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

Test Report No.	**: OT-196-RWD-014**
AGR No.	**: A192A-017**
Applicant	**: BIOLOG DEVICE**
Address	**: 3F, 64-10, Dongtangiheung-ro, Dongtan-myeon, Hwaseong-si, Gyeonggi-do, Korea**
Manufacturer	**: BIOLOG DEVICE**
Address	**: 3F, 64-10, Dongtangiheung-ro, Dongtan-myeon, Hwaseong-si, Gyeonggi-do, Korea**
Type of Equipment	**: Face Recognition Terminal**
FCC ID.	**: 2ATMI-FL1000-A**
Model Name	**: FL1000-A**
Multiple Model Name:	**FL1000-B, FL1000-C, FL1000-D, FL1000-E, FL1000-F, FL1000-G, FL1000-H, FL1000-I, FL1000-J, FL1000-K, FL1000-L, FL1000-M, FL1000-N, FL1000-O, FL1000-P, FL1000-Q, FL1000-R, FL1000-S, FL1000-T, FL1000-U, FL1000-V**
Serial number	**: N/A**
Total page of Report	**: 60 pages (including this page)**
Date of Incoming	**: April 15, 2019**
Date of issue	**: June 07, 2019**

SUMMARY

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

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

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

Reviewed by: Ha-Ram Lee / Assistant Manager
ONETECH Corp.

Approved by: Jae-Ho Lee / Chief Engineer
ONETECH Corp.

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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
OT-196-RWD-014	June 07, 2019	Initial Issue	All

DOCUMENT HISTORY

Revision No.	Issued Date	Revisions	Effect Section
Original	June 07, 2019	Initial Issue	-
Rev. 01	June 12, 2019	Added data of Conducted emission test	12. CONDUCTED EMISSION TEST

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1. VERIFICATION OF COMPLIANCE

Applicant : BIOLOG DEVICE
Address : 3F, 64-10, Dongtangiheung-ro, Dongtan-myeon, Hwaseong-si, Gyeonggi-do, Korea
Contact Person : PARK YUN HO / Deputy department head
Telephone No. : +82-70-5015-4176
FCC ID. : 2ATMI-FL1000-A
Model Name : FL1000-A
Brand Name : N/A
Serial Number : N/A
Date : June 07, 2019

EQUIPMENT CLASS	DTS-Digital Transmission System
E.U.T. DESCRIPTION	Face Recognition Terminal
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m, Semi Anechoic Chamber

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

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2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (2)	6 dB bandwidth	Met the Limit / PASS
15.247 (b) (3)	Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247 (d)	100 kHz Bandwidth Outside the Frequency Band	Met the Limit / PASS
15.247 (d)	Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.247 (e)	Peak Power Spectral Density	Met the Limit / PASS
15.209	Radiated Emission Limits	Met the Limit / PASS
15.207	Conducted Limits	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-4112/ C-14617/ G-10666 / T-1842

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

-. Site Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. GENERAL INFORMATION

3.1 Product Description

The BIOLOG DEVICE, Model FL1000-A (referred to as the EUT in this report) is a Face Recognition Terminal. Product specification information described herein was obtained from product data sheet or user's manual.

Device Type	Face Recognition Terminal		
Operating Frequency	Bluetooth	2 402 MHz ~ 2 480 MHz	
	WLAN 2.4 GHz Hand	2 412 MHz ~ 2 462 MHz	
	NFC	13.56 MHz	
RF Output Power	Bluetooth	1 Mbps	6.33 dBm
		2 Mbps	5.33 dBm
		3 Mbps	5.51 dBm
	WLAN 2.4 GHz Hand	Wi-Fi 802.11b (8.99 dBm) Wi-Fi 802.11g (8.37 dBm) Wi-Fi 802.11n(HT20) (8.23 dBm)	
Number of Channel	Bluetooth	79 Channels	
	WLAN 2.4 GHz Hand	11 Channels	
	NFC	1 Channel	
Modulation Type	Bluetooth	GFSK for 1 Mbps, π/4-DQPSK for 2 Mbps, 8-DPSK for 3 Mbps	
	WLAN 2.4 GHz Hand	DSSS Modulation(DBPSK/DQPSK/CCK) OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
	NFC	ASK	
Antenna Type	Bluetooth	FPCB Antenna	
	WLAN 2.4 GHz Hand		
	NFC	PCB Antenna	
Antenna Gain	Bluetooth	2.0 dBi	
	WLAN 2.4 GHz Hand		
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	12 MHz, 25 MHz, 26 MHz		
Rated Supply Voltage	DC 12.0 V		

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

-. The following lists consist of the added model and their differences.

Model Name	Differences	Tested
FL1000-A	Basic Model	☑
FL1000-B	This model is identical to the basic model except for model name. Multiple Model name is added for the marketing purpose.	☐
FL1000-C		☐
FL1000-D		☐
FL1000-E		☐
FL1000-F		☐
FL1000-G		☐
FL1000-H		☐
FL1000-I		☐
FL1000-J		☐
FL1000-K		☐
FL1000-L		☐
FL1000-M		☐
FL1000-N		☐
FL1000-O		☐
FL1000-P		☐
FL1000-Q		☐
FL1000-R		☐
FL1000-S		☐
FL1000-T		☐
FL1000-U		☐
FL1000-V		☐

Note: 1. Applicant consigns only basic model to test. Therefore, this test report just guarantees the units, which have been tested.

2. The Applicant/manufacturer is responsible for the compliance of all variants.

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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	N/A	N/A	-
LED Board	N/A	N/A	-
NFC Module Board	N/A	N/A	-
Camera Board	N/A	N/A	-

5.2 Peripheral equipment

-None

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5.3 Configuration of Test System

Line Conducted Test: The EUT was connected to LISN. 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 open area test site.

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

5.4 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 transmitter antenna of the EUT is FPCB Antenna, so no consideration of replacement by the user.

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6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

- As this product is only using DC power, AC conducted emission test has not been performed.

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

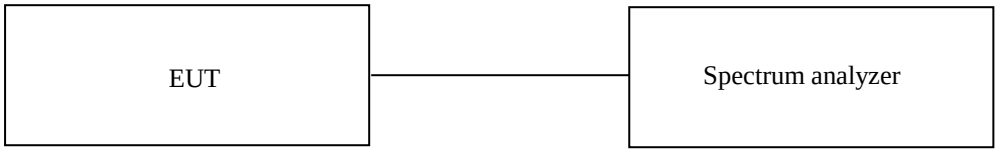
7.1 Operating environment

Temperature : 24 ℃

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 equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Aug. 23, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

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7.4 Test data for 802.11b WLAN Mode

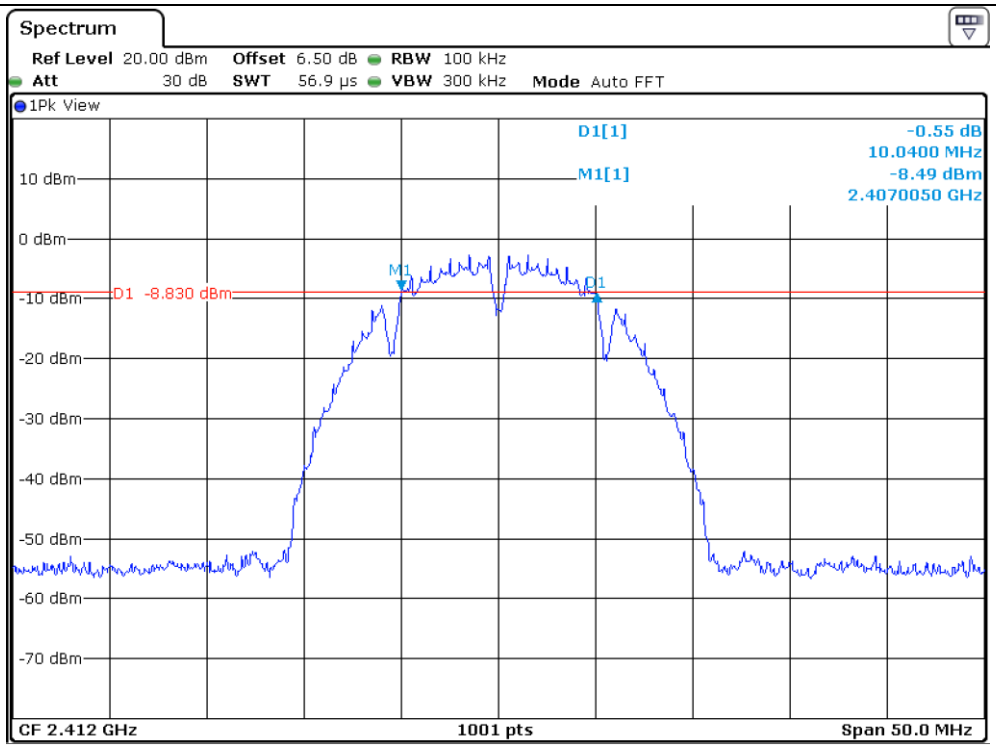
-. Test Date : May 15, 2019

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	LIMIT (MHz)	Bandwidth Margin(MHz)	
					6 dB	99 %
Low	2 412.00	10.04	14.24	>500	9.54	13.74
Middle	2 442.00	10.04	14.24	>500	9.54	13.74
High	2 462.00	10.04	14.24	>500	9.54	13.74

Remark. Margin = Measured Value - Limit

Tested by: Yu-Seog Sim / Assistant Manager



Low Channel (6 dB Bandwidth)

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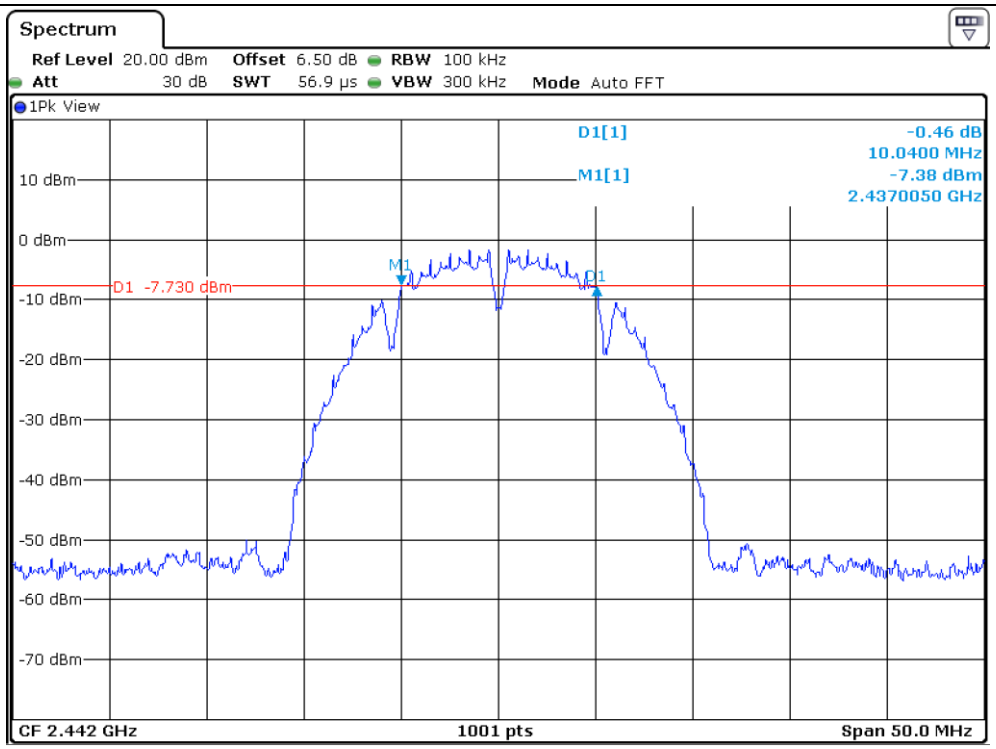
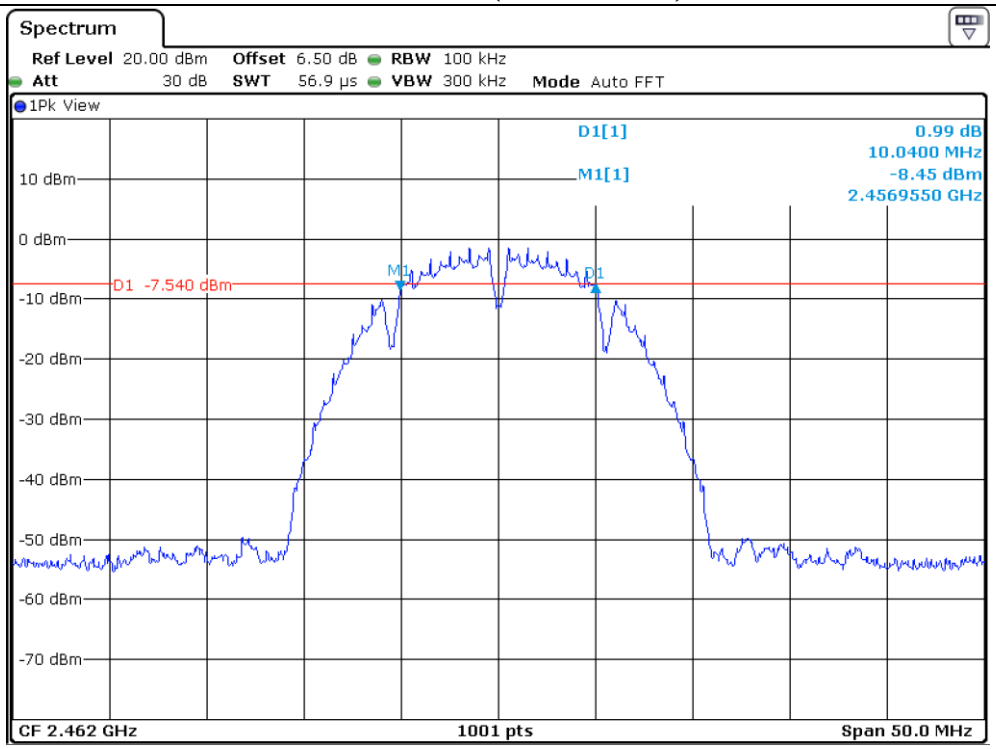


Middle Channel (6 dB Bandwidth)



High Channel (6 dB Bandwidth)

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7.5 Test data for 802.11g WLAN Mode

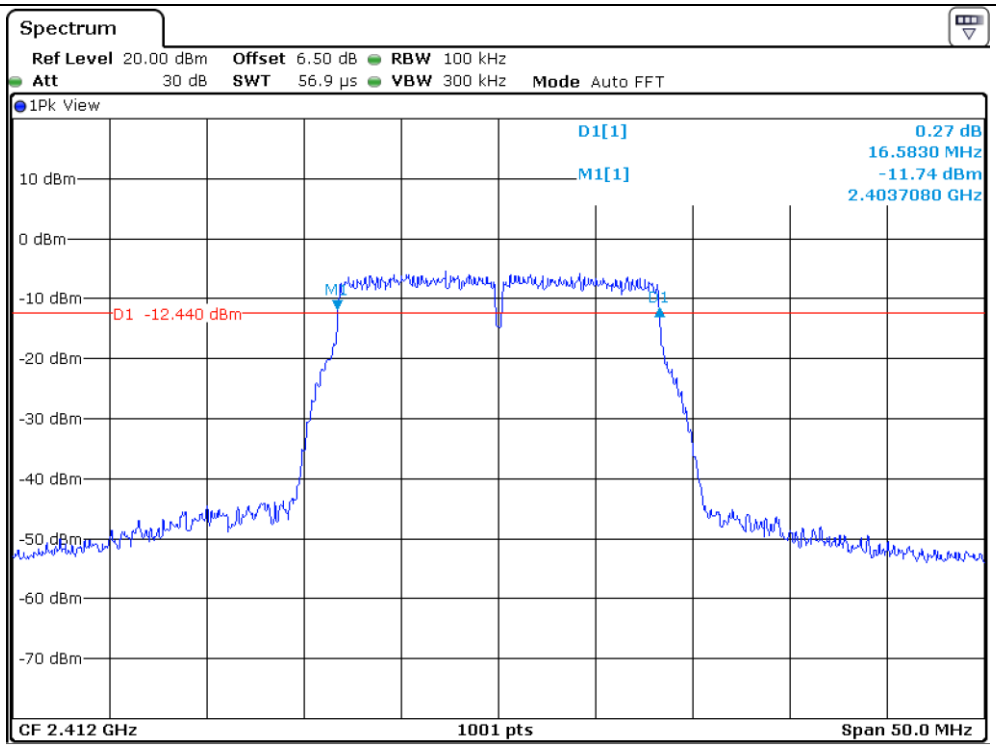
-. Test Date : May 15, 2019

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	LIMIT (MHz)	Bandwidth Margin(MHz)	
					6 dB	99 %
Low	2 412.00	16.58	16.48	>500	16.08	15.98
Middle	2 442.00	16.58	16.48	>500	16.08	15.98
High	2 462.00	16.58	16.48	>500	16.08	15.98

Remark. Margin = Measured Value - Limit

Tested by: Yu-Seog Sim / Assistant Manager



Low Channel (6 dB Bandwidth)

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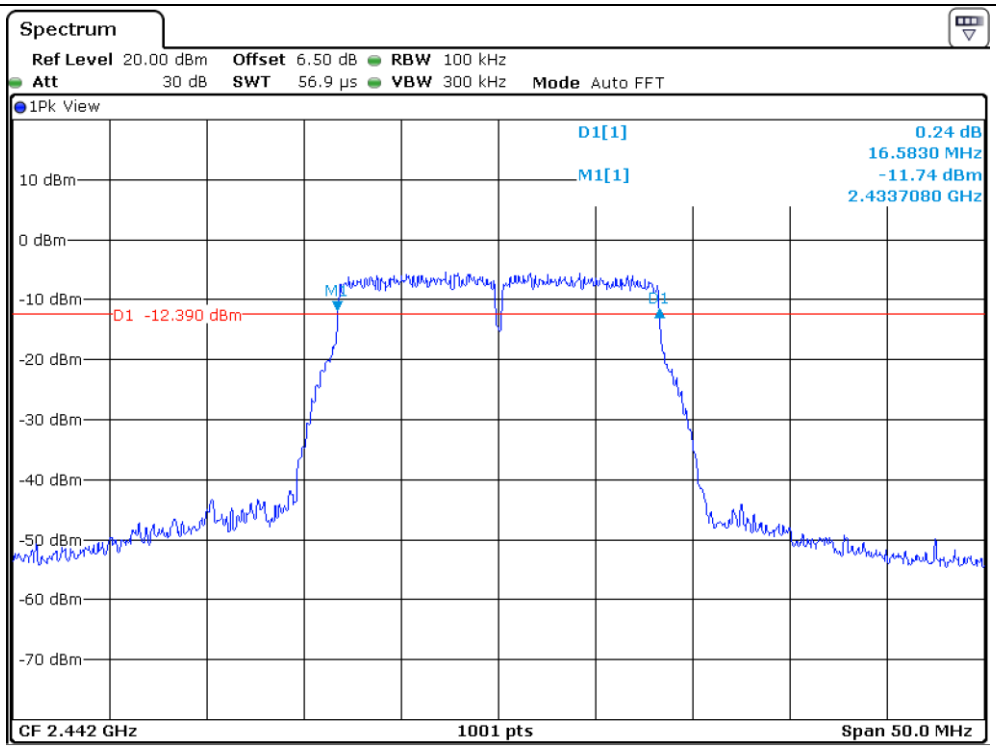
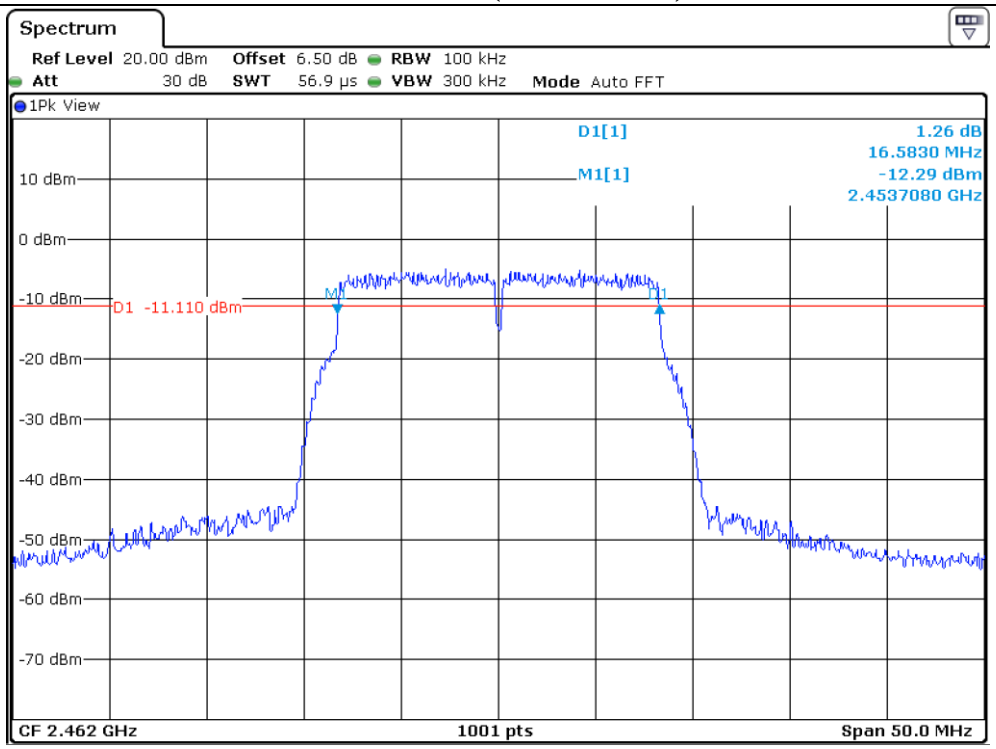


