시 험 성 적 서
TEST REPORT

성적서 번호 Report No.		ICRT-TR-E190539-0A
신청자 Client	기관명 Name	Sena Technologies,Inc.
	주 소 Address	FCC: 19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, South Korea IC: 210 Yangjae-dong, Seocho-gu Seoul 137-130 South Korea
시험대상품목 Sample description		ARK
모델명 Type designation		SP66
정 격 Ratings		DC 3.7 V
시험기간 Date of test		Mar. 22, 2019 ~ Mar. 26, 2019
시험방법/항목 Test Method/Item		FCC Part 15 Subpart C §15.247 / IC RSS-247
시험결과 Test Results		Refer to 3. Test Summary
확 인 Affirmation	작성자 Tested by 성 명 Name: Hong-Kyu, Lee (Signature)	기술책임자 Technical Manager 성 명 Name: Jun-Hui, Lee (Signature)

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This is certified that the above mentioned products have been tested for the sample provided by customer and forbid the use except for original purpose.

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2019. 04. 03

주식회사 아이씨알 대표이사

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경기도 김포시 양촌읍 황금3로7번길 112
112, Hwanggeum3-ro 7beon-gil, Yangchon-eup, Gimpo-si, Gyeonggi-do, Korea

Contents

Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
ICRT-TR-E190539-0A	03-Apr-2019	Initial Issue	All

1. Applicant & Manufacturer & Test Laboratory Information

1.1 Applicant information

Applicant	Sena Technologies,Inc.	
Address	FCC	19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, South Korea
	IC	210 Yangjae-dong, Seocho-gu Seoul 137-130 South Korea
Contact Person	Seunghyun Kim	
Telephone No.	+82-2-571-8283	
Fax No.	+82-2-573-7710	
E-mail	shkim77@sena.com	

1.2 Manufacturer Information

Manufacturer	Sena Technologies,Inc.	
Address	FCC	19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, South Korea
	IC	210 Yangjae-dong, Seocho-gu Seoul 137-130 South 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	ARK
Brand Name	-
Model Name	SP66
Additional Model Name	-
FCC ID / ISED number	S7A-SP66 / 8154A-SP66
Hardware Version	-
Software Version	-
Power Supply	DC 3.7 V

2.2 Additional Information

Equipment Class	DTS-Digital Transmission System
Device Type	Stand-alone
Operating Frequency	2 402 ㎒ ~ 2 480 ㎒
RF Output Power	10.32 ㏈m
Number of Channel	40
Modulation Type	GFSK
Antenna Type	PCB Pattern Antenna
Antenna Gain	0.55 ㏈i
Antenna Operating Mode	Single Antenna Equipment with only one antenna
List of Each Oscillator or Crystal Frequency	26 ㎒

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 & RSS-247 Issue 2 & RSS-GEN Issue 5				
Clause		Test items	Applied	Results
§15.247 (a) (2)	RSS-247 5.2(a) RSS-GEN 6.7	6 dB Bandwidth & 99 % Bandwidth	☒	PASS
§15.247 (b) (3)	RSS-247 5.4(d)	Maximum Conducted Output Power & e.i.r.p.	☒	PASS
§15.247 (e)	RSS-247 5.2(b)	Power Spectral Density	☒	PASS
§15.247 (d)	RSS-247 5.5	Conducted Spurious Emission	☒	PASS
§15.247 (d) §15.209 §15.205	RSS-247 5.5 RSS-GEN 8.9 RSS-GEN 8.10	Radiated Spurious Emission	☒	PASS
§15.207	RSS-GEN 8.8	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 and IC RSS-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 powerline conducted emission test

The EUT was connected to LISN. All supporting equipments 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 Pattern Antenna.*** The directional gain of the antenna is ***0.55 dBi.***

4. Used equipment on test

	Description	Model Name	Serial Number	Manufacturer	Last Cal. (cycle)
☐	Spectrum analyzer	FSW85	100864	Rohde & Schwarz	2019. 03. 04 (1Y)
☒	Spectrum analyzer	FSV40	101455	Rohde & Schwarz	2018 .07. 10 (1Y)
☒	Signal Generator	SMB100A	180607	Rohde & Schwarz	2019. 03. 04 (1Y)
☐	Wideband Power Sensor	NRP-Z81	103673	Rohde & Schwarz	2019. 03. 05 (1Y)
☐	Open Switch and Control Platform	OSP150	101000	Rohde & Schwarz	2019. 03. 05 (1Y)
☐	Environmental Test Chamber	MHK-408NKDA	1060908	TERCHY	2019. 03. 04 (1Y)
☒	DC Power Supply	XDL 35-5P	J00385373	Sorensen	2019. 03. 05 (1Y)
☐	DC Power Supply	6603D	672483	Topward	2019. 03. 05 (1Y)
☒	Loop Antenna	HFH2-Z2	100506	Rohde & Schwarz	2017. 06. 19 (2Y)
☒	TRILOG BROADBAND ANTENNA	VULB9162	120	SCHWARZBECK	2018. 11. 23 (2Y)
☒	RF Pre Amplifier	SCU08	100747	Rohde & Schwarz	2018. 04. 17 (1Y)
☒	DOUBLE-RIDGE WAVEGUIDE HORN ANTENNA	HF907	102556	Rohde & Schwarz	2017. 07. 05 (2Y)
☒	RF Pre Amplifier	SCU18	102342	Rohde & Schwarz	2018. 04. 17 (1Y)
☒	Horn Antenna	LB-42-10-C-KF	J202024625	AINFO Inc.	2018. 04. 20 (2Y)
☒	RF Pre Amplifier	AMF-4F-18265-35-8P-1	771846	MITEQ	2019. 03. 04 (1Y)
☐	Horn Antenna	LB-28-10-C-KF	J202024627	AINFO Inc.	2018. 04. 20 (2Y)
☐	RF Pre Amplifier	AMF-4D-260400-45-6P	779919	MITEQ	2019. 03. 04 (1Y)
☒	EMI Test Receiver	ESR26	101461	Rohde & Schwarz	2018. 04. 17 (1Y)
☒	EMI Test Receiver	ESR3	102119	Rohde & Schwarz	2018. 04. 17 (1Y)
☒	LISN	ENV216	102194	Rohde & Schwarz	2018. 04. 16 (1Y)
☒	RF Cable	MULTIFLEX_86	-	HUBER & SUHNER	-
☒	Chamber Cable	mwx221	-	Junkosha	-

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

5. 6 dB Bandwidth & 99 % Bandwidth

5.1 Operating environment

Temperature : 24 ℃

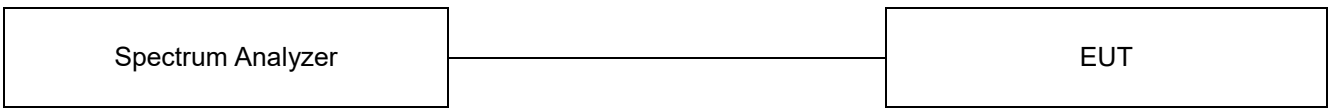
Relative humidity : 45 %

5.2 Measurement method

Standard : §15.247 (a) (2) / RSS-247 (5.2 a) & RSS-Gen (6.7)

5.3 Test setup

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 ㎑, 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

Test date : 22. Mar. 2019

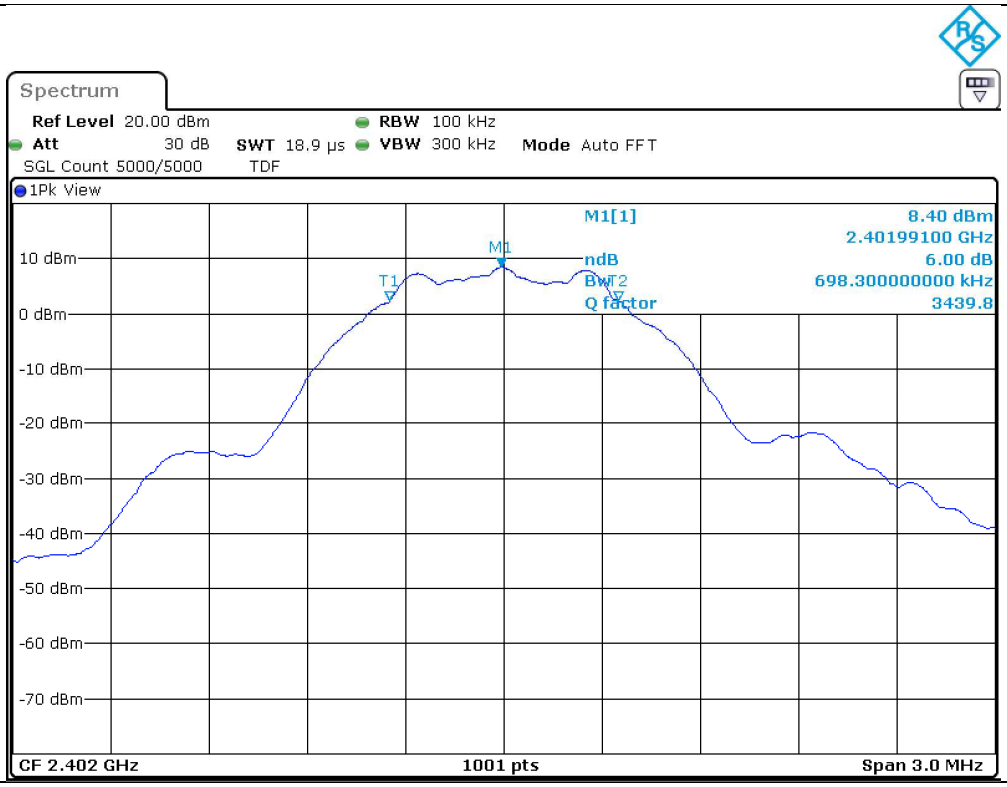
Operating mode : Transmit mode

Test Result : Pass

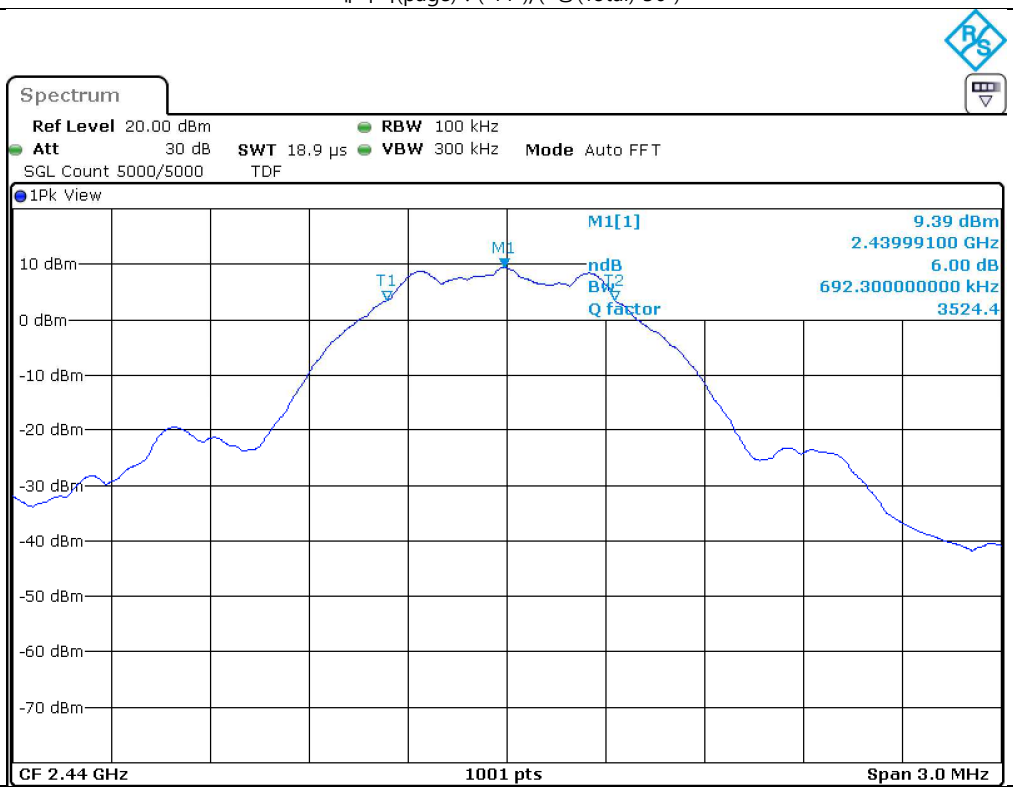
5.4.1 Measured Results

Modulation Type	Channel (Frequency)	6 dB Bandwidth (kHz)	99 % Occupied Bandwidth (kHz)	Limit (kHz)
Bluetooth LE	0 (2 402 MHz)	698.3	1 046.3	at least 500
	19 (2 440 MHz)	692.3	1 042.0	
	39 (2 480 MHz)	698.3	1 037.6	

