TEST REPORT

CTK Co., Ltd.
(Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea
Tel: +82-31-339-9970
Fax: +82-31-624-9501

1. Client

◦ Name : SOLUM CO.,LTD.

◦ Address : 4,5,6th F, 357, Guseong-ro, Giheung-gu, Gyeonggi-do, Yongin-si, Republic of Korea

◦ Date of Receipt : 2021-06-22

2. Manufacturer

◦ Name #1 : SOLUM CO.,LTD.

◦ Address #1 : 4,5,6th F, 357, Guseong-ro, Giheung-gu, Gyeonggi-do, Yongin-si, Republic of Korea

◦ Name #2 : SOLUM VINA CO., LTD

◦ Address #2 : Plot B3, Ba Thien 2 Industrial park, Thien Ke Ward, Binh Xuyen District, Vinh Phuc Province, 281200., People's Republic of Vietnam

3. Use of Report : For FCC Certification & Canadian Certification

4. Test Sample / Model : ESL Gateway / SLG-EN102S

5. Date of Test : 2021-07-12 to 2021-09-13

6. Test Standard(method) used : FCC 47 CFR part 15 subpart C 15.247, ANSI C63.10-2013, RSS-Gen Issue 5, RSS-247 Issue 2

7. Testing Environment : Temp.: (23 ± 1) ℃, Humidity: (51 ± 3) % R.H.

8. Test Results : Compliance

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

Affirmation	Tested by Bong-seok Kim: (Signature)	Technical Manager Young-taek Lee: (Signature)

2021-09-28

Republic of KOREA **CTK Co., Ltd.**

CTK Co., Ltd.
(Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea
Tel: +82-31-339-9970
Fax: +82-31-624-9501

REPORT REVISION HISTORY

Date	Revision	Page No
2021-09-28	Issued (CTK-2021-03548)	all

CONTENTS

CTK Co., Ltd.
(Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea
Tel: +82-31-339-9970
Fax: +82-31-624-9501

1. General Product Description

1.1 Client Information

Company	SOLUM CO.,LTD.
Contact Point	4,5,6th F, 357, Guseong-ro, Giheung-gu, Gyeonggi-do, Yongin-si, Republic of Korea
Contact Person	Name : Lee Byeong hyeon E-mail : bh.lee@solu-m.com Tel : +82-31-8006-7645

1.2 Product Information

FCC ID	2AFWN-SLG-EN102S
IC	22800-SLGEN102S
Product Description	ESL Gateway
Model name	SLG-EN102S
Variant Model name	-
Operating Frequency	2 402 MHz - 2 480 MHz
RF Output Power	11.17 dBm (13.09mW)
Antenna type	Antenna 1 : External Antenna(Dipole)
	Antenna 2 : External Antenna(Dipole)
Antenna gain	Antenna 1 : 4.9 dBi(Peak Gain)
	Antenna 2 : 4.9 dBi(Peak Gain)
Number of channels	40
Channel Spacing	2 MHz
Type of Modulation	GFSK
Power Source	DC 5-12 V(Adaptor), DC 48 V(PoE)
Firmware Version Id Number(FVIN)	1.6
RF Power setting in Test SW	Initial value

1.3 Peripheral Devices

-For Conducted Measurement and Radiated Measurement

Device	Manufacturer	Model No.	Serial No.
Notebook	HP Inc.	HP Probook 650 G1	5CG5114K13
AC Adapter	HP Inc.	PPP012D-S	677777-003

2. Facility and Accreditations

2.1 Test Facility

The measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yong-in-si, Gyeonggi-do, Korea.

2.2 Laboratory Accreditations and Listings

Country	Agency	Registration Number
USA	FCC	805871
CANADA	ISED	8737A-2
KOREA	NRRA	KR0025

2.3 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

3. Test Specifications

3.1 Standards

Section in FCC	Section in RSS	Requirement(s)	Status (Note 1)	Test Condition
15.247(a)	RSS-247 5.2(a)	6 dB Bandwidth	C	Conducted
15.247(e)	RSS-247 5.2(b)	Transmitter power spectral density	C	
15.247(b)	RSS-247 5.4(d)	Maximum peak conducted output power	C	
15.247(d)	RSS-247 5.5	Unwanted emission	C	
15.209	RSS-Gen 6.13	Transmitter emission	C	Radiated
15.207(a)	RSS-Gen 8.8	AC Conducted Emission	C	Line Conducted
Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable				
Note 2: The data in this test report are traceable to the national or international standards.				
Note 3: The sample was tested according to the following specification: FCC Part 15.247, ANSI C63.10-2013, RSS-247 Issue 2, RSS-GEN Issue 5				
Note 4: The tests were performed according to the method of measurements prescribed in KDB No.558074.				

3.2 Mode of operation during the test

The EUT is operated in a manner representative of the typical of the equipments.
During at testing, system components were manipulated within the confines of typical usage to maximize each emission. All modulation modes were tests.
The results are only attached worst cases.

Test Frequency

Lowest channel	Middle channel	Highest channel
2 402 MHz	2 440 MHz	2 480 MHz

Test mode

Modulation	Duty Cycle
GFSK	86 %

3.3 Maximum Measurement Uncertainty

The value of the measurement uncertainty for the measurement of each parameter.
Coverage factor k = 2, Confidence levels of 95 %

Description	Uncertainty
Conducted RF Output Power	1.5 dB (C.L. : Approx. 95%, k=2)
Occupied Bandwidth	0.1 MHz (C.L. : Approx. 95%, k=2)
Unwanted Emission(conducted)	3.0 dB (C.L. : Approx. 95%, k=2)
Radiated Emissions (f ≤ 1 GHz)	4.0 dB (C.L. : Approx. 95%, k=2)
Radiated Emissions (f > 1 GHz)	5.0 dB (C.L. : Approx. 95%, k=2)

4. Technical Characteristic Test

4.1 6dB Bandwidth & 99% Bandwidth

Test Procedures(ANSI C63.10-2013 6.9.2)

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.

Test Procedures(ANSI C63.10-2013 6.9.3)

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.
Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

Test Settings :

Center frequency = the highest, middle and the lowest channels

a) RBW = 100 kHz

b) VBW ≥ 3 x RBW

c) Detector = peak

d) Trace mode = Max hold

e) Sweep = auto couple

f) Allow trace to fully 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.

Limit :

6 dB Bandwidth	>	500 kHz

Test Data :

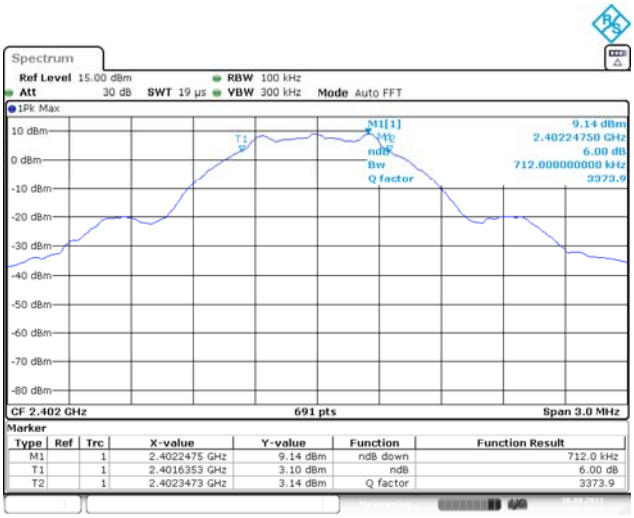
Mode	Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	99 % Bandwidth [MHz]	Result
ANT1	Low	2 402	0.712	1.050	Complies
	Middle	2 440	0.712	1.055	
	High	2 480	0.716	1.055	
ANT2	Low	2 402	0.708	1.051	
	Middle	2 440	0.716	1.051	
	High	2 480	0.708	1.055	

See next pages for actual measured spectrum plots.

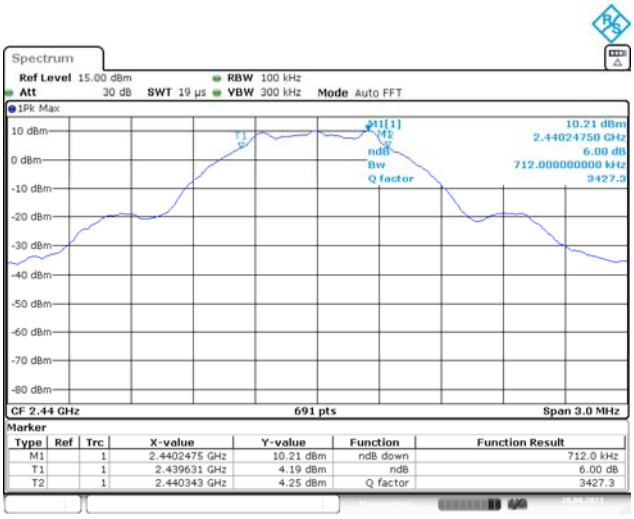
Test Mode : ANT1

6 dB Bandwidth[MHz]

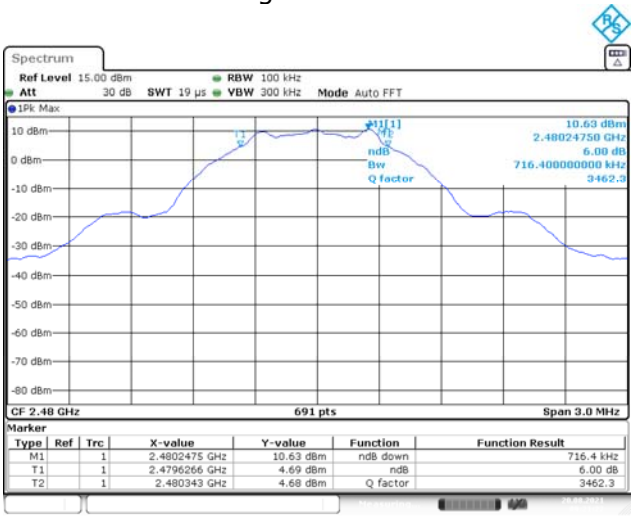
Low channel



Middle channel

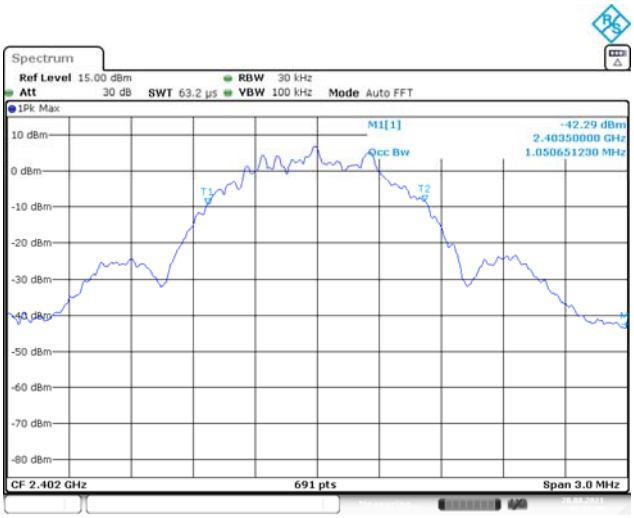


High channel

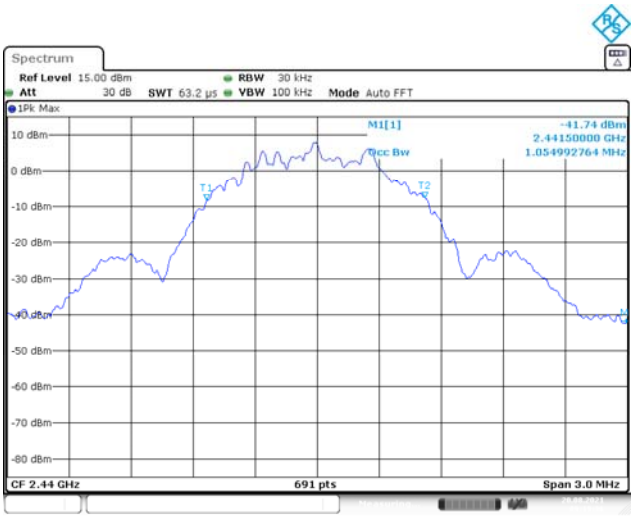


99 % Bandwidth[MHz]

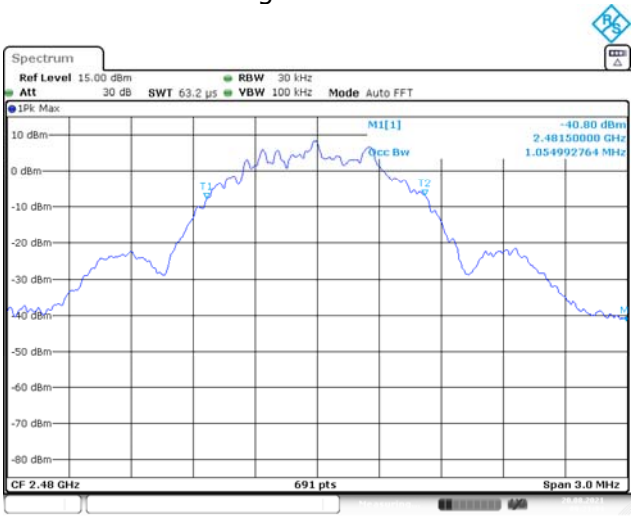
Low channel



Middle channel



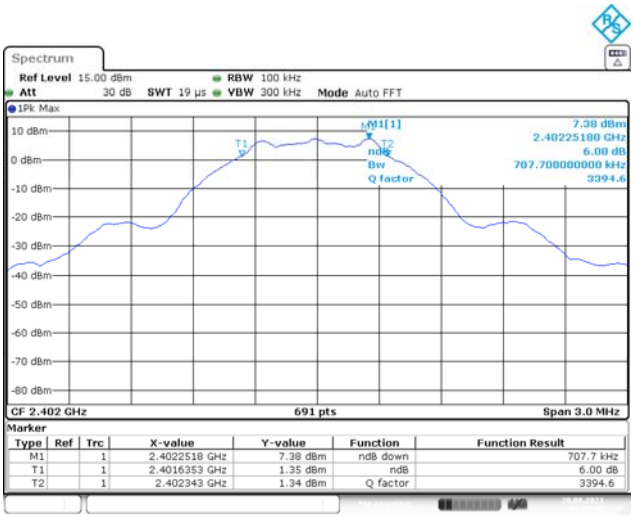
High channel



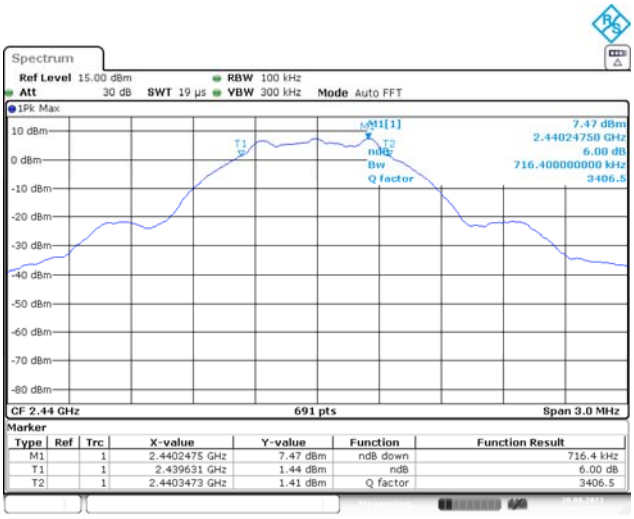
Test Mode : ANT2

6 dB Bandwidth[MHz]

