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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
ICRT-TR-E231069-0A	2023. 05. 16	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	RECEIVER
Brand Name	-
Model Name	CaluXReceiver
Additional Model Name	-
FCC ID	2A3QW-CALUXRECEIVER
Hardware Version	1.0
Software Version	1.0
Power Supply	DC 5.0 V

2.2 Additional Information

Equipment Class	FHSS - Frequency Hopping Spread Spectrum system
Device Type	Stand-alone
Operating Frequency	2 402 MHz ~ 2 479 MHz
RF Output Power	-1.12 dBm
Number of Channel	78
Modulation Type	FHSS
Antenna Type	PCB Antenna
Antenna Gain	-21.51 dBi
Antenna Operating Mode	Single Antenna Equipment with only one antenna
Hopping mode	Pseudorandom

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)(1)(i)	20 dB Bandwidth & 99 % Bandwidth	☒	PASS
§15.247 (a)(1)	Carrier Frequency Separation	☒	PASS
§15.247 (a)(1) (iii)	Number of Hopping Frequencies	☒	PASS
§15.247 (a)(1) (iii)	Time of Occupancy (dwell Time)	☒	PASS
§15.247 (a)(1)	Maximum Conducted Output Power	☒	PASS
§15.247 (d)	Conducted Spurious Emission & Band edge (Non-Restricted band)	☒	PASS
§15.209 §15.205	Radiated Spurious Emission(Restricted band)	☒	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 **-21.51 dBi**



4. 20 dB Bandwidth & 99 % Bandwidth

4.1 Measurement method

Standard : ANSI 63.10 (6.9.2)

4.2 Limit

Standard : §15.247 (a)(1)(i)

4.3 Test data

Operating mode : Transmit mode

Test Result : Pass

4.3.1 Measured Results

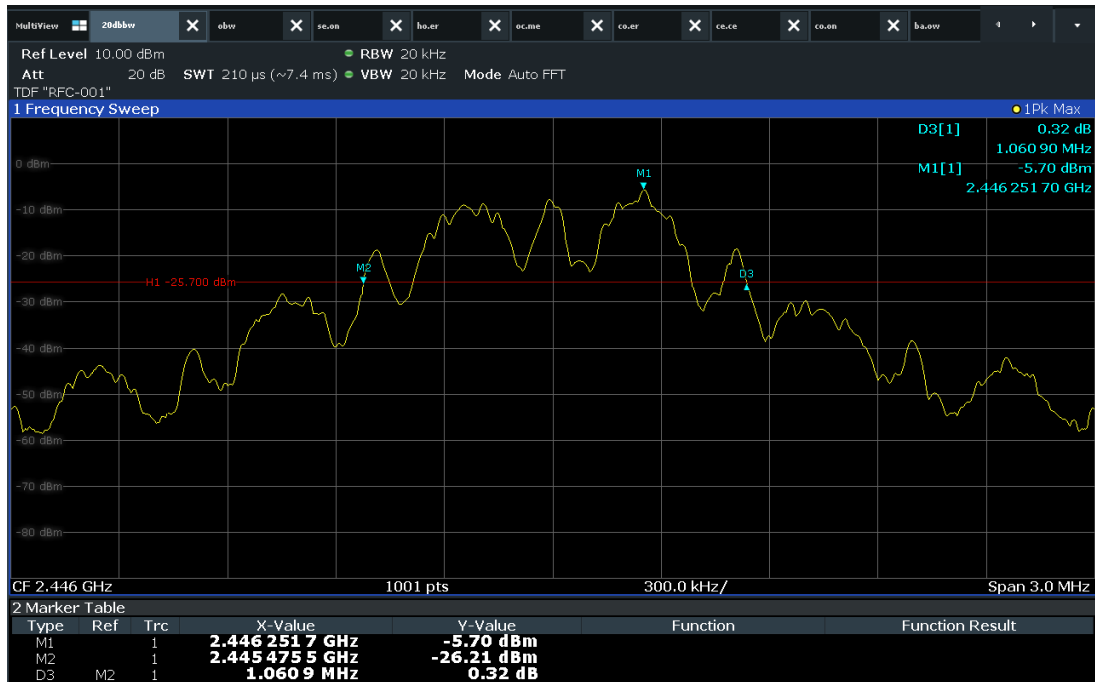
Modulation Type	Channel (Frequency)	20 dB Bandwidth (kHz)	99 % Occupied Bandwidth (kHz)
FHSS	2 402 MHz	1 063.90	1 031.62
	2 446 MHz	1 060.90	1 036.34
	2 479 MHz	1 057.90	1 034.54



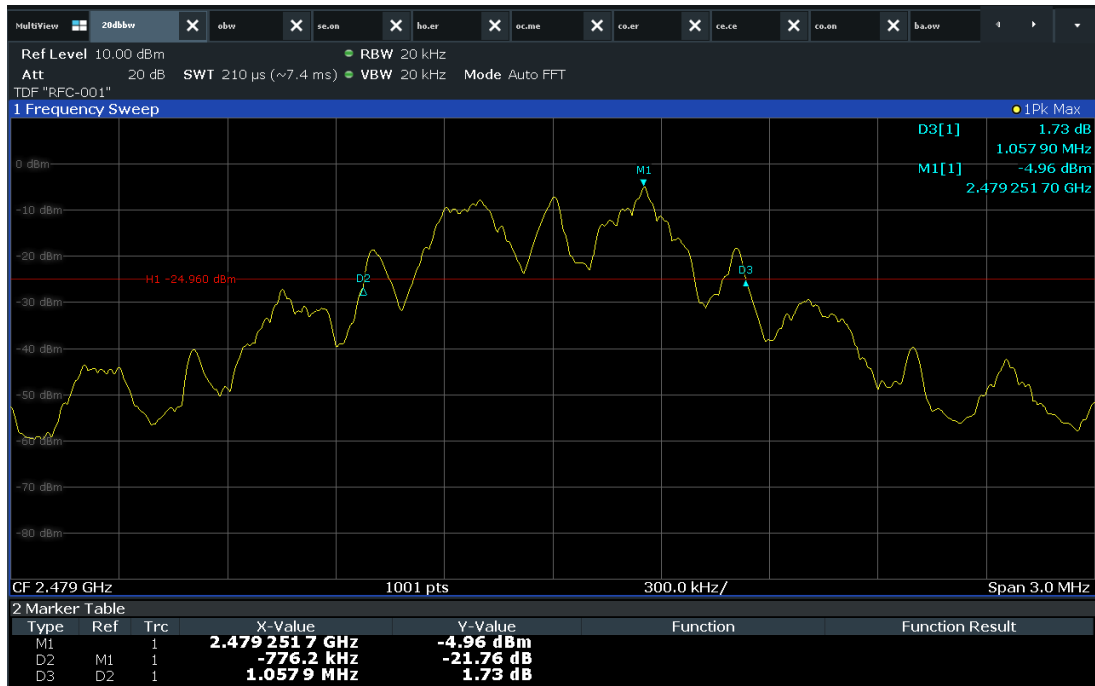
4.3.2 Measured Graph (20 dB Bandwidth)



Low CH



Mid CH

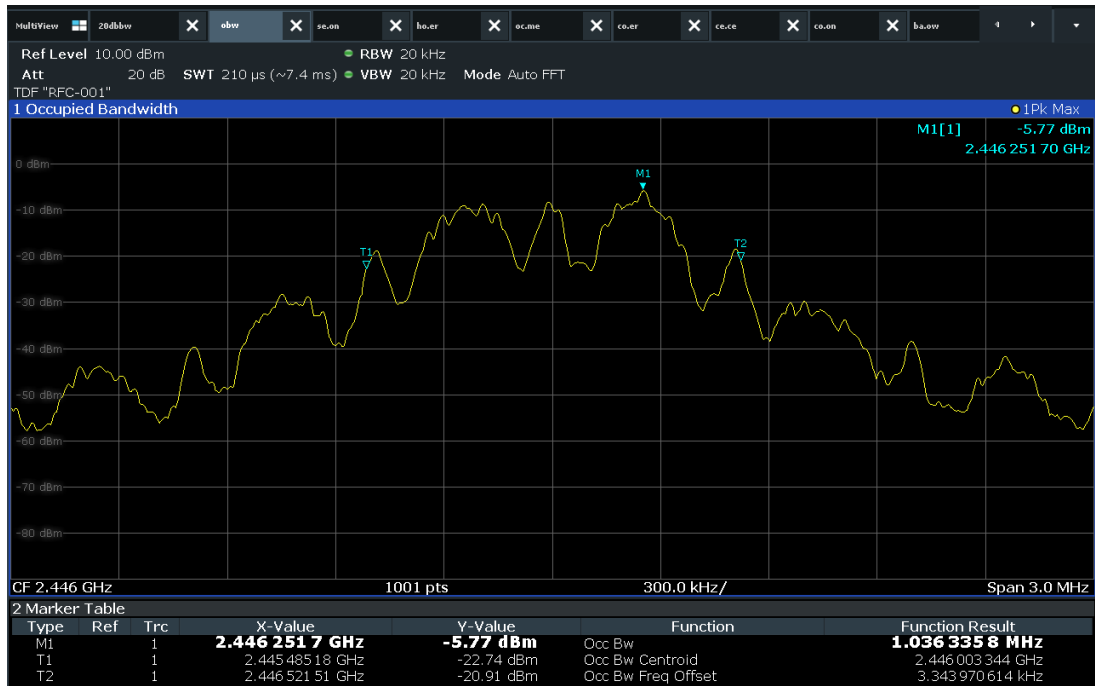


High CH

4.3.3 Measured Graph (99 % Bandwidth)



Low CH



Mid CH



High CH



5. Carrier Frequency Separation

5.1 Measurement method

Standard : ANSI 63.10 (7.8.2)

5.2 Limit

Standard : 15.247 (a)(1)

