

FCC - TEST REPORT

Report Number : **68.950.21.0420.01** Date of Issue: **2021-10-13**

Model : **AM001**

Product Type : **Z CAM IPMAN AMBR**

Applicant : **Shenzhen ImagineVision Technology Limited**

Address : **1A, F5, TCL International E City, 1001 Zhong Shan Park Road, Nan Shan, 518055 Shenzhen, PEOPLE'S REPUBLIC OF CHINA**

Manufacturer : **Shenzhen ImagineVision Technology Limited**

Address : **1A, F5, TCL International E City, 1001 Zhong Shan Park Road, Nan Shan, 518055 Shenzhen, PEOPLE'S REPUBLIC OF CHINA**

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

Total pages including Appendices : **68**

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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
Fax: 86 755 8828 5299

3 Description of the Equipment Under Test

Product:	Z CAM IPMAN AMBR
Model no.:	AM001
FCC ID:	2AENNZCAMAMBR2107
Options and accessories:	HDMI Cable and Type-C Cable
Rating:	6.2V-18VDC, 1.5A
RF Transmission Frequency:	2402MHz-2480MHz
No. of Operated Channel:	79
Modulation:	GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna Type:	Internal antenna
Antenna Ports	Ant 0
Antenna Gain:	Ant 0: 2.4G=4.43 dBi, 5G=4.59 dBi Ant 1: 2.4G=4.22 dBi, 5G=5.33 dBi
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 2.4GHz Wi-Fi, 5180MHz – 5240MHz 5745MHz – 5825MHz for 5GHz Wi-Fi.

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

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			
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 Ant 0: 2.4G=4.43 dBi, 5G=4.59 dBi, Ant 1: 2.4G=4.22 dBi, 5G=5.33 dBi. 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: 2AENNZCAMAMBR2107, complies with 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: 2021-06-03

Testing Start Date: 2021-06-04

Testing End Date: 2021-07-23

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

Reviewed by:

Prepared by:

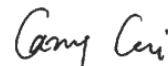
Tested by:



John Zhi
Project Manager



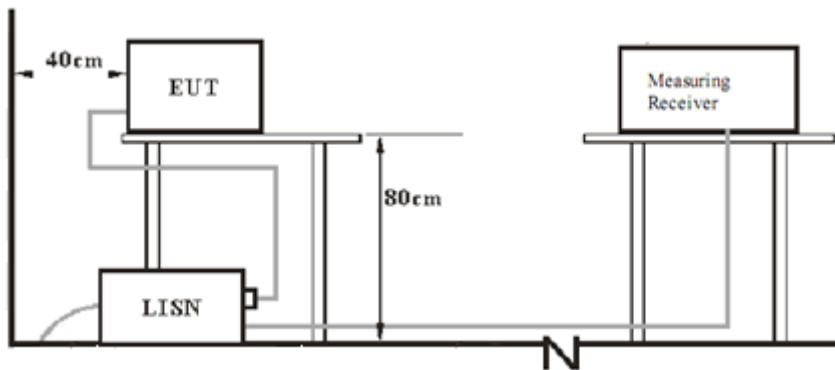
Warlen Song
Project Engineer



Carry Cai
Test Engineer

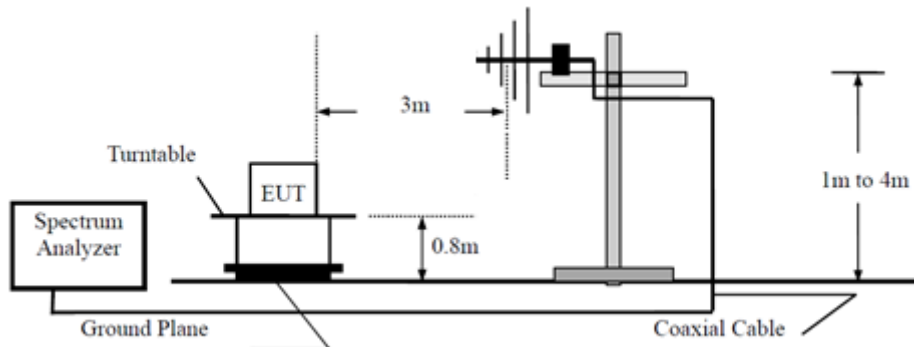
7 Test Setups

7.1 AC Power Line Conducted Emission test setups

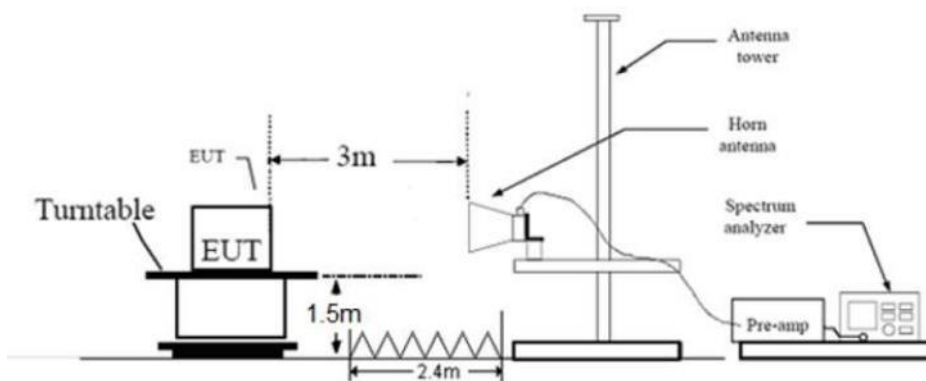


7.2 Radiated test setups

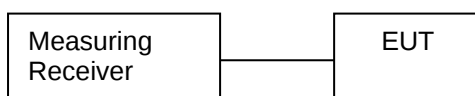
Below 1GHz



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.

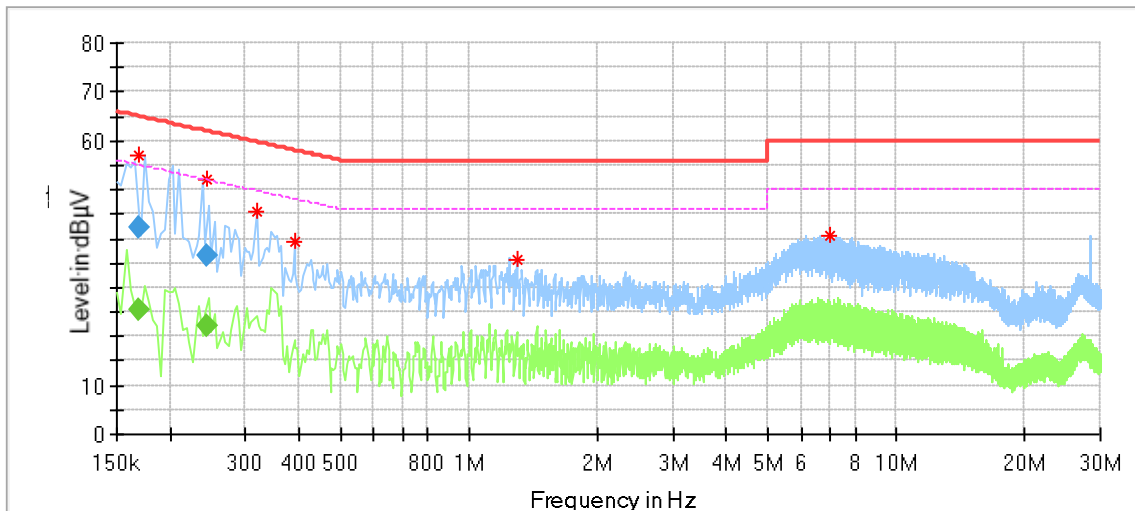
Limit

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 : Z CAM IPMAN AMBR
 M/N : AM001
 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)
0.169500	56.86	---	64.77	7.91	L1	9.64
0.242500	52.24	---	62.17	9.93	L1	9.64
0.318000	45.46	---	59.76	14.29	L1	9.64
0.390000	39.41	---	58.06	18.66	L1	9.64
1.294000	35.83	---	56.00	20.17	L1	9.67
6.966000	40.77	---	60.00	19.23	L1	9.83

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.169500	---	25.30	54.99	29.68	L1	9.64
0.169500	42.43	---	64.99	22.55	L1	9.64
0.242500	---	22.06	52.01	29.95	L1	9.64
0.242500	36.61	---	62.01	25.40	L1	9.64

Remark :

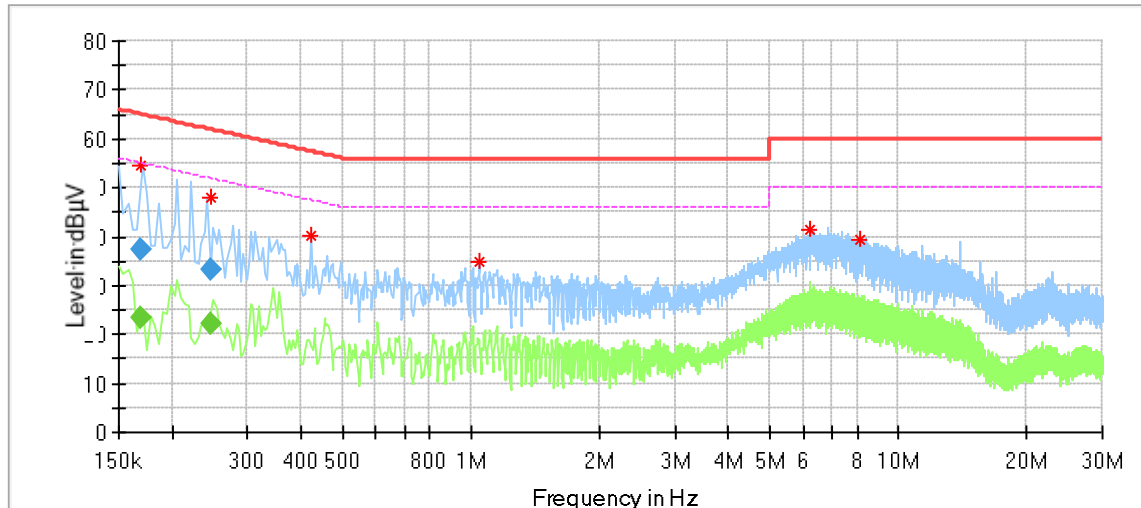
Level=Reading Level + Correction Factor

Correction Factor=Cable Loss + LISN Factor

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

Conducted Emission

Product Type : Z CAM IPMAN AMBR
 M/N : AM001
 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)
0.169500	54.68	---	64.96	10.28	N	9.62
0.245500	47.85	---	62.03	14.18	N	9.63
0.422000	40.30	---	57.41	17.10	N	9.63
1.046000	34.73	---	56.00	21.27	N	9.65
6.206000	41.32	---	60.00	18.68	N	9.80
8.170000	39.28	---	60.00	20.72	N	9.85

Final Result

Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.169500	---	23.58	54.99	31.40	N	9.62
0.169500	37.39	---	64.99	27.59	N	9.62
0.245500	---	22.21	51.91	29.70	N	9.63
0.245500	33.18	---	61.91	28.73	N	9.63

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.

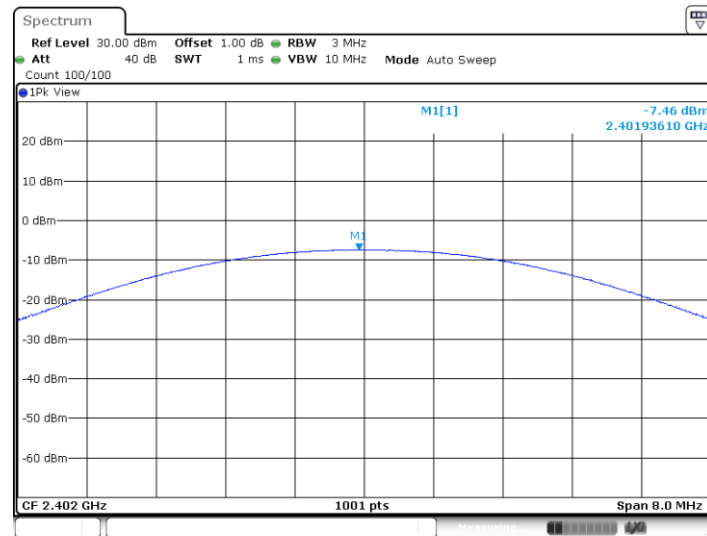
Limits

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

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

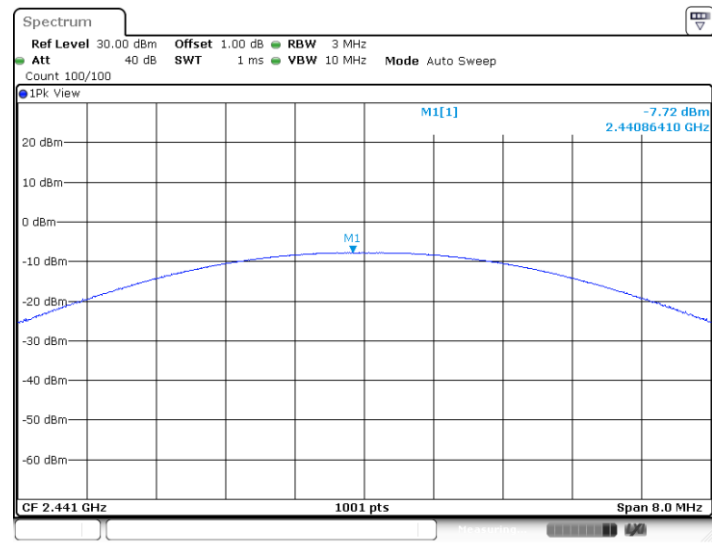
Conducted output power**Bluetooth Mode GFSK modulation Test Result**

Frequency MHz	Conducted Output Power dBm	Result
Low channel 2402MHz	-7.46	Pass
Middle channel 2441MHz	-7.72	Pass
High channel 2480MHz	-8.42	Pass

Low channel 2402MHz

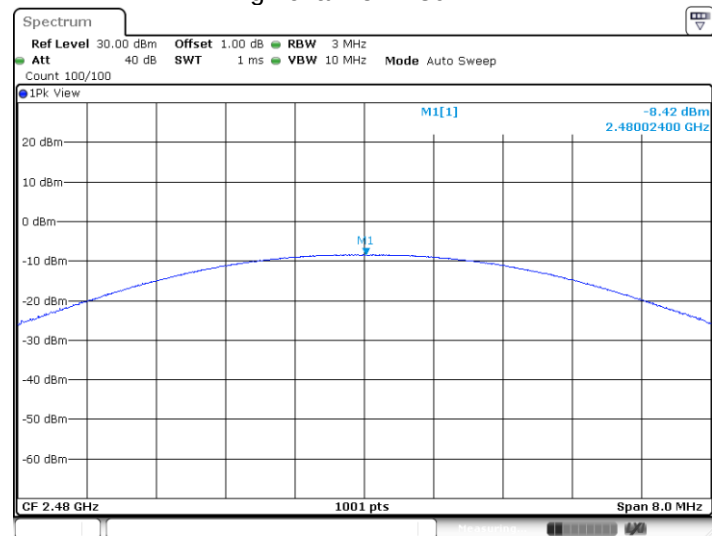
Date: 25 JUN 2021 11:11:33

Middle channel 2441MHz



Date: 25 JUN 2021 11:13:50

High channel 2480MHz

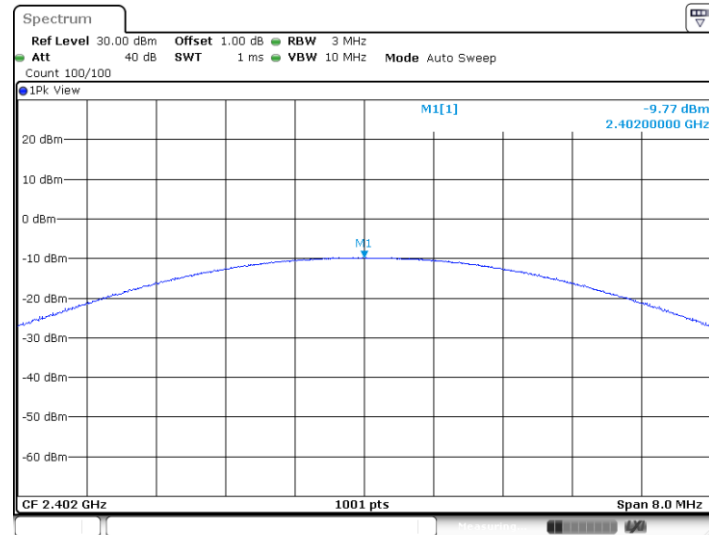


Date: 25 JUN 2021 11:15:50

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

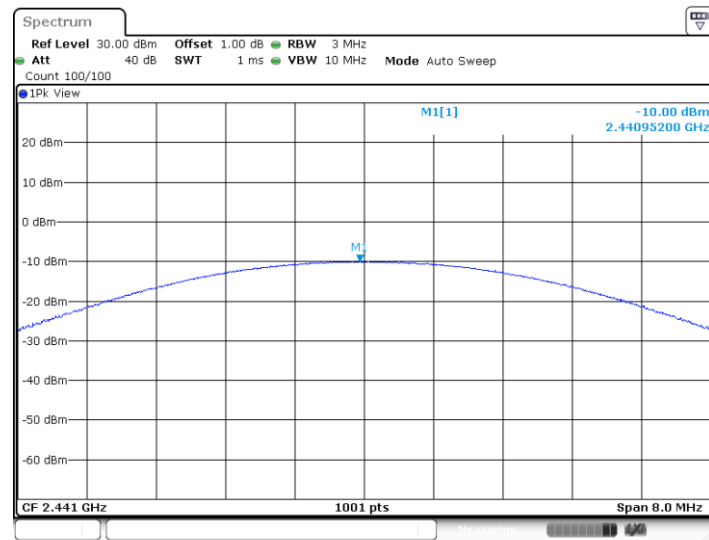
Frequency MHz	Conducted Output Power dBm	Result
Low channel 2402MHz	-9.77	Pass
Middle channel 2441MHz	-10	Pass
High channel 2480MHz	-10.75	Pass