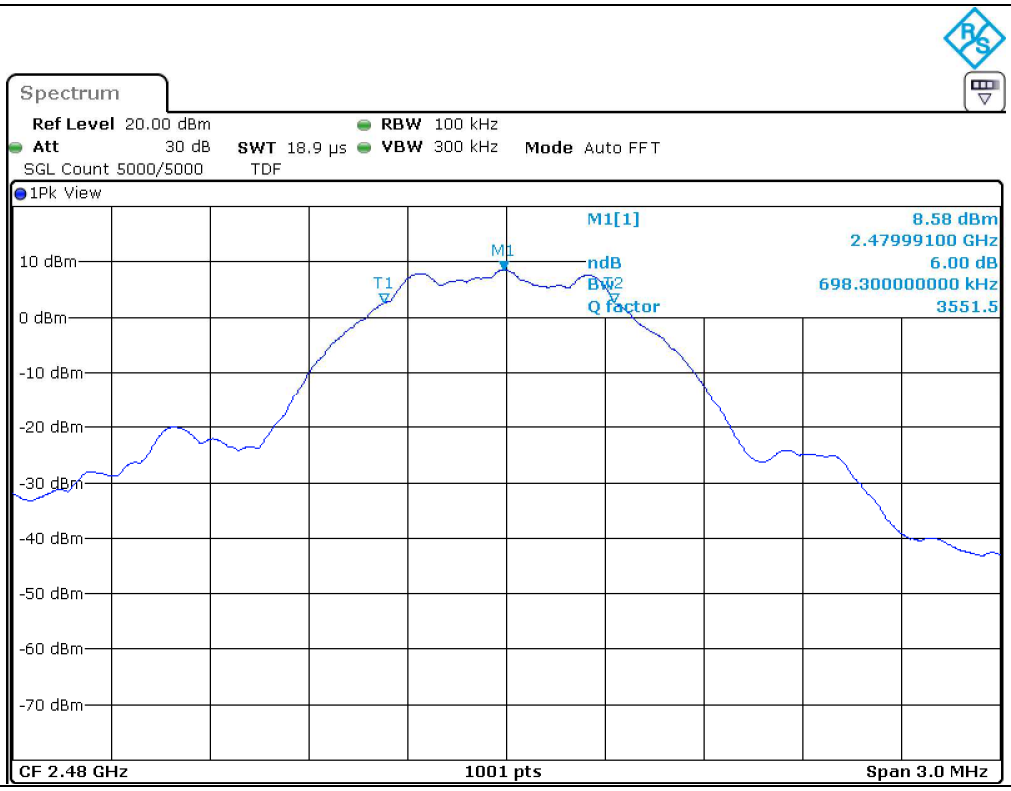
5.4.2 Measured Graph (6 dB Bandwidth)



Low CH

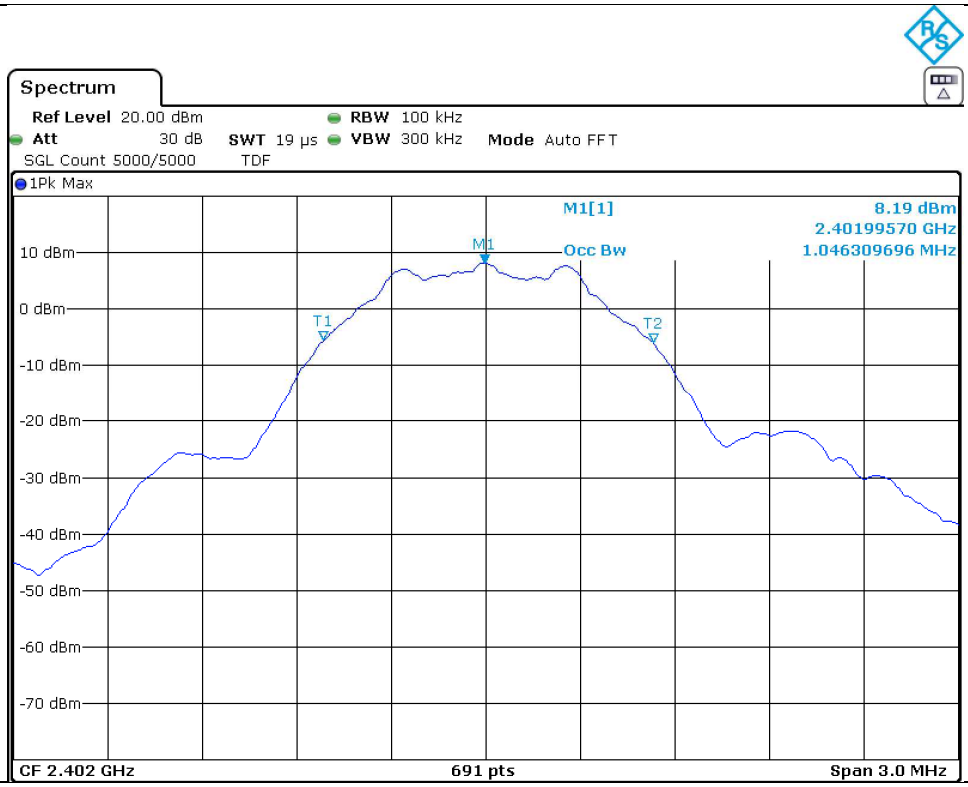


Mid CH



High CH

5.4.3 Measured Graph (99 % Bandwidth)



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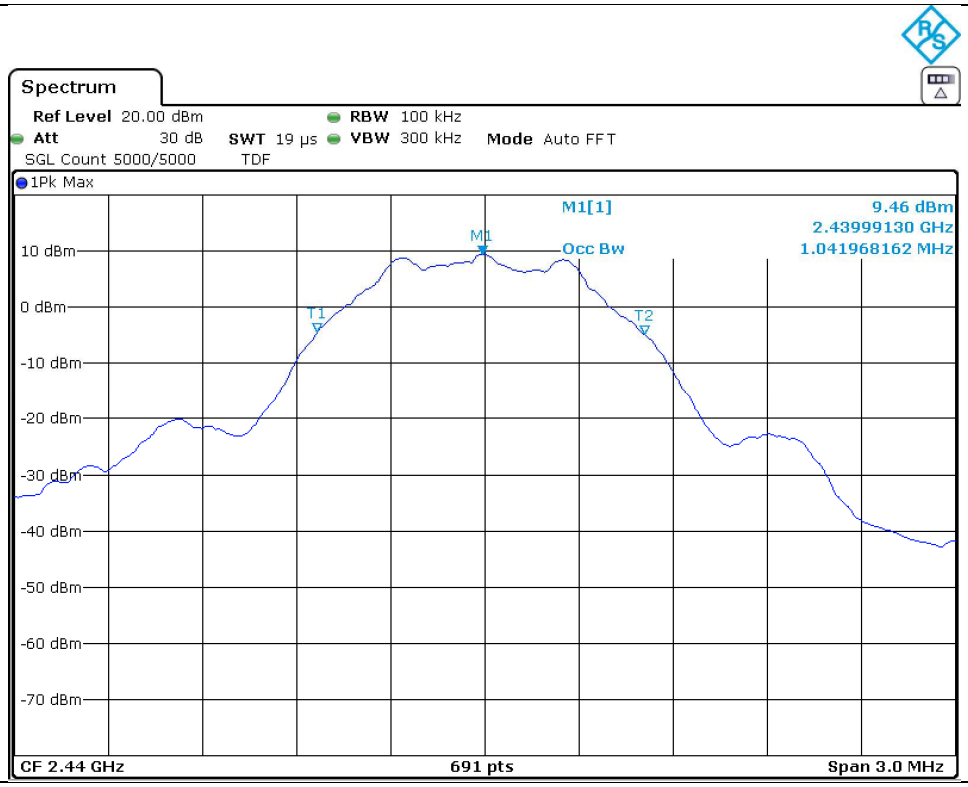
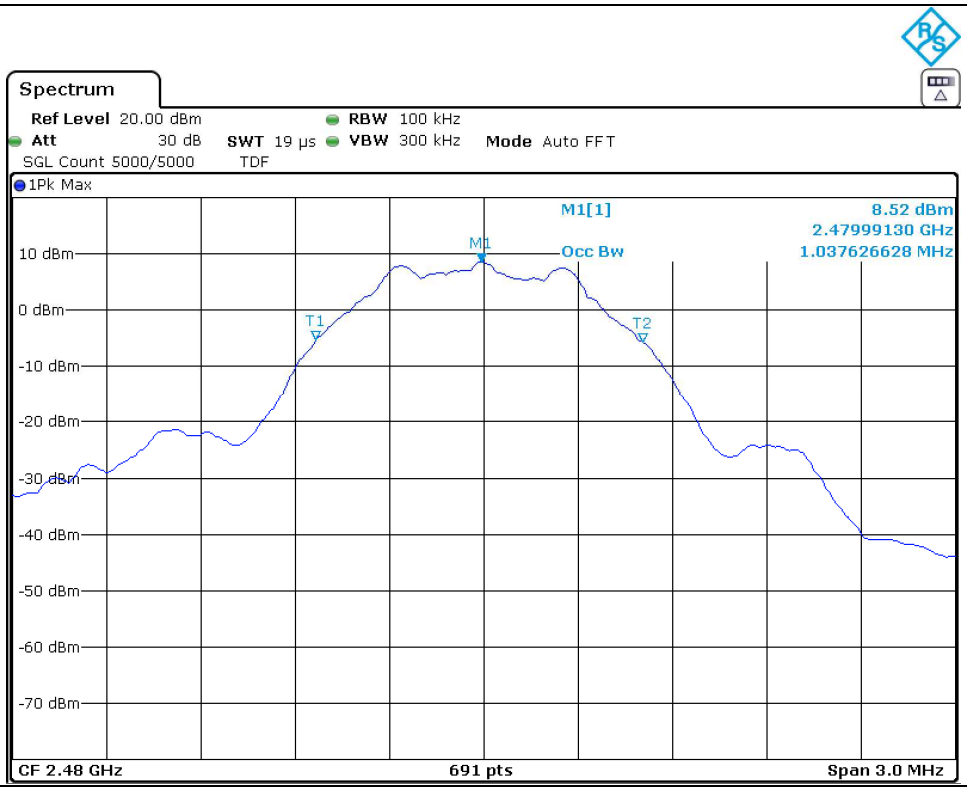


