

ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

Test Report No. : W179R-D021
AGR No. : A179A-375
Applicant : ROBOTIS
Address : #1505,1506, Ace High End Tower No.3, 371-50 Gasandong Geumcheongu, Seoul, Korea
Manufacturer : ROBOTIS
Address : #1505,1506, Ace High End Tower No.3, 371-50 Gasandong Geumcheongu, Seoul, Korea
Type of Equipment : Bluetooth Dongle
FCC ID. : SOD-BT-410-DONGLE
Model Name : BT-410 DONGLE
Multiple Model Name : N/A
Serial number : N/A
Total page of Report : 35 pages (including this page)
Date of Incoming : September 11, 2017
Date of issue : September 27, 2017

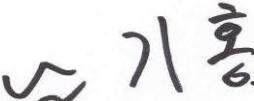
SUMMARY

The equipment complies with the regulation; **FCC PART 15 SUBPART C Section 15.247**

This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

Reviewed by:


Ki-Hong, Nam / Asst, Chief Engineer
ONETECH Corp.

Approved by:


Keun-Young, Choi / Vice President
ONETECH Corp.

CONTENTS

	PAGE
1. VERIFICATION OF COMPLIANCE	5
2. TEST SUMMARY	6
2.1 TEST ITEMS AND RESULTS	6
2.2 ADDITIONS, DEVIATIONS, EXCLUSIONS FROM STANDARDS.....	6
2.3 RELATED SUBMITTAL(S) / GRANT(S)	6
2.4 PURPOSE OF THE TEST	6
2.5 TEST METHODOLOGY.....	6
2.6 TEST FACILITY.....	6
3. GENERAL INFORMATION	7
3.1 PRODUCT DESCRIPTION.....	7
3.2 ALTERNATIVE TYPE(S)/MODEL(S); ALSO COVERED BY THIS TEST REPORT.....	7
4. EUT MODIFICATIONS.....	7
5. SYSTEM TEST CONFIGURATION	8
5.1 JUSTIFICATION	8
5.2 PERIPHERAL EQUIPMENT	8
5.3 MODE OF OPERATION DURING THE TEST	8
5.4 CONFIGURATION OF TEST SYSTEM	9
6. PRELIMINARY TEST	10
6.1 AC POWER LINE CONDUCTED EMISSIONS TESTS.....	10
6.2 GENERAL RADIATED EMISSIONS TESTS	10
7. MINIMUM 6 DB BANDWIDTH	11
7.1 OPERATING ENVIRONMENT	11
7.2 TEST SET-UP	11
7.3 TEST EQUIPMENT USED.....	11
7.4 TEST DATA	12
8. MAXIMUM PEAK OUTPUT POWER	14
8.1 OPERATING ENVIRONMENT	14
8.2 TEST SET-UP	14
8.3 TEST EQUIPMENT USED.....	14
8.4 TEST DATA	15
9. 100 KHZ BANDWIDTH OUTSIDE THE FREQUENCY BAND.....	17
9.1 OPERATING ENVIRONMENT	17

9.2 TEST SET-UP FOR CONDUCTED MEASUREMENT	17
9.3 TEST SET-UP FOR RADIATED MEASUREMENT.....	17
9.4 TEST EQUIPMENT USED.....	17
9.5 TEST DATA FOR CONDUCTED EMISSION	18
9.6 TEST DATA FOR RADIATED EMISSION.....	23
<i>9.6.1 Radiated Emission which fall in the Restricted Band and Band Edge</i>	23
<i>9.6.2 Spurious & Harmonic Radiated Emission.....</i>	24
10. PEAK POWER SPECTRAL DENSITY	25
10.1 OPERATING ENVIRONMENT	25
10.2 TEST SET-UP	25
10.3 TEST EQUIPMENT USED.....	25
10.4 TEST DATA.....	26
11. RADIATED EMISSION TEST	28
11.1 OPERATING ENVIRONMENT	28
11.2 TEST SET-UP	28
11.3 TEST EQUIPMENT USED.....	28
11.4 TEST DATA FOR TRANSMITTING MODE	29
<i>11.4.1 Test data for 30 MHz ~ 1 GHz</i>	29
<i>11.4.2 Test data for Below 30 MHz</i>	32
<i>11.4.3 Test data for above 1 GHz</i>	32
12. CONDUCTED EMISSION TEST.....	33
12.1 OPERATING ENVIRONMENT	33
12.2 TEST SET-UP	33
12.3 TEST EQUIPMENT USED.....	33
12.4 TEST DATA.....	34

Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
W179R-D021	September 27, 2017	Initial Issue	All

1. VERIFICATION OF COMPLIANCE

Applicant : ROBOTIS
Address : #1505,1506, Ace High End Tower No.3, 371-50 Gasandong Geumcheongu, Seoul, Korea
Contact Person : Eunsung, Lee / Senior Engineer
Telephone No. : +82-70-8671-2600
FCC ID : SOD-BT-410-DONGLE
Model Name : BT-410 DONGLE
Serial Number : N/A
Date : September 27, 2017

EQUIPMENT CLASS	DTS – DIGITAL TRANSMISSION SYSTEM
KIND OF EQUIPMENT	Bluetooth Dongle
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT	Certification
AUTHORIZATION REQUESTED	
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m, Semi Anechoic Chamber

- The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (2)	Minimum 6 dB Bandwidth	Met the Limit / PASS
15.247 (b) (3)	Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247 (d)	100 kHz Bandwidth Outside the Frequency Band	Met the Limit / PASS
15.247 (d)	Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.247 (e)	Peak Power Spectral Density	Met the Limit / PASS
15.209	Radiated Emission Limits	Met the Limit / PASS
15.207	Conducted Limits	Met the Limit / PASS
15.203	Antenna Requirement	Met requirement / PASS

2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART C Section 15.247.

2.5 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.

2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea

- Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-14617/ G-10666 / T-1842

IC (Industry Canada) – Registration No. Site# 3736A-3

- Site Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. GENERAL INFORMATION

3.1 Product Description

The ROBOTIS, Model BT-410 DONGLE (referred to as the EUT in this report) is a Bluetooth Dongle. The product specification described herein was obtained from product data sheet or user's manual.

Device Type	Bluetooth Dongle
Operating Frequency	2 402 MHz ~ 2 480 MHz
RF Output Power	-2.64 dBm
Number of Channel	40 Channel
Modulation Type	GFSK
Antenna Type	Chip Antenna
Antenna Gain	-0.92 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	16 MHz
Rated Supply Voltage	DC 5.0 V

3.2 Alternative type(s)/model(s); also covered by this test report.

- None

4. EUT MODIFICATIONS

- None

5. SYSTEM TEST CONFIGURATION

5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	ROBOTIS	BIC17-A01-E001	-

5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	Description	Connected to
BT-410 DONGLE	ROBOTIS	Bluetooth Dongle (EUT)	-
Lenovo IdeaPad Z560	Lenovo	Notebook PC	EUT

5.3 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting is programmed.

For final testing, the EUT was set at 2 402 MHz, 2 440 MHz, and 2 480 MHz to get a maximum emission levels from the EUT. The EUT was moved throughout the XY, XZ, and YZ planes and the worst case is "XZ" axis, but the worst data was recorded in this report.

5.4 Configuration of Test System

Line Conducted Test: The EUT was connected to Notebook PC and the power of USB was connected to Notebook PC. 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.

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 meter 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.

5.5 Antenna Requirement

For intentional device, according to section 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.

Antenna Construction:

The antenna of the EUT is a Chip Antenna on the main board in the EUT, so no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary Tests, the following operating mode was investigated

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

6.2 General Radiated Emissions Tests

During Preliminary Tests, the following operating modes were investigated

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

7. MINIMUM 6 dB BANDWIDTH

7.1 Operating environment

Temperature : 22.1 °C
Relative humidity : 43.7 % R.H.

7.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, and peak detection was used. The 6 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 6 dB.



7.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Apr. 05, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

