


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

**Test Report No.** : OT-18N-RWD-050  
**AGR No.** : A18NA-143  
**Applicant** : Samsung Electronics Co Ltd  
**Address** : 19 Chapin Rd., Building D, Pine Brook, New Jersey, 07058, United States  
**Manufacturer** : Samsung Electronics Co Ltd  
**Address** : Maetan dong 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do 16677, Korea  
**Type of Equipment** : Wi-Fi/BT Transceiver  
**FCC ID.** : A3LWCP731M  
**Model Name** : WCP731M  
**Serial number** : N/A  
**Total page of Report** : 166 pages (including this page)  
**Date of Incoming** : November 19, 2018  
**Date of issue** : November 29, 2018

## SUMMARY

The equipment complies with the regulation; *FCC PART 15 SUBPART C Section 15.247*  
 This test report only contains the result of a single test of the sample supplied for the examination.  
 It is not a generally valid assessment of the features of the respective products of the mass-production.

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

Approved by:   
 \_\_\_\_\_  
 Keun-Young, Choi / Vice President  
 ONETECH Corp.

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**Revision History**

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-18N-RWD-050	2018.11.29	Initial Release	All

## 1. VERIFICATION OF COMPLIANCE

Applicant : Samsung Electronics Co Ltd

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

Manufacturer : Samsung Electronics Co Ltd

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

Factory 1 : WISOL HA NOI COMPANY LIMITED

Address : No. 26, Street 05, Vsip Bac Ninh Industrial Park, Phu Chan Communt, Tu Son Town, Bac Ninh Province, Viet Nam.

Factory 2 : Shenzhen Zowee Technology Co., Ltd.

Address : Floor 5 & 6, Block 5, Science & Technology Park of Privately Owned Enterprises, Pingshan, Xili, Nanshan District, Shenzhen, Guangdong Province, P.R. China

Contact Person : minhyung cho / Senior Engineer

Telephone No. : +82-31-277-2688

FCC ID : A3LWCP731M

Model Name : WCP731M

Brand Name : 

Serial Number : N/A

Date : November 29, 2018

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Modular Transmitter, Wi-Fi/BT 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 DTS Meas Guidance v05
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.

## 2. TEST SUMMARY

### 2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (2)	Minimum 6 dB Bandwidth	Met the Limit / PASS
15.247 (b) (3)	Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247 (d)	100 kHz Bandwidth Outside the Frequency Band	Met the Limit / PASS
15.247 (d)	Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.247 (e)	Peak Power Spectral Density	Met the Limit / PASS
15.209	Radiated Emission Limits	Met the Limit / PASS
15.207	Conducted Limits	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 Samsung Electronics Co Ltd, Model WCP731M (referred to as the EUT in this report) is a Wi-Fi/BT Transceiver. The product specification described herein was obtained from product data sheet or user’s manual.

DEVICE TYPE	Wi-Fi/BT Transceiver			
Temperature Range	-20 °C ~ 50 °C			
OPERATING FREQUENCY	Bluetooth LE	2 402 MHz ~ 2 480 MHz		
	Bluetooth	2 402 MHz ~ 2 480 MHz		
	WLAN 2.4 GHz	2 412 MHz ~ 2 472 MHz (802.11b/g/n(HT20))		
2 422 MHz ~ 2 462 MHz (802.11n(HT40))				
MODULATION TYPE	Bluetooth LE	GFSK		
	Bluetooth	GFSK for 1Mbps, $\pi/4$ -DQPSK for 2Mbps, 8-DPSK for 3Mbps		
	WLAN 2.4 GHz	802.11b: DSSS Modulation(DBPSK/DQPSK/CCK) 802.11g/n(HT20)/n(HT40): OFDM Modulation(BPSK/QPSK/16QAM/64QAM)		
RF OUTPUT POWER'	Bluetooth LE	1 Mbps	10.10 dBm	
		2 Mbps	10.05 dBm	
	Bluetooth	1 Mbps	10.06 dBm	
		2 Mbps	9.29 dBm	
		3 Mbps	9.35 dBm	
	WLAN 2.4 GHz	Antenna 0	22.23 dBm(802.11b) 17.70 dBm(802.11g) 17.12 dBm(802.11n_HT20) 14.34 dBm(802.11n_HT40)	
			Antenna 1	22.68 dBm(802.11b) 18.20 dBm(802.11g) 17.54 dBm(802.11n_HT20) 15.04 dBm(802.11n_HT40)
		Multiple Antenna		20.97 dBm(802.11g) 20.35 dBm(802.11n_HT20) 17.71 dBm(802.11n_HT40)

MODULATION TYPE	Bluetooth LE	GFSK	
	Bluetooth	GFSK for 1Mbps, $\pi/4$ -DQPSK for 2Mbps, 8-DPSK for 3Mbps	
	WLAN 2.4 G	DSSS Modulation(DBPSK/DQPSK/CCK) OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
ANTENNA TYPE	Metal Antenna		
ANTENNA GAIN	Bluetooth LE	-1.12 dBi	
	Bluetooth		
	WLAN 2.4 GHz	Antenna 0	1.10 dBi
		Antenna 1	2.85 dBi
Multiple Antenna		5.07 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

## 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	WCP731M	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
WCP731M	Samsung Electronics Co Ltd	Wi-Fi/BT Transceiver (EUT)	
HP Pavilion g series	HP	Notebook PC	EUT
PPP009C	LIE-ON TECHNOLOGY (CHANGZHOU)CO.,LTD.	AC Adapter	

### 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.

Modulation	DATA RATE	OUTPUT POWER[dBm]	
		Antenna 0	Antenna 1
802.11 b (Middle Channel)	1 Mbps	22.16	22.20
	2 Mbps	22.02	22.13
	5.5 Mbps	21.88	22.03
	11 Mbps	21.77	21.97
802.11g (Middle Channel)	6 Mbps	17.48	18.16
	9 Mbps	17.36	18.10
	12 Mbps	17.22	18.02
	18 Mbps	17.09	17.88
	24 Mbps	17.03	17.78
	36 Mbps	16.89	17.63
	48 Mbps	16.84	17.58
	54 Mbps	16.77	17.53
HT 20 (Middle Channel)	6.5 Mbps	16.88	16.94
	13 Mbps	16.73	16.80
	19.5 Mbps	16.64	16.68
	26 Mbps	16.56	16.61
	39 Mbps	16.42	16.53
	52 Mbps	16.27	16.42
	58.5 Mbps	16.21	16.36
	65 Mbps	16.15	16.24
HT 40 (Middle Channel)	13.5 Mbps	13.36	13.60
	27 Mbps	13.24	13.50
	40.5 Mbps	13.11	13.39
	54 Mbps	12.97	13.33
	81 Mbps	12.91	13.24
	108 Mbps	12.77	13.18
	121.5 Mbps	12.63	13.06
	135 Mbps	12.56	12.93

-. 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.

## 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

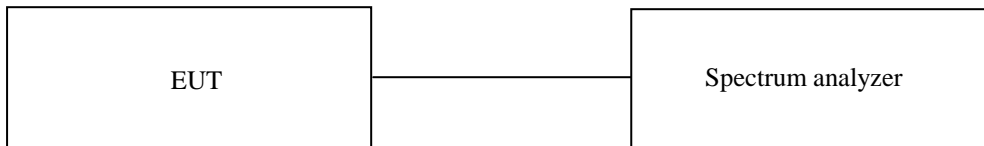
## 7. MIMIMUM 6 dB BANDWIDTH

### 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 equipment used

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

All test equipment used is calibrated on a regular basis.

### 7.4 Test data for 802.11b WLAN Mode

#### 7.4.1 Test data for Antenna 0

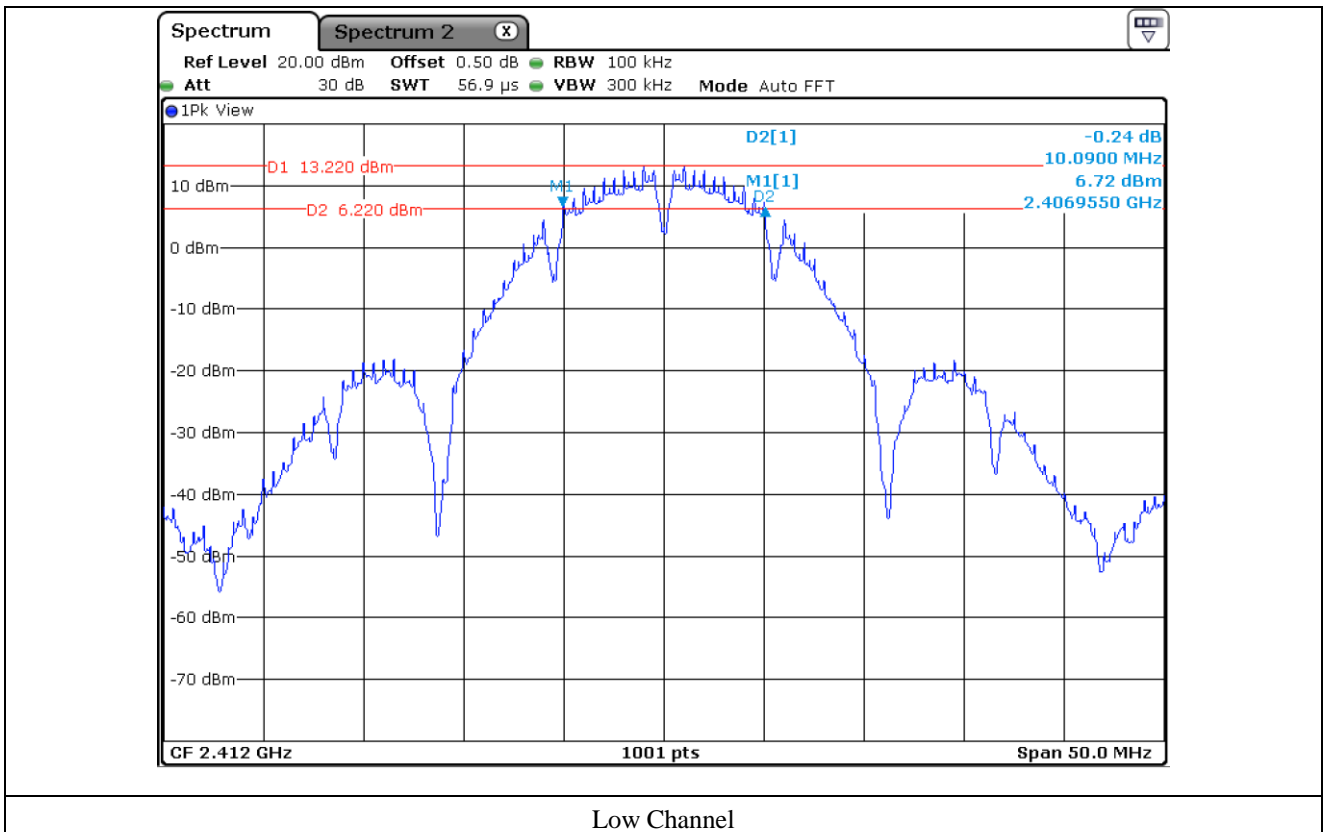
-. Test Date : November 21, 2018 ~ November 23, 2018

-. Test Result : Pass

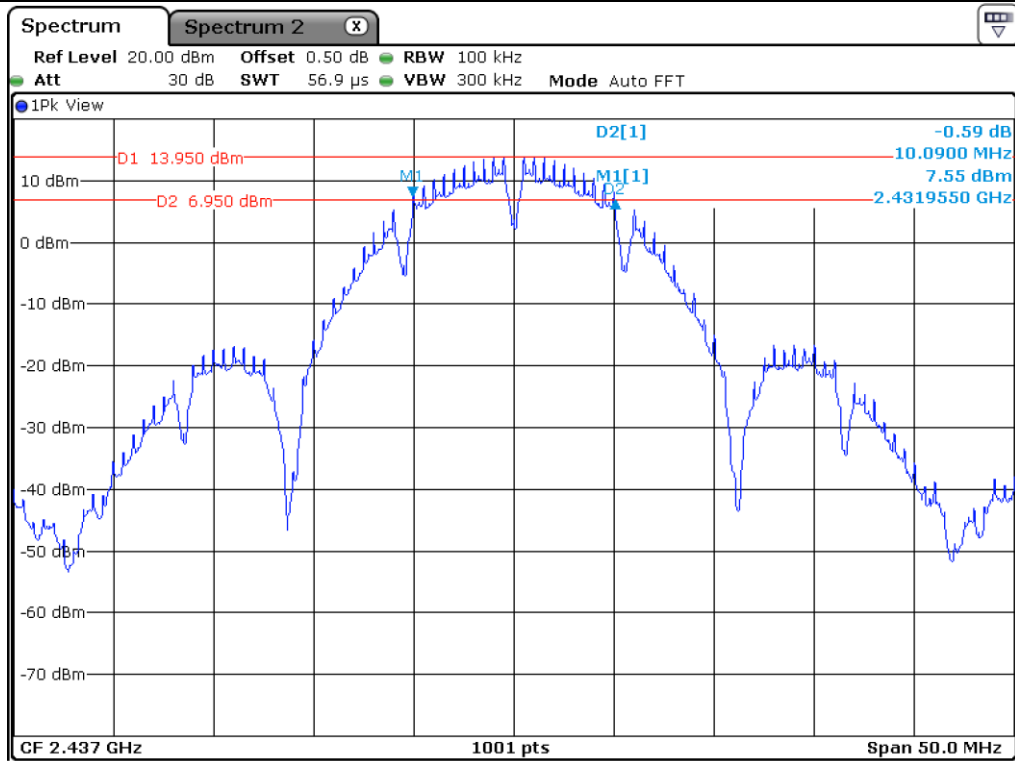
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	10.09	0.50	9.59
Middle	2 437.00	10.09	0.50	9.59
High 11	2 462.00	10.09	0.50	9.59
High 12	2 467.00	9.04	0.50	8.54
High 13	2 472.00	9.09	0.50	8.59

Remark. Margin = Measured Value - Limit

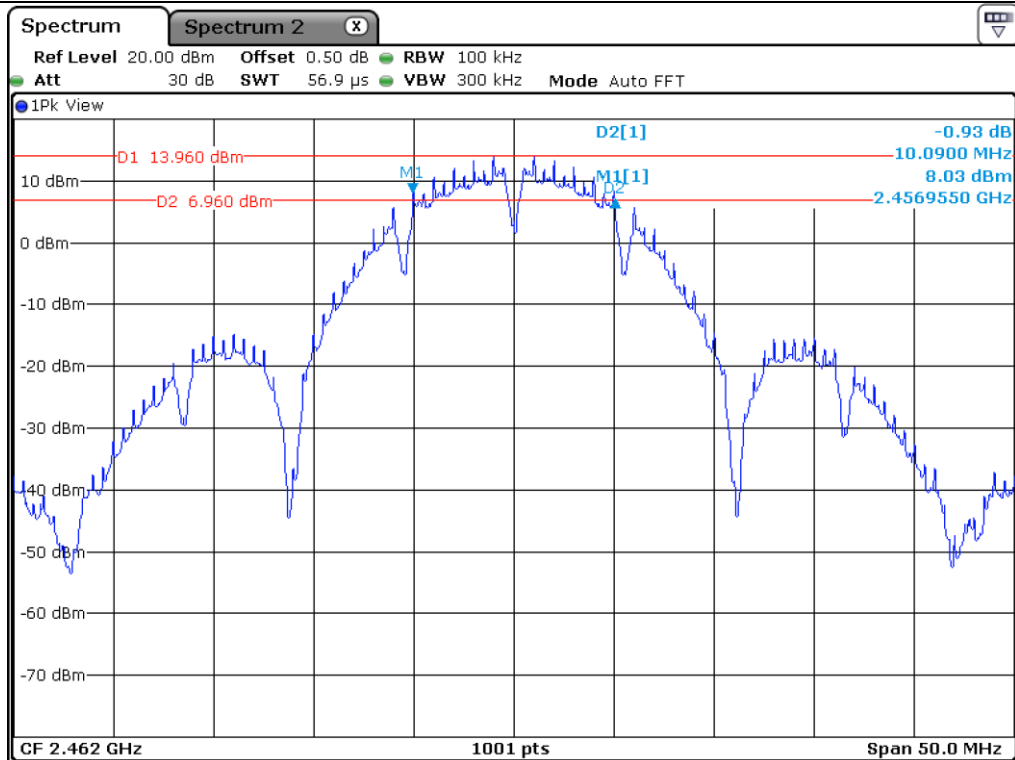
Tested by: Tae-Ho, Kim / Senior Manager



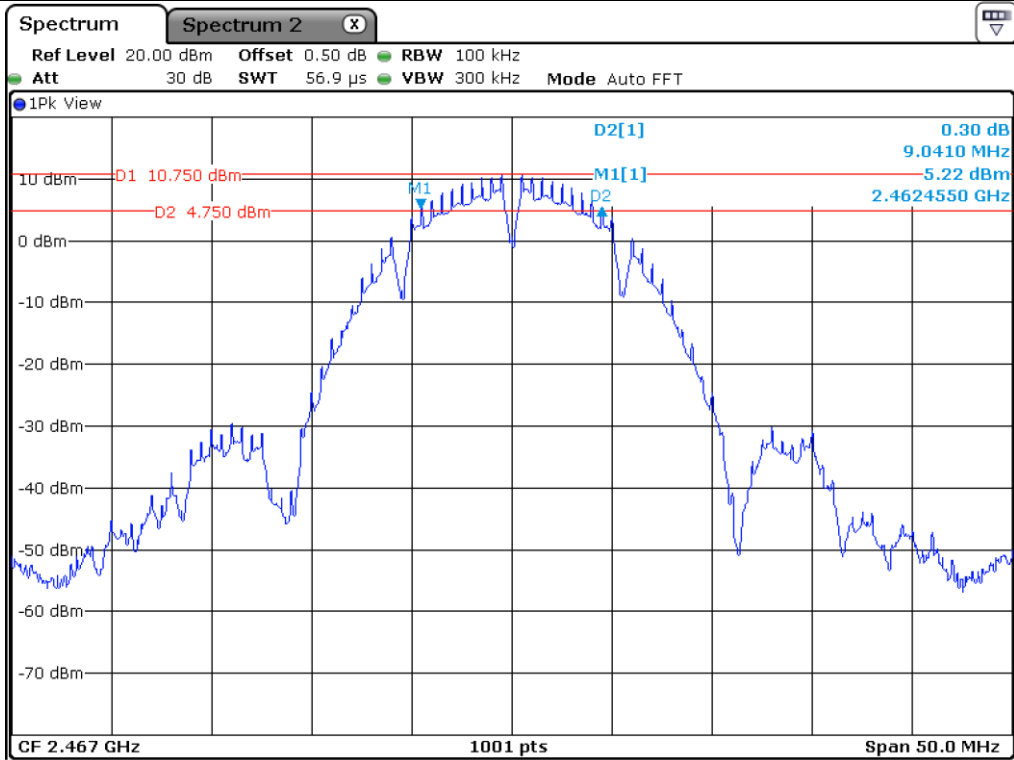




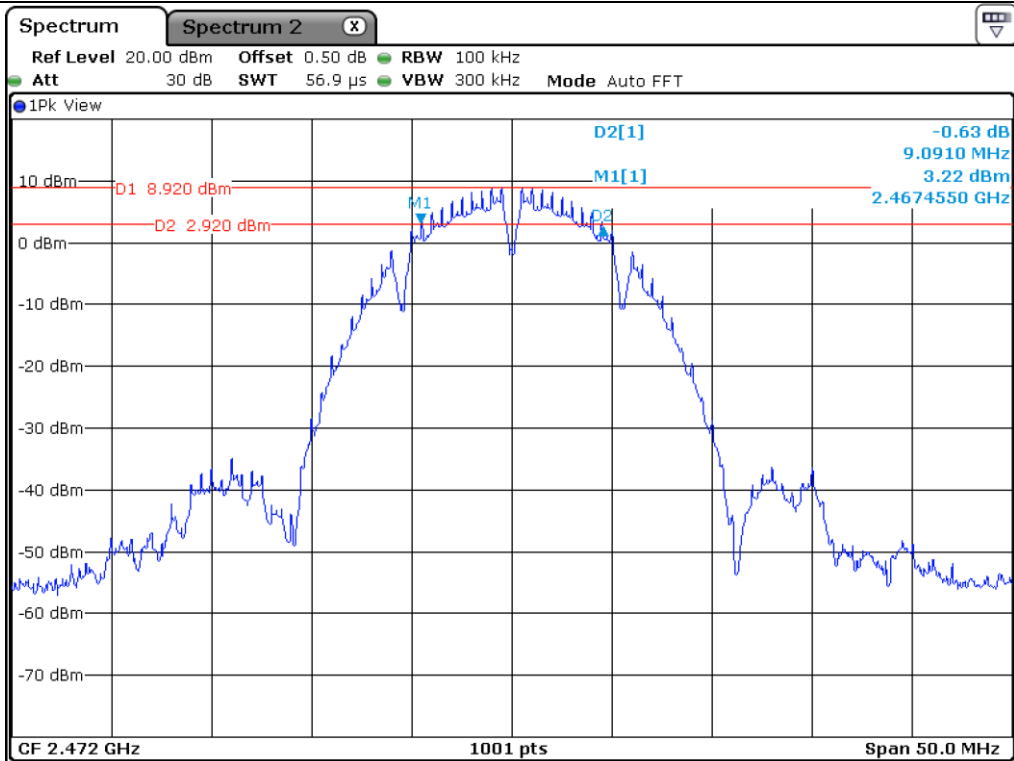
Middle Channel



High Channel 11



High Channel 12



High Channel 13

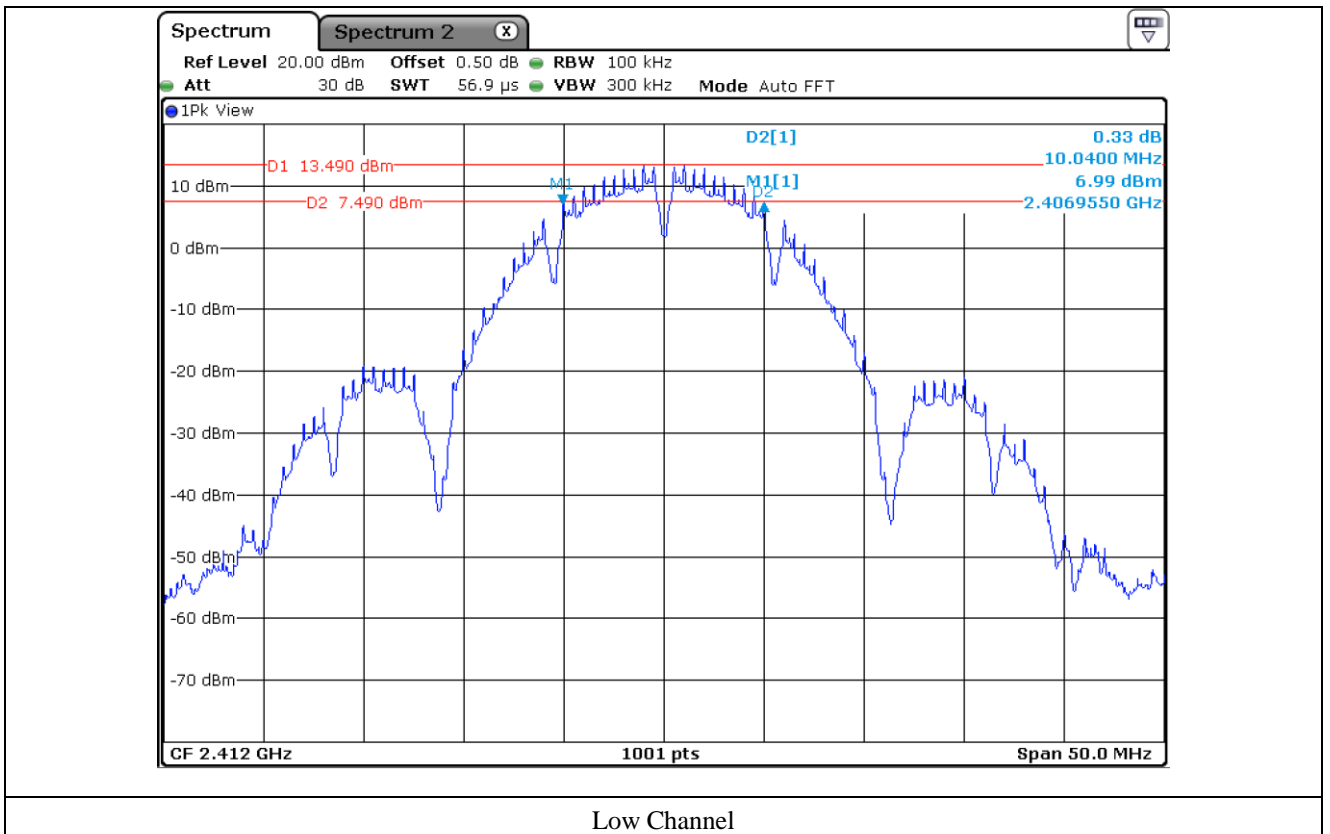
**7.4.2 Test data for Antenna 1**

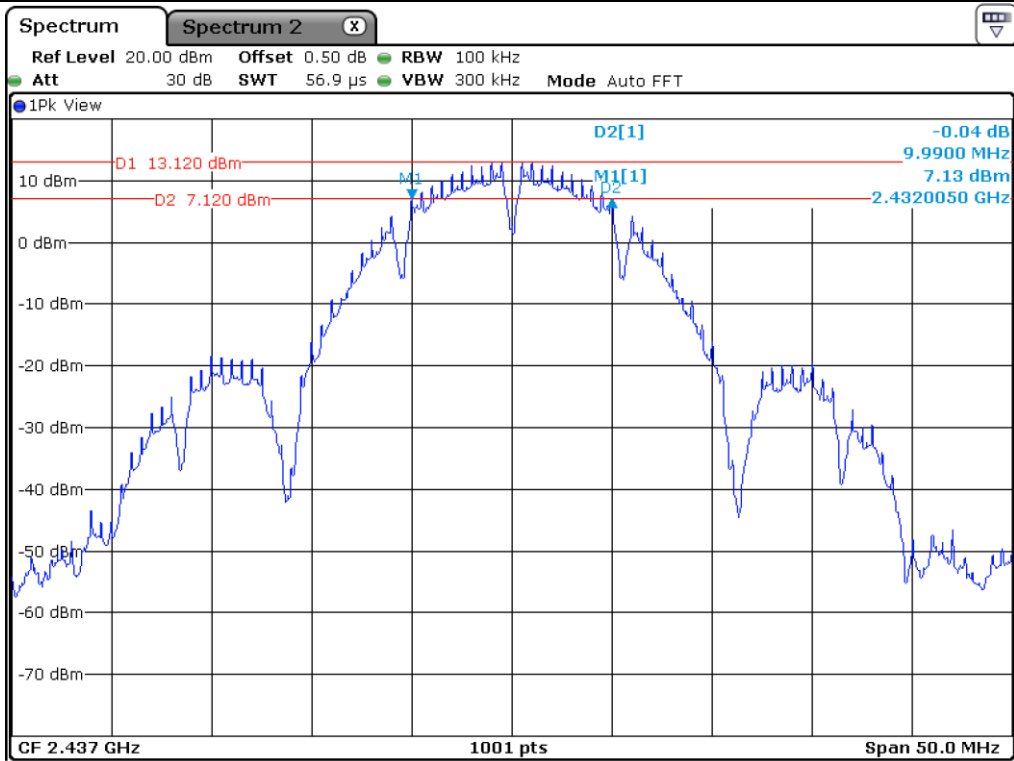
- Test Date : November 21, 2018 ~ November 23, 2018
- Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	10.04	0.50	9.54
Middle	2 437.00	9.99	0.50	9.49
High 11	2 462.00	9.54	0.50	9.04
High 12	2 467.00	9.09	0.50	8.59
High 13	2 472.00	9.49	0.50	8.99

