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

Test Report No. : **OT-213-RWD-049**

Reception No. : **2103001221**

Applicant : **Samsung Electronics Co Ltd**

Address : **19 Chapin Rd., Building D, Pine Brook, New Jersey, 07058, United States**

Manufacturer : **Samsung Electronics Co Ltd**

Address : **129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do 16677, Korea**

Type of Equipment : **WI-FI Transceiver**

FCC ID. : **A3LWCA720M**

Model Name : **WCA720M**

Serial number : **N/A**

Total page of Report : **173 pages (including this page)**

Date of Incoming : **March 12, 2021**

Date of issue : **March 25, 2021**

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
Ju Yun Park / Assistant 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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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-213-RWD-049	March 25, 2021	Initial Release	All

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1. VERIFICATION OF COMPLIANCE

Applicant : Samsung Electronics Co Ltd

Address : 19 Chapin Rd., Building D, Pine Brook, New Jersey, 07058, United States

Contact Person : Youngjoong Noh / Principal Engineer

Telephone No. : +82-31-277-0598

FCC ID : A3LWCA720M

Model Name : WCA720M

Brand Name :

Serial Number : N/A

Date : March 25, 2021

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Modular Transmitter, WI-FI Transceiver
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	Met the Limit / PASS
15.203	Antenna Requirement	Met requirement / PASS

2.2 Additions, deviations, exclusions from standards

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

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

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

2.5 Test Methodology

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

2.6 Test Facility

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

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

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-20122/ 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 Samsung Electronics Co Ltd, Model WCA720M (referred to as the EUT in this report) is a WI-FI Transceiver. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	WI-FI Transceiver	
Temperature Range	-10 °C ~ 70 °C	
OPERATING FREQUENCY	WLAN 2.4 GHz	2 412 MHz ~ 2 472 MHz (802.11b/g/n(HT20))
		2 422 MHz ~ 2 462 MHz (802.11n(HT40))
	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 (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	WLAN 2.4 GHz	802.11b: DSSS Modulation(DBPSK/DQPSK/CCK) 802.11g/n(HT20)/n(HT40): OFDM Modulation(BPSK/QPSK/16QAM/64QAM)
	WLAN 5 GHz	802.11a/n(HT20)/n(HT40)/ac(VHT80): OFDM Modulation(BPSK/QPSK/16QAM/64QAM)

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RF OUTPUT POWER	WLAN 2.4 GHz	Antenna 0	15.98 dBm(802.11b) 10.76 dBm(802.11g) 9.32 dBm(802.11n_HT20) 6.81 dBm(802.11n_HT40)
		Antenna 1	16.08 dBm(802.11b) 10.48 dBm(802.11g) 8.95 dBm(802.11n_HT20) 6.98 dBm(802.11n_HT40)
		Multiple Antenna	13.63 dBm(802.11g) 12.15 dBm(802.11n_HT20) 9.88 dBm(802.11n_HT40)
	5 150 MHz ~ 5 250 MHz Band	Antenna 0	12.25 dBm(802.11a) 12.15 dBm(802.11n_HT20) 12.91 dBm(802.11n_HT40) 10.24 dBm(802.11ac_VHT80)
		Antenna 1	12.27 dBm(802.11a) 11.94 dBm(802.11n_HT20) 12.95 dBm(802.11n_HT40) 10.80 dBm(802.11ac_VHT80)
		Multiple Antenna	15.20 dBm(802.11a) 15.06 dBm(802.11n_HT20) 15.94 dBm(802.11n_HT40) 13.54 dBm(802.11ac_VHT80)
	5 250 MHz ~ 5 350 MHz Band	Antenna 0	15.37 dBm(802.11a) 14.98 dBm(802.11n_HT20) 13.02 dBm(802.11n_HT40) 11.59 dBm(802.11ac_VHT80)
		Antenna 1	14.82 dBm(802.11a) 14.90 dBm(802.11n_HT20) 13.02 dBm(802.11n_HT40) 11.61 dBm(802.11ac_VHT80)
		Multiple Antenna	18.11 dBm(802.11a) 17.95 dBm(802.11n_HT20) 16.03 dBm(802.11n_HT40) 14.61 dBm(802.11ac_VHT80)

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RF OUTPUT POWER	5 470 MHz ~ 5 725 MHz Band	Antenna 0	15.00 dBm(802.11a) 14.62 dBm(802.11n_HT20) 12.84 dBm(802.11n_HT40) 11.51 dBm(802.11ac_VHT80)
		Antenna 0_Straddle	12.34 dBm(802.11a) 12.14 dBm(802.11n_HT20) 11.10 dBm(802.11n_HT40) 11.33 dBm(802.11ac_VHT80)
		Antenna 1	15.03 dBm(802.11a) 14.90 dBm(802.11n_HT20) 13.22 dBm(802.11n_HT40) 11.79 dBm(802.11ac_VHT80)
		Antenna 1_Straddle	13.32 dBm(802.11a) 13.27 dBm(802.11n_HT20) 12.30 dBm(802.11n_HT40) 13.71 dBm(802.11ac_VHT80)
		Multiple Antenna	18.02 dBm(802.11a) 17.76 dBm(802.11n_HT20) 15.95 dBm(802.11n_HT40) 14.66 dBm(802.11ac_VHT80)
		Multiple Antenna _Straddle	15.87 dBm(802.11a) 15.75 dBm(802.11n_HT20) 14.75 dBm(802.11n_HT40) 15.69 dBm(802.11ac_VHT80)

RF OUTPUT POWER	5 725 MHz ~ 5 850 MHz Band	Antenna 0	15.00 dBm(802.11a) 14.68 dBm(802.11n_HT20) 12.98 dBm(802.11n_HT40) 12.67 dBm(802.11ac_VHT80)
		Antenna 0_Straddle	4.41 dBm(802.11a) 4.51 dBm(802.11n_HT20) -1.21 dBm(802.11n_HT40) -3.73 dBm(802.11ac_VHT80)
		Antenna 1	15.20 dBm(802.11a) 14.76 dBm(802.11n_HT20) 12.72 dBm(802.11n_HT40) 12.60 dBm(802.11ac_VHT80)
		Antenna 1_Straddle	5.60 dBm(802.11a) 5.94 dBm(802.11n_HT20) 0.20 dBm(802.11n_HT40) -1.59 dBm(802.11ac_VHT80)
		Multiple Antenna	18.06 dBm(802.11a) 17.73 dBm(802.11n_HT20) 15.86 dBm(802.11n_HT40) 15.65 dBm(802.11ac_VHT80)
		Multiple Antenna _Straddle	8.06 dBm(802.11a) 8.29 dBm(802.11n_HT20) 2.56 dBm(802.11n_HT40) 0.48 dBm(802.11ac_VHT80)

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ANTENNA TYPE	Metal Antenna		
ANTENNA GAIN	WLAN 2.4 GHz	Antenna 0	0.50 dBi
		Antenna 1	0.00 dBi
		Multiple Antenna	3.27 dBi
	5 150 MHz ~ 5 250 MHz Band	Antenna 0	0.90 dBi
		Antenna 1	0.70 dBi
		Multiple Antenna	3.81 dBi
	5 250 MHz ~ 5 350 MHz Band	Antenna 0	0.50 dBi
		Antenna 1	-0.40 dBi
		Multiple Antenna	3.08 dBi
	5 470 MHz ~ 5 725 MHz Band	Antenna 0	0.10 dBi
		Antenna 1	-0.30 dBi
		Multiple Antenna	2.91 dBi
	5 725 MHz ~ 5 850 MHz Band	Antenna 0	-0.20 dBi
		Antenna 1	-0.30 dBi
		Multiple Antenna	2.76 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	Samsung Electronics Co Ltd	BN59-01XXXA	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
WCA720M	Samsung Electronics Co Ltd	WI-FI Transceiver (EUT)	
HP Probook 4540s	HP	Notebook PC	EUT
Series PPP009H	Hipro Electronics(Dongguan)Co., Ltd	AC Adapter	

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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.

-. Frequency / Channel Operations

Channel	Frequency
1	2 412
2	2 417
3	2 422
4	2 427
5	2 432
6	2 437
7	2 442
8	2 447
9	2 452
10	2 457
11	2 462
12	2 467
13	2 472

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Modulation	DATA RATE	OUTPUT POWER[dBm]	
		Antenna 0	Antenna 1
802.11 b (Low Channel)	1 Mbps	15.61	15.98
	2 Mbps	15.42	15.77
	5.5 Mbps	15.37	15.69
	11 Mbps	15.30	15.64
802.11 g (Low Channel)	6 Mbps	10.54	10.18
	9 Mbps	10.43	10.08
	12 Mbps	10.37	9.99
	18 Mbps	10.24	9.86
	24 Mbps	10.18	9.83
	36 Mbps	10.06	9.70
	48 Mbps	9.85	9.49
	54 Mbps	9.74	9.41
802.11 HT 20 (Low Channel)	6.5 Mbps	9.13	8.86
	13 Mbps	9.06	8.82
	19.5 Mbps	8.86	8.60
	26 Mbps	8.72	8.49
	39 Mbps	8.59	8.33
	52 Mbps	8.46	8.22
	58.5 Mbps	8.37	8.10
	65 Mbps	8.32	8.05
802.11 HT 40 (Low Channel)	13.5 Mbps	6.45	6.56
	27 Mbps	6.34	6.45
	40.5 Mbps	6.28	6.39
	54 Mbps	6.16	6.24
	81 Mbps	6.02	6.12
	108 Mbps	5.87	5.96
	121.5 Mbps	5.74	5.81
	135 Mbps	5.62	5.68

-. 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, 13.5 Mbps(Ant.0/Ant.1) for HT40.

-. 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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Modulation	DATA RATE	OUTPUT POWER[dBm]	
		Antenna 0	Antenna 1
802.11 b (Middle Channel)	1 Mbps	15.65	16.08
	2 Mbps	15.46	15.91
	5.5 Mbps	15.41	15.89
	11 Mbps	15.34	15.84
802.11 g (Middle Channel)	6 Mbps	10.65	10.48
	9 Mbps	10.54	10.39
	12 Mbps	10.48	10.33
	18 Mbps	10.35	10.23
	24 Mbps	10.29	10.20
	36 Mbps	10.17	10.10
	48 Mbps	9.96	9.92
	54 Mbps	9.85	9.84
802.11 HT 20 (Middle Channel)	6.5 Mbps	9.32	8.95
	13 Mbps	9.25	8.91
	19.5 Mbps	9.05	8.71
	26 Mbps	8.91	8.55
	39 Mbps	8.78	8.39
	52 Mbps	8.65	8.29
	58.5 Mbps	8.56	8.21
	65 Mbps	8.51	8.18
802.11 HT 40 (Middle Channel)	13.5 Mbps	6.81	6.63
	27 Mbps	6.70	6.51
	40.5 Mbps	6.64	6.45
	54 Mbps	6.52	6.35
	81 Mbps	6.38	6.23
	108 Mbps	6.23	6.10
	121.5 Mbps	6.10	5.95
	135 Mbps	5.98	5.81

-. 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, 13.5 Mbps(Ant.0/Ant.1) for HT40.

-. 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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Modulation	DATA RATE	OUTPUT POWER[dBm]	
		Antenna 0	Antenna 1
802.11 b (High Channel_11)	1 Mbps	15.98	16.05
	2 Mbps	15.79	15.89
	5.5 Mbps	15.74	15.87
	11 Mbps	15.67	15.77
802.11 g (High Channel_11)	6 Mbps	10.76	10.47
	9 Mbps	10.65	10.38
	12 Mbps	10.59	10.32
	18 Mbps	10.46	10.18
	24 Mbps	10.40	10.13
	36 Mbps	10.28	10.00
	48 Mbps	10.07	9.78
	54 Mbps	9.96	9.66
802.11 HT 20 (High Channel_11)	6.5 Mbps	9.28	8.91
	13 Mbps	9.21	8.87
	19.5 Mbps	9.01	8.67
	26 Mbps	8.87	8.55
	39 Mbps	8.74	8.42
	52 Mbps	8.61	8.26
	58.5 Mbps	8.52	8.14
	65 Mbps	8.47	8.12
802.11 HT 40 (High Channel_9)	13.5 Mbps	6.75	6.98
	27 Mbps	6.64	6.86
	40.5 Mbps	6.58	6.82
	54 Mbps	6.46	6.72
	81 Mbps	6.32	6.56
	108 Mbps	6.17	6.40
	121.5 Mbps	6.04	6.29
	135 Mbps	5.92	6.19

-. 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, 13.5 Mbps(Ant.0/Ant.1) for HT40.

-. 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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Modulation	DATA RATE	OUTPUT POWER[dBm]	
		Antenna 0	Antenna 1
802.11 b (High Channel_12)	1 Mbps	11.68	11.75
	2 Mbps	11.49	11.54
	5.5 Mbps	11.44	11.46
	11 Mbps	11.37	11.37
802.11 g (High Channel_12)	6 Mbps	3.75	4.48
	9 Mbps	3.64	4.34
	12 Mbps	3.58	4.29
	18 Mbps	3.45	4.17
	24 Mbps	3.39	4.12
	36 Mbps	3.27	4.00
	48 Mbps	3.06	3.78
	54 Mbps	2.95	3.67
802.11 HT 20 (High Channel_12)	6.5 Mbps	5.19	5.16
	13 Mbps	5.12	5.10
	19.5 Mbps	4.92	4.91
	26 Mbps	4.78	4.74
	39 Mbps	4.65	4.58
	52 Mbps	4.52	4.45
	58.5 Mbps	4.43	4.38
	65 Mbps	4.38	4.30
802.11 HT 40 (High Channel_10)	13.5 Mbps	5.41	5.65
	27 Mbps	5.30	5.56
	40.5 Mbps	5.24	5.48
	54 Mbps	5.12	5.33
	81 Mbps	4.98	5.22
	108 Mbps	4.83	5.09
	121.5 Mbps	4.70	4.96
	135 Mbps	4.58	4.87

-. 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, 13.5 Mbps(Ant.0/Ant.1) for HT40.

-. 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.

Modulation	DATA RATE	OUTPUT POWER[dBm]	
		Antenna 0	Antenna 1
802.11 b (High Channel_13)	1 Mbps	8.03	11.08
	2 Mbps	7.84	10.92
	5.5 Mbps	7.79	10.89
	11 Mbps	7.72	10.80
802.11 g (High Channel_13)	6 Mbps	0.95	1.63
	9 Mbps	0.84	1.50
	12 Mbps	0.78	1.46
	18 Mbps	0.65	1.31
	24 Mbps	0.59	1.22
	36 Mbps	0.47	1.11
	48 Mbps	0.26	0.90
	54 Mbps	0.15	0.78
802.11 HT 20 (High Channel_13)	6.5 Mbps	3.75	4.51
	13 Mbps	3.68	4.47
	19.5 Mbps	3.48	4.27
	26 Mbps	3.34	4.14
	39 Mbps	3.21	3.99
	52 Mbps	3.08	3.86
	58.5 Mbps	2.99	3.77
	65 Mbps	2.94	3.75
802.11 HT 40 (High Channel_11)	13.5 Mbps	5.15	5.86
	27 Mbps	5.04	5.77
	40.5 Mbps	4.98	5.68
	54 Mbps	4.86	5.58
	81 Mbps	4.72	5.46
	108 Mbps	4.57	5.29
	121.5 Mbps	4.44	5.13
	135 Mbps	4.32	4.99

-. 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, 13.5 Mbps(Ant.0/Ant.1) for HT40.

-. 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	-	-	100.00	-
802.11 g _Antenna 0	-	-	100.00	-
802.11 HT 20_Antenna 0	-	-	100.00	-
802.11 HT 40_ Antenna 0	-	-	100.00	-
802.11 b_Antenna 1	-	-	100.00	-
802.11 g _Antenna 1	-	-	100.00	-
802.11 HT 20_Antenna 1	-	-	100.00	-
802.11 HT 40_ Antenna 1	-	-	100.00	-

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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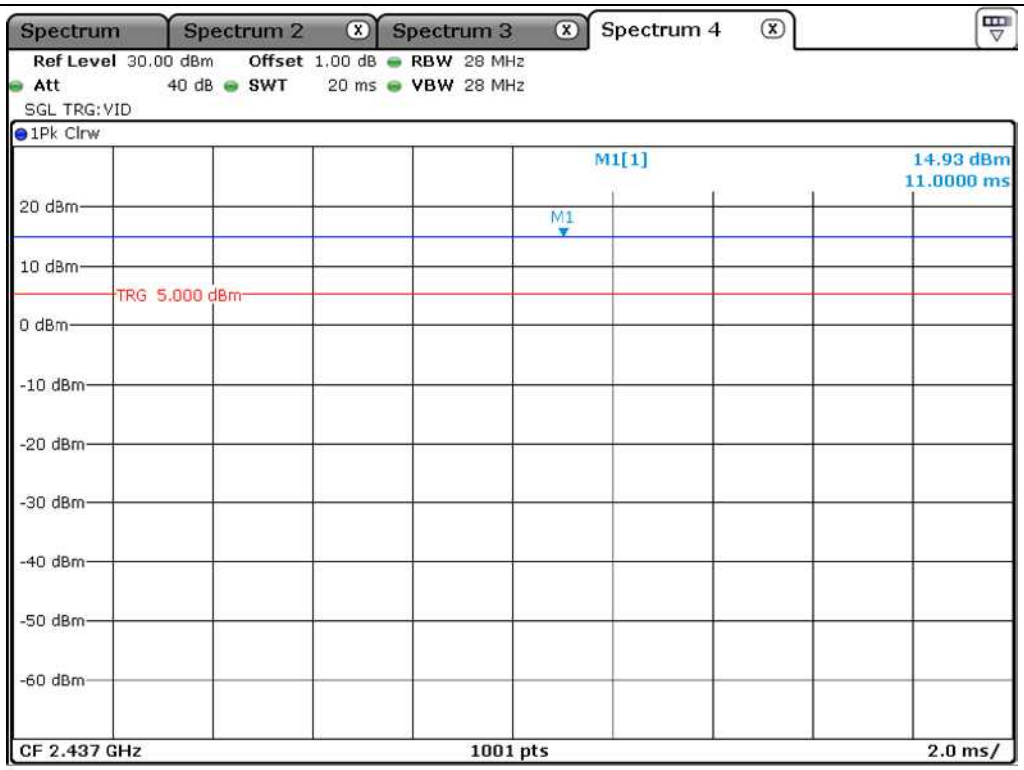
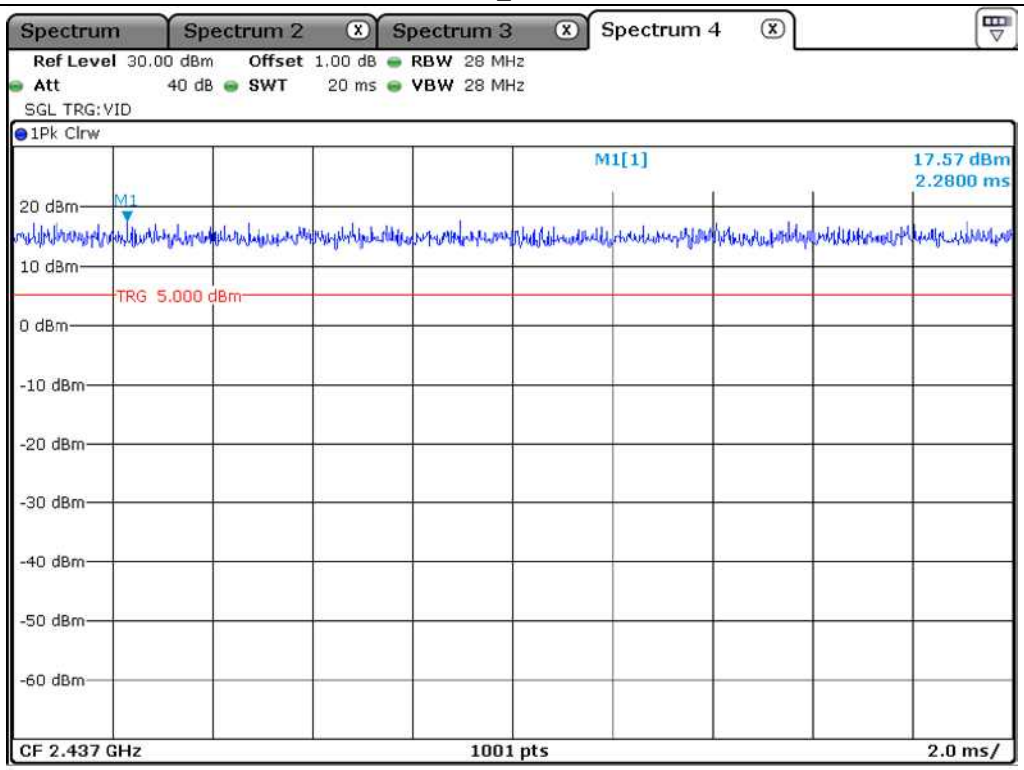
-. Test Plot



802.11 b_Antenna 0



802.11 g_Antenna 0

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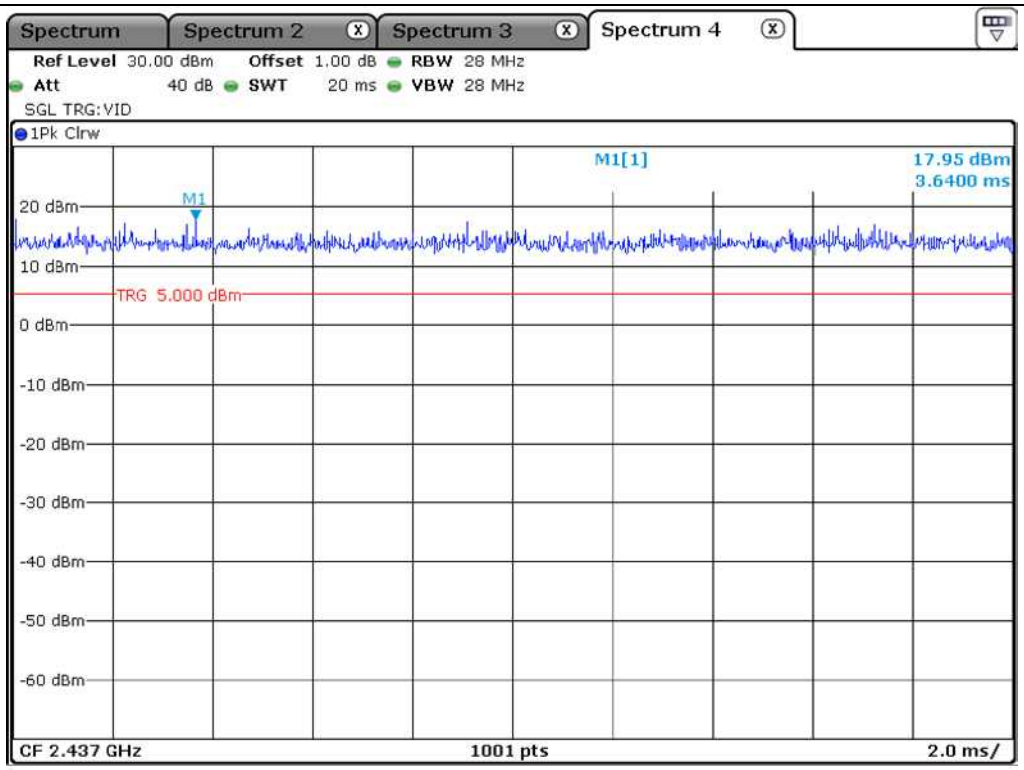
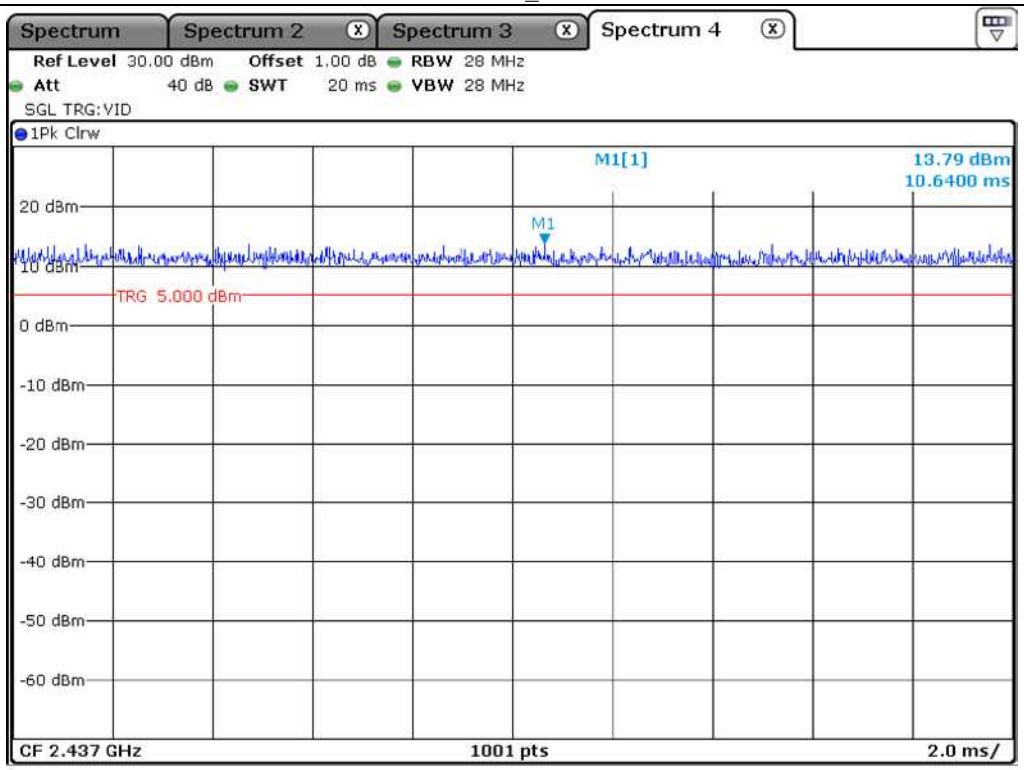


802.11 HT 20_Antenna 0



802.11 HT 40_Antenna 0

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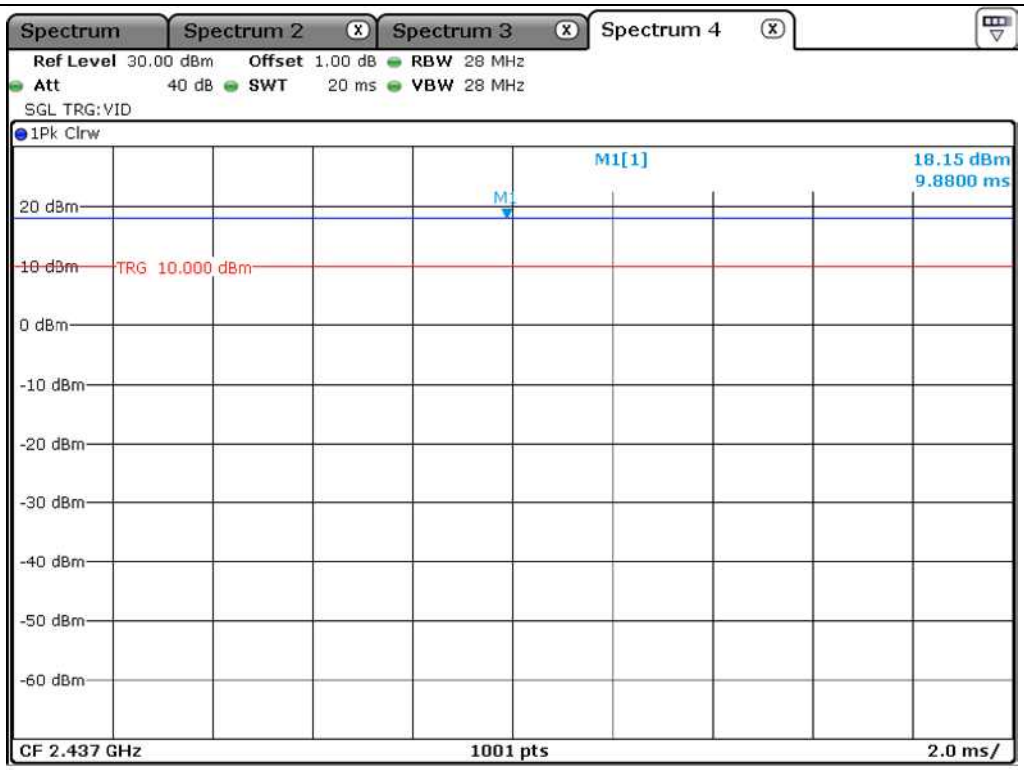
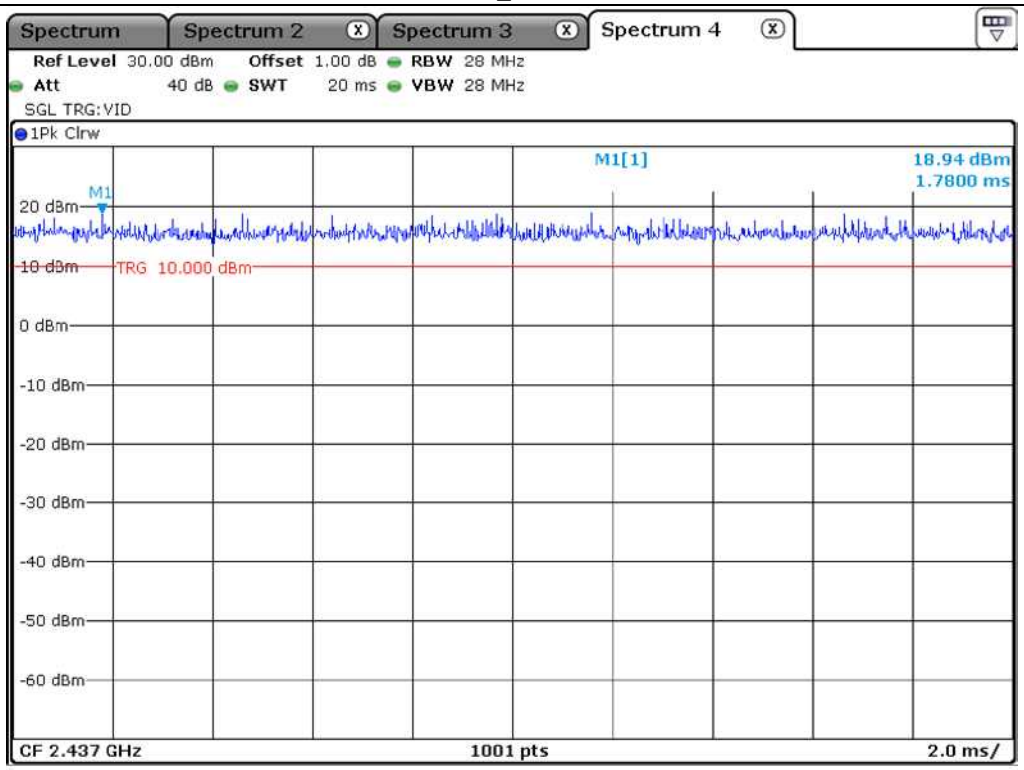
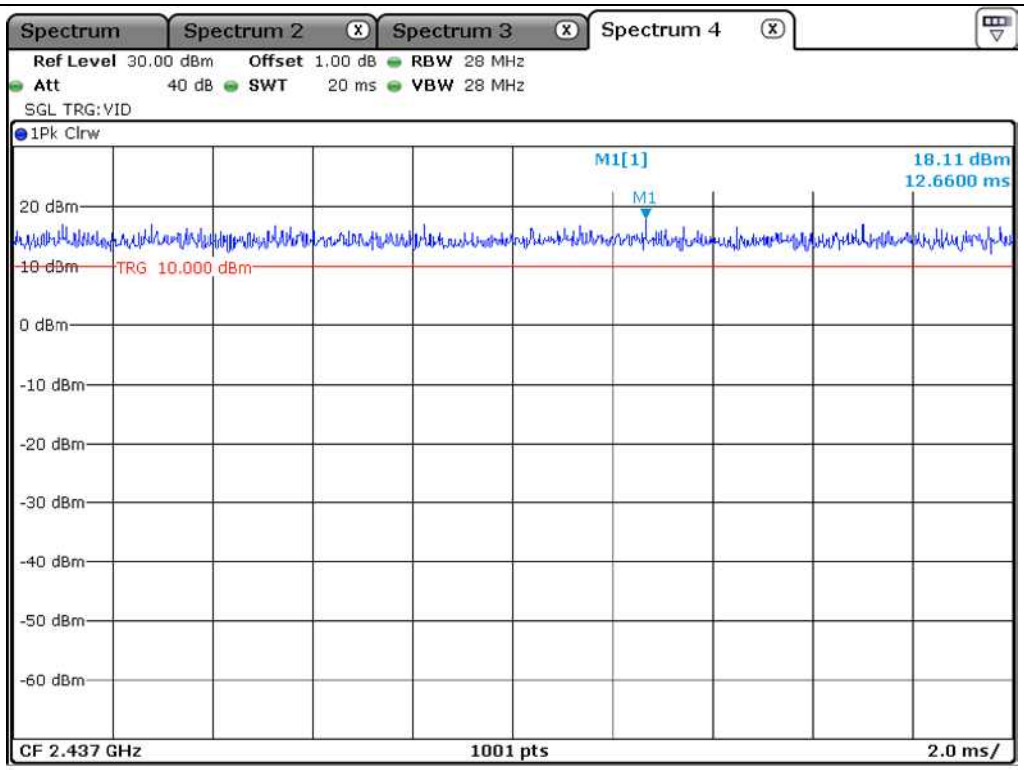


802.11 b_Antenna 1

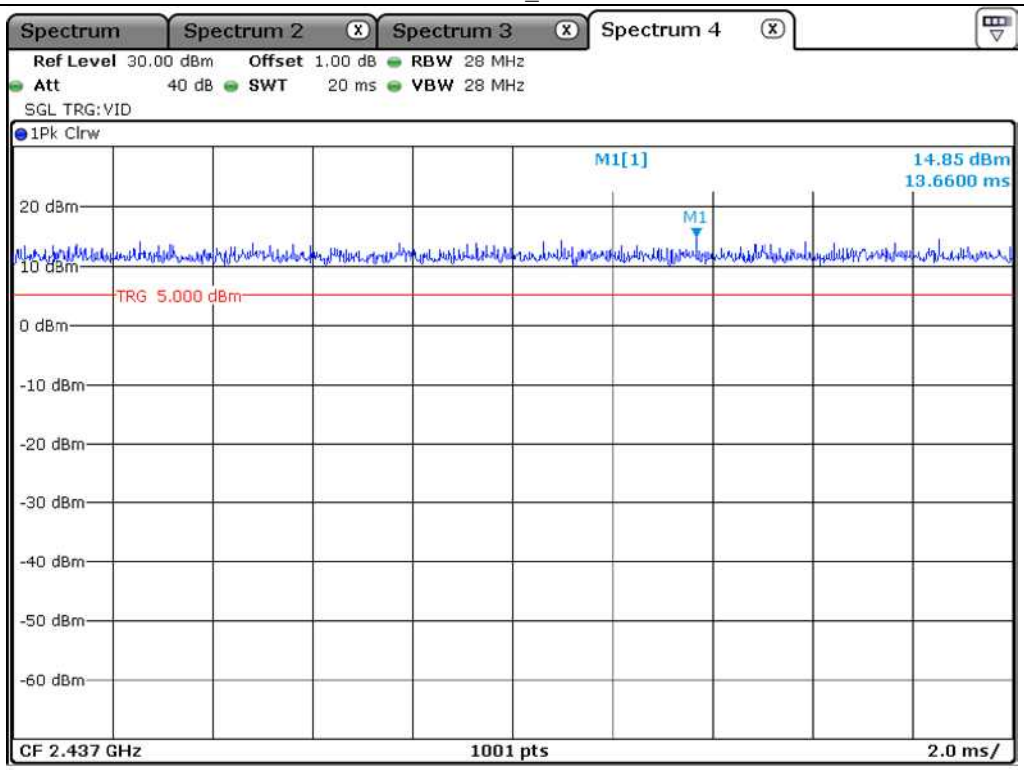


802.11 g_Antenna 1

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



802.11 HT 20_Antenna 1



802.11 HT 40_Antenna 1

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5.4 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.

