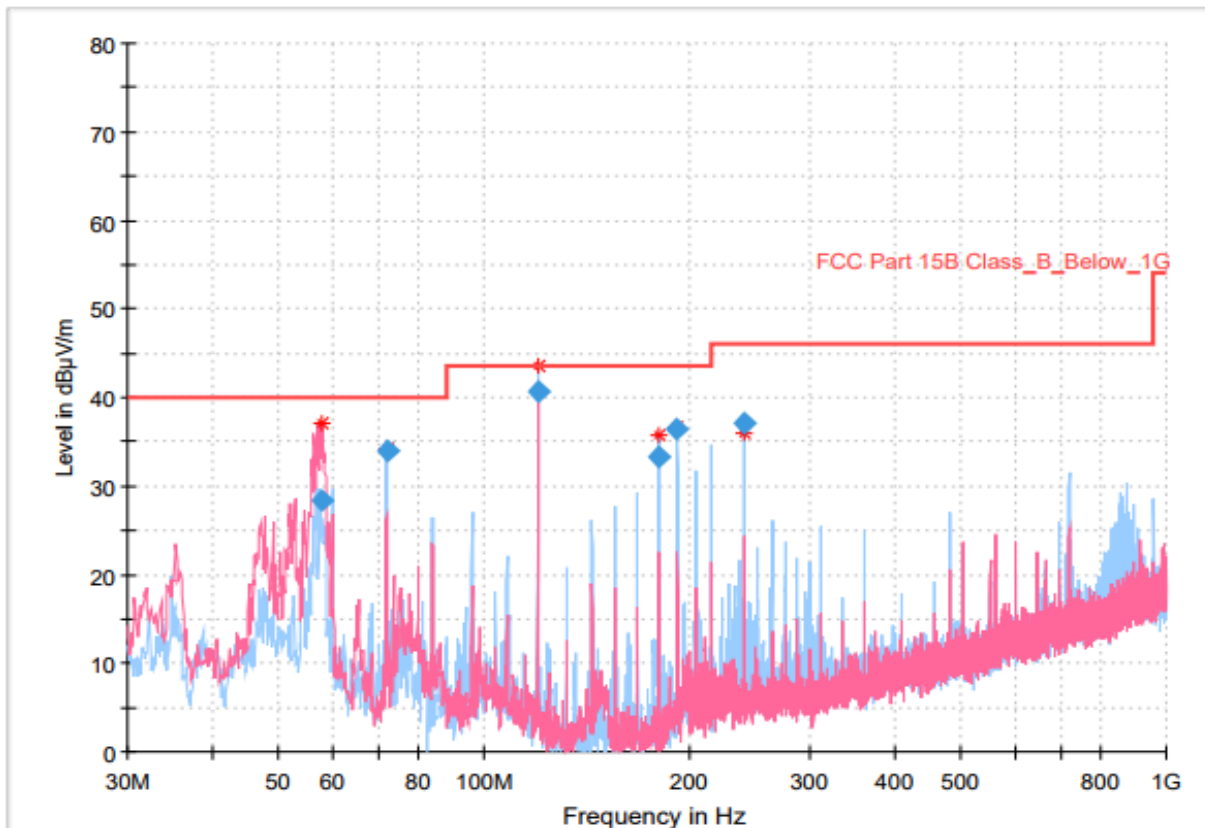
8.3.2.2 Measurement Results for below 1 GHz



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
57.257000	35.29	40.00	4.71	1000.0	120.000	100.0	V	26.0	-23.7
72.001000	35.23	40.00	4.77	1000.0	120.000	100.0	H	327.0	-28.1
120.016000	40.35	43.50	3.15	1000.0	120.000	100.0	H	0.0	-26.6
179.962000	33.49	43.50	10.01	1000.0	120.000	100.0	H	0.0	-26.7
191.990000	35.92	43.50	7.58	1000.0	120.000	100.0	H	0.0	-25.3
215.949000	28.60	43.50	14.90	1000.0	120.000	100.0	H	0.0	-24.8

