

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

Test Report No. : OT-196-RWD-034
AGR No. : A195A-013
Applicant : Samsung Electronics Co Ltd
Address : 1 Samsung-ro, Giheung-gu, Yongin-si Gyeonggi-do, South Korea
Manufacturer : Samsung Electronics Co Ltd
Address : 1 Samsung-ro, Giheung-gu, Yongin-si Gyeonggi-do, South Korea
Type of Equipment : IoT Module
FCC ID. : 2AR3A-ITM-D-BZ
Model Name : ITM-D-BZ
Serial number : N/A
Total page of Report : 51 pages (including this page)
Date of Incoming : June 05, 2019
Date of issue : June 17, 2019

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.

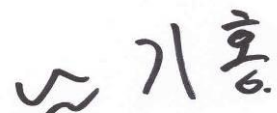
It is not a generally valid assessment of the features of the respective products of the mass-production.

Reviewed by:



Tae-Ho, Kim / Senior Manager
ONETECH Corp.

Approved by:



Ki-Hong, Nam / Chief Engineer
ONETECH Corp.

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-196-RWD-034	June 17, 2019	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : Samsung Electronics Co Ltd
Address : 1 Samsung-ro, Giheung-gu, Yongin-si Gyeonggi-do, South Korea
Contact Person : Mounjin, Jang / Staff Engineer
Telephone No. : +070-7142-1361
FCC ID : 2AR3A-ITM-D-BZ
Model Name : ITM-D-BZ
Brand Name : -
Serial Number : N/A
Date : June 17, 2019

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	IoT Module
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 558074 D01 15.247 Meas Guidance v05r02
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 & 99 % Occupied 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 Samsung Electronics Co Ltd, Model ITM-D-BZ (referred to as the EUT in this report) is a IoT Module. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	IoT Module	
Temperature Range	-20 °C ~ 50 °C	
OPERATING FREQUENCY	Bluetooth	2 402 MHz ~ 2 480 MHz
	Zigbee	2 405 MHz ~ 2 480 MHz
MODULATION TYPE	Bluetooth	GFSK
	Zigbee	O-QPSK
RF OUTPUT POWER	Bluetooth	LE Coded_125 kbps: 8.75 dBm LE Coded_500 kbps: 8.50 dBm LE 1 M_1 Mbps: 8.75 dBm LE 2 M_2 Mbps: 7.85 dBm
	Zigbee	8.39 dBm
Number of Channel	Bluetooth	40 Channel
	Zigbee	16 Channel
ANTENNA TYPE		PCB Antenna
ANTENNA GAIN		3.6 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)		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	ITM-D-BZ R0.2	N/A

5.2 Peripheral equipment

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

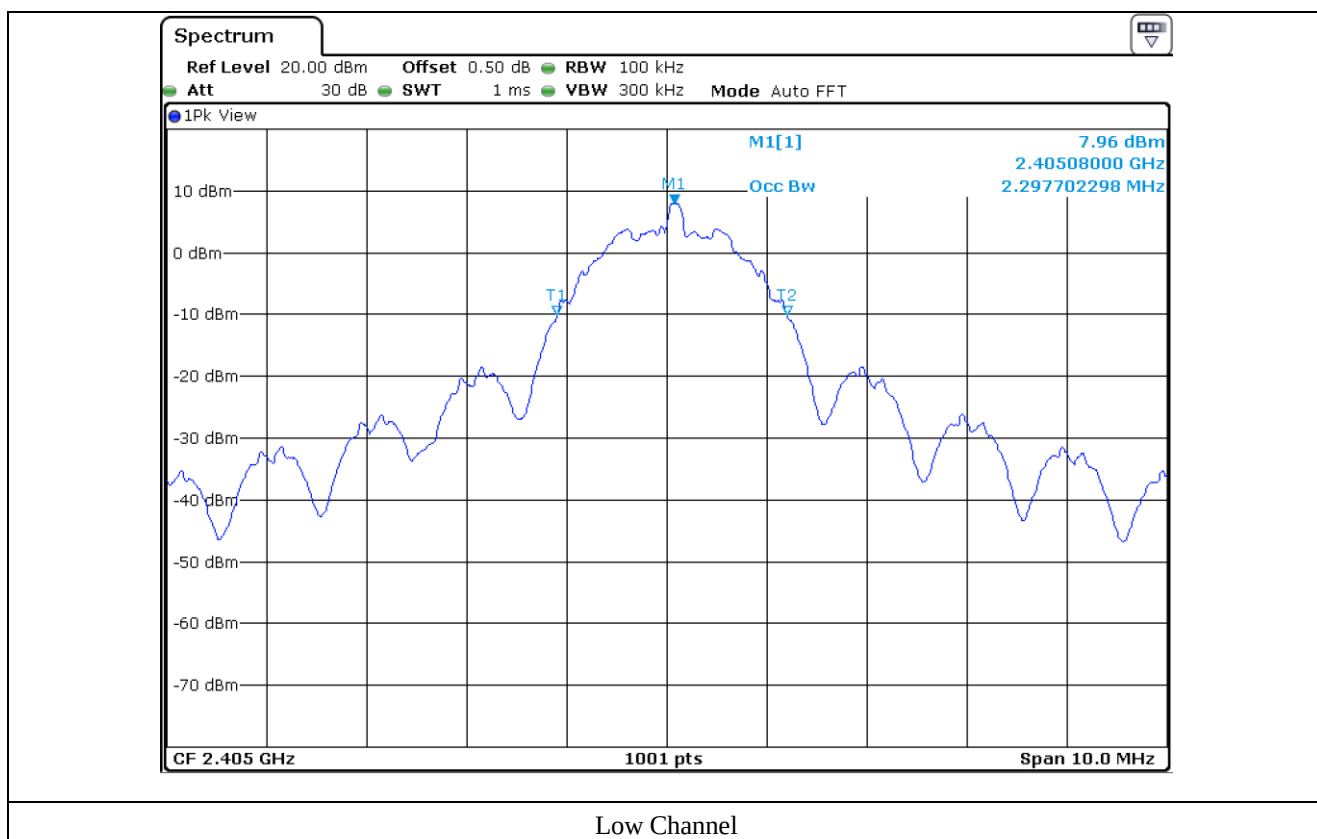
Model	Manufacturer	Description	Connected to
ITM-D-BZ	Samsung Electronics Co Ltd	IoT Module (EUT)	-
ITM-D-BZ_EVK Rev0.2	Samsung Electronics Co Ltd	Jig Board	EUT
HP Pavilion g series	HP	Notebook PC	-
PPP009C	LIE-ON TECHNOLOGY (CHANGZHOU)CO.,LTD.	AC Adapter	-

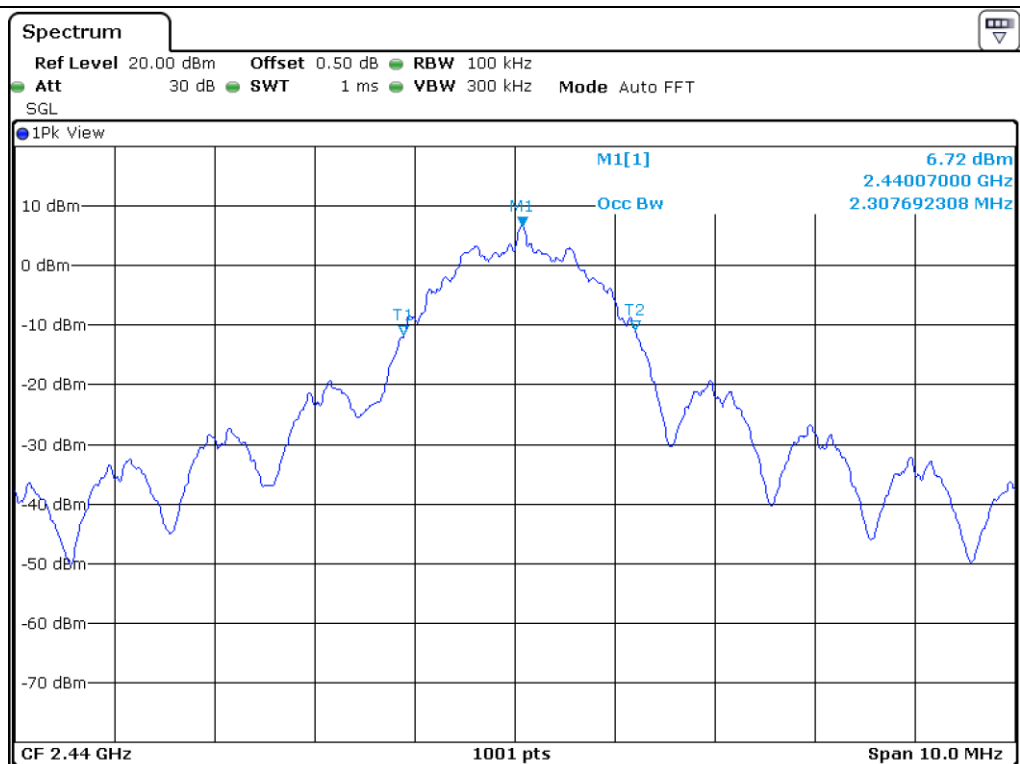
5.3 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting is programmed. For final testing, the EUT was set at 2 405 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.

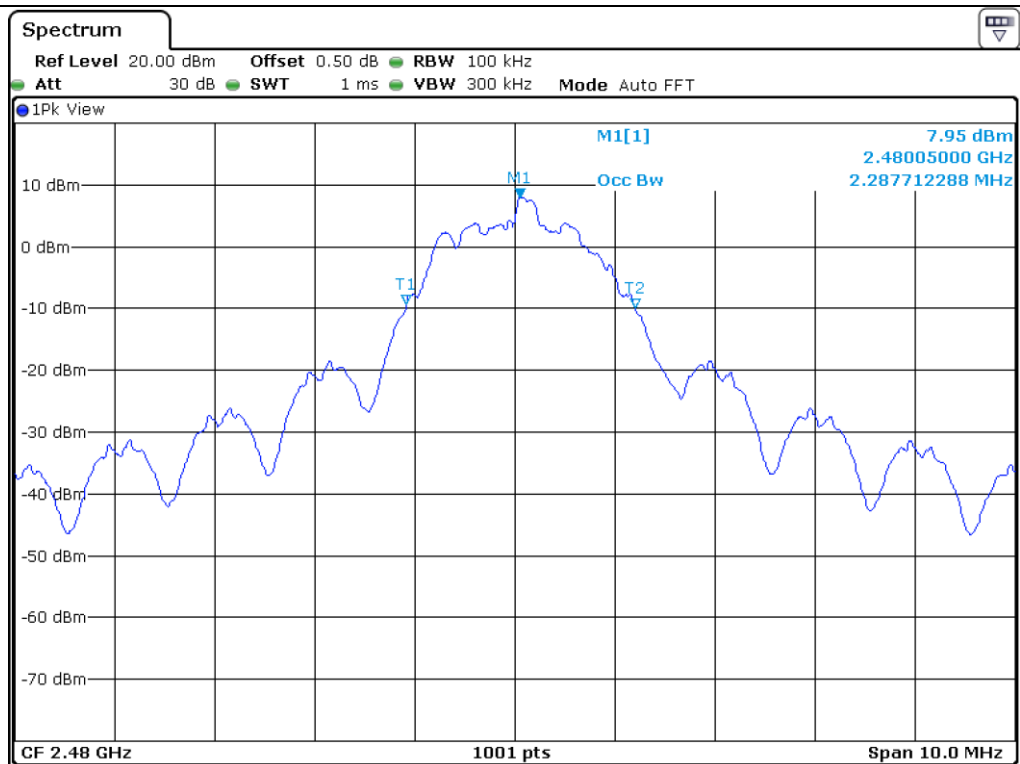
-. Occupied Bandwidth(99 %)

Modulation	CHANNEL	FREQUENCY (MHz)	Occupied Bandwidth(MHz)
Zigbee	Low	2 405	2.30
	Middle	2 440	2.31
	High	2 480	2.29





Middle Channel



High Channel

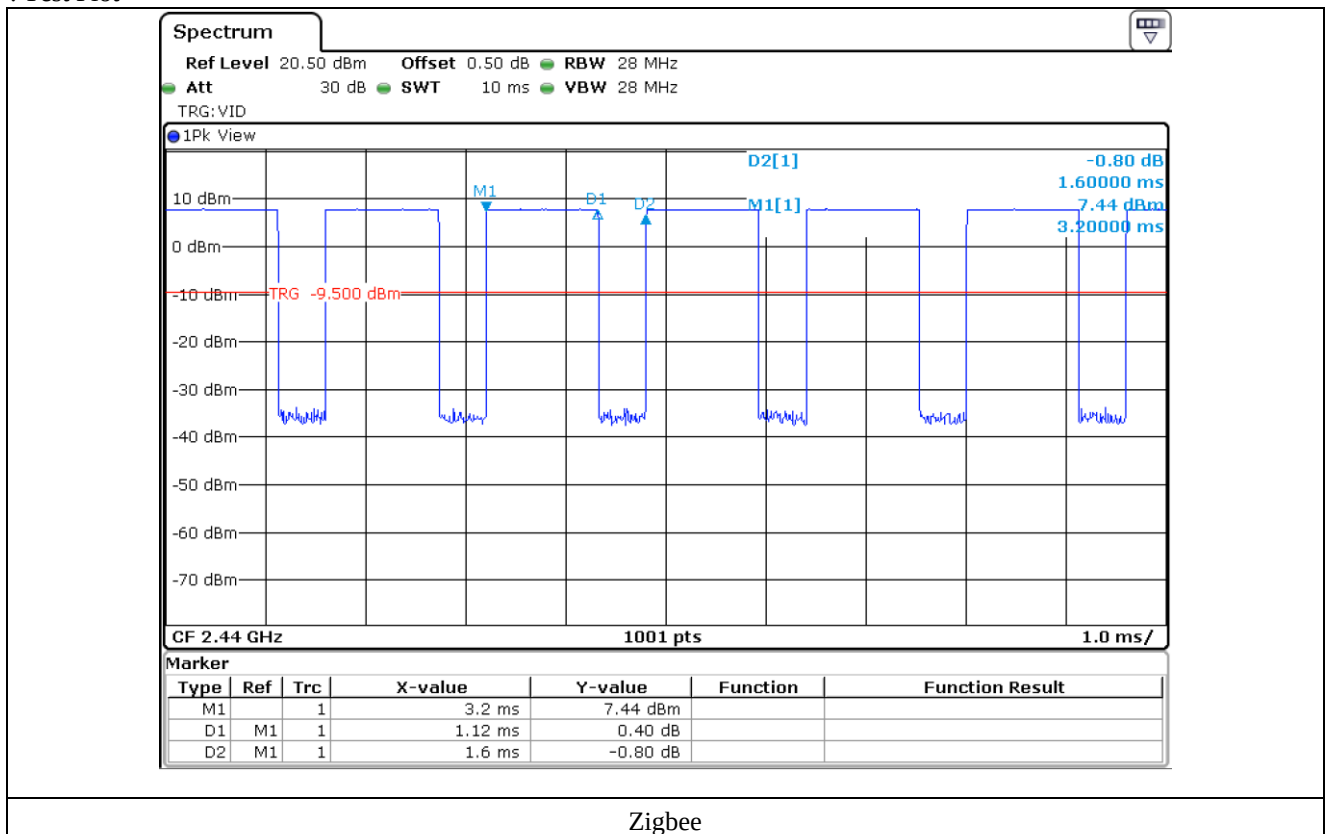
-. Duty Cycle

Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
Zigbee	1.12	0.48	70.00	1.55

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: The EUT was connected to Jig Board 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 PCB 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 Test, 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 Test, the following operating mode was investigated.

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

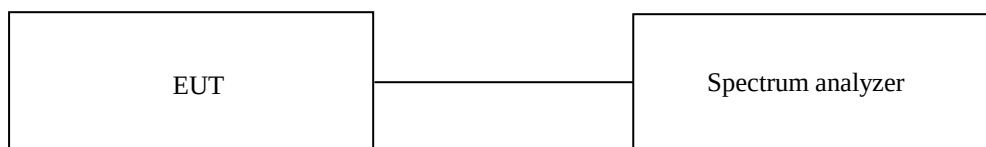
7. MINIMUM 6 dB BANDWIDTH

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. 11, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

