FCC - TEST REPORT

Report Number	:	**68.950.20.0781.01**	Date of Issue:	2021-05-20
Model	:	**L1, L1xy ("x" and "y" can be replaced by A-Z, 0-9 or blank, which stands for marketing purpose)**		
Product Type	:	LED PROJECTOR		
Applicant	:	ASUSTeK COMPUTER INC.		
Address	:	1F., No.15, Lide Rd., 112 Beitou Dist., Taipei City, Taiwan.		
Manufacturer	:	ASUSTeK COMPUTER INC.		
Address	:	1F., No.15, Lide Rd., 112 Beitou Dist., Taipei City, Taiwan.		
Test Result	:	■ **Positive** ☐ **Negative**		
Total pages including Appendices	:	**69**		

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1 Table of Contents

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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, Nantou Checkpoint Road 2, Nanshan District, Shenzhen City, 518052, P. R. China
FCC Designation Number:	CN5009
FCC Registration No.:	514049
Telephone:	86 755 8828 6998
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3 Description of the Equipment Under Test

Product:	LED PROJECTOR
Model no.:	L1, L1xy ("x" and "y" can be replaced by A-Z, 0-9 or blank, which stands for marketing purpose)
FCC ID:	MSQ-L1
Rating:	7.2VDC, 3120mAh, (Supplied by Rechargeable Li-ion Battery) or 12VDC (Supplied by external adapter for Charging rechargeable battery) Adapter Model: ADP-36PH B Input: 100-240VAC 50-60Hz, 1A, Output: 12VDC,3A Manufacturer: DELTA ELECTRONICS, INC
RF Transmission Frequency:	2402MHz-2480MHz
No. of Operated Channel:	79
Modulation:	GFSK, π/4-DQPSK, 8DPSK
Antenna Type:	Internal antenna
Antenna Ports	Ant 1
Antenna Gain:	2.6dBi Max for 2.4GHz 4.5dBi Max for 5GHz
Description of the EUT:	The equipment supports Bluetooth Low Energy/Bluetooth BR+EDR /WIFI functions. The TX and RX range is 2402MHz-2480MHz for Bluetooth, 2412MHz – 2462MHz for 2.4GHzWIFI, 5180MHz – 5320MHz, 5500MHz – 5700MHz, 5745MHz – 5825MHz for 5GHzWIFI

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4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2019 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to KDB 558074 D01 15.247 Meas Guidance 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	Test Site
§15.207	Conducted emission AC power port	Pass	Site 1
§15.247(b)(1)	Conducted output power	Pass	Site 1
§15.247(b)(1)	Equivalent Isotropic Radiated Power	N/A	--
§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	Site 1
§15.247(a)(1)	Min. of Hopping Channel Carrier Frequency Separation	Pass	Site 1
§15.247(a)(1)(iii)	Min number of hopping frequencies	Pass	Site 1
§15.247(a)(1)(iii)	Dwell Time - Average Time of Occupancy	Pass	Site 1
§15.247(d)	Spurious RF conducted emissions	Pass	Site 1
§15.247(d)	Band edge	Pass	Site 1
§15.247(d) & §15.209 & §15.205	Spurious radiated emissions for transmitter	Pass	Site 1
§15.203	Antenna requirement	See note 2	--

Note 1: N/A=Not Applicable.
Note 2: The EUT uses an Internal antenna, which gain is 2.6dBi Max for 2.4GHz, 4.5dBi Max for 5GHz. 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 intended for FCC ID: MSQ-L1, complies with15.207, 15.209, 15.205, 15.247 of the FCC Part 15, Subpart C

L1, L1xy ("x" and "y" can be replaced by A-Z, 0-9 or blank, which stands for marketing purpose) is a LED PROJECTOR with Bluetooth Low Energy/Bluetooth BDR+EDR/WIFI function.
The difference among all Models is only model name.
Unless otherwise specified the model L1 was chosen as the representative model to perform full tests, and model: L1xy ("x" and "y" can be replaced by A-Z, 0-9 or blank, which stands for marketing purpose) was deemed to fulfil relevant RF requirements without further testing.

This report is for the Bluetooth BR+EDR part.

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: 2020-12-01

Testing Start Date: 2020-12-01

Testing End Date: 2020-12-25

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

Reviewed by:	Prepared by:	Tested by:
John Zhi	Joe Gu	Carry Cai
Project Manager	Project Engineer	Test Engineer

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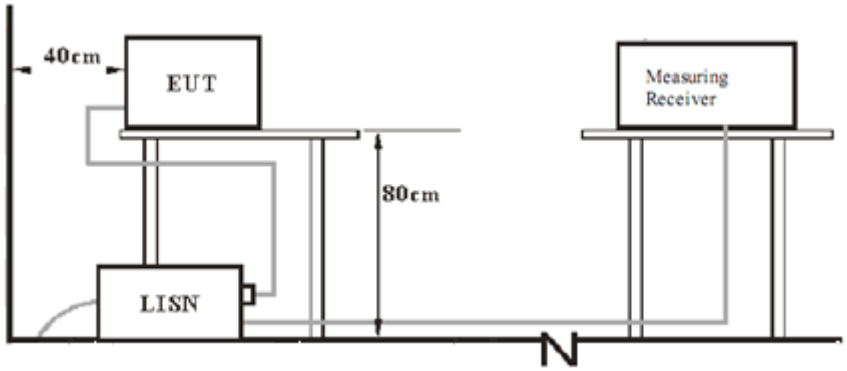
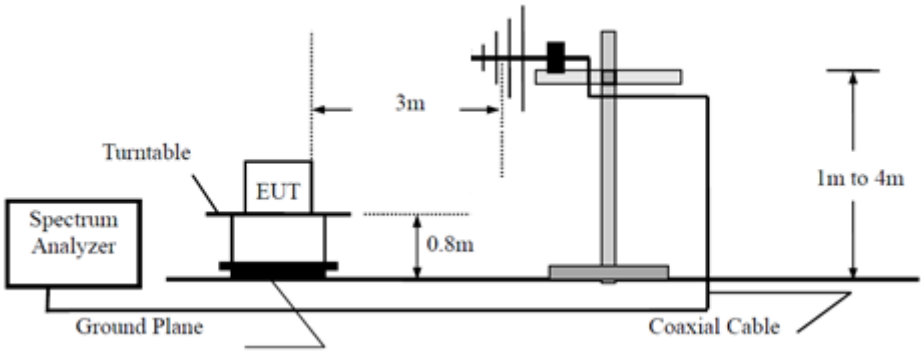
7 Test Setups

7.1 AC Power Line Conducted Emission test setups

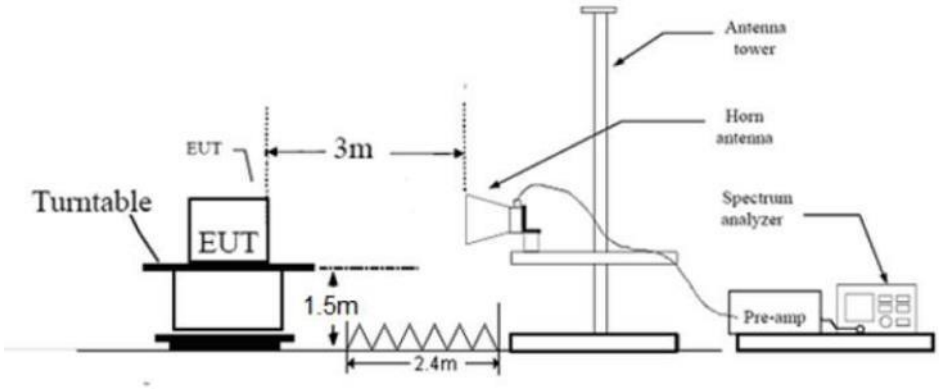


7.2 Radiated test setups

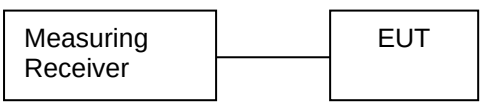
Below 1GHz



Above 1GHz



7.3 Conducted RF test setups



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8 Systems test configuration

Auxiliary Equipment Used during Test:

Description	Manufacturer	Model no.	Serial no.	CAL. DUe DATE
Laptop	Thinkpad	X220	---	---

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.

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9 Technical Requirement

9.1 Conducted Emission

Test Method

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. Both sides of AC line were checked for maximum conducted interference.
6. The frequency range from 150 kHz to 30 MHz was searched.
7. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

Limit

Frequency MHz	QP Limit dBµV	AV Limit dBµV
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

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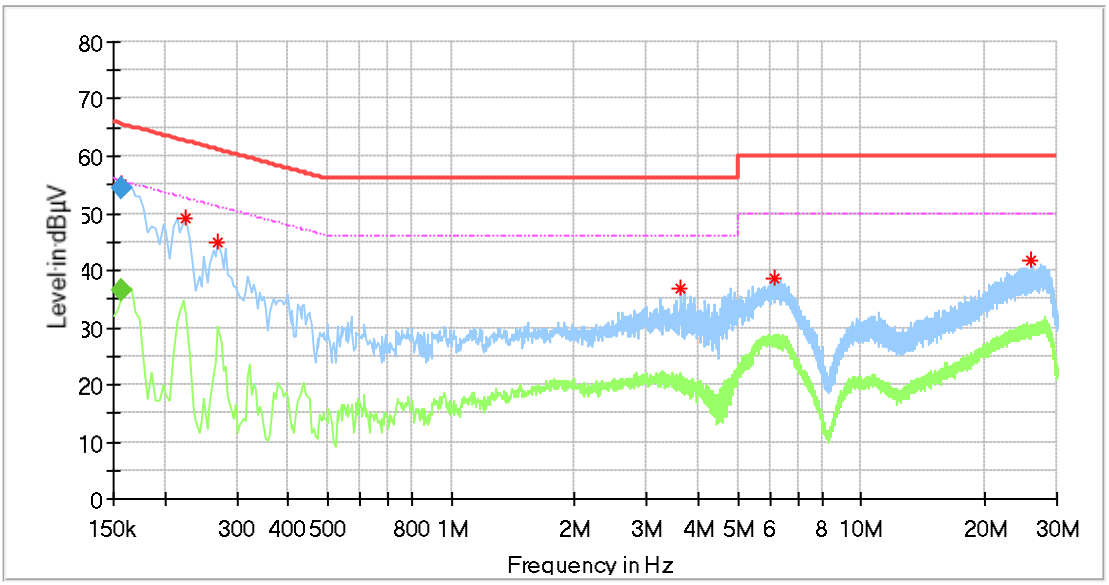
Conducted Emission

Product Type	:	LED PROJECTOR
M/N	:	L1
Operating Condition	:	Charging + Transmit
Test Specification	:	Power Line, Live
Comment	:	AC 120V/60Hz (External adapter)



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.157500	55.23	---	65.36	10.13	L1	10.32
0.226000	49.24	---	62.60	13.35	L1	10.32
0.270000	44.88	---	61.12	16.24	L1	10.32
3.638000	36.79	---	56.00	19.21	L1	10.45
6.138000	38.76	---	60.00	21.24	L1	10.57
26.022000	41.60	---	60.00	18.40	L1	11.56

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.157500	---	36.46	55.59	19.13	L1	10.32
0.157500	54.28	---	65.59	11.31	L1	10.32

Remark：

Level=Reading Level + Correction Factor

Correction Factor=Cable Loss + LISN Factor

(The Reading Level is recorded by software which is not shown in the sheet)

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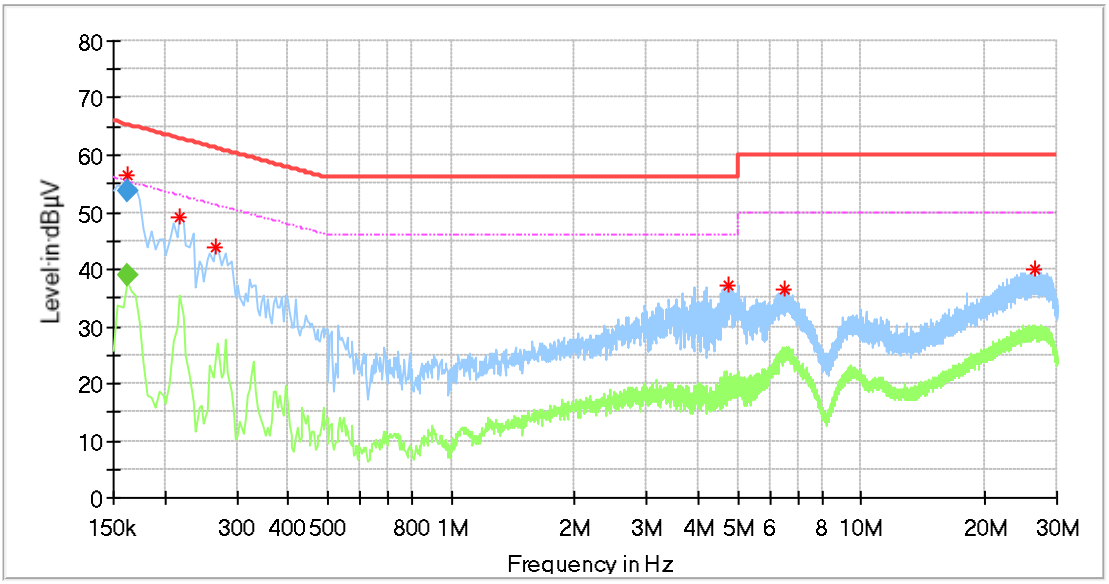
Conducted Emission

Product Type	:	LED PROJECTOR
M/N	:	L1
Operating Condition	:	Charging + Transmit
Test Specification	:	Power Line, Neutral
Comment	:	AC 120V/60Hz (External adapter)



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.161500	56.57	---	65.36	8.79	N	10.33
0.218000	49.17	---	62.89	13.72	N	10.33
0.266000	43.83	---	61.24	17.41	N	10.33
4.738000	37.23	---	56.00	18.77	N	10.54
6.522000	36.50	---	60.00	23.50	N	10.63
26.438000	40.10	---	60.00	19.90	N	11.71

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.161500	---	38.91	55.39	16.48	N	10.33
0.161500	53.67	---	65.39	11.72	N	10.33

Remark：

Level=Reading Level + Correction Factor

Correction Factor=Cable Loss + LISN Factor

(The Reading Level is recorded by software which is not shown in the sheet)

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9.2 Conducted output power

Test Method

1. The EUT was placed on 0.8m height table, the RF output of EUT was connected to the power meter by RF cable. The path loss was compensated to the results for each measurement.
2. Use the following spectrum analyzer settings:
   RBW > the 6dB bandwidth of the emission being measured, VBW≥3RBW, Span≥3RBW
   Sweep = auto, Detector function = peak, Trace = max hold.
3. 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.

Limits

According to §15.247(b)(1), conducted output power limit as below:

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

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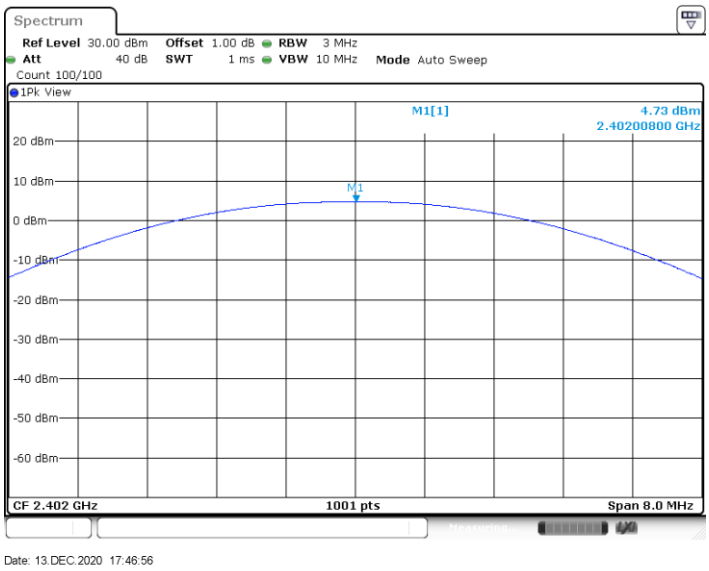
Conducted output power

Bluetooth Mode GFSK modulation Test Result

Frequency MHz	Conducted Output Power dBm	Result
Low channel 2402MHz	4.73	Pass
Middle channel 2441MHz	5.76	Pass
High channel 2480MHz	5.13	Pass

Low channel 2402MHz



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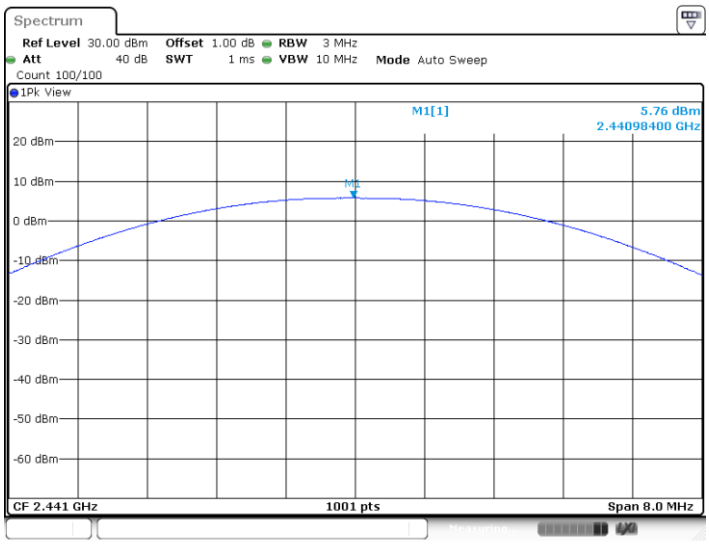
Middle channel 2441MHz



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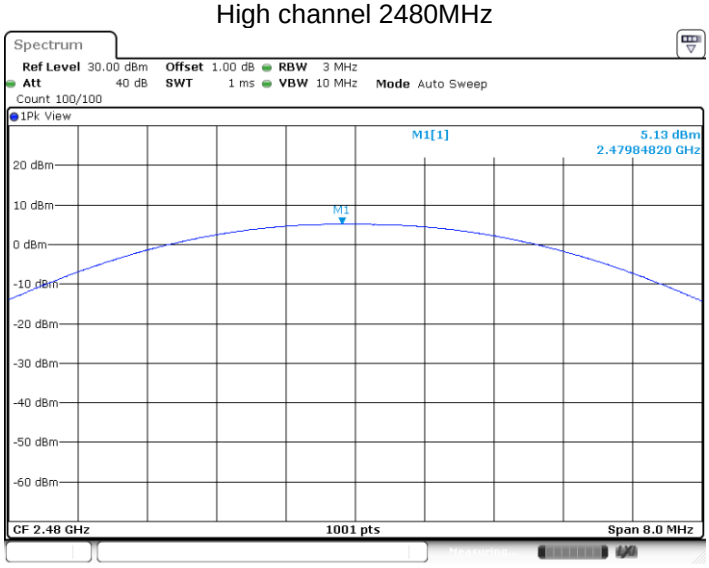
High channel 2480MHz



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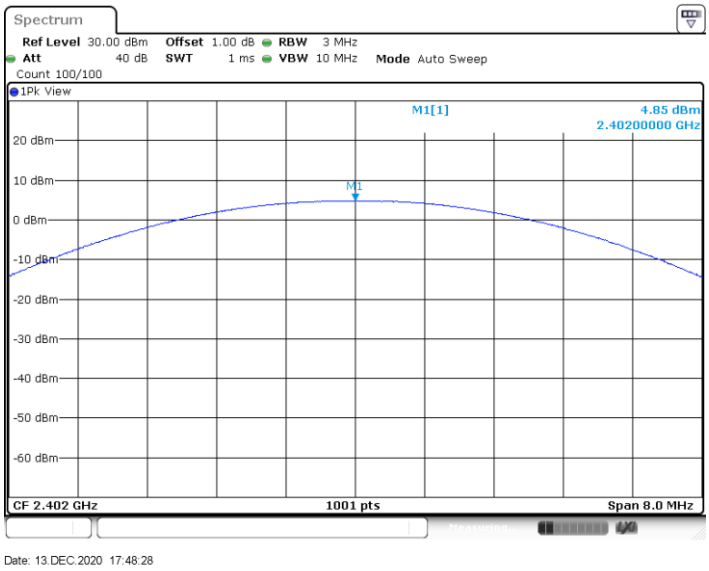
Bluetooth Mode π/4-DQPSK modulation Test Result

