



Contents

1. Applicant & Manufacturer & Test Laboratory Information.....	5
1.1 Applicant information.....	5
1.2 Manufacturer Information.....	5
1.3 Test Laboratory Information.....	5
2. Equipment under Test(EUT) Information.....	6
2.1 General Information	6
2.2 Additional Information	6
2.3 Mode of operation during the test.....	6
2.4 Modifications of EUT	6
3. Test Summary.....	7
3.1 Test standards and results	7
3.2 Purpose of the test.....	7
3.3 Test Methodology.....	7
3.4 Configuration of Test System	7
3.5 Antenna requirement.....	8
4. Used equipment on test.....	9
5. 6 dB Bandwidth.....	10
5.1 Operating environment	10
5.2 Measurement method.....	10
5.3 Test setup.....	10
5.4 Test data	11
6. Maximum Conducted Output Power.....	13
6.1 Operating environment	13
6.2 Measurement method.....	13
6.3 Test setup.....	13
6.4 Test data	14
7. Power Spectral Density.....	16
7.1 Operating environment	16
7.2 Measurement method.....	16
7.3 Test setup.....	16
7.4 Test data	17
8. Conducted Spurious Emission	19
8.1 Operating environment	19
8.2 Measurement method.....	19
8.3 Test setup.....	19
8.4 Test data	20
9. Radiated Spurious Emission	25
9.1 Operating environment	25
9.2 Measurement method.....	25
9.3 Test setup.....	25
9.4 Test data	27
10. Power Line Conducted Emission	32



10.1 Operating environment	32
10.2 Measurement method.....	32
10.3 Limit	32
10.4 Test data	32



Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
ICRT-TR-E221962-0A	2022-08-03	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	Jay Maeng
Telephone No.	82-01-3301-8347
Fax No.	82-07-3273-2420
E-mail	mjh@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

Conducted tests were performed at	
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 MOUSE
Brand Name	-
Model Name	WM3
Additional Model Name	-
FCC ID	2A3QW-WM3
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	-4.63 dBm
Number of Channel	40
Modulation Type	GFSK
Antenna Type	PCB Antenna
Antenna Gain	-1.52 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
§15.203	Antenna Requirement	☒	PASS
§15.207	Power Line Conducted Emission	☒	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 **-1.52 dBi**.

**4. Used equipment on test**

	Description	Model Name	Manufacturer	Serial Number	Next Cal. (cycle)
☒	Spectrum analyzer	FSW85	R&S	101306	2023-03-02 (1Y)
☒	Signal Generator	SMB100A	R&S	180607	2023-03-03 (1Y)
☒	DC Power Supply	XDL 35-5P	Sorensen	J00385373	2023-03-03 (1Y)
☒	10 dB Attenuator	WA54-10-11	Weinschel	-	2023-03-07 (1Y)
☒	Loop Antenna	HFH2-Z2	Rohde & Schwarz	100506	2023-07-05 (2Y)
☒	TRILOG BROADBAND ANTENNA	VULB9162	SCHWARZBECK	143	2022-12-08 (2Y)
☒	RF Pre Amplifier	SCU08	Rohde & Schwarz	100747	2023-04-13 (1Y)
☒	EMI Test Receiver	ESR7	Rohde & Schwarz	102034	2023-04-13 (1Y)
☒	Horn Antenna	HF907	Rohde & Schwarz	102556	2022-08-18 (1Y)
☒	RF Pre Amplifier	SCU18	Rohde & Schwarz	102342	2023-04-13 (1Y)
☒	EMI Test Receiver	ESR26	Rohde & Schwarz	101462	2023-04-13 (1Y)
☒	Horn Antenna	LB-42-10-C-KF	AIBFO Inc.	J202024625	2023-03-10 (1Y)
☒	PreAmplifier	AMF-4F-18265-35-8P-1	MITEQ	771846	2023-03-07 (1Y)
☒	LISN	ENV216	Rohde & Schwarz	102193	2023-05-20 (1Y)

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



5. 6 dB Bandwidth

5.1 Operating environment

Temperature : 23 °C

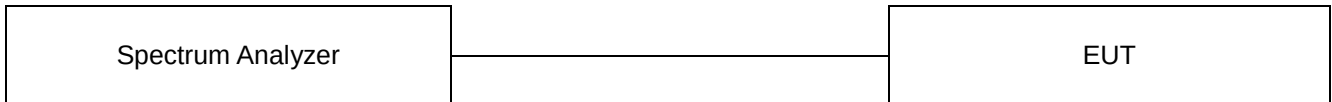
Relative humidity : 47 %

5.2 Measurement method

Standard : §15.247 (a) (2)

5.3 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.