Mid CH



High CH

6. Maximum Conducted Output Power & e.i.r.p.

6.1 Operating environment

Temperature : 24 ℃

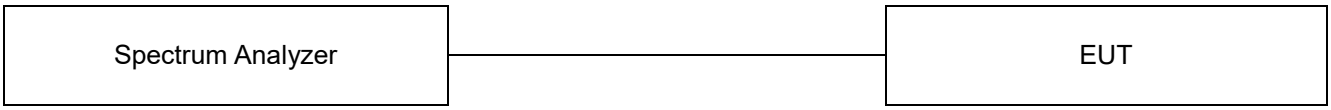
Relative humidity : 45 %

6.2 Measurement method

Standard : §15.247 (b) (3) / RSS-247 (5.4 d)

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

Test date : 22. Mar. 2019

Operating mode : Transmit mode

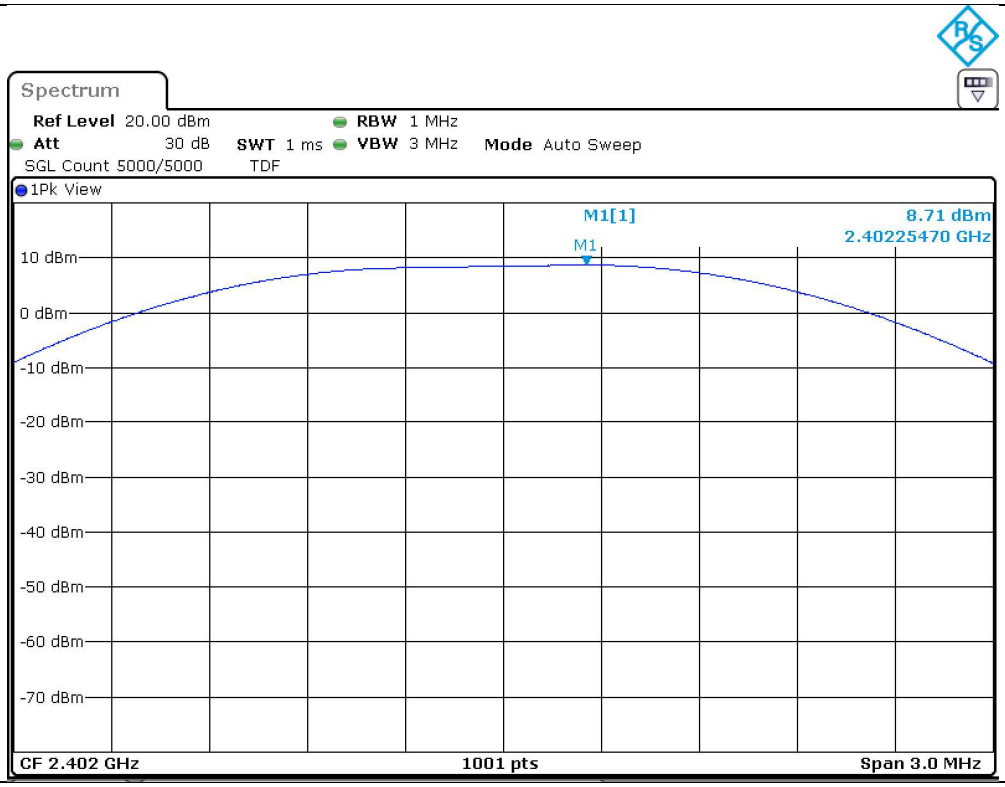
Test Result : Pass

6.4.1 Measured Results

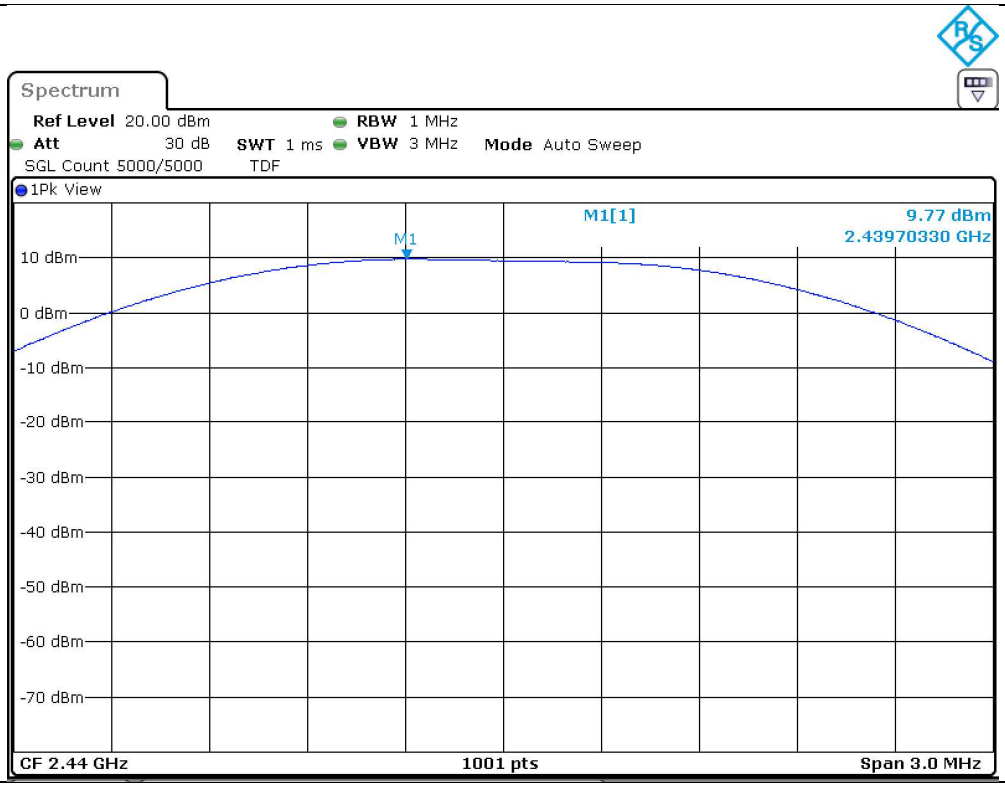
Modulation Type	Channel (Frequency)	Maximum Conducted Output Power		e.i.r.p.	
		Measured value (dBm)	Limit	Measured value (dBm)	Limit
Bluetooth LE	0 (2 402 ㎒)	8.71	30 dBm (1 Watt)	9.26	36 dBm (4 Watt)
	19 (2 440 ㎒)	***9.77***		***10.32***	
	39 (2 480 ㎒)	8.97		9.52	

※ Antenna Gain : 0.55 dBi

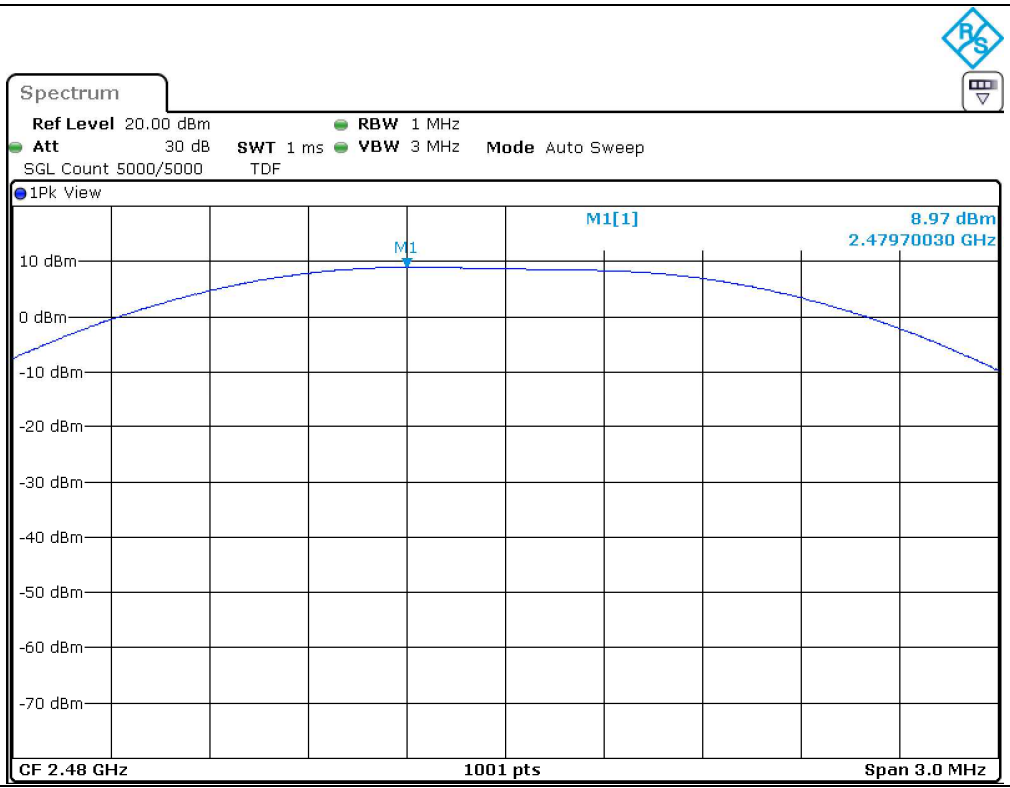
6.4.2 Measured Graph



Low CH



Mid CH



High CH

7. Power Spectral Density

7.1 Operating environment

Temperature : 24 ℃

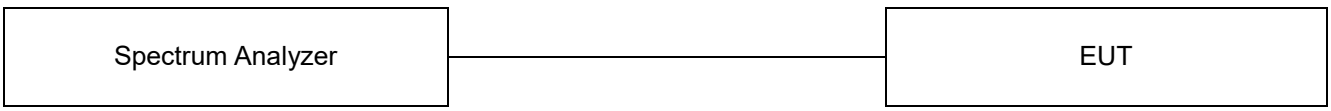
Relative humidity : 45 %

7.2 Measurement method

Standard : §15.247 (e) / RSS-247 (5.2 b)