5.3 Test data

Operating mode : Transmit mode

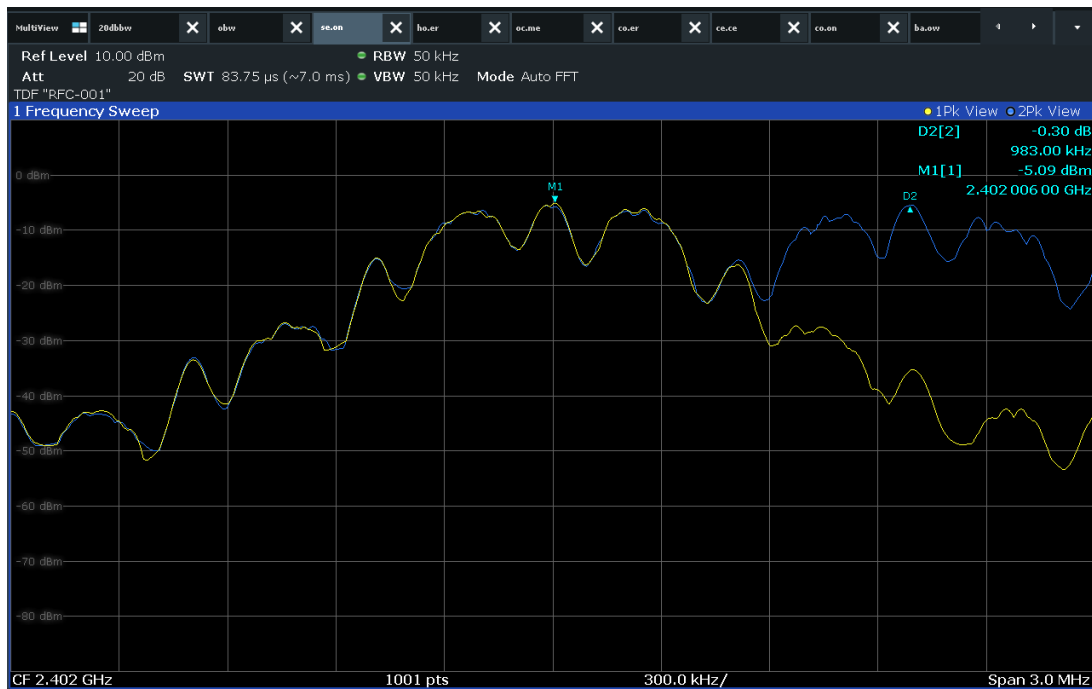
Test Result : Pass

5.3.1 Measured Results

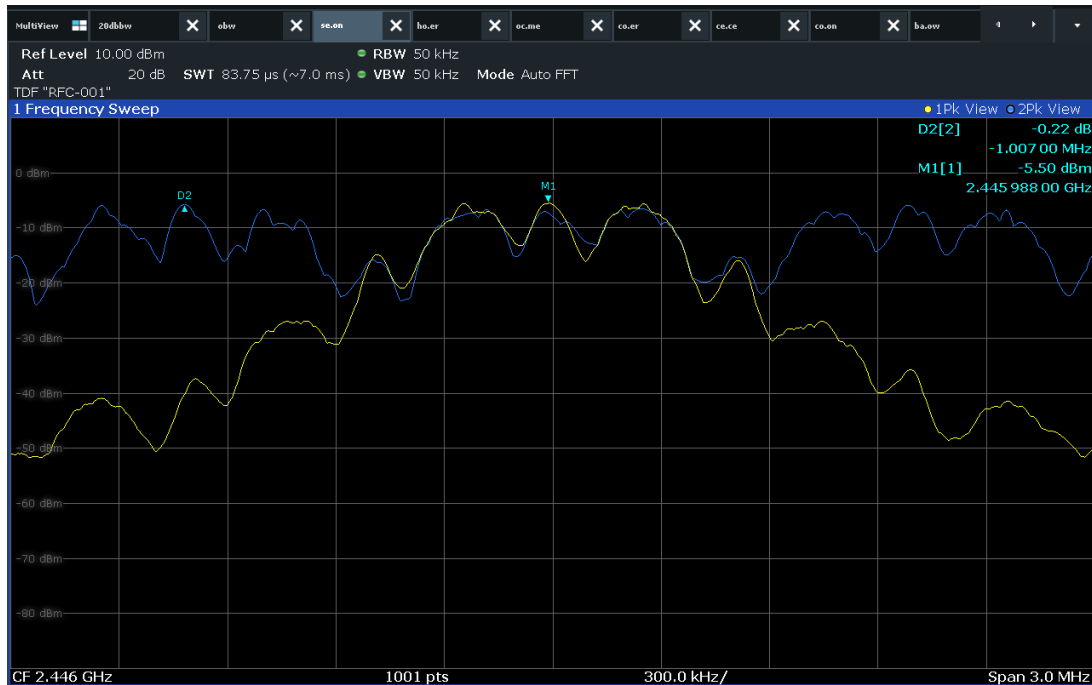
Modulation type	Channel (Frequency)	Separation (kHz)	Limit (kHz)	
FHSS	2 402 MHz	983.00	709.27	25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater
	2 446 MHz	1 007.00	707.27	
	2 479 MHz	1 001.00	705.27	



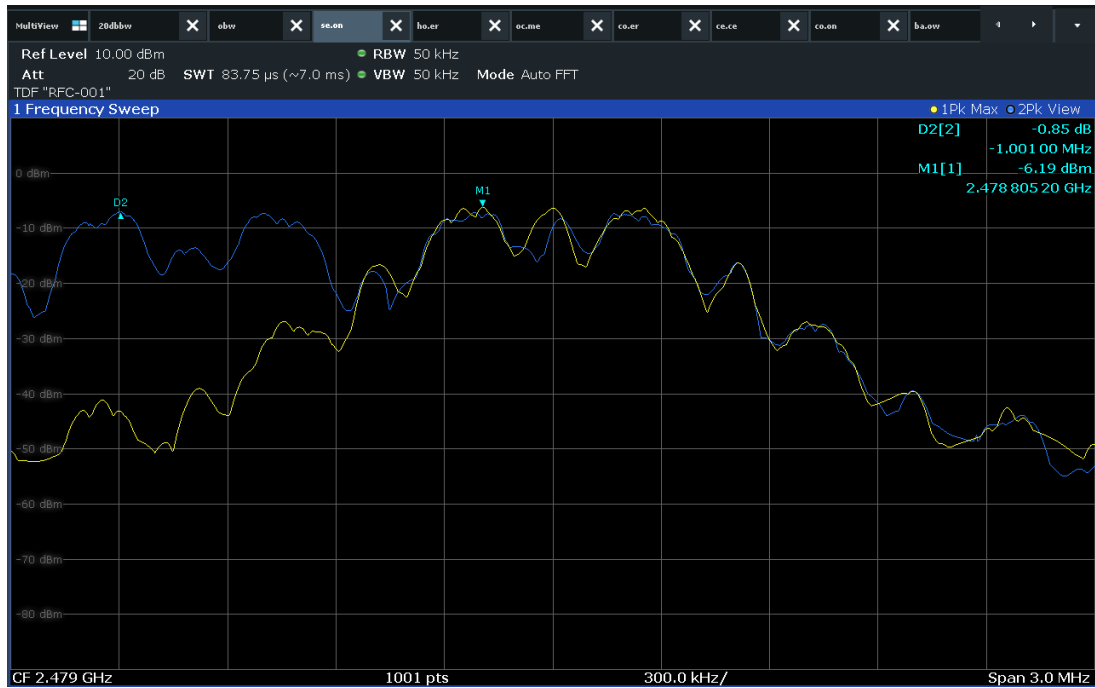
5.3.2 Measured Graph



Low CH



Mid CH



High CH



6. Number of Hopping Frequency

6.1 Measurement method

Standard : ANSI 63.10 (7.8.3)

6.2 Limit

Standard : 15.247 (a)(1)(iii)

6.3 Test data

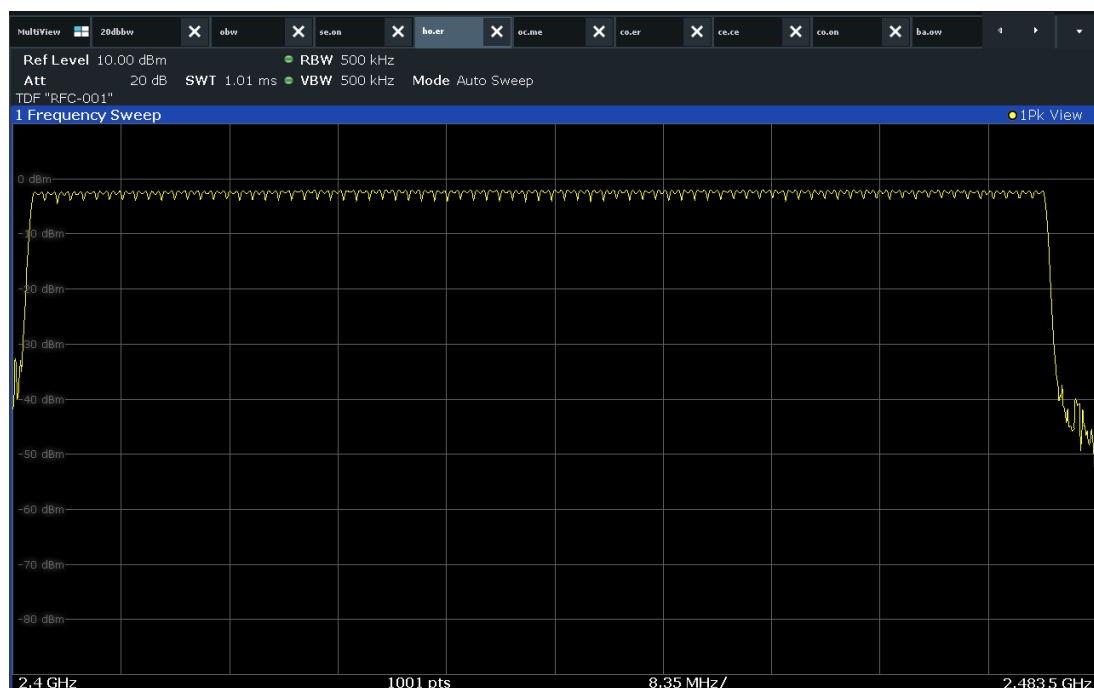
Operating mode : Hopping mode

Test Result : Pass

6.3.1 Measured Results

Modulation type	Hopping Channel Number	Limit
FHSS	78	> 15

6.3.2 Measured Graph



FHSS



7. Time of Occupancy (dwell Time)

7.1 Measurement method

Standard : ANSI 63.10 (7.8.4)

7.2 Limit

Standard : §15.247 (a)(1)(iii)

7.3 Test data

Test Result : Pass

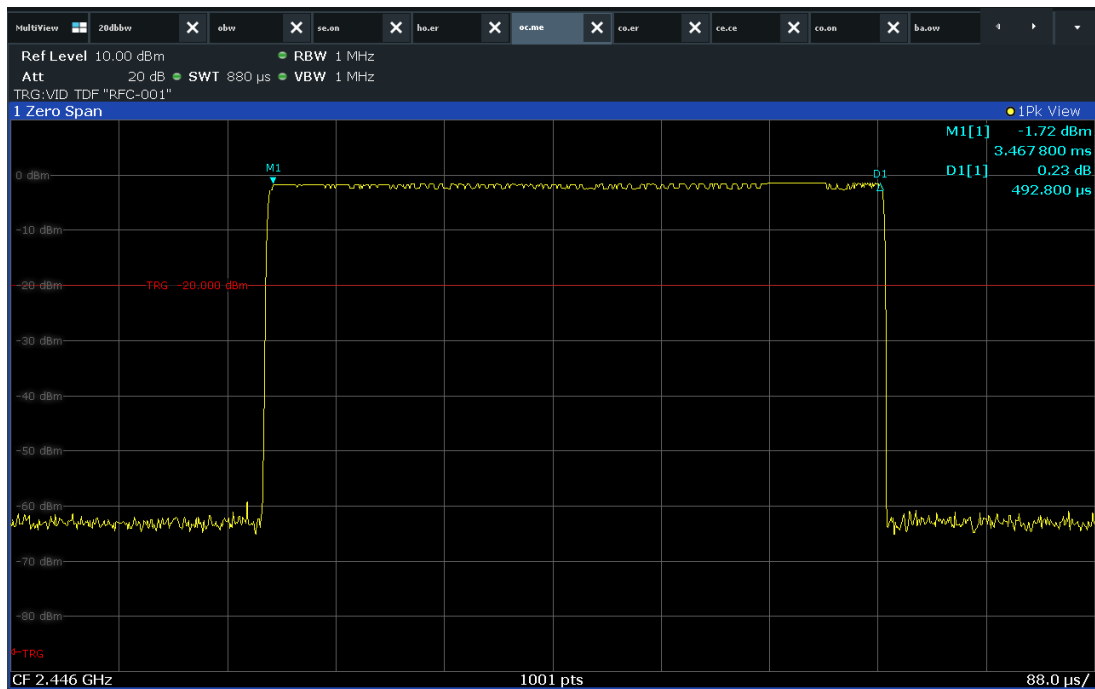
7.3.1 Measured Results

Operating Mode	Mode	Hops Over Occupancy Time (hops/s)	On Time (ms)	Occupancy Time (s)	Limit (s)
Hopping	FHSS	24	0.493	0.012	0.4

