

RADIO PERFORMANCE TEST REPORT

Test Report No. : OT-204-RWD-076

AGR No. : A201A-394

Applicant : PS TEC Co., Ltd.

Address : 80, HWANGGEUM 3-RO 7BEON-GIL, YANGCHON-EUP, GIMPO-SI,
GYEONGGI-DO, KOREA

Manufacturer : PS TEC Co., Ltd.

Address : 80, HWANGGEUM 3-RO 7BEON-GIL, YANGCHON-EUP, GIMPO-SI,
GYEONGGI-DO, KOREA

Type of Equipment : Autonomous Counter

FCC ID. : 2AVSN-PSM-NGC-NP01

Model Name : PSM-NGC-NP01

Multiple Model Name : N/A

Serial number : N/A

Total page of Report : 30 pages (including this page)

Date of Incoming : February 05, 2020


Date of issue : April 24, 2020

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: 

 Ha-Ram Lee / Manager
 ONETECH Corp.

Approved by: 

 Jae-Ho Lee / General Manager
 ONETECH Corp.

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-204-RWD-076	April 24, 2020	Initial Issue	All

1. VERIFICATION OF COMPLIANCE

Applicant : PS TEC Co., Ltd.
 Address : 80, HWANGGEUM 3-RO 7BEON-GIL, YANGCHON-EUP, GIMPO-SI, GYEONGGI-DO, KOREA
 Contact Person : Bo Young Hwang/General Manager
 Telephone No. : +82-2-3408-1750
 FCC ID : 2AVSN-PSM-NGC-NP01
 Model Name : PSM-NGC-NP01
 Brand Name : N/A
 Serial Number : N/A
 Date : April 24, 2020

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
KIND OF EQUIPMENT	Autonomous Counter
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. : As This product uses DC battery, This test has not been performed.

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

-. Lab Accreditation:

ISED (Innovation, Science and Economic Development Canada) – Registration No. Site# 3736A-3

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 PS TEC Co., Ltd., Model PSM-NGC-NP01 (referred to as the EUT in this report) is an Autonomous Counter. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	Autonomous Counter
OPERATING FREQUENCY	2 402 MHz ~ 2 480 MHz
RF OUTPUT POWER	-1.94 dBm
NUMBER OF CHANNEL	40 Channels
MODULATION TYPE	GFSK(Bluetooth LE)
ANTENNA TYPE	Chip Antenna
ANTENNA GAIN	2.31 dBi
LIST OF EACH OSC. OR CRYSTAL. FREQ.(FREQ.>=1 MHz)	32 MHz
Hardware / Software version	1.0 / 1.0

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	N/A	N/A	-
Sub Board	N/A	N/A	-
Battery	N/A	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
80QQ	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 “XY” axis, but the worst data was recorded in this report.

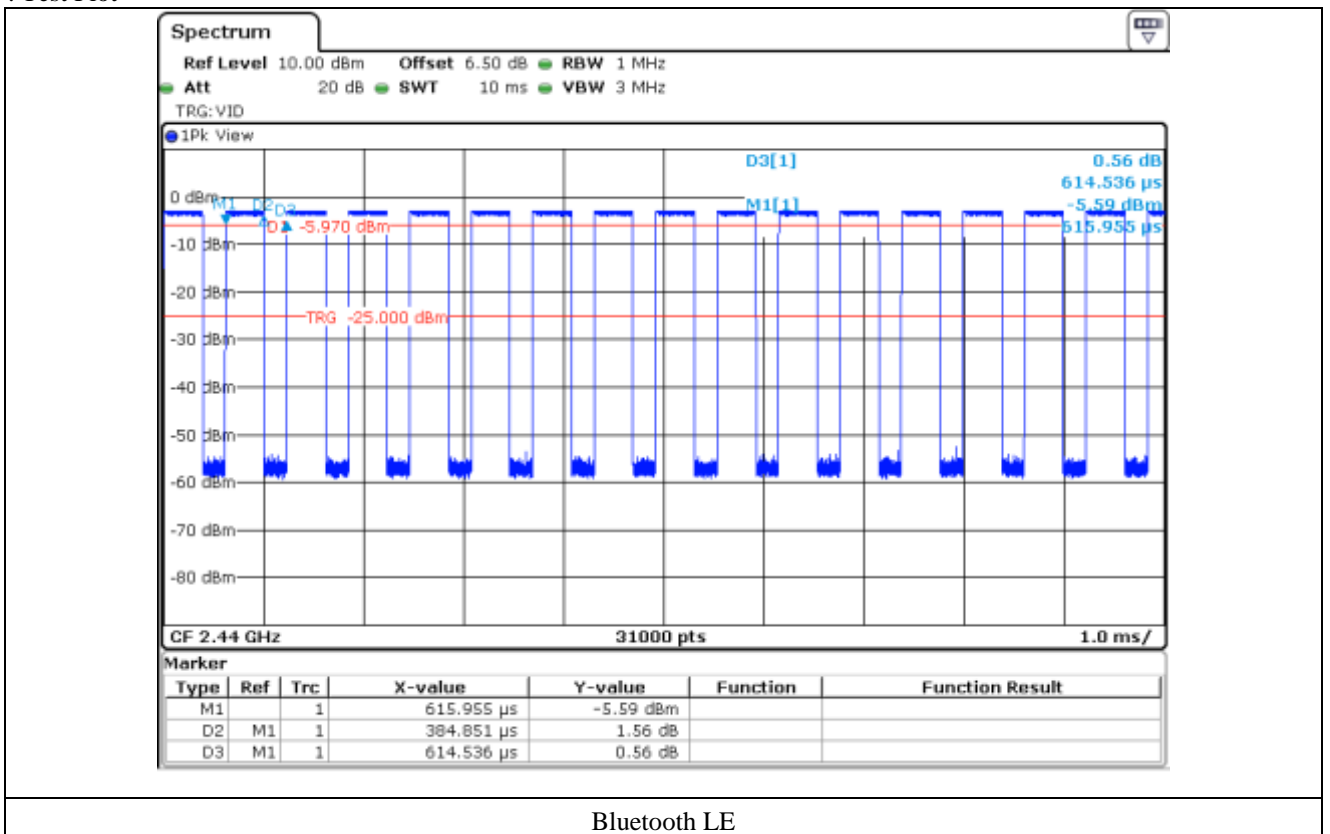
- Duty Cycle

Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
Bluetooth LE	0.385	0.615	38.50	4.15

Note – Duty Cycle : (Tx On Time / (Tx On Time + Tx Off Time)) * 100

Correction Factor : 10 * Log(1 / (Duty Cycle / 100))

- Test Plot



5.4 Configuration of Test System

Line Conducted Test: As the EUT is operated by DC battery, this test item is not requirement to be performed.

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 open area test site.

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

As the EUT is operated by DC battery, this test item is not requirement to be performed.

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. MIMIMUM 6 dB BANDWIDTH

7.1 Operating environment

Temperature : 25 °C
 Relative humidity : 49 % 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.
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101199	Mar. 11, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

