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

Test Report No. : **OT-209-RWD-080**

Reception No. : **2008003013**

Applicant : **LG Innotek Co., Ltd.**

Address : **26, Hanamsandan 5beon-ro Gwangsan-gu, Gwangju, 506-731, South Korea**

Manufacturer : **LG Innotek Co., Ltd.**

Address : **26, Hanamsandan 5beon-ro Gwangsan-gu, Gwangju, 506-731, South Korea**

Type of Equipment : **RF Module**

FCC ID. : **YZP-ATC5CPC001**

Model Name : **ATC5CPC001**

Serial number : **N/A**

Total page of Report : **107 pages (including this page)**

Date of Incoming : **September 07, 2020**

Date of issue : **September 23, 2020**

SUMMARY

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

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

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

Tested by	Reviewed by	Approved by
Hyung-Kwon, Oh / Manager	Tae-Ho, Kim / Senior Manager	Ki-Hong, Nam / General Manager
ONETECH Corp.	ONETECH Corp.	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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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-209-RWD-080	September 23, 2020	Initial Release	All

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1. VERIFICATION OF COMPLIANCE

Applicant : LG Innotek Co., Ltd.

Address : 26, Hanamsandan 5beon-ro Gwangsan-gu, Gwangju, 506-731, South Korea

Contact Person : Jeong Inchang / Chief Research Engineer

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

FCC ID : YZP-ATC5CPC001

Model Name : ATC5CPC001

Brand Name : LG Innotek Co., Ltd.

Serial Number : N/A

Date : September 23, 2020

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Modular Transmitter, RF Module
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247 KDB 558074 D01 15.247 Meas Guidance v05r02
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

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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 Conducted(average) 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 Power.

2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART C Section 15.247.

2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea.

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-14617/ G-10666/ T-11842

ISED (Innovation, Science and Economic Development Canada) – Registration No. Site# 3736A-3

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 ATC5CPC001 (referred to as the EUT in this report) is a RF Module. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	RF Module	
Temperature Range	-40 °C ~ 85 °C	
OPERATING FREQUENCY	Bluetooth LE	2 402 MHz ~ 2 480 MHz
	Bluetooth	2 402 MHz ~ 2 480 MHz
	WLAN 2.4 GHz	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))
	5 150 MHz ~ 5 250 MHz Band	5 180 MHz ~ 5 240 MHz (802.11a/n(HT20)/ac(VHT20))
		5 190 MHz ~ 5 230 MHz (802.11n(HT40)/ac(VHT40))
		5 210 MHz (802.11ac(VHT80))
	5 250 MHz ~ 5 350 MHz Band	5 260 MHz ~ 5 320 MHz (802.11a/n(HT20)/ac(VHT20))
		5 270 MHz ~ 5 310 MHz (802.11n(HT40)/ac(VHT40))
		5 290 MHz (802.11ac(VHT80))
	5 470 MHz ~ 5 725 MHz Band	5 500 MHz ~ 5 700 MHz (802.11a/n(HT20)/ac(VHT20))
		5 510 MHz ~ 5 670 MHz (802.11n(HT40)/ac(VHT40))
		5 530 MHz ~ 5 690 MHz (802.11ac(VHT80))
	5 725 MHz ~ 5 850 MHz Band	5 745 MHz ~ 5 825 MHz (802.11a/n(HT20)/ac(VHT20))
		5 755 MHz ~ 5 795 MHz (802.11n(HT40)/ac(VHT40))
		5 775 MHz (802.11ac(VHT80))
MODULATION TYPE	Bluetooth LE	GFSK for 1 Mbps
	Bluetooth	GFSK for 1Mbps, π/4-DQPSK for 2Mbps, 8-DPSK for 3Mbps
	WLAN 2.4 GHz	802.11b: DSSS Modulation(DBPSK/DQPSK/CCK) 802.11g/n(HT20) OFDM Modulation(BPSK/QPSK/16QAM/64QAM)
	WLAN 5 GHz	802.11a/n(HT20)/n(HT40)/ac(VHT80): OFDM Modulation(BPSK/QPSK/16QAM/64QAM)

RF OUTPUT POWER	Bluetooth LE	1 Mbps	4.25 dBm
	Bluetooth	1 Mbps	4.85 dBm
		2 Mbps	2.67 dBm
		3 Mbps	3.07 dBm
	WLAN 2.4 GHz	Antenna 0	16.05 dBm(802.11b) 16.48 dBm(802.11g) 14.62 dBm(802.11n_HT20)
		Antenna 1	16.06 dBm(802.11b) 18.22 dBm(802.11g) 16.20 dBm(802.11n_HT20)
		Multiple Antenna	18.29 dBm(802.11n_HT20)
	5 150 MHz ~ 5 250 MHz Band	Antenna 0	17.28 dBm(802.11a) 15.53 dBm(802.11n_HT20) 15.75 dBm(802.11n_HT40) 15.03 dBm(802.11ac_VHT80)
		Antenna 1	15.47 dBm(802.11a) 14.40 dBm(802.11n_HT20) 13.82 dBm(802.11n_HT40) 13.83 dBm(802.11ac_VHT80)
		Multiple Antenna	18.04 dBm(802.11n_HT20) 17.87 dBm(802.11n_HT40) 17.48 dBm(802.11ac_VHT80)
	5 250 MHz ~ 5 350 MHz Band	Antenna 0	17.99 dBm(802.11a) 16.87 dBm(802.11n_HT20) 16.37 dBm(802.11n_HT40) 16.12 dBm(802.11ac_VHT80)
		Antenna 1	15.36 dBm(802.11a) 14.18 dBm(802.11n_HT20) 14.12 dBm(802.11n_HT40) 14.13 dBm(802.11ac_VHT80)
		Multiple Antenna	18.66 dBm(802.11n_HT20) 18.31 dBm(802.11n_HT40) 18.25 dBm(802.11ac_VHT80)

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RF OUTPUT POWER	5 470 MHz ~ 5 725 MHz Band	Antenna 0	16.96 dBm(802.11a) 15.76 dBm(802.11n_HT20) 17.47 dBm(802.11n_HT40) 17.14 dBm(802.11ac_VHT80)
		Antenna 0_Straddle	14.04 dBm(802.11a) 12.84 dBm(802.11n_HT20) 15.23 dBm(802.11n_HT40) 15.09 dBm(802.11ac_VHT80)
		Antenna 1	16.39 dBm(802.11a) 15.41 dBm(802.11n_HT20) 15.85 dBm(802.11n_HT40) 15.55 dBm(802.11ac_VHT80)
		Antenna 1_Straddle	14.74 dBm(802.11a) 13.52 dBm(802.11n_HT20) 14.19 dBm(802.11n_HT40) 14.34 dBm(802.11ac_VHT80)
		Multiple Antenna	18.58 dBm(802.11n_HT20) 19.73 dBm(802.11n_HT40) 19.44 dBm(802.11ac_VHT80)
		Multiple Antenna _Straddle	16.23 dBm(802.11n_HT20) 17.76 dBm(802.11n_HT40) 17.75 dBm(802.11ac_VHT80)

RF OUTPUT POWER	5 725 MHz ~ 5 850 MHz Band	Antenna 0	15.67 dBm(802.11a) 14.59 dBm(802.11n_HT20) 15.34 dBm(802.11n_HT40) 14.72 dBm(802.11ac_VHT80)
		Antenna 0_Straddle	6.57 dBm(802.11a) 5.97 dBm(802.11n_HT20) 2.88 dBm(802.11n_HT40) -0.70 dBm(802.11ac_VHT80)
		Antenna 1	15.88 dBm(802.11a) 14.57 dBm(802.11n_HT20) 14.40 dBm(802.11n_HT40) 13.83 dBm(802.11ac_VHT80)
		Antenna 1_Straddle	7.26 dBm(802.11a) 6.69 dBm(802.11n_HT20) 2.22 dBm(802.11n_HT40) -1.34 dBm(802.11ac_VHT80)
		Multiple Antenna	17.57 dBm(802.11n_HT20) 17.92 dBm(802.11n_HT40) 17.31 dBm(802.11ac_VHT80)
		Multiple Antenna _Straddle	9.33 dBm(802.11n_HT20) 5.59 dBm(802.11n_HT40) 2.01 dBm(802.11ac_VHT80)

ANTENNA TYPE	PCB Antenna		
ANTENNA GAIN	Bluetooth LE	1.49 dBi	
	Bluetooth	1.49 dBi	
	WLAN 2.4 GHz	Antenna 0	1.49 dBi
		Antenna 1	0.14 dBi
		Multiple Antenna	3.88 dBi
	5 150 MHz ~ 5 250 MHz Band	Antenna 0	-2.10 dBi
		Antenna 1	-6.66 dBi
		Multiple Antenna	-0.80 dBi
	5 250 MHz ~ 5 350 MHz Band	Antenna 0	-2.10 dBi
		Antenna 1	-6.66 dBi
		Multiple Antenna	-0.80 dBi
	5 470 MHz ~ 5 725 MHz Band	Antenna 0	-2.82 dBi
		Antenna 1	-6.82 dBi
		Multiple Antenna	-1.36 dBi
	5 725 MHz ~ 5 850 MHz Band	Antenna 0	-2.61 dBi
		Antenna 1	-7.60 dBi
		Multiple Antenna	-1.41 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	37.4 MHz		

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

-. None

4. EUT MODIFICATIONS

-. None

5. SYSTEM TEST CONFIGURATION

5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	LG Innotek Co., Ltd.	RBHP-B216C_RDK_Rev0.2	N/A

5.2 Peripheral equipment

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

Model	Manufacturer	Description	Connected to
ATC5CPC001	LG Innotek Co., Ltd.	RF Module (EUT)	
HP Probook	HP	Notebook PC	EUT
PPP009L-E	LIE-ON TECHNOLOGY (CHANGZHOU)CO.,LTD.	AC Adapter	
RBHX-Q20XX_Carrier_Interface_Rev.0.2	LG Inntek Co., LTD.	Interface Board	EUT
PWS-3003D	Protek	DC Power Supply	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.

-. Channel List (WLAN 2.4 GHz)

Channel	Frequency[MHz]	Channel	Frequency[MHz]	Channel	Frequency[MHz]
1	2 412.00	6	2 437.00	11	2 462.00
2	2 417.00	7	2 442.00		
3	2 422.00	8	2 447.00		
4	2 427.00	9	2 452.00		
5	2 432.00	10	2 457.00		

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Modulation	DATA RATE	OUTPUT POWER[dBm]	
		Antenna 0	Antenna 1
802.11 b (Middle Channel)	1 Mbps	15.00	15.92
	2 Mbps	14.85	15.77
	5.5 Mbps	14.62	15.56
	11 Mbps	14.47	15.39
802.11 g (Middle Channel)	6 Mbps	15.33	17.84
	9 Mbps	15.22	17.73
	12 Mbps	15.10	17.60
	18 Mbps	14.53	17.02
	24 Mbps	14.16	16.48
	36 Mbps	13.82	16.20
	48 Mbps	13.63	15.89
	54 Mbps	13.39	15.54
802.11 HT 20 (Middle Channel)	6.5 Mbps	13.03	15.49
	13 Mbps	12.94	15.31
	19.5 Mbps	12.56	15.09
	26 Mbps	11.97	14.48
	39 Mbps	11.63	14.20
	52 Mbps	11.47	14.03
	58.5 Mbps	11.10	13.48
	65 Mbps	11.03	13.37

-. The worse case data rate for each modulation is determined 1 Mbps(Ant.0/Ant.1) for IEEE 802.11b, 6 Mbps(Ant.0/Ant.1) for IEEE 802.11g, 6.5 Mbps(Ant.0/Ant.1) for HT20.

-. 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.

-. Duty Cycle

Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
802.11 b_Antenna 0	8.64	0.08	99.08	0.04
802.11 b_Antenna 1	8.61	0.11	98.74	0.06
802.11 g _Antenna 0	1.42	0.10	93.42	0.30
802.11 g _Antenna 0	1.42	0.12	92.21	0.35
802.11 HT 20_Antenna 0	0.68	0.13	83.75	0.77
802.11 HT 20_Antenna 1	0.68	0.12	85.00	0.71

Note – Duty Cycle : (Tx On Time / (Tx On Time + Tx Off Time)) * 100

Correction Factor : 10 * Log(1 / (Duty Cycle / 100))

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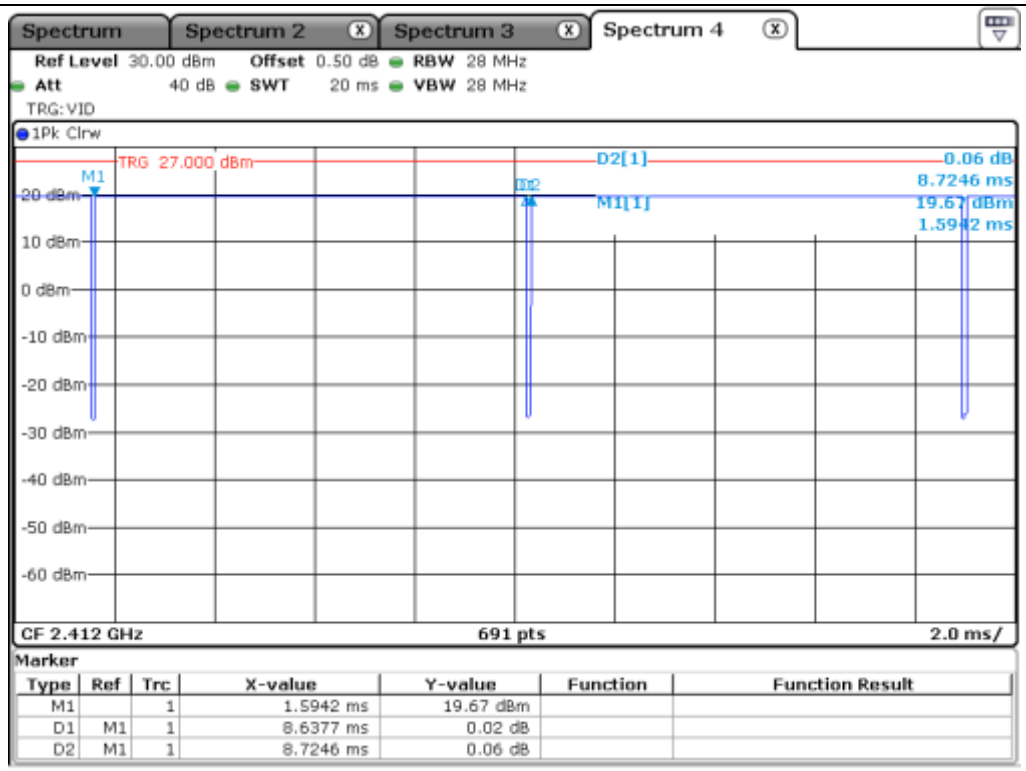
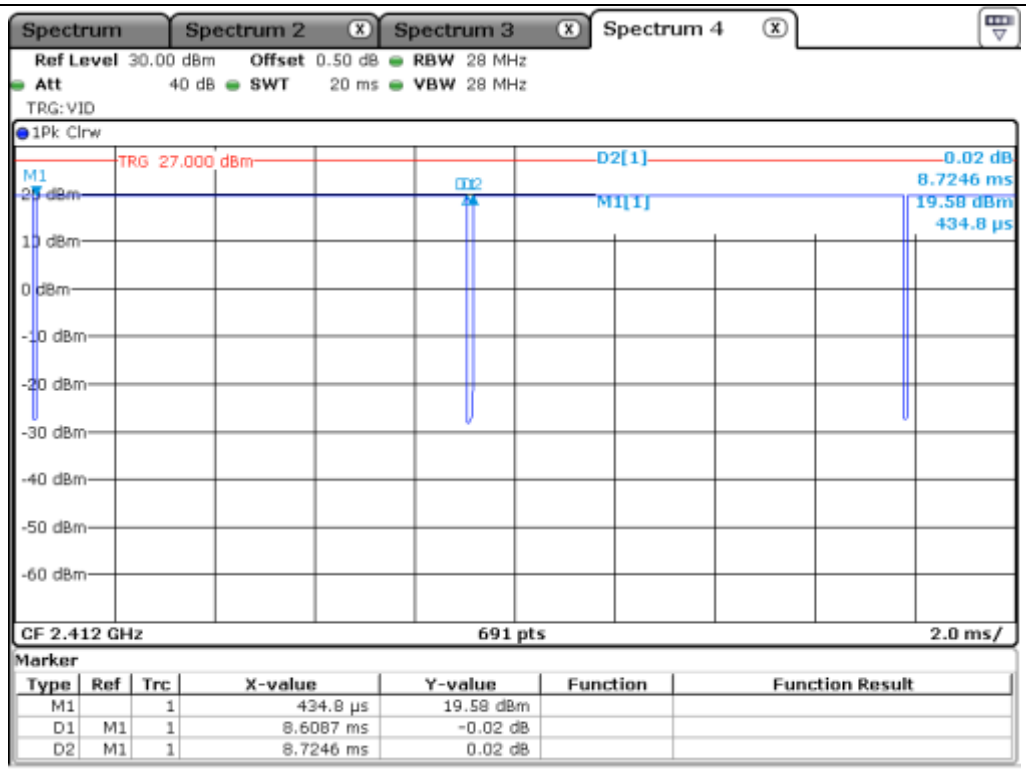
-. Test Plot



802.11 b_Antenna 0



802.11 b_Antenna 1

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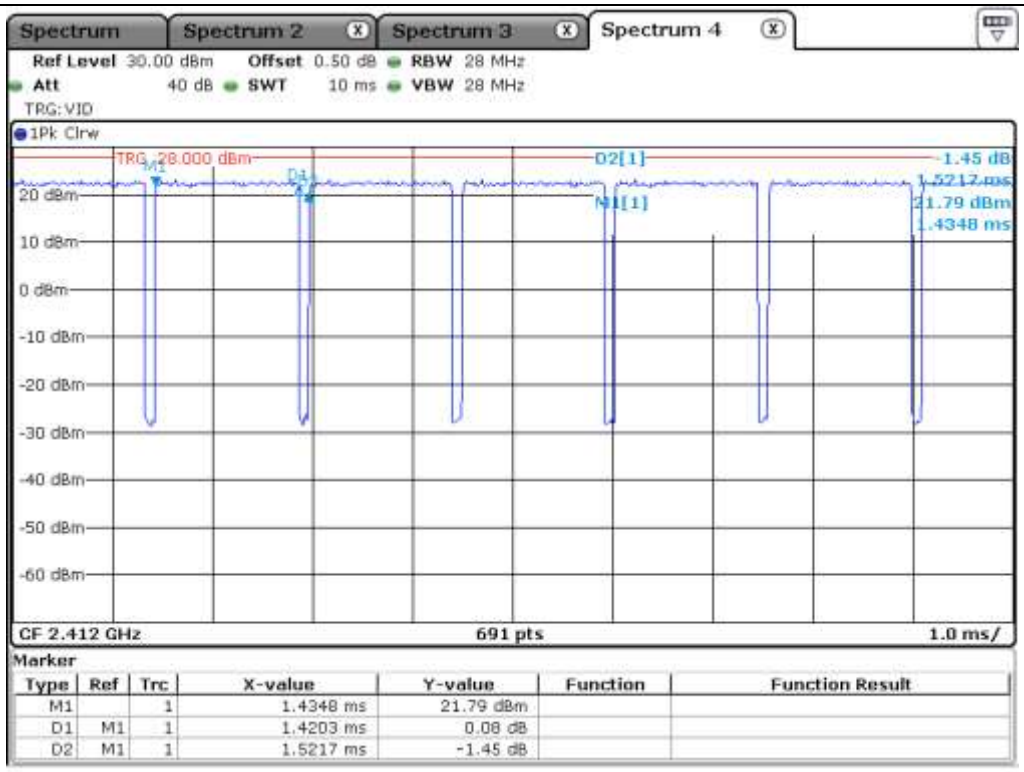
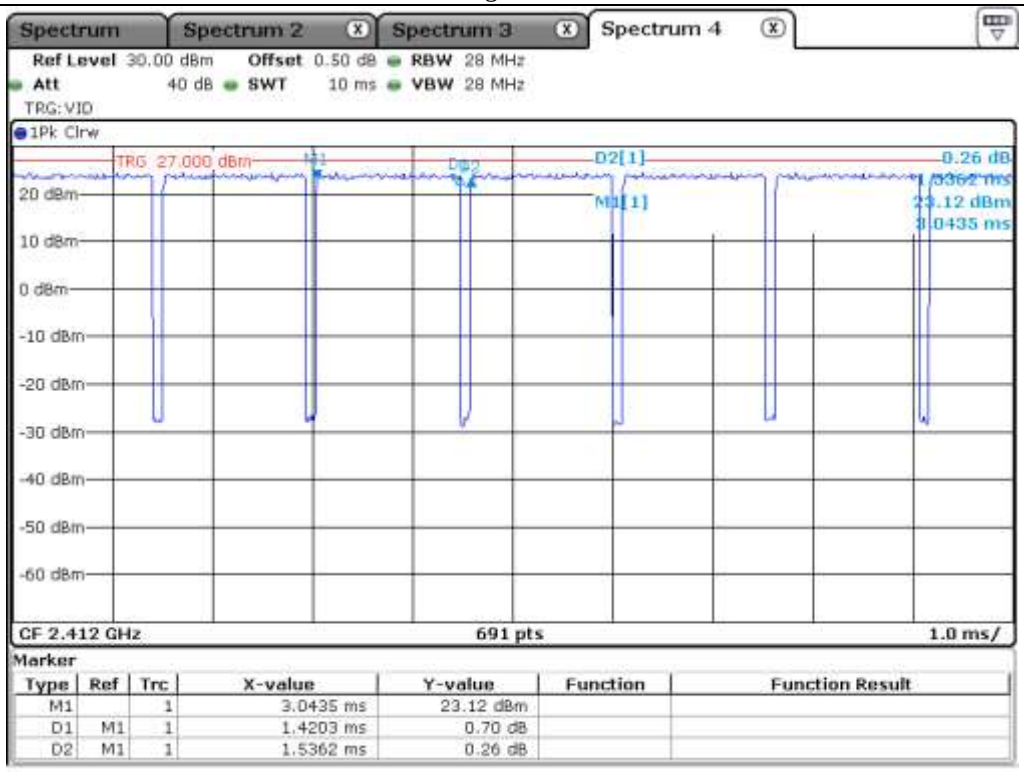


802.11 g_Antenna 0



802.11 g_Antenna 1

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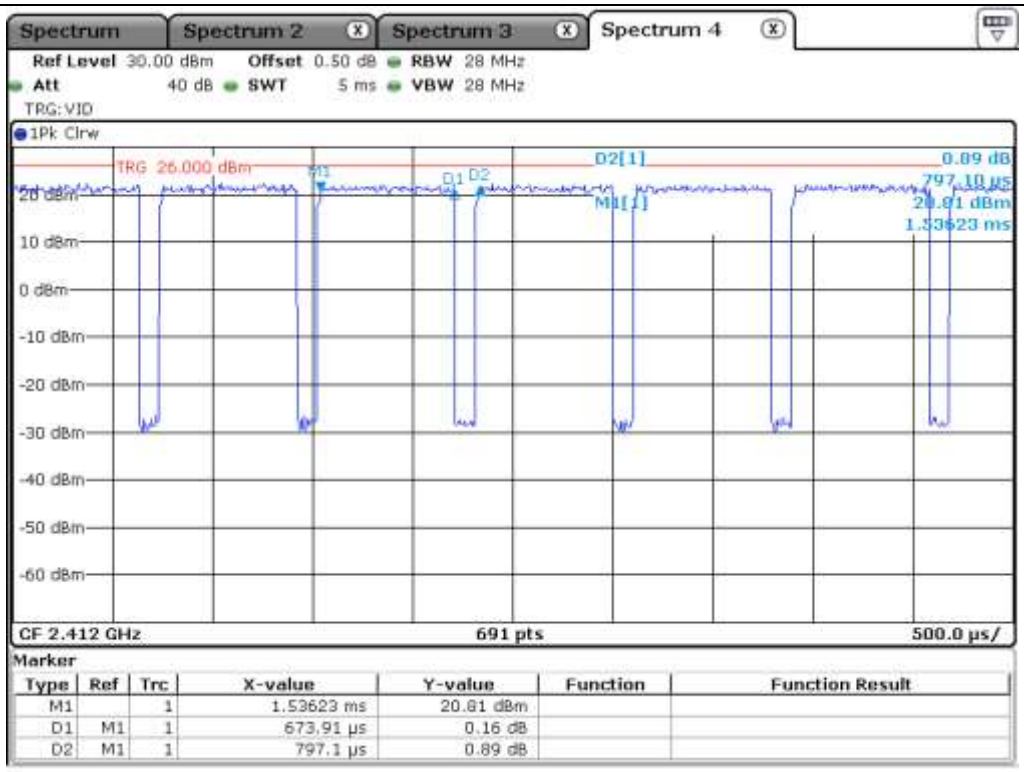
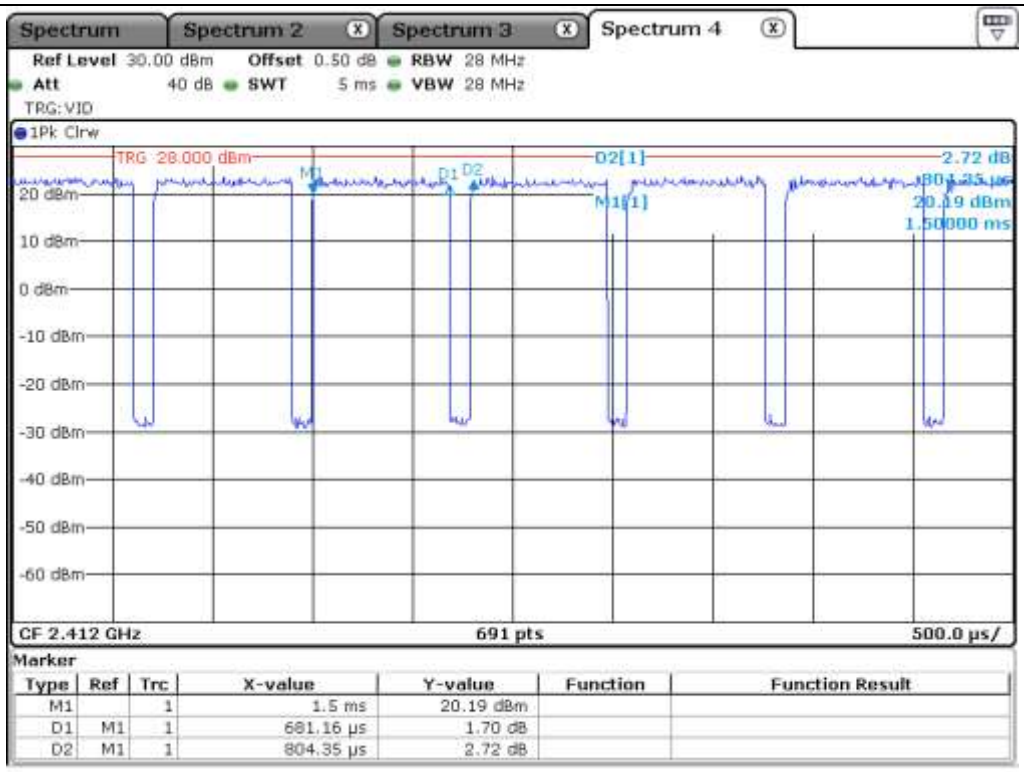


802.11 HT 20_Antenna 0



802.11 HT 20_Antenna 1

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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 Power.

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

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

5.5 Antenna Requirement

For intentional device, according to section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Antenna Construction:

The antenna of the EUT is a PCB Antenna on the main board in the EUT, The manufacturer has designed a structure that connects to the antenna using a unique coupling connector of the MCX type. So no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary Test, the following operating mode was investigated.

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

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

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7. MIMIMUM 6 dB BANDWIDTH

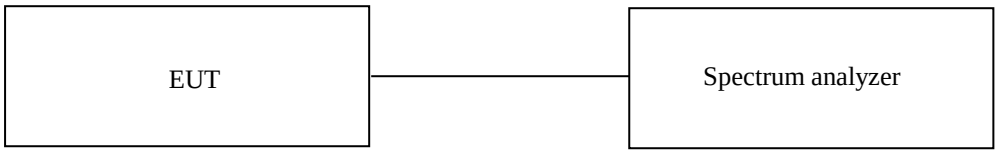
7.1 Operating environment

Temperature : 23 °C

Relative humidity : 45 % 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 Date

September 07, 2020 ~ September 11, 2020

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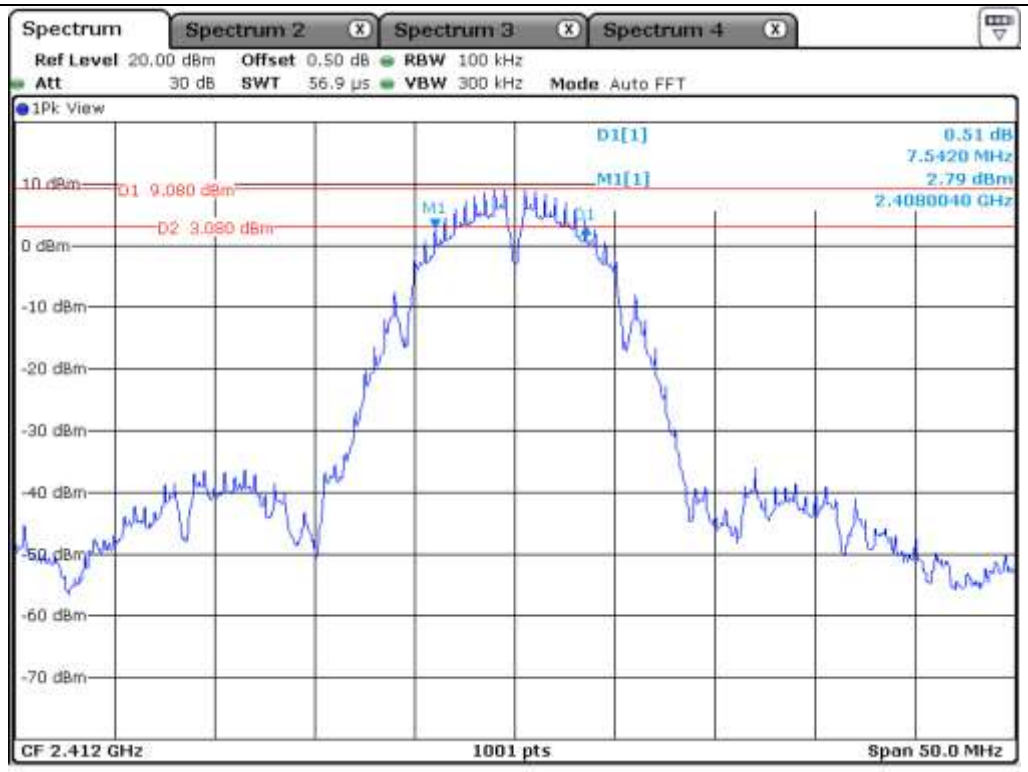
7.4 Test data for 802.11b WLAN Mode

7.4.1 Test data for Antenna 0

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	7.54	0.50	7.04
Middle	2 442.00	7.09	0.50	6.59
High	2 462.00	7.09	0.50	6.59

Remark. Margin = Measured Value - Limit



Low Channel

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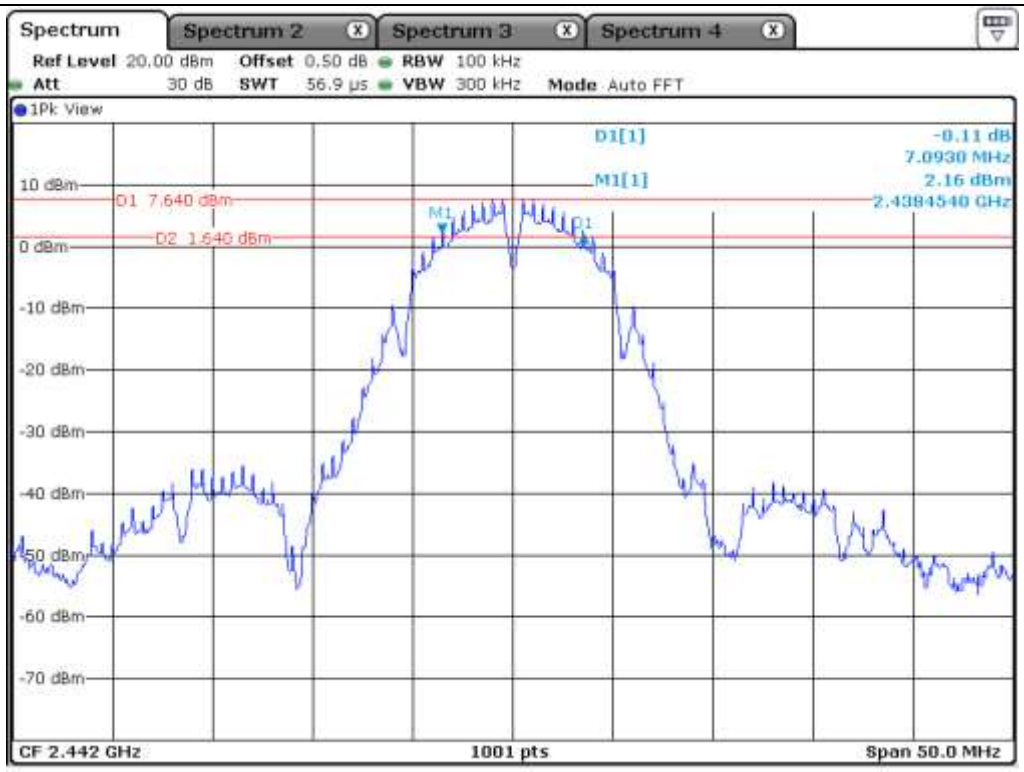
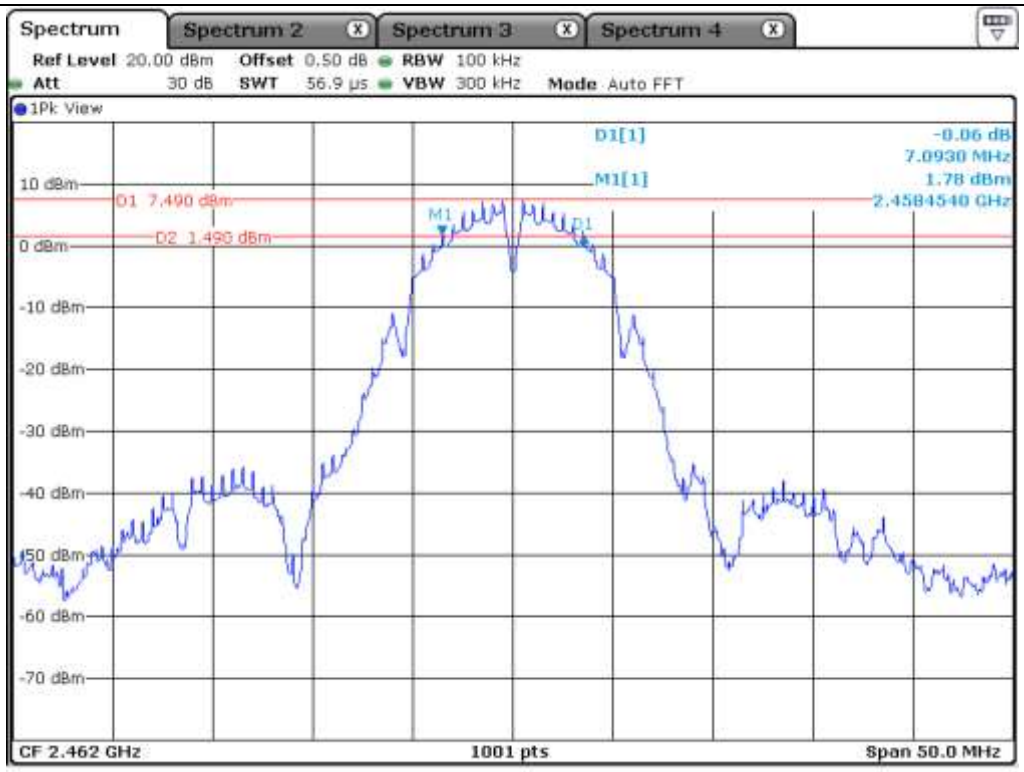


Middle Channel



High Channel

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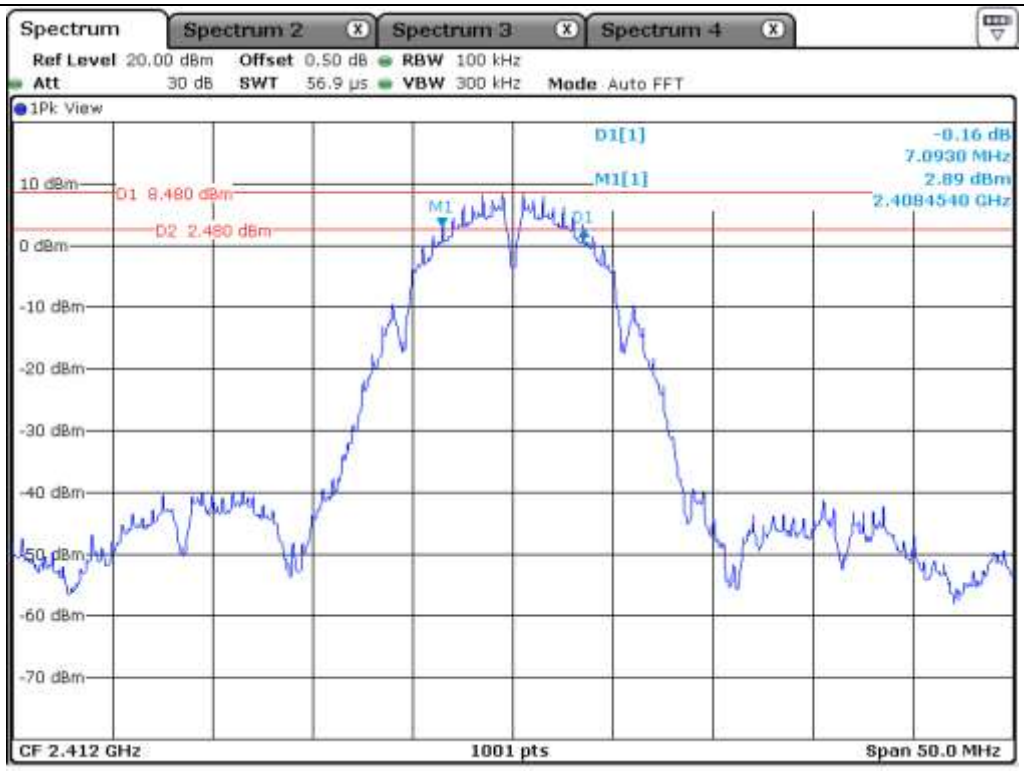
7.4.2 Test data for Antenna 1

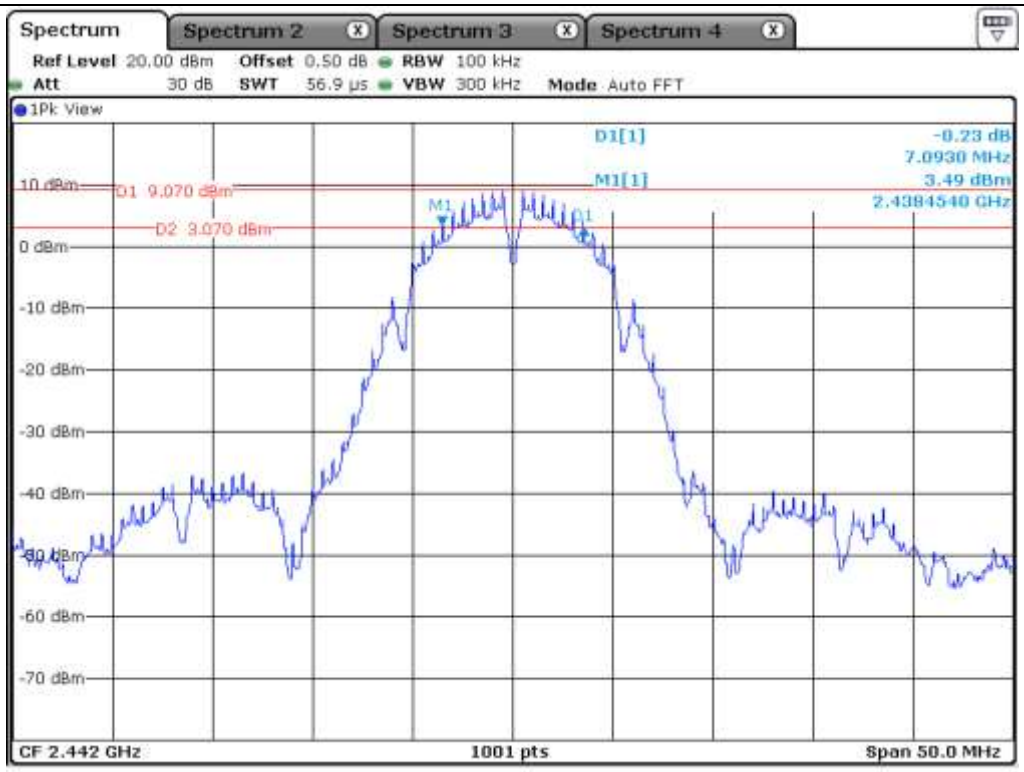
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	7.09	0.50	6.59
Middle	2 442.00	7.09	0.50	6.59
High	2 462.00	7.09	0.50	6.59

