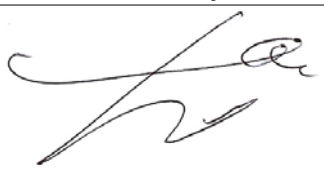
TEST REPORT

1. Applicant		
Name	:	ARAM Solution Co.,Ltd
Brand Name	:	N/A
Address	:	Venture-dong #202, jeonbuk technopark,109, Ballyong-ro, Deokjin-gu, Jeonju-si, Jeollabuk-do, Korea
FCC ID	:	2AAVTABP-1000
2. Products		
Name	:	BESEN
Model No.	:	ABP-1000
Variant Model No.	:	N/A
Manufacturer	:	ARAM Solution Co.,Ltd
Address	:	Venture-dong #202, jeonbuk technopark,109, Ballyong-ro, Deokjin-gu, Jeonju-si, Jeollabuk-do, Korea
3. Test Standard	:	47 CFR Part 15, Subpart C
4. Test Method	:	ANSI C63.10-2013
5. Test Result	:	PASS
6. Dates of Test	:	December 08, 2016 to December 14, 2016
7. Date of Issue	:	December 16, 2016
8. Test Laboratory	:	Standard Engineering Co. Ltd. FCC Designation Number : 624439

Tested by	Approved by
	
SoonHo, Kim / Test Engineer	SeongSeok, Seo / Compliance Engineer

Standard Engineering Co. Ltd.

377-11, Sinjang-ri, Eumam-myeon, Seosan-si,
ChoongNam 356-844, South Korea
Tel.: +82-41-663-9436, Fax :+82-41-663-9434
www.stdeng.com

1. Test Summary

Test	Test Requirement	Test method	Result
Antenna Requirement	47 CFR Part 15, Subpart C Section 15.203/15.247 (c)	ANSI C63.10 2013	PASS
AC Power Line Conducted Emission	47 CFR Part 15, Subpart C Section 15.207	ANSI C63.10 2013	PASS
Conducted Peak Output Power	47 CFR Part 15, Subpart C Section 15.247 (b)(3)	KDB558074 D01 v03r05	PASS
6dB Occupied Bandwidth	47 CFR Part 15, Subpart C Section 15.247 (a)(2)	KDB558074 D01 v03r05	PASS
Power Spectral Density	47 CFR Part 15, Subpart C Section 15.247 (e)	KDB558074 D01 v03r05	PASS
Band-edge for RF Conducted Emissions	47 CFR Part 15, Subpart C Section 15.247(d)	KDB558074 D01 v03r05	PASS
RF Conducted Spurious Emissions	47 CFR Part 15, Subpart C Section 15.247(d)	KDB558074 D01 v03r05	PASS
Radiated Spurious Emissions	47 CFR Part 15, Subpart C Section 15.205/15.209	ANSI C63.10 2013	PASS
Band Edge (Radiated Emission)	47 CFR Part 15, Subpart C Section 15.205/15.209	ANSI C63.10 2013	PASS

2. TABLE OF CONTENTS

3. General Information

3.1. Client Information

Applicant : ARAM Solution Co.,Ltd
Address of Applicant : Venture-dong #202, jeonbuk technopark,109, Ballyong-ro, Deokjin-gu, Jeonju-si, Jeollabuk-do, Korea

3.2. General Description of E.U.T.

Product Name : BESEN
Model No. : ABP-1000

3.3. Details of E.U.T.

Operation Frequency	:	2402 MHz to 2480 MHz
Wireless Type	:	Bluetooth
Channel Numbers	:	40 Channels
Channel Spacing	:	2MHz
Type of Modulation	:	GFSK
Antenna Type	:	Pattern Antenna
Antenna Gain	:	-0.68 dBi
Test Software	:	nrfgostudio_win-64_1.21.2_installer
Power Supply	:	DC 5.0 V
Test Voltage	:	DC 5.0 V

3.4. Operation Frequency each of channel

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2402MHz	11	2422MHz	21	2442MHz	31	2462MHz
2	2404MHz	12	2424MHz	22	2444MHz	32	2464MHz
3	2406MHz	13	2426MHz	23	2446MHz	33	2466MHz
4	2408MHz	14	2428MHz	24	2448MHz	34	2468MHz
5	2410MHz	15	2430MHz	25	2450MHz	35	2470MHz
6	2412MHz	16	2432MHz	26	2452MHz	36	2472MHz
7	2414MHz	17	2434MHz	27	2454MHz	37	2474MHz
8	2416MHz	18	2436MHz	28	2456MHz	38	2476MHz
9	2418MHz	19	2438MHz	29	2458MHz	39	2478MHz
10	2420MHz	20	2440MHz	30	2460MHz	40	2480MHz

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
Lowest channel	2402MHz
Middle channel	2440MHz
Highest channel	2480MHz

3.5. Description of Support Units

The EUT has been tested with corresponding accessories as below:

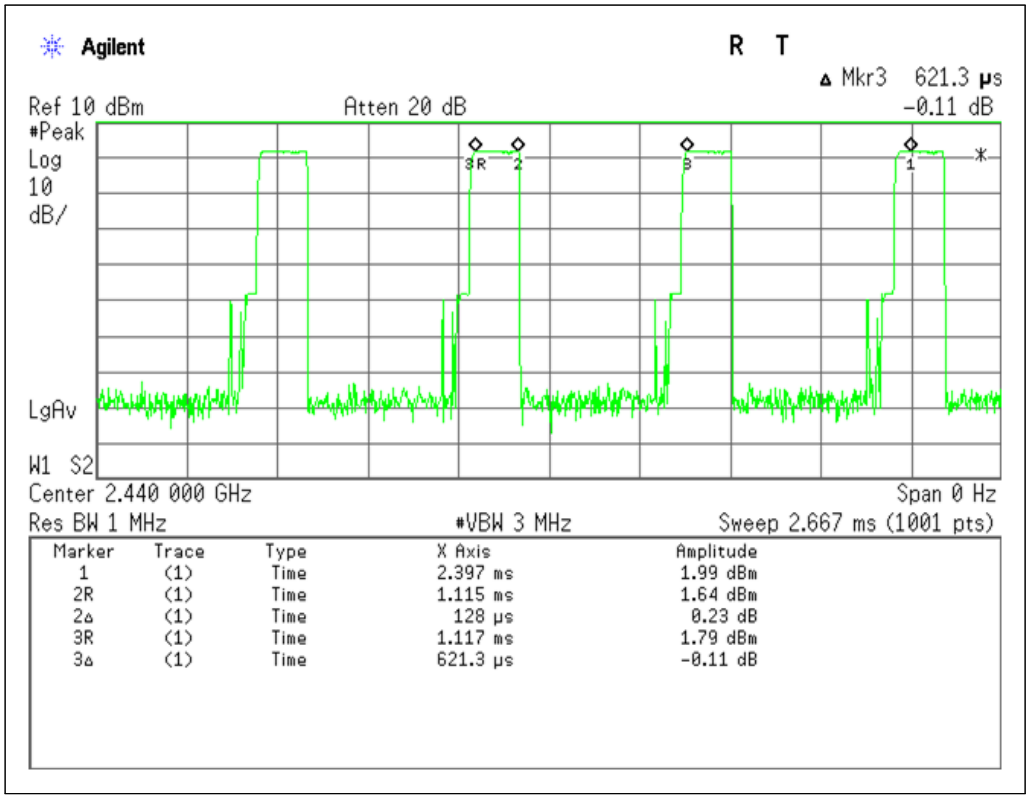
Supplied by Standard Engineering Laboratory.:

Description	Manufacturer	Model No.	Serial No.
NoteBook	LG	SD550	308QCZP556717
USB Cable	-	-	-
Jig	NORDIC SEMICONDUCTOR	JVE-M2	E232940
Power Supply	Provice	PWS-5005D	205050

3.6. Duty Cycle Of Test signal

Duty cycle is <93%, duty factor shall be considered. Duty cycle=Tx on/(Tx on+Tx off), Duty factor=10*log(1/duty cycle)

Band	Rate	Duty cycle	Duty Cycle Factor
2.4 GHz band	1 Byte	0.206	6.86



3.7. Abnormalities from Standard Conditions

None.

3.8. Other Information Requested by the Customer

None.

3.9. Test Location

377-11, Sinjang-ri, Eumam-myeon, Seosan-si, ChoongNam 356-844, South Korea
(FCC Designation Number : 624439)

This test site is in compliance with ISO/IEC 17025 for general requirements for the competence of testing and calibration laboratories.

4. Equipment Used during Test

No.	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Data	Used equipment
1	EMI Test Receiver	LIG	LSA-265	L07098033	03/08/2016	03/08/2017	■
2	EMI Test Receiver	Rhode & Schwarz	ESIB7	3311	02/11/2016	02/11/2017	■
3	Bi-log Antenna	Schwarzbeck	VULB9163	164	09/15/2014	09/30/2017	■
4	Loop Antenna	EMCO	6502	9206-2769	01/28/2016	01/28/2018	■
5	Spectrum Analyzer	Agilent	E4440A	US45303130	01/26/2016	01/26/2017	■
6	Frequency Counter	HP	5347A	3009A02742	01/26/2016	01/26/2017	□
7	Attenuator	Agilent	8495B	3308A22485	01/26/2016	01/26/2017	□
8	Power Meter	Agilent	E4418B	MY405111655	01/26/2016	01/26/2017	□
9	Power Sensor	HP	8485A	2347A02746	01/26/2016	01/26/2017	□
10	RF Cable	Gigalane	SMS102-MF141-SMS102-1.0M	PB1252301285	N/A	N/A	■
11	Signal Generator	HP	83630A	3420A00728	01/26/2016	01/26/2017	□
12	Oscilloscope	HP	54815A	US38380122	01/26/2016	01/26/2017	□
13	Pre Amplifier	Agilent	8449B	3008A02105	01/26/2016	01/26/2017	■
14	Signal Generator	Rhode & Schwarz	SML03	102330	01/26/2016	01/26/2017	□
15	Power Divider	Agilent	11636B	50309	01/26/2016	01/26/2017	□
16	Power Sensor	Seoksan Tech	SE-CT-02	S7400JD5340618	01/26/2016	01/26/2017	□
17	DC Power Supply	HP	6032A	US35420383	01/26/2016	01/26/2017	■
18	Slidacs	Sunchang Electrics	5KV	N/A	01/26/2016	01/26/2017	□
19	Bandreject Filter	K&L Microwave	50140	555	01/26/2016	01/26/2017	□
20	Horn Antenna	Schwarzbeck	BBHA9120A	346	02/05/2016	02/05/2018	■
21	Horn Antenna	A.H. SYSTEMS	SAS-572	269	09/03/2015	09/03/2017	■
22	DC Power Supply	Provice	PWS-5005D	205050	01/26/2016	01/26/2017	■
23	Pulse Limiter	Rhode & Schwarz	ESH3-Z2	100137	11/10/2016	11/10/2017	■
24	LISN	Rhode & Schwarz	ESH3-Z5	100204	11/10/2016	11/10/2017	■

5. Test Results and Measurement Data

5.1. Antenna Requirement

Standard requirement: 47 CFR Part 15C Section 15.203 /247(c)

15.203 requirement:

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, 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.

15.247(b) (4) requirement:

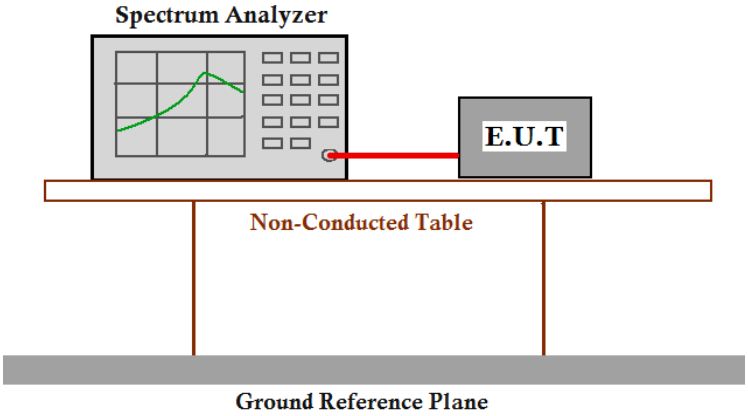
The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output 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.

EUT Antenna **PASS**

The transmitter has an Internal Pattern antenna. The directional gain of the antenna is -0.68 dBi. please refer to the EUT Internal photos and Antenna gain.

5.2. Conducted Peak Output Power

Test Requirement:	47 CFR Part 15C Section 15.247 (b)(3)
Test Method:	KDB558074 D01 v03r05
Test Configuration:	



Test Instruments:	Refer to section 4.10 for details
Exploratory Test Mode:	Transmitting mode
Final Test Mode:	Non-hopping transmitting with GFSK modulation
Limit:	30dBm
Test Results:	Pass

Measurement Data

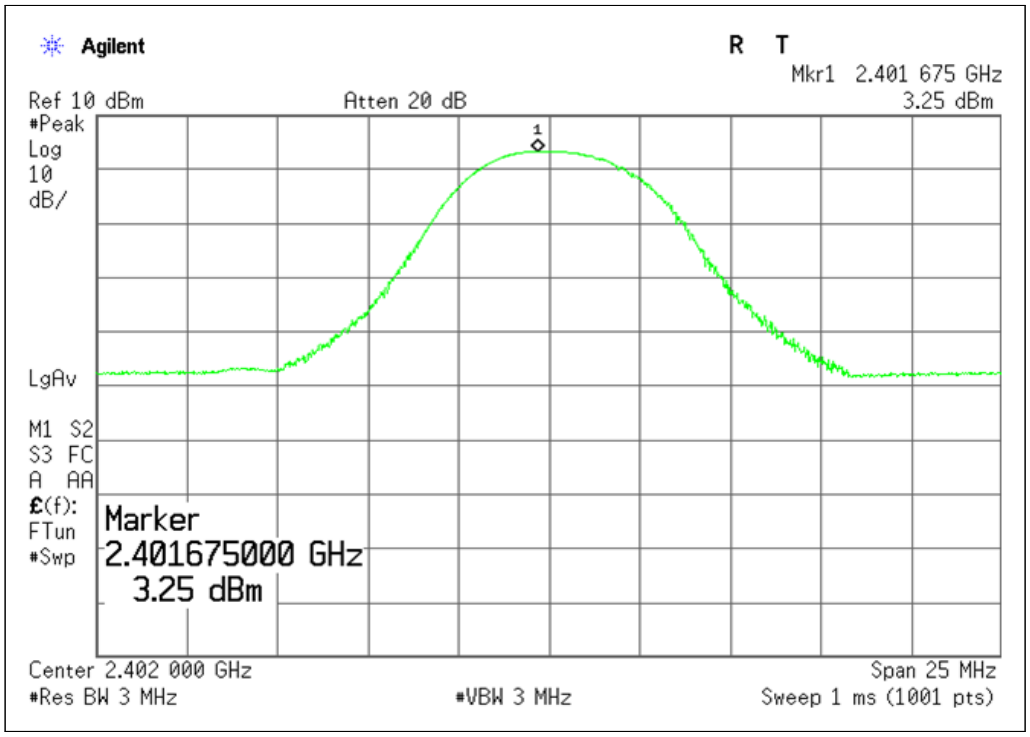
Peak Power			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	3.25	30.00	Pass
Middle	2.11	30.00	Pass
Highest	0.38	30.00	Pass

Average Power					
Test channel	Conducted Power (dBm)	Duty Cycle Factor	Final Conducted Power (dBm)	Limit (dBm)	Result
Lowest	-4.19	6.86	2.67	30.00	Pass
Middle	-6.10	6.86	0.76	30.00	Pass
Highest	-6.94	6.86	-0.08	30.00	Pass