7.4 Test data

- Test Date : September 12, 2017 ~ September 14, 2017

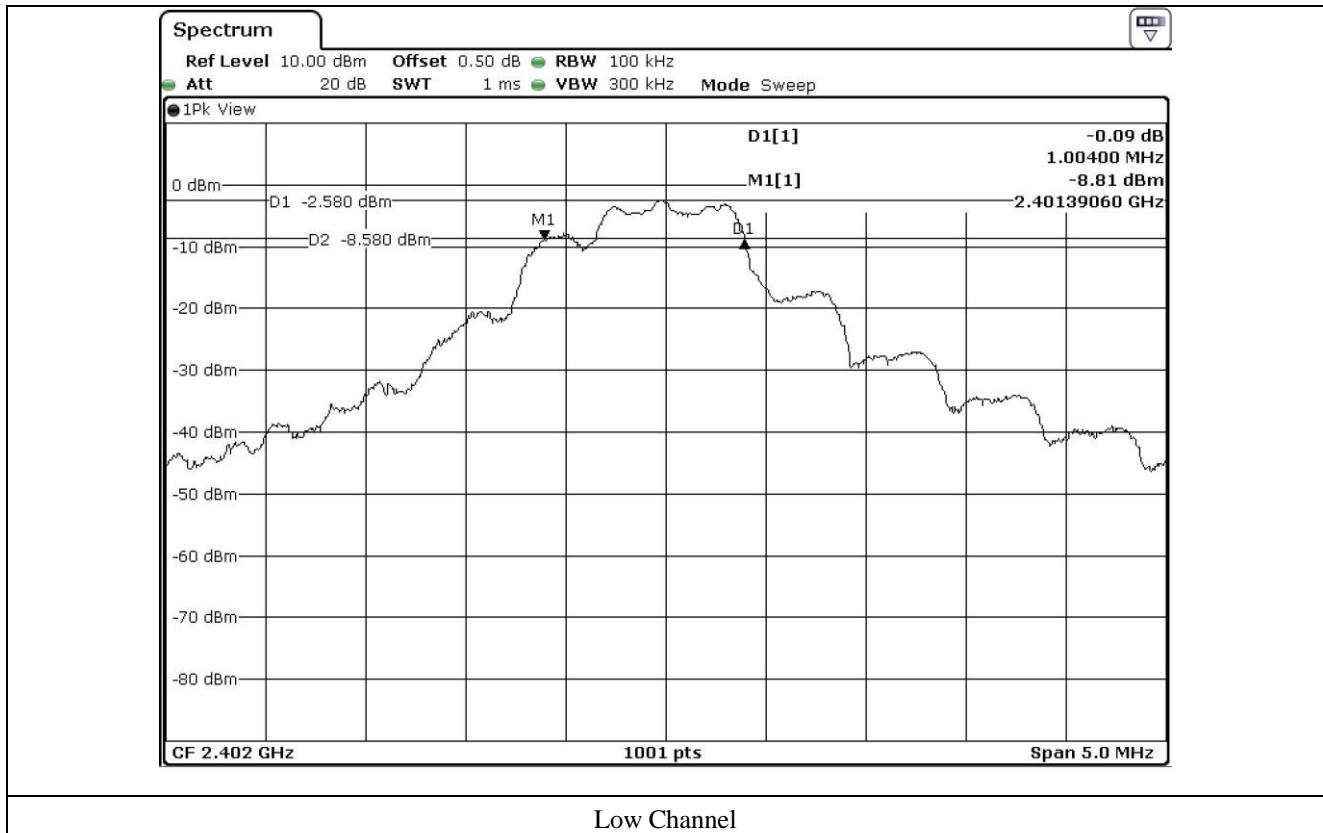
- Test Result : Pass

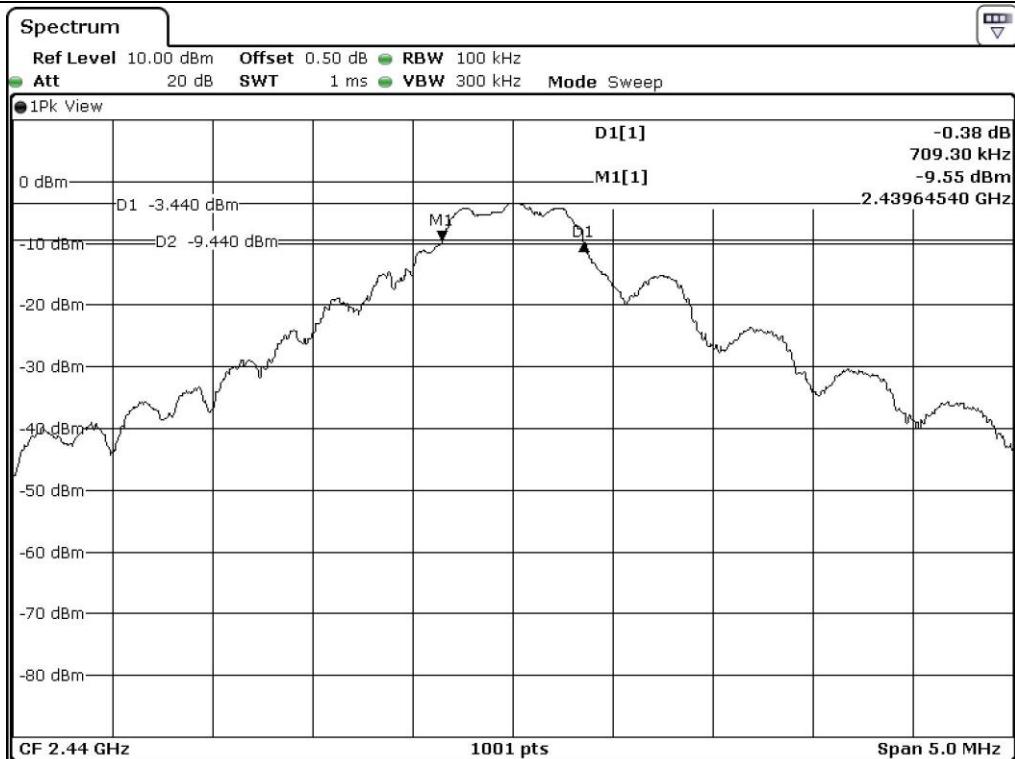
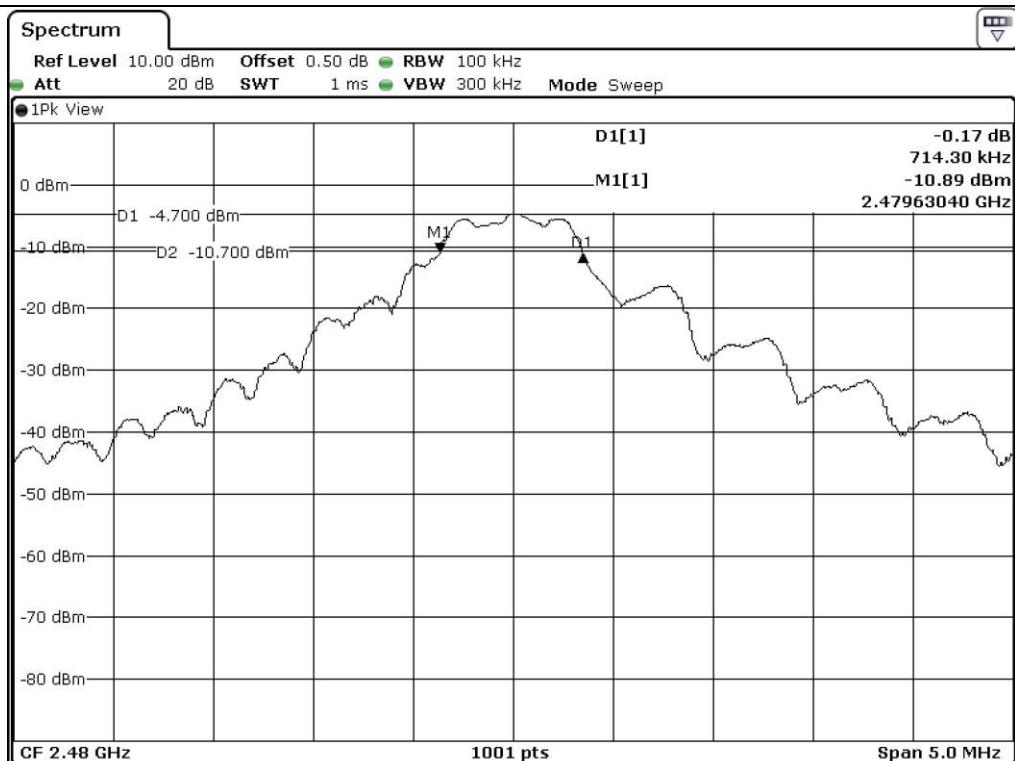
CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
Low	2 402.00	1 004.00	500.00	504.00
Middle	2 440.00	709.30	500.00	209.30
High	2 480.00	714.30	500.00	214.30

Remark. Margin = Measured Value - Limit



Tested by: Tae-Ho, Kim / Manager



**Middle Channel****High Channel**

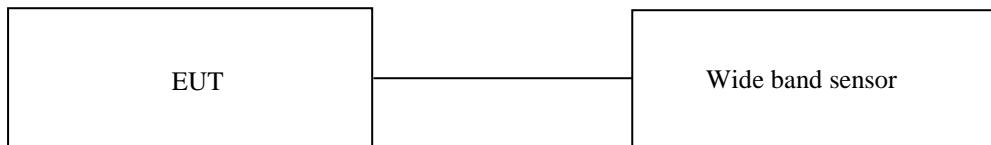
8. MAXIMUM PEAK OUTPUT POWER

8.1 Operating environment

Temperature : 22.1 °C
Relative humidity : 43.7 % R.H.

8.2 Test set-up

The maximum peak output power was measured with the wide band sensor connected to the antenna output of the EUT. The Wide Band Sensor is measured when the EUT is transmitting at the appropriate center frequency its maximum power control level as described in Section 9.2.3(KDB 558074 D01 DTS Meas Guidance V04). Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.



8.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - NRP-Z81	Rohde & Schwarz	Wide band Sensor	101975	Apr. 04, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

