

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

**Test Report No.** : OT-183-RWD-042  
**AGR No.** : A17NA-430  
**Applicant** : omnic&s.Inc.  
**Address** : #314, 288 Digital-ro, Guro-gu, Daerung Post Tower 1cha, Seoul, 08390, South Korea  
**Manufacturer** : omnic&s.Inc.  
**Address** : #314, 288 Digital-ro, Guro-gu, Daerung Post Tower 1cha, Seoul, 08390, South Korea  
**Type of Equipment** : EEG measurement & brain training wireless headset  
**FCC ID.** : 2APFA-OCW-H20  
**Model Name** : OCW-H20  
**Multiple Model Name** : N/A  
**Serial number** : N/A  
**Total page of Report** : 79 pages (including this page)  
**Date of Incoming** : March 01, 2018  
**Date of issue** : March 30, 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.

## CONTENTS

	PAGE
<b>1. VERIFICATION OF COMPLIANCE .....</b>	<b>6</b>
<b>2. TEST SUMMARY.....</b>	<b>7</b>
<b>2.1 TEST ITEMS AND RESULTS .....</b>	<b>7</b>
<b>2.2 ADDITIONS, DEVIATIONS, EXCLUSIONS FROM STANDARDS.....</b>	<b>7</b>
<b>2.3 RELATED SUBMITTAL(S) / GRANT(S) .....</b>	<b>7</b>
<b>2.4 PURPOSE OF THE TEST .....</b>	<b>7</b>
<b>2.5 TEST METHODOLOGY.....</b>	<b>7</b>
<b>2.6 TEST FACILITY.....</b>	<b>8</b>
<b>3. GENERAL INFORMATION.....</b>	<b>9</b>
<b>3.1 PRODUCT DESCRIPTION.....</b>	<b>9</b>
<b>3.2 ALTERNATIVE TYPE(S)/MODEL(S); ALSO COVERED BY THIS TEST REPORT.....</b>	<b>9</b>
<b>4. EUT MODIFICATIONS.....</b>	<b>9</b>
<b>5. SYSTEM TEST CONFIGURATION .....</b>	<b>10</b>
<b>5.1 JUSTIFICATION.....</b>	<b>10</b>
<b>5.2 PERIPHERAL EQUIPMENT .....</b>	<b>10</b>
<b>5.3 MODE OF OPERATION DURING THE TEST .....</b>	<b>10</b>
<b>5.4 CONFIGURATION OF TEST SYSTEM.....</b>	<b>11</b>
<b>5.5 ANTENNA REQUIREMENT .....</b>	<b>11</b>
<b>6. PRELIMINARY TEST .....</b>	<b>11</b>
<b>6.1 AC POWER LINE CONDUCTED EMISSIONS TESTS.....</b>	<b>11</b>
<b>6.2 GENERAL RADIATED EMISSIONS TESTS .....</b>	<b>11</b>
<b>7. MINIMUM 20 DB BANDWIDTH.....</b>	<b>12</b>
<b>7.1 OPERATING ENVIRONMENT .....</b>	<b>12</b>
<b>7.2 TEST SET-UP .....</b>	<b>12</b>
<b>7.3 TEST EQUIPMENT USED.....</b>	<b>12</b>
<b>7.4 TEST DATA FOR 1 MBPS .....</b>	<b>13</b>
<b>7.5 TEST DATA FOR 2 MBPS .....</b>	<b>15</b>
<b>7.6 TEST DATA FOR 3 MBPS .....</b>	<b>17</b>
<b>8. HOPPING FREQUENCY SEPARATION.....</b>	<b>19</b>
<b>8.1 OPERATING ENVIRONMENT .....</b>	<b>19</b>
<b>8.2 TEST SET-UP .....</b>	<b>19</b>

8.3 TEST EQUIPMENT USED .....	19
8.4 TEST DATA FOR 1 MBPS .....	20
8.5 TEST DATA FOR 2 MBPS .....	21
8.6 TEST DATA FOR 3 MBPS .....	22
<b>9. NUMBER OF HOPPING CHANNELS .....</b>	<b>23</b>
9.1 OPERATING ENVIRONMENT .....	23
9.2 TEST SET-UP .....	23
9.3 TEST EQUIPMENT USED .....	23
9.4 TEST DATA FOR 1 MBPS .....	24
9.5 TEST DATA FOR 2 MBPS .....	27
9.6 TEST DATA FOR 3 MBPS .....	30
<b>10. TIME OF OCCUPANCY .....</b>	<b>33</b>
10.1 OPERATING ENVIRONMENT .....	33
10.2 TEST SET-UP .....	33
10.3 TEST EQUIPMENT USED .....	33
10.4 TEST DATA FOR 1 MBPS .....	34
10.5 TEST DATA FOR 2 MBPS .....	37
10.6 TEST DATA FOR 3 MBPS .....	40
<b>11. MAXIMUM PEAK OUTPUT POWER .....</b>	<b>43</b>
11.1 OPERATING ENVIRONMENT .....	43
11.2 TEST SET-UP .....	43
11.3 TEST EQUIPMENT USED .....	43
11.4 TEST DATA FOR 1 MBPS .....	44
11.5 TEST DATA FOR 2 MBPS .....	46
11.6 TEST DATA FOR 3 MBPS .....	48
<b>12. 100 KHZ BANDWIDTH OUTSIDE THE FREQUENCY BAND .....</b>	<b>50</b>
12.1 OPERATING ENVIRONMENT .....	50
12.2 TEST SET-UP FOR CONDUCTED MEASUREMENT .....	50
12.3 TEST SET-UP FOR RADIATED MEASUREMENT .....	50
12.4 TEST EQUIPMENT USED .....	50
12.5 TEST DATA FOR CONDUCTED EMISSION .....	51
12.5.1 Test data for 1 Mbps .....	51
12.5.2 Test data for 2 Mbps .....	56
12.5.3 Test data for 3 Mbps .....	61
12.6 TEST DATA FOR TRANSMITTING MODE RADIATED EMISSION .....	66
12.6.1 Radiated Emission which fall in the Restricted Band .....	66

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12.6.2 Spurious & Harmonic Radiated Emission above 1 GHz.....	69
<b>13. RADIATED EMISSION TEST .....</b>	<b>72</b>
13.1 OPERATING ENVIRONMENT .....	72
13.2 TEST SET-UP .....	72
13.3 TEST EQUIPMENT USED.....	72
13.4 Test data for 30 MHz ~ 1 000 MHz.....	73
13.5 Test data for Below 30 MHz.....	76
13.6 Test data for above 1 GHz .....	76
<b>14. CONDUCTED EMISSION TEST .....</b>	<b>77</b>
14.1 OPERATING ENVIRONMENT .....	77
14.2 TEST SET-UP .....	77
14.3 TEST EQUIPMENT USED.....	77
14.4 TEST DATA.....	78

**Revision History**

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-183-RWD-042	2018.03.30	Initial Release	All

## 1. VERIFICATION OF COMPLIANCE

Applicant : omnic&s.Inc.  
 Address : #314, 288 Digital-ro, Guro-gu, Daerung Post Tower 1cha, Seoul, 08390, South Korea  
 Contact Person : Hyungmin, Kim / Dept. manager  
 Telephone No. : +82-2-70-7605-6127  
 FCC ID : 2APFA-OCW-H20  
 Model Name : OCW-H20  
 Serial Number : N/A  
 Date : March 30, 2018

EQUIPMENT CLASS	DSS – PART 15 SPREAD SPECTRUM TRANSMITTER
E.U.T. DESCRIPTION	EEG measurement & brain training wireless headset
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.

## 2. TEST SUMMARY

### 2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (1)	Carrier Frequency Separation	Met the Limit / PASS
15.247 (a) (1) (iii)	Minimum Number of Hopping Channels	Met the Limit / PASS
15.247 (a) (1) (iii)	Average Time of Occupancy	Met the Limit / PASS
15.247 (b) (1)	Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247 (b) (5)	Radio Frequency Exposure Level	Met requirement / 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
15.209	Radiated Emission Limits, General Requirement	Met the Limit / PASS
15.207	Conducted Limits	Met the Limit / PASS
15.203	Antenna Requirement	Met requirement / PASS

\* Please contact us [(TEL : +82-31-799-9500 (Ext.0)] for verification of this test report.

### 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 omnic&s.Inc., Model OCW-H20 (referred to as the EUT in this report) is a EEG measurement & brain training wireless headset. Product specification information described herein was obtained from product data sheet or user’s manual.

Device Type	EEG measurement & brain training wireless headset		
Temperature Range	5 °C ~ + 40 °C		
Operating Frequency	Bluetooth LE	2 402 MHz ~ 2 480 MHz	
	Bluetooth	2 402 MHz ~ 2 480 MHz	
RF Output Power	Bluetooth LE	-2.83 dBm	
	Bluetooth	1 Mbps	8.77 dBm
		2 Mbps	7.84 dBm
		3 Mbps	8.01 dBm
Modulation Type	Bluetooth LE	DSSS Modulation(GFSK)	
	Bluetooth	1 Mbps: GFSK 2 Mbps: $\pi/4$ -QPSK 3 Mbps: 8-DPSK	
Antenna Type	Bluetooth LE : Ceramic Chip Antenna Bluetooth : Chip Antenna		
Antenna Gain	Bluetooth LE : 1.10 dBi Bluetooth : 2.30 dBi		
SW version	EA1.0.0		
HW version	HS ver1.0.1		
Electrical Rating	DC 3.70 V		
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	Bluetooth LE	26 MHz	
	Bluetooth	32.768 kHz, 38.4 MHz	

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

-. None

### 4. EUT MODIFICATIONS

-. None

## 5. SYSTEM TEST CONFIGURATION

### 5.1 Justification

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

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	OMNIC&S Inc.	N/A	N/A
Sub Board	OMNIC&S Inc.	N/A	N/A

### 5.2 Peripheral equipment

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

Model	Manufacturer	Description	Connected to
OCW-H20	OMNIC&S Inc.	EEG measurement & brain training wireless headset (EUT)	-
JIG	N/A	TEST JIG	EUT
Probook	HP	Notebook PC	-
Adaptor	Apple Inc	DC Adaptor	-

### 5.3 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting is programmed.

For final testing, the EUT was set at 2 402 MHz, 2 441MHz, and 2 480 MHz 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 “XZ” axis, but the worst data was recorded in this report.

### 5.4 Configuration of Test System

**Line Conducted Test:** The EUT was connected to adapter. 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 a Chip Antenna (Bluetooth) and Ceramic Chip Antenna (Bluetooth LE) 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

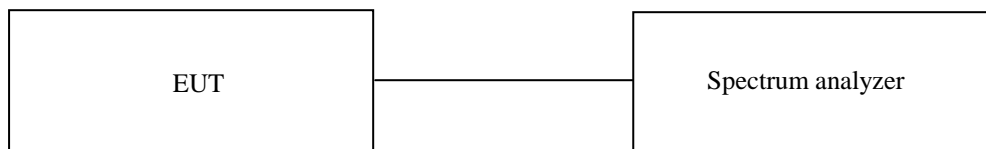
## 7. MINIMUM 20 dB BANDWIDTH

### 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 10 kHz, and peak detection was used. The 20 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 20 dB.



### 7.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Apr. 05, 2017 (1Y)

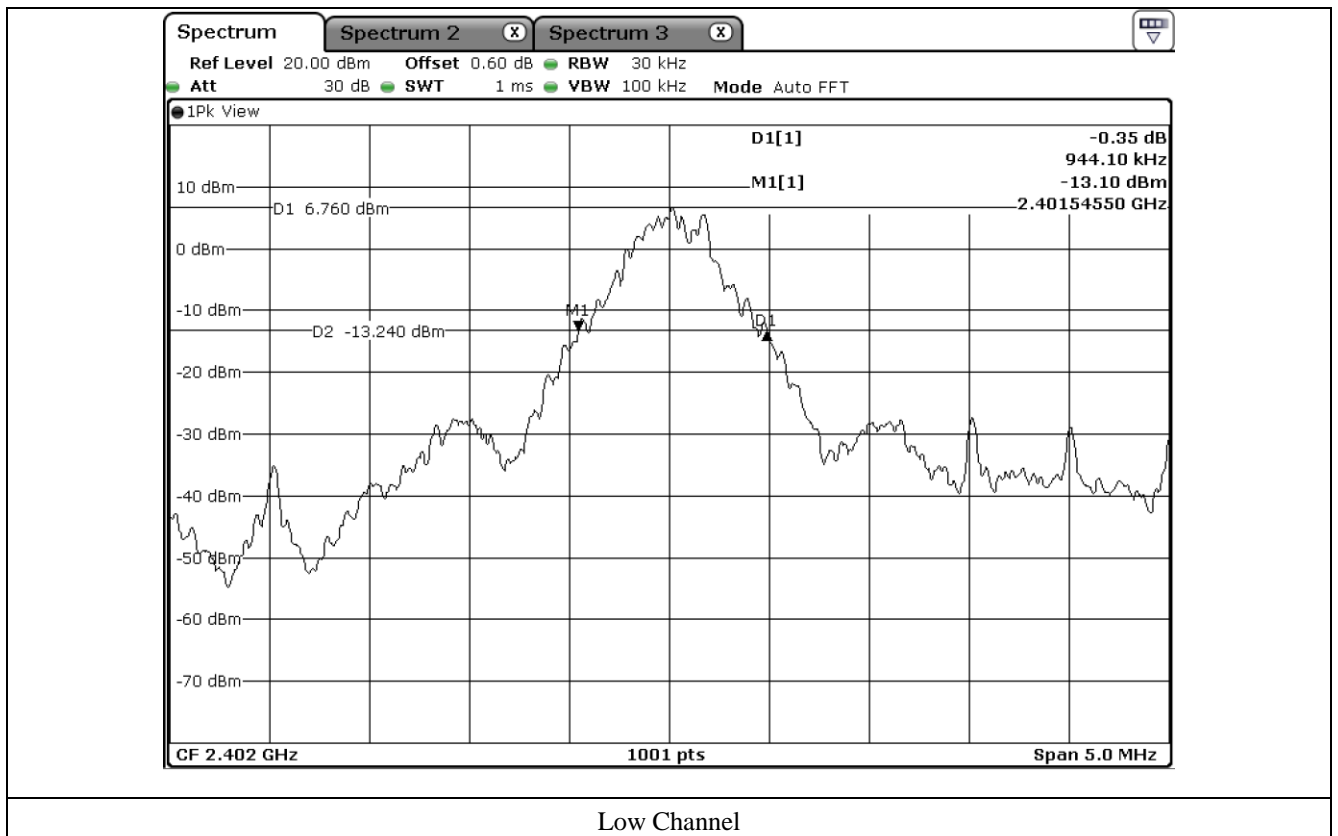
All test equipment used is calibrated on a regular basis.

### 7.4 Test data for 1 Mbps

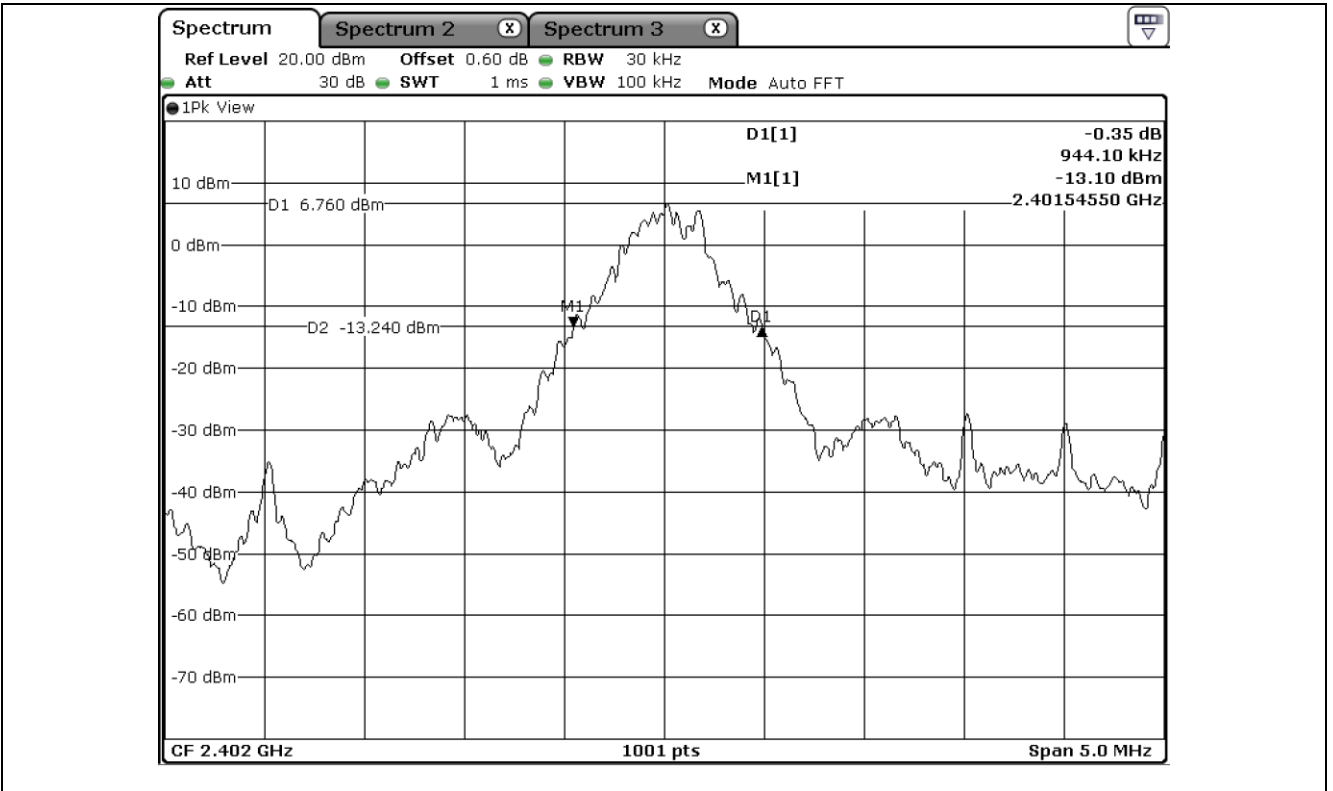
-. Test Date : March 01, 2018 ~ March 12, 2018

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)
Low	2 402.00	944.10
Middle	2 441.00	949.10
High	2 480.00	949.10

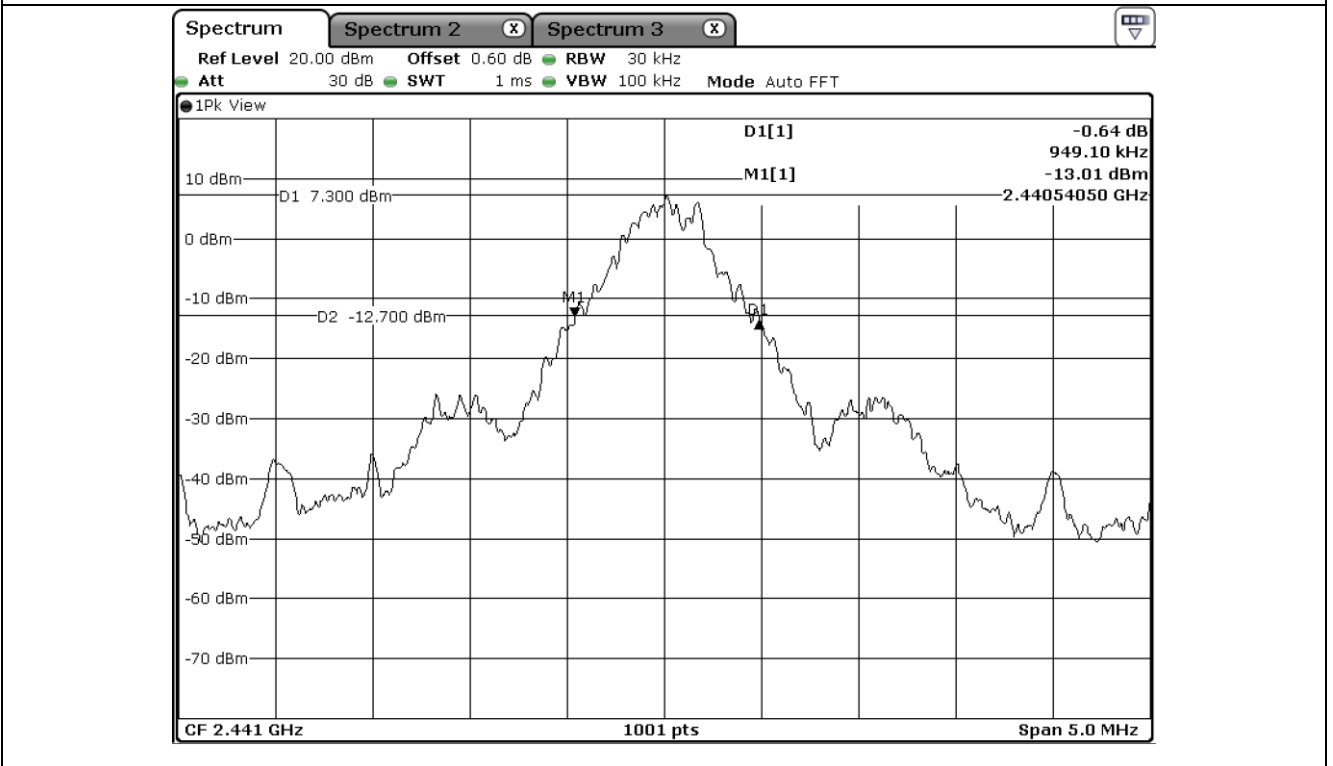
Tested by: Yu-Seog, Sim / Assistant Manager



Low Channel



Middle Channel



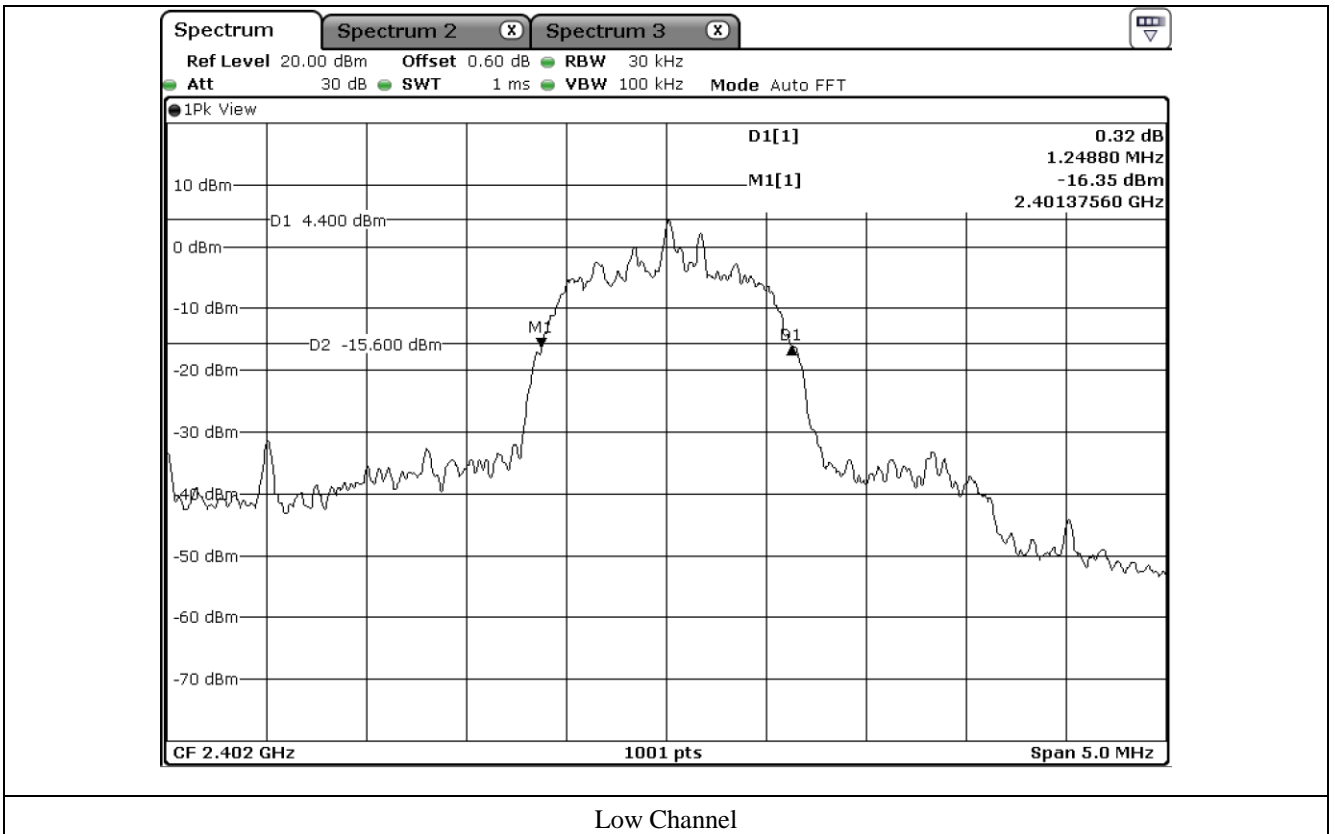
High Channel

### 7.5 Test data for 2 Mbps

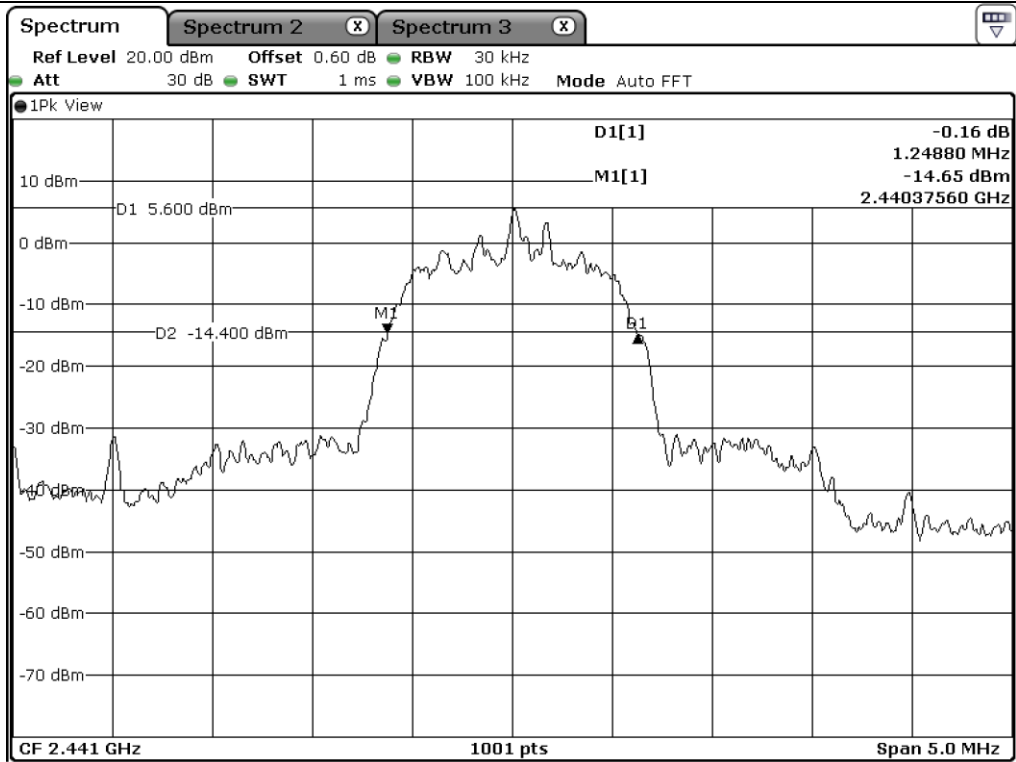
-. Test Date : March 01, 2018 ~ March 12, 2018

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)
Low	2 402.00	1 248.80
Middle	2 441.00	1 248.80
High	2 480.00	1 248.80

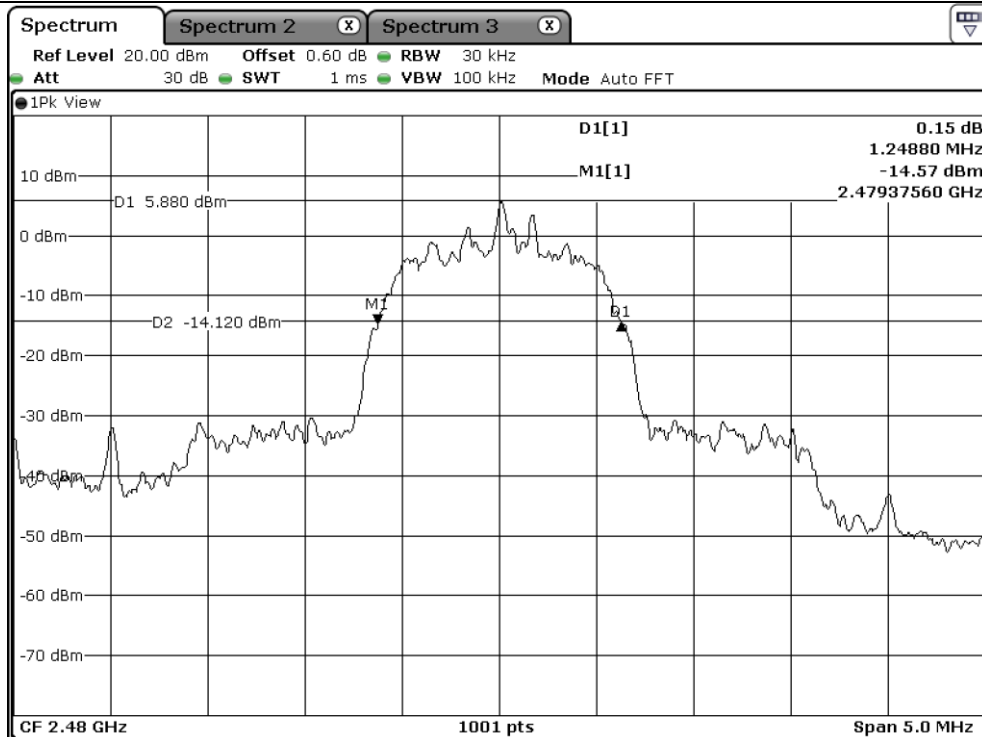
Tested by: Yu-Seog, Sim / Assistant Manager



