

RADIO PERFORMANCE TEST REPORT

Test Report No. : OT-21D-RWD-025

Reception No. : 2110004403

Applicant : CERAGEM CO., LTD.

Address : 10, Jeongja-1-gil, Seonggeo-eup, Seobuk-gu, Cheonan-si, Chungcheongnam-do,
Republic of Korea

Manufacturer : CERAGEM CO., LTD.

Address : 10, Jeongja-1-gil, Seonggeo-eup, Seobuk-gu, Cheonan-si, Chungcheongnam-do,
Republic of Korea

Type of Equipment : Bluetooth module

FCC ID. : 2A3VY-SQ310

Model Name : SQ310

Serial number : N/A

Total page of Report : 79 pages (including this page)

Date of Incoming : November 11, 2021

Date of issue : December 13, 2021

SUMMARY

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

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

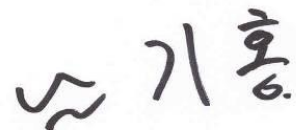
It is not a generally valid assessment of the features of the respective products of the mass-production.



Tested by
Ju Yun Park / Manager
ONETECH Corp.



Reviewed by
Tae-Ho, Kim / Senior Manager
ONETECH Corp.



Approved by
Ki-Hong, Nam / General Manager
ONETECH Corp.

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-21D-RWD-025	December 13, 2021	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : CERAGEM CO., LTD.

Address : 10, Jeongja-1-gil, Seonggeo-eup, Seobuk-gu, Cheonan-si, Chungcheongnam-do, Republic of Korea

Contact Person : HYEONGGEUN HWANG / Manager

Telephone No. : 041-529-4359

FCC ID : 2A3VY-SQ310

Model Name : SQ310

Brand Name : N/A

Serial Number : N/A

Date : December 13, 2021

EQUIPMENT CLASS	DSS – PART 15 SPREAD SPECTRUM TRANSMITTER
E.U.T. DESCRIPTION	Bluetooth module
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2020
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247 KDB 558074 D01 15.247 Meas Guidance v05r02
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m, Semi Anechoic Chamber

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

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 requirement / 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: 2020. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

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

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

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-20122/ C-14617/ G-10666/ T-11842

ISED (Innovation, Science and Economic Development Canada) – Registration No. Site# 3736A-3

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

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

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3. GENERAL INFORMATION

3.1 Product Description

The CERAGEM CO., LTD., Model SQ310 (referred to as the EUT in this report) is a Bluetooth module. The product specification described herein was obtained from product data sheet or user's manual.

Device Type	Bluetooth module	
Temperature Range	-20 °C ~ 70 °C	
Operating Frequency	2 402 MHz ~ 2 480 MHz	
MAX. RF OUTPUT POWER	1 Mbps	6.93 dBm
	2 Mbps	5.59 dBm
	3 Mbps	5.64 dBm
Number of Channel	79 Channels	
Modulation Type	GFSK for 1 Mbps, $\pi/4$ -DQPSK for 2 Mbps, 8-DPSK for 3 Mbps	
Antenna Type	PCB Antenna	
Antenna Gain	2.25 dBi	
List of each Osc. or crystal Freq.(Freq. $\geq$ 1 MHz)	26 MHz	
Rated Supply Voltage	DC 5.0 V	

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	CERAGEM CO., LTD.	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
SQ310	CERAGEM CO., LTD.	Bluetooth module (EUT)	-
HP Probook	HP	Notebook PC	EUT
PPP009L-E	LIE-ON TECHNOLOGY (CHANGZHOU)CO.,LTD.	AC Adapter	Notebook PC

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 “XY” axis, but the worst data was recorded in this report.

-. Frequency / Channel Operations

Channel	Frequency
0	2 402
39	2 441
78	2 480

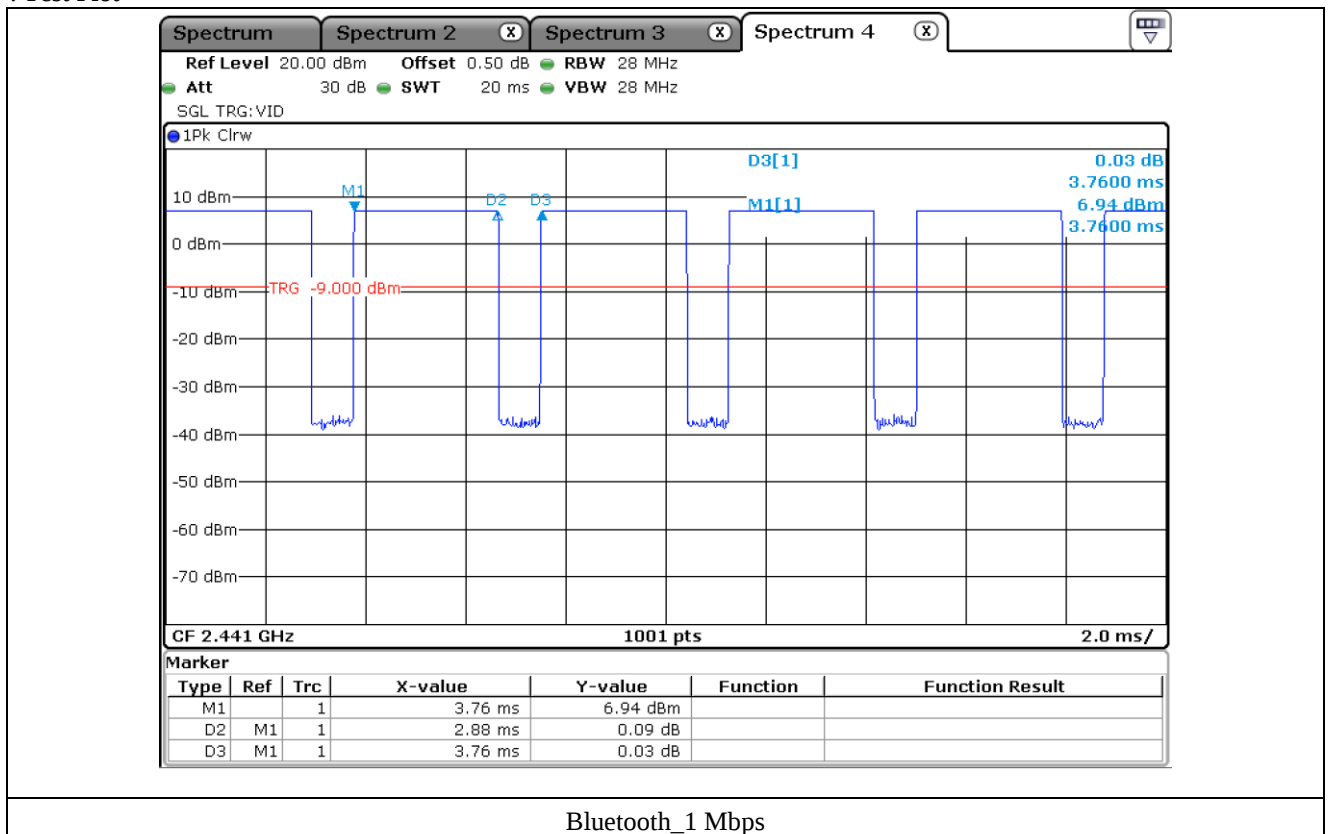
-. Duty Cycle

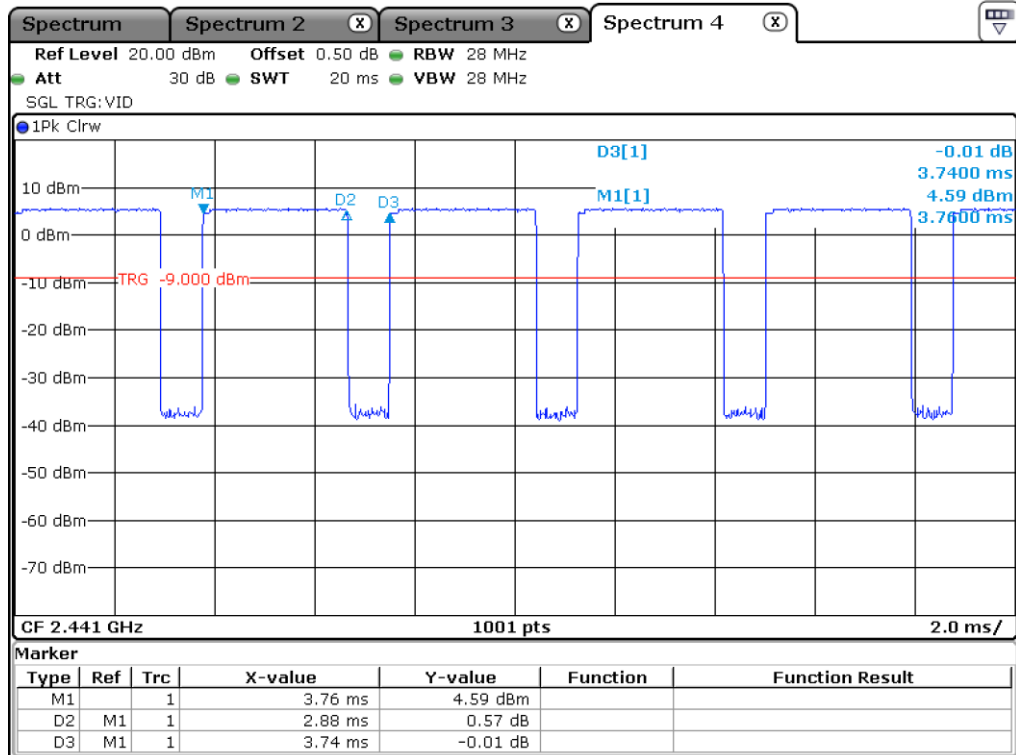
Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
Bluetooth [1 Mbps]	2.88	0.88	76.60	1.16
Bluetooth [2 Mbps]	2.88	0.86	77.01	1.13
Bluetooth [3 Mbps]	2.90	0.86	77.13	1.13