Low channel 2402MHz



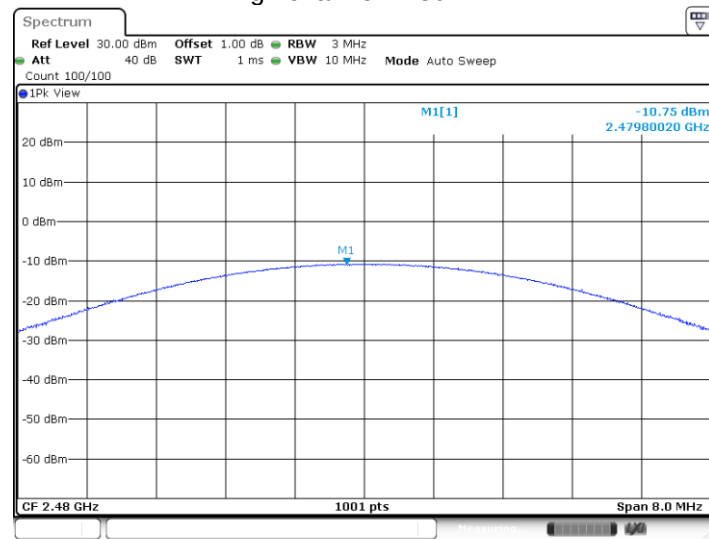
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Middle channel 2441MHz



Date: 25 JUN 2021 11:41:10

High channel 2480MHz

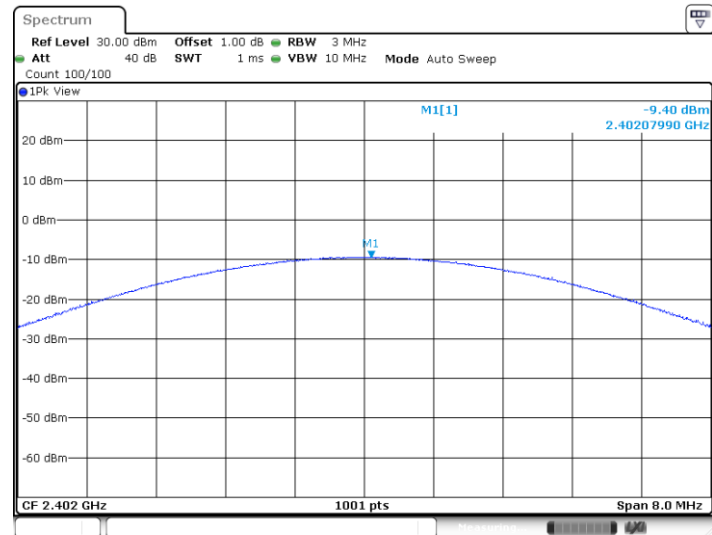


Date: 25 JUN 2021 11:43:34

Bluetooth Mode 8DPSK modulation Test Result

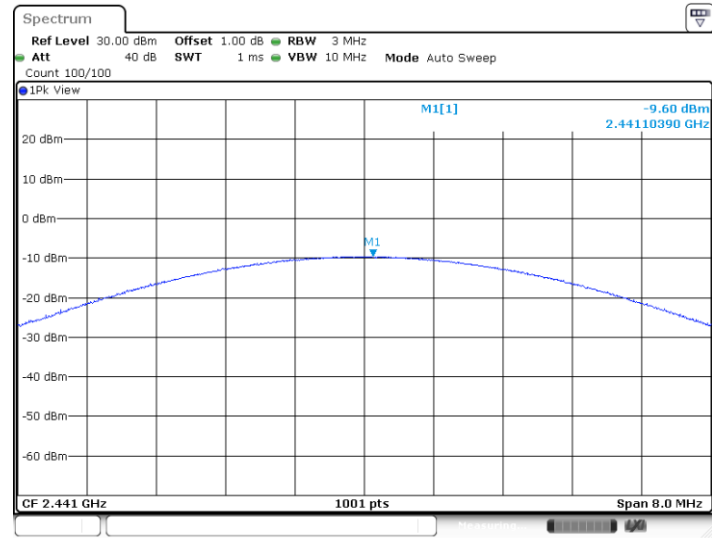
Frequency MHz	Conducted Output Power dBm	Result
Low channel 2402MHz	-9.4	Pass
Middle channel 2441MHz	-9.6	Pass
High channel 2480MHz	-10.35	Pass

Low channel 2402MHz



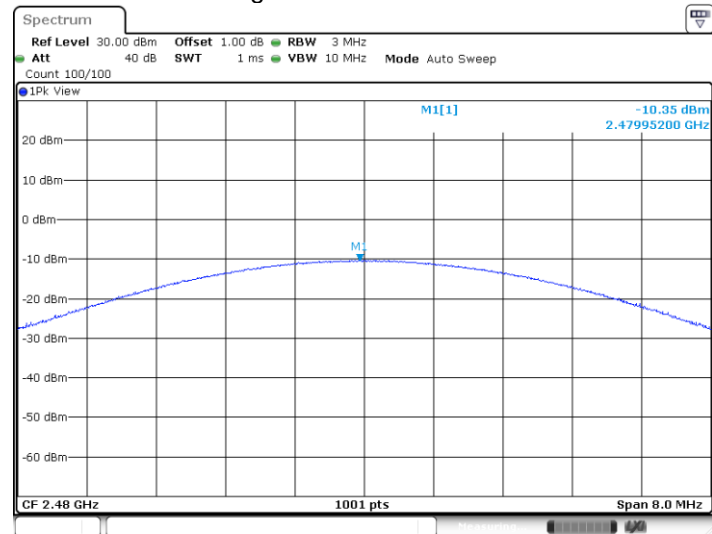
Date: 25 JUN 2021 11:17:59

Middle channel 2441MHz



Date: 25 JUN 2021 11:21:46

High channel 2480MHz



Date: 25 JUN 2021 11:24:41

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]

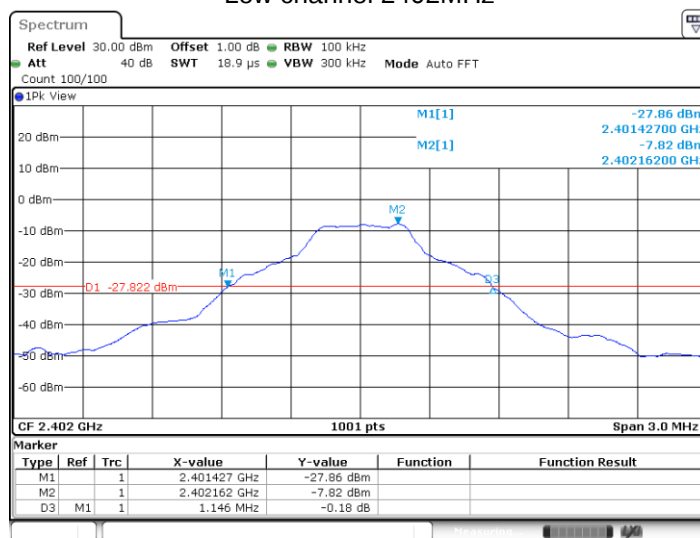
N/A

20 dB bandwidth and 99% Occupied Bandwidth

Bluetooth Mode GFSK Modulation test result

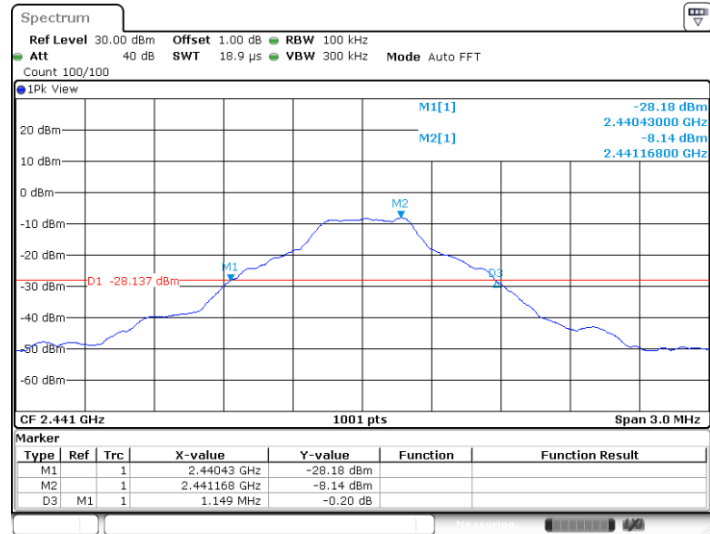
Frequency MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz	Result
2402	1146	905	--	Pass
2441	1149	902	--	Pass
2480	1146	905	--	Pass

Low channel 2402MHz



20 dB bandwidth and 99% Occupied Bandwidth

Middle channel 2441MHz



Date: 25 JUN 2021 11:13:14

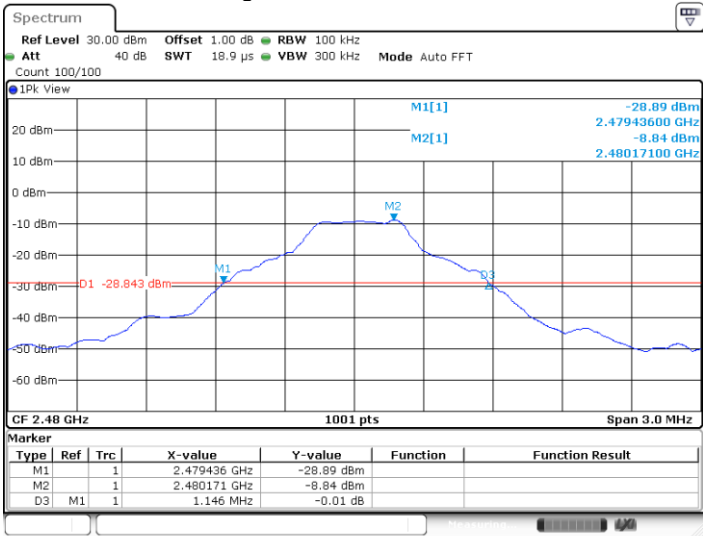


Date: 25 JUN 2021 11:13:25

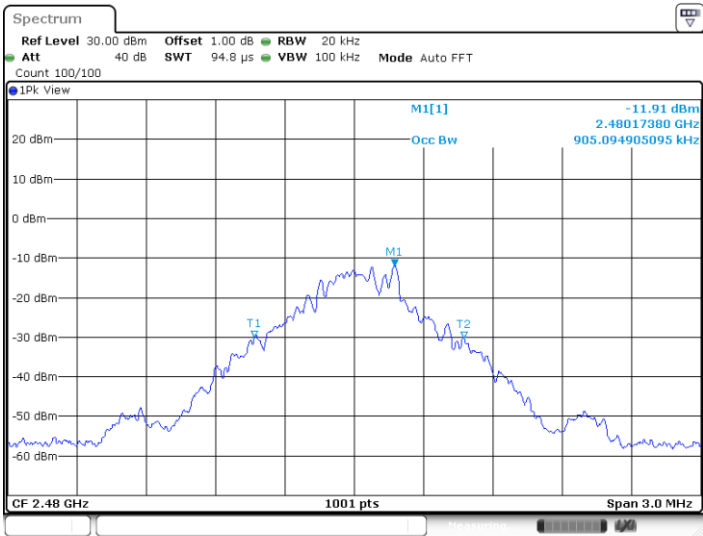


20 dB bandwidth and 99% Occupied Bandwidth

High channel 2480MHz



Date: 25 JUN 2021 11:15:04



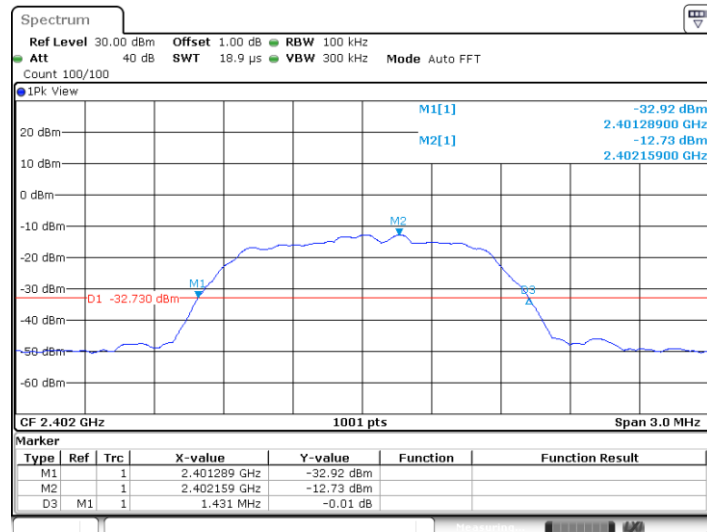
Date: 25 JUN 2021 11:15:15

20 dB bandwidth and 99% Occupied Bandwidth

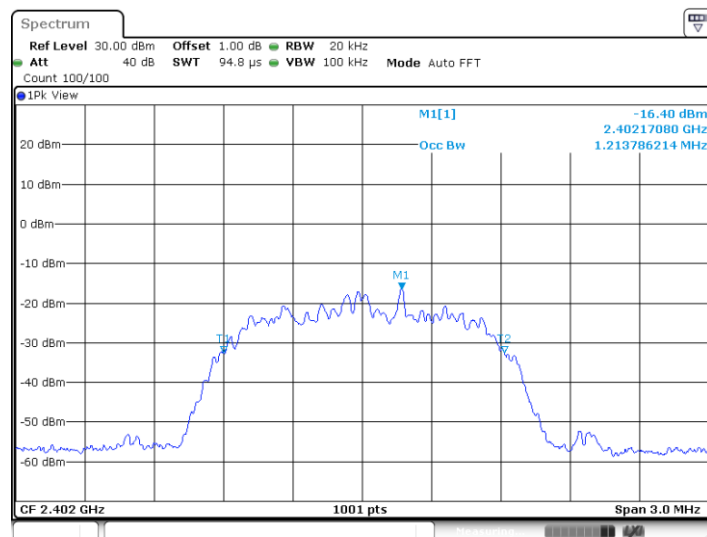
Bluetooth Mode $\pi/4$ -DQPSK Modulation test result

Frequency MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz	Result
2402	1431	1214	--	Pass
2441	1431	1214	--	Pass
2480	1431	1217	--	Pass

Low channel 2402MHz



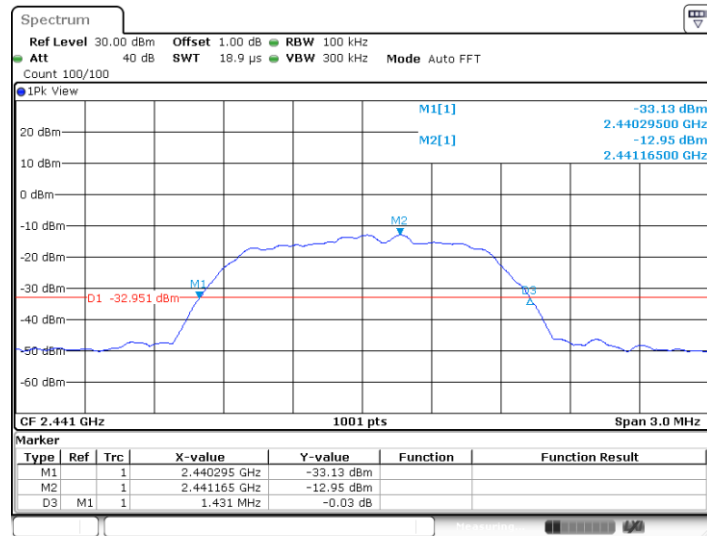
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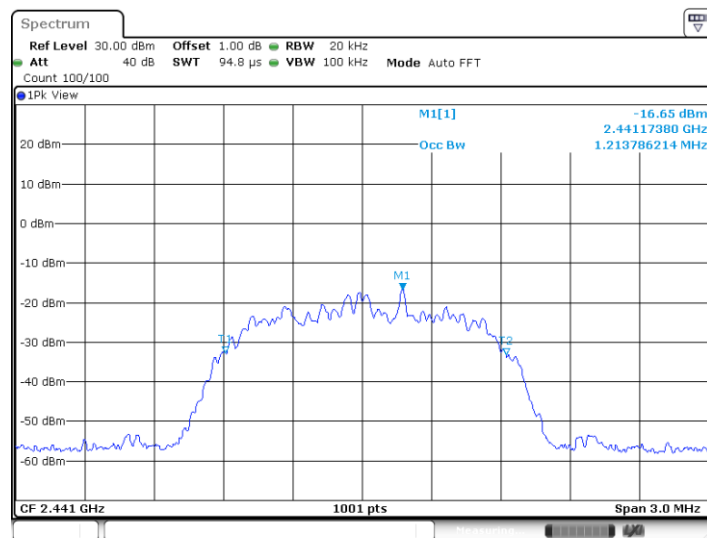
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20 dB bandwidth and 99% Occupied Bandwidth

