

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


Test Report No. : OT-180-RWD-057
AGR No. : A180A-191
Applicant : Samsung Electronics Co Ltd
Address : 19 Chapin Rd., Building D, Pine Brook, New Jersey, 07058, United States
Manufacturer : Samsung Electronics Co Ltd
Address : Maetan dong 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do 16677, Korea
Type of Equipment : SMART CONTROL
FCC ID. : A3LRMCRMRIAP1
Model Name : RMCRMRIAP1
Serial number : N/A
Total page of Report : 30 pages (including this page)
Date of Incoming : October 12, 2018
Date of issue : October 25, 2018

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 / Chief Engineer
 ONETECH Corp.

Approved by: 

 Keun-Young, Choi / Vice President
 ONETECH Corp.

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-18O-RWD-057	2018.10.25	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant	: Samsung Electronics Co Ltd
Address	: 19 Chapin Rd., Building D, Pine Brook, New Jersey, 07058, United States
Manufacturer	: Samsung Electronics Co Ltd
Address	: Maetan dong 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do 16677, Korea
Factory 1	: Samsung Electronics Co., Ltd.
Address	: 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea 16677
Factory 2	: WISOL CO., LTD.
Address	: 531-7 Gajang-ro, Osan-si, Gyeonggi-do, Korea
Factory 3	: WISOL HANOI Co., Ltd.
Address	: 26,ROAD 05,VSIP, PHU CHAN COMMUNE,TU SON DISTRICT, BAC NINH PROVINCE, VIETNAM
Factory 4	: ShenZhen Zowee Technology Co., Ltd
Address	: Block 5, Science&Technology Industrial Park of Privately Owned Enterprises, Pingshan, Xili Nanshan District Shenzhen Guangdong 518055, China
Factory 5	: ShenZhen Zowee Technology Co., Ltd
Address	: BaoAn Subcompany Zowee Factory TongfuyuIndustrial Zone Songgang, Baoan District Shenzhen Guangdong 518105, China
Factory 6	: ShenZhen Zowda Precision Mold Co., Ltd
Address	: Block 2&Block 3(Floor 1&2) Zowee Factory Tongfuyu Industrial Zone Songgang, Baoan District Shenzhen Guangdong 518055, China
Factory 7	: TianJin Zowee Technology Development Co., Limited
Address	: No.71 South Street XinHuan West Zone Economic Development Zone of Tianjin TianJin 300457 China
Factory 8	: Chengdu Xuguang Technology Co., Ltd.
Address	: No.86 2nd Section, Park Road, Longquanyi District, Chengdu City, Sichuan Province, P.R.China

Contact Person : minhyung, cho / Senior Engineer

Telephone No. : +82-31-277-2688

FCC ID : A3LRMCRMRIAP1

Model Name : RMCRRM1AP1

Brand Name : 

Serial Number : N/A

Date : October 25, 2018

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	SMART CONTROL
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
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	N/A (See Note)
15.203	Antenna Requirement	Met requirement / PASS

Note: This test is not performed because the EUT is operated by DC battery.

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 Samsung Electronics Co Ltd, Model RMCRM1AP1 (referred to as the EUT in this report) is a SMART CONTROL. The product specification described herein was obtained from product data sheet or user's manual.

Device Type	SMART CONTROL
Temperature Range	0 °C ~ 50 °C
Operating Frequency	2 402 MHz ~ 2 480 MHz
RF Output Power	7.44 dBm
Number of Channel	40 Channel
Modulation Type	GFSK (Bluetooth LE)
Antenna Type	Chip Antenna
Antenna Gain	0.97 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	32.768 kHz, 32 MHz

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	Samsung Electronics Co Ltd	N/A	N/A

5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested: None

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: It is not need to test this requirement, because the EUT shall be operated by DC battery.

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)
It is not need to test this requirement, because the power of the EUT is supplied by battery.	

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

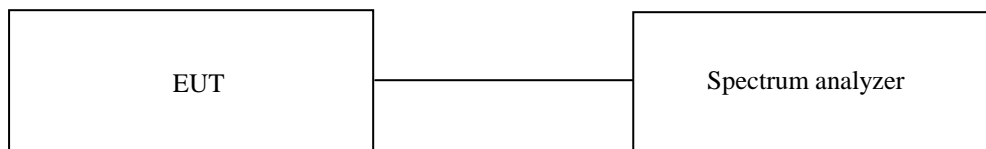
7. MINIMUM 6 dB BANDWIDTH

7.1 Operating environment

Temperature : 24.3 °C
 Relative humidity : 43.9 % 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	Mar. 14, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

7.4 Test data

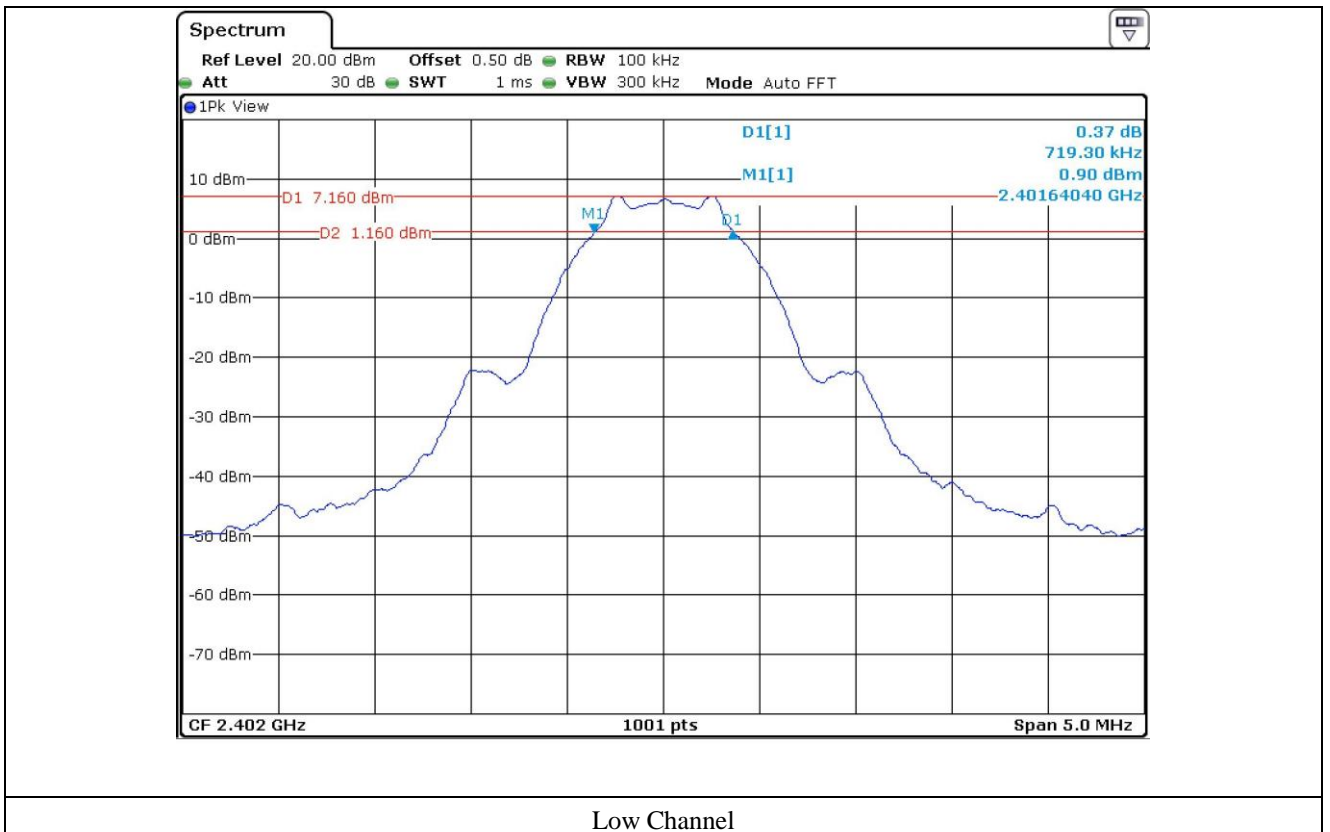
- Test Date : October 12, 2018 ~ October 19, 2018
- Test Result : Pass