7.4 Test data

-. Test Date : June 05, 2019 ~ June 11, 2019

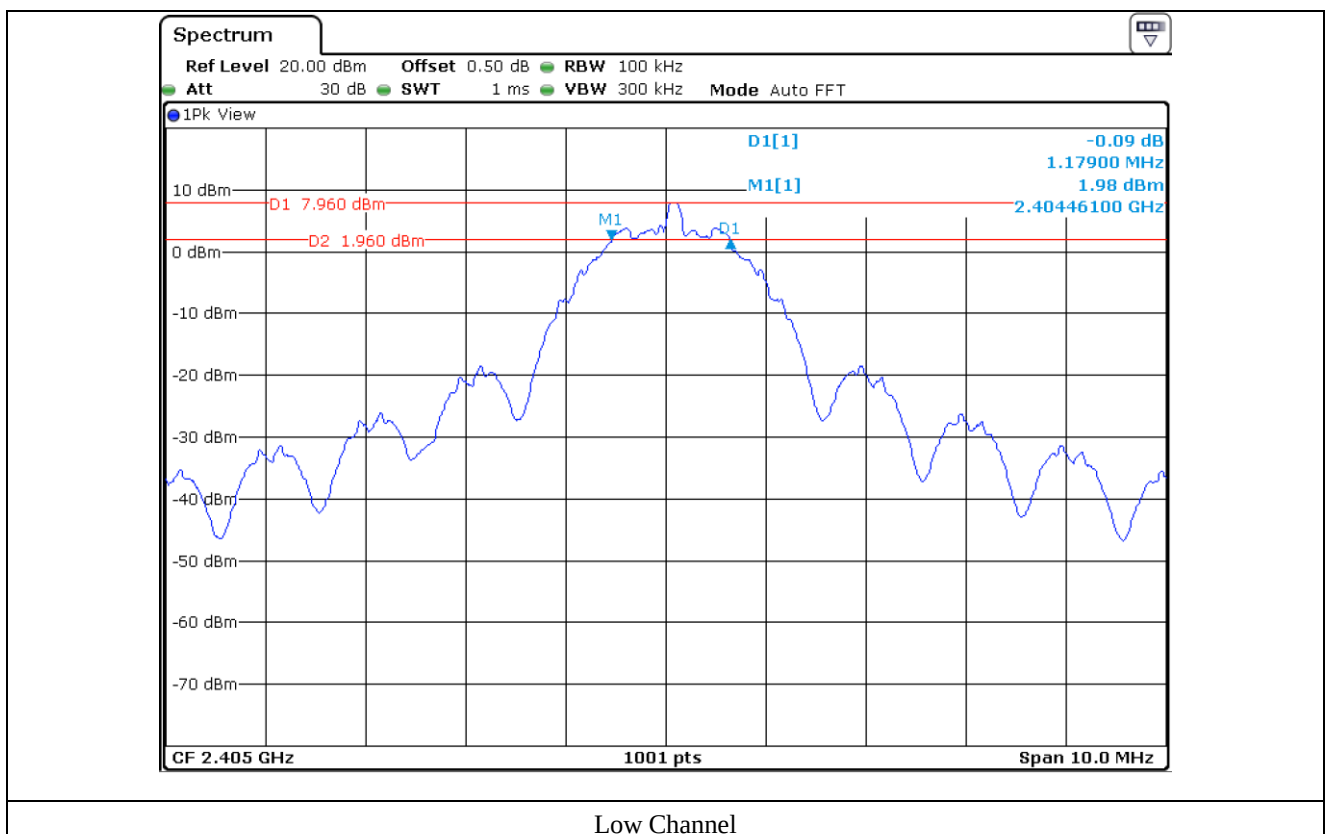
-. Test Result : Pass

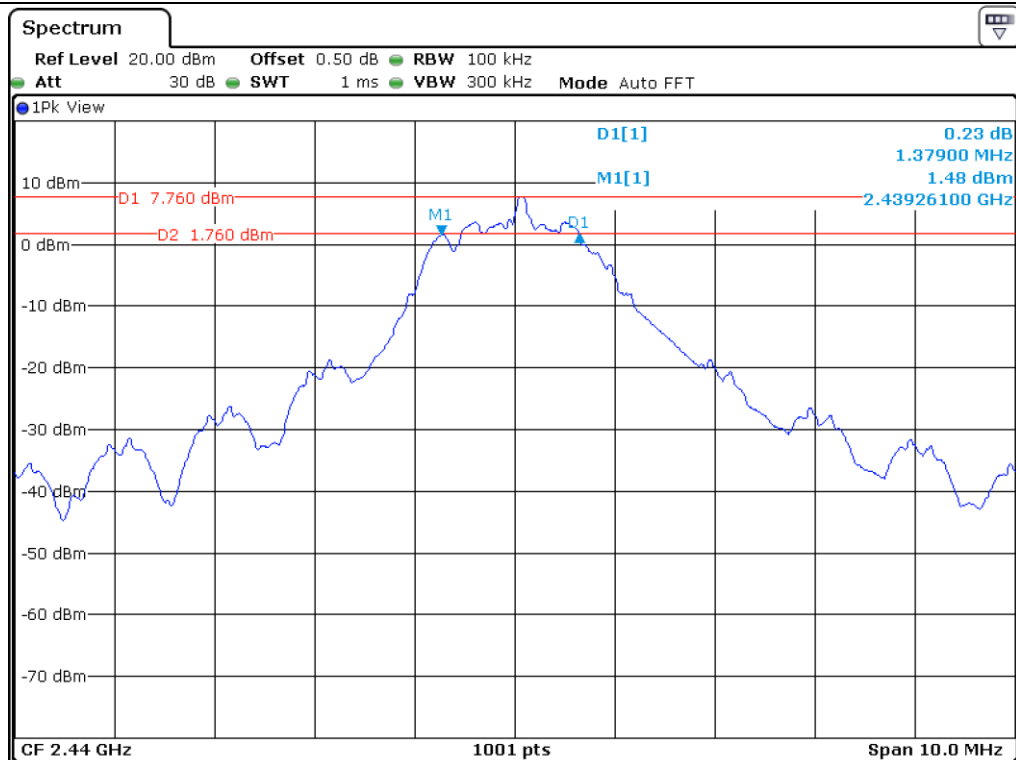
CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (MHz)	LIMIT (MHz)	Margin (MHz)
LOW	2 405.00	1.18	0.50	0.68
MIDDLE	2 440.00	1.38	0.50	0.88
HIGH	2 480.00	1.39	0.50	0.89

Remark. Margin = Measured Value - Limit

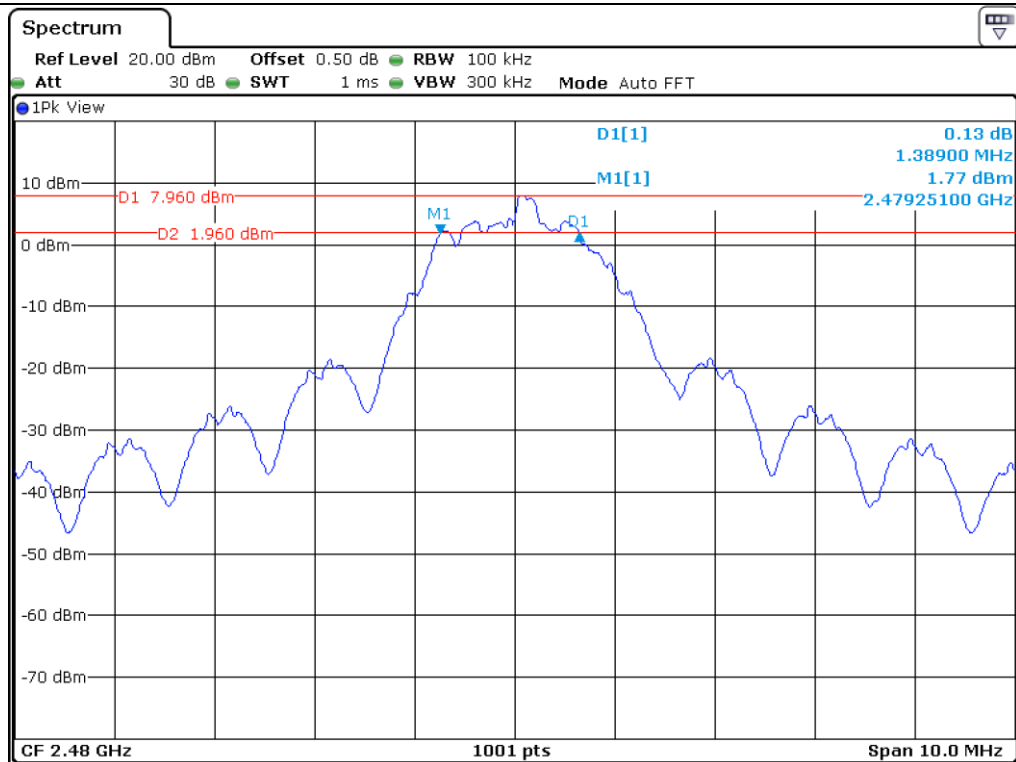


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

8. MAXIMUM PEAK OUTPUT POWER

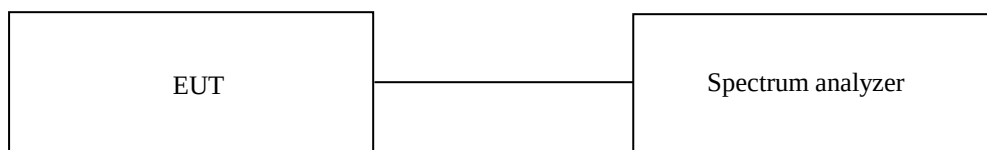
8.1 Operating environment

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.

Uses trace averaging across ON and OFF times of the EUT transmissions, followed by duty cycle correction.



8.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 11, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

8.4 Test data

-. Test Date : June 05, 2019 ~ June 11, 2019

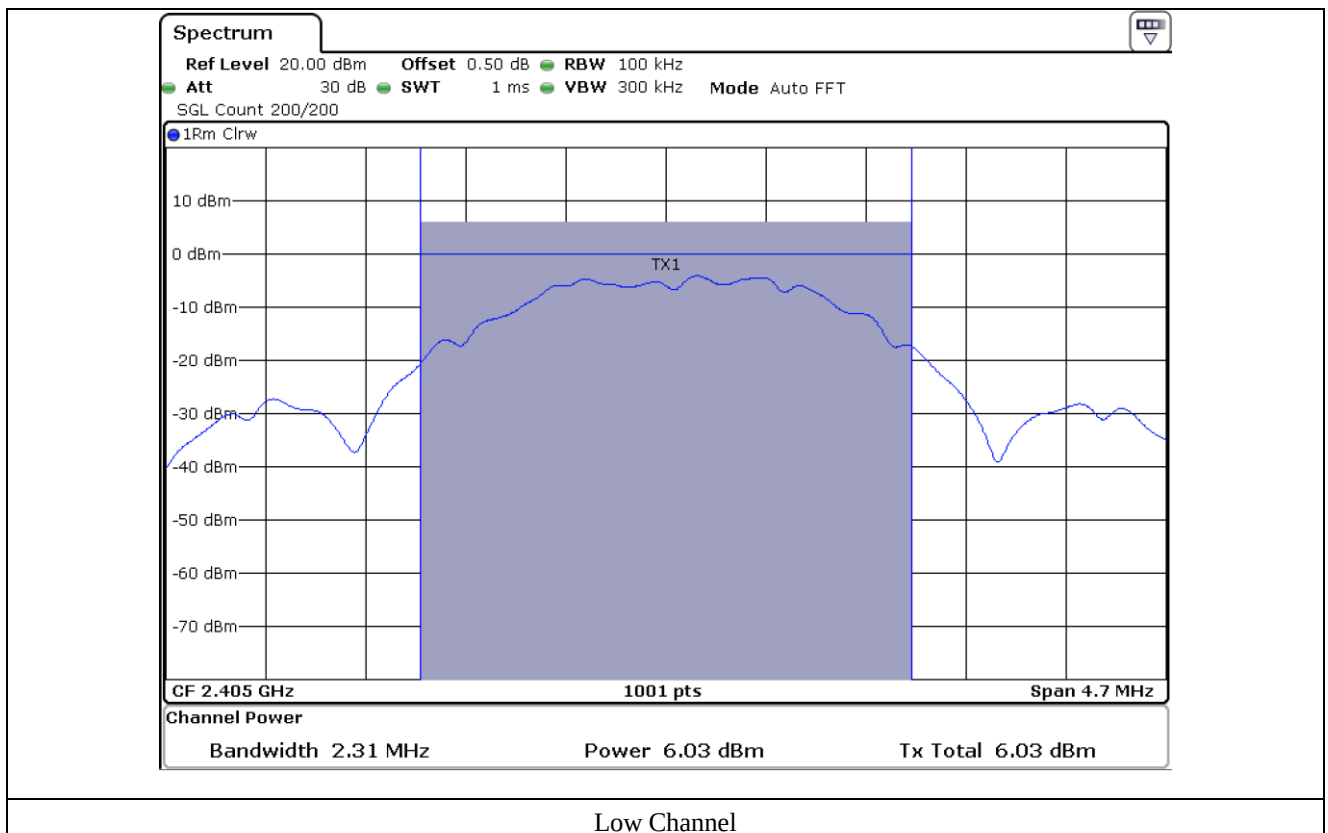
-. Test Result : Pass

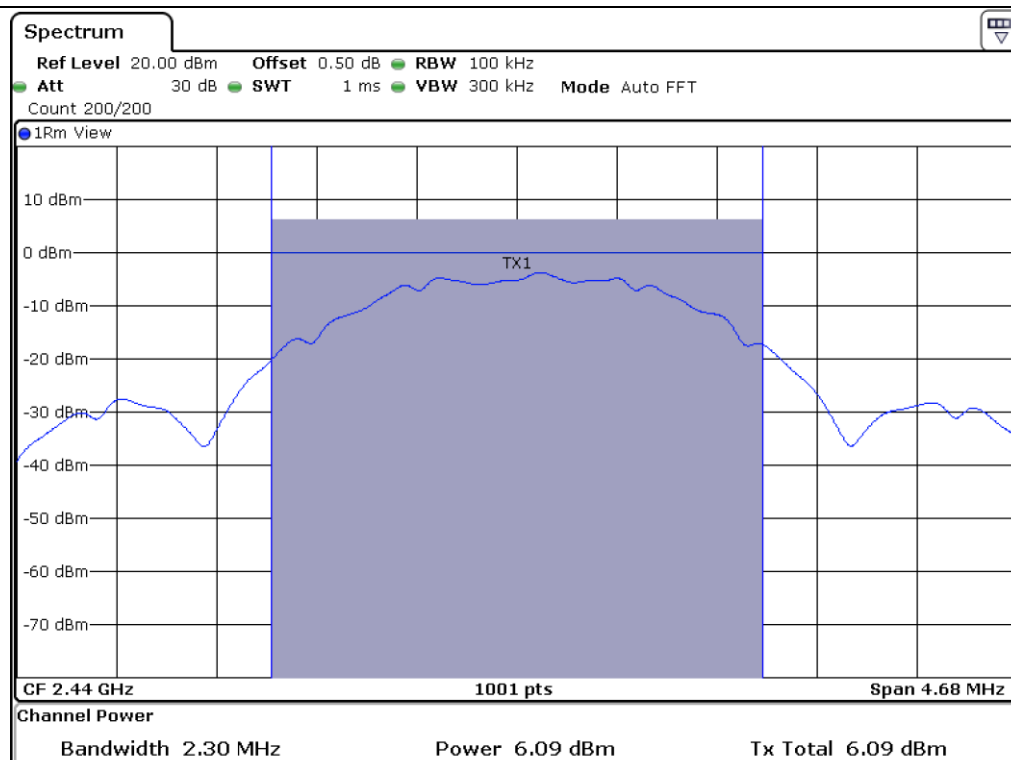
-. Duty Cycle : 70.00 %

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	CORRECTION FACTOR (dB)	RESULT (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 405.00	6.03	1.55	7.58	30.00	22.42
MIDDLE	2 440.00	6.09	1.55	7.64	30.00	22.36
HIGH	2 480.00	6.84	1.55	8.39	30.00	21.61

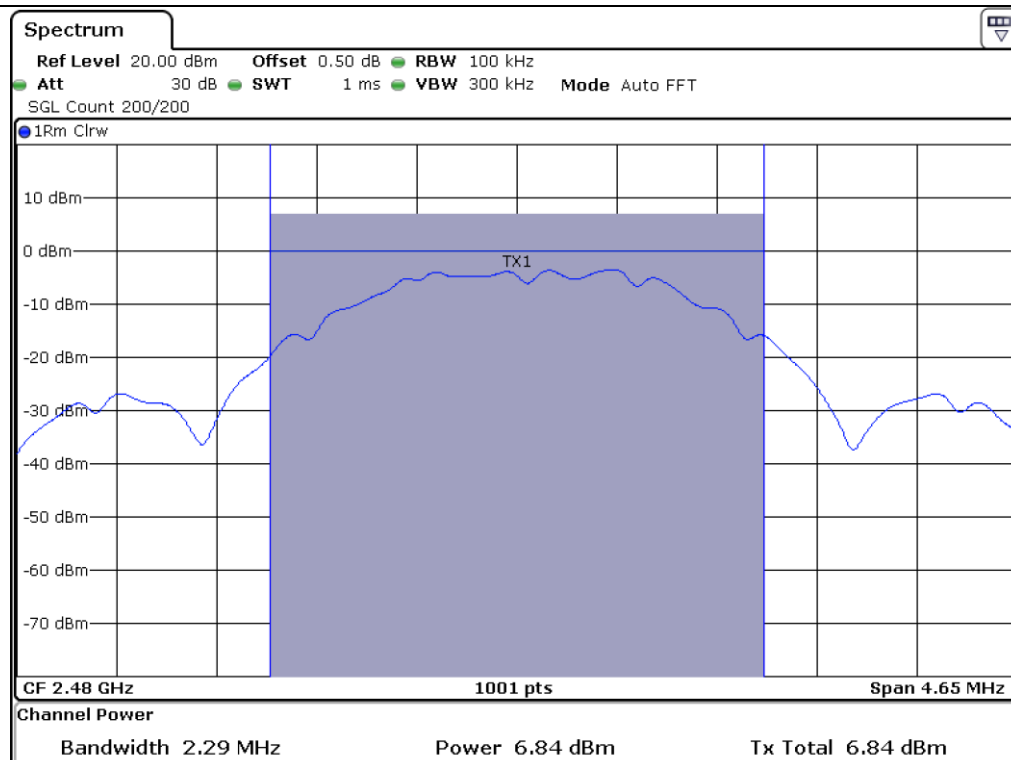
Remark : Margin = Limit – Result (= Measured Value + Correction Factor)

Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

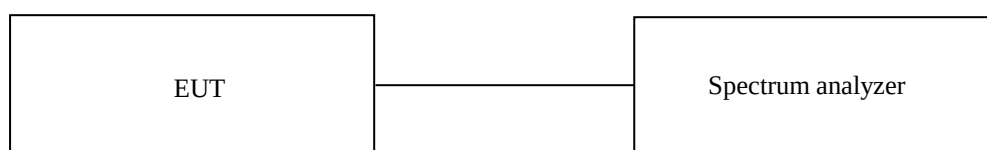
9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

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 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.

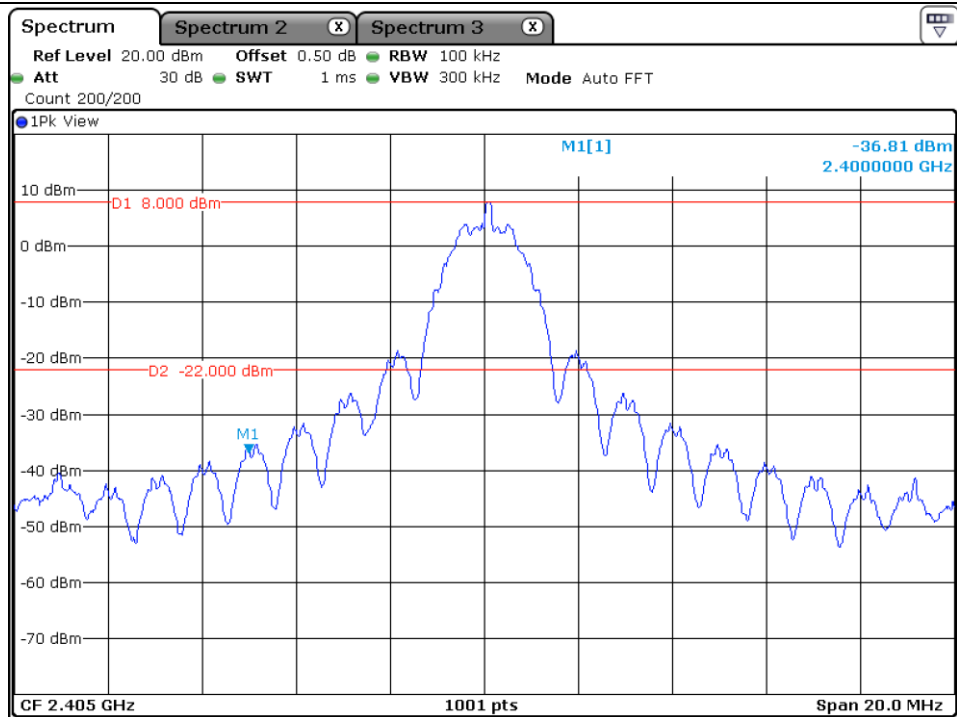
The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal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