5.4 Test data

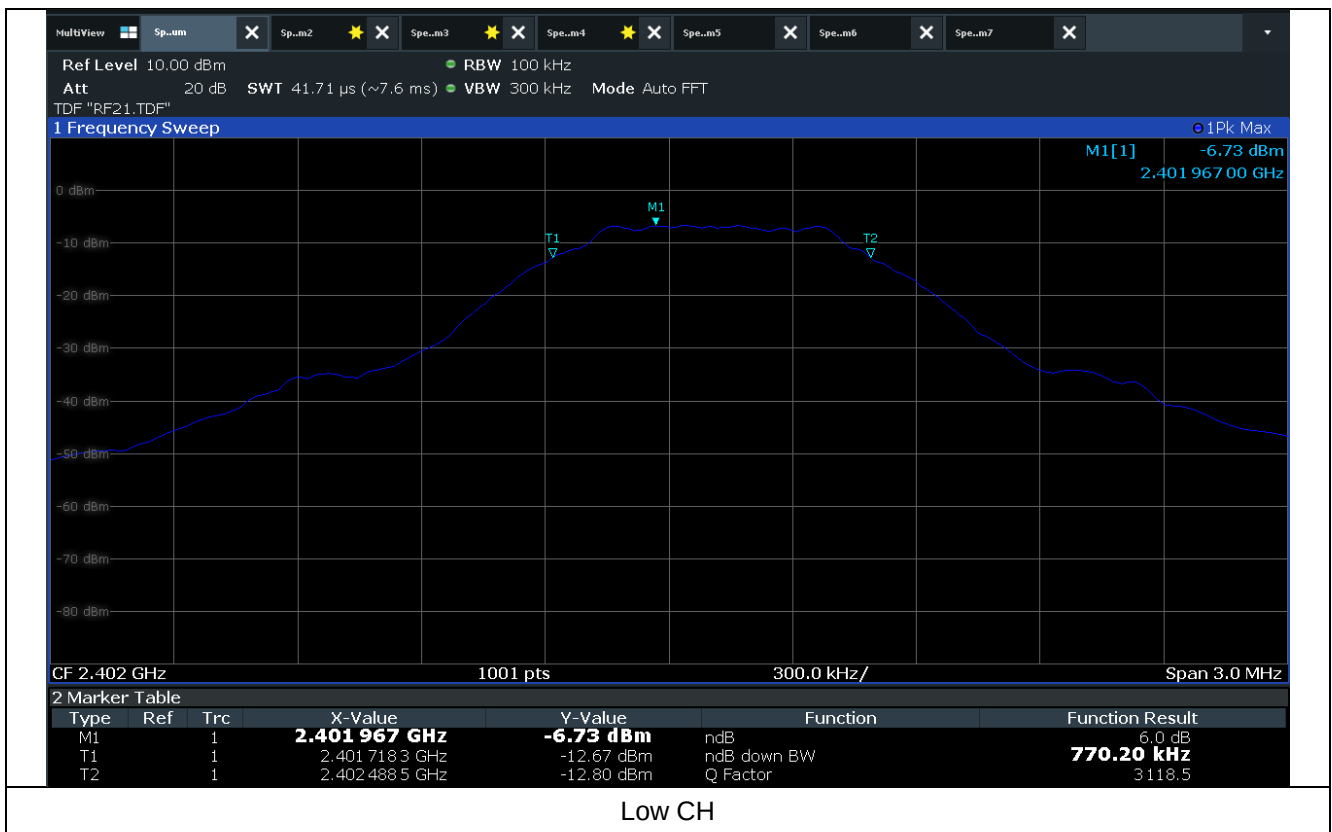
Operating mode : Transmit mode

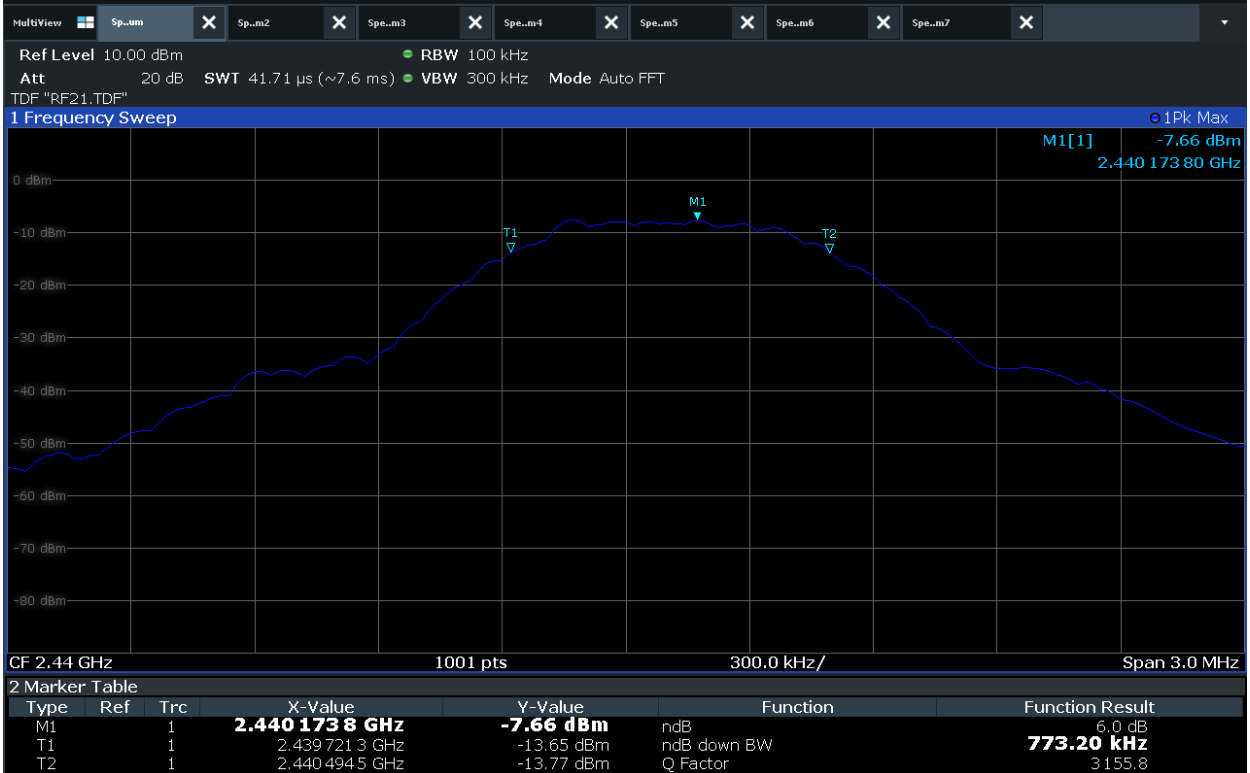
Test Result : Pass

5.4.1 Measured Results

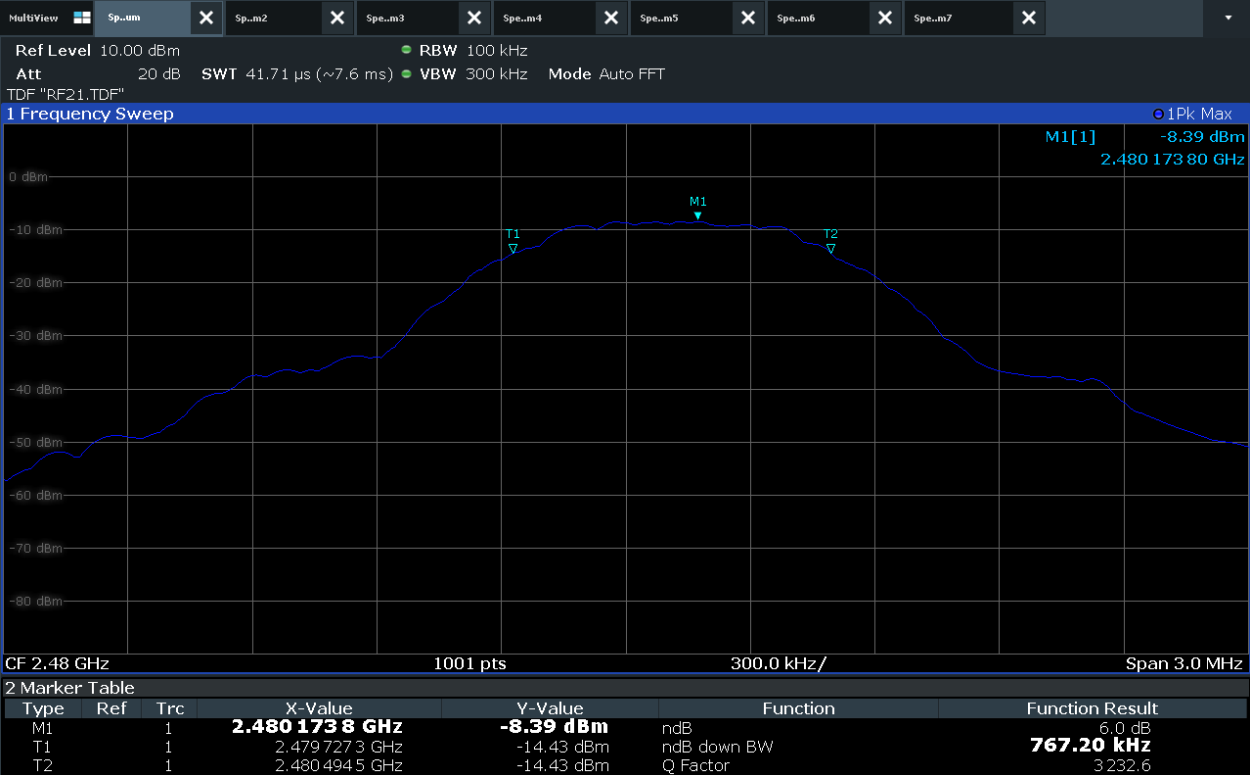
Modulation Type	Channel (Frequency)	Measured Value (kHz)	Limit (kHz)
Bluetooth LE	0 (2 402 MHz)	770.2	at least 500
	19 (2 440 MHz)	773.2	
	39 (2 480 MHz)	767.2	

5.4.2 Measured Graph (6 dB Bandwidth)





Mid CH



High CH



6. Maximum Conducted Output Power

6.1 Operating environment

Temperature : 23 °C

Relative humidity : 47 %

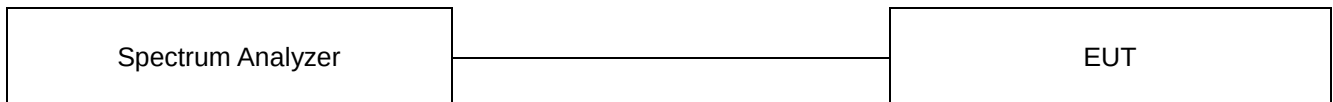
6.2 Measurement method

Standard : §15.247 (b) (3)

6.3 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.