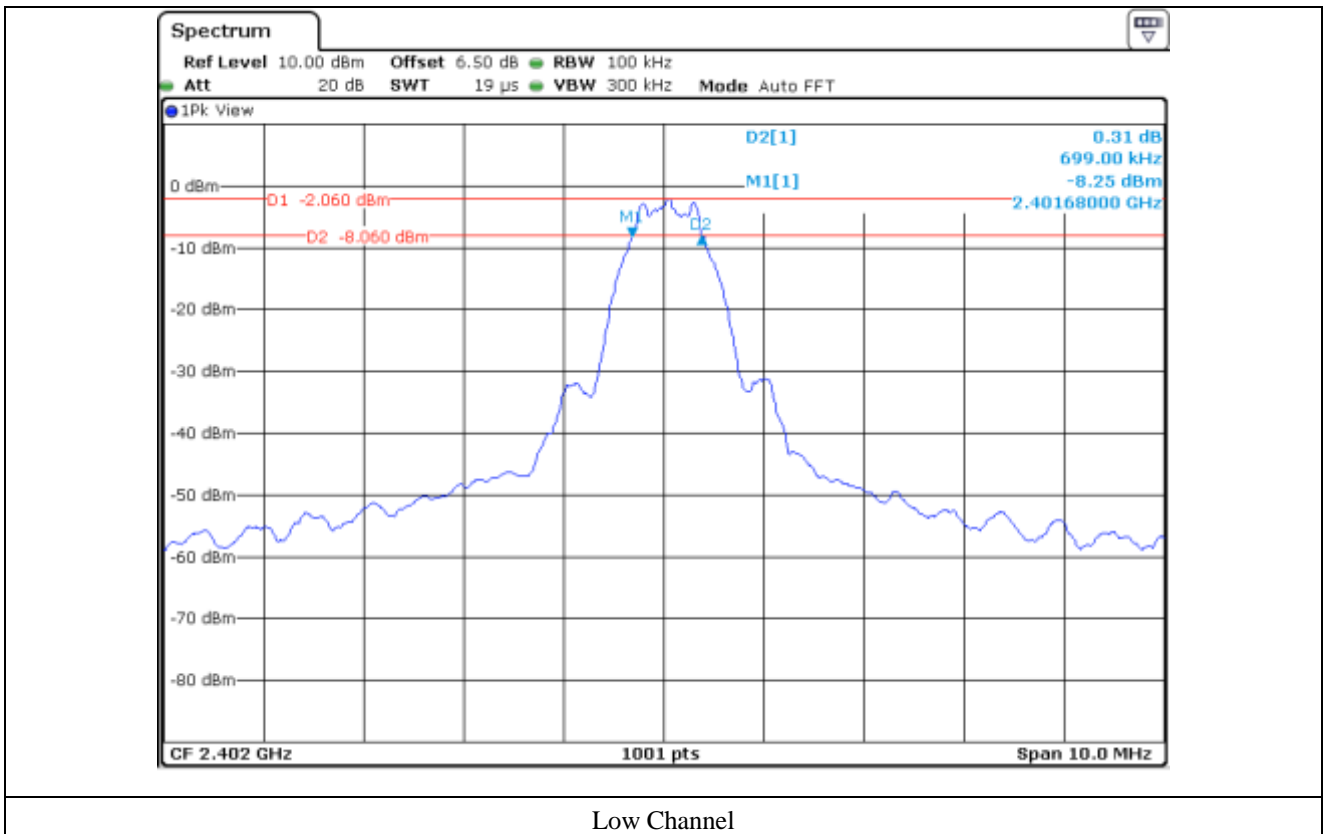
7.4 Test data

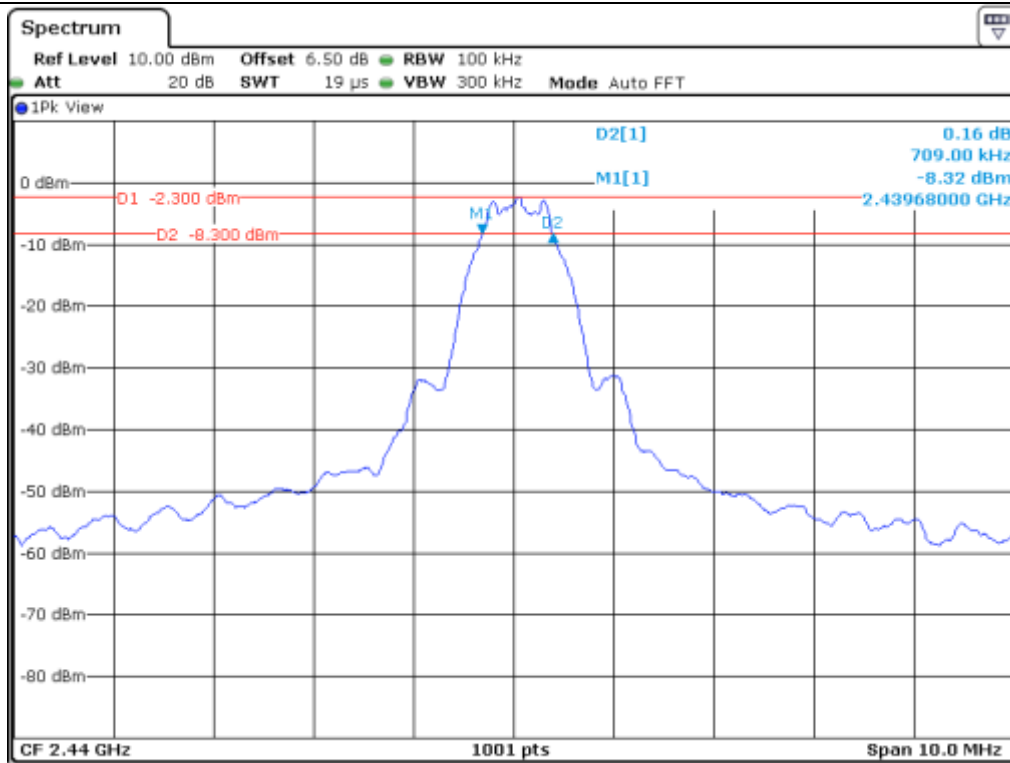
- Test Date : February 13, 2020 ~ February 28, 2020
- Test Result : Pass

CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
Low	2 402.00	699.00	500	199.00
Middle	2 440.00	709.00	500	209.00
High	2 480.00	689.00	500	189.00

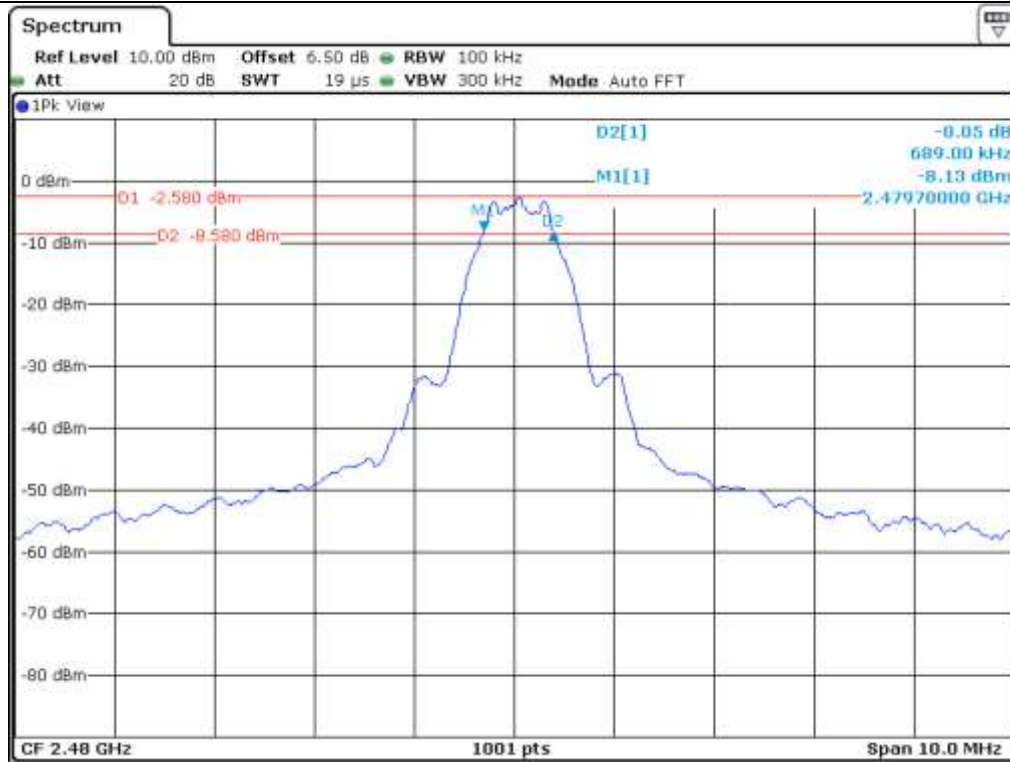
Remark. Margin = Measured Value - Limit

Tested by: Youngyong Kim/ Assistant Manager





Middle Channel



High Channel

8. MAXIMUM PEAK OUTPUT POWER

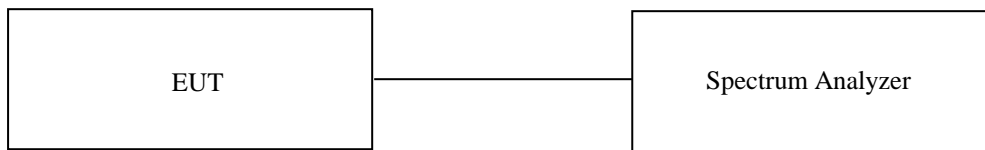
8.1 Operating environment

Temperature : 25 °C
 Relative humidity : 49 % 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.
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101199	Mar. 11, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