Middle channel 2441MHz



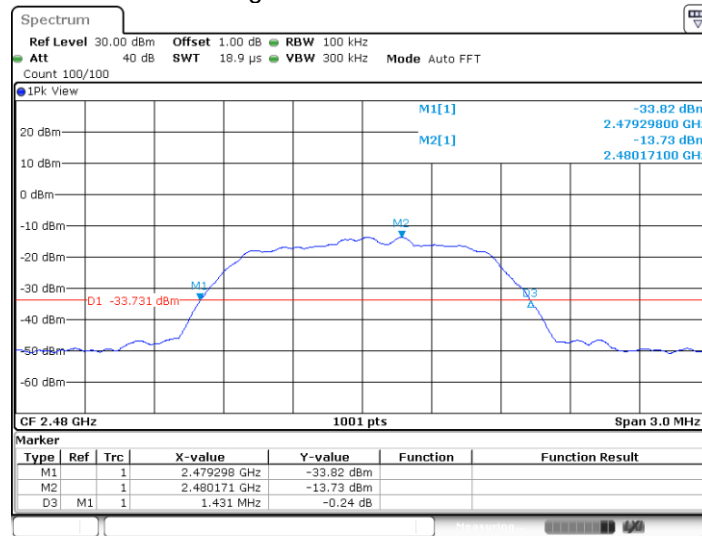
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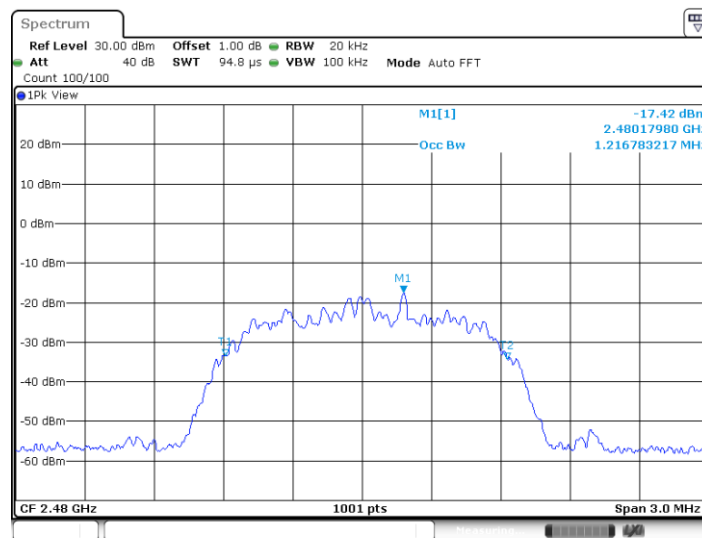
Date: 25 JUN 2021 11:40:44

20 dB bandwidth and 99% Occupied Bandwidth

High channel 2480MHz



Date: 25 JUN 2021 11:42:49



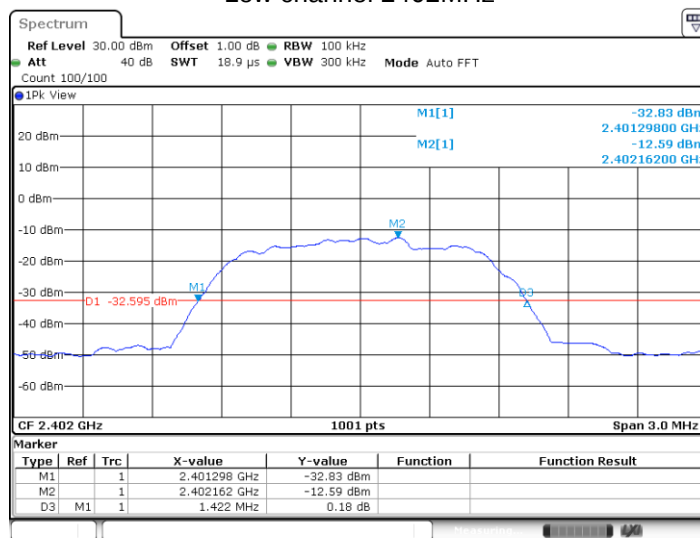
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20 dB bandwidth and 99% Occupied Bandwidth

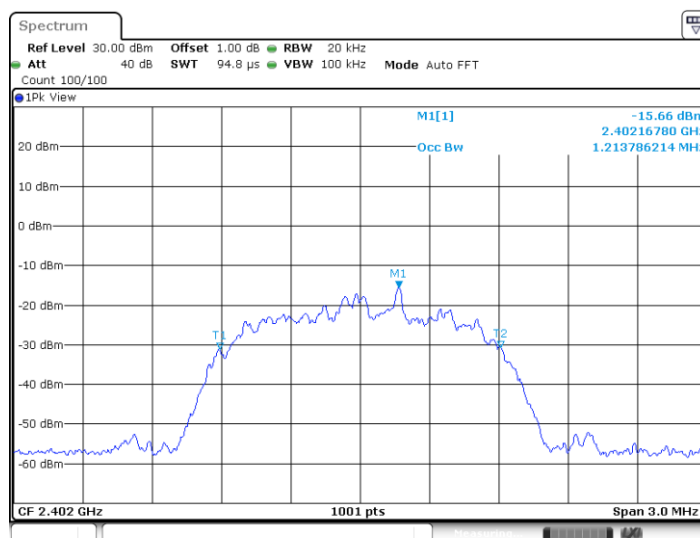
Bluetooth Mode 8DPSK Modulation test result

Frequency MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz	Result
2402	1422	1214	--	Pass
2441	1422	1214	--	Pass
2480	1419	1214	--	Pass

Low channel 2402MHz



Date: 25 JUN 2021 11:17:13

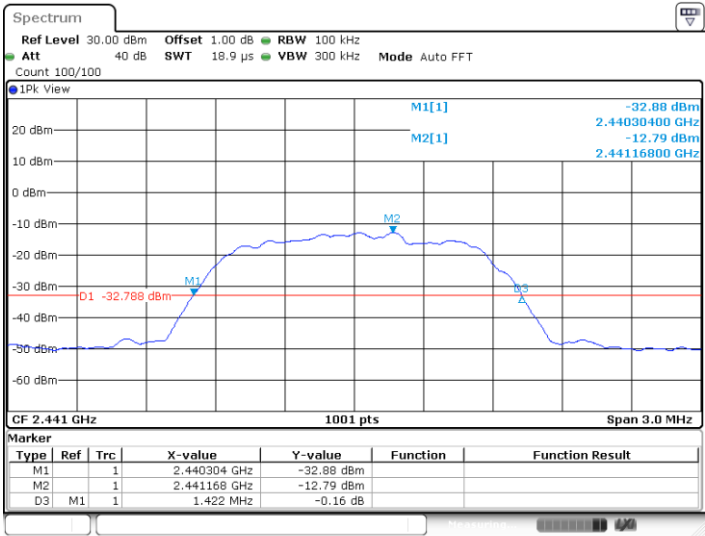


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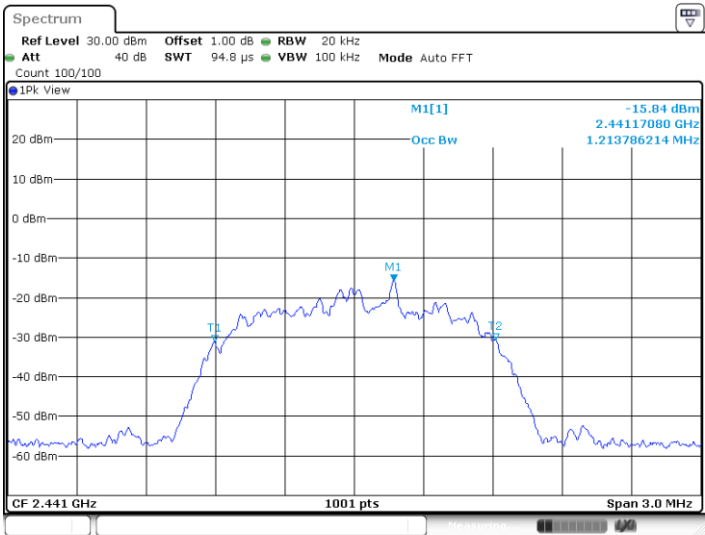


20 dB bandwidth and 99% Occupied Bandwidth

Middle channel 2441MHz



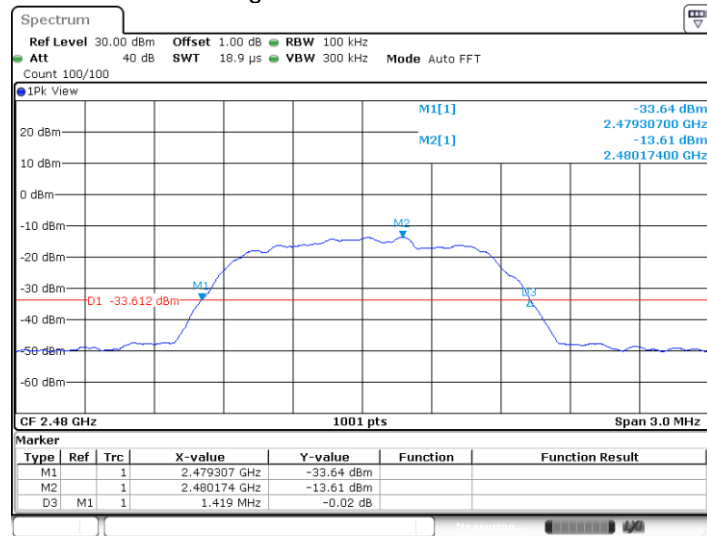
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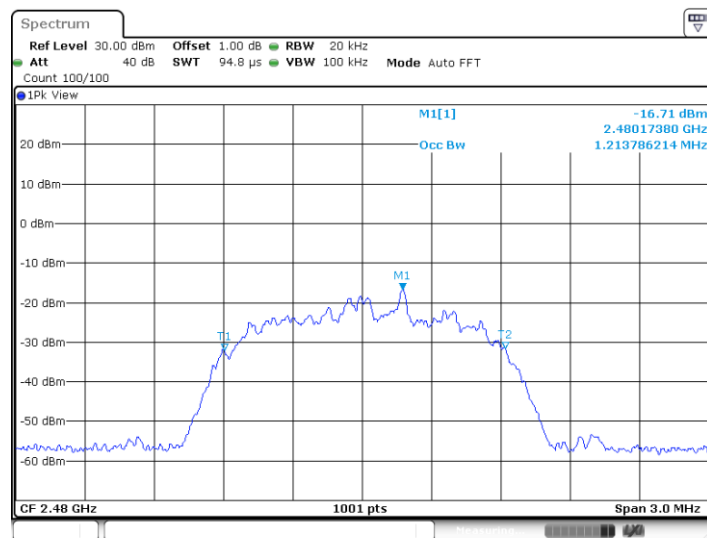
Date: 25 JUN 2021 11:21:21

20 dB bandwidth and 99% Occupied Bandwidth

High channel 2480MHz



Date: 25 JUN 2021 11:23:55



Date: 25 JUN 2021 11:24:06

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

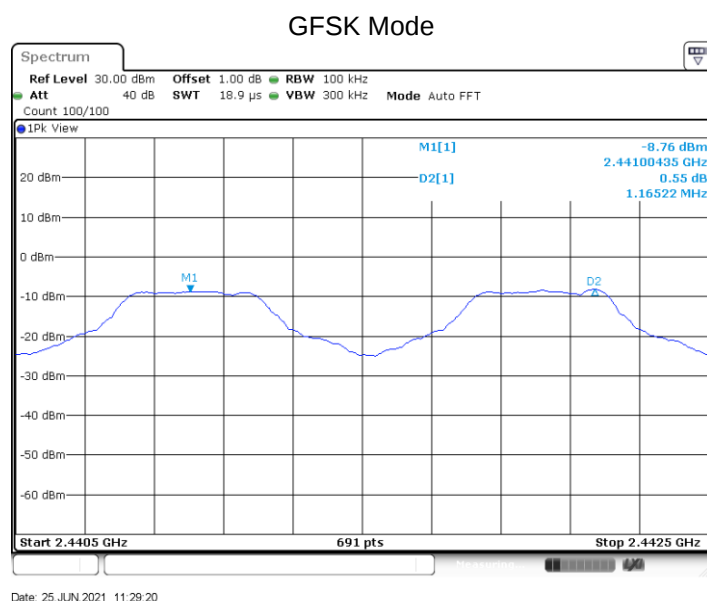
Limit kHz	
$\geq 25\text{kHz}$ or $2/3$ of the 20 dB bandwidth which is greater	
Frequency MHz	2/3 of 20 dB Bandwidth kHz
GFSK	764
$\pi/4$ -DQPSK	954
8DPSK	946

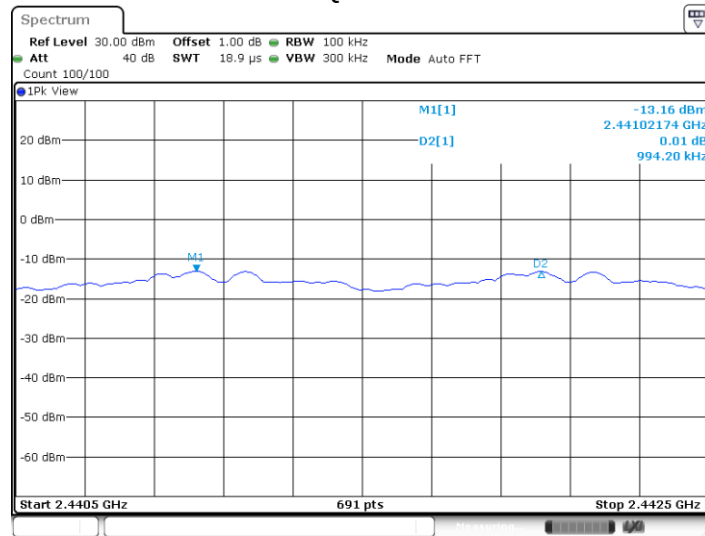
Carrier Frequency Separation

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

GFSK Modulation test result

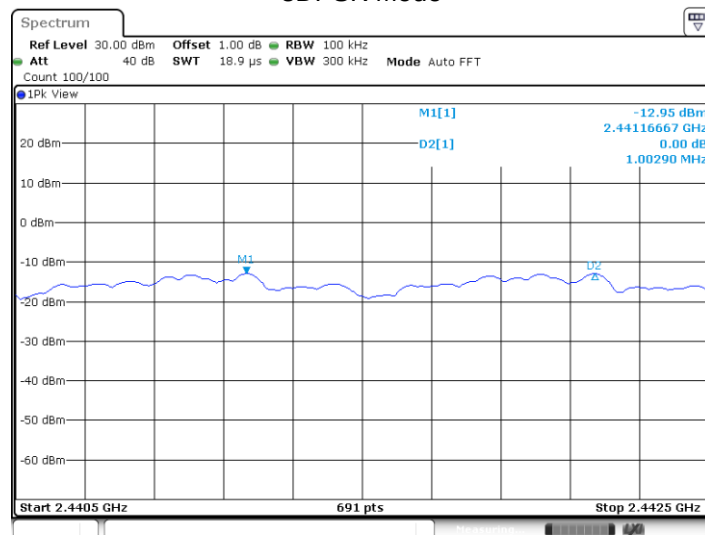
Modulation	Frequency MHz	Carrier Frequency Separation kHz	Result
GFSK	Hop	1165	Pass
$\pi/4$ -DQPSK	Hop	994	Pass
8DPSK	Hop	1003	Pass



$\pi/4$ -DQPSK Mode

Date: 25 JUN 2021 11:32:32

8DPSK Mode



Date: 25 JUN 2021 11:26:23

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

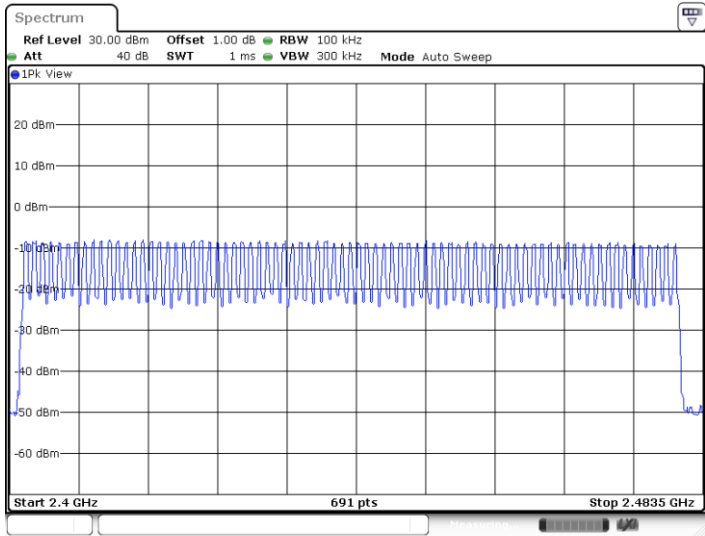


Number of hopping frequencies

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.

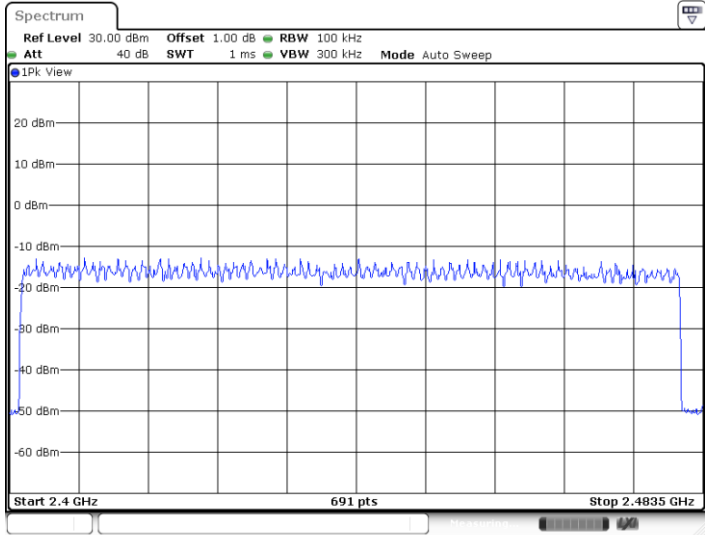
Number of hopping frequencies	Result
79	Pass

GFSK Mode



Date: 25 JUN 2021 11:29:33

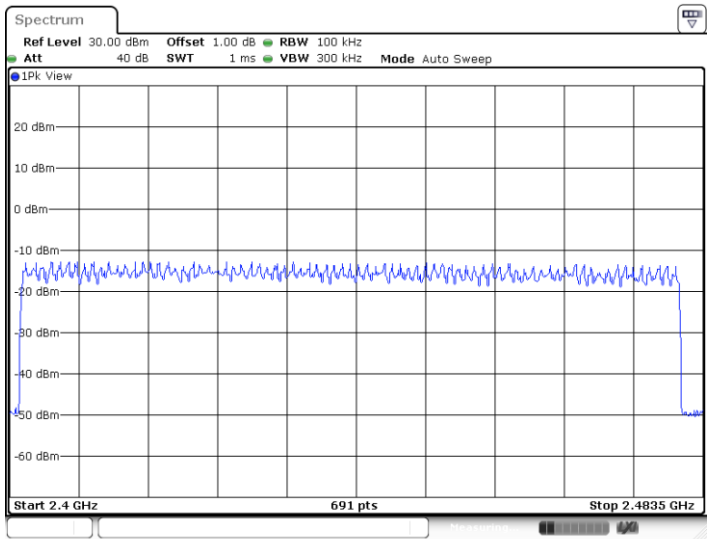
$\pi/4$ -DQPSK Mode



Date: 25 JUN 2021 11:32:43



8DPSK Mode



Date: 25 JUN 2021 11:26:42

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.

