

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

Test Report No. : OT-202-RWD-025
AGR No. : A202A-006
Applicant : AMOSENSE
Address : 56 Naruteo-ro, Seocho-gu, SEOUL, South Korea
Manufacturer : AMOSENSE
Address : 56 Naruteo-ro, Seocho-gu, SEOUL, South Korea
Type of Equipment : ATOZ
FCC ID. : 2AS9T-SB52SW2
Model Name : SB52-SW
Multiple Model Name : N/A
Serial number : N/A
Total page of Report : 52 pages (including this page)
Date of Incoming : February 03, 2020
Date of issue : February 13, 2020

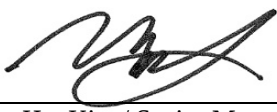
SUMMARY

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

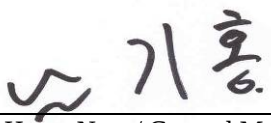
This test report only contains the result of a single test of the sample supplied for the examination.

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

Reviewed by:


 Tae-Ho, Kim / Senior Manager
 ONETECH Corp.

Approved by:


 Ki-Hong, Nam / General Manager
 ONETECH Corp.

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-202-RWD-025	February 13, 2020	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : AMOSENSE
 Address : 56 Naruteo-ro, Seocho-gu, SEOUL, South Korea
 Manufacturer : AMOSENSE
 Address : 56 Naruteo-ro, Seocho-gu, SEOUL, South Korea
 Factory : AMO VINA CO.,LTD
 Address : Lot CN12, Khai Quang industrial Park, Khai Quang Ward, Vinh Yen City, Vinh Phuc Province, Vietnam
 Contact Person : UIHAN JEONG/Research Engineer
 Telephone No. : +82-010-4948-5676
 FCC ID : 2AS9T-SB52SW2
 Model Name : SB52-SW
 Brand Name : -
 Serial Number : N/A
 Date : February 13, 2020

EQUIPMENT CLASS	DSS – PART 15 SPREAD SPECTRUM TRANSMITTER
E.U.T. DESCRIPTION	ATOZ
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)(1)(i)	20 dB Bandwidth	Met the Limit / PASS
15.247(b)(2)	Conducted Maximum Peak Output Power	Met the Limit / PASS
15.247(a)(1)	Carrier Frequency Separation	Met the Limit / PASS
15.247(a)(1)(i)	Number of Hopping Frequencies	Met the Limit / PASS
15.247(a)(1)(i)	Time of Occupancy	Met the Limit / PASS
15.247(d)	Conducted Spurious Emissions	Met the Limit / PASS
15.247(d)	Band Edge(Out of Band Emissions)	Met the Limit / PASS
15.207(a)	AC Power line Conducted Emissions	Met the Limit / PASS
15.247(d), 15.205, 15.209	Radiated Spurious Emissions	Met the Limit / PASS
15.247(d), 15.205, 15.209	Radiated Restricted Band Edge	Met the Limit / 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

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EMC-003 (Rev.2)

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

3. GENERAL INFORMATION

3.1 Product Description

The AMOSENSE, Model SB52-SW (referred to as the EUT in this report) is a ATOZ. Product specification information described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	ATOZ	
Temperature Range	-20 °C ~ 60 °C	
OPERATING FREQUENCY	NFC	13.56 MHz
	Sig Fox	902.137 5 MHz ~ 904.662 5 MHz
	Bluetooth LE	2 402 MHz ~ 2 480 MHz
	WLAN 2.4 GHz	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))
MODULATION TYPE	NFC	ASK
	Sig Fox	DBPSK
	Bluetooth LE	GFSK
	WLAN 2.4 GHz	802.11b: DSSS Modulation (DBPSK/DQPSK/CCK) 802.11g/n(HT20): OFDM Modulation (BPSK/QPSK/16QAM/64QAM)
RF OUTPUT POWER'	NFC	39.11 dBμV/m at 3 m
	Sig Fox	21.59 dBm
	Bluetooth LE	-1.37 dBm
	WLAN 2.4 GHz	-1.17 dBm(802.11b) -3.02 dBm(802.11g) -3.25 dBm(802.11n_HT20)
ANTENNA TYPE	NFC: FPCB Antenna Sig Fox: Chip Antenna Bluetooth LE: Chip Antenna WLAN 2.4 GHz: Chip Antenna	
ANTENNA GAIN	Sig Fox: 1.66 dBi Bluetooth LE / WLAN 2.4 GHz: 2.36 dBi	
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	26 MHz, 32 MHz, 50 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	AMONSENSE	ATOZ Rev2.0 / N/A	N/A
Sub Board	AMONSENSE	N/A	N/A
DC Battery	N/A	UFX303055 / N/A	N/A
Speaker	N/A	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
SB52-SW	AMONSENSE	ATOZ(EUT)	-
N/A	N/A	Jig Board	EUT
ACR1251U	Advanced Card Systems Ltd.	Card Reader	EUT
G6-1121TU	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 902.137 5 MHz, 903.387 5 MHz, and 904.662 5 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.

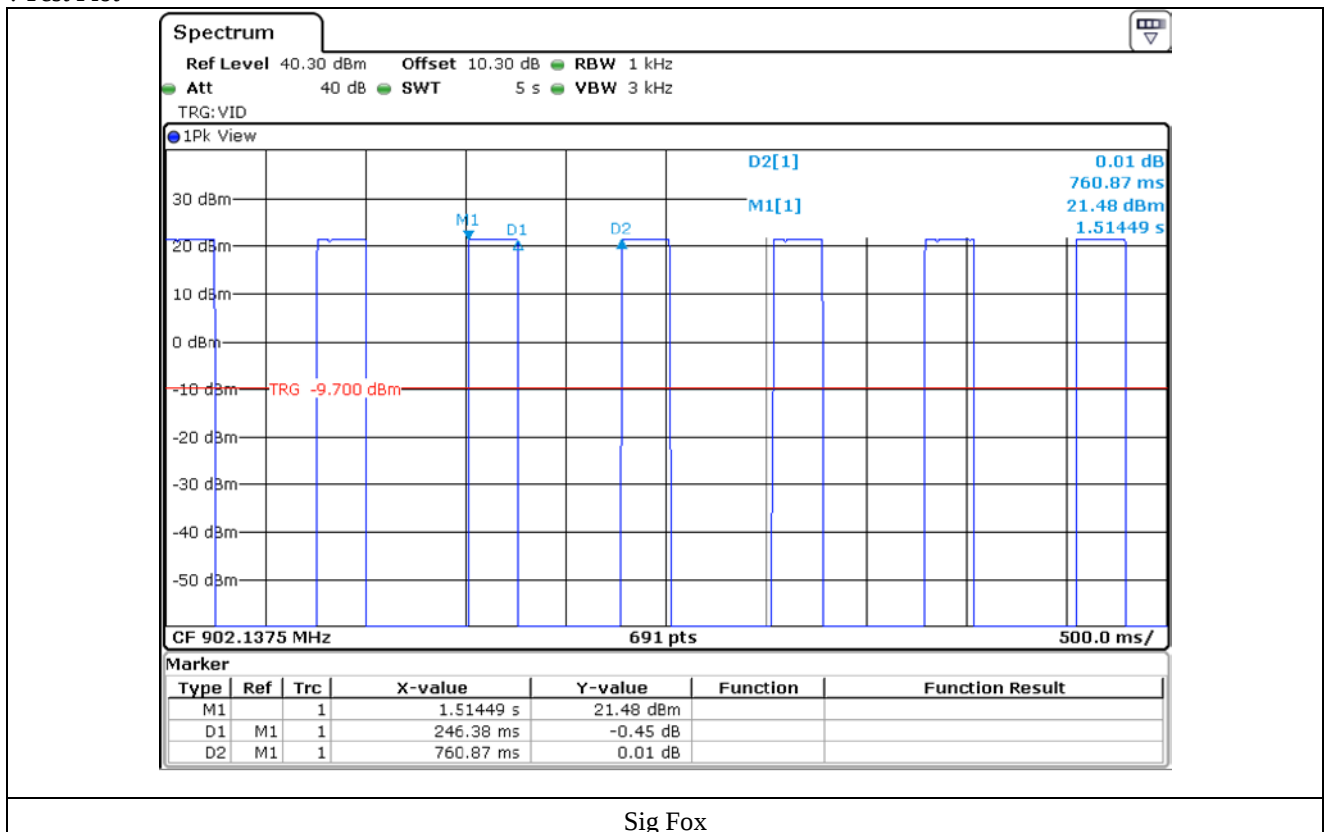
-. Duty Cycle

Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
Sig Fox	246.38	514.49	32.38	4.90

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 tested in a Charging & Transmitting mode. The EUT was connected to USB and the Power of USB was Connected to DC Adaptor. 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 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 Test, the following operating mode was investigated.

Operation Mode	The Worse operating condition (Please check one only)
Charging & 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. MAXIMUM PEAK OUTPUT POWER

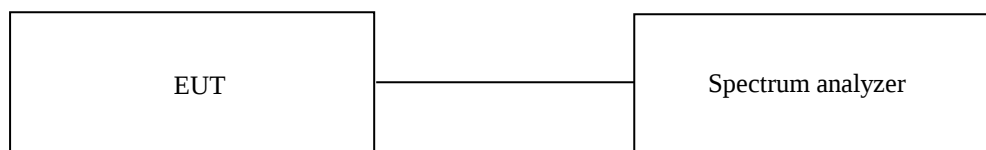
7.1 Operating environment

Temperature : 23 °C
Relative humidity : 46 % R.H.

7.2 Test set-up

The maximum peak output power of the intentional radiator shall not exceed the following:

1. For frequency hopping systems operating in the 902-928 MHz band: 1 watt (30 dBm) for systems employing at least 50 hopping channels; and, 0.25 watts (24 dBm) for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.
2. The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.
3. The e.i.r.p of this module not exceed 4 W because the antenna gain not exceed not 6 dBi.



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

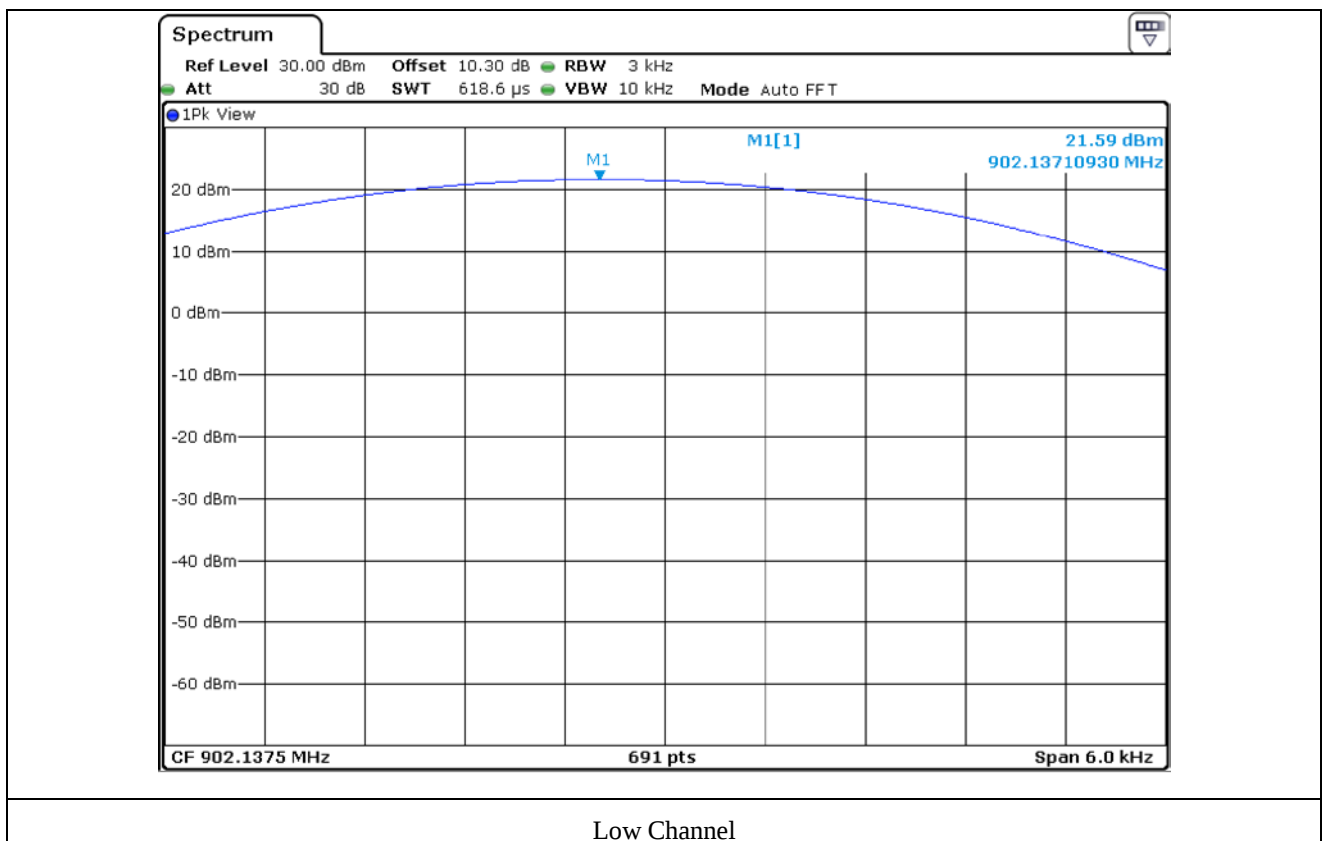
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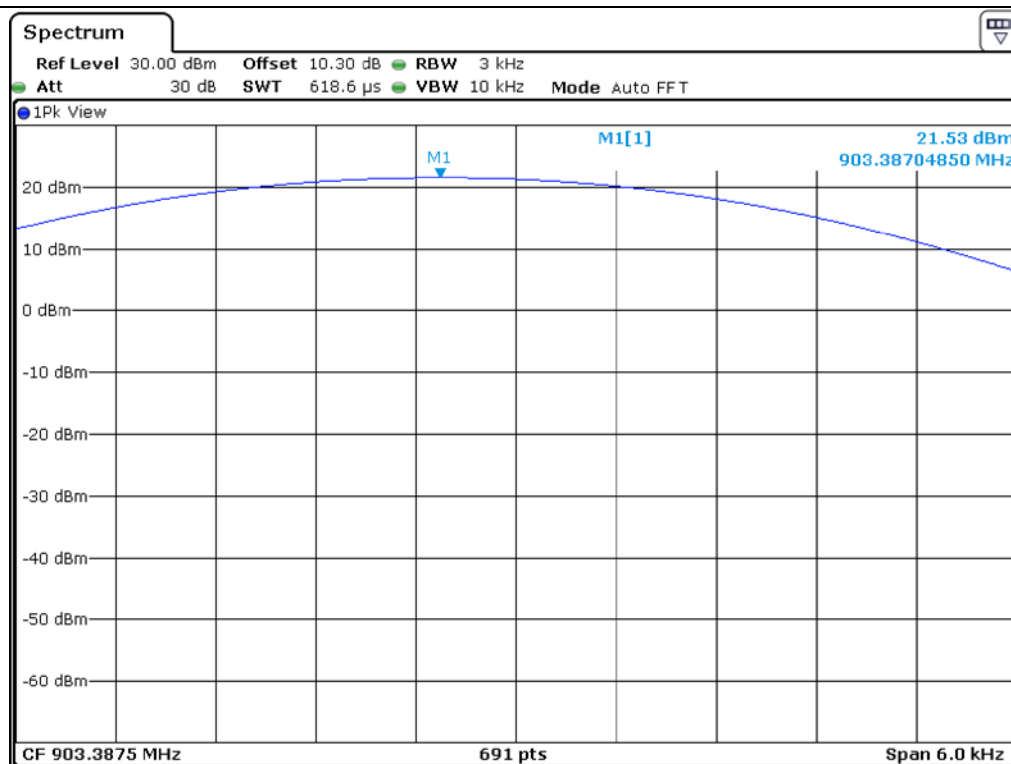
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE		LIMIT (mW)	MARGIN (dB)
		(dBm)	(mW)		
LOW	902.137 5	21.59	144.21	100 0.00	855.79
MIDDLE	903.387 5	21.53	142.23	100 0.00	857.77
HIGH	904.662 5	21.51	141.58	100 0.00	858.42

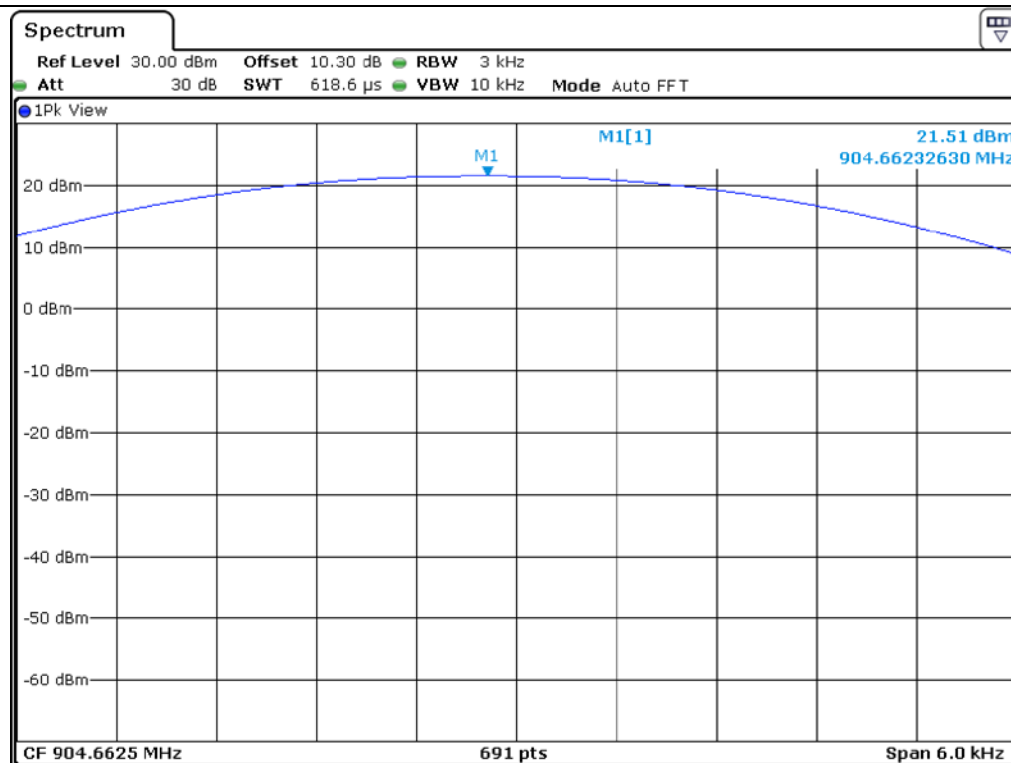


Tested by: Hyung-Kwon, Oh / Manager





Middle Channel



High Channel

8. BAND EDGES

8.1 Operating environment

Temperature : 23 °C
Relative humidity : 46 % R.H.

