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

Test Report No.	**: OT-189-RWD-054**
AGR No.	**: A189A-120**
Applicant	**: Samsung Electronics Co., Ltd.**
Address	**: 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 17113 Republic of Korea**
Manufacturer	**: Samsung Electronics Co., Ltd.**
Address	**: 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 17113 Republic of Korea**
Type of Equipment	**: ARTIK-0530**
FCC ID.	**: A3LSIP005AFS30**
IC Certification No.	**: 649E-SIP005AFS30**
Model Name	**: SIP005AFS30**
Multiple Model Name	**: N/A**
Serial number	**: N/A**
Total page of Report	**: 23 pages (including this page)**
Date of Incoming	**: September 02, 2018**
Date of issue	**: September 28, 2018**

SUMMARY

The equipment complies with the regulation; ***FCC PART 15 SUBPART C Section 15.247 and IC RSS-Gen Issue 4 Nov 2014 and RSS-247 Issue 2 February 2017***

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: 남기홍

Ki-Hong, Nam / Chief Engineer
ONETECH Corp.

Approved by:

Keun-Young, Choi / Vice President
ONETECH Corp.

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-189-RWD-054	2018.09.28	Initial Release	All

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1. VERIFICATION OF COMPLIANCE

Applicant	: Samsung Electronics Co., Ltd.
Address	: 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 17113 Republic of Korea
Contact Person	: Lee, Jae-Hyuk
Telephone No.	: +82-10-8848-6628
FCC ID	: A3LSIP005AFS30
IC Certification No.	: 649E-SIP005AFS30
Model Name	: SIP005AFS30
Serial Number	: N/A
Date	: September 28, 2018

EQUIPMENT CLASS	FCC: DTS – DIGITAL TRNSMISSION SYSTEM IC : Low Power License-Exempt Radio-communication Device
E.U.T. DESCRIPTION	Modular Transmitter, ARTIK-0530
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, RSS-Gen Issue 4 Nov 2014, RSS-247 Issue 2 February 2017
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&IC 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.

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2. TEST SUMMARY

2.1 Test items and results

SECTION		TEST ITEMS	RESULTS
15.205(a) 15.209 15.247(d)	RSS-247 Issue 2 5.5 RSS-Gen Issue 4 8.9	Transmitter Radiated Spurious Emissions	Met the Limit / PASS
15.247(a)(2)	RSS-247 Issue 2 5.2(1) RSS-Gen Issue 4 6.6	6 dB Bandwidth & 99 % Bandwidth	PASS (Note1)
15.247(b)(3)	RSS-247 Issue 2 5.4(4)	Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247(e)	RSS-247 Issue 2 5.2(2)	Power Spectral Density	PASS (Note1)
15.207	RSS-Gen Issue 4 8.8	AC Power Line Conducted Emissions	PASS (Note1)

Note1 - The EUT have a RF Test already approved. (Report No:16K23791-E5V3)

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, IC RSS-Gen Issue 4 Nov 2014 and RSS-247 Issue 2 February 2017

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 SIP005AFS30 (referred to as the EUT in this report) is a ARTIK-0530. Product specification information described herein was obtained from product data sheet or user's manual. .

DEVICE TYPE	ARTIK-0530	
Operating Frequency	2 402 MHz ~ 2 480 MHz (Bluetooth, Bluetooth Low Energy), 2 405 MHz ~ 2 475 MHz (Zigbee), 2 412 MHz ~ 2 462 MHz (11b/g/n_HT20), 5 745 MHz ~ 5 825 MHz (UNII 3: 11a/n_HT20), 5 755 MHz ~ 5 795 MHz (UNII 3: 11n_HT40), 5 180 MHz ~ 5 240 MHz (UNII 1: 11a/n_HT20), 5 190 MHz ~ 5 230 MHz (UNII 1: 11n_HT40), 5 260 MHz ~ 5 320 MHz (UNII 2A: 11a/n_HT20), 5 270 MHz ~ 5 310 MHz (UNII 2A: 11n_HT40), 5 500 MHz ~ 5 720 MHz (UNII 2C: 11a/n_HT20), 5 510 MHz ~ 5 710 MHz (UNII 2C: 11n_HT40),	
Modulation Type	DSSS, OFDM, GFSK, π/4DQPSK, 8DPSK	
Number of Channels	79 channel (Bluetooth), 40 channel (Bluetooth Low Energy), 15 channel (Zigbee), 11 channel (11b/g/n_HT20), 5 channel (UNII 3: 11a/n_HT20), 2 channel (UNII 3: 11n_HT40), 4 channel (UNII 1: 11a/n_HT20), 2 channel (UNII 1: 11n_HT40), 4 channel (UNII 2A: 11a/n_HT20), 2 channel (UNII 2A: 11n_HT40), 9 channel (UNII 2C: 11a/n_HT20), 4 channel (UNII 2C: 11n_HT40)	
Antenna Type	Dipole antenna	
Antenna Gain	Bluetooth(BDR / EDR / LE), Zigbee WLAN 2.4 GHz Band	3.80 dBi
	WLAN 5 GHz Band	5.50 dBi

3.2 Alternative type(s)/model(s); also covered by this test report.

-. None

3.3 Mode of operation during the test

To get a maximum radiated 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 test report.

4. EUT MODIFICATIONS

-. None

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5. Transmitter Radiated Spurious Emissions

5.1 Operating environment

Temperature : 28 ℃

Relative humidity : 46 % R.H.

5.2 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.

5.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 14, 2018 (1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Mar. 29, 2018 (1Y)
■ -	310N	Sonoma Instrument	Pre-Amplifier	312544	Mar. 28, 2018 (1Y)
■ -	BBV9718	Schwarzbeck	Amplifier	310	Mar. 30, 2018 (1Y)
■	SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Mar. 15, 2018 (1Y)
■ -	DT3000-3t	Innco System	Turn Table	DT3000/093	N/A
■ -	MA-4000XPET	Innco System	Antenna Master	MA4000/509	N/A
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-419	Oct. 17, 2017 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170179	Jul. 28, 2017 (2Y)

All test equipment used is calibrated on a regular basis.

