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

Test Report No.	**: OT-18D-RWD-015**
AGR No.	**: A18NA-357**
Applicant	**: LG Innotek Co., Ltd.**
Address	**: 26, Hanamsandan 5beon-ro, Gwangsan-gu,Gwangju, 62229, Korea**
Manufacturer	**: PT. LG innotek Indonesia**
Address	**: Bekasi International Industrial Estate, Block C8 No.12&12A Desa Cibatu, Cikarang Selatan, Bekasi 17750, Indonesia**
Type of Equipment	**: WiSA usb Wireless Audio Dongle**
FCC ID.	**: YZP-TWFDS001T**
Model Name	**: TWFD-S001T**
Serial number	**: N/A**
Total page of Report	**: 81 pages (including this page)**
Date of Incoming	**: November 28, 2018**
Date of issue	**: December 10, 2018**

SUMMARY

The equipment complies with the regulation; ***FCC PART 15 SUBPART E Section 15.407***

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 / Chief Engineer
ONETECH Corp.

Approved by: Keun-Young, Choi / Vice President
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)

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-18D-RWD-015	2018.12.10	Initial Release	All

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1. VERIFICATION OF COMPLIANCE

Applicant : LG Innotek Co., Ltd.

Address : 26, Hanamsandan 5beon-ro, Gwangsan-gu,Gwangju, 62229, Korea

Contact Person : Inchang Jeong / Chief Research Engineer

Telephone No. : +82-10-2326-9972

FCC ID : YZP-TWFDS001T

Model Name : TWFD-S001T

Brand Name : LG Innotek

Serial Number : N/A

Date : December 10, 2018

EQUIPMENT CLASS	Unlicensed National Information infrastructure(UNII)
E.U.T. DESCRIPTION	WiSA usb Wireless Audio Dongle
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 E Section 15.407 KDB 789033 D02 General UNII Test Procedures New Rules V02r01
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
15.407(a)	26 dB Bandwidth	PASS
15.407(a)	Maximum Conducted Output Power	Met the Limit / PASS
15.407(a)	Peak Power Spectral Density	Met the Limit / PASS
15.407(a)	Peak Excursion	Met the Limit / PASS
15.407(g)	Frequency Stability	Met the Limit / PASS
15.407(b)	Undesirable Emissions	Met the Limit / PASS
15.205, 15.407(b)	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Met the Limit / PASS
15.207	AC Conducted Emissions 150 kHz-30 MHz	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 E Section 15.407

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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3. GENERAL INFORMATION

3.1 Product Description

The LG Innotek Co., Ltd., Model TWFD-S001T (referred to as the EUT in this report) is a WiSA usb Wireless Audio Dongle. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	WiSA usb Wireless Audio Dongle	
Temperature Range	0 ℃ ~ 50 ℃	
OPERATING FREQUENCY	5 150 MHz ~ 5 250 MHz Band	5 180 MHz ~ 5 240 MHz
	5 250 MHz ~ 5 350 MHz Band	5 260 MHz ~ 5 320 MHz
	5 470 MHz ~ 5 725 MHz Band	5 500 MHz ~ 5 700 MHz
	5 725 MHz ~ 5 850 MHz Band	5 745 MHz ~ 5 825 MHz
MODULATION TYPE	WLAN 5 GHz	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)
RF OUTPUT POWER	5 150 MHz ~ 5 250 MHz Band	4.84 dBm(802.11a)
	5 250 MHz ~ 5 350 MHz Band	5.02 dBm(802.11a)
	5 470 MHz ~ 5 725 MHz Band	5.41 dBm(802.11a)
	5 725 MHz ~ 5 850 MHz Band	5.61 dBm(802.11a)
MODULATION TYPE	WLAN 5 G	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)
ANTENNA TYPE		PCB Antenna
ANTENNA GAIN	5 150 MHz ~ 5 250 MHz Band	0.97 dBi
	5 250 MHz ~ 5 350 MHz Band	0.91 dBi
	5 470 MHz ~ 5 725 MHz Band	1.44 dBi
	5 725 MHz ~ 5 850 MHz Band	1.56 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)		40 MHz

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	PT. LG innotek Indonesia	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
TWFD-S001T	PT. LG innotek Indonesia	WiSA usb Wireless Audio Dongle (EUT)	
Pavilion g6	HP	Notebook	EUT

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

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.

UNII 1

Modulation	DATA RATE	OUTPUT POWER[dBm]
802.11 a (Middle Channel)	6 Mbps	4.84
	18 Mbps	4.80
	36 Mbps	4.79

-. The worse case data rate for each modulation is determined 6 Mbps for IEEE 802.11a.

-. To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes and the worst case is “XY” axis.

UNII 2A

Modulation	DATA RATE	OUTPUT POWER[dBm]
802.11 a (Middle Channel)	6 Mbps	5.02
	18 Mbps	4.97
	36 Mbps	4.95

-. The worse case data rate for each modulation is determined 6 Mbps for IEEE 802.11a.

-. To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes and the worst case is “XY” axis.

UNII 2C

Modulation	DATA RATE	OUTPUT POWER[dBm]
802.11 a (Middle Channel)	6 Mbps	4.91
	18 Mbps	4.88
	36 Mbps	4.87

-. The worse case data rate for each modulation is determined 6 Mbps for IEEE 802.11a.

-. To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes and the worst case is “XY” axis.

UNII 3

Modulation	DATA RATE	OUTPUT POWER[dBm]
802.11 a (Middle Channel)	6 Mbps	5.22
	18 Mbps	5.20
	36 Mbps	5.17

-. The worse case data rate for each modulation is determined 6 Mbps for IEEE 802.11a.

-. To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes and the worst case is “XY” axis.

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5.4 Duty Cycle

- TEST DATA

BAND	Modulation	Duty Cycle(%)	Correction Factor(dB)
UNII 1	802.11 a (Middle Channel)	42.11	3.76
UNII 2A		42.11	3.76
UNII 2C		42.11	3.76
UNII 3		42.02	3.77

Note 1: Duty Cycle(%) = (On Time / (On Time + Off Time)) * 100

Note 2: Correction Factor(dB) = 10log(1 / Duty Cycle)

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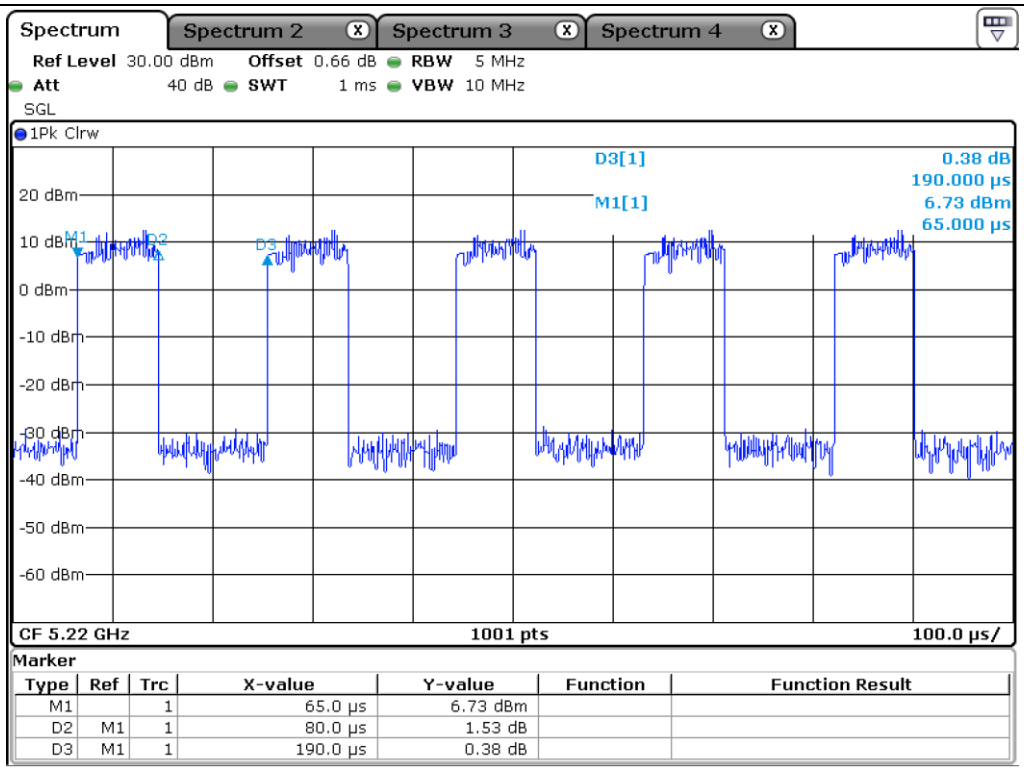
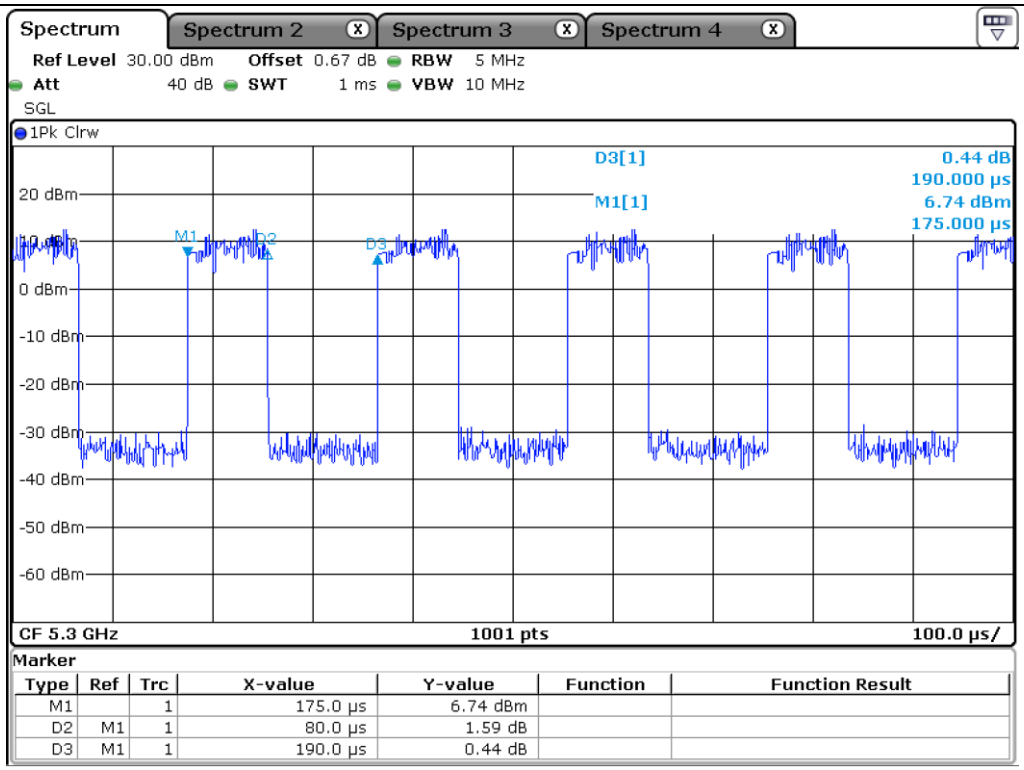
- Plot



UNII 1



UNII 2A

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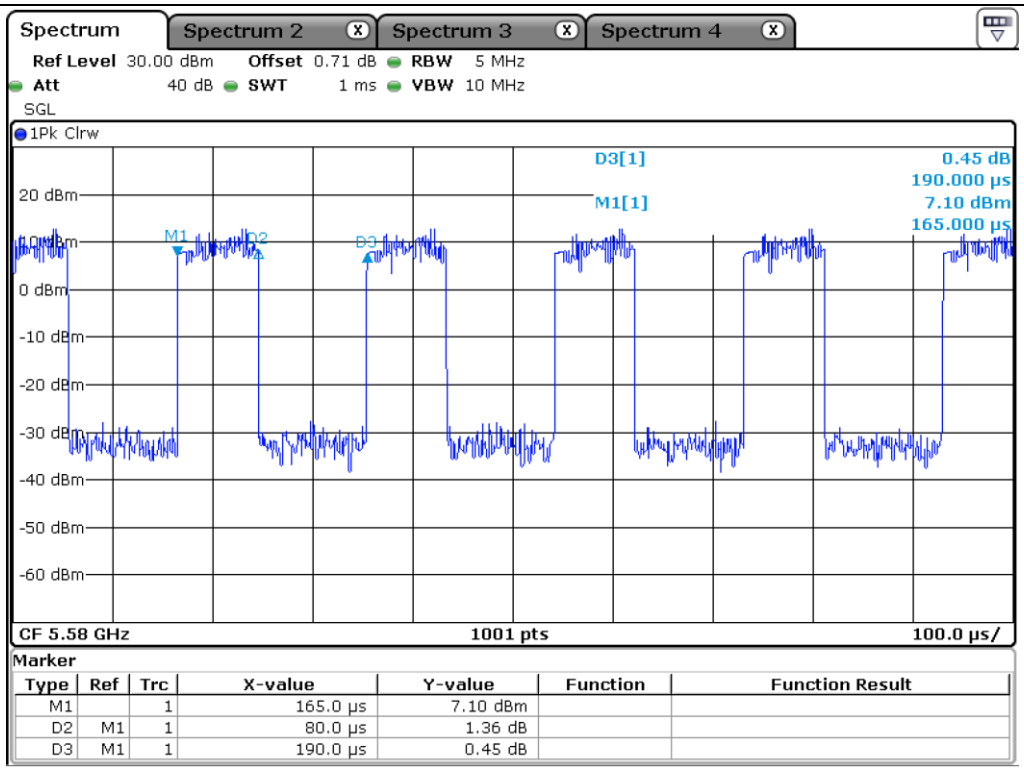
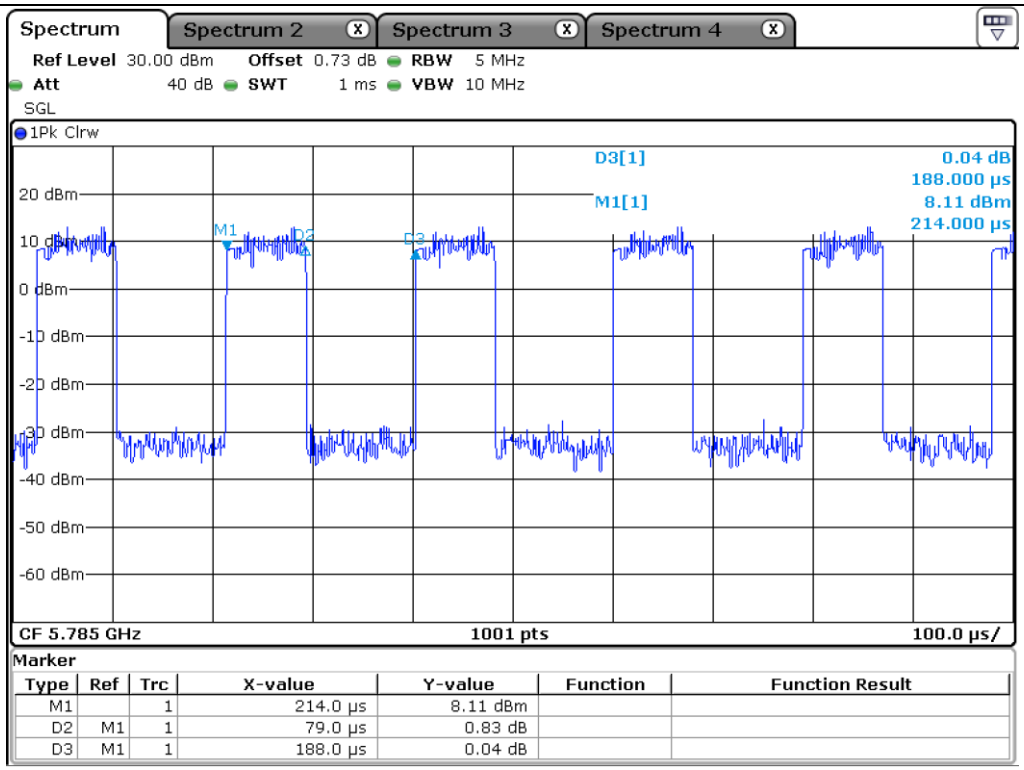


UNII 2C



UNII 3

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5.5 Configuration of Test System

Line Conducted Test: The EUT was connected to USB and the power of USB was connected to Notebook PC. All supporting equipments were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter Semi Anechoic Chamber.

The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

5.6 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 PCB Antenna 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 Test, the following operating mode was investigated.

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

6.2 General Radiated Emissions Tests

During Preliminary Test, the following operating mode was investigated.

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

7. MIMIMUM 26 dB BANDWIDTH

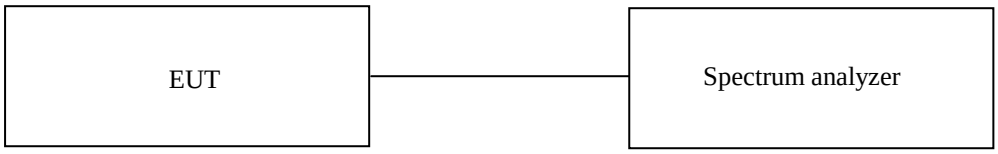
7.1 Operating environment

Temperature : 23 ℃

Relative humidity : 41 % 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 approximately 1% of the emission bandwidth(160 kHz ~ 800 kHz), and peak detection was used. The 26 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 26 dB.



7.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 14, 2018 (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)

7.4 Test data for 802.11a RLAN Mode

-. Test Date : November 28, 2018 ~ November 30, 2018

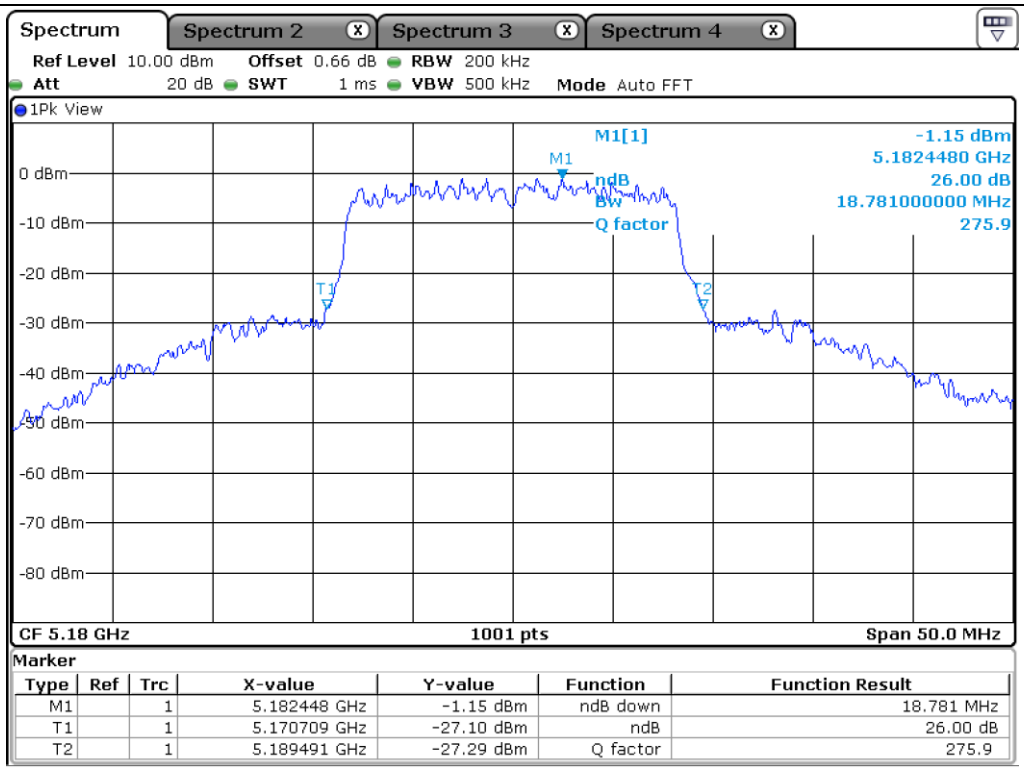
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 180.00	18.78
	Middle	5 220.00	18.58
	High	5 240.00	18.73
5 250 ~ 5 350	Low	5 260.00	18.68
	Middle	5 300.00	18.73
	High	5 320.00	18.63
5 470 ~ 5 725	Low	5 500.00	18.73
	Middle	5 580.00	18.58
	High	5 700.00	18.63
5 725 ~ 5 850	Low	5 745.00	18.68
	Middle	5 785.00	18.68
	High	5 825.00	18.68

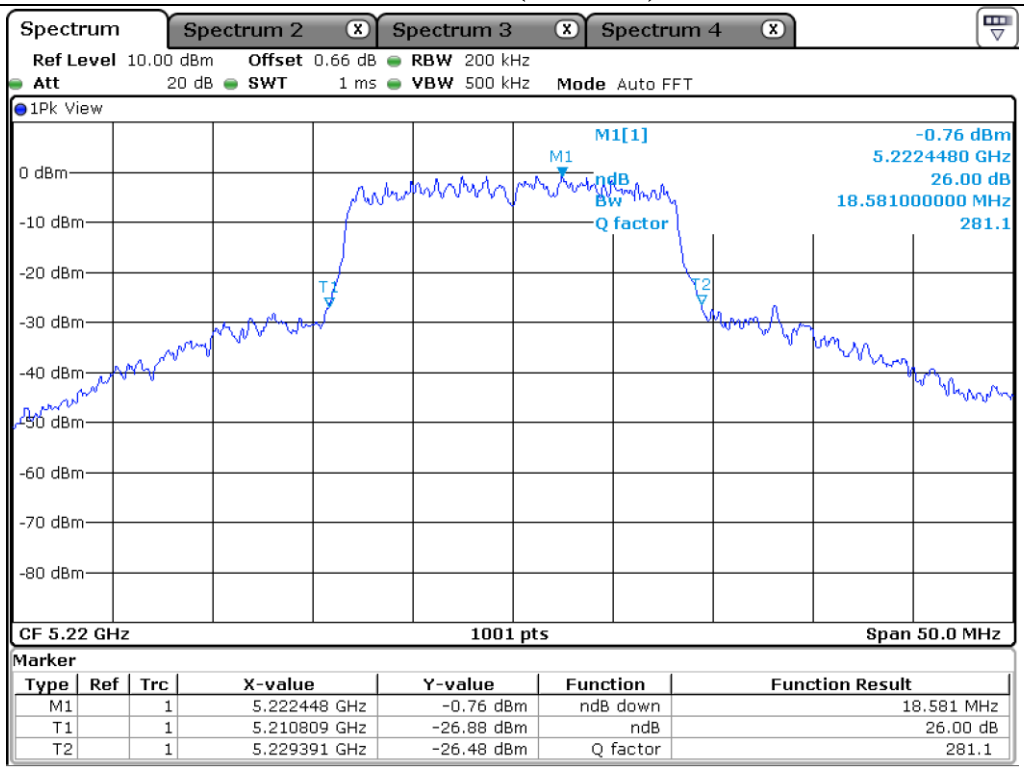
Remark: See next page for measurement data.