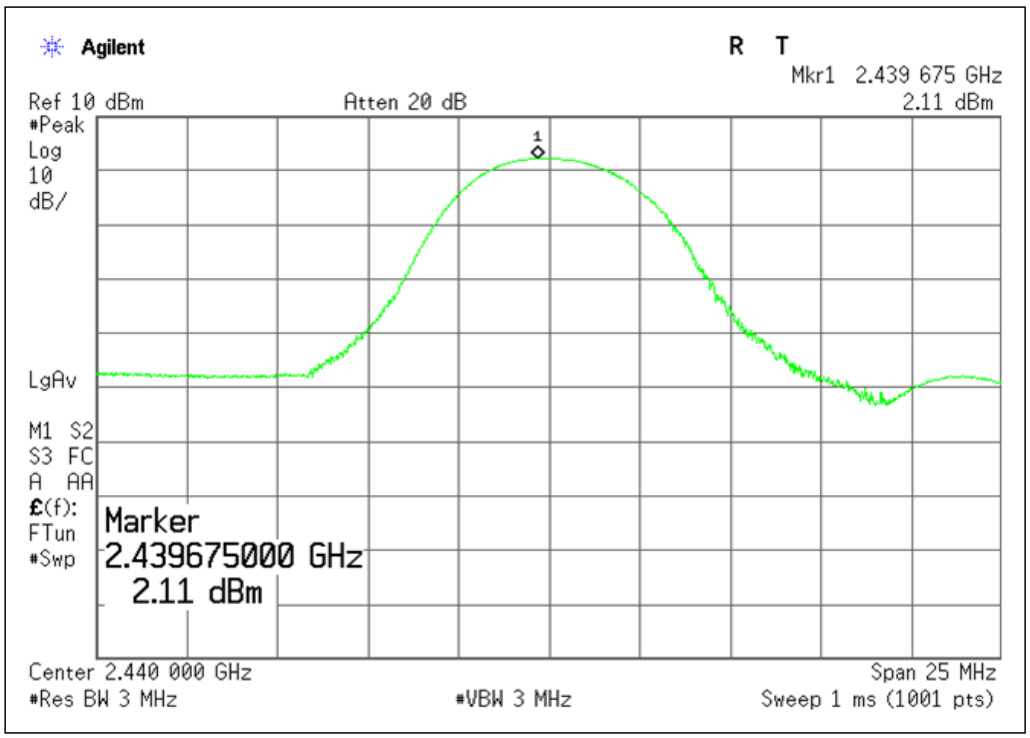
Result plot as follows:

Test mode: Peak Power

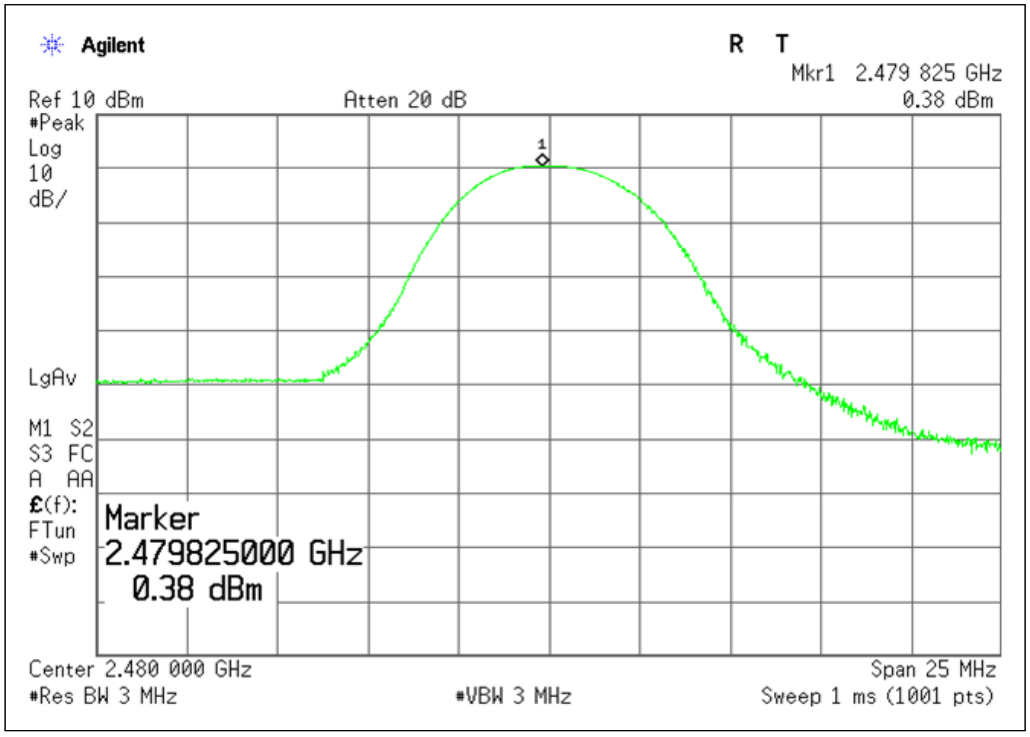
Lowest Channel:



Middle Channel:



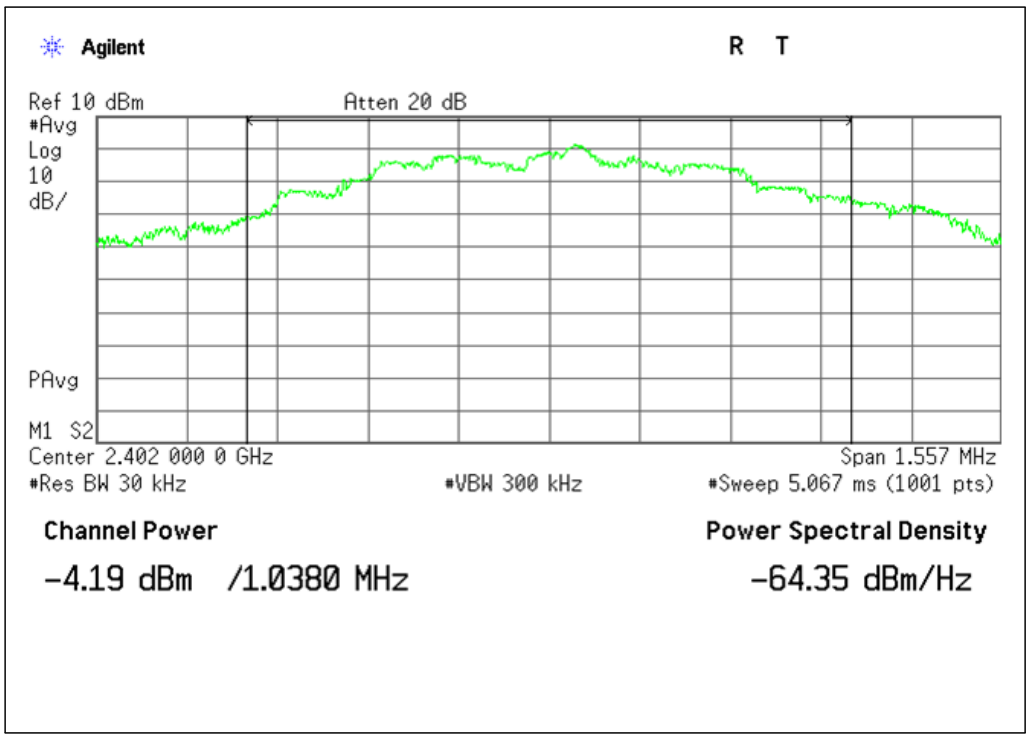
Highest Channel:



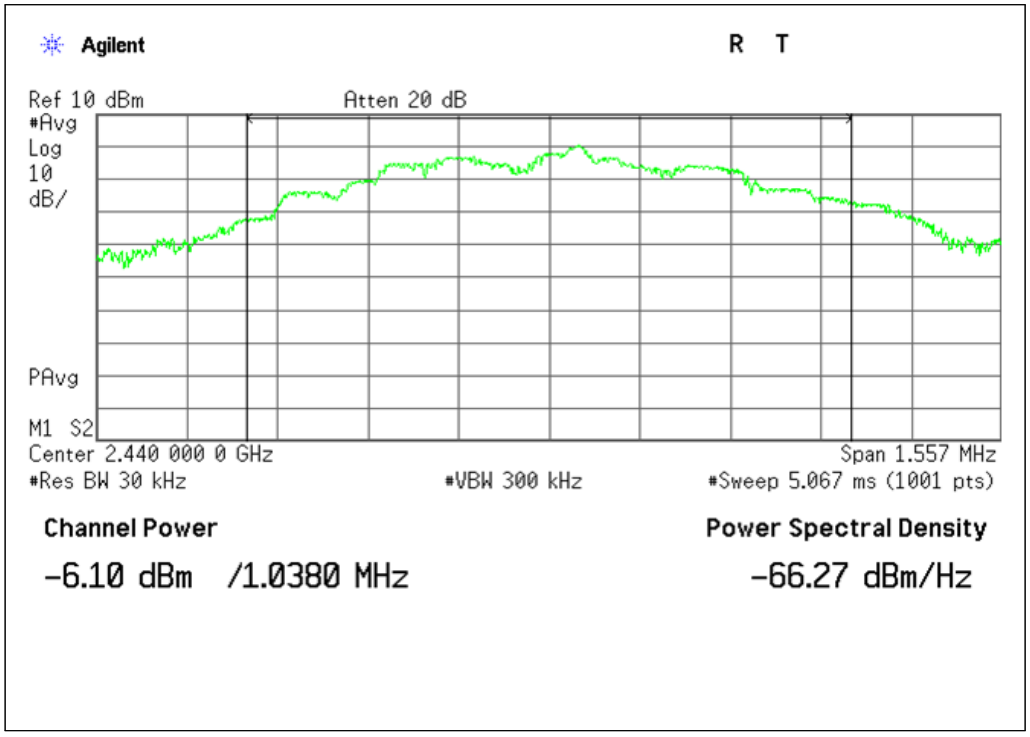
Result plot as follows:

Test mode: Average Power

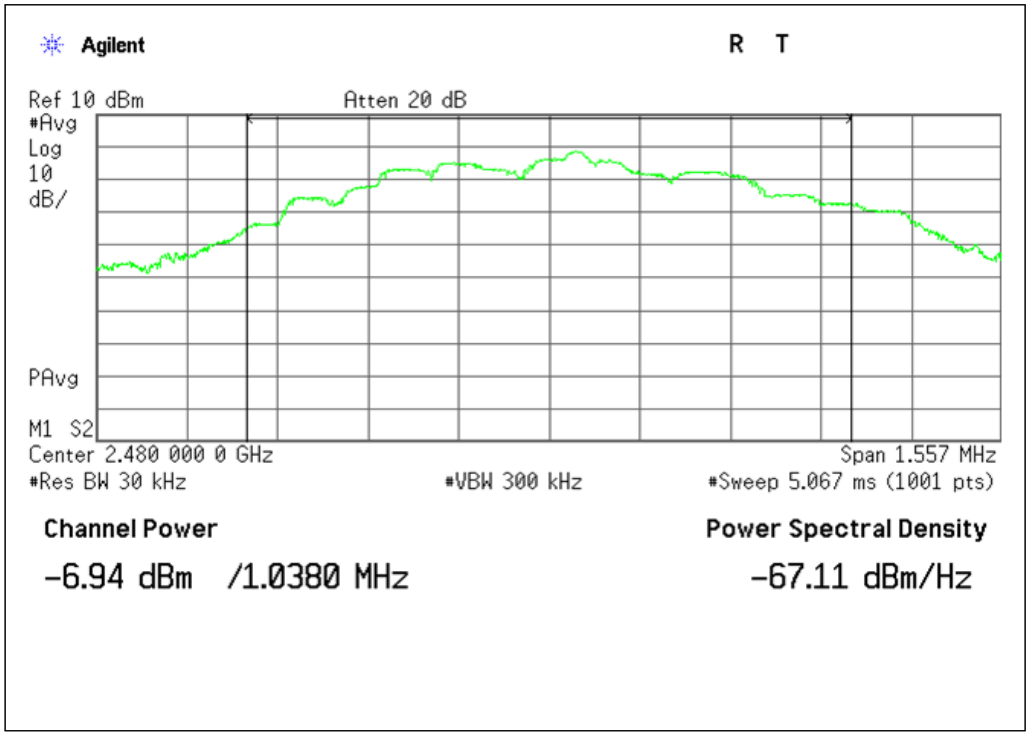
Lowest Channel:



Middle Channel:

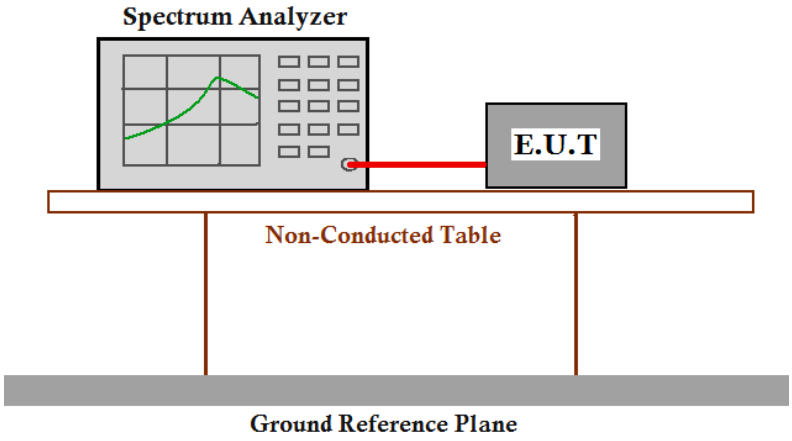


Highest Channel:



5.3. 6dB Occupy Bandwidth

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(2)
Test Method:	KDB558074 D01 v03r05
Test Configuration:	



Instruments Used:	Refer to section 4.10 for details
Exploratory Test Mode:	Transmitting mode
Final Test Mode:	Non-hopping transmitting with GFSK modulation
Limit:	≥ 500 kHz
Test Results:	Pass

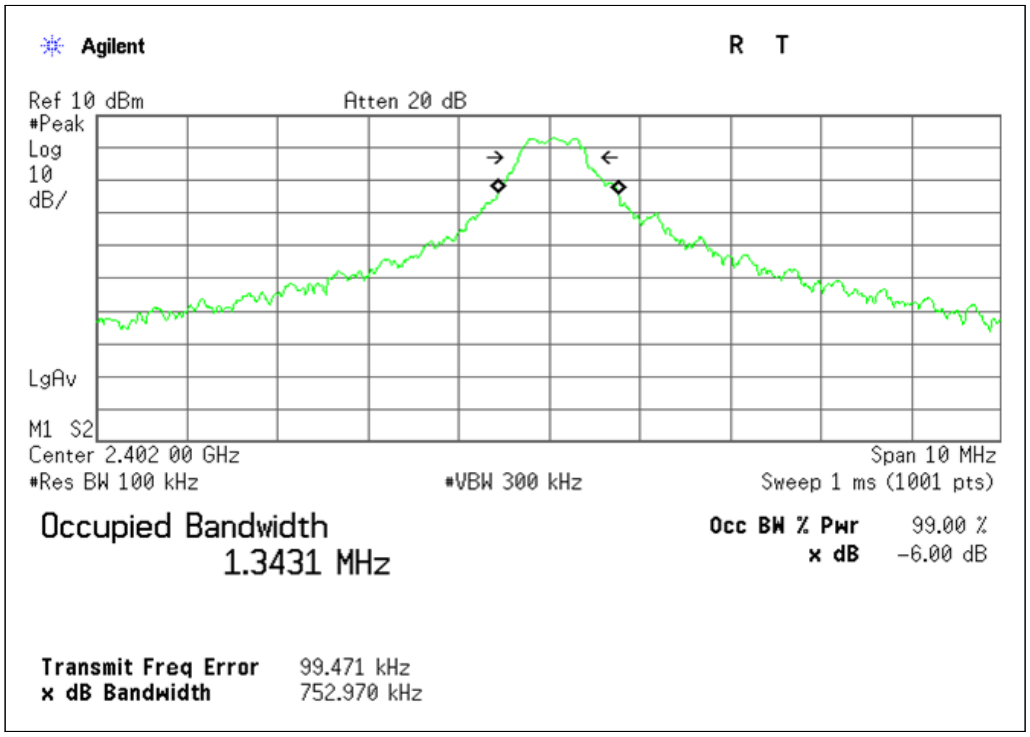
Measurement Data

Test channel	6dB Occupy Bandwidth (kHz)	Limit (kHz)	Result
Lowest	752	≥ 500	Pass
Middle	714	≥ 500	Pass
Highest	731	≥ 500	Pass

