

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

Test Report No. : OT-189-RWD-002  
AGR No. : A187A-312  
Applicant : Humax Co., Ltd.  
Address : HUMAX BLDG., 2, Yeongmun-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, 17040, South Korea  
Manufacturer : Humax Co., Ltd.  
Address : HUMAX BLDG., 2, Yeongmun-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, 17040, South Korea  
Type of Equipment : Beam Projector  
FCC ID. : O6ZW1  
Model Name : W1  
Multiple Model Name : N/A  
Serial number : N/A  
Total page of Report : 34 pages (including this page)  
Date of Incoming : August 02, 2018  
Date of issue : September 05, 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-189-RWD-002	2018.09.05	Initial Release	All

## 1. VERIFICATION OF COMPLIANCE

Applicant : Humax Co., Ltd.  
 Address : HUMAX BLDG., 2, Yeongmun-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, 17040, South Korea  
 Contact Person : Nak Yool Sung / Engineer  
 Telephone No. : +82-31-776-6448  
 FCC ID : O6ZW1  
 Model Name : W1  
 Brand Name : -  
 Serial Number : N/A  
 Date : September 05, 2018

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Beam Projector
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	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 Humax Co., Ltd., Model W1 (referred to as the EUT in this report) is a Beam Projector. The product specification described herein was obtained from product data sheet or user’s manual.

DEVICE TYPE	Beam Projector		
Operating Frequency	Bluetooth LE	2 402 MHz ~ 2 480 MHz	
	Bluetooth	2 402 MHz ~ 2 480 MHz	
	WLAN	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))	
	2.4 GHz Band	2 422 MHz ~ 2 452 MHz (802.11n(HT40))	
	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	5 180 MHz ~ 5 240 MHz (802.11a/n(HT20)/ac(VHT20))
			5 190 MHz ~ 5 230 MHz (802.11n(HT40)/ac(VHT40))
			5 210 MHz (802.11ac(VHT80))
		5 725 MHz ~ 5 850 MHz Band	5 745 MHz ~ 5 825 MHz (802.11a/n(HT20)/ac(VHT20))
5 755 MHz ~ 5 795 MHz (802.11n(HT40)/ac(VHT40))			
5 775 MHz (802.11ac(VHT80))			
RF Output Power	Bluetooth LE	1.91 dBm	
	Bluetooth	1 Mbps (-5.49 dBm)	
		2 Mbps (-7.21 dBm)	
		3 Mbps (-6.73 dBm)	
	WLAN 2.4 GHz Band	Antenna 0	Wi-Fi 802.11b (17.70 dBm) Wi-Fi 802.11g (21.34 dBm) Wi-Fi 802.11n(HT20) (21.53 dBm) Wi-Fi 802.11n(HT40) (22.44 dBm)
		Antenna 1	Wi-Fi 802.11b (17.62 dBm) Wi-Fi 802.11g (20.99 dBm) Wi-Fi 802.11n(HT20) (21.47 dBm) Wi-Fi 802.11n(HT40) (22.44 dBm)
		Antenna 0 + Antenna 1	Wi-Fi 802.11n(HT20) (21.20 dBm) Wi-Fi 802.11n(HT40) (22.09 dBm)

RF Output Power	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	Antenna 0	Wi-Fi 802.11a (14.72 dBm) Wi-Fi 802.11n(HT20) (14.66 dBm) Wi-Fi 802.11n(HT40) (16.49 dBm) Wi-Fi 802.11ac(HT80) (14.99 dBm)
			Antenna 1	Wi-Fi 802.11a (14.74 dBm) Wi-Fi 802.11n(HT20) (14.74 dBm) Wi-Fi 802.11n(HT40) (16.38 dBm) Wi-Fi 802.11ac(HT80) (14.78 dBm)
			Antenna 0 + Antenna 1	Wi-Fi 802.11n(HT20) (14.69 dBm) Wi-Fi 802.11n(HT40) (16.23 dBm) Wi-Fi 802.11ac(HT80) (14.95 dBm)
		5 725 MHz ~ 5 850 MHz Band	Antenna 0	Wi-Fi 802.11a (15.18 dBm) Wi-Fi 802.11n(HT20) (14.88 dBm) Wi-Fi 802.11n(HT40) (16.55 dBm) Wi-Fi 802.11ac(HT80) (15.21 dBm)
			Antenna 1	Wi-Fi 802.11a (15.11 dBm) Wi-Fi 802.11n(HT20) (14.94 dBm) Wi-Fi 802.11n(HT40) (16.48 dBm) Wi-Fi 802.11ac(HT80) (15.03 dBm)
			Antenna 0 + Antenna 1	Wi-Fi 802.11n(HT20) (14.94 dBm) Wi-Fi 802.11n(HT40) (16.46 dBm) Wi-Fi 802.11ac(HT80) (15.10 dBm)



Modulation Type	Bluetooth LE	DSSS Modulation(GFSK)	
	Bluetooth	GFSK (1 Mbps), $\pi/4$ -QPSK (2 Mbps), 8-DPSK (3 Mbp)	
	WLAN 2.4 GHz Band	DSSS Modulation(DBPSK/DQPSK/CCK) OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
	WLAN 5 GHz Band	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
Antenna Type	Bluetooth LE	Antenna 1	5.60 dBi
	Bluetooth		
	WLAN 2.4 GHz Band	Antenna 0	5.50 dBi
		Antenna 1	5.60 dBi
		Antenna 0 + Antenna 1	8.56 dBi
	5 150 MHz ~ 5 250 MHz Band	Antenna 0	6.90 dBi
		Antenna 1	5.90 dBi
		Antenna 0 + Antenna 1	9.44 dBi
	5 725 MHz ~ 5 850 MHz Band	Antenna 0	6.90 dBi
		Antenna 1	5.90 dBi
		Antenna 0 + Antenna 1	9.44 dBi
	Antenna Type	FPCB Antenna	
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	24 MHz, 37.4 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	Humax Co., Ltd.	CPU B/D REV 0.4	N/A
Button Board	Humax Co., Ltd.	W1 MIC B/D REV 0.4	N/A
AMP Board	Humax Co., Ltd.	W1 AMP B/D REV 0.4	N/A
Module	Humax Co., Ltd.	N/A	N/A
Adapter	Humax Co., Ltd.	ADS-48PI-12N-2 12048E	N/A

### 5.2 Peripheral equipment

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

Model	Manufacturer	Description	Connected to
ThinBe	Hironic Co., Ltd	Beam Projector (EUT)	-
JIG	N/A	TEST JIG	EUT
ProBook 650 G2	H.P.	Notebook PC	-

### 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 LISN. All supporting equipments were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions.

**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 FPCB 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

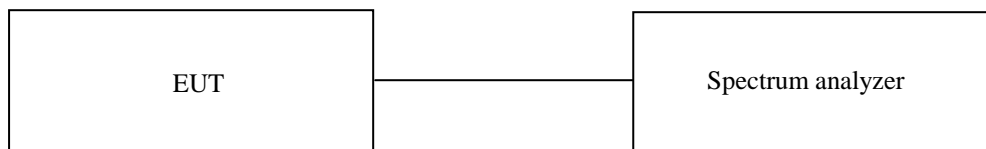
## 7. MINIMUM 6 dB BANDWIDTH

### 7.1 Operating environment

Temperature : 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**

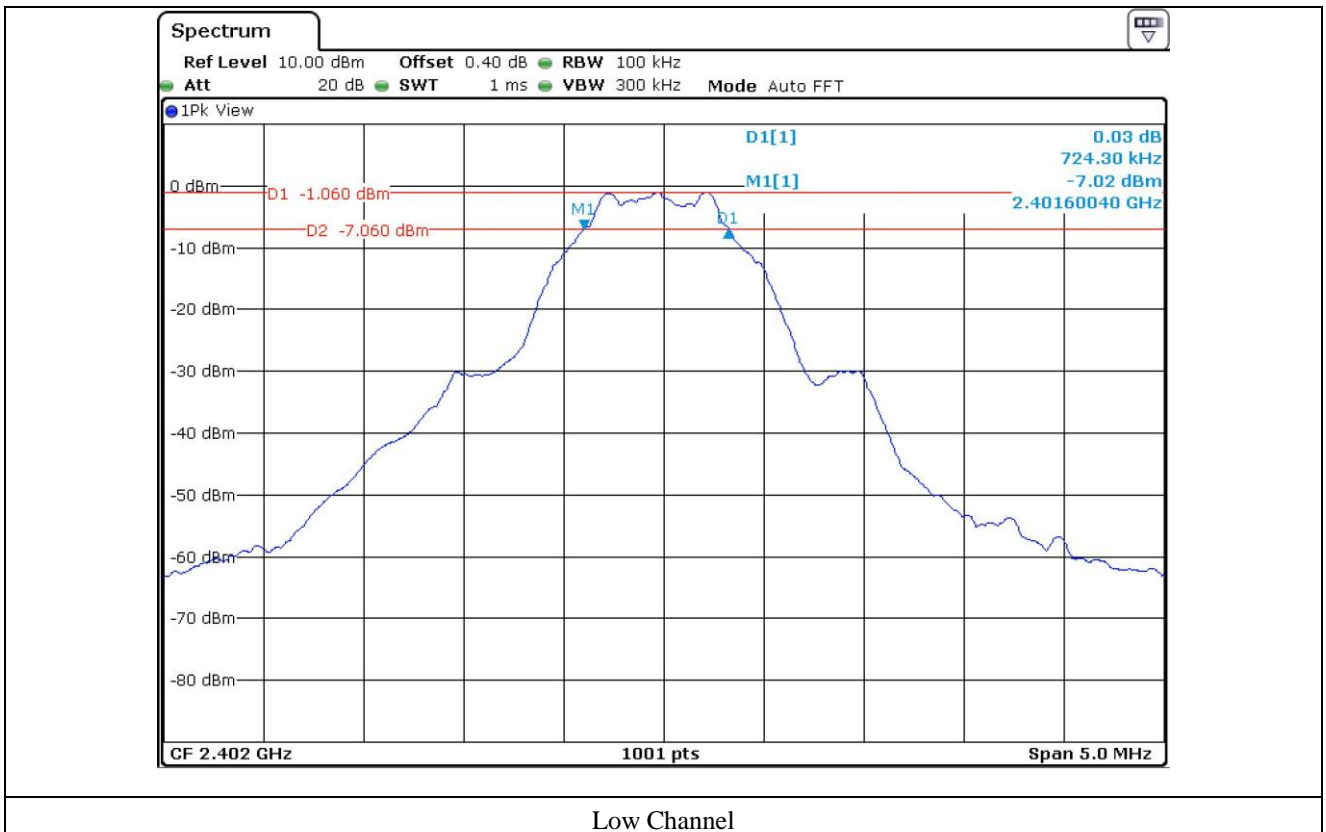
- Test Date : August 16, 2018 ~ August 28, 2018
- Test Result : Pass