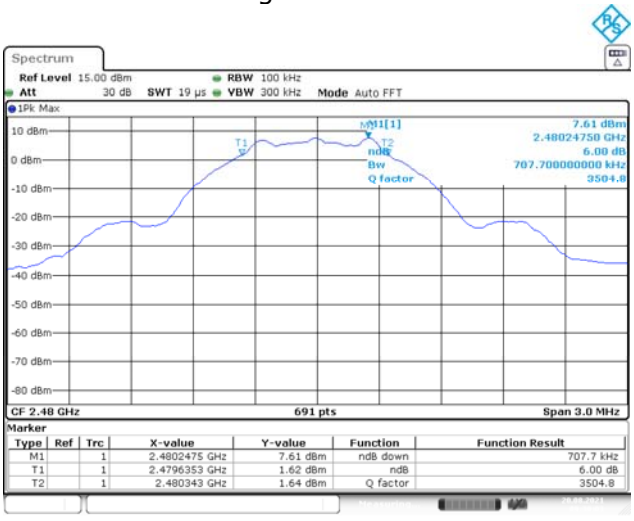
Low channel



Middle channel

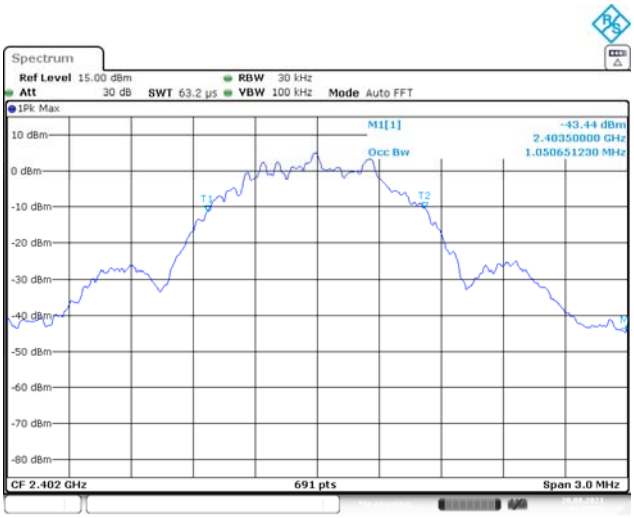


High channel

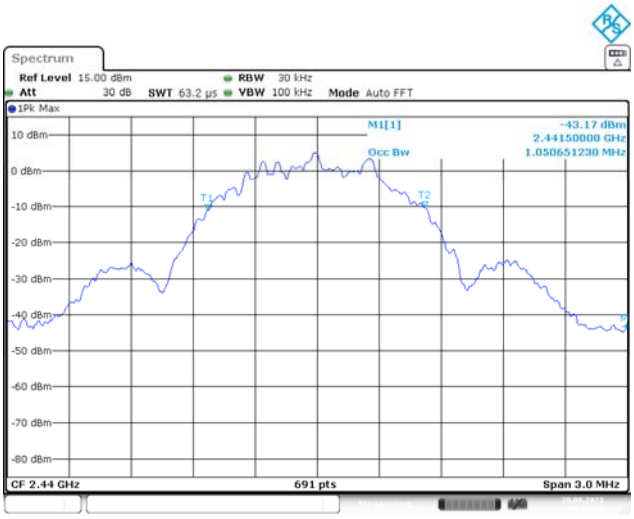


99 % Bandwidth[MHz]

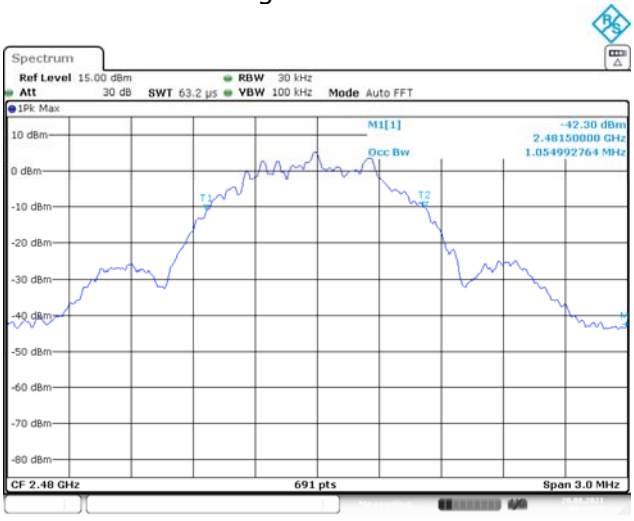
Low channel



Middle channel



High channel



4.2 Maximum peak Conducted Output Power

Test Procedures(ANSI C63.10-2013 11.9.1)

The following procedure can be used when the maximum available RBW of the instrument is less than the DTS bandwidth:

Test Settings:

Center frequency = the highest, middle and the lowest channels

a) RBW ≥ DTS Bandwidth

b) VBW ≥ 3 x RBW

c) span ≥ 3 x RBW

d) Sweep time = auto couple

e) Detector = peak

f) Trace mode= max hold

g) Allow trace to fully stabilize

h) Use peak marker function to determine the peak amplitude level.

Limit :

Maximum Output Power	<	1 W (30 dBm)

Test Data :

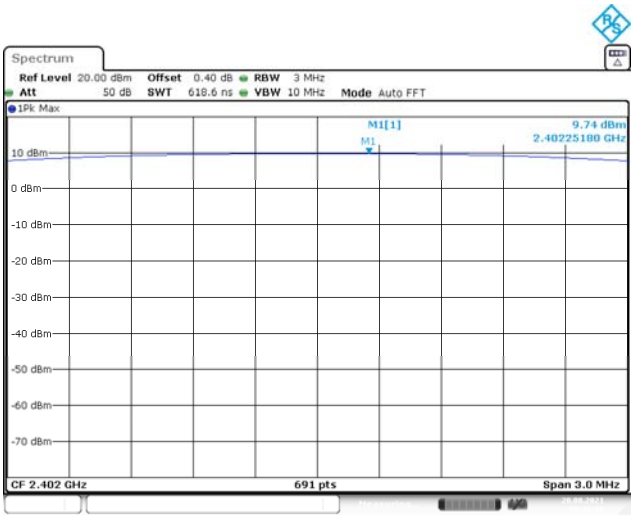
Mode	Channel	Frequency [MHz]	Measurement data [dBm]	Limit [dBm]	Result
ANT1	Low	2 402	9.74	30	Complies
	Middle	2 440	10.80		
	High	2 480	11.17		
ANT2	Low	2 402	7.95		
	Middle	2 440	8.12		
	High	2 480	8.16		

See next pages for actual measured spectrum plots.

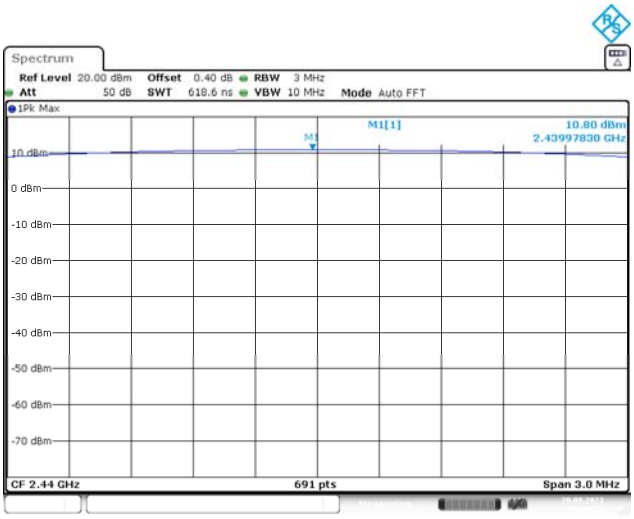
Output Power

Test Mode : ANT1

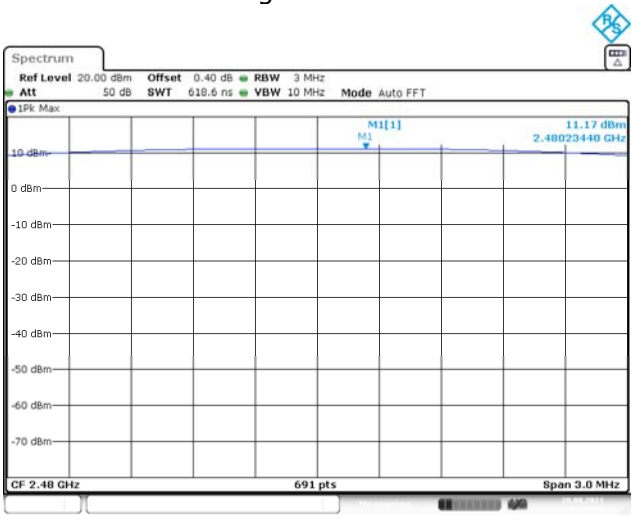
Low channel



Middle channel

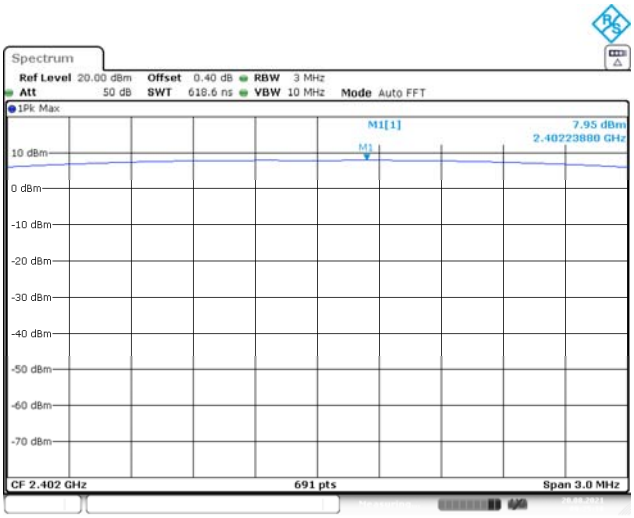


High channel

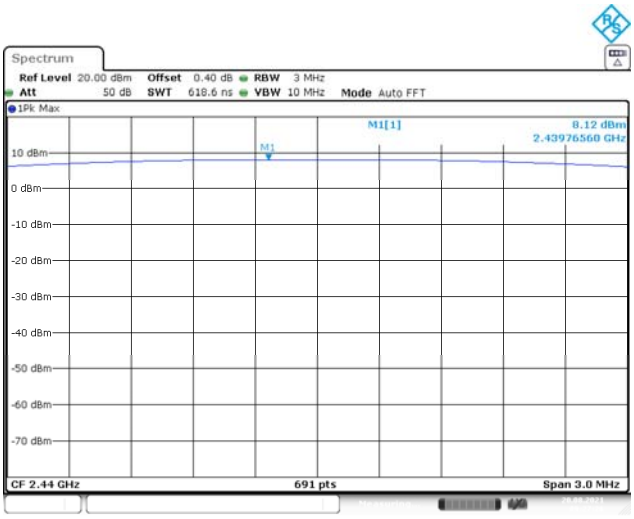


Test Mode : ANT2

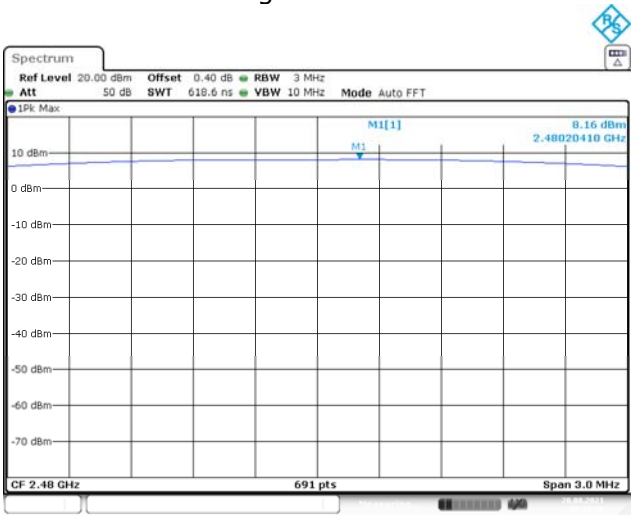
Low channel



Middle channel



High channel



4.3 Power Spectral Density

Test Procedures(ANSI C63.10-2013 11.10.2)

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance.

Test Settings:

Center frequency = the highest, middle and the lowest channels

a) RBW : 3 kHz ≤ RBW ≤ 100 kHz

b) VBW ≥ 3 x RBW

c) span ≥ 1.5 x DTS bandwidth

d) Sweep time = auto couple

e) Detector = peak

f) Trace mode= max hold

g) Allow trace to fully stabilize

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

Limit :

Power Spectral Density	<	8 dBm @ 3 kHz BW

Test Data :

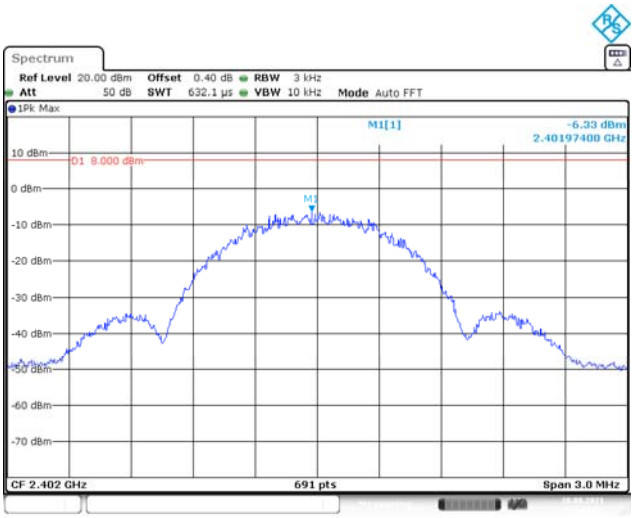
Mode	Channel	Frequency [MHz]	Measurement data [dBm]	Limit [dBm]	Result
ANT1	Low	2 402	-6.33	8	Complies
	Middle	2 440	-5.32		
	High	2 480	-4.98		
ANT2	Low	2 402	-8.17		
	Middle	2 440	-8.14		
	High	2 480	-8.05		

See next pages for actual measured spectrum plots.

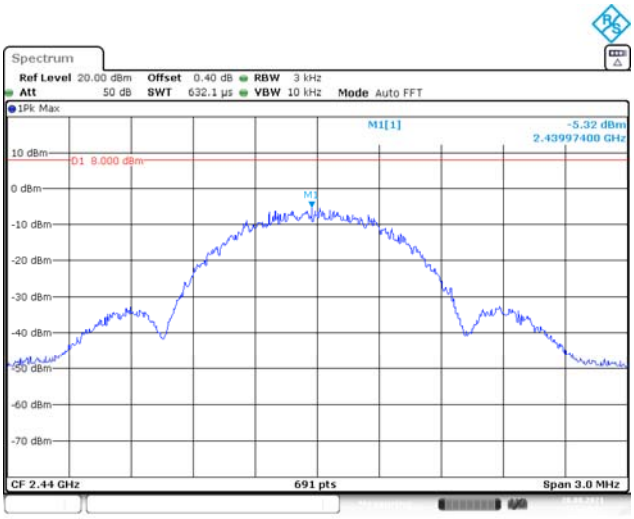
Power Spectral Density

Test Mode : ANT1

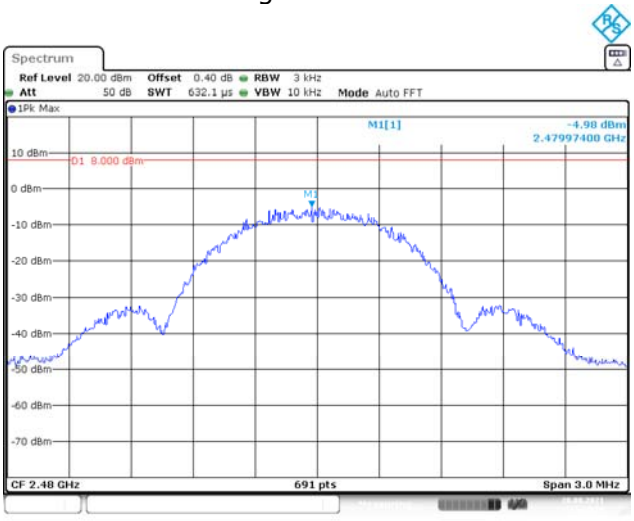
Low channel



Middle channel

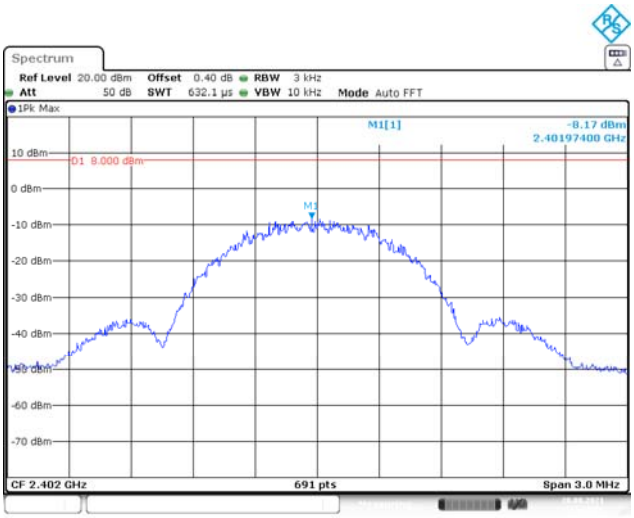


High channel

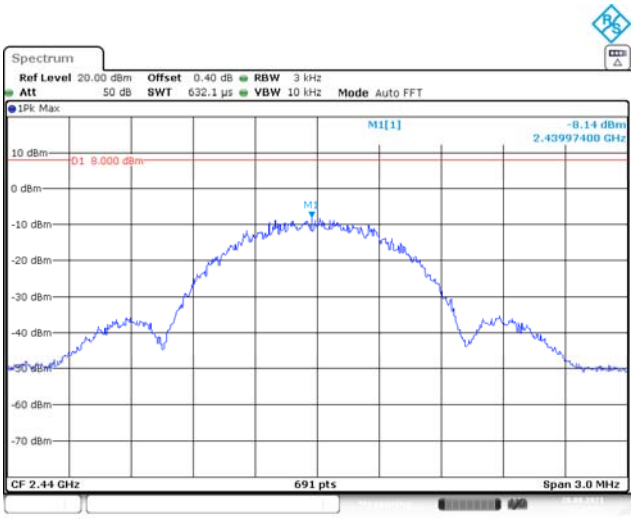


Test Mode : ANT2

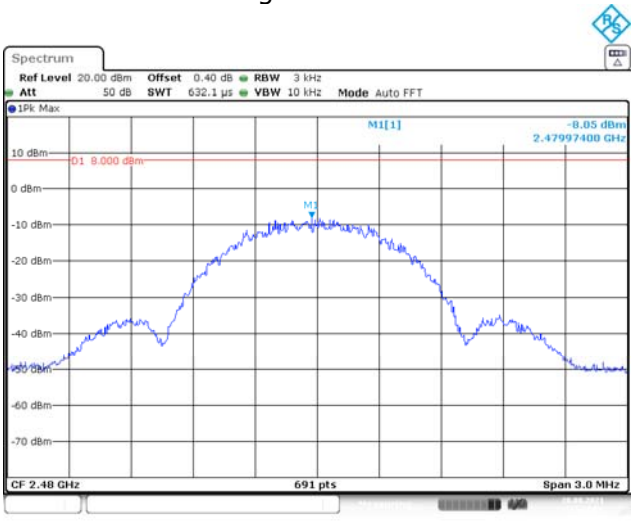
Low channel



Middle channel



High channel



4.4 Band Edge & Conducted Spurious emission

Test Procedures(ANSI C63.10-2013 11.11.3)

The Unwanted emission from the EUT were measured according to the dictates PKPSD measurement procedure in section 11.11 of ANSI C63.10-2013.