Low Channel



Middle Channel



High Channel

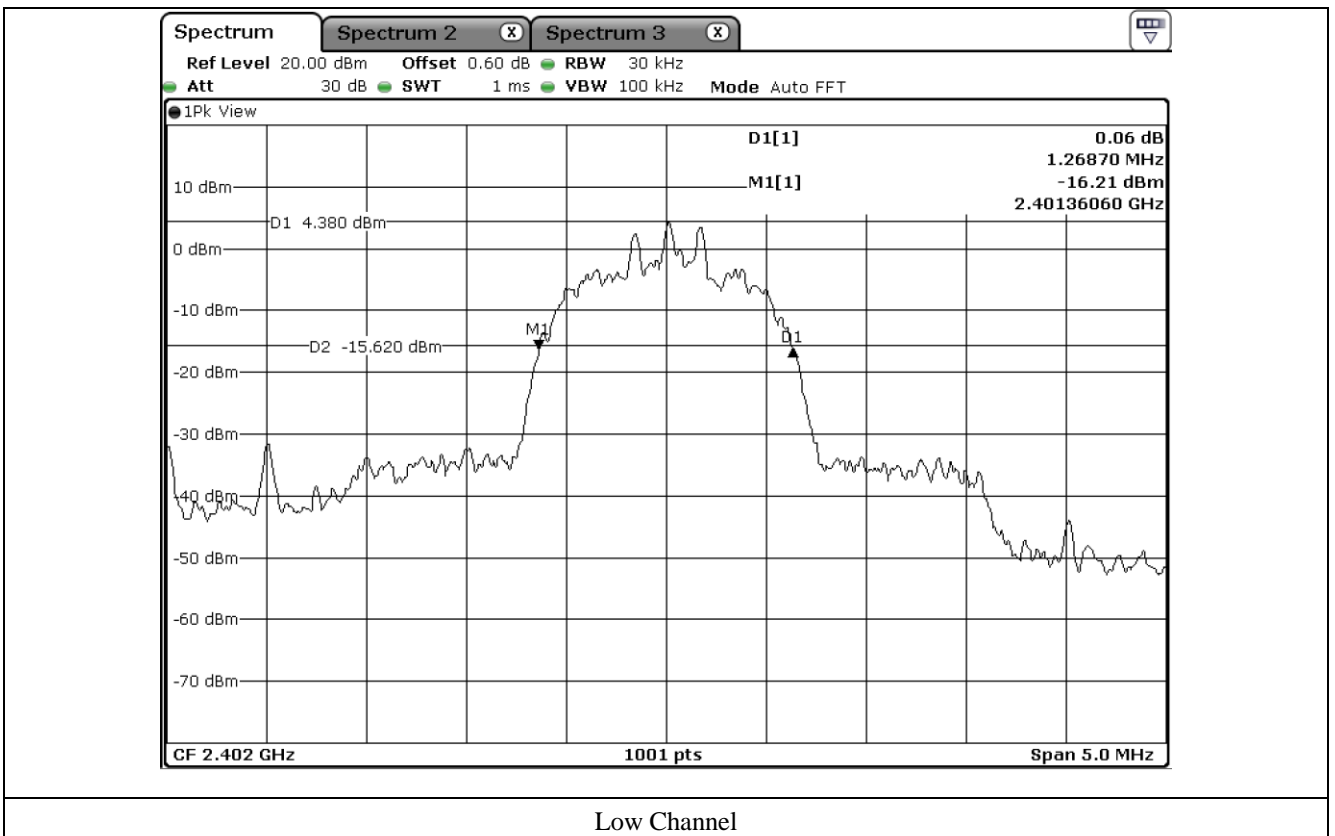


### 7.6 Test data for 3 Mbps

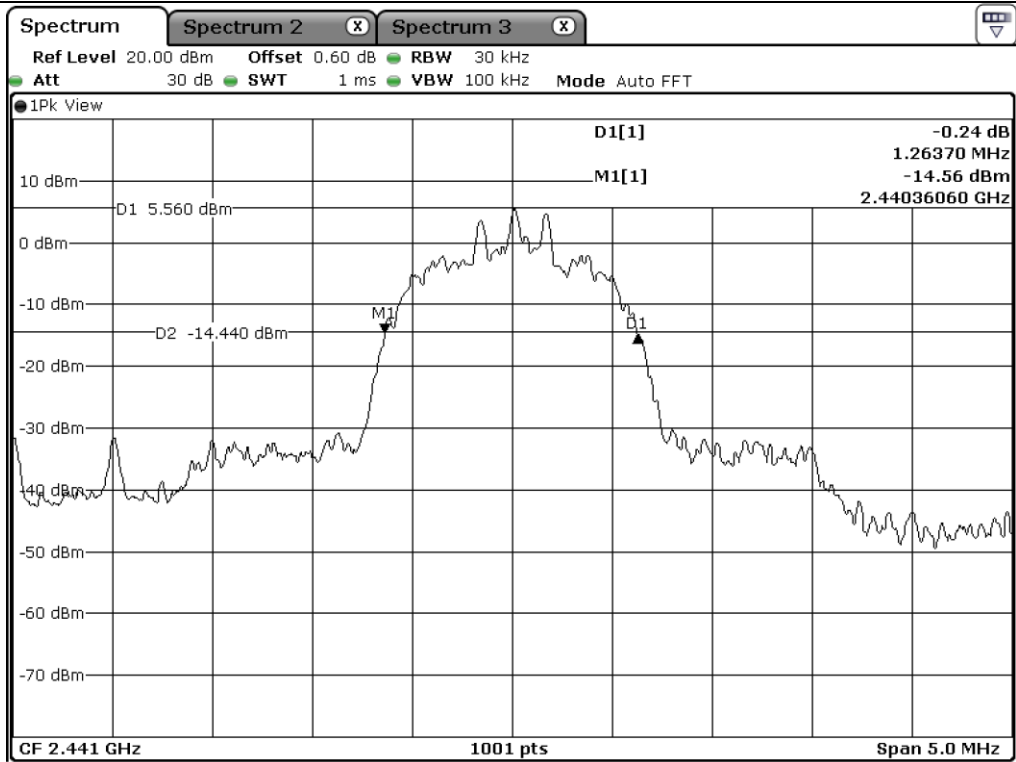
-. Test Date : March 01, 2018 ~ March 12, 2018

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)
Low	2 402.00	1 268.70
Middle	2 441.00	1 263.70
High	2 480.00	1 263.70

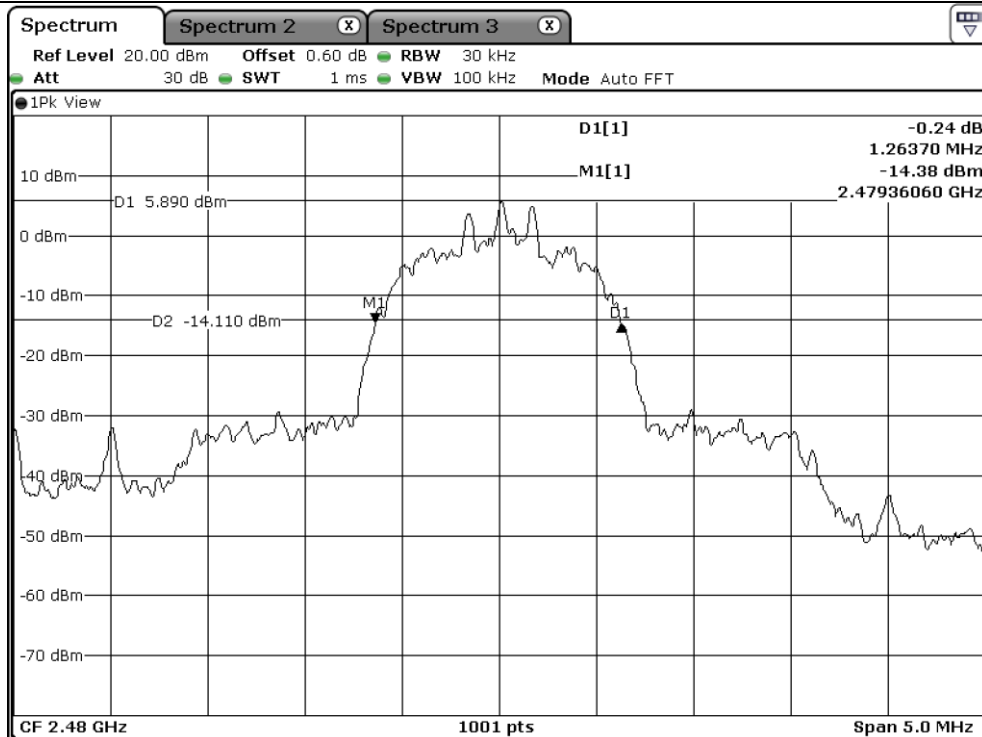
Tested by: Yu-Seog, Sim / Assistant Manager



Low Channel



Middle Channel



High Channel

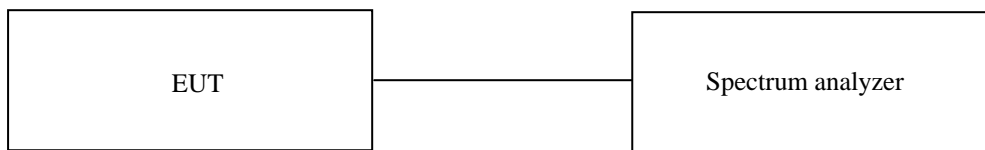
## 8. HOPPING FREQUENCY SEPARATION

### 8.1 Operating environment

Temperature : 23 °C  
 Relative humidity : 45 % R.H.

### 8.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to 10 MHz. The analyzer is set to peak hold then a pseudo-random hopping sequence of the transmitter is captured. The mark delta function was used to measure the frequency separation between two adjacent hopping channels.



### 8.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Apr. 05, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

**8.4 Test data for 1 Mbps**

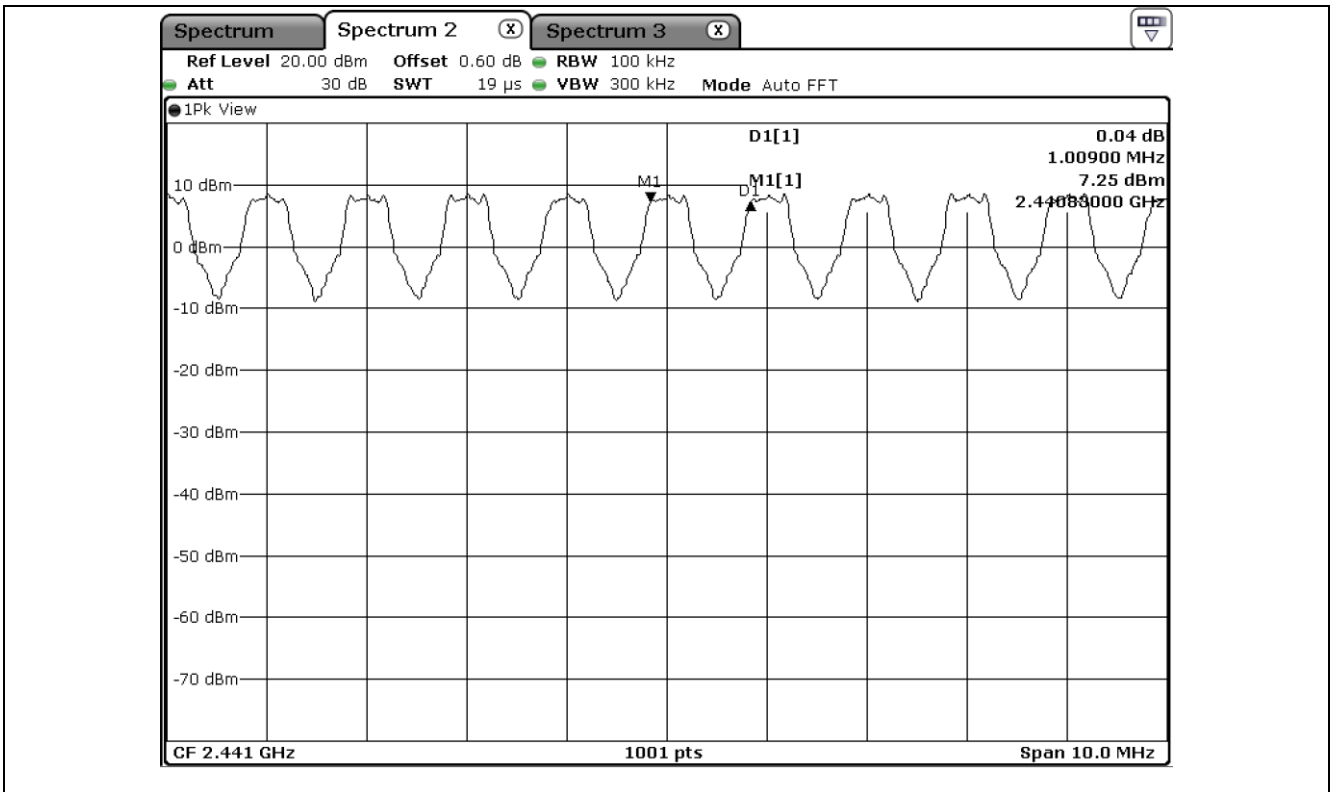
- Test Date : March 01, 2018 ~ March 12, 2018

- Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
1 009.00	632.73	Separated by a minimum of 25 kHz



**Tested by: Yu-Seog, Sim / Assistant Manager**



**8.5 Test data for 2 Mbps**

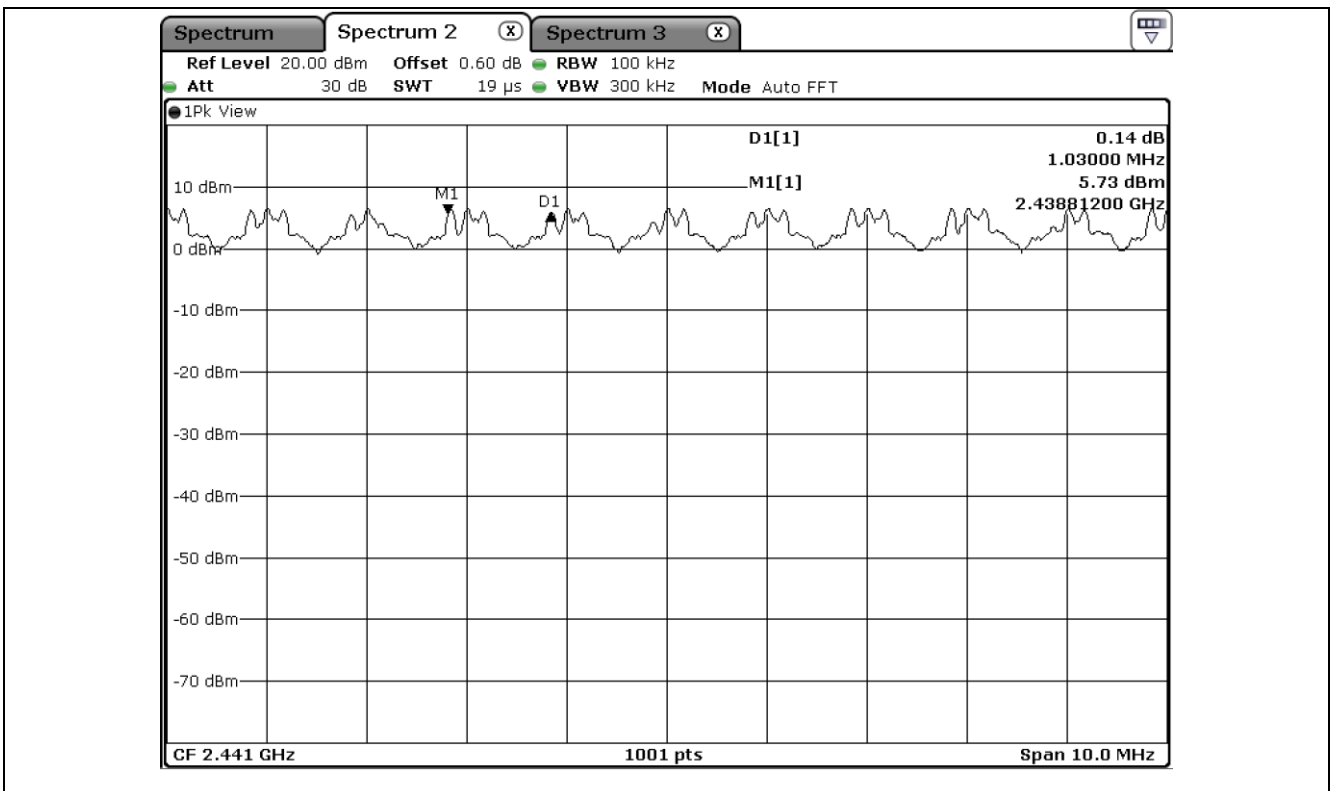
- Test Date : March 01, 2018 ~ March 12, 2018

- Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
1 030.00	832.53	Separated by a minimum of 25 kHz



**Tested by: Yu-Seog, Sim / Assistant Manager**



**8.6 Test data for 3 Mbps**

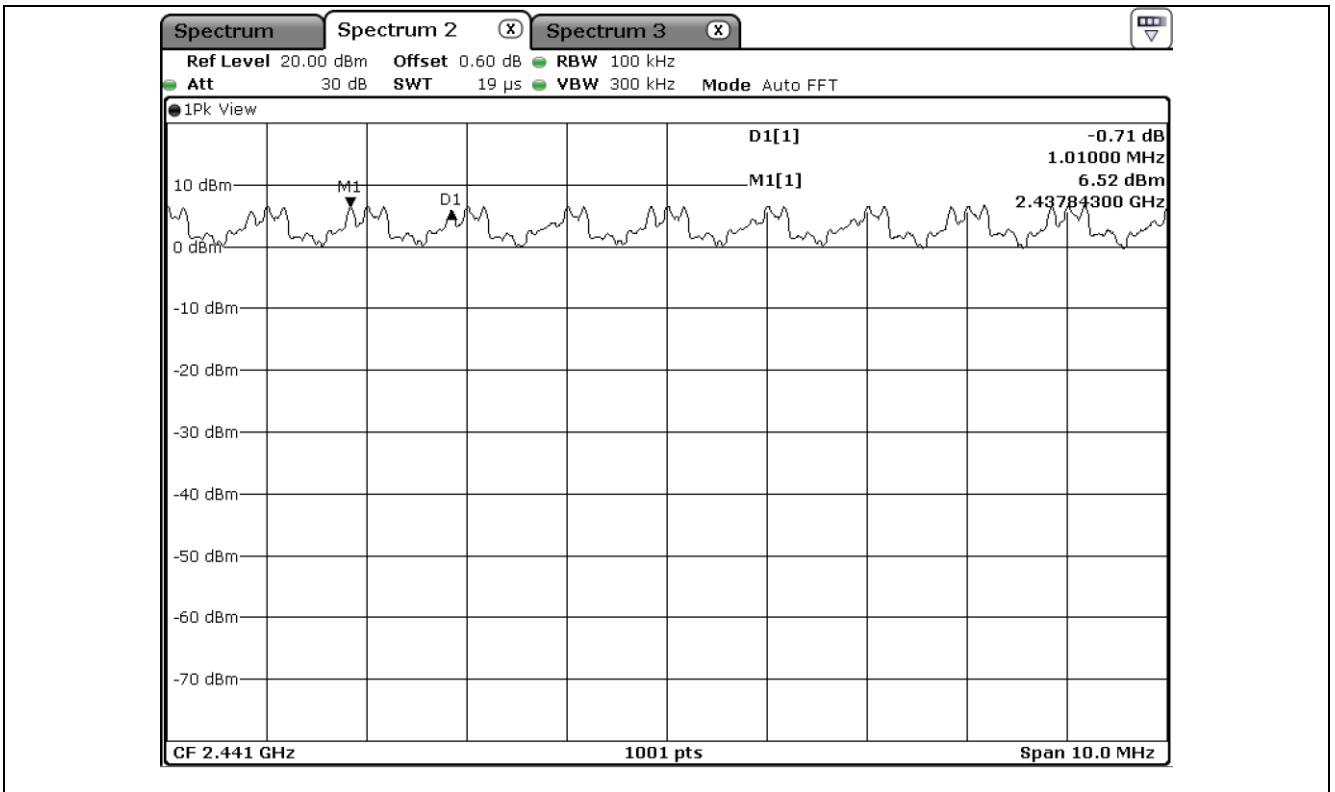
- Test Date : March 01, 2018 ~ March 12, 2018

- Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
1 010.00	842.47	Separated by a minimum of 25 kHz



**Tested by: Yu-Seog, Sim / Assistant Manager**



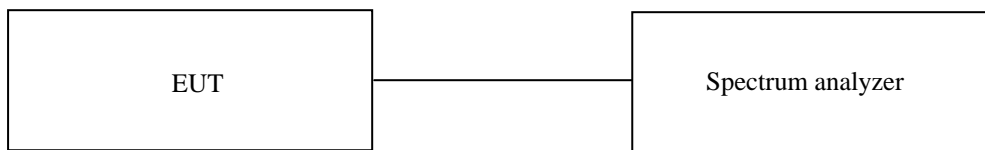
## 9. NUMBER OF HOPPING CHANNELS

### 9.1 Operating environment

Temperature : 23 °C  
 Relative humidity : 45 % R.H.

### 9.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to 100 MHz and the resolution bandwidth is set to 1 MHz. The analyzer is set to peak hold and then complete pseudo-random hopping sequence of the transmitter is captured.



### 9.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Apr. 05, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

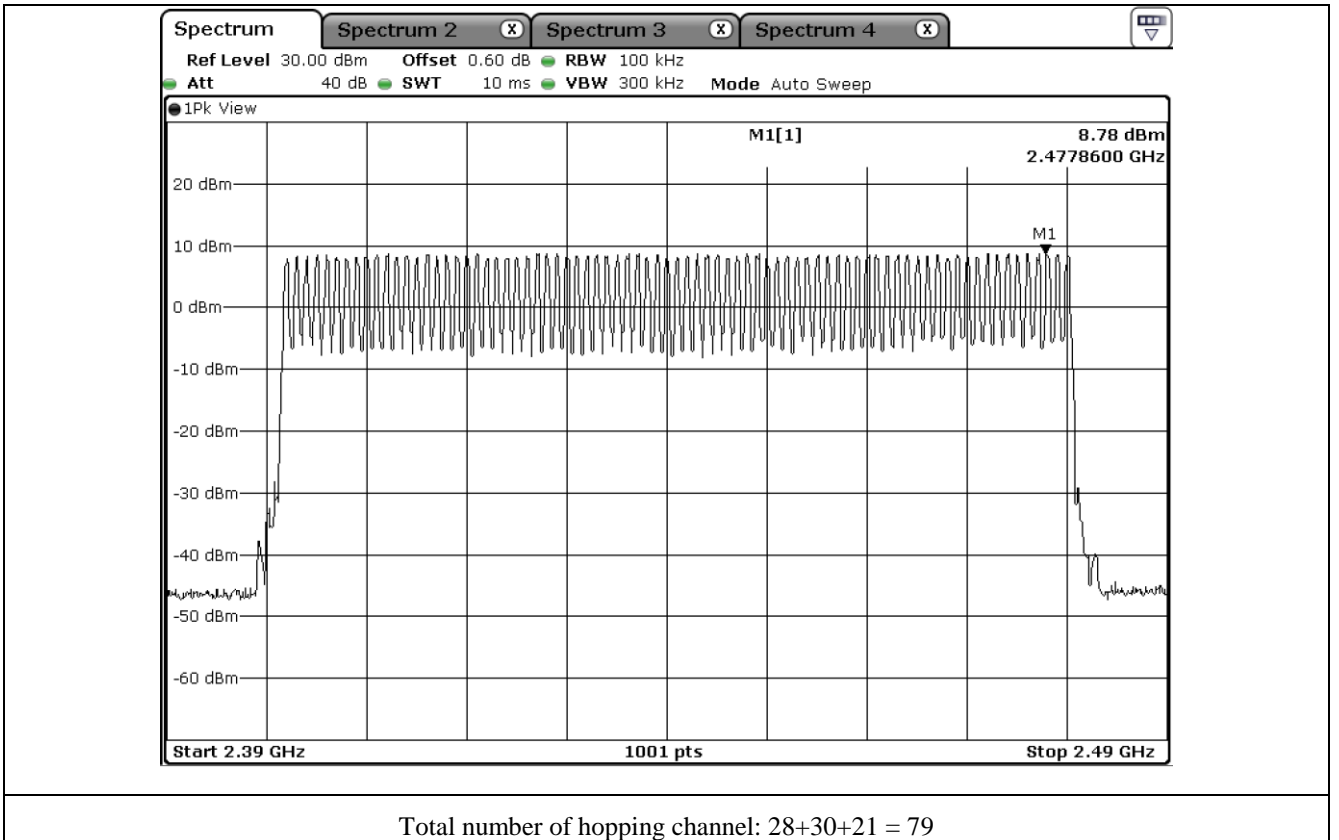
**9.4 Test data for 1 Mbps**

- Test Date : March 01, 2018 ~ March 12, 2018
- Test Result : Pass

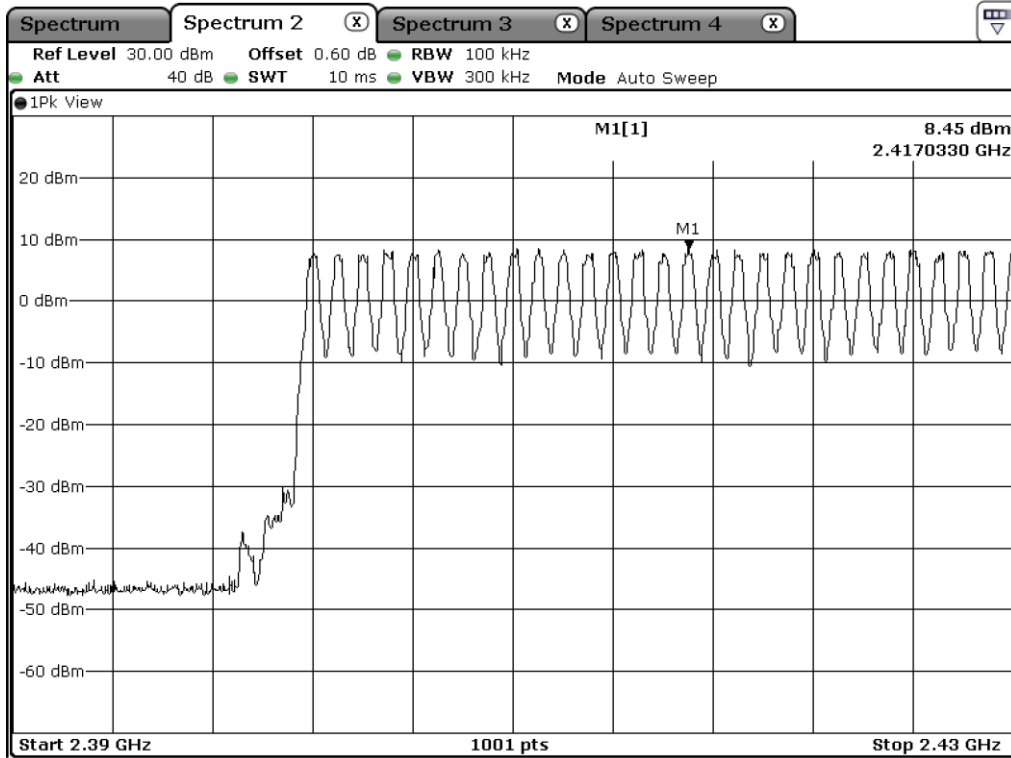
Data Transfer Rate	Measured value (Number)	Limit (Number)	Margin (Number)
1 Mbps	79	Minimum of 15	64



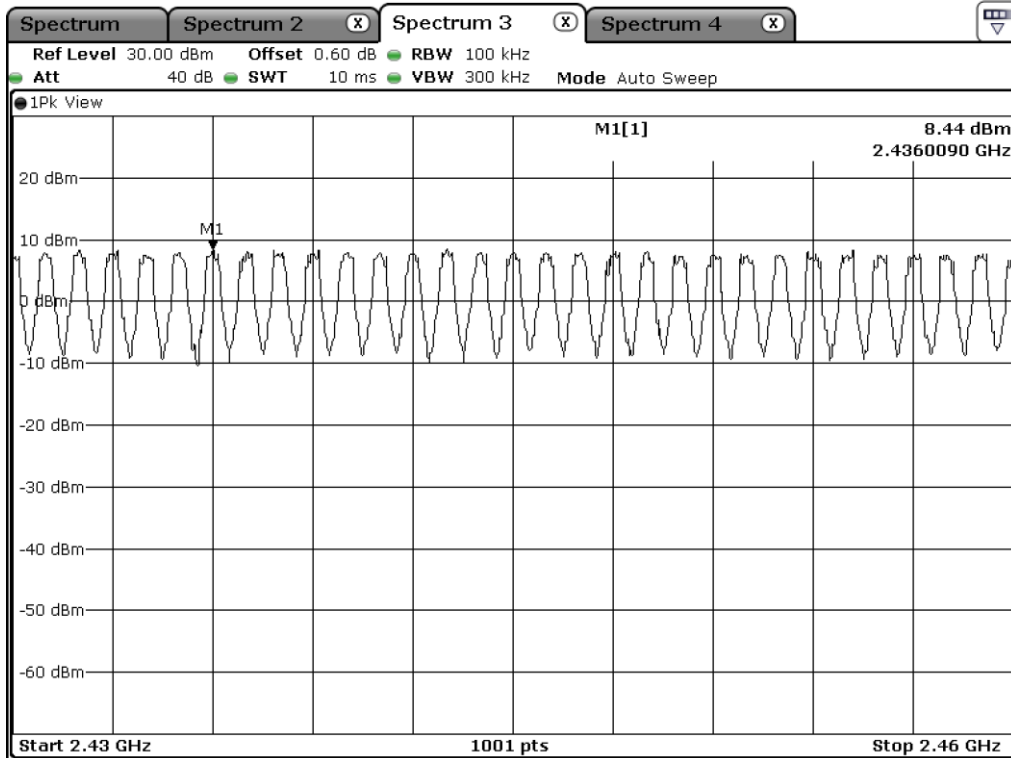
Tested by: Yu-Seog, Sim / Assistant Manager