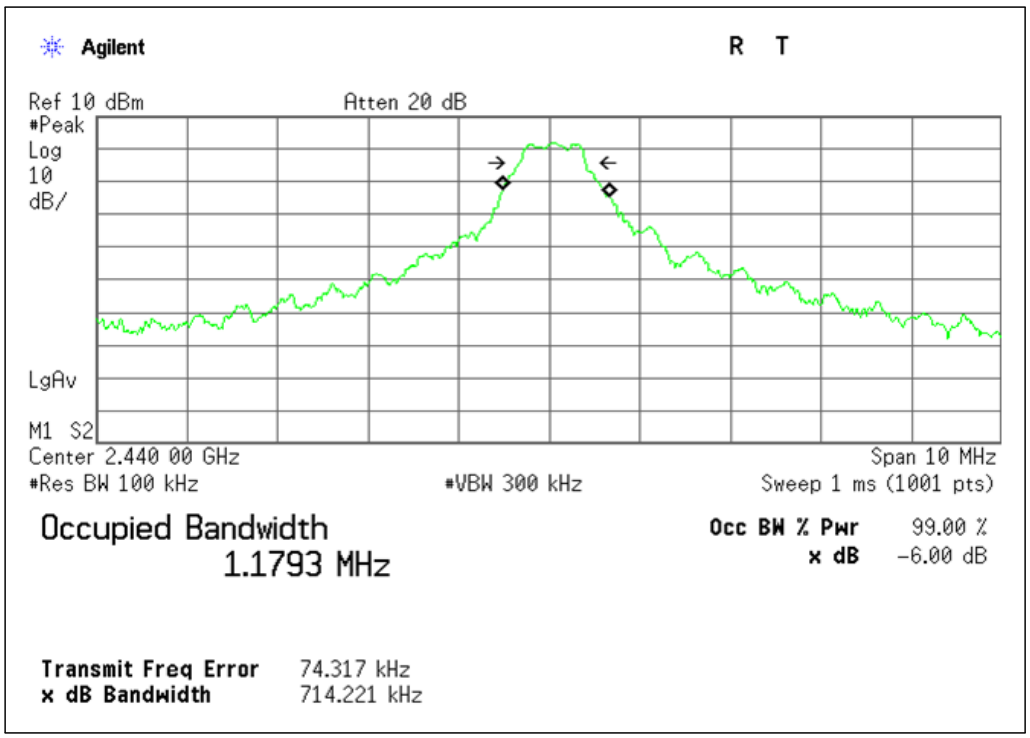
Result plot as follows:

Test mode: GFSK

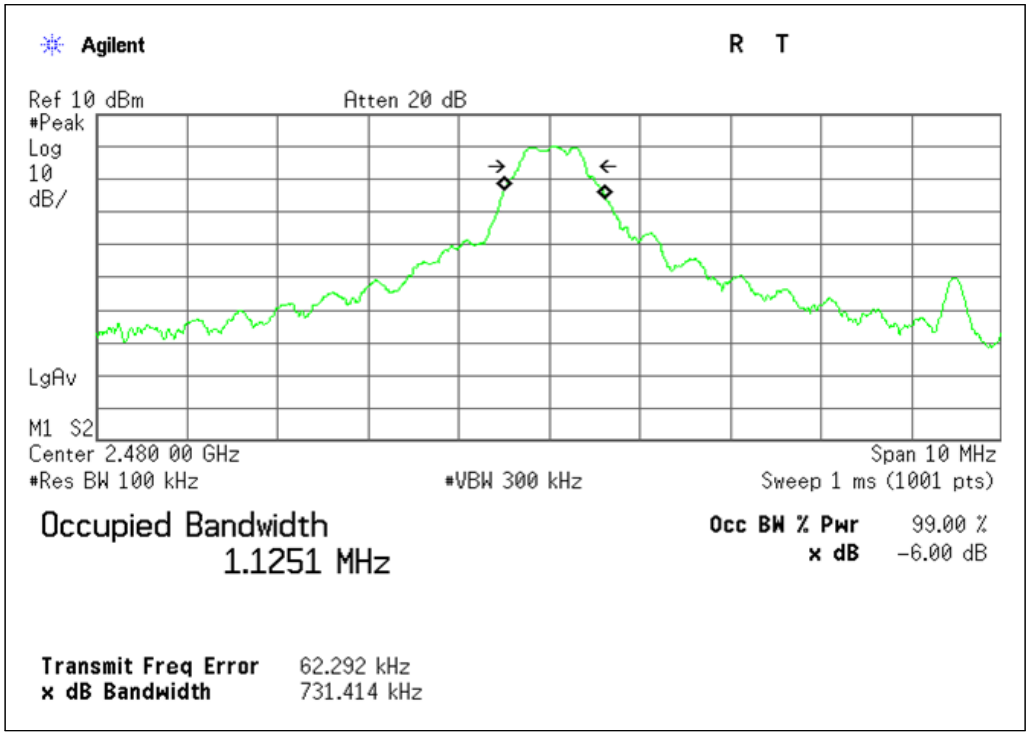
Lowest Channel:



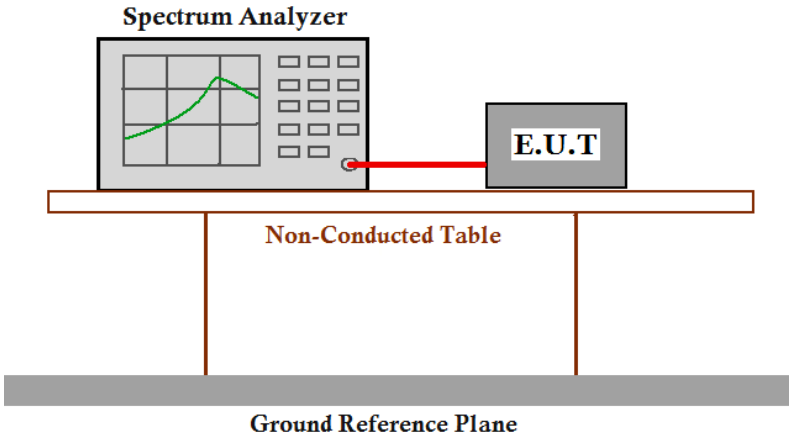
Middle Channel:



Highest Channel:



5.4. Power Spectral Density

Test Requirement:	47 CFR Part 15C Section 15.247 (e)
Test Method:	KDB558074 D01 v03r05
Test Configuration: 	
Test Instruments:	Refer to section 4.10 for details
Exploratory Test Mode:	Transmitting mode
Final Test Mode:	Non-hopping transmitting with GFSK modulation
Limit:	≤8dBm/3kHz
Test Results:	Pass

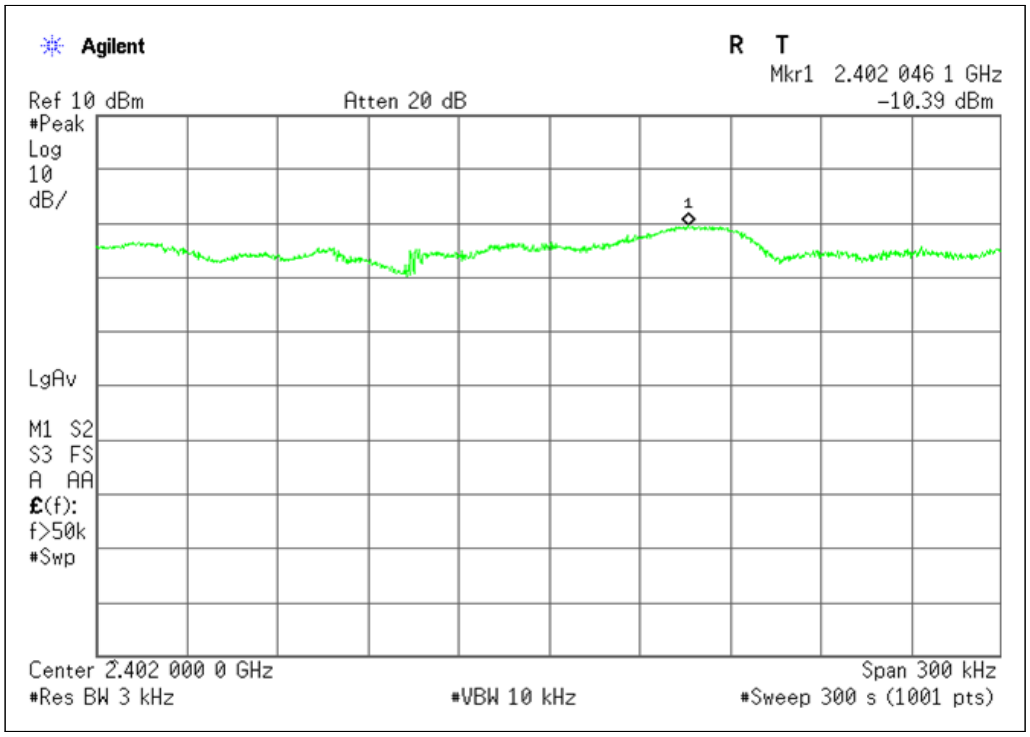
Measurement Data

GFSK mode			
Test channel	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
Lowest	-10.39	≤8 dBm/3kHz	Pass
Middle	-11.01	≤8 dBm/3kHz	Pass
Highest	-12.51	≤8 dBm/3kHz	Pass

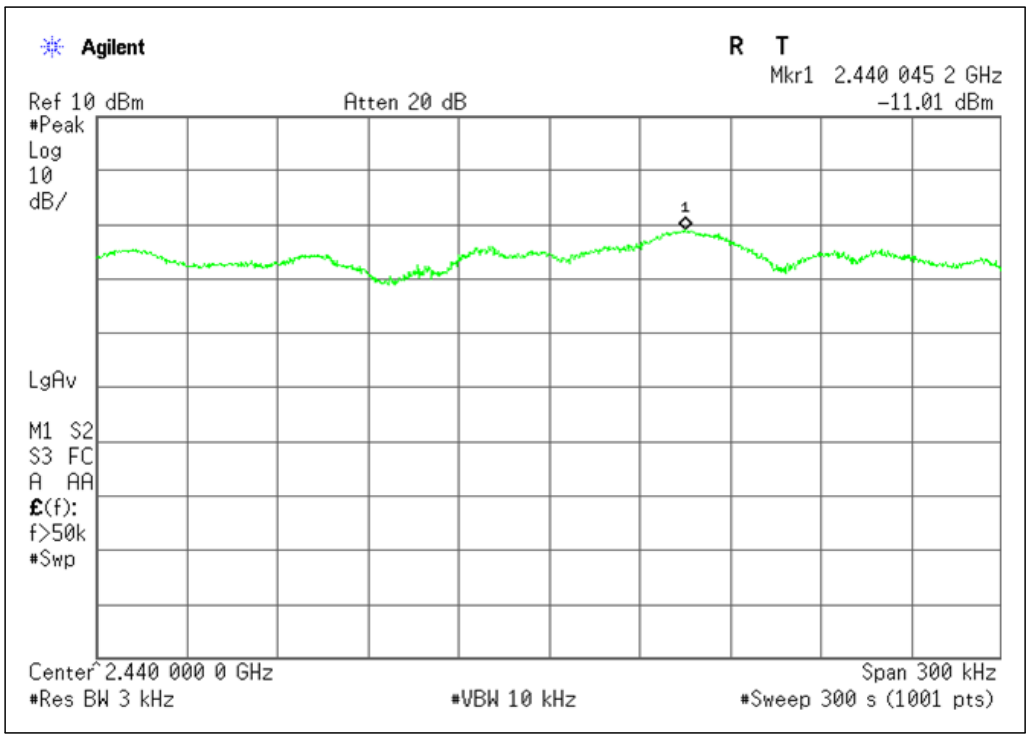
Result plot as follows:

Test mode: GFSK

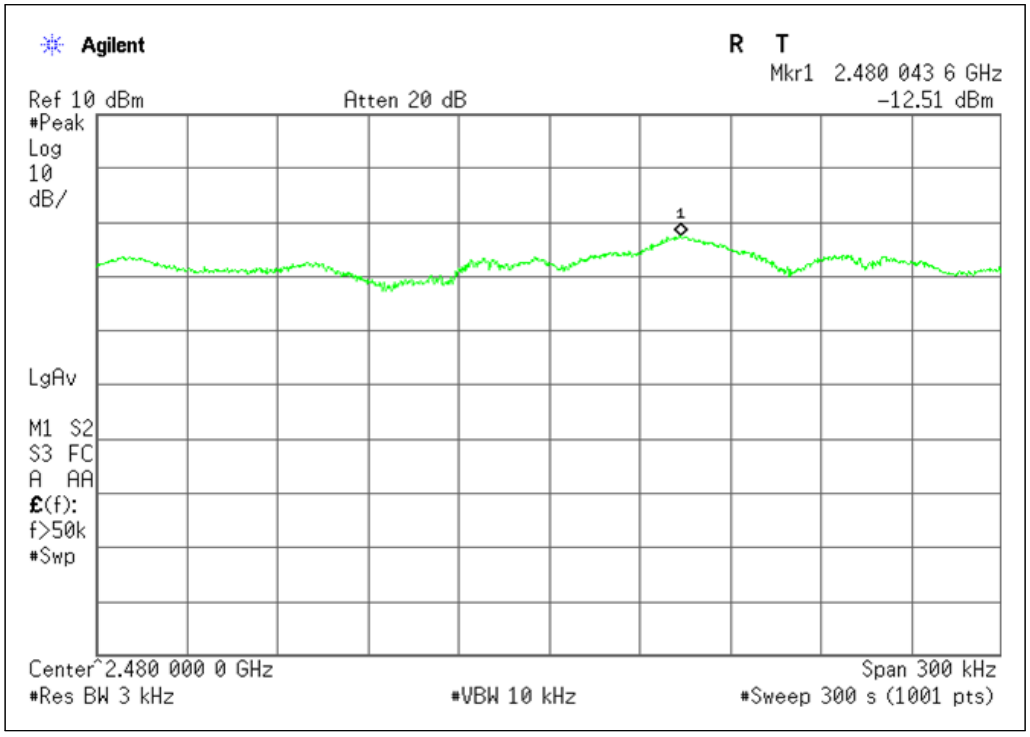
Lowest Channel:



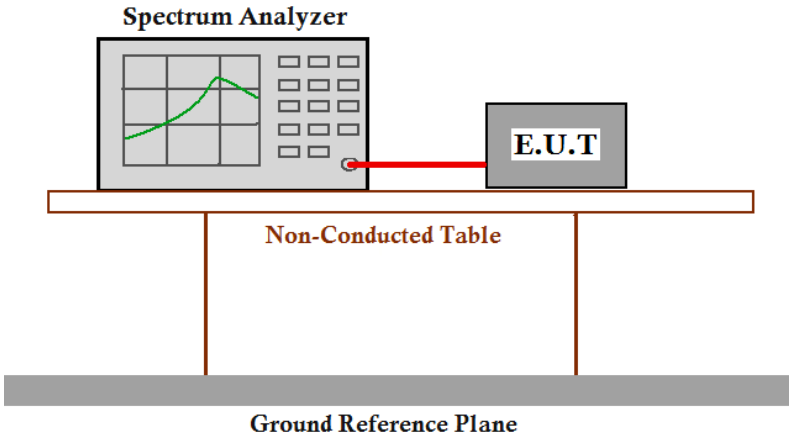
Middle Channel:



Highest Channel:



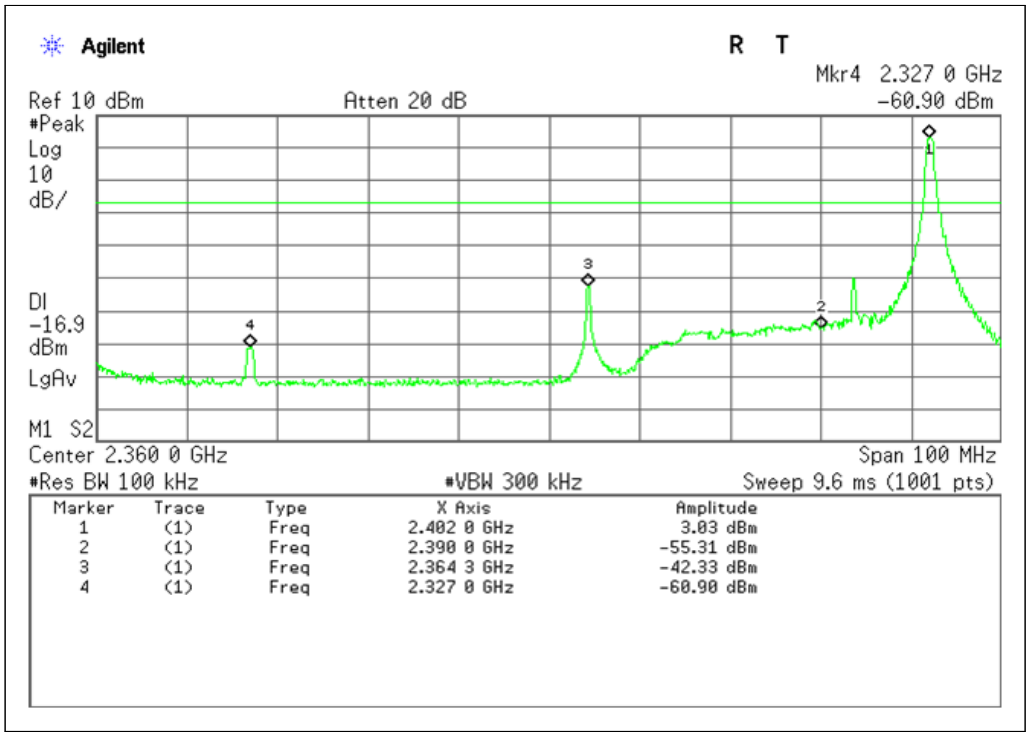
5.5. Band-edge for RF Conducted Emissions

Test Requirement:	FCC Part15 C section 15.247 (d)
Test Method:	KDB558074 D01 v03r05
Test Configuration: 	
Exploratory Test Mode:	Transmitting mode
Final Test Mode:	Non-hopping transmitting with GFSK modulation
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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.
Instruments Used:	Refer to section 4.10 for details
Test Results:	Pass

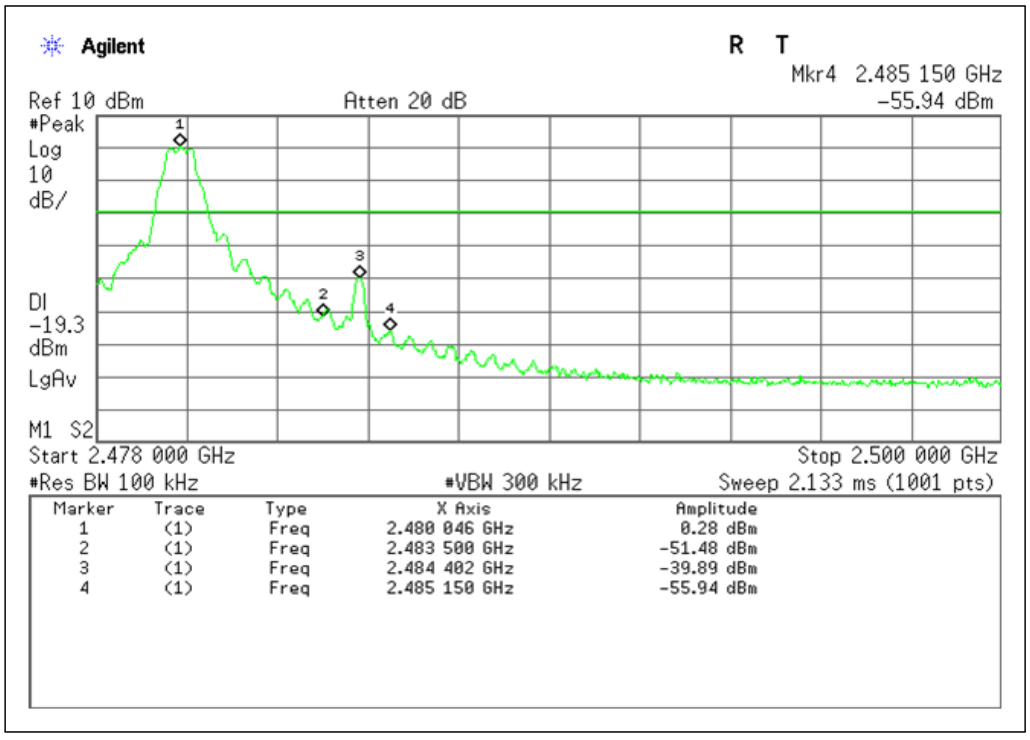
Result plot as follows:

Test mode: GFSK

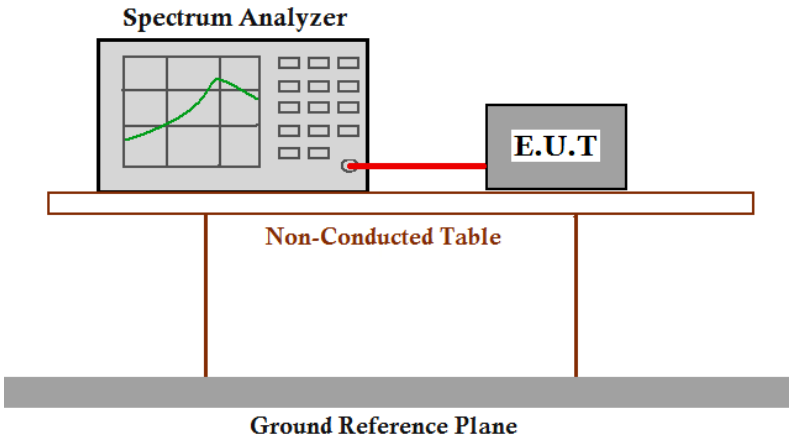
Lowest Channel:



Highest Channel:



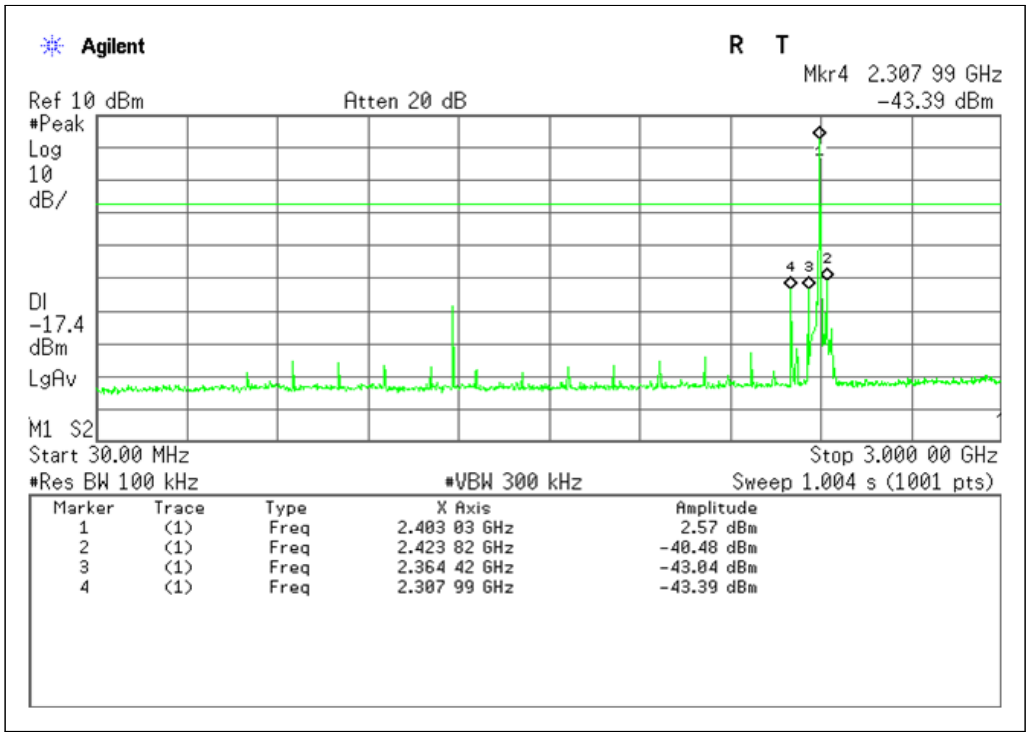
5.6. RF Conducted Spurious Emissions

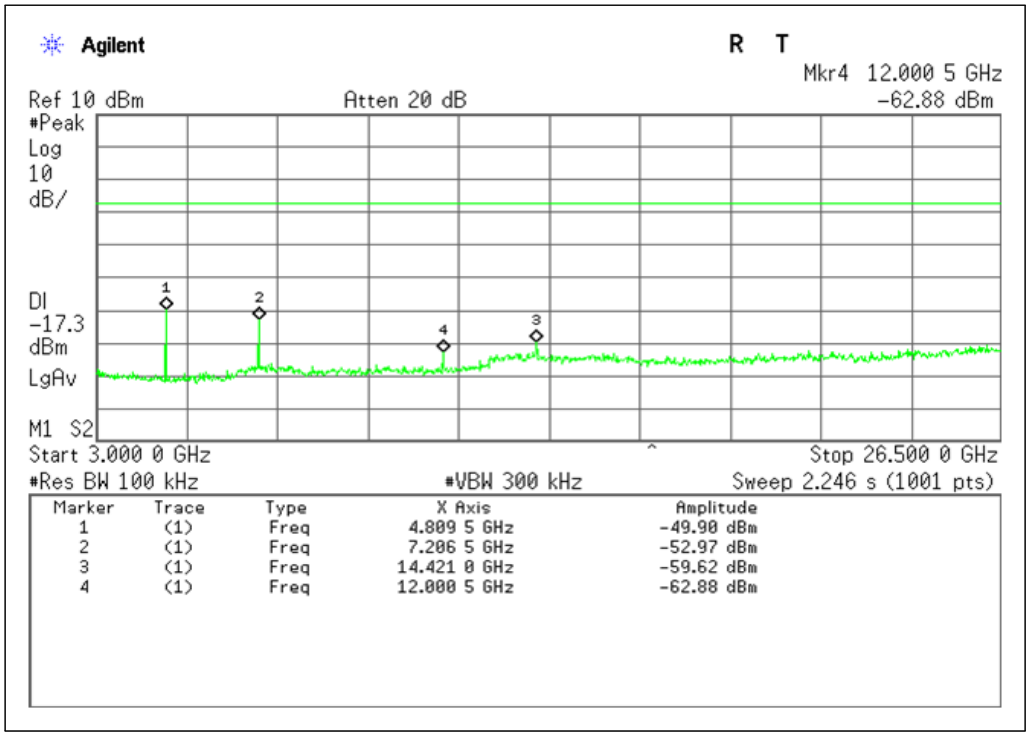
Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	KDB558074 D01 v03r05
Test Configuration: 	
Exploratory Test Mode:	Transmitting mode
Final Test Mode:	Non-hopping transmitting with GFSK modulation
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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.
Instruments Used:	Refer to section 4.10 for details
Test Results:	Pass

Result plot as follows:

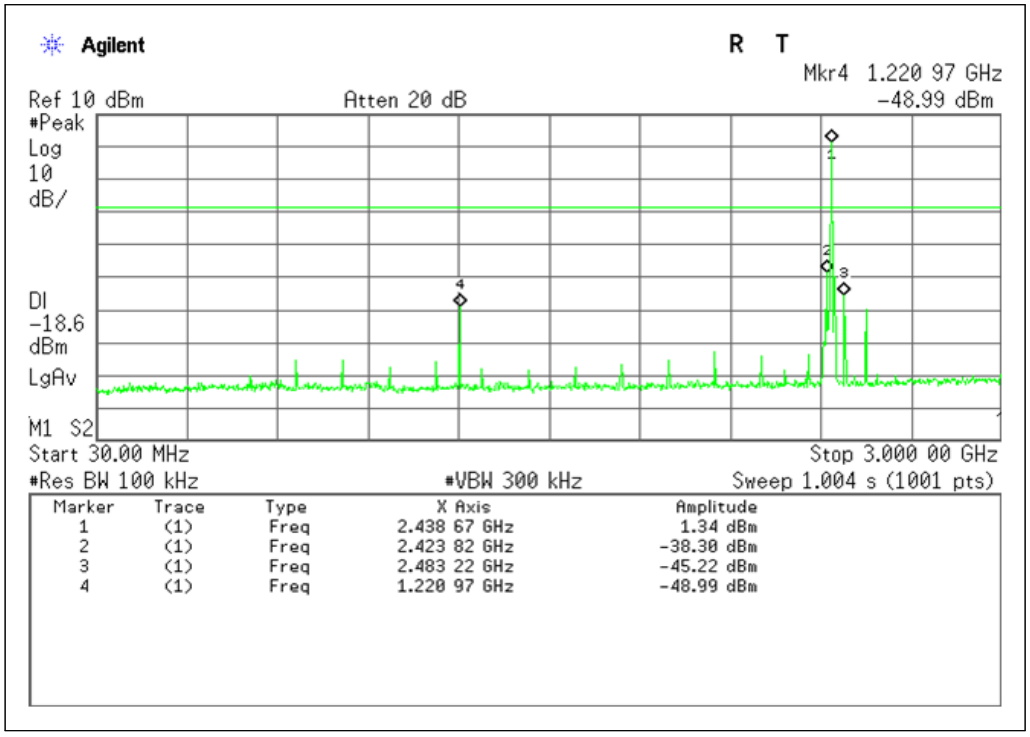
Test mode: GFSK

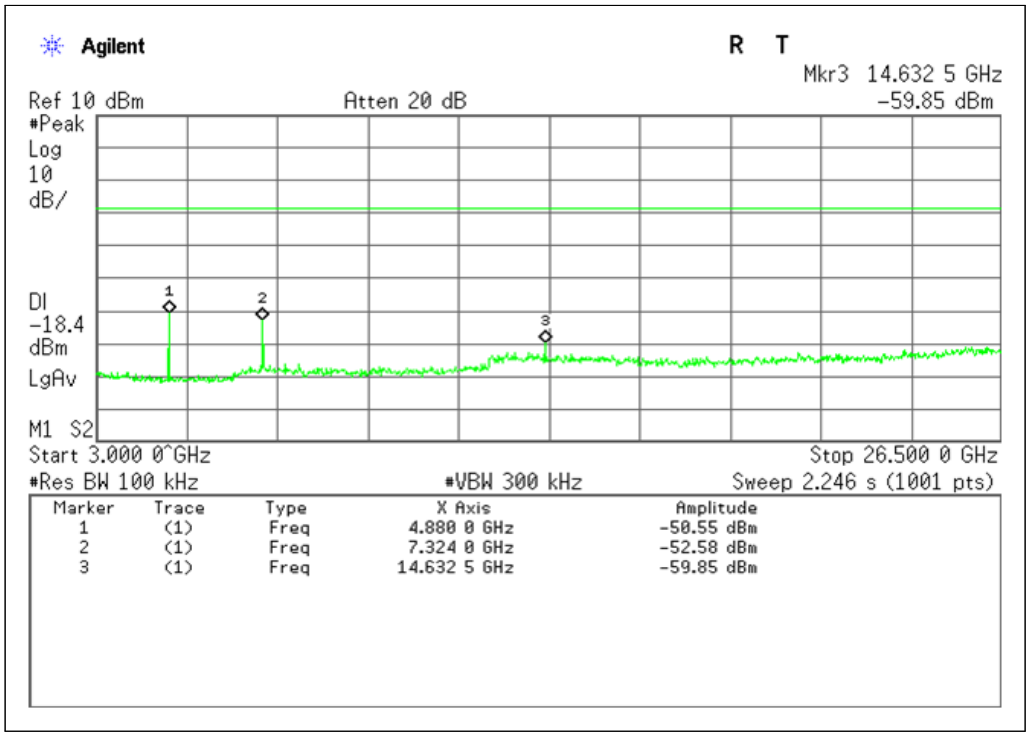
Lowest Channel:



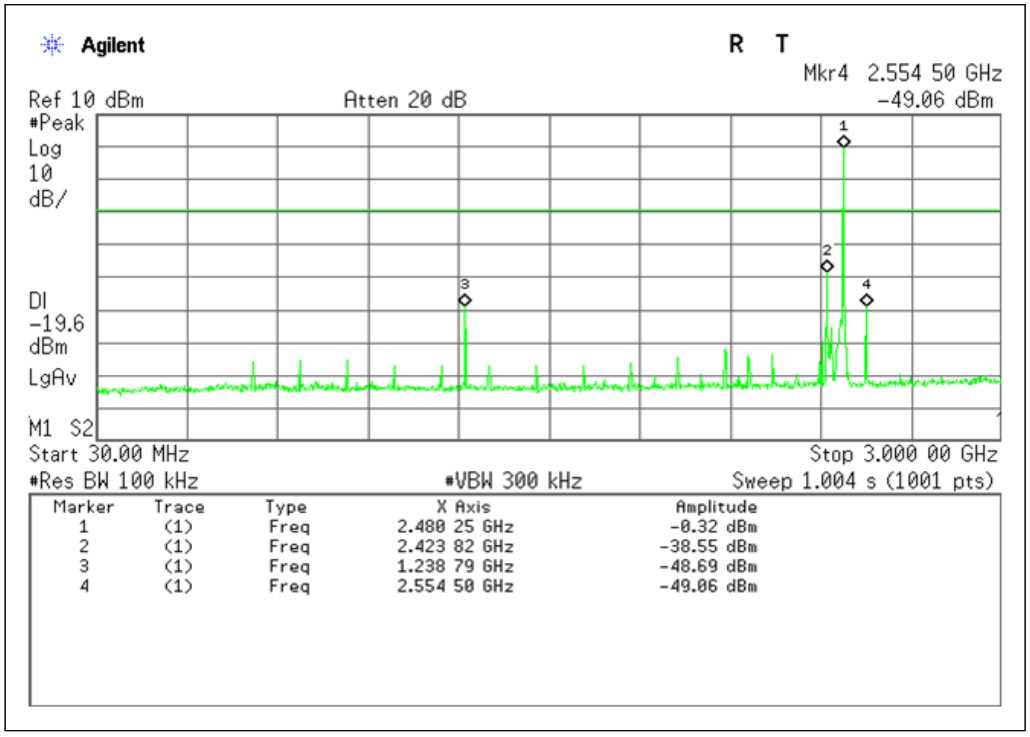


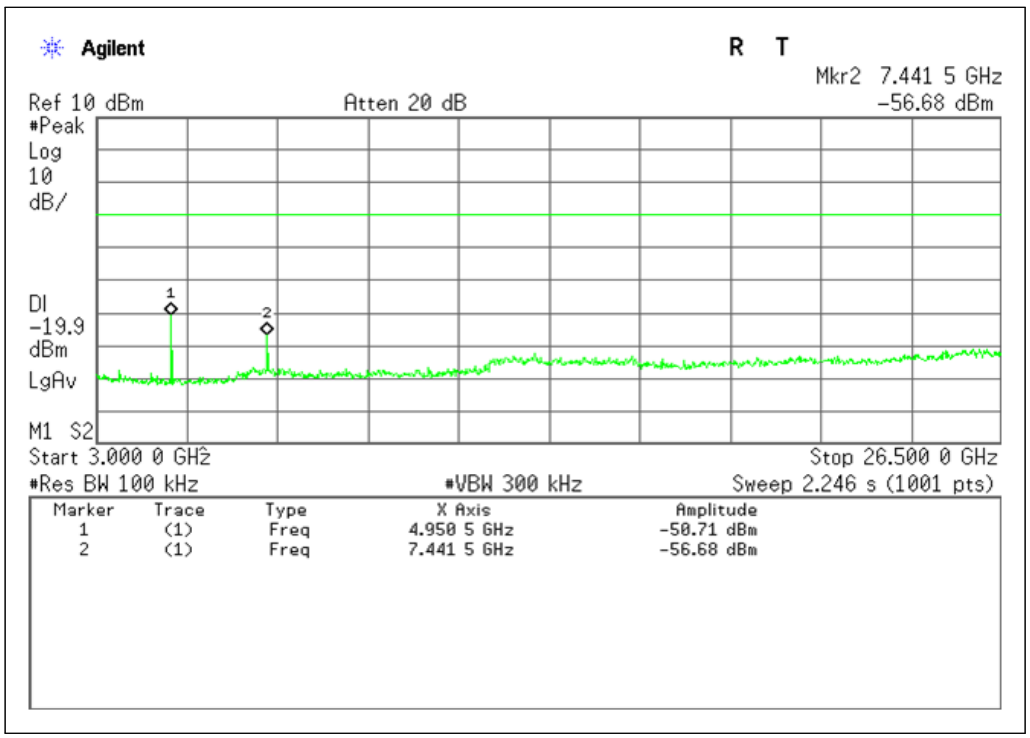
Middle Channel:





Highest Channel:



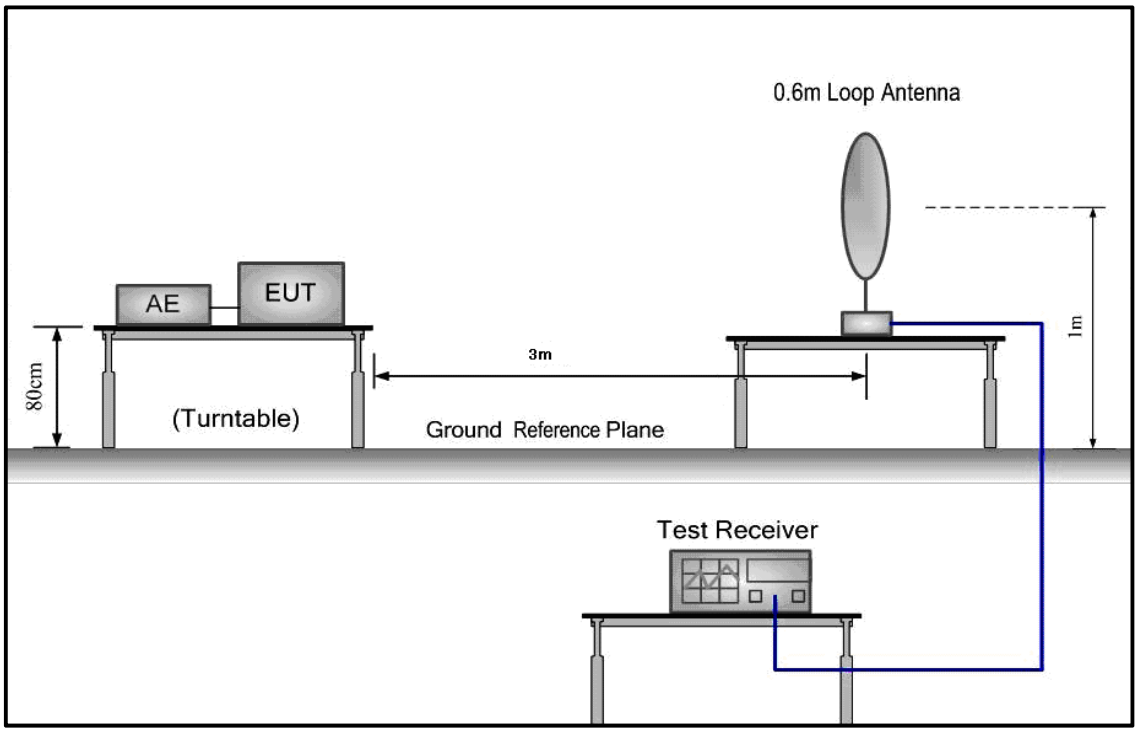


5.7. Radiated Spurious Emissions

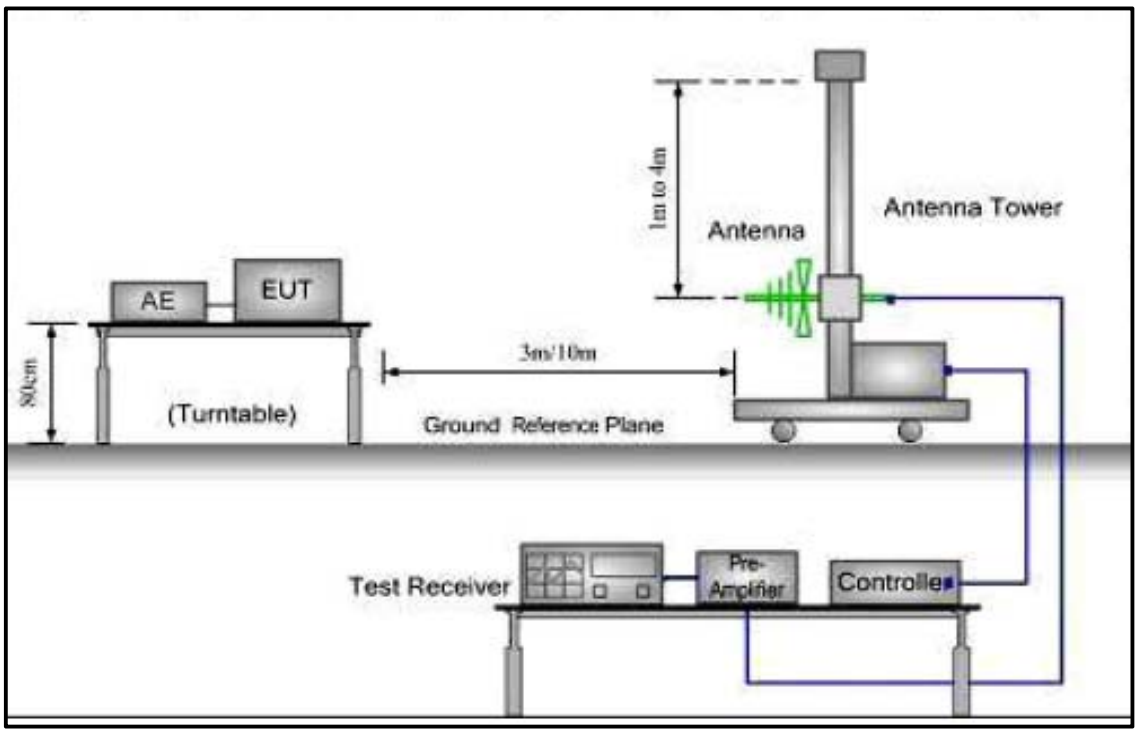
Test equirement:	47 CFR Part 15C Section 15.209 and 15.205				
Test Method:	ANSI C63.10 2013				
Test Site:	Measurement Distance: 3m				
Receiver Setup:	Frequency	Detector	RBW	VBW	Remark
	0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
	0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
	0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
	0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
	0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	30MHz-1GHz	Quasi-peak	100kHz	300kHz	Quasi-peak
	Above 1GHz	Peak	1MHz	3MHz	Peak
		Peak	1MHz	10Hz	Average
Limit:	Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
	0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
	0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
	1.705MHz-30MHz	30	-	-	30
	30MHz-88MHz	100	40.0	Quasi-peak	3
	88MHz-216MHz	150	43.5	Quasi-peak	3
	216MHz-960MHz	200	46.0	Quasi-peak	3
	960MHz-1GHz	500	54.0	Quasi-peak	3
	Above 1GHz	500	54.0	Average	3
	Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.				