7.3 Test setup

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



7.4 Test data

Test date : 22. Mar. 2019

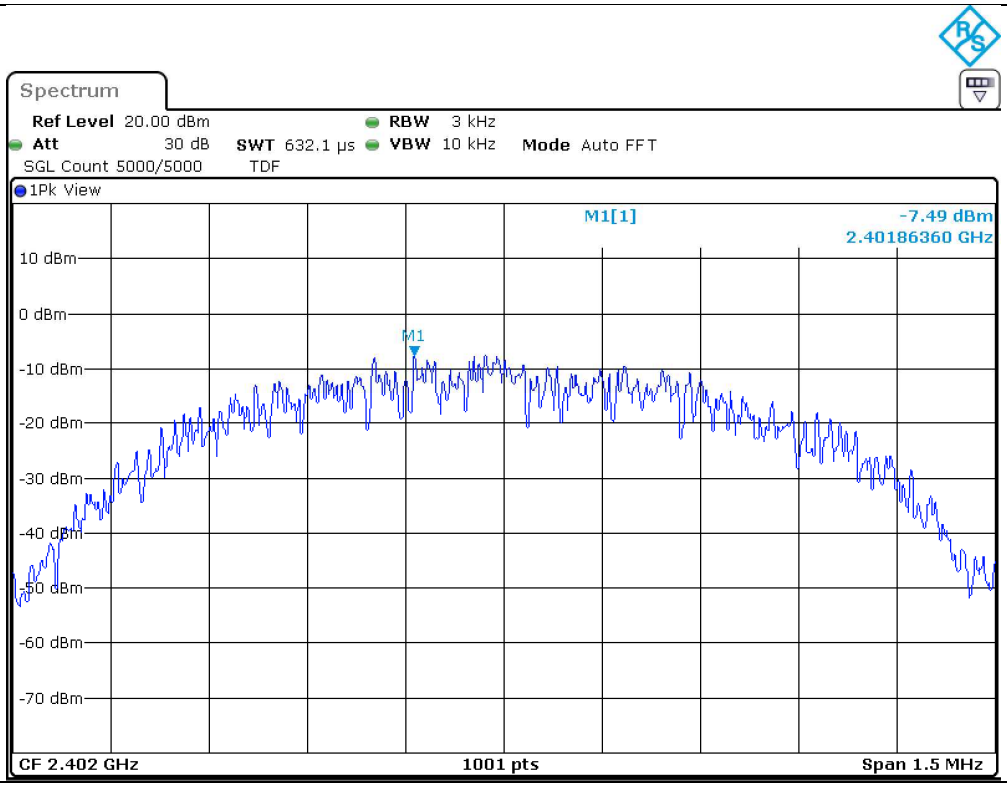
Operating mode : Transmit mode

Test Result : Pass

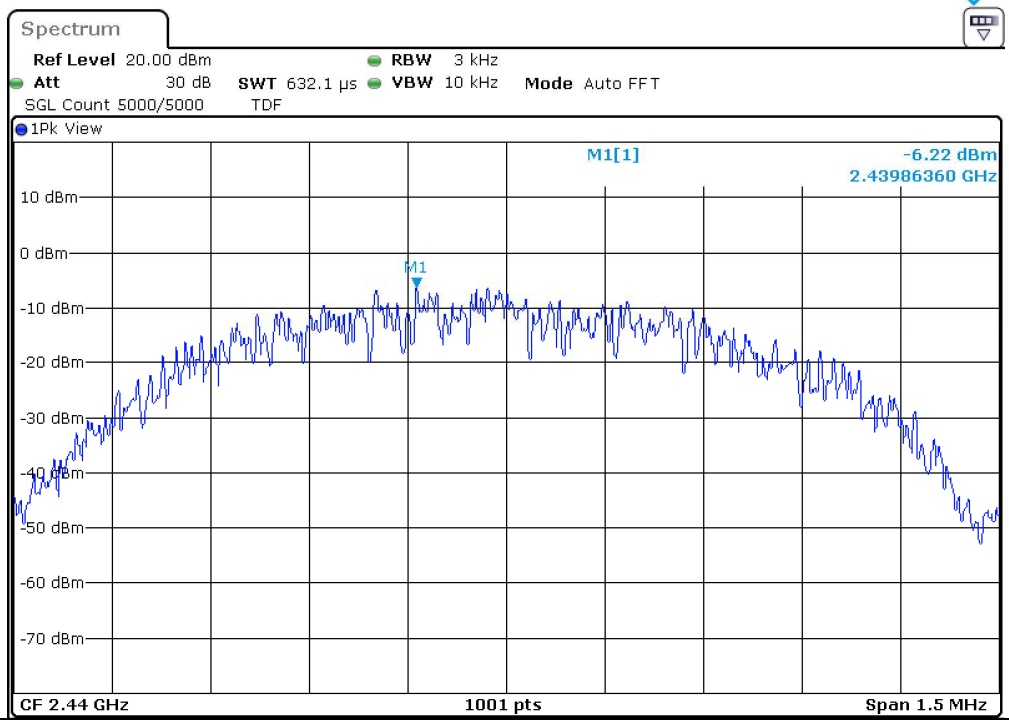
7.4.1 Measured Results

Modulation Type	Channel (Frequency)	Highest signal level (dBm)	Limit (dBm/3㎑)
Bluetooth LE	0 (2 402 ㎒)	-7.49	8
	19 (2 440 ㎒)	-6.22	
	39 (2 480 ㎒)	-7.03	

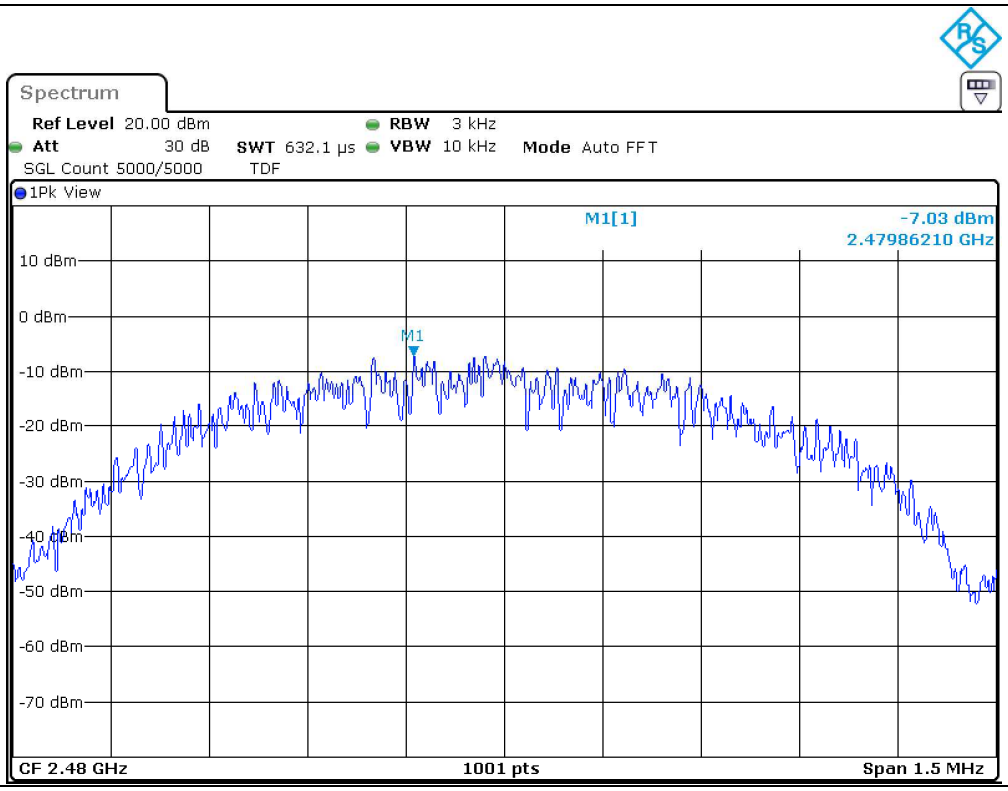
7.4.2 Measured Graph



Low CH



Mid CH



High CH

8. Conducted Spurious Emission

8.1 Operating environment

Temperature : 24 ℃

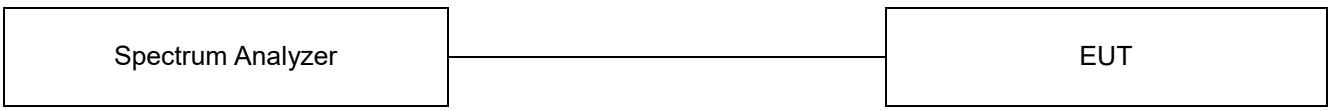
Relative humidity : 45 %

8.2 Measurement method

Standard : §15.247 (d) / RSS-247 (5.5)

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 ㎑, and peak detection was used.