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5.4 Test Data for Radiated Emission

5.4.1 Radiated Emission which fall in the Restricted Band

-. Test Date : September 12, 2018 ~ September 21, 2018

-. 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

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Test Data for Low Channel									
2 343.090	44.76	Peak	H	26.91	9.17	34.30	46.54	74.00	27.46
2 310.000	34.17	Average	H	26.91	9.17	34.30	35.95	54.00	18.05
2 319.910	44.47	Peak	V	26.91	9.17	34.30	46.25	74.00	27.75
2 342.990	34.35	Average	V	26.91	9.17	34.30	36.13	54.00	17.87
Test Data for High Channel									
2 487.220	44.40	Peak	H	27.47	9.49	34.46	46.90	74.00	27.10
2 483.500	34.15	Average	H	27.47	9.49	34.46	36.65	54.00	17.35
2 496.170	44.97	Peak	V	27.47	9.49	34.46	47.47	74.00	26.53
2 497.400	34.25	Average	V	27.47	9.49	34.46	36.75	54.00	17.25

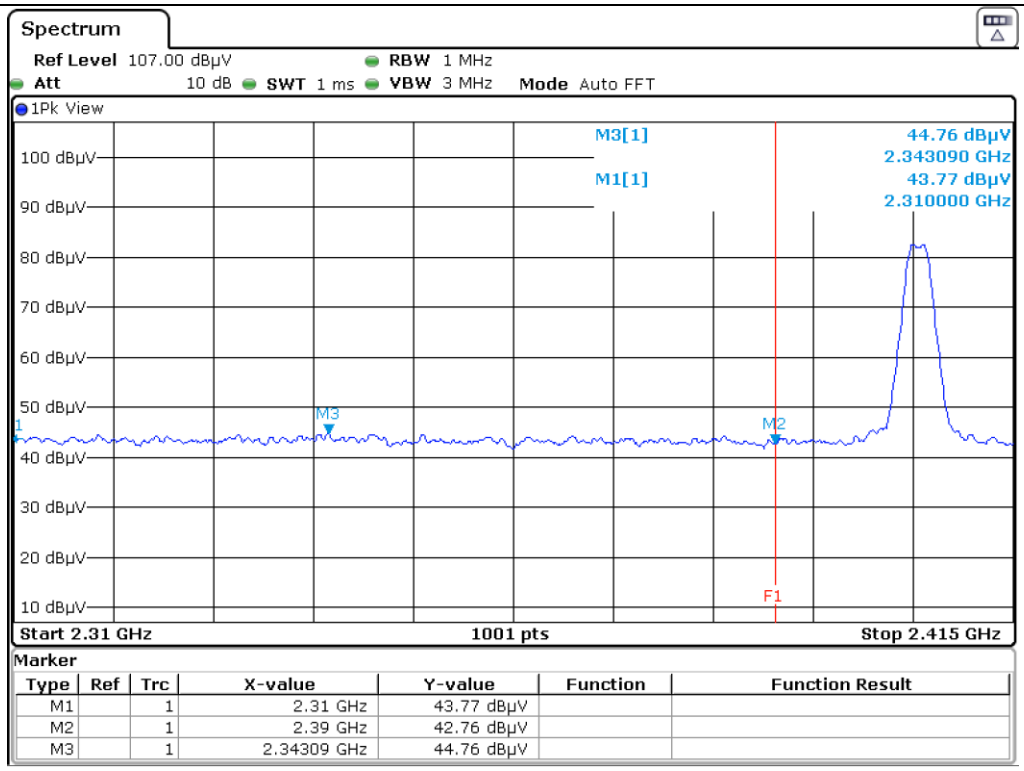
Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

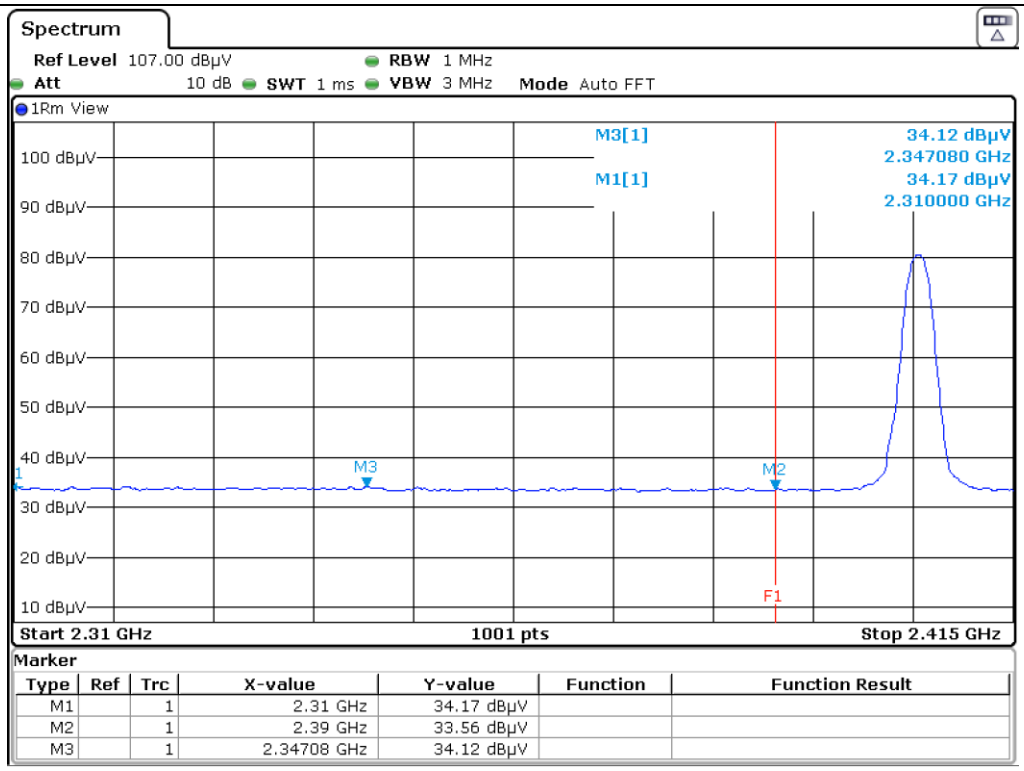
Margin (dB) = Limits (dBµV/m) - Total Level (dBµV/m)