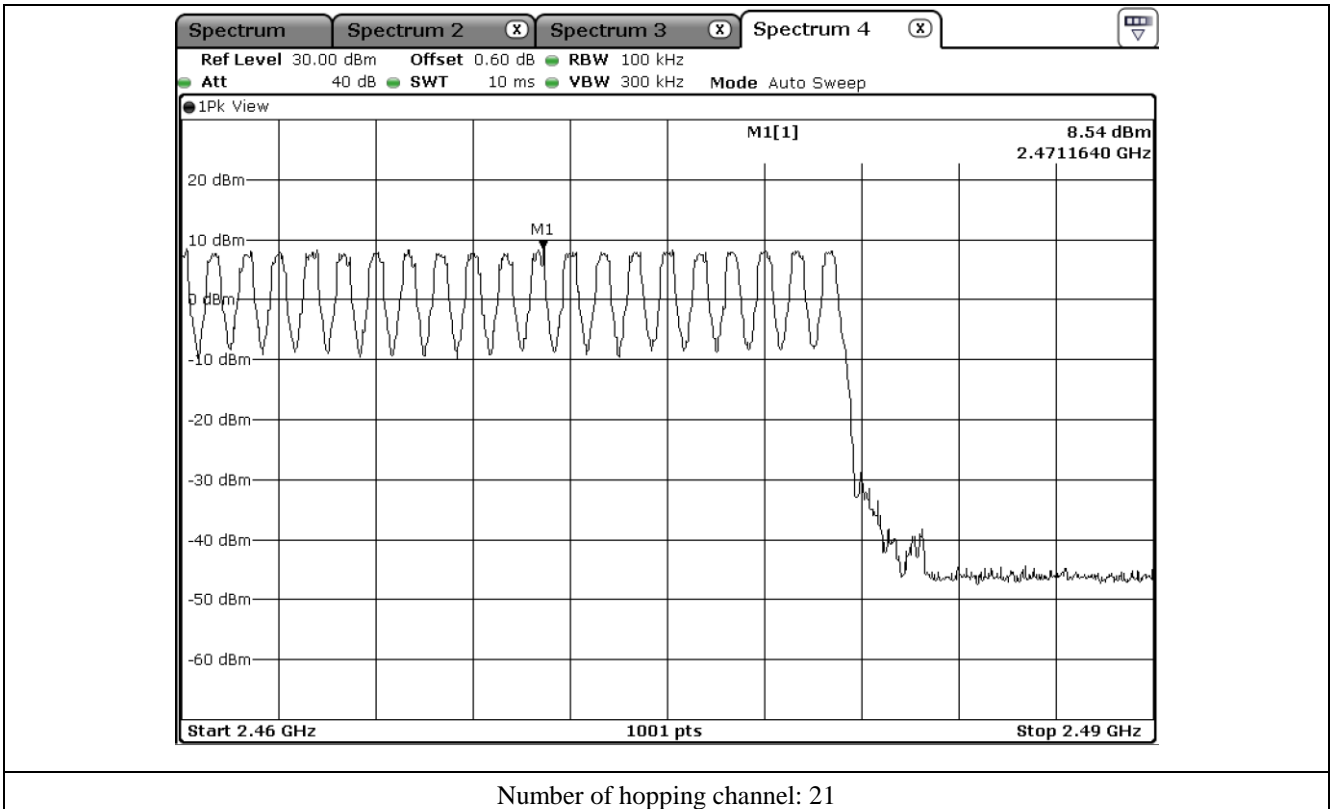




Number of hopping channel: 28



Number of hopping channel: 30



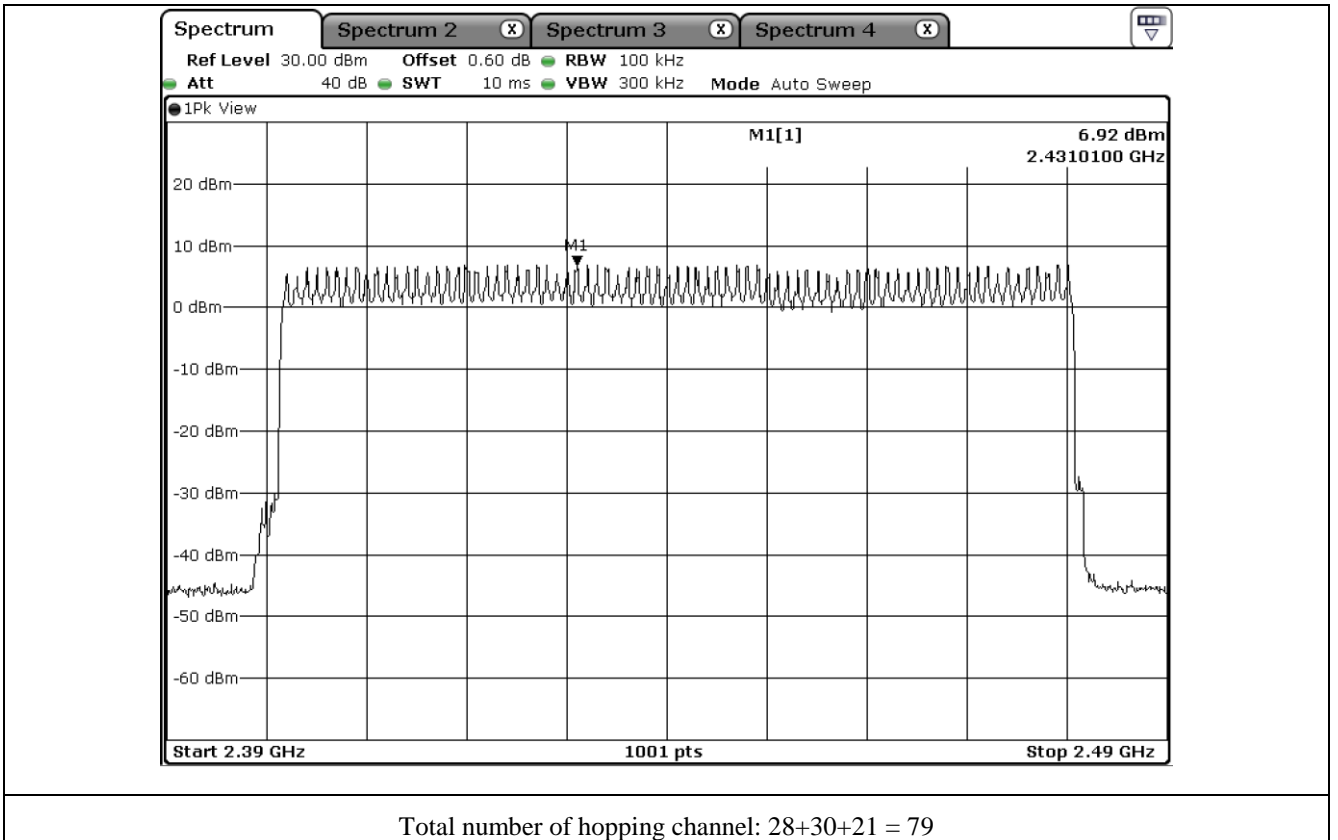
**9.5 Test data for 2 Mbps**

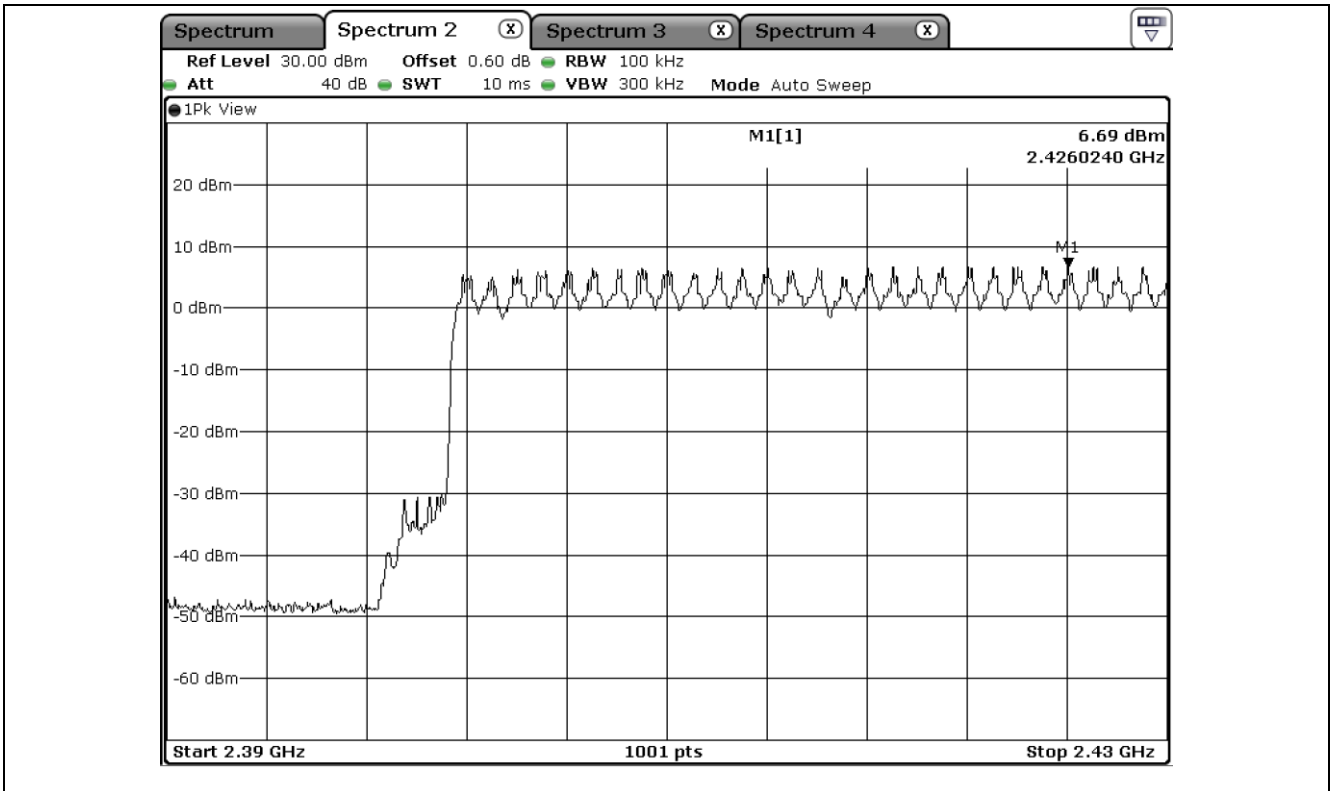
- Test Date : March 01, 2018 ~ March 12, 2018
- Test Result : Pass

Data Transfer Rate	Measured value (Number)	Limit (Number)	Margin (Number)
2 Mbps	79	Minimum of 15	64

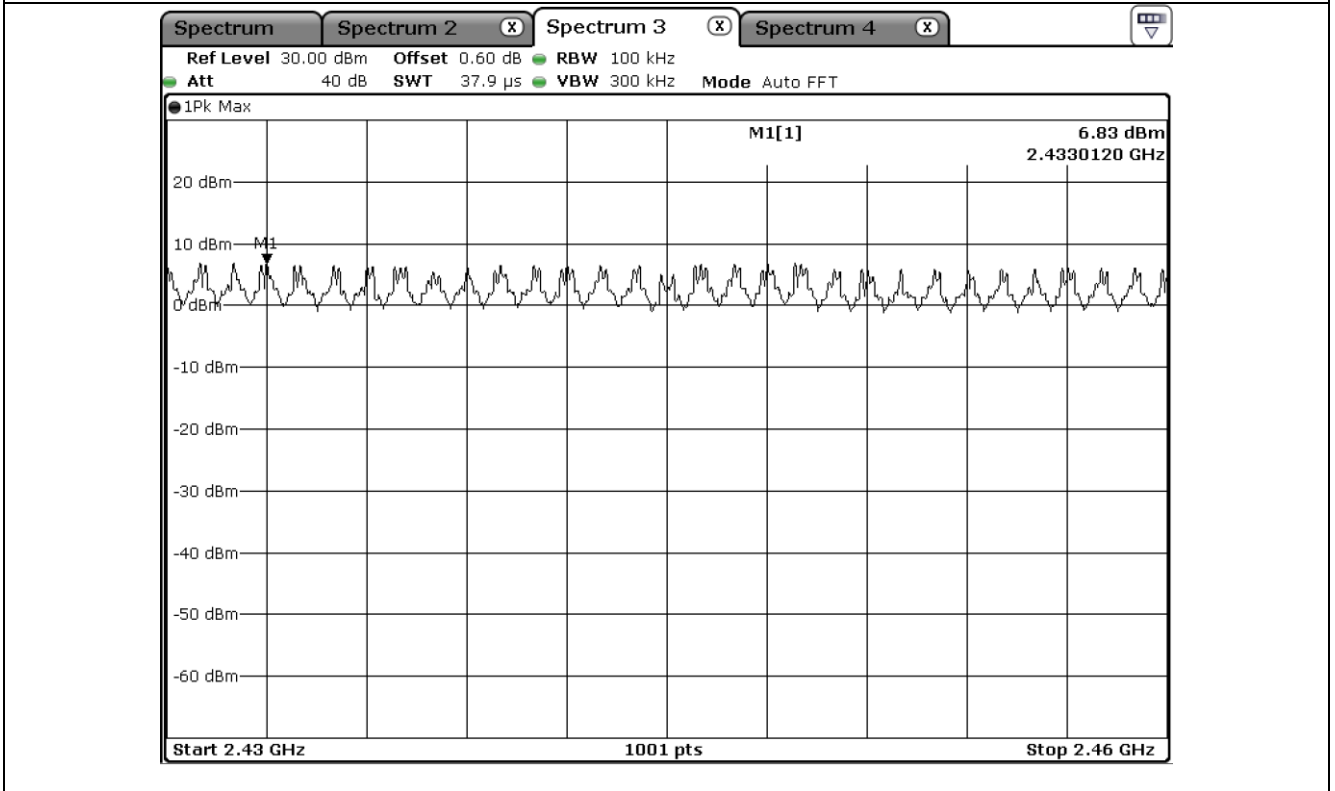


Tested by: Yu-Seog, Sim / Assistant Manager

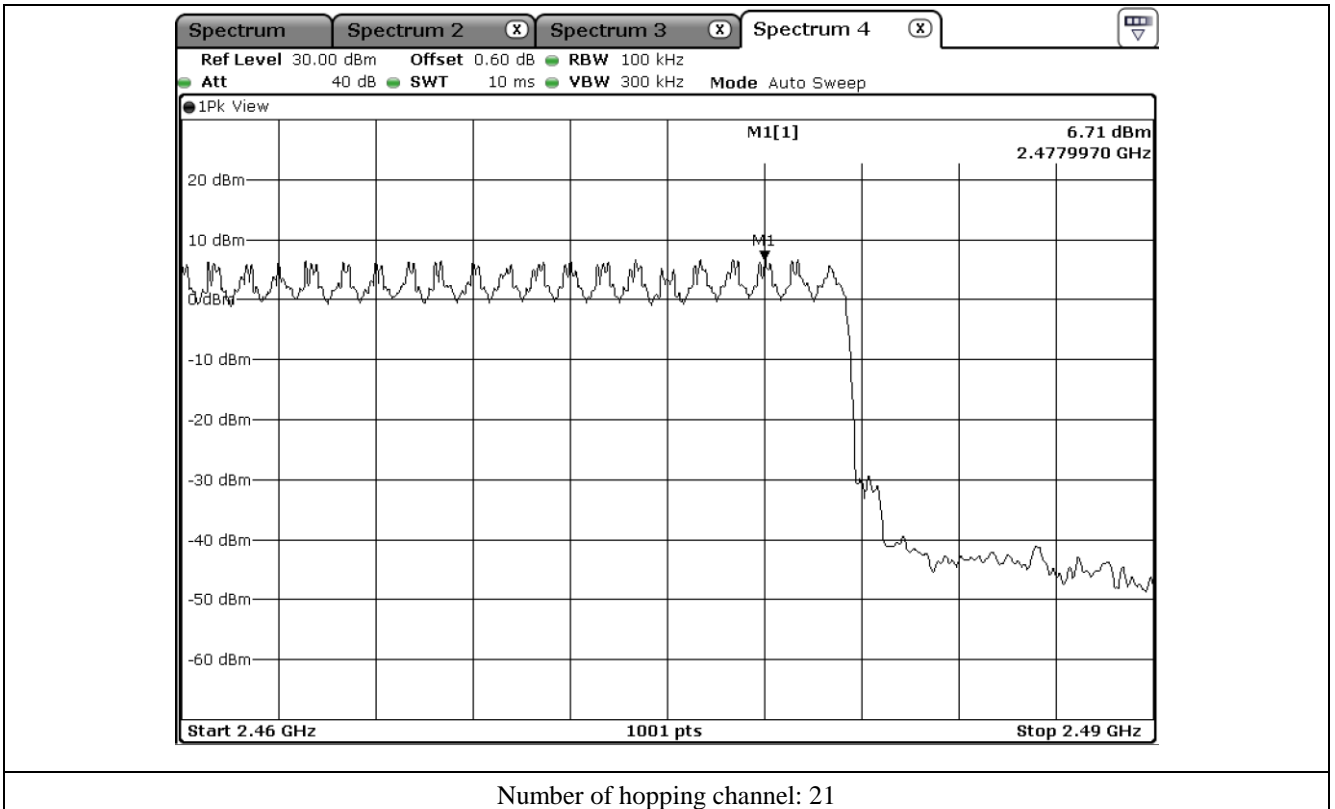




Number of hopping channel: 28



Number of hopping channel: 30



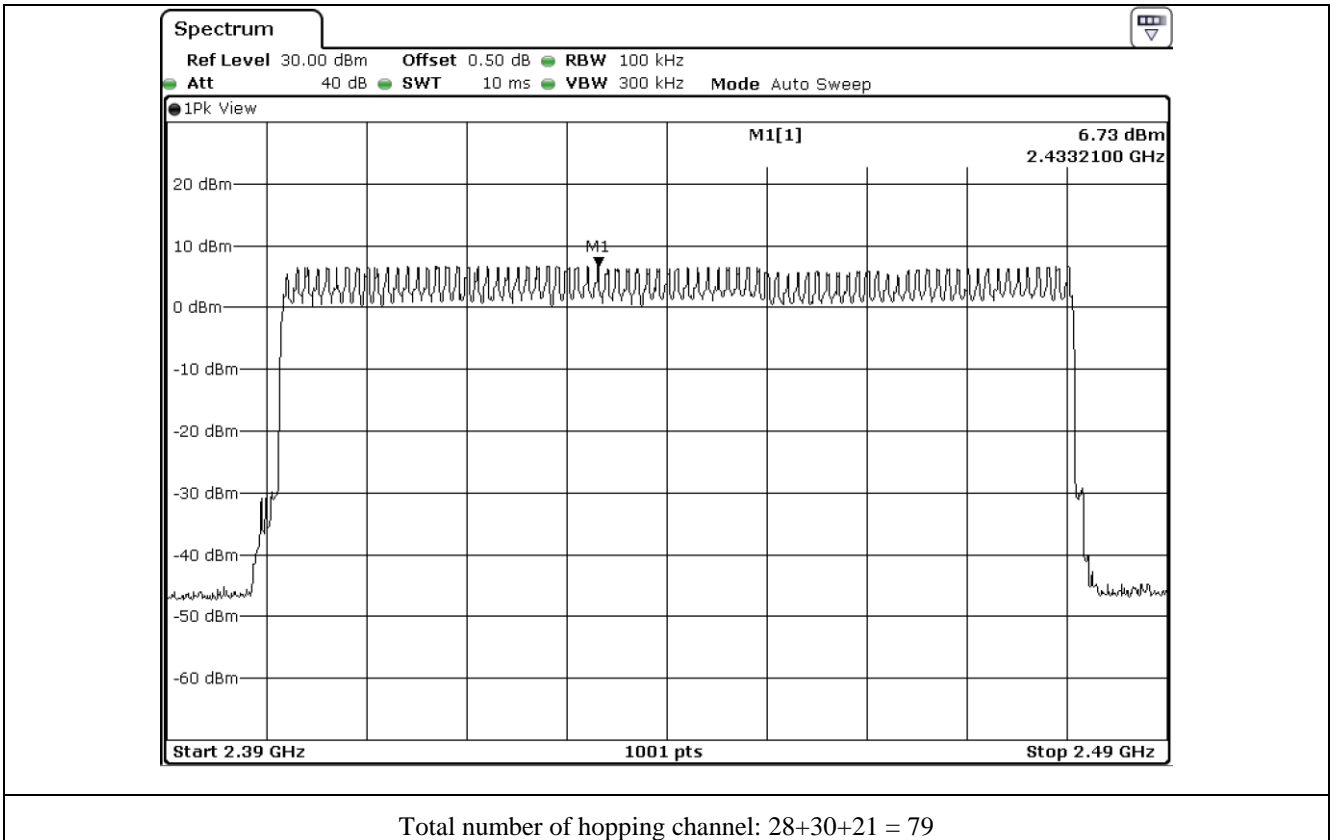
**9.6 Test data for 3 Mbps**

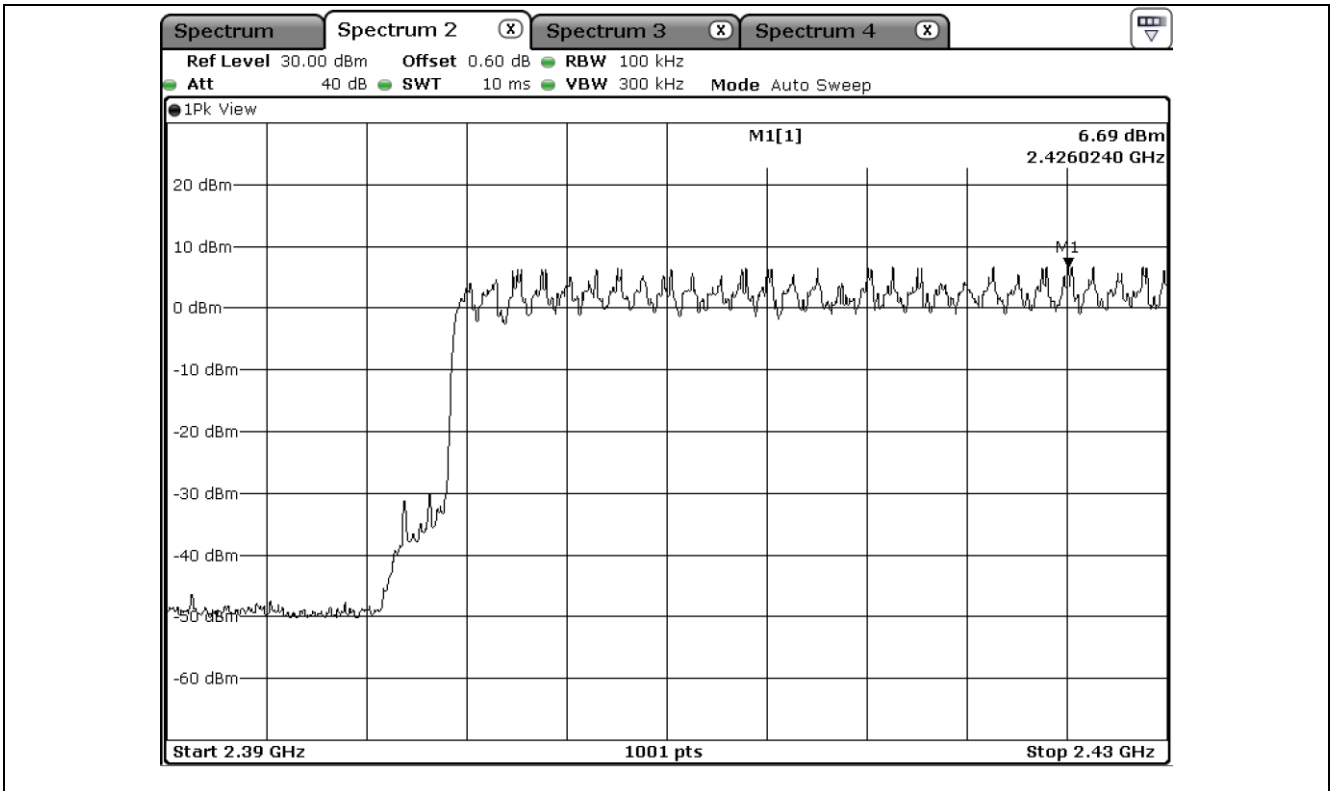
- Test Date : March 01, 2018 ~ March 12, 2018
- Test Result : Pass

Data Transfer Rate	Measured value (Number)	Limit (Number)	Margin (Number)
3 Mbps	79	Minimum of 15	64

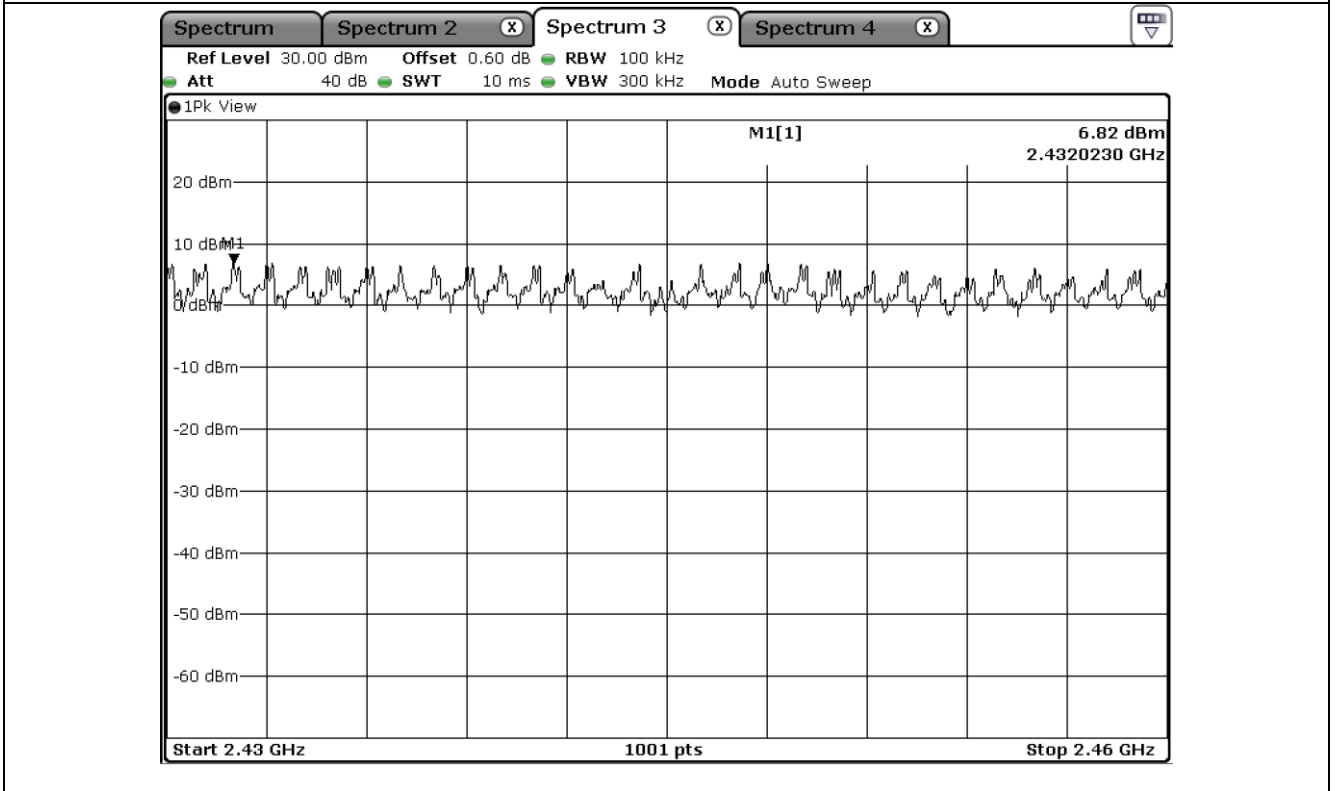


**Tested by: Yu-Seog, Sim / Assistant Manager**

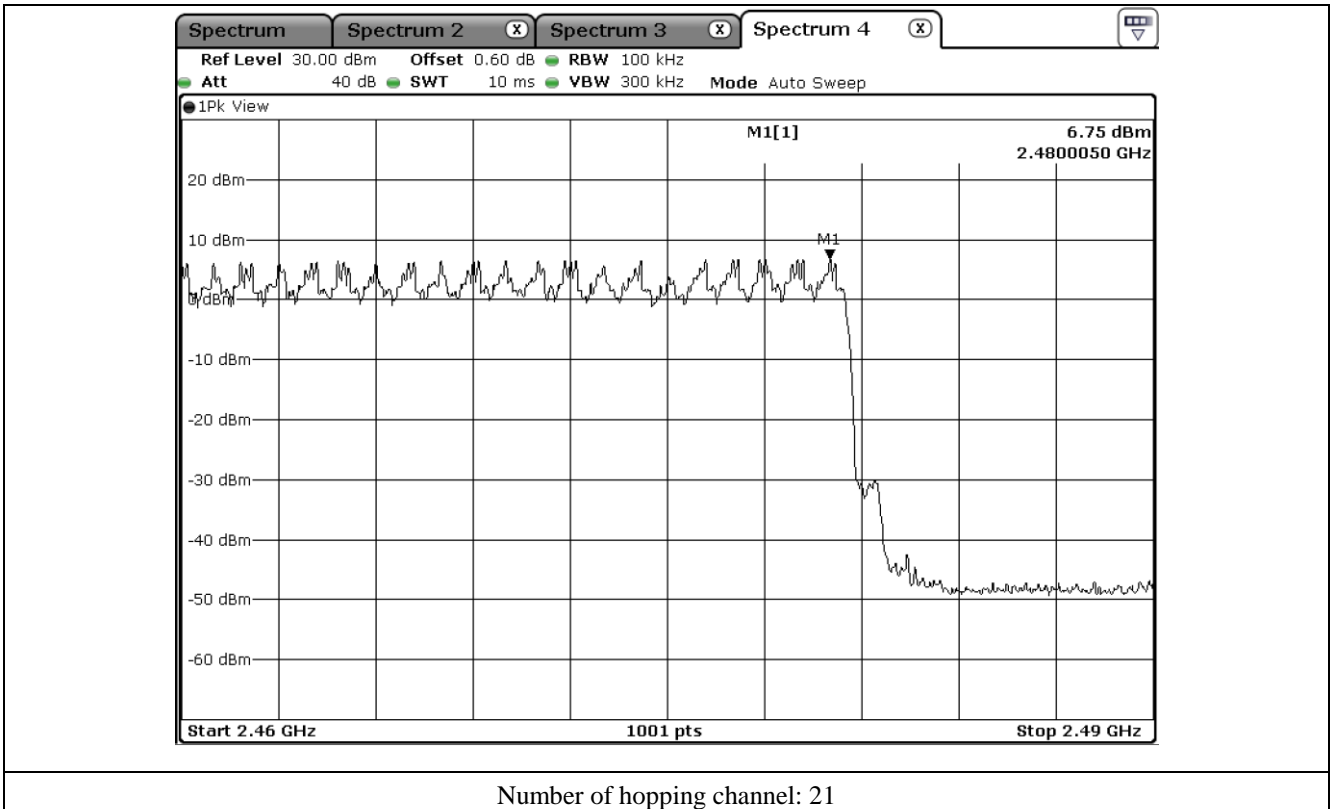




Number of hopping channel: 28



Number of hopping channel: 30





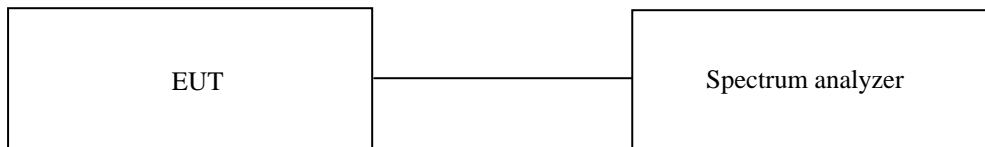
## 10. TIME OF OCCUPANCY

### 10.1 Operating environment

Temperature : 23 °C  
 Relative humidity : 45 % R.H.

### 10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The transmitter is set to operate in its normal frequency hopping mode. The center frequency of the spectrum analyzer is set to one of hopping channels near the center of the operating band and span is set to zero Hz. The sweep time is set to display one complete pulse. The mark delta function is used to measure the duration of the pulses.



### 10.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Apr. 05, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

**10.4 Test data for 1 Mbps**

- Test Date : March 01, 2018 ~ March 12, 2018

The system makes worst case 1 600 hops per second or 1 time slot has a length of 625 μs with 79 channels.

For DH1 packet type, the EUT needs 1 time slot for transmitting and 1 time slot for receiving and for DH3 packet type, the EUT needs 3 times slots for transmitting and 1 time slot for receiving, and DH5 packet needs 5 times slots for transmitting and 1 time slot for receiving. So The EUT has each channel for 10.13 times per second (= 1 600/2/79) for DH1, and 5.06 times (= 1 600/4/79) for DH3, and 3.38 times (= 1 600/6/79) for DH5.

