FCC - TEST REPORT

Report Number	:	**68.950.23.0616.01**	Date of Issue:	**2023-06-20**
Model	:	**ZL-BLE-002**		
Product Type	:	Bluetooth Module		
Applicant	:	Xiamen Zlink Electronic Technology Co., Ltd		
Address	:	Room 1001, No. 1707 Wulv Road, Tong'an District, Xiamen City, Fujian Province, China		
Manufacturer	:	Xiamen Zlink Electronic Technology Co., Ltd		
Address	:	Room 1001, No. 1707 Wulv Road, Tong'an District, Xiamen City, Fujian Province, China		
Test Result	:	■ **Positive** ☐ **Negative**		
Total pages including Appendices	:	**72**		

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2 Details about the Test Laboratory

Details about the Test Laboratory
Test Site 1

Company name:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
	Building 12 & 13, Zhiheng Wisdomland Business Park, Guankou Erlu, Nantou, Nanshan District, Shenzhen, Guangdong, China
Telephone:	86 755 8828 6998
Fax:	86 755 8828 5299
FCC Registration No.:	514049
FCC Designation Number:	CN5009

3 Description of the Equipment Under Test

Product:	Bluetooth Module
Model no.:	ZL-BLE-002
FCC ID:	2BA9M-ZLBLE002
Rating:	3.3VDC
RF Transmission Frequency:	2402MHz-2480MHz
No. of Operated Channel:	79
Modulation:	GFSK, π/4-DQPSK, 8DPSK
Antenna Type:	Integrated antenna
Antenna Gain:	-0.58dBi
Description of the EUT:	EUT is Bluetooth Module which supports Bluetooth Low Energy/Bluetooth BDR+EDR functions
Remark:	This report only for Bluetooth BR+EDR part.

NOTE 1: The above EUT's information is declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

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4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2021 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to Public Notice DA 00-705 -Frequency Hopper Spread Spectrum Test Procedure, KDB558074 D01 v05r02 and ANSI C63.10-2013.

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5 Summary of Test Results

Technical Requirements		
FCC Part 15 Subpart C		
Test Condition		Test Result
§15.207	Conducted emission AC power port	N/A
§15.247(b)(1)	Conducted peak output power	Pass
§15.247(e)	Power spectral density	N/A
§15.247(a)(2)	6dB bandwidth and 99% Occupied Bandwidth	N/A
§15.247(a)(1)	20dB bandwidth and 99% Occupied Bandwidth	Pass
§15.247(a)(1)	Min. of Hopping Channel Carrier Frequency Separation	Pass
§15.247(a)(1)(iii)	Min number of hopping frequencies	Pass
§15.247(a)(1)(iii)	Dwell Time - Average Time of Occupancy	Pass
§15.247(d)	Spurious RF conducted emissions	Pass
§15.247(d)	Band edge	Pass
§15.247(d) & §15.209	Spurious radiated emissions for transmitter	Pass
§15.203	Antenna requirement	Pass See note 2

Note 1: N/A=Not Applicable.
Note 2: The EUT uses an integrated antenna, which gain is -0.58dBi. In accordance to §15.203, it is considered sufficiently to comply with the provisions of this section.

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6 General Remarks

Remarks

This submittal(s) (test report) is complies with Section 15.209, 15.247 of the FCC Part 15, Subpart C rules.

SUMMARY:

All tests according to the regulations cited on page 6 were

■ - Performed

☐ - **Not** Performed

The Equipment Under Test

■ - **Fulfills** the general approval requirements.

☐ - **Does not** fulfill the general approval requirements.

Sample Received Date:	2023-02-28
Testing Start Date:	2023-02-28
Testing End Date:	2023-04-12

- TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch

Reviewed by:	Prepared by:	Tested by:
Project Manager	Vincent Zheng Project Engineer	Carry Cai Test Engineer

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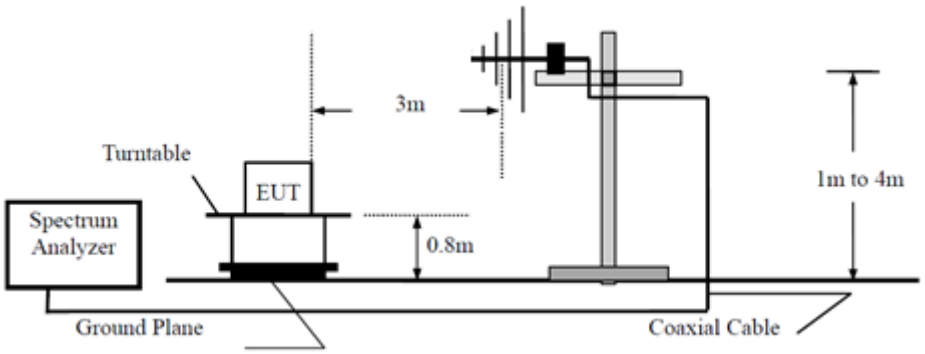
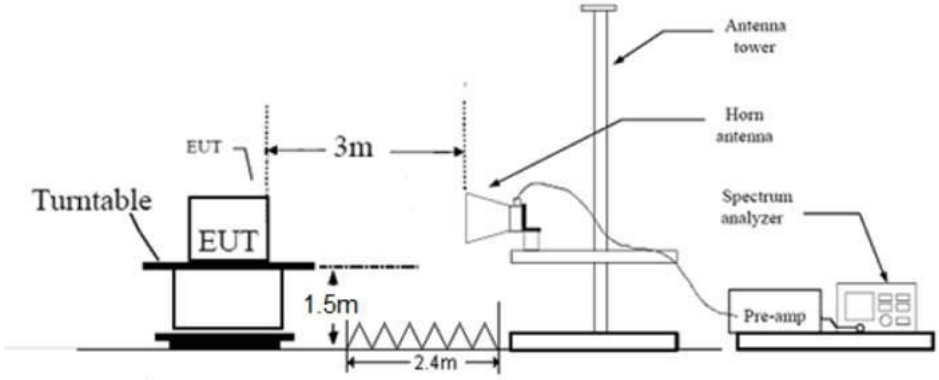
7 Test Setups

7.1 Radiated test setups

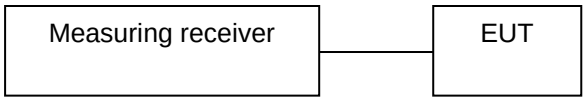
Below 1GHz



Above 1GHz



7.2 Conducted RF test setups



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8 Systems test configuration

Auxiliary Equipment Used during Test:

Description	Manufacturer	Model NO.	S/N
Laptop	LENOVO	X220	MP18DLC6

The system was configured to hopping mode and non-hopping mode.

Hopping mode: typical working mode (normal hopping status)

Non-hopping mode: The system was configured to operate at a signal channel transmitting. The test software allows the configuration and operation at the worst-case duty and the highest transmit power.

9 Technical Requirement

9.1 Conducted peak output power

Test Method

1. The RF output of EUT was connected to the test receiver by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following test receiver settings:
   Span = approximately 5 times the 20dB bandwidth, centered on a hopping channel
   RBW > the 20dB bandwidth of the emission being measured, VBW≥RBW,
   Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power and record the results in the test report.
5. Repeat above procedures until all frequencies measured were complete.

Limits

Conducted Peak Output Power:

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤1	≤30

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Conducted peak output power

Bluetooth Mode GFSK modulation Test Result

Frequency	Conducted Peak Output Power	Result
MHz	dBm	
Low channel 2402MHz	-0.4	Pass
Middle channel 2441MHz	0.62	Pass
High channel 2480MHz	1.39	Pass

Bluetooth Mode π/4-DQPSK modulation Test Result

Frequency	Conducted Peak Output Power	Result
MHz	dBm	
Low channel 2402MHz	0.46	Pass
Middle channel 2441MHz	1.47	Pass
High channel 2480MHz	2.28	Pass

Bluetooth Mode 8DPSK modulation Test Result

Frequency	Conducted Peak Output Power	Result
MHz	dBm	
Low channel 2402MHz	-0.41	Pass
Middle channel 2441MHz	0.63	Pass
High channel 2480MHz	1.45	Pass

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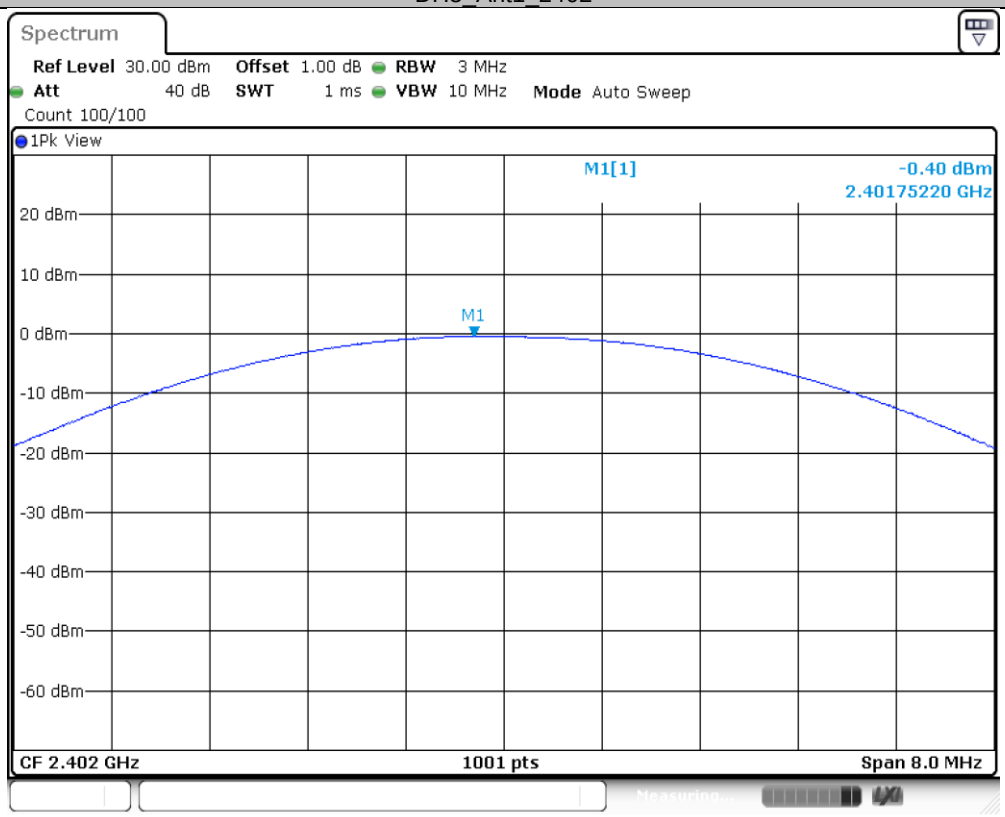

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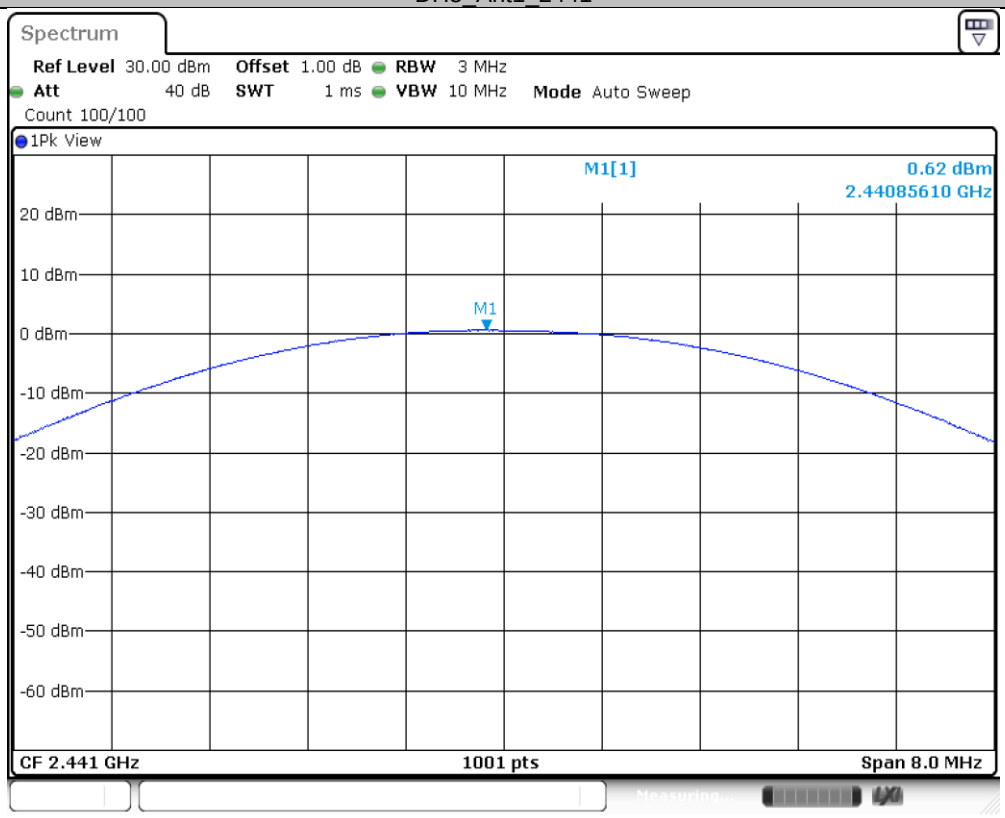

