

FCC/ISED - TEST REPORT

Report Number : **68.950.21.0621.01** Date of Issue: **2021-10-09**

Model : **SOUNDBOKS Go**

Product Type : Wireless Bluetooth Speaker

Applicant : Sun Technique Electric Co., Ltd.

Address : #35, Songshui Rd, Songmushan Village, Dalang Town, Dongguan, Guangdong, China.

Manufacturer : SOUNDBOKS ApS

Address : Esromgade 15, 1107, 2200 Copenhagen N, DENMARK

Test Result : ☒ **Positive** ☐ **Negative**

Total pages including Appendices : **70**

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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 City, 518052,
P. R. China

FCC Designation Number: CN5009

FCC Registration No.: 514049

IC Registration No.: 10320A

Telephone: 86 755 8828 6998
Fax: 86 755 8828 5299

3 Description of the Equipment Under Test

Product:	Wireless Bluetooth Speaker
Model no.:	SOUNDBOKS Go
FCC ID:	2A29M-SBGO-21-1
IC	27750-SBGO211
HVIN	SOUNDBOKS Go
PMN	Wireless Bluetooth Speaker
Options and accessories:	Adapter: KA4802A-1403300P
Rating:	14.0VDC, 3.3A
Adapter:	Input:100-240Vac, 50/60Hz; 1.2A Output: 14.0VDC, 3.3A 46.2W
Battery	Li-ion Rechargeable Battery 7.8Ah/12.8V 99.84Wh LiFePO4 Input:14.5VDC, 3.0A Output: 12.8Vdc, 7.8A
RF Transmission Frequency:	2402MHz-2480MHz for Bluetooth 2400MHz-2480MHz for 2.4G,
Antenna Type:	Integrated antenna for 2.4G PCB antenna for BT
Antenna Gain:	1.927dBi for BT antenna, 2dBi for 2.4G Hopping antenna
Description of the EUT:	The Equipment Under Test (EUT) is a Wireless Bluetooth Speaker which supports Bluetooth function and 2.4G hopping.

4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2020 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators
RSS-247 Issue 2 February 2017	Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSS) and License-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen Issue 5, Amendment 2, February 2021	General Requirements and Information for the Certification of Radio Apparatus

All the test methods were according to KDB 558074 D01 15.247 Meas Guidance v05r02 and ANSI C63.10 (2013).

5 Summary of Test Results

Technical Requirements			
FCC Part 15 Subpart C& RSS-247 Issue 2			
Test Condition		Test Result	Test Site
15.207 RSS-GEN 8.8	Conducted emission AC power port	Pass	Site 1
15.247(b)(1) RSS-247 5.4(b)	Conducted output power	Pass	Site 1
RSS-247 5.4(b)	Equivalent Isotropic Radiated Power	N/A	--
15.247(e) RSS-247 5.2(b)	Power spectral density	N/A	--
15.247(a)(2) RSS-247 5.2(a)&RSS- GEN 6.7	6dB bandwidth and 99% Occupied Bandwidth	N/A	--
15.247(a)(2) RSS-247 5.1(b)	20dB bandwidth and 99% Occupied Bandwidth	Pass	Site 1
15.247(a)(1) RSS-247 5.1(b)	Min. of Hopping Channel Carrier Frequency Separation	Pass	Site 1
15.247(a)(1)(iii) RSS-247 5.1(d)	Min number of hopping frequencies	Pass	Site 1
15.247(a)(1)(iii) RSS-247 5.1(d)	Dwell Time - Average Time of Occupancy	Pass	Site 1
15.247(d) RSS-247 5.5	Spurious RF conducted emissions	Pass	Site 1
15.247(d) RSS-247 5.5	Band edge	Pass	Site 1
15.247(d) & 15.209 & 15.205, RSS-247 5.5 & RSS-Gen 6.13	Spurious radiated emissions for transmitter	Pass	Site 1
15.203 RSS-Gen 6.8	Antenna requirement	See note 2	--

Note 1: N/A=Not Applicable.

Note 2: The EUT uses an Internal antenna, which gain is 1.927dBi for BT antenna, 2dBi for 2.4G Hopping antenna. In accordance to § 15.203, it is considered sufficiently to comply with the provisions of this section.

6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2A29M-SBGO-21-1, IC: 27750-SBGO211, complies with RSS-247, RSS-GEN, and 15.207, 15.209, 15.205, 15.247 of the FCC Part 15, Subpart C

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: 2021-07-20

Testing Start Date: 2021-07-21

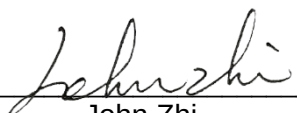
Testing End Date: 2021-09-10

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

Reviewed by:

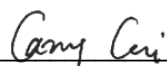
Prepared by:

Tested by:


John Zhi
Project Manager

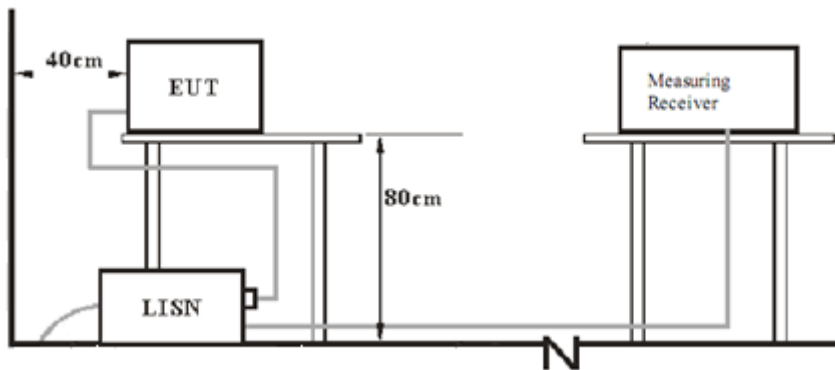

Warlen Song
Project Engineer




Carry Cai
Test Engineer

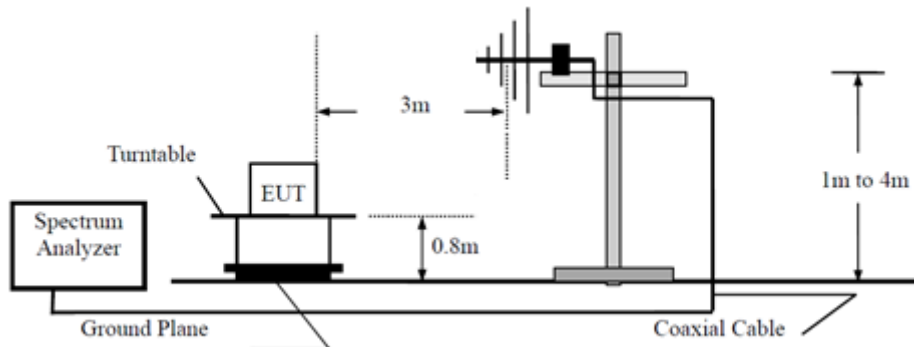
7 Test Setups

7.1 AC Power Line Conducted Emission test setups

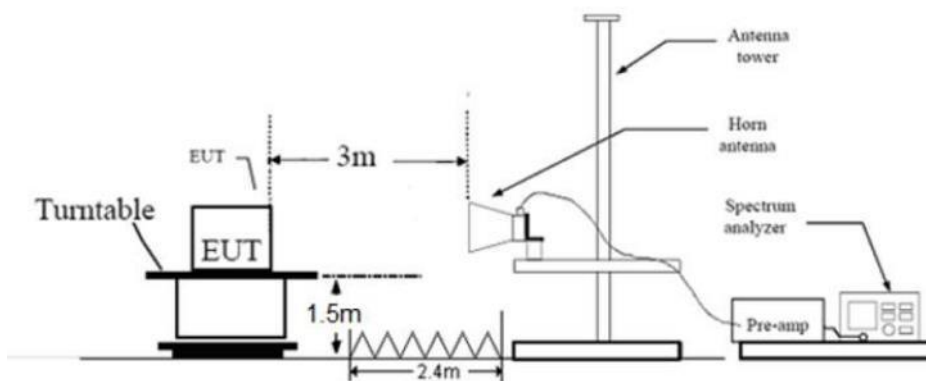


7.2 Radiated test setups

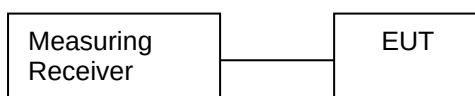
Below 1GHz



Above 1GHz



7.3 Conducted RF test setups



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.

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.

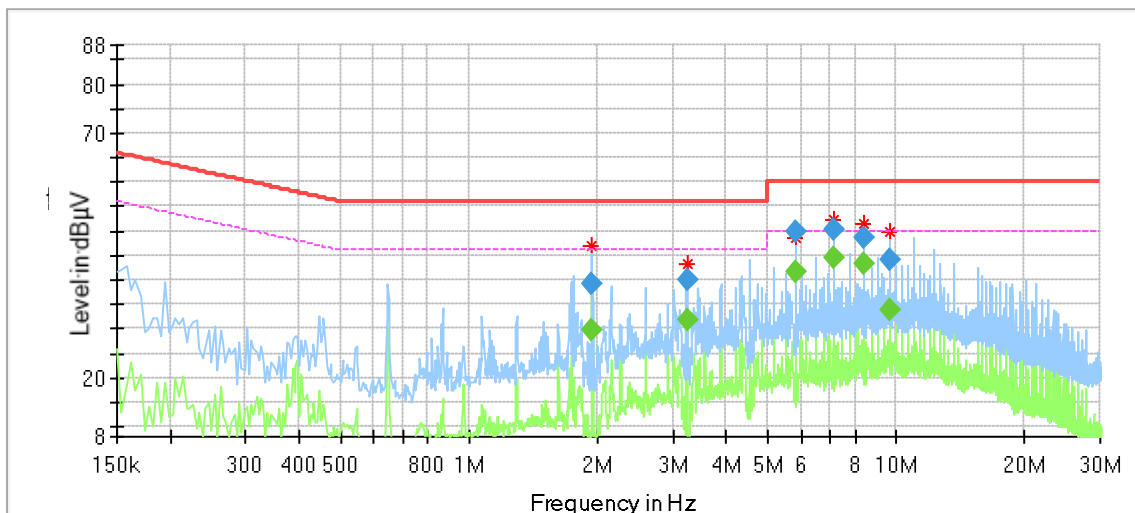
Limit

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

*Decreases with the logarithm of the frequency.

Conducted Emission

Product Type : Wireless Bluetooth Speaker
 M/N : SOUNDBOKS Go
 Operating Condition : Normal Working(Aux in + Charing)
 Test Specification : Line
 Comment : AC 120V/60Hz



Critical Freqs

Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
1.937500	46.78	---	56.00	9.22	L1	9.22
3.233500	43.33	---	56.00	12.67	L1	9.26
5.821500	48.59	---	60.00	11.41	L1	9.33
7.113500	52.19	---	60.00	7.81	L1	9.36
8.409500	51.55	---	60.00	8.45	L1	9.38
9.701500	49.91	---	60.00	10.09	L1	9.39

Final Result

Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
1.937500	---	29.66	46.00	16.34	L1	9.22
1.937500	39.35	---	56.00	16.65	L1	9.22
3.233500	---	31.62	46.00	14.38	L1	9.26
3.233500	40.09	---	56.00	15.91	L1	9.26
5.821500	---	41.81	50.00	8.19	L1	9.33
5.821500	49.72	---	60.00	10.28	L1	9.33
7.113500	---	44.36	50.00	5.64	L1	9.36
7.113500	50.35	---	60.00	9.65	L1	9.36
8.409500	48.61	---	60.00	11.39	L1	9.38
8.409500	---	43.21	50.00	6.79	L1	9.38
9.701500	43.94	---	60.00	16.06	L1	9.39
9.701500	---	33.70	50.00	16.30	L1	9.39

Remark :

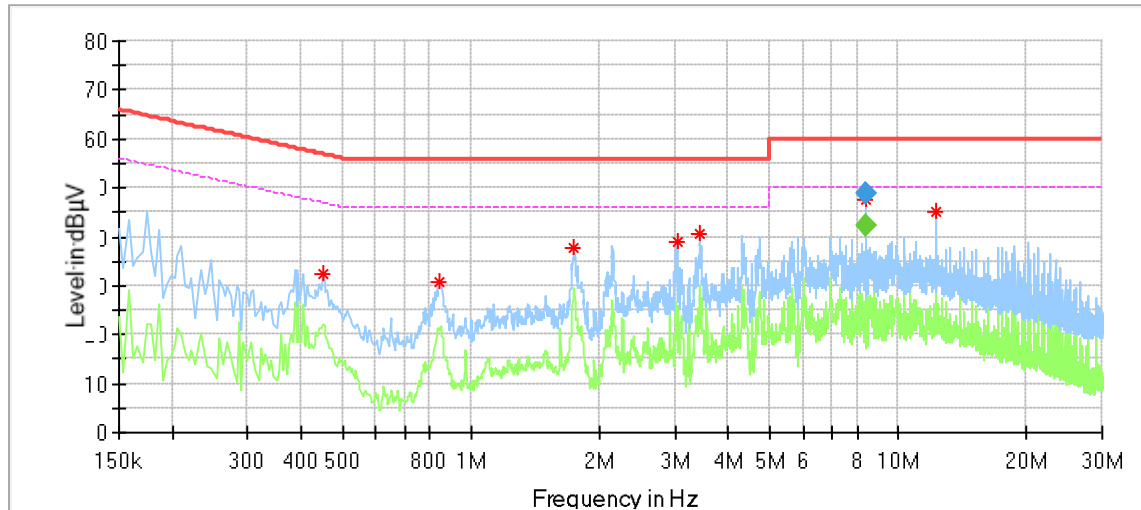
Level=Reading Level + Correction Factor

Correction Factor=Cable Loss + LISN Factor

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

Conducted Emission

Product Type : Wireless Bluetooth Speaker
 M/N : SOUNDBOKS Go
 Operating Condition : Normal Working(Aux in + Charing)
 Test Specification : Neutral
 Comment : AC 120V/60Hz



Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.450000	32.22	---	56.88	24.65	N	9.39
0.842000	30.75	---	56.00	25.25	N	9.39
1.742000	37.59	---	56.00	18.41	N	9.41
3.038000	38.83	---	56.00	17.17	N	9.44
3.430000	40.66	---	56.00	15.34	N	9.45
8.409500	47.70	---	60.00	12.30	N	9.59
12.286000	45.16	---	60.00	14.84	N	9.62

Final_Result

Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
8.409500	---	42.12	50.00	7.88	N	9.59
8.409500	48.83	---	60.00	11.17	N	9.59

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)

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 $\geq$ 3RBW, Span $\geq$ 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

According to RSS-247 5.4(b), conducted output power limit as below:

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

According to & RSS-247 5.4(b), EIRP limit as below:

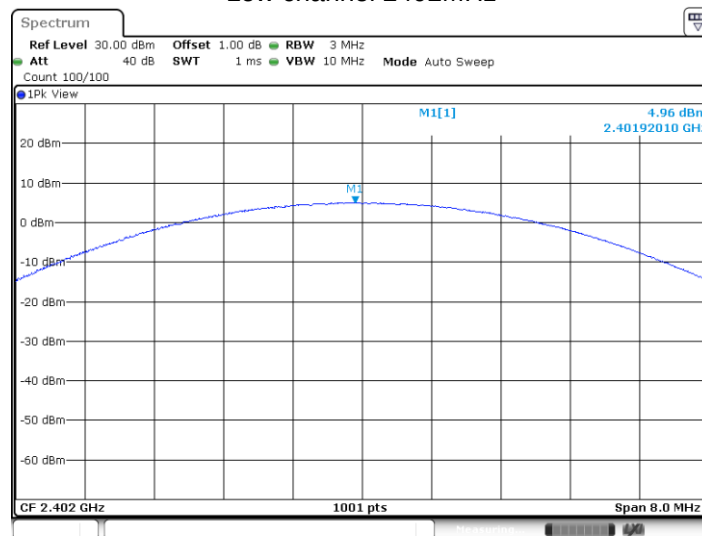
Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤ 4	≤ 36.02

Conducted output power

Bluetooth Mode GFSK modulation Test Result

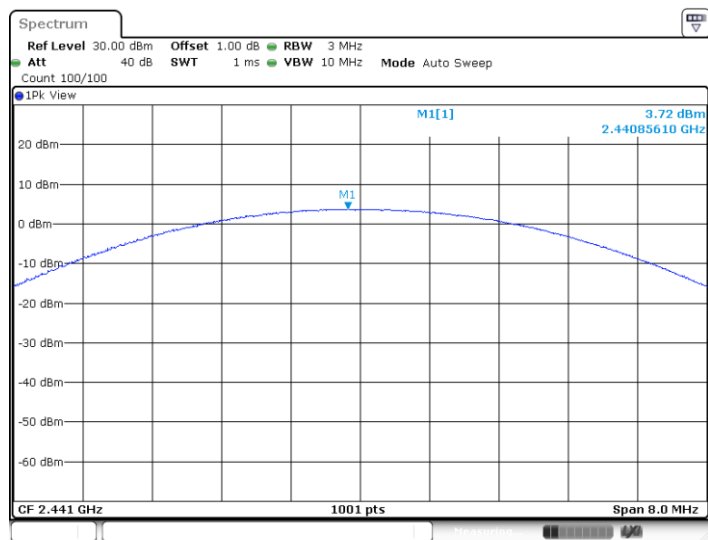
Frequency MHz	Conducted Output Power dBm	EIRP dBm	Result
Low channel 2402MHz	4.96	6.887	Pass
Middle channel 2441MHz	3.72	5.647	Pass
High channel 2480MHz	2.74	4.667	Pass

Low channel 2402MHz



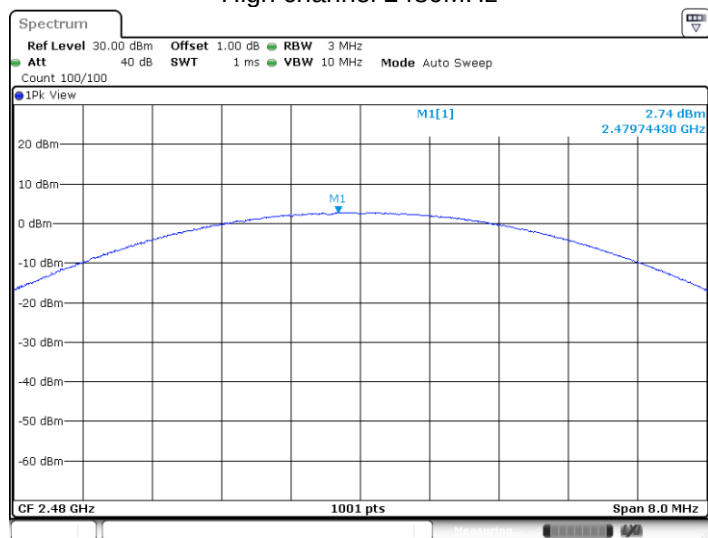
Date: 3 SEP 2021 15:15:06

Middle channel 2441MHz



Date: 3.SEP.2021 15:15:40

High channel 2480MHz

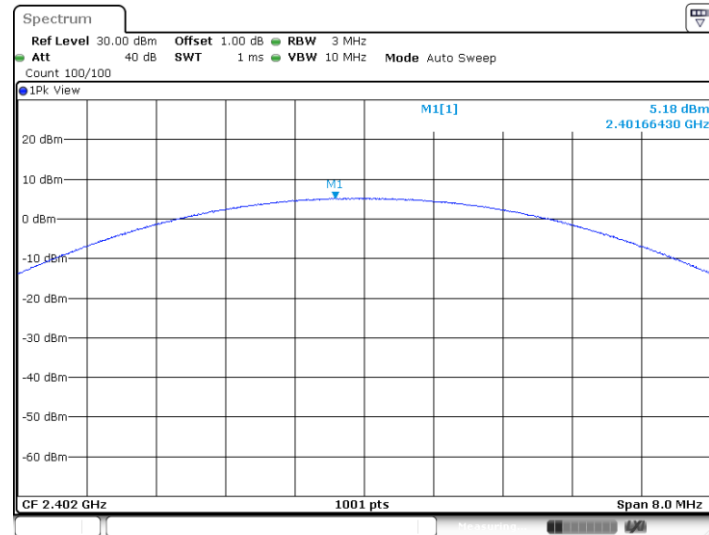


Date: 3.SEP.2021 15:16:10

Bluetooth Mode $\pi/4$ -DQPSK modulation Test Result

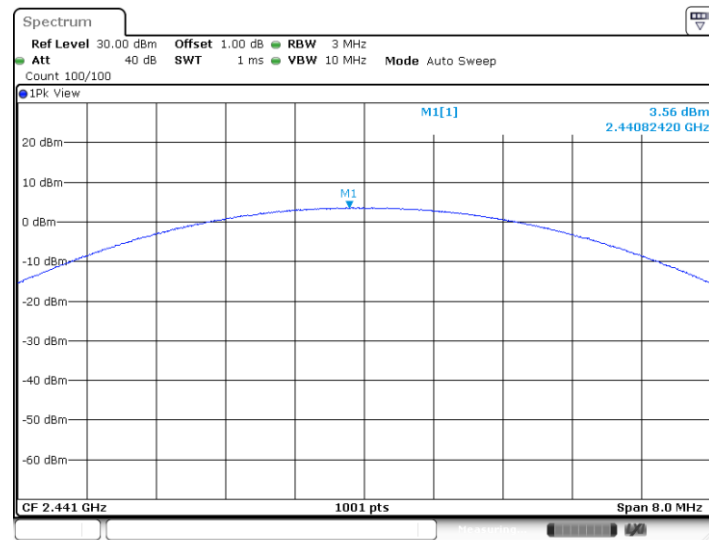
Frequency MHz	Conducted Output Power	EIRP	Result
	dBm	dBm	
Low channel 2402MHz	5.18	7.107	Pass
Middle channel 2441MHz	3.56	5.487	Pass
High channel 2480MHz	2.04	3.967	Pass

