FCC/ ISED - TEST REPORT

Report Number	:	**68.950.23.0402.01**	Date of Issue:	**2023-06-12**
Model	:	**SOUNDBOKS (Gen.4)**		
Product Type	:	**SOUNDBOKS**		
Applicant	:	SOUNDBOKS ApS		
Address	:	Esromgade 15, 1107, 2200 Copenhagen N, DENMARK		
Manufacturer	:	SOUNDBOKS ApS		
Address	:	Esromgade 15, 1107, 2200 Copenhagen N, DENMARK		
Factory	:	Dongguan Meiloon Acoustic Equipments Co., Ltd.		
Address	:	No. 80, Yuanlin Road, Fenghuang Gang, Tangxia Town, 523727 Dongguan City, Guangdong Province, PEOPLE'S REPUBLIC OF CHINA		
Test Result	:	■ **Positive** ☐ **Negative**		
Total pages including Appendices	:	**46**		

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1 Table of Contents

TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
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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
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3 Description of the Equipment Under Test

Product:	SOUNDBOKS
Model no.:	SOUNDBOKS (Gen.4)
FCC ID:	2BATX-SBGEN4
IC	30386-SBGEN4
HVIN	07L6
PMN	SOUNDBOKS
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-2477.3MHz for 2.4G,
Modulation type:	FSK
Channel no.	15
Antenna Type:	Bowtie Dipole
Antenna Gain:	2.3dBi for 2.4G Hopping antenna
Description of the EUT:	The Equipment Under Test (EUT) is a SOUNDBOKS which supports Bluetooth function and 2.4G hopping.

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4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2021 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators
RSS-Gen Issue 5, April 2018 Amendment 1, March 2019 + Amendment 2, February 2021	General Requirements for Compliance of Radio Apparatus
RSS-247 Issue 2 February 2017	Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSS) and License-Exempt Local Area Network (LE-LAN) Devices

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

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5 Summary of Test Results

Technical Requirements			
FCC Part 15 Subpart C/ RSS-247 Issue 2/RSS-Gen Issue 5			
Test Condition		Test Site	Test Result
§15.207& RSS-Gen 8.8	Conducted emission AC power port	Site 1	Pass
§15.247(b)(1)	Conducted peak output power	Site 1	Pass
RSS-247 5.4(b)	Conducted peak output power and Equivalent Isotropic Radiated Power	Site 1	Pass
§15.247(a)(1) & RSS-247 5.1(a) & RSS-Gen 6.7	20dB bandwidth and 99% occupied bandwidth	Site 1	Pass
§15.247(a)(1) & RSS-247 5.1(b)	Carrier channel frequency separation	Site 1	Pass
§15.247(a)(1)(iii) & RSS-247 5.1(d)	Number of hopping frequencies	Site 1	Pass
§15.247(a)(1)(iii) & RSS-247 5.1(d)	Dwell Time - Average Time of Occupancy	Site 1	Pass
§15.247(d) & RSS-247 5.5	Spurious RF conducted emissions	Site 1	Pass
§15.247(d) & RSS-247 5.5	Band edge	Site 1	Pass
§15.247(d) & §15.209 &§15.205 &RSS-247 5.5 & RSS-Gen 6.13	Spurious radiated emissions for transmitter	Site 1	Pass
§15.203 & RSS-Gen 6.8	Antenna requirement	See note 2	Pass

Note 1: N/A=Not Applicable.
Note 2: The EUT uses an Bowtie Dipole antenna, which gain is 2.3dBi for 2.4G Hopping antenna. In accordance to §15.203, it is considered sufficiently to comply with the provisions of this section.

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6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2BATX-SBGEN4, IC: 30386-SBGEN4 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 2.4G Hopping 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:	2023-04-06
Testing Start Date:	2023-04-06
Testing End Date:	2023-04-11

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

Reviewed by:	Prepared by:	Tested by:
Jessie He	Richard He	Carry Cai
Project Manager	Project Engineer	Test Engineer

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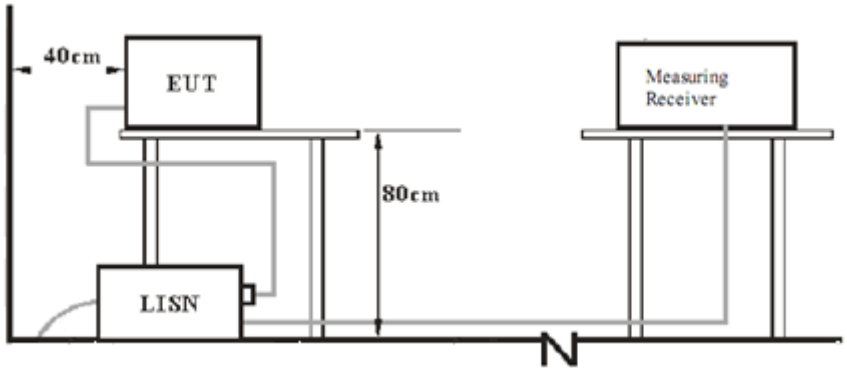
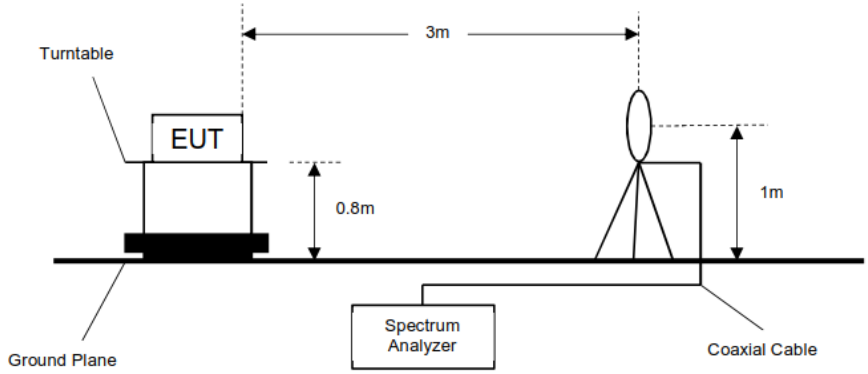
7 Test Setups