8.2 Test set-up

According to §15.247(d) in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.



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 : February 04, 2020 ~ February 07, 2020

-. Test Result : Pass

-. Without hopping

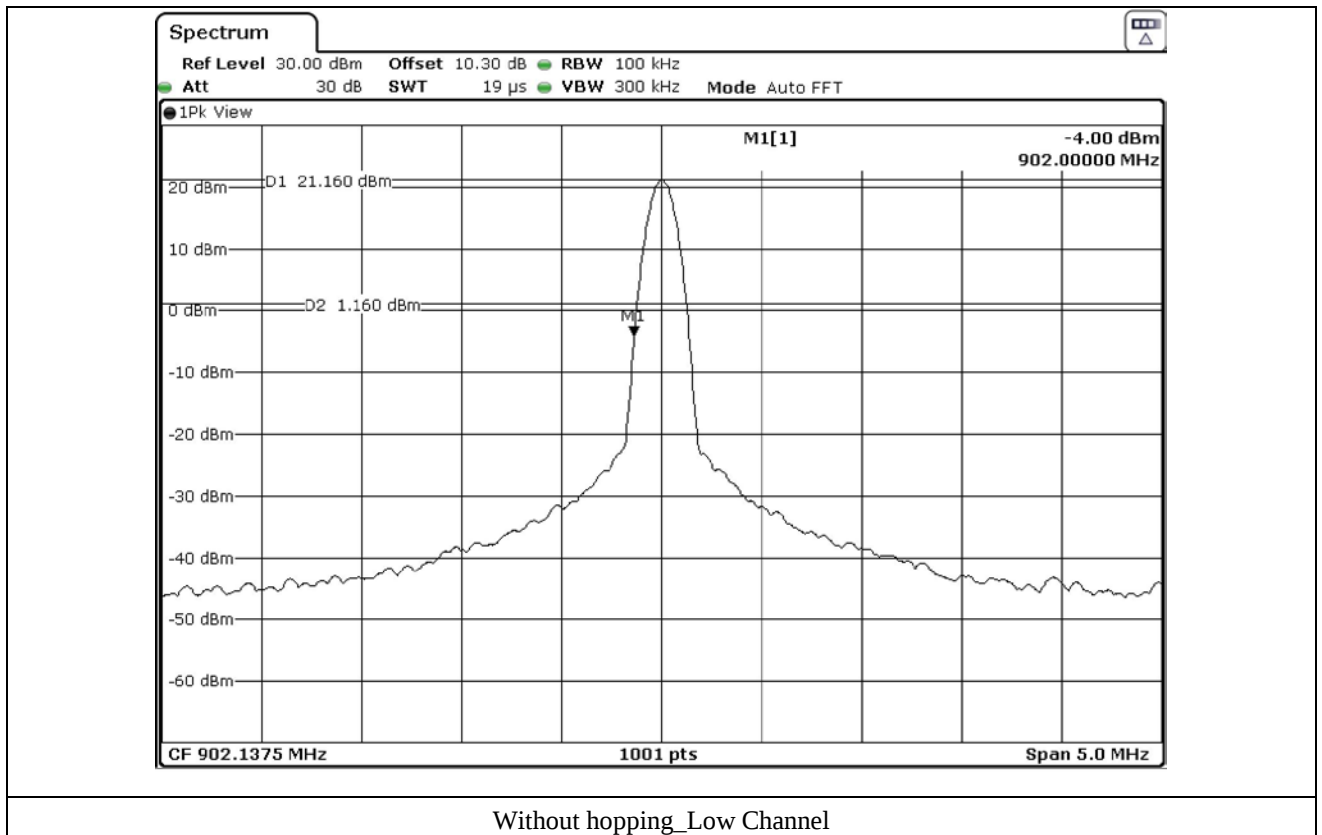
CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dB)	LIMIT (dBc)	MARGIN (dB)
LOW	902.137 5	25.16 (21.16 + 4.00)	20.00	5.16
HIGH	904.662 5	69.07 (21.09 + 47.98)	20.00	49.07

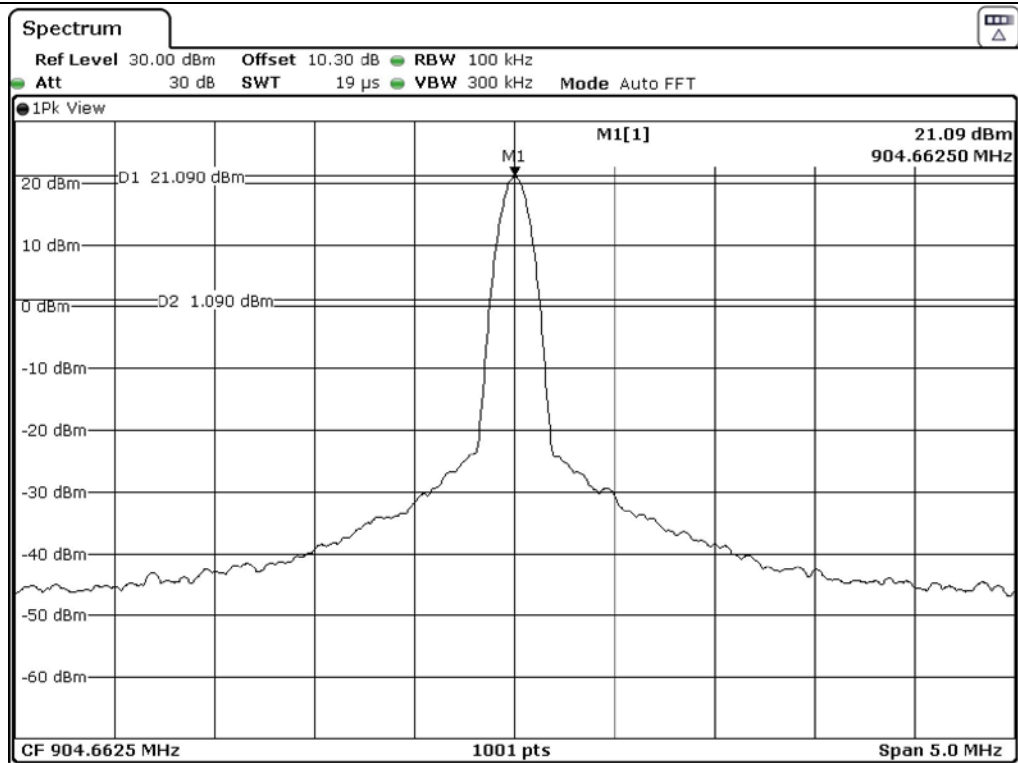
-. With Hopping

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dB)	LIMIT (dBc)	MARGIN (dB)
LOW	902.137 5	24.70 (21.12 + 3.58)	20.00	4.70
HIGH	904.662 5	68.88 (21.12 + 47.76)	20.00	48.88

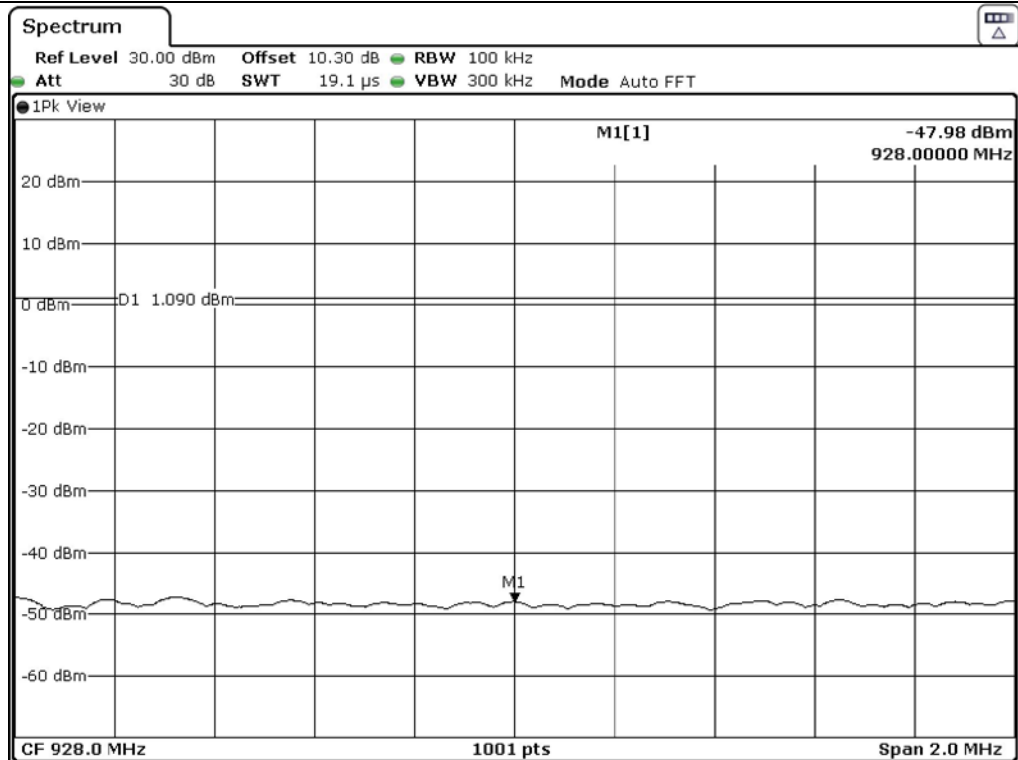


Tested by: Hyung-Kwon, Oh / Manager

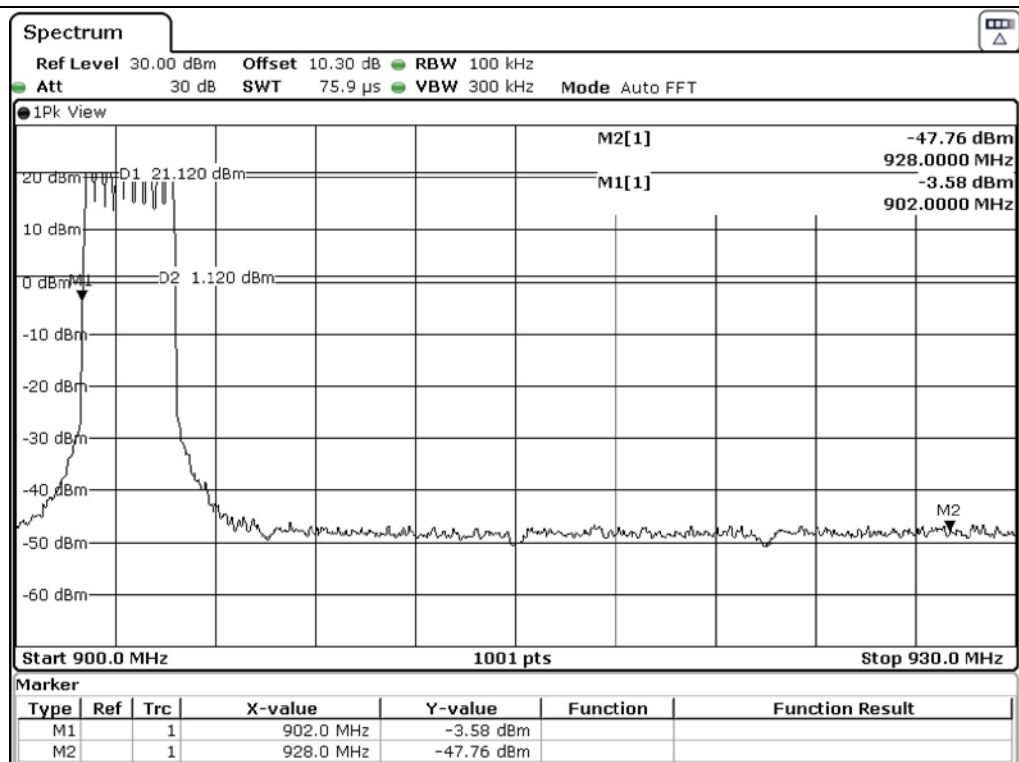




Without hopping_High Channel_1



Without hopping_High Channel_2



With Hopping_ High Channel

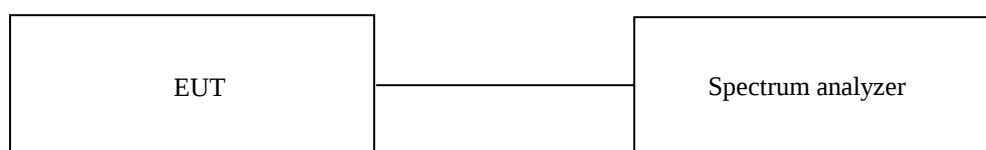
9. FREQUENCY SEPARATION / OCCUPIED BANDWIDTH (20 dB BANDWIDTH)

9.1 Operating environment

Temperature : 23 °C
Relative humidity : 46 % R.H.

9.2 Test set-up

According to §15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.



9.3 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.

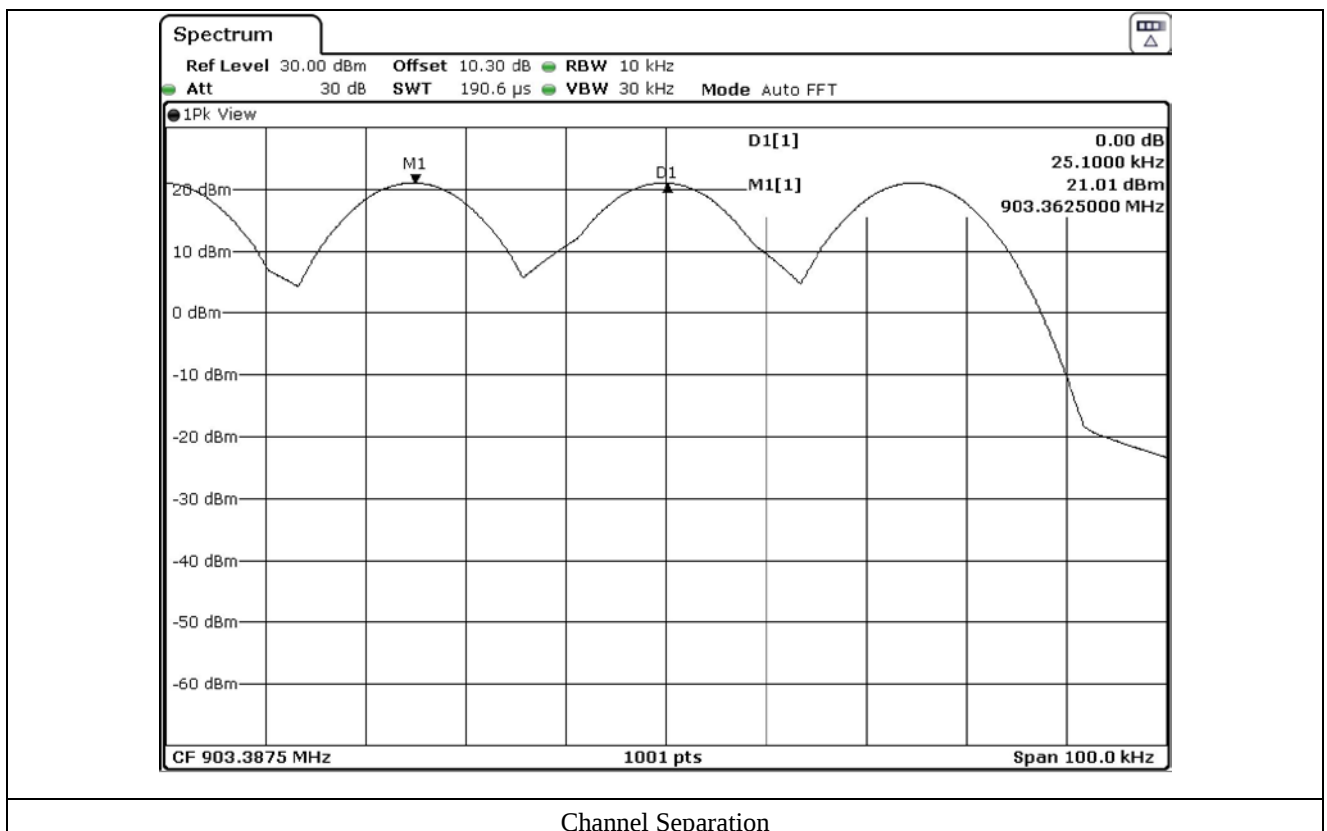
9.4 Test data

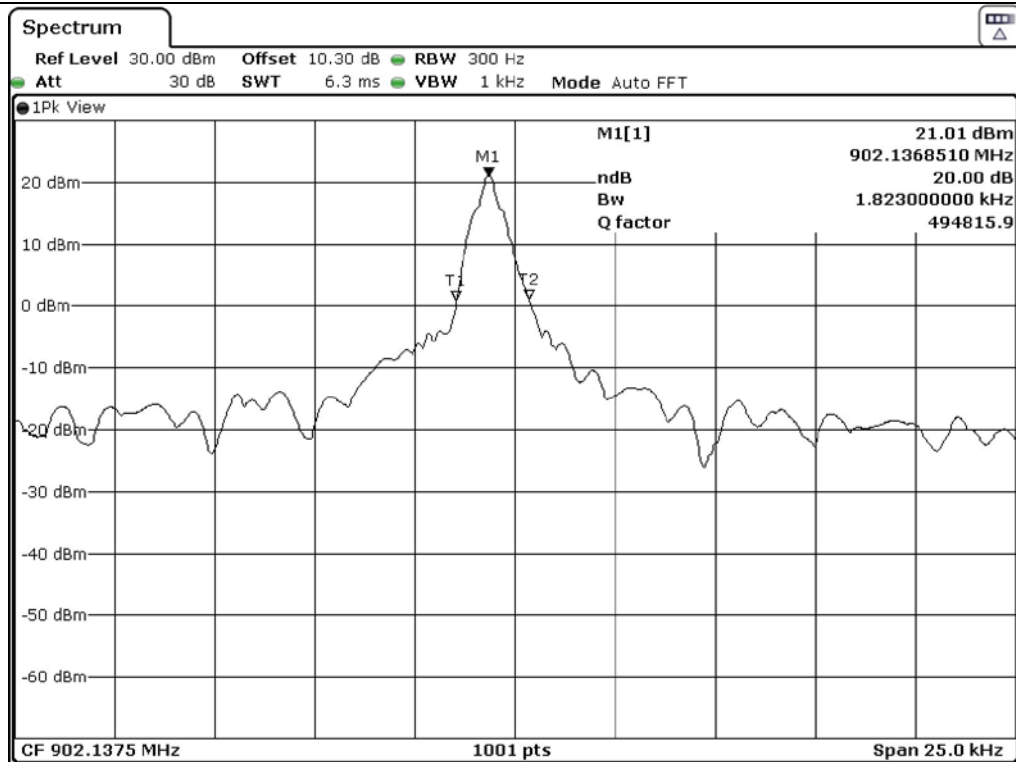
-. Test Date : February 04, 2020 ~ February 07, 2020

