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

Test Report No. : **W167R-D019**

AGR No. : **A154A-171**

Applicant : **Hanwha Corporation Asan 1 Plant**

Address : **Asanvalleynam-Ro 144, Dunpo-Myun, Asan-City, Chungnam, 31409, South Korea**

Manufacturer : **Flexsystem**

Address : **#1308~13, 126, Beolmal-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-060**

Type of Equipment : **Remote Control Unit**

FCC ID. : **2AGC5DJO-AR-DEF**

Model Name : **DJO-AR**

Serial number : **N/A**

Total page of Report : **50 pages (including this page)**

Date of Incoming : **April 28, 2015**

Date of issue : **July 07, 2016**

SUMMARY

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

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

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

Reviewed by: Ki-Hong, Nam / Asst, Chief Engineer, ONETECH Corp.

Approved by: Sung-Ik, Han/ Managing Director, ONETECH Corp.

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

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

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

Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
W167R-D019	July 07, 2016	Initial Issue	All

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1. VERIFICATION OF COMPLIANCE

Applicant	: Hanwha Corporation Asan 1 Plant
Address	: Asanvalleynam-Ro 144, Dunpo-Myun, Asan-City, Chungnam, 31409, South Korea
Contact Person	: SOYOUNG PARK / Assistant RESEARCH ENGINEER
Telephone No.	: +82-41-538-7886
FCC ID	: 2AGC5DJO-AR-DEF
Model Name	: DJO-AR
Brand Name	: -
Serial Number	: N/A
Date	: July 07, 2016

EQUIPMENT CLASS	***DTS – DIGITAL TRNSMISSION SYSTEM***
E.U.T. DESCRIPTION	Remote Control Unit
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.

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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: This test is not performed because the EUT is operated by DC battery.

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 section 2.1.

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-4617/ G-666/ T-1842

IC (Industry Canada) – Registration No. Site# 3736-3

-. 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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3. GENERAL INFORMATION

3.1 Product Description

The Hanwha Corporation Asan 1 Plant, Model DJO-AR (referred to as the EUT in this report) is a Remote Control Unit. Product specification information described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	Portable Device
FREQUENCY RANGE	2 405 MHz ~ 2 480 MHz
NUMBER OF CHANNEL	16 Channels
MAX. RF OUTPUT POWER	Zigbee 1: -11.40 dBm Zigbee 2: -10.99 dBm
ANTENNA TYPE	Dipole Antenna
ANTENNA GAIN	5.78 dBi
MODULATION METHOD	O-QPSK
USED RF CHIP	Marker: TEXAS INSTRUMENTS Model Name: CC2530F32RHA
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	32 MHz
POWER REQUIREMENT	DC 7.4 V
EXTERNAL CONNECTOR	-

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

-. None

4. EUT MODIFICATIONS

-. None

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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	Flexsystem	KETI RCEMB V4.0	N/A
Sub Board	Flexsystem	N/A	N/A
Zigbee Module Board	TEXAS INSTRUMENTS	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
DJO-AR	Flexsystem	Remote Control Unit (EUT)	-

5.3 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting mode is programmed.

-. The EUT was set at Low Channel (2 405 MHz), Middle Channel (2 440 MHz), and High Channel (2 480 MHz).
To get a maximum radiated emission levels from the EUT

5.4 Configuration of Test System

Line Conducted Test: It is not need to test this requirement, because the EUT shall be operated by DC battery.

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 m 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 Dipole Antenna with u.fl end connector on the main board in the EUT, so no consideration of replacement by the user.

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6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary Tests, the following operating mode was investigated

Operation Mode	The Worse operating condition (Please check one only)
It is not need to test this requirement, because the power of the EUT is supplied by battery.	

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

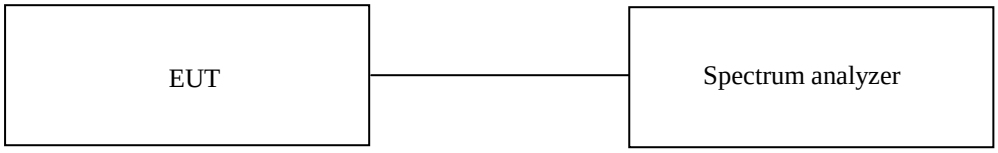
7.1 Operating environment

Temperature : 24.2 ℃

Relative humidity : 45.0 % 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	May 31, 2016 (1Y)

All test equipment used is calibrated on a regular basis.

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7.4 Test data for Zigbee 1

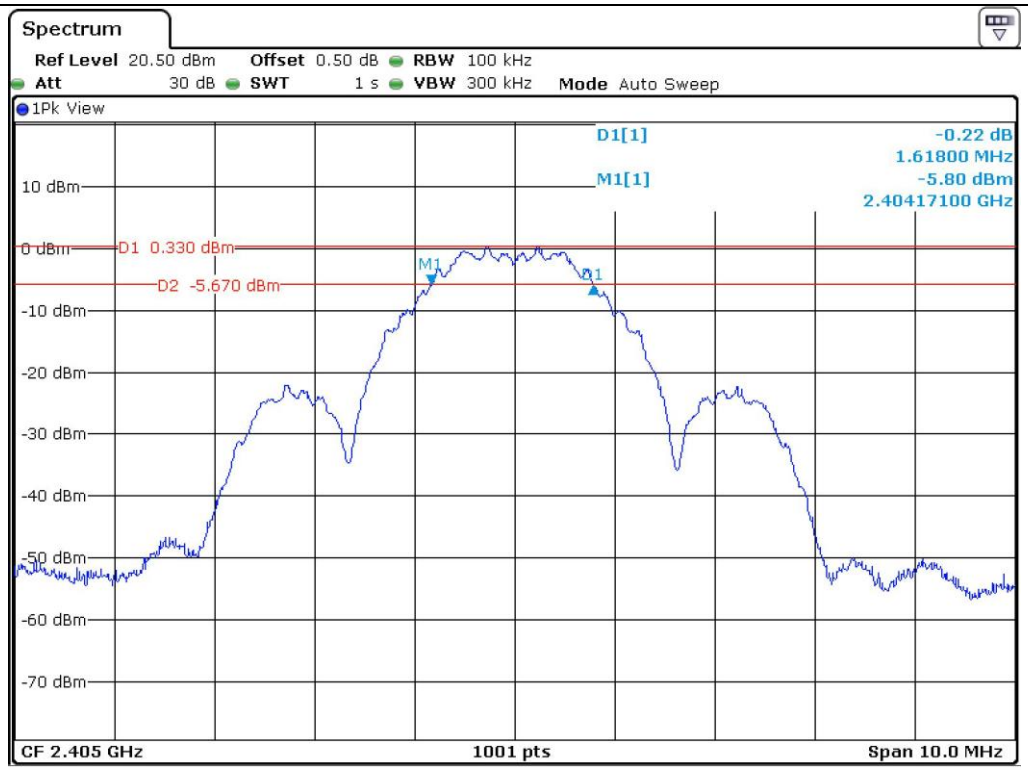
-. Test Date : June 22, 2016

-. Test Result : Pass

CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (MHz)	LIMIT (MHz)	MARGIN (MHz)
Low	2 405	1.62	0.50	1.12
Middle	2 440	1.62	0.50	1.12
High	2 480	1.62	0.50	1.12

Remark. Margin = Measured Value - Limit

Tested by: Tae-Ho, Kim / Senior Engineer



Low Channel

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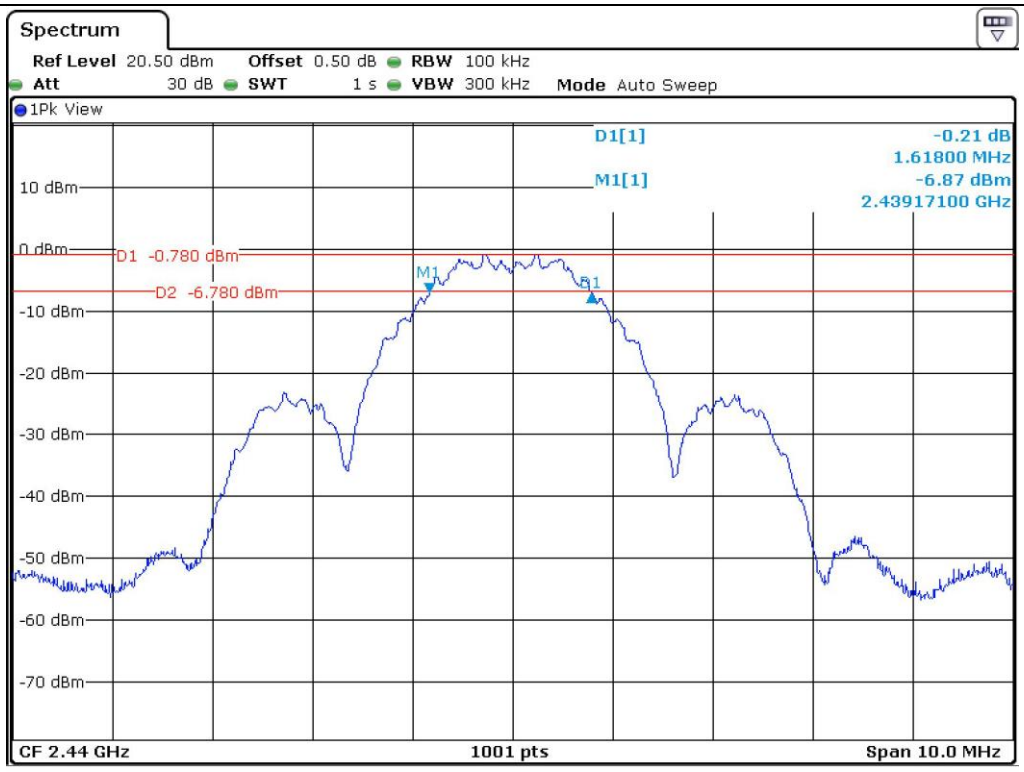

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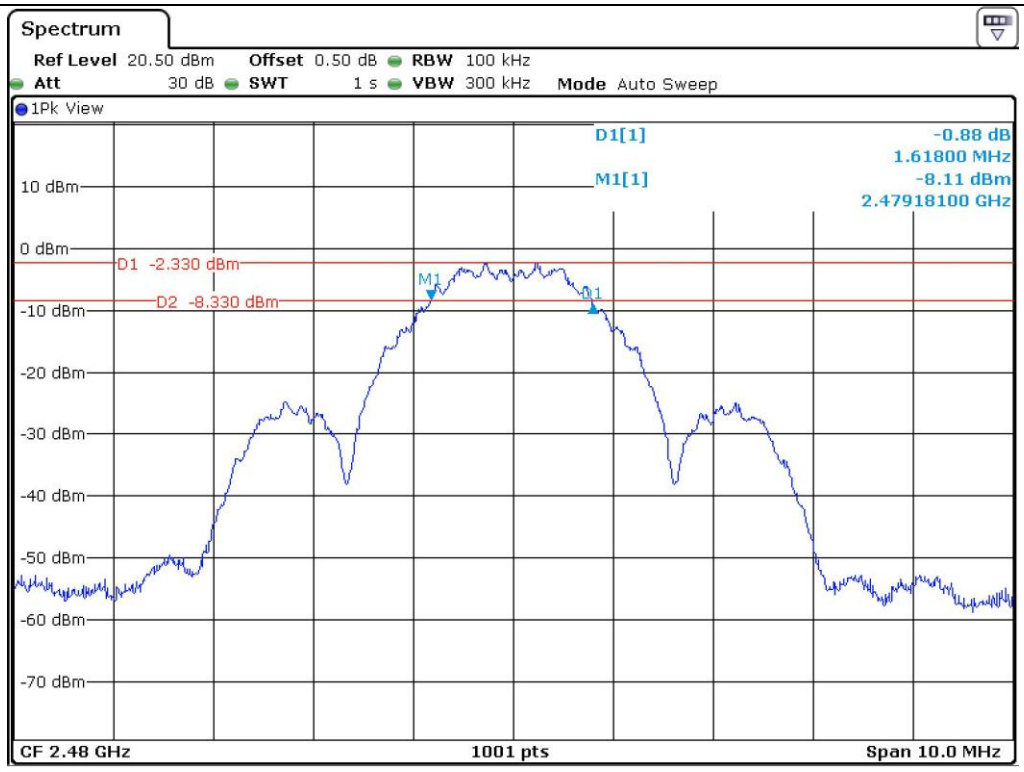

High Channel

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7.5 Test data for Zigbee 2

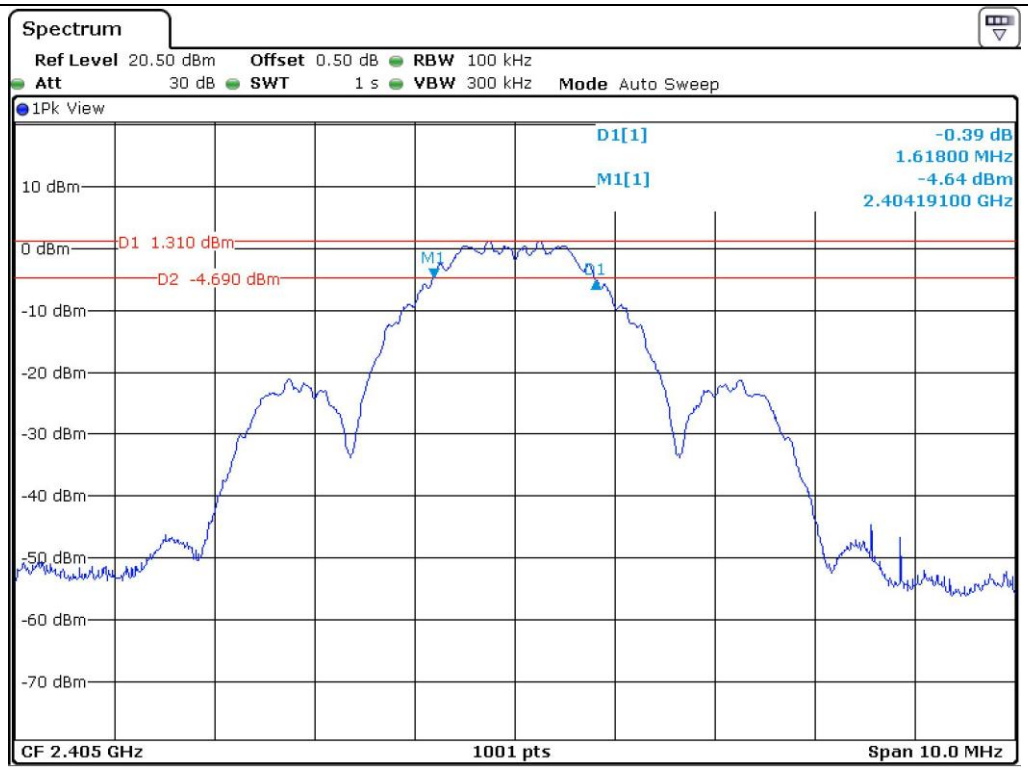
-. Test Date : June 22, 2015

-. Test Result : Pass

CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (MHz)	LIMIT (MHz)	MARGIN (MHz)
Low	2 405	1.62	0.50	1.12
Middle	2 440	1.62	0.50	1.12
High	2 480	1.62	0.50	1.12