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Test Settings:

Center frequency = the highest, middle and the lowest channels

a) RBW = 100 kHz
b) VBW ≥ 3 x RBW
c) Detector = peak
d) Sweep time = auto couple
e) Trace mode= max hold
f) Allow trace to fully stabilize
g) Use the peak marker function to determine the maximum amplitude level.

Limit :

Emission level	<	20 dBc

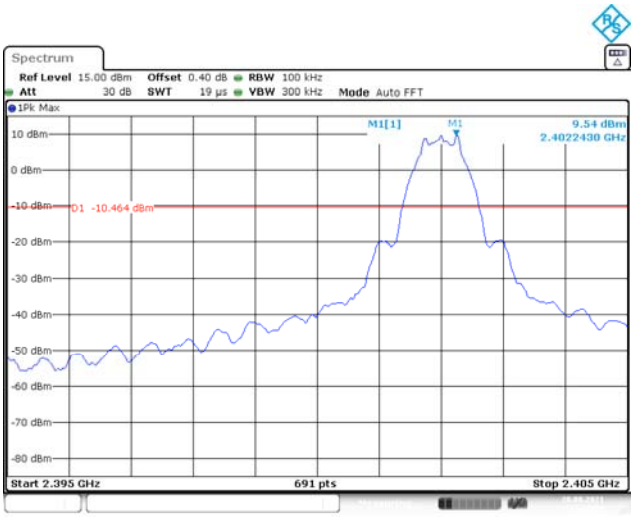
Test results: Complies

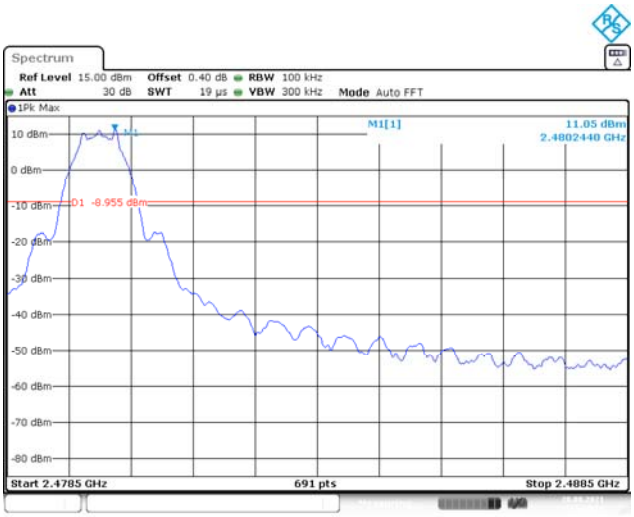
- All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest in-band spectral density. Therefore the applying equipment meets the requirement.

See next pages for actual measured spectrum plots.

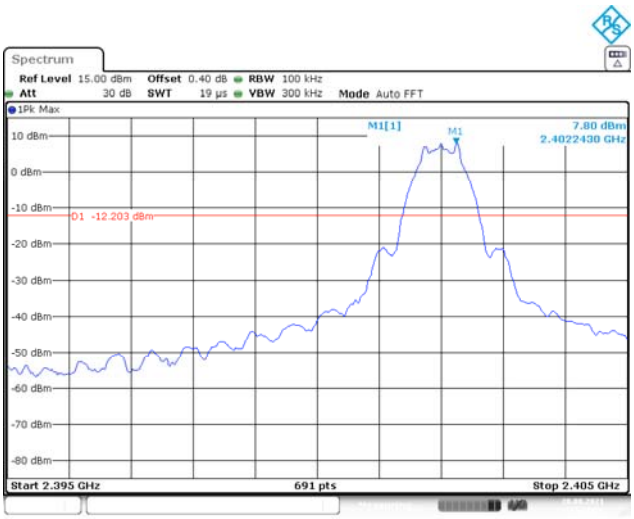
Conducted Band–Edge

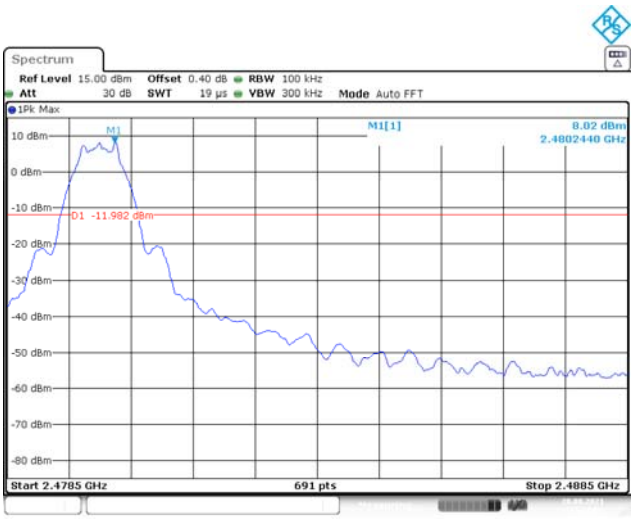
Test Mode : ANT1





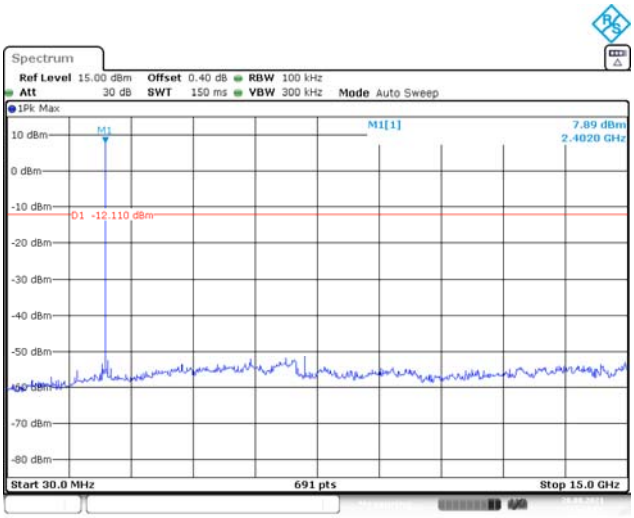
Test Mode : ANT2

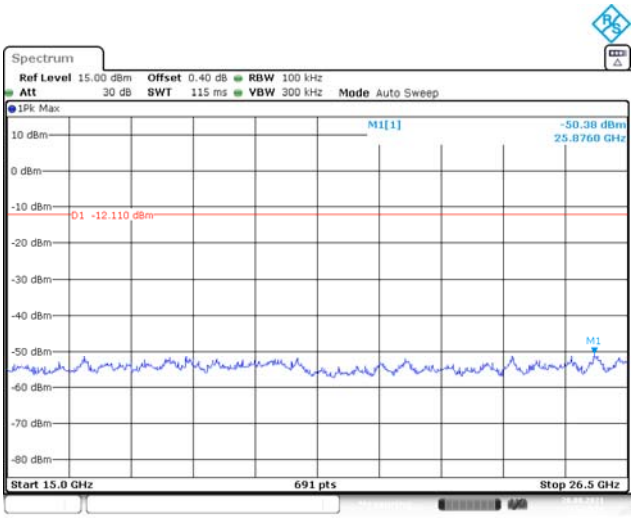




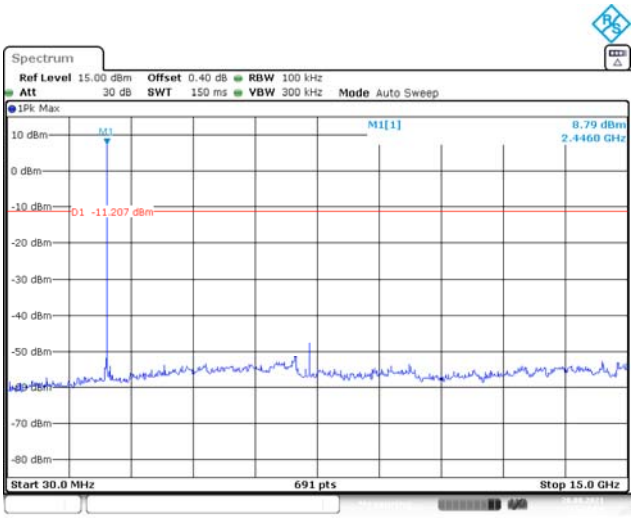
Conducted Spurious Emission
Test Mode : ANT1