Note – Duty Cycle : (Tx On Time / (Tx On Time + Tx Off Time)) * 100

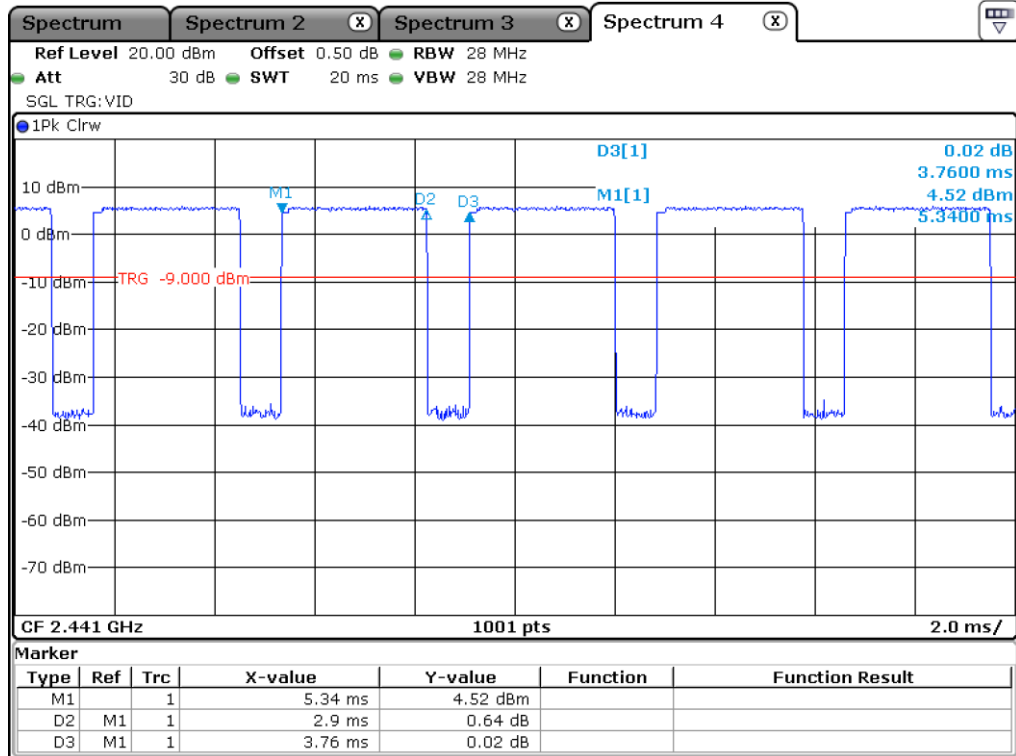
Correction Factor : 10 * Log(1 / (Duty Cycle / 100))

-. Test Plot





Bluetooth_2 Mbps



Bluetooth_3 Mbps

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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: 2020 to determine the worse operating conditions.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2020 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 PCB Antenna of the EUT is located on 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

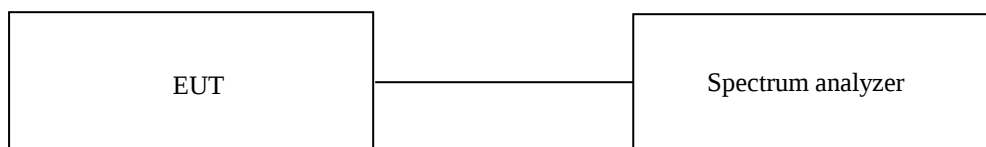
7. MINIMUM 20 dB BANDWIDTH

7.1 Operating environment

Temperature : 22 °C
Relative humidity : 46 % 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 20 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.