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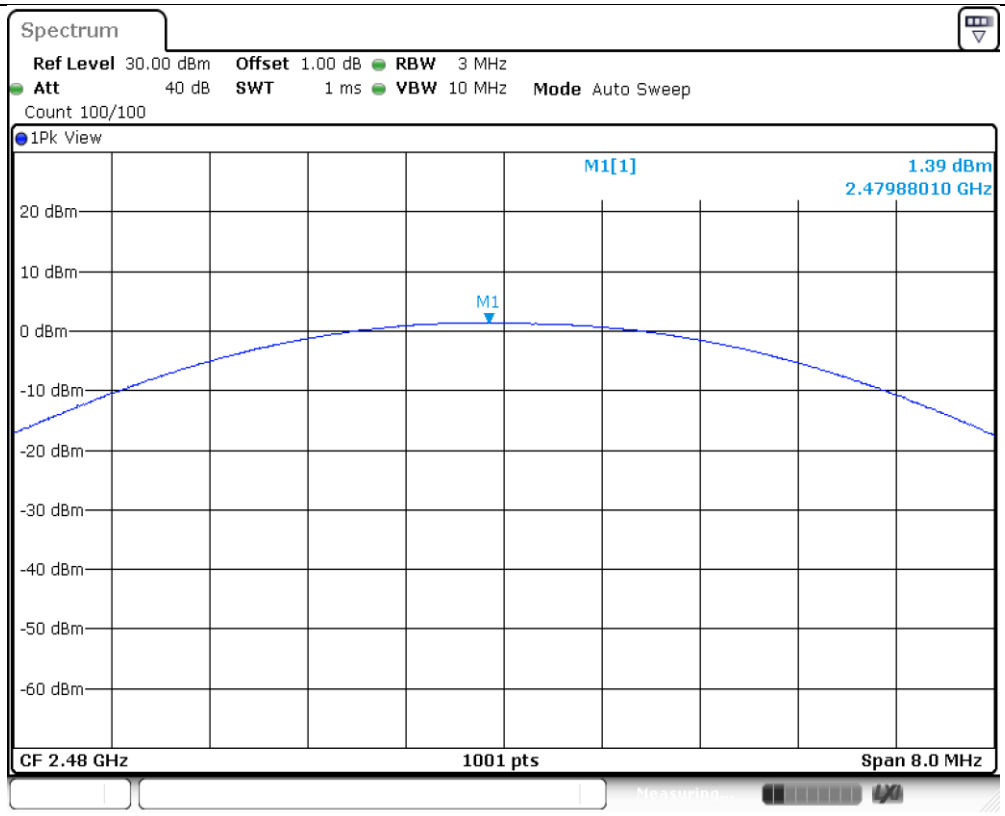

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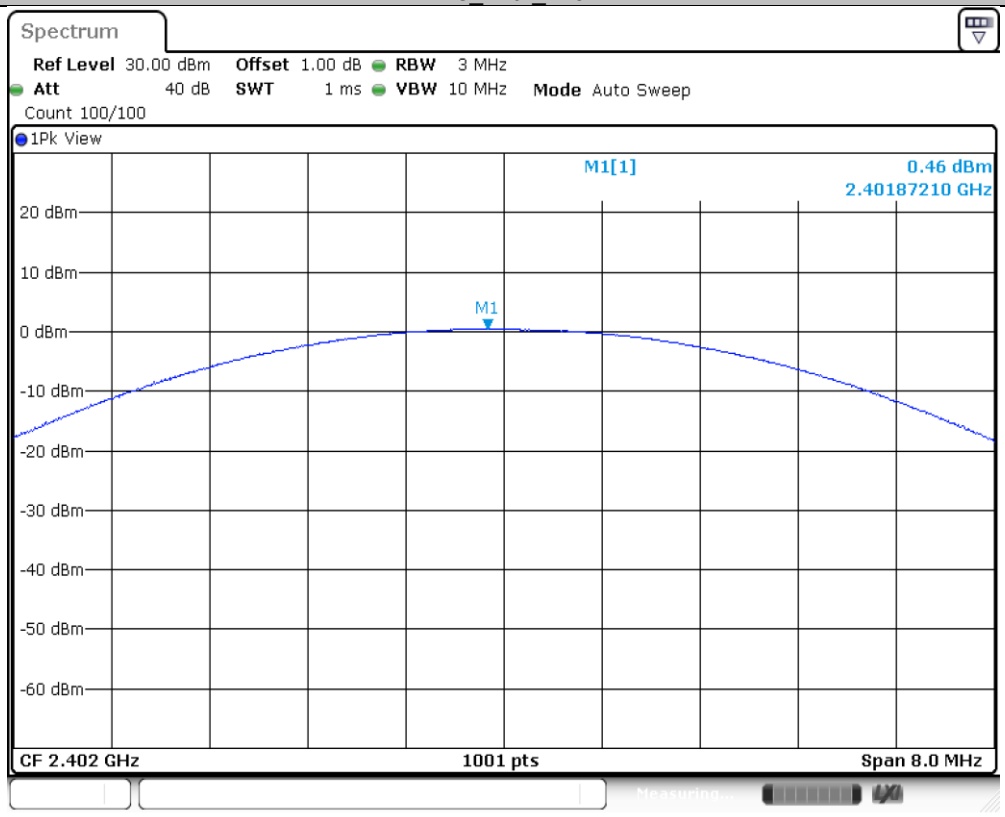

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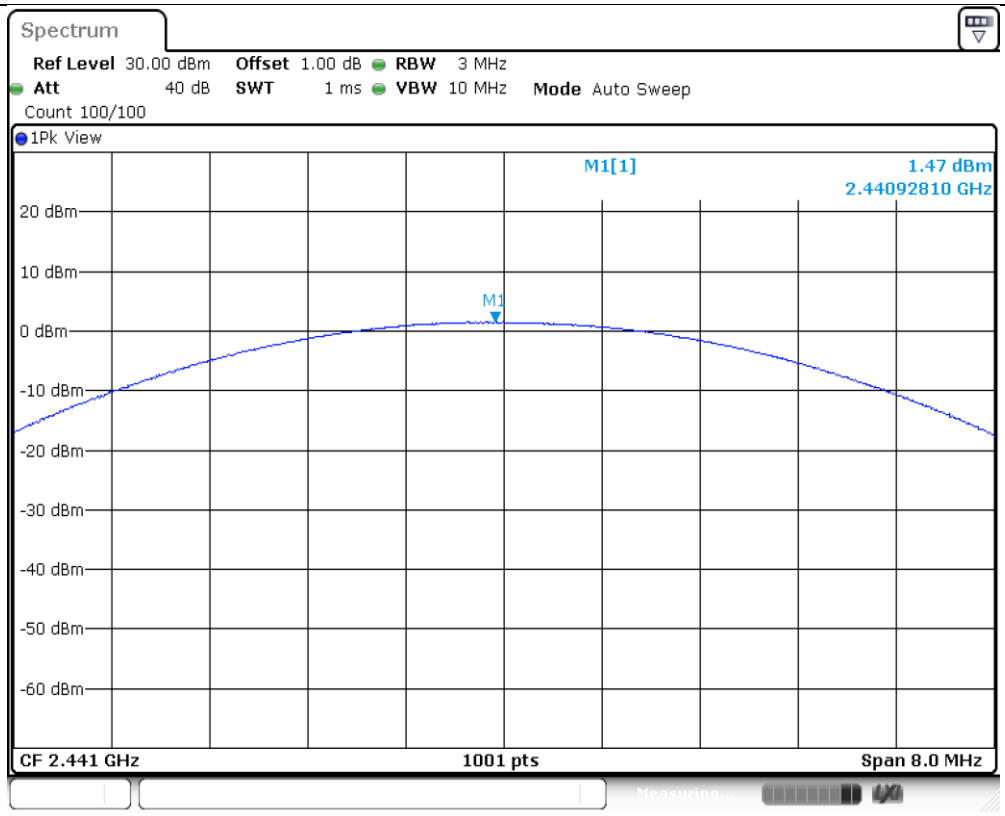

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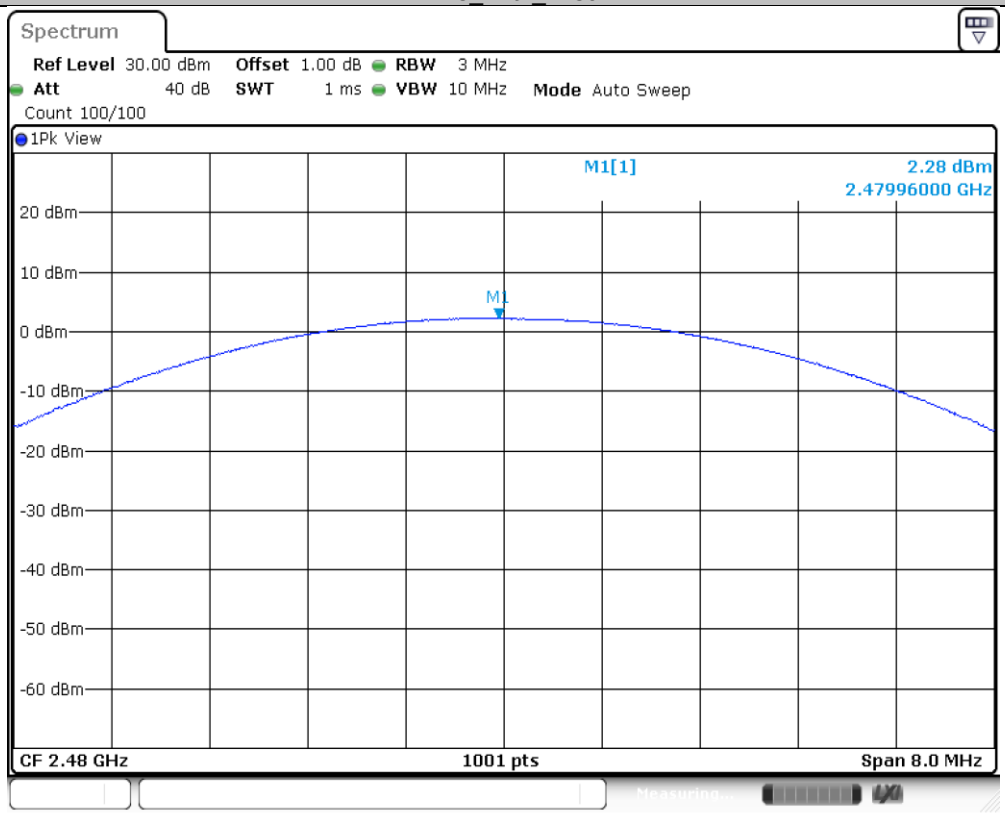

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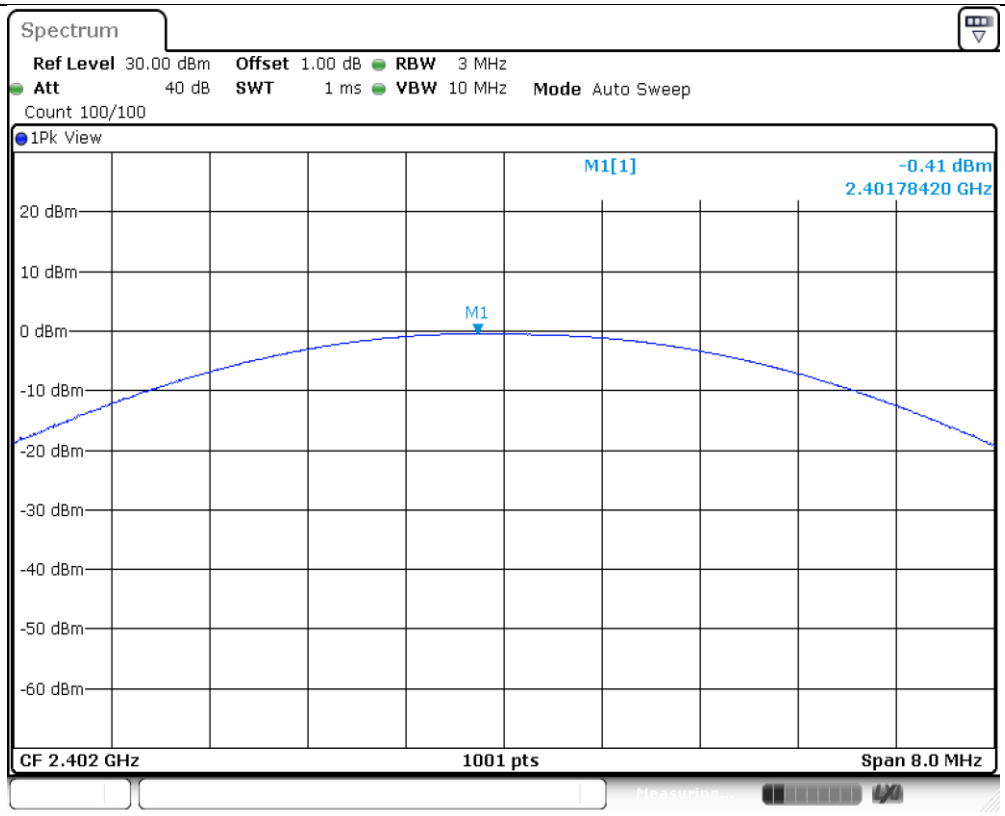

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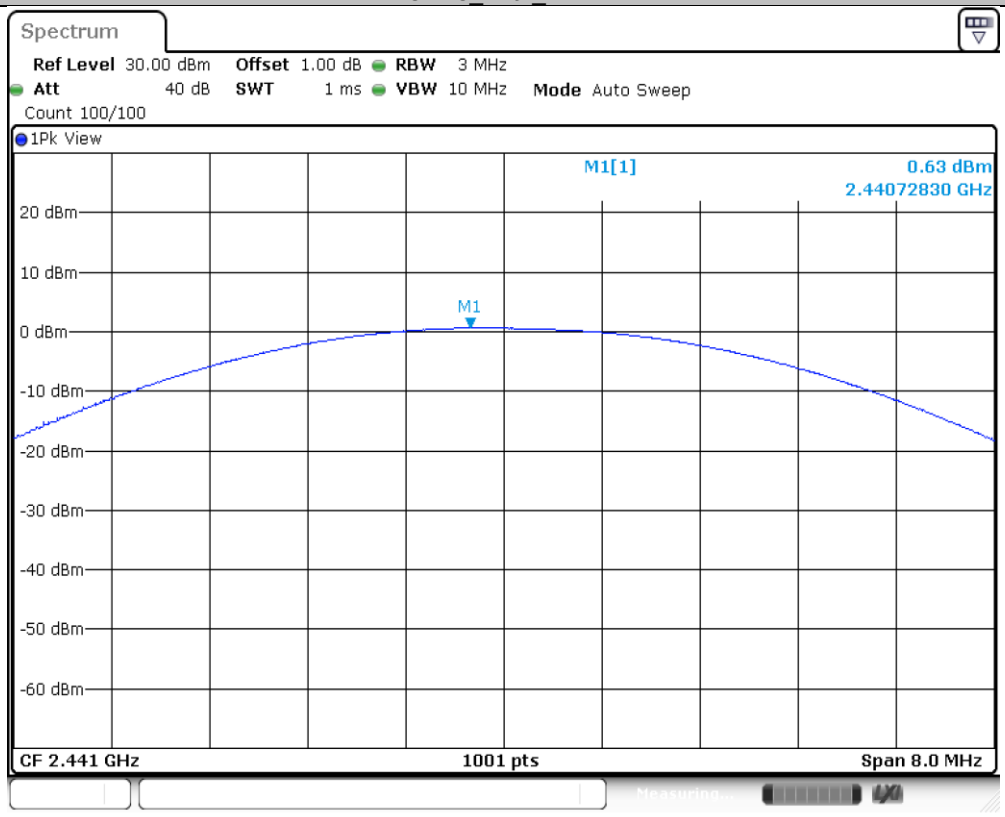