Tested by: Hyung-Kwon, Oh / Assistant Manager

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 (5 180 MHz)



Middle Channel (5 220 MHz)

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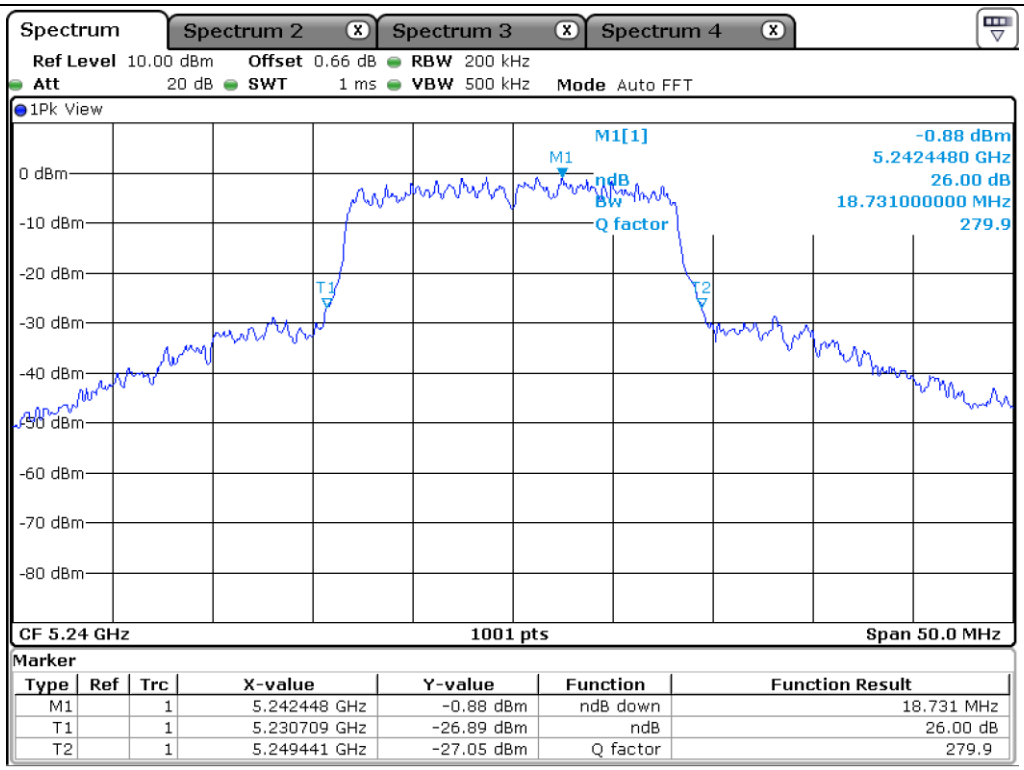
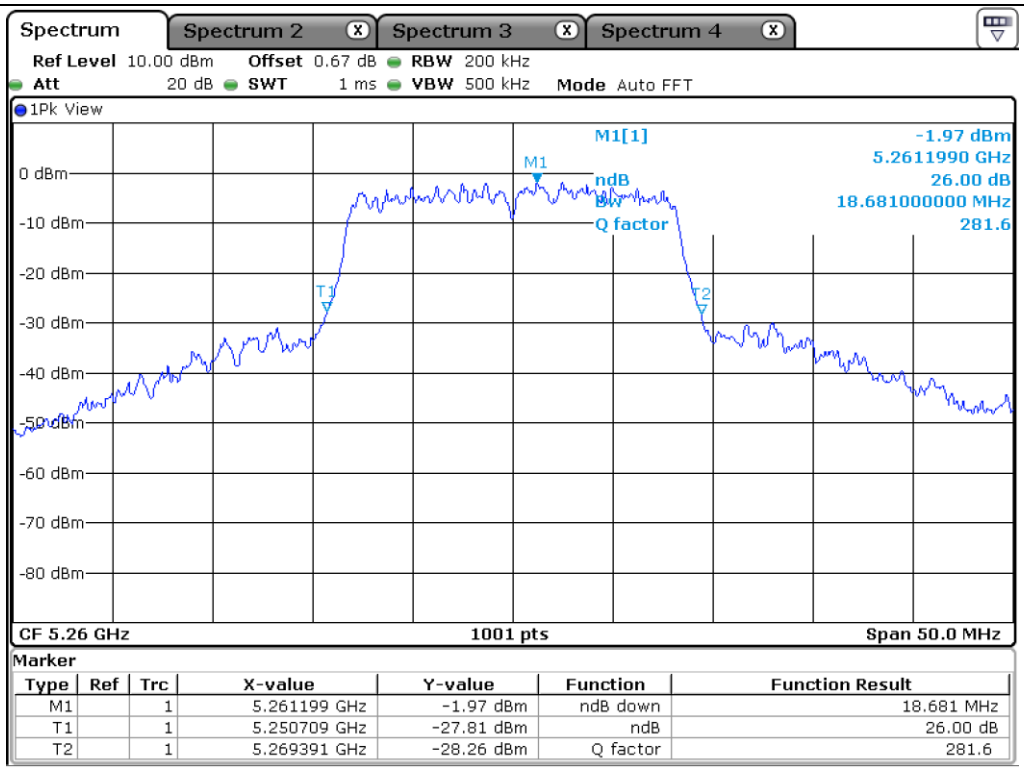
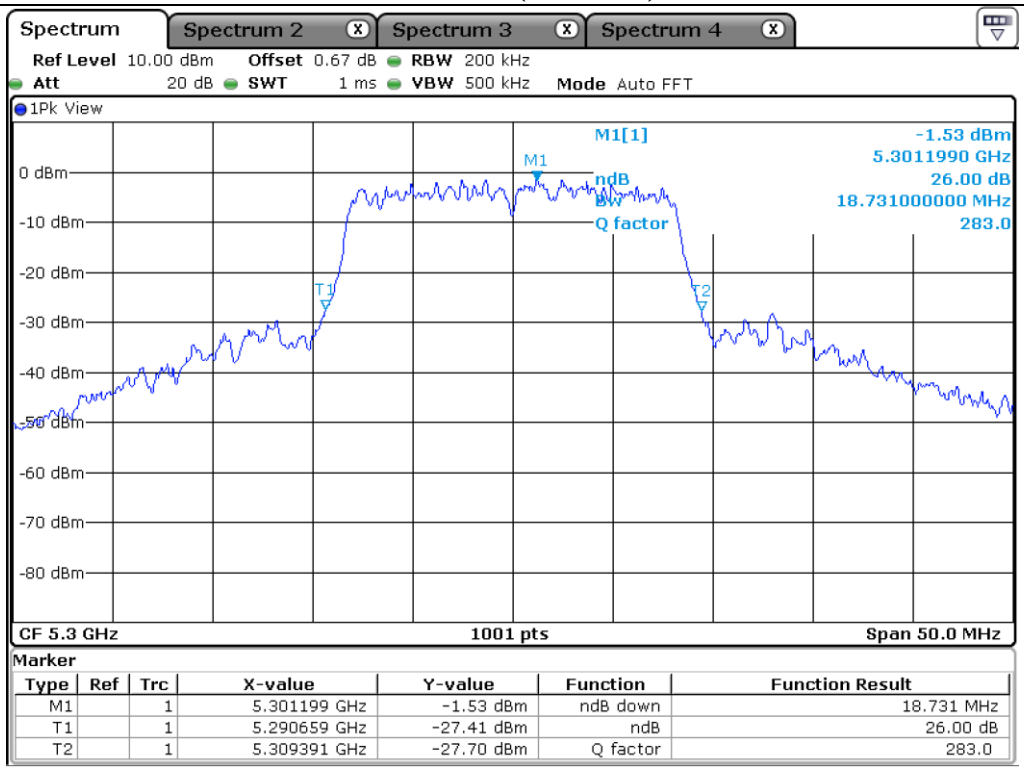


High Channel (5 240 MHz)



Low Channel (5 260 MHz)



Middle Channel (5 300 MHz)

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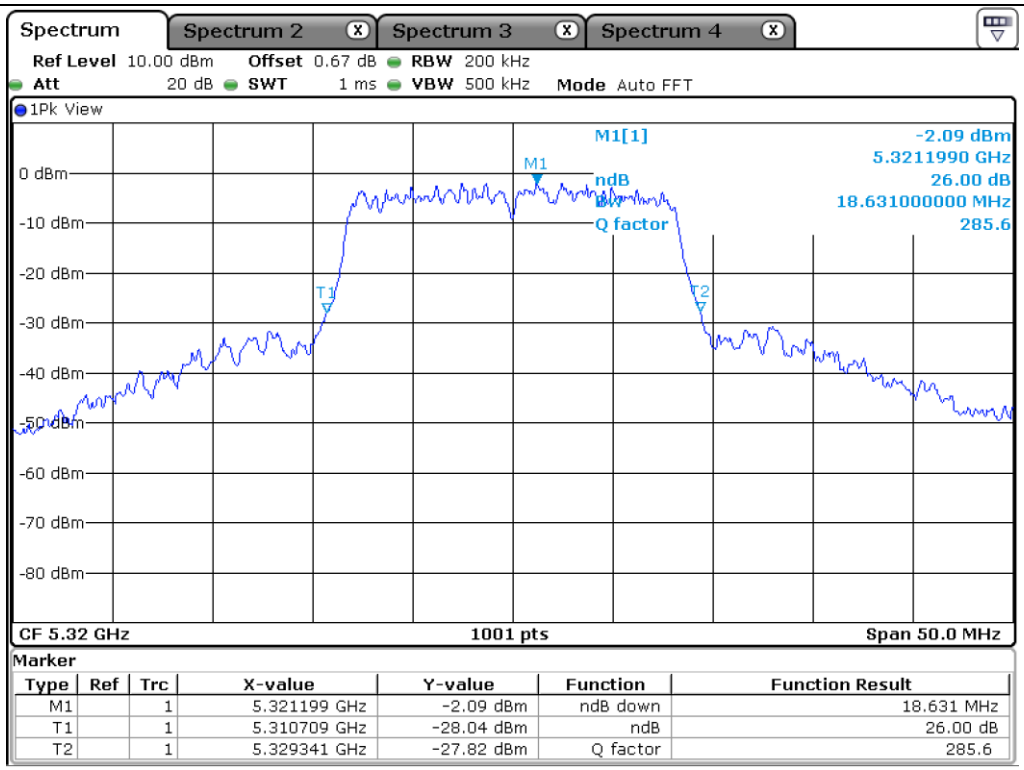
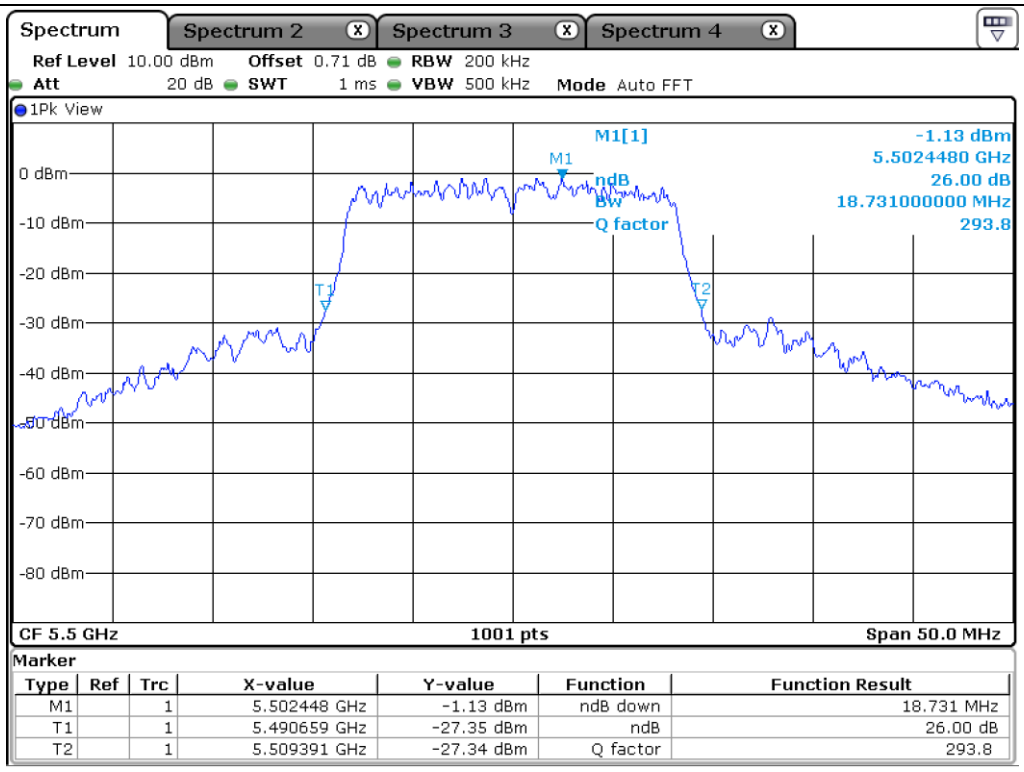
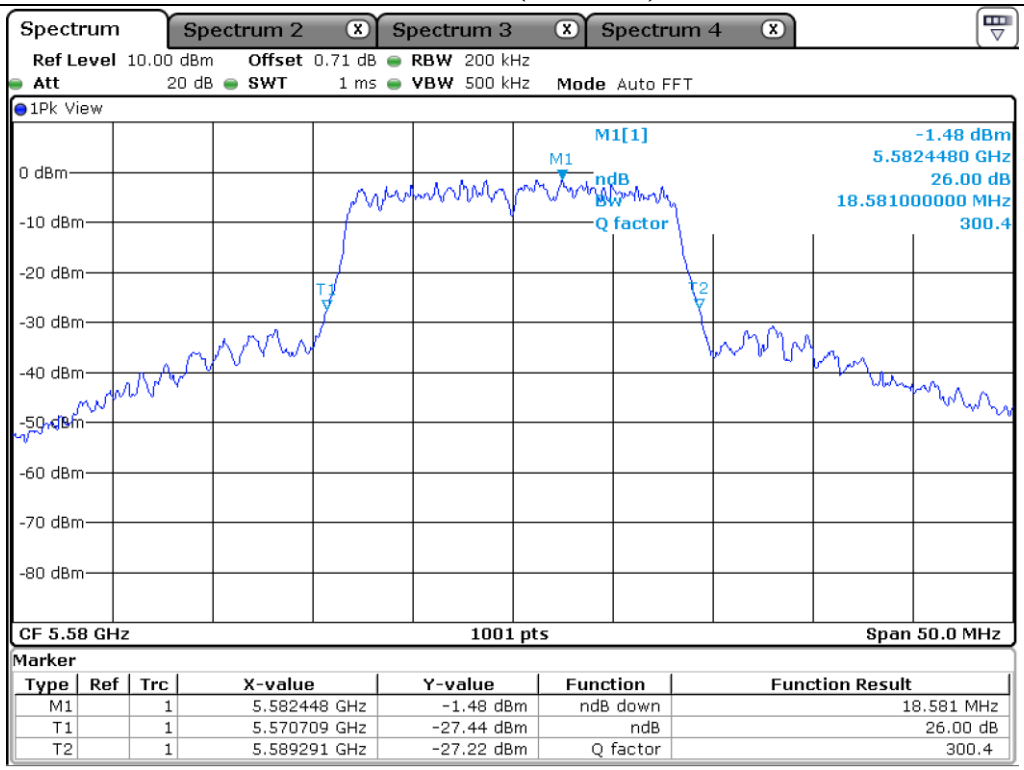


High Channel (5 320 MHz)



Low Channel (5 500 MHz)



Middle Channel (5 580 MHz)

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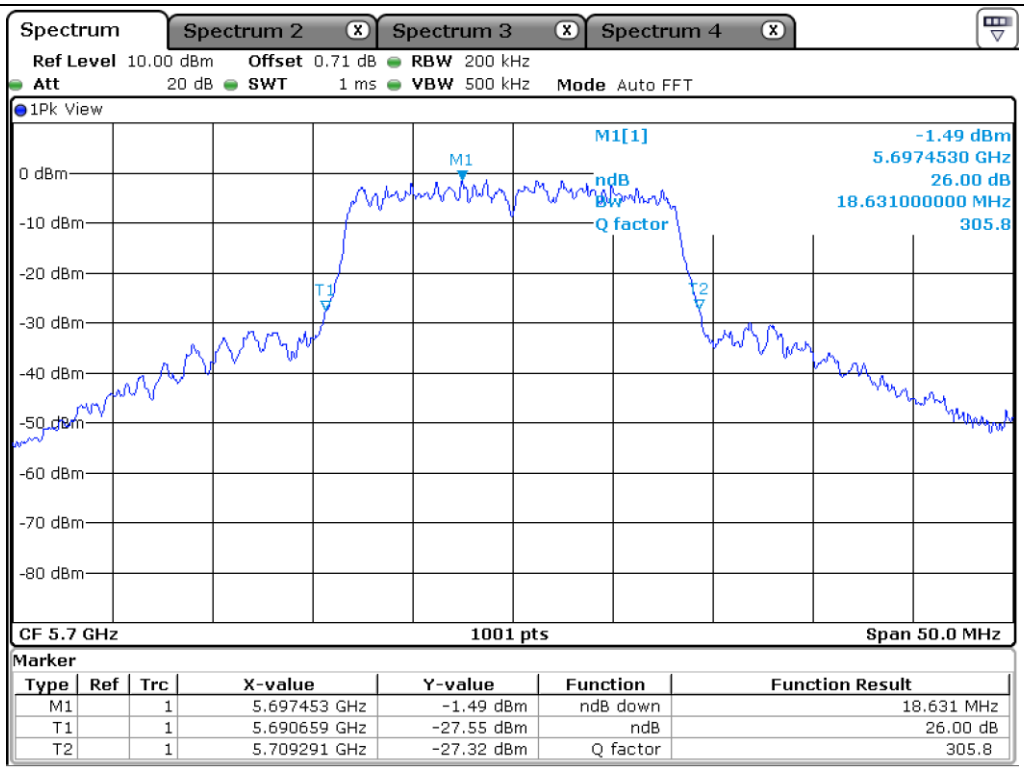

High Channel (5 700 MHz)

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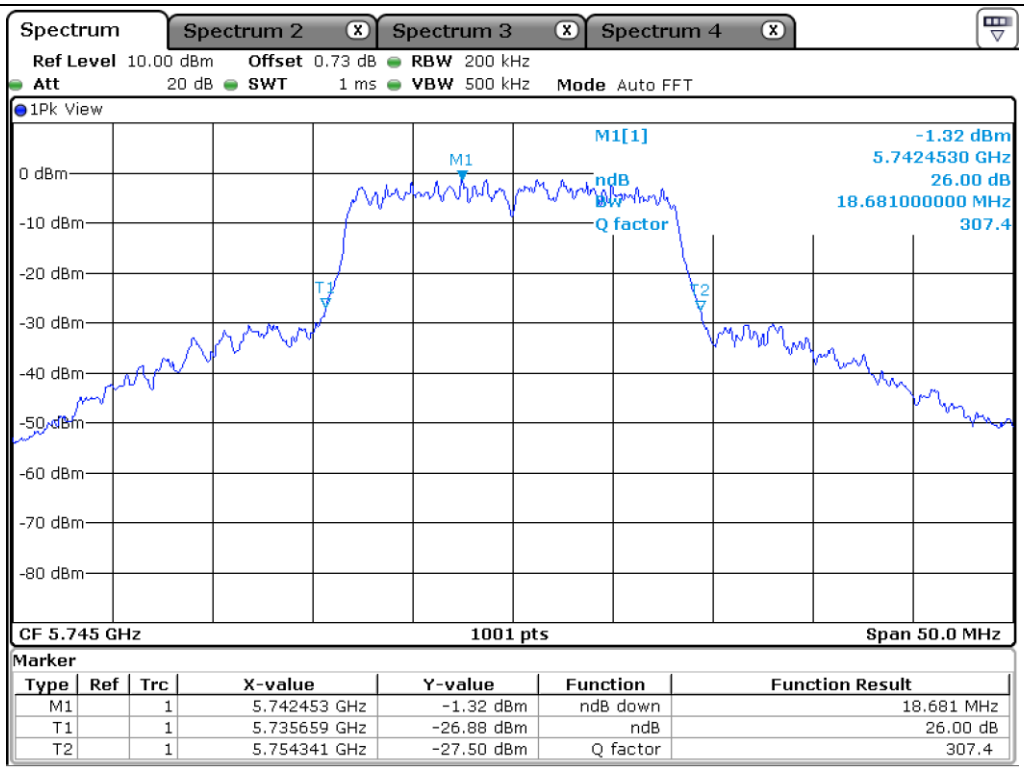
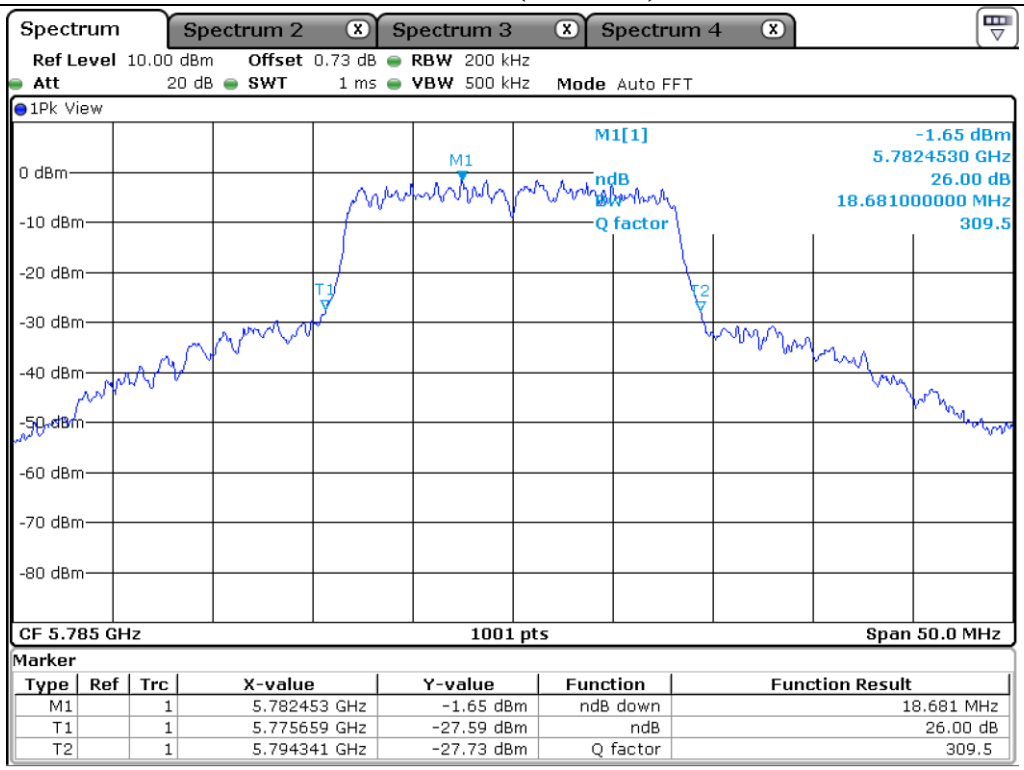


Low Channel (5 745 MHz)



Middle Channel (5 785 MHz)

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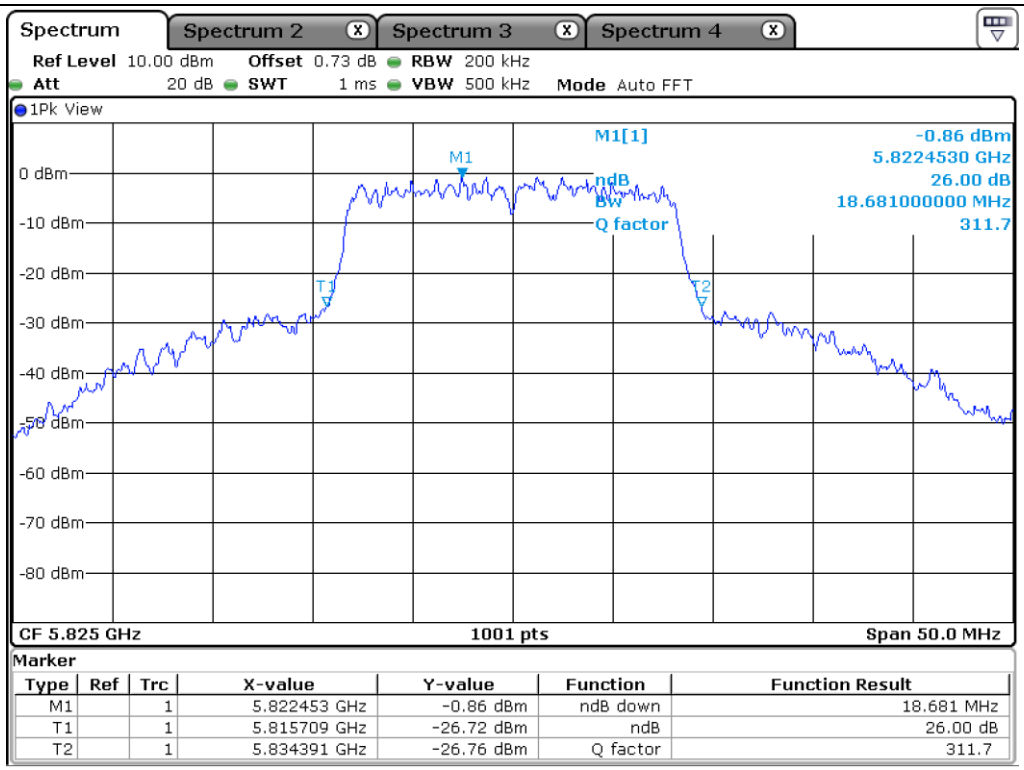

High Channel (5 825 MHz)

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8. 6 dB BANDWIDTH

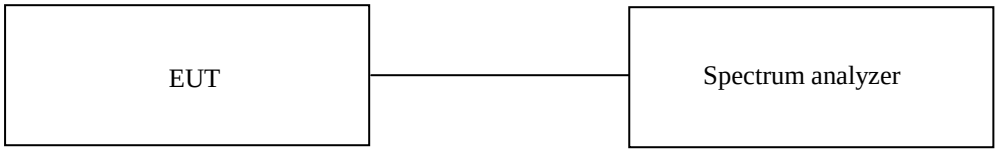
8.1 Operating environment

Temperature : 23 ℃

Relative humidity : 41 % R.H.