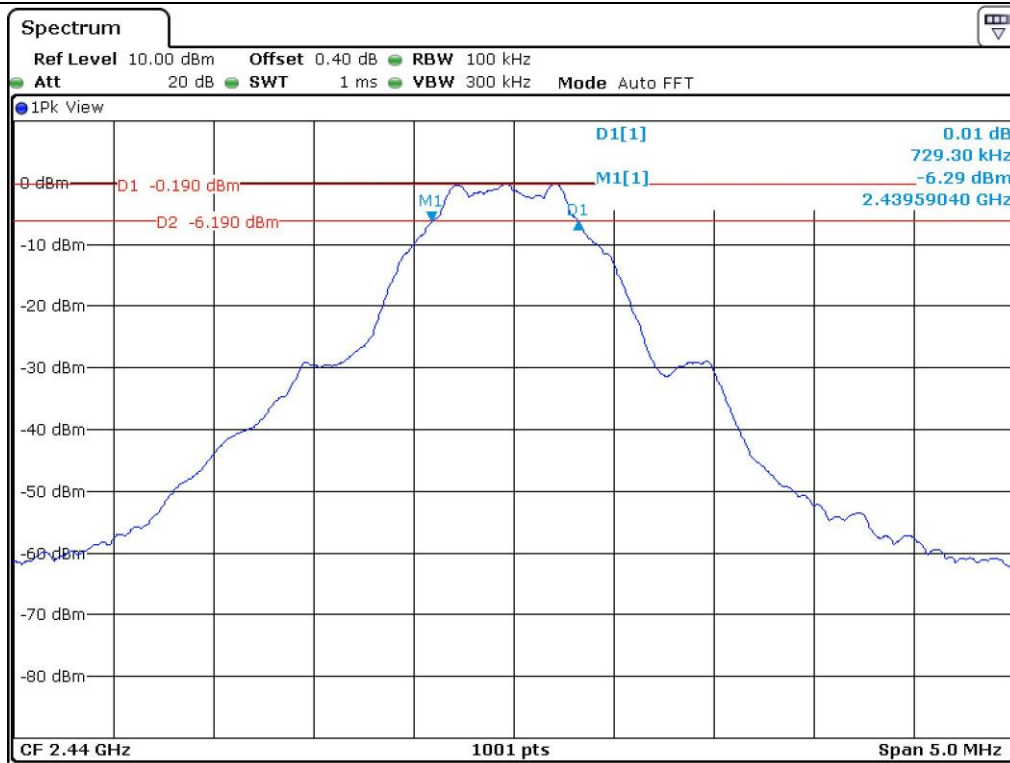
CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
Low	2 402.00	724.30	500.00	224.30
Middle	2 440.00	729.30	500.00	229.30
High	2 480.00	724.30	500.00	224.30

Remark. Margin = Measured Value - Limit

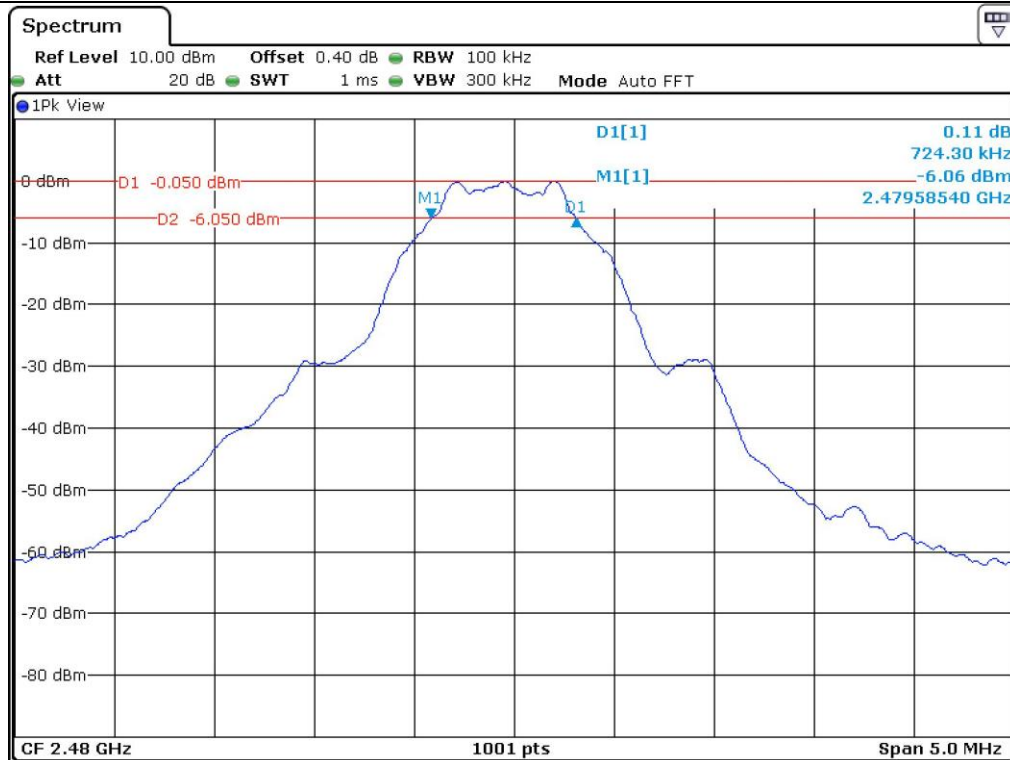


**Tested by: Tae-Ho, Kim / Senior Manager**





Middle Channel



High Channel

## 8. MAXIMUM PEAK OUTPUT POWER

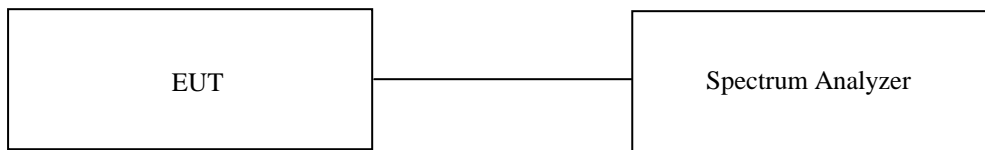
### 8.1 Operating environment

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.