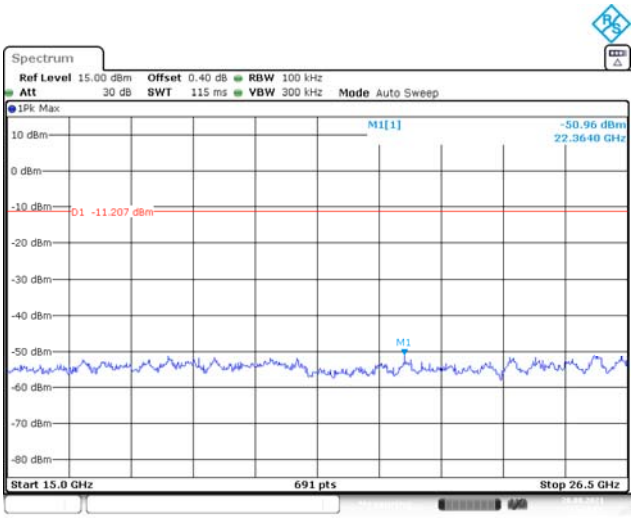
Low channel



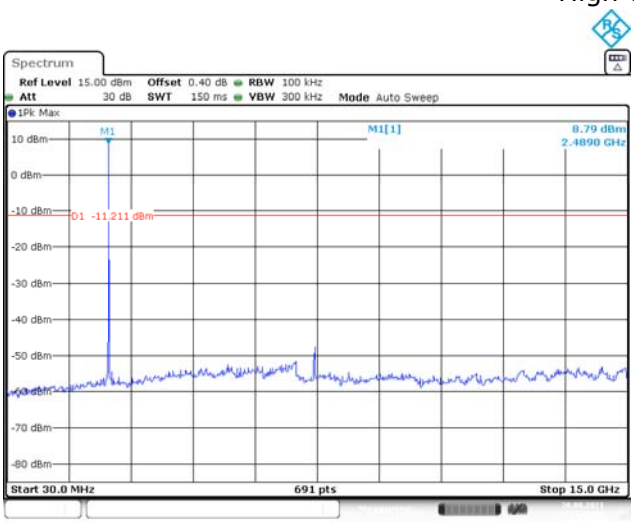


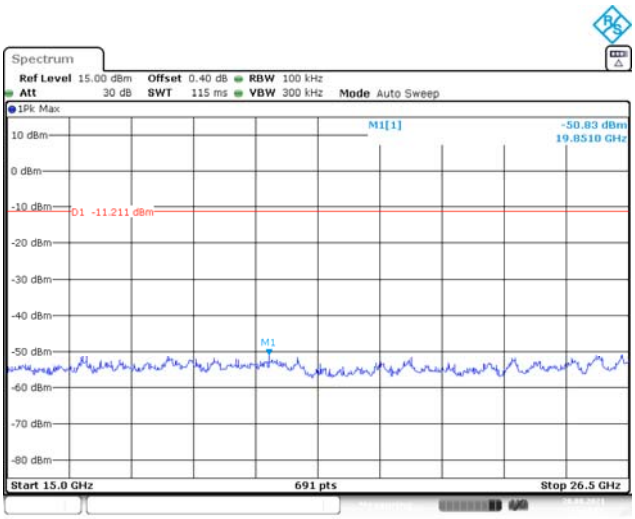
Middle channel





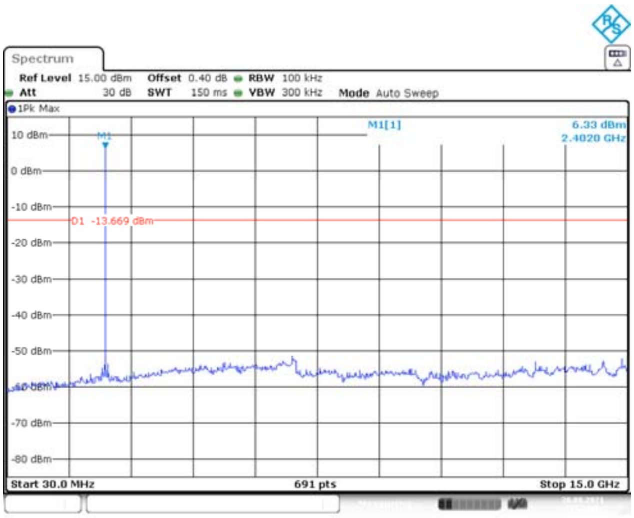
High channel

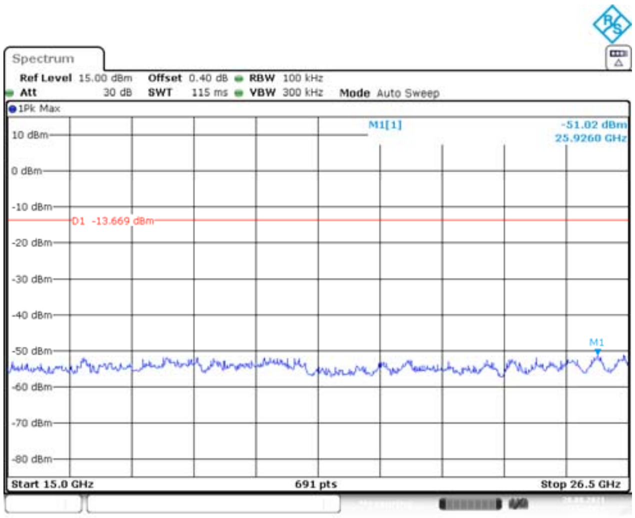




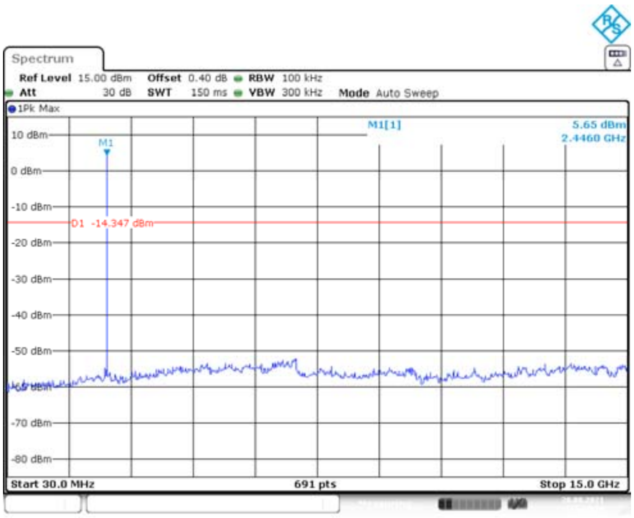
Test Mode : ANT2

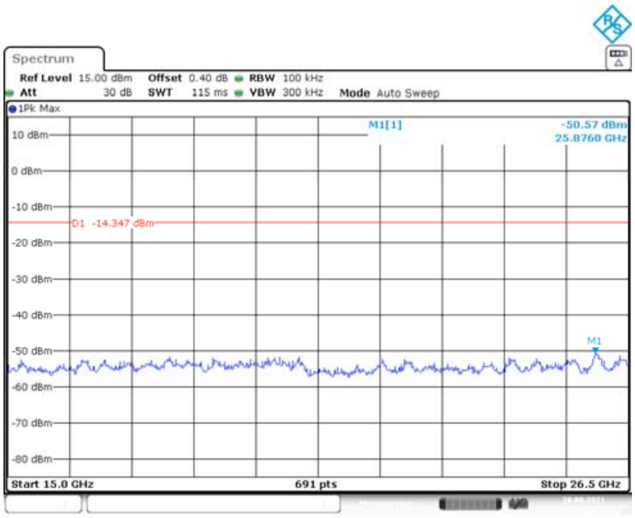
Low channel



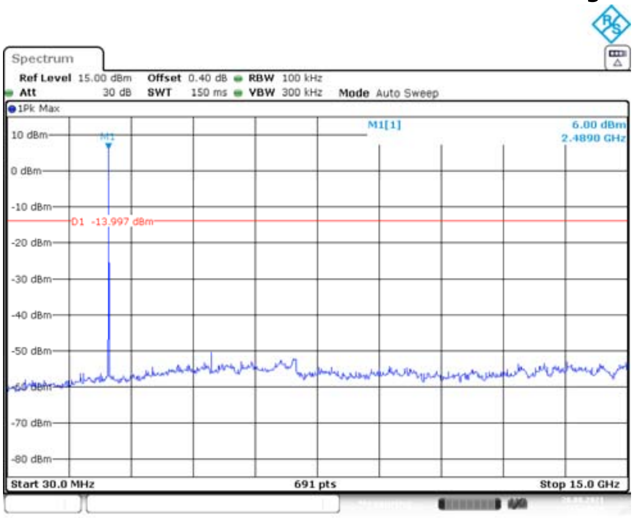


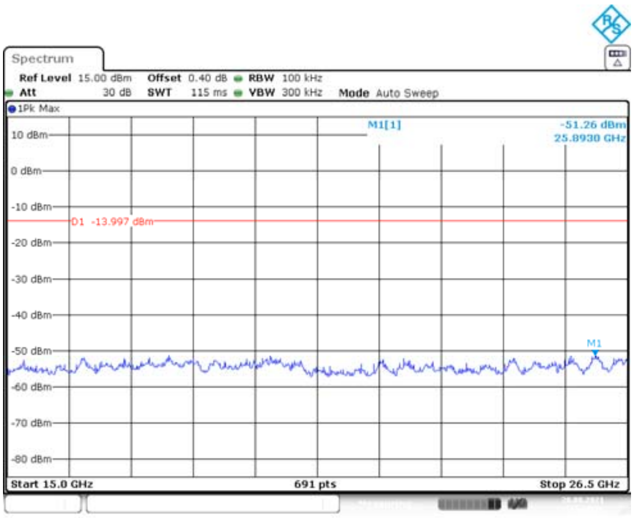
Middle channel





High channel





4.5 Radiated Emission

Test Location

☒ 10 m SAC (test distance : ☐ 10 m, ☒ 3 m)
☒ 3 m SAC (test distance : 3 m)

Test Procedures

1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
2) In the frequency rage above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) and Horn Test Antenna(above 1 GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.

Instrument Settings

Frequency Range = 9 kHz ~ 25 GHz (2.4 GHz 10^{th} harmonic)

a) RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz, 9 kHz for f < 30 MHz

b) VBW ≥ RBW

c) Sweep time = auto couple

Limit :

FCC Part 15 § 15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

Table 1. Restricted Frequency Bands

MHz	MHz	MHz	MHz	MHz	GHz
0.09-0.11	8.37626-8.38675	73-74.6	399.9-410	2690-2900	10.6-12.7
[1]0.495-0.505	8.41425-8.41475	74.8-75.2	608-614	3260-3267	13.25-13.4
2.1735-2.1905	12.29-12.293	108-121.94	960-1240	3332-3339	14.47-14.5
4.125-4.128	12.51975-12.52025	123-138	1300-1427	3345.8-3358	15.35-16.2
4.17725-4.17775	12.57675-12.57725	149.9-150.05	1435-1626.5	3600-4400	17.7-21.4
4.20725-4.20775	13.36-13.41	156.52475-156.52525	1645.5-1646.5	4500-5150	22.01-23.12
6.215-6.218	16.42-16.423	156.7-156.9	1660-1710	5350-5460	23.6-24
6.26775-6.26825	16.69475-16.69525	162.0125-167.17	1718.8-1722.2	7250-7750	31.2-31.8
6.31175-6.31225	16.80425-16.80475	167.72-173.2	2200-2300	8025-8500	36.43-36.5
8.291-8.294	25.5-25.67	240-285	**2310-2390**	9000-9200	[2]Above 38.6
8.362-8.366	37.5-38.25	322-335.4	**2483.5-2500**	9300-9500	

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

[2] Above 38.6

§ 15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown is Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

FCC Part 15 § 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 :

Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 2 Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 2. General Field Strength Limits for Licence-Exempt Transmitters

Frequency(MHz)	Field Strength (uA/m)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measurement Distance (meters)
0.009-0.490	6.37/F (F in kHz)	2400/F(kHz)	48.5 - 13.8	300
0.490-1.705	63.7/F (F in kHz)	24000/F(kHz)	33.8 - 23	30
1.705-30	0.08	30	29.5	30
30-88	-	100**	40	3
88-216	-	150**	43.5	3
216-960	-	200**	46	3
Above 960	-	500	54	3

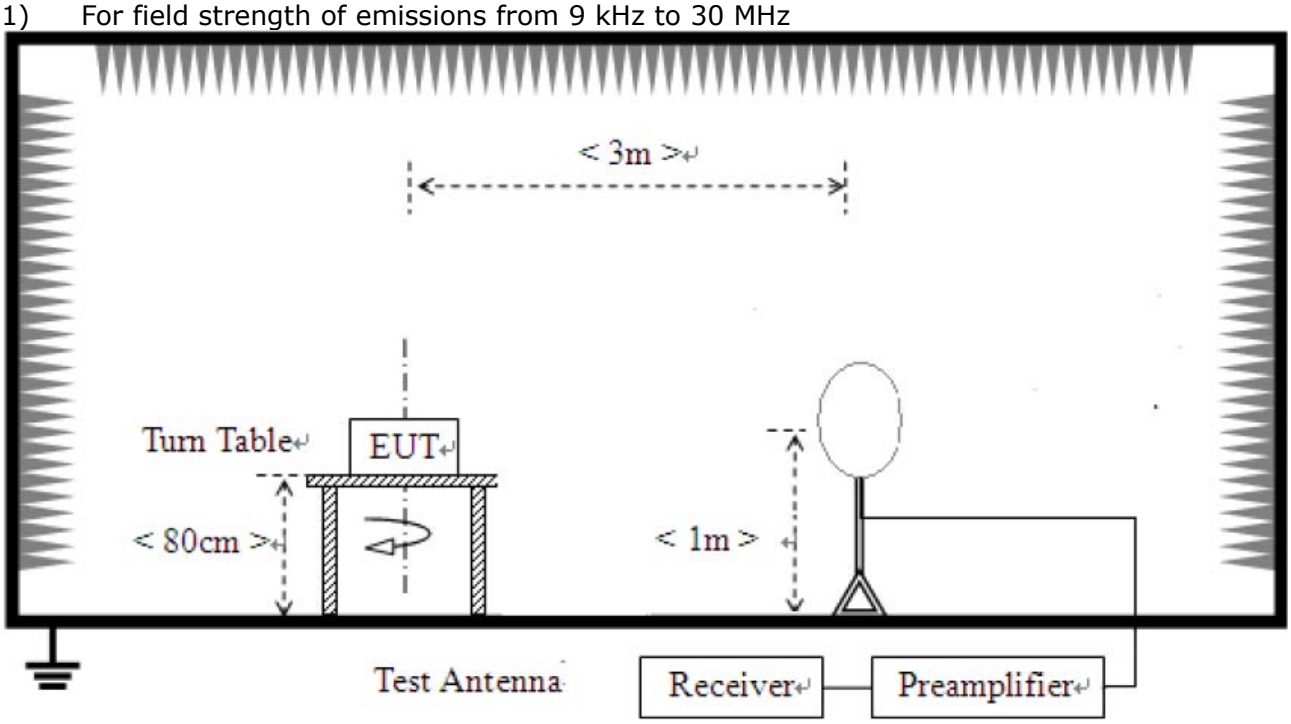
** Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

Note :

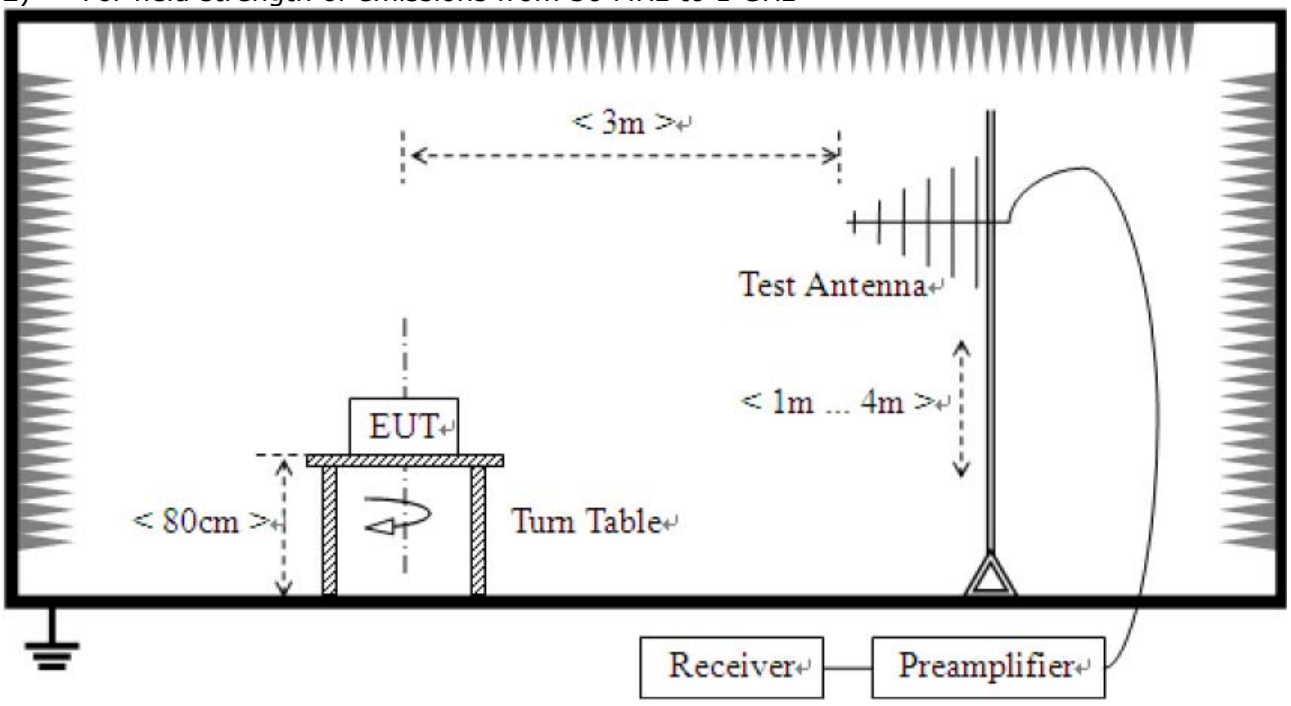
1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
2) For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)
3) For measurement above 1GHz, the resolution bandwidth is set to 1 MHz and video bandwidth is set to 3 MHz and detector is peak for peak measurement and detector RMS and Trace Averaging type for average measurement.

Test Setup:

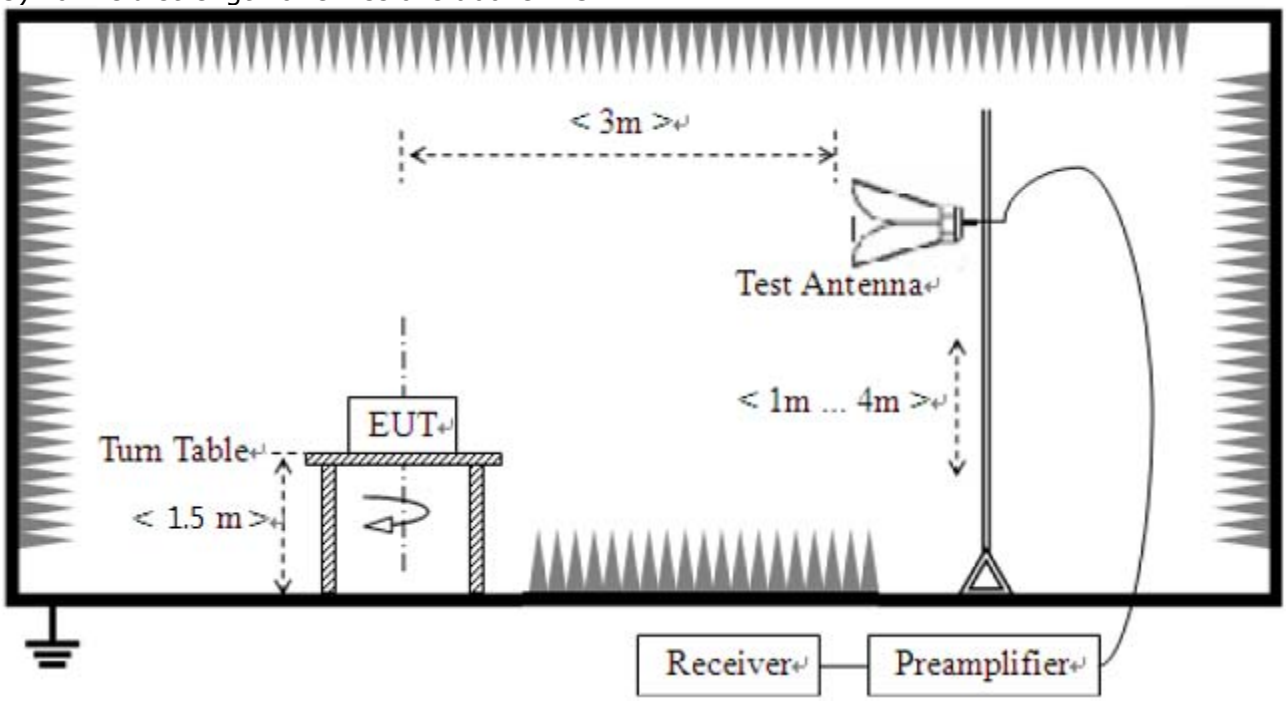
1) For field strength of emissions from 9 kHz to 30 MHz