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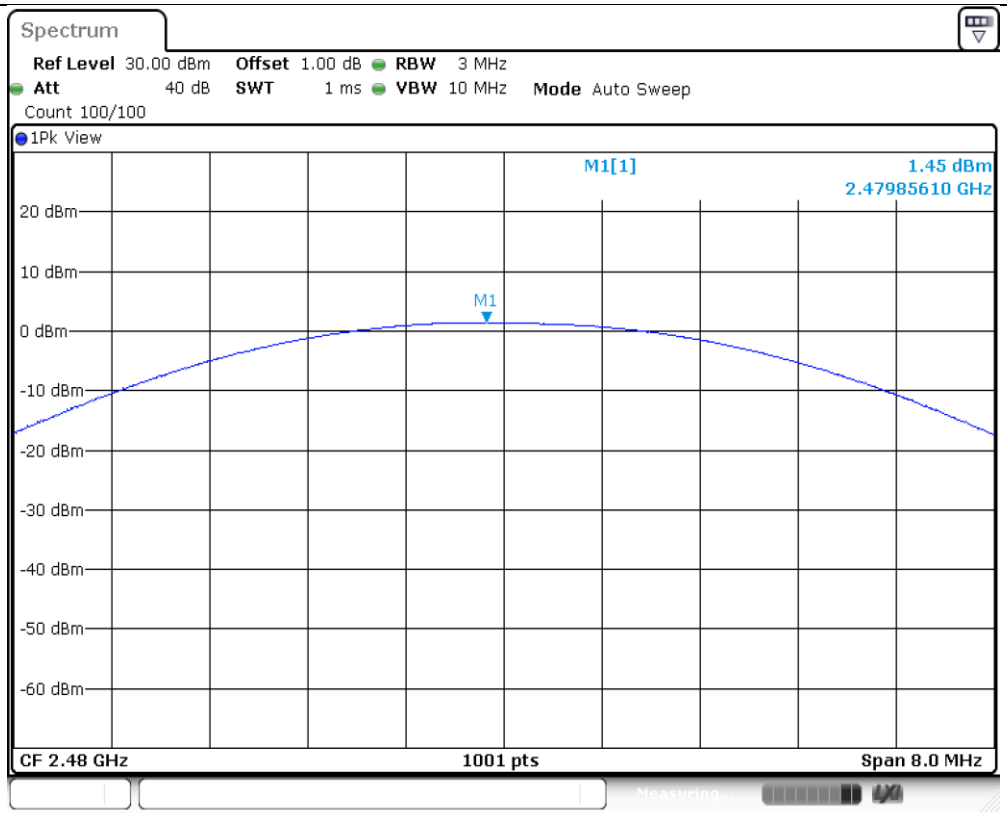

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9.2 20 dB bandwidth and 99% Occupied Bandwidth

Test Method

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Limit

Limit [kHz]
N/A

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20 dB bandwidth and 99% Occupied Bandwidth

Bluetooth Mode GFSK Modulation test result

Frequency	20 dB Bandwidth	99% Bandwidth	Limit	Result
MHz	kHz	kHz	kHz	
2402	1107	860	--	Pass
2441	1110	857	--	Pass
2480	1107	860	--	Pass

Bluetooth Mode π/4-DQPSK Modulation test result

Frequency	20 dB Bandwidth	99% Bandwidth	Limit	Result
MHz	kHz	kHz	kHz	
2402	1377	1175	--	Pass
2441	1371	1175	--	Pass
2480	1377	1175	--	Pass

Bluetooth Mode 8DPSK Modulation test result

Frequency	20 dB Bandwidth	99% Bandwidth	Limit	Result
MHz	kHz	kHz	kHz	
2402	1110	875	--	Pass
2441	1110	875	--	Pass
2480	1107	878	--	Pass

20 dB Bandwidth

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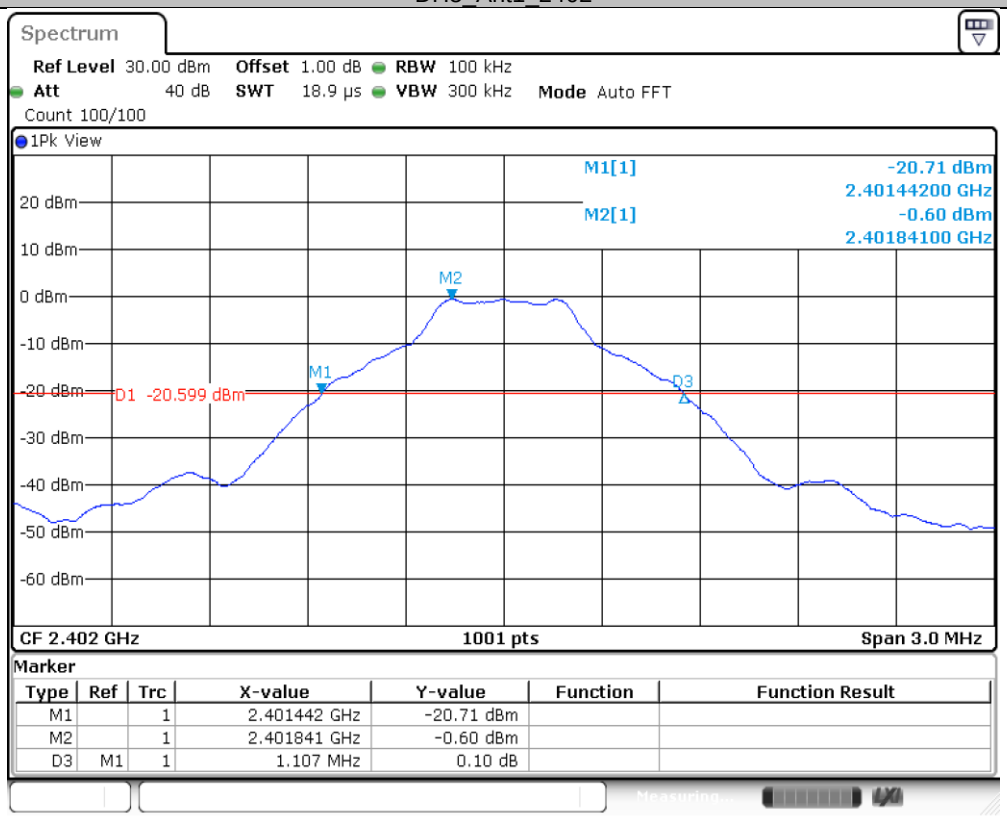

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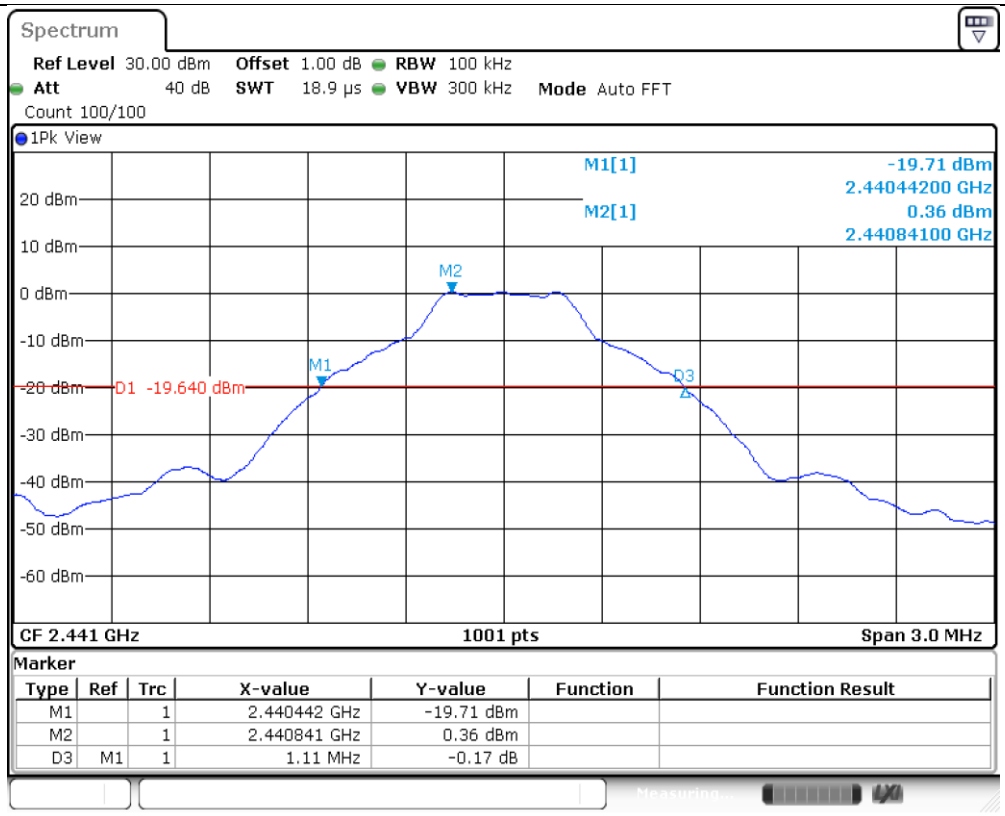

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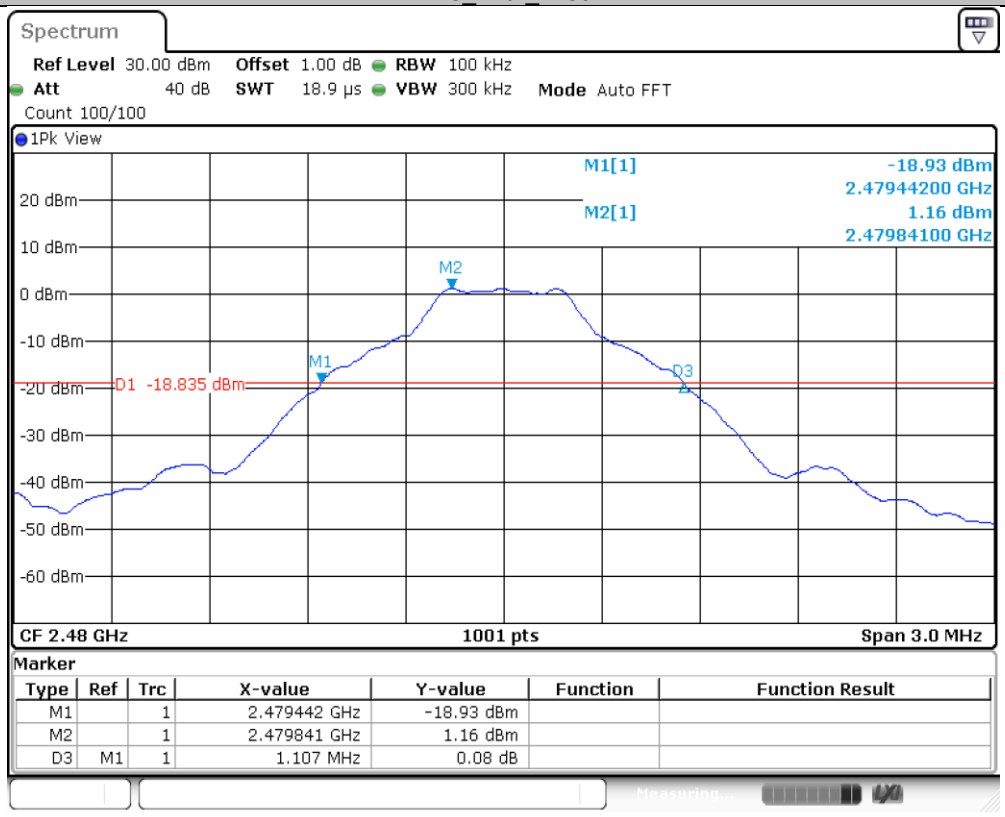

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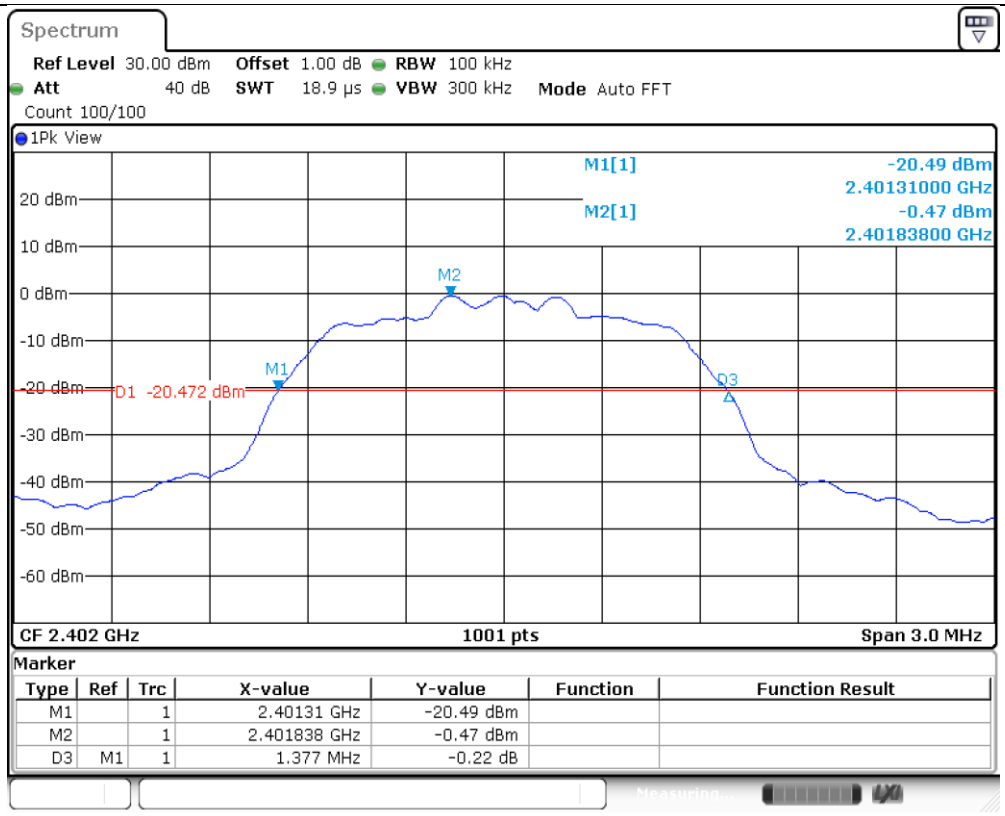