7.1 AC Power Line Conducted Emission test setups

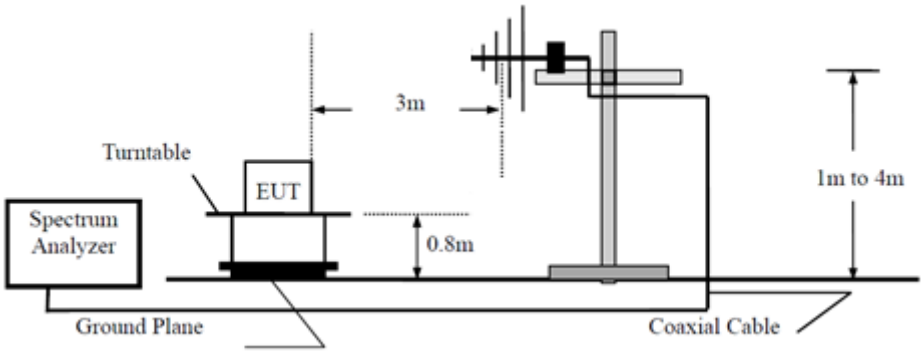


7.2 Radiated test setups

9kHz - 30MHz



30MHz - 1GHz



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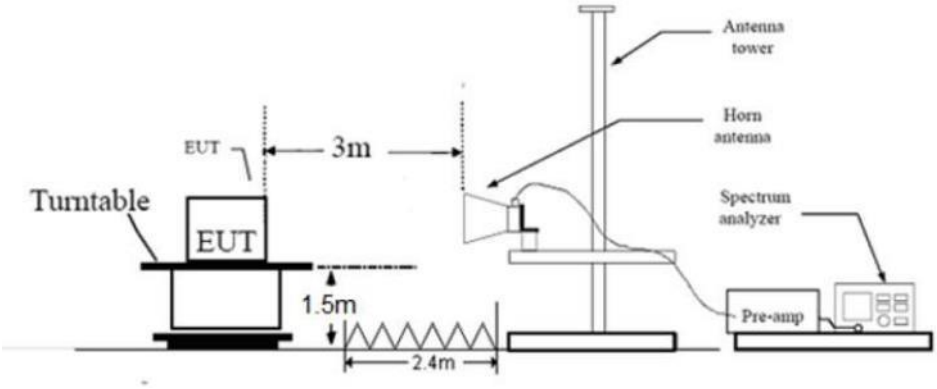
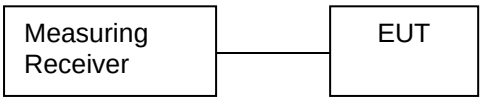
Above 1GHz



7.3 Conducted RF test setups



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8 Systems test configuration

Auxiliary Equipment Used during Test:

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

The system was configured to hopping mode and non-hopping mode.
Hopping mode: typical working mode (normal hopping status)
Non-hopping mode: The system was configured to operate at a signal channel transmitting.

Channel Table:

Channel #	Center Frequency (GHz)	Channel #	Center Frequency (GHz)
Center Frequencies (Channel Table)			
1	2.4020	26	2.4420
2	2.4051	27	2.4435
3	2.4066	28	2.4450
4	2.4081	29	2.4466
5	2.4097	30	2.4481
6	2.4112	31	2.4496
7	2.4128	32	2.4512
8	2.4143	33	2.4527
9	2.4158	34	2.4543
10	2.4174	35	2.4558
11	2.4189	36	2.4573
12	2.4204	37	2.4589
13	2.4220	38	2.4604
14	2.4235	39	2.4619
15	2.4251	40	2.4635
16	2.4266	41	2.4650
17	2.4281	42	2.4666
18	2.4297	43	2.4681
19	2.4312	44	2.4696
20	2.4327	45	2.4712
21	2.4343	46	2.4727
22	2.4358	47	2.4742
23	2.4374	48	2.4758
24	2.4389	49	2.4773
25	2.4404		

Remark: The EUT operation only 15 channels in these 49 channels.

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9 Technical Requirement

9.1 Conducted Emission

Test Method

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

Limit

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

*Decreases with the logarithm of the frequency.

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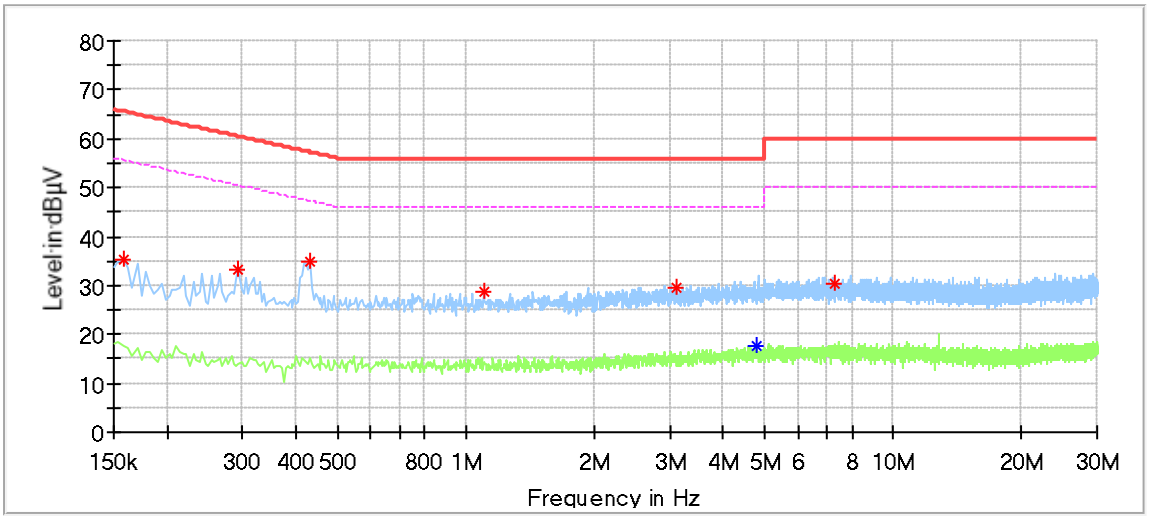
Conducted Emission

Product Type	:	SOUNDBOKS
M/N	:	SOUNDBOKS (Gen.4)
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)
0.158000	35.23	---	65.57	30.34	L1	9.58
0.294000	33.07	---	60.41	27.34	L1	9.61
0.434000	34.67	---	57.18	22.50	L1	9.62
1.102000	28.69	---	56.00	27.31	L1	9.64
3.126000	29.70	---	56.00	26.30	L1	9.70
4.770000	---	17.64	46.00	28.36	L1	9.77
7.334000	30.51	---	60.00	29.49	L1	9.87

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
---	---	---	---	---		---

Remark：
Level=Reading Level + Correction Factor
Correction Factor=Cable Loss + LISN Factor
(The Reading Level is recorded by software which is not shown in the sheet)

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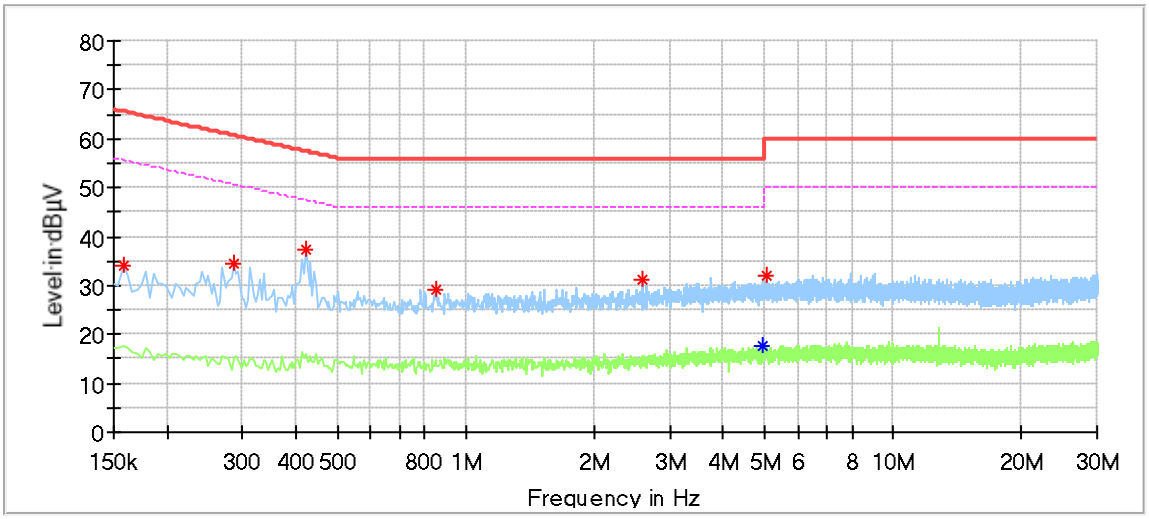
Conducted Emission

Product Type	:	SOUNDBOKS
M/N	:	SOUNDBOKS (Gen.4)
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)
0.158000	34.10	---	65.57	31.46	N	9.57
0.286000	34.57	---	60.64	26.07	N	9.60
0.422000	37.17	---	57.41	20.24	N	9.62
0.850000	29.04	---	56.00	26.96	N	9.64
2.590000	31.03	---	56.00	24.97	N	9.68
4.966000	---	17.44	46.00	28.56	N	9.77
5.070000	31.86	---	60.00	28.14	N	9.77

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
---	---	---	---	---		---

Remark：
Level=Reading Level + Correction Factor
Correction Factor=Cable Loss + LISN Factor
(The Reading Level is recorded by software which is not shown in the sheet)

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9.2 Conducted Peak Output Power & EIRP

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. Use the following test receiver settings:
   Span = approximately 5 times the 20dB bandwidth, centered on a hopping channel
   RBW > the 20dB bandwidth of the emission being measured, VBW≥RBW,
   Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power and record the results in the test report.
5. Repeat above procedures until all frequencies measured were complete.