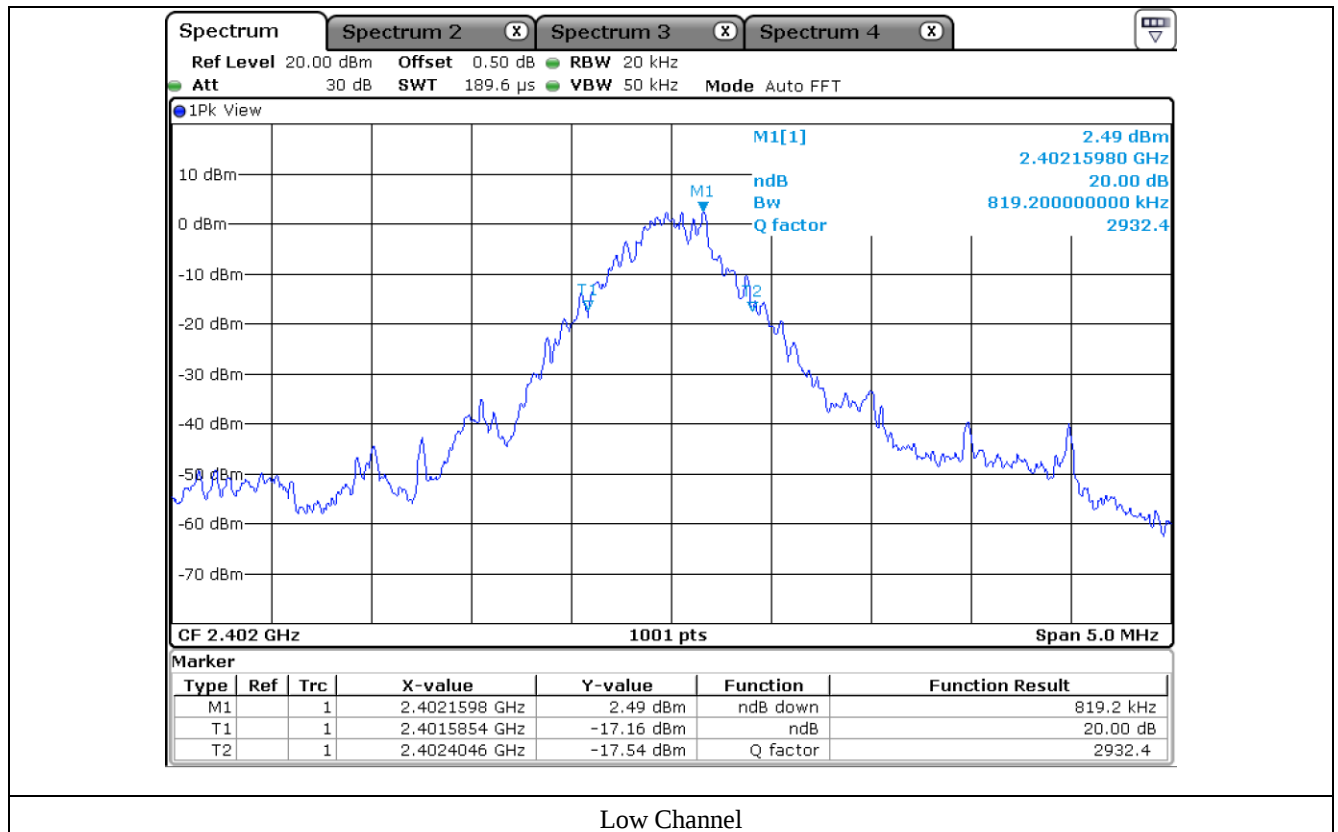
7.3 Test Date

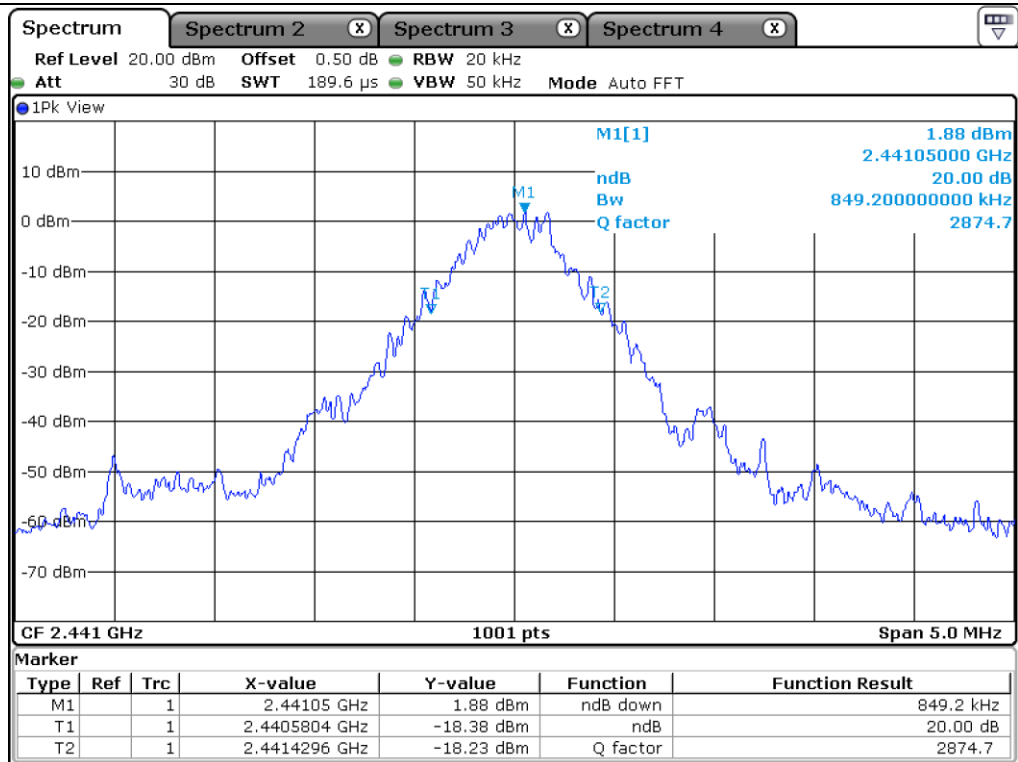
December 07, 2021 ~ December 09, 2021

7.4 Test Data

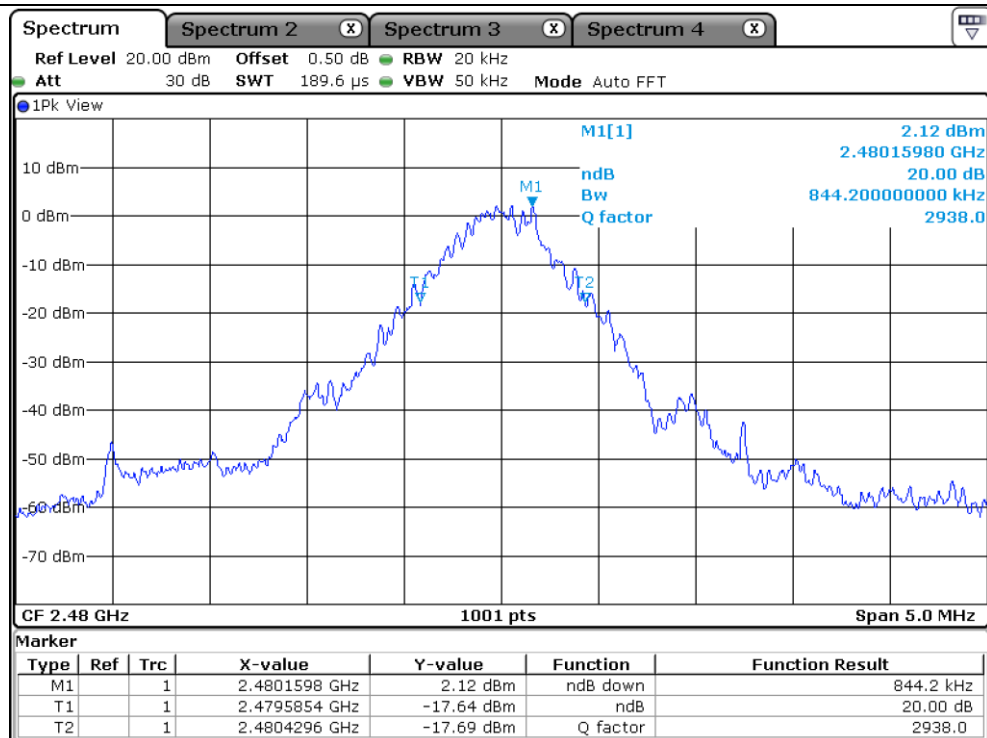
7.4.1 Test data for 1 Mbps

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)
Low	2 402.00	819.20
Middle	2 441.00	849.20
High	2 480.00	844.20