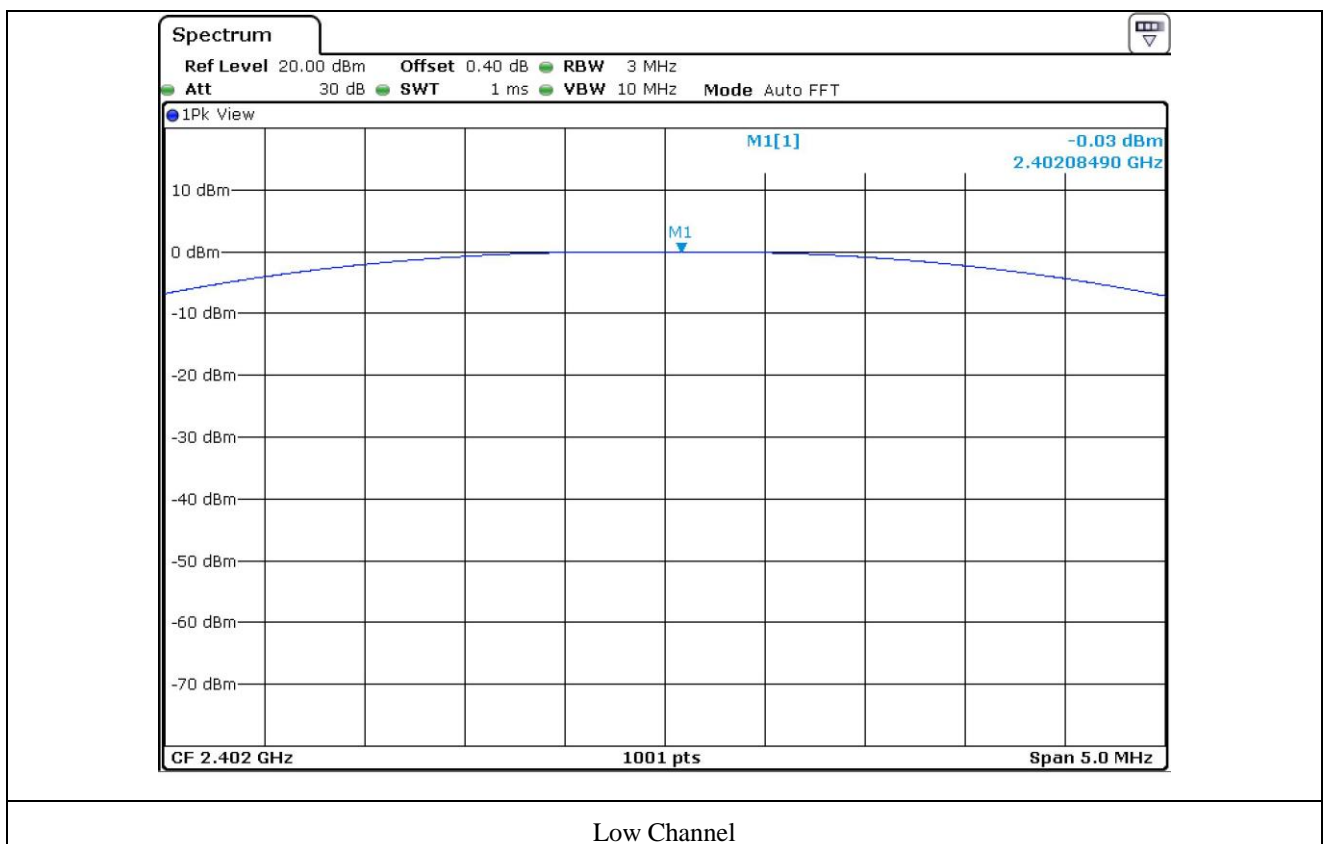
### 8.4 Test data

- Test Date : August 16, 2018 ~ August 28, 2018
- Duty Cycle : 77 %
- Test Result : Pass

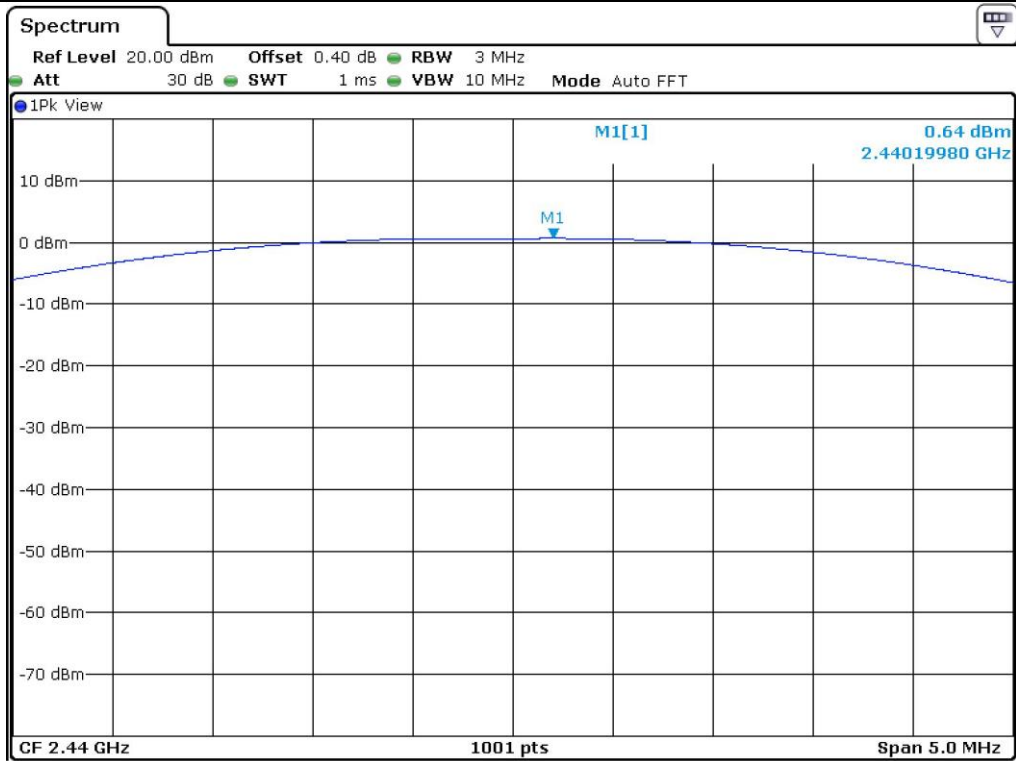
CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	Duty Cycle Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	-0.03	1.14	1.11	30.00	28.89
MIDDLE	2 440.00	0.64	1.14	1.78	30.00	28.22
HIGH	2 480.00	0.77	1.14	1.91	30.00	28.09

Remark : Result = MEASURED VALUE (dBm) + Duty Cycle Factor(dB)

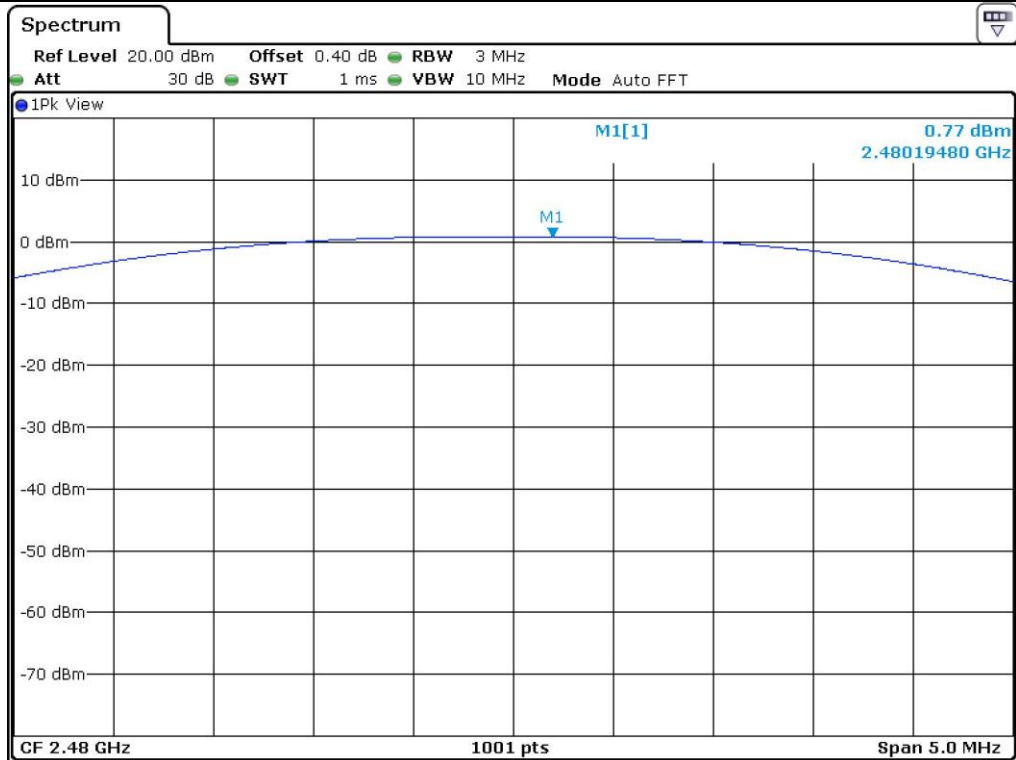
Tested by: Tae-Ho, Kim / Senior Manager







Middle Channel



High Channel

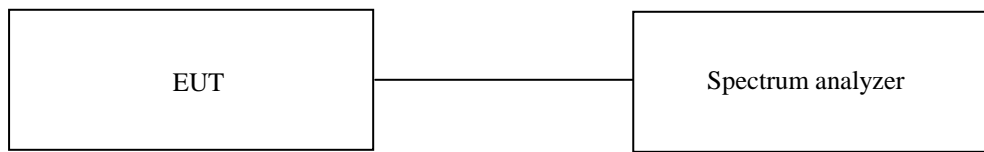
## 9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

### 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.

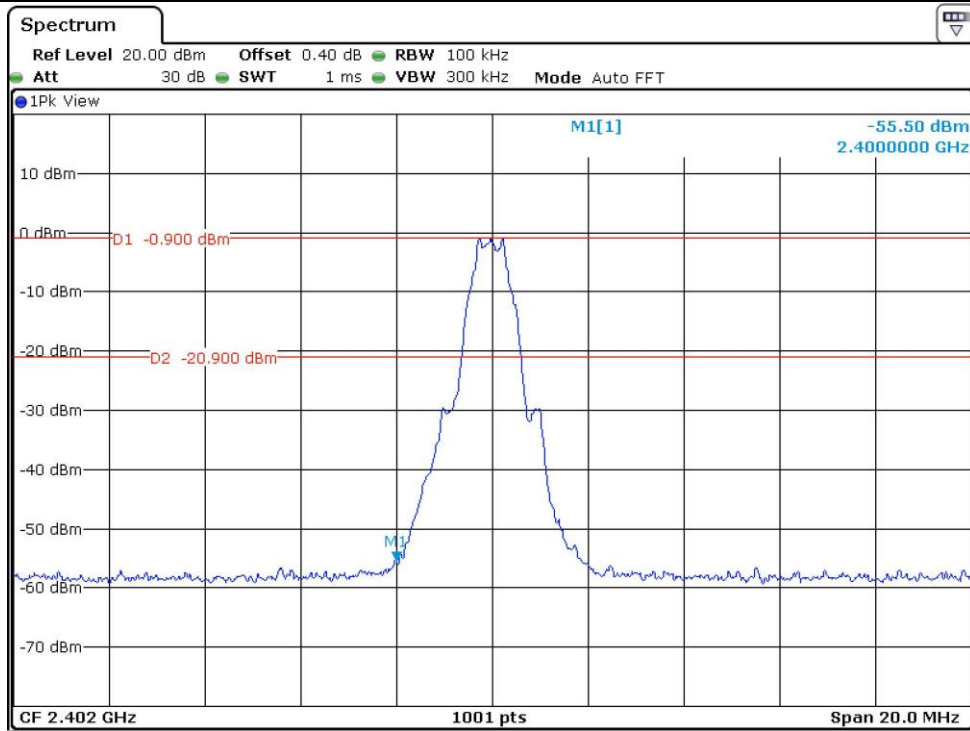
The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal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