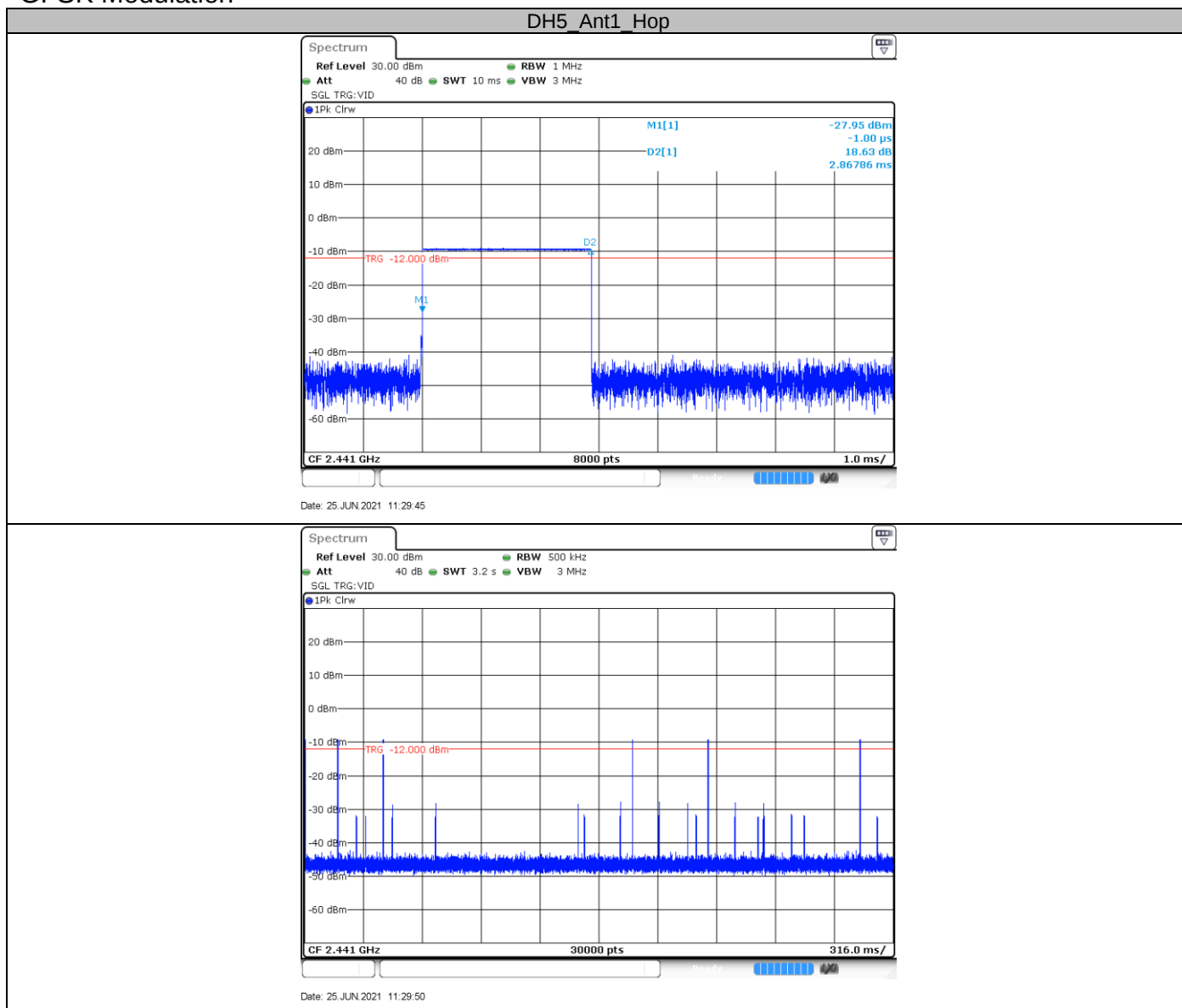
The Dwell Time = Burst Width * Total Hops. The detailed calculations are showed as follows:

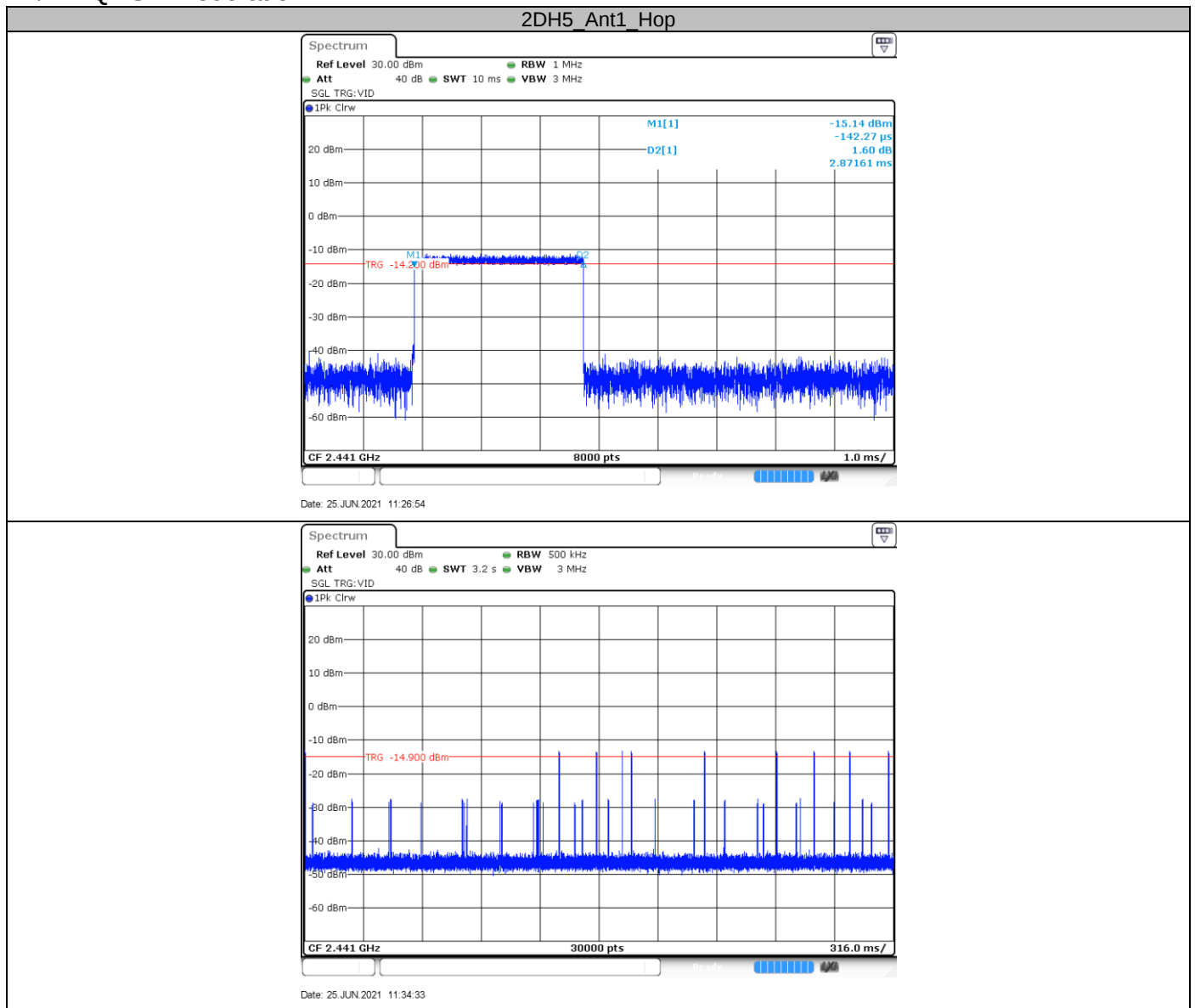
The duration for dwell time calculation: 0.4 [s] * hopping number = 0.4 [s] * 79 [ch] = 31.6 [s*ch];

Test Result

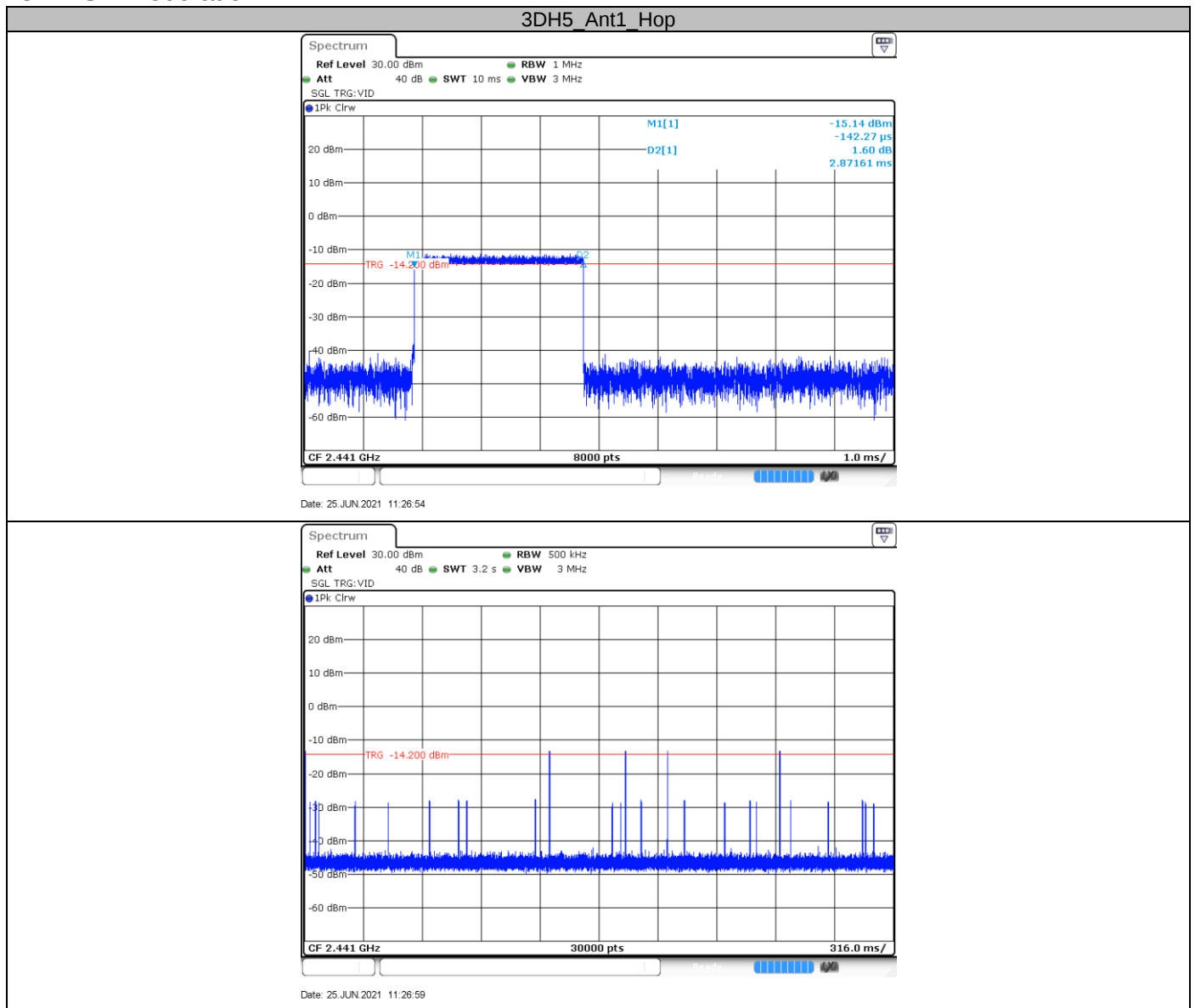
Modulation	Mode	BurstWidth (ms)	Total Hops	Test Result (s)	Limit (s)	Result
GFSK	DH5	2.87	60	0.172	0.4	Pass
$\pi/4$ -DQPSK	2DH5	2.87	100	0.287	0.4	Pass
8-DPSK	3DH5	2.87	50	0.144	0.4	Pass

GFSK Modulation



$\pi/4$ -DQPSK Modulation

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

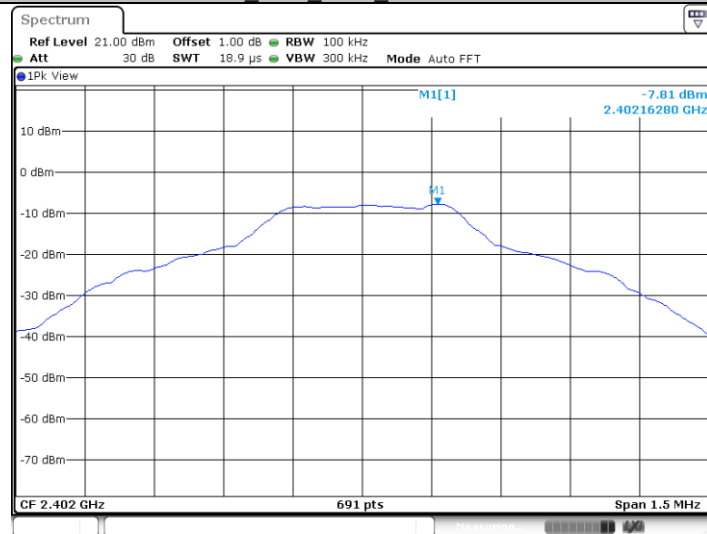
Limit

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

Test Result

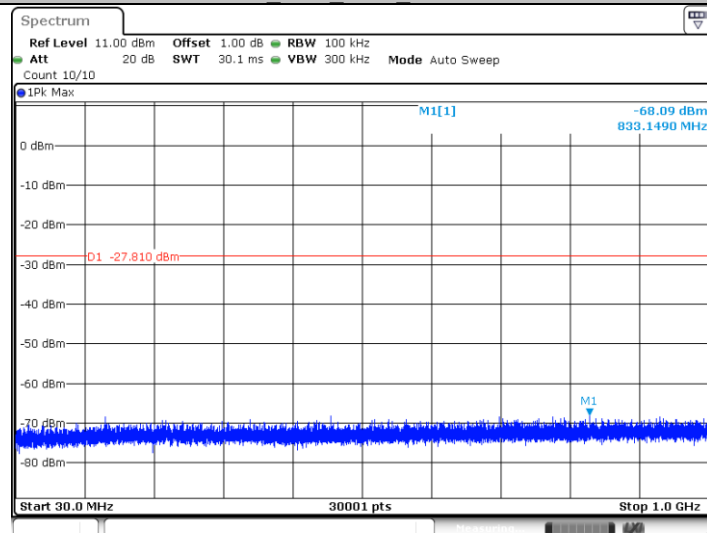
TestMode	Antenna	Channel [MHz]	FreqRange [MHz]	RefLevel	Result [dBm]	Limit [dBm]	Verdict
DH5	Ant1	2402	Reference	-7.81 dBm	-7.81	---	PASS
			30~1000	30~1000 MHz	-68.09	<=-27.81	PASS
			1000~26500	1000~26500 MHz	-50.96	<=-27.81	PASS
		2441	Reference	-8.16 dBm	-8.16	---	PASS
			30~1000	30~1000 MHz	-67.95	<=-28.16	PASS
			1000~26500	1000~26500 MHz	-50.3	<=-28.16	PASS
		2480	Reference	-8.85 dBm	-8.85	---	PASS
			30~1000	30~1000 MHz	-68.51	<=-28.85	PASS
			1000~26500	1000~26500 MHz	-50.46	<=-28.85	PASS
2DH5	Ant1	2402	Reference	-12.71 dBm	-12.71	---	PASS
			30~1000	30~1000 MHz	-67.24	<=-32.71	PASS
			1000~26500	1000~26500 MHz	-50.16	<=-32.71	PASS
		2441	Reference	-13.04 dBm	-13.04	---	PASS
			30~1000	30~1000 MHz	-67.53	<=-33.04	PASS
			1000~26500	1000~26500 MHz	-50.13	<=-33.04	PASS
		2480	Reference	-13.79 dBm	-13.79	---	PASS
			30~1000	30~1000 MHz	-68.72	<=-33.79	PASS
			1000~26500	1000~26500 MHz	-49.74	<=-33.79	PASS
3DH5	Ant1	2402	Reference	-12.58 dBm	-12.58	---	PASS
			30~1000	30~1000 MHz	-68.56	<=-32.58	PASS
			1000~26500	1000~26500 MHz	-48.95	<=-32.58	PASS
		2441	Reference	-12.88 dBm	-12.88	---	PASS
			30~1000	30~1000 MHz	-67.82	<=-32.88	PASS
			1000~26500	1000~26500 MHz	-50.53	<=-32.88	PASS
		2480	Reference	-13.64 dBm	-13.64	---	PASS
			30~1000	30~1000 MHz	-68.4	<=-33.64	PASS
			1000~26500	1000~26500 MHz	-50.1	<=-33.64	PASS