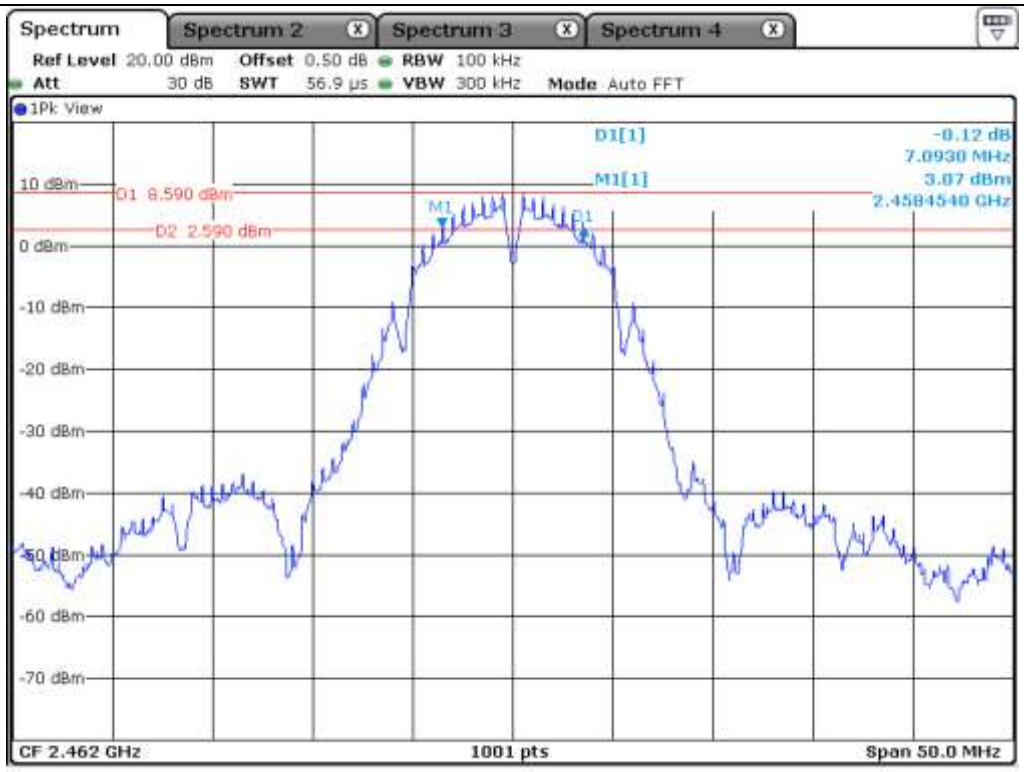
Remark. Margin = Measured Value - Limit



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)

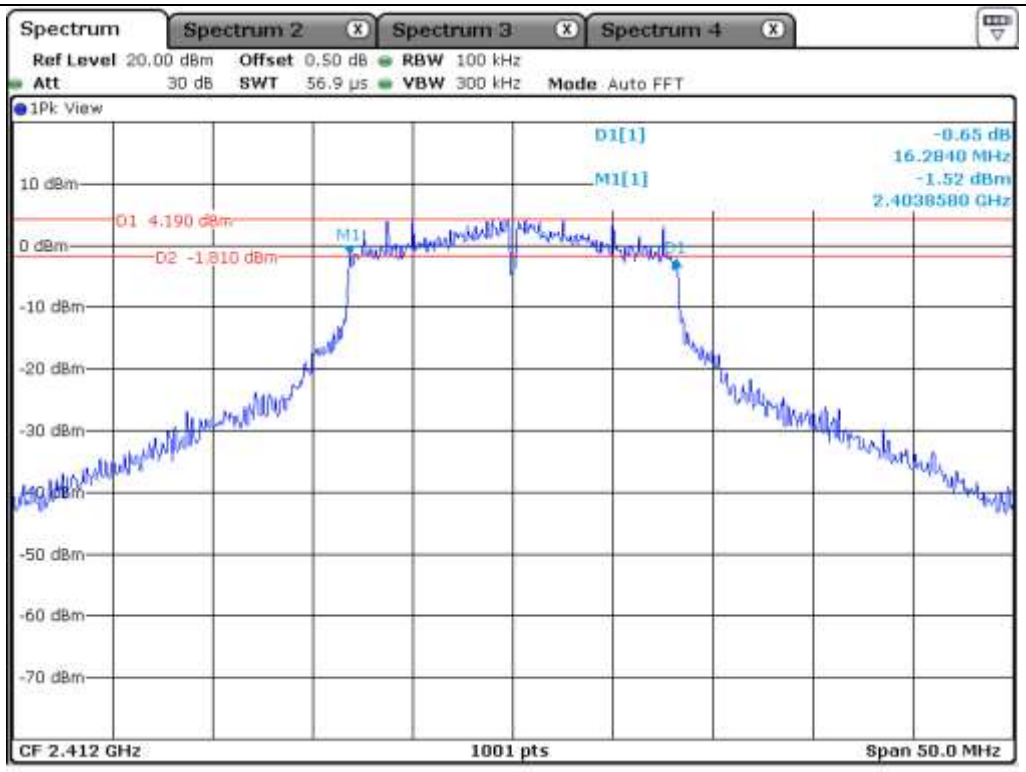
7.5 Test data for 802.11g WLAN Mode

7.5.1 Test data for Antenna 0

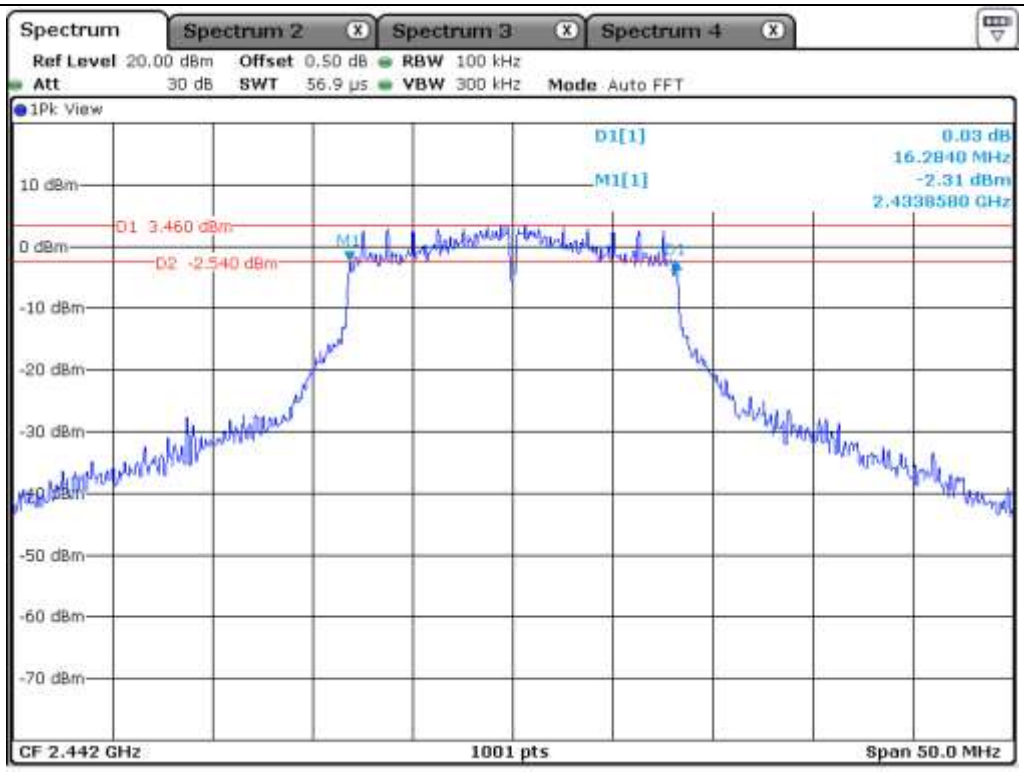
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	16.28	0.50	15.78
Middle	2 442.00	16.28	0.50	15.78
High	2 462.00	16.28	0.50	15.78

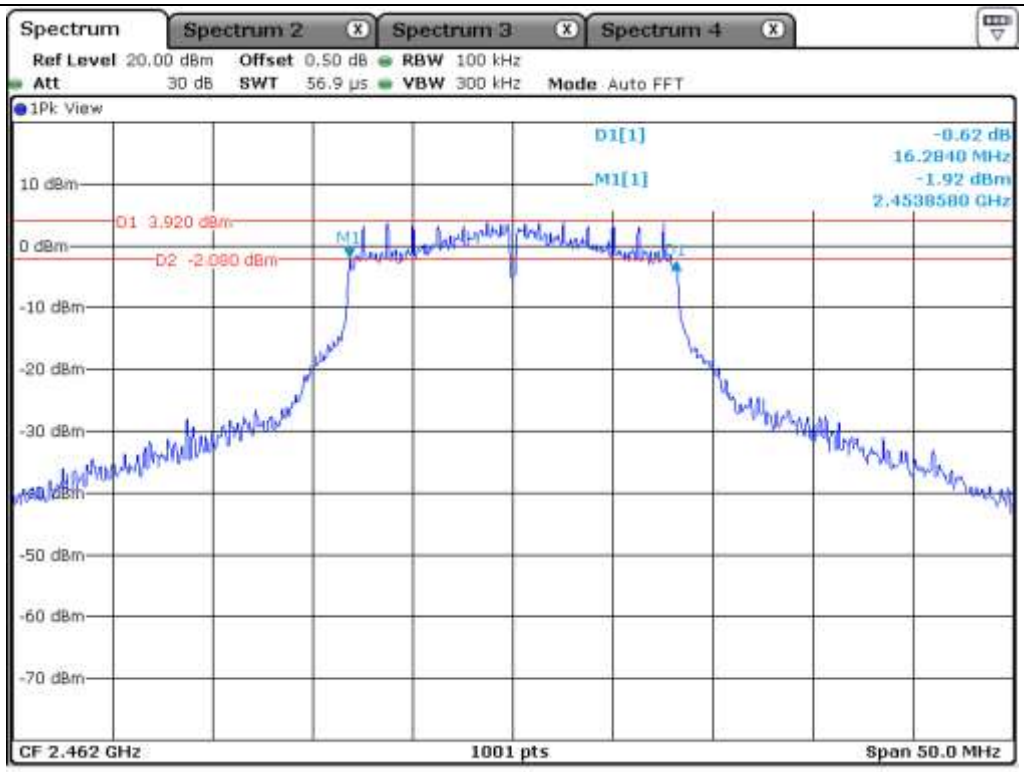
Remark. Margin = Measured Value - Limit



Low Channel



Middle Channel



High Channel

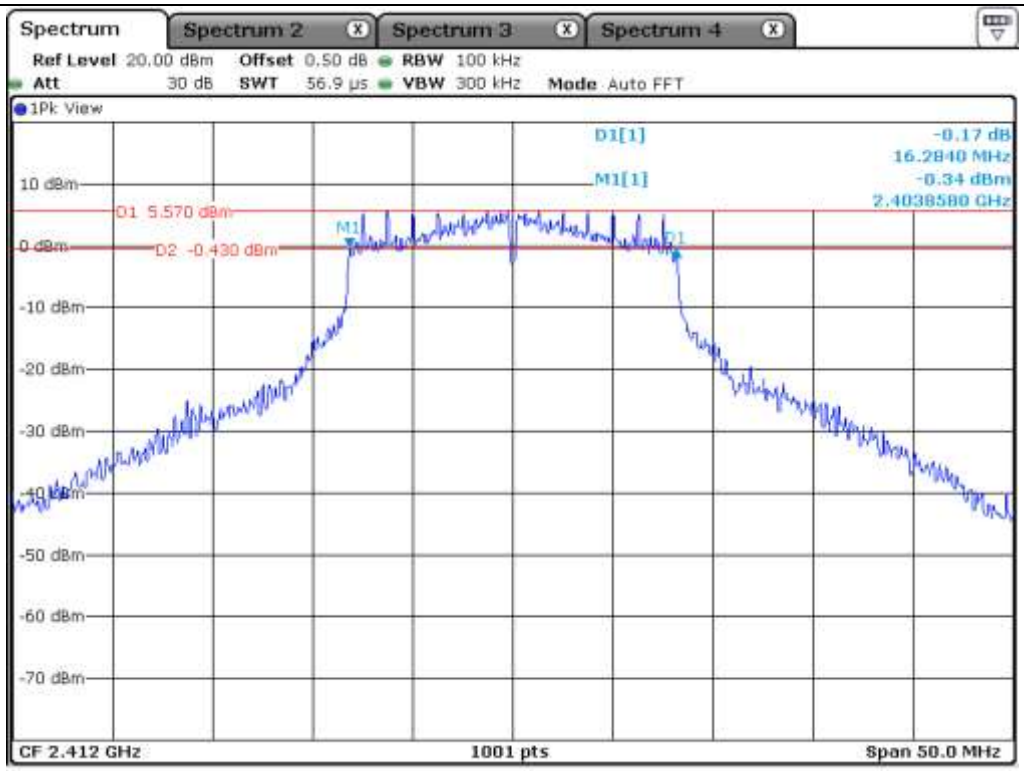
ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

7.5.2 Test data for Antenna 1

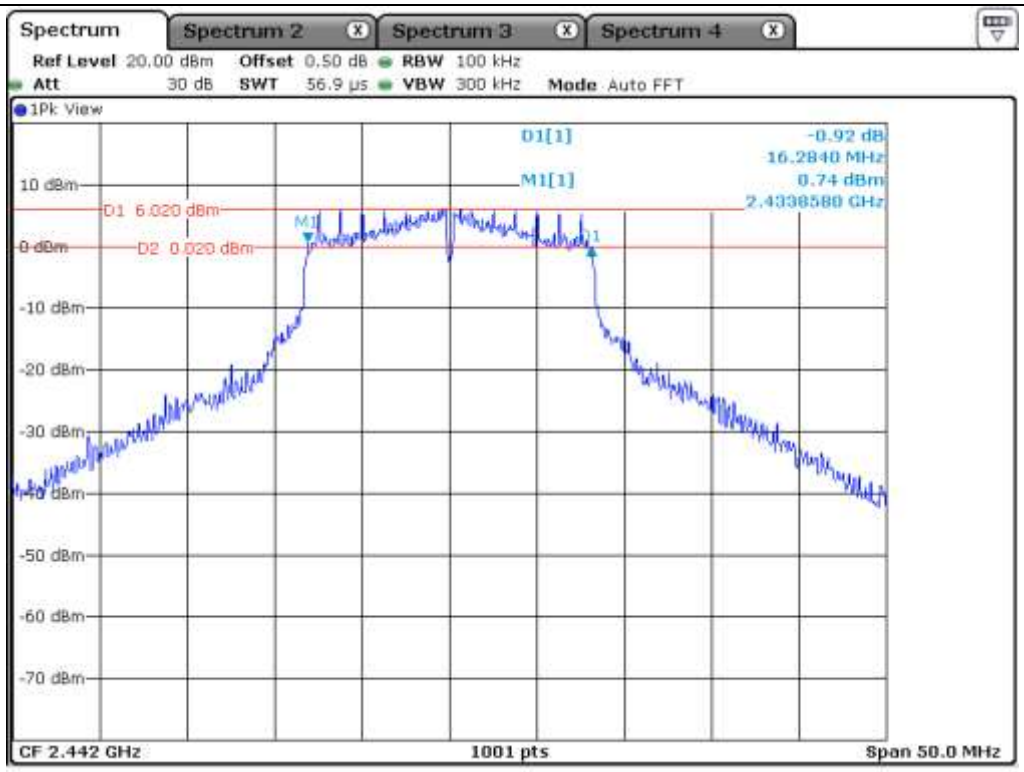
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	16.28	0.50	15.78
Middle	2 442.00	16.28	0.50	15.78
High	2 462.00	16.03	0.50	15.53

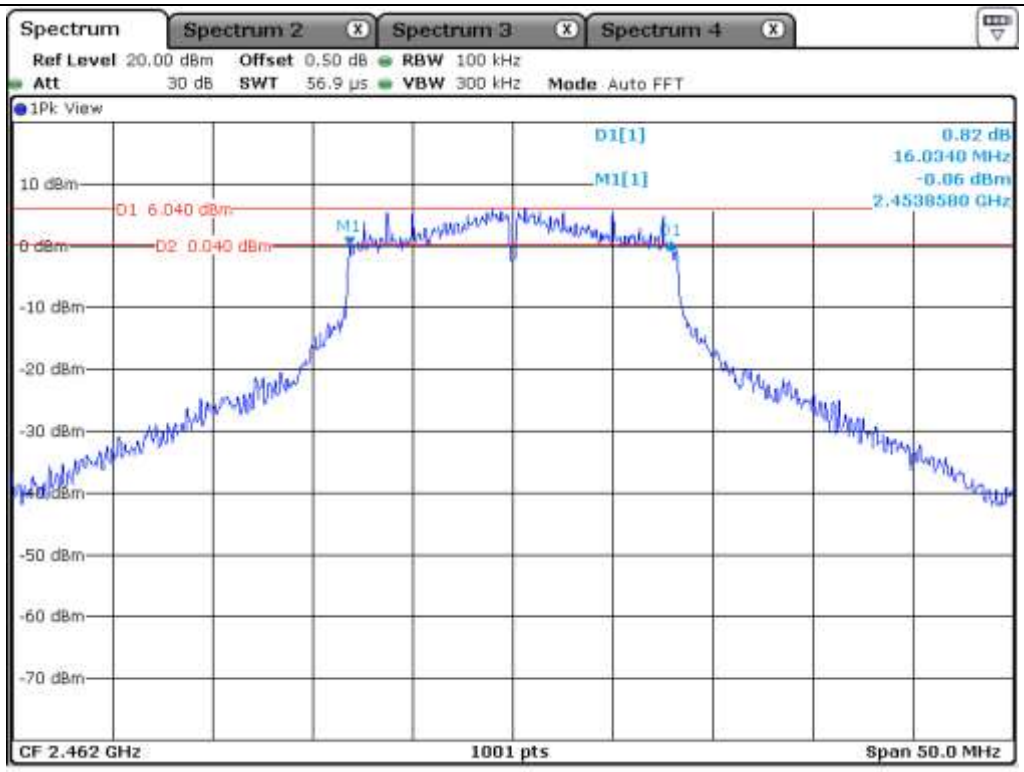
Remark. Margin = Measured Value – Limit



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)

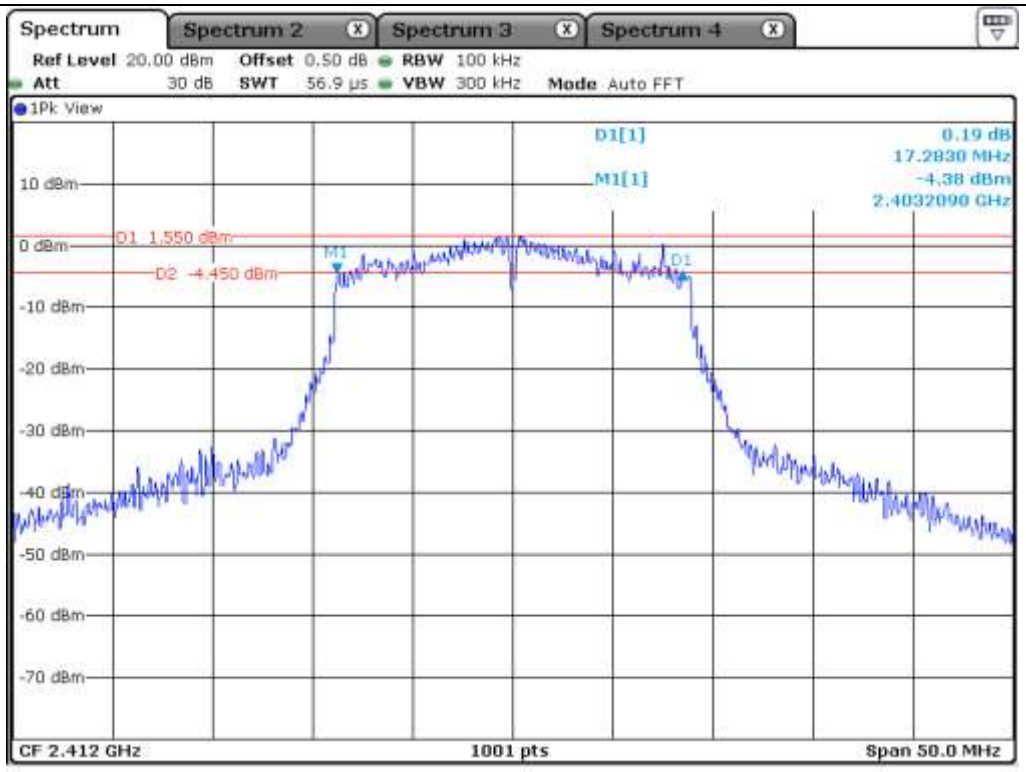
7.6 Test data for 802.11n_HT20 WLAN Mode

7.6.1 Test data for Antenna 0

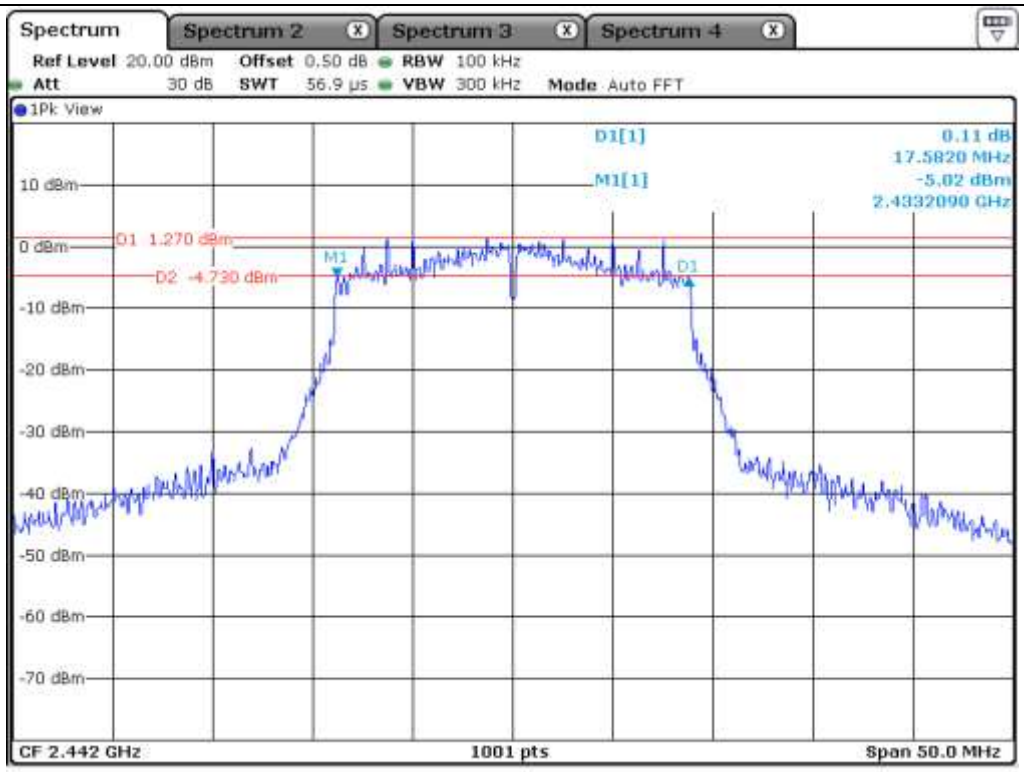
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	17.28	0.50	16.78
Middle	2 442.00	17.58	0.50	17.08
High	2 462.00	17.63	0.50	17.13

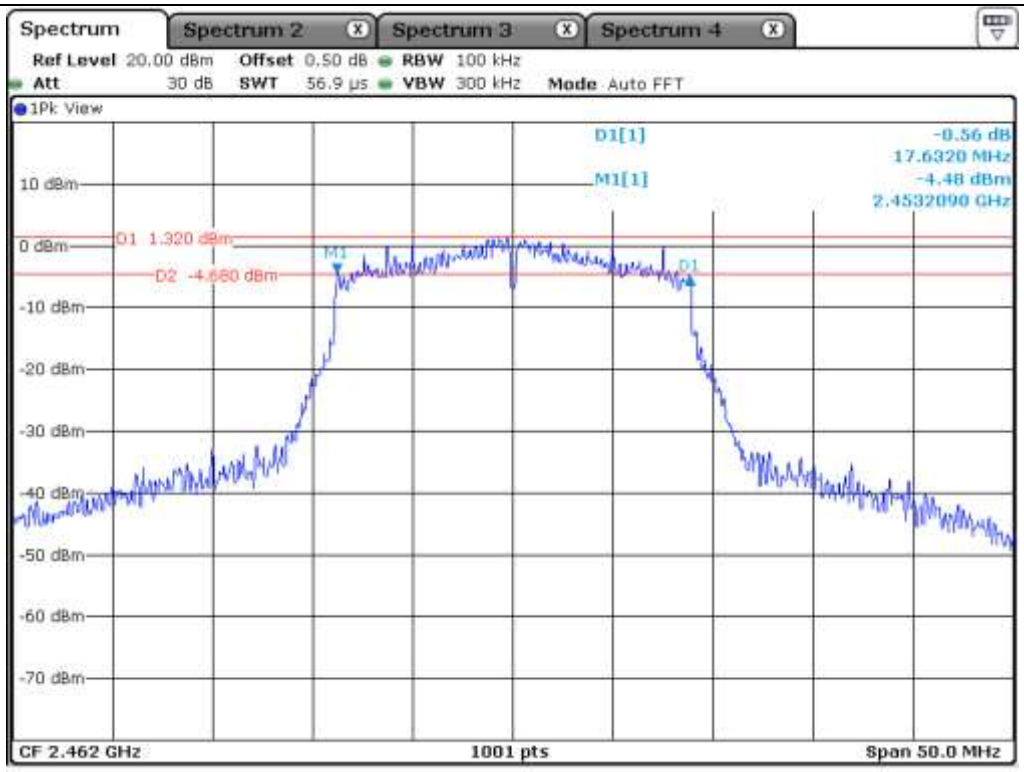
Remark. Margin = Measured Value - Limit



Low Channel



Middle Channel



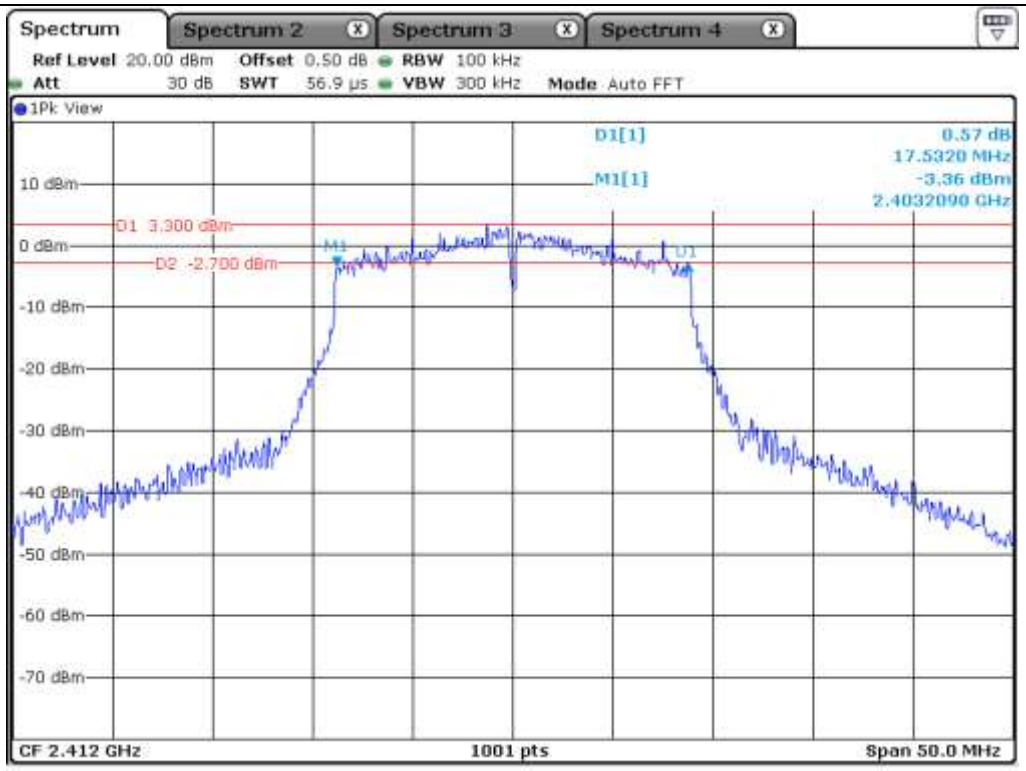
High Channel

7.6.2 Test data for Antenna 1

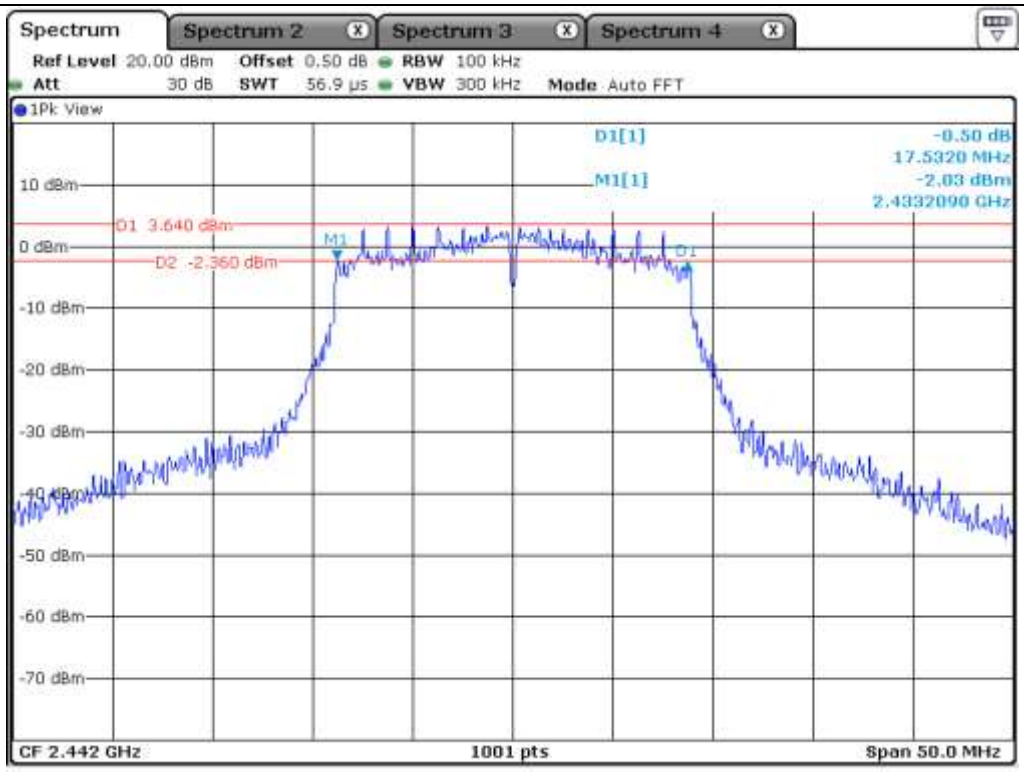
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	17.53	0.50	17.03
Middle	2 442.00	17.53	0.50	17.03
High	2 462.00	17.23	0.50	16.73

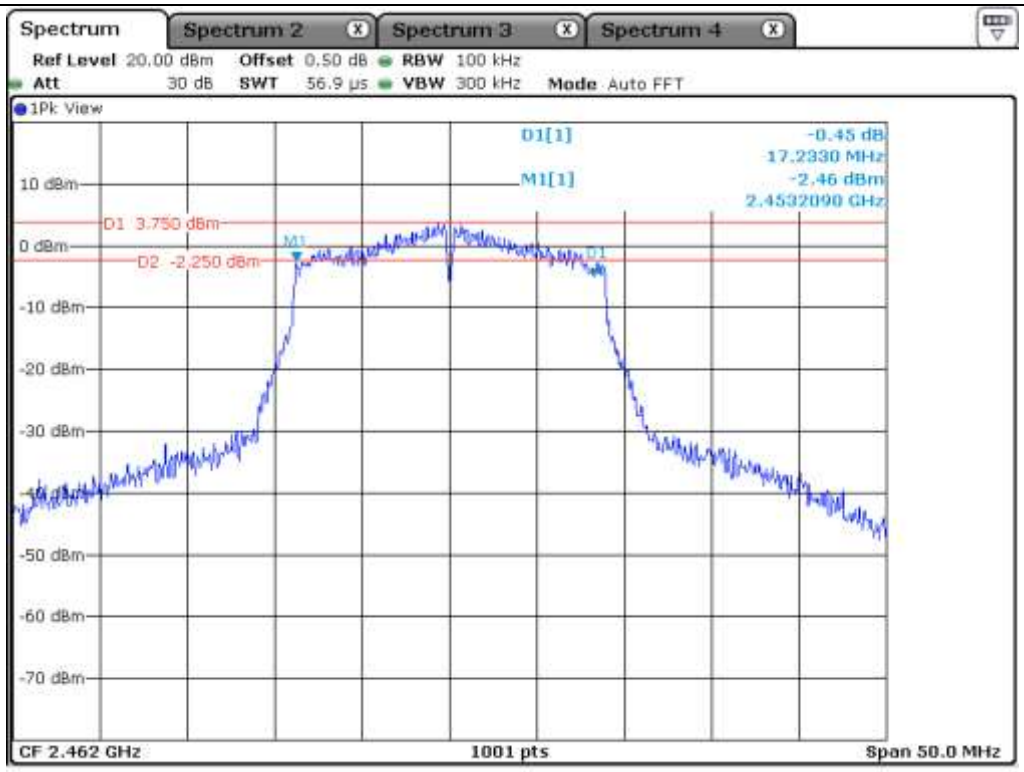
Remark. Margin = Measured Value - Limit



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)

8. MAXIMUM CONDUCTED (AVERAGE) OUTPUT POWER

8.1 Operating environment

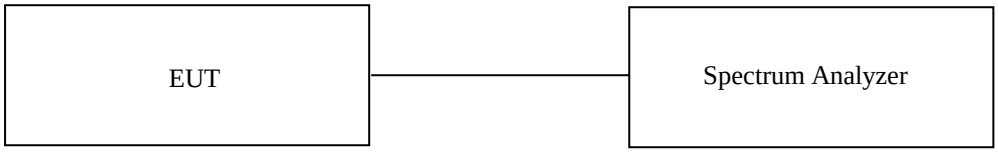
Temperature : 23 °C

Relative humidity : 45 % R.H.

8.2 Test set-up

The maximum Conducted (Average) output power was measured with the Spectrum Analyzer connected to the antenna output of the EUT.

Section 15.247 permits the maximum conducted (average) output power to be measured as an alternative to the maximum peak conducted output power for demonstrating compliance to the limit. When this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth (see ANSI C63.10 for measurement guidance).



8.3 Test Date

September 07, 2020 ~ September 11, 2020

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

8.4 Test data for 802.11b WLAN Mode

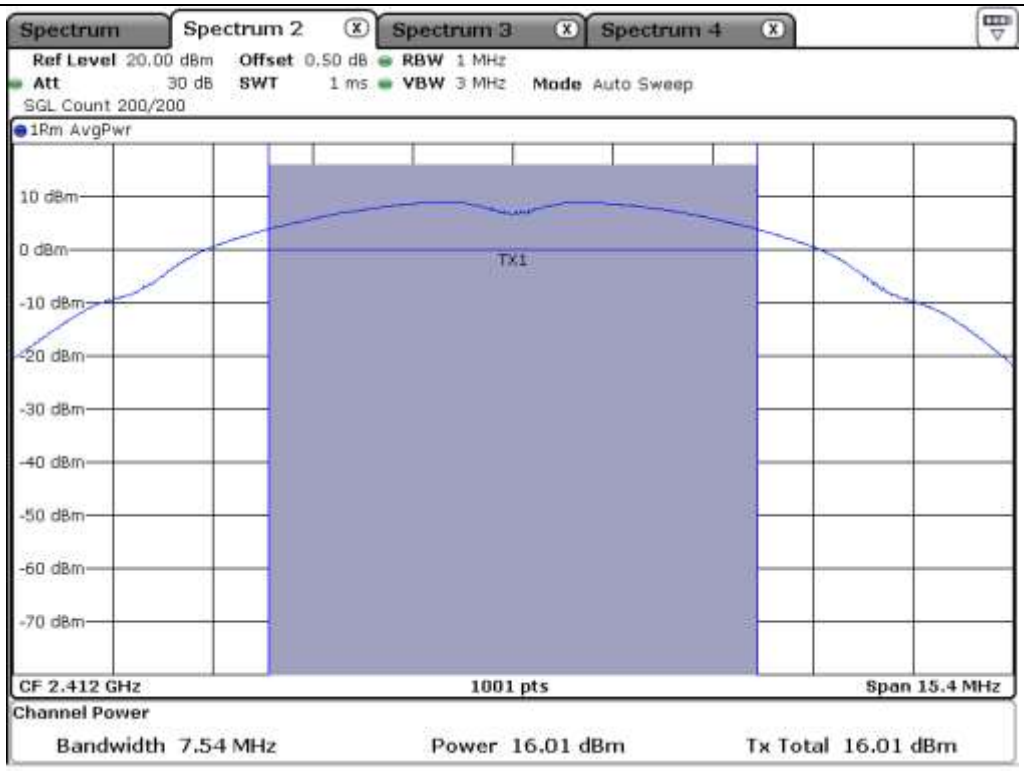
8.4.1 Test data for Antenna 0

-. Test Result : Pass

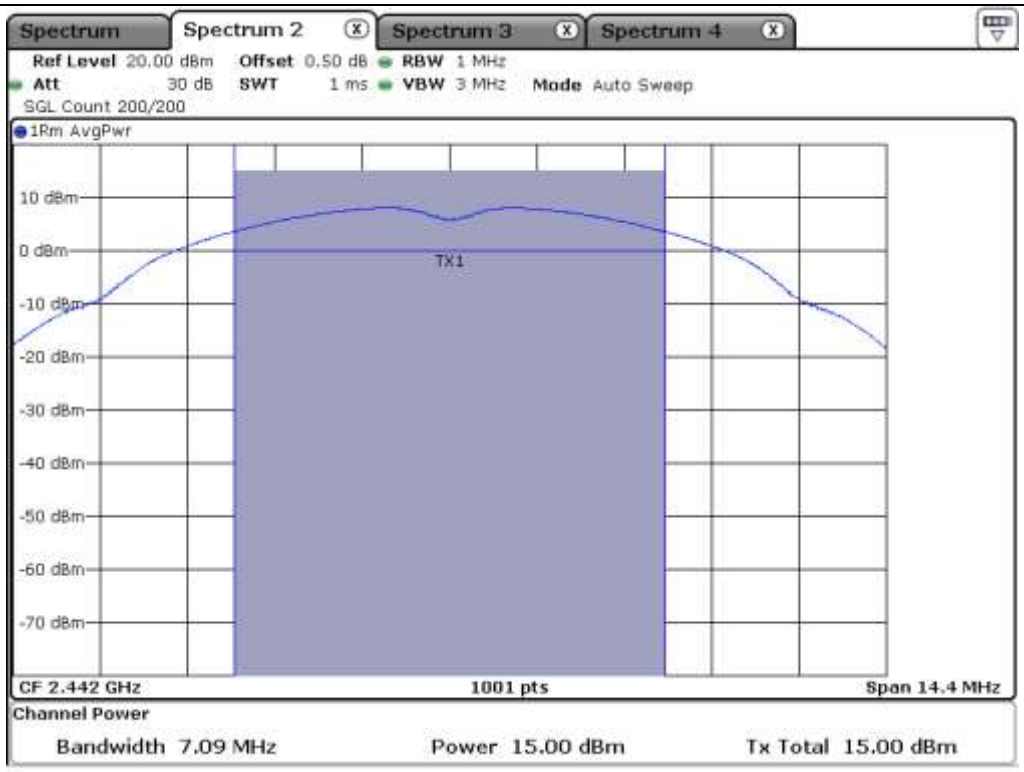
-. Duty Cycle : 99.08 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	16.01	0.04	16.05	30.00	13.95
MIDDLE	2 442.00	15.00	0.04	15.04	30.00	14.96
HIGH	2 462.00	15.16	0.04	15.20	30.00	14.80

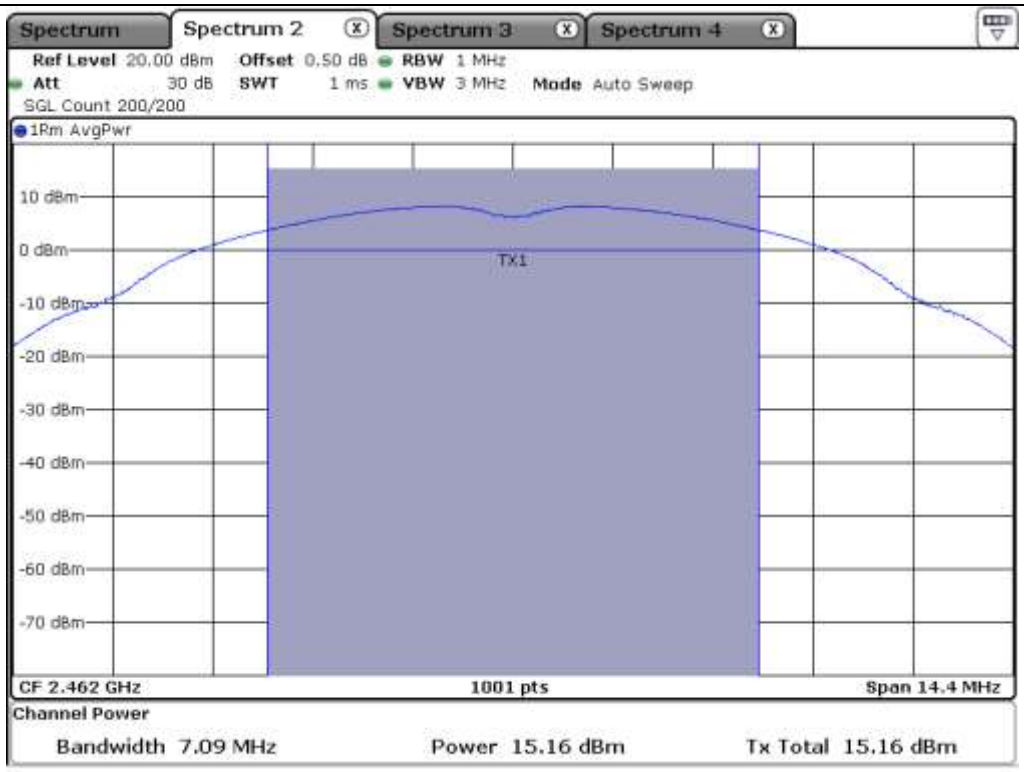
Remark : Margin = Limit – Result (= Measured Vlaue + Correction Factor)