9.4 Test equipment used

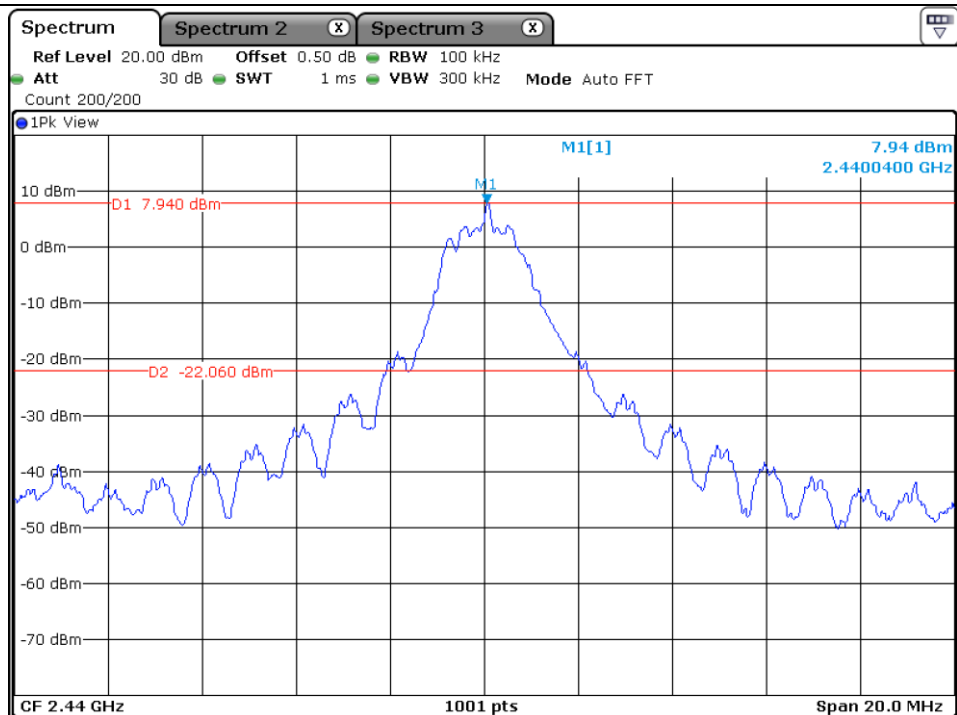
	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 11, 2019 (1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Mar. 28, 2019 (1Y)
■ -	310N	Sonoma Instrument	Pre-Amplifier	312545	Mar. 18, 2019 (1Y)
■ -	BBV9718	Schwarzbeck	Amplifier	310	Mar. 28, 2019 (1Y)
■	SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Mar. 11, 2019 (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)
■ -	BBHA 9120D	Schwarzbeck	Horn Antenna	9120D-1366	Aug. 02, 2017 (2Y)
■ -	BBHA 9170	Schwarzbeck	Horn Antenna	BBHA9170179	Jan. 16, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

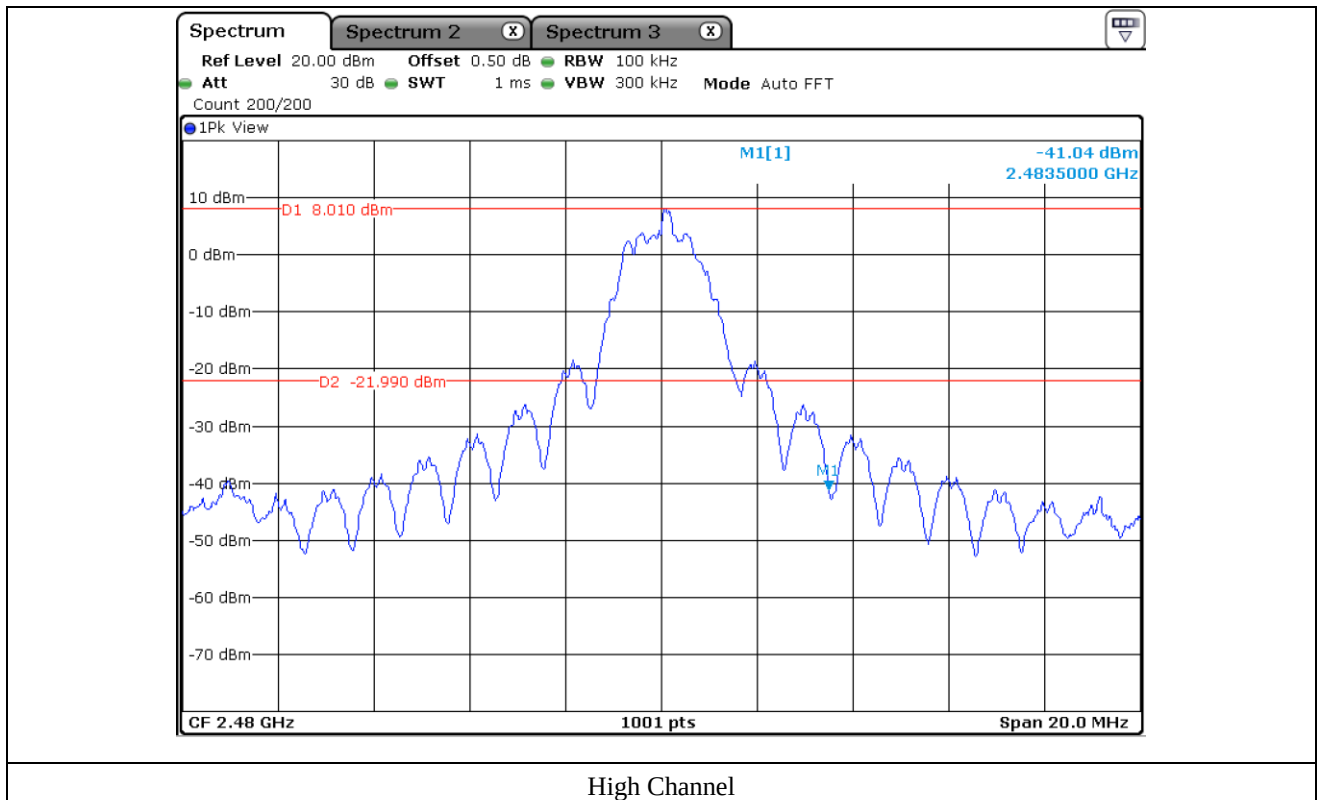
9.5 Test data for conducted emission

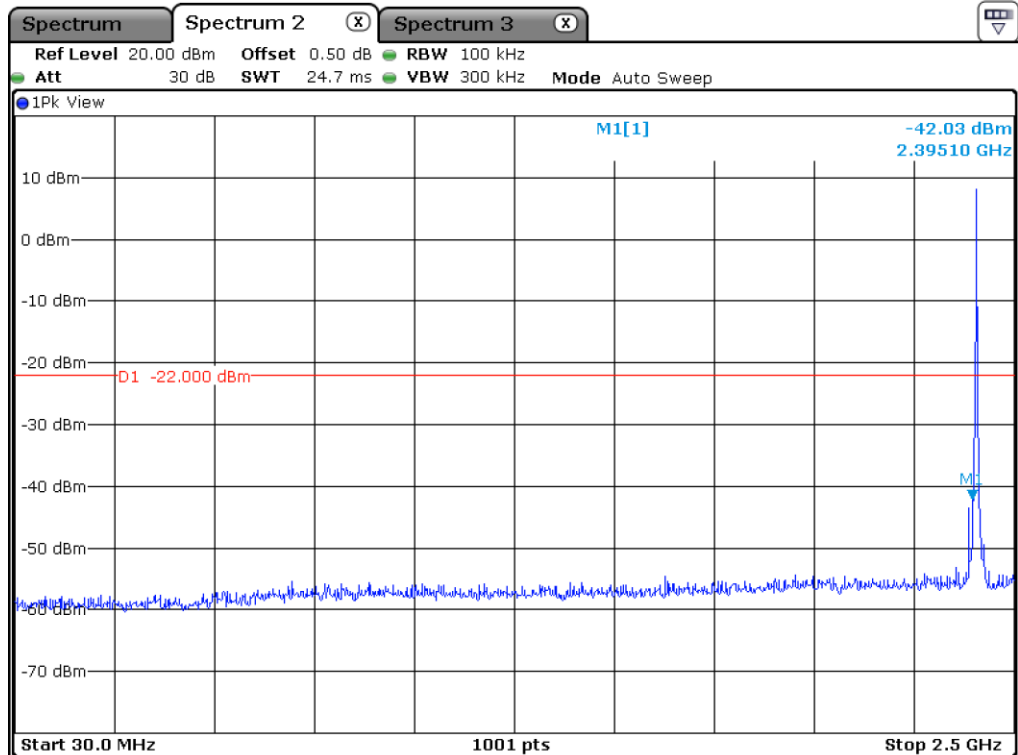


Low Channel

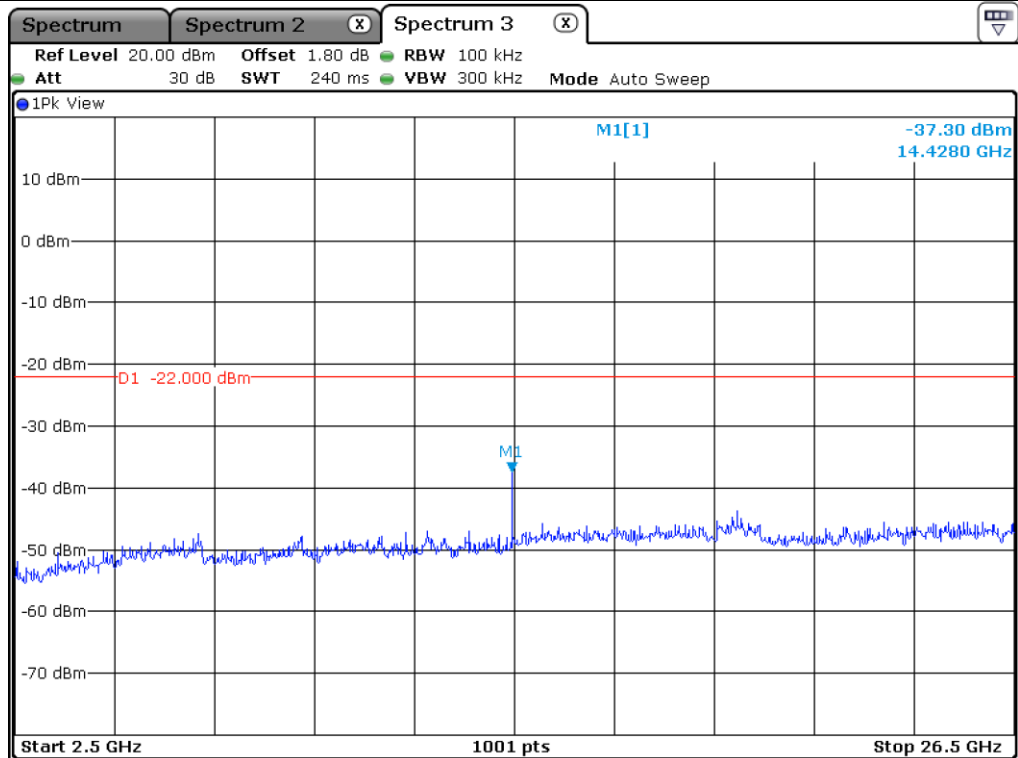


Middle Channel

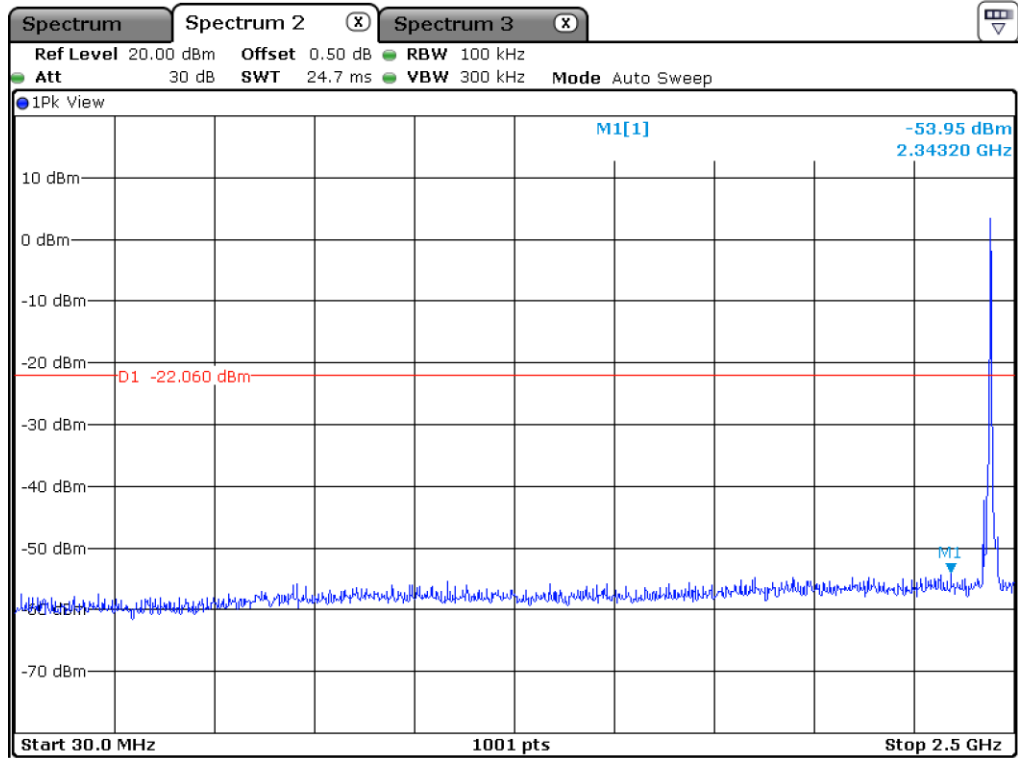




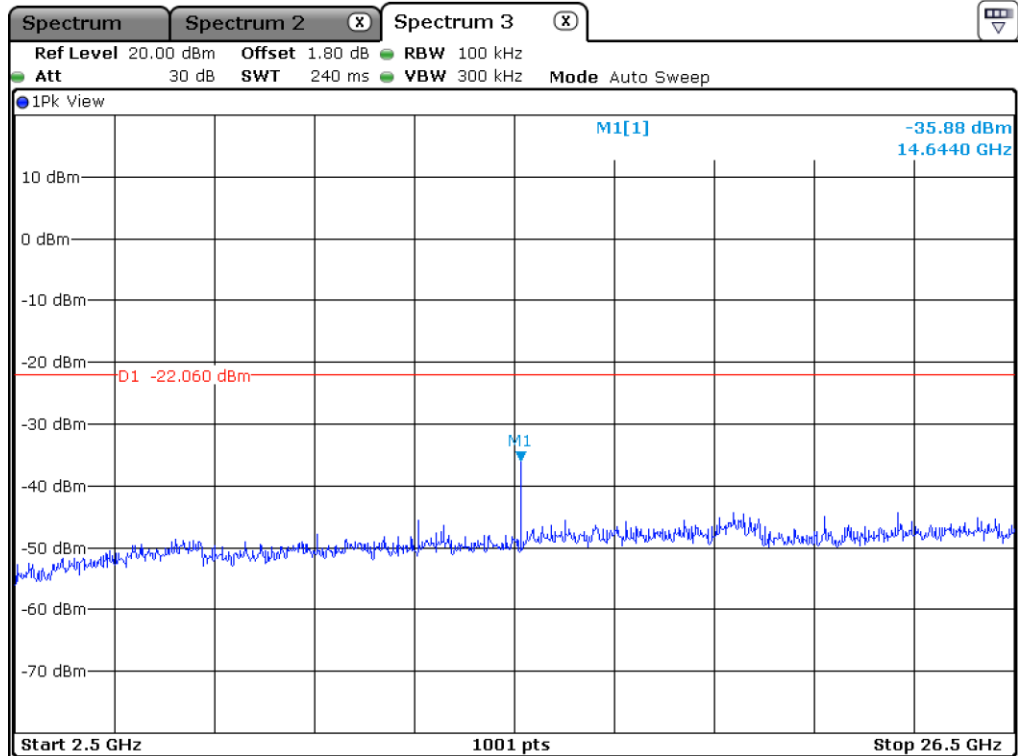
Low Channel



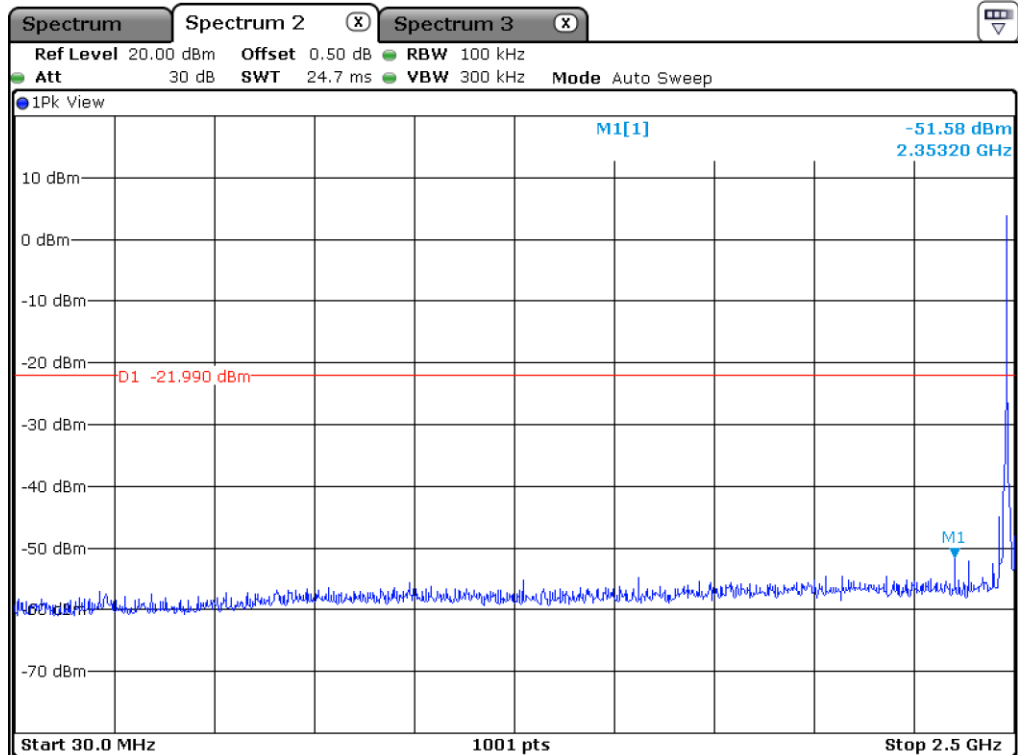
Low Channel



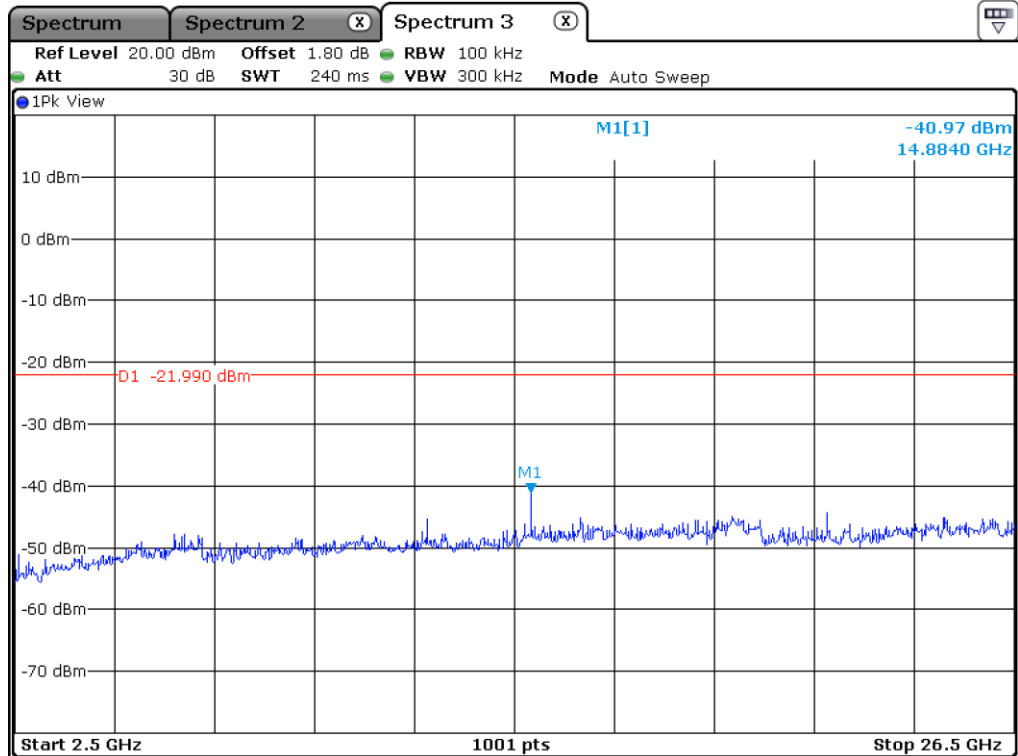
Middle Channel



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 : June 05, 2019 ~ June 11, 2019
- . Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Measurement distance : 3 m
- . Duty Cycle : 70.00 %
- . Result : PASSED