Remark. Margin = Measured Value - Limit

Tested by: Tae-Ho, Kim / Senior Engineer



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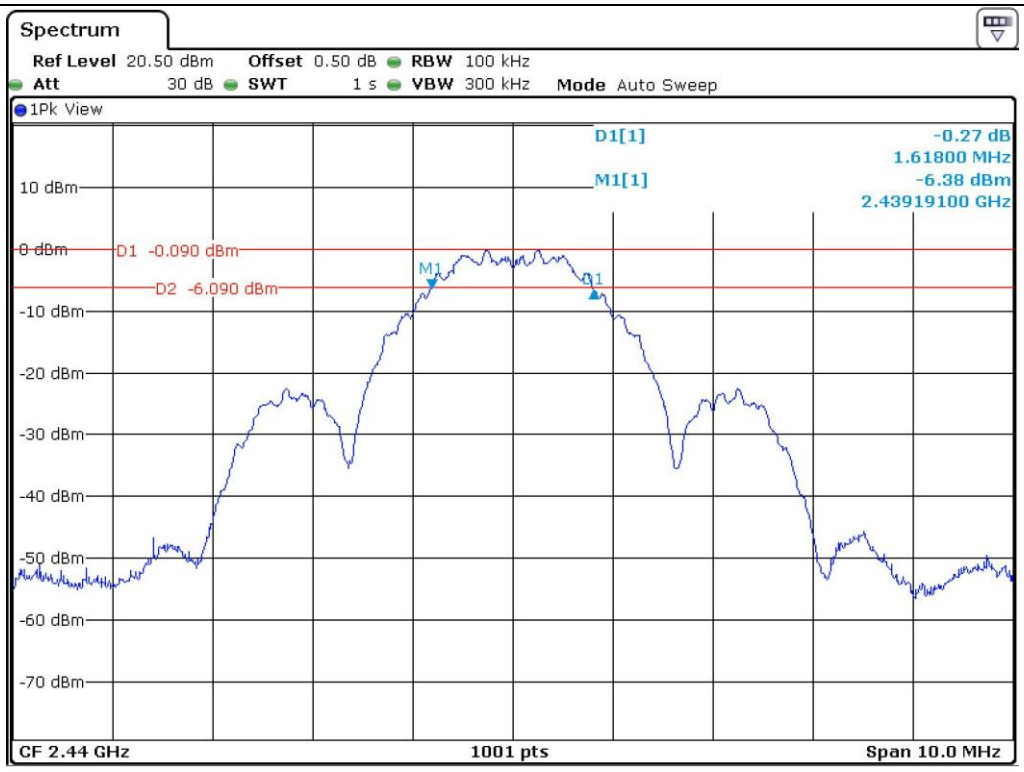
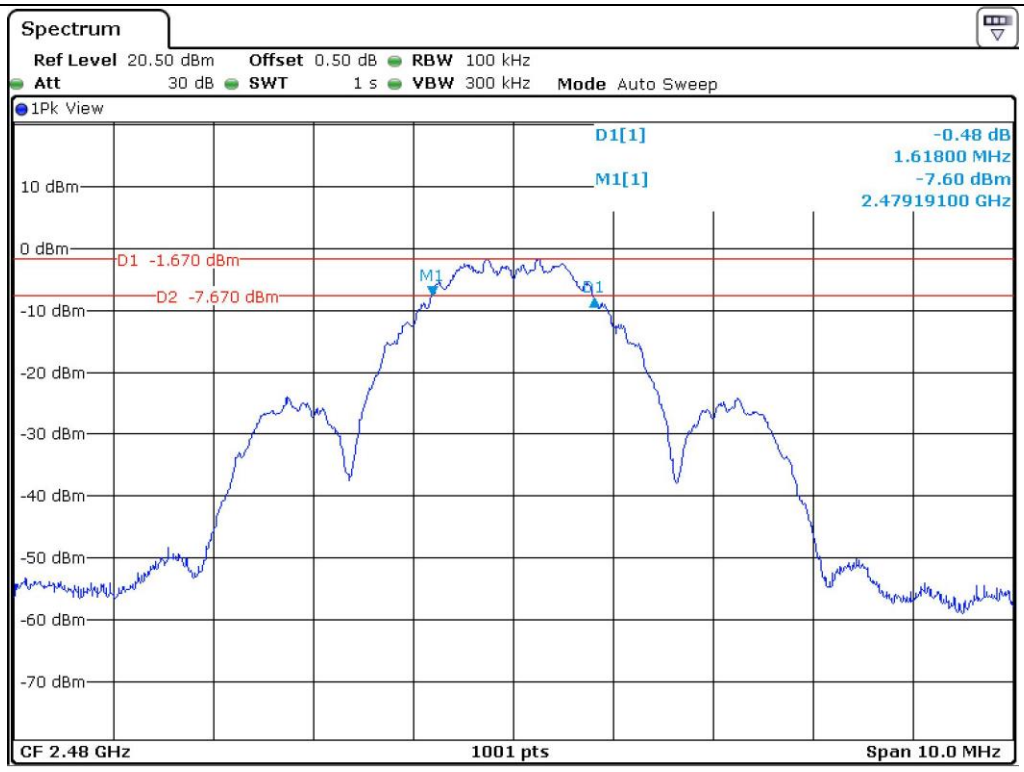


Middle Channel



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8. MAXIMUM PEAK OUTPUT POWER

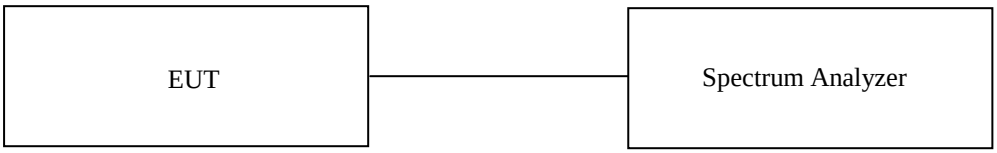
8.1 Operating environment

Temperature : 24.2 ℃

Relative humidity : 45.0 % R.H.

8.2 Test set-up

The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT. The EUT was operating in transmit mode at the appropriate center frequency.



8.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	May 31, 2016 (1Y)

All test equipment used is calibrated on a regular basis.

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8.4 Test data for Zigbee 1

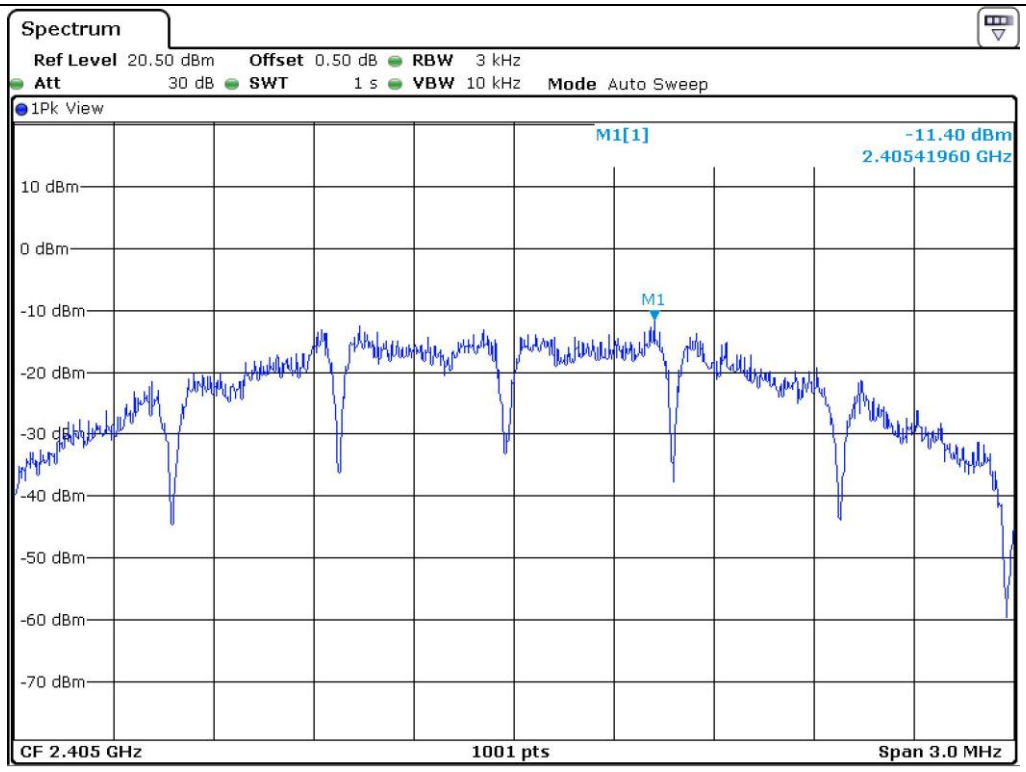
-. Test Date : June 21, 2016

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	DTS (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 405	1.62	-11.40	30.00	41.40
MIDDLE	2 440	1.62	-13.07	30.00	43.07
HIGH	2 480	1.62	-14.64	30.00	44.64

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

Tested by: Tae-Ho, Kim / Senior Engineer



Low Channel

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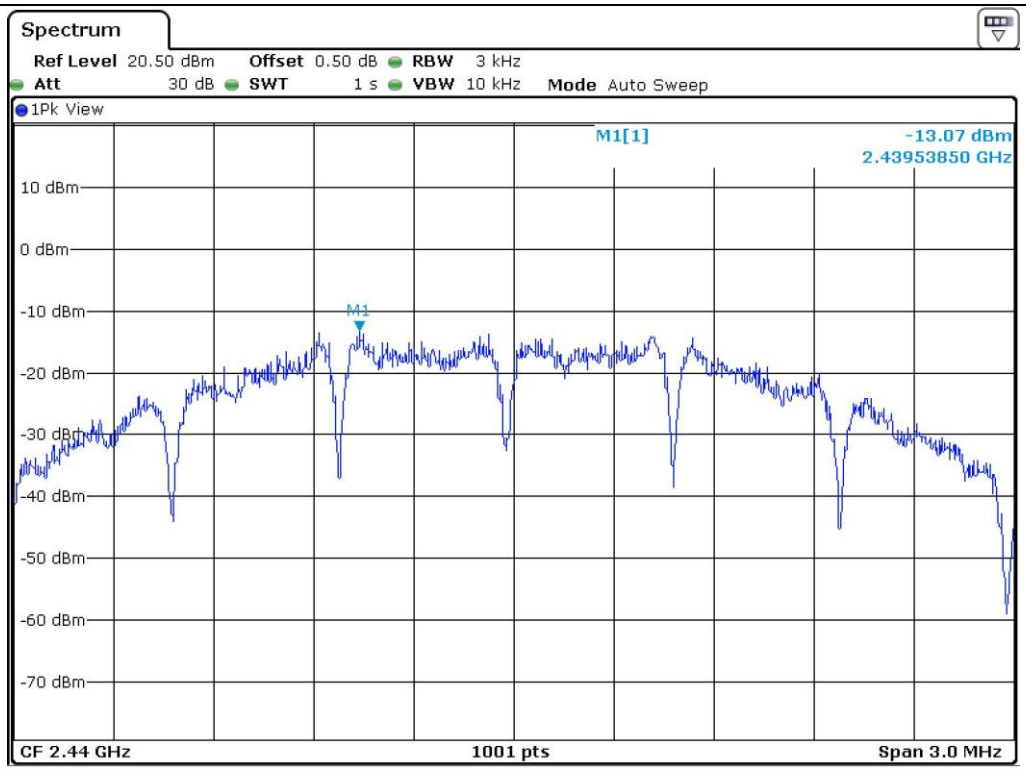
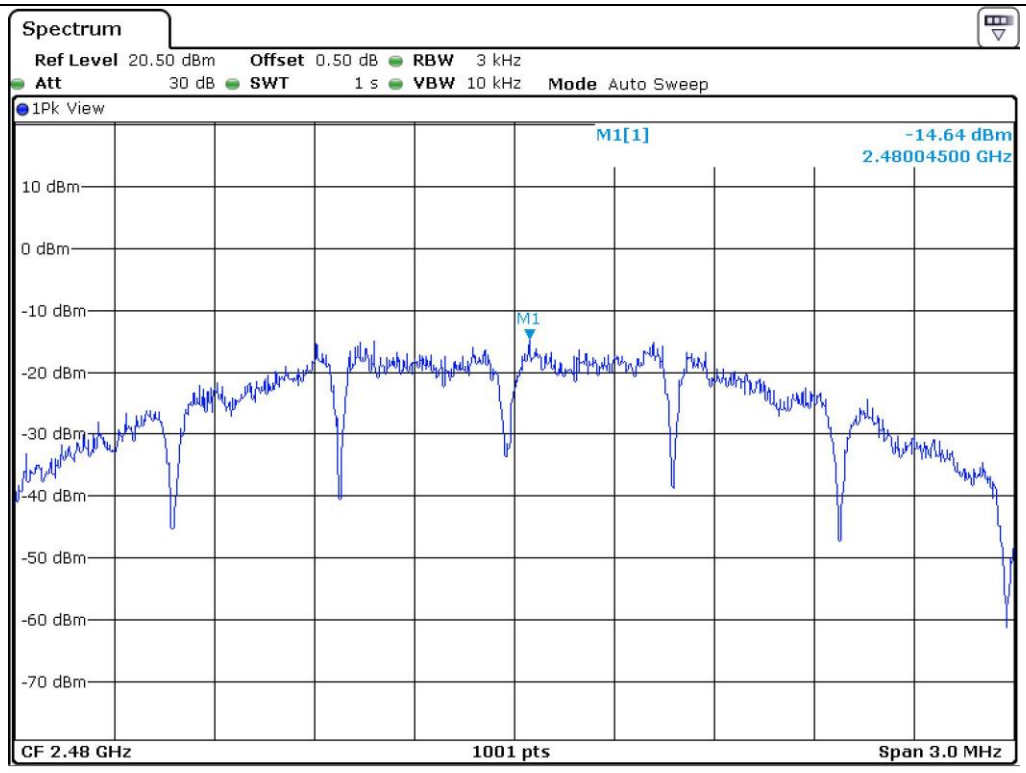


Middle Channel



High Channel

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8.5 Test data for Zigbee 2

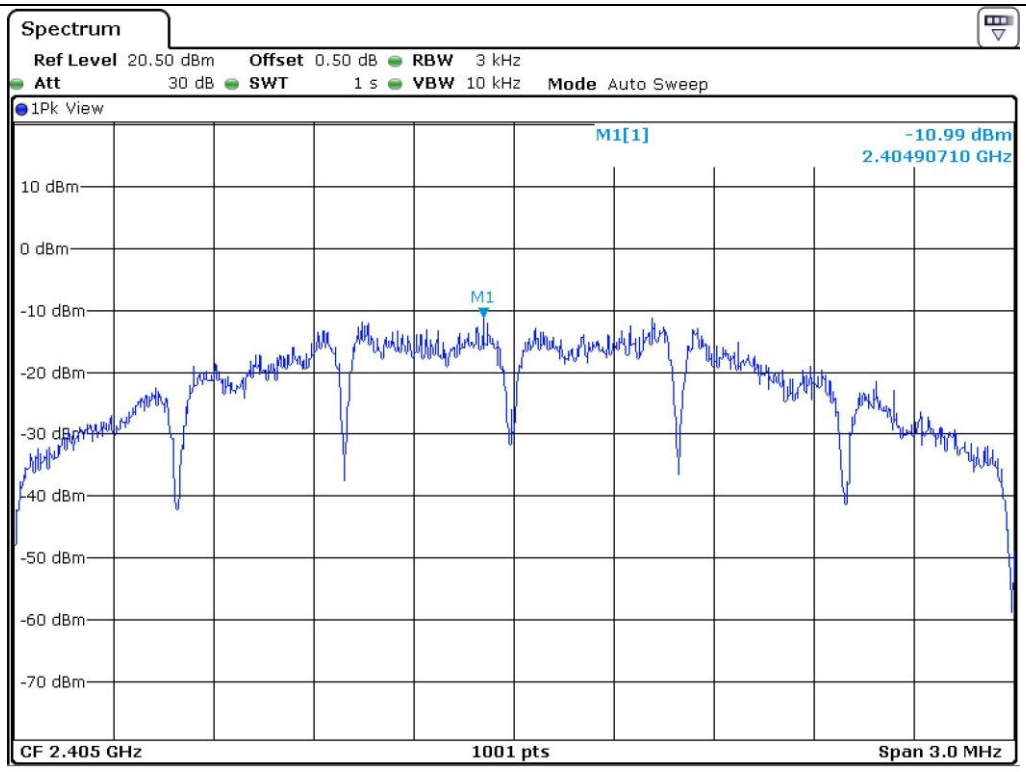
-. Test Date : June 21, 2016

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	DTS (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 405	1.62	-10.99	30.00	40.99
MIDDLE	2 440	1.62	-13.13	30.00	43.13
HIGH	2 480	1.62	-14.20	30.00	44.20