Middle Channel (6 dB Bandwidth)



High Channel (6 dB Bandwidth)

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7.6 Test data for 802.11n (HT 20) WLAN Mode

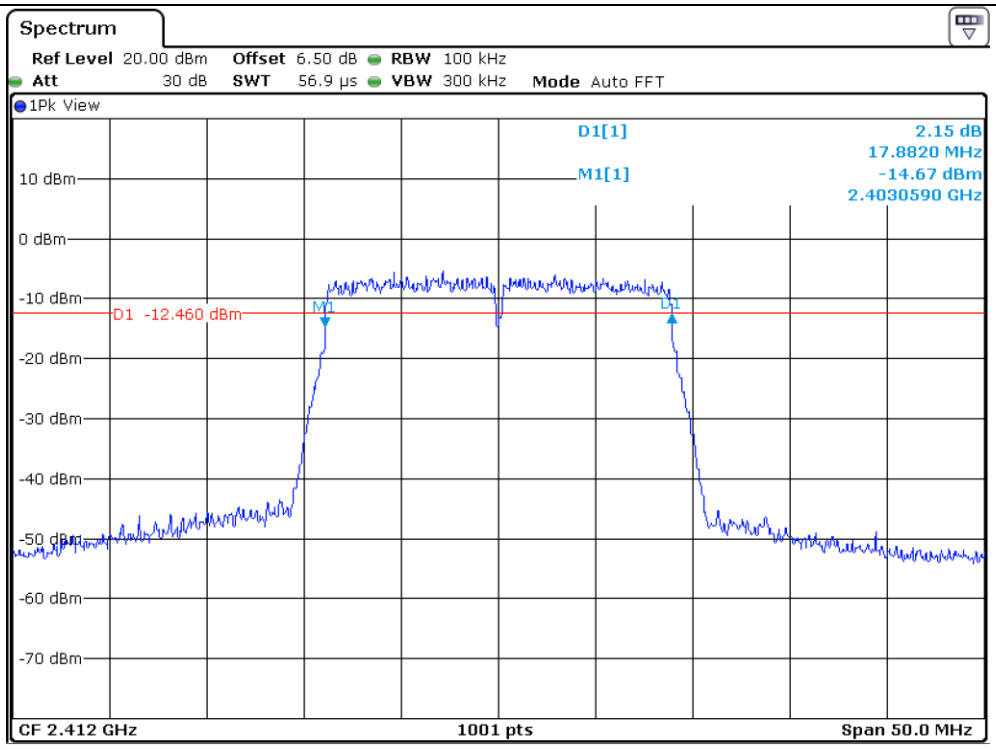
-. Test Date : May 15, 2019

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	LIMIT (MHz)	Bandwidth Margin(MHz)	
					6 dB	99 %
Low	2 412.00	17.88	17.68	>500	17.38	17.18
Middle	2 442.00	17.88	17.68	>500	17.38	17.18
High	2 462.00	17.88	17.63	>500	17.38	17.13

Remark. Margin = Measured Value - Limit

Tested by: Yu-Seog Sim / Assistant Manager



Low Channel (6 dB Bandwidth)

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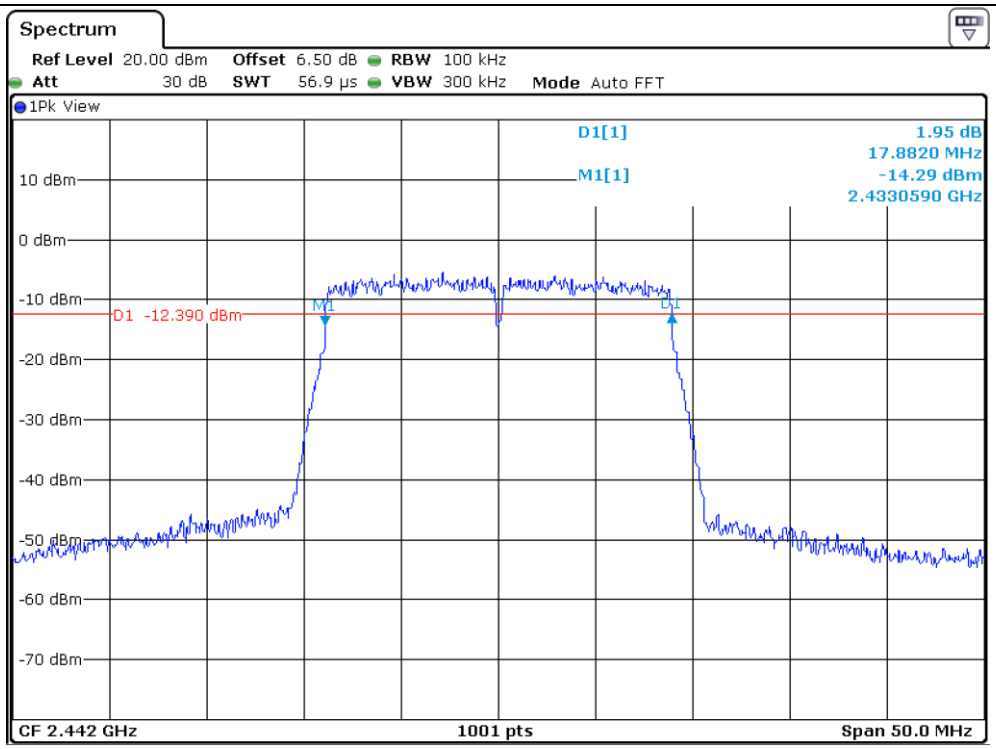
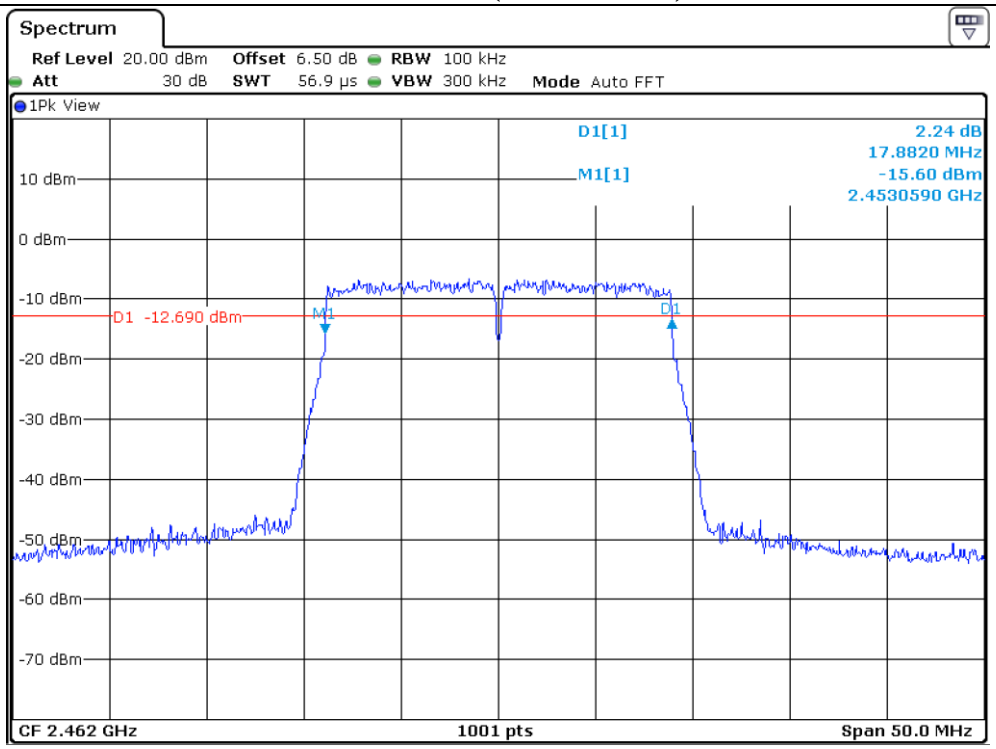


Middle Channel (6 dB Bandwidth)



High Channel (6 dB Bandwidth)

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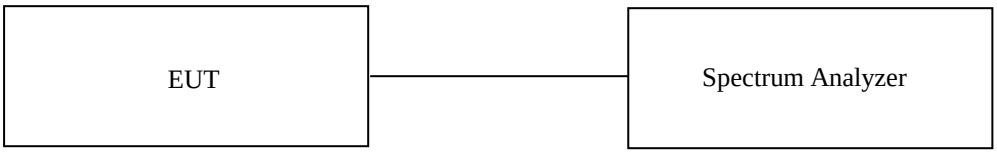
8. MAXIMUM PEAK OUTPUT POWER

8.1 Operating environment

Temperature	:	24 ℃
Relative humidity	:	45 % R.H.

8.2 Test set-up

The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT. The spectrum analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99 % bandwidth. The EUT was operating in transmit mode at the appropriate center frequency.



8.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Aug. 23, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

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8.4 Test data for 802.11b WLAN Mode

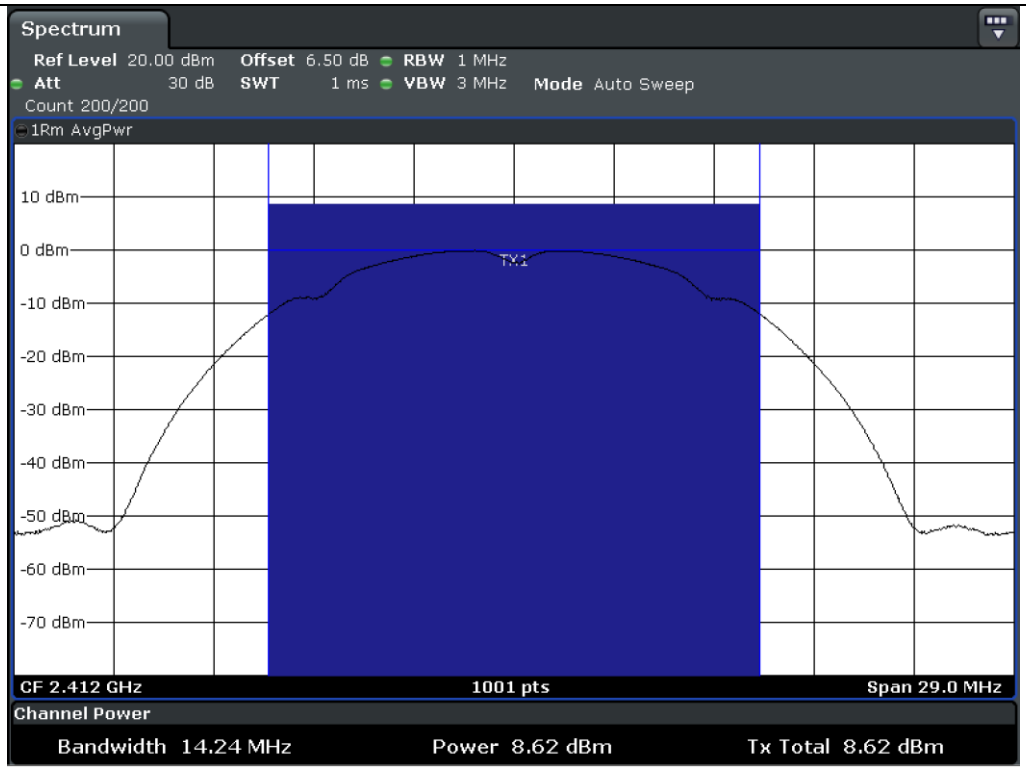
-. Test Date : May 15, 2019

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB bandwidth (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	10.04	8.62	30.00	21.38
MIDDLE	2 442.00	10.04	8.99	30.00	21.01
HIGH	2 462.00	10.04	8.82	30.00	21.18

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

Tested by: Yu-Seog Sim / Assistant Manager



Low Channel

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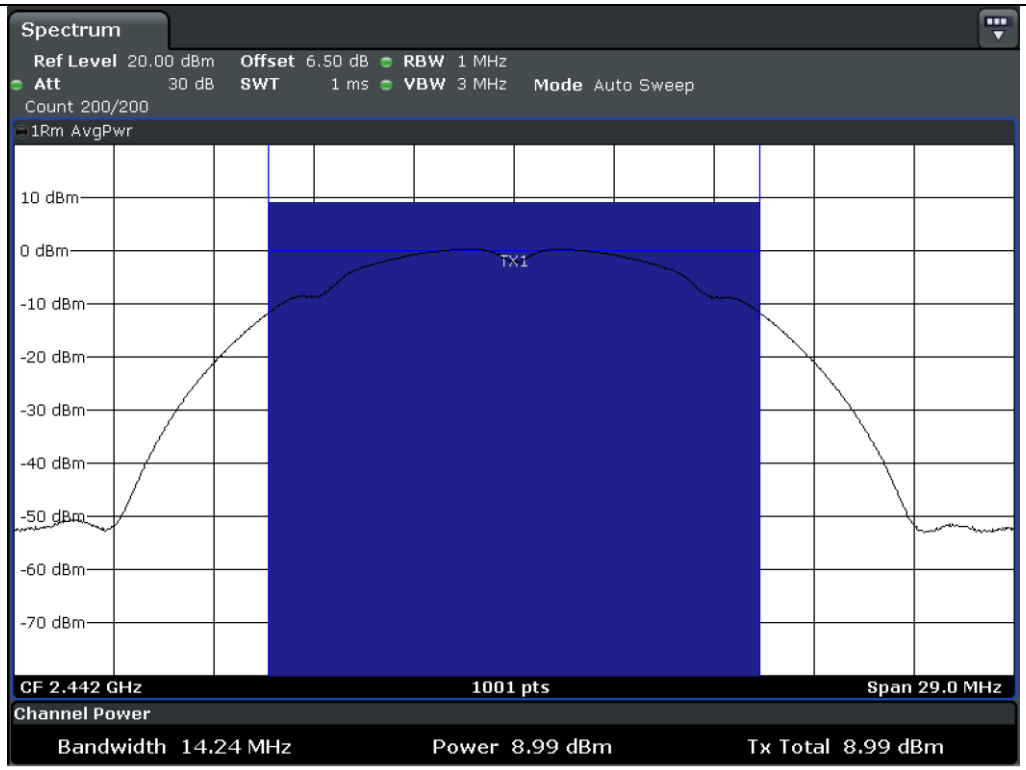
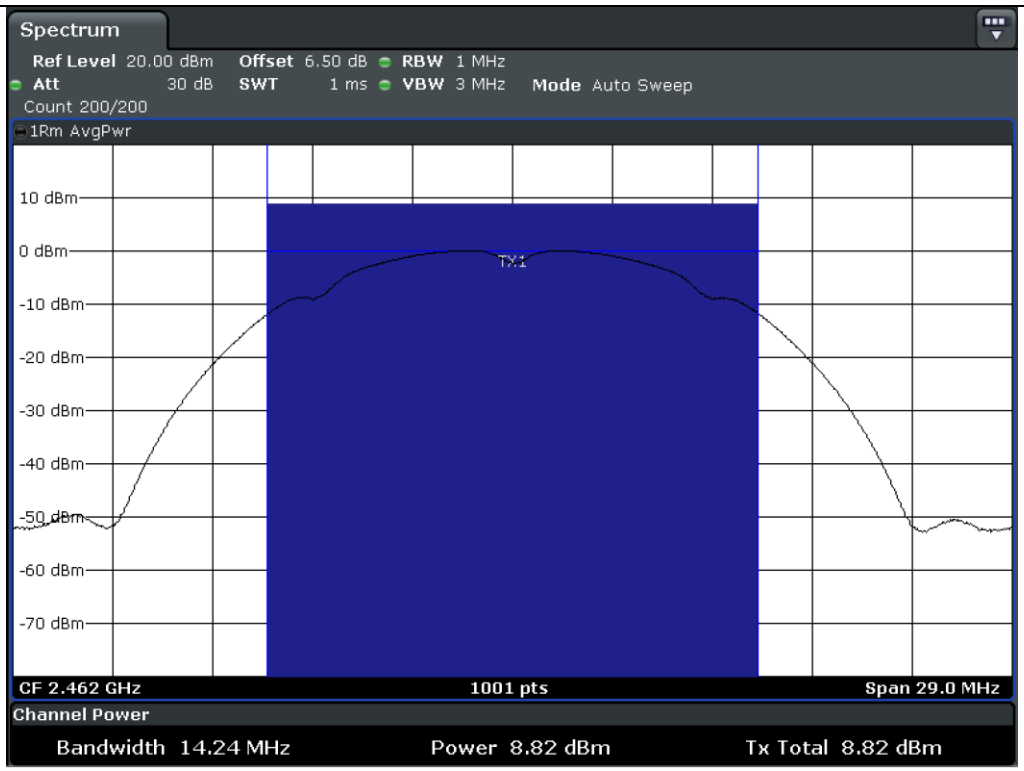


Middle Channel



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)

8.5 Test data for 802.11g WLAN Mode

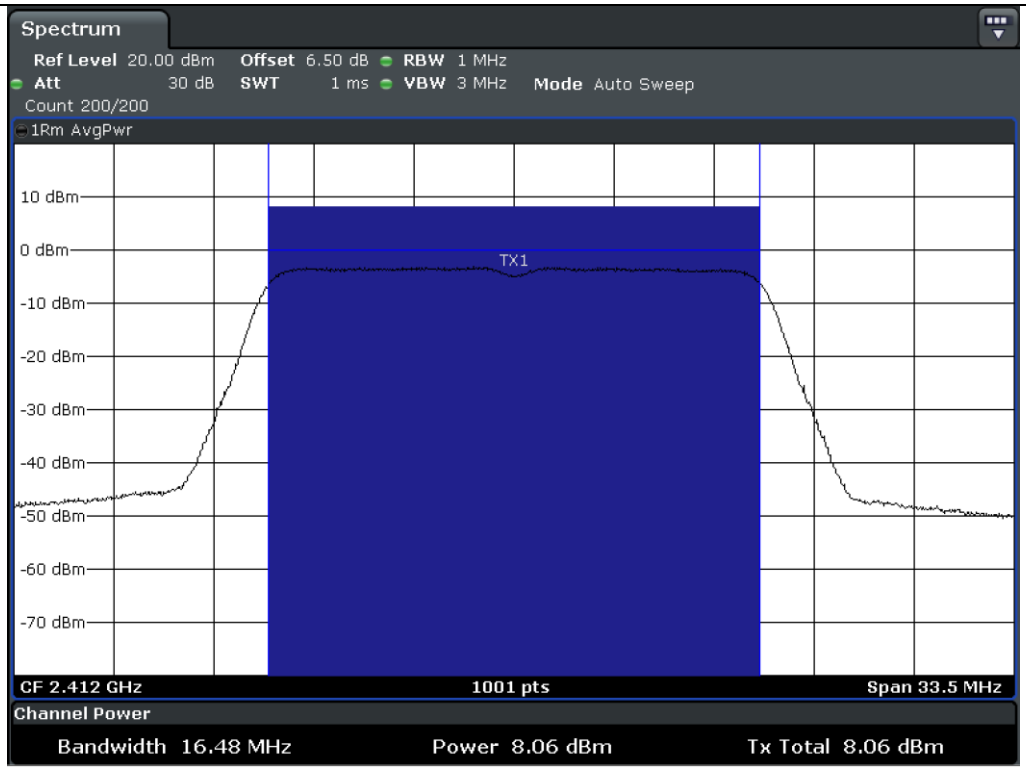
-. Test Date : May 15, 2019

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB bandwidth (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	16.58	8.06	30.00	21.94
MIDDLE	2 442.00	16.58	8.27	30.00	21.73
HIGH	2 462.00	16.58	8.37	30.00	21.63