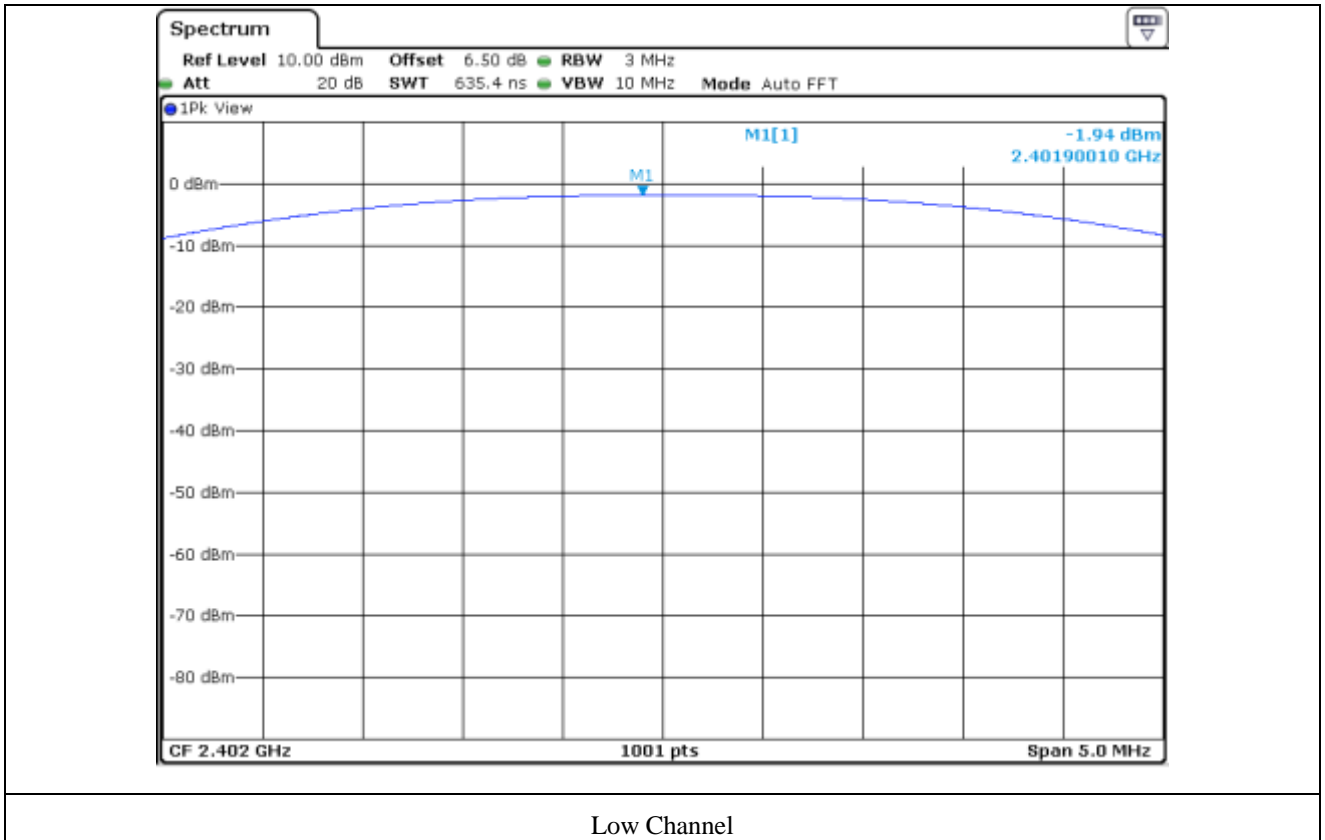
8.4 Test data

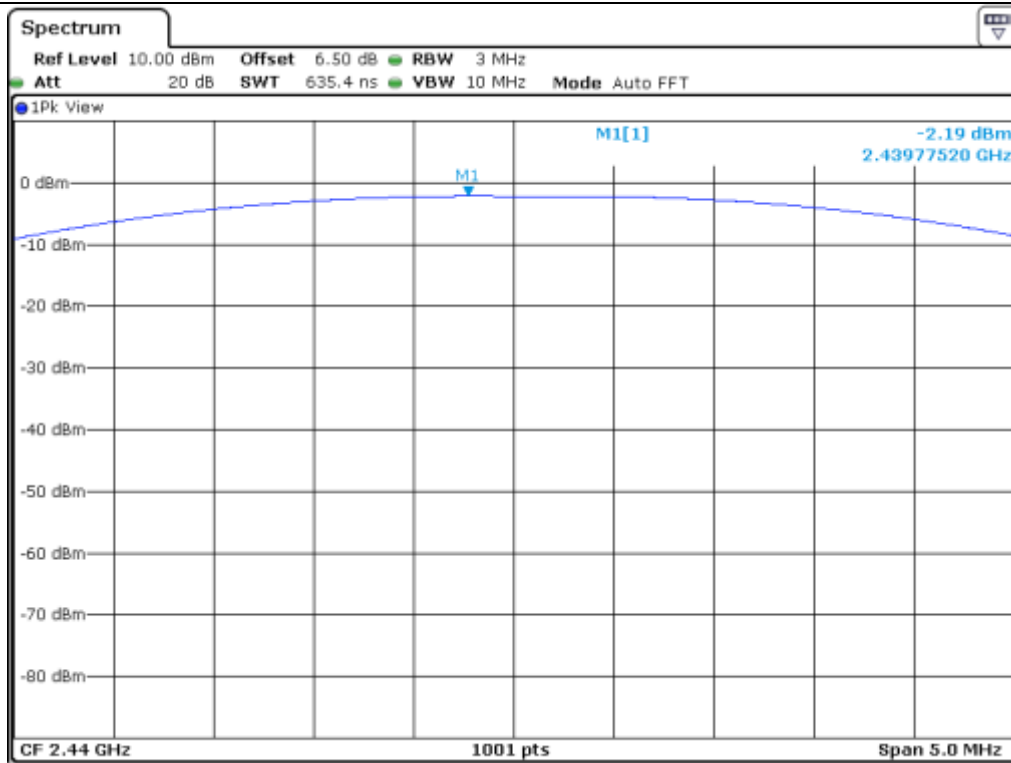
- Test Date : February 13, 2020 ~ February 28, 2020
- Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	-1.94	30.00	31.94
MIDDLE	2 440.00	-2.19	30.00	32.19
HIGH	2 480.00	-2.46	30.00	32.46

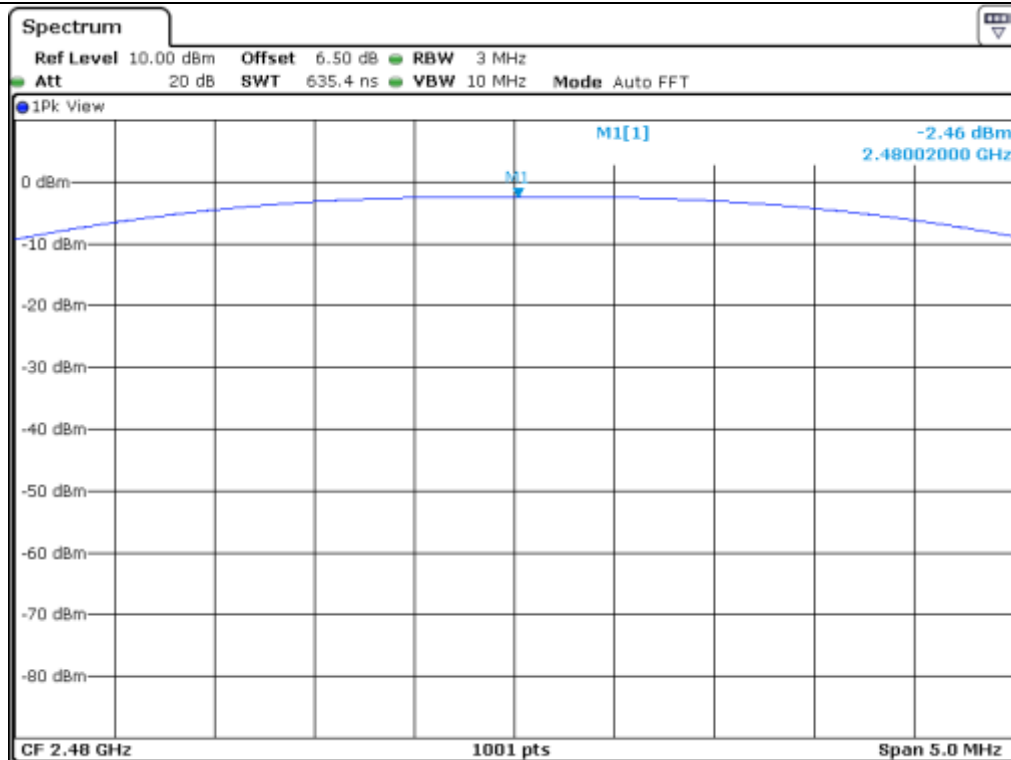
Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)

Tested by: Youngyong Kim/ Assistant Manager





Middle Channel



High Channel

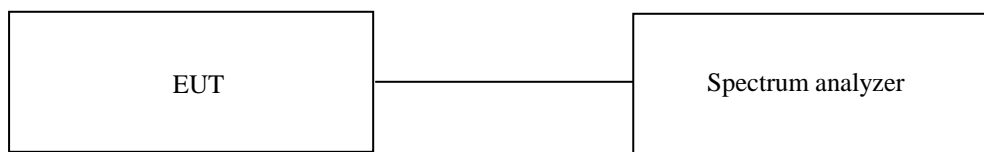
9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

9.1 Operating environment

Temperature : 25 °C
 Relative humidity : 49 % 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.