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

Tested by: Tae-Ho, Kim / Senior Engineer



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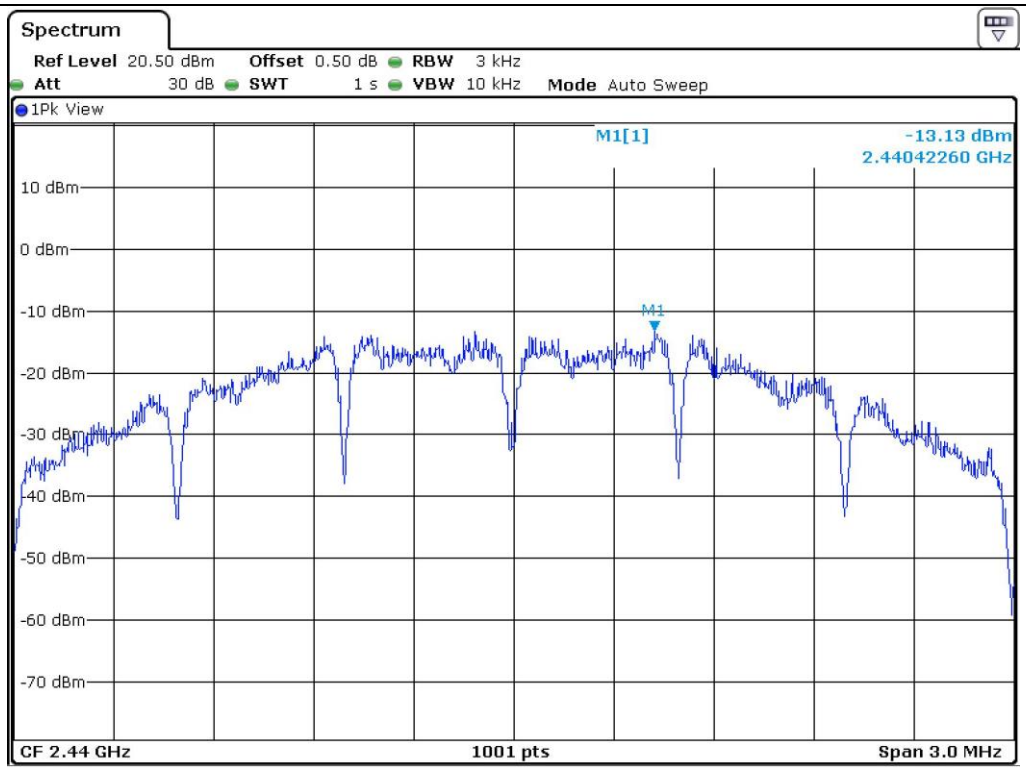
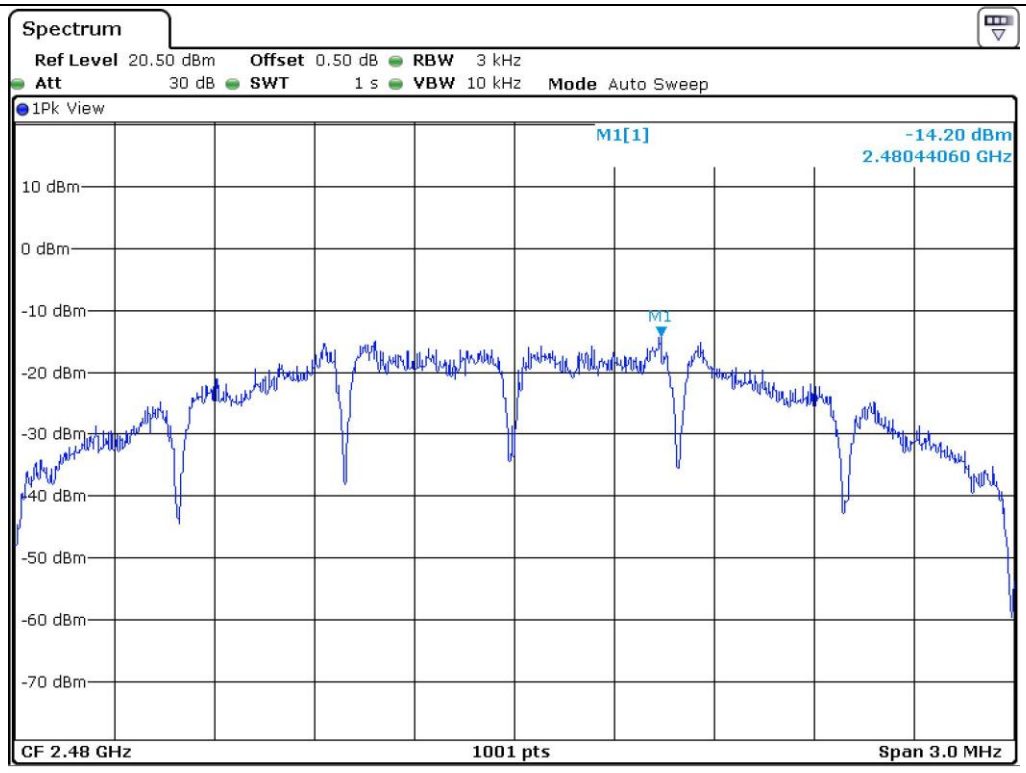


Middle Channel



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9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

9.1 Operating environment

Temperature : 24.2 ℃

Relative humidity : 45.0 % 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 a non-conductive turntable approximately 0.8 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)
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	May 31, 2016 (1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 29, 2016 (1Y)
■ -	310N	Sonoma Instrument	Pre-Amplifier	312544	Apr. 05, 2016 (1Y)
■ -	SCU-18	Rohde & Schwarz	Pre-Amplifier	10041	Nov. 23, 2015 (1Y)
■ -	DT3000	Innco System	Turn Table	930611	N/A
■ -	MA4000-EP	Innco System	Antenna Master	3320611	N/A
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-421	Apr. 15, 2016 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 31, 2015 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Apr. 31, 2015 (2Y)

All test equipment used is calibrated on a regular basis.

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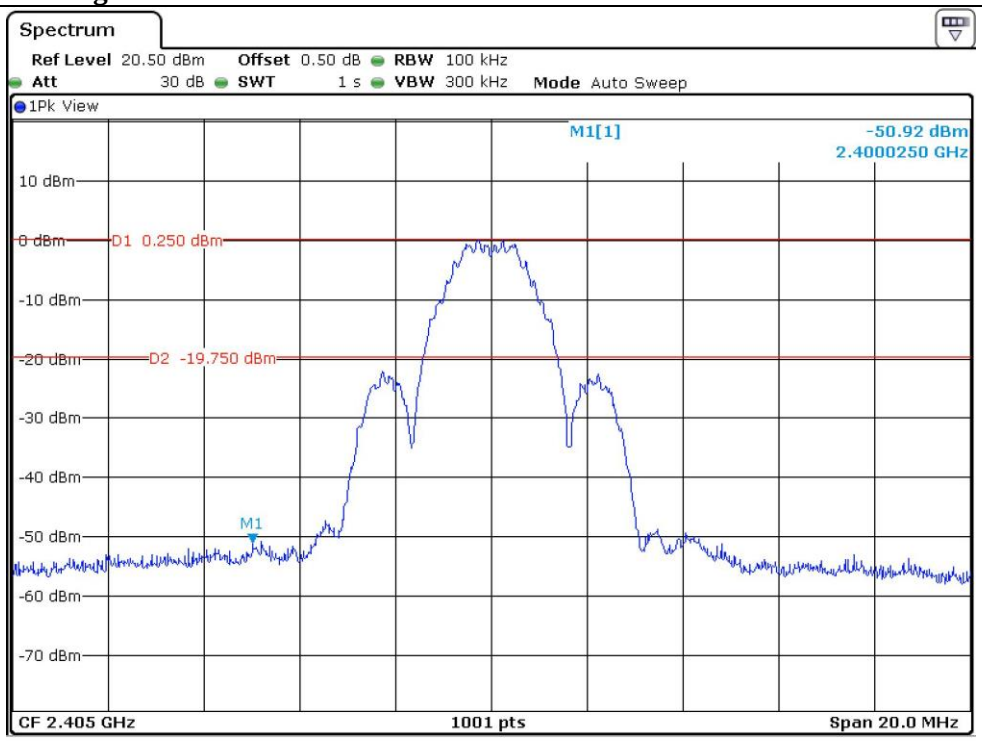
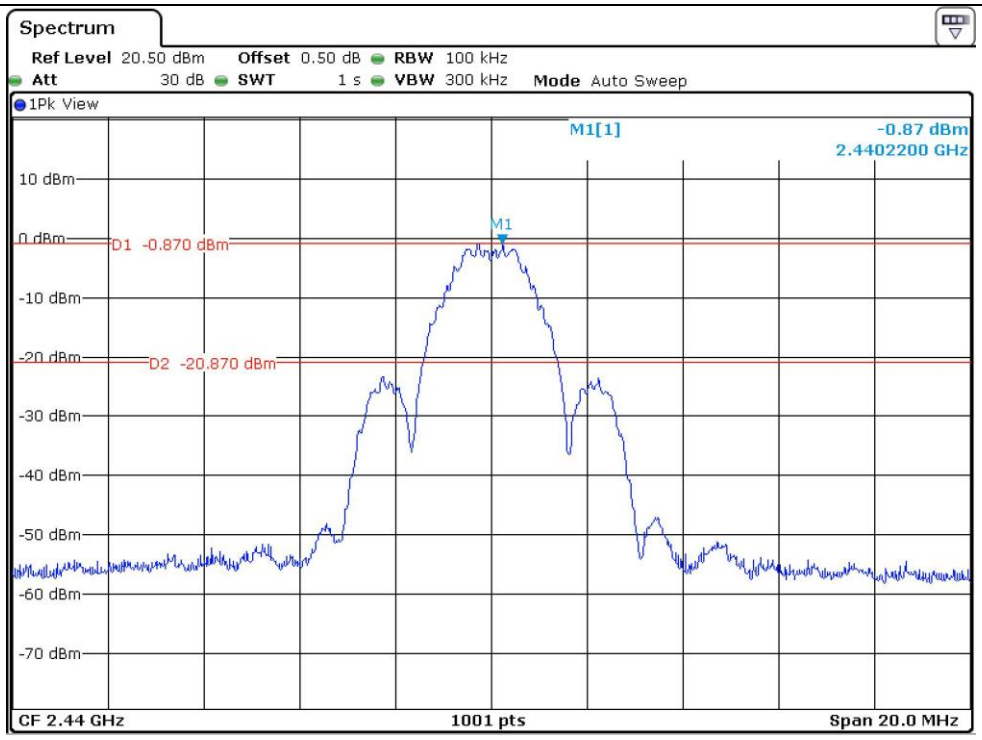
9.5 Test data for conducted emission

9.5.1 Test data for Zigbee 1



Low Channel



Middle Channel

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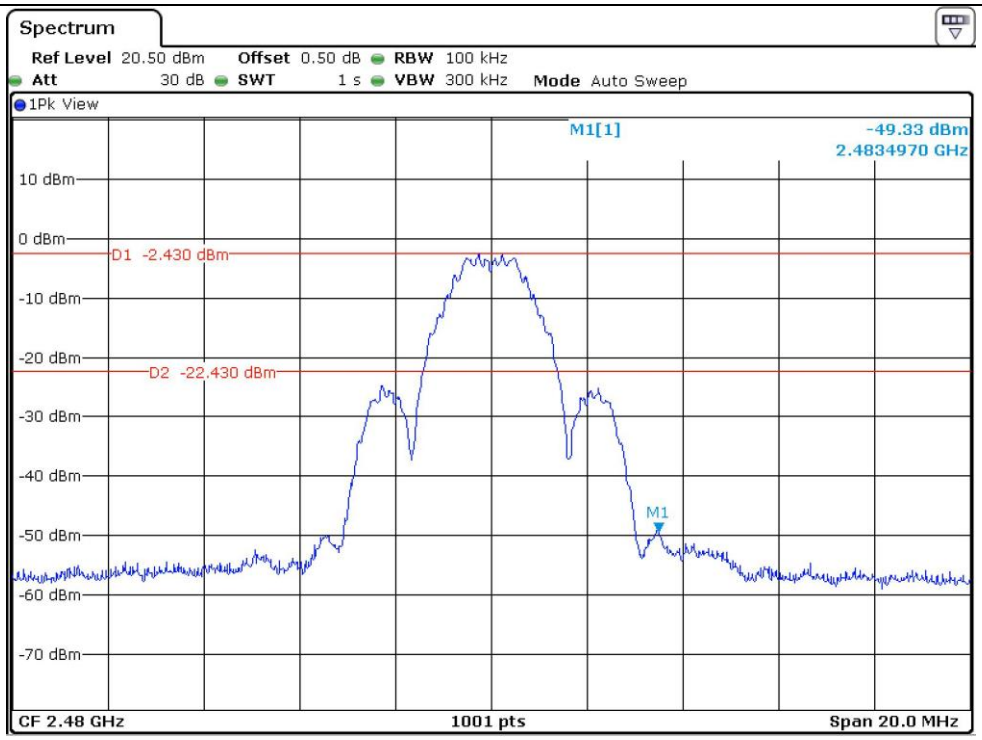

High Channel

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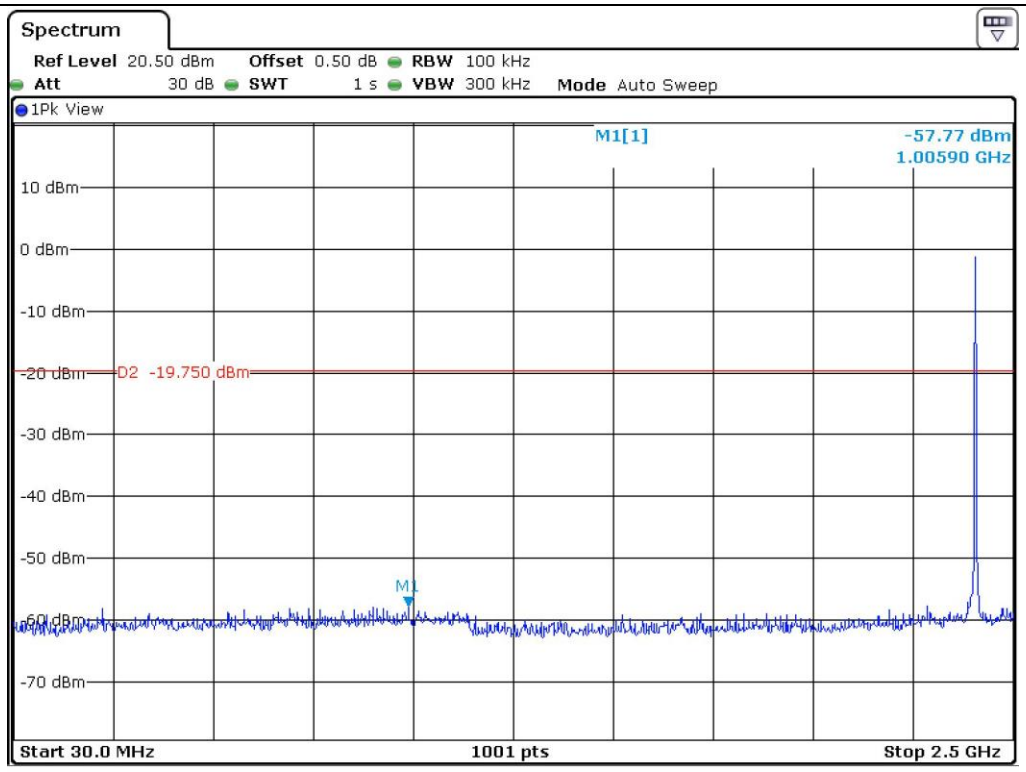