Frequency (MHz)	Reading (dB μ V)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Test Data for Low Channel Edge									
2 388.578	16.82	Peak	H	26.94	4.75	-	48.51	74.00	25.49
2 389.997	11.64	Average	H	26.94	4.75	1.55	44.88	54.00	9.12
2 387.674	20.26	Peak	V	26.94	4.75	-	51.95	74.00	22.05
2 389.997	9.89	Average	V	26.94	4.75	1.55	43.13	54.00	10.87
Test Data for Low Channel									
2 368.462	24.55	Peak	H	26.94	4.75	-	56.24	74.00	17.76
2 386.346	14.45	Average	H	26.94	4.75	1.55	47.69	54.00	6.31
2 383.247	22.18	Peak	V	26.94	4.75	-	53.87	74.00	20.13
2 389.960	10.48	Average	V	26.94	4.75	1.55	43.72	54.00	10.28

Test Data for High Channel									
2 483.508	22.45	Peak	H	27.47	4.39	-	54.31	74.00	19.69
2 483.508	18.00	Average	H	27.47	4.39	1.55	51.41	54.00	2.59
2 483.508	19.19	Peak	V	27.47	4.39	-	51.05	74.00	22.95
2 483.508	13.98	Average	V	27.47	4.39	1.55	47.39	54.00	6.61
Test Data for High Channel Edge									
2 483.502	21.55	Peak	H	27.47	4.39	-	53.41	74.00	20.59
2 483.502	17.94	Average	H	27.47	4.39	1.55	51.35	54.00	2.65
2 483.692	19.38	Peak	V	27.47	4.39	-	51.24	74.00	22.76
2 483.502	13.1	Average	V	27.47	4.39	1.55	46.51	54.00	7.49

Tabulated test data for Restricted Band

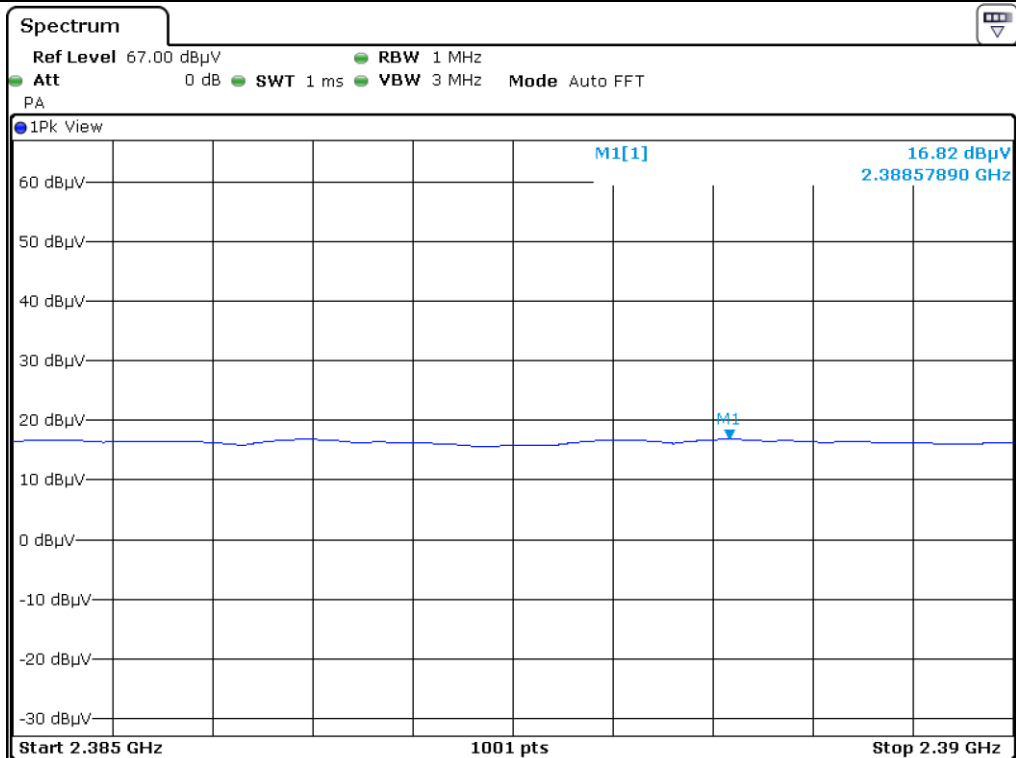
Remark: "H": Horizontal, "V": Vertical

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

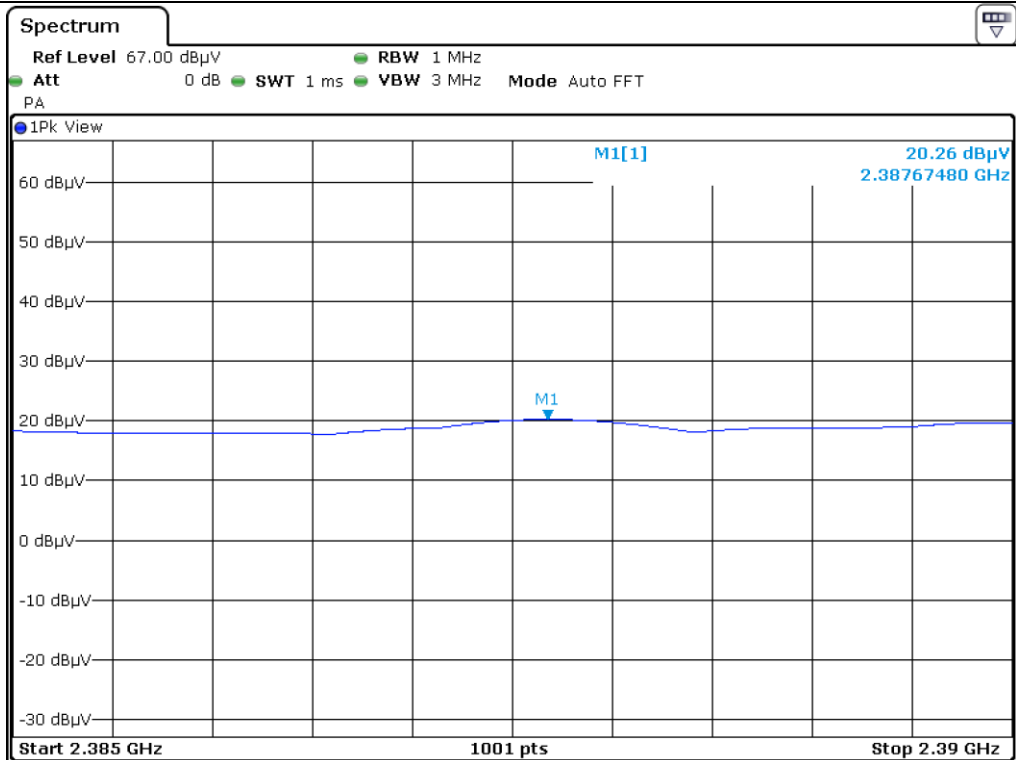
Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor



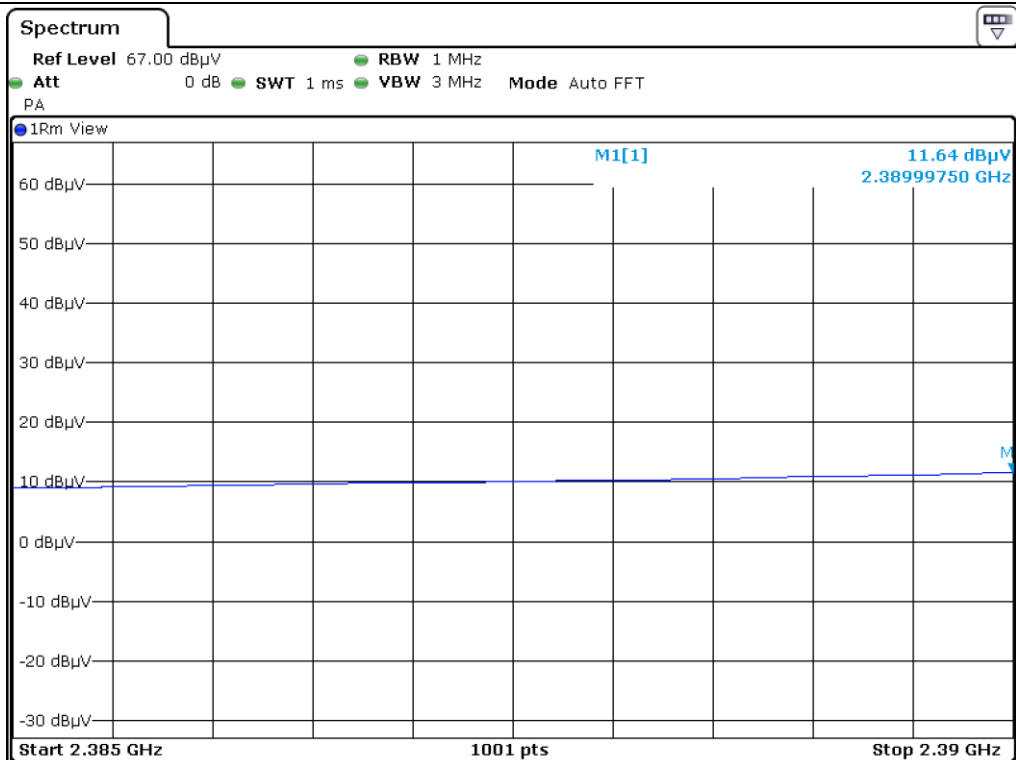
Tested by: Hyung-Kwon, Oh / Assistant Manager