DH5_Ant1_2402_0~Reference



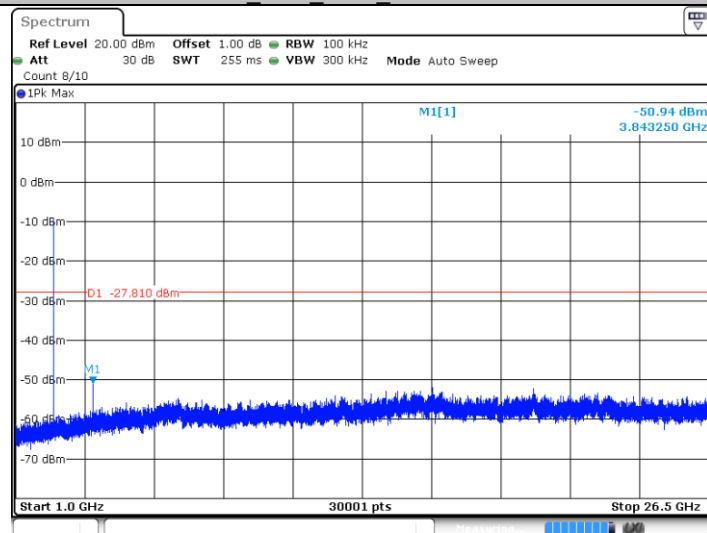
Date: 25 JUN 2021 11:11:13

DH5_Ant1_2402_30~1000



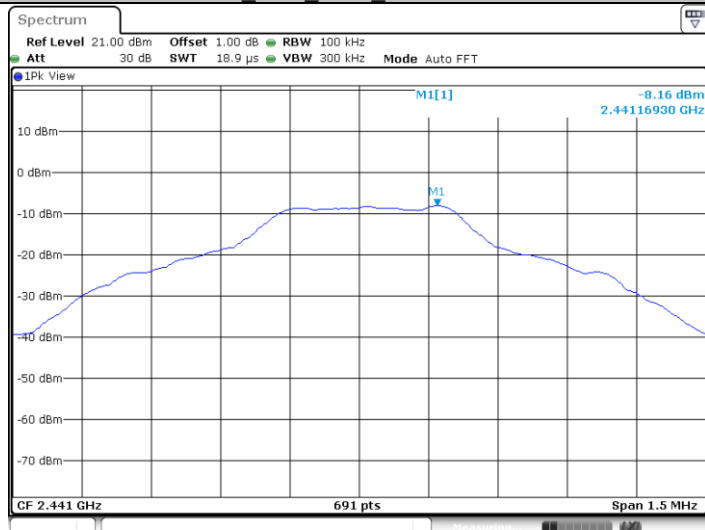
Date: 25 JUN 2021 11:11:19

DH5_Ant1_2402_1000~26500



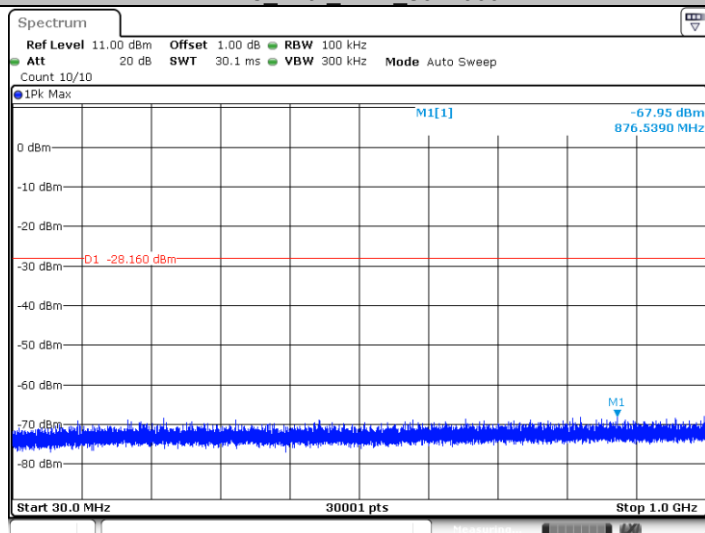
Date: 25 JUN 2021 11:11:27

DH5_Ant1_2441_0~Reference



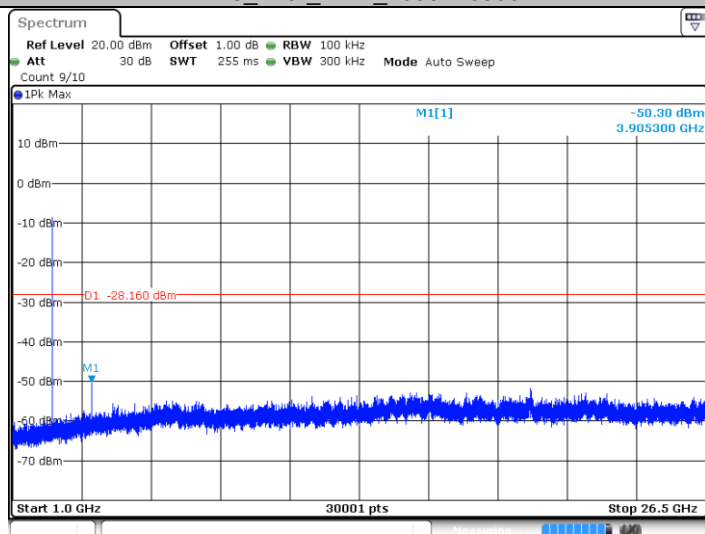
Date: 25 JUN 2021 11:13:30

DH5_Ant1_2441_30~1000



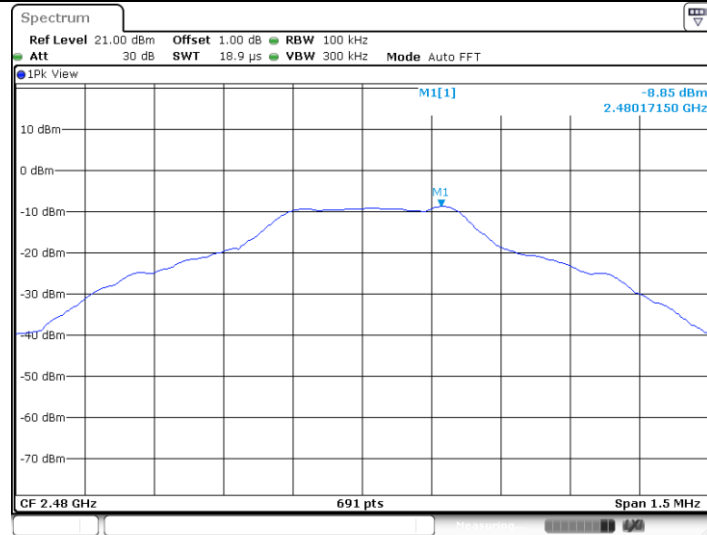
Date: 25 JUN 2021 11:13:36

DH5_Ant1_2441_1000~26500



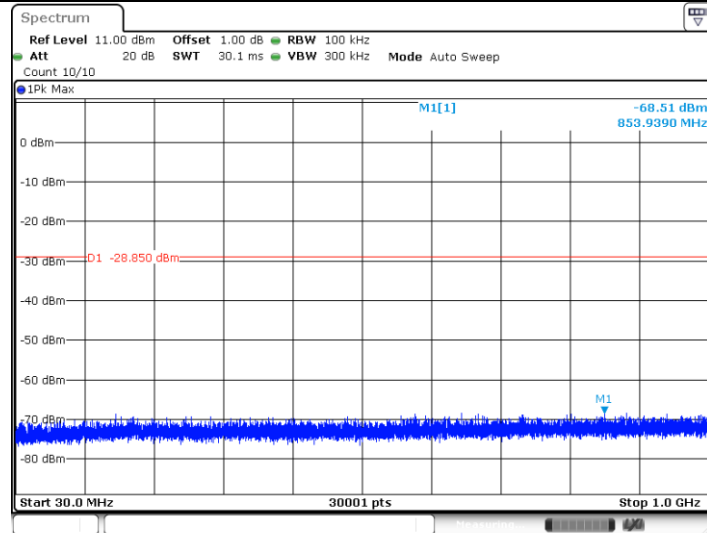
Date: 25 JUN 2021 11:13:44

DH5_Ant1_2480_0~Reference



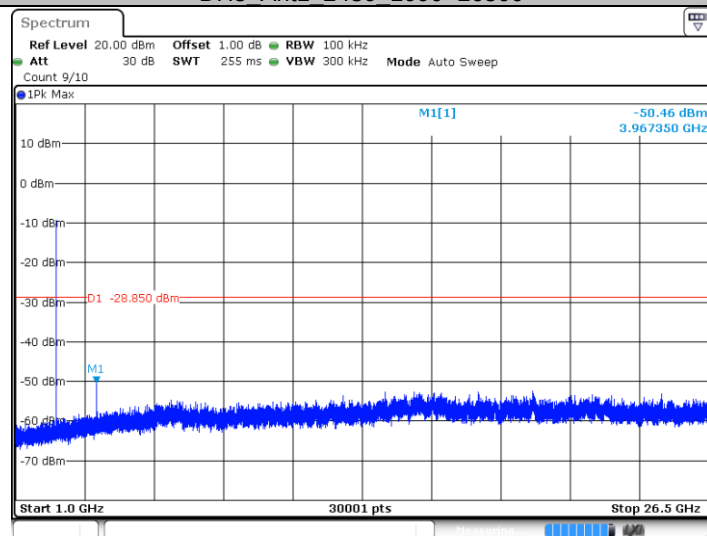
Date: 25 JUN 2021 11:15:30

DH5_Ant1_2480_30~1000



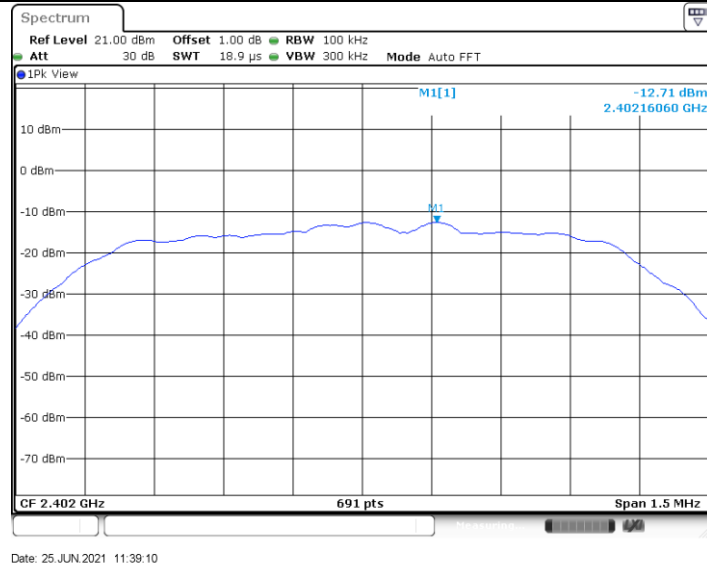
Date: 25 JUN 2021 11:15:36

DH5_Ant1_2480_1000~26500

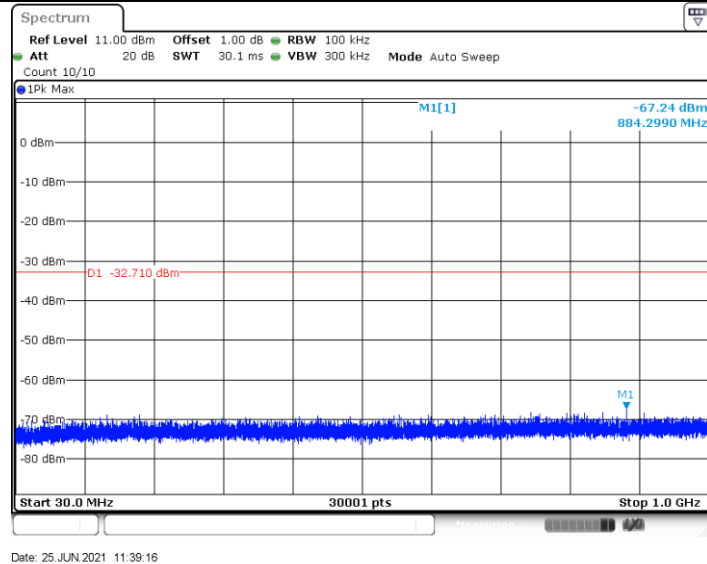


Date: 25 JUN 2021 11:15:44

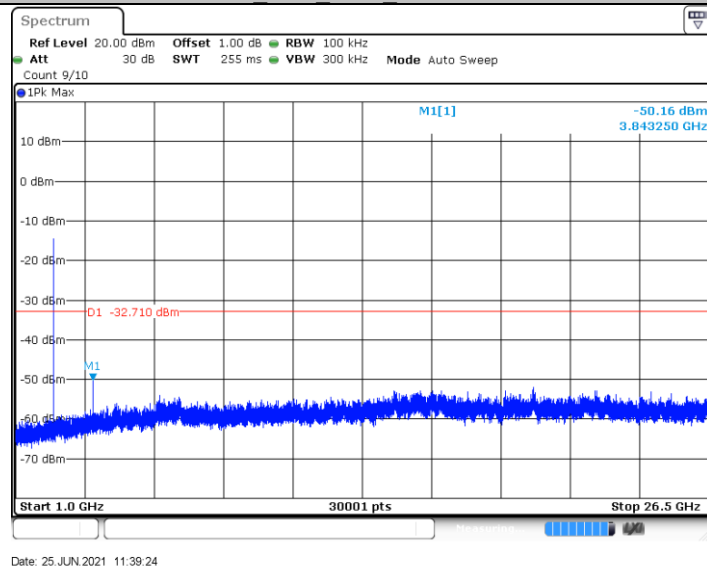
2DH5_Ant1_2402_0~Reference



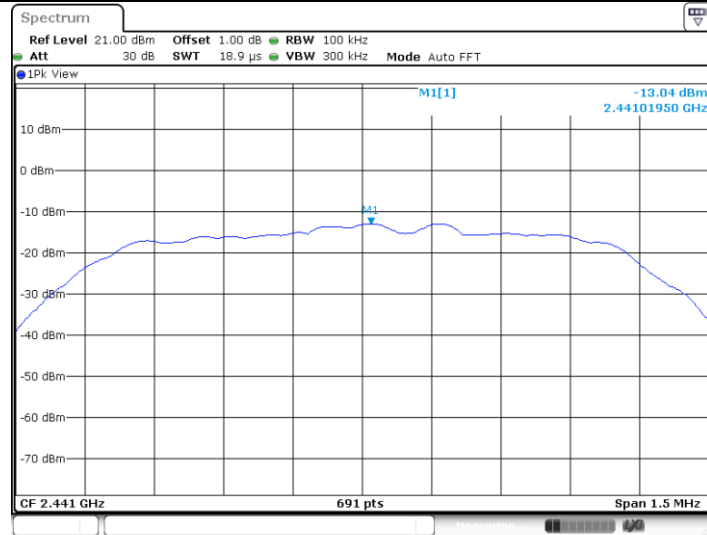
2DH5 Ant1 2402 30~1000



2DH5 Ant1 2402 1000~26500

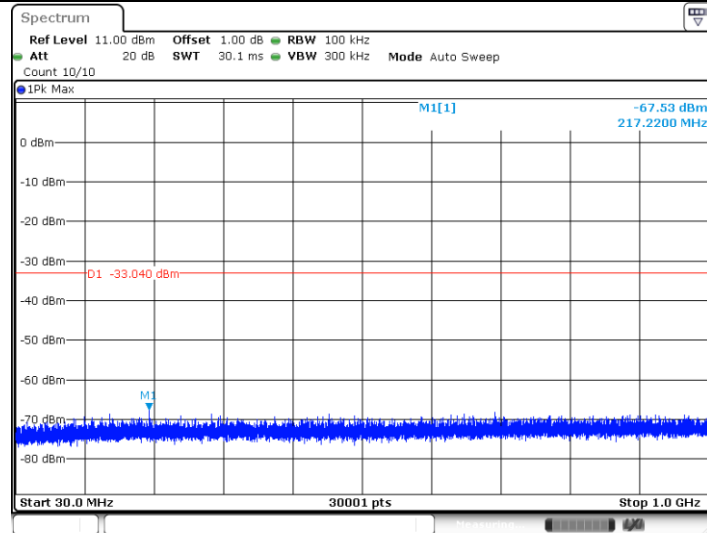


2DH5 Ant1 2441 0~Reference



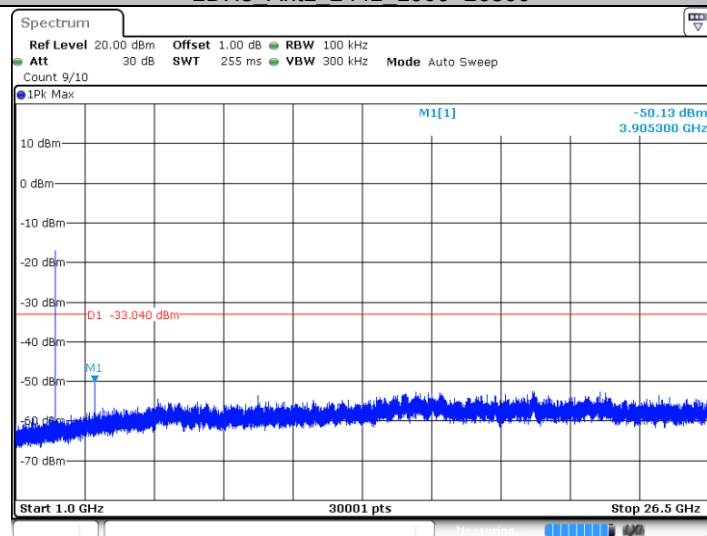
Date: 25 JUN 2021 11:40:49

2DH5 Ant1 2441 30~1000



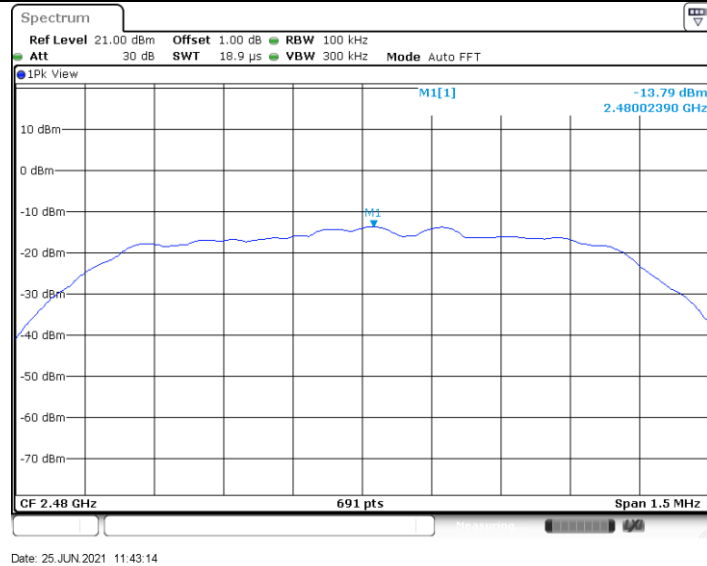