Frequency MHz	Conducted Output Power dBm	Result
Low channel 2402MHz	4.85	Pass
Middle channel 2441MHz	5.87	Pass
High channel 2480MHz	5.23	Pass

Low channel 2402MHz



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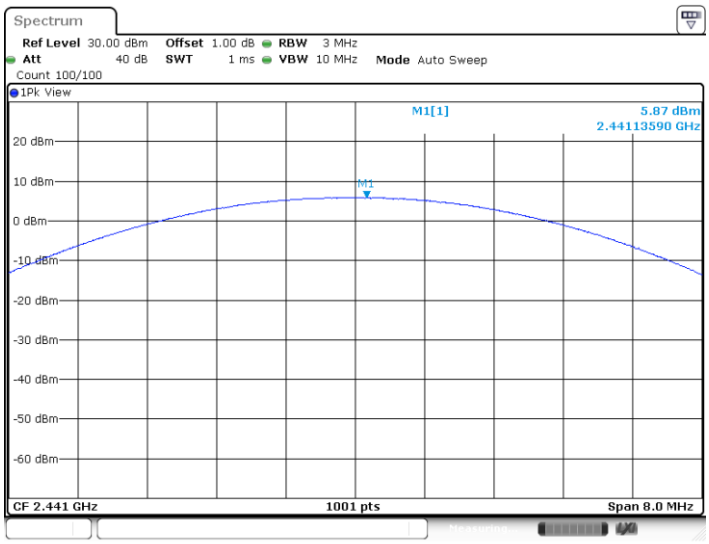
Middle channel 2441MHz



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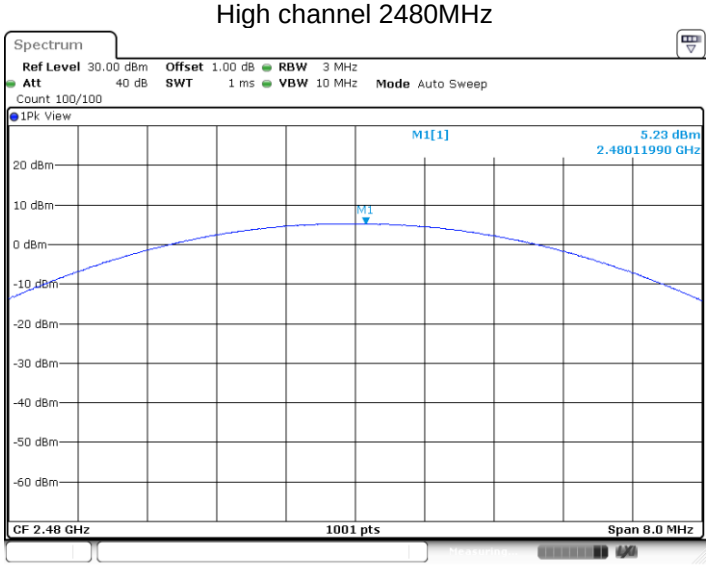
High channel 2480MHz



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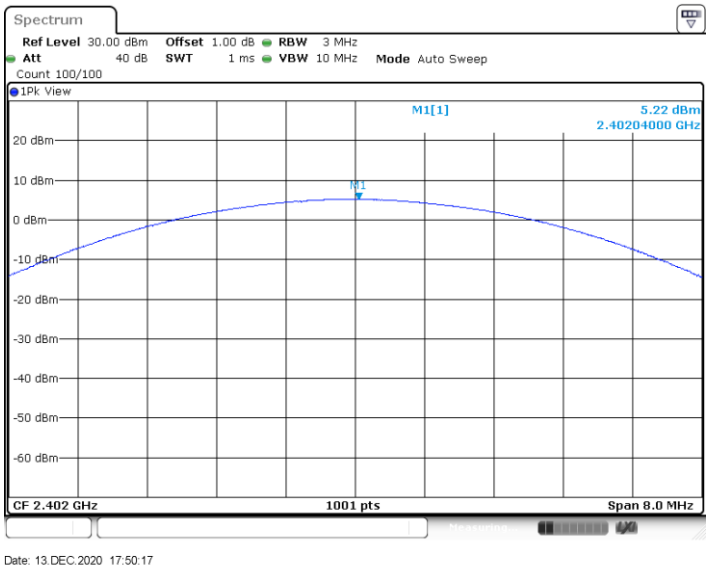
Bluetooth Mode 8DPSK modulation Test Result

Frequency MHz	Conducted Output Power dBm	Result
Low channel 2402MHz	5.22	Pass
Middle channel 2441MHz	6.26	Pass
High channel 2480MHz	5.64	Pass

Low channel 2402MHz



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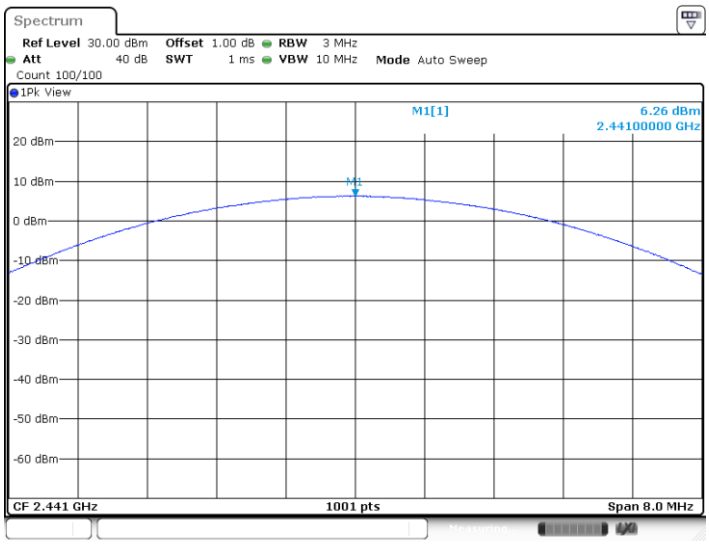
Middle channel 2441MHz



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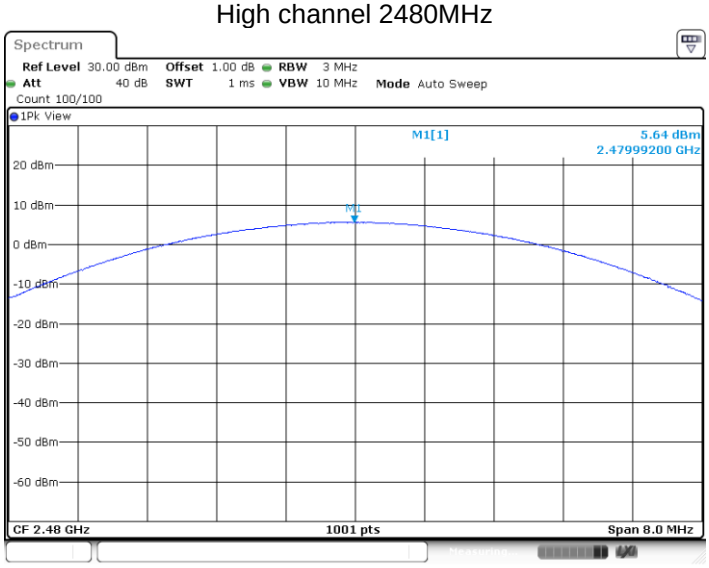
High channel 2480MHz



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9.3 20 dB bandwidth and 99% Occupied Bandwidth

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. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth. Record the results.
5. Repeat above procedures until all frequencies measured were complete.

Limit

Limit [kHz]
N/A

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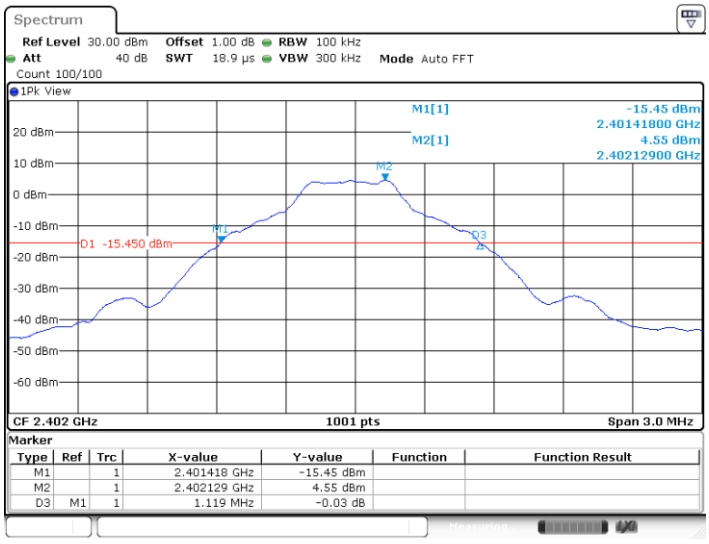
20 dB bandwidth and 99% Occupied Bandwidth

Bluetooth Mode GFSK Modulation test result

Frequency MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz	Result
2402	1119	884	--	Pass
2441	1122	878	--	Pass
2480	1122	881	--	Pass

Low channel 2402MHz



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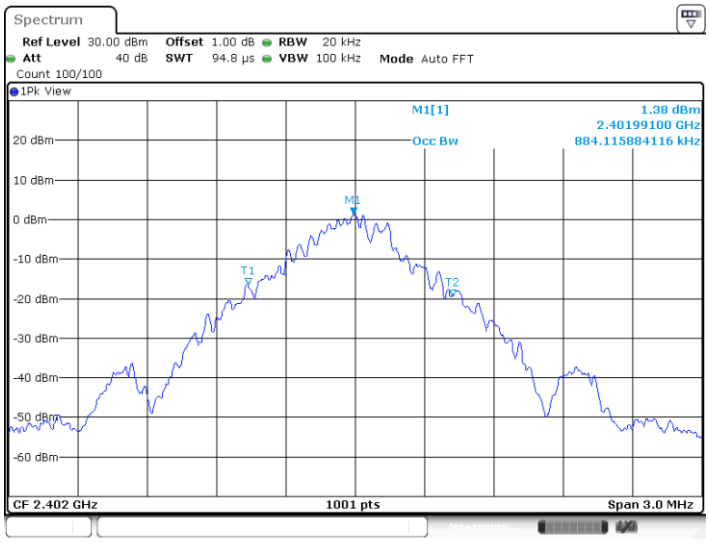

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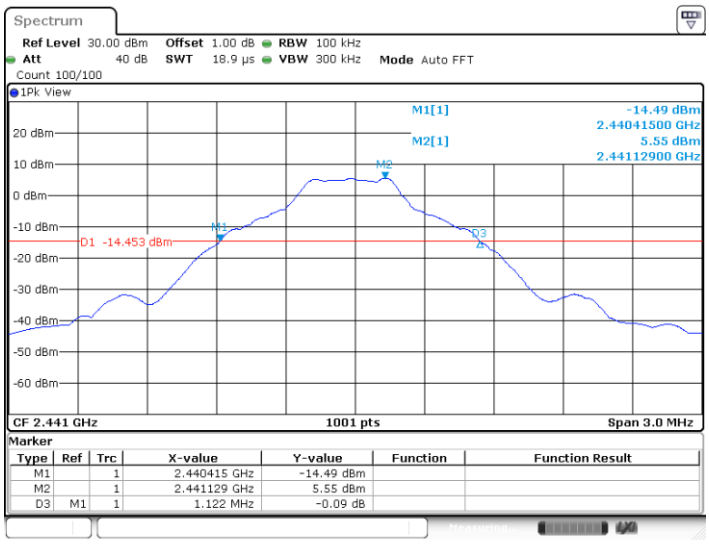
20 dB bandwidth and 99% Occupied Bandwidth

Middle channel 2441MHz



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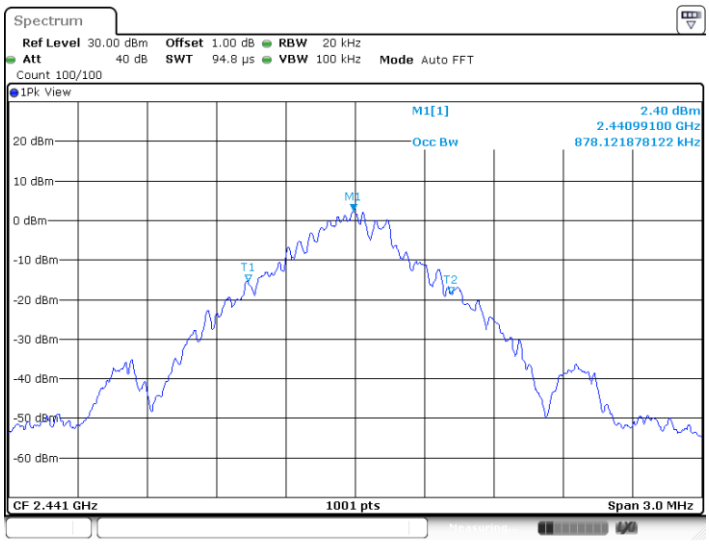

Date: 13.DEC.2020 17:19:02

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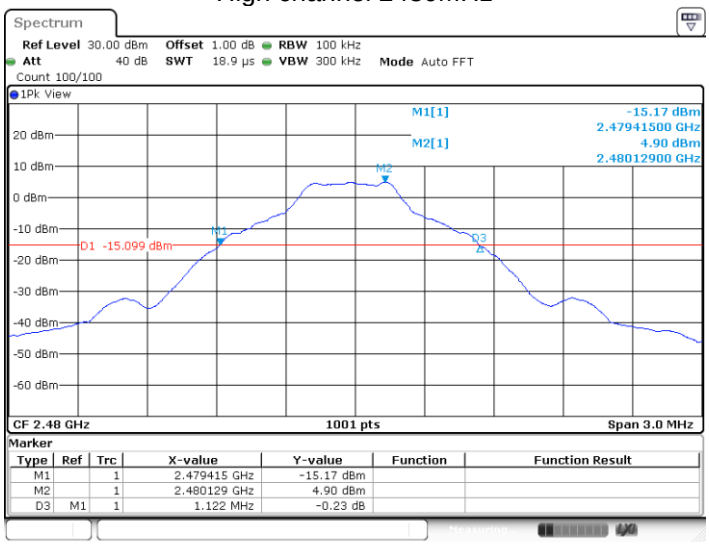
20 dB bandwidth and 99% Occupied Bandwidth

High channel 2480MHz



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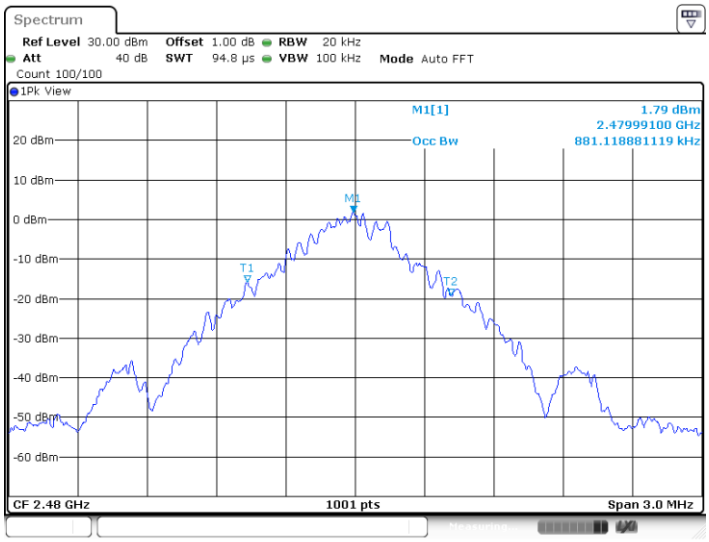

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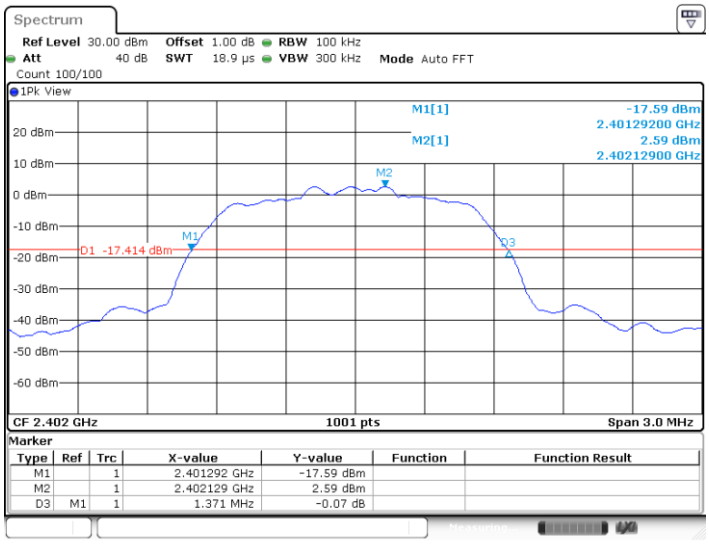
20 dB bandwidth and 99% Occupied Bandwidth

Bluetooth Mode π/4-DQPSK Modulation test result

Frequency	20 dB Bandwidth	99% Bandwidth	Limit	Result
MHz	kHz	kHz	kHz	
2402	1371	1172	--	Pass
2441	1371	1172	--	Pass
2480	1371	1169	--	Pass

Low channel 2402MHz



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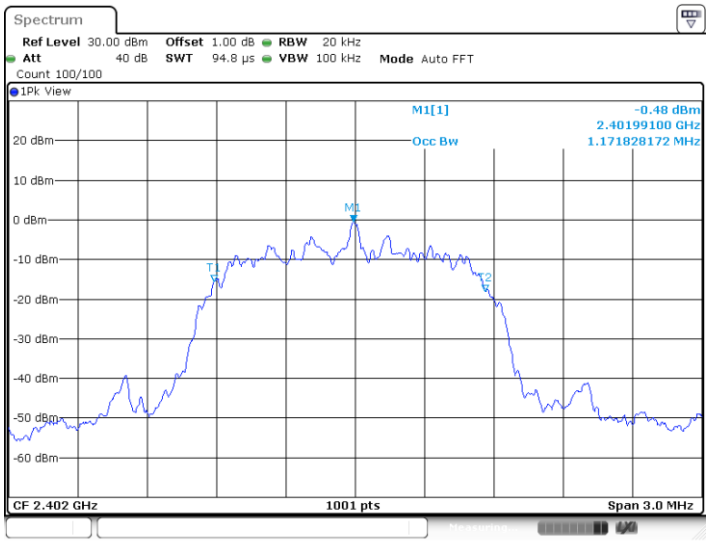

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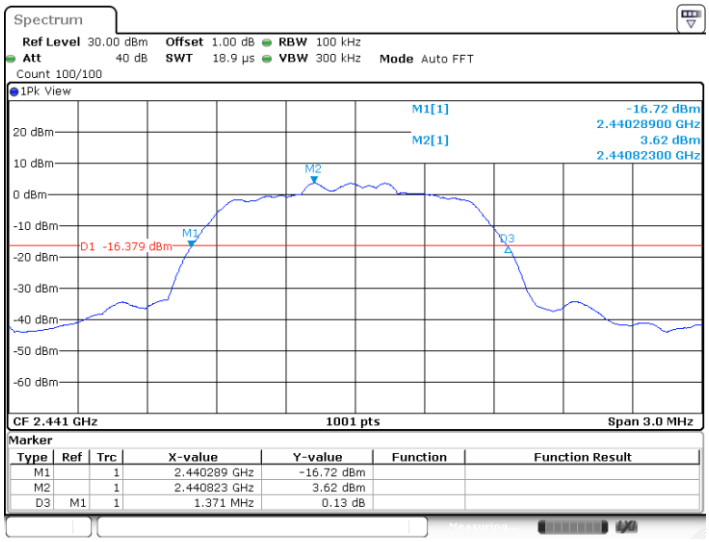
20 dB bandwidth and 99% Occupied Bandwidth

