

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

Test Report No. : OT-196-RWD-012

AGR No. : A192A-017

Applicant : BIOLOG DEVICE

Address : 3F, 64-10, Dongtangiheung-ro, Dongtan-myeon, Hwaseong-si, Gyeonggi-do, Korea

Manufacturer : BIOLOG DEVICE

Address : 3F, 64-10, Dongtangiheung-ro, Dongtan-myeon, Hwaseong-si, Gyeonggi-do, Korea

Type of Equipment : Face Recognition Terminal

FCC ID. : 2ATMI-FL1000-A

Model Name : FL1000-A

Multiple Model Name: FL1000-B, FL1000-C, FL1000-D, FL1000-E, FL1000-F, FL1000-G, FL1000-H,
FL1000-I, FL1000-J, FL1000-K, FL1000-L, FL1000-M, FL1000-N, FL1000-O,
FL1000-P, FL1000-Q, FL1000-R, FL1000-S, FL1000-T, FL1000-U, FL1000-V

Serial number : N/A

Total page of Report : 84 pages (including this page)

Date of Incoming : April 15, 2019

Date of issue : June 07, 2019

SUMMARY

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

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

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

Reviewed by:



Ha-Ram Lee / Assistant Manager
ONETECH Corp.

Approved by:



Jae-Ho Lee / Chief Engineer
ONETECH Corp.

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-196-RWD-012	June 07, 2019	Initial Issue	All

DOCUMENT HISTORY

Revision No.	Issued Date	Revisions	Effect Section
Original	June 07, 2019	Initial Issue	-
Rev. 01	June 12, 2019	Added data of Conducted emission test	13. CONDUCTED EMISSION TEST

1. VERIFICATION OF COMPLIANCE

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

EQUIPMENT CLASS	<i>DSS – PART 15 SPREAD SPECTRUM TRANSMITTER</i>
KIND OF EQUIPMENT	Face Recognition Terminal
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247
MODIFICATIONS ON THE EQUIPMENT TO ACHIEVE COMPLIANCE	None
FINAL TEST WAS CONDUCTED ON	3 m Semi Anechoic Chamber

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

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 (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

2.2 Additions, deviations, exclusions from standards

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

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

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

2.5 Test Methodology

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

2.6 Test Facility

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

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

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-14617/ G-10666 / T-1842

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

-. Site Accreditation:

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

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. GENERAL INFORMATION

3.1 Product Description

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

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

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

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

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

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

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

4. EUT MODIFICATIONS

-. None

5. SYSTEM TEST CONFIGURATION

5.1 Justification

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

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	N/A	N/A	-
LED Board	N/A	N/A	-
NFC Module Board	N/A	N/A	-
Camera Board	N/A	N/A	-

5.2 Peripheral equipment

-None

5.3 Mode of operation during the test

For Bluetooth function testing, software used to control the EUT for staying in continuous transmitting and receiving mode is programmed. The EUT was set at Low Channel (2 402 MHz), Middle Channel (2 441 MHz), and High Channel (2 480 MHz) with each data transfer rate, 1 Mbps, 2 Mbps, and 3 Mbps. To get a maximum radiated emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes and the worst case is “XY” axis, but the worst data was recorded in this test report.

5.4 Configuration of Test System

Line Conducted Test: The EUT was tested in the Transmitting mode. All supporting equipment 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: The EUT was tested in the Transmitting mode. Preliminary radiated emissions test was conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 m 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 as to be attached permanently to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Antenna Construction:

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

6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

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

6.2 General Radiated Emissions Tests

During Preliminary Tests, the following operating modes were investigated

Operation Mode	The Worse operating condition (Please check one only)
Transmitting mode.	X

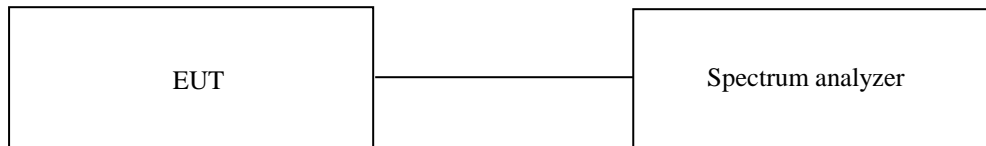
7. MINIMUM 20 dB BANDWIDTH

7.1 Operating environment

Temperature : 24 °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.
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101199	Mar. 11, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

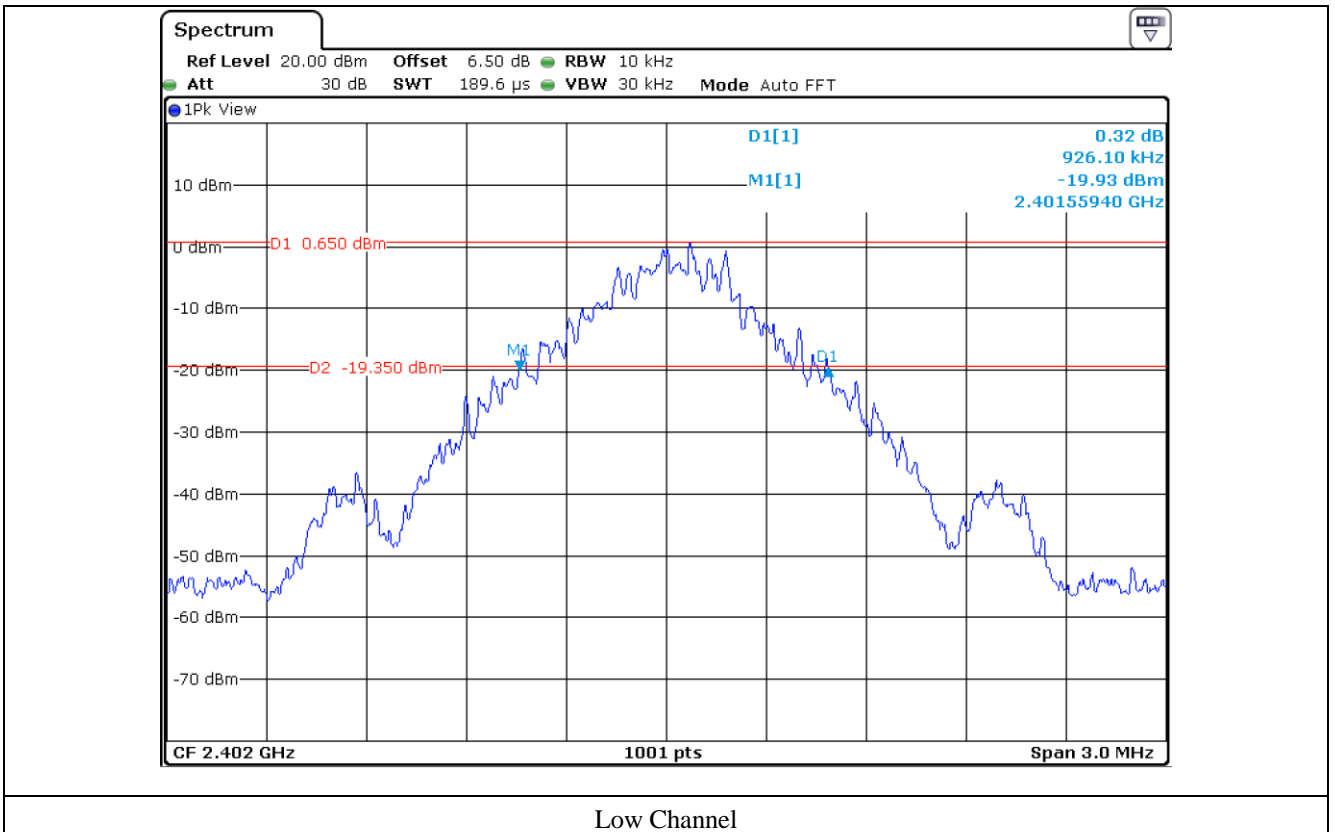
7.4 Test data for 1 Mbps

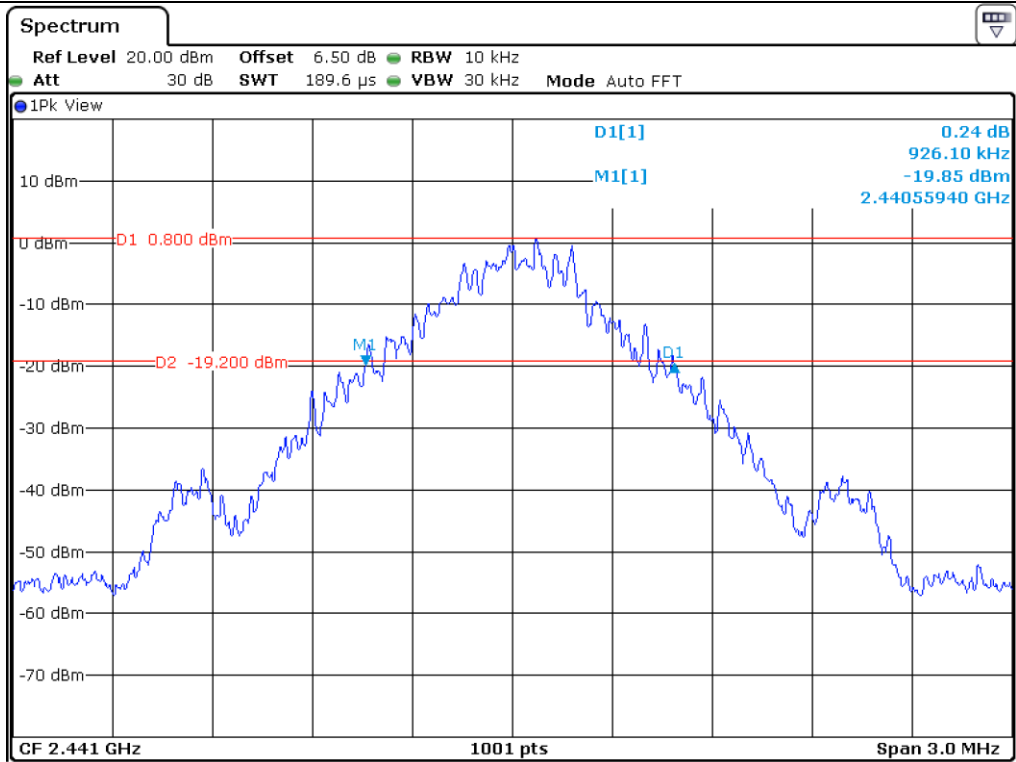
-. Test Date : May 07, 2019

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)
Low	2 402	926.10
Middle	2 441	926.10
High	2 480	926.10

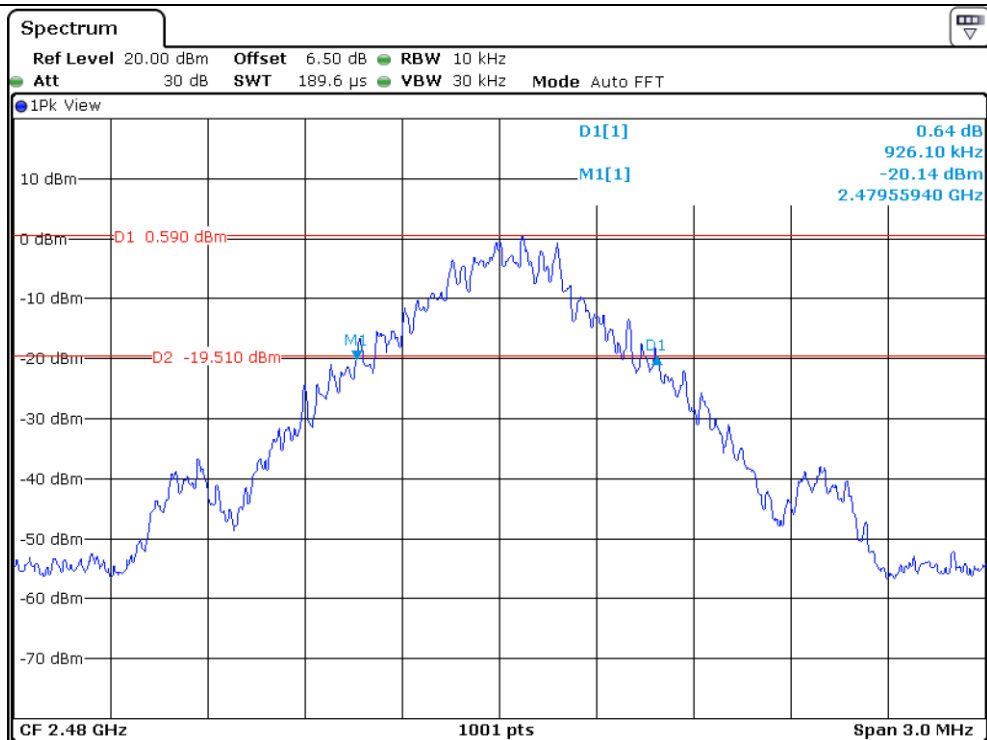


Tested by: Yu-Seog Sim / Assistant Manager





Middle Channel



High Channel

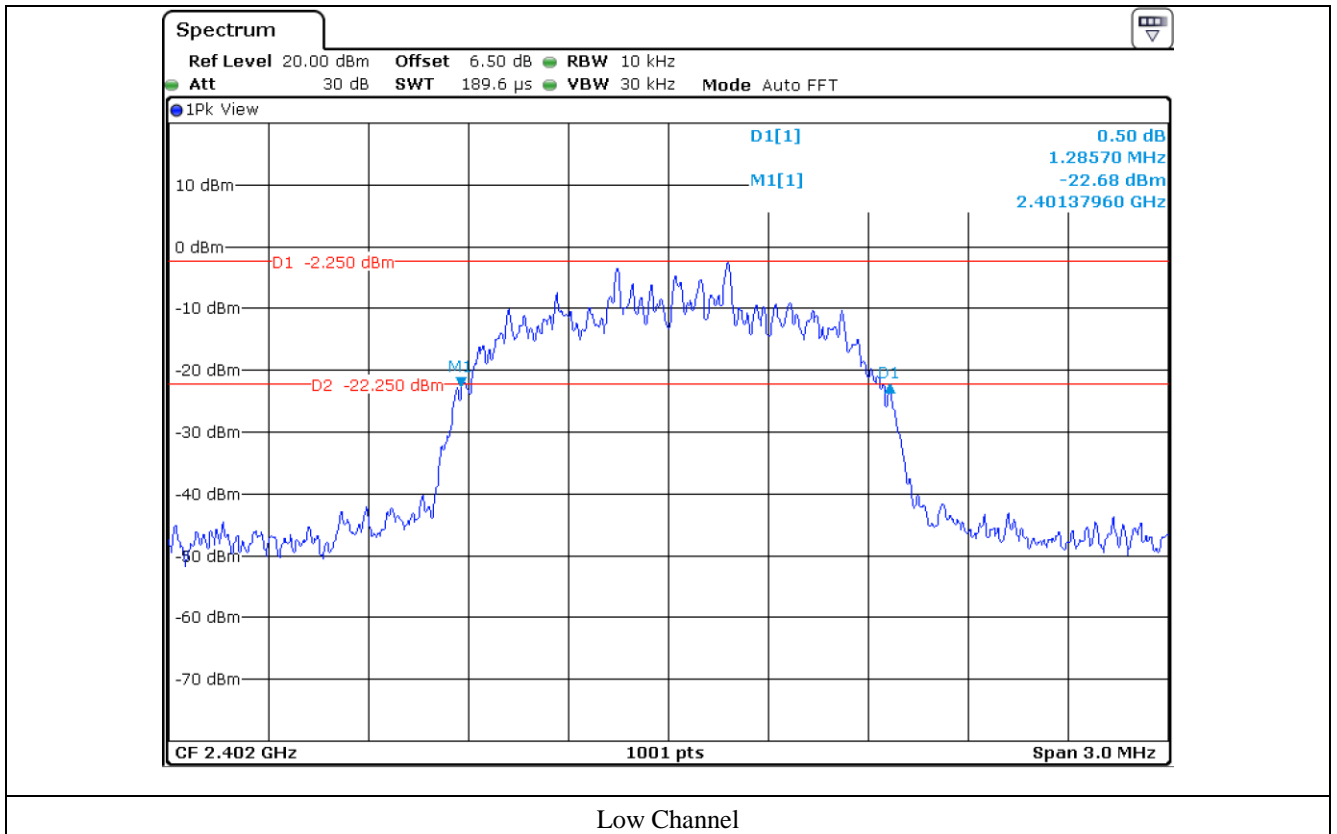
7.5 Test data for 2 Mbps

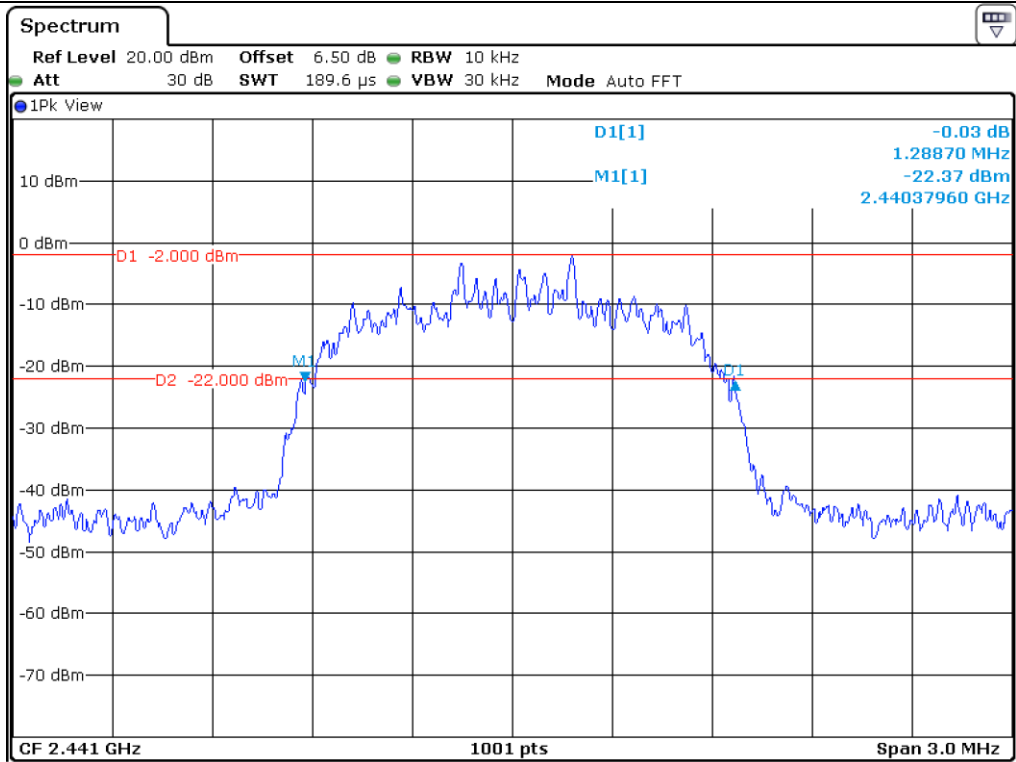
-. Test Date : May 07, 2019

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)
Low	2 402	1 285.70
Middle	2 441	1 288.70
High	2 480	1 288.70

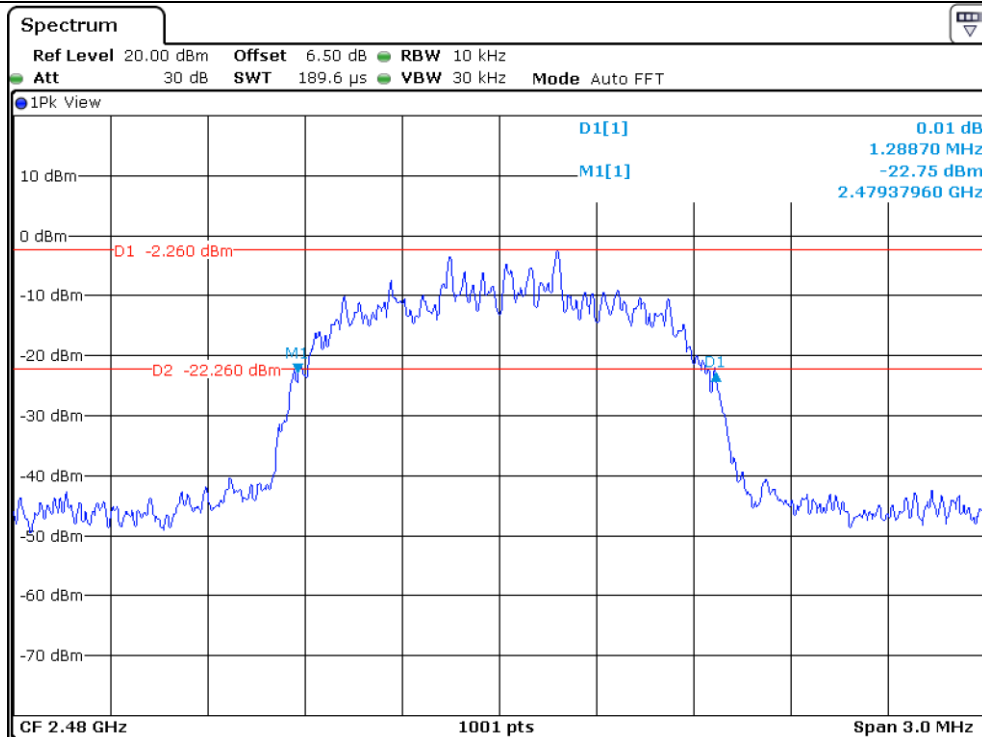


Tested by: Yu-Seog Sim / Assistant Manager





Middle Channel



High Channel

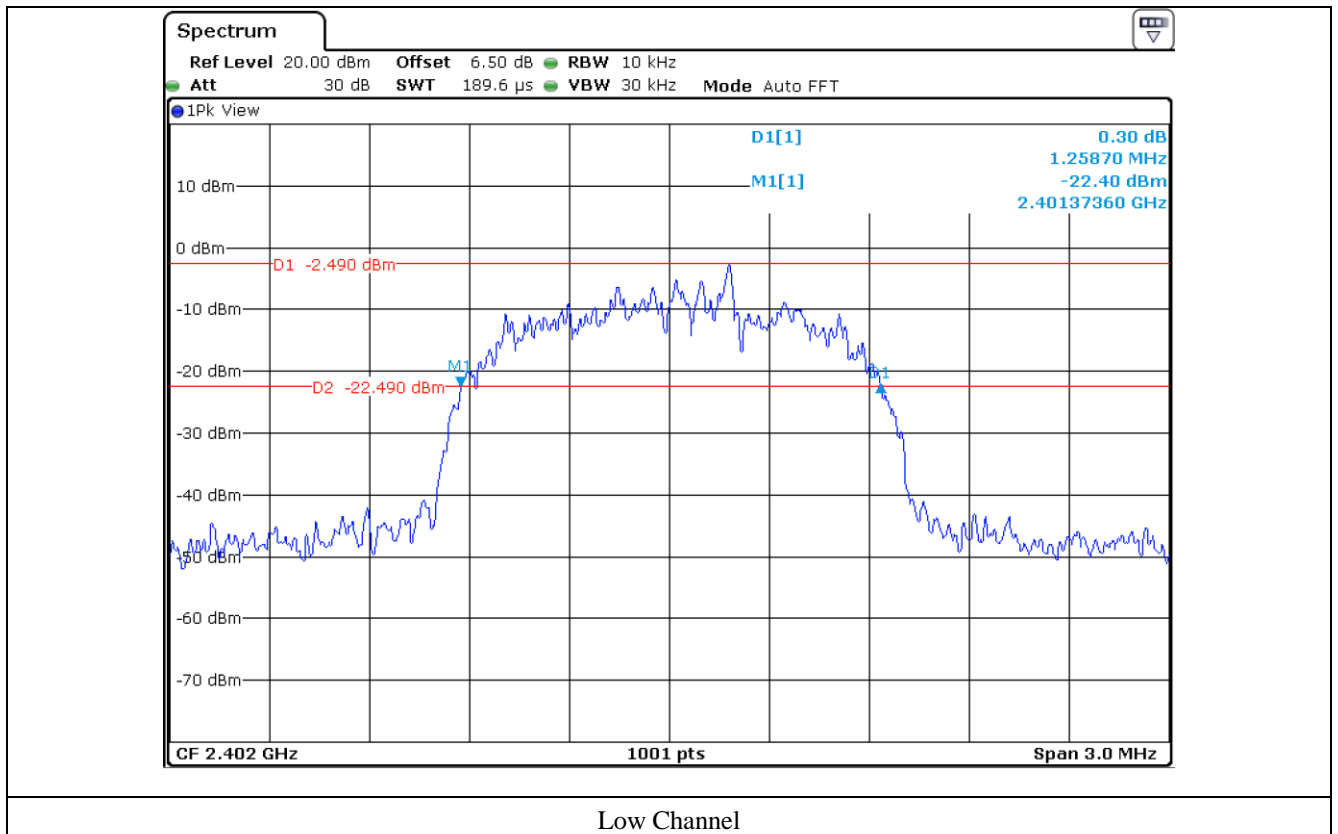
7.6 Test data for 3 Mbps

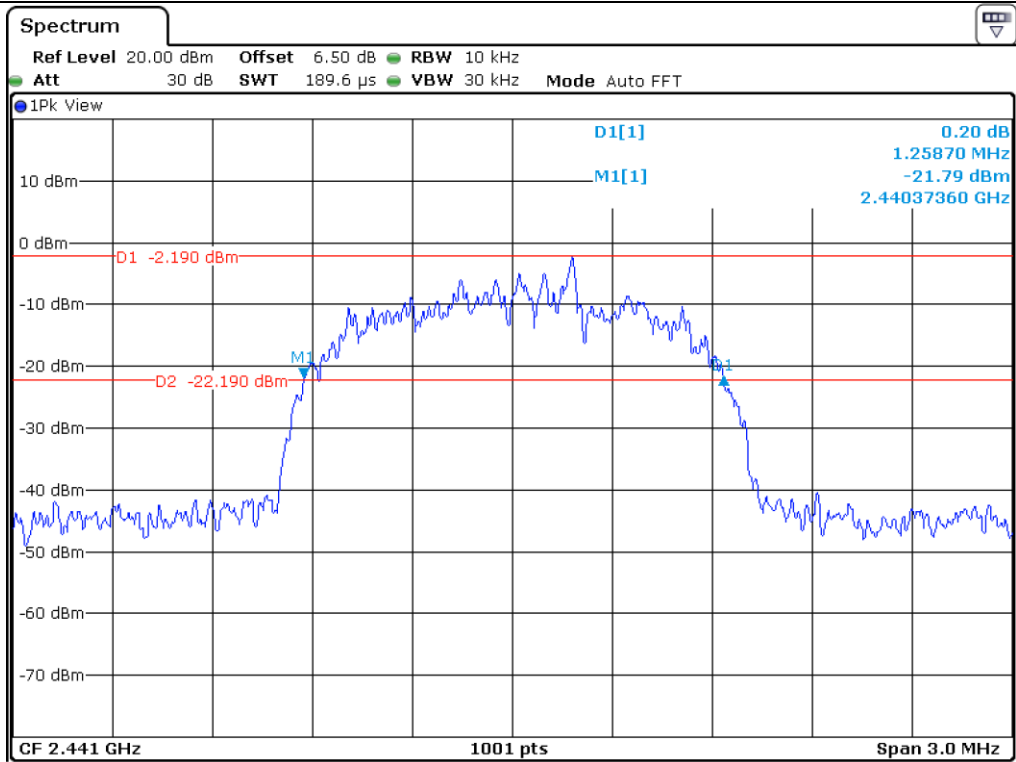
-. Test Date : May 07, 2019

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)
Low	2 402	1 258.70
Middle	2 441	1 258.70
High	2 480	1 258.70

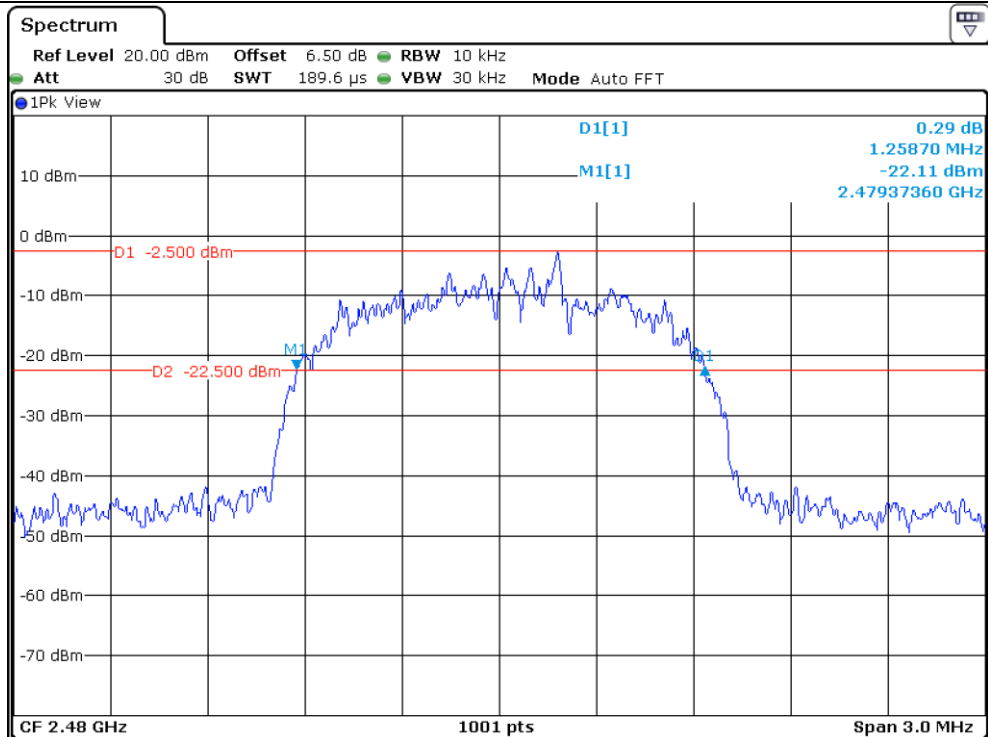


Tested by: Yu-Seog Sim / Assistant Manager





Middle Channel



High Channel

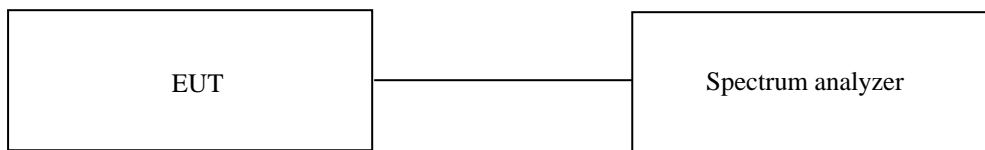
8. HOPPING FREQUENCY SEPARATION

8.1 Operating environment

Temperature : 24 °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.
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101199	Mar. 11, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

8.4 Test data for 1 Mbps

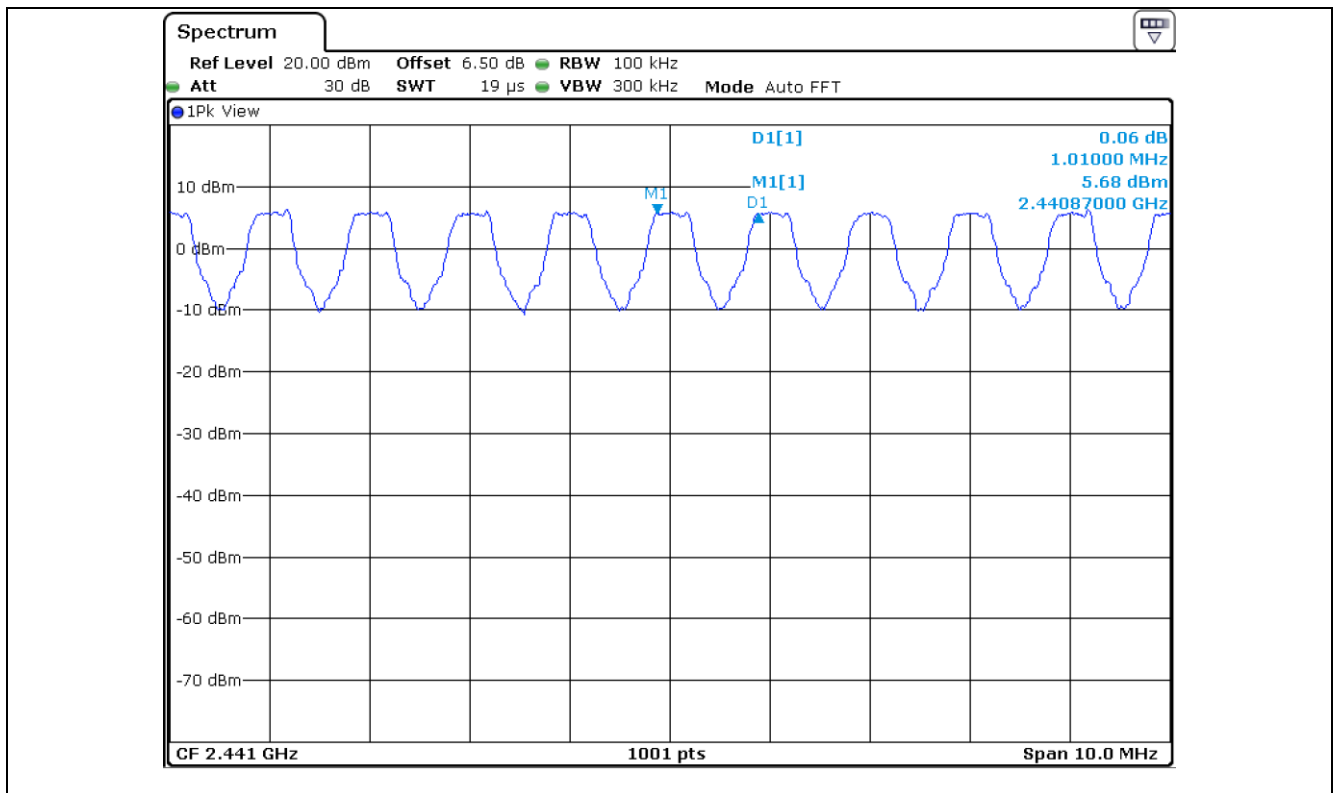
-. Test Date : May 07, 2019

-. Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
1 010.00	617.40	Separated by 25 kHz or <u>two-thirds of the 20 dB bandwidth of the hopping channel</u> , whichever is greater.