8.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 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.



8.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 14, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

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8.4 Test data for 802.11a RLAN Mode

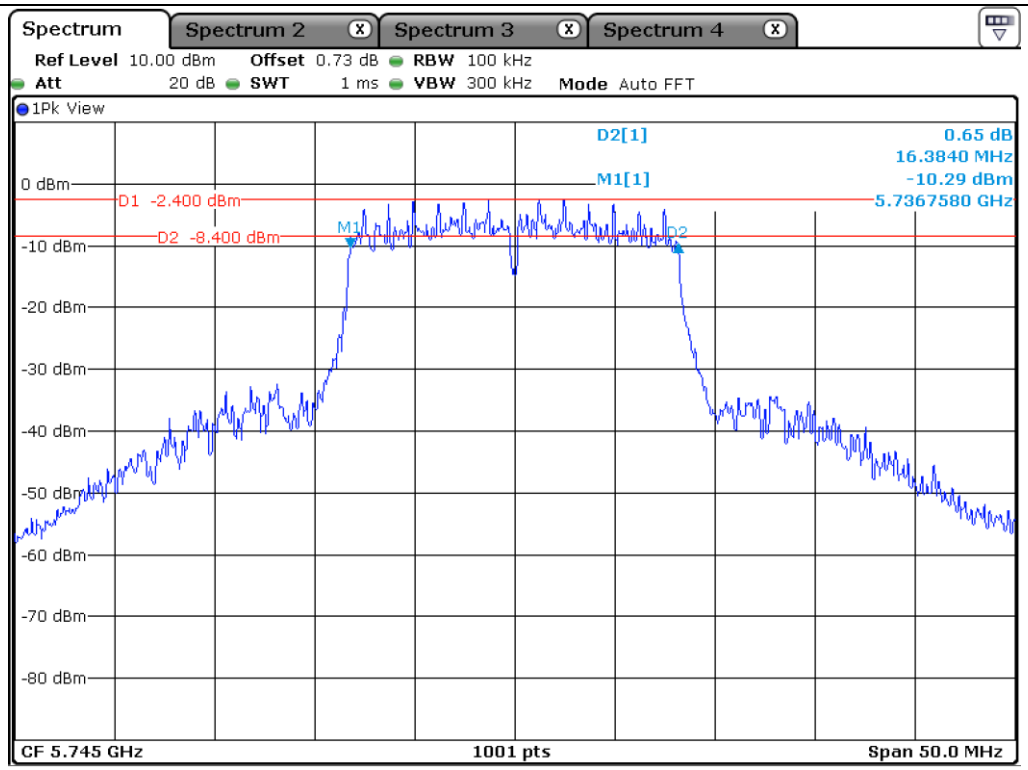
-. Test Date : November 28, 2018 ~ November 30, 2018

-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Low	5 745.00	16.38
	Middle	5 785.00	16.38
	High	5 825.00	16.38

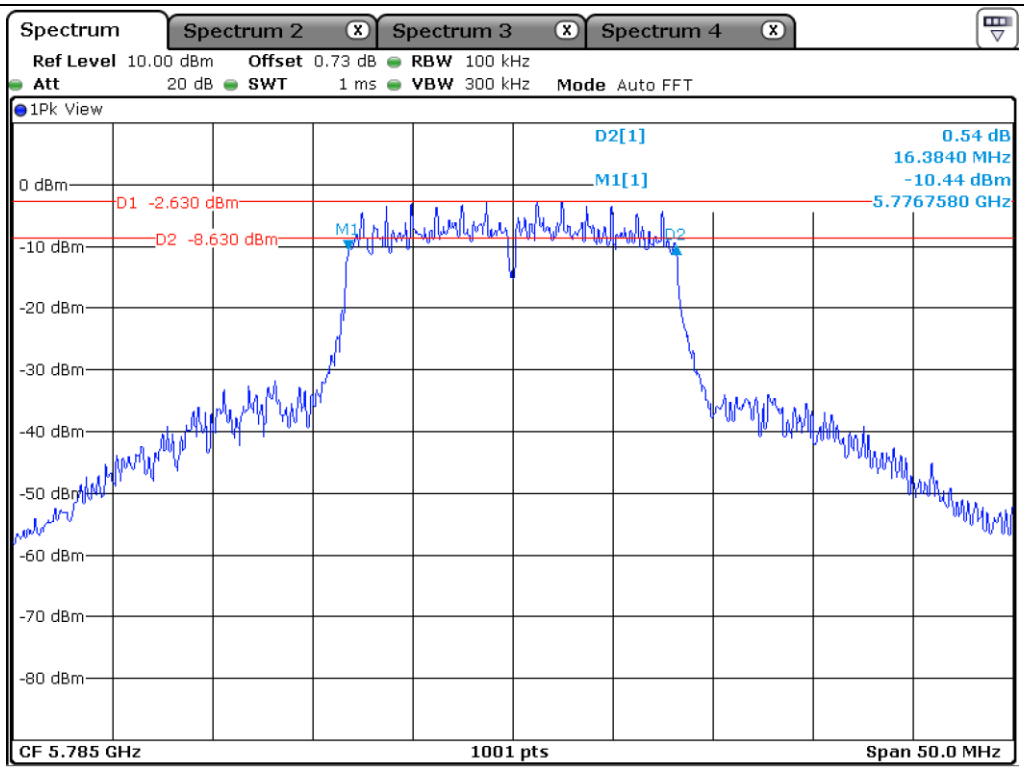
Remark: See next page for measurement data.

Tested by: Hyung-Kwon, Oh / Assistant Manager

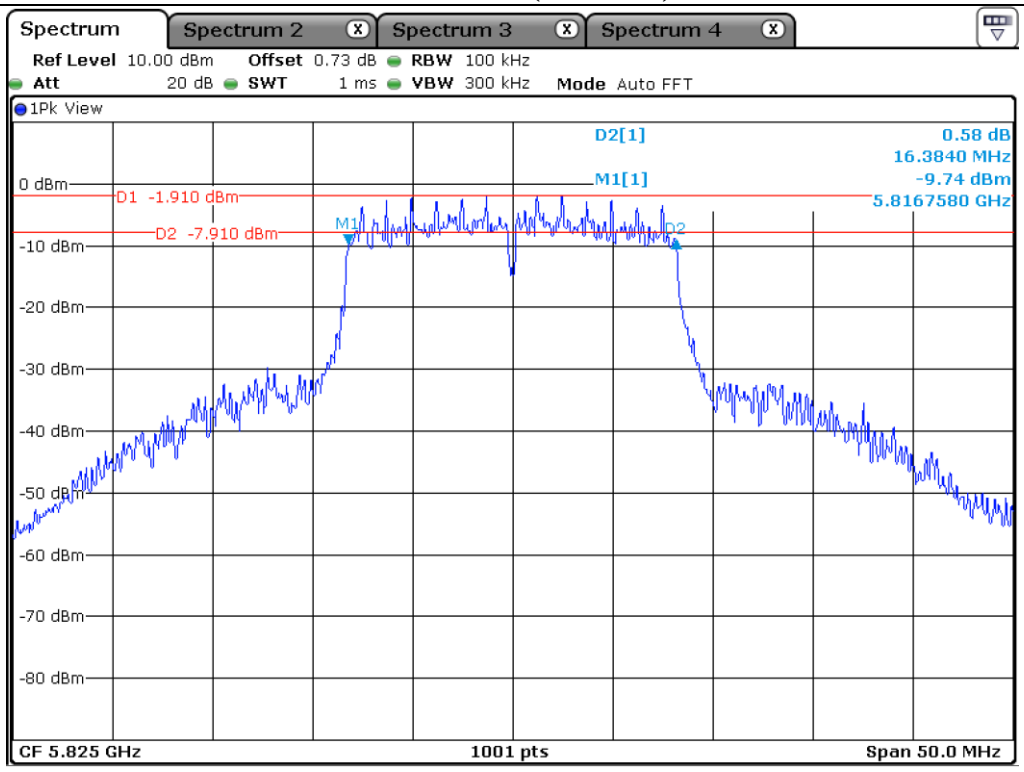


Low Channel (5 745 MHz)

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 (5 785 MHz)



High Channel (5 825 MHz)

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

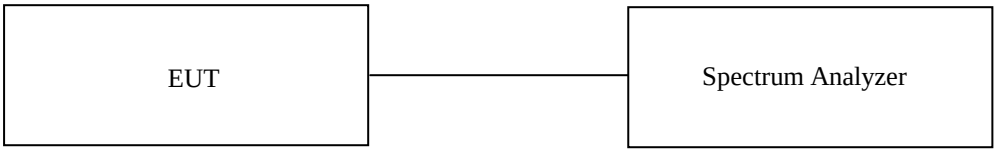
9. MAXIMUM PEAK OUTPUT POWER

9.1 Operating environment

Temperature : 23 ℃

Relative humidity : 41 % R.H.

9.2 Test set-up The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT. The spectrum analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 26 dB & 6 dB bandwidth. The EUT was operating in transmit mode at the appropriate center frequency.



9.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 14, 2018 (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)

9.4 Test data for 802.11a RLAN Mode

-. Test Date : November 28, 2018 ~ November 30, 2018

-. Duty Cycle : < 98 %

-. Test Result : Pass

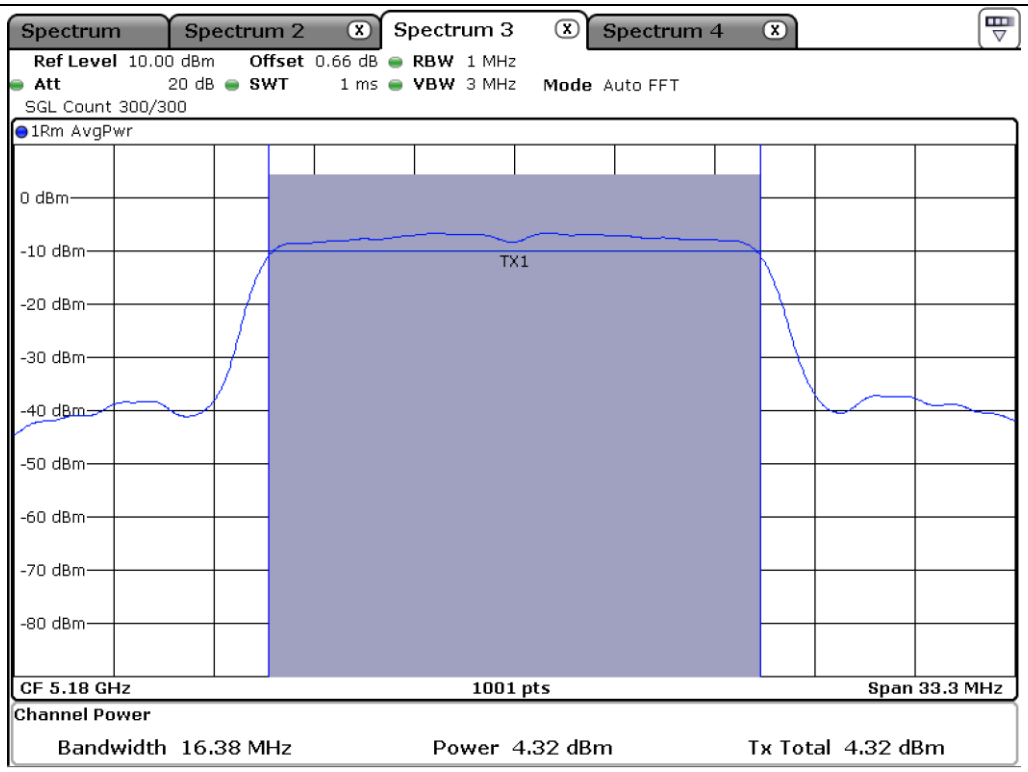
FREQUENCY RANGE (MHz)	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	CORRECTION FACTOR (dB)	RESULT (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	5 180.00	4.32	3.76	8.08	24.00	15.92
	5 220.00	4.84	3.76	8.60	24.00	15.4
	5 240.00	4.81	3.76	8.57	24.00	15.43
5 250 ~ 5 350	5 260.00	4.65	3.76	8.41	24.00	15.59
	5 300.00	5.02	3.76	8.78	24.00	15.22
	5 320.00	4.50	3.76	8.26	24.00	15.74
5 470 ~ 5 725	5 500.00	5.41	3.76	9.17	24.00	14.83
	5 580.00	4.91	3.76	8.67	24.00	15.33
	5 700.00	4.97	3.76	8.73	24.00	15.27
5 725 ~ 5 850	5 745.00	5.01	3.77	8.78	30.00	21.22
	5 785.00	5.22	3.77	8.99	30.00	21.01
	5 825.00	5.61	3.77	9.38	30.00	20.62

Note 1: Margin = Limit –Result (=Power Sensor Reading - Cable Loss)

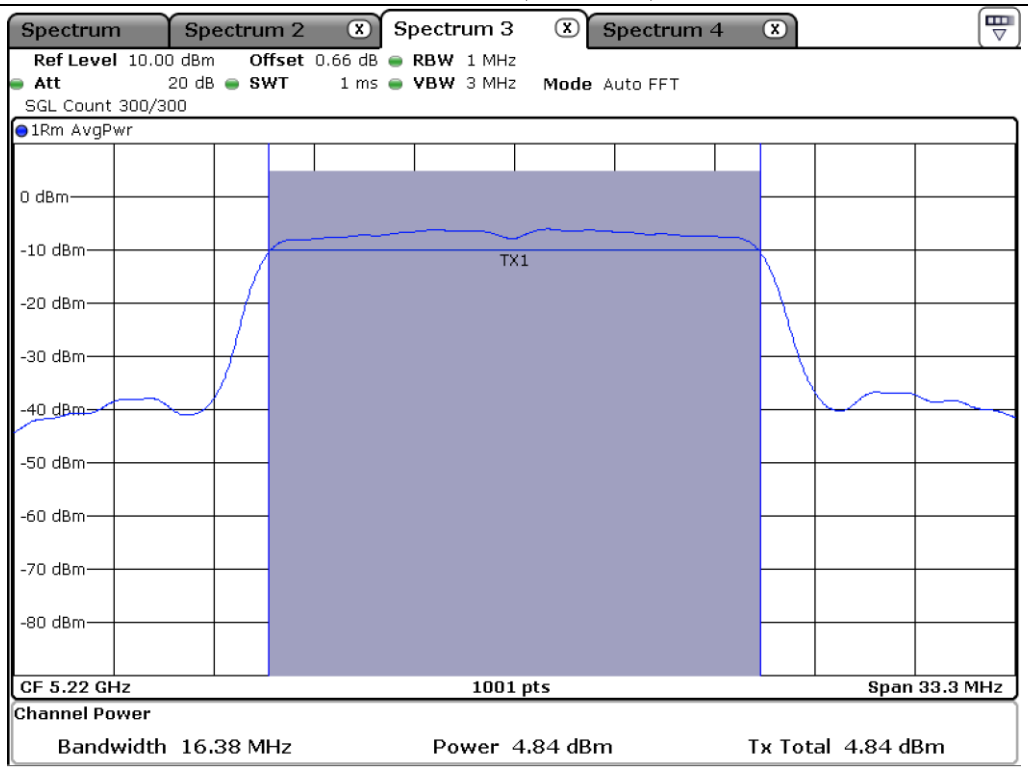
Note 2: Correction Factor = 10 * log(1 / Duty Cycle)

Tested by: Hyung-Kwon, Oh / Assistant Manager

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

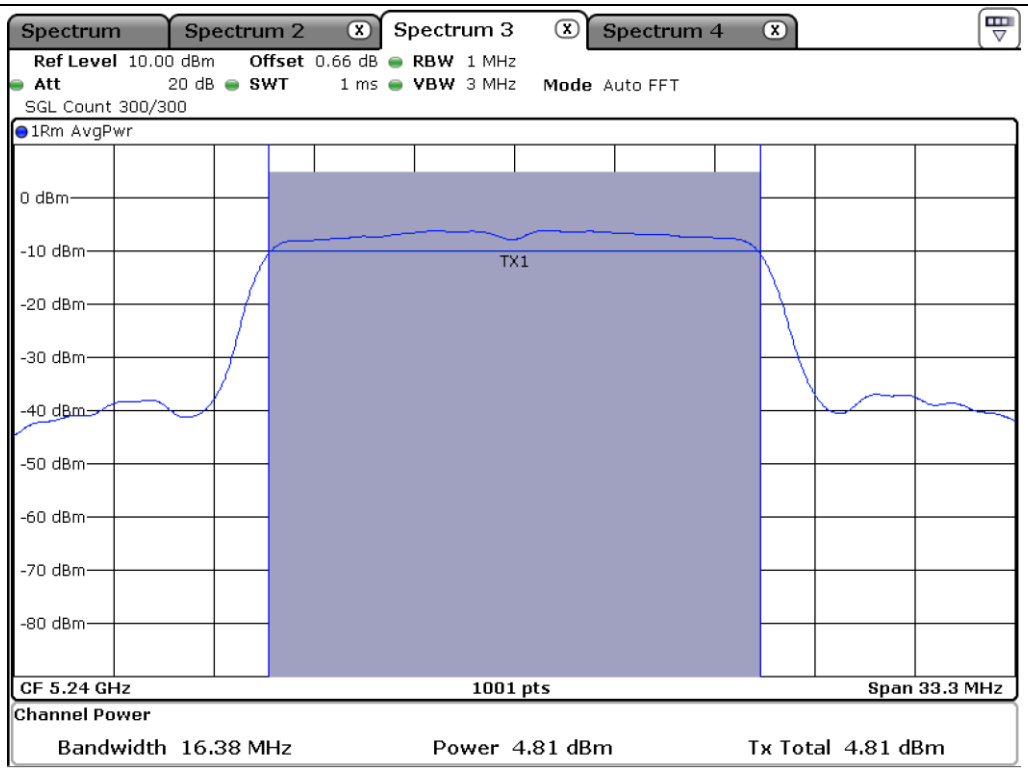


Low Channel (5 180 MHz)

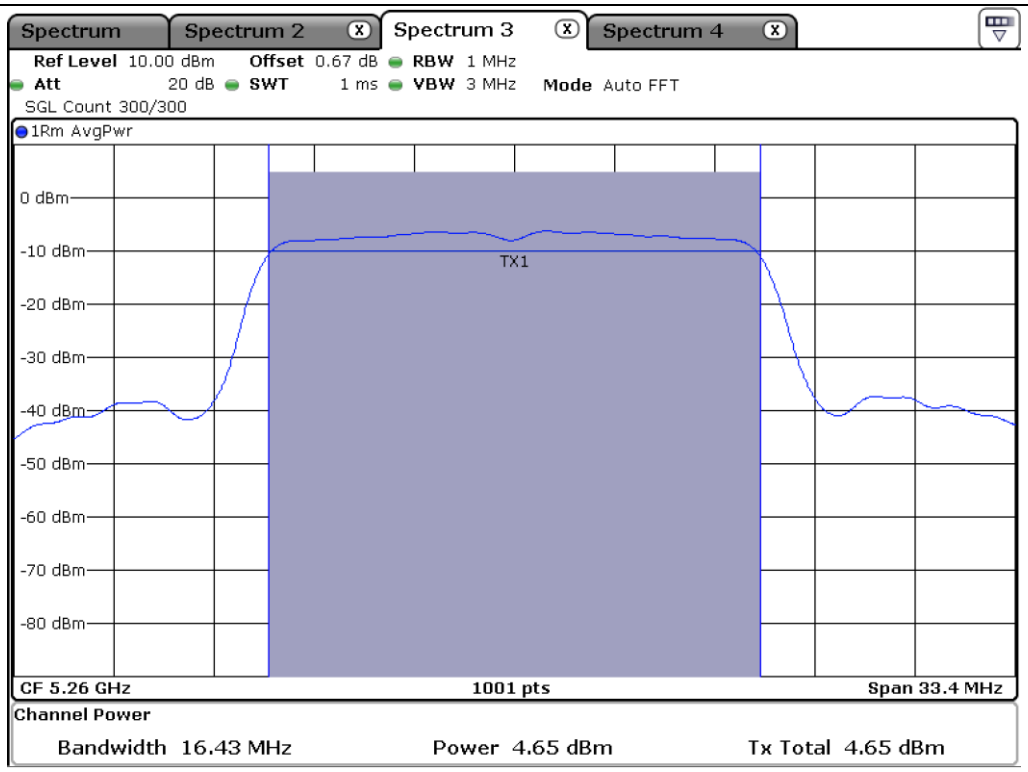


Middle Channel (5 220 MHz)