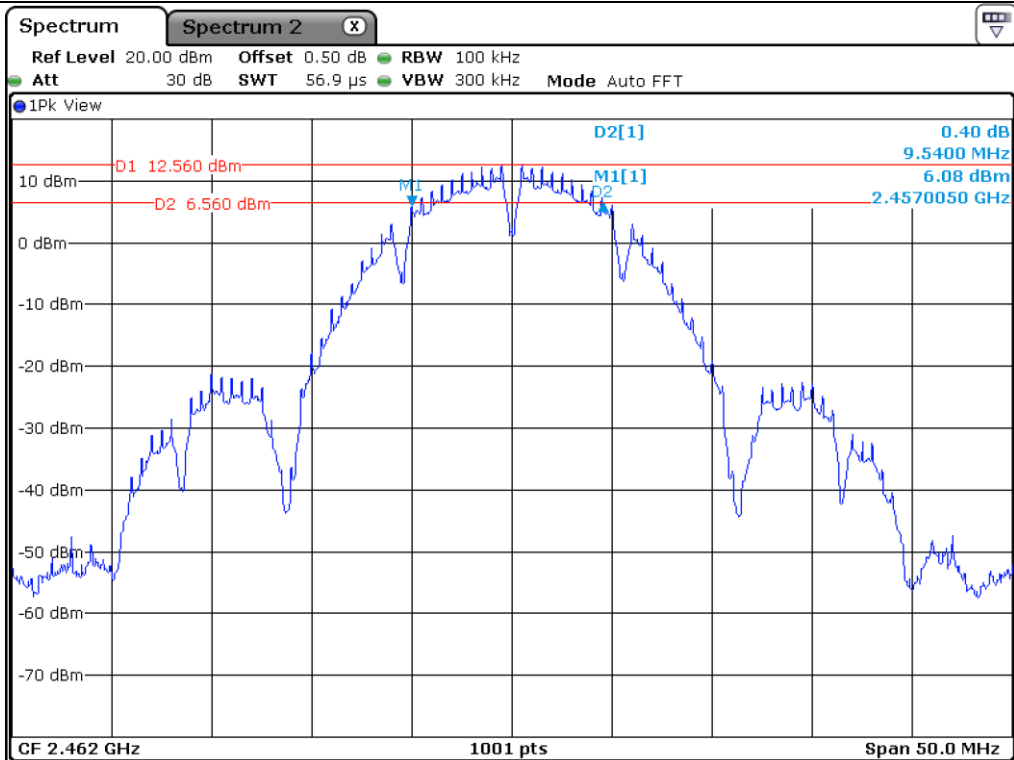
Remark. Margin = Measured Value - Limit

Tested by: Tae-Ho, Kim / Senior Manager

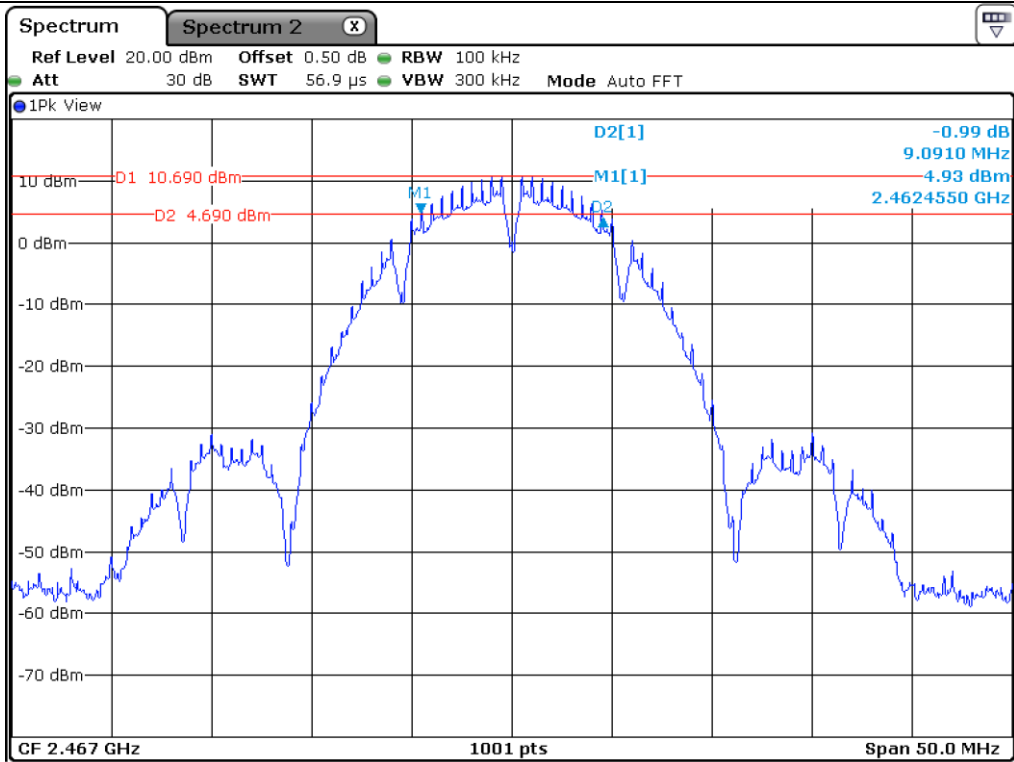




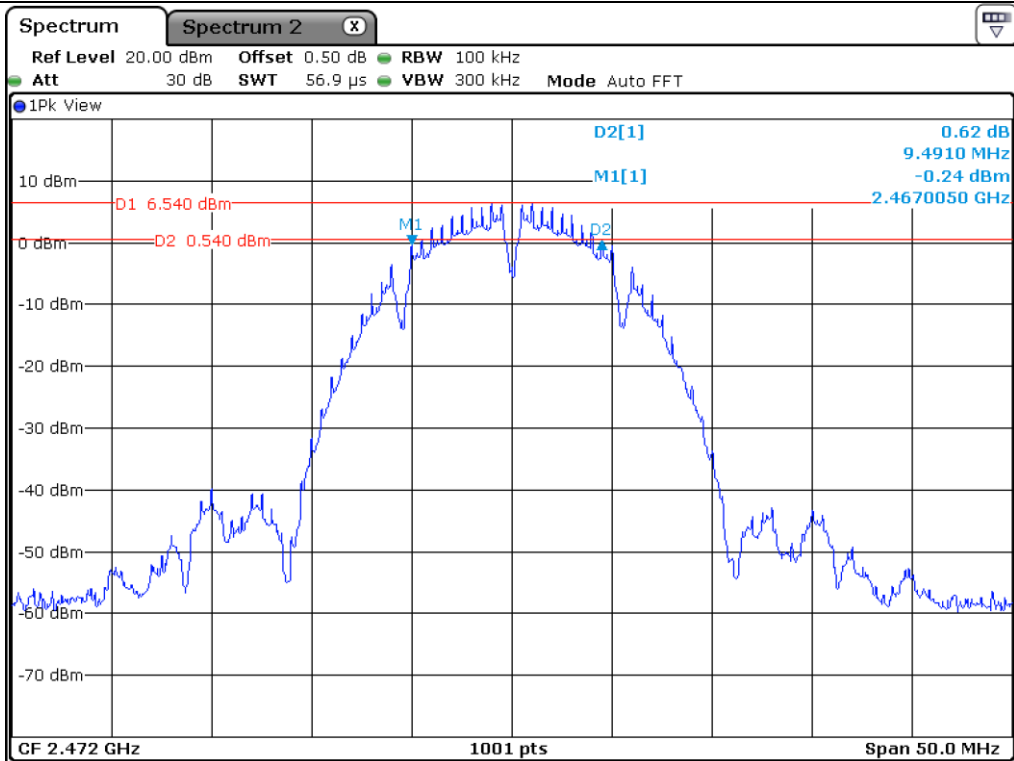
Middle Channel



High Channel 11



High Channel 12



High Channel 13

### 7.5 Test data for 802.11g WLAN Mode

#### 7.5.1 Test data for Antenna 0

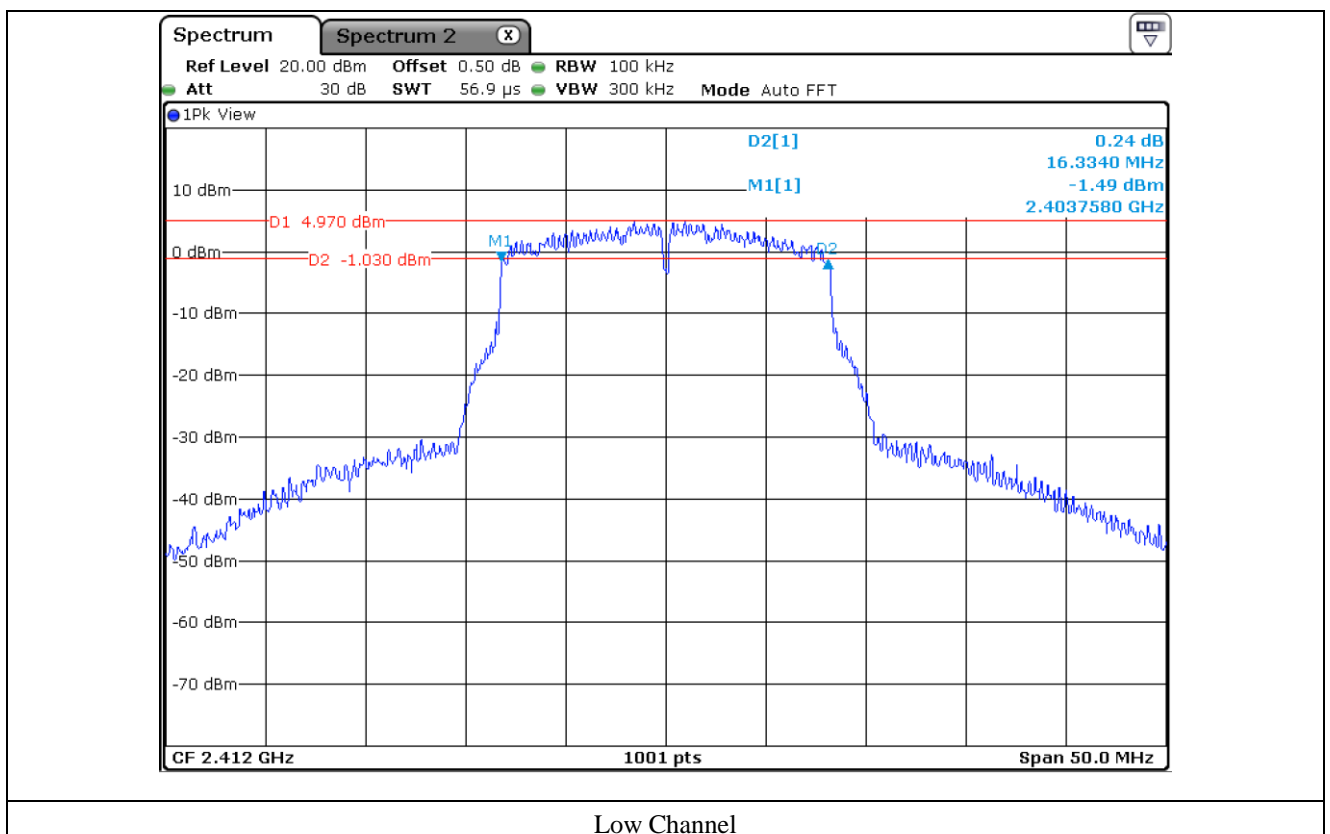
-. Test Date : November 21, 2018 ~ November 23, 2018

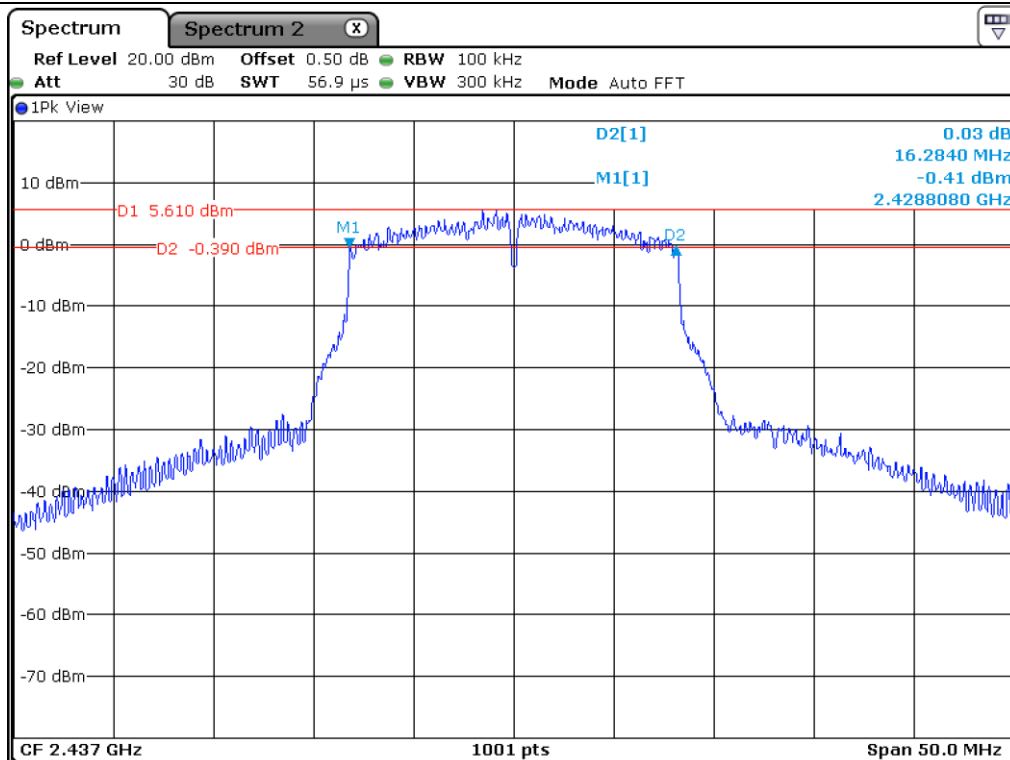
-. Test Result : Pass

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	16.28	0.50	15.78
High 11	2 462.00	16.23	0.50	15.73
High 12	2 467.00	15.78	0.50	15.28
High 13	2 472.00	16.28	0.50	15.78