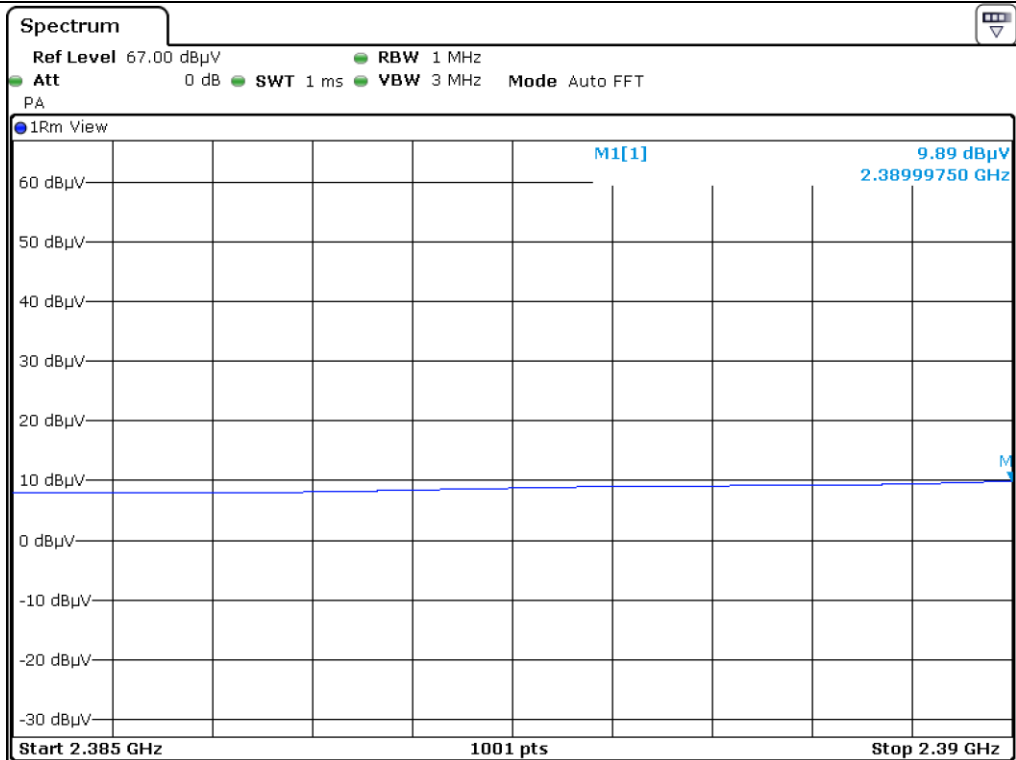
Low Channel Edge_Peak_H



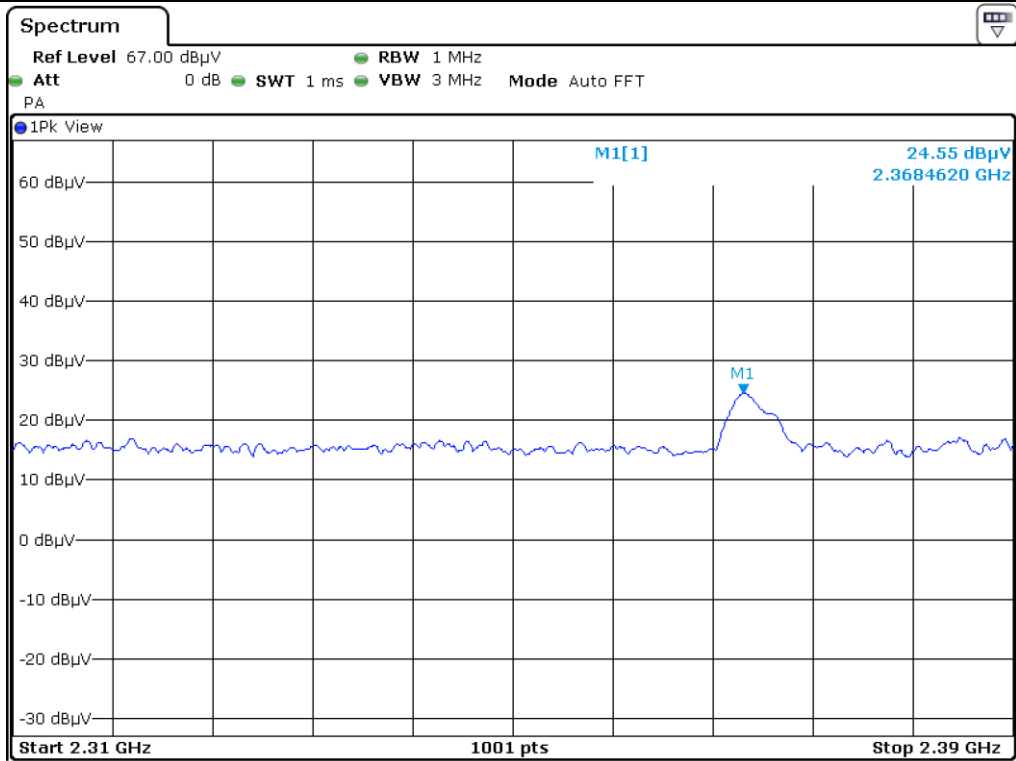
Low Channel Edge_Peak_V



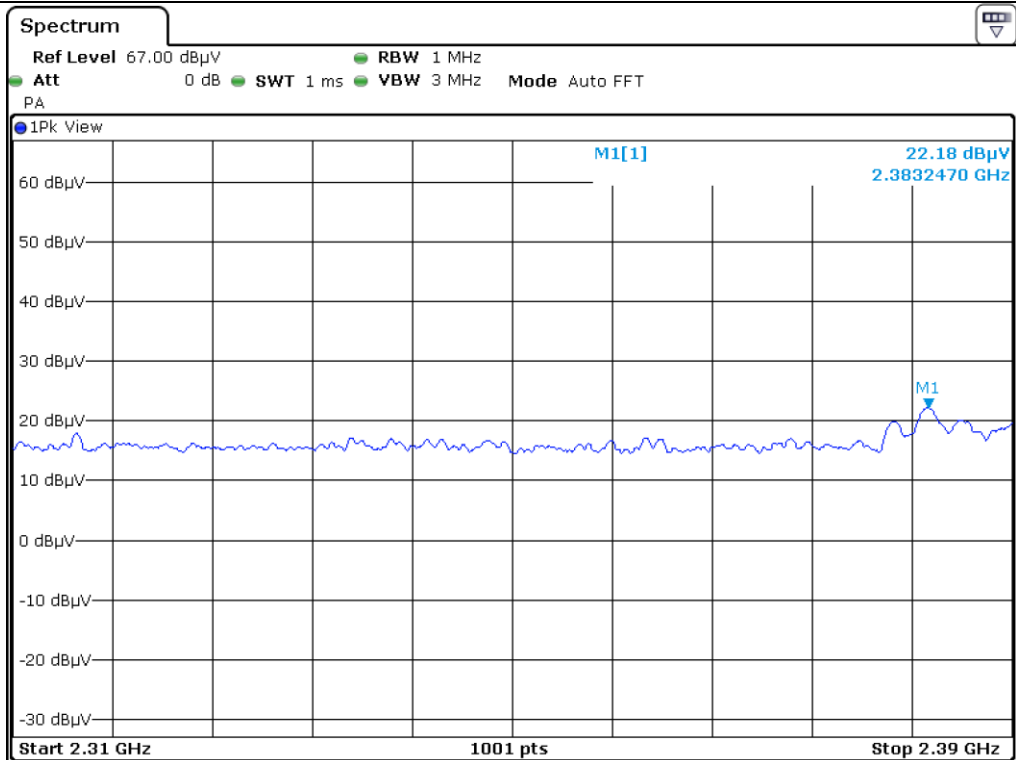
Low Channel Edge_Average_H



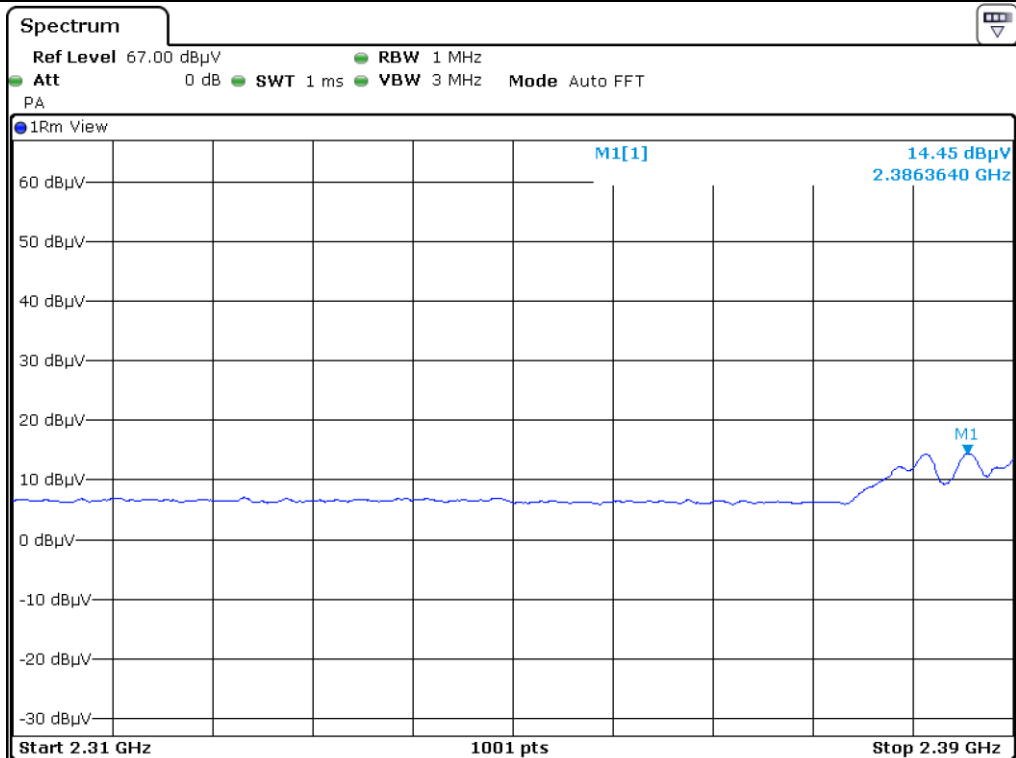
Low Channel Edge_Average_V



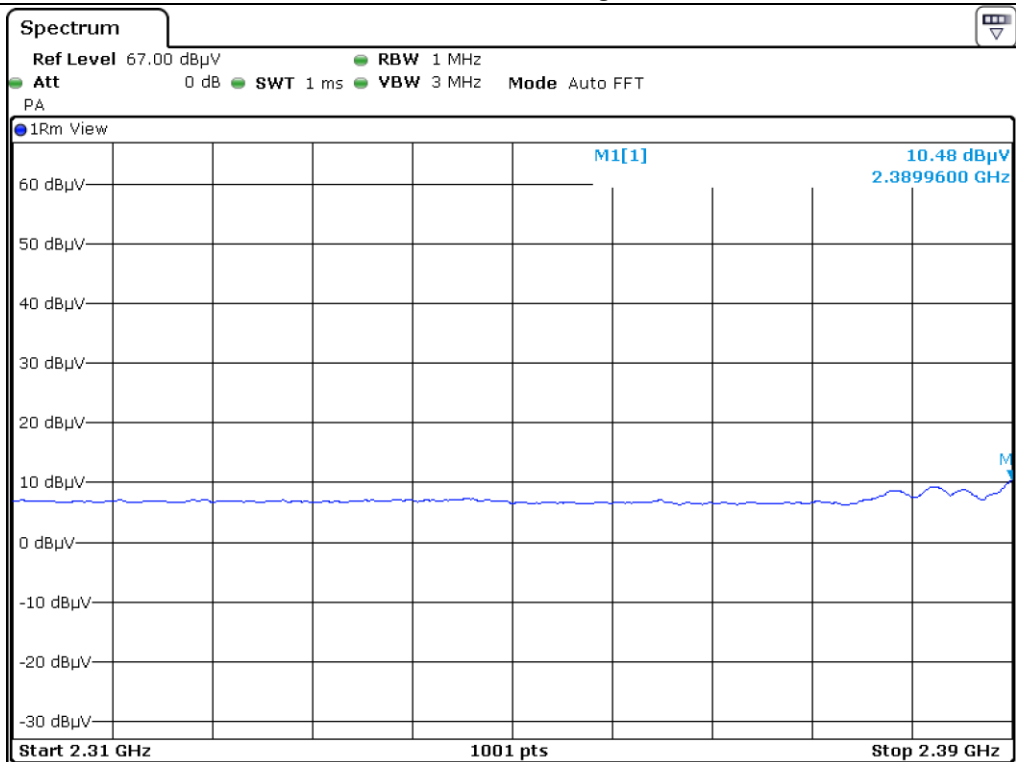
Low Channel_Peak_H



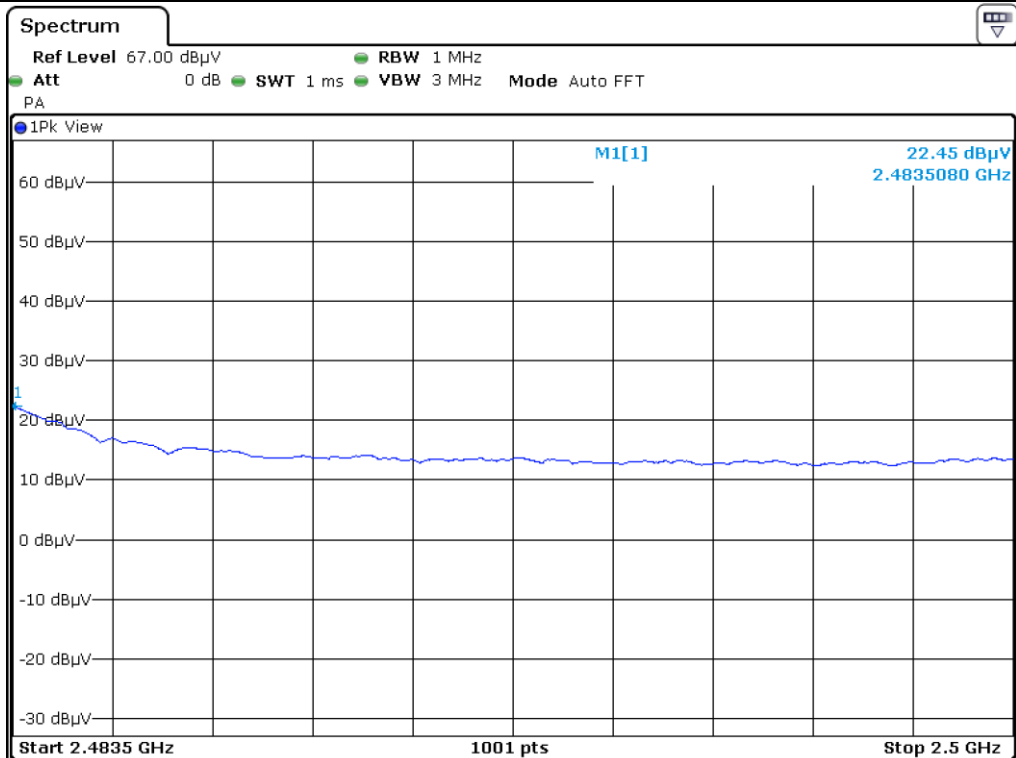
Low Channel_Peak_V



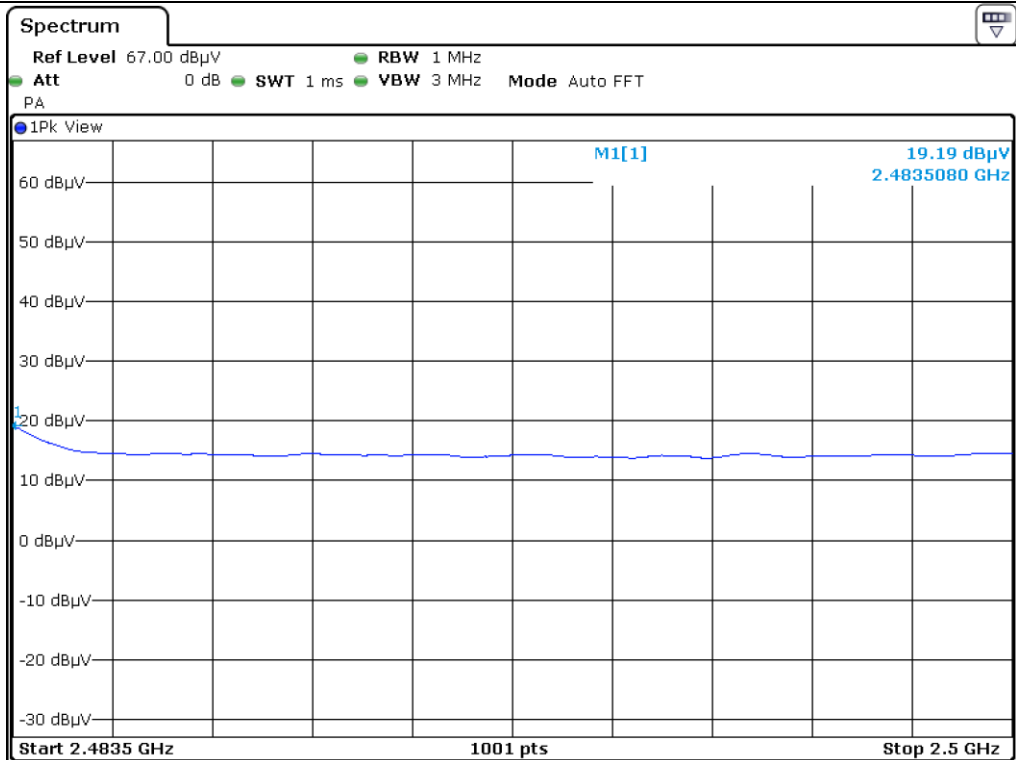
Low Channel_ Average_H



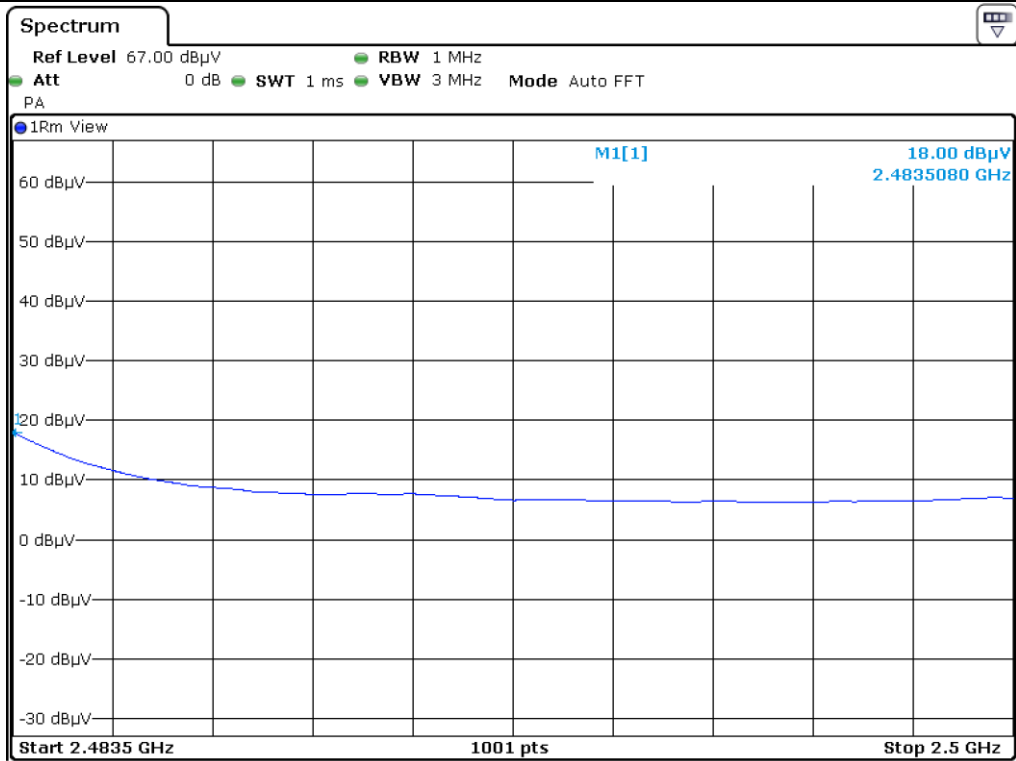
Low Channel_ Average_V



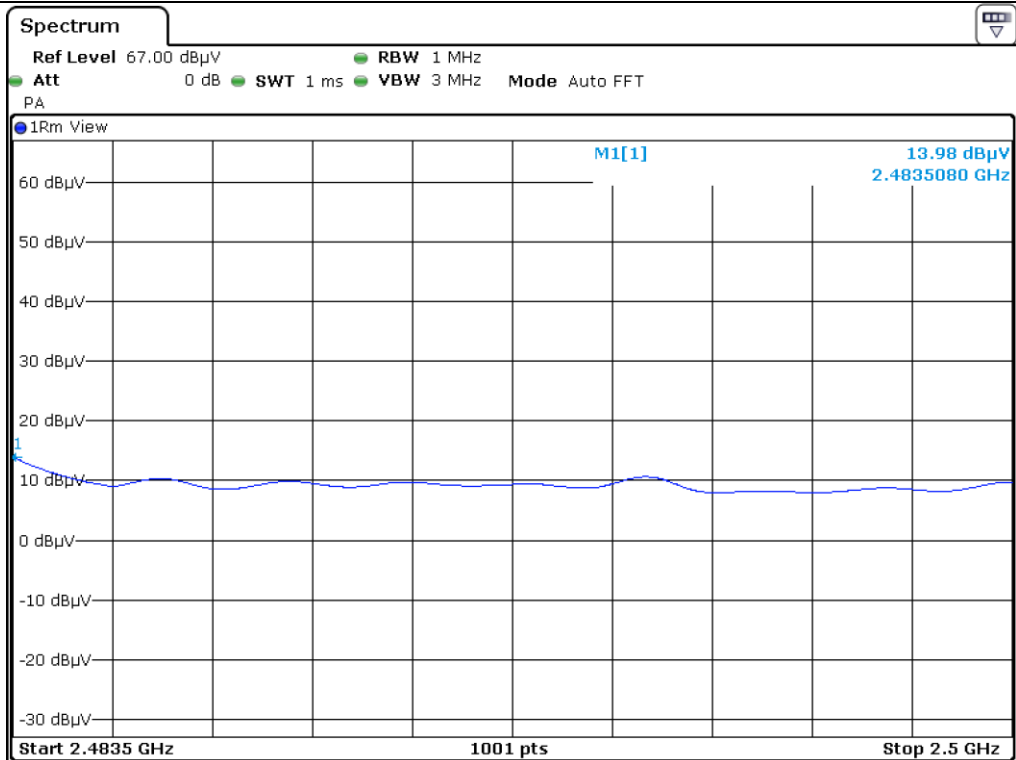
High Channel_Peak_H



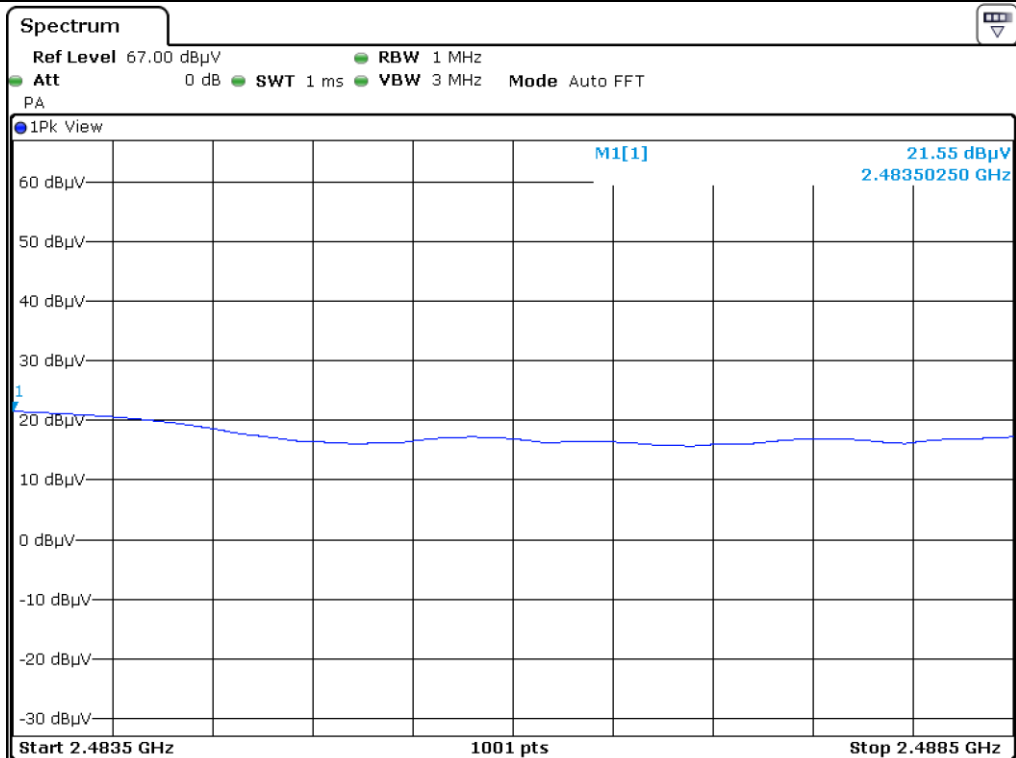
High Channel_Peak_V



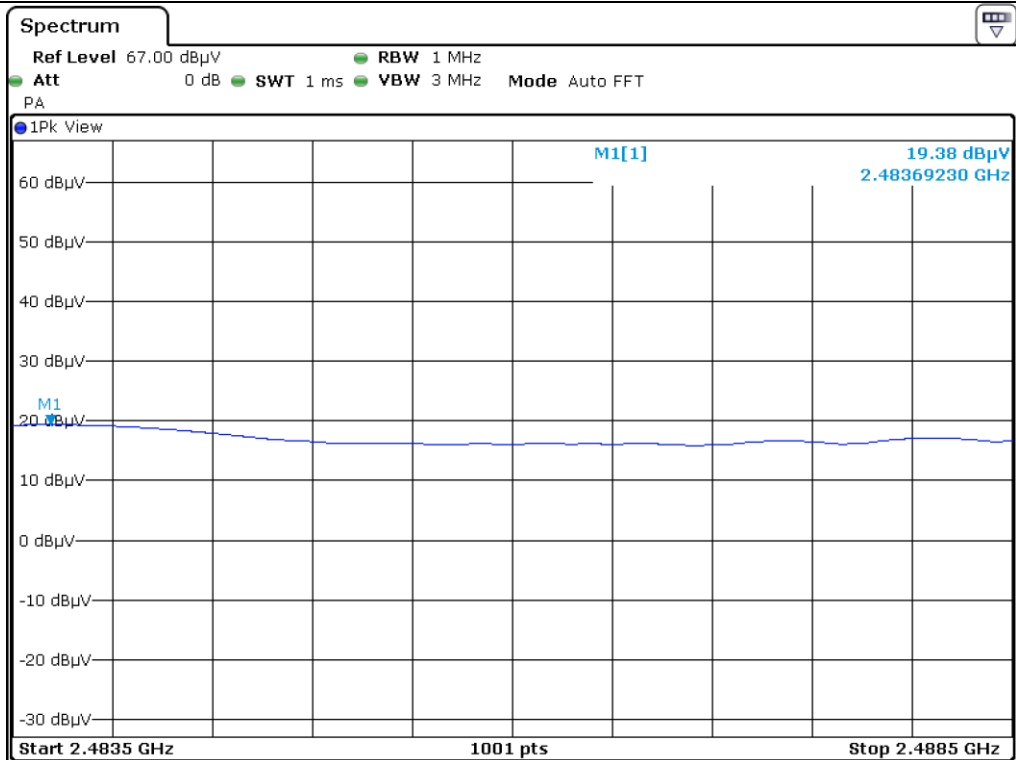
High Channel_Average_H



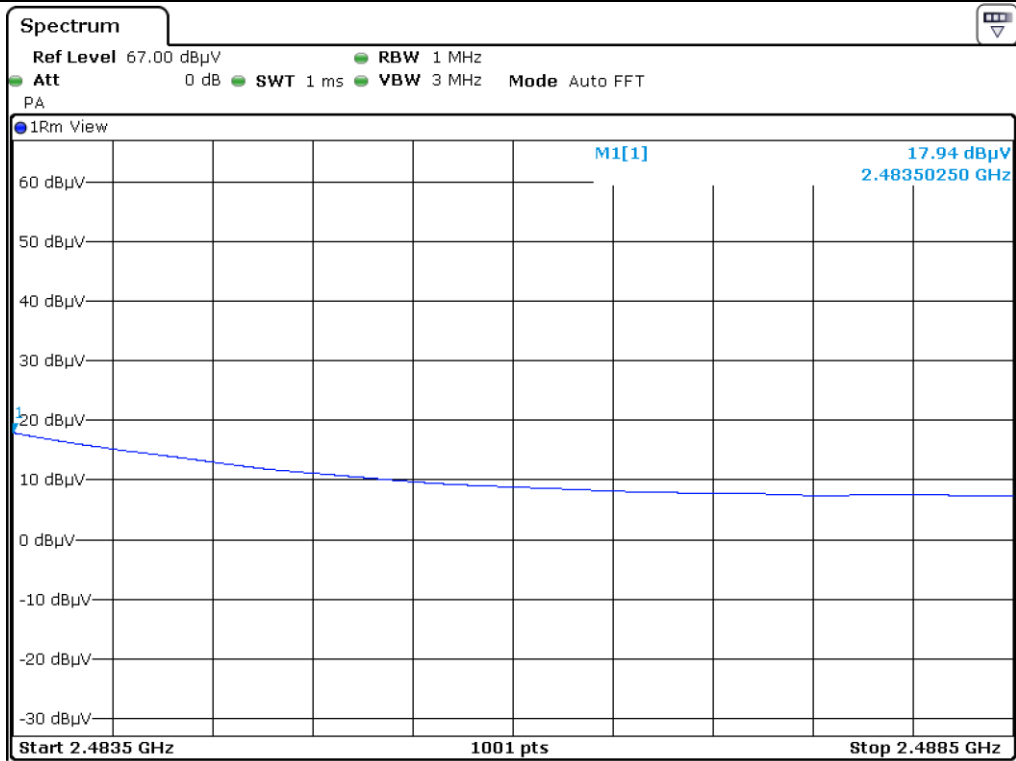
High Channel_Average_V



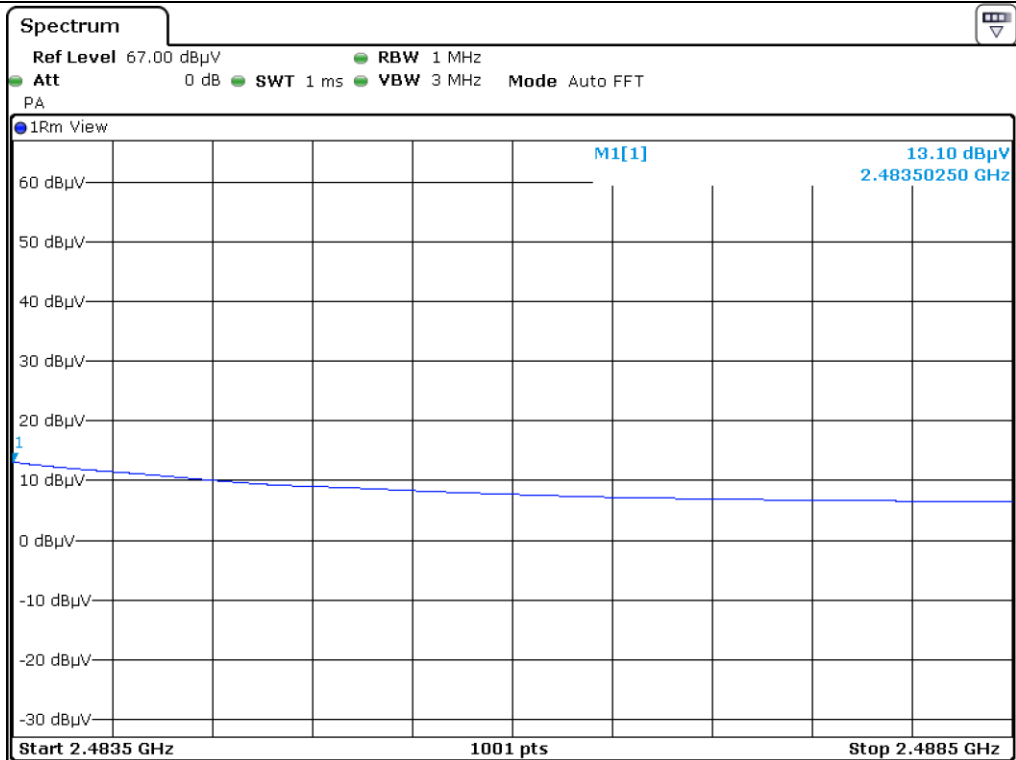
High Channel Edge_Peak_H



High Channel Edge_Peak_V



High Channel Edge_Average_H



High Channel Edge_Average_V

9.6.2 Spurious & Harmonic Radiated Emission

- Test Date : June 05, 2019 ~ June 11, 2019
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz 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