6.4 Test data

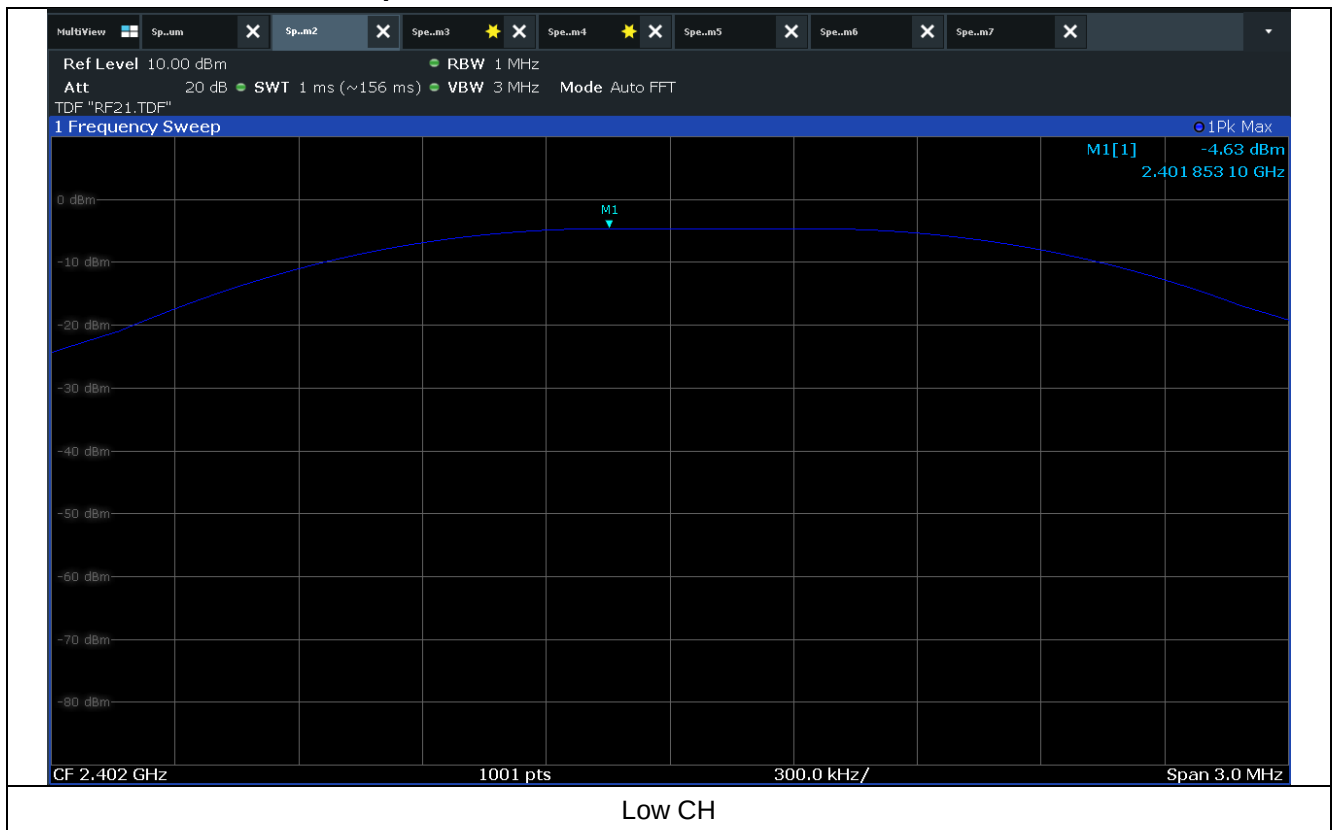
Operating mode : Transmit mode

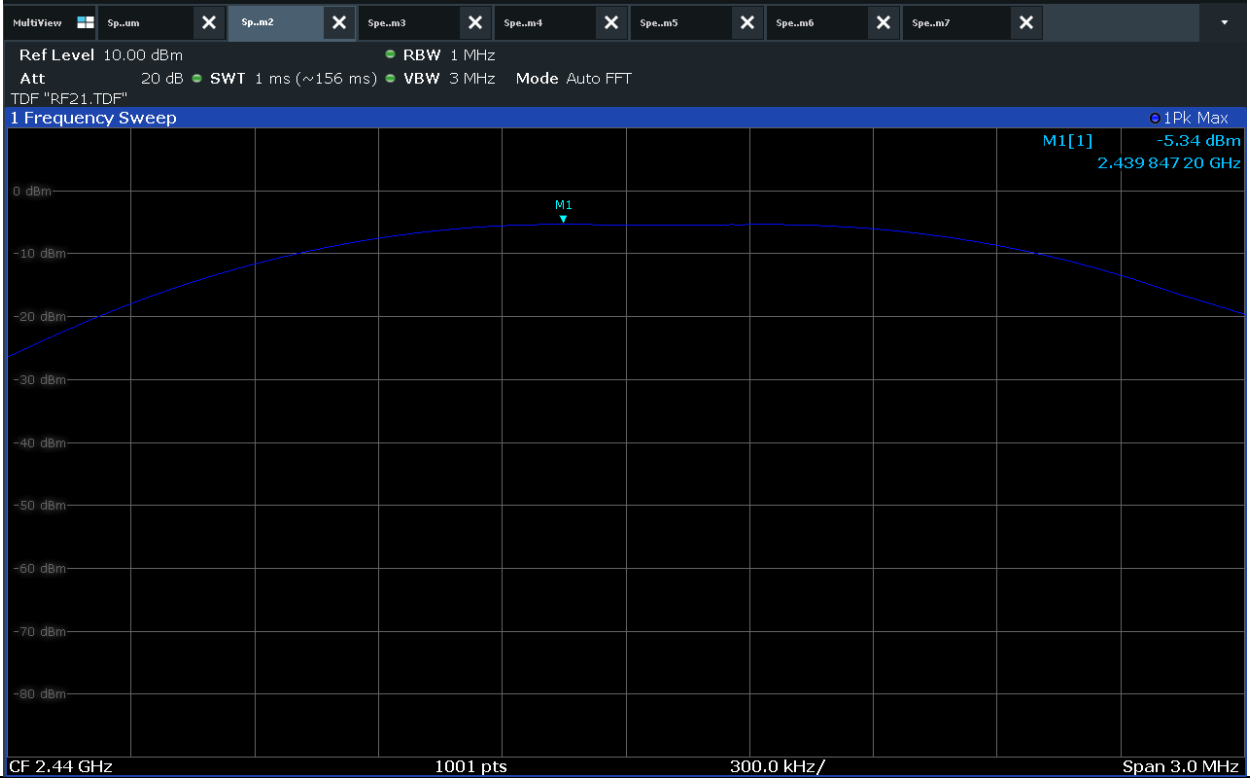
Test Result : Pass

6.4.1 Measured Results

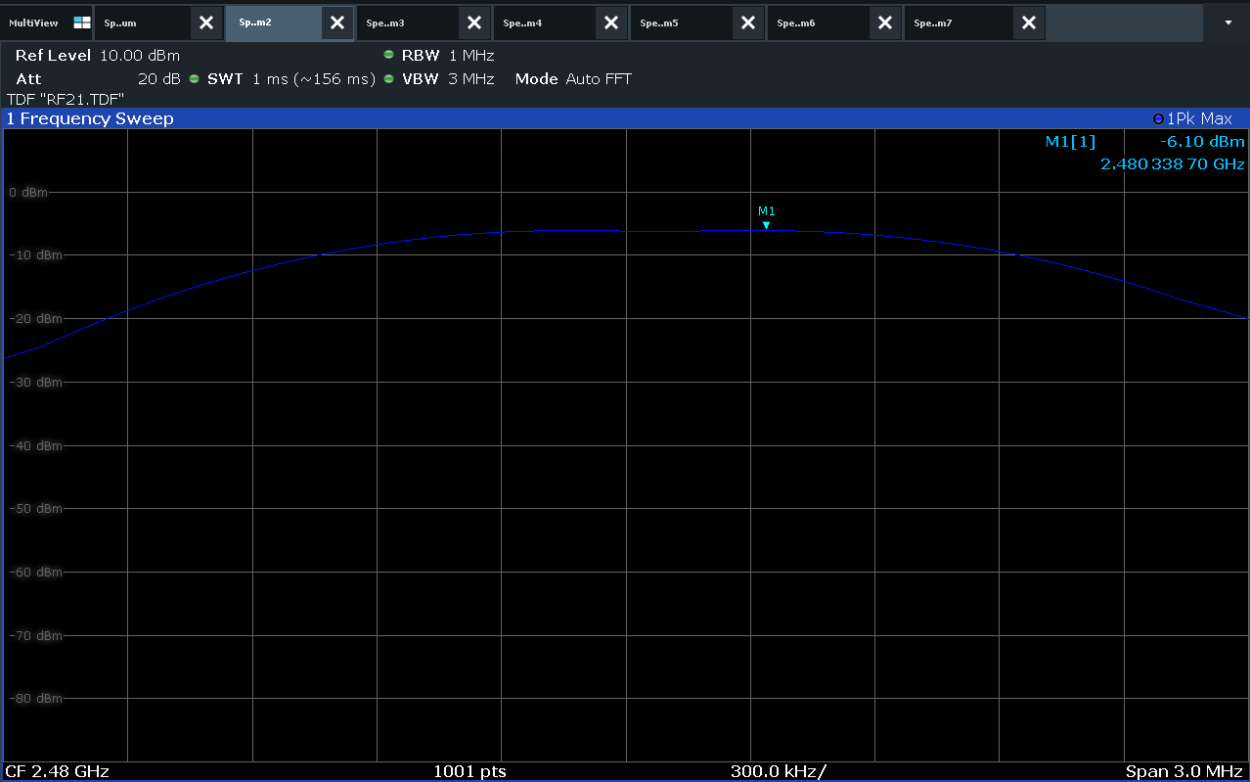
Modulation Type	Channel (Frequency)	Highest signal level (dBm)	Limit (dBm)
Bluetooth LE	0 (2 402 MHz)	-4.63	30 (1 Watt)
	19 (2 440 MHz)	-5.34	
	39 (2 480 MHz)	-6.10	

6.4.2 Measured Graph





Mid CH



High CH



7. Power Spectral Density

7.1 Operating environment

Temperature : 23 °C

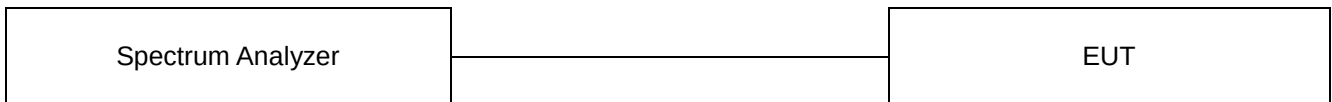