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)

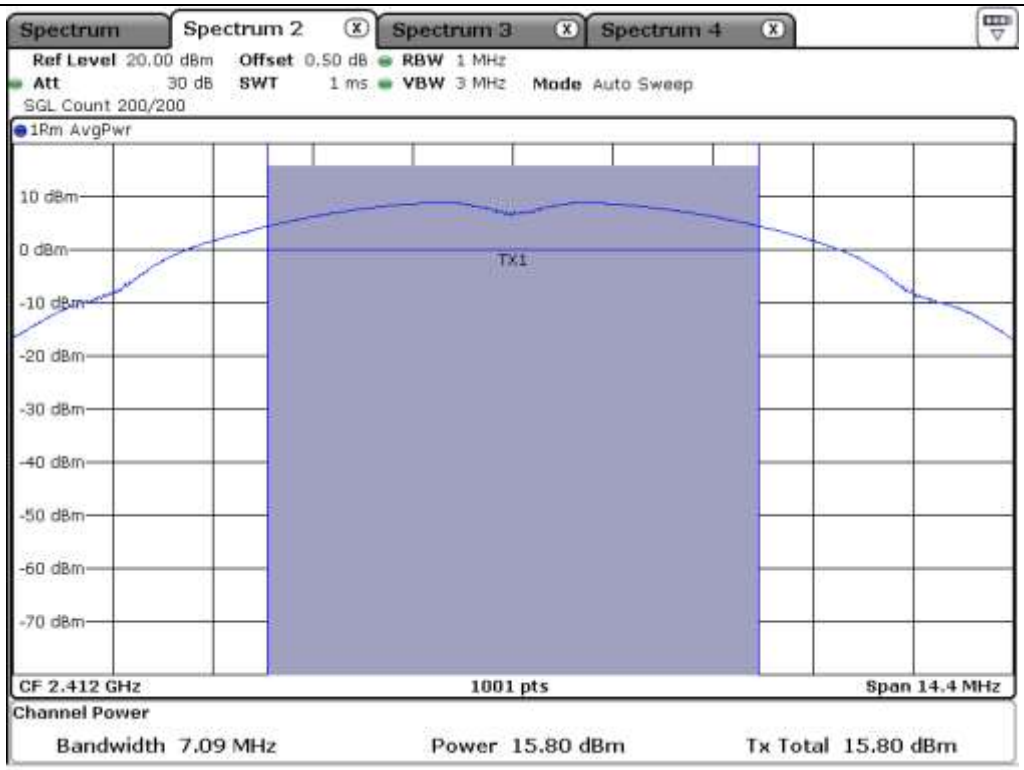
8.4.2 Test data for Antenna 1

-. Test Result : Pass

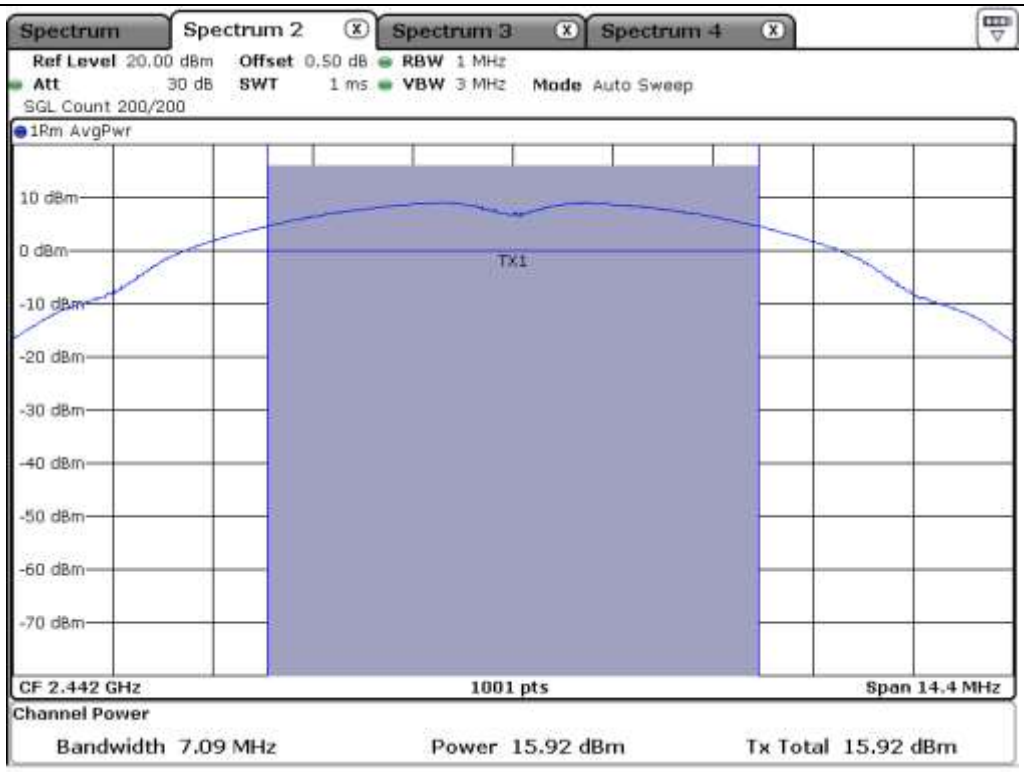
-. Duty Cycle : 98.74 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	15.80	0.06	15.86	30.00	14.14
MIDDLE	2 442.00	15.92	0.06	15.98	30.00	14.02
HIGH	2 462.00	16.00	0.06	16.06	30.00	13.94

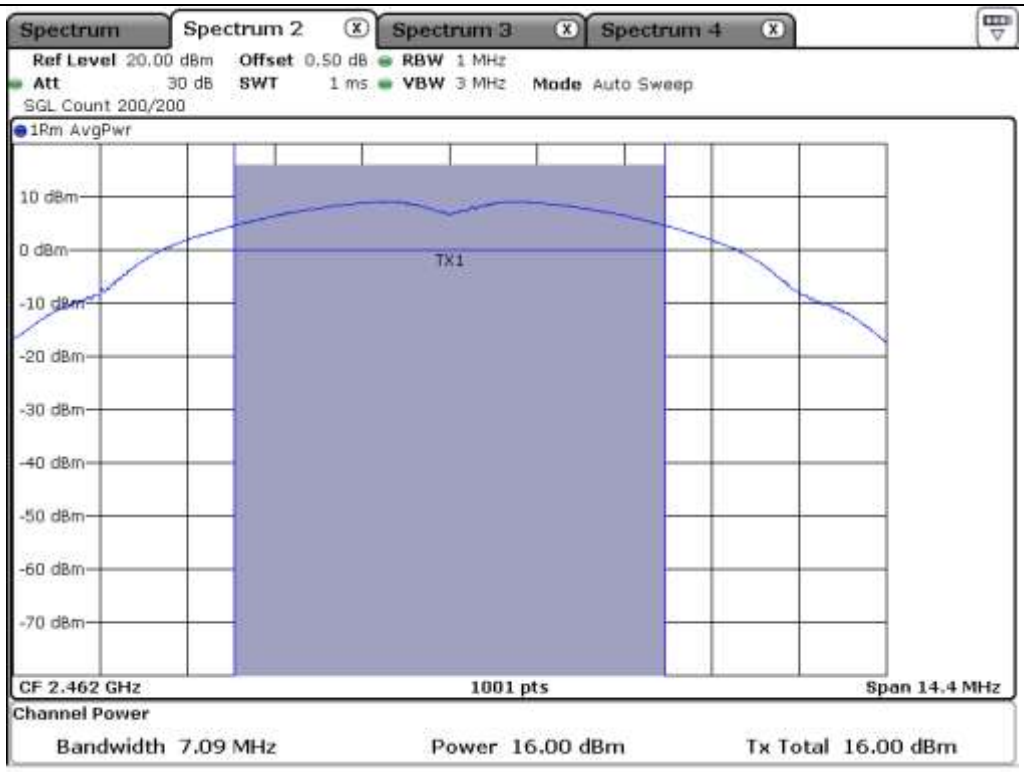
Remark : Margin = Limit – Result (= Measured Vlaue + Correction Factor)



Low Channel



Middle Channel



High Channel

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8.5 Test data for 802.11g WLAN Mode

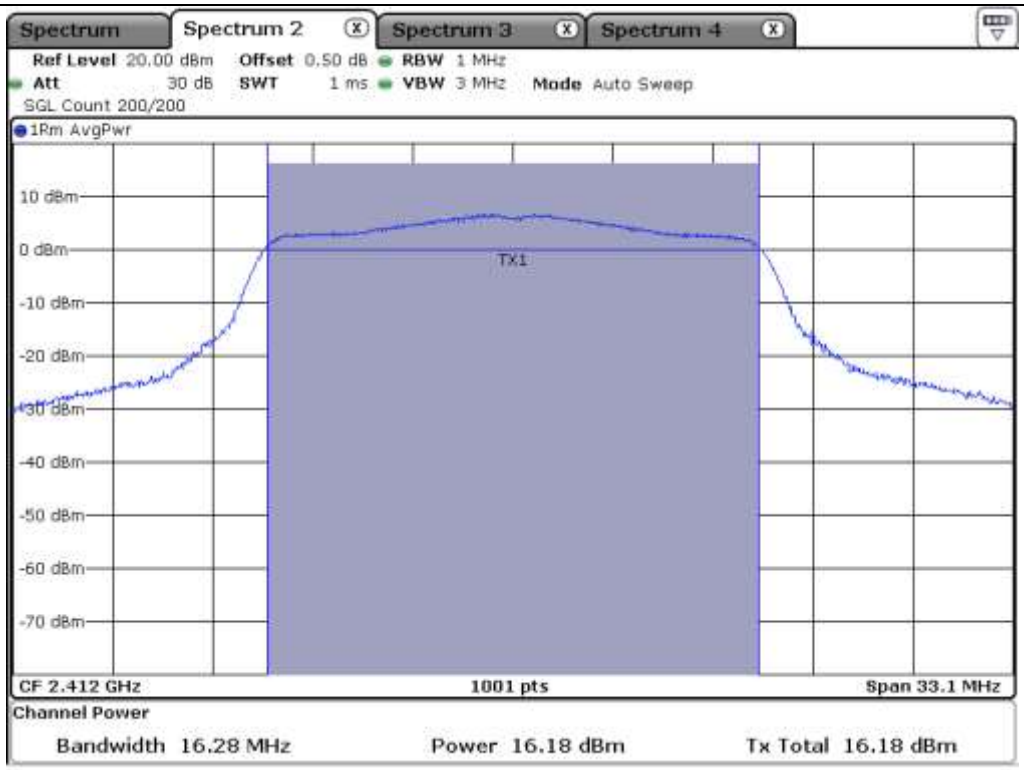
8.5.1 Test data for Antenna 0

-. Test Result : Pass

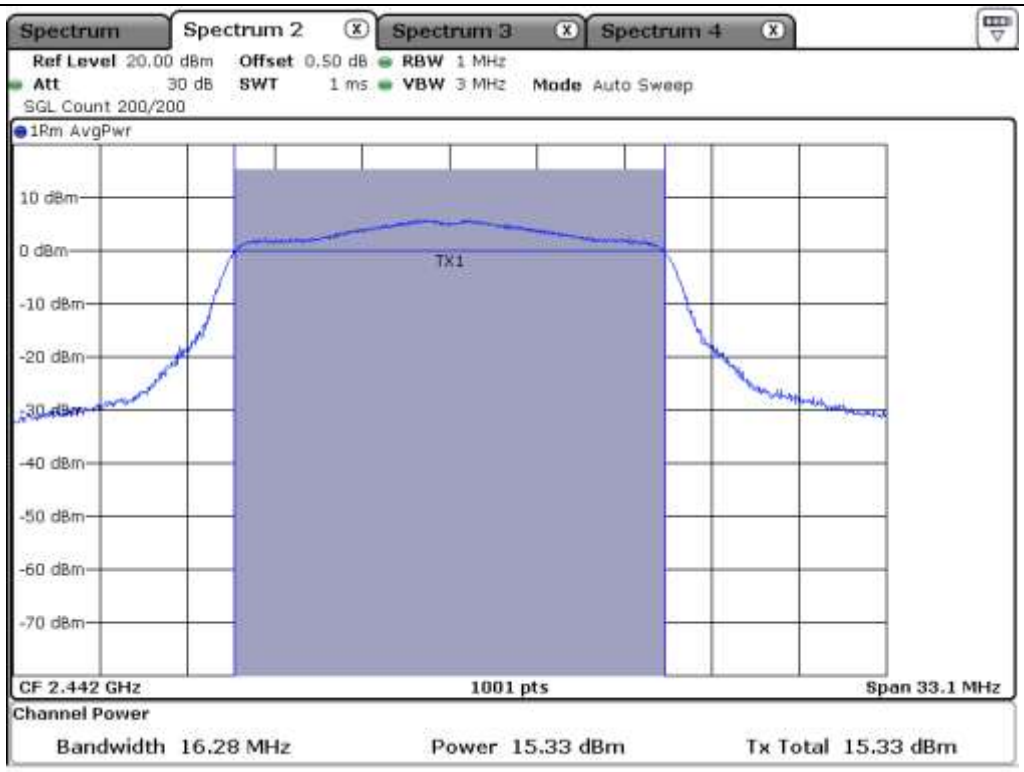
-. Duty Cycle : 93.42 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	16.18	0.30	16.48	30.00	13.52
MIDDLE	2 442.00	15.33	0.30	15.63	30.00	14.37
HIGH	2 462.00	15.38	0.30	15.68	30.00	14.32

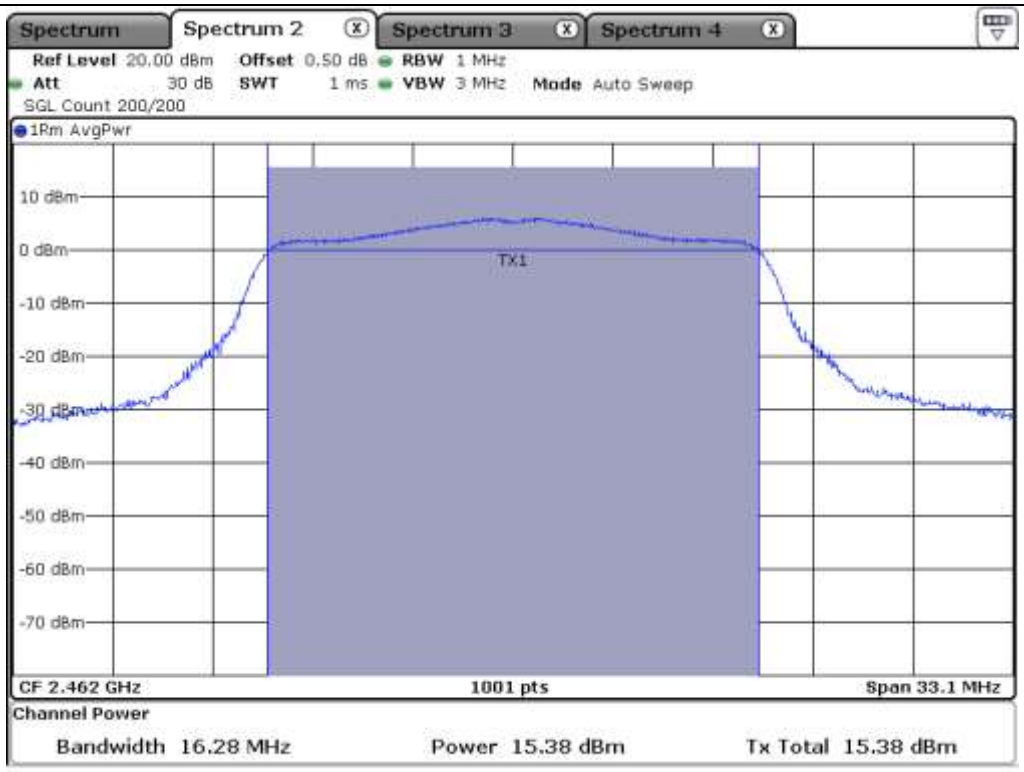
Remark : Margin = Limit – Result (= Measured Vlaue + Correction Factor)



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)

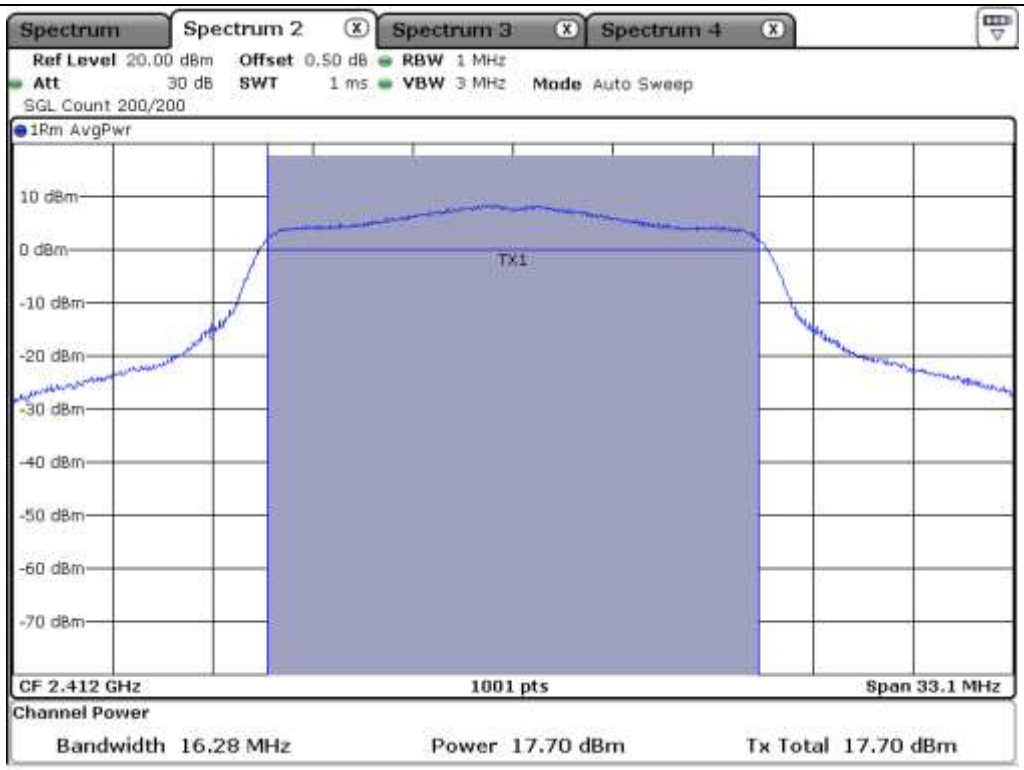
8.5.2 Test data for Antenna 1

-. Test Result : Pass

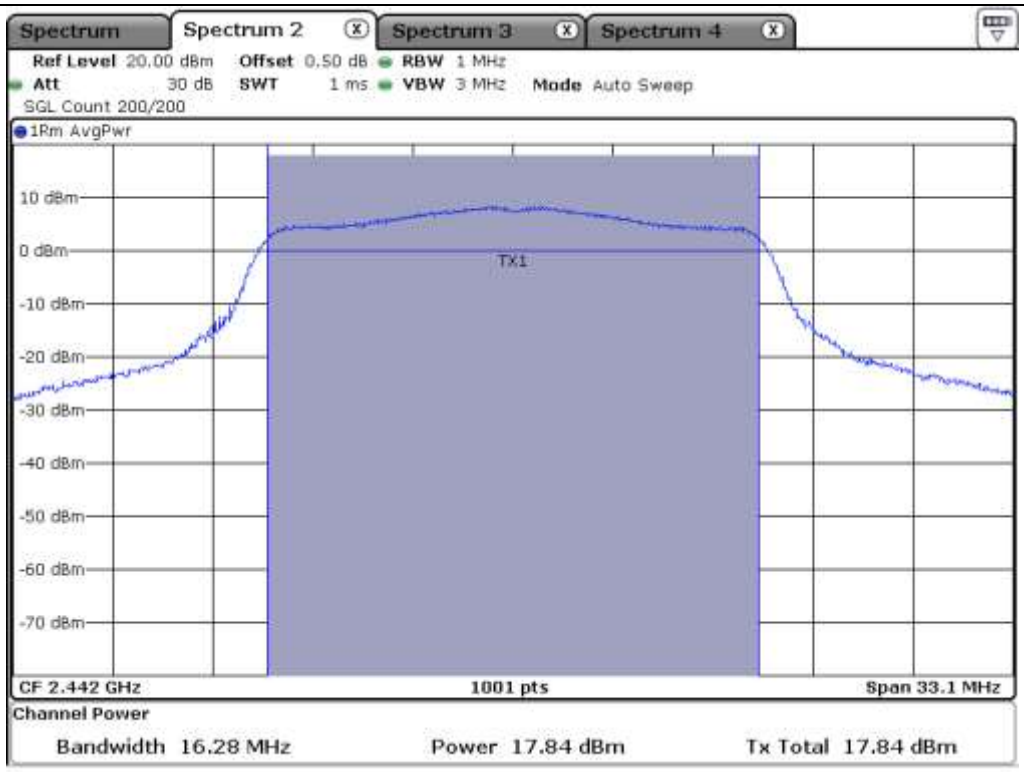
-. Duty Cycle : 92.21 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	17.70	0.35	18.05	30.00	11.95
MIDDLE	2 442.00	17.84	0.35	18.19	30.00	11.81
HIGH	2 462.00	17.87	0.35	18.22	30.00	11.78

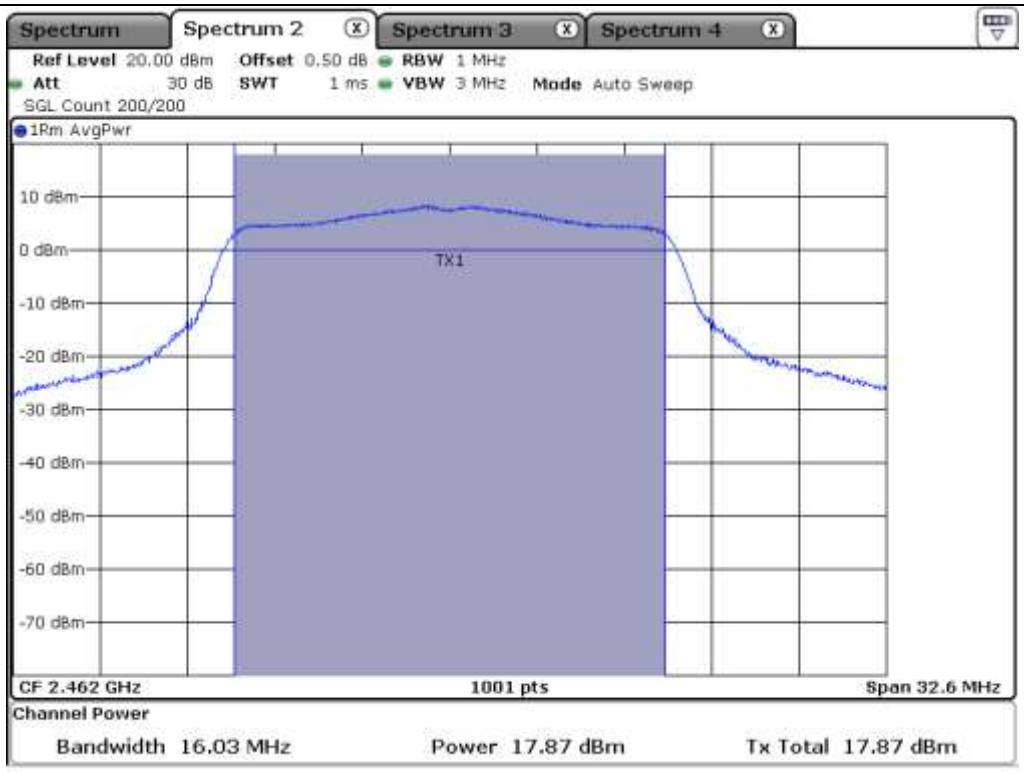
Remark : Margin = Limit – Result (= Measured Vlaue + Correction Factor)



Low Channel



Middle Channel



High Channel

8.6 Test data for 802.11n_HT20 WLAN Mode

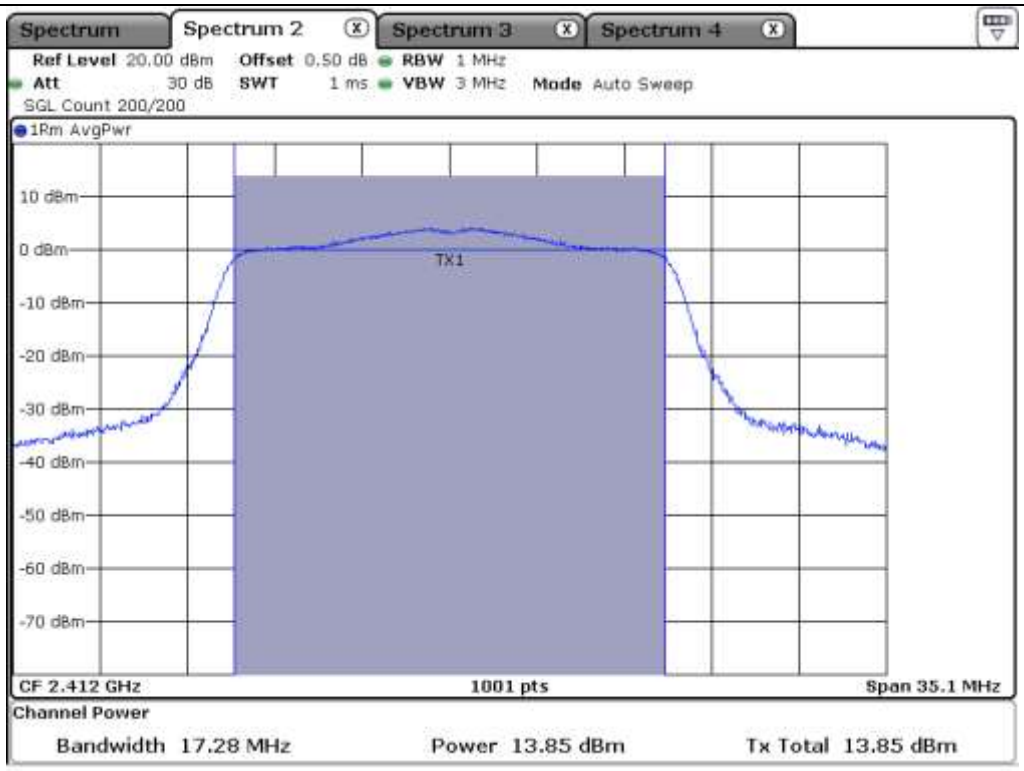
8.6.1 Test data for Antenna 0

-. Test Result : Pass

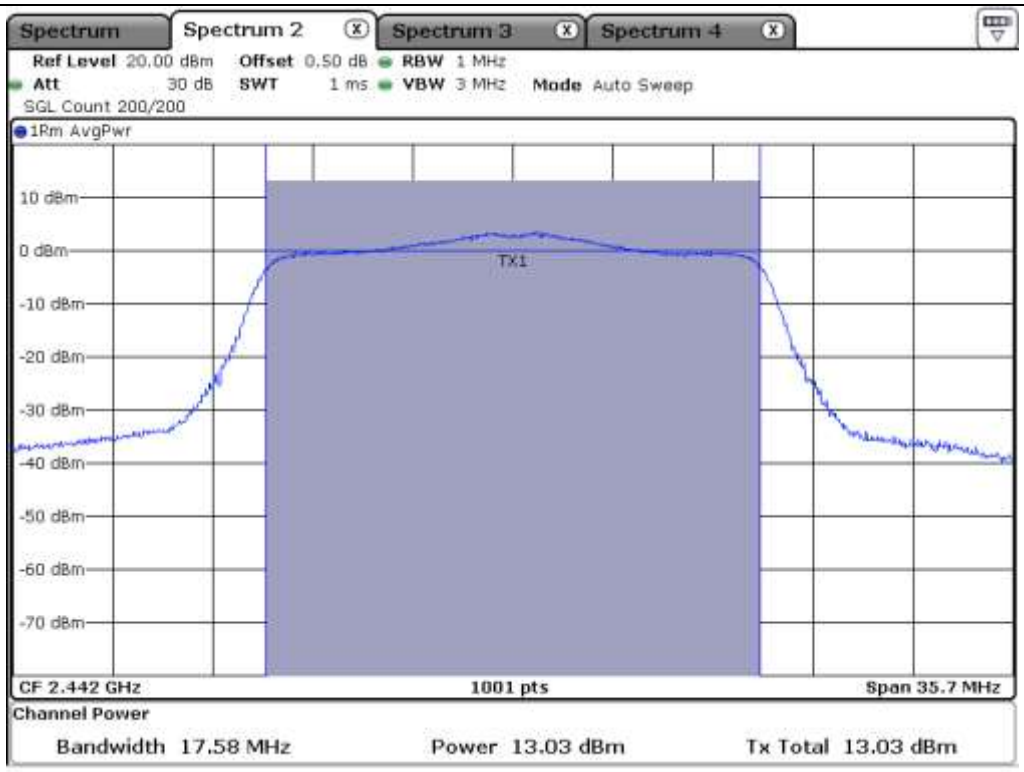
-. Duty Cycle : 83.75 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	13.85	0.77	14.62	30.00	15.38
MIDDLE	2 442.00	13.03	0.77	13.80	30.00	16.20
HIGH	2 462.00	13.25	0.77	14.02	30.00	15.98

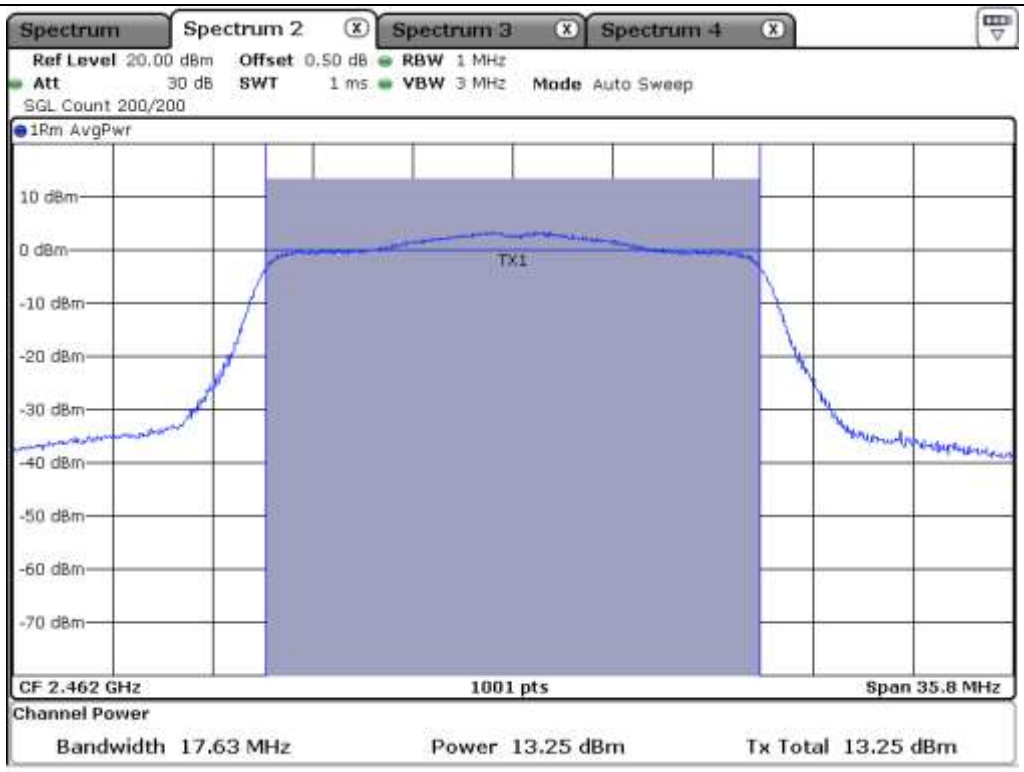
Remark : Margin = Limit – Result (= Measured Vlaue + Correction Factor)



Low Channel



Middle Channel



High Channel

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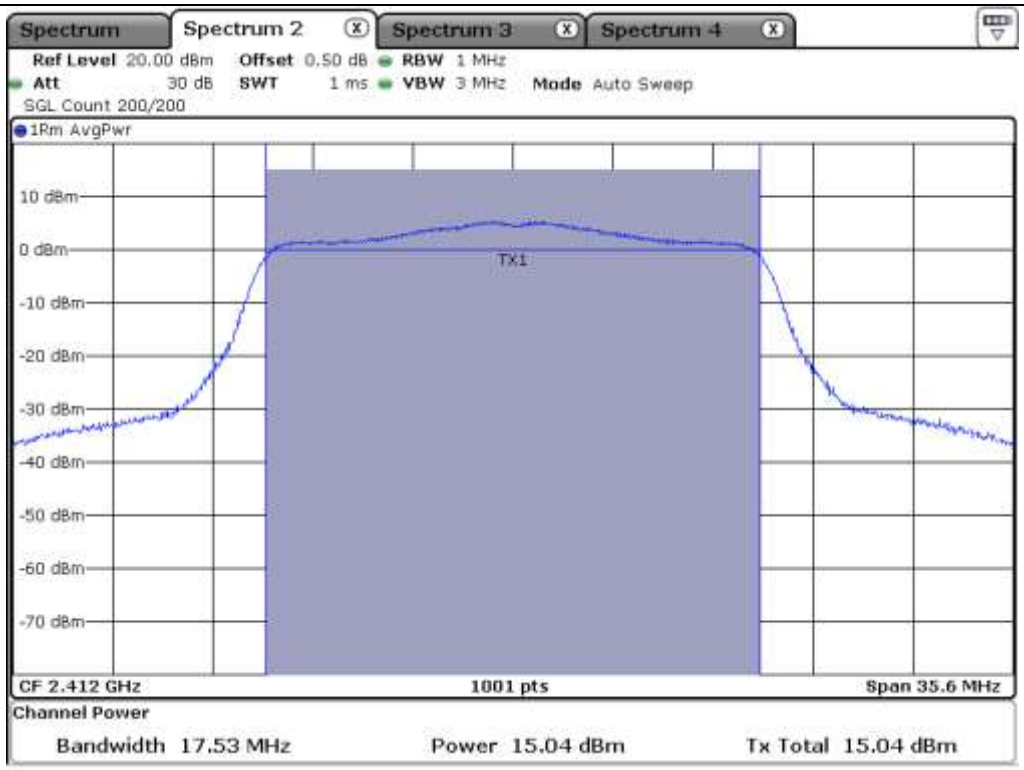
8.6.2 Test data for Antenna 1

-. Test Result : Pass

-. Duty Cycle : 85.00 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	15.04	0.71	15.75	30.00	14.25
MIDDLE	2 442.00	15.49	0.71	16.20	30.00	13.80
HIGH	2 462.00	15.49	0.71	16.20	30.00	13.80

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



Low Channel

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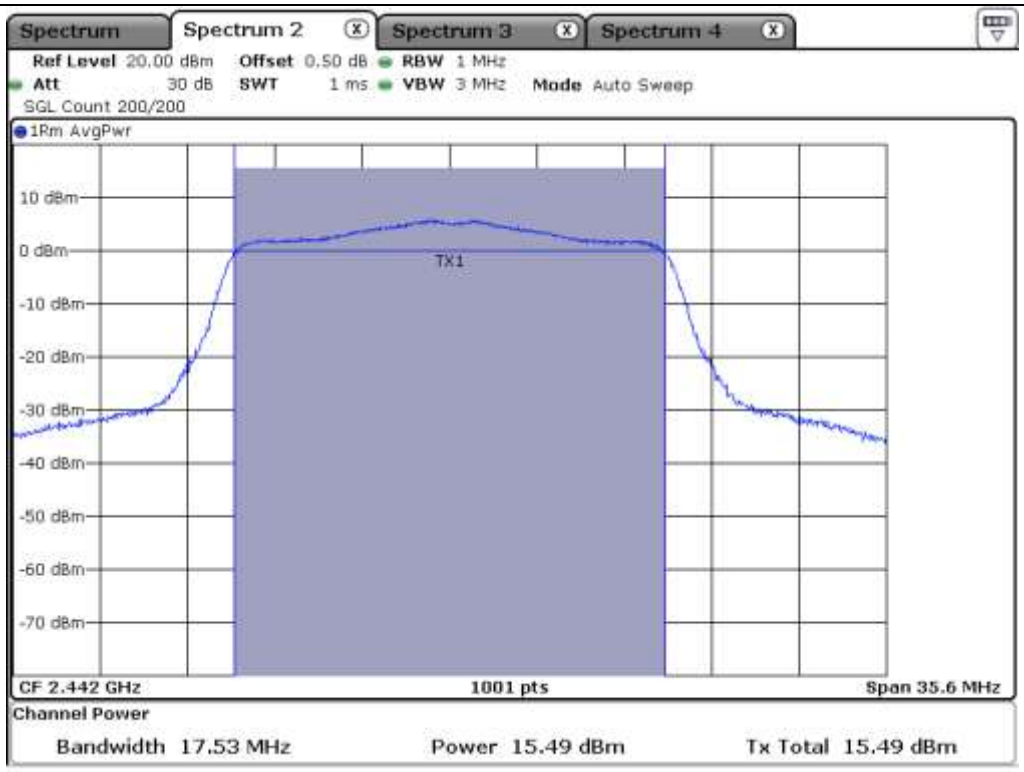
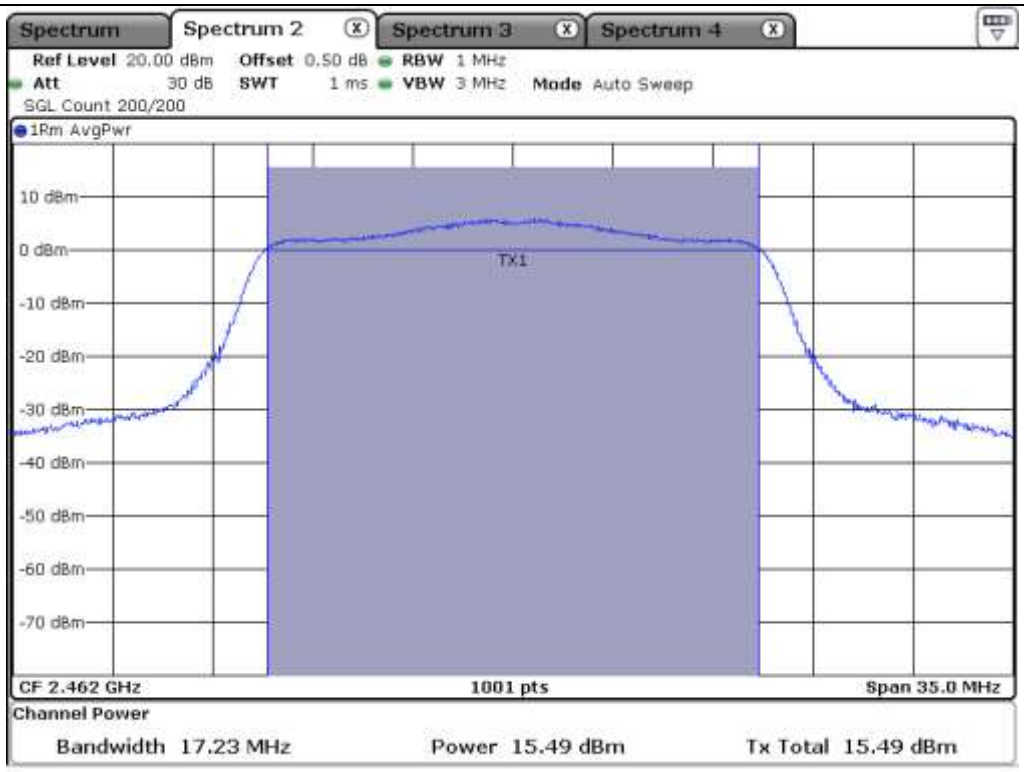


Middle Channel



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)

8.6.3 Test data for Multiple Transmit

-. Test Result : Pass

-. Duty Cycle : 85.00 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	17.50	0.77	18.27	30.00	11.73
MIDDLE	2 442.00	17.44	0.77	18.21	30.00	11.79
HIGH	2 462.00	17.52	0.77	18.29	30.00	11.71

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

Remark 2 : Calculated Output Power= $10\log (10^{(\text{Antenna0 Output Power}/10)}+10^{(\text{Antenna1 Output Power}/10)})$

Remark 3 : Directional gain = $10*\log[(10^{G0/20}+10^{G1/20})^2/N]$ dBi

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9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

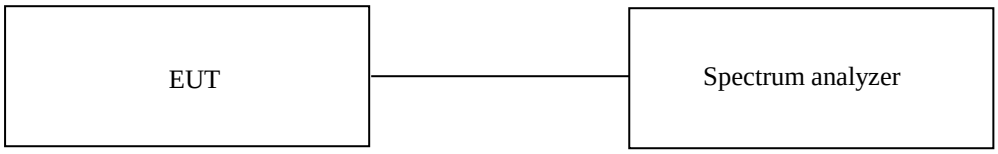
9.1 Operating environment

Temperature : 23 °C

Relative humidity : 45 % R.H.