Total Level = Reading + Antenna Factor + Cable Loss – Pre-Amplifier Gain

Tested by: Tae-Ho, Kim / Senior Manager



Low Channel_Horizontal_Peak



Low Channel_Horizontal_Average

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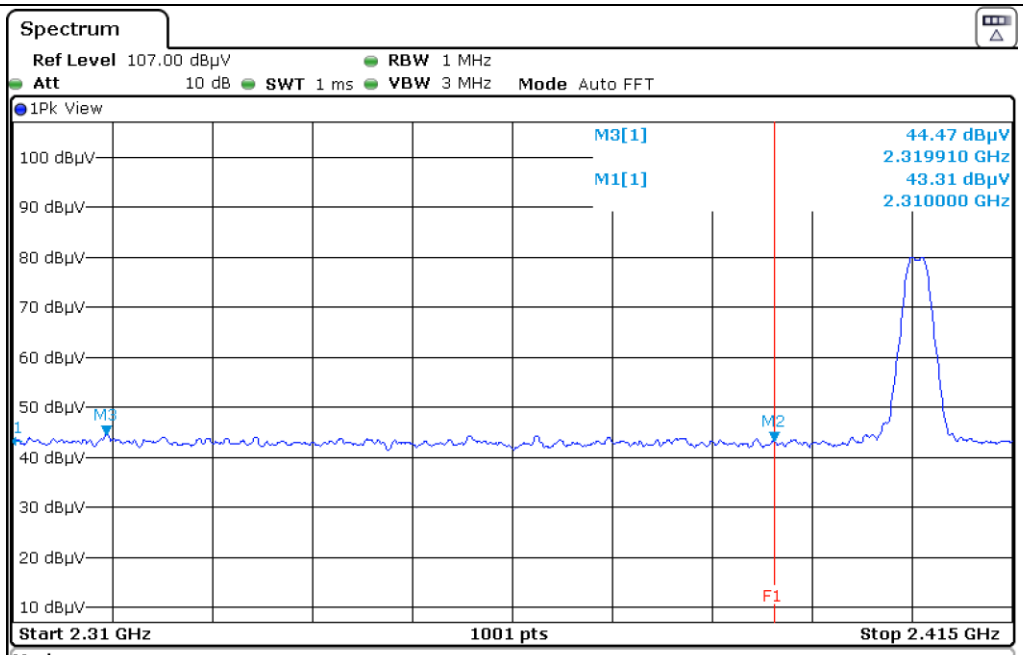
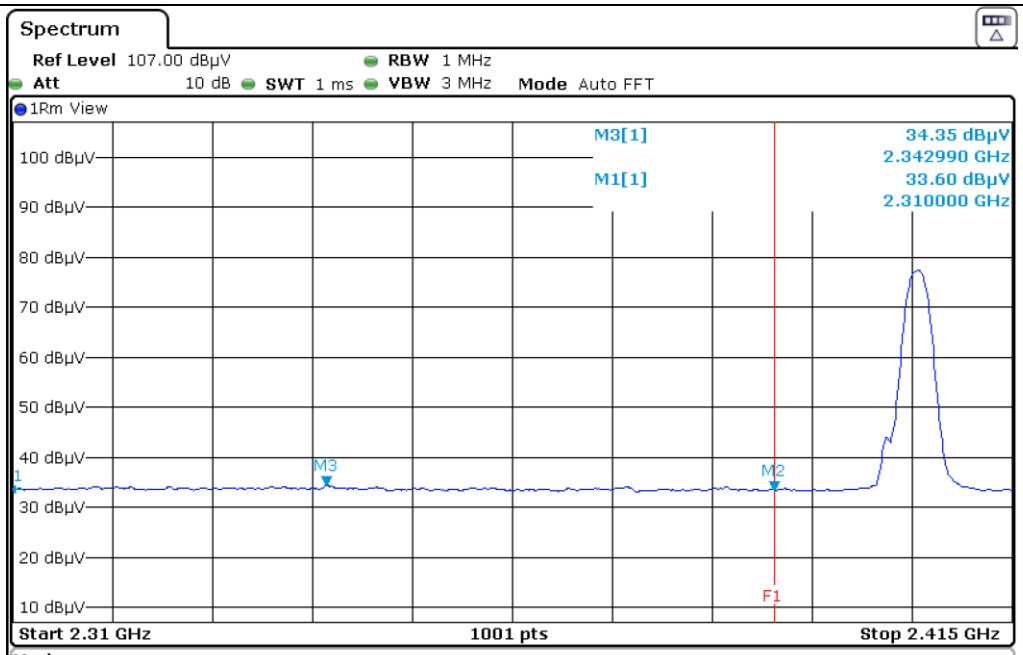


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.31 GHz	43.31 dBµV		
M2		1	2.39 GHz	43.11 dBµV		
M3		1	2.31991 GHz	44.47 dBµV		

Low Channel_Vertical_Peak



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Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.31 GHz	33.60 dBµV		
M2		1	2.39 GHz	33.41 dBµV		
M3		1	2.34299 GHz	34.35 dBµV		

Low Channel_Vertical_Average

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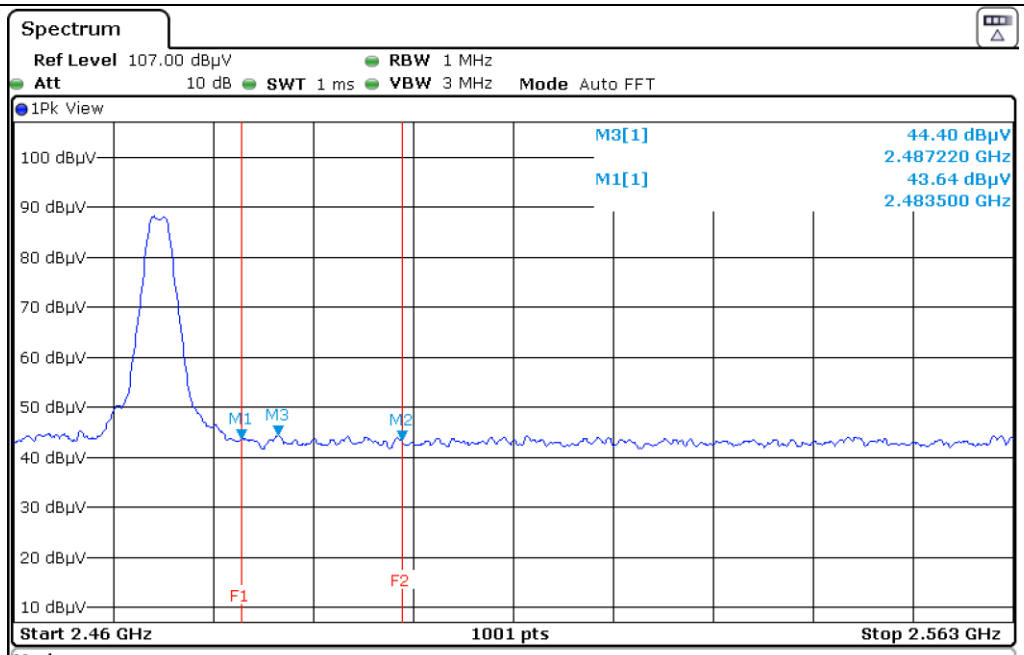