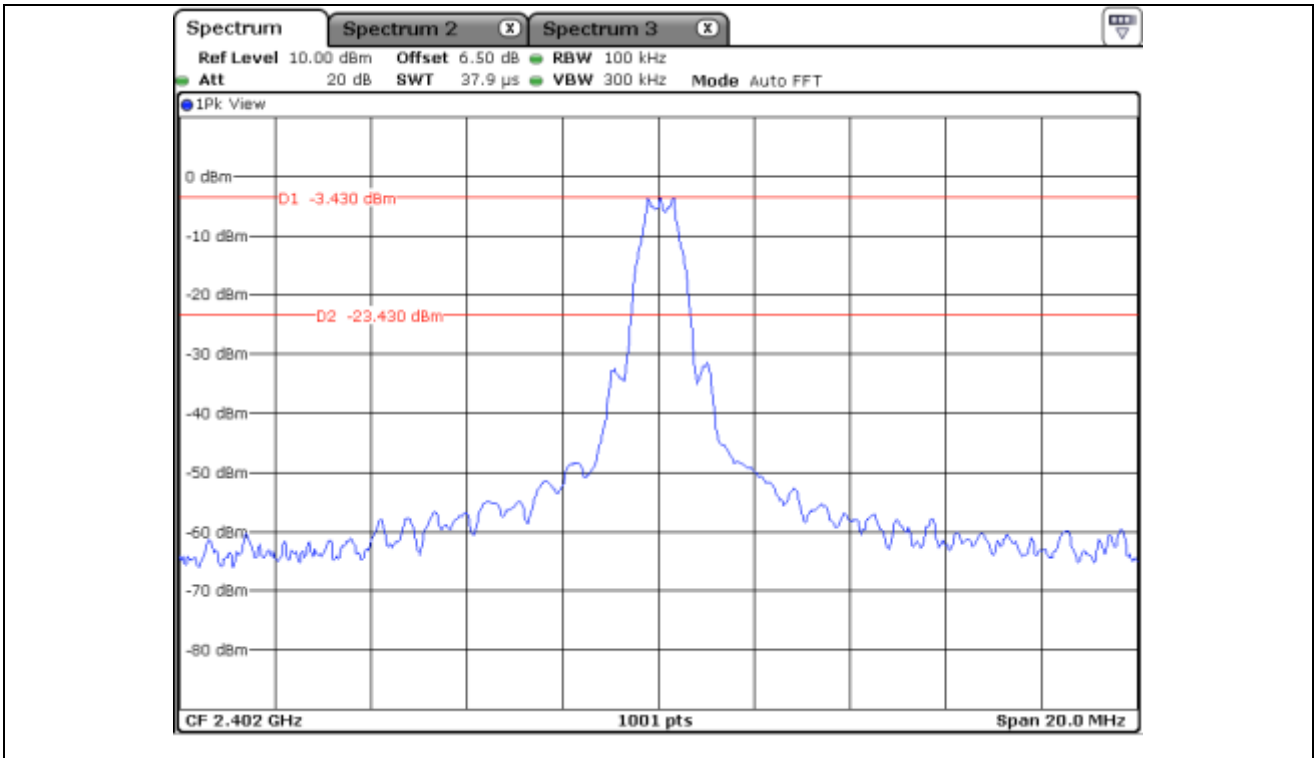
The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal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

9.4 Test equipment used

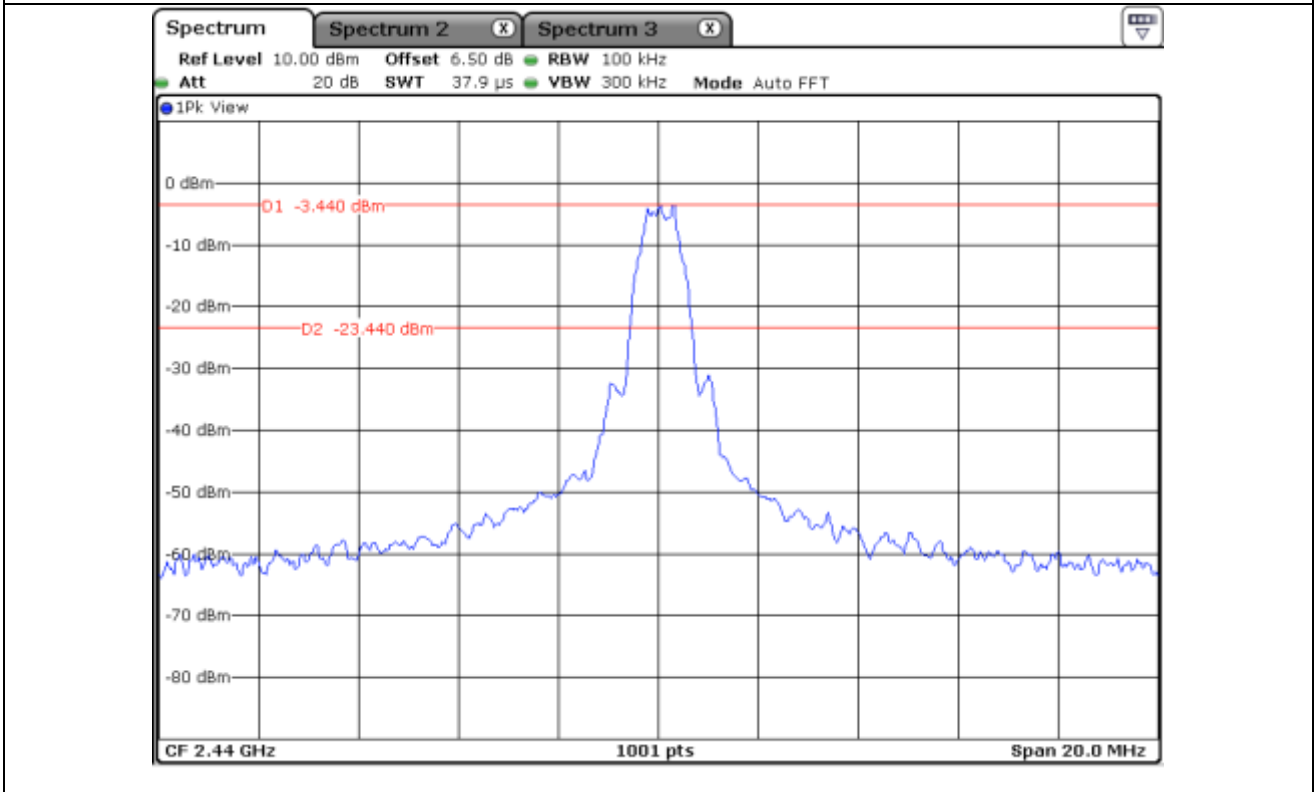
	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 22, 2019 (1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101199	Mar. 11, 2019 (1Y)
■ -	SCU18	Rohde & Schwarz	Pre-Amplifier	102266	Jul. 24, 2019 (1Y)
■ -	MA240	HD GmbH	Antenna Master	N/A	N/A
■ -	HD100	HD GmbH	Position Controller	N/A	N/A
■ -	DS420S	HD GmbH	Turn Table	N/A	N/A
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	9120D-1349	Nov. 25, 2019 (2Y)

All test equipment used is calibrated on a regular basis.