-. Test Result : Pass

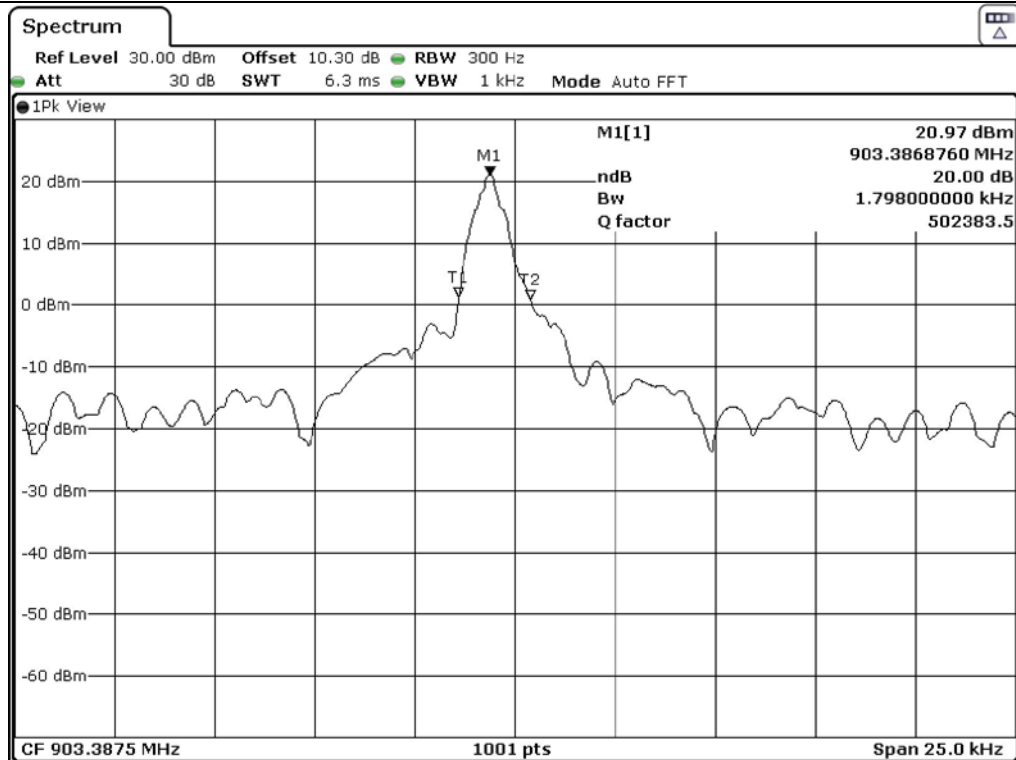
Channel Separation (kHz)	20 dB Bandwidth		Limit (kHz)	Result
	Channel	Measured Value (kHz)		
25.10	LOW	1.82	≥ 25 Or > 20 dB B.W. of Hopping Channel	Pass
	MIDDLE	1.80		
	HIGH	1.82		

Tested by: Hyung-Kwon, Oh / Manager

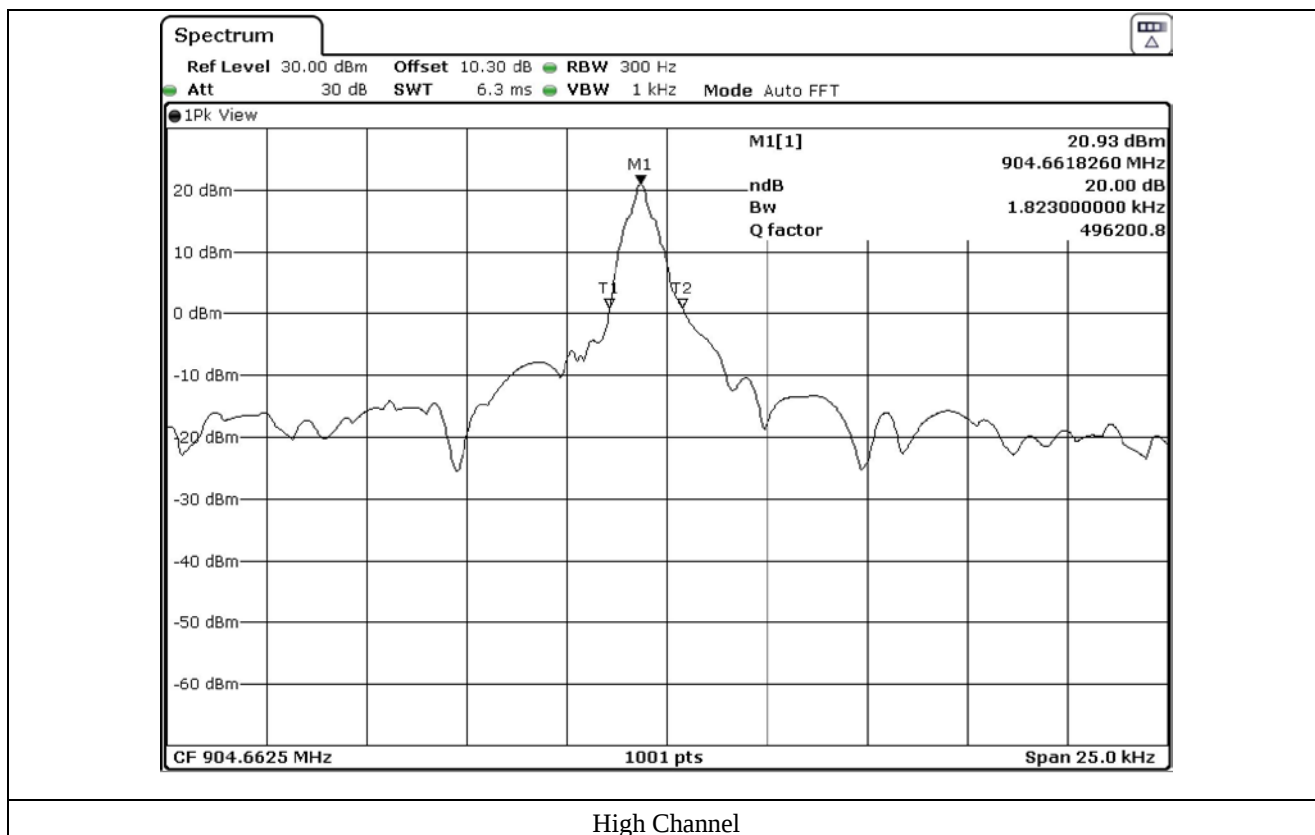




Low Channel



Middle Channel



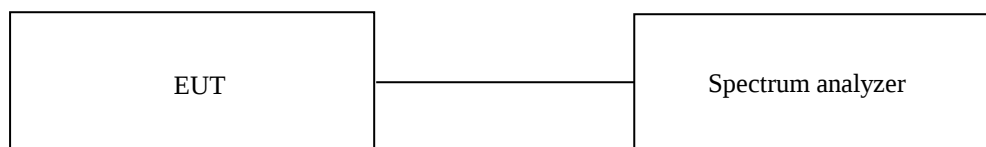
10. NUMBER OF HOPPING FREQUENCY

10.1 Operating environment

Temperature : 23 °C
Relative humidity : 46 % R.H.

10.2 Test set-up

According to §15.247(a)(1)(i) if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz..



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

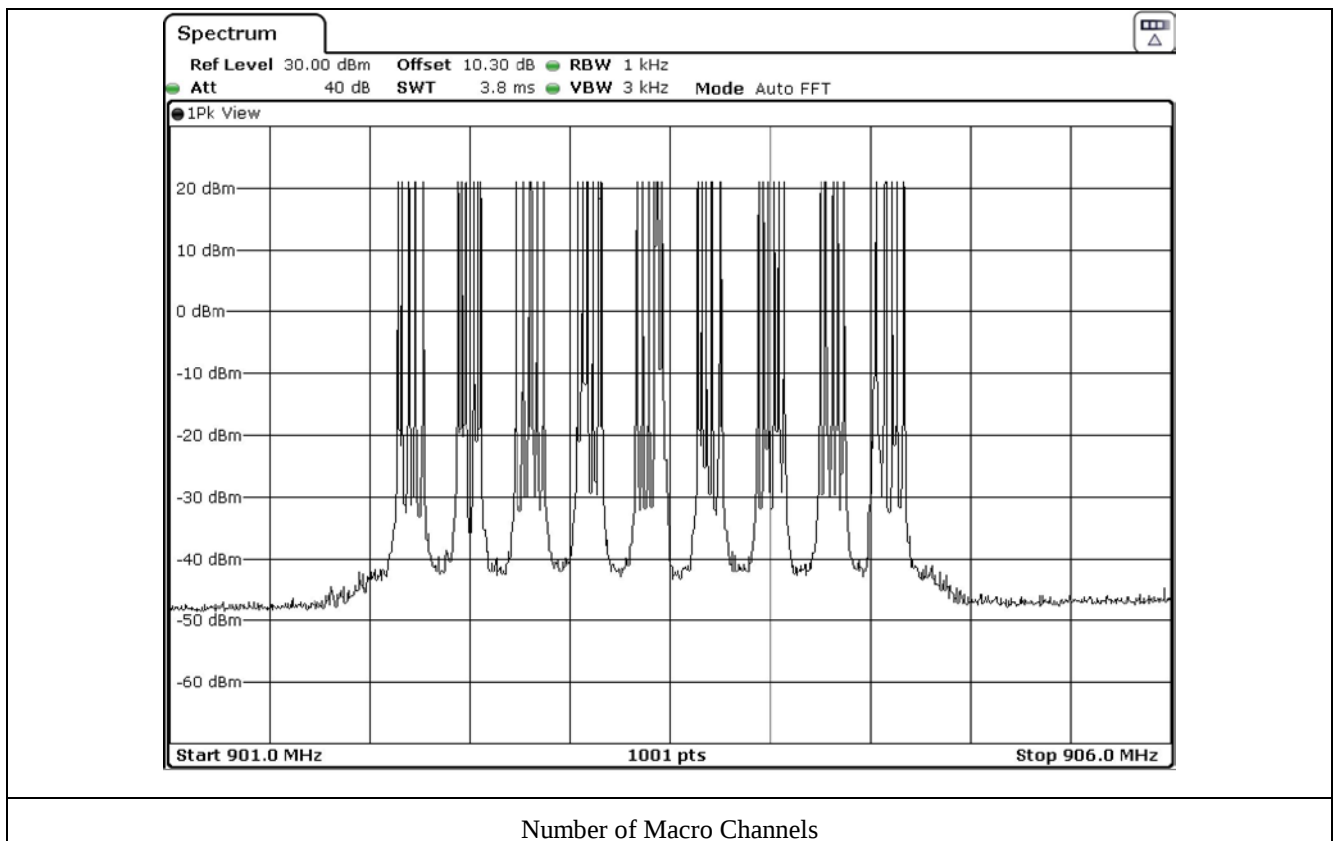
-. Test Date : February 04, 2020 ~ February 07, 2020

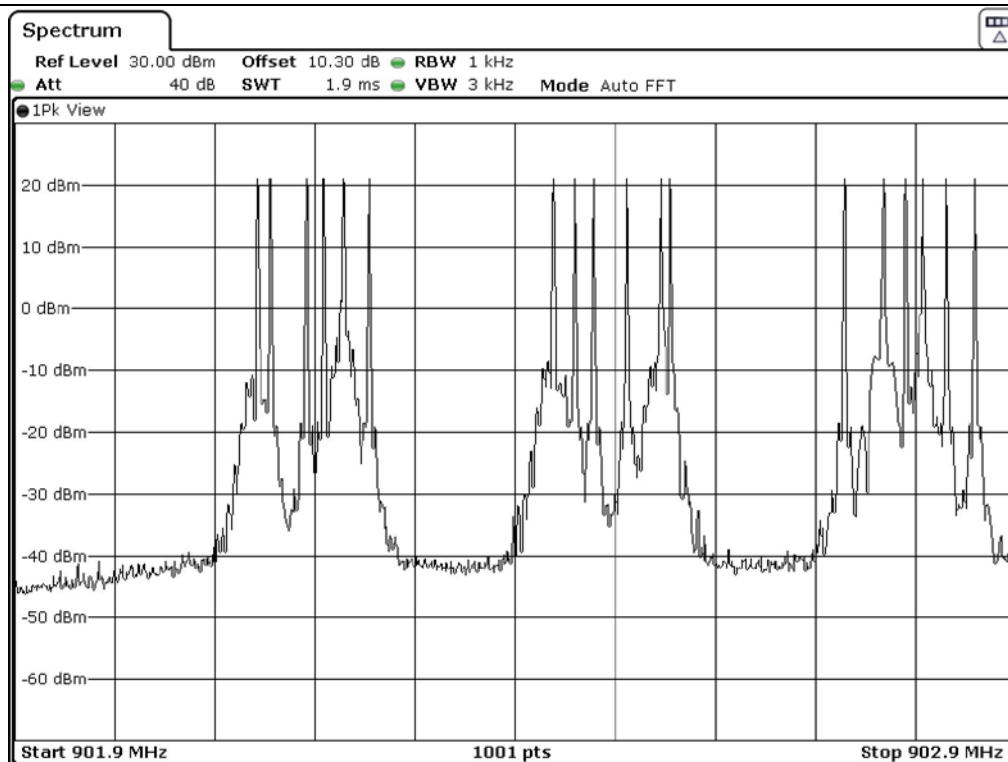
-. Test Result : Pass

Number of Macro Channels	One Single Macro Channel	Number of Hopping Frequencies	Limit (EA)
9	6	54.00	50.00