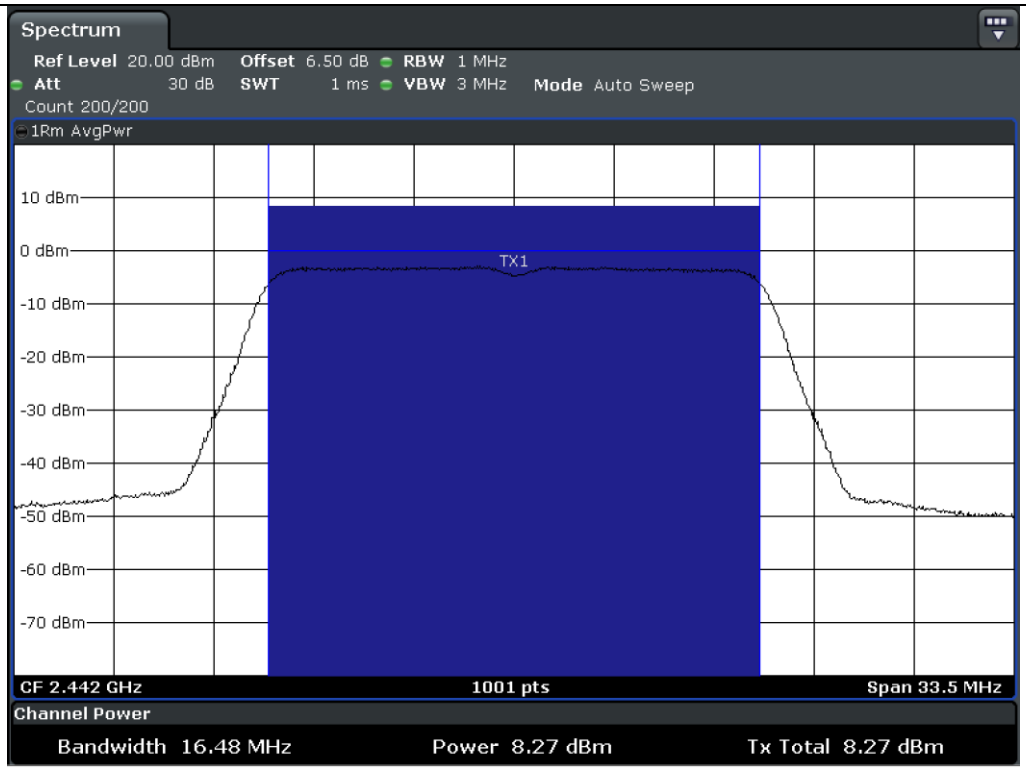
Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)

Tested by: Yu-Seog Sim / Assistant Manager

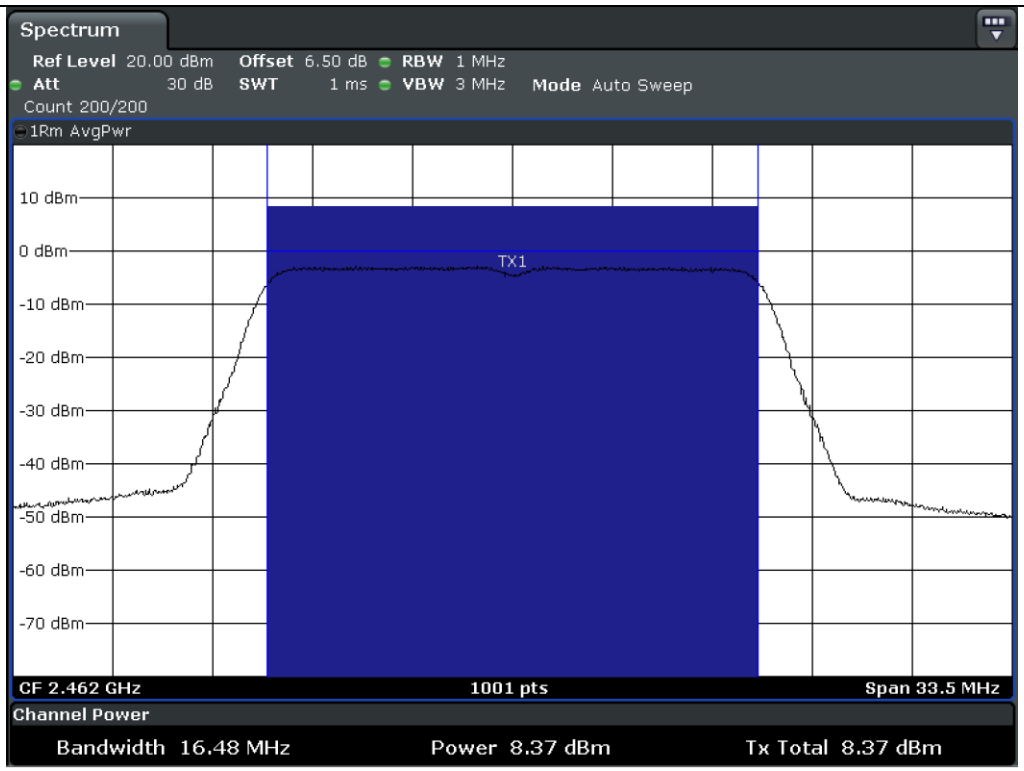


Low Channel

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



High Channel

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8.6 Test data for 802.11n(HT20) WLAN Mode

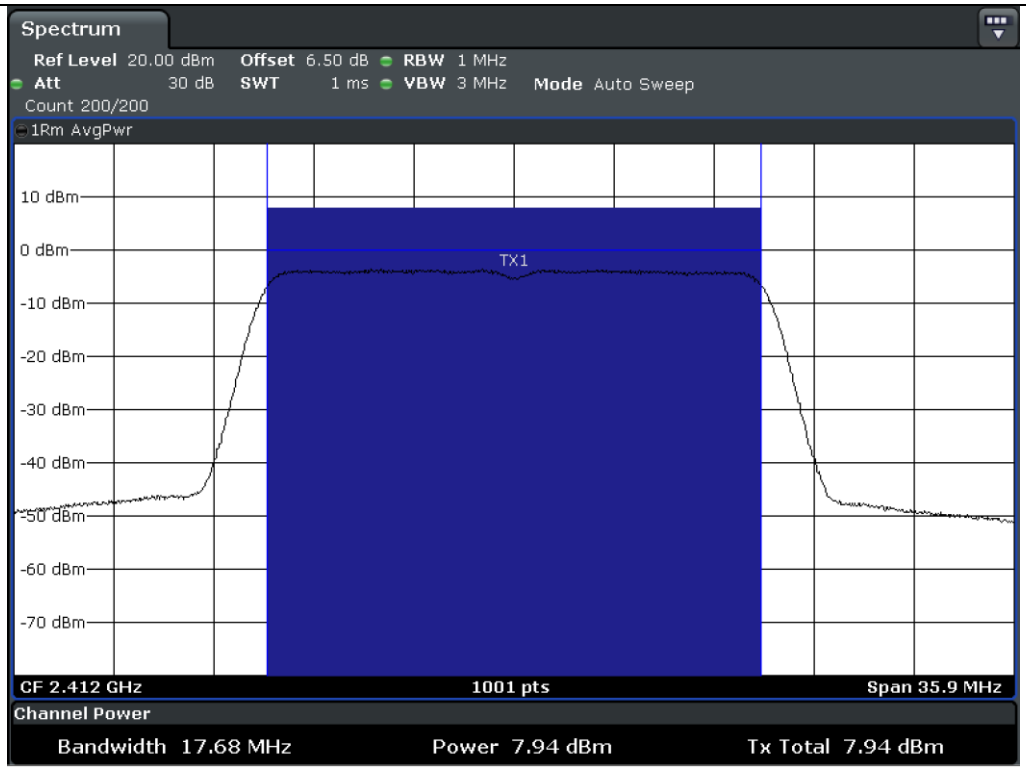
-. Test Date : May 15, 2019

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB bandwidth (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	17.88	7.94	30.00	22.06
MIDDLE	2 442.00	17.88	8.23	30.00	21.77
HIGH	2 462.00	17.88	8.15	30.00	21.85

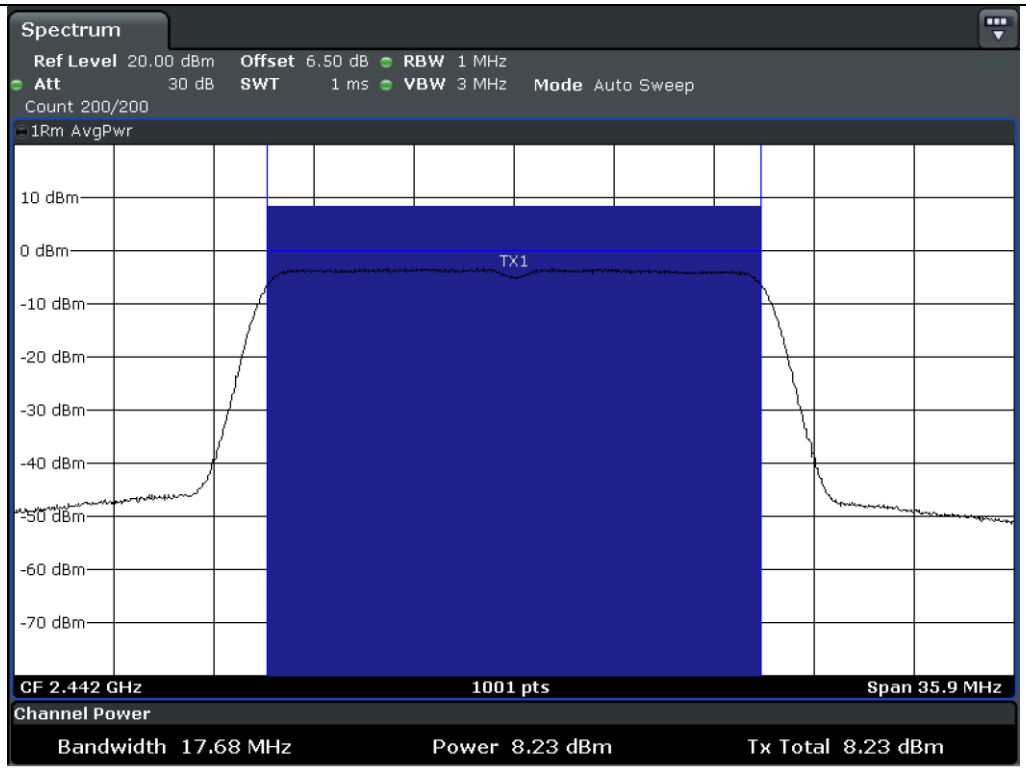
Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)

Tested by: Yu-Seog Sim / Assistant Manager

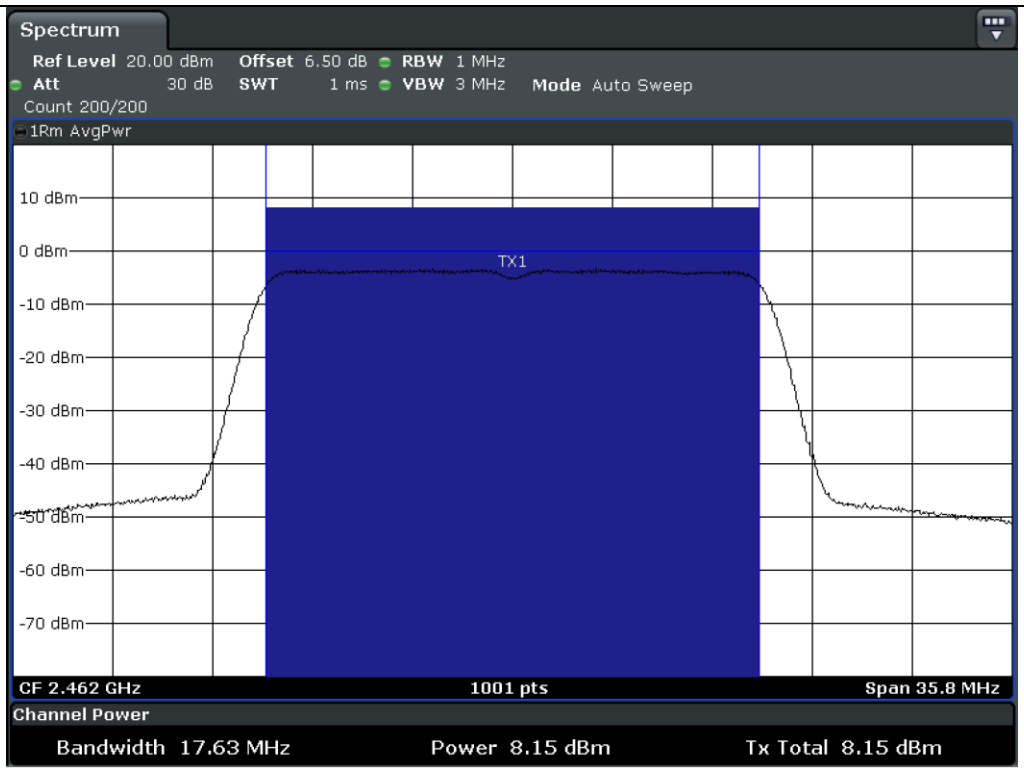


Low Channel

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



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. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

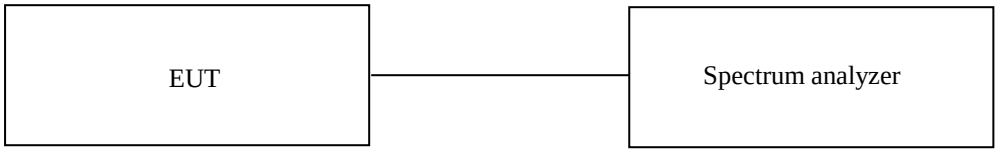
9.1 Operating environment

Temperature : 24 ℃

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, open-field test site. The EUT was placed on a non-conductive turntable above the ground plane.

The frequency spectrum from 30 MHz to 40 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

9.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
☐ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Oct. 22, 2018 (1Y)
■ -	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 22, 2018 (1Y)
☐ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Aug. 23, 2018 (1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Mar. 18, 2019 (1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Aug. 23, 2018 (1Y)
■ -	SCU-18	Rohde & Schwarz	Pre-Amplifier	102266	Aug. 24, 2018 (1Y)
■ -	MA-4000XPET	Innco Systems GmbH	Antenna Master	MA4000/509	N/A
☐ -	HD100	HD GmbH	Position Controller	N/A	N/A
■ -	DT3000-3t	Innco Systems GmbH	Turn Table	N/A	N/A
☐ -	FMZB 1513	Schwarzbeck	LOOP ANTENNA	1513-235	May. 13, 2018 (2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-419	Aug. 09, 2018 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA91700179	Jul. 28, 2017 (2Y)
■ -	BBV 9718 B	Schwarzbeck	Broadband Preamplifier	009	Mar. 11, 2019(1Y)

All test equipment used is calibrated on a regular basis.

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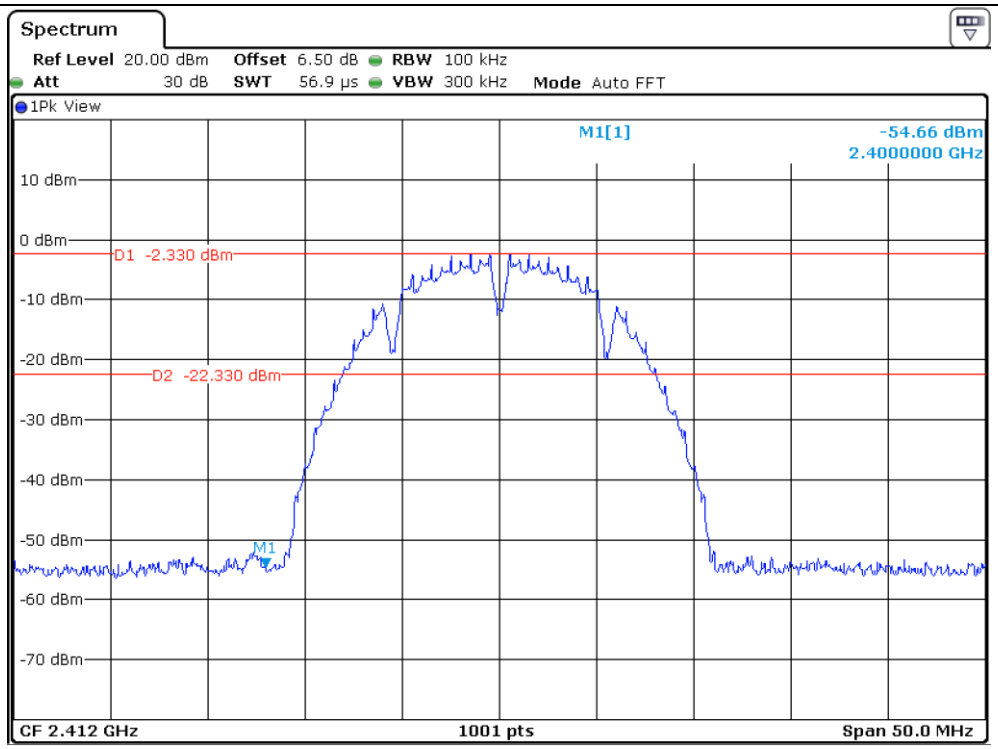
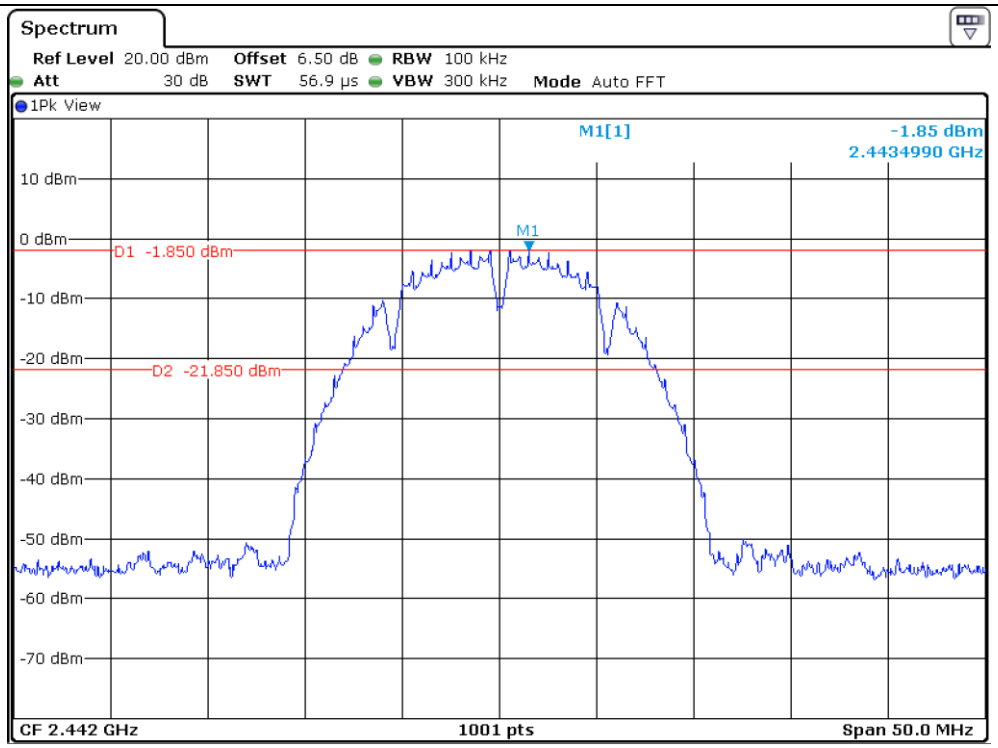
9.5 Test data for conducted emission