Relative humidity : 47 %

7.2 Measurement method

Standard : §15.247 (e)

7.3 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.





7.4 Test data

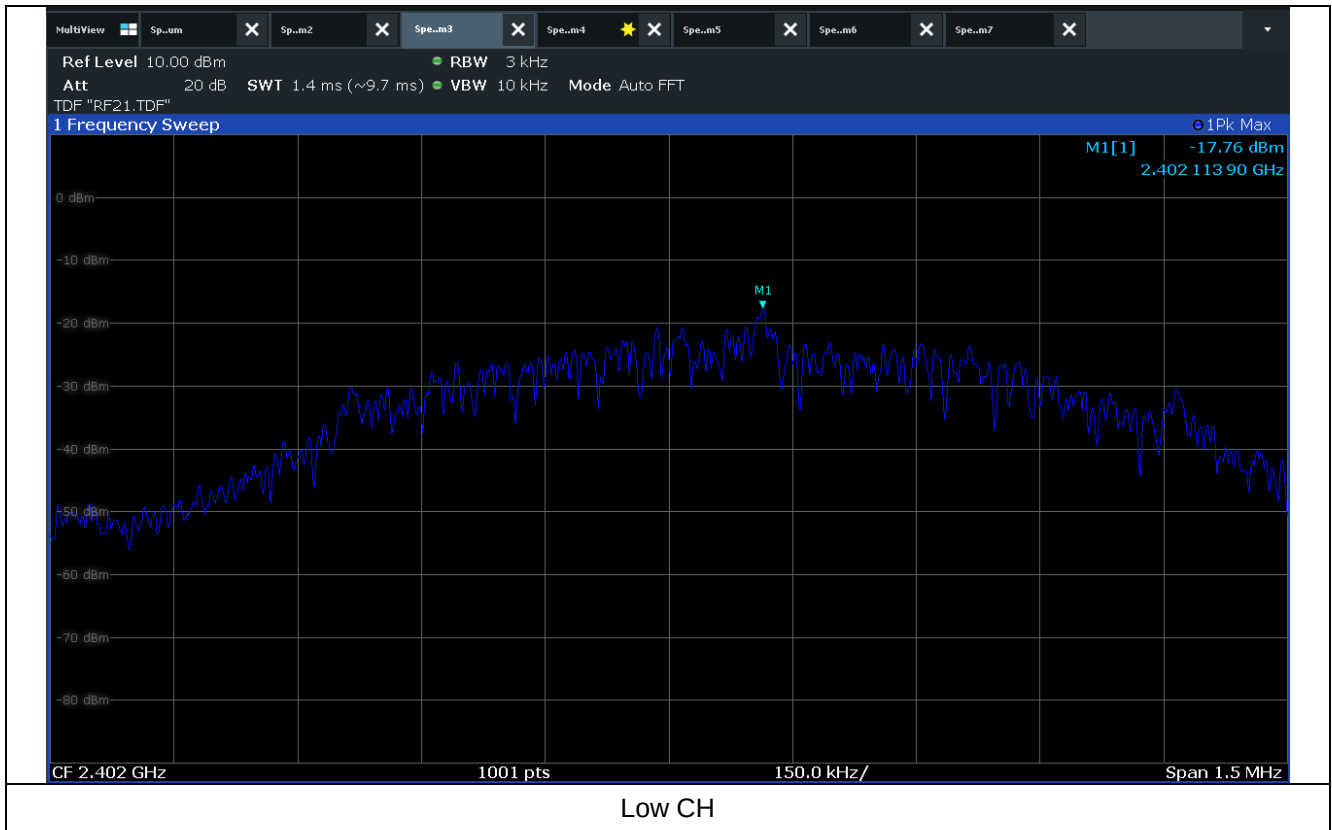
Operating mode : Transmit mode

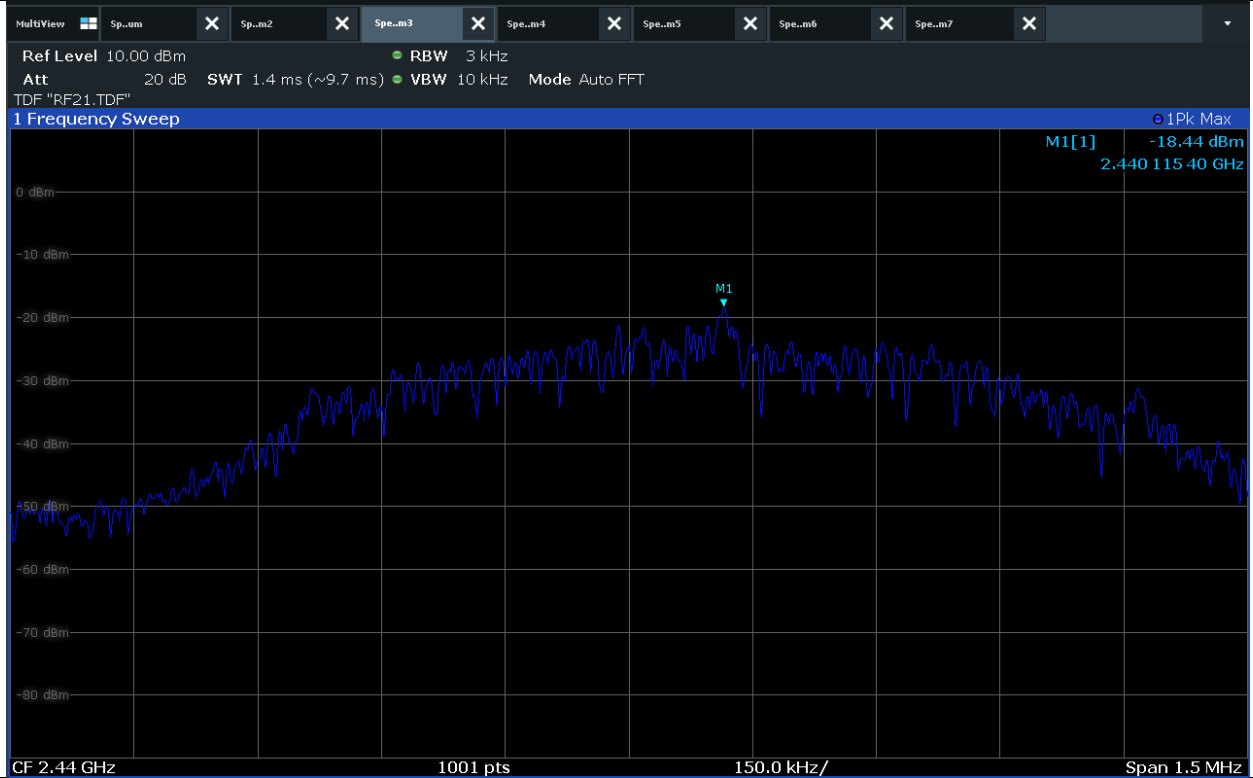
Test Result : Pass

7.4.1 Measured Results

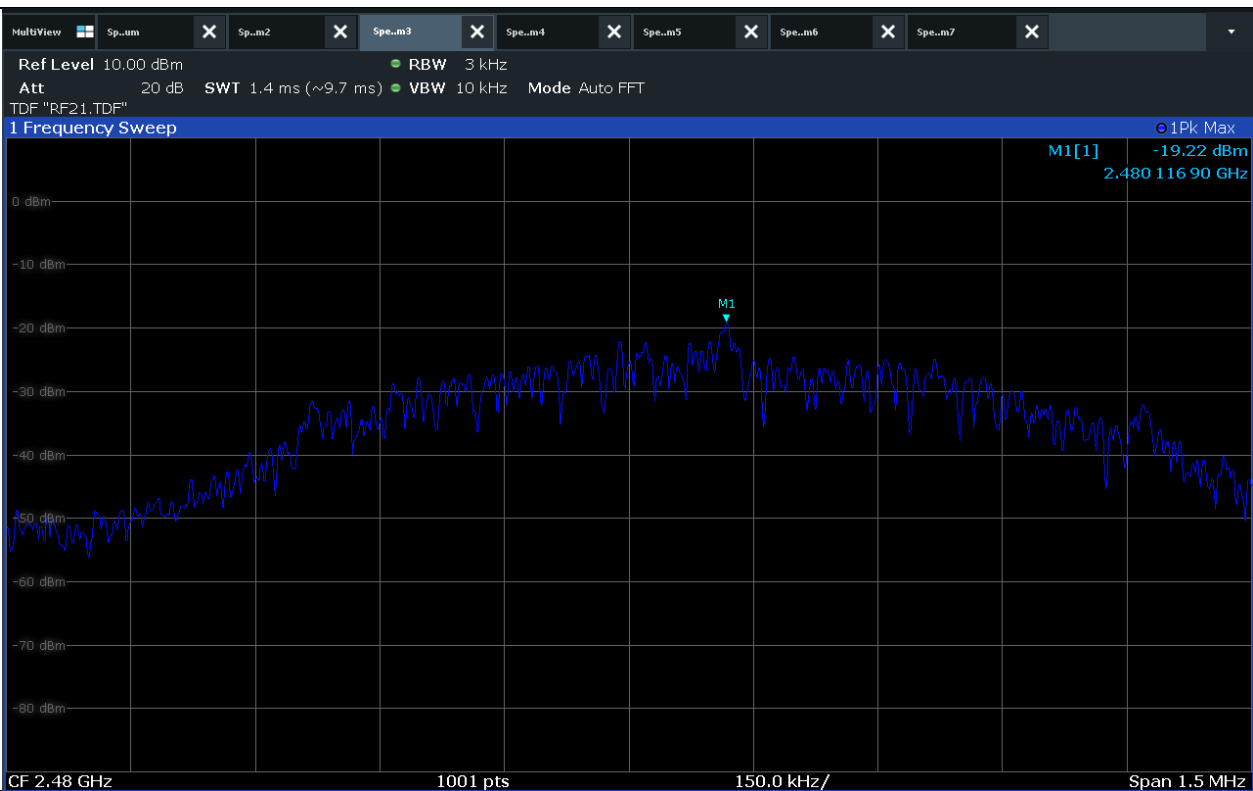
Modulation Type	Channel (Frequency)	Highest signal level (dBm)	Limit (dBm/3kHz)
Bluetooth LE	0 (2 402 MHz)	-17.76	8
	19 (2 440 MHz)	-18.44	
	39 (2 480 MHz)	-19.22	