8.4 Test data

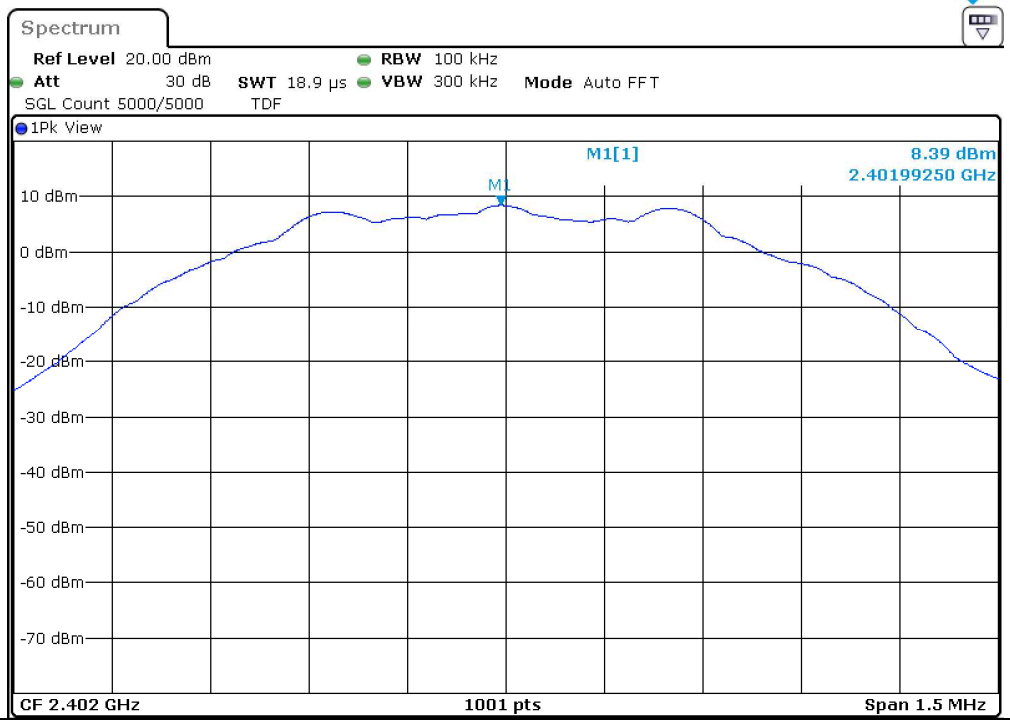
Test date : 22. Mar. 2019

Operating mode : Transmit mode

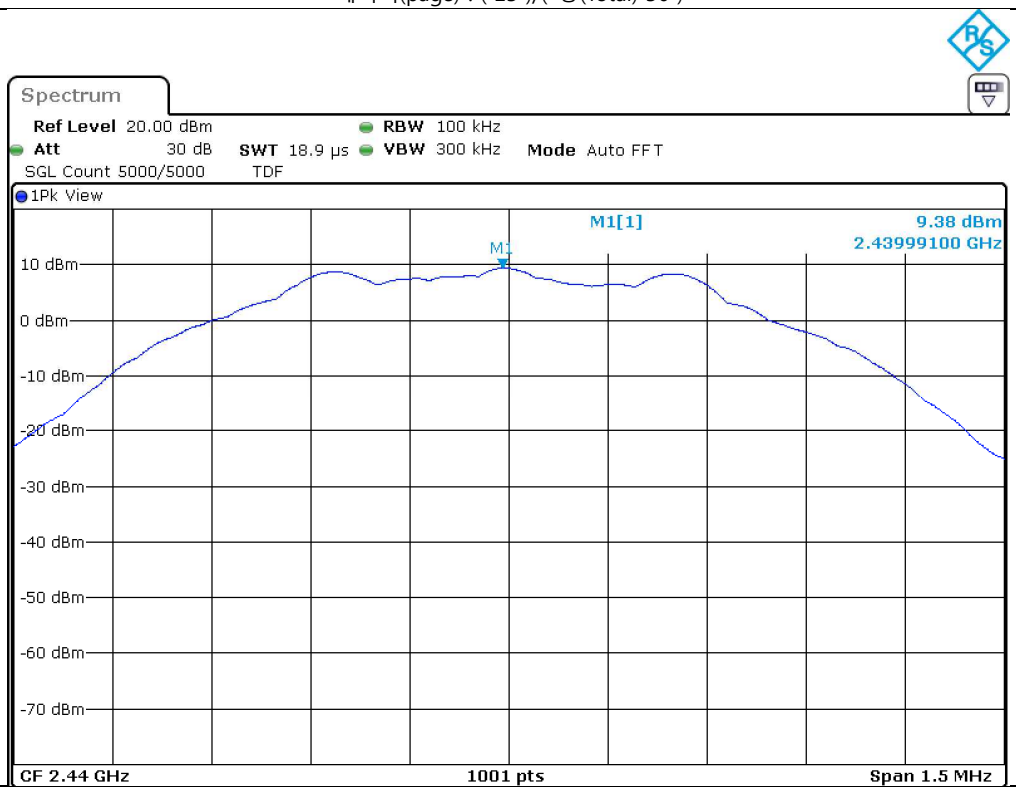
Test Result : Pass

8.4.1 Measured Results

8.4.1.1 Signal level (dB m)



Low CH



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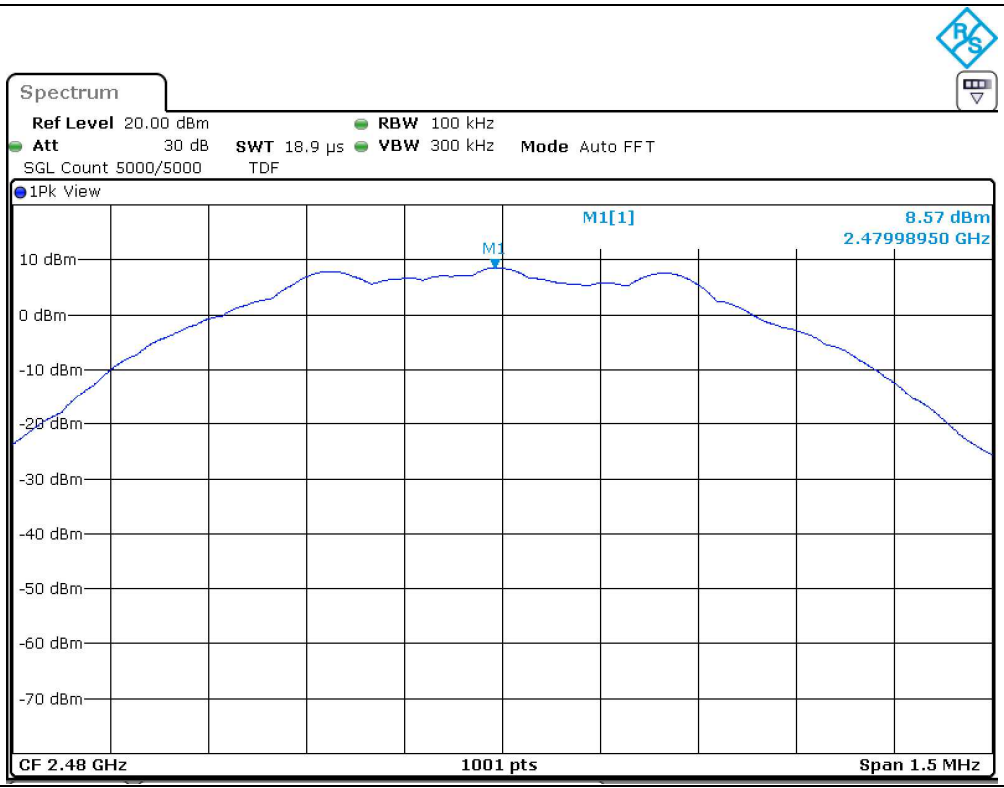
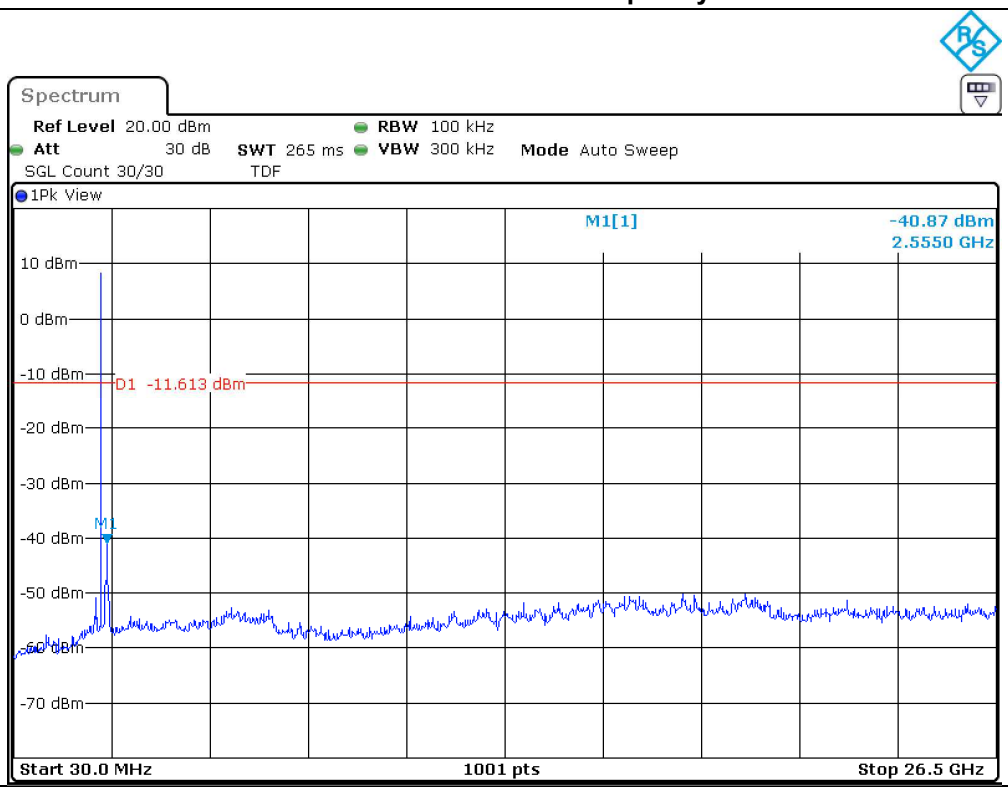
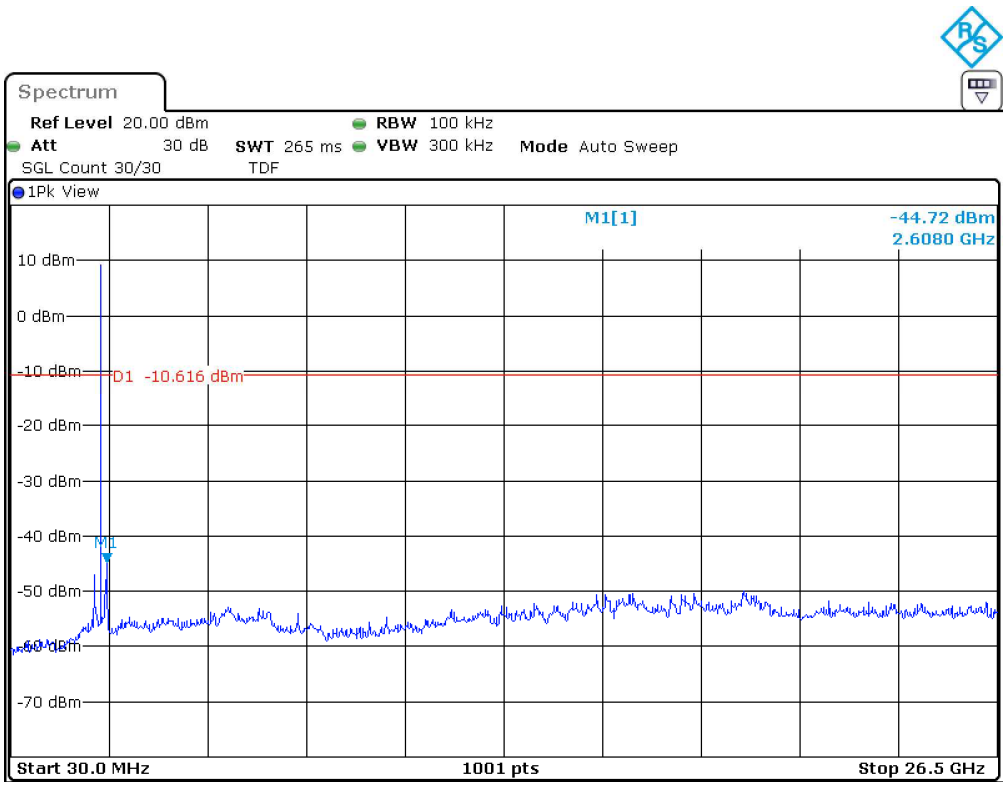


High CH

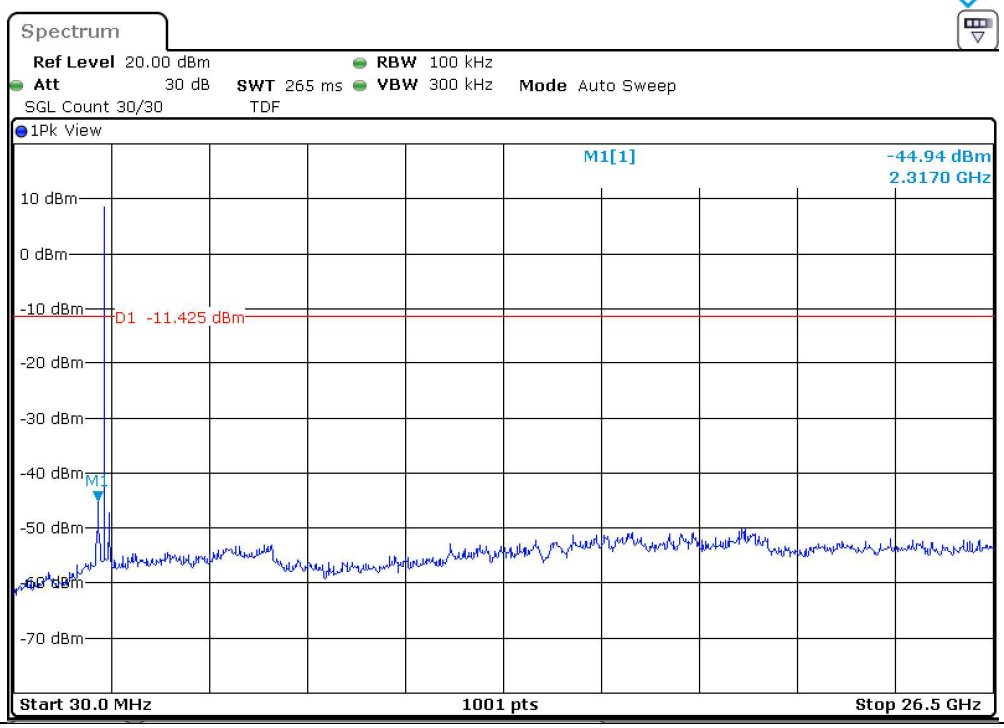
8.4.1.2 Unwanted Emissions In Non-Restricted Frequency Bands