Limits

According to §15.247 (b) (1) & RSS-247 5.4(b), conducted peak 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

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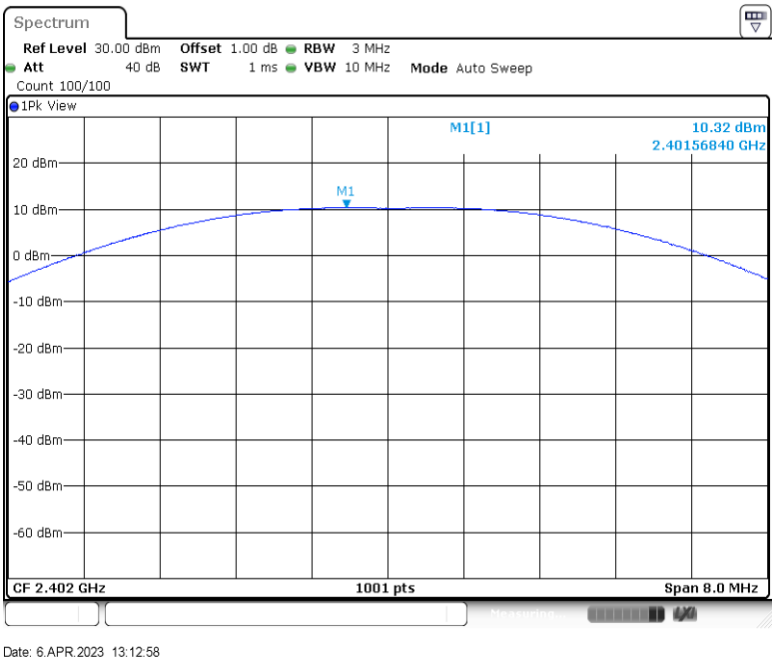
Conducted Peak Output Power & EIRP

FSK modulation Test Result

Frequency MHz	Conducted Output Power dBm	Antenna Gain dBi	EIRP dBm	Result
Low channel 2402MHz	10.32	2.3dBi	12.62	Pass
Middle channel 2438.9MHz	9.96	2.3dBi	12.26	Pass
High channel 2477.3MHz	6.06	2.3dBi	8.36	Pass

Low channel 2402MHz



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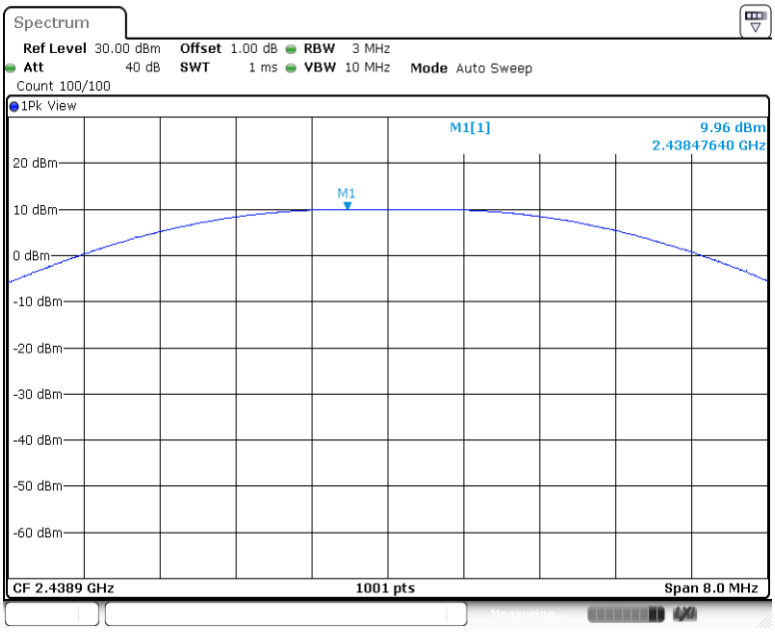
Middle channel 2438.9MHz



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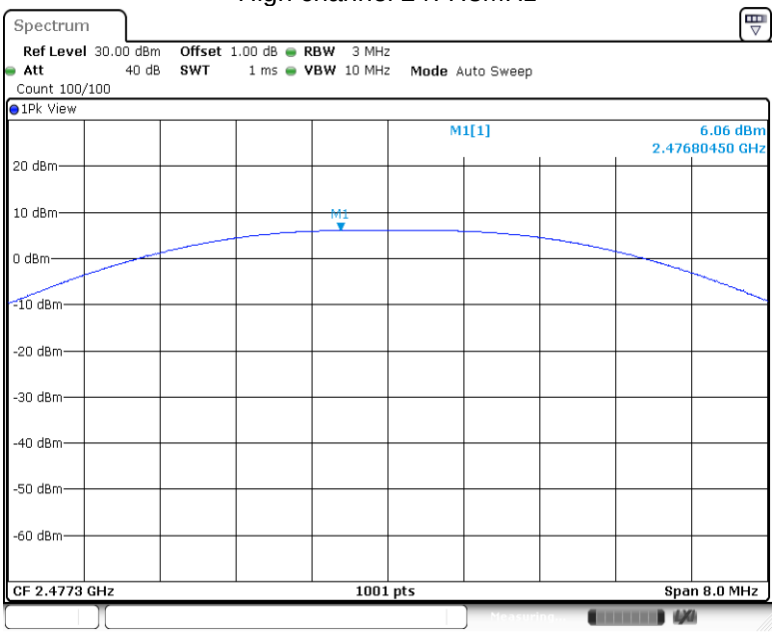
High channel 2477.3MHz



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9.3 20 dB bandwidth and 99% Occupied Bandwidth

Test Method

1. The RF output of EUT was connected to the 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. Use the following test receiver settings:
   Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
   RBW ≥ 1% to 5% of the 20 dB bandwidth/OBW, VBW≥3RBW,
   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/99% OBW from the reference level. Record the frequency difference as the emission bandwidth. Record the results.
5. Repeat above procedures until all frequencies measured were complete.