Low channel 2402MHz



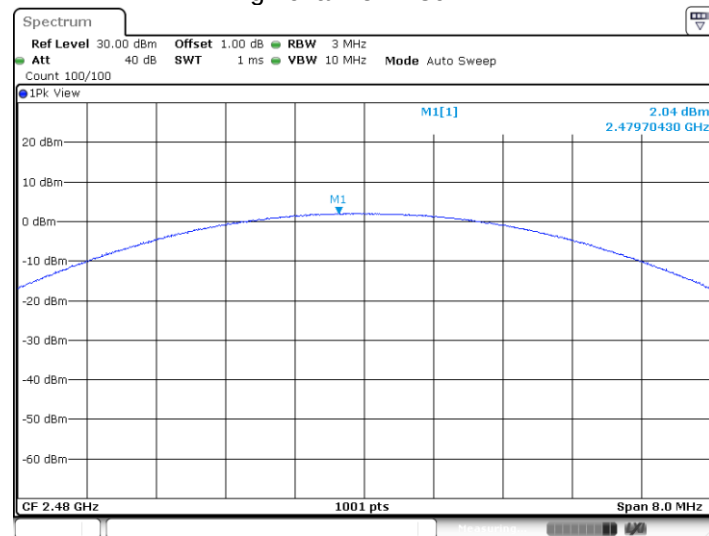
Date: 3 SEP 2021 15:17:50

Middle channel 2441MHz



Date: 3.SEP.2021 15:19:21

High channel 2480MHz

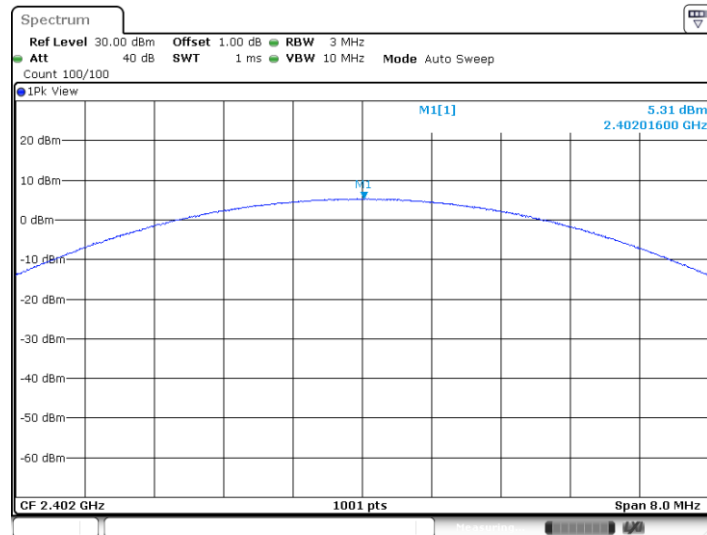


Date: 3.SEP.2021 15:19:56

Bluetooth Mode 8DPSK modulation Test Result

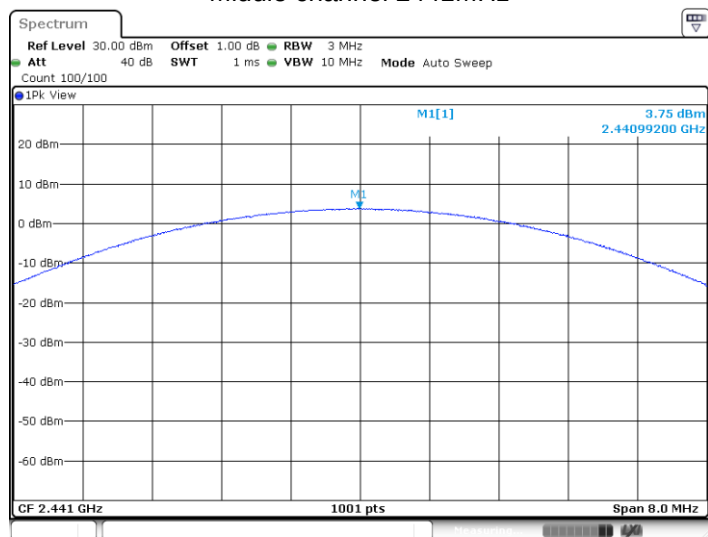
Frequency MHz	Conducted Output Power	EIRP	Result
	dBm	dBm	
Low channel 2402MHz	5.31	7.237	Pass
Middle channel 2441MHz	3.75	5.677	Pass
High channel 2480MHz	1.98	3.907	Pass

Low channel 2402MHz



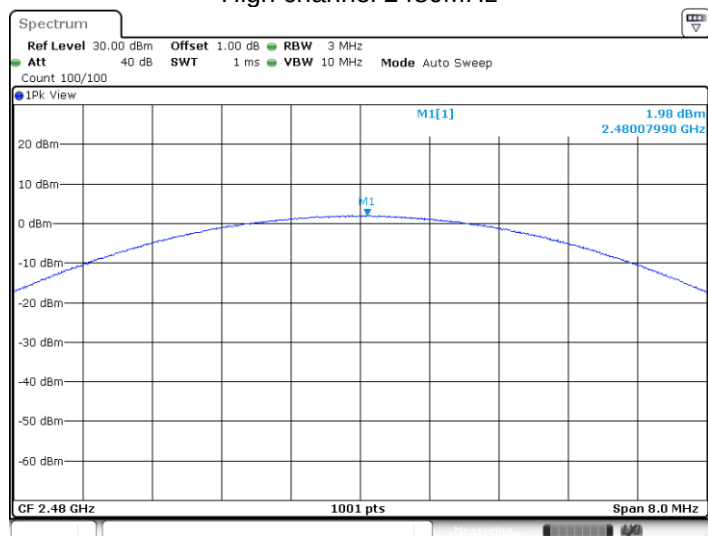
Date: 3 SEP. 2021 15:20:47

Middle channel 2441MHz



Date: 3 SEP.2021 15:21:51

High channel 2480MHz



Date: 3 SEP.2021 15:22:12

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 $\geq$ 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]

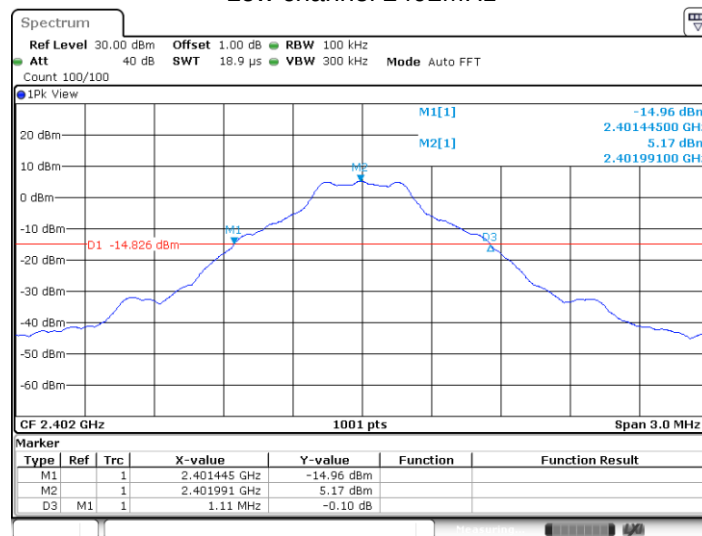
N/A

20 dB bandwidth and 99% Occupied Bandwidth

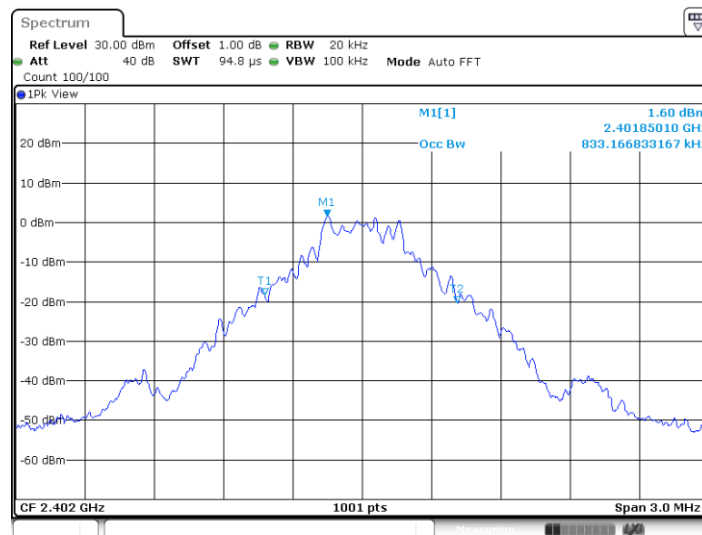
Bluetooth Mode GFSK Modulation test result

Frequency MHz	20 dB Bandwidth MHz	99% Bandwidth MHz	Limit MHz	Result
2402	1.110	0.833	--	Pass
2441	1.110	0.833	--	Pass
2480	1.110	0.833	--	Pass

Low channel 2402MHz



Date: 3 SEP. 2021 14:32:45

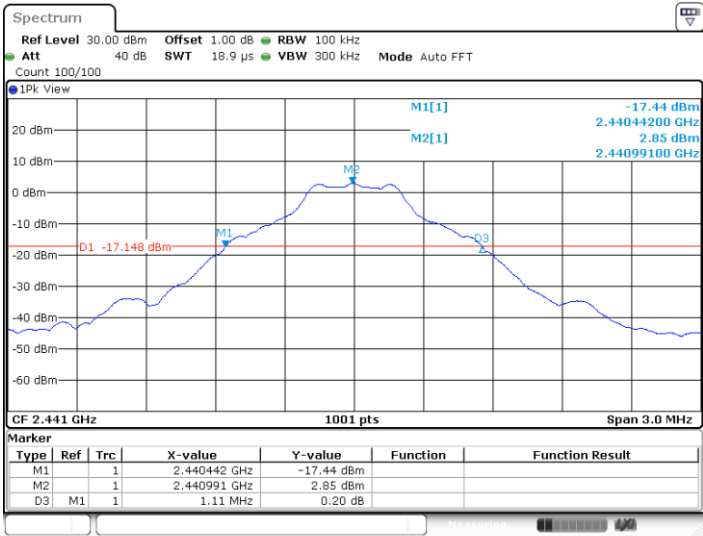


Date: 3 SEP. 2021 14:32:55

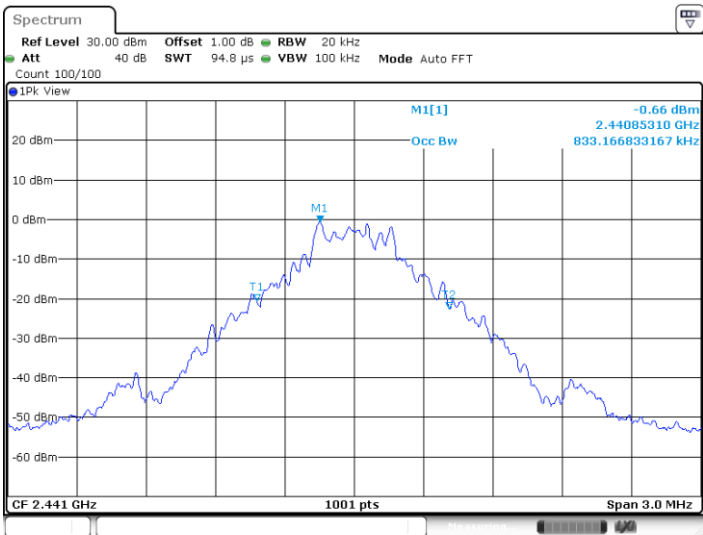


20 dB bandwidth and 99% Occupied Bandwidth

Middle channel 2441MHz



Date: 3 SEP.2021 14:35:01

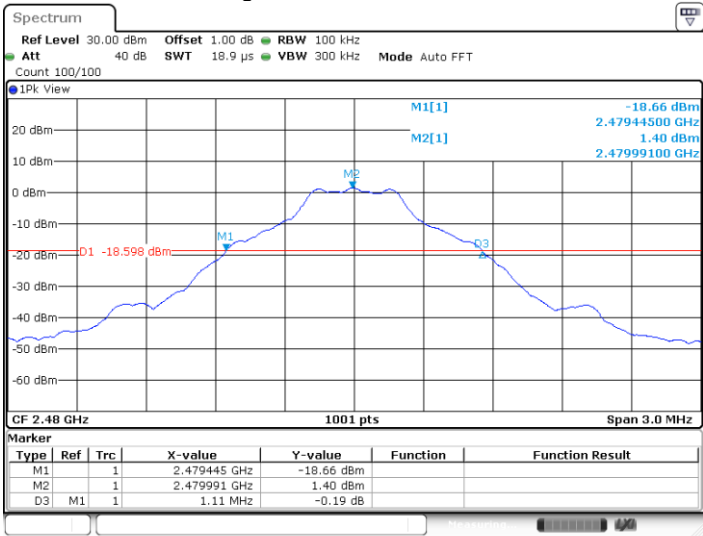


Date: 3 SEP.2021 14:35:12

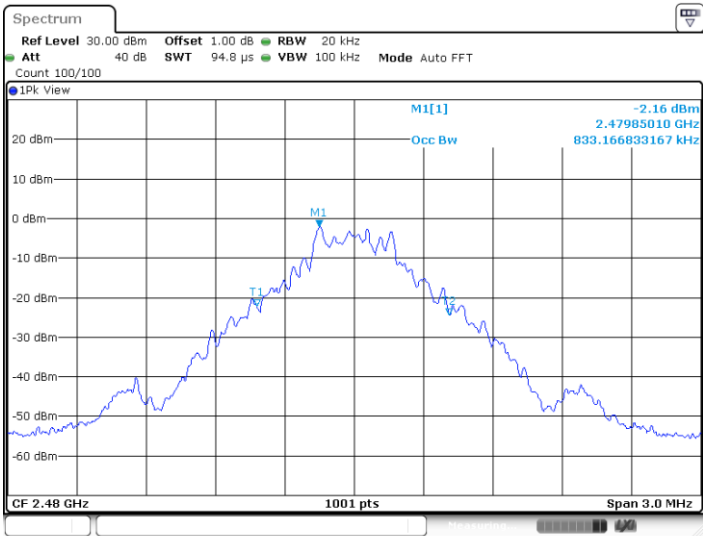


20 dB bandwidth and 99% Occupied Bandwidth

High channel 2480MHz



Date: 3 SEP.2021 14:36:37



Date: 3 SEP.2021 14:36:48

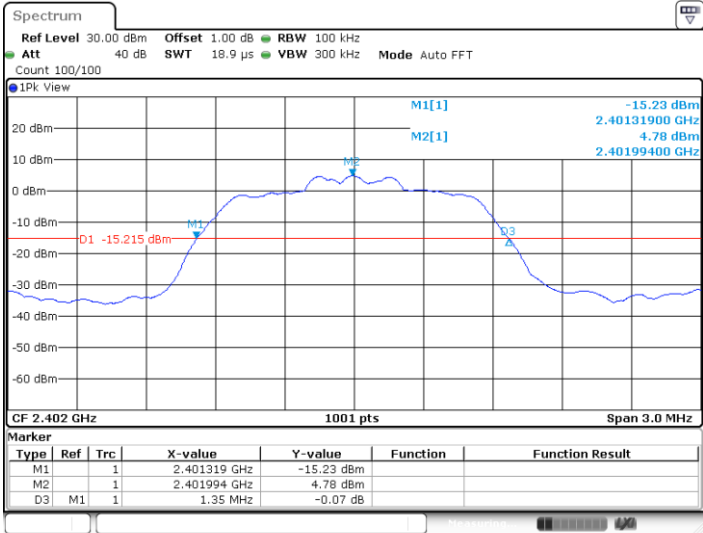


20 dB bandwidth and 99% Occupied Bandwidth

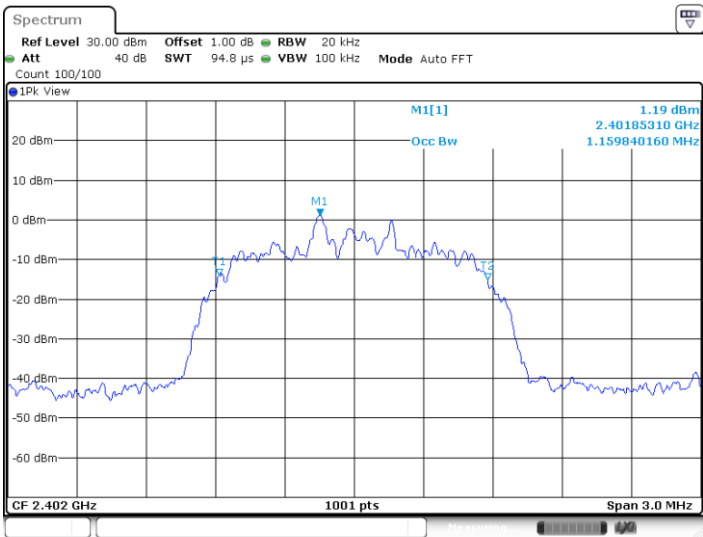
Bluetooth Mode $\pi/4$ -DQPSK Modulation test result

Frequency MHz	20 dB Bandwidth MHz	99% Bandwidth MHz	Limit MHz	Result
2402	1.350	1.16	--	Pass
2441	1.350	1.16	--	Pass
2480	1.353	1.16	--	Pass