5.5 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 Metal Antenna on the main board in the EUT, so no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary Test, the following operating mode was investigated.

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

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7. MIMIMUM 6 dB BANDWIDTH

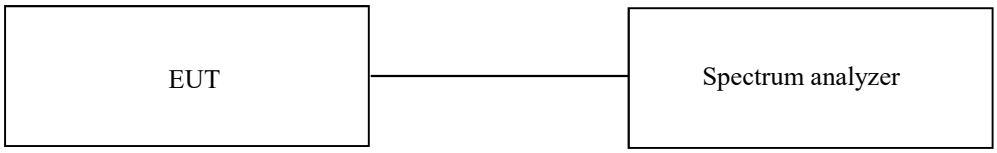
7.1 Operating environment

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

March 12, 2021 ~ March 22, 2021

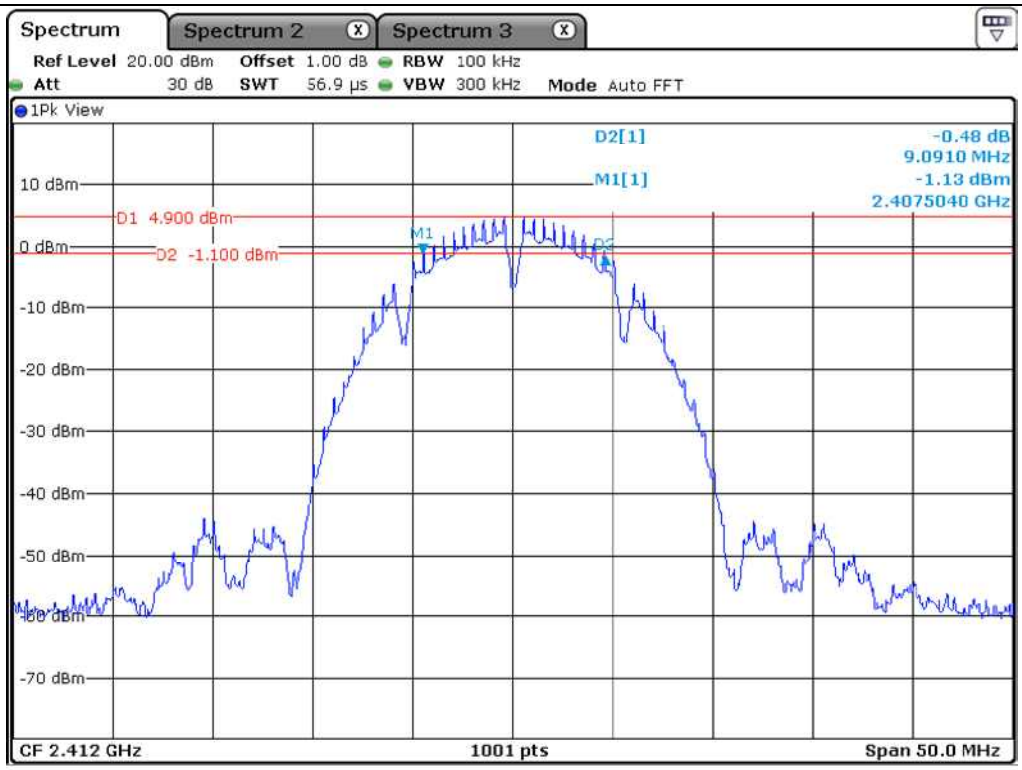
7.4 Test data for 802.11b WLAN Mode

7.4.1 Test data for Antenna 0

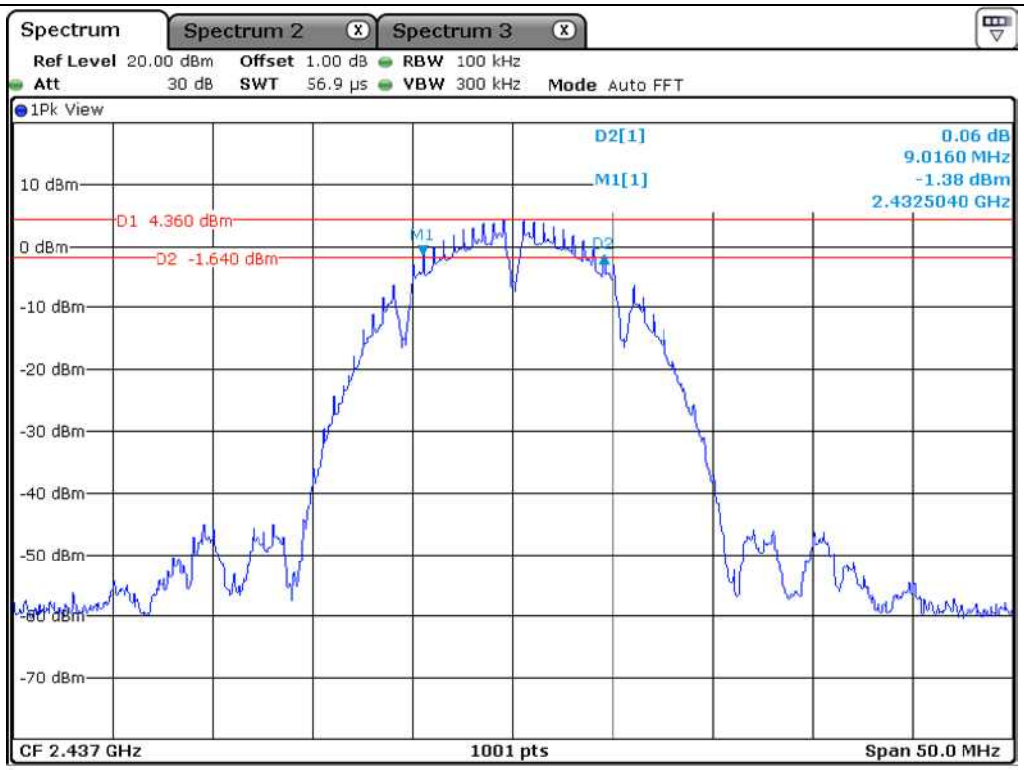
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	9.09	0.50	8.59
Middle	2 437.00	9.02	0.50	8.52
High 11	2 462.00	9.04	0.50	8.54
High 12	2 467.00	9.04	0.50	8.54
High 13	2 472.00	9.03	0.50	8.53

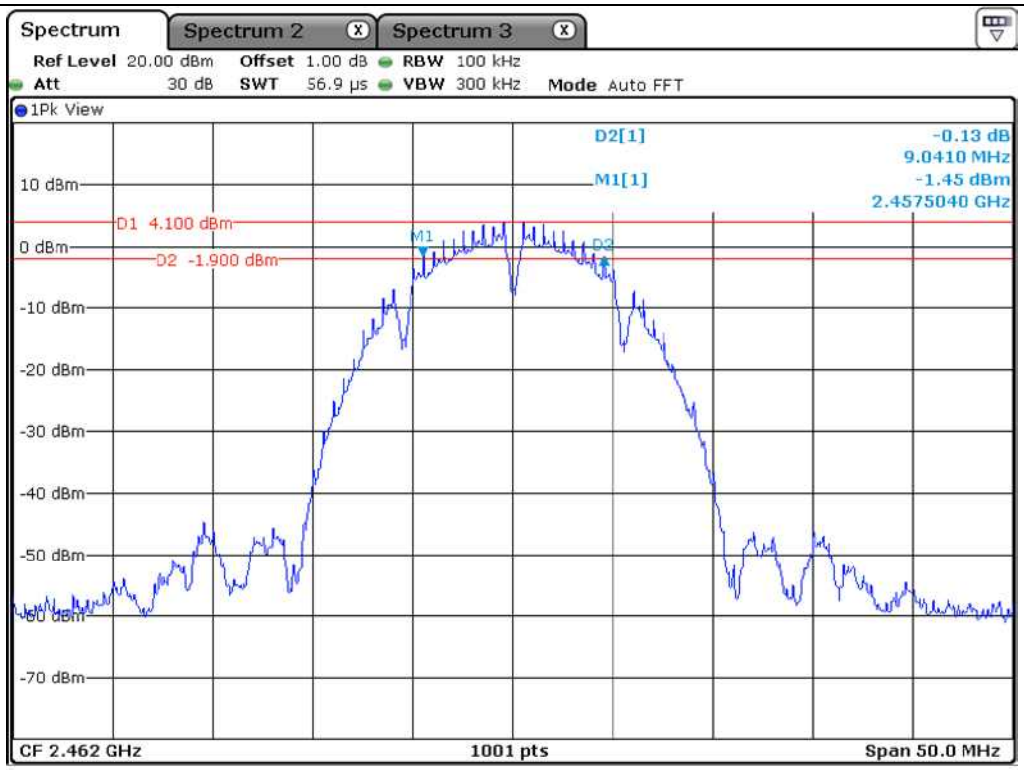
Remark. Margin = Measured Value - Limit



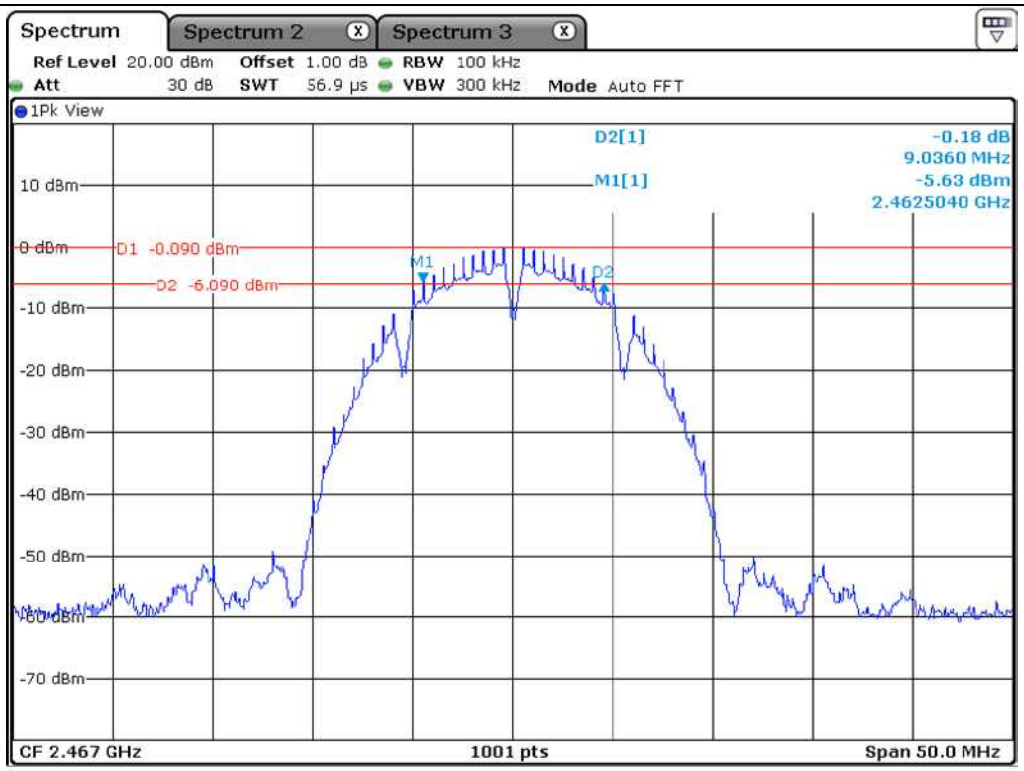
Low Channel



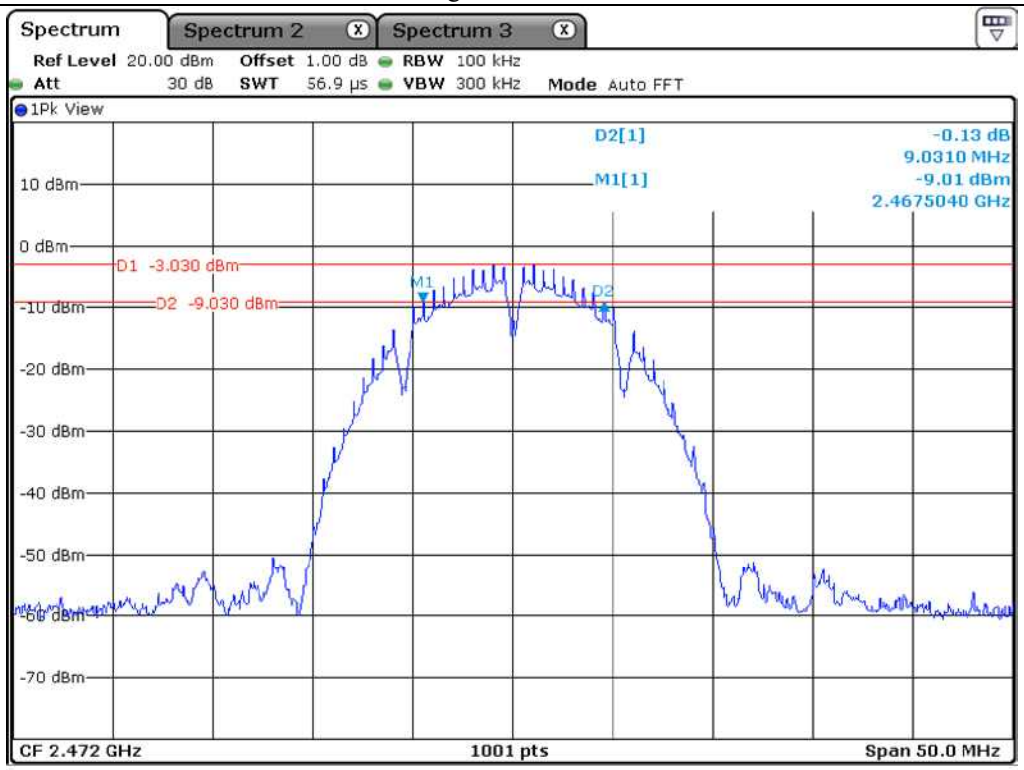
Middle Channel



High Channel 11



High Channel 12



High Channel 13

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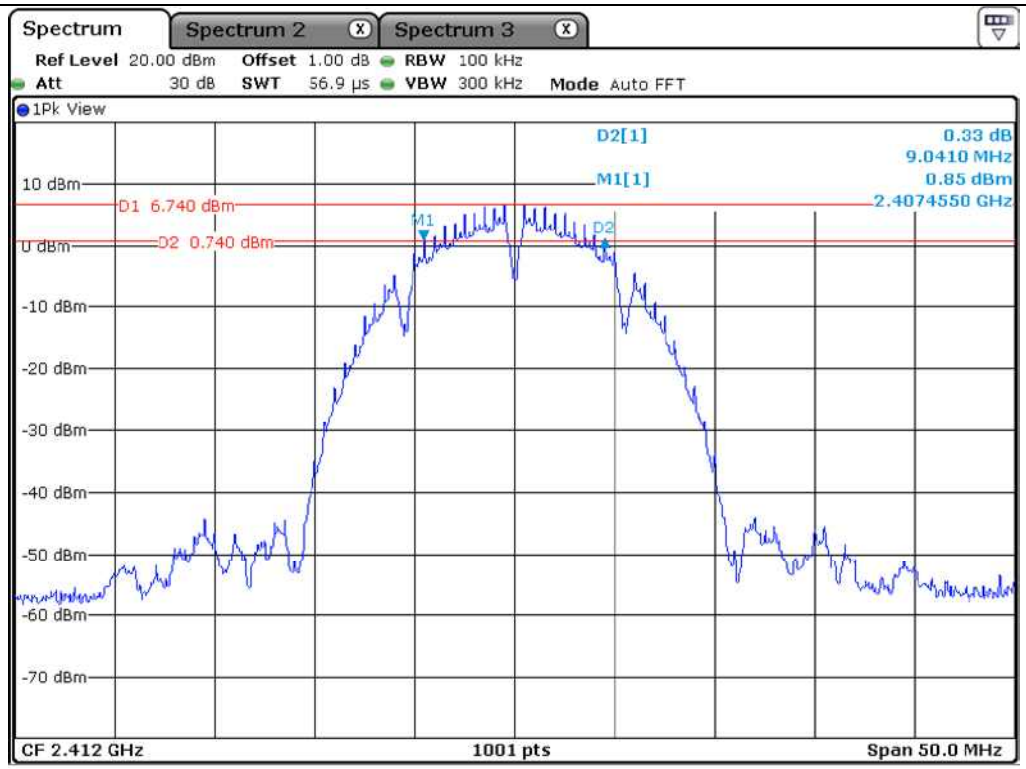
7.4.2 Test data for Antenna 1

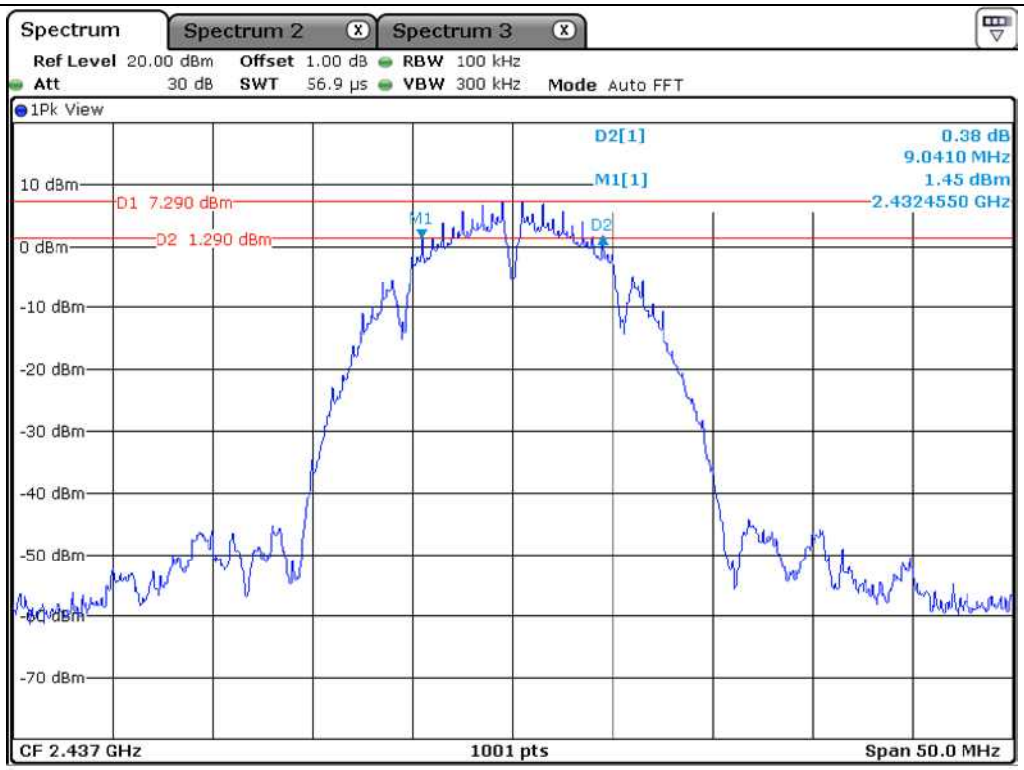
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	9.04	0.50	8.54
Middle	2 437.00	9.04	0.50	8.54
High 11	2 462.00	9.04	0.50	8.54
High 12	2 467.00	9.04	0.50	8.54
High 13	2 472.00	9.04	0.50	8.54

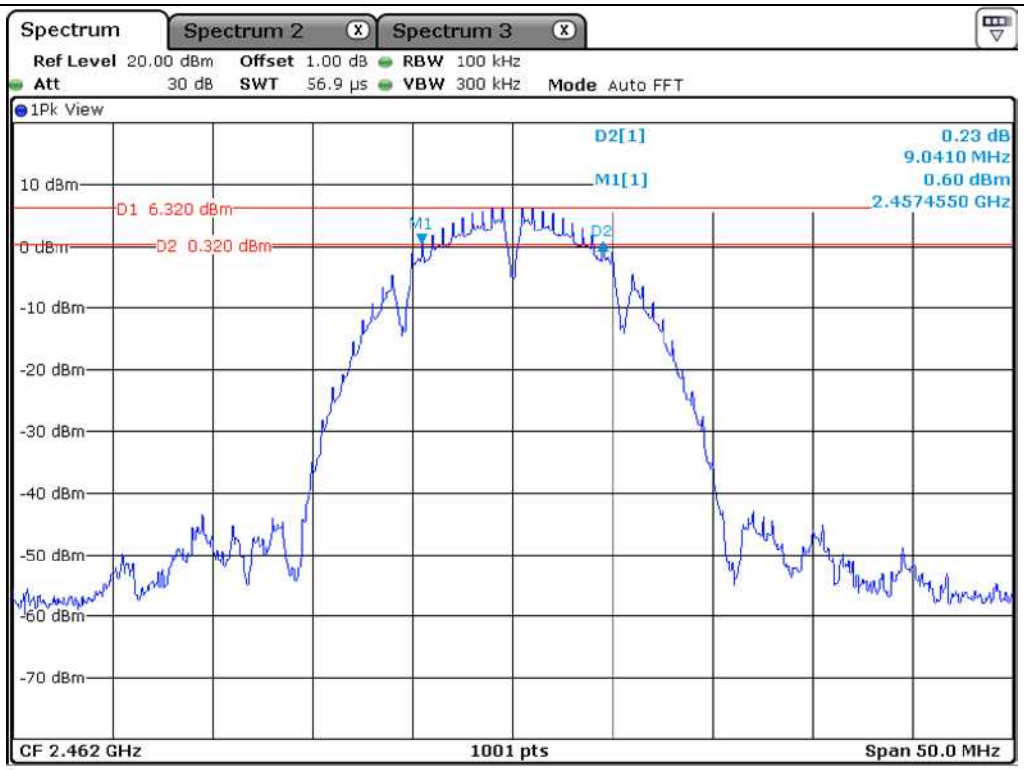
Remark. Margin = Measured Value - Limit



Low Channel



Middle Channel



High Channel 11

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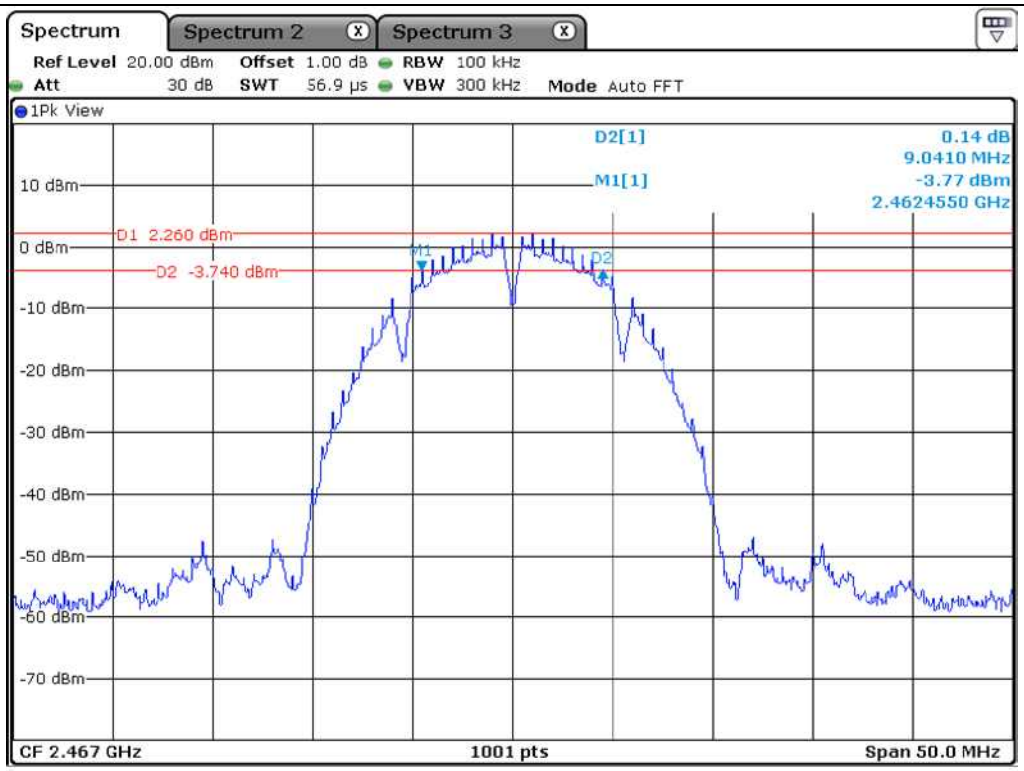
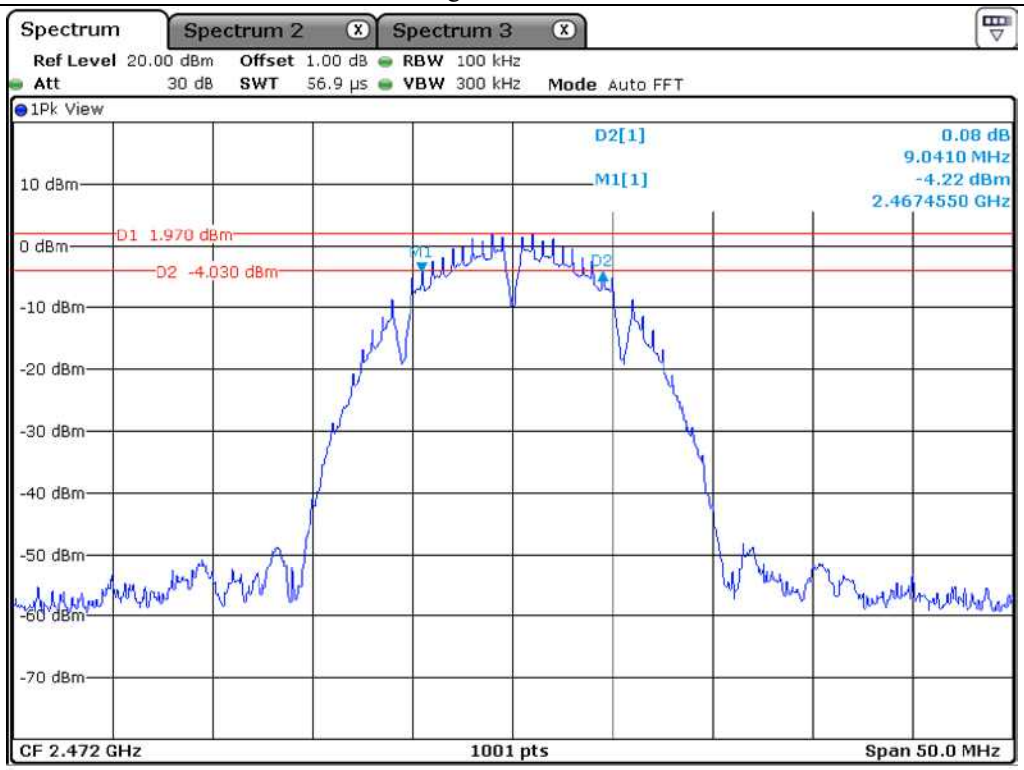


High Channel 12



High Channel 13

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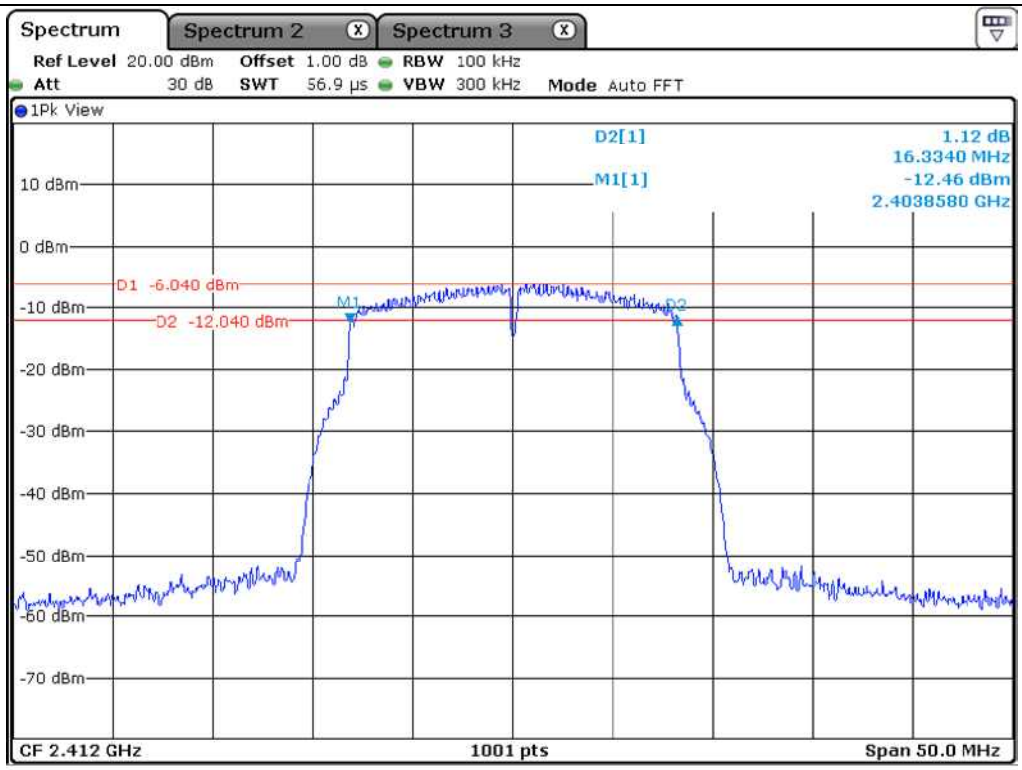
7.5 Test data for 802.11g WLAN Mode

7.5.1 Test data for Antenna 0

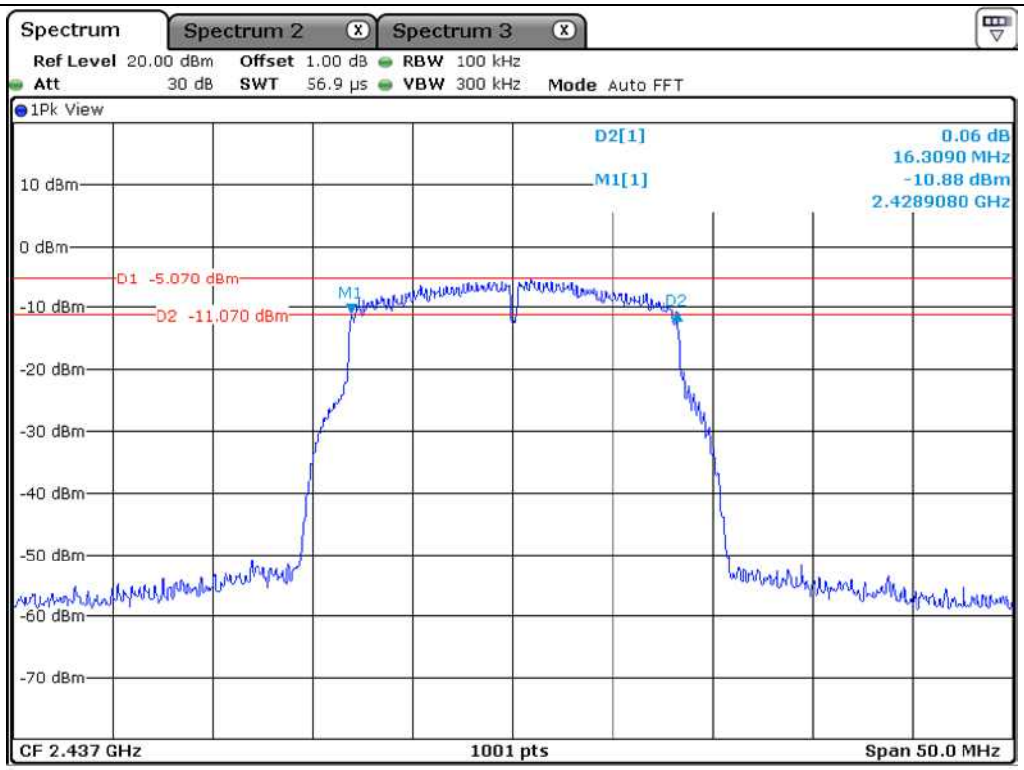
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	16.33	0.50	15.83
Middle	2 437.00	16.31	0.50	15.81
High 11	2 462.00	16.33	0.50	15.83
High 12	2 467.00	16.28	0.50	15.78
High 13	2 472.00	16.27	0.50	15.77