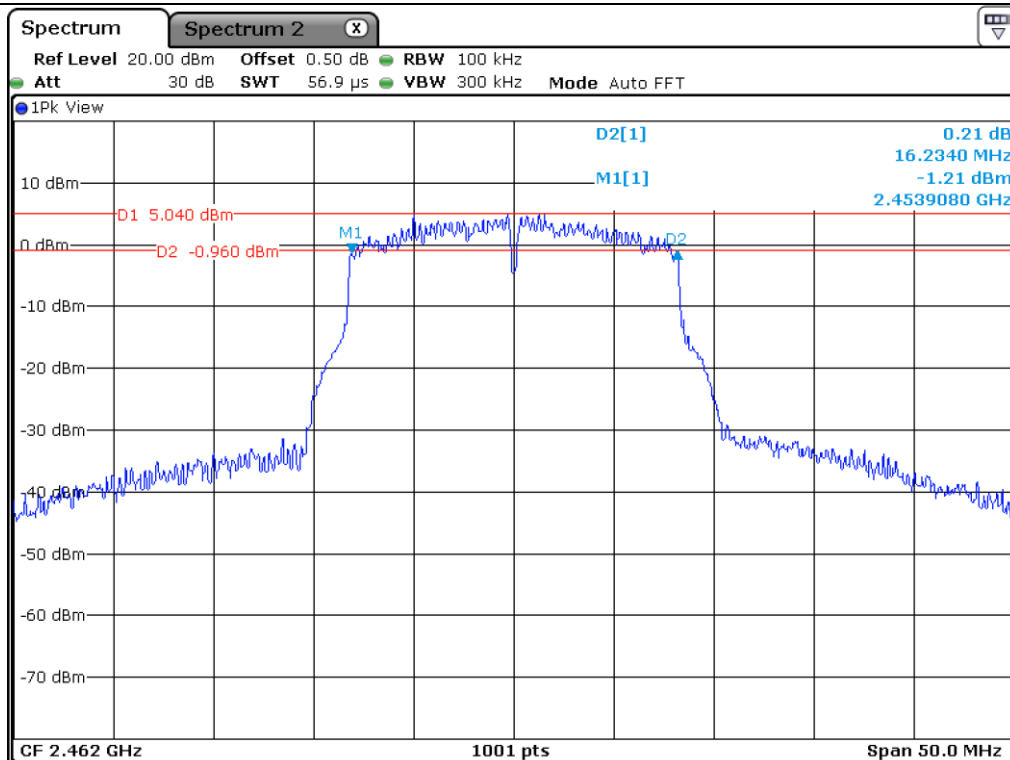
Remark. Margin = Measured Value - Limit

Tested by: Tae-Ho, Kim / Senior Manager

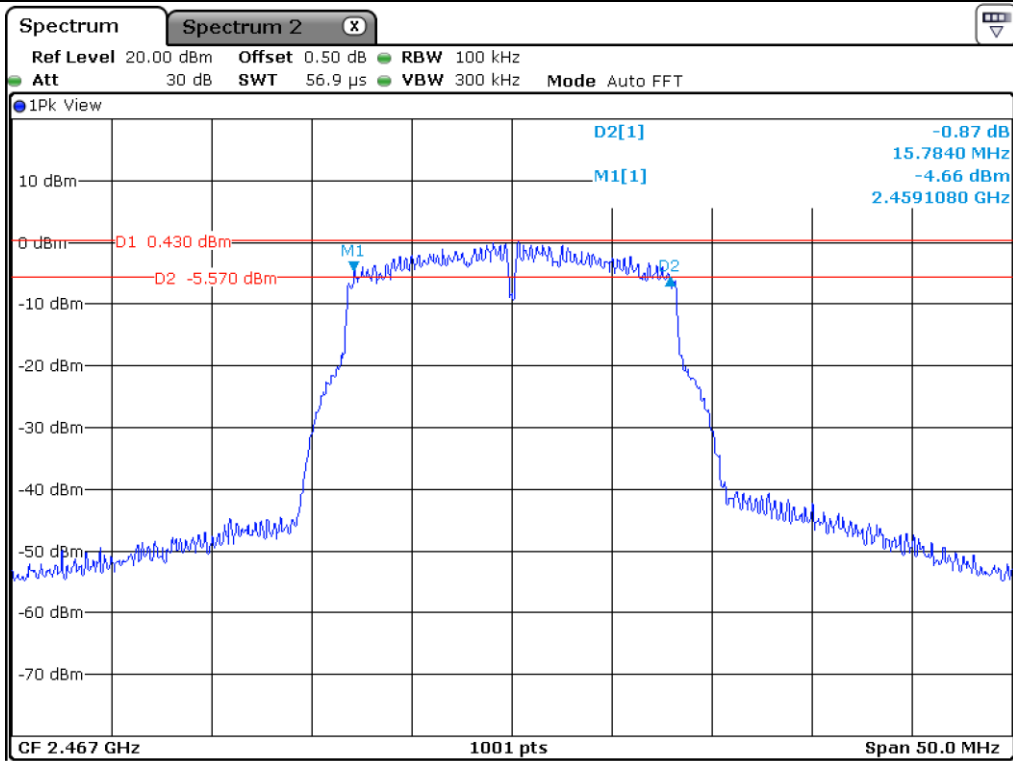




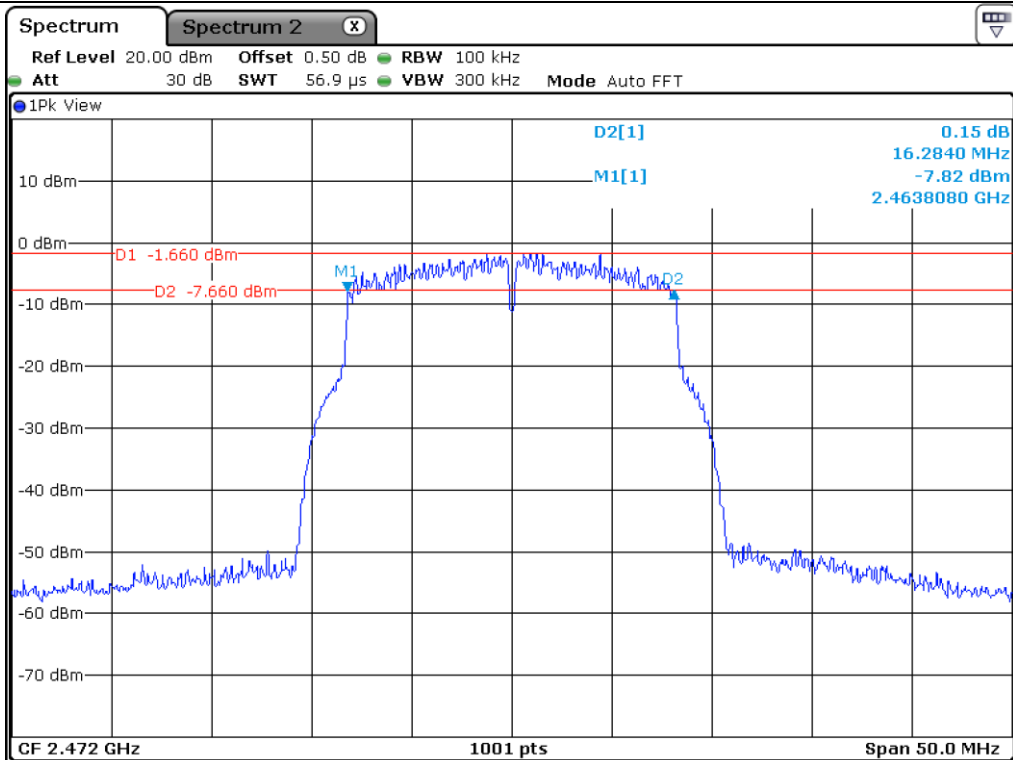
Middle Channel



High Channel 11



High Channel 12



High Channel 13



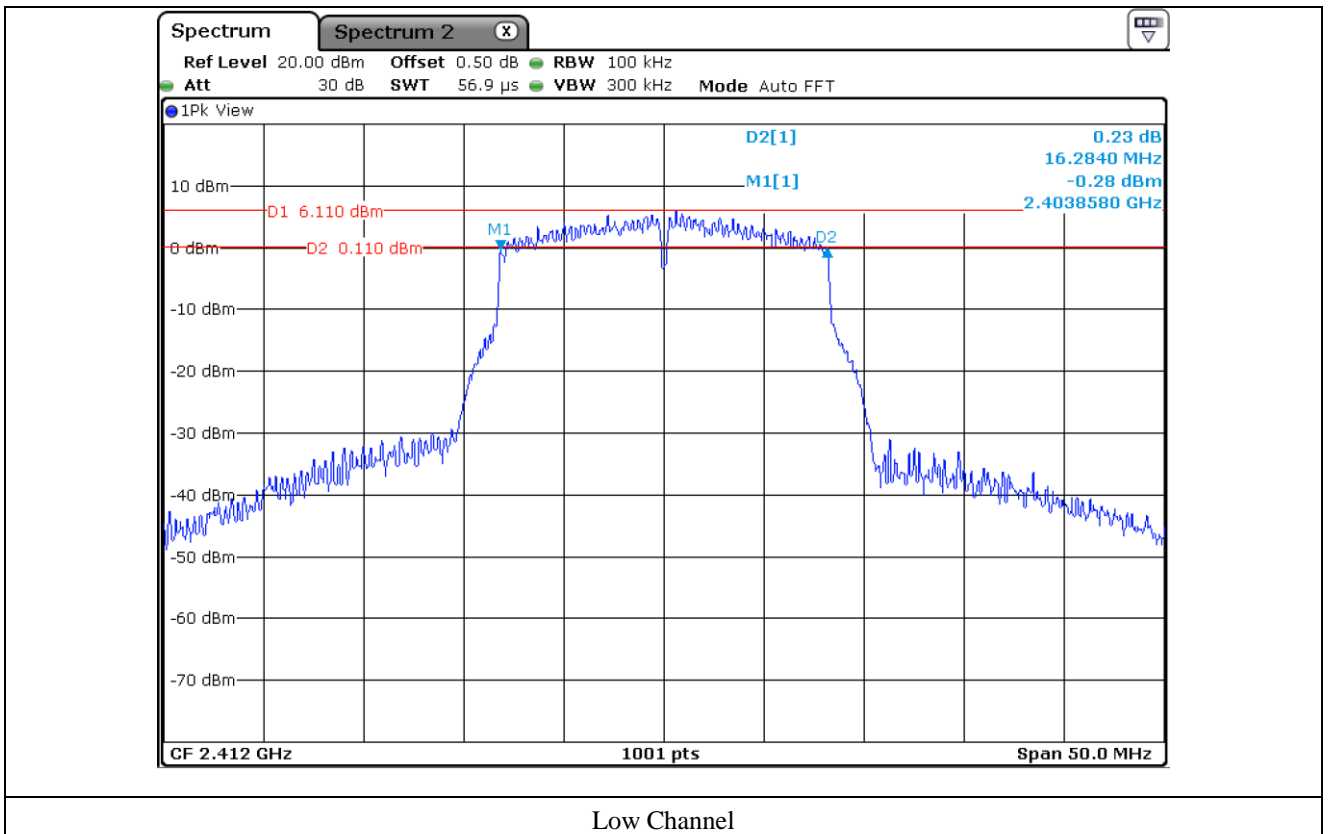
### 7.5.2 Test data for Antenna 1

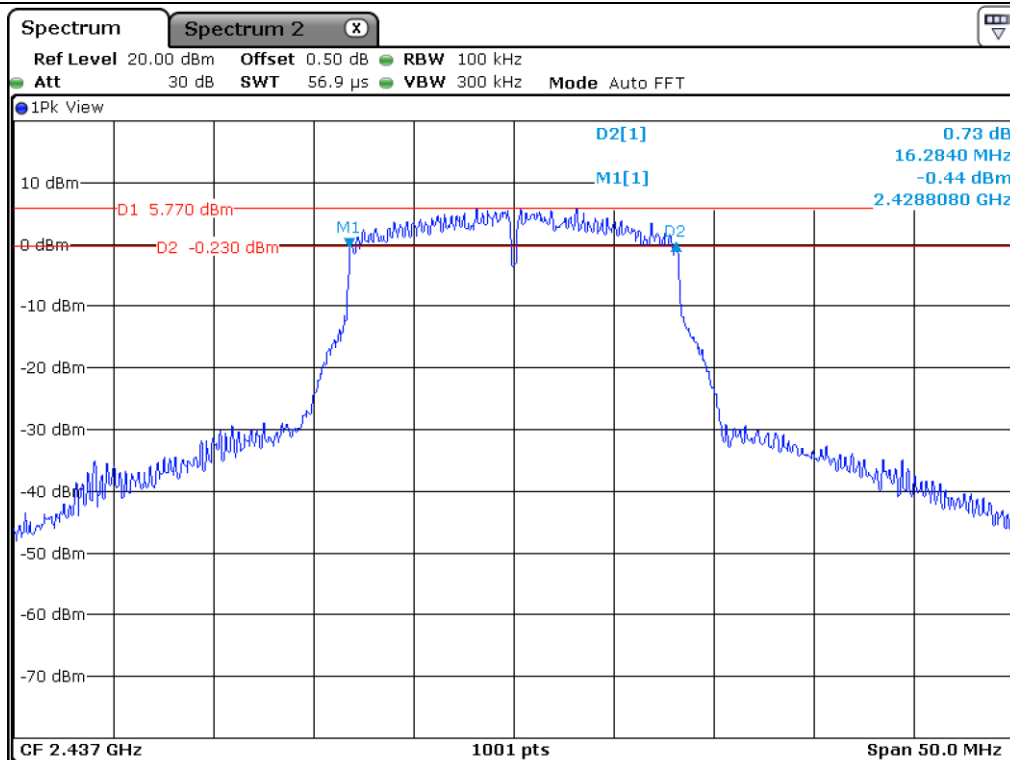
- Test Date : November 21, 2018 ~ November 23, 2018
- Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	16.28	0.50	15.78
Middle	2 437.00	16.28	0.50	15.78
High 11	2 462.00	16.28	0.50	15.78
High 12	2 467.00	16.03	0.50	15.53
High 13	2 472.00	16.23	0.50	15.73

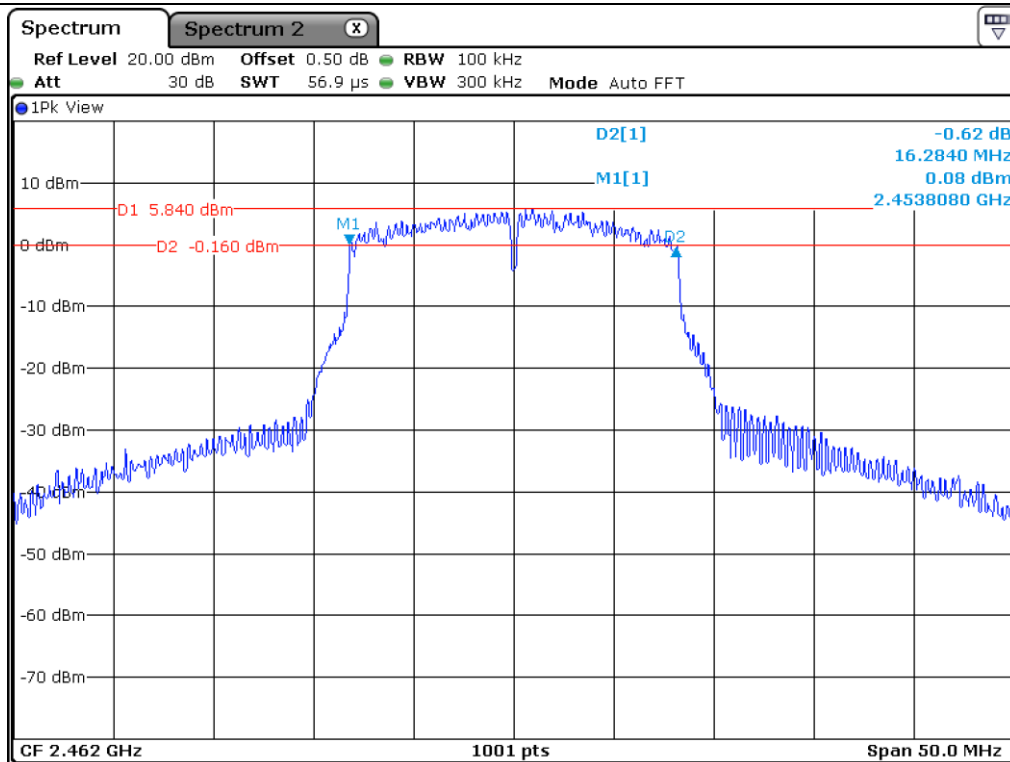
Remark. Margin = Measured Value - Limit

Tested by: Tae-Ho, Kim / Senior Manager

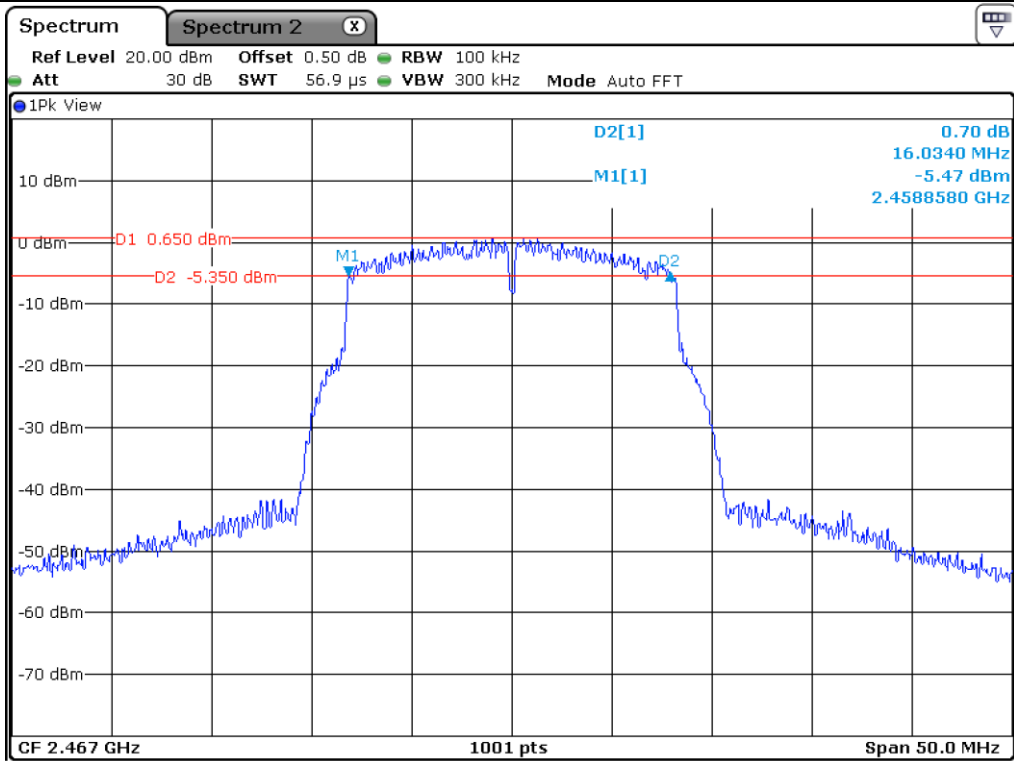




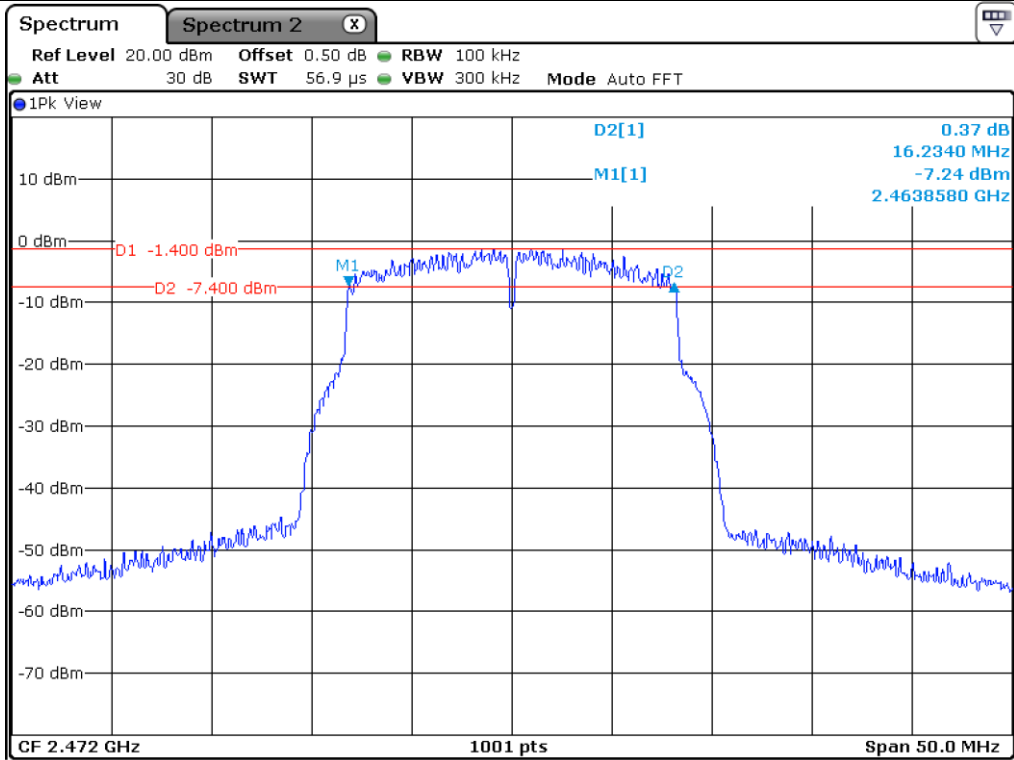
Middle Channel



High Channel 11



High Channel 12



High Channel 13

### 7.6 Test data for 802.11n\_HT20 WLAN Mode

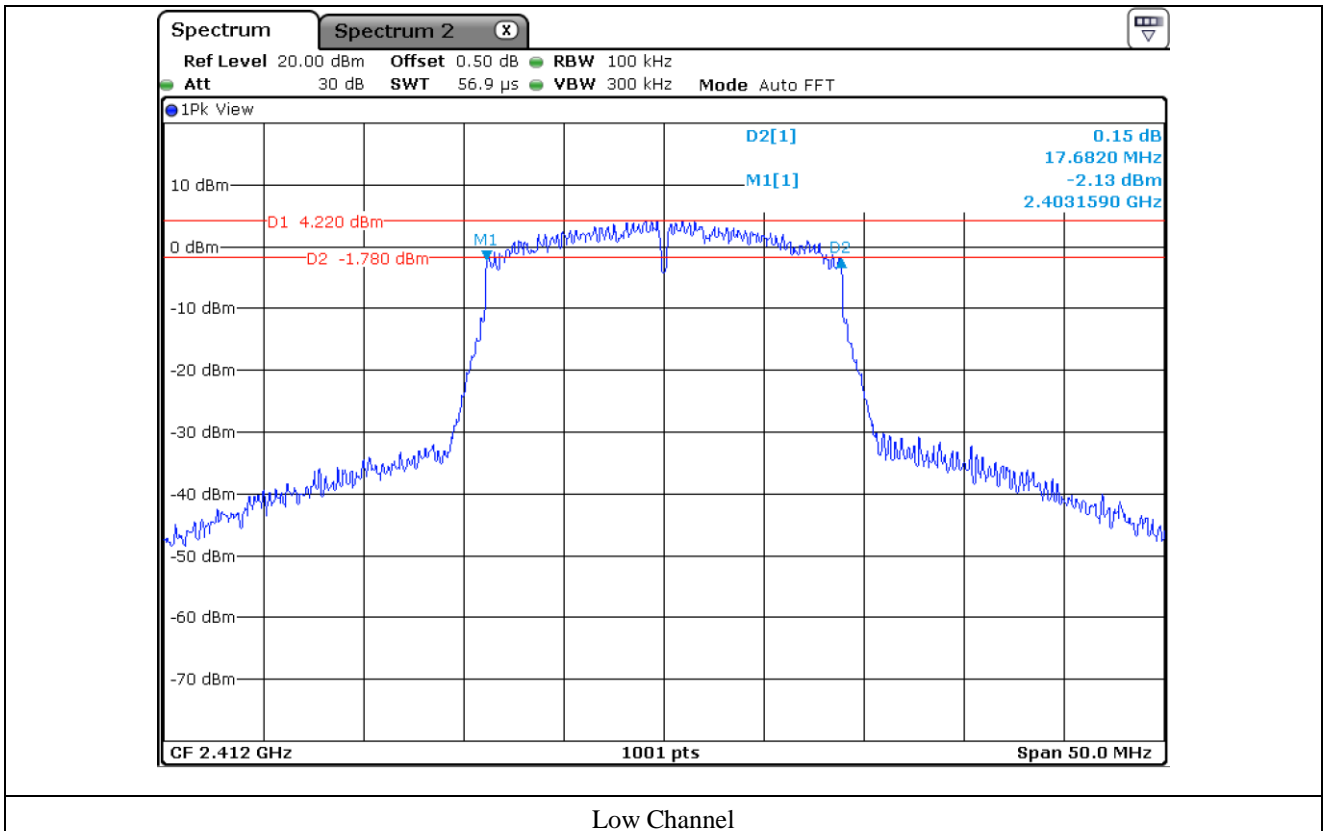
#### 7.6.1 Test data for Antenna 0

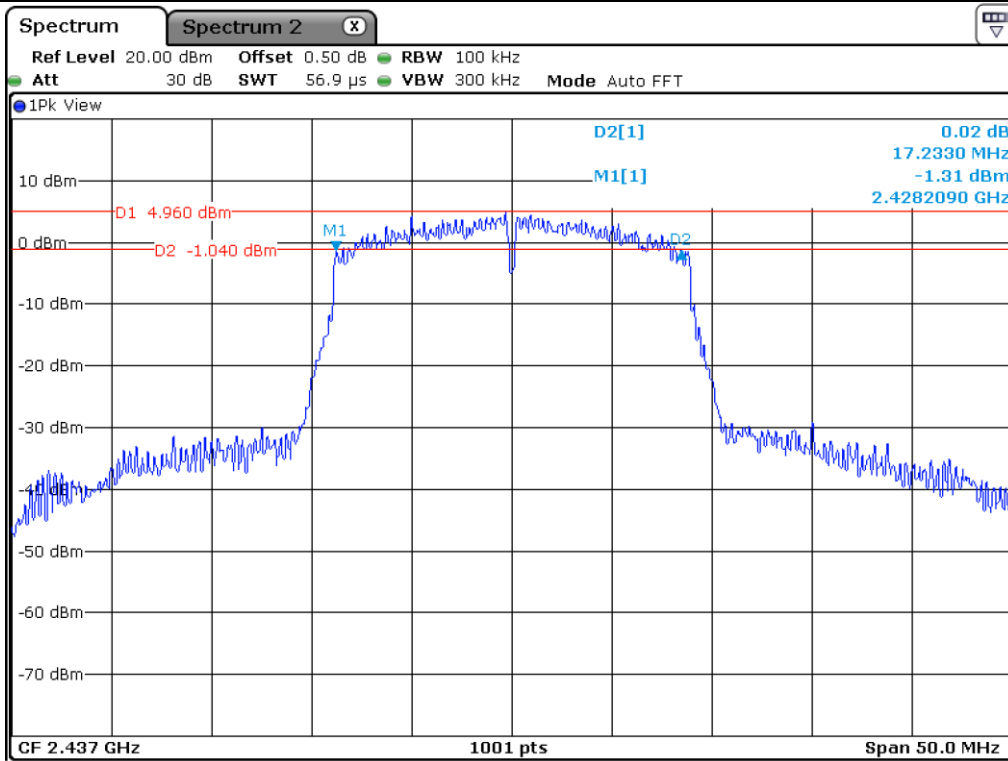
- Test Date : November 21, 2018 ~ November 23, 2018
- Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	17.68	0.50	17.18
Middle	2 437.00	17.23	0.50	16.73
High 11	2 462.00	17.23	0.50	16.73
High 12	2 467.00	16.93	0.50	16.43
High 13	2 472.00	17.28	0.50	16.78