Low CH

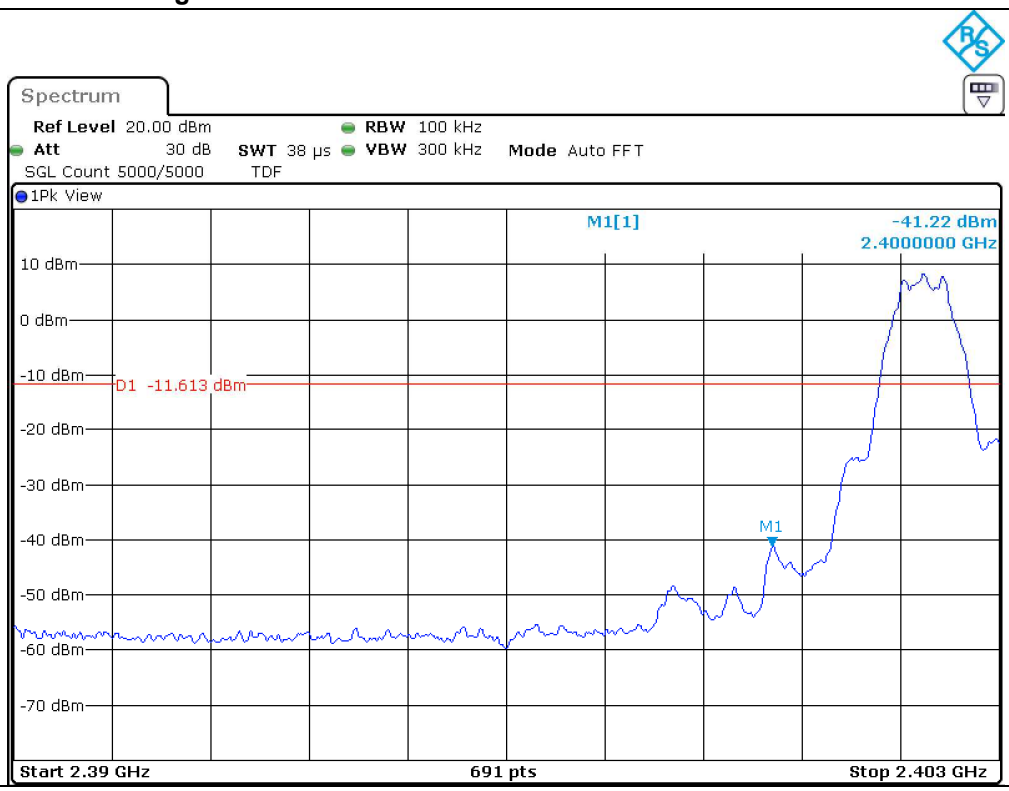


Mid CH

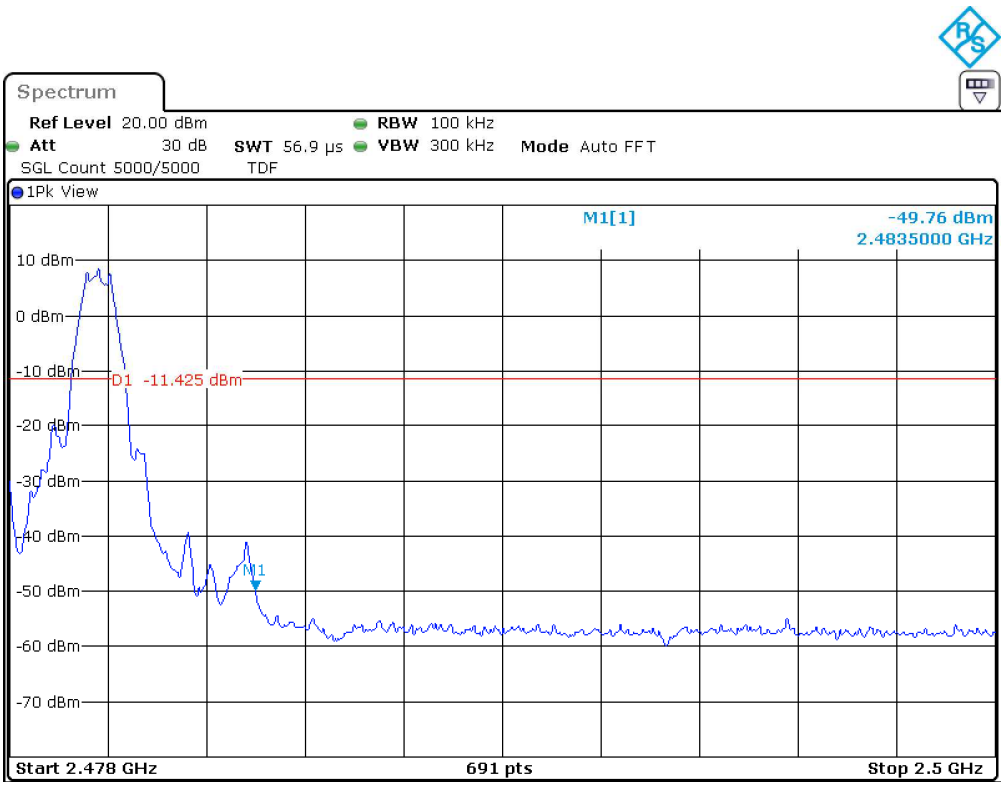

Spectrum
Ref Level 20.00 dBm
RBW 100 kHz
Att 30 dB
SWT 265 ms
VBW 300 kHz
Mode Auto Sweep
SGL Count 30/30
TDF
1Pk View
M1[1]
-44.94 dBm
2.3170 GHz
10 dBm
0 dBm
-10 dBm
D1 -11.425 dBm
-20 dBm
-30 dBm
-40 dBm
M1
-50 dBm
-70 dBm
Start 30.0 MHz
1001 pts
Stop 26.5 GHz

High CH

8.4.1.3 Band Edge



Low CH



High CH

9. Radiated Spurious Emission

9.1 Operating environment

Temperature : 25 ℃

Relative humidity : 48 %

9.2 Measurement method

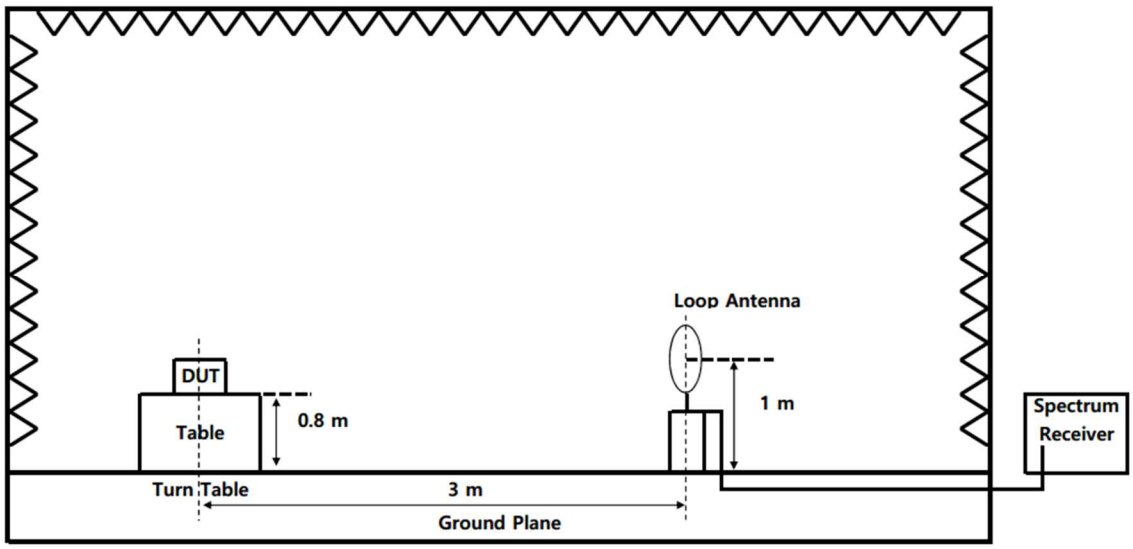
Standard :§15.247 (d), §15.209, §15.205 / RSS-247 (5.5), RSS-GEN (5.5), RSS-GEN (8.10)

9.3 Test setup

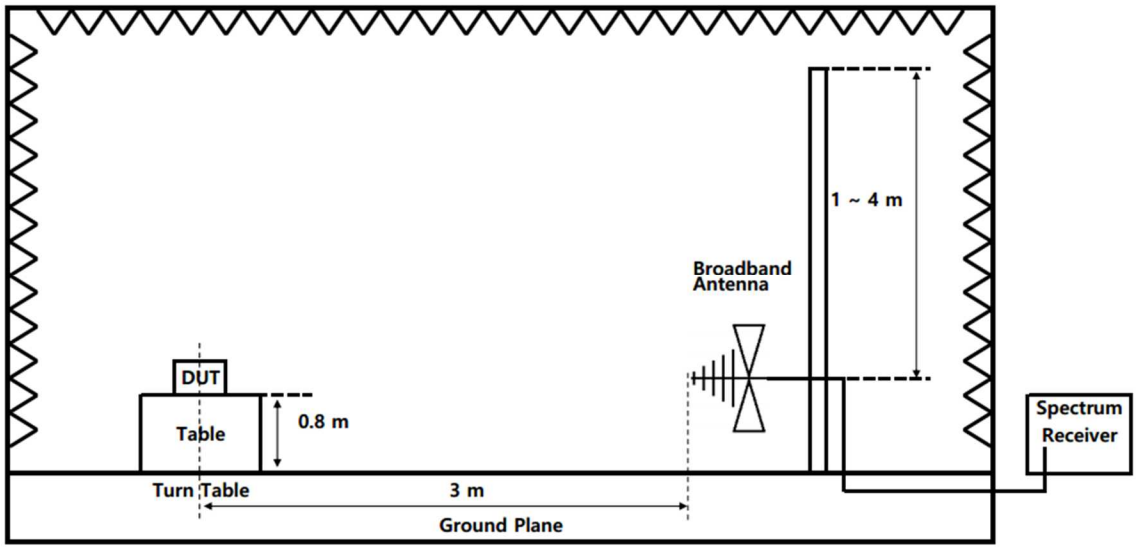
The radiated emissions measurements were performed on the 3 m,Semi-Anechoic Camber. The EUT was placed on a non-conductive turntable above the ground plane.

The frequency spectrum from 9 ㎑ to 26.5 ㎓ 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.