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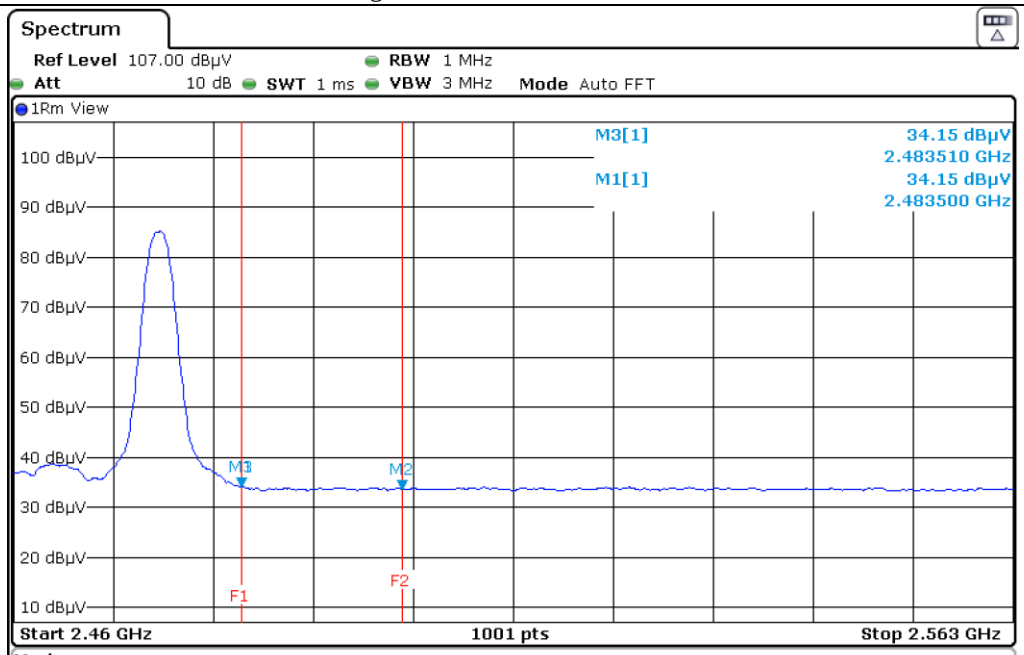
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4835 GHz	43.64 dBµV		
M2		1	2.5 GHz	43.34 dBµV		
M3		1	2.48722 GHz	44.40 dBµV		

High Channel_Horizontal_Peak



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Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4835 GHz	34.15 dBµV		
M2		1	2.5 GHz	33.56 dBµV		
M3		1	2.48351 GHz	34.15 dBµV		

High Channel_Horizontal_Average

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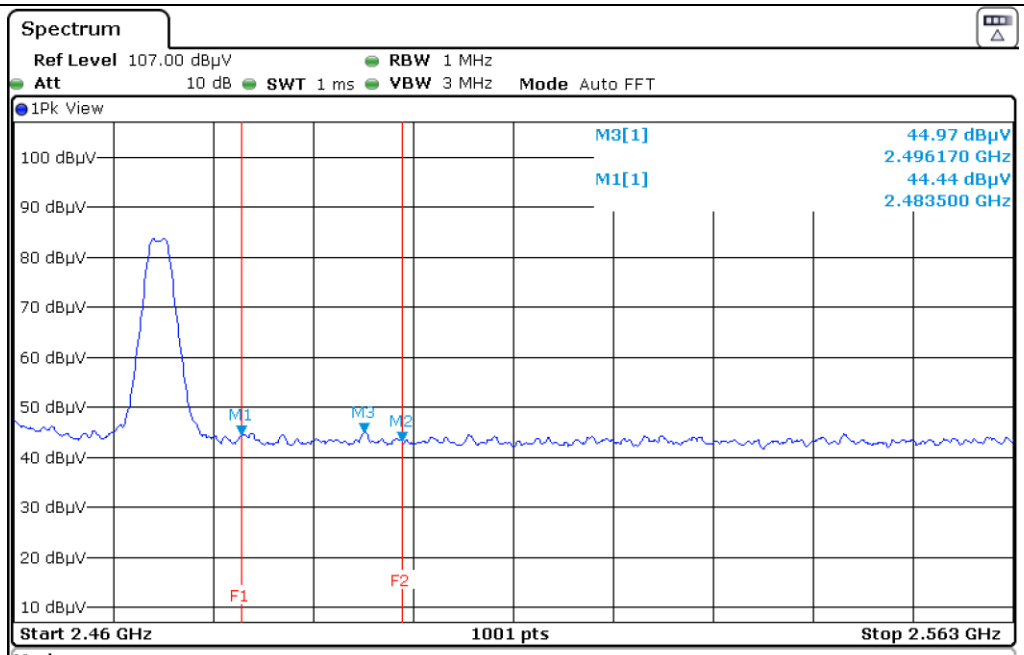

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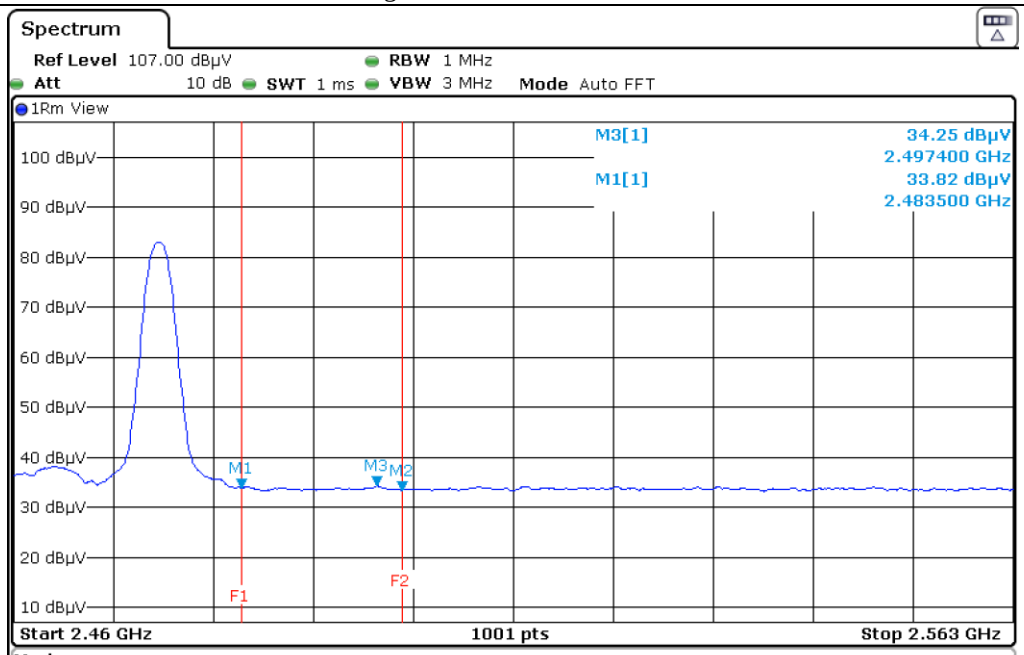
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4835 GHz	44.44 dBµV		
M2		1	2.5 GHz	43.16 dBµV		
M3		1	2.49617 GHz	44.97 dBµV		

High Channel_Vertical_Peak



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Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4835 GHz	33.82 dBµV		
M2		1	2.5 GHz	33.42 dBµV		
M3		1	2.4974 GHz	34.25 dBµV		

High Channel_Vertical_Average

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5.4.2 Spurious & Harmonic Radiated Emission