2) For field strength of emissions from 30 MHz to 1 GHz



3) For field strength of emissions above 1 GHz

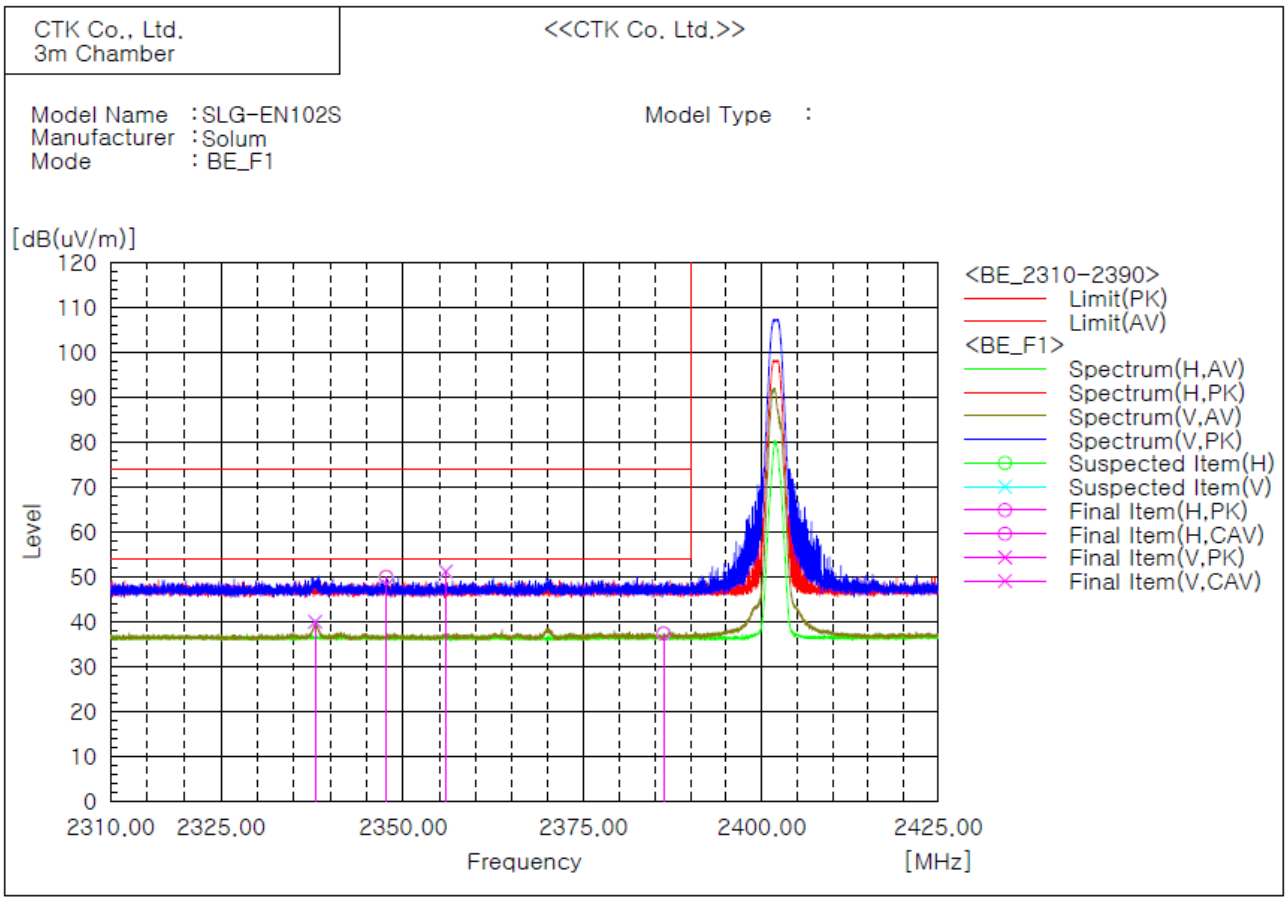


Test results

1) Restricted Frequency Bands

1. 2 310 MHz to 2 390 MHz

Test mode : ANT1



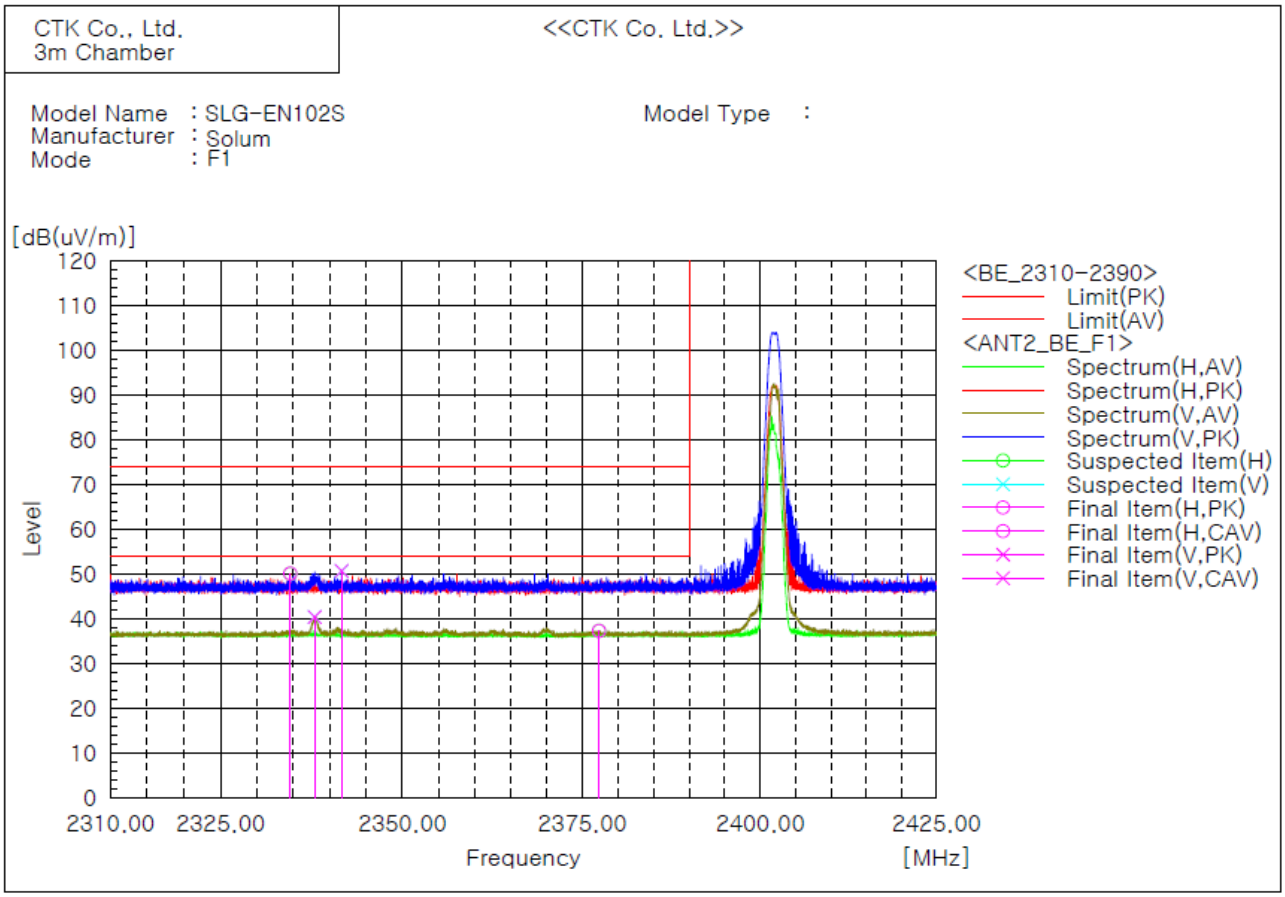
Final Result

No.	Frequency [MHz]	(P)	Reading PK [dB(uV)]	Reading CAV [dB(uV)]	o.f [dB(1/m)]	Result PK [dB(uV/m)]	Result CAV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin CAV [dB]	Height [cm]	Angle [deg]
1	2337.902	V	--------	43.0	-3.0	--------	40.0	74.0	54.0	--------	14.0	346.2	359.9
2	2347.677	H	53.1	--------	-3.1	50.0	--------	74.0	54.0	24.0	--------	356.1	40.8
3	2355.899	V	54.3	--------	-3.1	51.2	--------	74.0	54.0	22.8	--------	346.2	316.0
4	2386.216	H	--------	40.4	-3.0	--------	37.4	74.0	54.0	--------	16.6	99.8	359.9

Remark :

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(Z axis) and the worst case was recorded.
2. Result = Reading + c.f(correction factor)
3. Correction factor = Antenna factor + Cable loss - Amp Gain
4. ANT1 and ANT2 on the device do not work at the same time.

Test mode : ANT2



Final Result

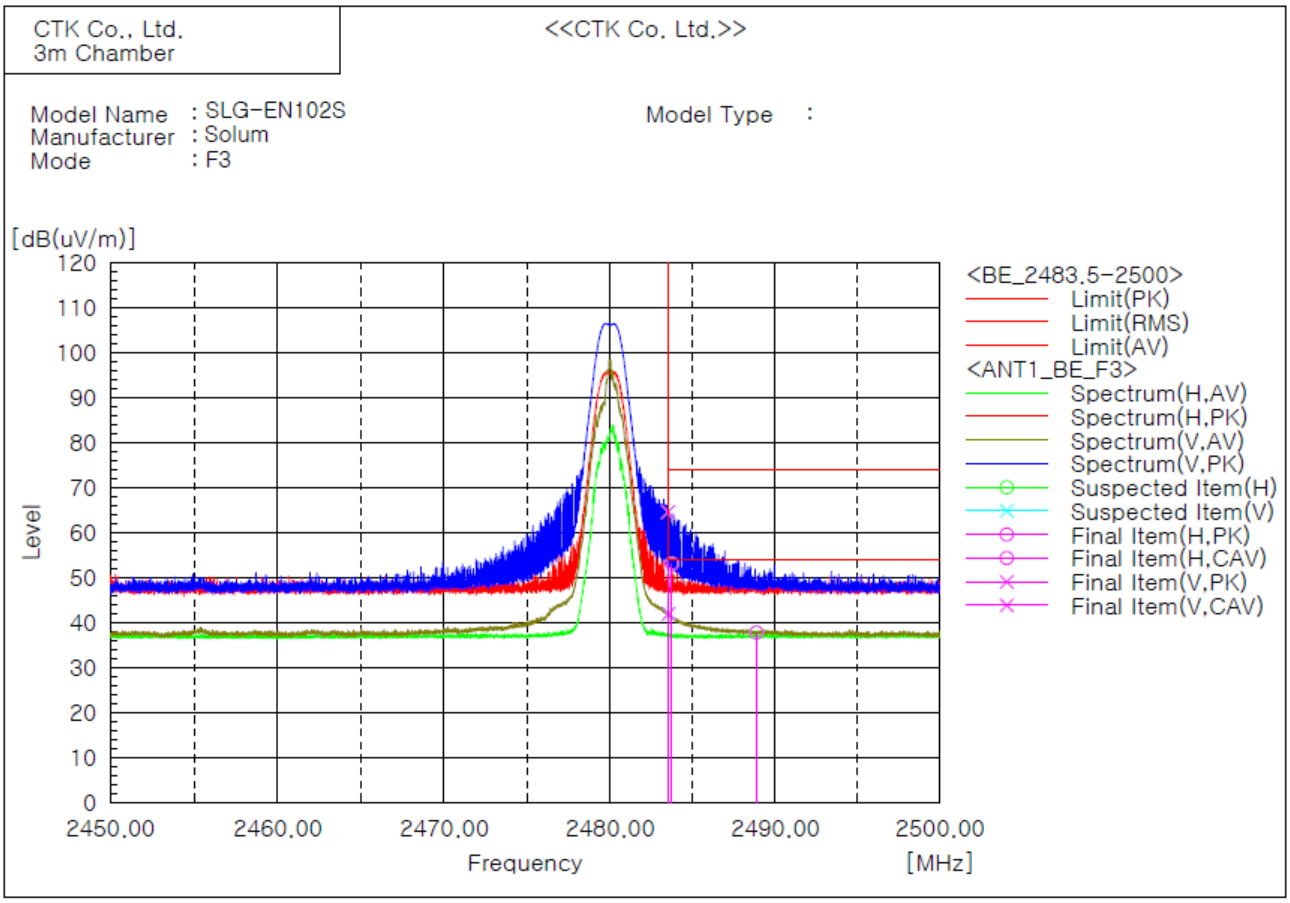
No.	Frequency [MHz]	(P)	Reading PK [dB(uV)]	Reading CAV [dB(uV)]	o.f [dB(1/m)]	Result PK [dB(uV/m)]	Result CAV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin CAV [dB]	Height [cm]	Angle [deg]
1	2334.567	H	53.1	--------	-3.0	50.1	--------	74.0	54.0	23.9	--------	356.2	0.1
2	2337.917	V	--------	43.4	-3.0	--------	40.4	74.0	54.0	--------	13.6	99.9	5.3
3	2341.639	V	53.8	--------	-3.1	50.7	--------	74.0	54.0	23.3	--------	99.9	5.3
4	2377.347	H	--------	40.3	-3.0	--------	37.3	74.0	54.0	--------	16.7	99.8	359.9

Remark :

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(Z axis) and the worst case was recorded.
2. Result = Reading + c.f(correction factor)
3. Correction factor = Antenna factor + Cable loss - Amp Gain
4. ANT1 and ANT2 on the device do not work at the same time.

2. 2 483.5 MHz – 2 500 MHz

Test mode : ANT1



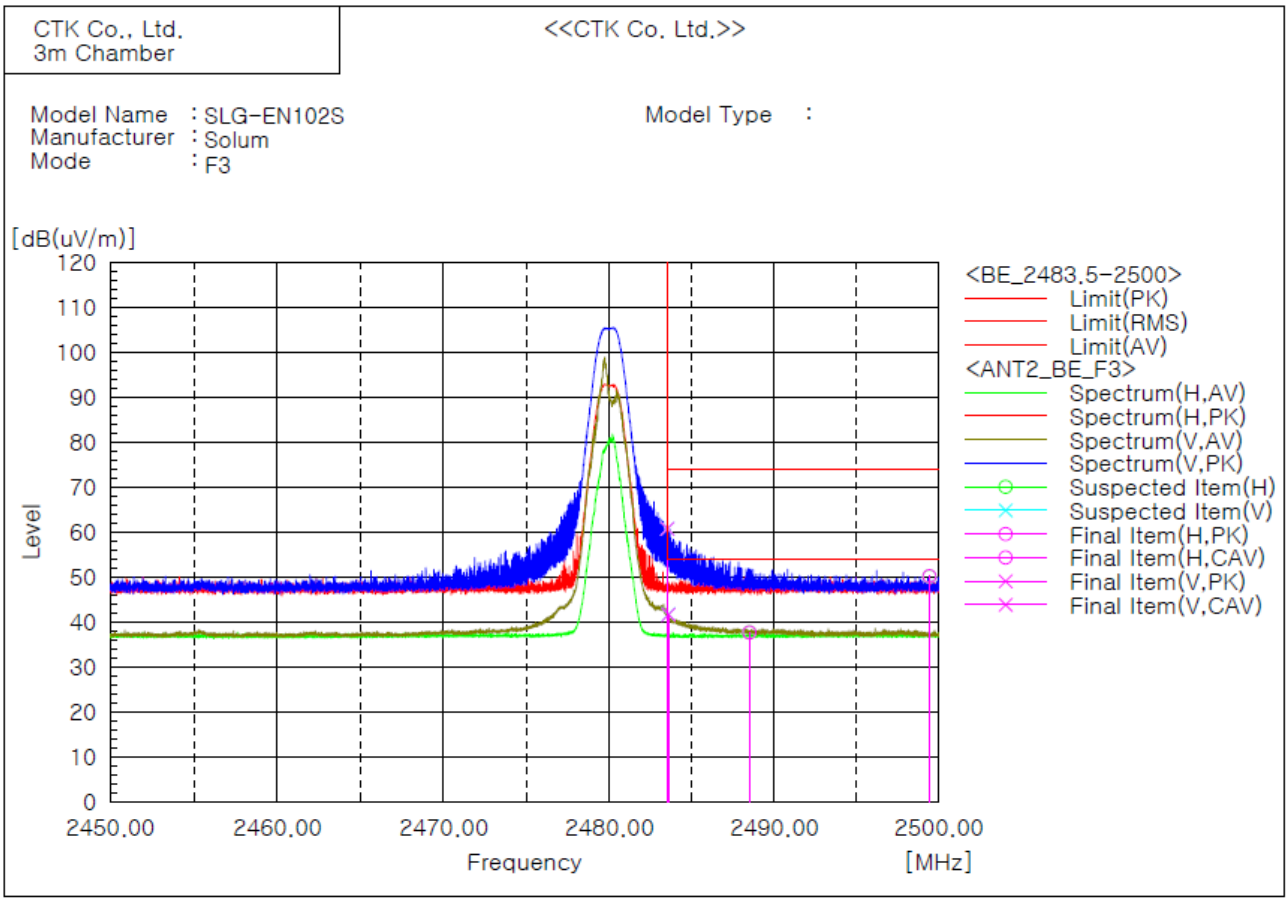
Final Result

No.	Frequency [MHz]	(P)	Reading PK [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Result CAV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin CAV [dB]	Height [cm]	Angle [deg]
1	2483.731	H	55.6	--------	-2.5	53.1	--------	74.0	54.0	20.9	--------	99.9	181.7
2	2488.863	H	--------	40.3	-2.5	--------	37.8	74.0	54.0	--------	16.2	99.9	0.0
3	2483.506	V	67.1	--------	-2.5	64.6	--------	74.0	54.0	9.4	--------	343.9	207.0
4	2483.538	V	--------	44.5	-2.5	--------	42.0	74.0	54.0	--------	12.0	343.9	182.9

Remark :

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(Z axis) and the worst case was recorded.
2. Result = Reading + c.f(correction factor)
3. Correction factor = Antenna factor + Cable loss - Amp Gain
4. ANT1 and ANT2 on the device do not work at the same time.