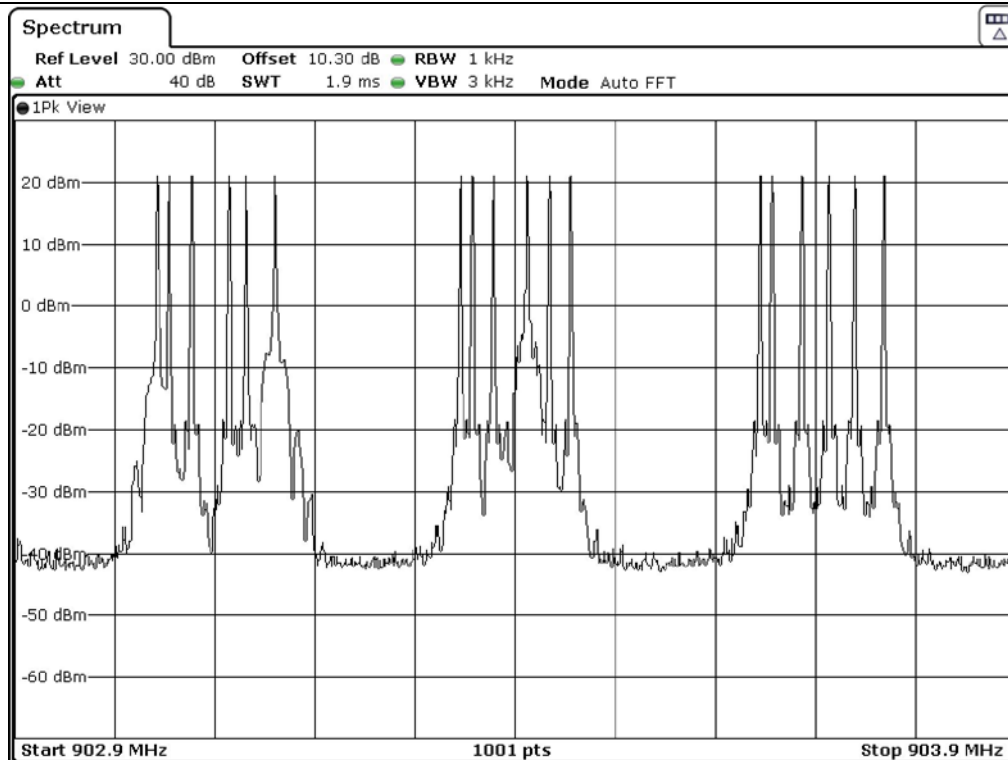


Tested by: Hyung-Kwon, Oh / Manager

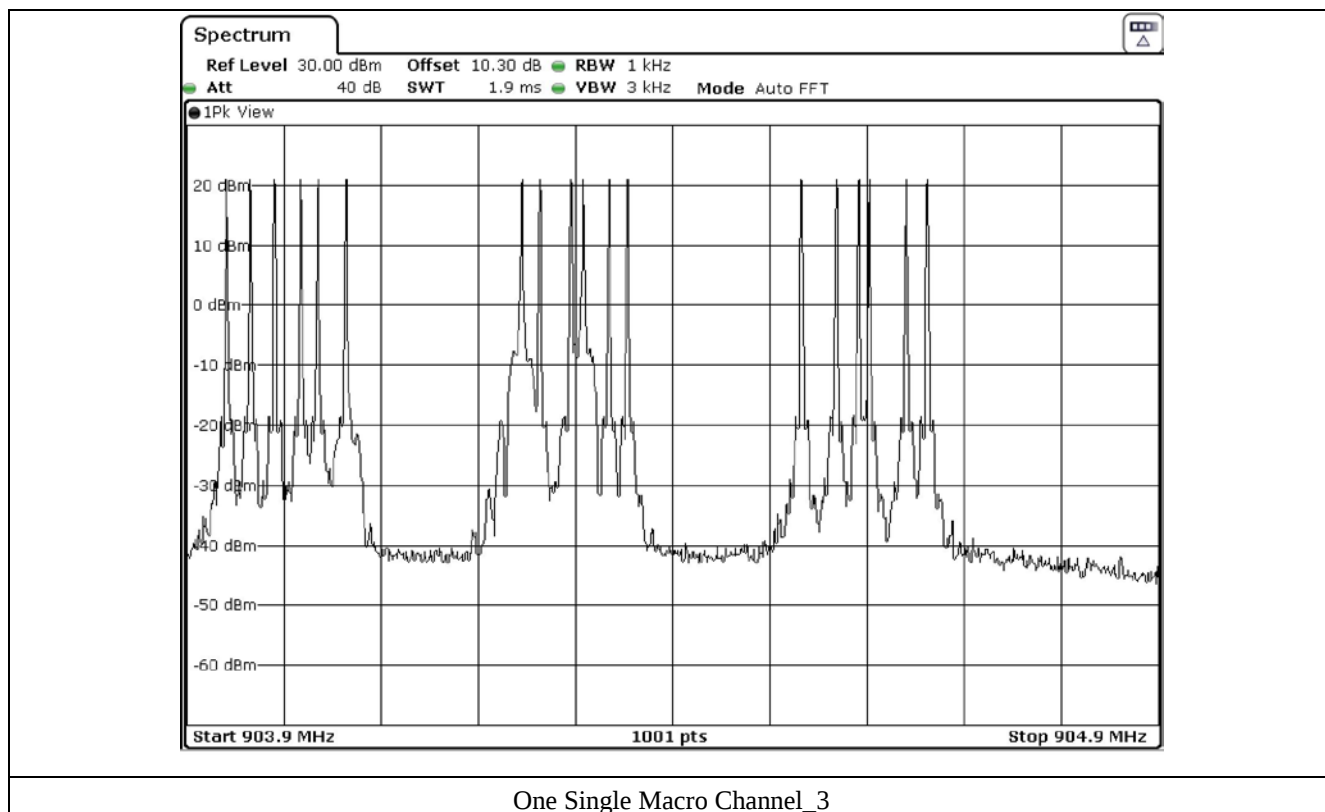




One Single Macro Channel_1



One Single Macro Channel_2



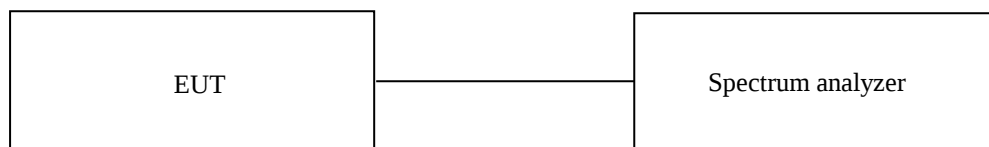
11. TIME OF OCCUPANCY(DWELL TIME)

11.1 Operating environment

Temperature : 23 °C
Relative humidity : 46 % R.H.

11.2 Test set-up

According to §15.247(a)(1)(i) / RSS-247 5.1.3, Frequency hopping systems operating in the 902 MHz ~ 928 MHz bands. if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.



11.3 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.

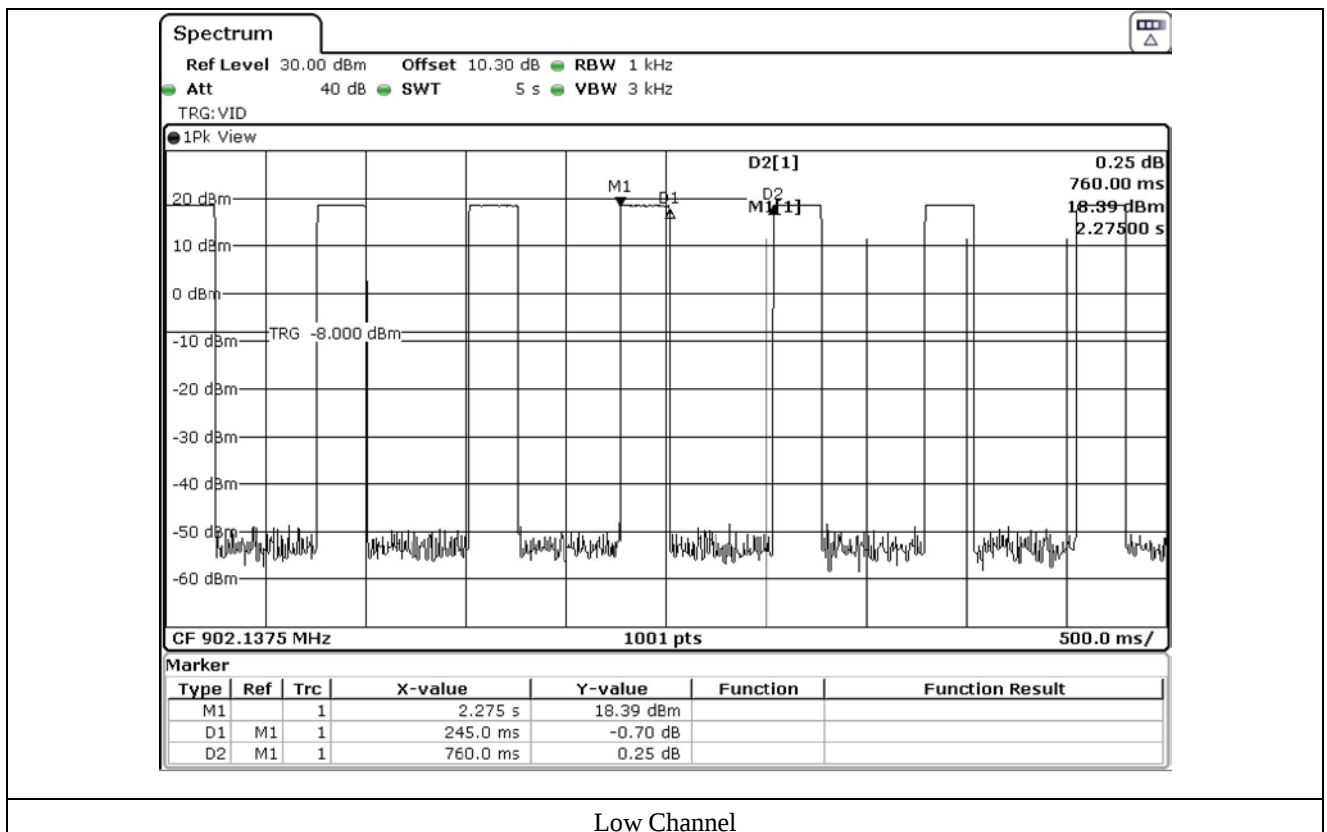
11.4 Test data

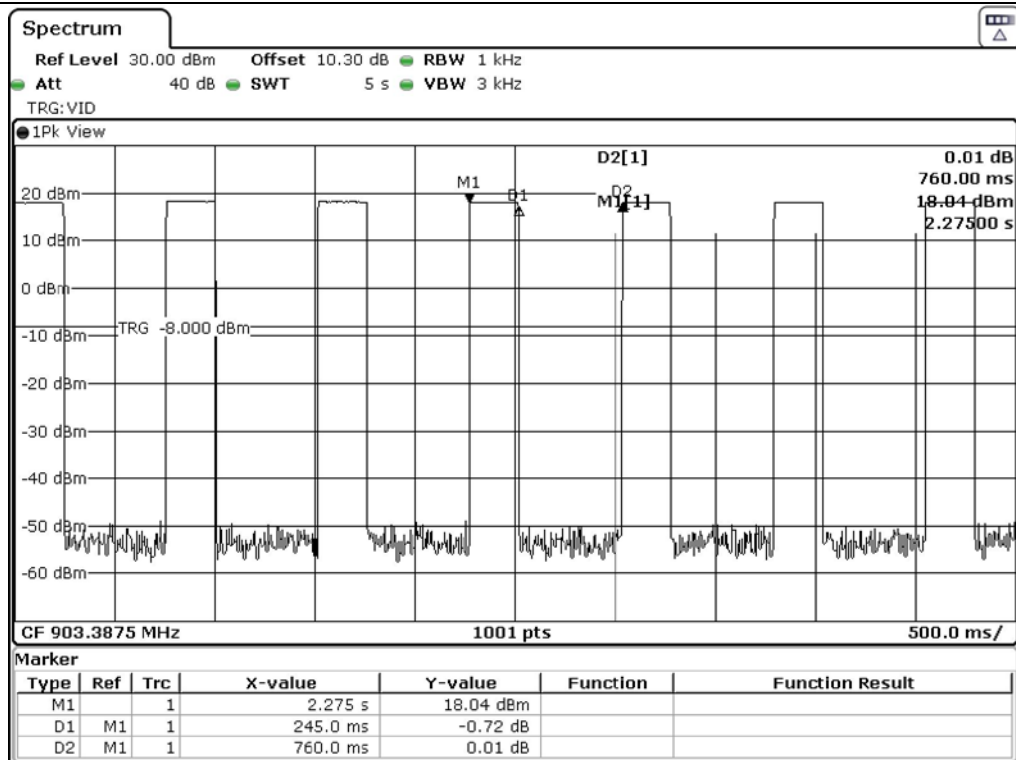
-. Test Date : February 04, 2020 ~ February 07, 2020

-. Test Result : Pass

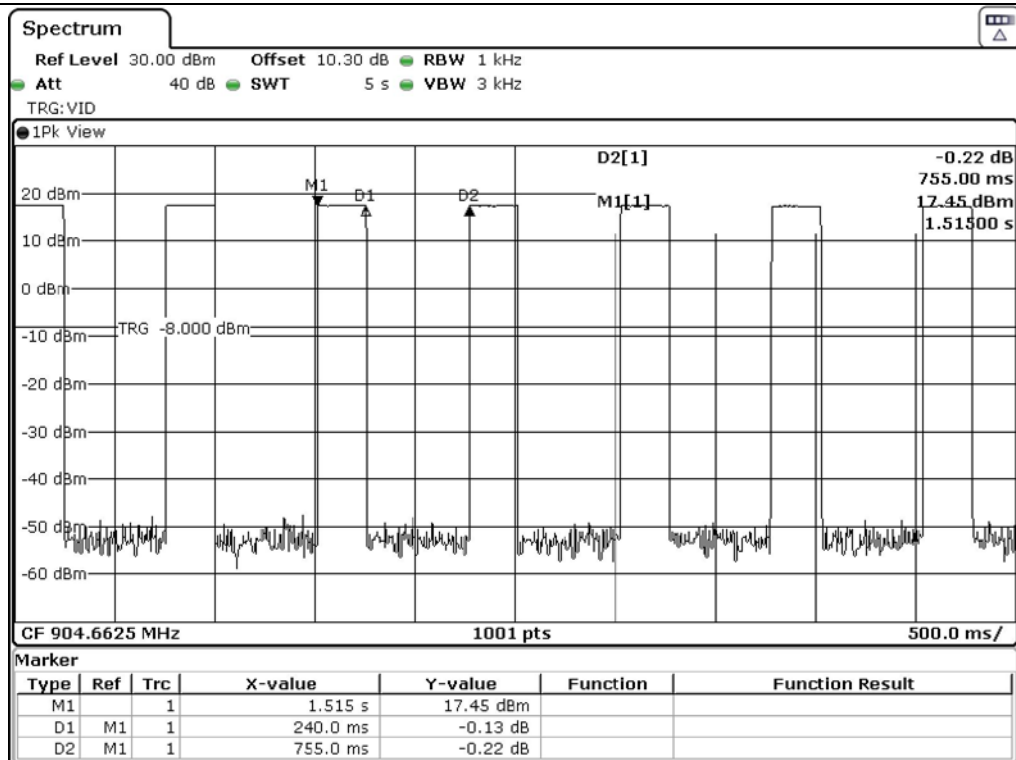
	Channel	Measured Value(ms)	Limit(ms)	Result
Pulse Time (ms)	LOW	245.00	400.00	Pass
	MIDDLE	245.00		
	HIGH	240.00		

Tested by: Hyung-Kwon, Oh / Manager





Middle Channel



High Channel

12. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

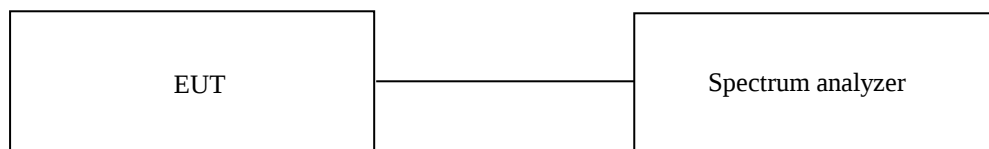
12.1 Operating environment

Temperature : 23 °C
Relative humidity : 46 % R.H.

12.2 Test set-up for conducted / radiated measurement

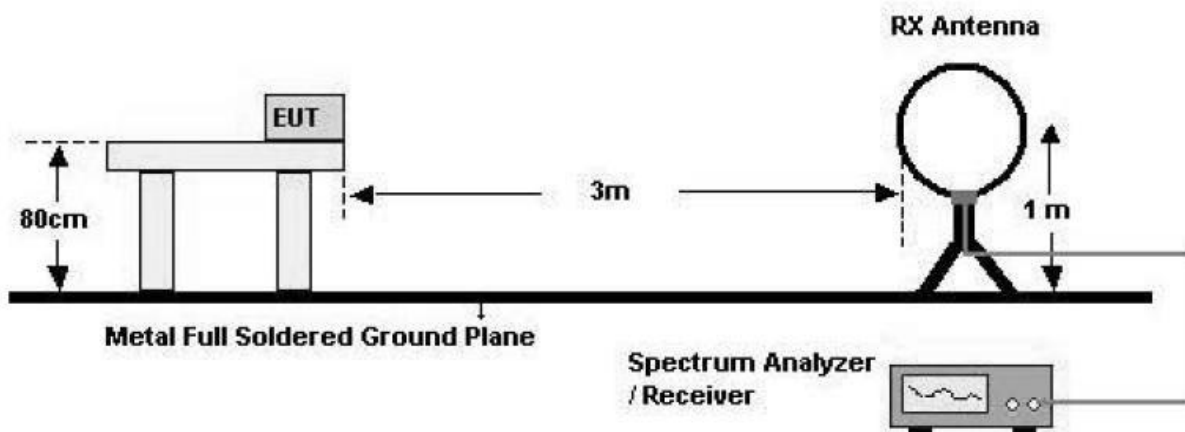
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

- Conducted Configuration

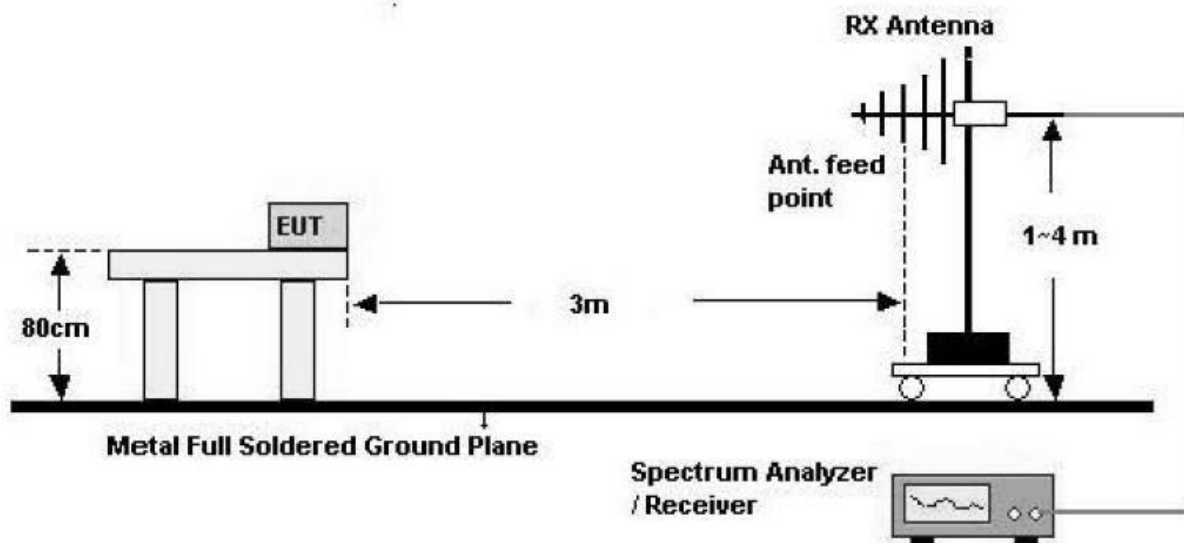


- Radiated Configuration

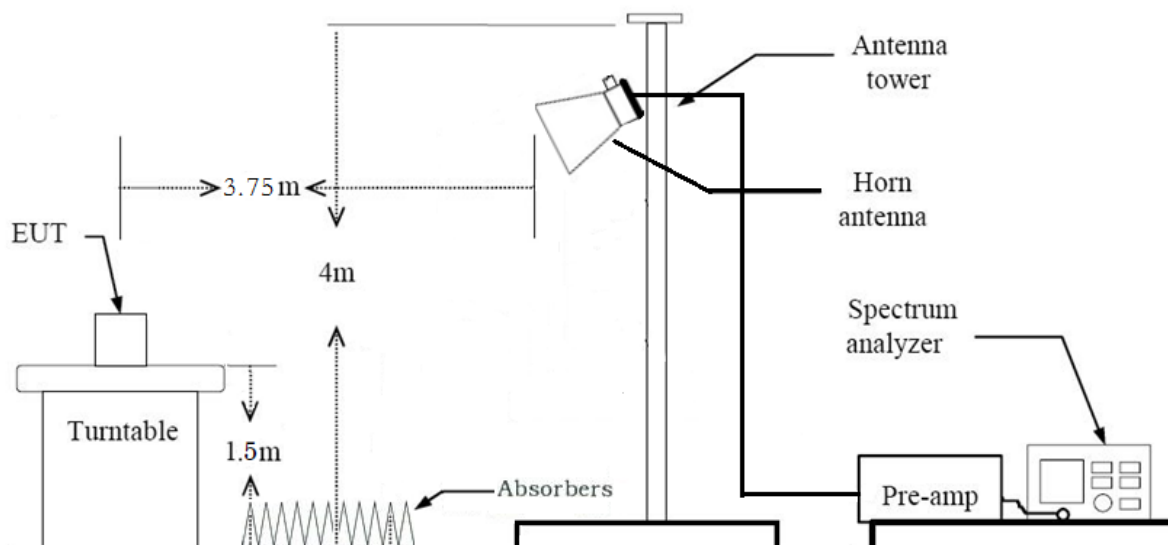
1. Below 30 MHz



2. 30 MHz - 1 GHz



3. Above 1 GHz



12.3 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)
■ - 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)
■ - BBHA9120D	Schwarzbeck	Horn Antenna	9120D-1366	Jul. 16, 2019 (1Y)
■ - BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jan. 07, 2020 (1Y)

All test equipment used is calibrated on a regular basis.