- Duty Cycle : 70.00 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 810.00	19.75	Peak	H	30.84	7.28	-	57.87	74.00	16.13
4 810.00	9.25	Average	H	30.84	7.28	1.55	48.92	54.00	5.08
4 810.00	20.84	Peak	V	30.84	7.28	-	58.96	74.00	15.04
4 810.00	9.14	Average	V	30.84	7.28	1.55	48.81	54.00	5.19
Test Data for Middle Channel									
4 880.00	19.50	Peak	H	30.01	7.42	-	56.93	74.00	17.07
4 880.00	8.67	Average	H	30.01	7.42	1.55	47.65	54.00	6.35
4 880.00	19.86	Peak	V	30.01	7.42	-	57.29	74.00	16.71
4 880.00	8.61	Average	V	30.01	7.42	1.55	47.59	54.00	6.41
Test Data for High Channel									
4 960.00	19.75	Peak	H	31.15	7.40	-	58.30	74.00	15.70
4 960.00	8.85	Average	H	31.15	7.40	1.55	48.95	54.00	5.05
4 960.00	19.87	Peak	V	31.15	7.40	-	58.42	74.00	15.58
4 960.00	8.81	Average	V	31.15	7.40	1.55	48.91	54.00	5.09

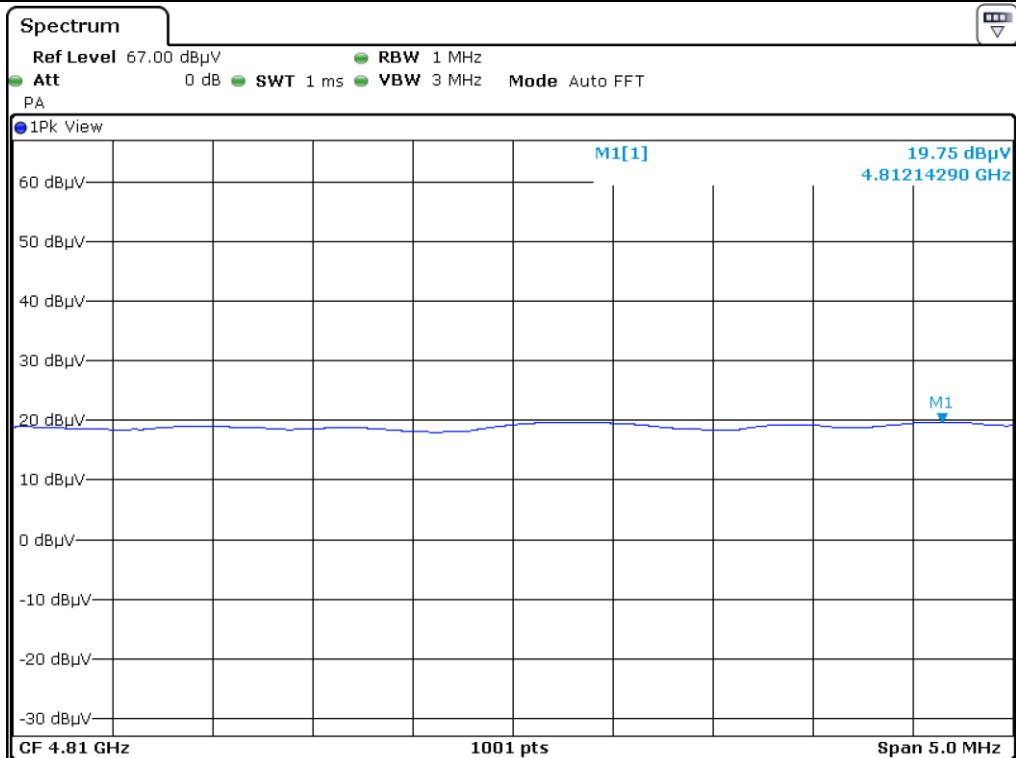
Tabulated test data for Restricted Band

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

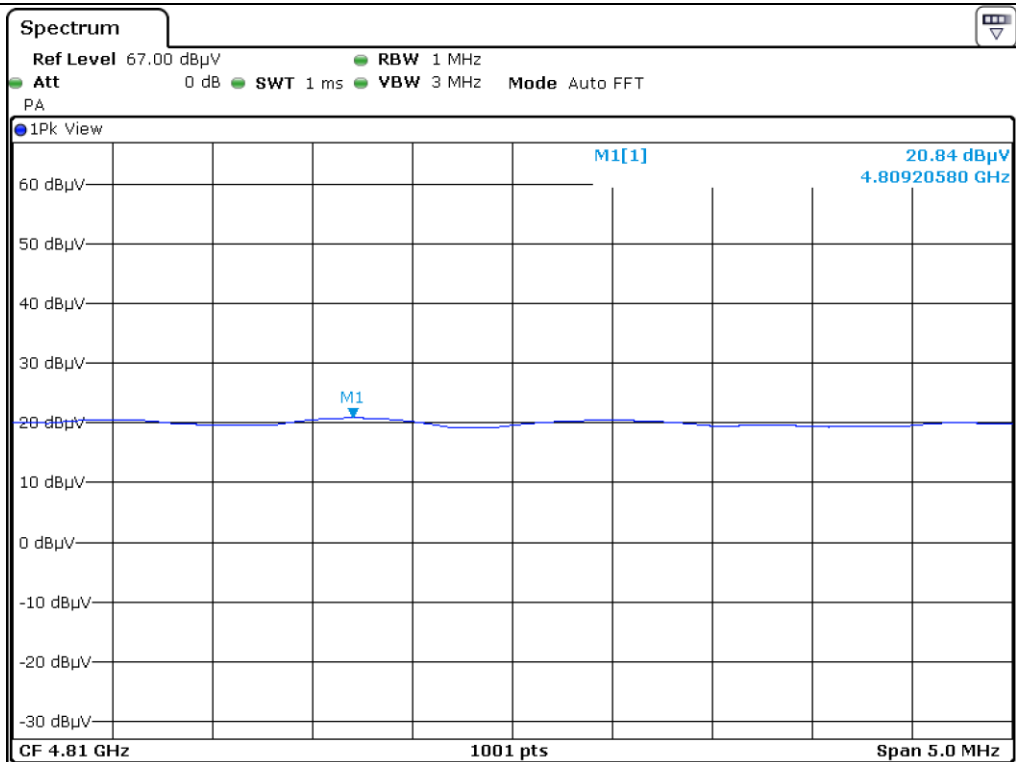
Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor

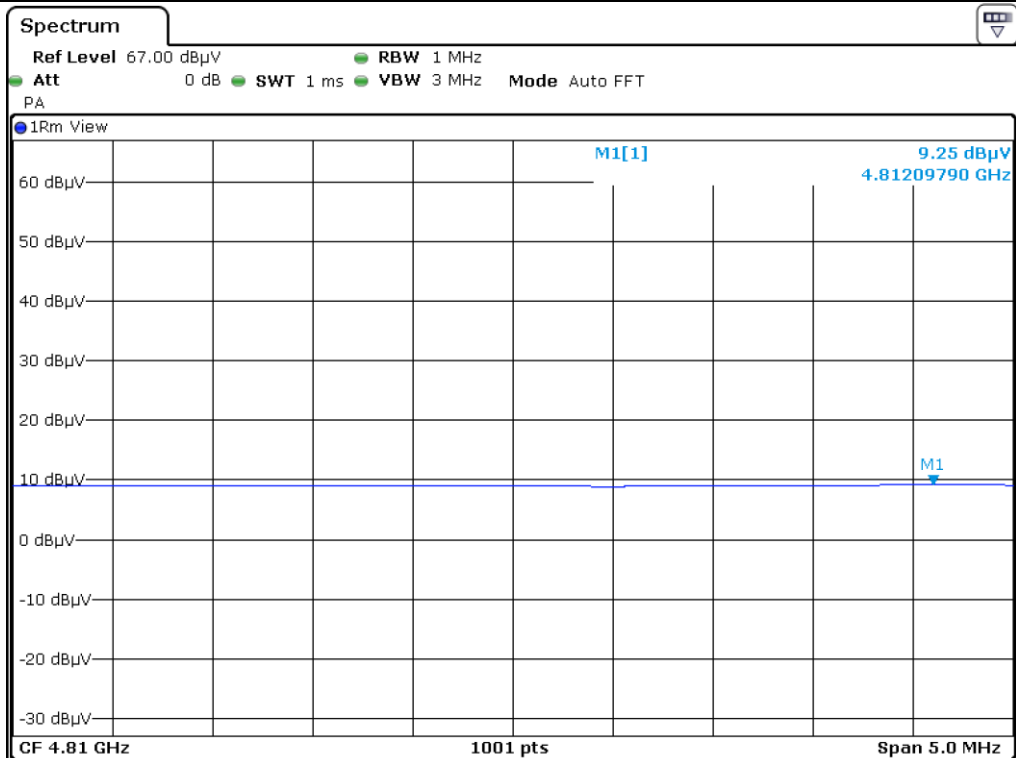
Tested by: Hyung-Kwon, Oh / Assistant Manager