7.4.2 Measured Graph





Mid CH



High CH



8. Conducted Spurious Emission

8.1 Operating environment

Temperature : 23 °C

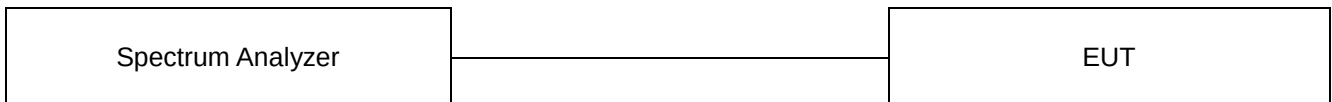
Relative humidity : 47 %

8.2 Measurement method

Standard : §15.247 (d)

8.3 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.





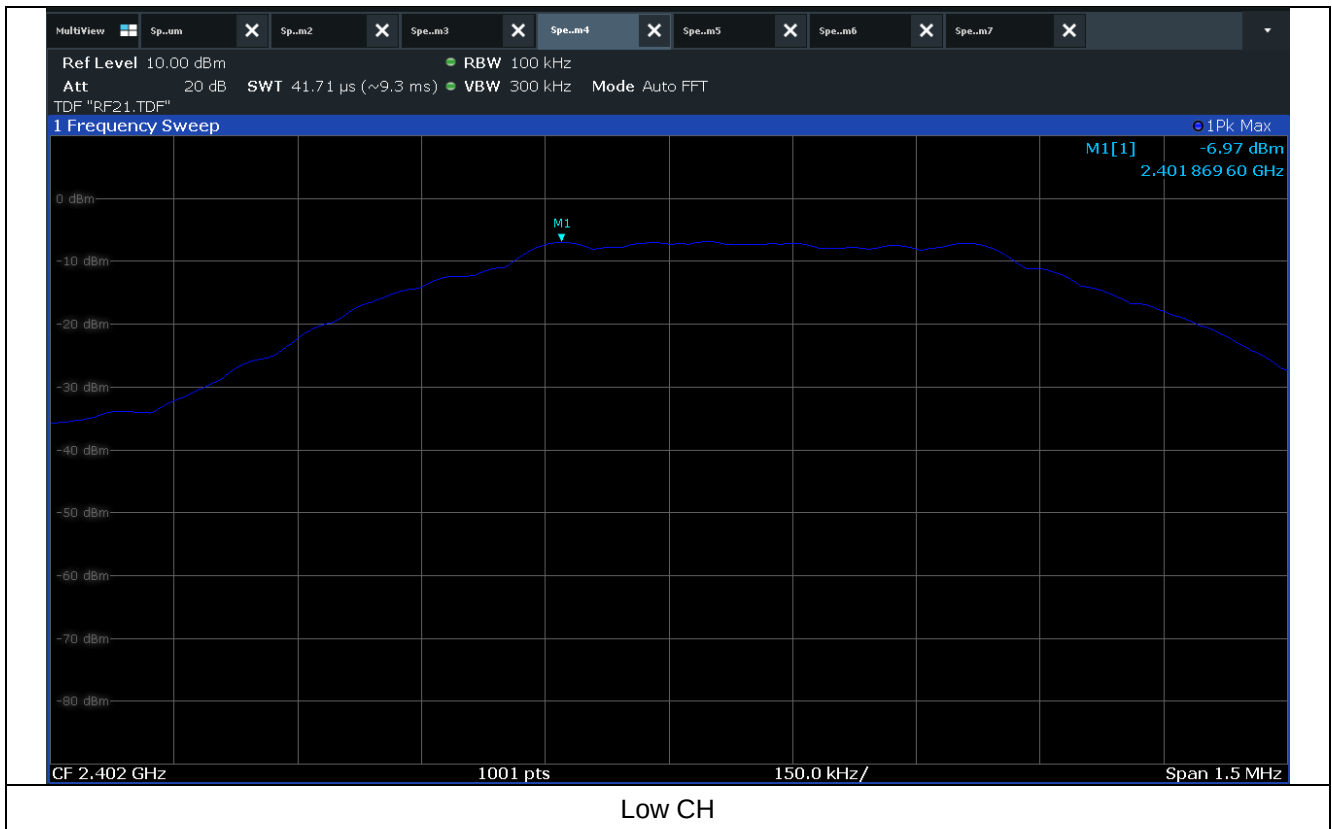
8.4 Test data

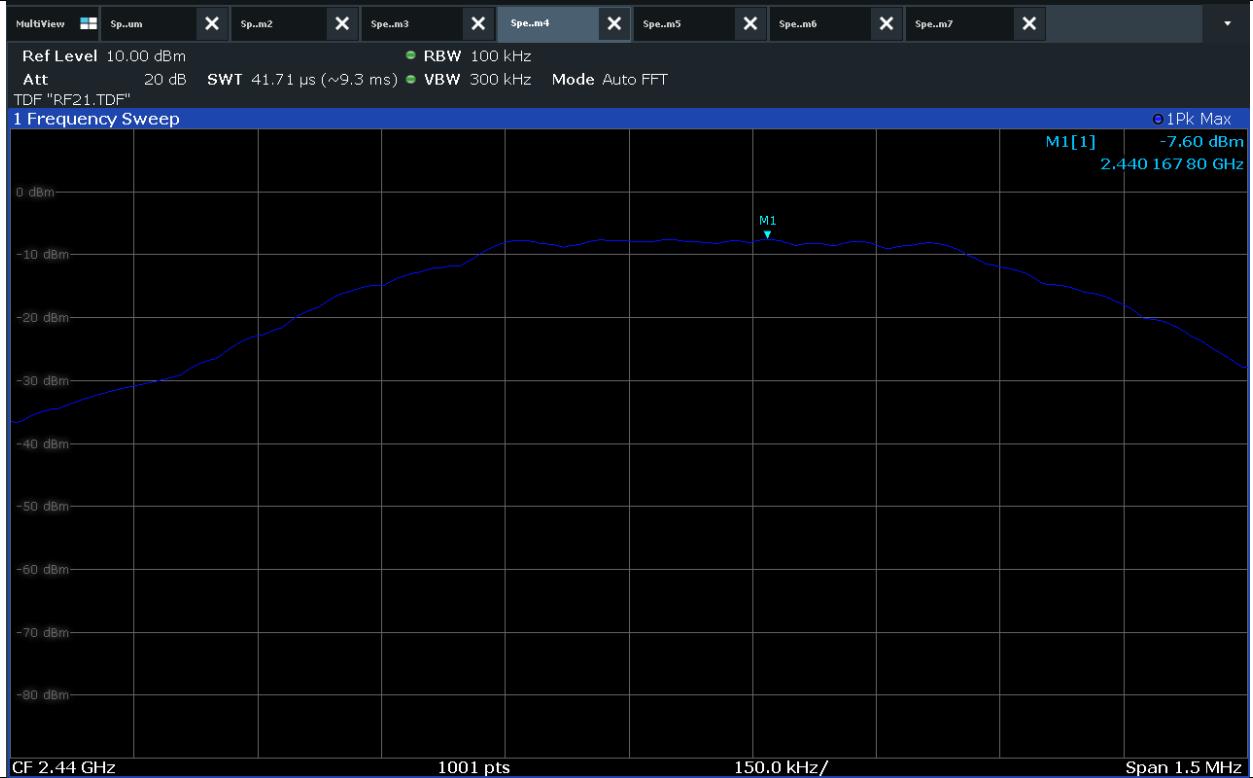
Operating mode : Transmit mode

Test Result : Pass

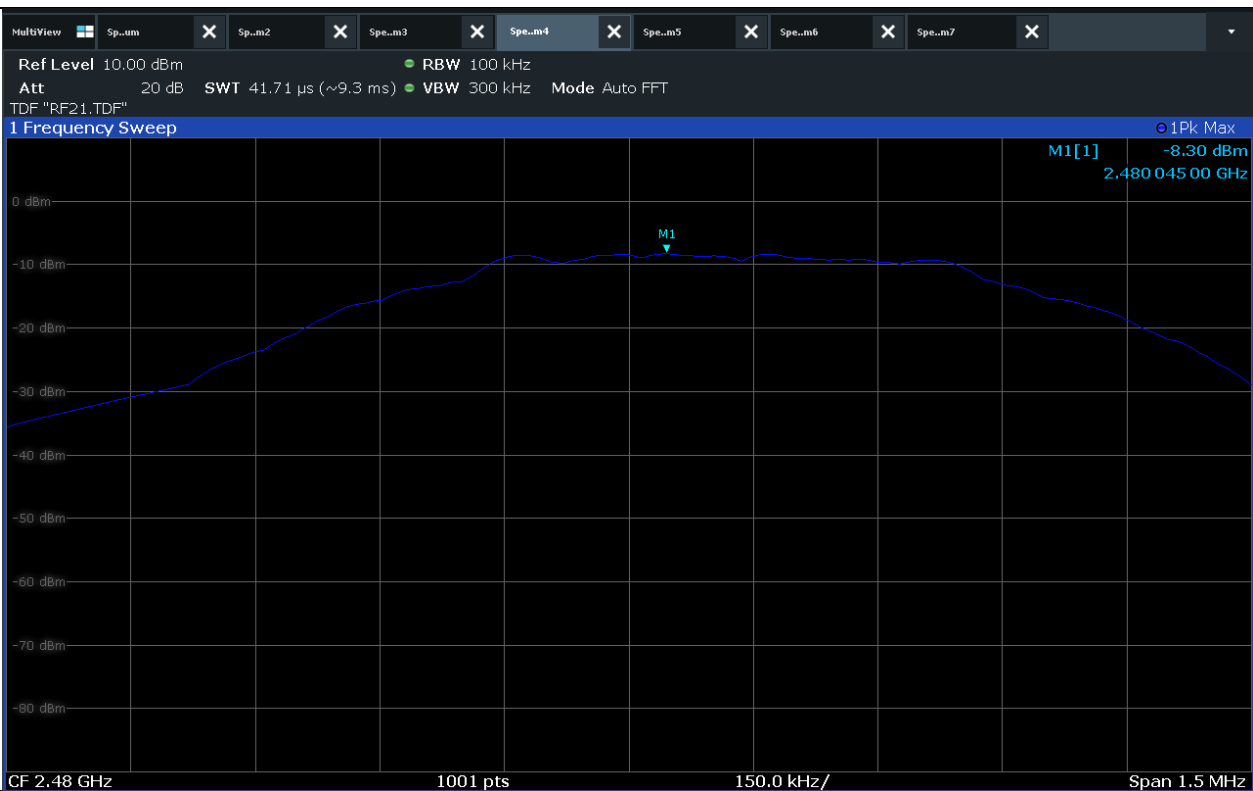
8.4.1 Measured Results

8.4.1.1 Signal level (dB m)





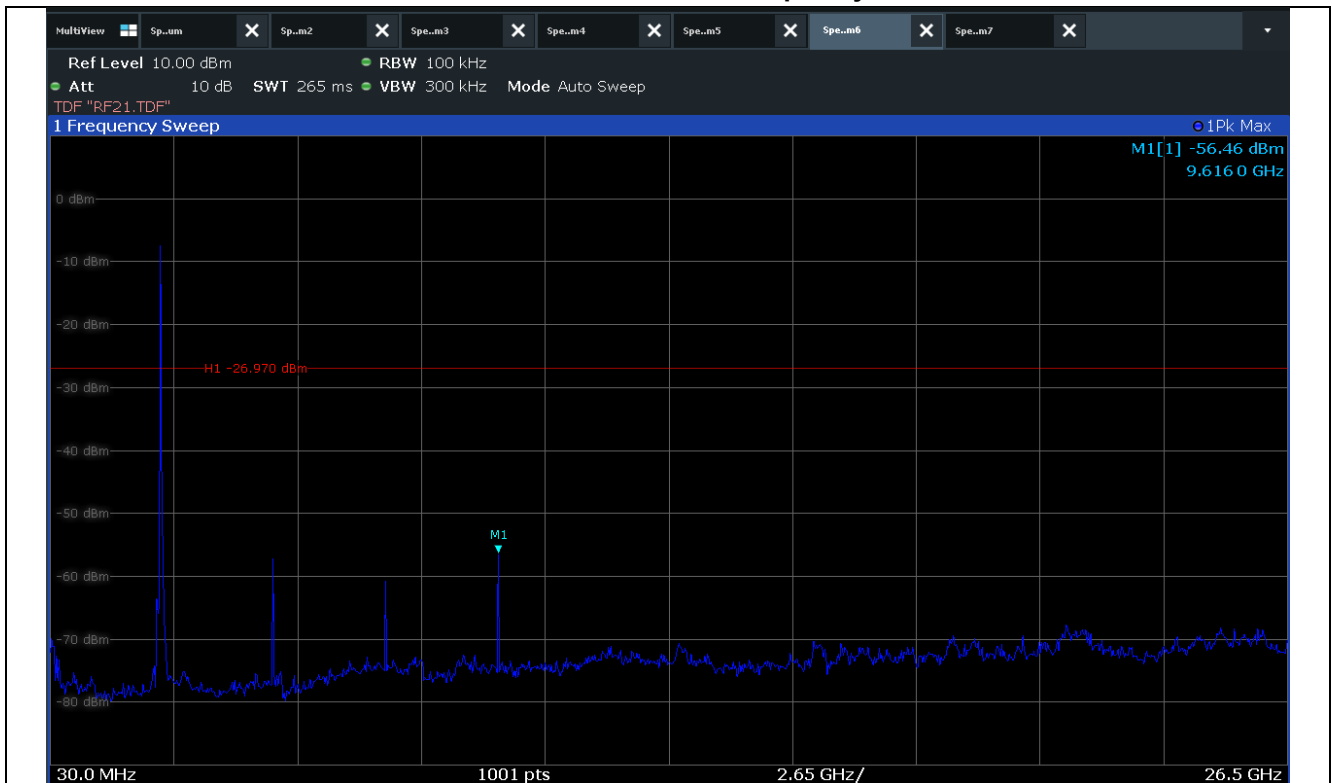
Mid CH



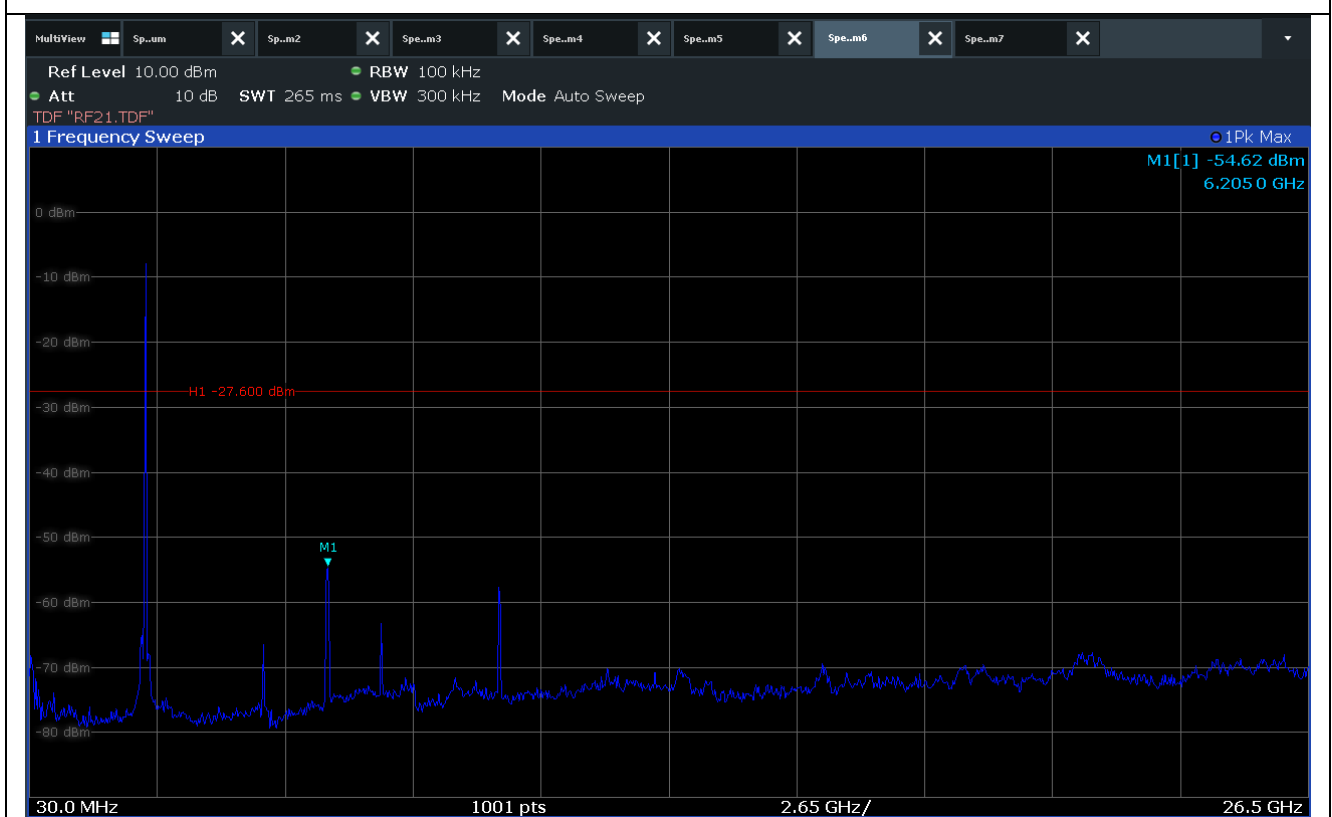
High CH



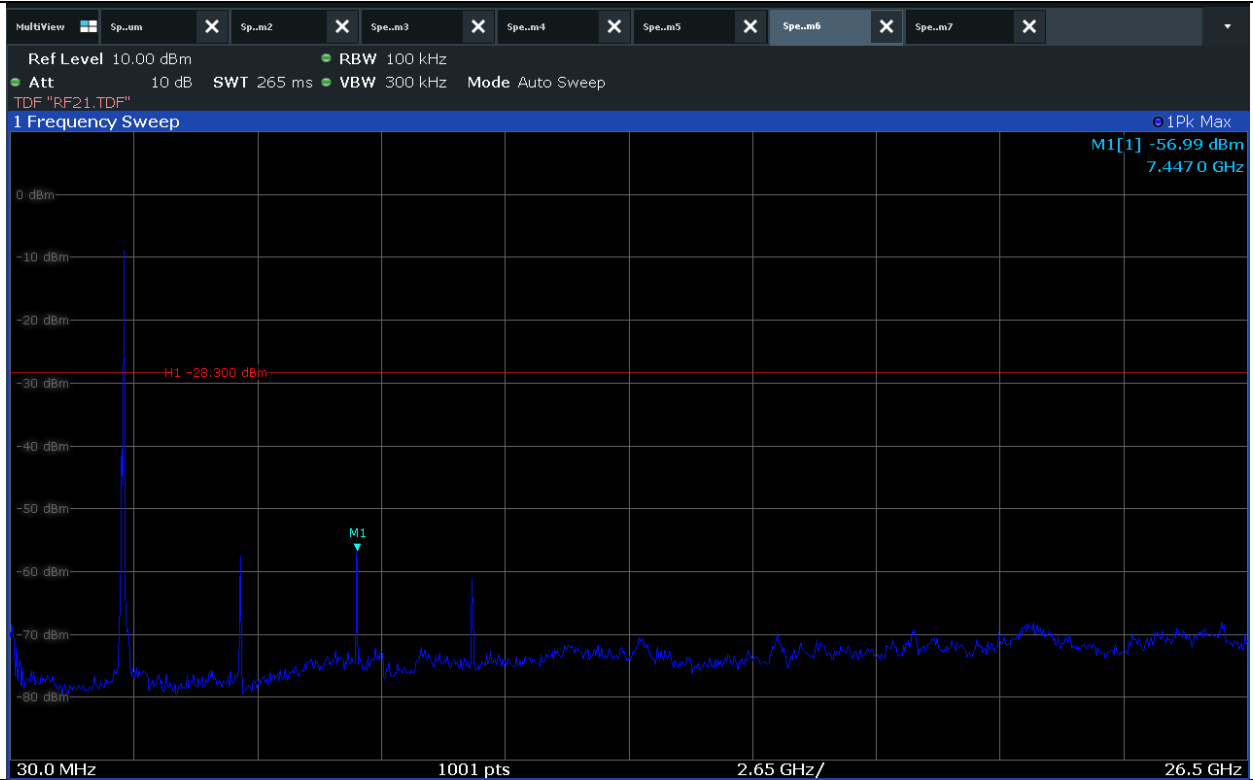
8.4.1.2 Unwanted Emissions In Non-Restricted Frequency Bands