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EMC-003 (Rev.2)

12.4 Test data for conducted emission

-. Test Date : February 04, 2020 ~ February 07, 2020
 -. Resolution bandwidth : 100 kHz
 -. Video bandwidth : 300 kHz
 -. Detector : Peak
 -. Result : PASSED

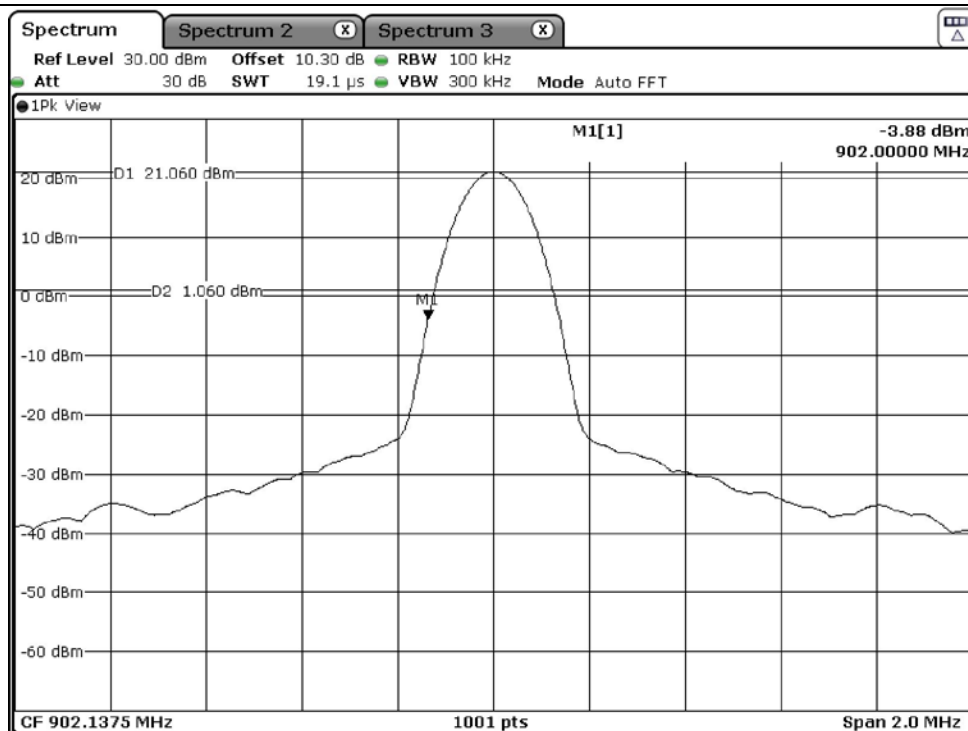
Channel	Frequency Range	Measured Value(dBm)	Limit(dBm)	Margin(dB)
Low	Fundamental	21.06	1.06	-
	30 M ~ 1 GHz	-35.42	1.06	36.48
	1 GHz ~ 10 GHz	-8.90	1.06	9.96
Middle	Fundamental	21.02	1.02	-
	30 M ~ 1 GHz	-36.51	1.02	37.53
	1 GHz ~ 10 GHz	-9.06	1.02	10.08
High	Fundamental	20.97	0.97	-
	30 M ~ 1 GHz	-36.43	0.97	37.40
	1 GHz ~ 10 GHz	-9.13	0.97	10.10