8.4 Test data

- Test Date : September 12, 2017 ~ September 14, 2017

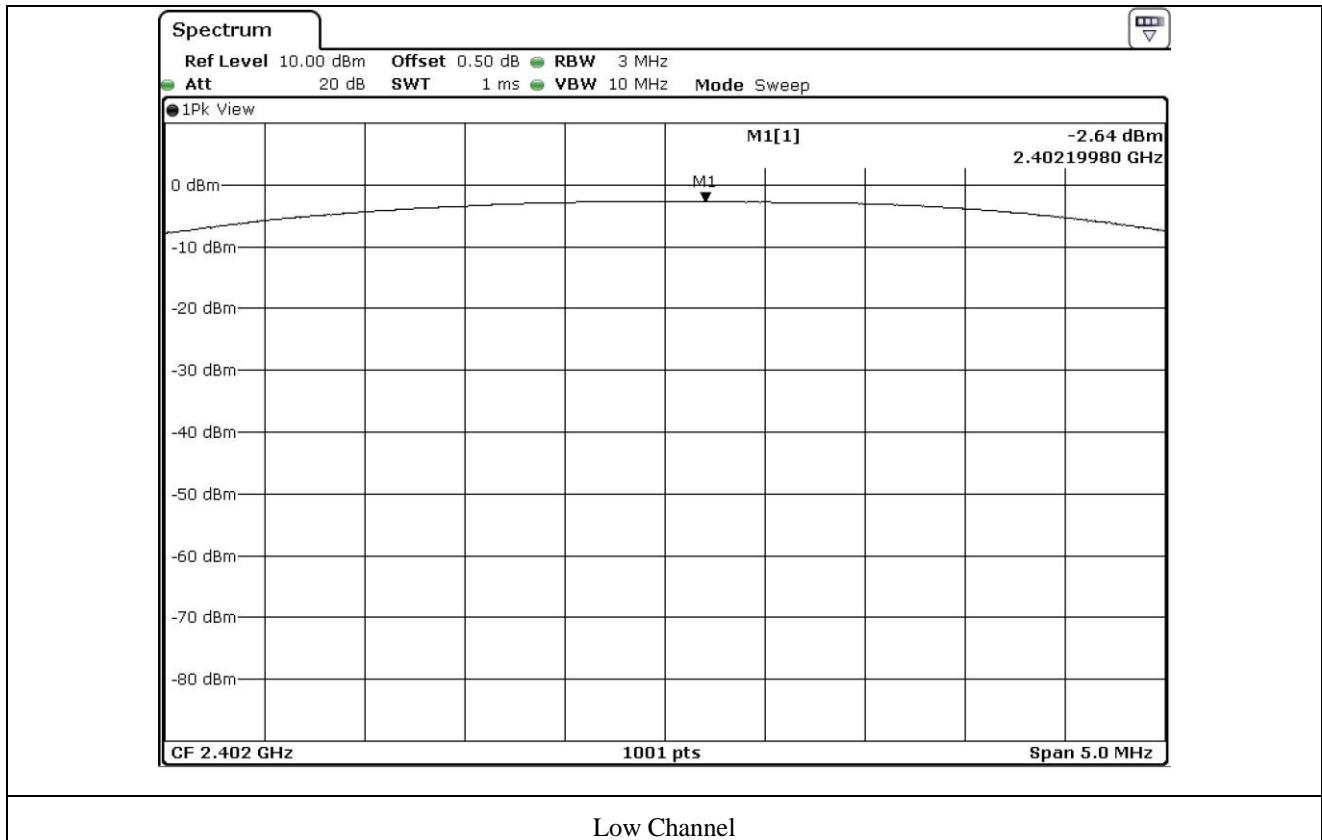
- Test Result : Pass

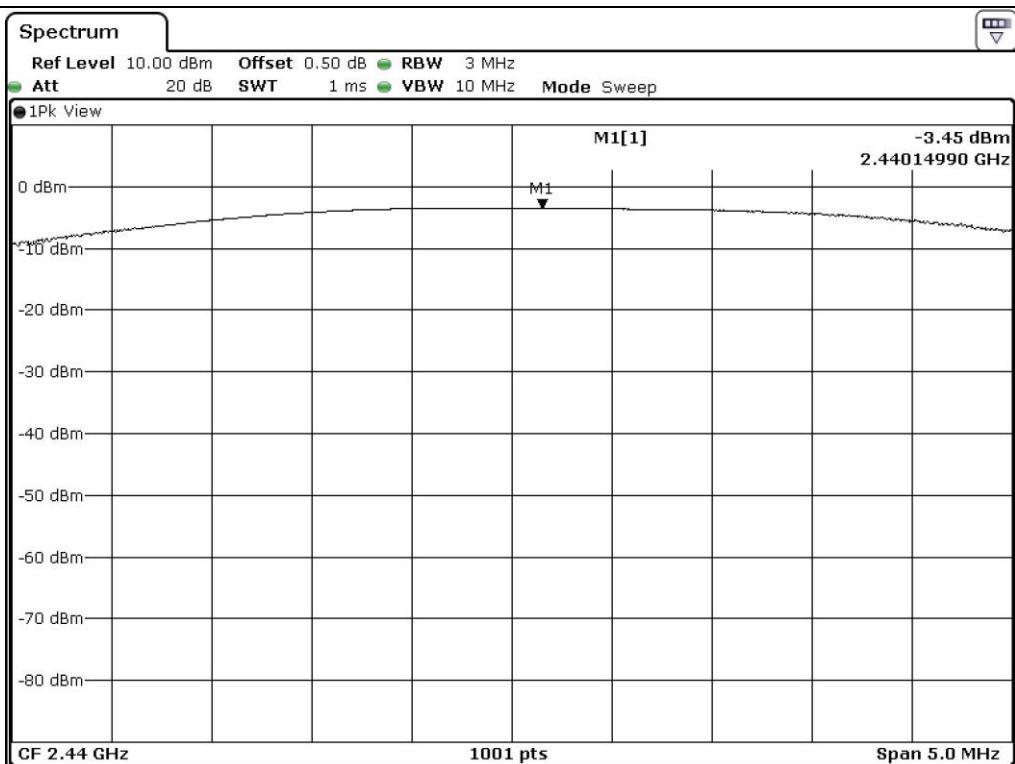
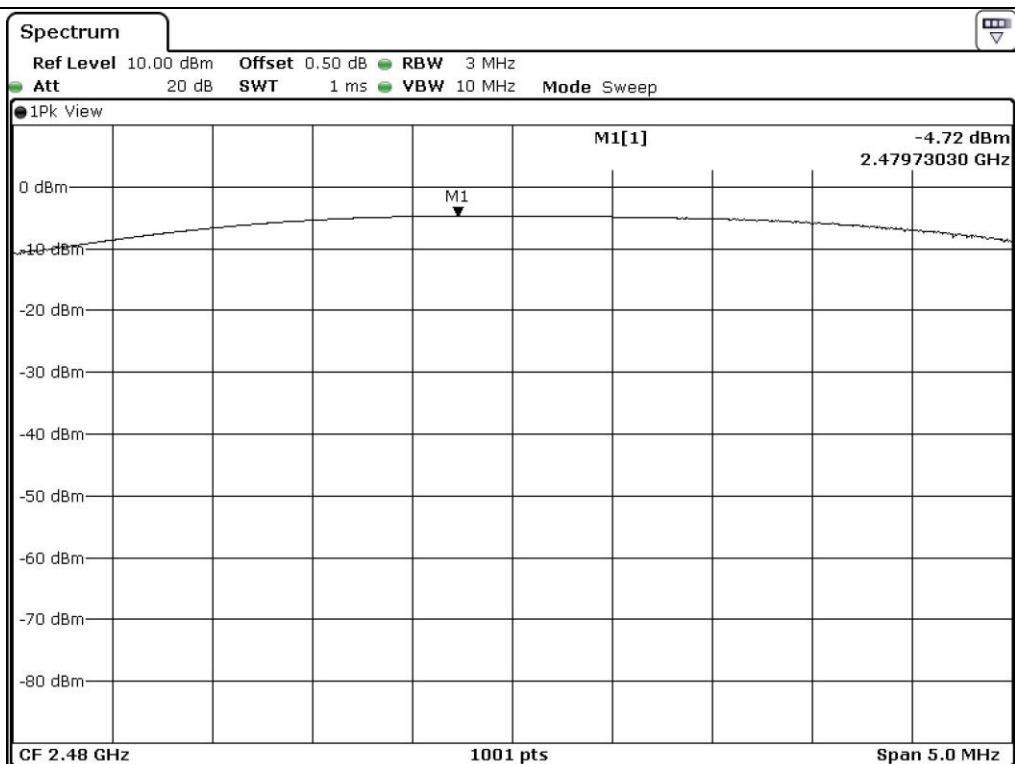
CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	-2.64	30.00	32.64
MIDDLE	2 440.00	-3.45	30.00	33.45
HIGH	2 480.00	-4.72	30.00	34.72

Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)



Tested by: Tae-Ho, Kim / Manager



**Middle Channel****High Channel**

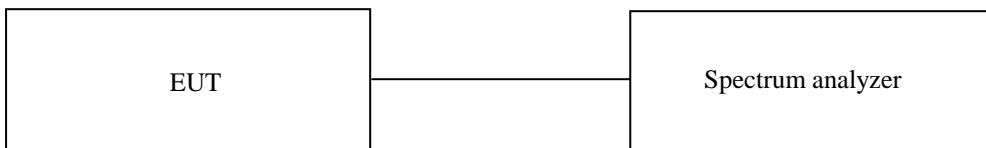
9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

9.1 Operating environment

Temperature : 22.1 °C
Relative humidity : 43.7 % R.H.

9.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution and video bandwidth is set to 100 kHz, and peak detection was used.



9.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 3 m semi anechoic chamber. The EUT was placed on turntable approximately 1.5 m above the ground plane.

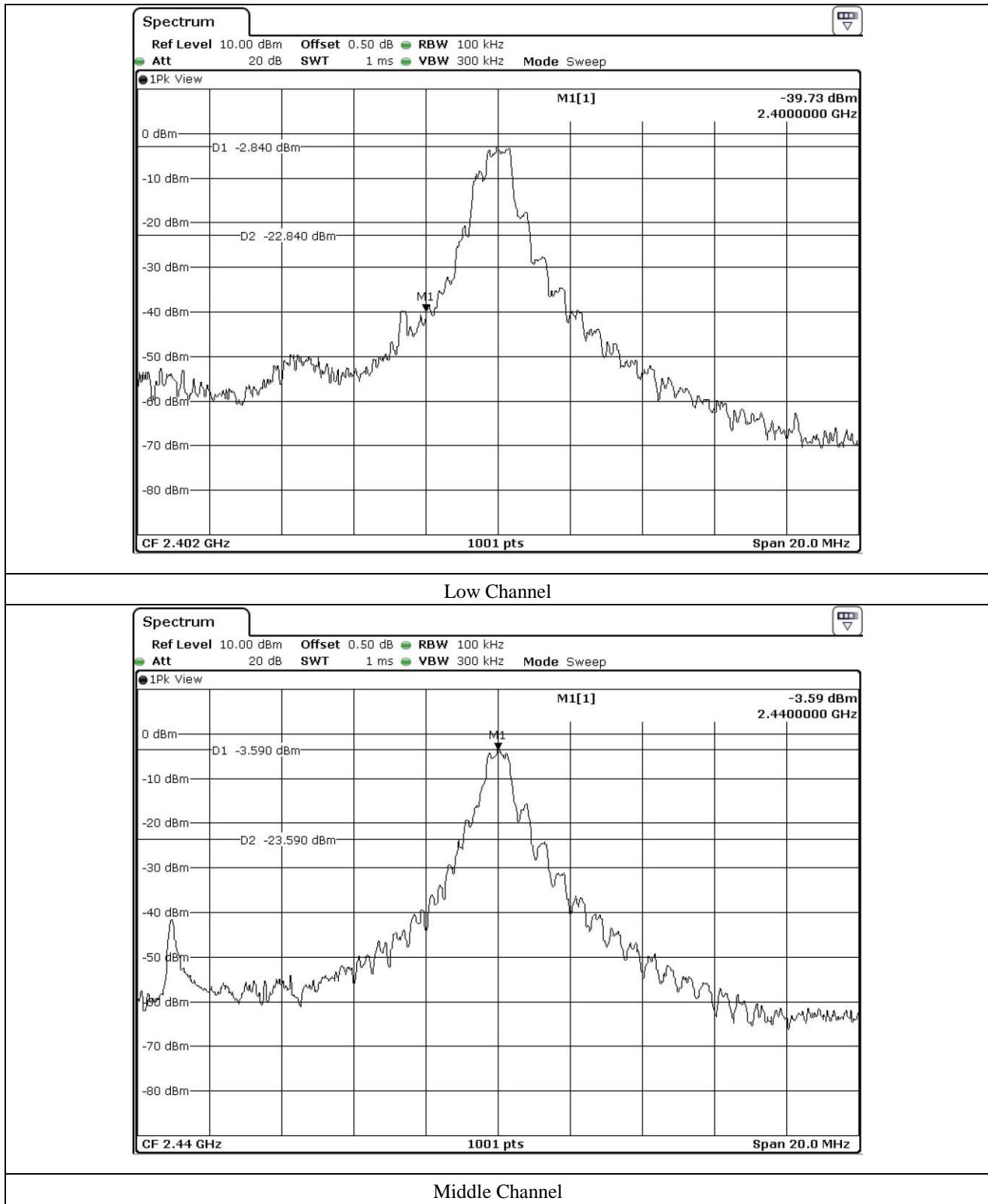
The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