9.5.1 Test data for 802.11b WLAN Mode

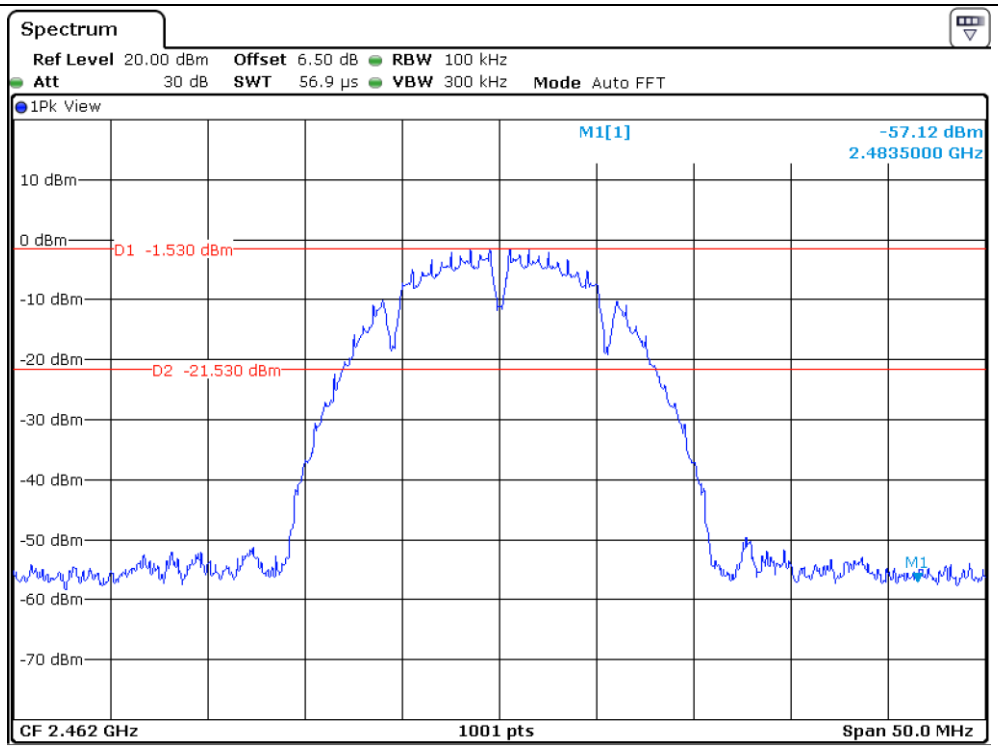


Low Channel



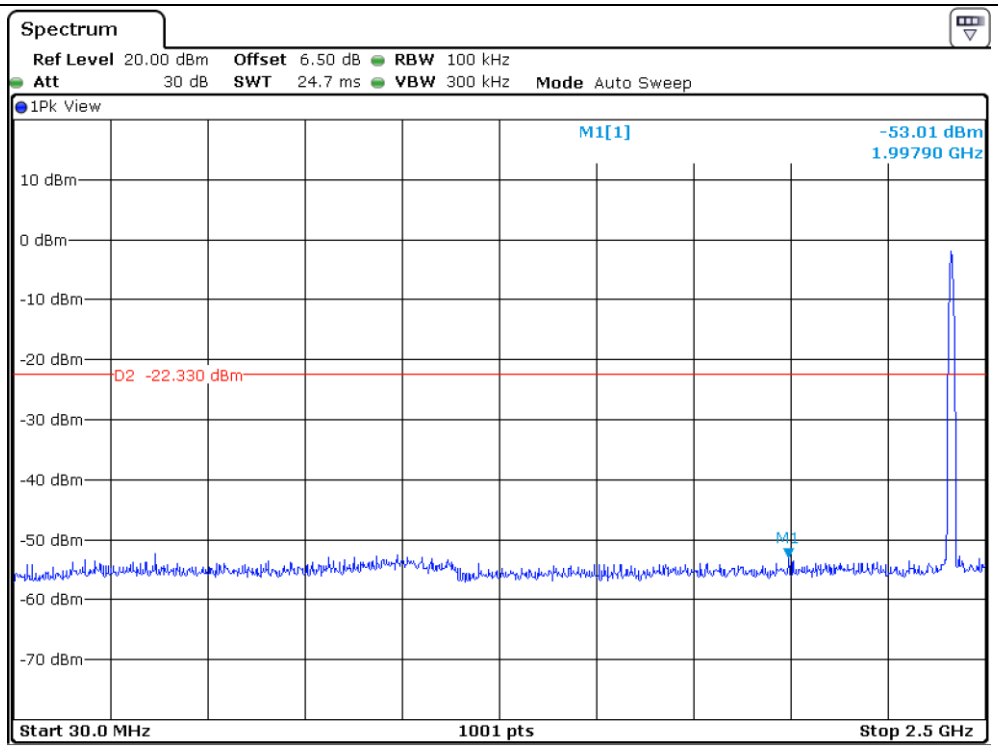
Middle Channel

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

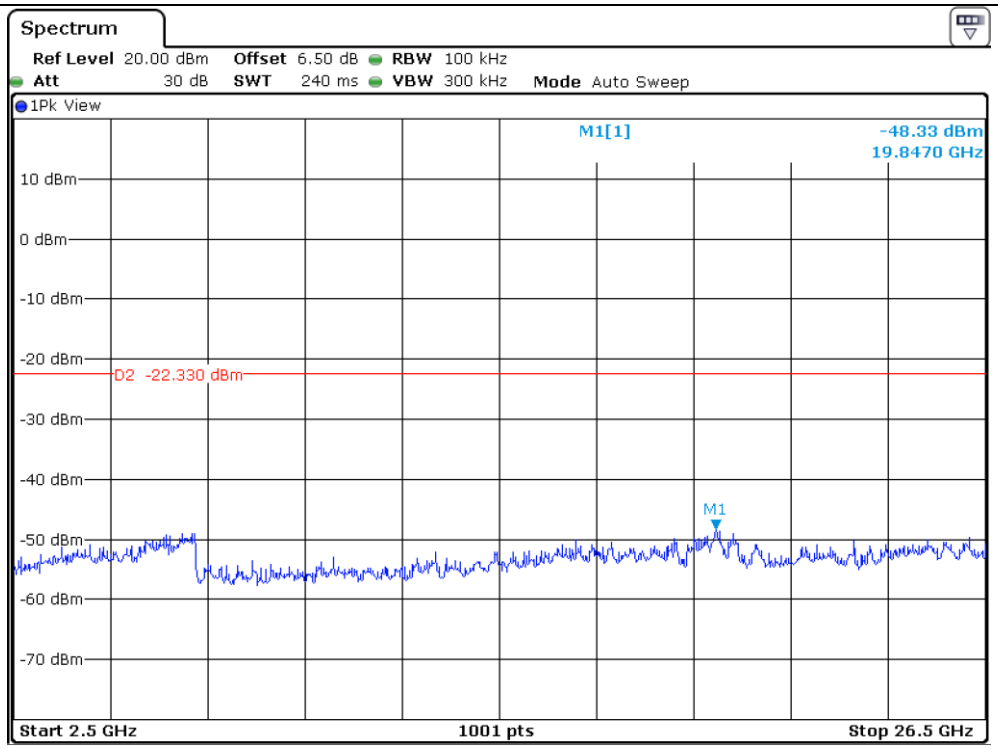


High Channel

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

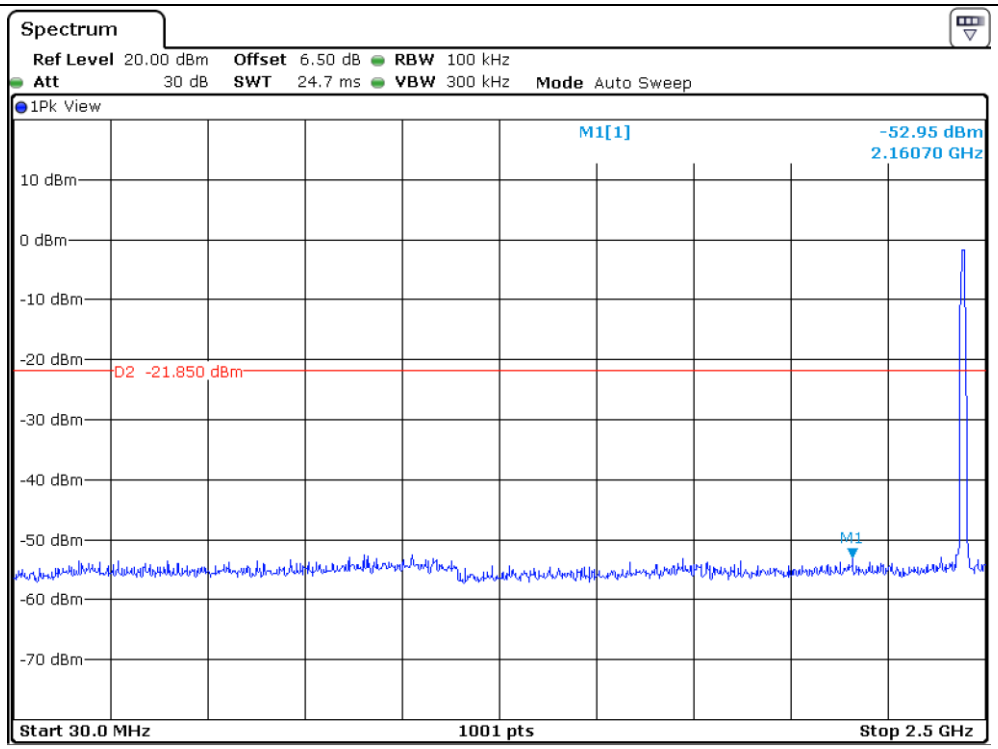


Low Channel

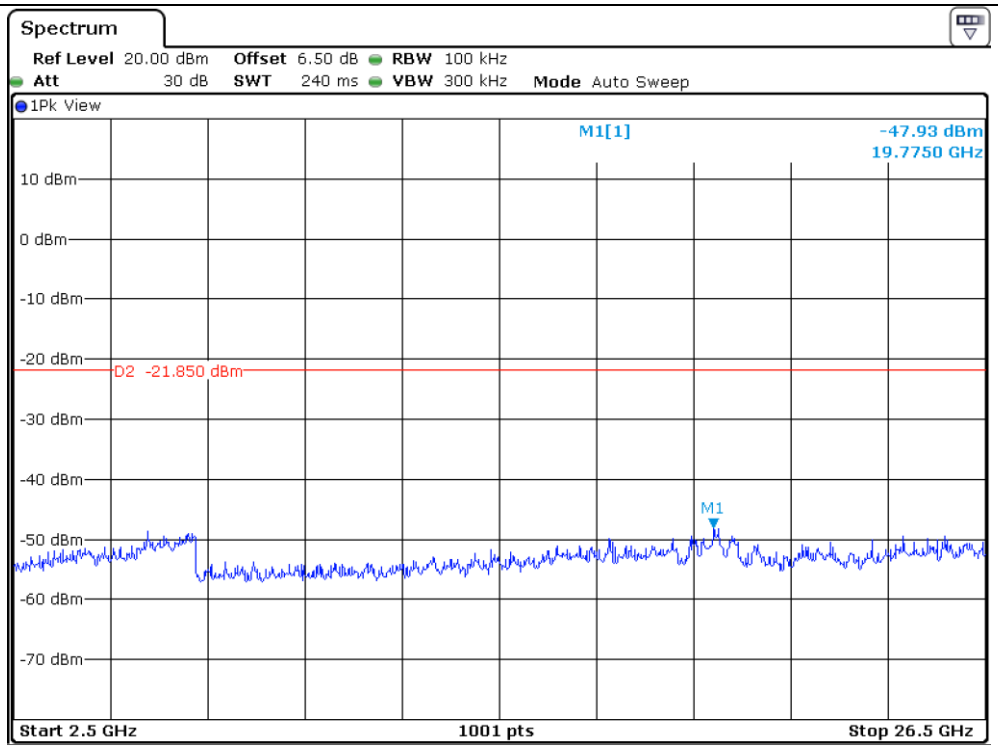


Low Channel

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

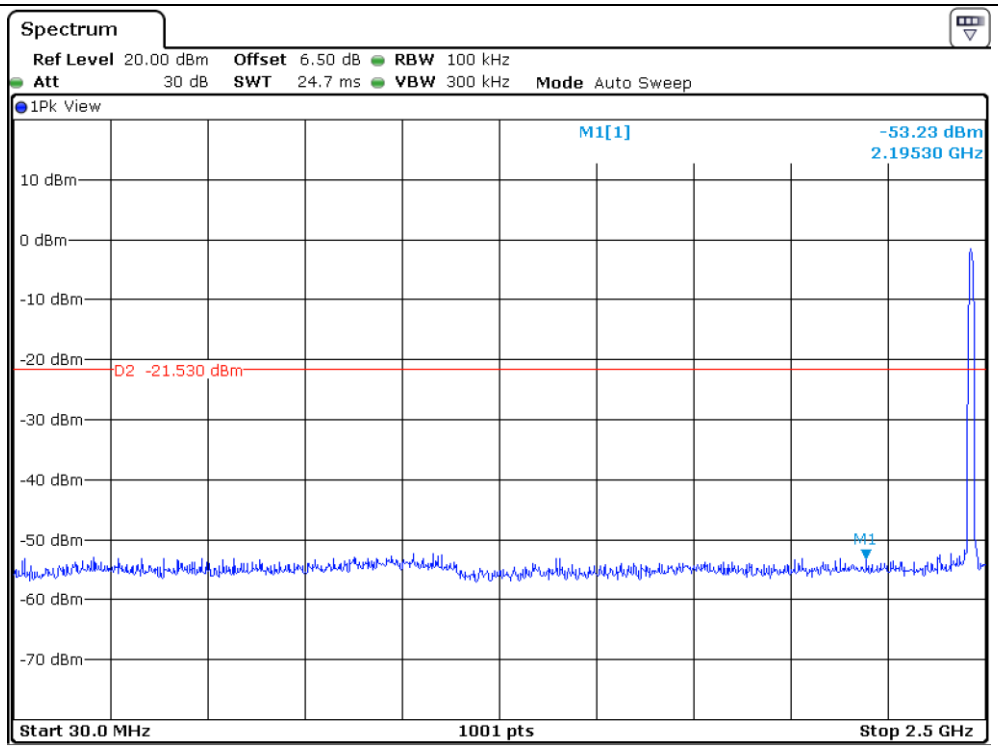


Middle Channel

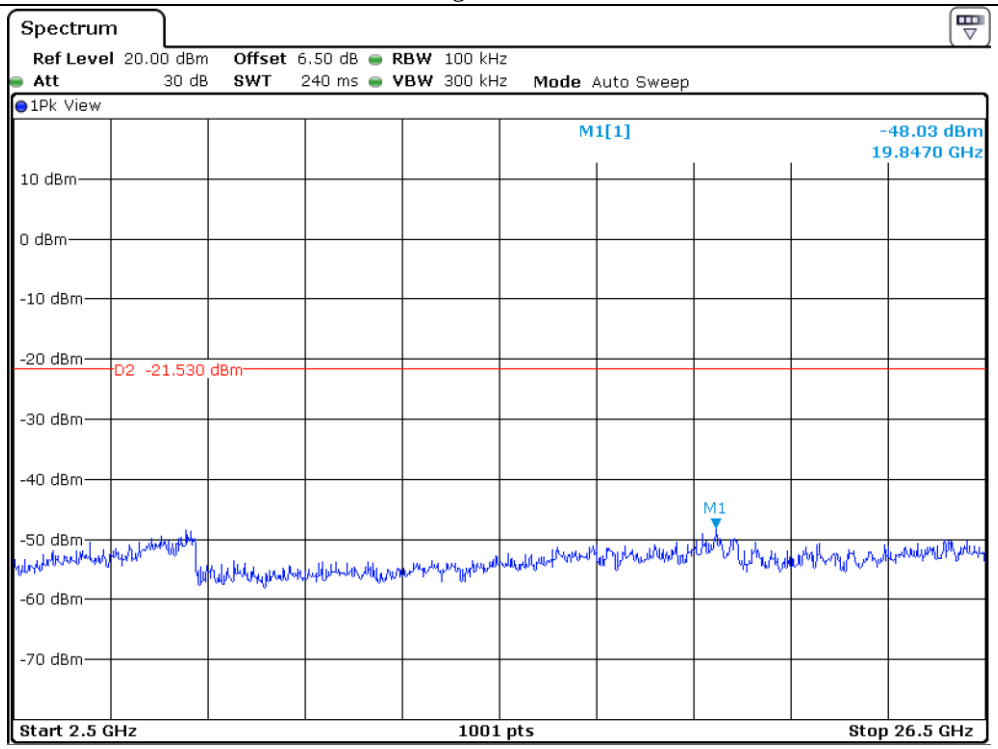


Middle Channel

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



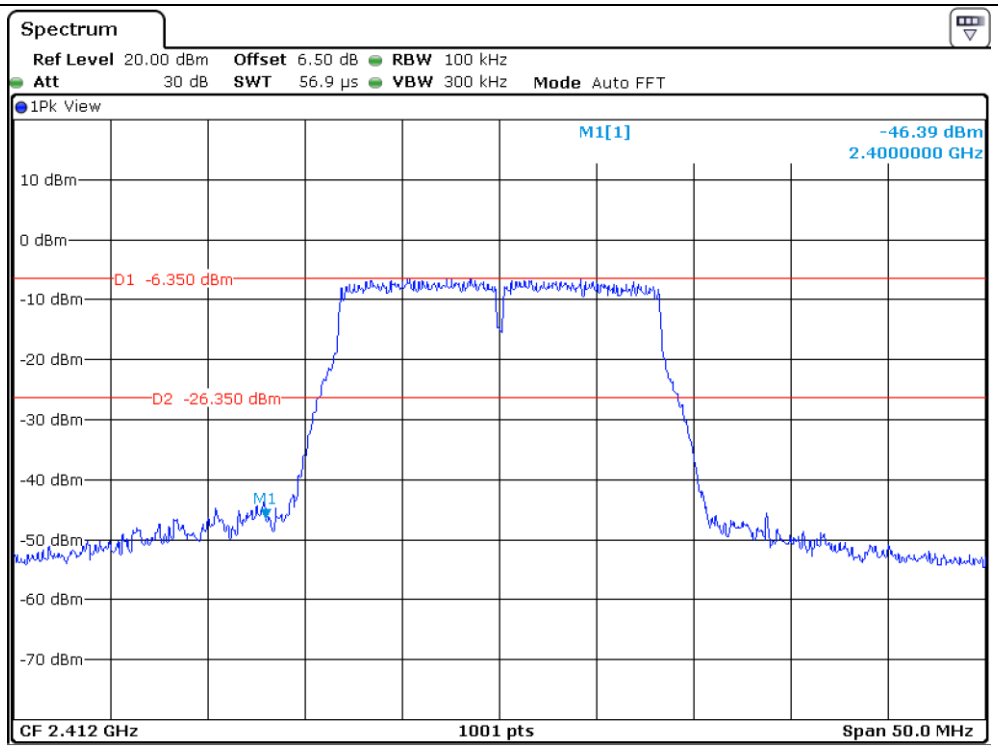
High Channel



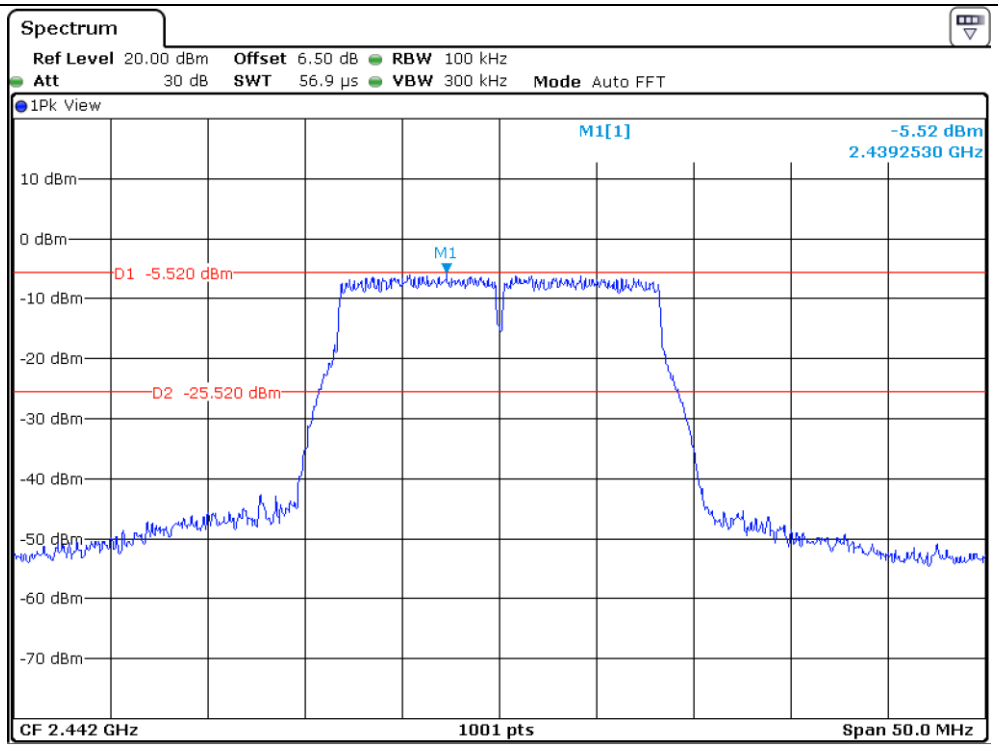
High Channel

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

9.5.2 Test data for 802.11g WLAN Mode

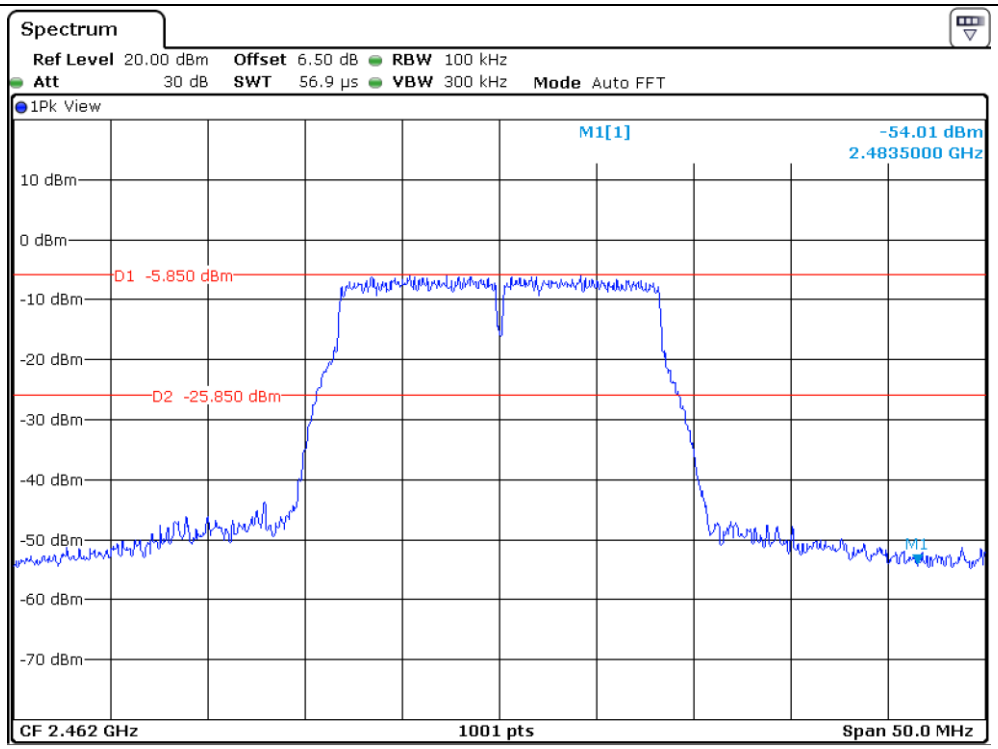


Low Channel



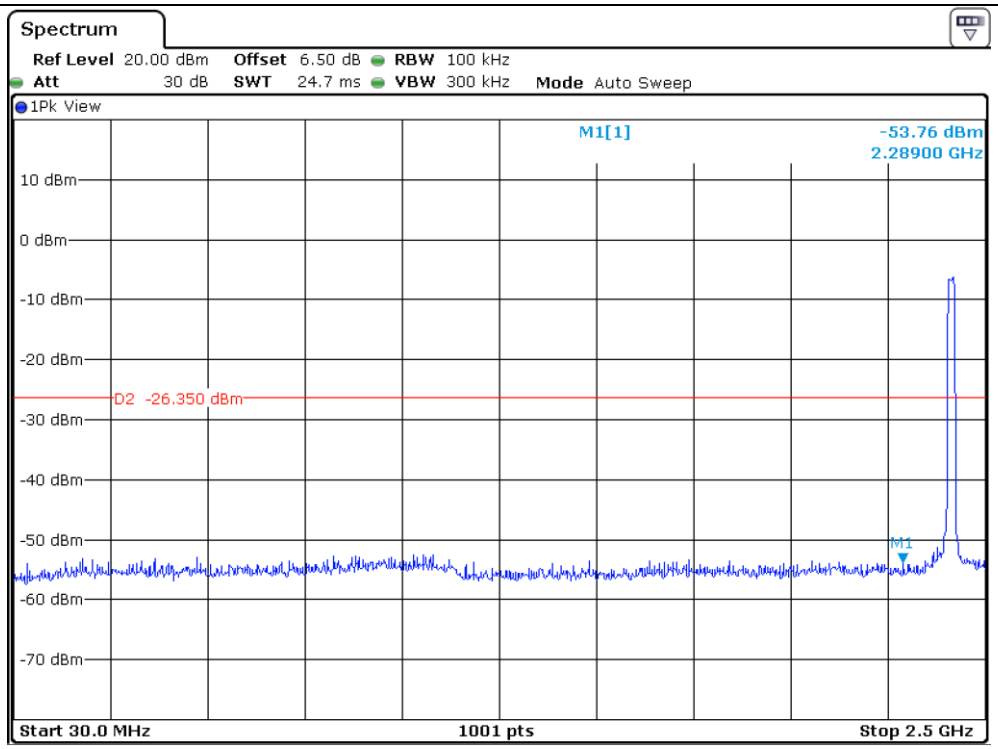
Middle Channel

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

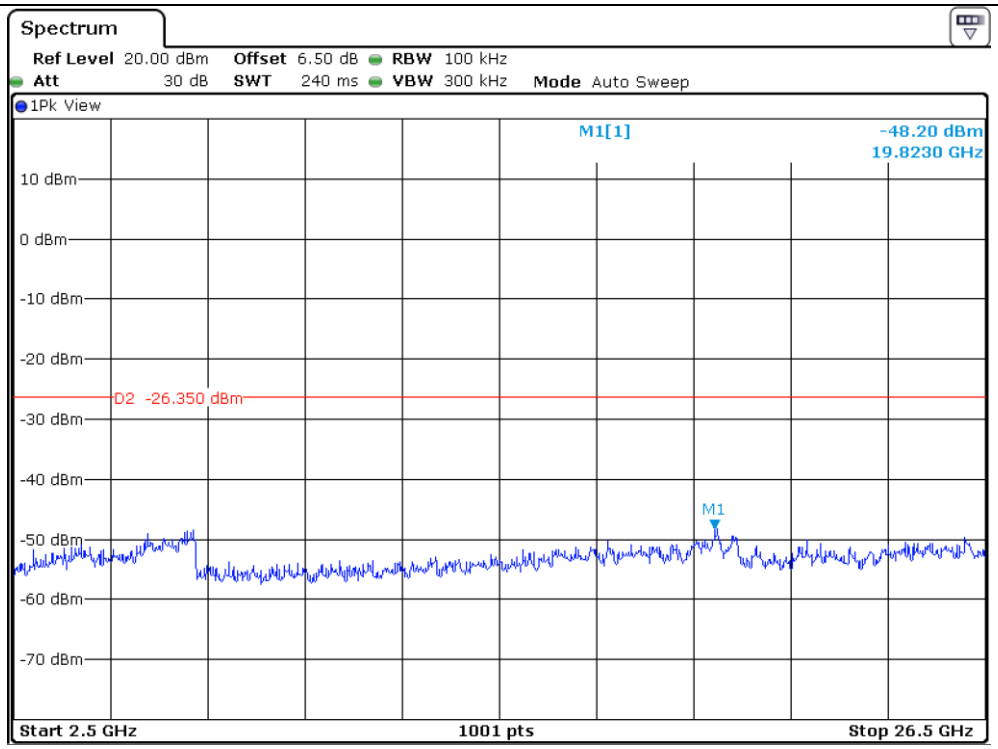


High Channel

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

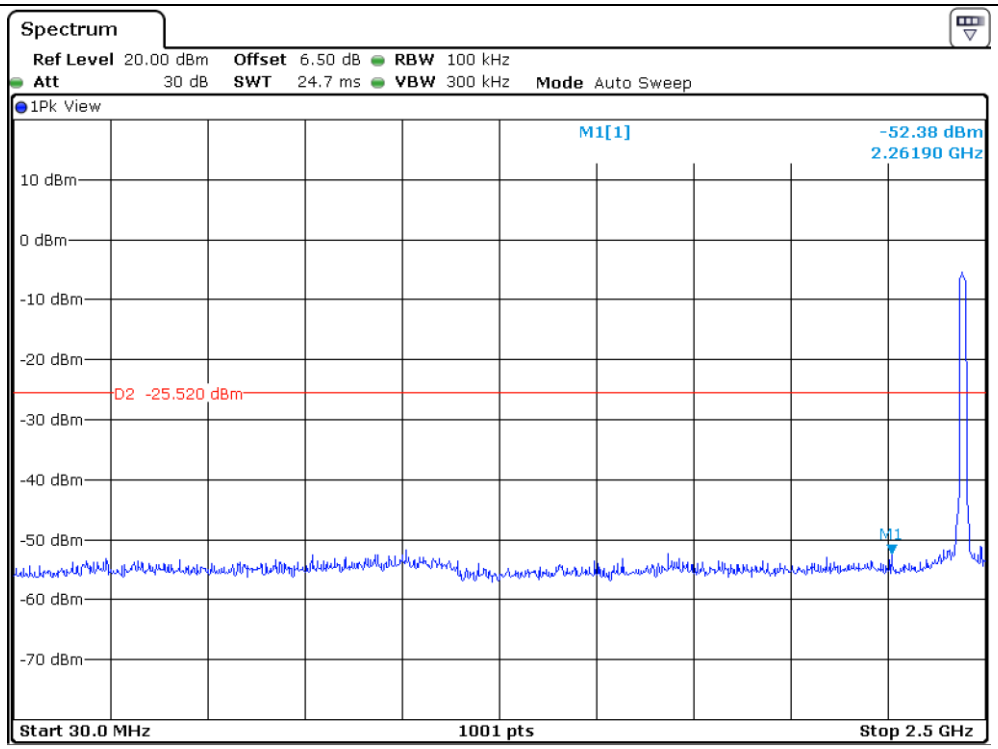


Low Channel

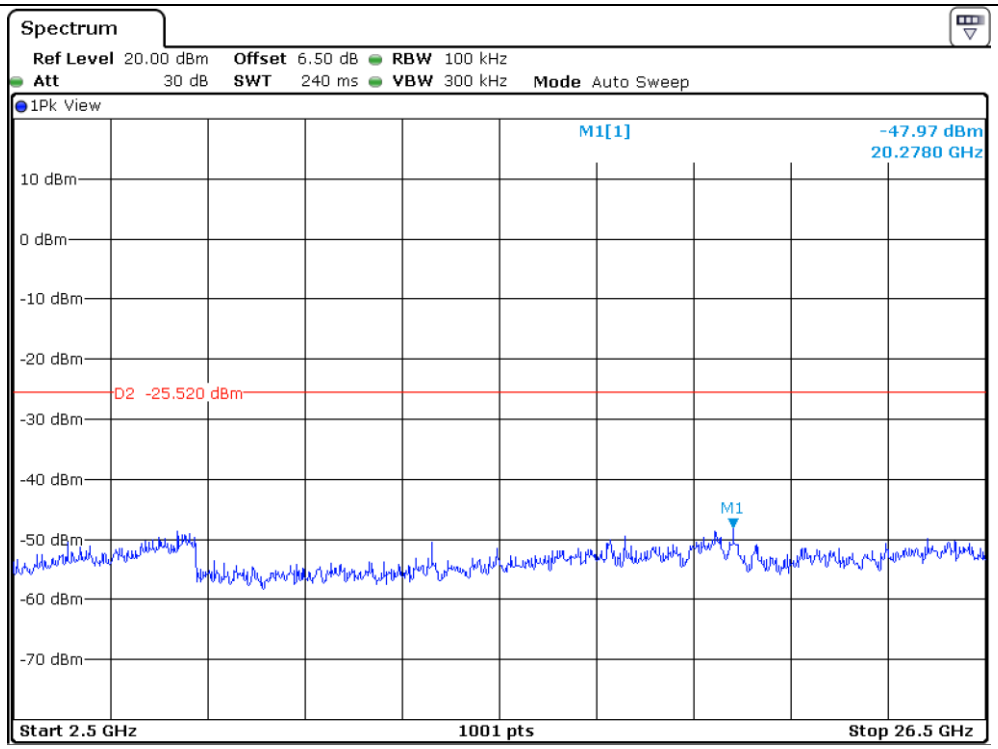


Low Channel

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

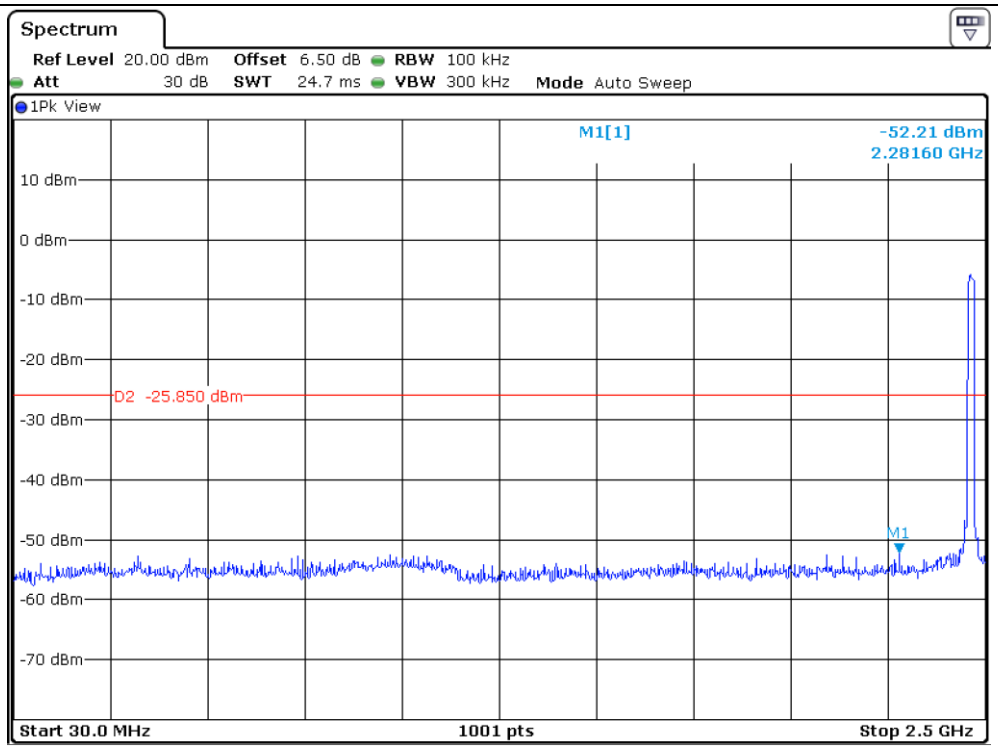


Middle Channel

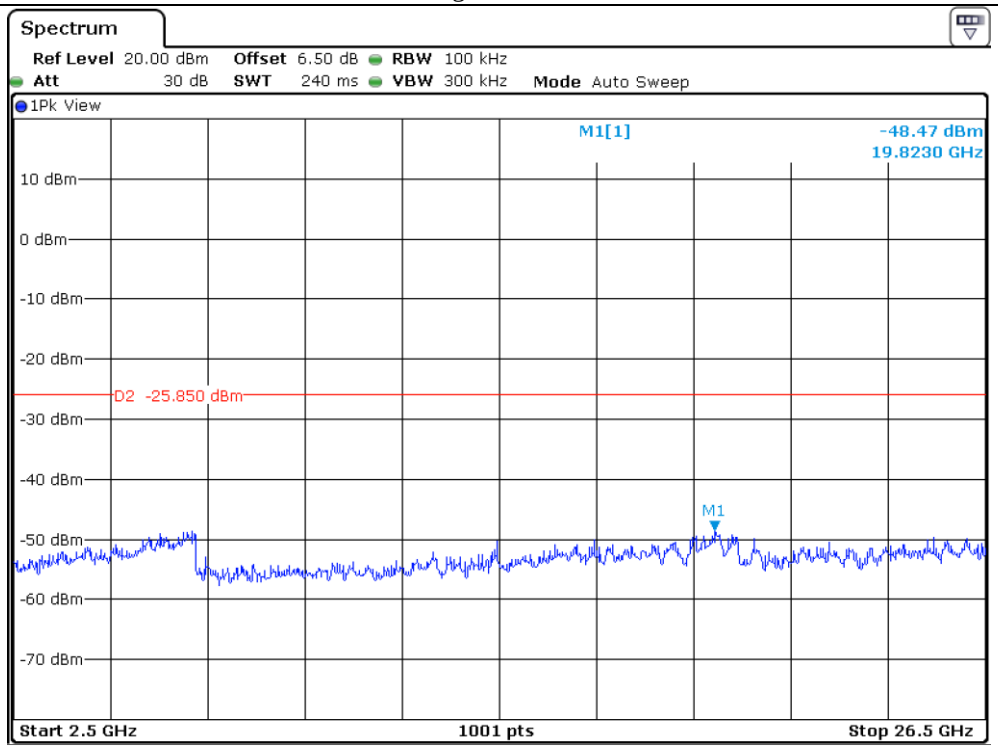


Middle Channel

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



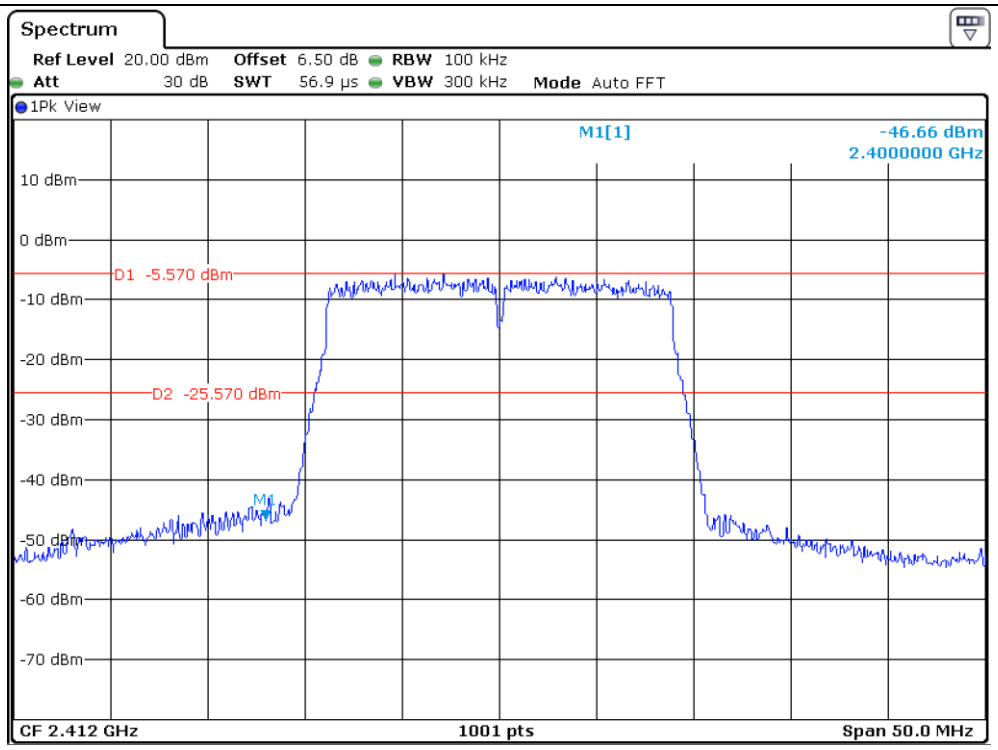
High Channel



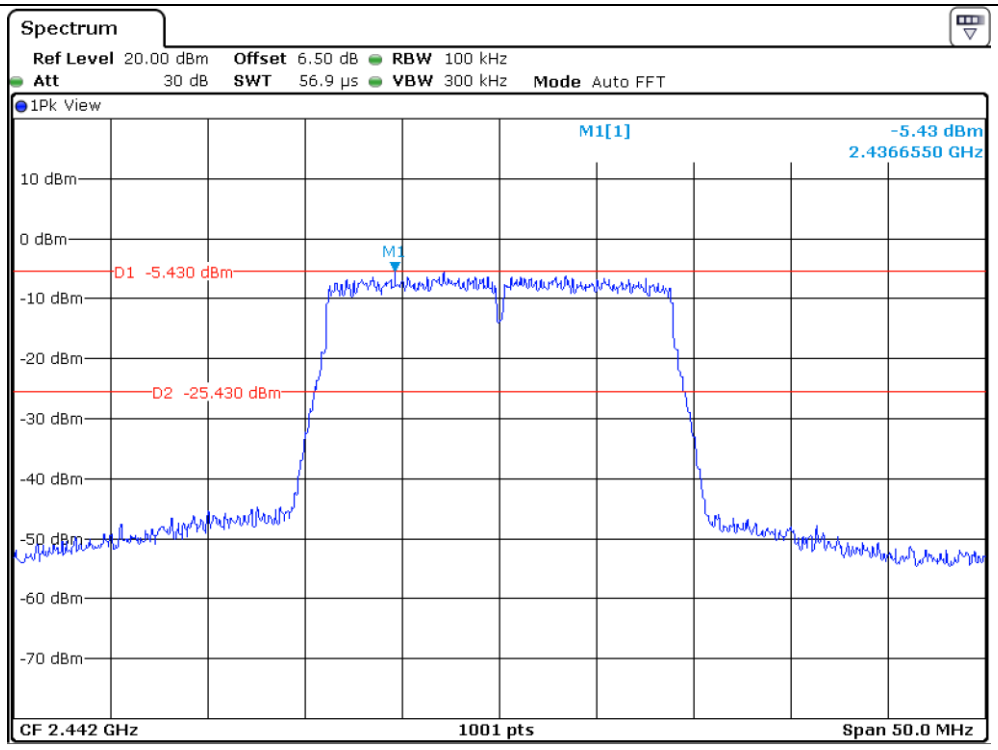
High Channel