9.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution and video bandwidth is set to 100 kHz, and peak detection was used.



9.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 3 m semi anechoic chamber. The EUT was placed on turntable approximately 1.5 m above the ground plane.

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

9.4 Test Date

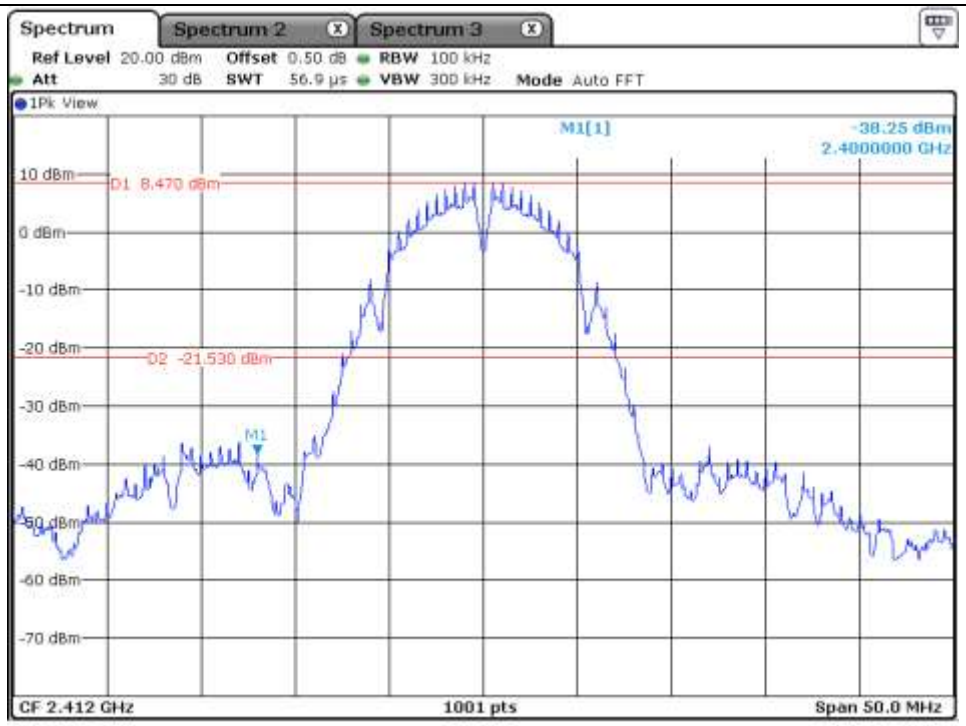
September 07, 2020 ~ September 11, 2020

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

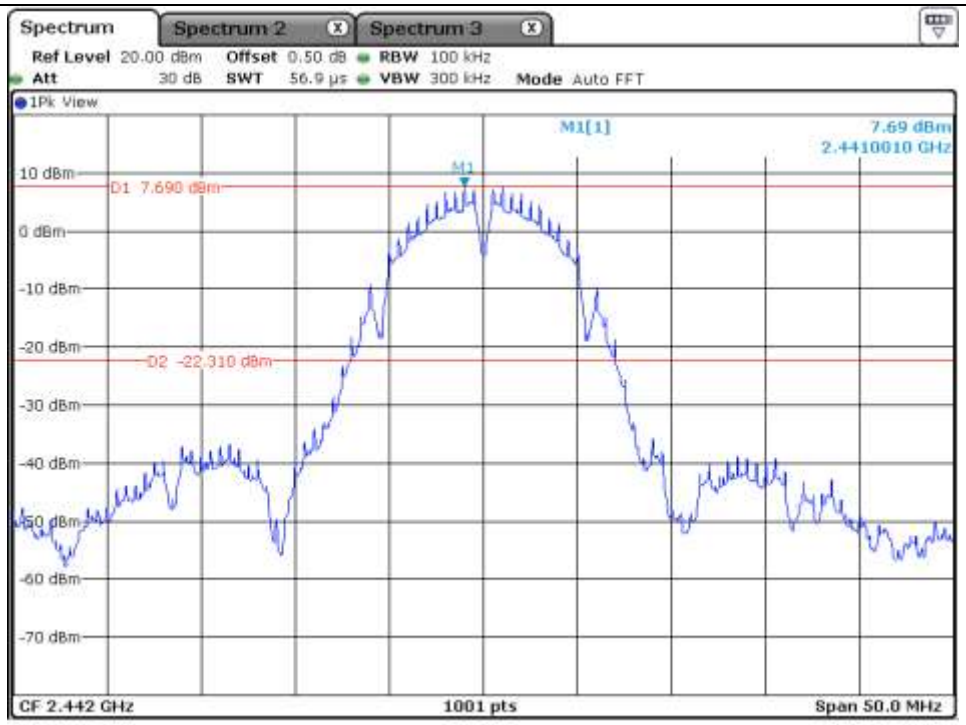
9.5 Test data for conducted emission

9.5.1 Test data for 802.11b WLAN Mode

9.5.1.1 Test data for Antenna 0

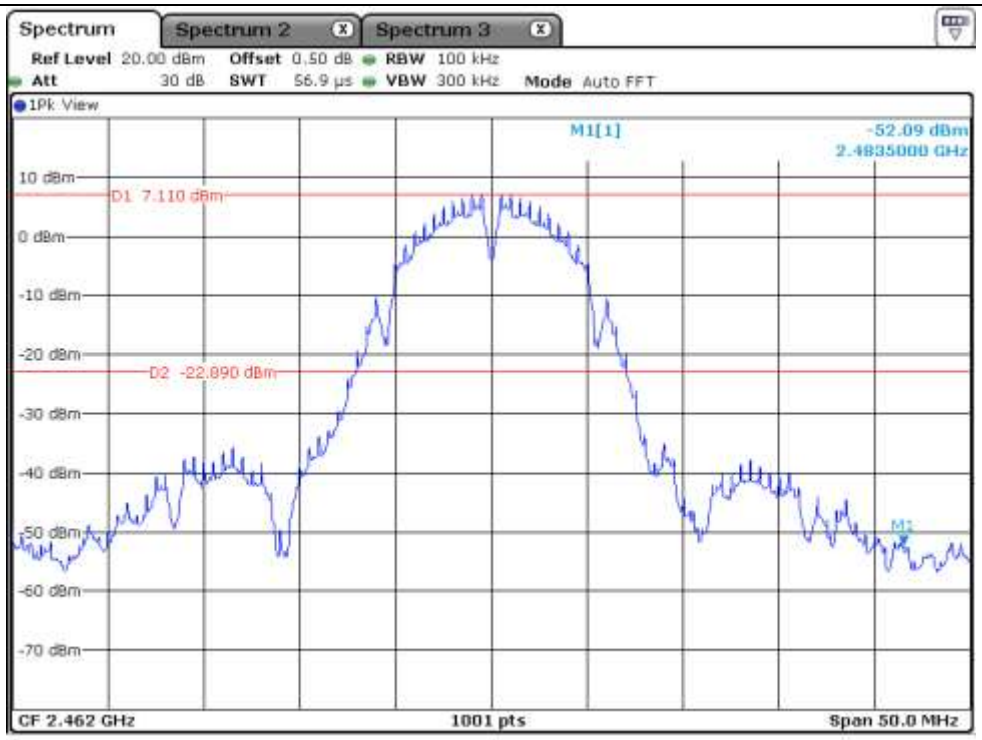


Low Channel

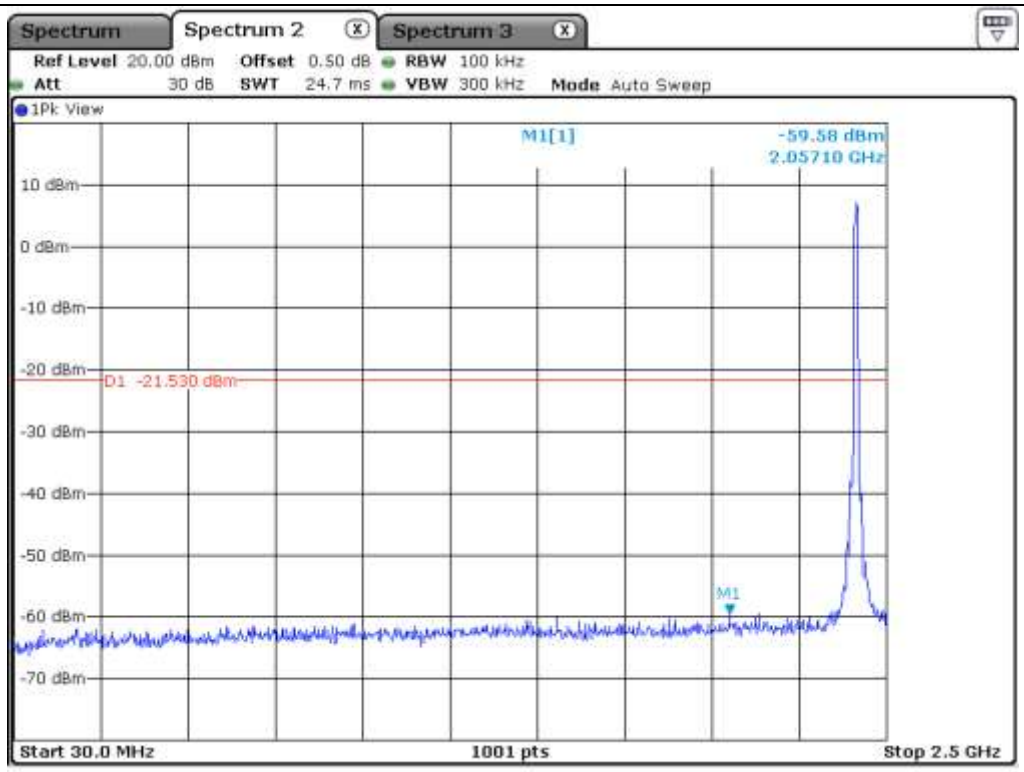


Middle Channel

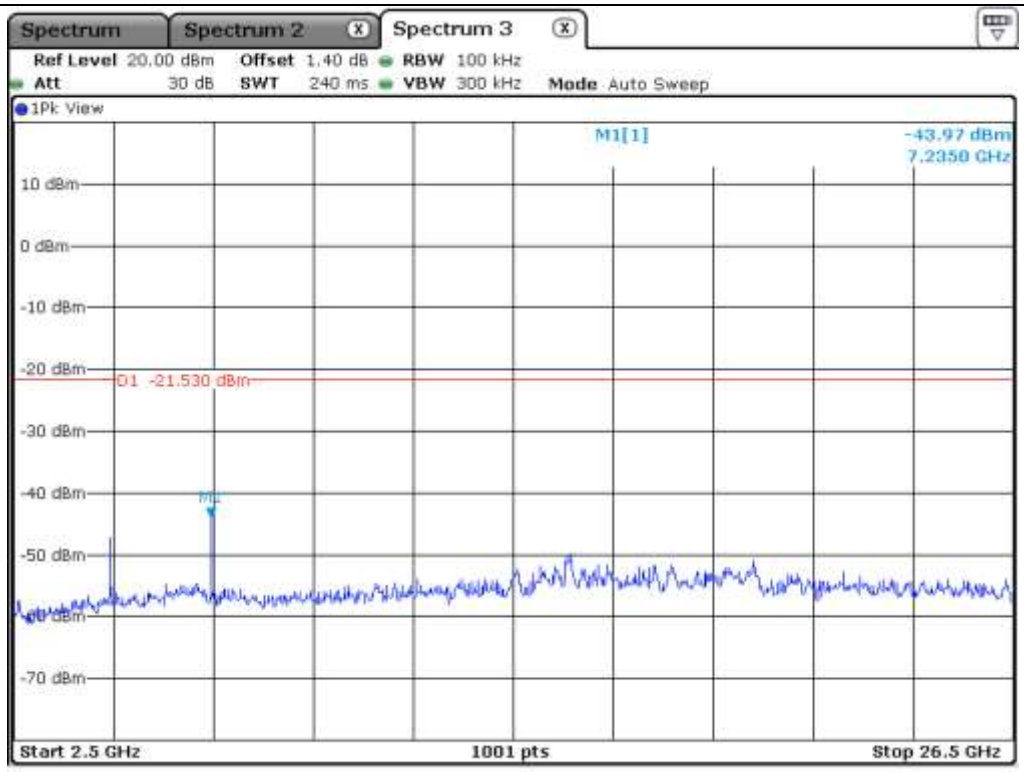
ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)



High Channel

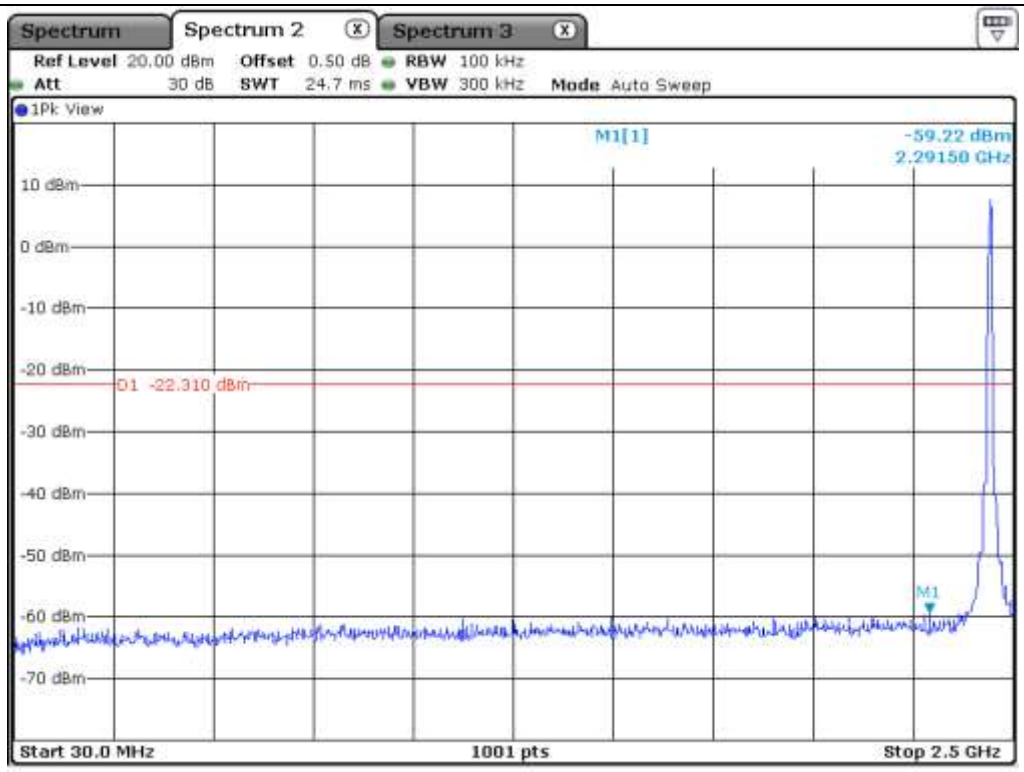


Low Channel



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)



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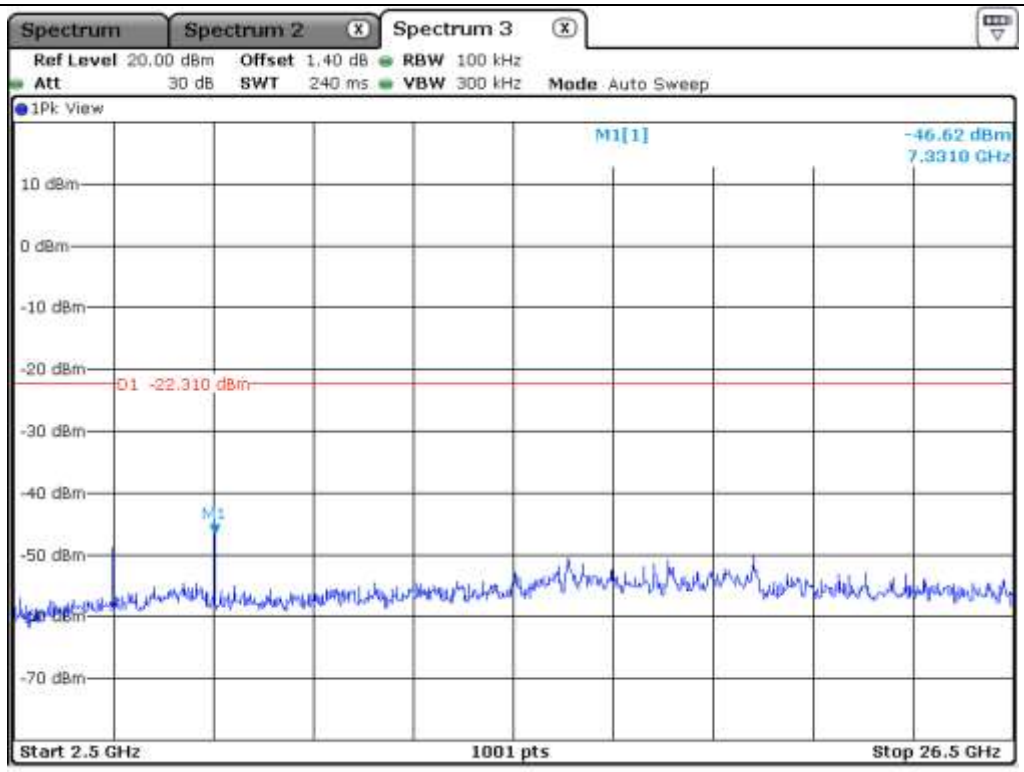

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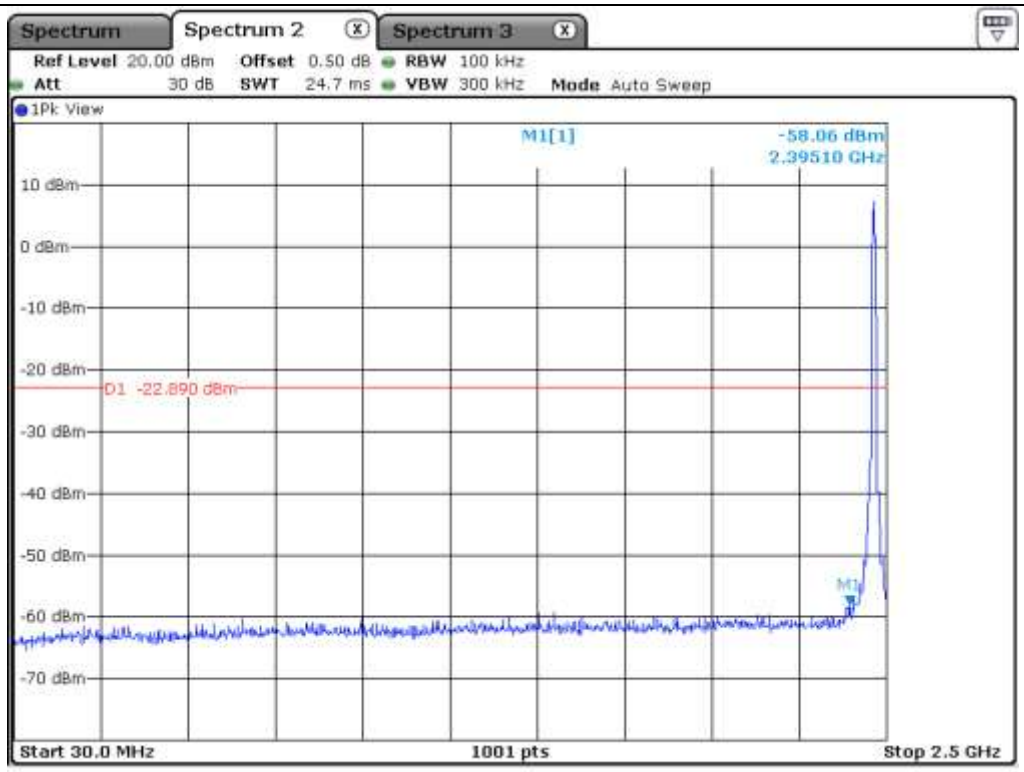

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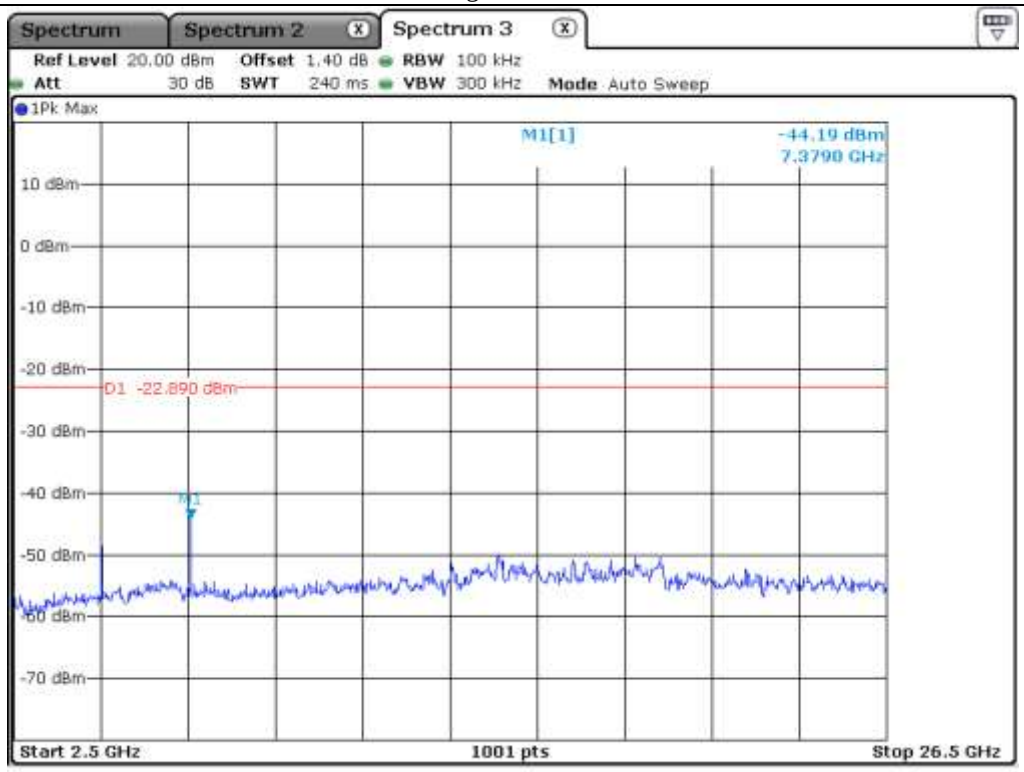
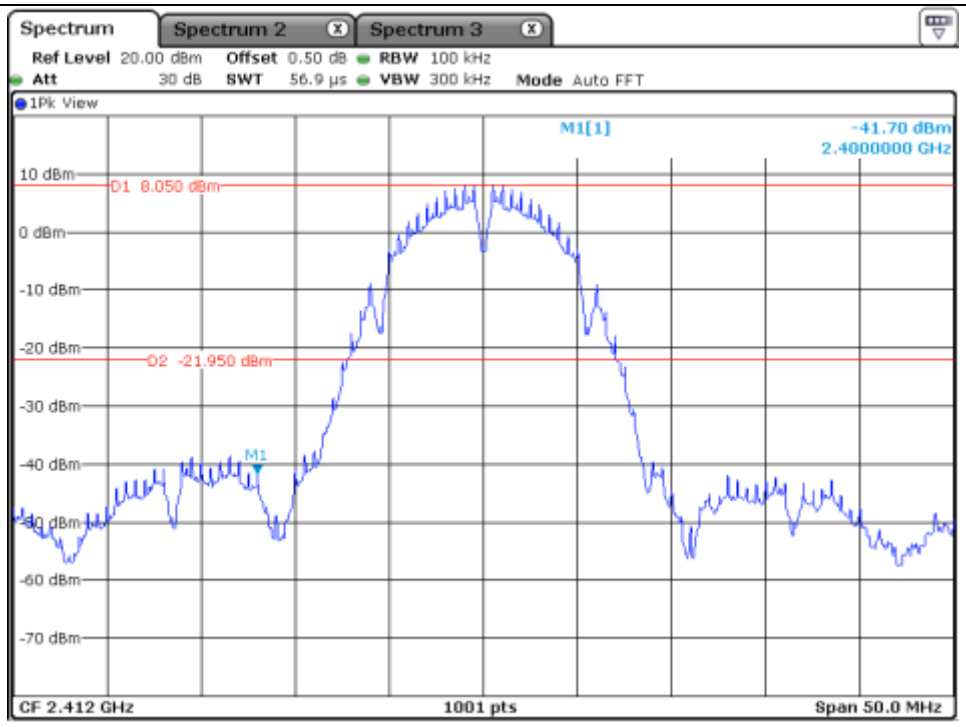
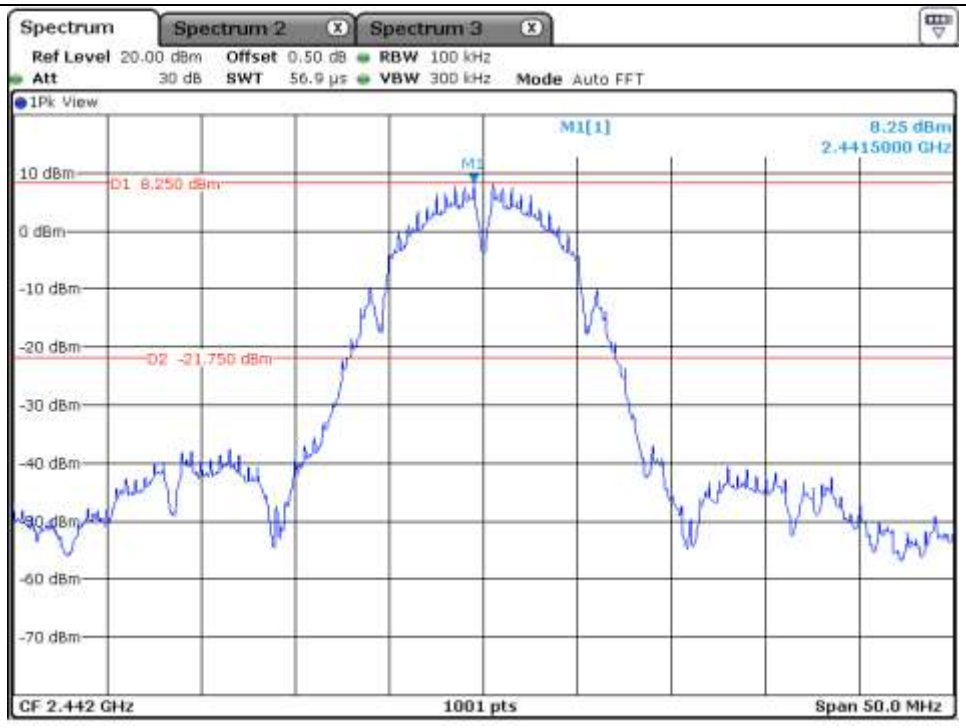


High Channel

9.5.1.2 Test data for Antenna 1

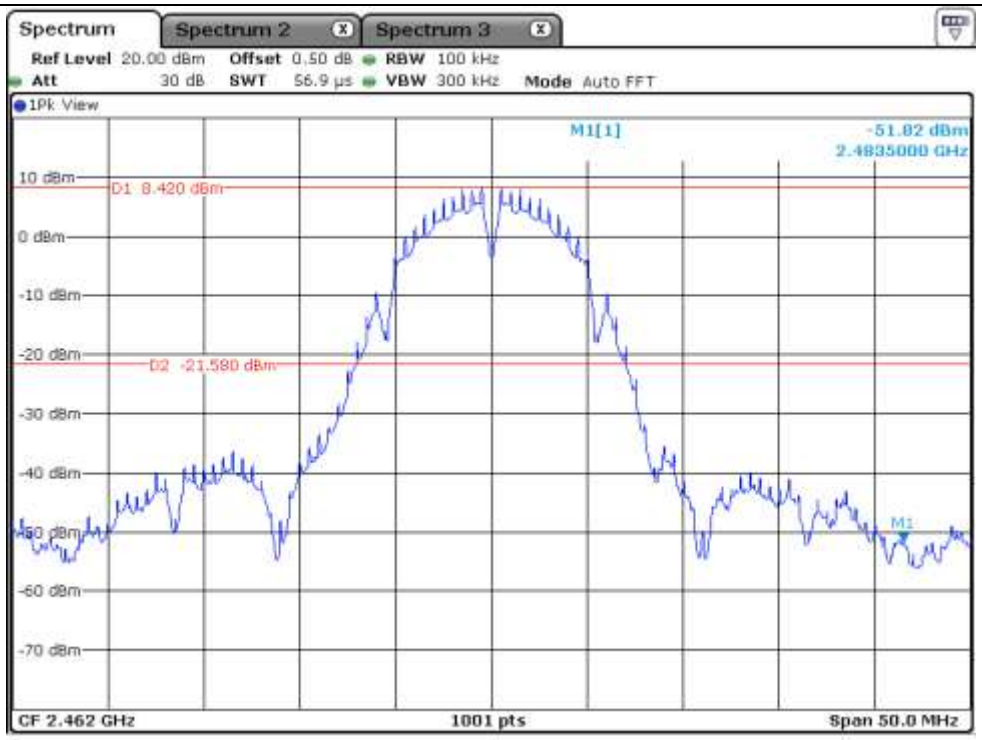


Low Channel

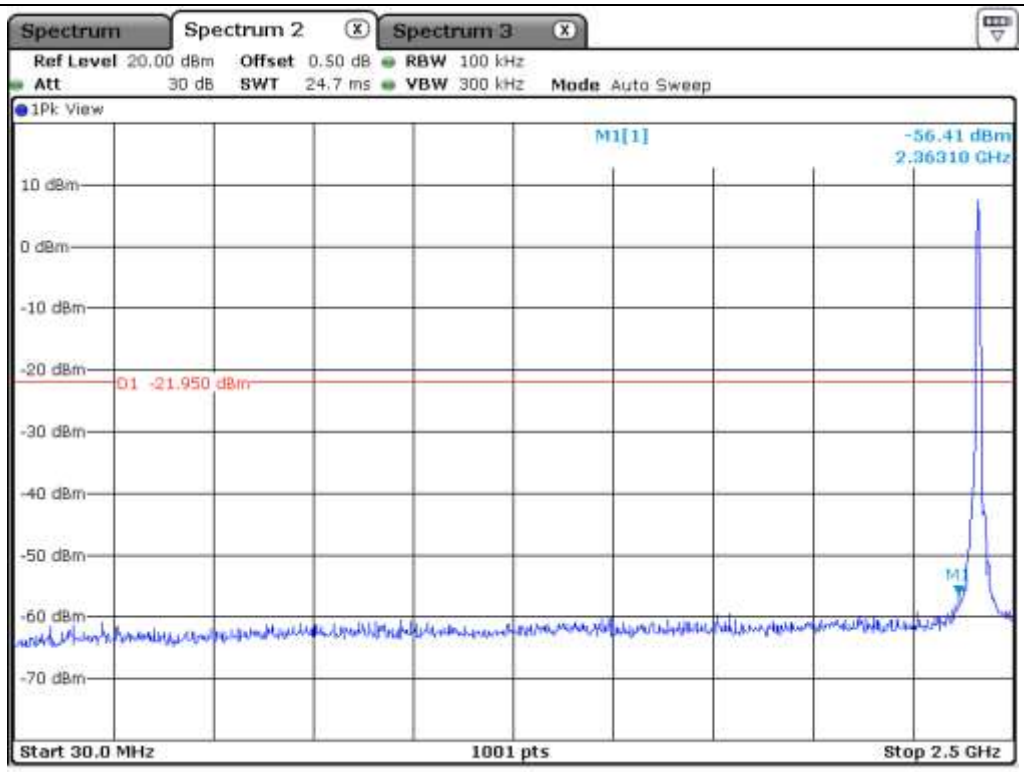


Middle Channel

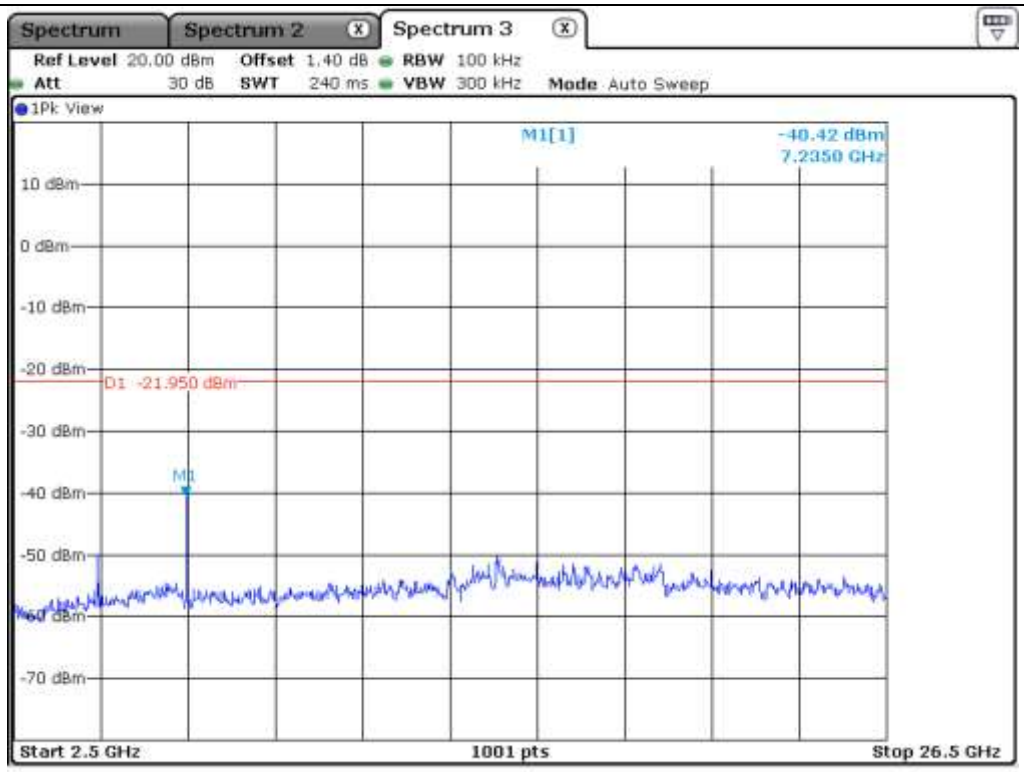
ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)



High Channel

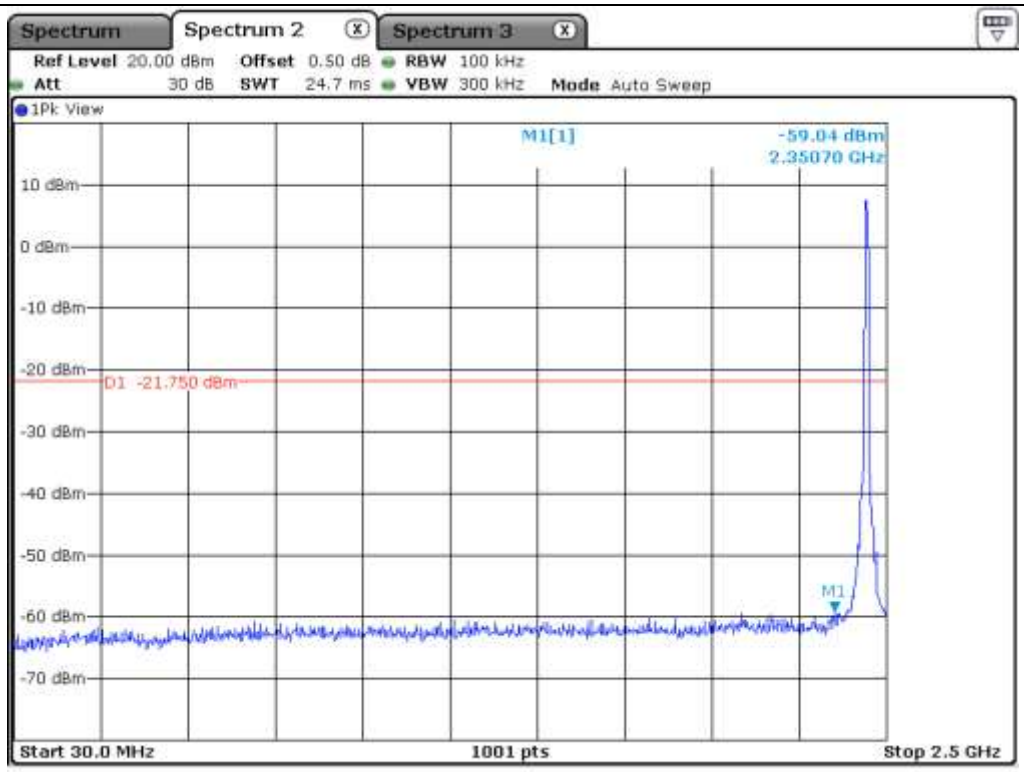


Low Channel



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)



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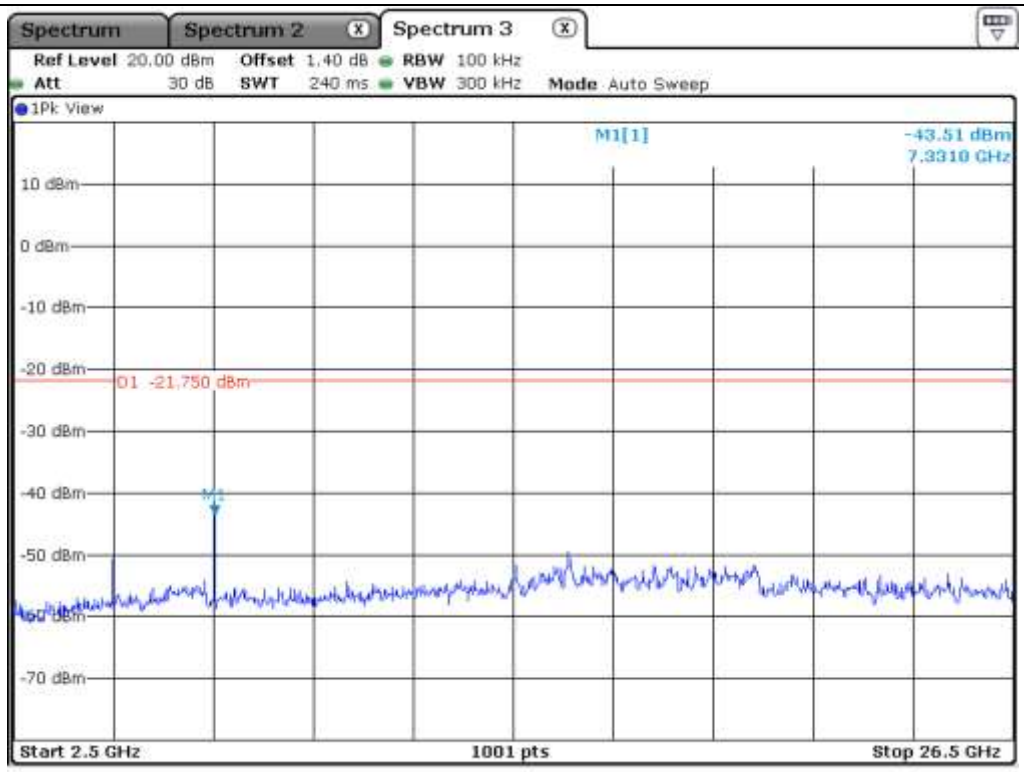
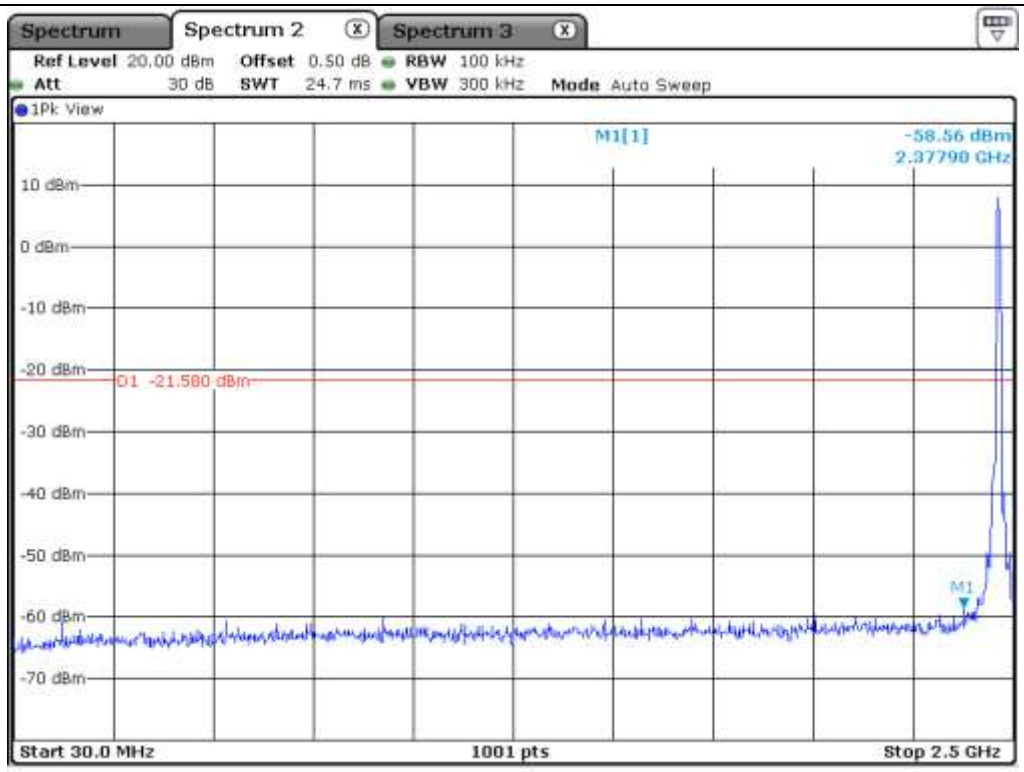