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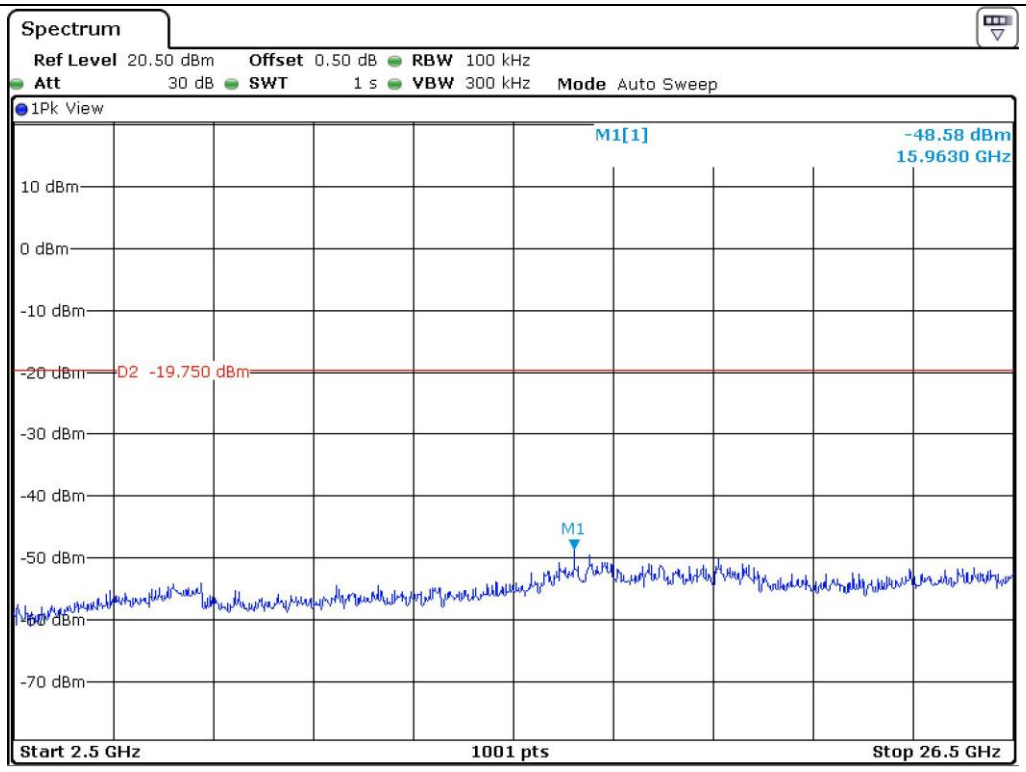

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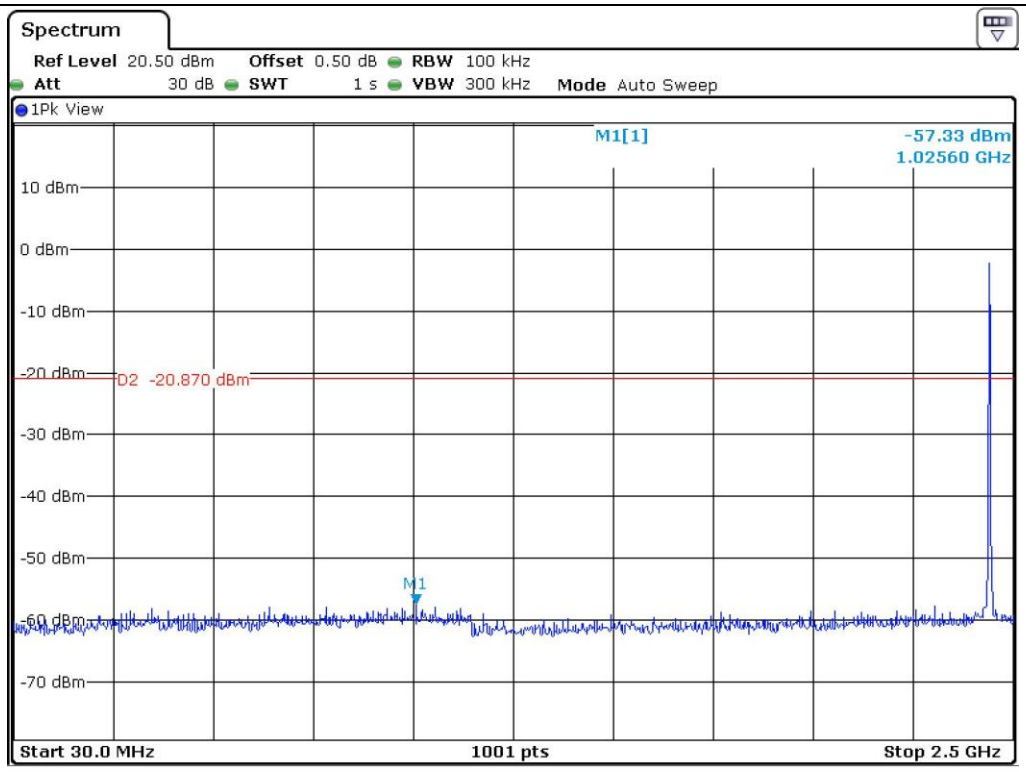

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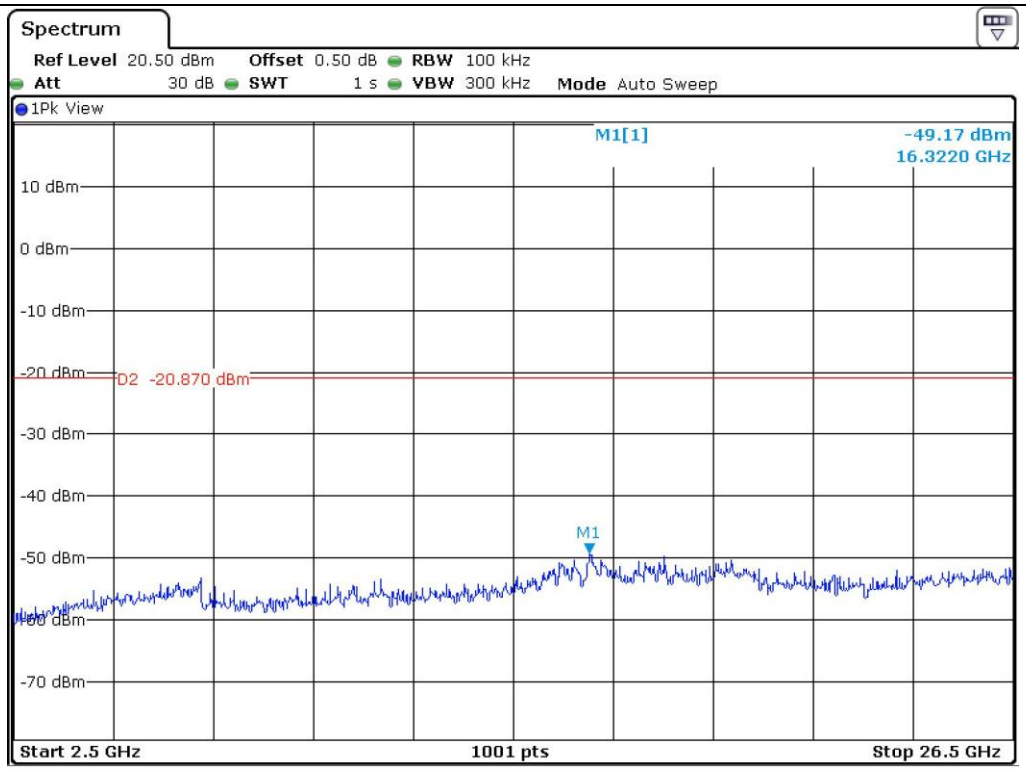
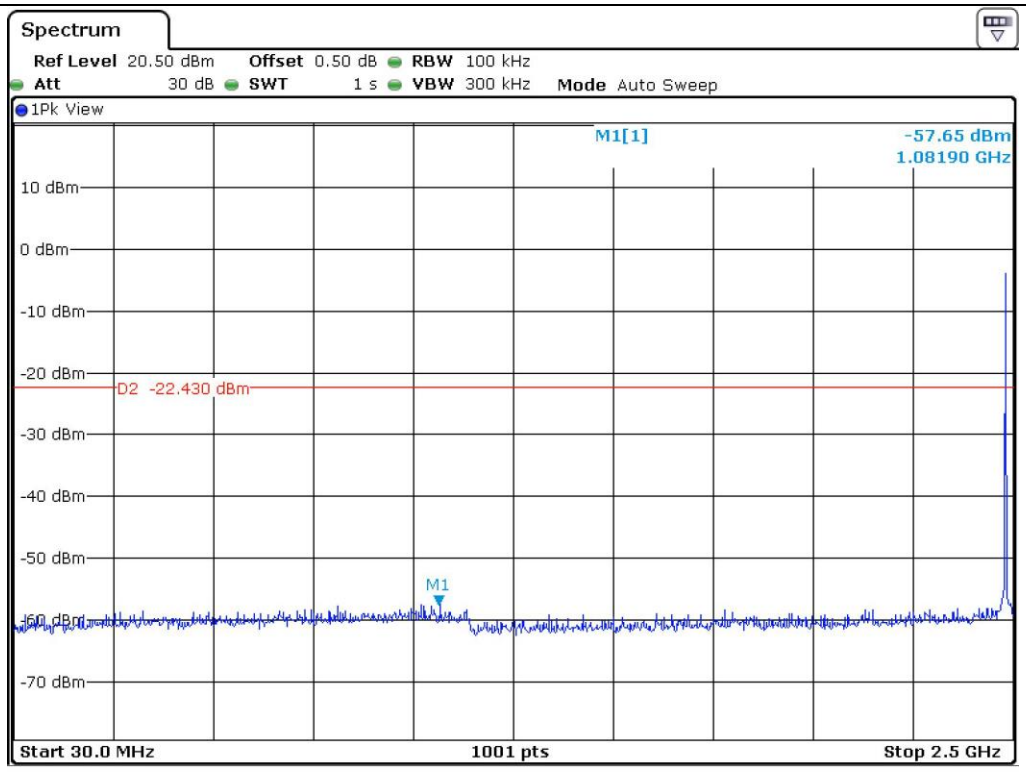
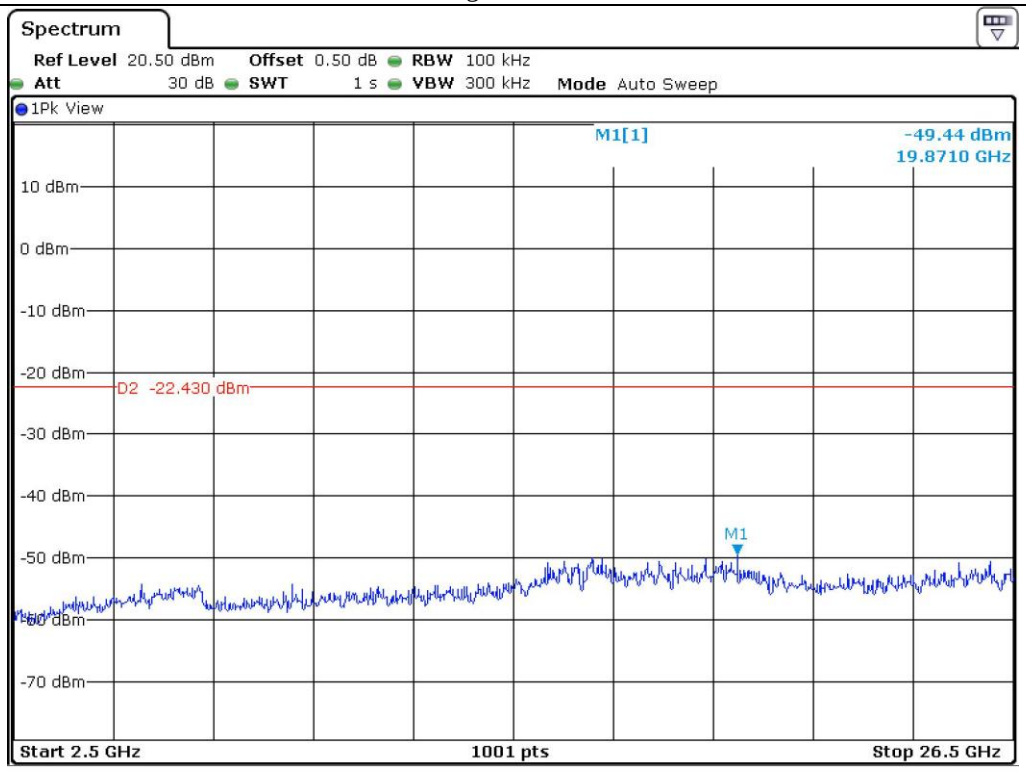