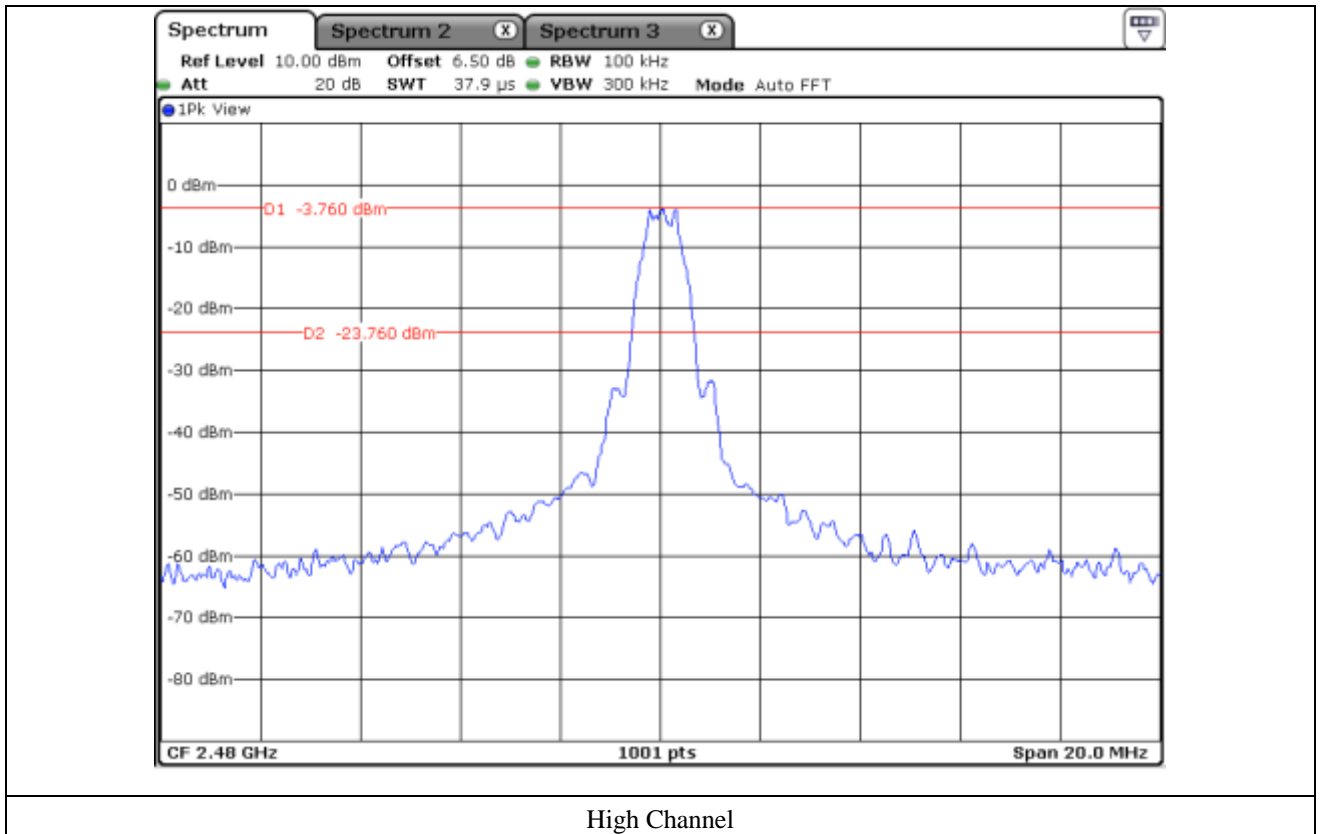
9.5 Test data for conducted emission



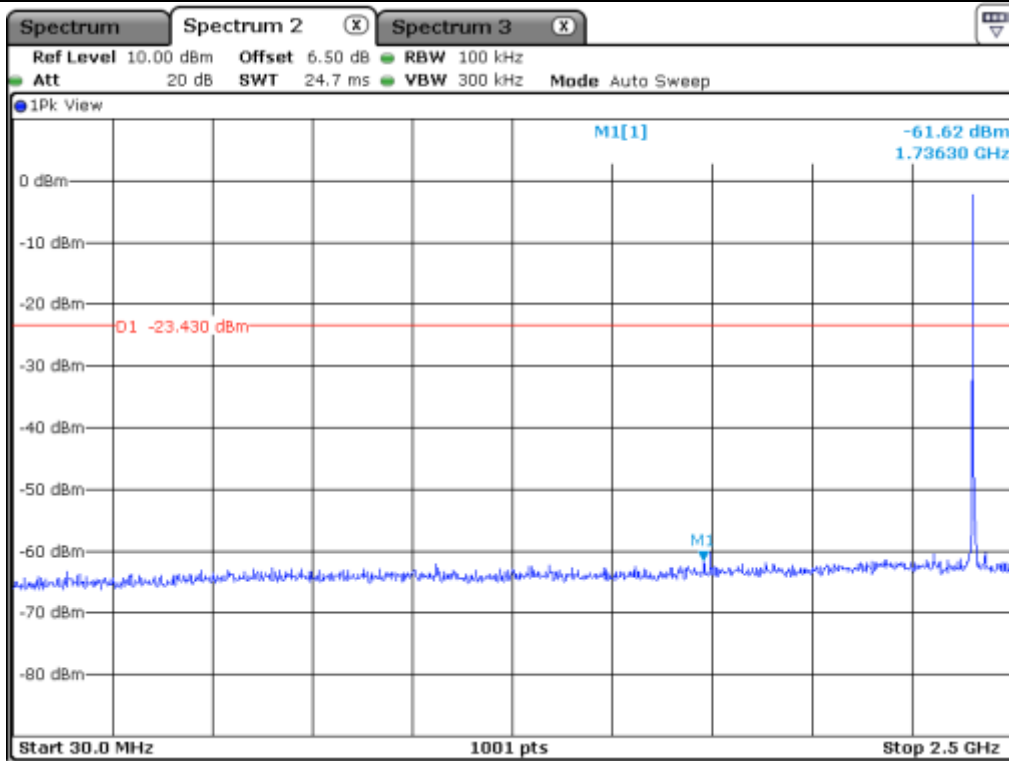
Low Channel



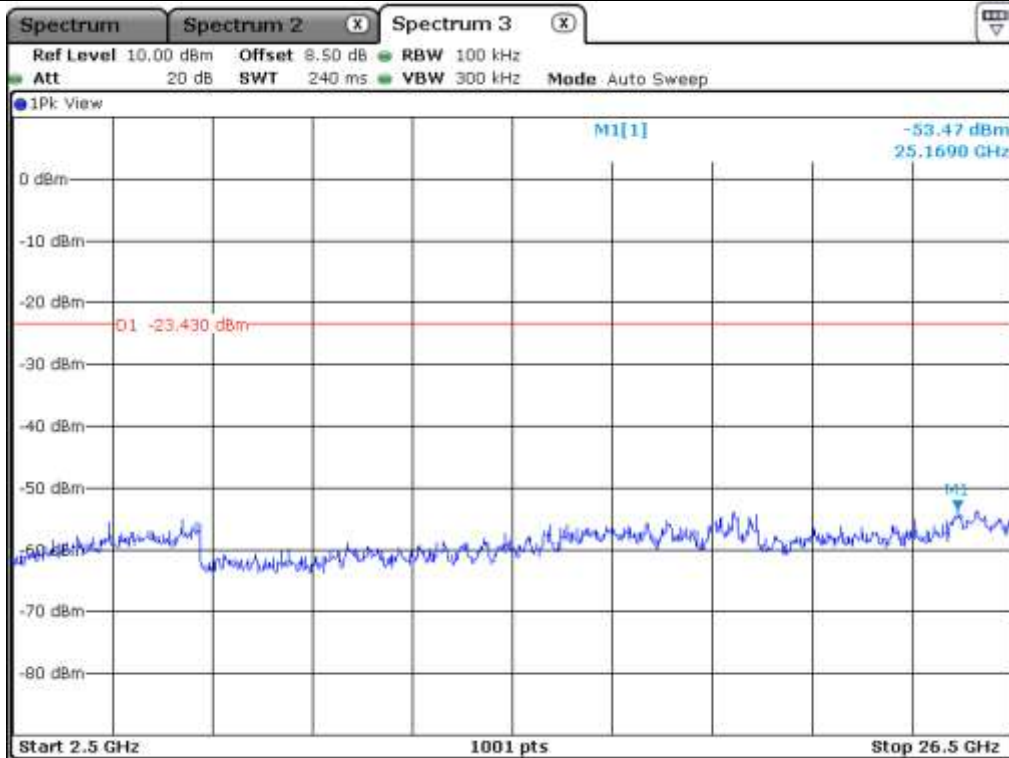
Middle Channel



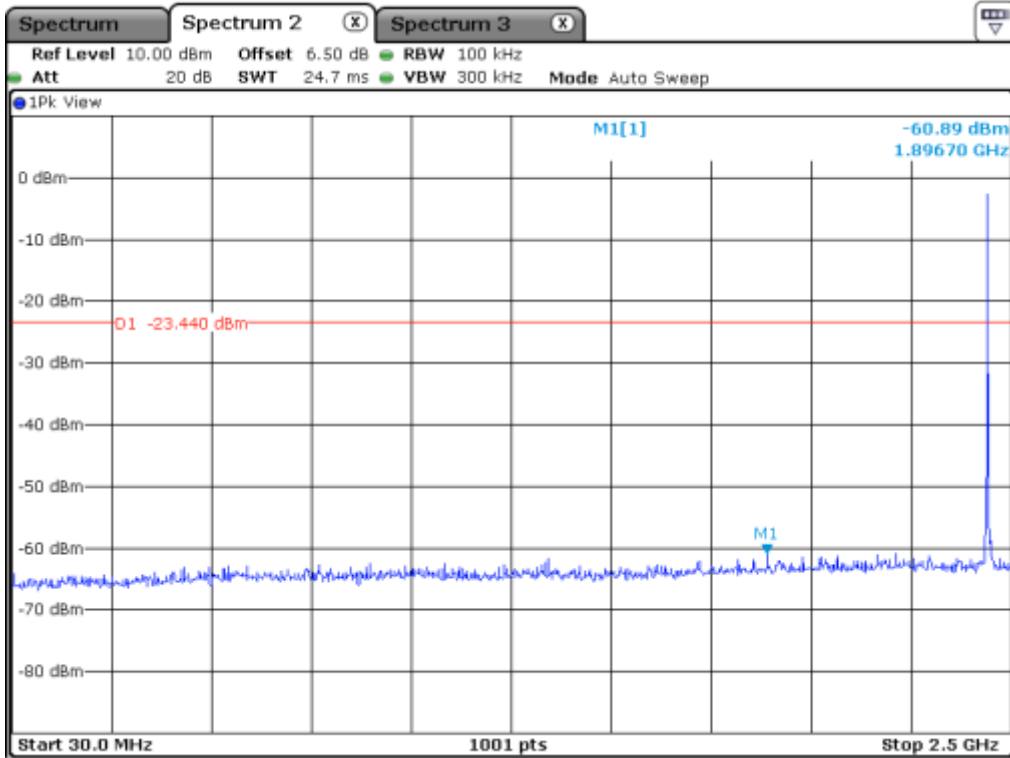
High Channel



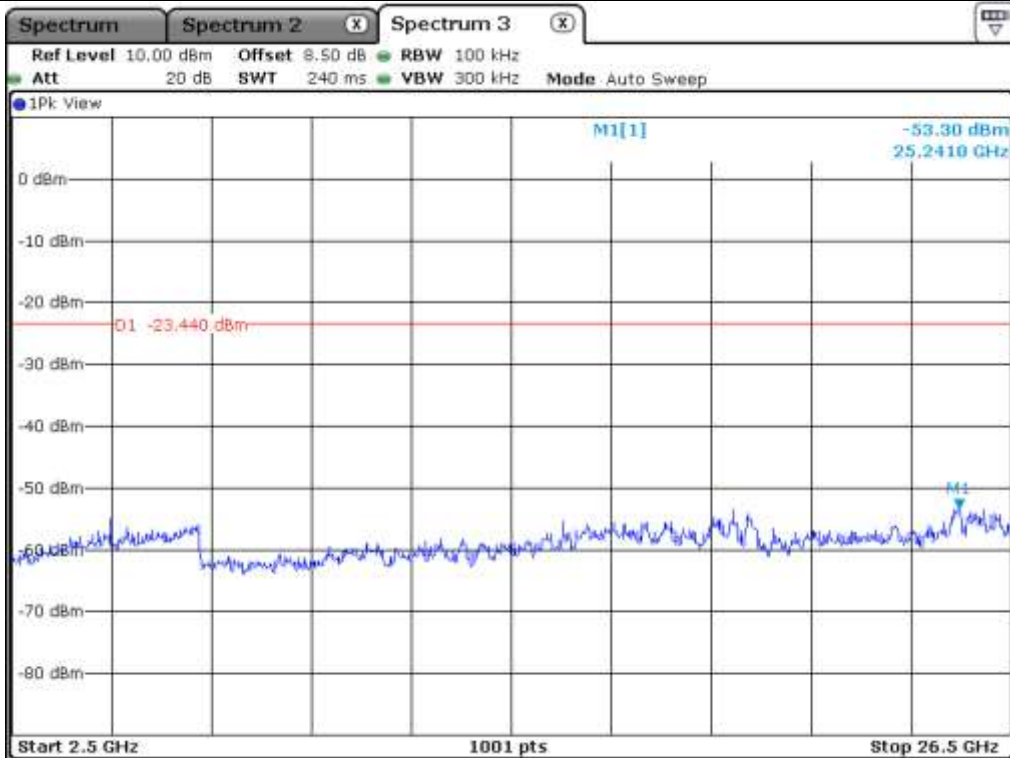
Low Channel



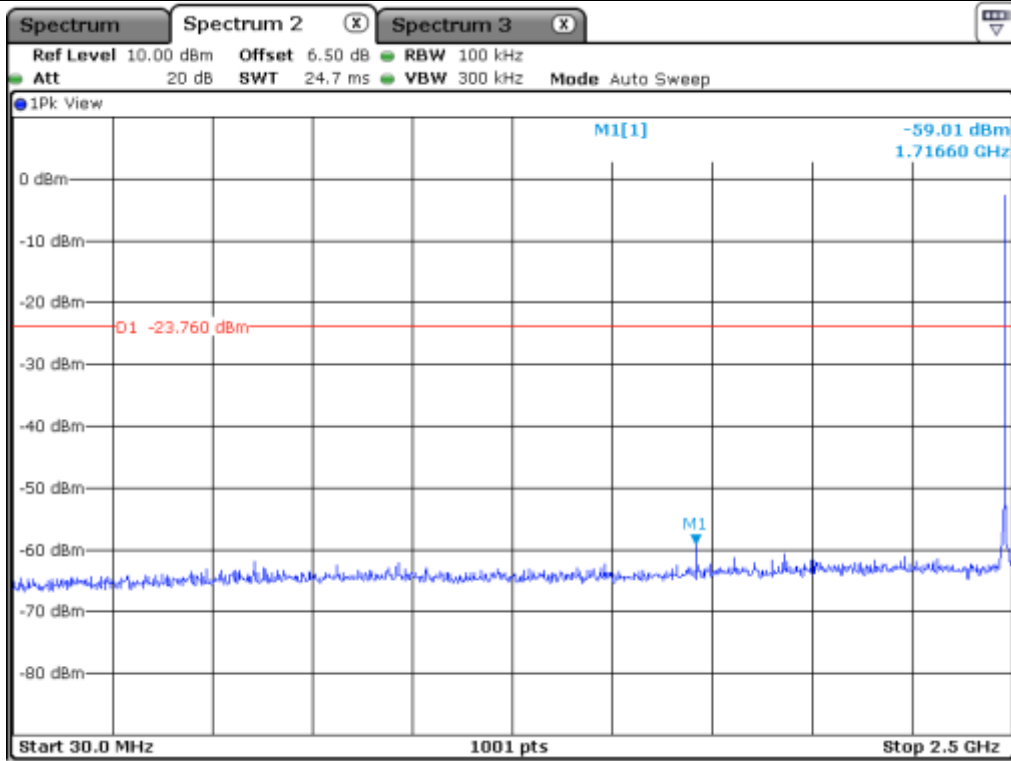
Low Channel



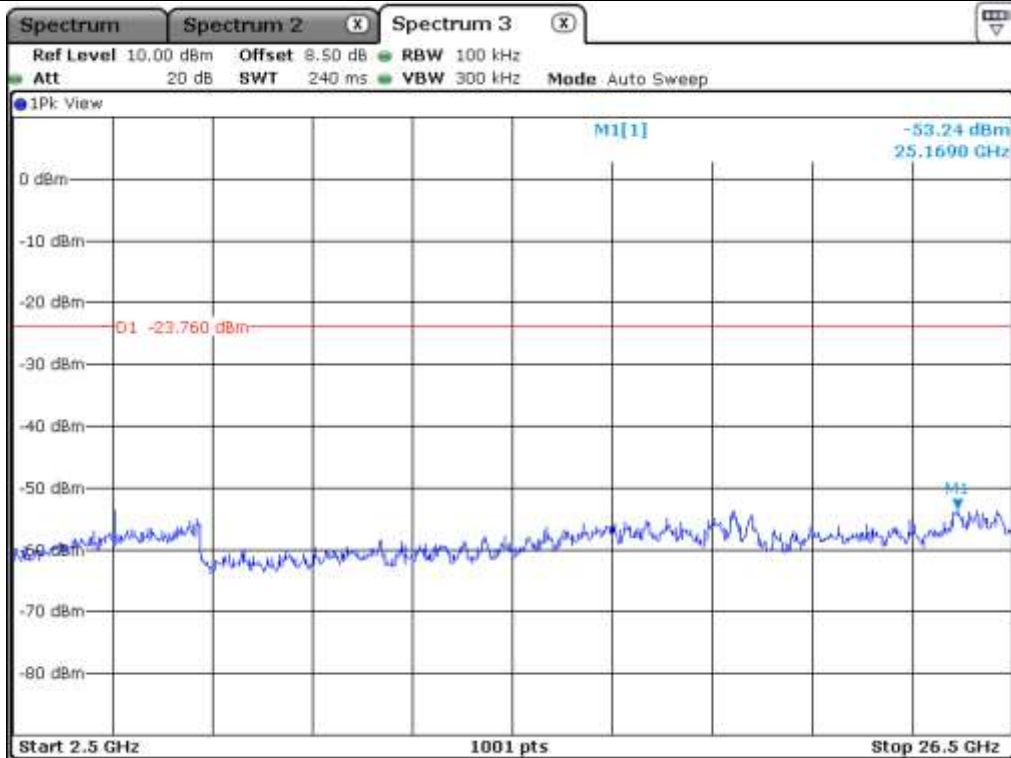
Middle Channel



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 : February 13, 2020 ~ February 28, 2020
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Detector : Peak Mode(Peak), Average Mode(RMS)
- Measurement distance : 3 m
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	C.F (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel										
2 347.20	20.68	Peak	H	27.60	2.91	-	-	51.19	74.00	22.81
2 373.34	13.43	Average	H				4.15	48.09	54.00	5.91
2 336.33	21.35	Peak	V				-	51.86	74.00	22.14
2 350.00	13.30	Average	V				4.15	47.96	54.00	6.04
Test Data for High Channel										
2 496.56	20.31	Peak	H	27.50	3.02	-	-	50.83	74.00	23.17