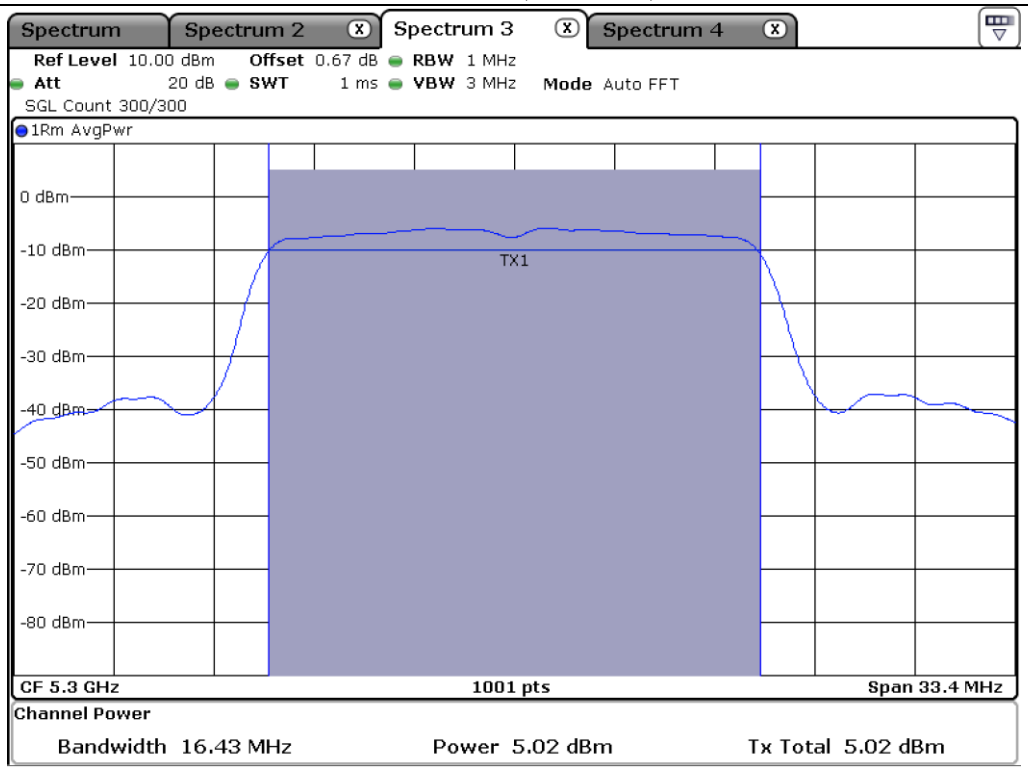
ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)



High Channel (5 240 MHz)

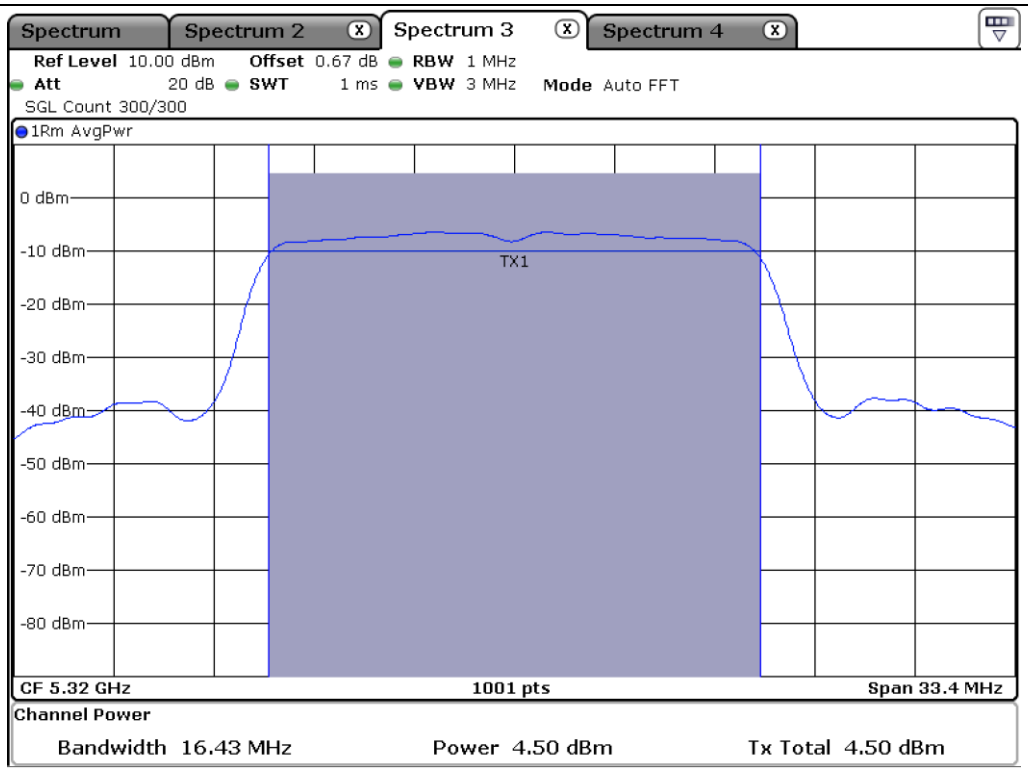


Low Channel (5 260 MHz)

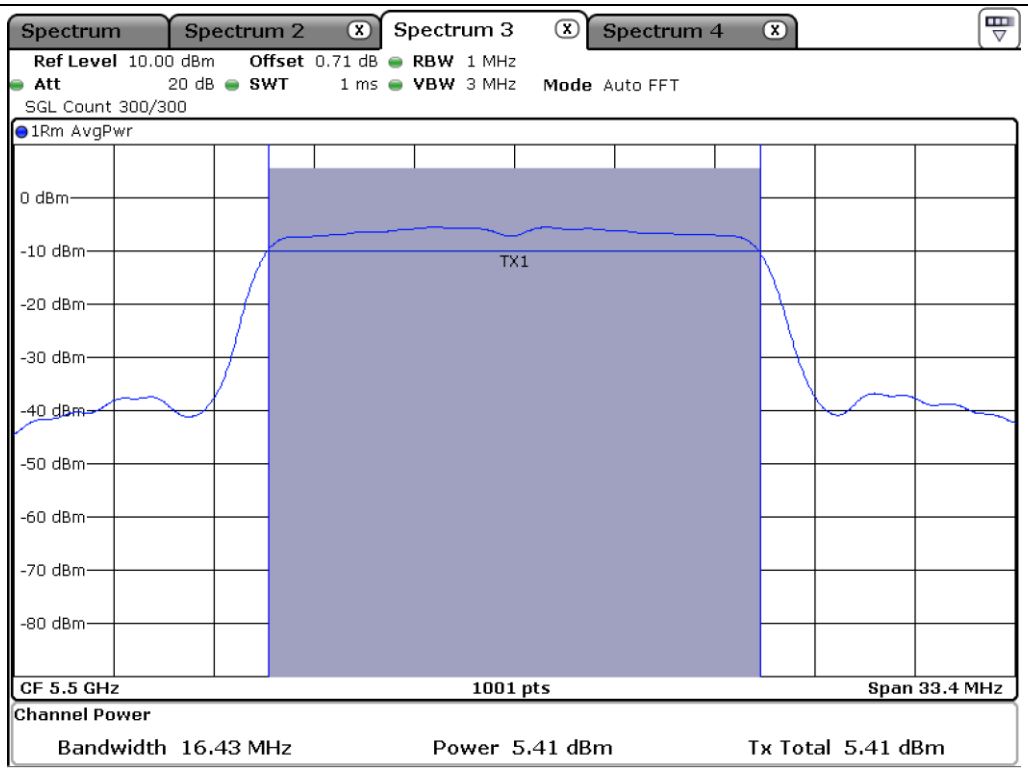


Middle Channel (5 300 MHz)

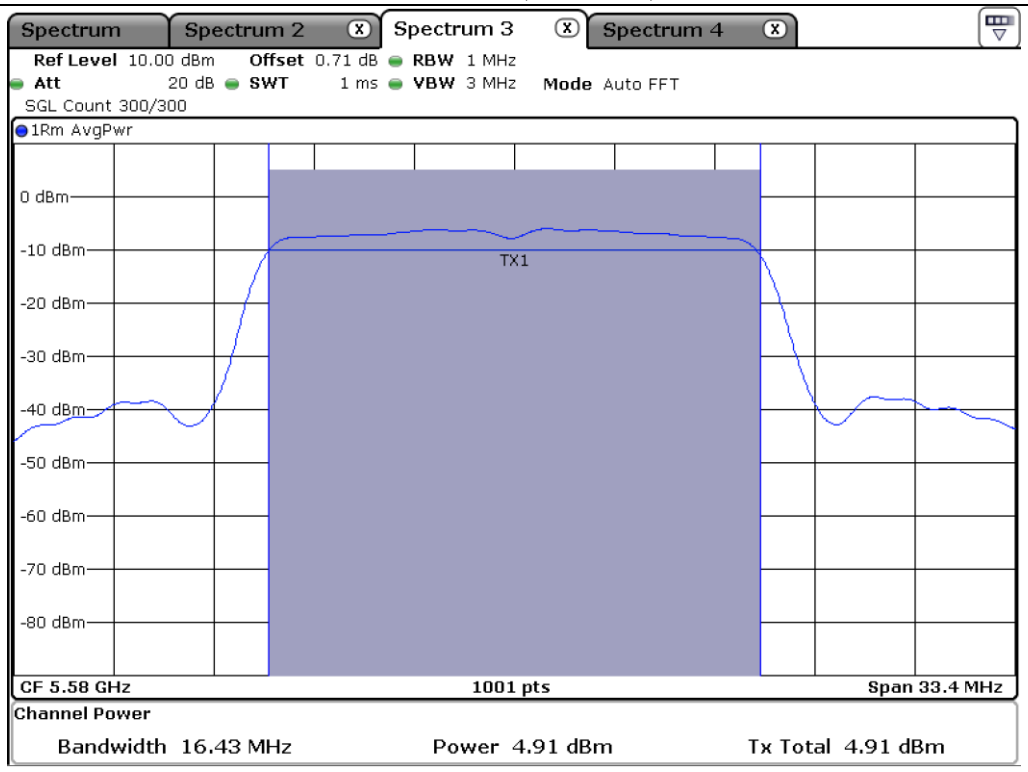
ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)



High Channel (5 320 MHz)

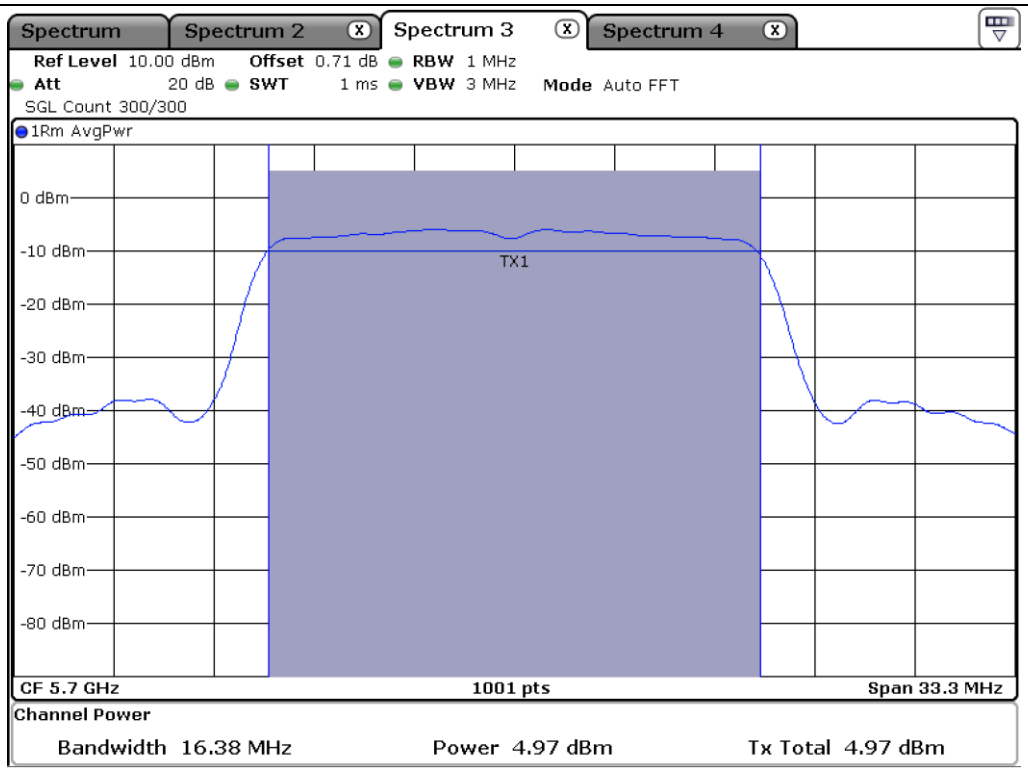


Low Channel (5 550 MHz)

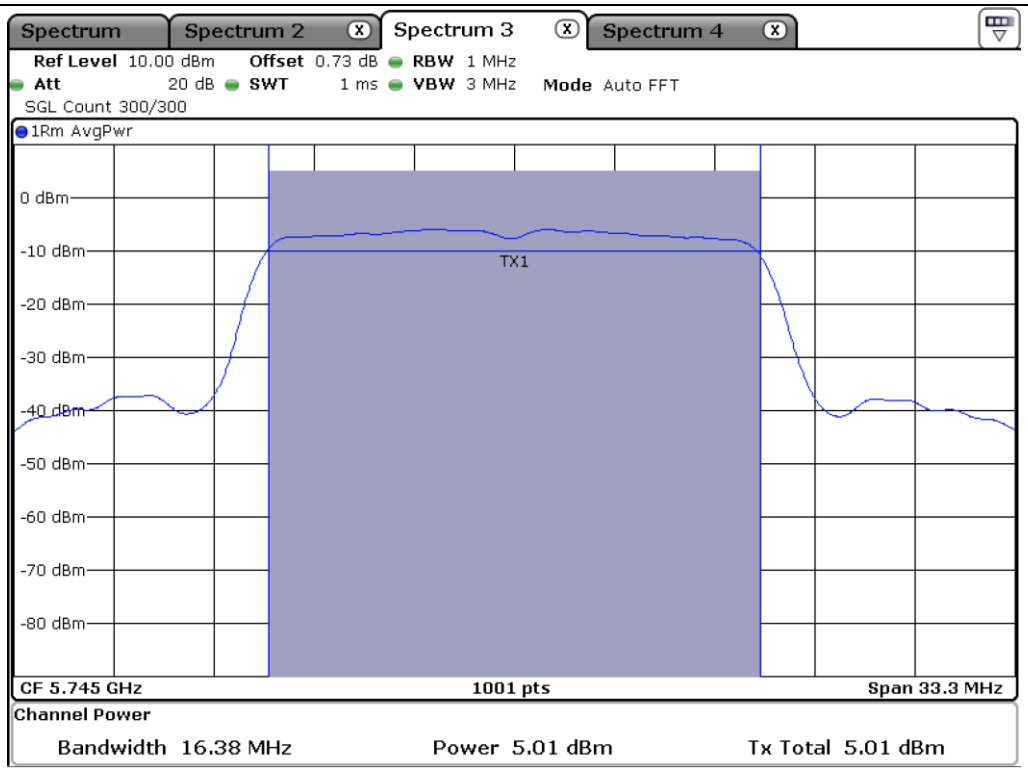


Middle Channel (5 560 MHz)

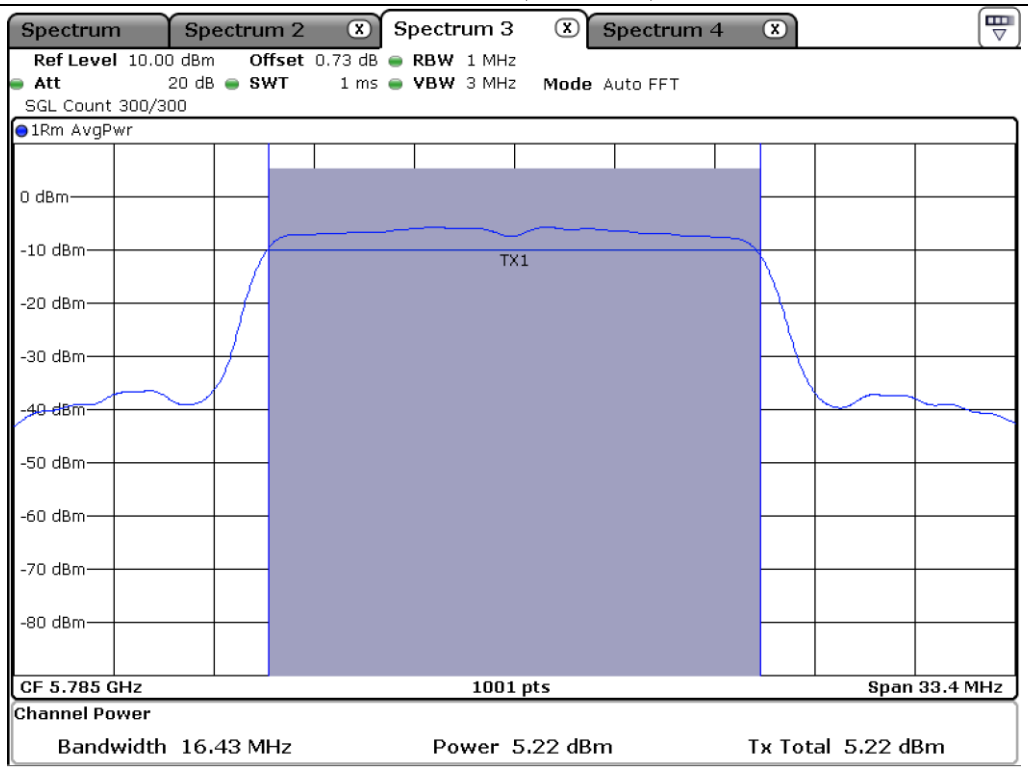
ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)



High Channel (5 720 MHz)

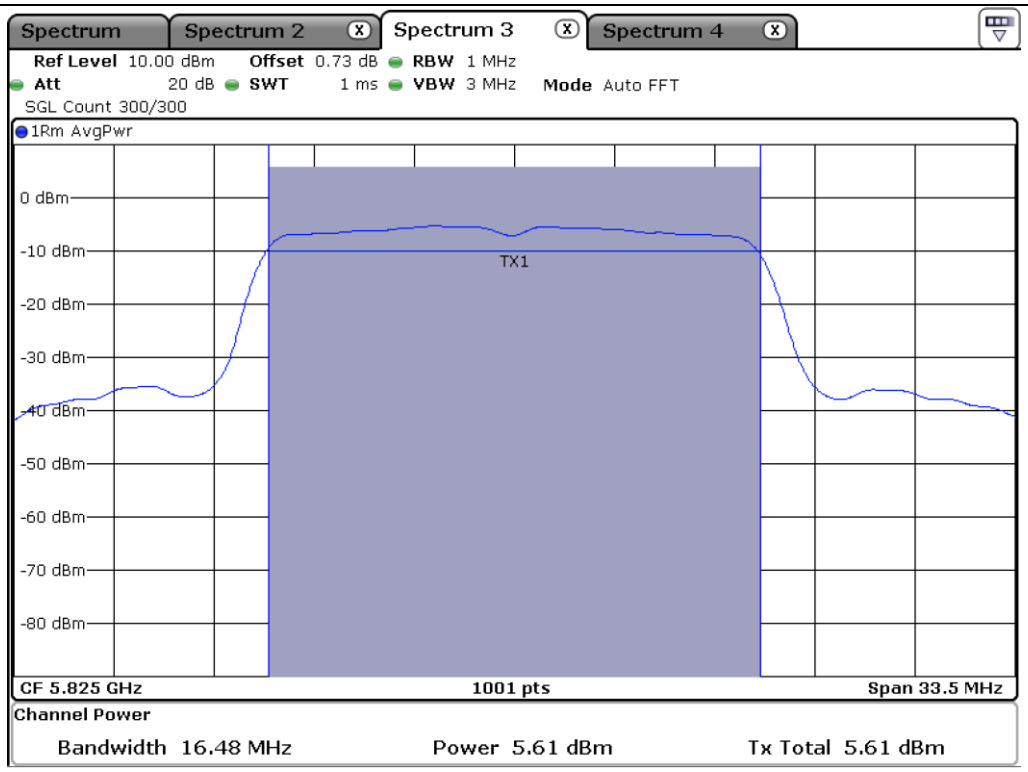


Low Channel (5 745 MHz)



Middle Channel (5 785 MHz)

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 (5 825 MHz)

10. PEAK POWER SPECTRUL DENSITY

10.1 Operating environment

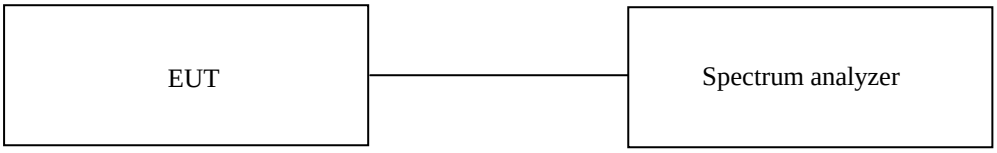
Temperature : 23 ℃

Relative humidity : 41 % 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 1 MHz, the video bandwidth is set to 3 times the resolution bandwidth.(But, 5.8 GHz Measured : The resolution bandwidth is set to 500 kHz, the video bandwidth is set to 3 times the resolution bandwidth.)