Middle Channel

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



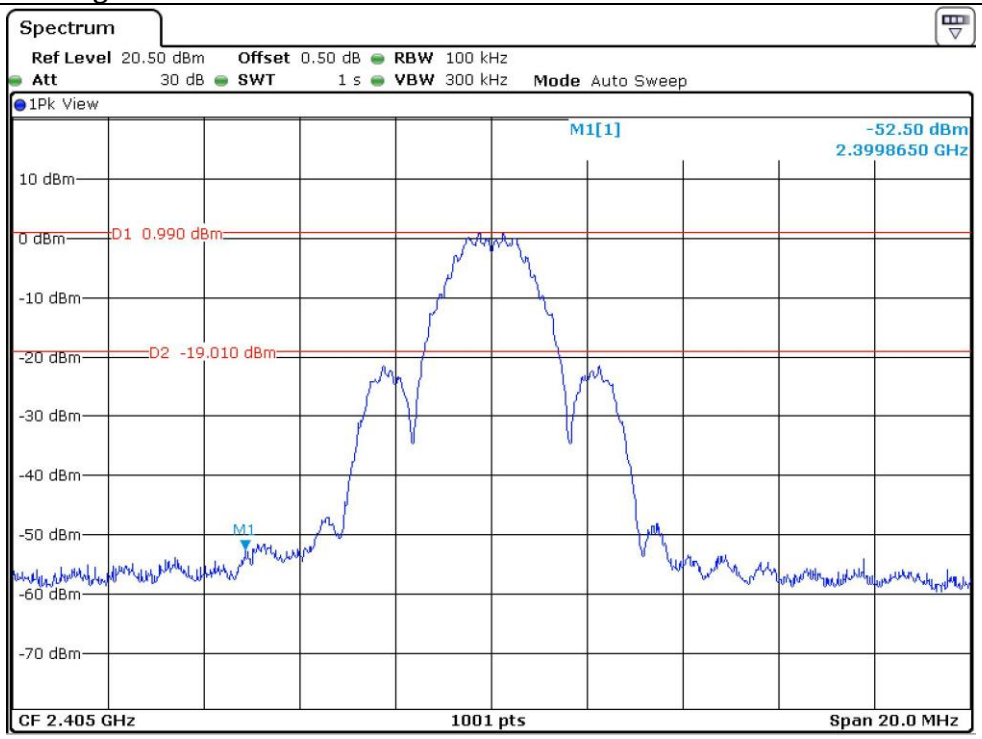
High Channel



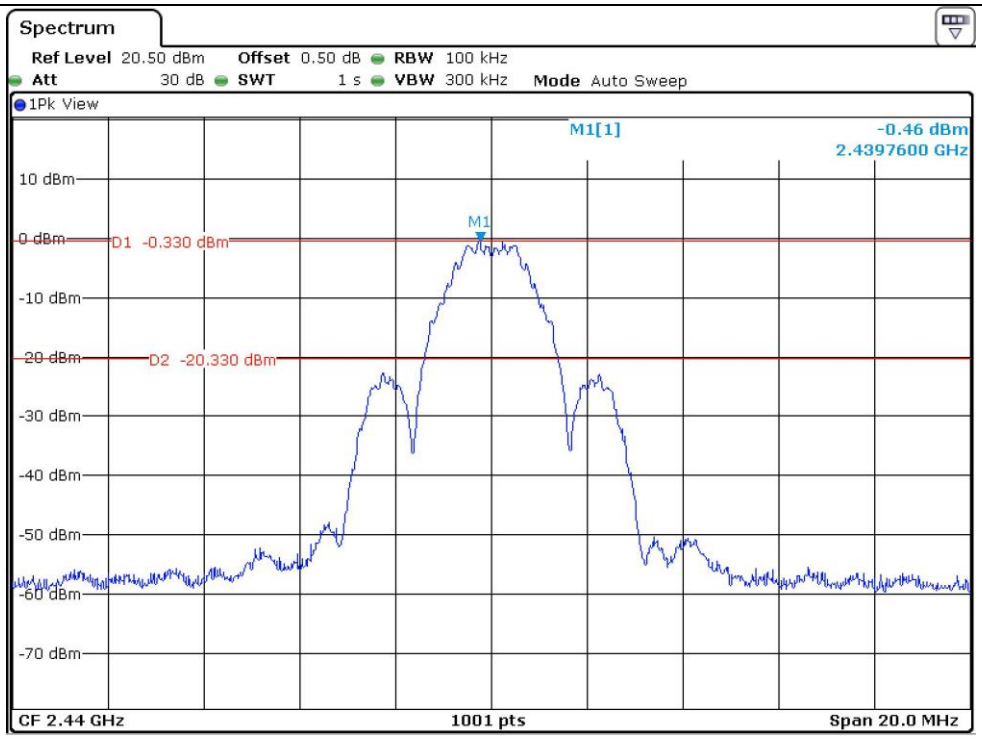
High Channel

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

9.5.2 Test data for Zigbee 2

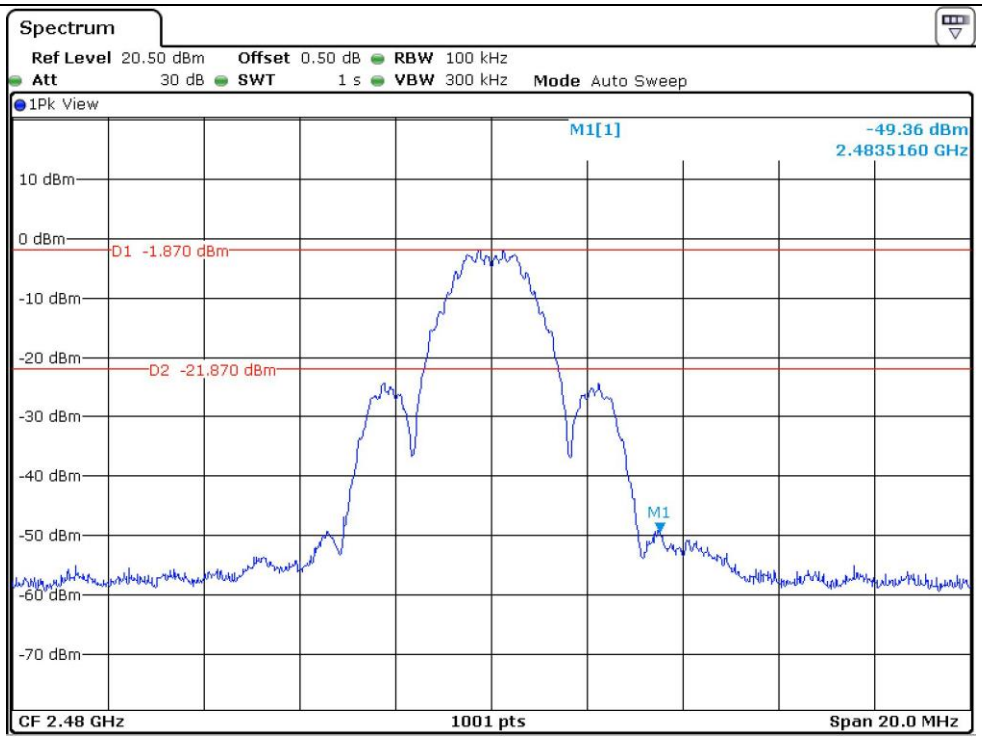


Low Channel



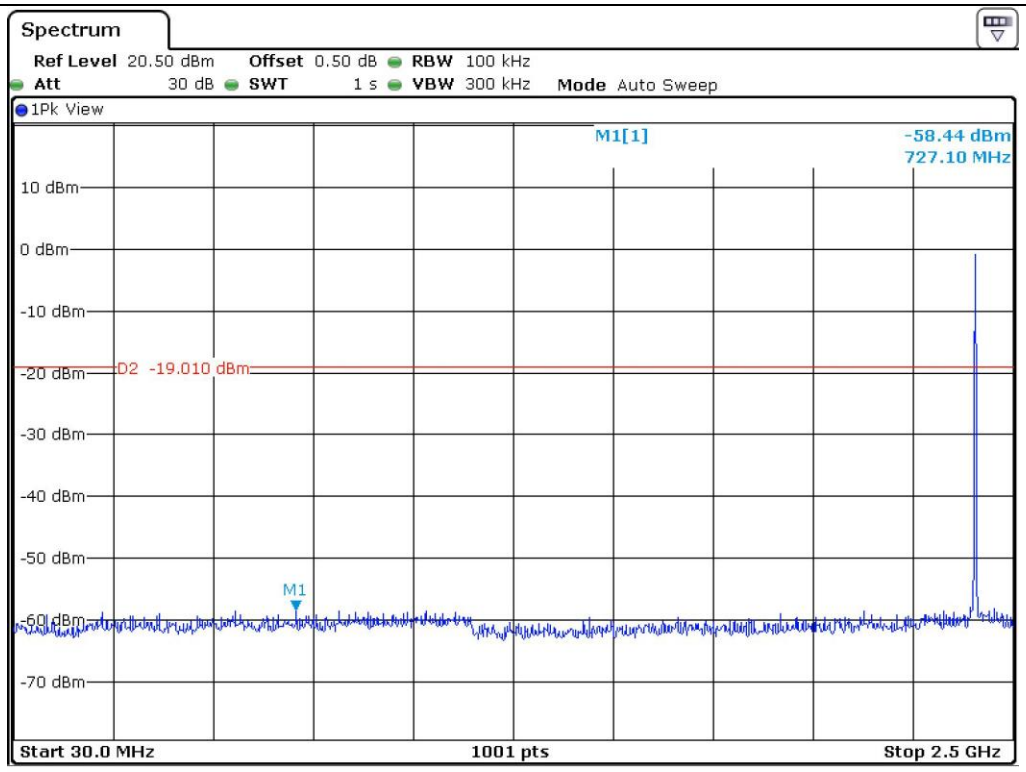
Middle Channel

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

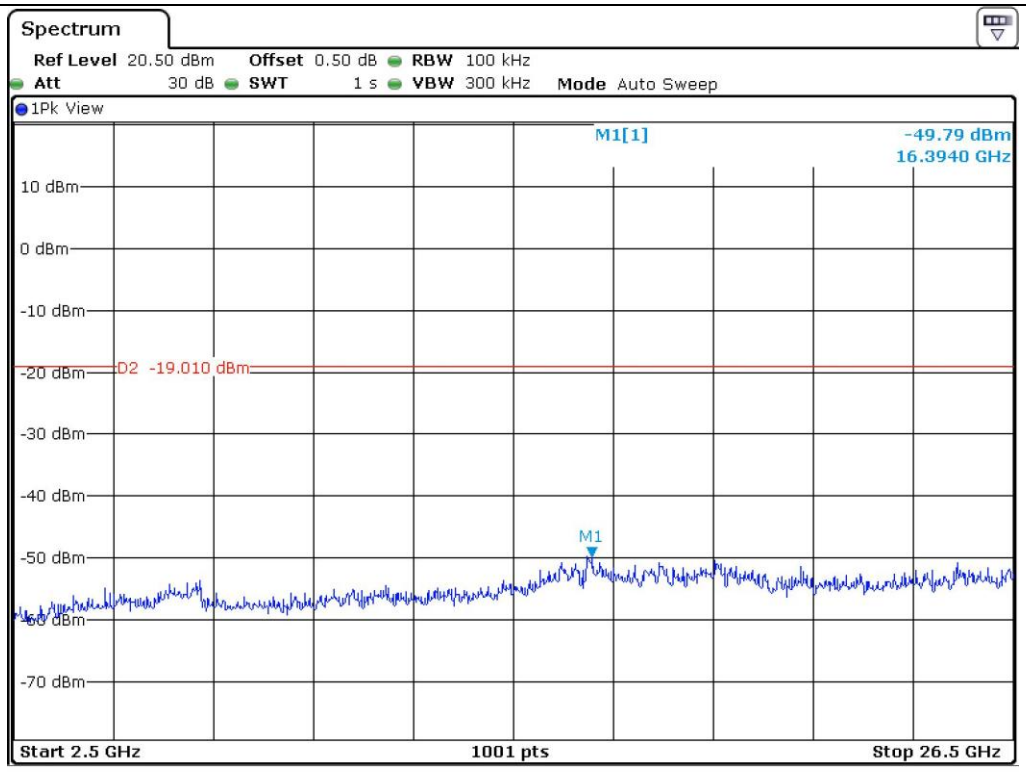


High Channel

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

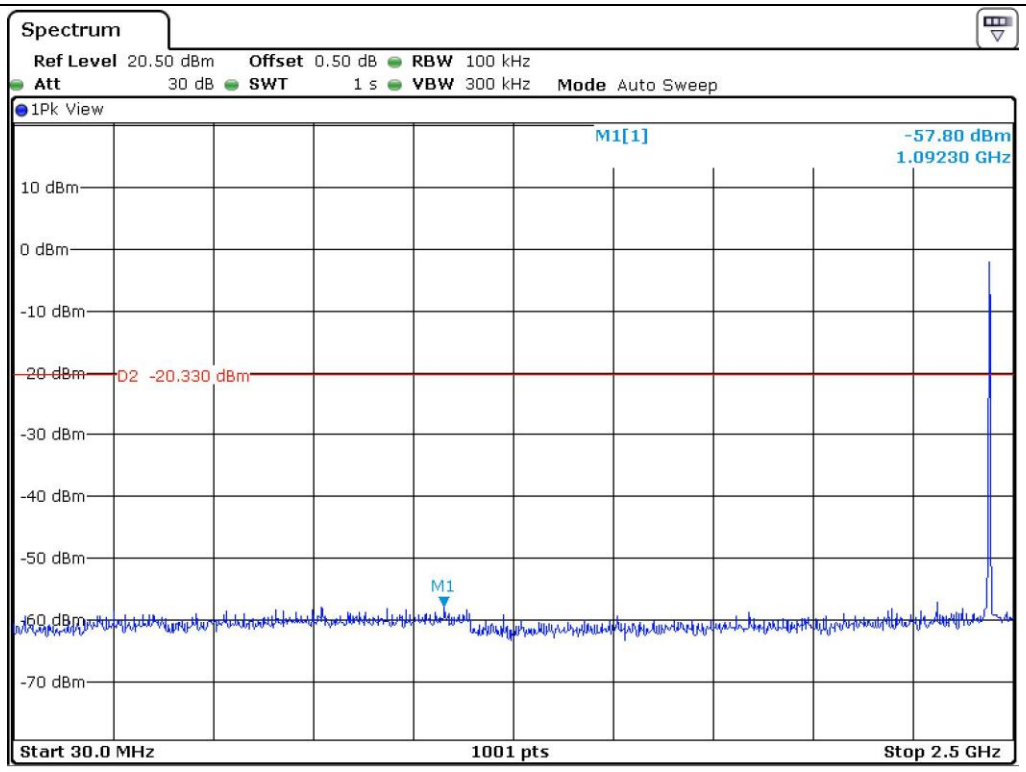


Low Channel

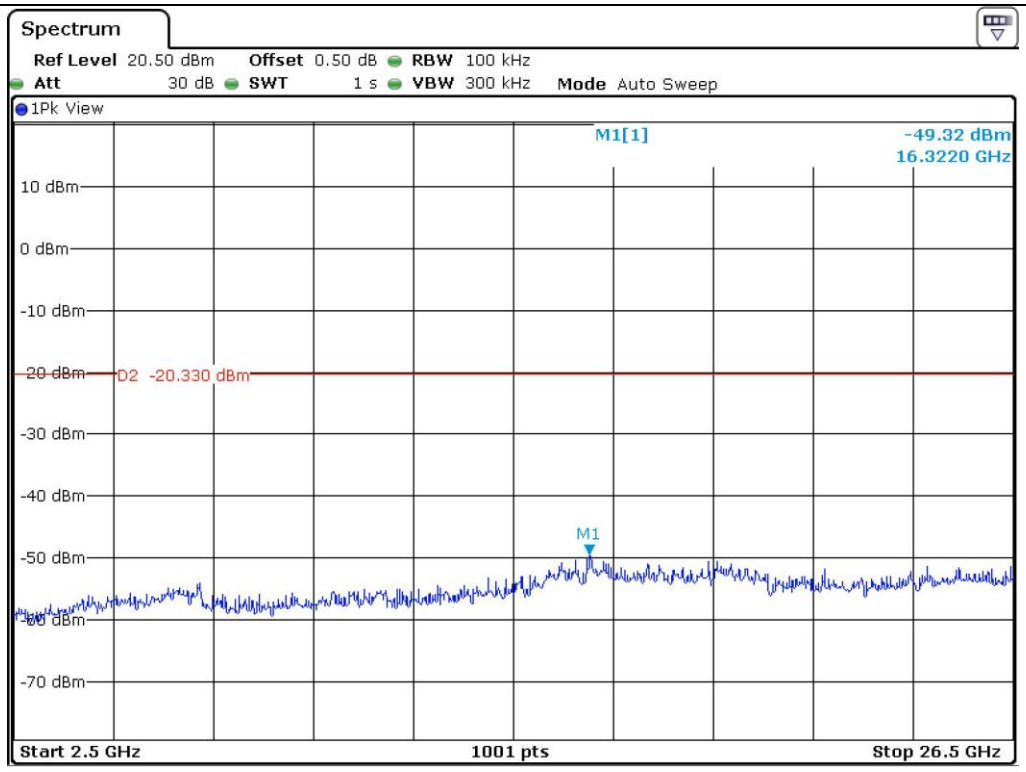


Low Channel

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

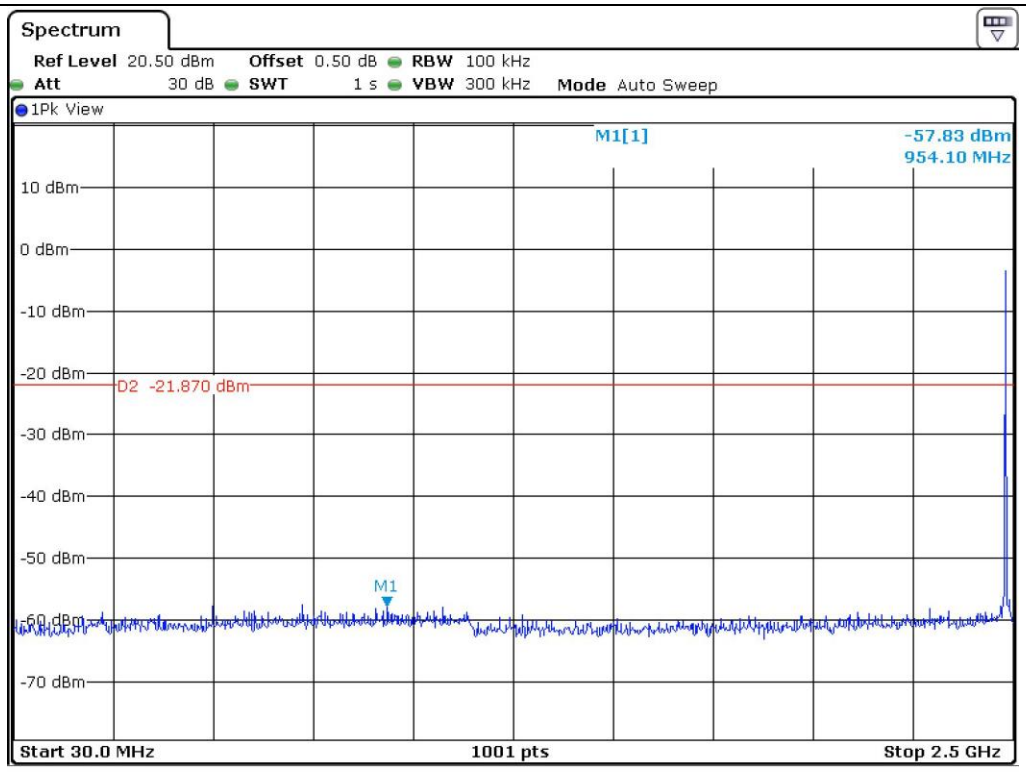


Middle Channel

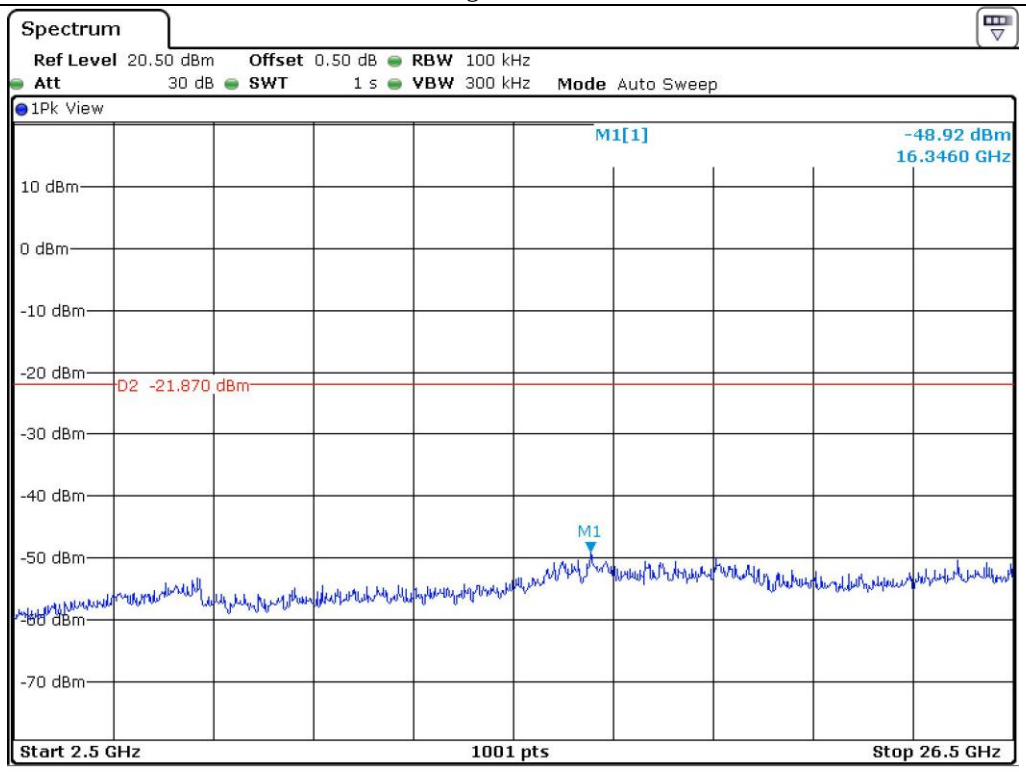


Middle Channel

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



High Channel



High Channel

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

9.6 Test data for radiated emission

9.6.1 Radiated Emission which fall in the Restricted Band

9.6.1.1 Test data for Zigbee 1

-. Test Date : June 24, 2016

-. Resolution bandwidth : 100 kHz for Peak and Average Mode at 30 MHz ~ 1 GHz
1 MHz for Peak and Average Mode at above 1 GHz

-. Video bandwidth : 100 kHz for Peak and Average Mode at 30 MHz ~ 1 GHz
1 MHz for Peak and 10 Hz for Average Mode at above 1 GHz

-. Frequency range : 30 MHz ~ 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									
2 390.00	48.37	Peak	H	27.20	7.10	43.10	39.57	74.00	34.43
	38.84	Average	H				30.04	54.00	23.96
	49.08	Peak	V				40.28	74.00	33.72
	39.26	Average	V				30.46	54.00	23.54
Test Data for Low Channel									
2 483.50	55.33	Peak	H	27.40	7.10	43.10	46.73	74.00	27.27
	46.18	Average	H				37.58	54.00	16.42
	55.60	Peak	V				47.00	74.00	27.00
	46.31	Average	V				37.71	54.00	16.29
Test Data for High Channel									
2 400.00	64.59	Peak	H	27.20	7.10	43.10	55.79	74.00	18.21
	53.28	Average	H				44.48	54.00	9.52
	64.76	Peak	V				55.96	74.00	18.04
	53.41	Average	V				44.61	54.00	9.39

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 Engineer

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

9.6.1.2 Test data for Zigbee 2

-. Test Date : June 24, 2016

-. Resolution bandwidth : 100 kHz for Peak and Average Mode at 30 MHz ~ 1 GHz
1 MHz for Peak and Average Mode at above 1 GHz

-. Video bandwidth : 100 kHz for Peak and Average Mode at 30 MHz ~ 1 GHz
1 MHz for Peak and 10 Hz for Average Mode at above 1 GHz

-. Frequency range : 30 MHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Result : PASSED

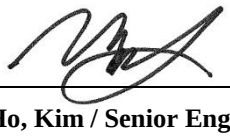
Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Test Data for Low Channel									
2 390.00	48.16	Peak	H	27.20	7.10	43.10	39.36	74.00	34.64
	38.69	Average	H				29.89	54.00	24.11
	48.74	Peak	V				39.94	74.00	34.06
	39.05	Average	V				30.25	54.00	23.75
Test Data for Low Channel									
2 483.50	55.51	Peak	H	27.40	7.10	43.10	46.91	74.00	27.09
	46.28	Average	H				37.68	54.00	16.32
	55.91	Peak	V				47.31	74.00	26.69
	46.69	Average	V				38.09	54.00	15.91
Test Data for High Channel									
2 400.00	64.55	Peak	H	27.20	7.10	43.10	55.75	74.00	18.25
	53.26	Average	H				44.46	54.00	9.54
	64.80	Peak	V				56.00	74.00	18.00