-. Test Date : September 12, 2018 ~ September 21, 2018

-. 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 : 30 kHz for Peak and Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
9 620.000	36.95	Peak	H	30.84	12.43	33.58	46.64	74.00	27.36
9 620.000	36.90	Peak	V	30.84	12.43	33.58	46.59	74.00	27.41
Test Data for Middle Channel									
4 880.000	32.19	Peak	H	30.01	12.31	35.26	39.25	74.00	34.75
4 880.000	31.49	Peak	V	30.01	12.31	35.26	38.55	74.00	35.45
Test Data for High Channel									
4 950.000	32.60	Peak	H	30.01	12.31	35.29	39.63	74.00	34.37
4 950.000	32.16	Peak	V	30.01	12.31	35.29	39.19	74.00	34.81

Tabulated test data for Restricted Band

Remark 1: “H”: Horizontal, “V”: Vertical

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

Total Level = Reading + Antenna Factor + Cable Loss – Pre-Amplifier Gain

Remark 2: maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.(ANSI C63.10-2013)

Tested by: Tae-Ho, Kim / Senior Manager

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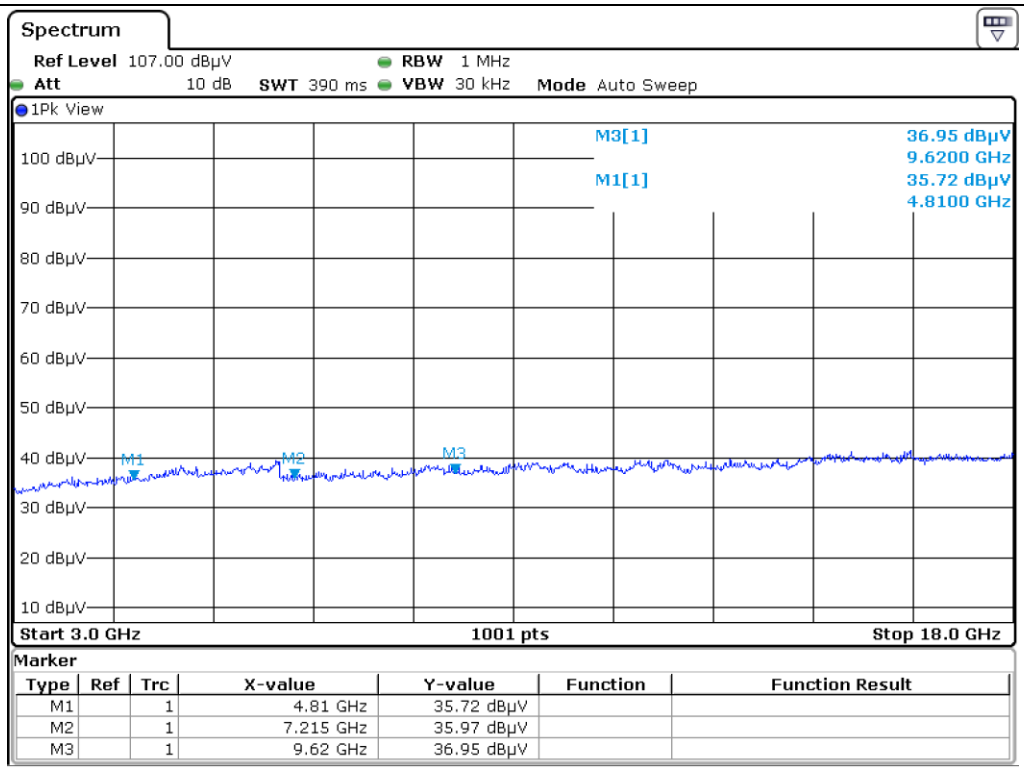
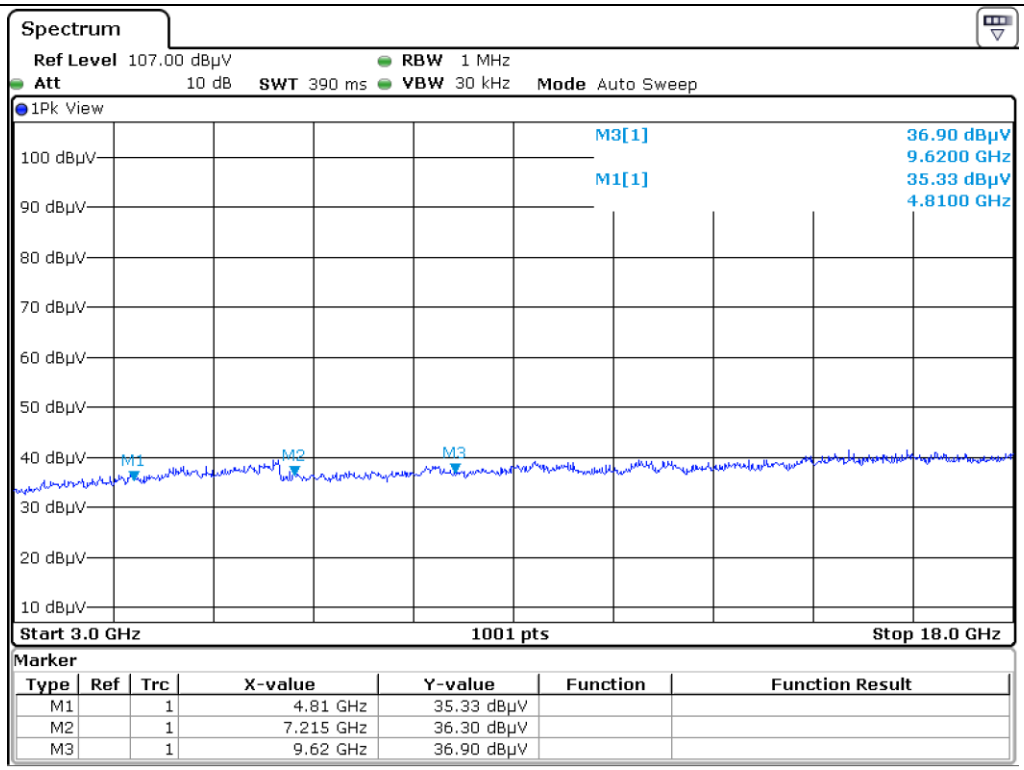


Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	4.81 GHz	35.72 dBµV		
M2		1	7.215 GHz	35.97 dBµV		
M3		1	9.62 GHz	36.95 dBµV		

Low Channel_Horizontal_Peak



Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	4.81 GHz	35.33 dBµV		
M2		1	7.215 GHz	36.30 dBµV		
M3		1	9.62 GHz	36.90 dBµV		