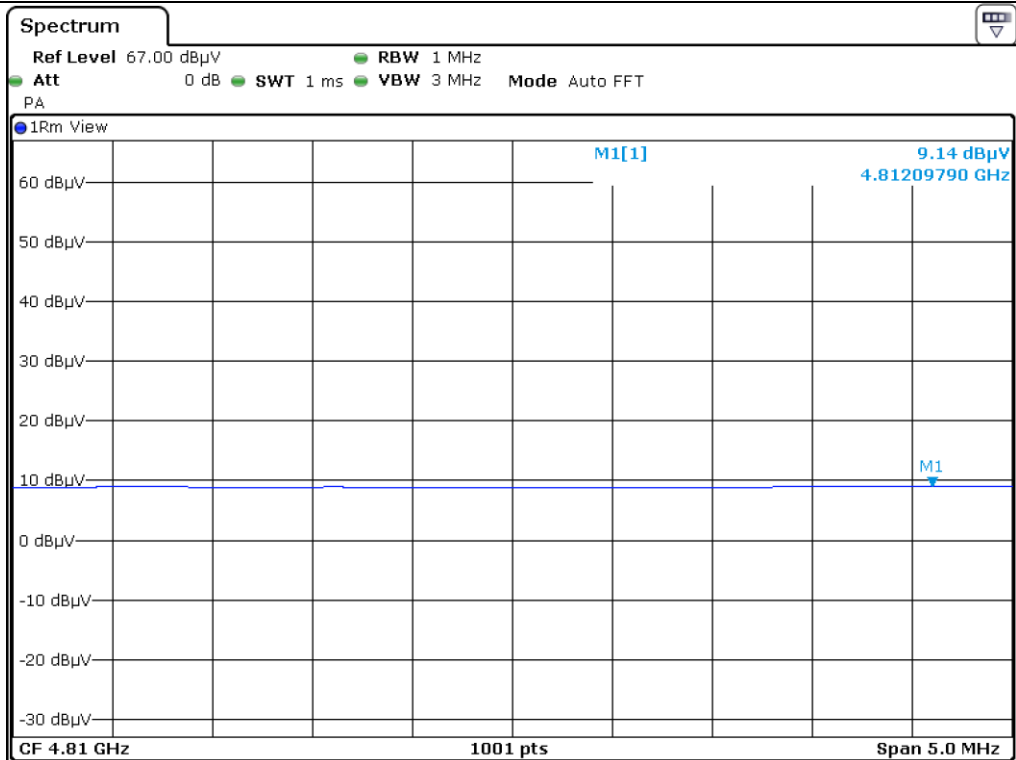
Low Channel_Peak_H



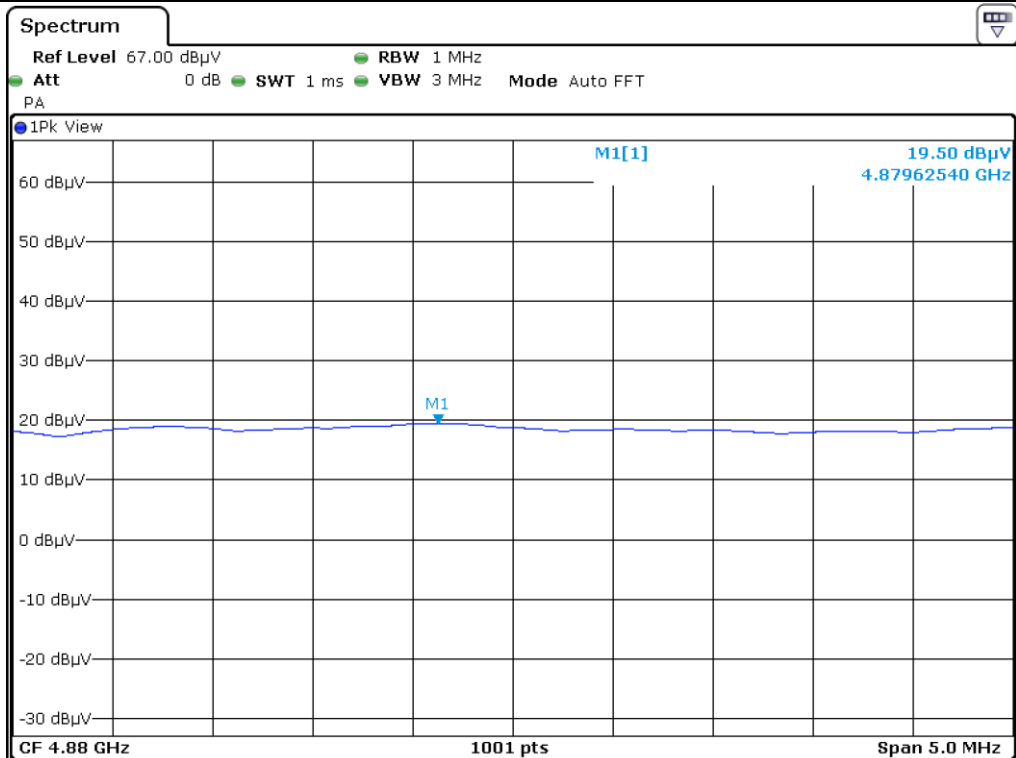
Low Channel_Peak_V



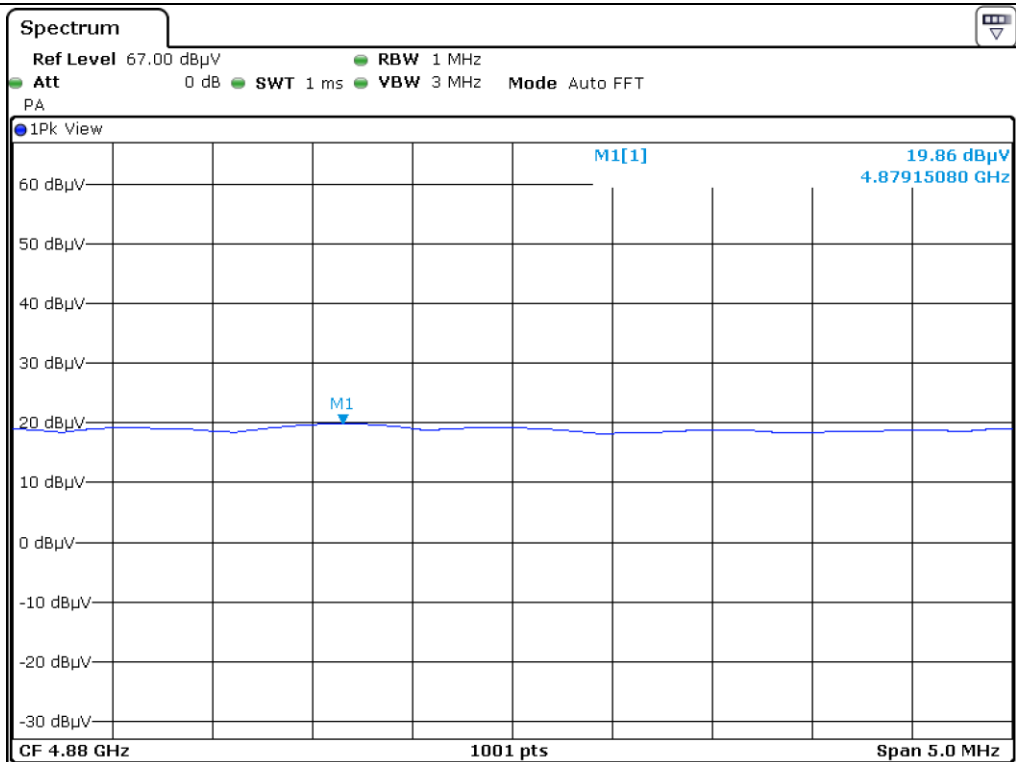
Low Channel_ Average_H



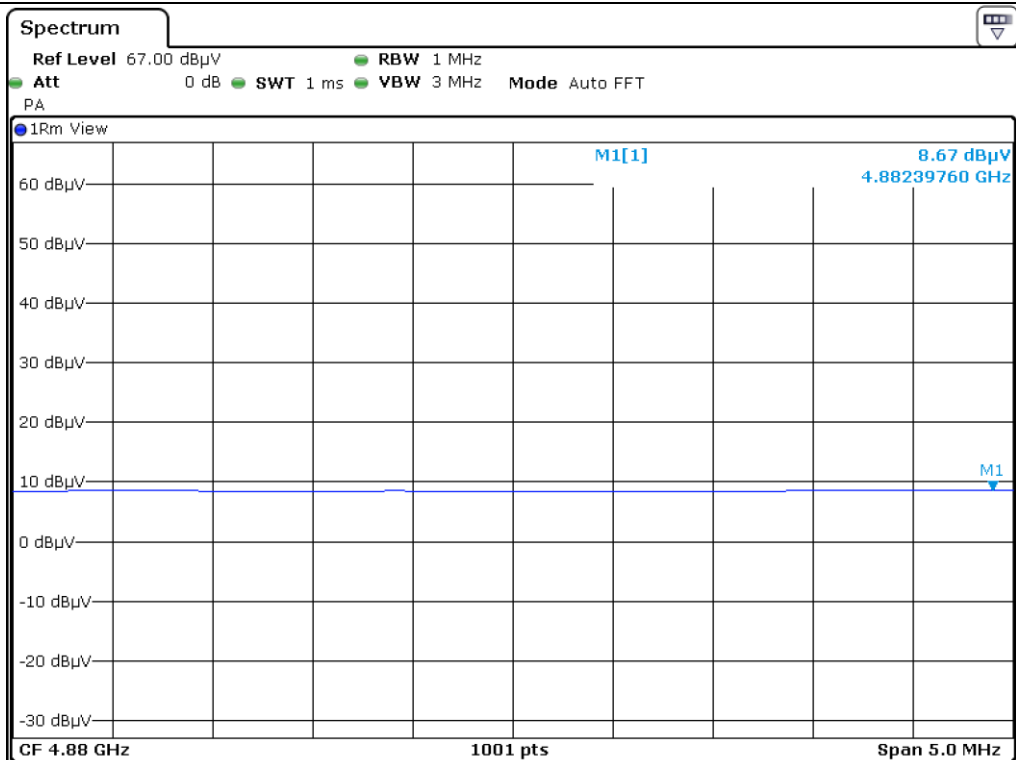
Low Channel_ Average_V



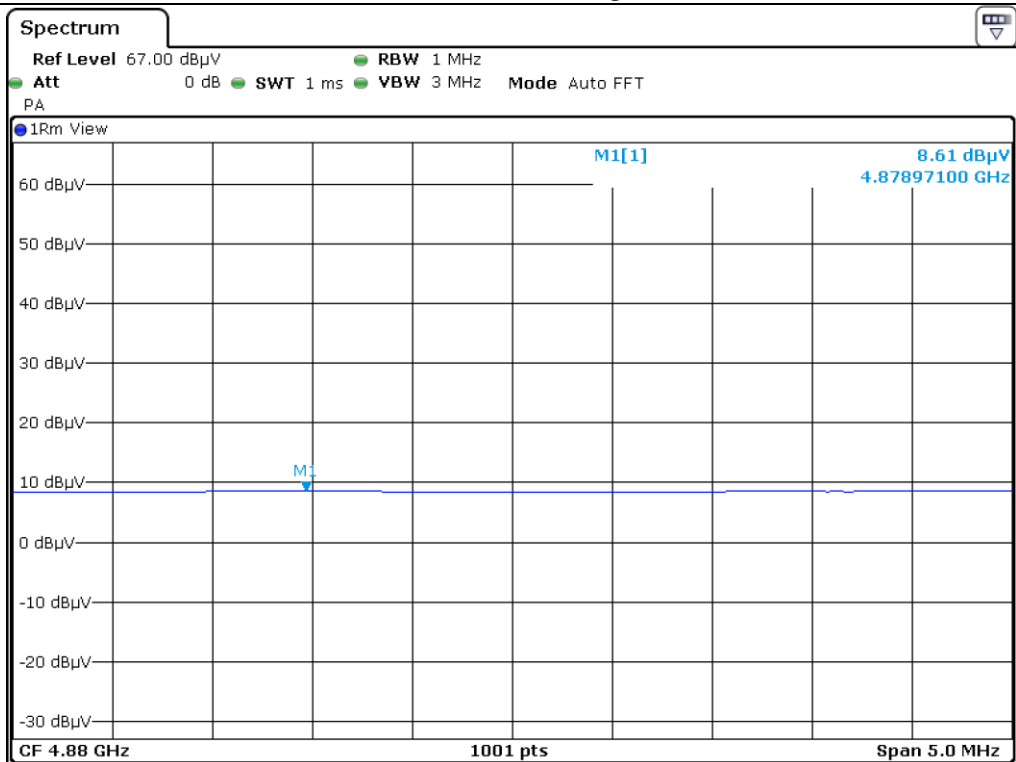
Middle Channel_Peak_H



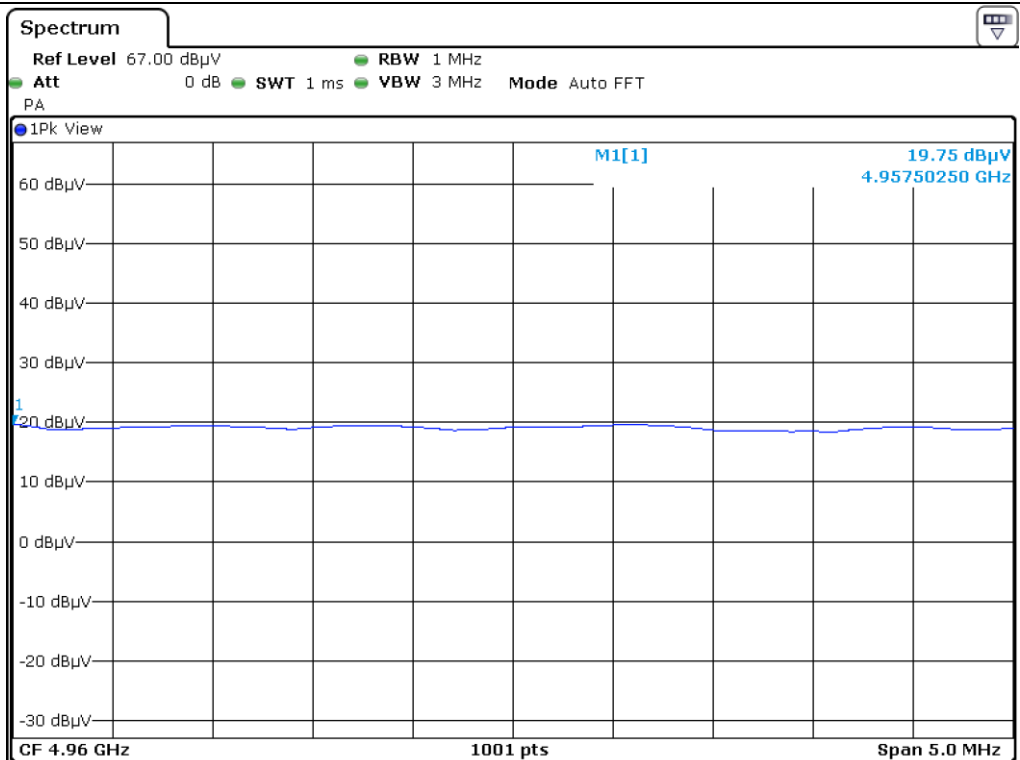
Middle Channel_Peak_V



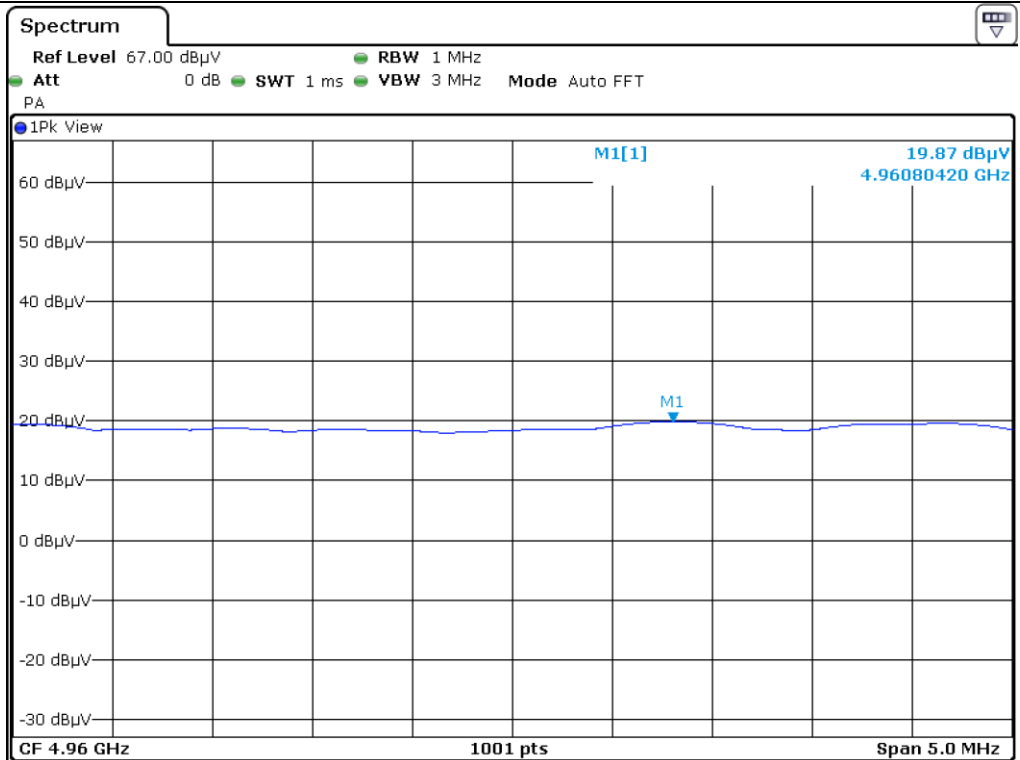
Middle Channel_Average_H



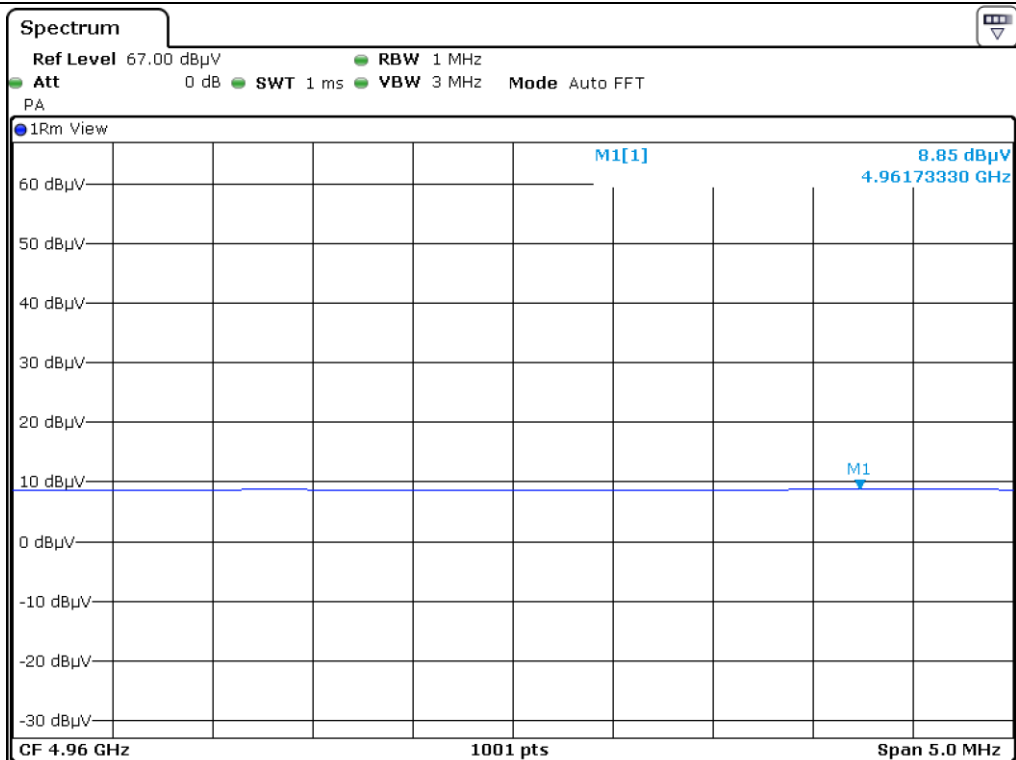
Middle Channel_Average_V



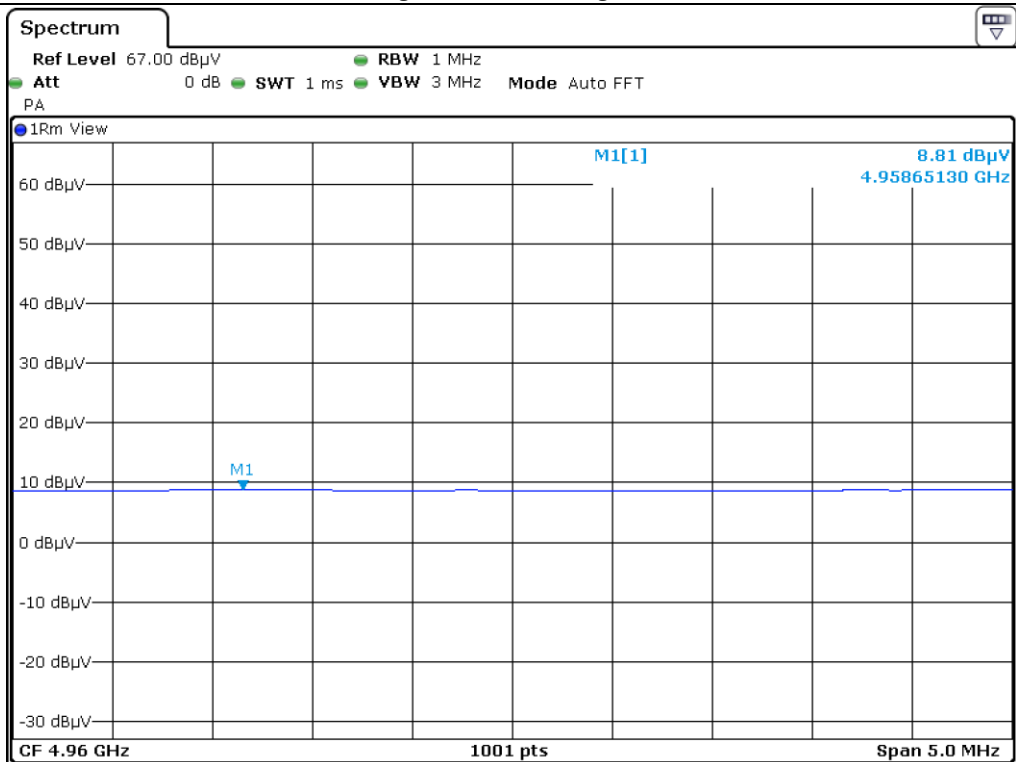
High Channel_Peak_H



High Channel_Peak_V



High Channel_Average_H



High Channel_Average_V

10. PEAK POWER SPECTRUL DENSITY

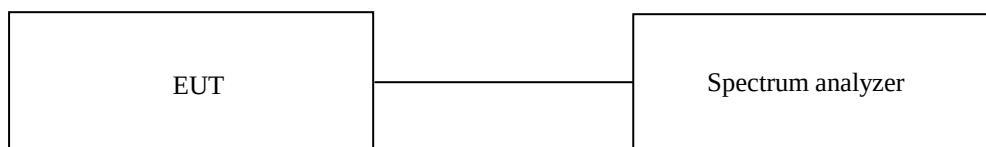
10.1 Operating environment

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. 11, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