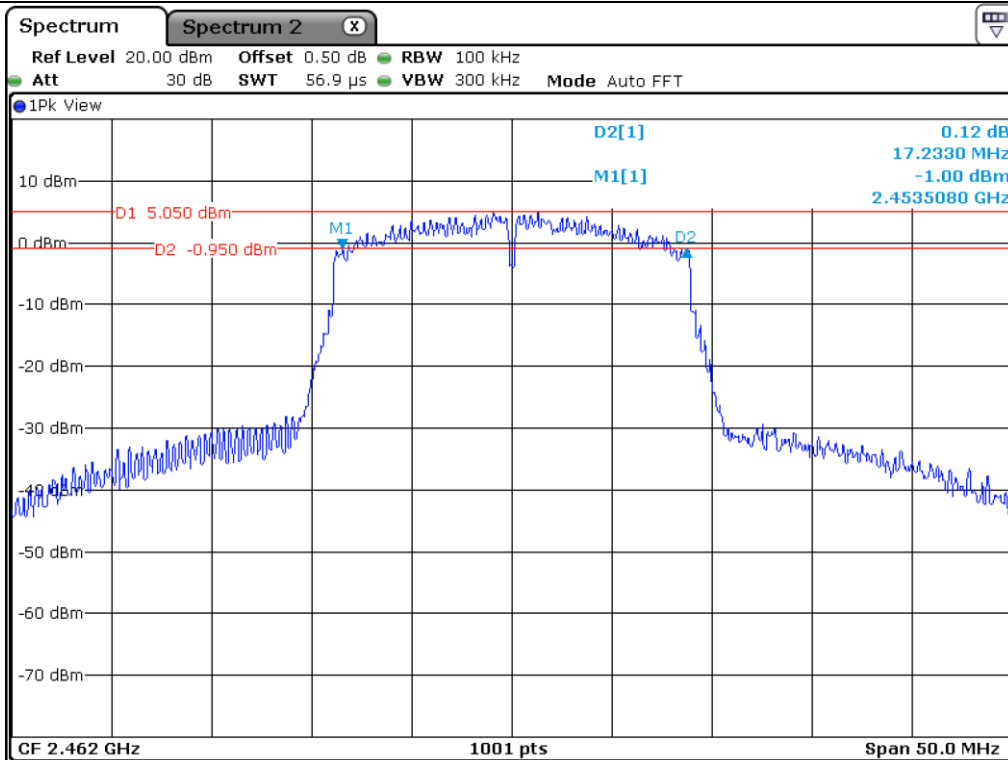
Remark. Margin = Measured Value - Limit

Tested by: Tae-Ho, Kim / Senior Manager

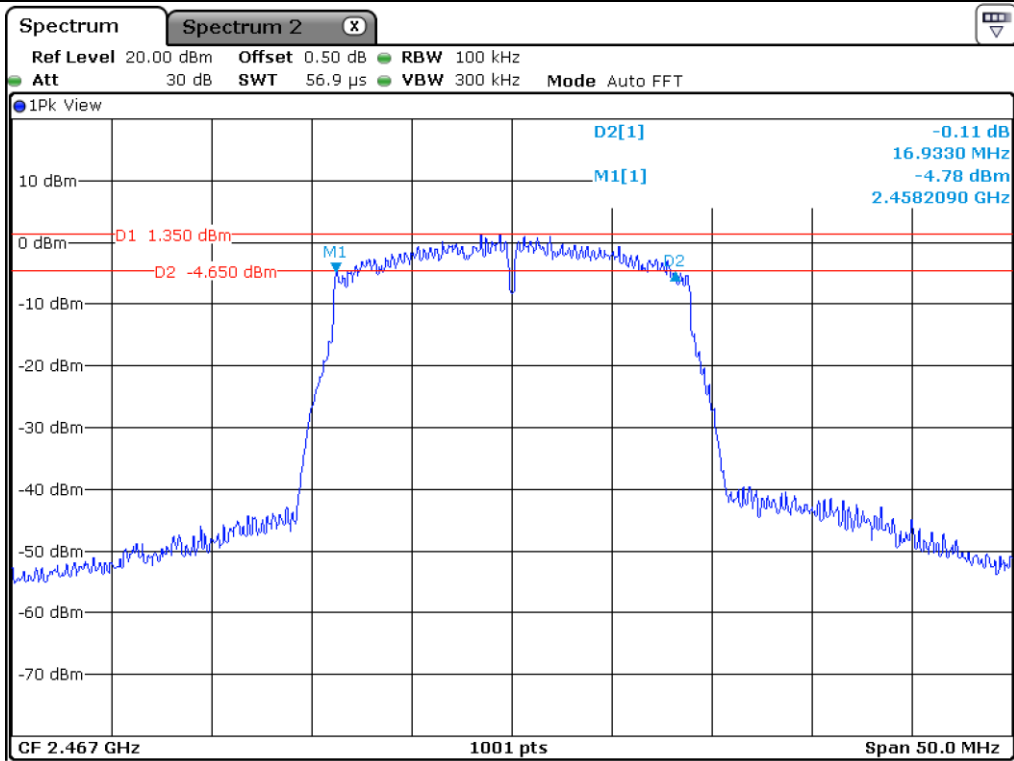




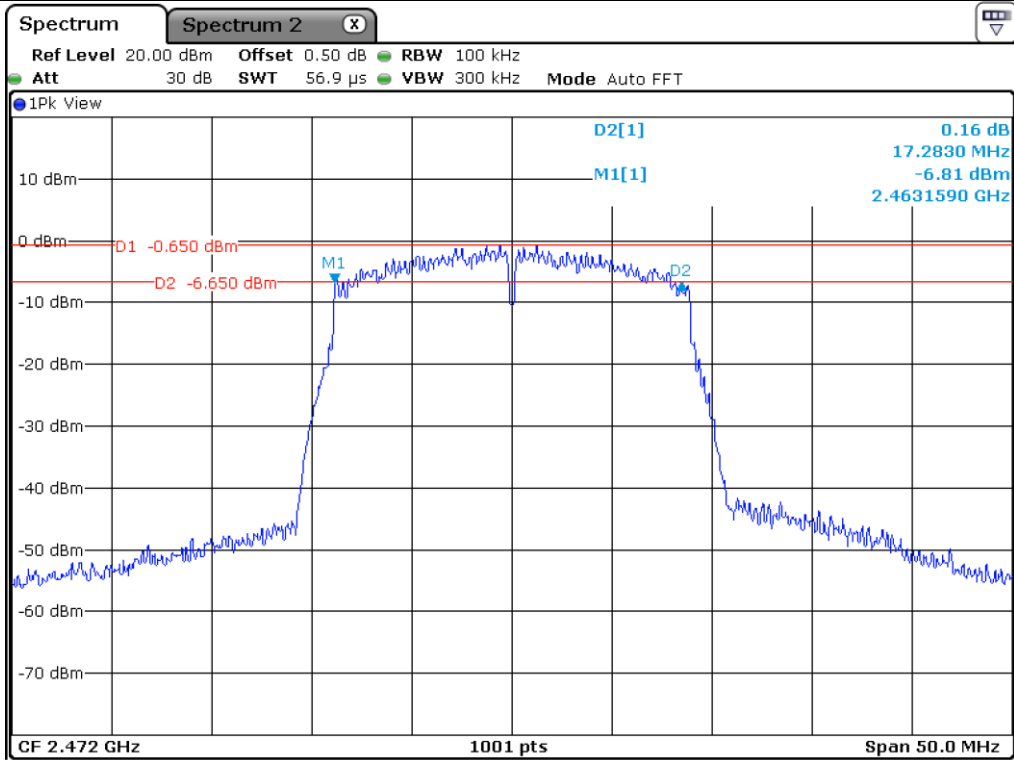
Middle Channel



High Channel 11



High Channel 12



High Channel 13

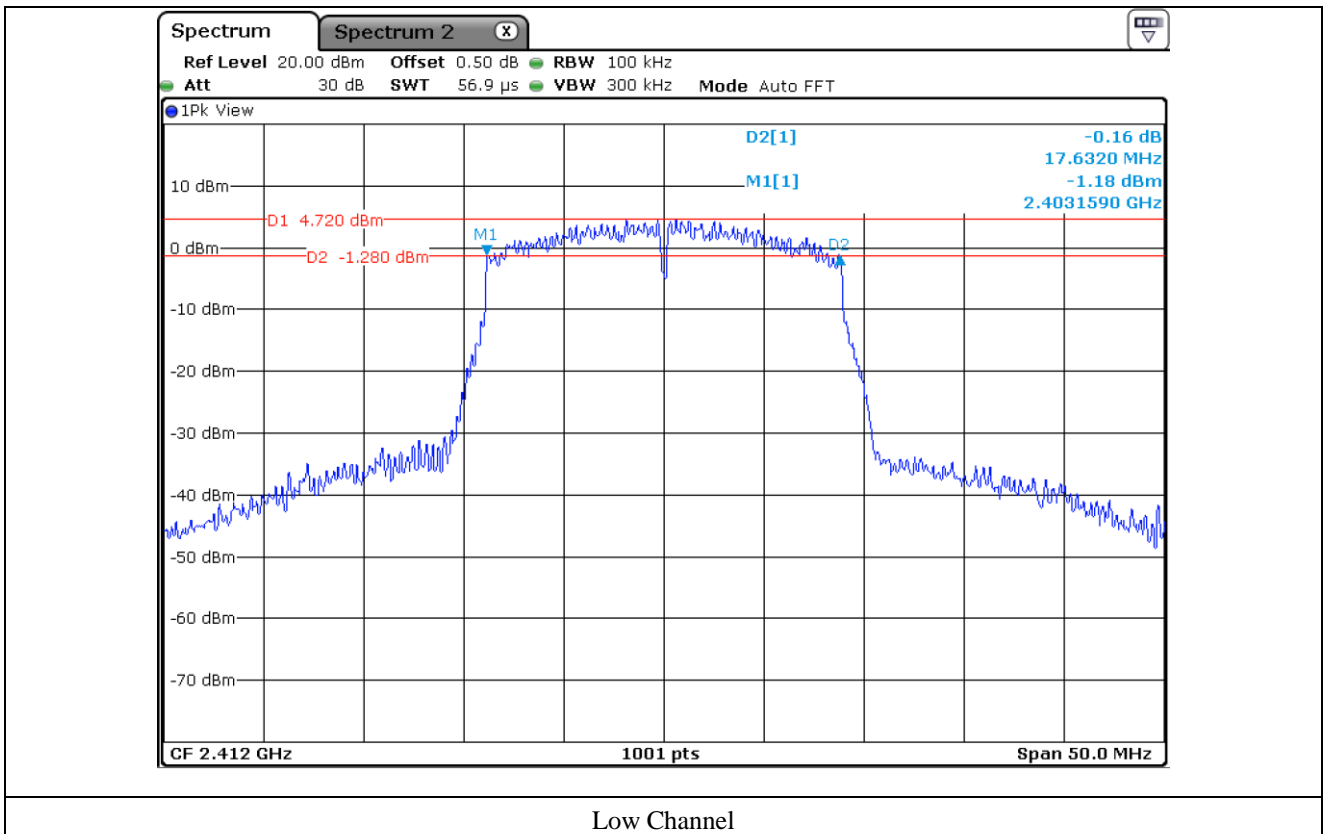
### 7.6.2 Test data for Antenna 1

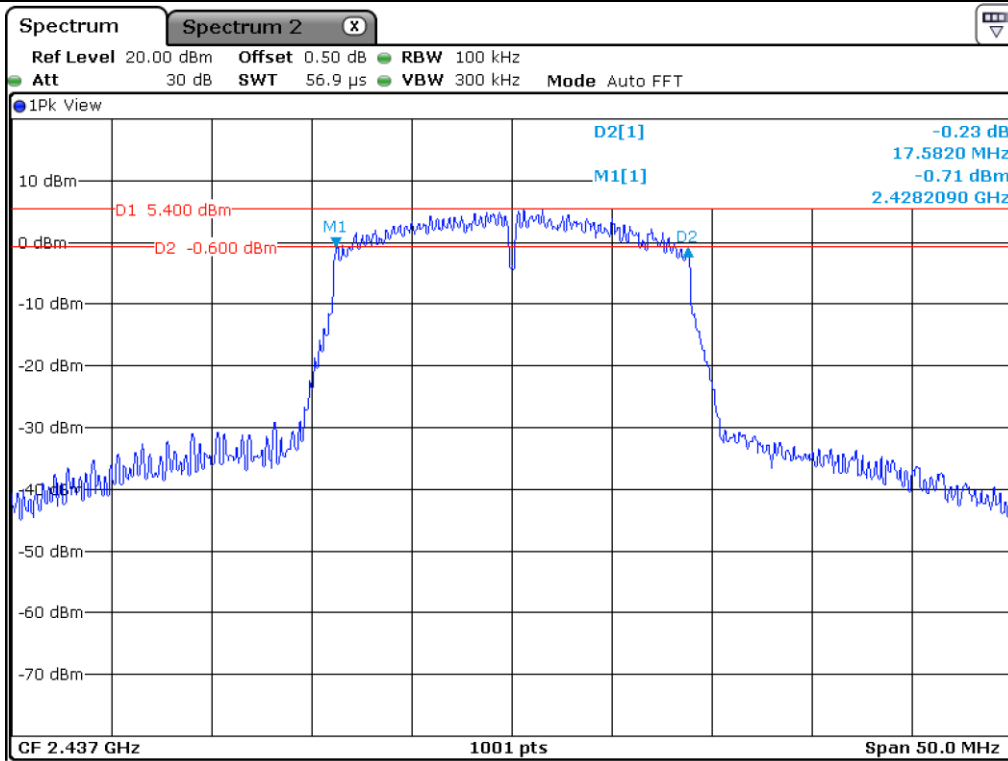
- Test Date : November 21, 2018 ~ November 23, 2018
- Test Result : Pass

CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	17.63	0.50	17.13
Middle	2 437.00	17.58	0.50	17.08
High 11	2 462.00	17.58	0.50	17.08
High 12	2 467.00	17.18	0.50	16.68
High 13	2 472.00	17.63	0.50	17.13

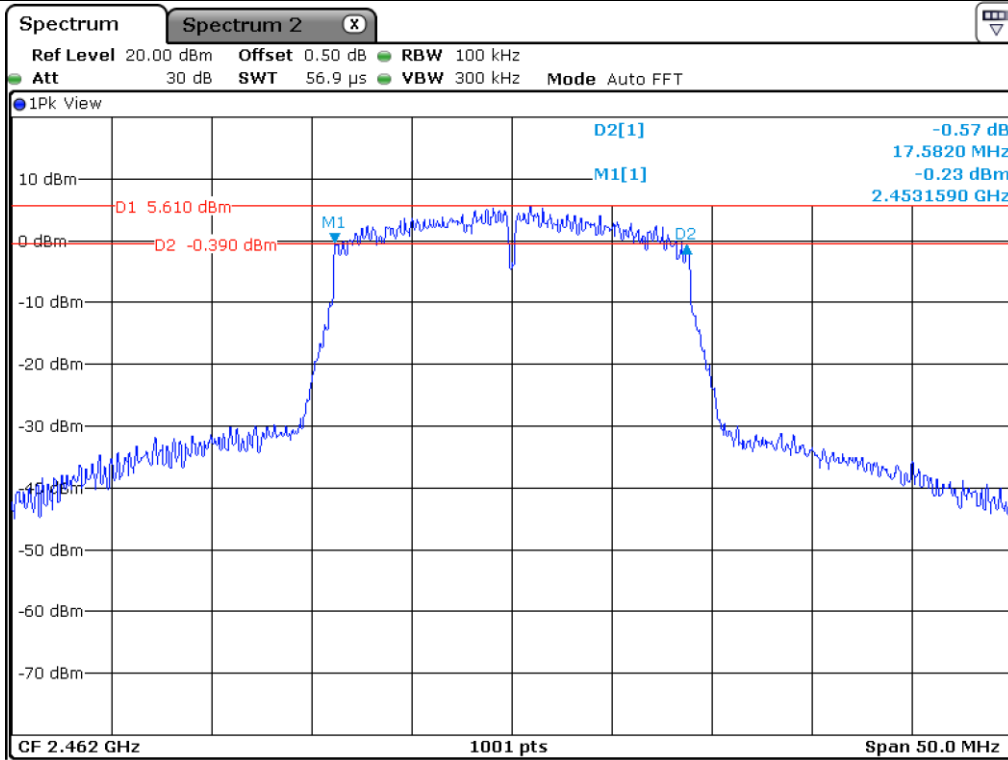
Remark. Margin = Measured Value - Limit

Tested by: Tae-Ho, Kim / Senior Manager



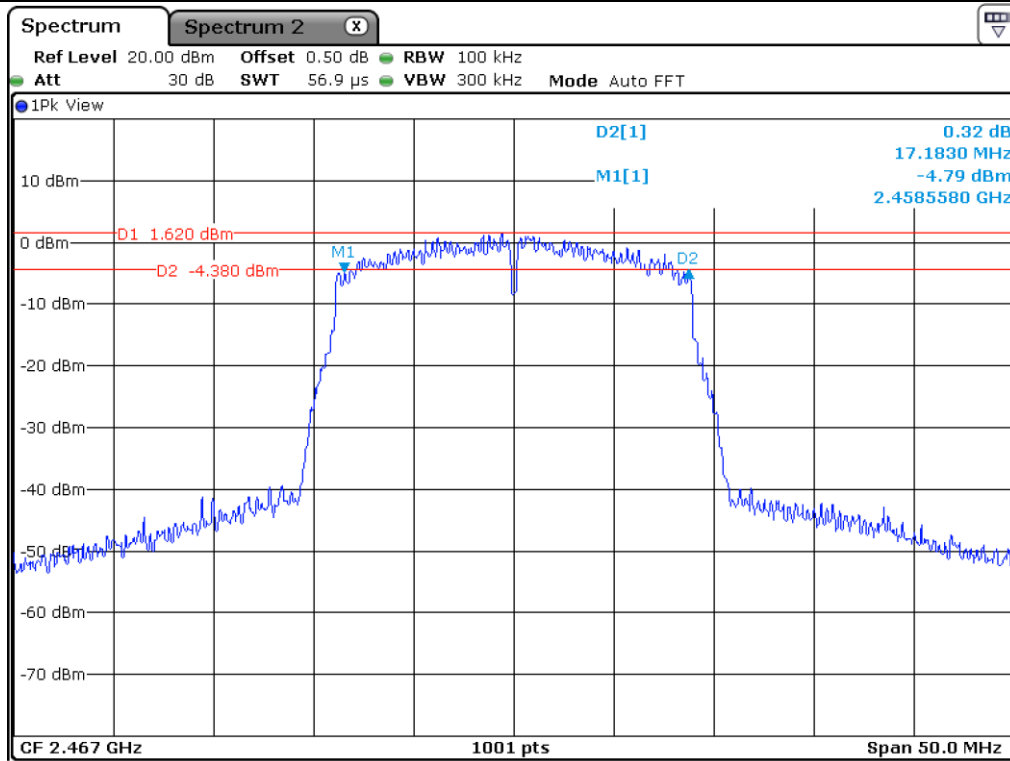


Middle Channel

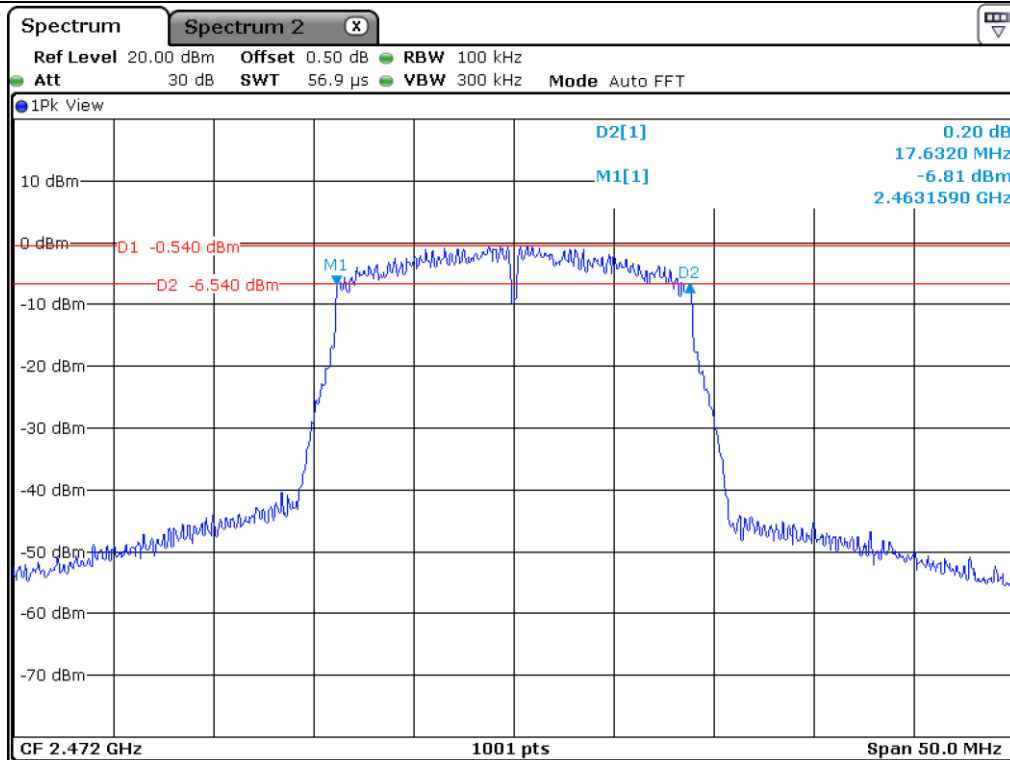


High Channel 11





High Channel 12



High Channel 13

7.7 Test data for 802.11n\_HT40 WLAN Mode

7.7.1 Test data for Antenna 0

-. Test Date : November 21, 2018 ~ November 23, 2018

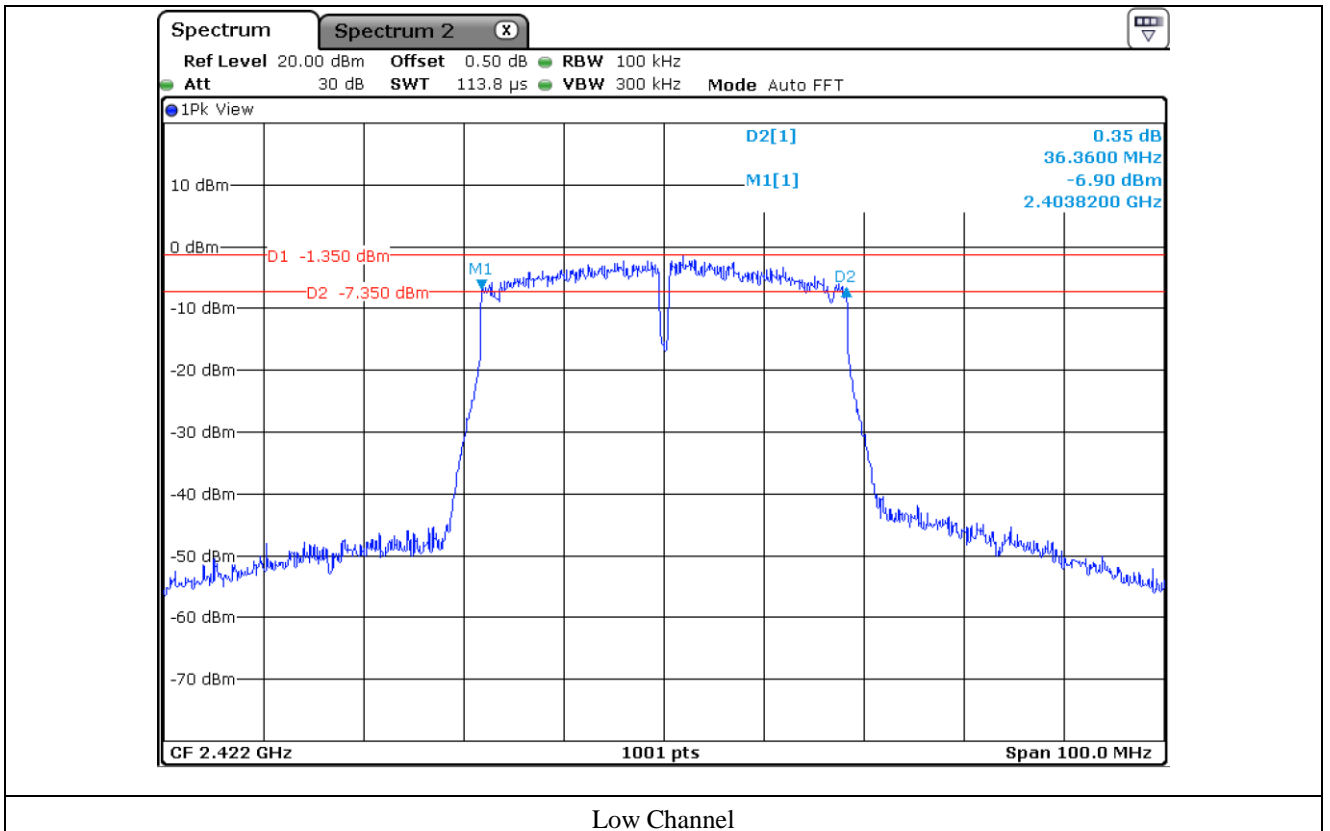
-. Test Result : Pass

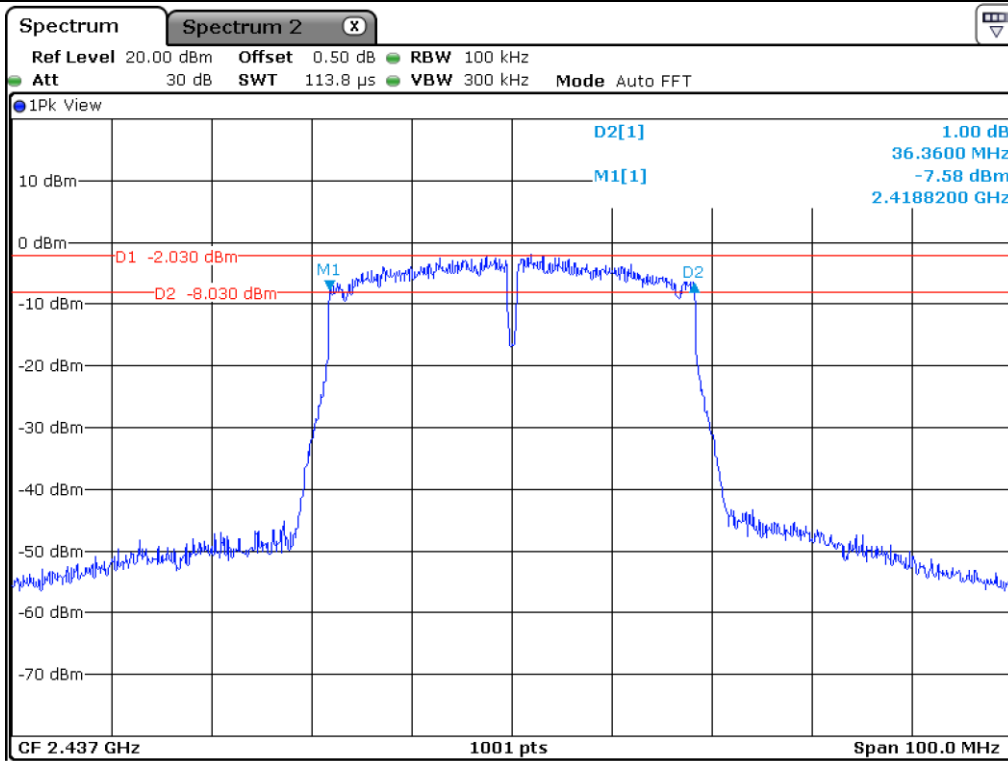
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 422.00	36.36	0.50	35.86
Middle	2 437.00	36.36	0.50	35.86
High 9	2 452.00	36.36	0.50	35.86
High 10	2 457.00	36.36	0.50	35.86
High 11	2 462.00	36.36	0.50	35.86