2 488.93	13.39	Average	H				4.15	48.06	54.00	5.94
2 492.54	20.65	Peak	V				-	51.17	74.00	22.83
2 492.16	13.29	Average	V				4.15	47.96	54.00	6.04

Tabulated test data for Restricted Band

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

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

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



Tested by: Youngyong Kim/ Assistant Manager

9.6.2 Spurious & Harmonic Radiated Emission

- Test Date : February 13, 2020 ~ February 28, 2020
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Detector : Peak Mode(Peak), Average Mode(RMS)
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	C.F (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel										
4 804.00	20.10	Peak	H	31.20	4.65	-	-	55.95	74.00	18.05
	10.94	Average	H				4.15	50.94	54.00	3.06
	21.04	Peak	V				-	56.89	74.00	17.11
	10.14	Average	V				4.15	50.14	54.00	3.86
Test Data for Middle Channel										
4 880.00	21.25	Peak	H	31.40	4.72	-	-	57.37	74.00	16.63
	10.67	Average	H				4.15	50.94	54.00	3.06
	20.54	Peak	V				-	56.66	74.00	17.34
	10.85	Average	V				4.15	51.12	54.00	2.88
Test Data for High Channel										
4 960.00	20.43	Peak	H	31.70	4.86	-	-	56.99	74.00	17.01
	10.31	Average	H				4.15	51.02	54.00	2.98
	20.18	Peak	V				-	56.74	74.00	17.26
	10.15	Average	V				4.15	50.86	54.00	3.14

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

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

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



Tested by: Youngyong Kim/ Assistant Manager

10. PEAK POWER SPECTRAL DENSITY

10.1 Operating environment

Temperature : 25 °C
 Relative humidity : 49 % 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.
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101199	Mar. 11, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

10.4 Test data

-. Test Date : February 13, 2020 ~ February 28, 2020

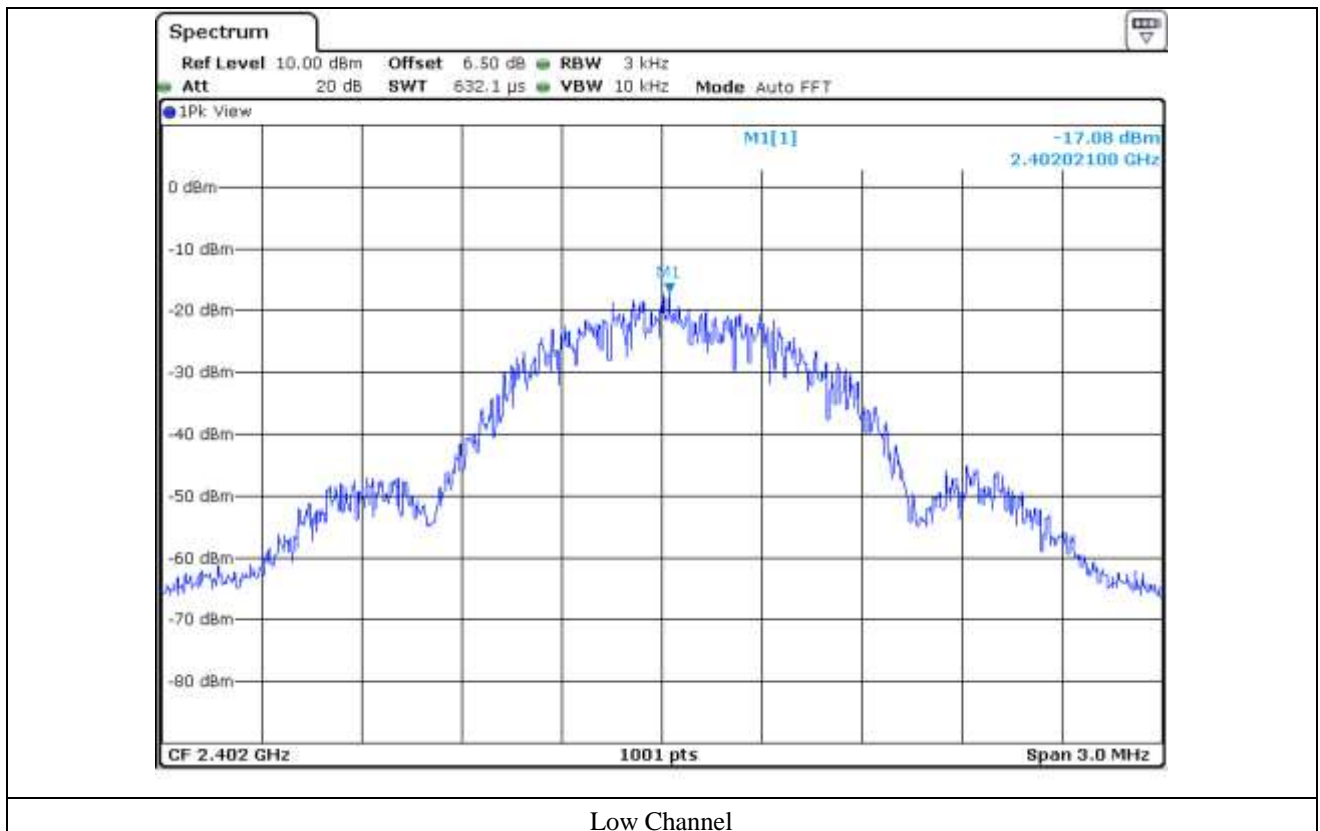
-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

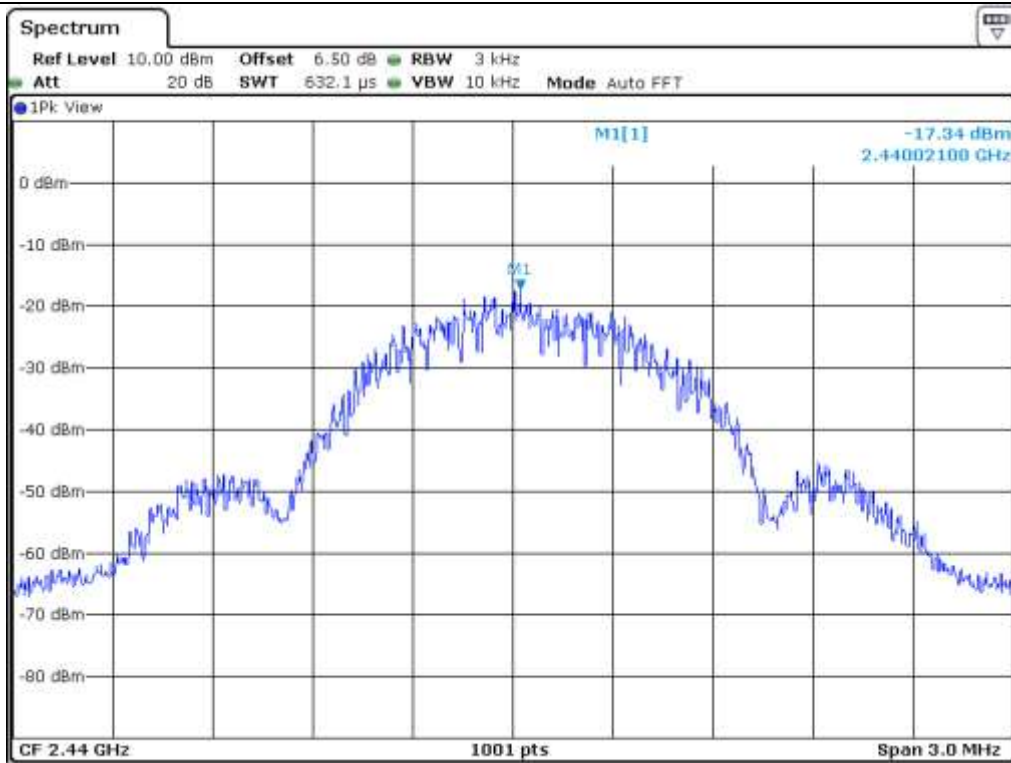
CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 402.00	-17.08	8.00	25.08
Middle	2 440.00	-17.34	8.00	25.34
High	2 480.00	-17.65	8.00	25.65