Low channel 2402MHz



Date: 3 SEP 2021 14:38:33

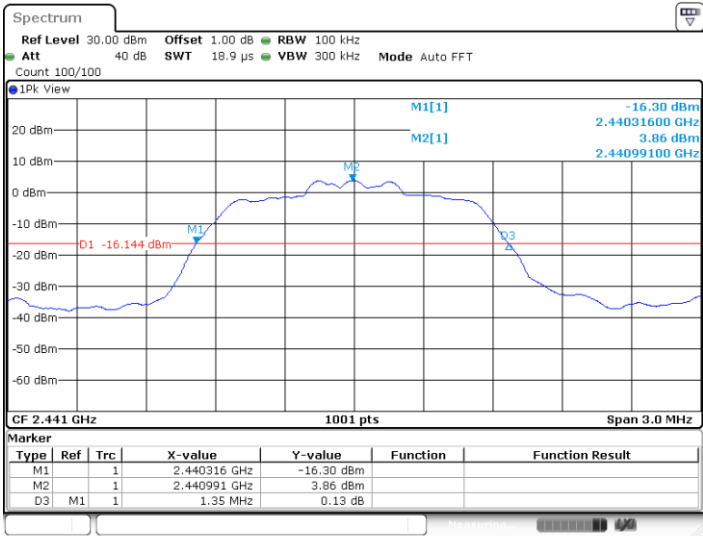


Date: 3 SEP 2021 14:38:44

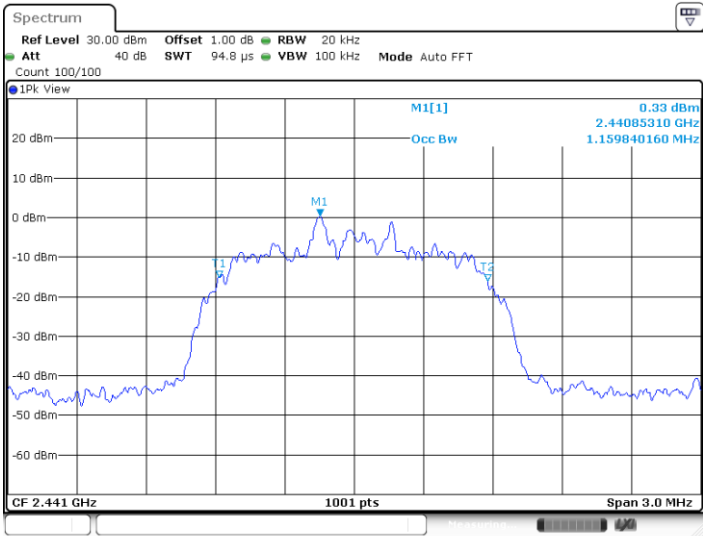


20 dB bandwidth and 99% Occupied Bandwidth

Middle channel 2441MHz



Date: 3.SEP.2021 14:40:42

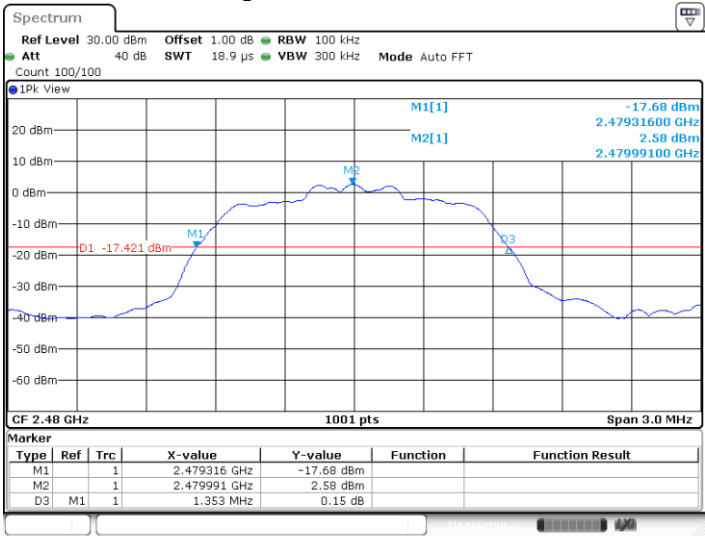


Date: 3.SEP.2021 14:40:53

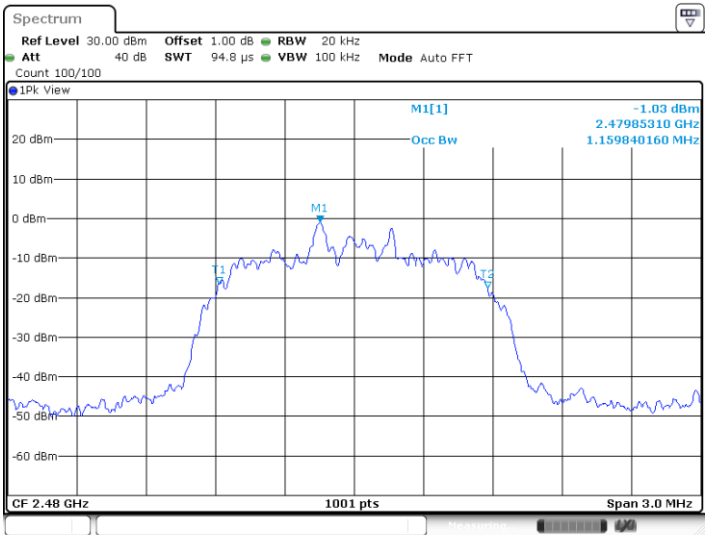


20 dB bandwidth and 99% Occupied Bandwidth

High channel 2480MHz



Date: 3.SEP.2021 14:42:26



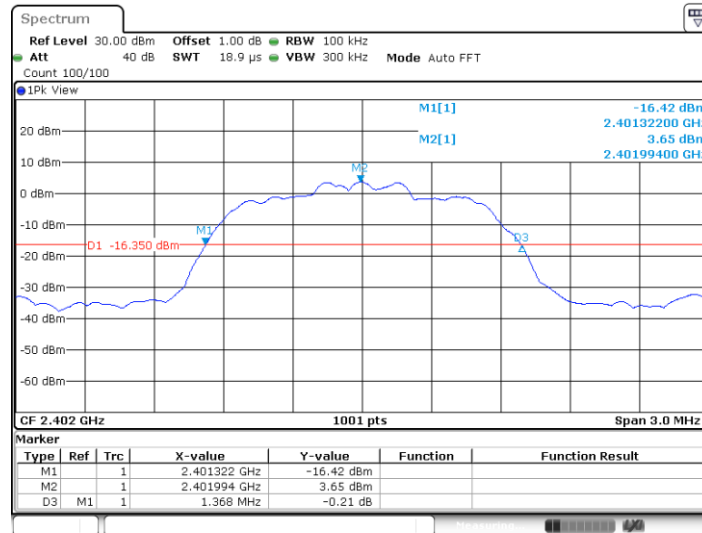
Date: 3.SEP.2021 14:42:37

20 dB bandwidth and 99% Occupied Bandwidth

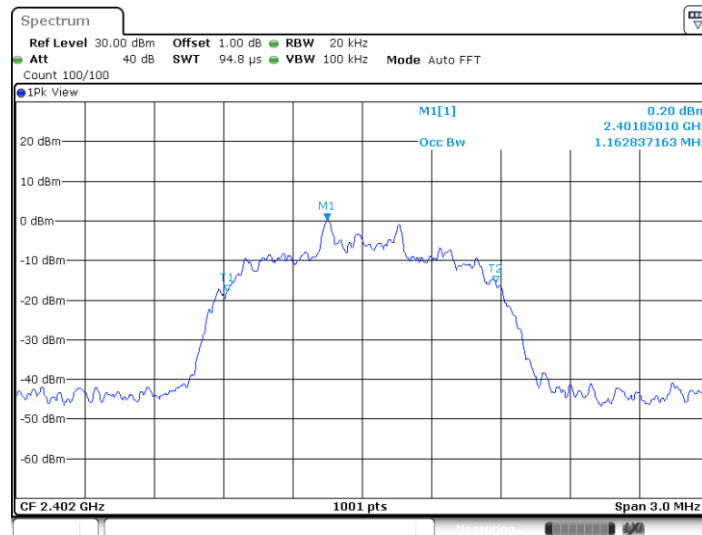
Bluetooth Mode 8DPSK Modulation test result

Frequency MHz	20 dB Bandwidth MHz	99% Bandwidth MHz	Limit MHz	Result
2402	1.368	1.163	--	Pass
2441	1.368	1.16	--	Pass
2480	1.365	1.16	--	Pass

Low channel 2402MHz



Date: 3.SEP.2021 14:44:27

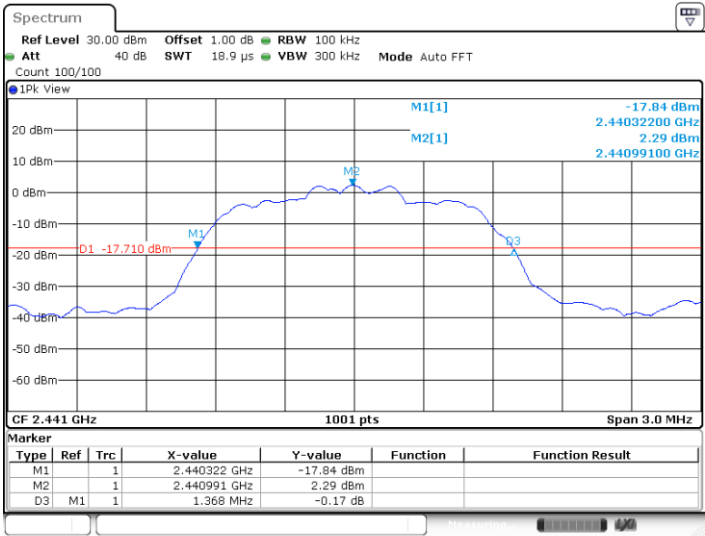


Date: 3.SEP.2021 14:44:38

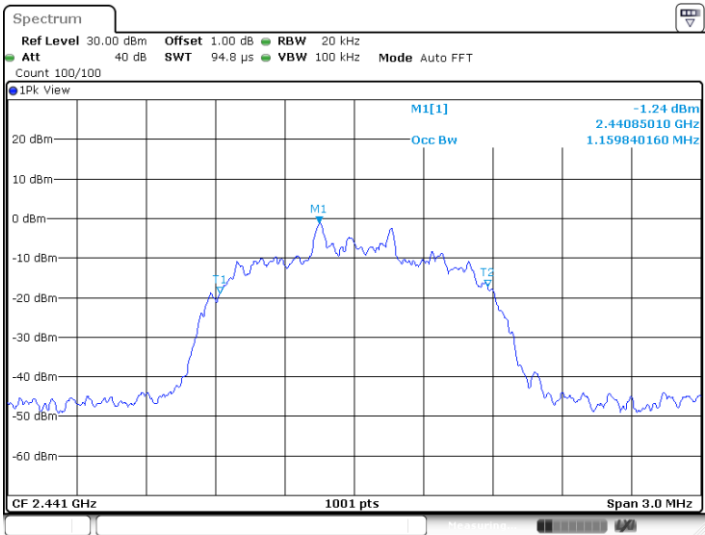


20 dB bandwidth and 99% Occupied Bandwidth

Middle channel 2441MHz



Date: 3.SEP.2021 14:46:29

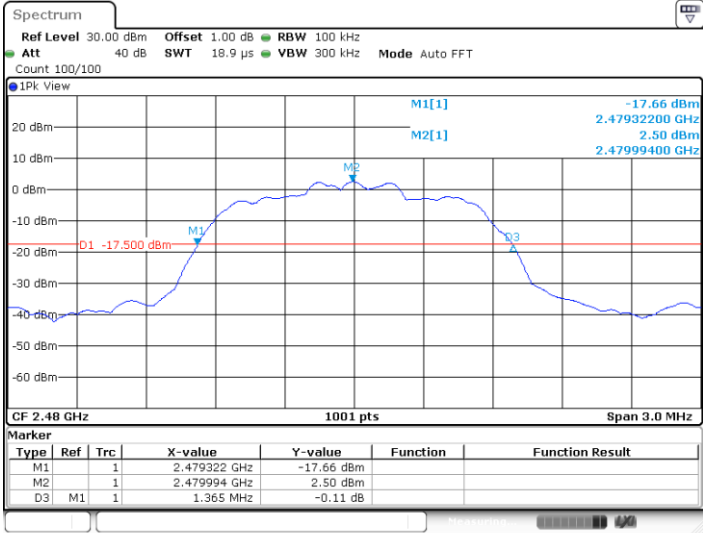


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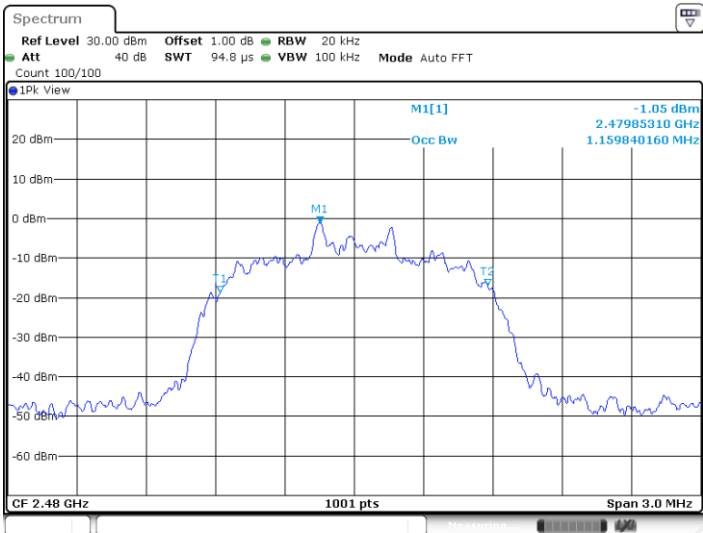


20 dB bandwidth and 99% Occupied Bandwidth

High channel 2480MHz



Date: 3.SEP.2021 14:51:25



Date: 3.SEP.2021 14:51:36

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, $RBW \geq 1\%$ of the span, $VBW \geq RBW$, 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

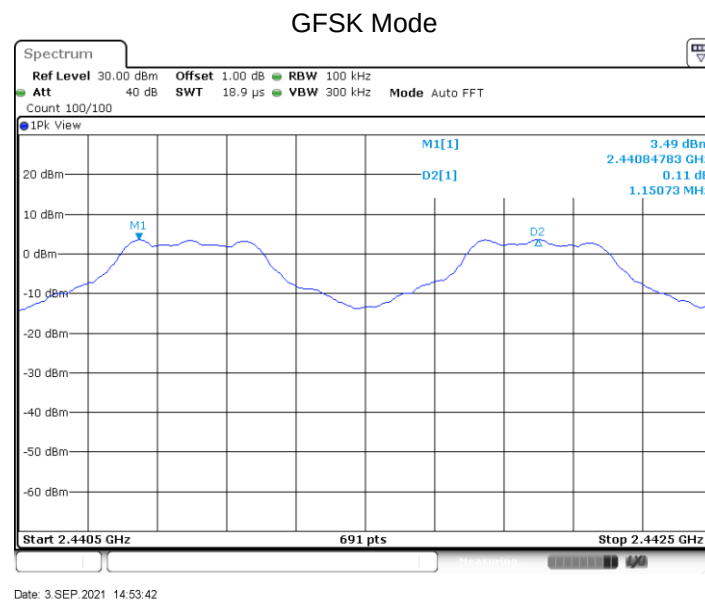
Limit kHz	
$\geq 25\text{kHz}$ or $2/3$ of the 20 dB bandwidth which is greater	
Frequency MHz	2/3 of 20 dB Bandwidth kHz
GFSK	555
$\pi/4$ -DQPSK	773
8DPSK	773

Carrier Frequency Separation

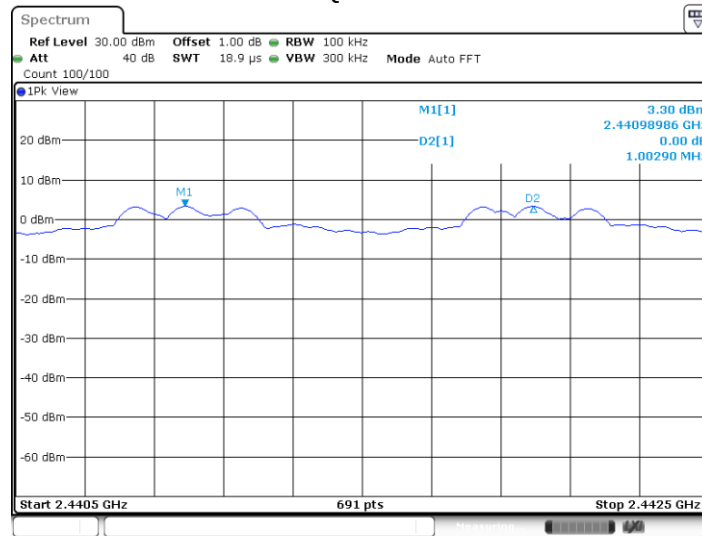
Test result: The measurement was performed with the typical configuration (normal hopping status).

GFSK Modulation test result

Modulation	Frequency MHz	Carrier Frequency Separation kHz	Result
GFSK	Hop	1151	Pass
$\pi/4$ -DQPSK	Hop	1003	Pass
8DPSK	Hop	1003	Pass

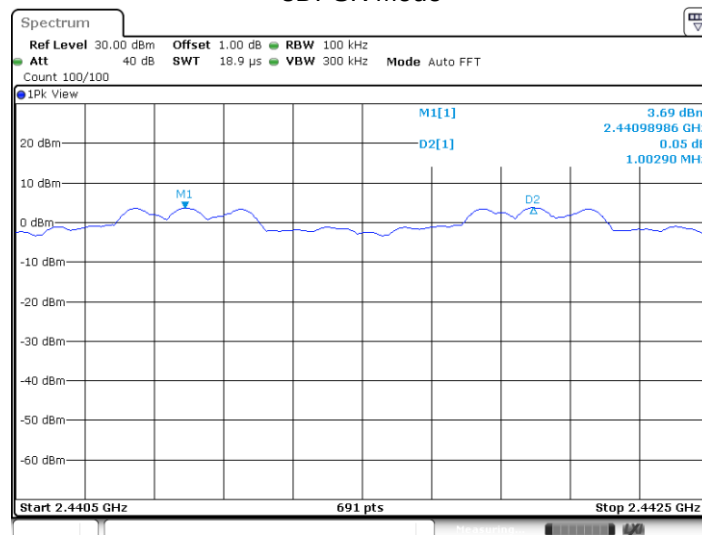


$\pi/4$ -DQPSK Mode



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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, $RBW \geq 1\%$ of the span, $VBW \geq RBW$, 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

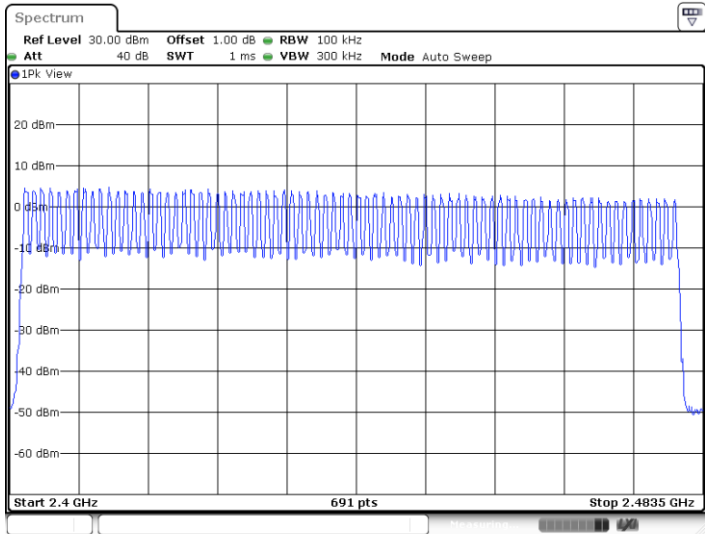


Number of hopping frequencies

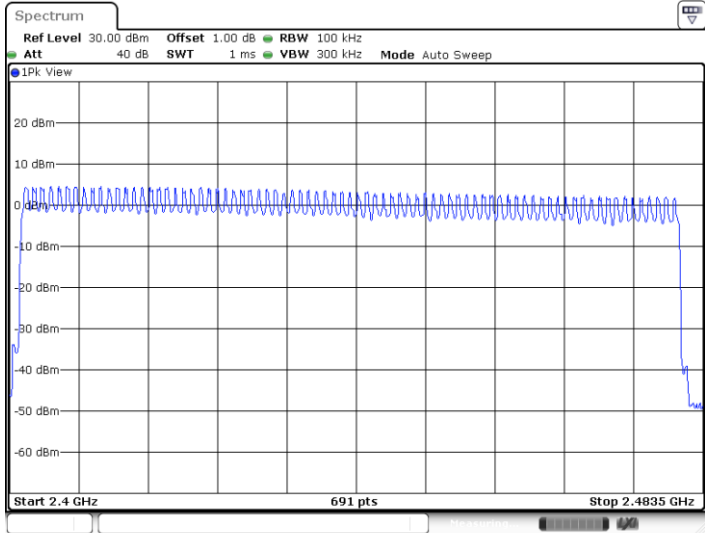
Test result: The measurement was performed with the typical configuration (normal hopping status), and the total hopping channels is constant for the all modulation mode according with the Bluetooth Core Specification.