### 9.4 Test equipment used

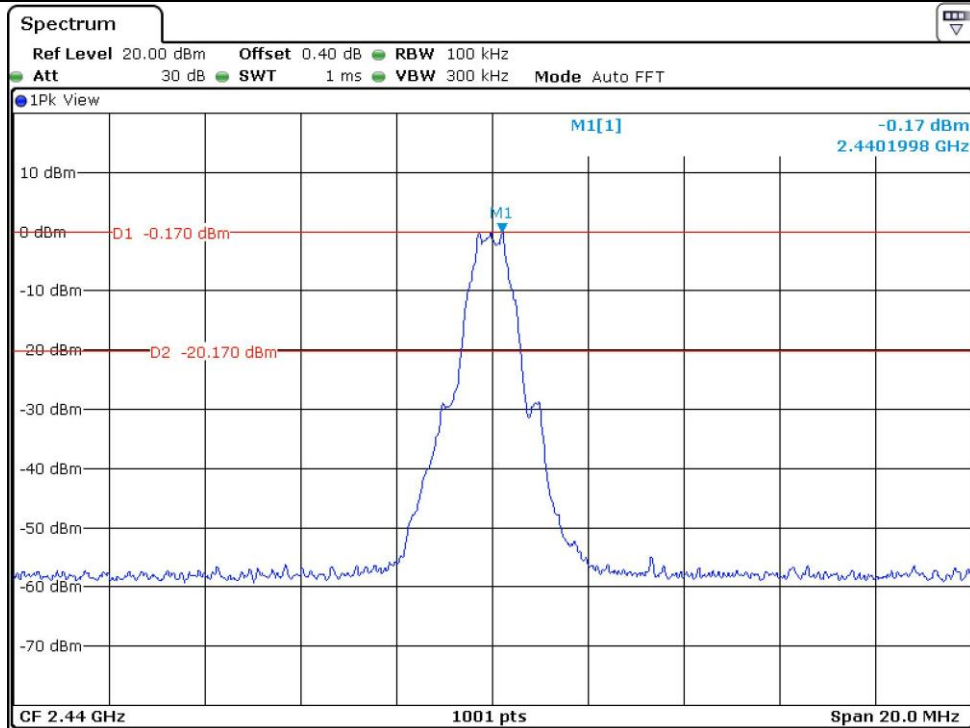
Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 14, 2018 (1Y)
■ - ESU	Rohde & Schwarz	EMI Test Receiver	100261	Mar. 29, 2018 (1Y)
■ - 310N	Sonoma Instrument	Pre-Amplifier	312544	Mar. 28, 2018 (1Y)
■ - BBV9718	Schwarzbeck	Amplifier	310	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.