Tabulated test data for Restricted Band

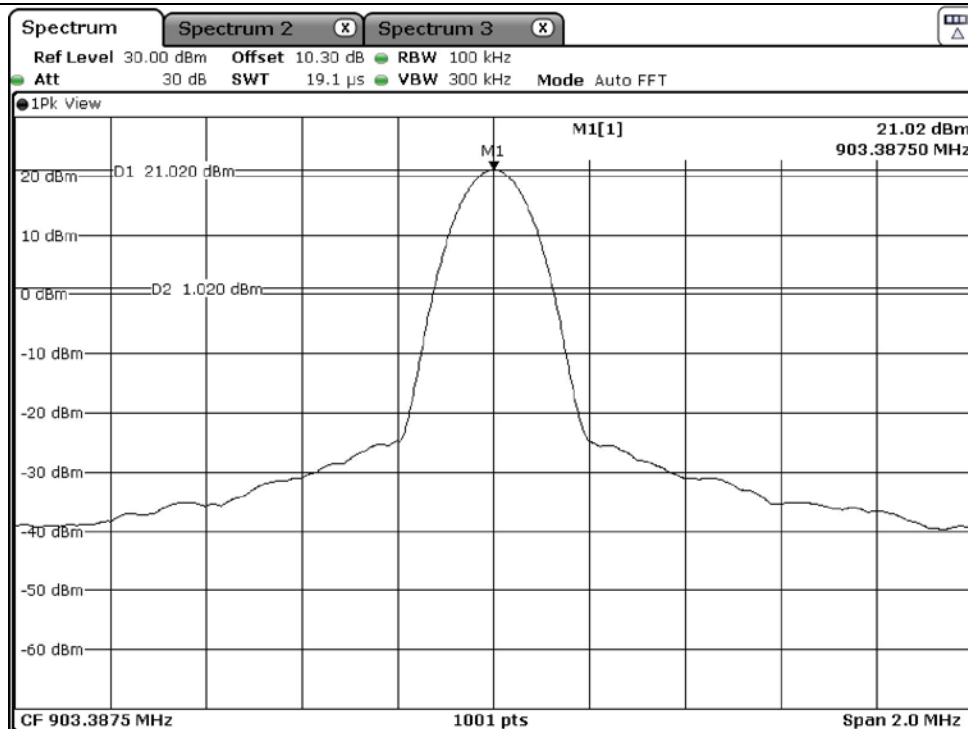
Remark: "H": Horizontal, "V": Vertical



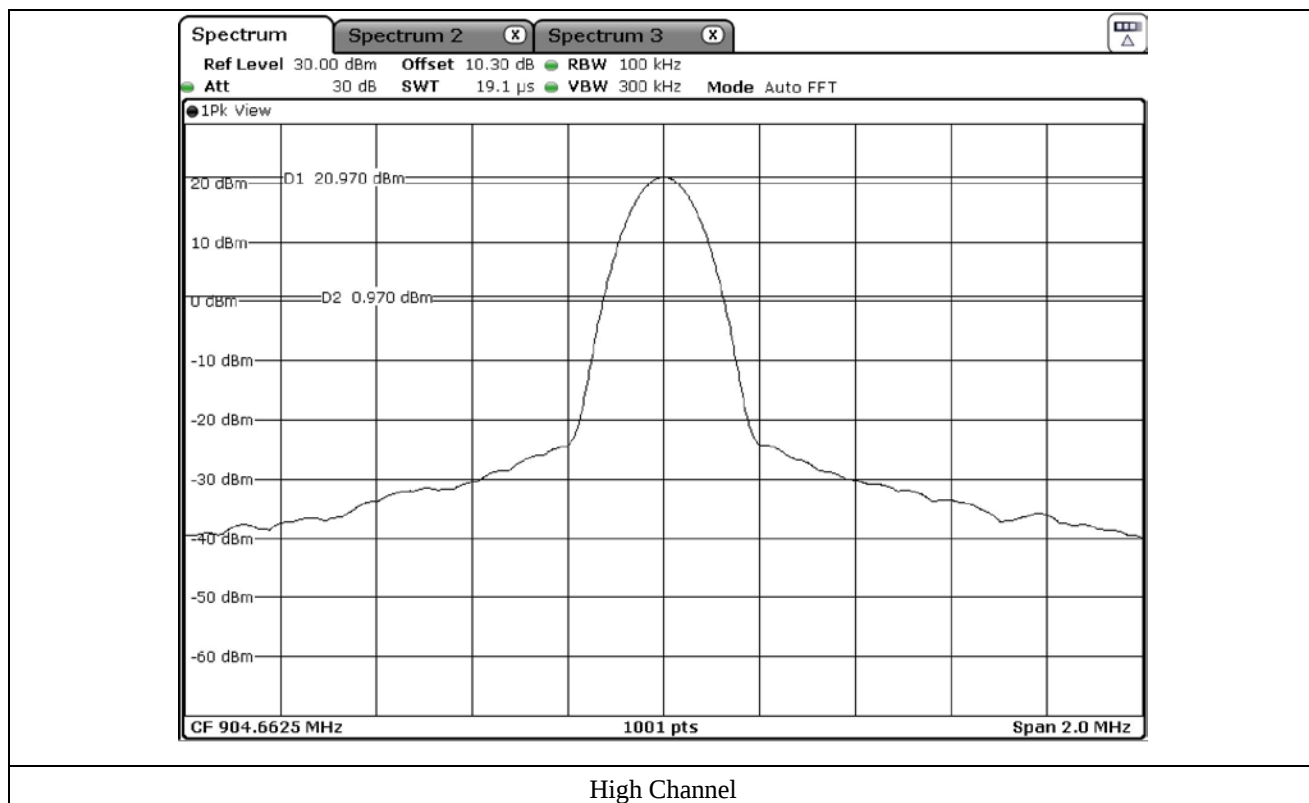
Tested by: Hyung-Kwon, Oh / Manager

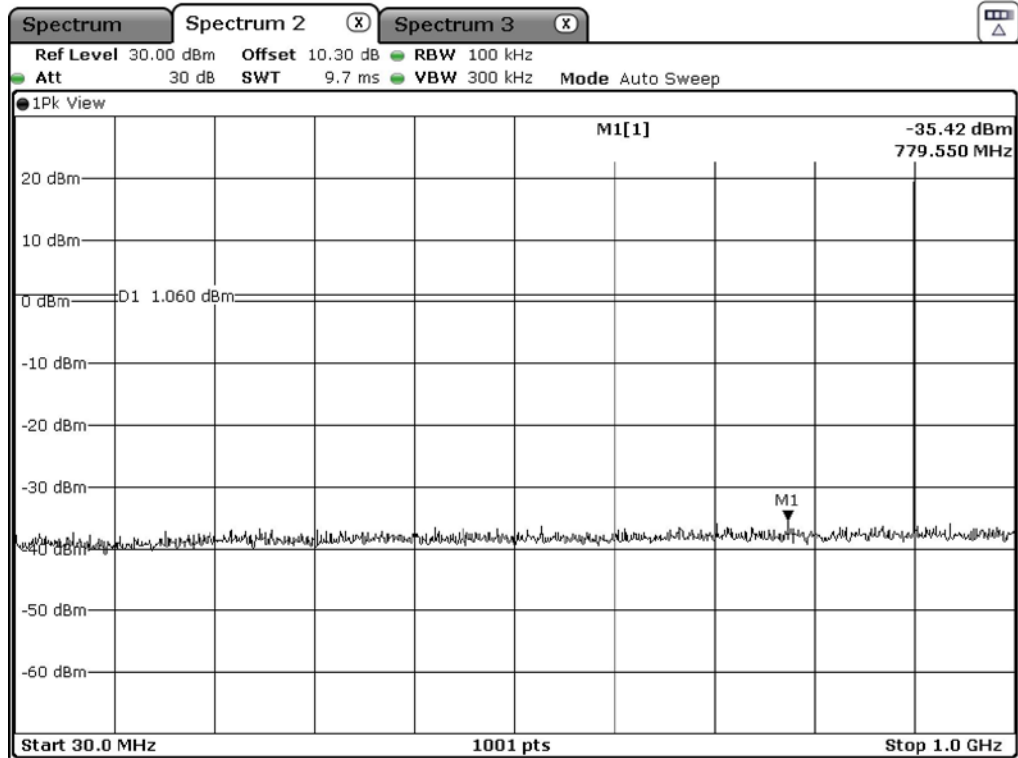


Low Channel

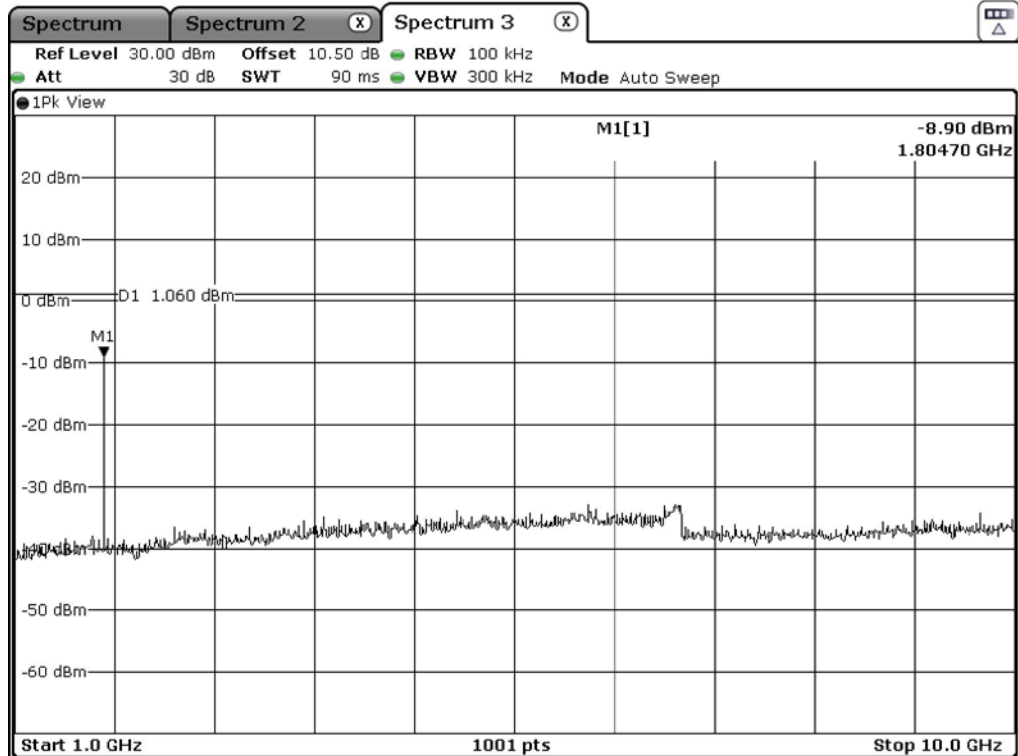


Middle Channel

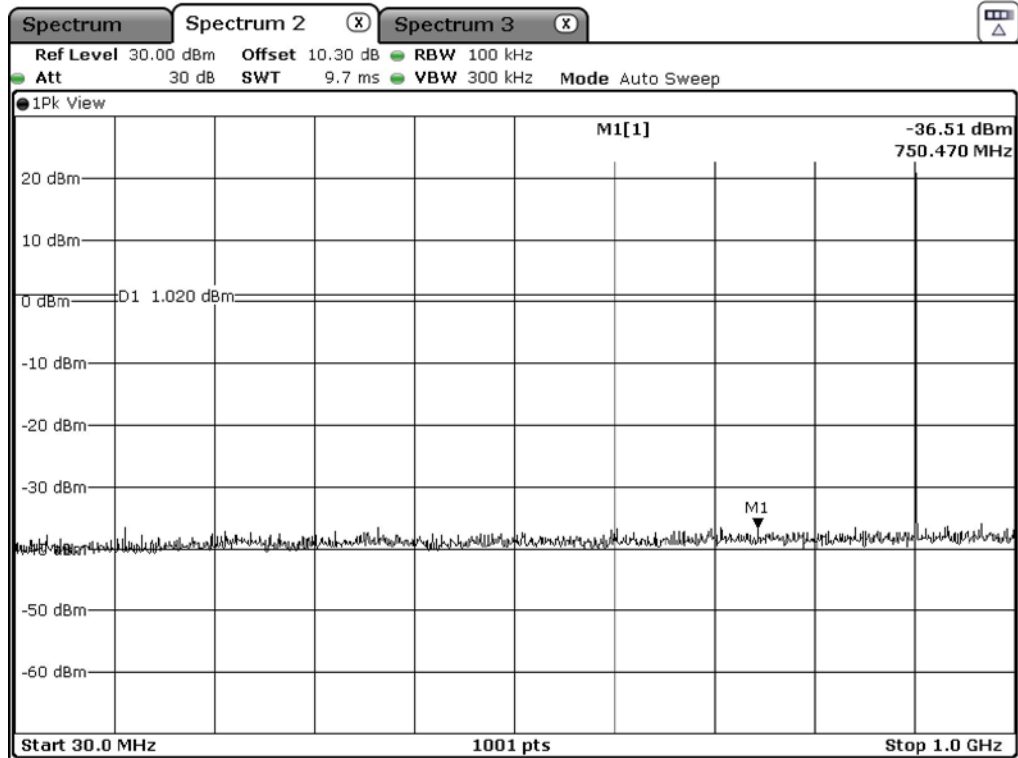




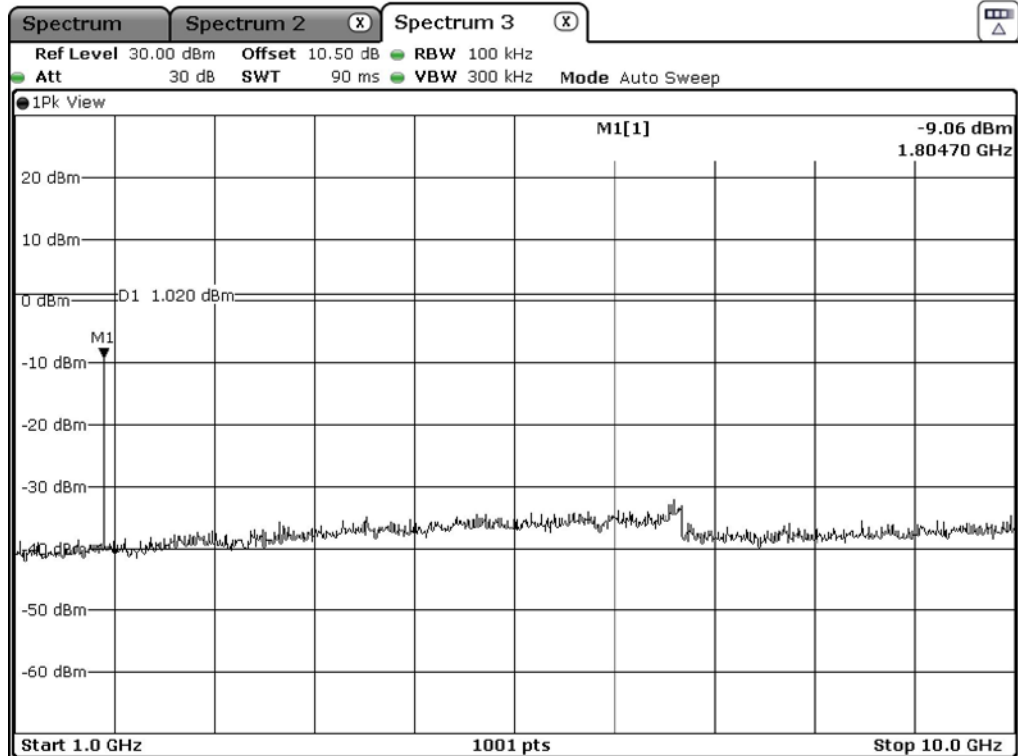
Low Channel



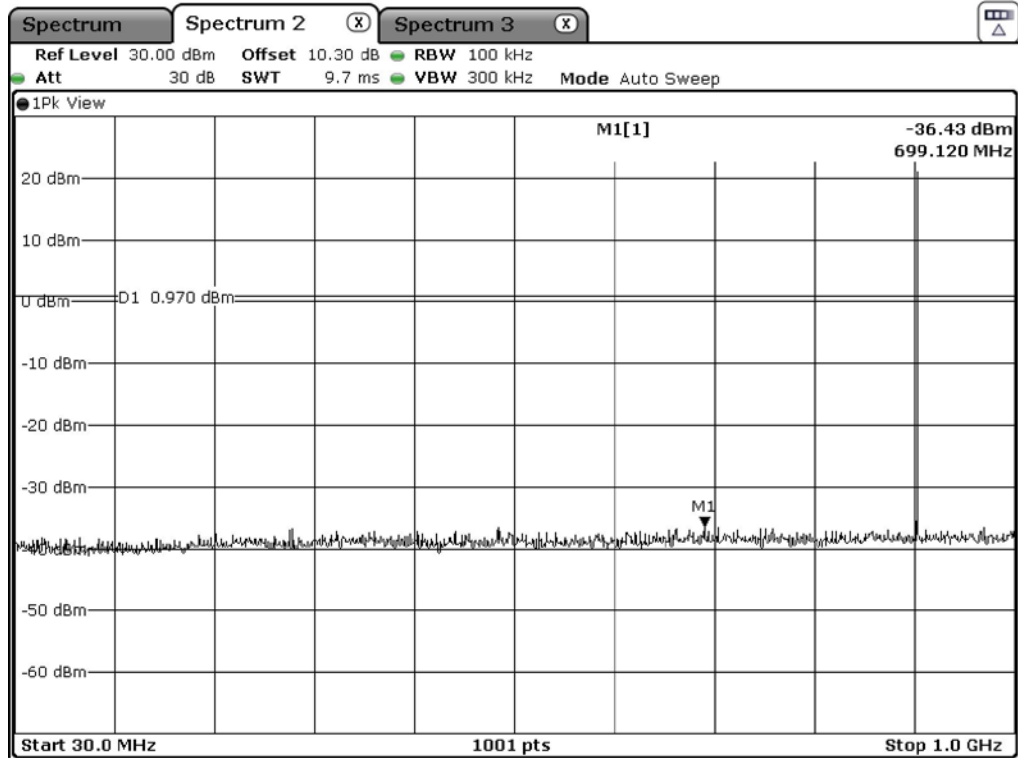
Low Channel



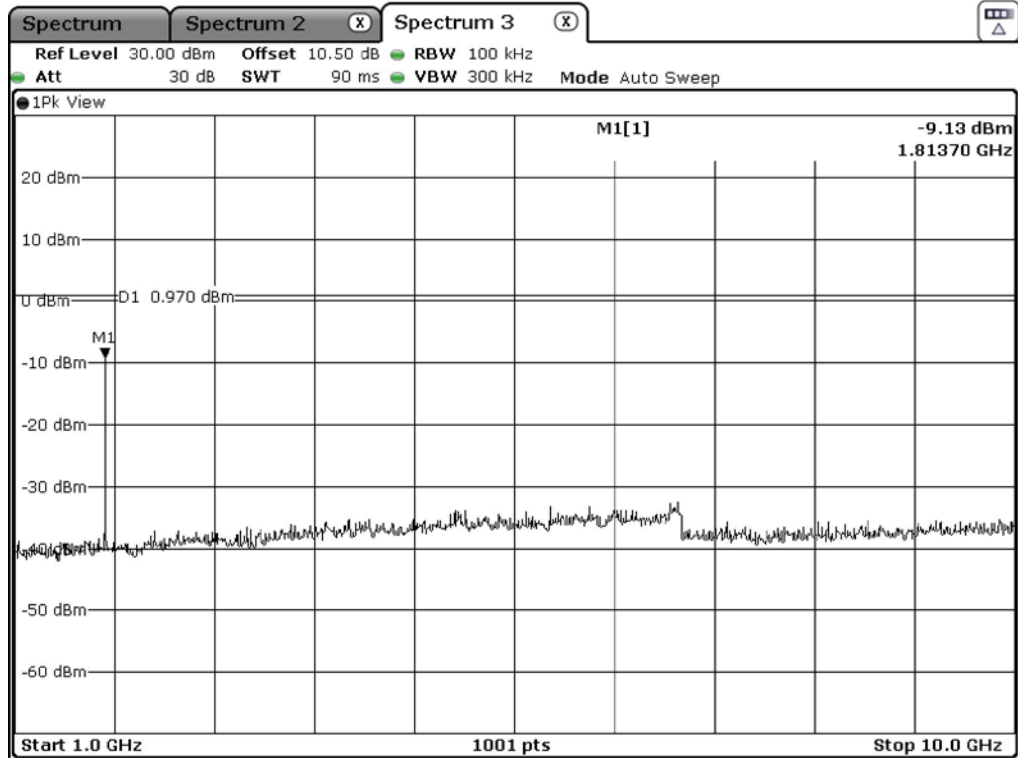
Middle Channel



Middle Channel



High Channel



High Channel

12.5 Test data for Transmitting mode radiated emission

12.5.1 Spurious & Harmonic Radiated Emission above 1 GHz

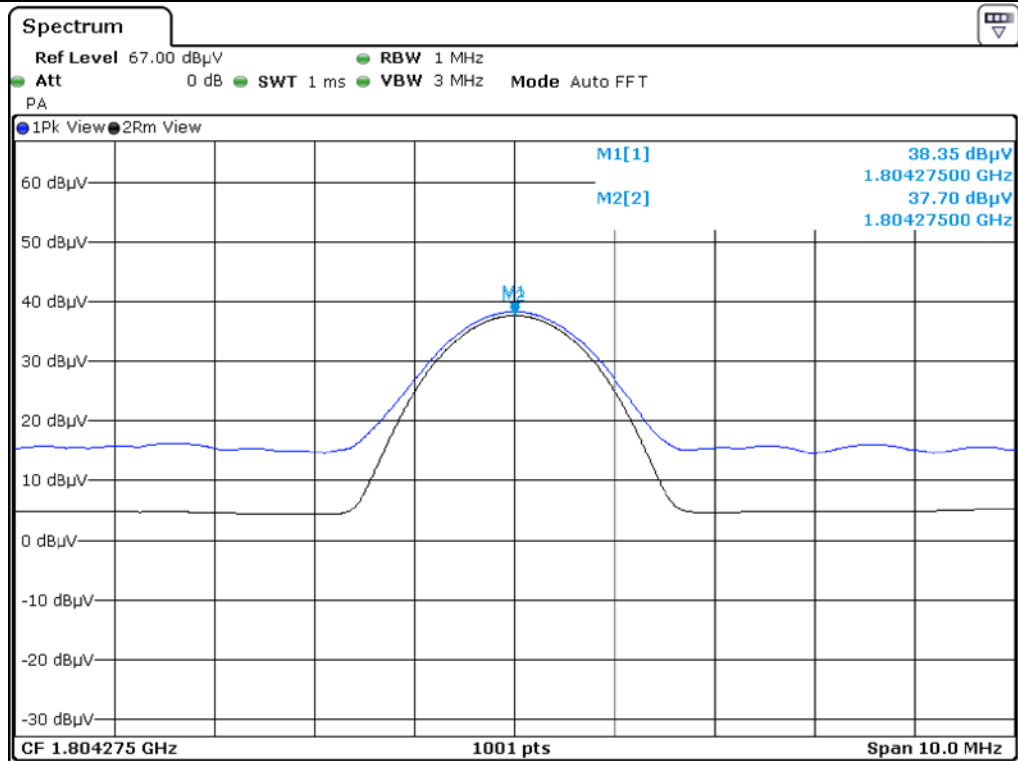
- Test Date : February 04, 2020 ~ February 07, 2020
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 3 MHz for Peak Mode(Peak Detector), 3 MHz for Average Mode(RMS Detector)
- Frequency range : 1 GHz ~ 10.0 GHz
- Duty Cycle : 32.38 %
- Measurement distance : 3 m
- Result : PASSED

Channel	Frequency (MHz)	Reading (dBuV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor (dB)	Total (dBuV/m)	Limits (dBuV/m)	Margin (dB)
Low	1 804.275	38.35	Peak	H	24.90	1.11	-	64.36	68.20	3.84
		36.94	Peak	V			-	62.95	68.20	5.25
	2 706.413	25.07	Peak	H	28.00	1.08	-	54.15	74.00	19.85
		16.21	Average	H			4.90	50.19	54.00	3.81
		22.18	Peak	V			-	51.26	74.00	22.74
		14.17	Average	V			4.90	48.15	54.00	5.85
Middle	1 806.775	36.66	Peak	H	24.90	1.11	-	62.67	68.20	5.53
		35.90	Peak	V			-	61.91	68.20	6.29
	2 710.163	24.75	Peak	H	28.00	1.08	-	53.83	74.00	20.17
		14.31	Average	H			4.90	48.29	54.00	5.71
		24.97	Peak	V			-	54.05	74.00	19.95
		13.02	Average	V			4.90	47.00	54.00	7.00
High	1 809.325	37.33	Peak	H	24.90	1.11	-	63.34	68.20	4.86
		36.60	Peak	V			-	62.61	68.20	5.59
	2 713.988	25.12	Peak	H	28.00	1.08	-	54.20	74.00	19.80
		14.02	Average	H			4.90	48.00	54.00	6.00
		25.05	Peak	V			-	54.13	74.00	19.87
		13.36	Average	V			4.90	47.34	54.00	6.66

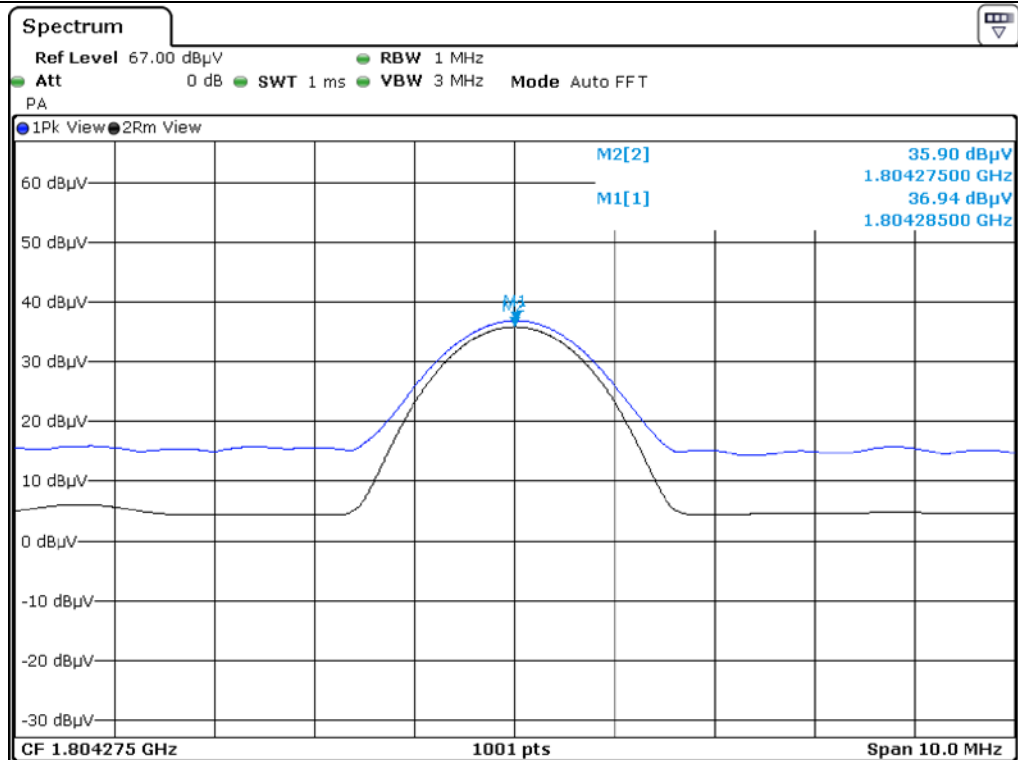
Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical, "*" Frequency fall in restricted band