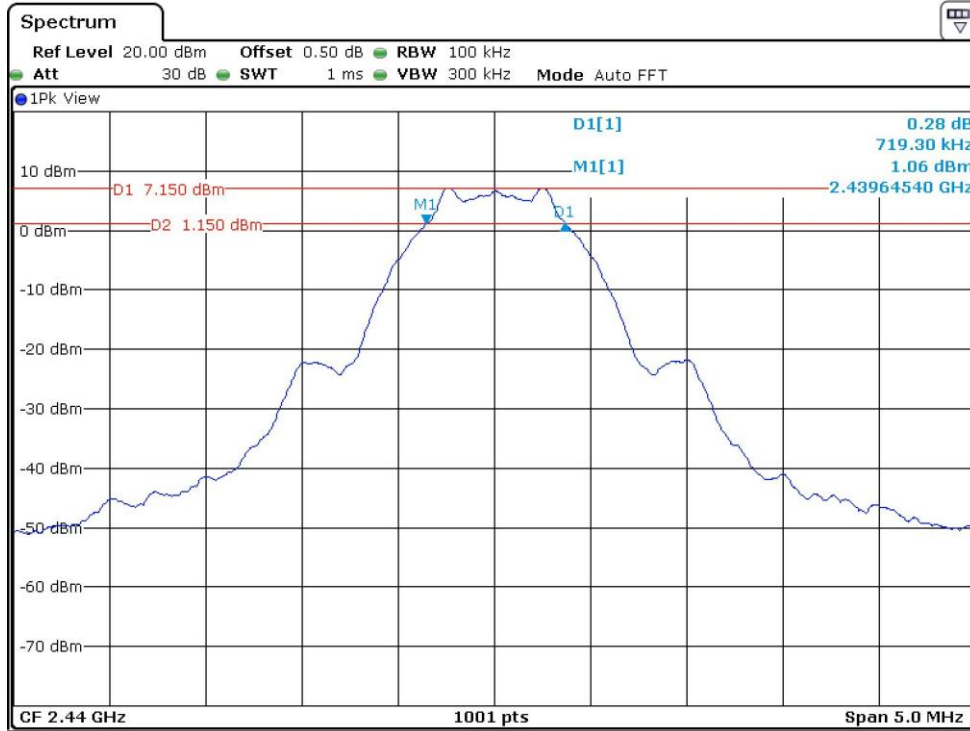
CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
Low	2 402.00	719.30	500.00	219.30
Middle	2 440.00	719.30	500.00	219.30
High	2 480.00	719.30	500.00	219.30

Remark. Margin = Measured Value - Limit

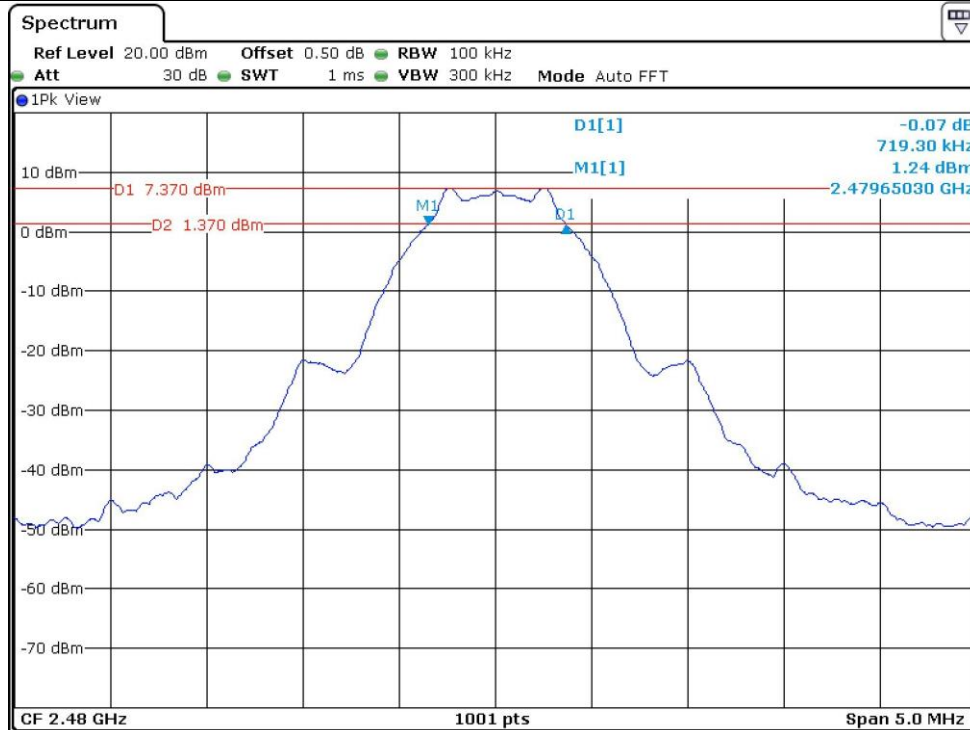


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

8. MAXIMUM PEAK OUTPUT POWER

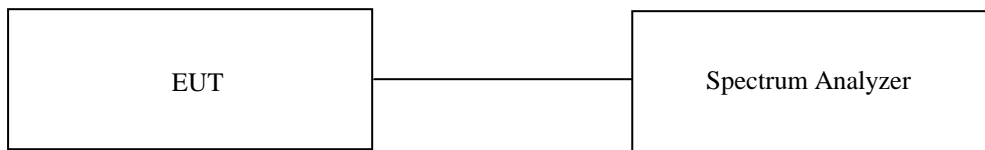
8.1 Operating environment

Temperature : 24.3 °C
 Relative humidity : 43.9 % R.H.

8.2 Test set-up

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

The resolution bandwidth is set to \geq DTS Bandwidth, the video bandwidth is set to 3 times the resolution bandwidth.



8.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 14, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