Date: 25 JUN 2021 11:40:56

2DH5 Ant1 2441 1000~26500

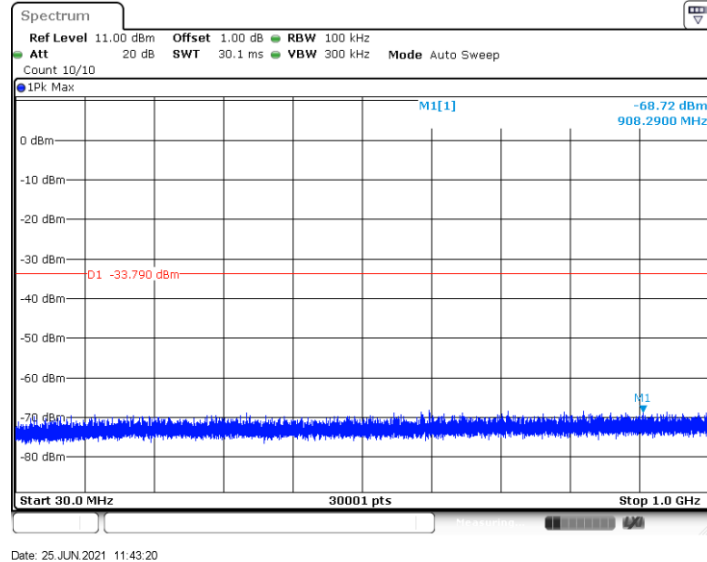


Date: 25 JUN 2021 11:41:03

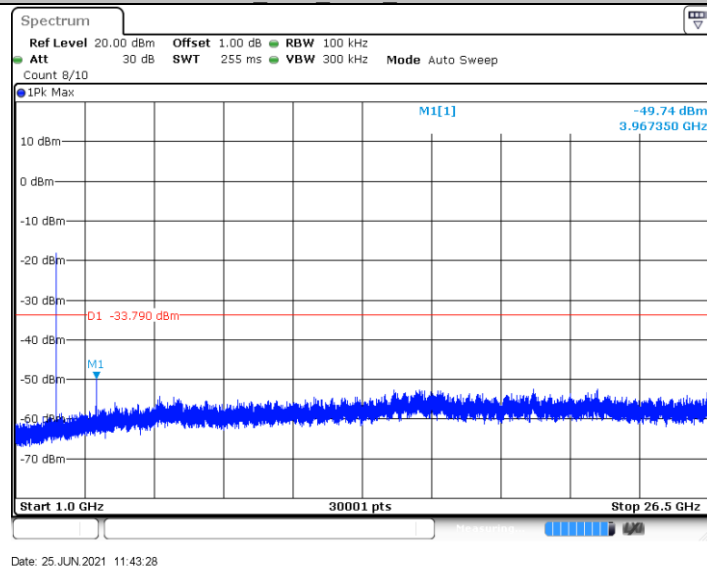
2DH5 Ant1 2480 0~Reference



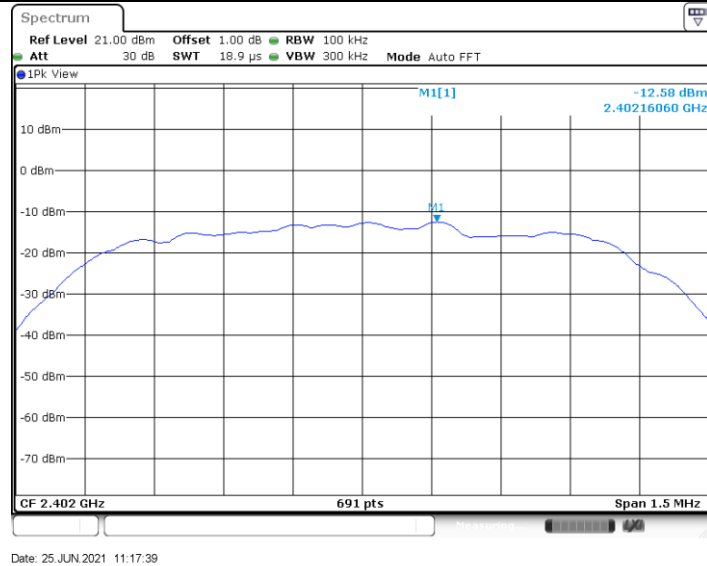
2DH5 Ant1 2480 30~1000



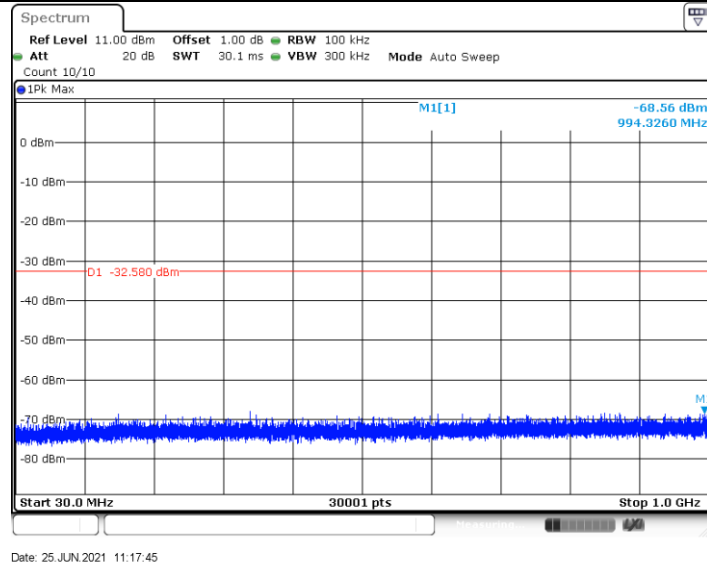
2DH5 Ant1 2480 1000~26500



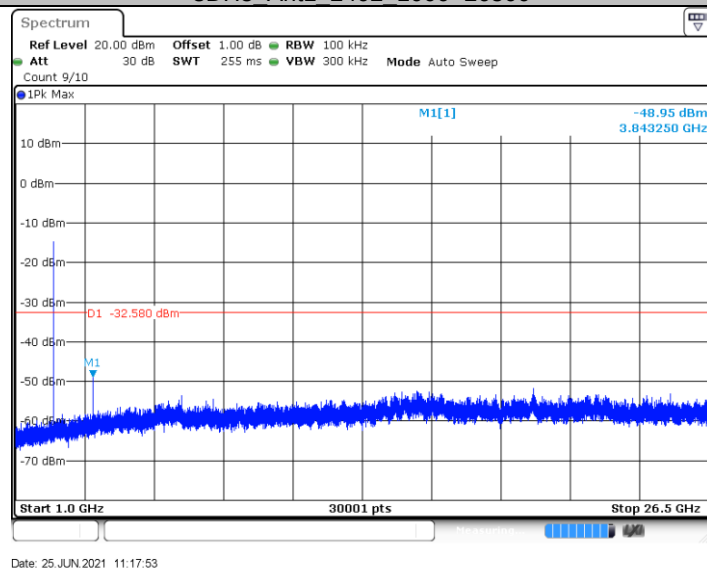
3DH5 Ant1 2402 0~Reference



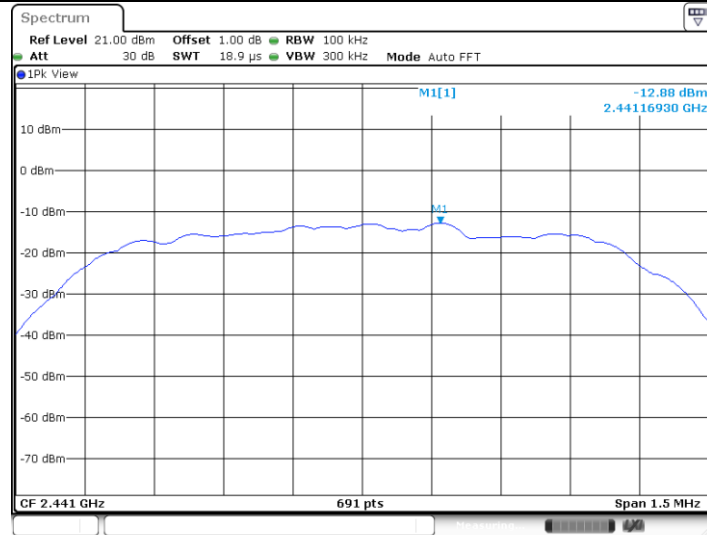
3DH5 Ant1 2402 30-1000



3DH5 Ant1 2402 1000-26500

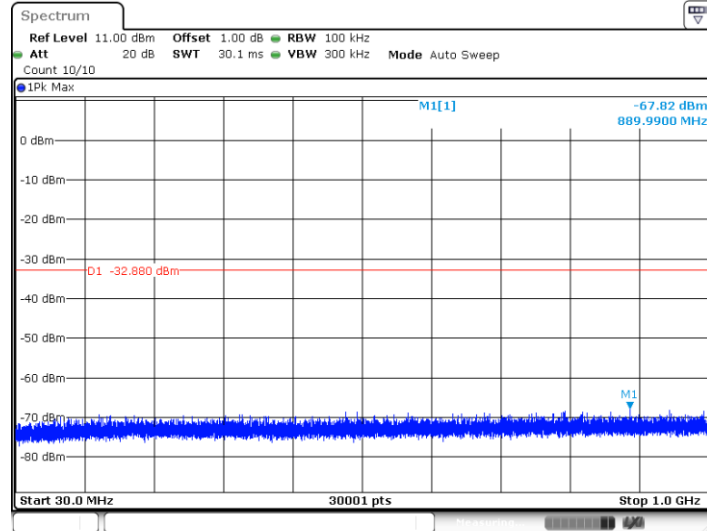


3DH5 Ant1 2441 0-Reference



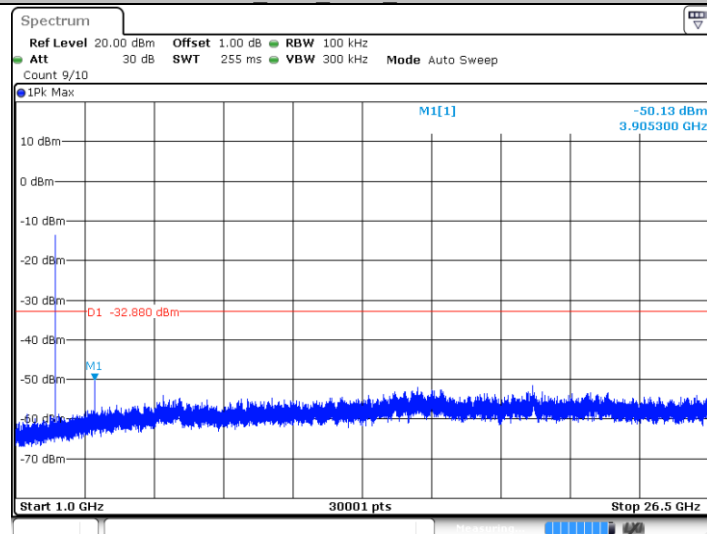
Date: 25 JUN 2021 11:21:26

3DH5 Ant1 2441 30~1000



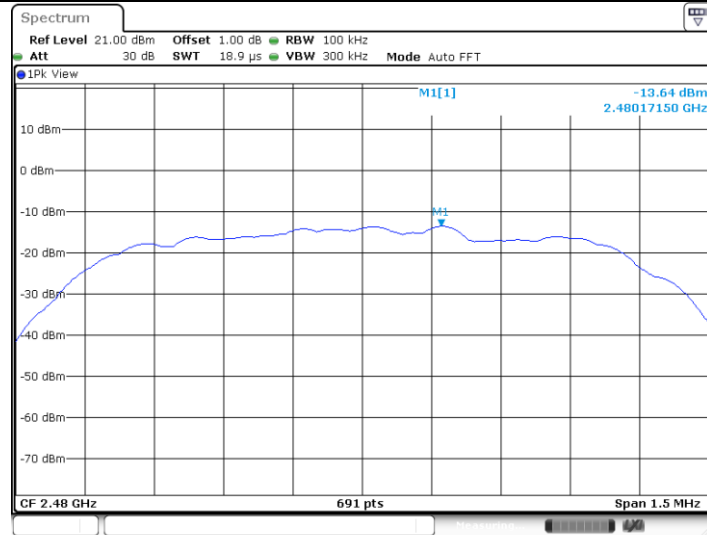
Date: 25 JUN 2021 11:21:32

3DH5 Ant1 2441 1000~26500



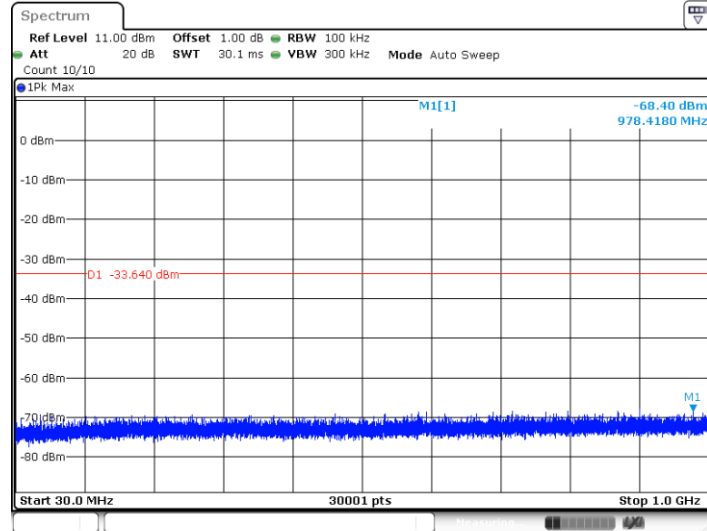
Date: 25 JUN 2021 11:21:40

3DH5 Ant1 2480 0~Reference



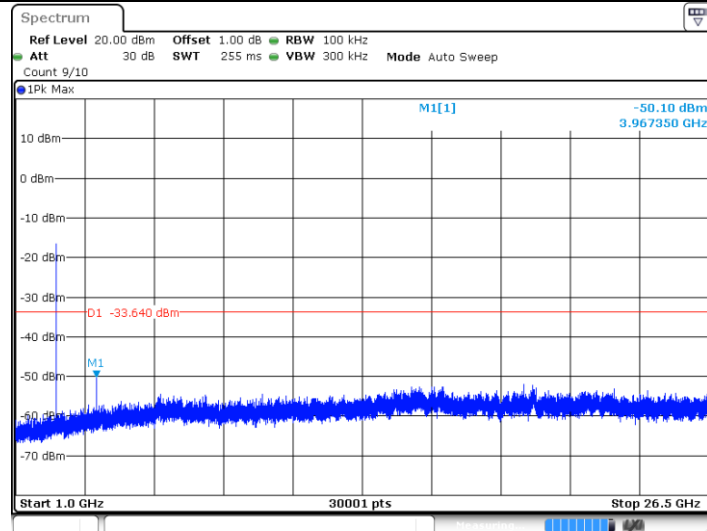
Date: 25 JUN 2021 11:24:20

3DH5 Ant1 2480 30~1000



Date: 25 JUN 2021 11:24:27

3DH5 Ant1 2480 1000~26500



Date: 25 JUN 2021 11:24:34

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.

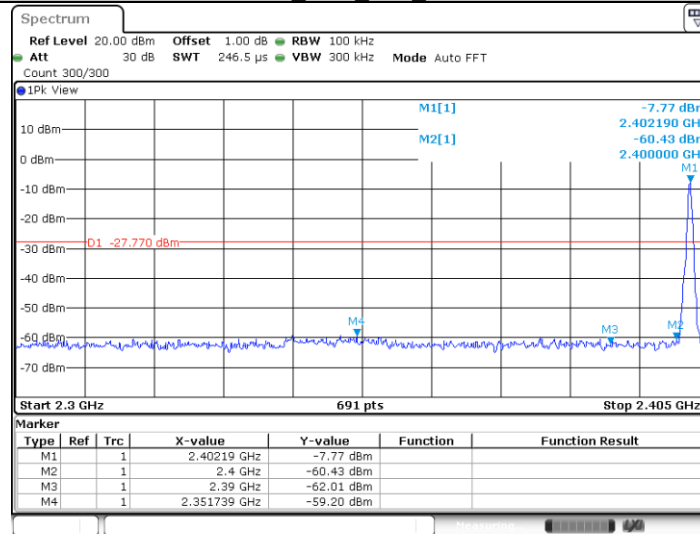
Limit:

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.