The maximum level form the EUT in 1 MHz(But, 5.8 GHz in 500 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	Mar. 14, 2018 (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 802.11a RLAN Mode

-. Test Date : November 28, 2018 ~ November 30, 2018

-. Operating condition : Highest Output Power Transmitting Mode

-. Duty Cycle : < 98 %

-. Test Result : Pass

FREQUENCY RANGE (MHz)	FREQUENCY (MHz)	MEASURED VALUE (dBm)	CORRECTION FACTOR (dB)	RESULT (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	5 180.00	-5.19	3.76	-1.43	11.00	12.43
	5 220.00	-4.73	3.76	-0.97	11.00	11.97
	5 240.00	-4.75	3.76	-0.99	11.00	11.99
5 250 ~ 5 350	5 260.00	-4.31	3.76	-0.55	11.00	11.55
	5 300.00	-4.45	3.76	-0.69	11.00	11.69
	5 320.00	-4.90	3.76	-1.14	11.00	12.14
5 470 ~ 5 725	5 500.00	-4.05	3.76	-0.29	11.00	11.29
	5 580.00	-4.57	3.76	-0.81	11.00	11.81
	5 700.00	-4.47	3.76	-0.71	11.00	11.71
5 725 ~ 5 850	5 745.00	-6.61	3.76	-2.85	30.00	32.85
	5 785.00	-6.82	3.76	-3.06	30.00	33.06
	5 825.00	-6.53	3.76	-2.77	30.00	32.77

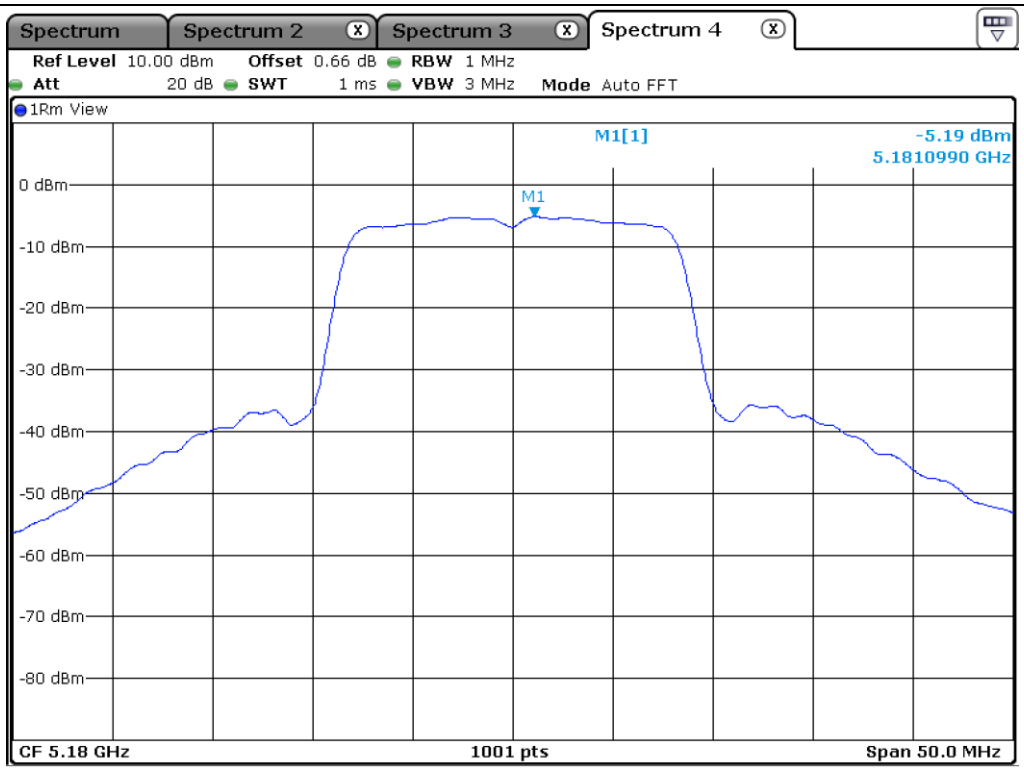
Note 1: See next page for measurement data.

Note 2: CORRECTION FACTOR(dB) = Duty Cycle Factor

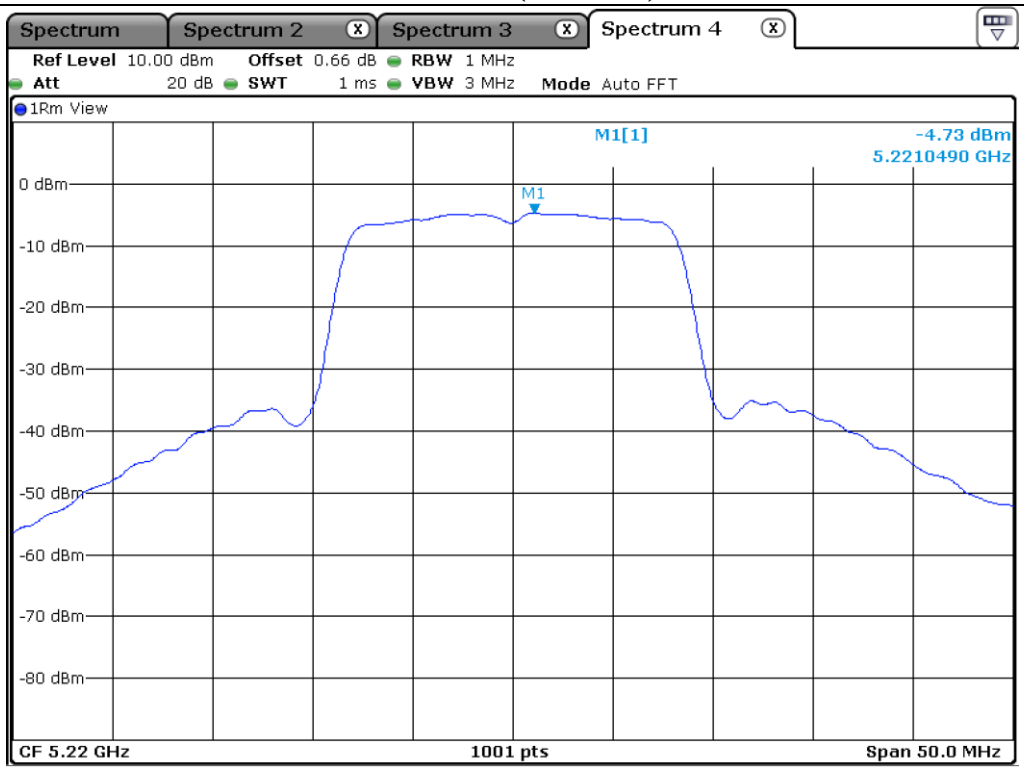
Note 3: Duty Cycle Factor(dB) = 10 * log(1 / ((On Time / (On Time + Off Time)) * 100)) / 100)

Tested by: Hyung-Kwon, Oh / Assistant Manager

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

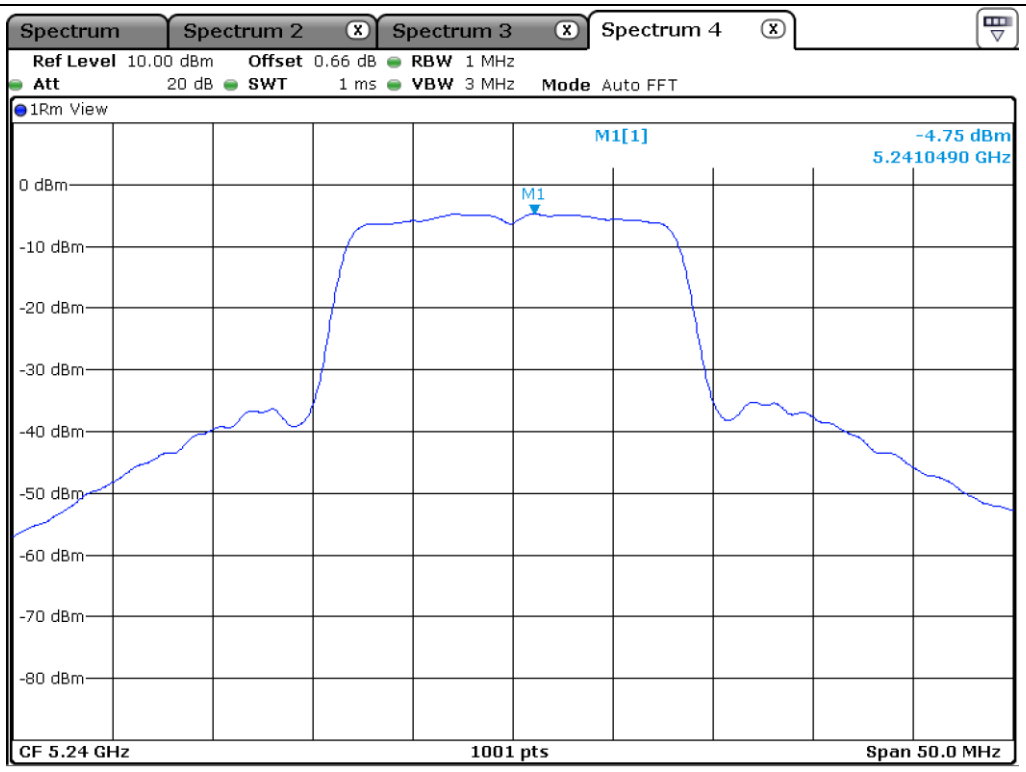


Low Channel (5 180 MHz)



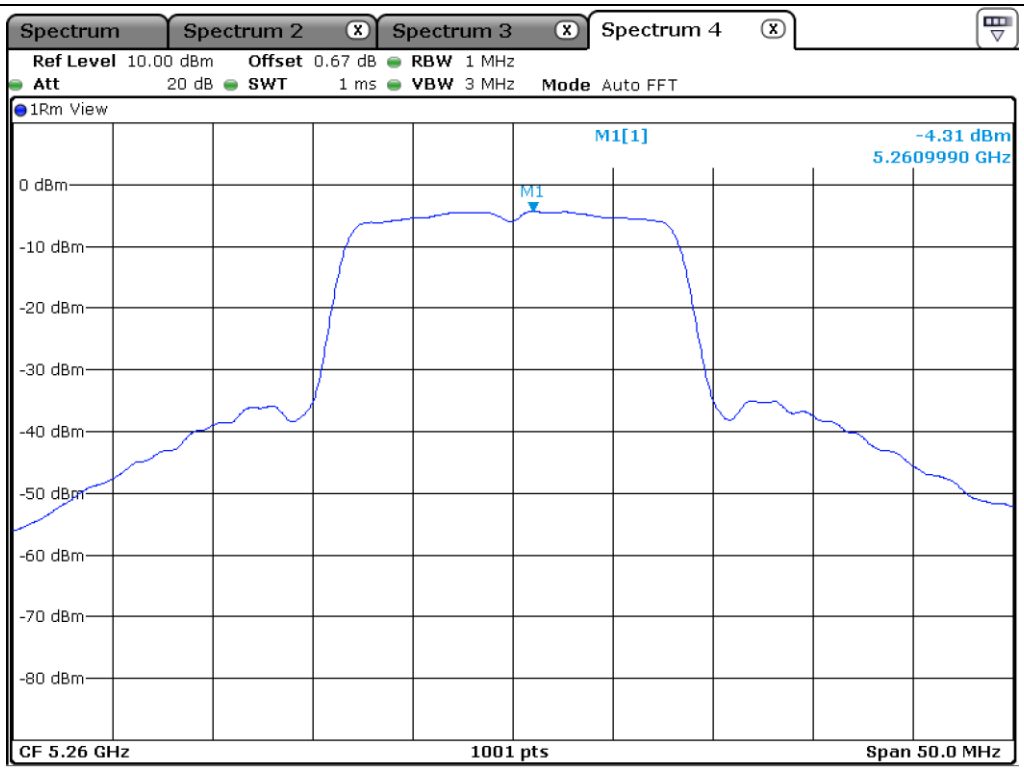
Middle Channel (5 220 MHz)

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

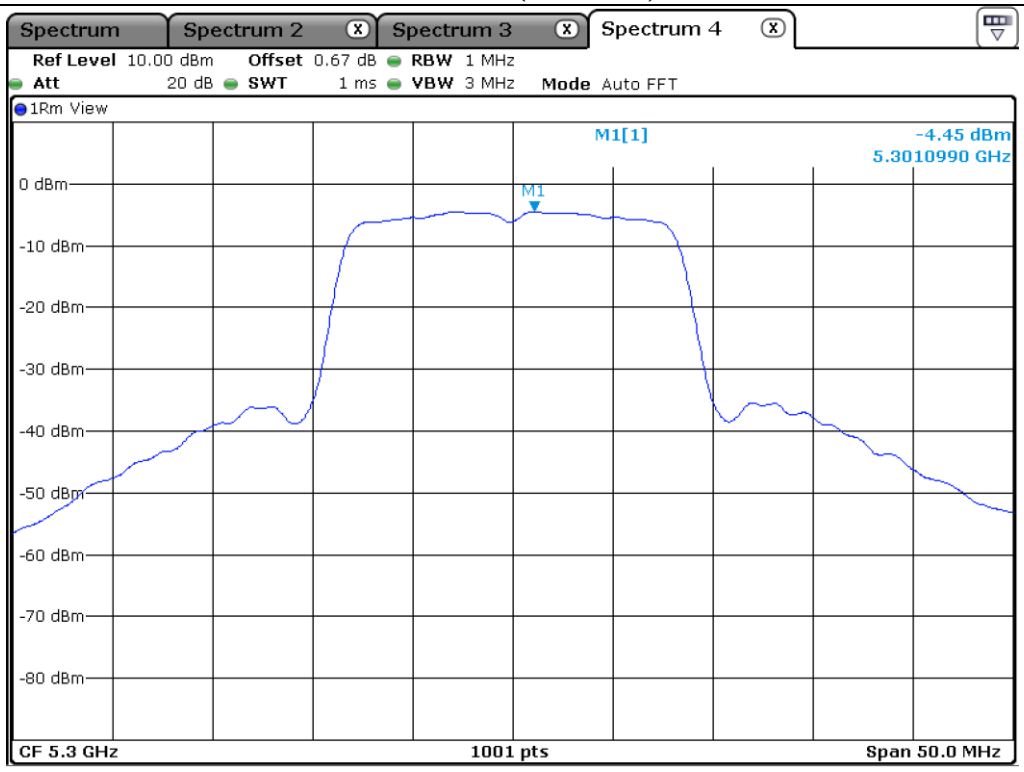


High Channel (5 240 MHz)

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

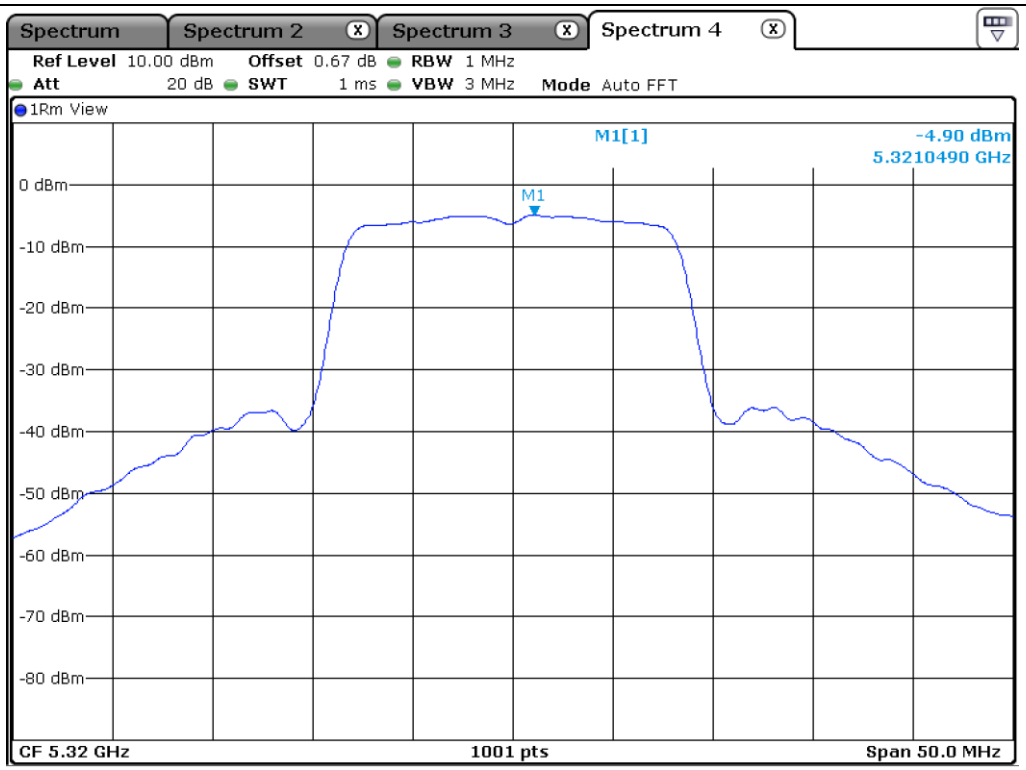


Low Channel (5 260 MHz)



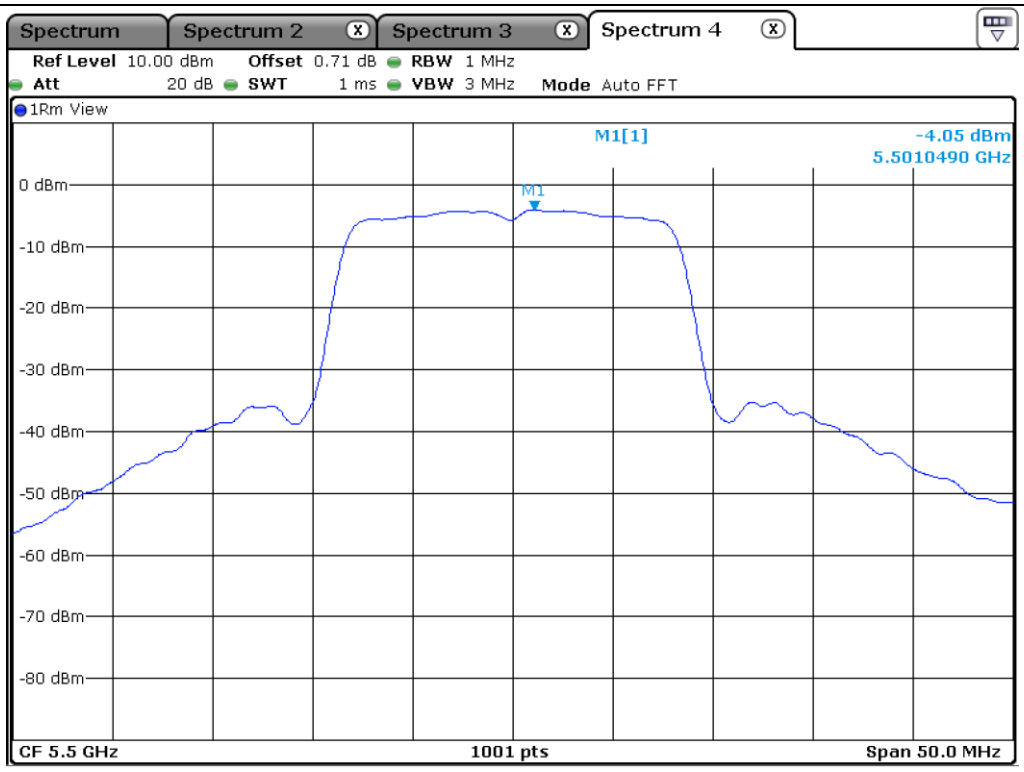
Middle Channel (5 300 MHz)

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

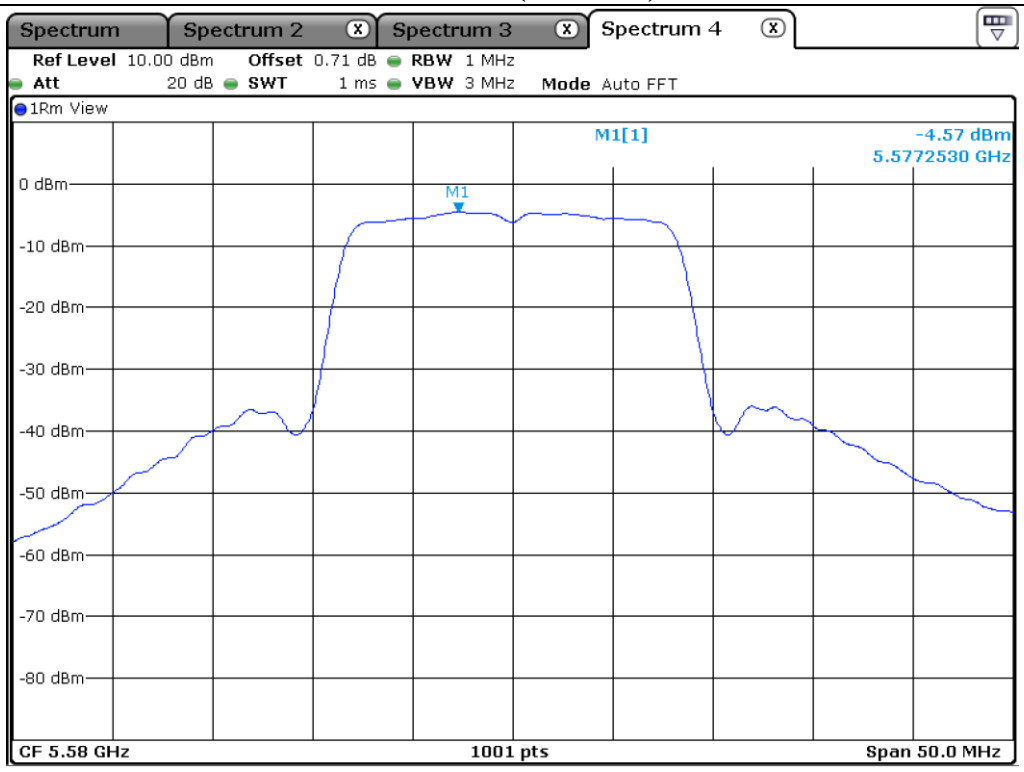


High Channel (5 320 MHz)

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

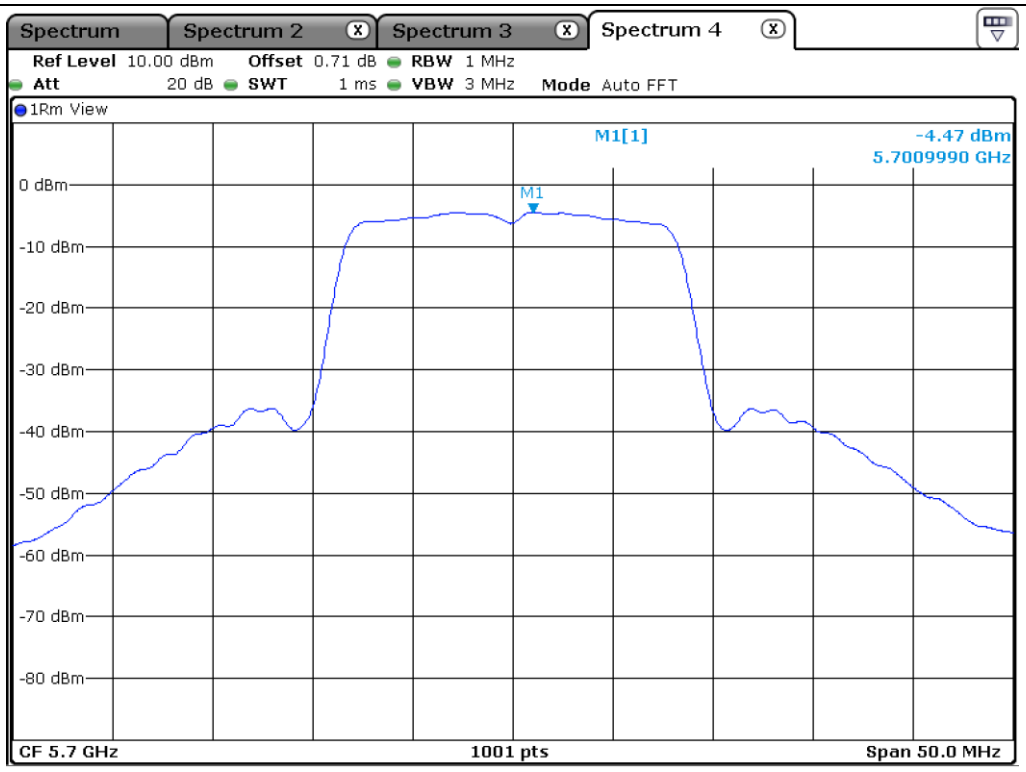


Low Channel (5 500 MHz)