Remark. Margin = Measured Value - Limit

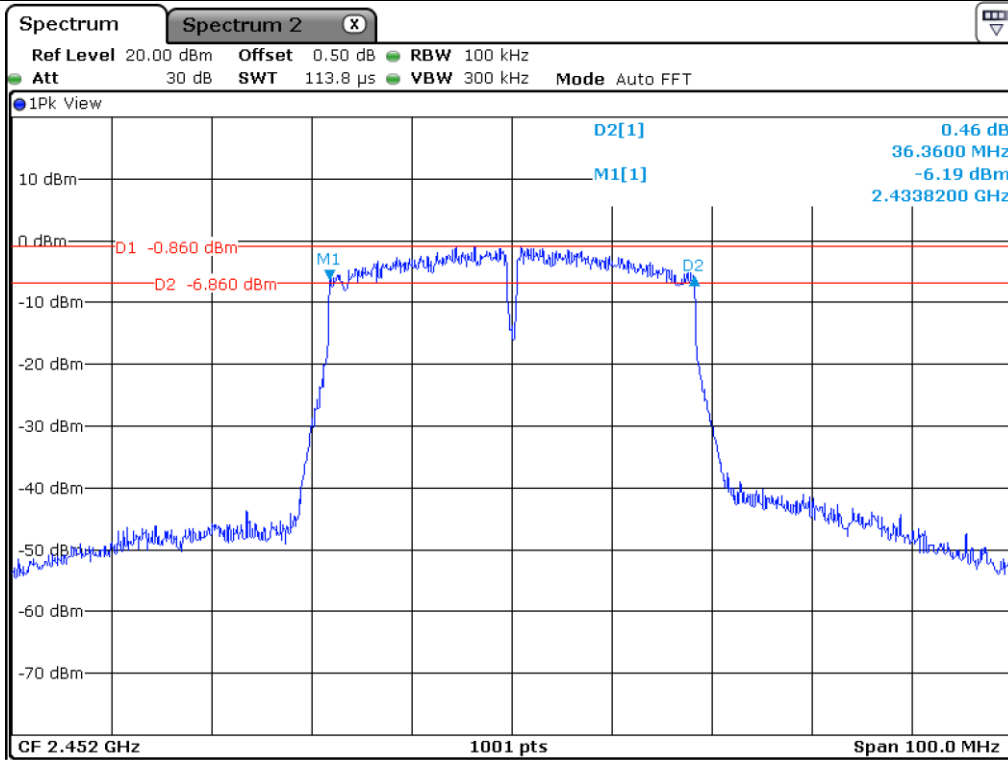


Tested by: Tae-Ho, Kim / Senior Manager

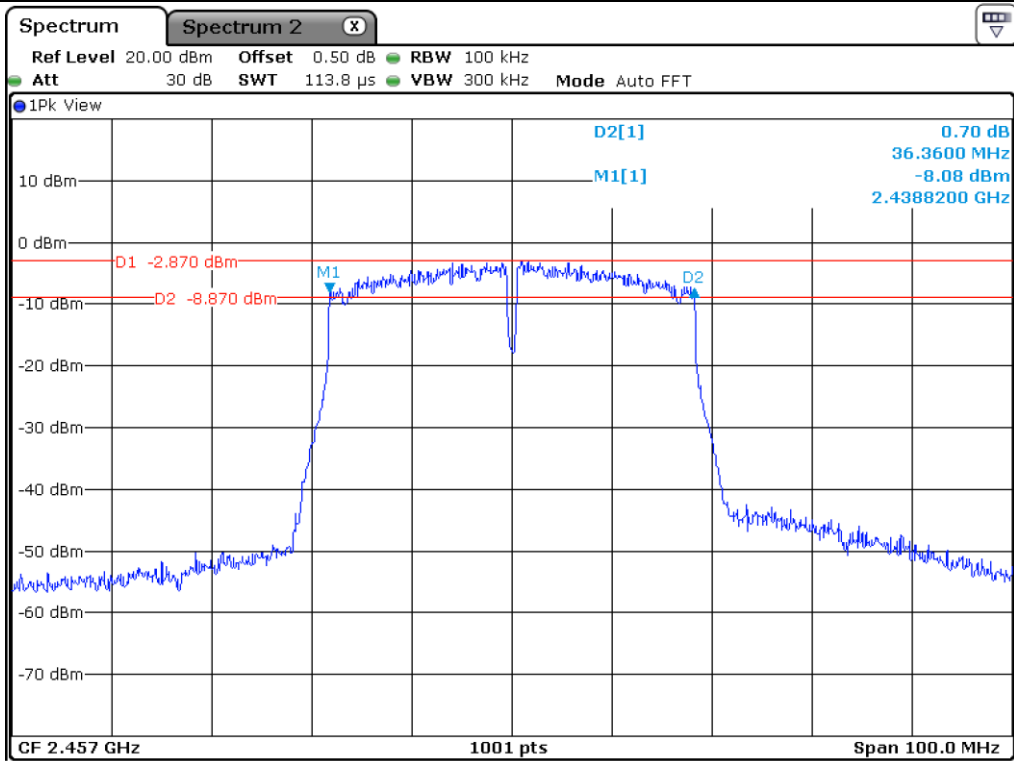




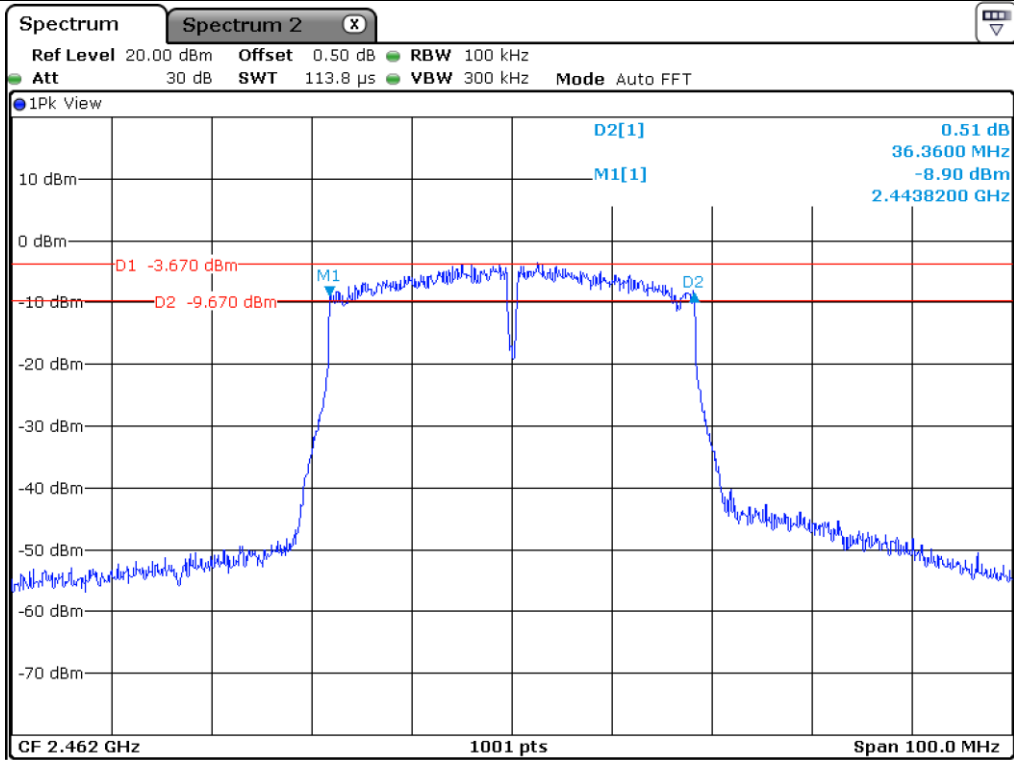
Middle Channel



High Channel 9



High Channel 10



High Channel 11

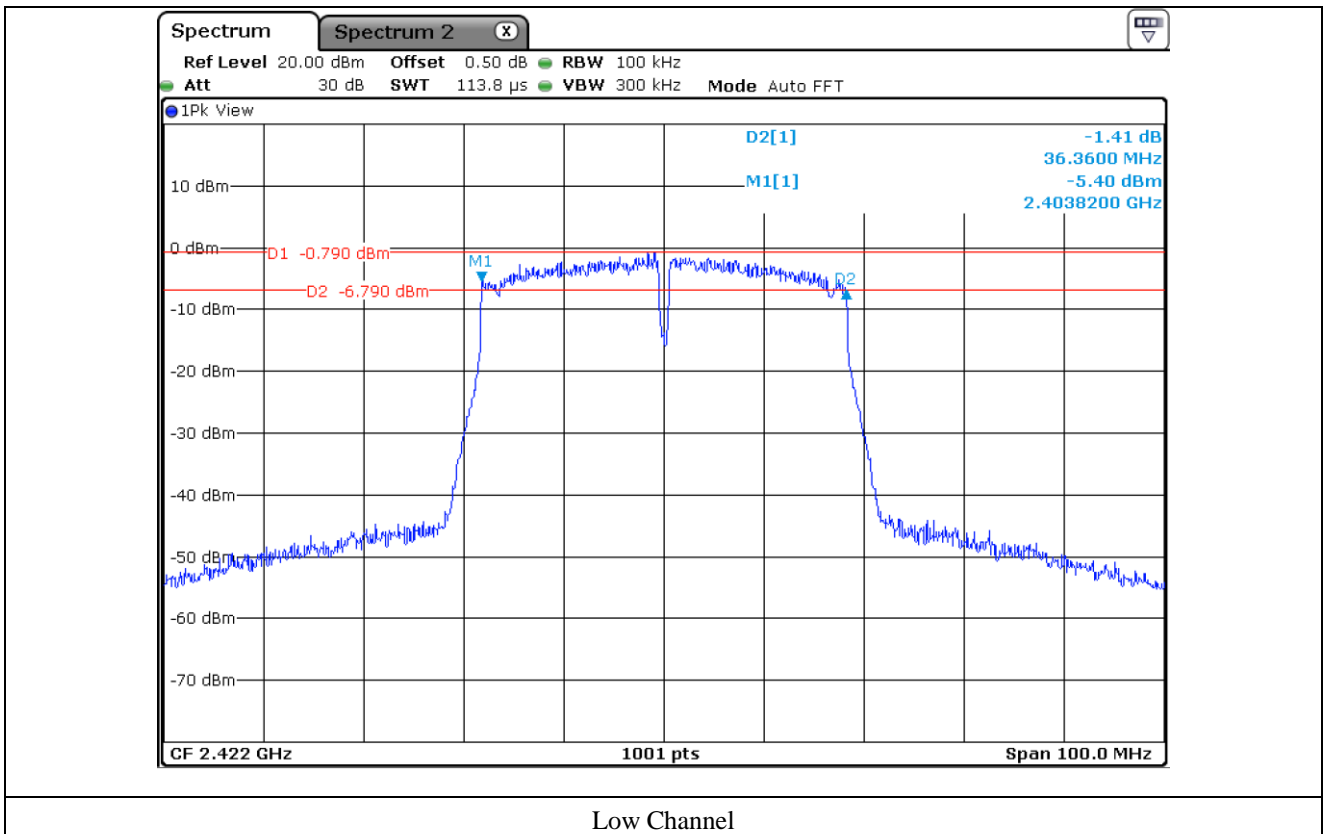
### 7.7.2 Test data for Antenna 1

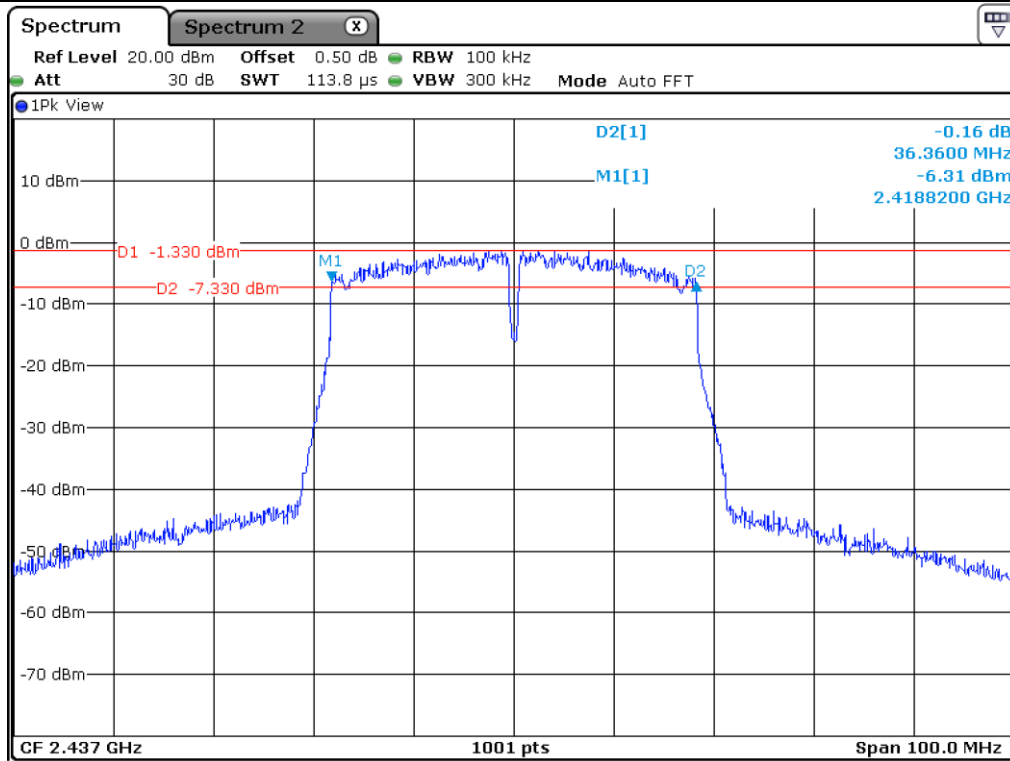
- Test Date : November 21, 2018 ~ November 23, 2018
- Test Result : Pass

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

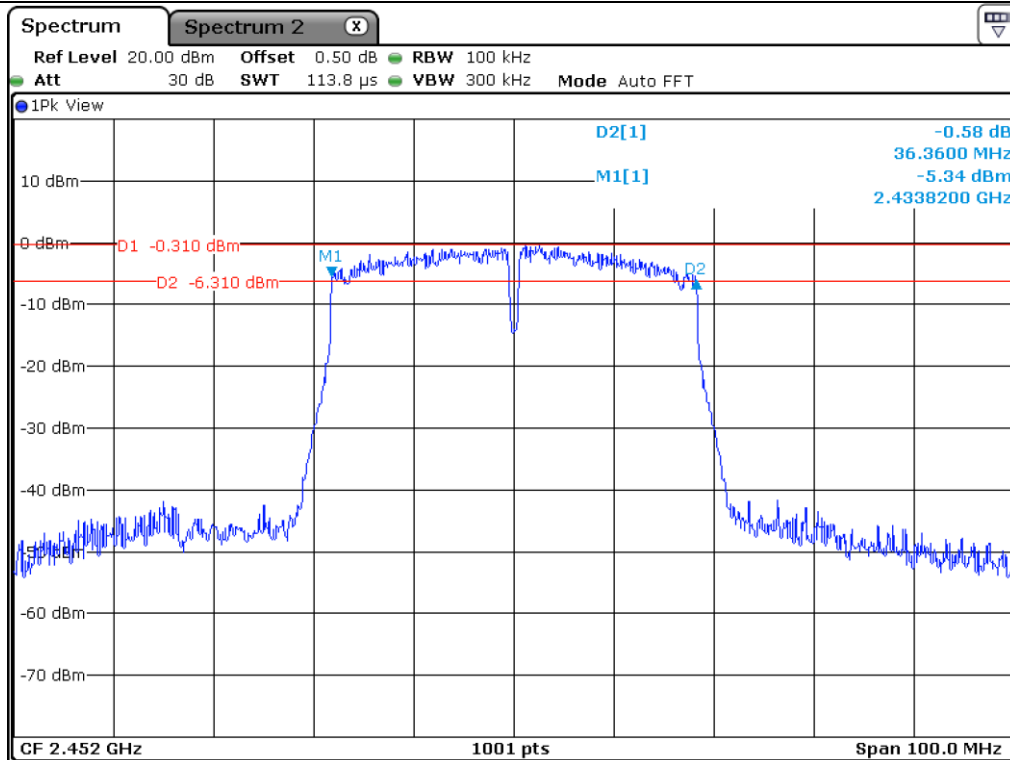
Remark. Margin = Measured Value - Limit

Tested by: Tae-Ho, Kim / Senior Manager

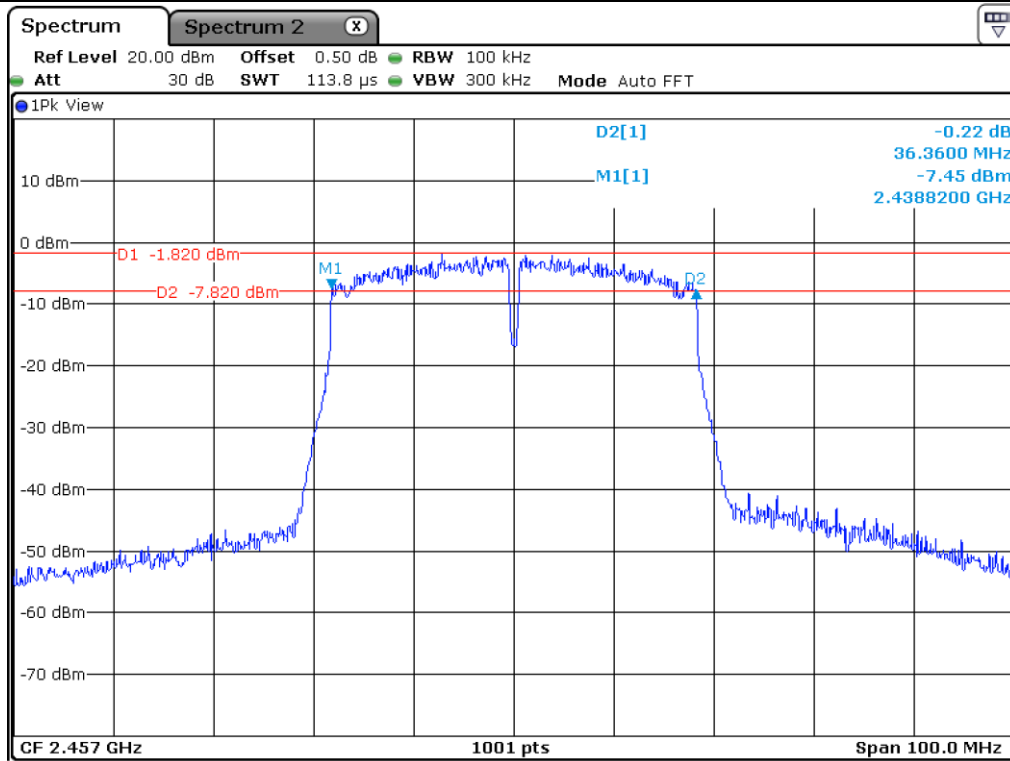




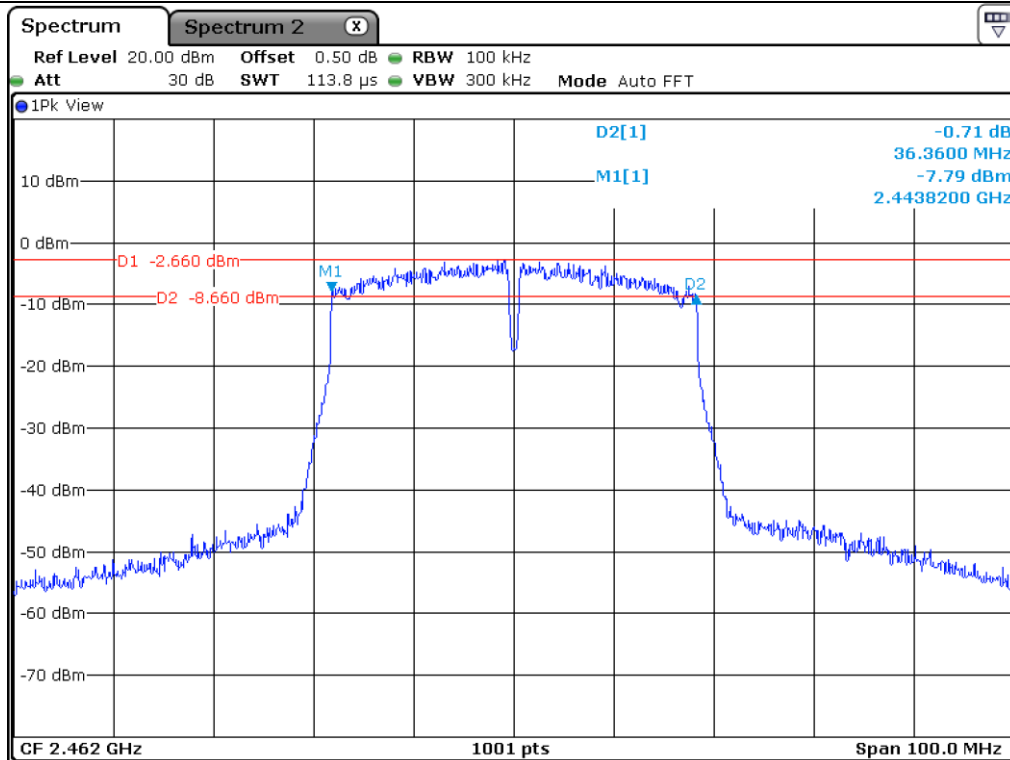
Middle Channel



High Channel 9



High Channel 10



High Channel 11

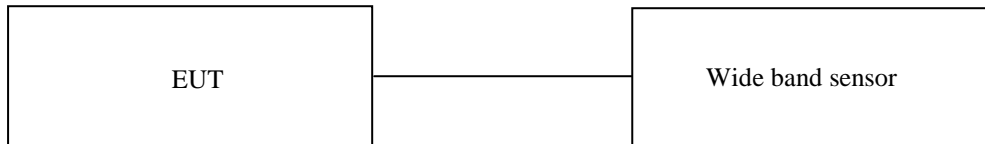
## 8. MAXIMUM PEAK OUTPUT POWER

### 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 9.2.3(KDB 558074 D01 DTS Meas Guidance V05). Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.



### 8.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - NRP-Z81	Rohde & Schwarz	Wide band Sensor	101975	Mar. 15, 2018 (1Y)

All test equipment used is calibrated on a regular basis.



### 8.4 Test data for 802.11b WLAN Mode

#### 8.4.1 Test data for Antenna 0

- Test Date : November 21, 2018 ~ November 23, 2018
- Test Result : Pass
- Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	22.23	30.00	7.77
MIDDLE	2 437.00	22.16	30.00	7.84
HIGH 11	2 462.00	19.82	30.00	10.18
HIGH 12	2 467.00	19.65	30.00	10.35
HIGH 13	2 472.00	17.42	30.00	12.58

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

#### 8.4.2 Test data for Antenna 1

- Test Date : November 21, 2018 ~ November 23, 2018
- Test Result : Pass
- Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	22.68	30.00	7.32
MIDDLE	2 437.00	22.20	30.00	7.80
HIGH 11	2 462.00	21.69	30.00	8.31
HIGH 12	2 467.00	19.33	30.00	10.67
HIGH 13	2 472.00	17.80	30.00	12.20

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



Tested by: Tae-Ho, Kim / Senior Manager

### 8.5 Test data for 802.11g WLAN Mode

#### 8.5.1 Test data for Antenna 0

- Test Date : November 21, 2018 ~ November 23, 2018
- Test Result : Pass
- Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	17.64	30.00	12.36
MIDDLE	2 437.00	17.48	30.00	12.52
HIGH 11	2 462.00	17.70	30.00	12.30
HIGH 12	2 467.00	12.35	30.00	17.65
HIGH 13	2 472.00	10.81	30.00	19.19

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

#### 8.5.2 Test data for Antenna 1

- Test Date : November 21, 2018 ~ November 23, 2018
- Test Result : Pass
- Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	18.10	30.00	11.90
MIDDLE	2 437.00	18.16	30.00	11.84
HIGH 11	2 462.00	18.20	30.00	11.80
HIGH 12	2 467.00	13.48	30.00	16.52
HIGH 13	2 472.00	11.76	30.00	18.24

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



Tested by: Tae-Ho, Kim / Senior Manager

### 8.5.3 Test data for Multiple Transmit

- Test Date : November 21, 2018 ~ November 23, 2018
- Test Result : Pass
- Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	20.89	30.00	9.11
MIDDLE	2 437.00	20.84	30.00	9.16
HIGH 11	2 462.00	20.97	30.00	9.03
HIGH 12	2 467.00	15.96	30.00	14.04
HIGH 13	2 472.00	14.32	30.00	15.68

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



**Tested by: Tae-Ho, Kim / Senior Manager**

### 8.6 Test data for 802.11n\_HT20 WLAN Mode

#### 8.6.1 Test data for Antenna 0

- Test Date : November 21, 2018 ~ November 23, 2018
- Test Result : Pass
- Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	16.70	30.00	13.30
MIDDLE	2 437.00	16.88	30.00	13.12
HIGH 11	2 462.00	17.12	30.00	12.88
HIGH 12	2 467.00	12.86	30.00	17.14
HIGH 13	2 472.00	11.46	30.00	18.54

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

#### 8.6.2 Test data for Antenna 1

- Test Date : November 21, 2018 ~ November 23, 2018
- Test Result : Pass
- Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	16.92	30.00	13.08
MIDDLE	2 437.00	16.94	30.00	13.06
HIGH 11	2 462.00	17.54	30.00	12.46
HIGH 12	2 467.00	13.46	30.00	16.54
HIGH 13	2 472.00	12.32	30.00	17.68

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



Tested by: Tae-Ho, Kim / Senior Manager

### 8.6.3 Test data for Multiple Transmit

- Test Date : November 21, 2018 ~ November 23, 2018
- Test Result : Pass
- Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	19.82	30.00	10.18
MIDDLE	2 437.00	19.92	30.00	10.08
HIGH 11	2 462.00	20.35	30.00	9.65
HIGH 12	2 467.00	16.18	30.00	13.82
HIGH 13	2 472.00	14.92	30.00	15.08

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



**Tested by: Tae-Ho, Kim / Senior Manager**

### 8.7 Test data for 802.11n\_HT40 WLAN Mode

#### 8.7.1 Test data for Antenna 0

- Test Date : November 21, 2018 ~ November 23, 2018
- Test Result : Pass
- Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 422.00	13.43	30.00	16.57
MIDDLE	2 437.00	13.36	30.00	16.64
HIGH 9	2 452.00	14.34	30.00	15.66
HIGH 10	2 457.00	12.29	30.00	17.71
HIGH 11	2 462.00	11.48	30.00	18.52

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

#### 8.7.2 Test data for Antenna 1

- Test Date : November 21, 2018 ~ November 23, 2018
- Test Result : Pass
- Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 422.00	13.76	30.00	16.24
MIDDLE	2 437.00	13.60	30.00	16.40
HIGH 9	2 452.00	15.04	30.00	14.96
HIGH 10	2 457.00	13.30	30.00	16.70
HIGH 11	2 462.00	13.90	30.00	16.10

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



Tested by: Tae-Ho, Kim / Senior Manager

**8.7.3 Test data for Antenna 1**

- Test Date : November 21, 2018 ~ November 23, 2018
- Test Result : Pass
- Duty Cycle : > 98 %

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 422.00	16.61	30.00	13.39
MIDDLE	2 437.00	16.49	30.00	13.51
HIGH 9	2 452.00	17.71	30.00	12.29
HIGH 10	2 457.00	15.83	30.00	14.17
HIGH 11	2 462.00	15.87	30.00	14.13

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

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

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



**Tested by: Tae-Ho, Kim / Senior Manager**

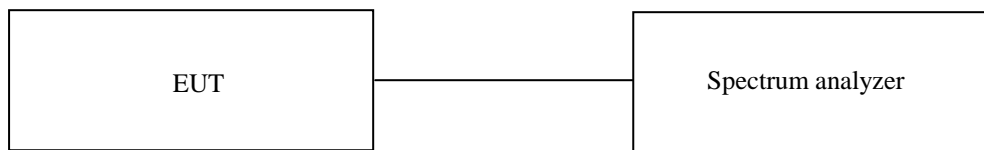
## 9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

### 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 equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 14, 2018 (1Y)
■ - ESU	Rohde & Schwarz	EMI Test Receiver	100261	Mar. 29, 2018 (1Y)
■ - 310N	Sonoma Instrument	Pre-Amplifier	312544	Mar. 28, 2018 (1Y)
■ - BBV 9718 B	Schwarzbeck	Amplifier	009	Mar. 16, 2018 (1Y)
■ - SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Mar. 15, 2018 (1Y)
■ - DT3000-3t	Innco System	Turn Table	DT3000/093	N/A
■ - MA-4000XPET	Innco System	Antenna Master	MA4000/509	N/A
■ - VULB9163	Schwarzbeck	TRILOG Broadband Antenna	777	Apr. 13, 2018 (2Y)
■ - BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
■ - BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170179	Jul. 28, 2017 (2Y)

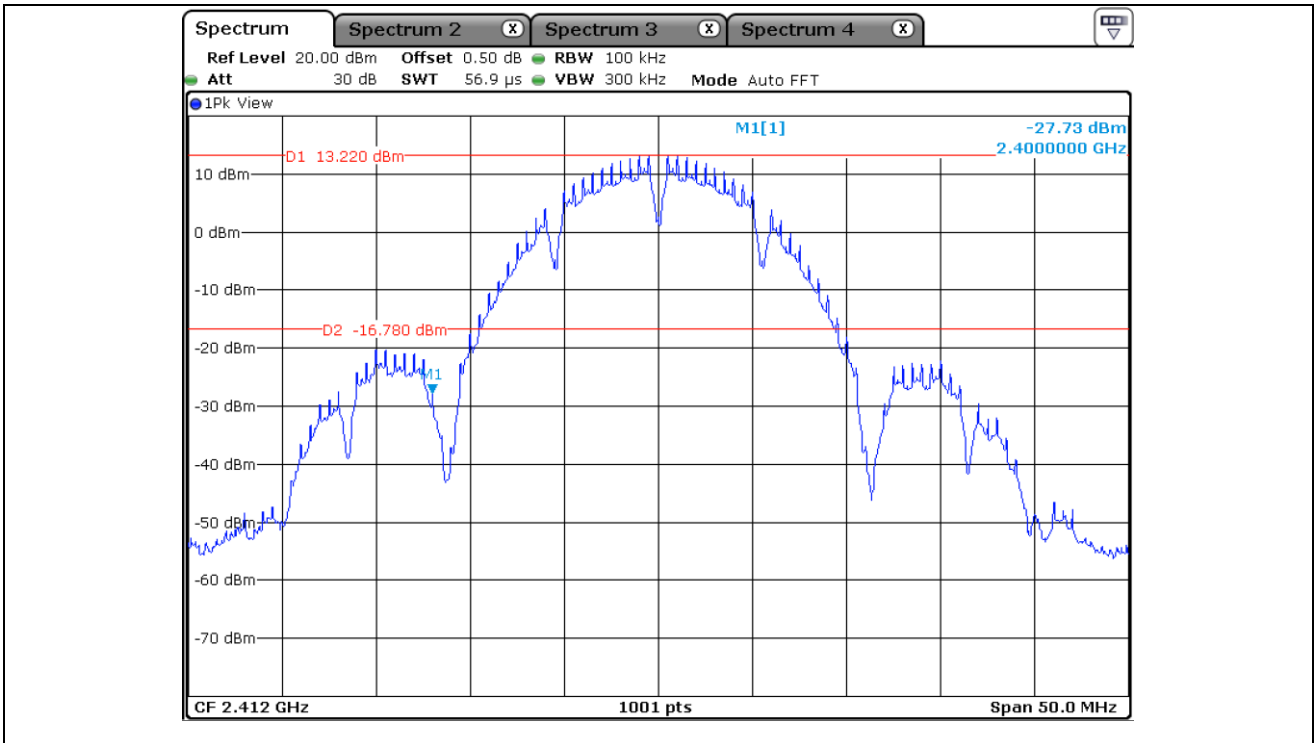
All test equipment used is calibrated on a regular basis.