Test Configuration:

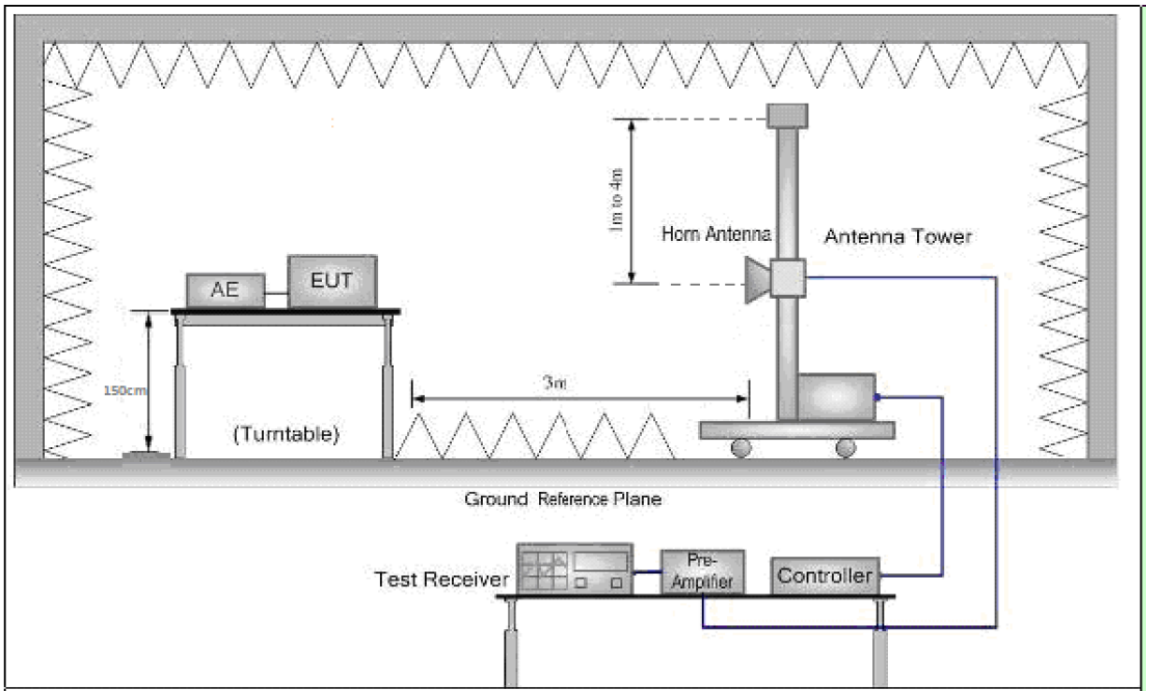
1) 9 kHz to 30 MHz emissions:



2) 30 MHz to 1 GHz emissions:



3) 1 GHz to 25 GHz emissions:



Test Procedure:	a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter OATS. The table was rotated 360 degrees to determine the position of the highest radiation. b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. c. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

Test Procedure:	e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. h. Test the EUT in the lowest channel (2402MHz),the middle channel (2440MHz),the Highest channel (2480MHz) i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case. j. Repeat above procedures until all frequencies measured was complete.
Test Mode:	Transmitting mode.
Test Results:	Pass

5.7.1. Harmonic and other spurious emissions

5.7.1.1. Test at Lowest Channel in transmitting status

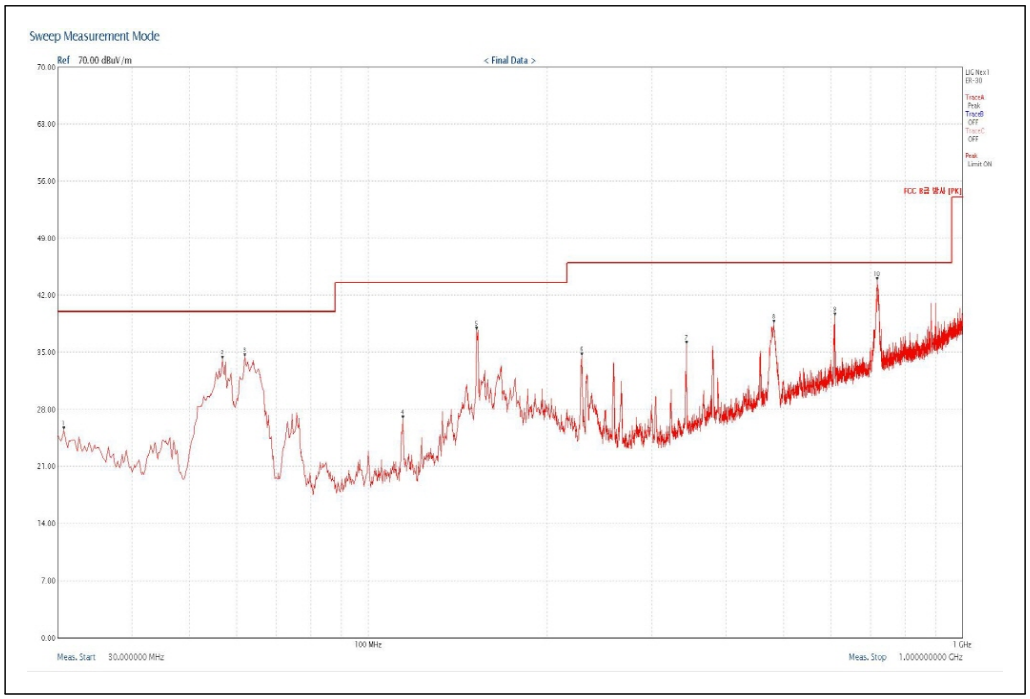
9 kHz~30 MHz Field Strength of Unwanted Emissions. Quasi-Peak Measurement

The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

30 MHz~1 GHz Spurious Emissions. Quasi-Peak Measurement

Test Mode: GFSK Test channel: Lowest

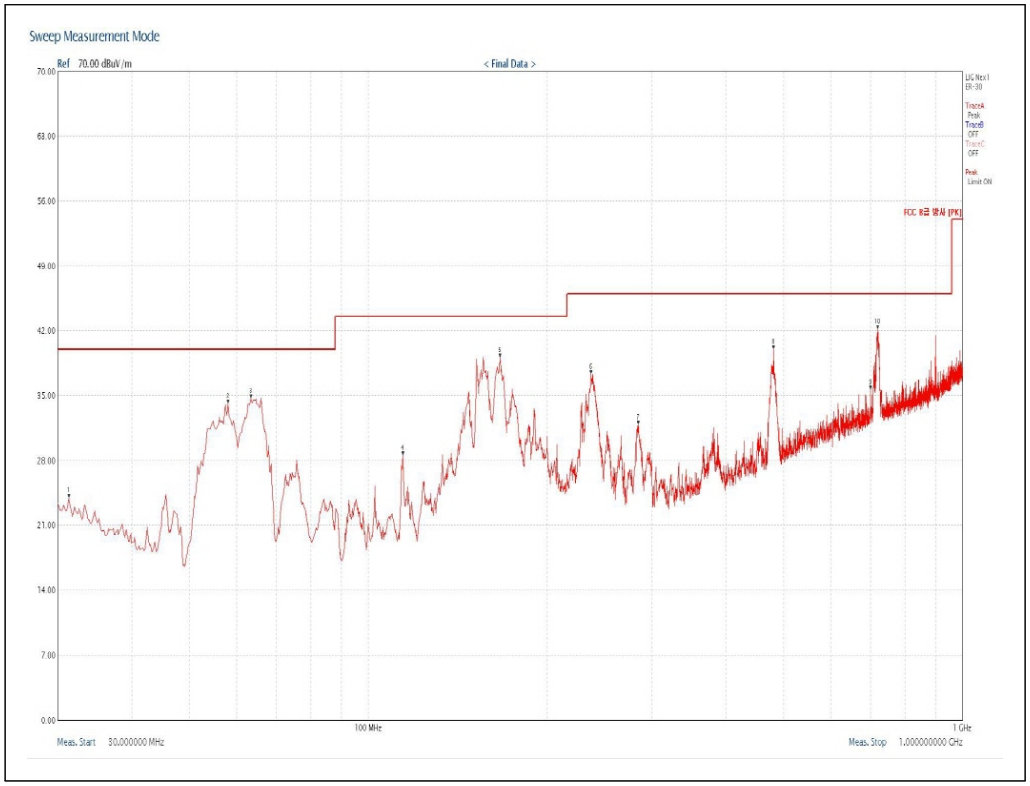
Vertical: Level (dBμV/m)



Quasi-peak measurement

Frequency (MHz)	Detect Mode	Polarization (V/H)	Measured Value (dBμV)	Antenna Factor + Cable Loss (dB/m)	Emission Level (dBμV/m)	Limit (dBμV/m)
56.70	QP	V	33.31	6.18	27.13	40.0
61.80	QP	V	34.39	5.65	28.74	40.0
152.28	QP	V	32.81	11.88	20.93	43.5
342.68	QP	V	29.37	16.62	12.75	46.0
481.45	QP	V	37.47	20.38	17.09	46.0
609.31	QP	V	37.79	23.03	14.76	46.0
719.27	QP	V	42.14	24.40	17.74	46.0

Horizontal: Level (dBμV/m)



Quasi-peak measurement

Frequency (MHz)	Detect Mode	Polarization (V/H)	Measured Value (dBμV)	Antenna Factor + Cable Loss (dB/m)	Emission Level (dBμV/m)	Limit (dBμV/m)
58.18	QP	H	33.12	5.82	27.30	40.0
63.97	QP	H	34.14	5.97	28.17	40.0
113.81	QP	H	28.88	11.68	17.20	43.5
166.08	QP	H	37.92	11.12	26.80	46.0
236.71	QP	H	37.01	13.33	23.68	46.0
480.73	QP	H	39.66	20.36	19.30	46.0
719.97	QP	H	44.97	24.41	20.56	46.0
899.99	QP	H	44.30	26.65	17.65	46.0

1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak / Average Measurement:

Frequency (MHz)	Polarization (V/H)	Measured Value (dBμV)	Antenna Factor + Cable Loss (dB/m)	Amplifier Gain (dB)	Emission Level (dBμV/m)	Limit (dBμV/m)
The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.						

5.7.1.2. Test at middle Channel in transmitting status

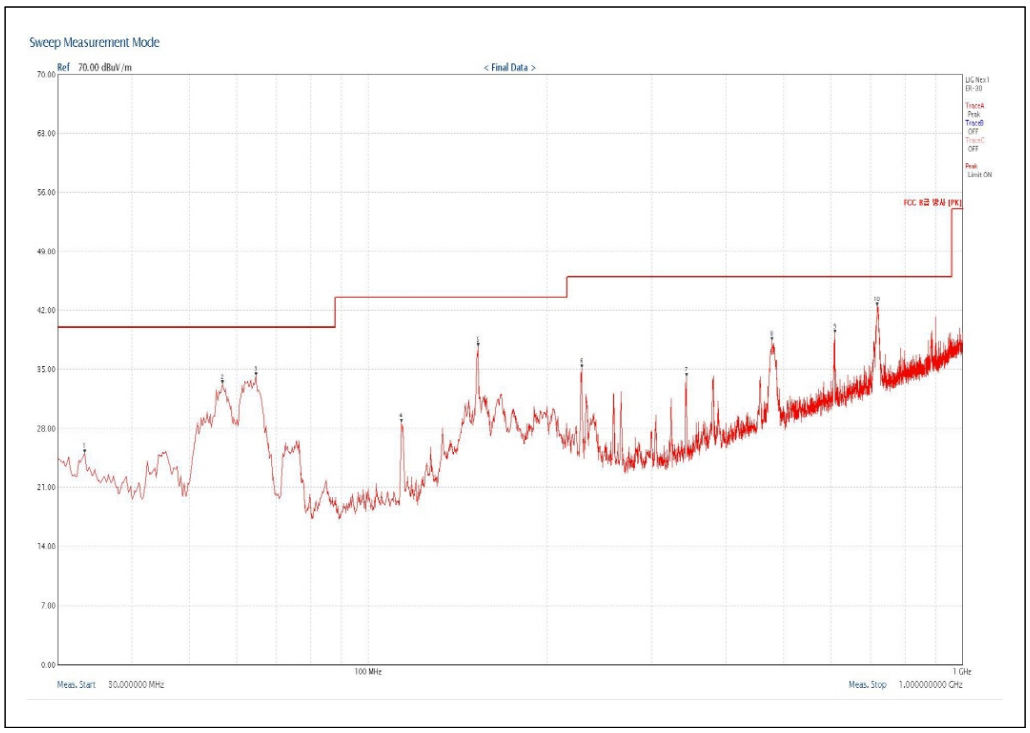
9 kHz~30 MHz Field Strength of Unwanted Emissions. Quasi-Peak Measurement

The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

30 MHz~1 GHz Spurious Emissions. Quasi-Peak Measurement

Test Mode: GFSK Test channel: Middle

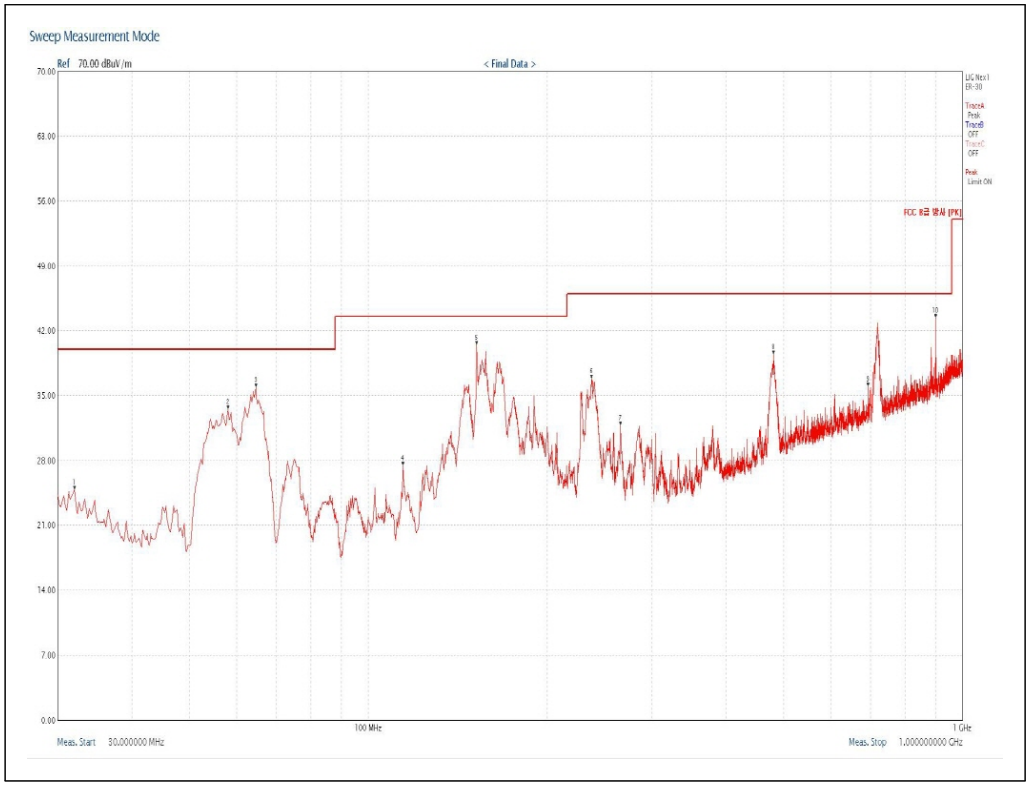
Vertical: Level (dBμV/m)



Quasi-peak measurement

Frequency (MHz)	Detect Mode	Polarization (V/H)	Measured Value (dBμV)	Antenna Factor + Cable Loss (dB/m)	Emission Level (dBμV/m)	Limit (dBμV/m)
57.07	QP	V	33.47	6.09	27.38	40.0
64.71	QP	V	32.16	6.07	26.09	40.0
152.34	QP	V	33.63	11.87	21.76	43.5
228.45	QP	V	32.84	12.63	20.21	46.0
478.18	QP	V	37.17	20.29	16.88	46.0
609.30	QP	V	39.37	23.03	16.34	46.0
718.20	QP	V	44.14	24.38	19.76	46.0

Horizontal: Level (dBμV/m)



Quasi-peak measurement

Frequency (MHz)	Detect Mode	Polarization (V/H)	Measured Value (dBμV)	Antenna Factor + Cable Loss (dB/m)	Emission Level (dBμV/m)	Limit (dBμV/m)
58.54	QP	H	29.12	5.74	23.38	40.0
64.69	QP	H	32.62	6.07	26.55	40.0
151.84	QP	H	34.99	11.90	23.09	43.5
237.07	QP	H	35.55	13.36	22.19	46.0
480.71	QP	H	36.67	20.36	16.31	46.0
719.61	QP	H	42.37	24.40	17.97	46.0
900.03	QP	H	42.64	26.65	15.99	46.0

1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak / Average Measurement:

Frequency (MHz)	Polarization (V/H)	Measured Value (dBμV)	Antenna Factor + Cable Loss (dB/m)	Amplifier Gain (dB)	Emission Level (dBμV/m)	Limit (dBμV/m)
The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.						