Middle Channel

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



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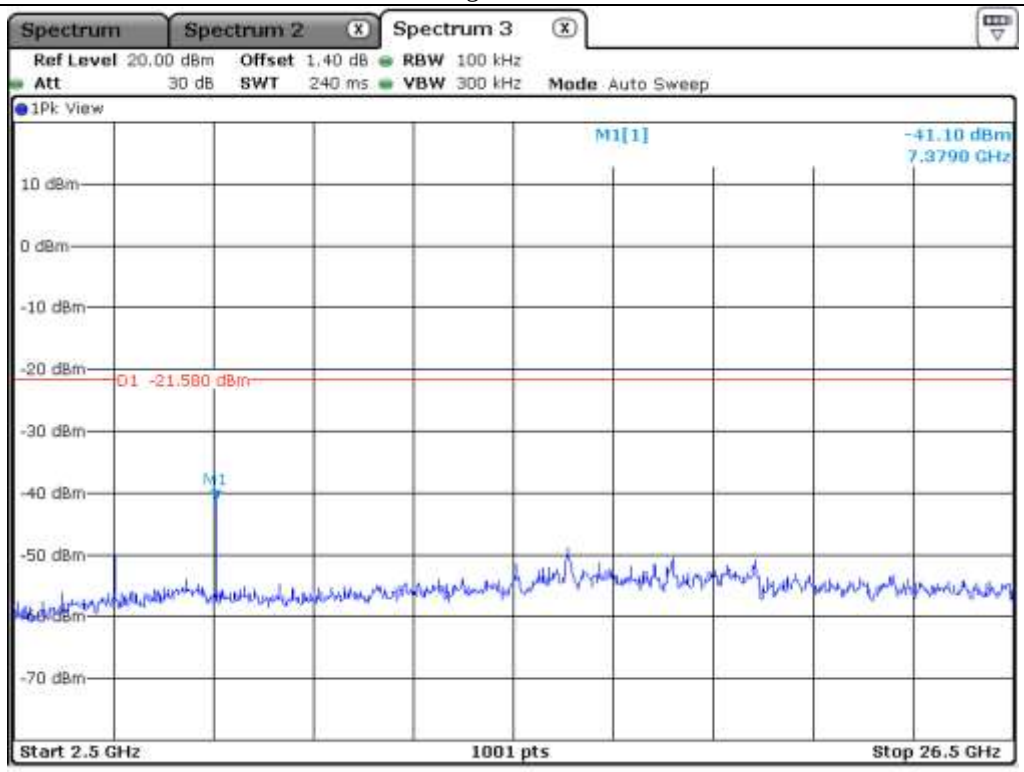
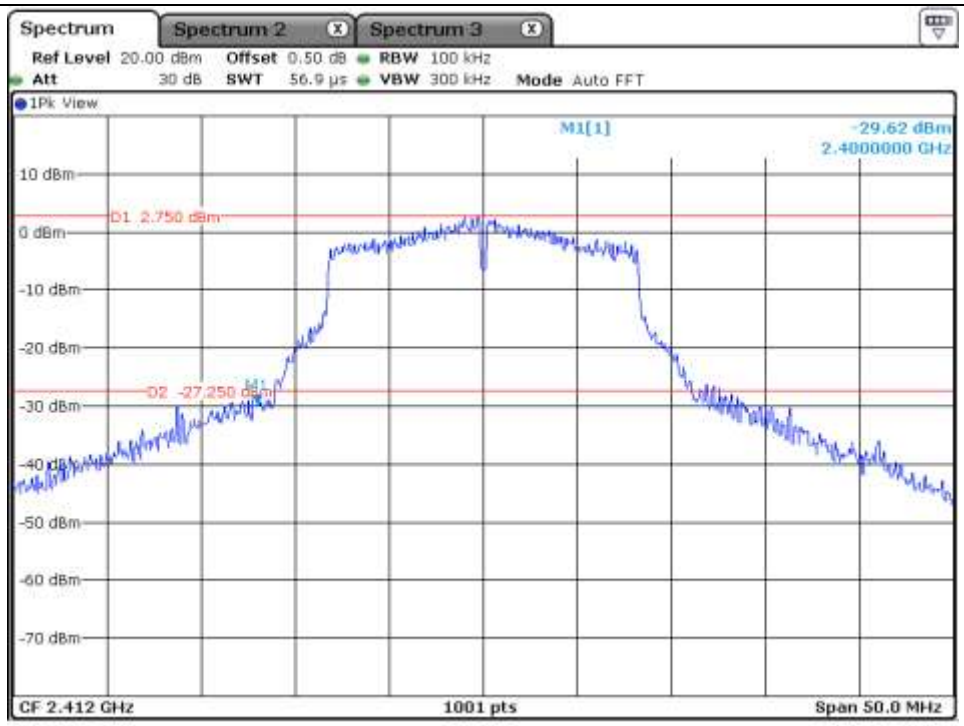


High Channel

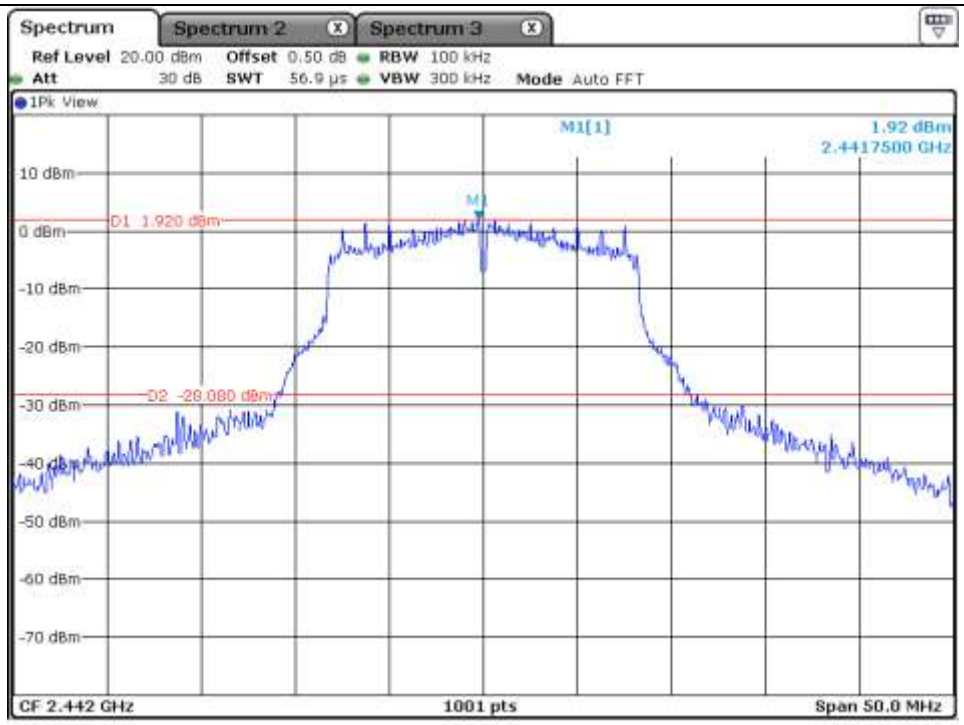
ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

9.5.2 Test data for 802.11g WLAN Mode

9.5.2.1 Test data for Antenna 0

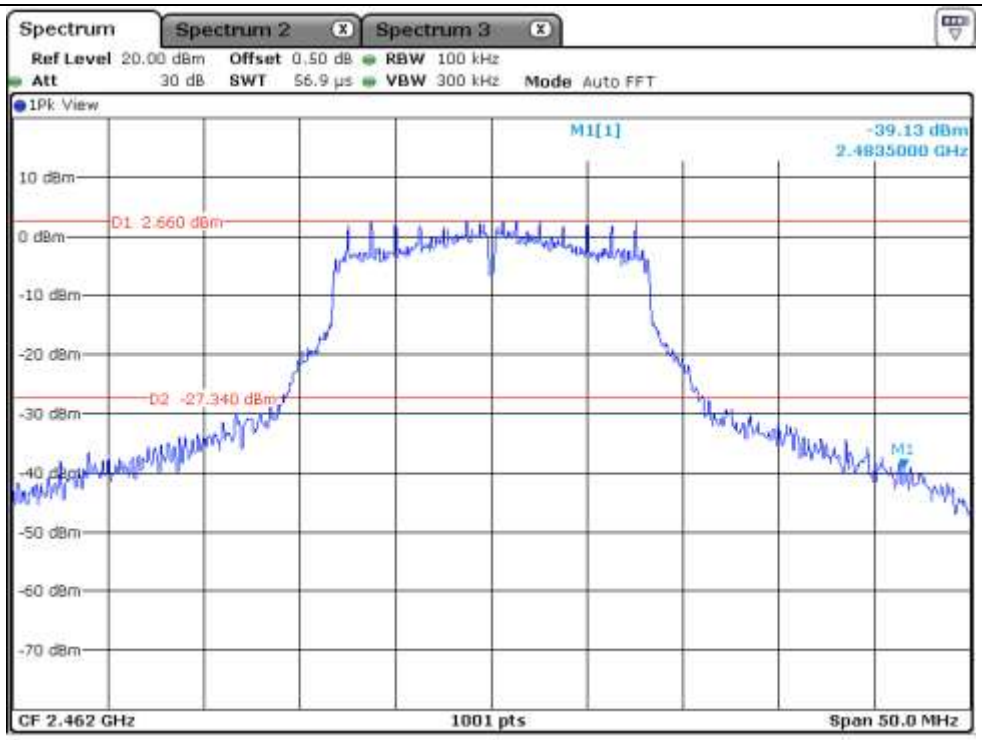


Low Channel



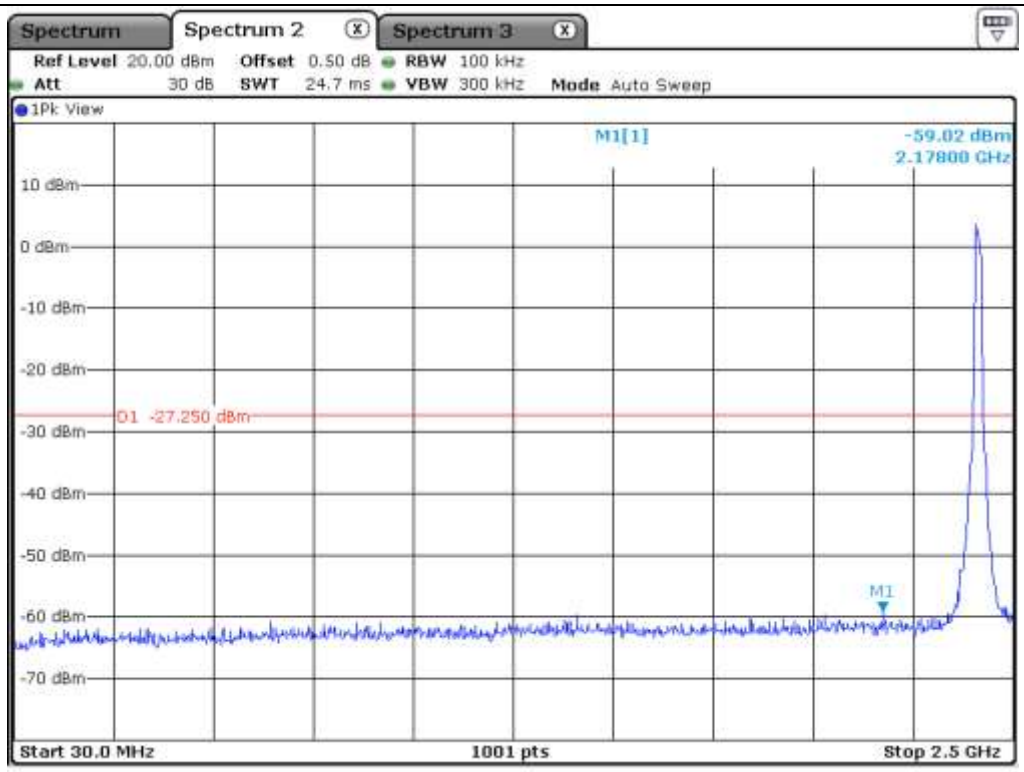
Middle Channel

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)



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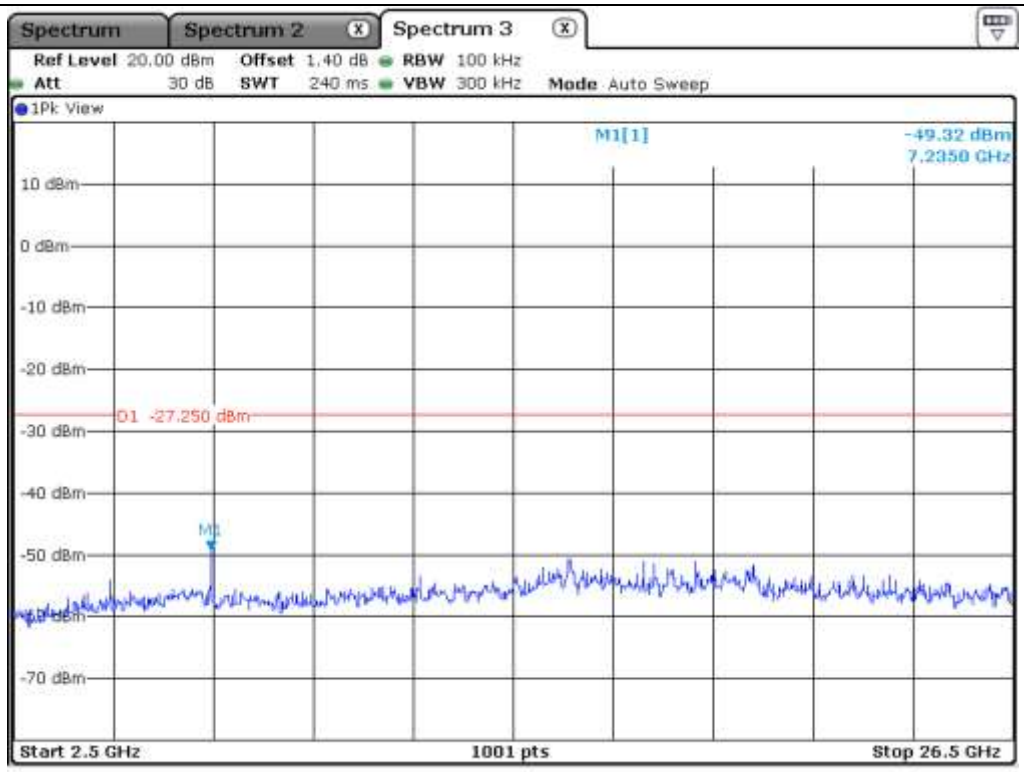
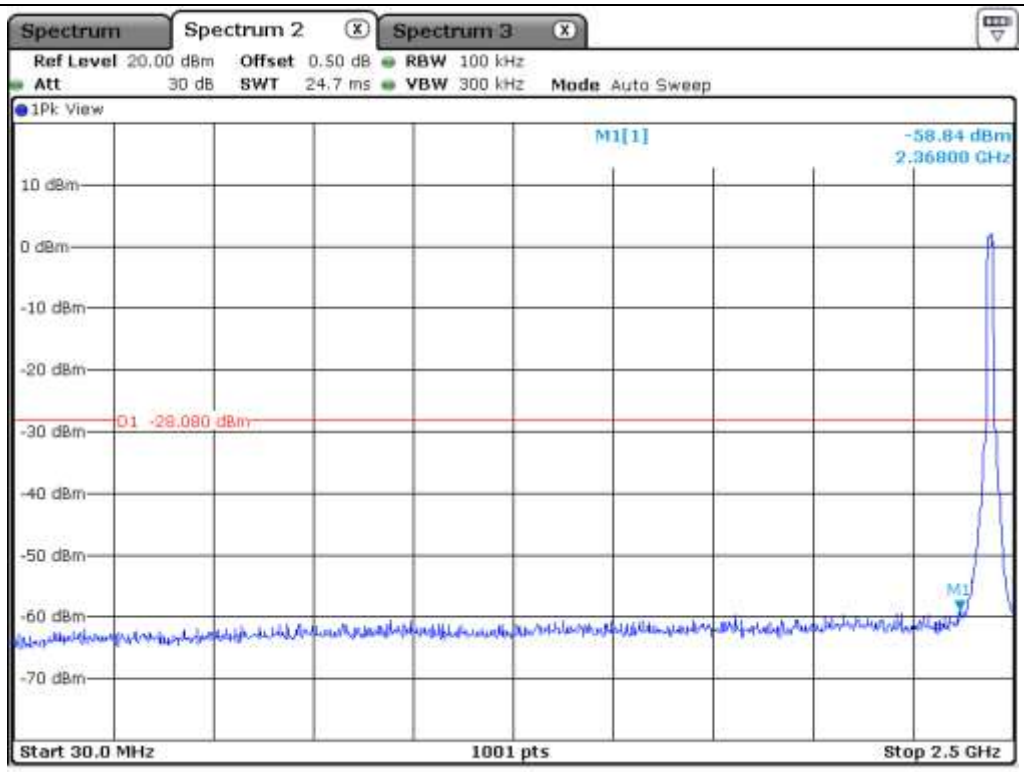
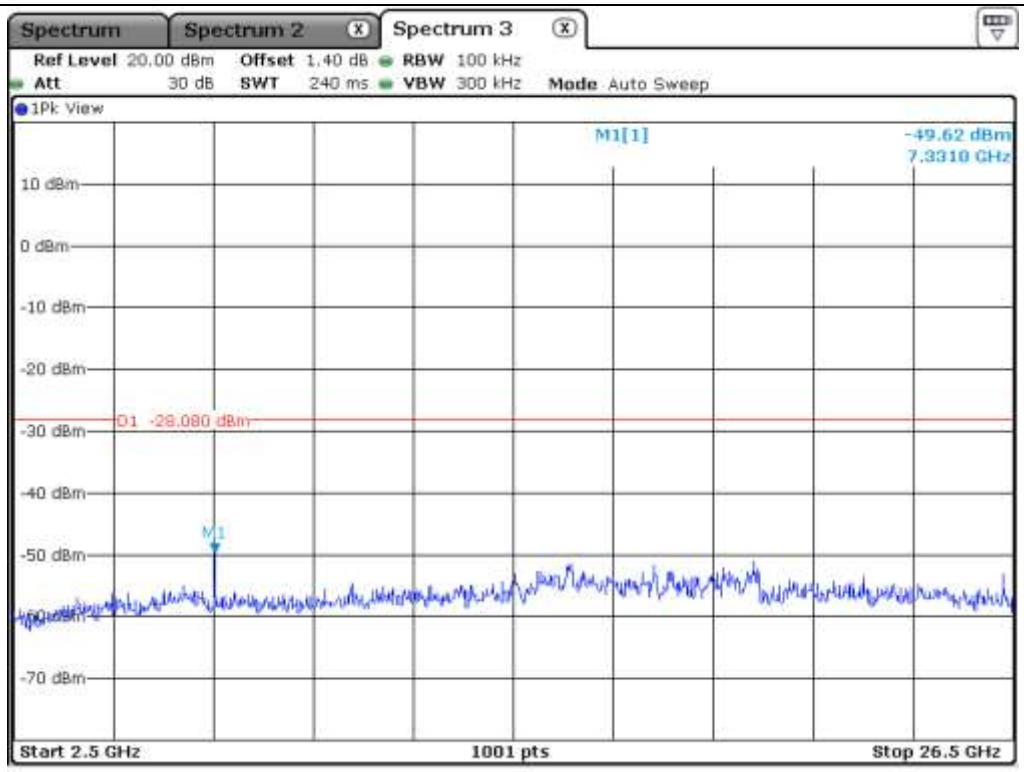


Low Channel

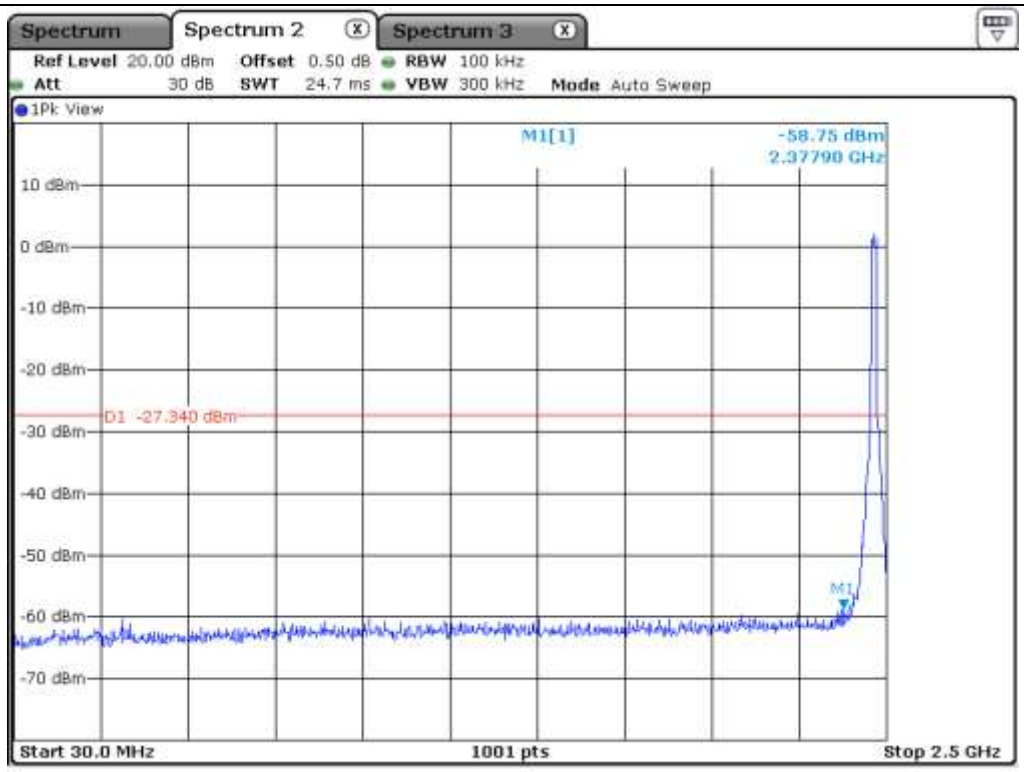


Middle Channel

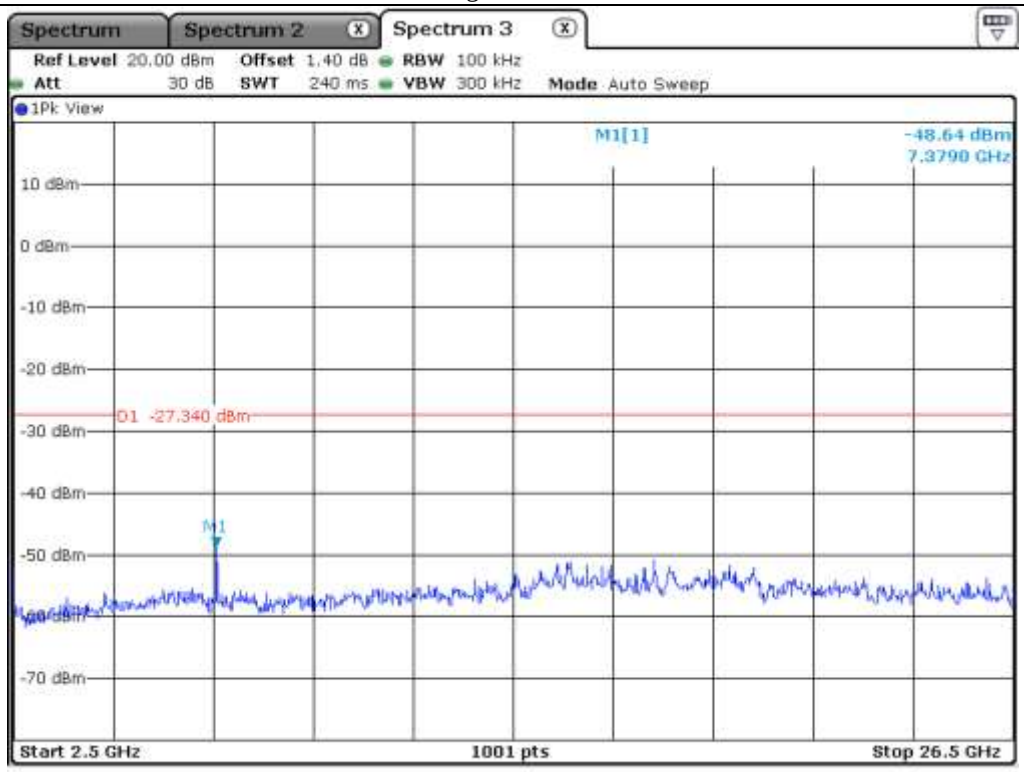


Middle Channel

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



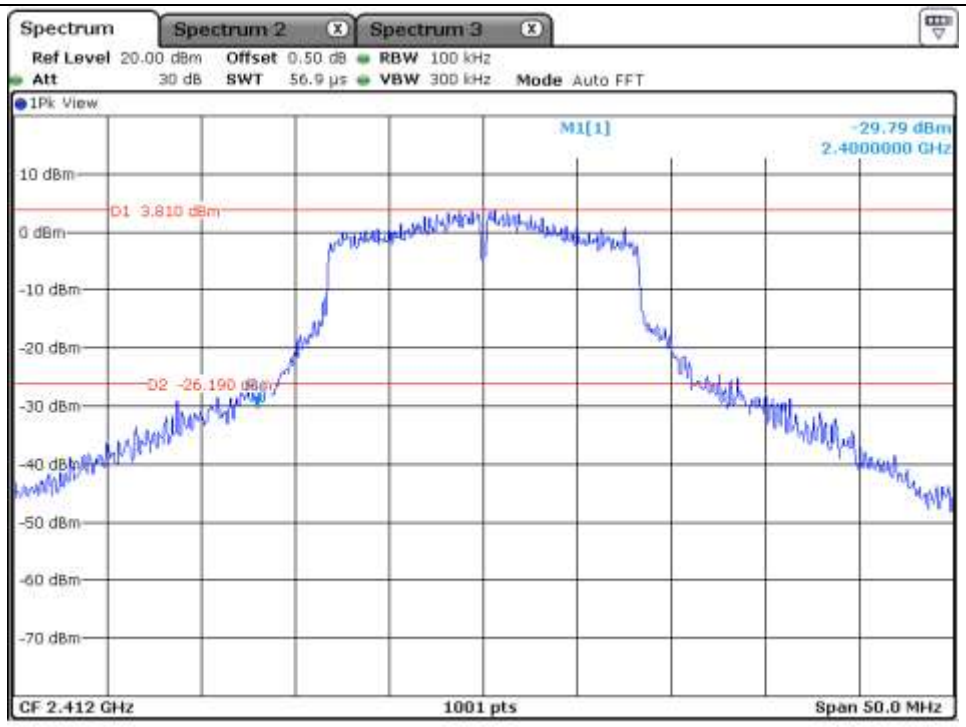
High Channel



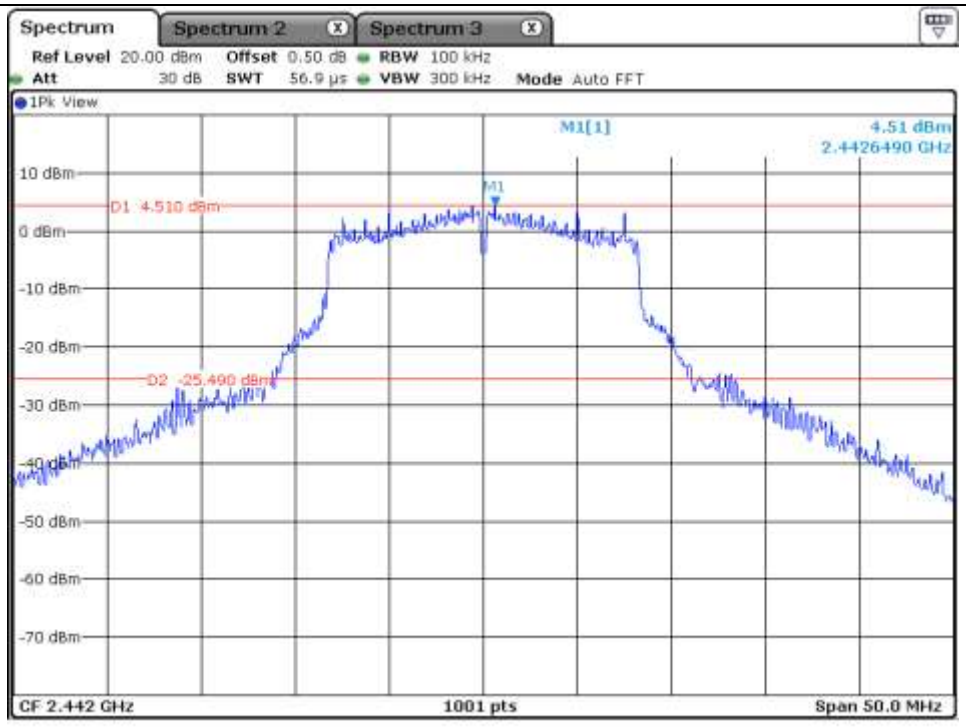
High Channel

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

9.5.2.2 Test data for Antenna 1

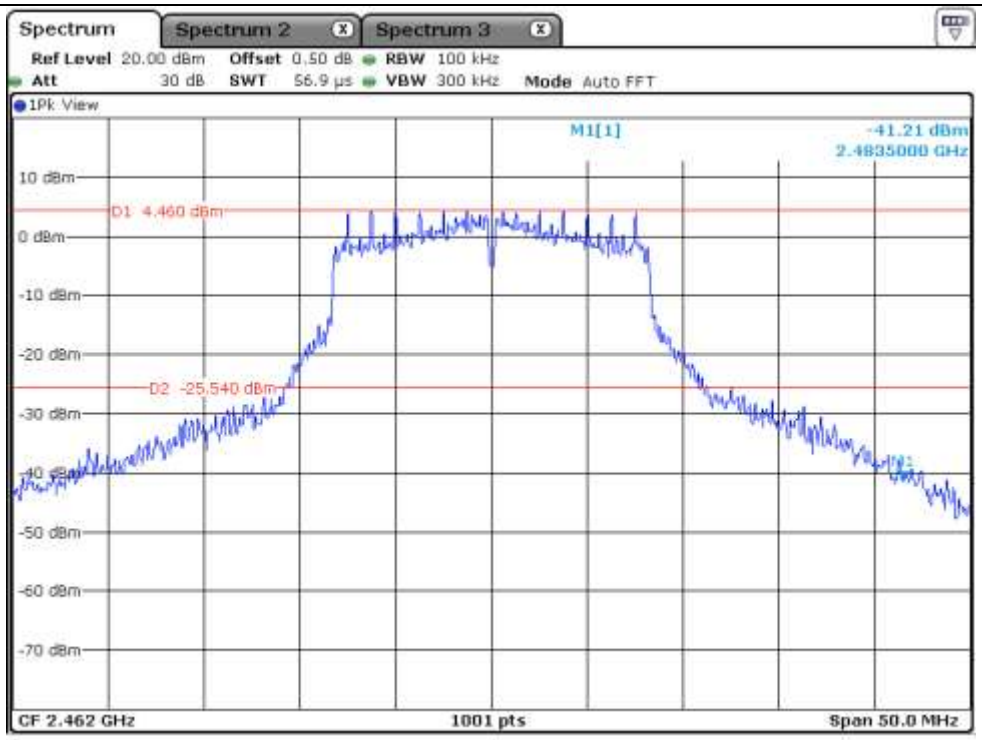


Low Channel



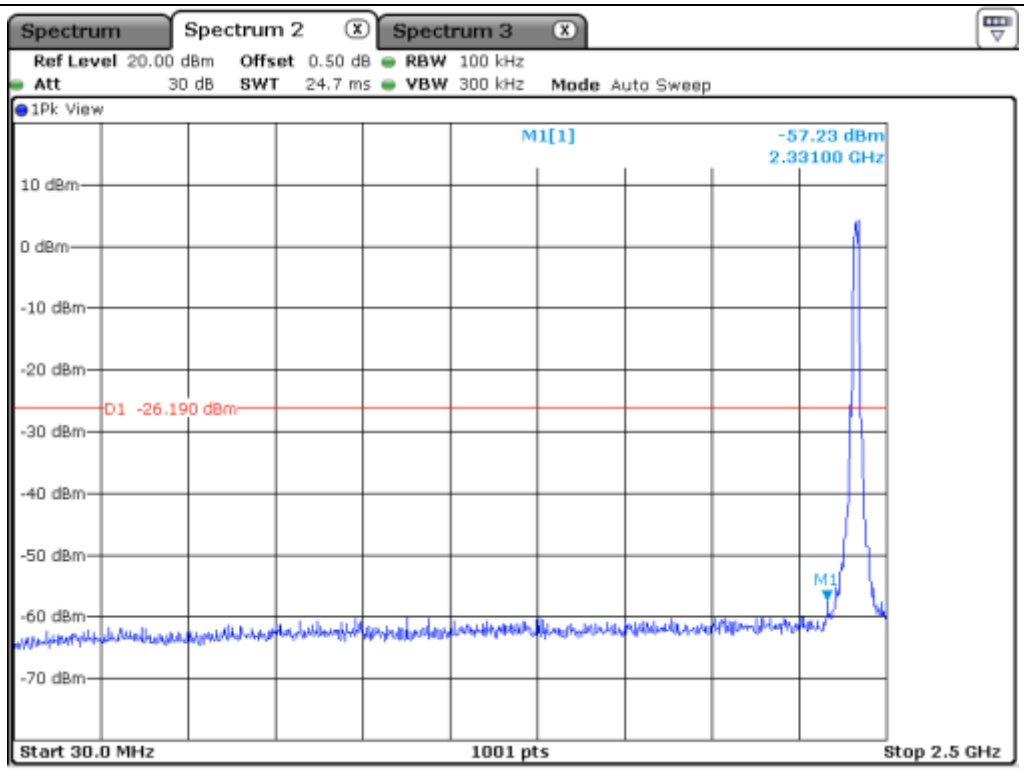
Middle Channel

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)



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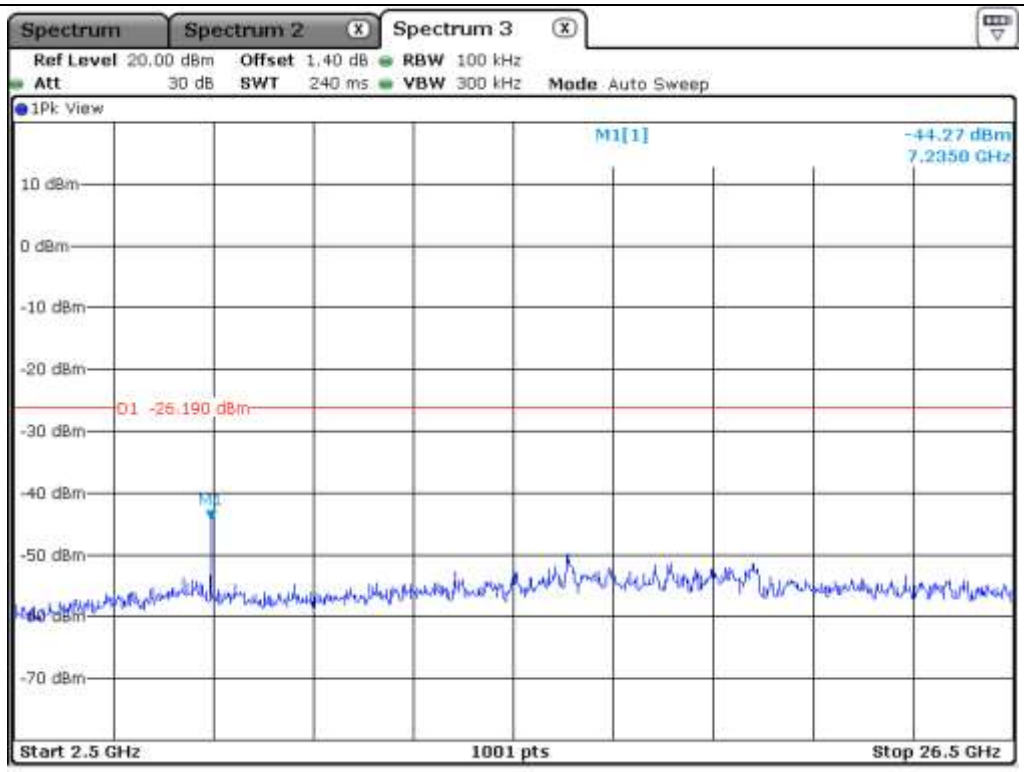
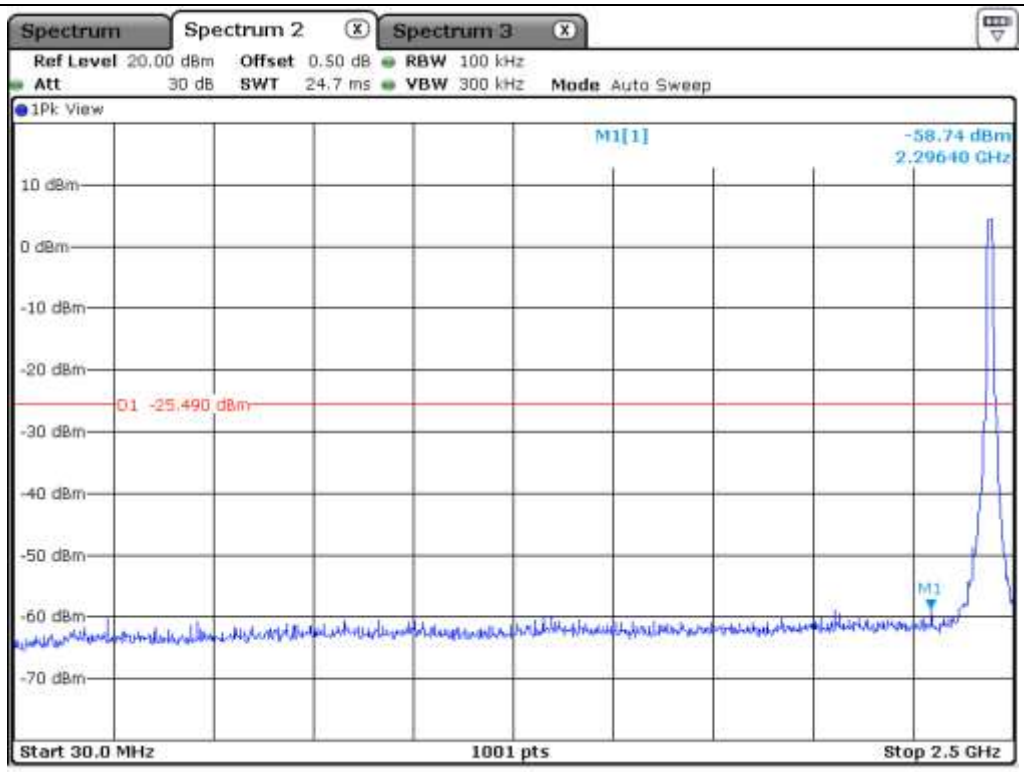
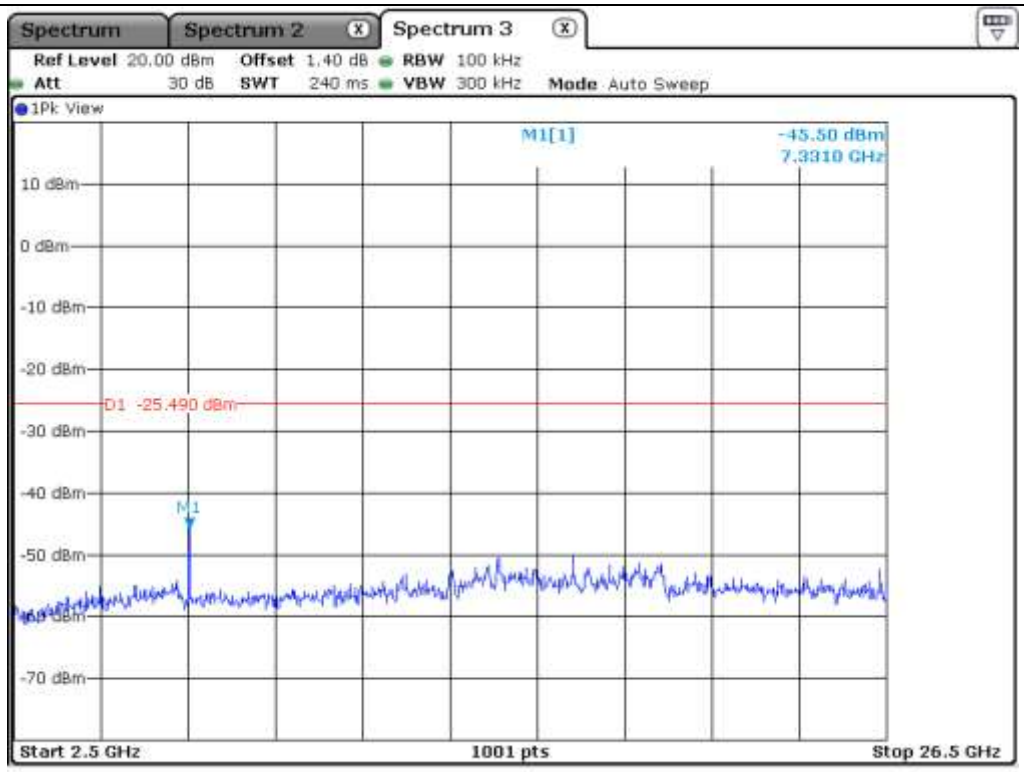