Low CH

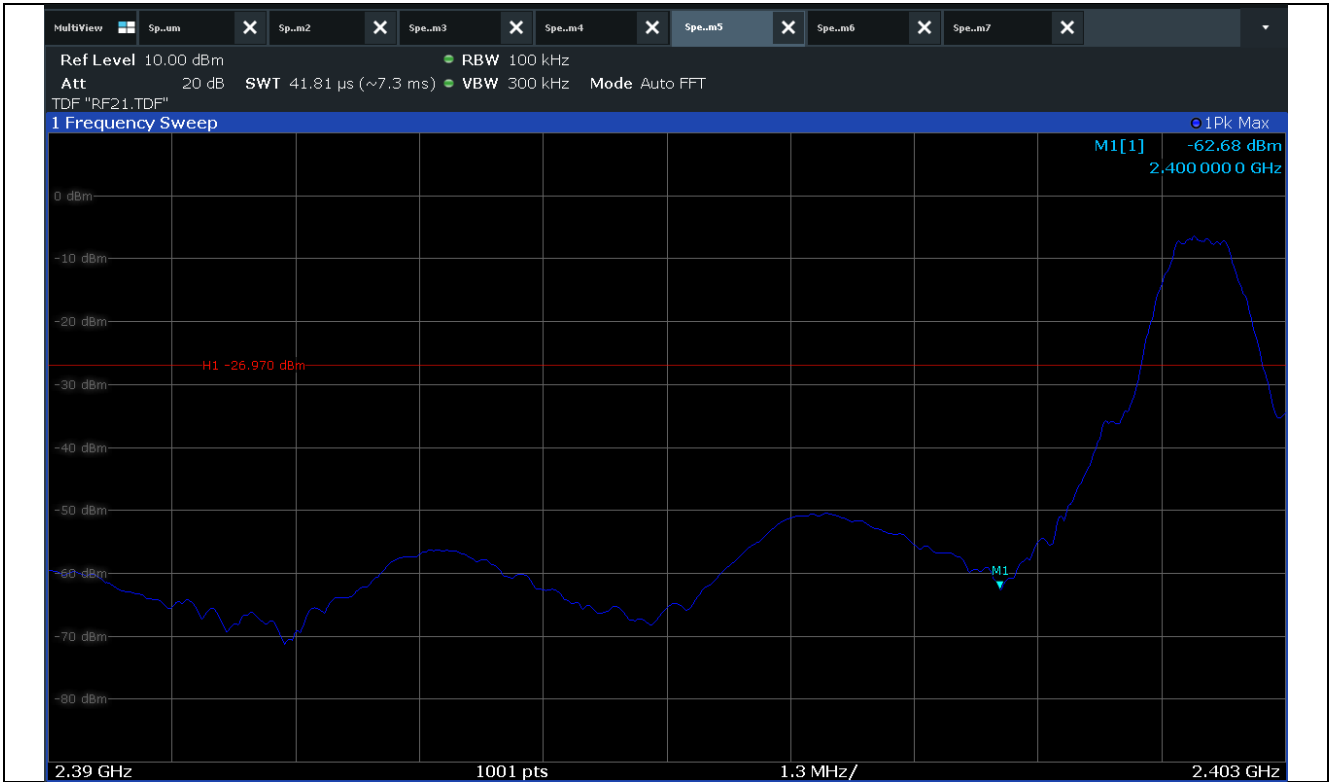


Mid CH

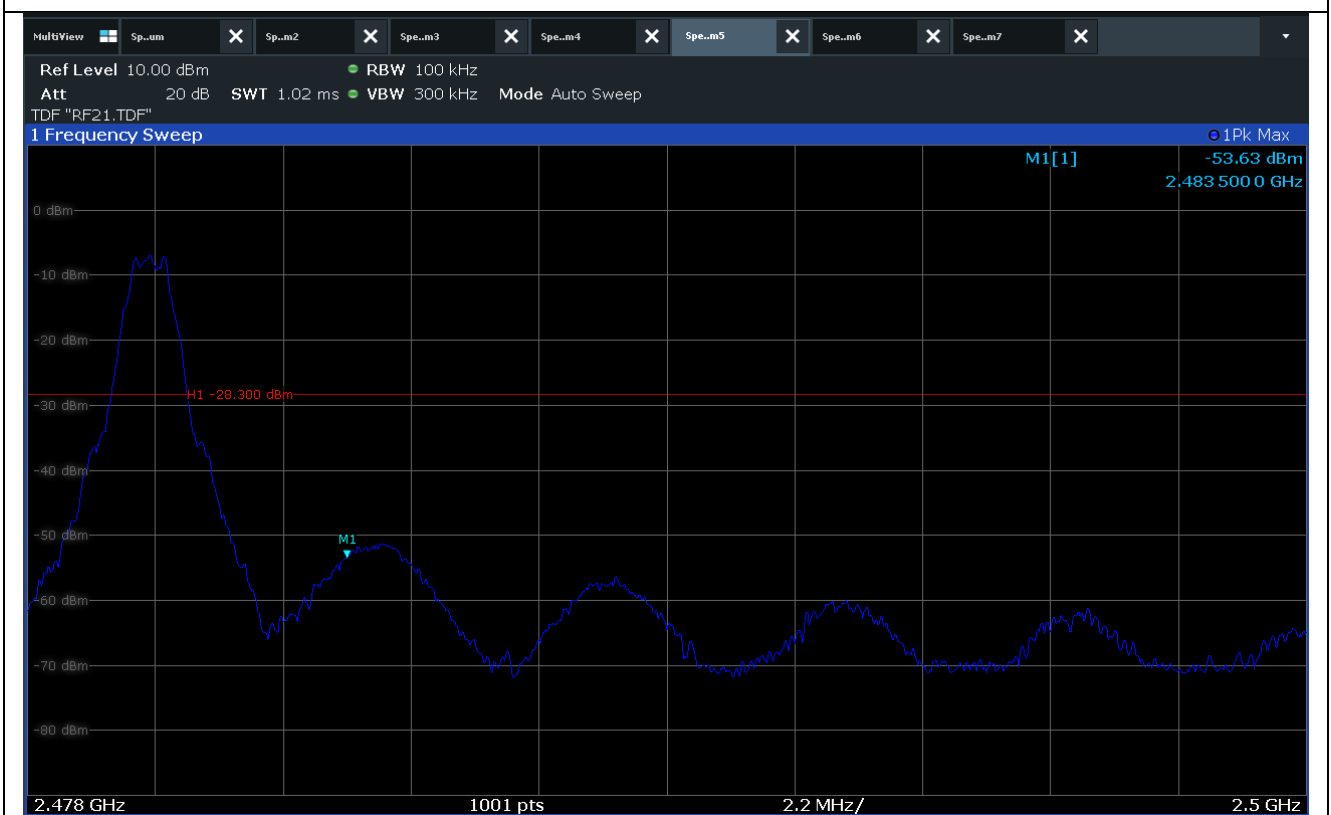




8.4.1.3 Band Edge



Low CH



High CH

9. Radiated Spurious Emission

9.1 Operating environment

Temperature : 24 °C
Relative humidity : 48 %

9.2 Measurement method

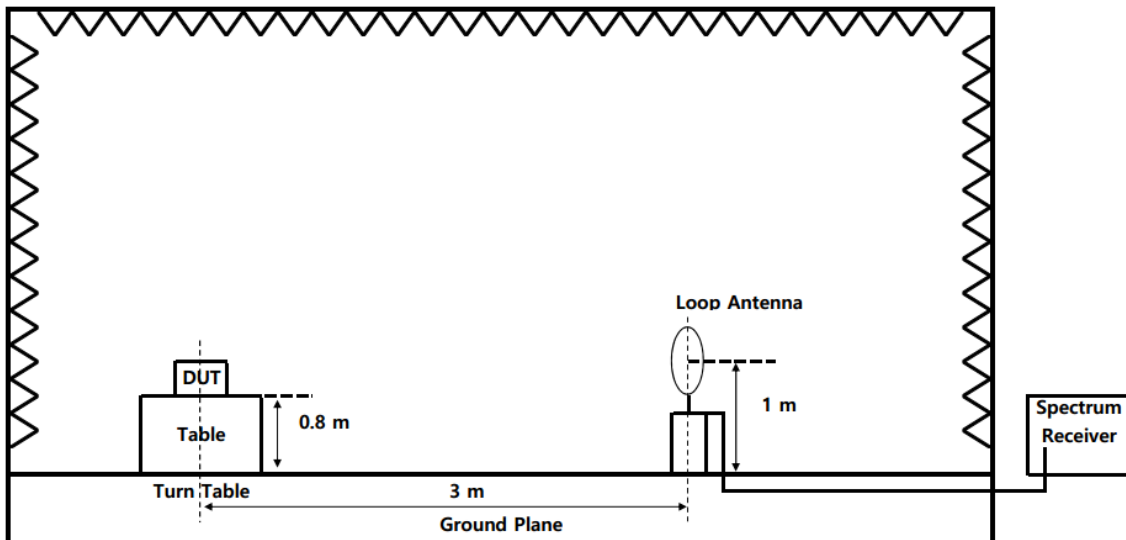
Standard : §15.247 (d), §15.209, §15.205

9.3 Test setup

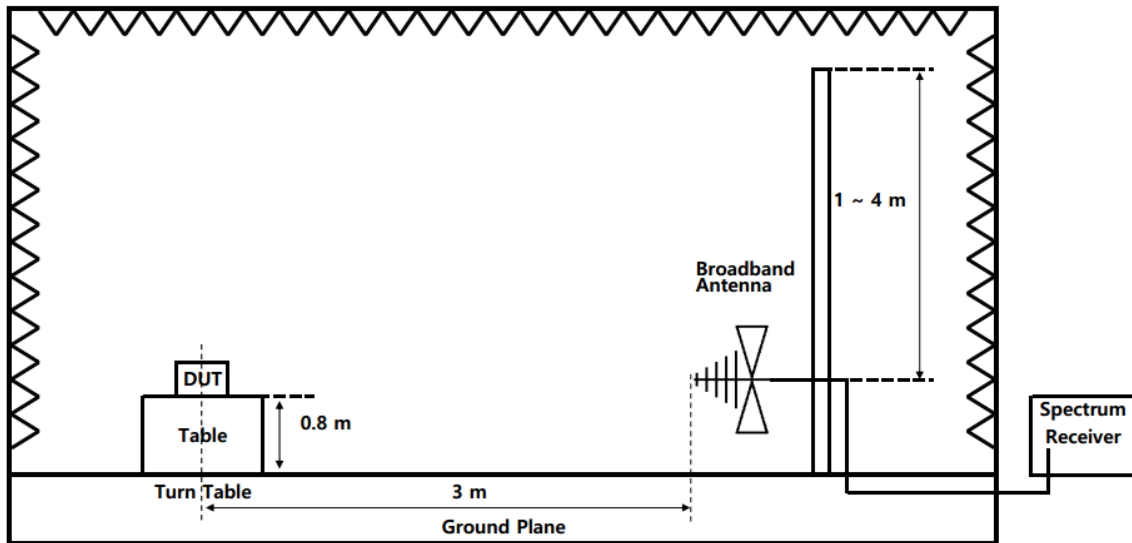
The radiated emissions measurements were performed on the 3 m, Semi-Anechoic Chamber. The EUT was placed on a non-conductive turntable above the ground plane.

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.

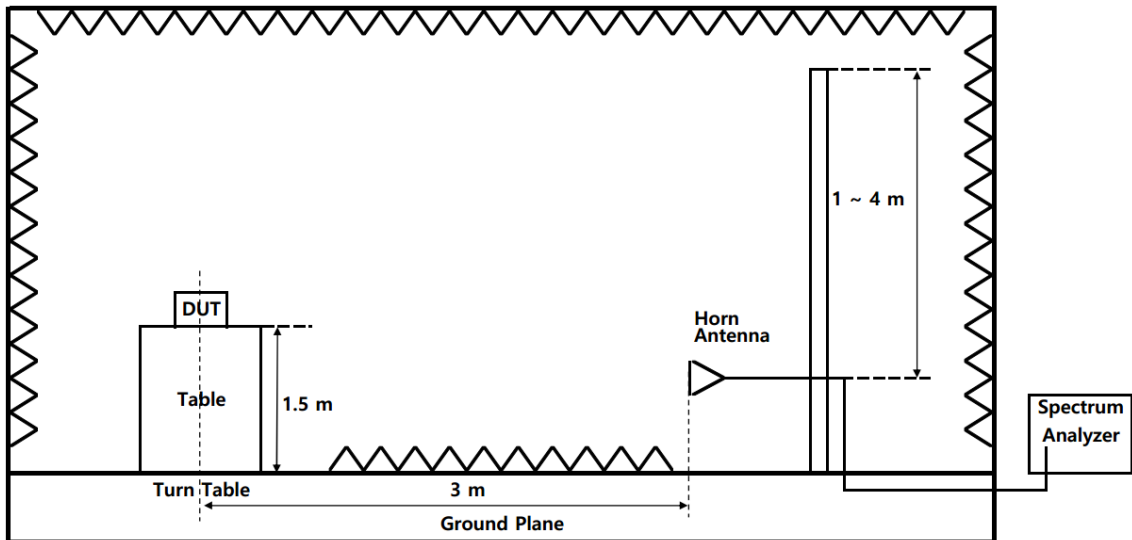
9.3.1 Below 30 MHz



9.3.2 30 MHz to 1 GHz



9.3.3 Above 1 GHz





9.4 Test data

Operating mode : Transmit mode

Test Result : Pass

9.4.1 Test data for Restricted band

Frequency (MHz)	Reading (dBμV)	Detector	Ant. Pol. (H/V)	Corr. Factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Low CH							
2 389.82	59.27	Peak	H	-14.70	44.57	73.98	29.41
	34.40	Average	H		19.70	53.98	34.28
High CH							
2 494.40	64.50	Peak	V	-14.40	50.10	73.98	23.88
	35.38	Average	V		20.98	53.98	33.00

※ Ant. Pol. : Antenna Polarization

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

※ Result = Reading + Corr. Factor

※ Margin = Limit - Result

9.4.2 Test data for Spurious & Harmonic

9.4.2.1 Measurement Results for below 30 MHz

Frequency (MHz)	Reading (dBμV)	Detector	Ant. Pol. (H/V)	Corr. Factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (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.							