5.7.1.3. Test at Highest Channel in transmitting status

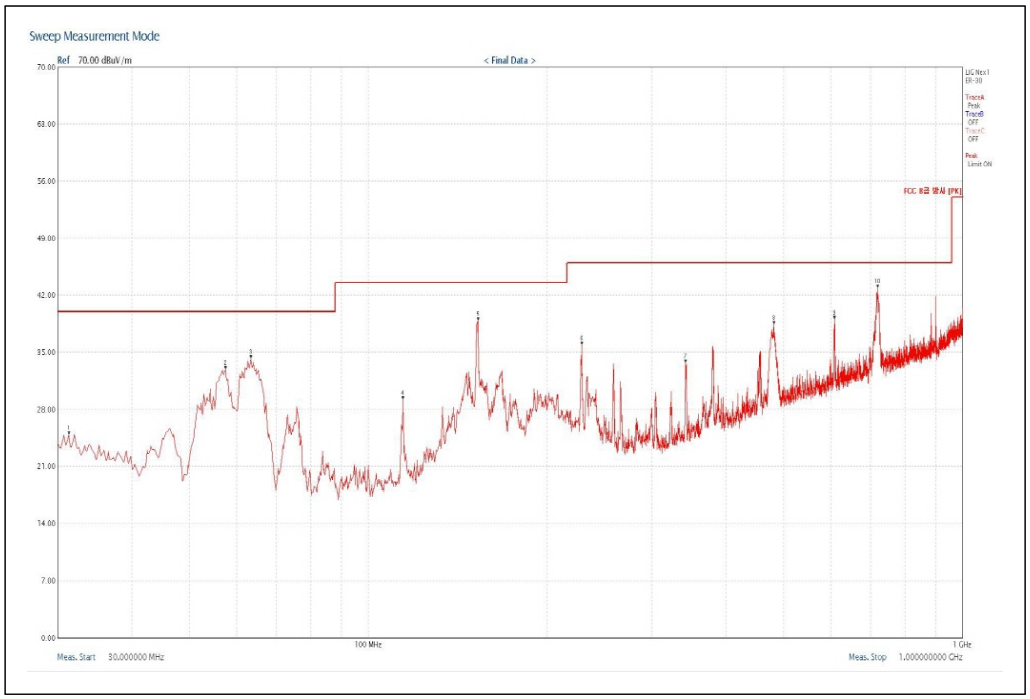
9 kHz~30 MHz Field Strength of Unwanted Emissions. Quasi-Peak Measurement

The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

30 MHz~1 GHz Spurious Emissions. Quasi-Peak Measurement

Test Mode: GFSK Test channel: Highest

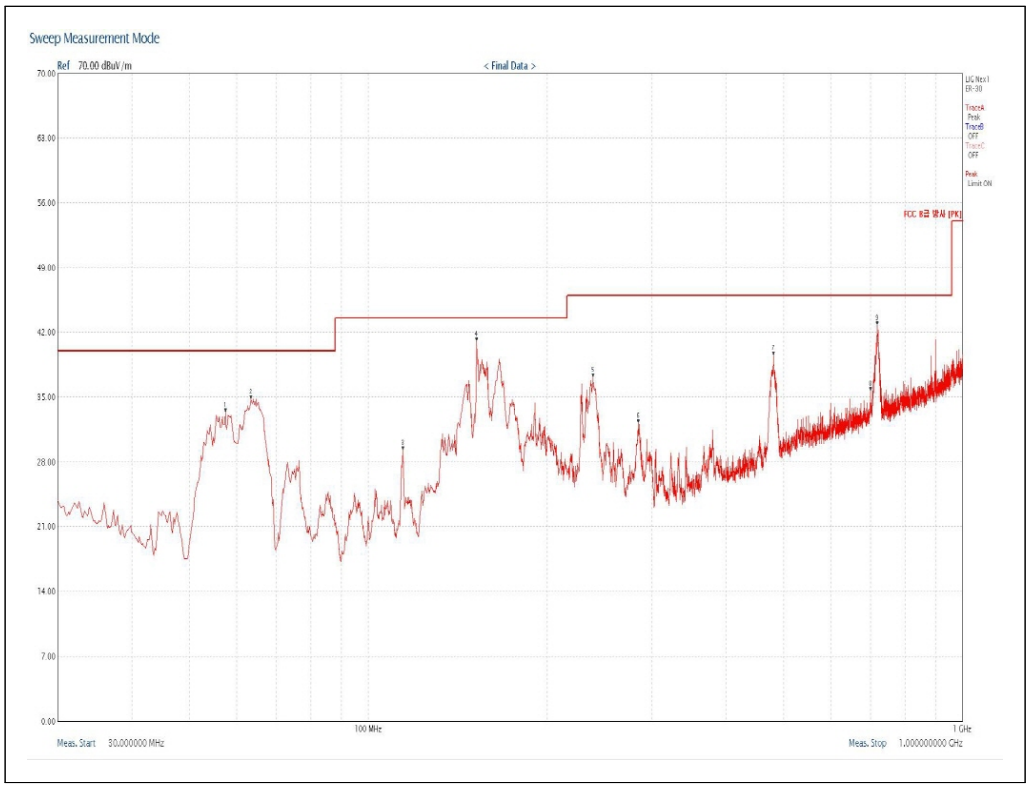
Vertical: Level (dBμV/m)



Quasi-peak measurement

Frequency (MHz)	Detect Mode	Polarization (V/H)	Measured Value (dBμV)	Antenna Factor + Cable Loss (dB/m)	Emission Level (dBμV/m)	Limit (dBμV/m)
57.08	QP	V	33.19	6.09	27.10	40.0
63.66	QP	V	33.28	5.92	27.36	40.0
152.33	QP	V	33.03	11.87	21.16	43.5
228.49	QP	V	31.49	12.63	18.86	46.0
380.76	QP	V	32.23	17.68	14.55	46.0
480.72	QP	V	37.37	20.36	17.01	46.0
609.27	QP	V	37.55	23.03	14.52	46.0
720.00	QP	V	42.26	24.41	17.85	46.0

Horizontal: Level (dBμV/m)



Quasi-peak measurement

Frequency (MHz)	Detect Mode	Polarization (V/H)	Measured Value (dBμV)	Antenna Factor + Cable Loss (dB/m)	Emission Level (dBμV/m)	Limit (dBμV/m)
57.84	QP	H	29.66	5.91	23.75	40.0
63.97	QP	H	31.28	5.97	25.31	40.0
151.72	QP	H	36.76	11.91	24.85	43.5
238.89	QP	H	33.19	13.52	19.67	46.0
479.99	QP	H	40.07	20.34	19.73	46.0
719.25	QP	H	42.13	24.40	17.73	46.0
899.99	QP	H	42.62	26.65	15.97	46.0

1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak / Average Measurement:

Frequency (MHz)	Polarization (V/H)	Measured Value (dBμV)	Antenna Factor + Cable Loss (dB/m)	Amplifier Gain (dB)	Emission Level (dBμV/m)	Limit (dBμV/m)
The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.						

Remark:

1). The field strength is calculated by adding the Antenna Factor. Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Emission = Measured Value + Antenna Factor + Cable Loss –Amplifier Gain.

2). As shown in Section, for frequencies above 1000 MHz. the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

3). The test only perform the EUT in transmitting status since the test frequencies were over 1GHz only required transmitting status.

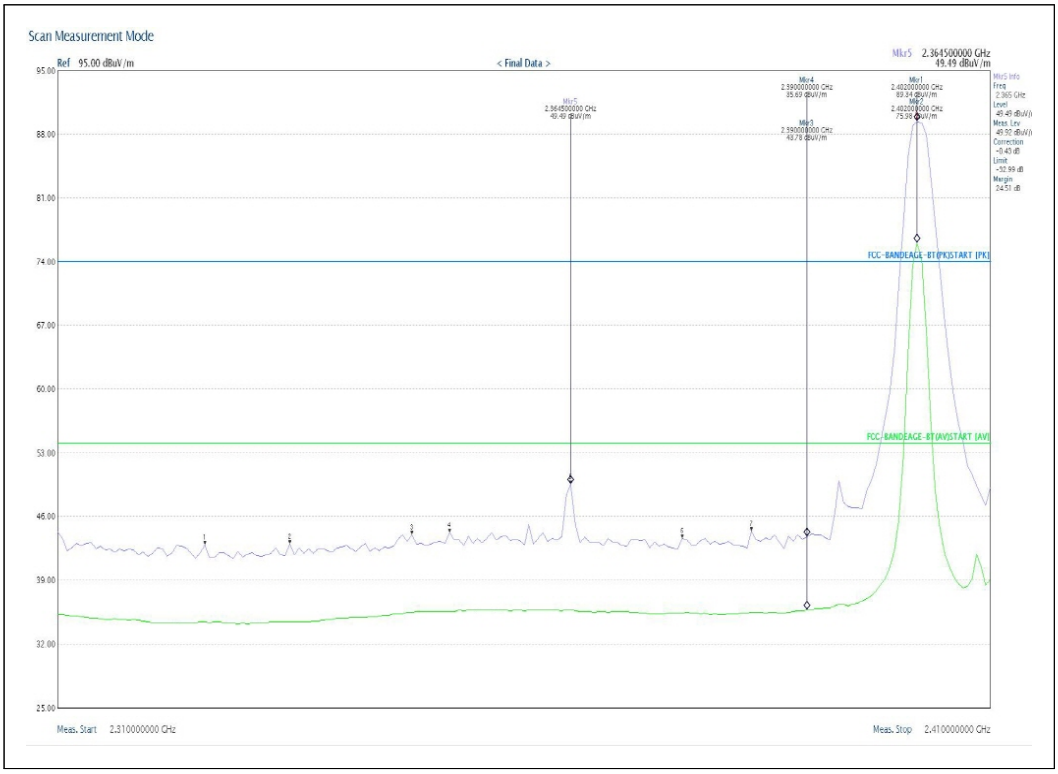
5.8. Band Edge (Radiated Emission)

Test Requirement:	FCC Part15 C Section 15.247 (d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).
Test Method:	ANSI C63.10: 2013
Measurement	3m
Limit:	Section 15.209(a) 40.0 dBμV/m between 30MHz & 88MHz; Quasi-peak Value 43.5 dBμV/m between 88MHz & 216MHz; Quasi-peak Value 46.0 dBμV/m between 216MHz & 960MHz; Quasi-peak Value 54.0 dBμV/m between 960MHz.& 1GHz; Quasi-peak Value 54.0 dBμV/m Above 1GHz; Average Value 74.0 dBμV/m Above 1GHz; Peak Value
Test Procedure:	a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. f. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channel g. Test the EUT in the lowest channel , the Highest channel h. The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, only the test worst case mode is recorded in the report. i. Repeat above procedures until all frequencies measured was complete.

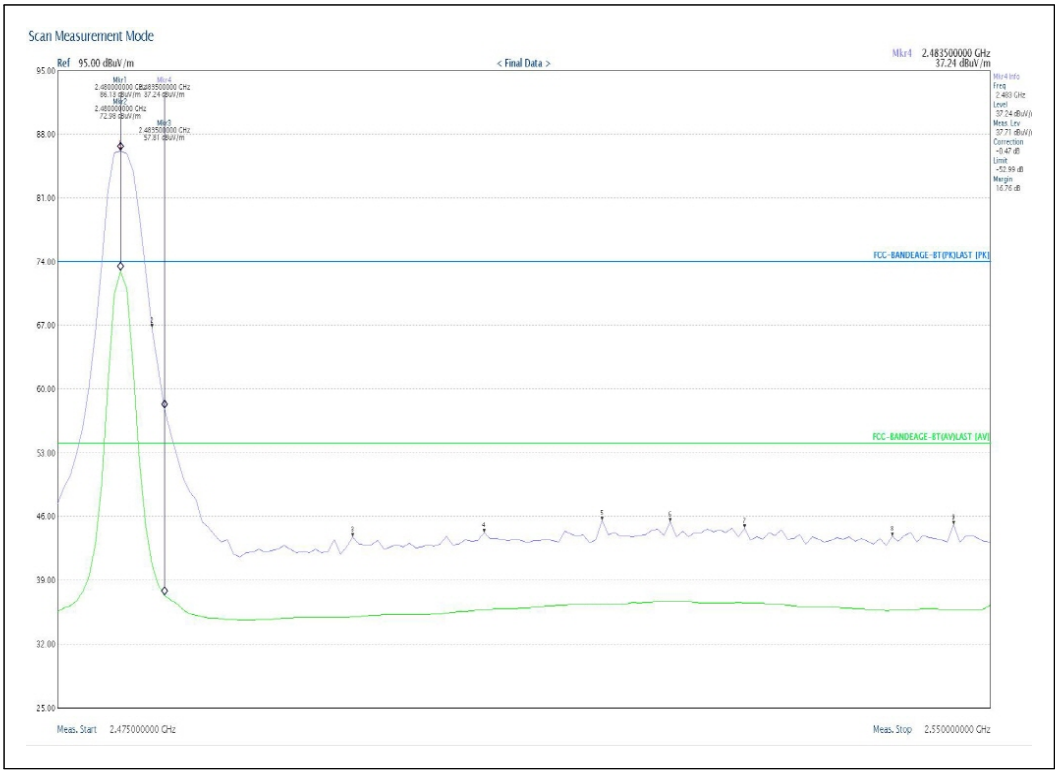
Exploratory Test Mode:	Transmitting mode
Final Test Mode:	Non-hopping transmitting with GFSK modulation
Instruments Used:	Refer to section 4.10 for details
Test Results:	Pass

Measurement Result:

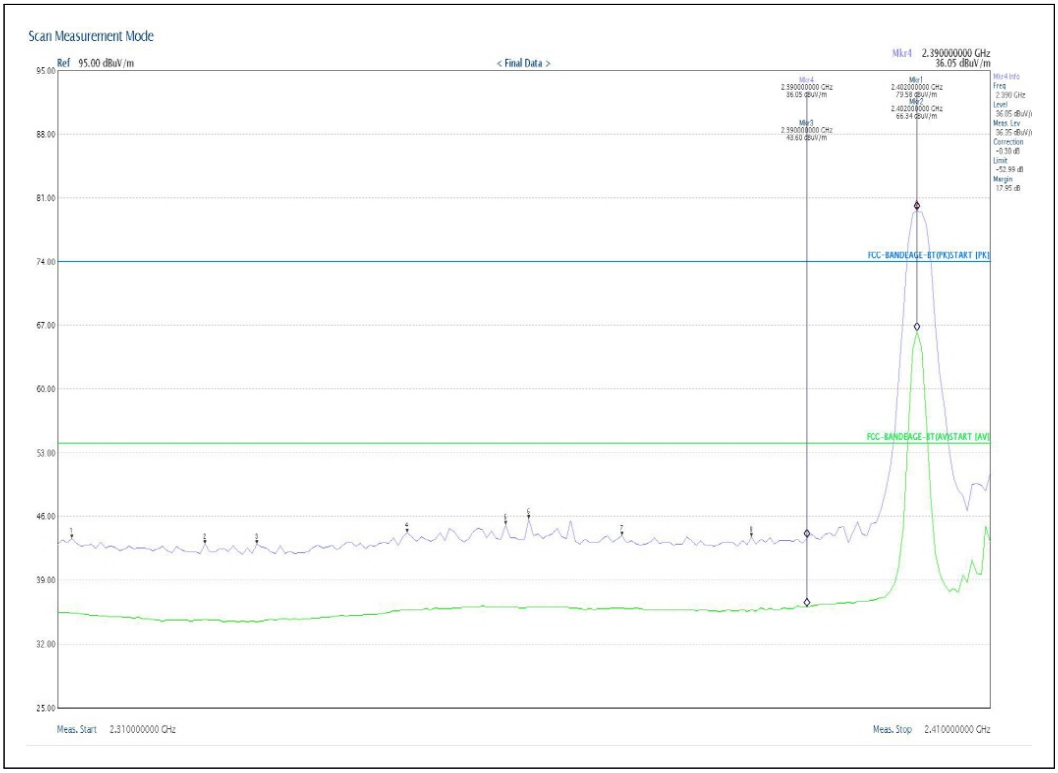
Lowest Channel , Horizontal , Peak/Average Detector