Low Channel_Vertical_Peak

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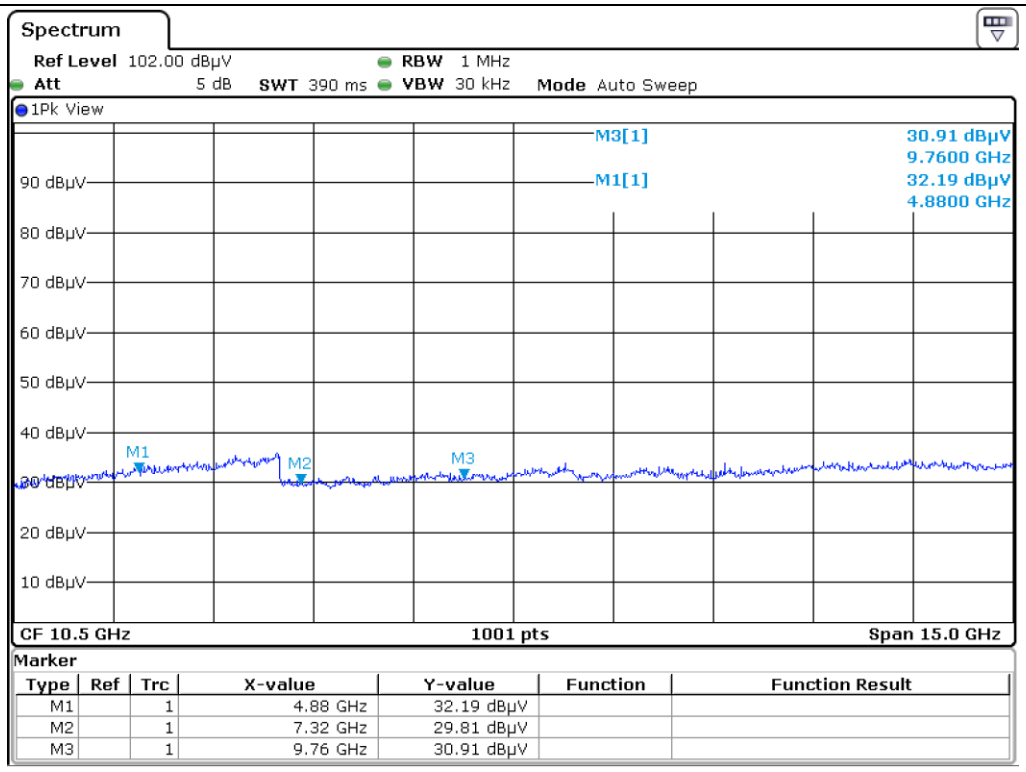
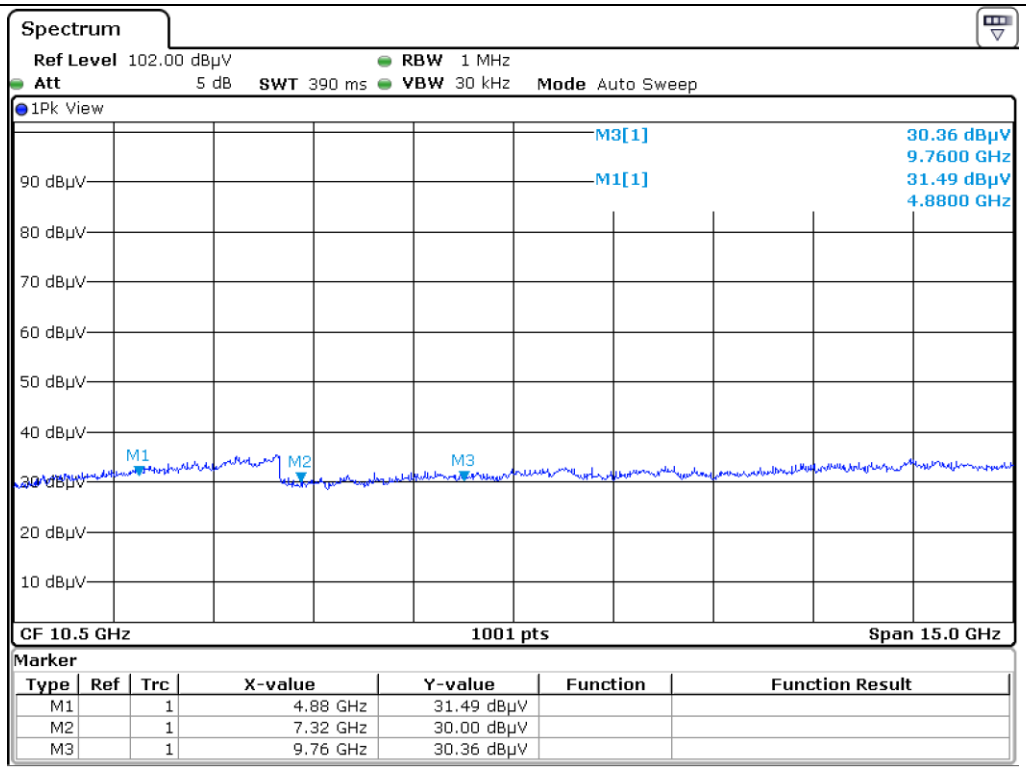