Tested by: Yu-Seog Sim / Assistant Manager



8.5 Test data for 2 Mbps

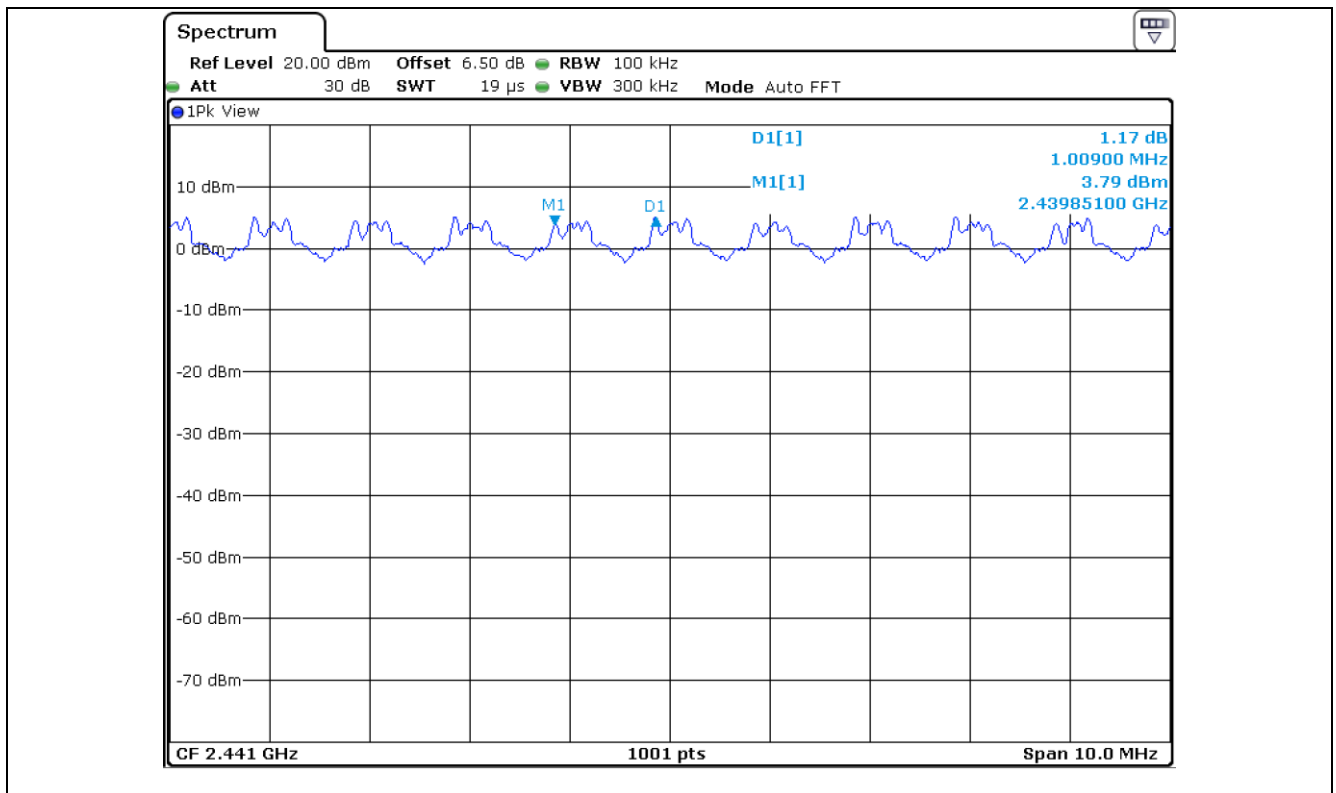
-. Test Date : May 07, 2019

-. Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
1 009.00	617.40	Separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.



Tested by: Yu-Seog Sim / Assistant Manager



8.6 Test data for 3 Mbps

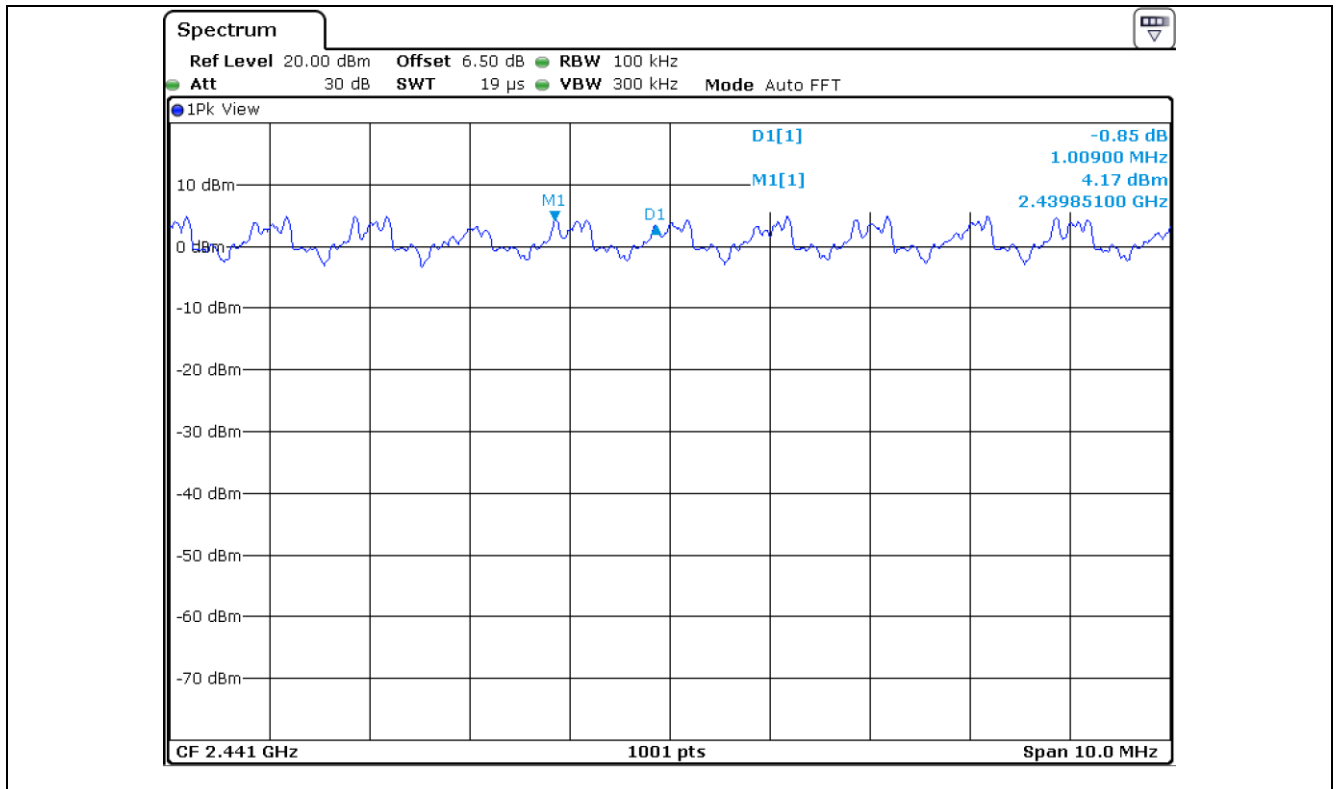
-. Test Date : May 07, 2019

-. Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
1 009.00	857.13	Separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.



Tested by: Yu-Seog Sim / Assistant Manager



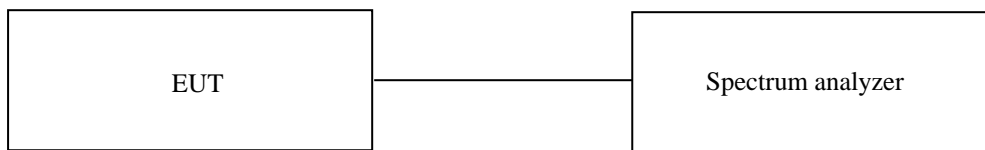
9. NUMBER OF HOPPING CHANNELS

9.1 Operating environment

Temperature : 24 °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.
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101199	Mar. 11, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

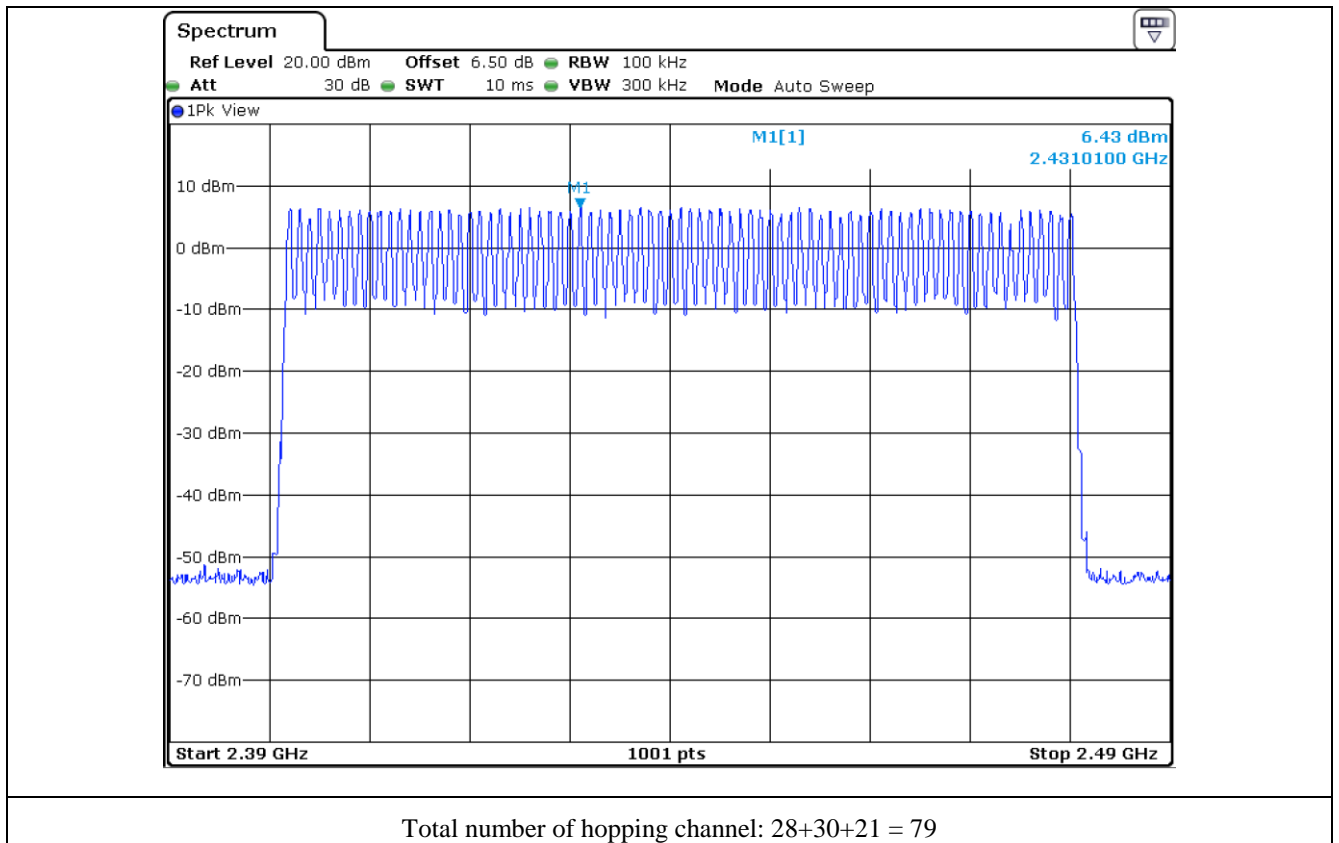
9.4 Test data for 1 Mbps

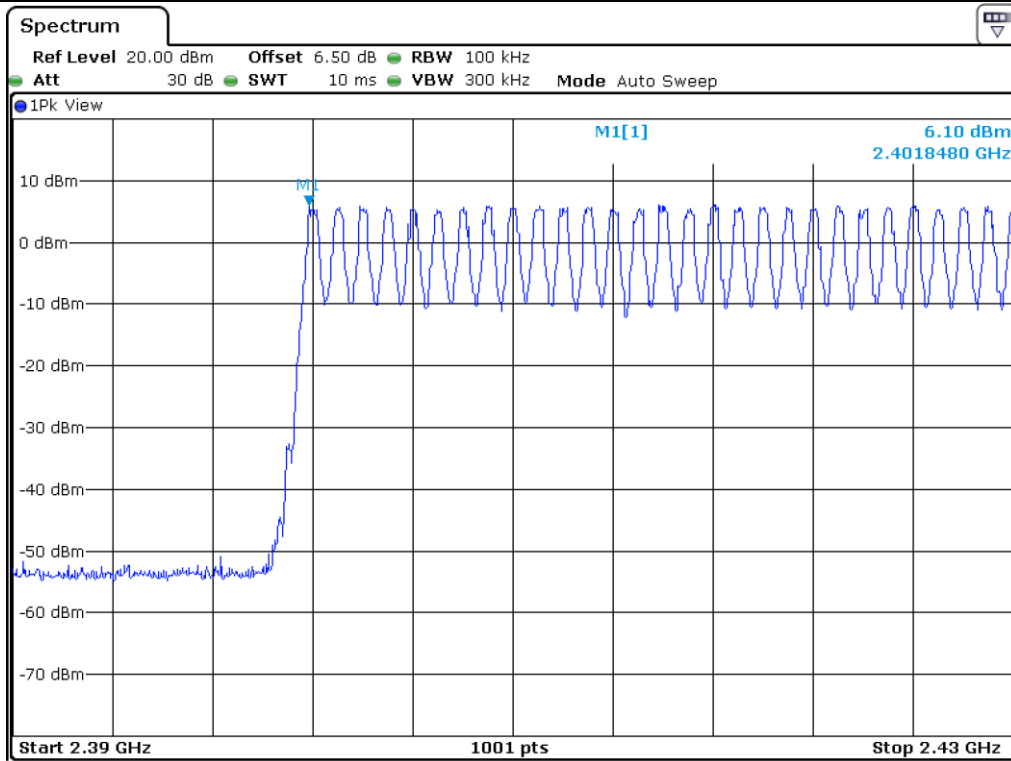
- Test Date : May 07, 2019
- Test Result : Pass

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

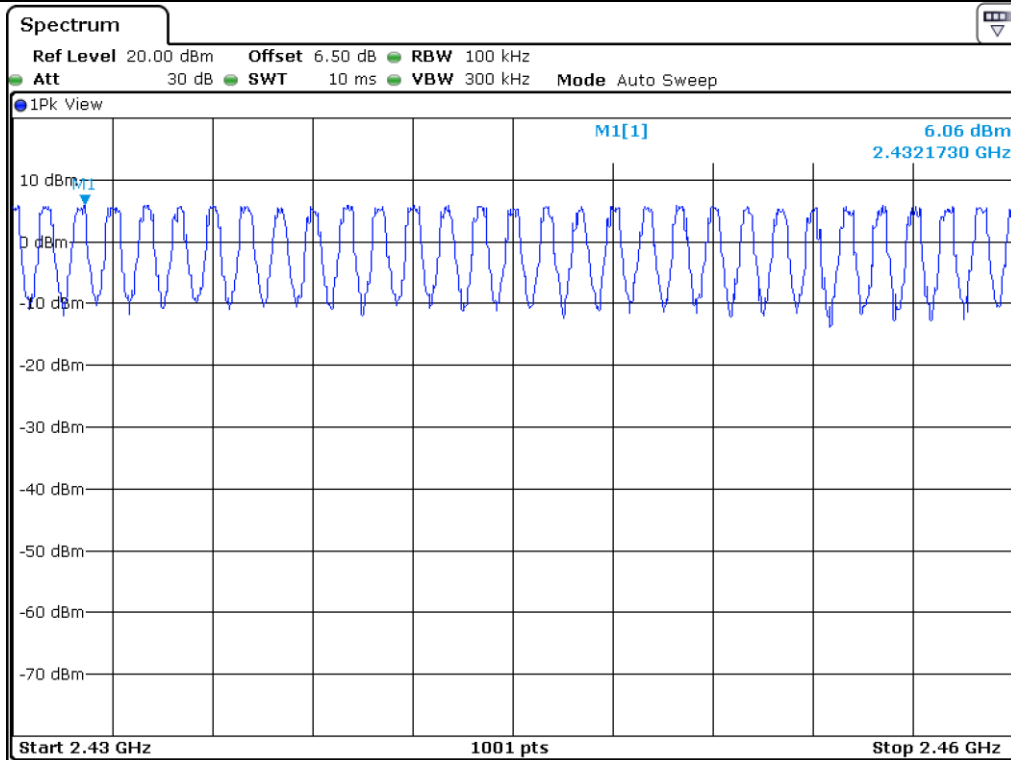


Tested by: Yu-Seog Sim / Assistant Manager

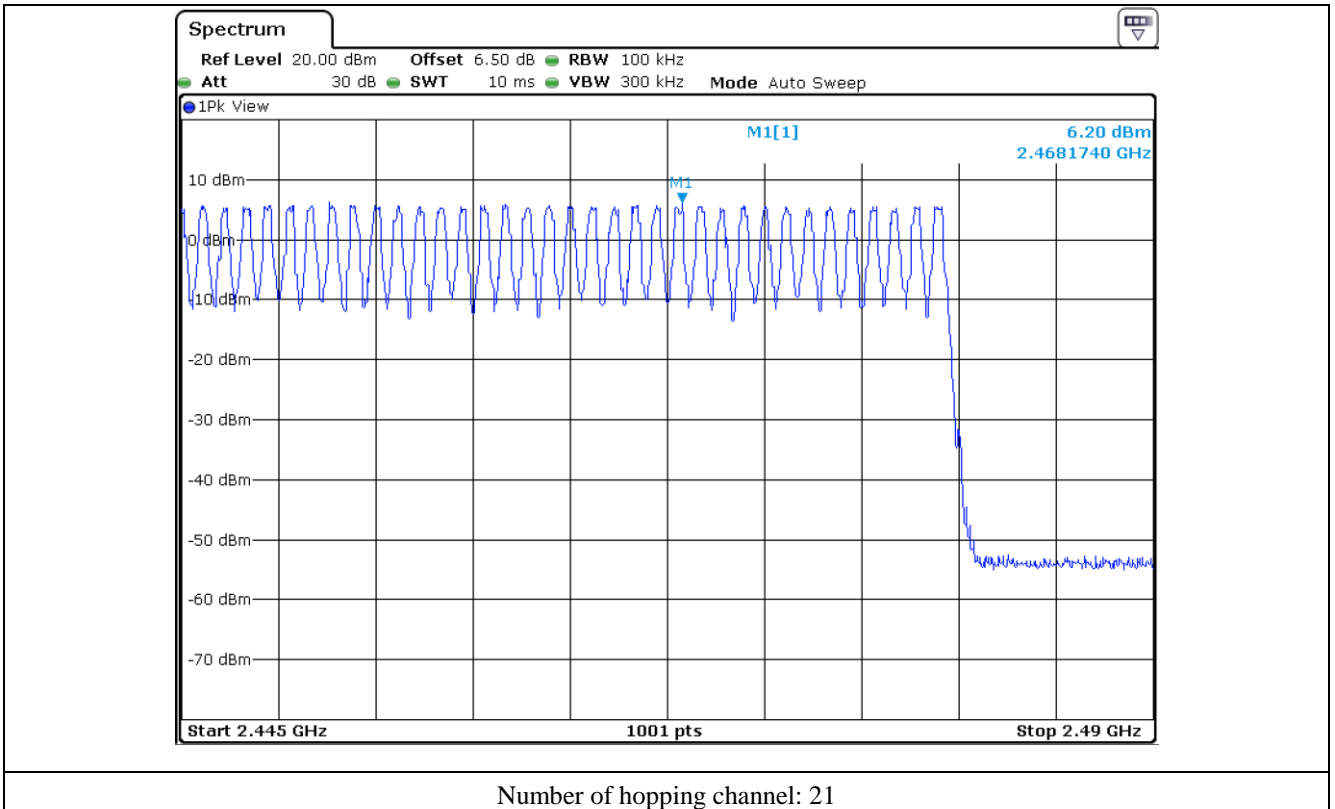




Number of hopping channel: 28



Number of hopping channel: 30



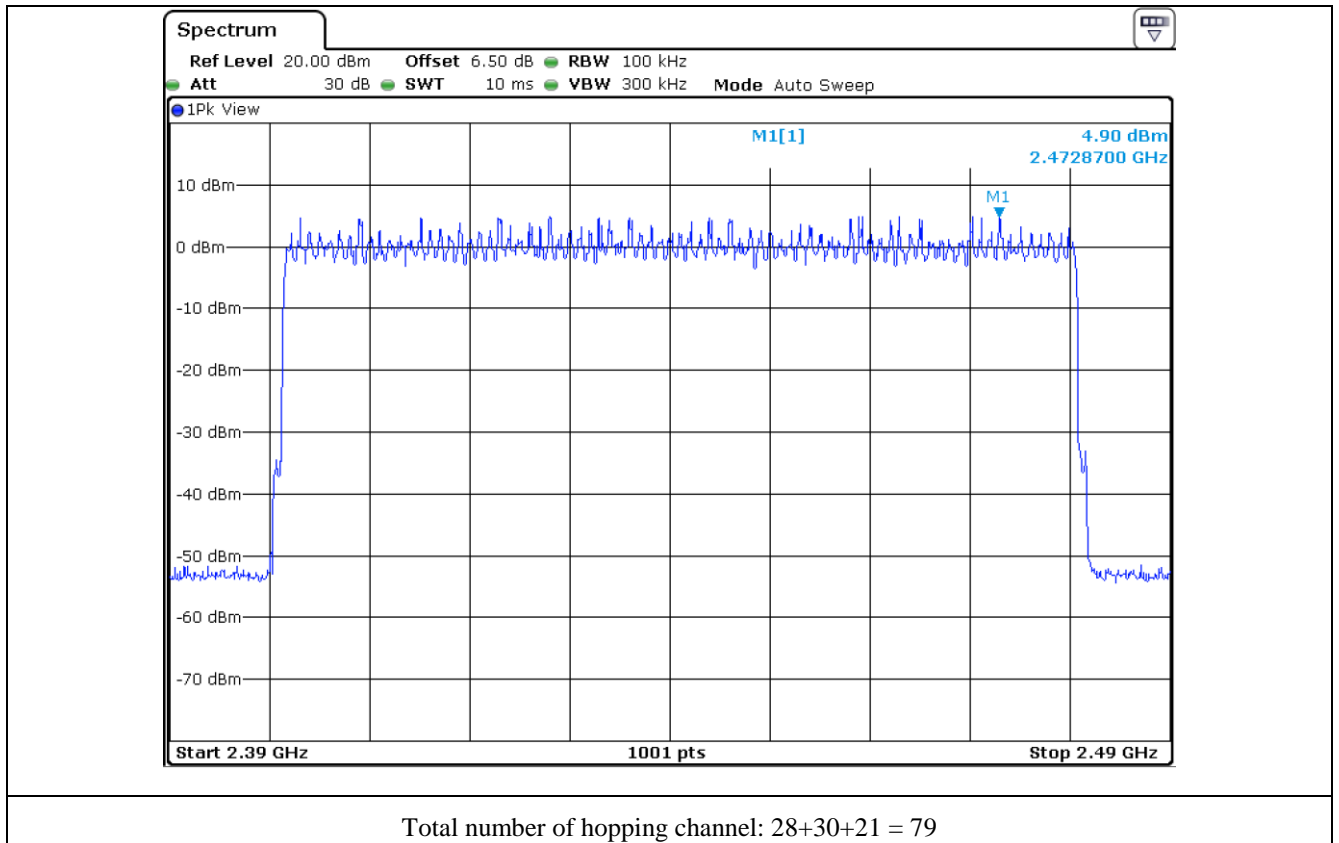
9.5 Test data for 2 Mbps

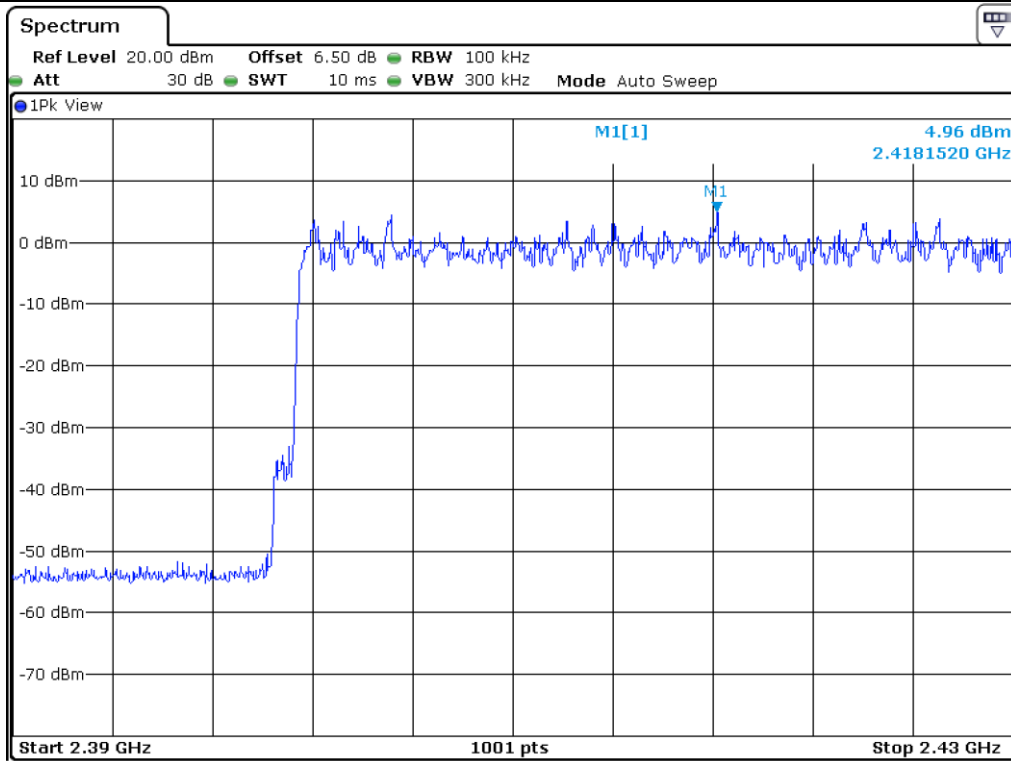
- Test Date : May 07, 2019
 - Test Result : Pass