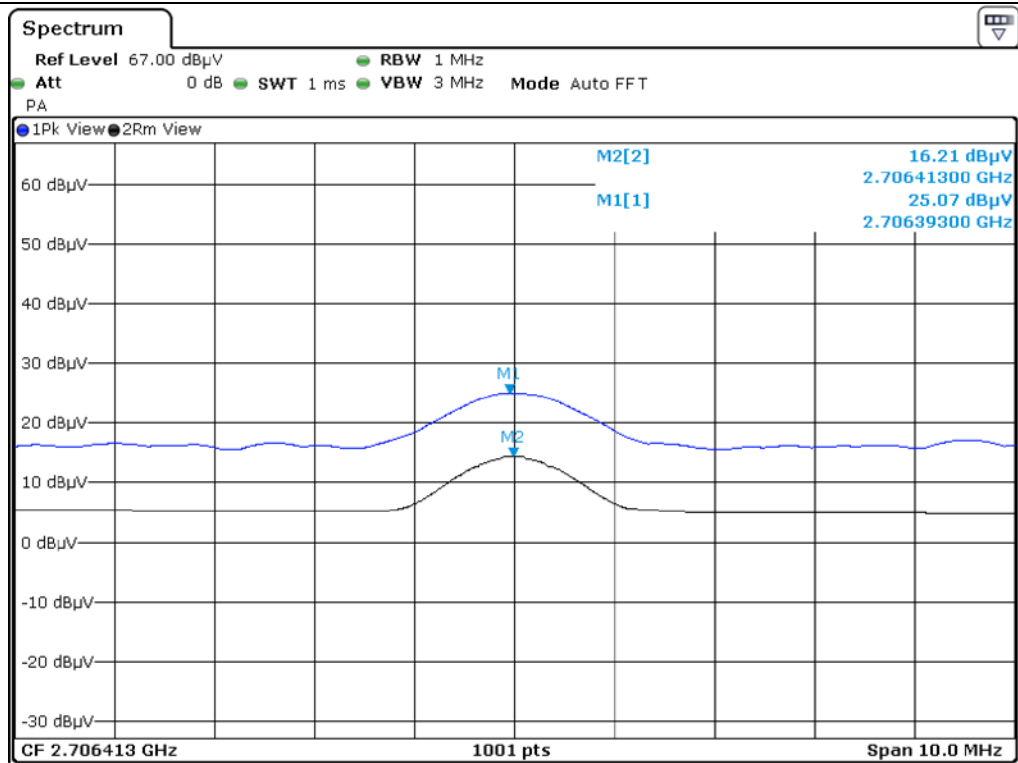

Tested by: Hyung-Kwon, Oh / Manager



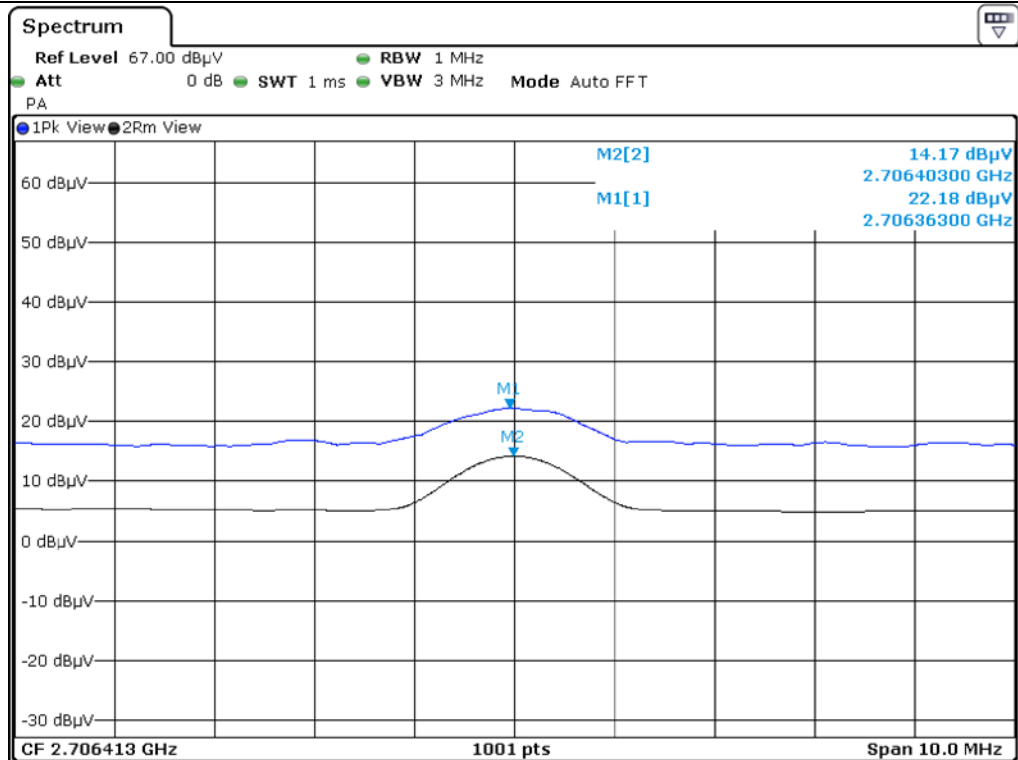
Low Channel_2nd Harmonic_H



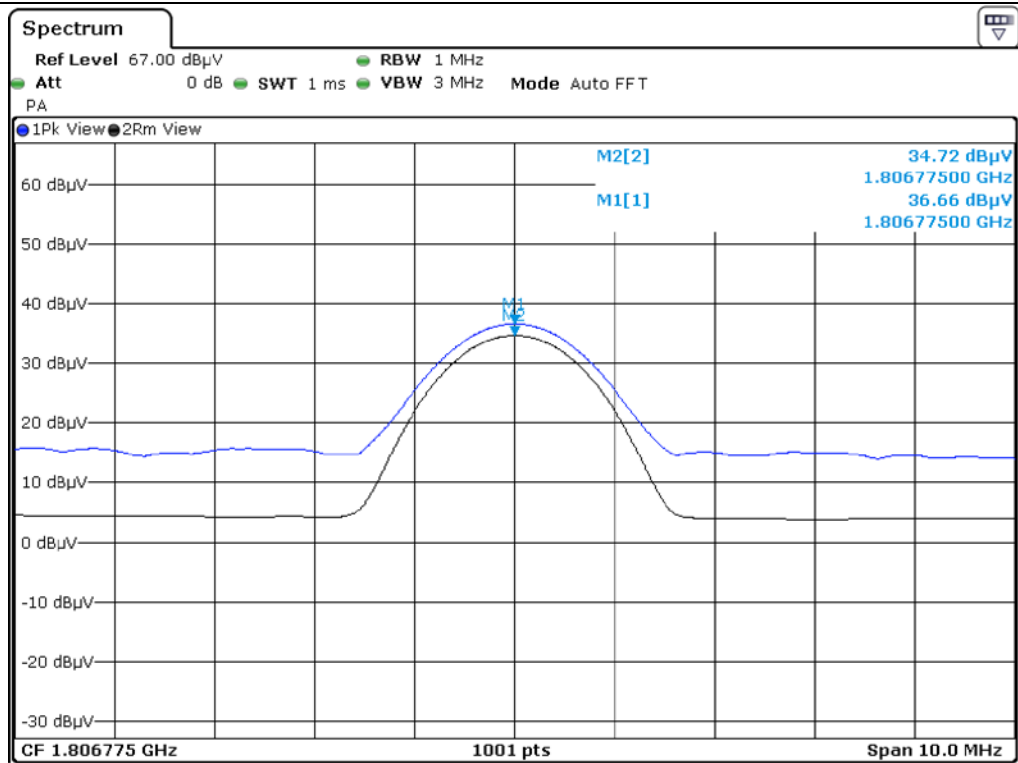
Low Channel_2nd Harmonic_V



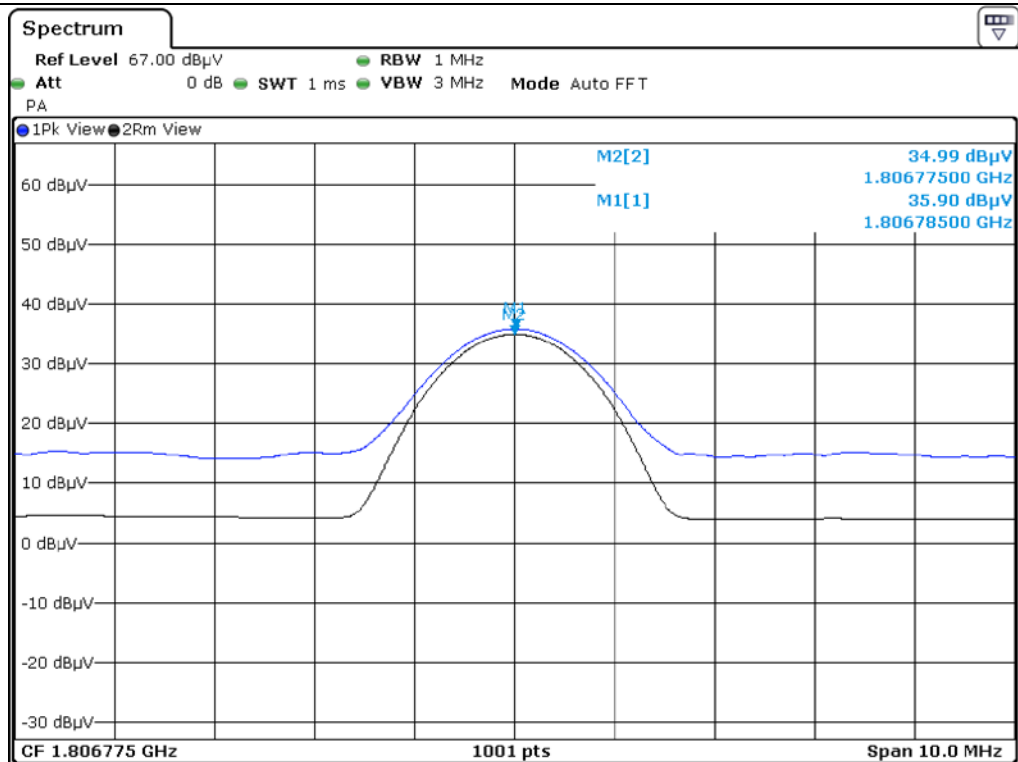
Low Channel_3rd Harmonic_H



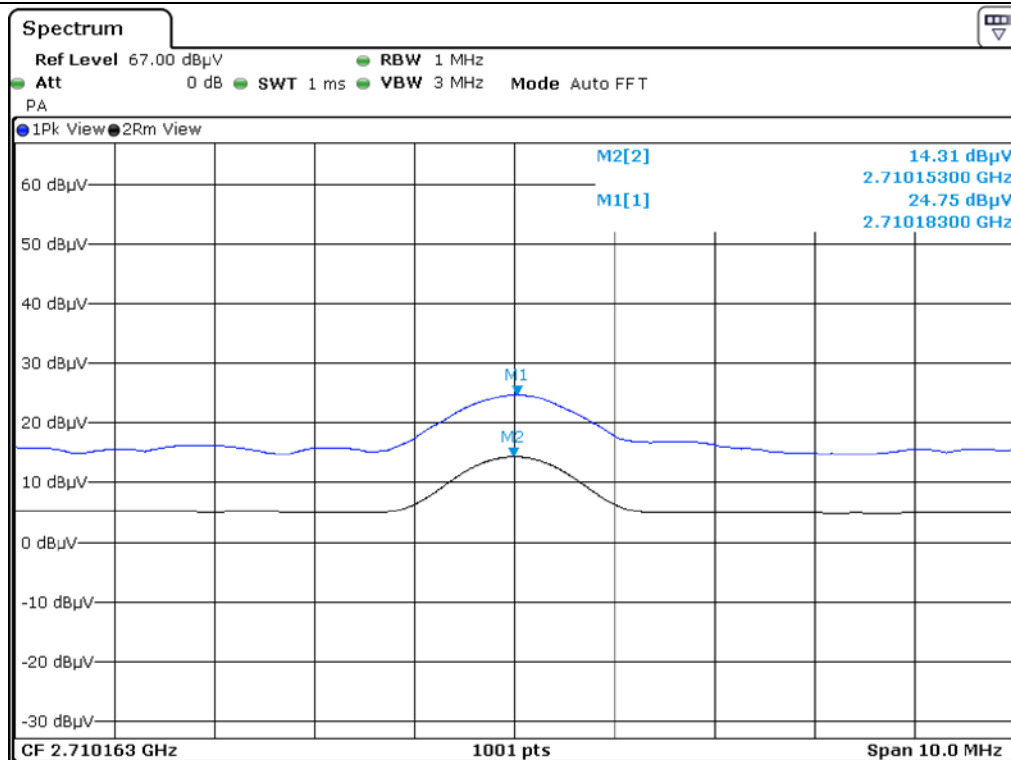
Low Channel_3rd Harmonic_V



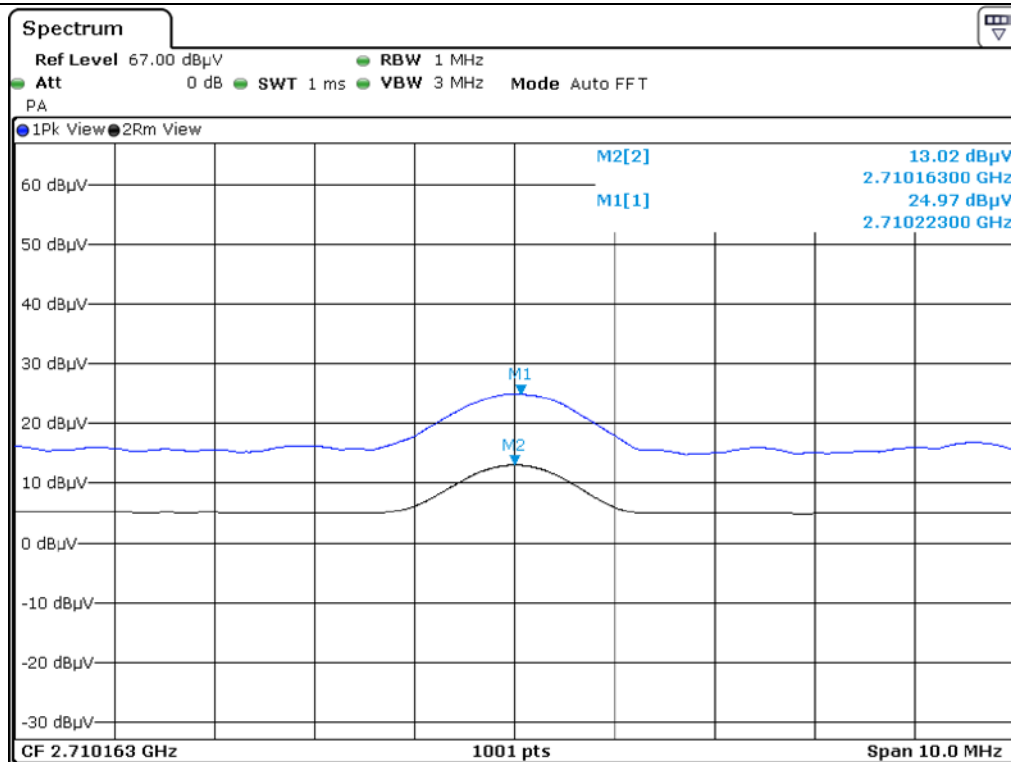
Middle Channel_2nd Harmonic_H



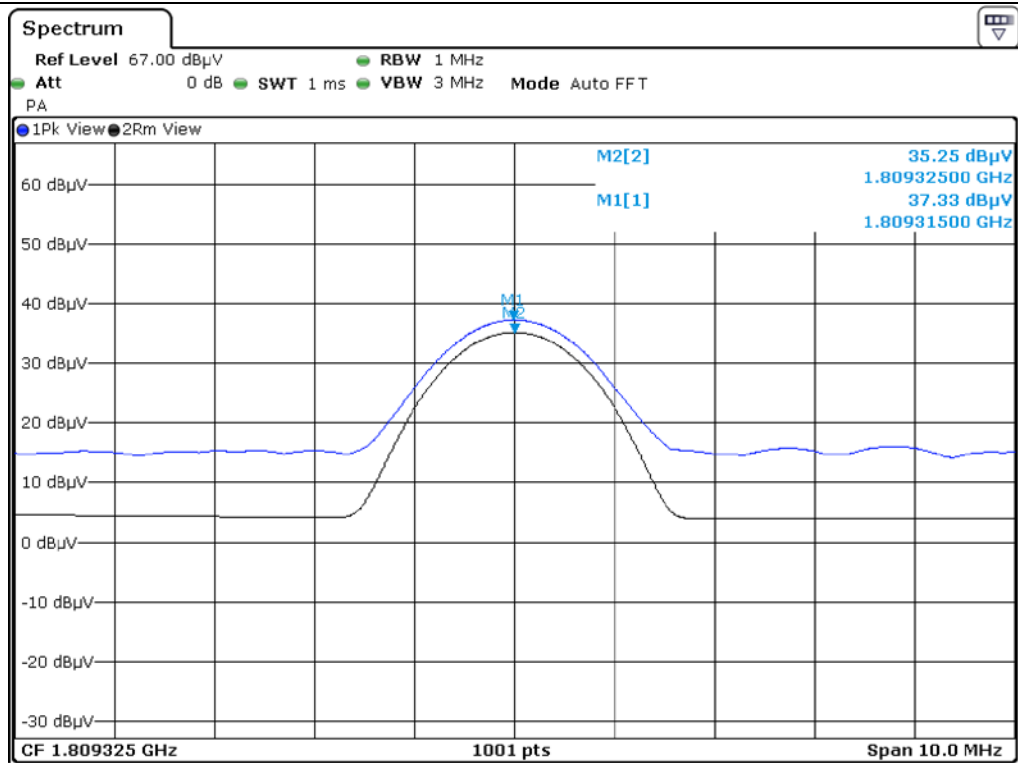
Middle Channel_2nd Harmonic_V



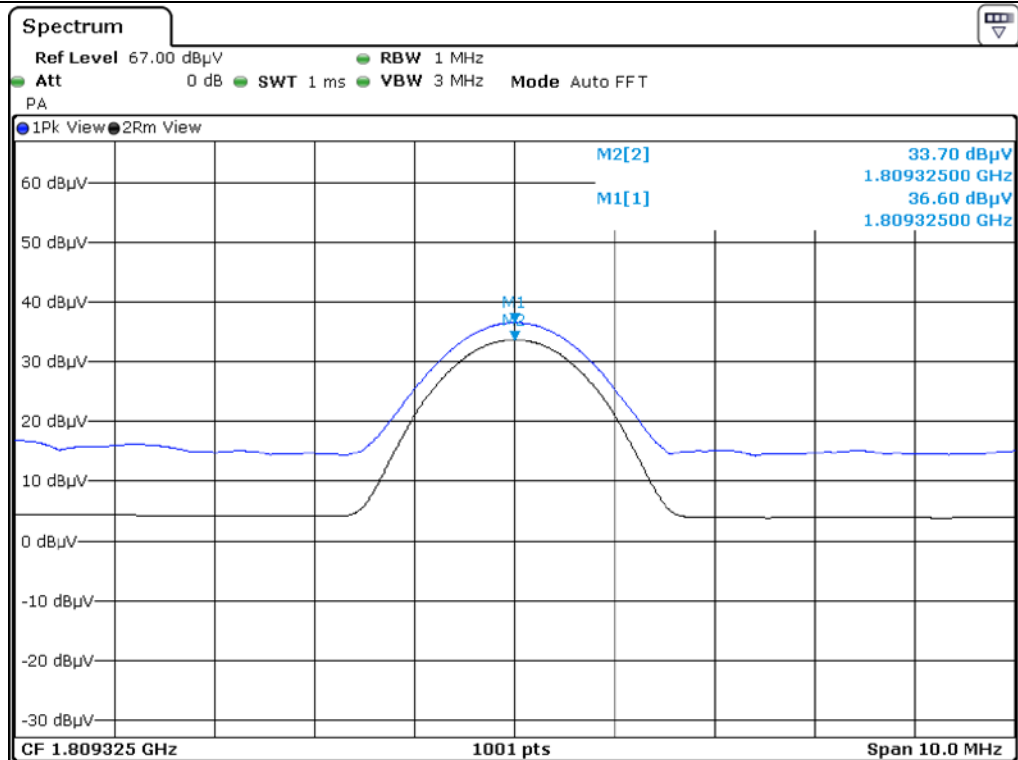
Middle Channel_3rd Harmonic_H



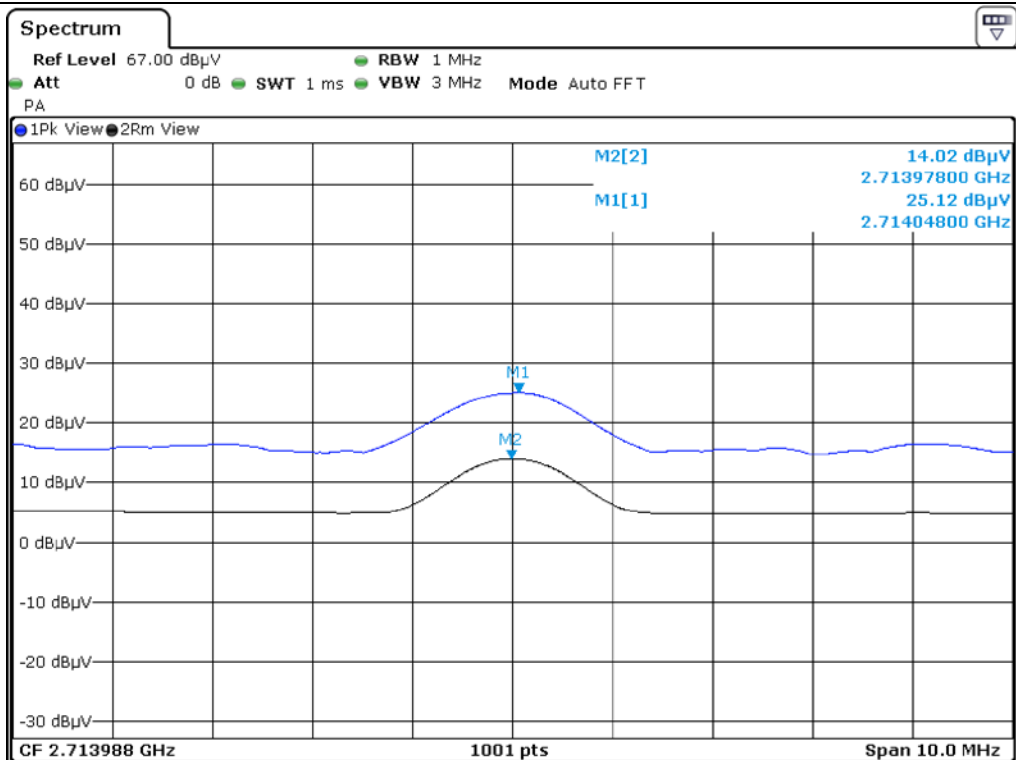
Middle Channel_3rd Harmonic_V



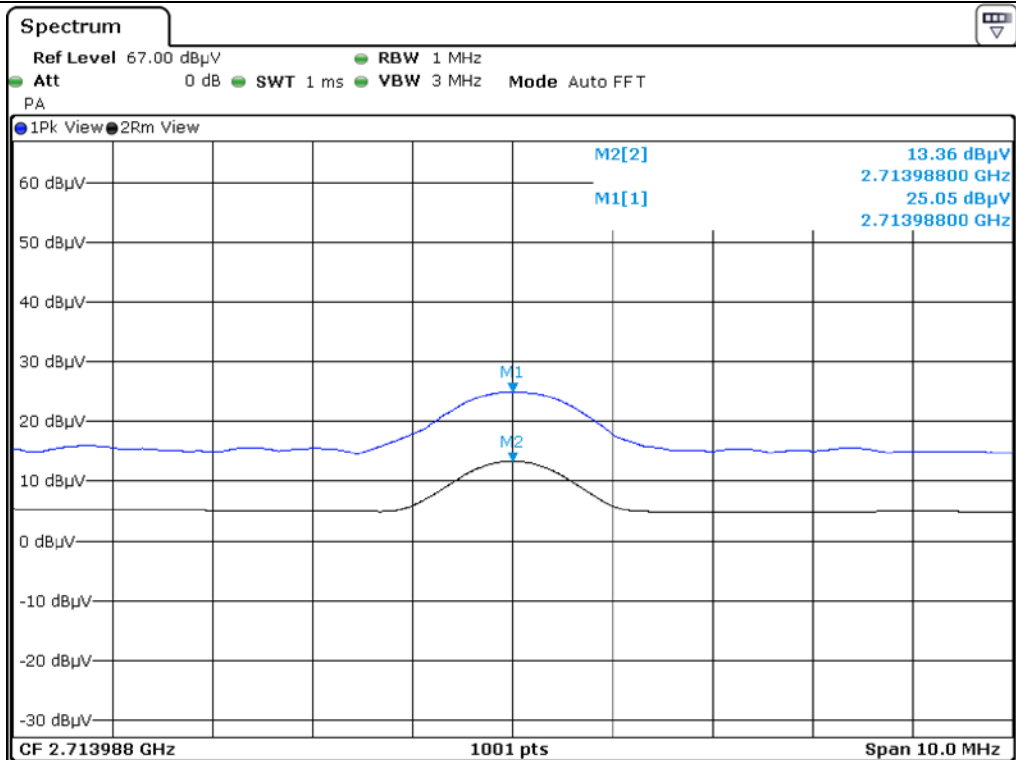
High Channel_2nd Harmonic_H



High Channel_2nd Harmonic_V



High Channel_3rd Harmonic_H



High Channel_3rd Harmonic_V

13. RADIATED EMISSION TEST

13.1 Operating environment

Temperature : 23 °C
Relative humidity : 46 % R.H.

13.2 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 9 kHz to 10.0 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.

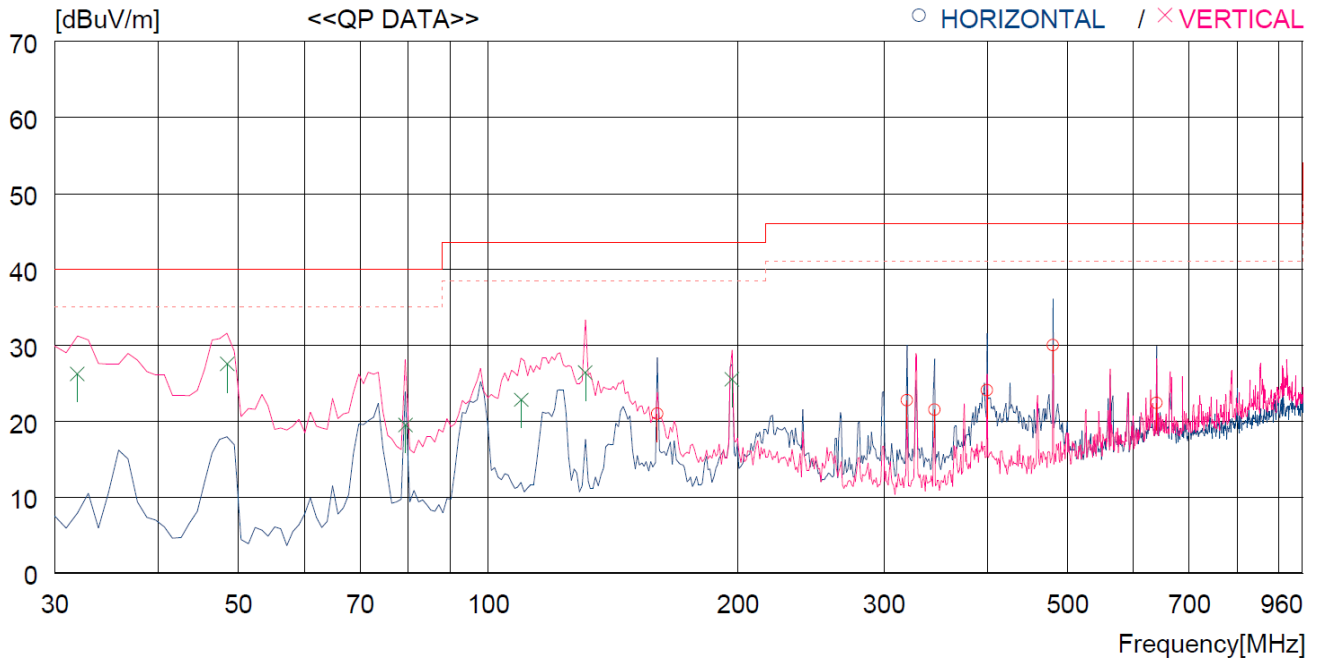
13.3 Test equipment used

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)
■ - BBHA9120D	Schwarzbeck	Horn Antenna	9120D-1366	Jul. 16, 2019 (1Y)
■ - BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jan. 07, 2020 (1Y)

All test equipment used is calibrated on a regular basis.

13.4 Test data for 30 MHz ~ 1 000 MHz

- Test Date : February 04, 2020 ~ February 07, 2020
- Resolution bandwidth : 120 kHz
- Frequency range : 30 MHz ~ 1 000 MHz
- Measurement distance : 3 m



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	QP [dBuV]	FACTOR [dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	159.980	42.2	8.7	3.0	33.0	20.9	43.5	22.6	100	184
2	320.030	37.6	14.0	4.1	33.0	22.7	46.0	23.3	100	16
3	345.250	35.5	14.7	4.3	33.0	21.5	46.0	24.5	100	184
4	399.570	36.6	15.9	4.6	33.1	24.0	46.0	22.0	100	0
5	480.081	41.1	17.0	5.1	33.2	30.0	46.0	16.0	100	181
6	640.127	30.2	19.7	5.8	33.3	22.4	46.0	23.6	100	98
----- Vertical -----										
7	31.940	45.3	12.7	1.3	33.1	26.2	40.0	13.8	100	195
8	48.430	44.8	14.2	1.6	33.1	27.5	40.0	12.5	100	359
9	79.470	42.8	7.7	2.0	33.0	19.5	40.0	20.5	100	359
10	109.540	41.9	11.5	2.4	33.0	22.8	43.5	20.7	100	179
11	130.880	47.8	9.0	2.6	33.0	26.4	43.5	17.1	100	359
12	196.840	44.4	10.8	3.3	33.0	25.5	43.5	18.0	100	282

Tested by: Hyung-Kwon, Oh / Manager

13.5 Test data for Below 30 MHz

- . Test Date : February 04, 2020 ~ February 07, 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

Frequency (MHz)	Reading (dB μ V)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
It was not observed any emissions from the EUT.								