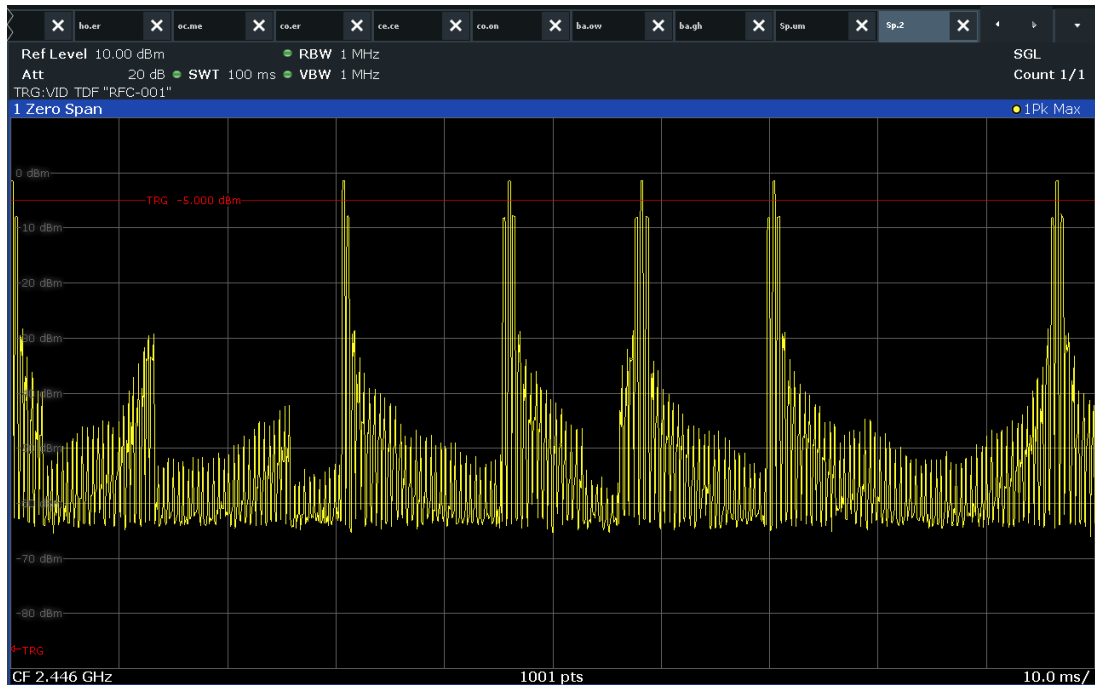
※ Hops Over Occupancy Time (hops/s) = $((6 / 0.1) / 78) \times (0.4 \times 78)$

※ Occupancy Time (s) = Hops Over Occupancy Time (hops/s) × On Time (ms)

7.3.2 Measurement Graph



FHSS



Hopping



8. Maximum Conducted Output Power

8.1 Measurement method

Standard : ANSI 63.10 (7.8.5)

8.2 Limit

Standard : §15.247 (a)(1)

8.3 Test data

Operating mode : Transmit mode

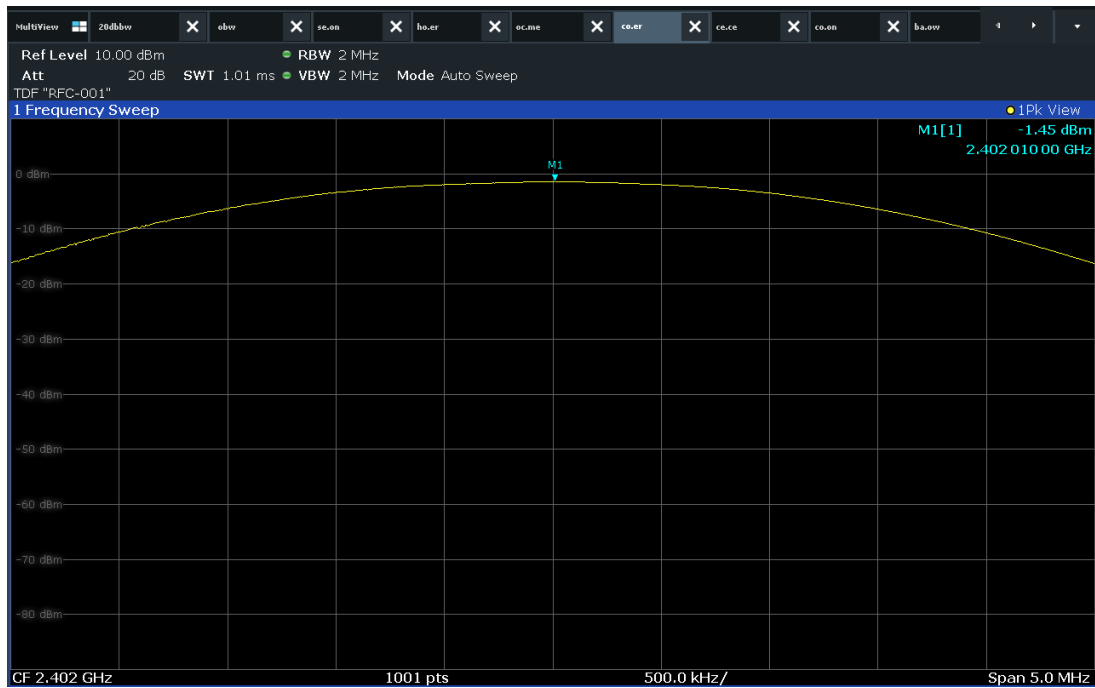
Test Result : Pass

8.3.1 Measured Results

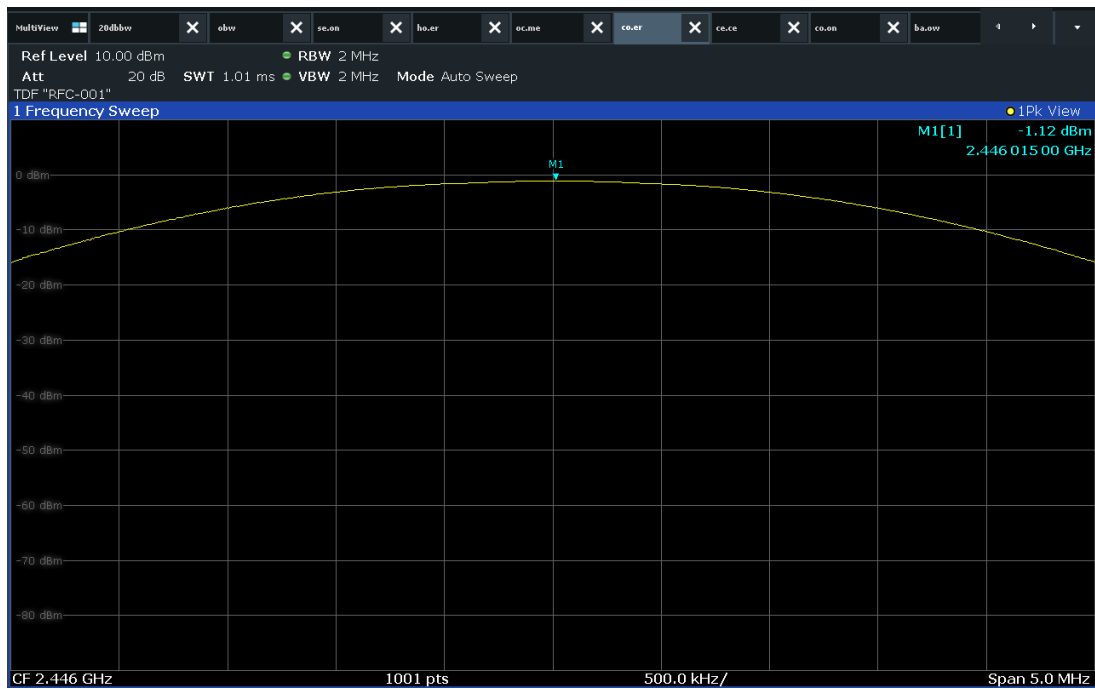
Modulation Type	Channel (Frequency)	Highest signal level (dBm)	Limit (dBm)
FHSS	2 402 MHz	-1.45	30 (1 Watt)
	2 446 MHz	-1.12	
	2 479 MHz	-1.35	



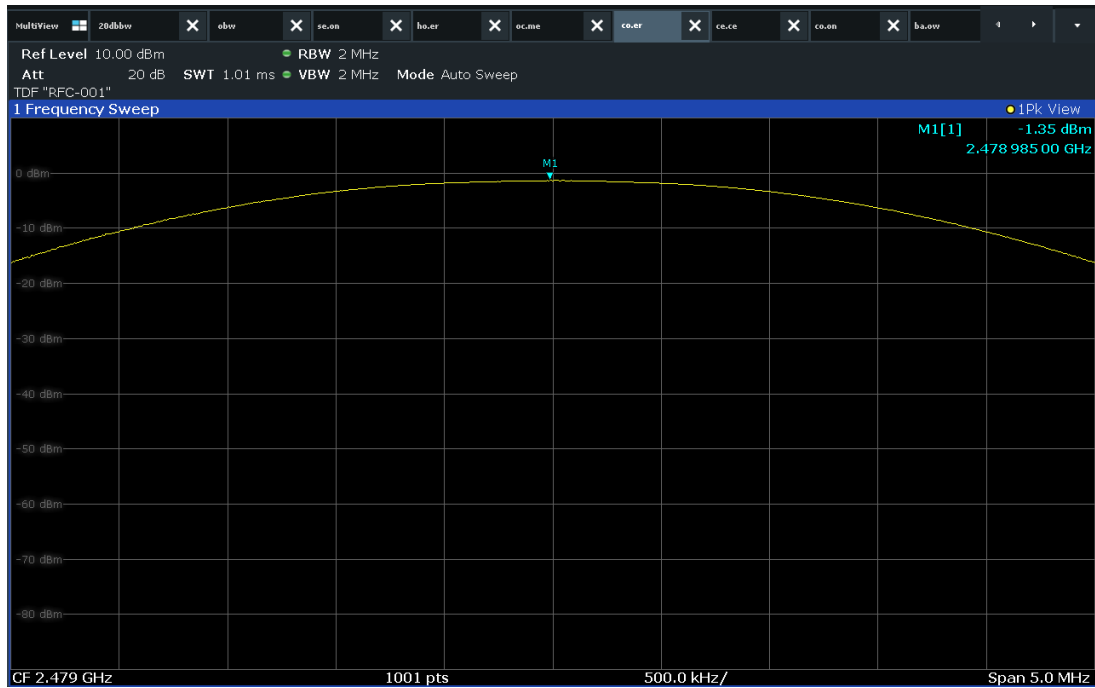
8.3.2 Measurement Graph



Low CH



Mid CH



High CH



9. Conducted Spurious Emission & Band edge (Non-Restricted band)

9.1 Measurement method

Standard : ANSI 63.10 (7.8.8) / ANSI 63.(10 6.10.4)