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

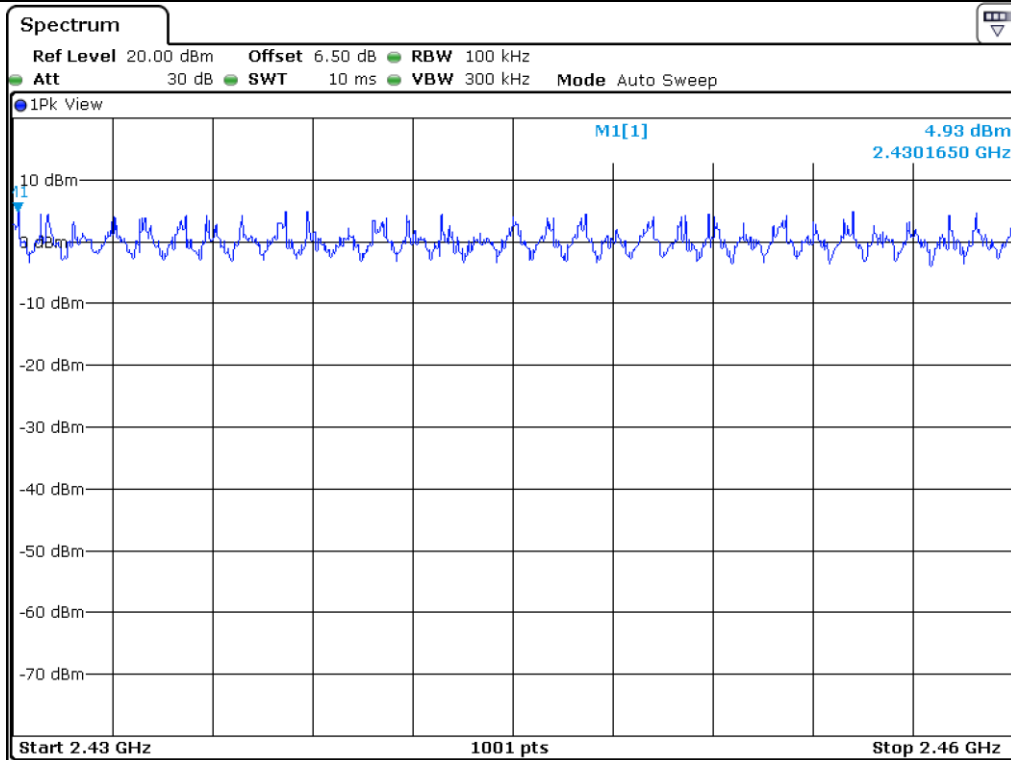


Tested by: Yu-Seog Sim / Assistant Manager

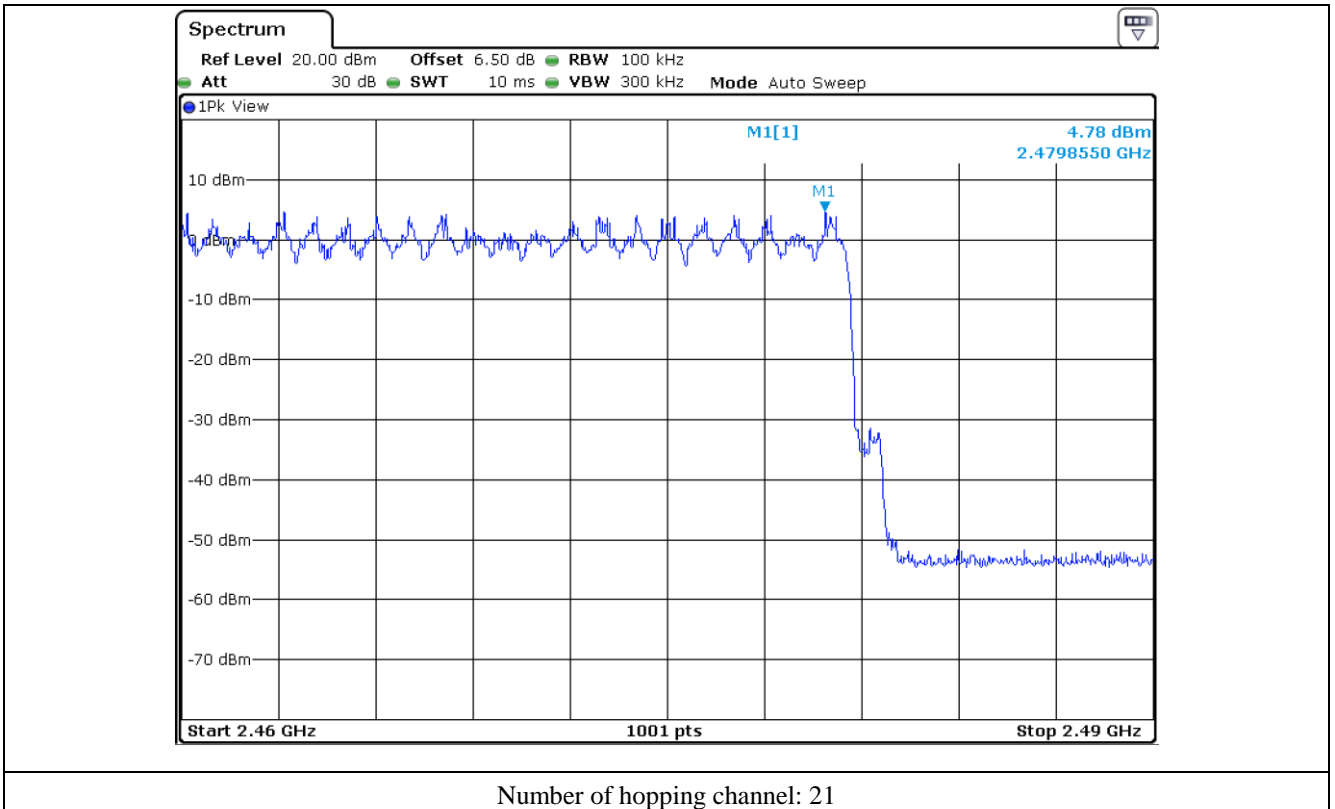




Number of hopping channel: 28



Number of hopping channel: 30



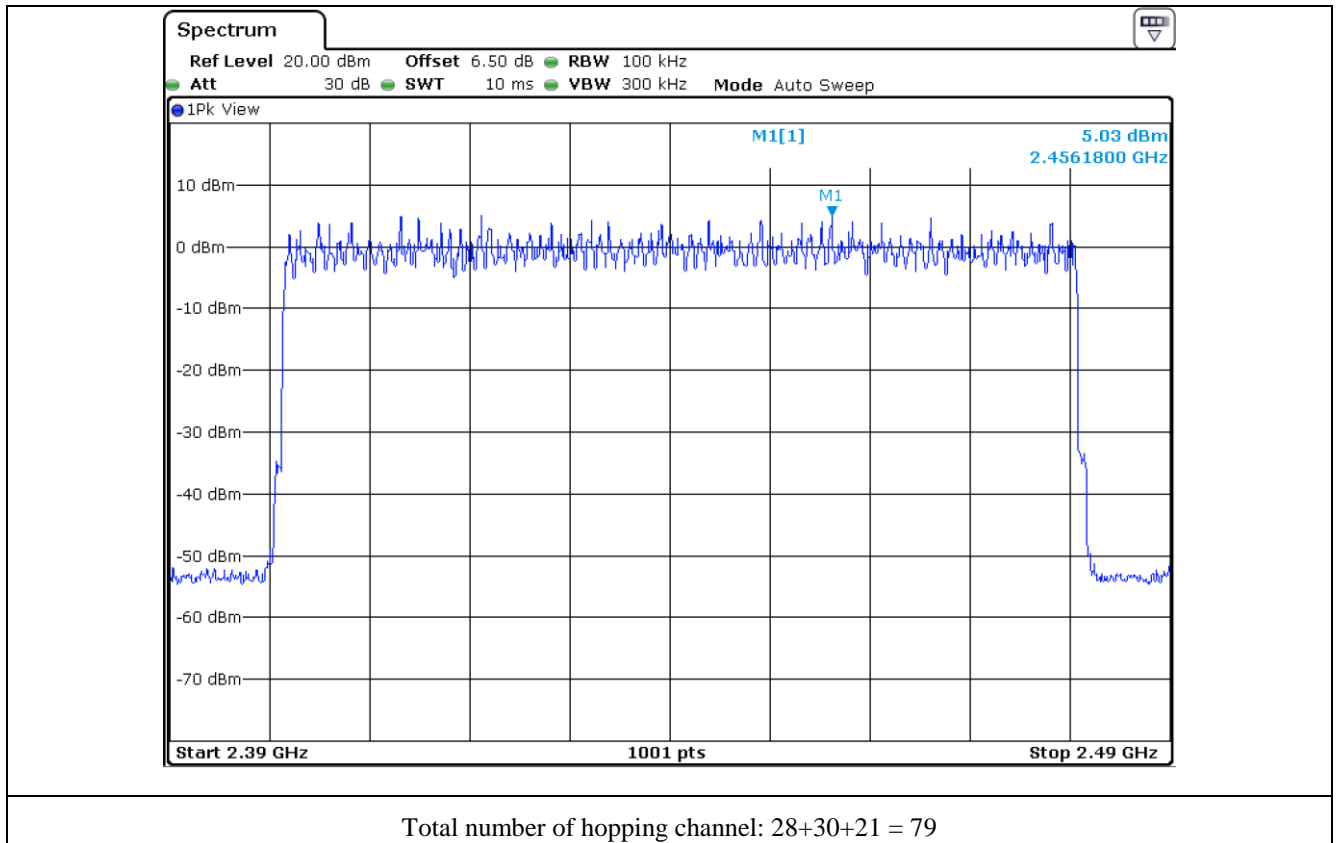
9.6 Test data for 3 Mbps

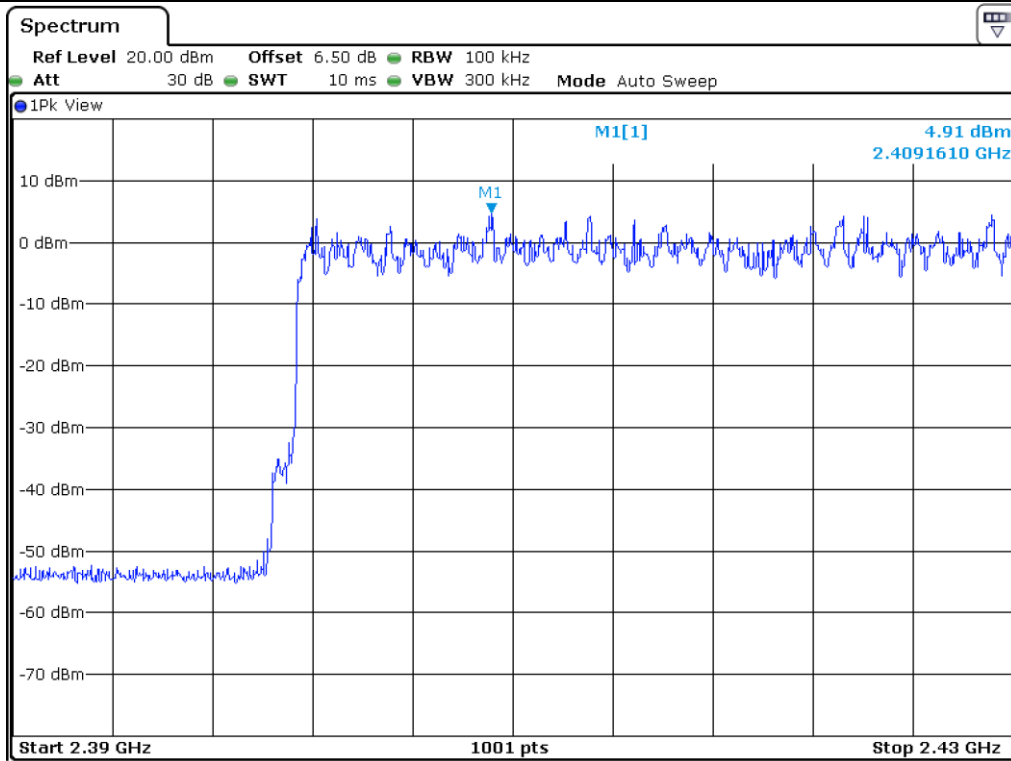
- Test Date : May 07, 2019
- Test Result : Pass

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

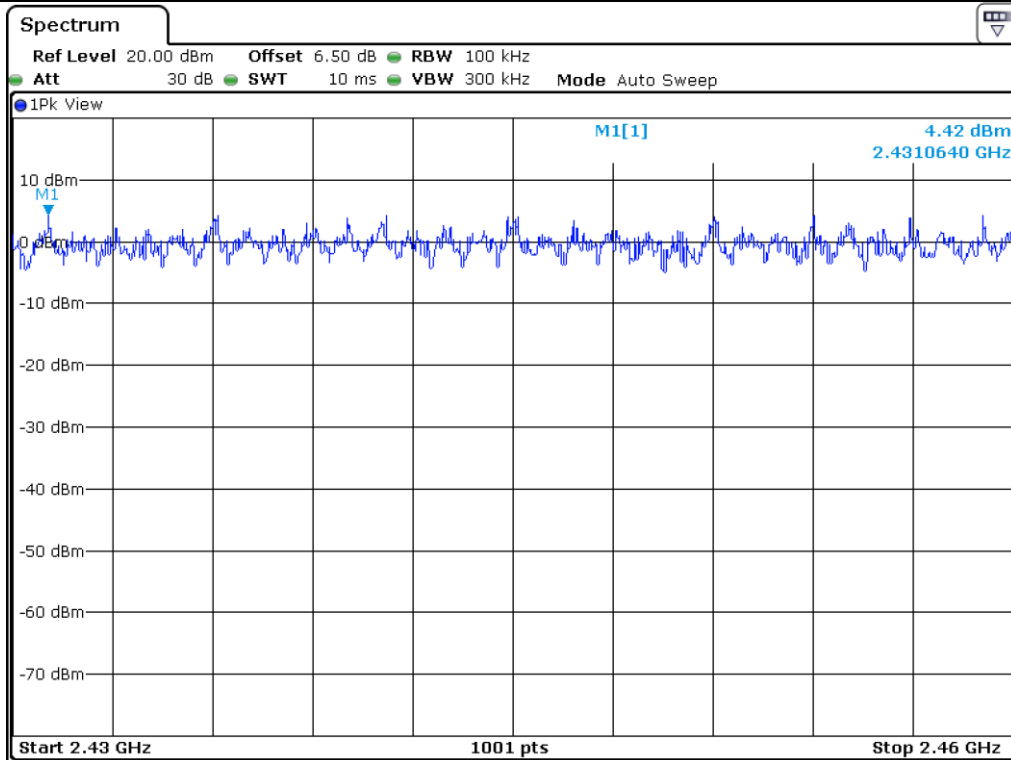


Tested by: Yu-Seog Sim / Assistant Manager

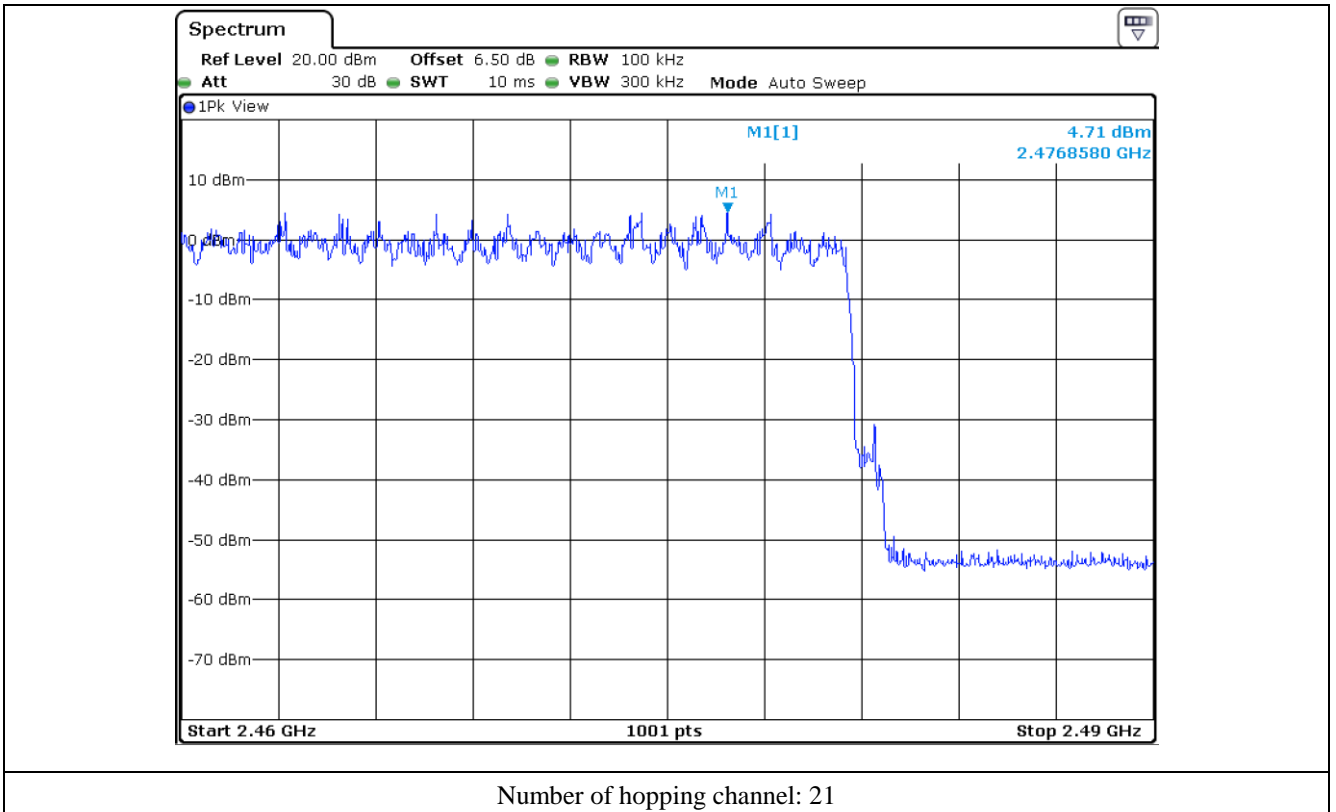




Number of hopping channel: 28



Number of hopping channel: 30



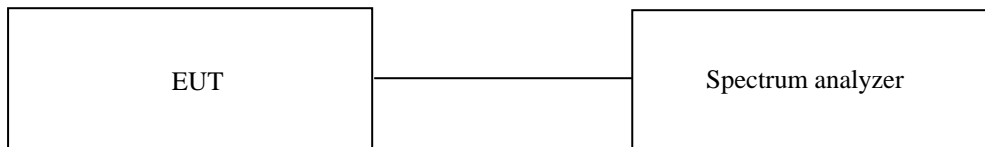
10. TIME OF OCCUPANCY

10.1 Operating environment

Temperature : 24 °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.
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101199	Mar. 11, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

10.4 Test data for 1 Mbps

- Test Date : May 07, 2019

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 (s)	Total Dwell Time (ms)	Limit (ms)	Test Result
DH1	0.370	10.13	31.6	118.44	400	PASS
DH3	1.630	5.06	31.6	260.63	400	
DH5	2.880	3.38	31.6	307.61	400	

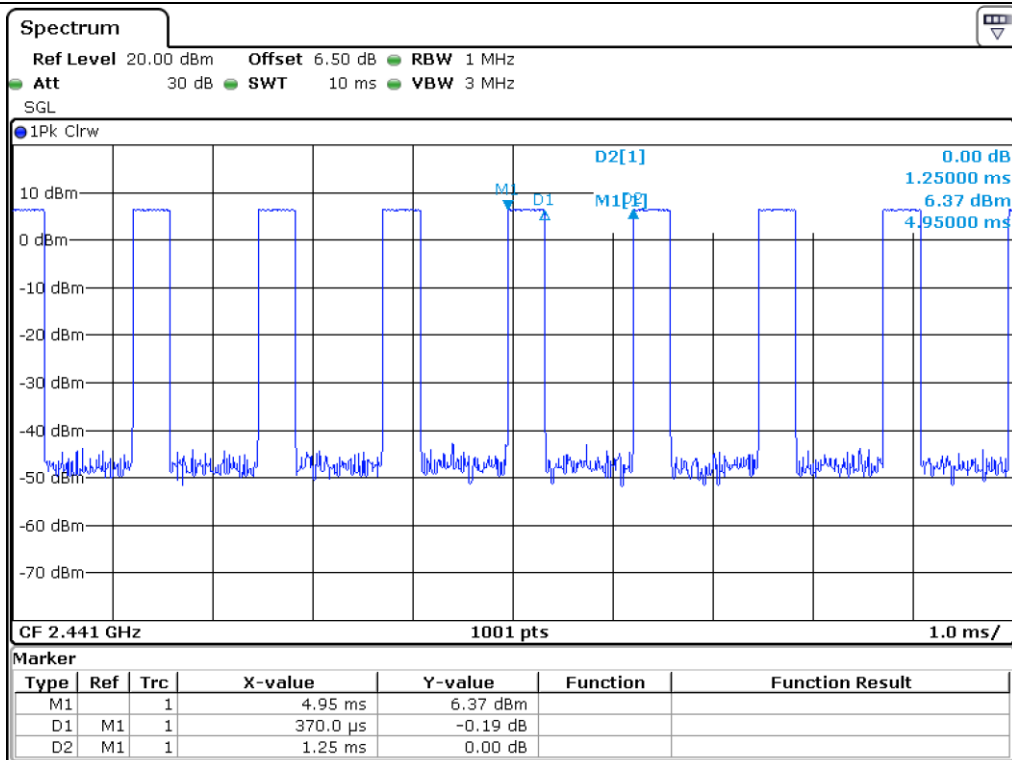
Total dwell time is calculated as following.

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

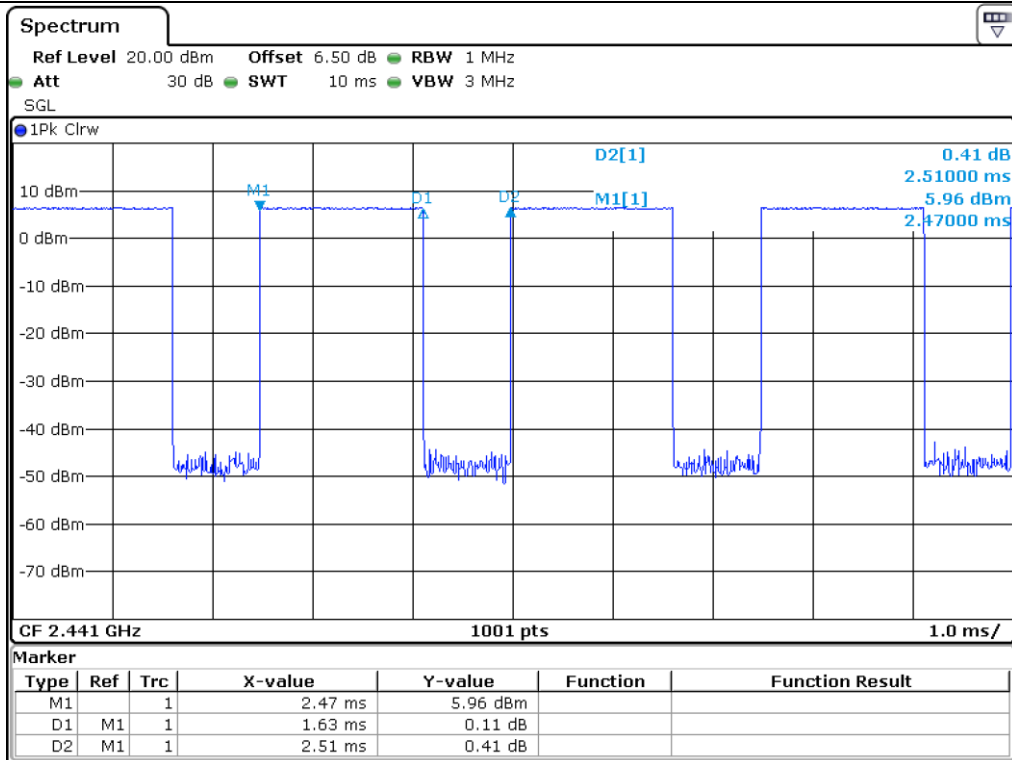
Remark: See next page for an overview sweep performed with peak detector.



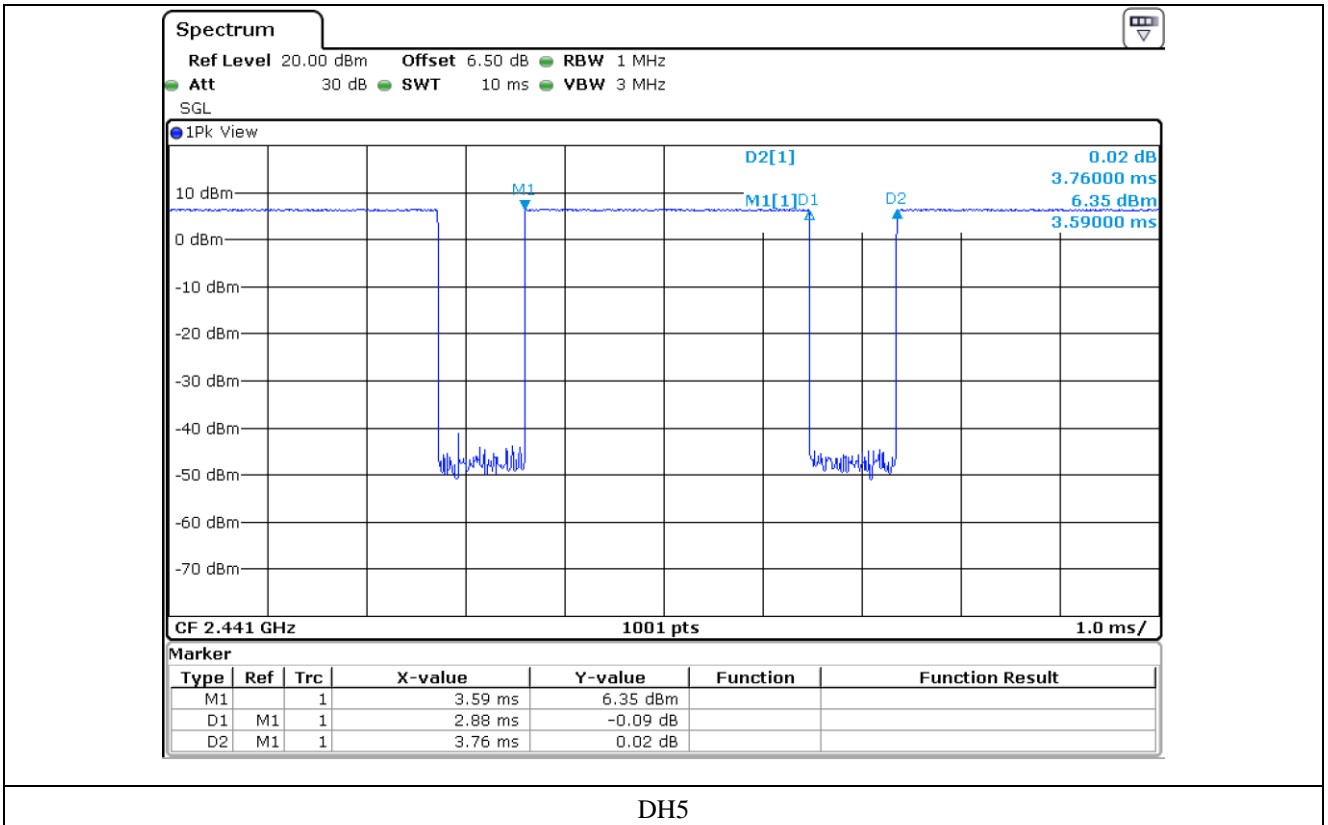
Tested by: Yu-Seog Sim / Assistant Manager



DH1



DH3



10.5 Test data for 2 Mbps

- Test Date : May 07, 2019

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

For 2-DH1 packet type, the EUT needs 1 time slot for transmitting and 1 time slot for receiving and for 2-DH3 packet type, the EUT needs 3 times slots for transmitting and 1 time slot for receiving, and 2-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 2-DH1, and 5.06 times (= 1 600/4/79) for 2-DH3, and 3.38 times (= 1 600/6/79) for 2-DH5.

Packet Type	Pulse Time (ms)	Hops per second with channels	Period Time (s)	Total Dwell Time (ms)	Limit (ms)	Test Result
2-DH1	0.370	10.13	31.6	118.44	400	PASS
2-DH3	1.630	5.06	31.6	260.63	400	
2-DH5	2.880	3.38	31.6	307.61	400	

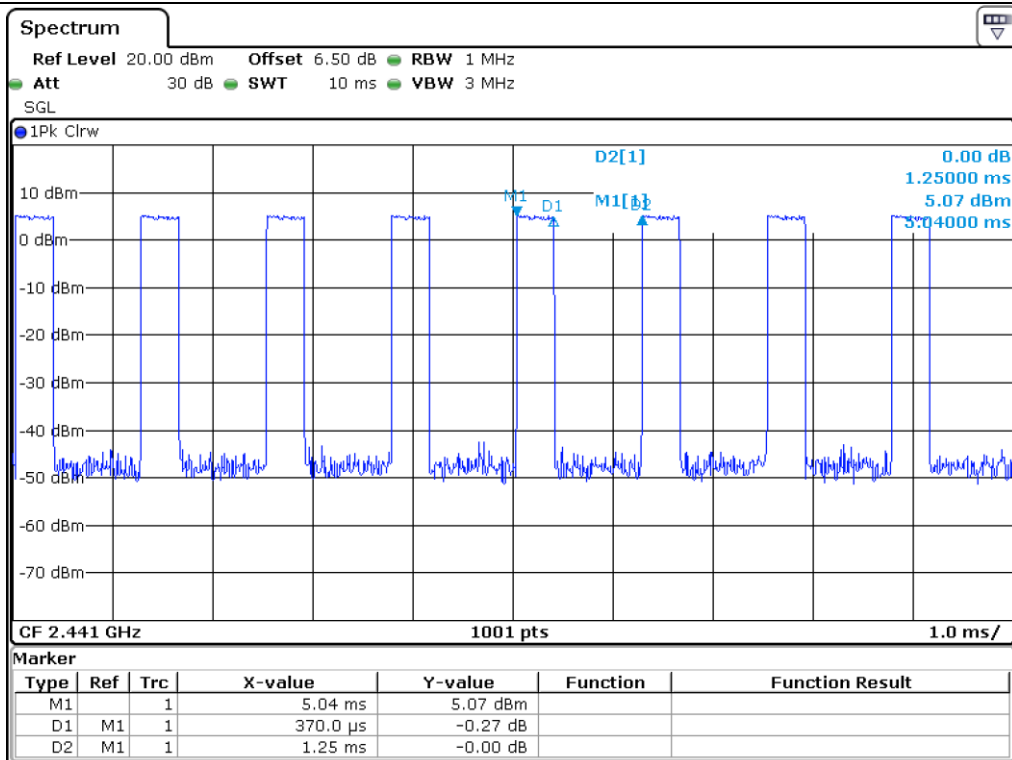
Total dwell time is calculated as following.