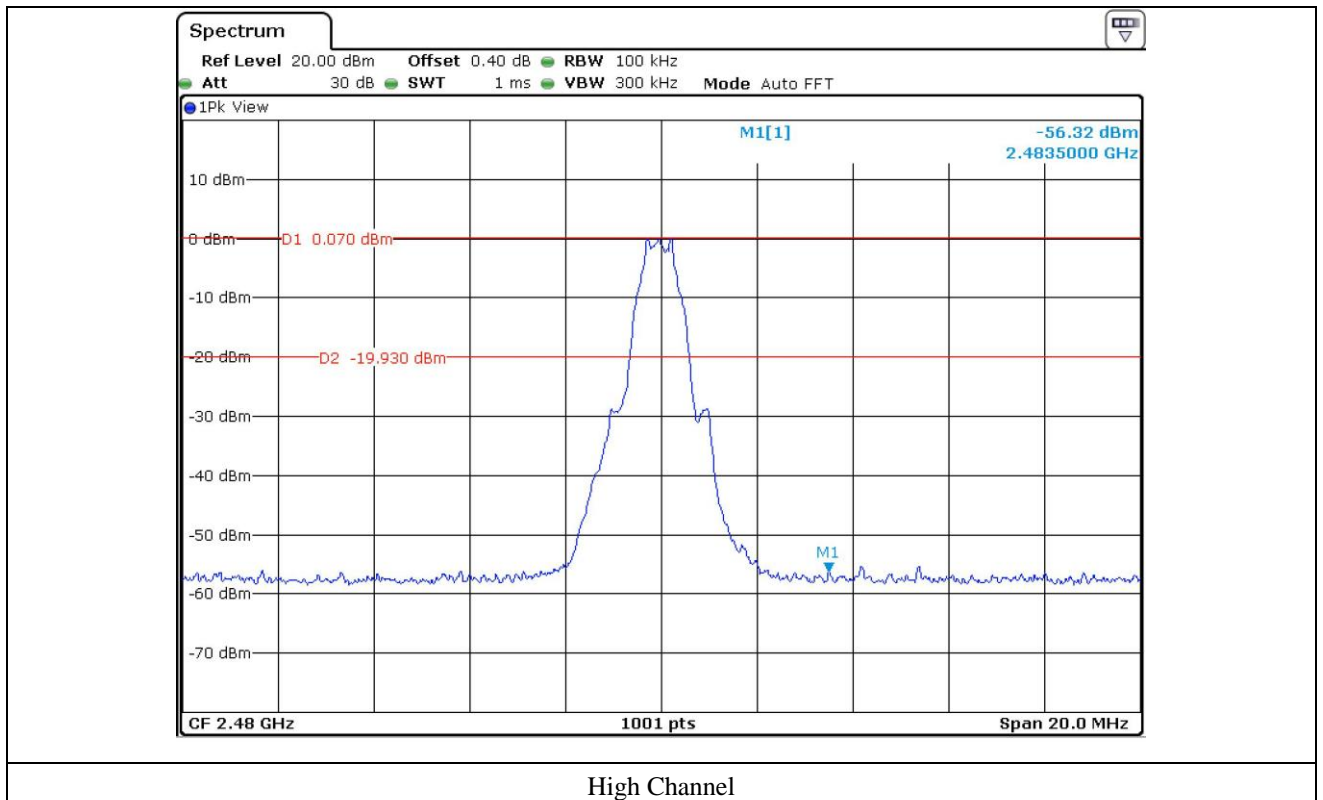
9.5 Test data for conducted emission

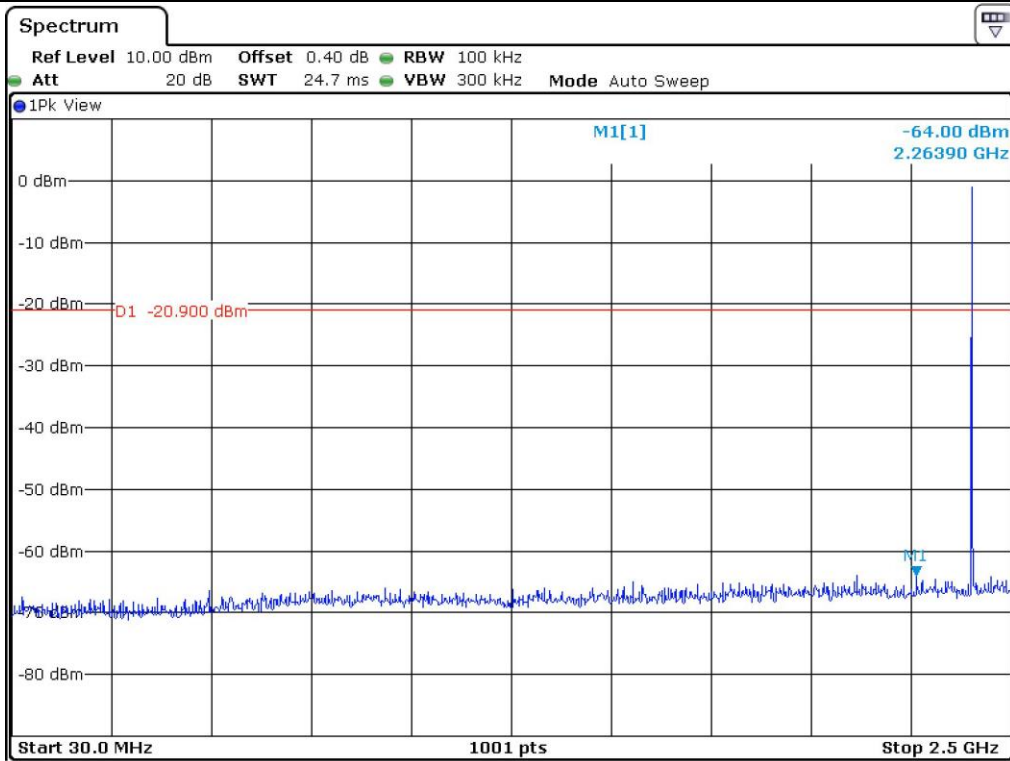


Low Channel

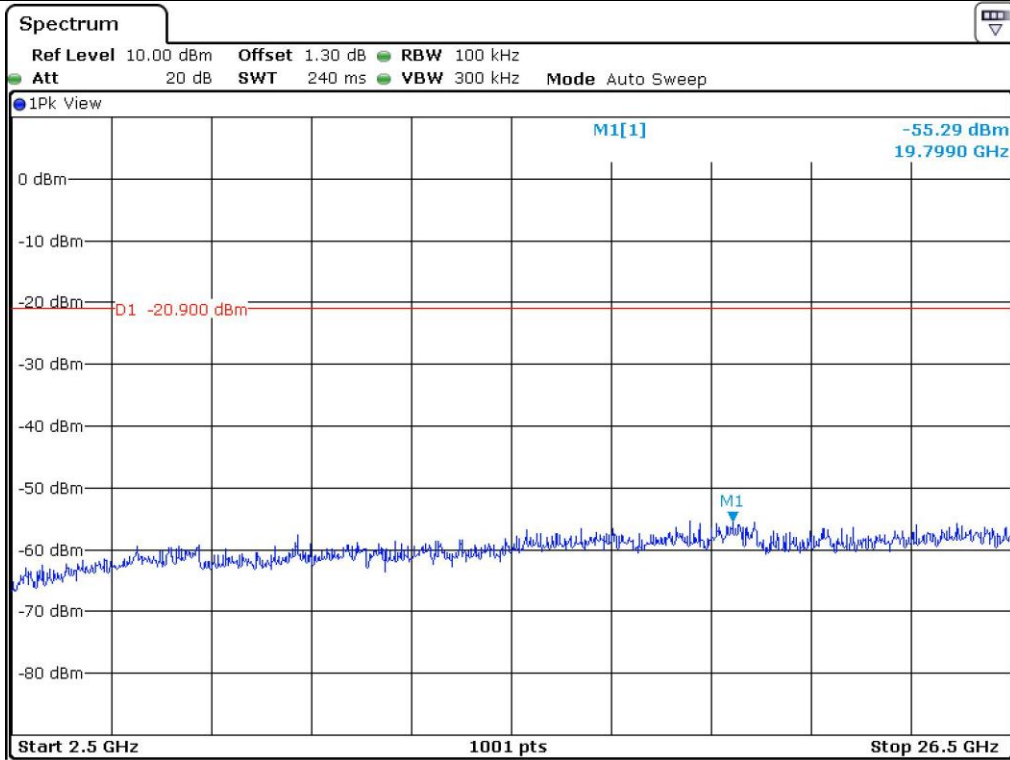


Middle Channel

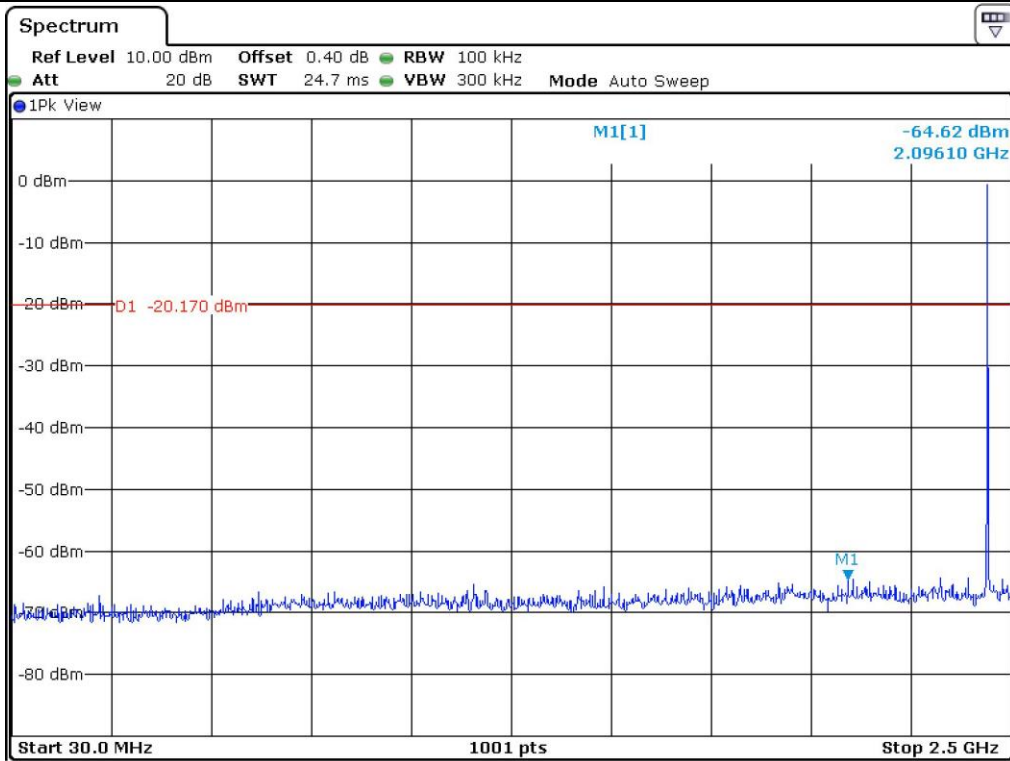




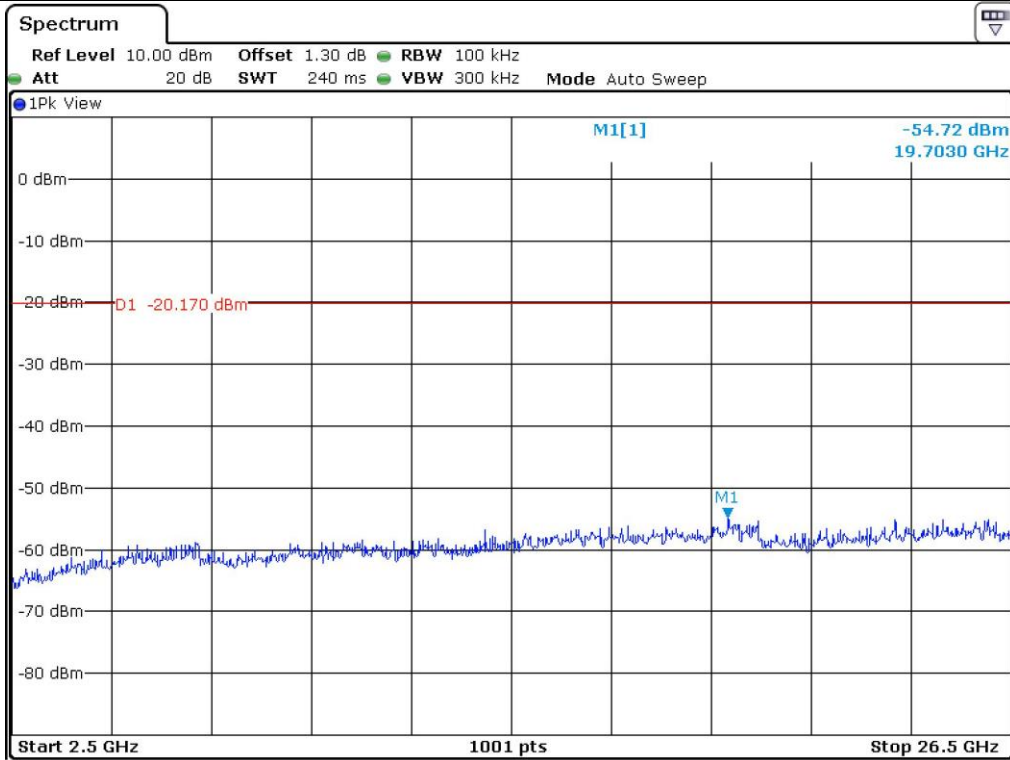
Low Channel



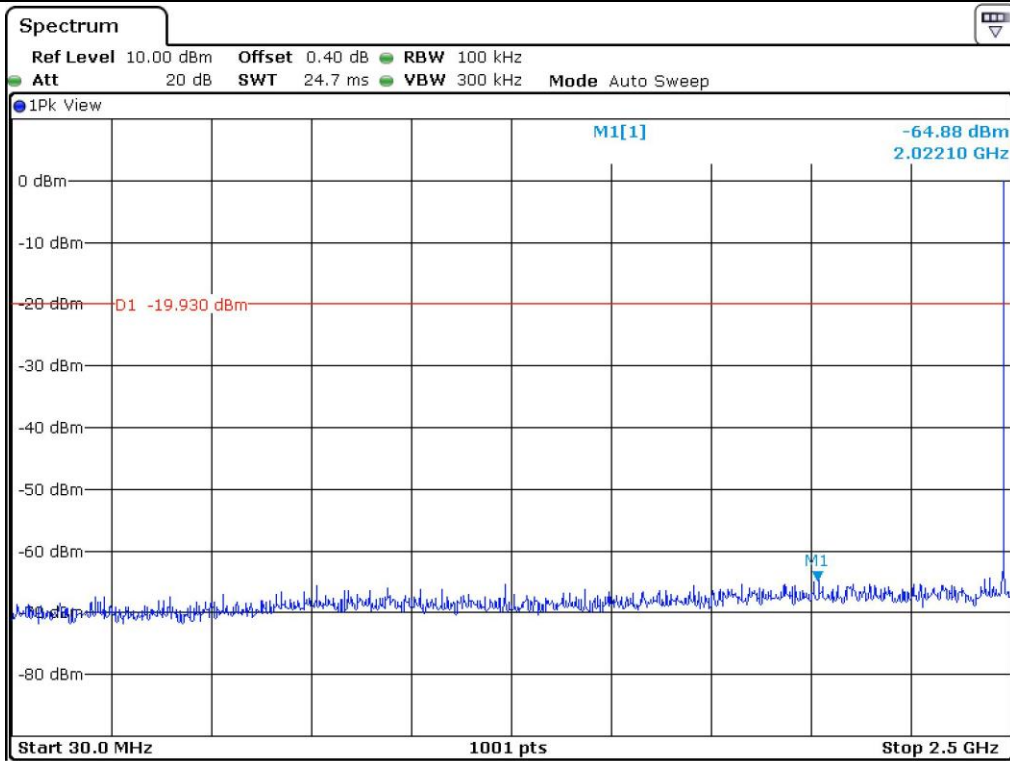
Low Channel



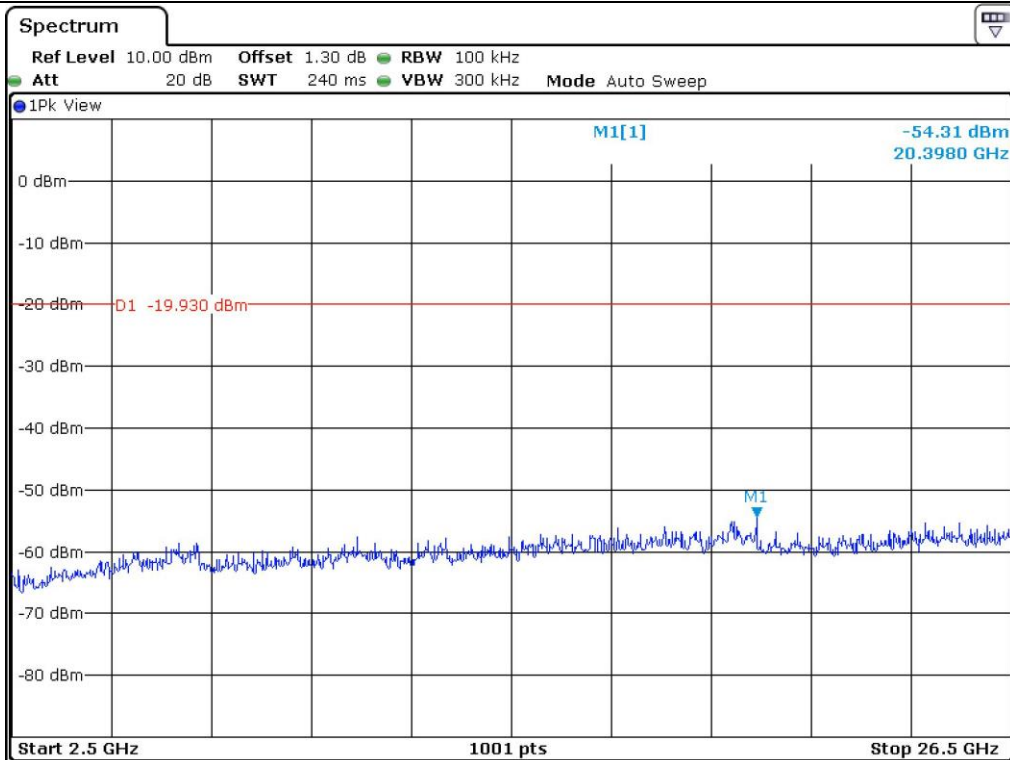
Middle Channel



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 : August 16, 2018 ~ August 28, 2018
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Duty Cycle : 77 %
- Measurement distance : 3 m
- Result : PASSED


Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Duty Cycle (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
<b>Test Data for Low Channel</b>										
2 375.962	45.28	Peak	H	26.94	9.20	34.76	-	46.66	74.00	27.34
2 348.156	33.27	Average	H	26.91	9.17	34.72	1.14	34.63	54.00	19.37
2 362.586	44.21	Peak	V	26.91	9.17	34.72	-	45.57	74.00	28.43
2 355.295	32.94	Average	V	26.91	9.17	34.72	1.14	34.30	54.00	19.70
<b>Test Data for High Channel</b>										
2 485.128	44.31	Peak	H	27.47	9.49	35.51	-	45.76	74.00	28.24
2 488.258	33.42	Average	H	27.47	9.49	35.51	1.14	34.87	54.00	19.13
2 491.841	43.81	Peak	V	27.48	9.49	35.52	-	45.26	74.00	28.74
2 490.621	32.43	Average	V	27.47	9.49	35.51	1.14	33.88	54.00	20.12

Tabulated test data for Restricted Band