	53.44	Average	V				44.64	54.00	9.36

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 Engineer

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

9.6.2 Spurious & Harmonic Radiated Emission

9.6.2.1 Test data for Zigbee 1

-. Test Date : June 24, 2016

-. Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,
100 kHz for Peak Mode for the emissions outside restricted band

-. Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Result : PASSED

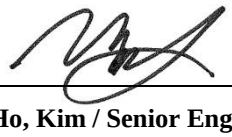
Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 810.00	48.11	Peak	H	31.10	9.60	42.40	46.41	74.00	27.59
	36.58	Average	H				34.88	54.00	19.12
	47.89	Peak	V				46.19	74.00	27.81
	36.35	Average	V				34.65	54.00	19.35
Test Data for Middle Channel									
4 880.00	47.25	Peak	H	31.30	9.80	42.40	45.95	74.00	28.05
	36.11	Average	H				34.81	54.00	19.19
	46.76	Peak	V				45.46	74.00	28.54
	35.83	Average	V				34.53	54.00	19.47
Test Data for High Channel									
4 960.00	46.58	Peak	H	31.30	9.90	42.30	45.48	74.00	28.52
	35.76	Average	H				34.66	54.00	19.34
	46.31	Peak	V				45.21	74.00	28.79
	35.59	Average	V				34.49	54.00	19.51

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 Engineer

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

9.6.2.2 Test data for Zigbee 2

-. Test Date : June 24, 2016

-. Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,
100 kHz for Peak Mode for the emissions outside restricted band

-. Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Result : PASSED

Frequency (GHz)	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									
4 810.00	47.79	Peak	H	31.10	9.60	42.40	46.09	74.00	27.91
	35.92	Average	H				34.22	54.00	19.78
	47.52	Peak	V				45.82	74.00	28.18
	35.61	Average	V				33.91	54.00	20.09
Test Data for Middle Channel									
4 880.00	47.05	Peak	H	31.30	9.80	42.40	45.75	74.00	28.25
	35.72	Average	H				34.42	54.00	19.58
	46.81	Peak	V				45.51	74.00	28.49
	35.59	Average	V				34.29	54.00	19.71
Test Data for High Channel									
4 960.00	46.58	Peak	H	31.30	9.90	42.30	45.48	74.00	28.52
	35.43	Average	H				34.33	54.00	19.67
	46.32	Peak	V				45.22	74.00	28.78
	35.18	Average	V				34.08	54.00	19.92

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 Engineer

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

10. PEAK POWER SPECTRUL DENSITY

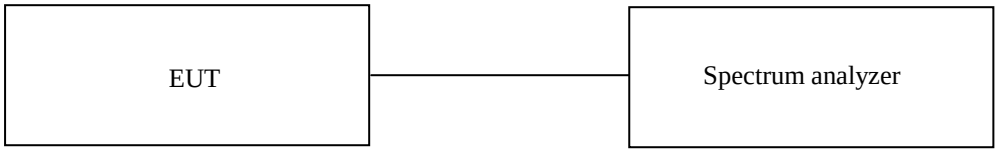
10.1 Operating environment

Temperature : 24.2 ℃

Relative humidity : 45.0 % 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 kHz, the video bandwidth is set to 3 times the resolution bandwidth. The maximum level form the EUT in 3 kHz bandwidth was measured with above condition.



10.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	May 31, 2016 (1Y)

All test equipment used is calibrated on a regular basis.

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

10.4 Test data for Zigbee 1

-. Test Date : June 20, 2016

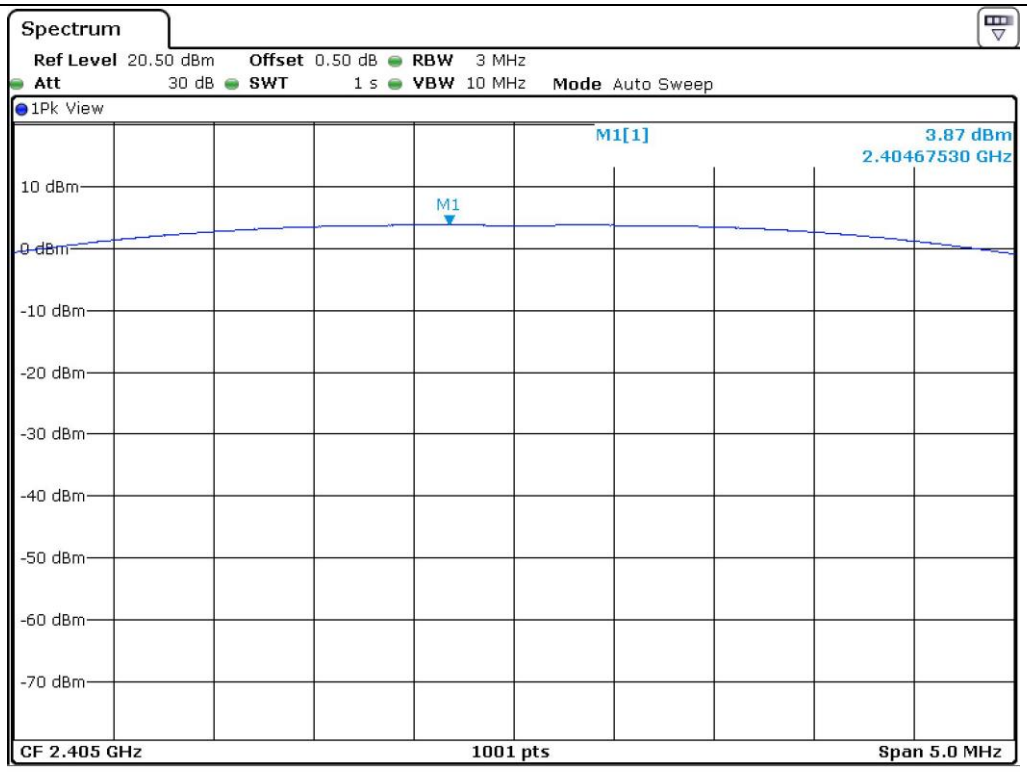
-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

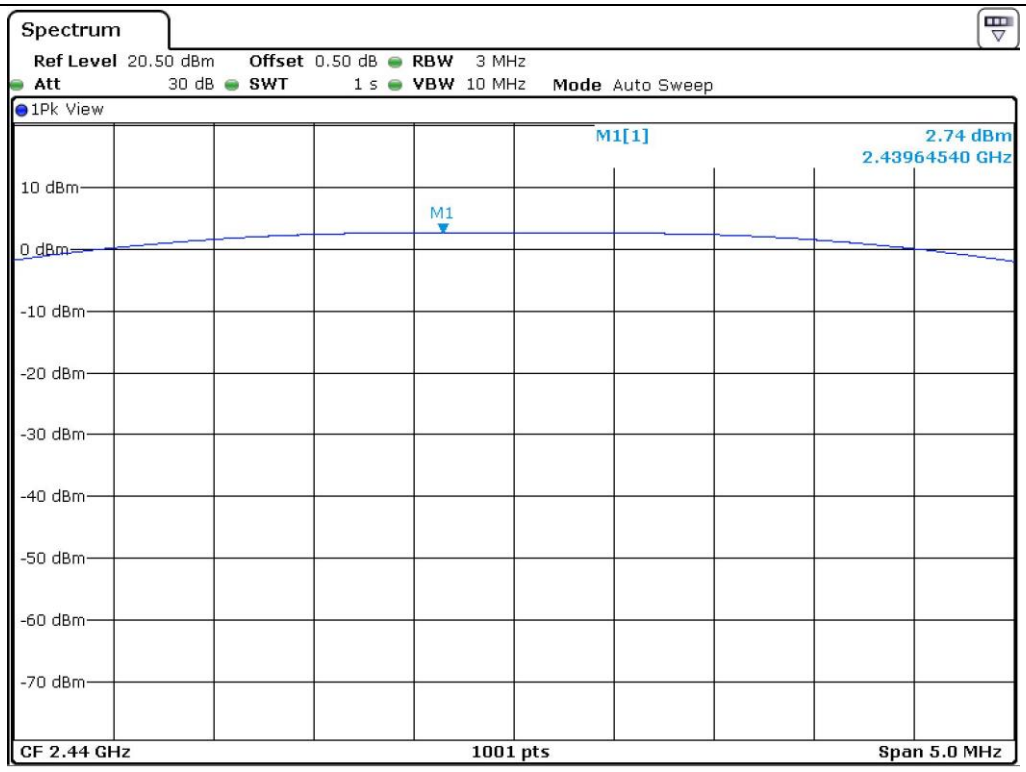
CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 405	3.87	8.00	4.13
Middle	2 440	2.74	8.00	5.26
High	2 480	1.26	8.00	6.74

Remark. Margin = Limit – Measured value

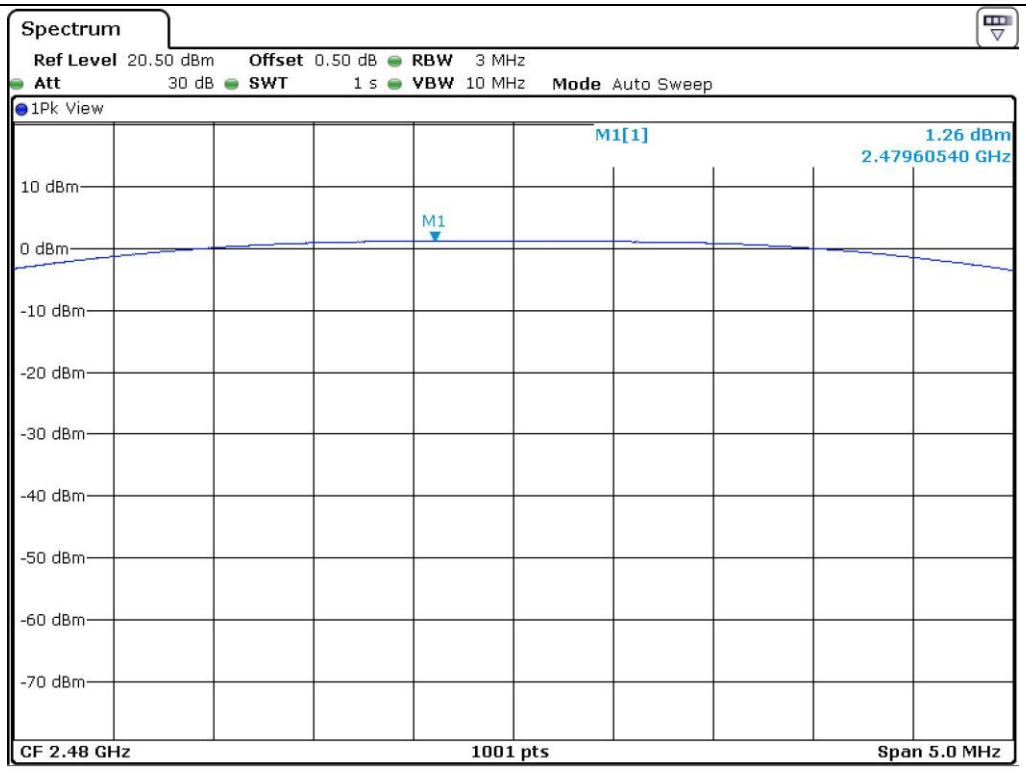
Tested by: Tae-Ho, Kim / Senior Engineer