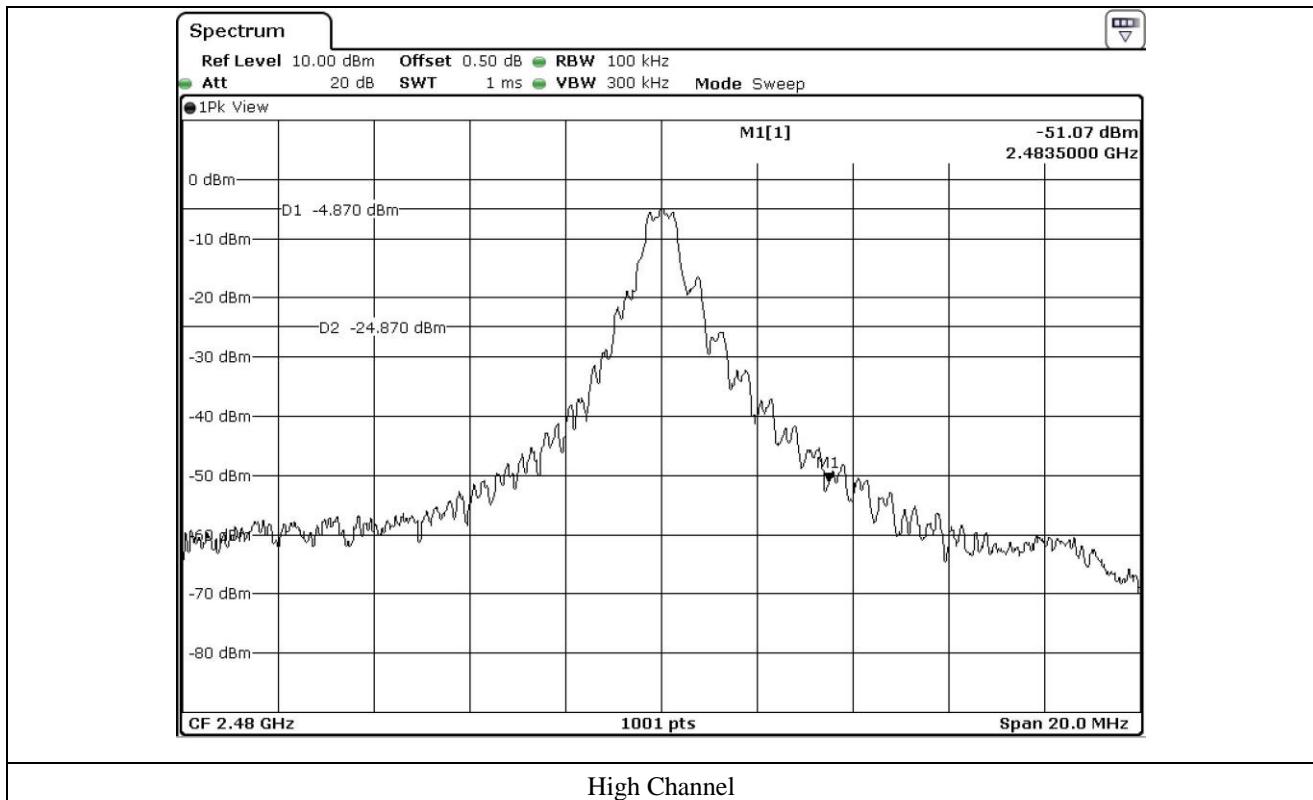
9.4 Test equipment used

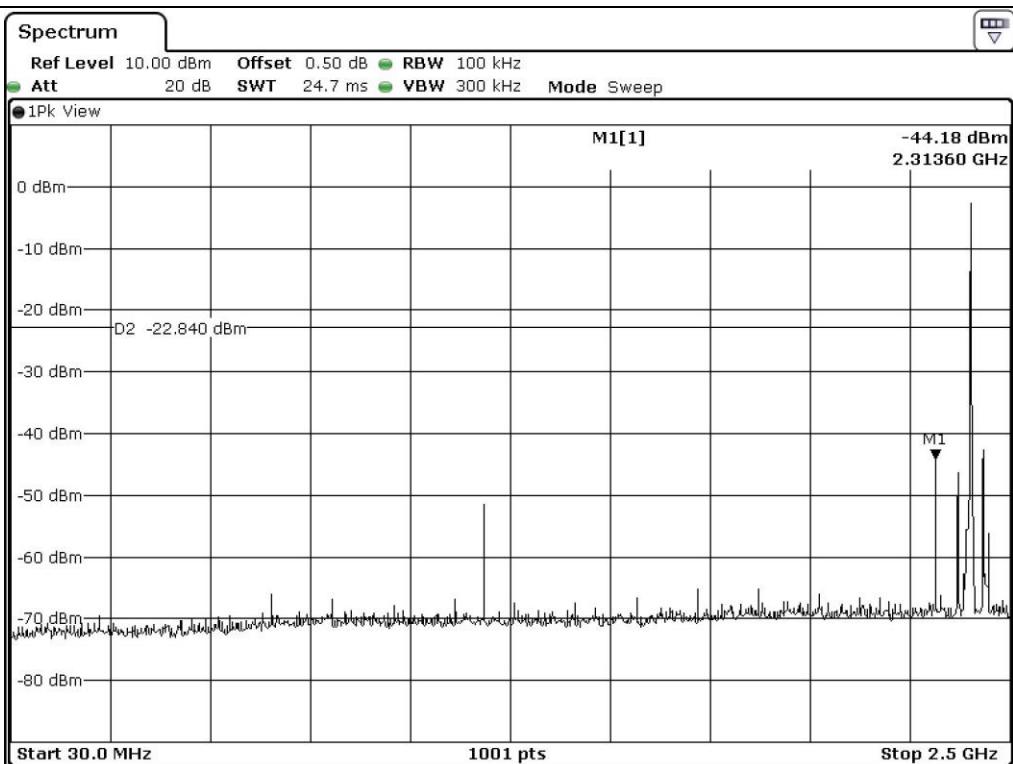
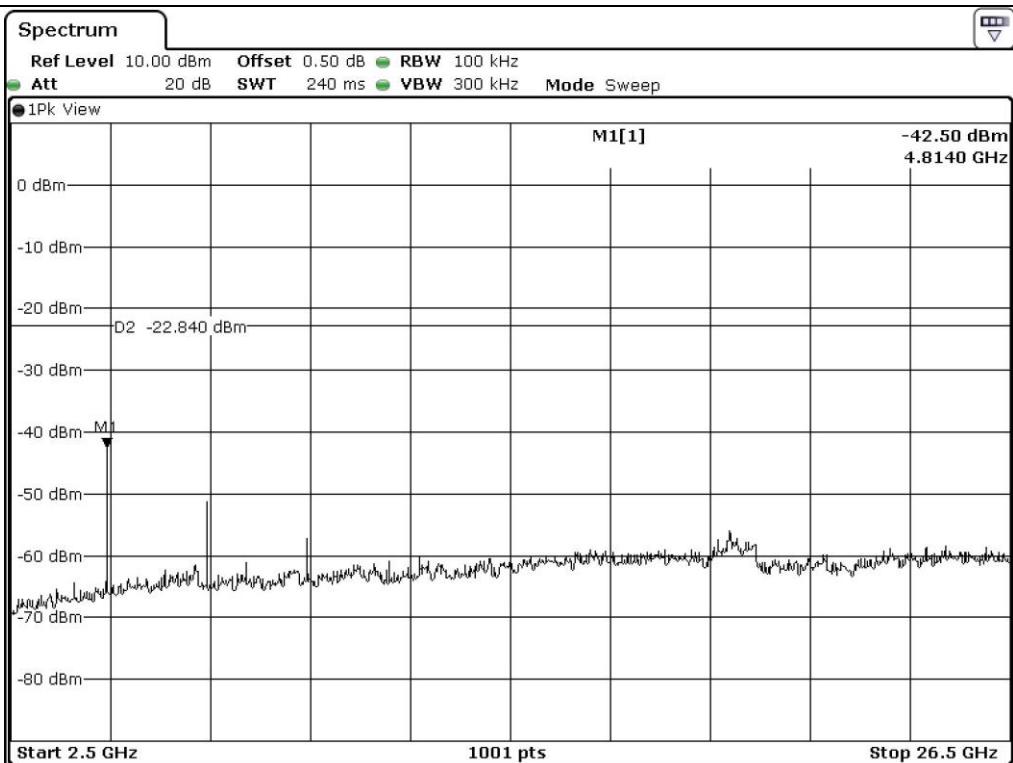
Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Apr. 05, 2017 (1Y)
■ - ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 06, 2017 (1Y)
■ - 310N	Sonoma Instrument	Pre-Amplifier	312544	Apr. 05, 2017 (1Y)
■ - BBV9718	Schwarzbeck	Amplifier	310	Sep. 01, 2017 (1Y)
■ - SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Apr. 04, 2017 (1Y)
■ - DT3000-3t	Innco System	Turn Table	DT3000/093	N/A
■ - MA-4000XPET	Innco System	Antenna Master	MA4000/509	N/A
■ - VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-421	Apr. 15, 2016 (2Y)
■ - BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	May 26, 2017 (2Y)
■ - BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170179	Jul. 28, 2017 (2Y)

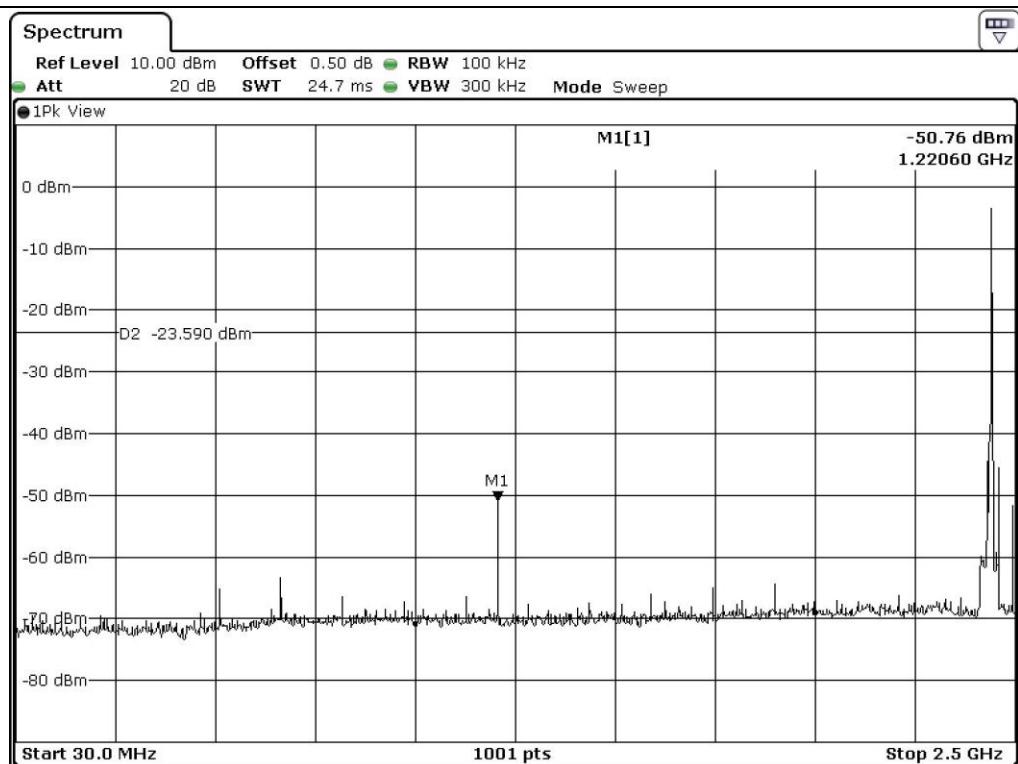
All test equipment used is calibrated on a regular basis.