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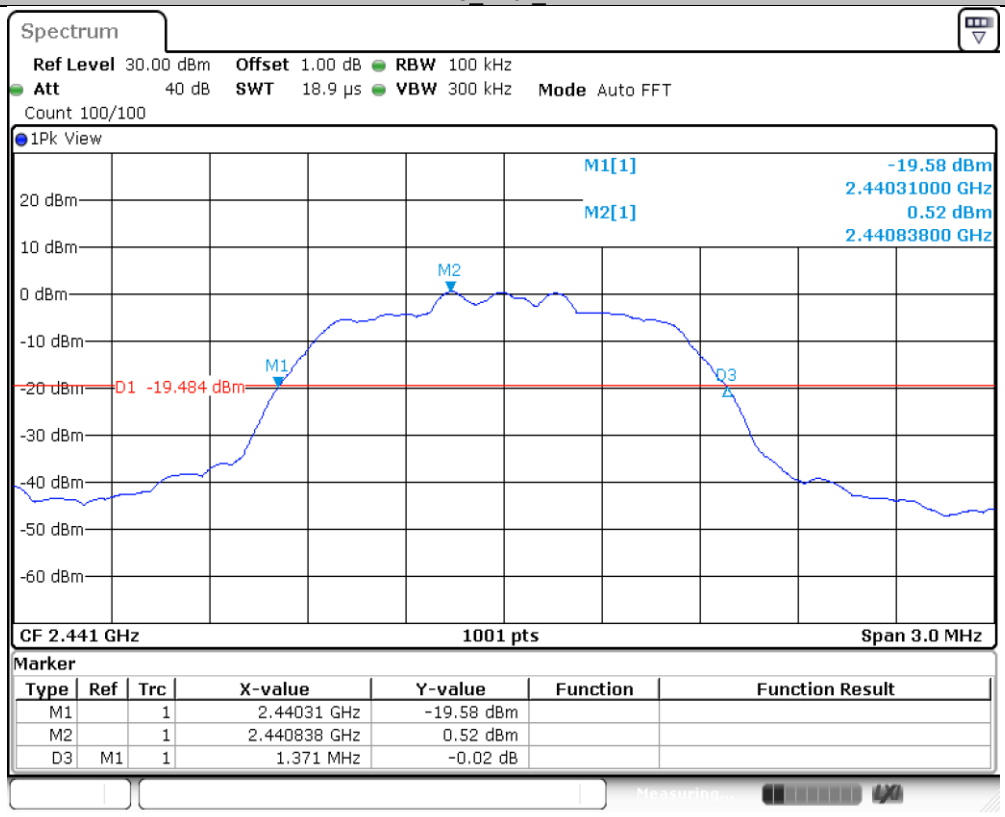

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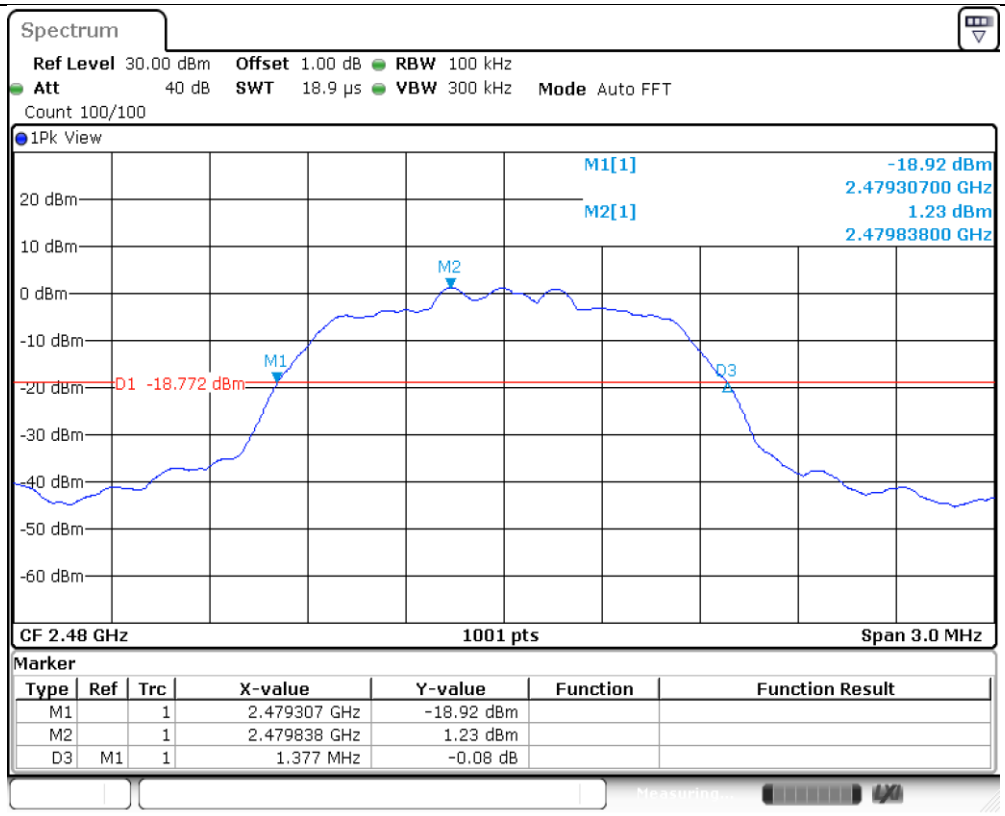

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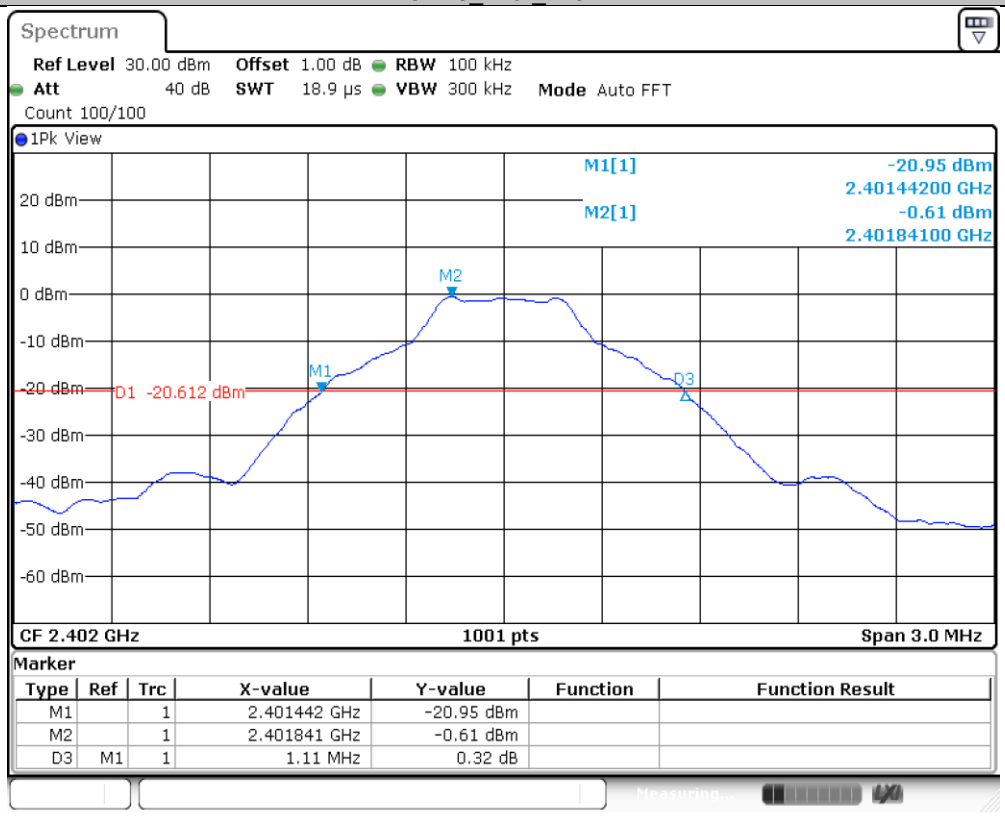

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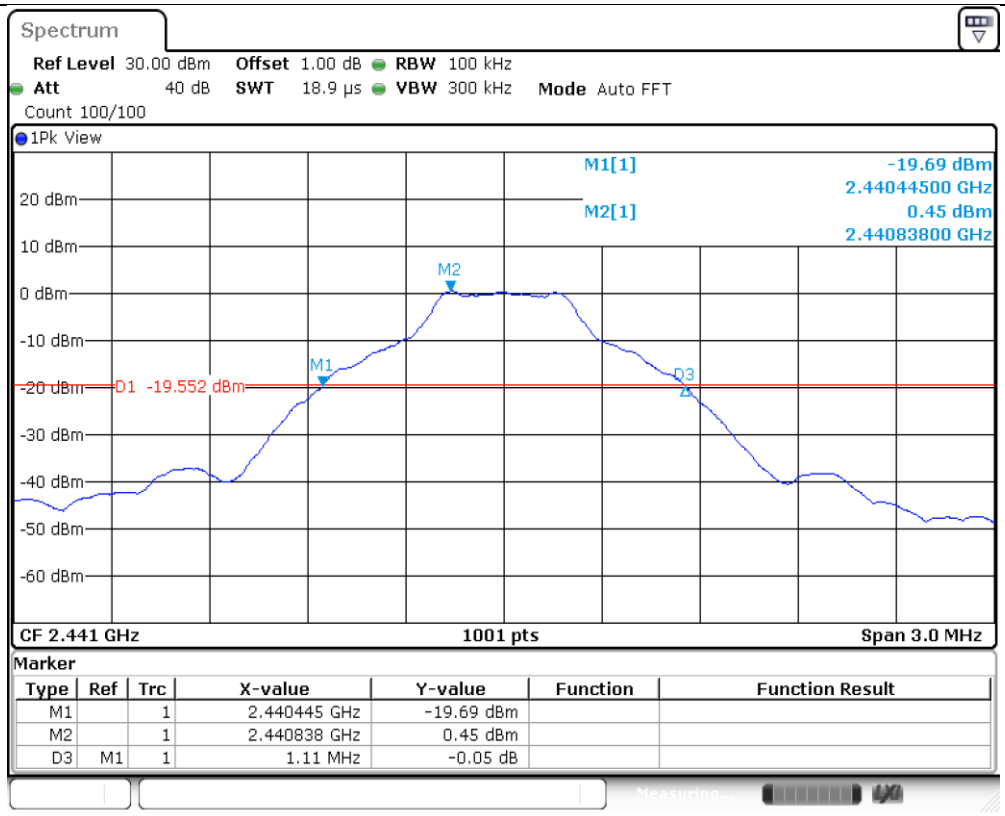

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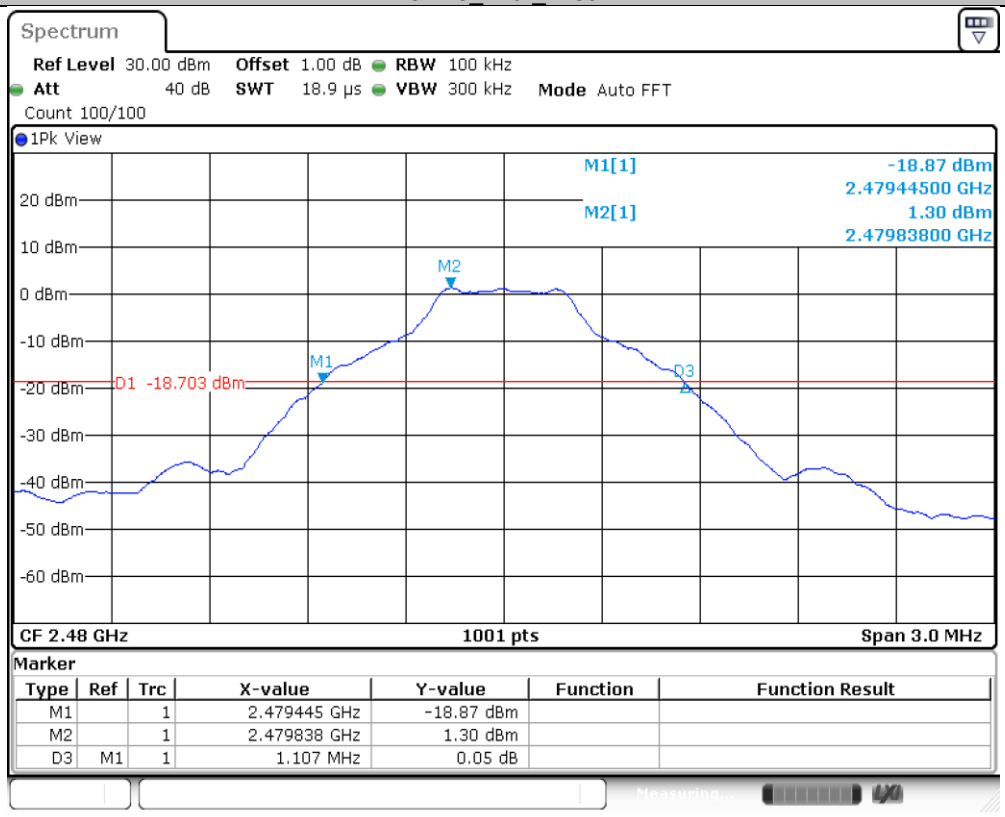