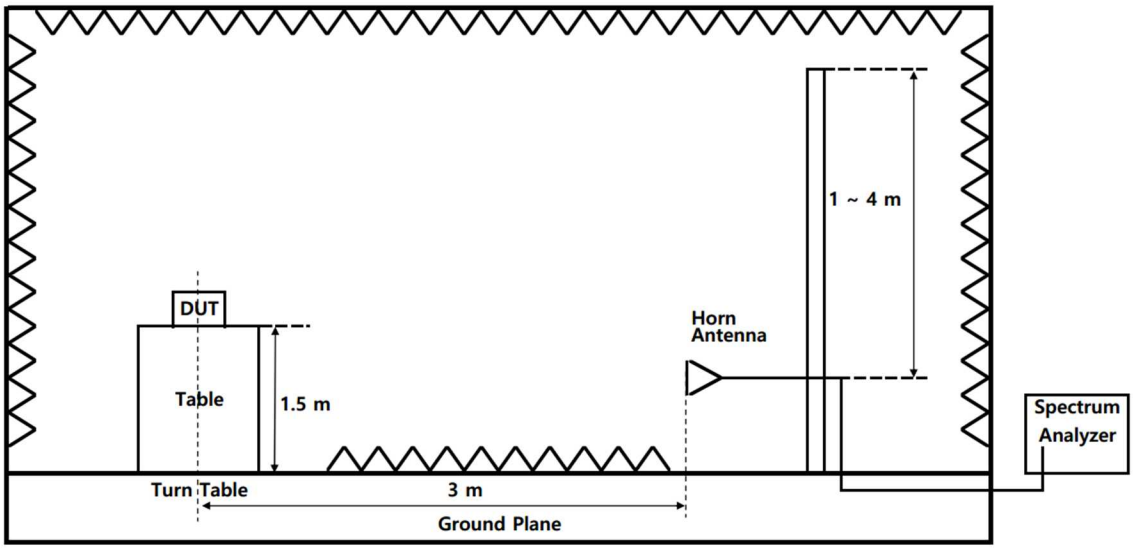
9.3.1 Below 30 ㎒



9.3.2 30 MHz to 1 GHz



9.3.3 Above 1 GHz



9.4 Test data

Test date : 25. Mar. 2019 ~ 25. Mar. 2019

Operating mode : Transmit mode

Test Result : Pass

9.4.1 Test data for Restricted band

Frequency (㎒)	Reading (dBμV)	Detector	Ant. Pol. (H/V)	Corr. Factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Low CH							
2 376.40	49.95	Peak	H	-9.90	40.05	73.98	-33.93
	36.07	Average	H		26.17	53.98	-27.81
High CH							
2 483.50	64.76	Peak	V	-9.65	55.11	73.98	-18.87
	44.05	Average	V		34.4	53.98	-19.58

※ Ant. Pol. : Antenna Polarization

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

※ Result = Reading + Corr. Factor

※ Margin = Result - Limit

9.4.2 Test data for Spurious & Harmonic

9.4.2.1 Measurement Results for below 30 ㎒

Frequency (㎒)	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.							

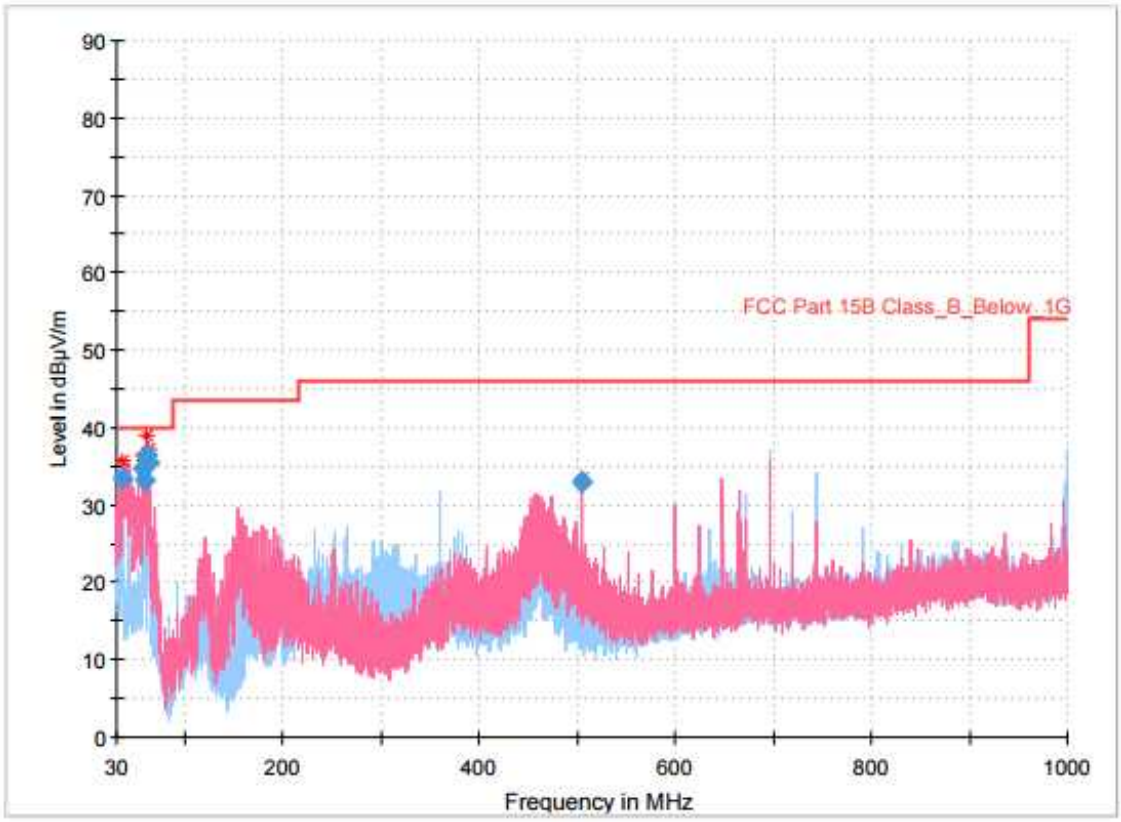
※ Ant. Pol. : Antenna Polarization

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

※ Result = Reading + Corr. Factor

※ Margin = Result - Limit

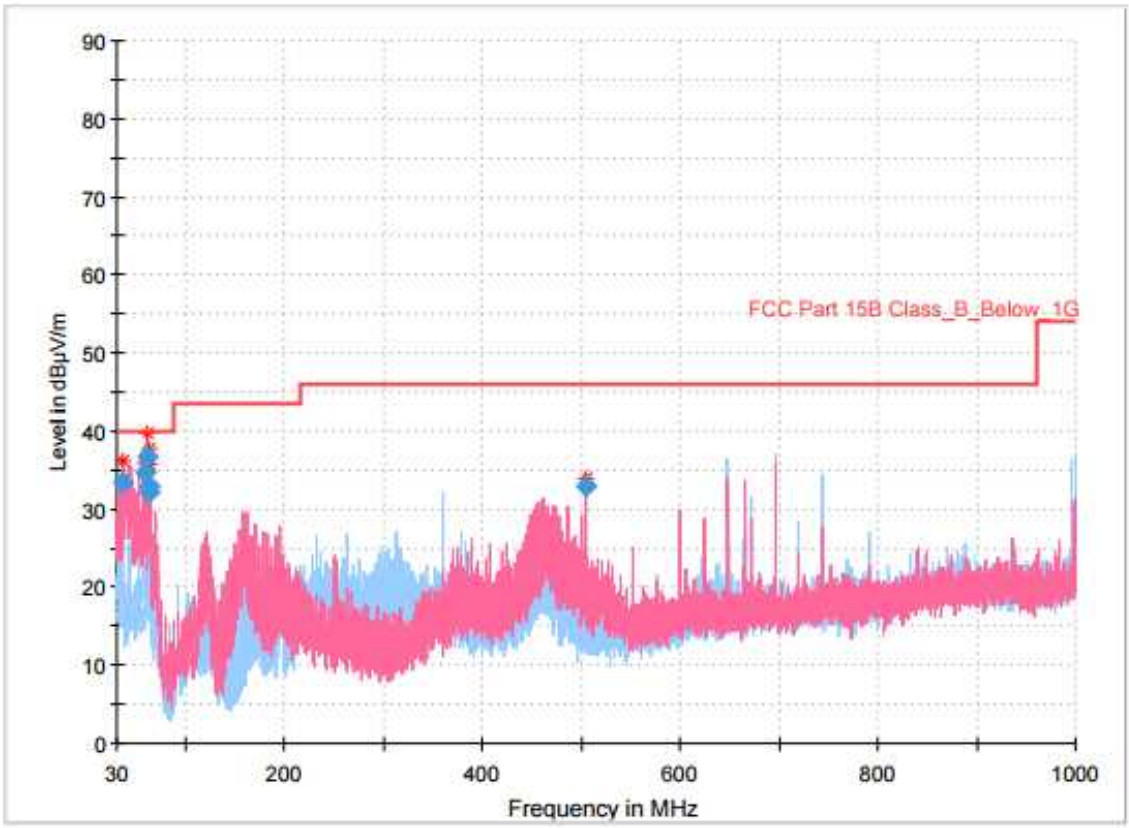
9.4.2.2 Measurement Results for below 1 ㎓



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
35.941250	33.54	40.00	6.46	1000.0	120.000	99.8	V	41.0	-24.4
57.402500	34.78	40.00	5.22	1000.0	120.000	99.8	V	0.0	-22.4
58.008750	33.28	40.00	6.72	1000.0	120.000	99.8	V	4.0	-22.5
60.009375	36.36	40.00	3.64	1000.0	120.000	99.8	V	256.0	-22.9
62.373750	35.38	40.00	4.62	1000.0	120.000	99.8	V	279.0	-23.5
504.026875	32.94	46.00	13.06	1000.0	120.000	99.8	V	212.0	-15.9