Remark. Margin = Limit – Measured value

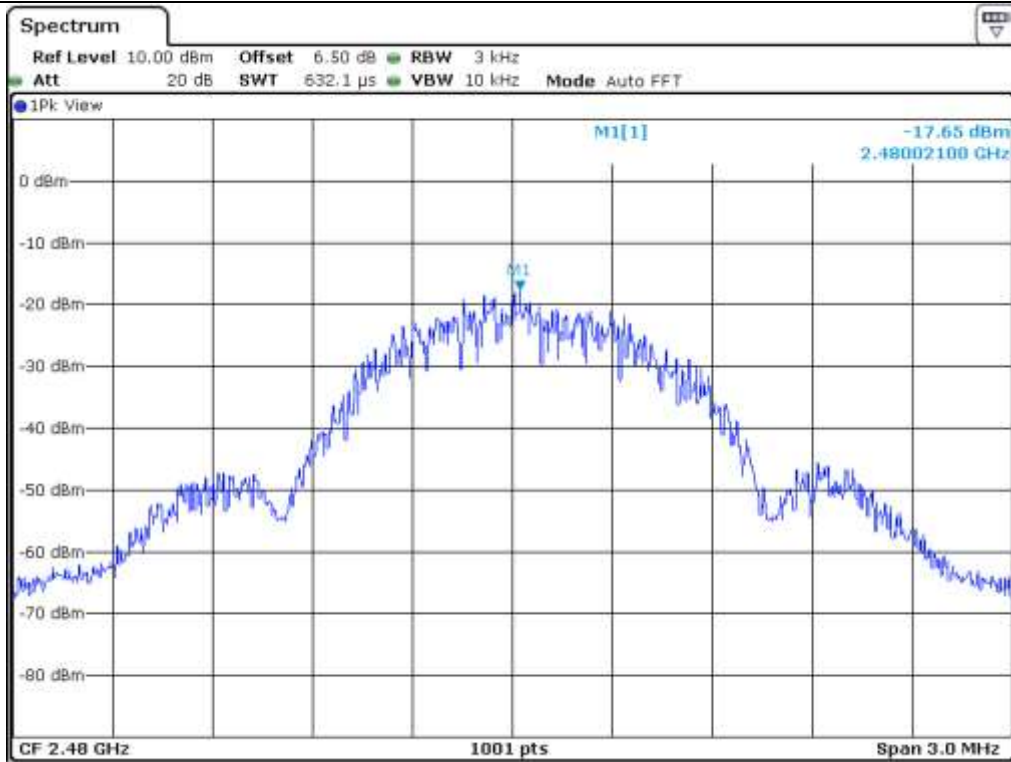
Tested by: Youngyong Kim/ Assistant Manager



Low Channel



Middle Channel



High Channel

11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 25 °C
 Relative humidity : 49 % 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. (Interval)
■ -	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 22, 2019 (1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Mar. 18, 2019 (1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101199	Mar. 11, 2019 (1Y)
■ -	SCU18	Rohde & Schwarz	Pre-Amplifier	102266	Jul. 24, 2019 (1Y)
■ -	MA240	HD GmbH	Antenna Master	N/A	N/A
■ -	HD100	HD GmbH	Position Controller	N/A	N/A
■ -	DS420S	HD GmbH	Turn Table	N/A	N/A
■ -	FMZB 1513	Schwarzbeck	LOOP ANTENNA	1513-235	May. 13, 2018 (2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-255	Jun. 05, 2018 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	9120D-1349	Nov. 25, 2019 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jan. 07, 2020 (1Y)
■ -	SCU40A	Rohde & Schwarz	Pre-Amplifier	100436	Mar. 11, 2019 (1Y)

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 : 49 % R.H.

Temperature: 25 °C

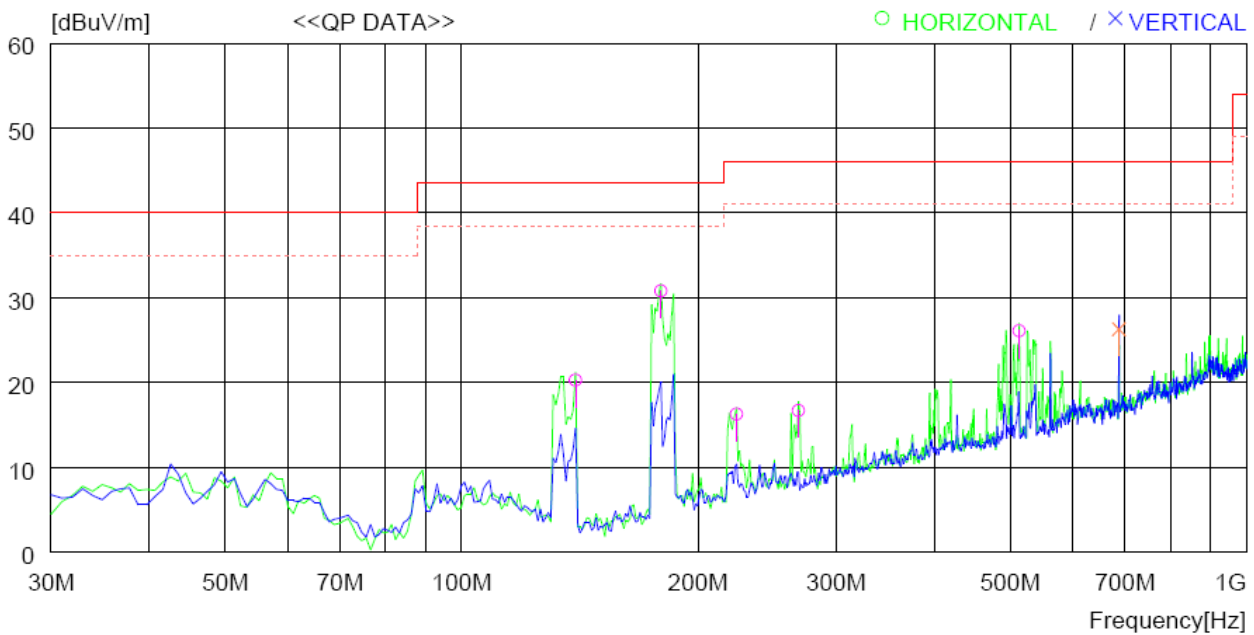
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : Autonomous Counter

Date: February 13, 2020 ~ February 28, 2020

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	139.610	43.6	8.0	1.4	32.7	20.3	43.5	23.2	400	0
2	179.380	52.4	9.3	1.7	32.6	30.8	43.5	12.7	200	92
3	224.000	35.8	11.2	1.9	32.6	16.3	46.0	29.7	200	278
4	268.620	35.2	12.2	2.0	32.7	16.7	46.0	29.3	100	80
5	513.061	39.1	17.2	2.7	32.9	26.1	46.0	19.9	200	42
----- Vertical -----										
6	687.655	36.6	19.2	3.4	32.9	26.3	46.0	19.7	200	359

Tested by: Youngyong Kim/ Assistant Manager

11.4.2 Test data for Below 30 MHz

- Test Date : February 13, 2020 ~ February 28, 2020
- 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)
All emissions observed were 20dB below the limit.									

11.4.3 Test data for above 1 GHz

- Test Date : February 13, 2020 ~ February 28, 2020
- 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)
All emissions observed were 20dB below the limit.									



Tested by: Youngyong Kim/ Assistant Manager