Middle Channel



High Channel

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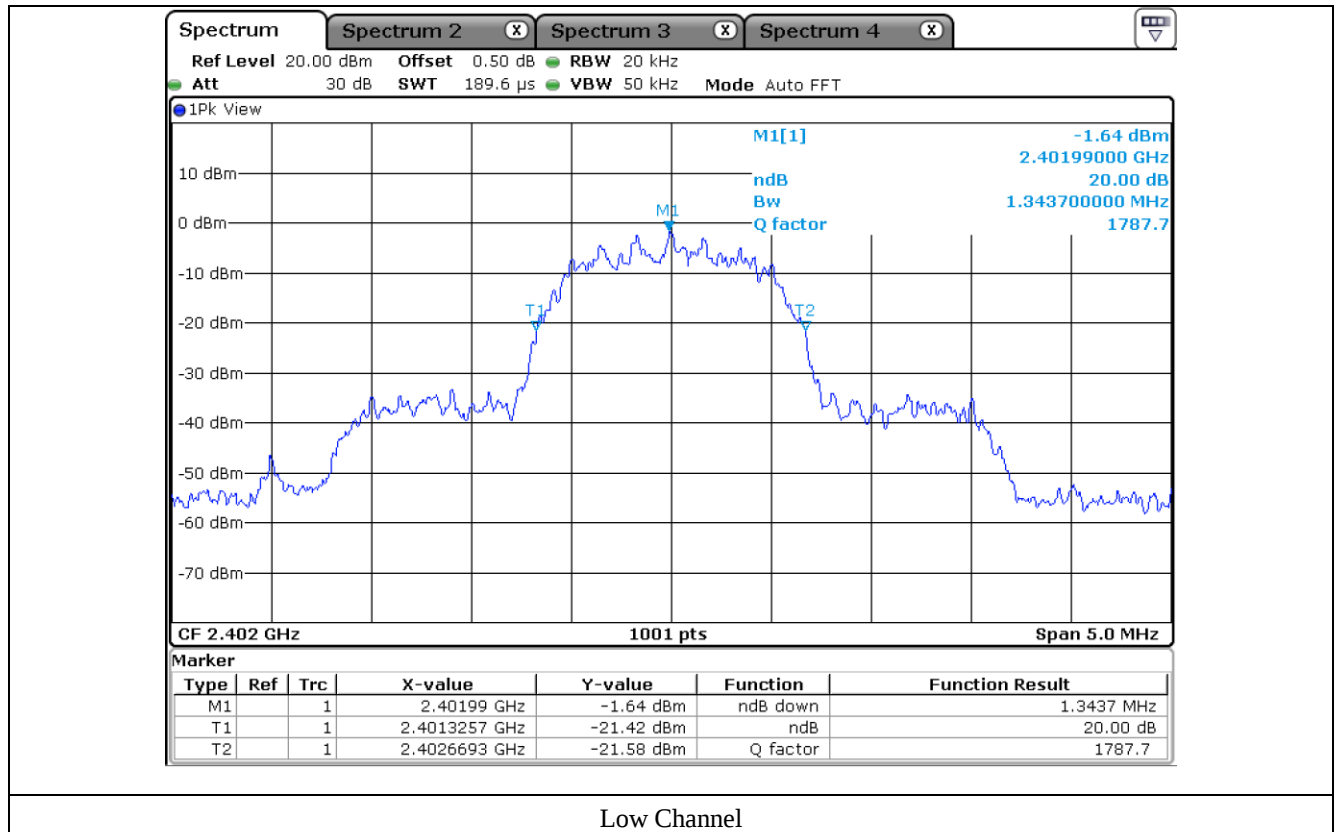
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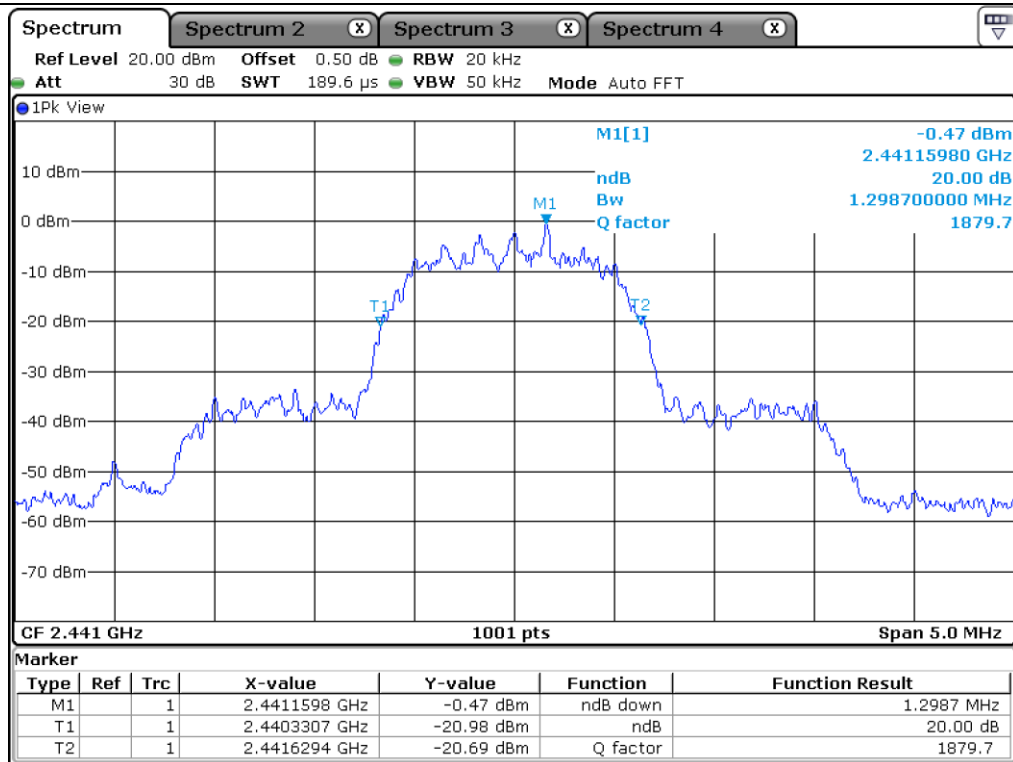
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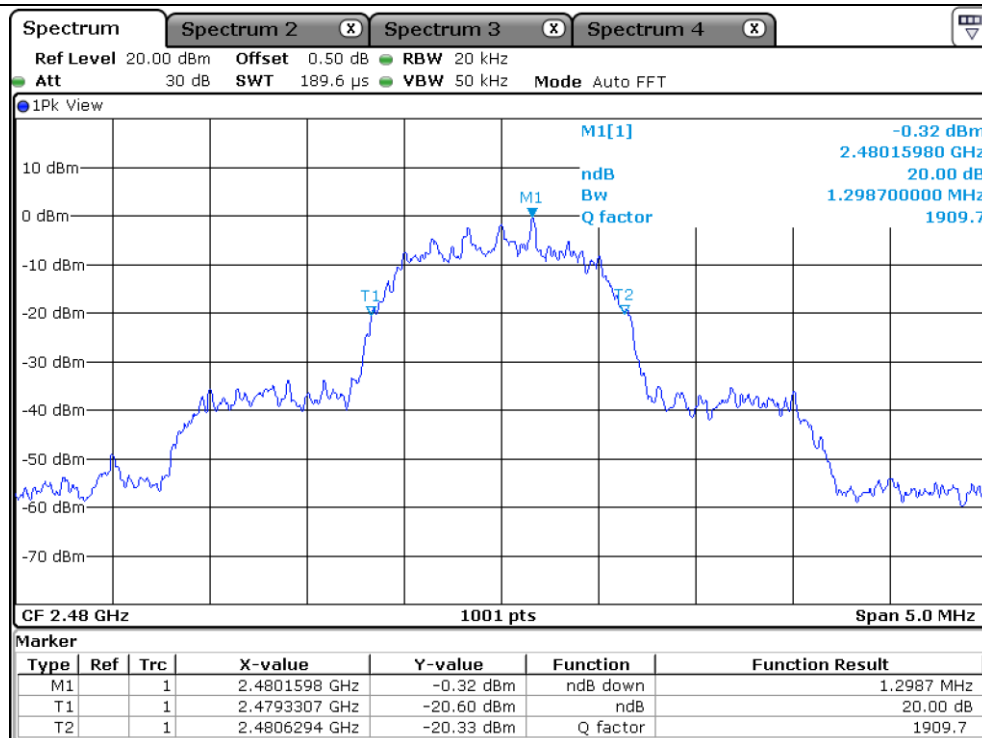
7.4.2 Test data for 2 Mbps

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)
Low	2 402.00	1 343.70
Middle	2 441.00	1 298.70
High	2 480.00	1 298.70





Middle Channel



High Channel

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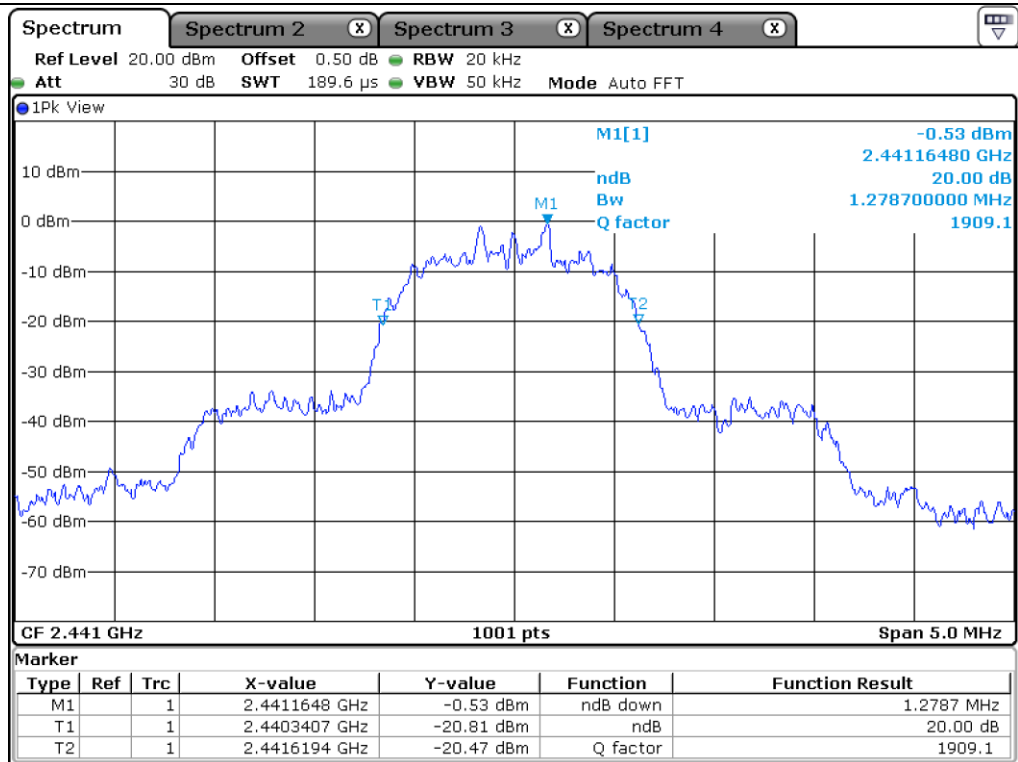
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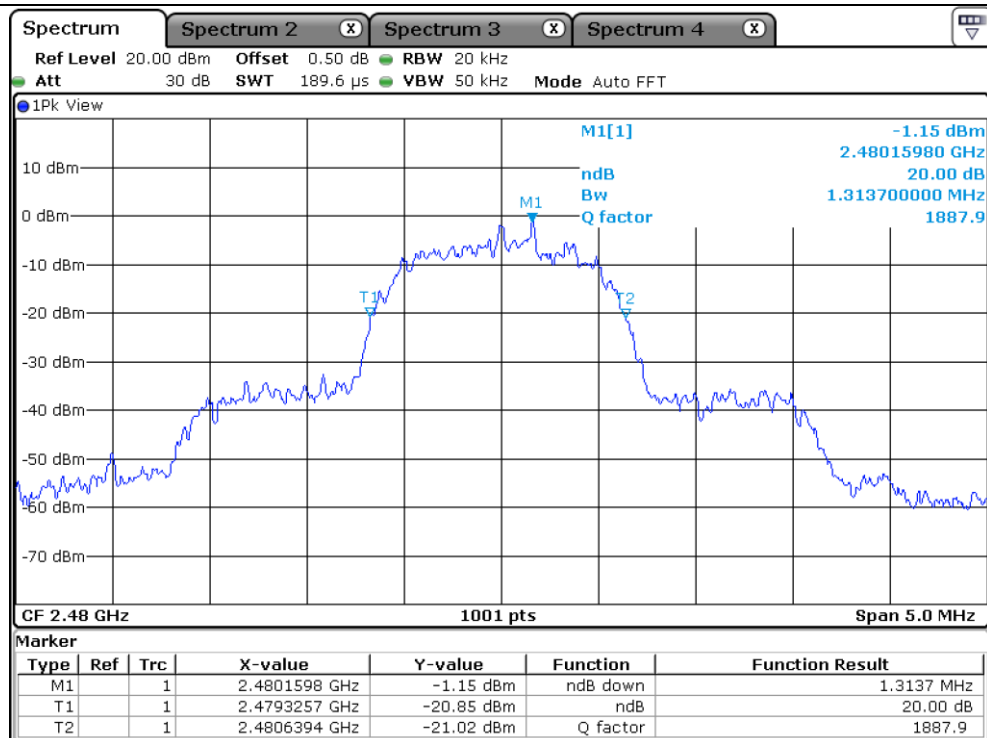
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Channel	Frequency (MHz)	20 dB Bandwidth (kHz)
Low	2 402.00	1 333.70
Middle	2 441.00	1 278.70
High	2 480.00	1 313.70