9.2 Limit

Standard : §15.247 (d)

9.3 Test data

Operating mode : Transmit mode

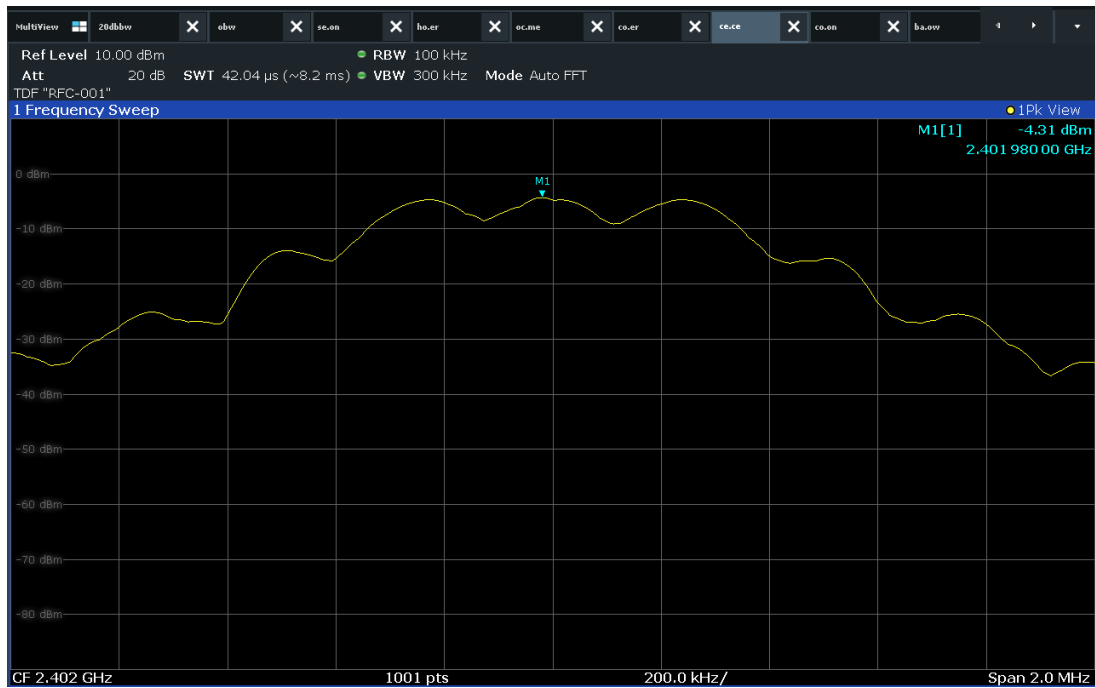
Test Result : Pass

9.3.1 Measured Results

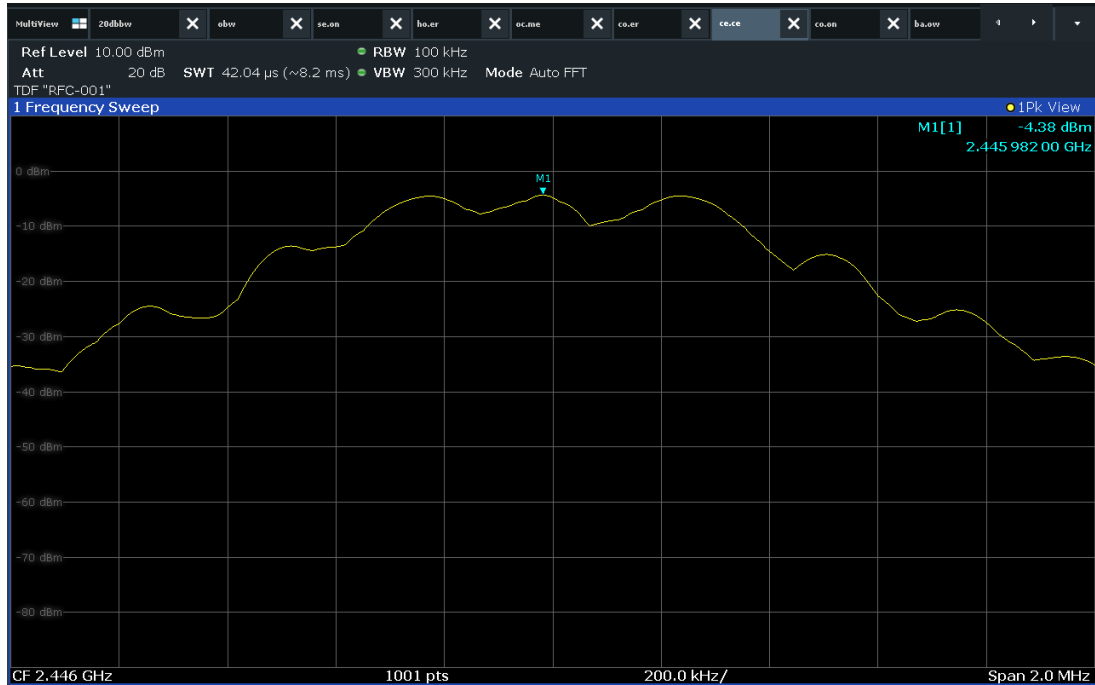
Modulation Type	Channel (Frequency)	Measurement band	Result
FHSS	2 402 MHz	Band Edge	Pass
		Band Edge (Hopping)	Pass
		30 MHz to 1 GHz	Pass
		1 GHz to 26 GHz	Pass
	2 446 MHz	30 MHz to 1 GHz	Pass
		1 GHz to 26.5 GHz	Pass
	2 479 MHz	Band Edge	Pass
		Band Edge (Hopping)	Pass
		30 MHz to 1 GHz	Pass
		1 GHz to 26.5 GHz	Pass



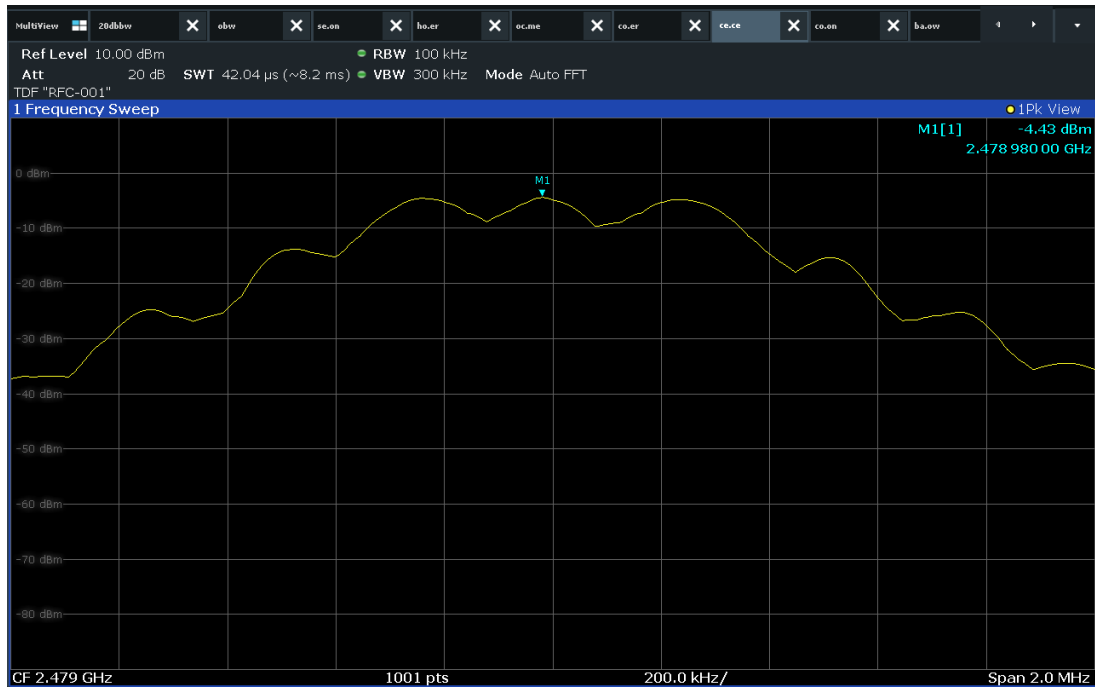
9.3.1.1 Signal level (dB m)