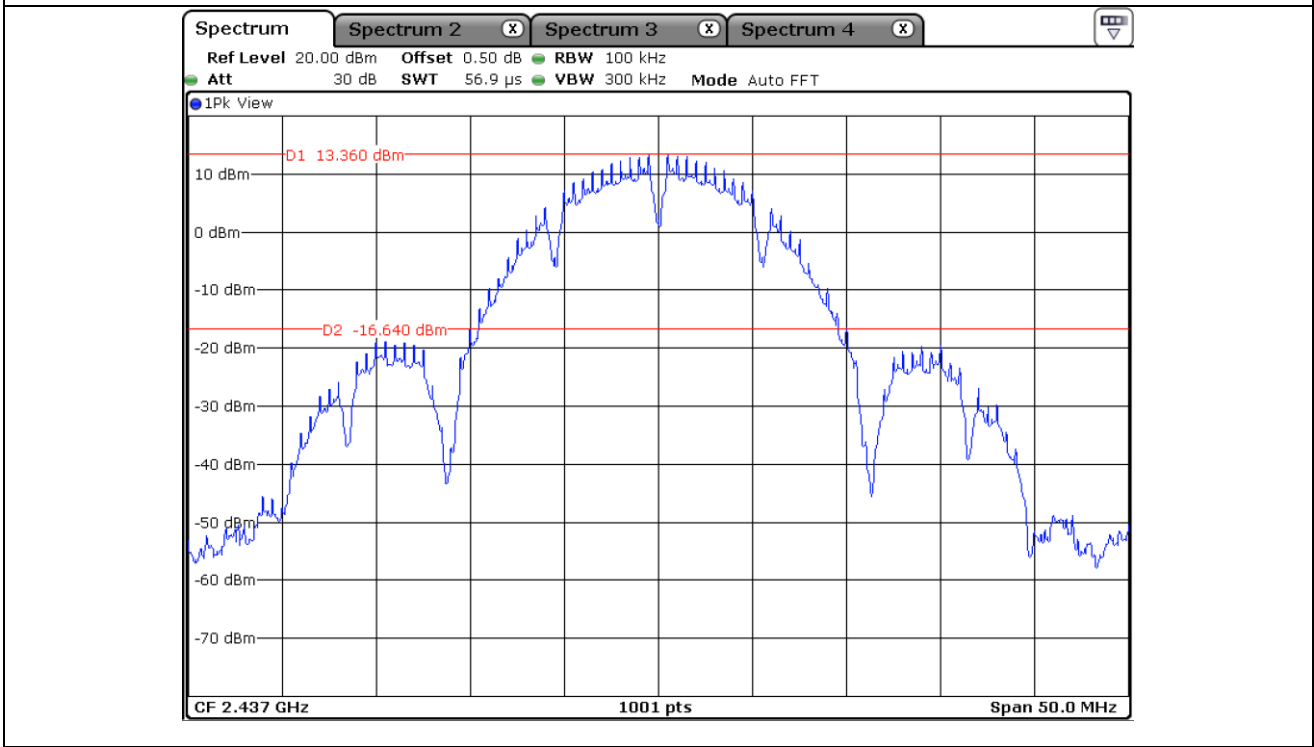
9.5 Test data for conducted emission

9.5.1 Test data for 802.11b WLAN Mode

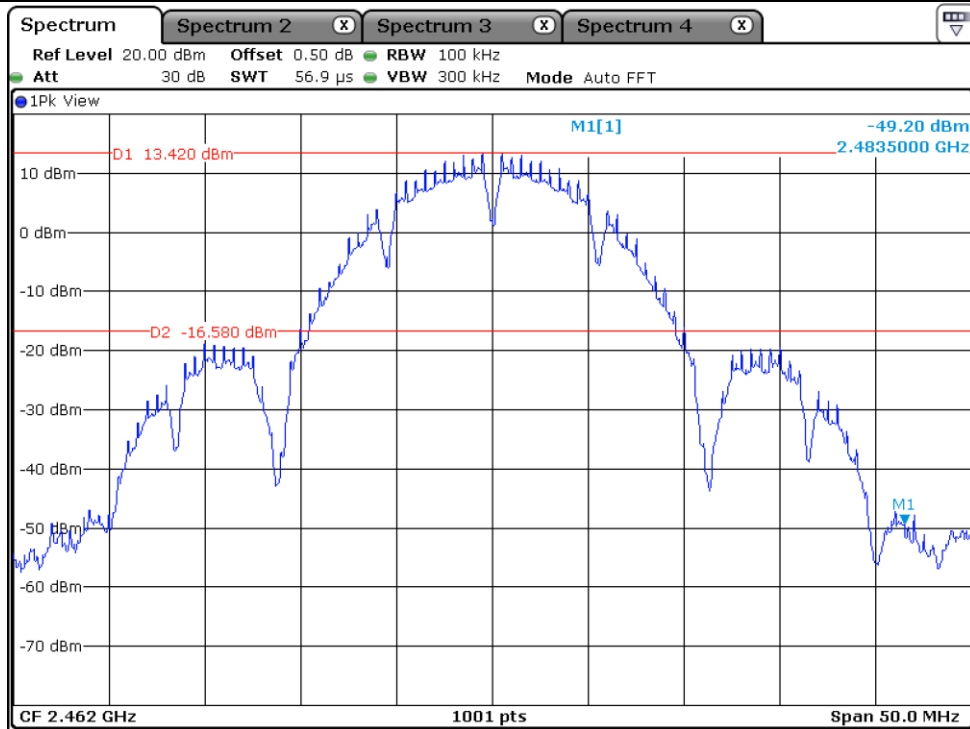
9.5.1.1 Test data for Antenna 0



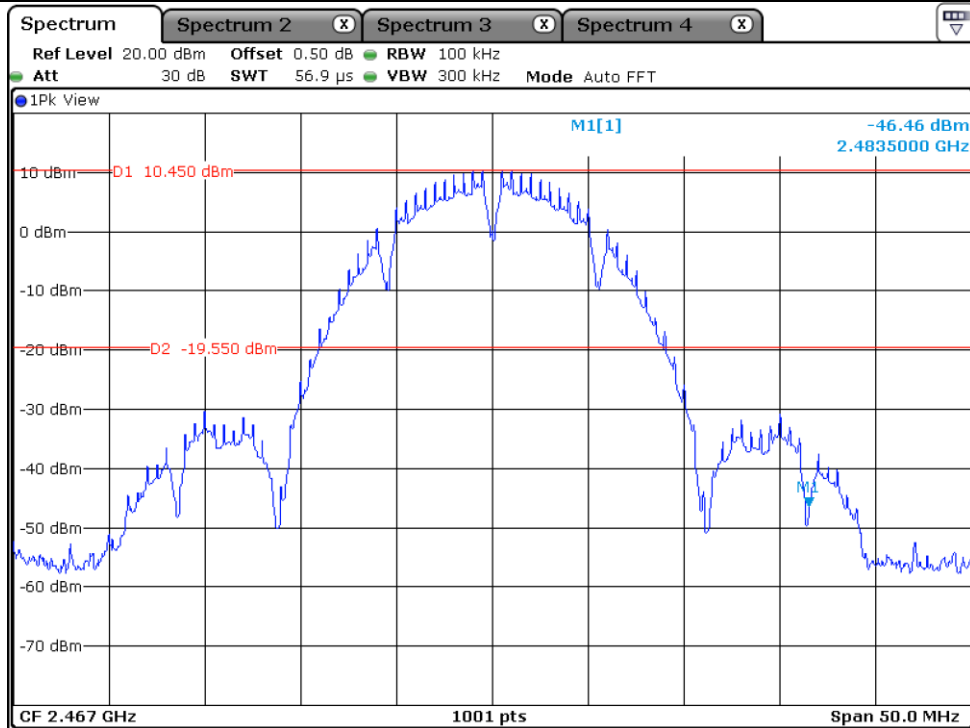
Low Channel



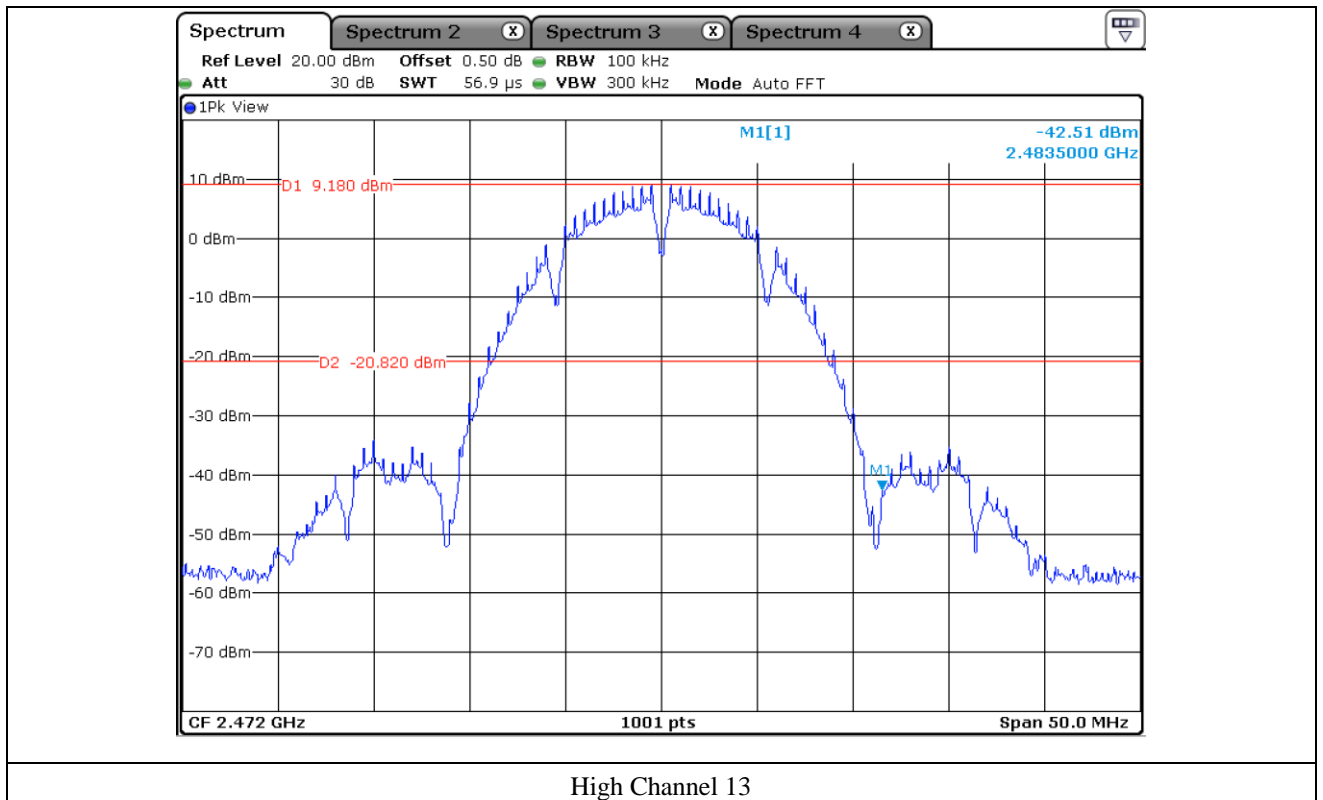
Middle Channel



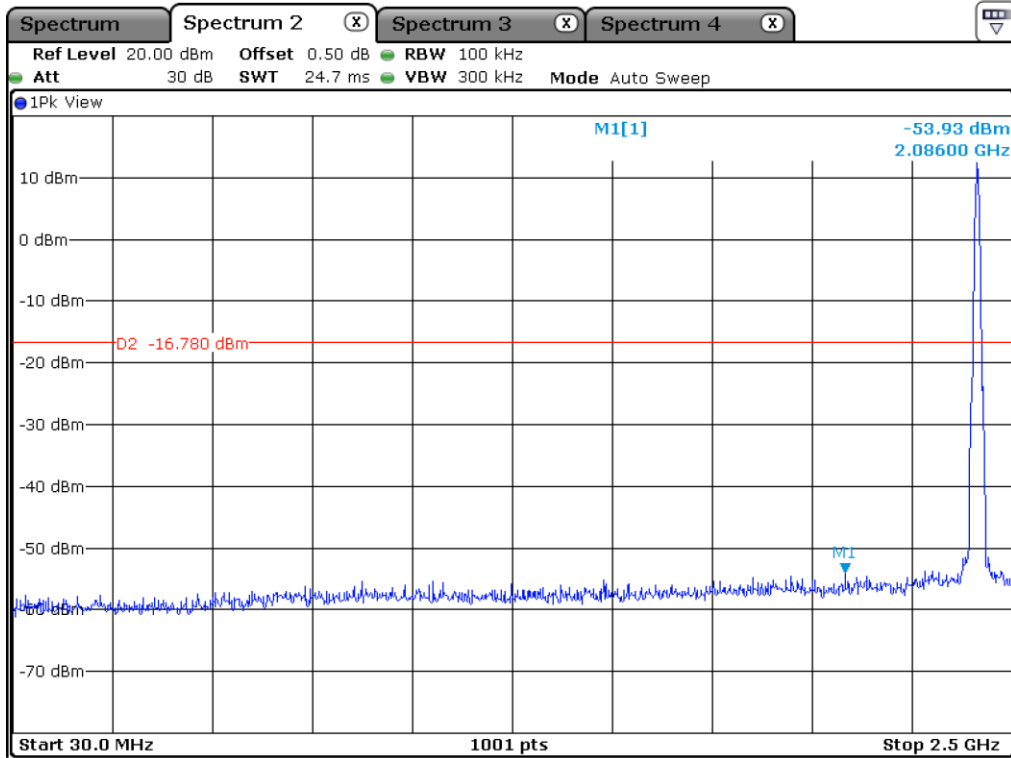
High Channel 11



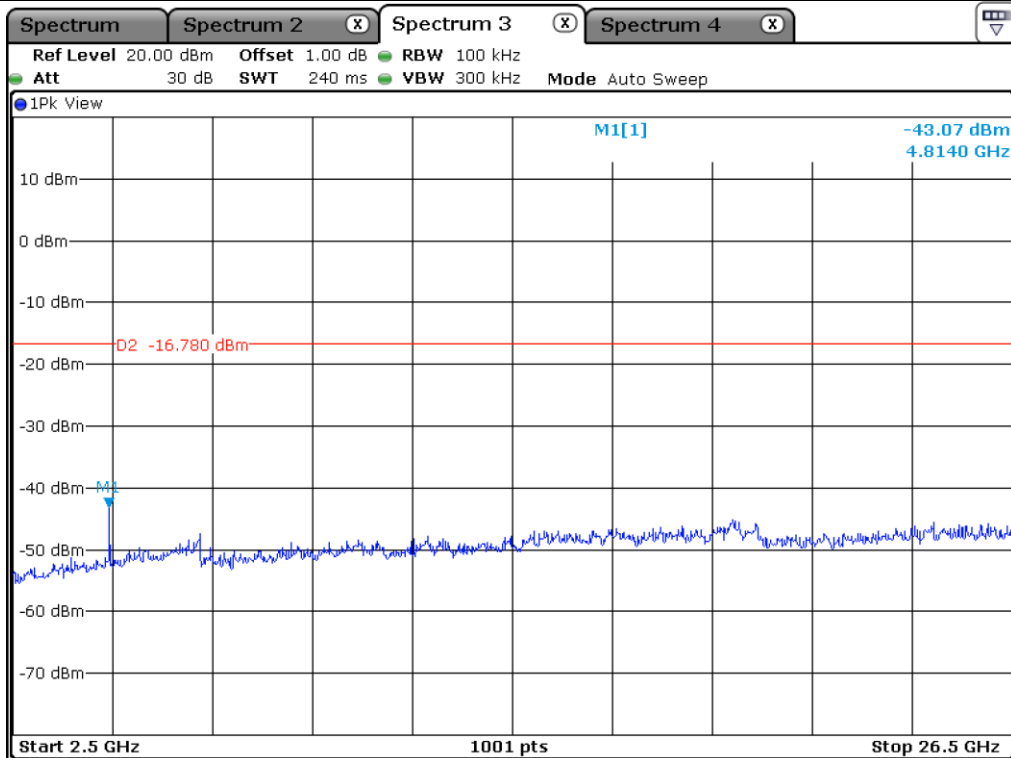
High Channel 12



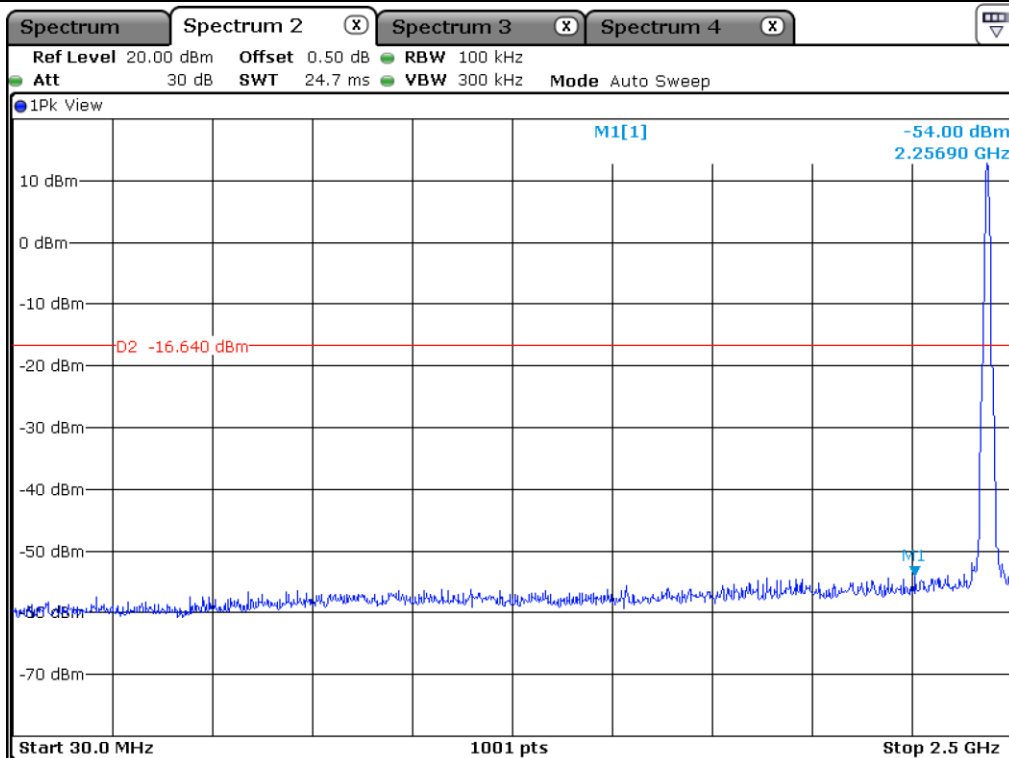
High Channel 13



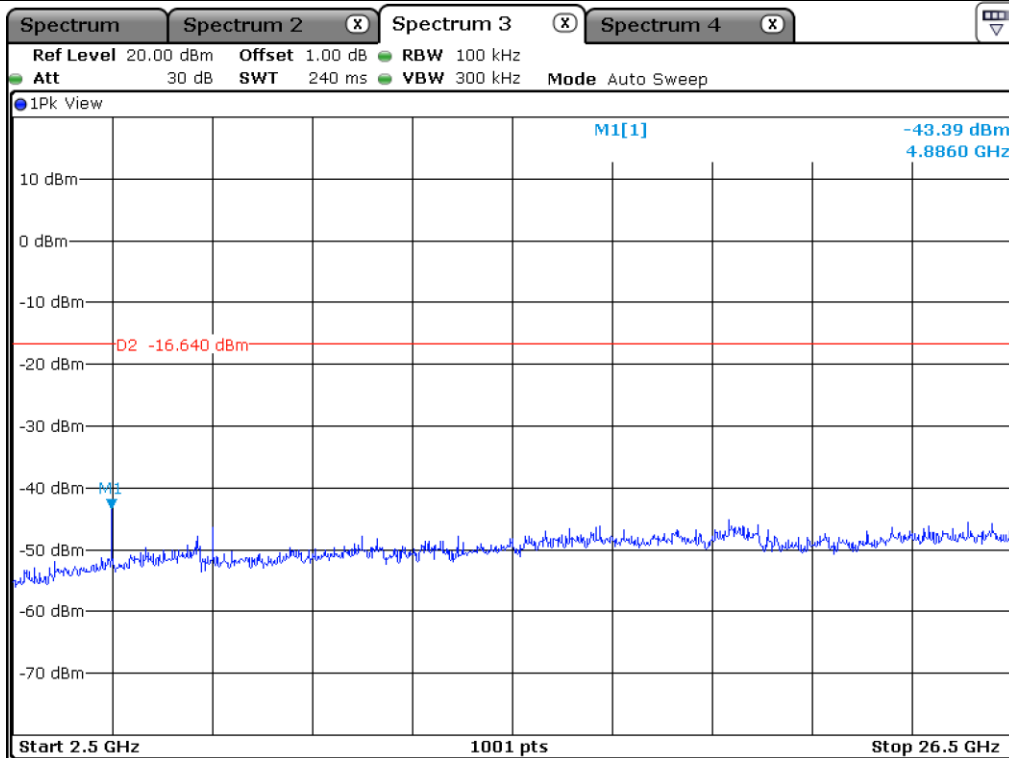
Low Channel



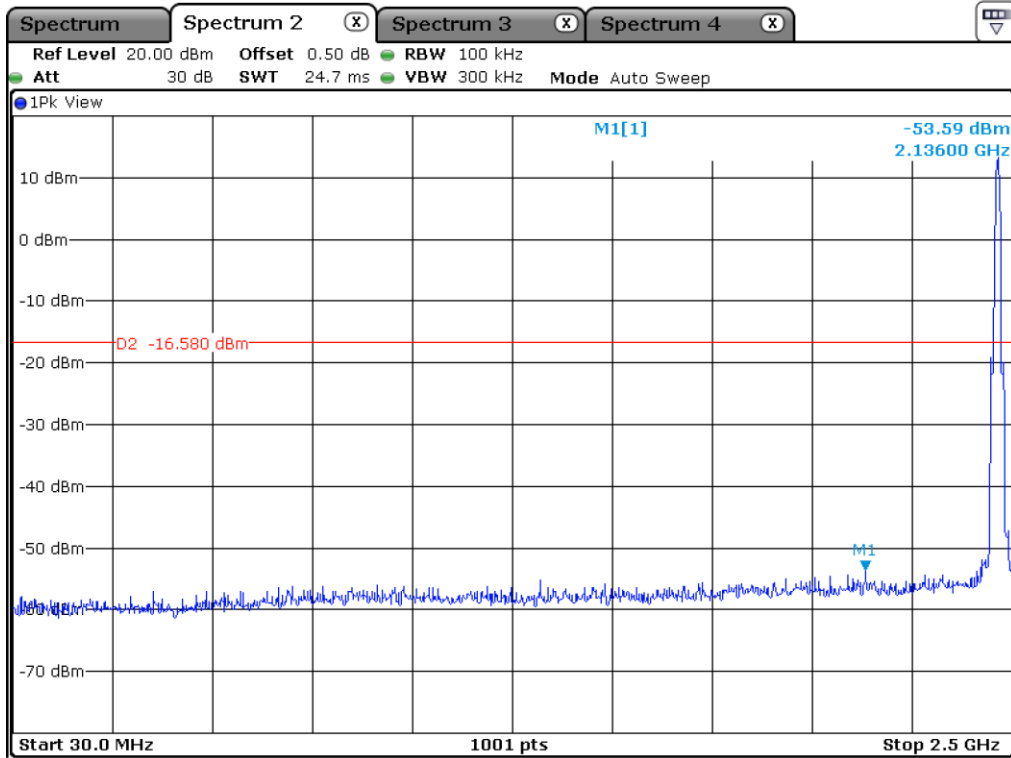
Low Channel



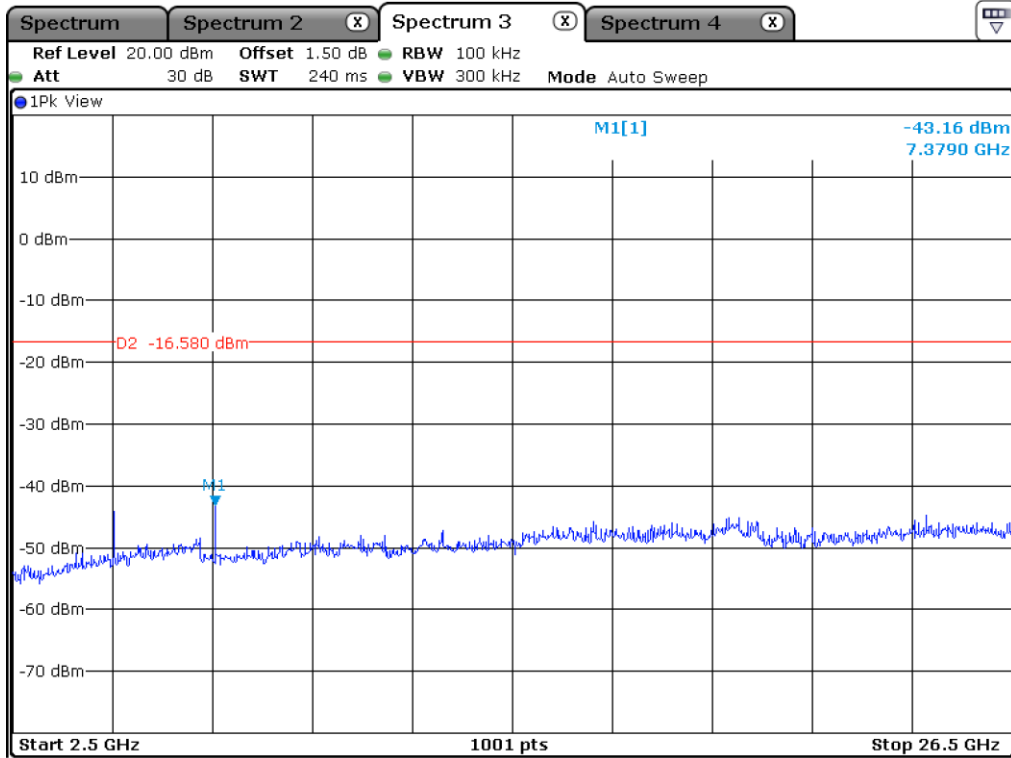