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

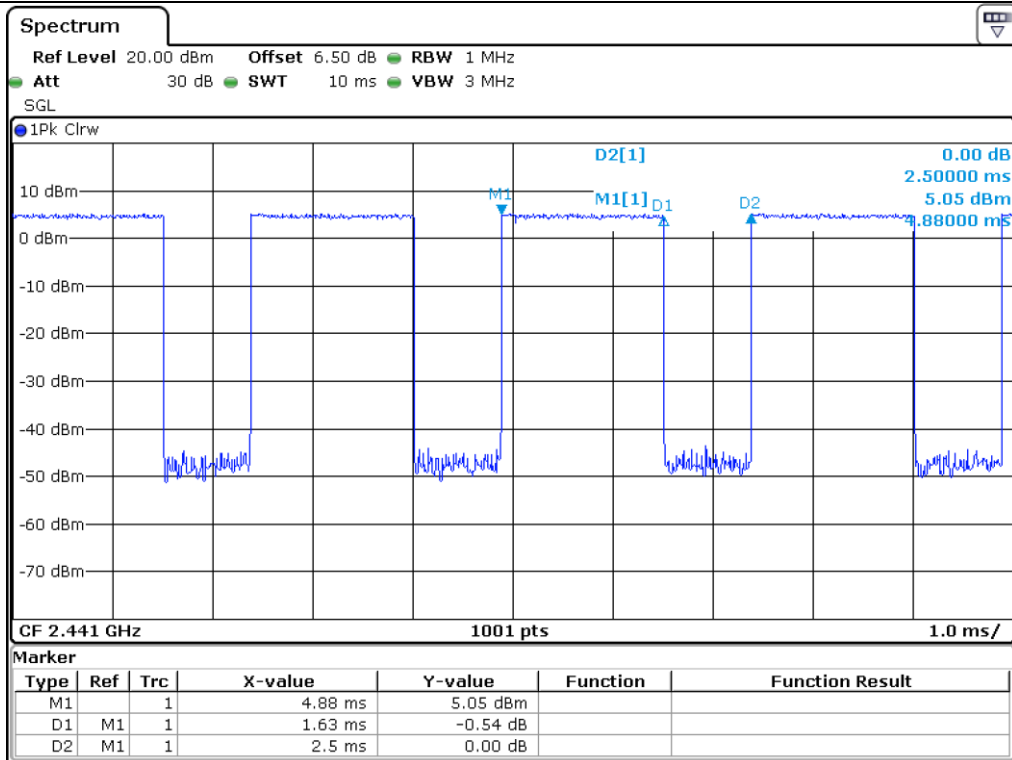
Remark: See next page for an overview sweep performed with peak detector.



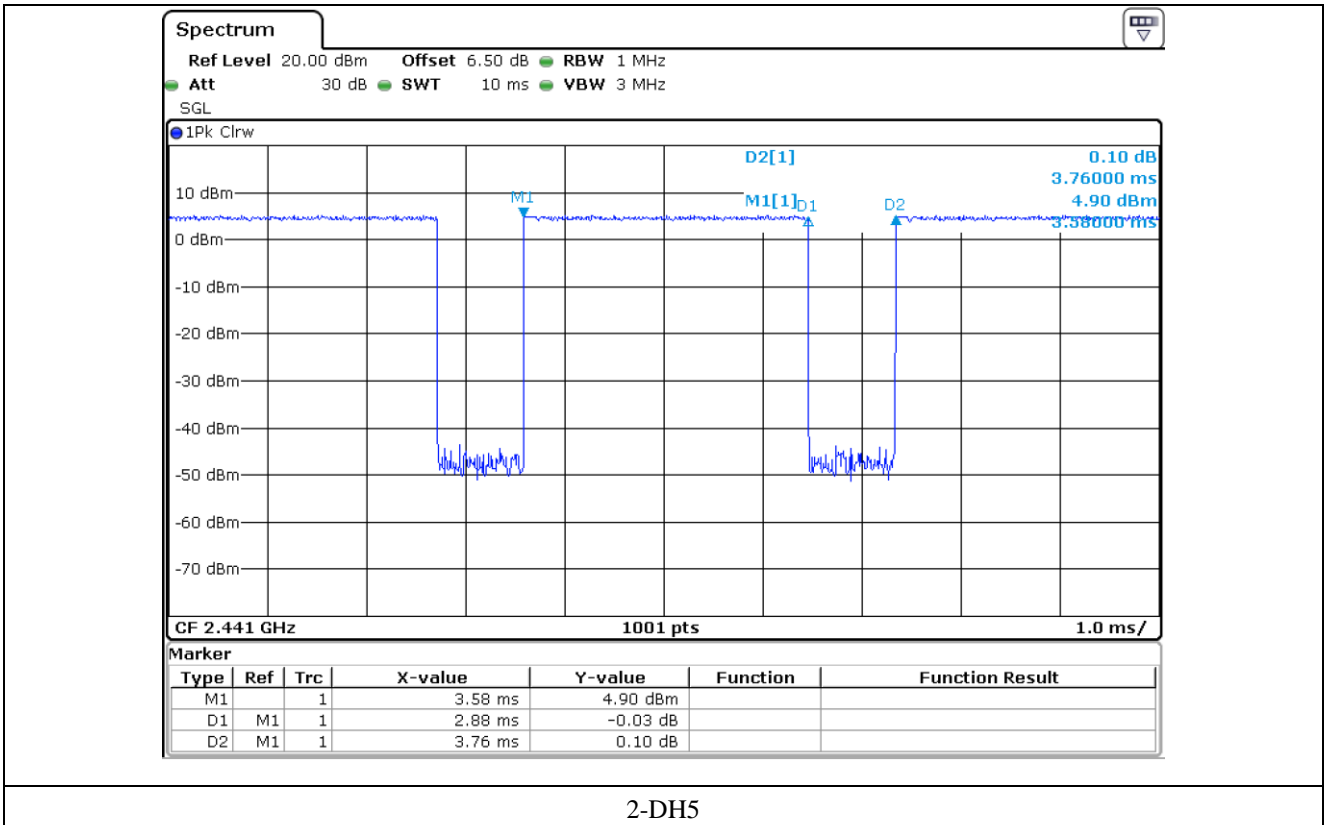
Tested by: Yu-Seog Sim / Assistant Manager



2-DH1



2-DH3



10.6 Test data for 3 Mbps

-. Test Date : May 07, 2019

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

For 3-DH1 packet type, the EUT needs 1 time slot for transmitting and 1 time slot for receiving and for 3-DH3 packet type, the EUT needs 3 times slots for transmitting and 1 time slot for receiving, and 3-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 3-DH1, and 5.06 times (= 1 600/4/79) for 3-DH3, and 3.38 times (= 1 600/6/79) for 3-DH5.

Packet Type	Pulse Time (ms)	Hops per second with channels	Period Time (s)	Total Dwell Time (ms)	Limit (ms)	Test Result
3-DH1	0.380	10.13	31.6	121.64	400	PASS
3-DH3	1.630	5.06	31.6	260.63	400	
3-DH5	2.880	3.38	31.6	307.61	400	

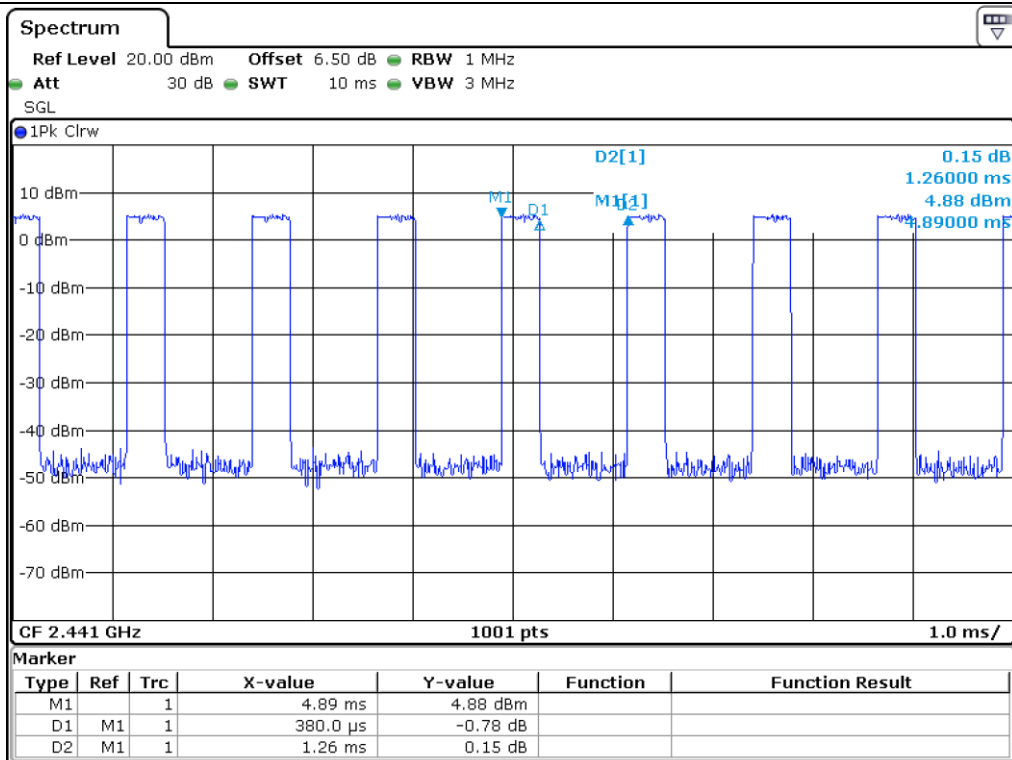
Total dwell time is calculated as following.

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

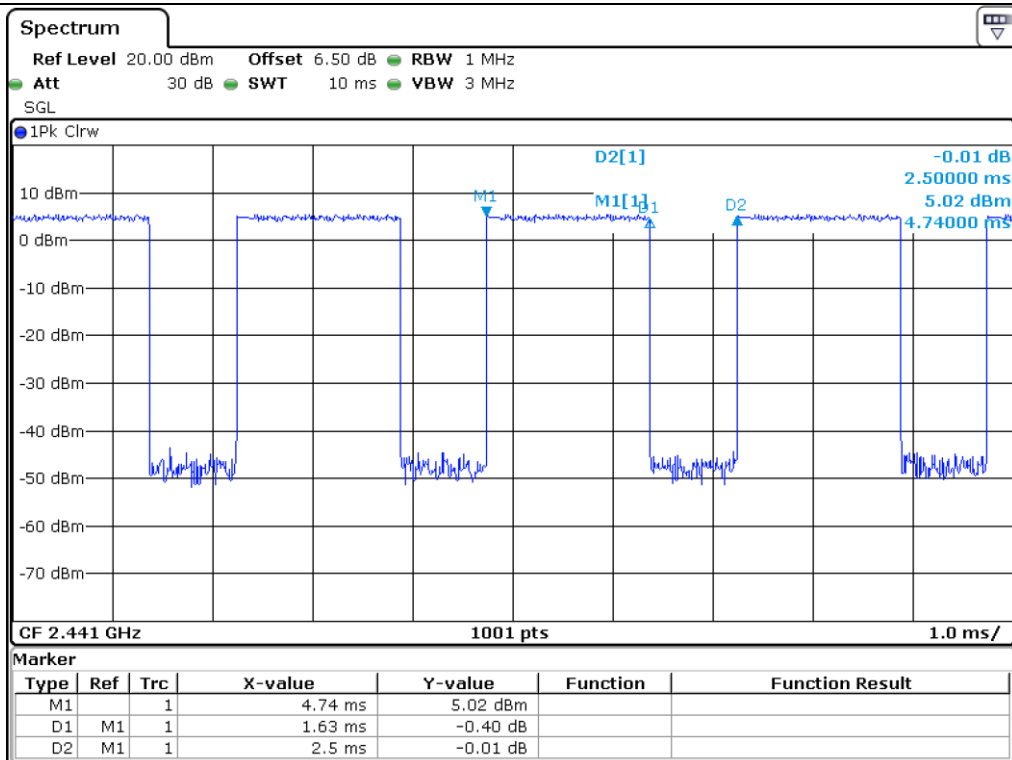
Remark: See next page for an overview sweep performed with peak detector.



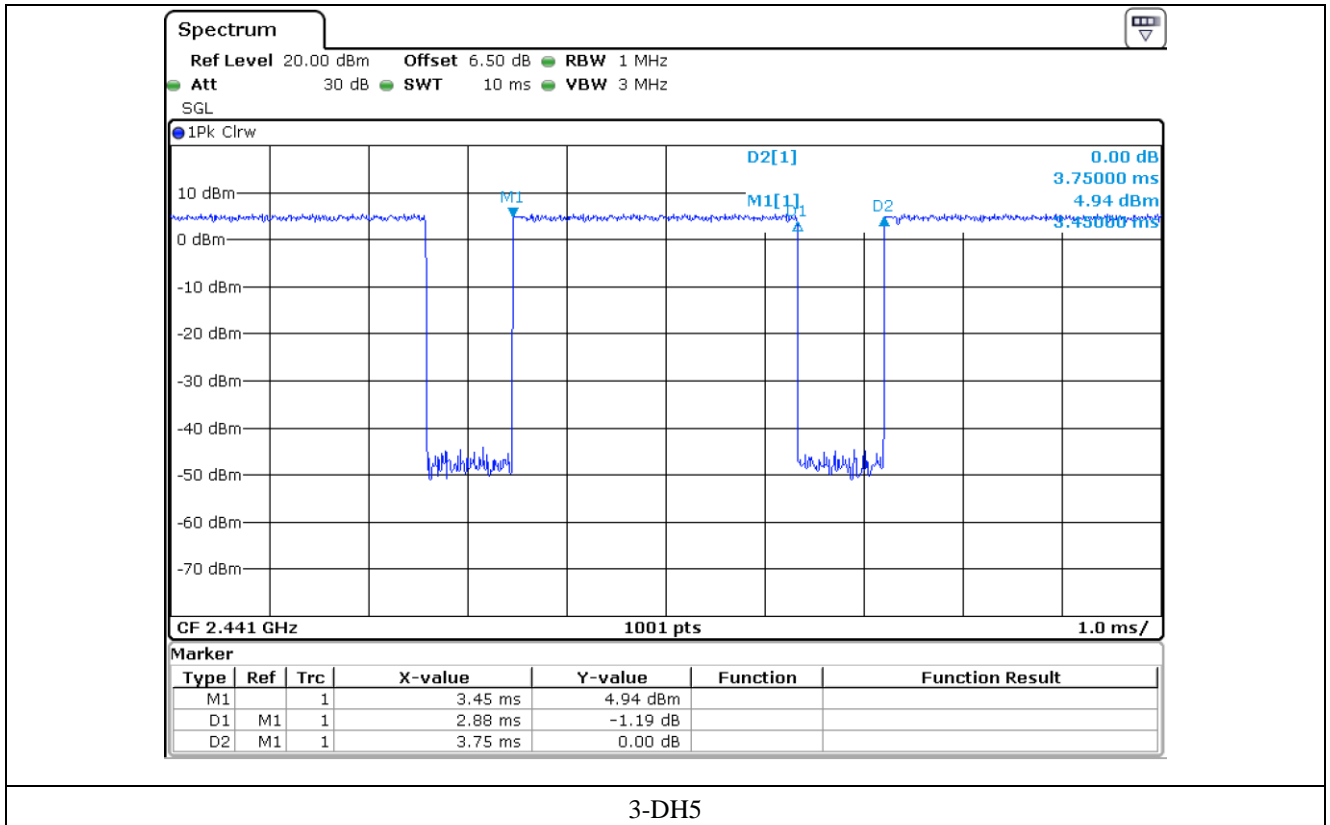
Tested by: Yu-Seog Sim / Assistant Manager



3-DH1



3-DH3



3-DH5

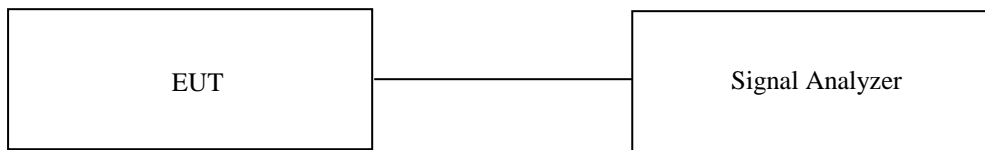
11. MAXIMUM PEAK OUTPUT POWER

11.1 Operating environment

Temperature : 24 °C
 Relative humidity : 45 % R.H

11.2 Test set-up

The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT. The EUT was operating in transmit mode at the appropriate center frequency.



11.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101199	Mar. 11, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

11.4 Test data for 1 Mbps

-. Test Date : May 07, 2019

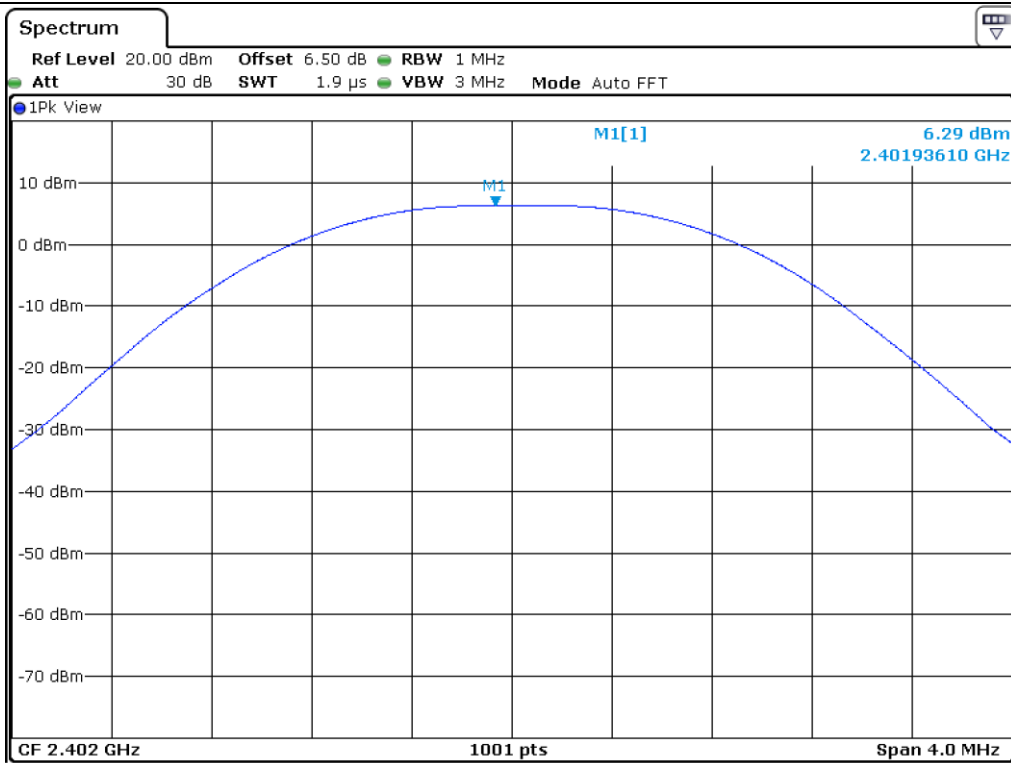
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402	6.29	21.00	14.71
MIDDLE	2 441	6.33	21.00	14.67
HIGH	2 480	6.06	21.00	14.94

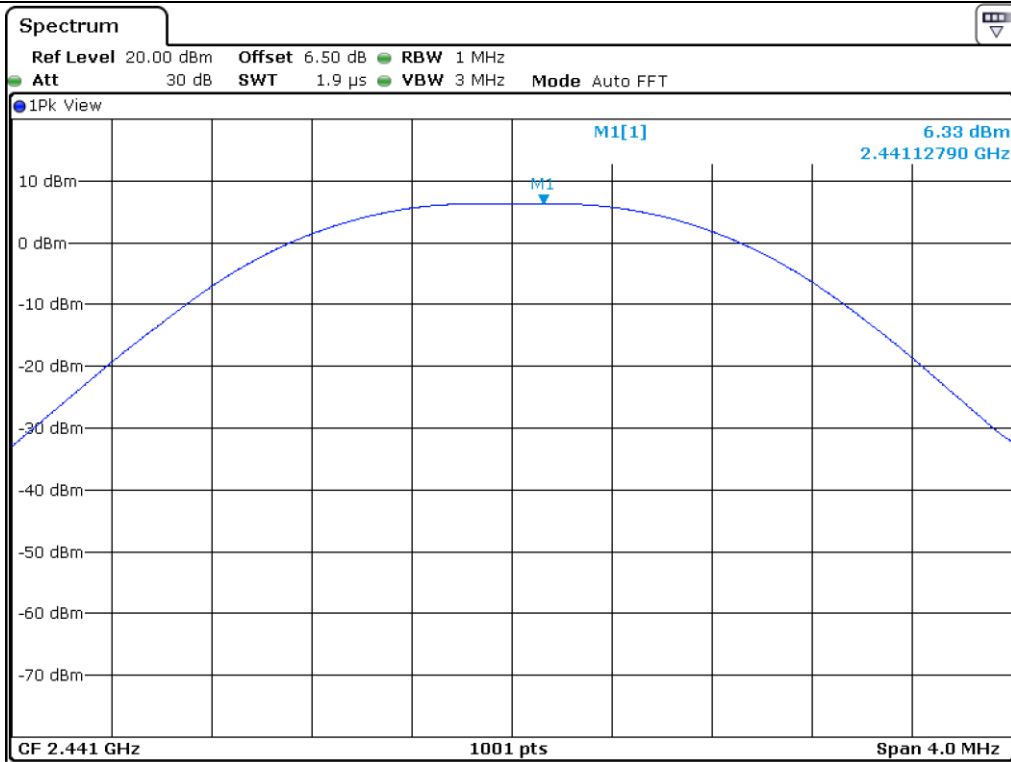
Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)



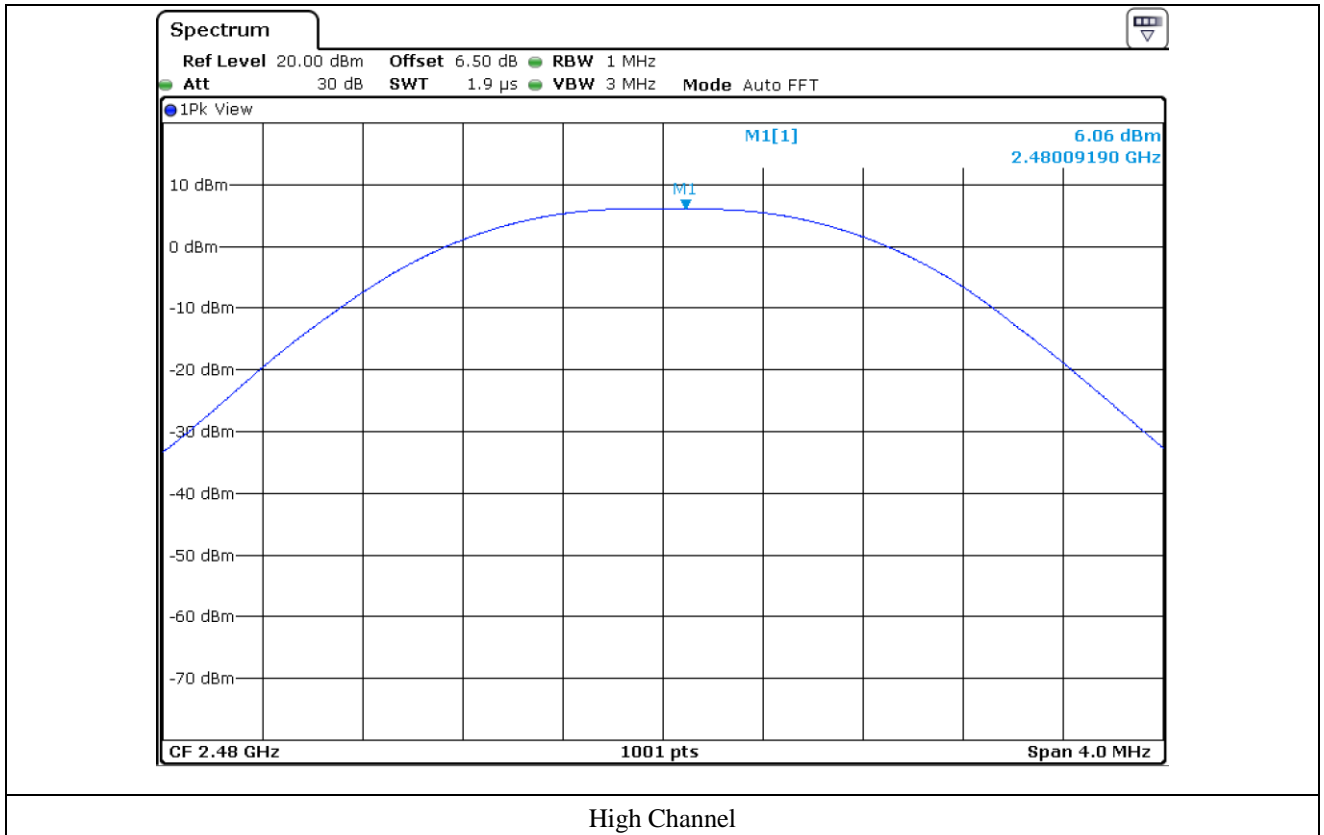
Tested by: Yu-Seog Sim / Assistant Manager



Low Channel



Middle Channel



High Channel

11.5 Test data for 2 Mbps

-. Test Date : May 07, 2019

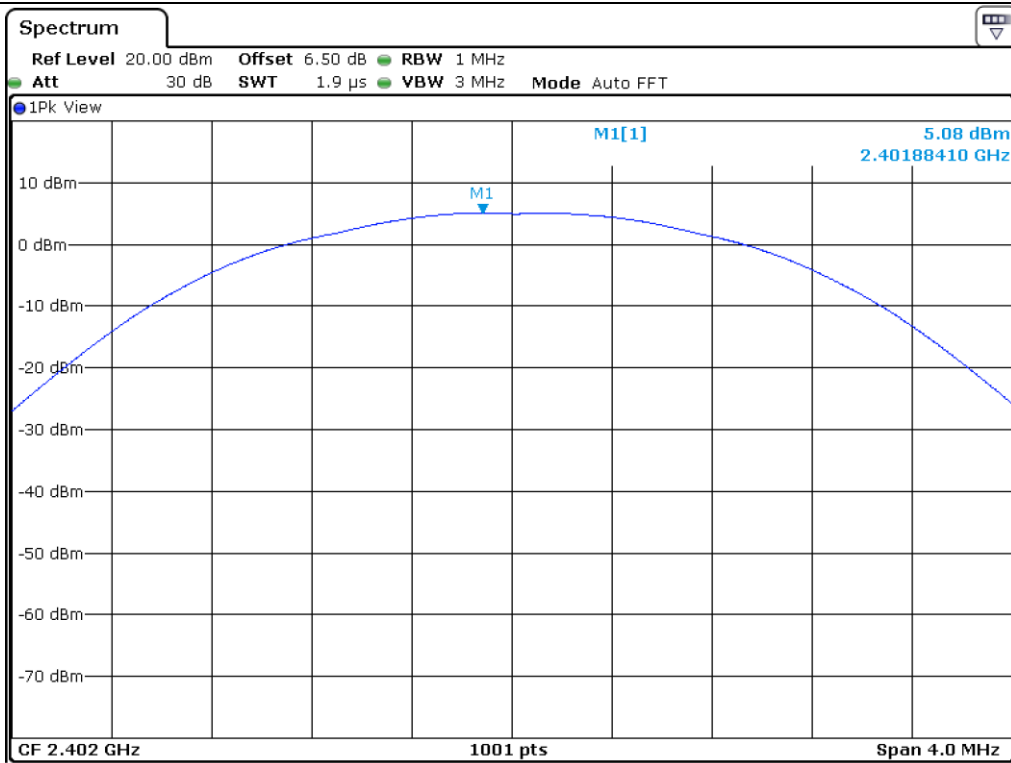
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402	5.08	21.00	15.92
MIDDLE	2 441	5.33	21.00	15.67
HIGH	2 480	4.97	21.00	16.03

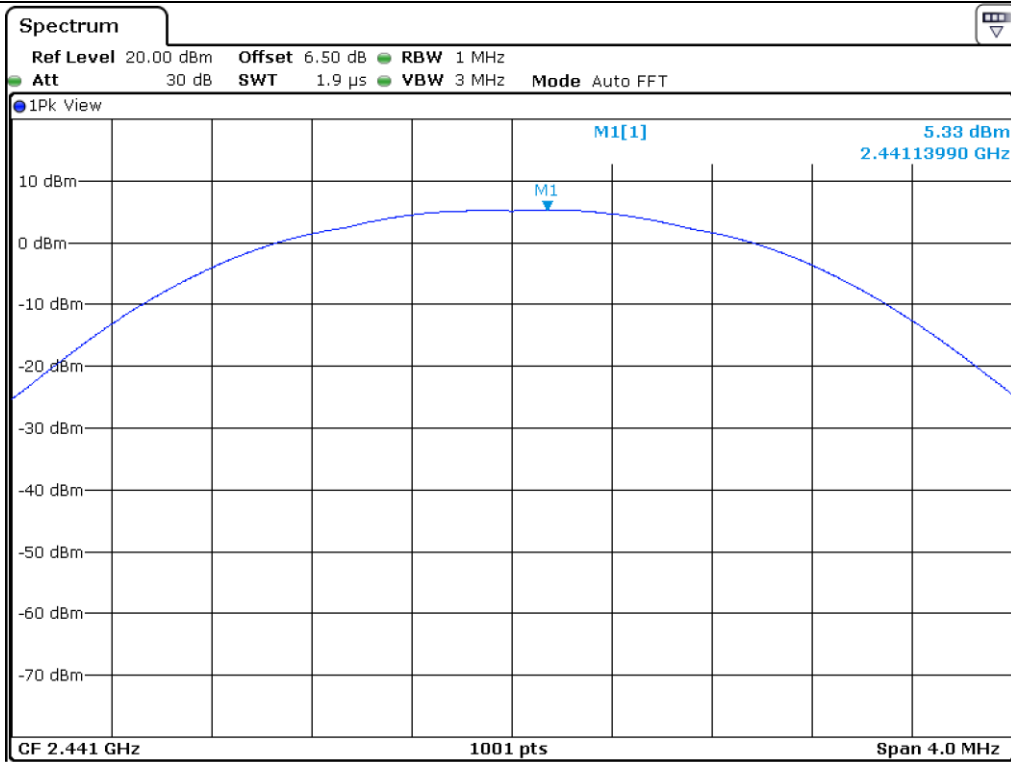
Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)