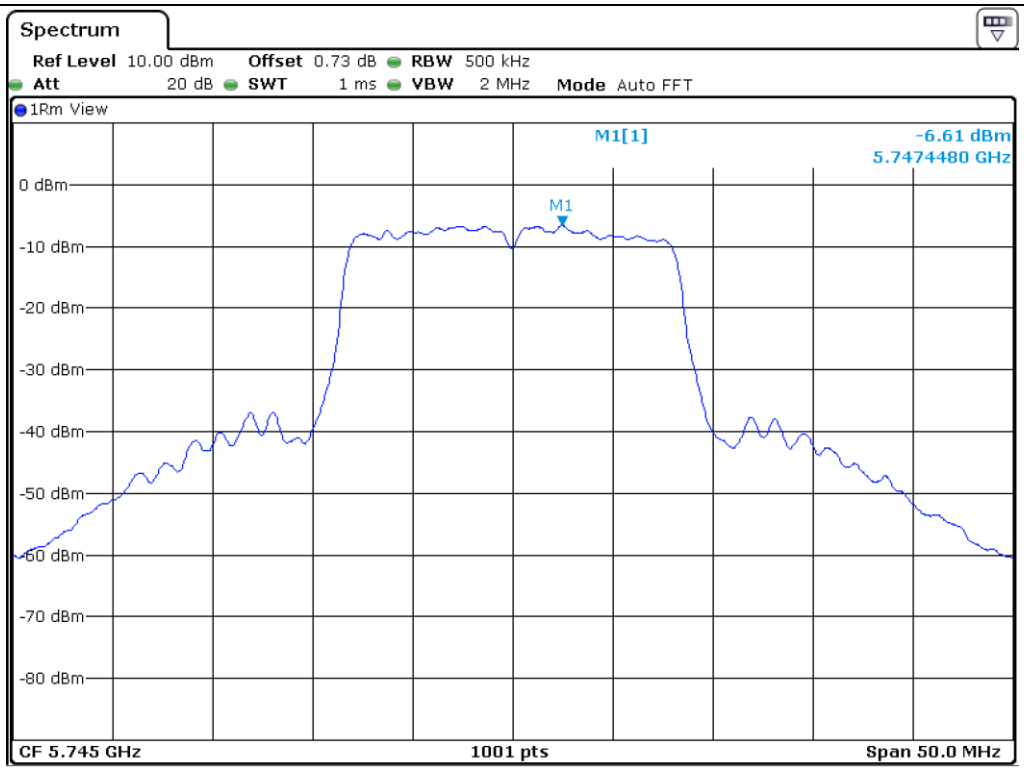
Middle Channel (5 580 MHz)

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

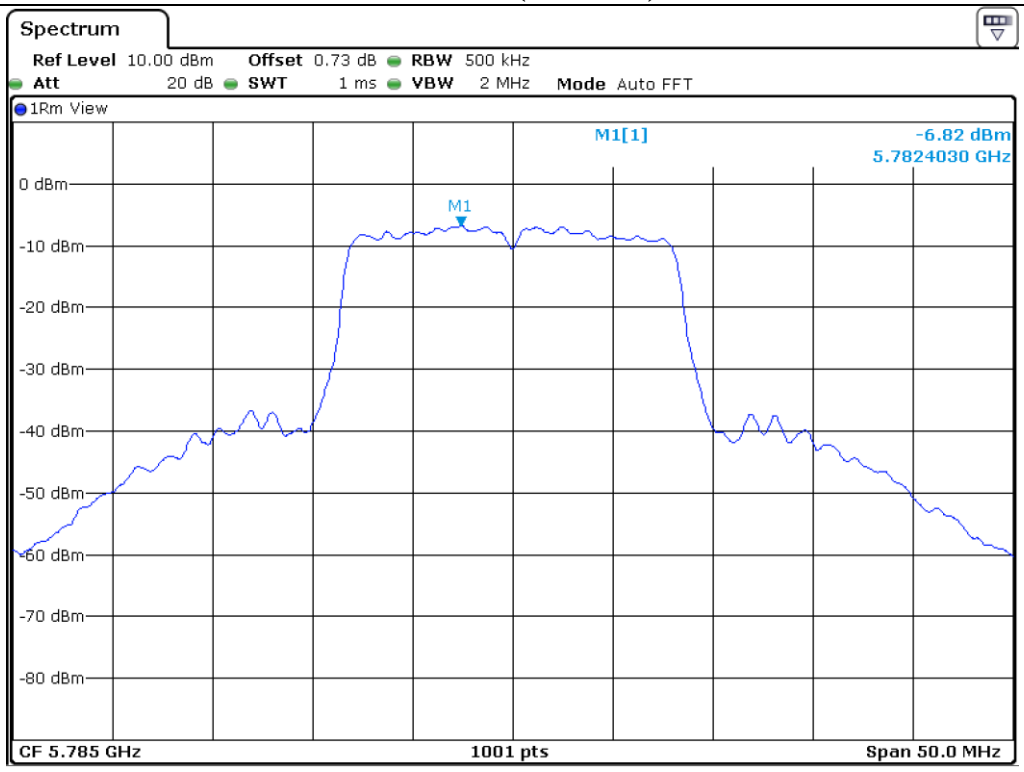


High Channel (5 700 MHz)

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

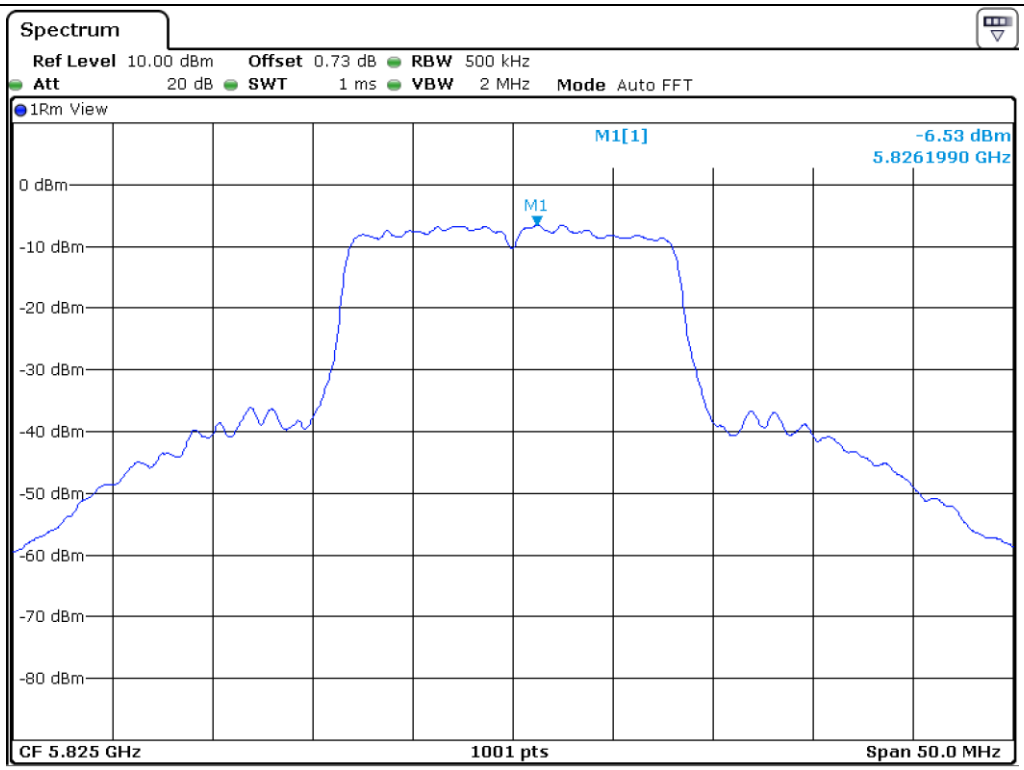


Low Channel (5 745 MHz)



Middle Channel (5 785 MHz)

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 (5 825 MHz)

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. FREQUENCY STABILITY WITH TEMPERATURE VARIATION

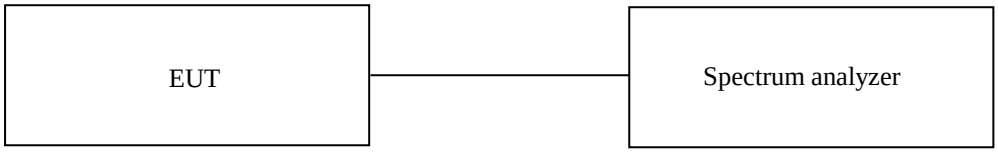
11.1 Operating environment

Temperature : 23 ℃

Relative humidity : 41 % R.H.

11.2 Test set-up

Turn EUT off and set chamber temperature to 0 ℃ and then allow sufficient time (approximately 20 min to 30 min after chamber reach the assigned temperature) for EUT to stabilize. Turn on the EUT and measure the EUT operating frequency and then turn off the EUT after the measurement. The temperature in the chamber was raised 10 ℃ step from 0 ℃ to +50 ℃. Repeat above method for frequency measurements every 10 ℃ step and then record all measured frequencies on each temperature step.



11.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 14, 2018 (1Y)
■ -	SSE-43CI-A	Samkun Tech	Humidity Chamber	60712	Feb. 23, 2018 (1Y)
■ -	H-3005D	FinePower	DC Power supply	FP09092008	Mar. 14, 2018 (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)

11.4 Test Data for U-NII-1

-. Test Date : November 28, 2018 ~ November 30, 2018

-. Result : Pass

Temperature (˚C)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Frequency Error (kHz)
0	5 180 000 000	5 179 982 182	-17.818
10		5 179 981 532	-18.468
20		5 179 981 435	-18.565
30		5 179 980 836	-19.164
40		5 179 980 467	-19.533
50		5 179 978 401	-21.599
0	5 220 000 000	5 219 982 932	-17.068
10		5 219 981 971	-18.029
20		5 219 981 085	-18.915
30		5 219 980 508	-19.492
40		5 219 980 075	-19.925
50		5 219 978 067	-21.933
0	5 240 000 000	5 239 982 208	-17.792
10		5 239 981 649	-18.351
20		5 239 981 088	-18.912
30		5 239 980 671	-19.329
40		5 239 980 213	-19.787
50		5 239 979 566	-20.434

Note : While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.(ANSI C63.10-2013)

Tested by: Hyung-Kwon, Oh / Assistant Manager

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 for U-NII-2A

-. Test Date : November 28, 2018 ~ November 30, 2018

-. Result : Pass

Temperature (˚C)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Frequency Error (kHz)
0	5 260 000 000	5 259 982 714	-17.286
10		5 259 981 895	-18.105
20		5 259 981 182	-18.818
30		5 259 980 841	-19.159
40		5 259 980 492	-19.508
50		5 259 979 677	-20.323
0	5 300 000 000	5 299 982 867	-17.133
10		5 299 981 769	-18.231
20		5 299 981 096	-18.904
30		5 299 980 729	-19.271
40		5 299 980 487	-19.513
50		5 299 979 634	-20.366
0	5 320 000 000	5 319 982 197	-17.803
10		5 319 981 626	-18.374
20		5 319 981 240	-18.760
30		5 319 980 625	-19.375
40		5 319 980 370	-19.630
50		5 319 979 390	-20.610

Note : While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.(ANSI C63.10-2013)

Tested by: Hyung-Kwon, Oh / Assistant Manager

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

11.6 Test Data for U-NII-2C

-. Test Date : November 28, 2018 ~ November 30, 2018

-. Result : Pass

Temperature (˚C)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Frequency Error (kHz)
0	5 500 000 000	5 499 982 263	-17.737
10		5 499 981 626	-18.374
20		5 499 981 460	-18.540
30		5 499 980 559	-19.441
40		5 499 980 266	-19.734
50		5 499 978 070	-21.930
0	5 580 000 000	5 579 982 765	-17.235
10		5 579 981 886	-18.114
20		5 579 981 470	-18.530
30		5 579 980 770	-19.230
40		5 579 980 335	-19.665
50		5 579 979 667	-20.333
0	5 700 000 000	5 699 982 148	-17.852
10		5 699 981 929	-18.071
20		5 699 981 465	-18.535
30		5 699 980 914	-19.086
40		5 699 980 143	-19.857
50		5 699 979 661	-20.339

Note : While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.(ANSI C63.10-2013)

Tested by: Hyung-Kwon, Oh / Assistant Manager

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

11.7 Test Data for U-NII-3

-. Test Date : November 28, 2018 ~ November 30, 2018

-. Result : Pass

Temperature (˚C)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Frequency Error (kHz)
0	5 745 000 000	5 744 982 150	-17.850
10		5 744 981 861	-18.139
20		5 744 981 391	-18.609
30		5 744 980 875	-19.125
40		5 744 980 182	-19.818
50		5 744 978 796	-21.204
0	5 785 000 000	5 784 982 104	-17.896
10		5 784 981 566	-18.434
20		5 784 981 468	-18.532
30		5 784 980 543	-19.457
40		5 784 980 286	-19.714
50		5 784 979 625	-20.375
0	5 825 000 000	5 824 982 525	-17.475
10		5 824 981 833	-18.167
20		5 824 981 402	-18.598
30		5 824 980 838	-19.162
40		5 824 980 071	-19.929
50		5 824 978 948	-21.052

Note : While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.(ANSI C63.10-2013)

Tested by: Hyung-Kwon, Oh / Assistant Manager

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

12. FREQUENCY STABILITY WITH VOLTAGE VARIATION

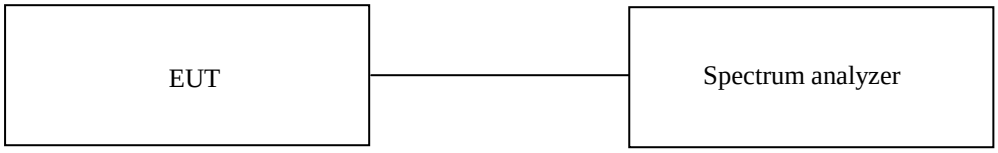
12.1 Operating environment

Temperature : 23 ℃

Relative humidity : 41 % R.H.

12.2 Test set-up

An external DC power supply was connected to the input of the EUT. The voltage of EUT set to 105.0 % of the nominal value and then was reduced to 95.0 % of nominal voltage. The output frequency was recorded at each step.



12.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 14, 2018 (1Y)
■ -	H-3005D	FinePower	DC Power supply	FP09092008	Mar. 14, 2018 (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)

12.4 Test Data for U-NII-1

-. Test Date : November 28, 2018 ~ November 30, 2018

-. Result : Pass

Voltage (VDC)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Frequency Error (kHz)
5.00	5 180 000 000	5 179 978 676	-21.324
4.75		5 179 977 773	-22.227
5.25		5 179 976 408	-23.592
5.00	5 220 000 000	5 219 978 877	-21.123
4.75		5 219 977 226	-22.774
5.25		5 219 976 186	-23.814
5.00	5 240 000 000	5 239 978 939	-21.061
4.75		5 239 977 679	-22.321
5.25		5 239 975 513	-24.487

12.5 Test Data for U-NII-2A

-. Test Date : November 28, 2018 ~ November 30, 2018

-. Result : Pass

Voltage (VDC)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Frequency Error (kHz)
5.00	5 260 000 000	5 259 978 485	-21.515
4.75		5 259 976 707	-23.293
5.25		5 259 975 031	-24.969
5.00	5 300 000 000	5 299 979 442	-20.558
4.75		5 299 977 851	-22.149
5.25		5 299 976 014	-23.986
5.00	5 320 000 000	5 319 978 944	-21.056
4.75		5 319 977 119	-22.881
5.25		5 319 976 102	-23.898

Tested by: Hyung-Kwon, Oh / Assistant Manager

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

12.6 Test Data for U-NII-2C

-. Test Date : November 28, 2018 ~ November 30, 2018

-. Result : Pass

Voltage (VDC)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Frequency Error (kHz)
5.00	5 500 000 000	5 499 979 500	-20.500
4.75		5 499 977 339	-22.661
5.25		5 499 975 629	-24.371
5.00	5 580 000 000	5 579 979 835	-20.165
4.75		5 579 976 514	-23.486
5.25		5 579 975 517	-24.483
5.00	5 700 000 000	5 699 979 185	-20.815
4.75		5 699 976 814	-23.186
5.25		5 699 976 307	-23.693

12.7 Test Data for U-NII-3

-. Test Date : November 28, 2018 ~ November 30, 2018

-. Result : Pass

Voltage (VDC)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Frequency Error (kHz)
5.00	5 745 000 000	5 744 978 963	-21.037
4.75		5 744 976 755	-23.245
5.25		5 744 976 436	-23.564
5.00	5 785 000 000	5 784 978 574	-21.426
4.75		5 784 977 384	-22.616
5.25		5 784 975 341	-24.659
5.00	5 825 000 000	5 824 978 509	-21.491
4.75		5 824 976 584	-23.416
5.25		5 824 975 222	-24.778

Tested by: Hyung-Kwon, Oh / Assistant Manager

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

13. RADIATED SPURIOUS EMISSIONS

13.1 Operating environment

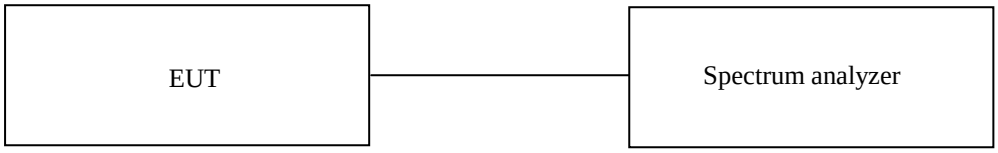
Temperature : 23 ℃

Relative humidity : 41 % R.H.

13.2 Test set-up for conducted measurement

The radiated emissions measurements were on the 3 m semi anechoic chamber. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 40 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.



13.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
■ -	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)
■ -	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	Aug. 09, 2018 (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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13.4 Test data for Below 30 MHz

-. Test Date : November 28, 2018 ~ November 30, 2018

-. 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: Hyung-Kwon, Oh / Assistant Manager

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

13.5 Test data for 30 MHz ~ 1 000 MHz

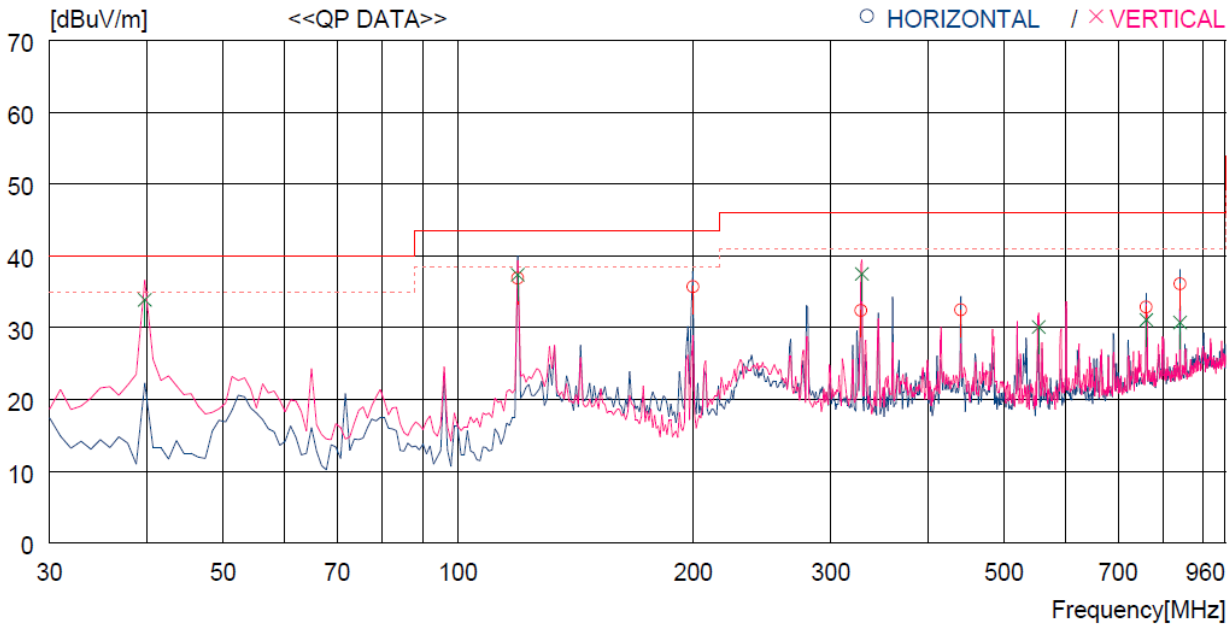
Humidity Level : 41 % R.H. Temperature: 23 ℃

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

Result : PASSED

EUT : WiSA usb Wireless Audio Dongle Date: November 28, 2018 ~ November 30, 2018

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



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal ------										
1	119.240	57.1	10.2	2.6	33.0	36.9	43.5	6.6	300	359
2	199.750	55.1	10.5	3.3	33.2	35.7	43.5	7.8	200	0
3	327.790	47.3	14.0	4.2	33.1	32.4	46.0	13.6	100	359
4	440.311	44.3	16.6	4.8	33.2	32.5	46.0	13.5	100	359
5	760.403	39.2	20.7	6.3	33.3	32.9	46.0	13.1	100	137
6	839.941	41.5	21.0	6.7	33.1	36.1	46.0	9.9	100	194
----- Vertical ------										
7	39.700	52.1	13.3	1.6	33.1	33.9	40.0	6.1	100	0
8	119.240	57.6	10.2	2.6	33.0	37.4	43.5	6.1	100	15
9	328.760	52.4	14.0	4.2	33.1	37.5	46.0	8.5	200	204
10	553.799	40.4	17.6	5.4	33.3	30.1	46.0	15.9	100	165
11	760.403	37.4	20.7	6.3	33.3	31.1	46.0	14.9	200	210
12	839.941	36.1	21.0	6.7	33.1	30.7	46.0	15.3	100	1

Tested by: Hyung-Kwon, Oh / Assistant Manager

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

13.6 Test data for Above 1 GHz

13.6.1 Test data for Frequency UNII I

-. Test Date : November 28, 2018 ~ November 30, 2018

-. 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 ~ 40 GHz

-. Measurement distance : 3 m

-. Duty Cycle : < 98 %

-.Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Correction Factor (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Low Channel										
10 360.00	37.73	Peak	H	39.66	16.38	34.74	3.76	62.79	68.20	5.41
	35.48	Peak	V					60.54	68.20	7.66
Middle Channel										
10 440.00	36.45	Peak	H	39.84	16.74	34.76	3.76	62.03	68.20	6.17
	35.88	Peak	V					61.46	68.20	6.74
High Channel										
10 480.00	37.51	Peak	H	40.02	17.09	34.77	3.76	63.61	68.20	4.59
	36.32	Peak	V					62.42	68.20	5.78