Packet Type	Pulse Time (ms)	Hops per second with channels	Period Time (ms)	Total Dwell Time (ms)	Limit (ms)	Test Result
DH1	0.380	10.13	31.60	121.64	400	PASS
DH3	1.630	5.06	31.60	260.63	400	
DH5	2.890	3.38	31.60	308.68	400	

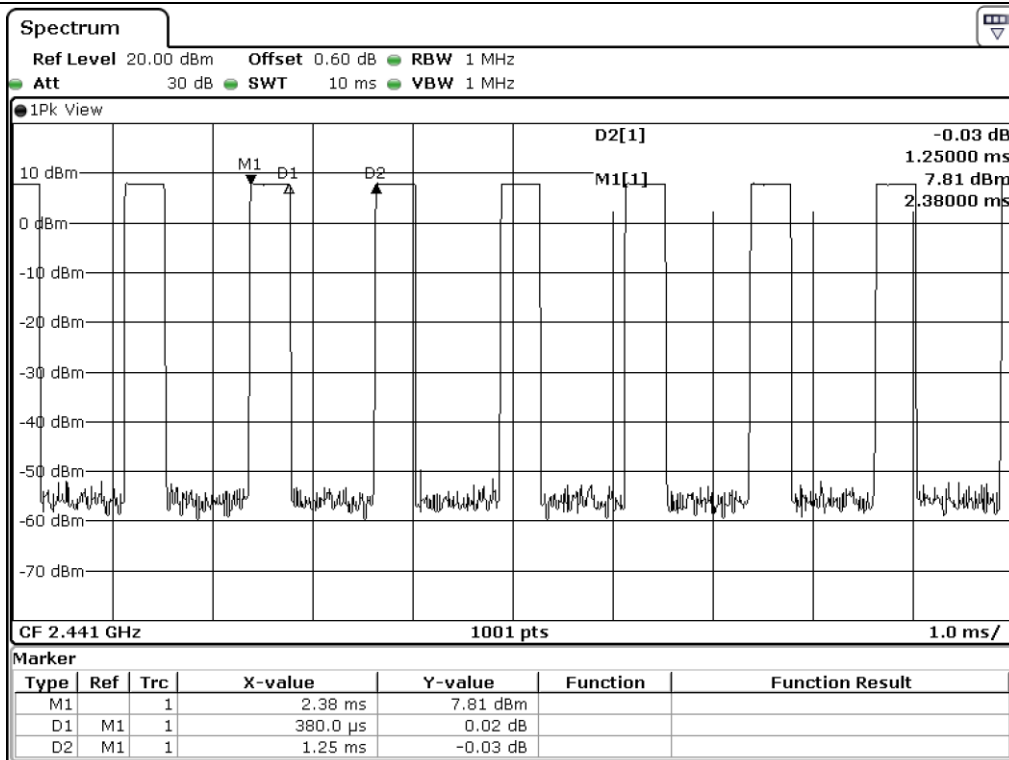
Total dwell time is calculated as following.

Total Dwell Time = Pulse time \* Hops per second with channels \* period time

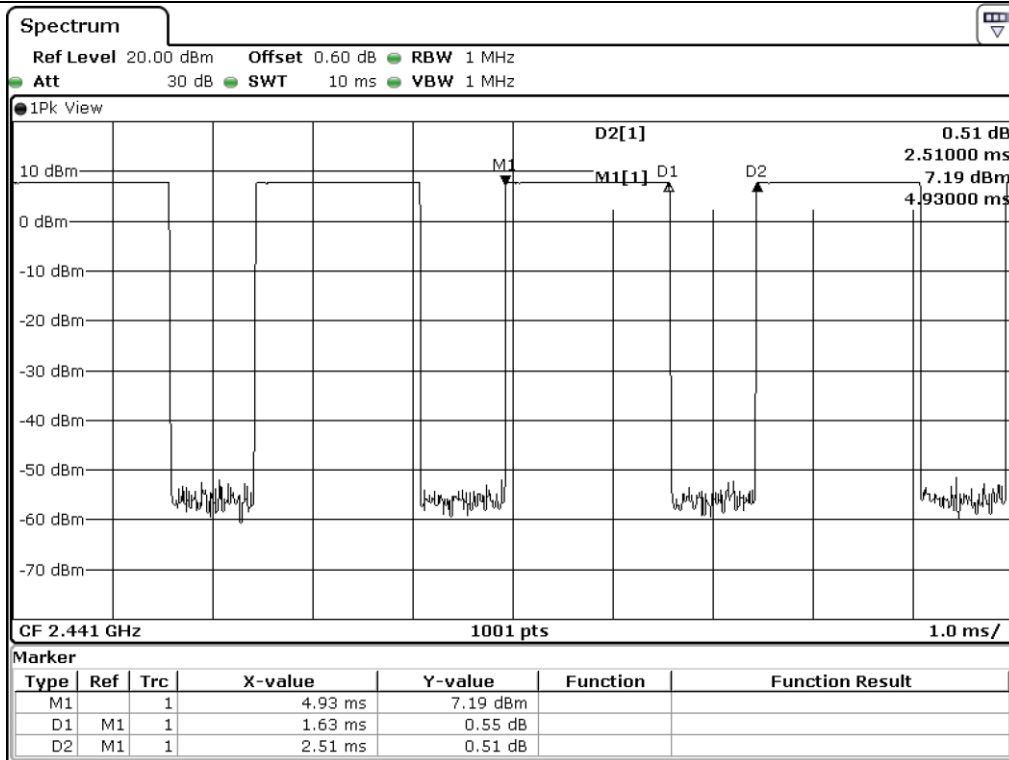
Remark: See next page for an overview sweep performed with peak detector.



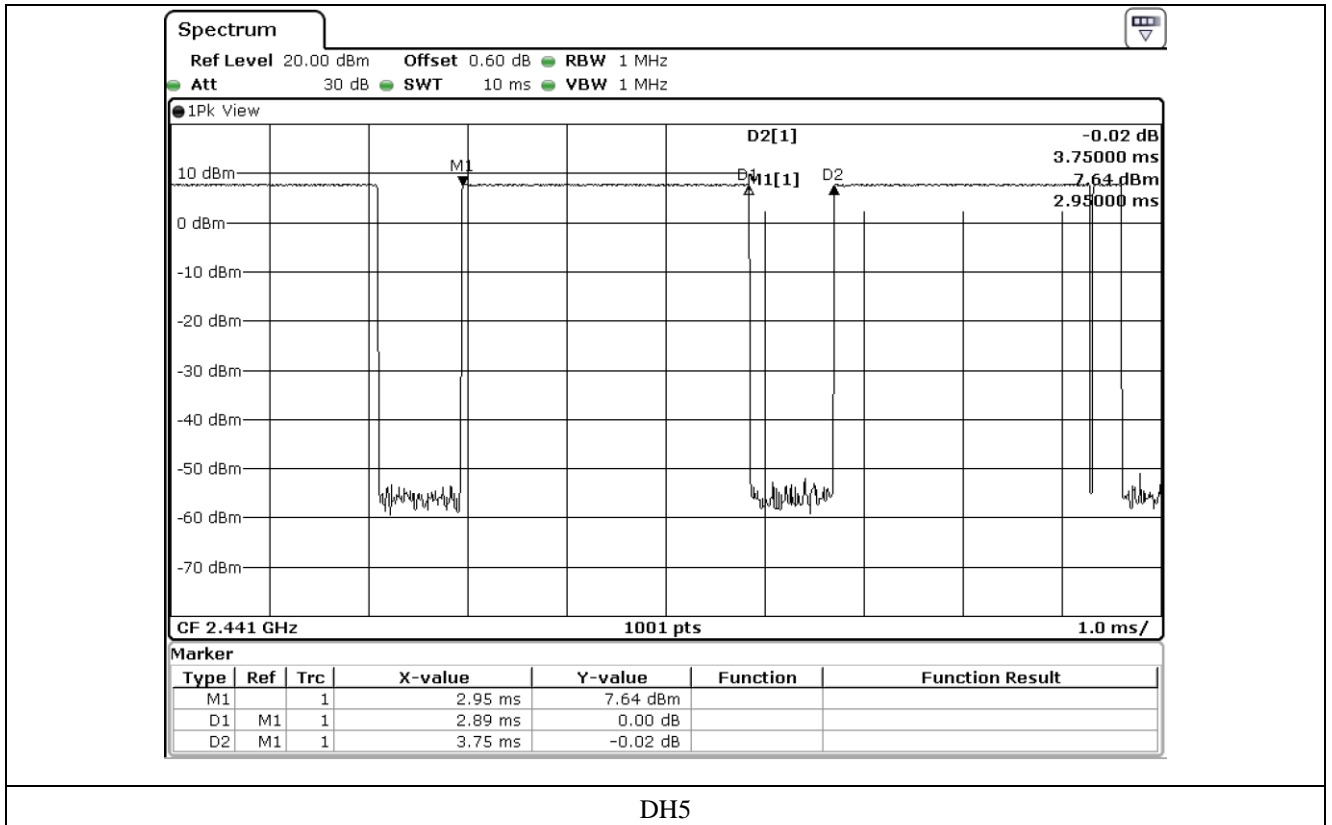
**Tested by: Yu-Seog, Sim / Assistant Manager**



DH1



DH3



**10.5 Test data for 2 Mbps**

- Test Date : March 01, 2018 ~ March 12, 2018

The system makes worst case 1 600 hops per second or 1 time slot has a length of 625 μs with 79 channels.

For DH1 packet type, the EUT needs 1 time slot for transmitting and 1 time slot for receiving and for DH3 packet type, the EUT needs 3 times slots for transmitting and 1 time slot for receiving, and DH5 packet needs 5 times slots for transmitting and 1 time slot for receiving. So The EUT has each channel for 10.13 times per second (= 1 600/2/79) for DH1, and 5.06 times (= 1 600/4/79) for DH3, and 3.38 times (= 1 600/6/79) for DH5.

Packet Type	Pulse Time (ms)	Hops per second with channels	Period Time (ms)	Total Dwell Time (ms)	Limit (ms)	Test Result
DH1	0.380	10.13	31.60	121.64	400	PASS
DH3	1.640	5.06	31.60	262.23	400	
DH5	2.890	3.38	31.60	308.68	400	

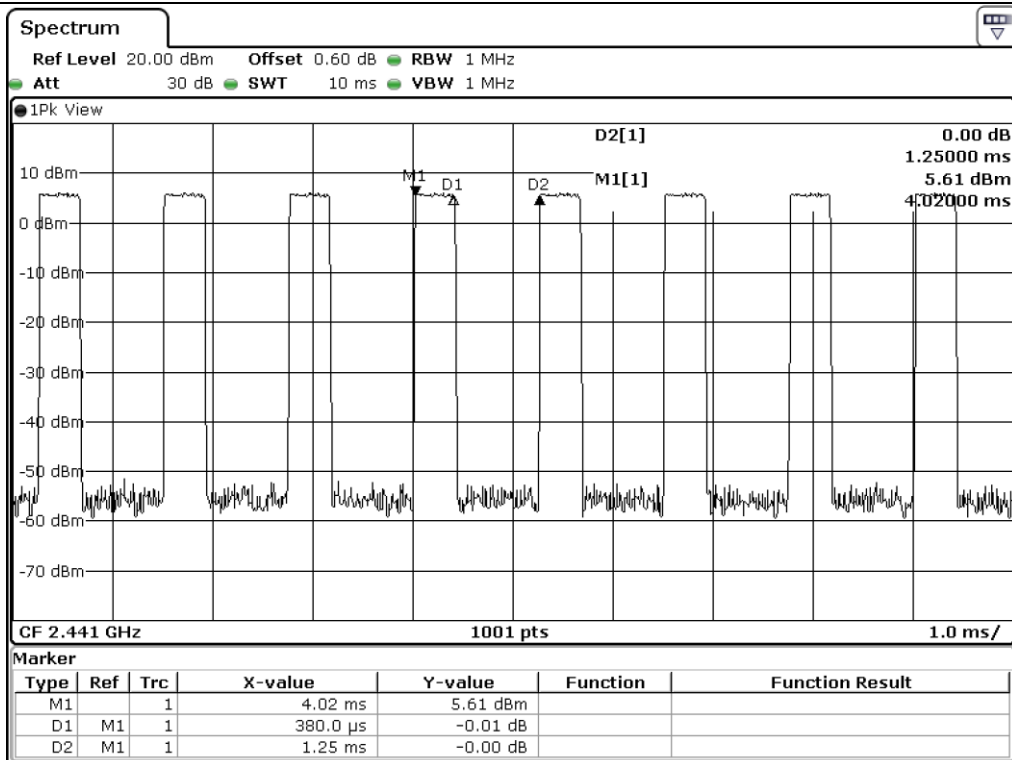
Total dwell time is calculated as following.

Total Dwell Time = Pulse time \* Hops per second with channels \* period time

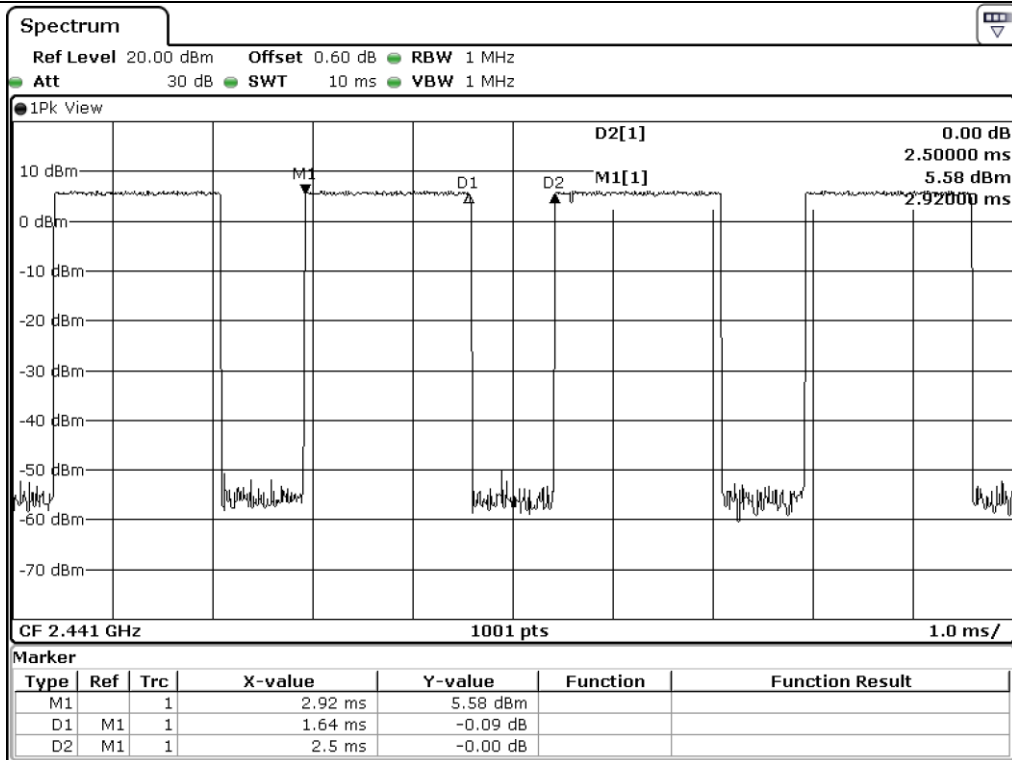
Remark: See next page for an overview sweep performed with peak detector.



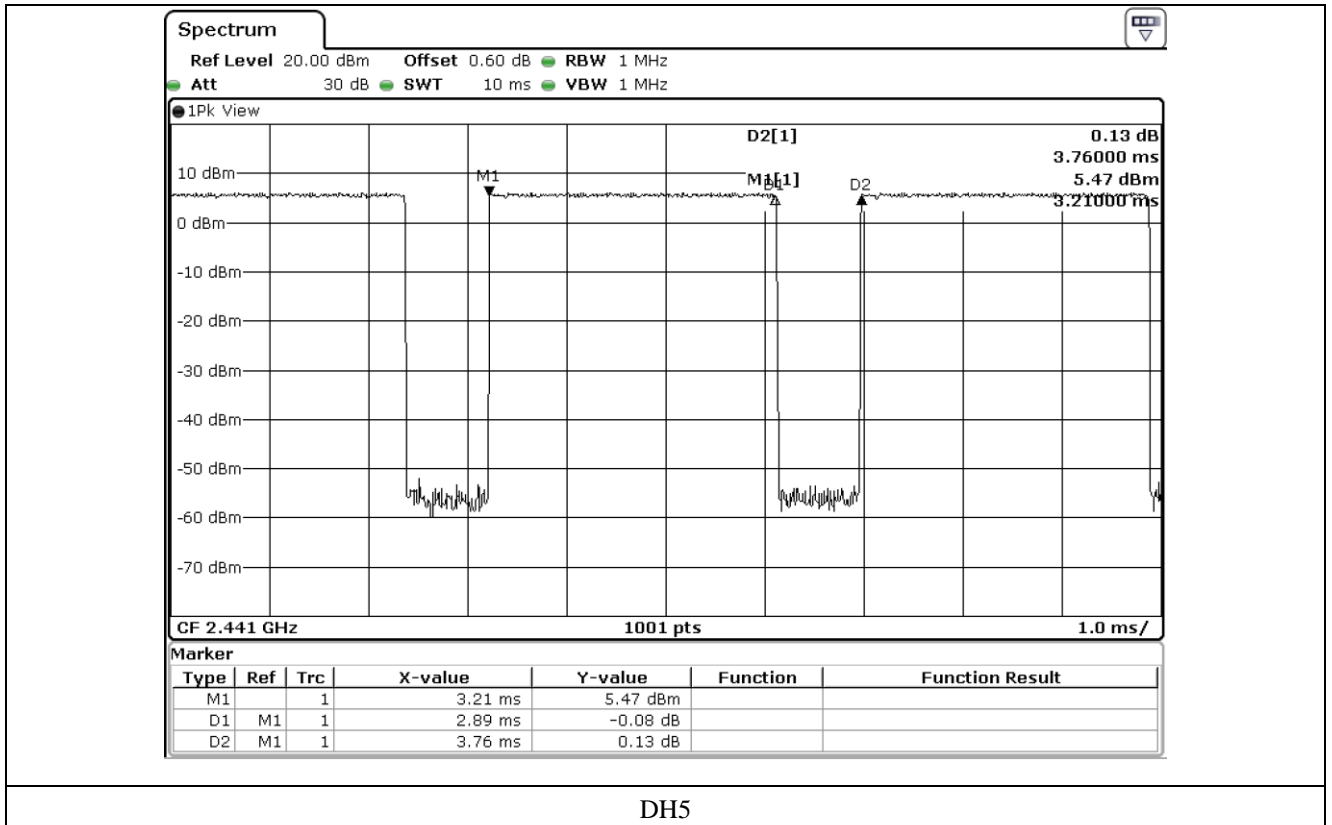
**Tested by: Yu-Seog, Sim / Assistant Manager**



DH1



DH3



**10.6 Test data for 3 Mbps**

- Test Date : March 01, 2018 ~ March 12, 2018

The system makes worst case 1 600 hops per second or 1 time slot has a length of 625 μs with 79 channels.

For DH1 packet type, the EUT needs 1 time slot for transmitting and 1 time slot for receiving and for DH3 packet type, the EUT needs 3 times slots for transmitting and 1 time slot for receiving, and DH5 packet needs 5 times slots for transmitting and 1 time slot for receiving. So The EUT has each channel for 10.13 times per second (= 1 600/2/79) for DH1, and 5.06 times (= 1 600/4/79) for DH3, and 3.38 times (= 1 600/6/79) for DH5.

Packet Type	Pulse Time (ms)	Hops per second with channels	Period Time (ms)	Total Dwell Time (ms)	Limit (ms)	Test Result
DH1	0.390	10.13	31.60	124.84	400	PASS
DH3	1.640	5.06	31.60	262.23	400	
DH5	2.900	3.38	31.60	309.74	400	

Total dwell time is calculated as following.

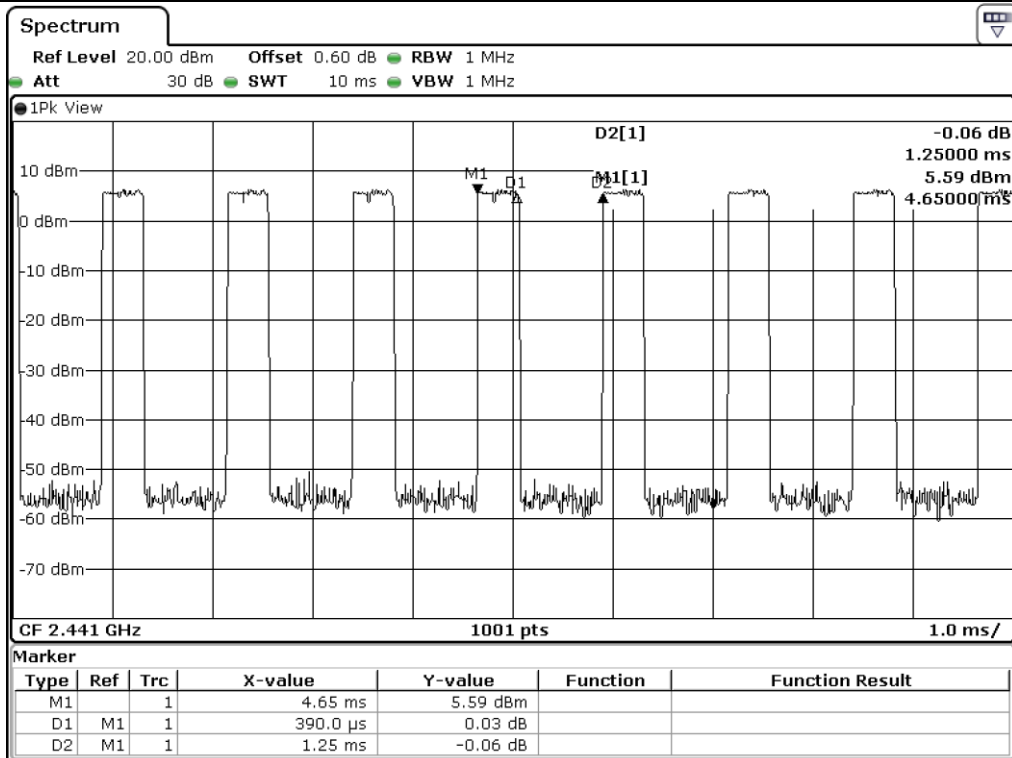
Total Dwell Time = Pulse time \* Hops per second with channels \* period time

Remark: See next page for an overview sweep performed with peak detector.

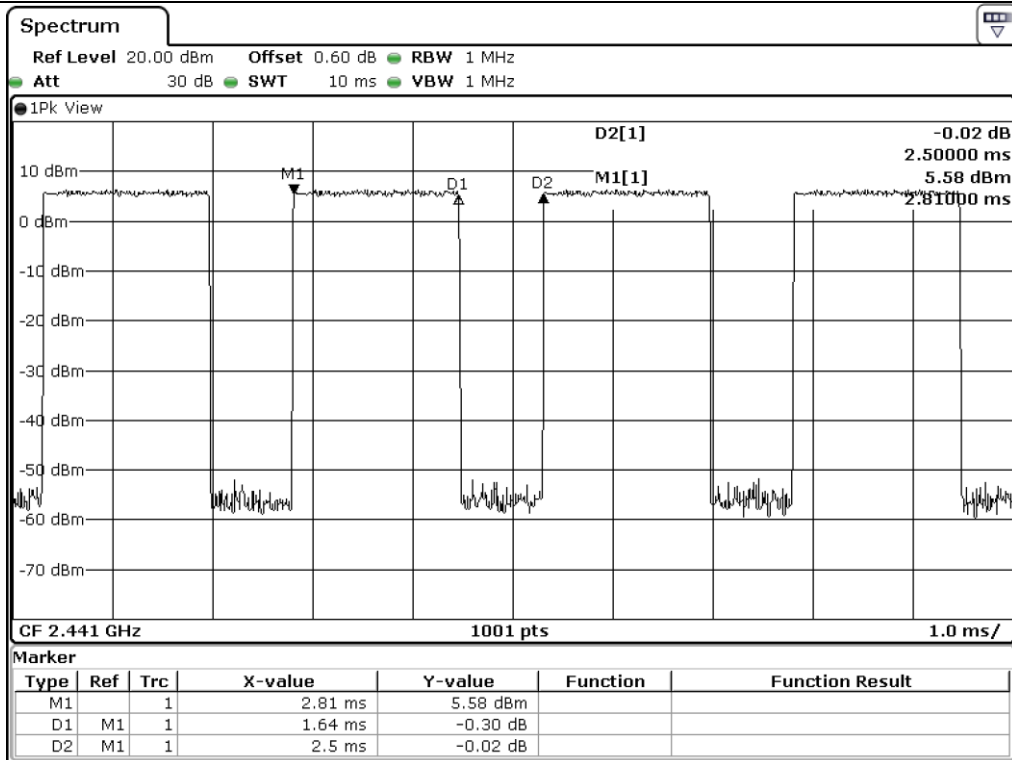


**Tested by: Yu-Seog, Sim / Assistant Manager**

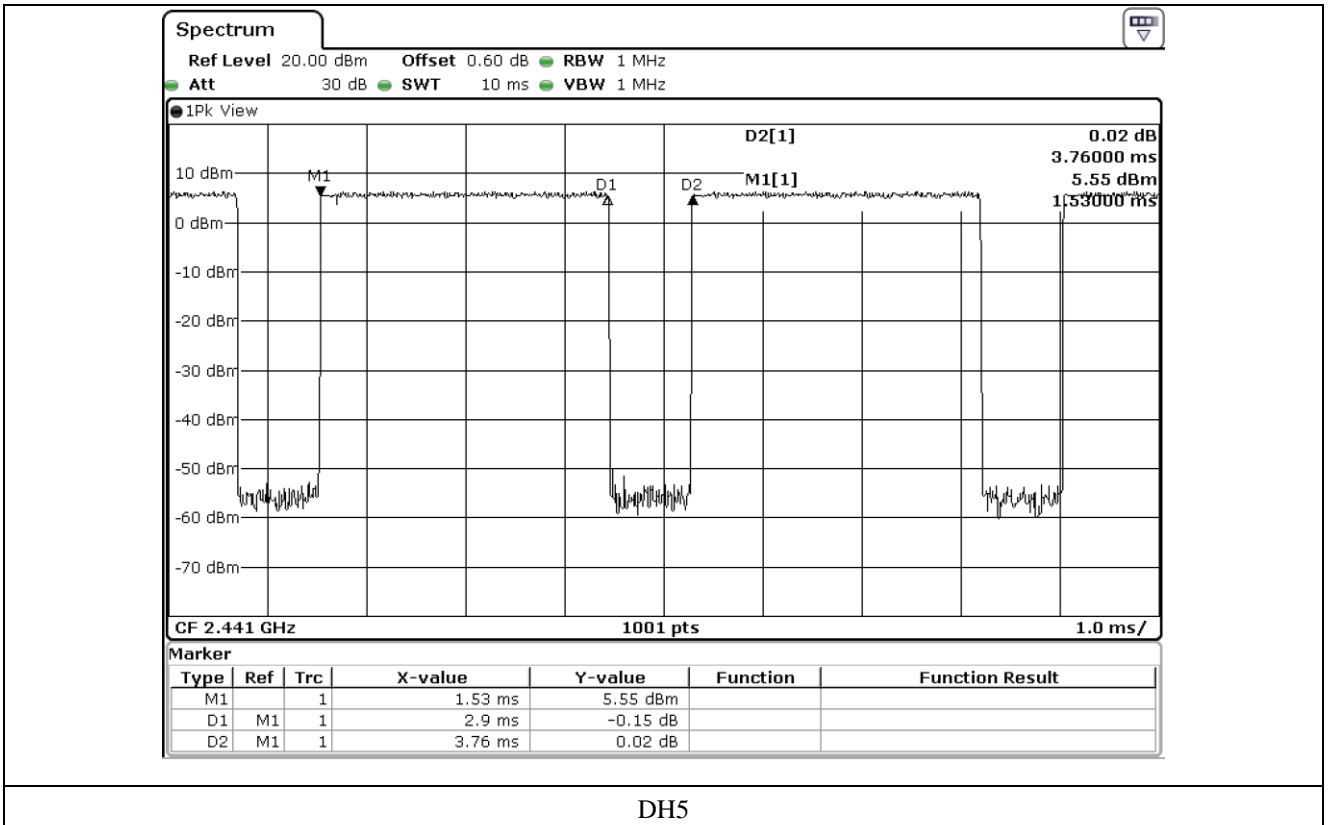




DH1



DH3



## 11. MAXIMUM PEAK OUTPUT POWER

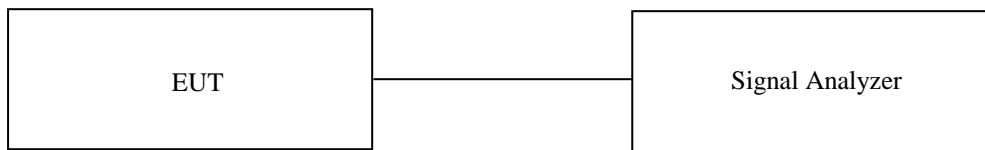
### 11.1 Operating environment

Temperature : 23 °C  
 Relative humidity : 45 % R.H.

### 11.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer.

The resolution bandwidth is set to  $\geq$  DTS Bandwidth, the video bandwidth is set to 3 times the resolution bandwidth.