Number of hopping frequencies	Result
79	Pass

GFSK Mode

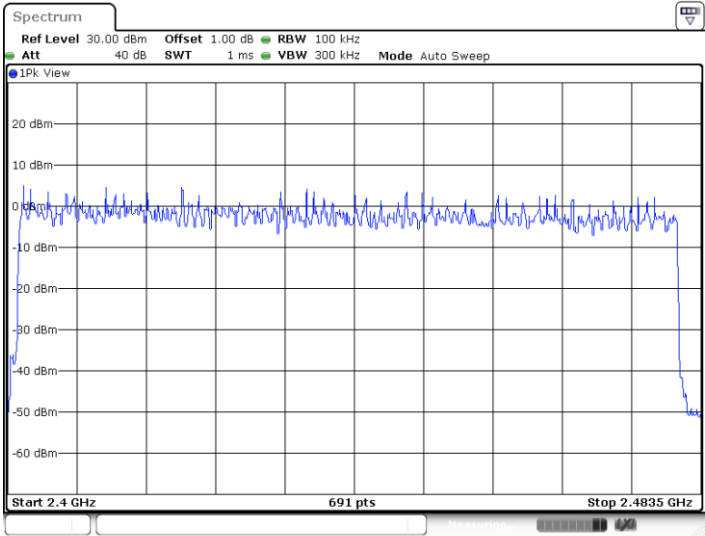


$\pi/4$ -DQPSK Mode





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.
 $\text{Dwell Time} = \text{Burst Width} * \text{Total Hops}$
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.

Dwell Time

Dwell time

The maximum dwell time shall be 0.4 s.

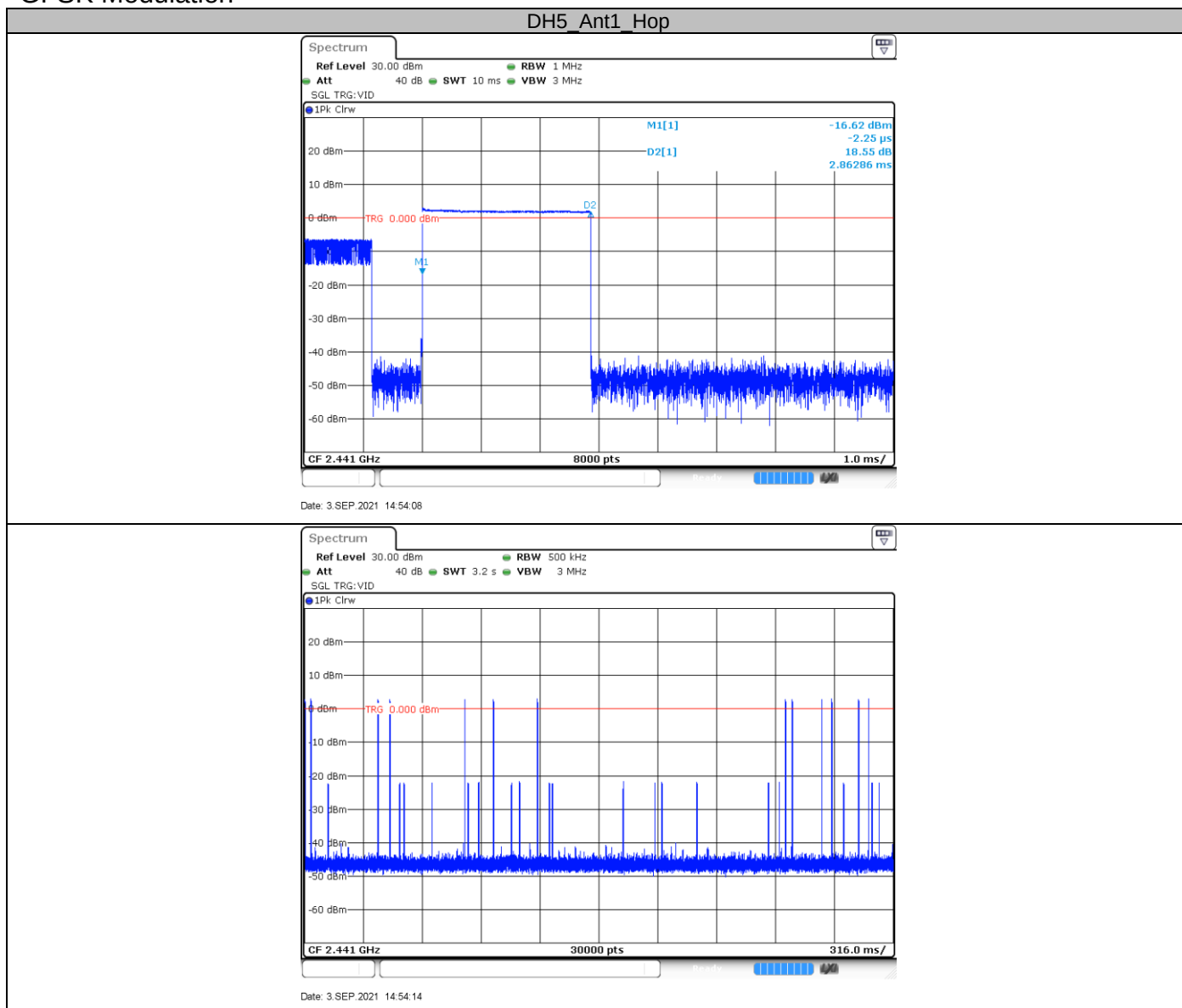
The Dwell Time = Burst Width * Total Hops. The detailed calculations are showed as follows:

The duration for dwell time calculation: 0.4 [s] * hopping number = 0.4 [s] * 79 [ch] = 31.6 [s*ch];

Test Result

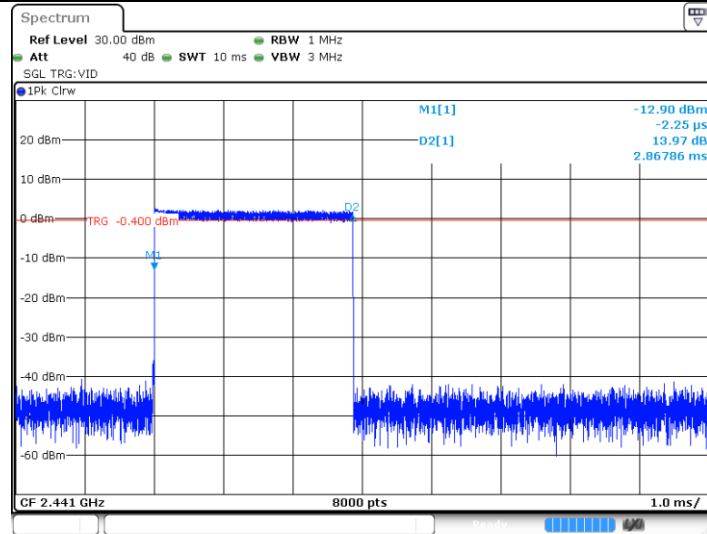
Modulation	Mode	BurstWidth (ms)	Total Hops	Test Result (s)	Limit (s)	Result
GFSK	DH5	2.86	130	0.372	0.4	Pass
$\pi/4$ -DQPSK	2DH5	2.87	120	0.344	0.4	Pass
8-DPSK	3DH5	2.87	90	0.258	0.4	Pass

GFSK Modulation

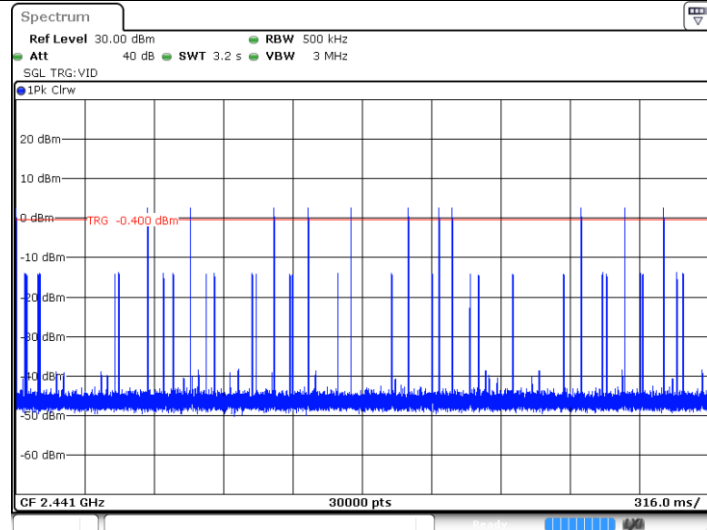


$\pi/4$ -DQPSK Modulation

2DH5_Ant1_Hop

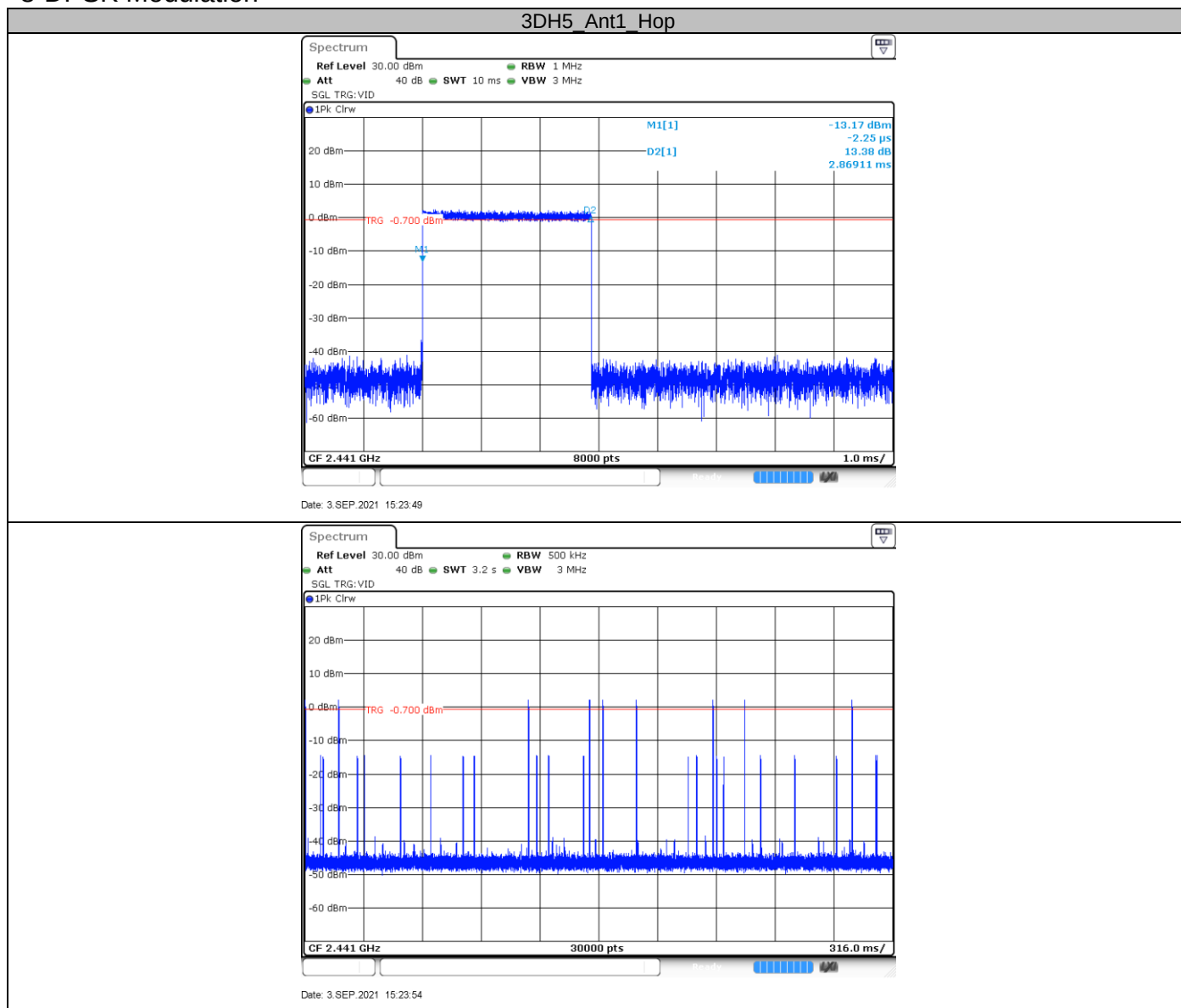


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8-DPSK Modulation



9.7 Spurious RF conducted emissions

Test Method

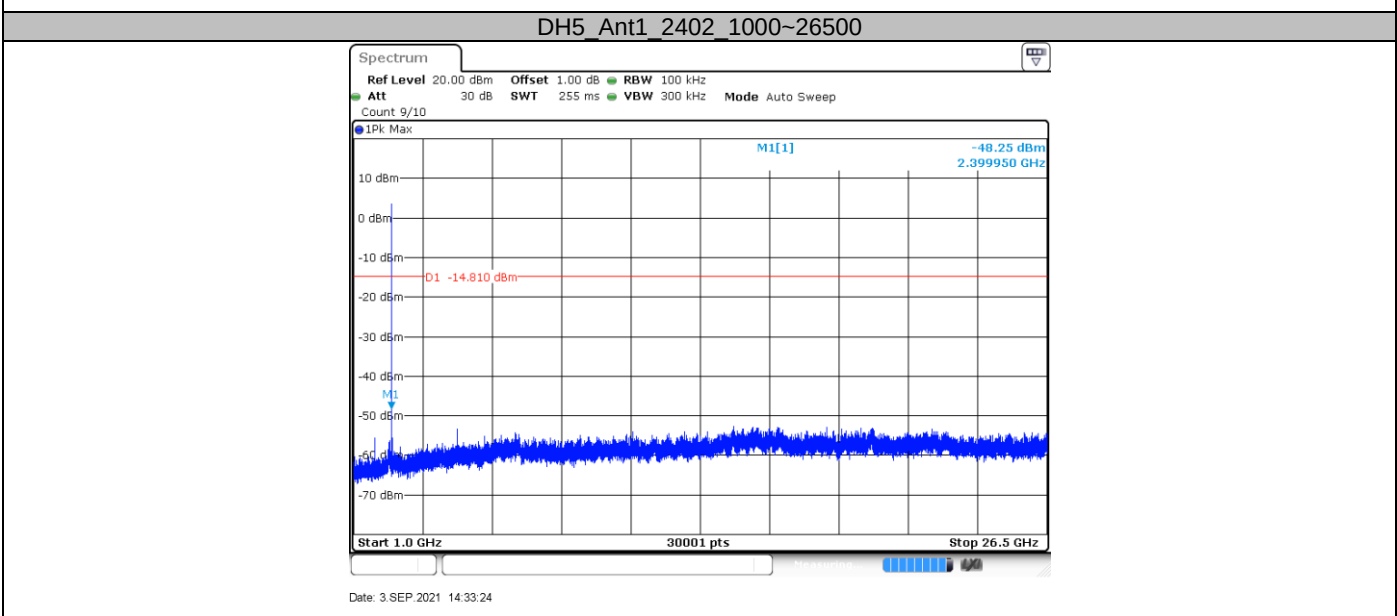
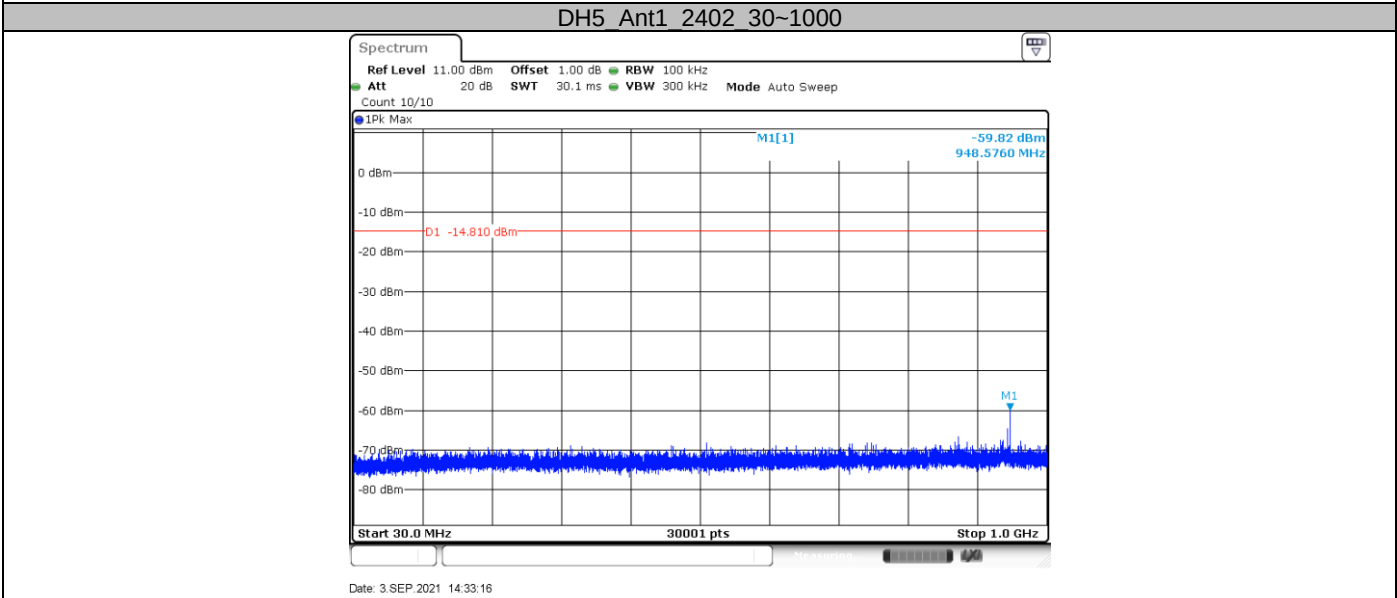
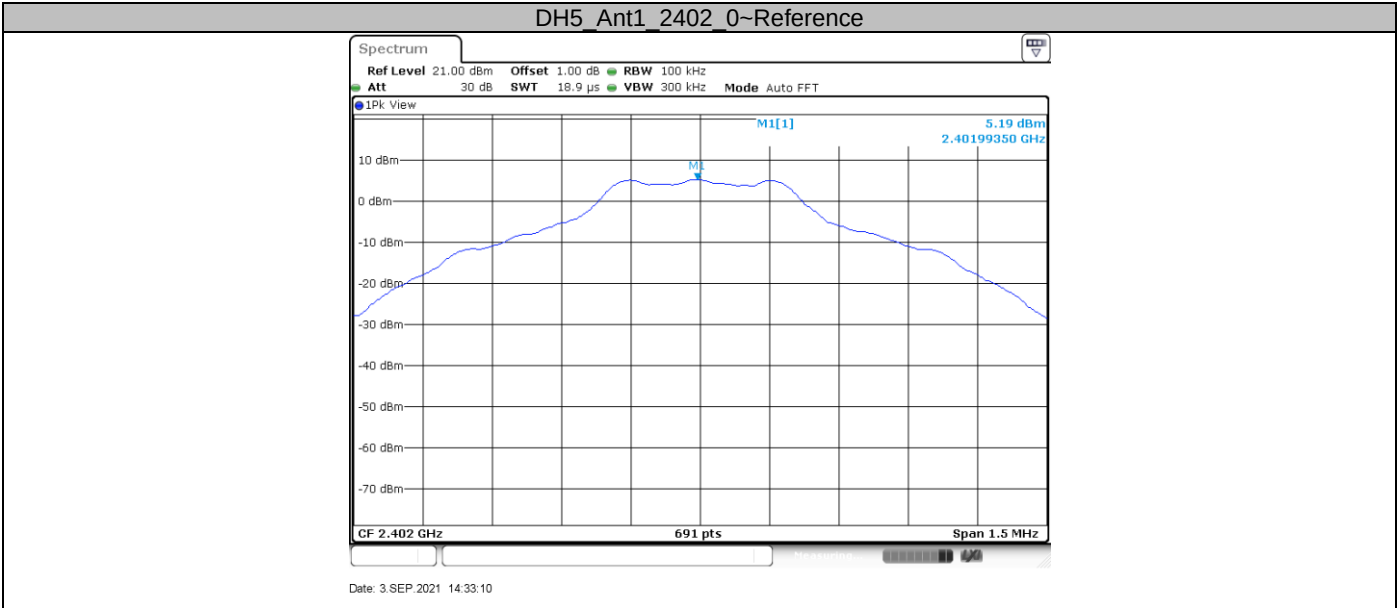
1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in 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