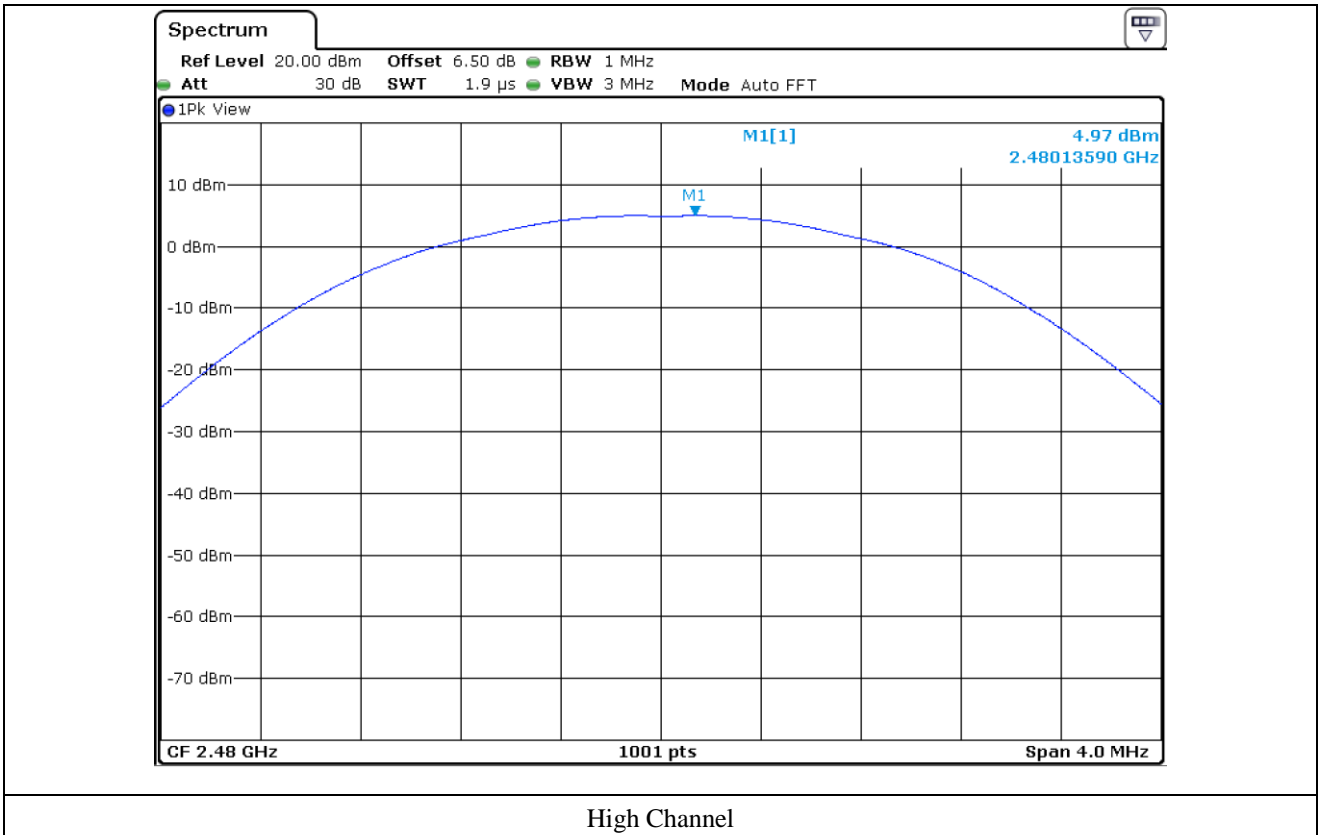
Tested by: Yu-Seog Sim / Assistant Manager



Low Channel



Middle Channel



11.6 Test data for 3 Mbps

-. Test Date : May 07, 2019

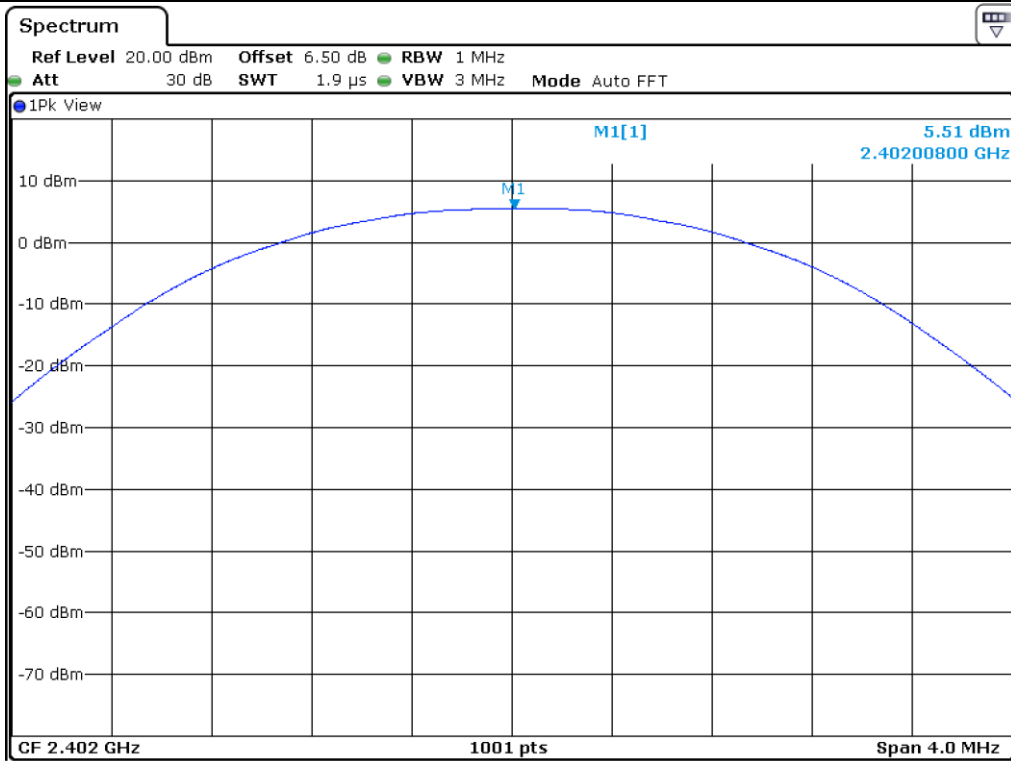
-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402	5.51	21.00	15.49
MIDDLE	2 441	5.43	21.00	15.57
HIGH	2 480	5.44	21.00	15.56

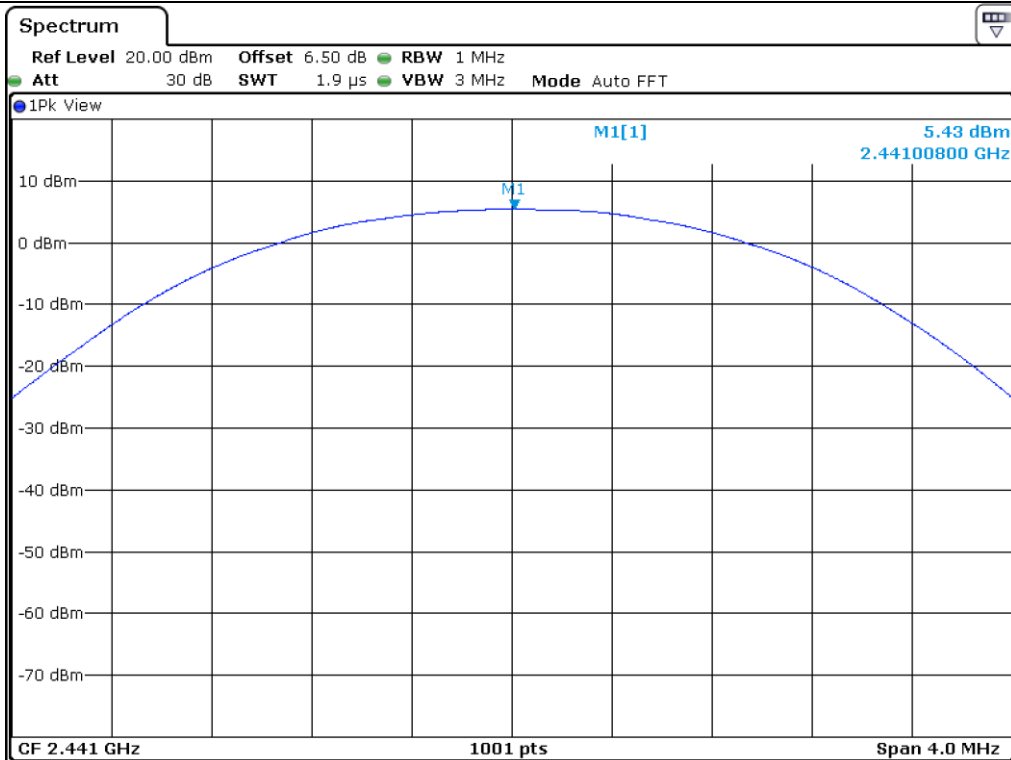
Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)



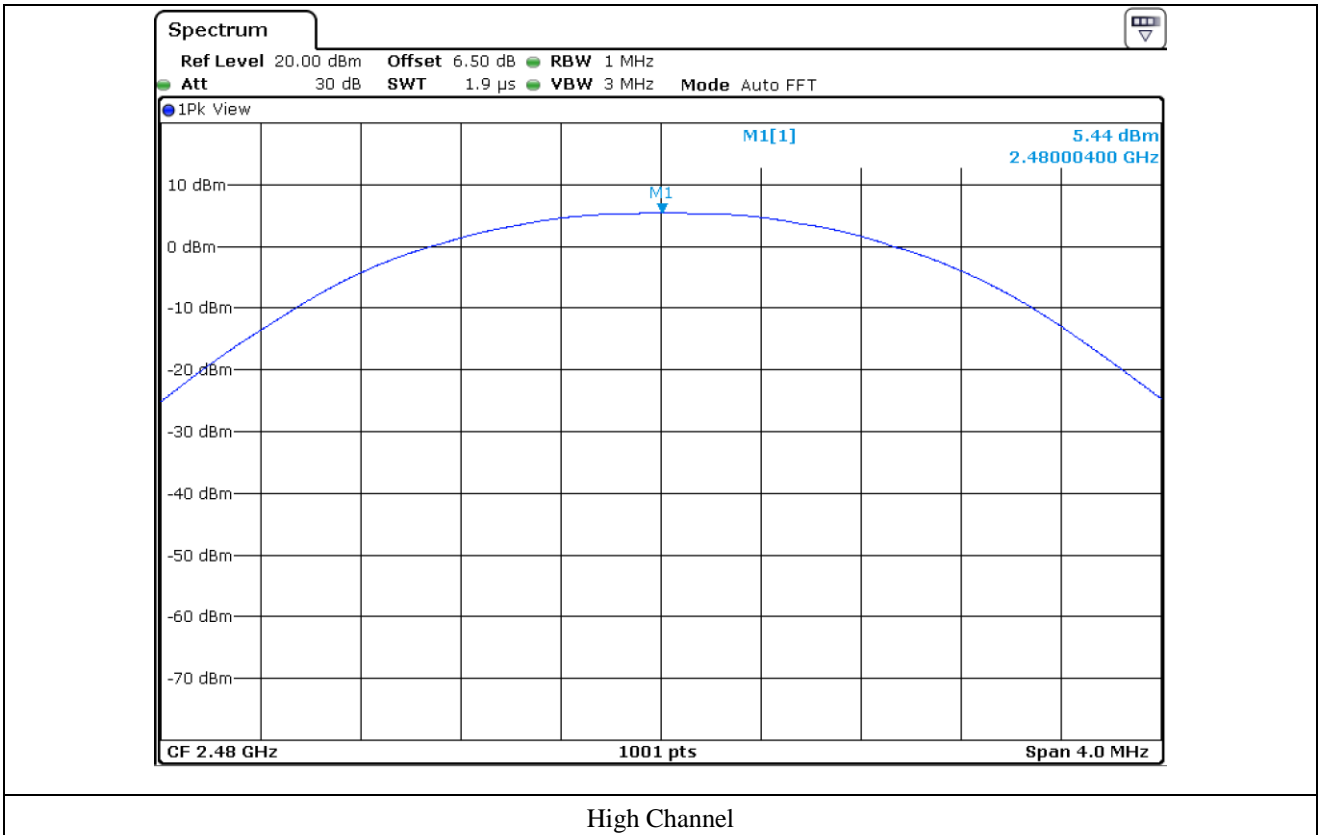
Tested by: Yu-Seog Sim / Assistant Manager



Low Channel



Middle Channel



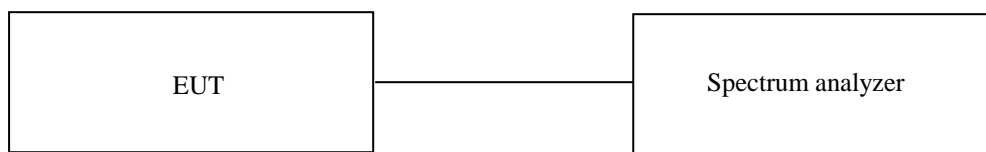
12. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

12.1 Operating environment

Temperature : 24 °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, open-field test site. The EUT was placed on a non-conductive turntable approximately 0.8 m above the ground plane.

The frequency spectrum from 30 kHz 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 ms in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

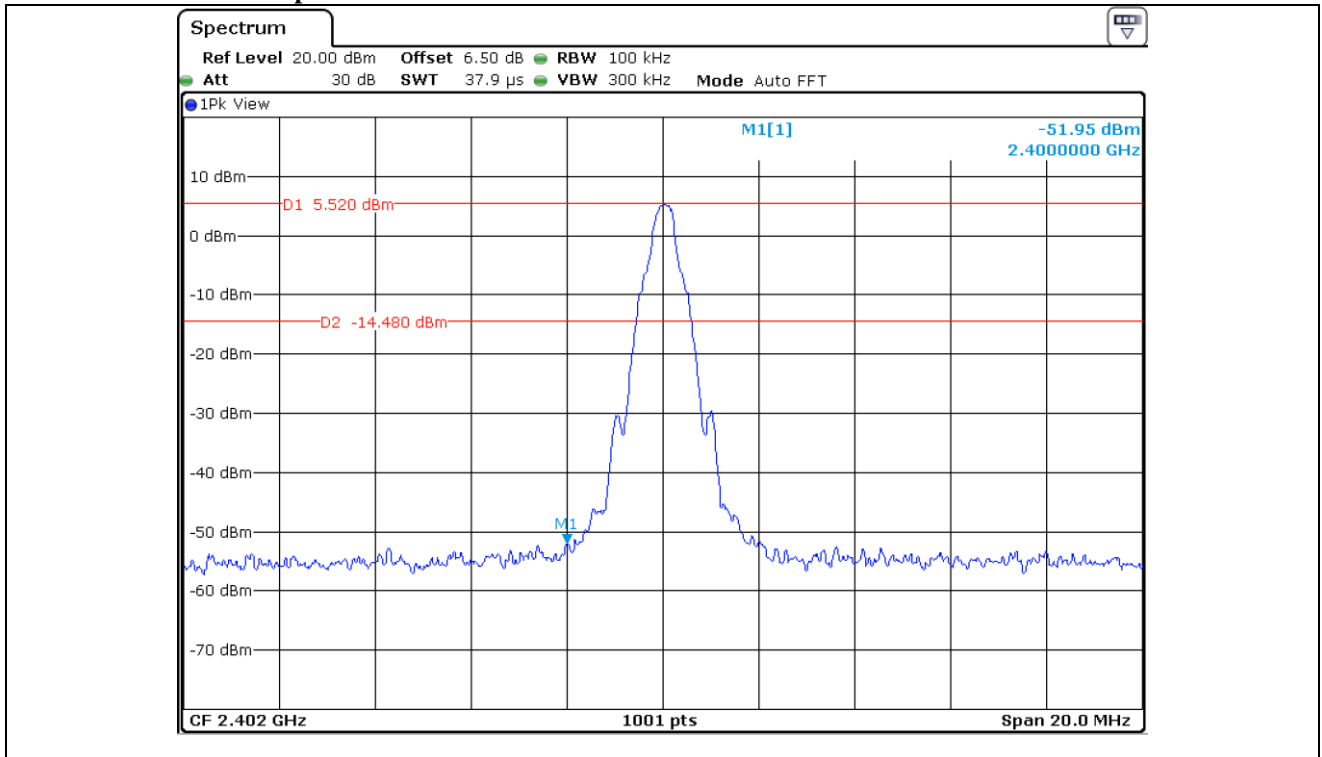
12.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
<input type="checkbox"/>	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Oct. 22, 2018 (1Y)
<input checked="" type="checkbox"/>	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 22, 2018 (1Y)
<input checked="" type="checkbox"/>	310N	Sonoma Instrument	AMPLIFIER	312544	Mar. 18, 2019 (1Y)
<input type="checkbox"/>	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Aug. 23, 2018 (1Y)
<input checked="" type="checkbox"/>	BBV 9718 B	Schwarzbeck	Broadband Pre-Amplifier	009	Mar. 20, 2019 (1Y)
<input checked="" type="checkbox"/>	MA240	HD GmbH	Antenna Master	N/A	N/A
<input type="checkbox"/>	HD100	HD GmbH	Position Controller	N/A	N/A
<input checked="" type="checkbox"/>	DS420S	HD GmbH	Turn Table	N/A	N/A
<input type="checkbox"/>	FMZB 1513	Schwarzbeck	LOOP ANTENNA	1513-235	May. 13, 2018 (2Y)
<input checked="" type="checkbox"/>	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-255	Jun. 05, 2018 (2Y)
<input checked="" type="checkbox"/>	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
<input type="checkbox"/>	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Dec. 04, 2017 (2Y)
<input type="checkbox"/>	83051A	Agilent	Microwave System Preamplifer	3950M00201	Mar. 12, 2019 (1Y)

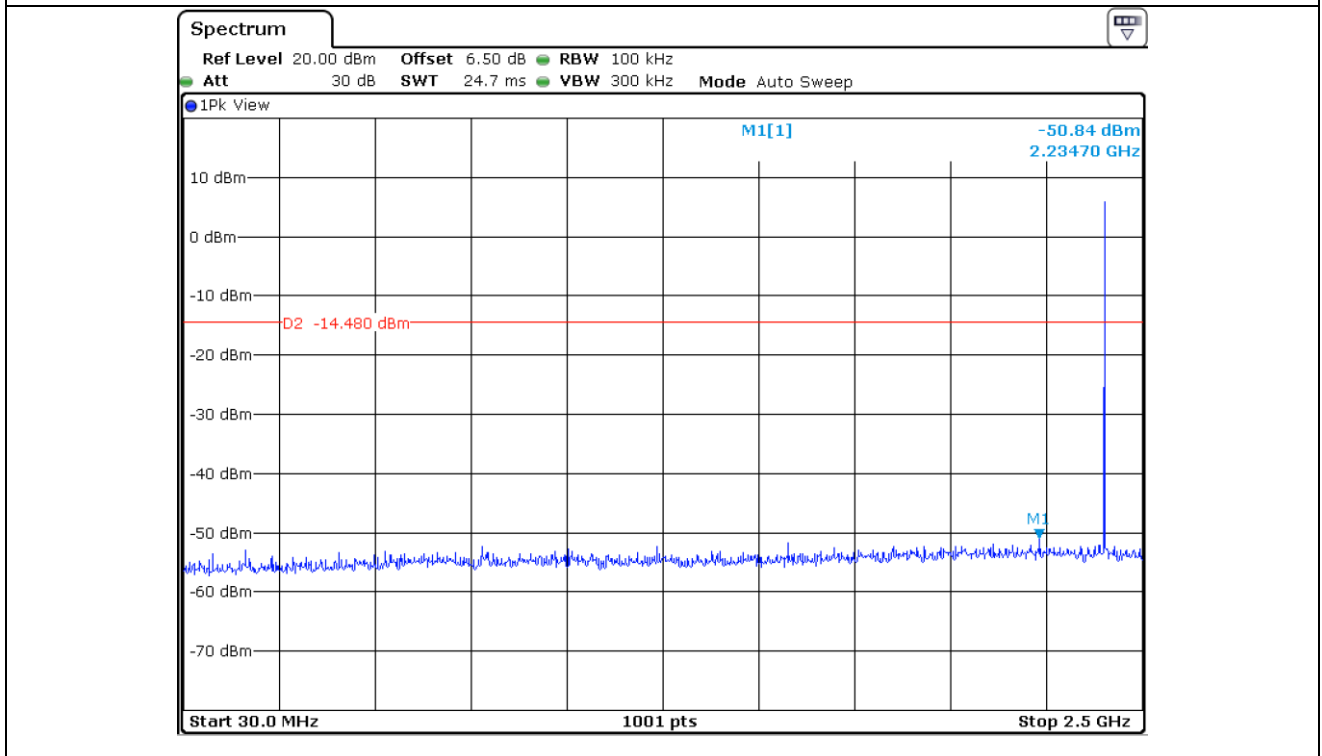
All test equipment used is calibrated on a regular basis.