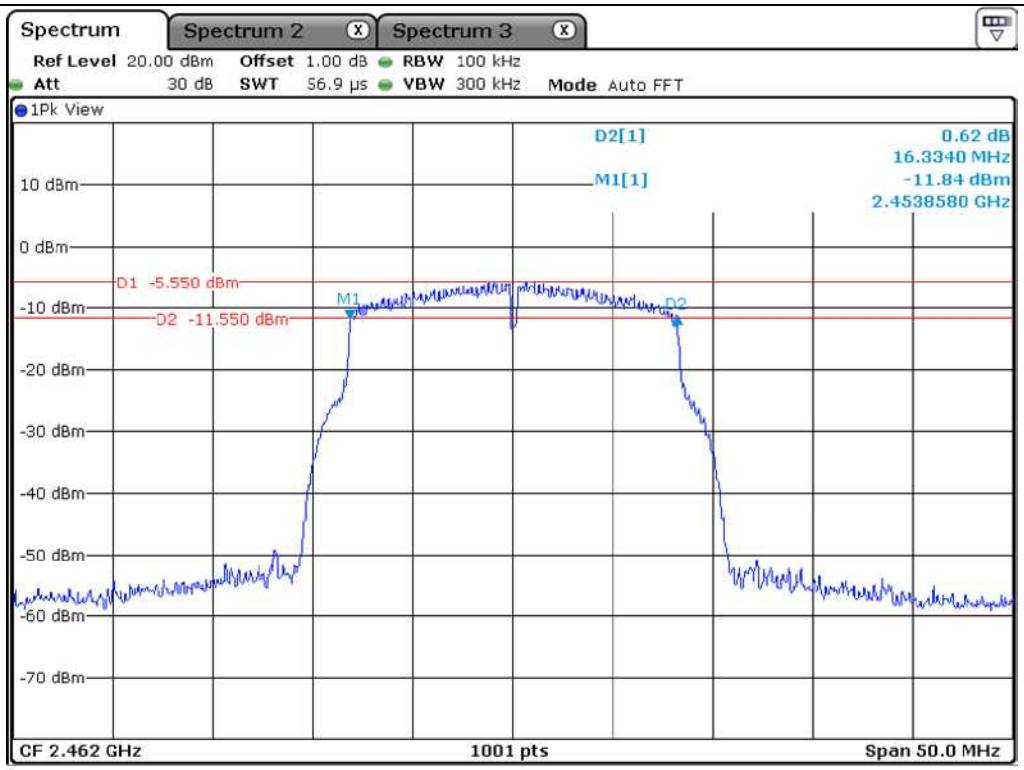
Remark. Margin = Measured Value - Limit



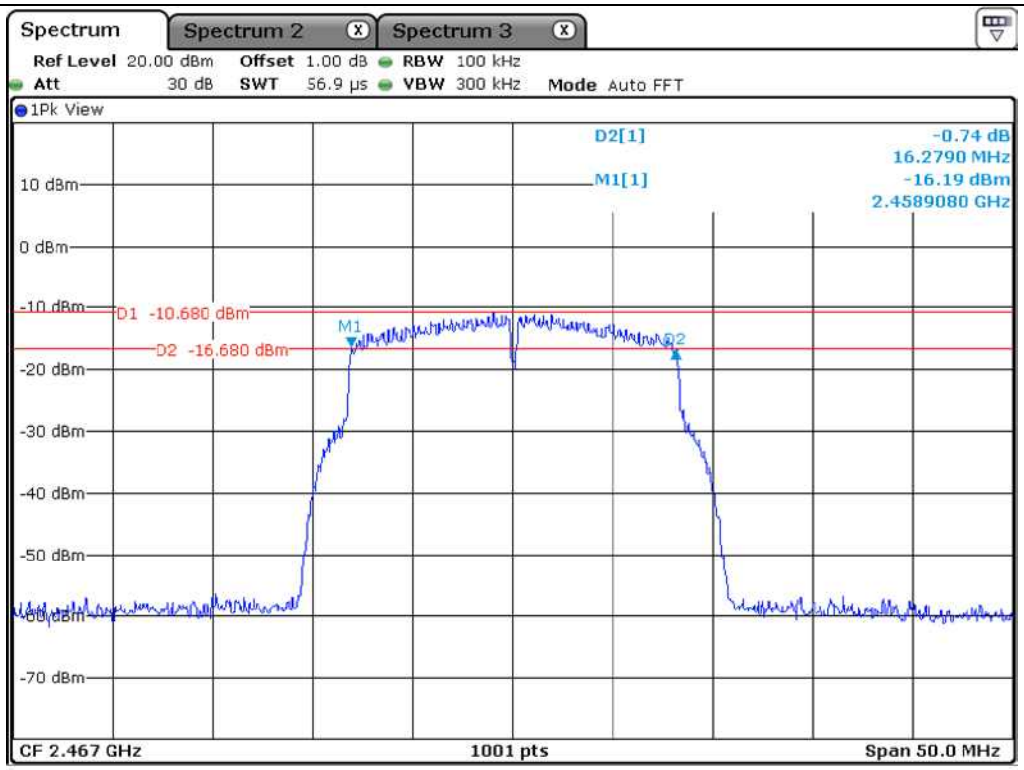
Low Channel



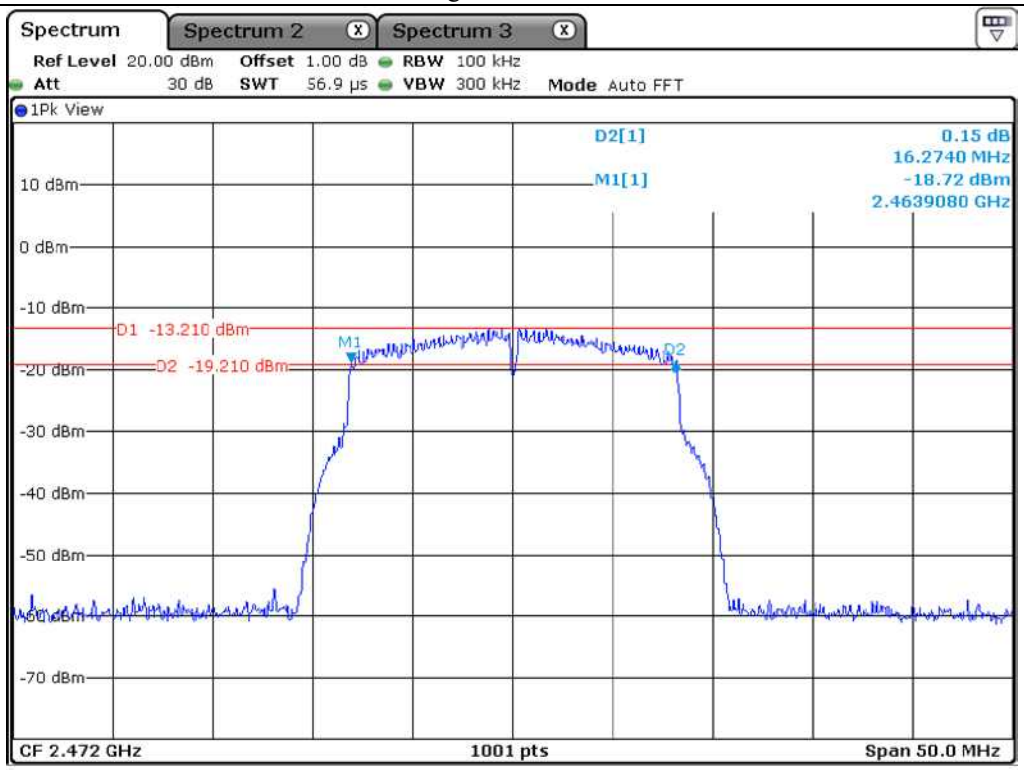
Middle Channel



High Channel 11



High Channel 12



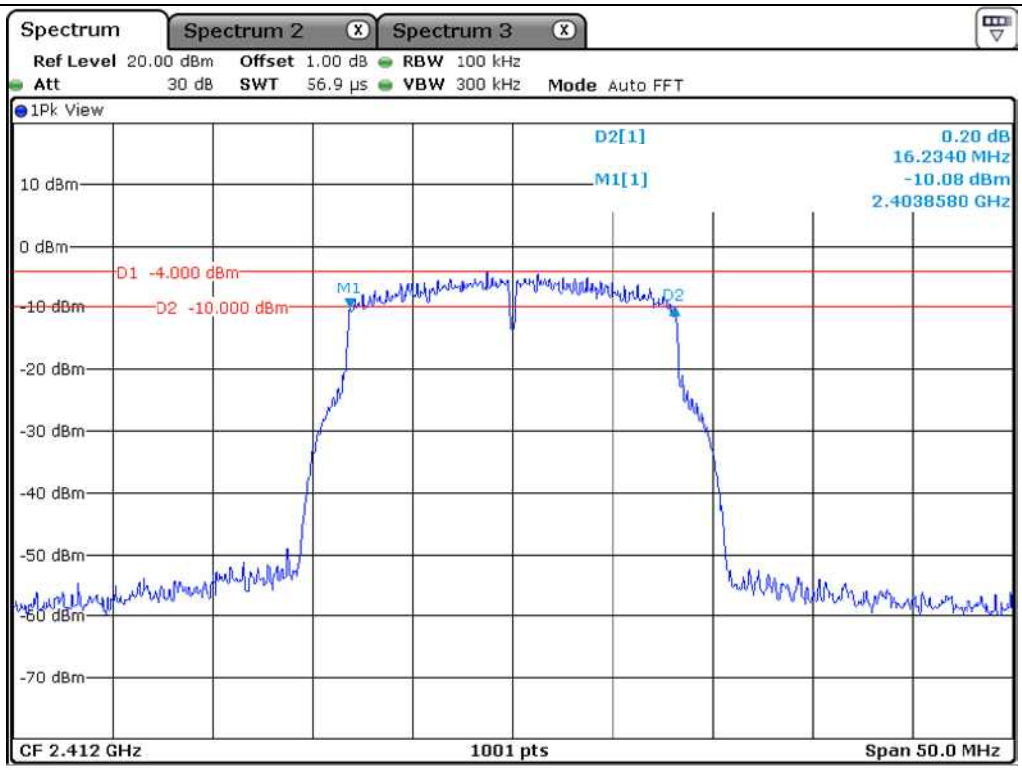
High Channel 13

7.5.2 Test data for Antenna 1

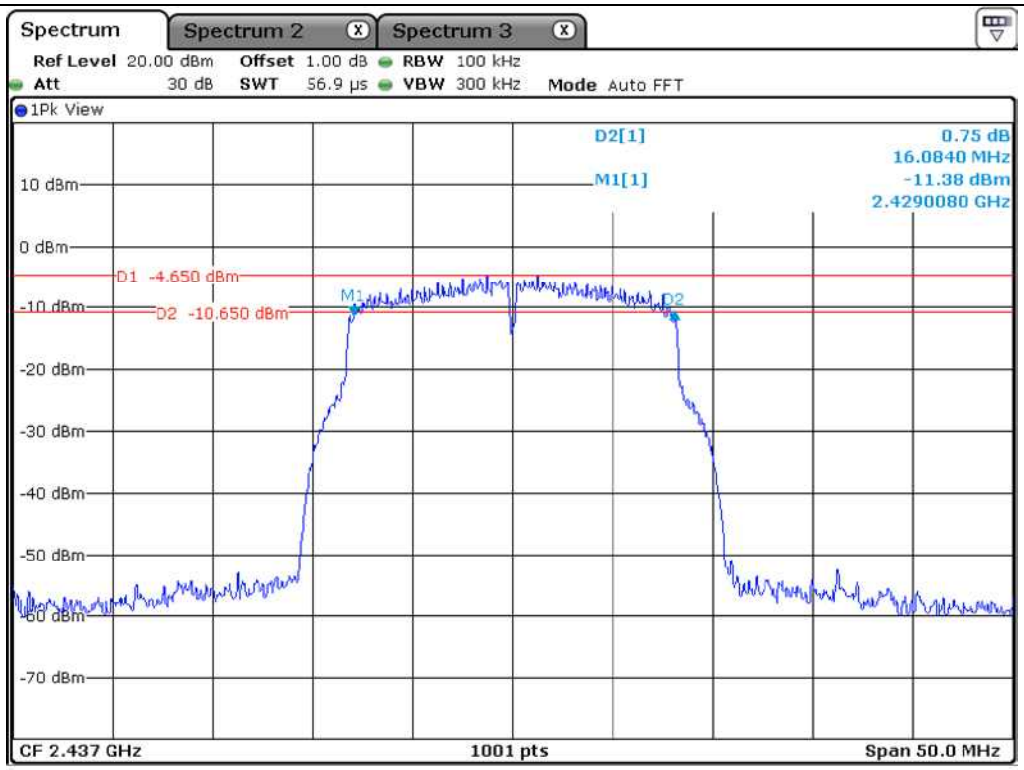
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	16.23	0.50	15.73
Middle	2 437.00	16.08	0.50	15.58
High 11	2 462.00	16.28	0.50	15.78
High 12	2 467.00	16.28	0.50	15.78
High 13	2 472.00	16.33	0.50	15.83

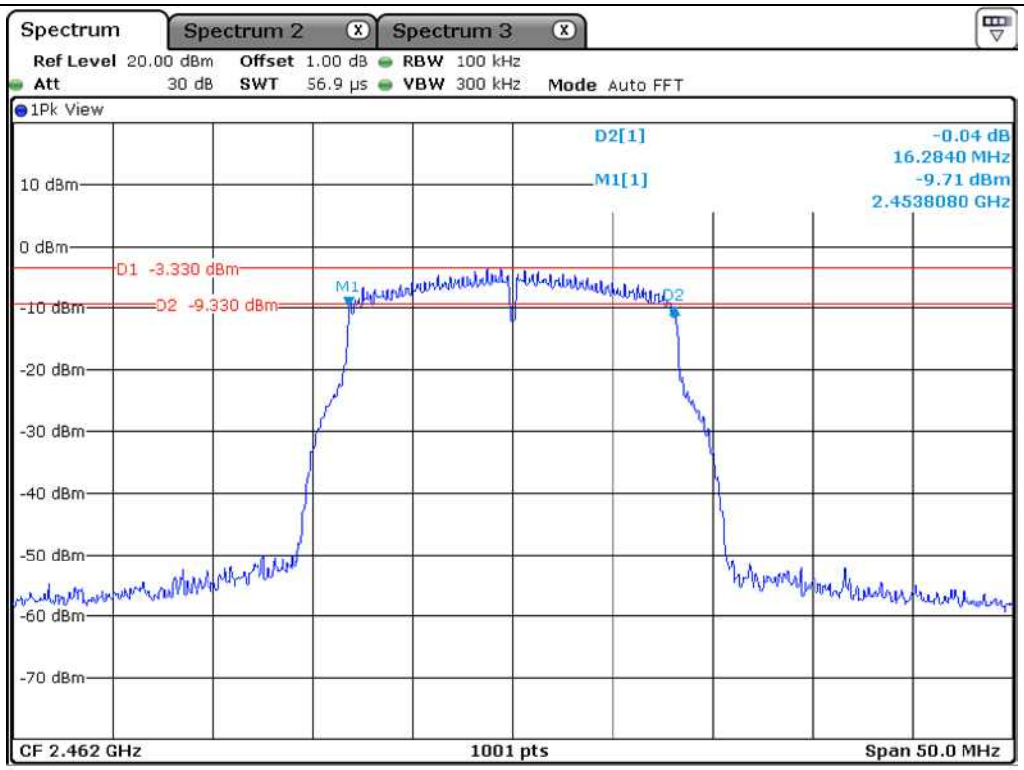
Remark. Margin = Measured Value – Limit



Low Channel



Middle Channel



High Channel 11

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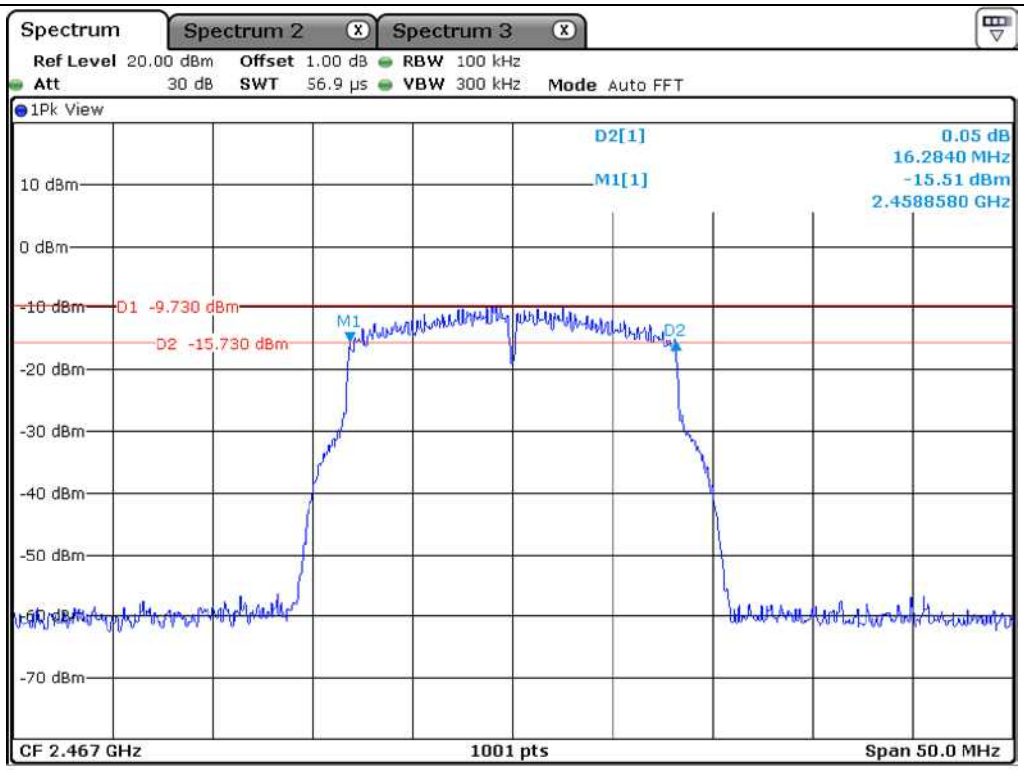
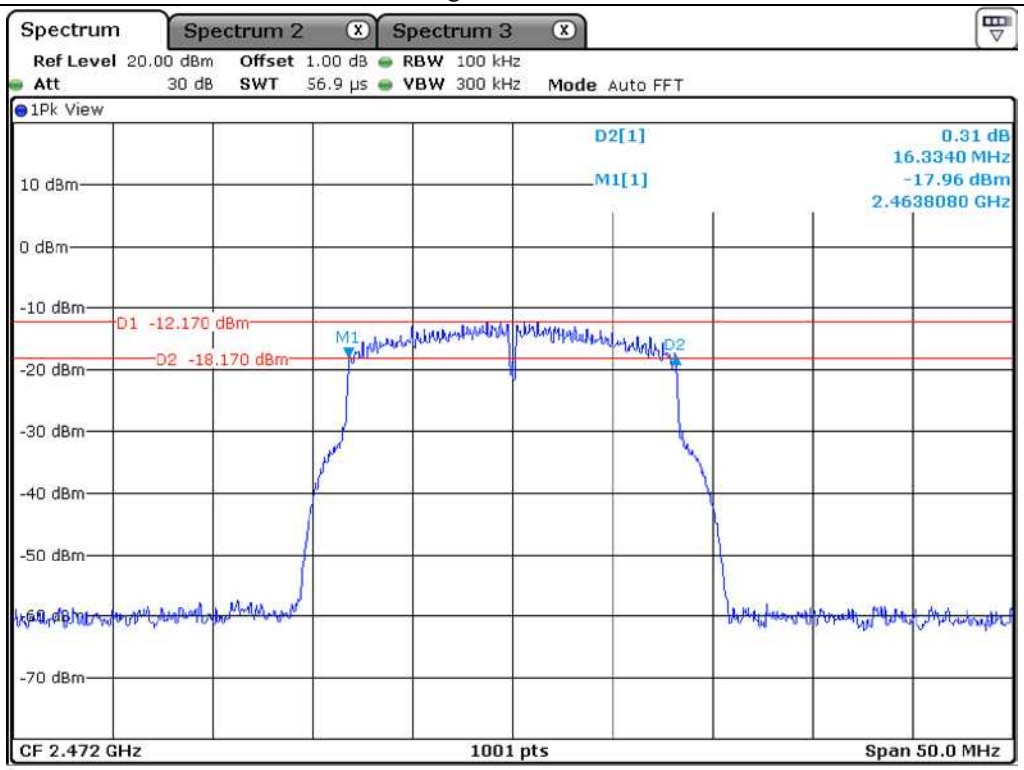


High Channel 12



High Channel 13

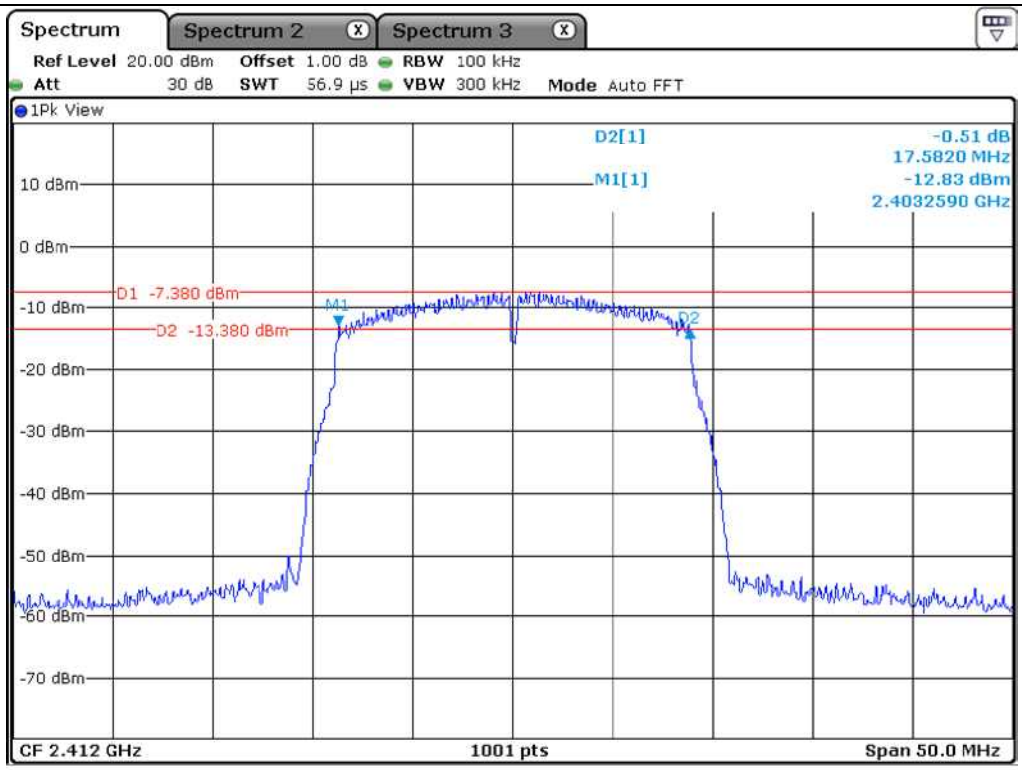
7.6 Test data for 802.11n_HT20 WLAN Mode

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	17.58	0.50	17.08
Middle	2 437.00	17.51	0.50	17.01
High 11	2 462.00	17.53	0.50	17.03
High 12	2 467.00	17.58	0.50	17.08
High 13	2 472.00	17.52	0.50	17.02

Remark. Margin = Measured Value - Limit



Low Channel

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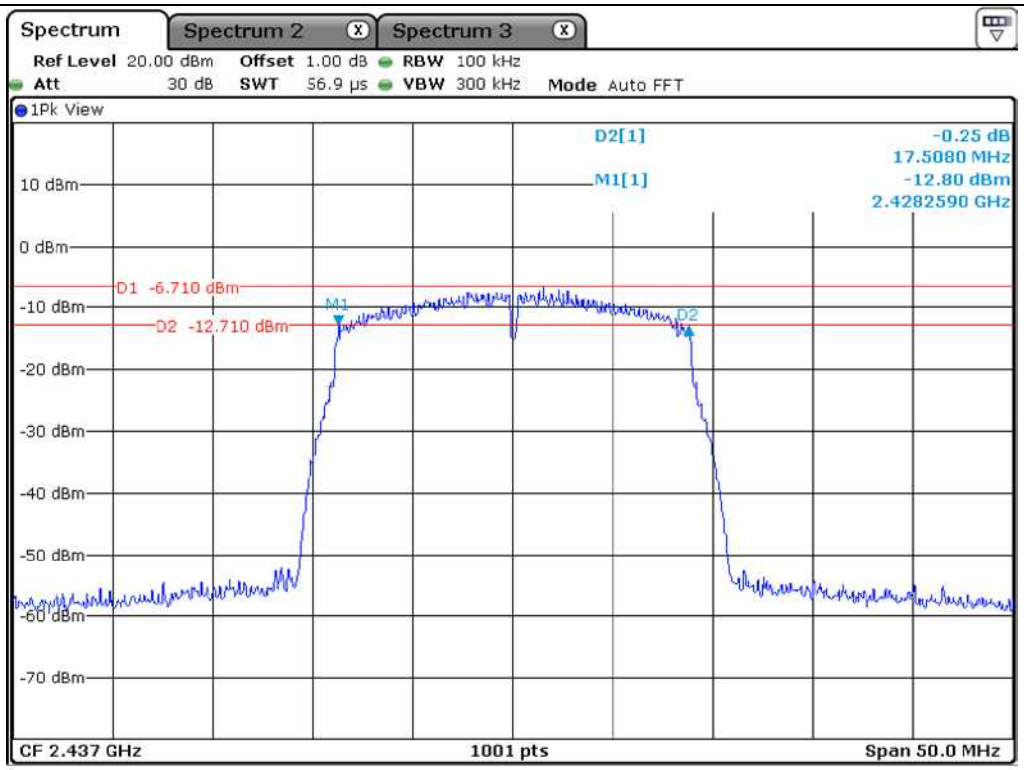
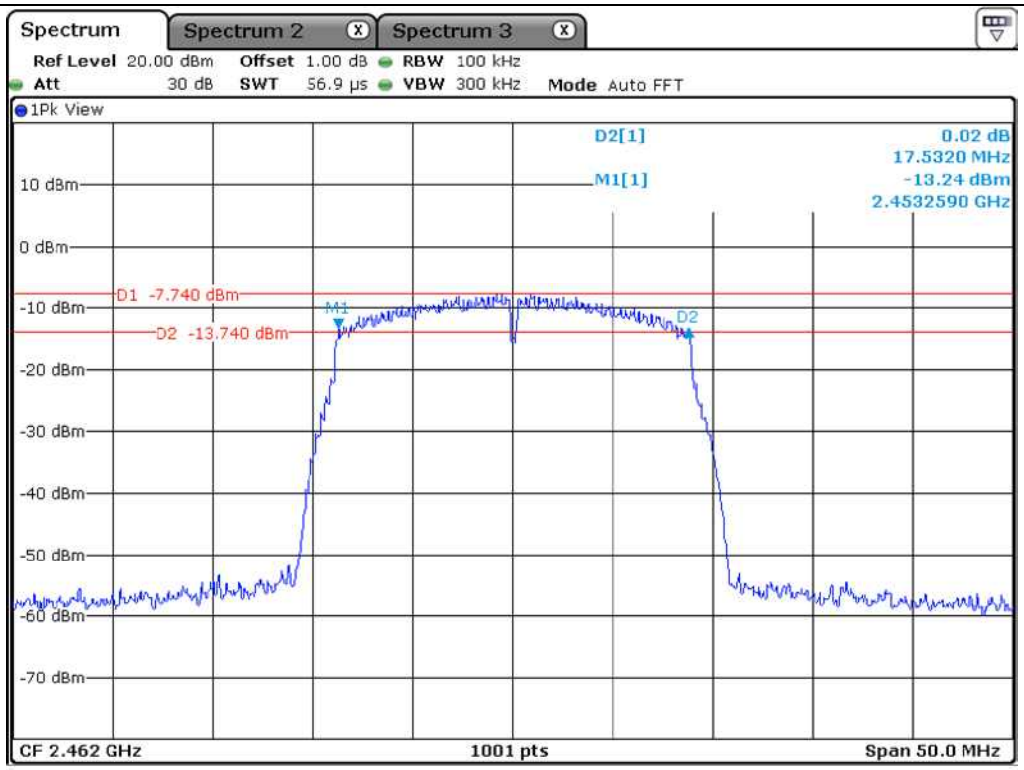
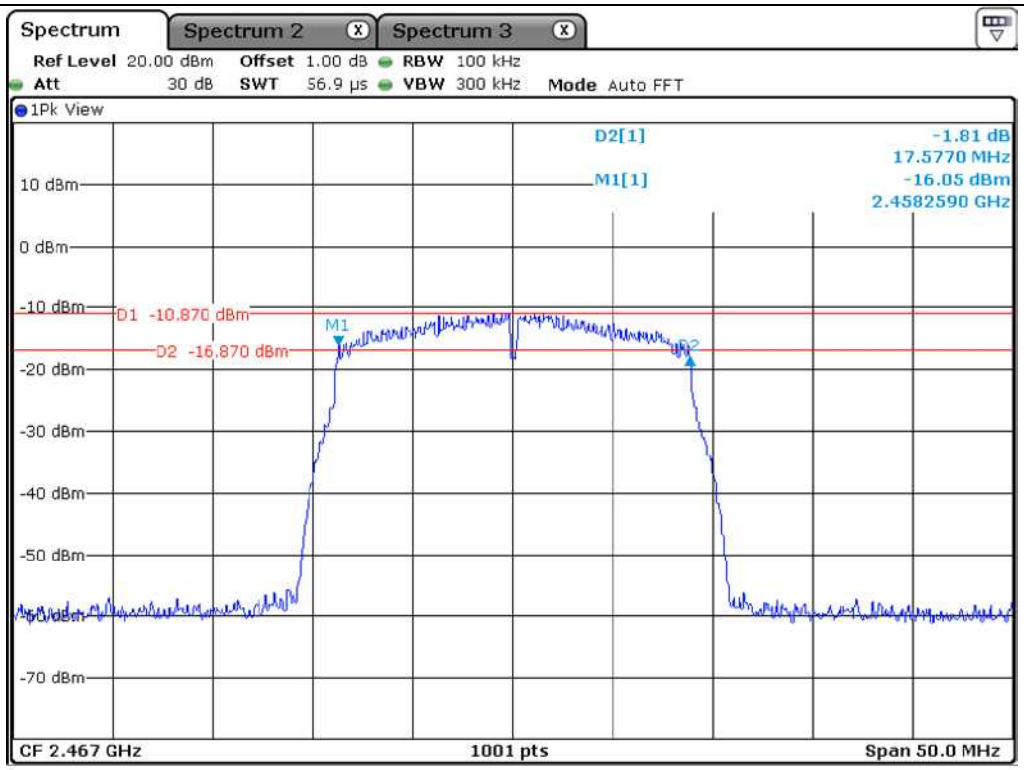