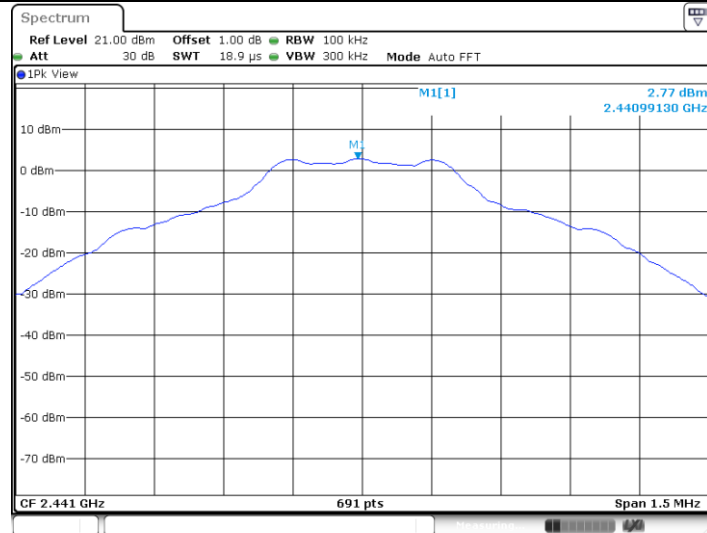
Frequency Range MHz	Limit (dBc)
30-25000	-20

Test Result

TestMode	Antenna	Channel [MHz]	FreqRange [MHz]	RefLevel	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	2402	Reference	5.19 dBm	5.19	---	PASS
			30~1000	30~1000 MHz	-63.06	<=-14.81	PASS
			1000~26500	1000~26500 MHz	-48.25	<=-14.81	PASS
		2441	Reference	2.77 dBm	2.77	---	PASS
			30~1000	30~1000 MHz	-61.9	<=-17.23	PASS
			1000~26500	1000~26500 MHz	-51.5	<=-17.23	PASS
		2480	Reference	1.35 dBm	1.35	---	PASS
			30~1000	30~1000 MHz	-62.74	<=-18.65	PASS
			1000~26500	1000~26500 MHz	-52.52	<=-18.65	PASS
2DH5	Ant1	2402	Reference	4.87 dBm	4.87	---	PASS
			30~1000	30~1000 MHz	-65.32	<=-15.13	PASS
			1000~26500	1000~26500 MHz	-36.36	<=-15.13	PASS
		2441	Reference	3.82 dBm	3.82	---	PASS
			30~1000	30~1000 MHz	-64.19	<=-16.18	PASS
			1000~26500	1000~26500 MHz	-52.21	<=-16.18	PASS
		2480	Reference	2.54 dBm	2.54	---	PASS
			30~1000	30~1000 MHz	-60.46	<=-17.46	PASS
			1000~26500	1000~26500 MHz	-52.76	<=-17.46	PASS
3DH5	Ant1	2402	Reference	3.72 dBm	3.72	---	PASS
			30~1000	30~1000 MHz	-63.59	<=-16.28	PASS
			1000~26500	1000~26500 MHz	-43.76	<=-16.28	PASS
		2441	Reference	2.18 dBm	2.18	---	PASS
			30~1000	30~1000 MHz	-63.21	<=-17.82	PASS
			1000~26500	1000~26500 MHz	-52.07	<=-17.82	PASS
		2480	Reference	2.46 dBm	2.46	---	PASS
			30~1000	30~1000 MHz	-60.33	<=-17.54	PASS
			1000~26500	1000~26500 MHz	-50.74	<=-17.54	PASS