Middle Channel



High Channel

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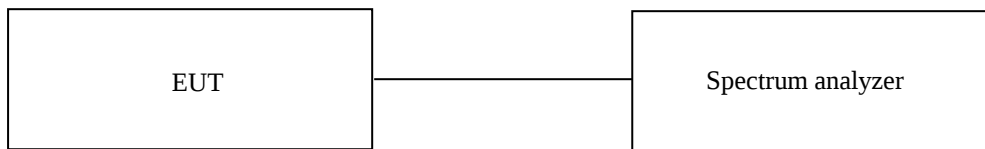
8. HOPPING FREQUENCY SEPARATION

8.1 Operating environment

Temperature : 22 °C
Relative humidity : 46 % 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 5 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 Date

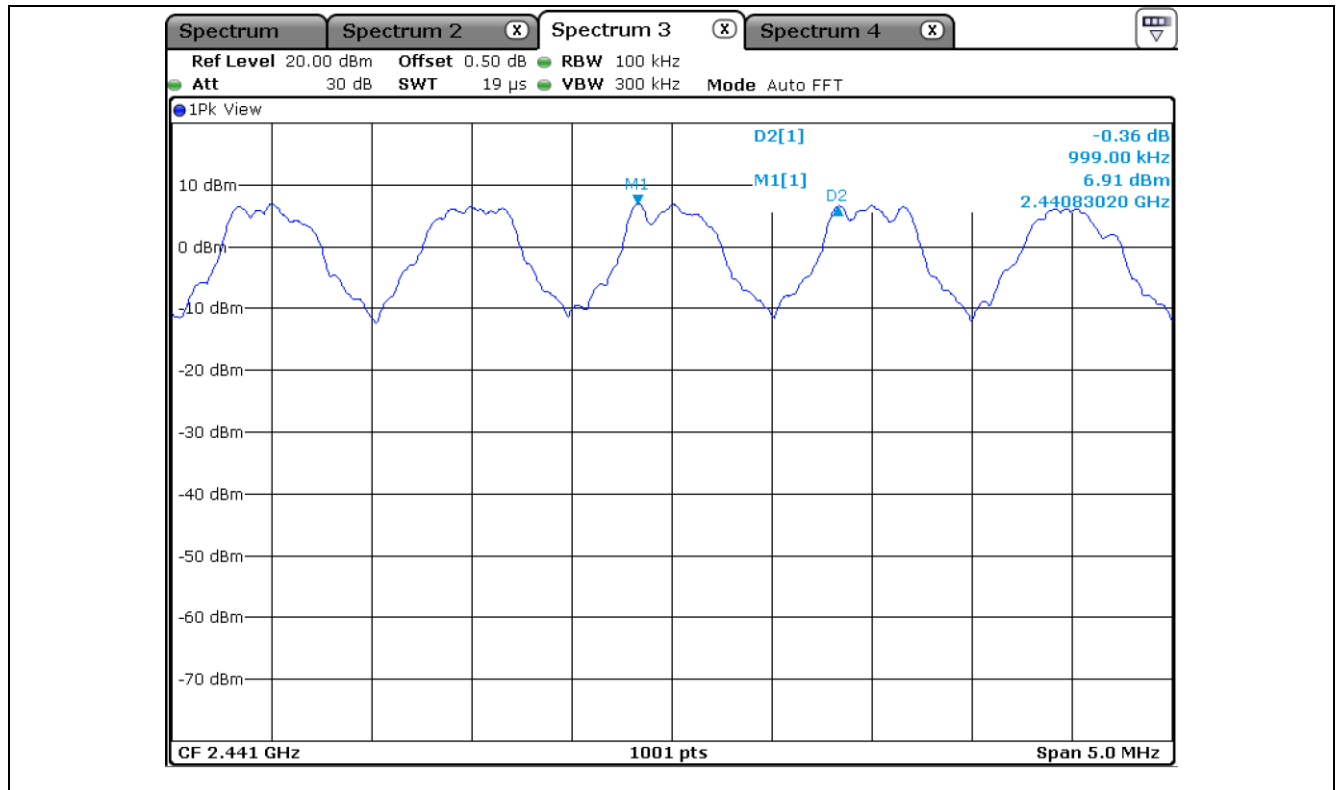
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8.4 Test Data

8.4.1 Test data for 1 Mbps

-. Test Result : Pass

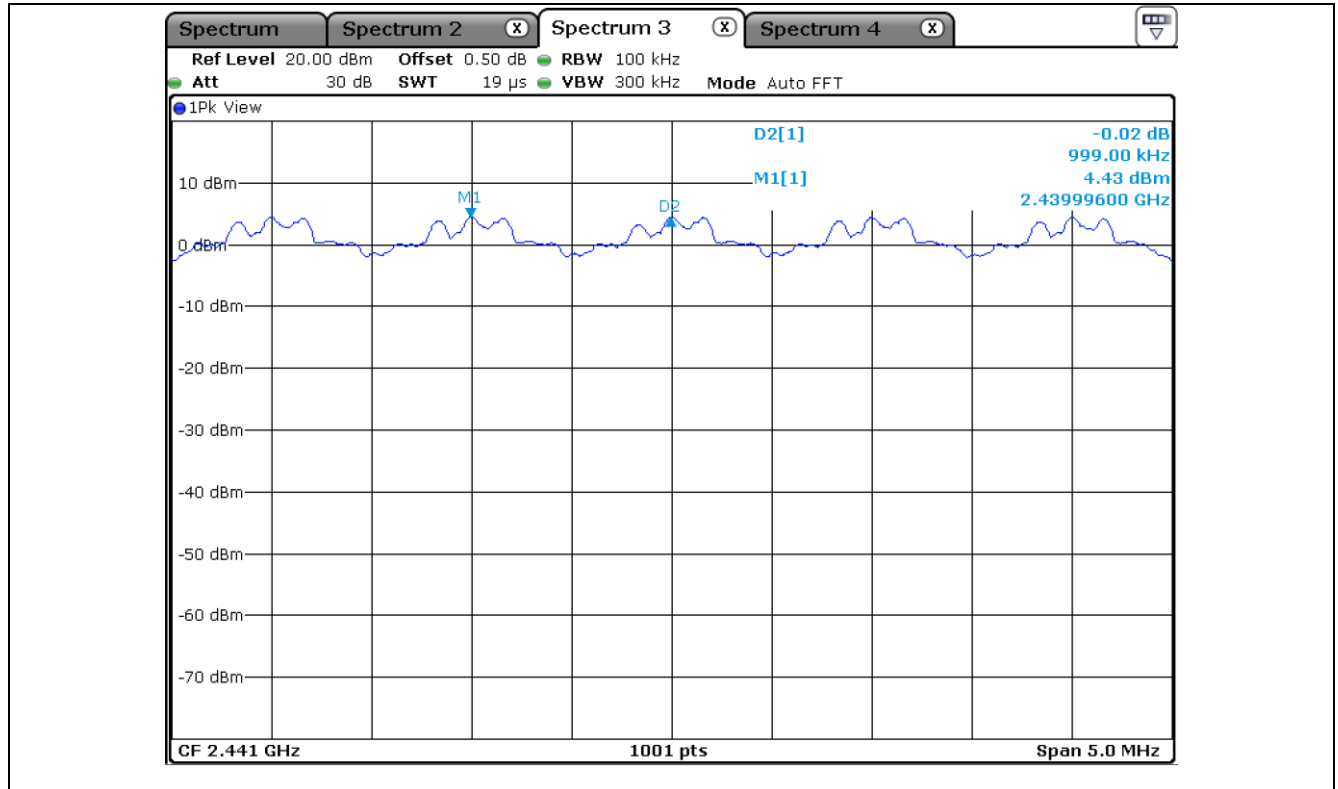
Measured Value (kHz)	Two-third of 20 dB Bandwidth (kHz)	Limit
999.00	566.13	Separated by a minimum of 566.13 kHz