### 11.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Apr. 05, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

### 11.4 Test data for 1 Mbps

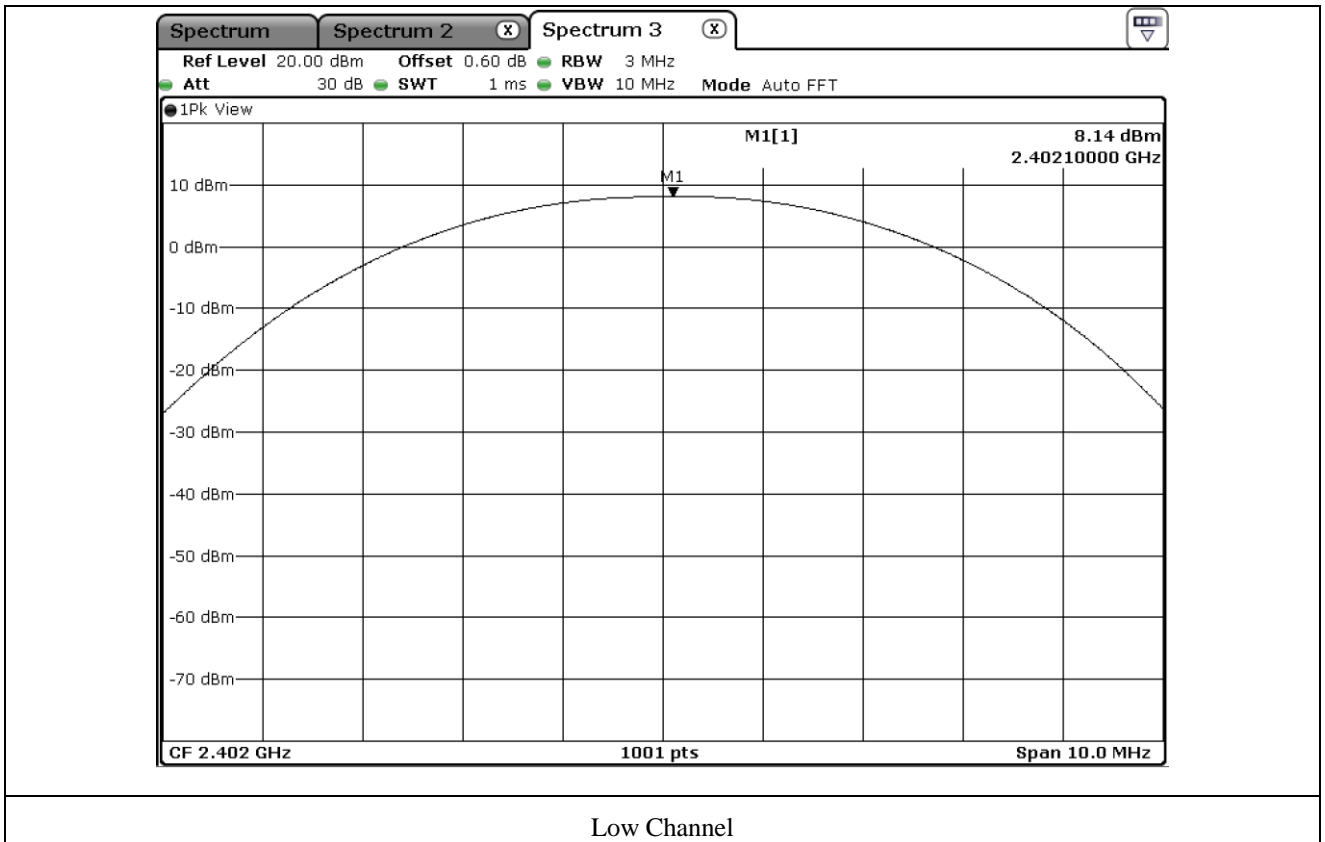
- Test Date : March 01, 2018 ~ March 12, 2018

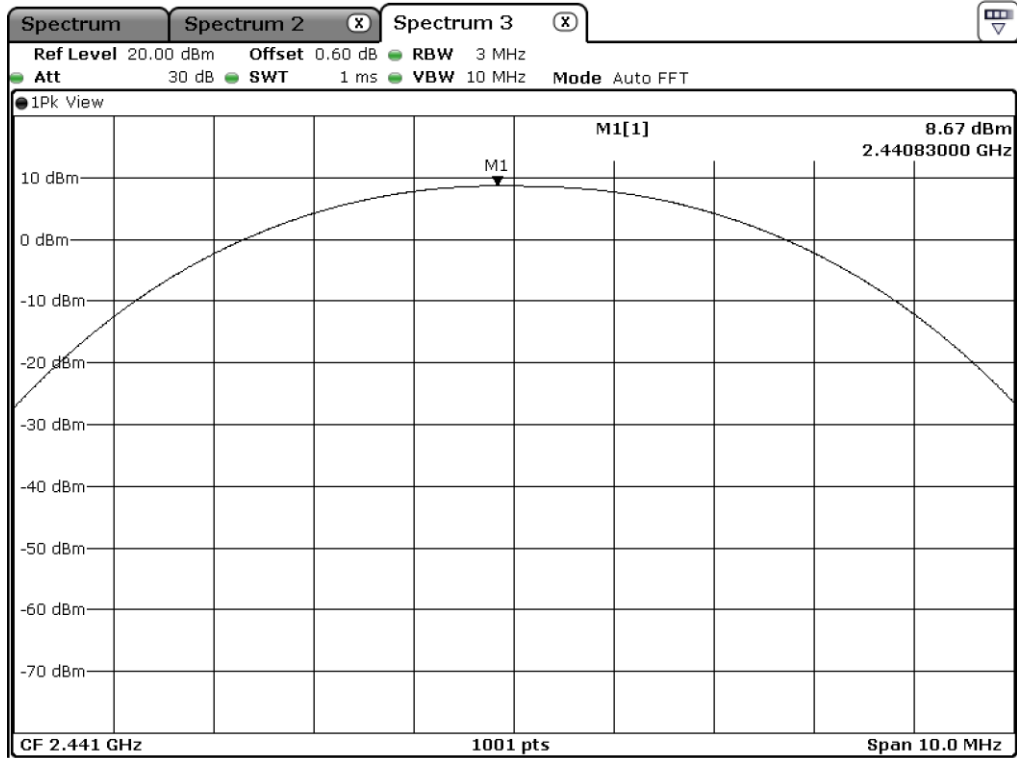
- Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	8.14	21.00	12.86
MIDDLE	2 441.00	8.67	21.00	12.33
HIGH	2 480.00	8.77	21.00	12.23

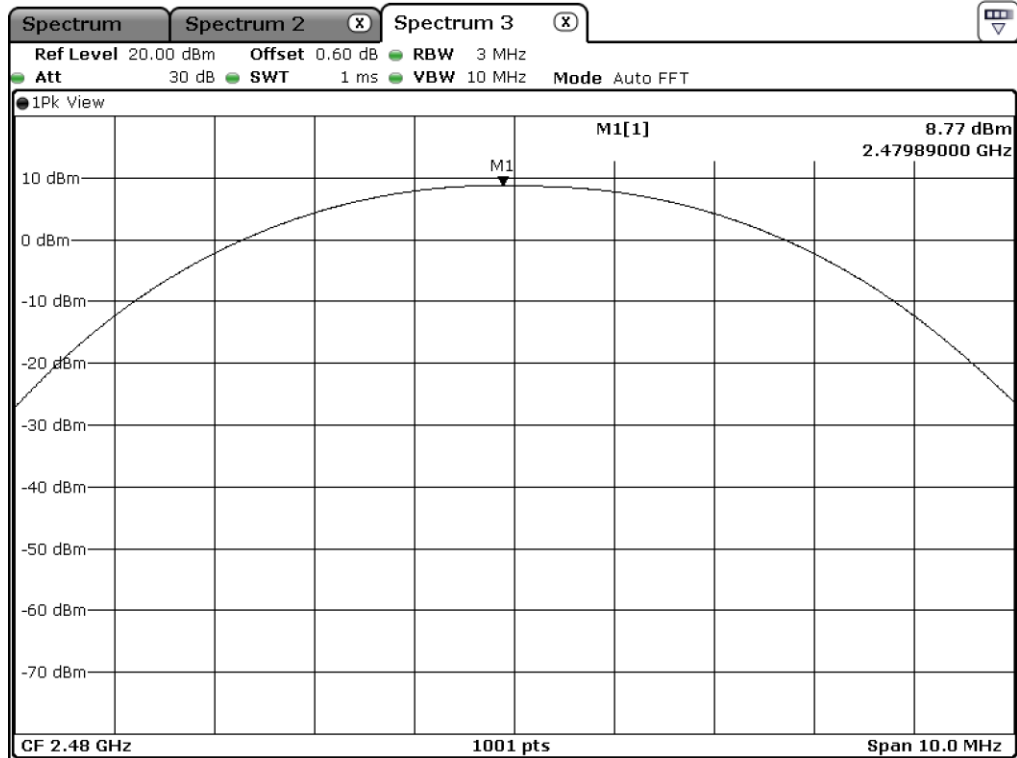
Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)

Tested by: Yu-Seog, Sim / Assistant Manager





Middle Channel



High Channel

**11.5 Test data for 2 Mbps**

-. Test Date : March 01, 2018 ~ March 12, 2018

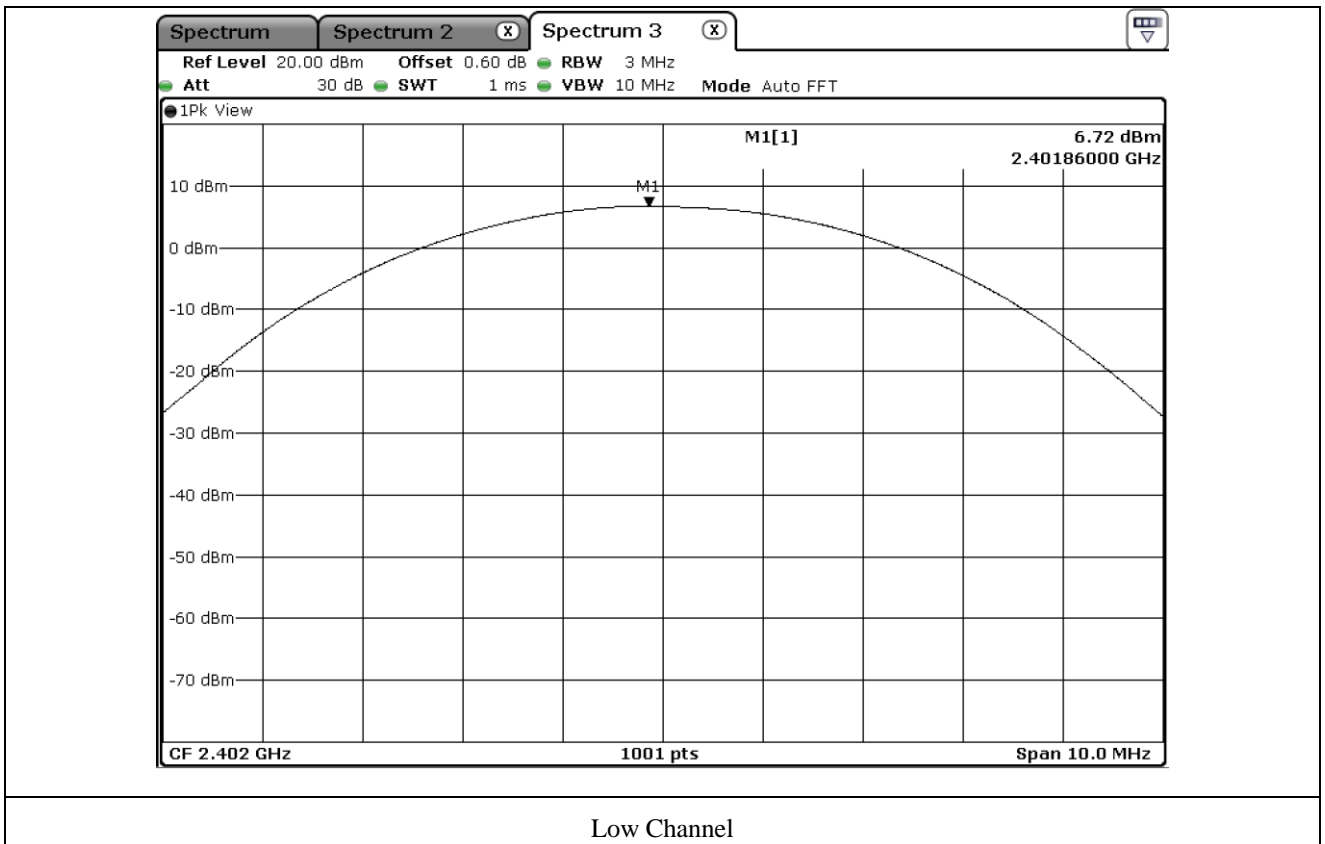
-. Test Result : Pass

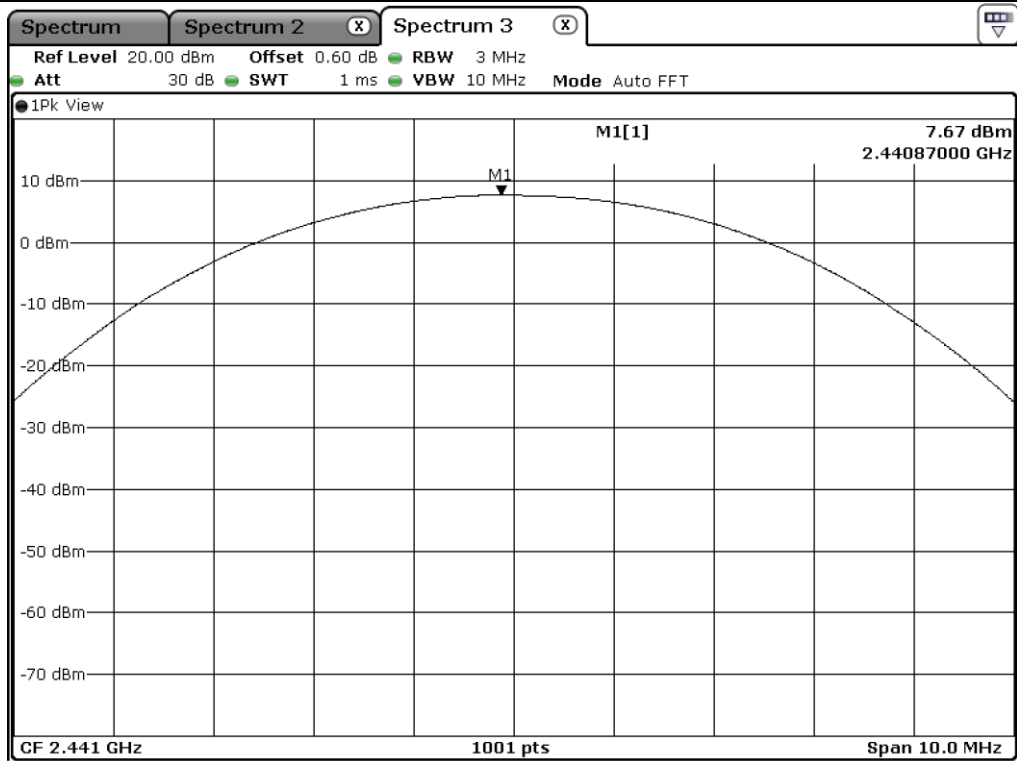
CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	6.72	21.00	14.28
MIDDLE	2 441.00	7.67	21.00	13.33
HIGH	2 480.00	7.84	21.00	13.16

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

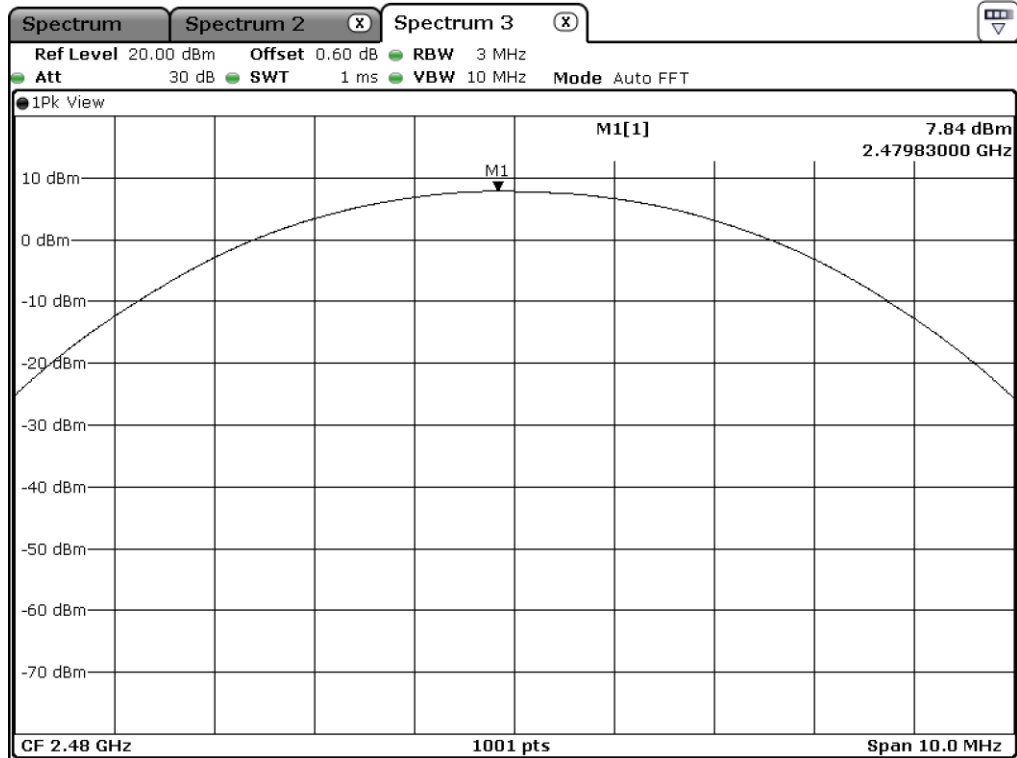


Tested by: Yu-Seog, Sim / Assistant Manager





Middle Channel



High Channel

### 11.6 Test data for 3 Mbps

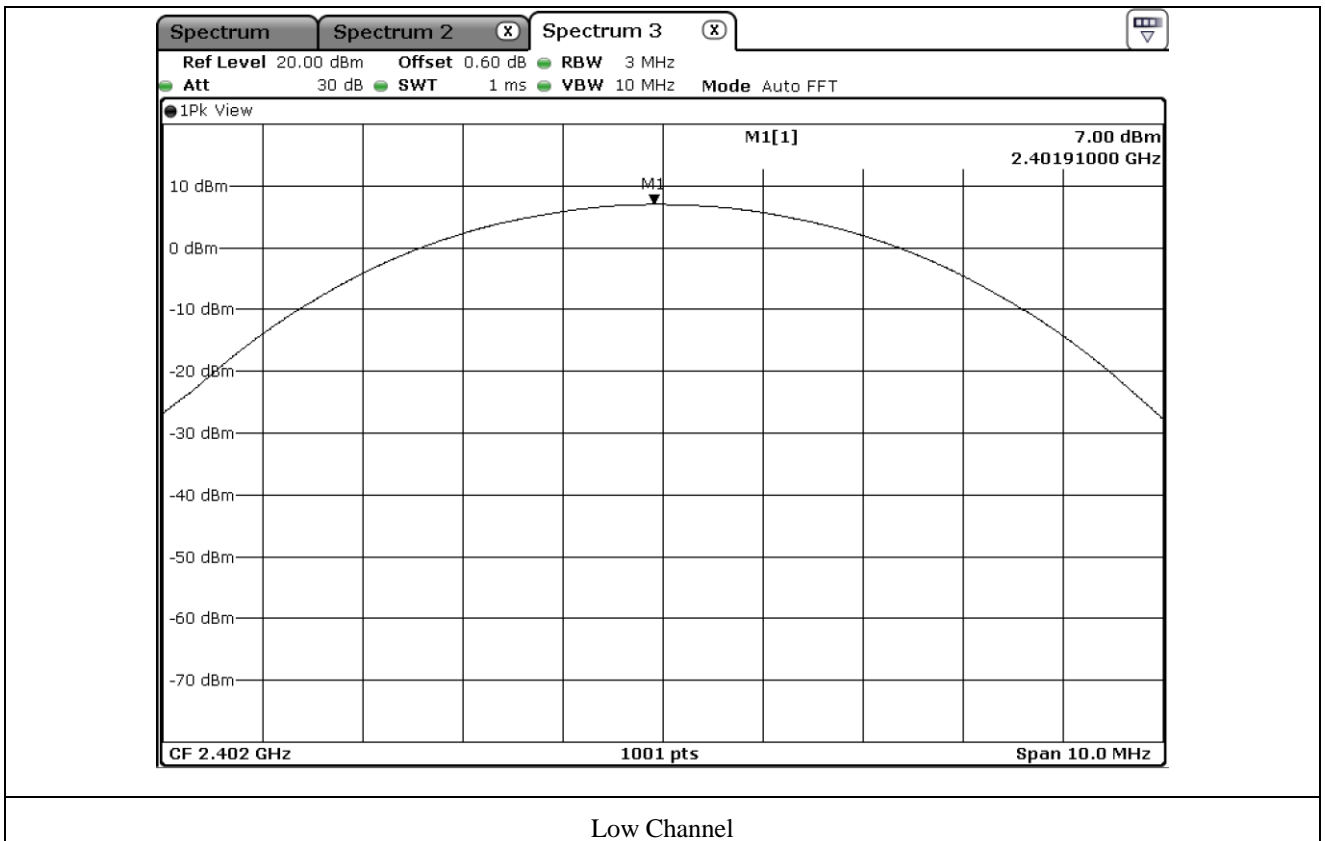
- Test Date : March 01, 2018 ~ March 12, 2018

- Test Result : Pass

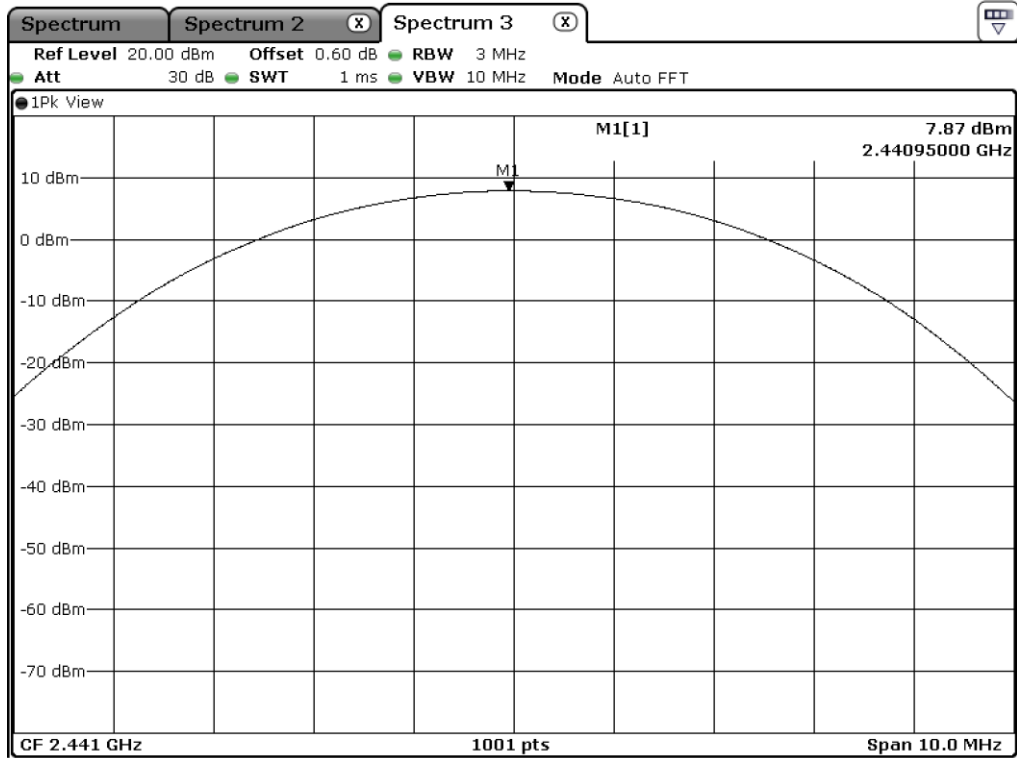
CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	7.00	21.00	14.00
MIDDLE	2 441.00	7.87	21.00	13.13
HIGH	2 480.00	8.01	21.00	12.99

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

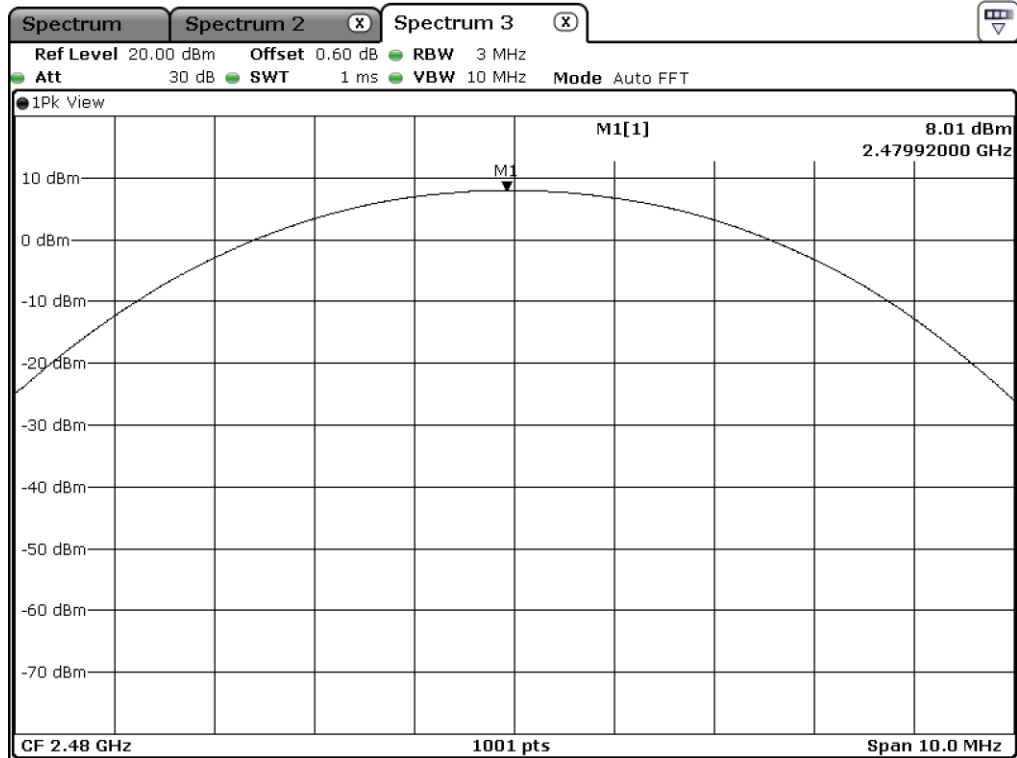
Tested by: Yu-Seog, Sim / Assistant Manager







Middle Channel



High Channel

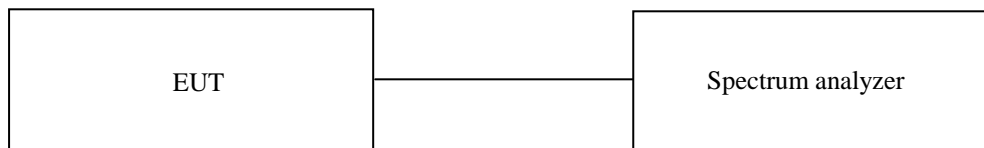
## 12. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

### 12.1 Operating environment

Temperature : 23 °C  
 Relative humidity : 45 % R.H.

### 12.2 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.



### 12.3 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.

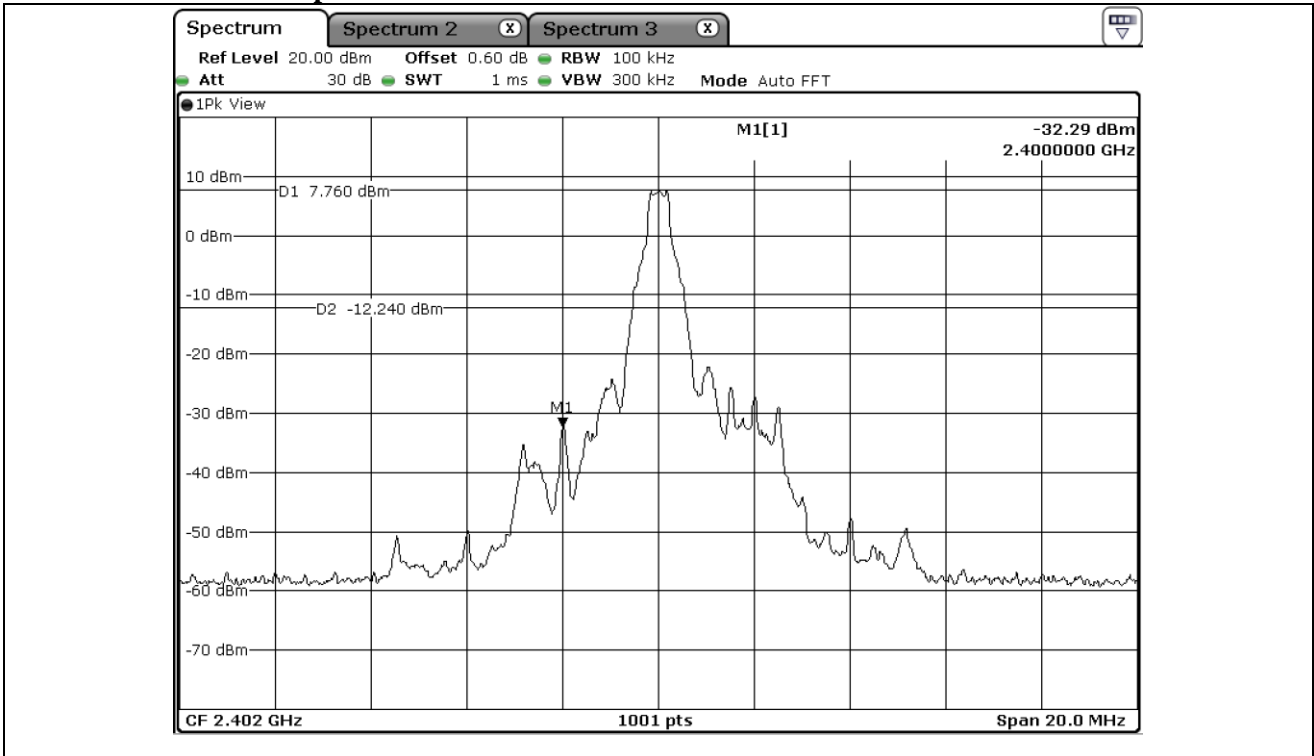
### 12.4 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Apr. 05, 2017 (1Y)
■ - ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 06, 2017 (1Y)
■ - 310N	Sonoma Instrument	Pre-Amplifier	312544	Apr. 05, 2017 (1Y)
■ - BBV9718	Schwarzbeck	Amplifier	310	Sep. 01, 2017 (1Y)
■ - SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Apr. 04, 2017 (1Y)
■ - DT3000-3t	Innco System	Turn Table	DT3000/093	N/A
■ - MA-4000XPET	Innco System	Antenna Master	MA4000/509	N/A
■ - VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-421	Apr. 15, 2016 (2Y)
■ - BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	May 26, 2017 (2Y)
■ - BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170179	Jul. 28, 2017 (2Y)

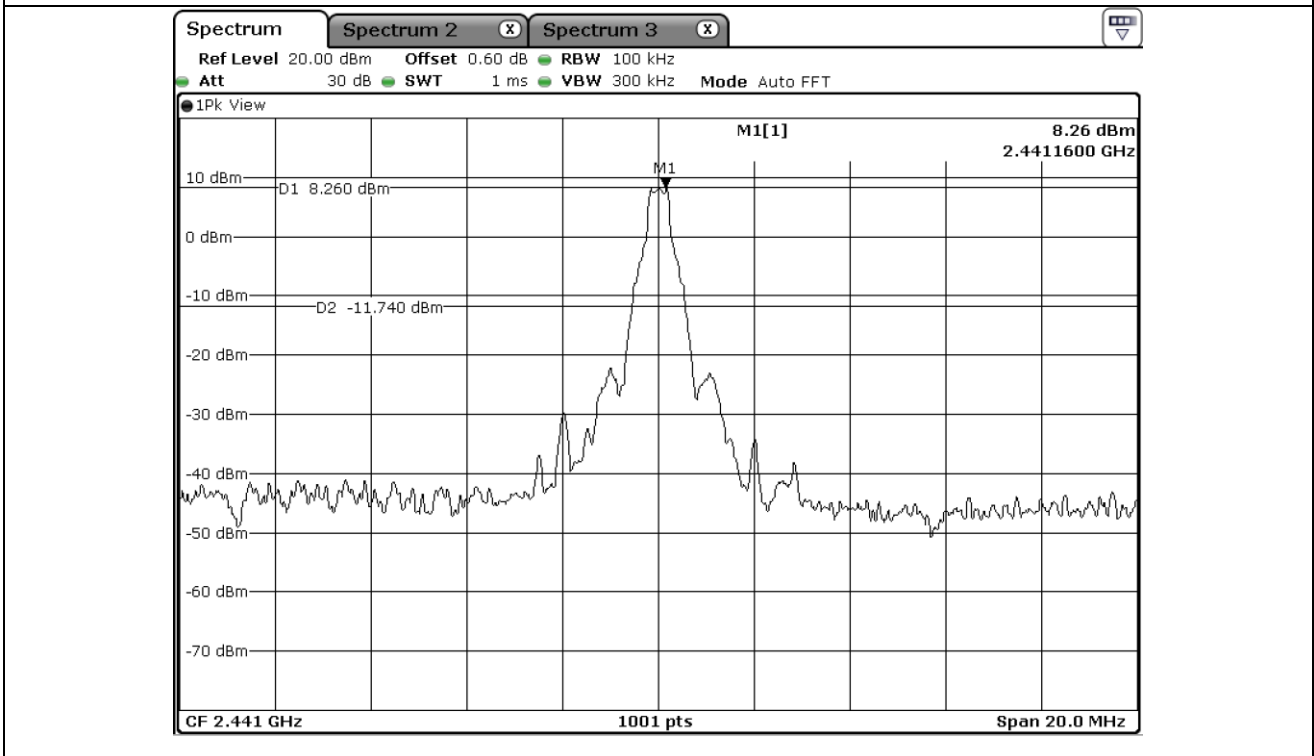
All test equipment used is calibrated on a regular basis.