10.4 Test data

-. Test Date : June 05, 2019 ~ June 11, 2019

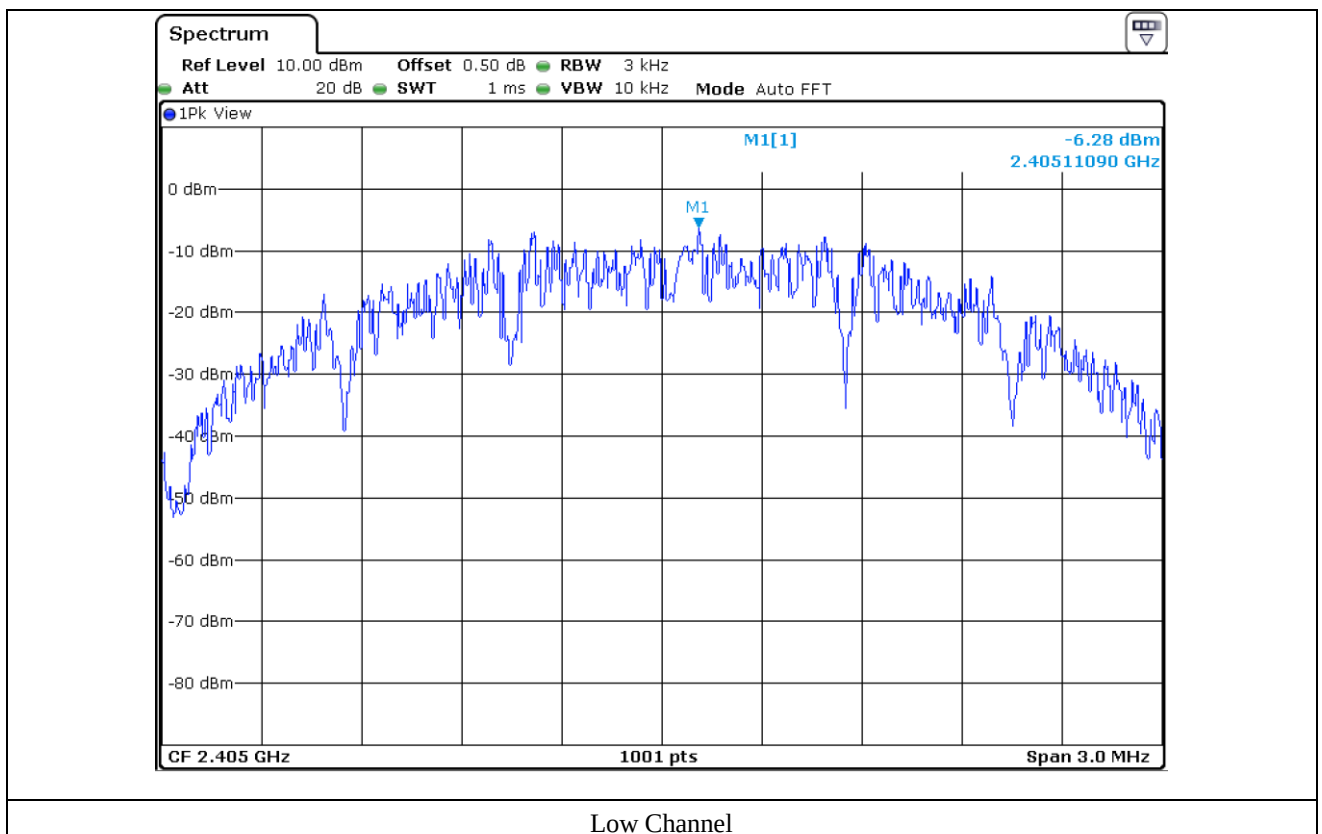
-. Test Result : Pass

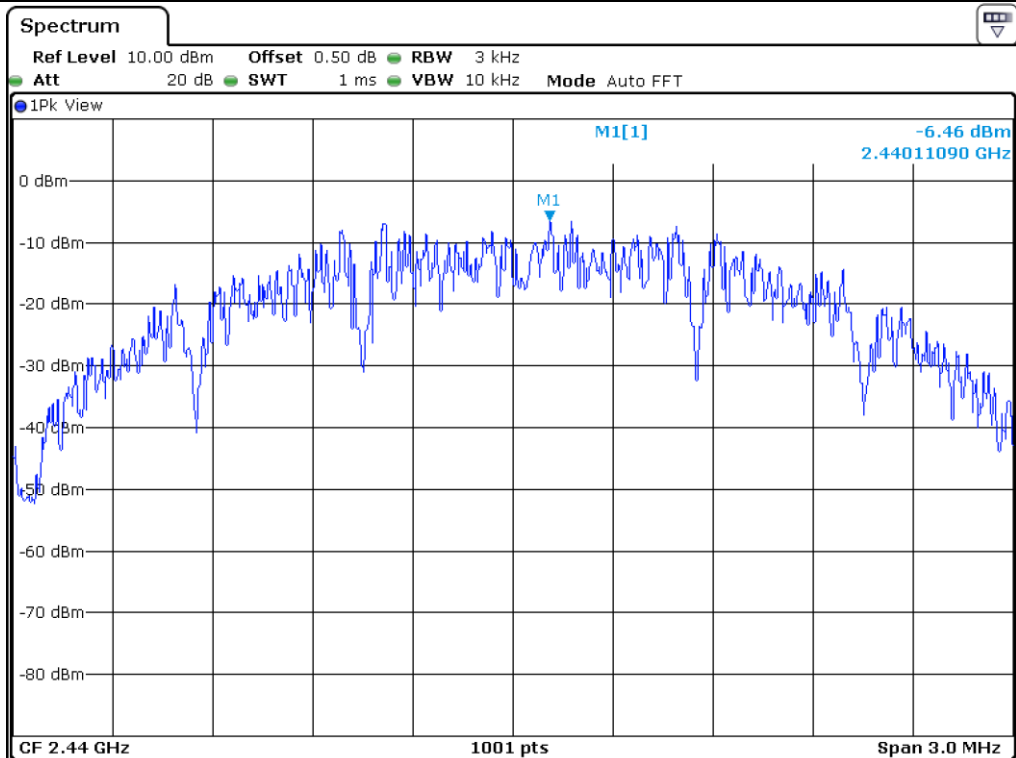
-. Operating Condition : Continuous transmitting mode

CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 405.00	-6.28	8.00	14.28
Middle	2 440.00	-6.46	8.00	14.46
High	2 480.00	-6.26	8.00	14.26

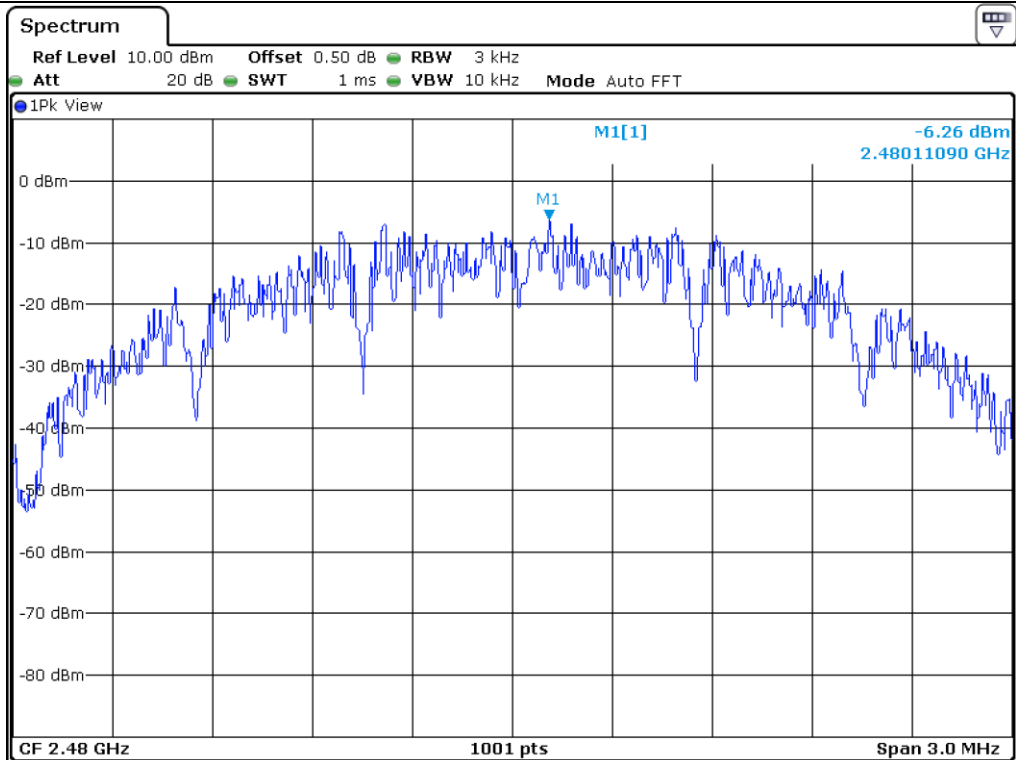
Remark. Margin = Limit – Measured value

Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 24 °C
Relative humidity : 43 % 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	Mar. 11, 2019 (1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Mar. 28, 2019 (1Y)
■ -	310N	Sonoma Instrument	Pre-Amplifier	312545	Mar. 18, 2019 (1Y)
■ -	BBV9718	Schwarzbeck	Amplifier	310	Mar. 28, 2019 (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)
■ -	BBHA 9120D	Schwarzbeck	Horn Antenna	9120D-1366	Aug. 02, 2017 (2Y)
■ -	BBHA 9170	Schwarzbeck	Horn Antenna	BBHA9170179	Jan. 16, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

11.4 Test data

11.4.1 Test data for 30 MHz ~ 1 GHz

Humidity Level : 43 % R.H.

Temperature: 24 °C

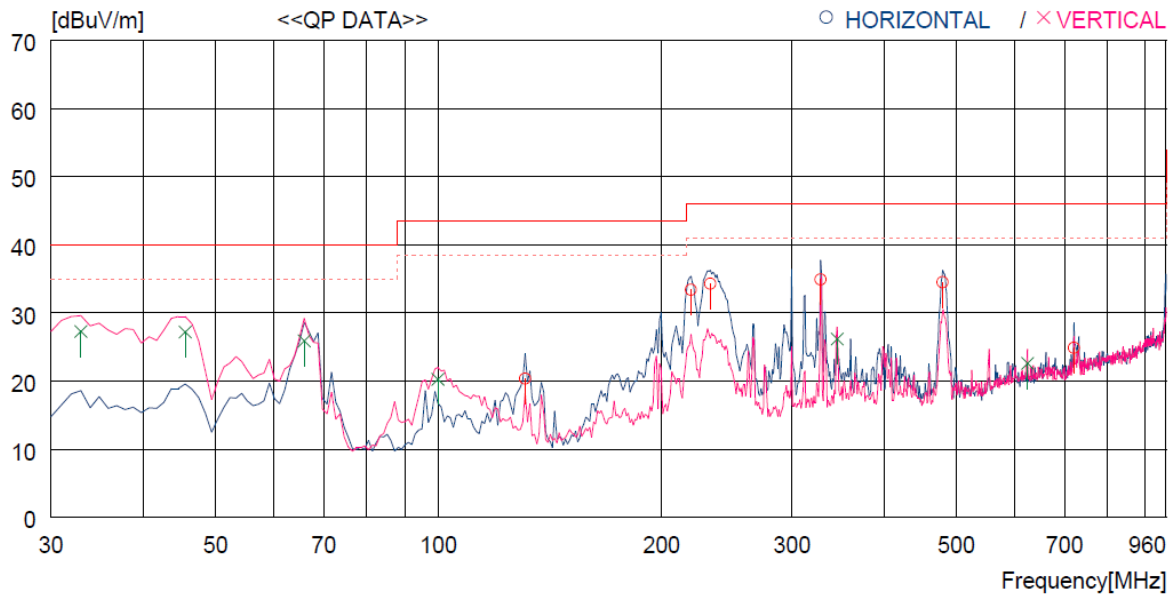
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : IoT Module

Date: June 05, 2019 ~ June 11, 2019

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



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	Q.P.	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	130.880	41.8	9.0	2.6	33.0	20.4	43.5	23.1	300	263
2	219.150	51.4	11.5	3.4	32.9	33.4	46.0	12.6	200	234
3	232.730	51.7	11.7	4.0	33.1	34.3	46.0	11.7	200	209
4	479.111	45.3	16.8	5.7	33.3	34.5	46.0	11.5	100	359
5	720.634	31.8	19.5	7.1	33.5	24.9	46.0	21.1	300	255
6	327.790	49.3	14.0	4.7	33.1	34.9	46.0	11.1	100	359
----- Vertical -----										
7	32.910	46.1	12.9	1.4	33.1	27.3	40.0	12.7	100	0
8	45.520	44.3	14.5	1.5	33.1	27.2	40.0	12.8	100	0
9	65.890	46.2	10.9	1.9	33.1	25.9	40.0	14.1	100	0
10	99.840	38.5	12.5	2.3	33.0	20.3	43.5	23.2	100	0
11	345.250	39.5	15.0	4.8	33.1	26.2	46.0	19.8	200	201
12	623.637	30.1	19.4	6.5	33.4	22.6	46.0	23.4	100	0

Tested by: Hyung-Kwon, Oh / Assistant Manager

11.4.2 Test data for Below 30 MHz

- . Test Date : June 05, 2019 ~ June 11, 2019
- . 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.									

11.4.3 Test data for above 1 GHz

- . Test Date : June 05, 2019 ~ June 11, 2019
- . 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

12. CONDUCTED EMISSION TEST

12.1 Operating environment

Temperature : 24 °C
Relative humidity : 43 % 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 μ H + 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)
■ -	ESCI	Rohde & Schwarz	Test Receiver	101012	Oct. 22, 2018 (1Y)
□ -	NSLK8128	Schwarzbeck	AMN	8128-216	Mar. 20, 2019 (1Y)
■ -	NSLK8126	Schwarzbeck	AMN	8126-404	Mar. 19, 2019 (1Y)
□ -	3825/2	EMCO	AMN	9109-1869	Mar. 19, 2019 (1Y)
■ -	3825/2	EMCO	AMN	9109-1867	Mar. 27, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

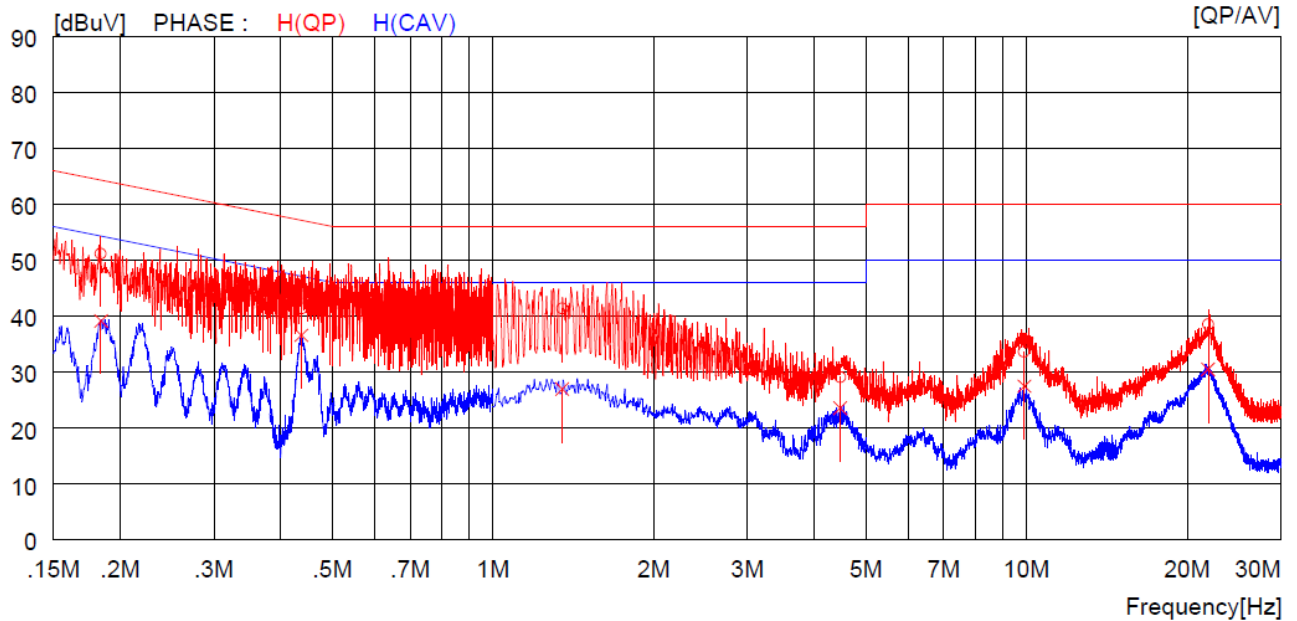
12.4 Test data

-. Test Date : June 05, 2019 ~ June 11, 2019

-. Resolution bandwidth : 9 kHz

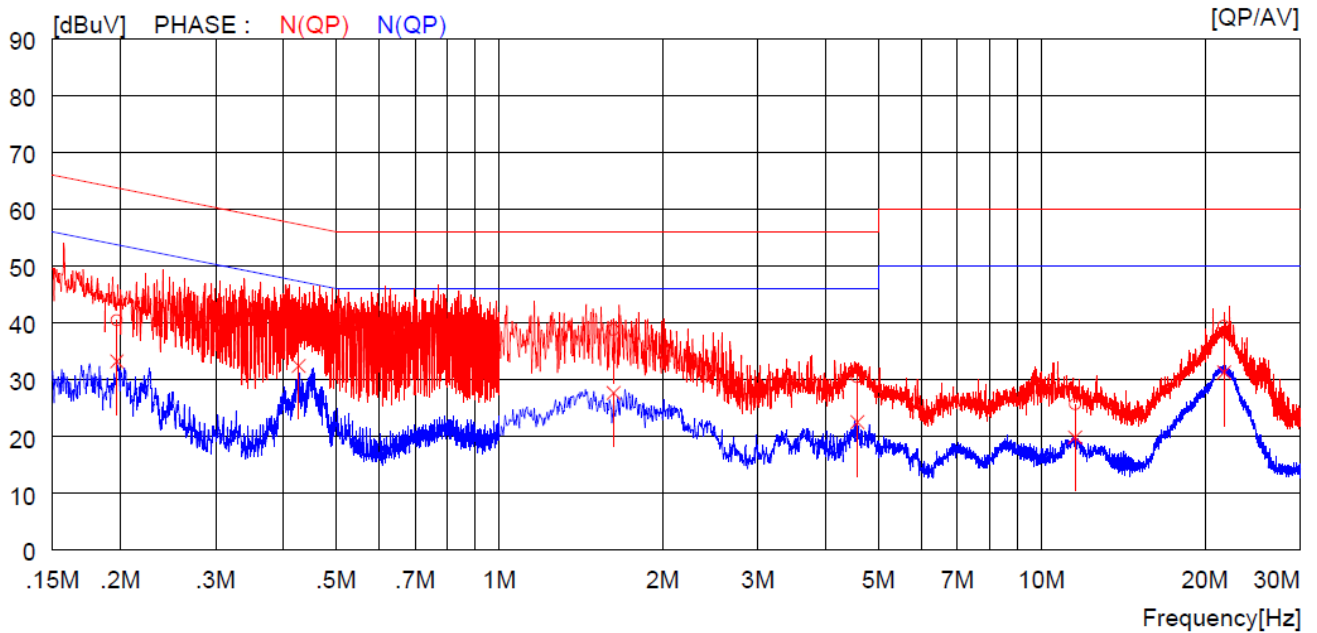
-. Frequency range : 0.15 MHz ~ 30 MHz

-. 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	0.18400	41.2	----	10.0	51.2	----	64.3	----	13.1	----	H (QP)
2	0.43700	31.4	----	10.0	41.4	----	57.1	----	15.7	----	H (QP)
3	1.34800	31.3	----	10.1	41.4	----	56.0	----	14.6	----	H (QP)
4	4.47200	19.0	----	10.1	29.1	----	56.0	----	26.9	----	H (QP)
5	9.90000	23.3	----	10.3	33.6	----	60.0	----	26.4	----	H (QP)
6	21.91000	27.8	----	10.7	38.5	----	60.0	----	21.5	----	H (QP)
7	0.18400	----	29.2	10.0	----	39.2	----	54.3	----	15.1	H (CAV)
8	0.43700	----	26.6	10.0	----	36.6	----	47.1	----	10.5	H (CAV)
9	1.34800	----	16.9	10.1	----	27.0	----	46.0	----	19.0	H (CAV)
10	4.47200	----	13.5	10.1	----	23.6	----	46.0	----	22.4	H (CAV)
11	9.90000	----	17.2	10.3	----	27.5	----	50.0	----	22.5	H (CAV)
12	21.91000	----	19.8	10.7	----	30.5	----	50.0	----	19.5	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	0.19700	30.5	----	10.0	40.5	----	63.7	----	23.2	----	N (QP)
2	0.42600	31.8	----	10.0	41.8	----	57.3	----	15.5	----	N (QP)
3	1.62400	28.7	----	10.1	38.8	----	56.0	----	17.2	----	N (QP)
4	4.56800	20.4	----	10.1	30.5	----	56.0	----	25.5	----	N (QP)
5	11.53000	15.1	----	10.5	25.6	----	60.0	----	34.4	----	N (QP)
6	21.69000	28.7	----	10.7	39.4	----	60.0	----	20.6	----	N (QP)
7	0.19700	----	23.2	10.0	----	33.2	----	53.7	----	20.5	N (CAV)
8	0.42600	----	22.5	10.0	----	32.5	----	47.3	----	14.8	N (CAV)
9	1.62400	----	17.6	10.1	----	27.7	----	46.0	----	18.3	N (CAV)
10	4.56800	----	12.5	10.1	----	22.6	----	46.0	----	23.4	N (CAV)
11	11.53000	----	9.4	10.5	----	19.9	----	50.0	----	30.1	N (CAV)
12	21.69000	----	20.6	10.7	----	31.3	----	50.0	----	18.7	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: Hyung-Kwon, Oh / Assistant Manager