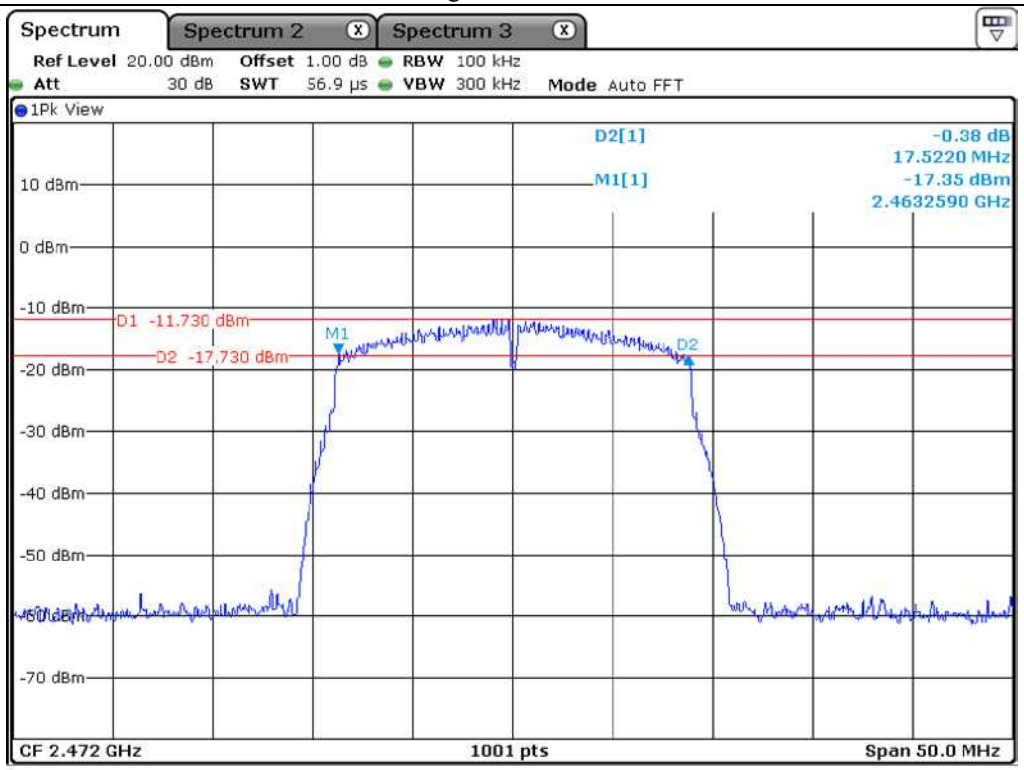
Middle Channel



High Channel 11



High Channel 12



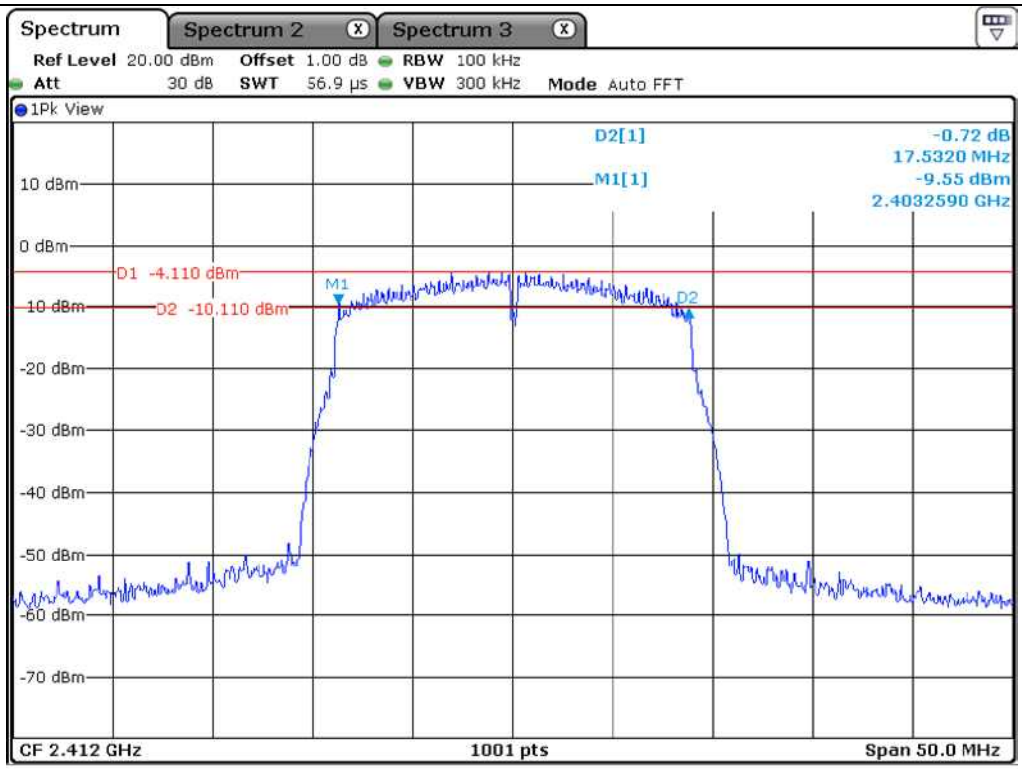
High Channel 13

7.6.2 Test data for Antenna 1

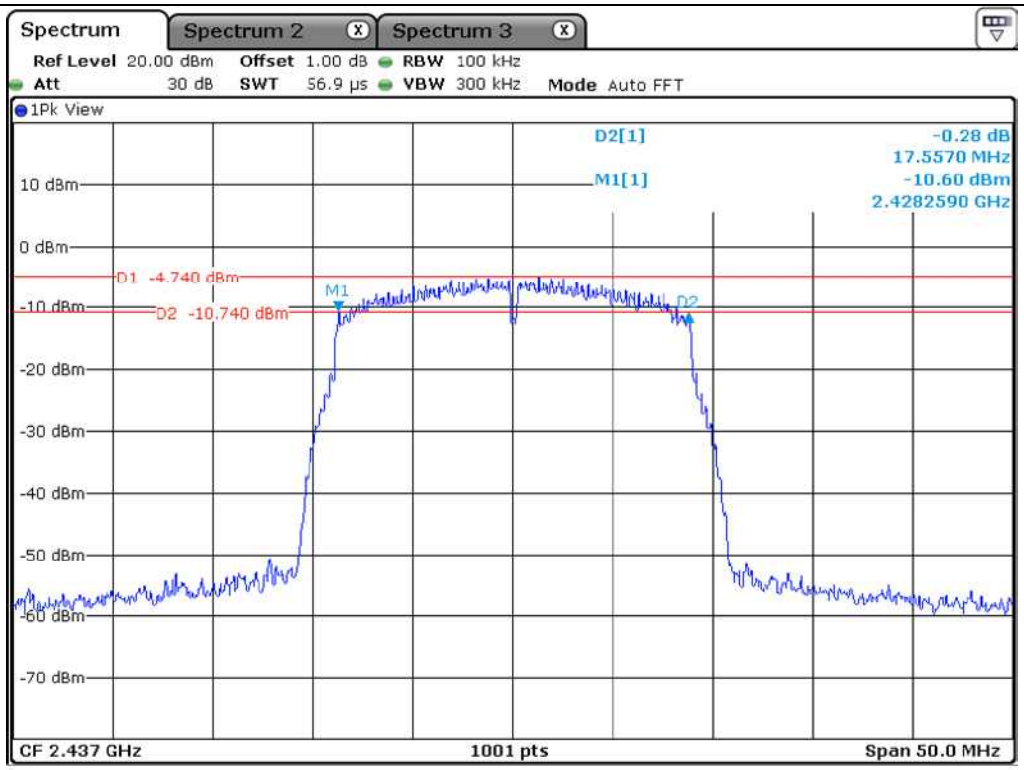
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	17.53	0.50	17.03
Middle	2 437.00	17.56	0.50	17.06
High 11	2 462.00	17.53	0.50	17.03
High 12	2 467.00	17.53	0.50	17.03
High 13	2 472.00	17.53	0.50	17.03

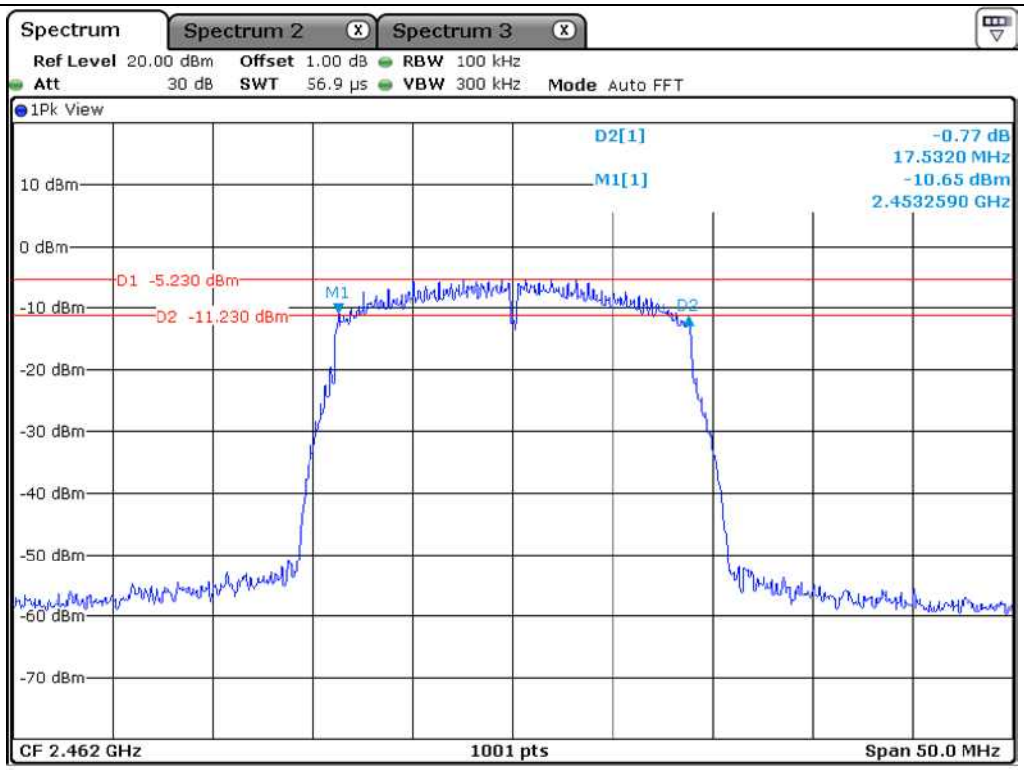
Remark. Margin = Measured Value - Limit



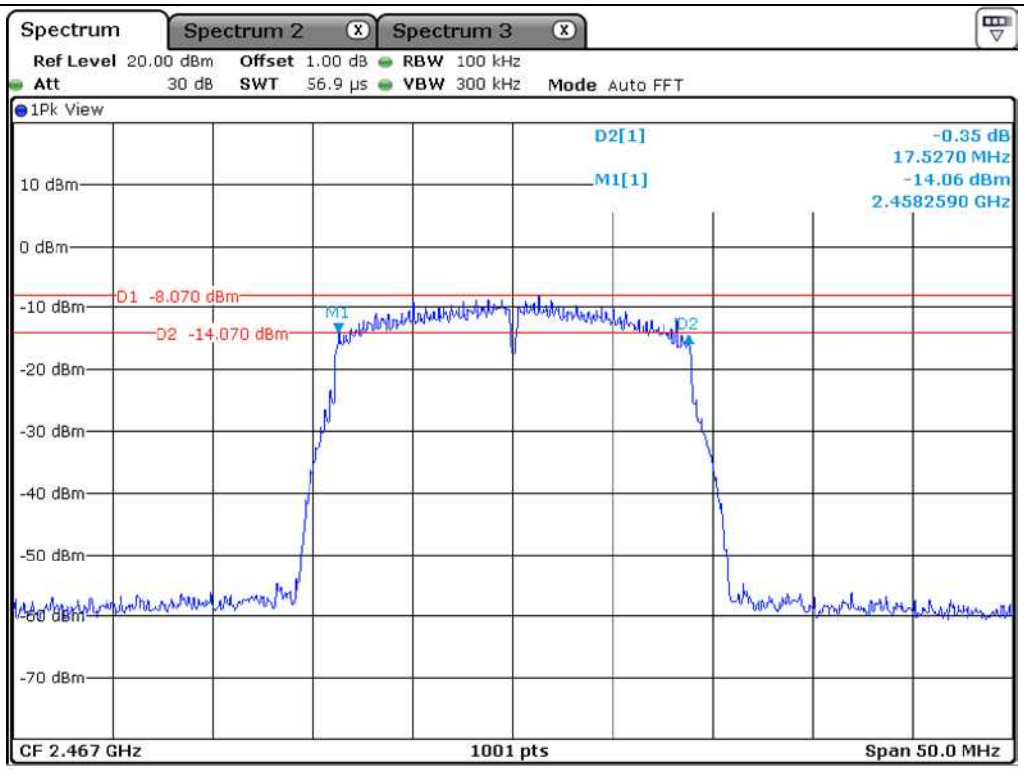
Low Channel



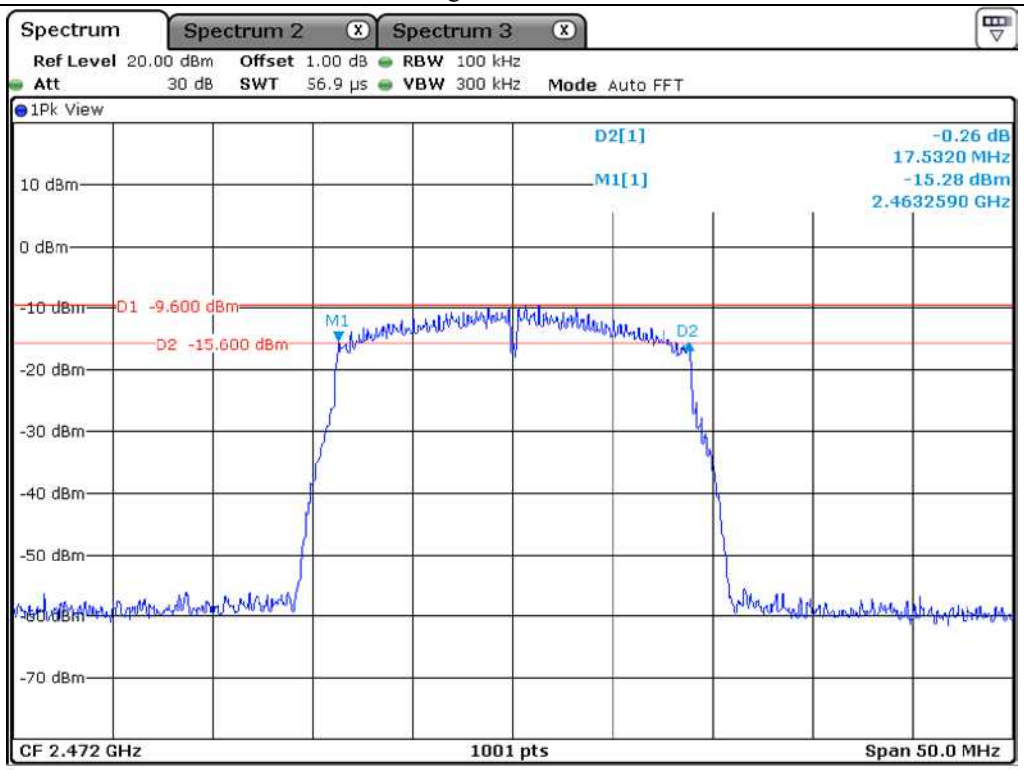
Middle Channel



High Channel 11



High Channel 12



High Channel 13

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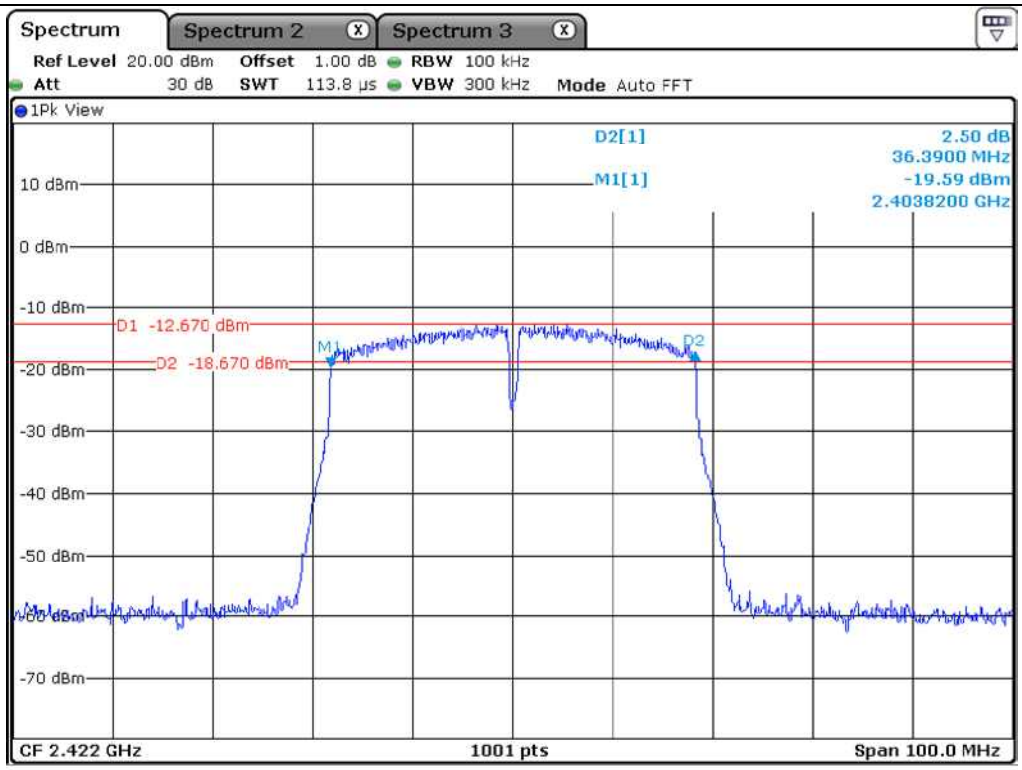
7.7 Test data for 802.11n_HT40 WLAN Mode

7.7.1 Test data for Antenna 0

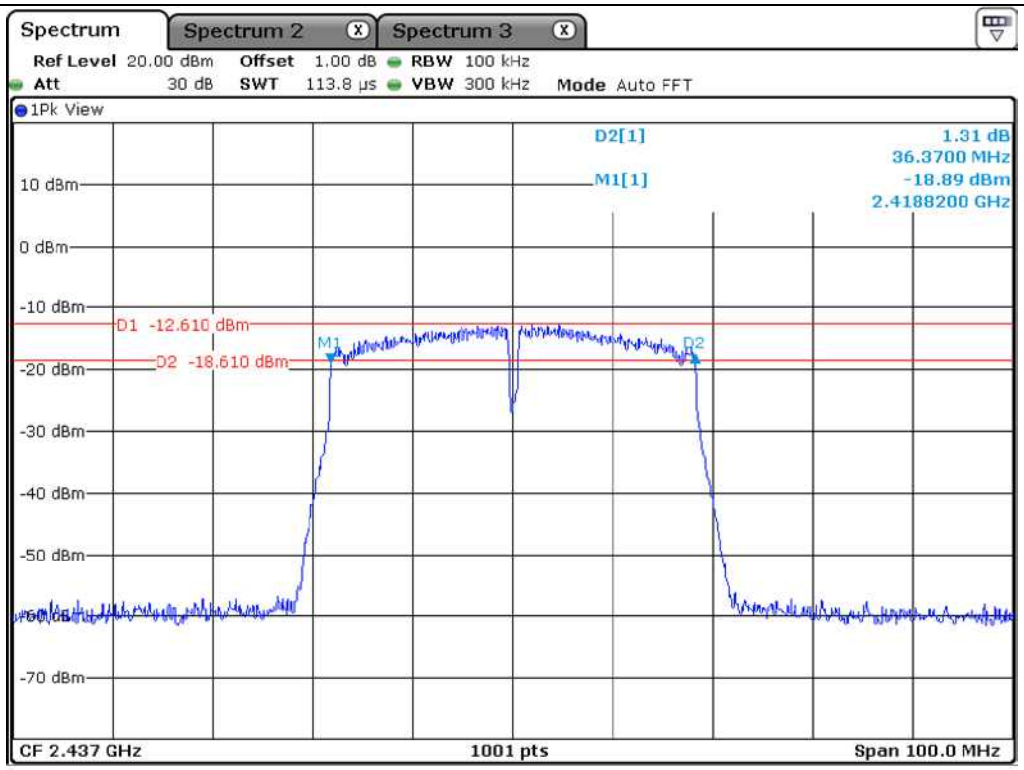
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 422.00	36.39	0.50	35.89
Middle	2 437.00	36.37	0.50	35.87
High 9	2 452.00	36.36	0.50	35.86
High 10	2 457.00	36.35	0.50	35.85
High 11	2 462.00	36.35	0.50	35.85

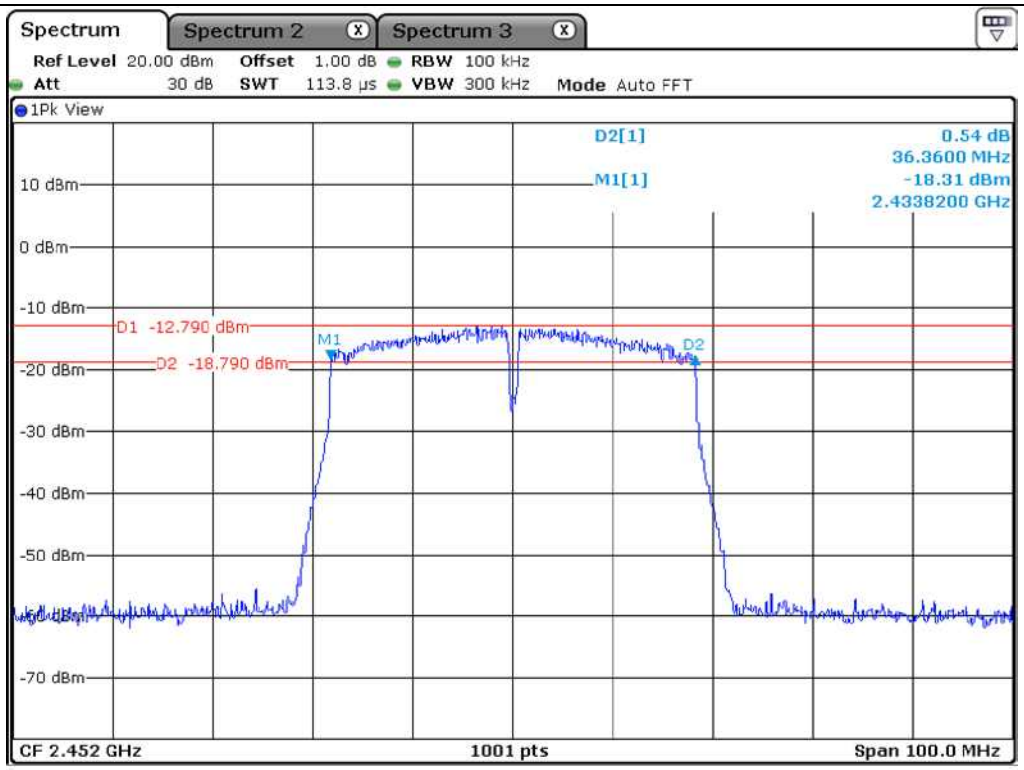
Remark. Margin = Measured Value - Limit



Low Channel

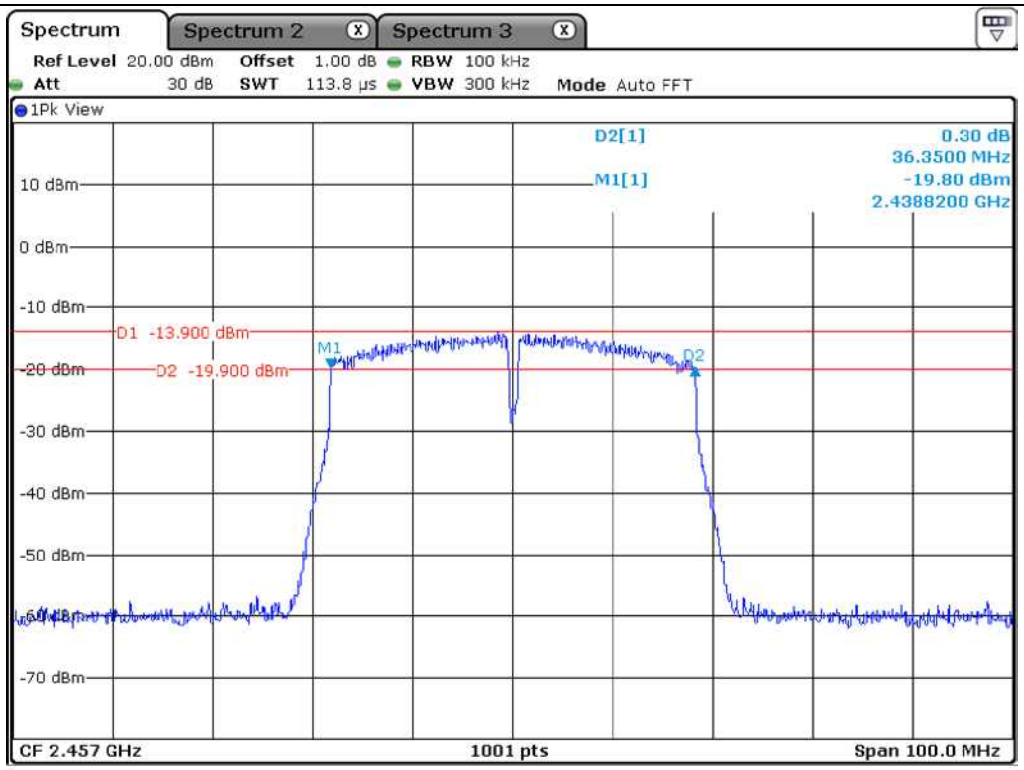


Middle Channel

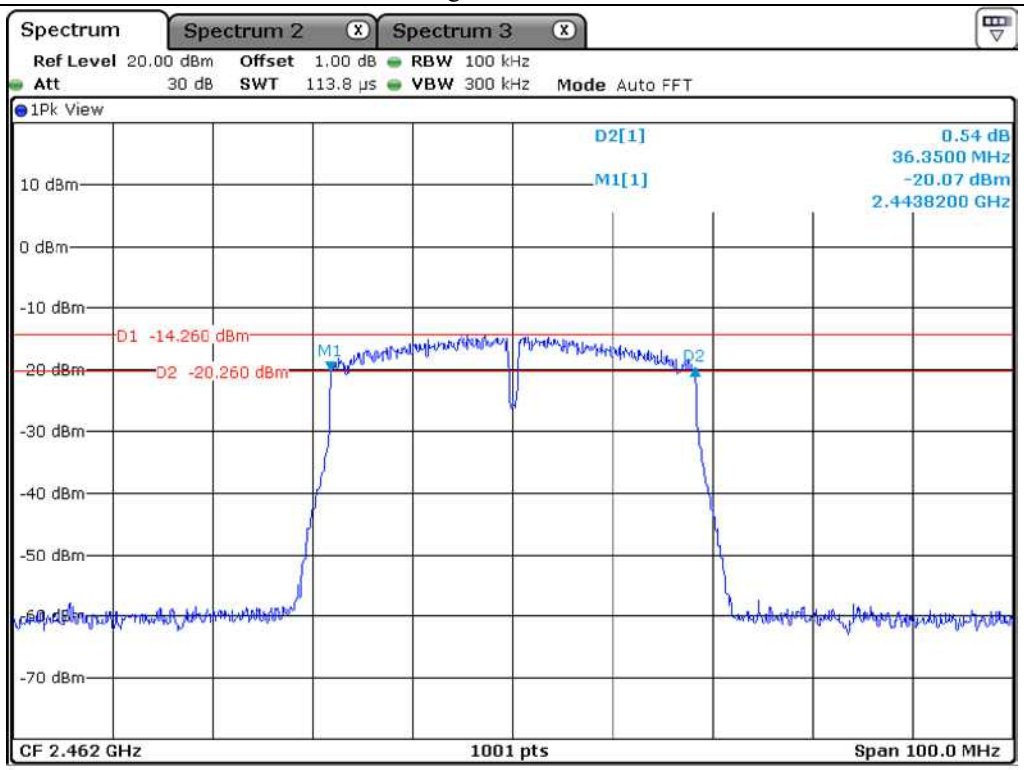


High Channel 9

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 10



High Channel 11

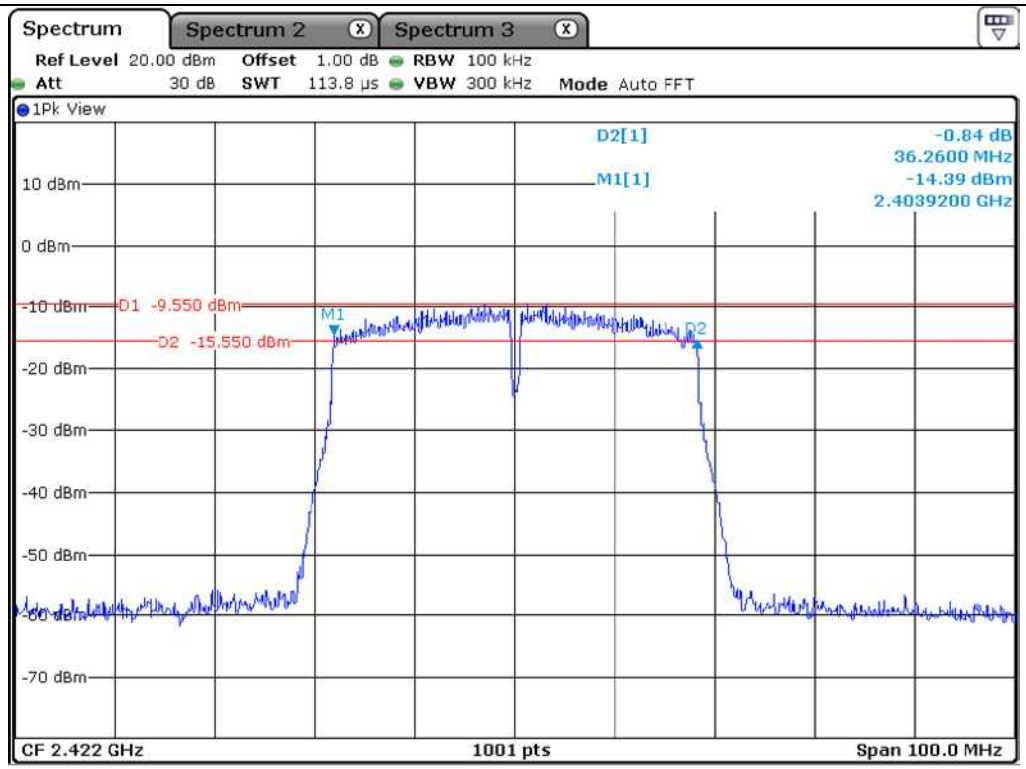
ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

7.7.2 Test data for Antenna 1

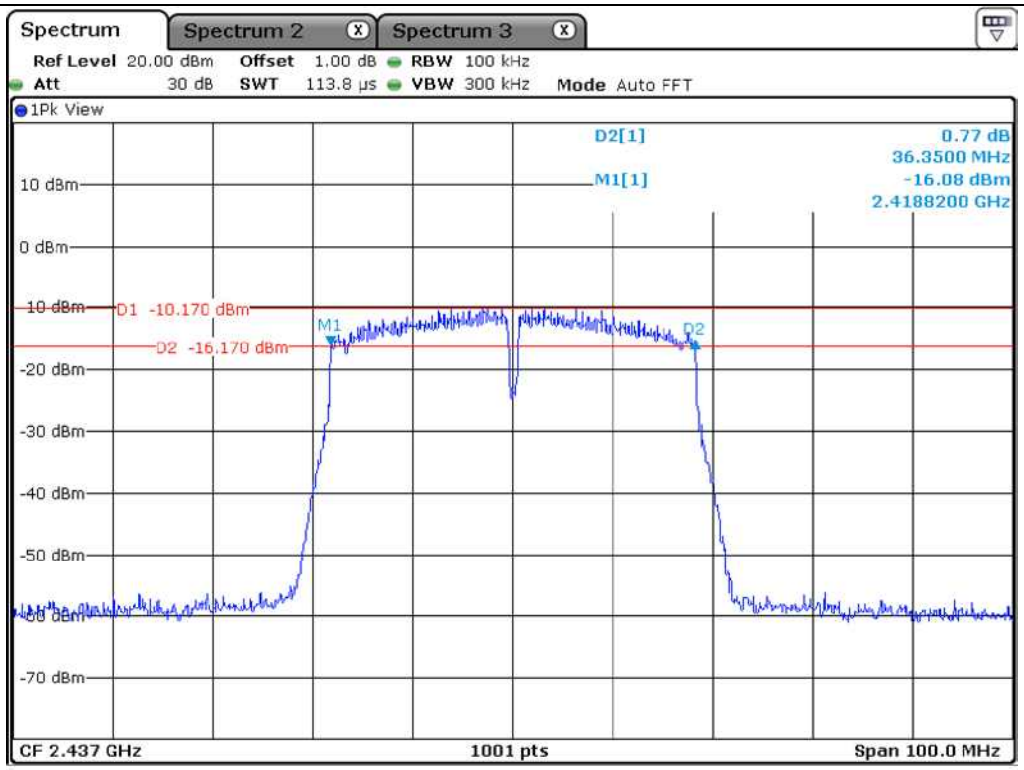
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 422.00	36.26	0.50	35.76
Middle	2 437.00	36.35	0.50	35.85
High 9	2 452.00	36.33	0.50	35.83
High 10	2 457.00	36.23	0.50	35.73
High 11	2 462.00	36.32	0.50	35.82