12.5 Test data for conducted emission

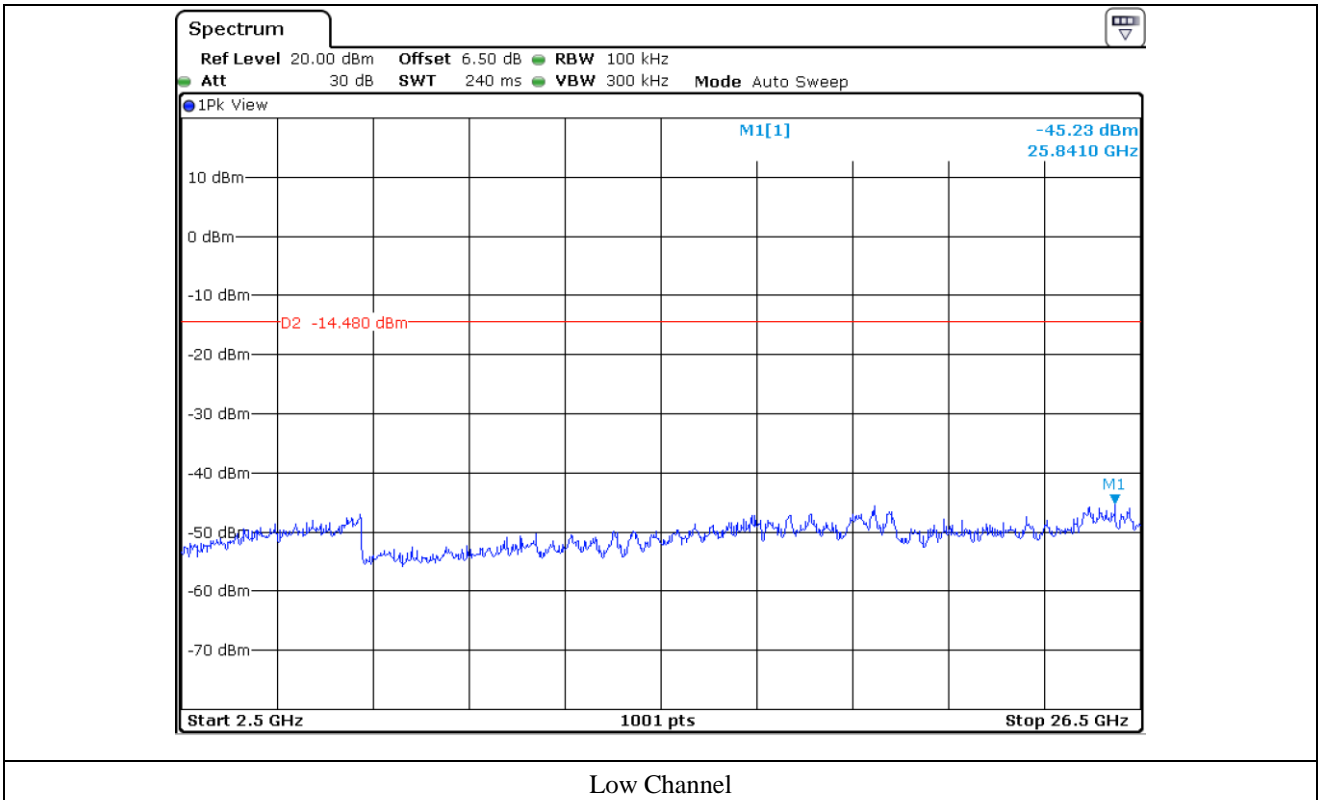
12.5.1 Test data for 1 Mbps

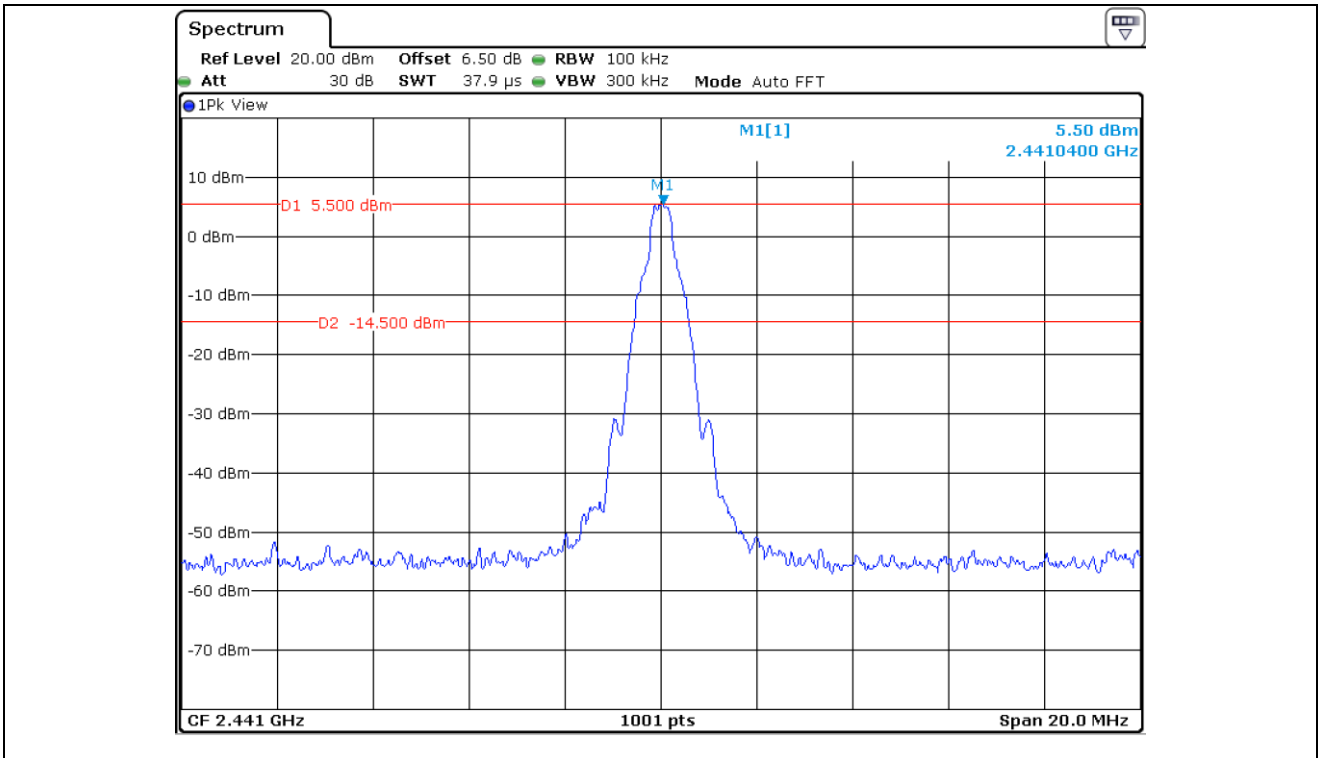


Low Channel

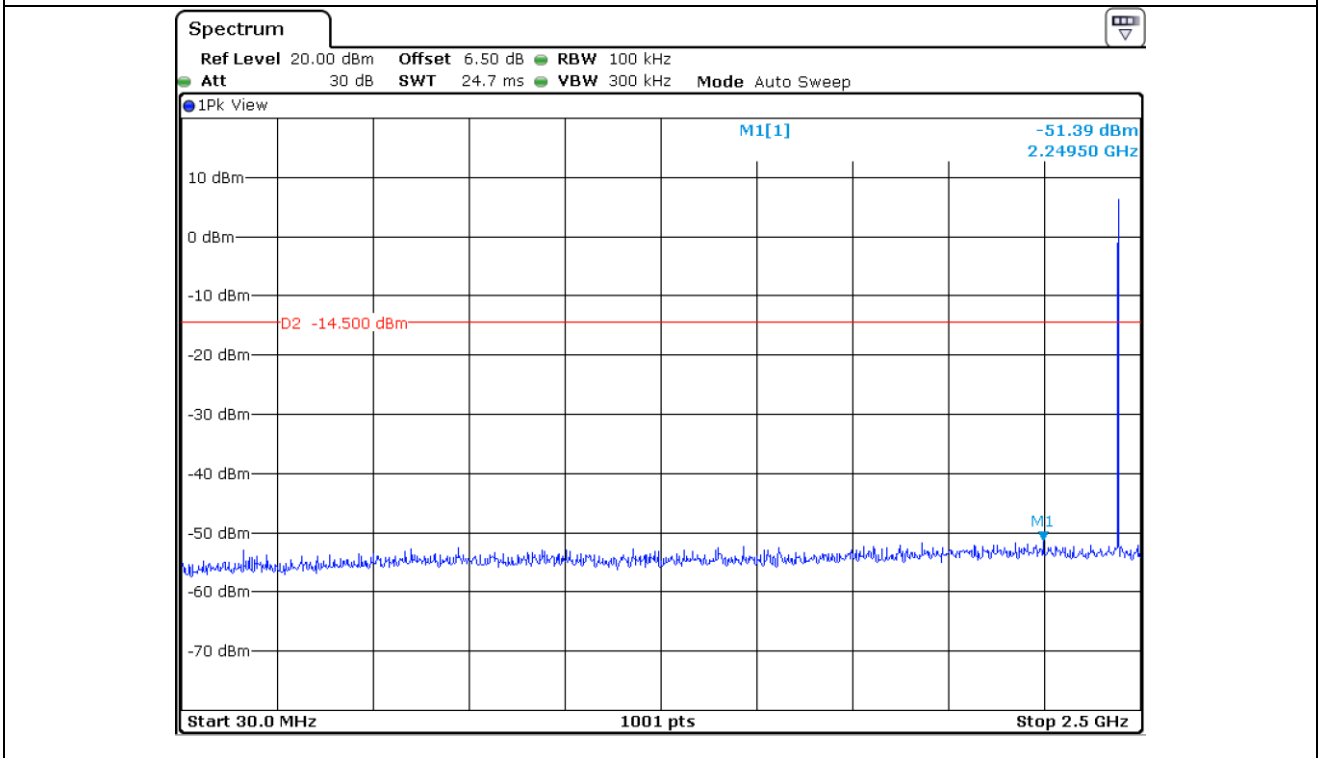


Low Channel

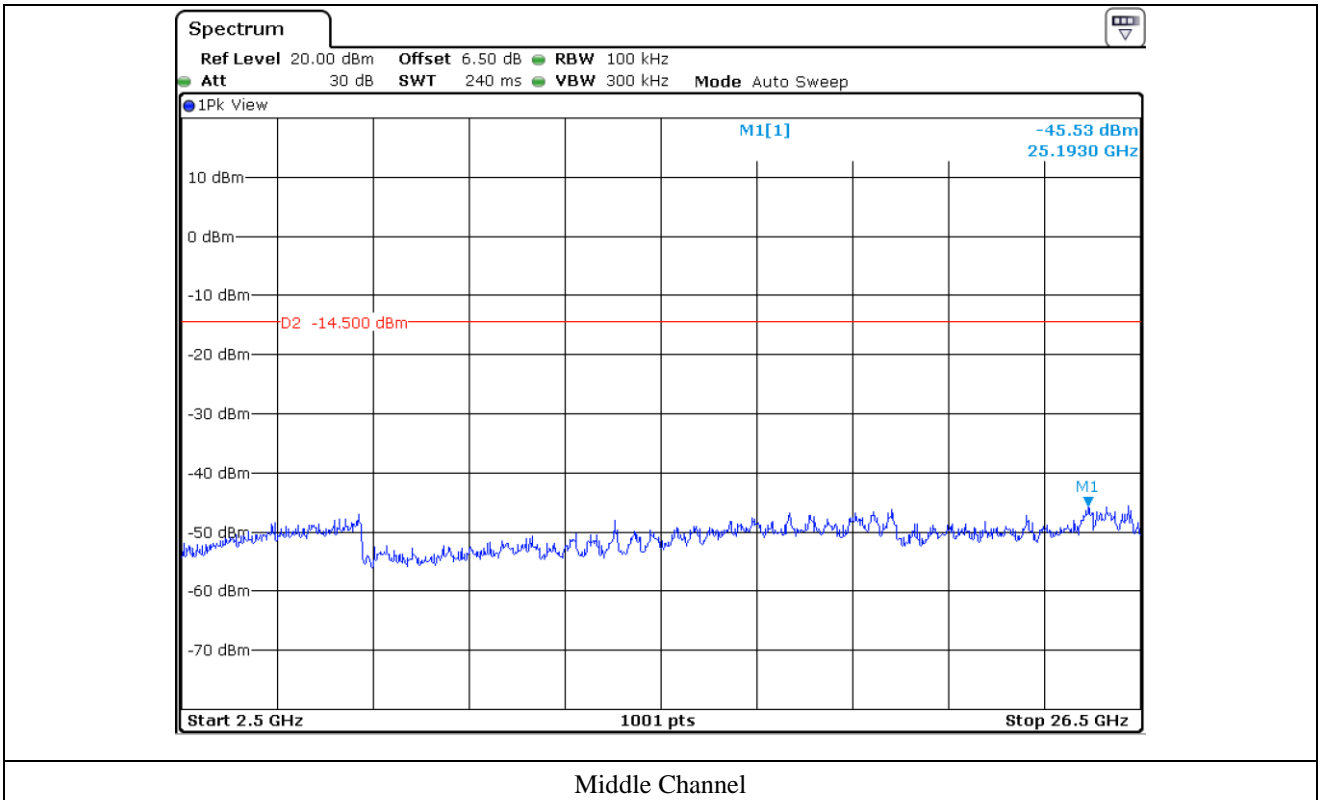


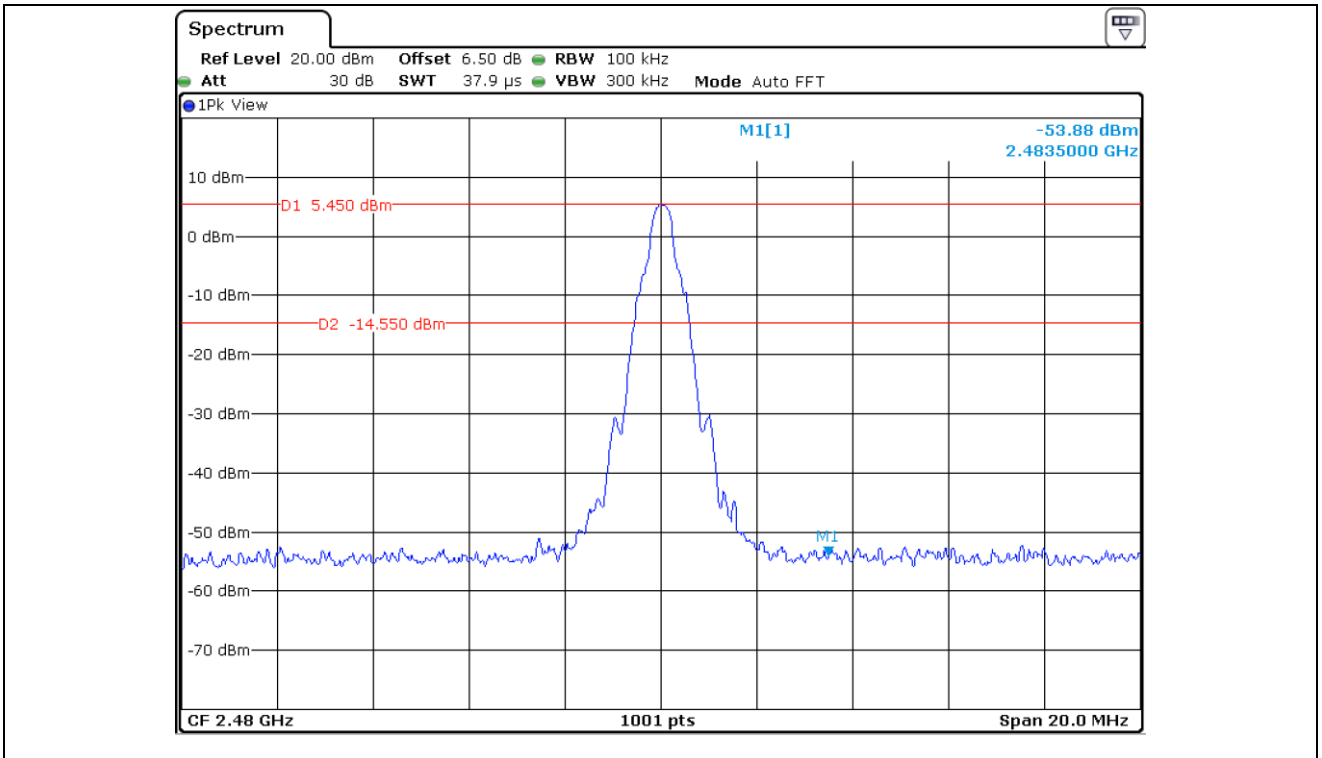


Middle Channel

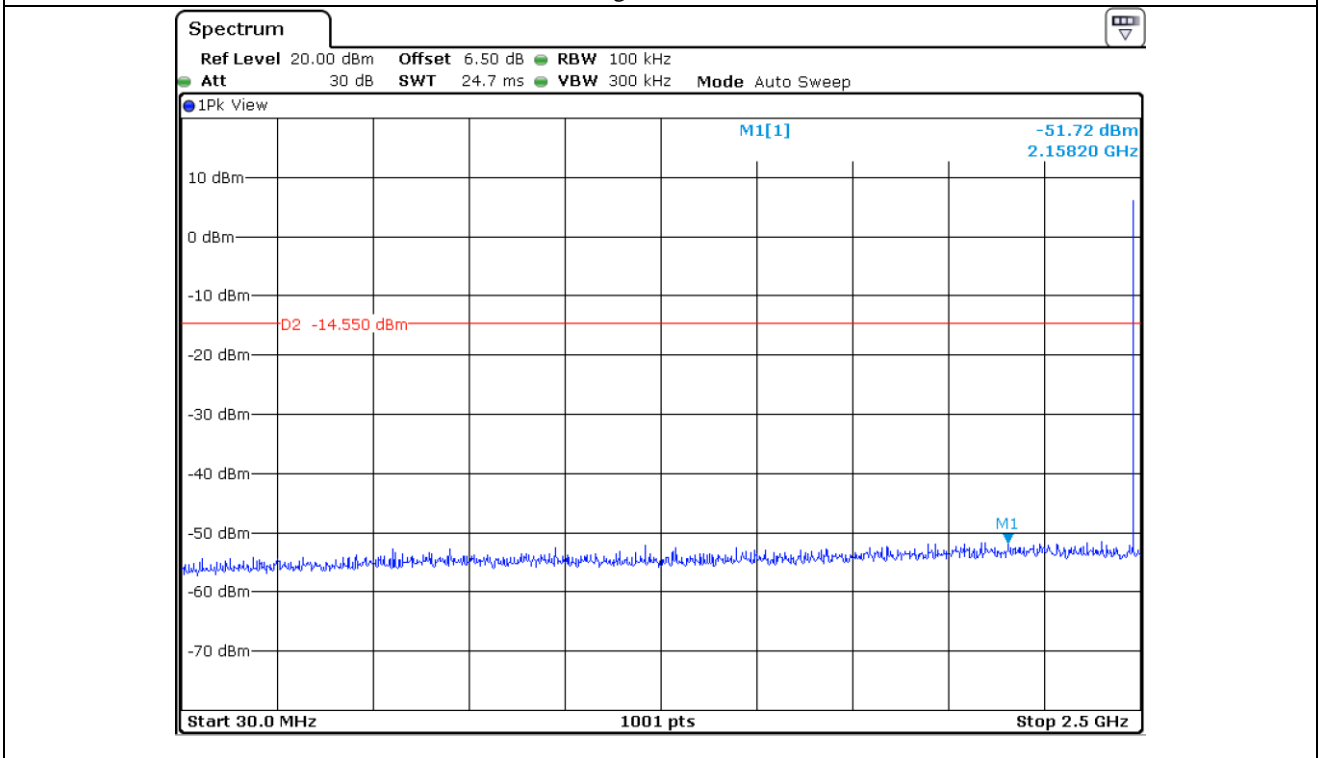


Middle Channel

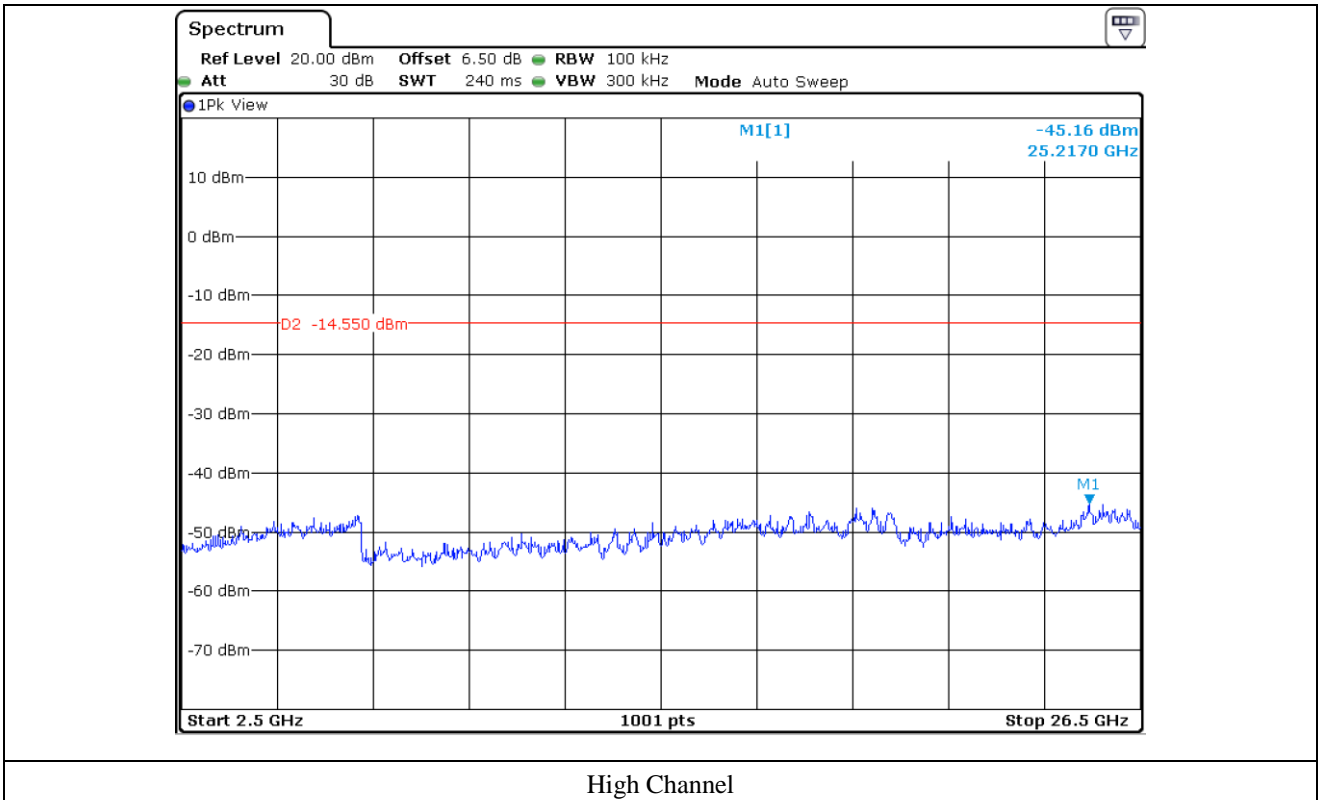




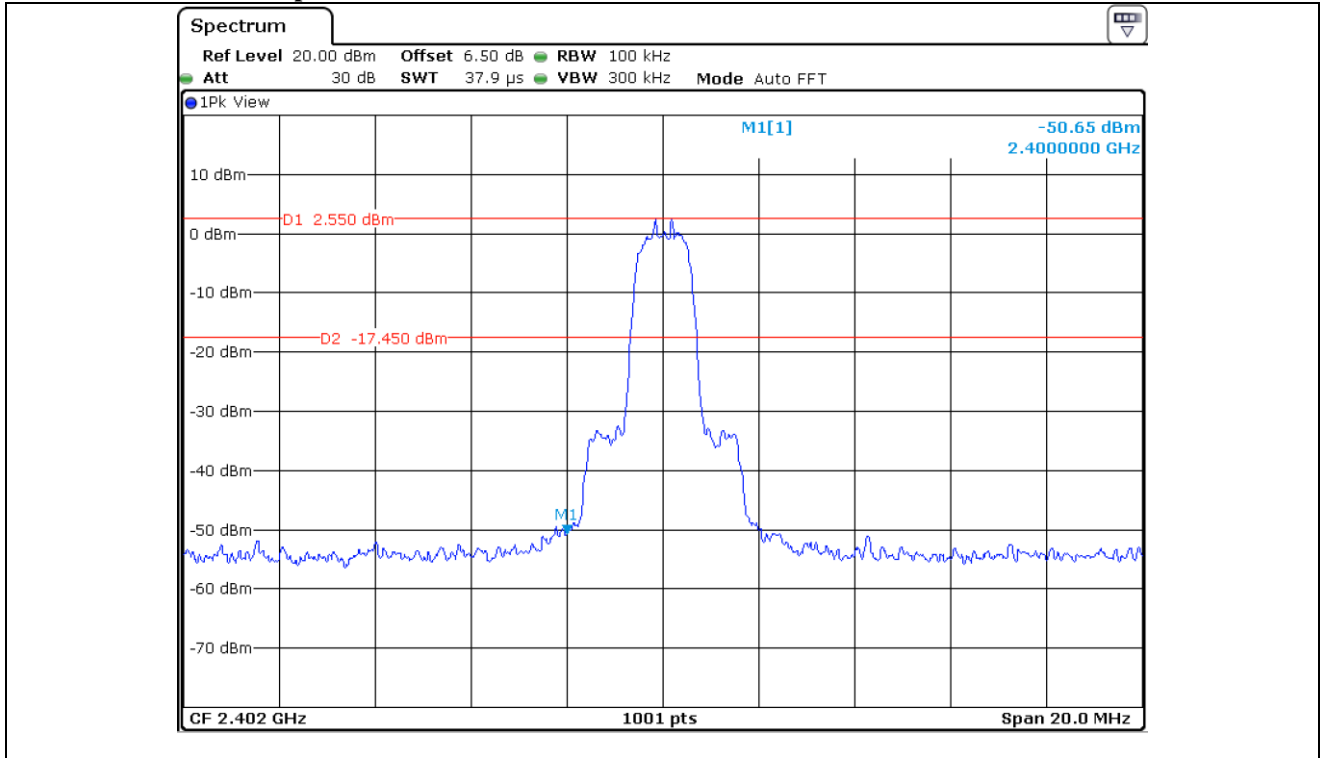
High Channel



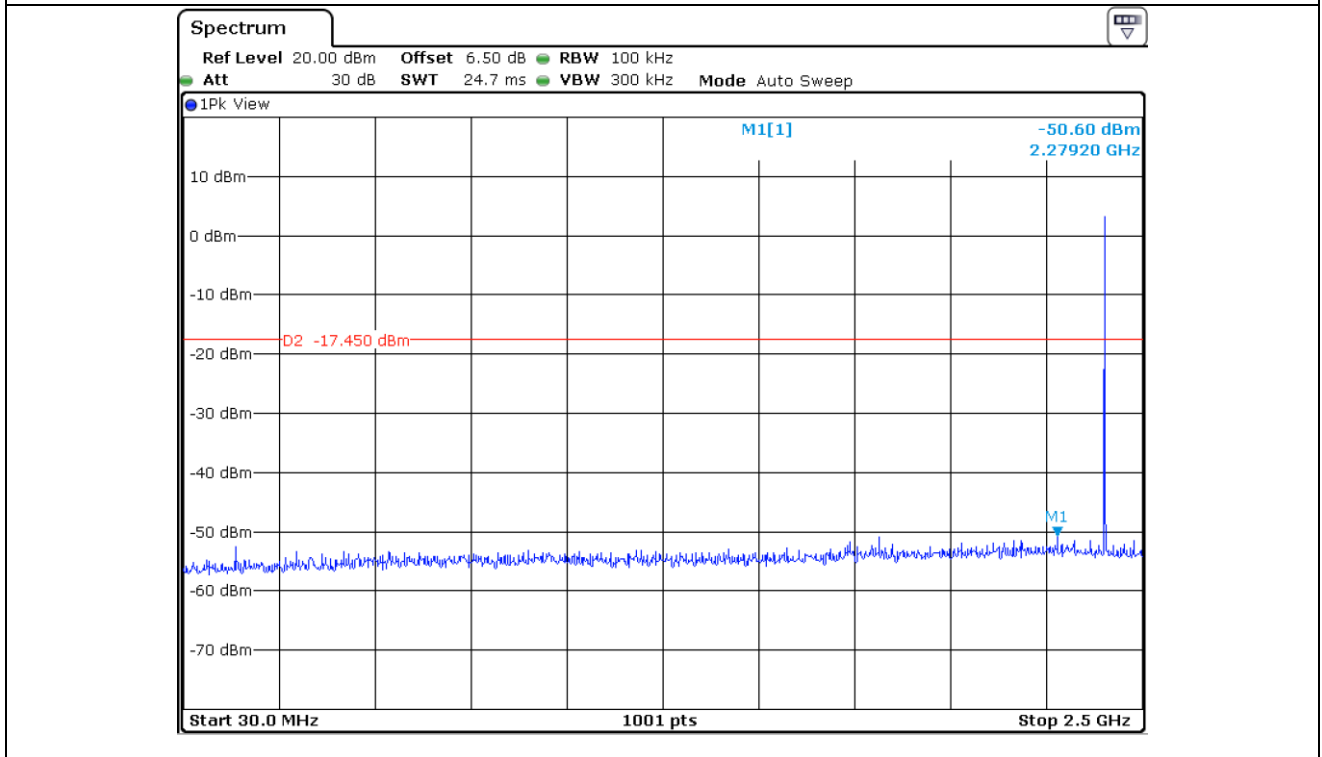
High Channel



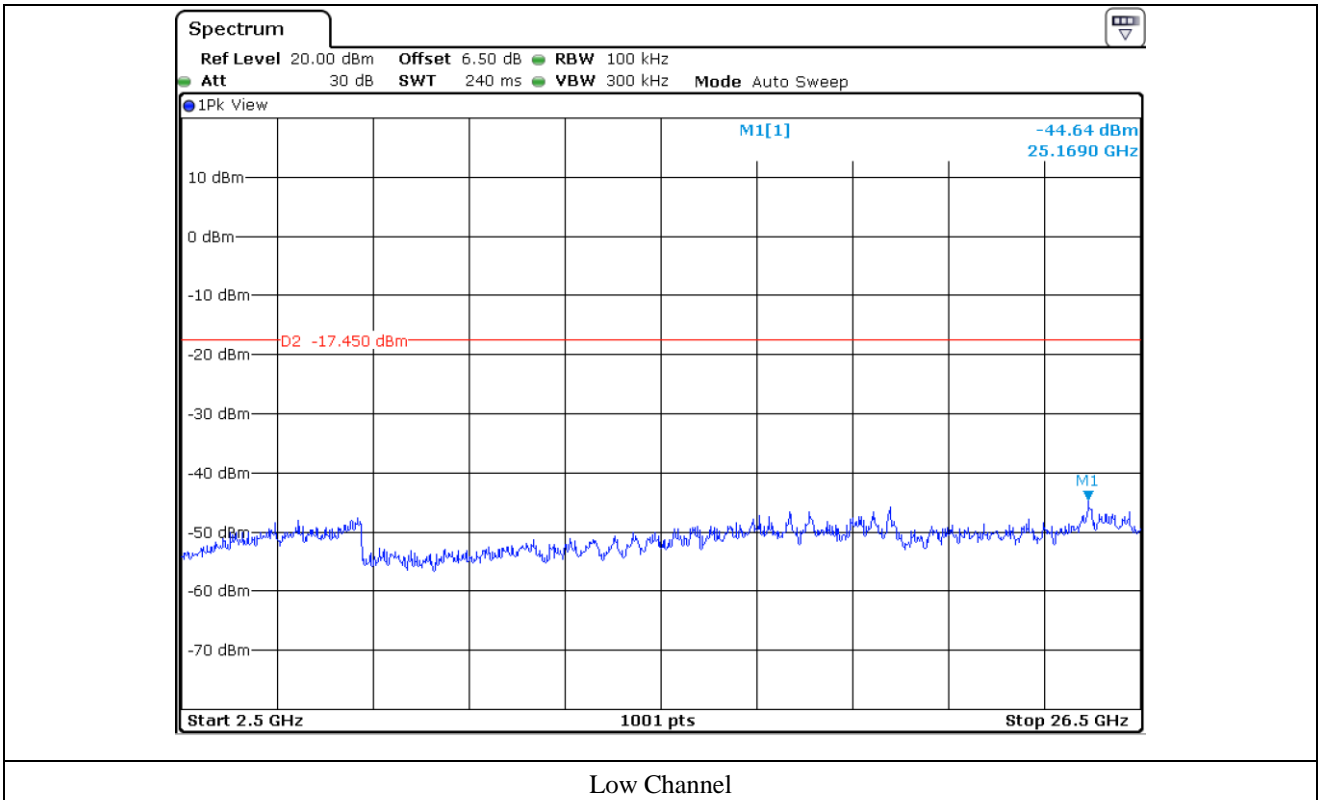
12.5.2 Test data for 2 Mbps

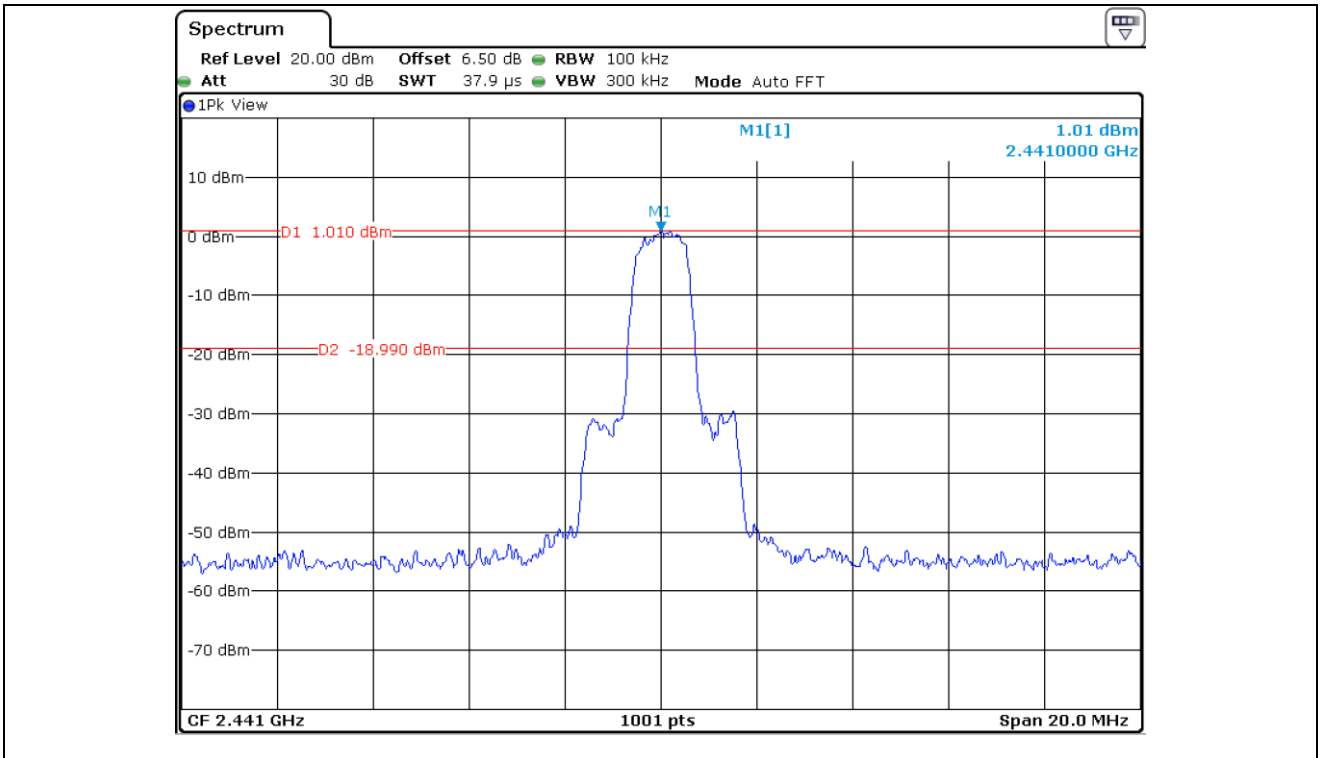


Low Channel

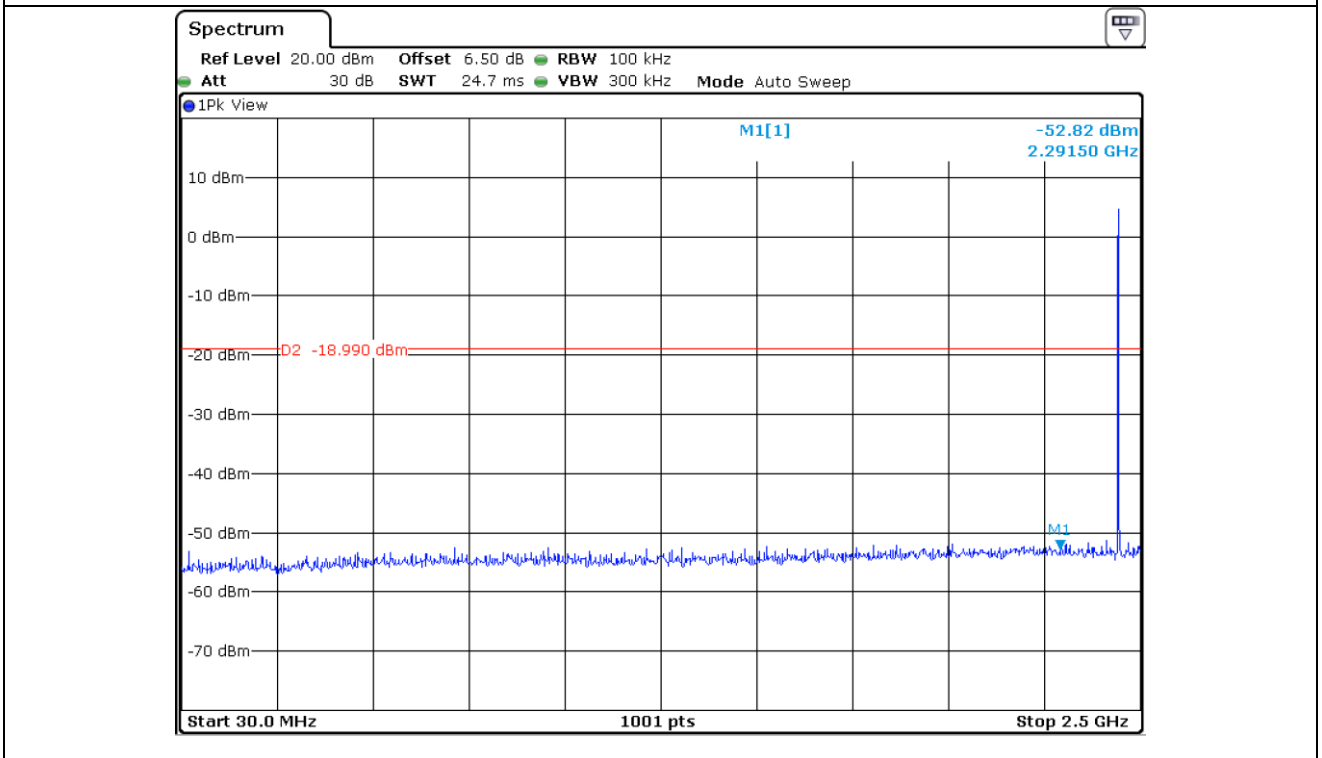


Low Channel

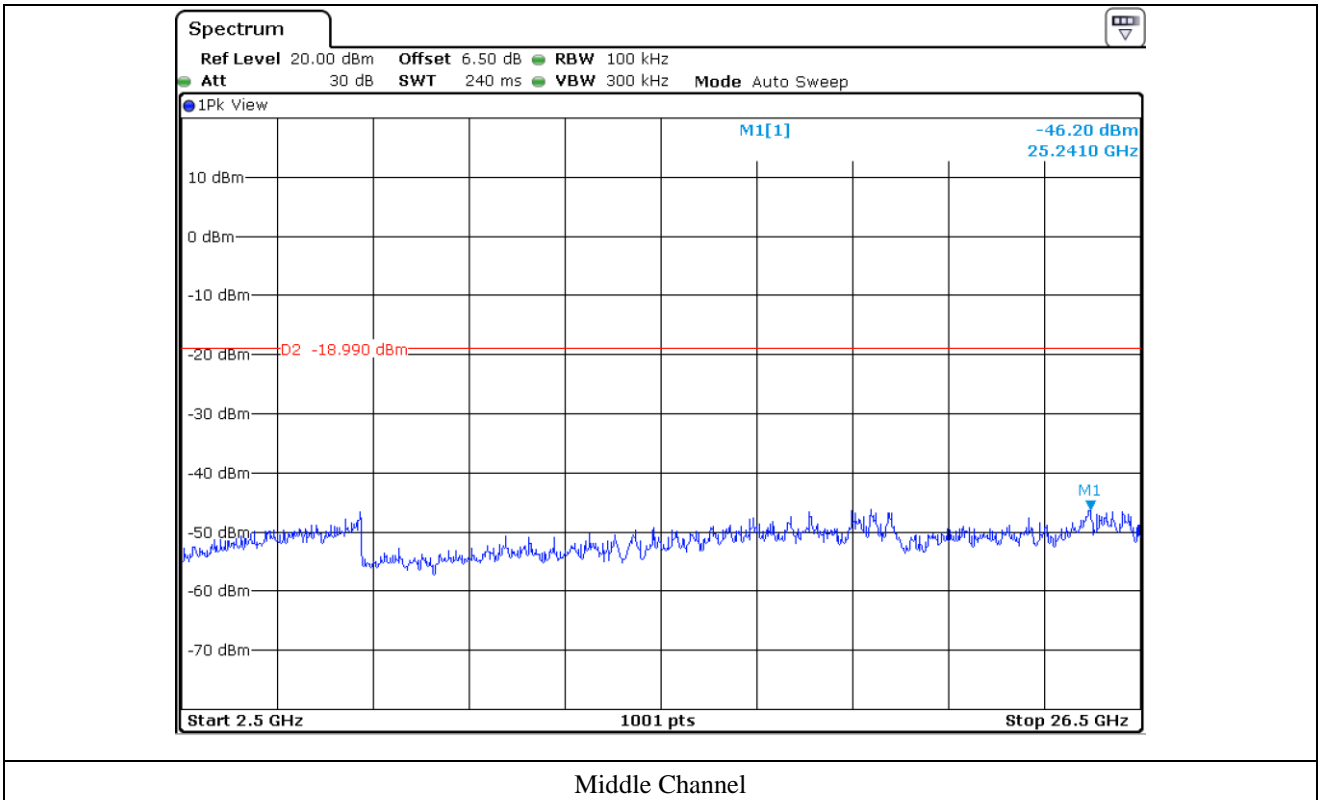


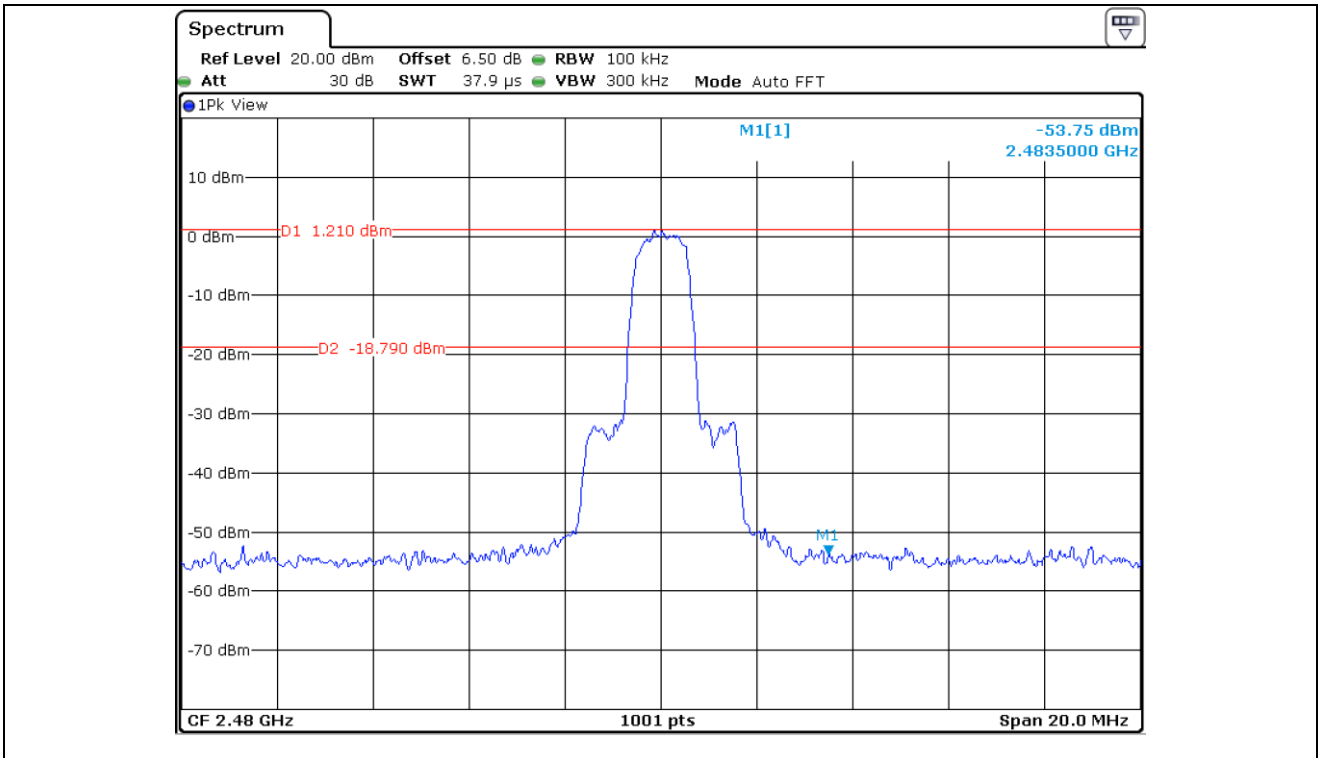


Middle Channel

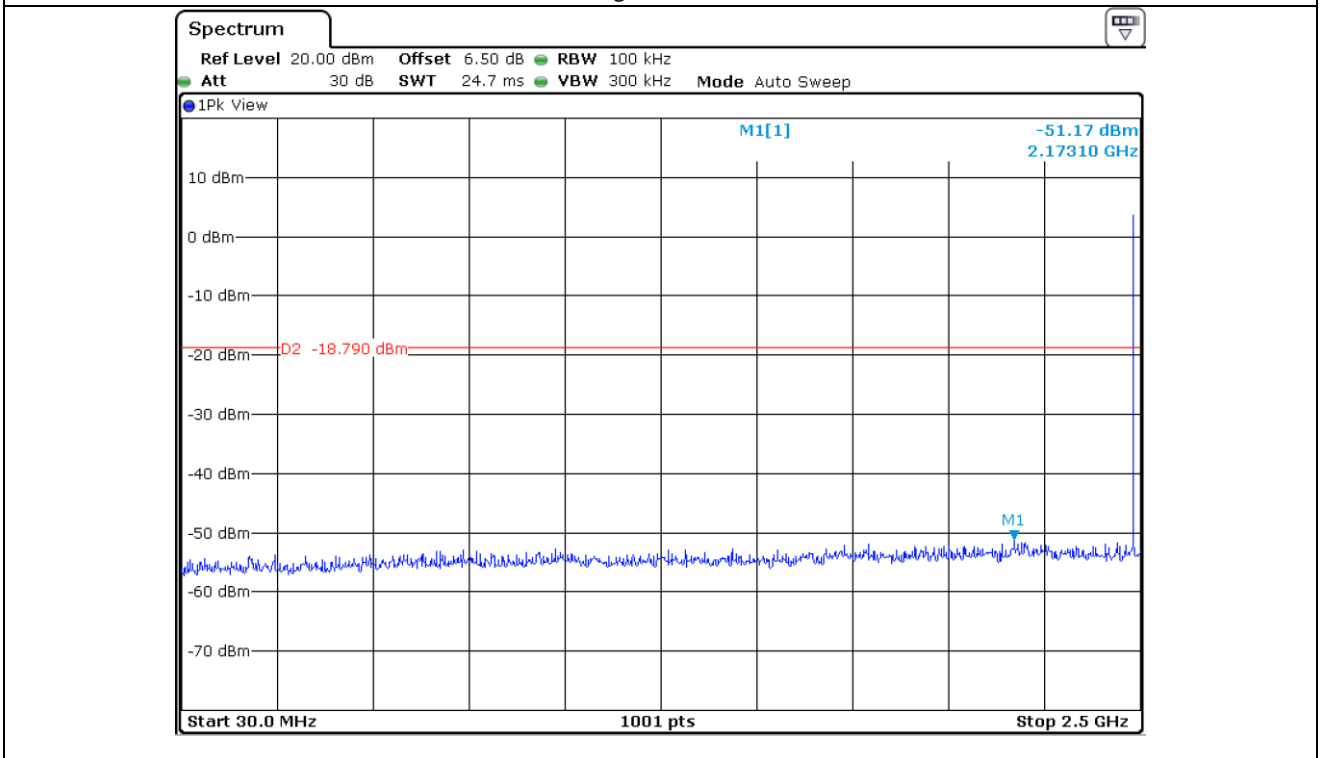


Middle Channel

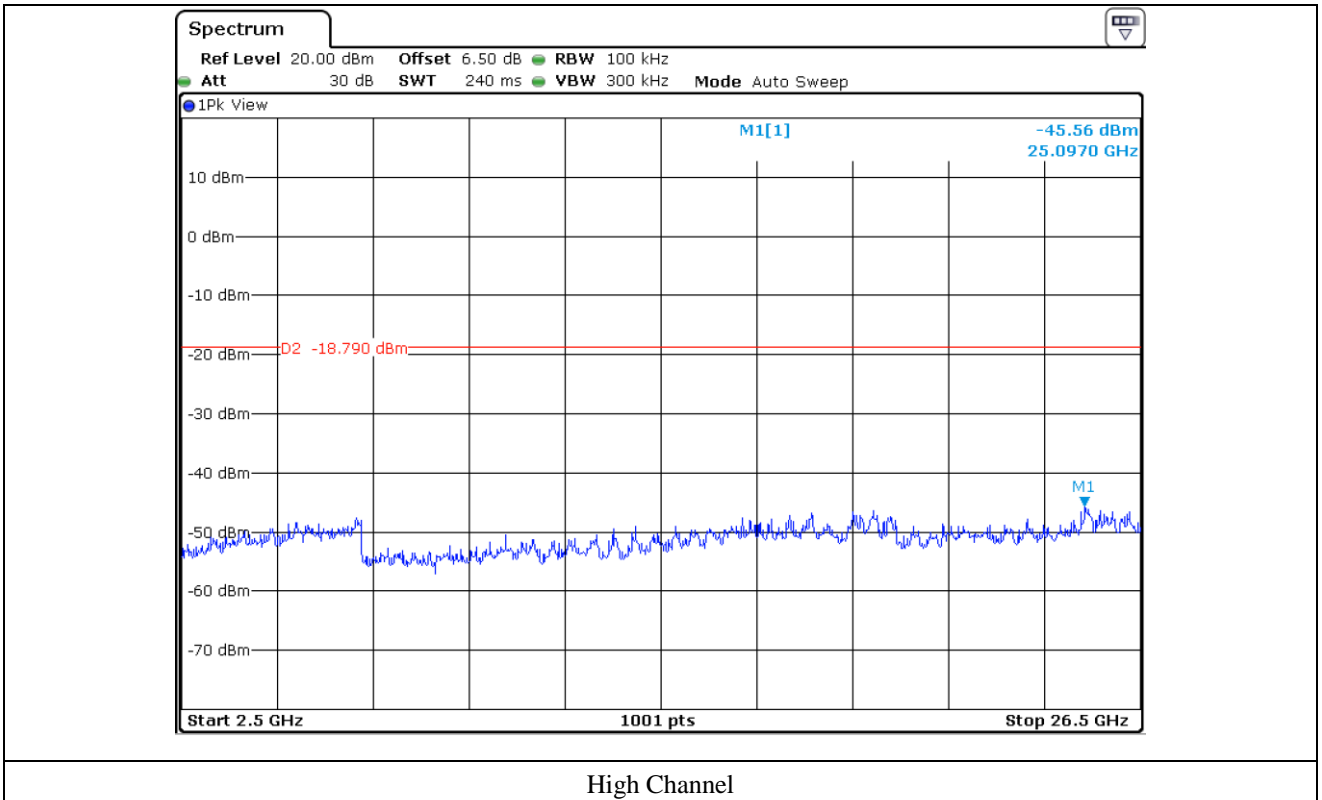




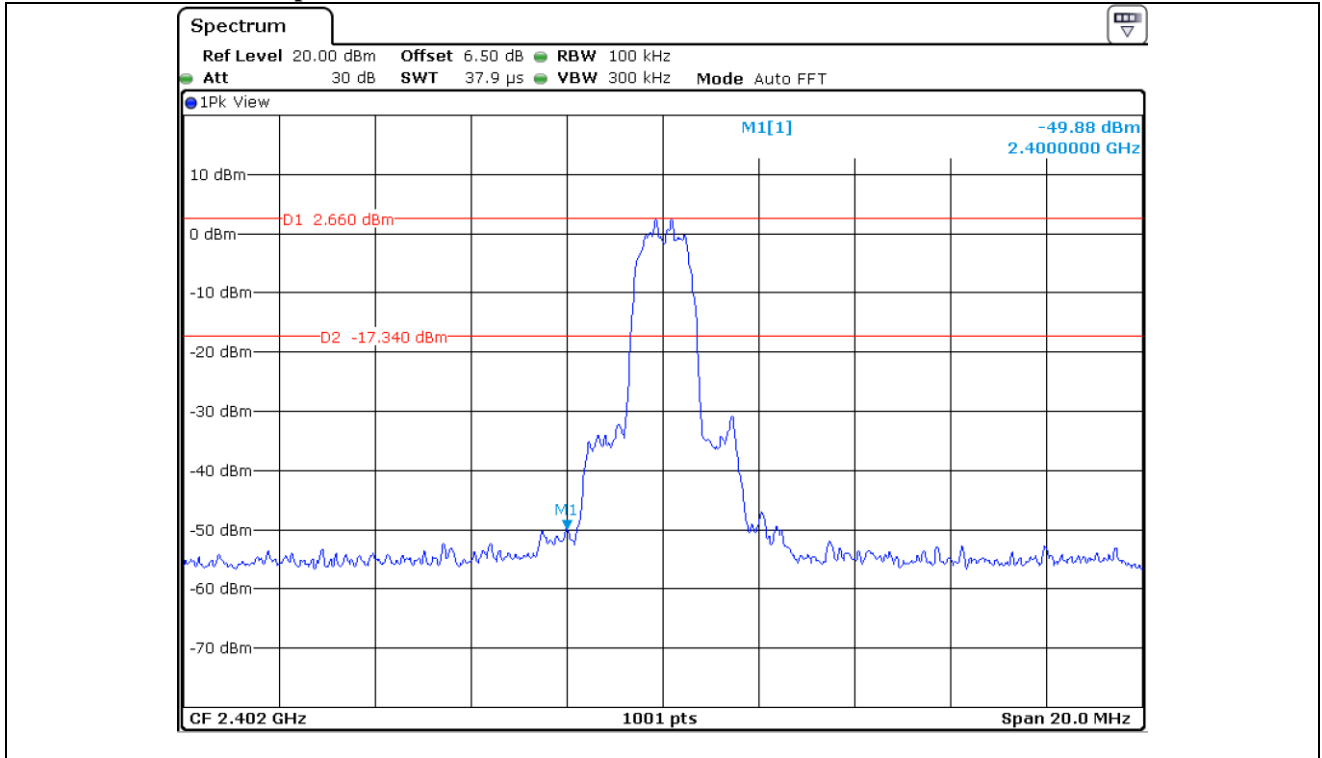
High Channel



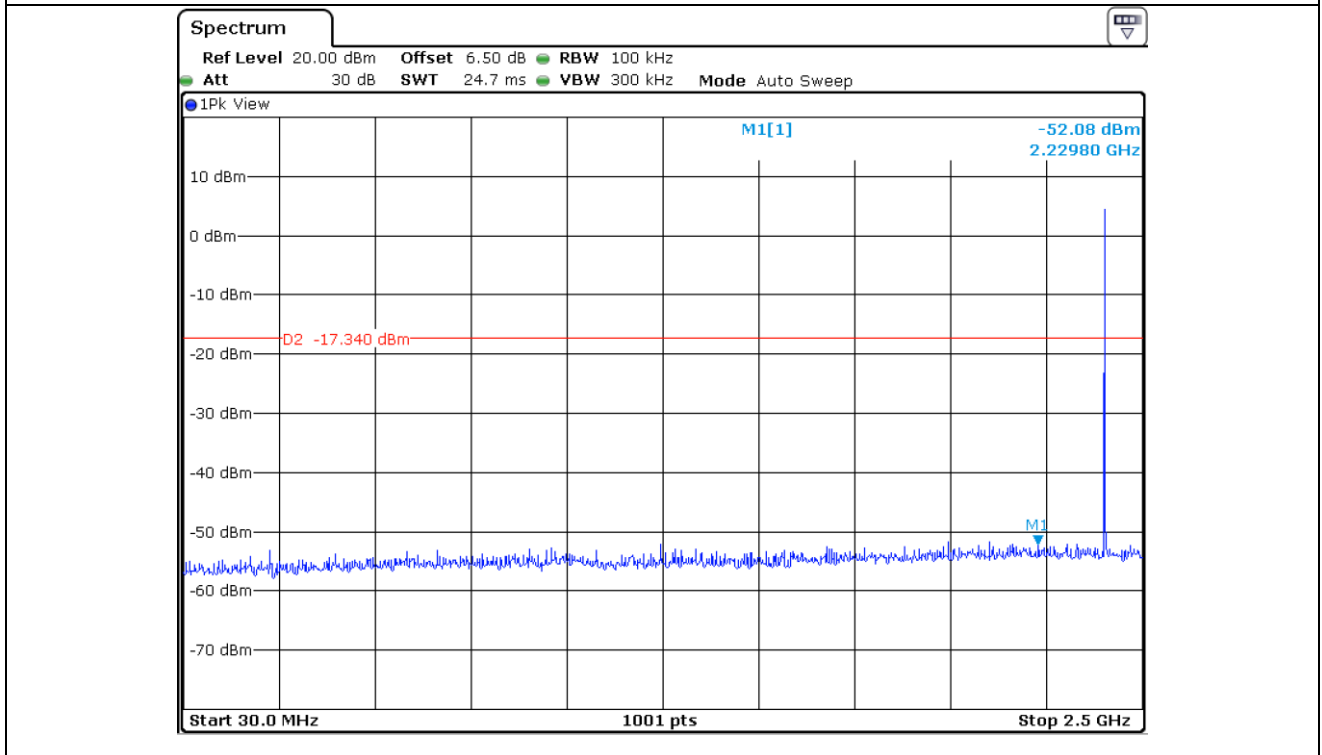
High Channel



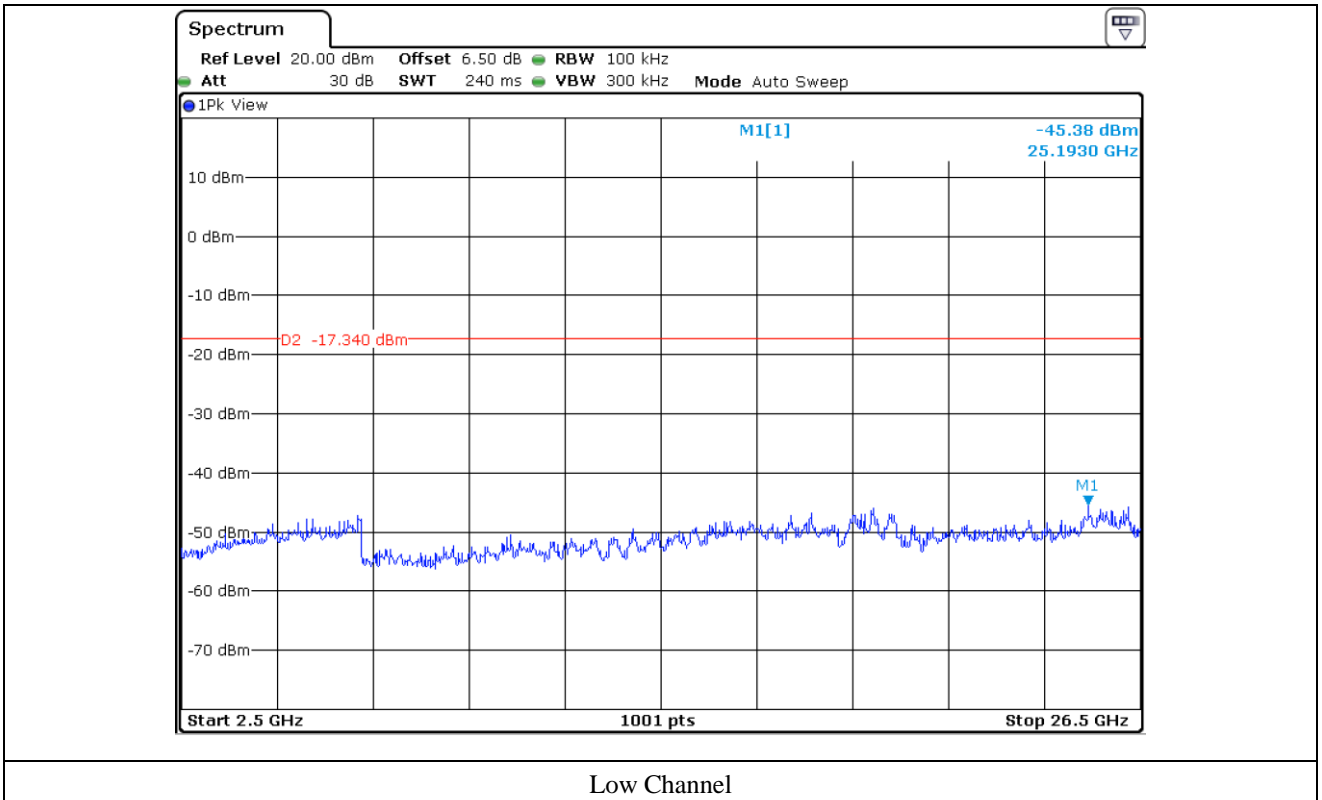
12.5.3 Test data for 3 Mbps

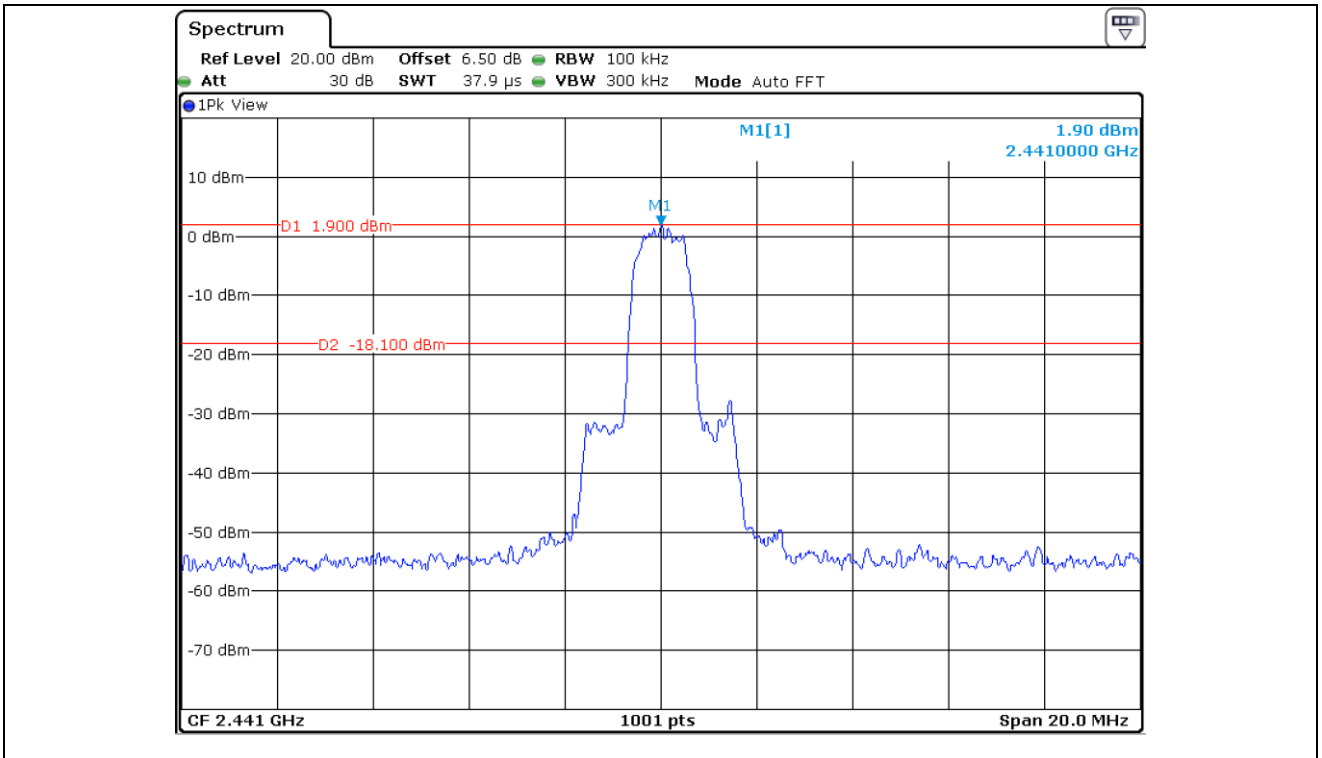


Low Channel

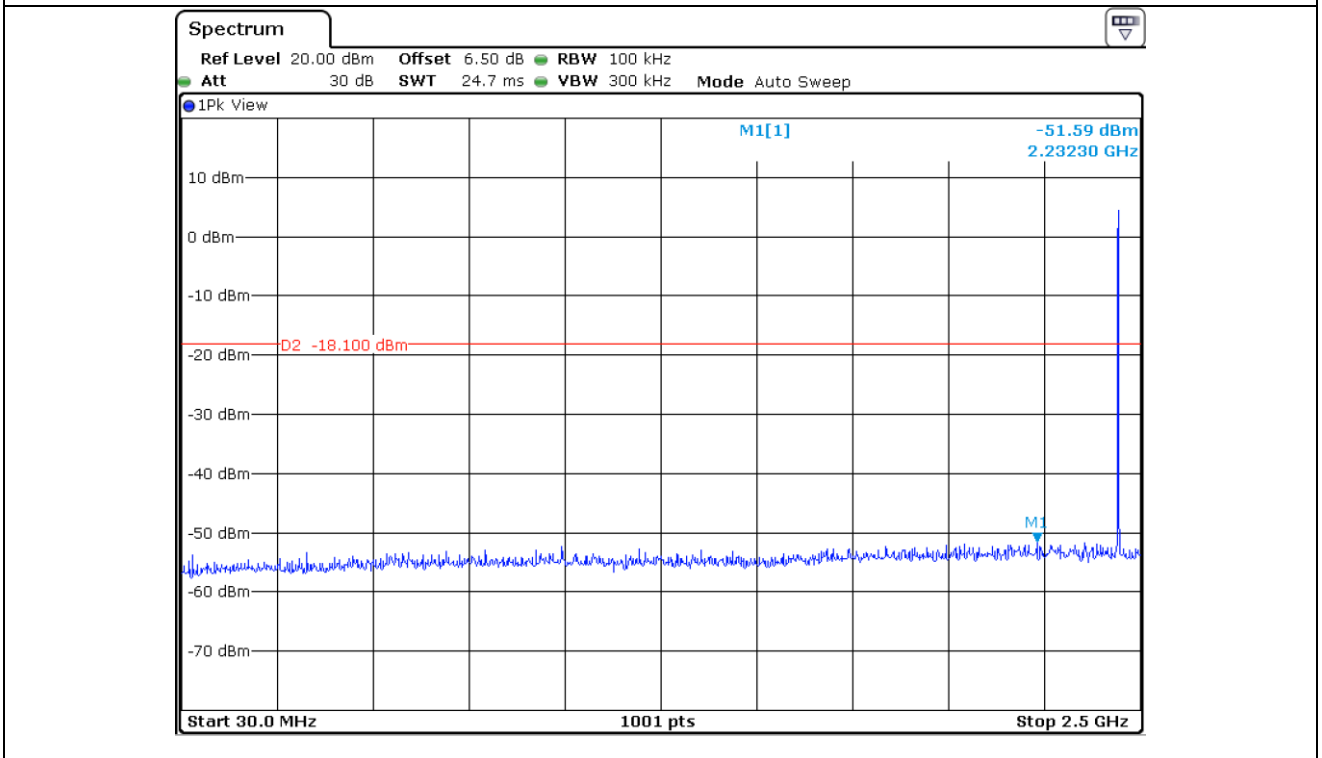


Low Channel

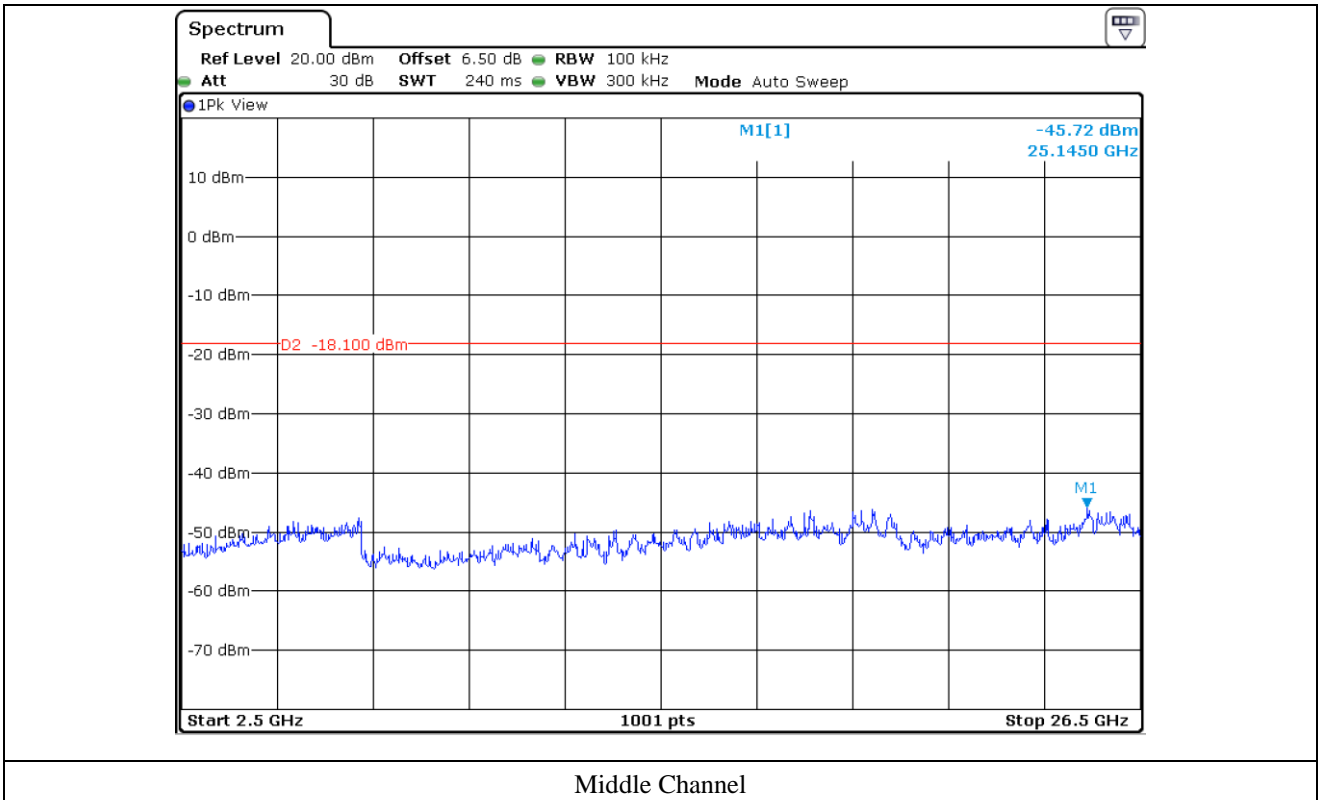


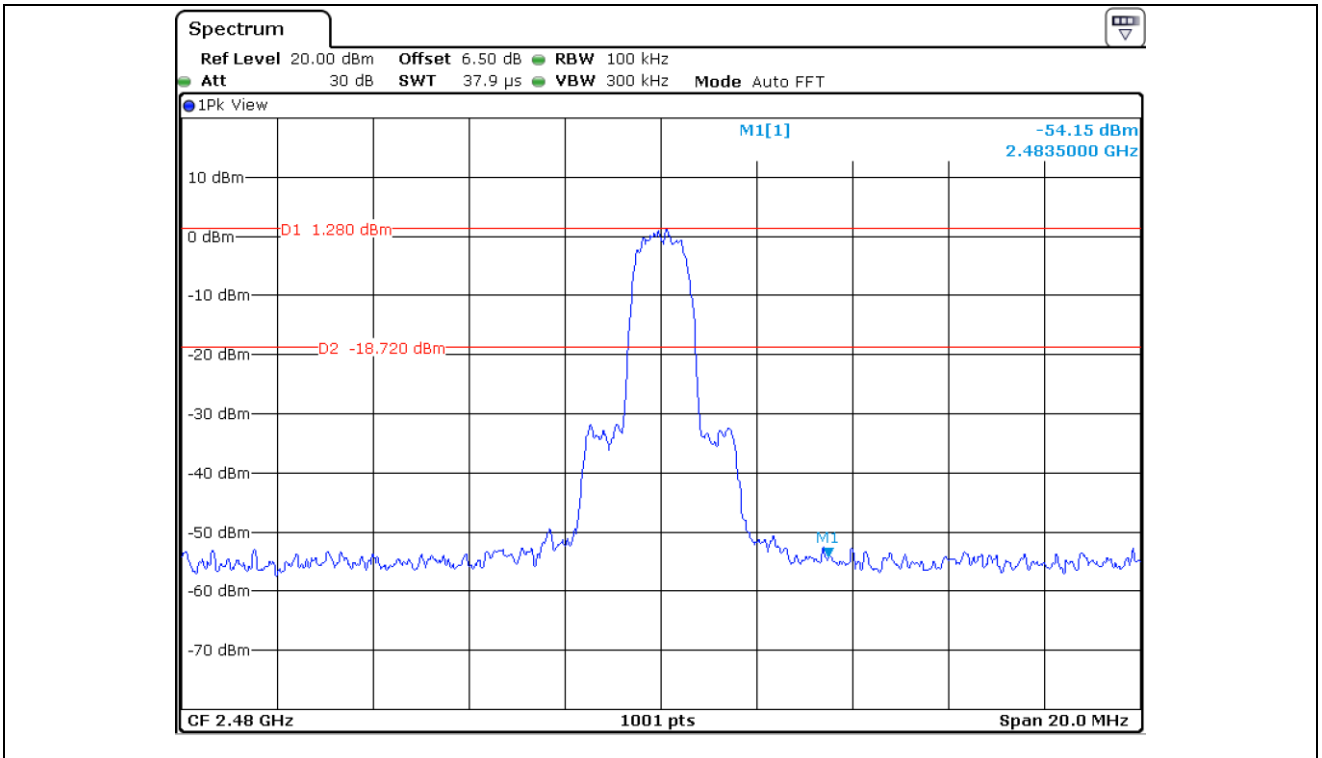


Middle Channel

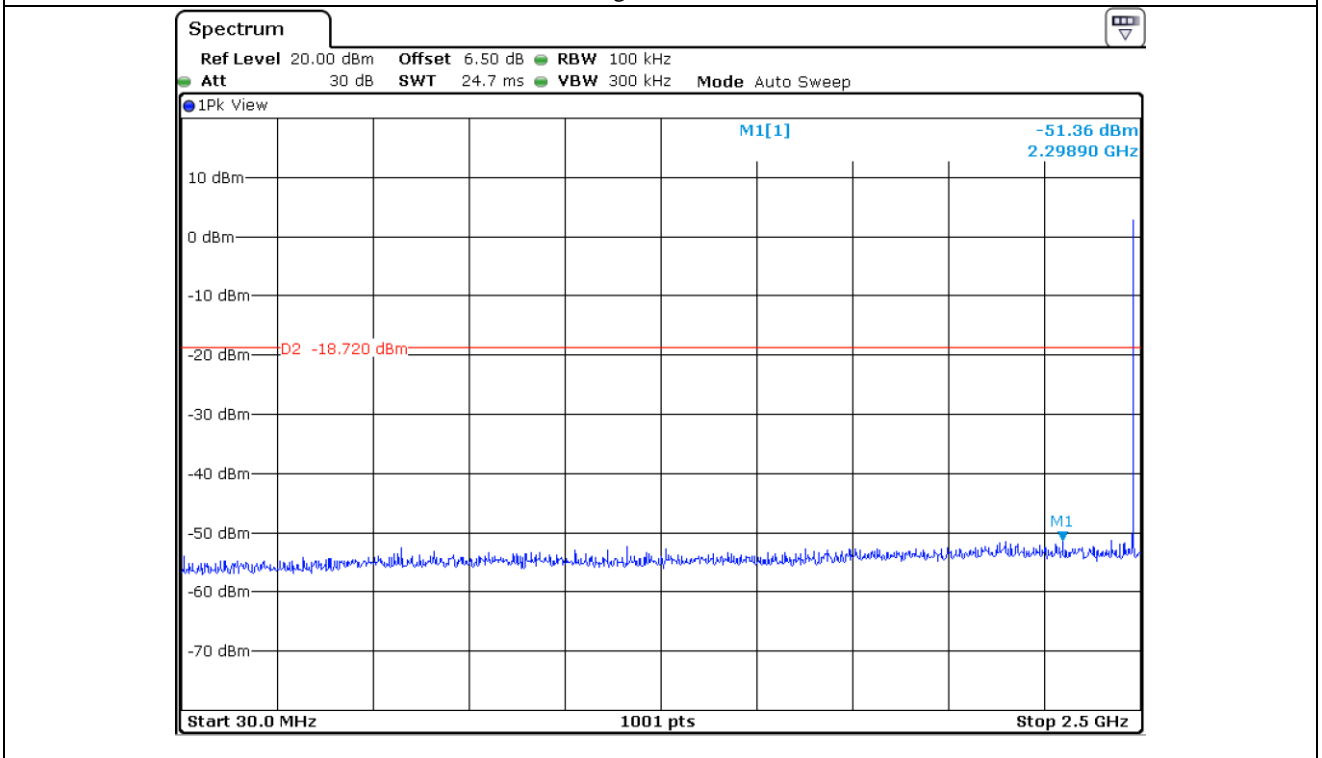


Middle Channel

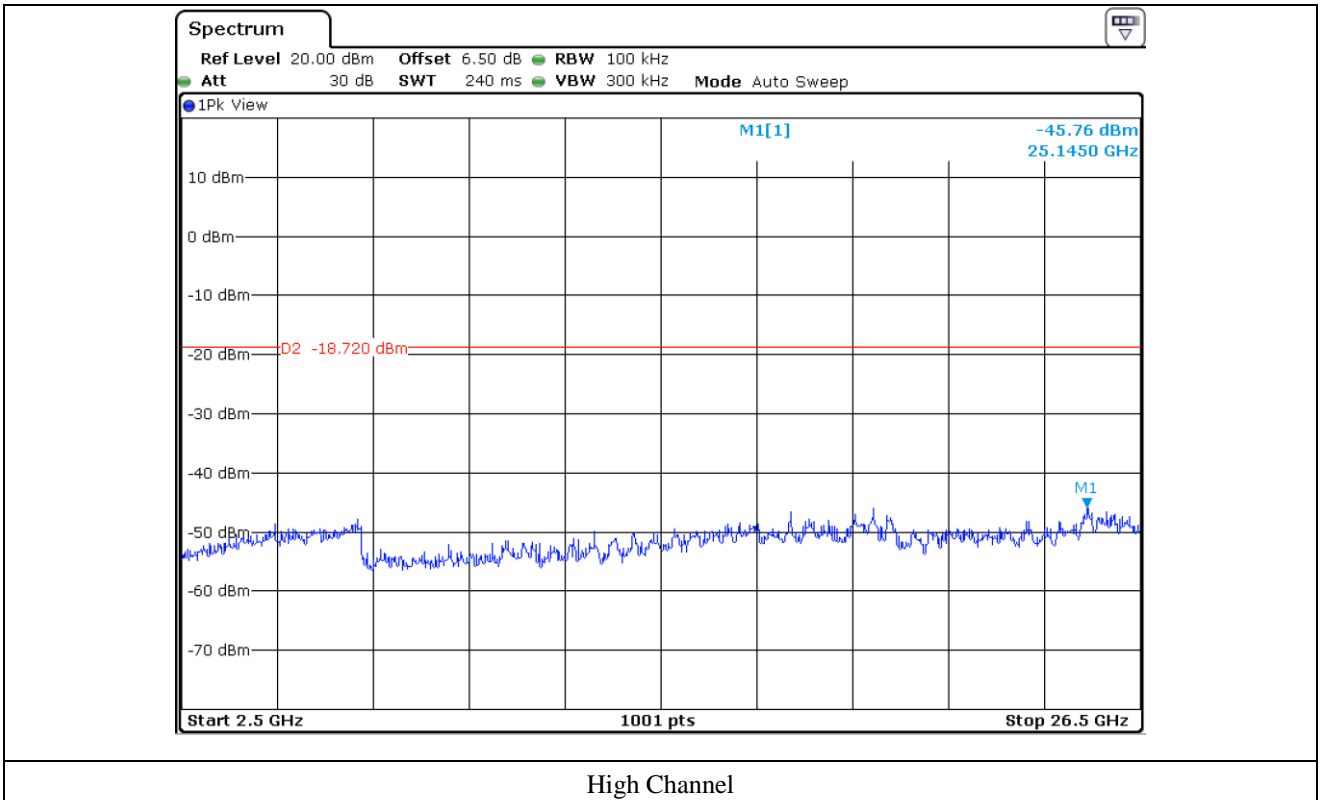




High Channel



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 : May 07, 2019
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Detector : Peak Mode(Peak), Average Mode(RMS)
- . Measurement distance : 3 m
- . Operating Condition : Highest Output Power Transmitting Mode(Low Channel and High Channel)
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 389.71	45.06	Peak	H	27.60	8.80	34.31	47.15	74.00	26.85
2 327.19	30.85	Average	H				32.94	54.00	21.06
2 372.23	43.34	Peak	V				45.43	74.00	28.57
2 358.57	31.40	Average	V				33.49	54.00	20.51
Test Data for High Channel									
2 484.87	43.10	Peak	H	27.80	8.80	34.40	45.30	74.00	28.70
2 497.24	30.66	Average	H				32.86	54.00	21.14
2 489.94	42.08	Peak	V				44.28	74.00	29.72
2 495.33	30.77	Average	V				32.97	54.00	21.03

Tabulated test data for Restricted Band

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



Tested by: Yu-Seog Sim / Assistant Manager

12.6.1.2 Test data for 2 Mbps

- Test Date : May 07, 2019
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Detector : Peak Mode(Peak), Average Mode(RMS)
- Measurement distance : 3 m
- Operating Condition : Highest Output Power Transmitting Mode(Low Channel and High Channel)
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 340.04	42.97	Peak	H	27.60	8.80	34.31	45.06	74.00	28.94
2 350.81	31.10	Average	H				33.19	54.00	20.81
2 326.96	44.07	Peak	V				46.16	74.00	27.84
2 359.61	31.19	Average	V				33.28	54.00	20.72
Test Data for High Channel									
2 487.26	42.99	Peak	H	27.80	8.80	34.40	45.19	74.00	28.81
2 483.89	30.86	Average	H				33.06	54.00	20.94
2 498.87	42.60	Peak	V				44.80	74.00	29.20
2 492.40	30.92	Average	V				33.12	54.00	20.88

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 : May 07, 2019
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Detector : Peak Mode(Peak), Average Mode(RMS)
- Measurement distance : 3 m
- Operating Condition : Highest Output Power Transmitting Mode(Low Channel and High Channel)
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 376.74	43.21	Peak	H	27.60	8.80	34.31	45.30	74.00	28.70