Middle channel 2441MHz



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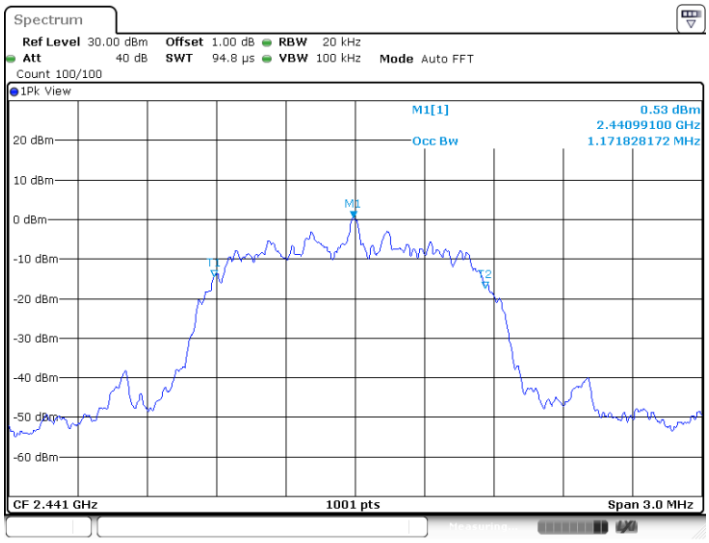

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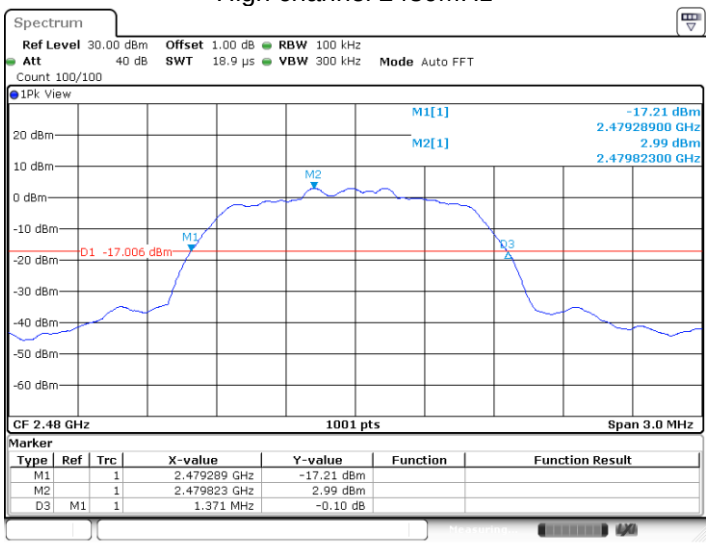
20 dB bandwidth and 99% Occupied Bandwidth

High channel 2480MHz



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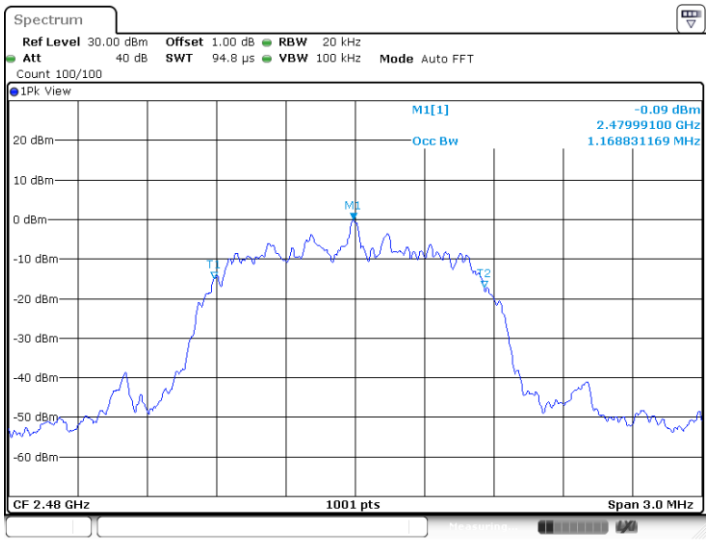

Date: 13.DEC.2020 17:26:22

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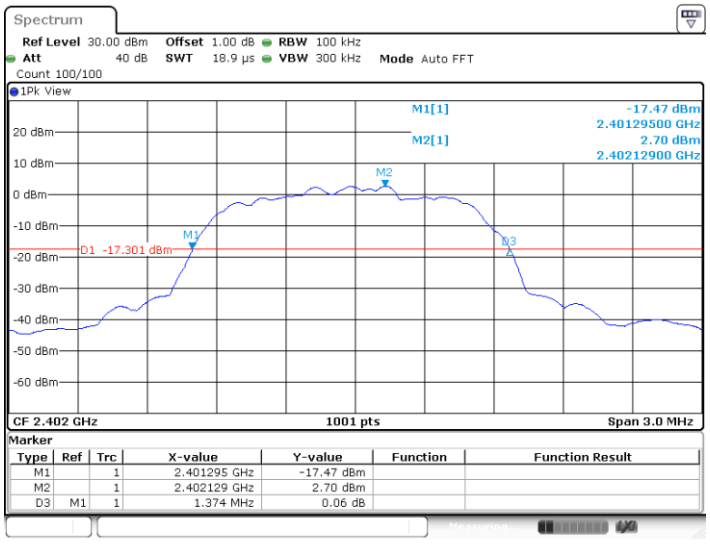
20 dB bandwidth and 99% Occupied Bandwidth

Bluetooth Mode 8DPSK Modulation test result

Frequency MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz	Result
2402	1374	1169	--	Pass
2441	1377	1172	--	Pass
2480	1377	1169	--	Pass

Low channel 2402MHz



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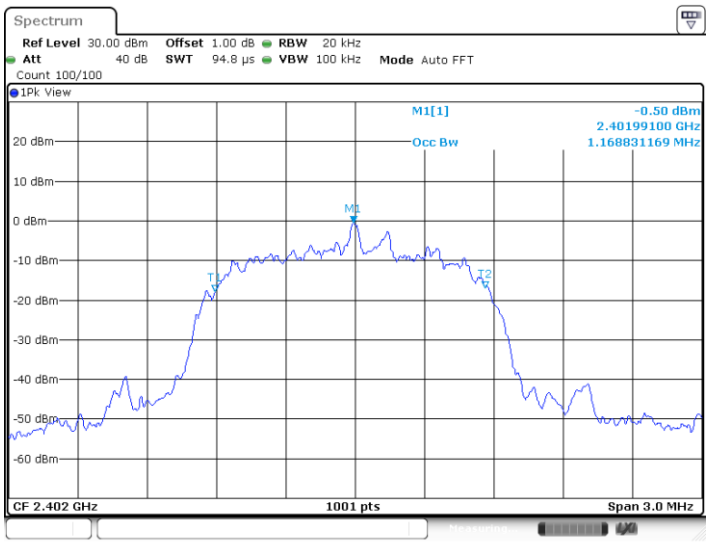

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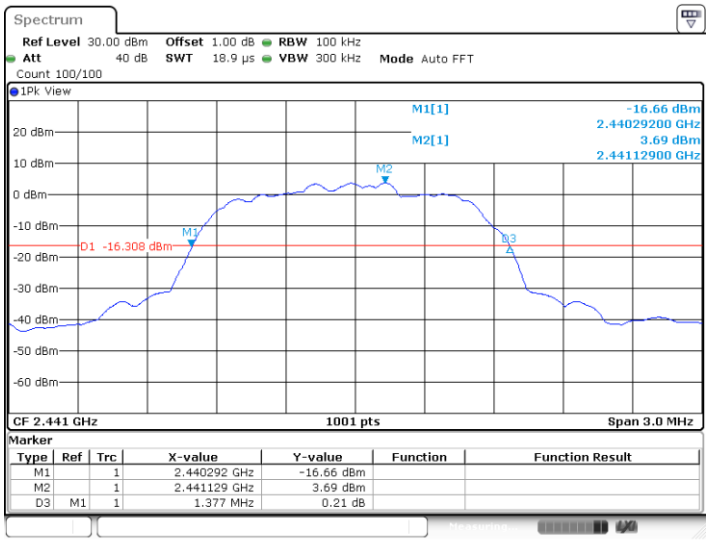
20 dB bandwidth and 99% Occupied Bandwidth

Middle channel 2441MHz



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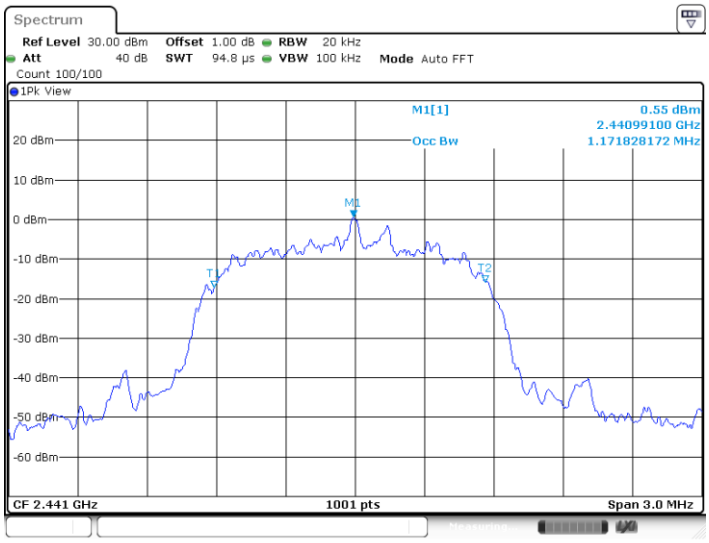

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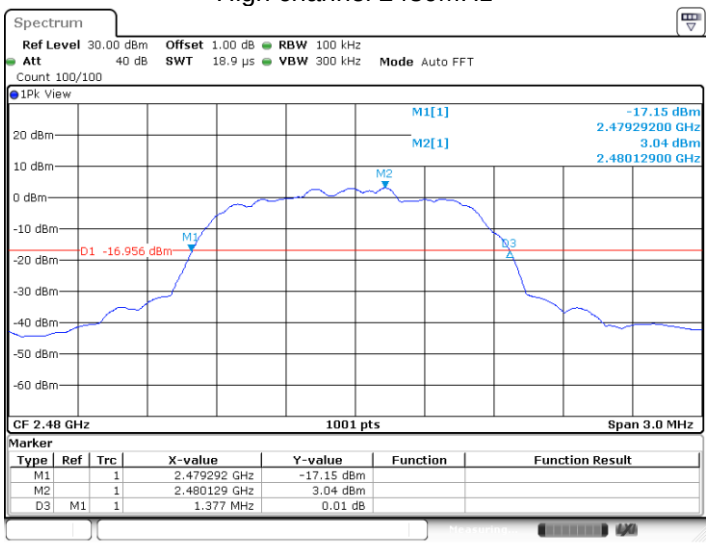
20 dB bandwidth and 99% Occupied Bandwidth

High channel 2480MHz



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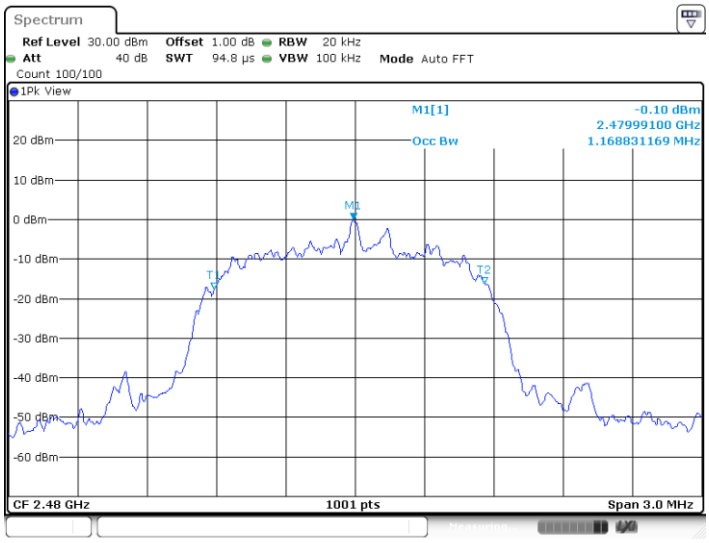

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9.4 Carrier Frequency Separation

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 to hopping mode.
3. 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
4. By using the Max-Hold function record the separation of two adjacent channels.
5. Measure the frequency difference of these two adjacent channels by spectrum analyzer marker function. Record the results.
6. Repeat above procedures until all frequencies measured were complete.

Limit

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

Frequency MHz	2/3 of 20 dB Bandwidth kHz
GFSK	752
π/4-DQPSK	918
8DPSK	926

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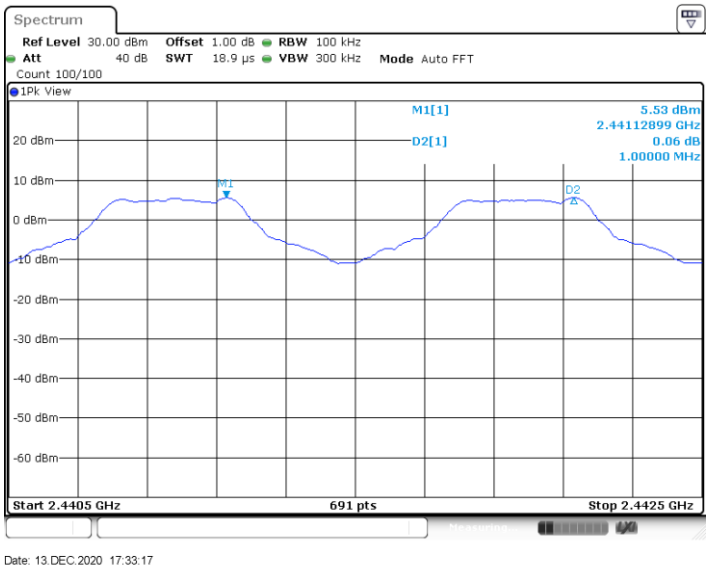
Carrier Frequency Separation

Test result: The measurement was performed with the typical configuration (normal hopping status).

GFSK Modulation test result

Modulation	Frequency MHz	Carrier Frequency Separation kHz	Result
GFSK	Hop	1000	Pass
π/4-DQPSK	Hop	1017	Pass
8DPSK	Hop	1171	Pass

GFSK Mode



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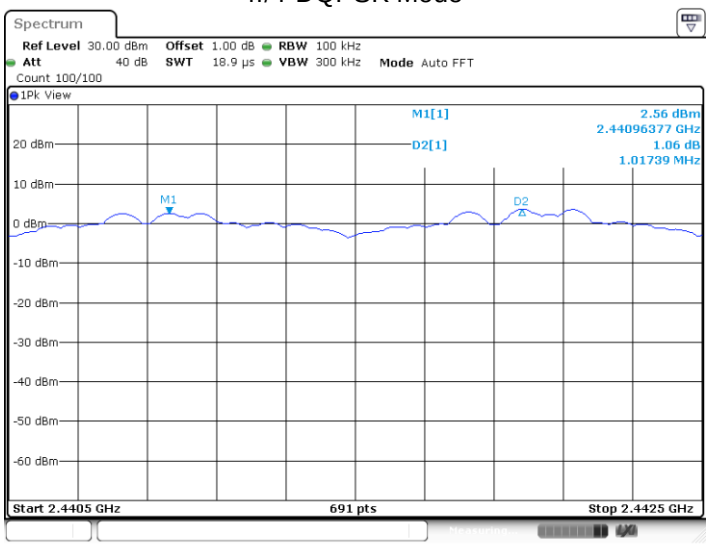
π/4-DQPSK Mode



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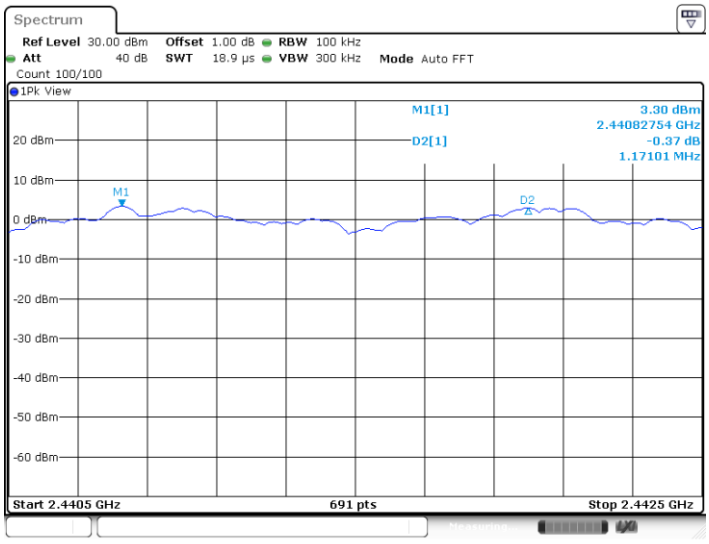
8DPSK Mode



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9.5 Number of hopping frequencies

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 to hopping mode.
3. 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
4. Set the spectrum analyzer on Max-Hold Mode,
5. Record all the signals from each channel until each one has been recorded.
6. Repeat above procedures until all frequencies measured were complete.

Limit

Limit number
≥ 15

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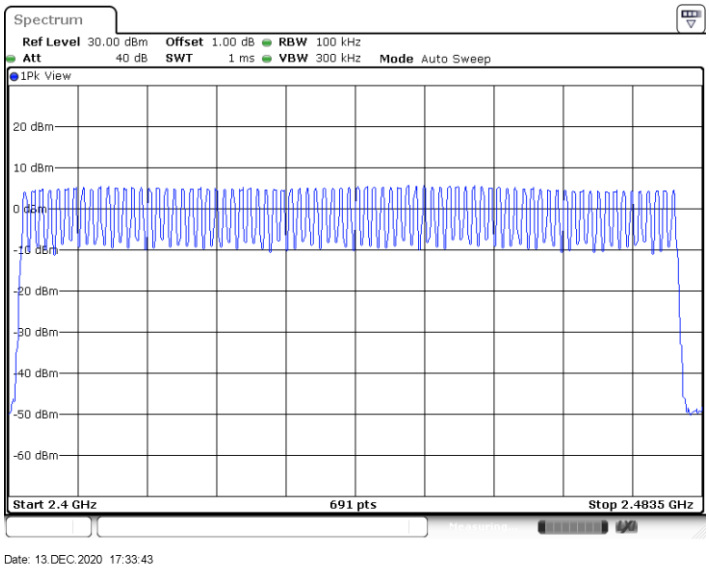
Number of hopping frequencies

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.