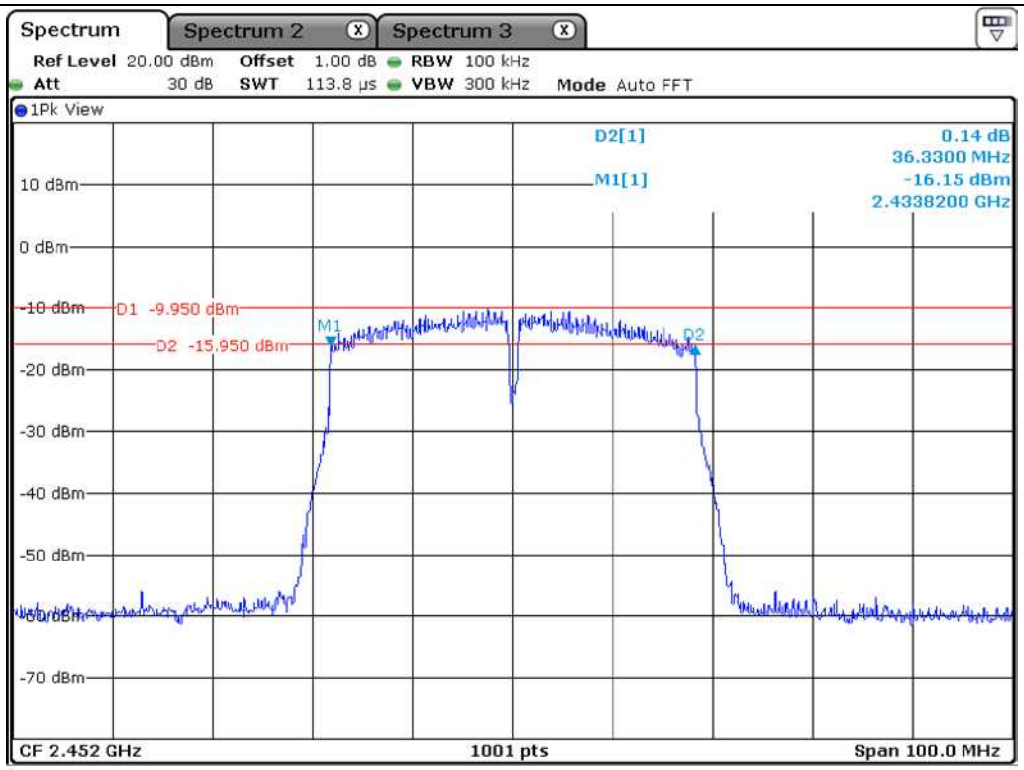
Remark. Margin = Measured Value - Limit



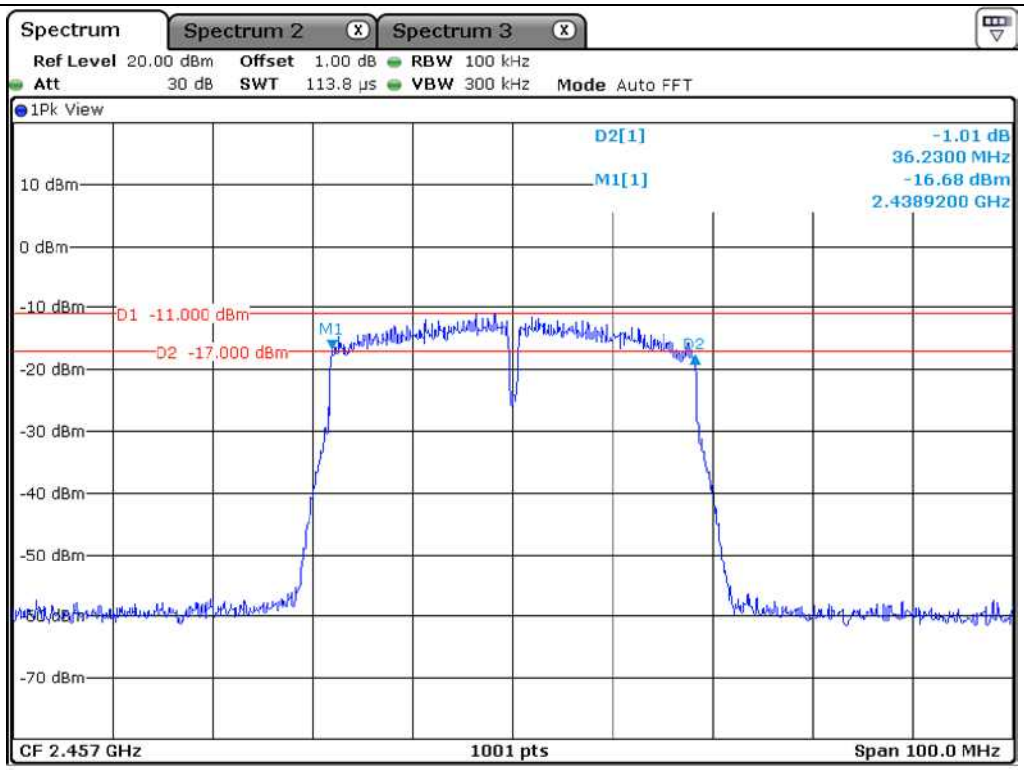
Low Channel



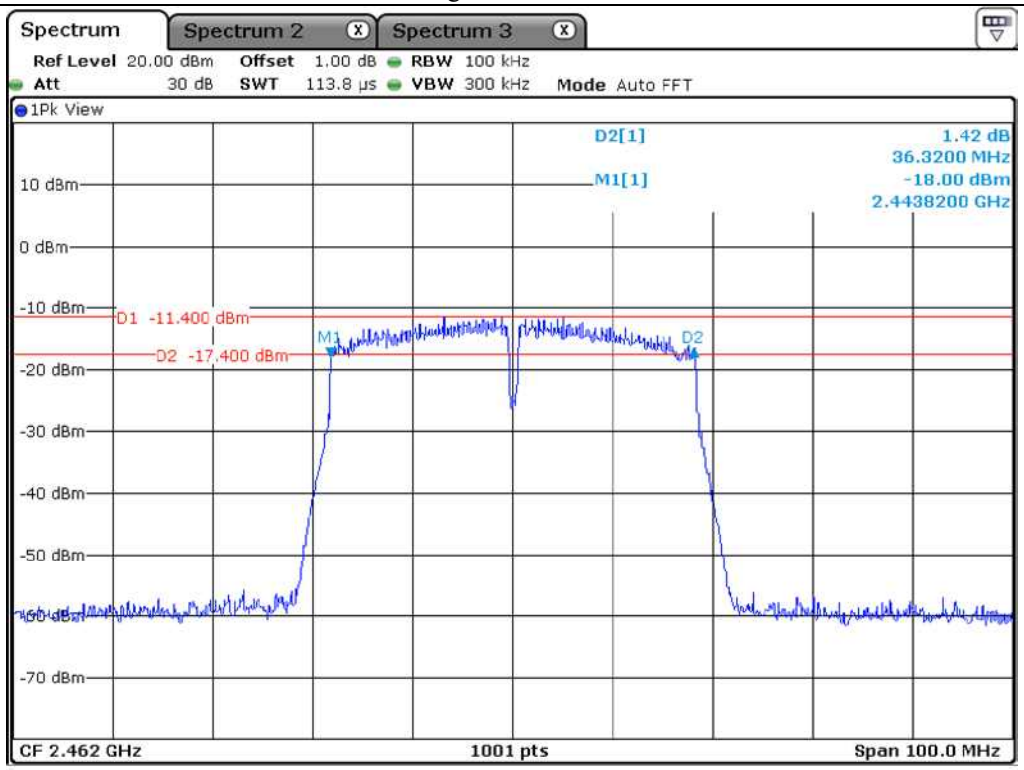
Middle Channel



High Channel 9



High Channel 10



High Channel 11

8. MAXIMUM CONDUCTED (AVERAGE) OUTPUT POWER

8.1 Operating environment

Temperature : 23 °C

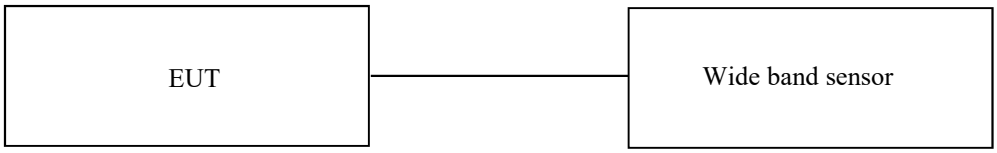
Relative humidity : 45 % R.H.

8.2 Test set-up

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

The Wide Band Sensor is measured when the EUT is transmitting at the appropriate center frequency its maximum power control level as described in Section 8.3(558074 D01 15.247 Meas Guidance v05r02).

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



8.3 Test Date

March 12, 2021 ~ March 22, 2021

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 : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	15.61	30.00	14.39
MIDDLE	2 437.00	15.65	30.00	14.35
HIGH 11	2 462.00	15.98	30.00	14.02
HIGH 12	2 467.00	11.68	30.00	18.32
HIGH 13	2 472.00	8.03	30.00	21.97

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

8.4.2 Test data for Antenna 1

-. Test Result : Pass

-. Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	15.98	30.00	14.02
MIDDLE	2 437.00	16.08	30.00	13.92
HIGH 11	2 462.00	16.05	30.00	13.95
HIGH 12	2 467.00	11.75	30.00	18.25
HIGH 13	2 472.00	11.08	30.00	18.92

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

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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 : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	10.54	30.00	19.46
MIDDLE	2 437.00	10.65	30.00	19.35
HIGH 11	2 462.00	10.76	30.00	19.24
HIGH 12	2 467.00	3.75	30.00	26.25
HIGH 13	2 472.00	0.95	30.00	29.05

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

8.5.2 Test data for Antenna 1

-. Test Result : Pass

-. Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	10.18	30.00	20.87
MIDDLE	2 437.00	10.48	30.00	20.68
HIGH 11	2 462.00	10.47	30.00	20.72
HIGH 12	2 467.00	4.48	30.00	24.81
HIGH 13	2 472.00	1.63	30.00	26.25

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

8.5.3 Test data for Multiple Transmit

-. Test Result : Pass

-. Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	13.37	30.00	16.63
MIDDLE	2 437.00	13.58	30.00	16.42
HIGH 11	2 462.00	13.63	30.00	16.37
HIGH 12	2 467.00	7.14	30.00	22.86
HIGH 13	2 472.00	4.31	30.00	25.69

Remark 1 : Margin = Limit – Measured Value (=Power Sensor Reading + Cable Loss)

Remark 2 : Calculated Output Power= 10log (10(Antenna0 Output Power/10)+10(Antenna1 Output Power/10))

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

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8.6 Test data for 802.11n_HT20 WLAN Mode

8.6.1 Test data for Antenna 0

-. Test Result : Pass

-. Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	9.13	30.00	20.87
MIDDLE	2 437.00	9.32	30.00	20.68
HIGH 11	2 462.00	9.28	30.00	20.72
HIGH 12	2 467.00	5.19	30.00	24.81
HIGH 13	2 472.00	3.75	30.00	26.25

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

8.6.2 Test data for Antenna 1

-. Test Result : Pass

-. Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	8.86	30.00	21.14
MIDDLE	2 437.00	8.95	30.00	21.05
HIGH 11	2 462.00	8.91	30.00	21.09
HIGH 12	2 467.00	5.16	30.00	24.84
HIGH 13	2 472.00	4.51	30.00	25.49

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

8.6.3 Test data for Multiple Transmit

-. Test Result : Pass

-. Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	12.01	30.00	17.99
MIDDLE	2 437.00	12.15	30.00	17.85
HIGH 11	2 462.00	12.11	30.00	17.89
HIGH 12	2 467.00	8.19	30.00	21.81
HIGH 13	2 472.00	7.16	30.00	22.84

Remark 1 : Margin = Limit – Measured Value (=Power Sensor Reading + Cable Loss)

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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8.7 Test data for 802.11n_HT40 WLAN Mode

8.7.1 Test data for Antenna 0

-. Test Result : Pass

-. Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 422.00	6.45	30.00	23.55
MIDDLE	2 437.00	6.81	30.00	23.19
HIGH 9	2 452.00	6.75	30.00	23.25
HIGH 10	2 457.00	5.41	30.00	24.59
HIGH 11	2 462.00	5.15	30.00	24.85

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

8.7.2 Test data for Antenna 1

-. Test Result : Pass

-. Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 422.00	6.56	30.00	23.44
MIDDLE	2 437.00	6.63	30.00	23.37
HIGH 9	2 452.00	6.98	30.00	23.02
HIGH 10	2 457.00	5.65	30.00	24.35
HIGH 11	2 462.00	5.86	30.00	24.14

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

8.7.3 Test data for Multiple Transmit

-. Test Result : Pass

-. Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 422.00	9.52	30.00	20.48
MIDDLE	2 437.00	9.73	30.00	20.27
HIGH 9	2 452.00	9.88	30.00	20.12
HIGH 10	2 457.00	8.54	30.00	21.46
HIGH 11	2 462.00	8.53	30.00	21.47

Remark 1 : Margin = Limit – Measured Value (=Power Sensor Reading + Cable Loss)

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

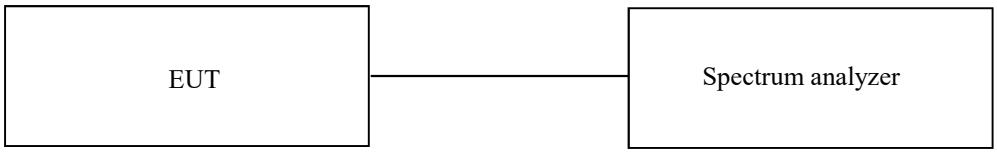
9.1 Operating environment

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

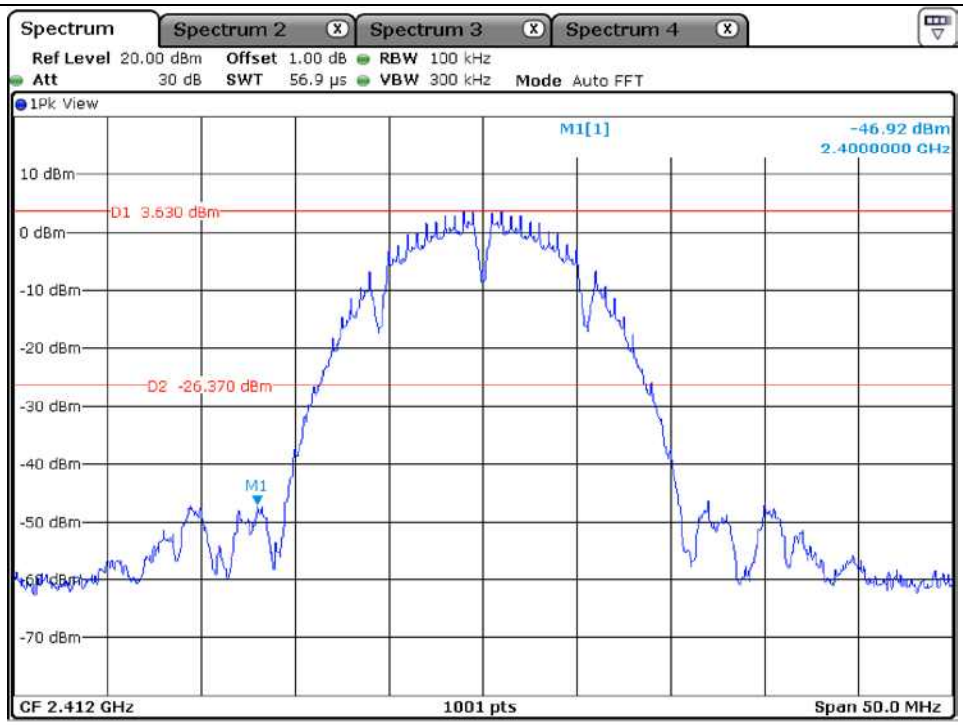
March 12, 2021 ~ March 22, 2021

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

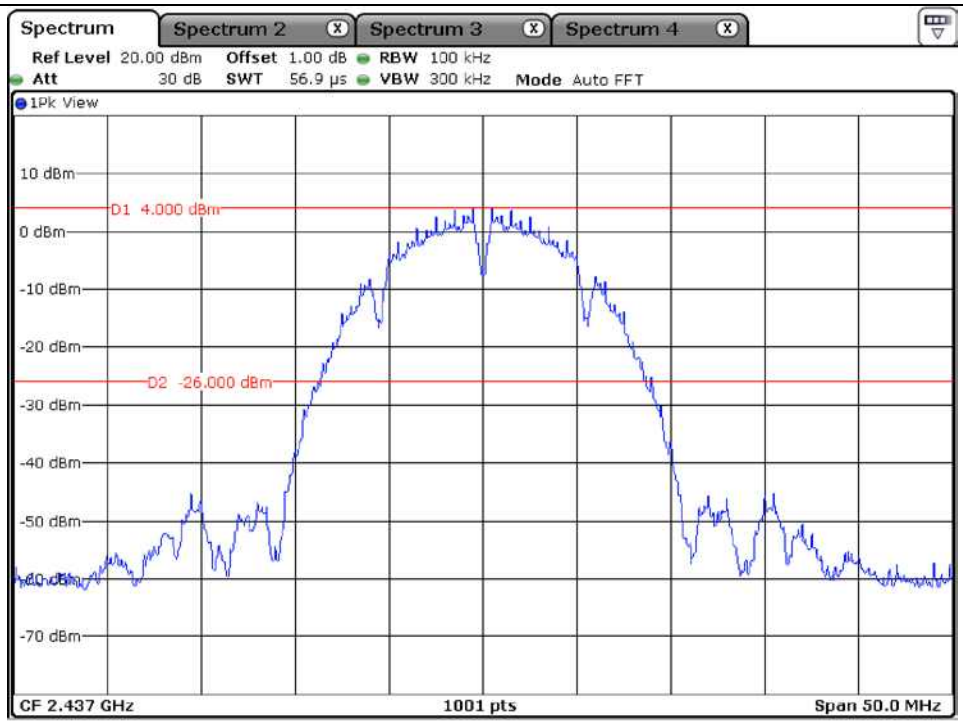
9.5 Test data for conducted emission

9.5.1 Test data for 802.11b WLAN Mode

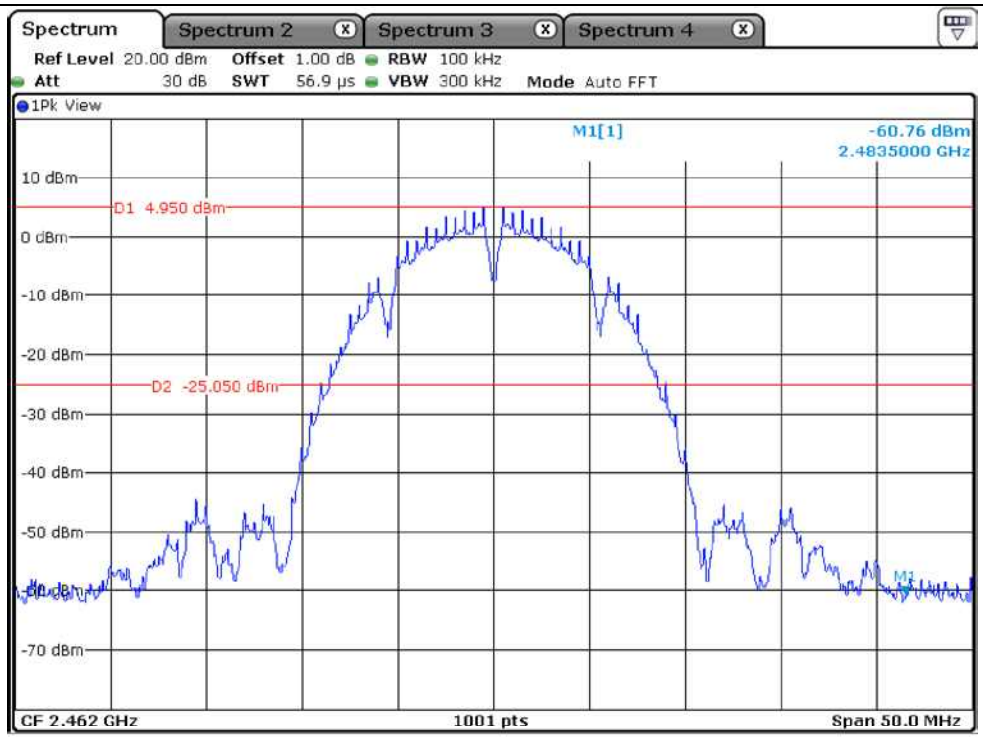
9.5.1.1 Test data for Antenna 0



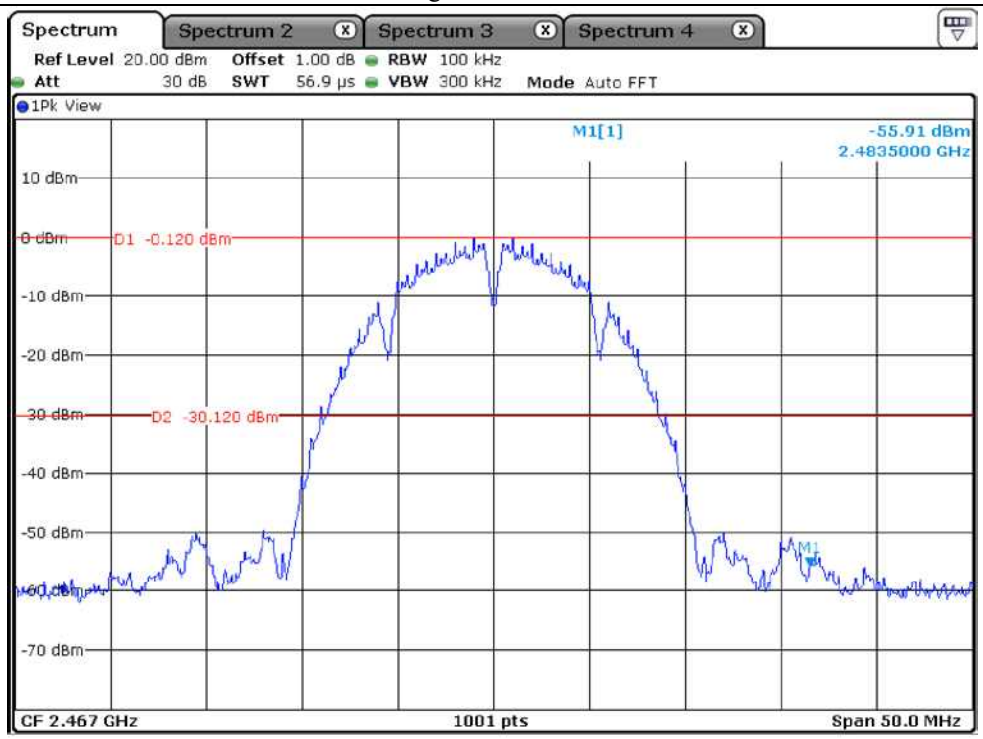
Low Channel



Middle Channel

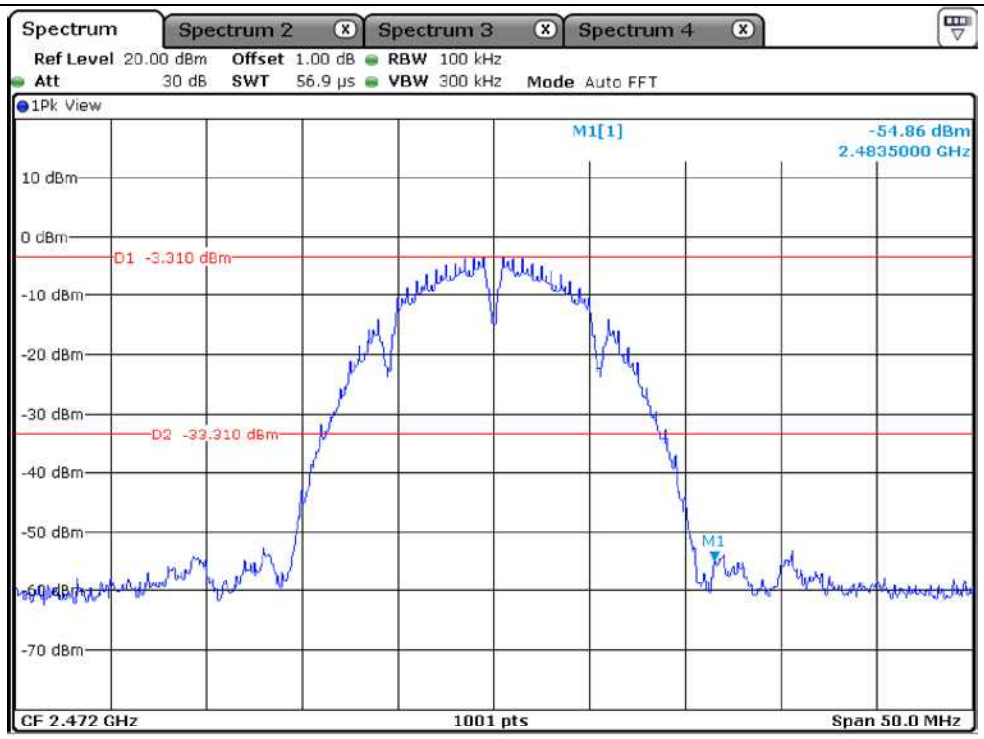


High Channel 11



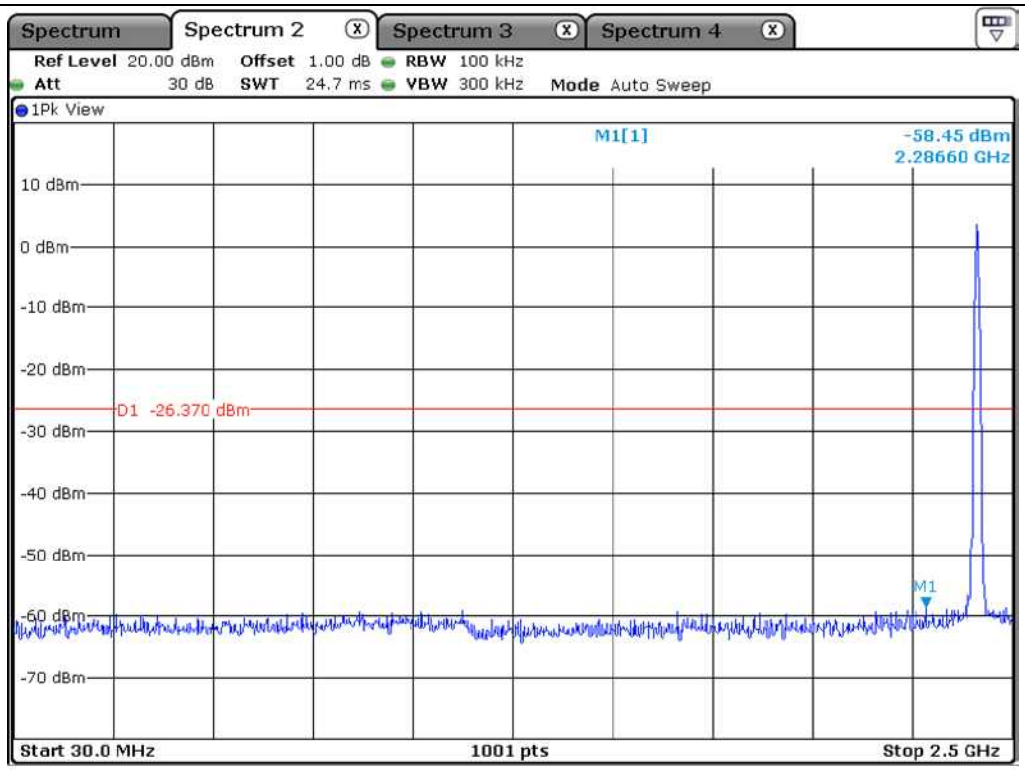
High Channel 12

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

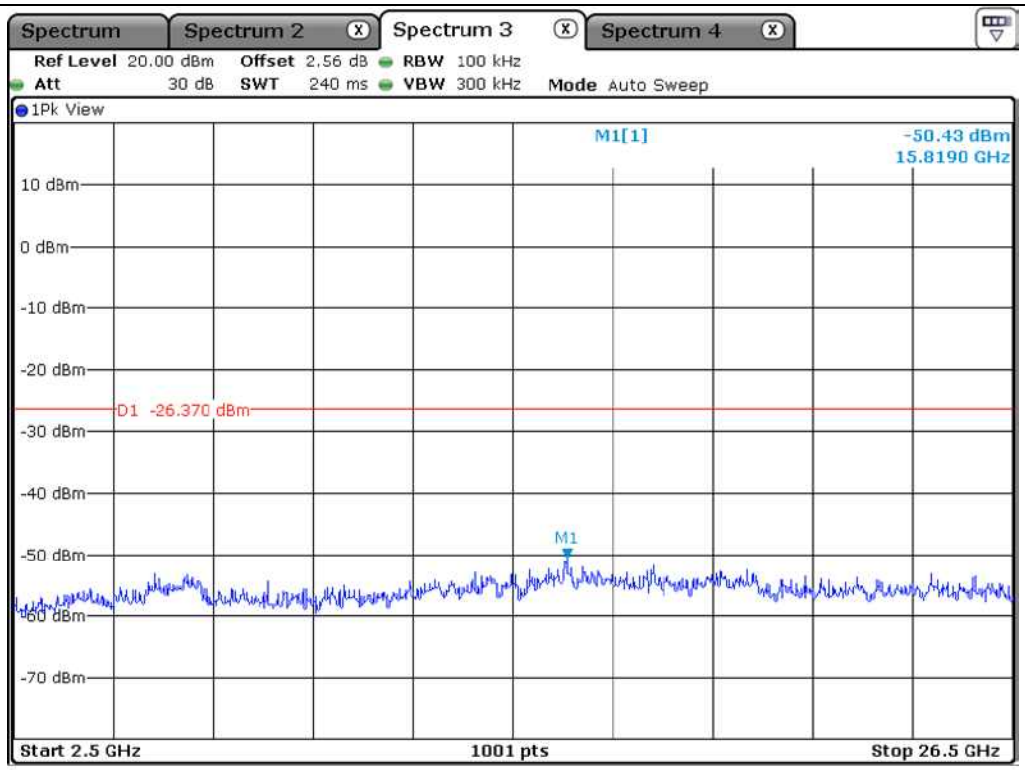


High Channel 13

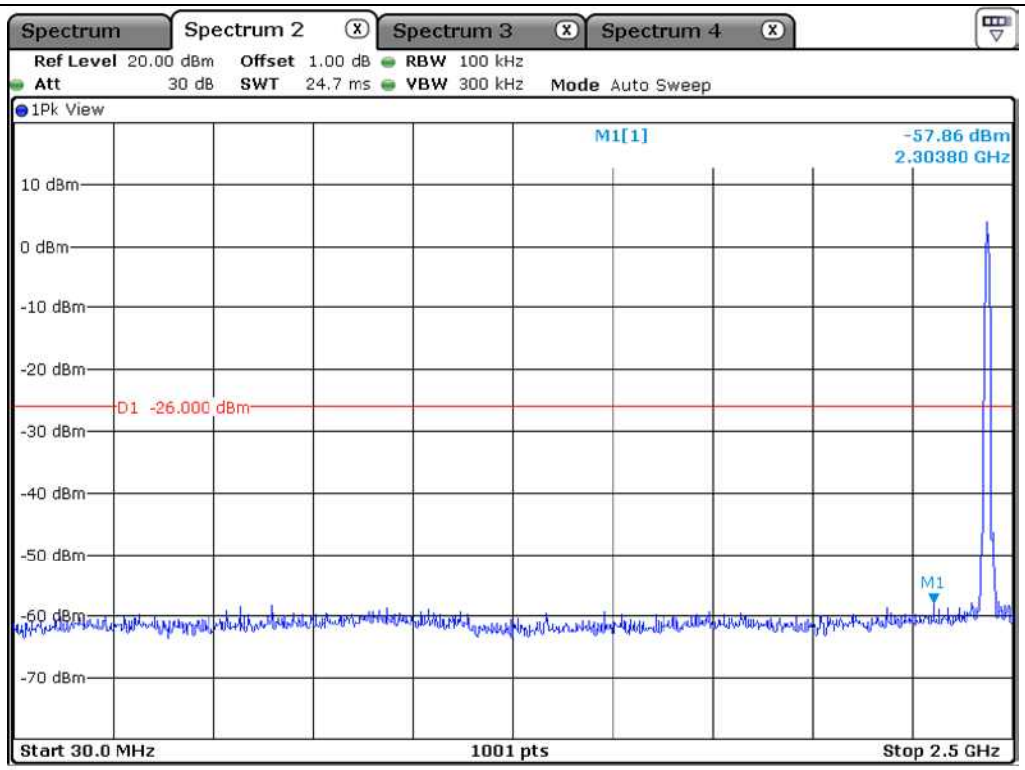
ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)