8.4.2 Test data for 2 Mbps

-. Test Result : Pass

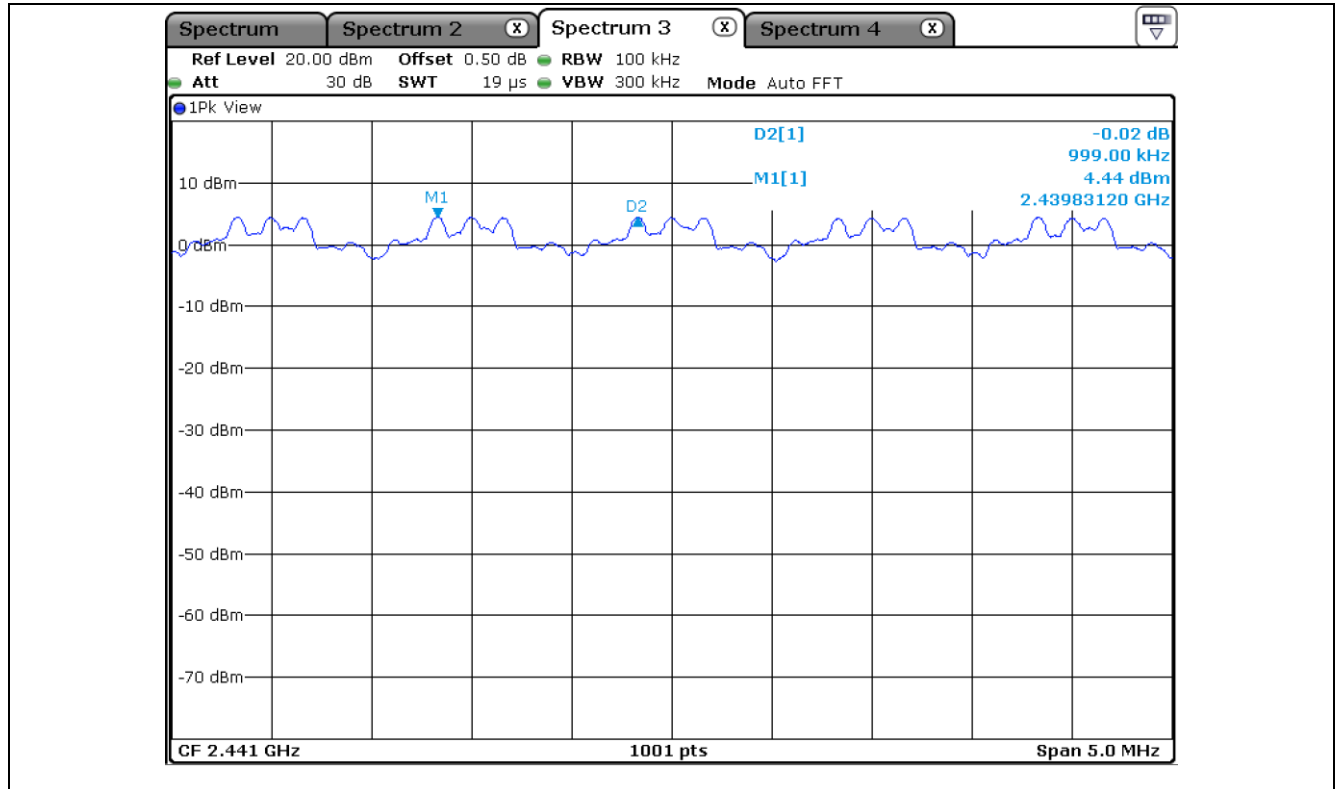
Measured Value (kHz)	Two-third of 20 dB Bandwidth (kHz)	Limit
999.00	865.80	Separated by a minimum of 865.80 kHz



8.4.3 Test data for 3 Mbps

-. Test Result : Pass

Measured Value (kHz)	Two-third of 20 dB Bandwidth (kHz)	Limit
999.00	852.47	Separated by a minimum of 852.47 kHz



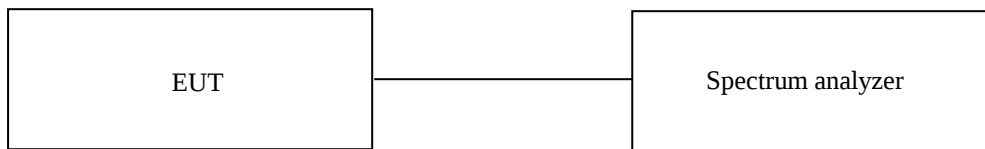
9. NUMBER OF HOPPING CHANNELS

9.1 Operating environment

Temperature : 22 °C
Relative humidity : 46 % 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 100 kHz. The analyzer is set to peak hold and then complete pseudo-random hopping sequence of the transmitter is captured.



9.3 Test Date

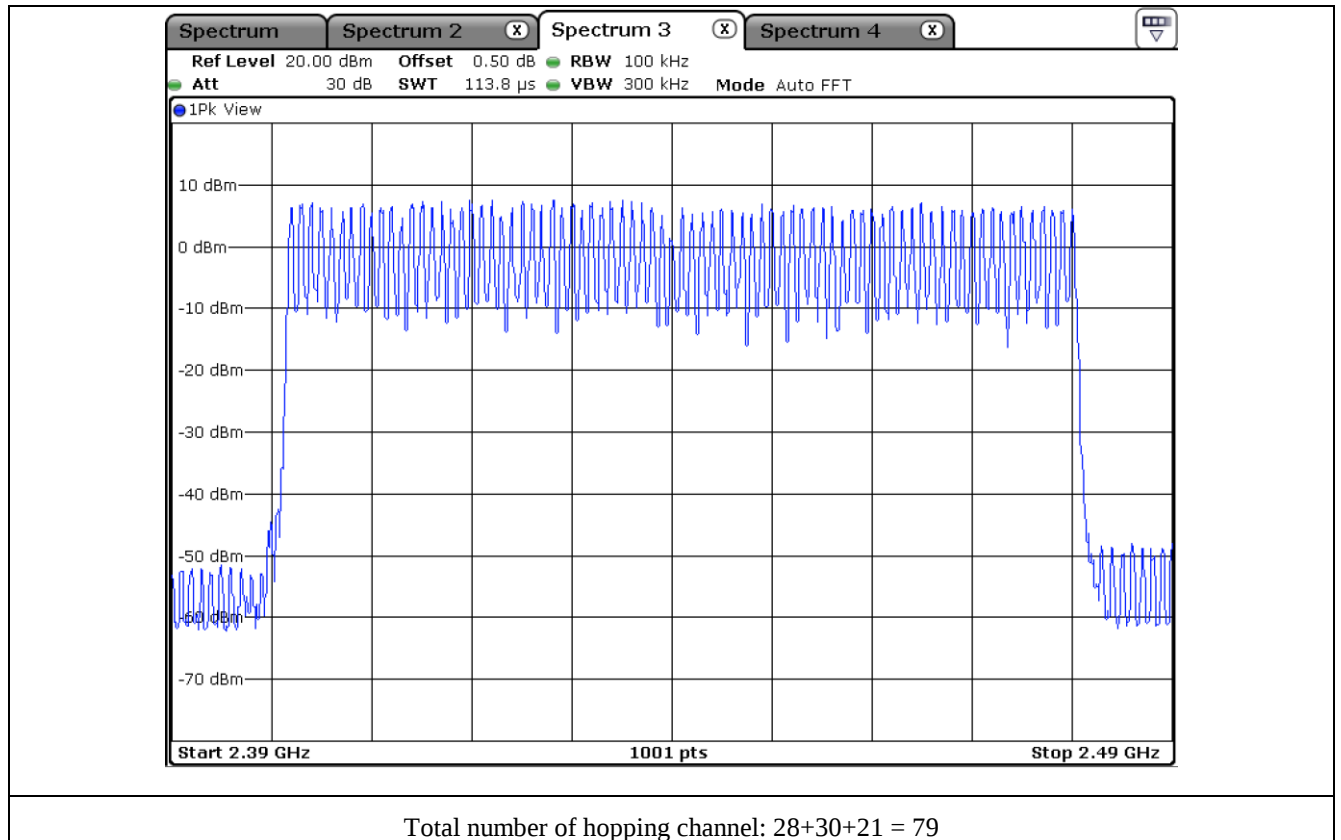
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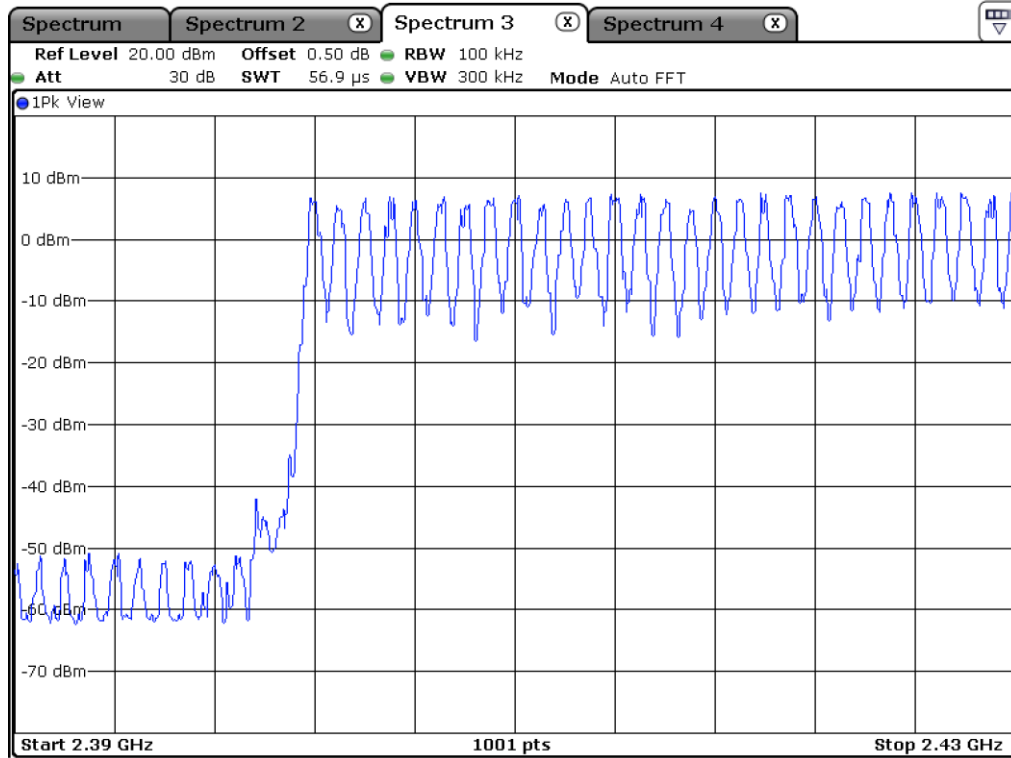
9.4 Test Data