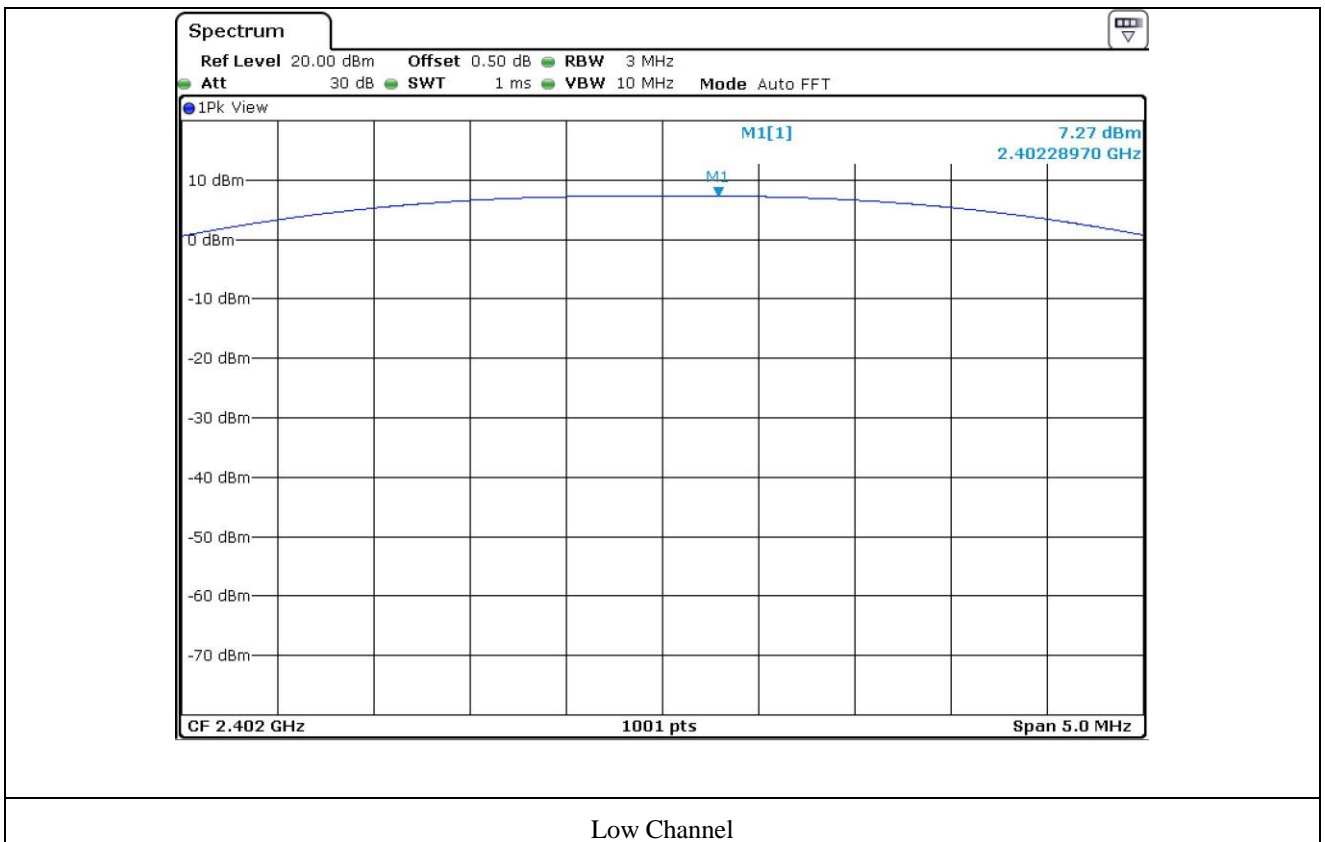
8.4 Test data

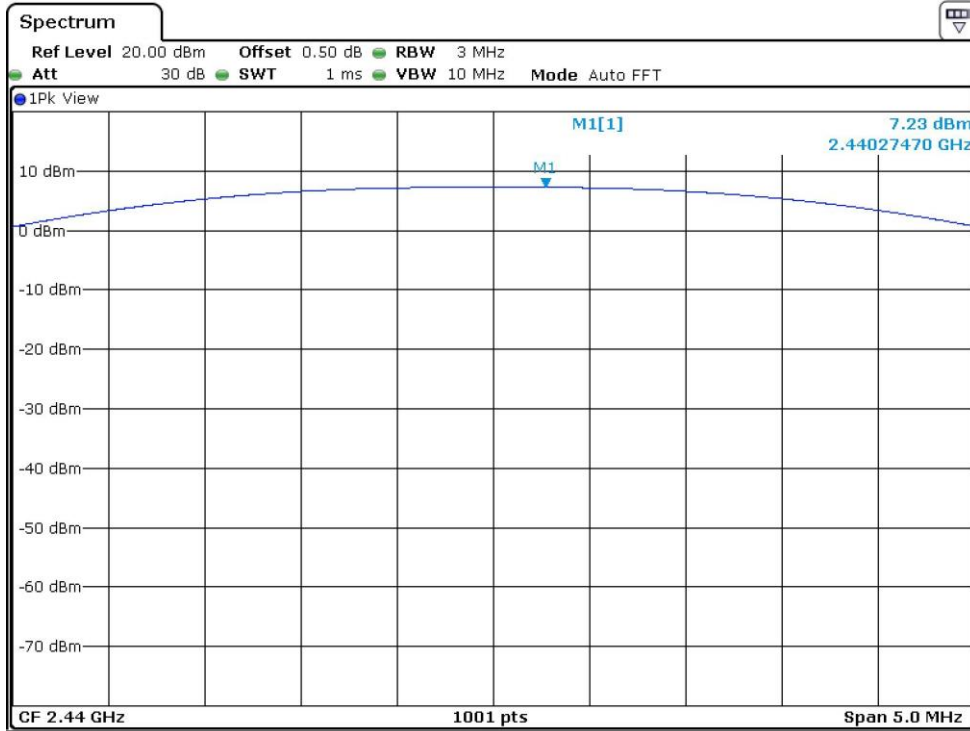
- Test Date : October 12, 2018 ~ October 19, 2018
- Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	7.27	30.00	22.73
MIDDLE	2 440.00	7.23	30.00	22.77
HIGH	2 480.00	7.44	30.00	22.56

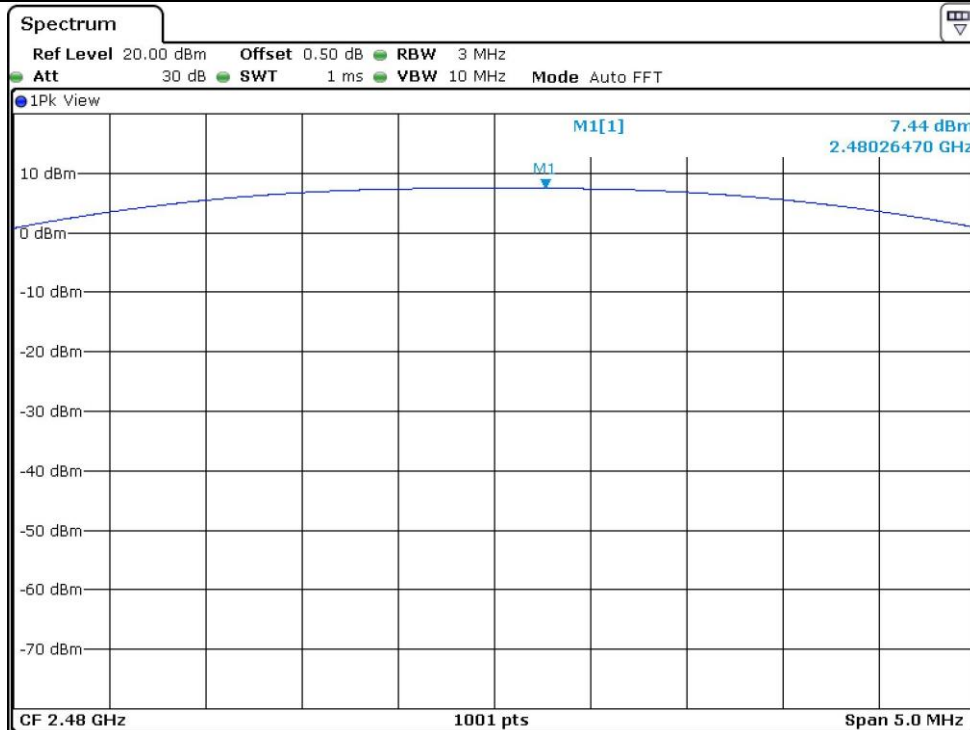
Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)

Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

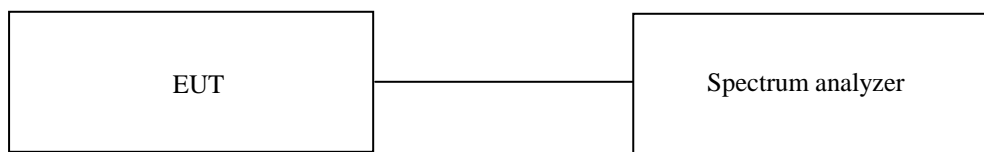
9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

9.1 Operating environment

Temperature : 24.3 °C
 Relative humidity : 43.9 % R.H.

9.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, the video bandwidth is set to 3 times the resolution bandwidth 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.