12.5 Test data for conducted emission

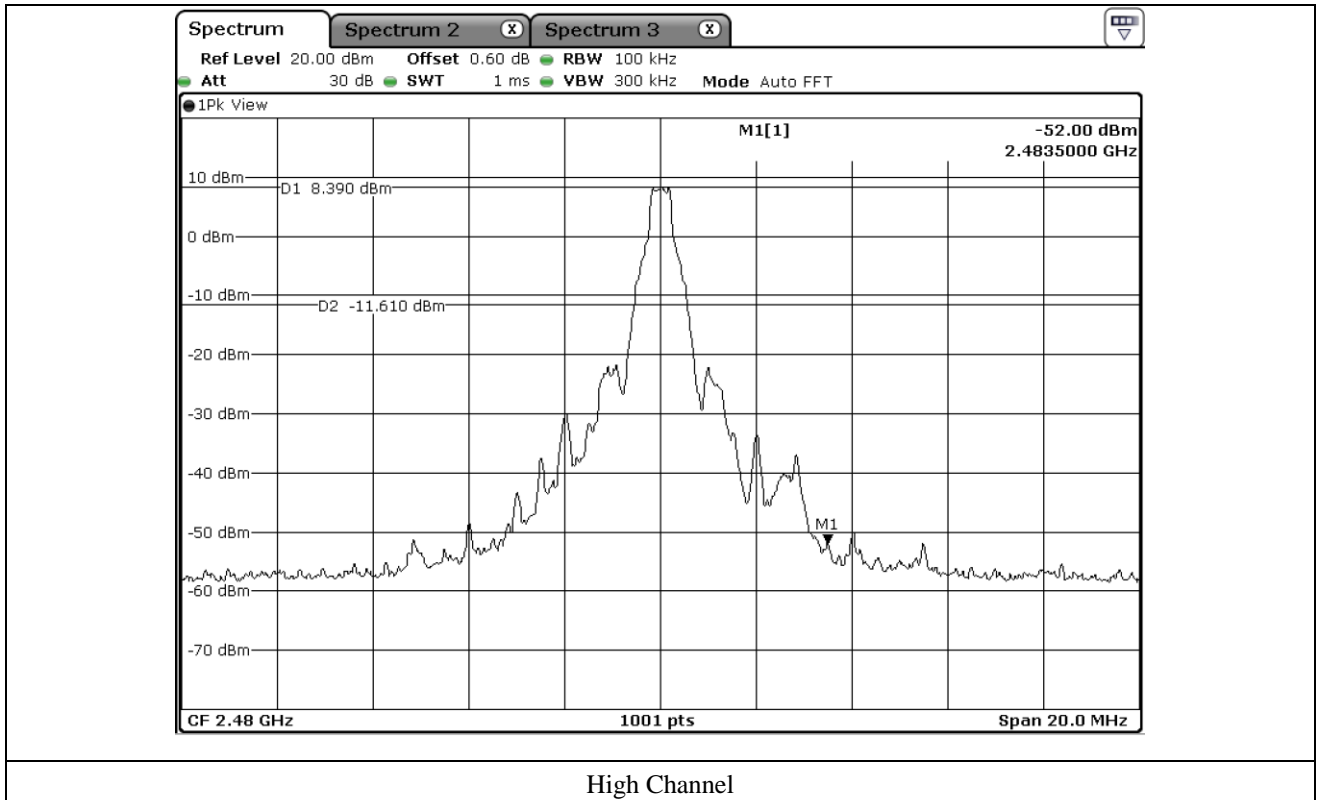
12.5.1 Test data for 1 Mbps

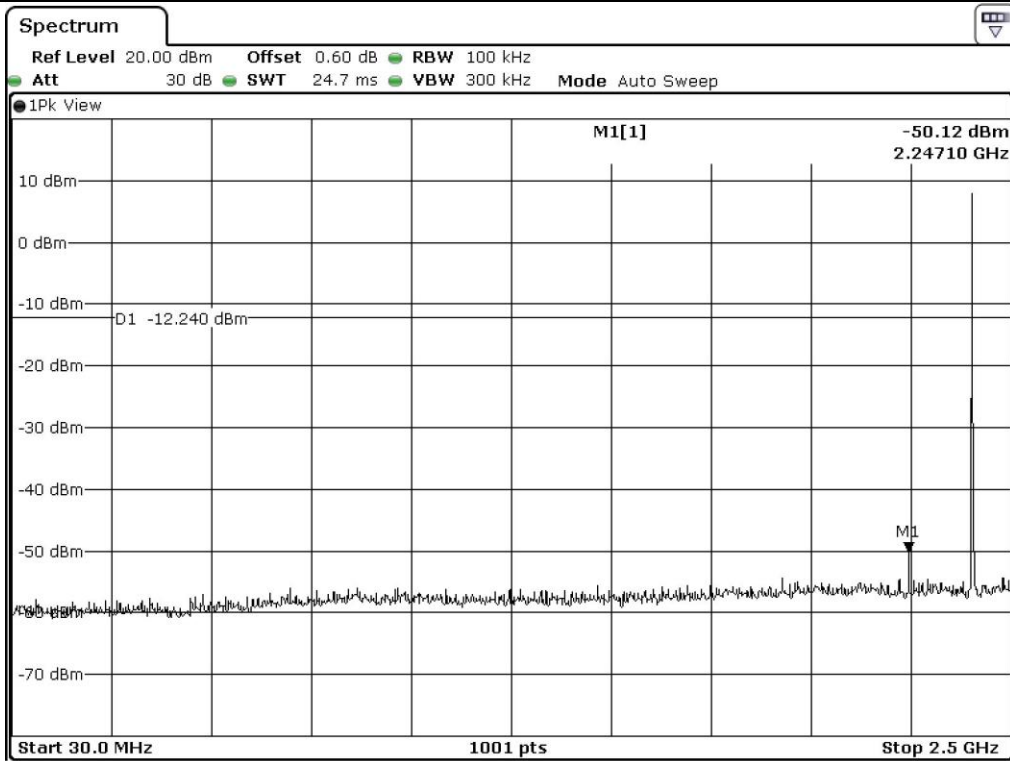


Low Channel

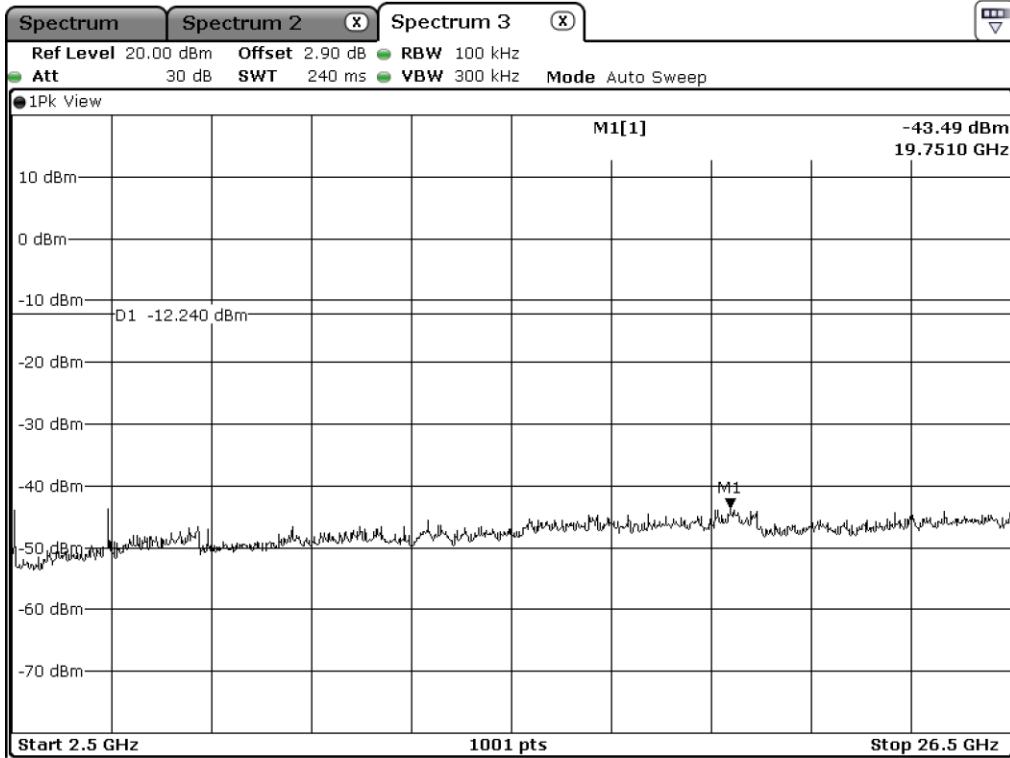


Middle Channel

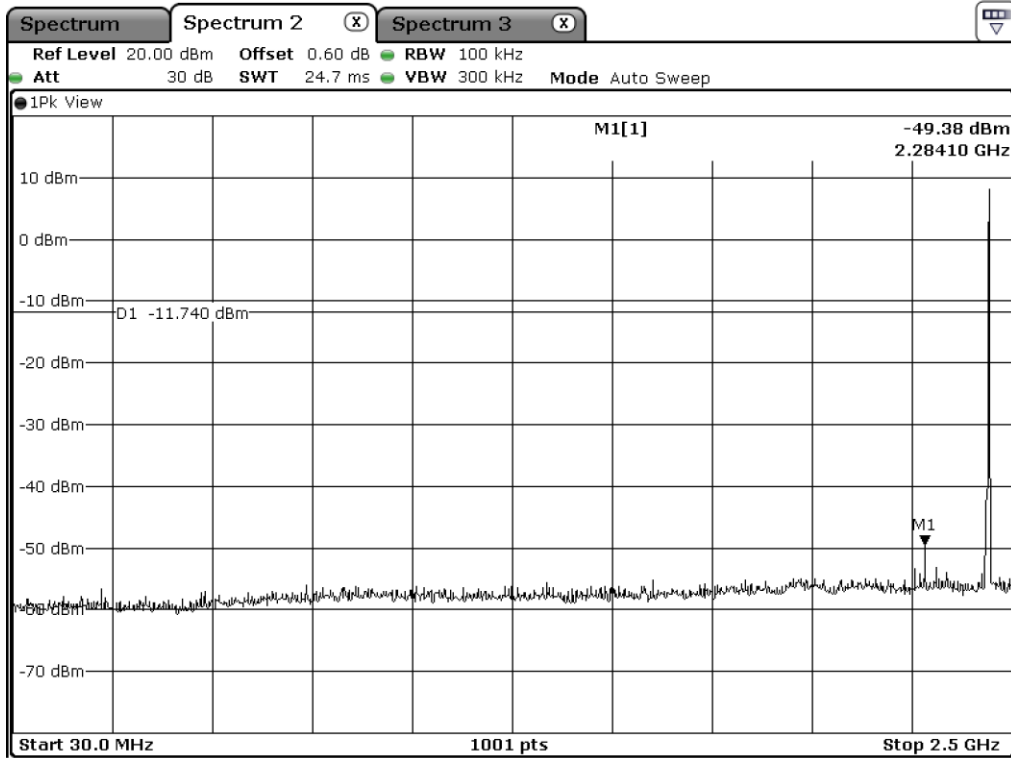




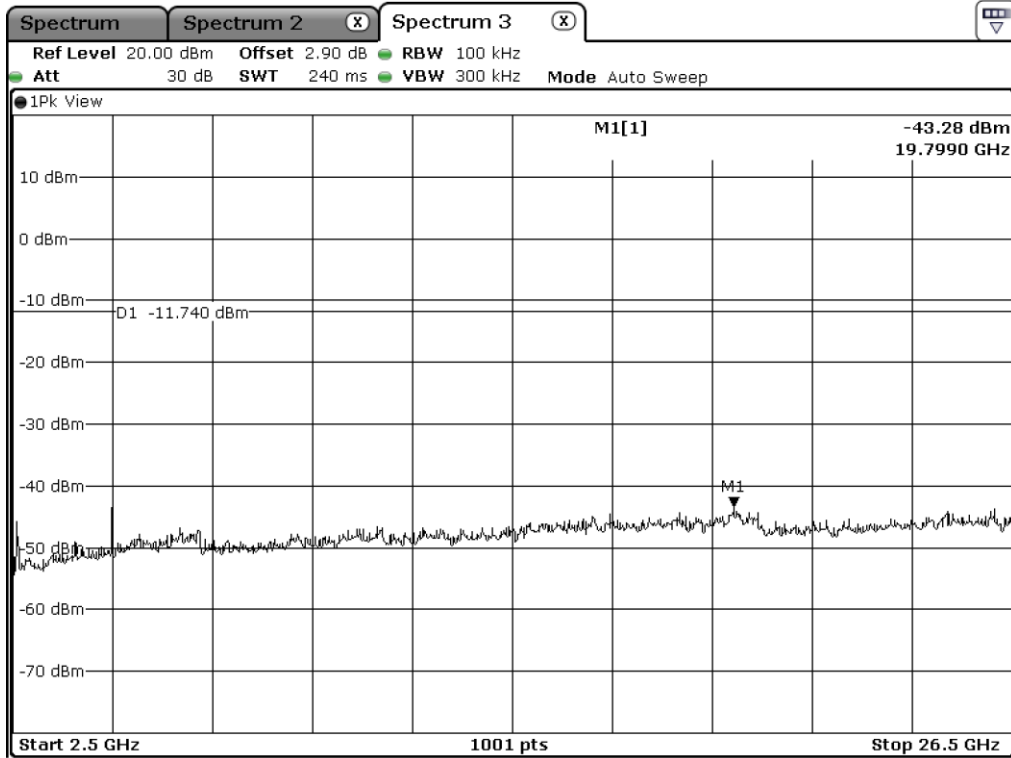
Low Channel



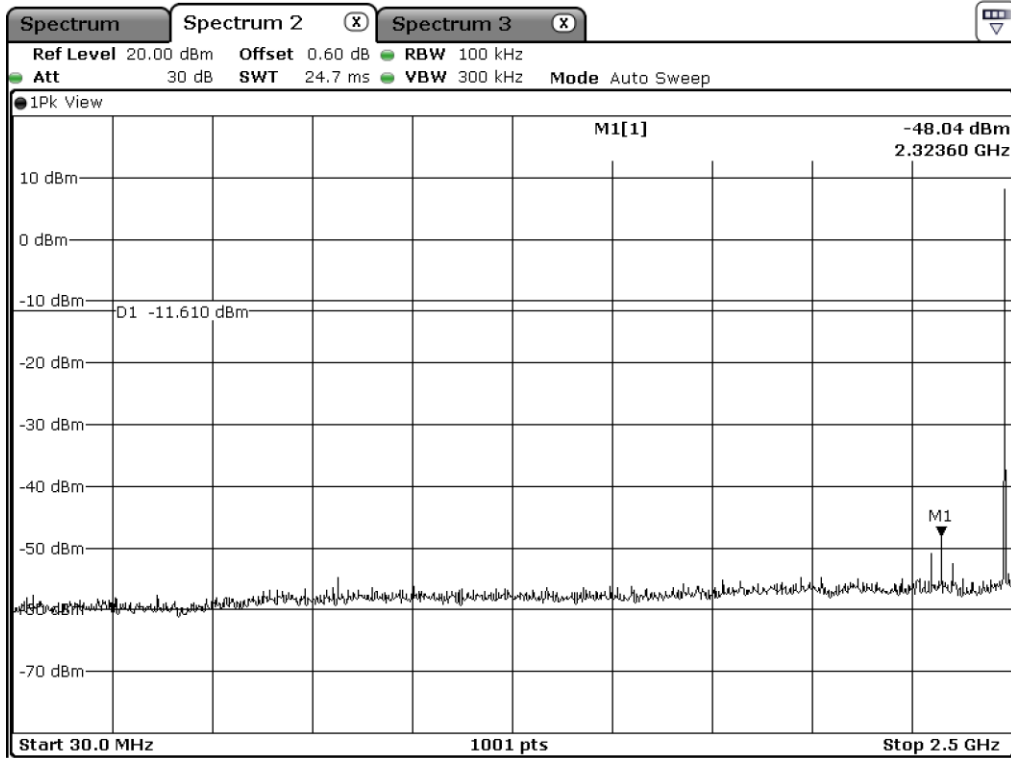
Low Channel



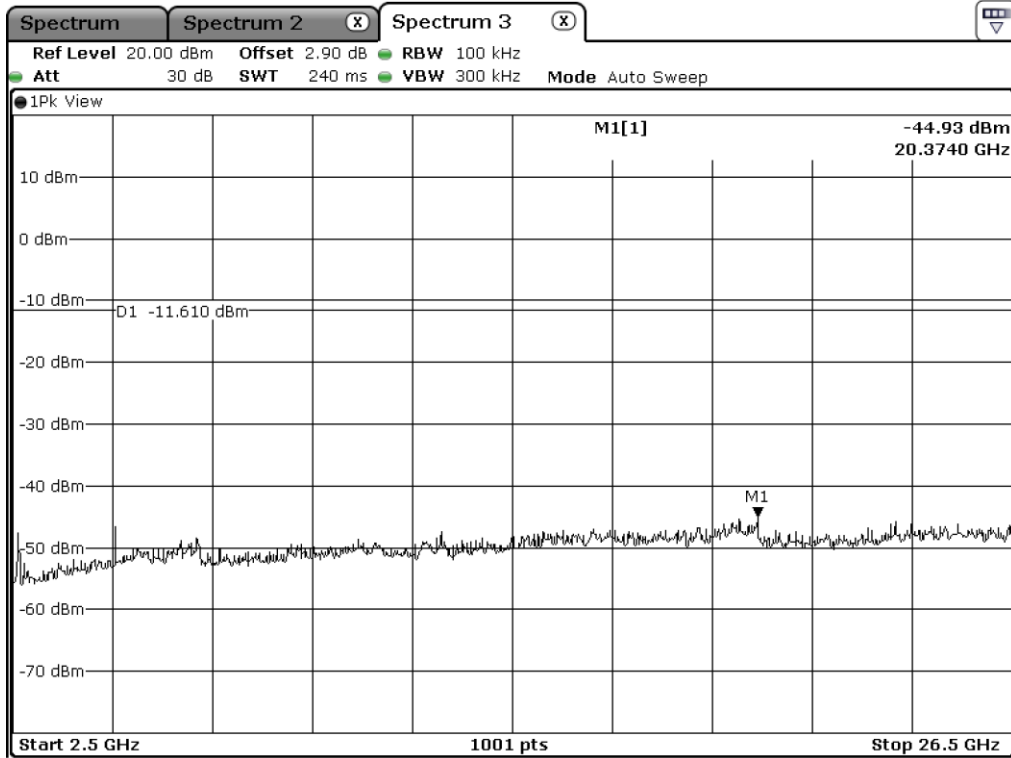
Middle Channel



Middle Channel

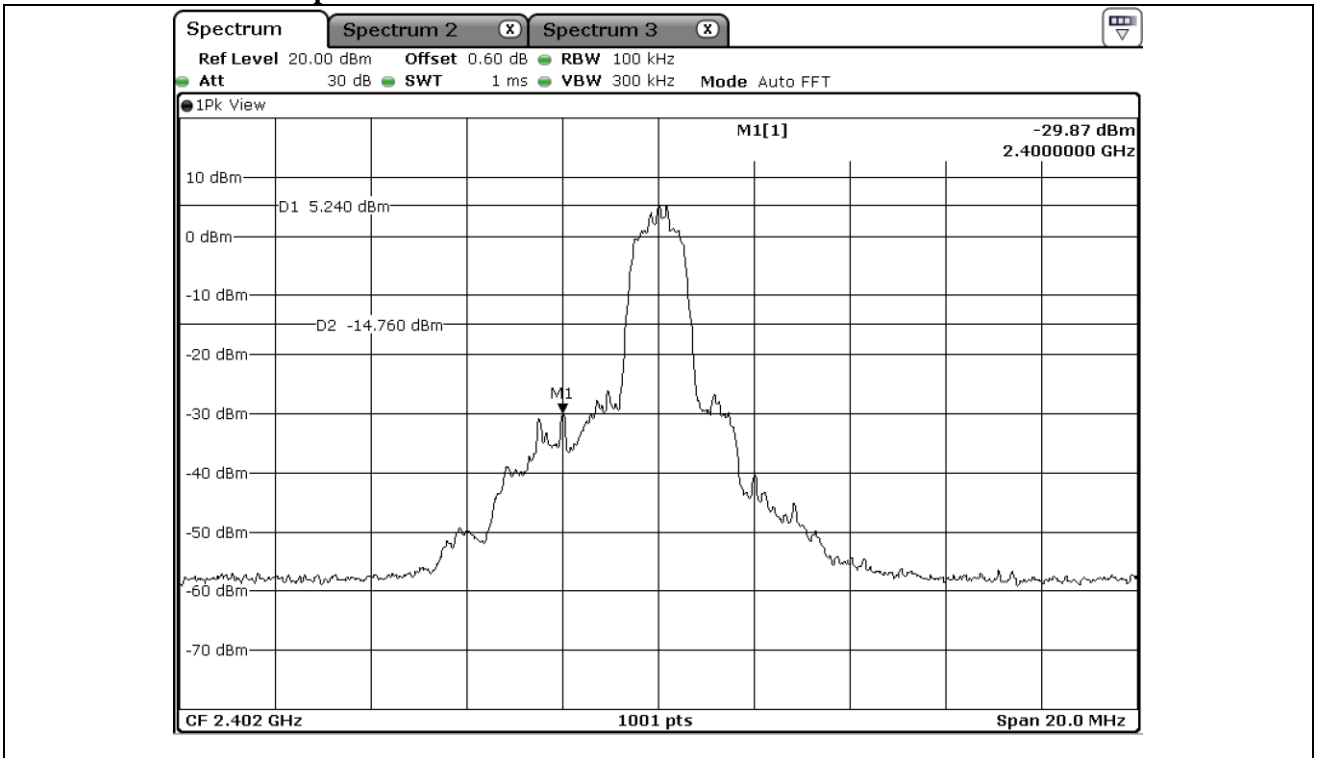


High Channel

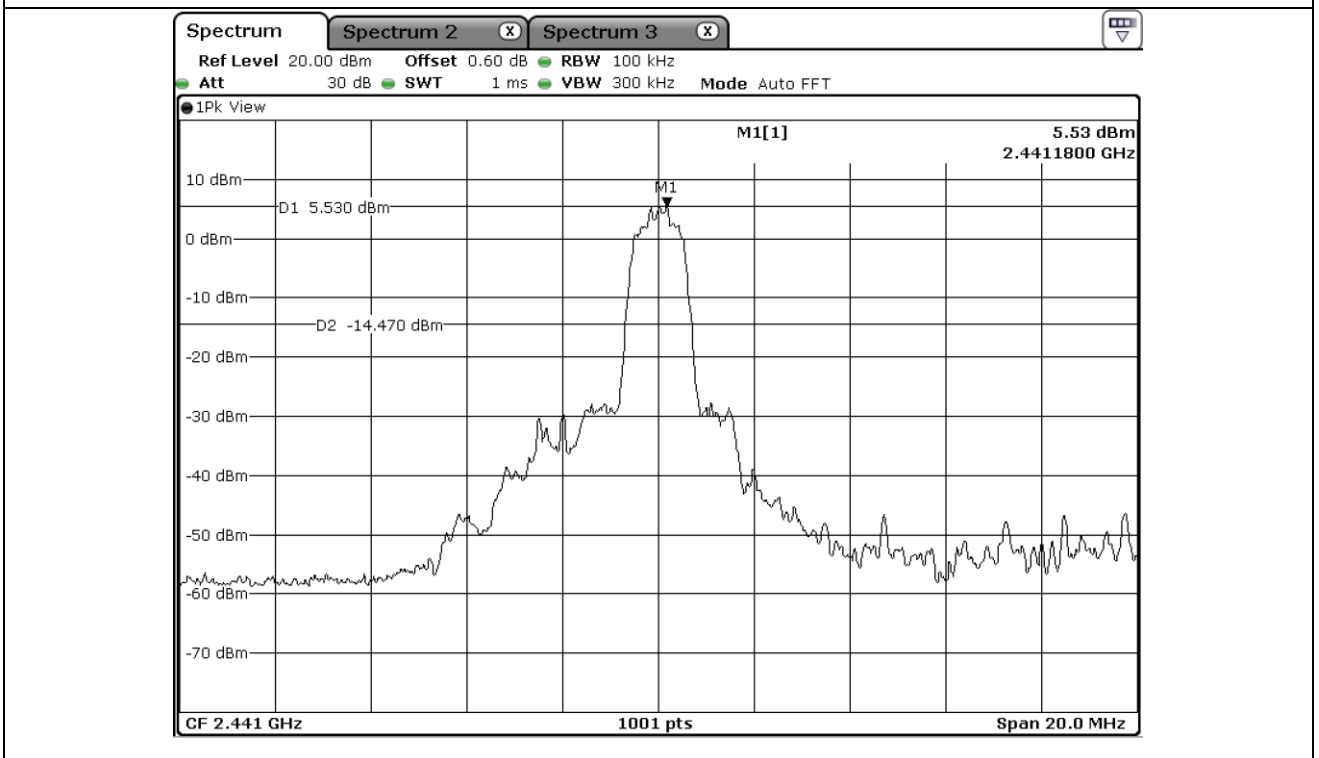


High Channel

12.5.2 Test data for 2 Mbps

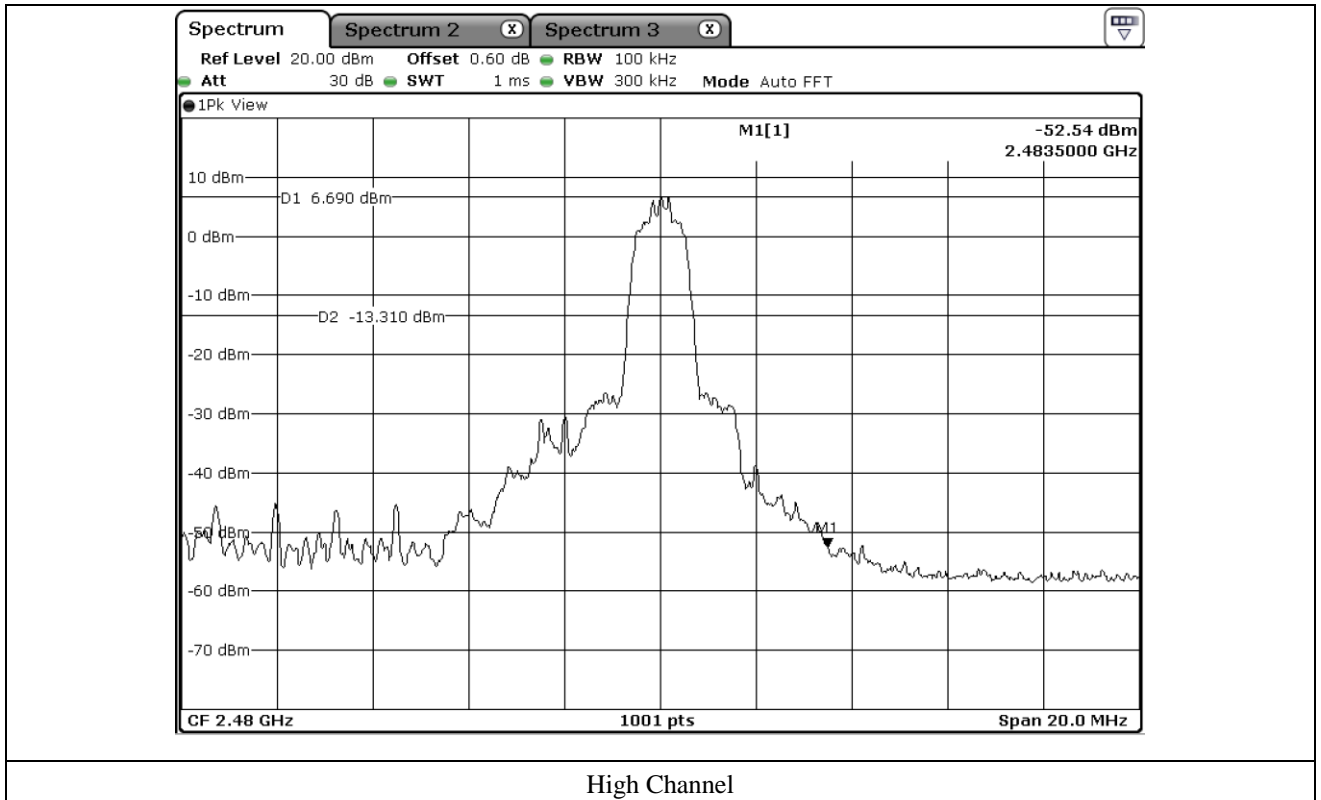


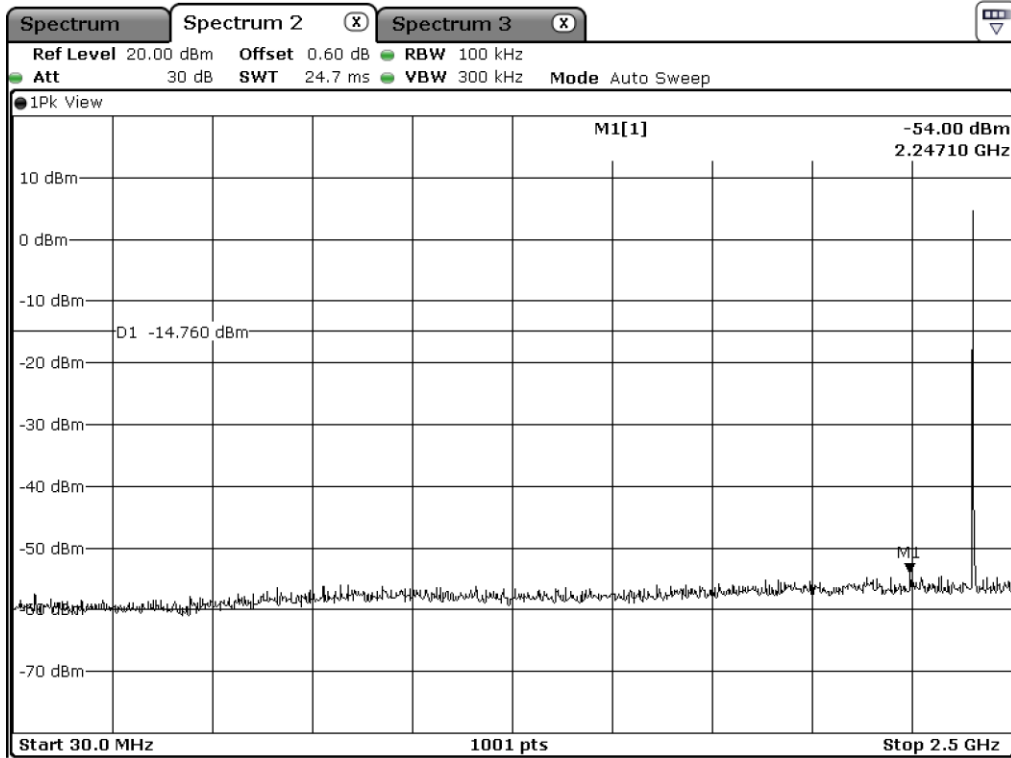
Low Channel



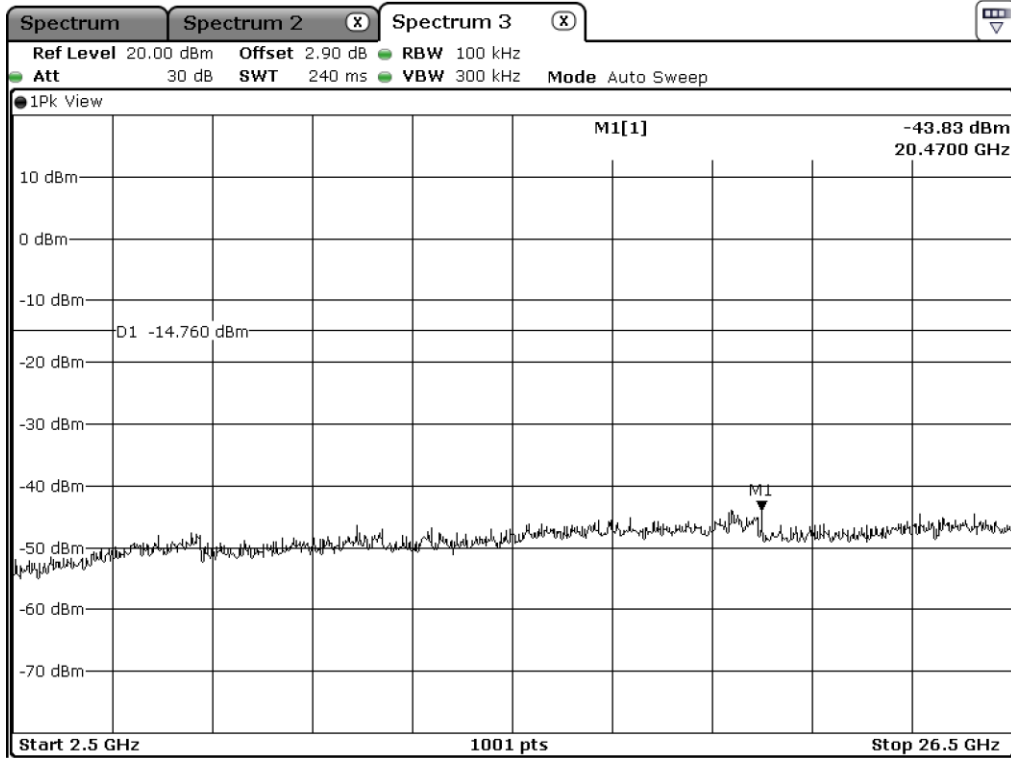
Middle Channel



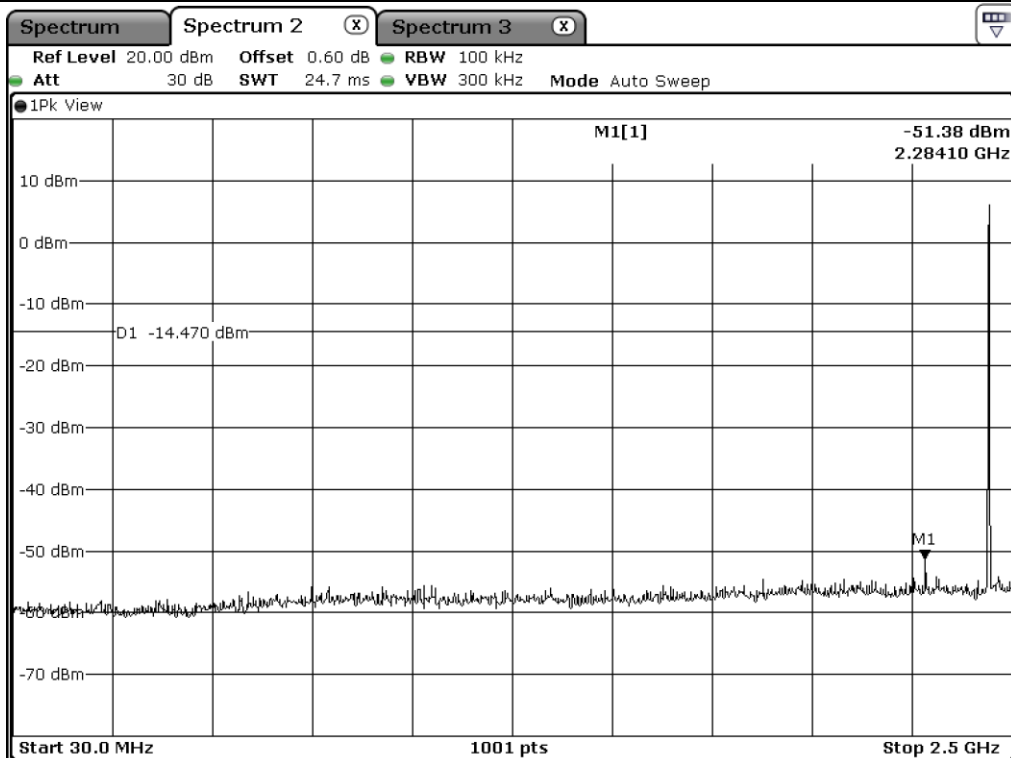




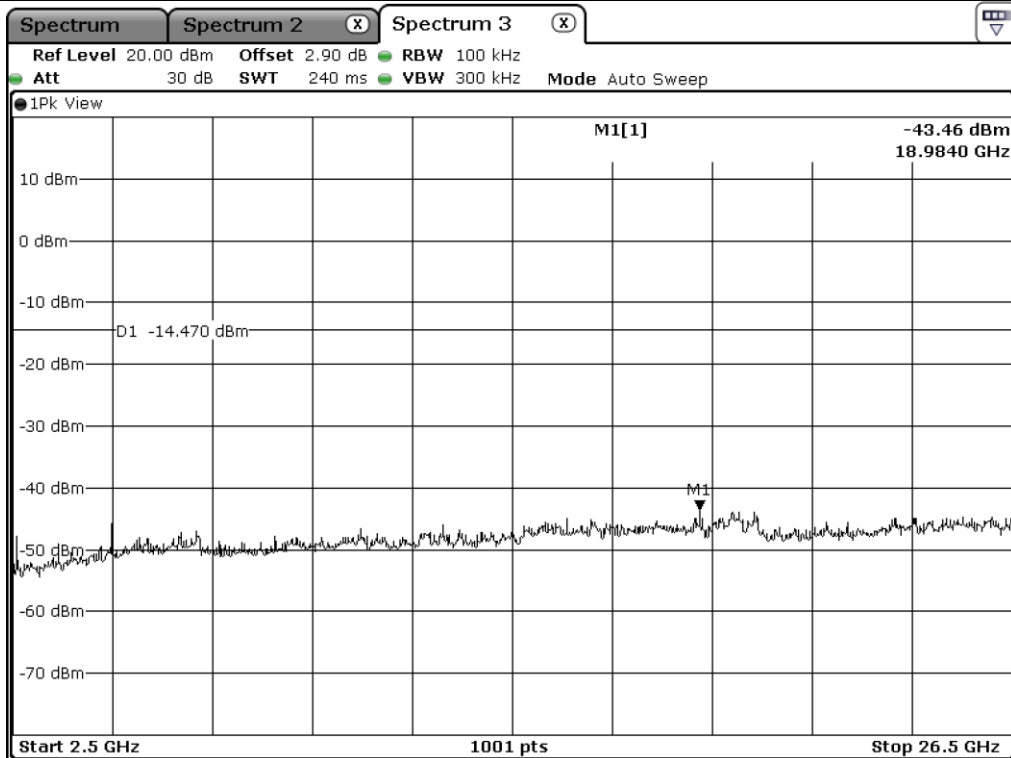
Low Channel



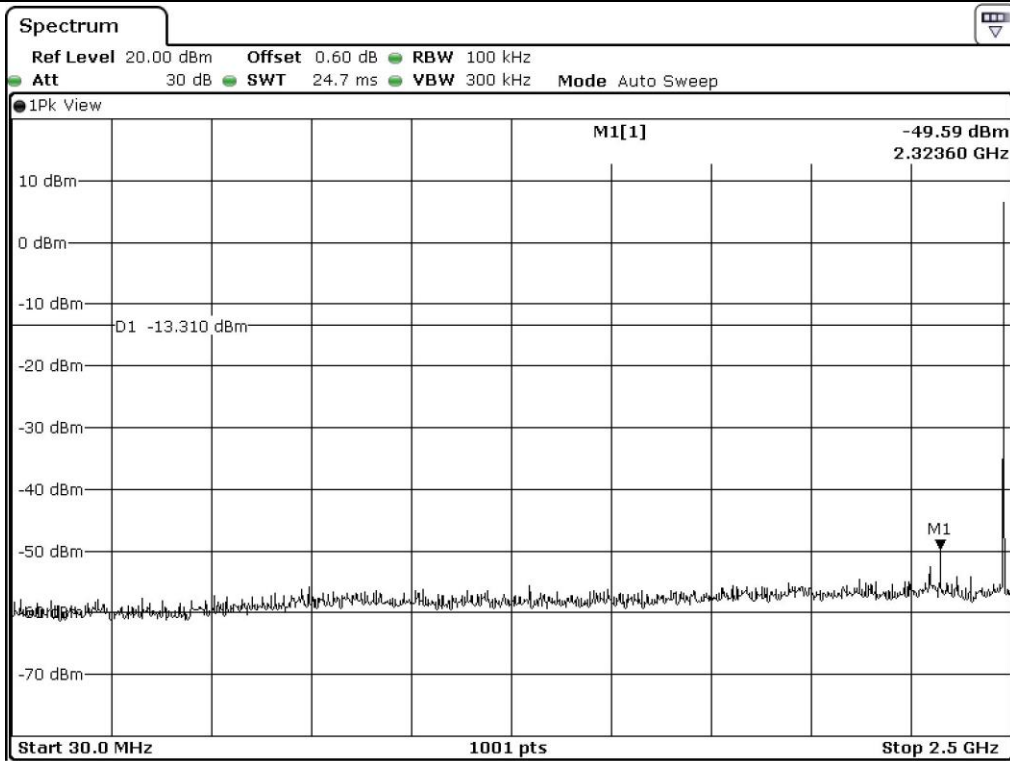
Low Channel



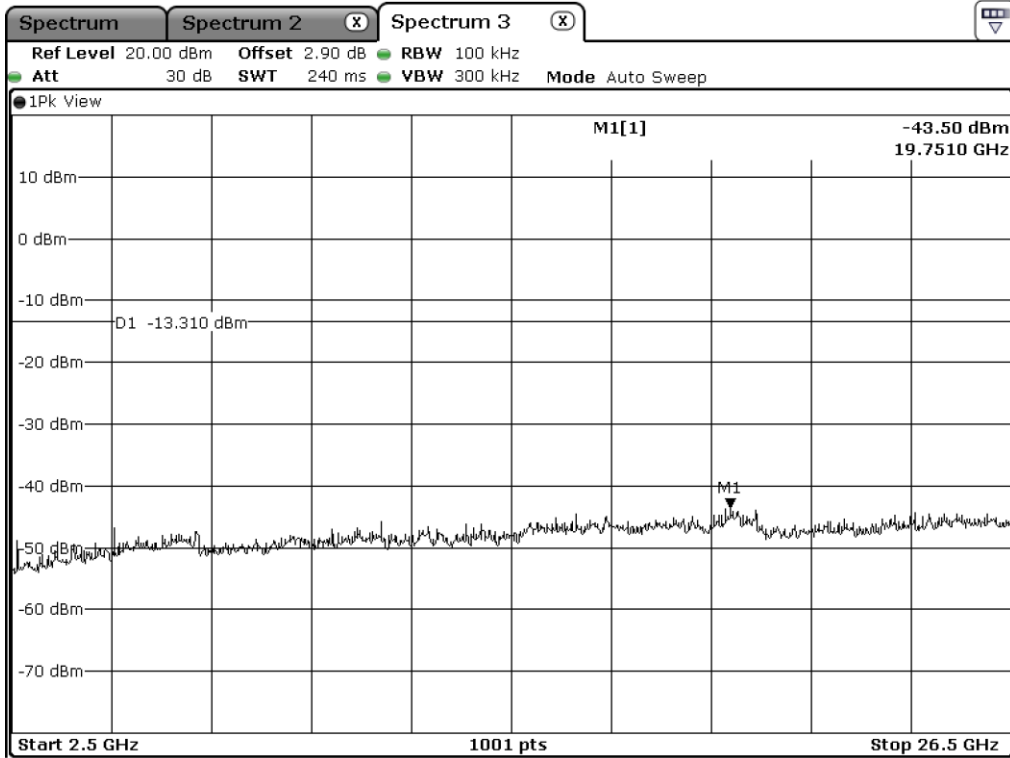
Middle Channel



Middle Channel

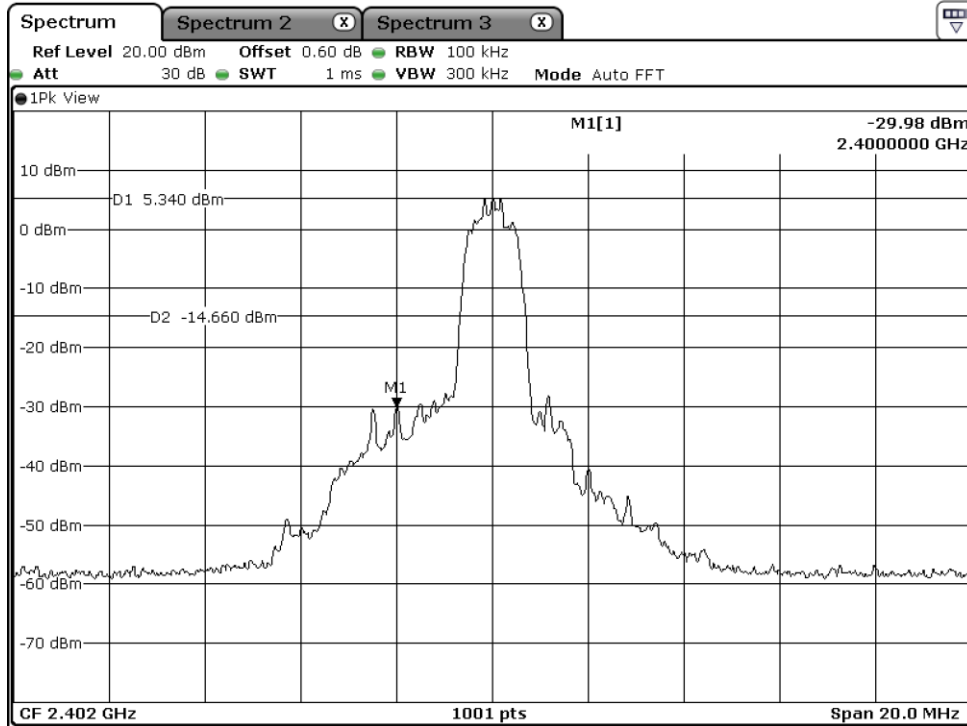


High Channel

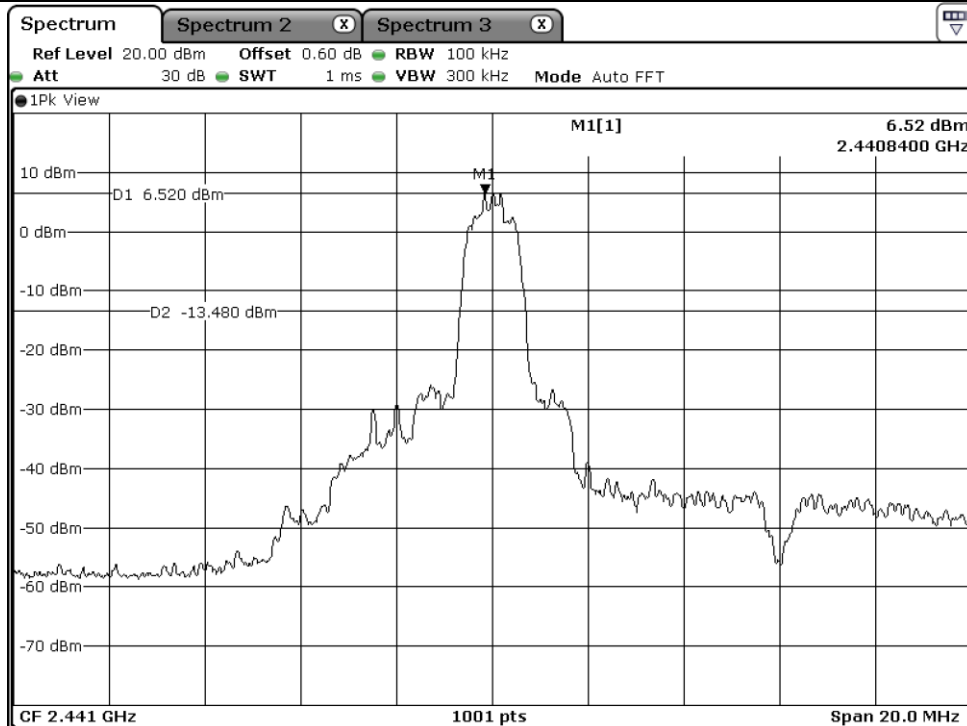


High Channel

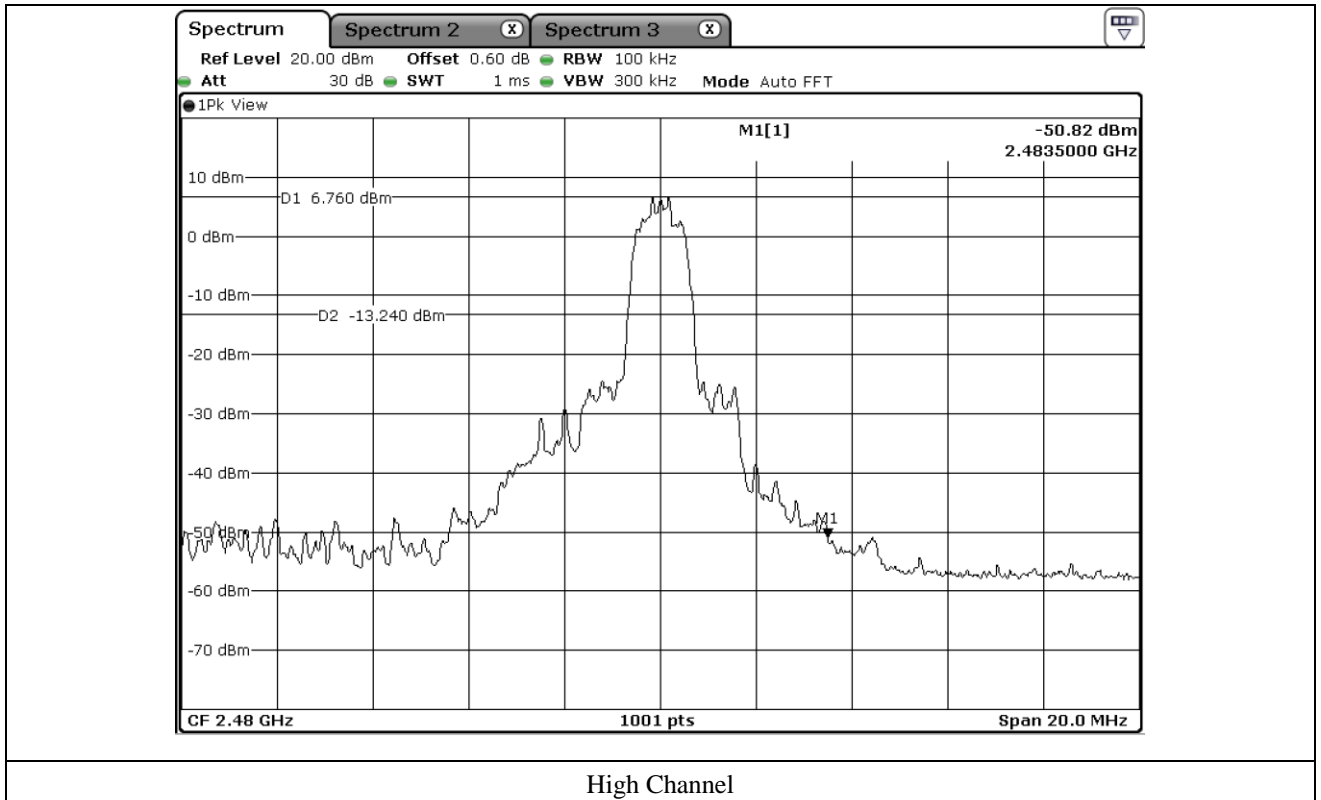
12.5.3 Test data for 3 Mbps

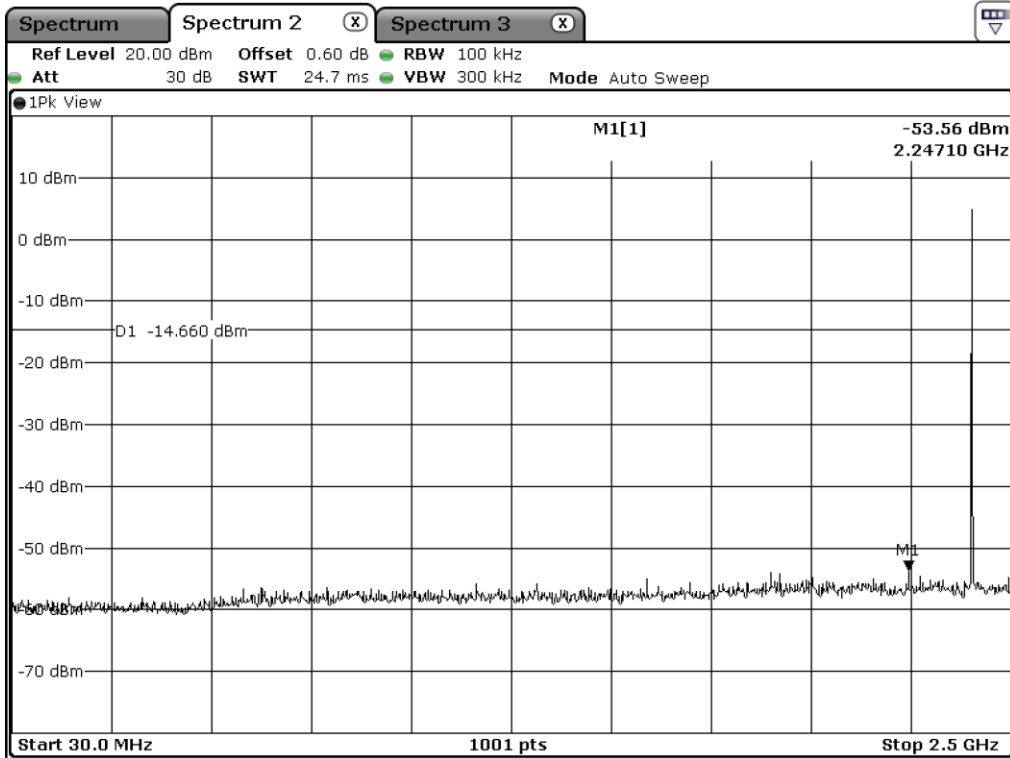


Low Channel

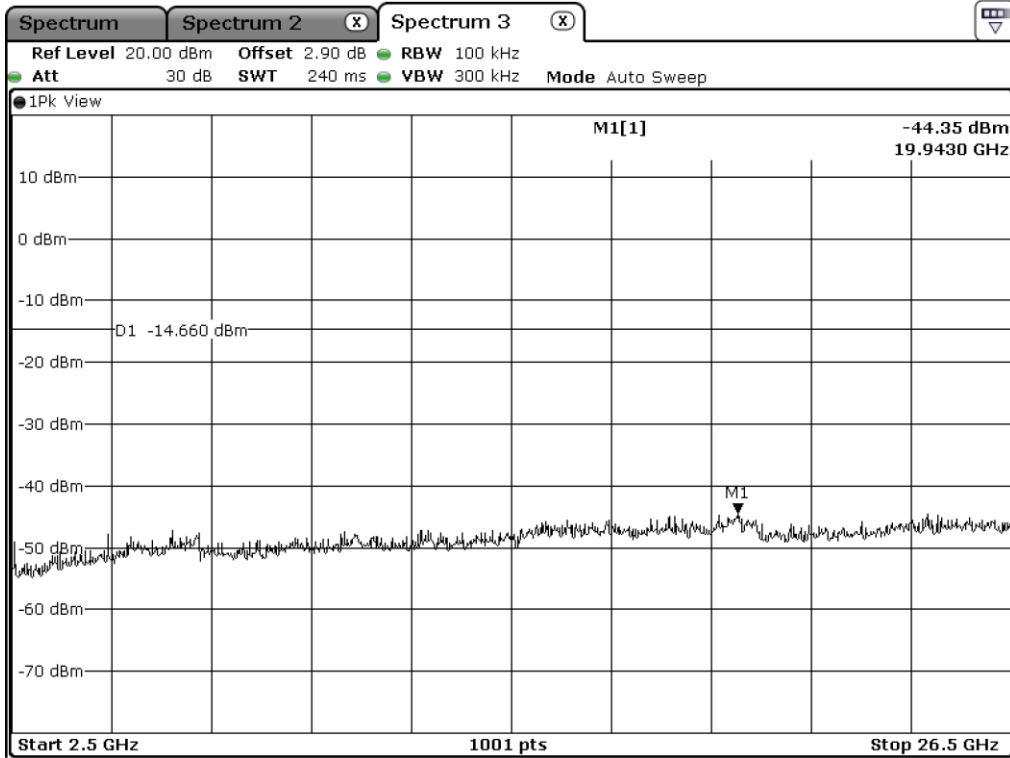


Middle Channel

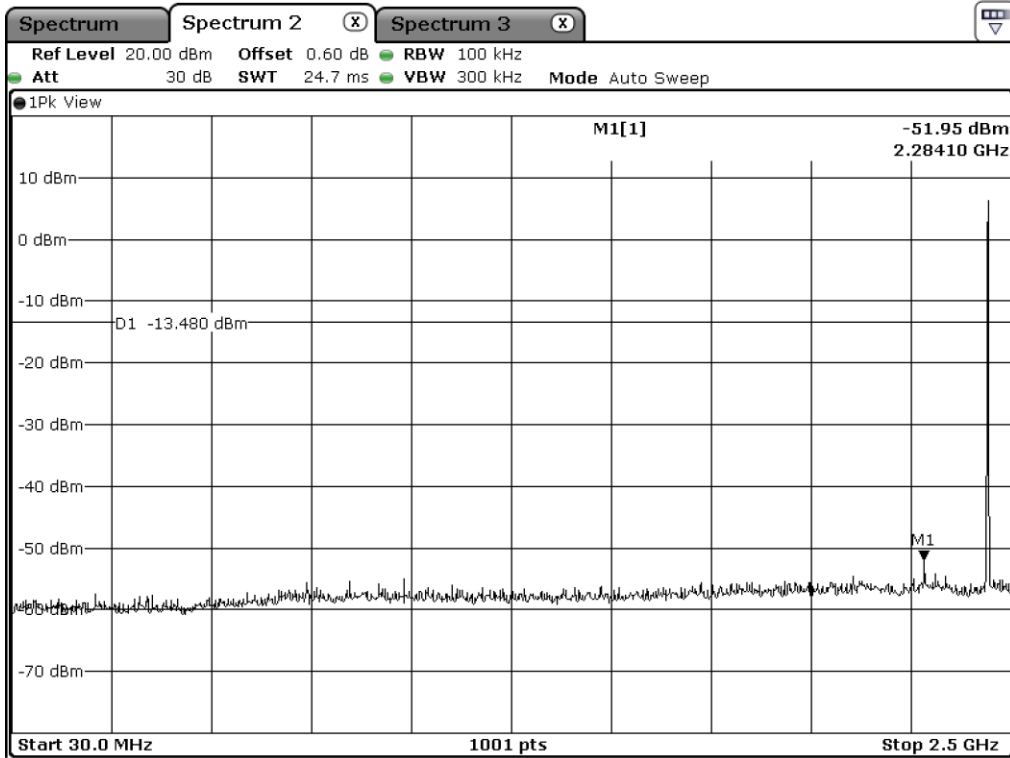




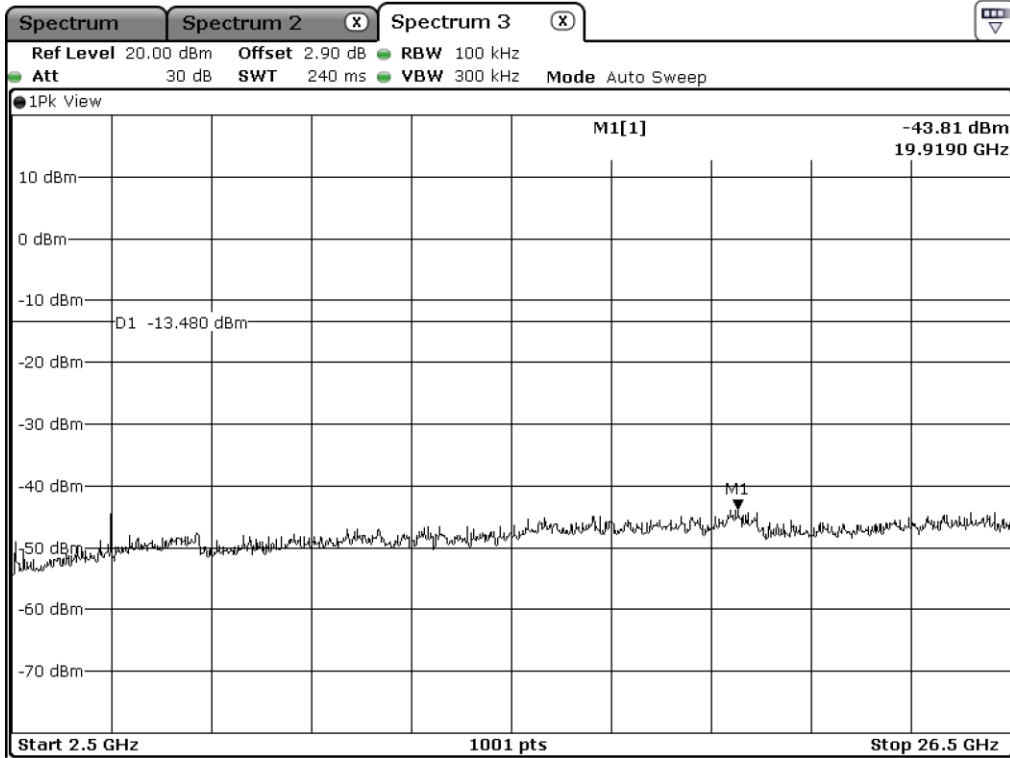
Low Channel



Low Channel

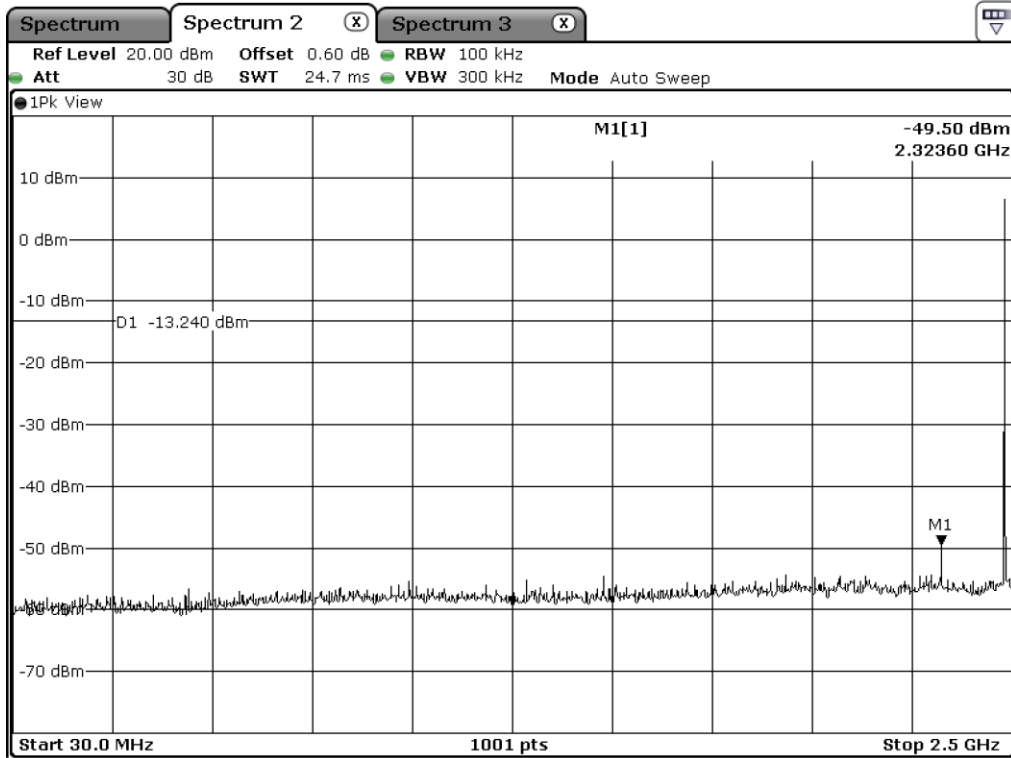


Middle Channel

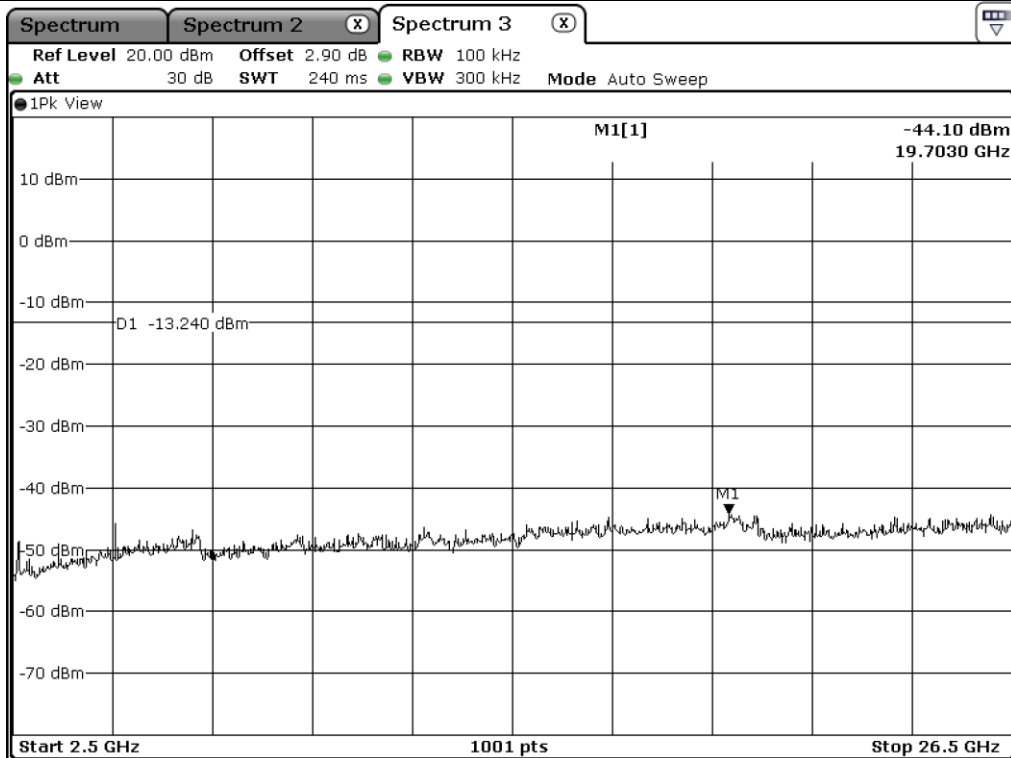


Middle Channel





High Channel



High Channel

**12.6 Test data for Transmitting mode radiated emission**

**12.6.1 Radiated Emission which fall in the Restricted Band**


**12.6.1.1 Test data for 1 Mbps**

- Test Date : March 01, 2018 ~ March 12, 2018
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- 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)
<b>Test Data for Low Channel</b>									
2 376.13	37.46	Peak	H	26.94	9.20	34.76	38.84	74.00	35.16
2 376.37	30.12	Average	H				31.50	54.00	22.50
2 363.18	39.68	Peak	V				41.06	74.00	32.94
2 332.81	32.54	Average	V				33.92	54.00	20.08
<b>Test Data for High Channel</b>									
2 489.19	39.95	Peak	H	27.47	9.49	35.51	41.40	74.00	32.60
2 488.63	32.88	Average	H				34.33	54.00	19.67
2 489.32	36.54	Peak	V				37.99	74.00	36.01
2 496.36	30.68	Average	V				32.13	54.00	21.87

Tabulated test data for Restricted Band

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




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**Tested by: Yu-Seog, Sim / Assistant Manager**

**12.6.1.2 Test data for 2 Mbps**

- Test Date : March 01, 2018 ~ March 12, 2018
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- 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)
<b>Test Data for Low Channel</b>									
2 376.13	35.12	Peak	H	26.94	9.20	34.76	36.50	74.00	37.50
2 376.37	29.01	Average	H				30.39	54.00	23.61
2 363.18	34.55	Peak	V				35.93	74.00	38.07
2 332.81	25.98	Average	V				27.36	54.00	26.64
<b>Test Data for High Channel</b>									
2 489.19	38.57	Peak	H	27.47	9.49	35.51	40.02	74.00	33.98
2 488.63	29.21	Average	H				30.66	54.00	23.34
2 489.32	36.98	Peak	V				38.43	74.00	35.57
2 496.36	28.77	Average	V				30.22	54.00	23.78

Tabulated test data for Restricted Band

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



**Tested by: Yu-Seog, Sim / Assistant Manager**

**12.6.1.3 Test data for 3 Mbps**

- Test Date : March 01, 2018 ~ March 12, 2018
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Measurement distance : 3 m
- Duty Cycle : 100 %
- 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)
<b>Test Data for Low Channel</b>									
2 376.13	35.21	Peak	H	26.94	9.20	34.76	36.59	74.00	37.41
2 376.37	28.83	Average	H				30.21	54.00	23.79
2 363.18	34.10	Peak	V				35.48	74.00	38.52
2 332.81	26.35	Average	V				27.73	54.00	26.27
<b>Test Data for High Channel</b>									
2 489.19	38.33	Peak	H	27.47	9.49	35.51	39.78	74.00	34.22
2 488.63	29.12	Average	H				30.57	54.00	23.43
2 489.32	36.52	Peak	V				37.97	74.00	36.03
2 496.36	28.10	Average	V				29.55	54.00	24.45

Tabulated test data for Restricted Band

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



**Tested by: Yu-Seog, Sim / Assistant Manager**

**12.6.2 Spurious & Harmonic Radiated Emission above 1 GHz**

**12.6.2.1 Test data for 1 Mbps**

- Test Date : March 01, 2018 ~ March 12, 2018
- Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,  
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- 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)