Low Channel



Middle Channel



High Channel

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

10.5 Test data for Zigbee 2

-. Test Date : June 20, 2016

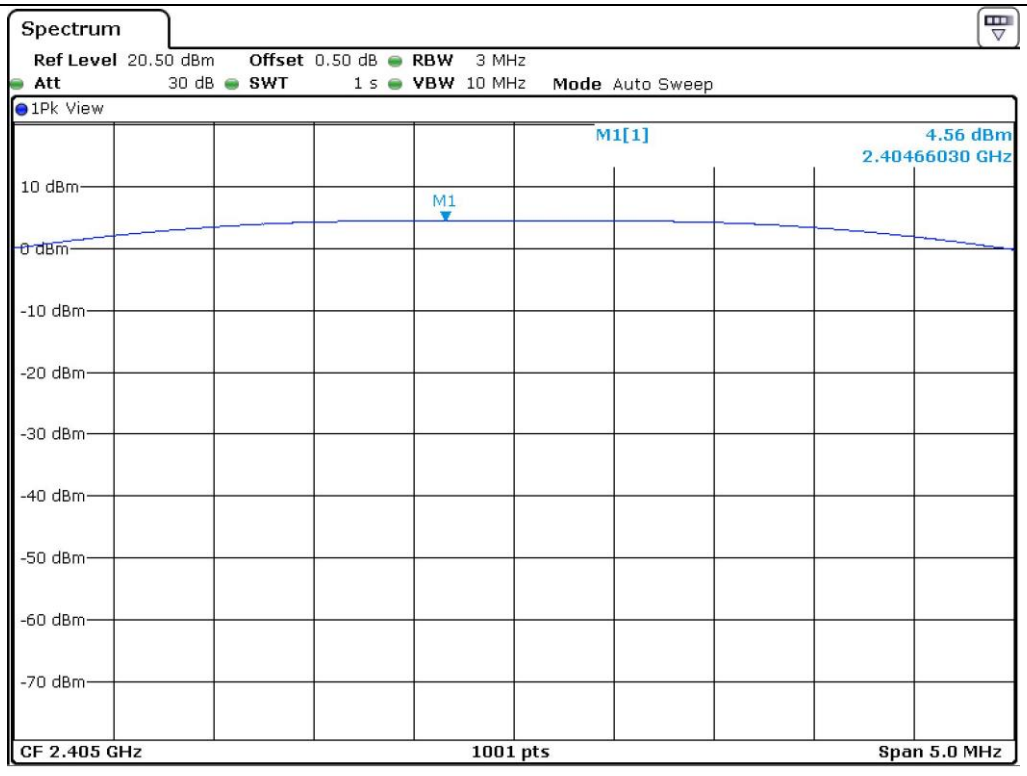
-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

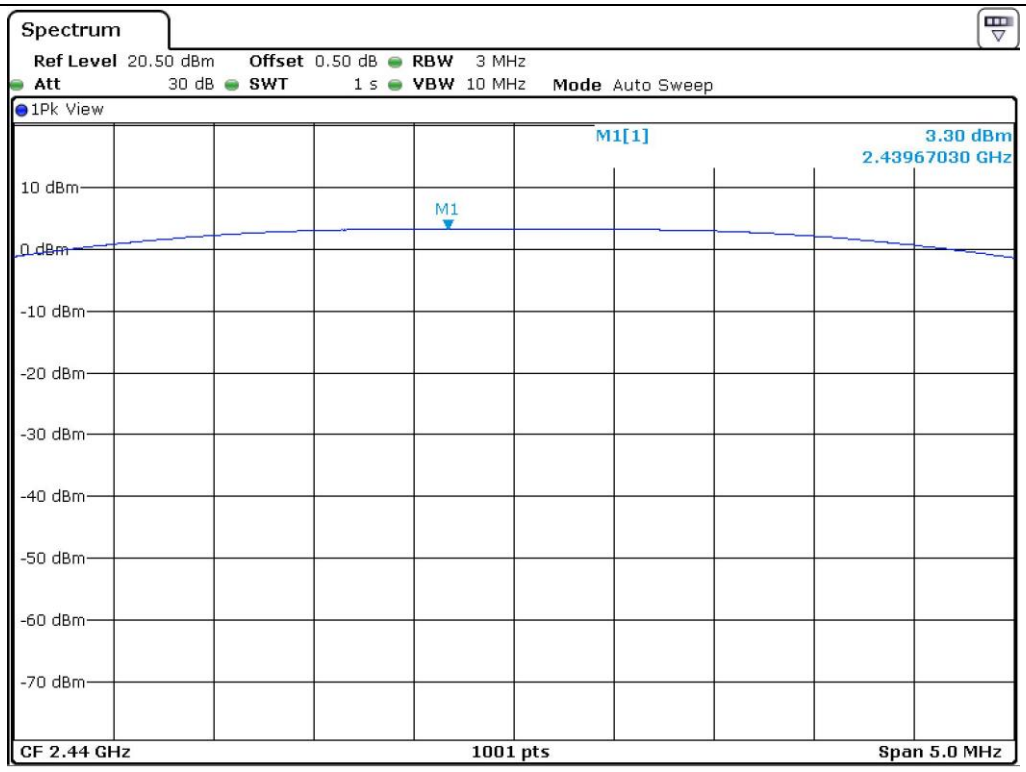
CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 405	4.56	8.00	3.44
Middle	2 440	3.30	8.00	4.70
High	2 480	1.81	8.00	6.19

Remark. Margin = Limit – Measured value

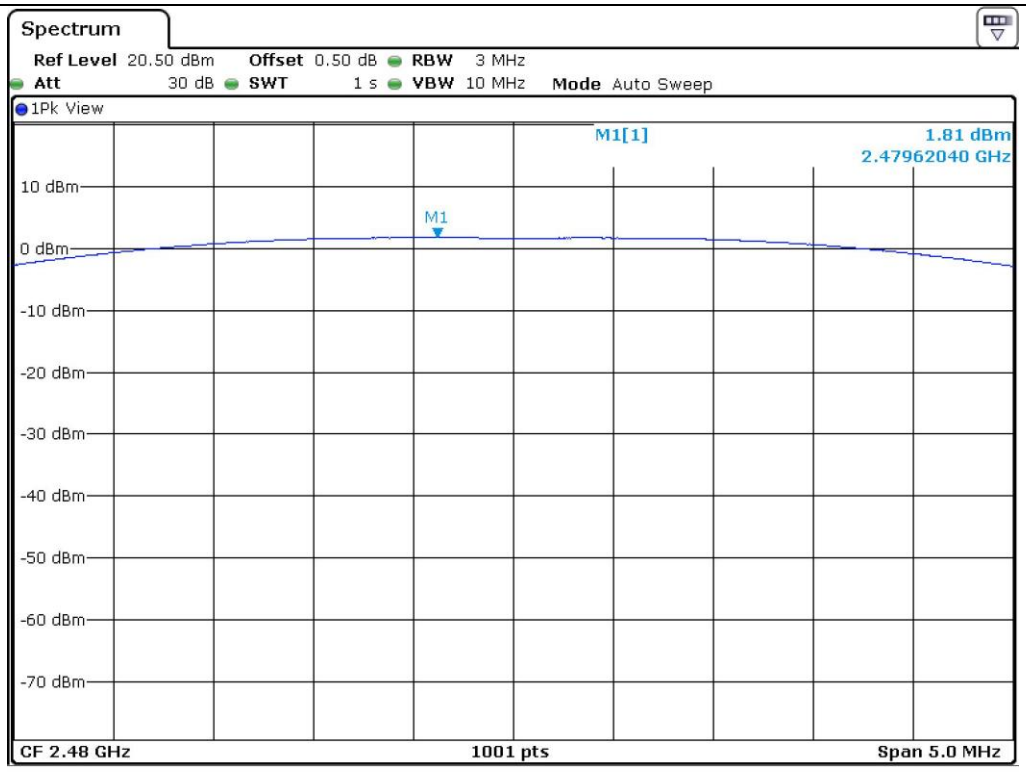
Tested by: Tae-Ho, Kim / Senior Engineer



Low Channel



Middle Channel



High Channel

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

11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 24.2 ℃

Relative humidity : 45.0 % R.H.

11.2 Test set-up

The radiated emissions measurements were performed 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 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 and 4.0 meters 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)
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	May 31, 2016 (1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 29, 2016 (1Y)
■ -	310N	Sonoma Instrument	Pre-Amplifier	312544	Apr. 05, 2016 (1Y)
■ -	SCU-18	Rohde & Schwarz	Pre-Amplifier	10041	Nov. 23, 2015 (1Y)
■ -	DT3000	Innco System	Turn Table	930611	N/A
■ -	MA4000-EP	Innco System	Antenna Master	3320611	N/A
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-421	Apr. 15, 2016 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 31, 2015 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Apr. 31, 2015 (2Y)

All test equipment used is calibrated on a regular basis.

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

11.4 Test data Zigbee 1

11.4.1 Test data for Below 30 MHz

-. Test Date : June 20, 2016

-. 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.									

Tested by: Tae-Ho, Kim / Senior Engineer

11.4.2 Test data for 30 MHz ~ 1 000 MHz

-. Test Date : June 20, 2016

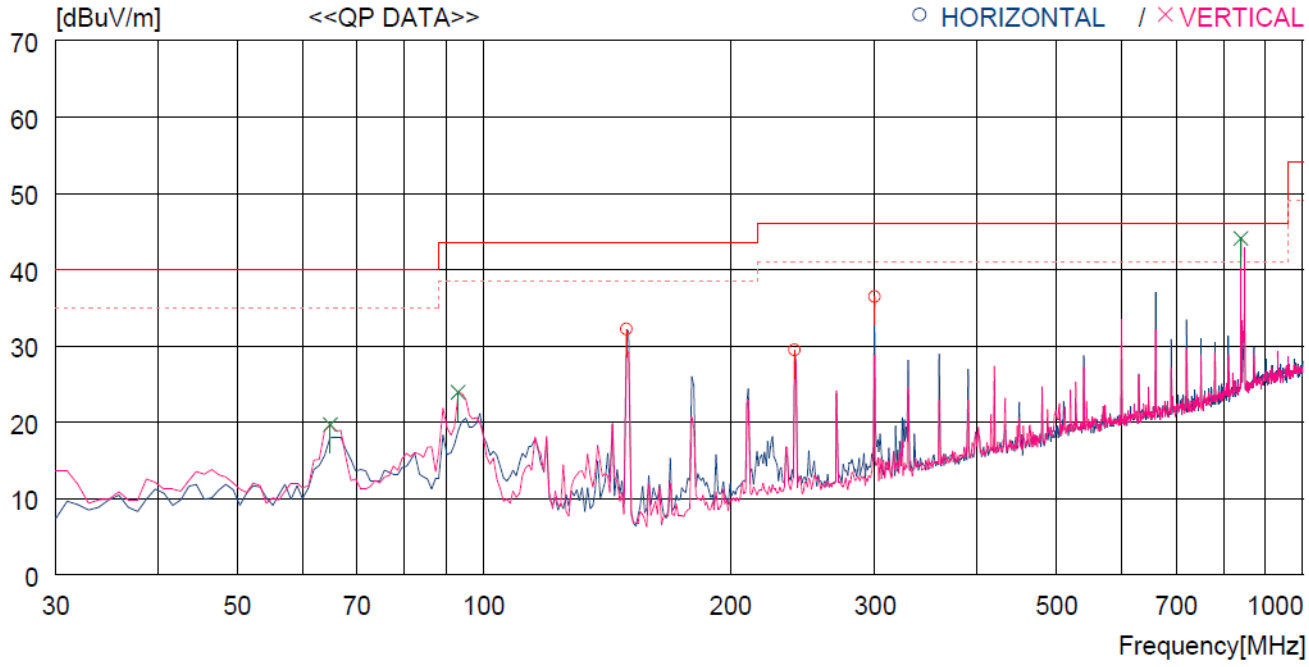
-. Resolution bandwidth : 120 kHz

-. Frequency range : 30 MHz ~ 1 000 MHz

-. Measurement distance : 3 m

-.Operating mode : Transmitting mode

Operating condition : Low Channel



No.	FREQ	READING QP	ANT FACTOR	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	[dBuV]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal ------										
1	149.310	53.6	8.3	3.3	33.0	32.2	43.5	11.3	200	281
2	239.520	46.0	12.1	4.1	32.8	29.4	46.0	16.6	100	0
3	299.660	50.9	13.6	4.6	32.7	36.4	46.0	9.6	100	0
----- Vertical ------										
4	64.920	39.1	11.5	2.2	33.1	19.7	40.0	20.3	100	284
5	93.050	43.9	10.7	2.6	33.3	23.9	43.5	19.6	100	359
6	839.941	48.0	21.4	8.1	33.4	44.1	46.0	1.9	100	270

Remark: Margin (dB) = Limit – Result and Result = Reading Quasi- Peak + Antenna Factor + Loss – Gain Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

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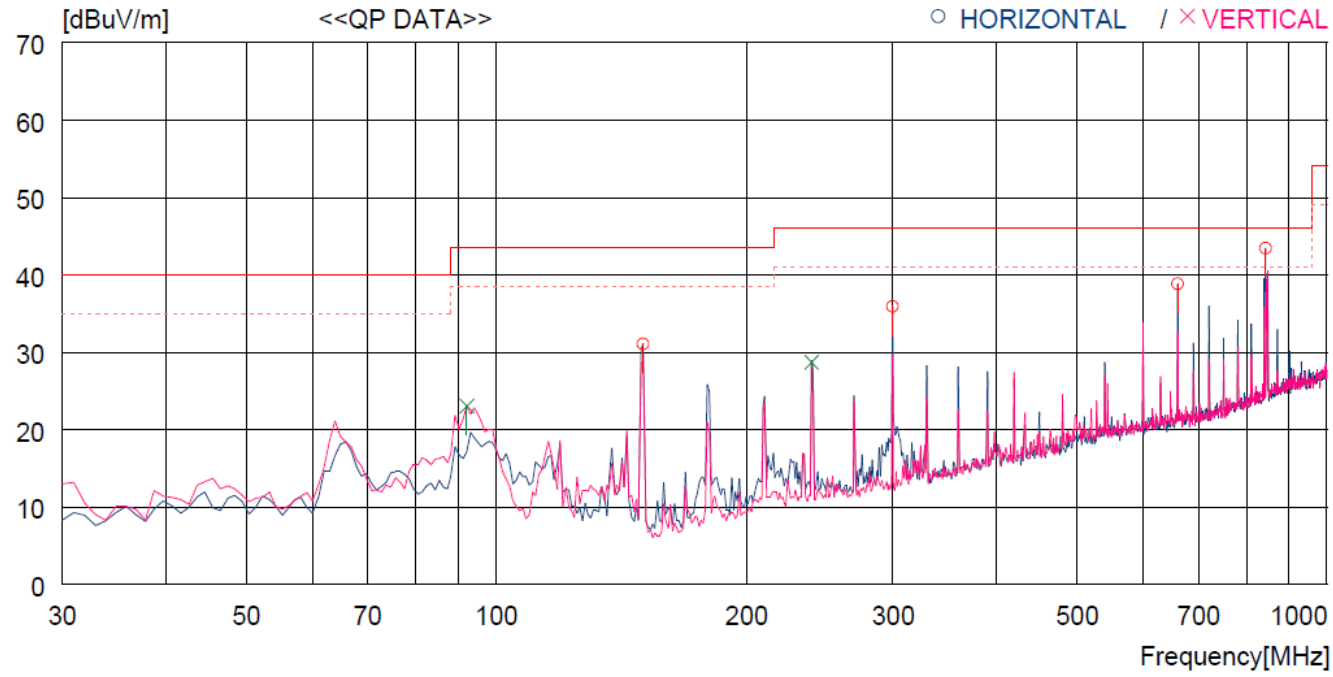
Operating condition : Middle Channel