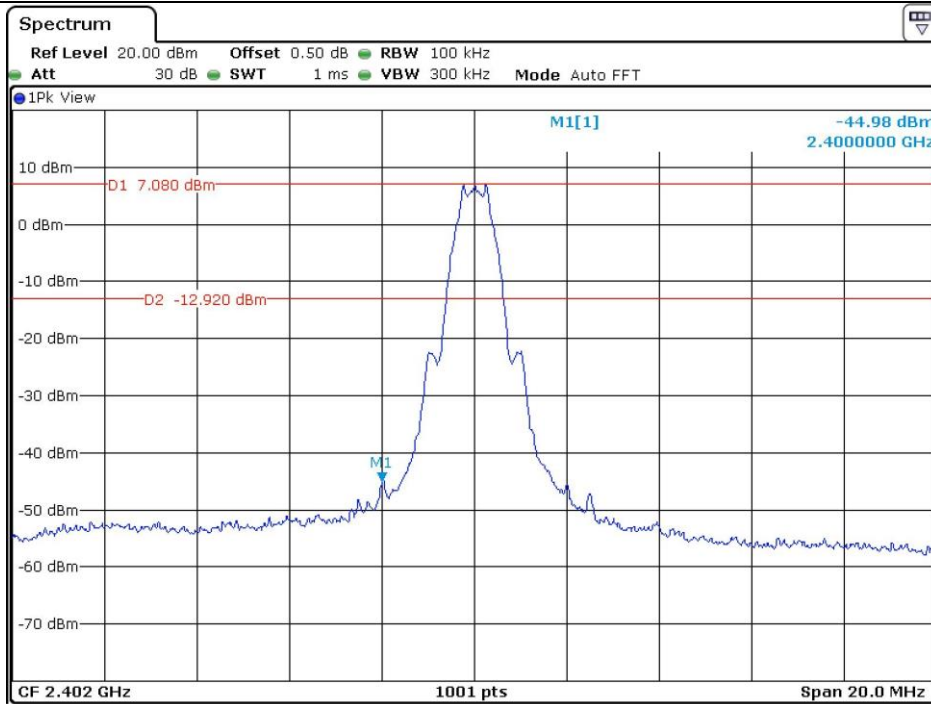
The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal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

9.4 Test equipment used

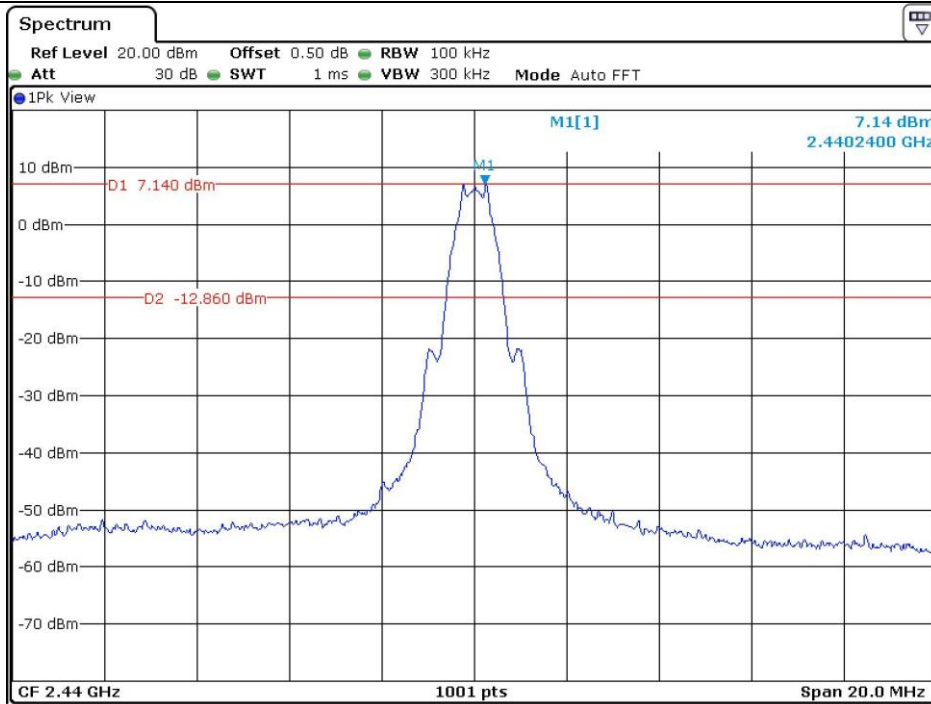
Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 14, 2018 (1Y)
■ - ESU	Rohde & Schwarz	EMI Test Receiver	100261	Mar. 29, 2018 (1Y)
■ - 310N	Sonoma Instrument	Pre-Amplifier	312544	Mar. 28, 2018 (1Y)
■ - BBV9718	Schwarzbeck	Amplifier	310	Mar. 30, 2018 (1Y)
■ - SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Mar. 15, 2018 (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	777	Apr. 13, 2018 (2Y)
■ - BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
■ - BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170179	Jul. 28, 2017 (2Y)

All test equipment used is calibrated on a regular basis.