Middle Channel_Horizontal_Peak



Middle Channel_Vertical_Peak

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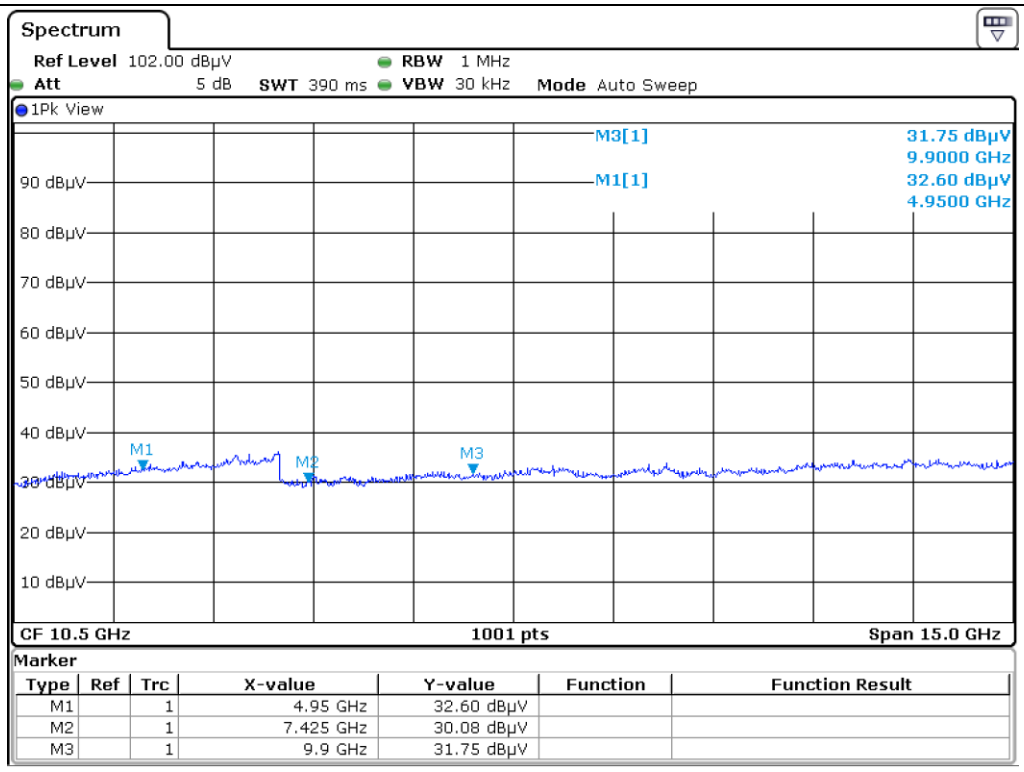
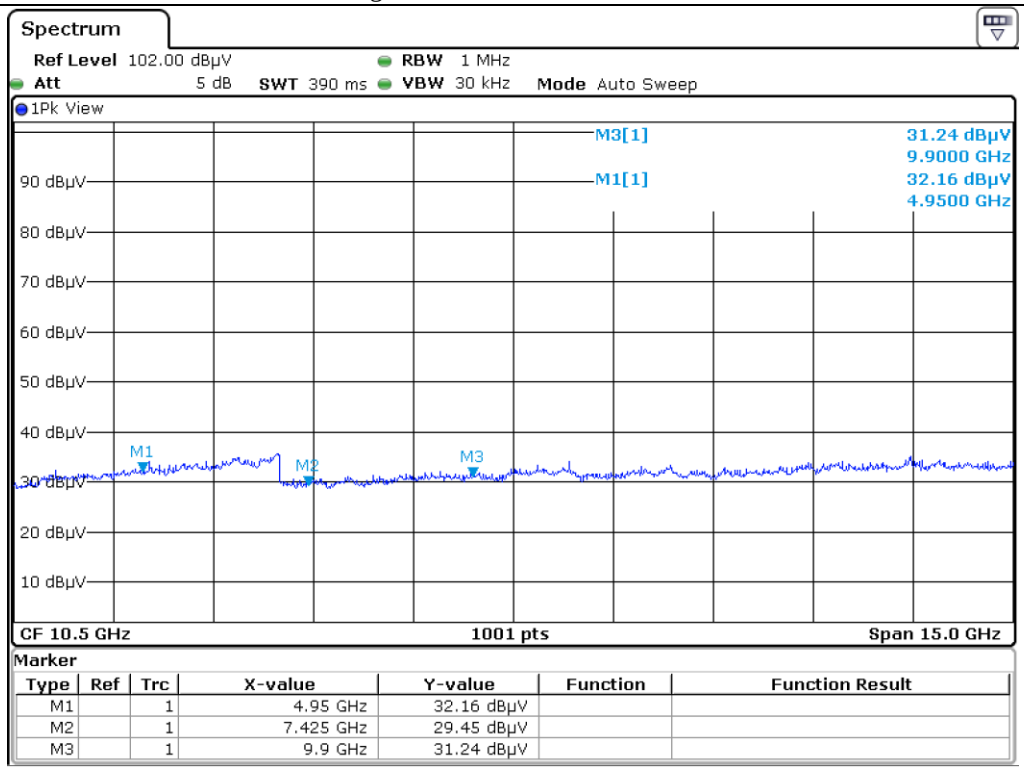


High Channel_Horizontal_Peak



High Channel_Vertical_Peak

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5.4.3 Test Data FCC for below 1 000 MHz

Humidity Level : 43.9 % R.H. Temperature: 24.3 ℃

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

Result : PASSED

EUT EUT : ARTIK-0530 Date: September 12, 2018 ~ September 21, 2018

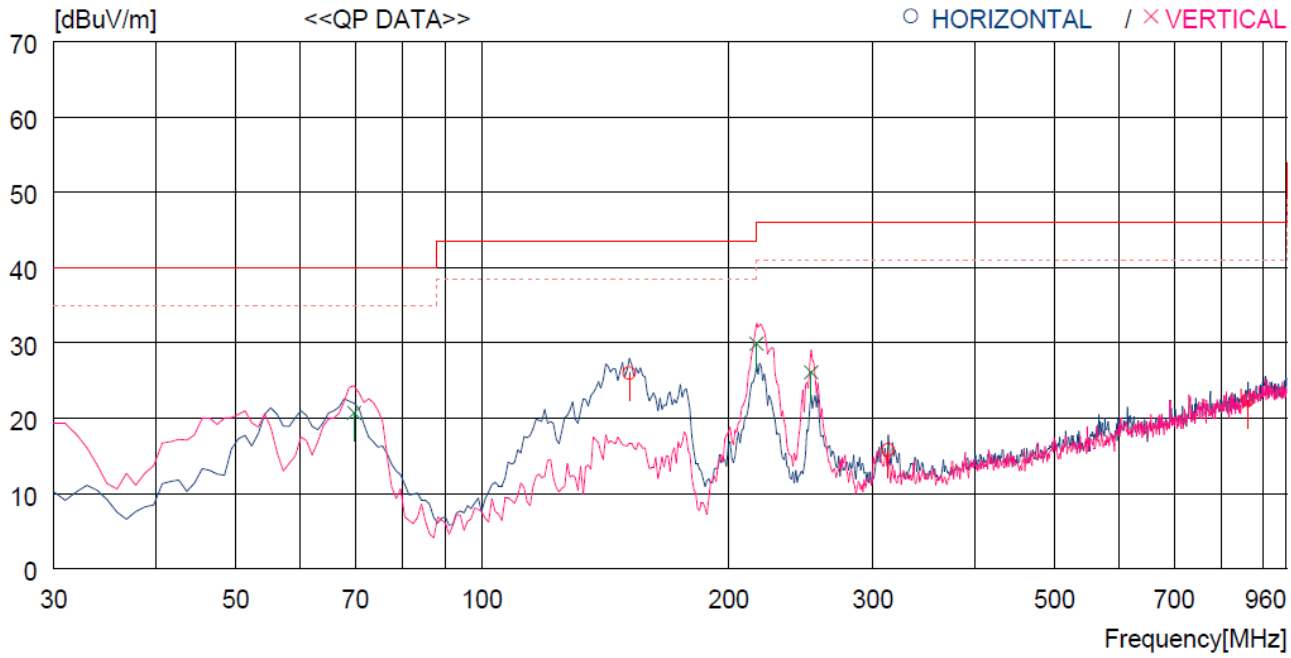
Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)

The frequency spectrum from 9 kHz to 1 000 MHz was investigated.