Limit

Limit [kHz]
N/A

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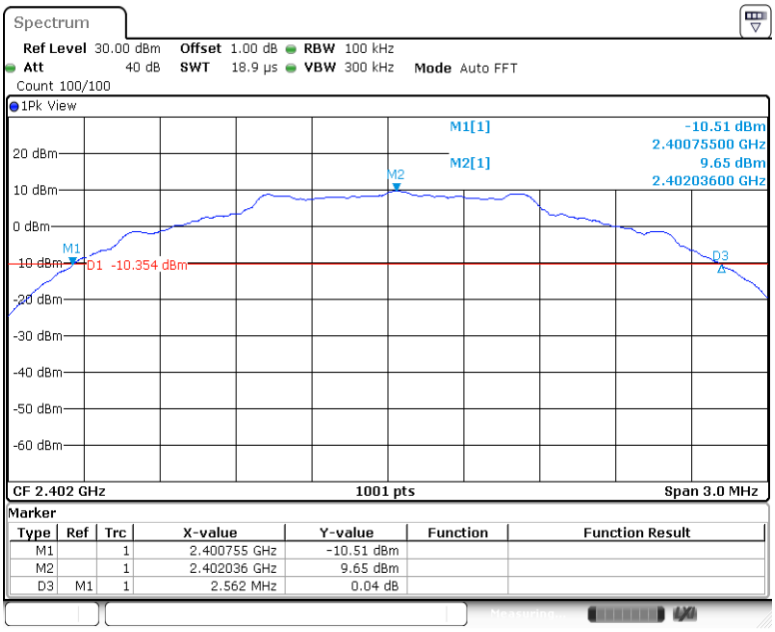
20 dB bandwidth and 99% Occupied Bandwidth

FSK Modulation test result

Frequency MHz	20 dB Bandwidth MHz	99% Bandwidth MHz	Limit MHz	Result
2402.0	2.562	2.152	--	Pass
2438.9	2.562	2.155	--	Pass
2477.3	2.553	2.158	--	Pass

Low channel 2402.0 MHz



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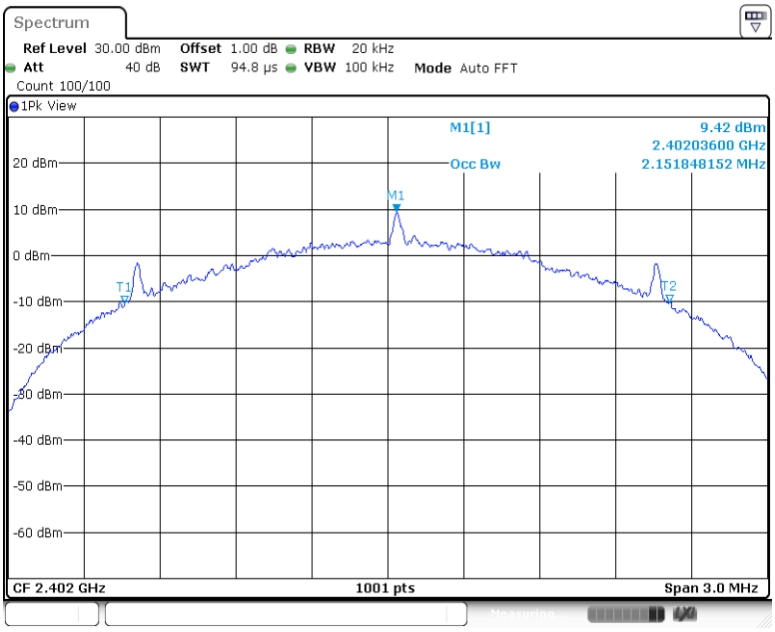

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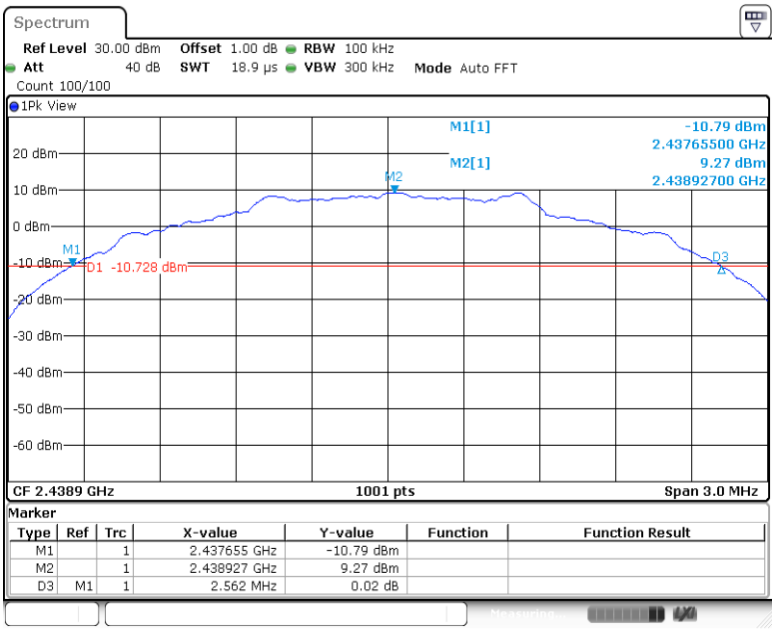
20 dB bandwidth and 99% Occupied Bandwidth

Middle channel 2438.9MHz



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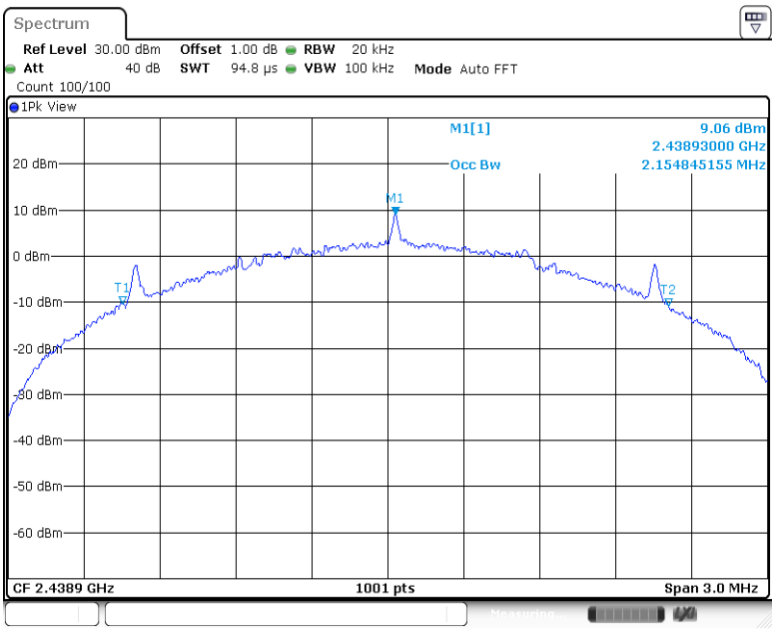

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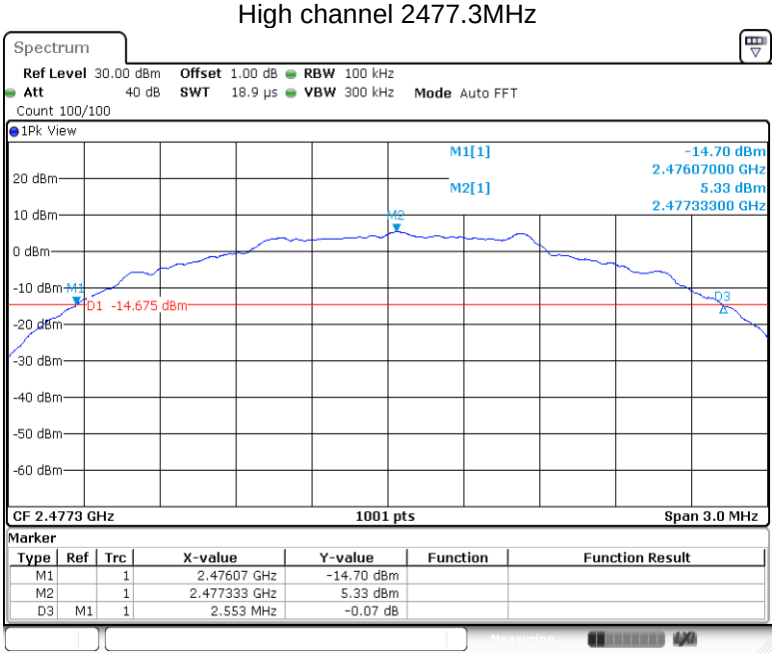
20 dB bandwidth and 99% Occupied Bandwidth