Middle Channel



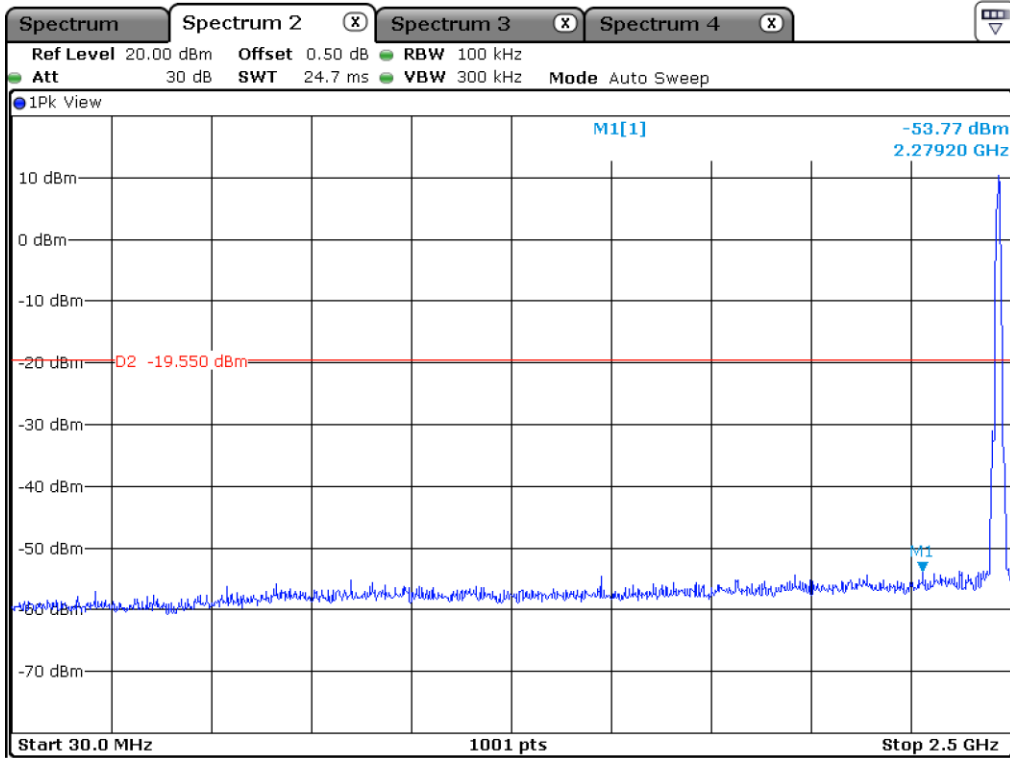
Middle Channel



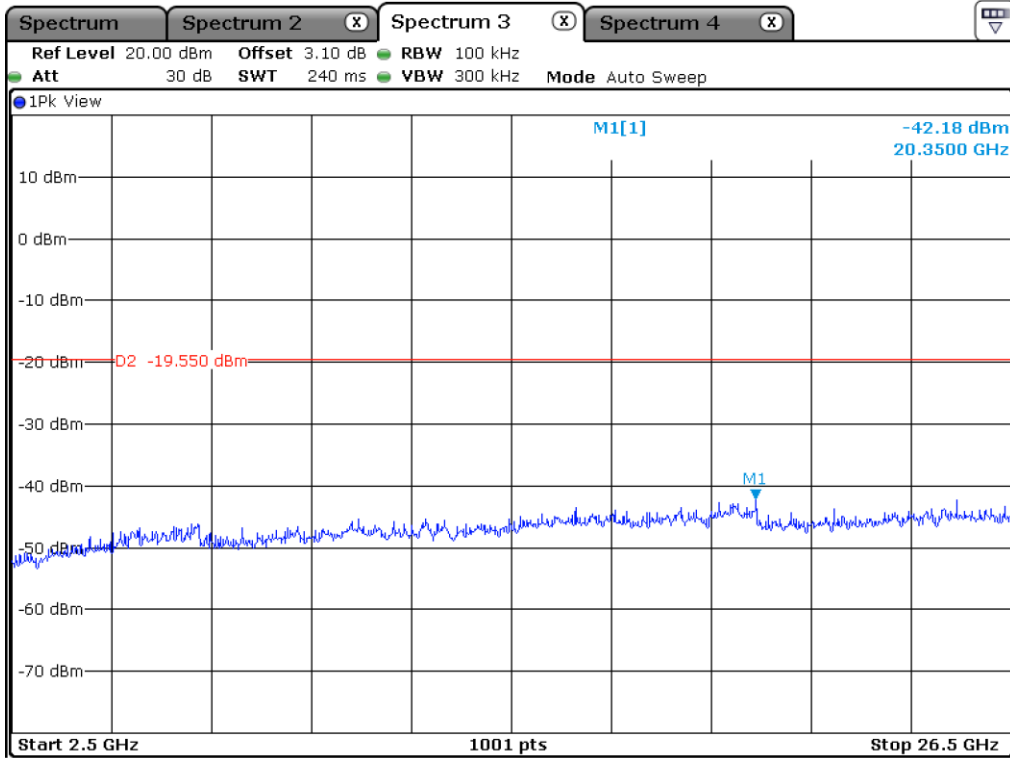
High Channel 11



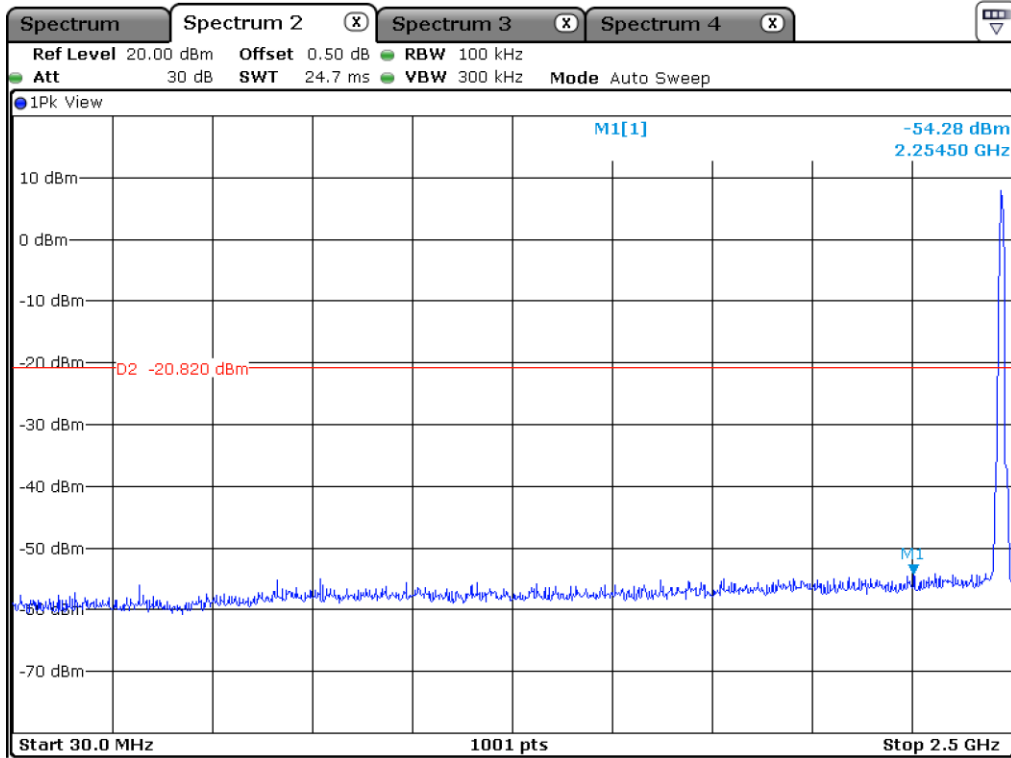
High Channel 11



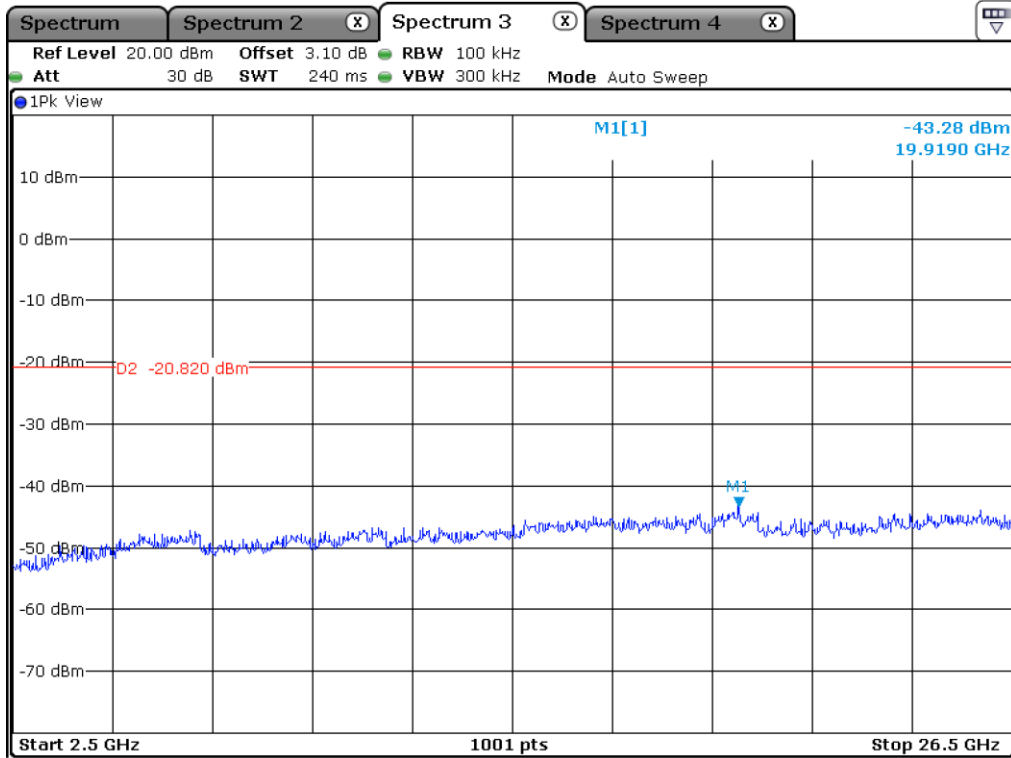
High Channel 12



High Channel 12



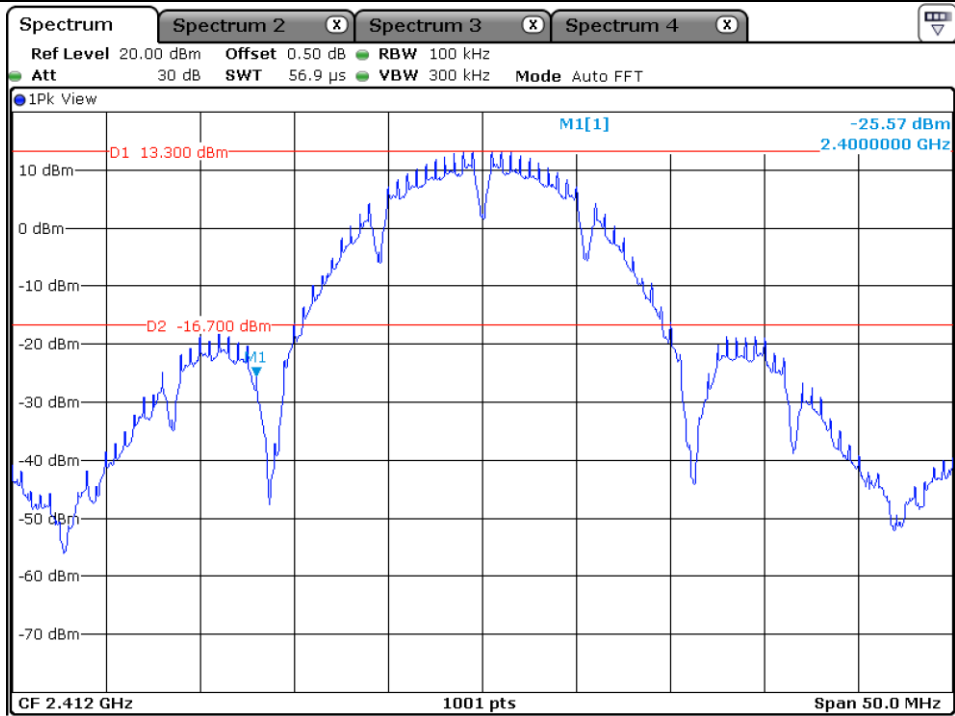
High Channel 13



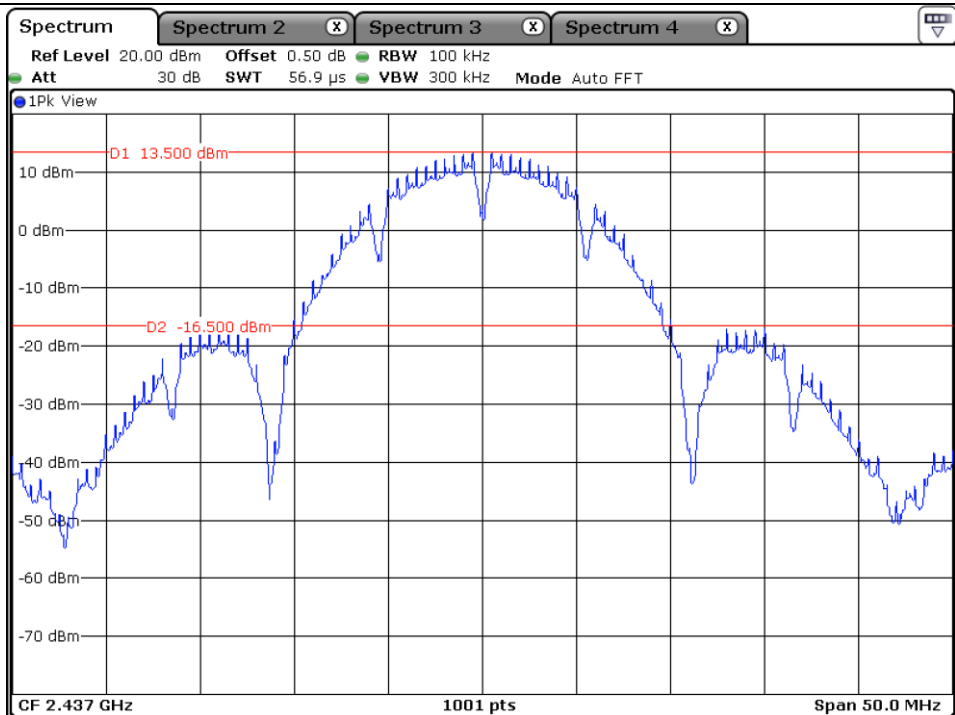
High Channel 13



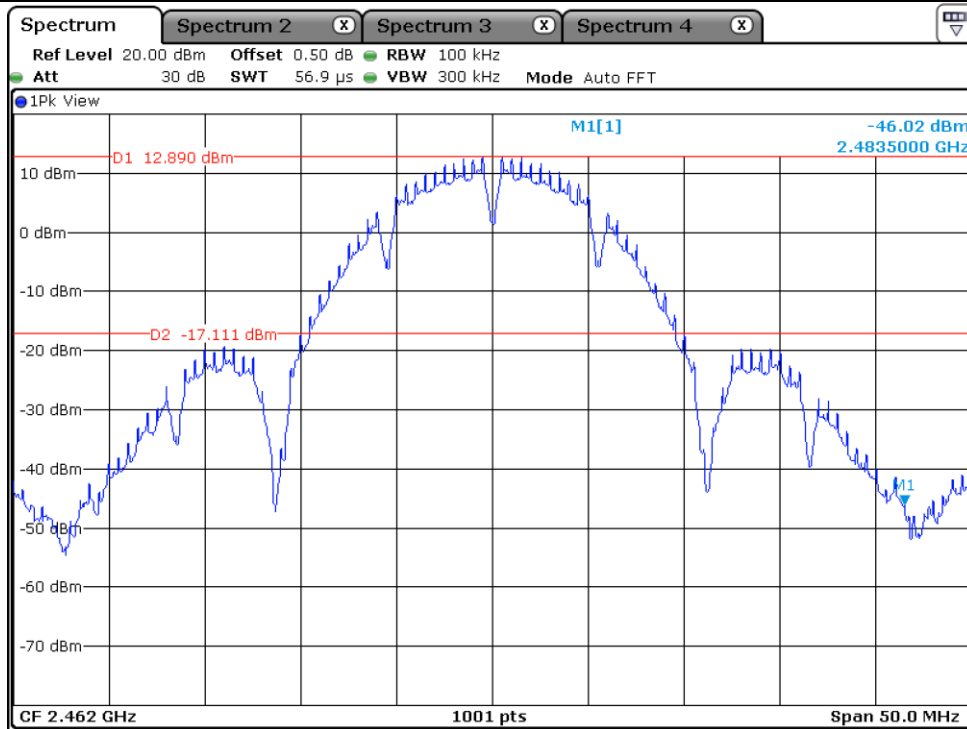
9.5.1.2 Test data for Antenna 1



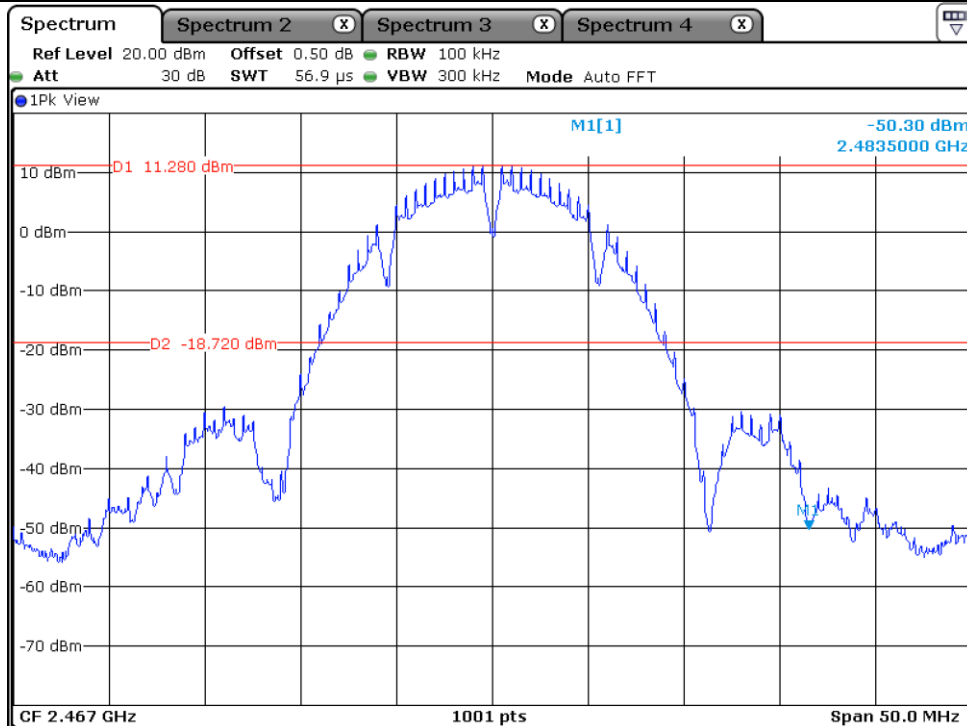
Low Channel



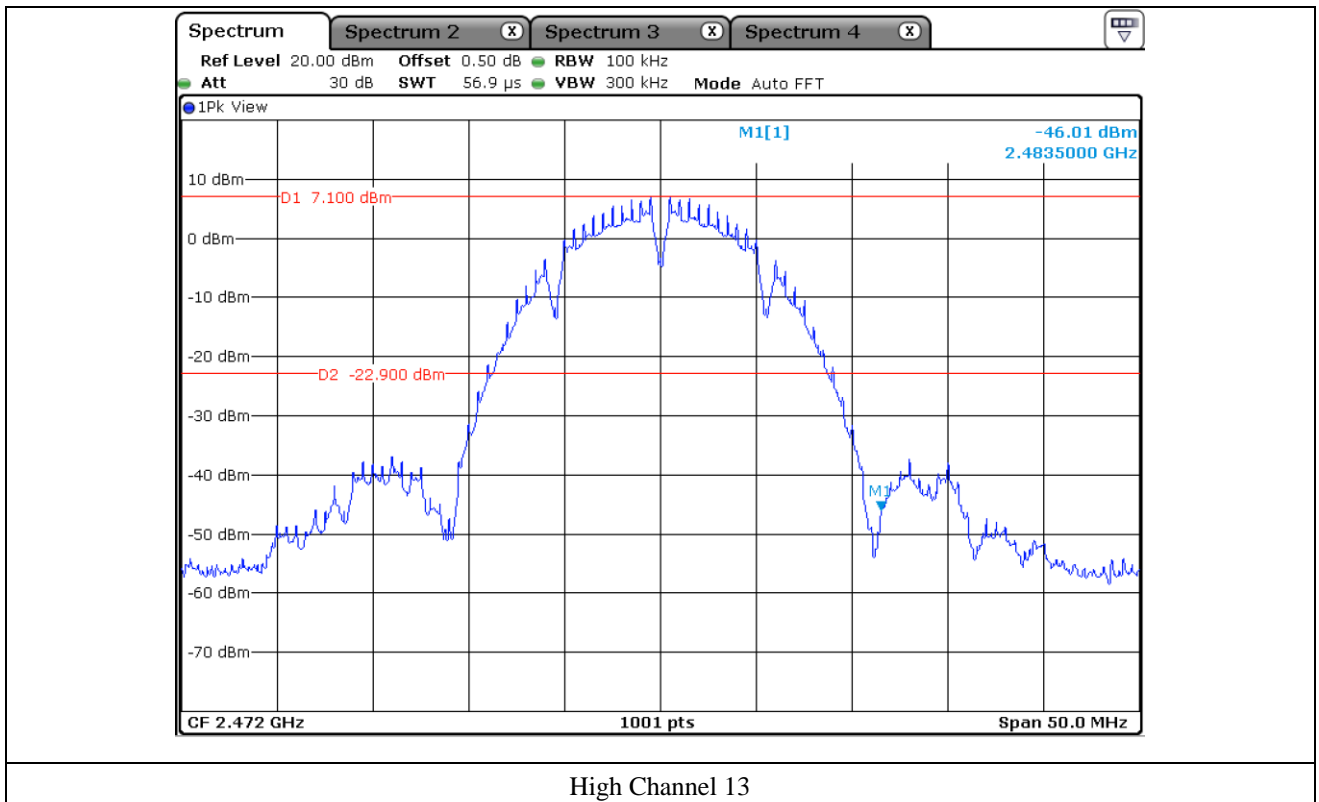
Middle Channel