2 311.68	31.27	Average	H				33.36	54.00	20.64
2 374.66	42.99	Peak	V				45.08	74.00	28.92
2 358.45	30.78	Average	V				32.87	54.00	21.13
Test Data for High Channel									
2 483.82	42.89	Peak	H	27.80	8.80	34.40	45.09	74.00	28.91
2 483.51	31.23	Average	H				33.43	54.00	20.57
2 499.06	42.38	Peak	V				44.58	74.00	29.42
2 489.55	30.61	Average	V				32.81	54.00	21.19

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 : May 07, 2019
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Detector : Peak Mode(Peak), Average Mode(RMS)
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Operating Condition : Highest Output Power Transmitting Mode
- . Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 804.00	41.52	Peak	H	31.30	13.30	35.23	50.89	74.00	23.11
	28.85	Average	H				38.22	54.00	15.78
	41.48	Peak	V				50.85	74.00	23.15
	29.30	Average	V				38.67	54.00	15.33
Test Data for Middle Channel									
4 882.00	40.99	Peak	H	31.30	13.50	35.27	50.52	74.00	23.48
	27.96	Average	H				37.49	54.00	16.51
	40.91	Peak	V				50.44	74.00	23.56
	28.39	Average	V				37.92	54.00	16.08
Test Data for High Channel									
4 960.00	40.94	Peak	H	31.10	13.70	35.28	50.46	74.00	23.54
	28.36	Average	H				37.88	54.00	16.12
	39.97	Peak	V				49.49	74.00	24.51
	28.07	Average	V				37.59	54.00	16.41

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 : May 07, 2019
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Detector : Peak Mode(Peak), Average Mode(RMS)
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Operating Condition : Highest Output Power Transmitting Mode
- . Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 804.00	42.38	Peak	H	31.30	13.30	35.23	51.75	74.00	22.25
	28.93	Average	H				38.30	54.00	15.70
	41.87	Peak	V				51.24	74.00	22.76
	29.08	Average	V				38.45	54.00	15.55
Test Data for Middle Channel									
4 882.00	40.51	Peak	H	31.30	13.50	35.27	50.04	74.00	23.96
	27.95	Average	H				37.48	54.00	16.52
	40.65	Peak	V				50.18	74.00	23.82
	28.33	Average	V				37.86	54.00	16.14
Test Data for High Channel									
4 960.00	40.54	Peak	H	31.10	13.70	35.28	50.06	74.00	23.94
	28.14	Average	H				37.66	54.00	16.34
	40.40	Peak	V				49.92	74.00	24.08
	28.37	Average	V				37.89	54.00	16.11

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 : May 07, 2019
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Detector : Peak Mode(Peak), Average Mode(RMS)
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Operating Condition : Highest Output Power Transmitting Mode
- . Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 804.00	41.37	Peak	H	31.30	13.30	35.23	50.74	74.00	23.26
	28.97	Average	H				38.34	54.00	15.66
	41.63	Peak	V				51.00	74.00	23.00
	28.83	Average	V				38.20	54.00	15.80
Test Data for Middle Channel									
4 882.00	40.23	Peak	H	31.30	13.50	35.27	49.76	74.00	24.24
	28.21	Average	H				37.74	54.00	16.26
	40.77	Peak	V				50.30	74.00	23.70
	28.10	Average	V				37.63	54.00	16.37
Test Data for High Channel									
4 960.00	41.27	Peak	H	31.10	13.70	35.28	50.79	74.00	23.21
	28.43	Average	H				37.95	54.00	16.05
	40.32	Peak	V				49.84	74.00	24.16
	27.89	Average	V				37.41	54.00	16.59

Tabulated test data for Restricted Band

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



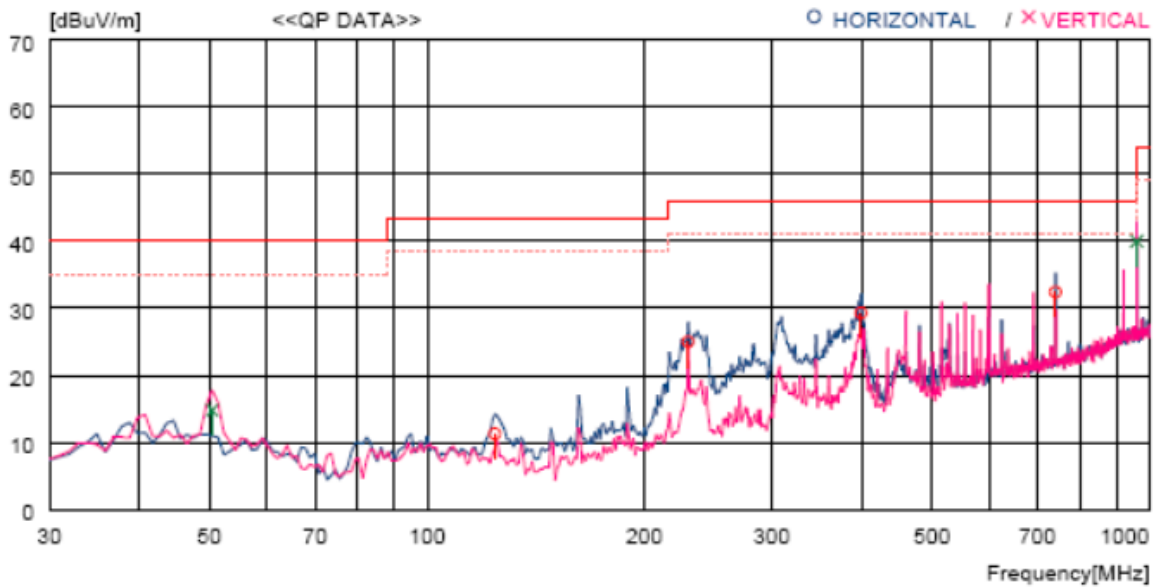
Tested by: Yu-Seog Sim / Assistant Manager

12.6.3 Spurious Radiated Emission

12.6.3.1 Test Data for 30 MHz ~ 1 GHz

Humidity Level : 50 % R.H. Temperature: 24 °C
 Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247
 Result : PASSED