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

9.5.3 Test data for 802.11n (HT20) WLAN Mode

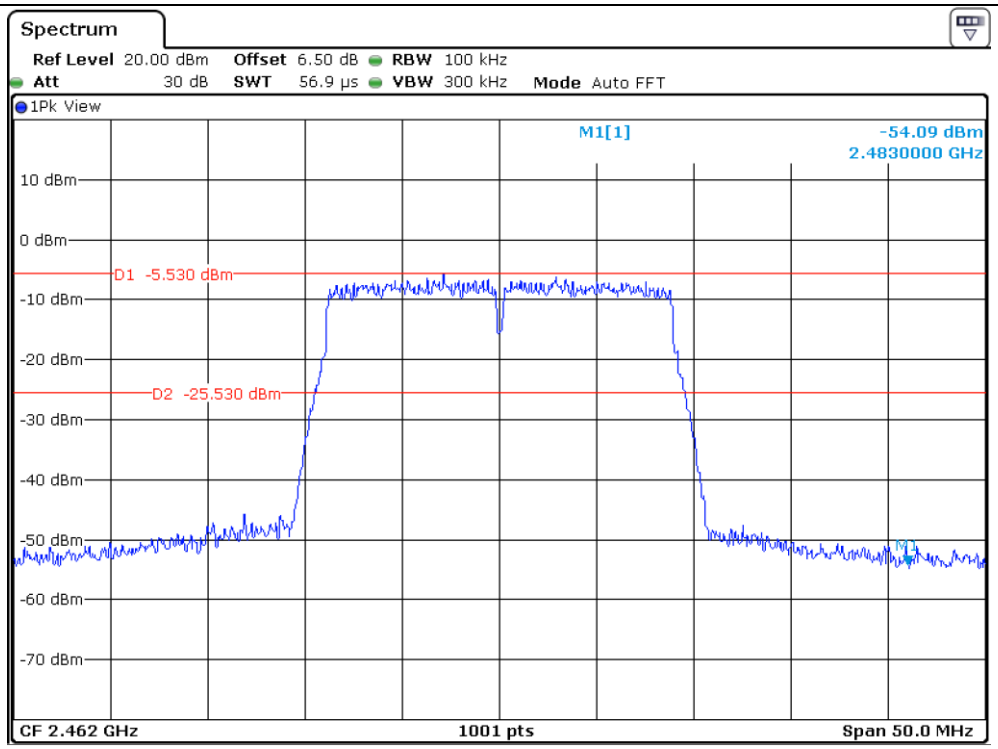


Low Channel



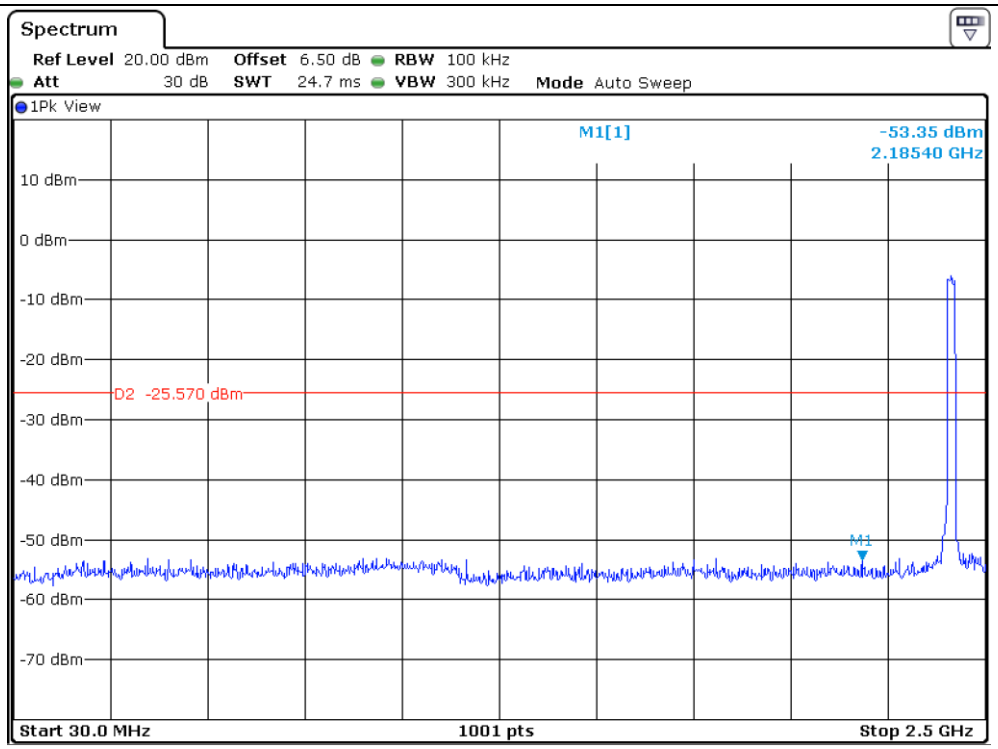
Middle Channel

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

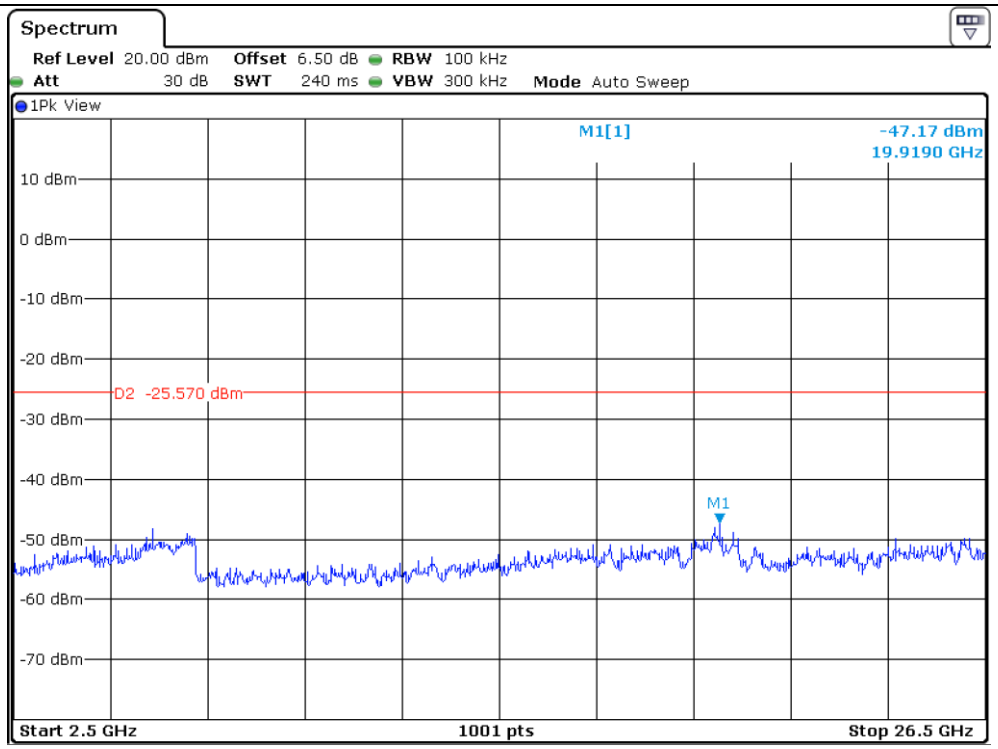


High Channel

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

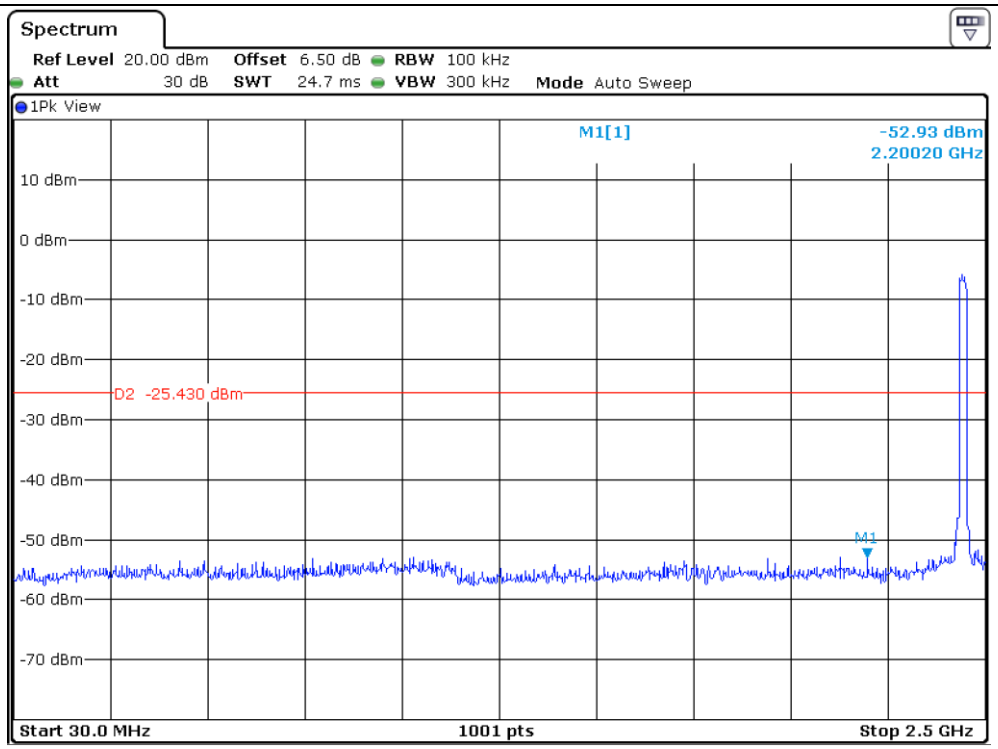


Low Channel

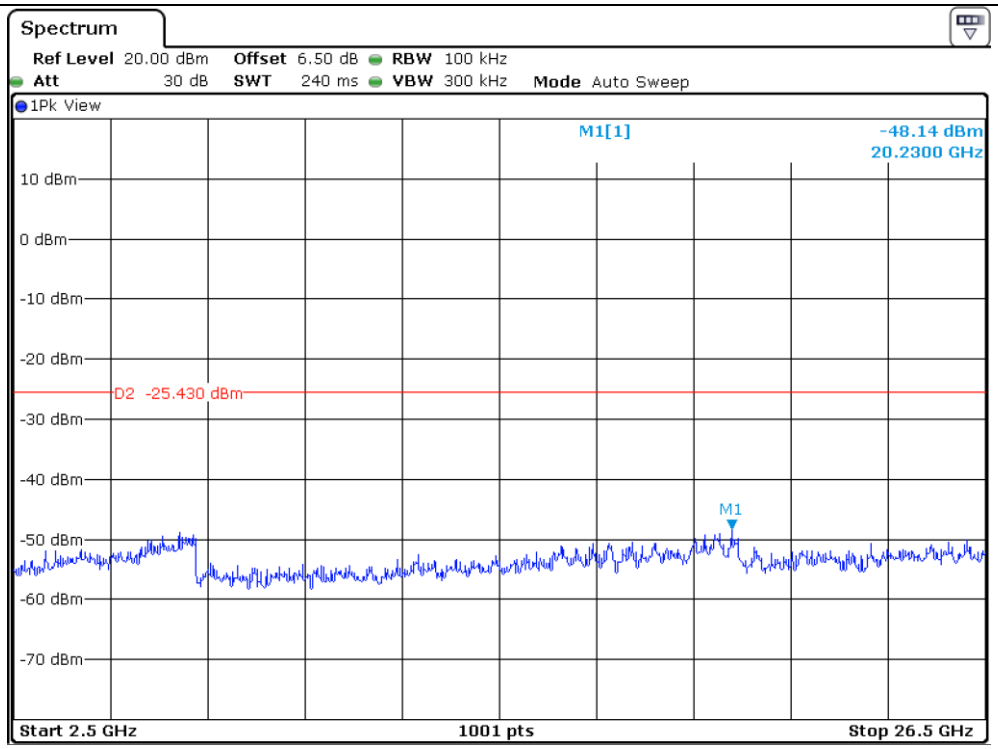


Low Channel

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

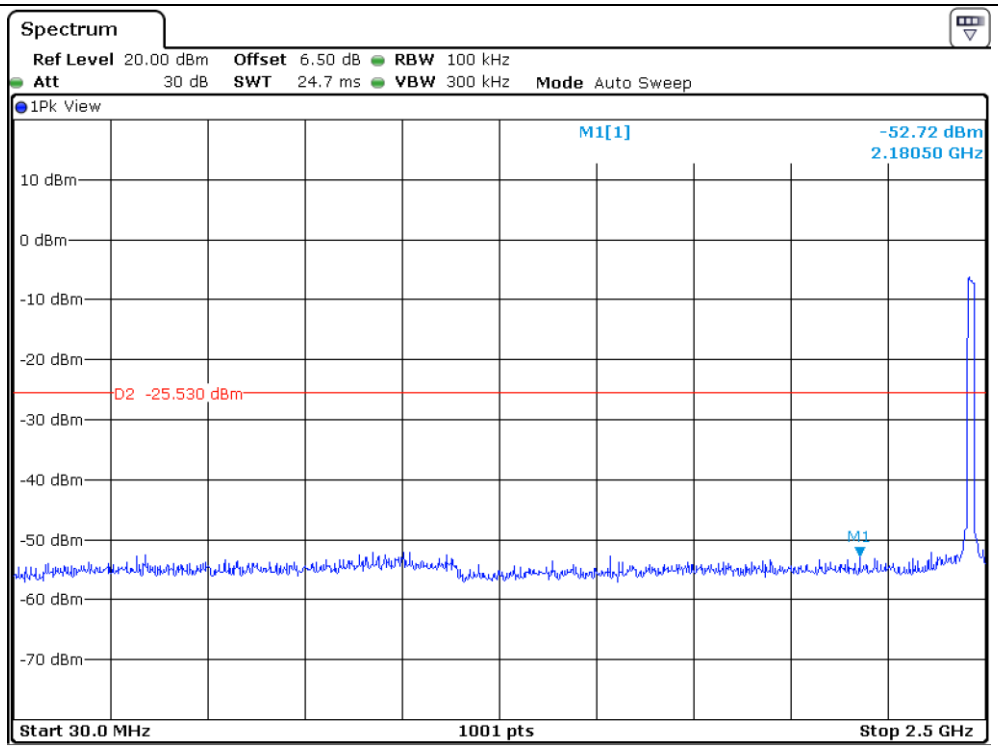


Middle Channel

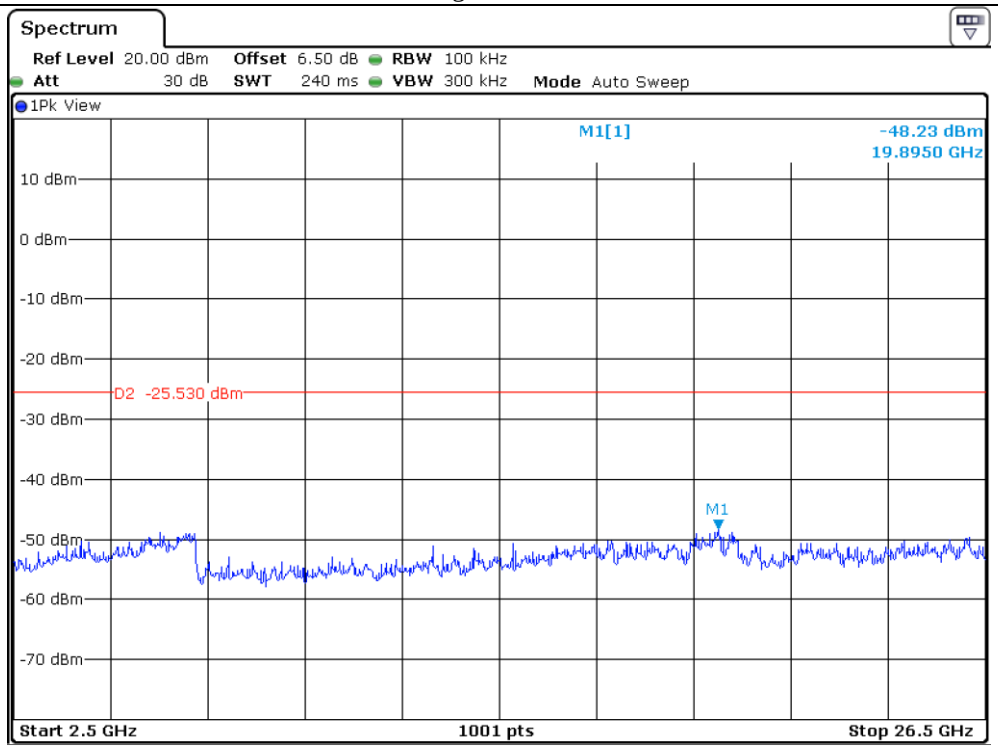


Middle Channel

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



High Channel



High Channel

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

9.6 Test data for radiated emission

9.6.1 Radiated Emission which fall in the Restricted Band

9.6.1.1 Test data for 802.11b WLAN Mode

-. Test Date : May 07, 2019

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

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

-. Detector : Peak Mode(Peak), Average Mode(RMS)

-. Frequency range : 30 MHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 389.48	46.60	Peak	H	27.60	8.80	34.31	48.69	74.00	25.31
2 389.25	36.49	Average	H				38.58	54.00	15.42
2 398.48	45.06	Peak	V				47.15	74.00	26.85
2 371.19	31.97	Average	V				34.06	54.00	19.94
Test Data for High Channel									
2 483.51	53.56	Peak	H	27.80	8.80	34.40	55.76	74.00	18.24
2 484.80	34.20	Average	H				36.40	54.00	17.60
2 483.51	51.61	Peak	V				53.81	74.00	20.19