No.	FREQ	READING QP	ANT FACTOR	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	[dBuV]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal ------										
1	150.280	52.6	8.2	3.3	33.1	31.0	43.5	12.5	200	326
2	299.660	51.0	13.3	4.6	33.0	35.9	46.0	10.1	100	0
3	660.496	46.0	19.2	7.0	33.4	38.8	46.0	7.2	100	290
4	842.851	47.3	21.0	8.2	33.1	43.4	46.0	2.6	200	79
----- Vertical ------										
5	92.080	43.1	10.4	2.6	33.1	23.0	43.5	20.5	100	359
6	239.520	45.9	11.8	4.0	33.0	28.7	46.0	17.3	200	30

Remark: Margin (dB) = Limit – Result and Result = Reading Quasi- Peak + Antenna Factor + Loss – Gain Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

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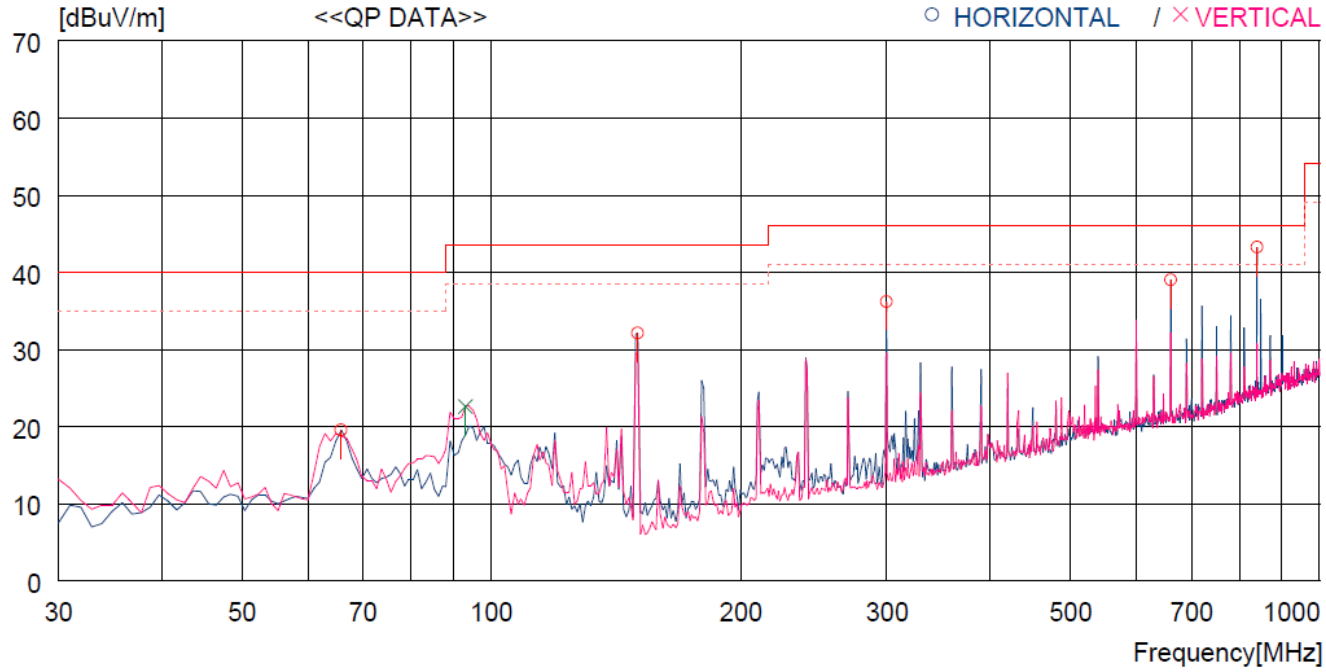
Operating condition : High Channel



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	65.890	39.1	11.2	2.3	33.1	19.5	40.0	20.5	300	230
2	150.280	53.4	8.4	3.3	33.0	32.1	43.5	11.4	200	0
3	299.660	50.7	13.6	4.6	32.7	36.2	46.0	9.8	100	316
4	660.496	45.9	19.5	7.0	33.4	39.0	46.0	7.0	100	300
5	839.941	47.1	21.4	8.1	33.4	43.2	46.0	2.8	400	227
----- Vertical ------										
6	93.050	42.6	10.7	2.6	33.3	22.6	43.5	20.9	100	0

Remark: Margin (dB) = Limit – Result and Result = Reading Quasi- Peak + Antenna Factor + Loss – Gain Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

Tested by: Tae-Ho, Kim / Senior Engineer

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

11.4.3 Test data for above 1 GHz

-. Test Date : June 20, 2016

-. 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: Tae-Ho, Kim / Senior Engineer

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

11.5 Test data Zigbee 2

11.5.1 Test data for Below 30 MHz

-. Test Date : June 20, 2016

-. 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.									

Tested by: Tae-Ho, Kim / Senior Engineer

11.5.2 Test data for 30 MHz ~ 1 000 MHz

-. Test Date : June 20, 2016

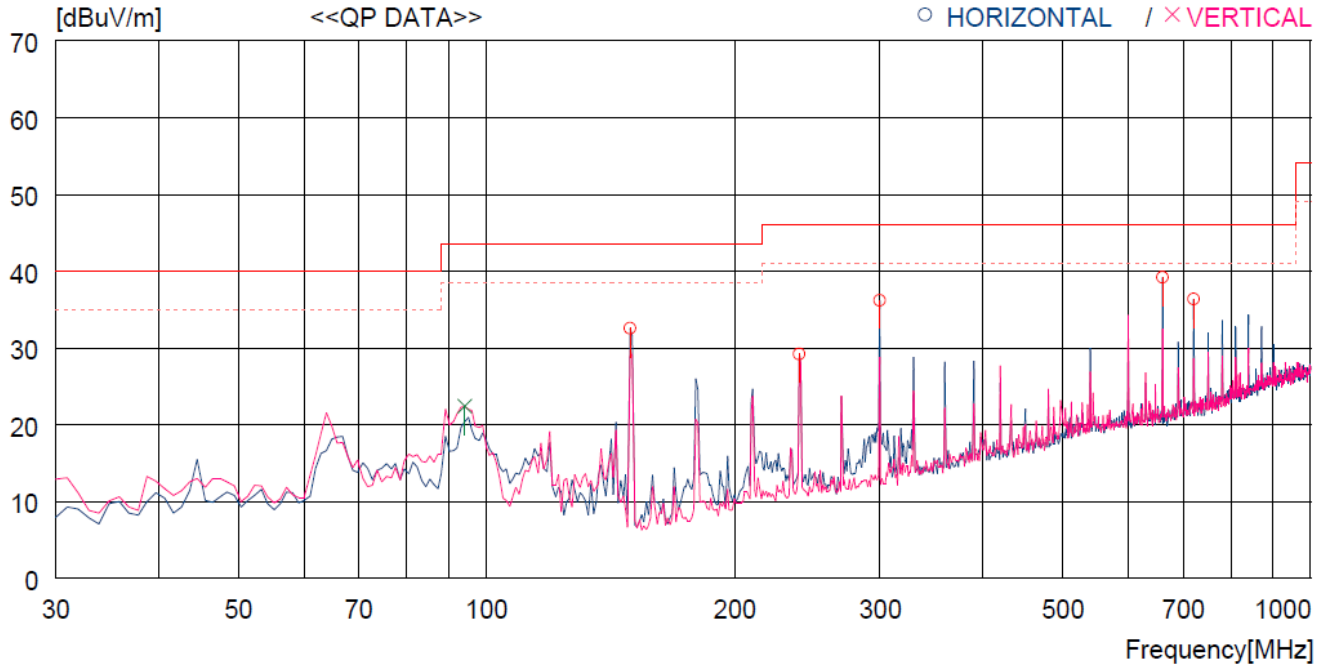
-. Resolution bandwidth : 120 kHz

-. Frequency range : 30 MHz ~ 1 000 MHz

-. Measurement distance : 3 m

-.Operating mode : Transmitting mode

Operating condition : Low Channel



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	149.310	54.2	8.2	3.2	33.1	32.5	43.5	11.0	200	0
2	239.520	46.4	11.8	4.0	33.0	29.2	46.0	16.8	100	98
3	299.660	51.3	13.3	4.6	33.0	36.2	46.0	9.8	100	309
4	660.496	46.4	19.2	7.0	33.4	39.2	46.0	6.8	100	287
5	720.634	42.8	19.6	7.4	33.5	36.3	46.0	9.7	100	359
----- Vertical ------										
6	94.020	42.2	10.7	2.6	33.1	22.4	43.5	21.1	100	0

Remark: Margin (dB) = Limit – Result and Result = Reading Quasi- Peak + Antenna Factor + Loss – Gain Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

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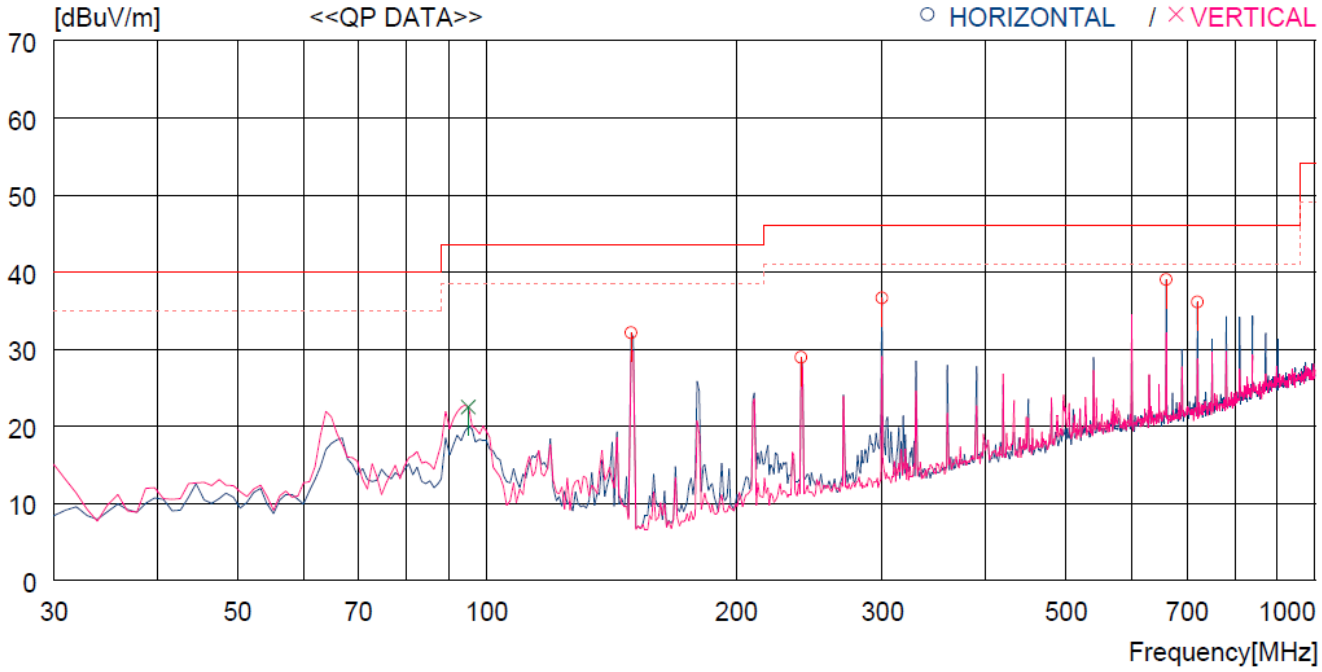
Operating condition : Middle Channel



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	149.310	53.8	8.2	3.2	33.1	32.1	43.5	11.4	200	280
2	239.520	46.1	11.8	4.0	33.0	28.9	46.0	17.1	100	359
3	299.660	51.7	13.3	4.6	33.0	36.6	46.0	9.4	100	287
4	660.496	46.2	19.2	7.0	33.4	39.0	46.0	7.0	100	300
5	720.634	42.6	19.6	7.4	33.5	36.1	46.0	9.9	100	359
----- Vertical ------										
6	94.990	42.1	10.9	2.6	33.1	22.5	43.5	21.0	100	7

Remark: Margin (dB) = Limit – Result and Result = Reading Quasi- Peak + Antenna Factor + Loss – Gain Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

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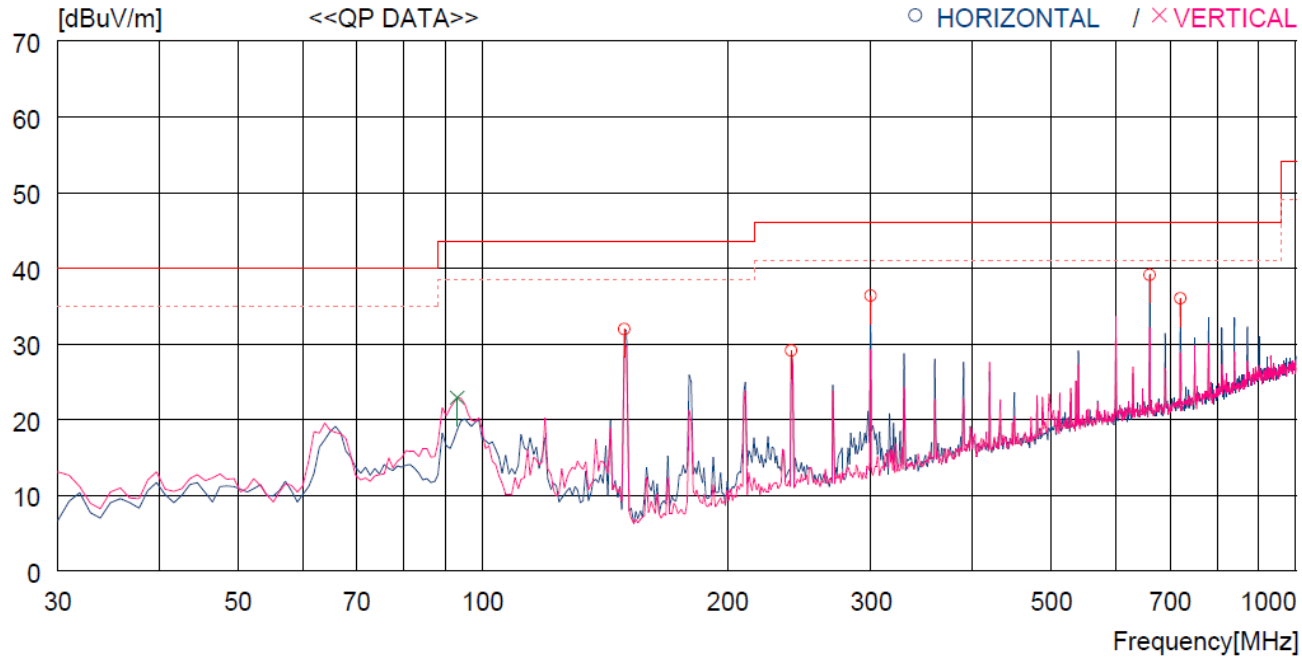
Operating condition : High Channel



No.	FREQ	READING QP	ANT FACTOR	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	[dBuV]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal ------										
1	149.310	53.3	8.3	3.3	33.0	31.9	43.5	11.6	200	0
2	239.520	45.7	12.1	4.1	32.8	29.1	46.0	16.9	100	101
3	299.660	50.8	13.6	4.6	32.7	36.3	46.0	9.7	100	303
4	660.496	46.0	19.5	7.0	33.4	39.1	46.0	6.9	100	359
5	720.634	42.4	19.9	7.4	33.7	36.0	46.0	10.0	100	359
----- Vertical ------										
6	93.050	42.9	10.7	2.6	33.3	22.9	43.5	20.6	100	0

Remark: Margin (dB) = Limit – Result and Result = Reading Quasi- Peak + Antenna Factor + Loss – Gain
Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

Tested by: Tae-Ho, Kim / Senior Engineer

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

11.5.3 Test data for above 1 GHz

-. Test Date : June 20, 2016

-. 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: Tae-Ho, Kim / Senior Engineer

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