EUT : Face Recognition Terminal Date: May 07, 2019
 Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)
 Operating mode : Transmitting mode (NFC & BT)



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	124.090	31.5	9.9	2.9	33.0	11.3	43.5	32.2	200	191
2	229.820	42.3	11.9	3.9	33.1	25.0	46.0	21.0	100	340
3	398.600	41.5	15.8	5.2	33.2	29.3	46.0	16.7	100	290
4	741.004	38.1	20.5	7.2	33.4	32.4	46.0	13.6	100	359
---- Vertical ----										
5	50.370	31.9	14.1	1.9	33.1	14.8	40.0	25.2	200	323
6	960.217	40.5	23.3	8.2	32.0	40.0	54.0	14.0	100	349

Tested by: Yu-Seog Sim / Assistant Manager

12.6.3.2 Test Data for Below 30 MHz

- . Test Date : May 07, 2019
- . Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- . Frequency range : 9 kHz ~ 30 MHz
- . Measurement distance : 3 m
- . Operating mode : Transmitting mode (NFC & BT)
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Not sufficient to state emissions were not detected, emissions detected were 20 dB below the limit								

12.6.3.3 Test Data for above 1 GHz

- . Test Date : May 07, 2019
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Operating mode : Transmitting mode (NFC & BT)
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Not sufficient to state emissions were not detected, emissions detected were 20 dB below the limit								



Tested by: Yu-Seog Sim / Assistant Manager

13. CONDUCTED EMISSION TEST

13.1 Operating environment

Temperature : 24 °C
 Relative humidity : 50 % R.H

13.2 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.

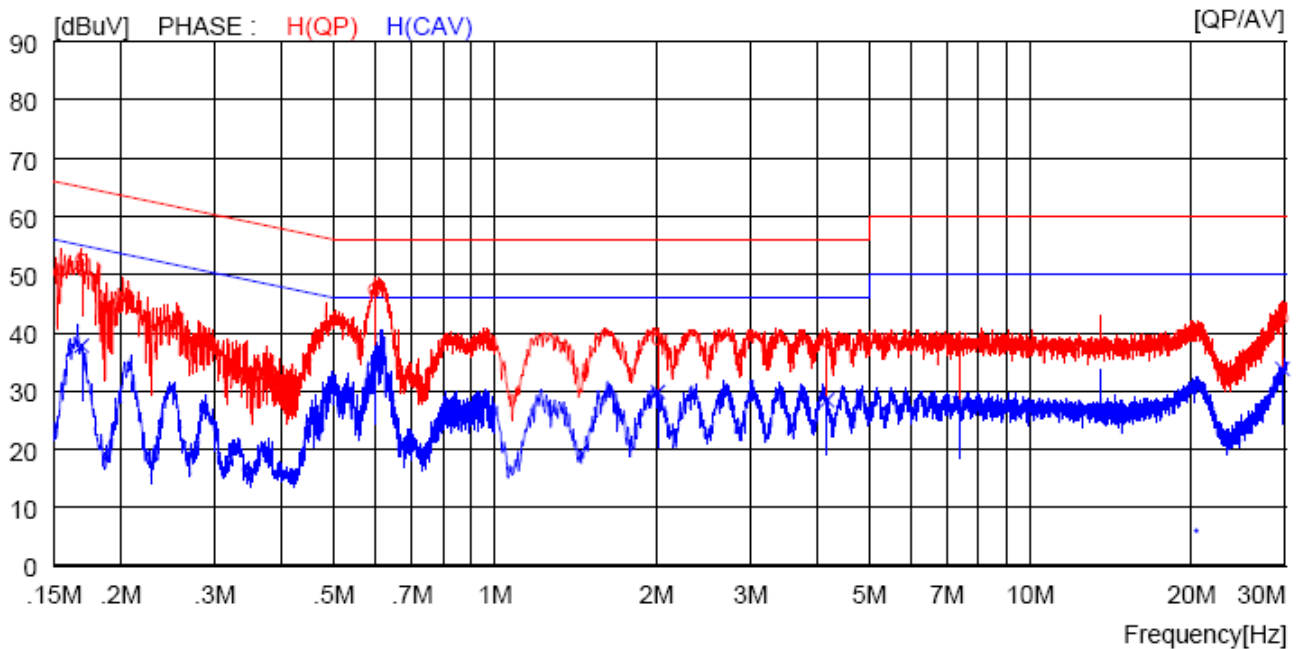
13.3 Test equipment used

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

All test equipment used is calibrated on a regular basis.

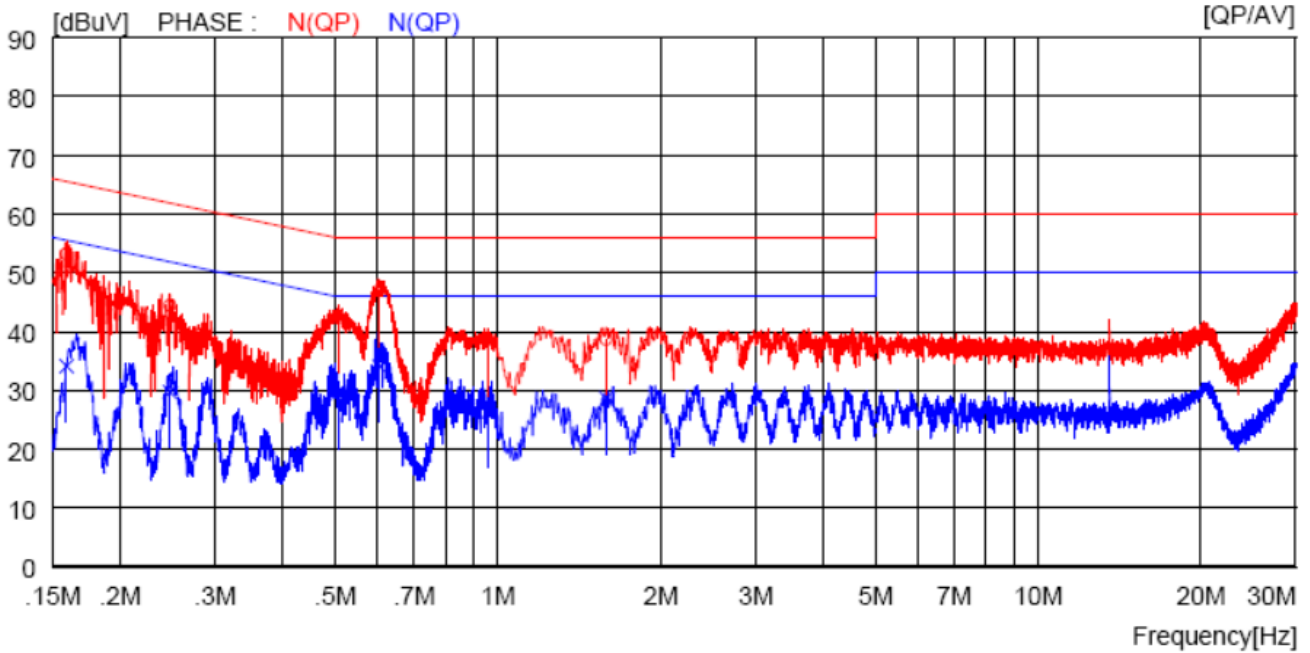
13.4 Test data

- Test Date : May 21, 2019
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Tested Line : HOT LINE



NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.16900	42.4	----	10.1	52.5	----	65.0	----	12.5	----	H (QP)
2	0.59500	37.3	----	10.1	47.4	----	56.0	----	8.6	----	H (QP)
3	2.01600	28.8	----	10.1	38.9	----	56.0	----	17.1	----	H (QP)
4	4.17200	28.6	----	10.1	38.7	----	56.0	----	17.3	----	H (QP)
5	7.39000	28.0	----	10.2	38.2	----	60.0	----	21.8	----	H (QP)
6	29.59000	31.9	----	10.6	42.5	----	60.0	----	17.5	----	H (QP)
7	0.16900	----	27.7	10.1	----	37.8	----	55.0	----	17.2	H (CAV)
8	0.59500	----	23.8	10.1	----	33.9	----	46.0	----	12.1	H (CAV)
9	2.01600	----	19.7	10.1	----	29.8	----	46.0	----	16.2	H (CAV)
10	4.17200	----	18.4	10.1	----	28.5	----	46.0	----	17.5	H (CAV)
11	7.39000	----	17.7	10.2	----	27.9	----	50.0	----	22.1	H (CAV)
12	29.59000	----	23.2	10.6	----	33.8	----	50.0	----	16.2	H (CAV)

- Test 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	0.15900	43.1	----	10.1	53.2	----	65.5	----	12.3	----	N(QP)
2	0.24700	34.3	----	10.1	44.4	----	61.9	----	17.5	----	N(QP)
3	0.50600	32.3	----	10.1	42.4	----	56.0	----	13.6	----	N(QP)
4	0.60300	36.9	----	10.1	47.0	----	56.0	----	9.0	----	N(QP)
5	0.96100	28.5	----	10.1	38.6	----	56.0	----	17.4	----	N(QP)
6	1.58800	28.6	----	10.1	38.7	----	56.0	----	17.3	----	N(QP)
7	0.15900	----	24.1	10.1	----	34.2	----	55.5	----	21.3	N(CAV)
8	0.24700	----	19.6	10.1	----	29.7	----	51.9	----	22.2	N(CAV)
9	0.50600	----	19.5	10.1	----	29.6	----	46.0	----	16.4	N(CAV)
10	0.60300	----	24.0	10.1	----	34.1	----	46.0	----	11.9	N(CAV)
11	0.96100	----	16.3	10.1	----	26.4	----	46.0	----	19.6	N(CAV)
12	1.58800	----	18.5	10.1	----	28.6	----	46.0	----	17.4	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