9.4.1 Test data for 1 Mbps

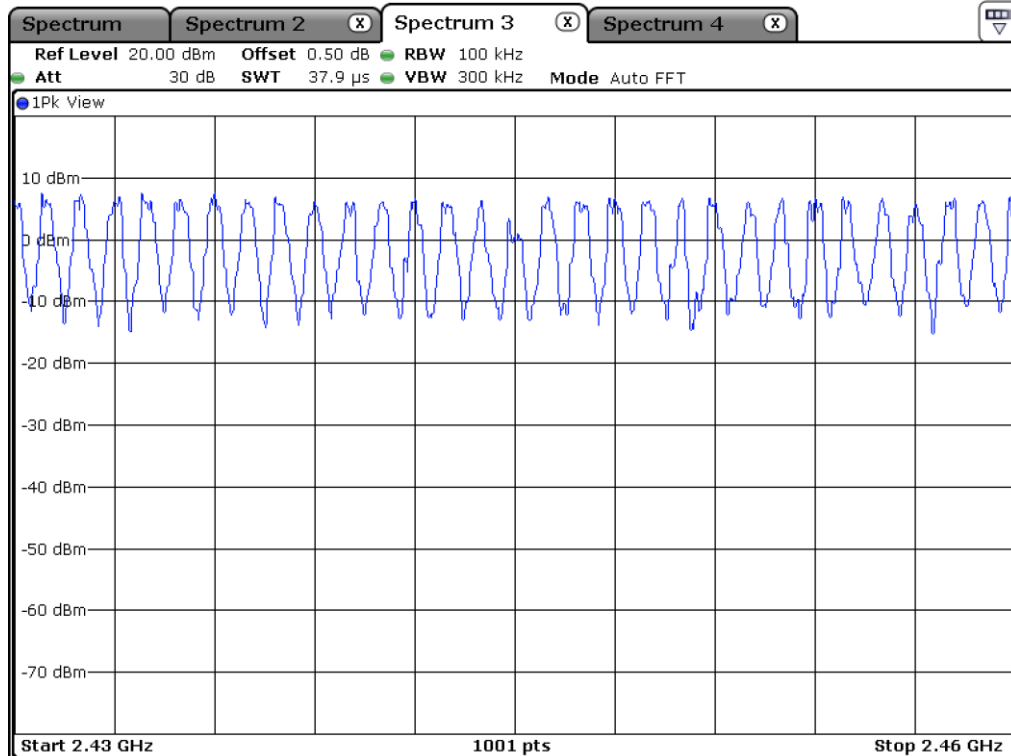
-. Test Result : Pass

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

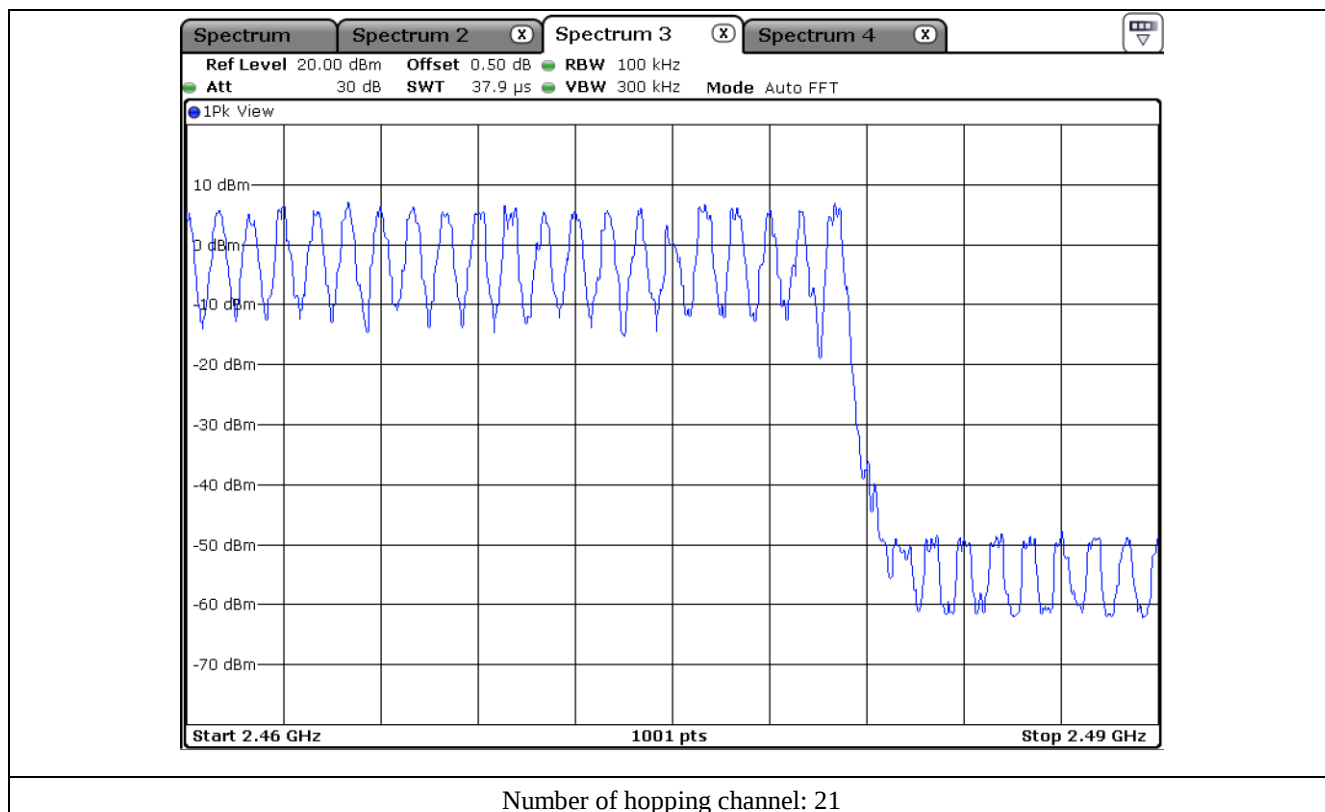




Number of hopping channel: 28



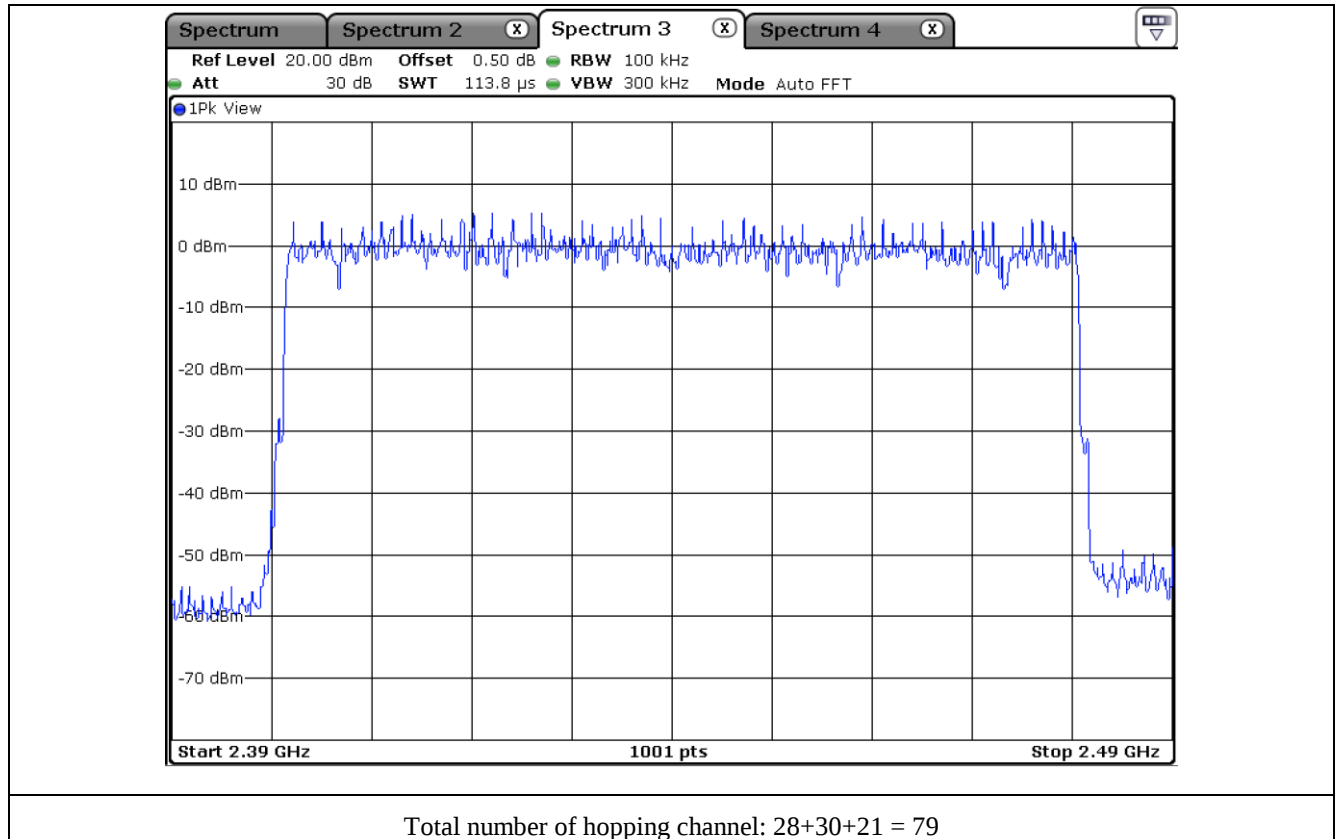
Number of hopping channel: 30