<b>Test Data for Low Channel</b>									
4 804.00	36.75	Peak	H	30.84	12.31	35.74	44.16	74.00	29.84
	33.12	Average	H				40.53	54.00	13.47
	38.54	Peak	V				45.95	74.00	28.05
	35.54	Average	V				42.95	54.00	11.05
<b>Test Data for Middle Channel</b>									
4 882.00	37.45	Peak	H	30.01	12.43	35.80	44.09	74.00	29.91
	34.69	Average	H				41.33	54.00	12.67
	38.45	Peak	V				45.09	74.00	28.91
	35.12	Average	V				41.76	54.00	12.24
<b>Test Data for High Channel</b>									
4 960.00	37.99	Peak	H	31.15	12.81	35.96	45.99	74.00	28.01
	34.67	Average	H				42.67	54.00	11.33
	38.97	Peak	V				46.97	74.00	27.03
	35.17	Average	V				43.17	54.00	10.83

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical, "\*" Frequency fall in restricted band



**Tested by: Yu-Seog, Sim / Assistant Manager**

**12.6.2.2 Test data for 2 Mbps**

- Test Date : March 01, 2018 ~ March 12, 2018
- Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,  
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- 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)
<b>Test Data for Low Channel</b>									
4 804.00	36.45	Peak	H	30.84	12.31	35.74	43.86	74.00	30.14
	33.65	Average	H				41.06	54.00	12.94
	37.22	Peak	V				44.63	74.00	29.37
	34.21	Average	V				41.62	54.00	12.38
<b>Test Data for Middle Channel</b>									
4 882.00	37.56	Peak	H	30.01	12.43	35.80	44.20	74.00	29.80
	34.17	Average	H				40.81	54.00	13.19
	37.98	Peak	V				44.62	74.00	29.38
	34.29	Average	V				40.93	54.00	13.07
<b>Test Data for High Channel</b>									
4 960.00	36.48	Peak	H	31.15	12.81	35.96	44.48	74.00	29.52
	33.96	Average	H				41.96	54.00	12.04
	37.65	Peak	V				45.65	74.00	28.35
	34.25	Average	V				42.25	54.00	11.75

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical, "\*" Frequency fall in restricted band



**Tested by: Yu-Seog, Sim / Assistant Manager**

**12.6.2.3 Test data for 3 Mbps**

- Test Date : March 01, 2018 ~ March 12, 2018
- Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,  
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- 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)
<b>Test Data for Low Channel</b>									
4 804.00	37.22	Peak	H	30.84	12.31	35.74	44.63	74.00	29.37
	34.22	Average	H				41.63	54.00	12.37
	37.12	Peak	V				44.53	74.00	29.47
	34.68	Average	V				42.09	54.00	11.91
<b>Test Data for Middle Channel</b>									
4 882.00	36.84	Peak	H	30.01	12.43	35.80	43.48	74.00	30.52
	33.87	Average	H				40.51	54.00	13.49
	36.98	Peak	V				43.62	74.00	30.38
	34.16	Average	V				40.80	54.00	13.20
<b>Test Data for High Channel</b>									
4 960.00	37.21	Peak	H	31.15	12.81	35.96	45.21	74.00	28.79
	34.21	Average	H				42.21	54.00	11.79
	38.47	Peak	V				46.47	74.00	27.53
	35.24	Average	V				43.24	54.00	10.76

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical, "\*" Frequency fall in restricted band



**Tested by: Yu-Seog, Sim / Assistant Manager**

### 13. RADIATED EMISSION TEST

#### 13.1 Operating environment

Temperature : 23 °C  
 Relative humidity : 45 % R.H.

#### 13.2 Test set-up

The radiated emissions measurements were on the 3 m semi anechoic chamber. The EUT and other support equipment were placed on 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.

#### 13.3 Test equipment used

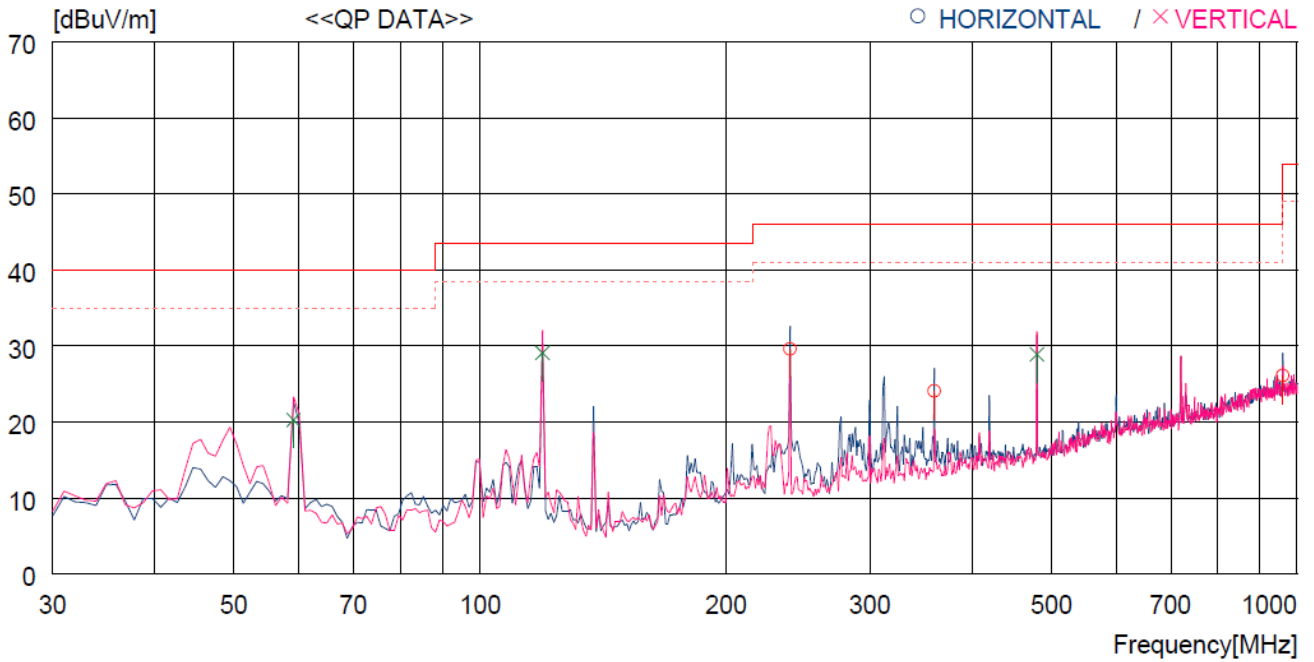
Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Apr. 05, 2017 (1Y)
■ - ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 06, 2017 (1Y)
■ - 310N	Sonoma Instrument	Pre-Amplifier	312544	Apr. 05, 2017 (1Y)
■ - BBV9718	Schwarzbeck	Amplifier	310	Sep. 01, 2017 (1Y)
■ - SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Apr. 04, 2017 (1Y)
■ - DT3000-3t	Innco System	Turn Table	DT3000/093	N/A
■ - MA-4000XPET	Innco System	Antenna Master	MA4000/509	N/A
■ - VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-421	Apr. 15, 2016 (2Y)
■ - BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	May 26, 2017 (2Y)
■ - BBHA 9170	Schwarzbeck	Horn Antenna	BBHA9170179	Jul. 28, 2017 (2Y)

All test equipment used is calibrated on a regular basis.



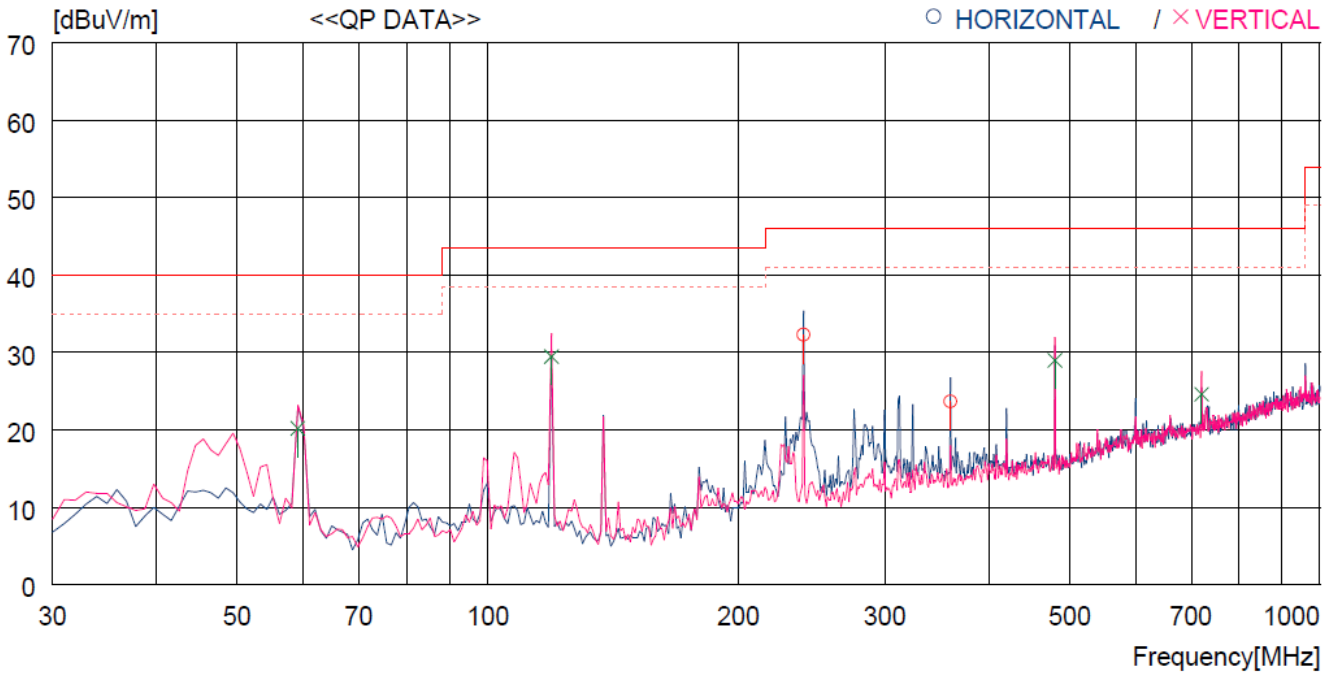
**13.4 Test data for 30 MHz ~ 1 000 MHz**

- Test Date : March 09, 2018
- Resolution bandwidth : 120 kHz
- Frequency range : 30 MHz ~ 1 000 MHz
- Measurement distance : 3 m
  
- Operating condition : Low Channel



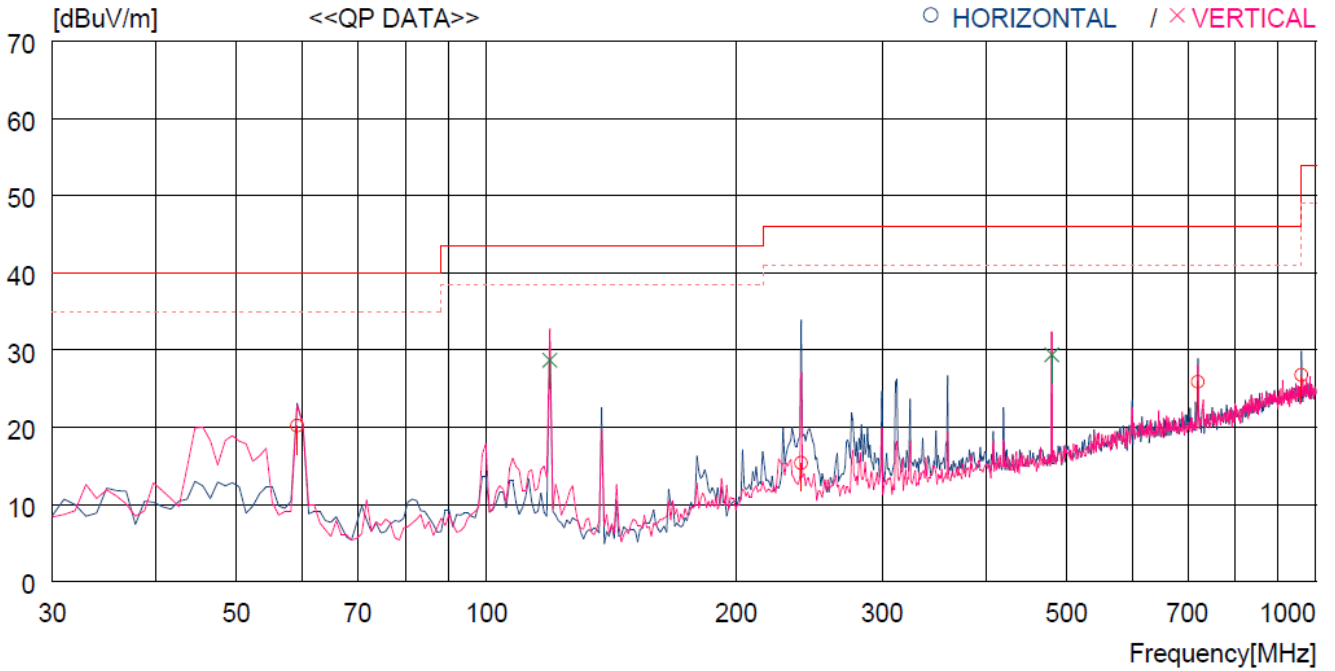
No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	239.520	47.1	12.0	3.6	33.1	29.6	46.0	16.4	400	190