High channel 2477.3MHz



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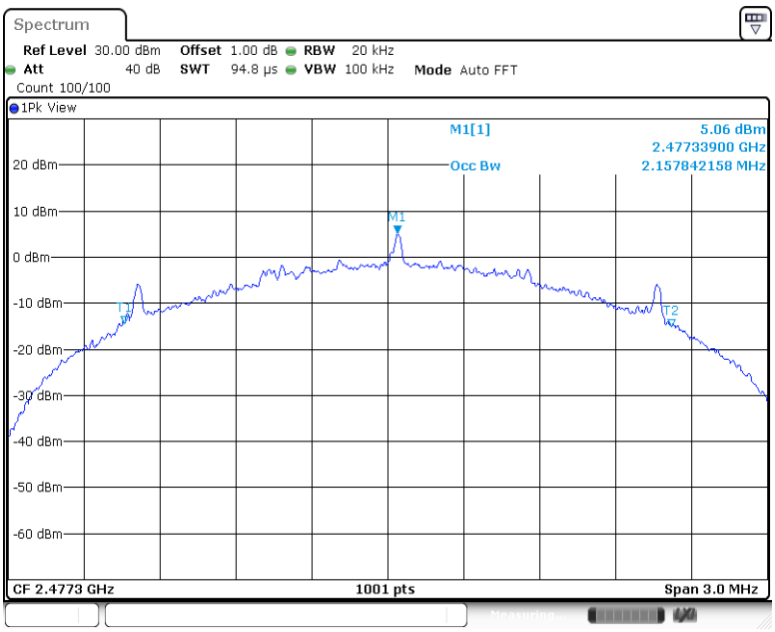

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9.4 Carrier Frequency Separation

Test Method

1. The RF output of EUT was connected to the test receiver by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit to hopping mode.
3. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peaks of two adjacent channels, RBW ≥ 1% of the span, VBW) ≥RBW, Sweep = auto, Detector function = peak
4. By using the Max-Hold function record the separation of two adjacent channels.
5. Measure the frequency difference of these two adjacent channels by spectrum analyzer marker function. Record the results.
6. Repeat above procedures until all frequencies measured were complete.

Limit

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

Frequency MHz	2/3 of 20 dB Bandwidth kHz
FSK	1717

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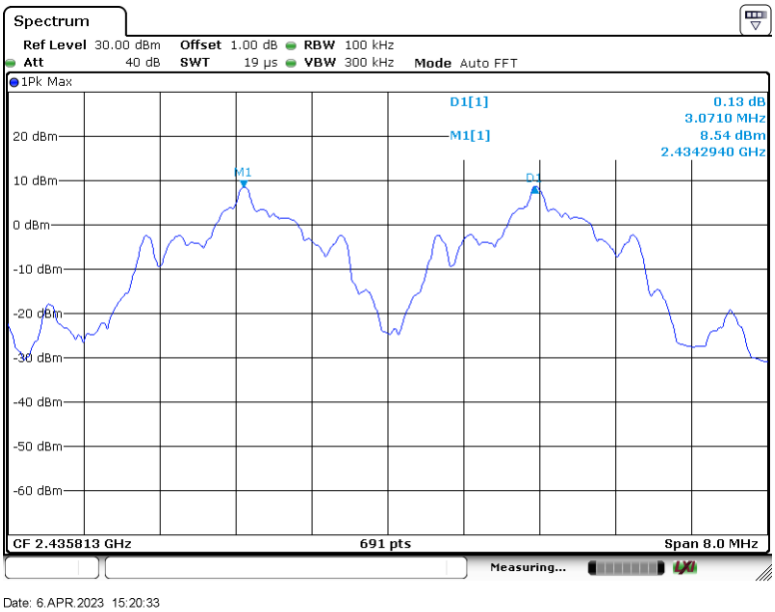
Carrier Frequency Separation

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

FSK Modulation test result

Modulation	Frequency MHz	Carrier Frequency Separation KHz	Result
FSK	Hop	2434	Pass

FSK Mode



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9.5 Number of hopping frequencies

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 to hopping mode.
3. Use the following spectrum analyzer settings:
   Span = the frequency band of operation, RBW ≥ 1% of the span, VBW ≥RBW,
   Sweep = auto, Detector function = peak
4. Set the spectrum analyzer on Trace = max hold
5. Allow the trace to stabilize. It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

Limit

Limit number
⩾ 15

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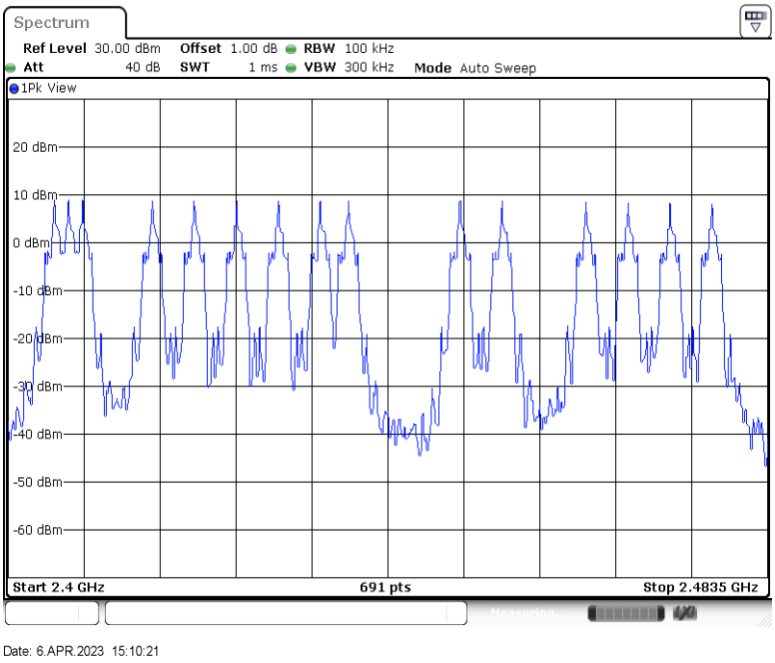
Number of hopping frequencies

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

Number of hopping frequencies	Result
15	Pass

FSK Mode



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9.6 Dwell Time

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 to hopping mode.
3. Span: Zero span, centered on a hopping channel.
4. RBW shall be \ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
5. Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
6. Detector function: Peak.
7. Trace: Max hold. Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Limit