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99% Occupied Bandwidth

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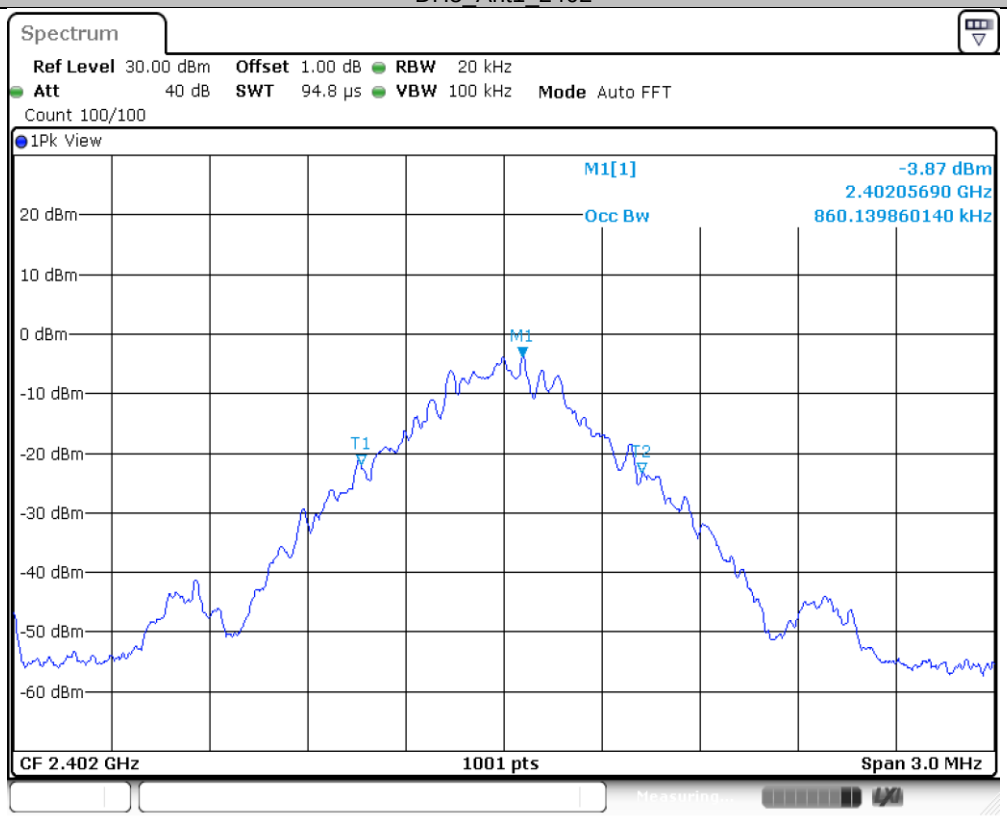

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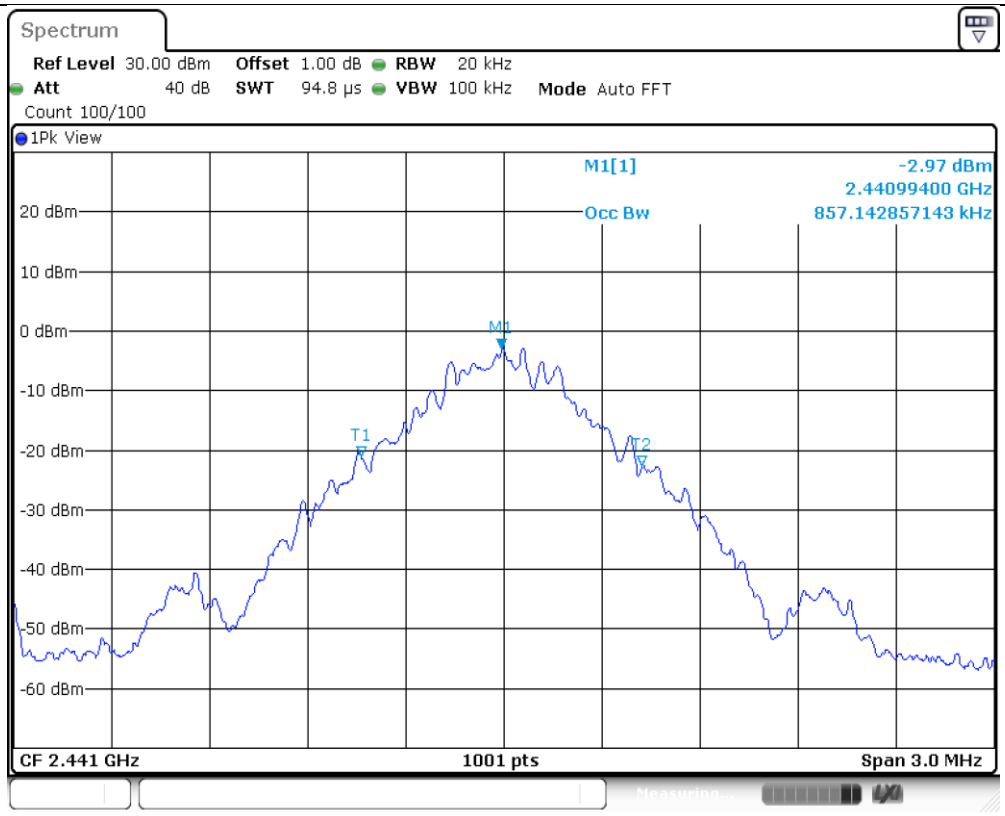

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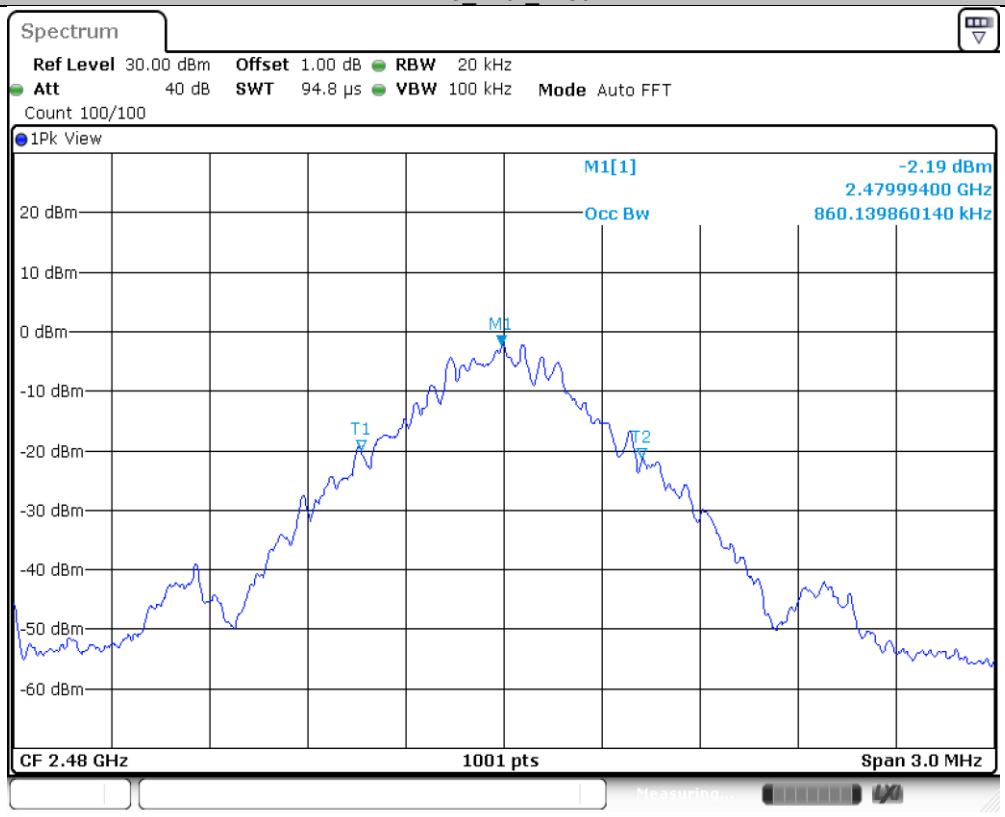

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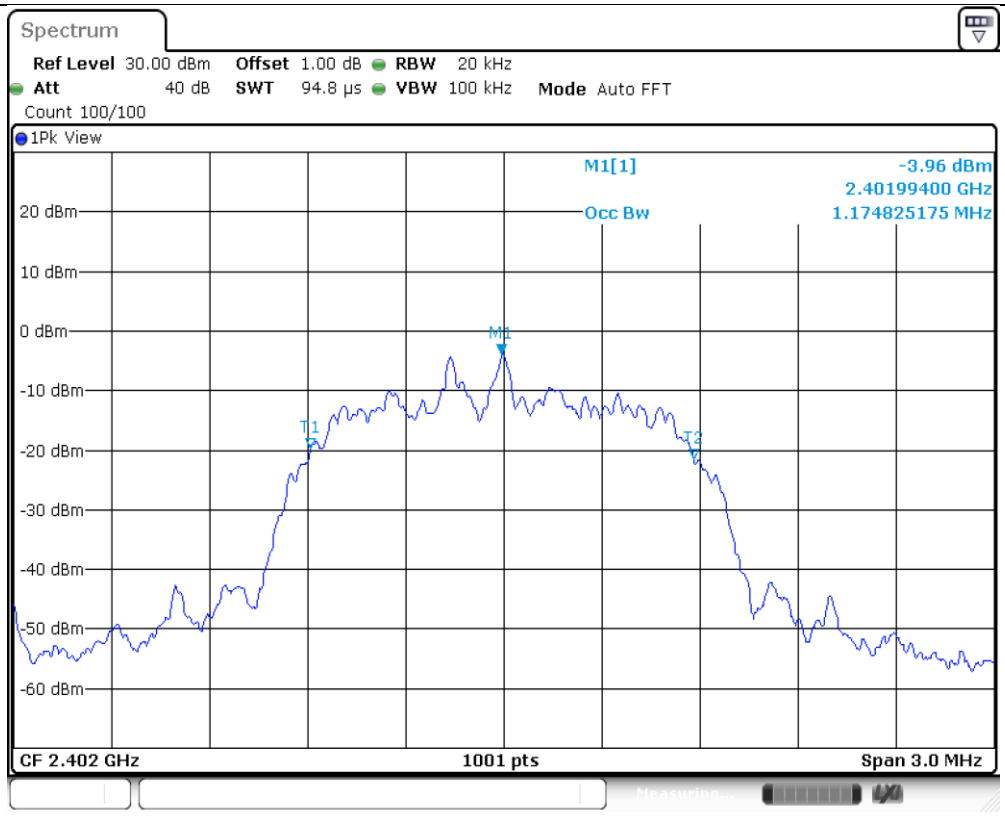

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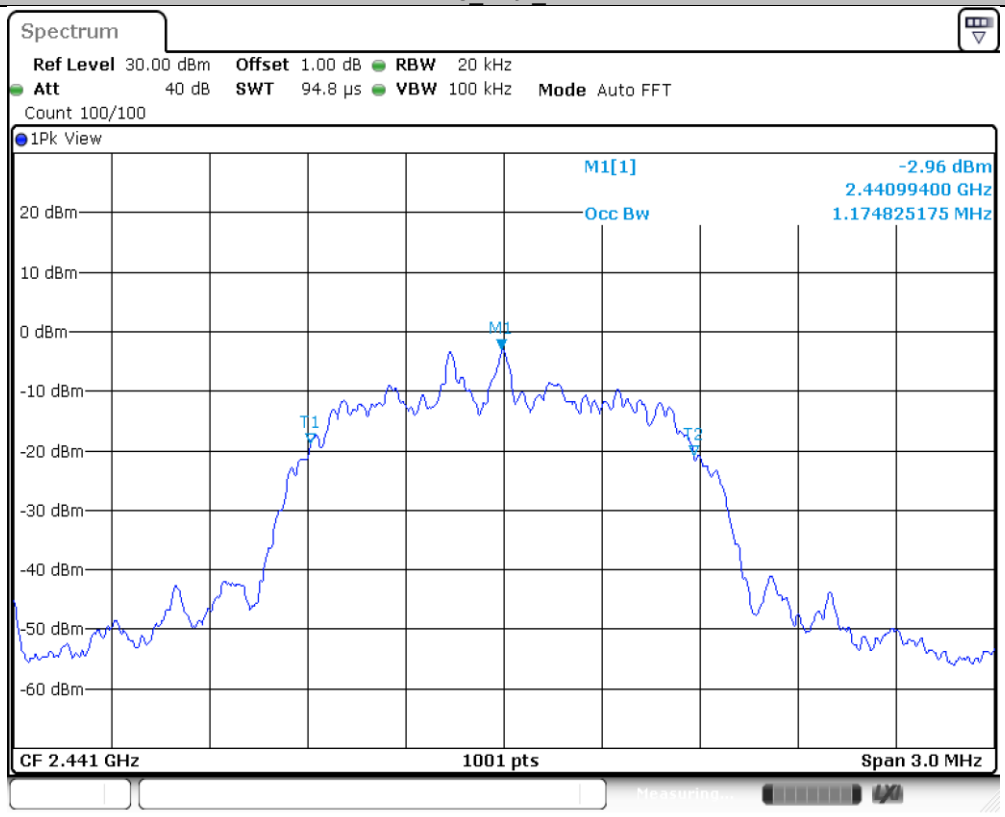