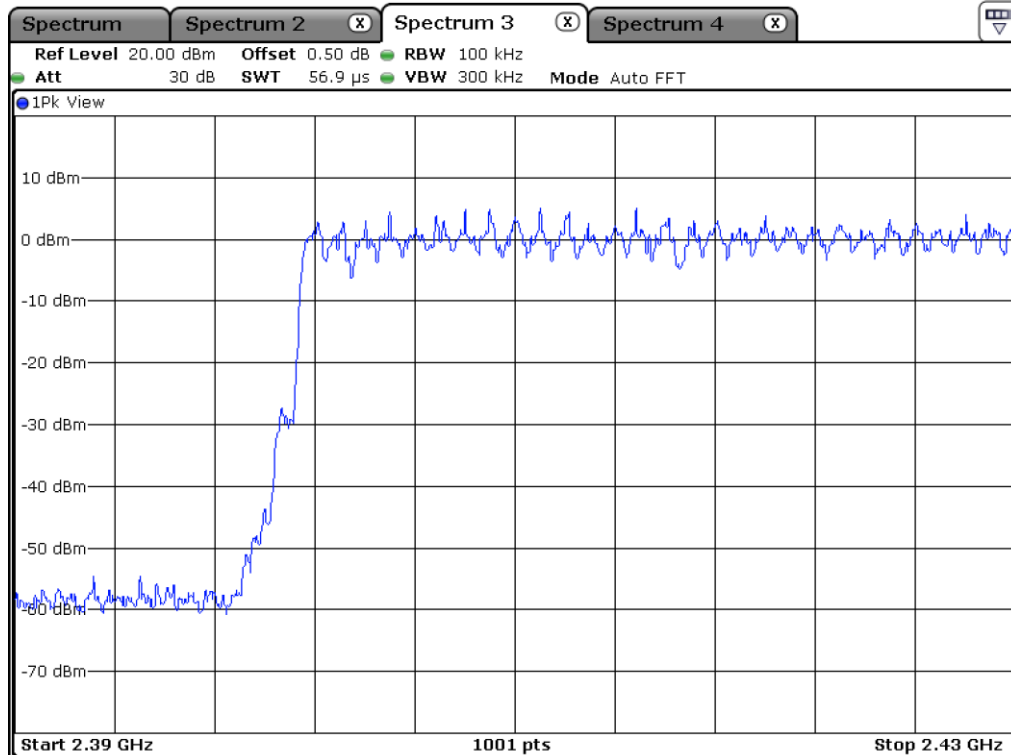


9.4.2 Test data for 2 Mbps

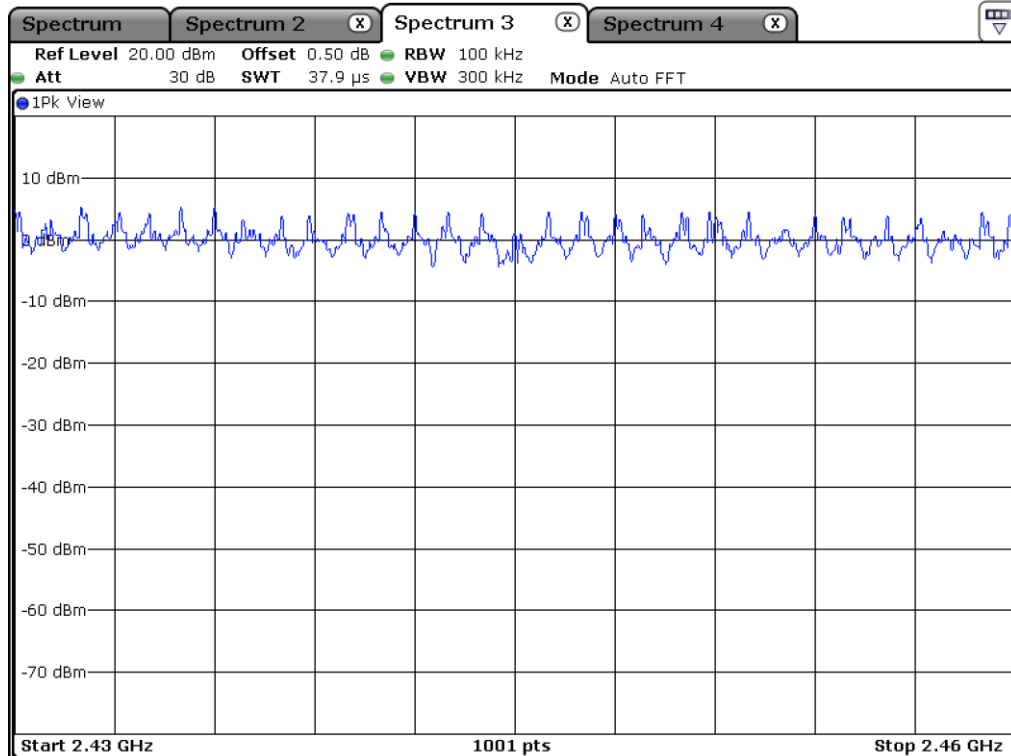
-. Test Result : Pass

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





Number of hopping channel: 28



Number of hopping channel: 30

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