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

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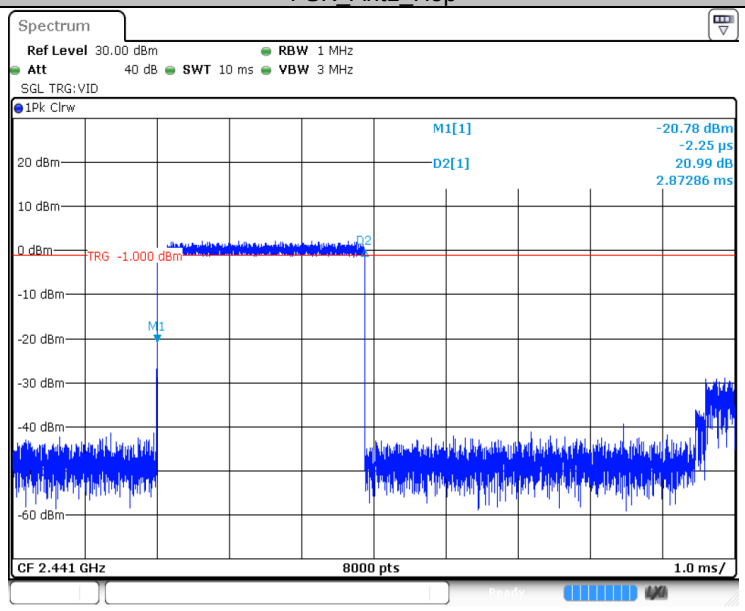
Dwell Time

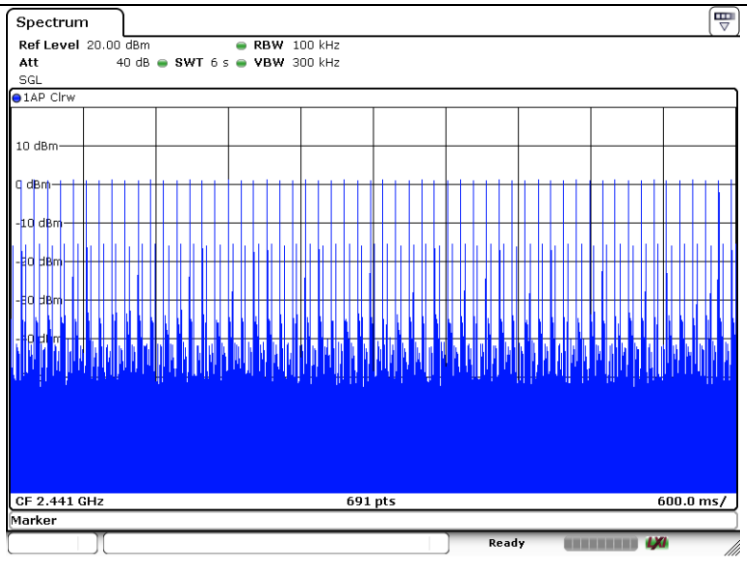
Dwell time

The maximum dwell time shall be 0.4 s.
The Dwell Time = Burst Width * Total Hops. The detailed calculations are showed as follows:
The duration for dwell time calculation: 0.4 [s] * hopping number = 0.4 [s] * 15 [ch] = 6 [s];

Test Result

Modulation	BurstWidth (ms)	Total Hops	Test Result (s)	Limit (s)	Result
FSK	2.87	60	0.172	0.4	Pass
FSK_Ant1_Hop					





Remark: Test Result= BurstWidth* Total Hops=2.87*60=172.2ms=0.172s.

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9.7 Spurious RF conducted emissions

Test Method

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

Limit

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

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Test Result

Test Mode	Antenna	Channel (MHz)	Frequency Range (MHz)	Reference Level	Result (dBm)	Limit (dBm)	Verdict
FSK	Ant1	2402	Reference	9.62	9.62	---	PASS
			30~1000	30~1000	-67.84	<=-10.38	PASS
			1000~26500	1000~26500	-16.1	<=-10.38	PASS
		2438.9	Reference	9.33	9.33	---	PASS
			30~1000	30~1000	-68.61	<=-10.67	PASS
			1000~26500	1000~26500	-52.65	<=-10.67	PASS
		2477.3	Reference	5.30	5.30	---	PASS
			30~1000	30~1000	-68.4	<=-14.7	PASS
			1000~26500	1000~26500	-52.13	<=-14.7	PASS

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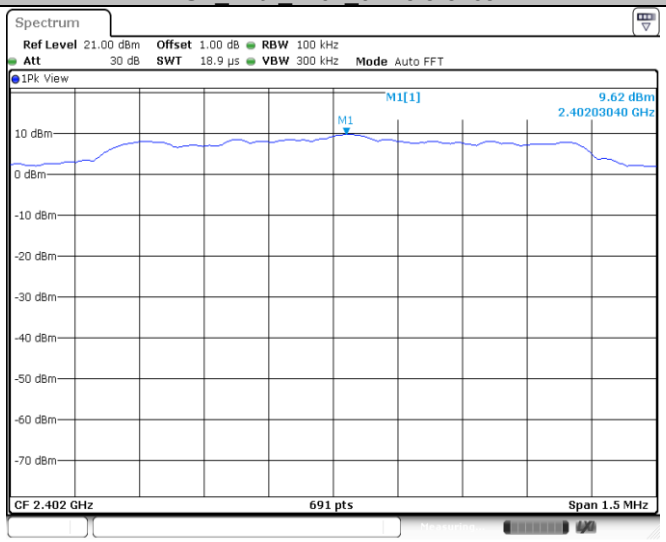
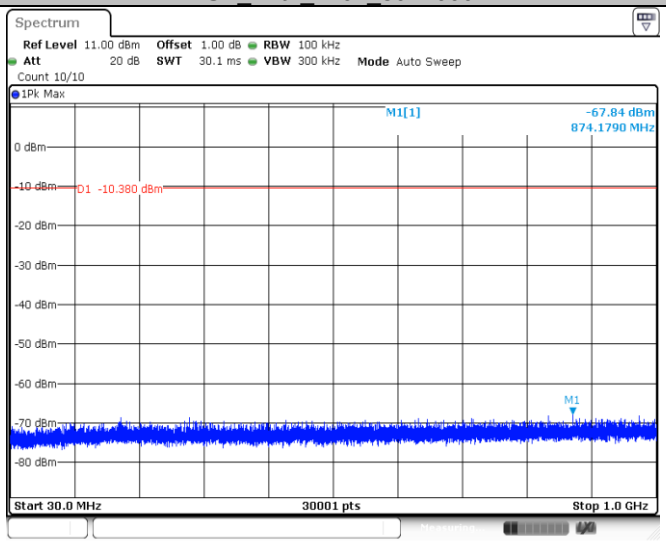
FSK_Ant1_2402_0~Reference