2	359.800	38.4	14.4	4.4	33.1	24.1	46.0	21.9	400	28
3	960.217	28.9	22.0	7.2	32.0	26.1	54.0	27.9	400	359
----- Vertical -----										
4	59.100	38.1	13.4	1.9	33.1	20.3	40.0	19.7	400	63
5	119.240	49.3	10.2	2.6	33.0	29.1	43.5	14.4	400	4
6	480.081	40.3	16.8	5.1	33.3	28.9	46.0	17.1	400	243

Operating condition : Middle Channel



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	239.520	49.8	12.0	3.6	33.1	32.3	46.0	13.7	400	173
2	359.800	38.0	14.4	4.4	33.1	23.7	46.0	22.3	400	40
----- Vertical -----										
3	59.100	38.0	13.4	1.9	33.1	20.2	40.0	19.8	400	249
4	119.240	49.7	10.2	2.6	33.0	29.5	43.5	14.0	400	249
5	480.081	40.4	16.8	5.1	33.3	29.0	46.0	17.0	400	249
6	720.634	32.4	19.5	6.2	33.5	24.6	46.0	21.4	400	156

Operating condition : High Channel



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	59.100	37.8	13.3	2.1	33.0	20.2	40.0	19.8	400	214
2	239.520	32.4	12.0	4.0	33.0	15.4	46.0	30.6	400	198
3	720.634	32.1	19.9	7.4	33.5	25.9	46.0	20.1	400	85
4	960.217	27.8	22.4	8.7	32.1	26.8	54.0	27.2	400	0
----- Vertical -----										
5	119.240	47.9	10.5	3.4	33.1	28.7	43.5	14.8	400	106
6	480.081	40.1	16.6	5.9	33.2	29.4	46.0	16.6	400	285

Tested by: Yu-Seog, Sim / Assistant Manager

**13.5 Test data for Below 30 MHz**

- . Test Date : March 09, 2018
- . Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- . Frequency range : 9 kHz ~ 30 MHz
- . Measurement distance : 3 m

Frequency (MHz)	Reading (dB $\mu$ V)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Margin (dB)
It was not observed any emissions from the EUT.								

**13.6 Test data for above 1 GHz**

- . Test Date : March 09, 2018
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m

Frequency (MHz)	Reading (dB $\mu$ V)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Margin (dB)
It was not observed any emissions from the EUT.								



Tested by: Yu-Seog, Sim / Assistant Manager

## 14. CONDUCTED EMISSION TEST

### 14.1 Operating environment

Temperature : 23 °C  
 Relative humidity : 45 % R.H.

### 14.2 Test set-up

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

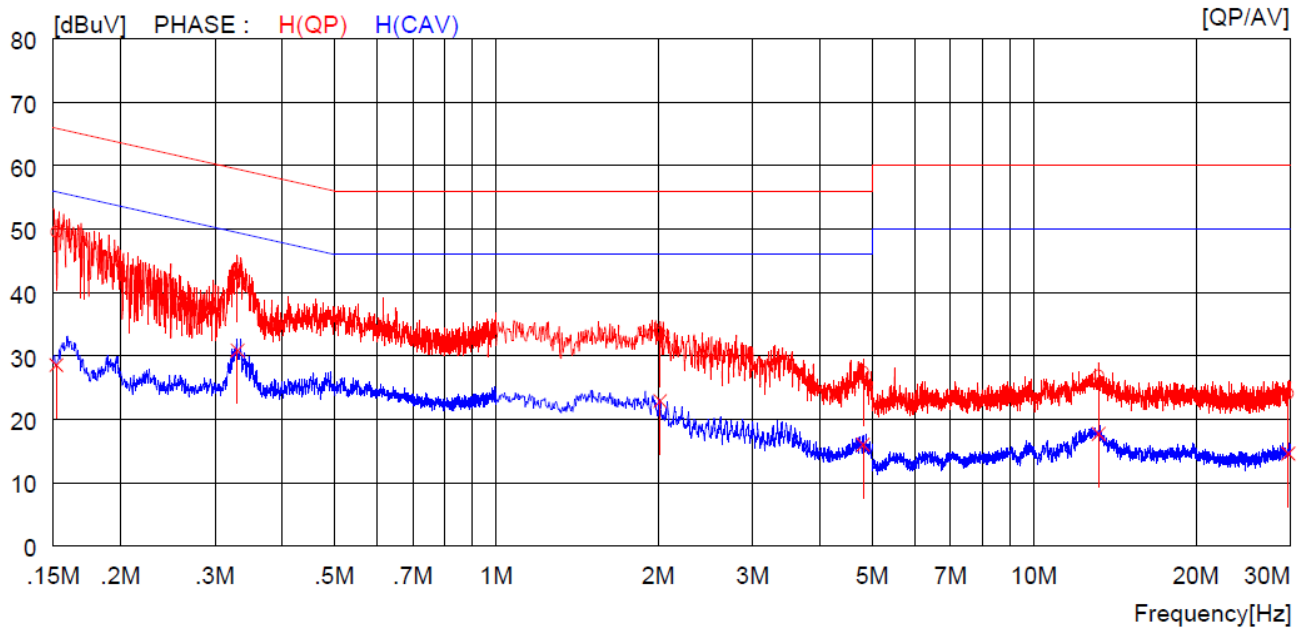
### 14.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - ESPI	Rohde & Schwarz	Test Receiver	101012	Oct. 27, 2017 (1Y)
□ - ESHS10	Rohde & Schwarz	Test Receiver	834467/007	Apr. 05, 2017 (1Y)
□ - NSLK8128	Schwarzbeck	AMN	8128-216	Apr. 06, 2017 (1Y)
■ - NSLK8126	Schwarzbeck	AMN	8126-404	Apr. 05, 2017 (1Y)
□ - 3825/2	EMCO	AMN	9109-1869	Apr. 06, 2017 (1Y)
■ - 3825/2	EMCO	AMN	9109-1867	Apr. 06, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

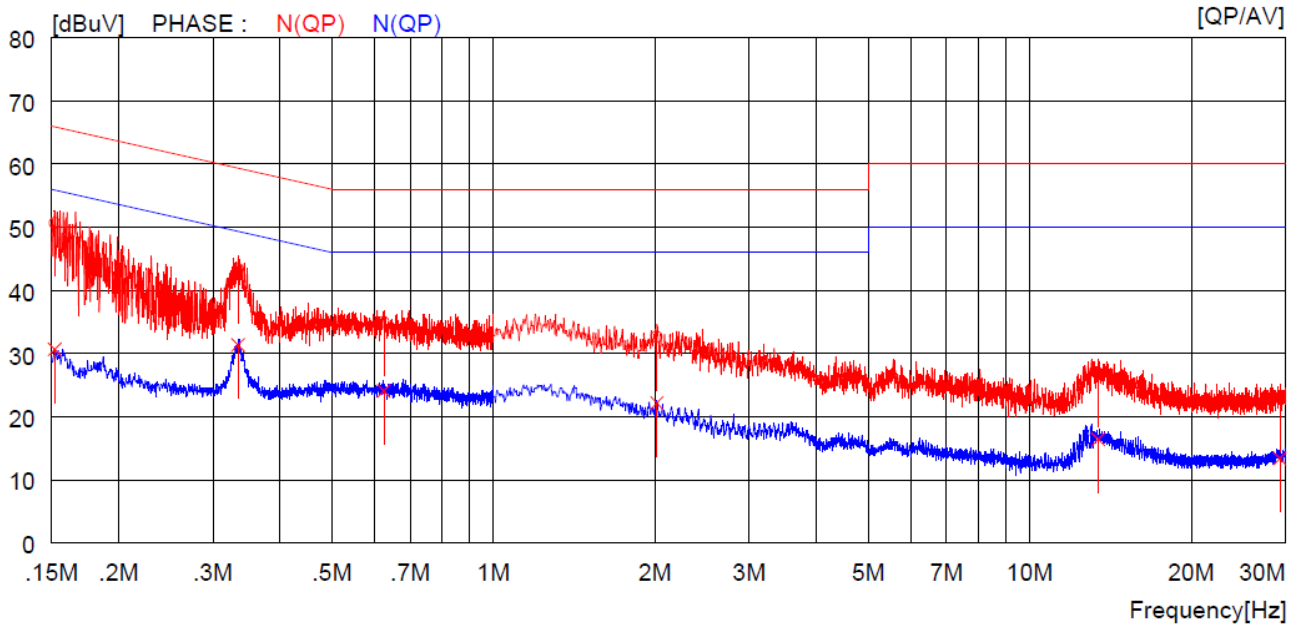
### 14.4 Test data

- Test Date : March 09, 2018
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Tested Line : HOT LINE



NO	FREQ [MHz]	READING		C. FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.15200	39.5	----	10.0	49.5	----	65.9	----	16.4	----	H(QP)
2	0.33000	33.8	----	10.0	43.8	----	59.5	----	15.7	----	H(QP)
3	2.01600	23.4	----	10.1	33.5	----	56.0	----	22.5	----	H(QP)
4	4.81200	17.3	----	10.2	27.5	----	56.0	----	28.5	----	H(QP)
5	13.19000	16.4	----	10.5	26.9	----	60.0	----	33.1	----	H(QP)
6	29.70000	13.2	----	10.8	24.0	----	60.0	----	36.0	----	H(QP)
7	0.15200	----	18.5	10.0	----	28.5	----	55.9	----	27.4	H(CAV)
8	0.33000	----	20.9	10.0	----	30.9	----	49.5	----	18.6	H(CAV)
9	2.01600	----	12.8	10.1	----	22.9	----	46.0	----	23.1	H(CAV)
10	4.81200	----	5.8	10.2	----	16.0	----	46.0	----	30.0	H(CAV)
11	13.19000	----	7.2	10.5	----	17.7	----	50.0	----	32.3	H(CAV)
12	29.70000	----	3.8	10.8	----	14.6	----	50.0	----	35.4	H(CAV)

- Tested Line : NEUTRAL LINE



NO	FREQ [MHz]	READING		C. FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.15200	40.6	----	10.0	50.6	----	65.9	----	15.3	----	N (QP)
2	0.33400	33.3	----	10.0	43.3	----	59.4	----	16.1	----	N (QP)
3	0.62400	24.9	----	10.1	35.0	----	56.0	----	21.0	----	N (QP)
4	2.01600	22.5	----	10.1	32.6	----	56.0	----	23.4	----	N (QP)
5	13.41000	16.3	----	10.6	26.9	----	60.0	----	33.1	----	N (QP)
6	29.27000	12.1	----	10.8	22.9	----	60.0	----	37.1	----	N (QP)
7	0.15200	----	20.7	10.0	----	30.7	----	55.9	----	25.2	N (CAV)
8	0.33400	----	21.4	10.0	----	31.4	----	49.4	----	18.0	N (CAV)
9	0.62400	----	14.0	10.1	----	24.1	----	46.0	----	21.9	N (CAV)
10	2.01600	----	12.1	10.1	----	22.2	----	46.0	----	23.8	N (CAV)
11	13.41000	----	5.8	10.6	----	16.4	----	50.0	----	33.6	N (CAV)
12	29.27000	----	2.6	10.8	----	13.4	----	50.0	----	36.6	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**