2 483.51	34.13	Average	V				36.33	54.00	17.67

Tabulated test data for Restricted Band

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

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

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

Tested by: Yu-Seog Sim / Assistant Manager

9.6.1.2 Test data for 802.11g WLAN Mode

-. Test Date : May 07, 2019

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

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

-. Detector : Peak Mode(Peak), Average Mode(RMS)

-. Frequency range : 30 MHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Test Data for Low Channel									
2 389.36	48.24	Peak	H	27.60	8.80	34.31	50.33	74.00	23.67
2 389.94	34.45	Average	H				36.54	54.00	17.46
2 388.90	48.20	Peak	V				50.29	74.00	23.71
2 389.48	33.60	Average	V				35.69	54.00	18.31
Test Data for High Channel									
2 484.40	51.35	Peak	H	27.80	8.80	34.40	53.55	74.00	20.45
2 484.78	37.18	Average	H				39.38	54.00	14.62
2 483.51	49.56	Peak	V				51.76	74.00	22.24
2 483.51	36.84	Average	V				39.04	54.00	14.96

Tabulated test data for Restricted Band

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

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

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

Tested by: Yu-Seog Sim / Assistant Manager

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9.6.1.3 Test data for 802.11n (HT 20) WLAN Mode

-. Test Date : May 07, 2019

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

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

-. Detector : Peak Mode(Peak), Average Mode(RMS)