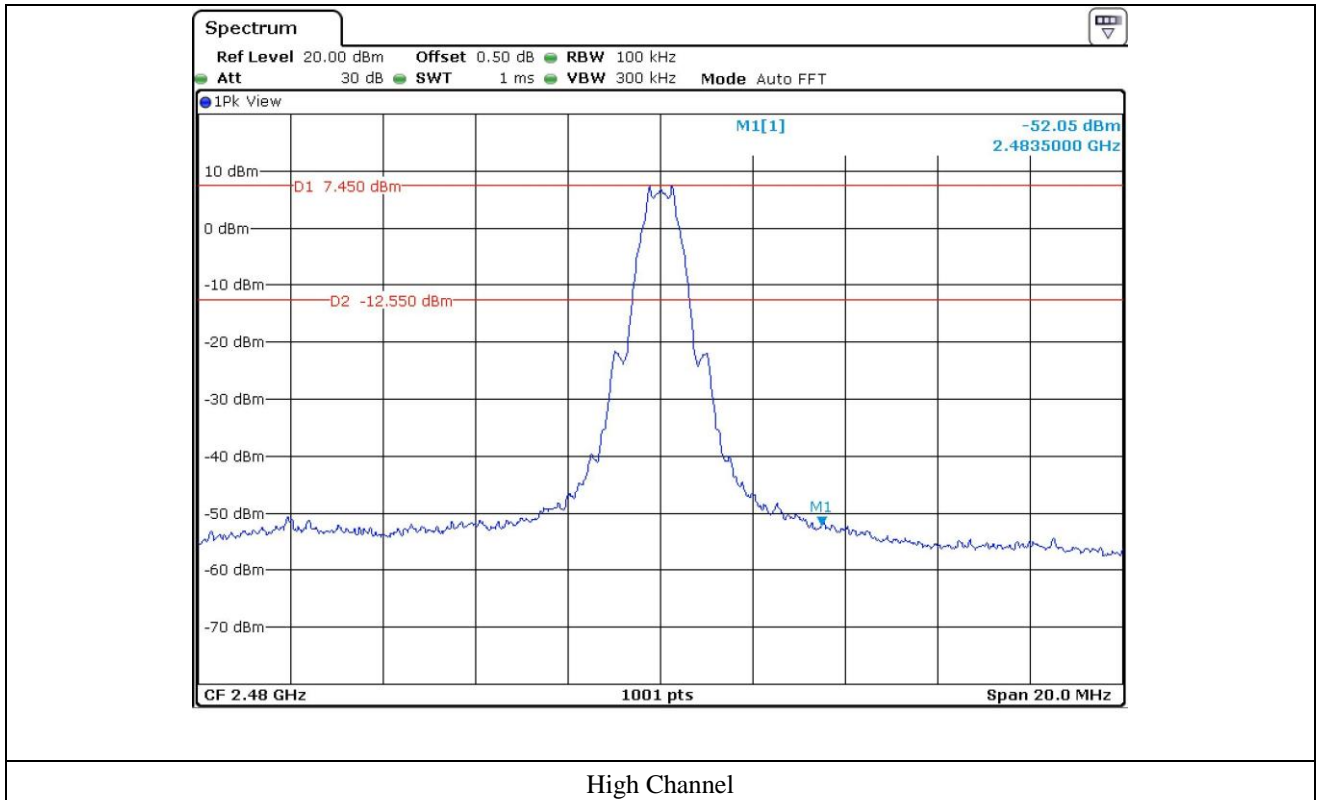
9.5 Test data for conducted emission

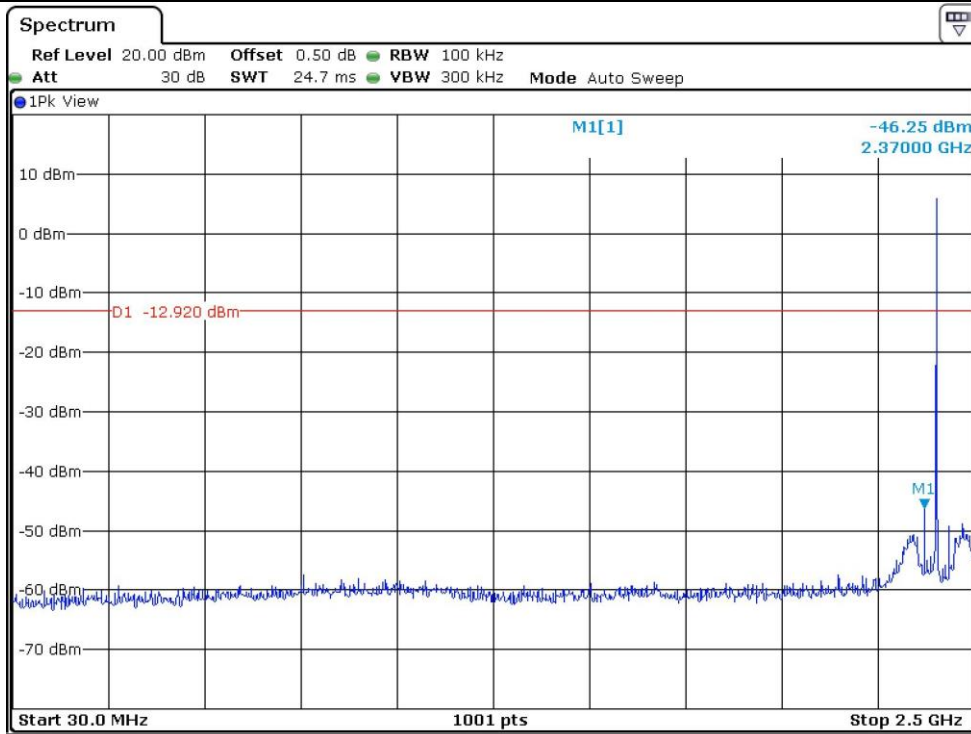


Low Channel

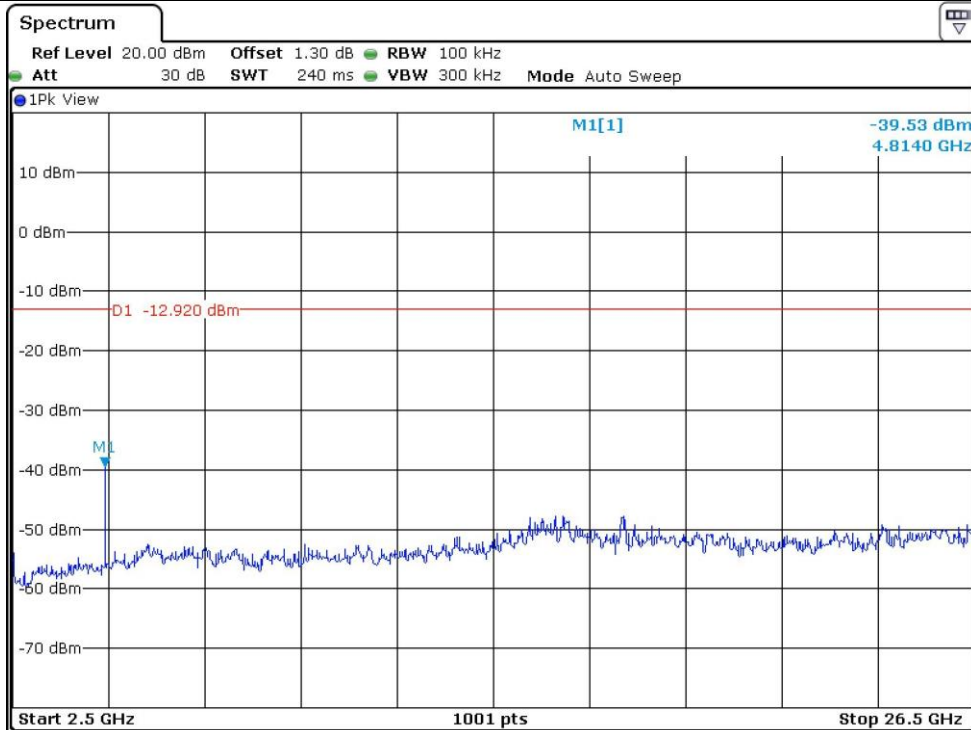


Middle Channel

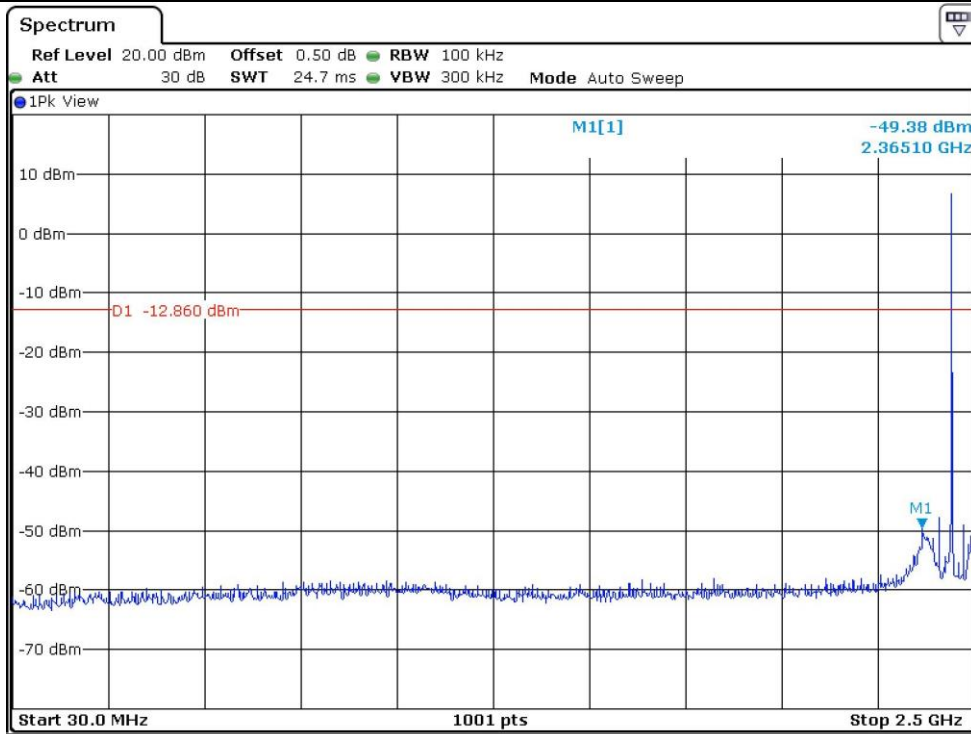




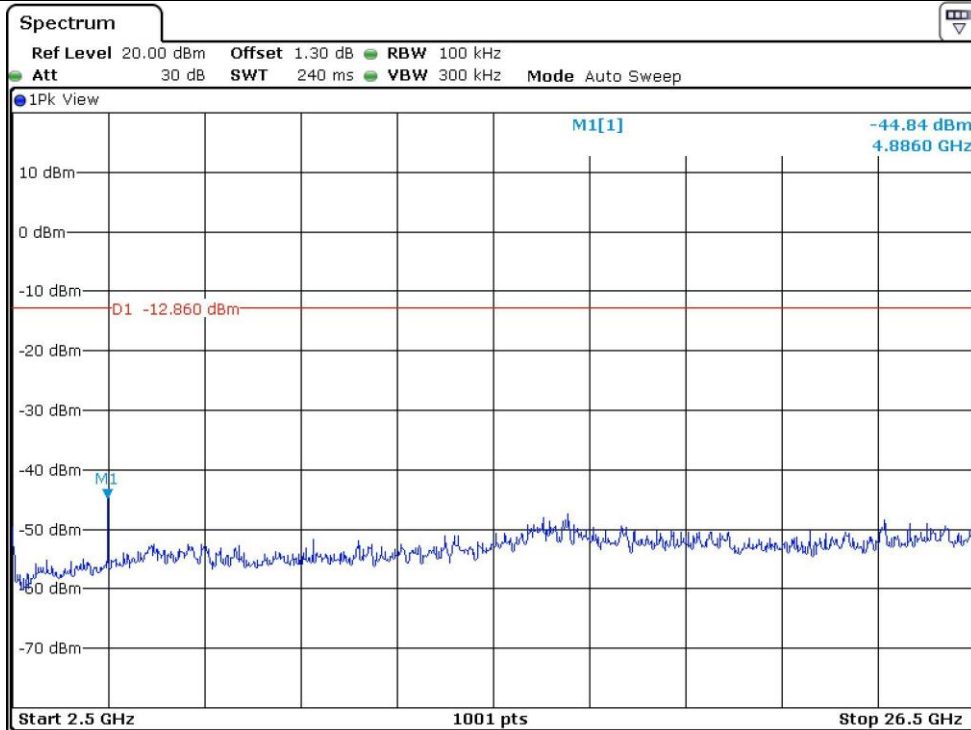
Low Channel



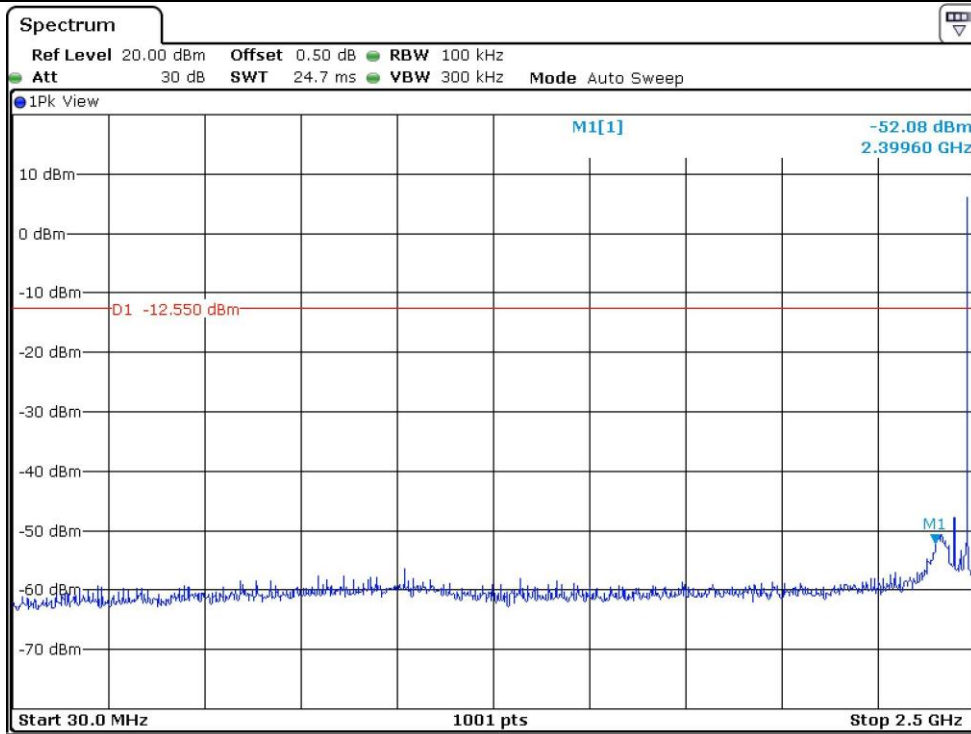
Low Channel



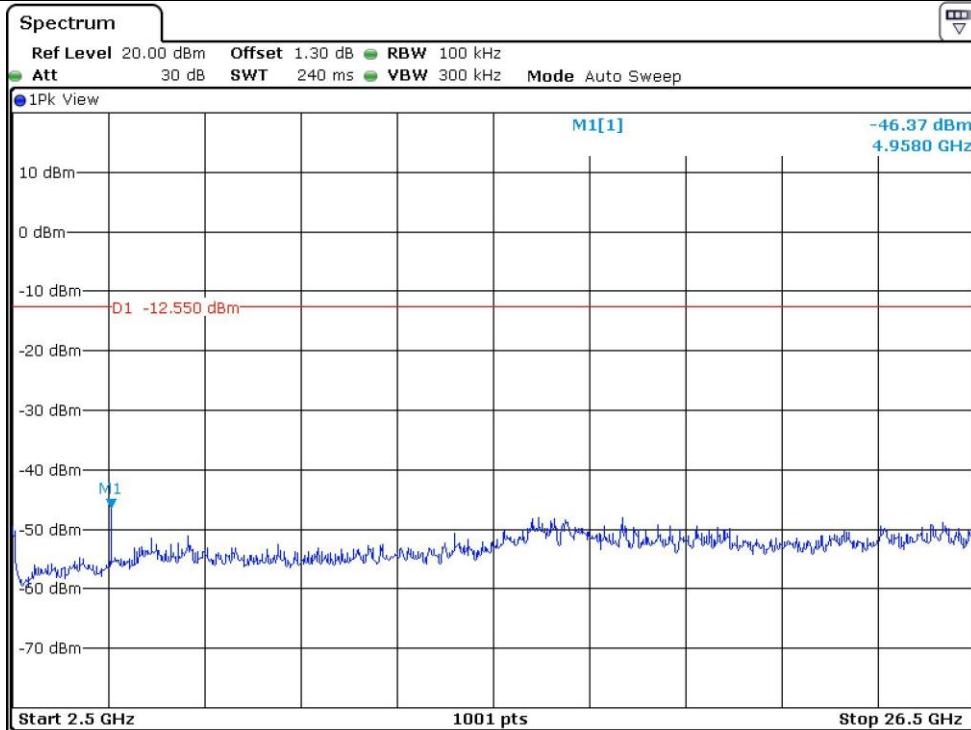
Middle Channel



Middle Channel



High Channel



High Channel

9.6 Test data for radiated emission

9.6.1 Radiated Emission which fall in the Restricted Band

- Test Date : October 12, 2018 ~ October 19, 2018
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Measurement distance : 3 m
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 347.123	45.20	Peak	H	26.94	9.20	34.76	46.58	74.00	27.42
2 370.060	37.66	Average	H	26.91	9.17	34.72	39.02	54.00	14.98
2 389.960	44.58	Peak	V	26.91	9.17	34.72	45.94	74.00	28.06
2 369.980	34.84	Average	V	26.91	9.17	34.72	36.20	54.00	17.80
Test Data for High Channel									
2 484.184	44.47	Peak	H	27.47	9.49	35.51	45.92	74.00	28.08
2 483.508	33.77	Average	H	27.47	9.49	35.51	35.22	54.00	18.78
2 485.536	44.18	Peak	V	27.48	9.49	35.52	45.63	74.00	28.37
2 483.508	33.02	Average	V	27.47	9.49	35.51	34.47	54.00	19.53