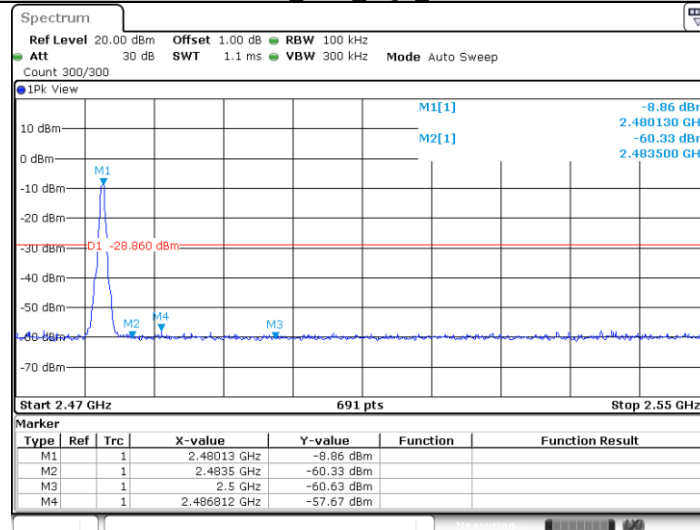
Test Result

TestMode	Antenna	ChName	Channel[MHz]	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
DH5	Ant1	Low	2402	-7.77	-59.2	<=-27.77	PASS
		High	2480	-8.86	-57.67	<=-28.86	PASS
		Low	Hop_2402	-8.90	-58.78	-28.9	PASS
		High	Hop_2480	-9.13	-58.54	-29.13	PASS
2DH5	Ant1	Low	2402	-12.76	-58.55	<=-32.76	PASS
		High	2480	-13.74	-57.09	<=-33.74	PASS
		Low	Hop_2402	-15.79	-58.87	-35.79	PASS
		High	Hop_2480	-14.06	-58	-34.06	PASS
3DH5	Ant1	Low	2402	-13.46	-57.63	<=-33.46	PASS
		High	2480	-13.68	-58	<=-33.68	PASS
		Low	Hop_2402	-14.61	-59.21	-34.61	PASS
		High	Hop_2480	-13.55	-58.02	-33.55	PASS

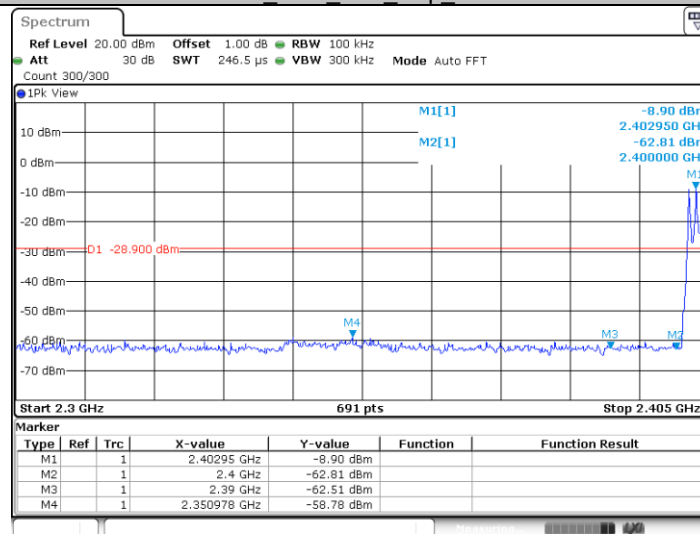
DH5_Ant1_Low_2402



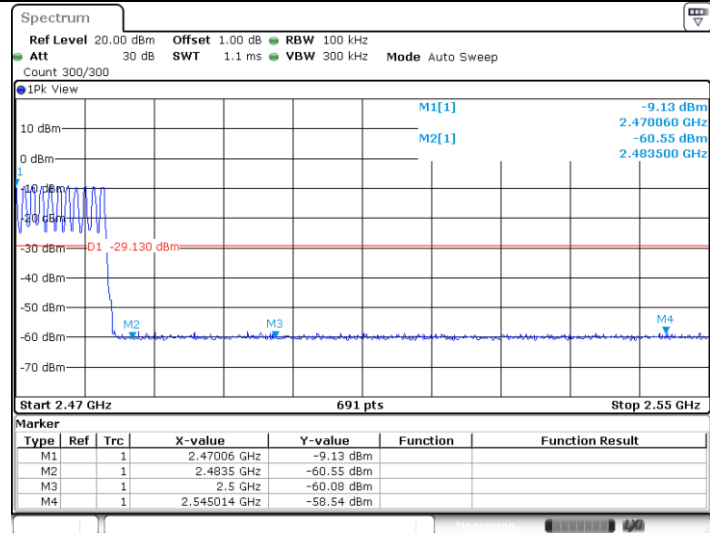
DH5_Ant1_High_2480



DH5_Ant1_Low_Hop_2402

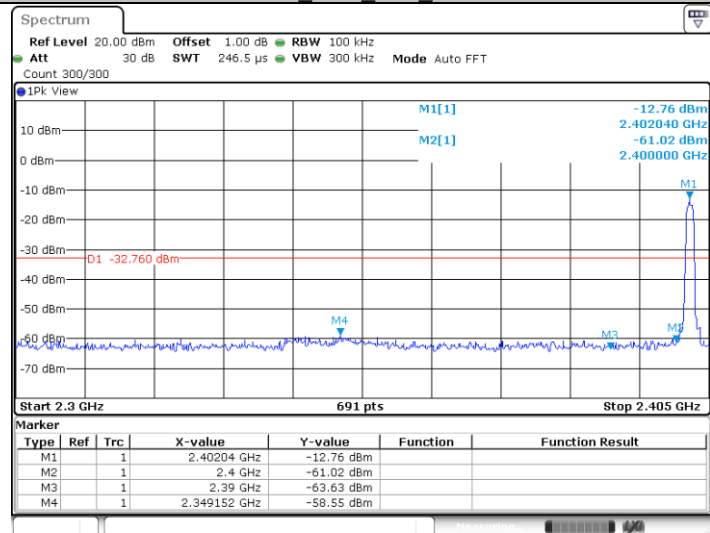


DH5_Ant1_High_Hop_2480



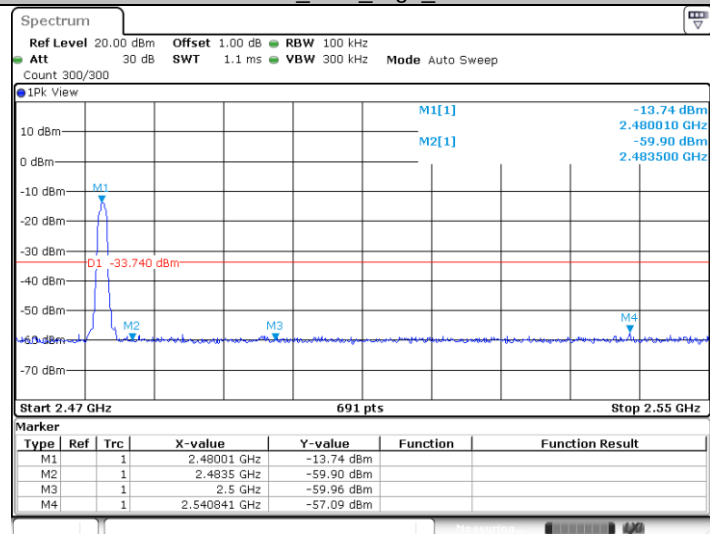
Date: 25 JUN 2021 11:28:46

2DH5_Ant1_Low_2402



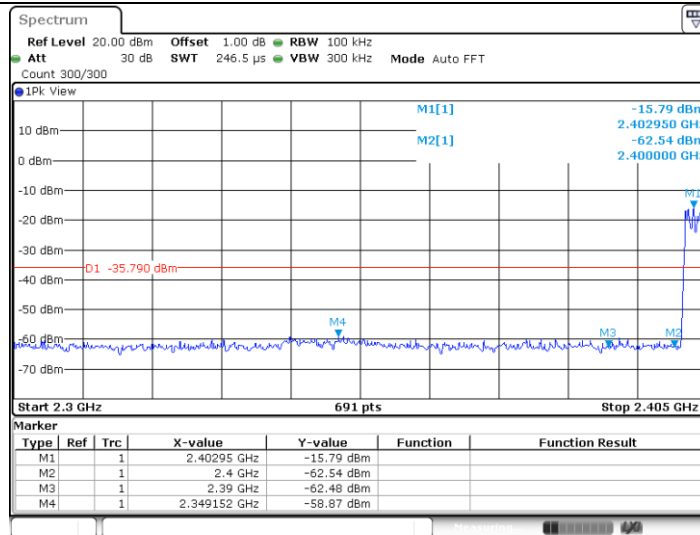
Date: 25 JUN 2021 11:39:05

2DH5_Ant1_High_2480



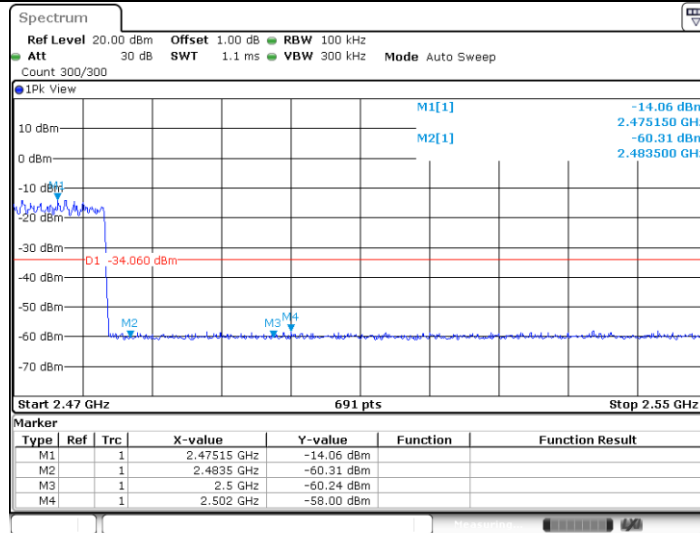
Date: 25 JUN 2021 11:43:08

2DH5_Ant1_Low_Hop_2402



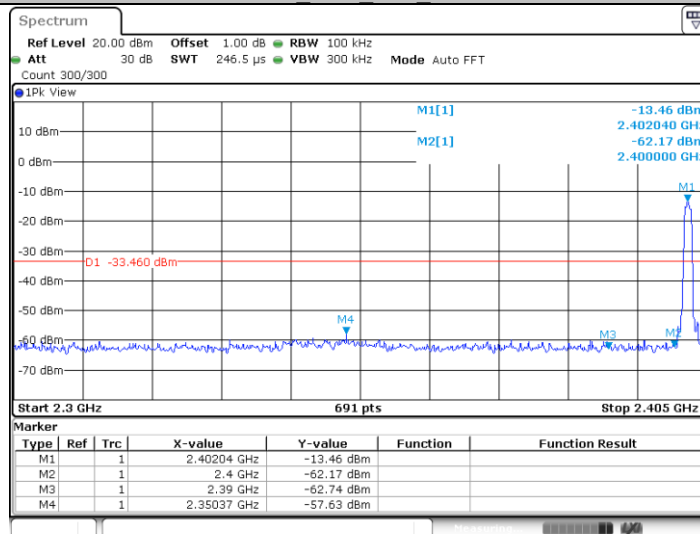
Date: 25 JUN 2021 11:31:25

2DH5 Ant1 High Hop 2480



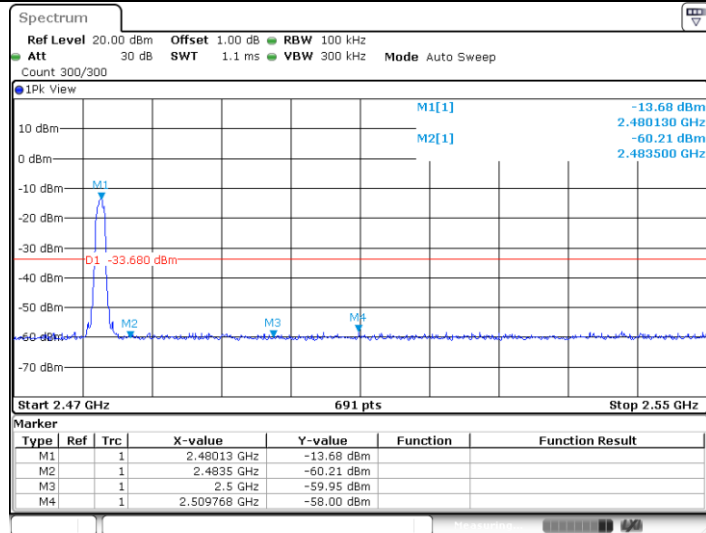
Date: 25 JUN 2021 11:33:11

3DH5 Ant1 Low 2402



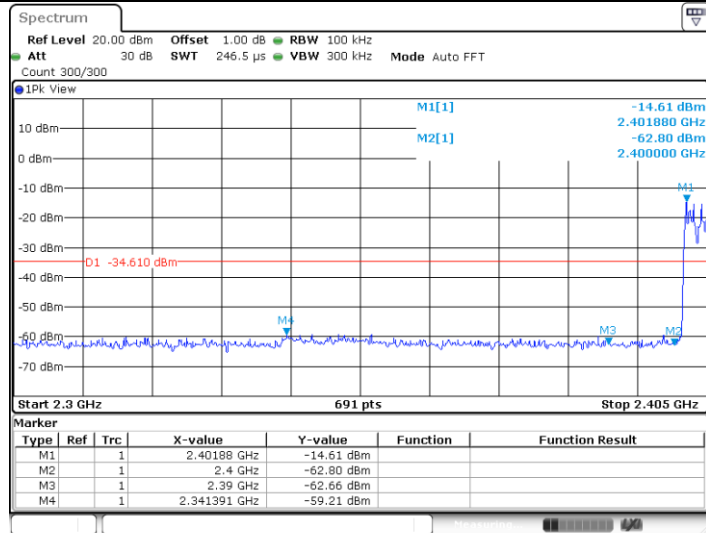
Date: 25 JUN 2021 11:17:33

3DH5 Ant1 High 2480



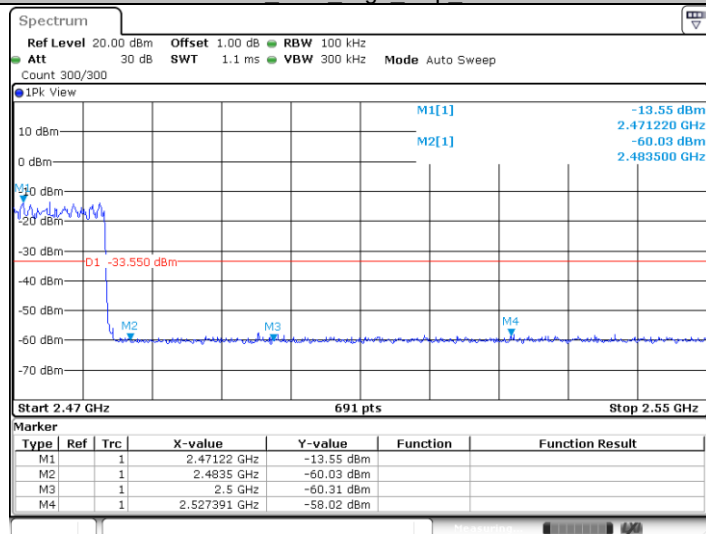
Date: 25 JUN 2021 11:24:15

3DH5 Ant1 Low Hop 2402



Date: 25 JUN 2021 11:25:37

3DH5 Ant1 High Hop 2480



Date: 25 JUN 2021 11:27:10

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.

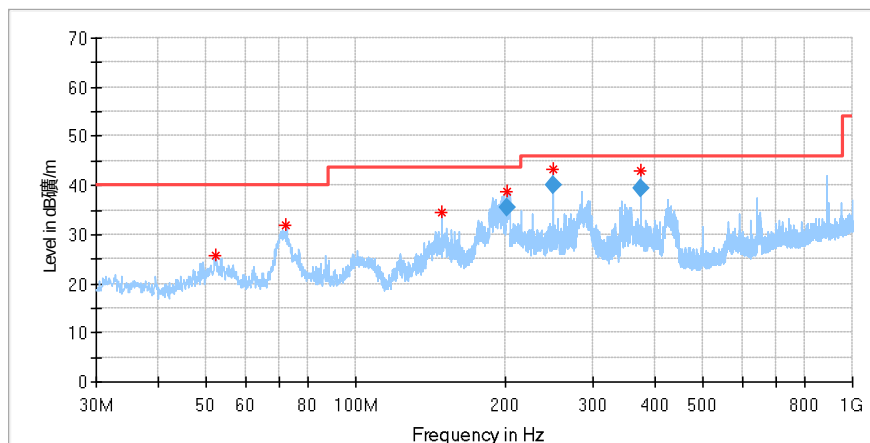
Frequency MHz	Field Strength uV/m	Field Strength dBµV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

Spurious radiated emissions for transmitter

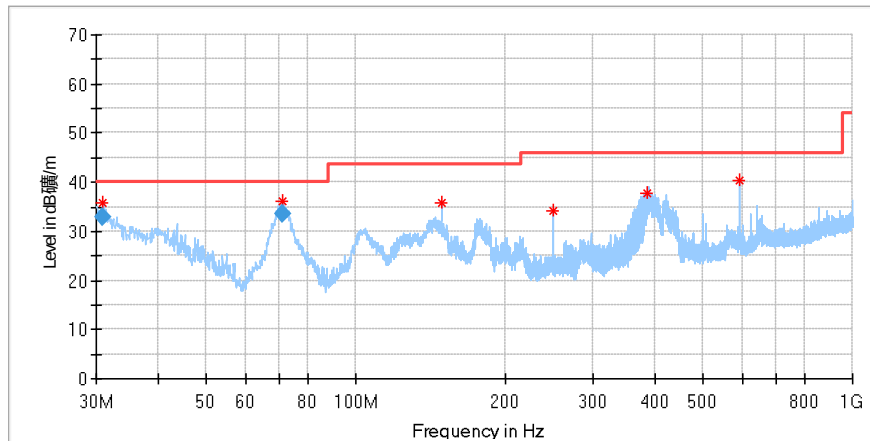
According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

The only worse case (GFSK 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)
52.310000	25.59	40.00	14.41	200.0	H	17.0	15.28
72.134375	31.80	40.00	8.20	100.0	H	68.0	10.58
148.461250	34.56	43.50	8.94	200.0	H	243.0	9.91
201.750625	38.91	43.50	4.59	100.0	H	252.0	13.32
250.008125	43.31	46.00	2.69	100.0	H	317.0	14.38
375.016875	42.94	46.00	3.06	100.0	H	353.0	17.67
Frequency	QuasiPeak	Limit	Margin	Height	Pol	Azimuth	Corr.
201.750625	35.39	43.50	7.61	100.0	H	252.0	13.32
250.008125	40.17	46.00	5.83	100.0	H	317.0	14.38
375.016875	39.55	46.00	6.45	100.0	H	353.0	17.67