-. Frequency range : 30 MHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Test Data for Low Channel									
2 389.36	47.08	Peak	H	27.60	8.80	34.31	49.17	74.00	24.83
2 389.83	34.31	Average	H				36.40	54.00	17.60
2 352.20	44.34	Peak	V				46.43	74.00	27.57
2 368.99	32.11	Average	V				34.20	54.00	19.80
Test Data for High Channel									
2 484.20	52.40	Peak	H	27.80	8.80	34.40	54.60	74.00	19.40
2 483.51	37.90	Average	H				40.10	54.00	13.90
2 483.58	51.55	Peak	V				53.75	74.00	20.25
2 483.51	34.91	Average	V				37.11	54.00	16.89

Tabulated test data for Restricted Band

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

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

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

Tested by: Yu-Seog Sim / Assistant Manager

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9.6.2 Spurious & Harmonic Radiated Emission

9.6.2.1 Test data for 802.11b WLAN Mode

-. Test Date : May 07, 2019

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

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

-. Detector : Peak Mode(Peak), Average Mode(RMS)

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 824.00	41.99	Peak	H	31.30	13.30	35.24	51.35	74.00	22.65
	29.15	Average	H				38.51	54.00	15.49
	42.08	Peak	V				51.44	74.00	22.56
	28.98	Average	V				38.34	54.00	15.66
Test Data for Middle Channel									
4 884.00	40.89	Peak	H	31.30	13.50	35.27	50.42	74.00	23.58
	28.32	Average	H				37.85	54.00	16.15
	40.33	Peak	V				49.86	74.00	24.14
	28.14	Average	V				37.67	54.00	16.33
Test Data for High Channel									
4 924.00	41.20	Peak	H	31.10	13.70	35.29	50.71	74.00	23.29
	28.17	Average	H				37.68	54.00	16.32
	40.55	Peak	V				50.06	74.00	23.94
	28.49	Average	V				38.00	54.00	16.00

Tabulated test data for Spurious & Harmonic

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

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

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

Tested by: Yu-Seog Sim / Assistant Manager

9.6.2.2 Test data for 802.11g WLAN Mode

-. Test Date : May 07, 2019

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

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

-. Detector : Peak Mode(Peak), Average Mode(RMS)

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 824.00	42.09	Peak	H	31.30	13.30	35.24	51.45	74.00	22.55
	29.13	Average	H				38.49	54.00	15.51
	41.51	Peak	V				50.87	74.00	23.13
	28.96	Average	V				38.32	54.00	15.68
Test Data for Middle Channel									
4 884.00	40.81	Peak	H	31.30	13.50	35.27	50.34	74.00	23.66
	28.40	Average	H				37.93	54.00	16.07
	39.18	Peak	V				48.71	74.00	25.29
	28.46	Average	V				37.99	54.00	16.01
Test Data for High Channel									
4 924.00	41.54	Peak	H	31.10	13.70	35.29	51.05	74.00	22.95
	28.26	Average	H				37.77	54.00	16.23
	40.69	Peak	V				50.20	74.00	23.80
	28.35	Average	V				37.86	54.00	16.14

Tabulated test data for Spurious & Harmonic

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

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

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

Tested by: Yu-Seog Sim / Assistant Manager

9.6.2.3 Test data for 802.11n (HT 20) WLAN Mode

-. Test Date : May 07, 2019

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

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

-. Detector : Peak Mode(Peak), Average Mode(RMS)

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 824.00	42.04	Peak	H	31.30	13.30	35.24	51.40	74.00	22.60
	28.92	Average	H				38.28	54.00	15.72
	41.49	Peak	V				50.85	74.00	23.15
	29.58	Average	V				38.94	54.00	15.06
Test Data for Middle Channel									
4 884.00	40.26	Peak	H	31.30	13.50	35.27	49.79	74.00	24.21
	28.27	Average	H				37.80	54.00	16.20
	40.12	Peak	V				49.65	74.00	24.35
	28.19	Average	V				37.72	54.00	16.28
Test Data for High Channel									
4 924.00	41.41	Peak	H	31.10	13.70	35.29	50.92	74.00	23.08
	28.13	Average	H				37.64	54.00	16.36
	39.95	Peak	V				49.46	74.00	24.54
	28.75	Average	V				38.26	54.00	15.74

Tabulated test data for Spurious & Harmonic

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

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

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

Tested by: Yu-Seog Sim / Assistant Manager

10. PEAK POWER SPECTRAL DENSITY

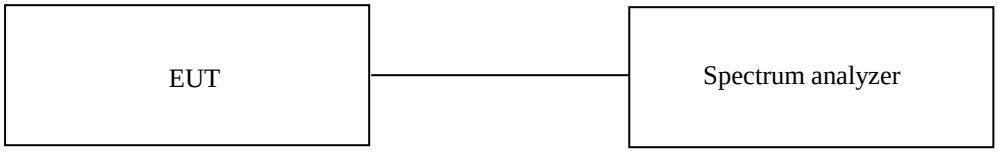
10.1 Operating environment

Temperature : 24 ℃

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, the video bandwidth is set to 3 times the resolution bandwidth.



10.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Aug. 23, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

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10.4 Test data for 802.11b WLAN Mode

-. Test Date : May 15, 2019

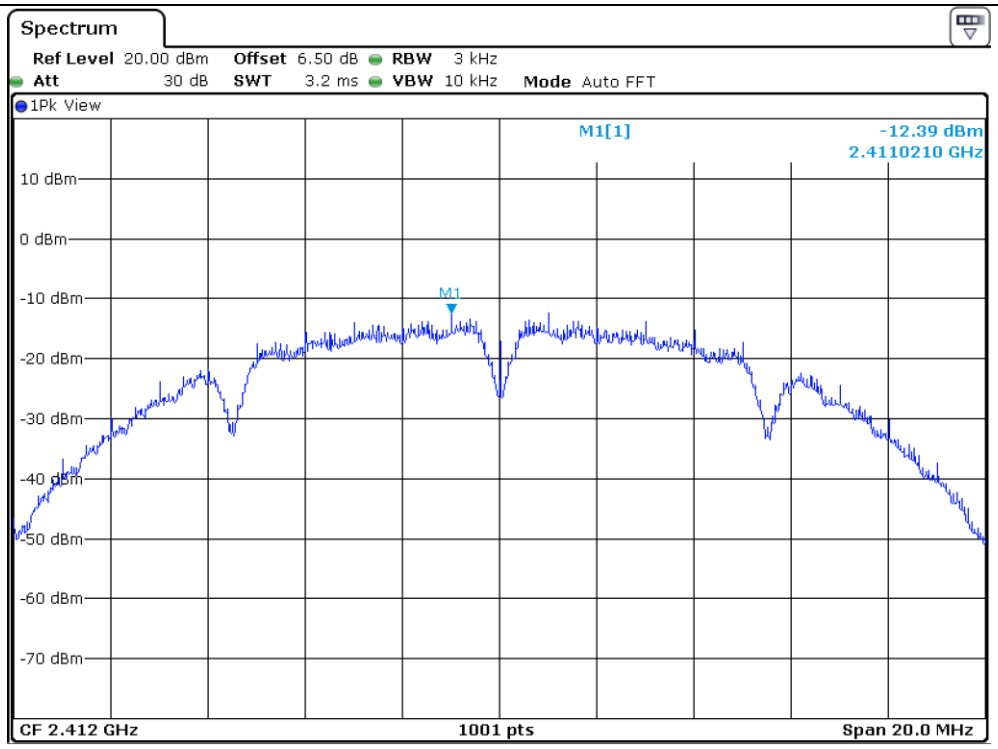
-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-12.39	8.00	20.39
Middle	2 442.00	-13.16	8.00	21.16
High	2 462.00	-14.11	8.00	22.11

Remark. Margin = Limit – Measured value

Tested by: Yu-Seog Sim / Assistant Manager



Low Channel

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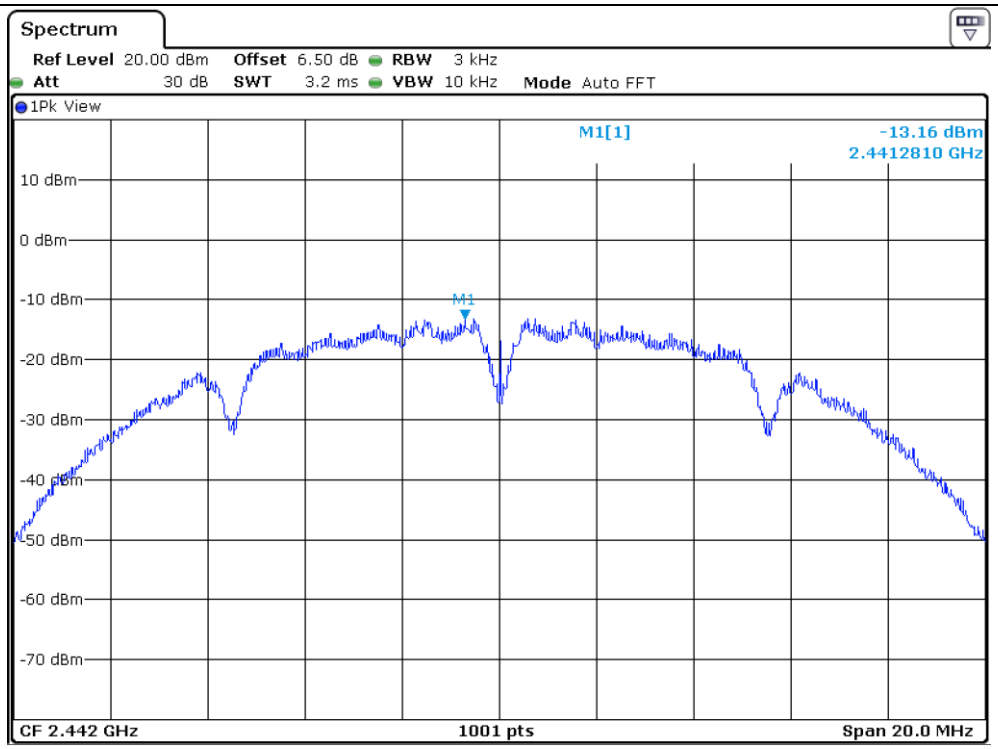
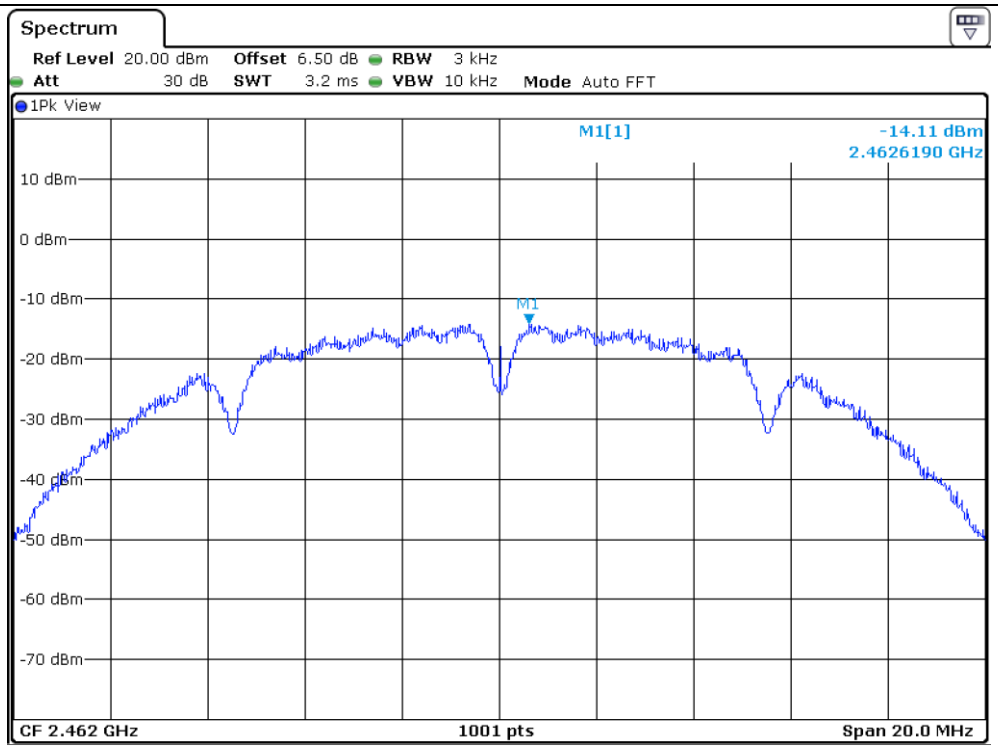


Middle Channel



High Channel

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10.5 Test data for 802.11g WLAN Mode

-. Test Date : May 15, 2019

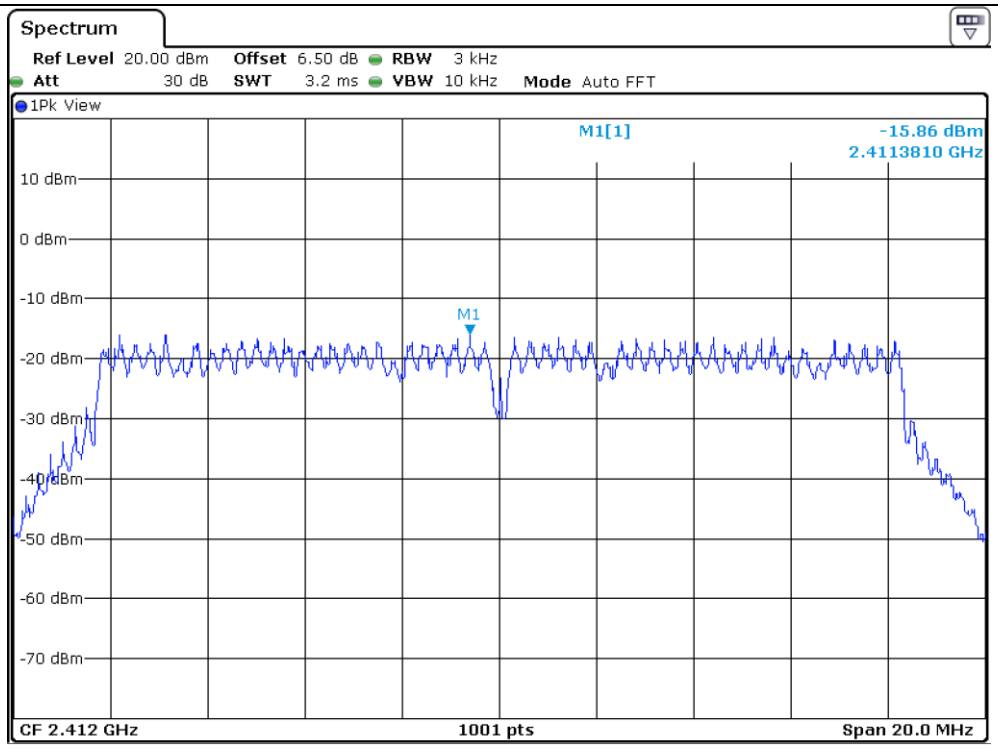
-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-15.86	8.00	23.86
Middle	2 442.00	-15.67	8.00	23.67
High	2 462.00	-14.81	8.00	22.81

Remark. Margin = Limit – Measured value

Tested by: Yu-Seog Sim / Assistant Manager



Low Channel

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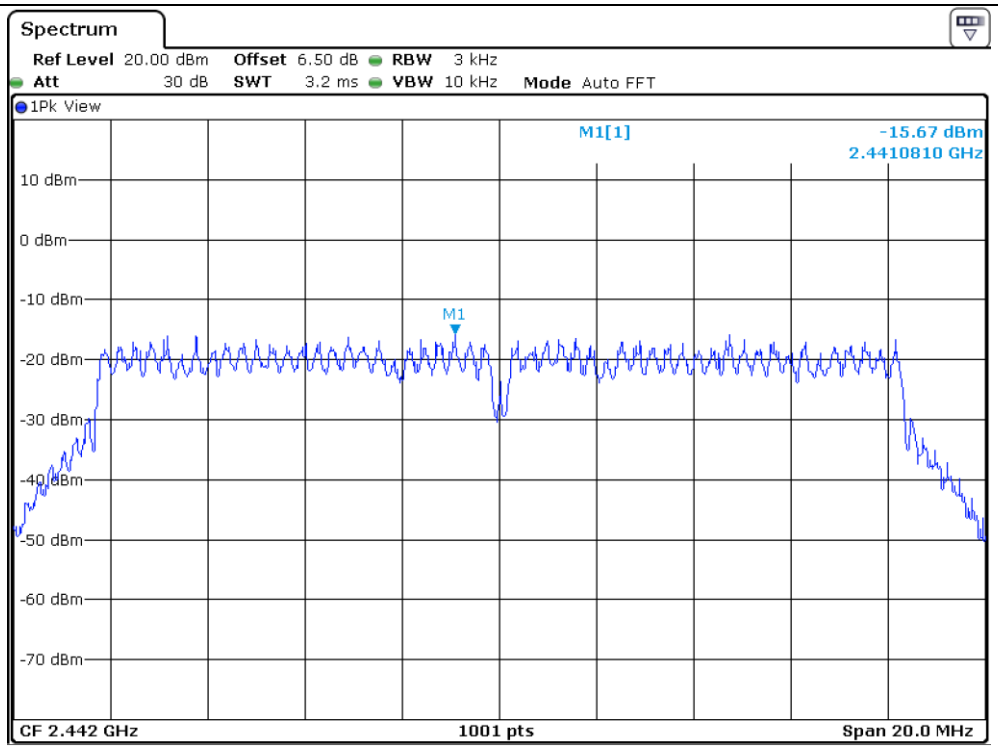
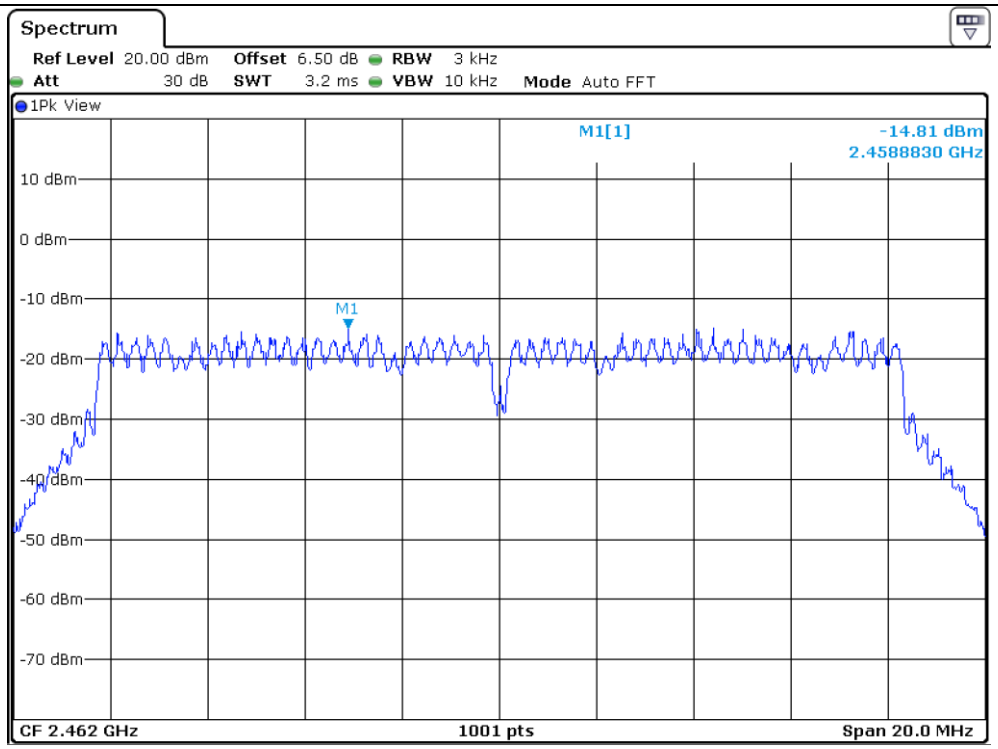


Middle Channel



High Channel

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10.6 Test data for 802.11n (HT20) WLAN Mode