Tabulated test data for Restricted Band

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

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Pre-Amplifier Gain}$$



Tested by: Hyung-Kwon, Oh / Assistant Manager

9.6.2 Spurious & Harmonic Radiated Emission

- Test Date : October 12, 2018 ~ October 19, 2018
- Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,
1 MHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 804.000	41.59	Peak	H	30.84	12.31	35.74	49.00	74.00	25.00
	33.52	Average	H				40.93	54.00	13.07
	40.88	Peak	V				48.29	74.00	25.71
	32.96	Average	V				40.37	54.00	13.63
Test Data for Middle Channel									
4 880.000	42.21	Peak	H	30.01	12.43	35.80	48.85	74.00	25.15
	32.55	Average	H				39.19	54.00	14.81
	44.64	Peak	V				51.28	74.00	22.72
	35.01	Average	V				41.65	54.00	12.35
Test Data for High Channel									
4 960.000	43.92	Peak	H	31.15	12.81	35.96	51.92	74.00	22.08
	30.80	Average	H				38.80	54.00	15.20
	42.04	Peak	V				50.04	74.00	23.96
	32.38	Average	V				40.38	54.00	13.62

Tabulated test data for Restricted Band

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

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Pre-Amplifier Gain}$$



Tested by: Hyung-Kwon, Oh / Assistant Manager

10. PEAK POWER SPECTRAL DENSITY

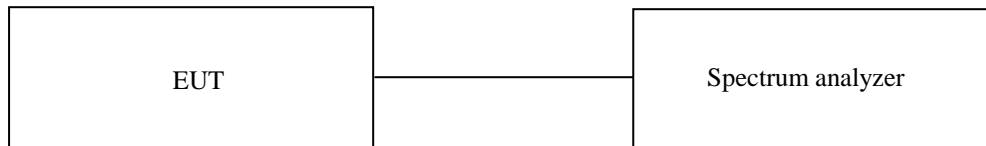
10.1 Operating environment

Temperature : 24.3 °C
 Relative humidity : 43.9 % 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	Mar. 14, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

10.4 Test data

- Test Date : October 12, 2018 ~ October 19, 2018

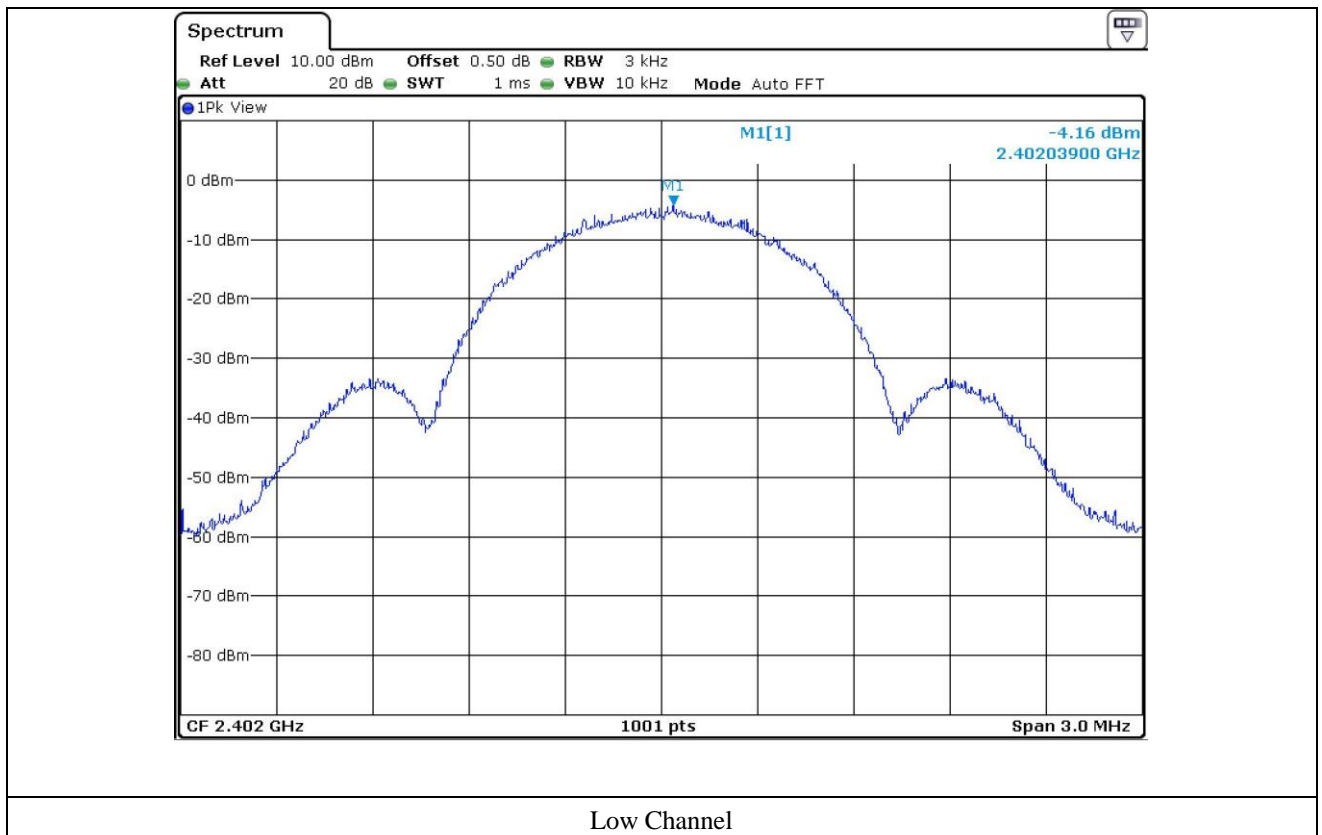
- Test Result : Pass

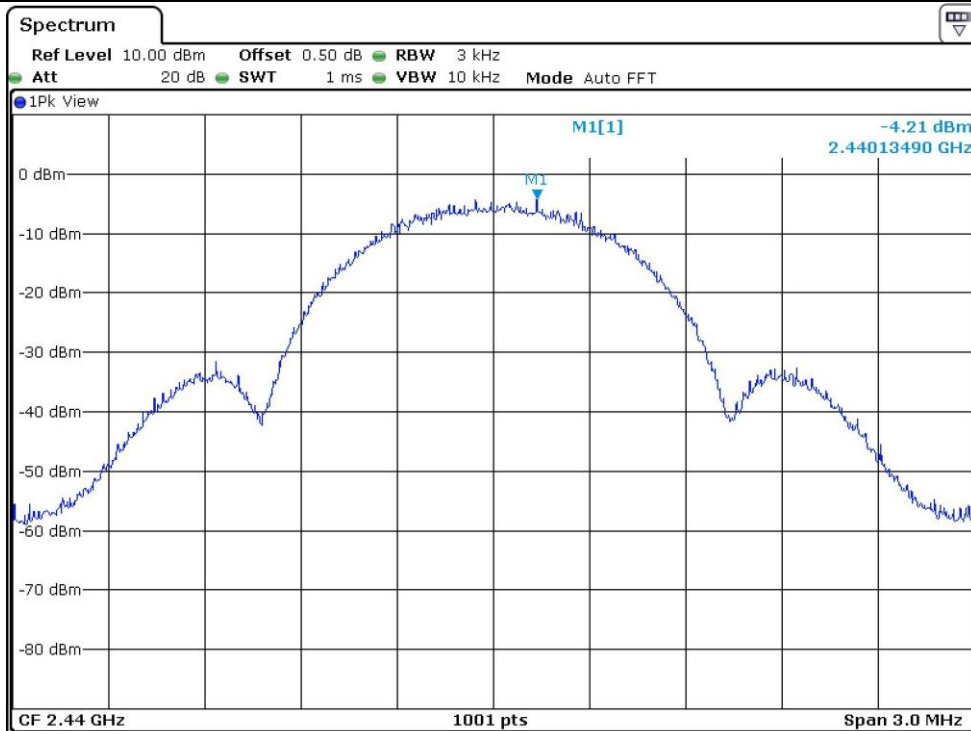
- Operating Condition : Continuous transmitting mode

CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 402.00	-4.16	8.00	12.16
Middle	2 440.00	-4.21	8.00	12.21
High	2 480.00	-4.16	8.00	12.16

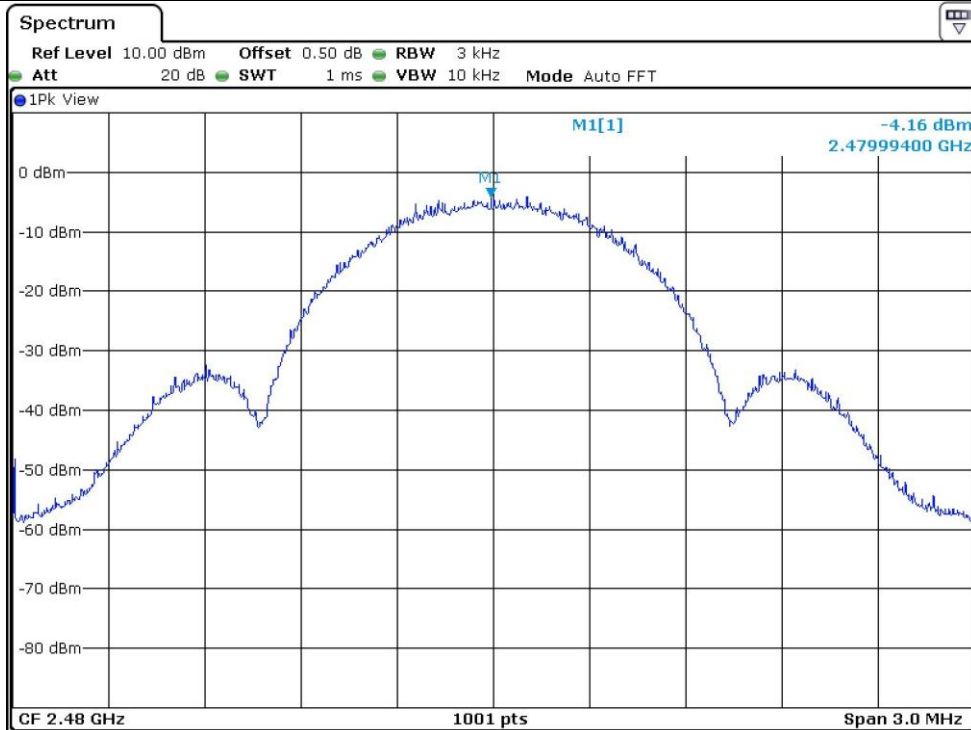
Remark. Margin = Limit – Measured value

Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : (22 ~ 23) °C
 Relative humidity : (45 ~ 46) % 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 a non-conductive 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

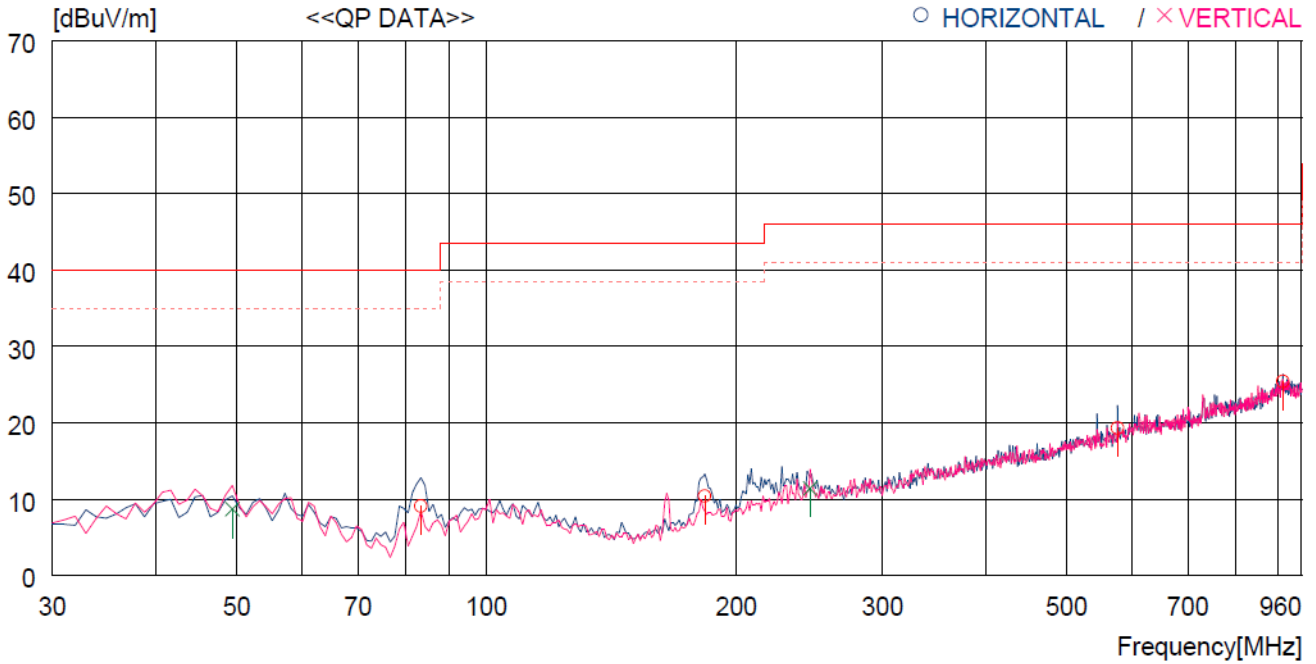
Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 14, 2018 (1Y)
■ - ESU	Rohde & Schwarz	EMI Test Receiver	100261	Mar. 29, 2018 (1Y)
■ - 310N	Sonoma Instrument	Pre-Amplifier	312544	Mar. 28, 2018 (1Y)
■ - BBV9718	Schwarzbeck	Amplifier	310	Mar. 30, 2018 (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	777	Apr. 13, 2018 (2Y)
■ - BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 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 30 MHz ~ 1 GHz

Humidity Level : (45 ~ 46) % R.H. Temperature: (22 ~ 23) °C
 Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247
 Result : PASSED

EUT : SMART CONTROL Date: October 18, 2018
 Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	83.350	31.5	8.5	2.1	33.0	9.1	40.0	30.9	100	359
2	183.260	30.4	9.9	3.1	33.0	10.4	43.5	33.1	400	0
3	576.109	28.6	18.5	5.5	33.3	19.3	46.0	26.7	200	0
4	910.749	28.1	22.5	7.1	32.3	25.4	46.0	20.6	200	154
----- Vertical -----										
5	49.400	26.2	13.9	1.7	33.1	8.7	40.0	31.3	100	98
6	245.340	28.2	12.4	3.7	32.9	11.4	46.0	34.6	100	0

[Signature]
Tested by: Hyung-Kwon, Oh / Assistant Manager

11.5 Test data for Below 30 MHz

- . Test Date : October 18, 2018
- . 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 (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.									

11.6 Test data for above 1 GHz

- . Test Date : October 18, 2018
- . 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 (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.									



Tested by: Hyung-Kwon, Oh / Assistant Manager