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

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

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

  
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**Tested by: Tae-Ho, Kim / Senior Manager**



**9.6.2 Spurious & Harmonic Radiated Emission**

- Test Date : August 16, 2018 ~ August 28, 2018
- 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
- Duty Cycle : 77 %
- Measurement distance : 3 m
- Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Duty Cycle (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
<b>Test Data for Low Channel</b>										
4 804.000	42.60	Peak	H	30.84	12.31	35.74	-	50.01	74.00	23.99
	31.40	Average	H				1.14	39.95	54.00	14.05
	43.11	Peak	V				-	50.52	74.00	23.48
	31.20	Average	V				1.14	39.75	54.00	14.25
<b>Test Data for Middle Channel</b>										
4 880.000	43.31	Peak	H	30.01	12.43	35.80	-	49.95	74.00	24.05
	31.03	Average	H				1.14	38.81	54.00	15.19
	42.32	Peak	V				-	48.96	74.00	25.04
	29.54	Average	V				1.14	37.32	54.00	16.68
<b>Test Data for High Channel</b>										
4 960.000	43.89	Peak	H	31.15	12.81	35.96	-	51.89	74.00	22.11
	31.62	Average	H				1.14	40.76	54.00	13.24
	43.29	Peak	V				-	51.29	74.00	22.71
	33.02	Average	V				1.14	42.16	54.00	11.84

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: Tae-Ho, Kim / Senior 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.