Low CH

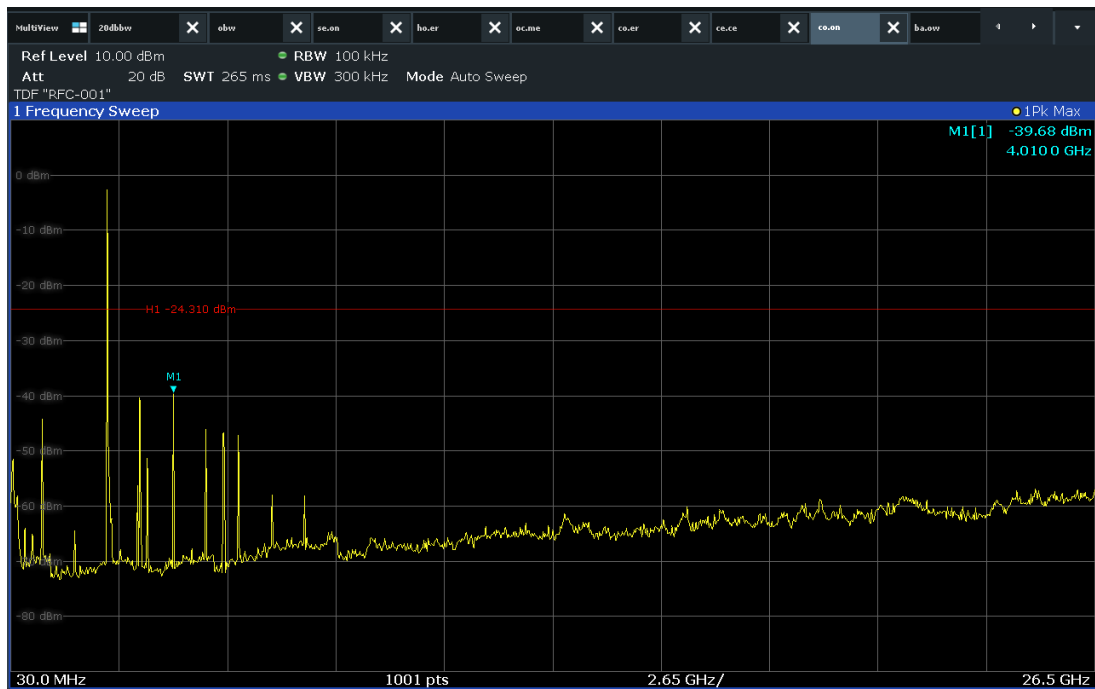


Mid CH

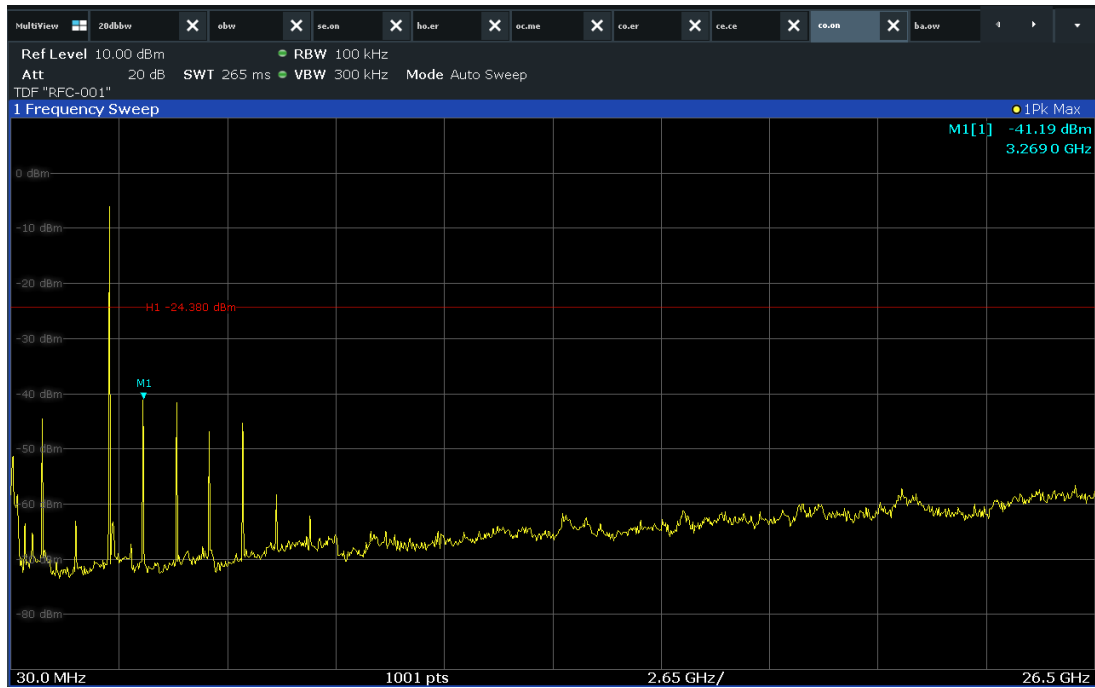


High CH

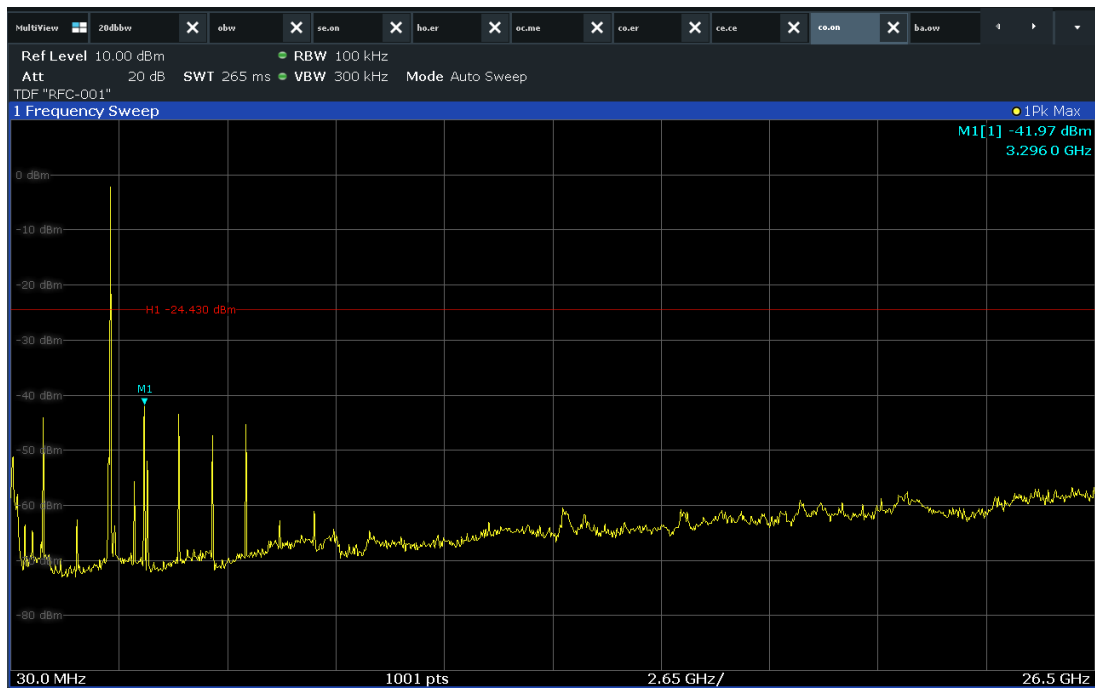
9.3.1.2 Unwanted Emissions In Non-Restricted Frequency Bands