Number of hopping frequencies	Result
79	Pass

GFSK Mode



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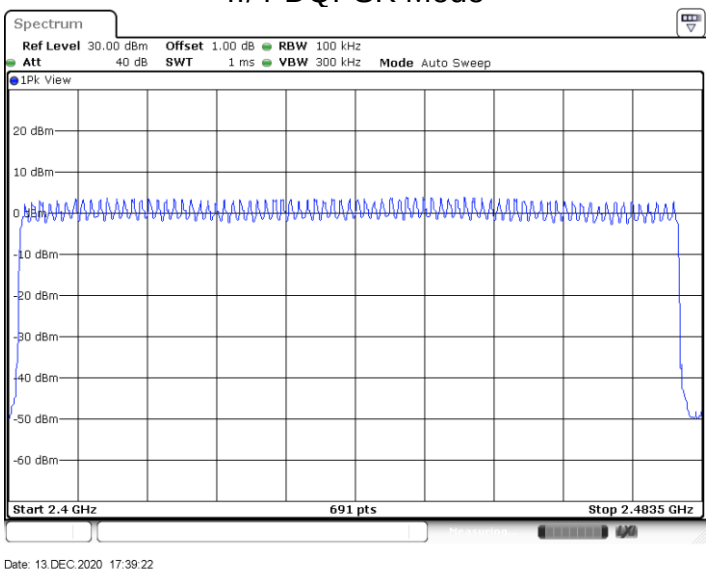
π/4-DQPSK Mode



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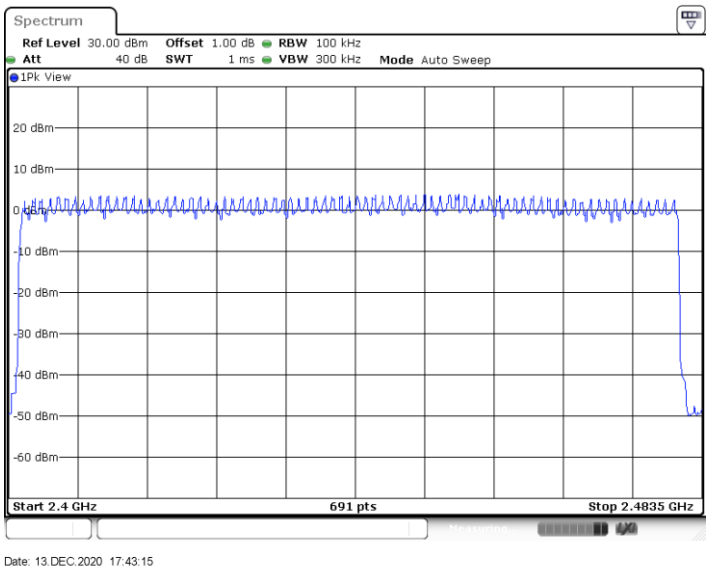
8DPSK Mode



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9.6 Dwell Time

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 to hopping mode.
3. Use the following spectrum analyzer settings:
   RBW: 1MHz; VBW: 1MHz; SPAN: Zero Span
   Set the spectrum analyzer on Max-Hold Mode,
4. Adjust the center frequency of spectrum analyzer on any frequency be measured.
5. Measure the Dwell Time by spectrum analyzer Marker function. Record the results.
   Dwell Time = Burst Width * Total Hops
6. 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

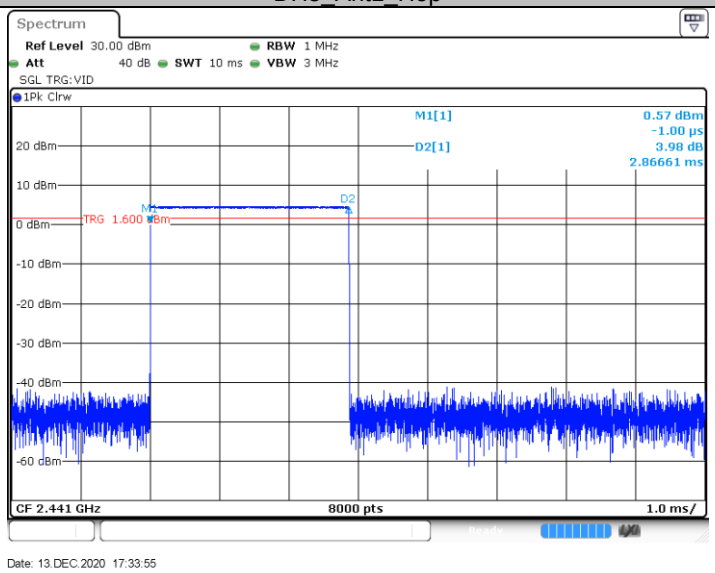
The maximum dwell time shall be 0.4 s.
The Dwell Time = Burst Width * Total Hops. The detailed calculations are showed as follows:
The duration for dwell time calculation: 0.4 [s] * hopping number = 0.4 [s] * 79 [ch] = 31.6 [s*ch];

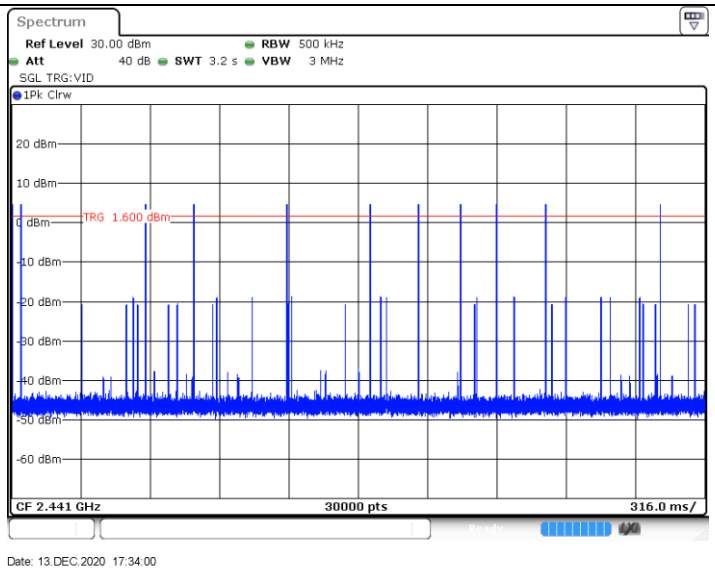
Test Result

Modulation	Mode	BurstWidth (ms)	Total Hops	Test Result (s)	Limit (s)	Result
GFSK	DH5	2.87	110	0.315	0.4	Pass
π/4-DQPSK	2DH5	2.87	130	0.373	0.4	Pass
8-DPSK	3DH5	2.87	120	0.345	0.4	Pass

GFSK Modulation

DH5_Ant1_Hop





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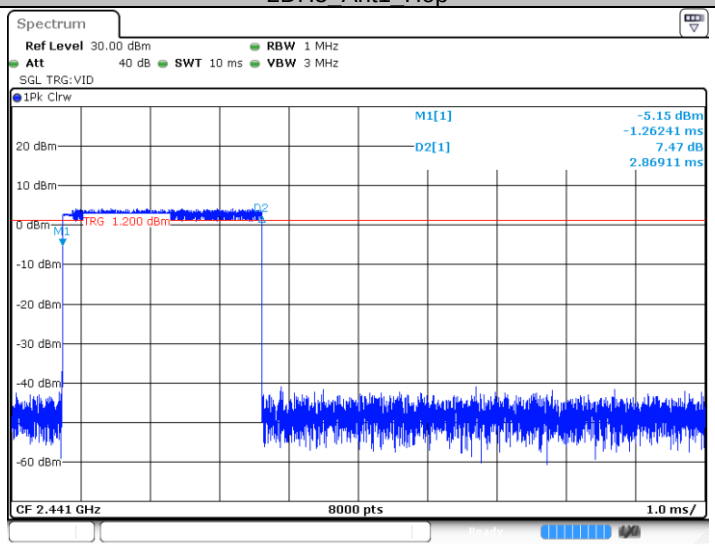
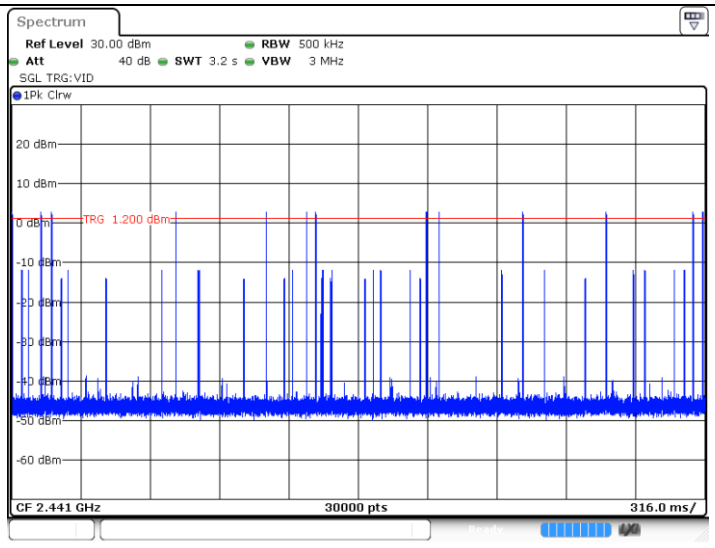
π/4-DQPSK Modulation

2DH5_Ant1_Hop



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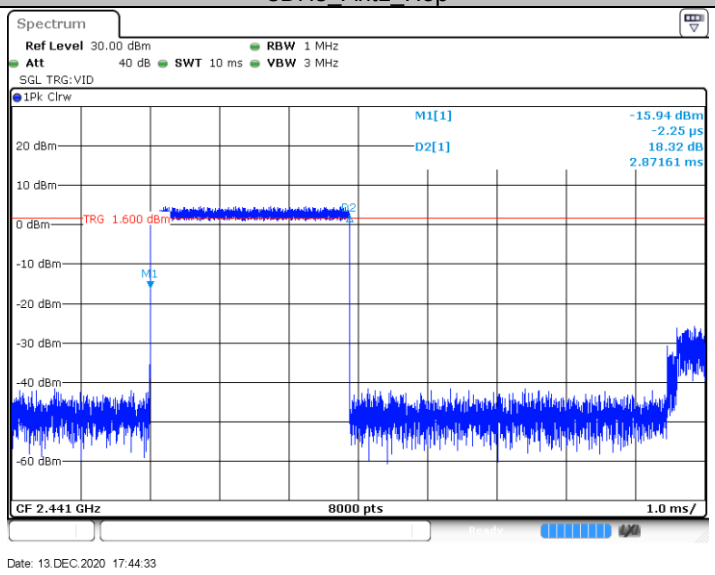
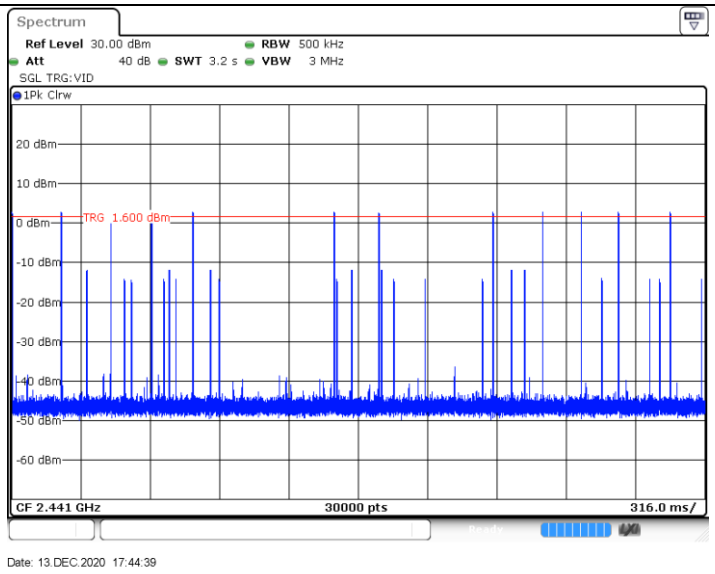
8-DPSK Modulation

3DH5_Ant1_Hop



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9.7 Spurious RF conducted emissions

Test Method

1. The RF output of EUT was connected to the spectrum analyzer 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. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
4. Measure and record the results in the test report.
5. The RF fundamental frequency should be excluded against the limit line in the operating frequency

Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

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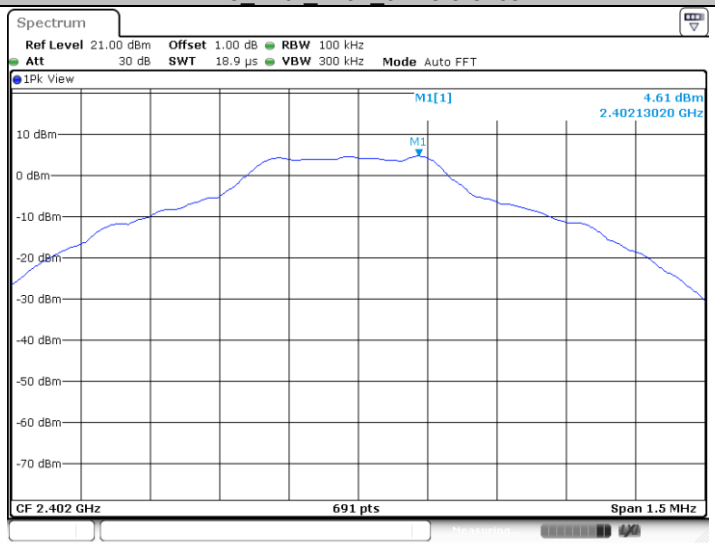
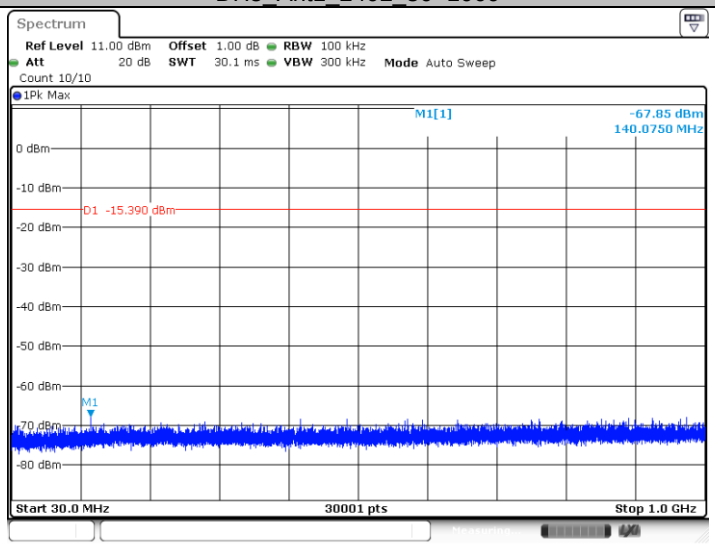
Spurious RF conducted emissions

DH5_Ant1_2402_0~Reference



Date: 13.DEC.2020 17:17:42

DH5_Ant1_2402_30~1000



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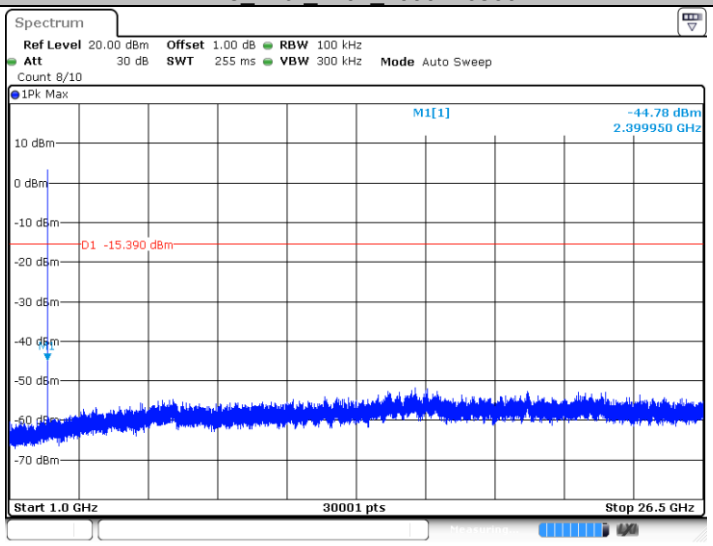
DH5_Ant1_2402_1000~26500



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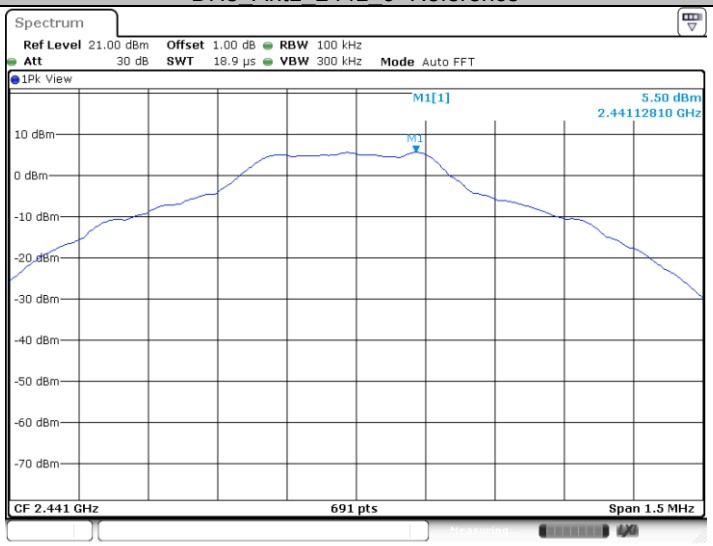
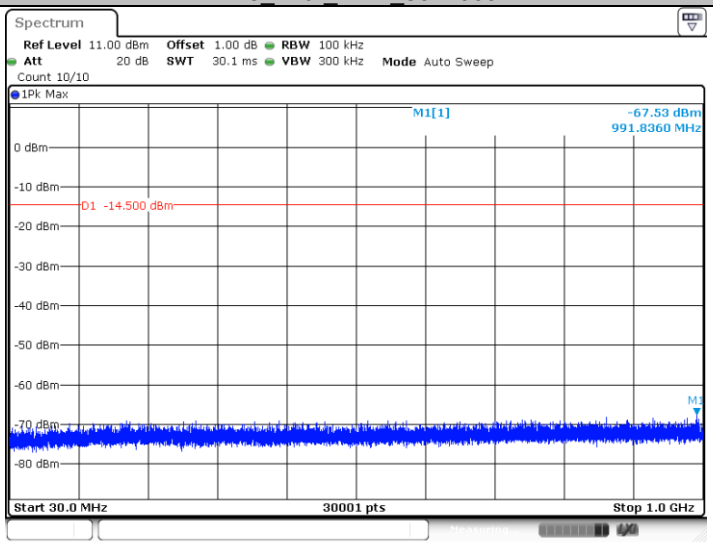
DH5_Ant1_2441_0~Reference



Date: 13.DEC.2020 17:19:08

DH5_Ant1_2441_30~1000



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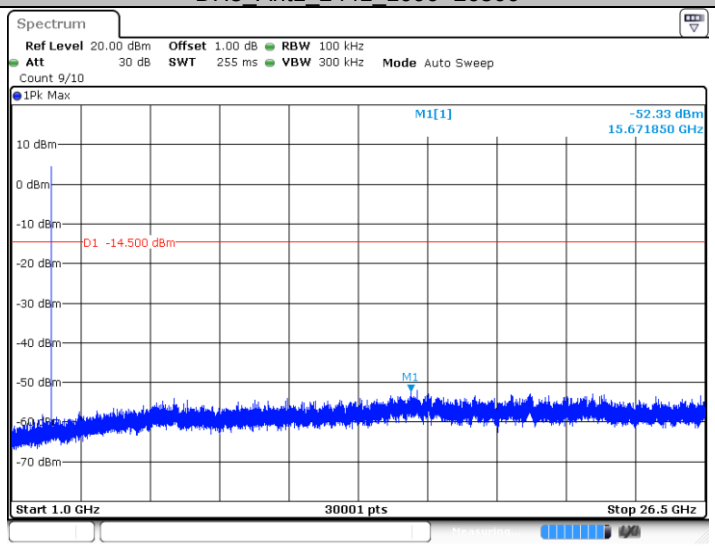
DH5_Ant1_2441_1000~26500



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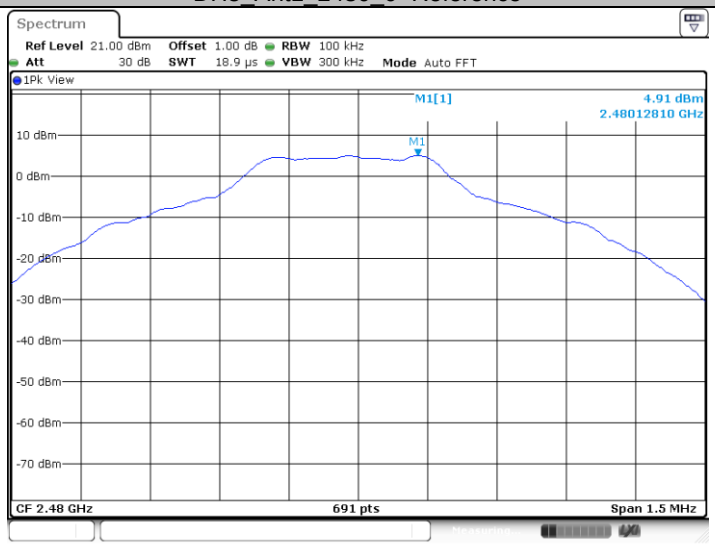