Test mode : ANT2



Final Result

No.	Frequency [MHz]	(P)	Reading PK [dB(uV)]	Reading CAV [dB(uV)]	o.f [dB(1/m)]	Result PK [dB(uV/m)]	Result CAV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin CAV [dB]	Height [cm]	Angle [deg]
1	2483.575	V	---------	44.2	-2.5	---------	41.7	74.0	54.0	---------	12.3	345.4	355.2
2	2483.506	V	63.3	---------	-2.5	60.8	---------	74.0	54.0	13.2	---------	345.4	349.5
3	2486.481	H	---------	40.2	-2.5	---------	37.7	74.0	54.0	---------	16.3	99.9	359.9
4	2499.431	H	52.7	---------	-2.5	50.2	---------	74.0	54.0	23.8	---------	99.9	298.6

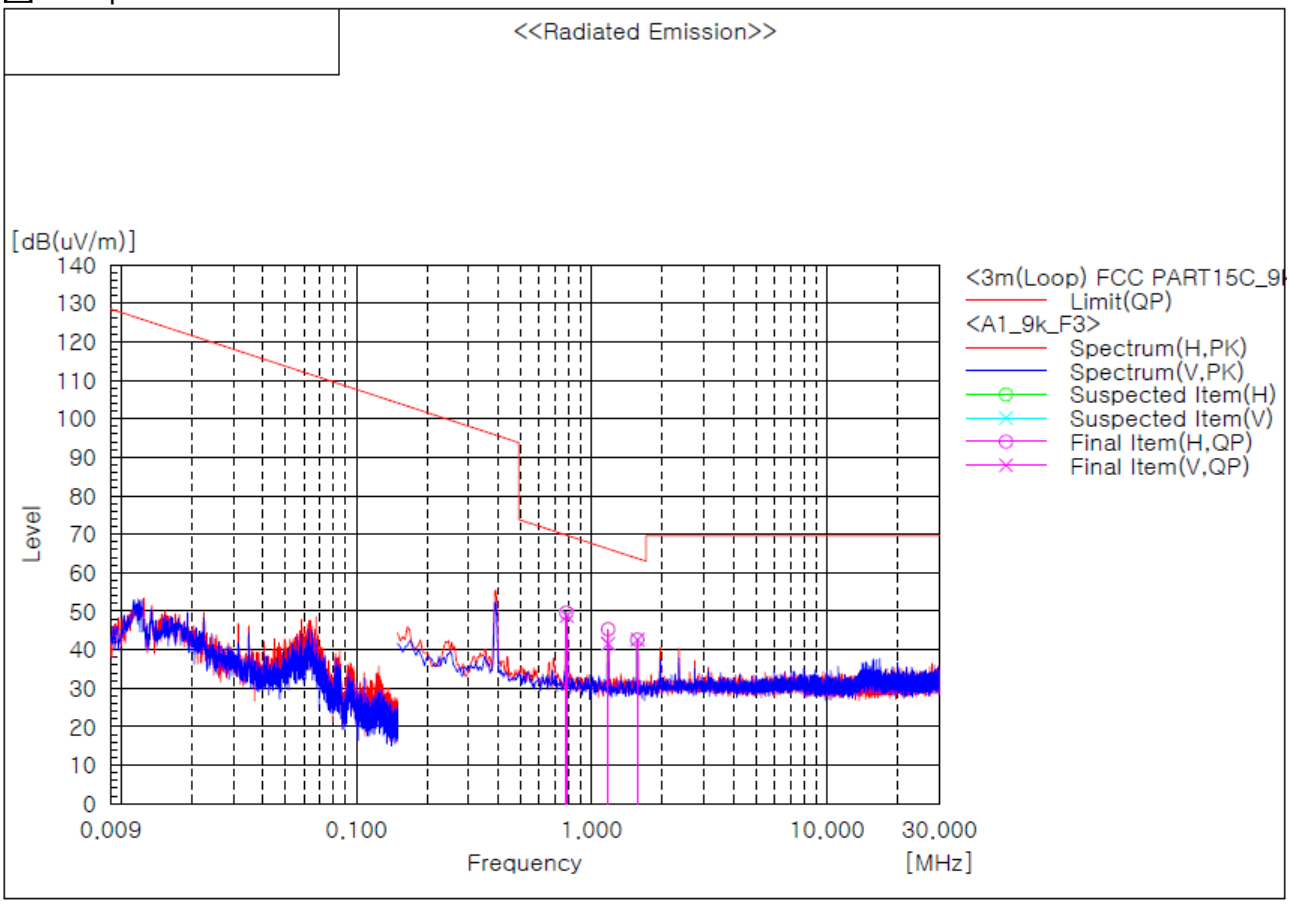
Remark :

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(Z axis) and the worst case was recorded.
2. Result = Reading + c.f(correction factor)
3. Correction factor = Antenna factor + Cable loss - Amp Gain
4. ANT1 and ANT2 on the device do not work at the same time.

2) Spurious
1. 9 kHz to 30 MHz

Test mode : ANT1, High Channel(Worst case)

The requirements are:
☒ Complies



Final Result

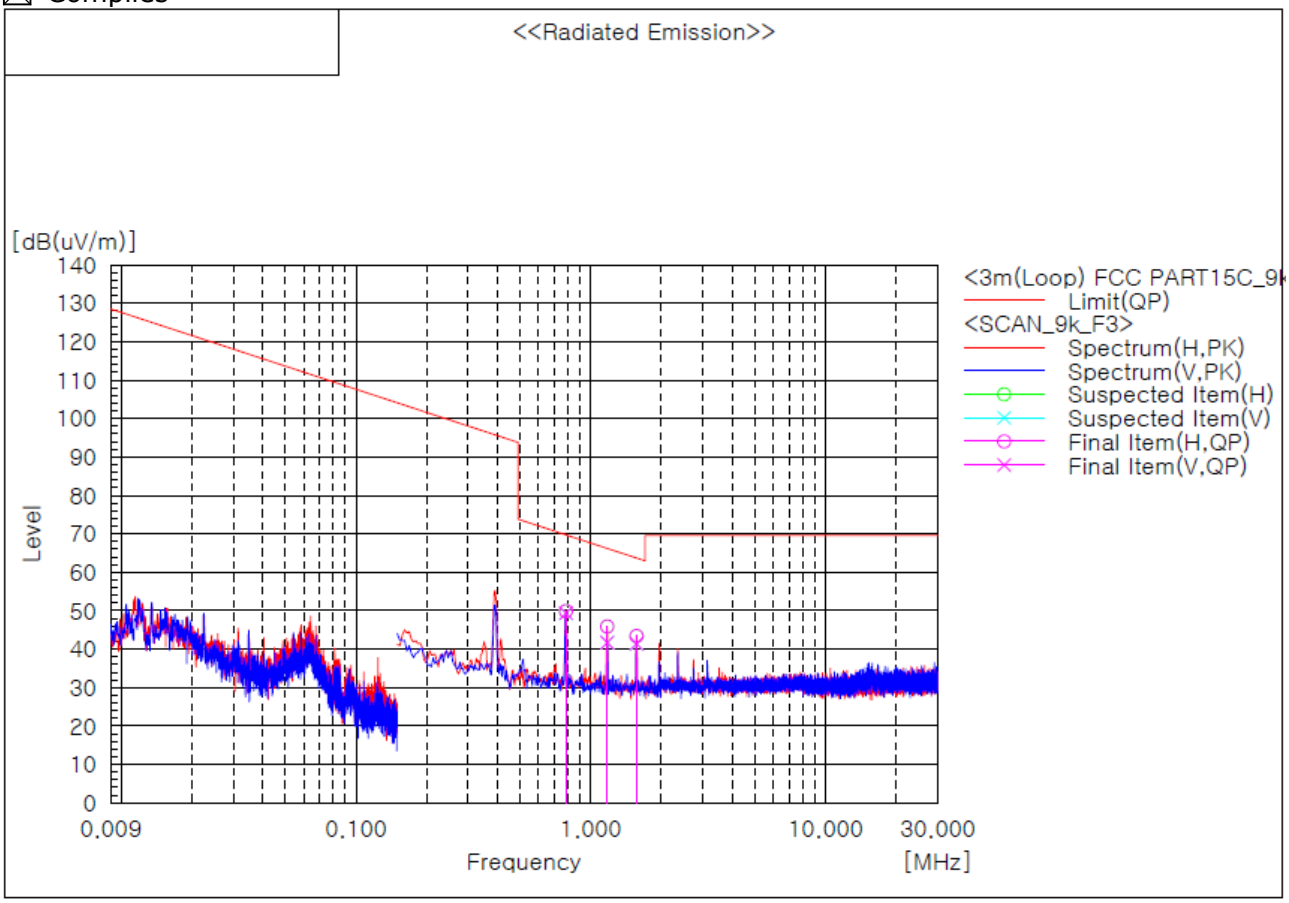
No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	0.781	H	24.6	25.0	49.6	69.8	20.2	100.0	313.0
2	0.784	V	23.8	25.0	48.8	69.7	20.9	100.0	240.0
3	1.176	H	20.3	25.0	45.3	66.2	20.9	100.0	241.0
4	1.176	V	16.5	25.0	41.5	66.2	24.7	100.0	293.0
5	1.564	H	17.6	25.0	42.6	63.7	21.1	100.0	293.0
6	1.568	V	17.6	25.0	42.6	63.7	21.1	100.0	240.0

Note :
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(Z axis) and the worst case was recorded.
2. Result = Reading + c.f(correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator
4. ANT1 and ANT2 on the device do not work at the same time.

* Reading data is the peak value.

Test mode : ANT2, High Channel(Worst case)

The requirements are:
☒ Complies



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	0.784	H	24.9	25.0	49.9	69.7	19.8	100.0	312.0
2	0.784	V	24.4	25.0	49.4	69.7	20.3	100.0	257.0
3	1.176	H	20.9	25.0	45.9	66.2	20.3	100.0	240.0
4	1.176	V	16.7	25.0	41.7	66.2	24.5	100.0	313.0
5	1.568	H	18.4	25.0	43.4	63.7	20.3	100.0	204.0
6	1.568	V	16.4	25.0	41.4	63.7	22.3	100.0	241.0

Note :
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(Z axis) and the worst case was recorded.
2. Result = Reading + c.f(correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator
4. ANT1 and ANT2 on the device do not work at the same time.

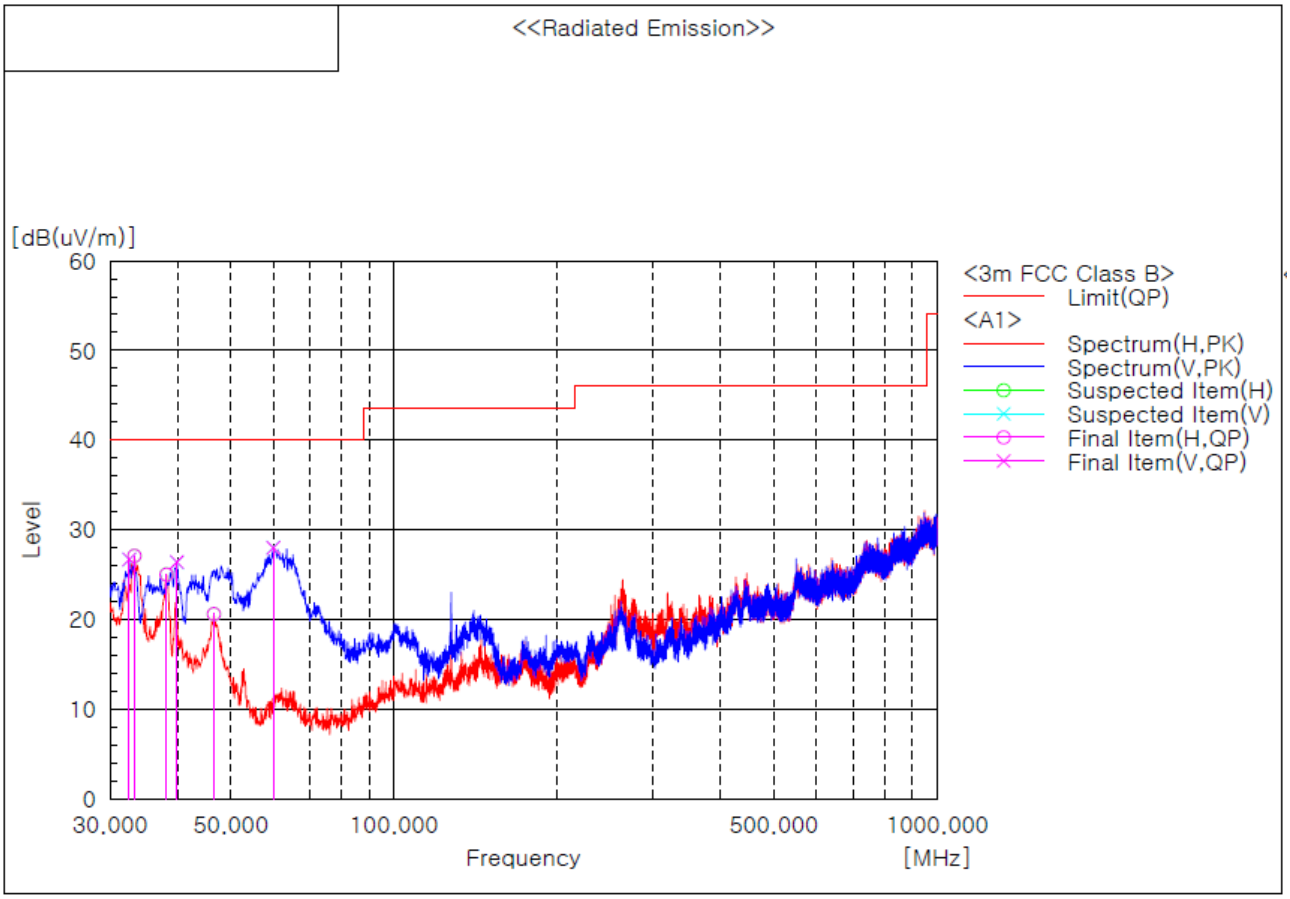
* Reading data is the peak value.