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

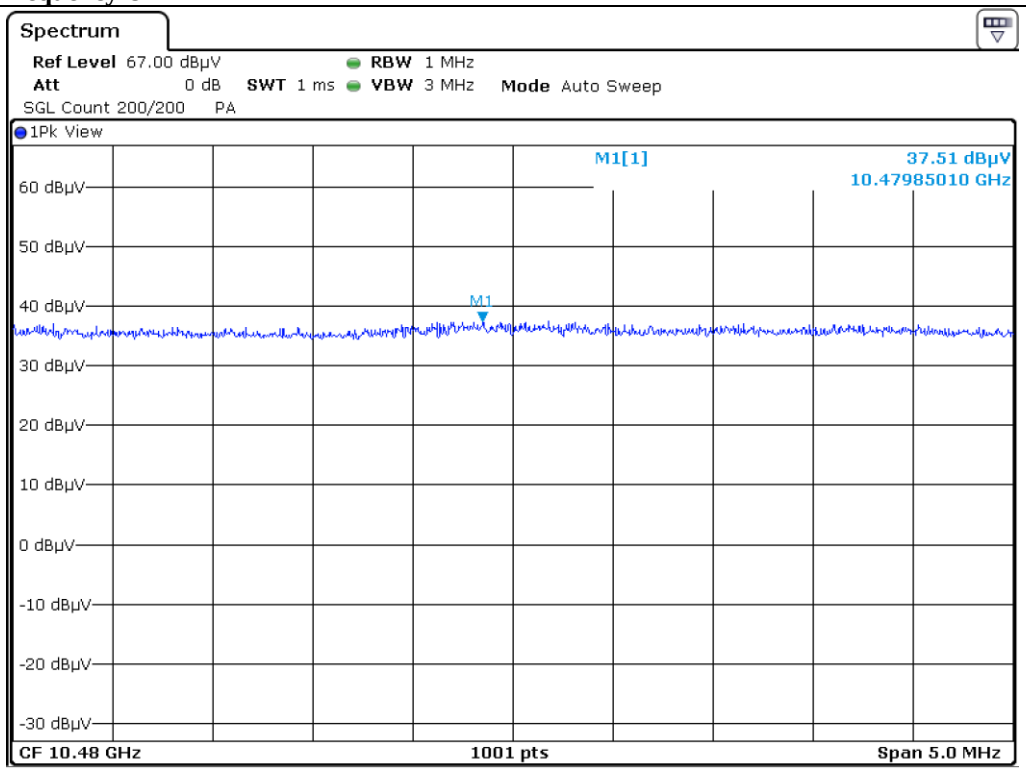
Note 1: Total(dBµV/m) = Reading(dBµV/m) + Ant Factor(dB) + Cable Loss(dB) – Amp Gain(dB) + Correction Factor(dB)

Note 2: Margin (dB) = Limits (dBµV/m) - Emission Level (dBµV/m)

Tested by: Hyung-Kwon, Oh / Assistant Manager

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

Test Plot for Frequency UNII I



High Channel_H_Peak

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13.6.2 Test data for Frequency UNII 2A

-. Test Date : November 28, 2018 ~ November 30, 2018

-. 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 ~ 40 GHz

-. Measurement distance : 3 m

-. Duty Cycle : < 98 %

-.Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Correction Factor (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Low Channel										
10 520.00	38.07	Peak	H	39.97	17.03	34.53	3.76	64.30	68.20	3.90
	36.22	Peak	V					62.45	68.20	5.75
Middle Channel										
10 600.00	37.06	Peak	H	40.02	17.26	34.38	3.76	63.72	74.00	10.28
	25.63	Average	H					52.29	54.00	1.71
	37.49	Peak	V					64.15	74.00	9.85
	24.71	Average	V					51.37	54.00	2.63
High Channel										
10 640.00	37.08	Peak	H	40.09	17.32	34.26	3.76	63.99	74.00	10.01
	25.97	Average	H					52.88	54.00	1.12
	36.81	Peak	V					63.72	74.00	10.28
	25.74	Average	V					52.65	54.00	1.35

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

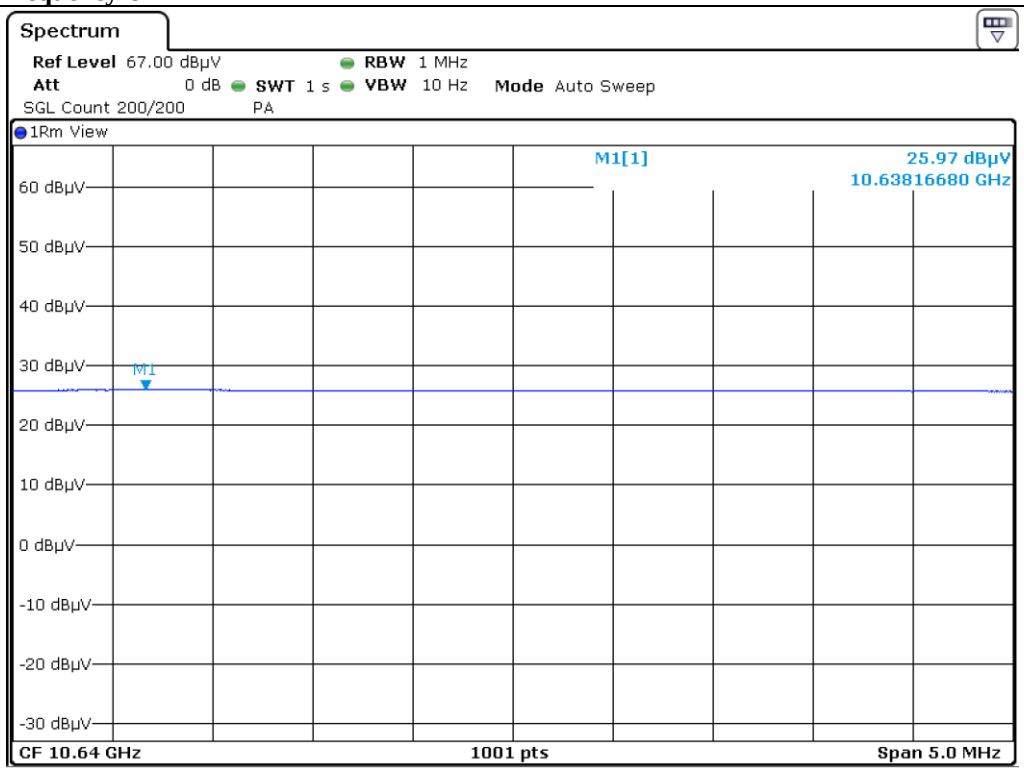
Note 1: Total(dBµV/m) = Reading(dBµV/m) + Ant Factor(dB) + Cable Loss(dB) – Amp Gain(dB) + Correction Factor(dB)

Note 2: Margin (dB) = Limits (dBµV/m) - Emission Level (dBµV/m)

Tested by: Hyung-Kwon, Oh / Assistant Manager

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

Test Plot for Frequency UNII 2A



High Channel_H_Avg

13.6.3 Test data for Frequency UNII 2C

-. Test Date : November 28, 2018 ~ November 30, 2018

-. 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 ~ 40 GHz

-. Measurement distance : 3 m

-. Duty Cycle : < 98 %

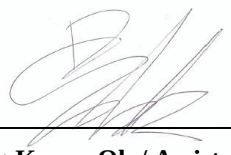
-.Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Correction Factor (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Low Channel										
11 000.00	39.18	Peak	H	40.06	17.56	34.26	3.76	66.30	74.00	7.70
	23.70	Average	H					50.82	54.00	3.18
	35.13	Peak	V					62.25	74.00	11.75
	24.75	Average	V					51.87	54.00	2.13
Middle Channel										
11 160.00	35.63	Peak	H	40.11	17.83	33.95	3.76	63.38	74.00	10.62
	24.06	Average	H					51.81	54.00	2.19
	34.27	Peak	V					62.02	74.00	11.98
	22.38	Average	V					50.13	54.00	3.87
High Channel										
11 400.00	35.07	Peak	H	40.09	18.14	33.79	3.76	63.27	74.00	10.73
	24.19	Average	H					52.39	54.00	1.61
	35.09	Peak	V					63.29	74.00	10.71
	22.48	Average	V					50.68	54.00	3.32

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

Note 1: Total(dBµV/m) = Reading(dBµV/m) + Ant Factor(dB) + Cable Loss(dB) – Amp Gain(dB) + Correction Factor(dB)

Note 2: Margin (dB) = Limits (dBµV/m) - Emission Level (dBµV/m)



Tested by: Hyung-Kwon, Oh / Assistant Manager

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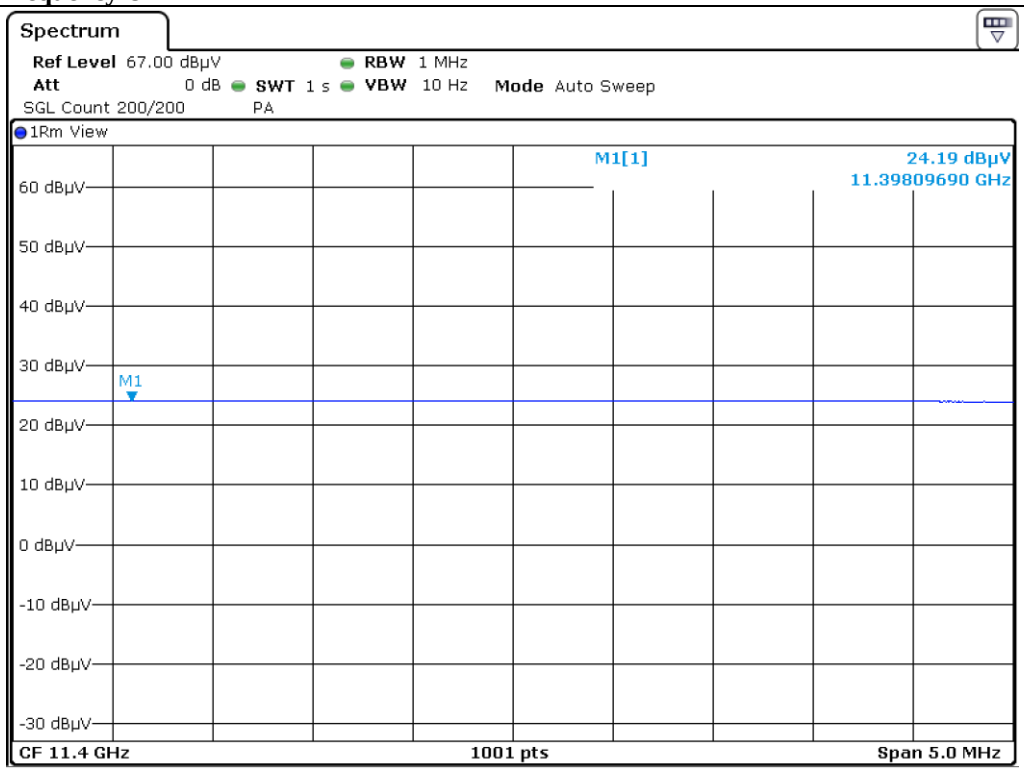
Test Plot for Frequency UNII 2A



High Channel_H_Avg

13.6.4 Test data for Frequency UNII 3

-. Test Date : November 28, 2018 ~ November 30, 2018

-. 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 ~ 40 GHz

-. Measurement distance : 3 m

-. Duty Cycle : < 98 %

-.Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Correction Factor (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Low Channel										
11 490.00	34.01	Peak	H	40.07	18.32	33.75	3.77	62.42	74.00	11.58
	23.48	Average	H					51.89	54.00	2.11
	34.81	Peak	V					63.22	74.00	10.78
	23.46	Average	V					51.87	54.00	2.13
Middle Channel										
11 570.00	34.63	Peak	H	39.78	18.52	33.64	3.77	63.06	74.00	10.94
	24.29	Average	H					52.72	54.00	1.28
	34.27	Peak	V					62.70	74.00	11.30
	24.12	Average	V					52.55	54.00	1.45
High Channel										
11 650.00	34.21	Peak	H	39.49	18.73	33.61	3.77	62.59	74.00	11.41
	24.42	Average	H					52.80	54.00	1.20
	34.00	Peak	V					62.38	74.00	11.62
	22.64	Average	V					51.02	54.00	2.98

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

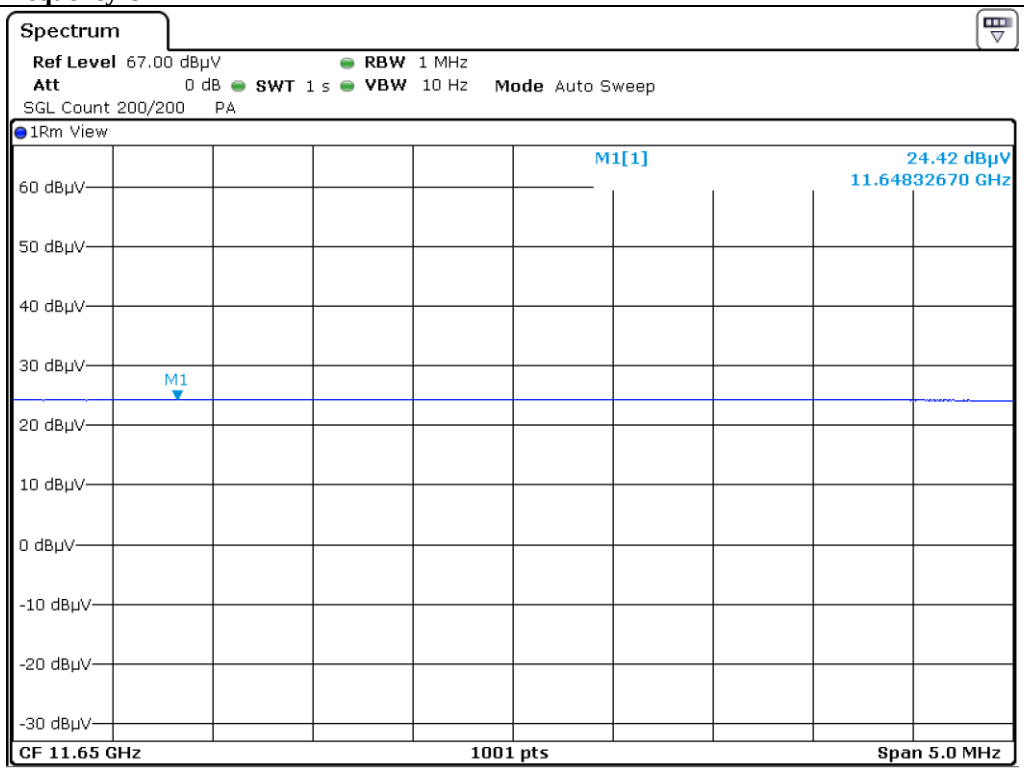
Note 1: Total(dBµV/m) = Reading(dBµV/m) + Ant Factor(dB) + Cable Loss(dB) – Amp Gain(dB) + Correction Factor(dB)

Note 2: Margin (dB) = Limits (dBµV/m) - Emission Level (dBµV/m)

Tested by: Hyung-Kwon, Oh / Assistant Manager

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

Test Plot for Frequency UNII 2A



High Channel_H_Avg

14. RADIATED RESTRICTED BAND EDGE MEASUREMENTS

14.1 Operating environment

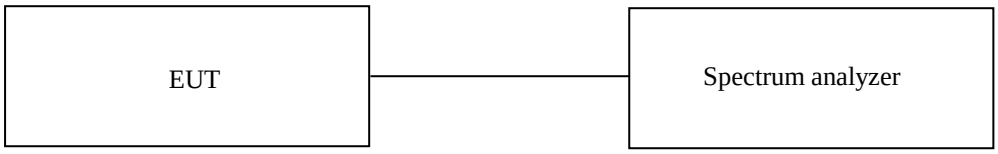
Temperature : 23 ℃

Relative humidity : 41 % R.H.

14.2 Test set-up for conducted measurement

The radiated emissions measurements were performed on the 3 m, open-field test site. The EUT was placed on a non-conductive turntable above the ground plane.

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.



14.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
■ -	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)
■ -	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	Aug. 09, 2018 (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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14.4 Test data for Frequency UNII I

-. Test Date : November 28, 2018 ~ November 30, 2018

-. 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

-. Measurement distance : 3 m

-. Duty Cycle : < 98 %

-. Result : Pass

Frequency (GHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Correction Factor (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
5 013.887	43.51	Peak	H	31.28	12.65	35.85	3.76	55.35	74.00	18.65
5 050.970	36.84	Average	H					48.68	54.00	5.32
5 067.558	45.92	Peak	V					57.76	74.00	16.24
4 835.175	35.63	Average	V					47.47	54.00	6.53

Tabulated test data for Restricted Band

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

Note 1: Total(dBµV/m) = Reading(dBµV/m) + Ant Factor(dB) + Cable Loss(dB) – Amp Gain(dB) + Correction Factor(dB)

Note 2: Margin (dB) = Limits (dBµV/m) - Emission Level (dBµV/m)

Tested by: Hyung-Kwon, Oh / Assistant Manager

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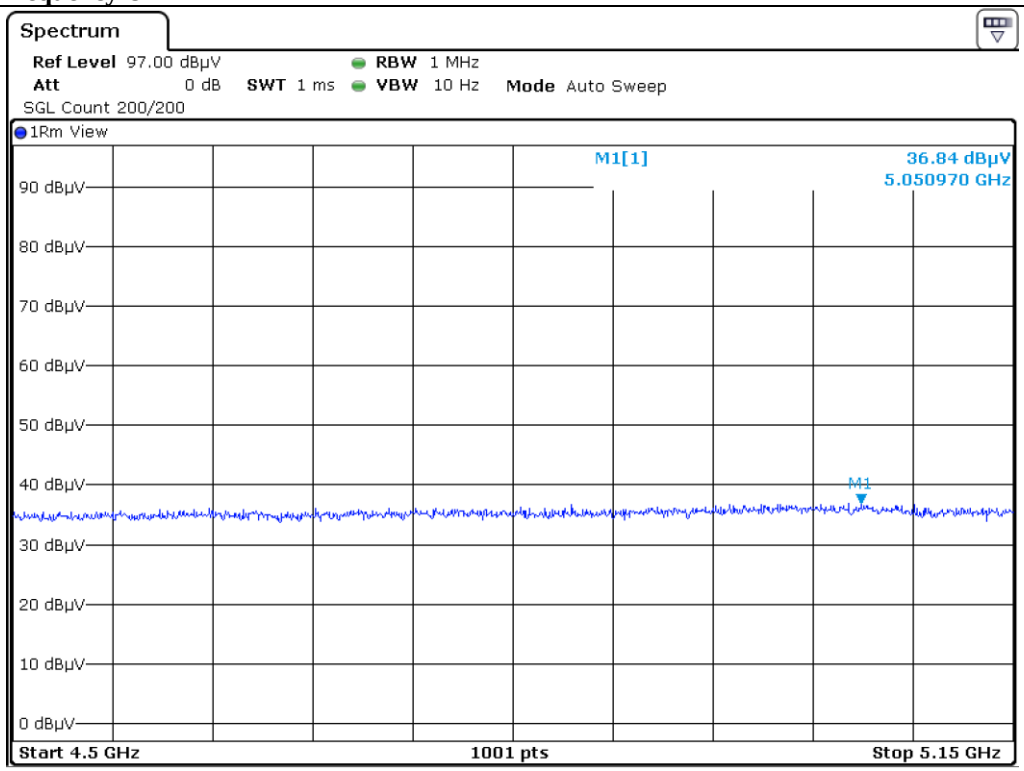
Test Plot for Frequency UNII 1



Low Channel_H_Avg

14.5 Test data for Frequency UNII 2A

-. Test Date : November 28, 2018 ~ November 30, 2018

-. 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

-. Measurement distance : 3 m

-. Duty Cycle : < 98 %

-. Result : Pass

Frequency (GHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Correction Factor (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
5 424.114	46.24	Peak	H	31.50	12.33	35.74	3.76	58.09	74.00	15.91
5 362.140	34.73	Average	H					46.58	54.00	7.42
5 351.724	45.73	Peak	V					57.58	74.00	16.42
5 350.153	34.06	Average	V					45.91	54.00	8.09

Tabulated test data for Restricted Band

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

Note 1: Total(dBµV/m) = Reading(dBµV/m) + Ant Factor(dB) + Cable Loss(dB) – Amp Gain(dB) + Correction Factor(dB)

Note 2: Margin (dB) = Limits (dBµV/m) - Emission Level (dBµV/m)

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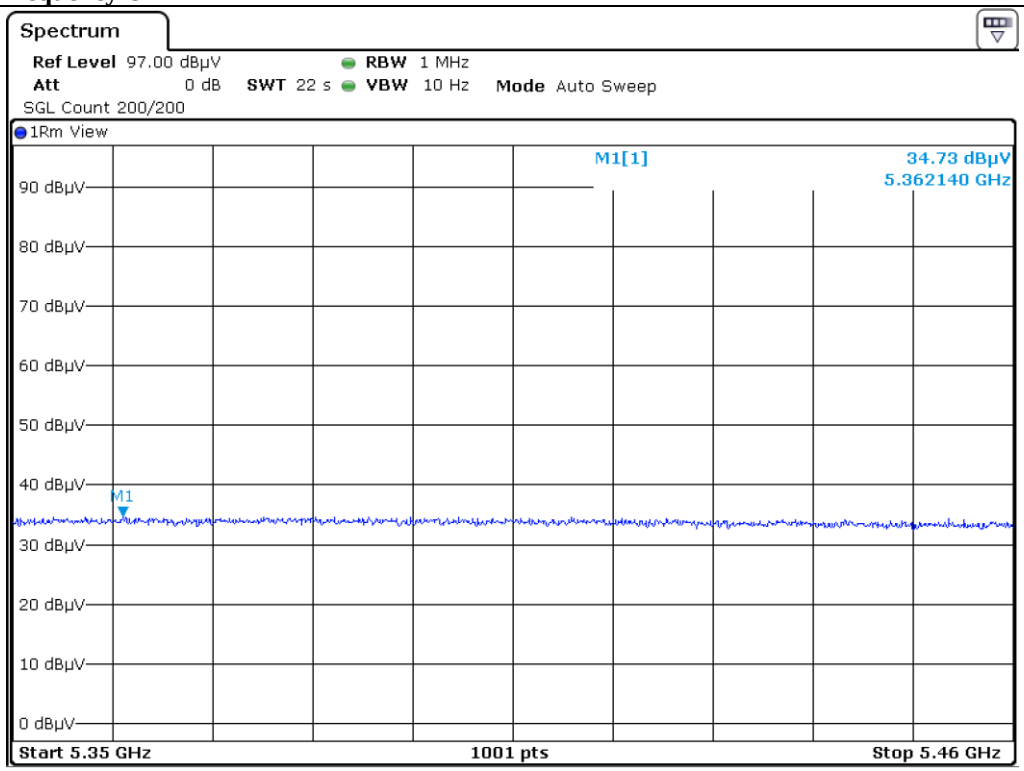
Test Plot for Frequency UNII 2A



High Channel_H_Avg

14.6 Test data for Frequency UNII 2C

-. Test Date : November 28, 2018 ~ November 30, 2018

-. 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

-. Measurement distance : 3 m

-. Duty Cycle : < 98 %

-. Result : Pass

Frequency (GHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Correction Factor (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
5 458.611	45.71	Peak	H	31.60	12.17	35.63	3.76	57.61	74.00	16.39
5 379.400	34.92	Average	H					46.82	54.00	7.18
5 438.731	46.91	Peak	V					58.81	74.00	15.19
5 451.550	33.93	Average	V					45.83	54.00	8.17