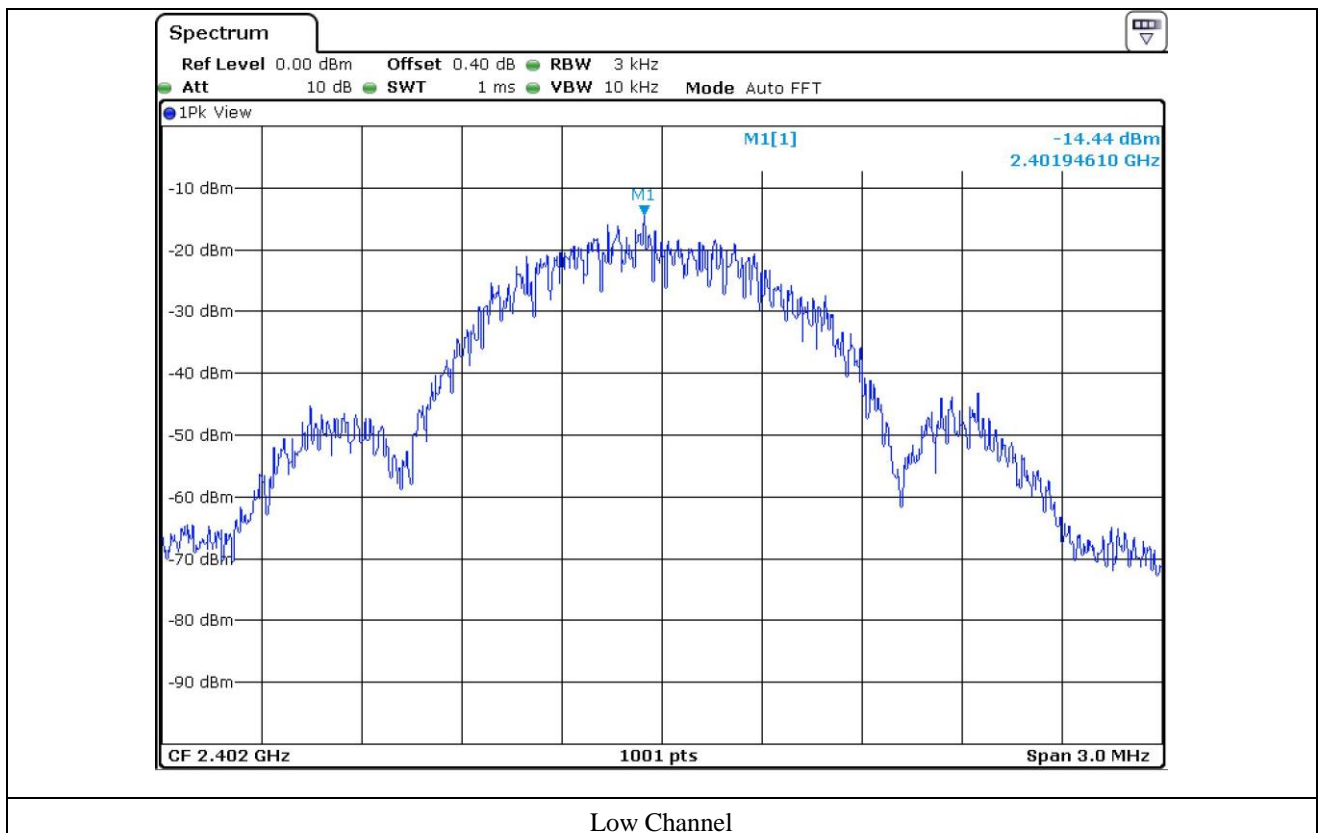
**10.4 Test data**

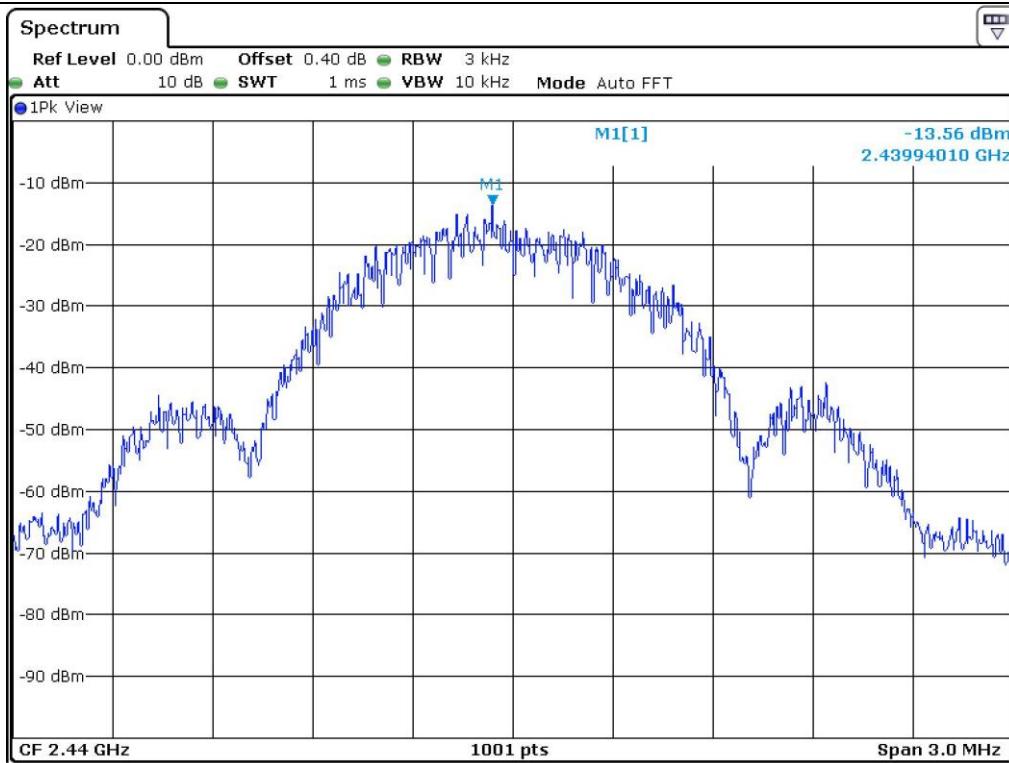
- Test Date : August 16, 2018 ~ August 28, 2018
- Test Result : Pass
- Duty Cycle : 77 %

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	Duty Cycle Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 402.00	-14.44	1.14	-13.30	8.00	22.44
Middle	2 440.00	-13.56	1.14	-12.42	8.00	21.56
High	2 480.00	-13.69	1.14	-12.55	8.00	21.69

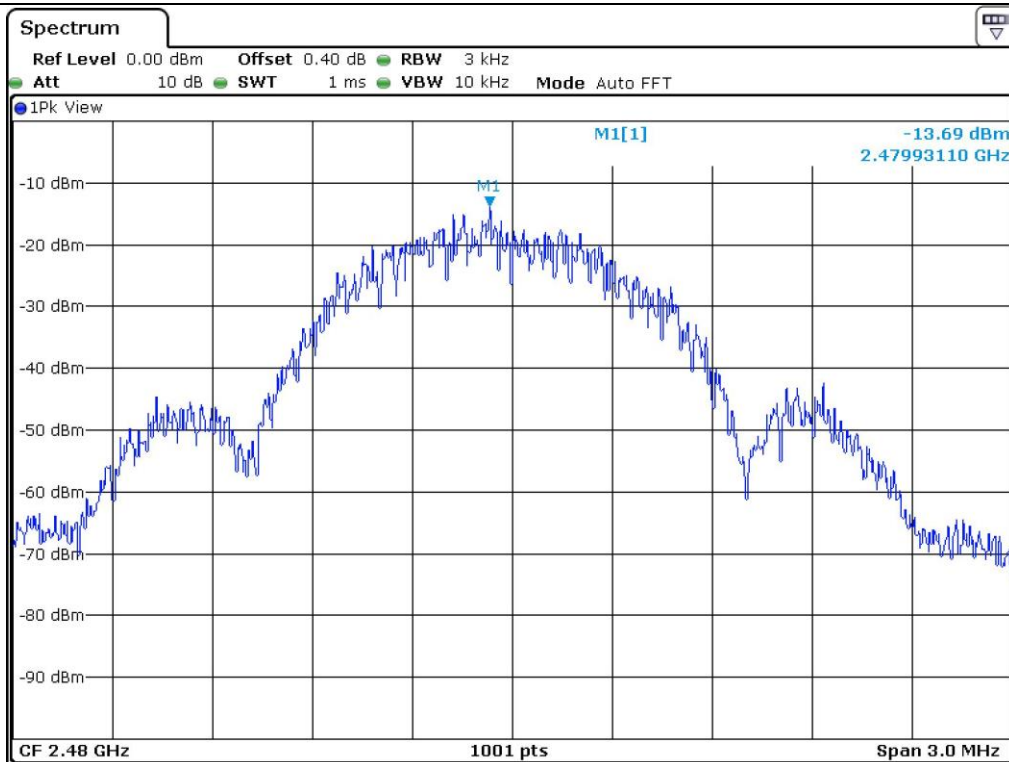
Remark : Result = MEASURED VALUE (dBm) + Duty Cycle Factor(dB)

Tested by: Tae-Ho, Kim / Senior Manager





Middle Channel



High Channel

## 11. RADIATED EMISSION TEST

### 11.1 Operating environment

Temperature : 24.3 °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 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 : 43.9 % R.H.

Temperature: 24.3 °C

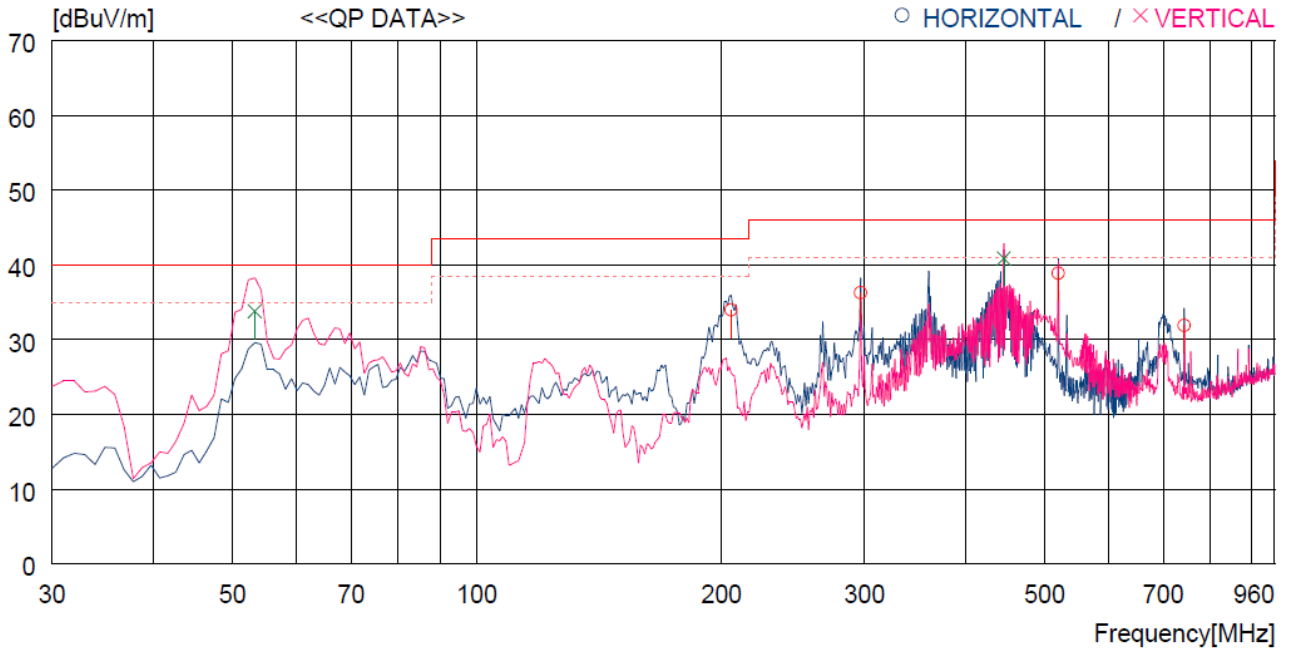
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED


EUT : Beam Projector

Date: August 16, 2018 ~ August 28, 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	205.570	52.8	10.9	3.3	33.0	34.0	43.5	9.5	100	0
2	296.750	51.9	13.4	4.0	33.0	36.3	46.0	9.7	100	137
3	519.850	49.0	17.9	5.3	33.3	38.9	46.0	7.1	200	359
4	742.944	38.2	20.6	6.3	33.2	31.9	46.0	14.1	100	224
----- Vertical -----										
5	53.280	51.3	13.8	1.8	33.1	33.8	40.0	6.2	100	359
6	445.161	53.1	16.1	4.8	33.1	40.9	46.0	5.1	100	157

  
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**11.5 Test data for Below 30 MHz**


- . Test Date : August 16, 2018 ~ August 28, 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 (dB $\mu$ V)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Margin (dB)
It was not observed any emissions from the EUT.									