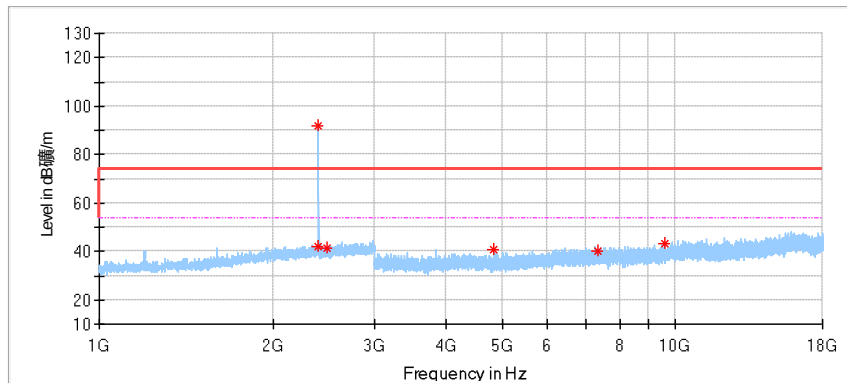


Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.970000	35.80	40.00	4.20	100.0	V	78.0	11.49
71.285625	36.26	40.00	3.74	200.0	V	0.0	10.81
148.461250	35.75	43.50	7.75	100.0	V	0.0	9.91
249.947500	34.05	46.00	11.95	100.0	V	154.0	14.37
386.232500	37.91	46.00	8.09	100.0	V	0.0	17.96
593.933750	40.00	46.00	6.00	100.0	V	154.0	22.36
Frequency	QuasiPeak	Limit	Margin	Height	Pol	Azimuth	Corr.
30.970000	32.86	40.00	7.14	100.0	V	78.0	11.49
71.285625	33.58	40.00	6.42	200.0	V	0.0	10.81

1GHz -18GHz:

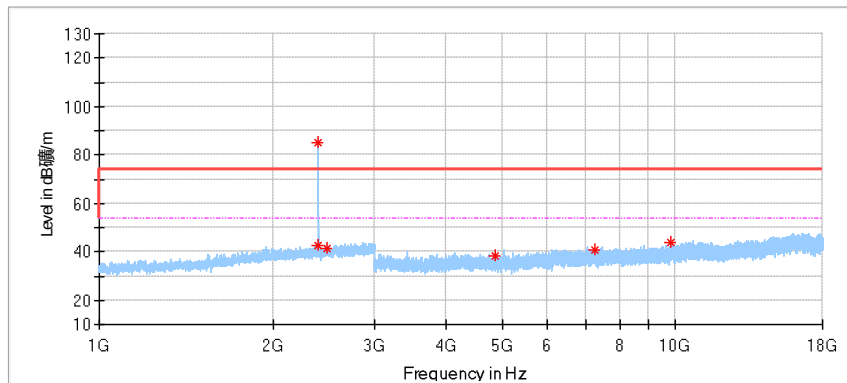
GFSK_2402MHz

Horizontal:



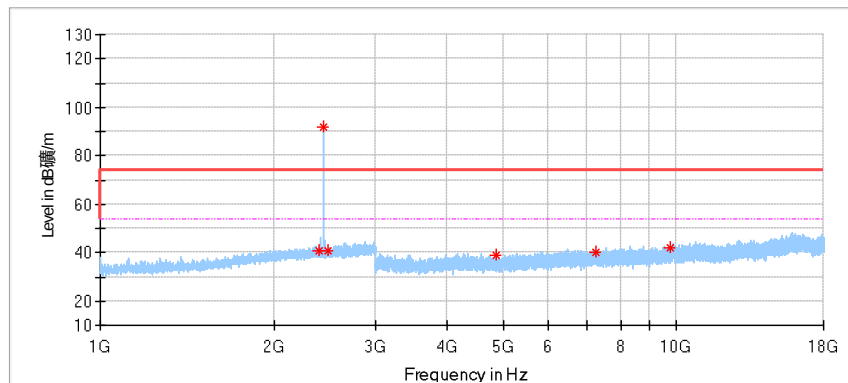
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2390.000000	42.03	74.00	31.97	150.0	H	313.0	-2.96
2402.380952	92.10	74.00	-18.10	150.0	H	8.0	-2.99
2486.190476	41.09	74.00	32.91	150.0	H	38.0	-2.69
4835.500000	40.87	74.00	33.13	150.0	H	25.0	2.27
7347.500000	40.30	74.00	33.70	150.0	H	123.0	7.10
9572.000000	43.44	74.00	30.56	150.0	H	327.0	9.19

Vertical



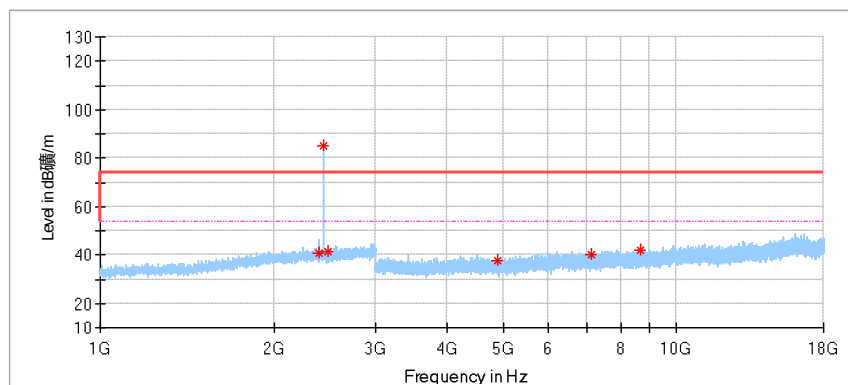
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2390.476191	42.34	74.00	31.66	150.0	V	230.0	-2.96
2402.380952	85.33	74.00	-11.33	150.0	V	288.0	-2.99
2486.666667	41.11	74.00	32.89	150.0	V	282.0	-2.69
4868.500000	38.43	74.00	35.57	150.0	V	198.0	2.43
7260.500000	40.68	74.00	33.32	150.0	V	172.0	6.96
9823.500000	44.12	74.00	29.88	150.0	V	301.0	10.79

GFSK_2441MHz
Horizontal:



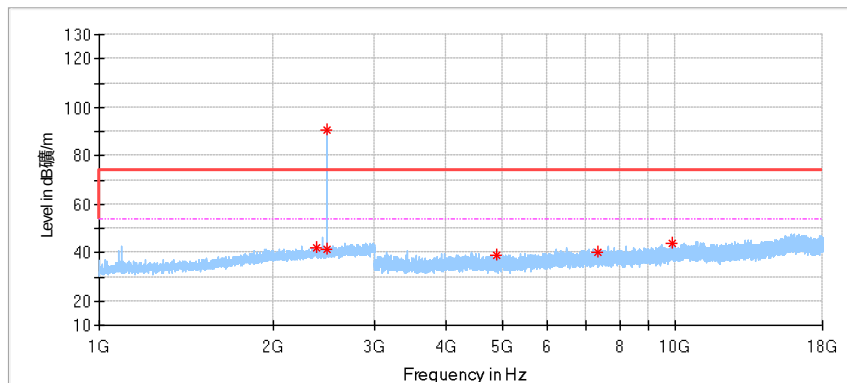
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2391.428571	41.06	74.00	32.95	150.0	H	198.0	-2.96
2441.428571	91.81	74.00	-17.81	150.0	H	4.0	-2.90
2482.857143	41.05	74.00	32.95	150.0	H	108.0	-2.69
4851.000000	38.72	74.00	35.28	150.0	H	7.0	2.36
7252.000000	40.34	74.00	33.66	150.0	H	7.0	6.95
9730.000000	42.02	74.00	31.98	150.0	H	225.0	9.56

Vertical



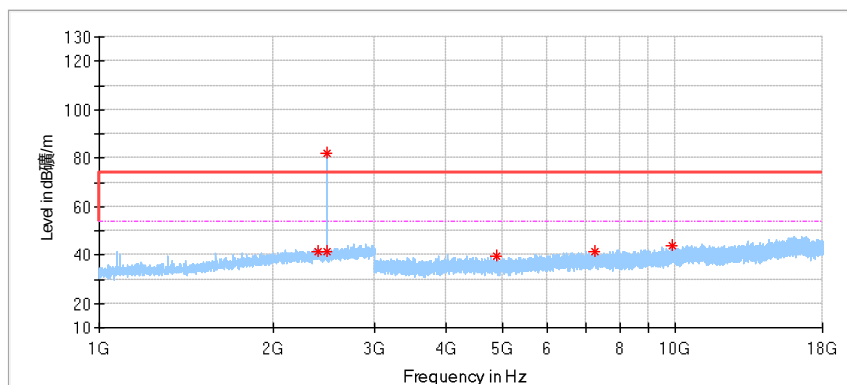
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2390.000000	40.70	74.00	33.30	150.0	V	327.0	-2.96
2441.428571	85.05	74.00	-11.05	150.0	V	314.0	-2.90
2481.904762	41.45	74.00	32.55	150.0	V	51.0	-2.69
4885.500000	37.64	74.00	36.36	150.0	V	101.0	2.35
7128.000000	40.35	74.00	33.65	150.0	V	175.0	6.70
8639.500000	41.97	74.00	32.03	150.0	V	251.0	8.41

GFSK_2480MHz
Horizontal:



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2386.666667	42.12	74.00	31.88	150.0	H	358.0	-2.95
2480.476191	90.66	74.00	-16.66	150.0	H	358.0	-2.69
2483.333333	41.16	74.00	32.84	150.0	H	327.0	-2.69
4903.500000	38.73	74.00	35.27	150.0	H	246.0	2.27
7335.000000	40.08	74.00	33.92	150.0	H	272.0	7.08
9898.500000	43.71	74.00	30.29	150.0	H	4.0	10.76

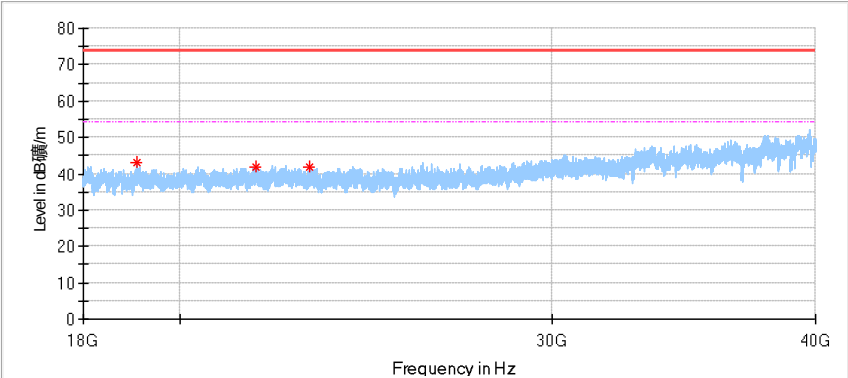
Vertical



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2390.476191	41.34	74.00	32.66	150.0	V	359.0	-2.96
2480.476191	82.14	74.00	-8.14	150.0	V	240.0	-2.69
2484.761905	41.33	74.00	32.67	150.0	V	31.0	-2.69
4902.500000	39.48	74.00	34.52	150.0	V	225.0	2.27
7247.500000	41.21	74.00	32.79	150.0	V	276.0	6.94
9882.500000	44.10	74.00	29.90	150.0	V	251.0	11.06

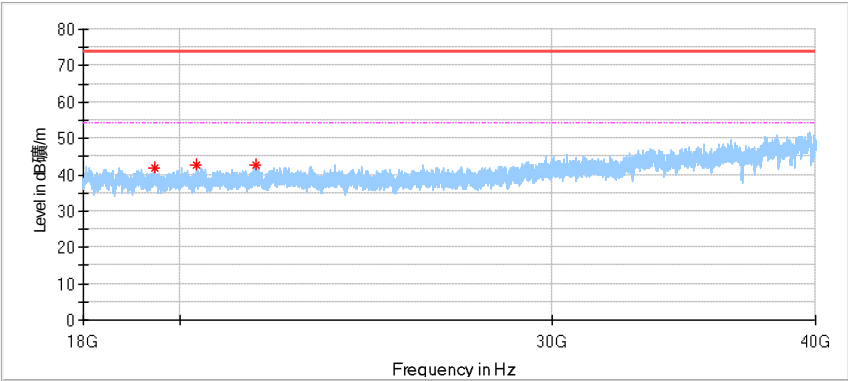


Above 18GHz:
GFSK_2402MHz
Horizontal:



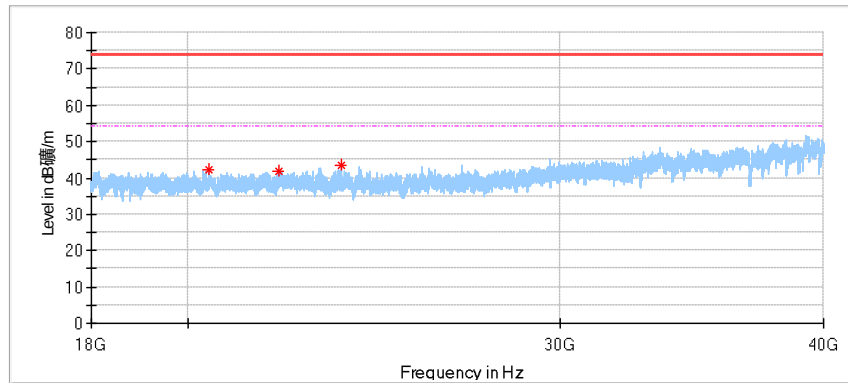
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19067.687500	43.05	74.00	30.95	150.0	H	32.0	-1.80
21721.437500	41.84	74.00	32.16	150.0	H	80.0	0.47
23038.000000	41.83	74.00	32.17	150.0	H	263.0	1.05

Vertical



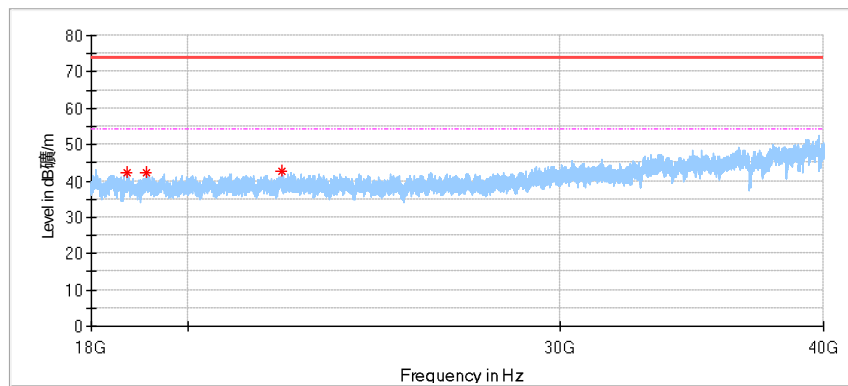
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19445.125000	41.79	74.00	32.21	150.0	V	7.0	-1.48
20369.812500	42.48	74.00	31.52	150.0	V	234.0	-0.72
21743.437500	42.51	74.00	31.49	150.0	V	57.0	0.48

GFSK_2441MHz
Horizontal:



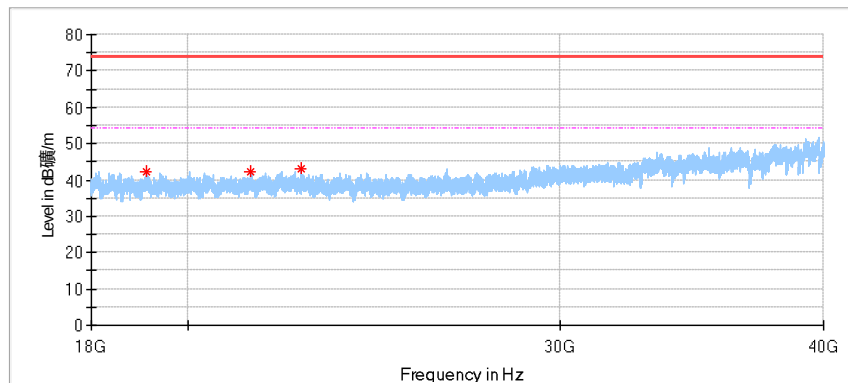
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
20466.062500	42.24	74.00	31.76	150.0	H	31.0	-0.55
22077.562500	41.85	74.00	32.15	150.0	H	111.0	0.62
23624.437500	43.59	74.00	30.41	150.0	H	0.0	0.80

Vertical



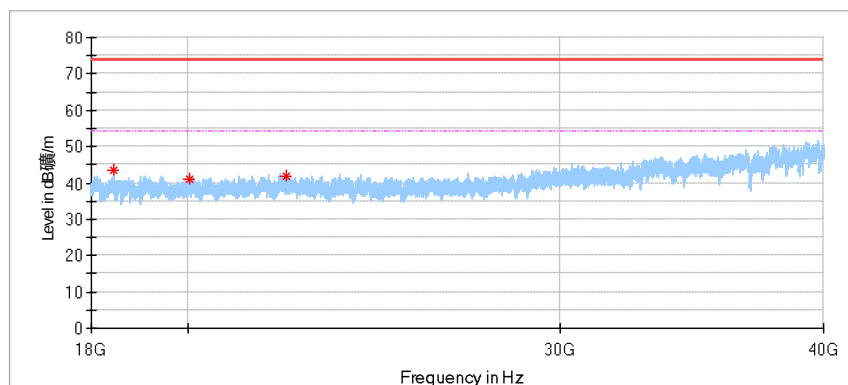
Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18720.500000	42.12	74.00	31.88	150.0	V	170.0	-1.90
19112.375000	42.39	74.00	31.61	150.0	V	354.0	-1.78
22153.187500	42.54	74.00	31.46	150.0	V	344.0	0.75

GFSK_2480MHz
Horizontal:



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19127.500000	42.18	74.00	31.82	150.0	H	175.0	-1.80
21403.812500	42.23	74.00	31.77	150.0	H	0.0	0.28
22633.750000	43.01	74.00	30.99	150.0	H	0.0	0.90

Vertical



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18444.812500	43.62	74.00	30.38	150.0	V	111.0	-1.86
20036.375000	40.96	74.00	33.04	150.0	V	260.0	-1.40
22248.750000	41.65	74.00	32.35	150.0	V	0.0	0.88

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	2021-7-30
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---