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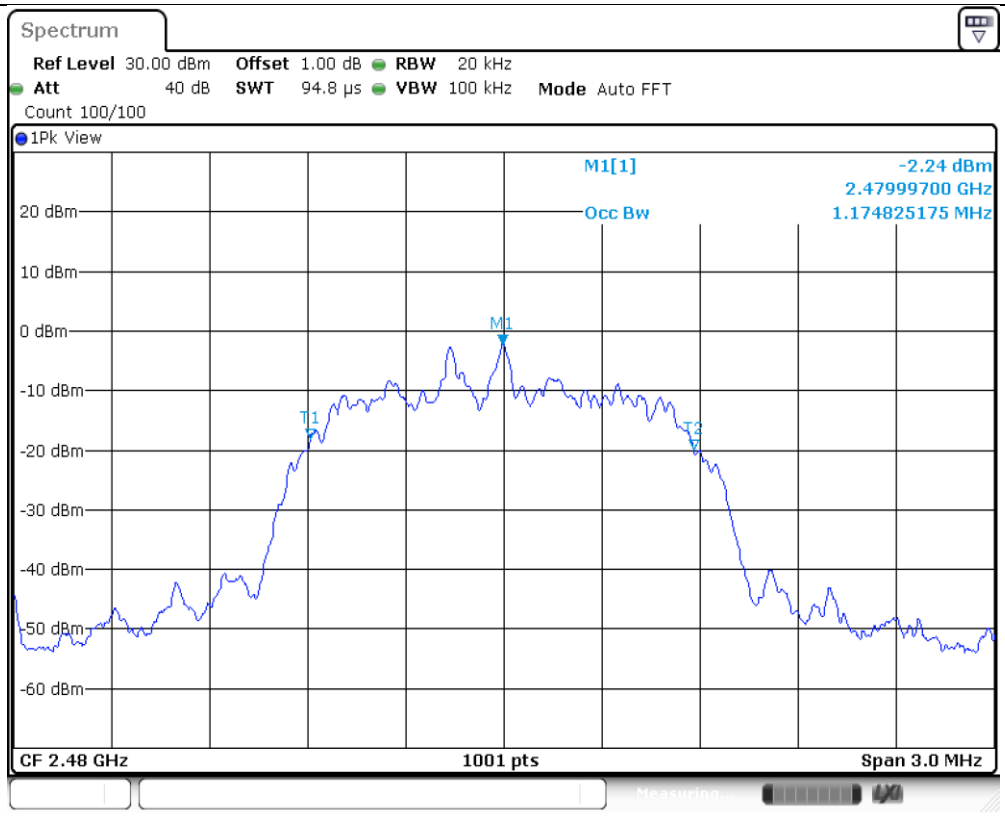

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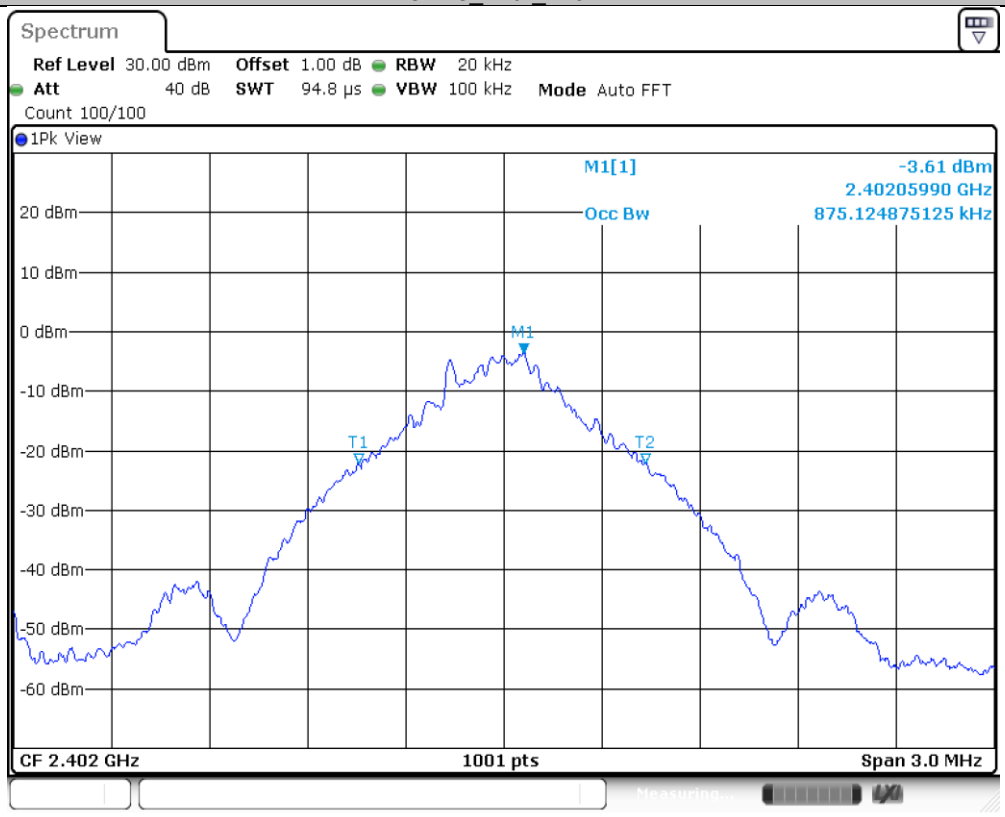

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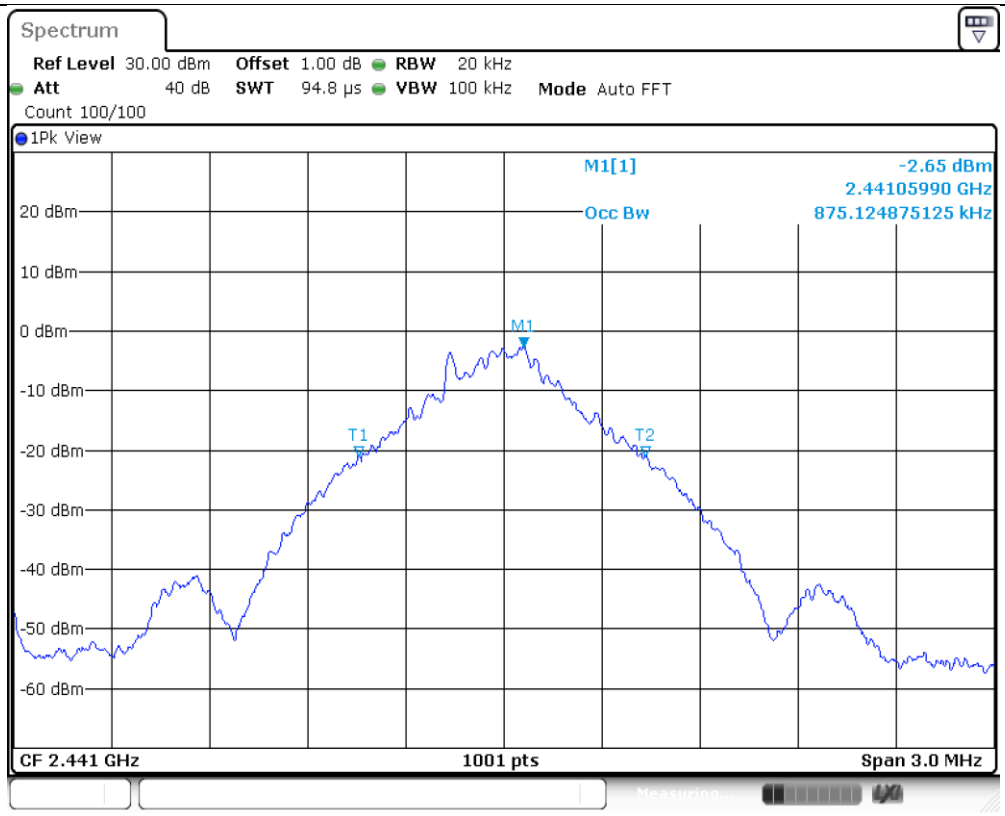

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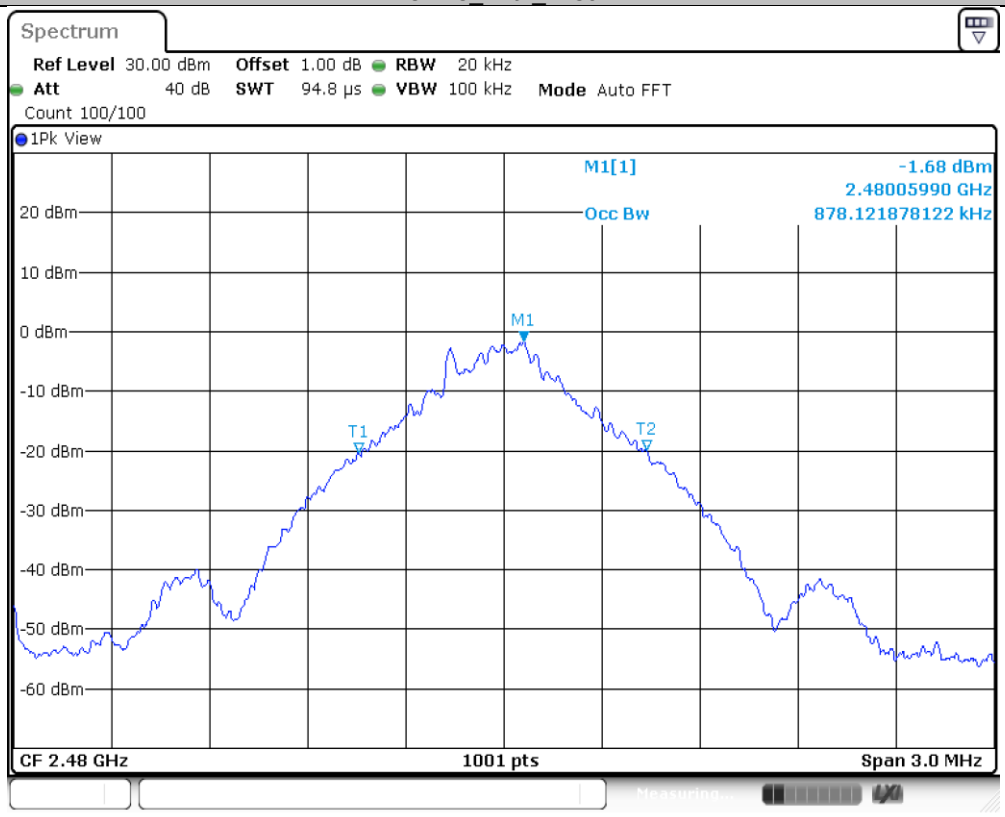

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9.3 Carrier Frequency Separation

Test Method

1. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peaks of two adjacent channels, RBW ≥ 1% of the span, VBW) ≥RBW, Sweep = auto, Detector function = peak
2. By using the Max-Hold function record the separation of two adjacent channels.
3. Measure the frequency difference of these two adjacent channels by spectrum analyzer marker function.
4. Repeat above procedures until all frequencies measured were complete.

Limit

Limit kHz
⩾25KHz or 2/3 of the 20 dB bandwidth which is greater

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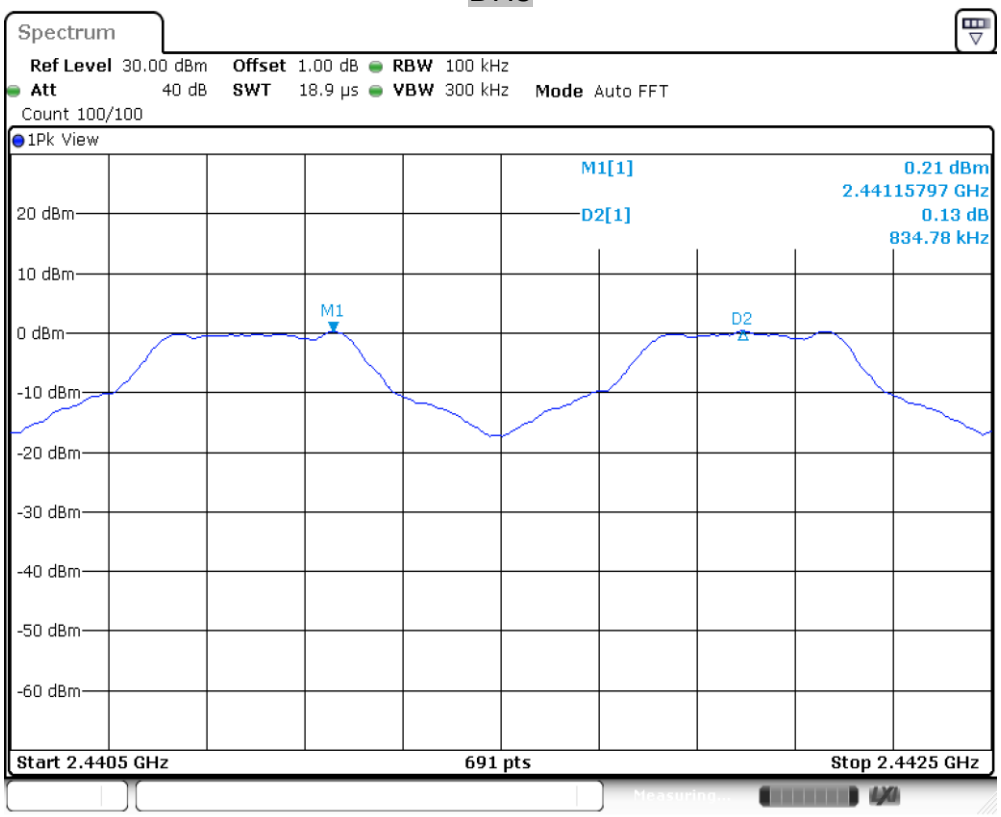
Carrier Frequency Separation

TestMode	Channel	Result[MHz]	Limit[MHz]	Verdict
DH5	Hop	0.835	>=0.740	PASS
2DH5	Hop	1.003	>=0.918	PASS
3DH5	Hop	1.157	>=1.110	PASS