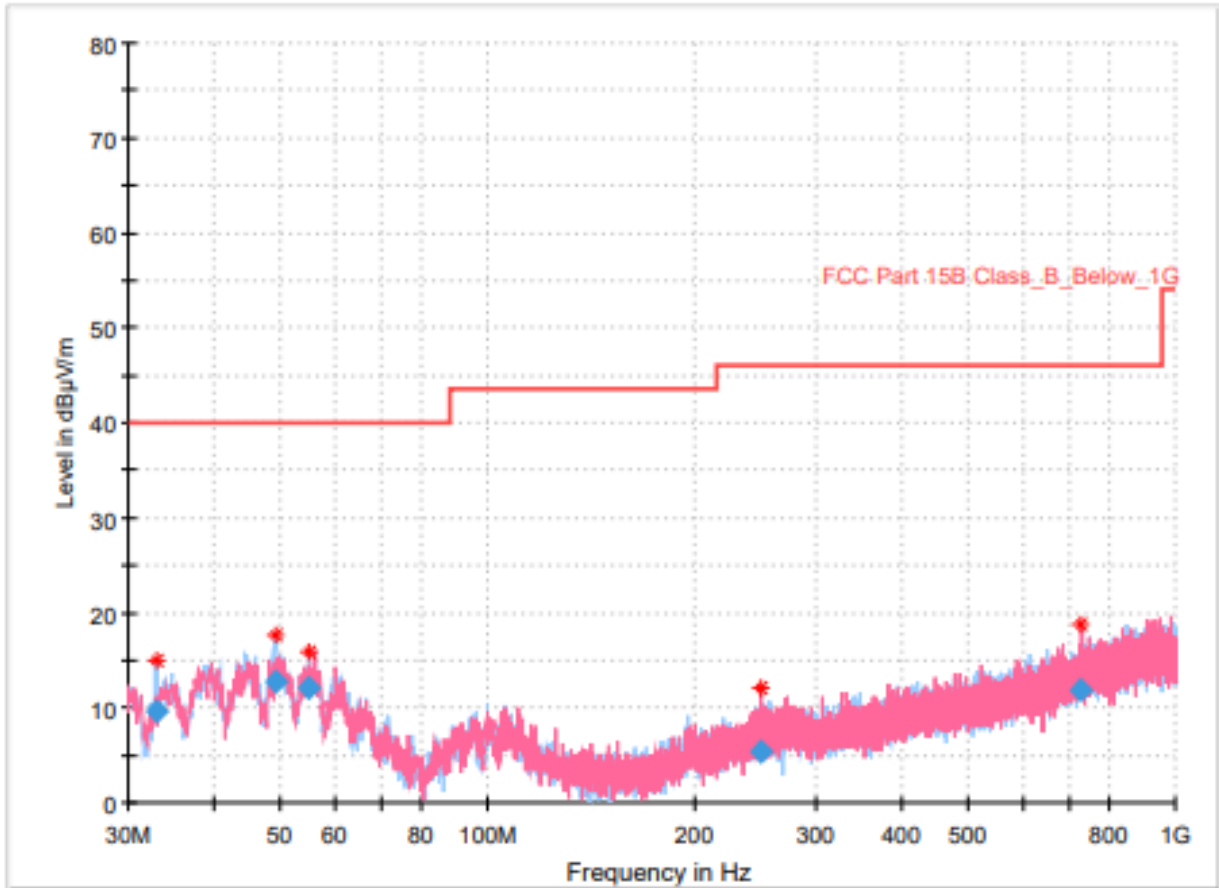
※ Ant. Pol. : Antenna Polarization

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

※ Result = Reading + Corr. Factor

※ Margin = Limit – Result

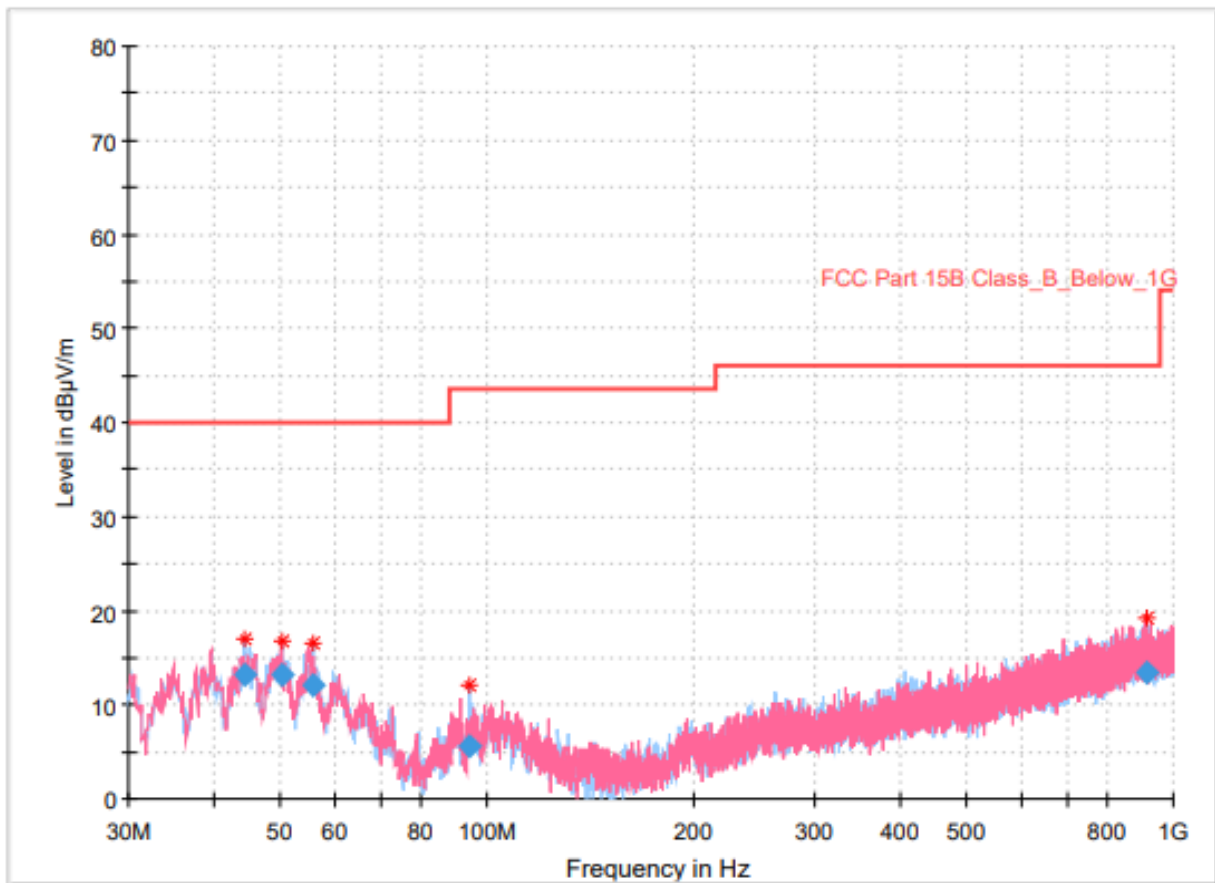
9.4.2.2 Measurement Results for below 1 GHz



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
33.104000	9.57	40.00	30.43	1000.0	120.000	99.9	H	262.0	-25.2
49.109000	12.82	40.00	27.18	1000.0	120.000	99.9	H	221.0	-20.2
55.026000	12.08	40.00	27.92	1000.0	120.000	99.9	H	126.0	-20.6
249.802000	5.43	46.00	40.57	1000.0	120.000	99.9	V	79.0	-21.7
730.631000	11.80	46.00	34.20	1000.0	120.000	99.9	V	0.0	-13.7

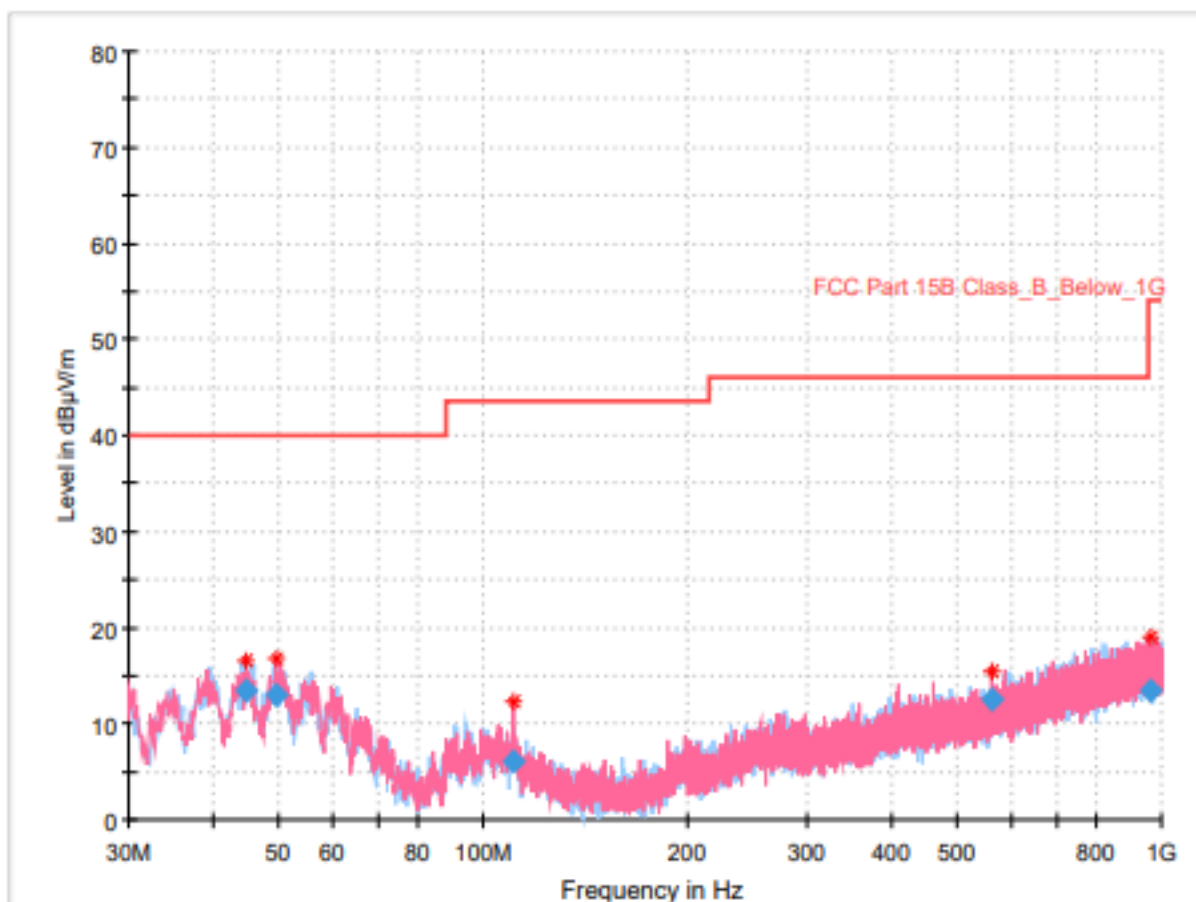
Low CH



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
44.259000	13.21	40.00	26.79	1000.0	120.000	99.9	H	0.0	-20.9
50.176000	13.21	40.00	26.79	1000.0	120.000	99.9	V	148.0	-20.1
55.705000	12.04	40.00	27.96	1000.0	120.000	99.9	H	257.0	-20.7
94.117000	5.48	43.50	38.02	1000.0	120.000	99.9	H	0.0	-23.7
913.864000	13.32	46.00	32.68	1000.0	120.000	99.9	H	122.0	-11.6