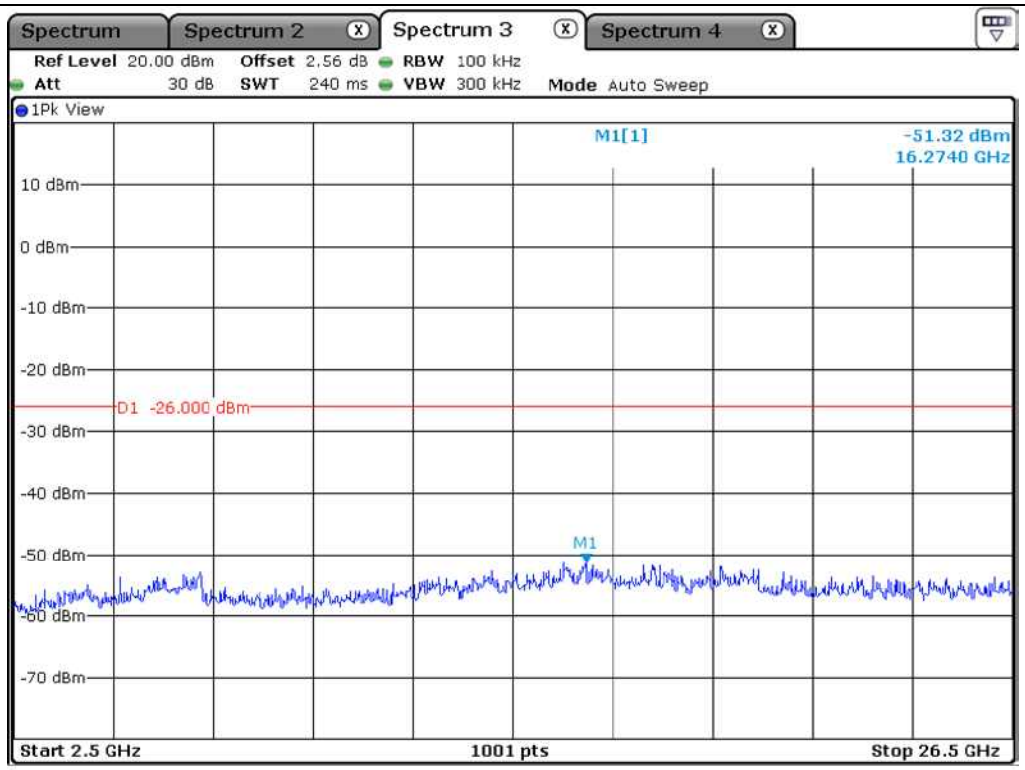
Low Channel



Low Channel

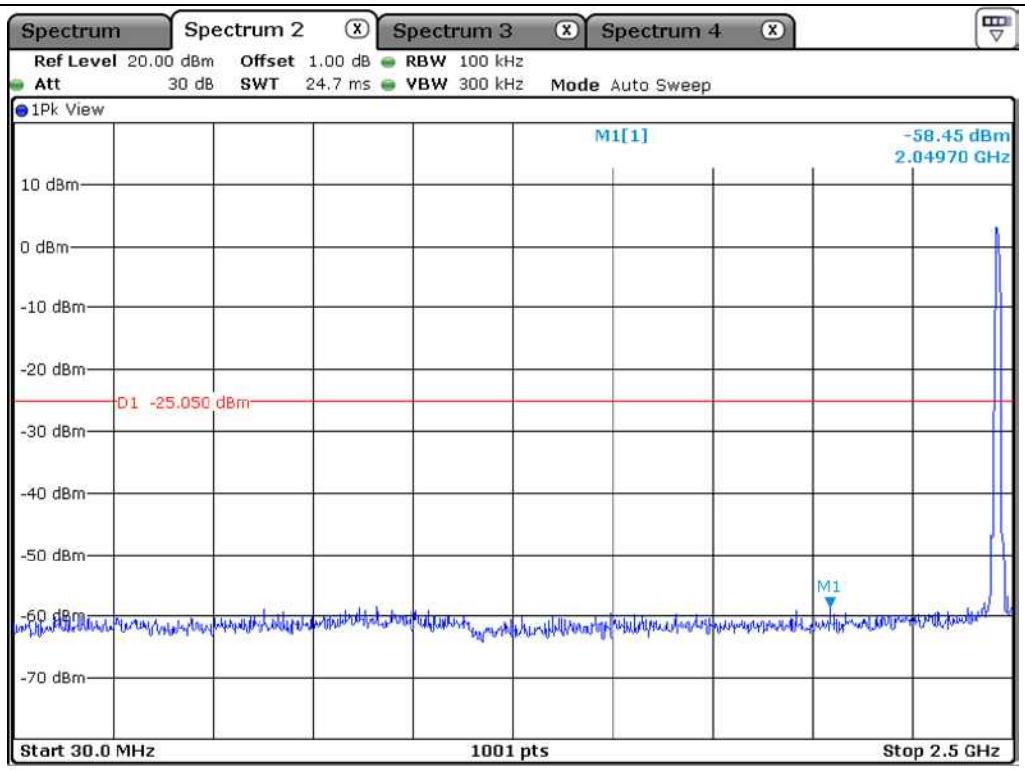


Middle Channel

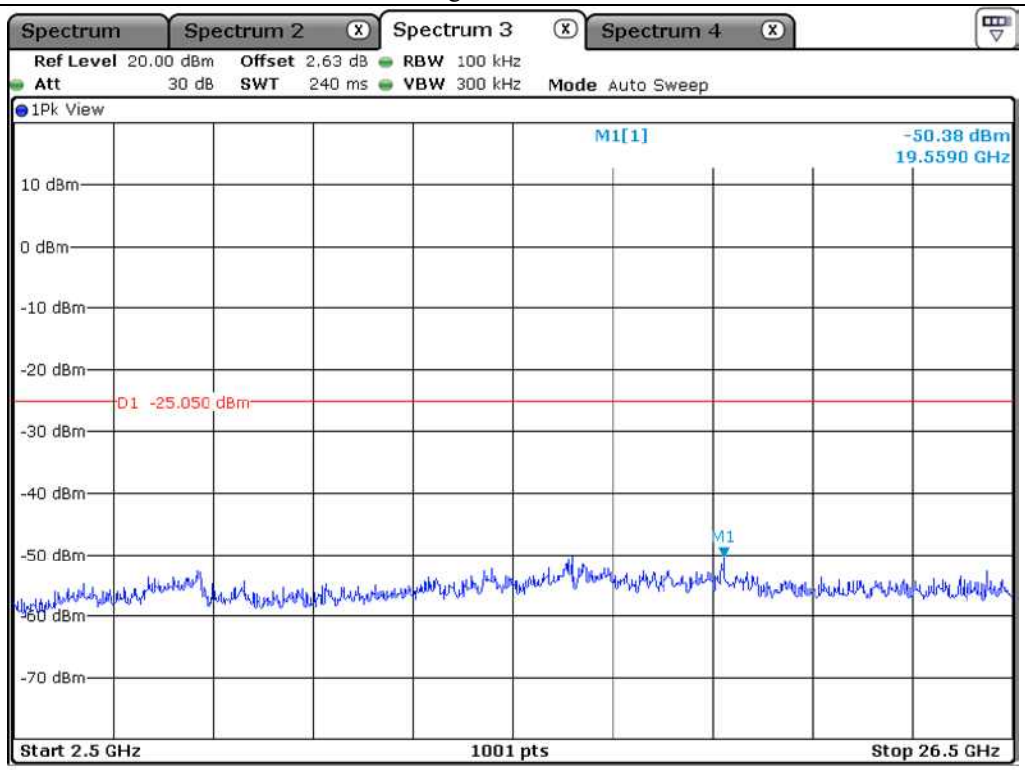


Middle Channel

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

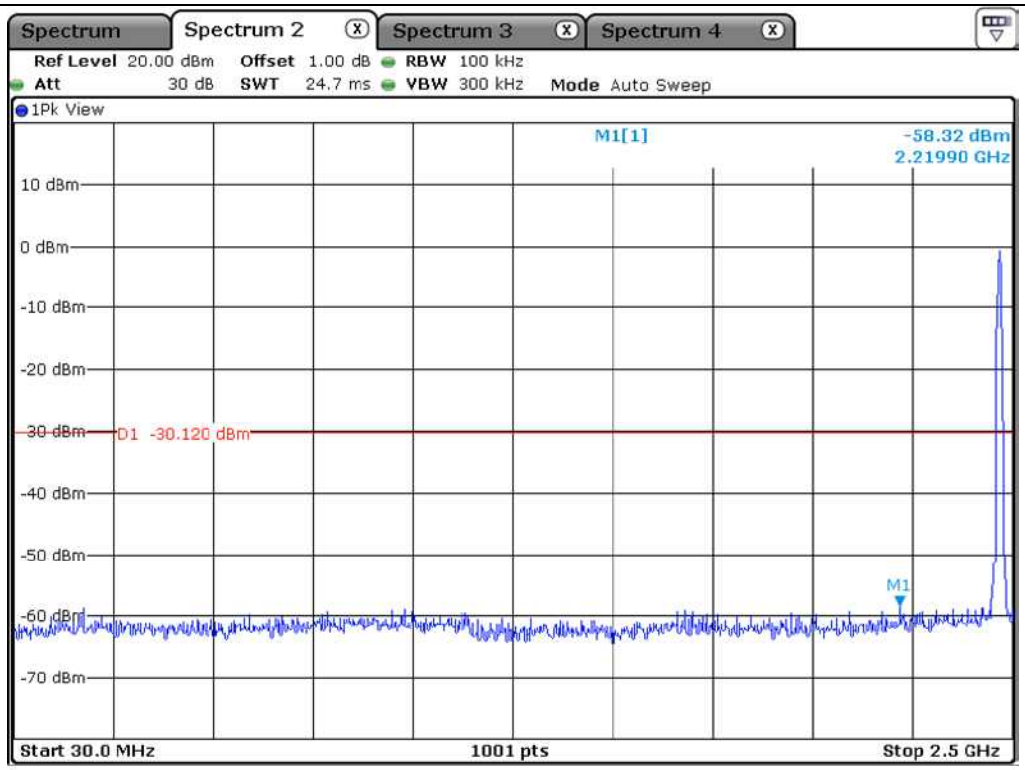


High Channel 11

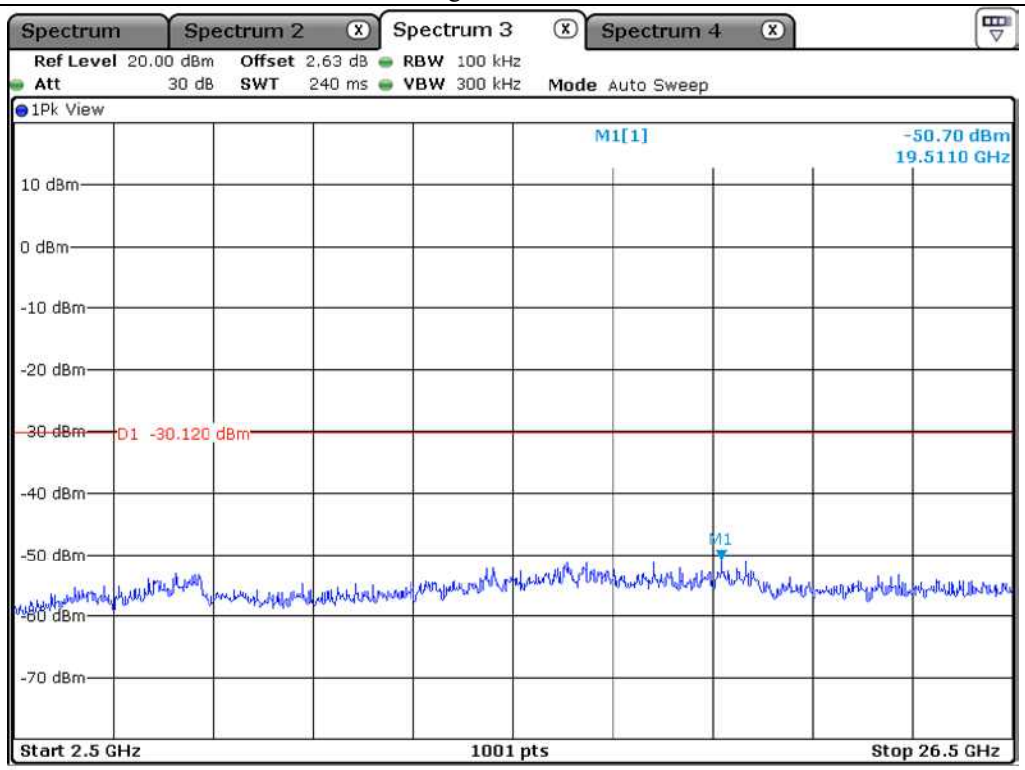


High Channel 11

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

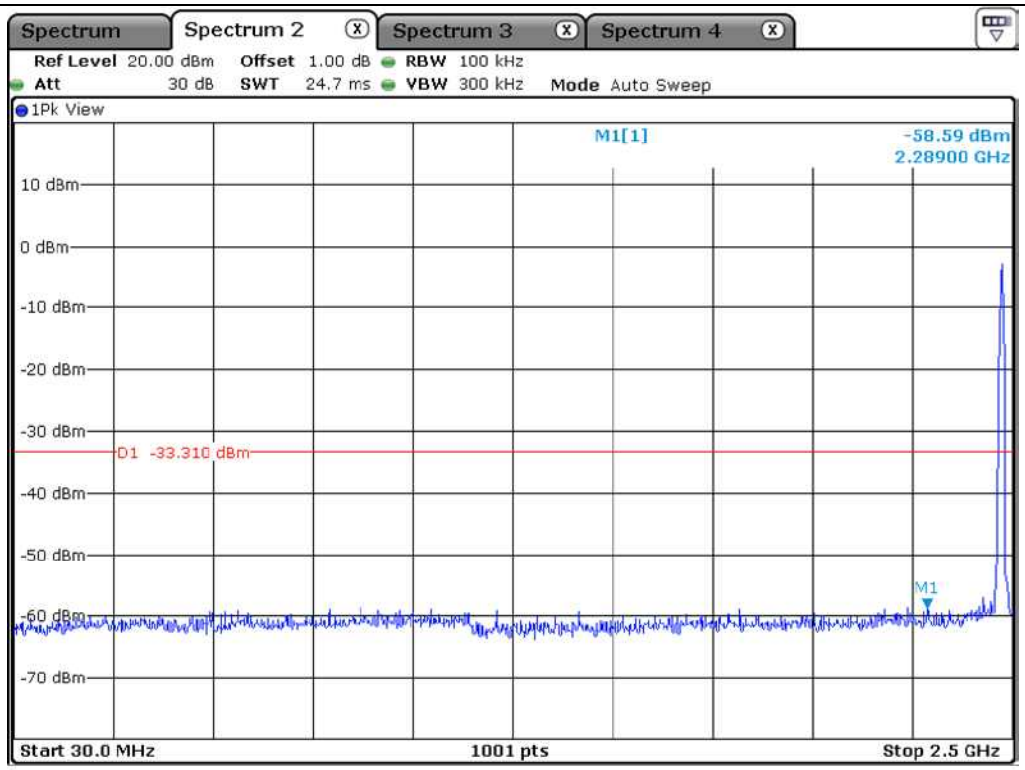


High Channel 12

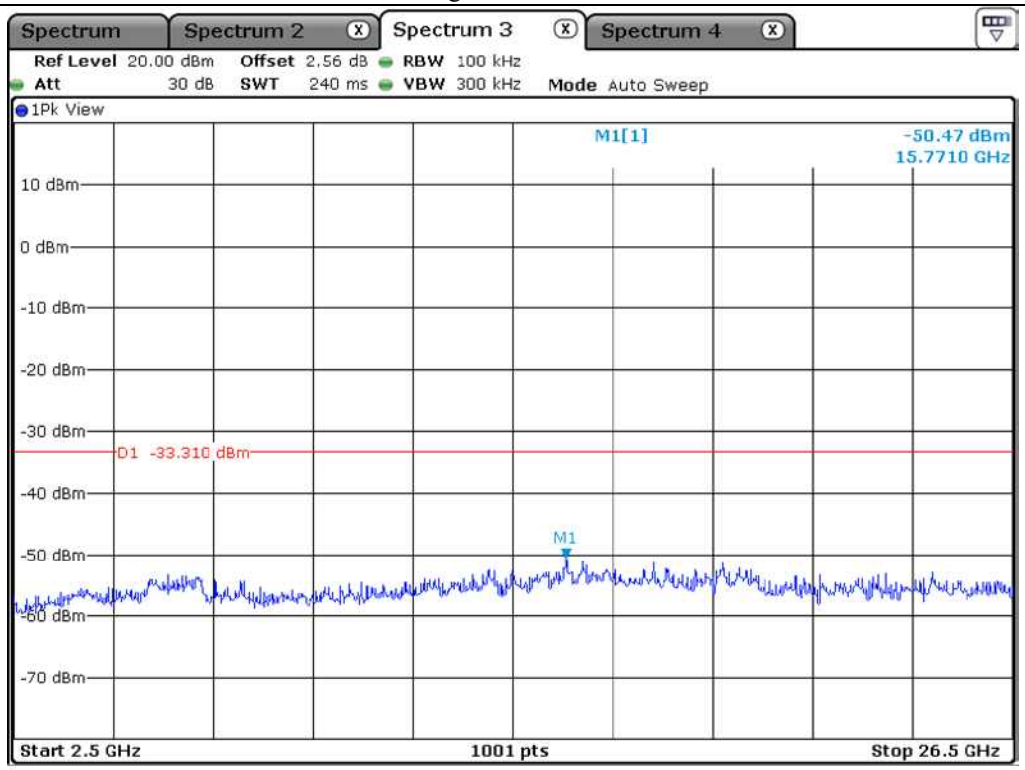


High Channel 12

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 13



High Channel 13

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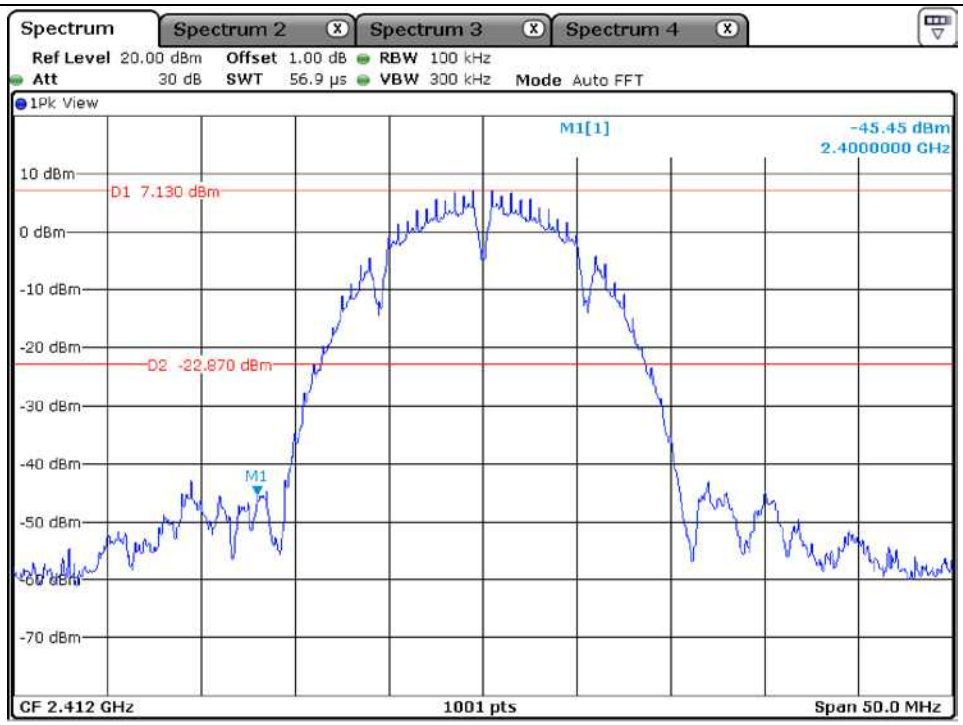
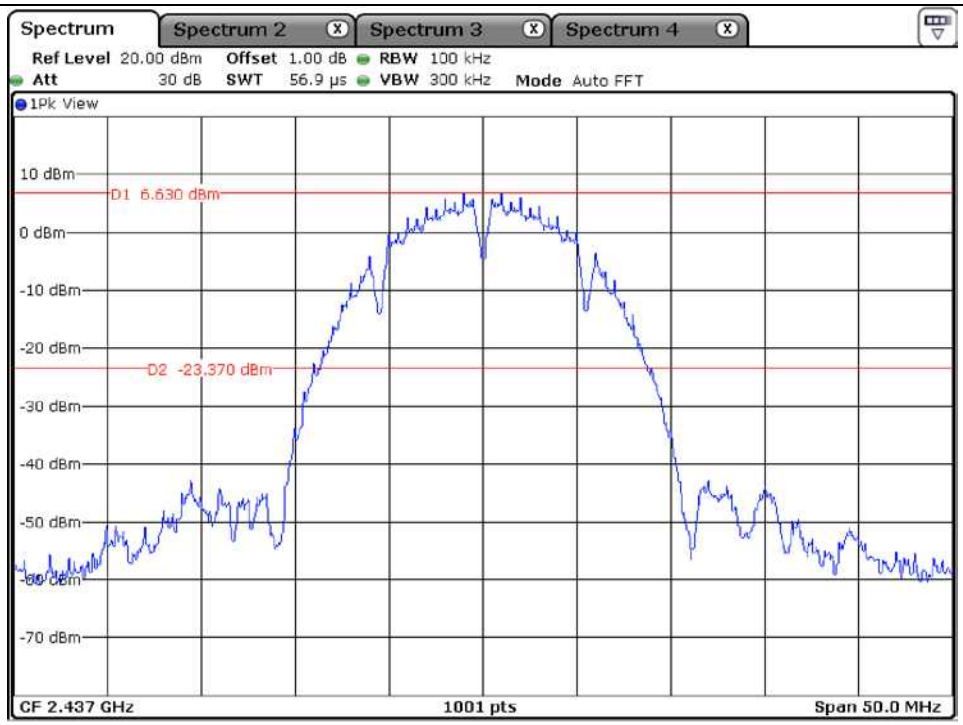
9.5.1.2 Test data for Antenna 1

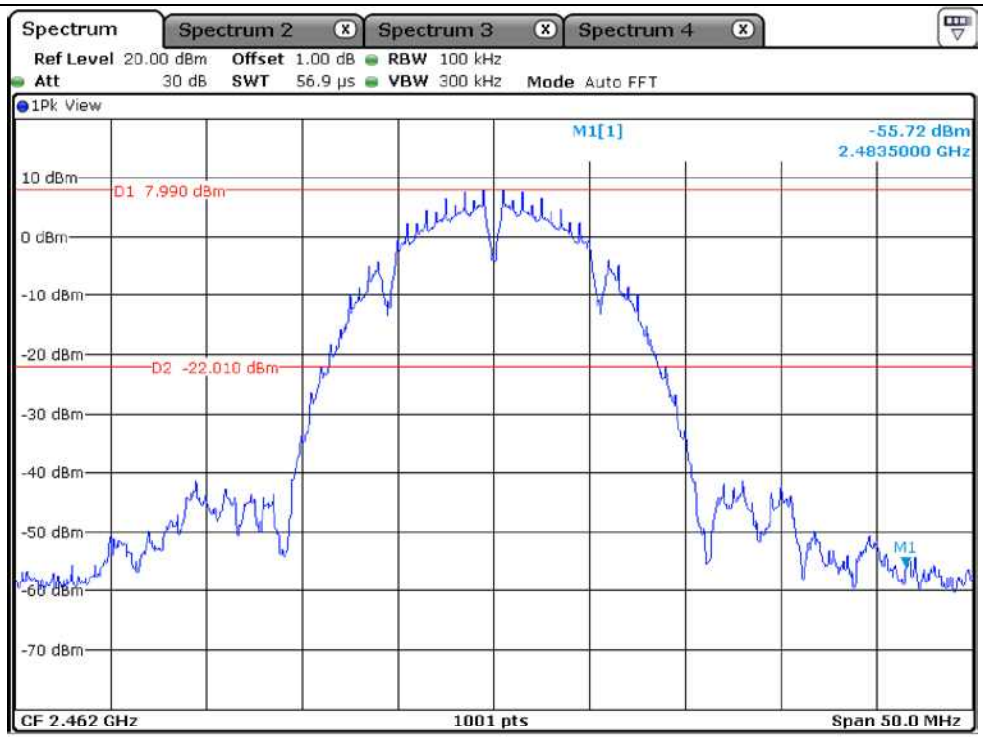


Low Channel

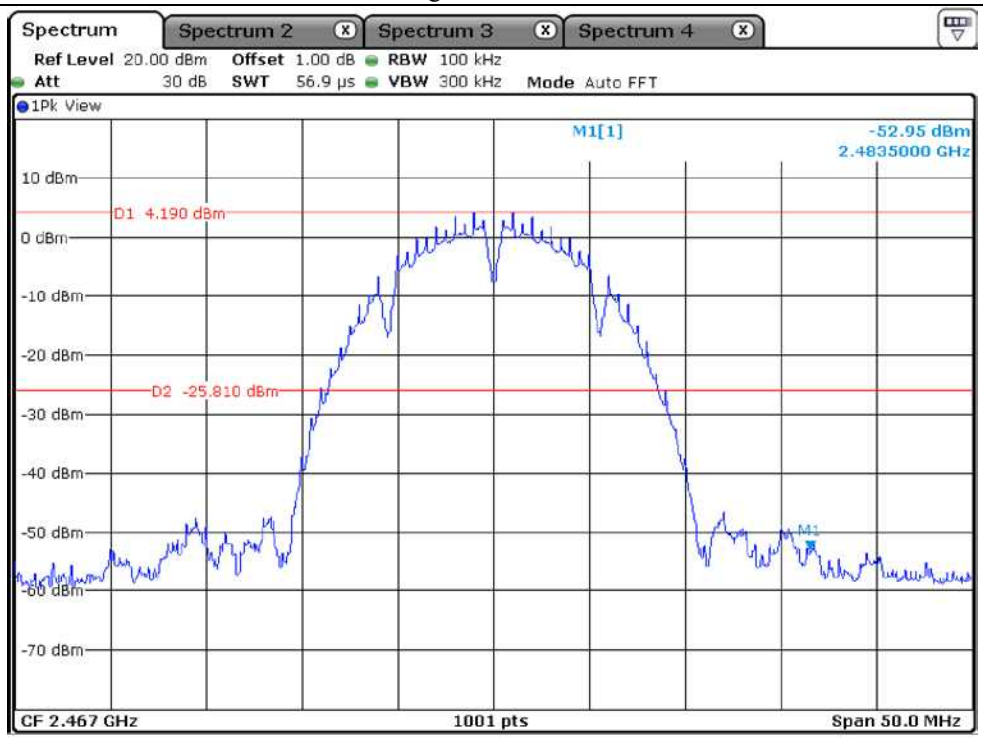


Middle Channel

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

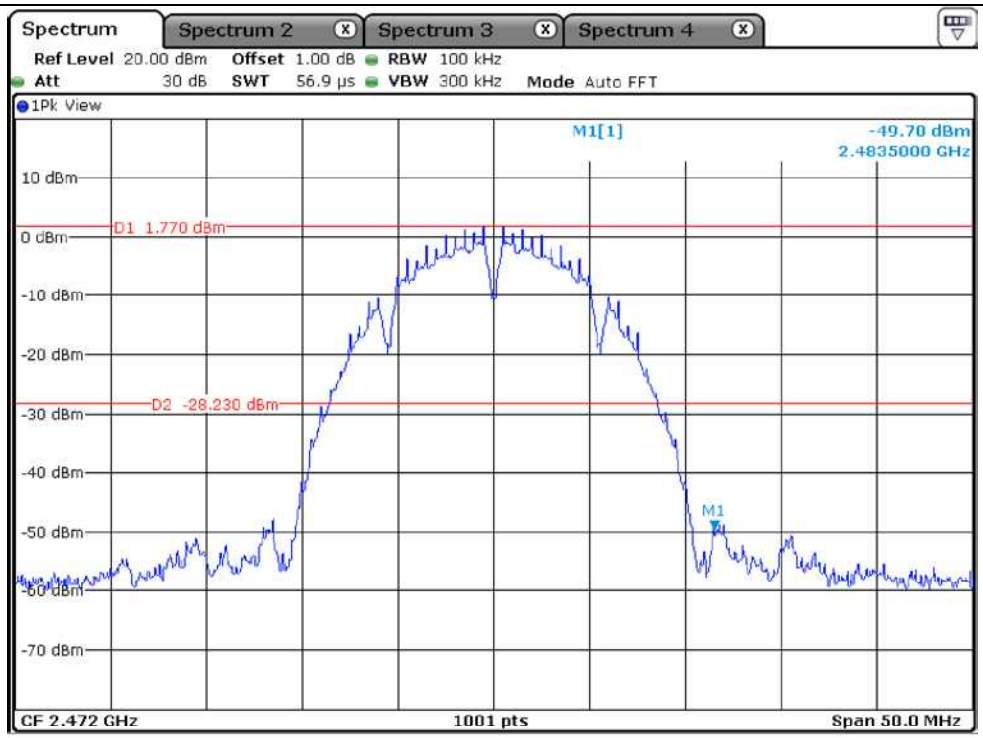


High Channel 11

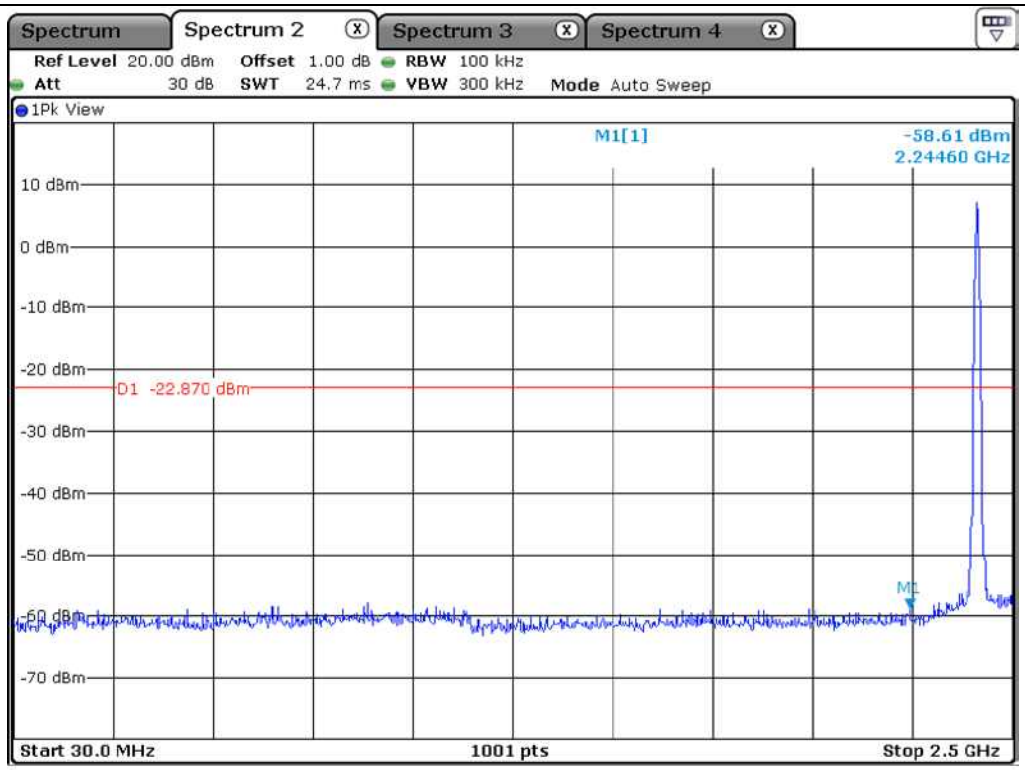


High Channel 12

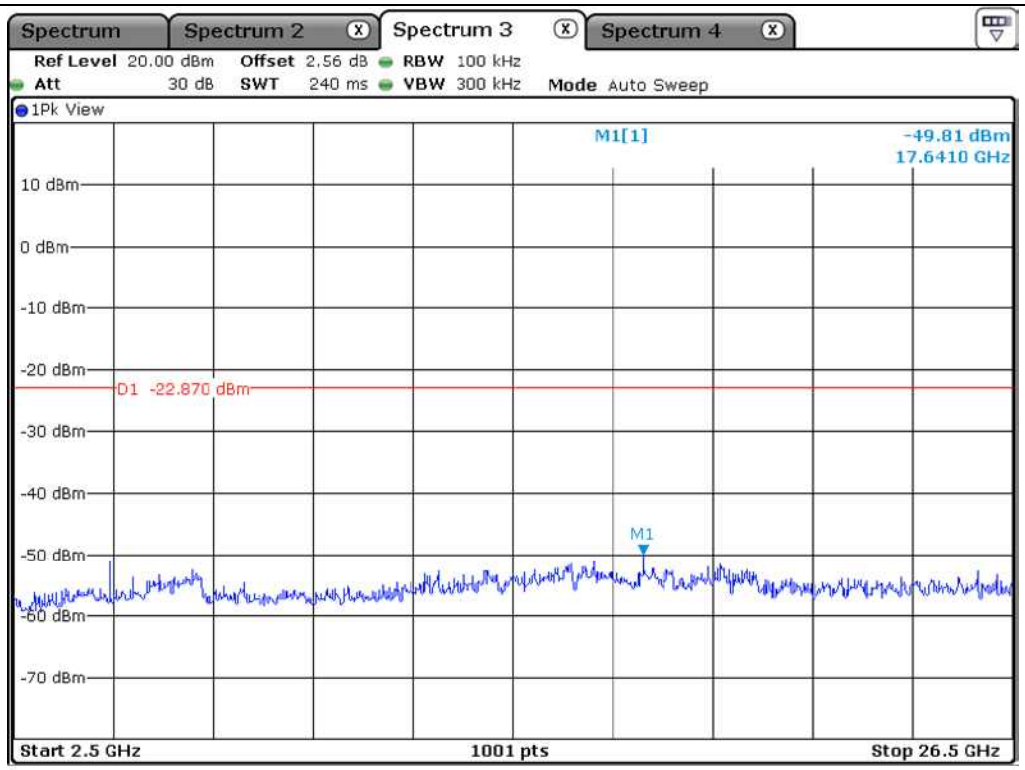
ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)