9.5 Test data for conducted emission

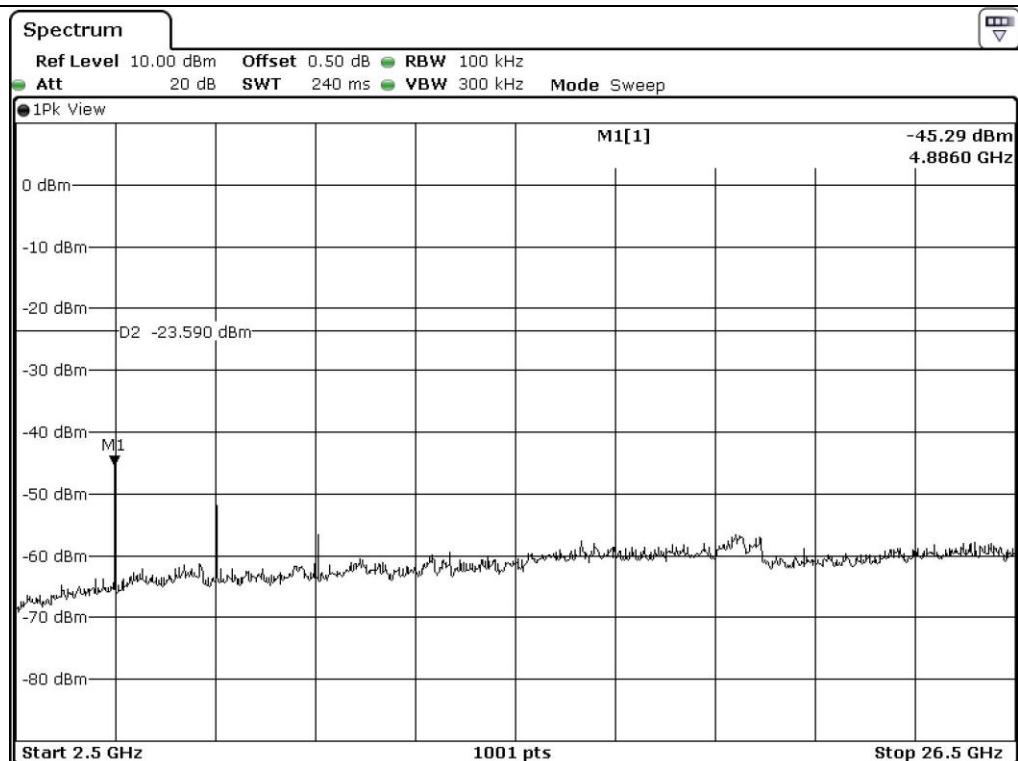




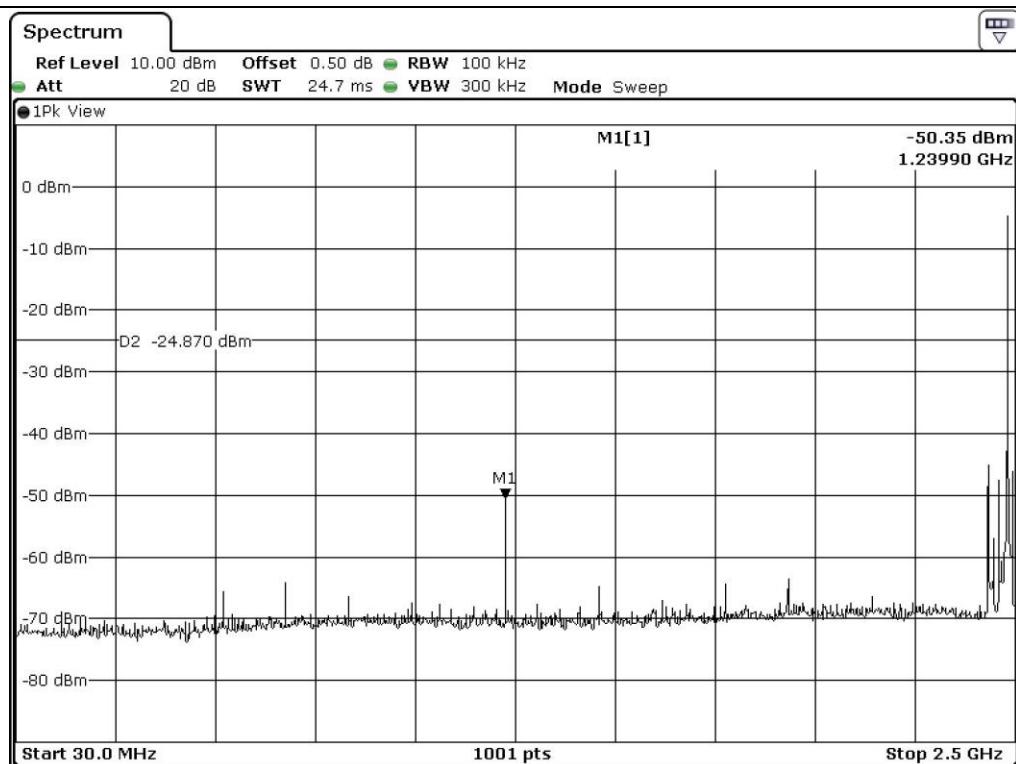
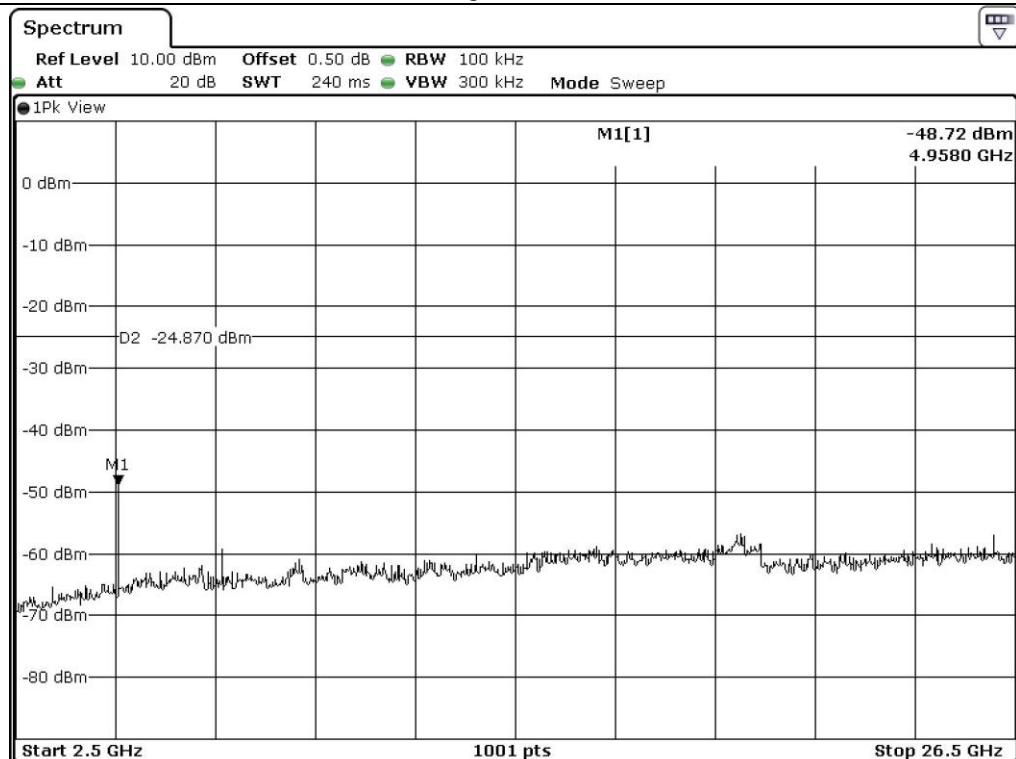
**Low Channel****Low Channel**



Middle Channel



Middle Channel

**High Channel****High Channel**

9.6 Test data for radiated emission

9.6.1 Radiated Emission which fall in the Restricted Band and Band Edge

- Test Date : September 12, 2017 ~ September 14, 2017
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Measurement distance : 3 m
- Duty Cycle : 100 %
- Result : PASSED

Frequency (MHz)	Reading (dB μ V)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Test Data for Low Channel									
2 384.60	52.66	Peak	H	27.30	11.40	42.70	48.66	74.00	25.34
	36.52	Average	H				32.52	54.00	21.48
	45.90	Peak	V				41.90	74.00	32.10
	31.70	Average	V				27.70	54.00	26.30
Test Data for Band Edge									
2 400.00	60.71	Peak	H	27.30	11.40	42.70	56.71	74.00	17.29
	49.33	Average	H				45.33	54.00	8.67
	53.18	Peak	V				49.18	74.00	24.82
	41.40	Average	V				37.40	54.00	16.60
Test Data for High Channel									
2 483.51	51.85	Peak	H	27.30	11.40	42.70	47.85	74.00	26.15
	35.90	Average	H				31.90	54.00	22.10
	43.27	Peak	V				39.27	74.00	34.73
	32.99	Average	V				28.99	54.00	25.01

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dB μ V/m) - Total Level (dB μ V/m)

Total Level = Reading + Antenna Factor + Cable Loss - Pre-Amplifier Gain



Tested by: Tae-Ho, Kim / Manager

9.6.2 Spurious & Harmonic Radiated Emission

- Test Date : September 12, 2017 ~ September 14, 2017
- Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band, 100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Duty Cycle : 100 %
- Result : PASSED

Frequency (GHz)	Reading (dB μ V)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Test Data for Low Channel									
4 804.00	40.15	Peak	H	30.80	16.10	43.80	43.30	74.00	30.75
	33.07	Average	H				36.17	54.00	17.83
	37.56	Peak	V				40.66	74.00	33.34
	29.84	Average	V				32.94	54.00	21.06
Test Data for Middle Channel									
4 880.00	40.52	Peak	H	30.90	16.10	43.80	43.72	74.00	30.28
	34.15	Average	H				37.35	54.00	16.65
	37.91	Peak	V				41.11	74.00	32.89
	33.52	Average	V				36.72	54.00	17.28
Test Data for High Channel									
4 960.00	40.26	Peak	H	31.00	16.10	43.80	43.56	74.00	30.44
	35.49	Average	H				38.79	54.00	15.21
	36.77	Peak	V				40.07	74.00	33.93
	34.28	Average	V				37.58	54.00	16.42

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dB μ V/m) - Total Level (dB μ V/m)

Total Level = Reading + Antenna Factor + Cable Loss - Pre-Amplifier Gain



Tested by: Tae-Ho, Kim / Manager

10. PEAK POWER SPECTRAL DENSITY

10.1 Operating environment

Temperature : 22.1 °C
Relative humidity : 43.7 % R.H.