Date: 13.DEC.2020 17:20:42

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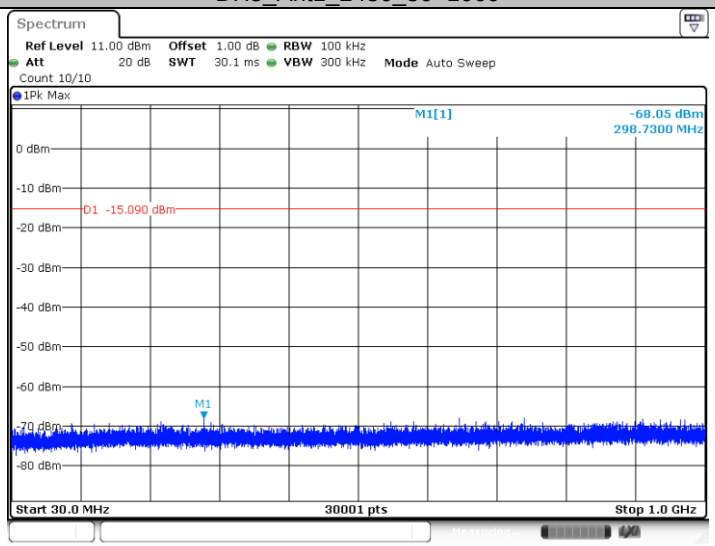

Date: 13.DEC.2020 17:20:48

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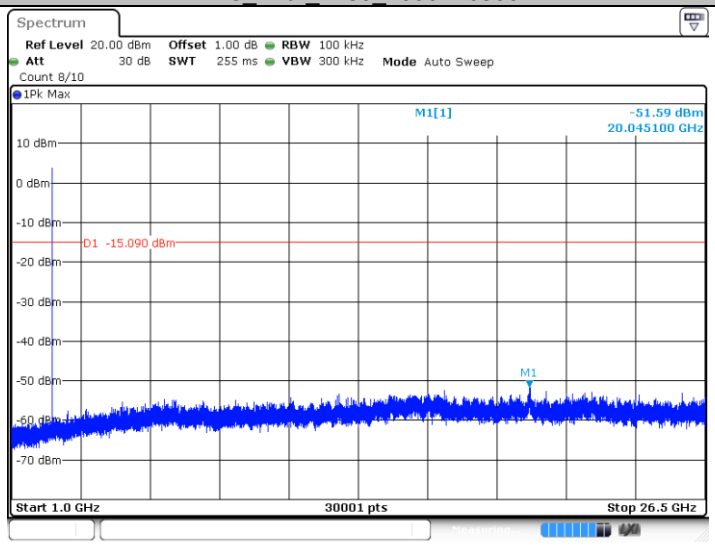
DH5_Ant1_2480_1000~26500



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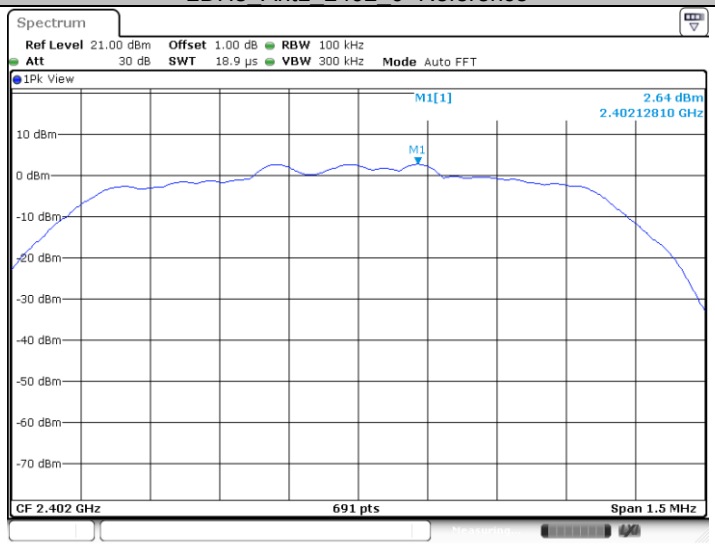

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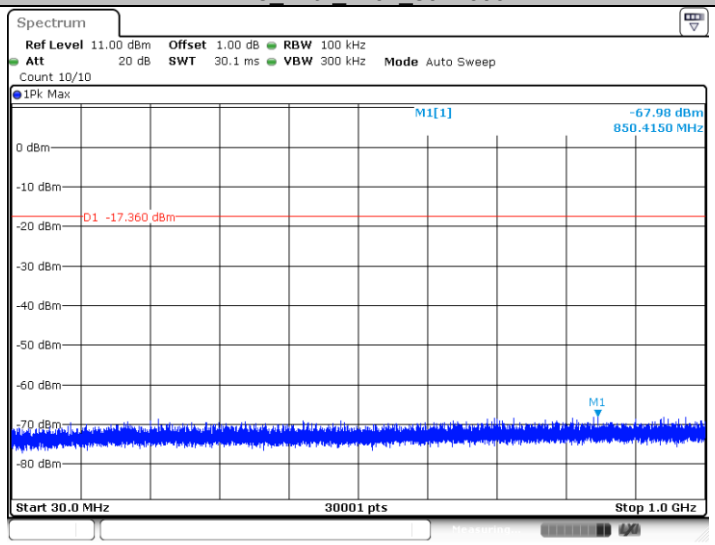

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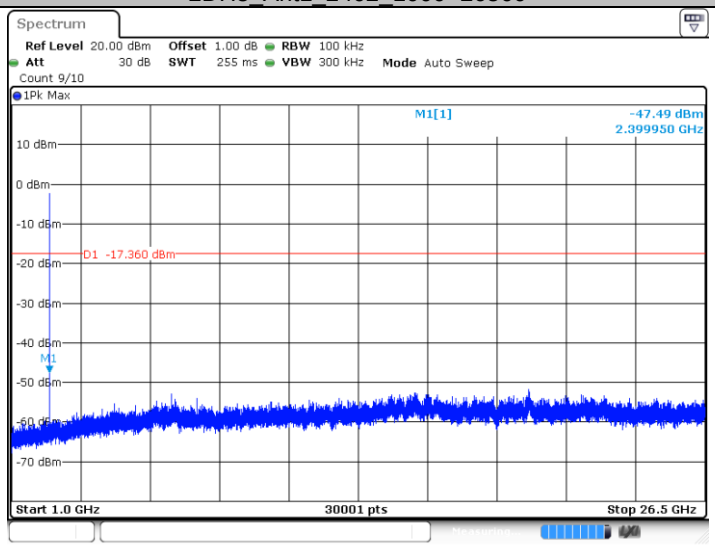
2DH5_Ant1_2402_1000~26500



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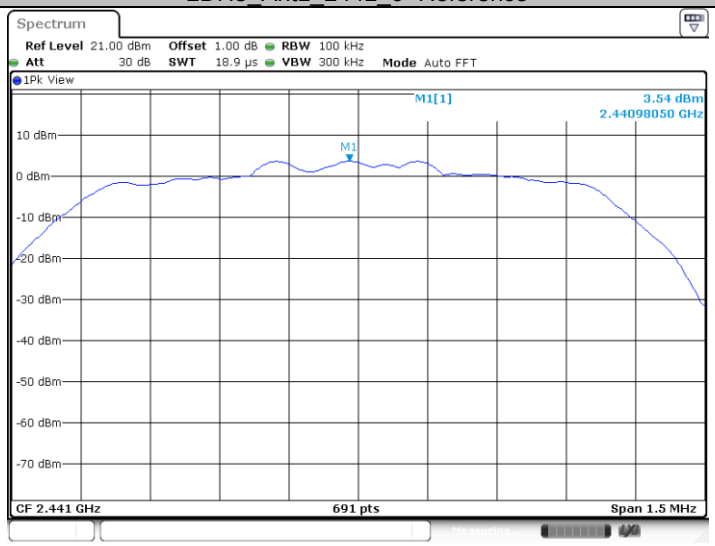

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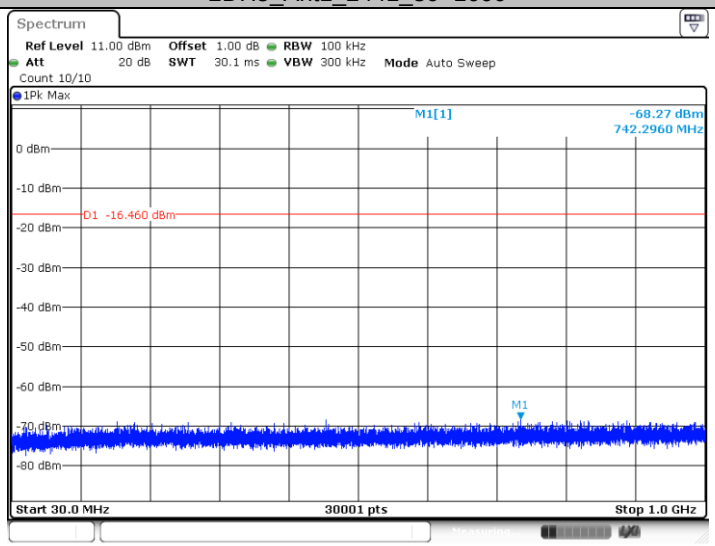

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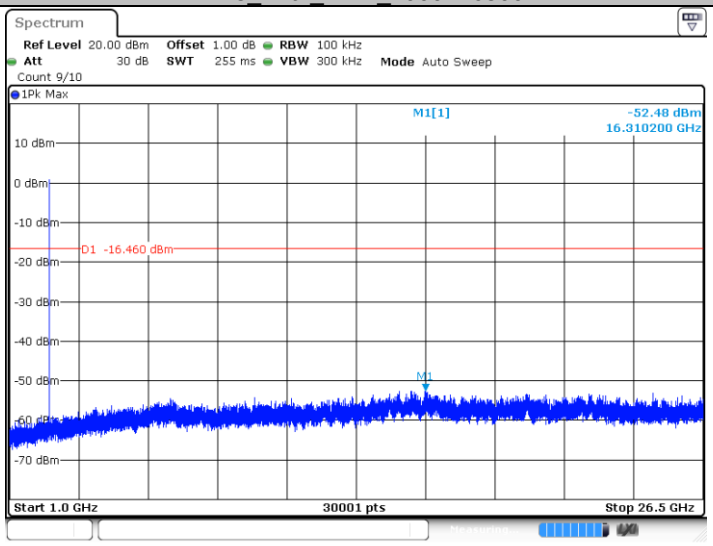
2DH5_Ant1_2441_1000~26500



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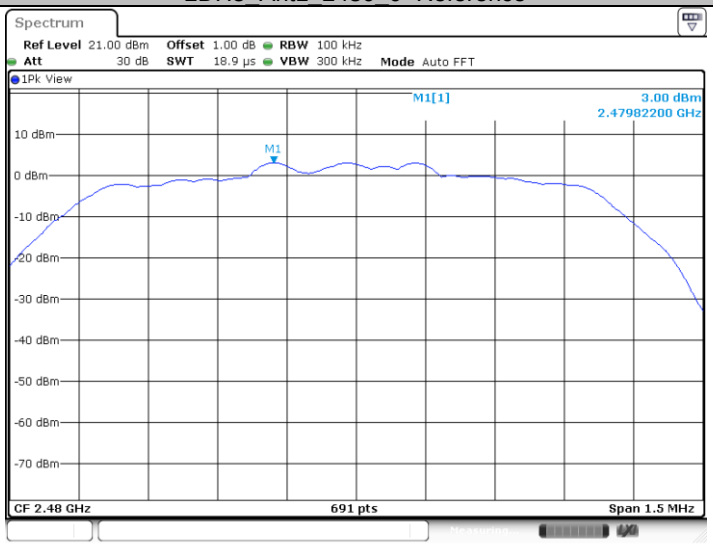

Date: 13.DEC.2020 17:26:37

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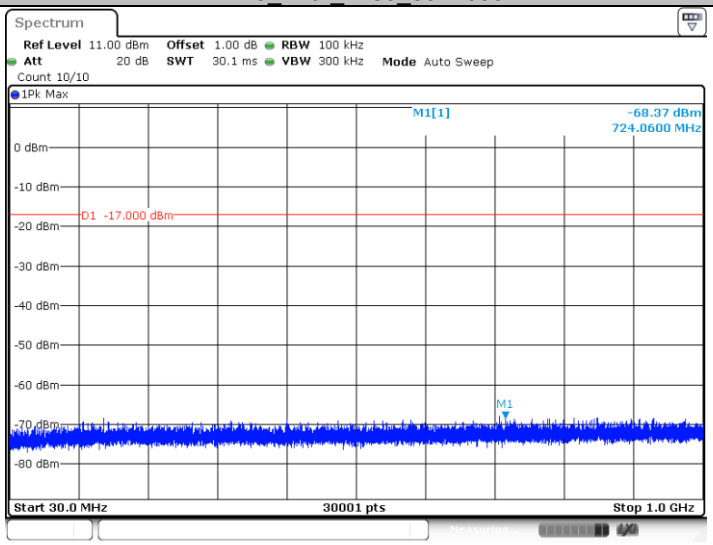

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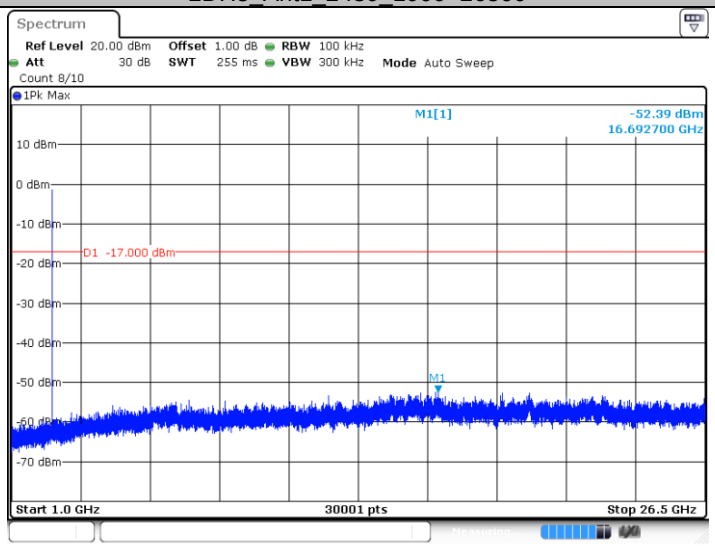
2DH5_Ant1_2480_1000~26500



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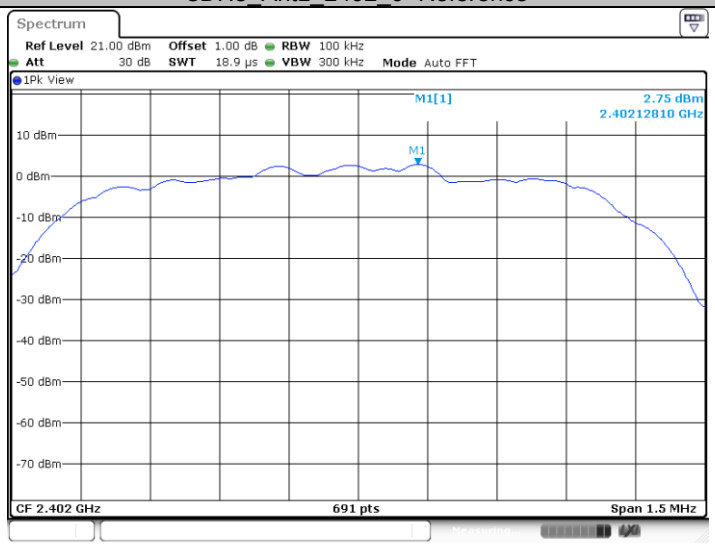

Date: 13.DEC.2020 17:28:18

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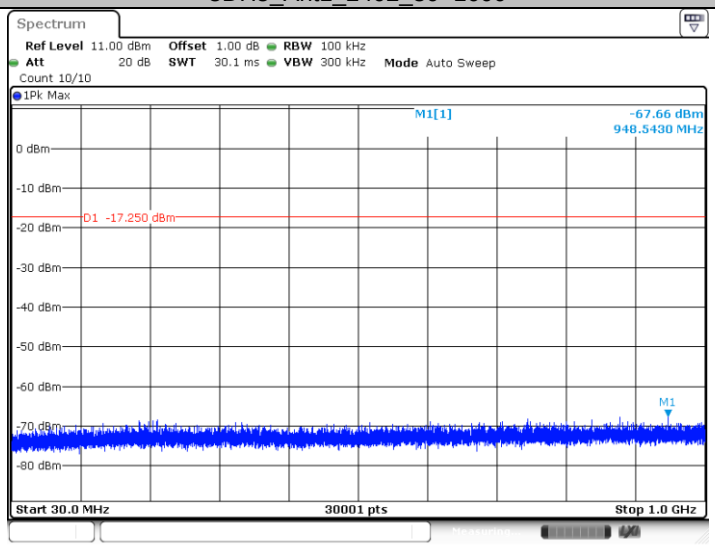

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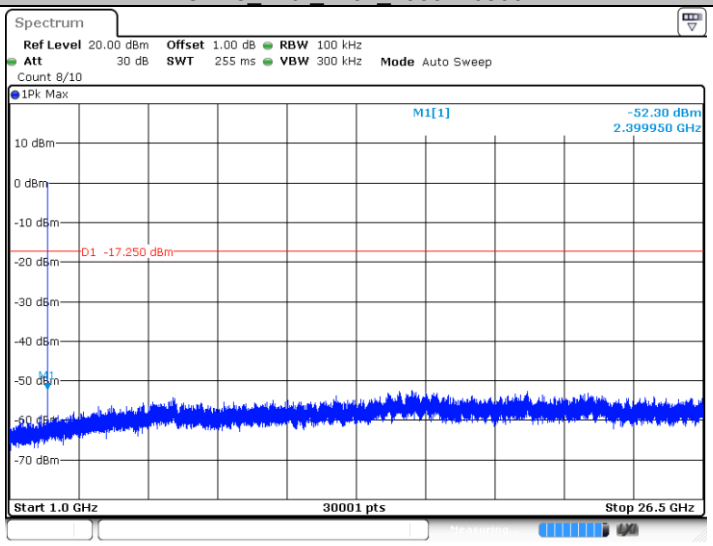

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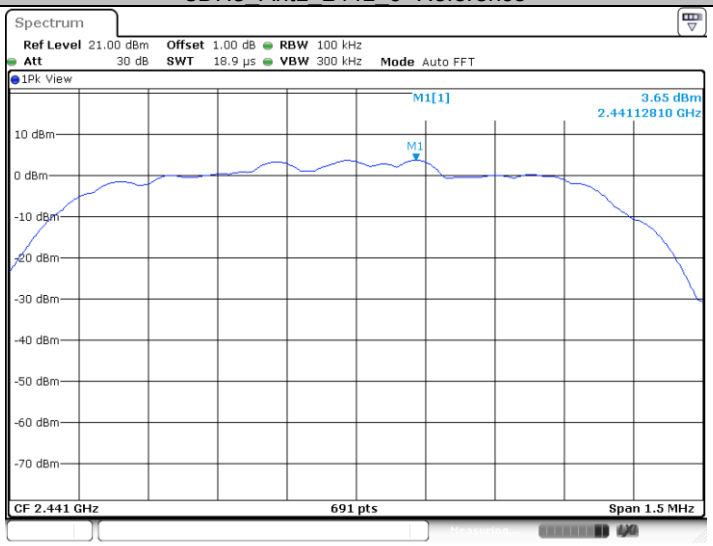