DH5



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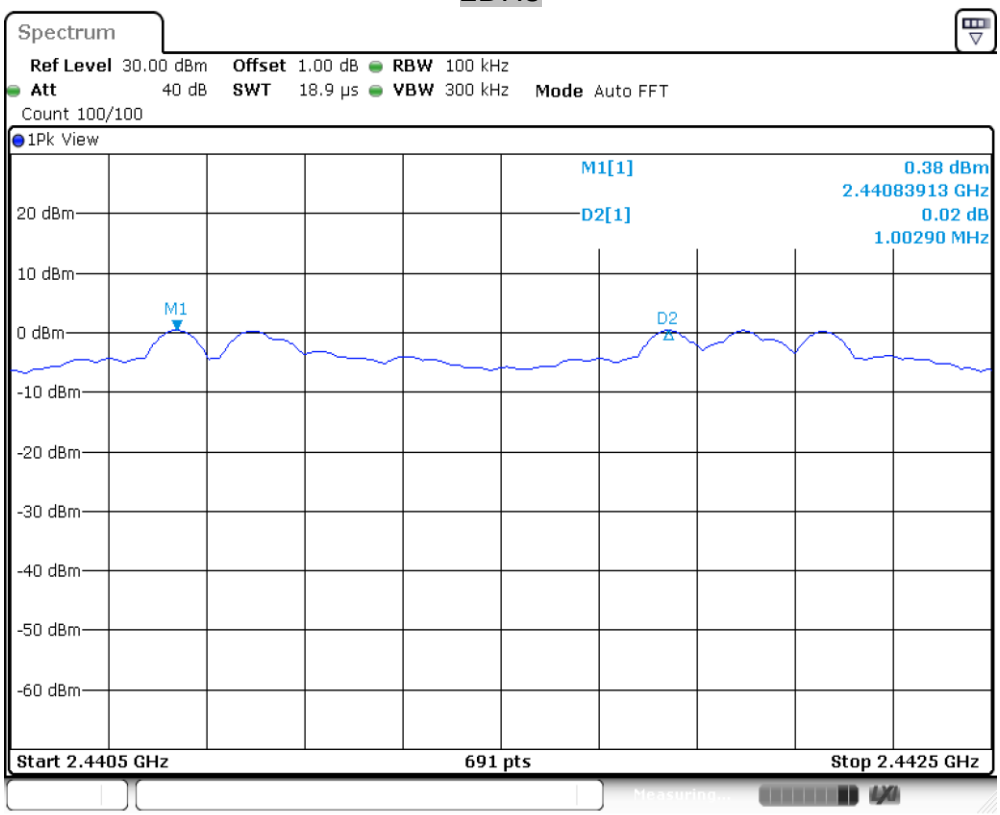
2DH5



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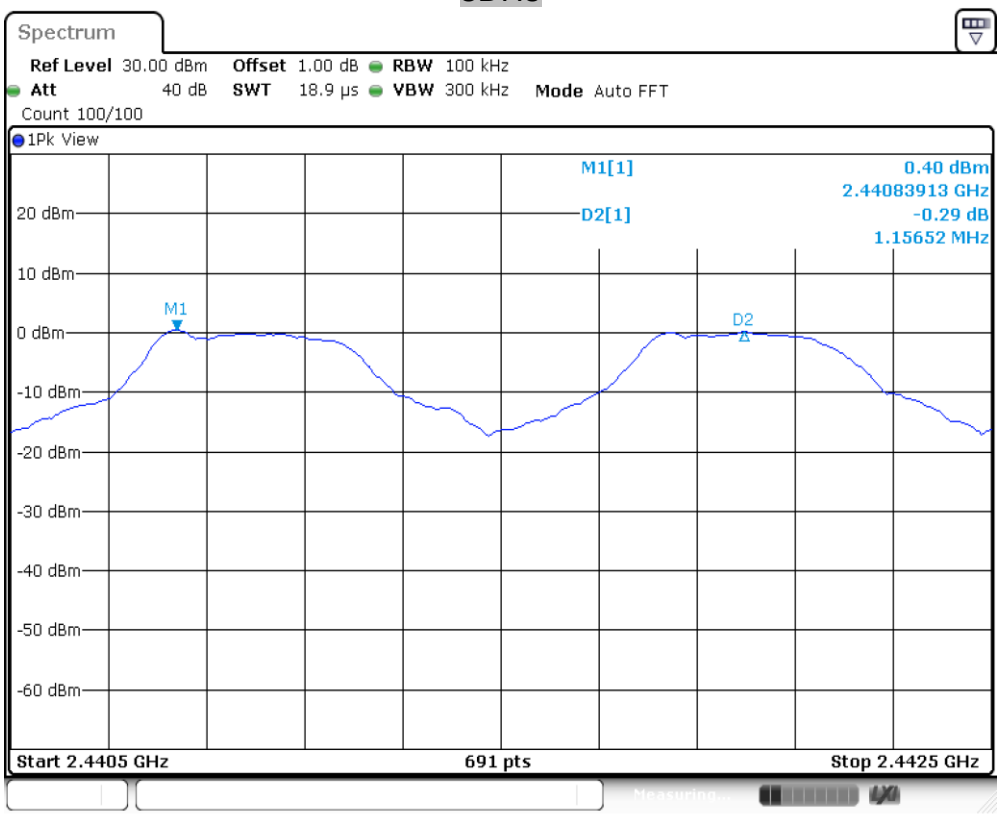
3DH5



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9.4 Number of hopping frequencies

Test Method

1. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peaks of two adjacent channels, RBW ≥ 1% of the span, VBW) ≥RBW, Sweep = auto, Detector function = peak
2. Set the spectrum analyzer on Max-Hold Mode, and then keep the EUT in hopping mode.
3. Record all the signals from each channel until each one has been recorded.
4. Repeat above procedures until all frequencies measured were complete.

Limit

Limit number
⩾15

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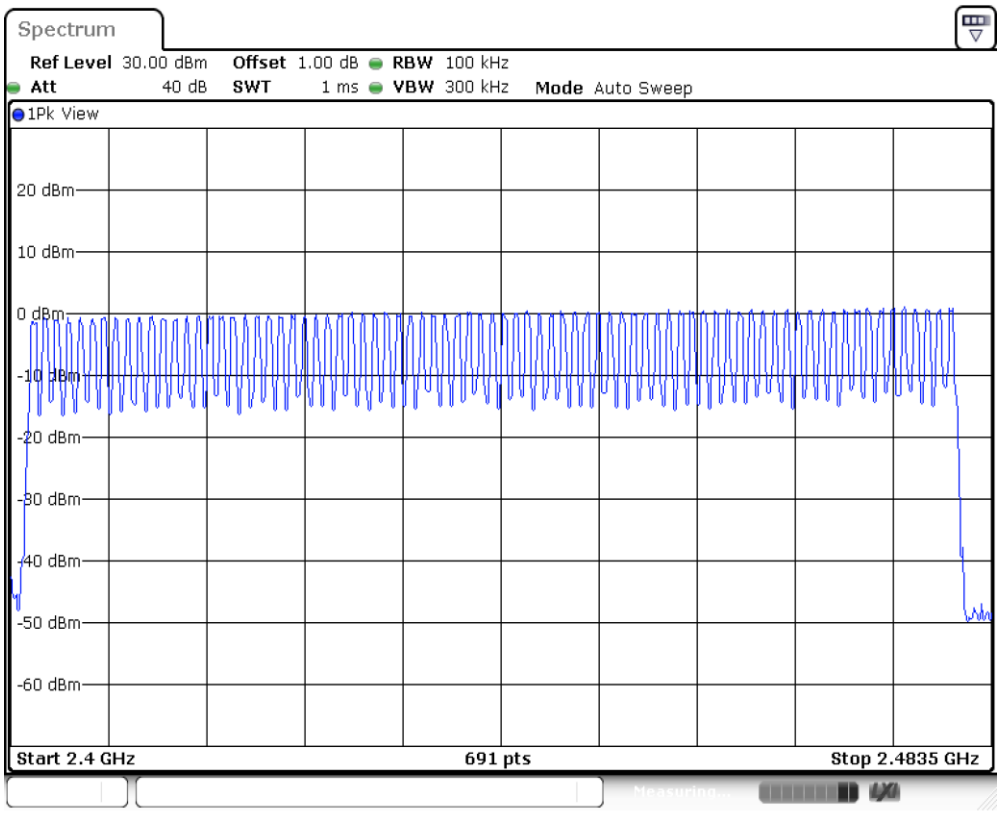
Number of hopping frequencies

Test result: The measurement was performed with the typical configuration (normal hopping status), and the total hopping channels is constant for the all modulation mode according with the Bluetooth Core Specification. Here GFSK modulation mode was used to show compliance.

Number of hopping frequencies	Result
79	Pass

GFSK Mode



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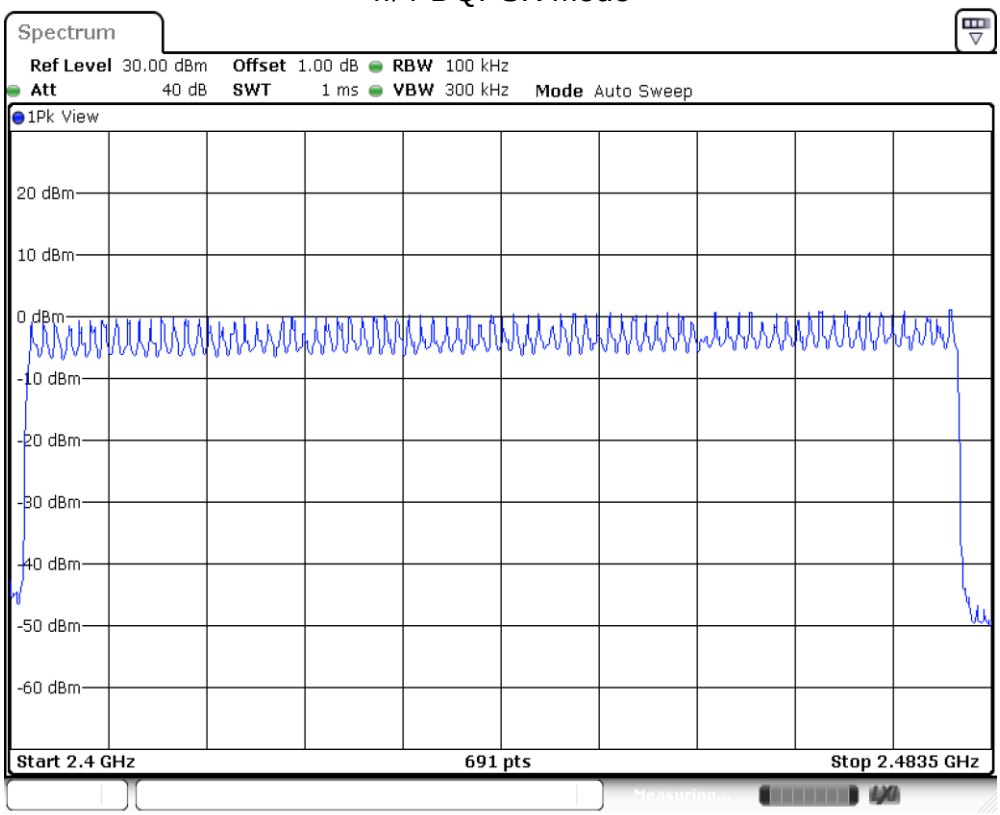
π/4-DQPSK Mode



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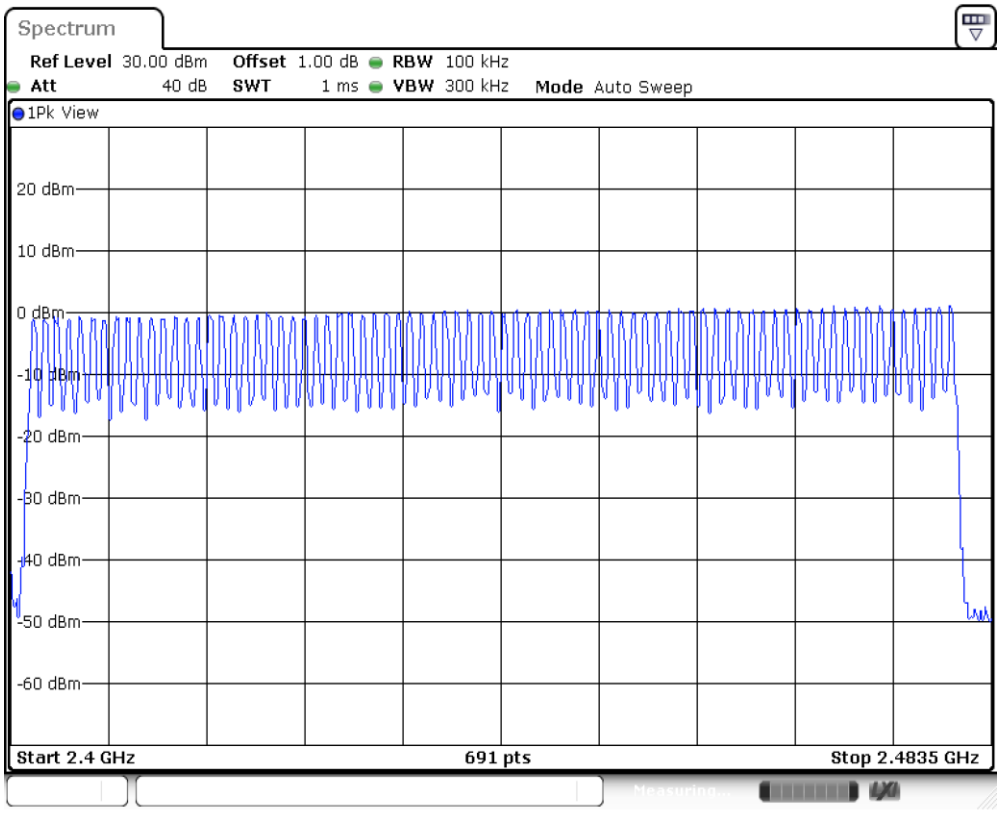
8DPSK Mode



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9.5 Dwell Time

Test Method

1. Connect EUT antenna terminal to the spectrum analyzer with a low loss cable. Equipment mode: Spectrum analyzer
2. RBW: 1MHz; VBW: 1MHz; SPAN: Zero Span
3. Adjust the center frequency of spectrum analyzer on any frequency be measured.
4. Measure the Dwell Time by spectrum analyzer Marker function.
5. Repeat above procedures until all frequencies measured were complete.