**11.6 Test data for above 1 GHz**

- . Test Date : August 16, 2018 ~ August 28, 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 (dB $\mu$ V)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Margin (dB)
It was not observed any emissions from the EUT.									

  
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**Tested by: Tae-Ho, Kim / Senior Manager**

## 12. CONDUCTED EMISSION TEST

### 12.1 Operating environment

Temperature : 24.3 °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 50 Ω / 50 μH + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

### 12.3 Test equipment used

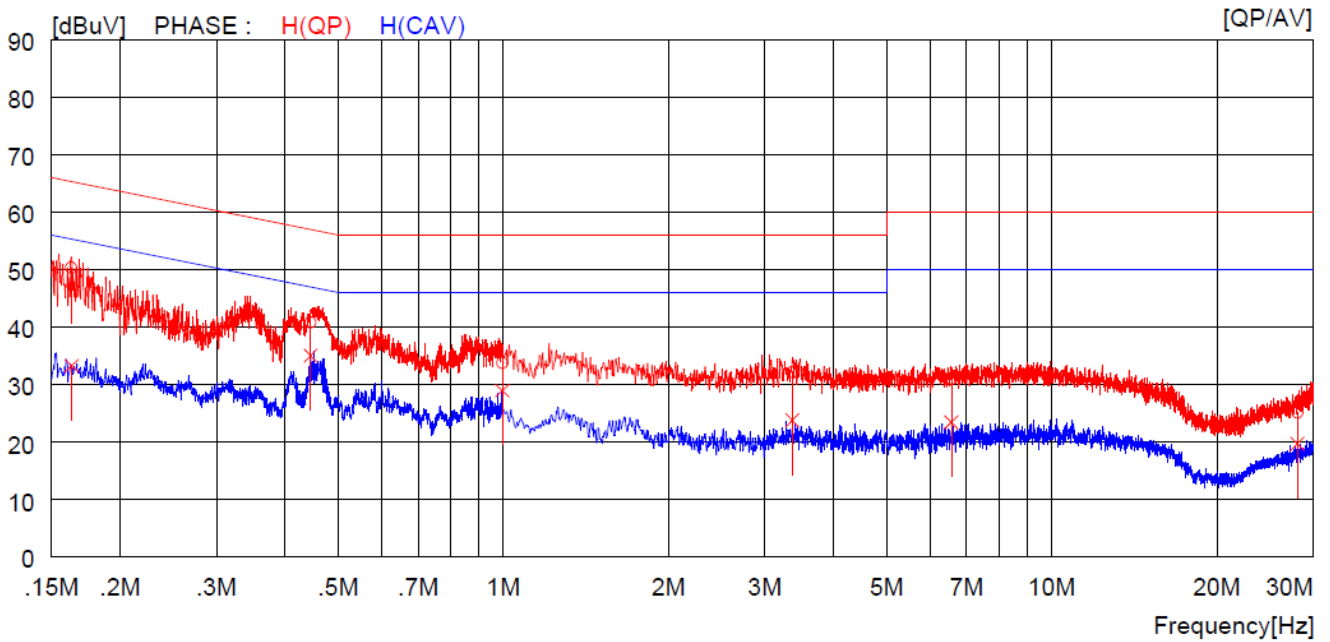
Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - ESPI	Rohde & Schwarz	EMI Test Receiver	101278	Oct. 27, 2017 (1Y)
□ - ESHS10	Rohde & Schwarz	EMI Test Receiver	834467/007	Mar. 29, 2018 (1Y)
□ - NSLK8128	Schwarzbeck	AMN	8128-216	Mar. 29, 2018 (1Y)
■ - NSLK8126	Schwarzbeck	AMN	8126-404	Apr. 04, 2018 (1Y)
□ - 3825/2	EMCO	AMN	9109-1869	Apr. 11, 2018 (1Y)
■ - 3825/2	EMCO	AMN	9109-1867	Mar. 28, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

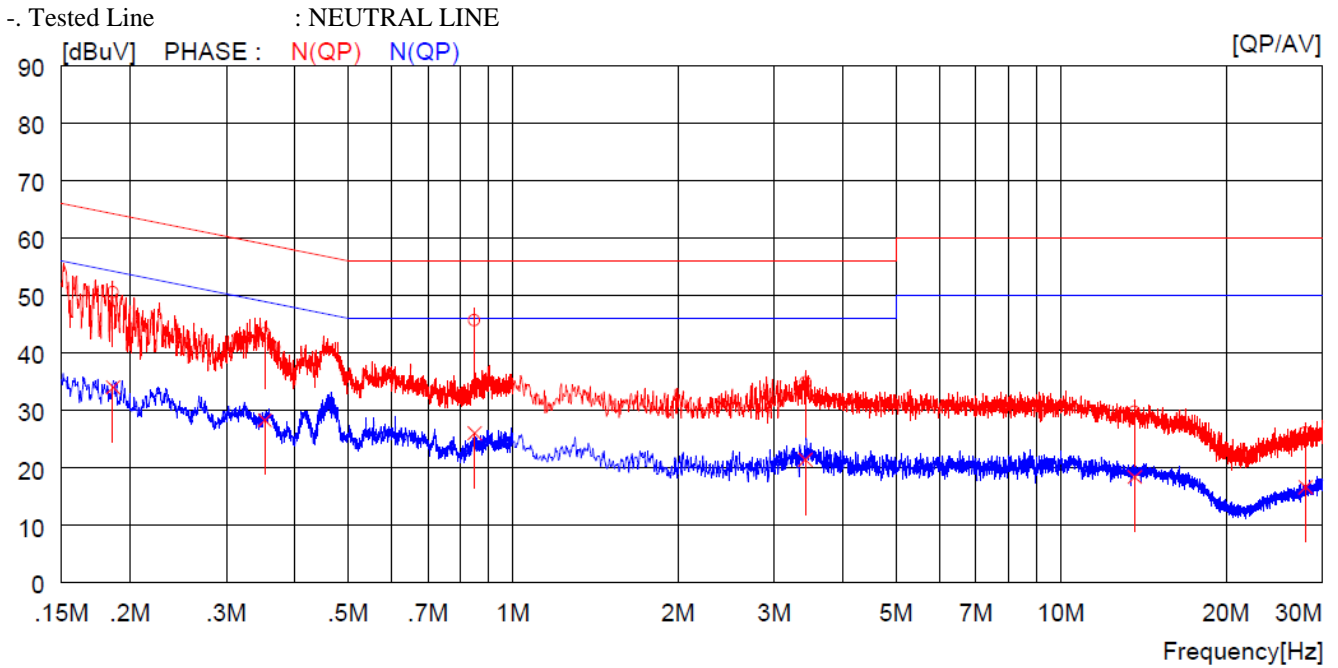


### 12.4 Test data

- Test Date : August 16, 2018 ~ August 28, 2018
- 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	0.16300	40.4	----	9.9	50.3	----	65.3	----	15.0	----	H (QP)
2	0.44500	31.0	----	9.8	40.8	----	57.0	----	16.2	----	H (QP)
3	0.99500	23.8	----	9.9	33.7	----	56.0	----	22.3	----	H (QP)
4	3.36400	22.1	----	10.1	32.2	----	56.0	----	23.8	----	H (QP)
5	6.56000	20.8	----	10.2	31.0	----	60.0	----	29.0	----	H (QP)
6	28.07000	14.3	----	10.8	25.1	----	60.0	----	34.9	----	H (QP)
7	0.16300	----	23.4	9.9	----	33.3	----	55.3	----	22.0	H (CAV)
8	0.44500	----	25.3	9.8	----	35.1	----	47.0	----	11.9	H (CAV)
9	0.99500	----	19.1	9.9	----	29.0	----	46.0	----	17.0	H (CAV)
10	3.36400	----	13.7	10.1	----	23.8	----	46.0	----	22.2	H (CAV)
11	6.56000	----	13.3	10.2	----	23.5	----	50.0	----	26.5	H (CAV)
12	28.07000	----	8.9	10.8	----	19.7	----	50.0	----	30.3	H (CAV)



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	0.18600	40.7	----	9.9	50.6	----	64.2	----	13.6	----	N (QP)
2	0.35200	33.5	----	9.9	43.4	----	58.9	----	15.5	----	N (QP)
3	0.85000	35.8	----	9.9	45.7	----	56.0	----	10.3	----	N (QP)
4	3.41600	24.8	----	10.1	34.9	----	56.0	----	21.1	----	N (QP)
5	13.63000	19.5	----	10.3	29.8	----	60.0	----	30.2	----	N (QP)
6	27.96000	15.4	----	10.8	26.2	----	60.0	----	33.8	----	N (QP)
7	0.18600	----	24.1	9.9	----	34.0	----	54.2	----	20.2	N (CAV)
8	0.35200	----	18.4	9.9	----	28.3	----	48.9	----	20.6	N (CAV)
9	0.85000	----	16.2	9.9	----	26.1	----	46.0	----	19.9	N (CAV)
10	3.41600	----	11.3	10.1	----	21.4	----	46.0	----	24.6	N (CAV)
11	13.63000	----	8.1	10.3	----	18.4	----	50.0	----	31.6	N (CAV)
12	27.96000	----	5.8	10.8	----	16.6	----	50.0	----	33.4	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 / Senior Manager