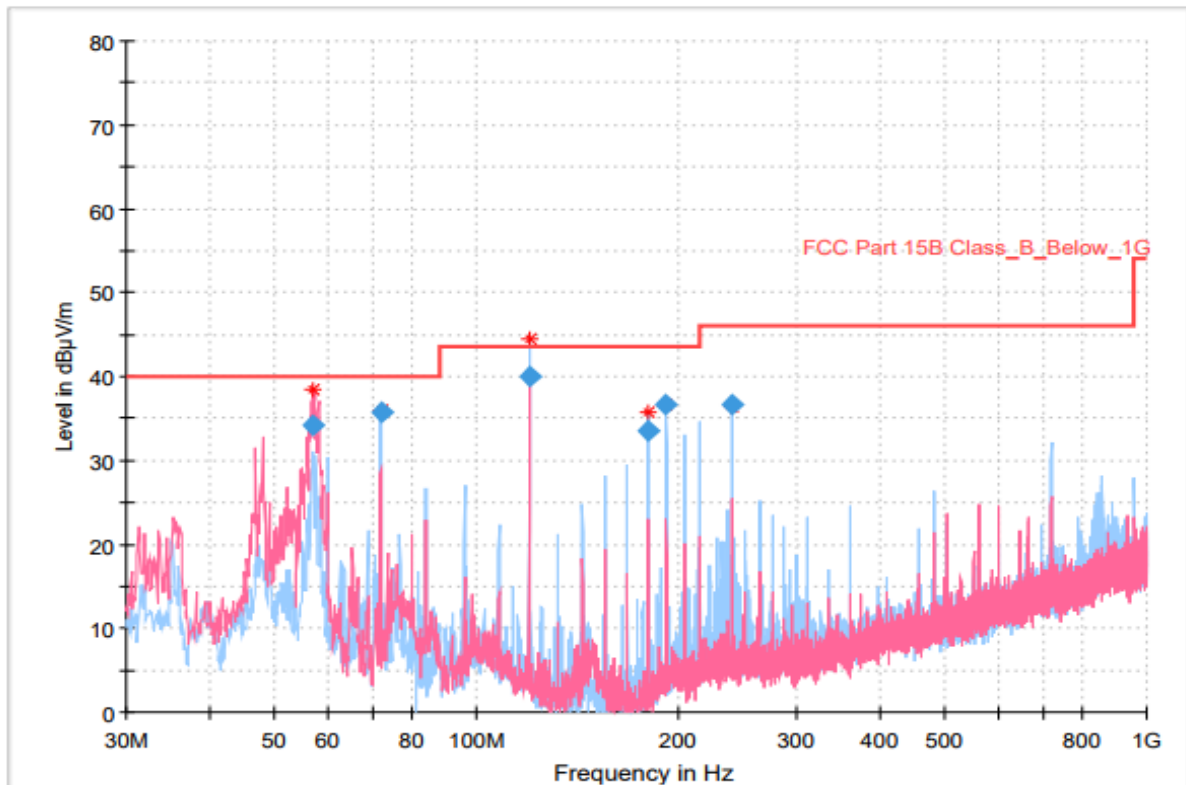
Low CH



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
58.033000	28.44	40.00	11.56	1000.0	120.000	100.0	V	181.0	-23.8
72.001000	34.00	40.00	6.00	1000.0	120.000	100.0	H	136.0	-28.1
120.016000	40.59	43.50	2.91	1000.0	120.000	100.0	H	12.0	-26.6
179.962000	33.39	43.50	10.11	1000.0	120.000	100.0	H	4.0	-26.7
191.990000	36.42	43.50	7.08	1000.0	120.000	100.0	H	4.0	-25.3
240.005000	36.99	46.00	9.01	1000.0	120.000	100.0	H	163.0	-23.1

Mid CH



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
57.160000	34.08	40.00	5.92	1000.0	120.000	100.0	V	146.0	-23.7
72.001000	35.69	40.00	4.31	1000.0	120.000	100.0	H	350.0	-28.1
120.016000	40.10	43.50	3.40	1000.0	120.000	100.0	H	0.0	-26.6
179.962000	33.46	43.50	10.04	1000.0	120.000	100.0	H	350.0	-26.7
191.990000	36.67	43.50	6.83	1000.0	120.000	100.0	H	0.0	-25.3
240.005000	36.70	46.00	9.30	1000.0	120.000	100.0	H	0.0	-23.1

High CH



8.3.2.3 Measurement Results for Above 1 GHz

Frequency	Reading	Detector	Ant. Pol.	Corr. Factor	Result	Limit	Margin
(MHz)	(dBμV)		(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
Low CH							
4 804.60	41.41	Peak	H	-1.00	40.41	73.98	33.57
	27.87	Average	H		26.87	53.98	27.11
7 206.70	39.14	Peak	V	3.30	42.44	73.98	31.54
	25.44	Average	V		28.74	53.98	25.24
Mid CH							
4 879.40	43.75	Peak	V	-1.00	42.75	73.98	31.23
	31.28	Average	V		30.28	53.98	23.70
7 322.30	38.64	Peak	H	3.00	41.64	73.98	32.34
	25.20	Average	H		28.20	53.98	25.78
High CH							
4 959.30	43.19	Peak	V	-1.00	42.19	73.98	31.79
	30.24	Average	V		29.24	53.98	24.74
7 441.30	38.65	Peak	V	2.80	41.45	73.98	32.53
	25.21	Average	V		28.01	53.98	25.97