Limit

The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

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Dwell Time

Dwell time

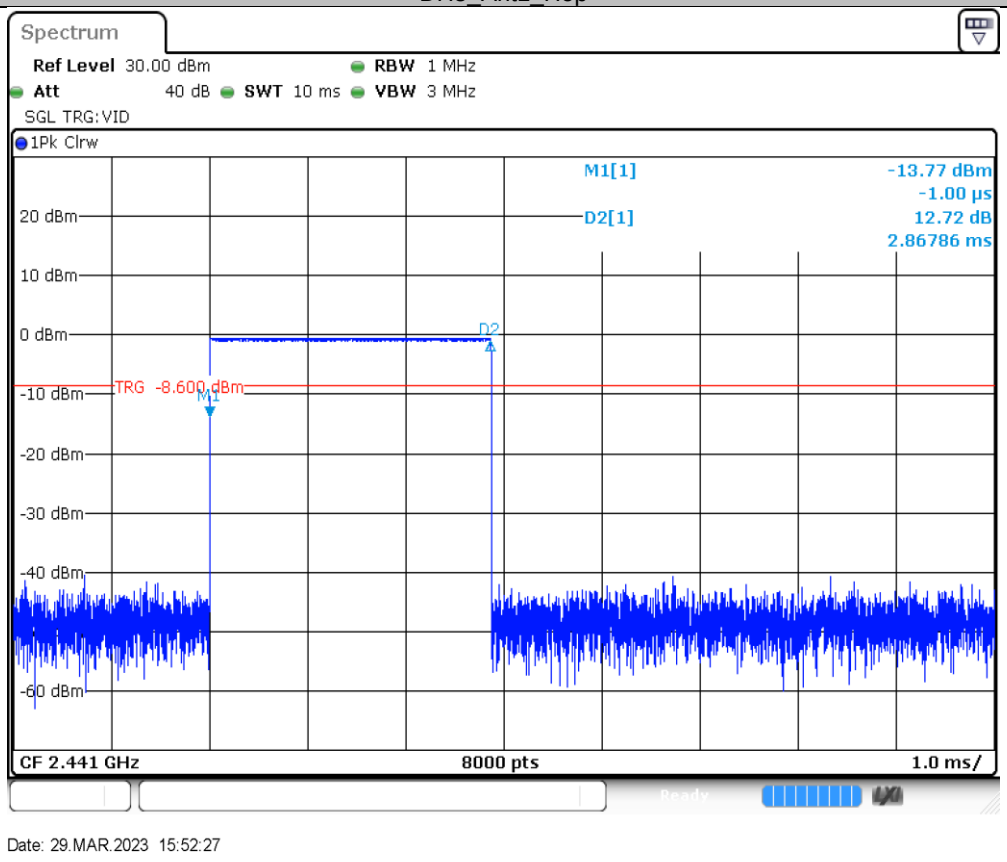
The maximum dwell time shall be 0.4 s.

The Dwell Time = Burst Width * Total Hops. The detailed calculations are showed as follows:
The duration for dwell time calculation: 0.4 [s] * hopping number = 0.4 [s] * 79 [ch] = 31.6 [s*ch];

Test Result

TestMode	Channel	BurstWidth (ms)	TotalHops	Result(s)	Limit(s)	Verdict
DH5	Hop	2.87	120	0.344	<=0.4	PASS
2DH5	Hop	2.87	110	0.316	<=0.4	PASS
3DH5	Hop	2.35	140	0.328	<=0.4	PASS

DH5_Ant1_Hop



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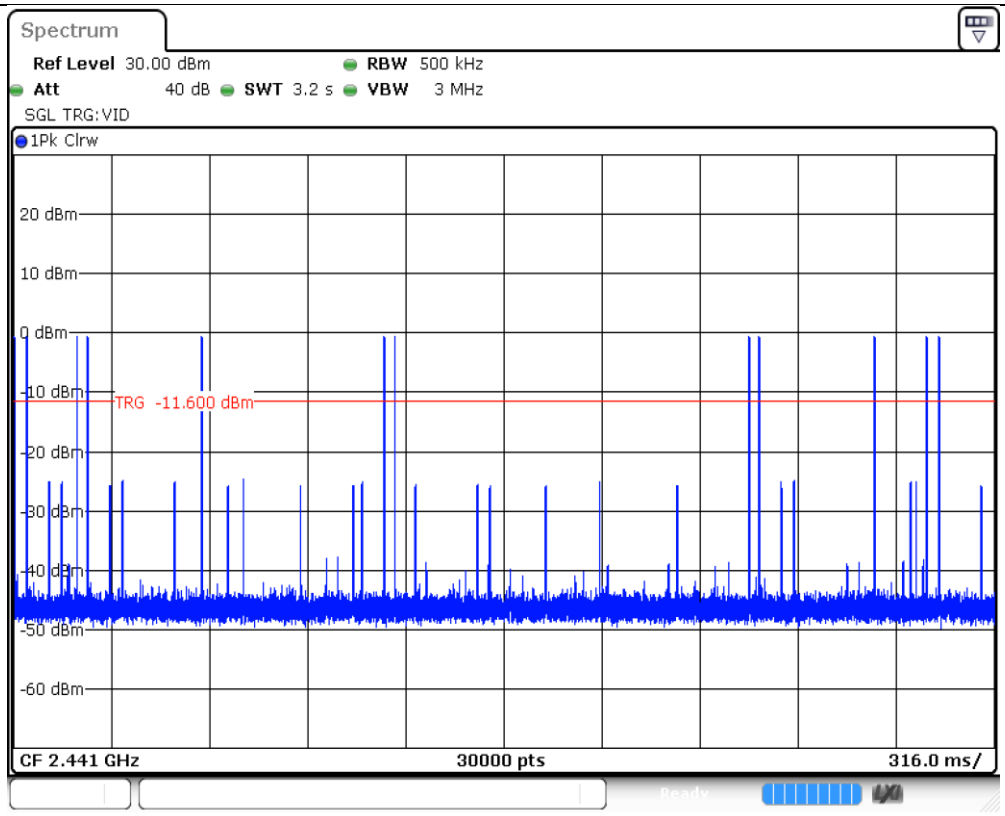

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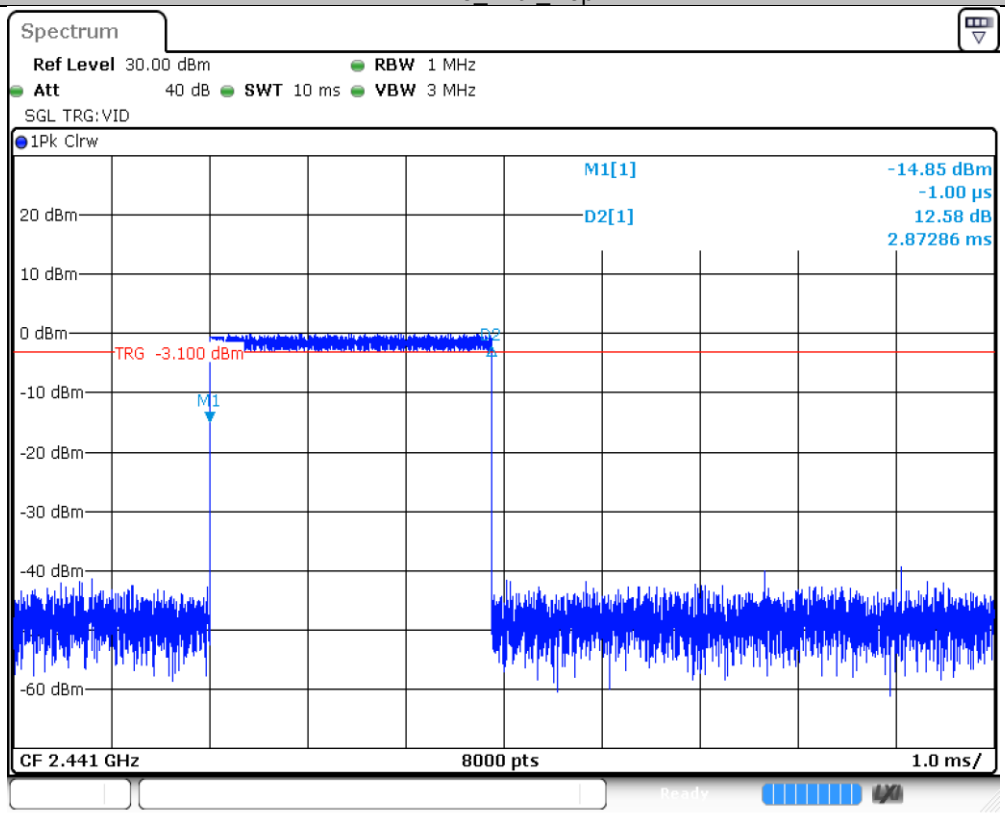
2DH5_Ant1_Hop



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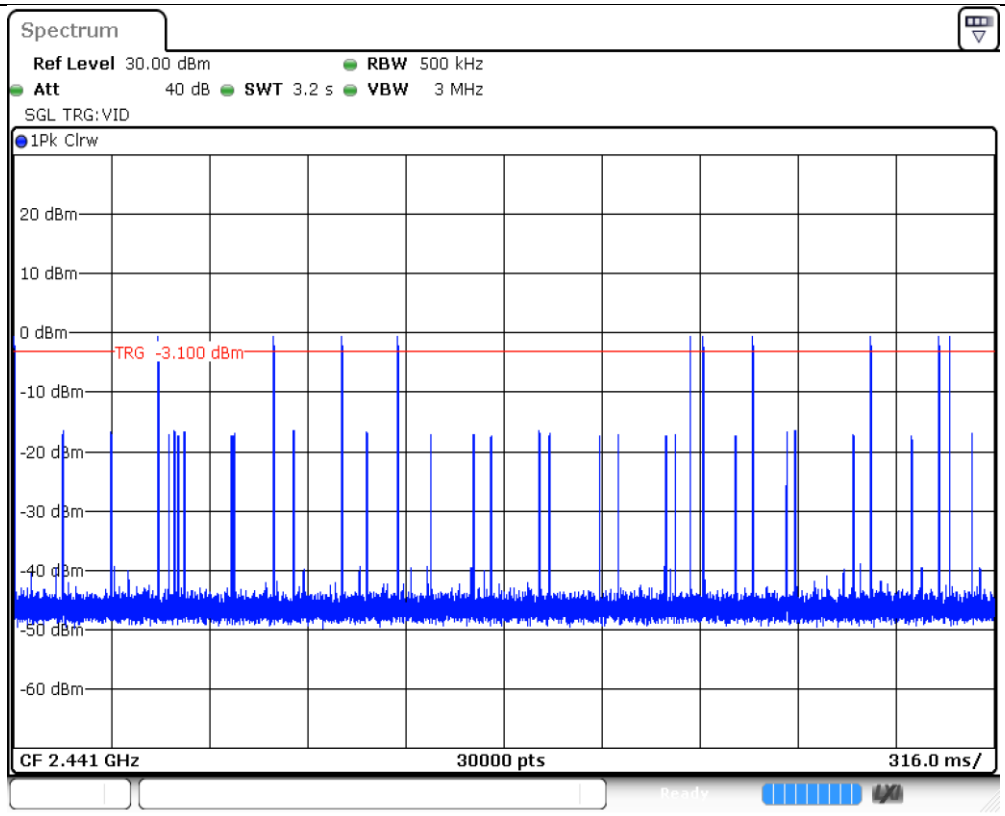

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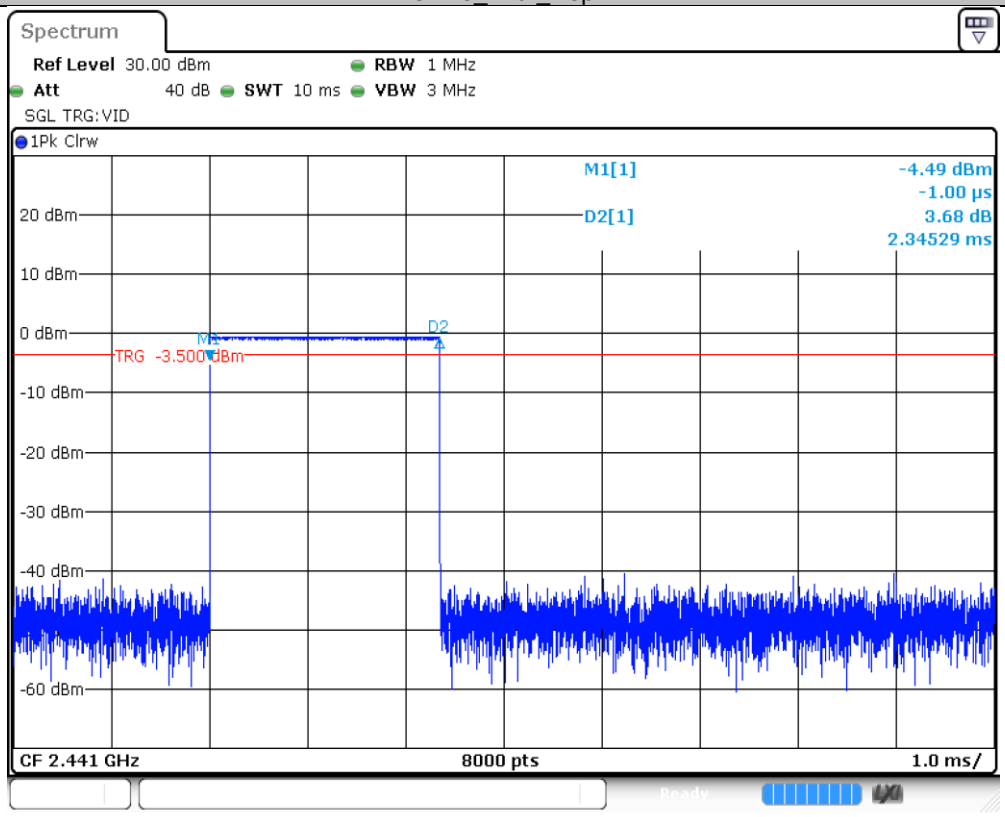
3DH5_Ant1_Hop



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