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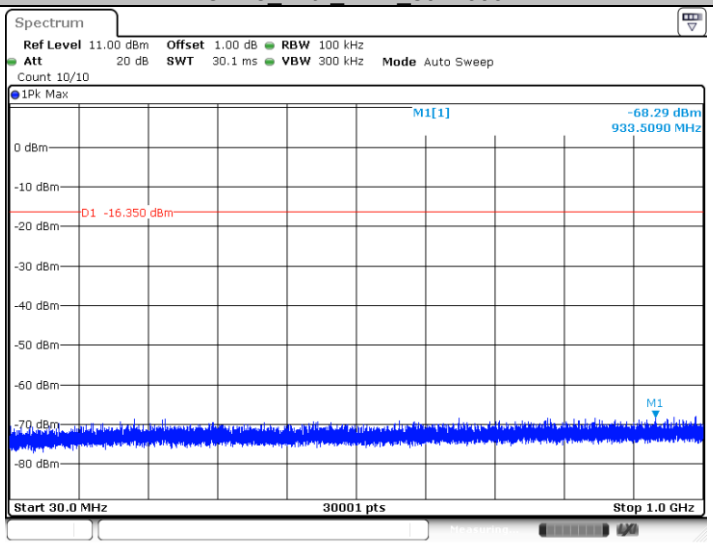

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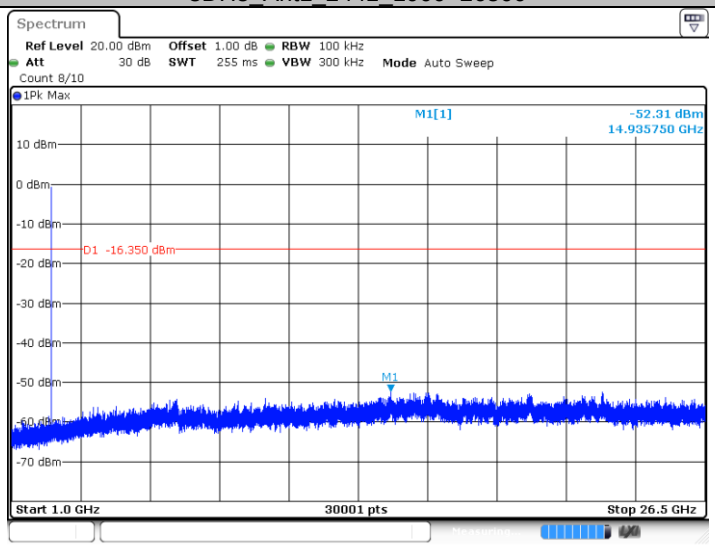
3DH5_Ant1_2441_1000~26500



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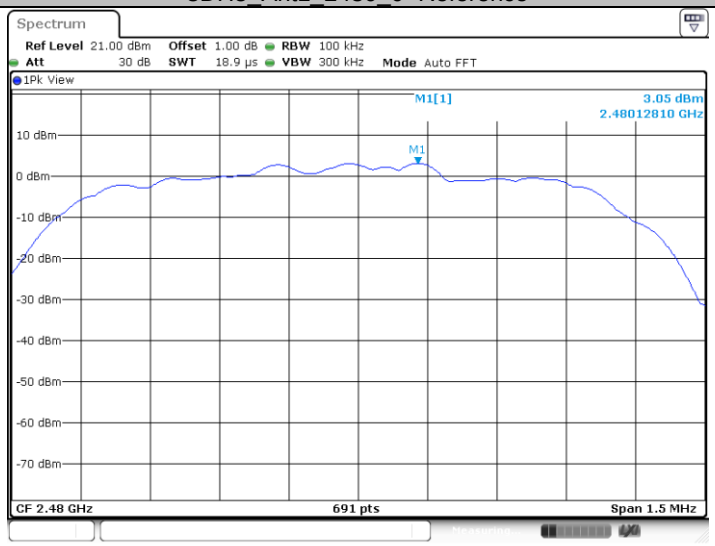

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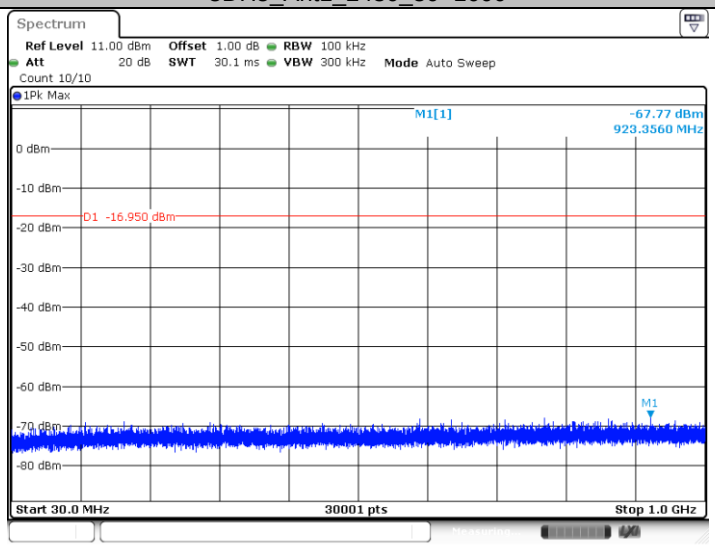

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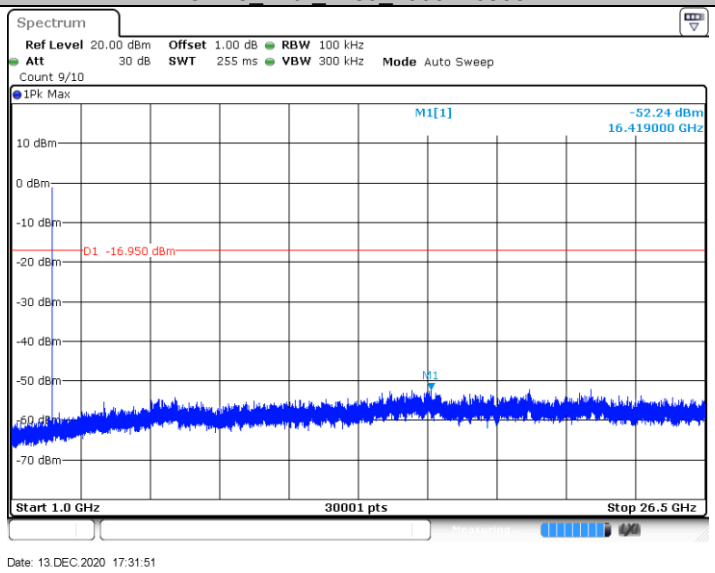

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9.8 Band edge testing

Test Method

1. The RF output of EUT was connected to the spectrum analyzer 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. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
4. Measure and record the results in the test report.
5. The RF fundamental frequency should be excluded against the limit line in the operating frequency
6. Set to the maximum power setting and enable the EUT hopping mode, repeat the test.

Limit:

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits.

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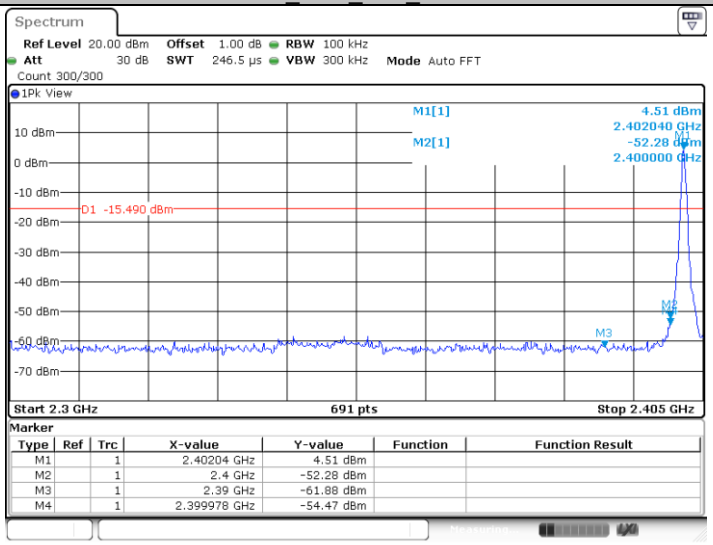
Band edge

DH5_Ant1_Low_2402



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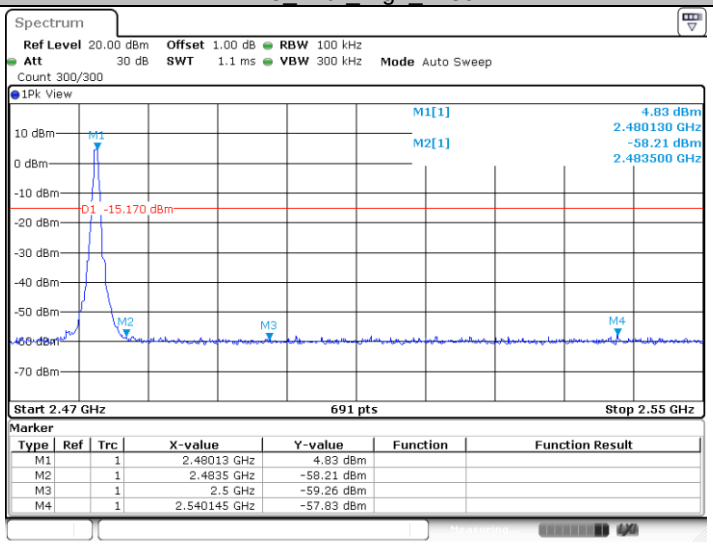
DH5_Ant1_High_2480



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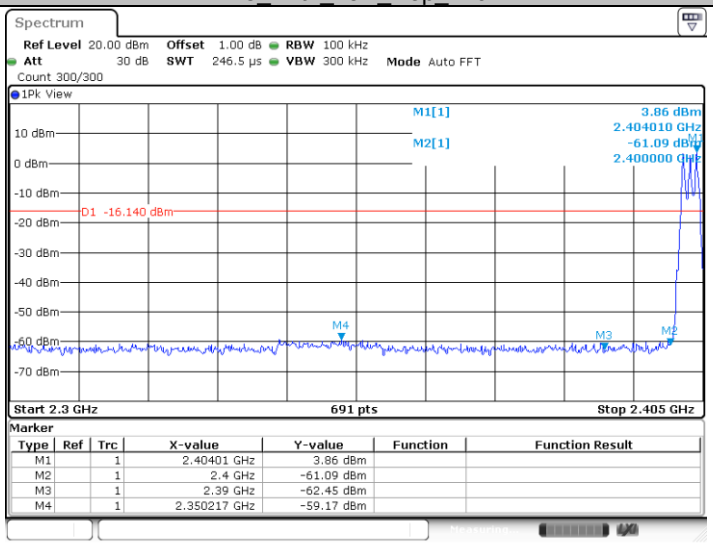
DH5_Ant1_Low_Hop_2402



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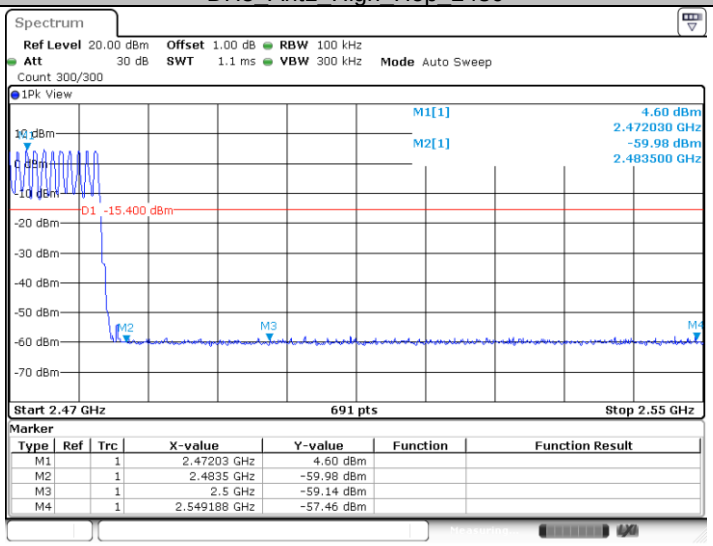

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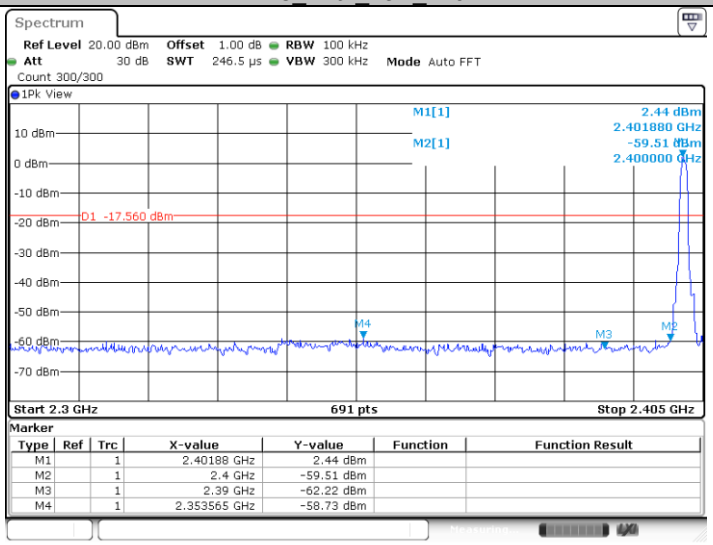

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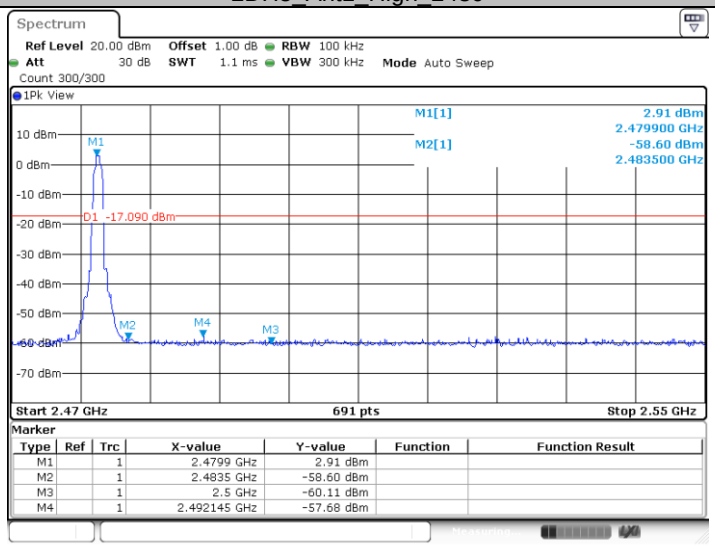
2DH5_Ant1_High_2480



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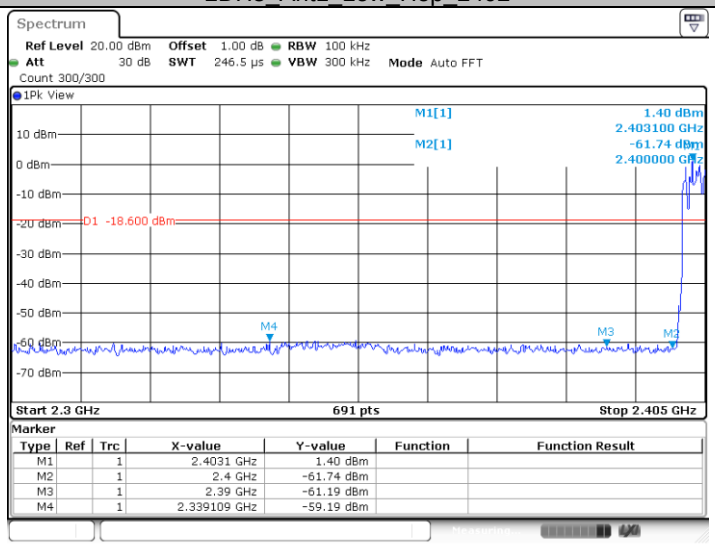

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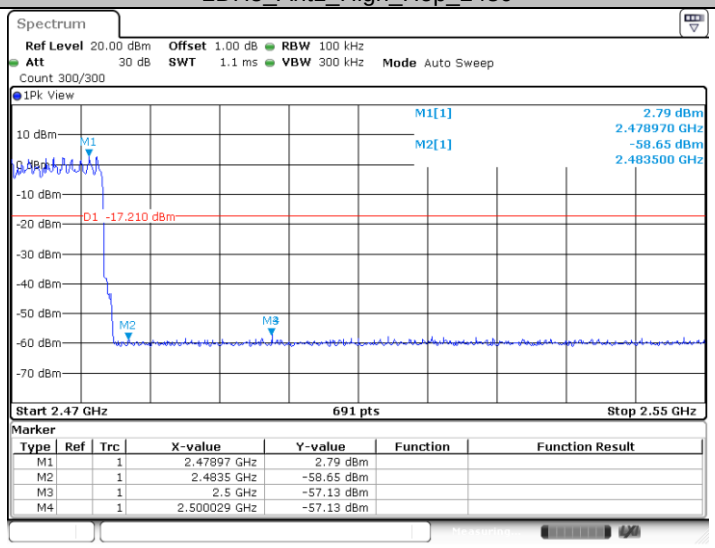

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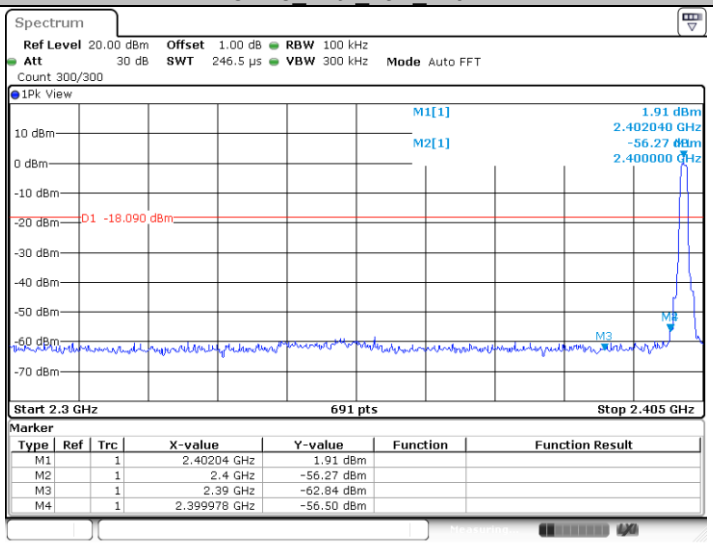
3DH5_Ant1_Low_2402



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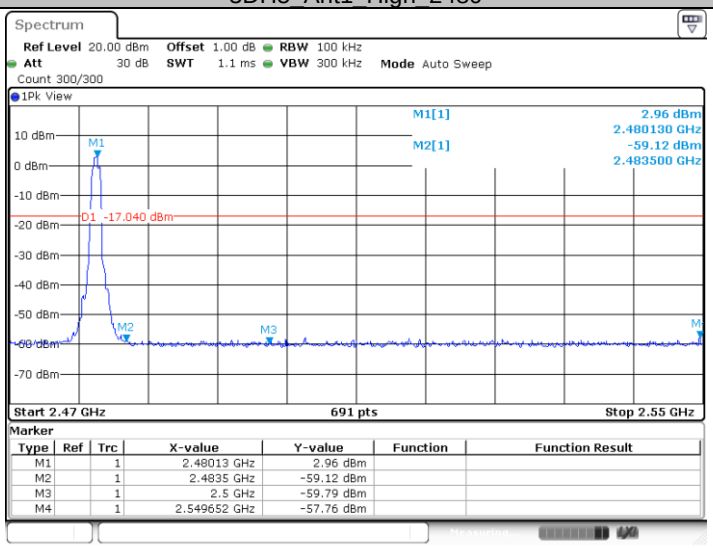

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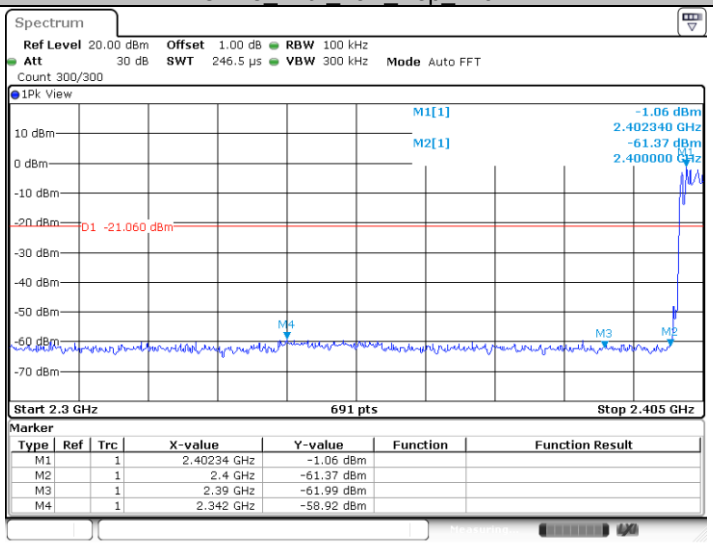
3DH5_Ant1_Low_Hop_2402



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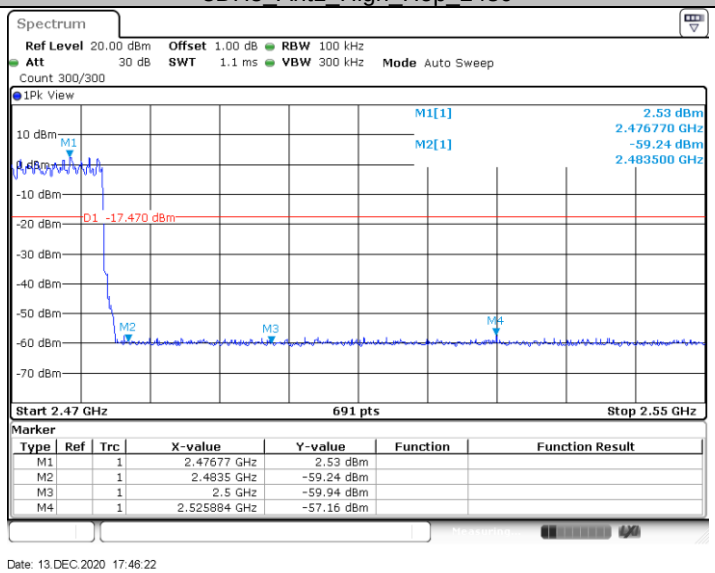
3DH5_Ant1_High_Hop_2480



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9.9 Spurious radiated emissions for transmitter

Test Method

1: The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3-meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.