10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer.

The resolution bandwidth is set to $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$, the video bandwidth is set to 3 times the resolution bandwidth.



10.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Apr. 05, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

10.4 Test data

- Test Date : September 12, 2017 ~ September 14, 2017

- Test Result : Pass

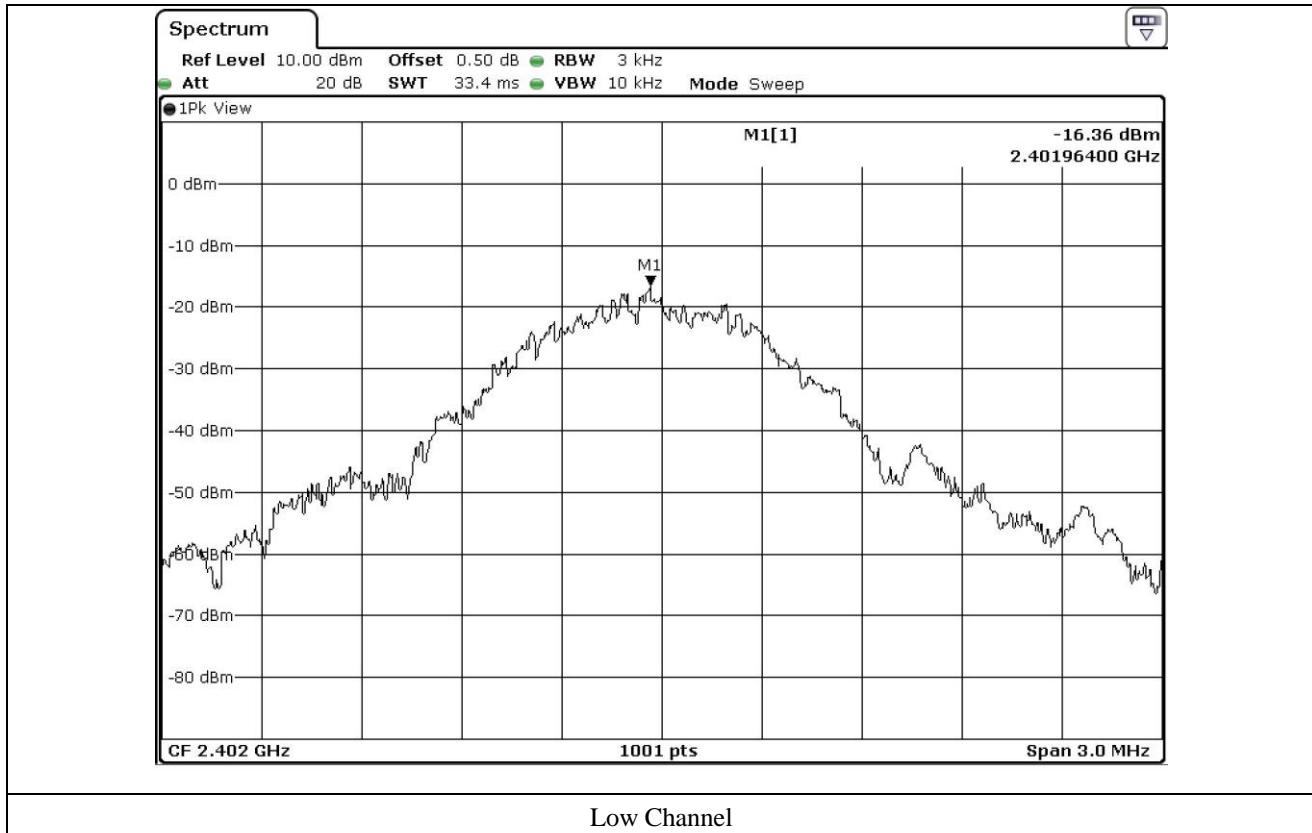
- Operating Condition : Continuous transmitting mode

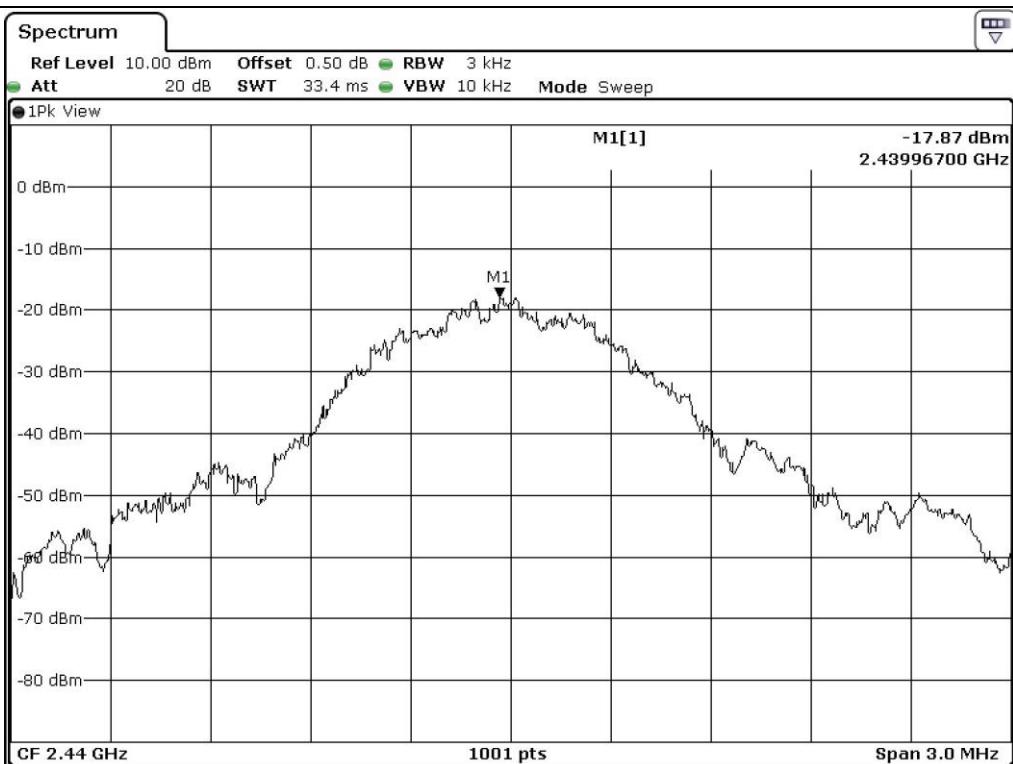
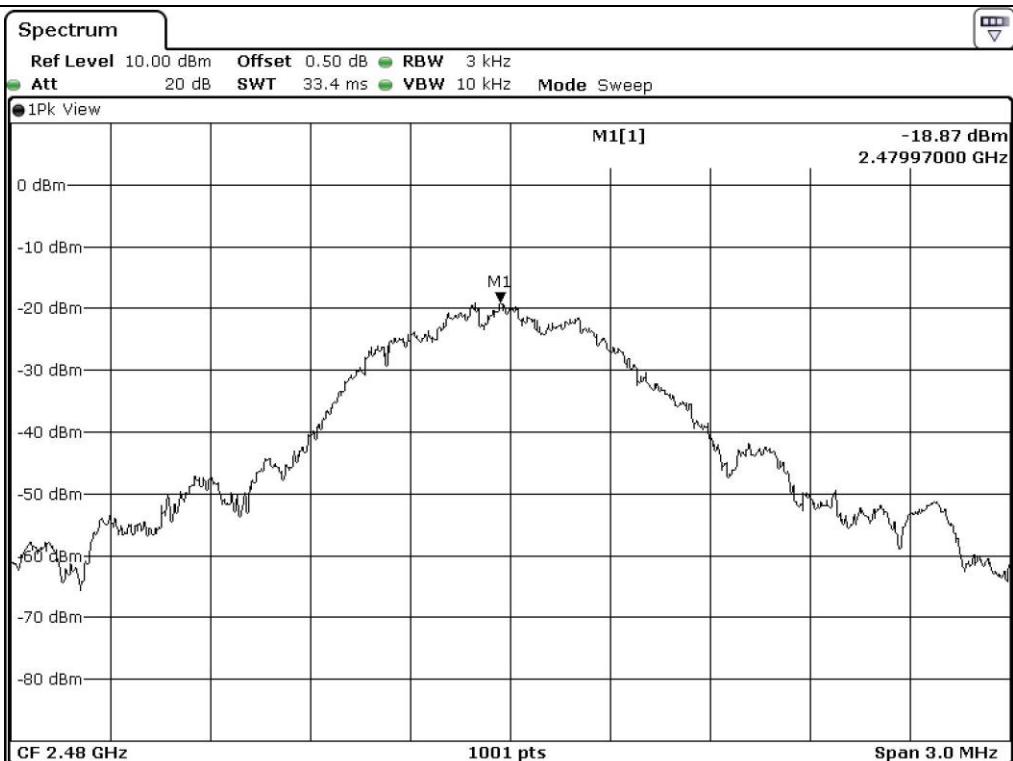
CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 402.00	-16.36	8.00	24.36
Middle	2 440.00	-17.87	8.00	25.87
High	2 480.00	-18.87	8.00	26.87

Remark. Margin = Limit – Measured value



Tested by: Tae-Ho, Kim / Manager



**Middle Channel****High Channel**

11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 22.1 °C
Relative humidity : 43.9 % R.H.