※ Ant. Pol. : Antenna Polarization

※ Corr. Factor. : Antenna Factor + Cable Loss - Amplifier Gain

※ Result = Reading + Corr. Factor

※ Margin = Limit – Result



9. Power Line Conducted Emission

9.1 Measurement method

Standard : §15.207

9.2 Test setup

The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a $50\ \Omega$ / $50\ \mu\text{H} + 5\ \Omega$ Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

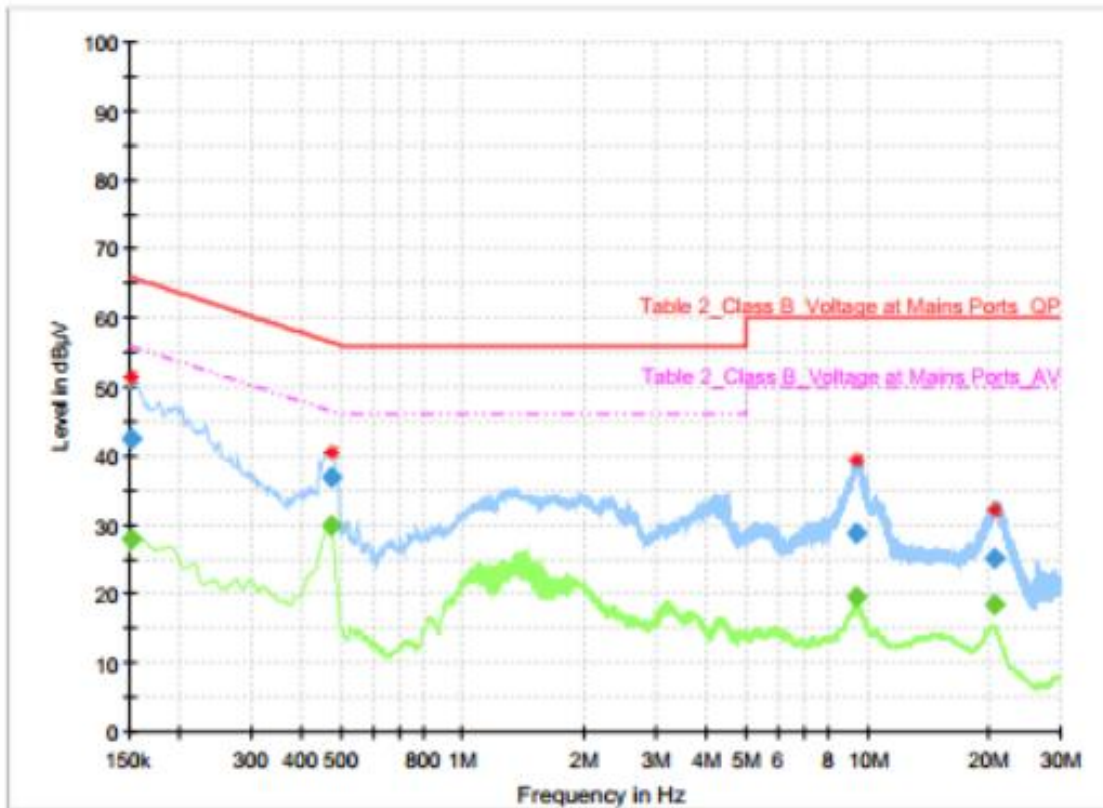


9.3 Test data

Operating mode : Transmit mode

Test Result : Pass

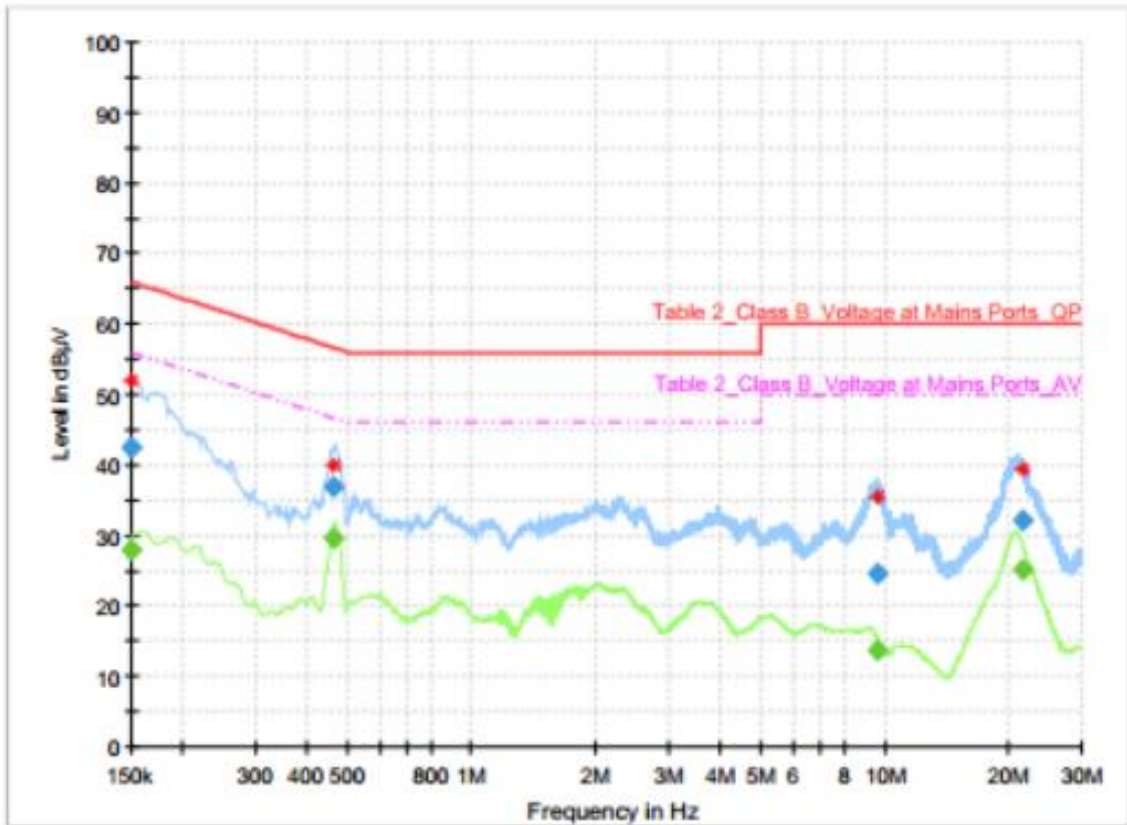
9.3.1 Measured Results & Graph



Final Result

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.152250	---	27.90	55.88	27.98	5000.0	9.000	L1	9.8
0.152250	42.34	---	65.88	23.54	5000.0	9.000	L1	9.8
0.474000	---	29.96	46.44	16.48	5000.0	9.000	L1	9.9
0.474000	36.85	---	56.44	19.60	5000.0	9.000	L1	9.9
9.334500	---	19.43	50.00	30.57	5000.0	9.000	L1	9.9
9.334500	28.79	---	60.00	31.21	5000.0	9.000	L1	9.9
20.649750	---	18.49	50.00	31.51	5000.0	9.000	L1	10.0
20.649750	25.25	---	60.00	34.75	5000.0	9.000	L1	10.0

Live line



Final Result

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.150000	---	28.07	56.00	27.94	5000.0	9.000	N	9.7