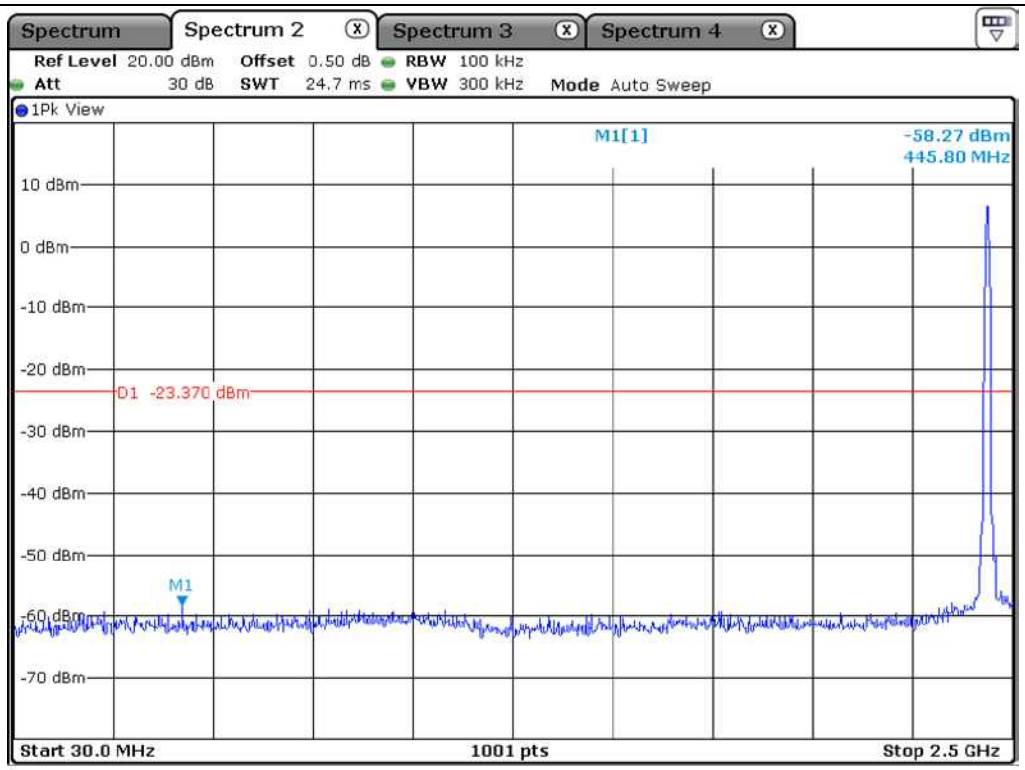
High Channel 13



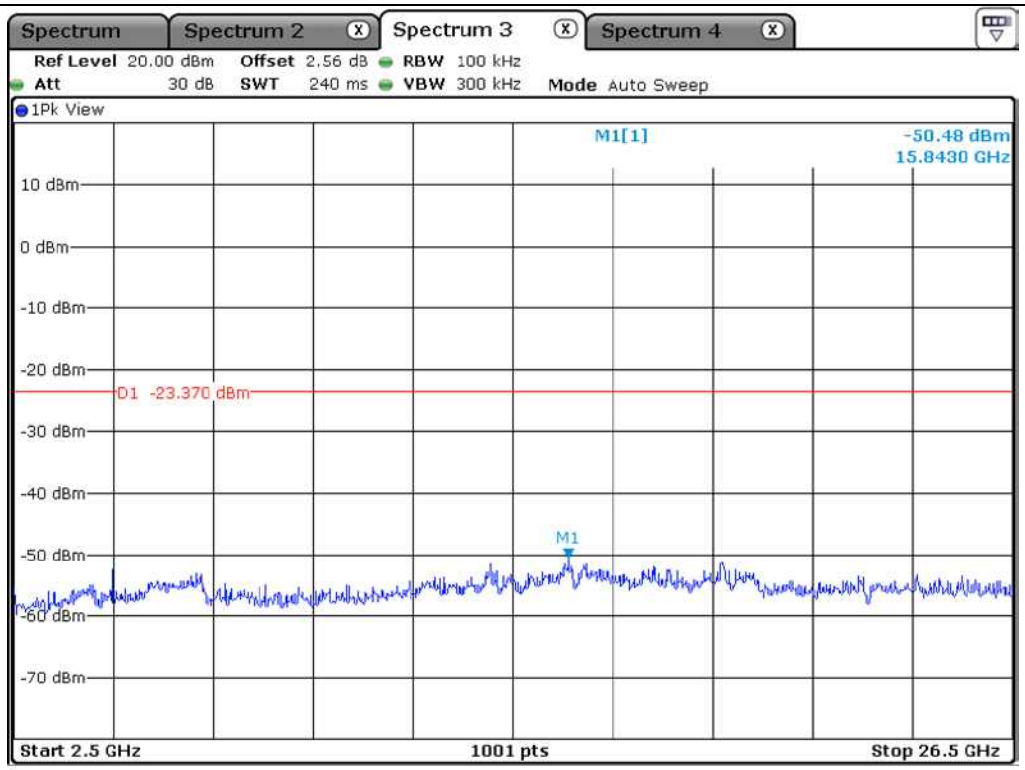
Low Channel



Low Channel

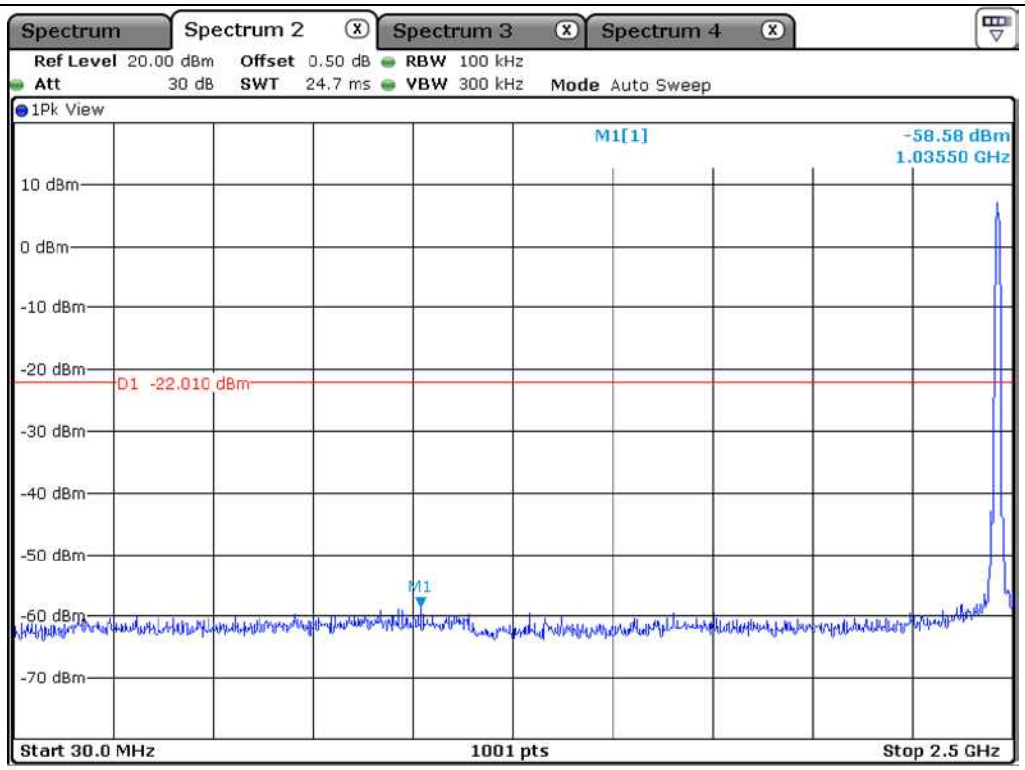


Middle Channel

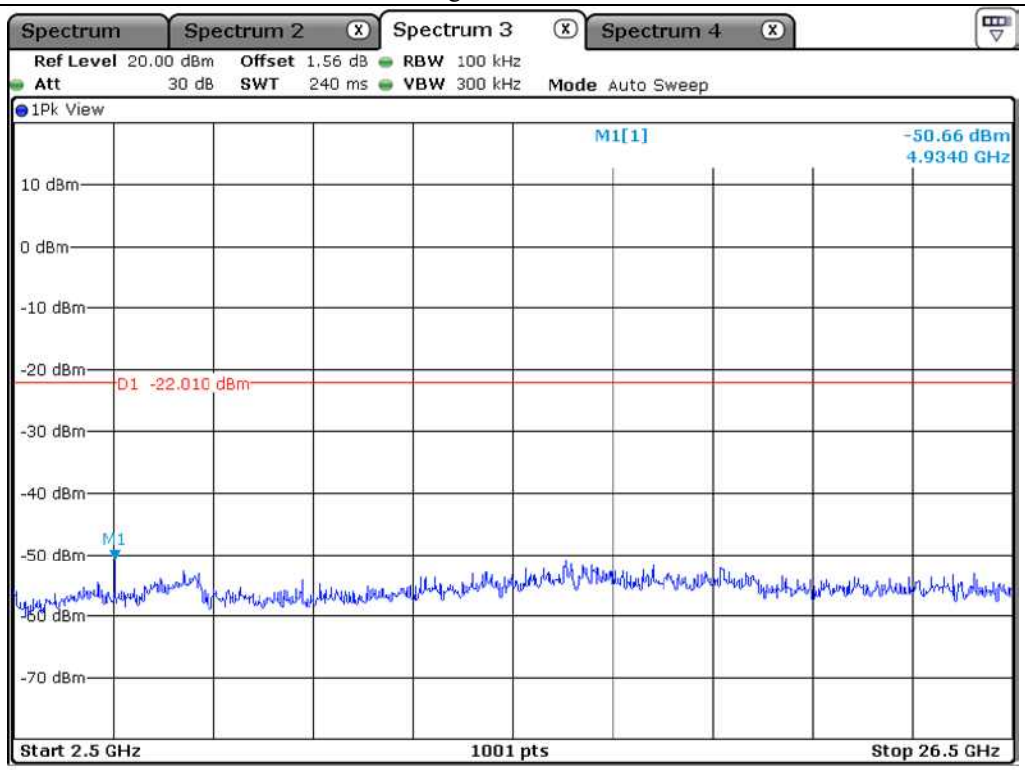


Middle Channel

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

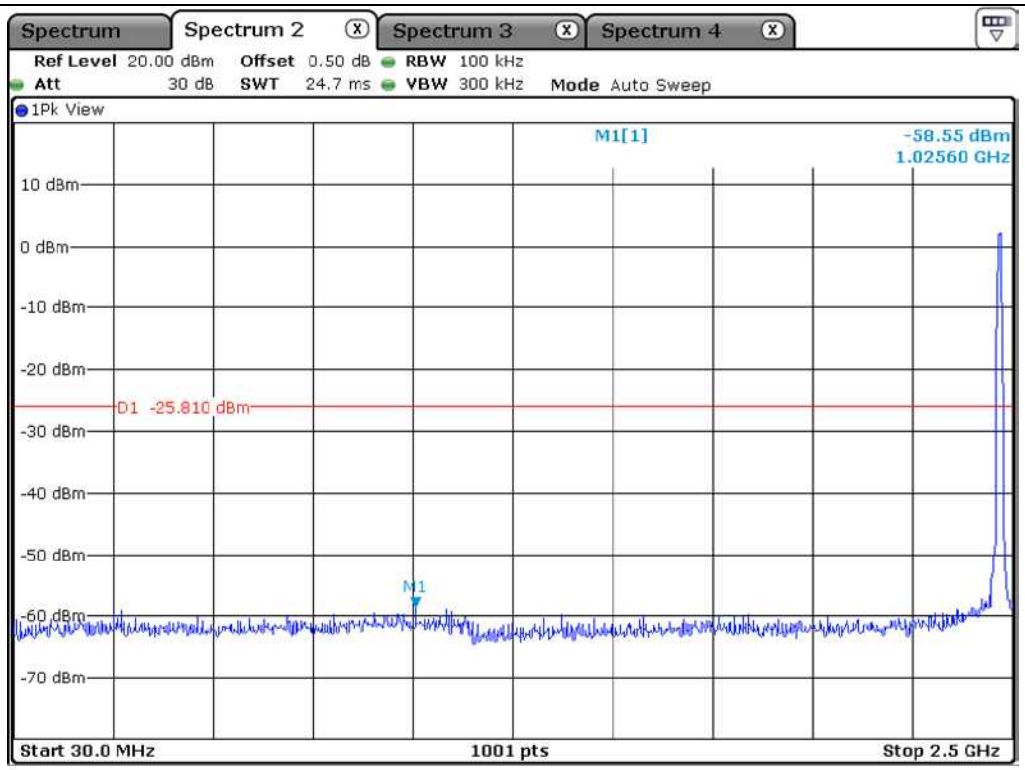


High Channel 11

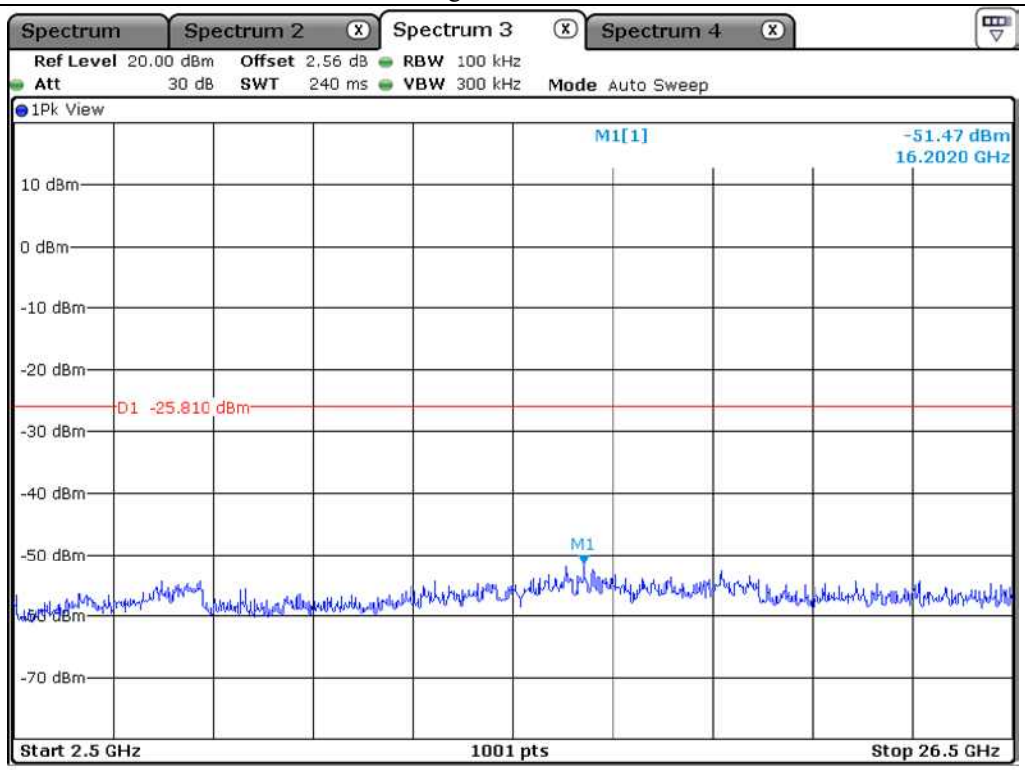


High Channel 11

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

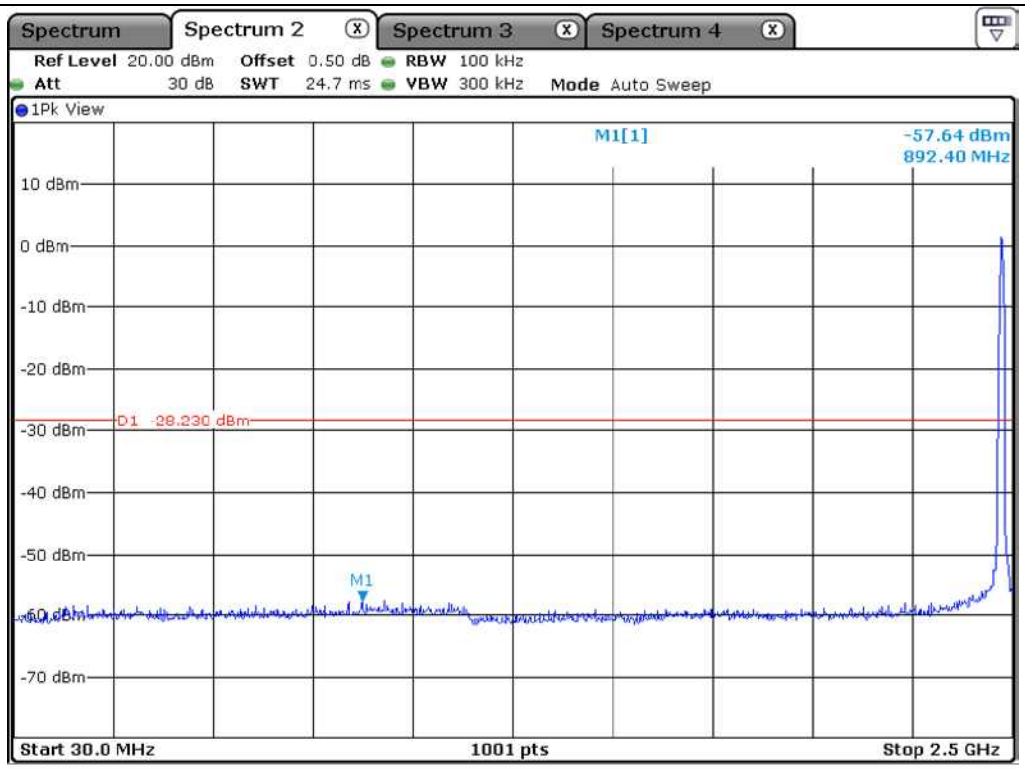


High Channel 12

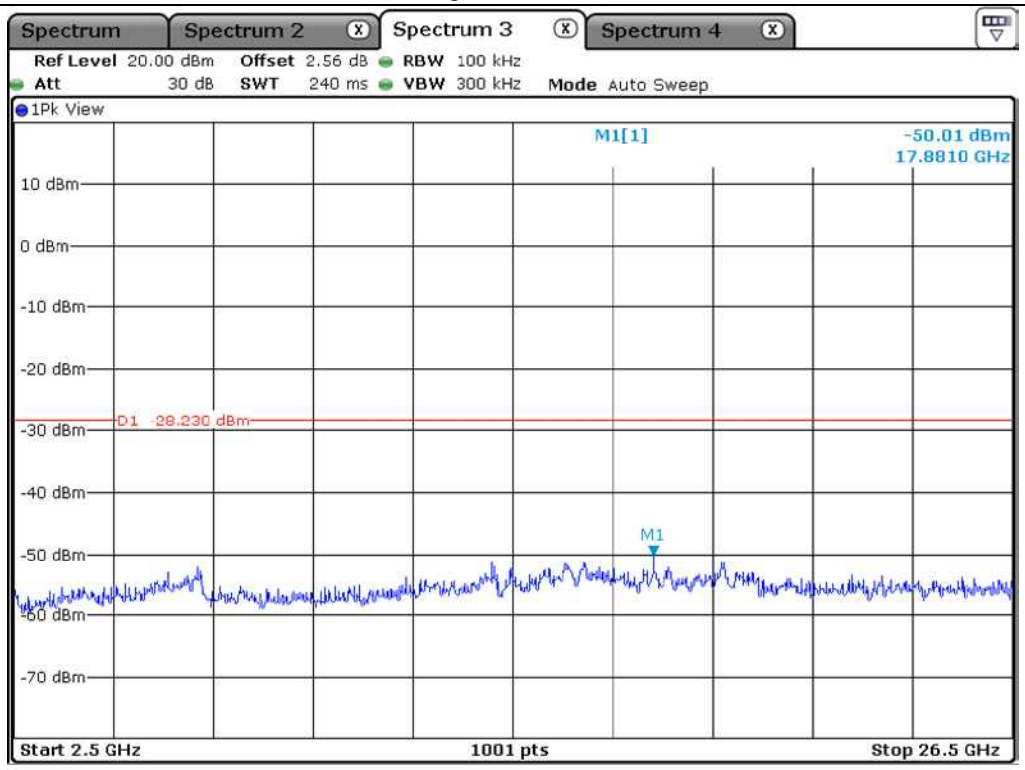


High Channel 12

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 13

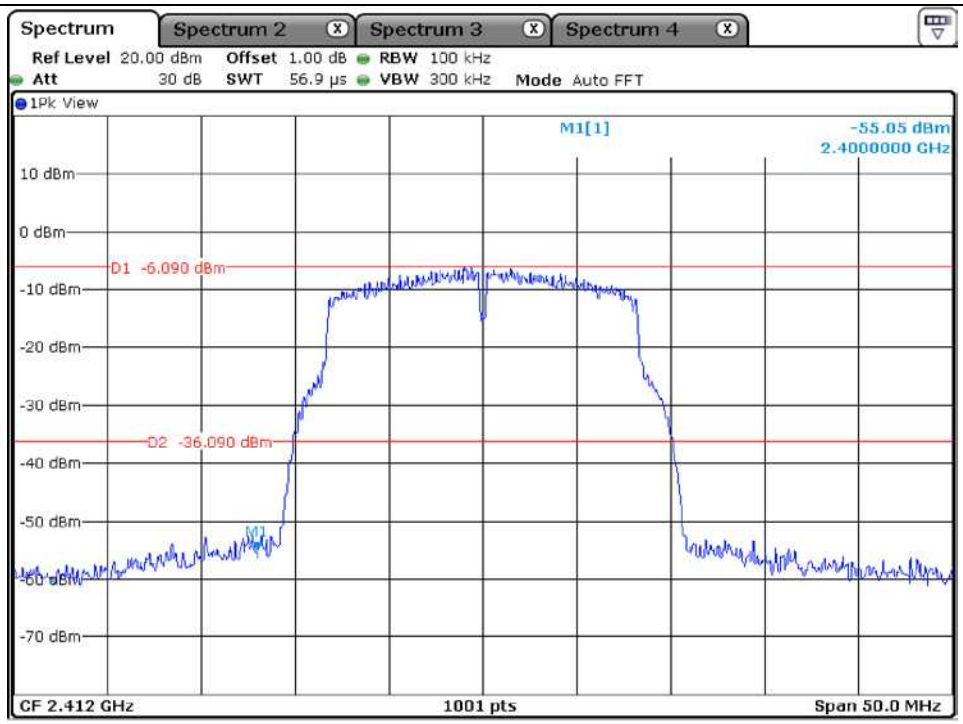


High Channel 13

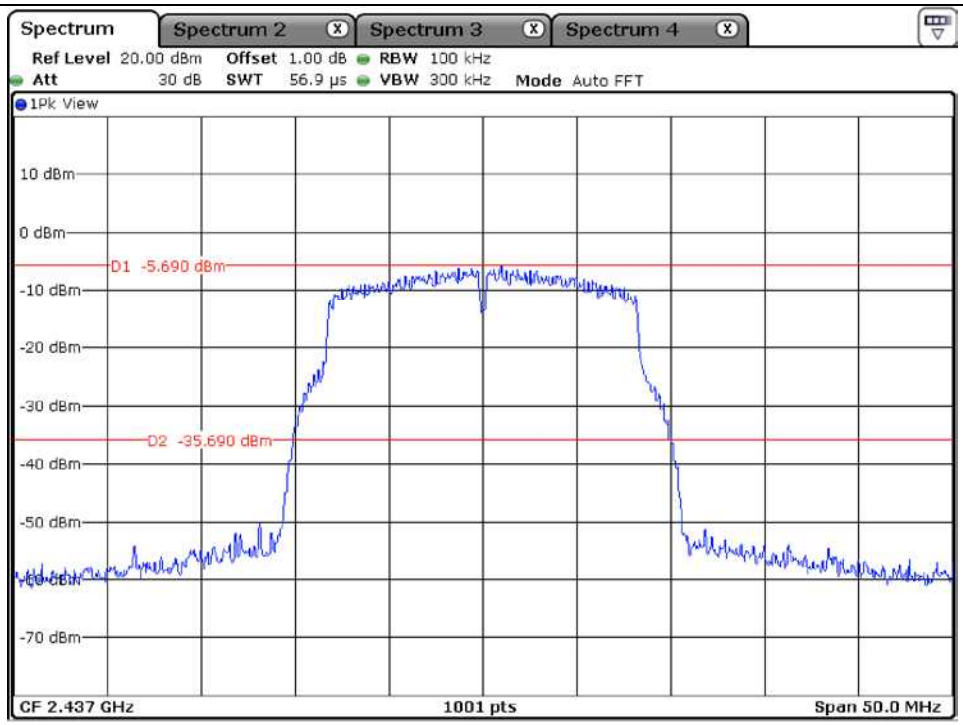
ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

9.5.2 Test data for 802.11g WLAN Mode

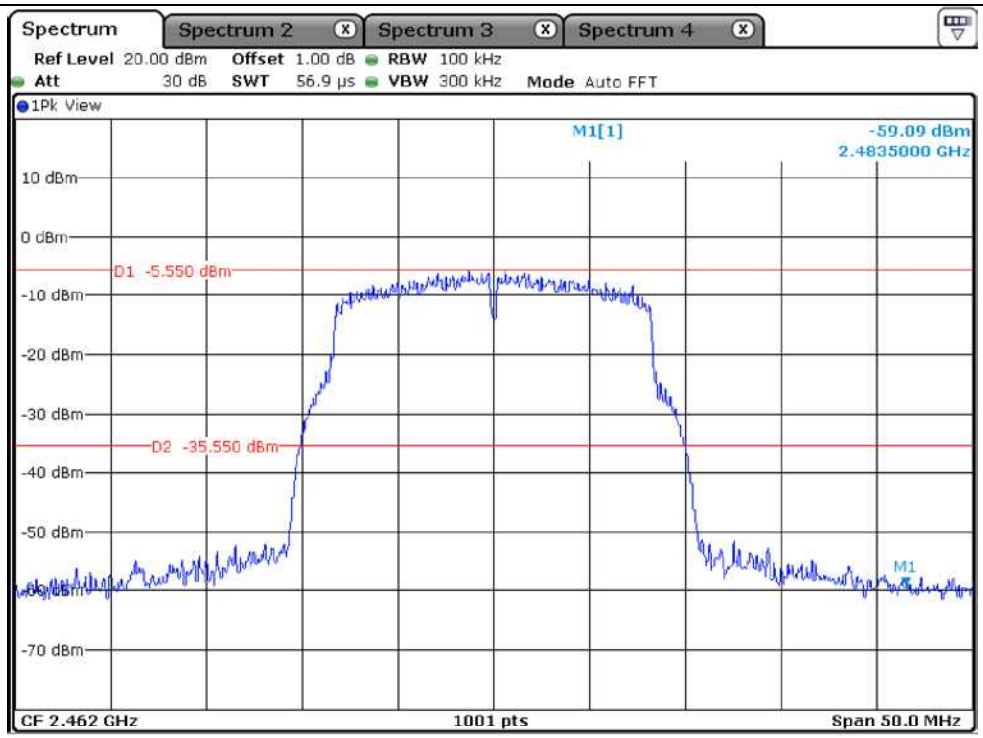
9.5.2.1 Test data for Antenna 0



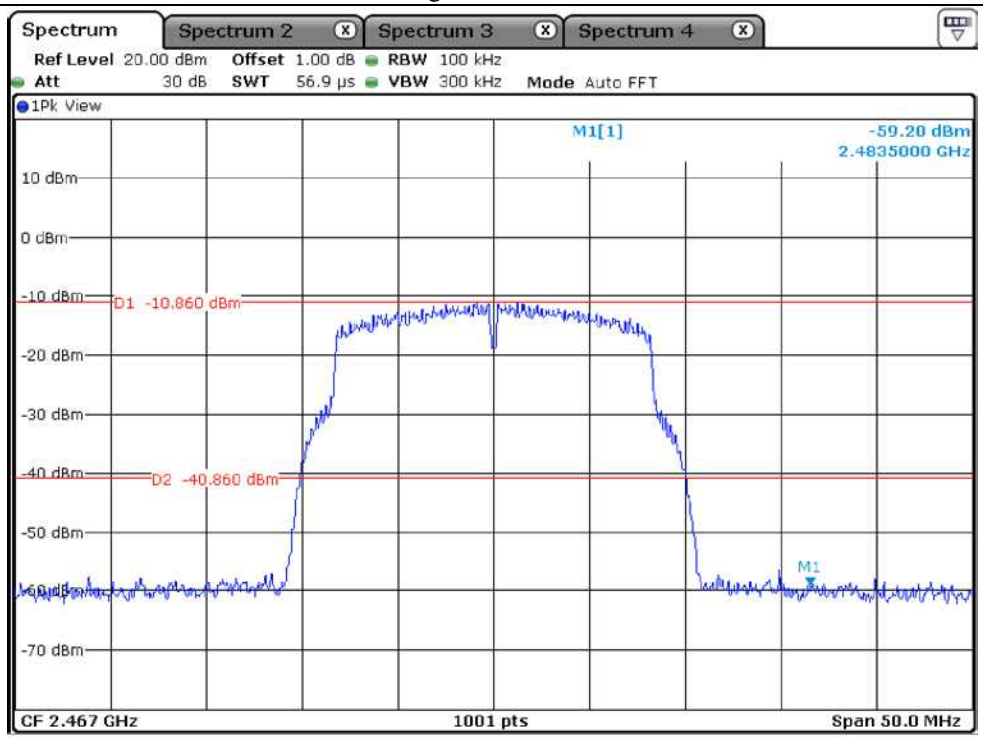
Low Channel



Middle Channel

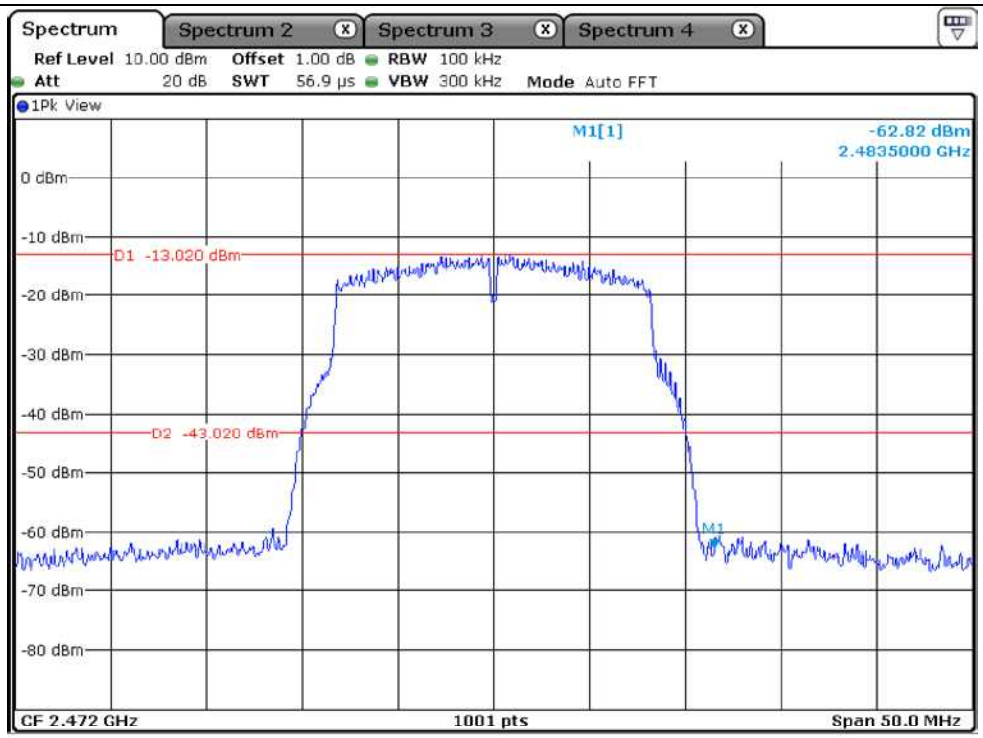


High Channel 11

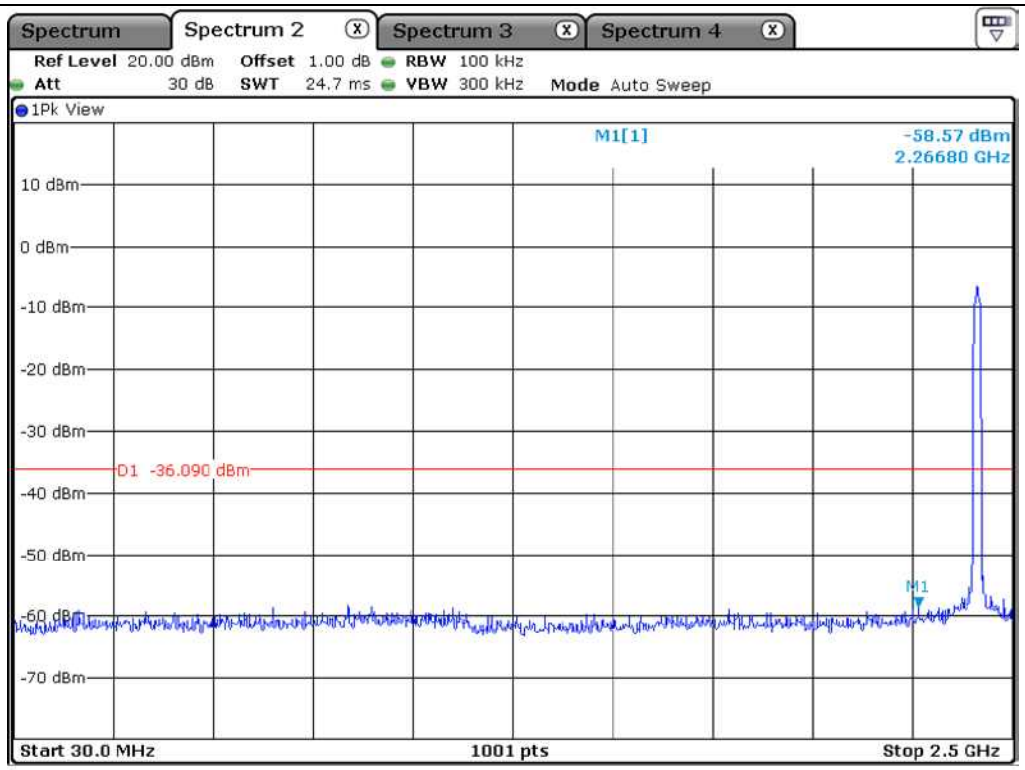


High Channel 12

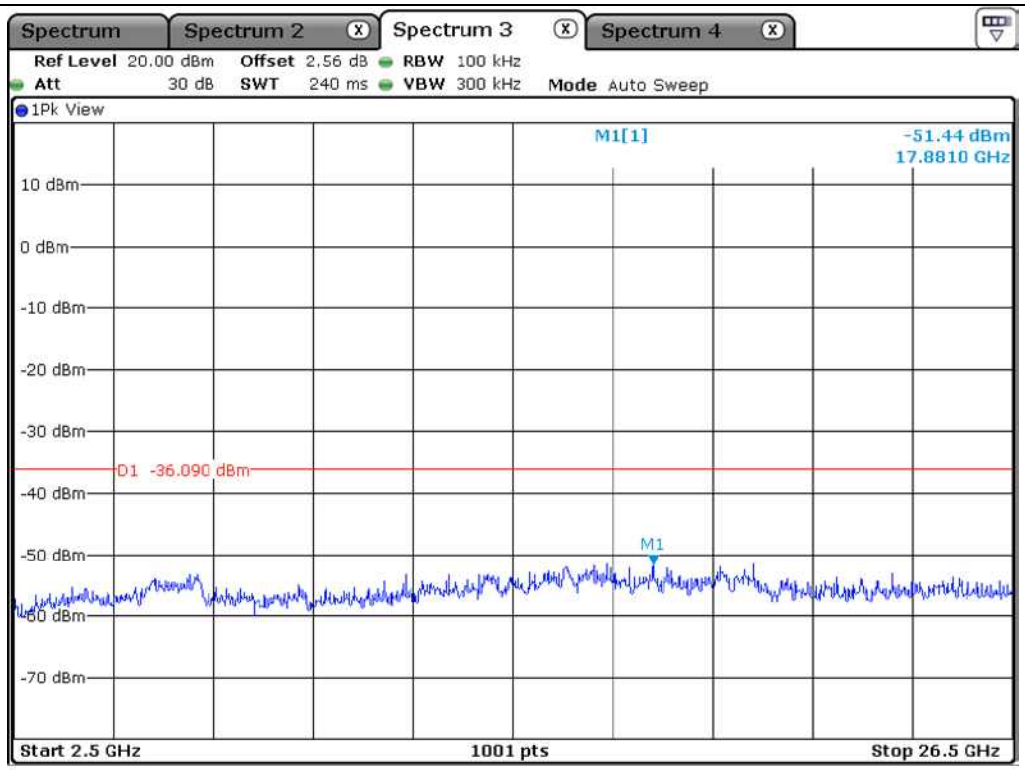
ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)