Low CH

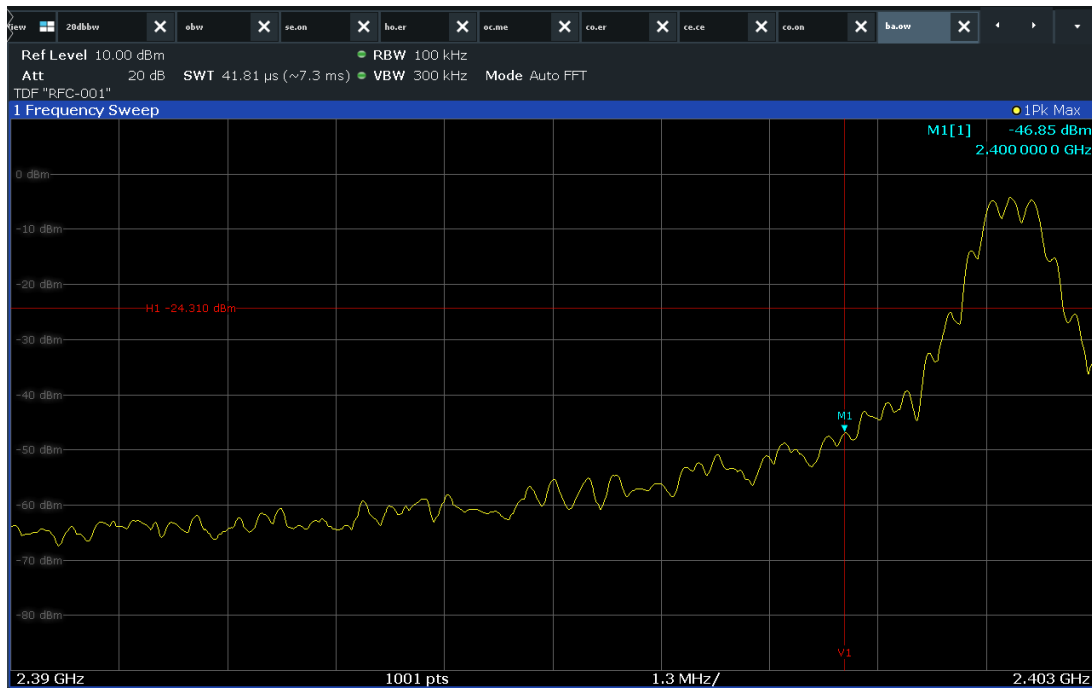


Mid CH

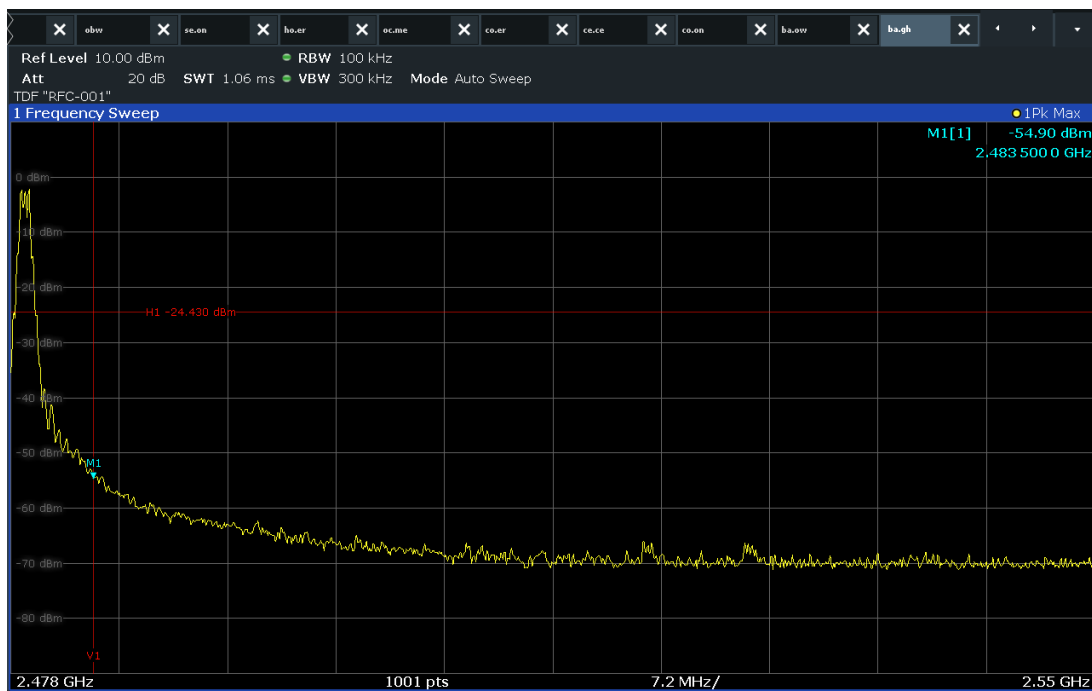


High CH

9.3.1.3 Band Edge (single channels)

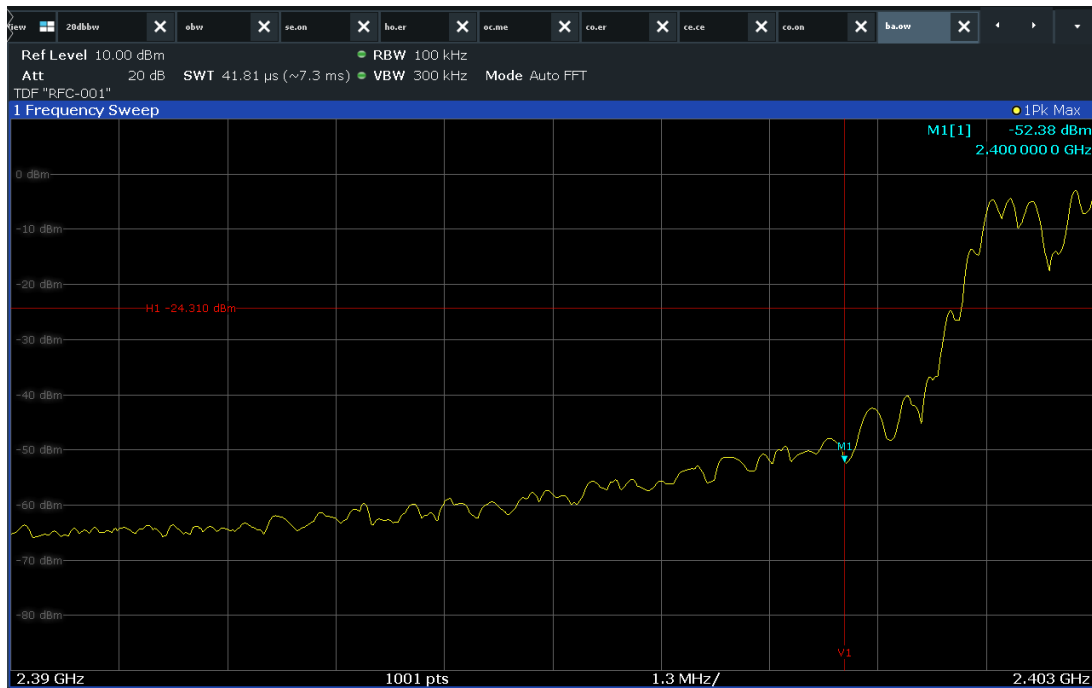


Low CH

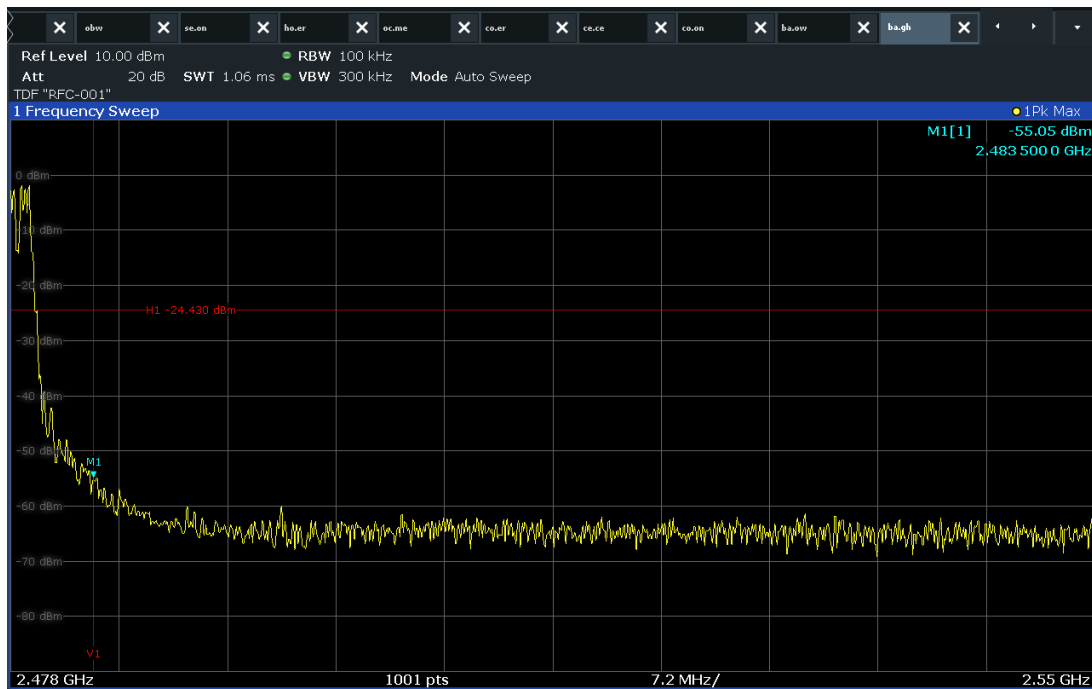


High CH

9.3.1.4 Band Edge (hopping)



Low CH



High CH

10. Radiated Spurious Emission

10.1 Measurement method

Standard : ANSI 63.10 (6.4/6.5/6.6)

10.2 Limit

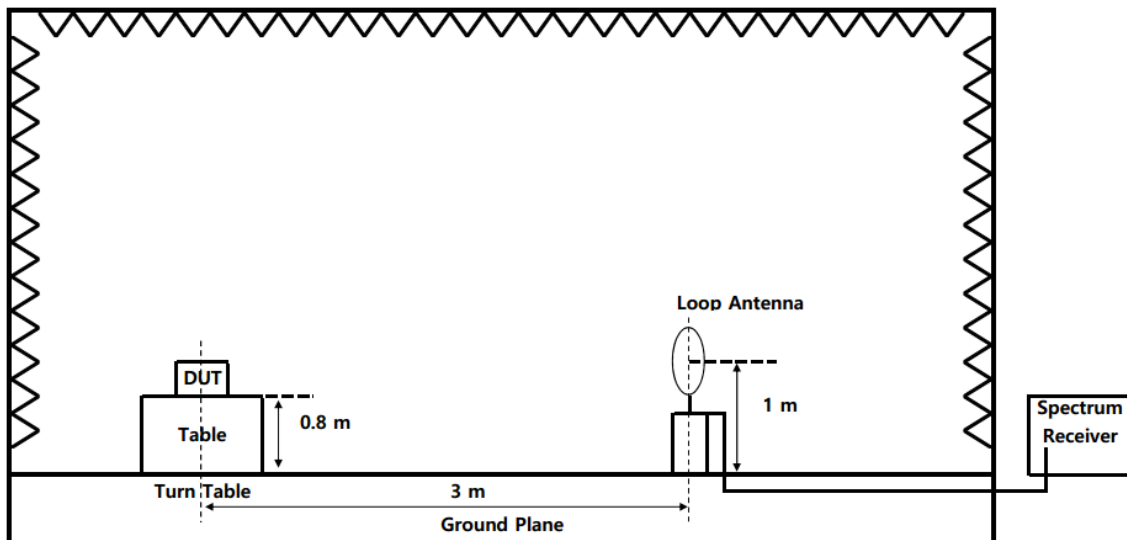
Standard : §15.205, §15.209

10.3 Test setup

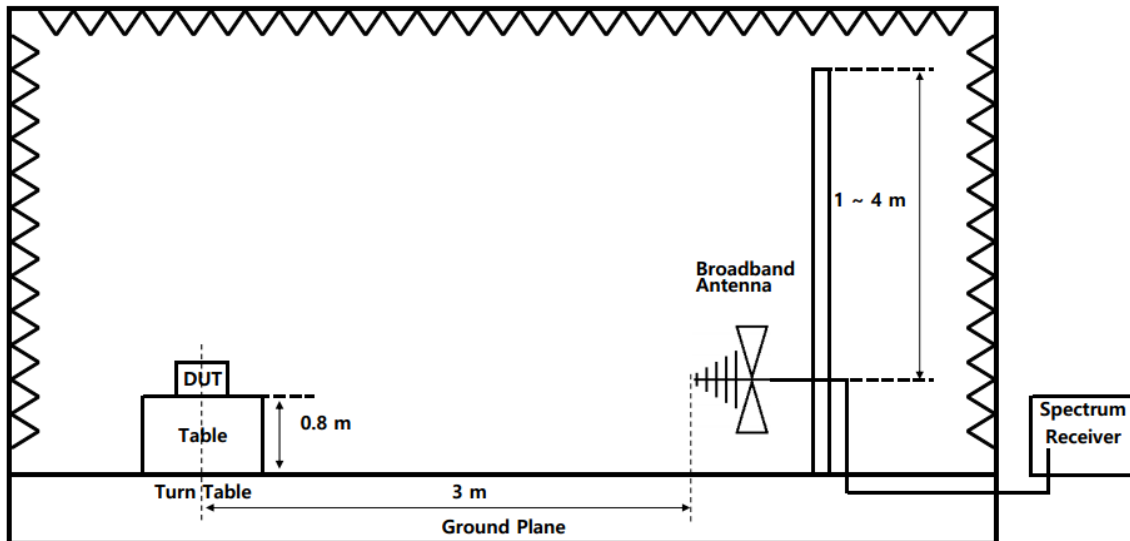
The radiated emissions measurements were performed on the 3 m, Semi-Anechoic Chamber. The EUT was placed on a non-conductive turntable above the ground plane.

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.

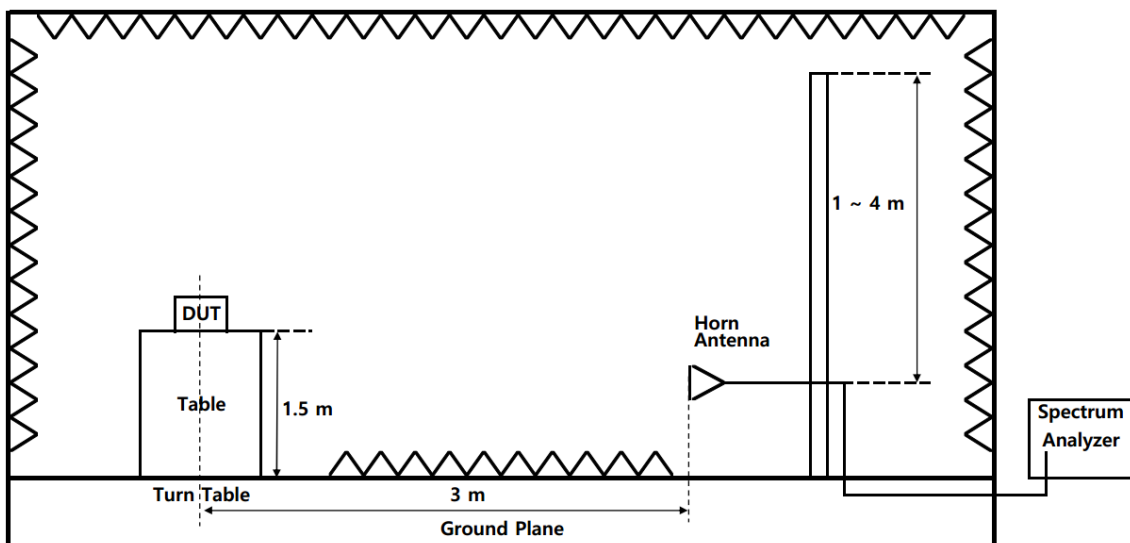
10.3.1 Below 30 MHz



10.3.2 30 MHz to 1 GHz



10.3.3 Above 1 GHz



**10.4 Test data**

Operating mode : Transmit mode

Test Result : Pass

10.4.1 Test data for Restricted band**10.4.1.1 Measure Results for FHSS**

Frequency	Reading	Detector	Ant. Pol.	Corr. Factor	Result	Limit	Margin
(MHz)	(dBμV)		(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
Low CH							
2 389.85	54.94	Peak	H	-10.10	44.84	73.98	29.14
	33.39	Average	H		23.29	53.98	30.69
High CH							
2 484.20	68.47	Peak	H	-9.70	58.77	73.98	15.21
	40.53	Average	H		30.83	53.98	23.15