3: The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

4: For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

5: Use the following spectrum analyzer settings According to C63.10:

For Below 1GHz

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 KHz to 120KHz, VBW≥RBW for peak measurement, Sweep = auto,
Detector function = peak, Trace = max hold.

For Peak unwanted emissions Above 1GHz:

Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 1MHz, VBW≥RBW for peak measurement, Sweep = auto,
Detector function = peak, Trace = max hold.

Procedures for average unwanted emissions measurements above 1000 MHz:

Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 1MHz, VBW=10Hz, Sweep = auto, Detector function = peak, Trace = max hold.
If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a “duty cycle correction factor”, derived from 20log(dwell time/100 ms), in an effort to demonstrate compliance with the limit.

If the emission is pulsed, modify the unit for continuous operation; use the settings shown above, then correct the reading by subtracting the peak-average correct factor, derived from the appropriate the duty cycle calculation.

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Limit

The radio emission outside the operating frequency band shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Radiated emissions which fall in the restricted bands, as defined in section15.205 and RSS-GEN 8.10, must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength uV/m	Field Strength dBµV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

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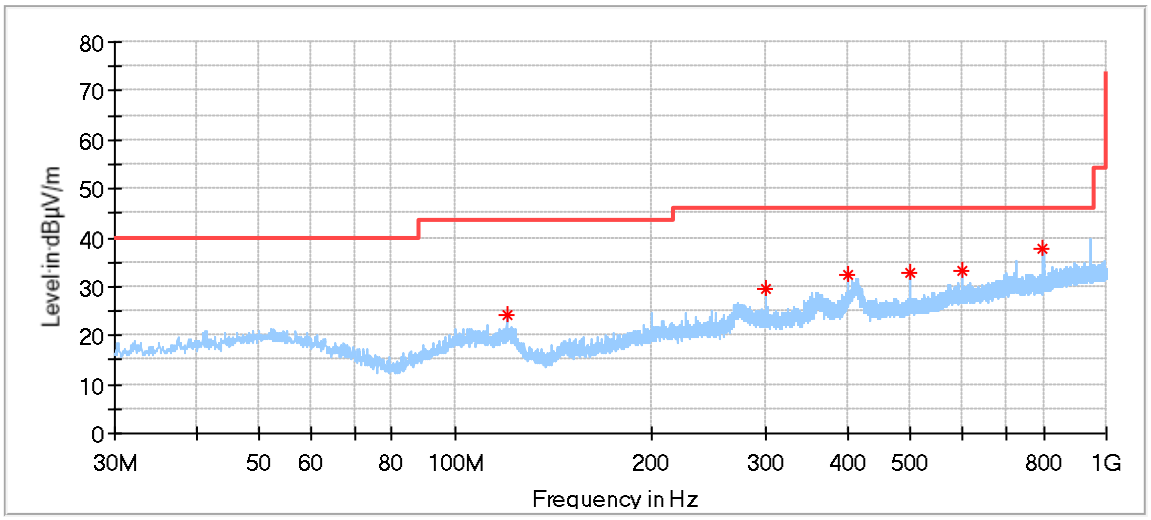
Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

The only worse case (8DPSK mode) test result is listed in the report.

Below 1G:



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
119.994444	24.39	43.50	19.11	200.0	H	313.0	10.58
299.983333	29.66	46.00	16.34	100.0	H	163.0	14.73
400.055000	32.32	46.00	13.68	100.0	H	258.0	17.38
500.018889	32.98	46.00	13.02	200.0	H	266.0	19.21
599.982778	33.22	46.00	12.78	200.0	H	153.0	21.20
799.910556	37.79	46.00	8.21	100.0	H	267.0	23.65

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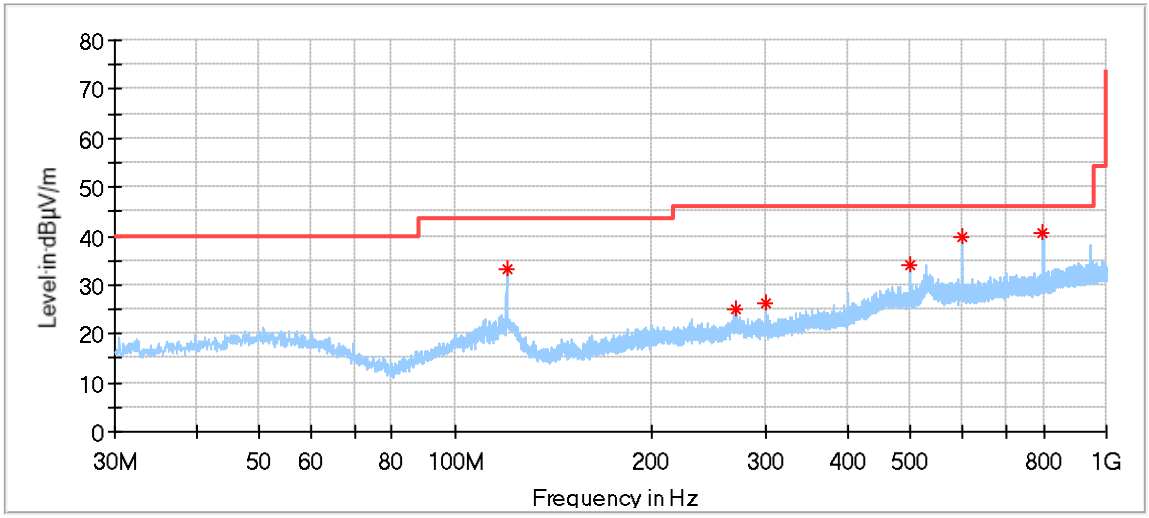

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
119.994444	33.32	43.50	10.18	100.0	V	73.0	10.58
270.613889	24.85	46.00	21.15	100.0	V	65.0	14.19
299.983333	26.13	46.00	19.87	100.0	V	224.0	14.73
499.965000	34.23	46.00	11.77	100.0	V	271.0	19.20
600.090556	39.60	46.00	6.40	100.0	V	239.0	21.21
799.964444	40.56	46.00	5.44	100.0	V	37.0	23.65

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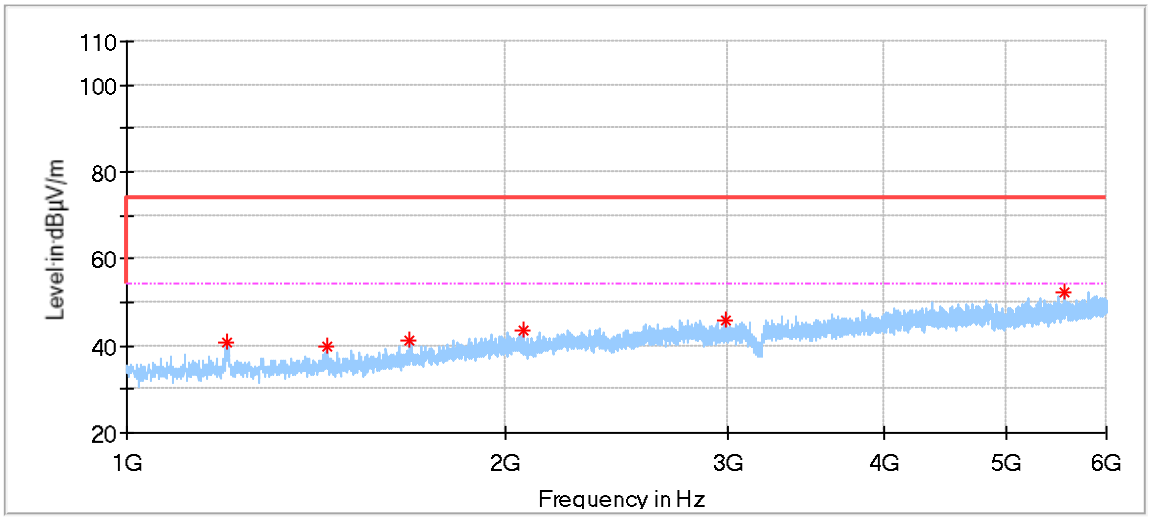
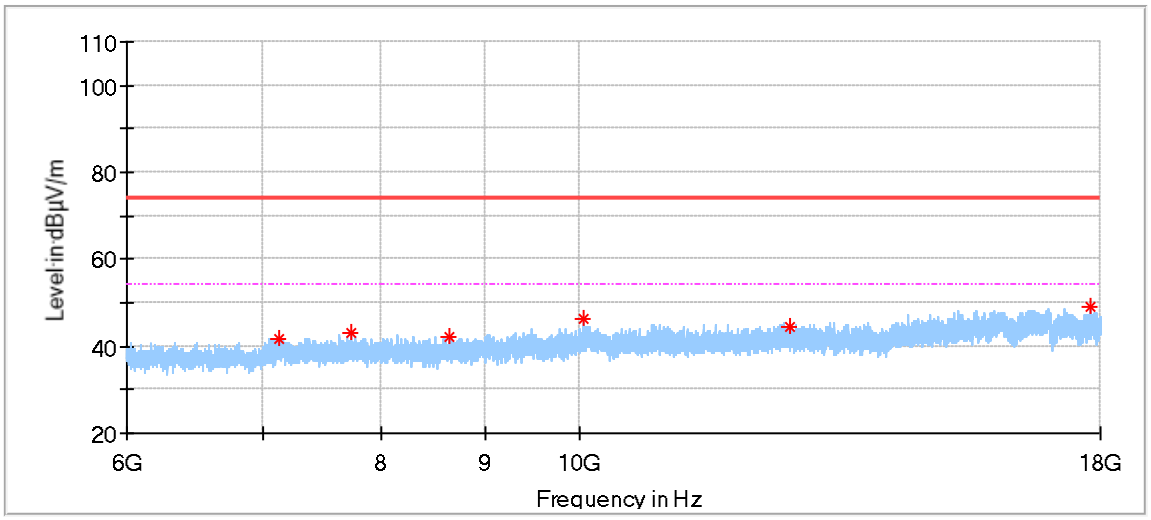
Low channel 2402MHz



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1199.000000	40.69	74.00	33.31	150.0	H	312.0	-9.41
1440.000000	39.69	74.00	34.31	150.0	H	231.0	-8.46
1679.000000	41.01	74.00	32.99	150.0	H	251.0	-6.68
2062.500000	43.58	74.00	30.42	150.0	H	325.0	-4.06
2988.000000	46.07	74.00	27.93	150.0	H	152.0	-1.53
5552.500000	52.30	74.00	21.70	150.0	H	265.0	4.41



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7121.000000	41.66	74.00	32.34	150.0	H	201.0	4.93
7725.000000	43.06	74.00	30.94	150.0	H	221.0	5.64
8626.000000	42.21	74.00	31.79	150.0	H	83.0	6.44
10046.500000	46.20	74.00	27.80	150.0	H	142.0	9.17
12668.000000	44.36	74.00	29.64	150.0	H	22.0	9.40
17781.500000	49.04	74.00	24.96	150.0	H	0.0	16.50

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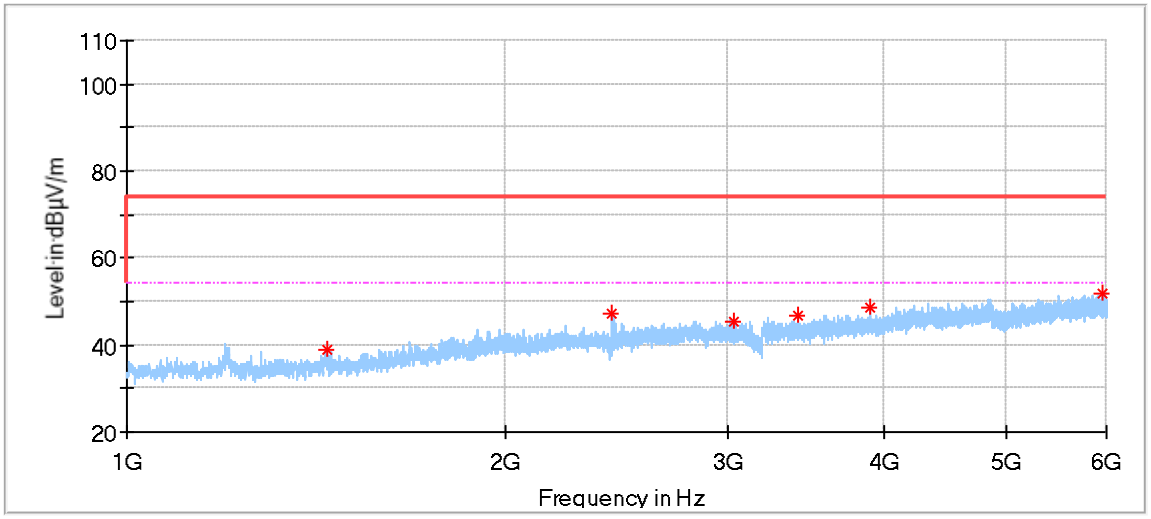
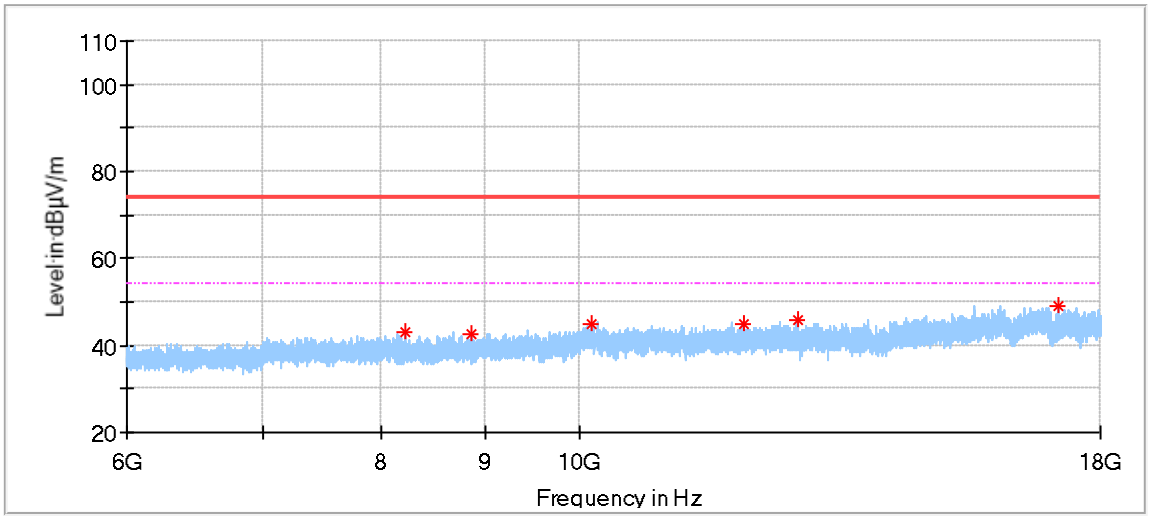


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1442.000000	38.79	74.00	35.21	150.0	V	9.0	-8.46
2429.000000	47.07	74.00	26.93	150.0	V	133.0	-3.13
3038.000000	45.29	74.00	28.71	150.0	V	0.0	-1.28
3413.000000	46.96	74.00	27.04	150.0	V	0.0	-0.57
3898.500000	48.69	74.00	25.31	150.0	V	15.0	1.03
5952.500000	51.80	74.00	22.20	150.0	V	133.0	5.45



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8223.000000	43.04	74.00	30.96	150.0	V	312.0	6.17
8853.500000	42.55	74.00	31.45	150.0	V	171.0	6.45
10139.500000	44.83	74.00	29.17	150.0	V	194.0	9.10
12027.500000	44.93	74.00	29.07	150.0	V	0.0	9.03
12803.000000	45.95	74.00	28.05	150.0	V	336.0	9.32
17175.000000	49.07	74.00	24.93	150.0	V	240.0	15.88