0.150000	42.56	---	66.00	23.44	5000.0	9.000	N	9.7
0.462750	---	29.52	46.64	17.12	5000.0	9.000	N	9.9
0.462750	36.85	---	56.64	19.79	5000.0	9.000	N	9.9
9.654000	---	13.73	50.00	36.27	5000.0	9.000	N	9.8
9.654000	24.50	---	60.00	35.50	5000.0	9.000	N	9.8
21.446250	---	25.11	50.00	24.89	5000.0	9.000	N	10.0
21.446250	32.21	---	60.00	27.79	5000.0	9.000	N	10.0

Neutral line



10. Used equipment on test

	Description	Model Name	Manufacturer	Serial Number	Next Cal. (cycle)
☒	SIGNAL & SPECTRUM ANALYZER	FSW85	Rohde & Schwarz	101306	2024-03-02 (1Y)
☒	LOOP ANTENNA	HFH2-Z2	Rohde & Schwarz	100271	2025-03-08 (2Y)
☒	TRILOG BROADBAND ANTENNA	VULB9162	SCHWARZBECK	143	2024-12-14 (1Y)
☒	RF Pre Amplifier	SCU08	Rohde & Schwarz	100746	2024-04-03 (1Y)
☒	EMI Test Receiver	ESR7	Rohde & Schwarz	102034	2024-04-04 (2Y)
☒	Horn Antenna	HF907	Rohde & Schwarz	102556	2023-08-22 (2Y)
☒	RF Pre Amplifier	SCU18	Rohde & Schwarz	102342	2024-04-03 (1Y)
☒	EMI Test Receiver	ESR26	Rohde & Schwarz	101462	2024-04-04 (1Y)
☒	Horn Antenna	LB-42-10-C-KF	A-INFOMW	J202024625	2024-03-07 (1Y)
☒	PREAMPLIFIER	AMF-4F-18265-35-8P-1	MITEQ	771846	2024-03-07 (1Y)
☒	LISN	ENV216	Rohde & Schwarz	102193	2024-04-03 (1Y)

※ All test equipment used is calibration on a regular basis.

End of Report