Tabulated test data for Restricted Band

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

Note 1: Total(dBµV/m) = Reading(dBµV/m) + Ant Factor(dB) + Cable Loss(dB) – Amp Gain(dB) + Correction Factor(dB)

Note 2: Margin (dB) = Limits (dBµV/m) - Emission Level (dBµV/m)

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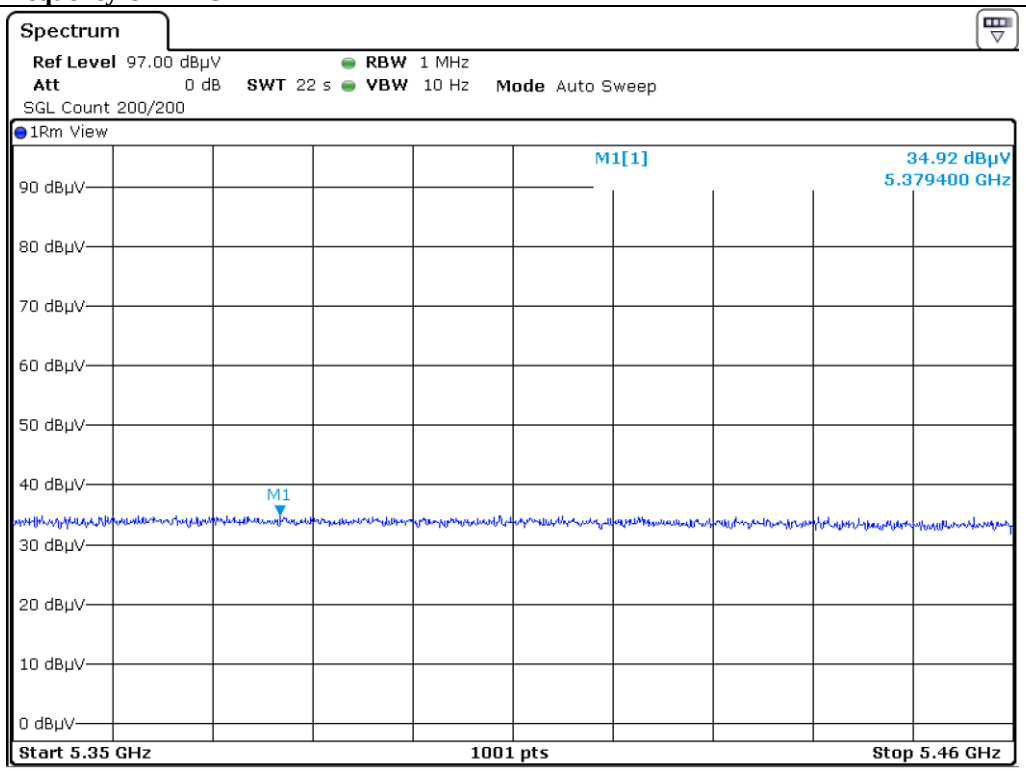
Test Plot for Frequency UNII 2C



Low Channel_H_Avg

14.7 Test data for Frequency U-NII-3

-. Test Date : November 28, 2018 ~ November 30, 2018

-. 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

-. Measurement distance : 3 m

-. Duty Cycle : < 98 %

-. Result : Pass

Frequency (GHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Correction Factor (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Low Channel										
5 650.000	42.64	Peak	H	32.17	12.09	35.18	3.77	55.49	80.00	24.51
5 710.000	42.66	Peak	H					55.51	119.80	64.29
5 715.000	43.62	Peak	H					56.47	121.20	64.73
5 725.000	43.65	Peak	H					56.50	134.00	77.50
5 706.380	45.01	Peak	H					57.86	118.79	60.93
5 650.000	42.61	Peak	V					55.46	80.00	24.54
5 710.000	42.79	Peak	V					55.64	119.80	64.16
5 715.000	44.09	Peak	V					56.94	121.20	64.26
5 725.000	43.35	Peak	V					56.20	134.00	77.80
5 724.520	45.05	Peak	V					57.90	132.91	75.01

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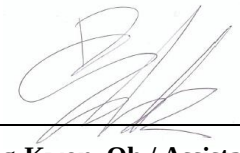
High Channel										
5 850.000	43.66	Peak	H	32.17	12.09	35.18	3.77	56.51	134.00	77.49
5 855.000	43.99	Peak	H					56.84	122.60	65.76
5 875.000	43.80	Peak	H					56.65	117.00	60.35
5 925.000	43.95	Peak	H					56.80	80.00	23.20
5 851.090	44.92	Peak	H					57.77	131.51	73.74
5 850.000	44.72	Peak	V					57.57	134.00	76.43
5 855.000	43.86	Peak	V					56.71	122.60	65.89
5 875.000	43.39	Peak	V					56.24	117.00	60.76
5 925.000	44.46	Peak	V					57.31	80.00	22.69
5 850.540	46.58	Peak	V					59.43	132.77	73.34

Tabulated test data for Restricted Band

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

Note 1: Total(dBμV/m) = Reading(dBμV/m) + Ant Factor(dB) + Cable Loss(dB) – Amp Gain(dB) + Correction Factor(dB)

Note 2: Margin (dB) = Limits (dBμV/m) - Emission Level (dBμV/m)



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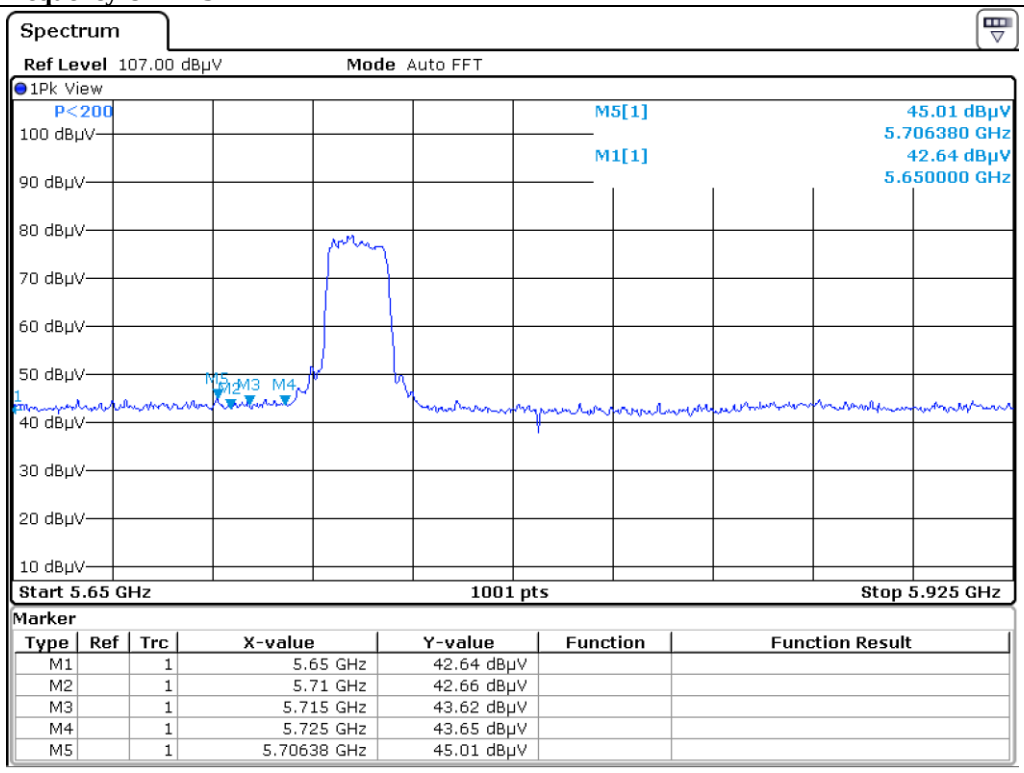
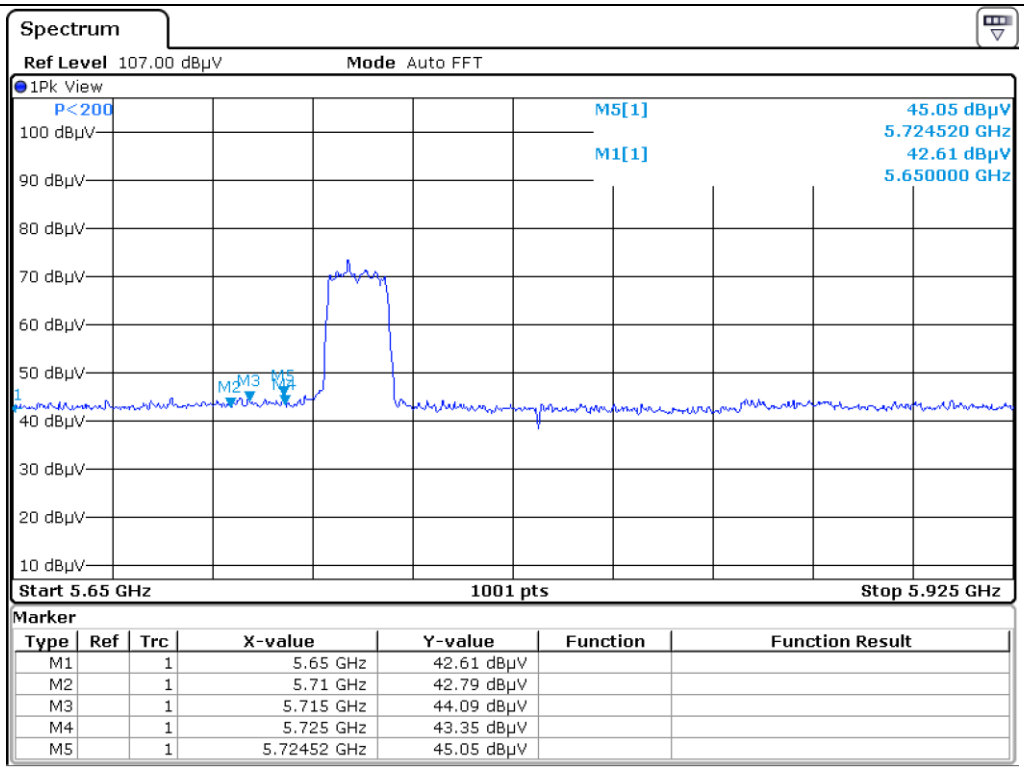
Test Plot for Frequency U-NII-3



Low Channel_H_Peak



Low Channel_V_Peak

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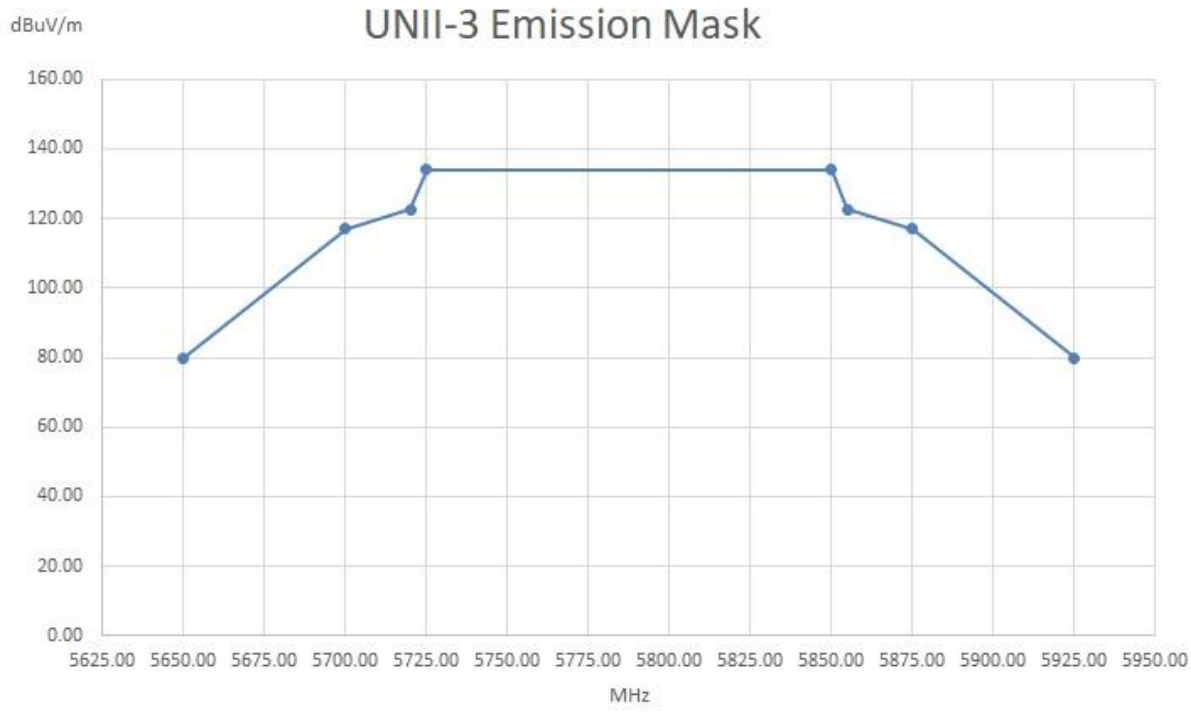
14.8 U-NII-3 Emission Limits

14.8.1 Emission Mask Plots



Remark.

-. Title 47 → Part 15 → Subpart E—UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE DEVICES

§ 15.407 General technical requirements.

(4) For transmitters operating in the 5.725-5.85 GHz band:

(i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

Tested by: Hyung-Kwon, Oh / Assistant Manager

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15. CONDUCTED EMISSION TEST

15.1 Operating environment

Temperature : 23 ℃

Relative humidity : 41 % R.H.

15.2 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 μH + 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.

15.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	ESCI	Rohde & Schwarz	Test Receiver	101012	Oct. 22, 2018 (1Y)
☐ -	ESHS10	Rohde & Schwarz	Test Receiver	834467/007	Mar. 29, 2018 (1Y)
☐ -	NSLK8128	Schwarzbeck	AMN	8128-216	Mar. 29, 2018 (1Y)
■ -	NSLK8126	Schwarzbeck	AMN	8126-404	Apr. 04, 2018 (1Y)
☐ -	3825/2	EMCO	AMN	9109-1869	Apr. 11, 2018 (1Y)
■ -	3825/2	EMCO	AMN	9109-1867	Mar. 28, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

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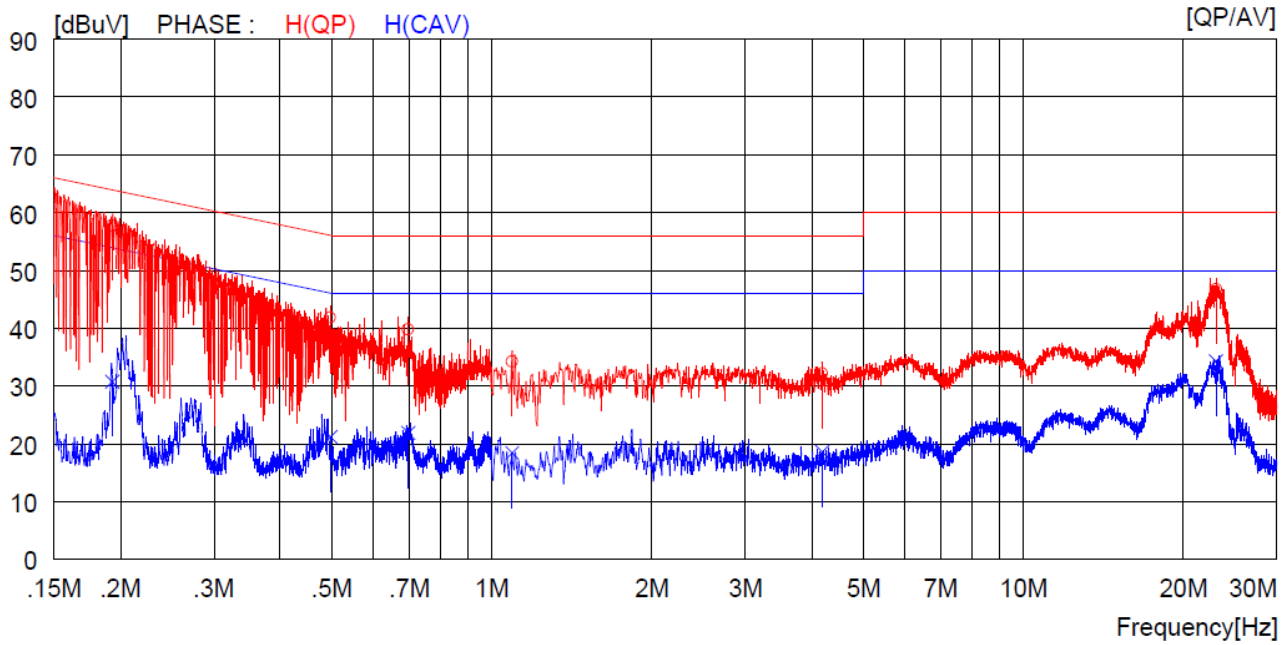
15.4 Test data

-. Test Date : November 28, 2018 ~ November 30, 2018

-. Resolution bandwidth : 9 kHz

-. Frequency range : 0.15 MHz ~ 30 MHz

-. Tested Line : HOT LINE



NO	FREQ [MHz]	READING QP [dBuV]	READING AV [dBuV]	C.FACTOR [dB]	RESULT QP [dBuV]	RESULT AV [dBuV]	LIMIT QP [dBuV]	LIMIT AV [dBuV]	MARGIN QP [dBuV]	MARGIN AV [dBuV]	PHASE
1	0.19300	47.9	----	9.9	57.8	----	63.9	----	6.1	----	H(QP)
2	0.49700	31.8	----	10.0	41.8	----	56.0	----	14.2	----	H(QP)
3	0.69600	29.8	----	10.0	39.8	----	56.0	----	16.2	----	H(QP)
4	1.09200	24.2	----	10.0	34.2	----	56.0	----	21.8	----	H(QP)
5	4.18400	22.0	----	10.2	32.2	----	56.0	----	23.8	----	H(QP)
6	23.05000	36.2	----	10.5	46.7	----	60.0	----	13.3	----	H(QP)
7	0.19300	----	20.9	9.9	----	30.8	----	53.9	----	23.1	H(CAV)
8	0.49700	----	11.2	10.0	----	21.2	----	46.0	----	24.8	H(CAV)
9	0.69600	----	11.9	10.0	----	21.9	----	46.0	----	24.1	H(CAV)
10	1.09200	----	8.4	10.0	----	18.4	----	46.0	----	27.6	H(CAV)
11	4.18400	----	8.4	10.2	----	18.6	----	46.0	----	27.4	H(CAV)
12	23.05000	----	23.8	10.5	----	34.3	----	50.0	----	15.7	H(CAV)

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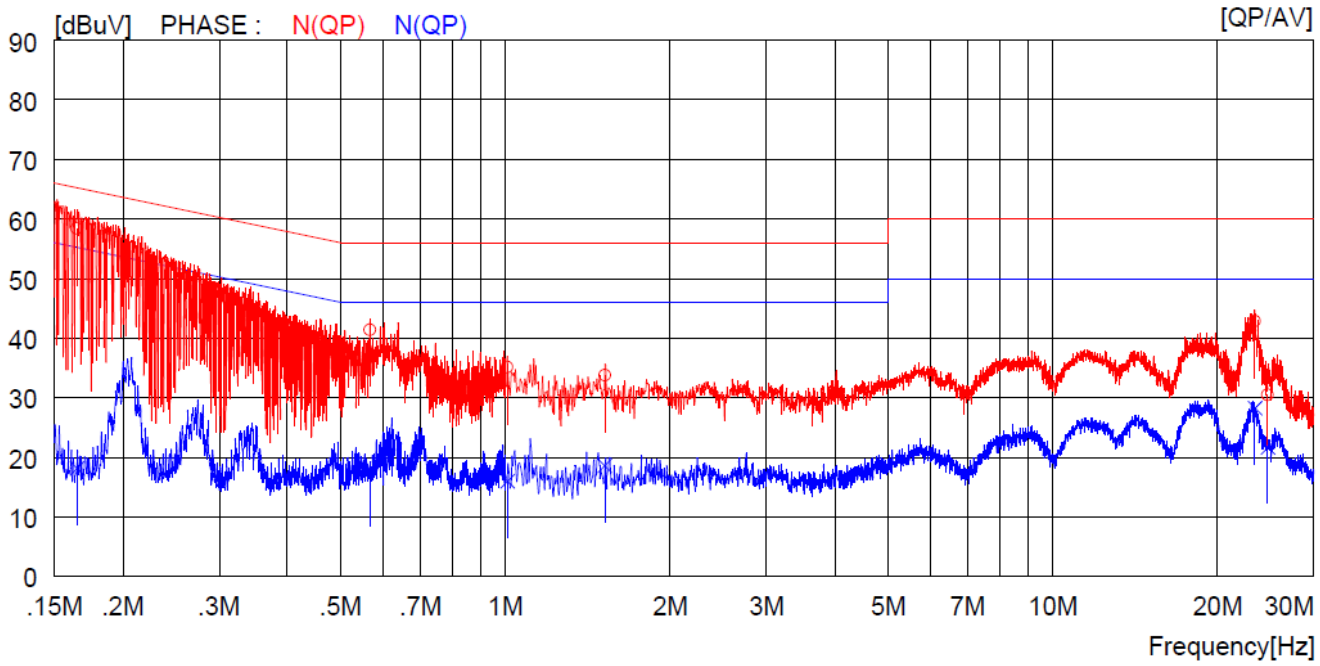
-. Tested Line : NEUTRAL LINE



NO	FREQ [MHz]	READING QP [dBuV]	READING AV [dBuV]	C.FACTOR [dB]	RESULT QP [dBuV]	RESULT AV [dBuV]	LIMIT QP [dBuV]	LIMIT AV [dBuV]	MARGIN QP [dBuV]	MARGIN AV [dBuV]	PHASE
1	0.16500	48.5	----	9.9	58.4	----	65.2	----	6.8	----	N(QP)
2	0.56600	31.4	----	10.0	41.4	----	56.0	----	14.6	----	N(QP)
3	1.00800	25.1	----	10.0	35.1	----	56.0	----	20.9	----	N(QP)
4	1.52000	23.8	----	10.0	33.8	----	56.0	----	22.2	----	N(QP)
5	23.42000	32.3	----	10.5	42.8	----	60.0	----	17.2	----	N(QP)
6	24.71000	20.0	----	10.5	30.5	----	60.0	----	29.5	----	N(QP)
7	0.16500	----	8.2	9.9	----	18.1	----	55.2	----	37.1	N(CAV)
8	0.56600	----	8.0	10.0	----	18.0	----	46.0	----	28.0	N(CAV)
9	1.00800	----	6.0	10.0	----	16.0	----	46.0	----	30.0	N(CAV)
10	1.52000	----	8.6	10.0	----	18.6	----	46.0	----	27.4	N(CAV)
11	23.42000	----	17.7	10.5	----	28.2	----	50.0	----	21.8	N(CAV)
12	24.71000	----	11.2	10.5	----	21.7	----	50.0	----	28.3	N(CAV)

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

Tested by: Hyung-Kwon, Oh / Assistant Manager

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