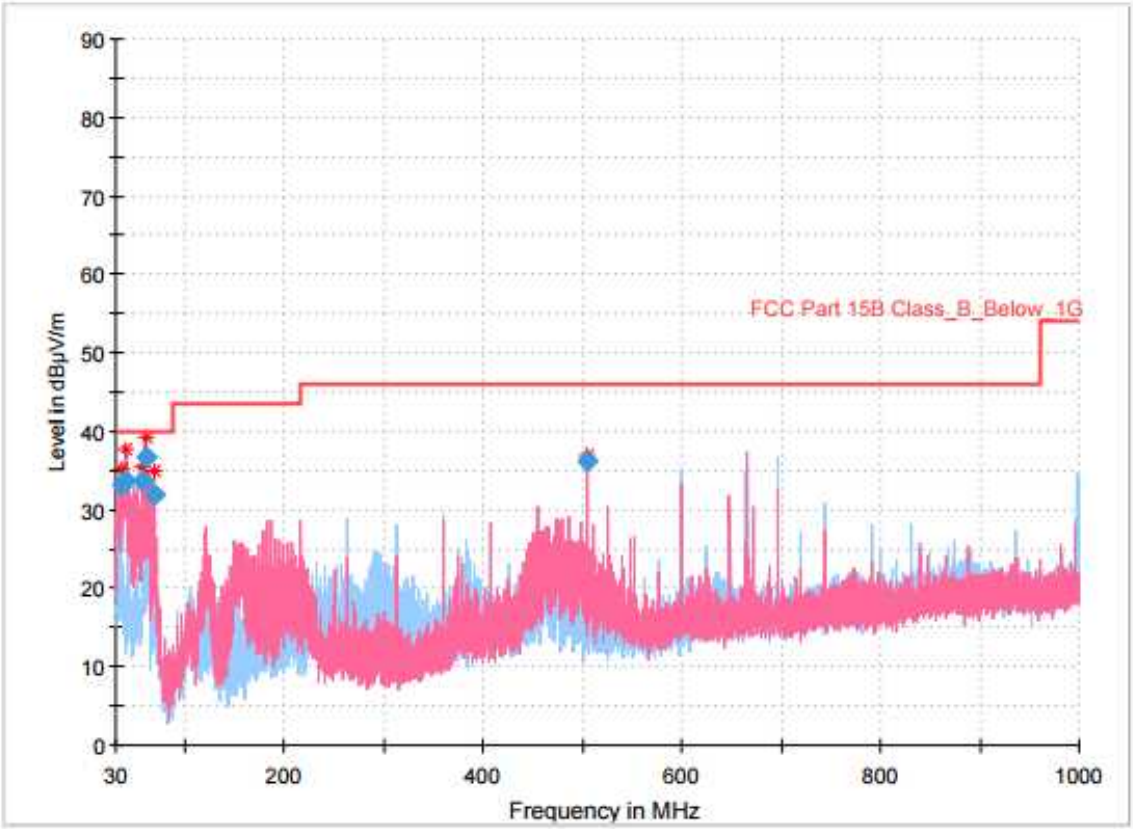
Low CH



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
35.941250	33.38	40.00	6.62	1000.0	120.000	99.8	V	50.0	-24.4
58.130000	34.67	40.00	5.33	1000.0	120.000	99.8	V	270.0	-22.5
60.009375	36.62	40.00	3.38	1000.0	120.000	99.8	V	270.0	-22.9
62.313125	32.96	40.00	7.04	1000.0	120.000	99.8	V	270.0	-23.4
63.950000	32.24	40.00	7.76	1000.0	120.000	99.8	V	329.0	-24.0
504.026875	32.88	46.00	13.12	1000.0	120.000	99.8	V	211.0	-15.9

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)
35.820000	33.18	40.00	6.82	1000.0	120.000	99.9	V	167.0	-24.5
39.700000	33.76	40.00	6.24	1000.0	120.000	99.9	V	128.0	-23.1
57.766250	33.70	40.00	6.30	1000.0	120.000	99.9	V	318.0	-22.5
60.009375	36.81	40.00	3.19	1000.0	120.000	99.9	V	252.0	-22.9
68.193750	32.02	40.00	7.98	1000.0	120.000	99.9	V	0.0	-25.3
504.026875	36.11	46.00	9.89	1000.0	120.000	99.9	V	0.0	-15.9

High CH

9.4.2.3 Measurement Results for Above 1 ㎓

Frequency (㎒)	Reading (dBμV)	Detector	Ant. Pol. (H/V)	Corr. Factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Low CH							
4 804.00	48.12	Peak	V	-2.22	45.90	73.98	-28.08
	40.73	Average	V		38.51	53.98	-15.47
Mid CH							
4 880.00	51.50	Peak	V	-1.98	49.52	73.98	-24.46
	39.25	Average	V		37.27	53.98	-16.71
High CH							
4 960.00	53.47	Peak	V	-1.74	51.73	73.98	-22.25
	41.27	Average	V		39.53	53.98	-14.45

※ Ant. Pol. : Antenna Polarization

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

※ Result = Reading + Corr. Factor

※ Margin = Result - Limit

10. Power Line Conducted Emission

10.1 Operating environment

Temperature : 22 ℃

Relative humidity : 44 %

10.2 Measurement method

Standard : §15.207 / RSS-GEN 8.8

10.3 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 Ω / 50 μH + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

10.4 Test data

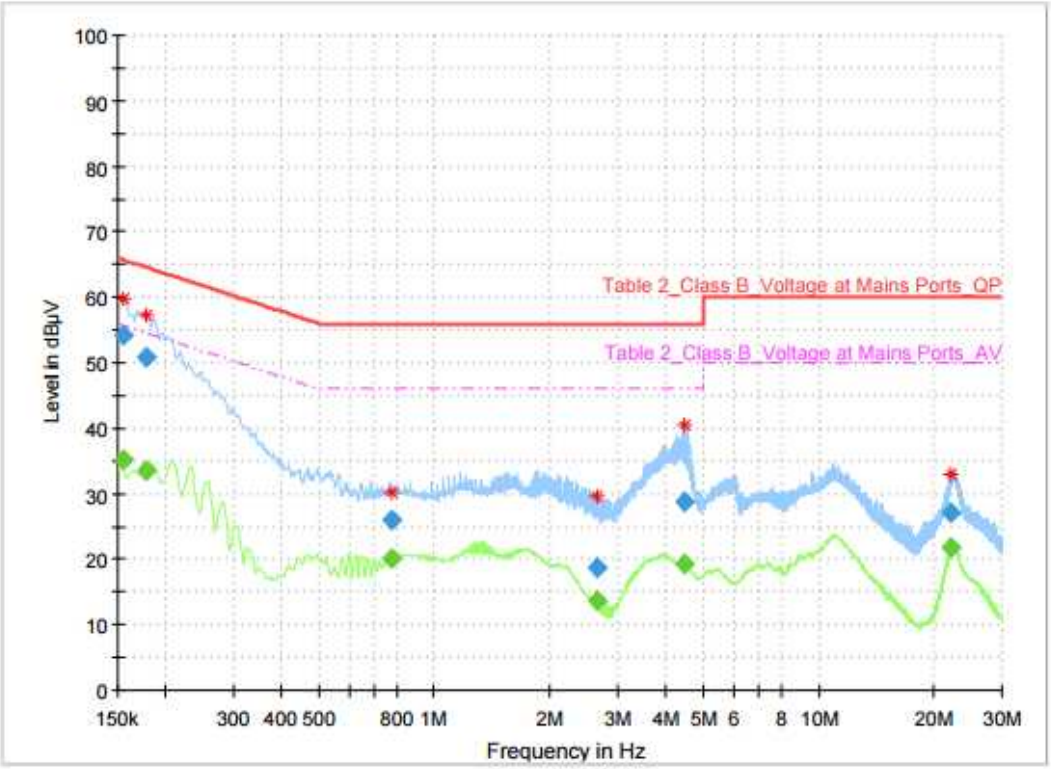
Test date : 26. Mar. 2019

Operating mode : Transmit mode

Test Result : Pass

10.4.1 Measured Results & Graph

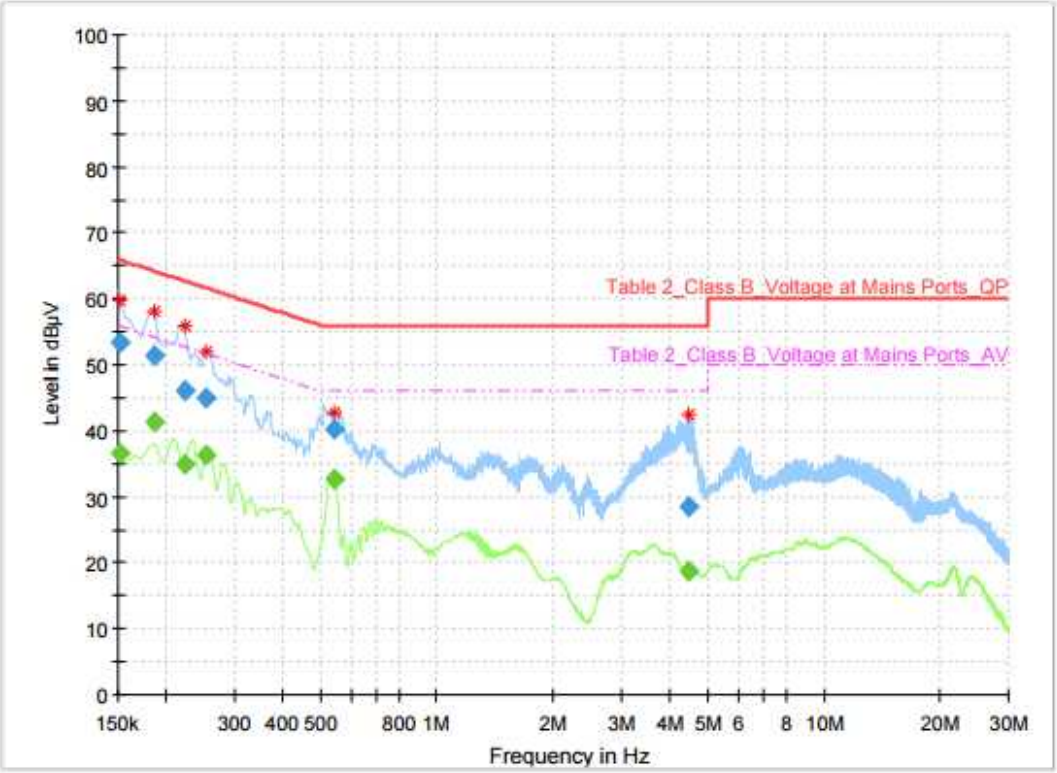
Live line



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.154500	---	35.19	55.75	20.57	1000.0	9.000	L1	ON	9.8
0.154500	54.21	---	65.75	11.54	1000.0	9.000	L1	ON	9.8
0.177000	---	33.60	54.63	21.03	1000.0	9.000	L1	ON	9.9
0.177000	50.89	---	64.63	13.73	1000.0	9.000	L1	ON	9.9
0.771000	---	20.11	46.00	25.89	1000.0	9.000	L1	ON	9.8
0.771000	26.08	---	56.00	29.92	1000.0	9.000	L1	ON	9.8
2.638500	---	13.58	46.00	32.42	1000.0	9.000	L1	ON	9.7
2.638500	18.70	---	56.00	37.30	1000.0	9.000	L1	ON	9.7
4.472250	---	19.14	46.00	26.86	1000.0	9.000	L1	ON	9.8
4.472250	28.64	---	56.00	27.36	1000.0	9.000	L1	ON	9.8
22.038000	---	21.65	50.00	28.35	1000.0	9.000	L1	ON	10.0
22.038000	27.17	---	60.00	32.83	1000.0	9.000	L1	ON	10.0

Neutral line



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.152250	---	36.57	55.88	19.30	1000.0	9.000	N	ON	9.7
0.152250	53.23	---	65.88	12.64	1000.0	9.000	N	ON	9.7
0.186000	---	41.47	54.21	12.75	1000.0	9.000	N	ON	9.9
0.186000	51.37	---	64.21	12.85	1000.0	9.000	N	ON	9.9
0.224250	---	34.85	52.66	17.81	1000.0	9.000	N	ON	9.7
0.224250	46.21	---	62.66	16.45	1000.0	9.000	N	ON	9.7
0.253500	---	36.32	51.64	15.32	1000.0	9.000	N	ON	9.6
0.253500	45.06	---	61.64	16.58	1000.0	9.000	N	ON	9.6
0.541500	---	32.75	46.00	13.25	1000.0	9.000	N	ON	9.9
0.541500	40.30	---	56.00	15.70	1000.0	9.000	N	ON	9.9
4.485750	---	18.84	46.00	27.16	1000.0	9.000	N	ON	9.8
4.485750	28.47	---	56.00	27.53	1000.0	9.000	N	ON	9.8