11.2 Test set-up

The radiated emissions measurements were on the 3 m semi anechoic chamber. The EUT and other support equipment were placed on turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 26.5 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

11.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Apr. 05, 2017 (1Y)
■ - ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 06, 2017 (1Y)
■ - 310N	Sonoma Instrument	Pre-Amplifier	312544	Apr. 05, 2017 (1Y)
■ - BBV9718	Schwarzbeck	Amplifier	310	Sep. 01, 2017 (1Y)
■ - DT3000-3t	Innco System	Turn Table	DT3000/093	N/A
■ - MA-4000XPET	Innco System	Antenna Master	MA4000/509	N/A
■ - VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-421	Apr. 15, 2016 (2Y)
■ - BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	May 26, 2017 (2Y)
■ - BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170179	Jul. 28, 2017 (2Y)

All test equipment used is calibrated on a regular basis.

11.4 Test data for Transmitting Mode

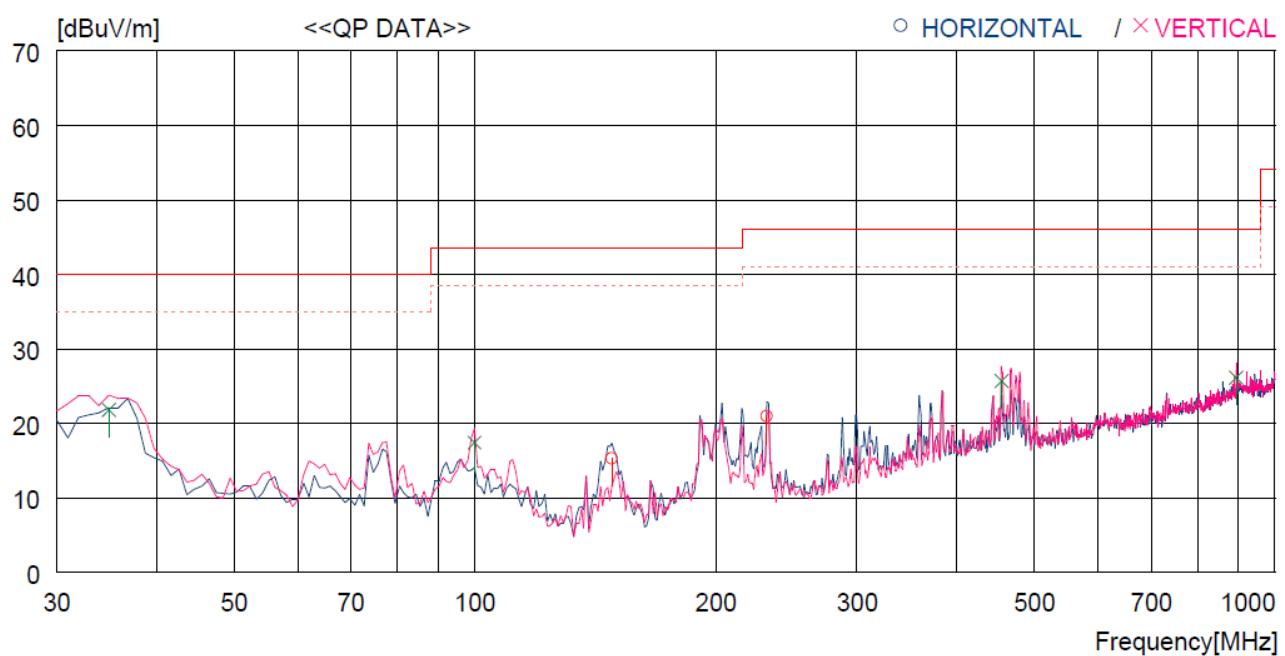
11.4.1 Test data for 30 MHz ~ 1 GHz

Humidity Level : 43.9 % R.H. Temperature: 22.1 °C
 Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247
 Result : PASSED

EUT : Bluetooth Dongle Date: September 13, 2017

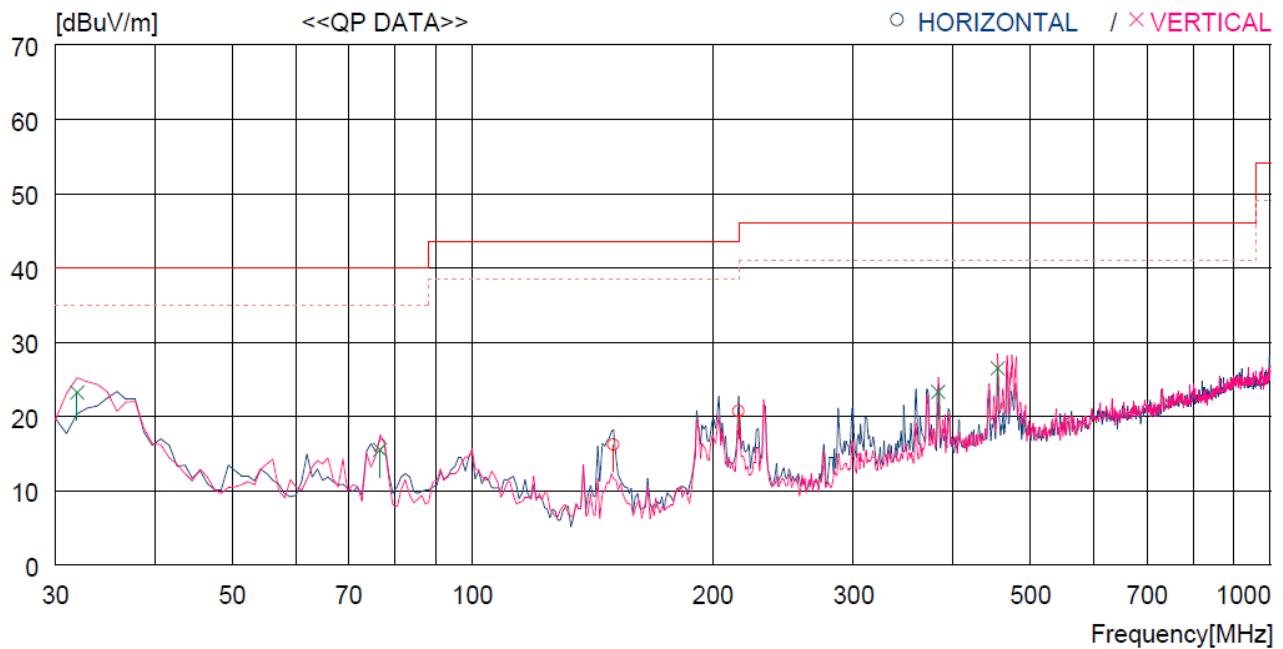
Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)

Operating condition : Low Channel



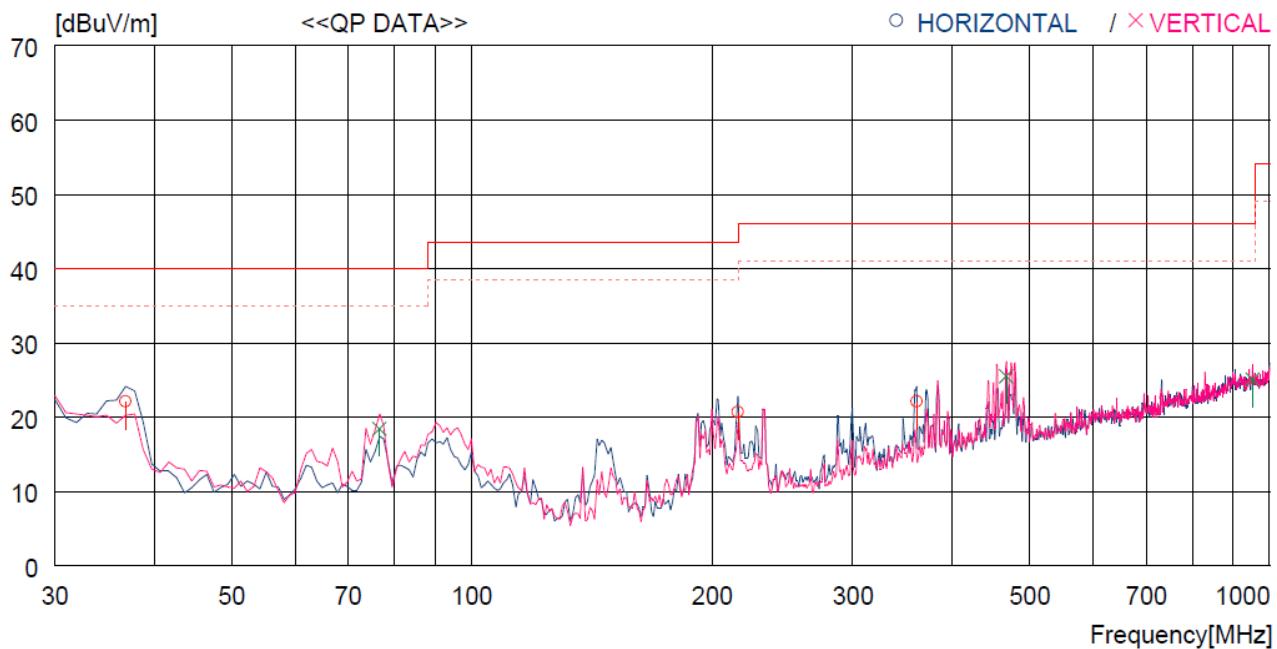
No.	FREQ [MHz]	READING QP [dB μ V]	ANT FACTOR	LOSS [dB]	GAIN [dB]	RESULT [dB μ V/m]	LIMIT [dB]	MARGIN [cm]	ANTENNA TABLE	
									RESULT [dB μ V/m]	ANT [DEG]
----- Horizontal -----										
1	148.340	37.6		7.7	2.9	32.9	15.3	43.5	28.2	200
2	231.760	38.8			11.7	33.1	20.9	46.0	25.1	100
----- Vertical -----										
3	34.850	41.2		12.3	1.4	33.1	21.8	40.0	18.2	400
4	99.840	36.1		11.9	2.4	33.0	17.4	43.5	26.1	100
5	454.861	37.6		16.4	4.9	33.2	25.7	46.0	20.3	100
6	894.259	29.7		22.1	7.0	32.7	26.1	46.0	19.9	359

Operating condition : Middle Channel



No.	FREQ [MHz]	READING [dBuV]	ANT FACTOR	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [cm]	ANTENNA TABLE [DEG]
----- Horizontal -----									
1	150.280	38.5		7.7	2.9	32.9	16.2	43.5	27.3
2	215.270	39.5			11.0	33.2	20.7	43.5	22.8
----- Vertical -----									
3	31.940	43.2		11.7	1.4	33.1	23.2	40.0	16.8
4	76.560	38.7		7.8	2.1	33.1	15.5	40.0	24.5
5	383.080	36.6		15.4	4.5	33.2	23.3	46.0	22.7
6	454.861	38.4		16.4	4.9	33.2	26.5	46.0	19.5

Operating condition : High Channel



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	QP	FACTOR				[dBuV/m]	[dBuV/m]	[dB]		

	[MHz]	[dBuV]	[dB]	[dB]	[dB]	[dB]	[cm]	[DEG]
--	-------	--------	------	------	------	------	------	-------

----- Horizontal -----

1	36.790	39.7	13.6	1.8	33.0	22.1	40.0	17.9	400	359
2	215.270	38.6	11.2	3.9	33.0	20.7	43.5	22.8	100	0
3	360.770	35.1	15.0	5.1	33.1	22.1	46.0	23.9	100	0

----- Vertical -----

4	76.560	40.9	8.2	2.4	33.1	18.4	40.0	21.6	400	0
5	467.471	36.5	16.4	5.8	33.2	25.5	46.0	20.5	100	140
6	951.487	26.3	22.4	8.6	32.2	25.1	46.0	20.9	200	0

Tested by: Tae-Ho, Kim / Manager

11.4.2 Test data for Below 30 MHz

- Test Date : September 13, 2017
- Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- Frequency range : 9 kHz ~ 30 MHz
- Measurement distance : 3 m
- Operating mode : Transmitting mode

Frequency (MHz)	Reading (dB μ V)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Any emissions less than 20 dB below the limit were not observed.									