2. 30 MHz to 1 GHz

Test mode : ANT1, Transmit, Middle channel(Worst case)

The requirements are:
☒ Complies

Test Data



Final Result

--- QP Measurement ---

No.	Frequency [MHz]	Reading [dB(uV)][H/V]	c.f [dB(1/m)][H/V]	Result [dB(uV/m)][H/V]	Limit [dB(uV/m)]	Margin [dB][H/V]
1	32.546	-------/ 33.4	-------/ -6.7	-------/ 26.7	40.0	-------/ 13.3
2	33.274	34.1/-------	-7.0/-------	27.1/-------	40.0	12.9/-------
3	38.124	34.1/-------	-9.1/-------	25.0/-------	40.0	15.0/-------
4	39.821	-------/ 36.3	-------/ -9.9	-------/ 26.4	40.0	-------/ 13.6
5	46.611	34.1/-------	-13.5/-------	20.6/-------	40.0	19.4/-------
6	59.949	-------/ 46.5	-------/ -18.5	-------/ 28.0	40.0	-------/ 12.0

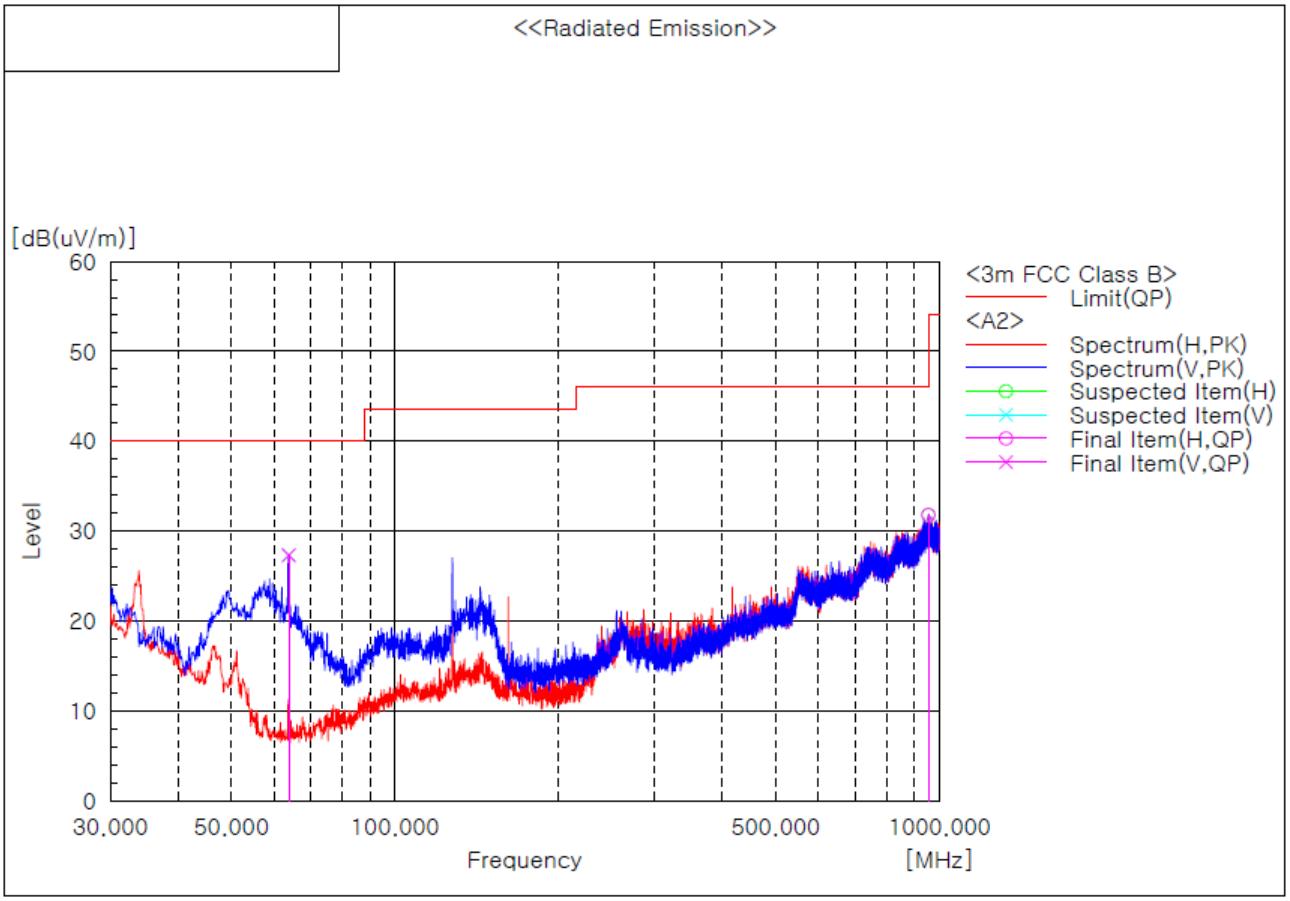
Remark :
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(Z axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
4. ANT1 and ANT2 on the device do not work at the same time.

* Reading data is the Quasi-peak value.

Test mode : ANT2, Transmit, Low Channel(Worst case)

The requirements are:
☒ Complies

Test Data



Final Result

--- QP Measurement ---

No.	Frequency [MHz]	Reading [dB(uV)][H/V]	c.f [dB(1/m)][H/V]	Result [dB(uV/m)][H/V]	Limit [dB(uV/m)]	Margin [dB][H/V]
1	63.829	-------/ 45.8	-------/ -18.5	-------/ 27.3	40.0	-------/ 12.7
2	955.138	23.4/-------	8.4/-------	31.8/-------	46.0	14.2/-------

Remark :
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(Z axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
4. ANT1 and ANT2 on the device do not work at the same time.

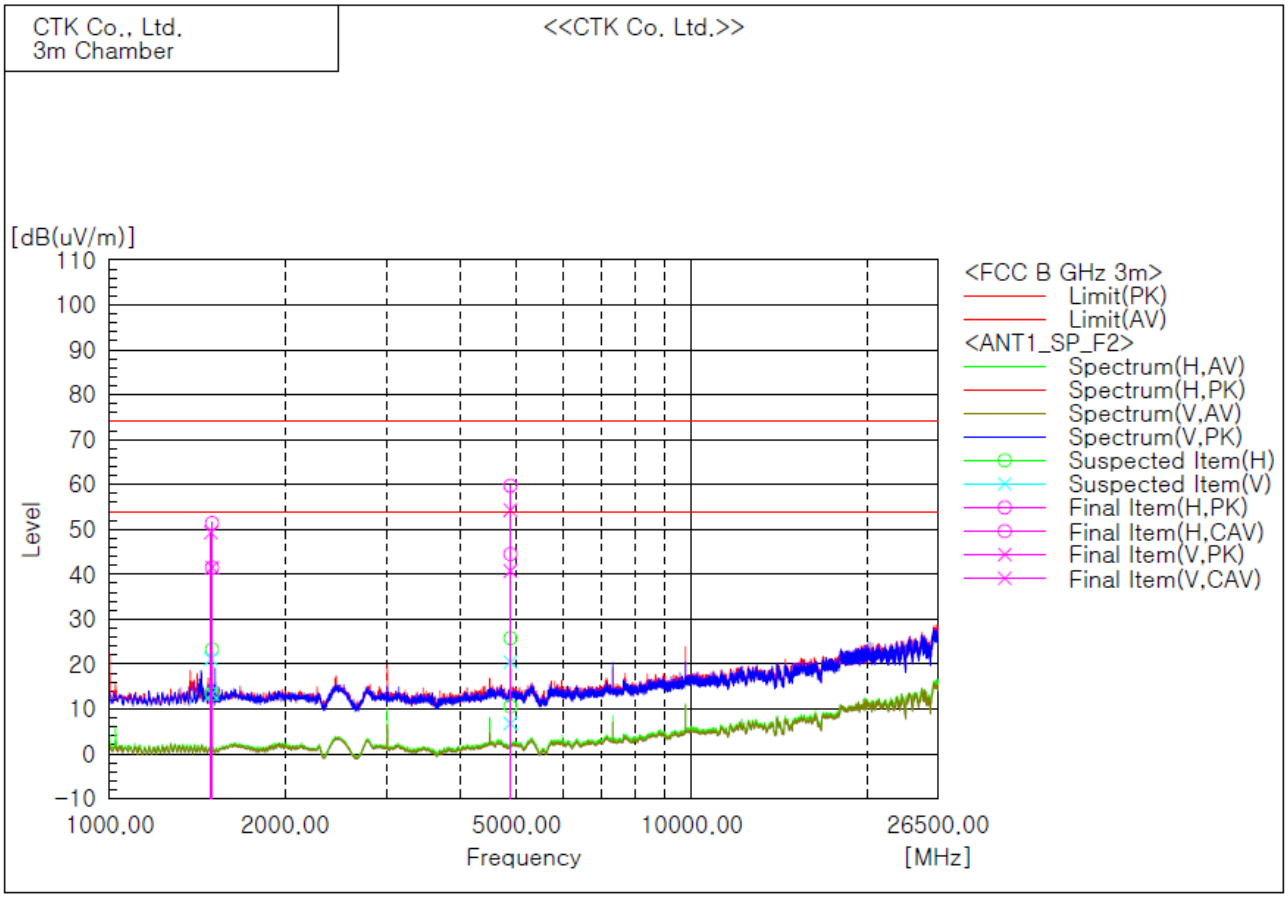
* Reading data is the Quasi-peak value.

3. 1 GHz to 26.5 GHz

Test mode : ANT1, Transmit, Middle channel(Worst case)

The requirements are:
☒ Complies

Test Data



Final Result

No.	Frequency [MHz]	(P)	Reading PK [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Result CAV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin CAV [dB]	Height [cm]	Angle [deg]
1	1499.375	V	---------	49.1	-7.6	---------	41.5	74.0	54.0	---------	12.5	464.2	62.3
2	1493.000	V	56.9	---------	-7.6	49.3	---------	74.0	54.0	24.7	---------	99.8	297.9
3	1499.375	H	---------	49.1	-7.6	---------	41.5	74.0	54.0	---------	12.5	99.9	73.8
4	1499.375	H	59.0	---------	-7.6	51.4	---------	74.0	54.0	22.6	---------	99.9	344.6
5	4880.250	V	---------	39.2	1.5	---------	40.7	74.0	54.0	---------	13.3	344.9	197.2
6	4880.250	V	52.8	---------	1.5	54.3	---------	74.0	54.0	19.7	---------	344.9	334.2
7	4880.250	H	---------	43.0	1.5	---------	44.5	74.0	54.0	---------	9.5	234.8	359.9
8	4880.250	H	58.2	---------	1.5	59.7	---------	74.0	54.0	14.3	---------	99.9	296.9

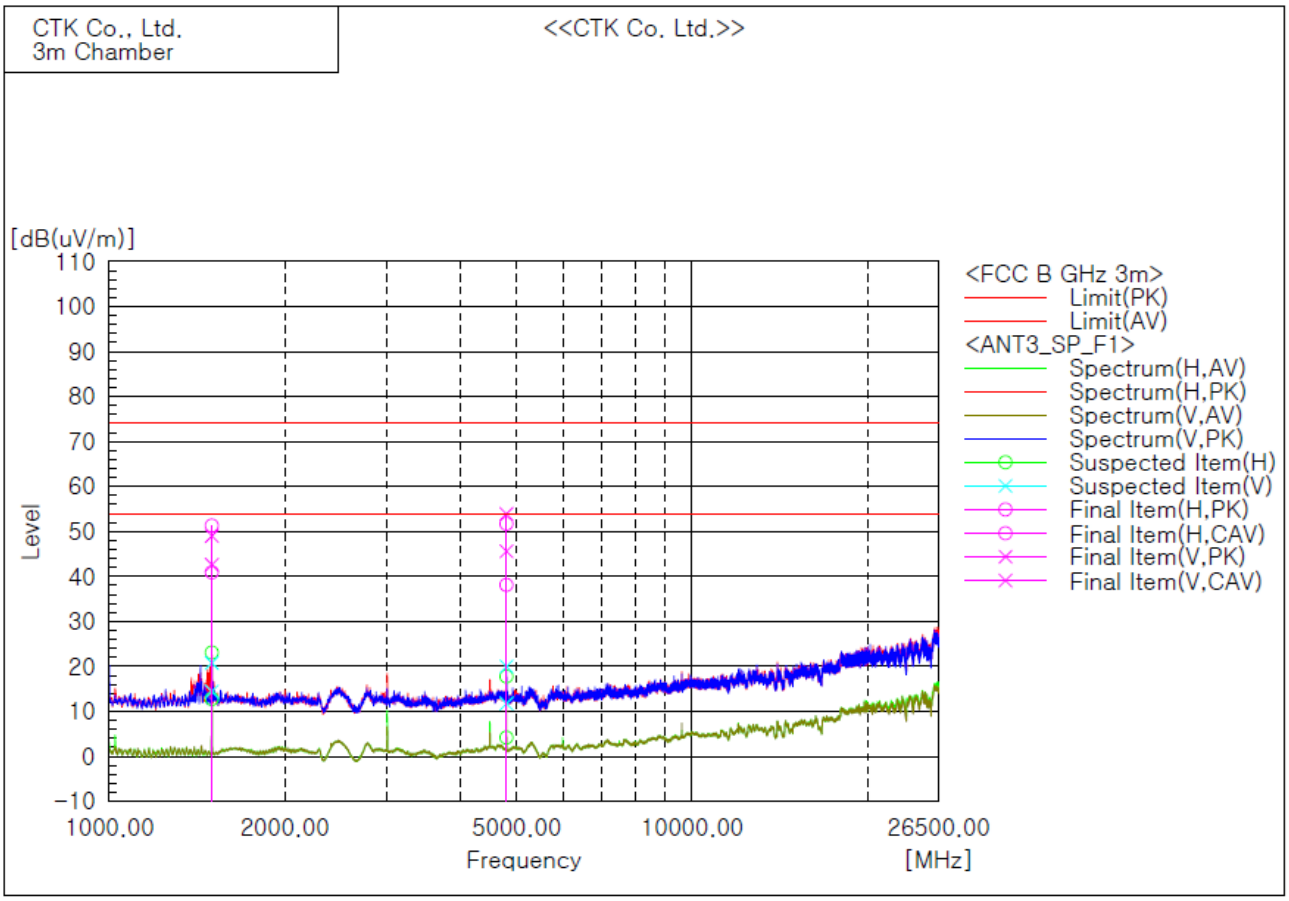
Remarks

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(correction factor)
3. Correction factor = Antenna factor + Cable loss - Amp Gain
4. ANT1 and ANT2 on the device do not work at the same time.

Test mode : ANT2, Transmit, Low channel(Worst case)

The requirements are:
☒ Complies

Test Data



Final Result

No.	Frequency [MHz]	(P)	Reading PK [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Result CAV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin CAV [dB]	Height [cm]	Angle [deg]
1	1499.375	H	---------	48.5	-7.6	---------	40.9	74.0	54.0	---------	13.1	99.8	65.0
2	1499.375	V	---------	50.2	-7.6	---------	42.6	74.0	54.0	---------	11.4	464.1	64.5
3	1499.375	V	56.6	---------	-7.6	49.0	---------	74.0	54.0	25.0	---------	99.8	27.0
4	1499.375	H	58.9	---------	-7.6	51.3	---------	74.0	54.0	22.7	---------	99.8	351.4
5	4803.750	H	---------	36.8	1.3	---------	38.1	74.0	54.0	---------	15.9	99.8	351.4
6	4803.750	V	---------	44.3	1.3	---------	45.6	74.0	54.0	---------	8.4	344.7	359.9
7	4803.750	H	50.4	---------	1.3	51.7	---------	74.0	54.0	22.3	---------	99.8	314.5
8	4803.750	V	52.6	---------	1.3	53.9	---------	74.0	54.0	20.1	---------	344.7	344.9

Remarks

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(correction factor)
3. Correction factor = Antenna factor + Cable loss - Amp Gain
4. ANT1 and ANT2 on the device do not work at the same time.

4.6 AC Power Line Conducted Emissions

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits.

Instrument Settings

IF Band Width: 9 kHz

Test Procedures

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m.
Amplitude measurements were performed with a quasi-peak detector and an average detector.

Limit

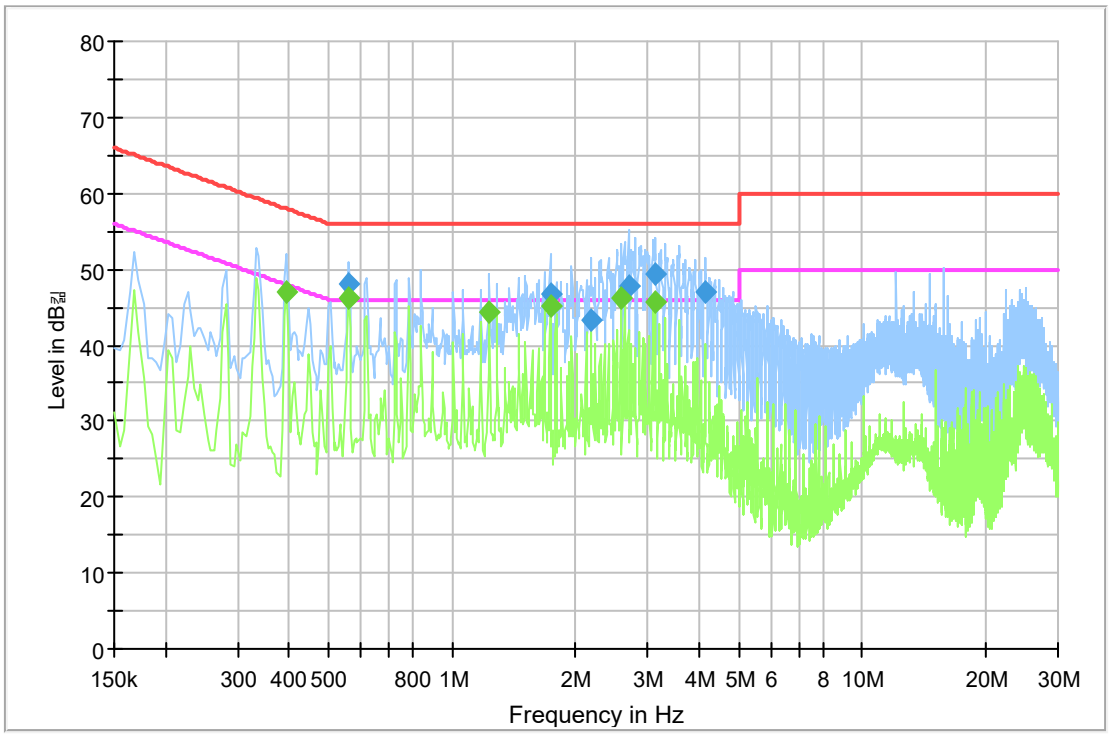
Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average**
0.15 ~ 0.5	66 to 56*	56 to 46*
0.5 ~ 5	56	46
5 ~ 30	60	50

* The level decreases linearly with the logarithm of the frequency.
** A linear average detector is required.