※ Ant. Pol. : Antenna Polarization

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

※ Result = Reading + Corr. Factor

※ Margin = Limit – Result

10.4.2 Test data for Spurious & Harmonic**10.4.2.1 Measurement Results for FHSS****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

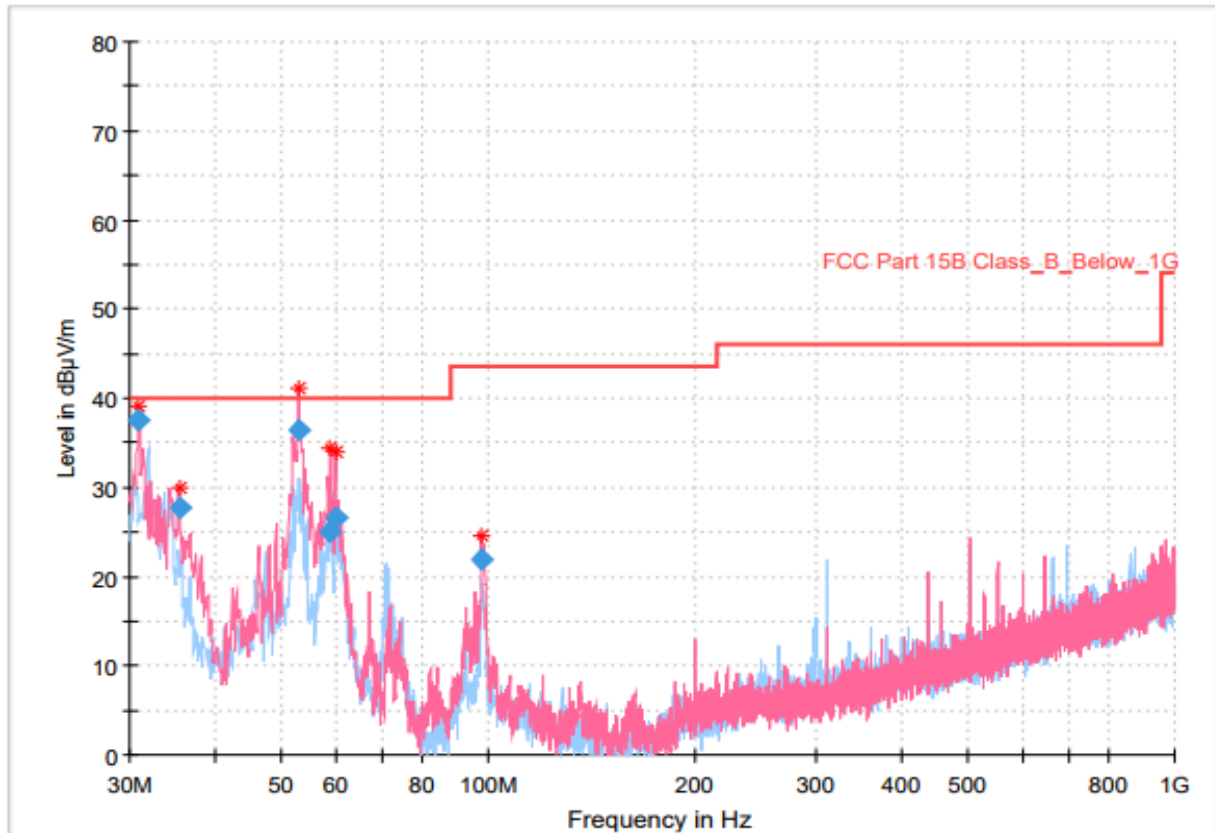
※ Corr. Factor. : Antenna Factor + Cable Loss - Amplifier Gain

※ Result = Reading + Corr. Factor

※ Margin = Limit – Result



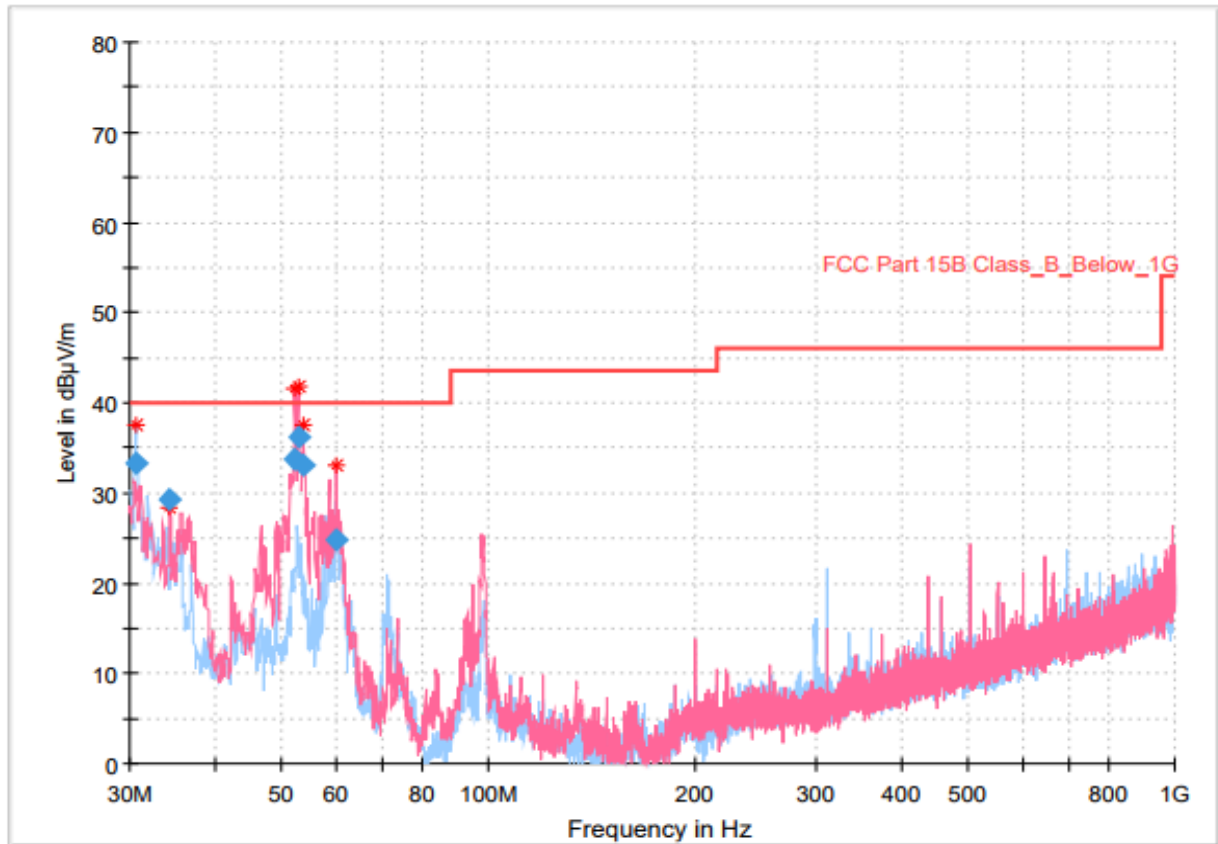
Measurement Results for below 1 GHz



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.970000	37.48	40.00	2.52	1000.0	120.000	99.8	V	109.0	-26.9
35.432000	27.69	40.00	12.31	1000.0	120.000	99.8	V	149.0	-26.0
52.892000	36.33	40.00	3.67	1000.0	120.000	99.8	V	233.0	-23.0
58.906000	24.93	40.00	15.07	1000.0	120.000	99.8	V	44.0	-24.0
59.973000	26.55	40.00	13.45	1000.0	120.000	99.8	V	44.0	-24.3
97.706000	21.98	43.50	21.52	1000.0	120.000	99.8	V	301.0	-25.0

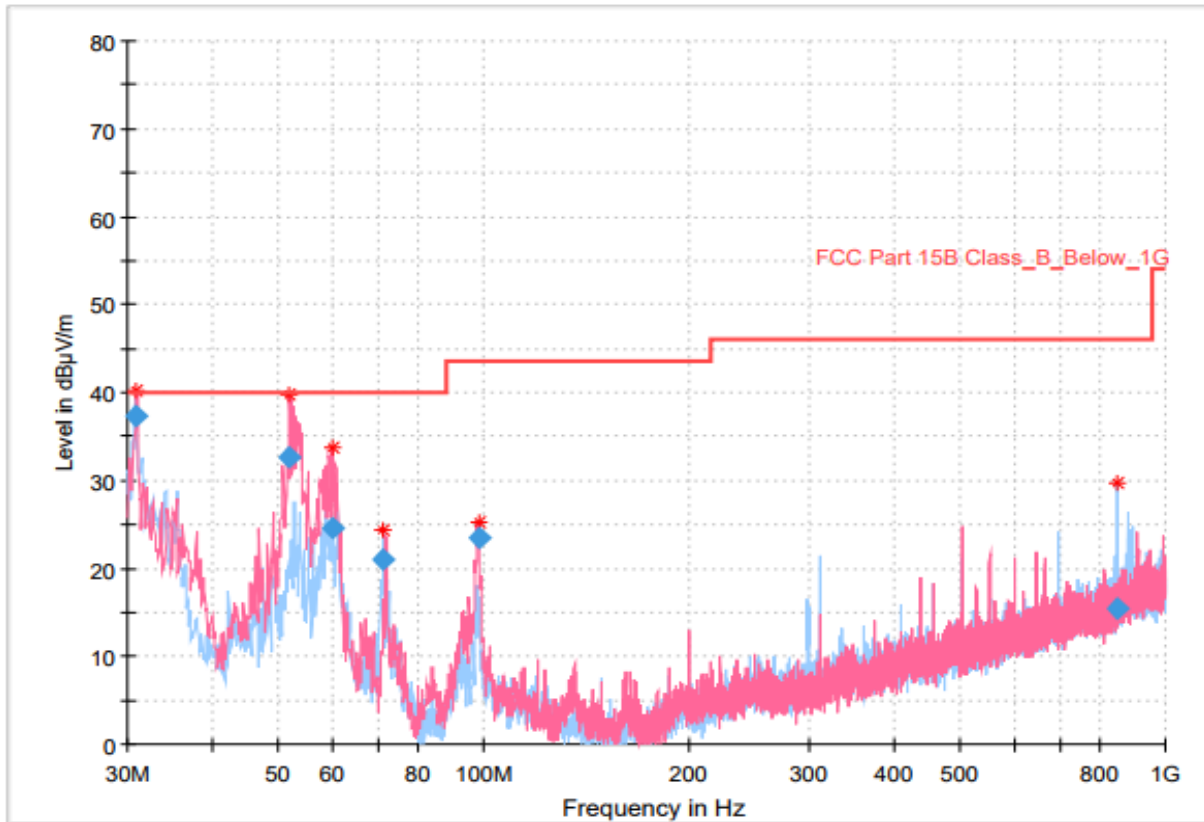
Low CH



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.679000	33.22	40.00	6.78	1000.0	120.000	99.8	H	45.0	-26.8
34.365000	29.23	40.00	10.77	1000.0	120.000	99.8	V	316.0	-26.4
52.116000	33.67	40.00	6.33	1000.0	120.000	99.8	V	35.0	-23.1
52.795000	36.12	40.00	3.88	1000.0	120.000	99.8	V	316.0	-23.0
53.765000	33.07	40.00	6.93	1000.0	120.000	99.8	V	35.0	-23.2
60.167000	24.81	40.00	15.19	1000.0	120.000	99.8	V	316.0	-24.3