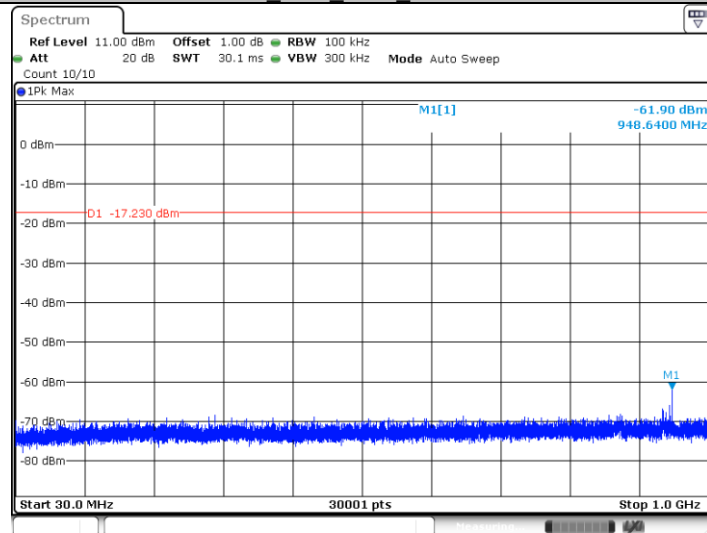


DH5_Ant1_2441_0~Reference



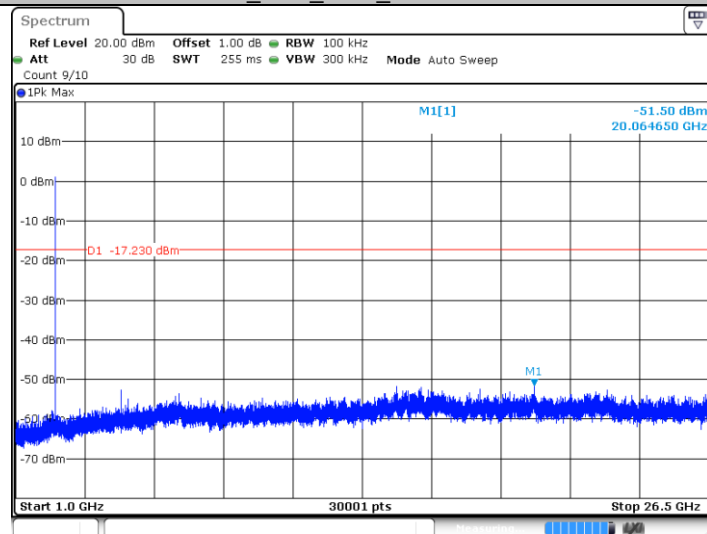
Date: 3 SEP.2021 14:35:18

DH5_Ant1_2441_30~1000



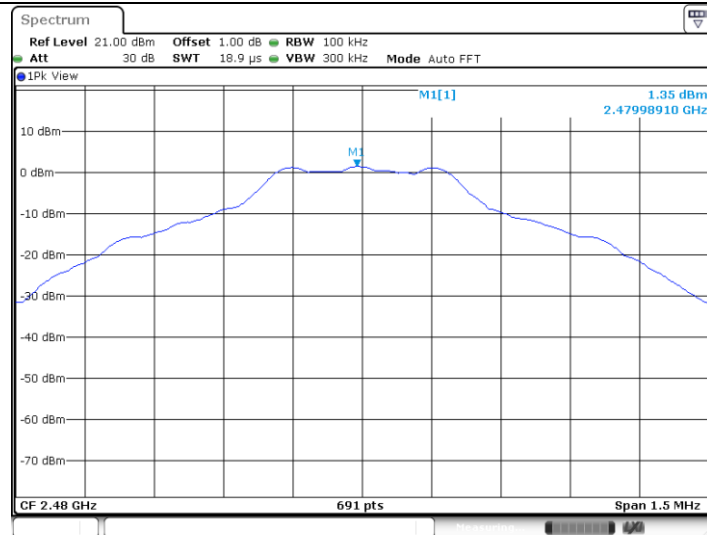
Date: 3 SEP.2021 14:35:24

DH5_Ant1_2441_1000~26500



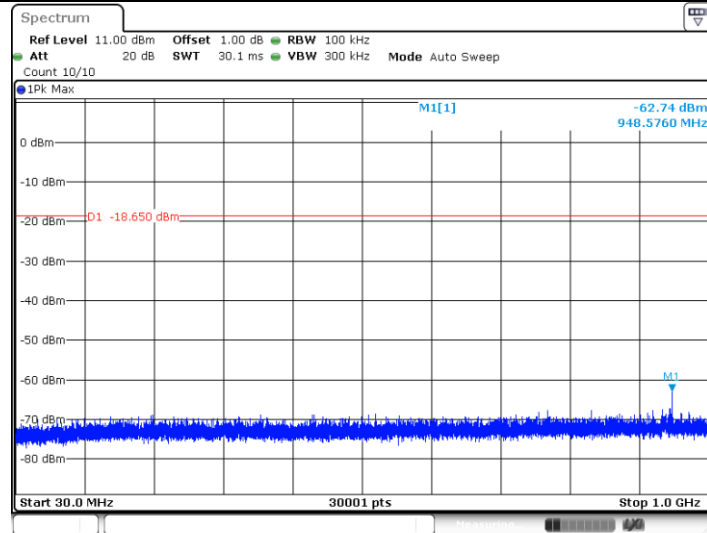
Date: 3 SEP.2021 14:35:31

DH5_Ant1_2480_0~Reference



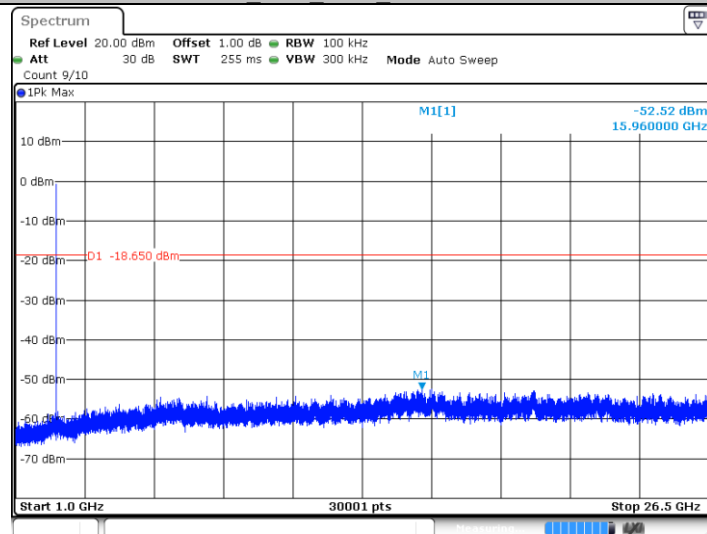
Date: 3 SEP 2021 14:37:02

DH5 Ant1 2480 30~1000



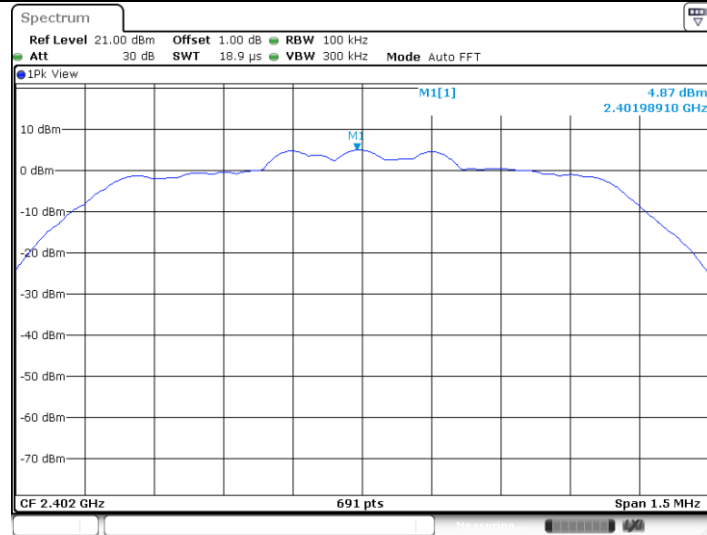
Date: 3 SEP 2021 14:37:08

DH5 Ant1 2480 1000~26500



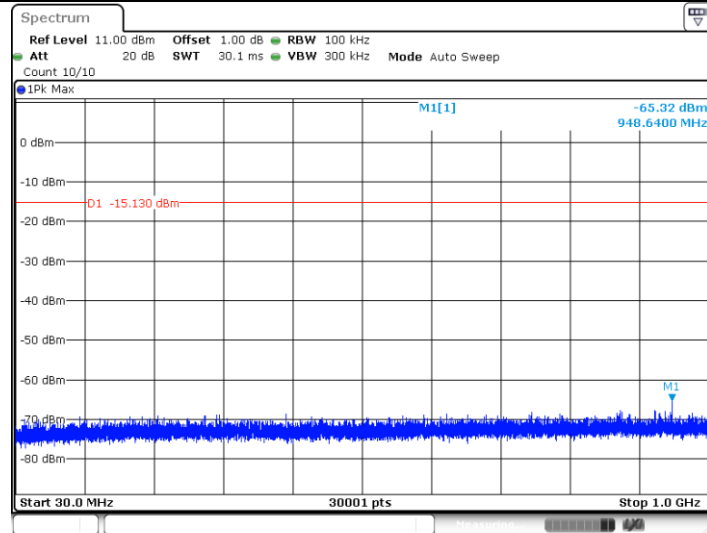
Date: 3 SEP 2021 14:37:16

2DH5 Ant1 2402 0~Reference



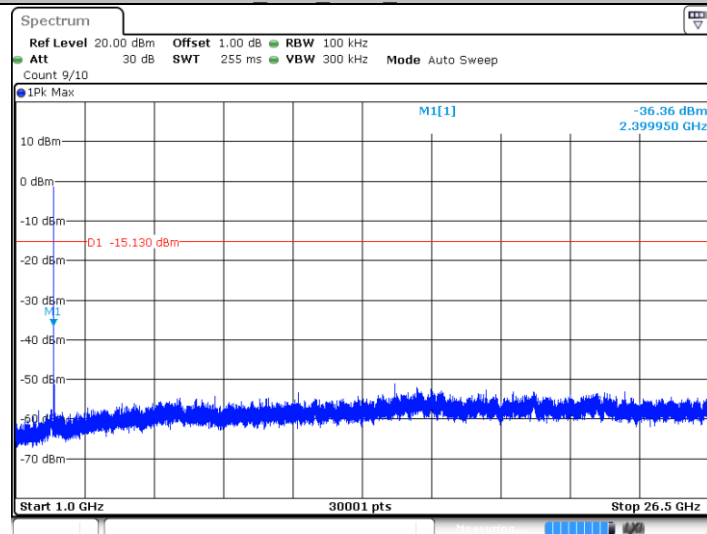
Date: 3.SEP.2021 14:38:58

2DH5_Ant1_2402_30~1000



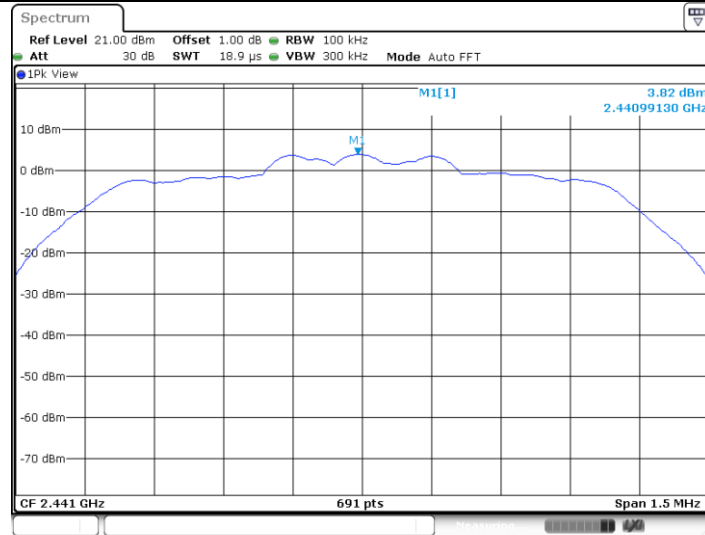
Date: 3.SEP.2021 14:39:05

2DH5_Ant1_2402_1000~26500



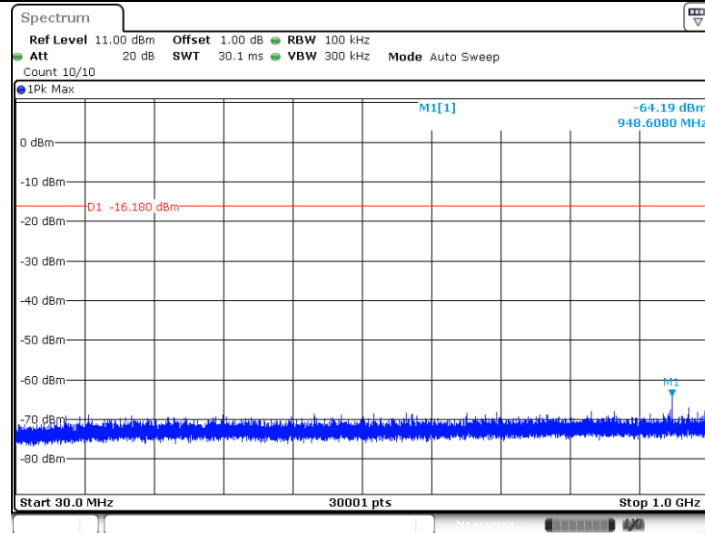
Date: 3.SEP.2021 14:39:12

2DH5_Ant1_2441_0~Reference



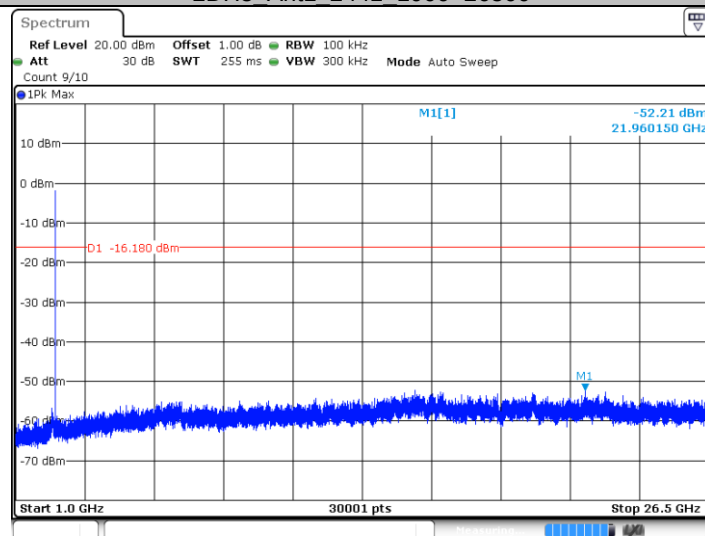
Date: 3.SEP.2021 14:40:58

2DH5_Ant1_2441_30~1000



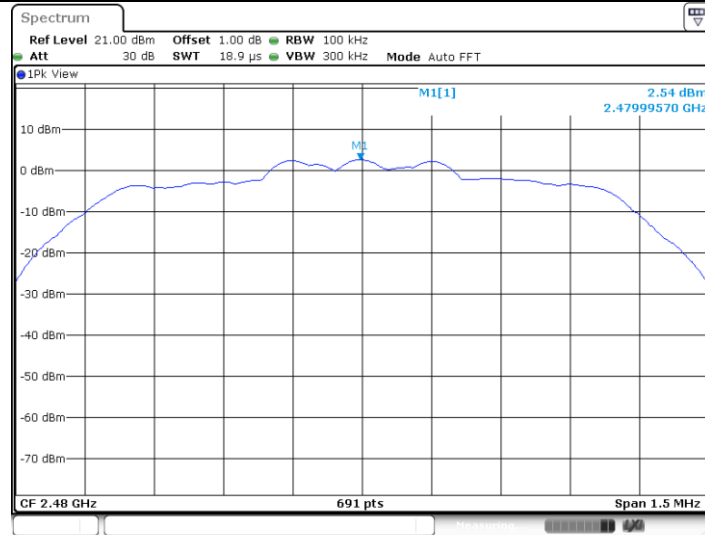
Date: 3.SEP.2021 14:41:04

2DH5_Ant1_2441_1000~26500



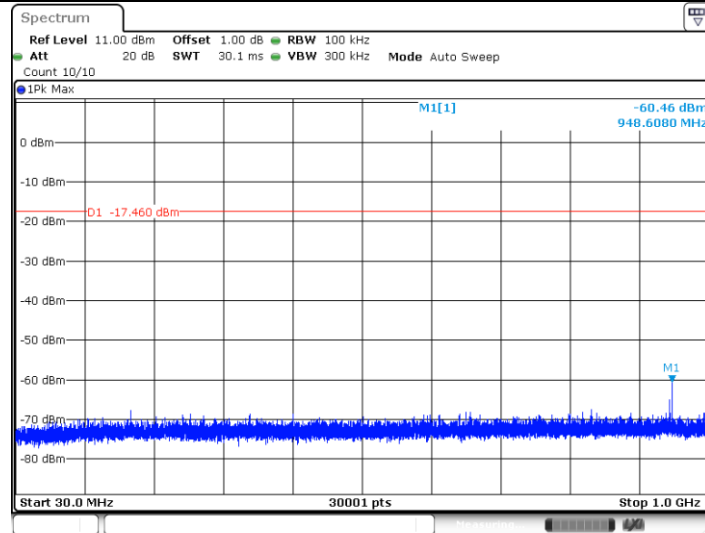
Date: 3.SEP.2021 14:41:12

2DH5_Ant1_2480_0~Reference



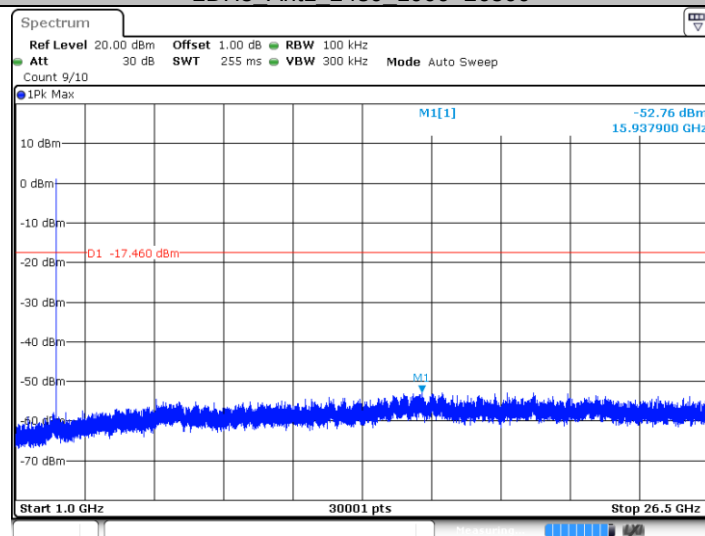
Date: 3.SEP.2021 14:42:52

2DH5 Ant1 2480 30~1000



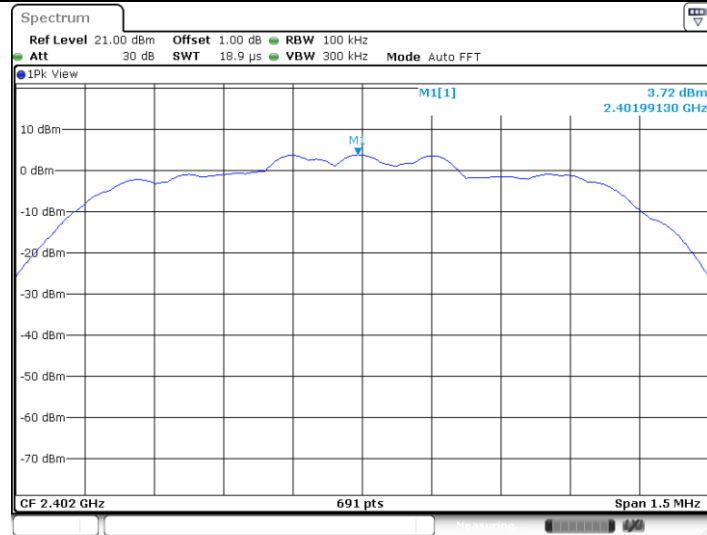
Date: 3.SEP.2021 14:42:58

2DH5 Ant1 2480 1000~26500



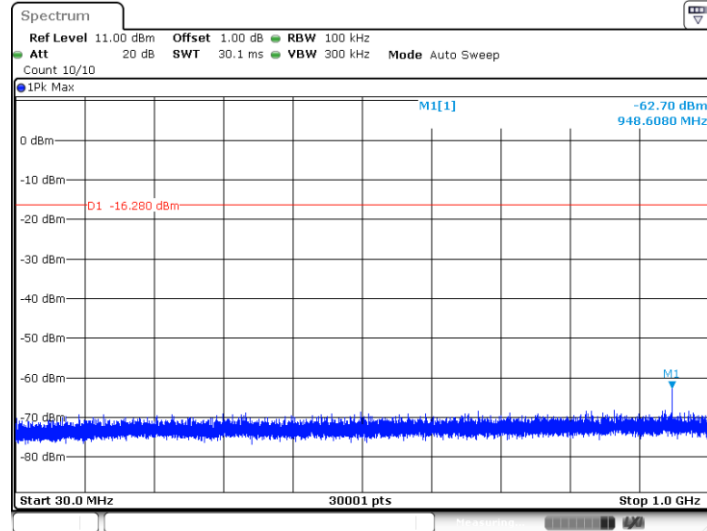
Date: 3.SEP.2021 14:43:06

3DH5 Ant1 2402 0~Reference



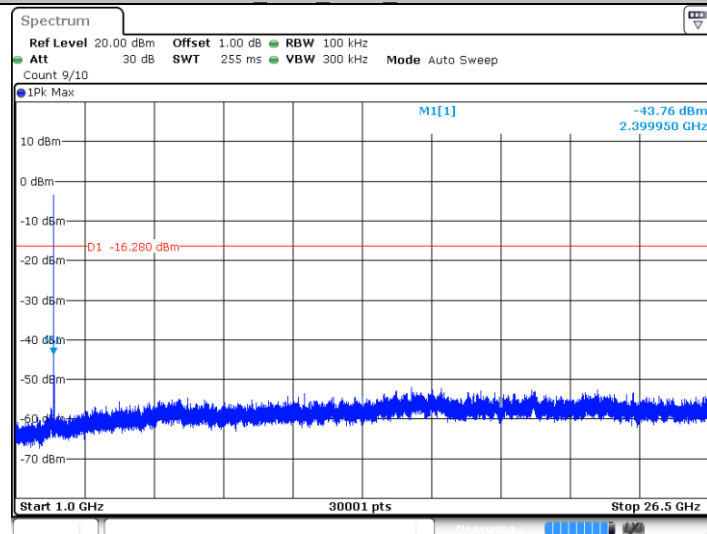
Date: 3.SEP.2021 14:44:53

3DH5_Ant1_2402_30~1000



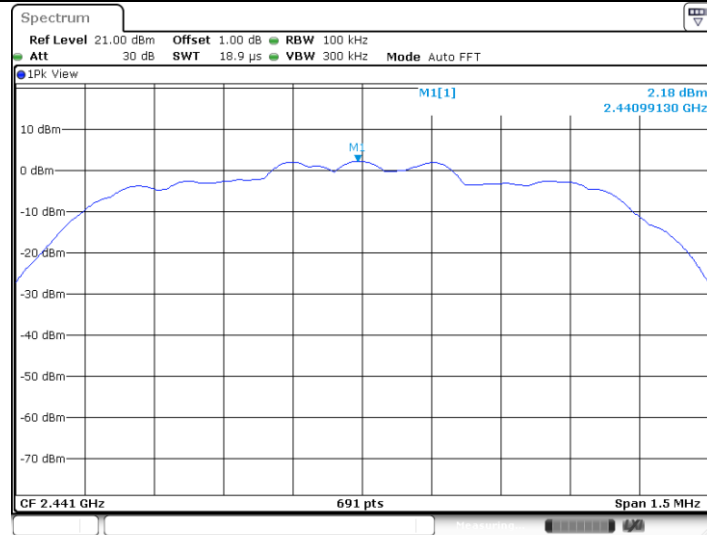
Date: 3.SEP.2021 14:44:59

3DH5_Ant1_2402_1000~26500



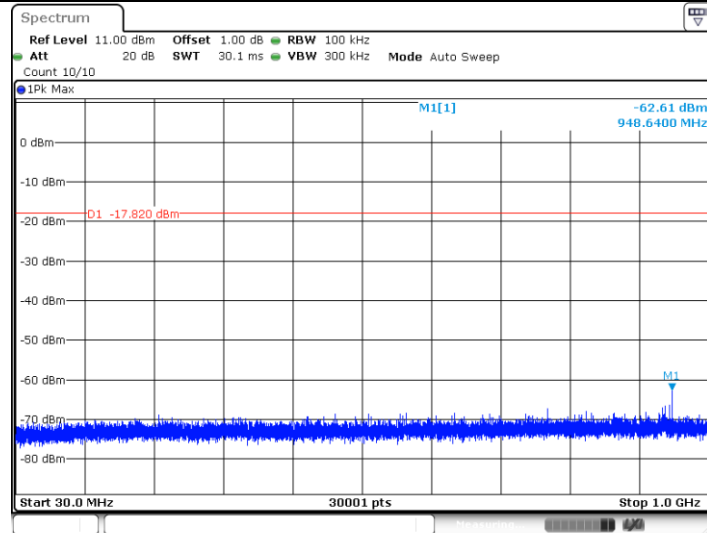
Date: 3.SEP.2021 14:45:06

3DH5_Ant1_2441_0~Reference



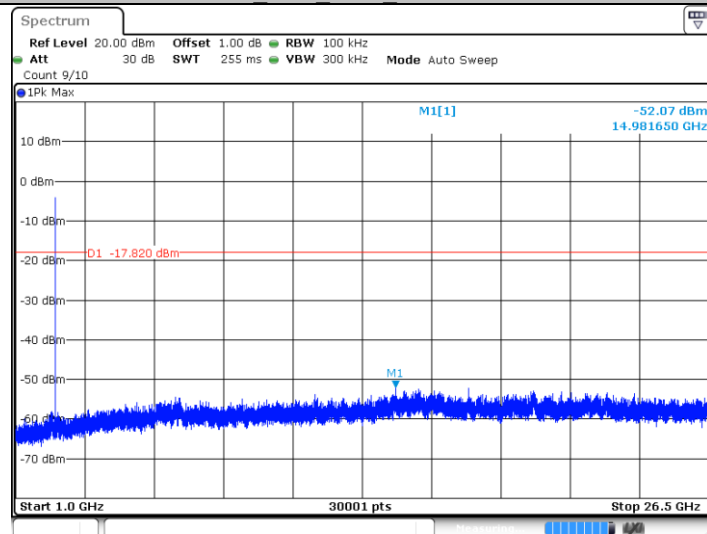
Date: 3.SEP.2021 14:46:46

3DH5_Ant1_2441_30~1000



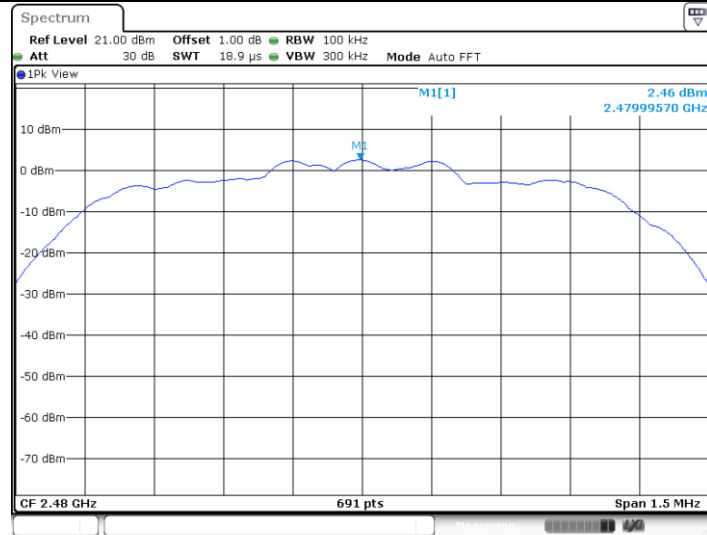
Date: 3.SEP.2021 14:46:52

3DH5_Ant1_2441_1000~26500



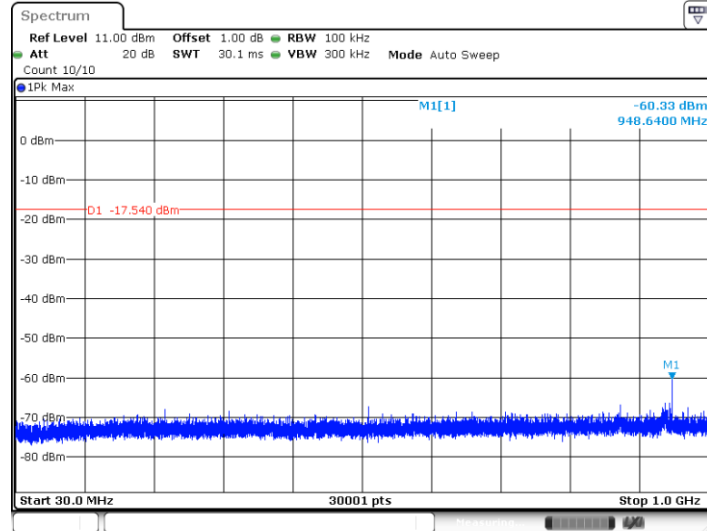
Date: 3.SEP.2021 14:47:00

3DH5_Ant1_2480_0~Reference



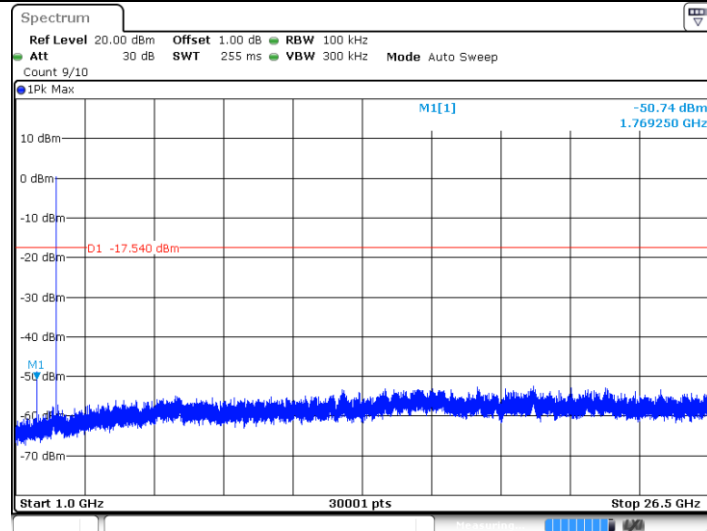
Date: 3.SEP.2021 14:51:50

3DH5_Ant1_2480_30~1000



Date: 3.SEP.2021 14:51:57

3DH5_Ant1_2480_1000~26500



Date: 3.SEP.2021 14:52:04

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.

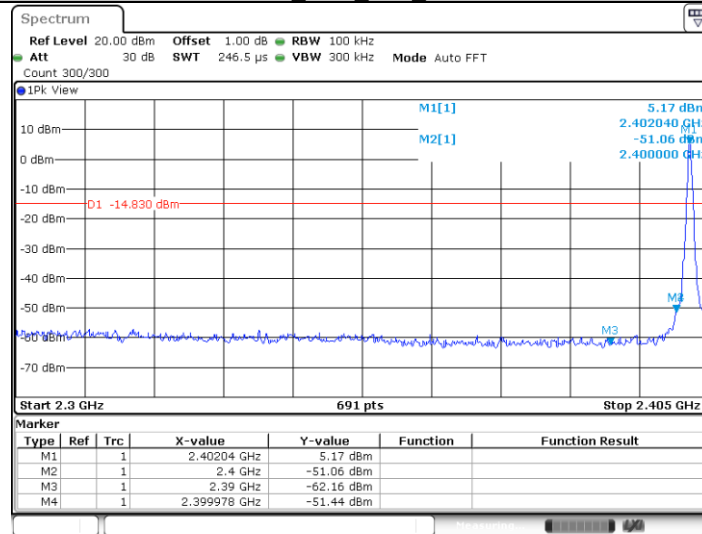
Limit:

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 the 100 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.

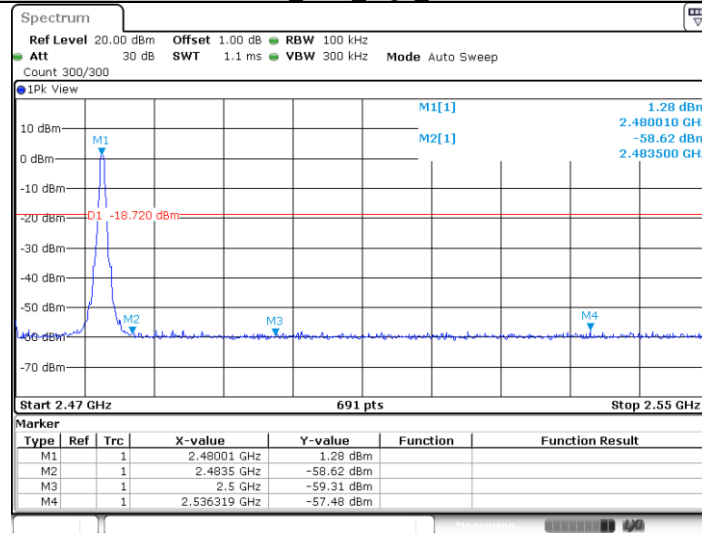
Test Result

TestMode	Antenna	ChName	Channel[MHz]	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
DH5	Ant1	Low	2402	5.17	-51.44	<=-14.83	PASS
		High	2480	1.28	-57.48	<=-18.72	PASS
		Low	Hop_2402	3.31	-56.87	-16.69	PASS
		High	Hop_2480	2.27	-56.76	-17.73	PASS
2DH5	Ant1	Low	2402	4.68	-46.77	<=-15.32	PASS
		High	2480	2.54	-57.49	<=-17.46	PASS
		Low	Hop_2402	2.27	-55.93	-17.73	PASS
		High	Hop_2480	2.00	-57.3	-18	PASS
3DH5	Ant1	Low	2402	3.52	-49.71	<=-16.48	PASS
		High	2480	2.43	-57.3	<=-17.57	PASS
		Low	Hop_2402	-0.91	-55.71	-20.91	PASS
		High	Hop_2480	1.24	-57.59	-18.76	PASS