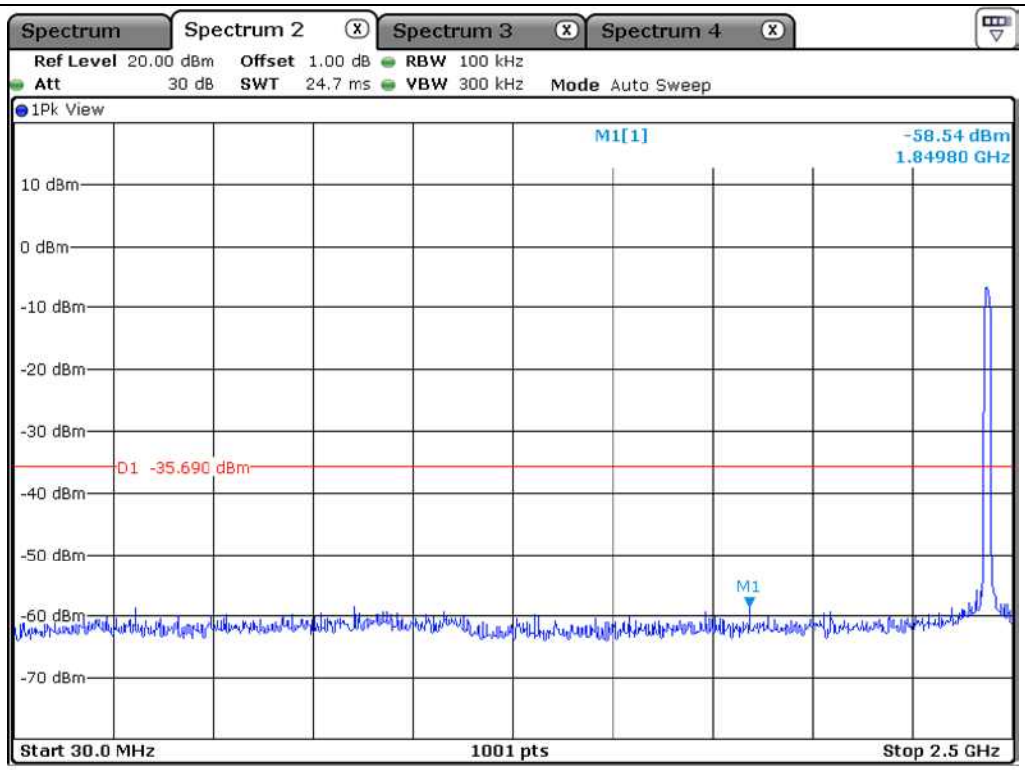
High Channel 13



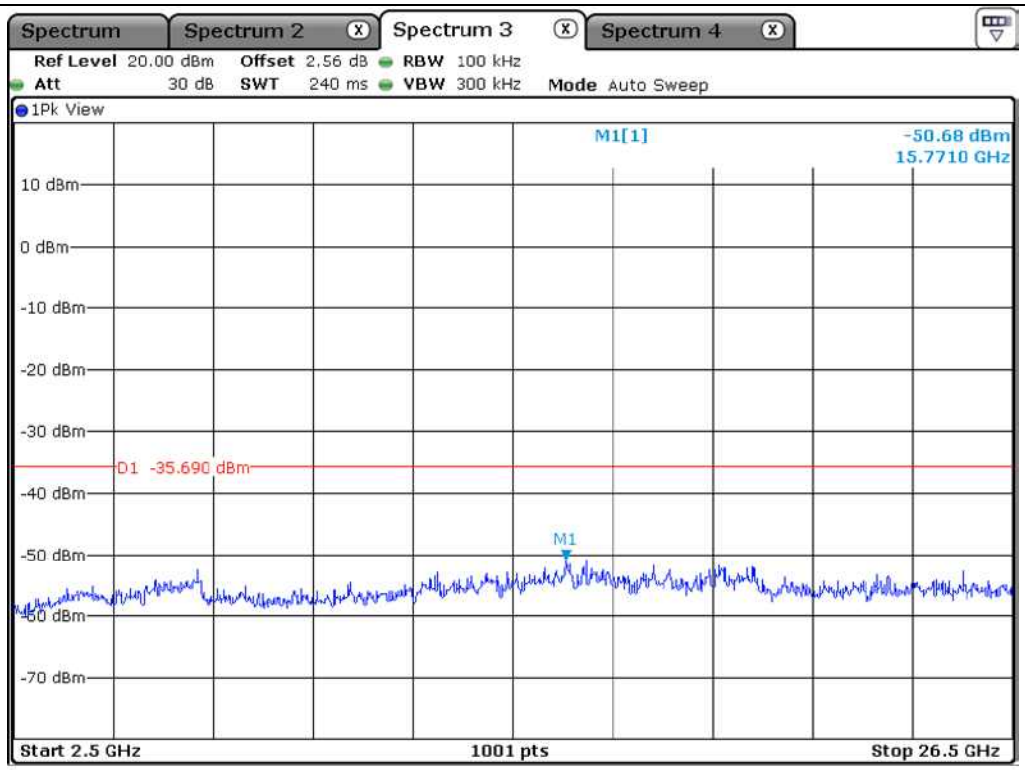
Low Channel



Low Channel

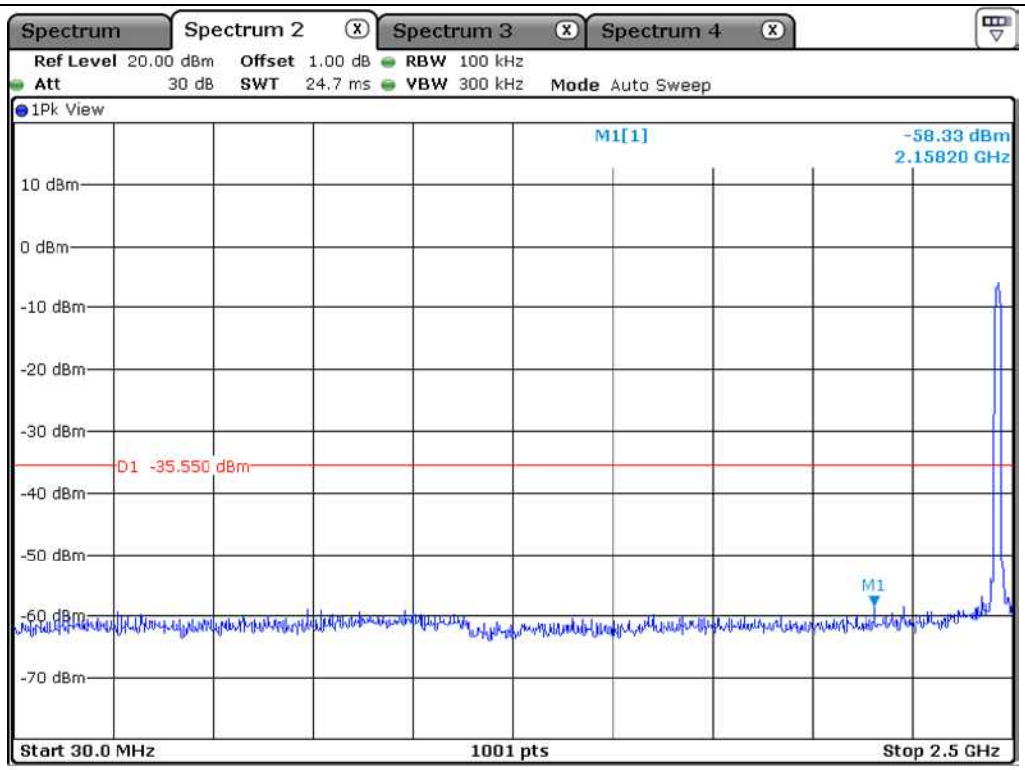


Middle Channel

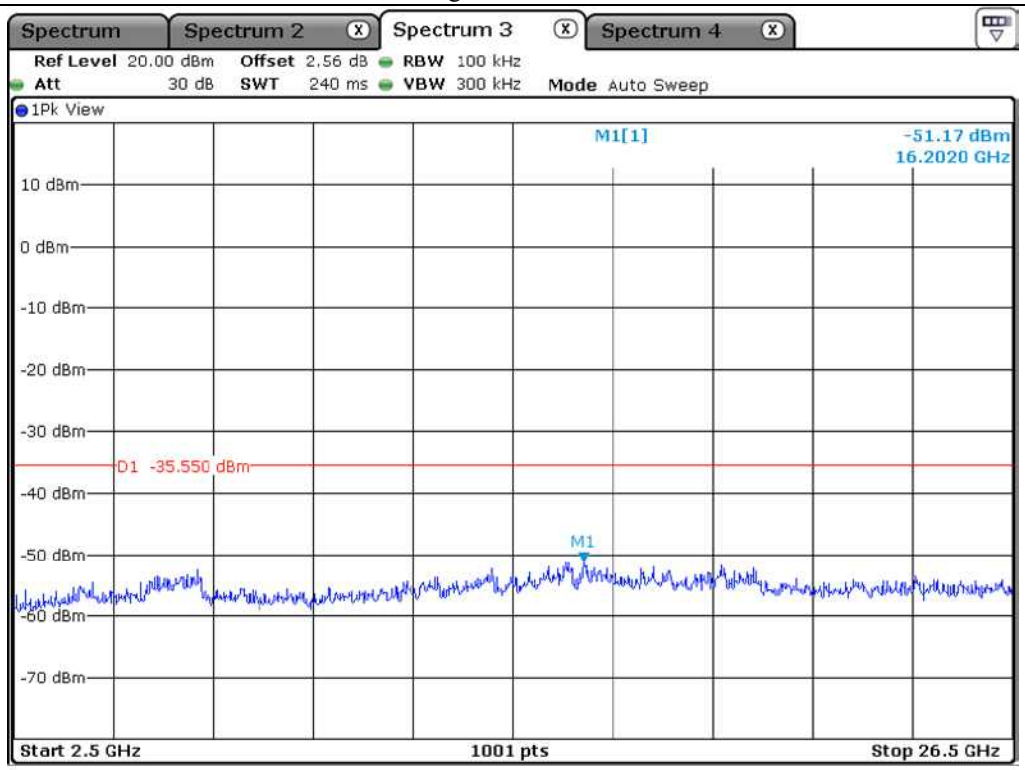


Middle Channel

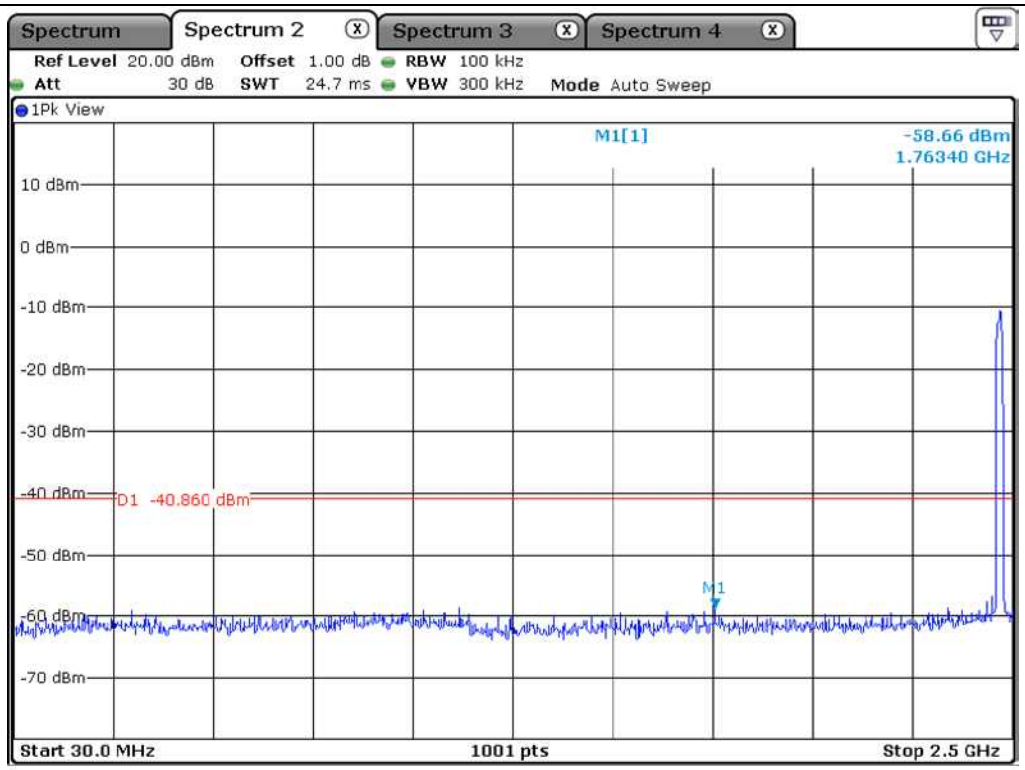
ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)



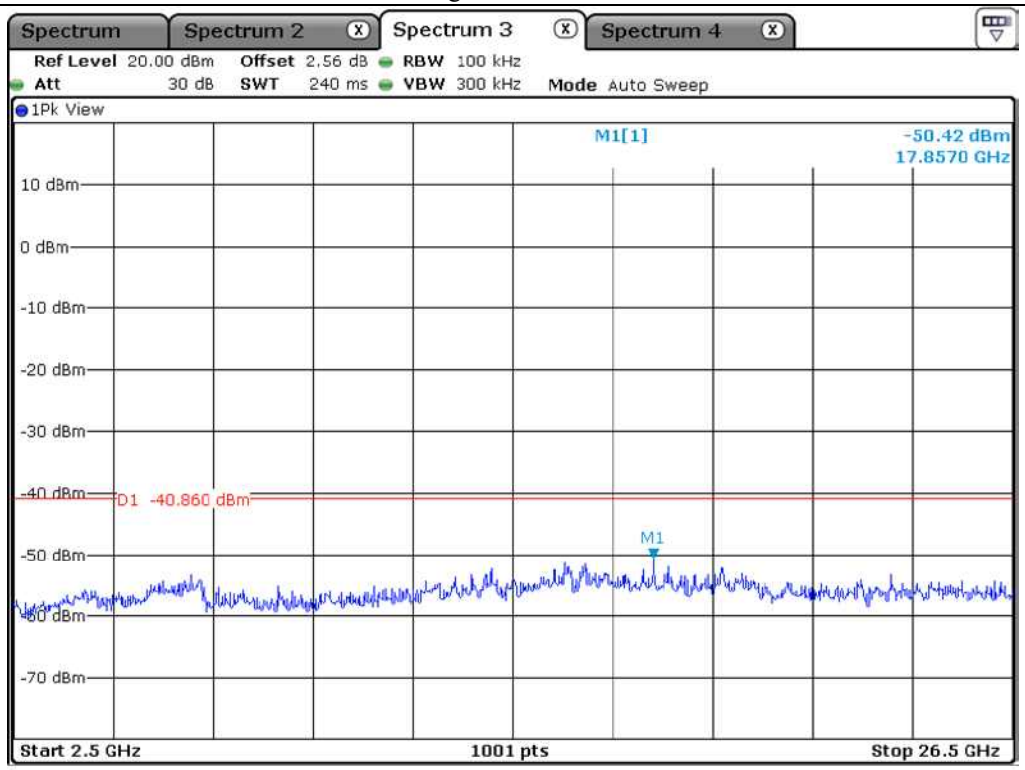
High Channel 11



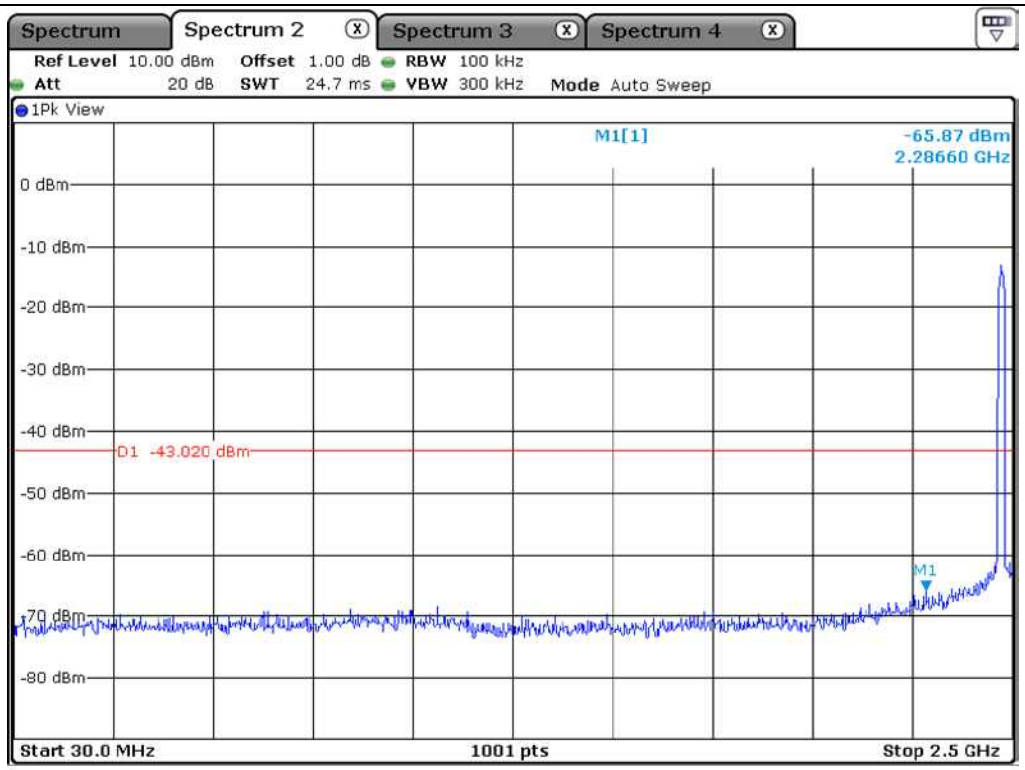
High Channel 11



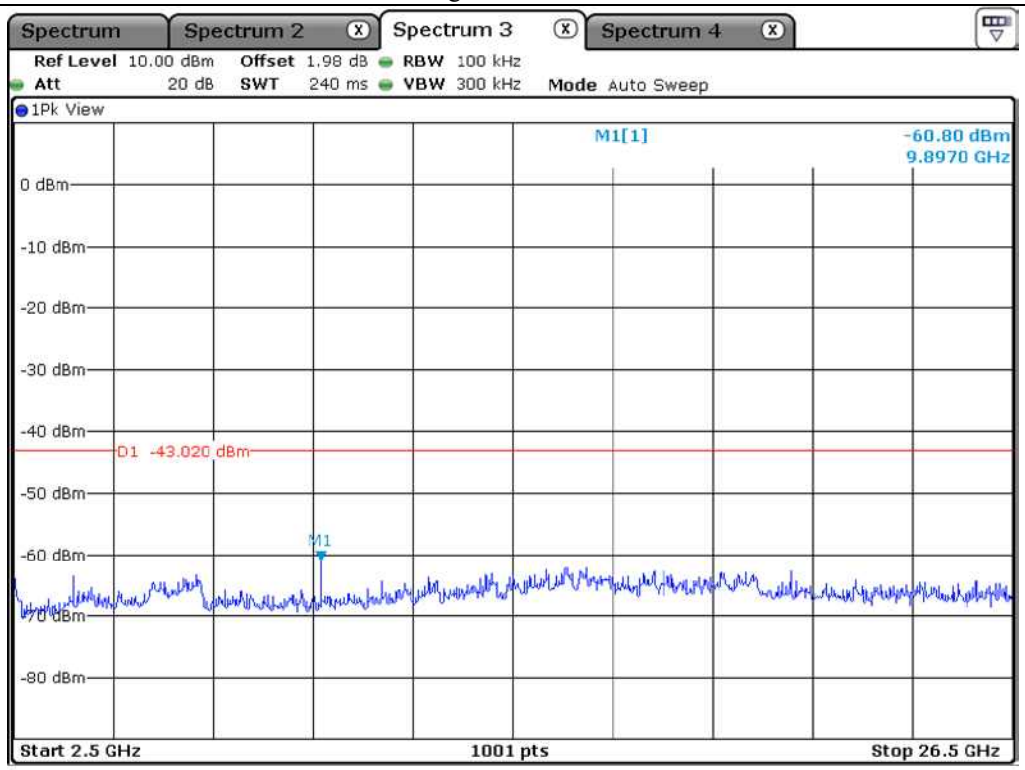
High Channel 12



High Channel 12



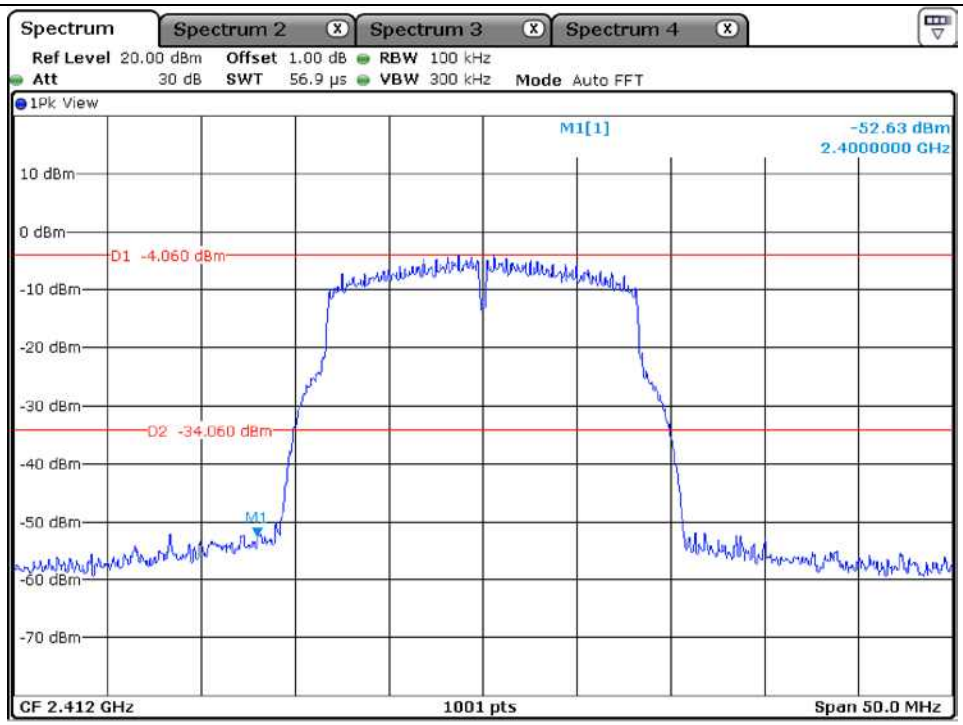
High Channel 13



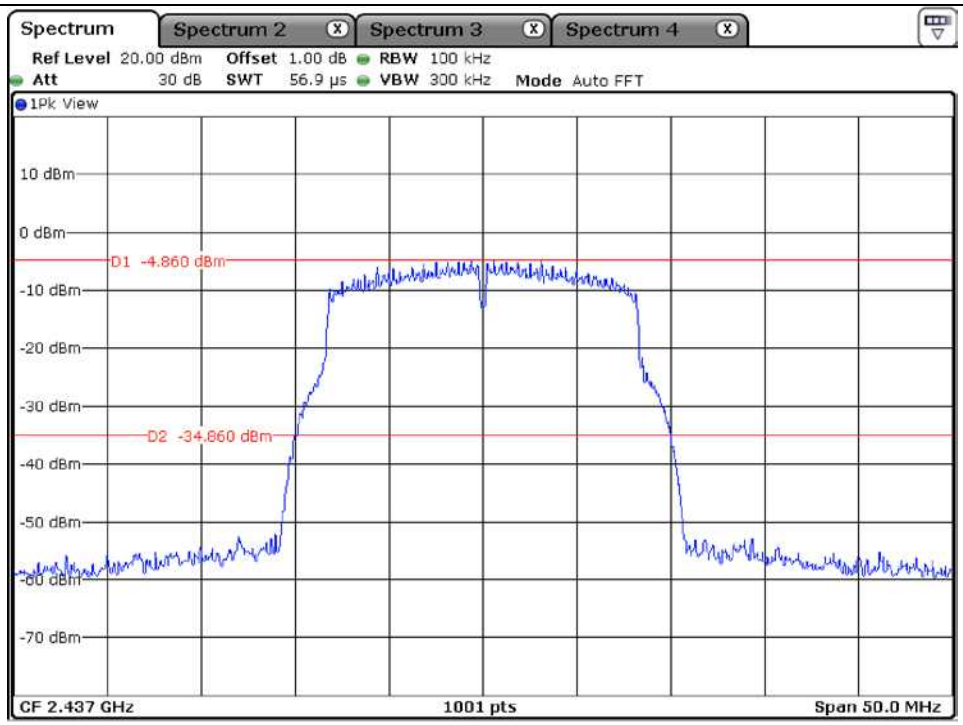
High Channel 13

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

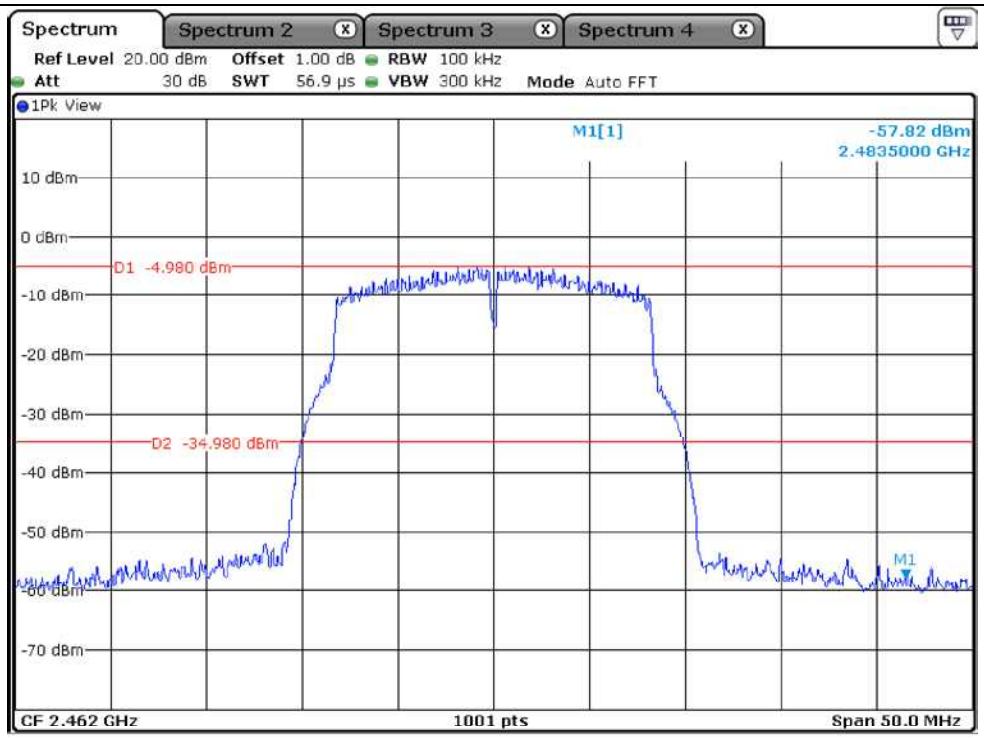
9.5.2.2 Test data for Antenna 1



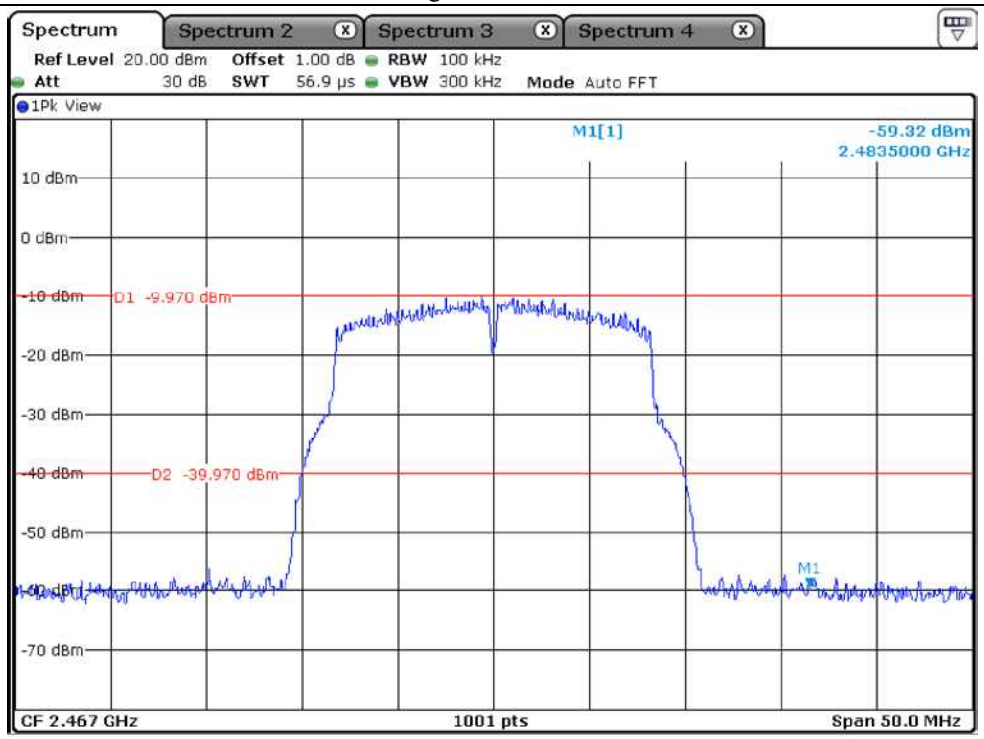
Low Channel



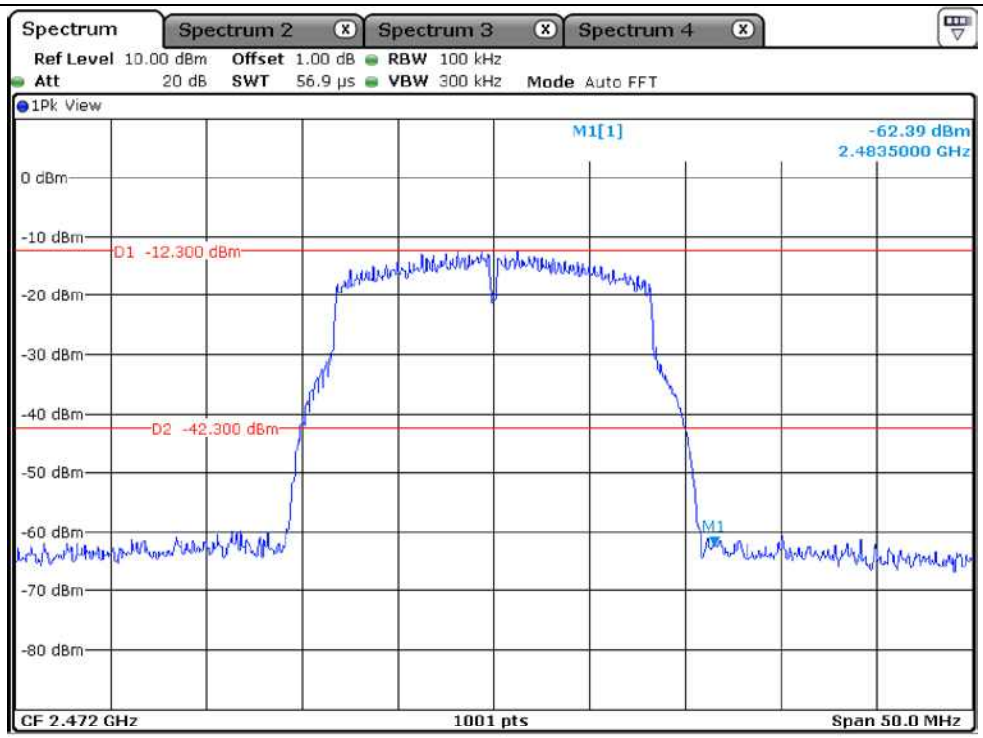
Middle Channel



High Channel 11



High Channel 12



High Channel 13

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