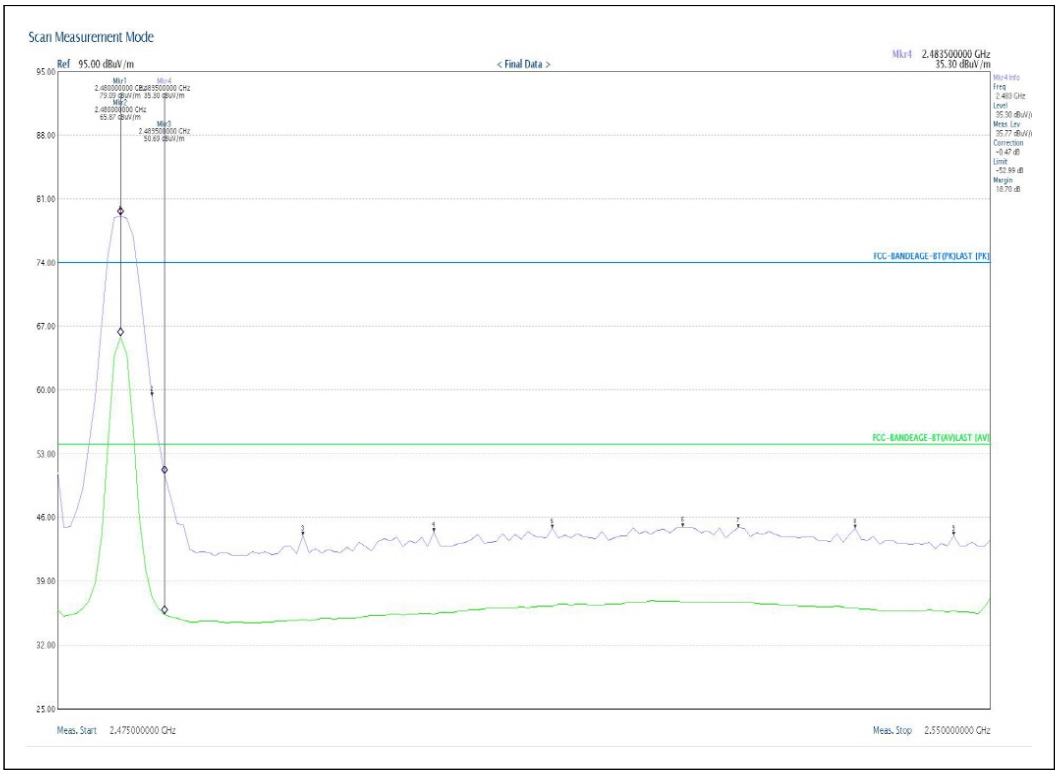
High Channel , Horizontal , Peak/Average Detector



Low Channel , Vertical , Peak/Average Detector



High Channel , Vertical , Peak/Average Detector



Section 15.205 Restricted bands of operation.

(a) Except as shown in paragraph (d) of this section. only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	
13.36 - 13.41			

5.9. Conducted Emissions at Mains Terminals 150 kHz to 30 MHz

Test Requirement: FCC Part 15 C section 15.207
Test Method: ANSI C63.10: ANSI C63.10: 2013
Frequency Range: 150 kHz to 30 MHz
Detector: Peak for pre-scan (9 kHz Resolution Bandwidth)

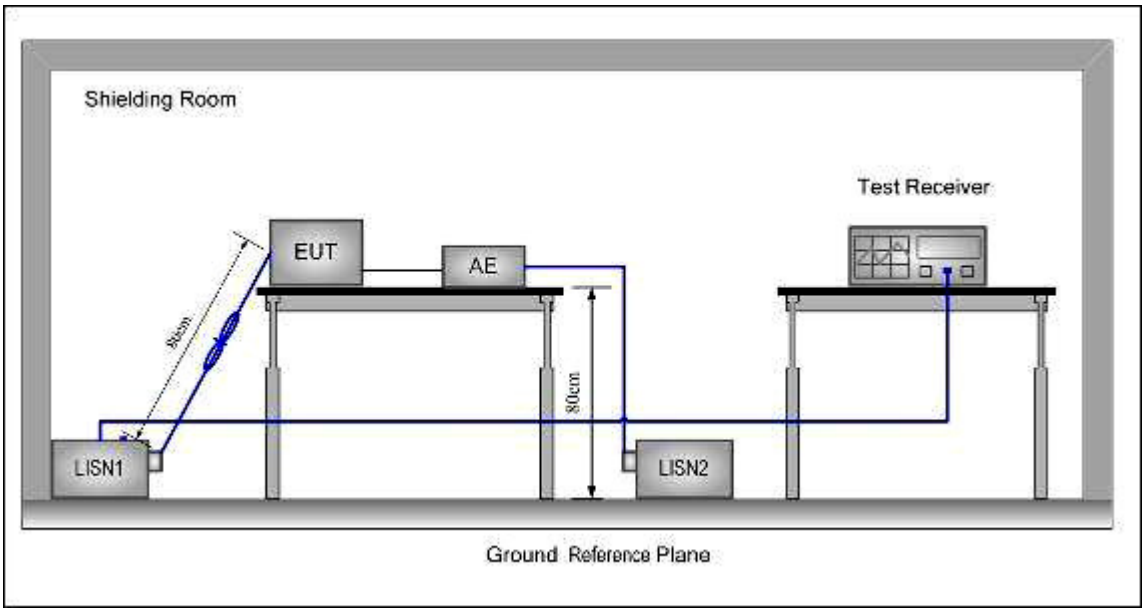
Test Limit

Limits for conducted disturbance at the mains ports of class B

Frequency Range (MHz)	Class B Limit dB(μV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
NOTE 1 The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.		

EUT Operation: Test in normal operating mode. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage.
Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Test Configuration:



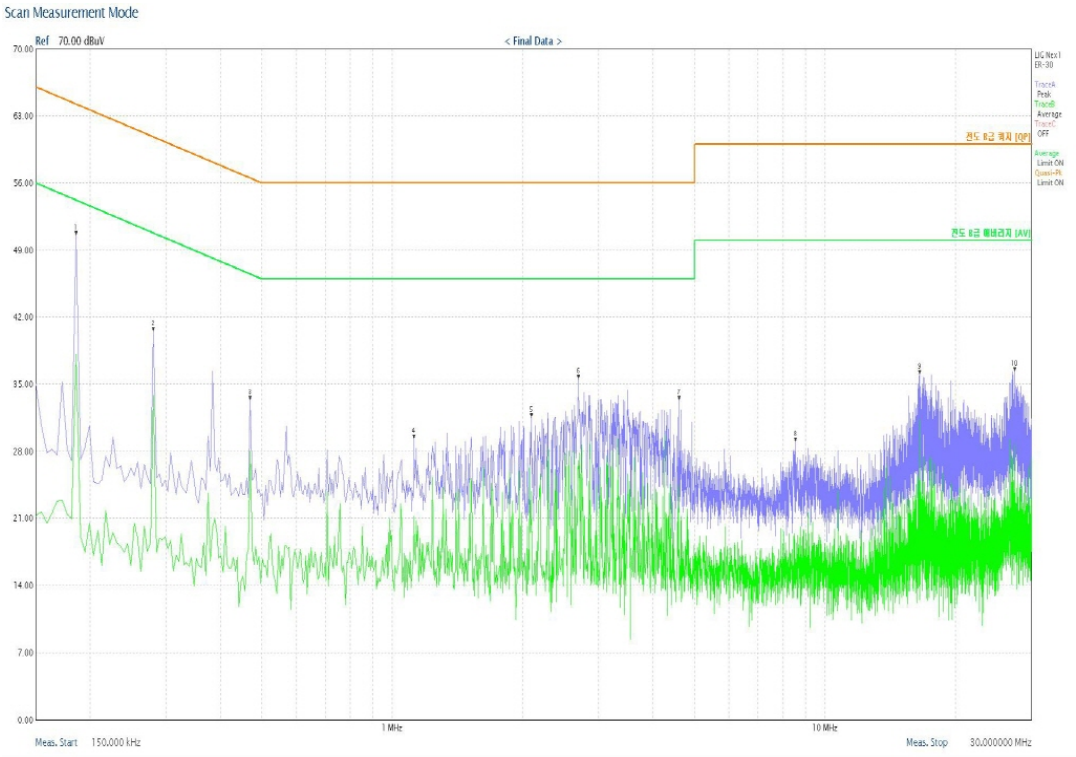
Test procedure:

1. The mains terminal disturbance voltage test was conducted in a shielded room.
2. The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50/50μH + 5linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
3. The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane, but separated from metallic contact with the ground reference plane by 0.1m of insulation.
4. The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0,4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0,8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0,8 m from the LISN 2.
5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2009 on conducted measurement.

5.9.1. Measurement Data

Pre-scan was performed with peak detected on all ports, Quasi-peak & average measurements were performed at the frequencies at which maximum peak emission level were detected. Please see the attached Quasi-peak and Average test results.

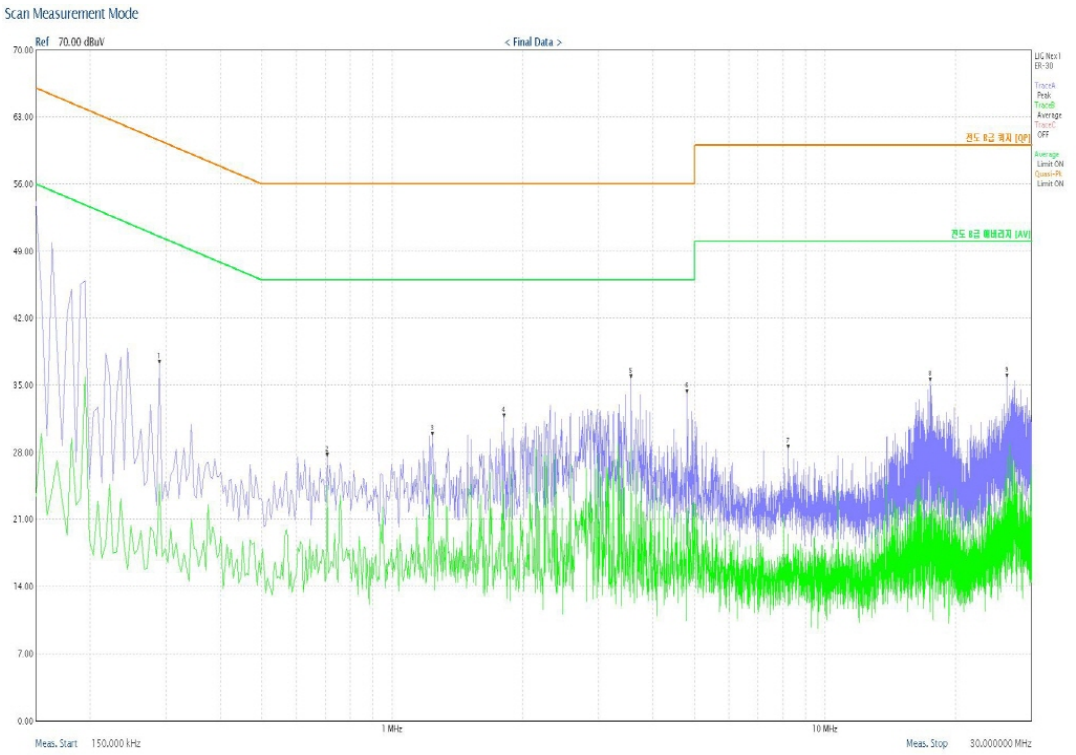
Line - PE(QusiPeak and Average detector used)



REDUCTION TABLE

No	Freq (MHz)	Level (dBuV)	Corr (dB)	Limit (dBuV)	Margin (dB)	State	Reference
1	0.180	47.90	10.06	64.49	16.59	Pass	QP
2	0.273	37.79	9.96	61.03	23.24	Pass	QP
3	0.378	33.59	10.94	58.33	24.74	Pass	QP
4	0.473	29.91	9.98	56.46	26.55	Pass	QP
5	2.000	28.19	10.12	56.00	27.81	Pass	QP
6	16.527	30.19	10.92	60.00	29.81	Pass	QP
7	27.468	31.24	11.31	60.00	28.76	Pass	QP
8	0.180	27.71	10.06	54.49	26.78	Pass	AV
9	0.273	20.51	9.96	51.03	30.52	Pass	AV
10	0.378	21.07	10.94	48.33	27.26	Pass	AV
11	0.473	20.53	9.98	46.46	25.93	Pass	AV
12	2.000	19.16	10.12	46.00	26.84	Pass	AV
13	16.527	19.71	10.92	50.00	30.29	Pass	AV
14	27.468	23.31	11.31	50.00	26.69	Pass	AV

Neutral – PE(QusiPeak and Average detector used)



REDUCTION TABLE

No	Freq (MHz)	Level (dBuV)	Corr (dB)	Limit (dBuV)	Margin (dB)	State	Reference
1	0.163	48.89	10.15	65.31	16.42	Pass	QP
2	0.715	23.94	9.99	56.00	32.06	Pass	QP
3	1.232	27.98	10.04	56.00	28.02	Pass	QP
4	3.547	29.45	10.18	56.00	26.55	Pass	QP
5	4.793	26.75	10.25	56.00	29.25	Pass	QP
6	17.476	28.72	10.80	60.00	31.28	Pass	QP
7	26.340	32.00	11.05	60.00	28.00	Pass	QP
8	0.163	27.47	10.15	55.31	27.84	Pass	AV
9	0.715	17.28	9.99	46.00	28.72	Pass	AV
10	1.232	21.57	10.04	46.00	24.43	Pass	AV
11	3.547	20.18	10.18	46.00	25.82	Pass	AV
12	4.793	16.60	10.25	46.00	29.40	Pass	AV
13	17.476	17.94	10.80	50.00	32.06	Pass	AV
14	26.340	25.04	11.05	50.00	24.96	Pass	AV

Measurement data:

* Detector function was set into Quasi-peak & Average mode.

* Corr = LISN Factor + Cable loss + Pulse Limiter

5.10. Radio Frequency Exposure Procedures

Regulation

According to §2.1091, §2.1093 and §1.1307(b), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission''s guidelines.

Table 1—Limits for Maximum Permissible Exposure (MPE)

Frequency range(MHz)	Electric field strength(V/m)	Magnetic field strength(A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f^2)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f^2)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

Note 1 to Table 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

The $S = PG / (4\pi R^2)$

Where S = power density in mW/cm^2

P = transmit power in mW

G = numeric gain of transmit antenna (numeric gain=Log-1(dB antenna gain/10))

R = distance (cm)

The calculations in the table below use the highest gain of antenna for client EUT. These calculations represent worst case in terms of the exposure levels.

Measurement Data

Channel Frequency	Power		Antenna Gain	Numeric antenna gain	R	S	Limits
(MHz)	(dBm)	(mW)	(dBi)	(mW)	(cm)	(mW/cm^2)	(mW/cm^2)
2402	3.25	2.113	-0.68	0.855	20	0.00035	1.0
2440	2.11	1.626	-0.68	0.855	20	0.00027	1.0
2480	0.38	1.091	-0.68	0.855	20	0.00018	1.0

Note: 1.0 mW/cm² from 1.310 §Table 1

The worst MPE = 0.00035 mW/cm² < 1.0 mW/cm².

Conclusion : The SAR measurement is exempt.

APPENDIX

1. EUT photo