-. Test Date : May 15, 2019

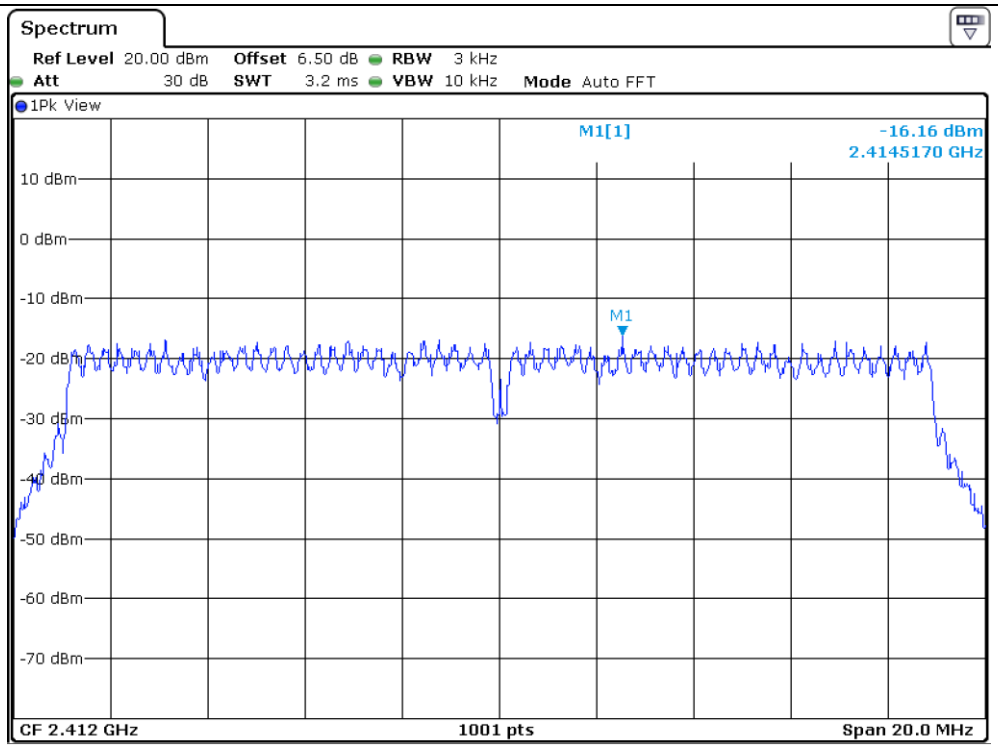
-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-16.16	8.00	24.16
Middle	2 442.00	-15.13	8.00	23.13
High	2 462.00	-16.69	8.00	24.69

Remark. Margin = Limit – Measured value

Tested by: Yu-Seog Sim / Assistant Manager



Low Channel

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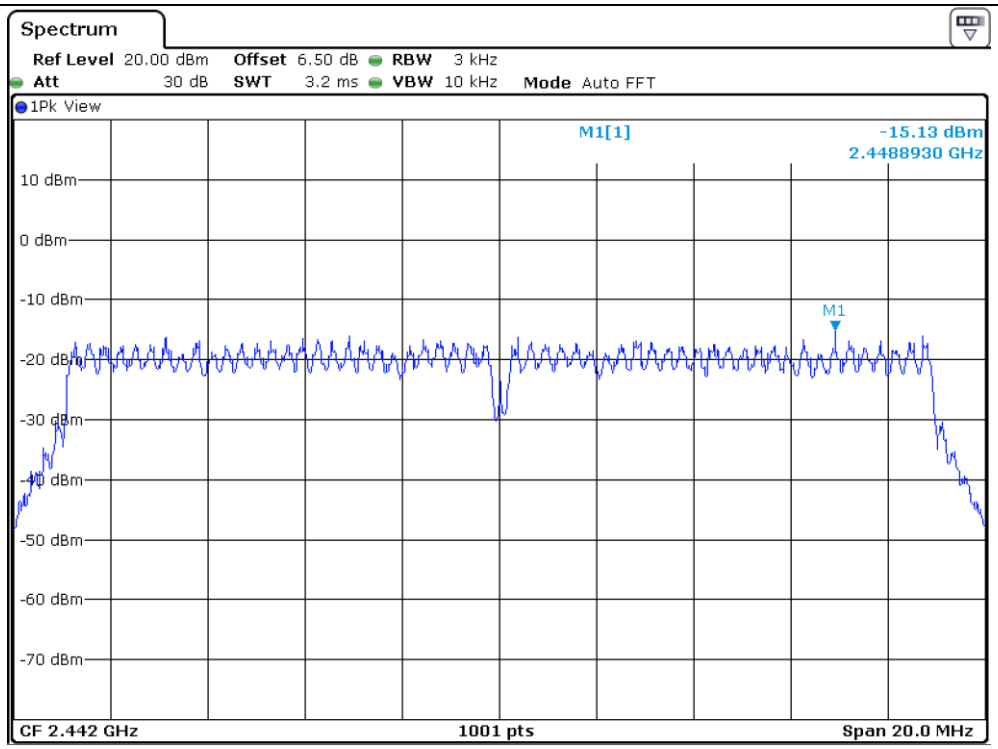
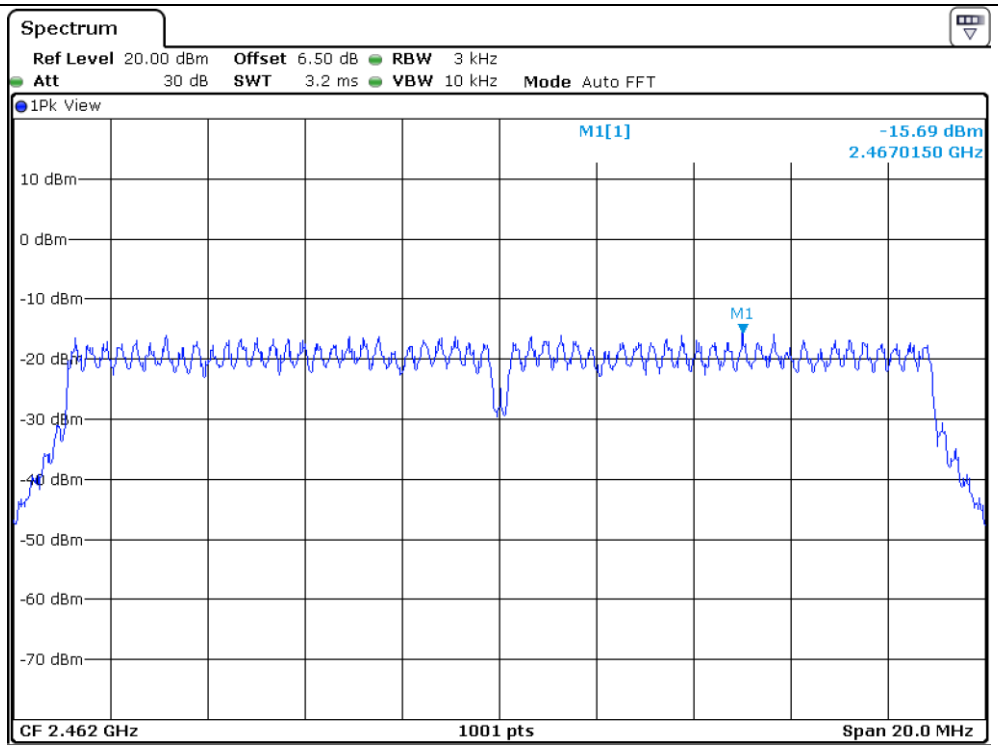


Middle Channel



High Channel

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11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 24 ℃

Relative humidity : 45 % R.H.

11.2 Test set-up

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

The frequency spectrum from 30 MHz to 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.

11.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
☐ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Oct. 22, 2018 (1Y)
■ -	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 22, 2018 (1Y)
☐ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Aug. 23, 2018 (1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Mar. 18, 2019 (1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Aug. 23, 2018 (1Y)
■ -	SCU-18	Rohde & Schwarz	Pre-Amplifier	102266	Aug. 24, 2018 (1Y)
■ -	MA-4000XPET	Innco Systems GmbH	Antenna Master	MA4000/509	N/A
☐ -	HD100	HD GmbH	Position Controller	N/A	N/A
■ -	DT3000-3t	Innco Systems GmbH	Turn Table	N/A	N/A
☐ -	FMZB 1513	Schwarzbeck	LOOP ANTENNA	1513-235	May. 13, 2018 (2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-419	Aug. 09, 2018 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA91700179	Jul. 28, 2017 (2Y)
■ -	BBV 9718 B	Schwarzbeck	Broadband Preamplifier	009	Mar. 11, 2019(1Y)

All test equipment used is calibrated on a regular basis.

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11.4 Test data for 30 MHz ~ 1 GHz

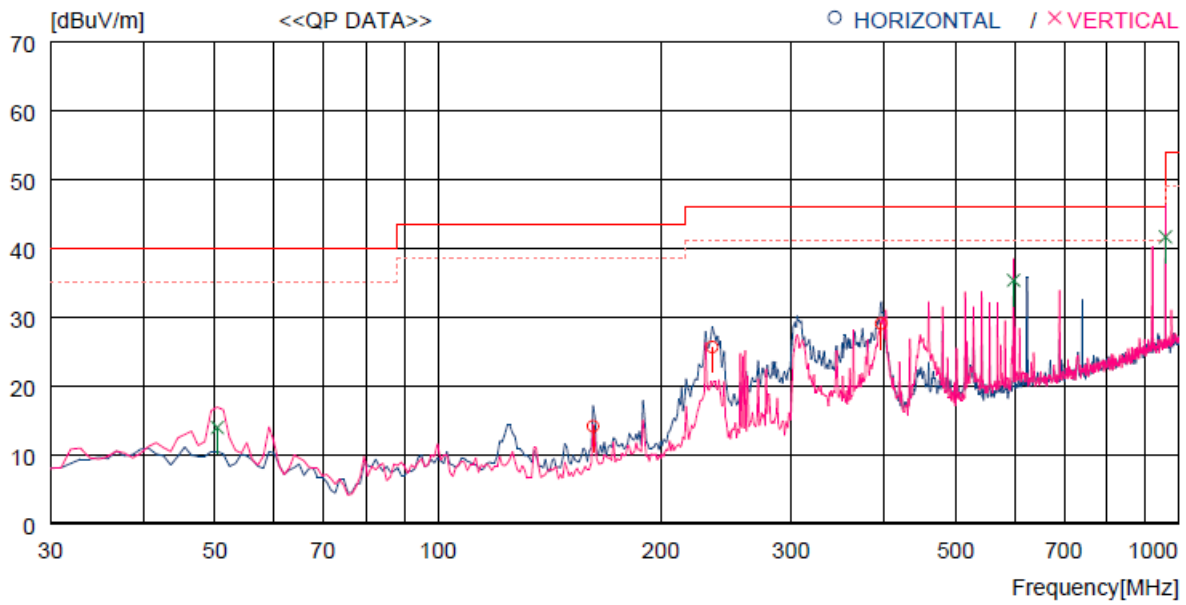
-. Test Date : May 07, 2019

-. Resolution bandwith : 120 kHz

-. Frequency range : 30 MHz ~ 1 GHz

-. Measurement distance : 3 m

-.Operating mode : Transmitting mode (NFC & WLAN)



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	161.920	35.0	**8.8**	3.3	33.0	14.1	43.5	29.4	200	359
2	234.670	42.6	**12.1**	4.0	33.1	25.6	46.0	20.4	100	348
3	396.660	41.2	**15.8**	5.2	33.2	29.0	46.0	17.0	100	0
----- Vertical ------										
4	50.370	31.0	**14.1**	1.9	33.1	13.9	40.0	26.1	200	0
5	598.418	42.8	**19.4**	6.4	33.3	35.3	46.0	10.7	100	7
6	960.217	42.1	**23.3**	8.2	32.0	41.6	54.0	12.4	100	349

Tested by: Yu-Seog Sim / Assistant Manager

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11.5 Test data for Below 30 MHz

-. Test Date : May 07, 2019

-. 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 (NFC & WLAN)

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)
All emissions observed were 20dB below the limit and thus not reported.									

11.6 Test data for above 1 GHz

-. Test Date : May 07, 2019

-. 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 (NFC & WLAN)

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)
All emissions observed were 20dB below the limit and thus not reported.									

Tested by: Yu-Seog Sim / Assistant Manager

12. CONDUCTED EMISSION TEST

12.1 Operating environment

Temperature : 24 ℃

Relative humidity : 45 % R.H

12.2 Test set-up

The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a 5 0 Ω / 50 μH + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the referenc e ground system and all power lines were filtered from ambient.

12.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	ESCI	Rohde & Schwarz	Test Receiver	101420	Mar. 28, 2019 (1Y)
■ -	3825/2	EMCO	AMN	9109-1867	Mar. 27, 2019 (1Y)
■ -	NSLK8126	Schwarzbeck	LISN	8126-480	Oct. 22, 2018 (1Y)
■ -	11947A	Hewlett Packard	Transient Limiter	3107A02762	Mar. 28, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

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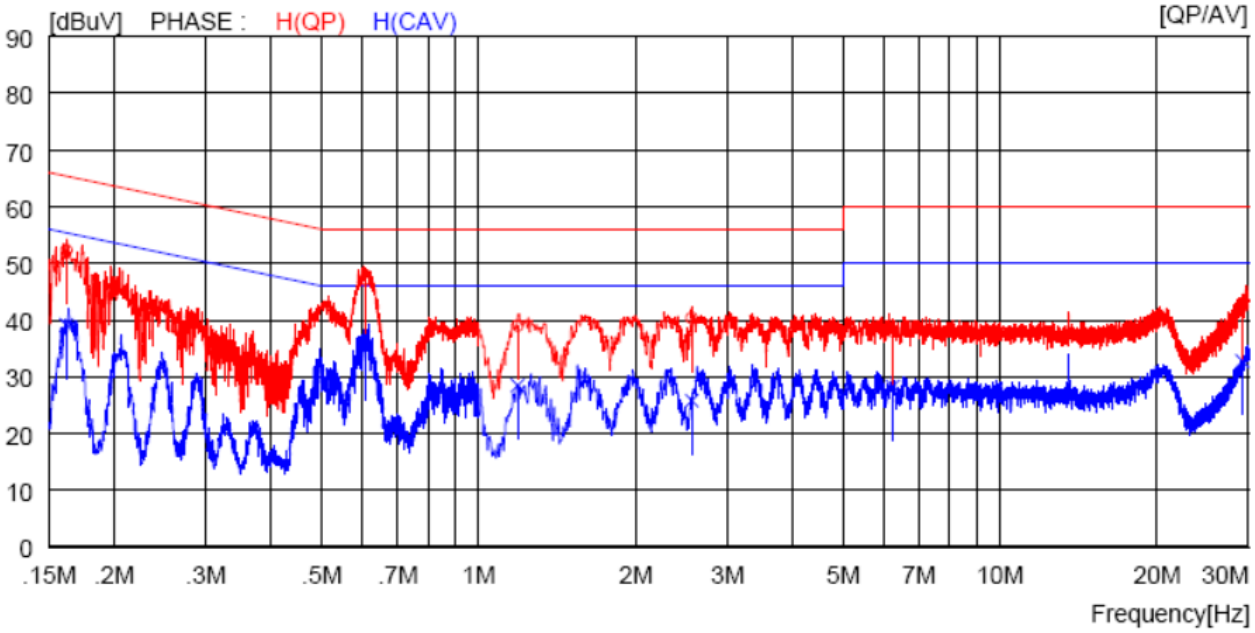
12.4 Test data

-. Test Date : May 21, 2019

-. Resolution bandwidth : 9 kHz

-. Frequency range : 0.15 MHz ~ 30 MHz

-. Tested Line : HOT LINE



NO	FREQ [MHz]	READING QP [dBuV]	READING AV [dBuV]	C.FACTOR [dB]	RESULT QP [dBuV]	RESULT AV [dBuV]	LIMIT QP [dBuV]	LIMIT AV [dBuV]	MARGIN QP [dBuV]	MARGIN AV [dBuV]	PHASE
1	0.16200	42.2	----	10.1	52.3	----	65.4	----	13.1	----	H(QP)
2	0.60600	37.1	----	10.1	47.2	----	56.0	----	8.8	----	H(QP)
3	1.18800	28.9	----	10.1	39.0	----	56.0	----	17.0	----	H(QP)
4	2.56400	30.3	----	10.1	40.4	----	56.0	----	15.6	----	H(QP)
5	6.22500	27.9	----	10.2	38.1	----	60.0	----	21.9	----	H(QP)
6	29.20000	31.8	----	10.6	42.4	----	60.0	----	17.6	----	H(QP)
7	0.16200	----	29.1	10.1	----	39.2	----	55.4	----	16.2	H(CAV)
8	0.60600	----	25.3	10.1	----	35.4	----	46.0	----	10.6	H(CAV)
9	1.18800	----	18.4	10.1	----	28.5	----	46.0	----	17.5	H(CAV)
10	2.56400	----	15.7	10.1	----	25.8	----	46.0	----	20.2	H(CAV)
11	6.22500	----	18.1	10.2	----	28.3	----	50.0	----	21.7	H(CAV)
12	29.20000	----	22.2	10.6	----	32.8	----	50.0	----	17.2	H(CAV)

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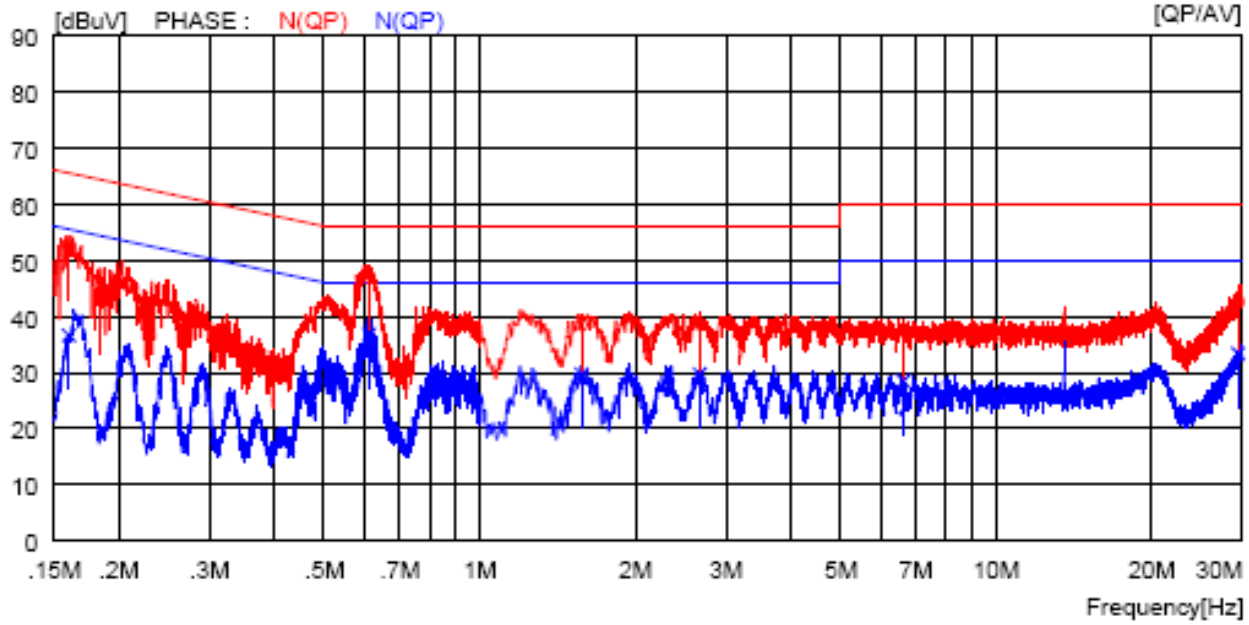
-. Tested Line : NEUTRAL LINE



NO	FREQ [MHz]	READING QP [dBuV]	READING AV [dBuV]	C.FACTOR [dB]	RESULT QP [dBuV]	RESULT AV [dBuV]	LIMIT QP [dBuV]	LIMIT AV [dBuV]	MARGIN QP [dBuV]	MARGIN AV [dBuV]	PHASE
1	0.16000	42.4	----	10.1	52.5	----	65.5	----	13.0	----	N(QP)
2	0.61100	36.9	----	10.1	47.0	----	56.0	----	9.0	----	N(QP)
3	1.57600	28.3	----	10.1	38.4	----	56.0	----	17.6	----	N(QP)
4	2.66400	28.5	----	10.1	38.6	----	56.0	----	17.4	----	N(QP)
5	6.61500	27.2	----	10.2	37.4	----	60.0	----	22.6	----	N(QP)
6	29.45000	31.9	----	10.6	42.5	----	60.0	----	17.5	----	N(QP)
7	0.16000	----	26.5	10.1	----	36.6	----	55.5	----	18.9	N(CAV)
8	0.61100	----	26.7	10.1	----	36.8	----	46.0	----	9.2	N(CAV)
9	1.57600	----	19.6	10.1	----	29.7	----	46.0	----	16.3	N(CAV)
10	2.66400	----	19.6	10.1	----	29.7	----	46.0	----	16.3	N(CAV)
11	6.61500	----	18.3	10.2	----	28.5	----	50.0	----	21.5	N(CAV)
12	29.45000	----	22.8	10.6	----	33.4	----	50.0	----	16.6	N(CAV)

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

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

Tested by: Yu-Seog Sim / Assistant Manager

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