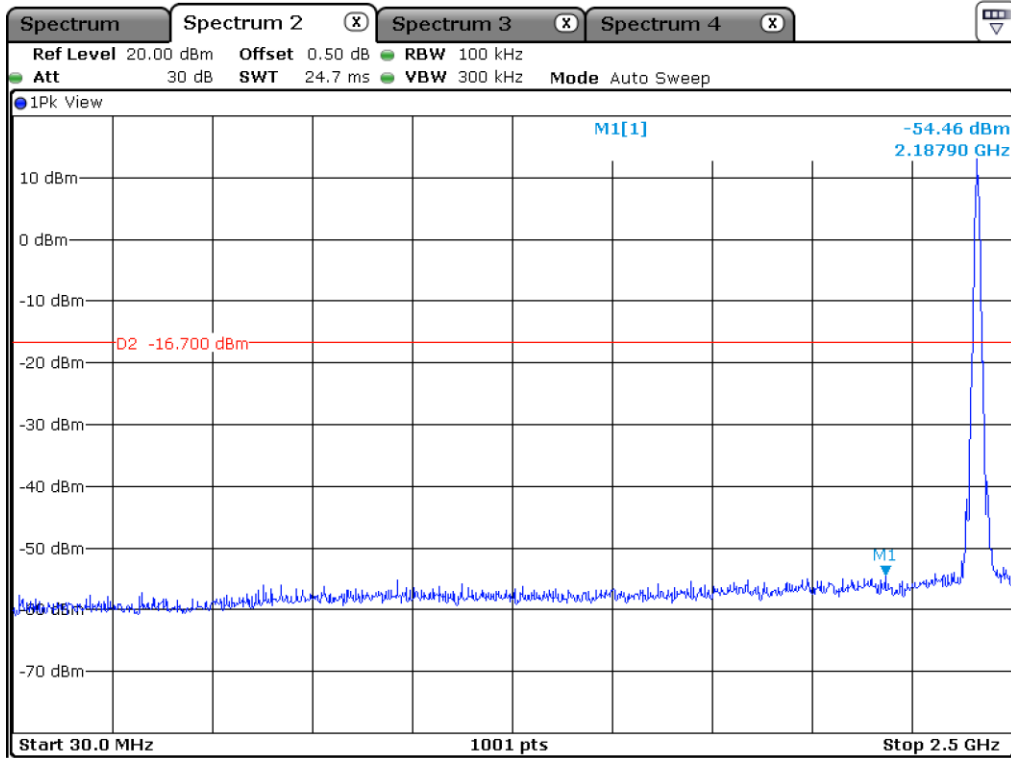
High Channel 11



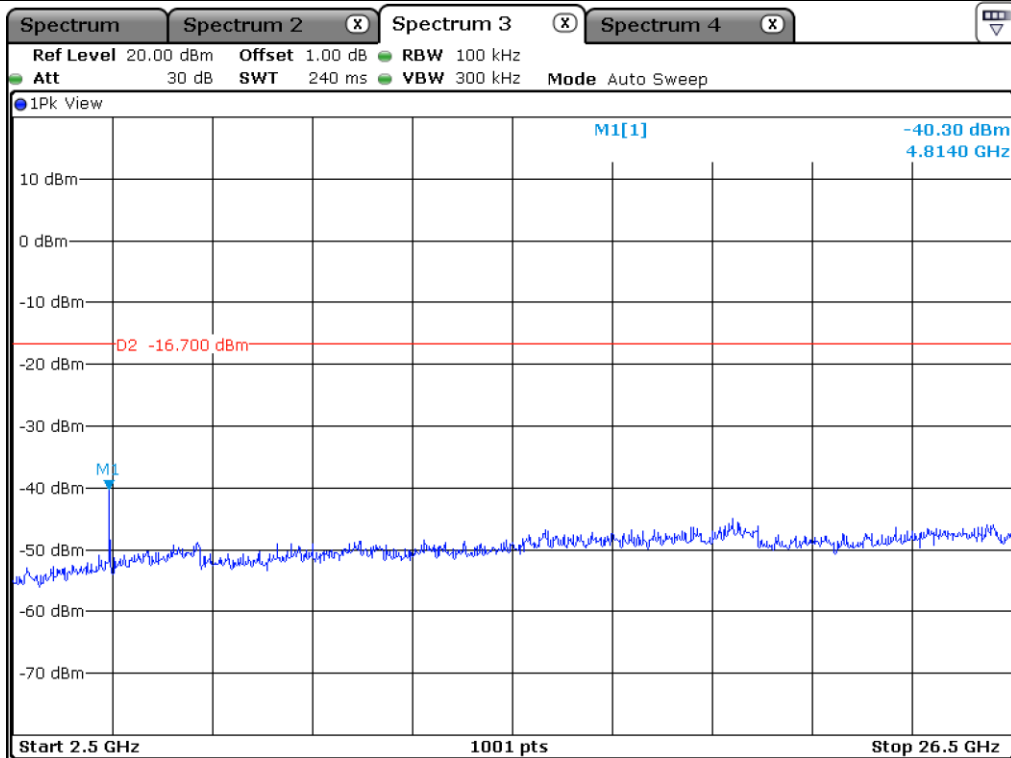
High Channel 12



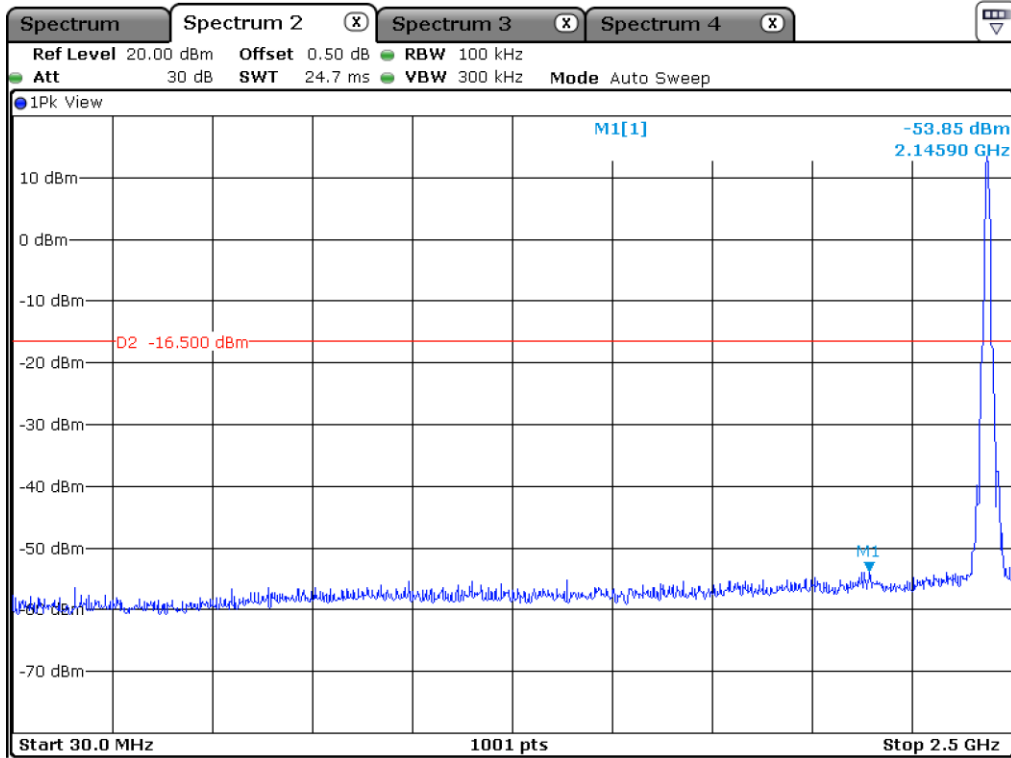
High Channel 13



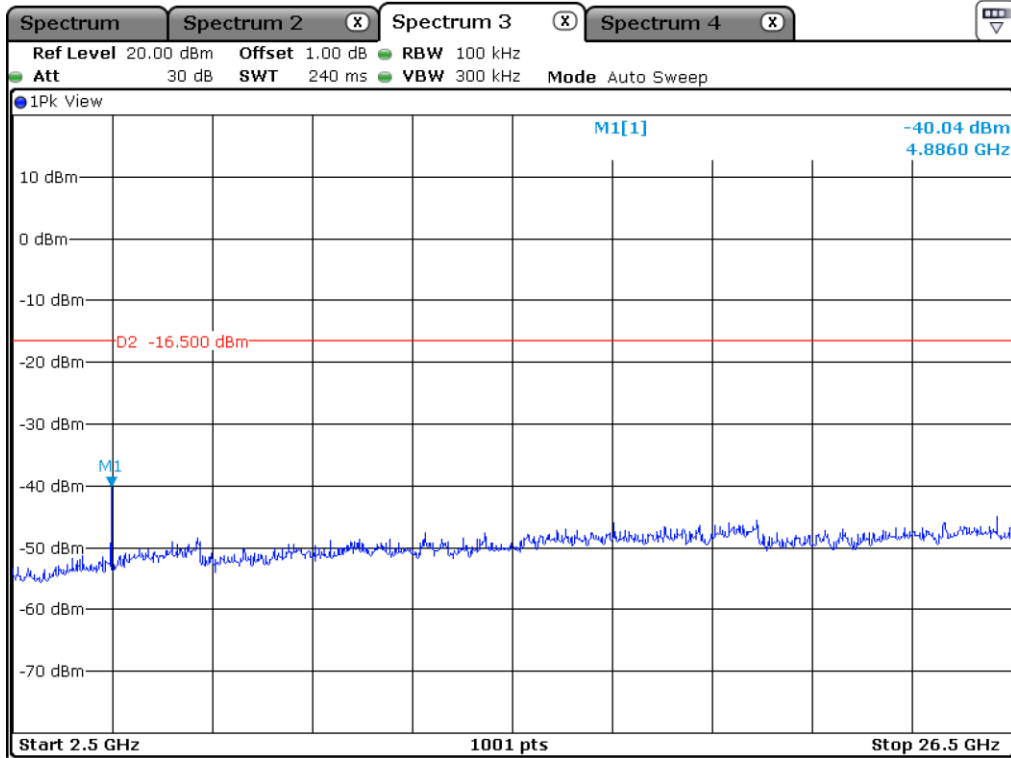
Low Channel



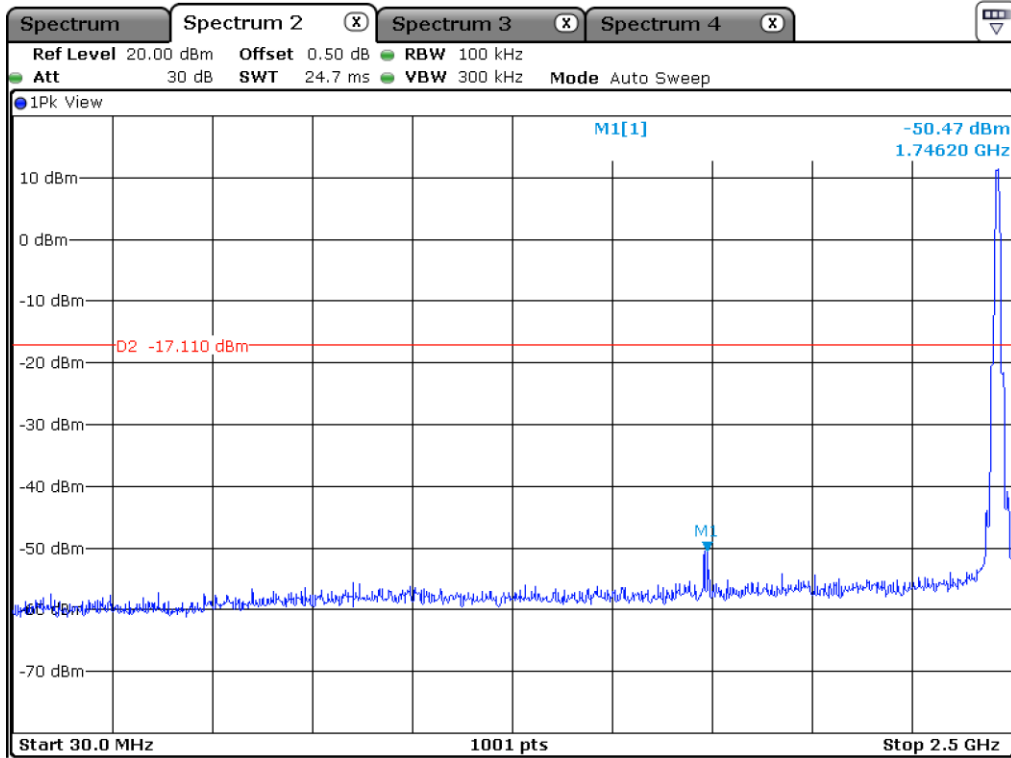
Low Channel



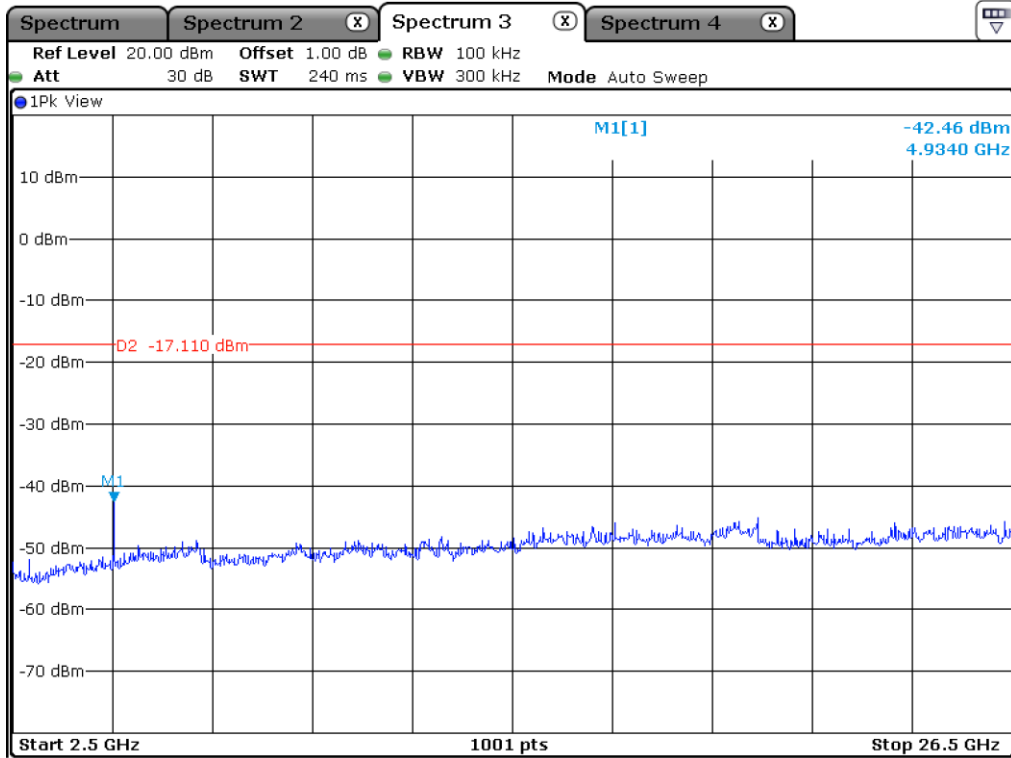
Middle Channel



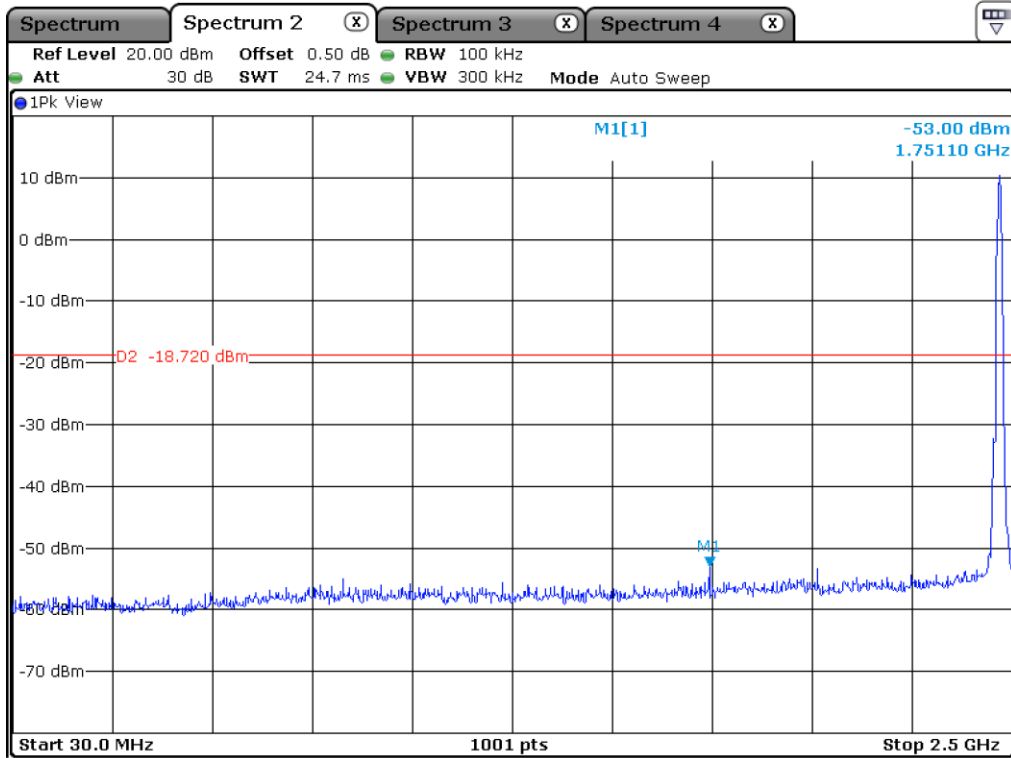
Middle Channel



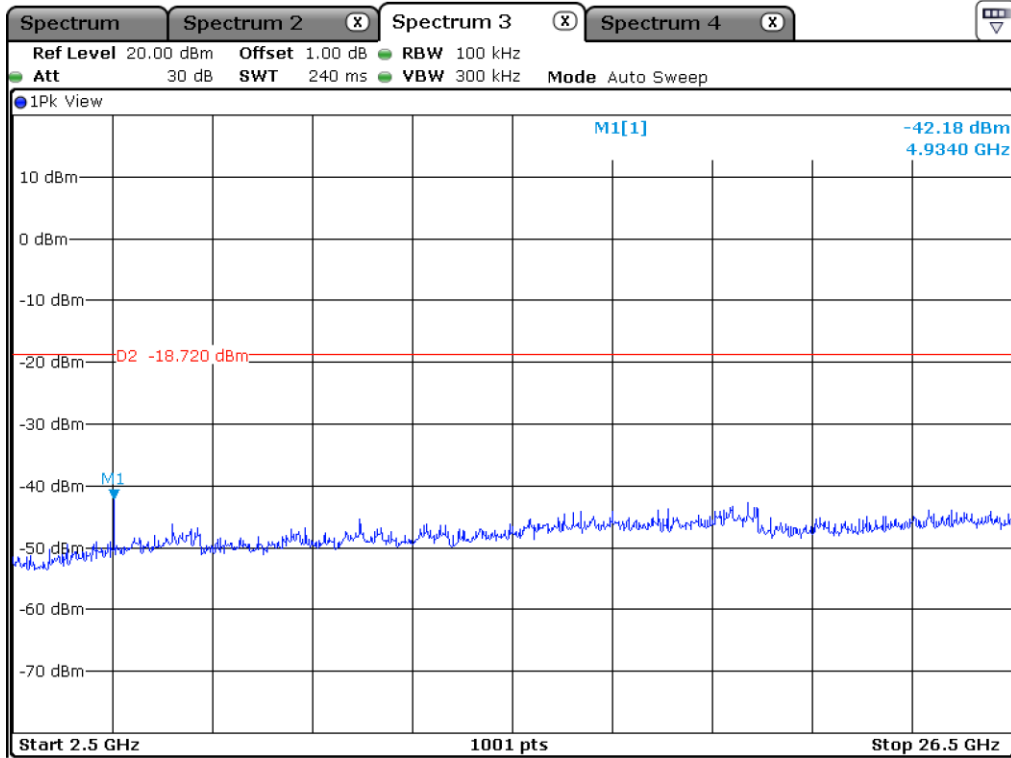
High Channel 11



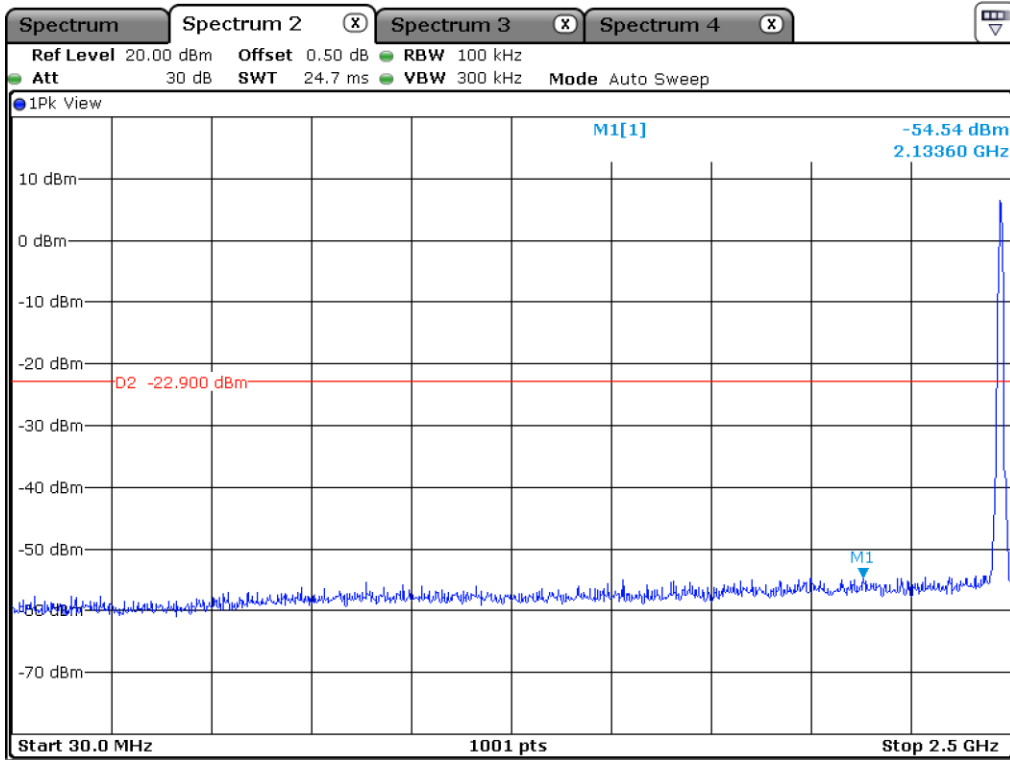
High Channel 11



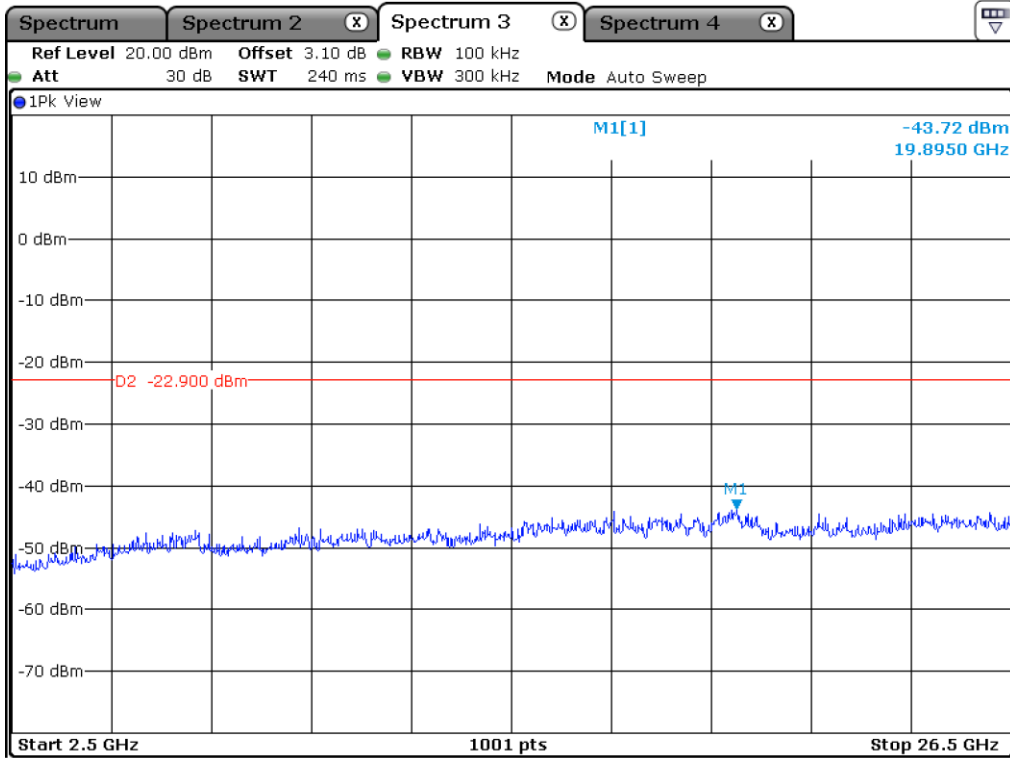
High Channel 12



High Channel 12



High Channel 13



High Channel 13