Low Channel

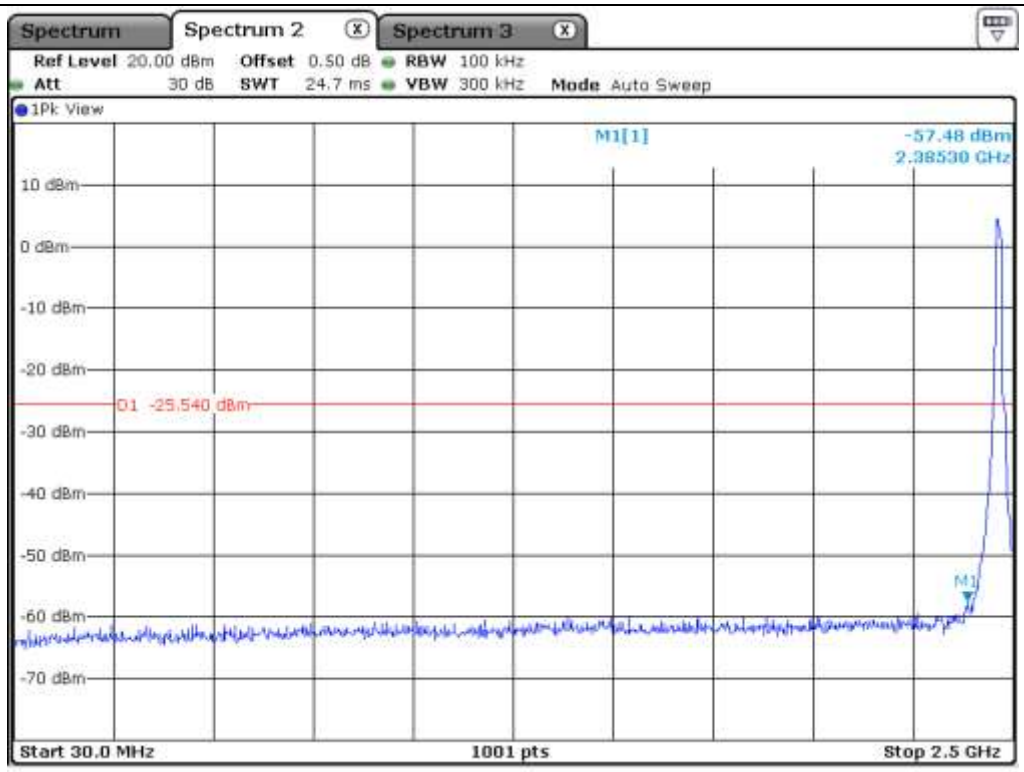


Middle Channel

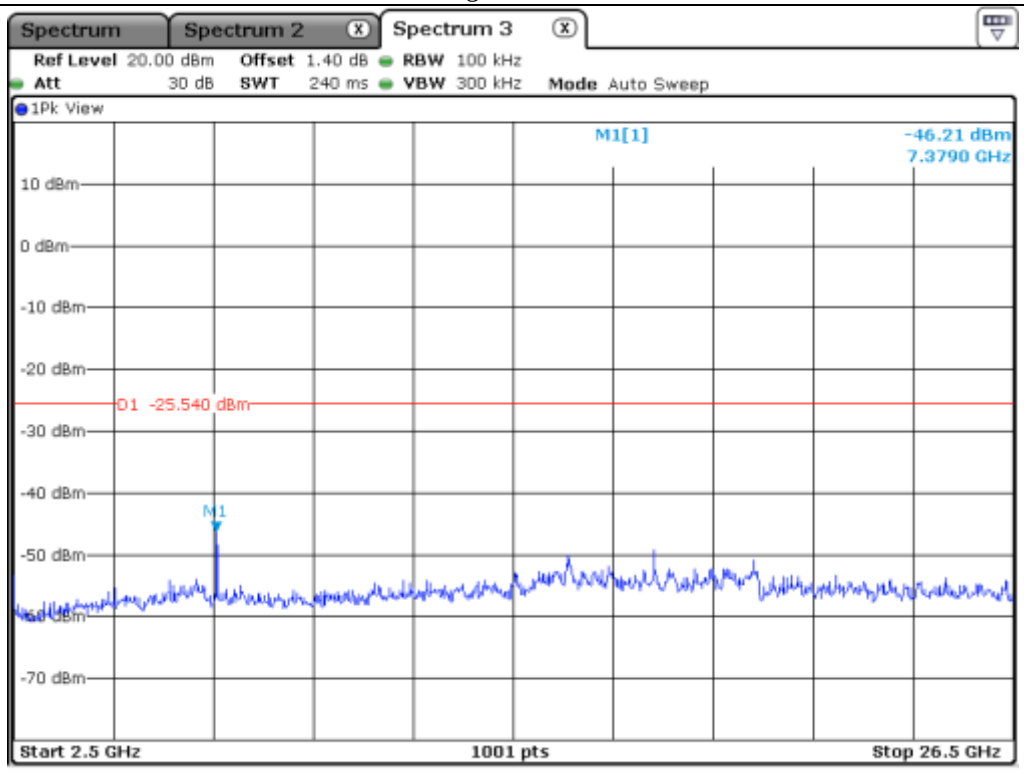


Middle Channel

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

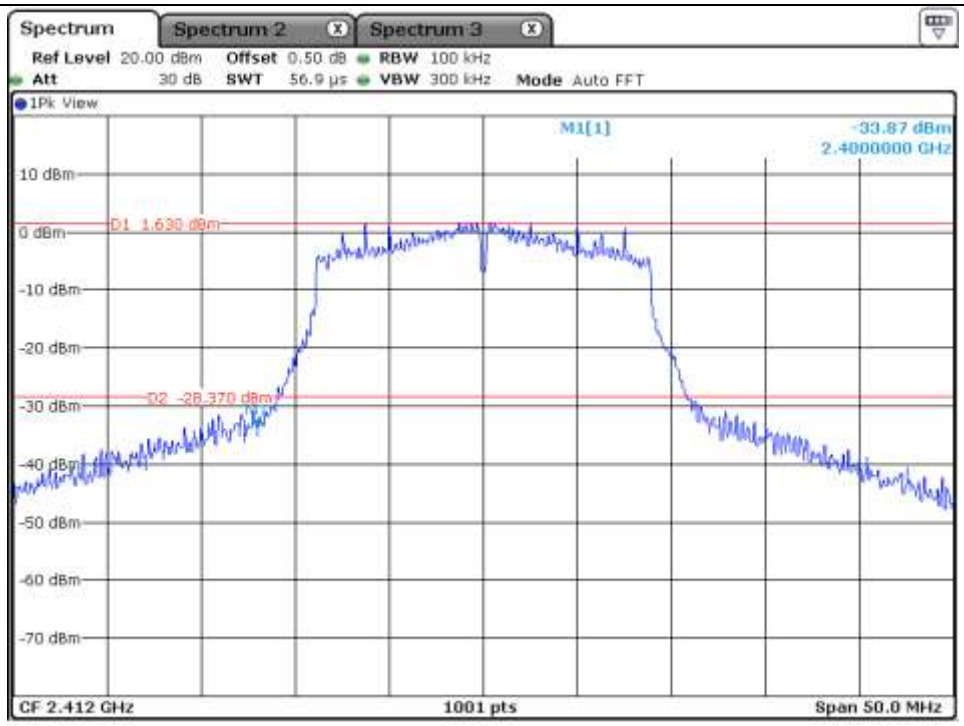


High Channel

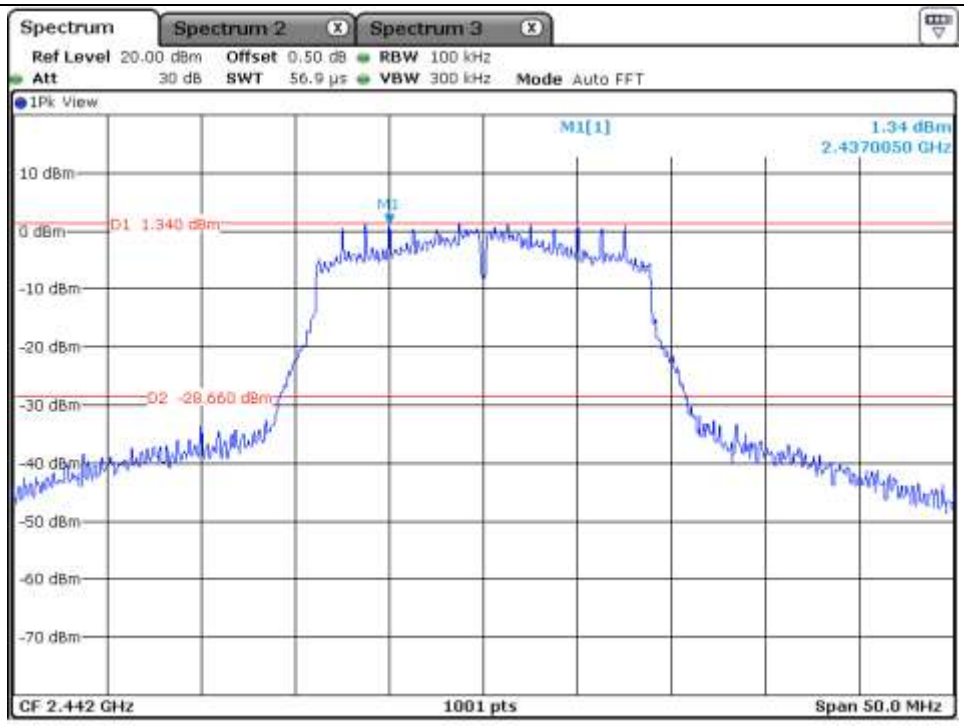
ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

9.5.3 Test data for 802.11n_HT20 WLAN Mode

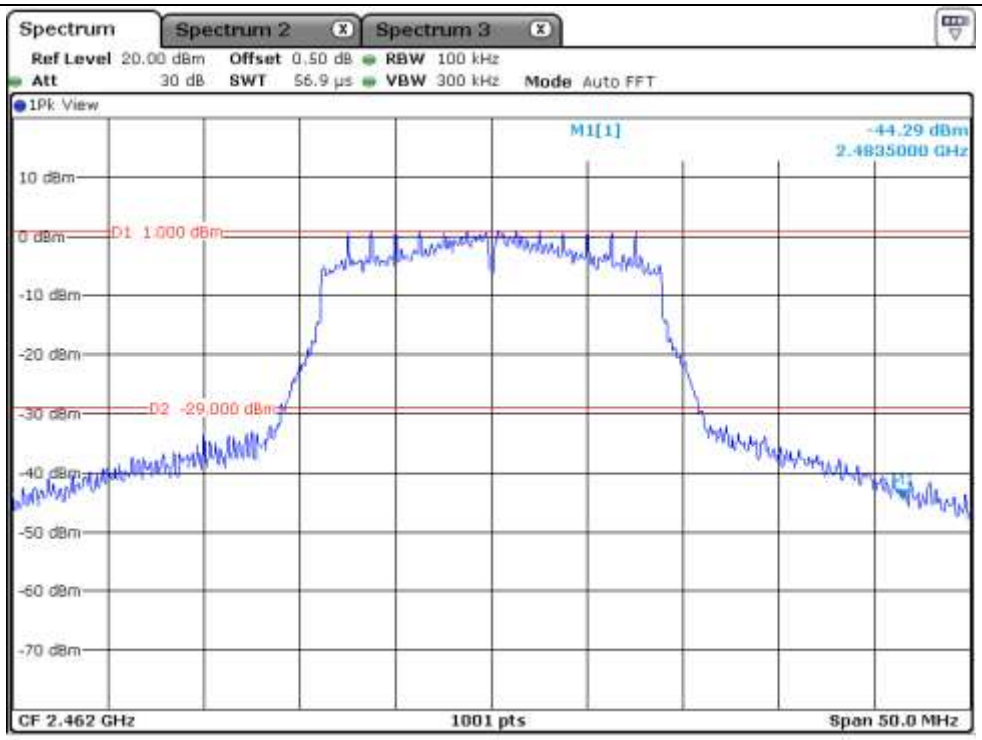
9.5.3.1 Test data for Antenna 0



Low Channel

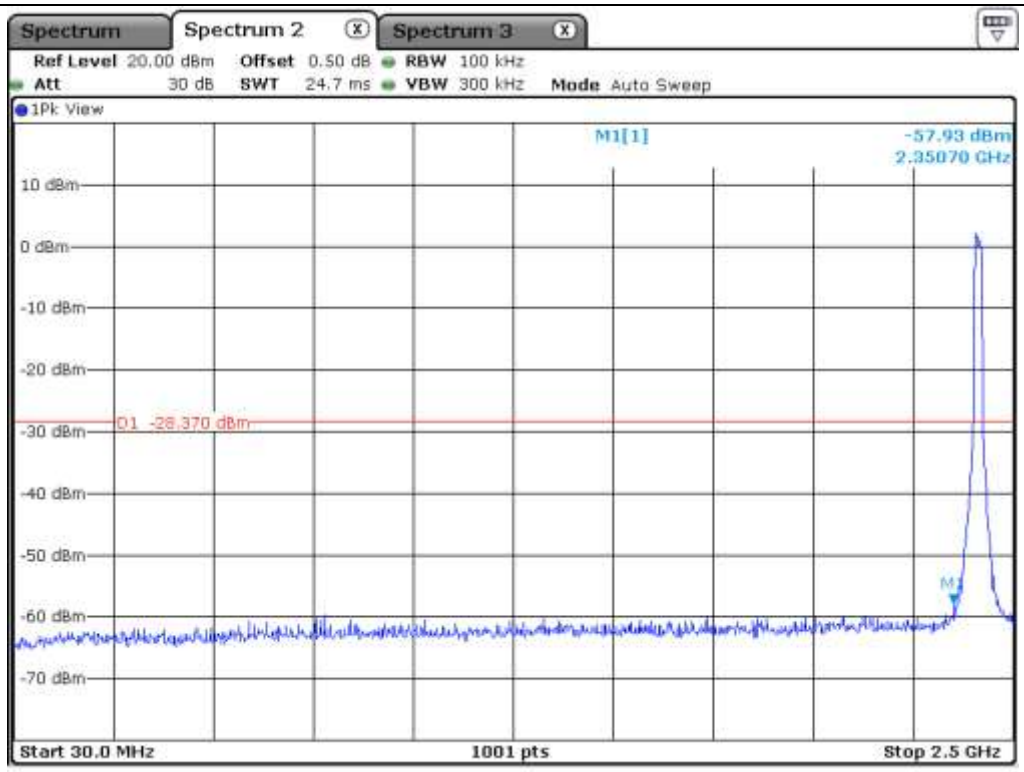


Middle Channel

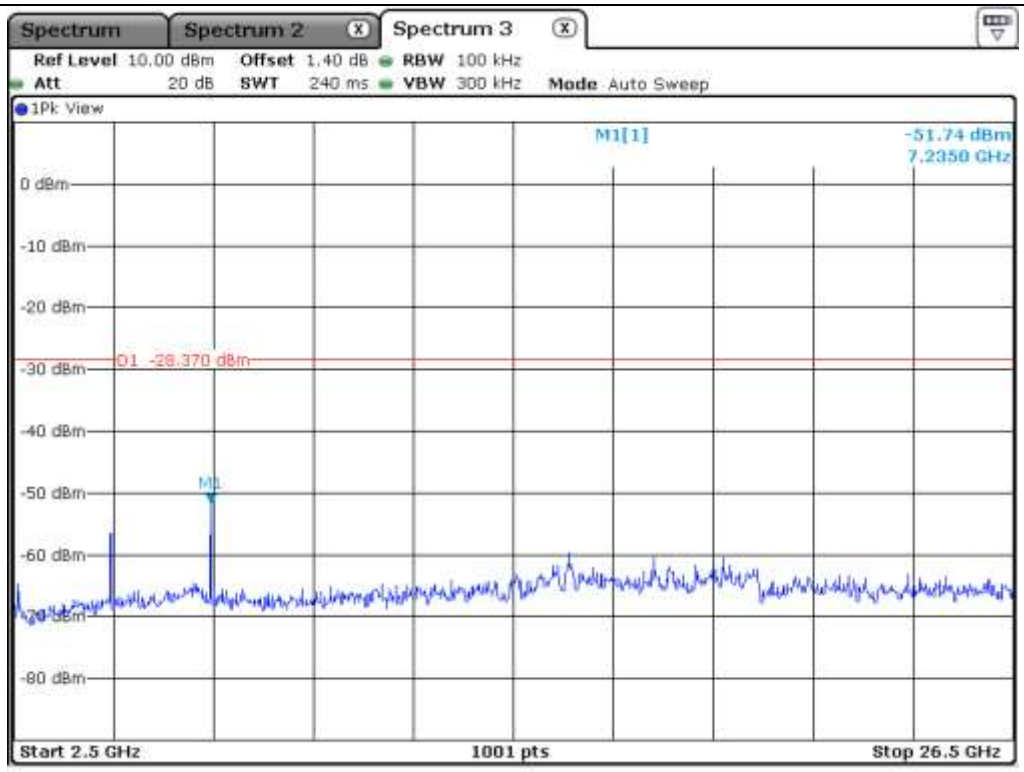


High Channel

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

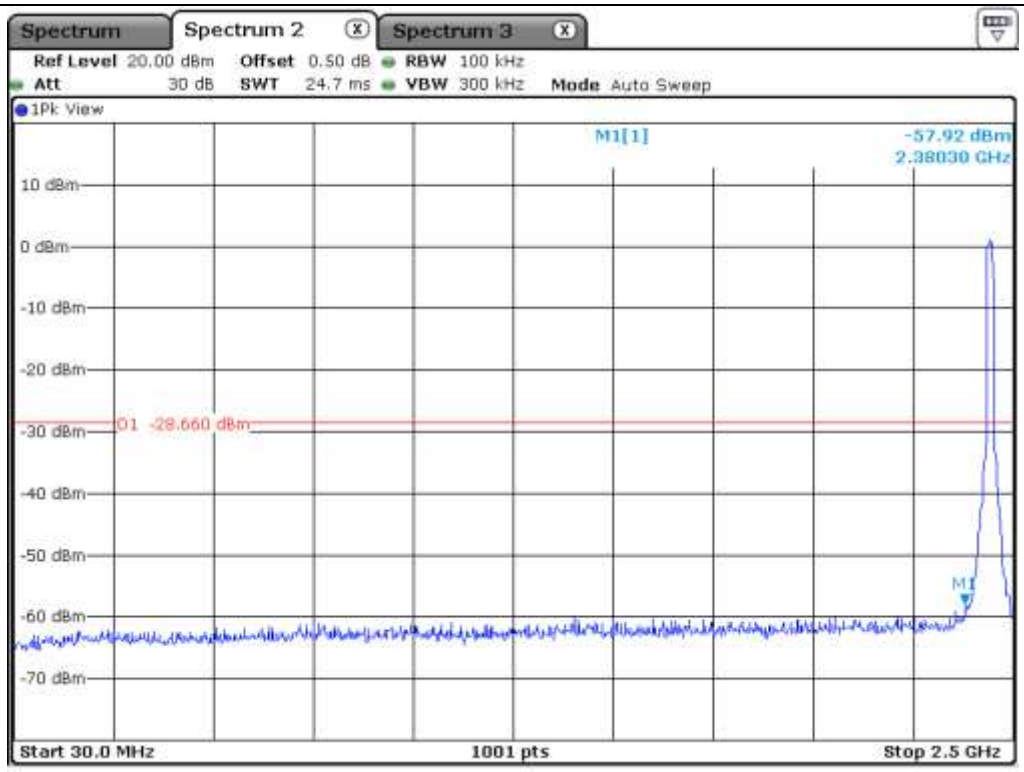


Low Channel

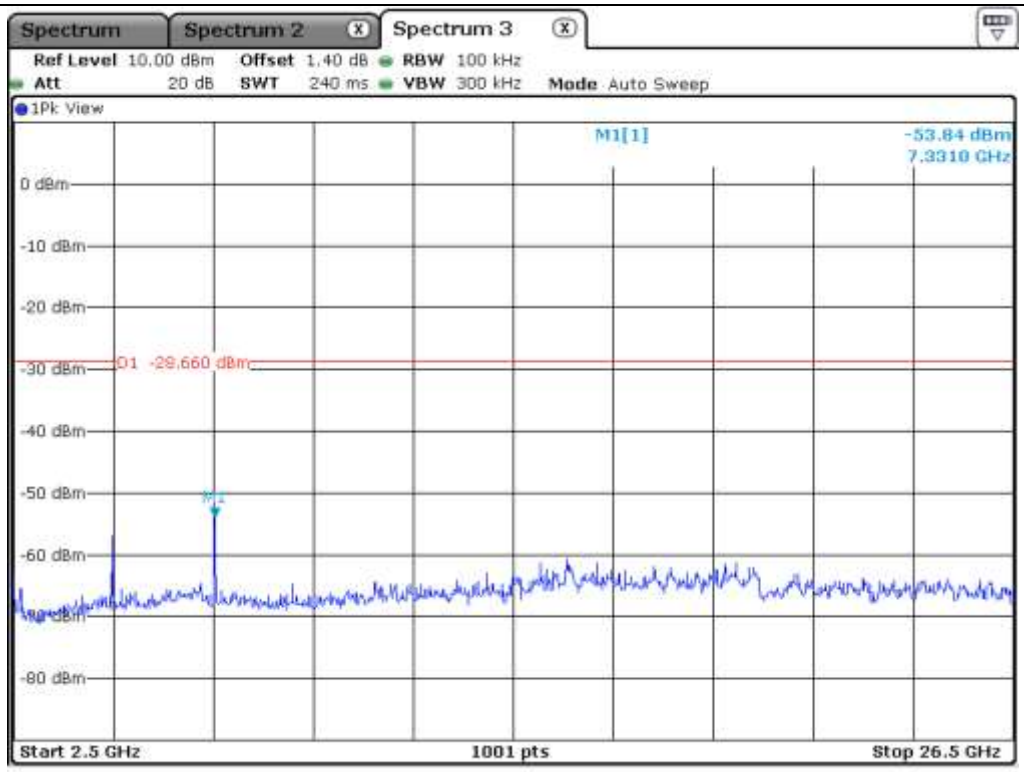


Low Channel

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

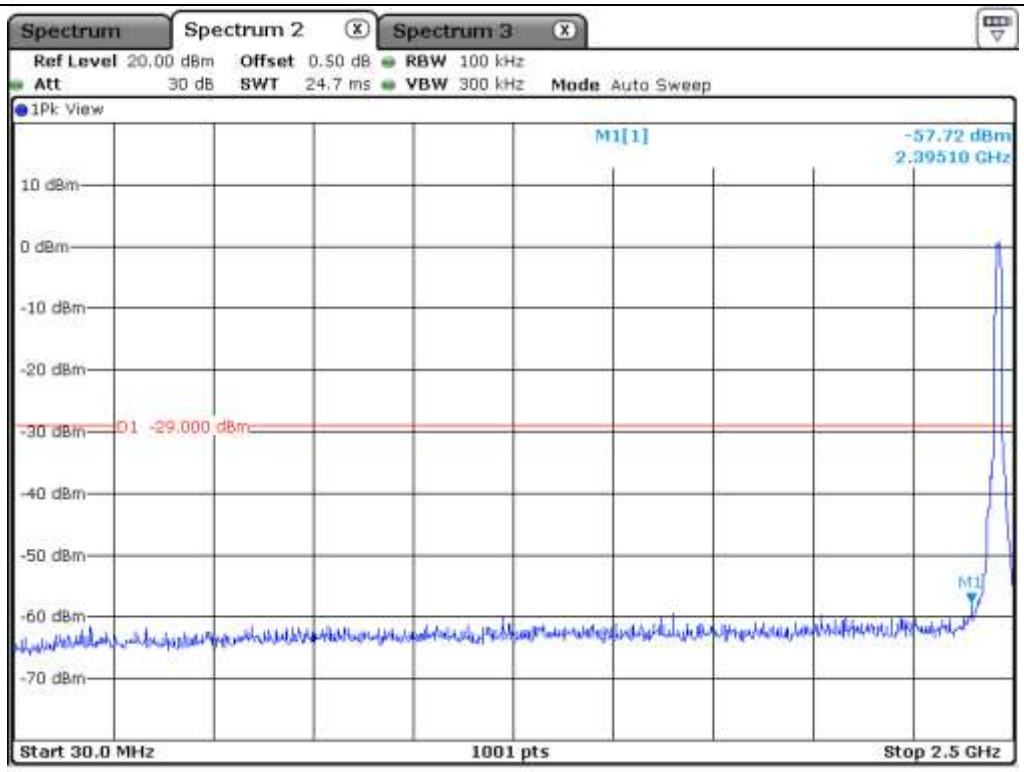


Middle Channel

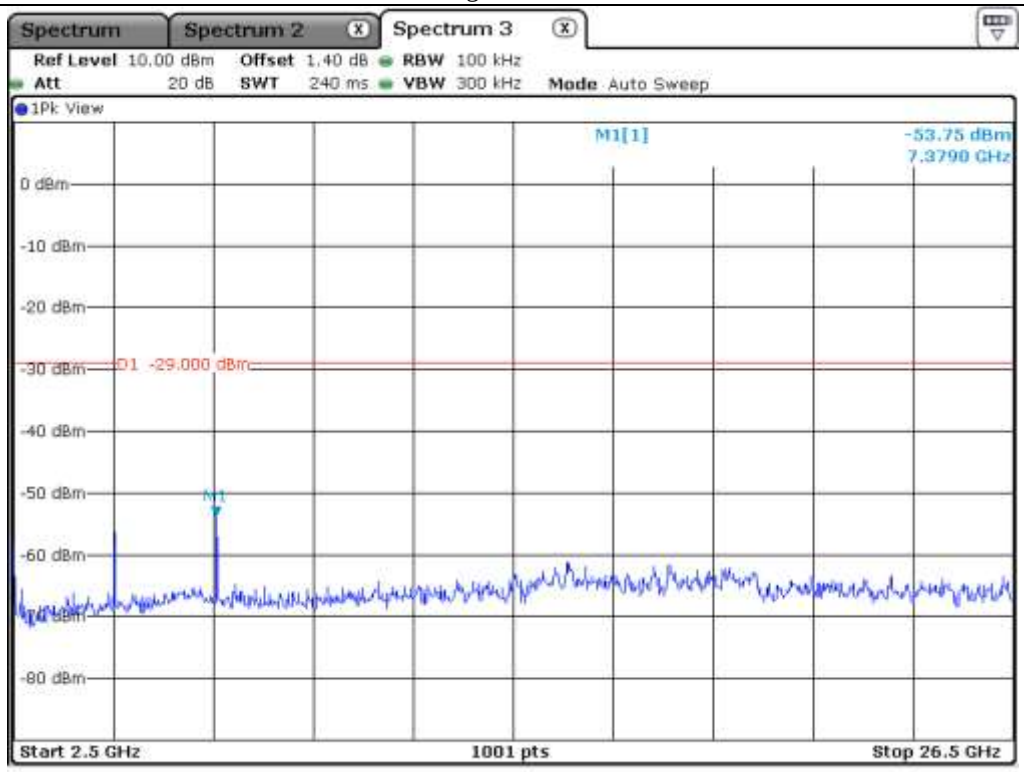


Middle Channel

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



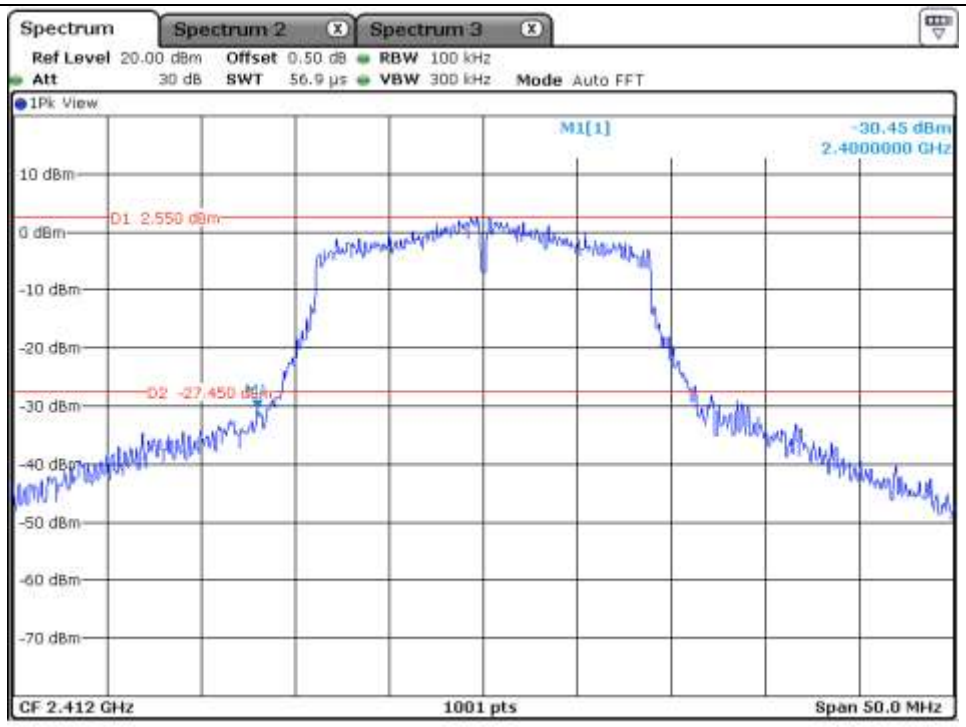
High Channel



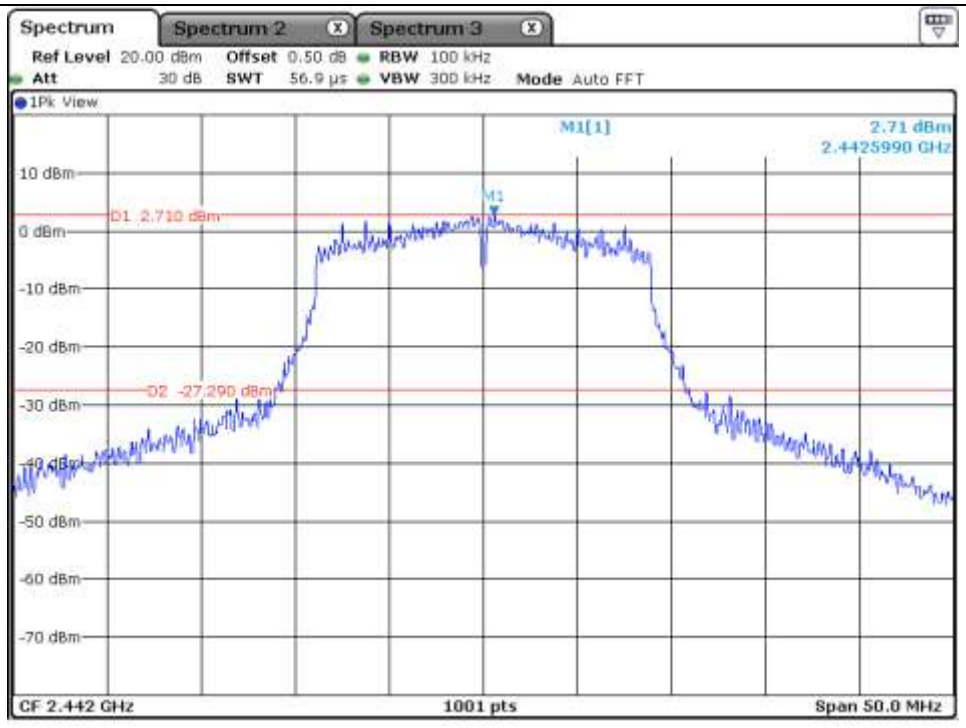
High Channel

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

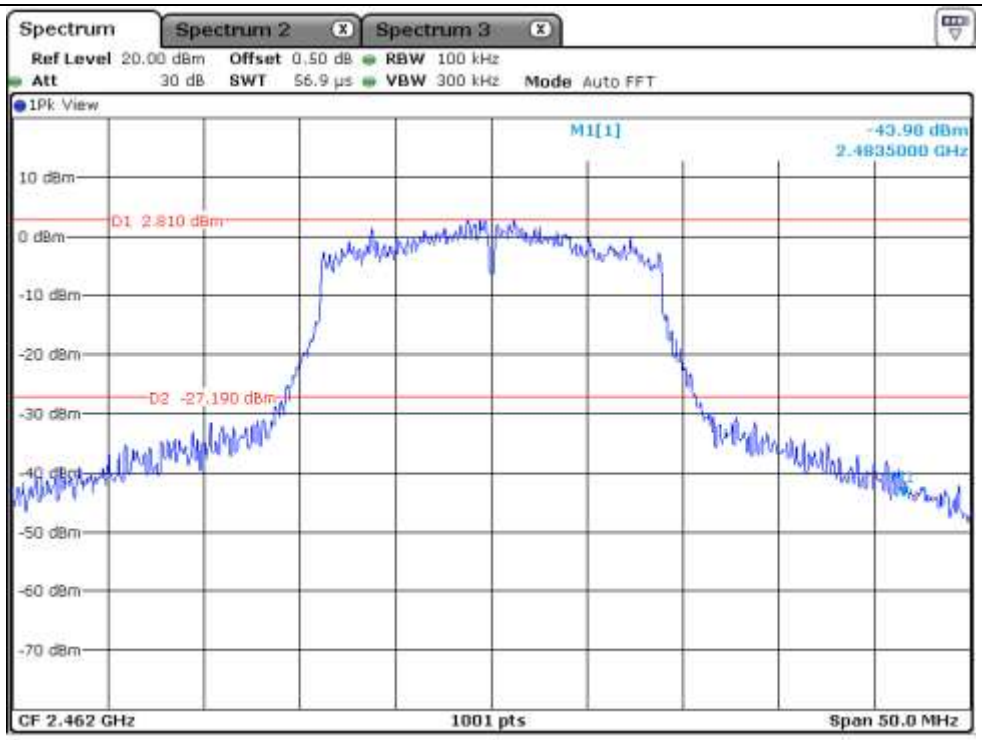
9.5.3.2 Test data for Antenna 1



Low Channel

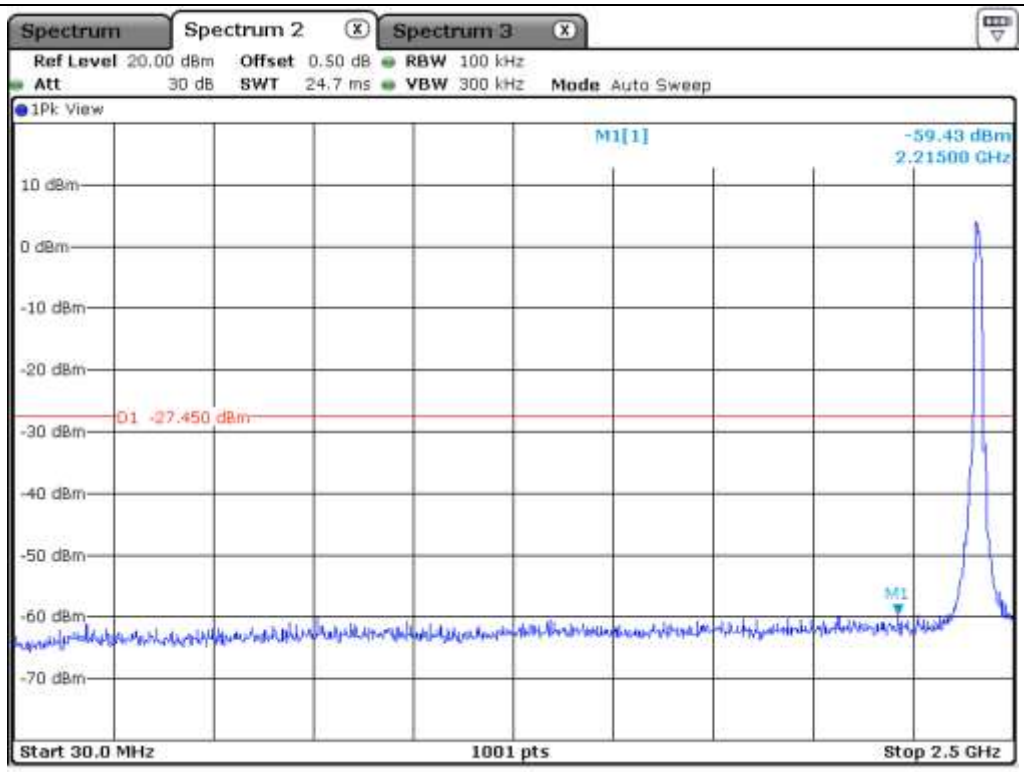


Middle Channel

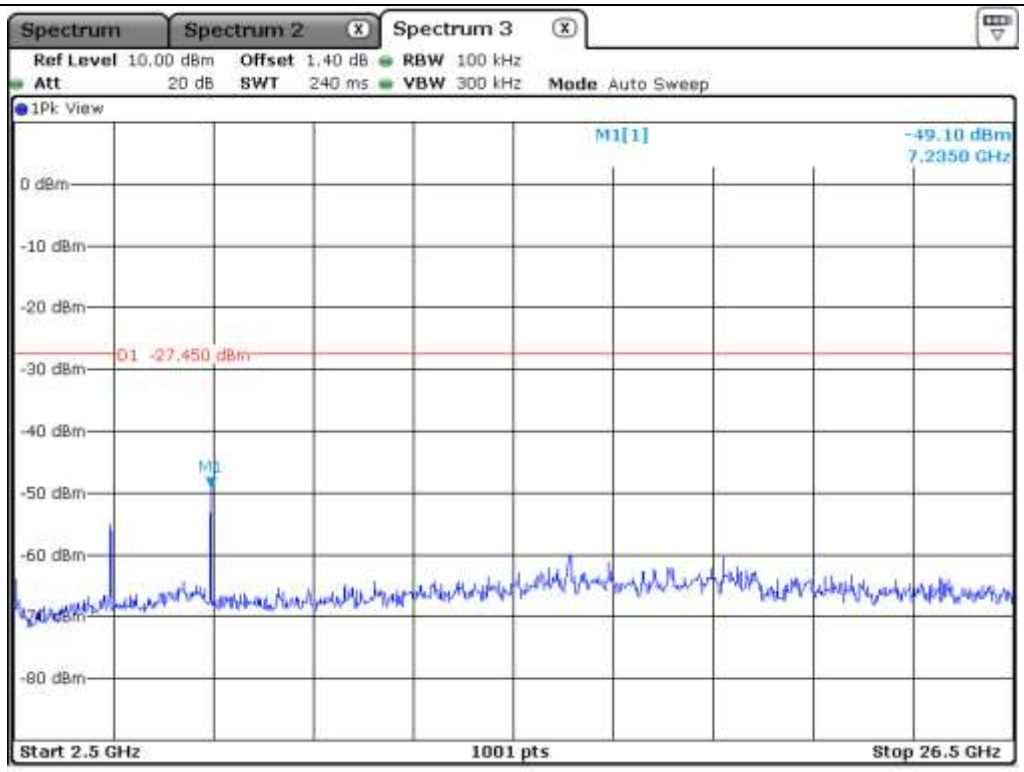


High Channel

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

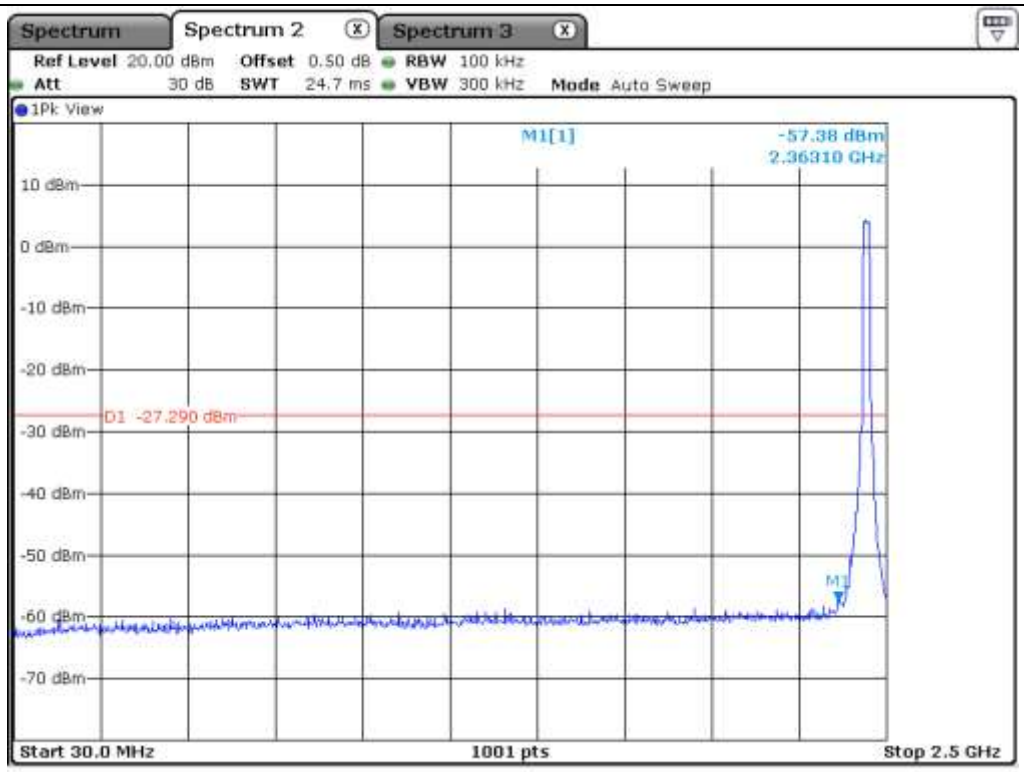


Low Channel

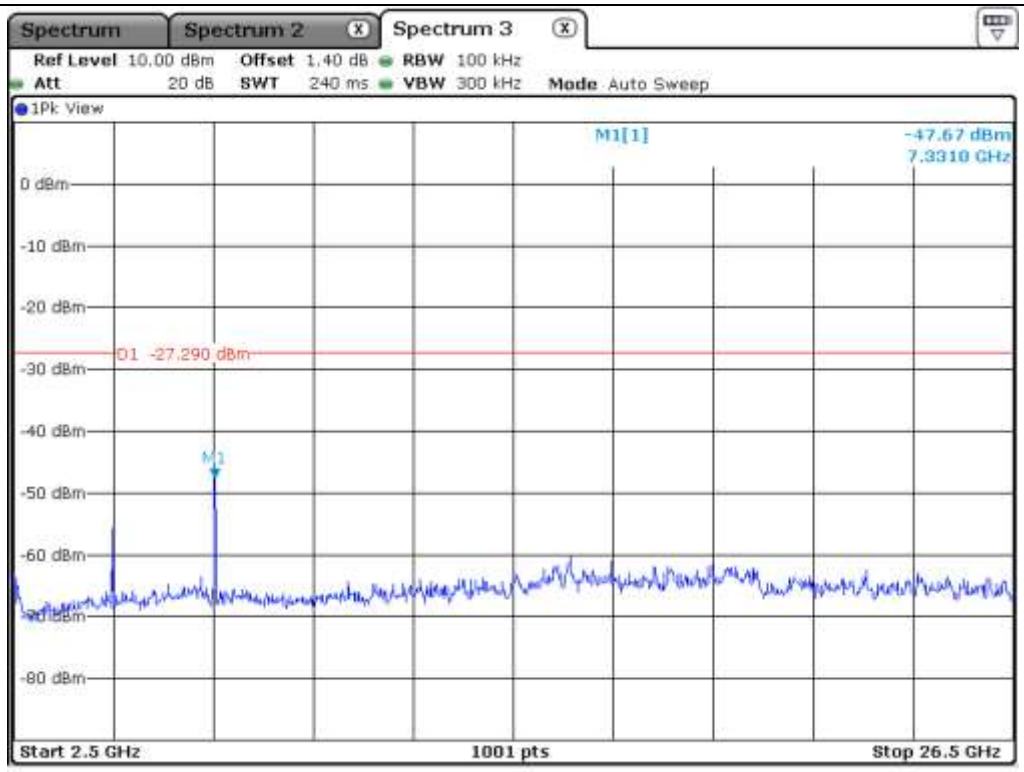


Low Channel

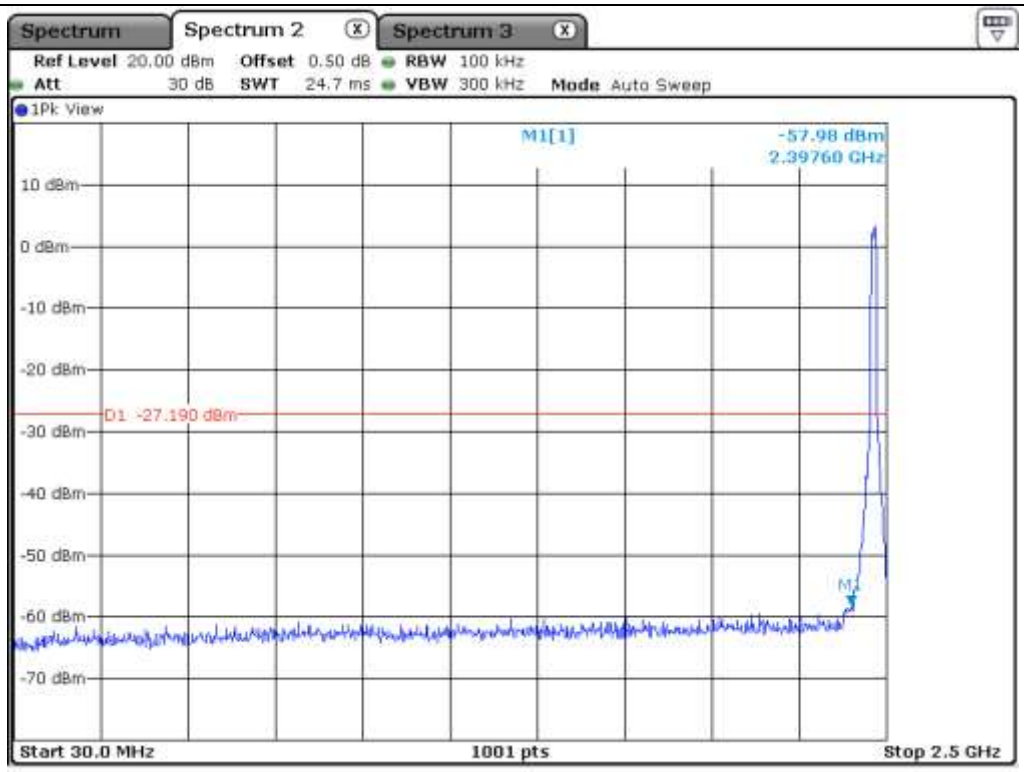
ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)