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)
30.970000	37.30	40.00	2.70	1000.0	120.000	99.8	V	161.0	-26.9
51.922000	32.57	40.00	7.43	1000.0	120.000	99.8	V	0.0	-23.1
60.167000	24.66	40.00	15.34	1000.0	120.000	99.8	V	0.0	-24.3
71.322000	20.91	40.00	19.09	1000.0	120.000	99.8	H	145.0	-27.8
98.288000	23.57	43.50	19.93	1000.0	120.000	99.8	V	188.0	-24.9
848.195000	15.40	46.00	30.60	1000.0	120.000	99.8	H	351.0	-10.7

High CH



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							
3 201.50	44.74	Peak	V	-4.90	39.84	73.98	34.14
	30.28	Average	V		25.38	53.98	28.60
4 804.60	46.0	Peak	H	-1.00	45.07	73.98	28.91
	31.43	Average	H		30.43	53.98	23.55
7 205.00	55.47	Peak	V	3.30	58.77	73.98	15.21
	37.21	Average	V		40.51	53.98	13.47
Mid CH							
3 261.00	49.31	Peak	V	-4.70	44.61	73.98	29.37
	36.33	Average	V		31.63	53.98	22.35
4 891.30	45.54	Peak	H	-1.00	44.54	73.98	29.44
	30.45	Average	H		29.45	53.98	24.53
7 339.30	49.48	Peak	H	3.00	52.48	73.98	21.50
	32.72	Average	H		35.72	53.98	18.26
High CH							
4 957.60	56.19	Peak	V	-1.00	55.19	73.98	18.79
	37.32	Average	V		36.32	53.98	17.66
7 436.20	55.75	Peak	H	2.80	58.55	73.98	15.43
	39.03	Average	H		41.83	53.98	12.15

※ Ant. Pol. : Antenna Polarization

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

※ Result = Reading + Corr. Factor

※ Margin = Limit – Result



11. Power Line Conducted Emission

11.1 Operating environment

Temperature : 24 °C

Relative humidity : 48 %

11.2 Measurement method

Standard : §15.207

11.3 Limit

Standard : §15.207

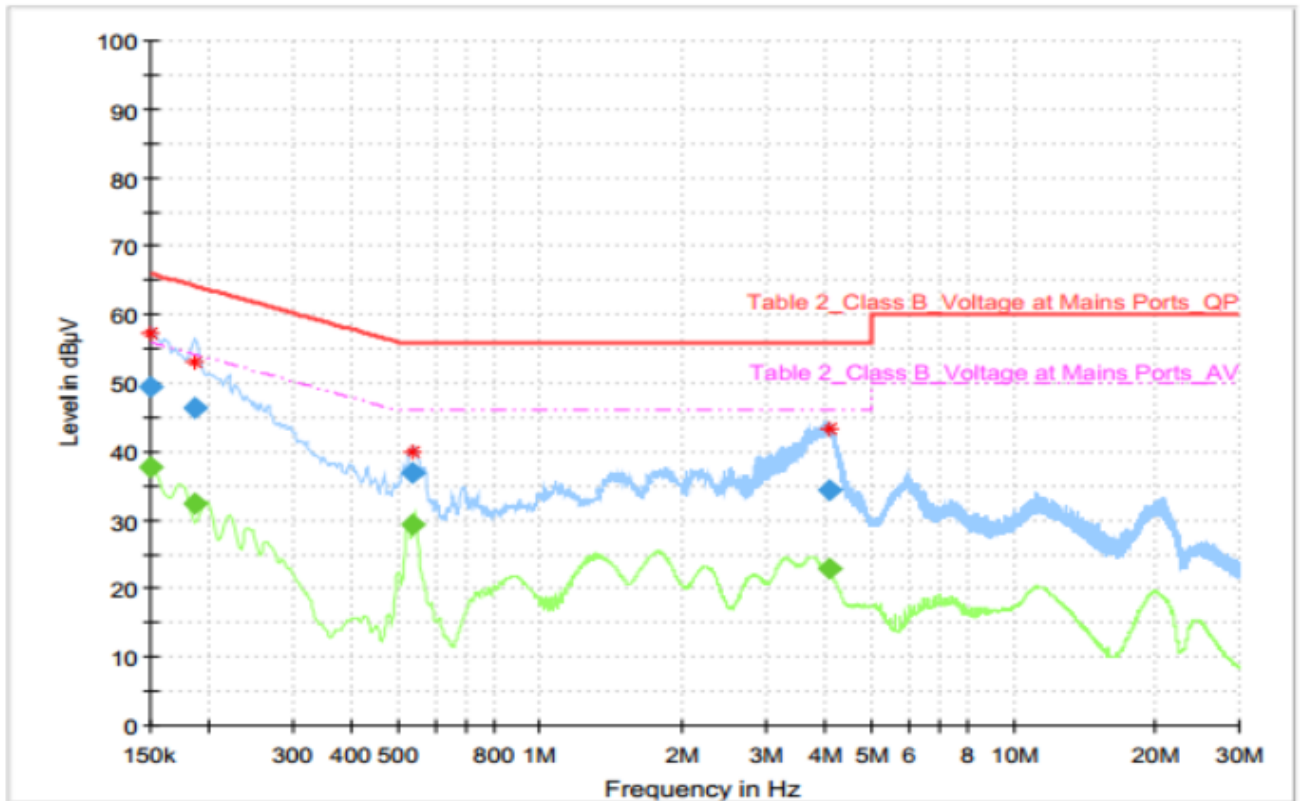
11.4 Test data

Operating mode : Transmit mode

Test Result : Pass

11.4.1 Measured Results & Graph

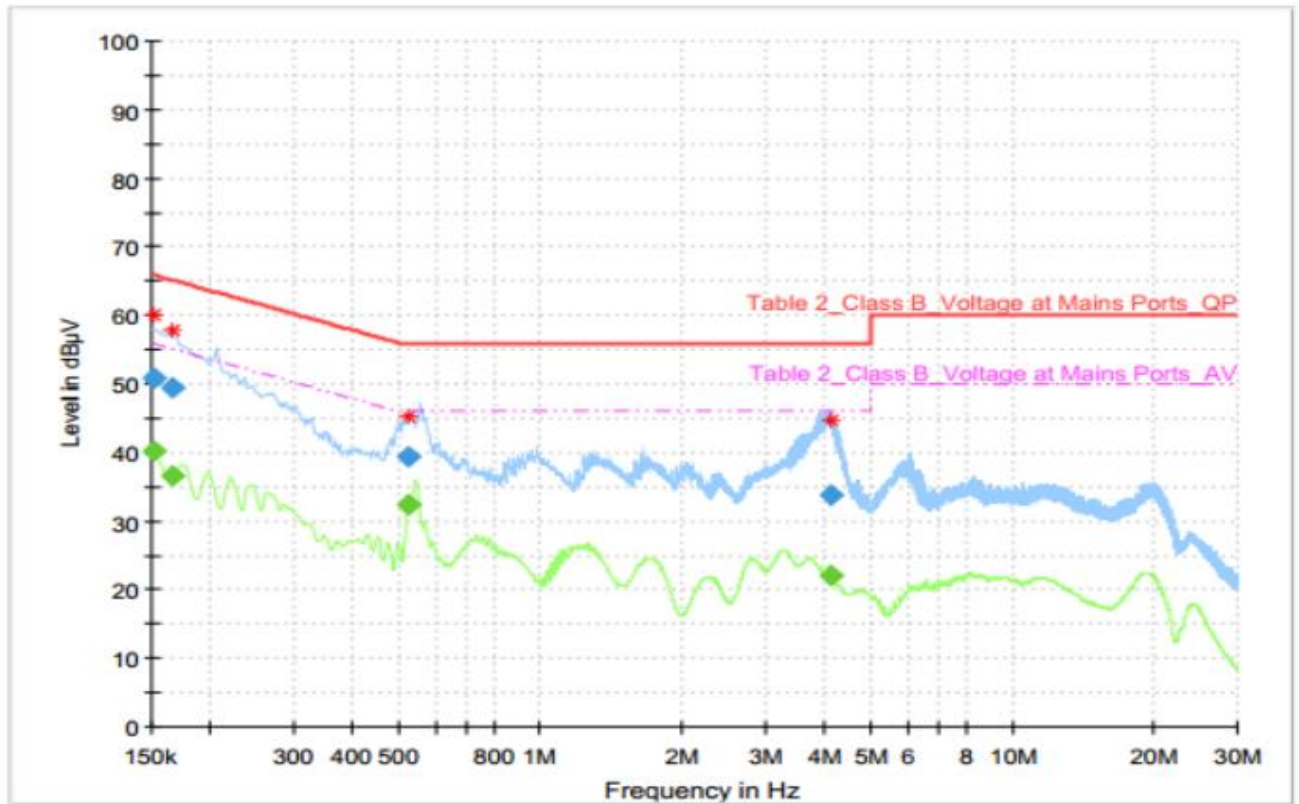
Live line



Final Result

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.150000	---	37.69	56.00	18.31	5000.0	9.000	L1	9.7
0.150000	49.34	---	66.00	16.66	5000.0	9.000	L1	9.7
0.186000	---	32.35	54.21	21.86	5000.0	9.000	L1	9.9
0.186000	46.34	---	64.21	17.88	5000.0	9.000	L1	9.9
0.537000	---	29.35	46.00	16.65	5000.0	9.000	L1	9.9
0.537000	36.93	---	56.00	19.07	5000.0	9.000	L1	9.9
4.069500	---	22.98	46.00	23.02	5000.0	9.000	L1	9.7
4.069500	34.43	---	56.00	21.57	5000.0	9.000	L1	9.7

Neutral line



Final Result

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.152250	---	40.17	55.88	15.71	5000.0	9.000	N	9.8
0.152250	50.82	---	65.88	15.06	5000.0	9.000	N	9.8
0.165750	---	36.61	55.17	18.56	5000.0	9.000	N	9.9
0.165750	49.41	---	65.17	15.76	5000.0	9.000	N	9.9
0.525750	---	32.42	46.00	13.58	5000.0	9.000	N	9.9
0.525750	39.51	---	56.00	16.49	5000.0	9.000	N	9.9
4.114500	---	22.03	46.00	23.97	5000.0	9.000	N	9.7
4.114500	33.91	---	56.00	22.09	5000.0	9.000	N	9.7



12. 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 (1Y)
☒	Horn Antenna	HF907	Rohde & Schwarz	102556	2023-08-22 (2M)
☒	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