Test Results :

The requirements are:
☒ Complies

Test mode : ANT1
[L1]



Final Result 1

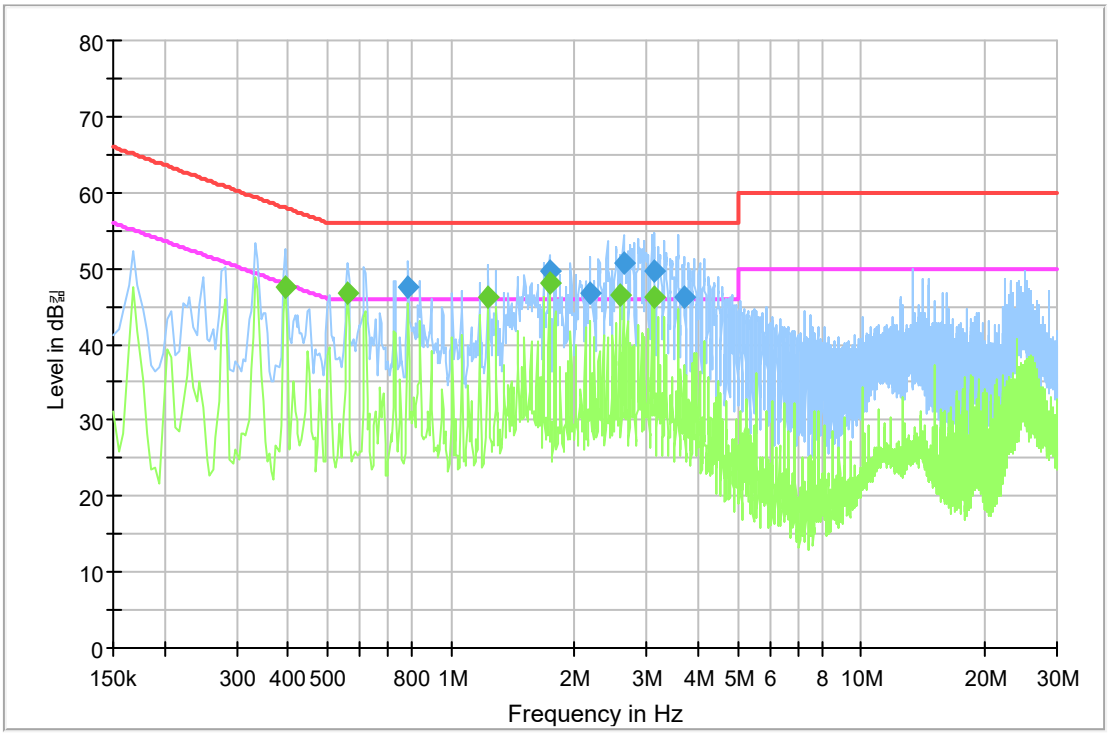
Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.559500	48.1	1000.0	9.000	On	L1	9.9	7.9	56.0
1.734000	46.7	1000.0	9.000	On	L1	9.8	9.3	56.0
2.184000	43.4	1000.0	9.000	On	L1	9.8	12.6	56.0
2.688000	47.8	1000.0	9.000	On	L1	9.8	8.2	56.0
3.133500	49.3	1000.0	9.000	On	L1	9.8	6.7	56.0
4.137000	47.1	1000.0	9.000	On	L1	9.9	8.9	56.0

Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.393000	46.9	1000.0	9.000	On	L1	9.9	1.1	48.0
0.559500	46.1	1000.0	9.000	On	L1	9.9	-0.1	46.0
1.230000	44.4	1000.0	9.000	On	L1	9.8	1.6	46.0
1.734000	45.1	1000.0	9.000	On	L1	9.8	0.9	46.0
2.575500	46.1	1000.0	9.000	On	L1	9.8	-0.1	46.0
3.133500	45.7	1000.0	9.000	On	L1	9.8	0.3	46.0

[NEUTRAL]

3CE_Class B_N



Final Result 1

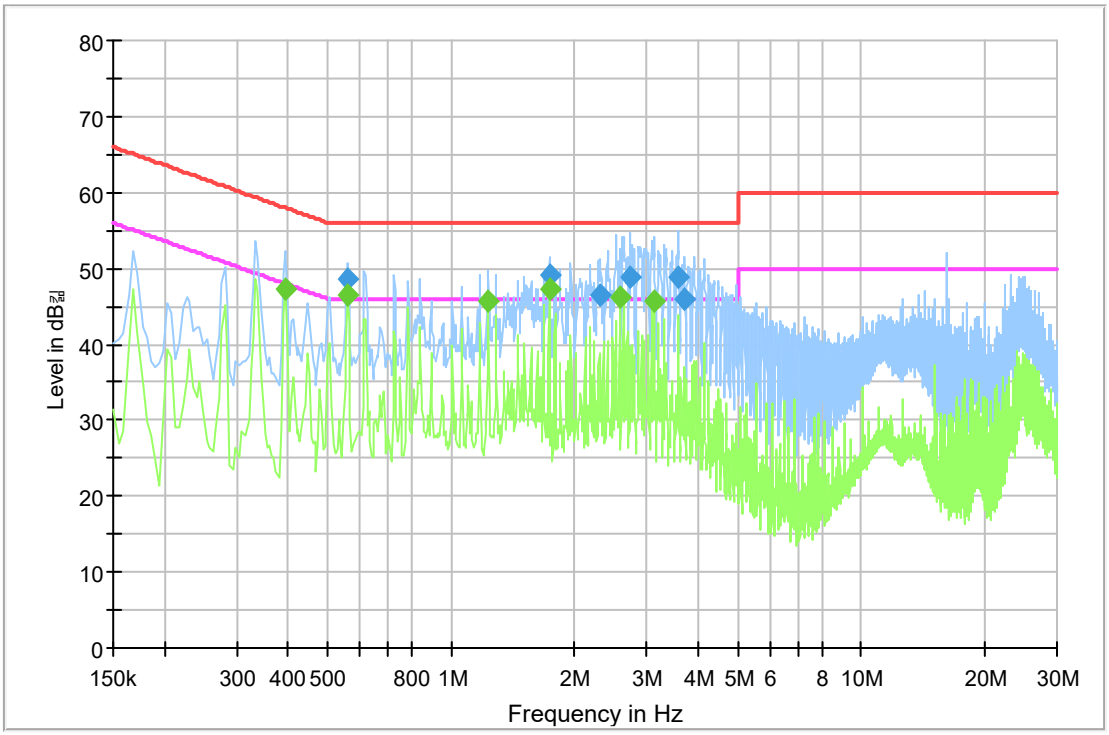
Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.784500	47.6	1000.0	9.000	On	N	9.8	8.4	56.0
1.734000	49.7	1000.0	9.000	On	N	9.7	6.3	56.0
2.184000	46.7	1000.0	9.000	On	N	9.7	9.3	56.0
2.629500	50.8	1000.0	9.000	On	N	9.7	5.2	56.0
3.133500	49.6	1000.0	9.000	On	N	9.7	6.4	56.0
3.696000	46.2	1000.0	9.000	On	N	9.7	9.8	56.0

Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.393000	47.5	1000.0	9.000	On	N	9.9	0.5	48.0
0.559500	46.7	1000.0	9.000	On	N	9.9	-0.7	46.0
1.230000	46.3	1000.0	9.000	On	N	9.8	-0.3	46.0
1.734000	48.0	1000.0	9.000	On	N	9.7	-2.0	46.0
2.575500	46.6	1000.0	9.000	On	N	9.7	-0.6	46.0
3.133500	46.2	1000.0	9.000	On	N	9.7	-0.2	46.0

Test mode : ANT2
[L1]

3CE_Class B_L1



Final Result 1

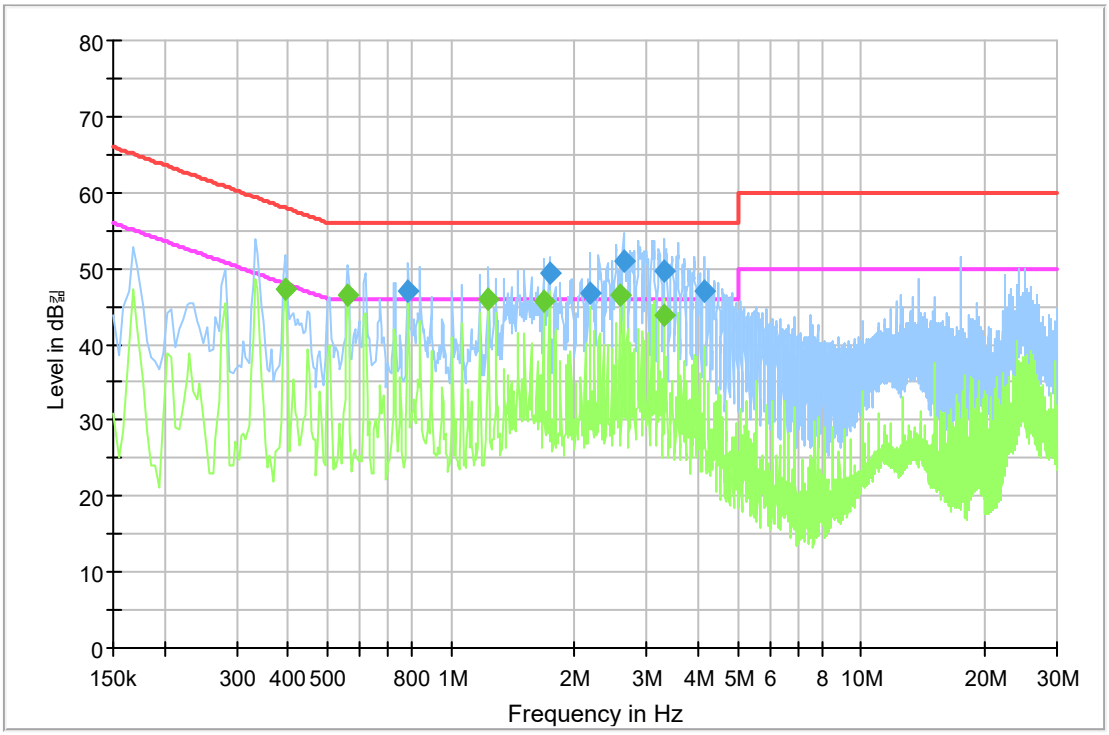
Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.559500	48.5	1000.0	9.000	On	L1	9.9	7.5	56.0
1.734000	49.1	1000.0	9.000	On	L1	9.8	6.9	56.0
2.296500	46.4	1000.0	9.000	On	L1	9.8	9.6	56.0
2.742000	48.8	1000.0	9.000	On	L1	9.8	7.2	56.0
3.583500	49.0	1000.0	9.000	On	L1	9.8	7.0	56.0
3.691500	46.0	1000.0	9.000	On	L1	9.8	10.0	56.0

Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.393000	47.1	1000.0	9.000	On	L1	9.9	0.9	48.0
0.559500	46.5	1000.0	9.000	On	L1	9.9	-0.5	46.0
1.230000	45.7	1000.0	9.000	On	L1	9.8	0.3	46.0
1.734000	47.3	1000.0	9.000	On	L1	9.8	-1.3	46.0
2.575500	46.1	1000.0	9.000	On	L1	9.8	-0.1	46.0
3.133500	45.6	1000.0	9.000	On	L1	9.8	0.4	46.0

[NEUTRAL]

3CE_Class B_N



Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.784500	47.1	1000.0	9.000	On	N	9.8	8.9	56.0
1.734000	49.4	1000.0	9.000	On	N	9.7	6.6	56.0
2.184000	46.8	1000.0	9.000	On	N	9.7	9.2	56.0
2.629500	50.8	1000.0	9.000	On	N	9.7	5.2	56.0
3.309000	49.6	1000.0	9.000	On	N	9.7	6.4	56.0
4.137000	46.9	1000.0	9.000	On	N	9.8	9.1	56.0

Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.393000	47.3	1000.0	9.000	On	N	9.9	0.7	48.0
0.559500	46.5	1000.0	9.000	On	N	9.9	-0.5	46.0
1.230000	46.1	1000.0	9.000	On	N	9.8	-0.1	46.0
1.680000	45.7	1000.0	9.000	On	N	9.7	0.3	46.0
2.575500	46.4	1000.0	9.000	On	N	9.7	-0.4	46.0
3.309000	43.8	1000.0	9.000	On	N	9.7	2.2	46.0

APPENDIX A – Test Equipment Used For Tests

No.	Name of Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	SPECTRUM ANALYZER	R&S	FSV30	100925	2021-01-14	2022-01-14
2	EMI Test Receiver	Rohde & Schwarz	ESCI7	100814	2020-10-20	2021-10-20
3	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-126	2020-05-20	2022-05-20
4	Bilog Antenna	Schaffner	CBL6111C	2551	2021-03-22	2023-03-22
5	AMPLIFIER	SONOMA	310	291721	2021-01-22	2022-01-22
6	6dB Attenuator	R&S	DNF	272.4110.50-2	2020-10-23	2021-10-23
7	EMI Test Receiver	Rohde & Schwarz	ESU40	100336	2021-01-12	2022-01-12
8	Double Ridged Guide Antenna	ETS-Lindgren	3117	00154525	2019-10-14	2021-10-14
9	Double Ridged Guide Antenna	ETS-Lindgren	3116	00062916	2020-04-14	2022-04-14
10	Preamplifier	Agilent	8449B	3008A02011	2020-11-30	2021-11-30
11	Band Reject Filter	Micro Tronics	BRM50702	G233	2021-01-14	2022-01-14
12	Signal Generator	R&S	SMB100A	175528	2021-04-12	2022-04-12
13	DC Power Supply	Agilent	E3632A	MY40011638	2021-10-06	2022-10-06
14	6dB Attenuator	BIRD	5W 6dB	1744	2020-12-16	2021-12-16
15	LISN	R&S	ENV216	101236	2020-10-20	2021-10-20
16	EMI Test Receiver	R&S	ESCI3	100032	2021-01-15	2022-01-15

No.	Name of Equipment	Manufacturer	Model No.	Serial No.	Check Date
1	RF Cable (conducted)	Junkosha Inc.	MWX221	1510S087	2021-02-02
2	3m Loop Cable (Radiated)	HUBER+SUHNER	N/A	N/A	2020-10-25
3	3 m 1GHz Above RF Cable (Radiated)	HUBER+SUHNER	SUCOFLEX 104	MY27558/4	2021-01-28
4	3 m 1GHz Below RF Cable (Radiated)	HUBER+SUHNER	SUCOFLEX 104	N/A (below 1GHz)	2021-01-28
4	3 m 1GHz Above RF Cable (Radiated)	HUBER+SUHNER	SUCOFLEX 104	MY27573/4	2020-12-12
5	3 m 1GHz Above RF Cable (Radiated)	HUBER+SUHNER	SUCOFLEX 104	801924/4	2020-12-12
6	3 m 1GHz Above RF Cable (Radiated)	HUBER+SUHNER	SUCOFLEX 102	MY4728/2	2021-02-02
7	3 m 1GHz Above RF Cable (Radiated)	HUBER+SUHNER	SUCOFLEX 102	MY2374/2	2021-02-02