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)
44.647000	13.34	40.00	26.66	1000.0	120.000	99.9	H	266.0	-20.8
49.400000	12.92	40.00	27.08	1000.0	120.000	99.9	V	100.0	-20.2
110.898000	5.98	43.50	37.52	1000.0	120.000	99.9	V	166.0	-22.9
562.530000	12.62	46.00	33.38	1000.0	120.000	99.9	V	166.0	-16.1
965.080000	13.36	54.00	40.64	1000.0	120.000	99.9	H	332.0	-11.6

High CH



9.4.2.3 Measurement Results for Above 1 GHz

Frequency (MHz)	Reading (dBμV)	Detector	Ant. Pol. (H/V)	Corr. Factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Low CH							
2 999.20	54.16	Peak	V	-12.40	41.76	73.98	32.22
	40.78	Average	V		28.38	53.98	25.60
4 802.90	59.13	Peak	V	-4.40	54.73	73.98	19.25
	36.21	Average	V		31.81	53.98	22.17
5 999.70	52.49	Peak	V	-2.40	50.09	73.98	23.89
	46.59	Average	V		44.19	53.98	9.79
7 205.00	54.28	Peak	V	0.10	54.38	73.98	19.60
	34.29	Average	V		34.39	53.98	19.59
9 607.10	45.30	Peak	V	3.20	48.50	73.98	25.48
	28.86	Average	V		32.06	53.98	21.92
Mid CH							
4 847.10	61.50	Peak	V	-4.00	57.50	73.98	16.48
	29.64	Average	V		25.64	53.98	28.34
7 320.60	62.11	Peak	H	0.30	62.41	73.98	11.57
	42.09	Average	H		42.39	53.98	11.59
9 760.10	43.67	Peak	H	3.40	47.07	73.98	26.91
	28.06	Average	H		31.46	53.98	22.52
High CH							
4 959.30	61.44	Peak	V	-3.60	57.84	73.98	16.14
	40.95	Average	V		37.35	53.98	16.63
7 439.60	64.33	Peak	V	0.60	64.93	73.98	9.05
	44.05	Average	V		44.65	53.98	9.33
9 921.60	45.66	Peak	V	3.70	49.36	73.98	24.62
	28.13	Average	V		31.83	53.98	22.15

※ Ant. Pol. : Antenna Polarization

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

※ Result = Reading + Corr. Factor

※ Margin = Limit – Result



10. Power Line Conducted Emission

10.1 Operating environment

Temperature : 24 °C

Relative humidity : 48 %

10.2 Measurement method

Standard : §15.207

10.3 Limit

Standard : §15.207

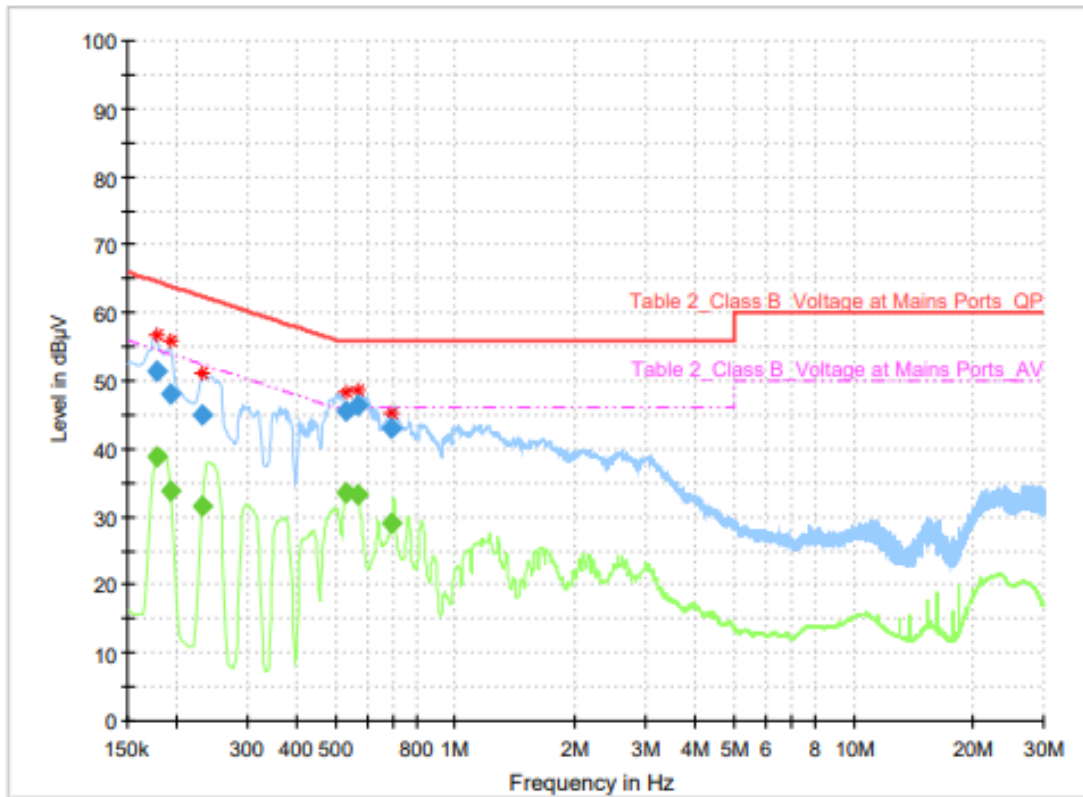
10.4 Test data

Operating mode : Transmit mode

Test Result : Pass

10.4.1 Measured Results & Graph

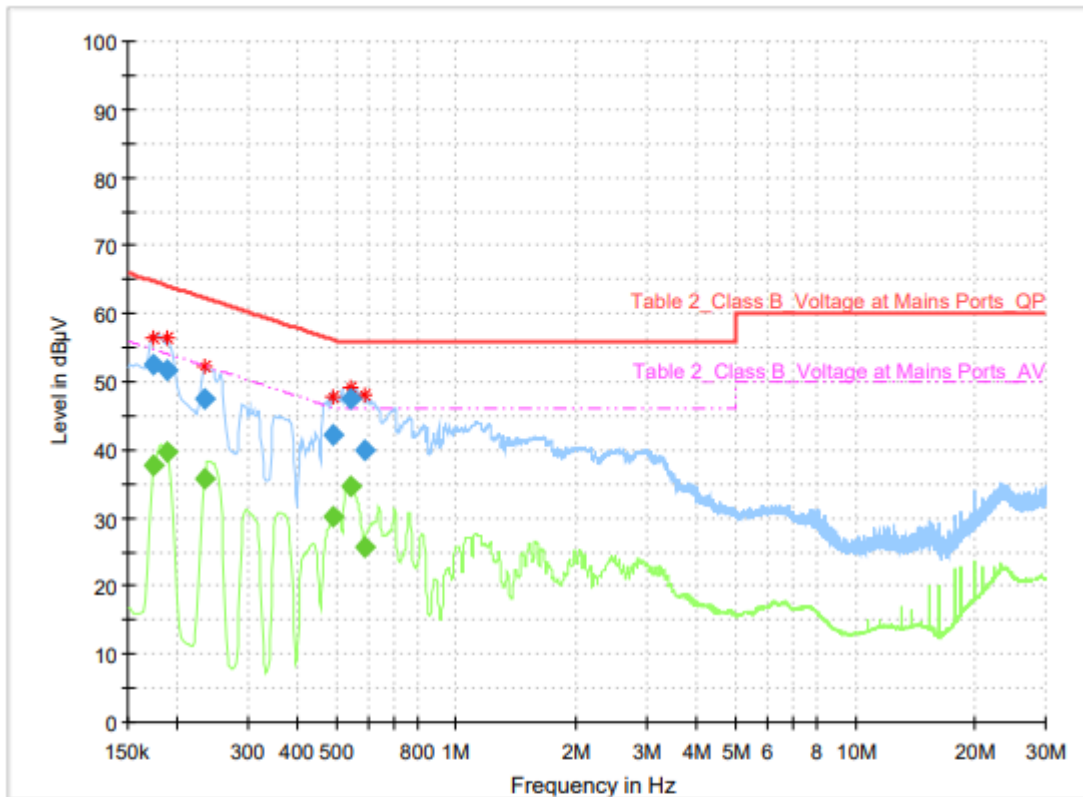
Live line



Final Result

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.177000	---	38.79	54.63	15.84	5000.0	9.000	L1	ON	10.0
0.177000	51.33	---	64.63	13.29	5000.0	9.000	L1	ON	10.0
0.192750	---	33.92	53.92	19.99	5000.0	9.000	L1	ON	9.9
0.192750	48.18	---	63.92	15.74	5000.0	9.000	L1	ON	9.9
0.231000	---	31.54	52.41	20.88	5000.0	9.000	L1	ON	9.8
0.231000	45.04	---	62.41	17.37	5000.0	9.000	L1	ON	9.8
0.532500	---	33.41	46.00	12.59	5000.0	9.000	L1	ON	9.9
0.532500	45.64	---	56.00	10.36	5000.0	9.000	L1	ON	9.9
0.566250	---	33.24	46.00	12.76	5000.0	9.000	L1	ON	9.9
0.566250	46.41	---	56.00	9.59	5000.0	9.000	L1	ON	9.9
0.692250	---	28.93	46.00	17.07	5000.0	9.000	L1	ON	9.9
0.692250	42.97	---	56.00	13.03	5000.0	9.000	L1	ON	9.9

Neutral line



Final Result

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.174750	---	37.58	54.73	17.15	5000.0	9.000	N	ON	10.0
0.174750	52.46	---	64.73	12.27	5000.0	9.000	N	ON	10.0
0.188250	---	39.54	54.11	14.58	5000.0	9.000	N	ON	9.9
0.188250	51.60	---	64.11	12.52	5000.0	9.000	N	ON	9.9
0.233250	---	35.67	52.33	16.66	5000.0	9.000	N	ON	9.8
0.233250	47.43	---	62.33	14.91	5000.0	9.000	N	ON	9.8
0.489750	---	30.19	46.17	15.98	5000.0	9.000	N	ON	9.9
0.489750	42.08	---	56.17	14.09	5000.0	9.000	N	ON	9.9
0.546000	---	34.50	46.00	11.50	5000.0	9.000	N	ON	9.9
0.546000	47.38	---	56.00	8.62	5000.0	9.000	N	ON	9.9
0.586500	---	25.74	46.00	20.26	5000.0	9.000	N	ON	9.9
0.586500	39.91	---	56.00	16.09	5000.0	9.000	N	ON	9.9

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