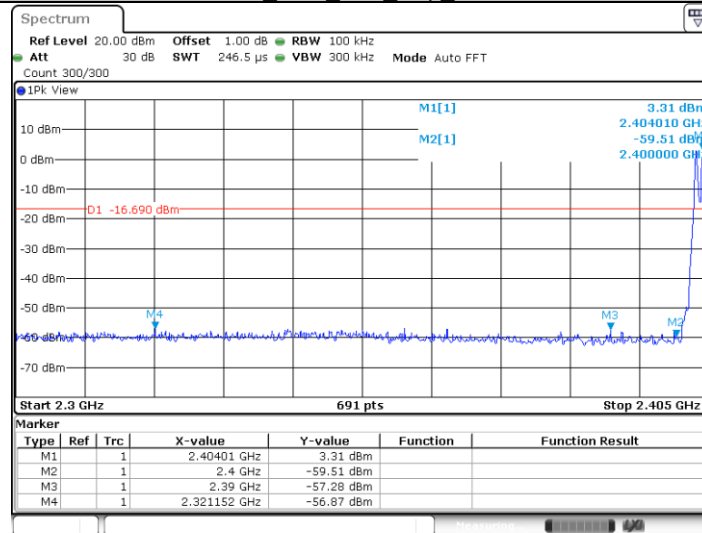
DH5_Ant1_Low_2402



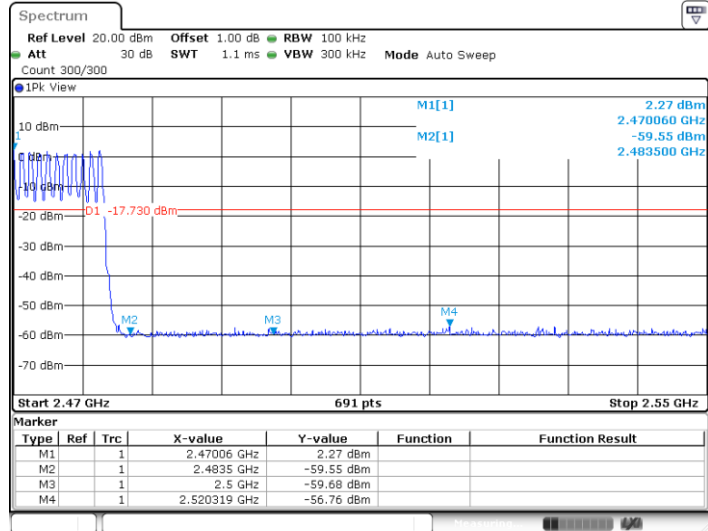
DH5_Ant1_High_2480



DH5_Ant1_Low_Hop_2402

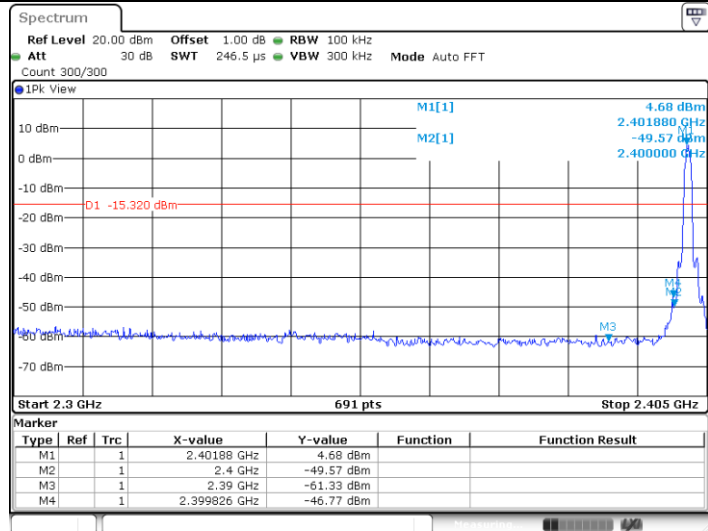


DH5_Ant1_High_Hop_2480



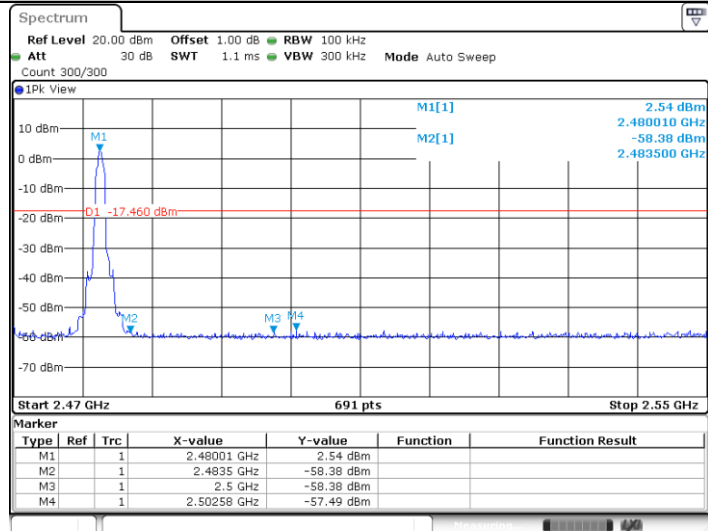
Date: 3 SEP.2021 14:55:57

2DH5_Ant1_Low_2402



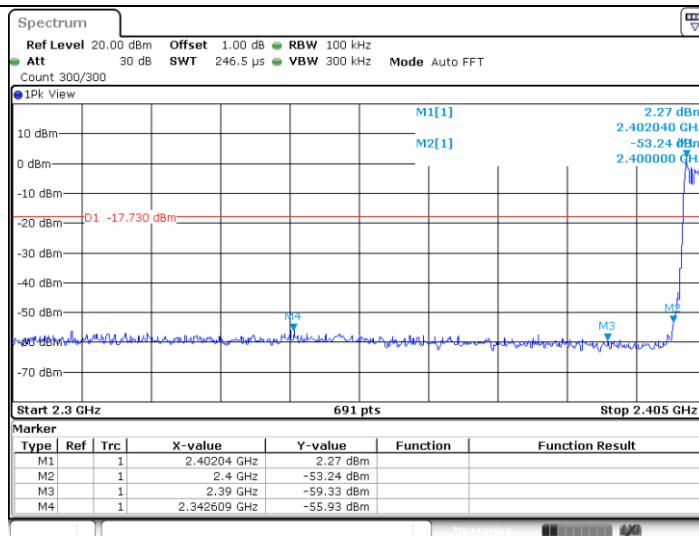
Date: 3 SEP.2021 14:38:53

2DH5_Ant1_High_2480



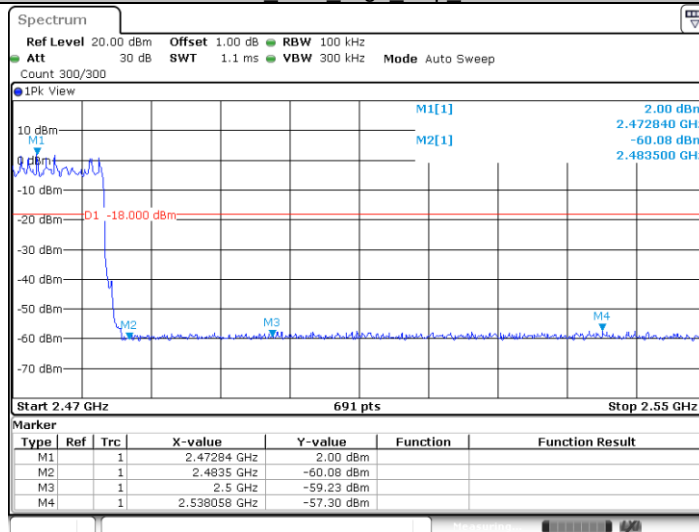
Date: 3 SEP.2021 14:42:46

2DH5_Ant1_Low_Hop_2402



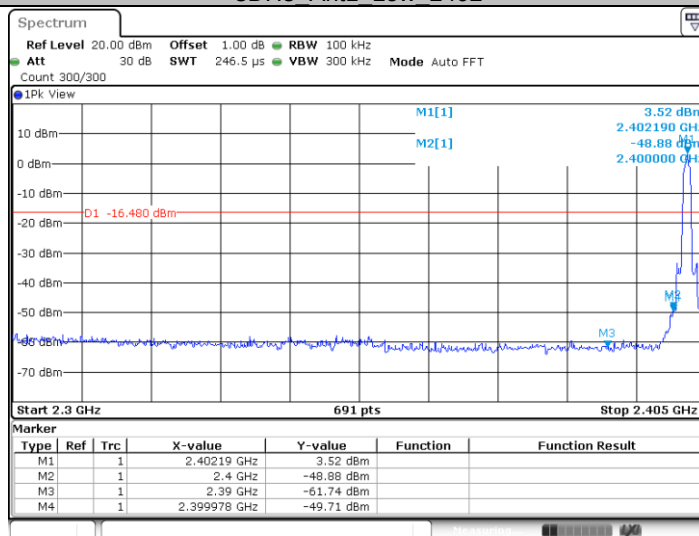
Date: 3 SEP.2021 14:56:22

2DH5 Ant1 High Hop 2480



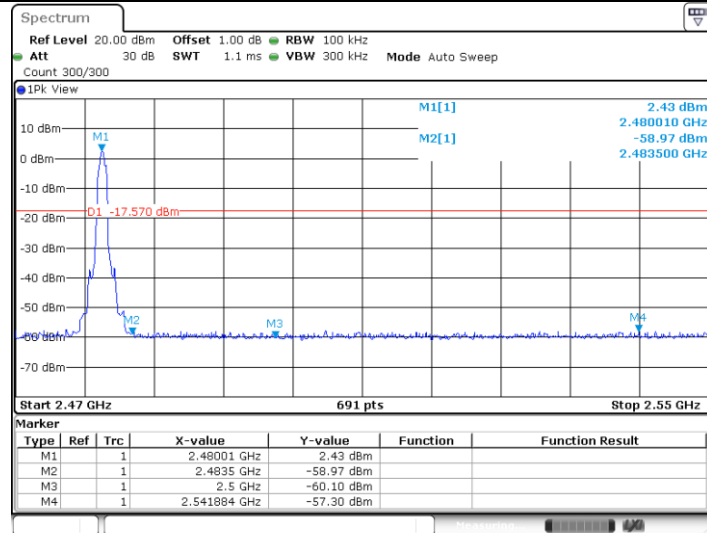
Date: 3 SEP.2021 15:06:58

3DH5 Ant1 Low 2402



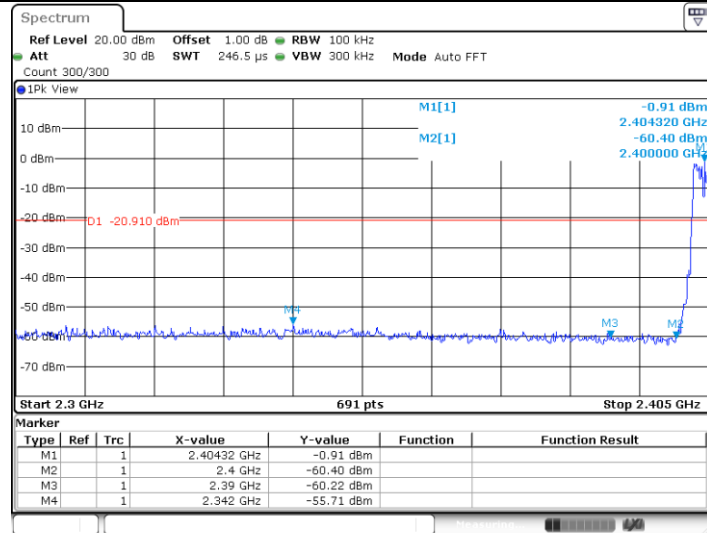
Date: 3 SEP.2021 14:44:47

3DH5 Ant1 High 2480



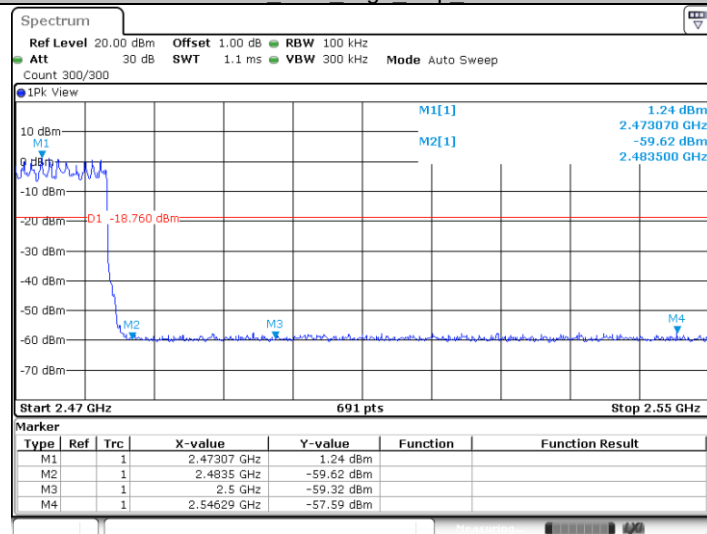
Date: 3.SEP.2021 14:51:45

3DH5 Ant1 Low Hop 2402



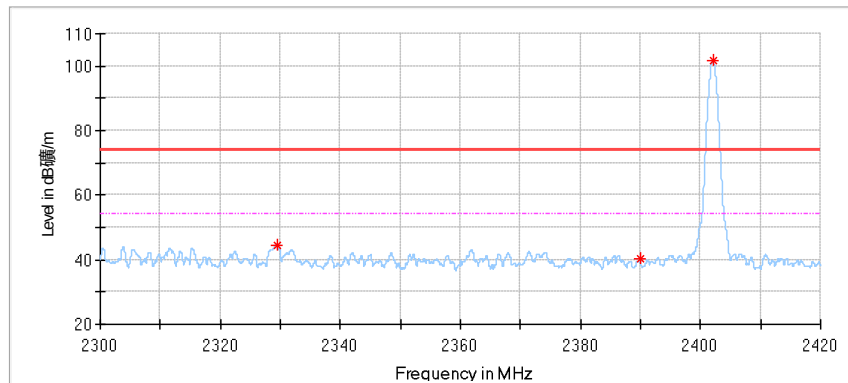
Date: 3.SEP.2021 15:09:37

3DH5 Ant1 High Hop 2480



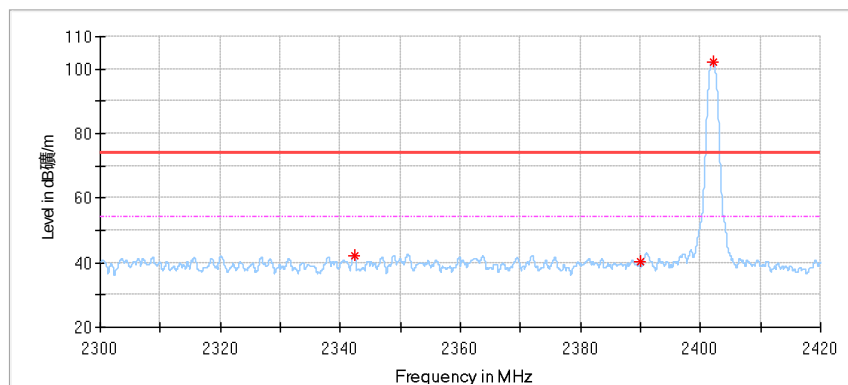
Date: 3.SEP.2021 15:14:27

8-DPSK_2402MHz
Horizontal:



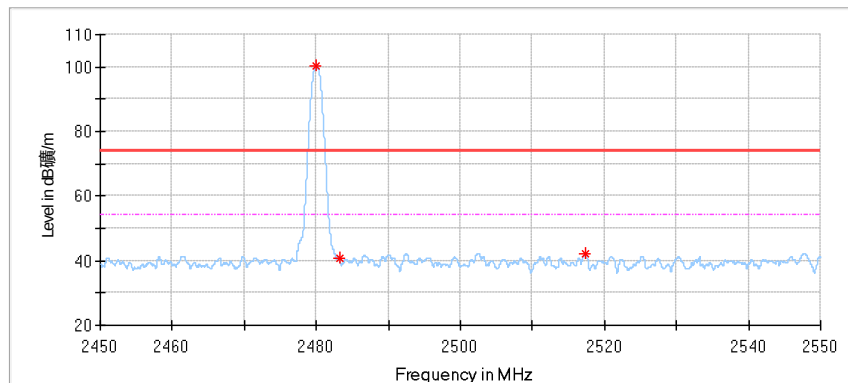
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2329.457143	44.41	74.00	29.59	150.0	H	200.0	-3.18
2390.000000	40.42	74.00	33.58	150.0	H	200.0	-3.06
2402.028571	101.88	74.00	-27.88	150.0	H	10.0	-3.08

Vertical



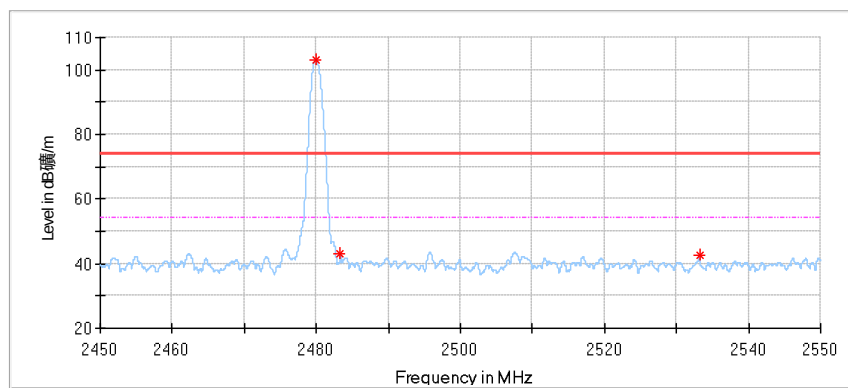
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2342.371429	42.33	74.00	31.67	150.0	V	51.0	-3.15
2390.028572	40.52	74.00	33.48	150.0	V	352.0	-3.06
2402.142857	102.24	74.00	-28.24	150.0	V	51.0	-3.08

8-DPSK_2480MHz
Horizontal:



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2480.023810	100.22	74.00	-26.22	150.0	H	10.0	-2.70
2483.309524	40.56	74.00	33.44	150.0	H	356.0	-2.70
2517.357143	41.99	74.00	32.01	150.0	H	115.0	-2.62

Vertical



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2479.857143	103.13	74.00	-29.13	150.0	V	44.0	-2.70
2483.333333	43.00	74.00	31.00	150.0	V	172.0	-2.70
2533.190476	42.48	74.00	31.52	150.0	V	37.0	-2.57

Remark: The radiated band edge only show max output power data.

9.9 Spurious radiated emissions for transmitter

Test Method

- 1: The EUT was placed 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 $\geq$ 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 $\geq$ 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 $20\log(\text{dwell time}/100 \text{ ms})$, 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 correction factor, derived from the appropriate duty cycle calculation.

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 section 15.205 and RSS-GEN 8.10, must comply with the radiated emission limits specified in section 15.209.

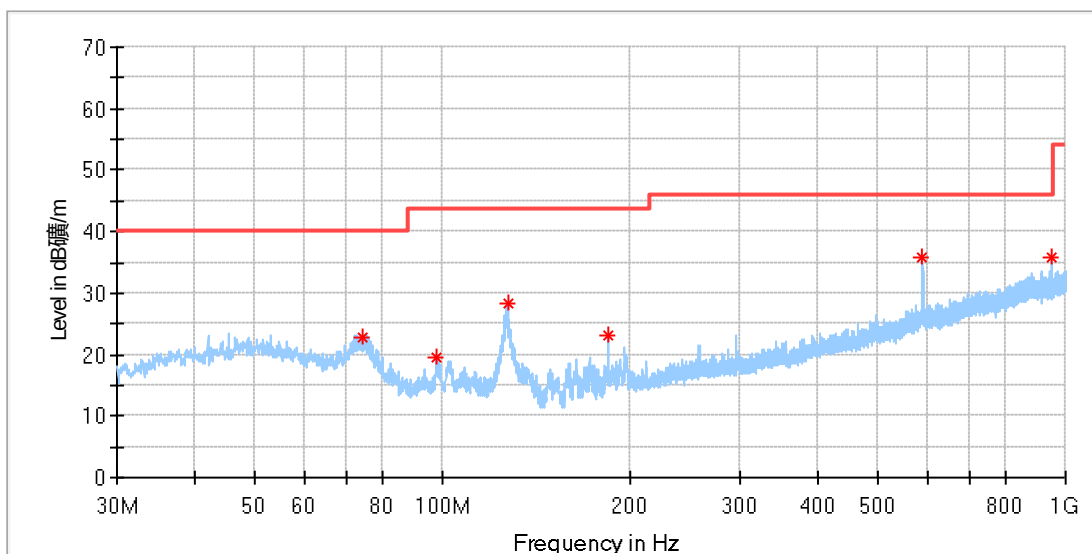
Frequency MHz	Field Strength uV/m	Field Strength dBμV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

Spurious radiated emissions for transmitter

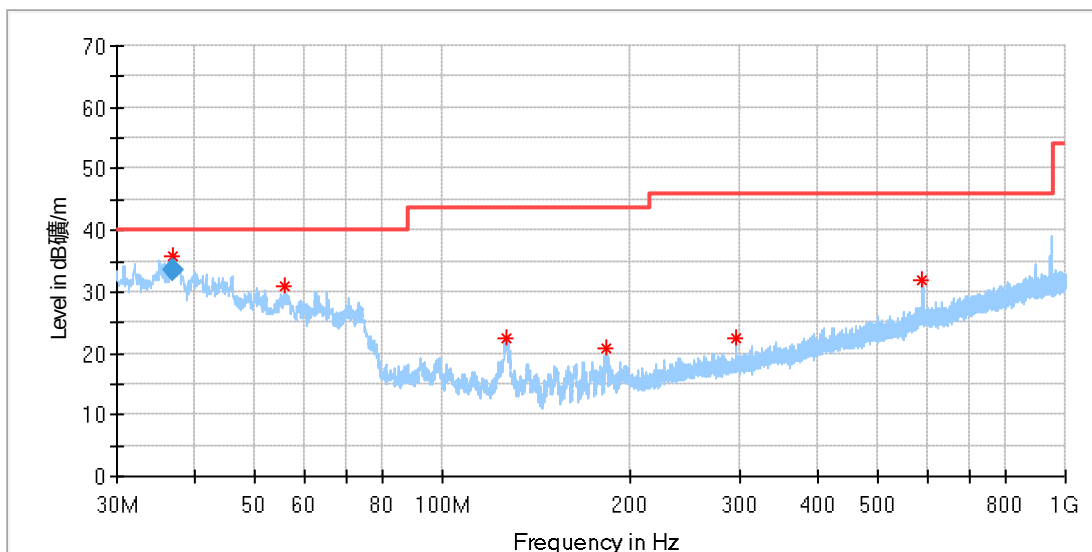
According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

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

30MHz to 1000MHz:



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
74.620000	22.94	40.00	17.06	200.0	H	346.0	8.99
98.081875	19.47	43.50	24.03	200.0	H	0.0	12.91
127.121250	28.29	43.50	15.21	200.0	H	196.0	10.48
184.290625	23.04	43.50	20.46	100.0	H	0.0	11.62
589.811250	35.71	46.00	10.29	100.0	H	29.0	22.33
948.590000	35.82	46.00	10.18	100.0	H	0.0	27.11

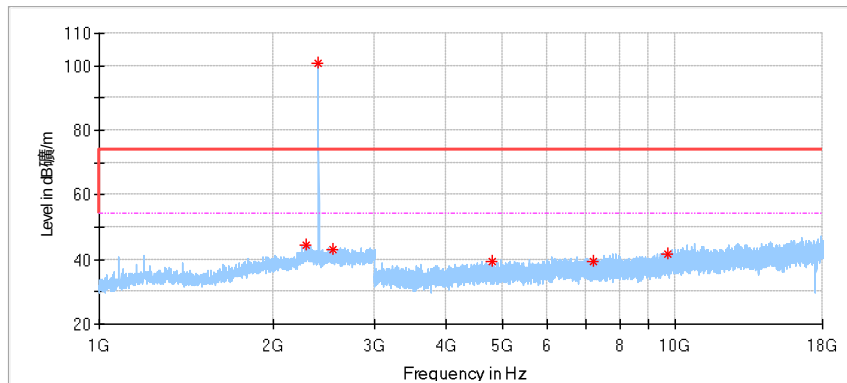


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
36.971875	35.68	40.00	4.32	100.0	V	172.0	12.88
55.826250	30.85	40.00	9.15	100.0	V	0.0	14.74
126.818125	22.32	43.50	21.18	100.0	V	0.0	10.49
182.653750	20.78	43.50	22.72	100.0	V	135.0	11.43
294.870625	22.55	46.00	23.45	200.0	V	0.0	15.33
589.871875	32.02	46.00	13.98	100.0	V	78.0	22.33
Frequency	QuasiPeak	Limit	Margin	Height	Pol	Azimuth	Corr.
36.971875	33.42	40.00	6.58	100.0	V	172.0	12.88

1GHz -18GHz:

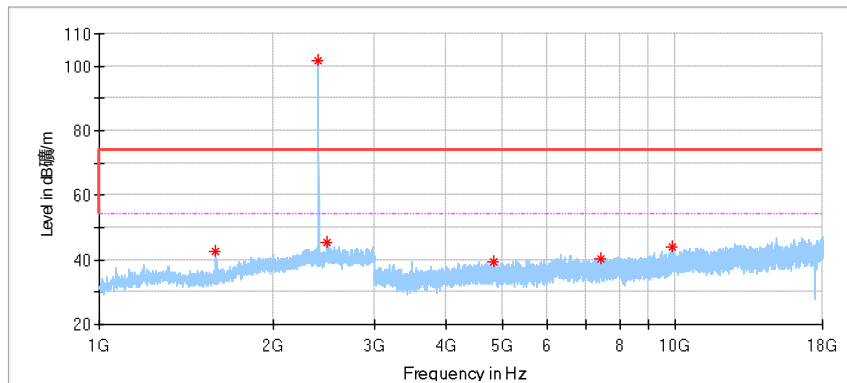
GFSK_2402MHz

Horizontal:



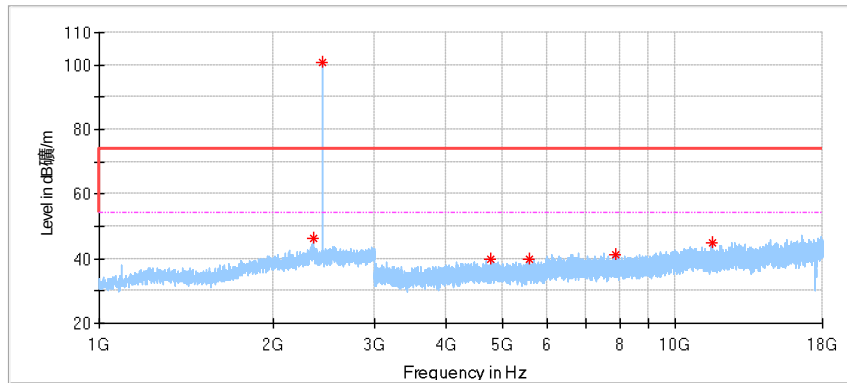
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2282.857143	44.69	74.00	29.31	150.0	H	202.0	-3.49
2402.380952	100.94	74.00	-26.94	150.0	H	23.0	-3.08
2538.095238	42.95	74.00	31.05	150.0	H	232.0	-2.55
4804.000000	39.38	74.00	34.62	150.0	H	124.0	3.48
7197.500000	39.55	74.00	34.45	150.0	H	240.0	7.01
9676.000000	41.76	74.00	32.24	150.0	H	0.0	9.31

Vertical



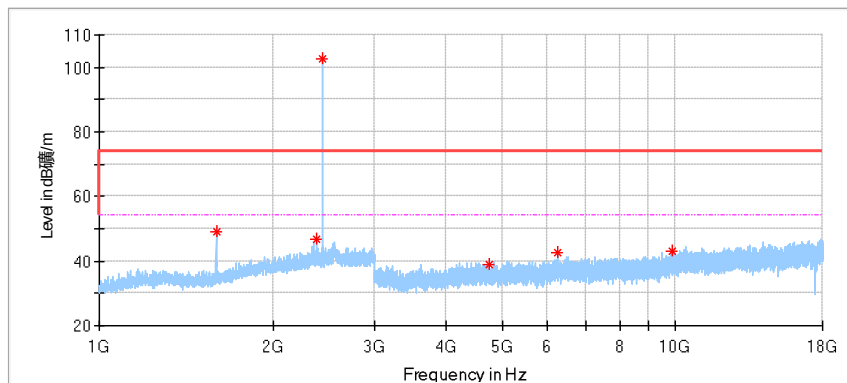
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1593.809524	42.81	74.00	31.19	150.0	V	60.0	-8.64
2402.380952	101.75	74.00	-27.75	150.0	V	97.0	-3.08
2483.333333	45.16	74.00	28.84	150.0	V	67.0	-2.70
4822.500000	39.18	74.00	34.82	150.0	V	4.0	3.49
7439.500000	40.30	74.00	33.70	150.0	V	183.0	7.36
9889.000000	43.88	74.00	30.12	150.0	V	212.0	10.78

GFSK_2441MHz
Horizontal:



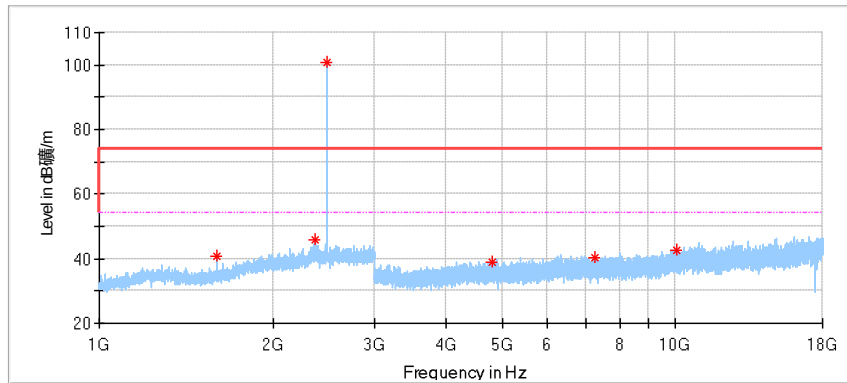
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2348.095238	46.13	74.00	27.87	150.0	H	195.0	-3.14
2441.428571	100.98	74.00	-26.98	150.0	H	11.0	-2.95
4791.500000	39.80	74.00	34.20	150.0	H	33.0	3.50
5571.500000	39.68	74.00	34.32	150.0	H	124.0	4.60
7888.000000	41.00	74.00	33.00	150.0	H	153.0	8.03
11576.500000	45.12	74.00	28.88	150.0	H	297.0	11.04

Vertical



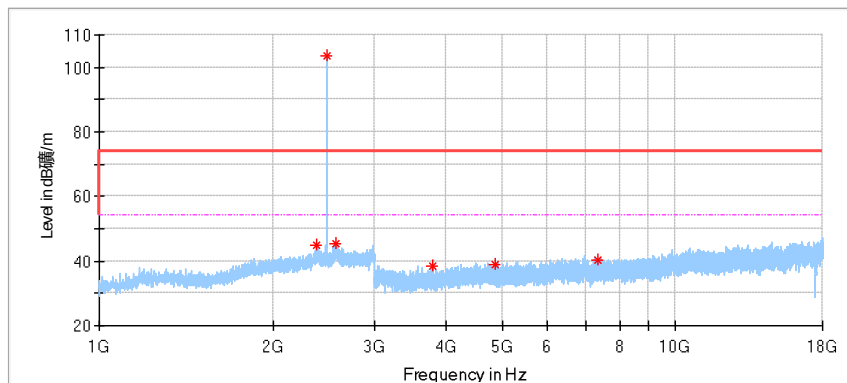
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1595.238095	49.14	74.00	24.86	150.0	V	5.0	-8.62
2389.047619	46.95	74.00	27.05	150.0	V	335.0	-3.05
2441.428571	102.57	74.00	-28.57	150.0	V	56.0	-2.95
4752.500000	39.02	74.00	34.98	150.0	V	125.0	3.49
6241.000000	42.40	74.00	31.60	150.0	V	0.0	6.77
9859.000000	43.26	74.00	30.74	150.0	V	96.0	11.26

GFSK_2480MHz
Horizontal:



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1596.190476	40.97	74.00	33.03	150.0	H	8.0	-8.61
2369.523810	45.89	74.00	28.11	150.0	H	158.0	-3.05
2480.476191	100.82	74.00	-26.82	150.0	H	2.0	-2.70
4797.000000	38.94	74.00	35.06	150.0	H	153.0	3.49
7225.000000	40.13	74.00	33.87	150.0	H	33.0	7.10
10023.000000	42.63	74.00	31.37	150.0	H	183.0	9.63

Vertical

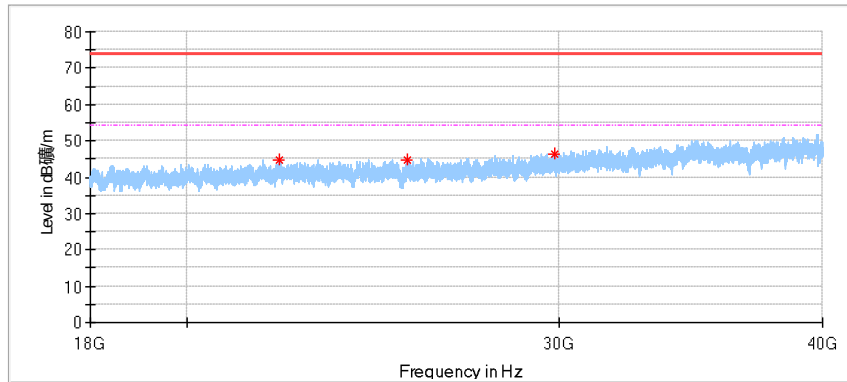


Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2382.380952	44.81	74.00	29.19	150.0	V	344.0	-3.04
2480.476191	103.52	74.00	-29.52	150.0	V	73.0	-2.70
2578.095238	45.33	74.00	28.67	150.0	V	344.0	-2.42
3785.500000	38.47	74.00	35.53	150.0	V	236.0	0.75
4869.500000	38.79	74.00	35.21	150.0	V	86.0	3.69
7343.000000	40.31	74.00	33.69	150.0	V	266.0	7.20

Above 18GHz:

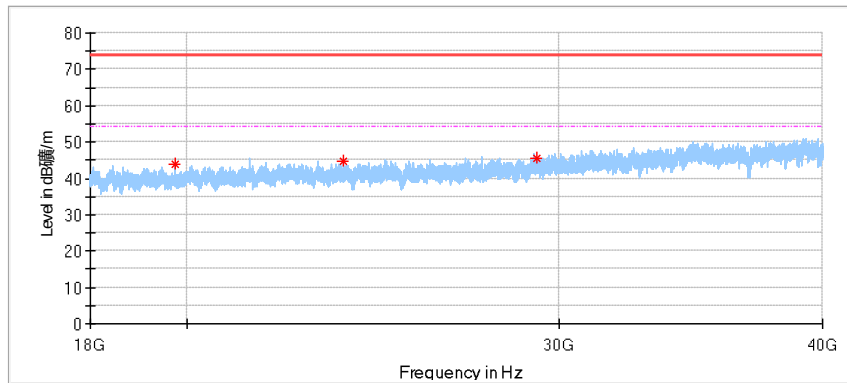
GFSK_2402MHz

Horizontal:



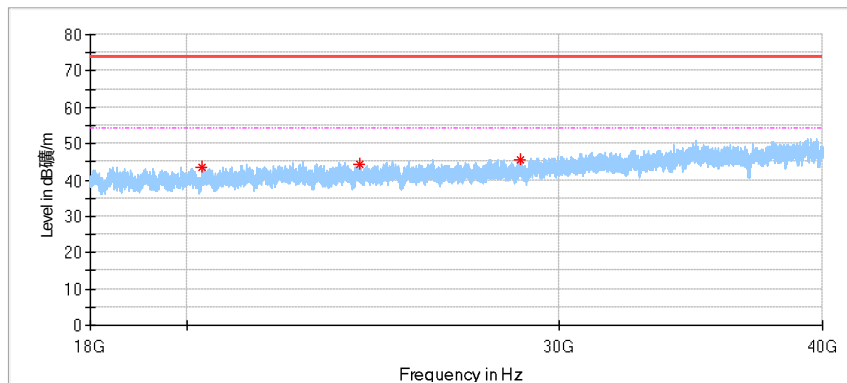
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
22119.500000	44.53	74.00	29.47	150.0	H	185.0	2.0
25451.125000	44.89	74.00	29.11	150.0	H	14.0	3.5
29862.812500	46.29	74.00	27.71	150.0	H	107.0	3.7

Vertical



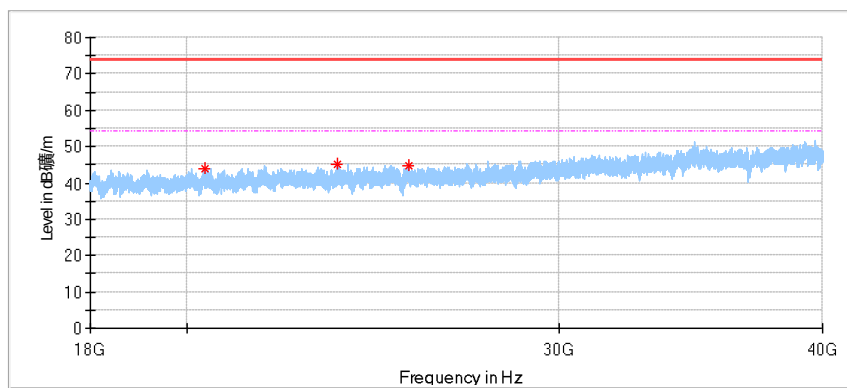
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19746.937500	43.92	74.00	30.08	150.0	V	0.0	-0.6
23718.625000	44.64	74.00	29.36	150.0	V	65.0	2.4
29280.500000	45.56	74.00	28.44	150.0	V	215.0	3.8

GFSK_2441MHz
Horizontal:



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
20332.000000	43.30	74.00	30.70	150.0	H	93.0	0.0
24133.187500	44.33	74.00	29.67	150.0	H	170.0	2.6
28776.562500	45.53	74.00	28.47	150.0	H	246.0	3.8

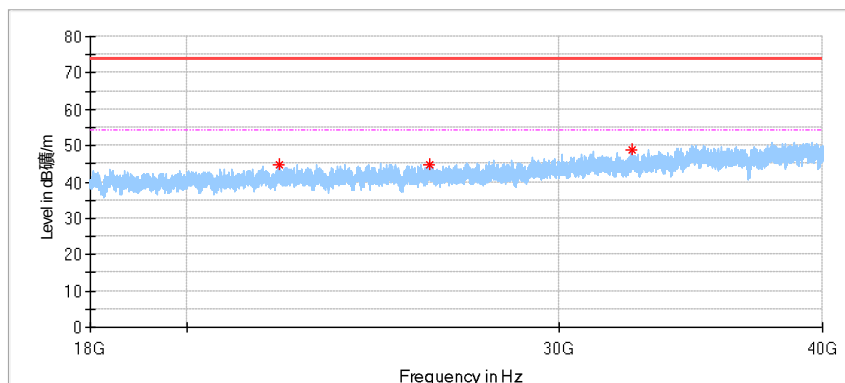
Vertical



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
20395.250000	43.74	74.00	30.26	150.0	V	207.0	0.1
23574.250000	45.11	74.00	28.89	150.0	V	207.0	2.2
25475.875000	44.89	74.00	29.11	150.0	V	31.0	3.5

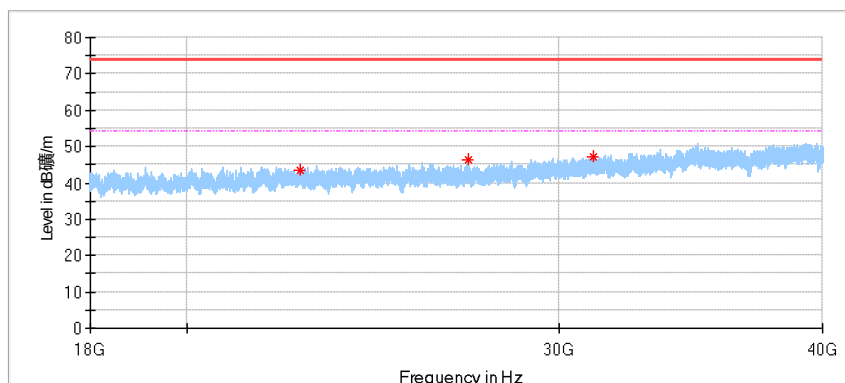
GFSK_2480MHz

Horizontal:



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
22127.062500	44.90	74.00	29.10	150.0	H	63.0	2.0
26045.125000	44.76	74.00	29.24	150.0	H	78.0	3.5
32495.937500	48.63	74.00	25.37	150.0	H	295.0	5.3

Vertical



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
22614.500000	43.34	74.00	30.66	150.0	V	99.0	2.3
27166.437500	46.24	74.00	27.76	150.0	V	347.0	3.9
31147.062500	47.09	74.00	26.91	150.0	V	254.0	4.0

Remark:

- (1) 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.
- (2) Level= Reading Level + Correction Factor
- (3) 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)

10 Test Equipment List

Conducted Emission Test

Description	Manufacturer	Model no.	Serial no.	cal. due date
EMI Test Receiver	Rohde & Schwarz	ESR 3	101782	2022-6-4
LISN	Rohde & Schwarz	ENV4200	100249	2022-6-5
Attenuator	Shanghai Huaxiang	TS2-26-3	080928189	2022-6-5
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	2022-6-4
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2022-2-2
Wave Guide Antenna	ETS	3117	68-4-80-19-001	2022-5-24
Sideband Horn Antenna	Q-PAR	QWH-SL-18-40-K-SG	68-4-80-14-008	2021-8-5
Pre-amplifier	Rohde & Schwarz	SCU 18F	68-4-29-19-001	2021-10-25
Pre-amplifier	Rohde & Schwarz	SCU 08F2	68-4-29-19-004	2021-10-25
Pre-amplifier	Rohde & Schwarz	SCU 40A	68-4-29-14-002	2022-7-27
3m Semi-anechoic chamber	TDK	9X6X6	----	2022-12-29

RF conducted test

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Signal Analyzer	Rohde & Schwarz	FSV40	101030	2022-6-3
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	101226/100851	2022-6-3
Power Splitter	Weinschel	1580	SC319	2022-6-3
Test software	Tonscend	System for BT/WIFI	Version 2.5.77.0418	N/A

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: 4.70dB; Vertical: 4.67dB;
Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz	Horizontal: 4.65dB; Vertical: 4.63dB;
Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 5.05dB; Vertical: 5.04dB;
Uncertainty for Conducted RF test with TS 8997	RF Power Conducted: 1.16dB Frequency test involved: 0.6×10^{-7} or 1%
Uncertainty Evaluation for Humidity	0.936%
Uncertainty Evaluation for Temperature	0.195 °C

---The End---