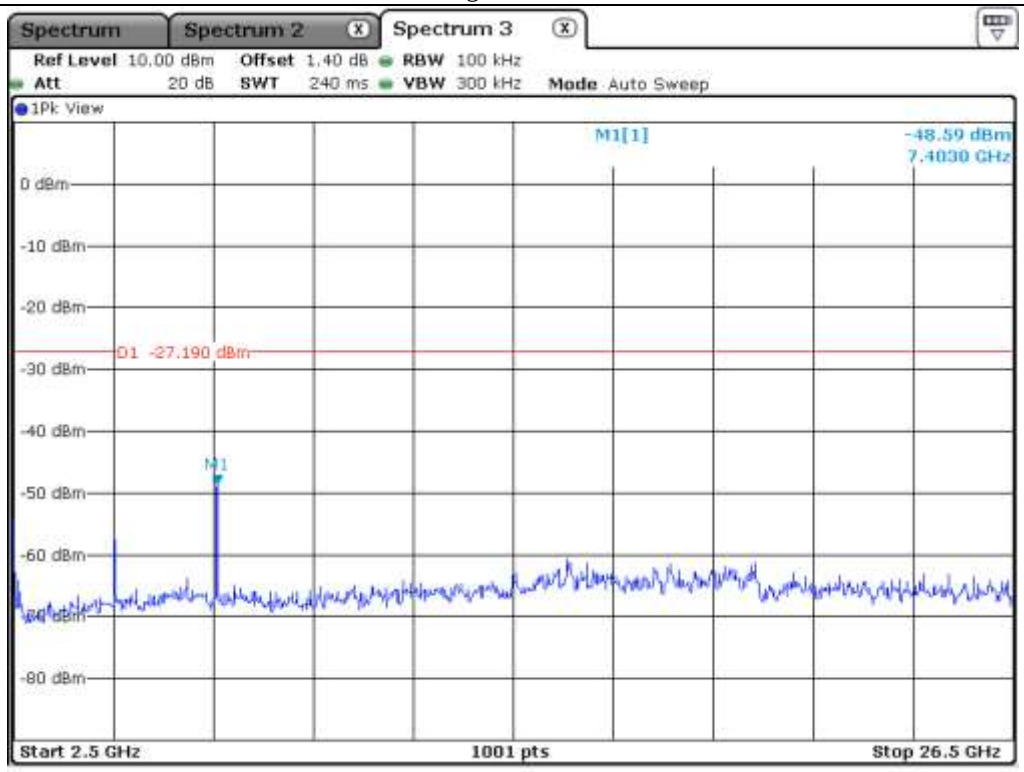
Middle Channel



Middle Channel



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 802.11b WLAN Mode

9.6.1.1.1 Test data for Antenna 0

-. Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Measurement distance : 3 m

-. Duty Cycle : 99.08 %

-. Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 384.611	22.42	Peak	H	26.90	3.07	-	52.39	74.00	21.61
2 386.523	11.43	Average	H	26.90	3.07	0.04	41.44	54.00	12.56
2 310.040	16.16	Peak	V	26.90	3.07	-	46.13	74.00	27.87
2 386.753	6.44	Average	V	26.90	3.07	0.04	36.45	54.00	17.55
Test Data for High Channel									
2 487.631	21.32	Peak	H	26.60	3.16	-	51.08	74.00	22.92
2 483.508	15.00	Average	H	26.60	3.16	0.04	44.80	54.00	9.20
2 488.074	18.94	Peak	V	26.60	3.16	-	48.70	74.00	25.30
2 483.508	9.25	Average	V	26.60	3.16	0.04	39.05	54.00	14.95

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

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9.6.1.1.2 Test data for Antenna 1

-. Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Measurement distance : 3 m

-. Duty Cycle : 98.74 %

-. Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 386.204	21.90	Peak	H	26.90	3.07	-	51.87	74.00	22.13
2 386.371	11.46	Average	H	26.90	3.07	0.06	41.49	54.00	12.51
2 386.763	15.89	Peak	V	26.90	3.07	-	45.86	74.00	28.14
2 386.518	6.85	Average	V	26.90	3.07	0.06	36.88	54.00	17.12
Test Data for High Channel									
2 487.983	20.70	Peak	H	26.60	3.16	-	50.46	74.00	23.54
2 483.508	14.67	Average	H	26.60	3.16	0.06	44.49	54.00	9.51
2 486.617	18.73	Peak	V	26.60	3.16	-	48.49	74.00	25.51
2 483.508	8.43	Average	V	26.60	3.16	0.06	38.25	54.00	15.75

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

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9.6.1.2 Test data for 802.11g WLAN Mode

9.6.1.2.1 Test data for Antenna 0

-. Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Measurement distance : 3 m

-. Duty Cycle : 93.42 %

-. Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 389.960	23.89	Peak	H	26.90	3.07	-	53.86	74.00	20.14
2 389.960	12.93	Average	H	26.90	3.07	0.30	43.20	54.00	10.80
2 389.960	17.95	Peak	V	26.90	3.07	-	47.92	74.00	26.08
2 389.960	7.89	Average	V	26.90	3.07	0.30	38.16	54.00	15.84
Test Data for High Channel									
2 483.607	24.33	Peak	H	26.60	3.16	-	54.09	74.00	19.91
2 483.508	16.16	Average	H	26.60	3.16	0.30	46.22	54.00	7.78
2 483.631	22.93	Peak	V	26.60	3.16	-	52.69	74.00	21.31
2 483.508	12.93	Average	V	26.60	3.16	0.30	42.99	54.00	11.01

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

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9.6.1.2.2 Test data for Antenna 1

-. Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Measurement distance : 3 m

-. Duty Cycle : 92.21 %

-. Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 389.724	24.61	Peak	H	26.90	3.07	-	54.58	74.00	19.42
2 389.960	12.94	Average	H	26.90	3.07	0.35	43.26	54.00	10.74
2 389.651	18.01	Peak	V	26.90	3.07	-	47.98	74.00	26.02
2 389.960	8.40	Average	V	26.90	3.07	0.35	38.72	54.00	15.28
Test Data for High Channel									
2 483.545	25.55	Peak	H	26.60	3.16	-	55.31	74.00	18.69
2 483.508	16.46	Average	H	26.60	3.16	0.35	46.57	54.00	7.43
2 483.728	21.95	Peak	V	26.60	3.16	-	51.71	74.00	22.29
2 483.508	13.92	Average	V	26.60	3.16	0.35	44.03	54.00	9.97

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

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9.6.1.3 Test data for 802.11n_HT20 WLAN Mode

9.6.1.3.1 Test data for Multiple Transmit

-. Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Measurement distance : 3 m

-. Duty Cycle : 83.75 %

-. Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 389.960	26.99	Peak	H	26.90	3.07	-	56.96	74.00	17.04
2 389.960	15.60	Average	H	26.90	3.07	0.73	46.30	54.00	7.70
2 389.960	21.09	Peak	V	26.90	3.07	-	51.06	74.00	22.94
2 389.960	11.45	Average	V	26.90	3.07	0.73	42.15	54.00	11.85
Test Data for High Channel									
2 483.508	38.26	Peak	H	26.60	3.16	-	68.02	74.00	5.98
2 483.508	21.17	Average	H	26.60	3.16	0.73	51.66	54.00	2.34
2 483.508	25.79	Peak	V	26.60	3.16	-	55.55	74.00	18.45
2 483.508	17.54	Average	V	26.60	3.16	0.73	48.03	54.00	5.97

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

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9.6.2 Spurious & Harmonic Radiated Emission

9.6.2.1 Test data for 802.11b WLAN Mode

9.6.2.1.1 Test data for Antenna 0

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

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Duty Cycle : 99.08 %

-. Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 824.00	17.99	Peak	H	28.20	4.85	-	51.04	74.00	22.96
4 824.00	8.59	Average	H	28.20	4.85	0.04	41.68	54.00	12.32
4 824.00	17.26	Peak	V	28.20	4.85	-	50.31	74.00	23.69
4 824.00	8.55	Average	V	28.20	4.85	0.04	41.64	54.00	12.36
Test Data for Middle Channel									
4 884.00	17.56	Peak	H	28.30	4.91	-	50.77	74.00	23.23
4 884.00	8.42	Average	H	28.30	4.91	0.04	41.67	54.00	12.33
4 884.00	17.56	Peak	V	28.30	4.91	-	50.77	74.00	23.23
4 884.00	9.08	Average	V	28.30	4.91	0.04	42.33	54.00	11.67
Test Data for High Channel									
4 924.00	18.08	Peak	H	28.60	5.04	-	51.72	74.00	22.28
4 924.00	9.13	Average	H	28.60	5.04	0.04	42.81	54.00	11.19
4 924.00	16.81	Peak	V	28.60	5.04	-	50.45	74.00	23.55
4 924.00	8.18	Average	V	28.60	5.04	0.04	41.86	54.00	12.14

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

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

9.6.2.1.2 Test data for Antenna 1

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

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Duty Cycle : 98.74 %

-. Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 824.00	18.44	Peak	H	28.20	4.85	-	51.49	74.00	22.51
4 824.00	8.37	Average	H	28.20	4.85	0.06	41.48	54.00	12.52
4 824.00	18.12	Peak	V	28.20	4.85	-	51.17	74.00	22.83
4 824.00	7.92	Average	V	28.20	4.85	0.06	41.03	54.00	12.97
Test Data for Middle Channel									
4 884.00	17.61	Peak	H	28.30	4.91	-	50.82	74.00	23.18
4 884.00	8.30	Average	H	28.30	4.91	0.06	41.57	54.00	12.43
4 884.00	17.39	Peak	V	28.30	4.91	-	50.60	74.00	23.40
4 884.00	7.97	Average	V	28.30	4.91	0.06	41.24	54.00	12.76
Test Data for High Channel									
4 924.00	17.83	Peak	H	28.60	5.04	-	51.47	74.00	22.53
4 924.00	8.09	Average	H	28.60	5.04	0.06	41.79	54.00	12.21
4 924.00	16.86	Peak	V	28.60	5.04	-	50.50	74.00	23.50
4 924.00	7.92	Average	V	28.60	5.04	0.06	41.62	54.00	12.38

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

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9.6.2.2 Test data for 802.11g WLAN Mode

9.6.2.2.1 Test data for Antenna 0

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

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Duty Cycle : 93.42 %

-. Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 824.00	18.51	Peak	H	28.20	4.85	-	51.56	74.00	22.44
4 824.00	7.95	Average	H	28.20	4.85	0.30	41.30	54.00	12.70
4 824.00	17.38	Peak	V	28.20	4.85	-	50.43	74.00	23.57
4 824.00	8.62	Average	V	28.20	4.85	0.30	41.97	54.00	12.03
Test Data for Middle Channel									
4 884.00	17.66	Peak	H	28.30	4.91	-	50.87	74.00	23.13
4 884.00	7.85	Average	H	28.30	4.91	0.30	41.36	54.00	12.64
4 884.00	17.19	Peak	V	28.30	4.91	-	50.40	74.00	23.60
4 884.00	8.07	Average	V	28.30	4.91	0.30	41.58	54.00	12.42
Test Data for High Channel									
4 924.00	17.89	Peak	H	28.60	5.04	-	51.53	74.00	22.47
4 924.00	7.80	Average	H	28.60	5.04	0.30	41.74	54.00	12.26
4 924.00	17.43	Peak	V	28.60	5.04	-	51.07	74.00	22.93
4 924.00	7.52	Average	V	28.60	5.04	0.30	41.46	54.00	12.54

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

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9.6.2.2.2 Test data for Antenna 1

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

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Duty Cycle : 92.21 %

-. Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 824.00	18.71	Peak	H	28.20	4.85	-	51.76	74.00	22.24
4 824.00	7.77	Average	H	28.20	4.85	0.35	41.17	54.00	12.83
4 824.00	17.38	Peak	V	28.20	4.85	-	50.43	74.00	23.57
4 824.00	8.51	Average	V	28.20	4.85	0.35	41.91	54.00	12.09
Test Data for Middle Channel									
4 884.00	17.99	Peak	H	28.30	4.91	-	51.20	74.00	22.80
4 884.00	9.01	Average	H	28.30	4.91	0.35	42.57	54.00	11.43
4 884.00	16.68	Peak	V	28.30	4.91	-	49.89	74.00	24.11
4 884.00	8.57	Average	V	28.30	4.91	0.35	42.13	54.00	11.87
Test Data for High Channel									
4 924.00	18.50	Peak	H	28.60	5.04	-	52.14	74.00	21.86
4 924.00	8.56	Average	H	28.60	5.04	0.35	42.55	54.00	11.45
4 924.00	17.67	Peak	V	28.60	5.04	-	51.31	74.00	22.69
4 924.00	7.89	Average	V	28.60	5.04	0.35	41.88	54.00	12.12

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

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9.6.2.3 Test data for 802.11n_HT20 WLAN Mode

9.6.2.3.1 Test data for Multiple Transmit

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

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Duty Cycle : 83.75 %

-. Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 824.00	18.37	Peak	H	28.20	4.85	-	51.42	74.00	22.58
4 824.00	7.61	Average	H	28.20	4.85	0.73	41.39	54.00	12.61
4 824.00	17.87	Peak	V	28.20	4.85	-	50.92	74.00	23.08
4 824.00	8.27	Average	V	28.20	4.85	0.73	42.05	54.00	11.95
Test Data for Middle Channel									
4 884.00	18.35	Peak	H	28.30	4.91	-	51.56	74.00	22.44
4 884.00	8.31	Average	H	28.30	4.91	0.73	42.25	54.00	11.75
4 884.00	17.34	Peak	V	28.30	4.91	-	50.55	74.00	23.45
4 884.00	9.27	Average	V	28.30	4.91	0.73	43.21	54.00	10.79
Test Data for High Channel									
4 924.00	17.96	Peak	H	28.60	5.04	-	51.60	74.00	22.40
4 924.00	7.84	Average	H	28.60	5.04	0.73	42.21	54.00	11.79
4 924.00	17.62	Peak	V	28.60	5.04	-	51.26	74.00	22.74
4 924.00	7.66	Average	V	28.60	5.04	0.73	42.03	54.00	11.97

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

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10. PEAK POWER SPECTRUL DENSITY

10.1 Operating environment

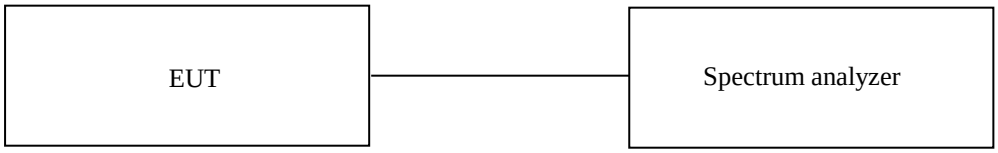
Temperature : 23 °C

Relative humidity : 45 % 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 ≤ RBW ≤ 100 kHz , the video bandwidth is set to 3 times the resolution bandwidth.



10.3 Test Date

September 07, 2020 ~ September 11, 2020

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

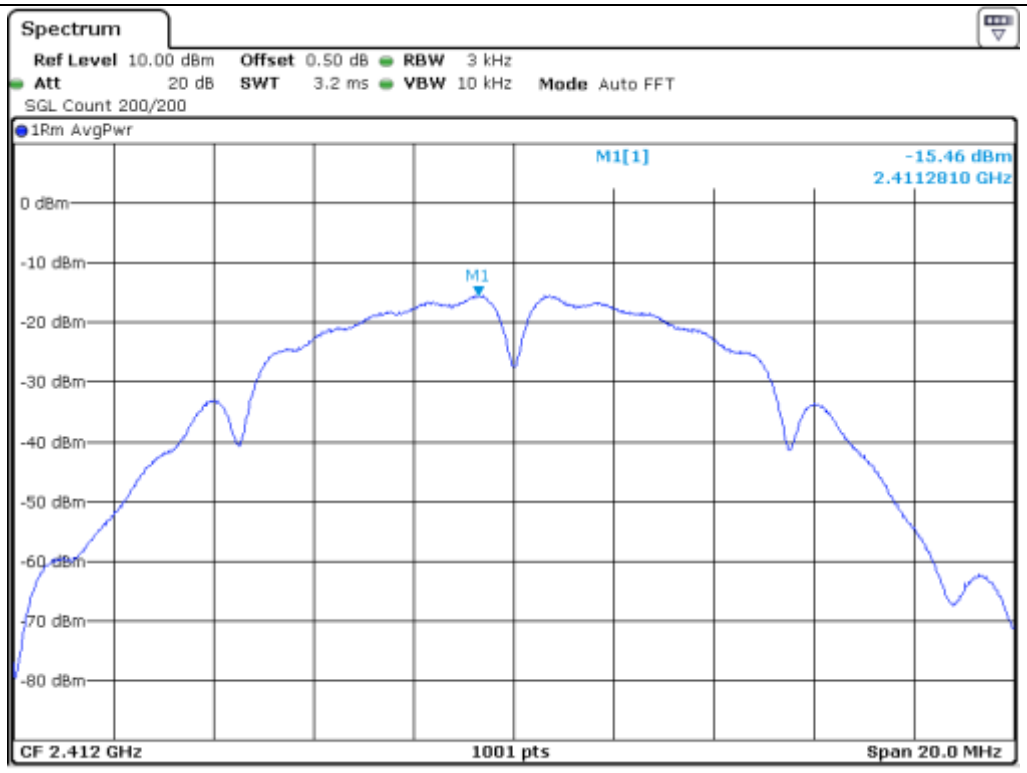
10.4 Test data for 802.11b WLAN Mode

10.4.1 Test data for Antenna 0

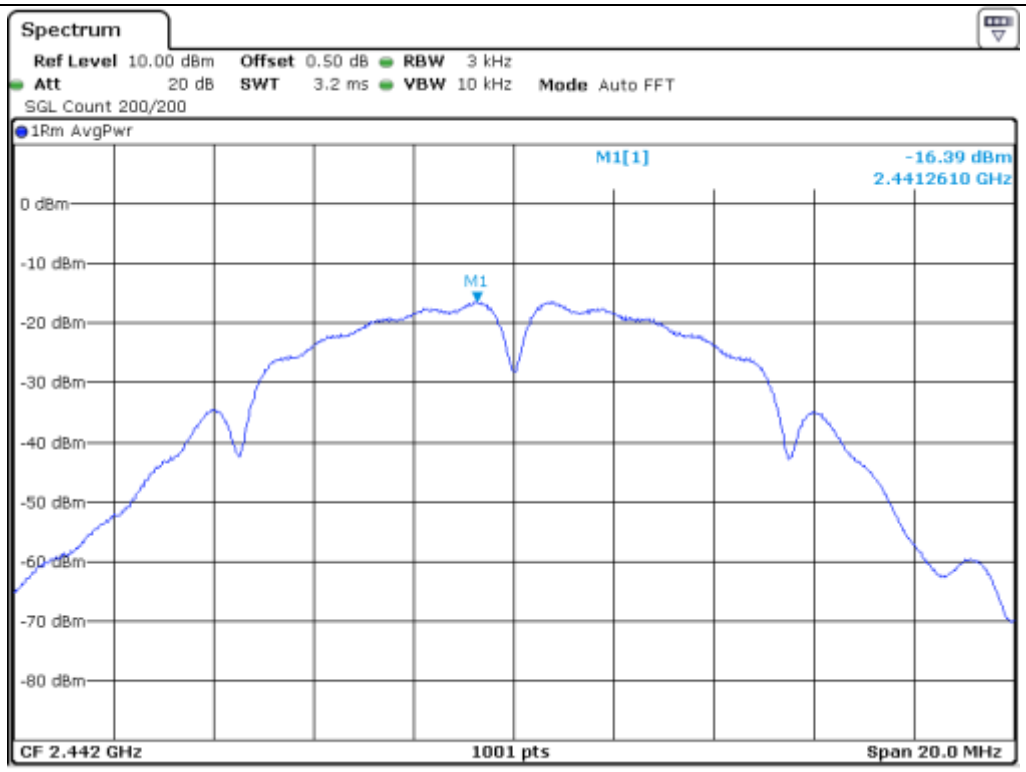
-. Test Result : Pass

FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
2 412.00	-15.46	0.04	-15.42	8.00	23.42
2 442.00	-16.39	0.04	-16.35	8.00	24.35
2 462.00	-16.37	0.04	-16.33	8.00	24.33

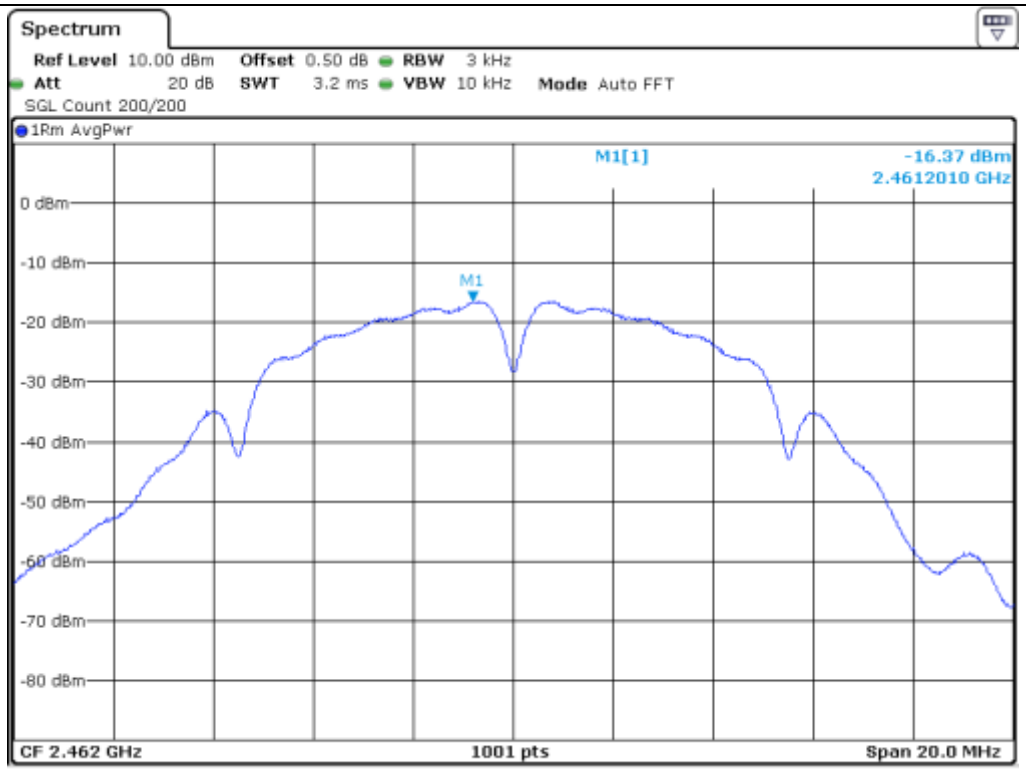
Remark : Margin = Limit – Result(Measured Value + Correction Factor)



Low Channel



Middle Channel



High Channel

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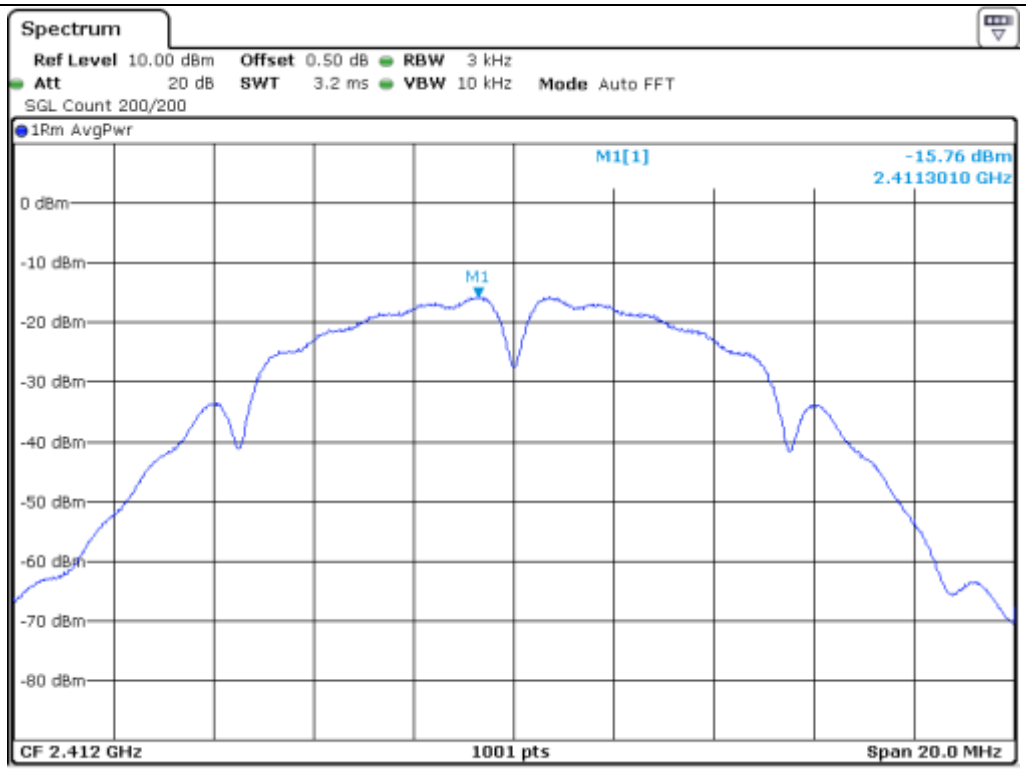
10.4.2 Test data for Antenna 1

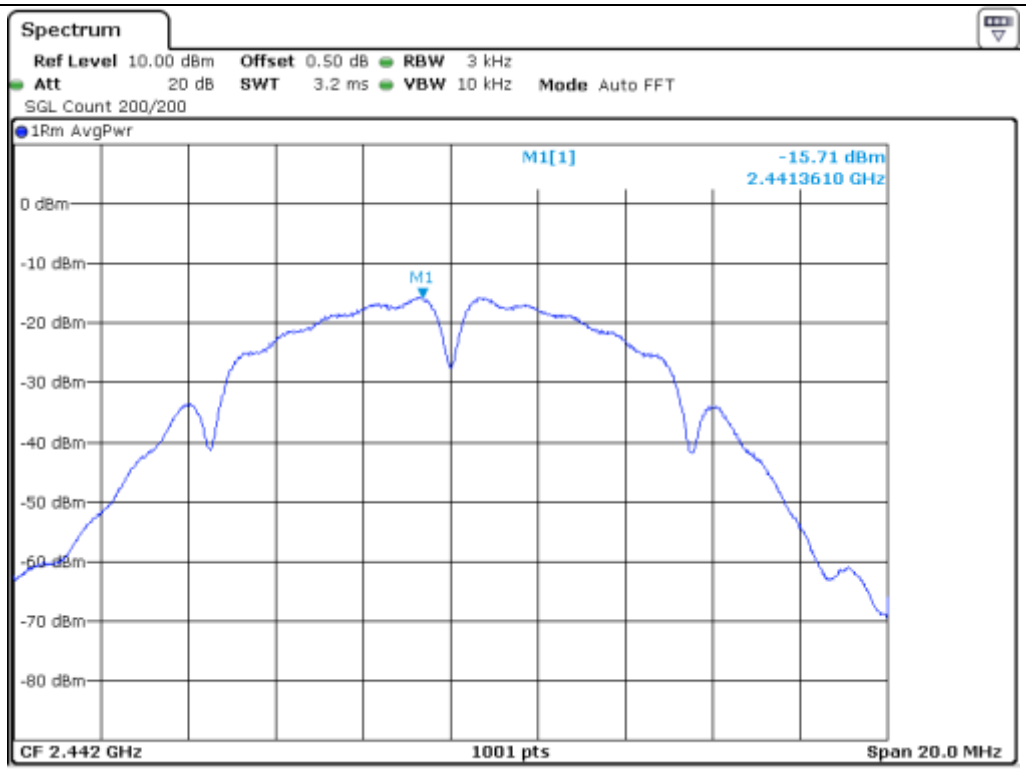
-. Test Result : Pass

FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
2 412.00	-15.76	0.06	-15.70	8.00	23.70
2 442.00	-15.71	0.06	-15.65	8.00	23.65
2 462.00	-15.45	0.06	-15.39	8.00	23.39

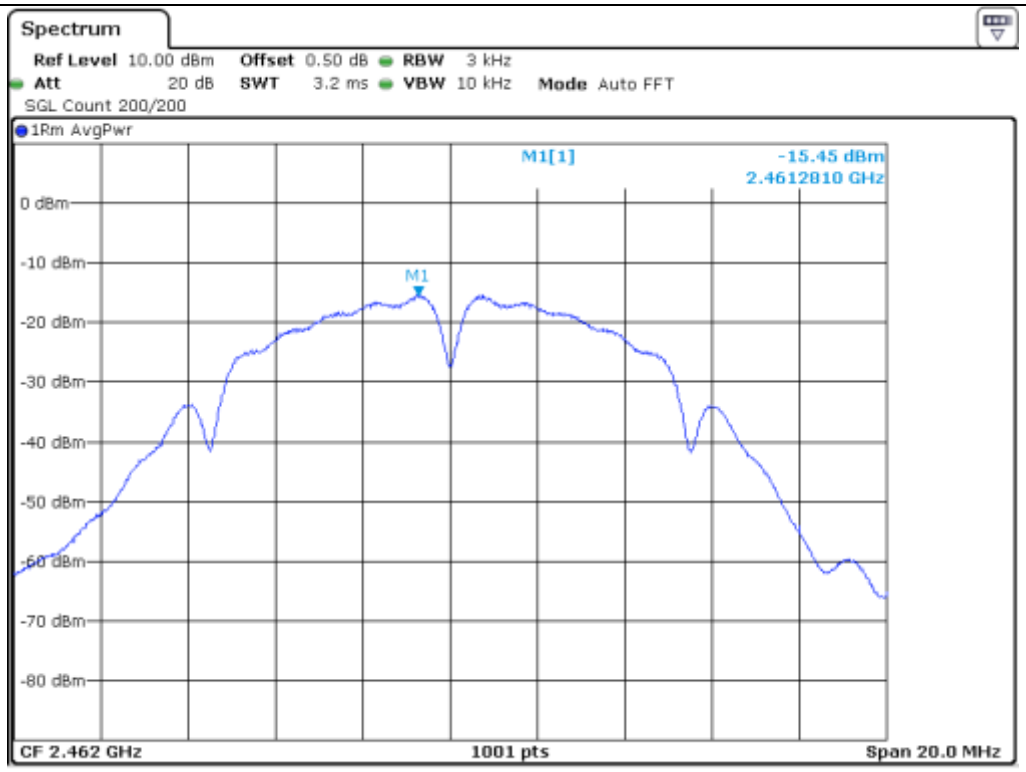
Remark : Margin = Limit – Result(Measured Value + Correction Factor)



Low Channel



Middle Channel



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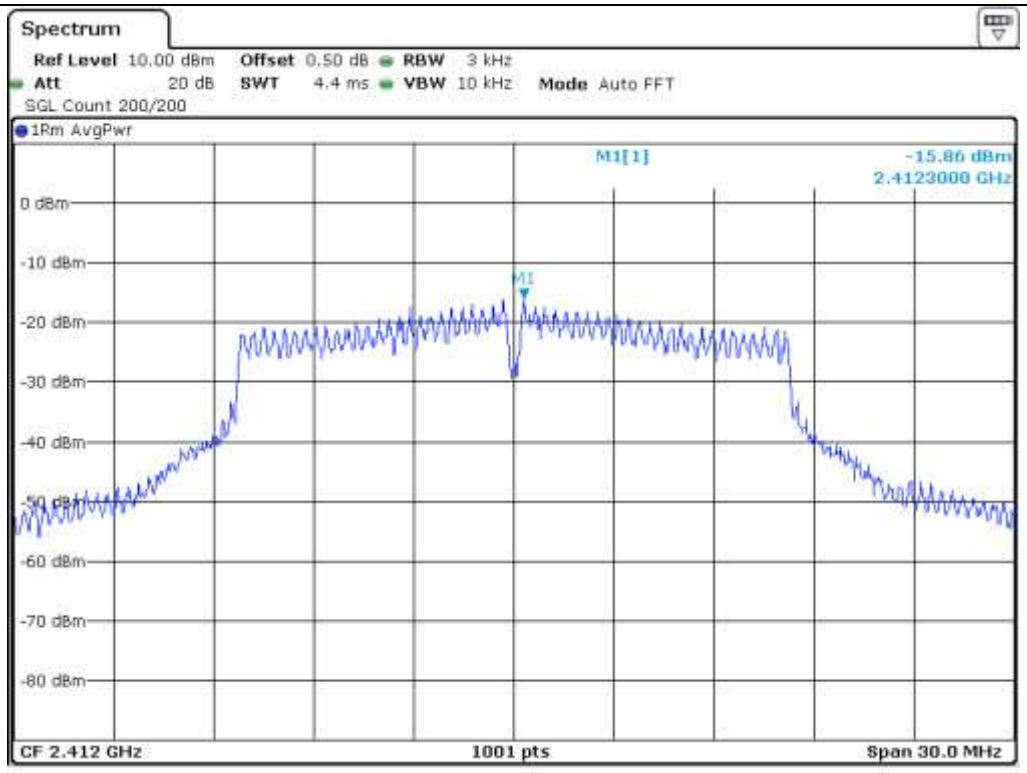
10.5 Test data for 802.11g WLAN Mode

10.5.1 Test data for Antenna 0

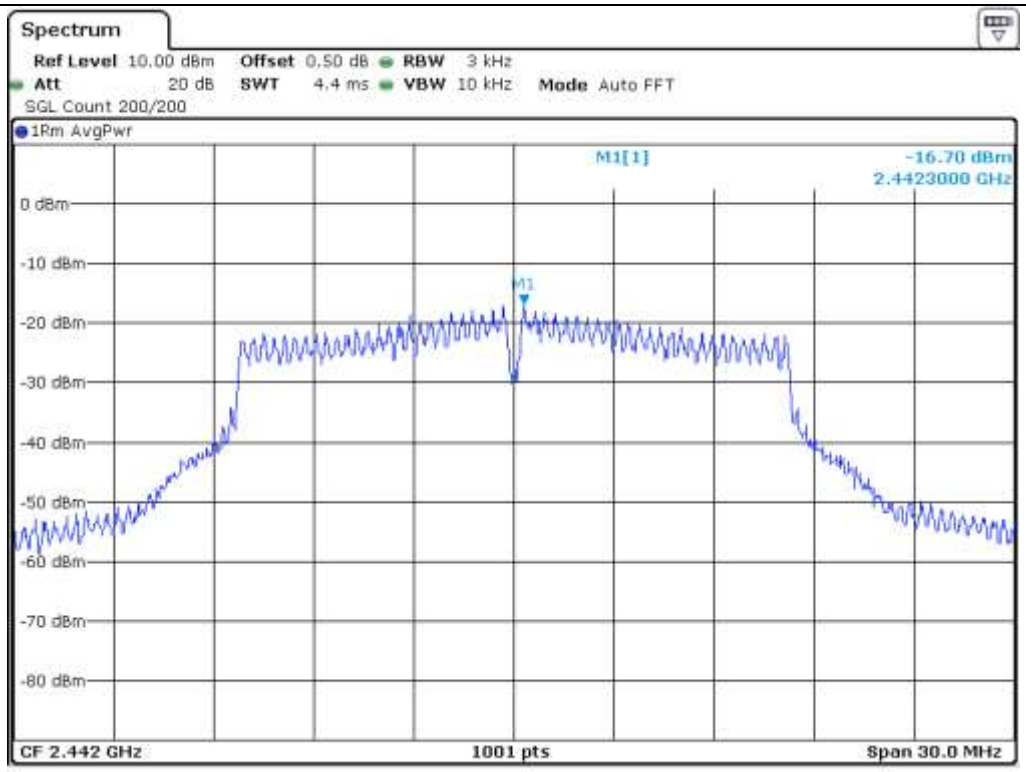
-. Test Result : Pass

FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
2 412.00	-15.86	0.30	-15.56	8.00	23.56
2 442.00	-16.70	0.30	-16.40	8.00	24.40
2 462.00	-16.57	0.30	-16.27	8.00	24.27