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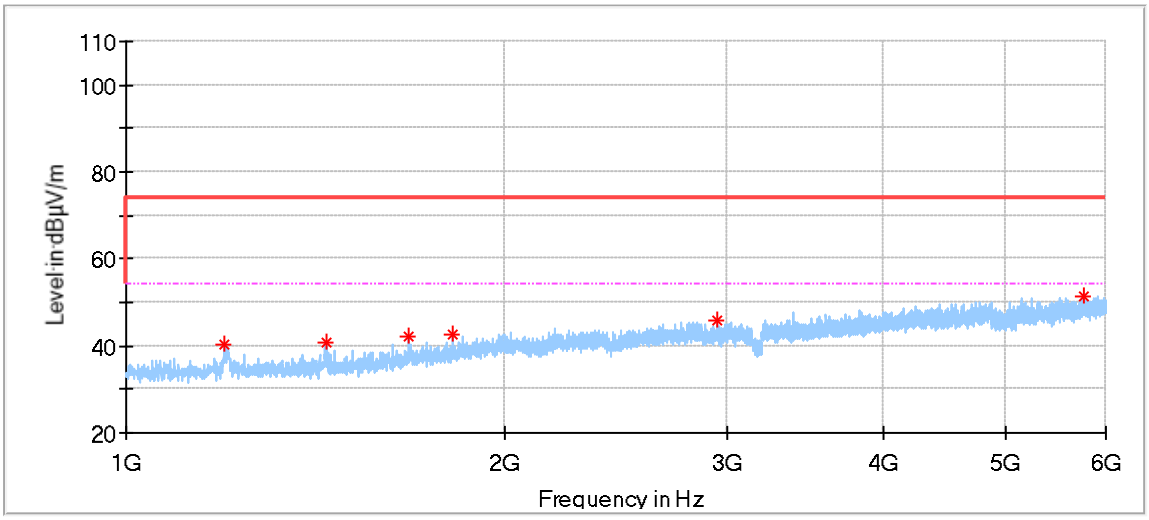
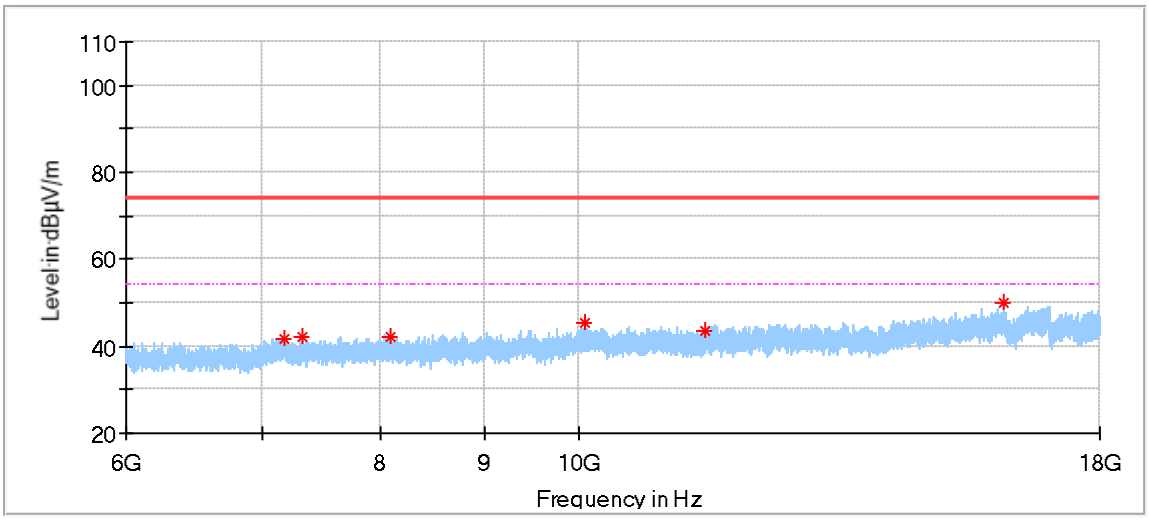
Middle channel 2441MHz



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1198.500000	40.39	74.00	33.61	150.0	H	305.0	-9.41
1440.000000	40.94	74.00	33.06	150.0	H	258.0	-8.46
1677.000000	42.09	74.00	31.91	150.0	H	251.0	-6.69
1816.500000	42.65	74.00	31.35	150.0	H	198.0	-5.63
2949.000000	45.90	74.00	28.10	150.0	H	238.0	-1.55
5772.500000	51.60	74.00	22.40	150.0	H	356.0	5.18



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7174.500000	41.88	74.00	32.12	150.0	H	201.0	4.93
7322.500000	41.99	74.00	32.01	150.0	H	63.0	5.30
8080.000000	42.25	74.00	31.75	150.0	H	356.0	6.70
10059.000000	45.18	74.00	28.82	150.0	H	340.0	9.31
11522.000000	43.60	74.00	30.40	150.0	H	320.0	8.19
16132.000000	49.84	74.00	24.16	150.0	H	241.0	14.67

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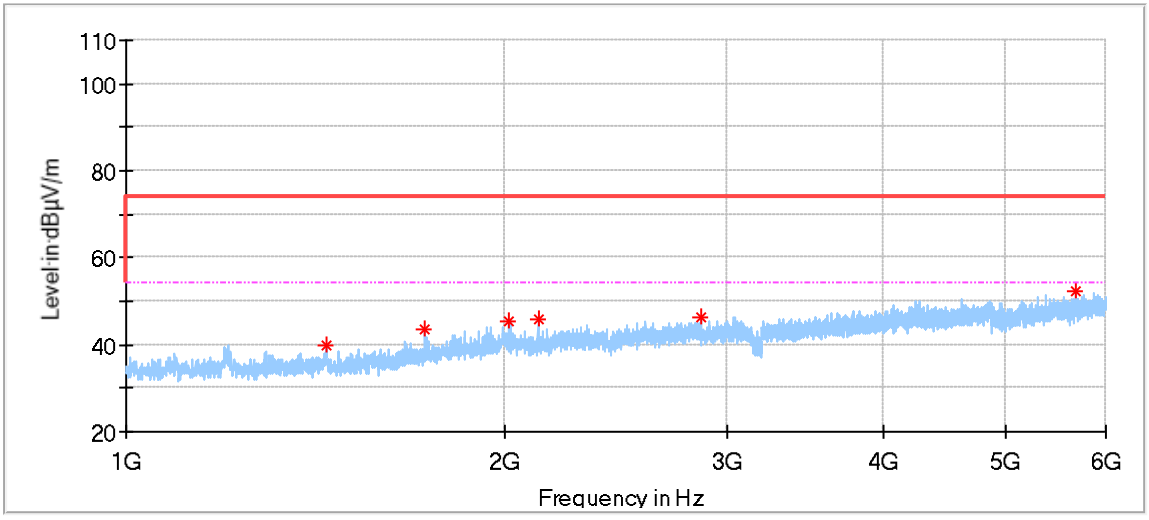
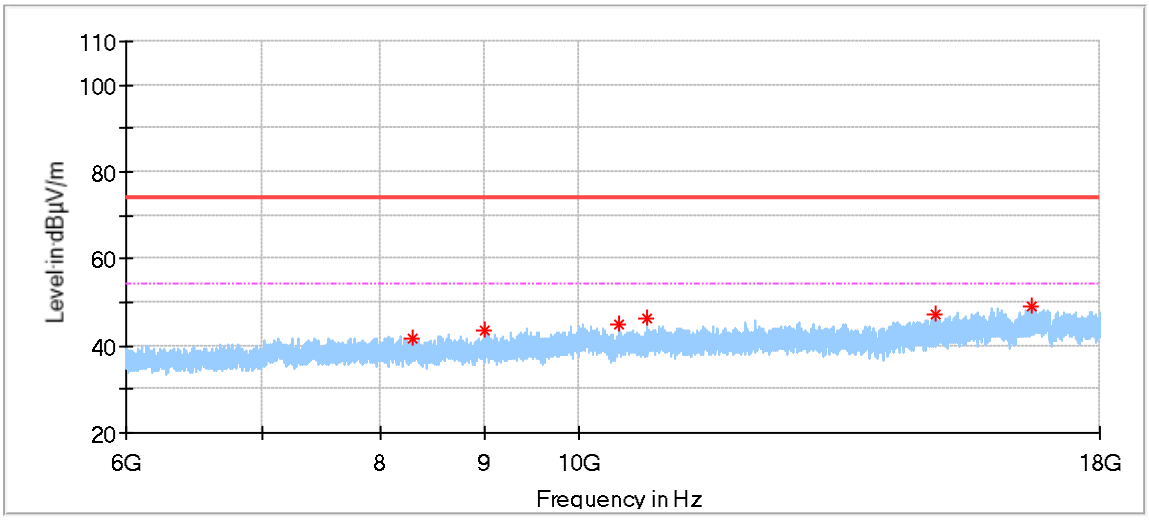


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1444.000000	39.66	74.00	34.34	150.0	V	0.0	-8.45
1728.000000	43.74	74.00	30.26	150.0	V	271.0	-6.17
2012.500000	45.22	74.00	28.78	150.0	V	295.0	-4.25
2123.500000	46.02	74.00	27.98	150.0	V	287.0	-3.96
2861.000000	46.14	74.00	27.86	150.0	V	124.0	-1.84
5689.000000	52.14	74.00	21.86	150.0	V	23.0	4.75



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8289.000000	41.66	74.00	32.34	150.0	V	79.0	6.35
8990.500000	43.37	74.00	30.63	150.0	V	217.0	6.66
10468.000000	44.88	74.00	29.12	150.0	V	0.0	8.58
10805.500000	46.13	74.00	27.87	150.0	V	309.0	8.41
14956.500000	47.32	74.00	26.68	150.0	V	194.0	12.25
16663.500000	49.10	74.00	24.90	150.0	V	102.0	15.86

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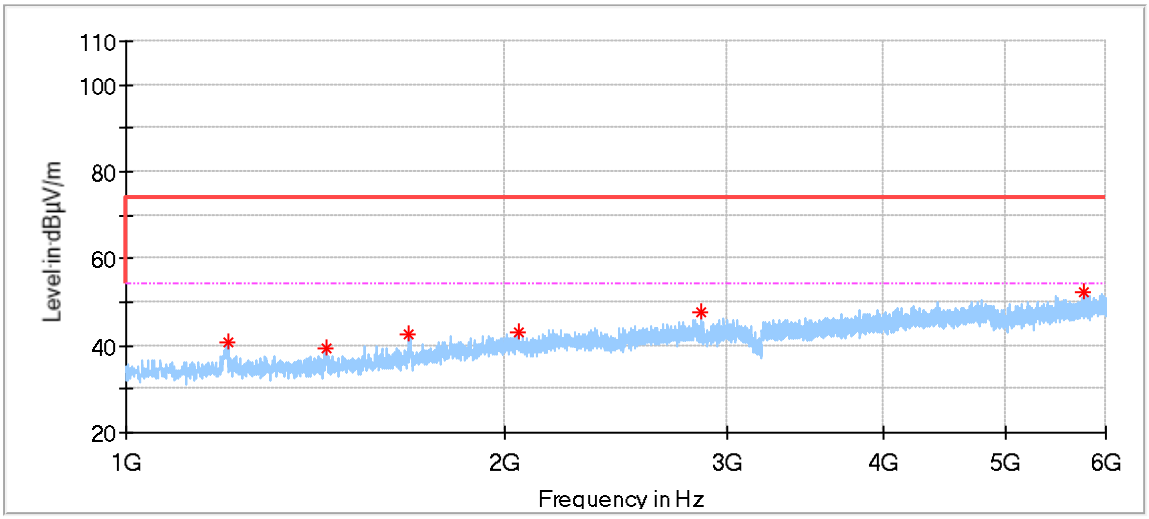
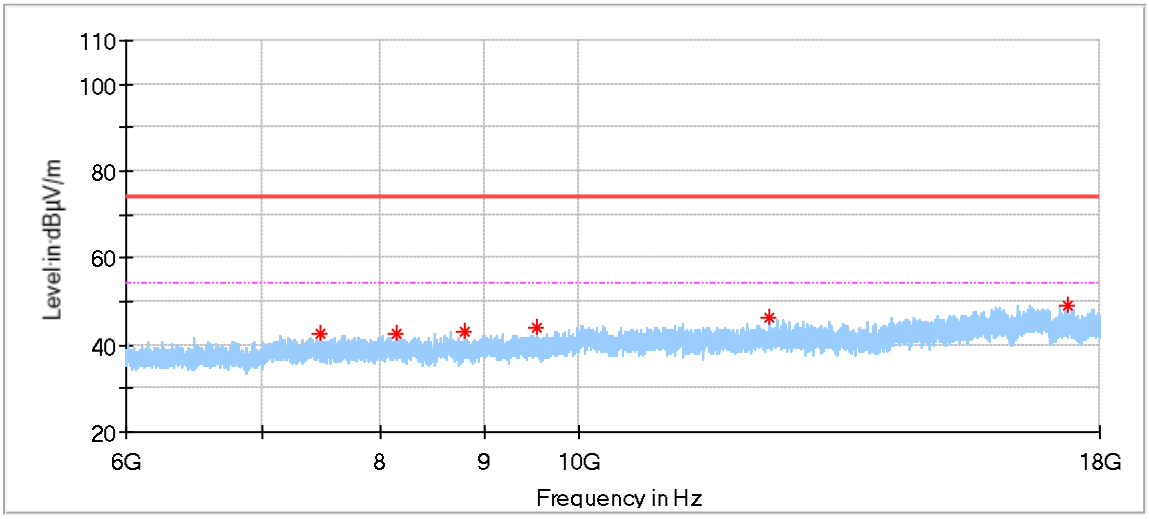
High channel 2480MHz



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1204.000000	40.63	74.00	33.37	150.0	H	305.0	-9.38
1440.000000	39.50	74.00	34.50	150.0	H	225.0	-8.46
1677.500000	42.76	74.00	31.24	150.0	H	258.0	-6.69
2053.500000	43.21	74.00	30.79	150.0	H	305.0	-4.08
2862.000000	47.62	74.00	26.38	150.0	H	178.0	-1.84
5771.500000	52.47	74.00	21.53	150.0	H	345.0	5.18



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7465.500000	42.67	74.00	31.33	150.0	H	243.0	5.45
8139.500000	42.84	74.00	31.16	150.0	H	0.0	6.20
8788.000000	42.99	74.00	31.01	150.0	H	342.0	6.44
9535.500000	43.96	74.00	30.04	150.0	H	63.0	7.50
12400.000000	46.26	74.00	27.74	150.0	H	122.0	8.98
17352.500000	49.08	74.00	24.92	150.0	H	263.0	16.29

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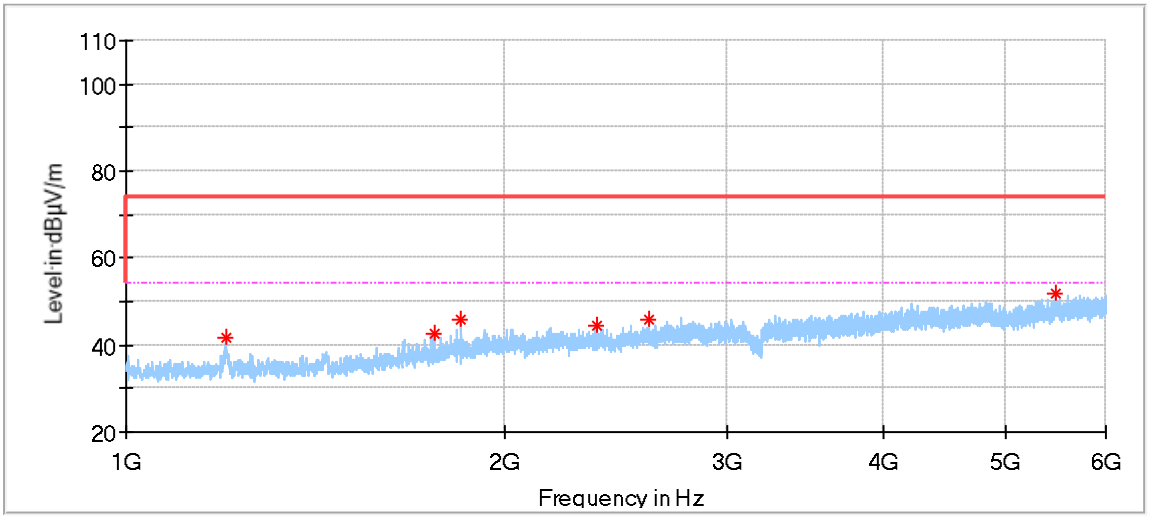
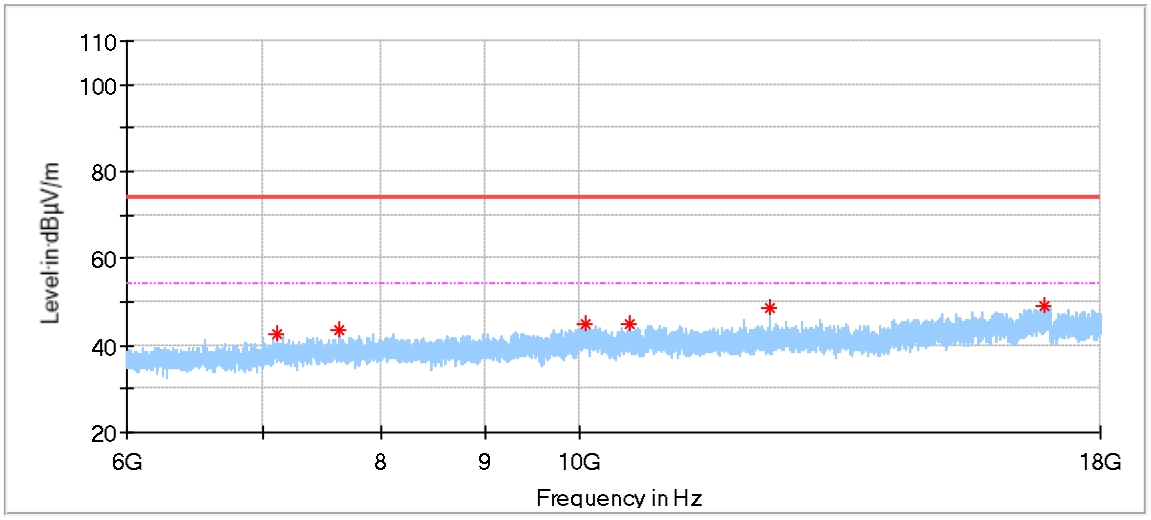


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1199.000000	41.85	74.00	32.15	150.0	V	228.0	-9.41
1755.500000	42.65	74.00	31.35	150.0	V	260.0	-6.03
1846.500000	45.63	74.00	28.38	150.0	V	260.0	-5.41
2363.000000	44.41	74.00	29.59	150.0	V	321.0	-3.23
2600.500000	45.88	74.00	28.12	150.0	V	127.0	-2.55
5471.500000	51.76	74.00	22.24	150.0	V	0.0	4.36



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7105.500000	42.54	74.00	31.46	150.0	V	35.0	4.94
7617.500000	43.32	74.00	30.68	150.0	V	266.0	5.48
10067.000000	44.91	74.00	29.09	150.0	V	128.0	9.29
10571.000000	44.80	74.00	29.20	150.0	V	174.0	8.54
12401.000000	48.42	74.00	25.58	150.0	V	336.0	8.98
16880.500000	49.09	74.00	24.91	150.0	V	356.0	16.55

Remark:

(1) Data of measurement within frequency range18-26GHz are the noise floor or attenuated more than 20dB below the permissible limits or the field strength is too small to be measured, so test data does not present in this report,

(2) Data of measurement within this frequency range shown “--” in the table above means the reading of emissions are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.

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(3) Level= Reading Level + Correction Factor
(4) Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
(The Reading Level is recorded by software which is not shown in the sheet)

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10 Test Equipment List

Conducted Emission Test

Description	Manufacturer	Model no.	Serial no.	cal. due date
EMI Test Receiver	Rohde & Schwarz	ESR 3	101782	2021-6-29
LISN	Rohde & Schwarz	ENV4200	100249	2021-6-12
Attenuator	Shanghai Huaxiang	TS2-26-3	080928189	2021-6-21
Test software	Rohde & Schwarz	EMC32	Version9.15.00	N/A

Radiated Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	101269	2021-6-29
High Pass Filter (HPF)	UCL	UCL-BPF1-7G	1504005103	2021-6-28
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2021-8-20
Horn Antenna	Rohde & Schwarz	HF907	102295	2021-6-22
Wideband Horn Antenna	Q-PAR	QWH-SL-18-40-K-SG	12827	2021-7-12
Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2021-6-21
Pre-amplifier	Rohde & Schwarz	SCU 40A	100432	2021-7-16
Attenuator	Agilent	8491A	MY39264334	2021-6-21
3m Semi-anechoic chamber	TDK	9X6X6	----	2022-10-28
Test software	Rohde & Schwarz	EMC32	Version 9.15.00	N/A

RF conducted test

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Signal Analyzer	Rohde & Schwarz	FSV40	101030	2021-6-21
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	101226/100851	2021-6-21
Power Splitter	Weinschel	1580	SC319	2021-7-7
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	101226/100851	2021-6-21
Test software	Tonscend	System for BT/WIFI	Version 2.6	N/A

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11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Conducted Emission 150kHz-30MHz (for test using AMN ENV432 or ENV4200)	3.62dB
Uncertainty for Radiated Spurious Emission 25MHz-3000MHz	Horizontal: 4.81dB; Vertical: 4.89dB;
Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz	Horizontal: 4.69dB; Vertical: 4.68dB;
Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 4.89dB; Vertical: 4.87dB;
Uncertainty for Conducted RF test with TS 8997	RF Power Conducted: 1.16dB Frequency test involved: 0.6×10^{-7} or 1%

---The End---

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