13.6 Test data for above 1 GHz

- . Test Date : February 04, 2020 ~ February 07, 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 ~ 10.0 GHz
- . Measurement distance : 3 m

Frequency (MHz)	Reading (dB μ V)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
It was not observed any emissions from the EUT.								


 Tested by: Hyung-Kwon, Oh / Manager

14. CONDUCTED EMISSION TEST

14.1 Operating environment

Temperature : 23 °C
Relative humidity : 46 % R.H.

14.2 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.

14.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	ESCI	Rohde & Schwarz	Test Receiver	101012	Oct. 22, 2019 (1Y)
□ -	ESU	Rohde & Schwarz	Test Receiver	100261	Mar. 28, 2019 (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.

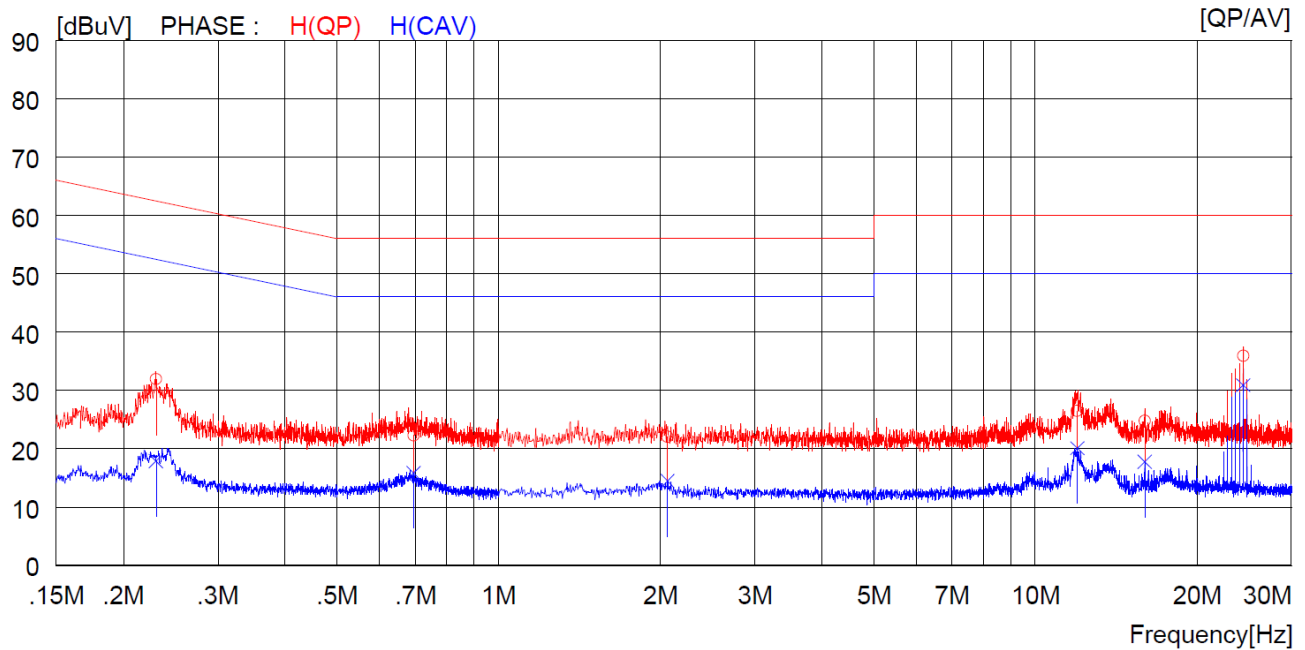
14.4 Test data

-. Test Date : February 04, 2020 ~ February 07, 2020

-. Resolution bandwidth : 9 kHz

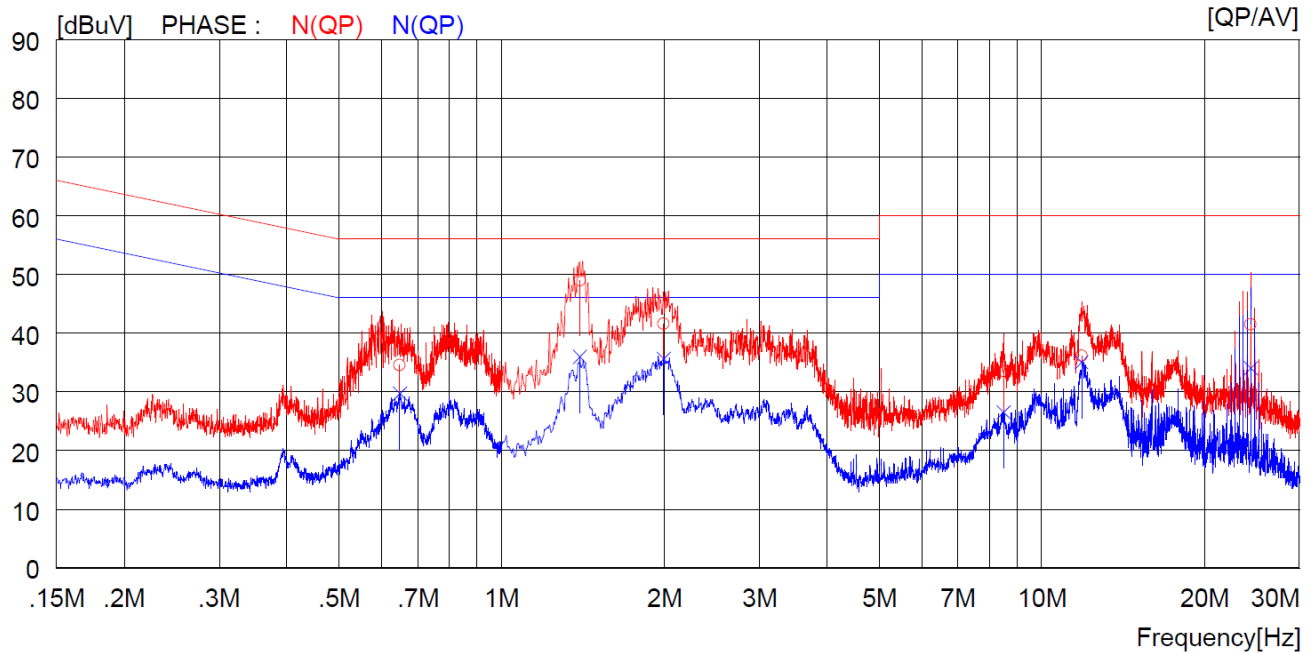
-. Frequency range : 0.15 MHz ~ 30 MHz

-. 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	0.23000	21.8	----	10.1	31.9	----	62.4	----	30.5	----	H (QP)
2	0.69500	12.2	----	10.1	22.3	----	56.0	----	33.7	----	H (QP)
3	2.06400	12.0	----	10.1	22.1	----	56.0	----	33.9	----	H (QP)
4	11.96000	16.2	----	10.3	26.5	----	60.0	----	33.5	----	H (QP)
5	15.98000	14.4	----	10.4	24.8	----	60.0	----	35.2	----	H (QP)
6	24.39000	25.5	----	10.4	35.9	----	60.0	----	24.1	----	H (QP)
7	0.23000	----	7.8	10.1	----	17.9	----	52.4	----	34.5	H (CAV)
8	0.69500	----	5.8	10.1	----	15.9	----	46.0	----	30.1	H (CAV)
9	2.06400	----	4.4	10.1	----	14.5	----	46.0	----	31.5	H (CAV)
10	11.96000	----	9.8	10.3	----	20.1	----	50.0	----	29.9	H (CAV)
11	15.98000	----	7.4	10.4	----	17.8	----	50.0	----	32.2	H (CAV)
12	24.39000	----	20.5	10.4	----	30.9	----	50.0	----	19.1	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	0.64800	24.4	----	10.1	34.5	----	56.0	----	21.5	----	N (QP)
2	1.39600	38.9	----	10.1	49.0	----	56.0	----	7.0	----	N (QP)
3	1.99600	31.5	----	10.1	41.6	----	56.0	----	14.4	----	N (QP)
4	8.50500	23.3	----	10.2	33.5	----	60.0	----	26.5	----	N (QP)
5	11.86000	25.8	----	10.3	36.1	----	60.0	----	23.9	----	N (QP)
6	24.38000	31.1	----	10.4	41.5	----	60.0	----	18.5	----	N (QP)
7	0.64800	----	19.6	10.1	----	29.7	----	46.0	----	16.3	N (CAV)
8	1.39600	----	25.9	10.1	----	36.0	----	46.0	----	10.0	N (CAV)
9	1.99600	----	25.5	10.1	----	35.6	----	46.0	----	10.4	N (CAV)
10	8.50500	----	16.3	10.2	----	26.5	----	50.0	----	23.5	N (CAV)
11	11.86000	----	24.8	10.3	----	35.1	----	50.0	----	14.9	N (CAV)
12	24.38000	----	23.6	10.4	----	34.0	----	50.0	----	16.0	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 / Manager