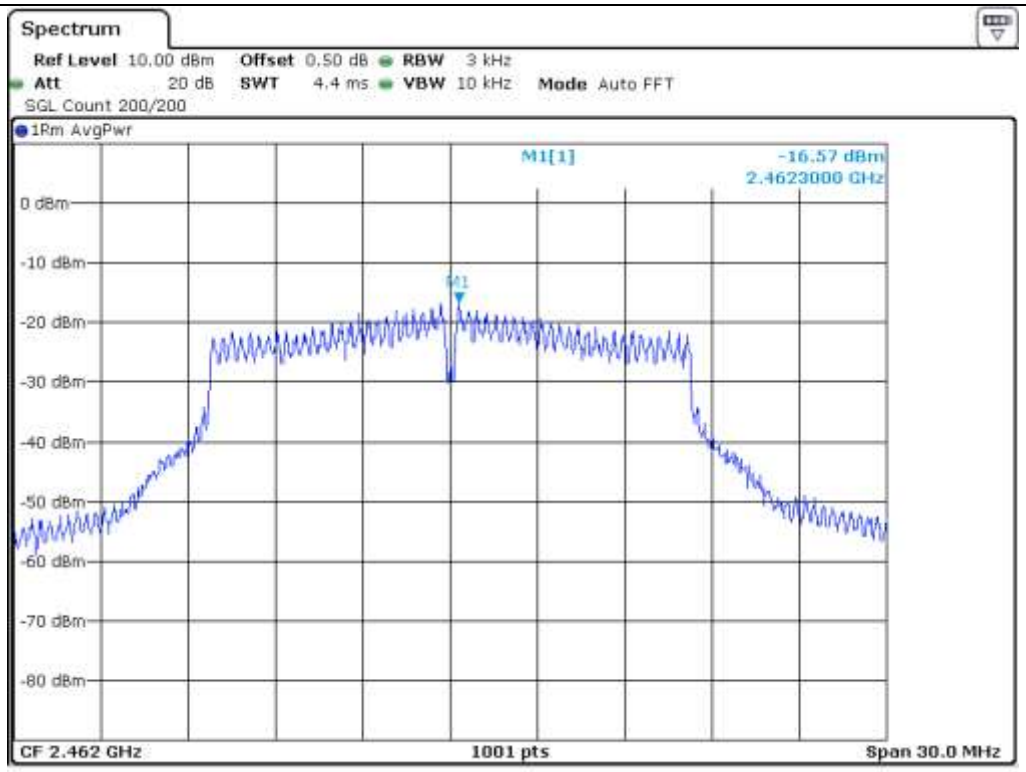
Remark : Margin = Limit – Result(Measured Value + Correction Factor)



Low Channel



Middle Channel



High Channel

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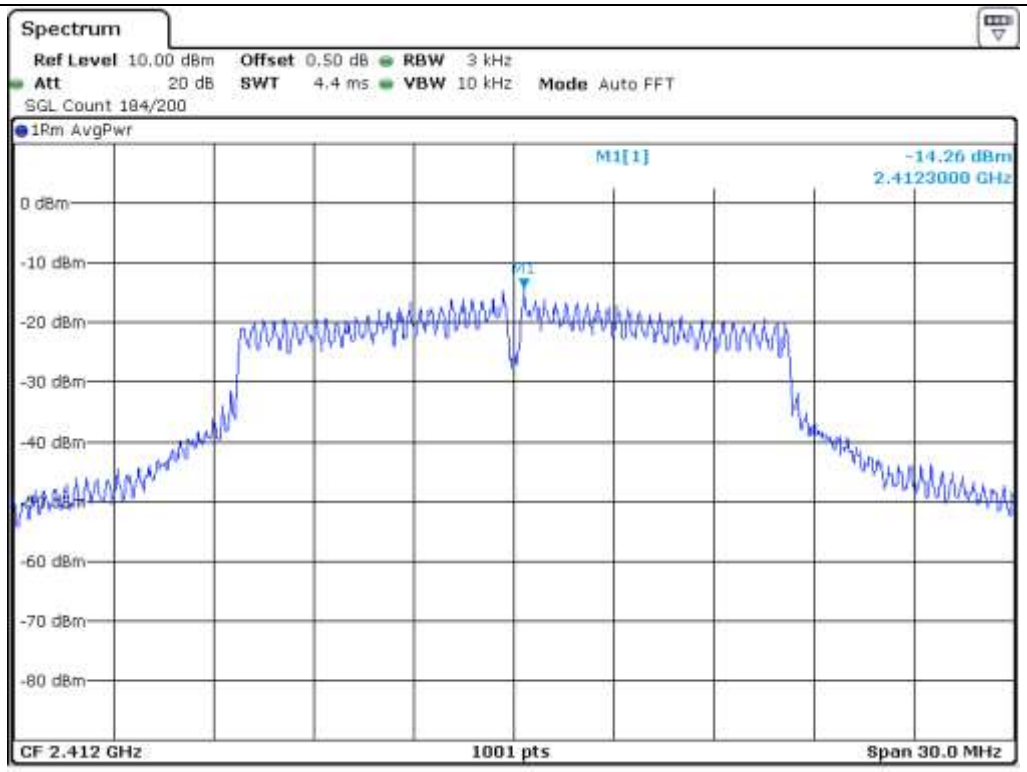
10.5.2 Test data for Antenna 1

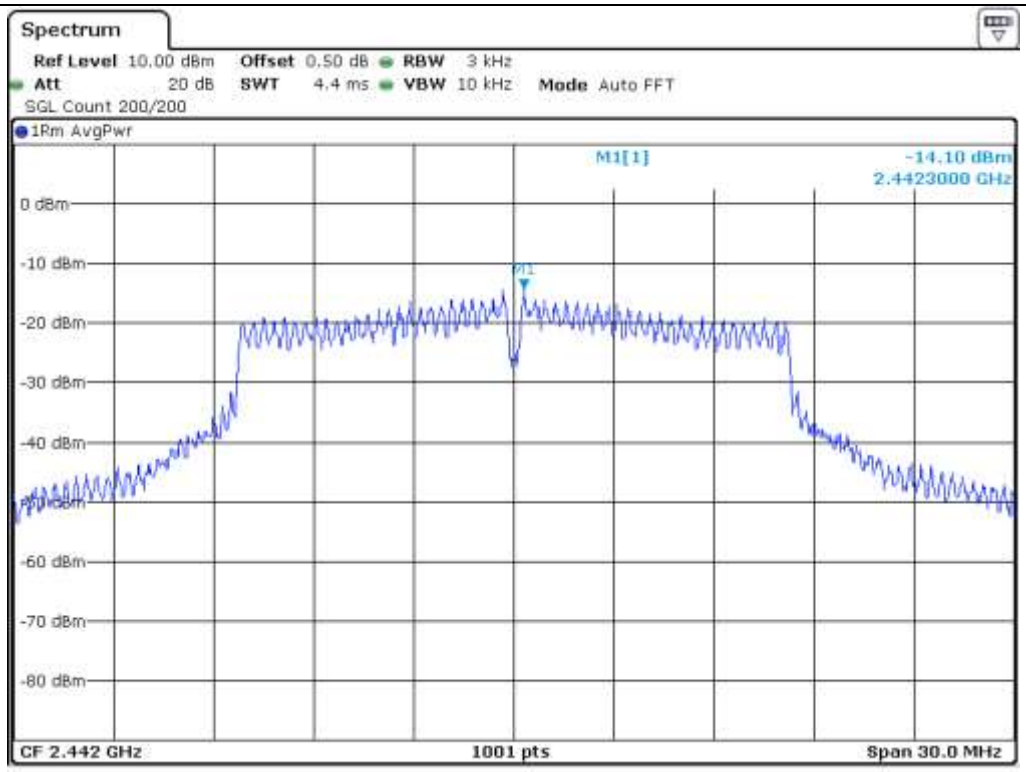
-. Test Result : Pass

FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
2 412.00	-14.26	0.35	-13.91	8.00	21.91
2 442.00	-14.10	0.35	-13.75	8.00	21.75
2 462.00	-14.14	0.35	-13.79	8.00	21.79

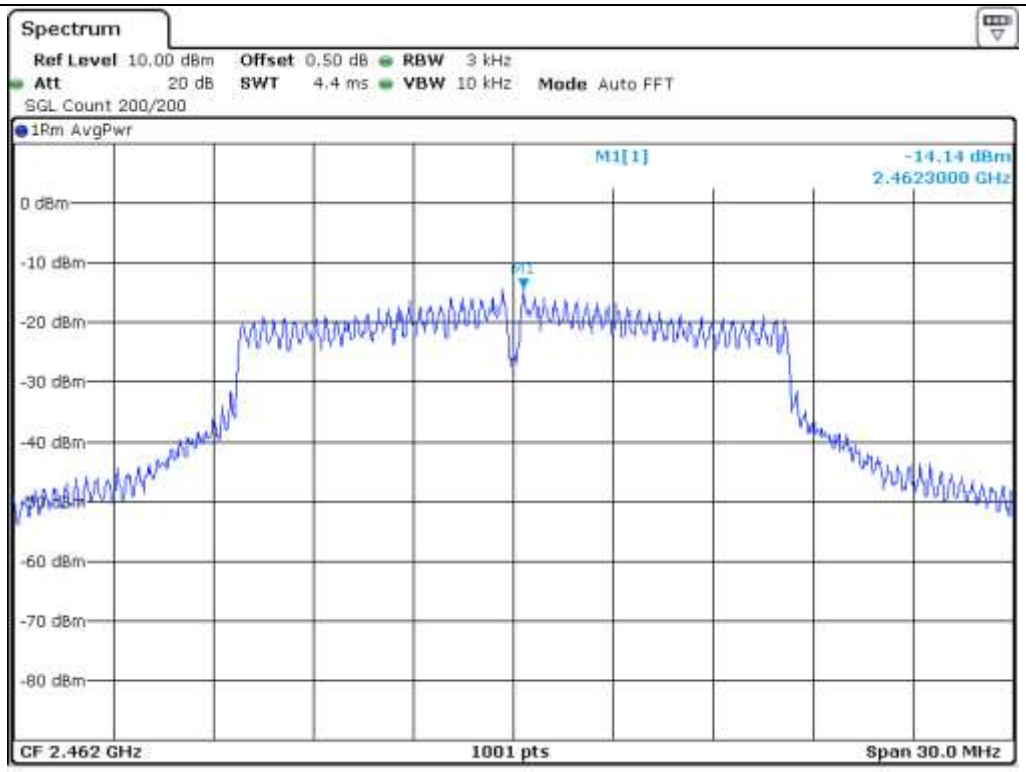
Remark : Margin = Limit – Result(Measured Value + Correction Factor)



Low Channel



Middle Channel



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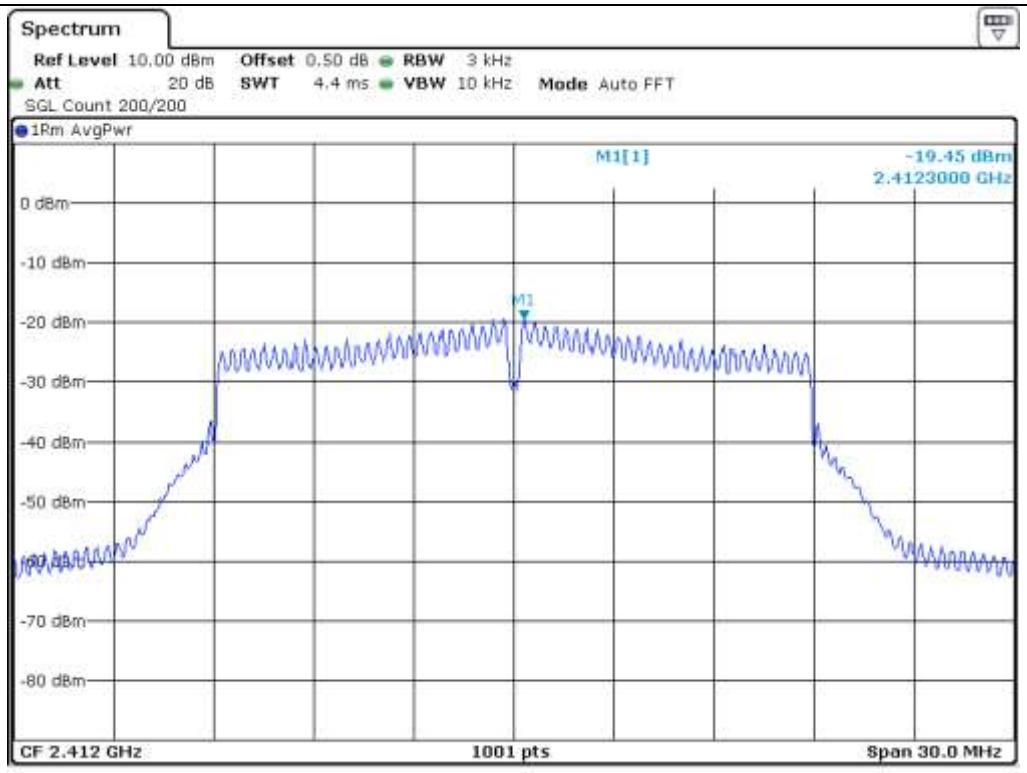
10.6 Test data for 802.11n_HT20 WLAN Mode

10.6.1 Test data for Antenna 0

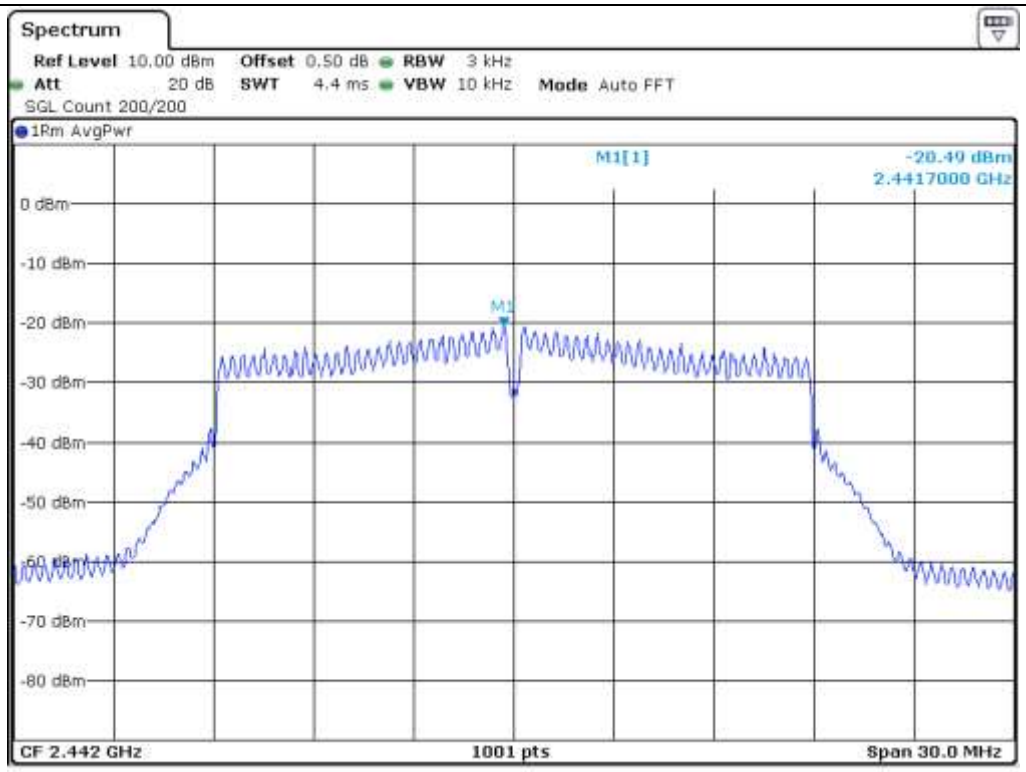
-. Test Result : Pass

FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
2 412.00	-19.45	0.77	-18.68	8.00	26.68
2 442.00	-20.49	0.77	-19.72	8.00	27.72
2 462.00	-20.36	0.77	-19.59	8.00	27.59

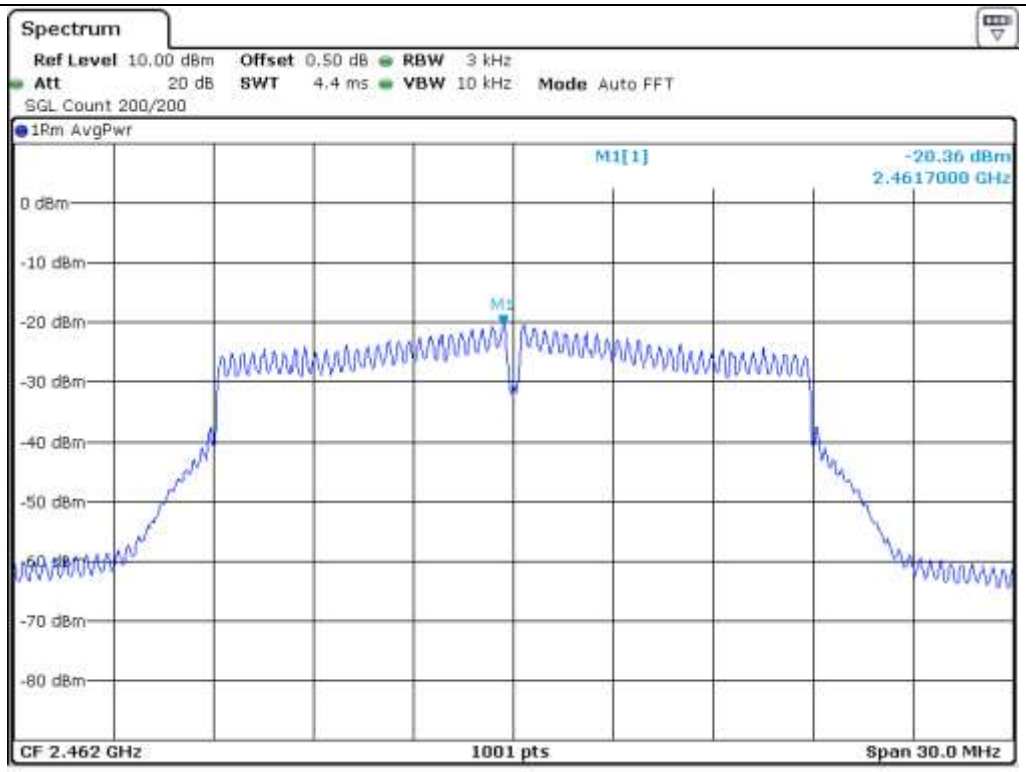
Remark : Margin = Limit – Result(Measured Value + Correction Factor)



Low Channel



Middle Channel



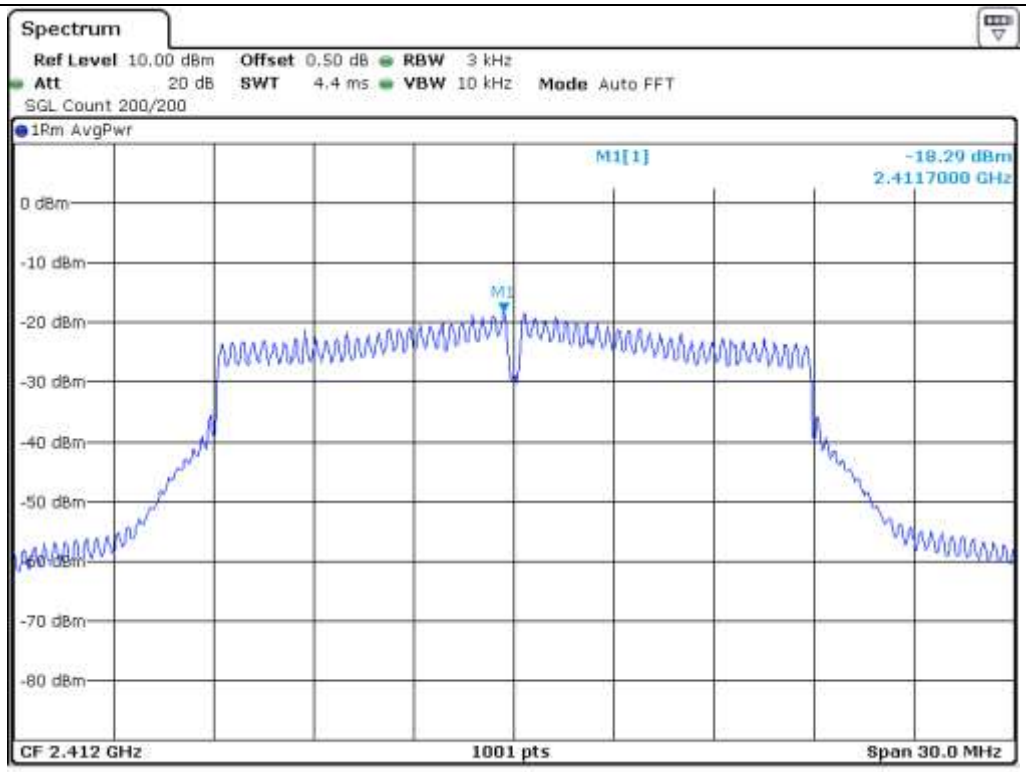
High Channel

10.6.2 Test data for Antenna 1

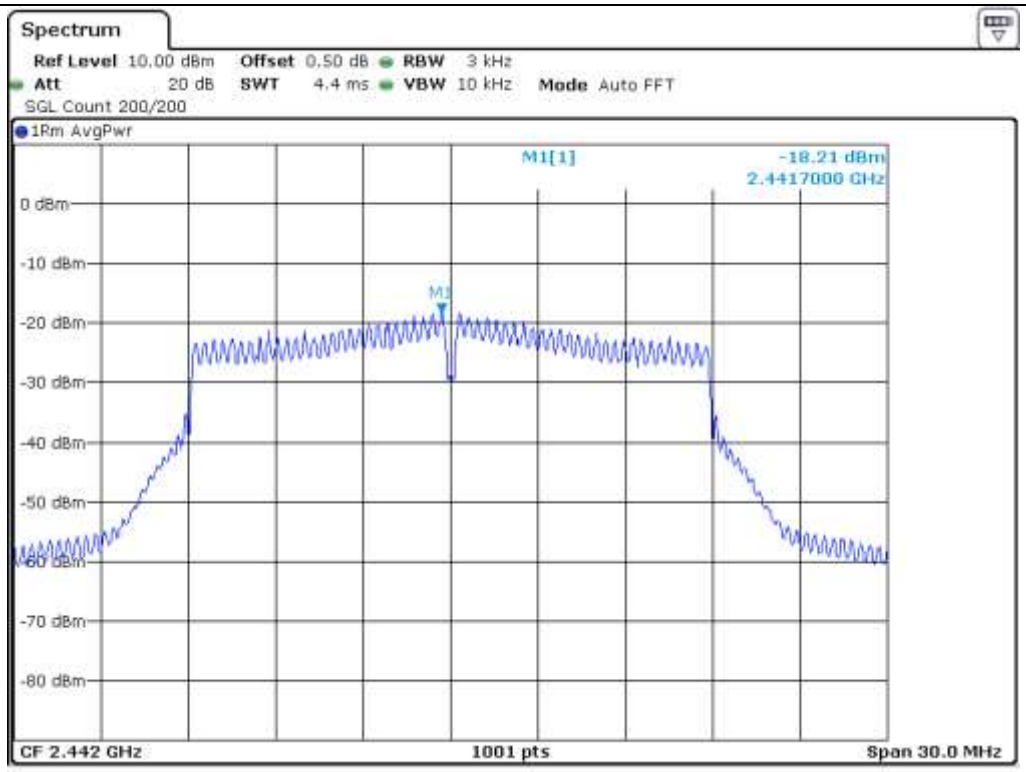
-. Test Result : Pass

FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
2 412.00	-18.29	0.71	-17.58	8.00	25.58
2 442.00	-18.21	0.71	-17.50	8.00	25.50
2 462.00	-17.87	0.71	-17.16	8.00	25.16

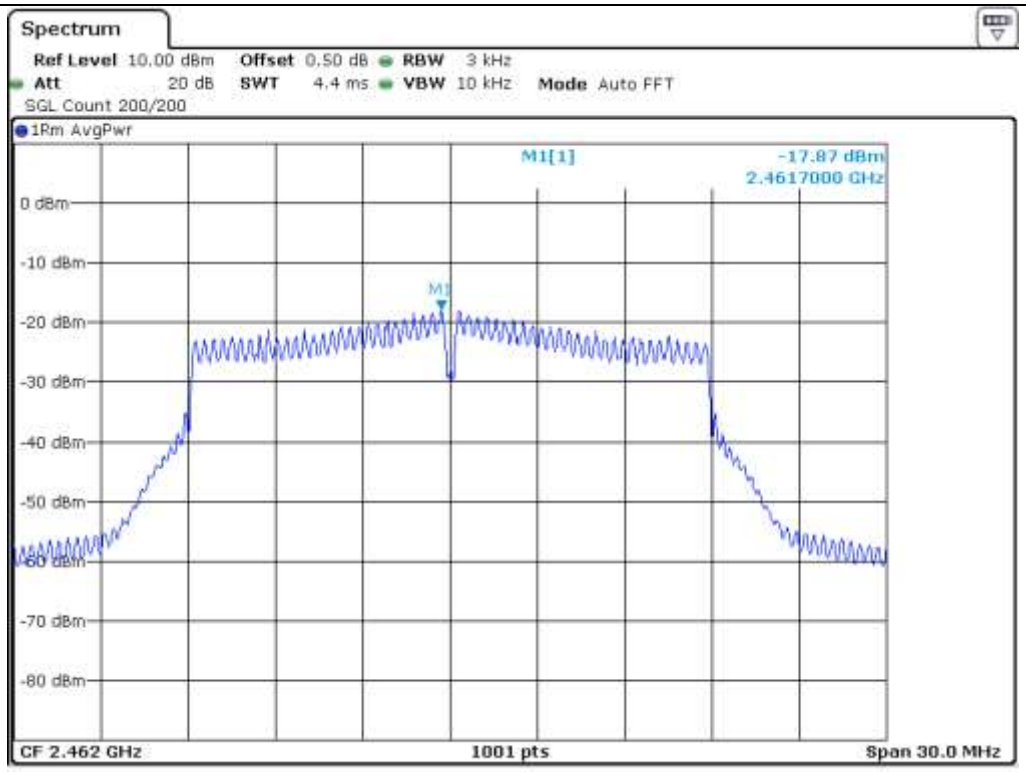
Remark : Margin = Limit – Result(Measured Value + Correction Factor)



Low Channel



Middle Channel



High Channel

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10.6.3 Test data for Multiple Transmit

-. Test Result : Pass

FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
2 412.00	-15.82	0.77	-15.05	8.00	23.05
2 442.00	-16.19	0.77	-15.42	8.00	23.42
2 462.00	-15.93	0.77	-15.16	8.00	23.16

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

Remark 2 : Calculated Power Density = $10\log (10^{(\text{Antenna 0 Power Density}/10)}+10^{(\text{Antenna 1 Power Density}/10)})$

Remark 3 : Directional gain = $10*\log[(10^{G0/20}+10^{G1/20})^2/N]$ dBi

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11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 23 °C

Relative humidity : 45 % R.H.

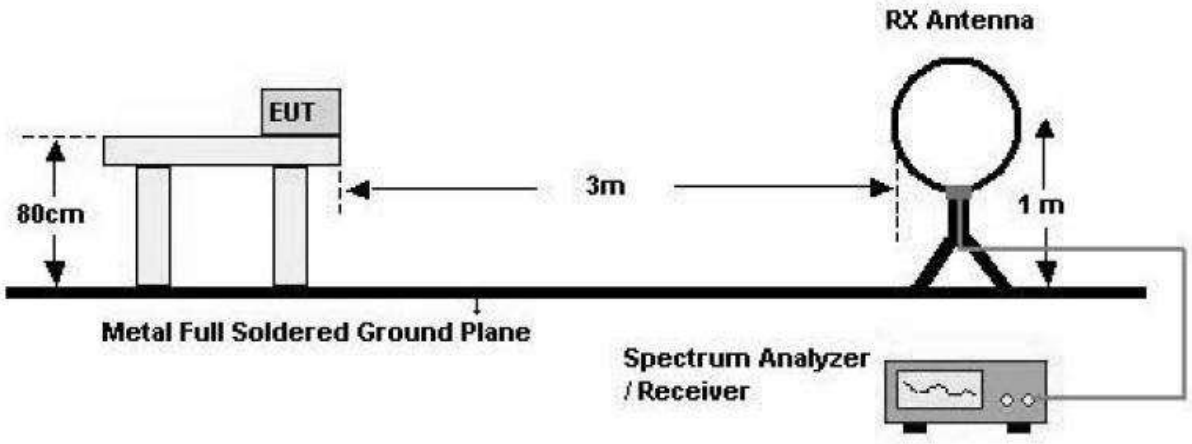
11.2 Test set-up

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

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

- Test Configuration

1. Below 30 MHz



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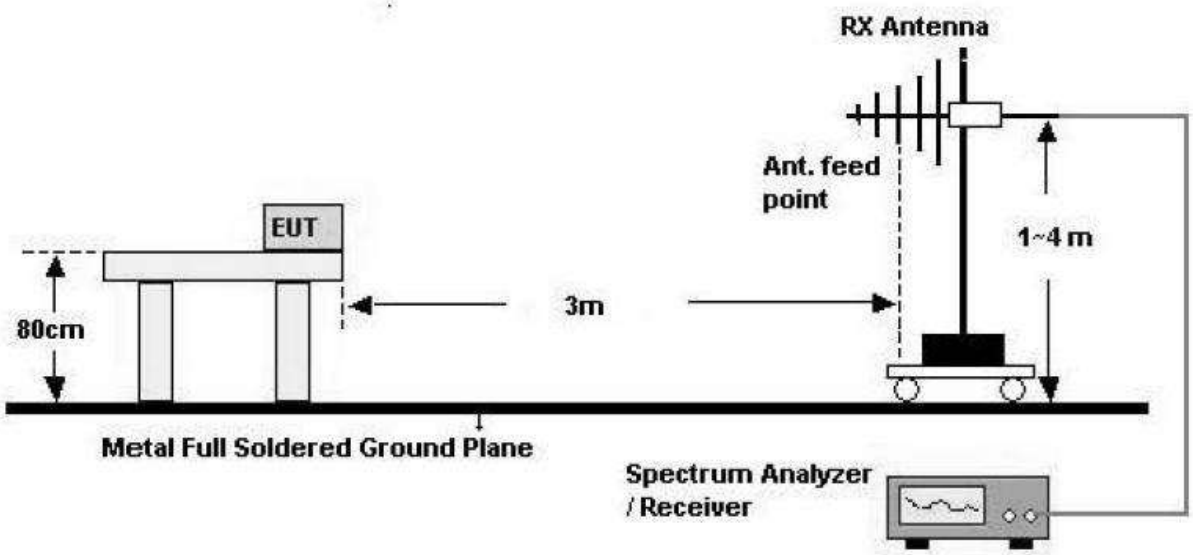
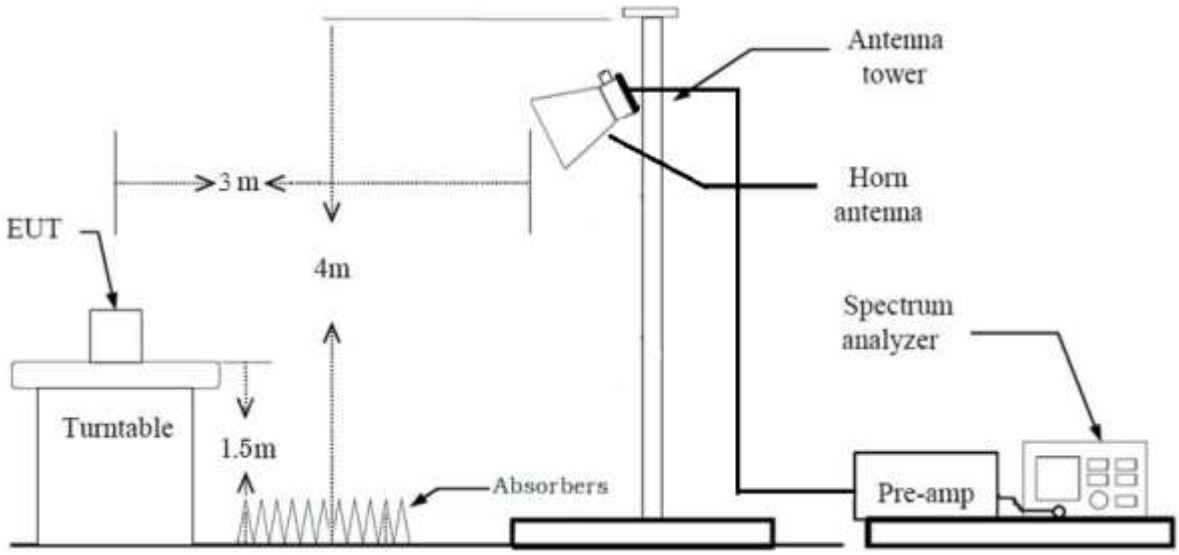
2. 30 MHz - 1 GHz



3. Above 1 GHz



11.3 Test Date

September 07, 2020 ~ September 11, 2020

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11.4 Test data for 30 MHz ~ 1 GHz

11.4.1 Test data for WLAN 2.4 GHz

Humidity Level : 45 % R.H. Temperature: 23 °C

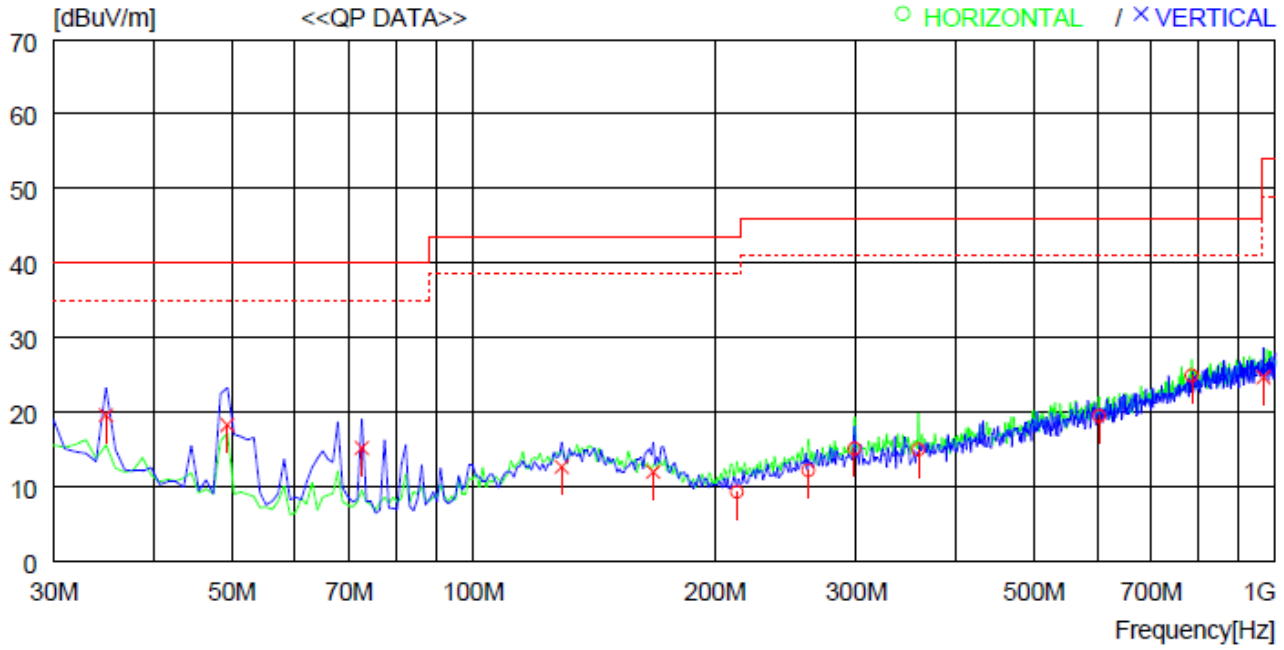
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : RF Module

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

-. Antenna 0, Antenna 1 and Multiple transmit tested, but the worst data were recorded.



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	213.330	28.6	11.9	1.4	32.6	9.3	43.5	34.2	400	151
2	261.830	32.4	10.9	1.6	32.7	12.2	46.0	33.8	400	213
3	298.690	32.6	13.5	1.7	32.7	15.1	46.0	30.9	400	252
4	358.830	30.6	15.3	1.8	32.7	15.0	46.0	31.0	400	252
5	603.268	30.2	19.9	2.4	33.0	19.5	46.0	26.5	400	197
6	786.592	33.7	21.8	2.1	32.6	25.0	46.0	21.1	400	252
----- Vertical ------										
7	34.850	40.6	11.1	0.5	32.6	19.6	40.0	20.4	400	235
8	49.400	40.5	9.9	0.6	32.7	18.3	40.0	21.7	400	279
9	72.680	38.5	8.6	0.8	32.7	15.2	40.0	24.8	400	235
10	128.940	33.5	10.8	1.1	32.7	12.7	43.5	30.8	400	235
11	167.740	30.6	12.8	1.2	32.6	12.0	43.5	31.5	400	235
12	966.037	29.8	23.6	3.0	31.7	24.7	54.0	29.3	400	258

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11.4.2 Test data for Intermodulation Mode(Bluetooth + WLAN 2.4 GHz)

Humidity Level : 45 % R.H. Temperature: 23 °C

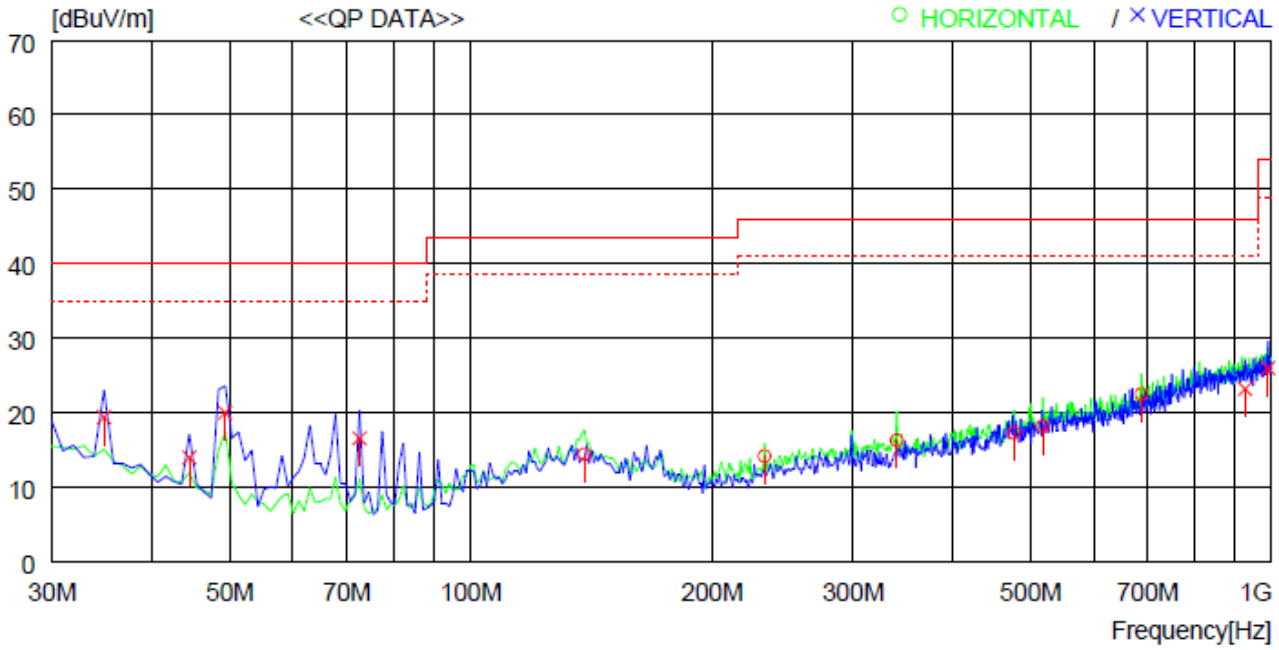
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : RF Module

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

-. Antenna 0, Antenna 1 and Multiple transmit tested, but the worst data were recorded.



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	138.640	35.2	10.8	1.1	32.7	14.4	43.5	29.1	400	272
2	232.730	34.4	10.9	1.5	32.6	14.2	46.0	31.8	400	272
3	340.400	32.5	14.7	1.8	32.7	16.3	46.0	29.7	400	272
4	477.171	30.6	17.5	2.1	32.9	17.3	46.0	28.7	400	272
5	517.910	30.8	18.1	2.2	32.9	18.2	46.0	27.8	400	262
6	687.655	32.1	20.8	2.5	32.9	22.5	46.0	23.5	400	204
----- Vertical ------										
7	34.850	40.4	11.1	0.5	32.6	19.4	40.0	20.6	400	269
8	44.550	35.6	10.5	0.6	32.7	14.0	40.0	26.0	400	299
9	49.400	42.2	9.9	0.6	32.7	20.0	40.0	20.0	400	269
10	72.680	39.9	8.6	0.8	32.7	16.6	40.0	23.4	400	299
11	926.268	28.8	23.4	2.9	31.9	23.2	46.0	22.8	400	291
12	989.316	30.9	23.7	3.0	31.6	26.0	54.0	28.0	400	291

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11.5 Test data for Below 30 MHz

-. 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)
Emission from the EUT more than 20 dB below the limit in each frequency range.									

11.6 Test data for above 1 GHz

-. 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)
Emission from the EUT more than 20 dB below the limit in each frequency range.									

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12. LIST OF TEST EQUIPMENT

Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
FSV40-N	Rohde & Schwarz	Signal Analyzer	102177	Apr. 20, 2020 (1Y)
ESW	Rohde & Schwarz	EMI Test Receiver	101851	Mar. 27, 2020 (1Y)
310N	Sonoma Instrument	Pre-Amplifier	312544	Mar. 16, 2020 (1Y)
BBV 9718 B	Schwarzbeck	Broadband Preamplifier	00009	Mar. 16, 2020 (1Y)
SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Feb. 20, 2020 (1Y)
SCU18	Rohde & Schwarz	Signal Conditioning unit	102266	Jul. 15, 2020 (1Y)
DT3000-3t	Innco System	Turn Table	DT3000/093	N/A
MA-4000XPET	Innco System	Antenna Master	MA4000/509	N/A
VULB9163	Schwarzbeck	TRILOG Broadband Antenna	777	Apr. 08, 2020 (2Y)
BBHA 9120D	Schwarzbeck	Horn Antenna	9120D-1366	Jul. 23, 2020 (1Y)
BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jan. 07, 2020(1Y)

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