Frequency [MHz]	Reading [dBuV]	Ant Pol.	Ant Factor [dB]	Cable Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]
69.770	42.1	V	9.7	2.0	33.1	20.7	40.0	19.3
151.250	47.9	H	8.2	2.9	33.0	26.0	43.5	17.5
216.240	48.3	V	11.2	3.4	33.0	29.9	46.0	16.1
252.130	42.8	V	12.5	3.7	32.9	26.1	46.0	19.9
313.240	31.0	H	13.7	4.1	33.0	15.8	46.0	30.2
861.280	26.5	H	21.7	6.9	32.7	22.4	46.0	23.6

Tested by: Tae-Ho, Kim / Senior Manager

- Result Plot



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	151.250	47.9	8.2	2.9	33.0	26.0	43.5	17.5	400	2
2	313.240	31.0	13.7	4.1	33.0	15.8	46.0	30.2	400	2
3	861.280	26.5	21.7	6.9	32.7	22.4	46.0	23.6	400	2
----- Vertical ------										
4	69.770	42.1	9.7	2.0	33.1	20.7	40.0	19.3	400	24
5	216.240	48.3	11.2	3.4	33.0	29.9	46.0	16.1	400	24
6	252.130	42.8	12.5	3.7	32.9	26.1	46.0	19.9	400	48

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5.4.4 Test data IC for below 1 000 MHz

Humidity Level : 43.9 % R.H. Temperature: 24.3 ℃

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

Result : PASSED

EUT EUT : ARTIK-0530 Date: September 12, 2018 ~ September 21, 2018

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

The frequency spectrum from 9 kHz to 1 000 MHz was investigated.

Frequency [MHz]	Reading [dBuV]	Ant Pol.	Ant Factor [dB]	Cable Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]
67.830	44.8	V	10.4	2.0	33.1	24.1	40.0	15.9
146.400	46.2	H	8.2	2.8	33.0	24.2	43.5	19.3
218.180	48.2	V	10.4	2.0	33.1	24.1	40.0	15.9
253.100	41.0	V	12.5	3.7	32.9	24.3	46.0	21.7
312.270	28.7	H	13.6	4.1	33.0	13.4	46.0	32.6

Tested by: Tae-Ho, Kim / Senior Manager

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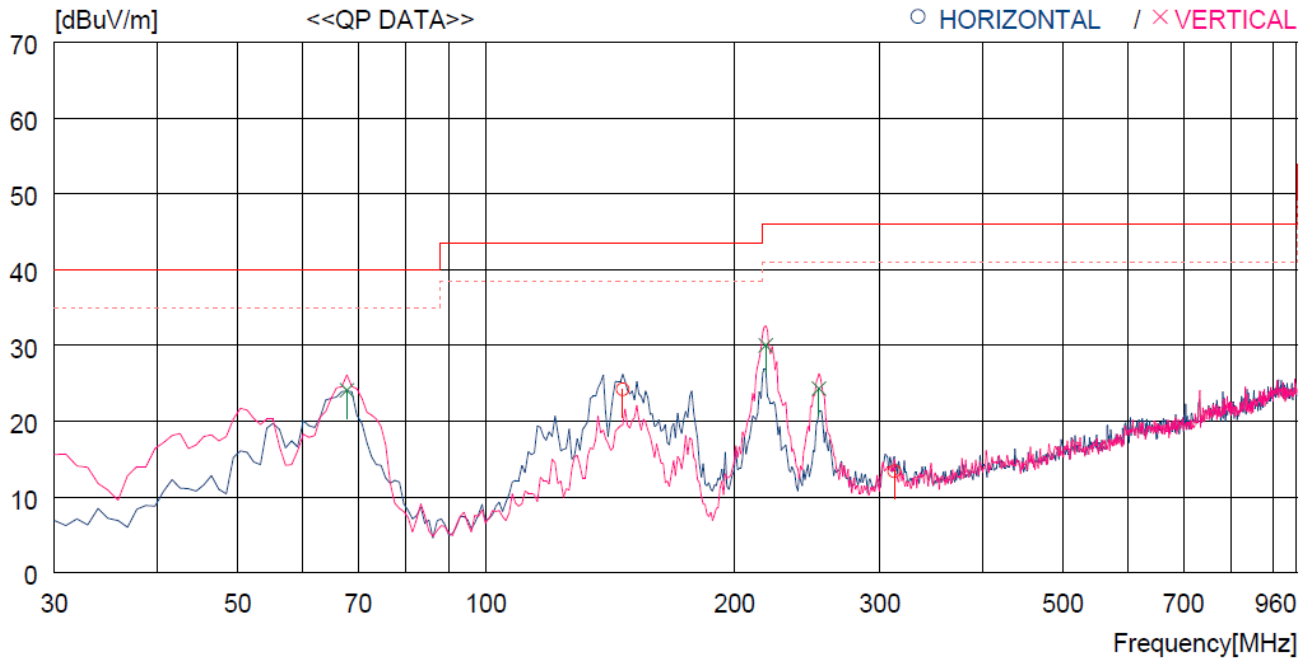
- Result Plot



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	146.400	46.2	8.2	2.8	33.0	24.2	43.5	19.3	400	82
2	312.270	28.7	13.6	4.1	33.0	13.4	46.0	32.6	400	358
----- Vertical ------										
3	67.830	44.8	10.4	2.0	33.1	24.1	40.0	15.9	400	0
4	218.180	48.2	11.3	3.4	32.9	30.0	46.0	16.0	400	176
5	253.100	41.0	12.5	3.7	32.9	24.3	46.0	21.7	400	0

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6. Maximum Peak Conducted Output Power

6.1 Operating environment

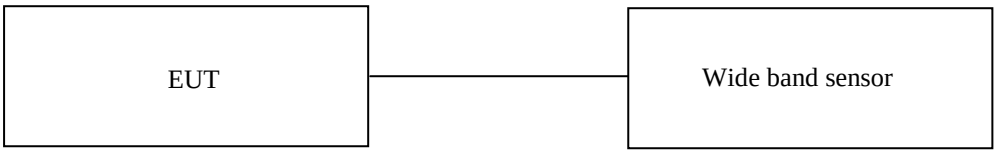
Temperature	:	24.3 ℃
Relative humidity	:	43.9 % R.H.

6.2 Test set-up

The maximum peak output power was measured with the wide band sensor connected to the antenna output of the EUT.

The Wide Band Sensor is measured when the EUT is transmitting at the appropriate center frequency its maximum power control level as described in Section 9.2.3(KDB 558074 D01 DTS Meas Guidance V04).

Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.



6.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	NRP-Z81	Rohde & Schwarz	Wide band Sensor	101975	Mar. 15, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

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6.4 TEST Result

-. Test Date : September 12, 2018 ~ September 21, 2018

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 405.00	15.74	30.00	14.26
MIDDLE	2 440.00	15.53	30.00	14.47
HIGH	2 475.00	15.26	30.00	14.74

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

Tested by: Tae-Ho, Kim / Senior Manager

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