11.4.3 Test data for above 1 GHz

- Test Date : September 13, 2017
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Operating mode : Transmitting mode

Frequency (MHz)	Reading (dB μ V)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Any emissions less than 20 dB below the limit were not observed.									



Tested by: Tae-Ho, Kim / Manager

12. CONDUCTED EMISSION TEST

12.1 Operating environment

Temperature : 22.1 °C
Relative humidity : 43.9 % R.H.

12.2 Test set-up

The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a 50Ω / $50 \mu\text{H}$ + 5Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

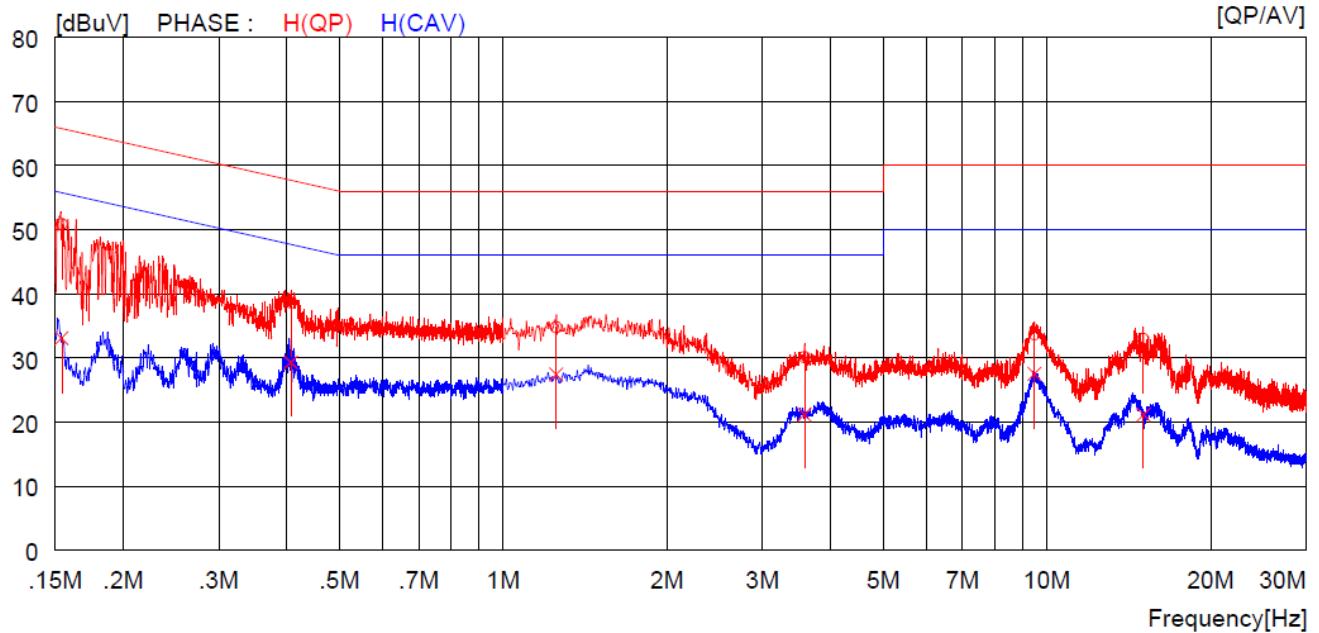
12.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - ESPI	Rohde & Schwarz	EMI Test Receiver	101278	Nov. 01, 2016 (1Y)
□ - ESHS10	Rohde & Schwarz	EMI Test Receiver	834467/007	Apr. 03, 2017 (1Y)
□ - NSLK8128	Schwarzbeck	AMN	8128-216	Apr. 05, 2017 (1Y)
■ - NSLK8126	Schwarzbeck	AMN	8126-404	Apr. 03, 2017 (1Y)
□ - 3825/2	EMCO	AMN	9109-1869	Apr. 06, 2017 (1Y)
■ - 3825/2	EMCO	AMN	9109-1867	Apr. 07, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

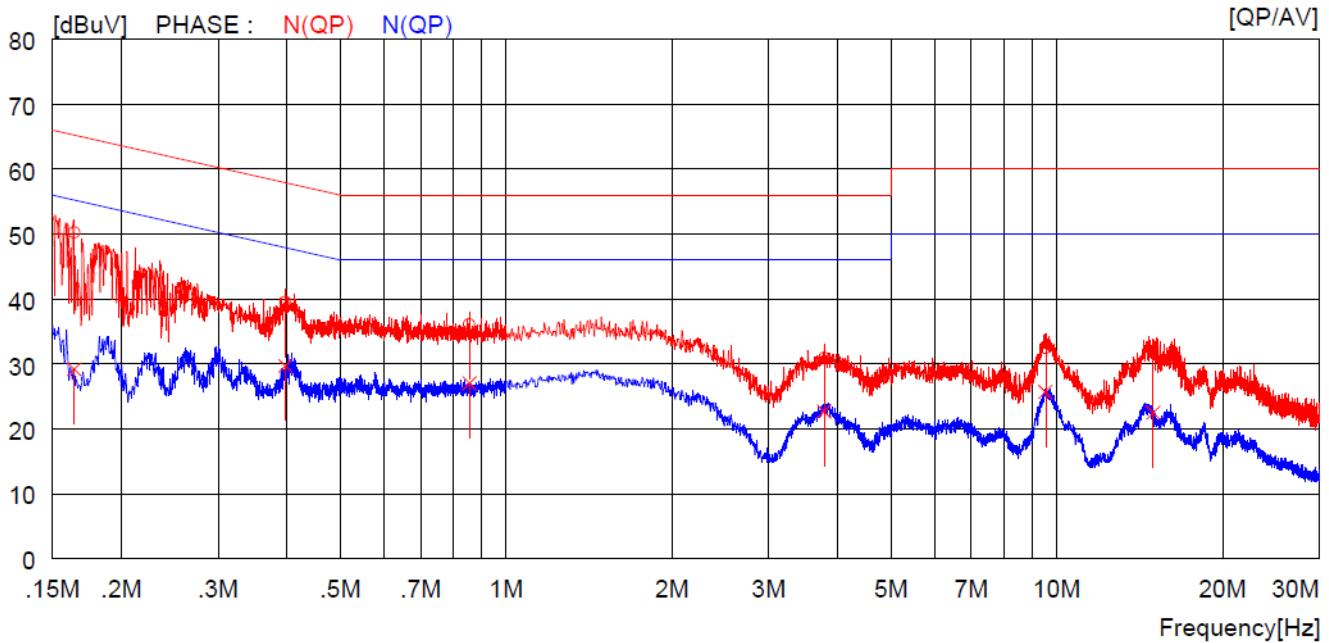
12.4 Test data

- Test Date : September 13, 2017
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Tested Line : HOT LINE



NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.15400	40.8	----	10.0	50.8	----	65.8	----	15.0	----	H (QP)
2	0.40700	28.6	----	10.0	38.6	----	57.7	----	19.1	----	H (QP)
3	1.25200	24.7	----	10.1	34.8	----	56.0	----	21.2	----	H (QP)
4	3.58000	19.9	----	10.2	30.1	----	56.0	----	25.9	----	H (QP)
5	9.48500	23.2	----	10.4	33.6	----	60.0	----	26.4	----	H (QP)
6	15.05000	22.3	----	10.6	32.9	----	60.0	----	27.1	----	H (QP)
7	0.15400	----	23.1	10.0	----	33.1	----	55.8	----	22.7	H (CAV)
8	0.40700	----	19.3	10.0	----	29.3	----	47.7	----	18.4	H (CAV)
9	1.25200	----	17.3	10.1	----	27.4	----	46.0	----	18.6	H (CAV)
10	3.58000	----	11.0	10.2	----	21.2	----	46.0	----	24.8	H (CAV)
11	9.48500	----	17.1	10.4	----	27.5	----	50.0	----	22.5	H (CAV)
12	15.05000	----	10.6	10.6	----	21.2	----	50.0	----	28.8	H (CAV)

-. Tested Line : NEUTRAL LINE



NO	FREQ [MHz]	READING		C. FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.16400	40.2	----	10.0	50.2	----	65.3	----	15.1	----	N (QP)
2	0.39700	29.5	----	10.0	39.5	----	57.9	----	18.4	----	N (QP)
3	0.85700	26.0	----	10.1	36.1	----	56.0	----	19.9	----	N (QP)
4	3.78400	20.7	----	10.2	30.9	----	56.0	----	25.1	----	N (QP)
5	9.53500	22.0	----	10.4	32.4	----	60.0	----	27.6	----	N (QP)
6	14.96000	21.2	----	10.6	31.8	----	60.0	----	28.2	----	N (QP)
7	0.16400	----	19.2	10.0	----	29.2	----	55.3	----	26.1	N (CAV)
8	0.39700	----	19.7	10.0	----	29.7	----	47.9	----	18.2	N (CAV)
9	0.85700	----	16.9	10.1	----	27.0	----	46.0	----	19.0	N (CAV)
10	3.78400	----	12.5	10.2	----	22.7	----	46.0	----	23.3	N (CAV)
11	9.53500	----	15.3	10.4	----	25.7	----	50.0	----	24.3	N (CAV)
12	14.96000	----	11.9	10.6	----	22.5	----	50.0	----	27.5	N (CAV)

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.



Tested by: Tae-Ho, Kim / Manager