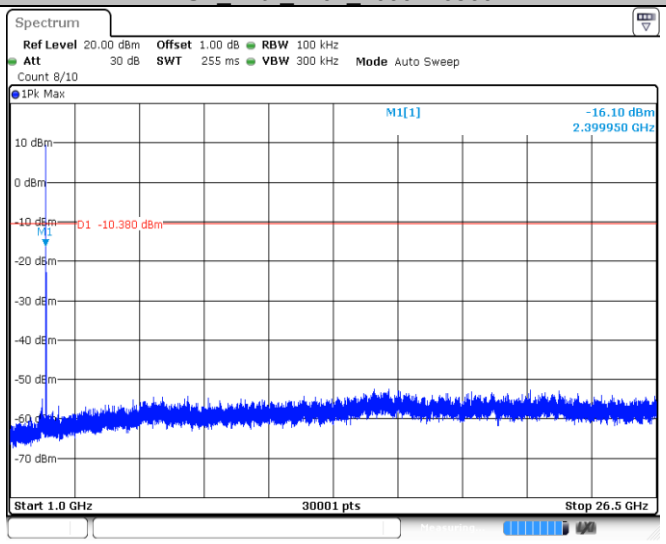
Date: 6.APR.2023 13:13:55

FSK_Ant1_2402_30~1000



Date: 6.APR.2023 13:14:01

FSK_Ant1_2402_1000~26500



Date: 6.APR.2023 13:14:09

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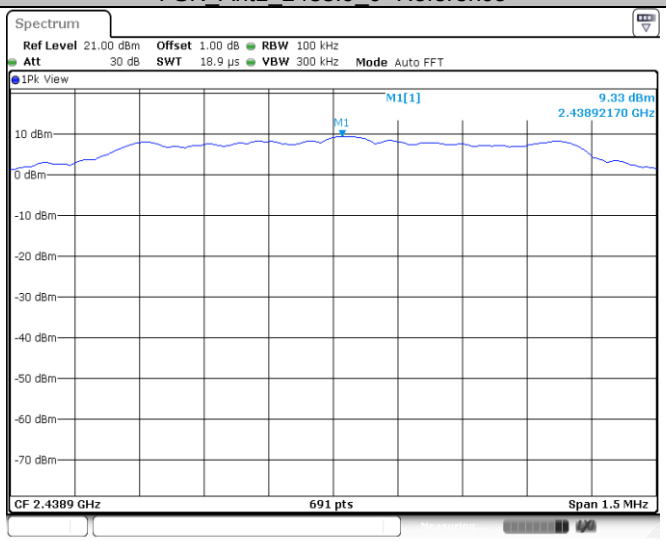
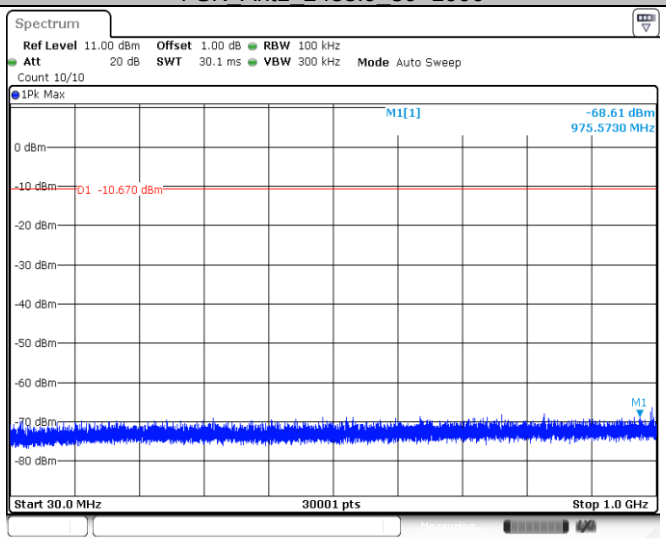
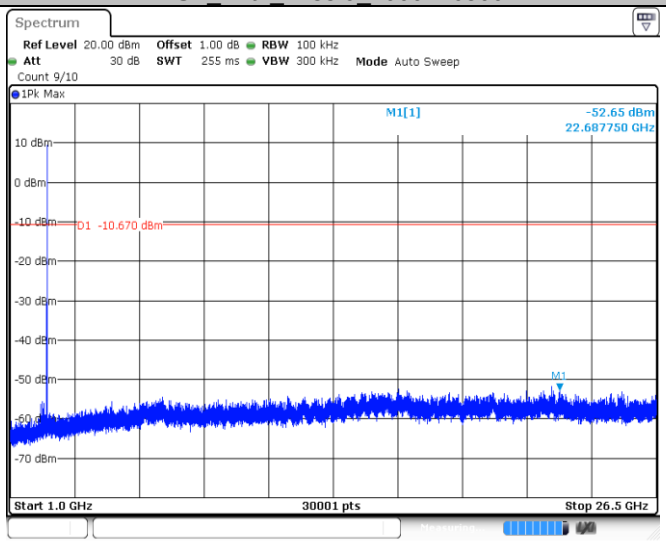
FSK_Ant1_2438.9_0~Reference



FSK_Ant1_2438.9_30~1000



FSK_Ant1_2438.9_1000~26500



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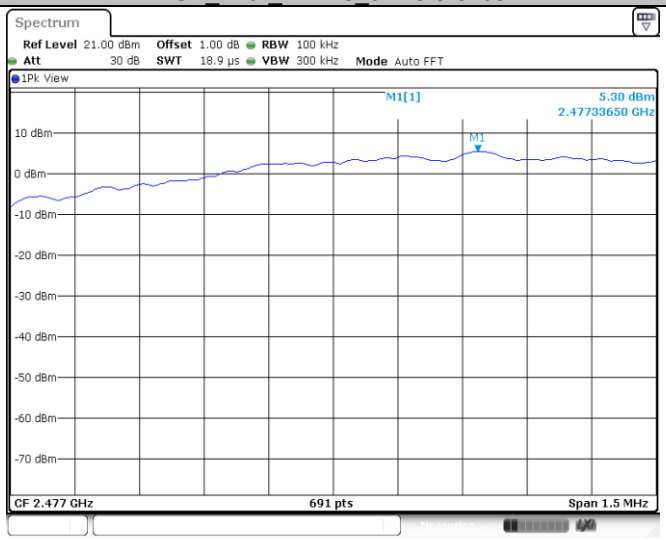
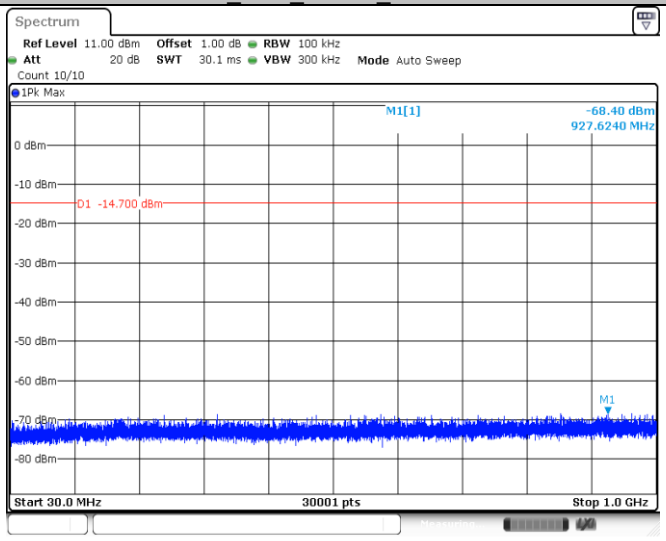
FSK_Ant1_2477.3_0~Reference



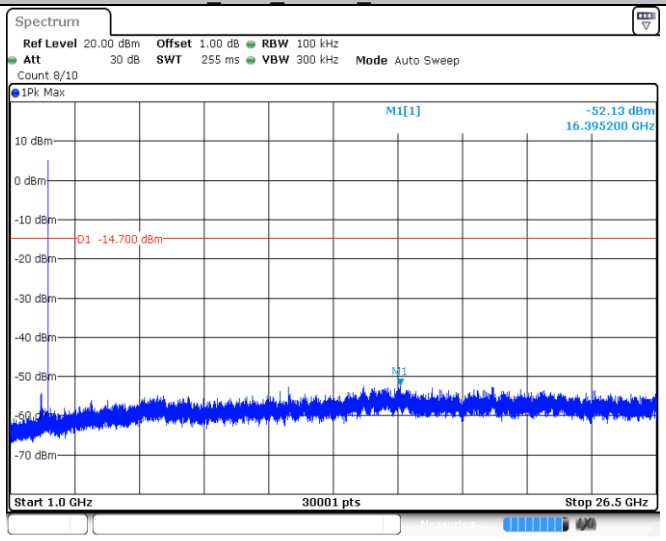
Date: 6.APR.2023 12:56:30

FSK_Ant1_2477.3_30~1000



Date: 6.APR.2023 12:56:36

FSK_Ant1_2477.3_1000~26500



Date: 6.APR.2023 12:56:44

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9.8 Band edge testing

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

Limit:

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

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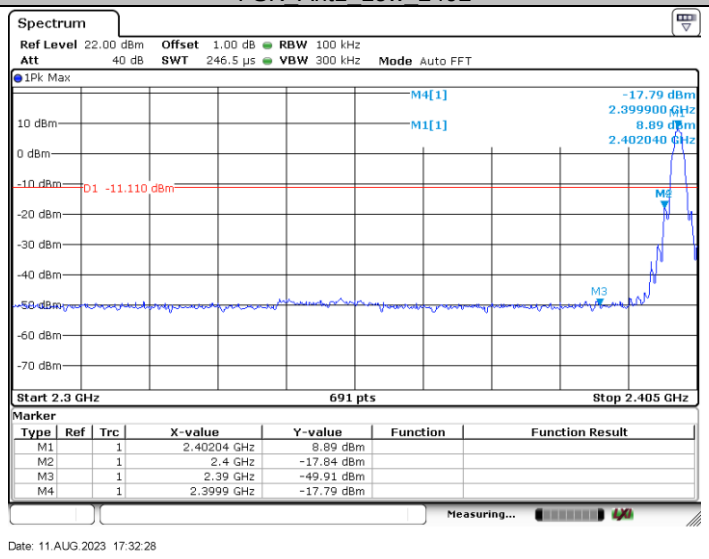
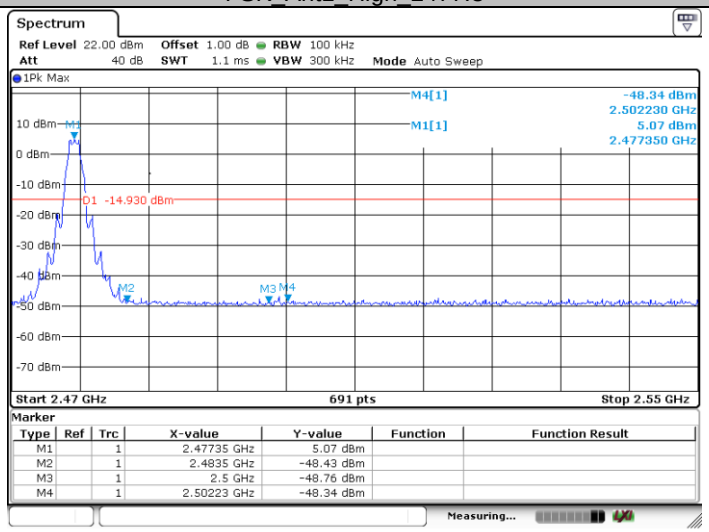
Test Result

Test Mode	Antenna	Channel	Channel (MHz)	Reference Level (dBm)	Result (dBm)	Limit (dBm)	Verdict
FSK	Ant1	Low	2402	8.89	-17.84	<=-11.11	PASS
		High	2477.3	5.07	-48.43	<=-14.93	PASS
		Low	Hop_2402	6.49	-37.58	-13.51	PASS
		High	Hop_2480	9.08	-38.19	-10.92	PASS

FSK_Ant1_Low_2402



FSK_Ant1_High_2477.3



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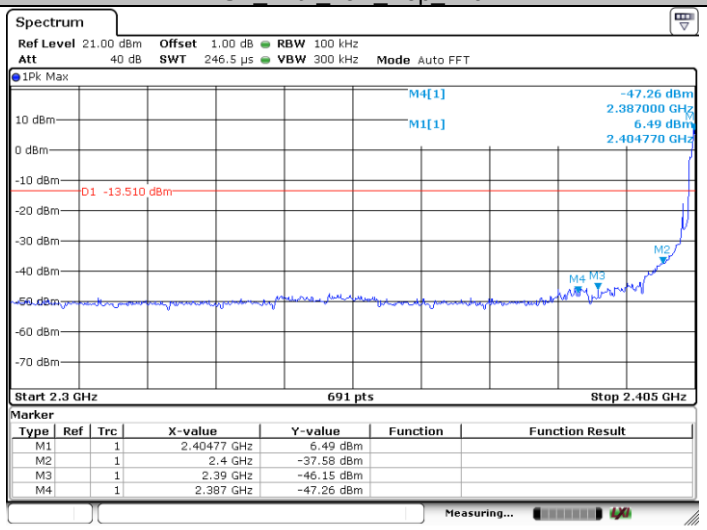
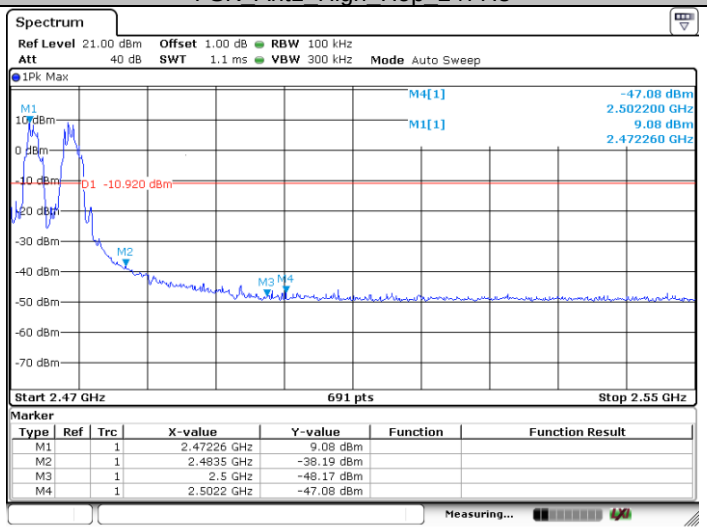
FSK_Ant1_Low_Hop_2402



FSK_Ant1_High_Hop_2477.3



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9.9 Spurious radiated emissions for transmitter

Test Method

1. The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meters chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
4. 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.
5. 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.
6. Use the following test receiver settings According to C63.10:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz to 120KHz for f < 1 GHz; VBW RBW; Sweep = auto; Detector function = QP; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3MHz for f ≥1 GHz for peak measurement.
   For average measurement:
   The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average ((duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor (20log(1/duty cycle)).
   The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.
7. Repeat above procedures until all frequencies measured were complete.

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Spurious Radiated Emissions for Transmitter

Limit

The radio emission outside the operating frequency band shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Radiated emissions which fall in the restricted bands, as defined in section15.205 & RSS-GEN 8.10, must comply with the radiated emission limits specified in section 15.209 & RSS-Gen 6.13.

Frequency MHz	Field Strength µV/m	Field Strength dBµV/m	Detector	Measurement distance meters
0.009-0.490	2400/F(kHz)	48.5-13.8	AV	300
0.490-1.705	24000/F(kHz)	33.8-23.0	QP	30
1.705-30	30	29.5	QP	30
30-88	100	40	QP	3
88-216	150	43.5	QP	3
216-960	200	46	QP	3
960-1000	500	54	QP	3
Above 1000	500	54	AV	3
Above 1000	5000	74	PK	3

Note 1: Limit 3m(dBµV/m)=Limit 300m(dBµV/m)+40Log(300m/3m) (Below 30MHz)
Note 2: Limit 3m(dBµV/m)=Limit 30m(dBµV/m)+40Log(30m/3m) (Below 30MHz)

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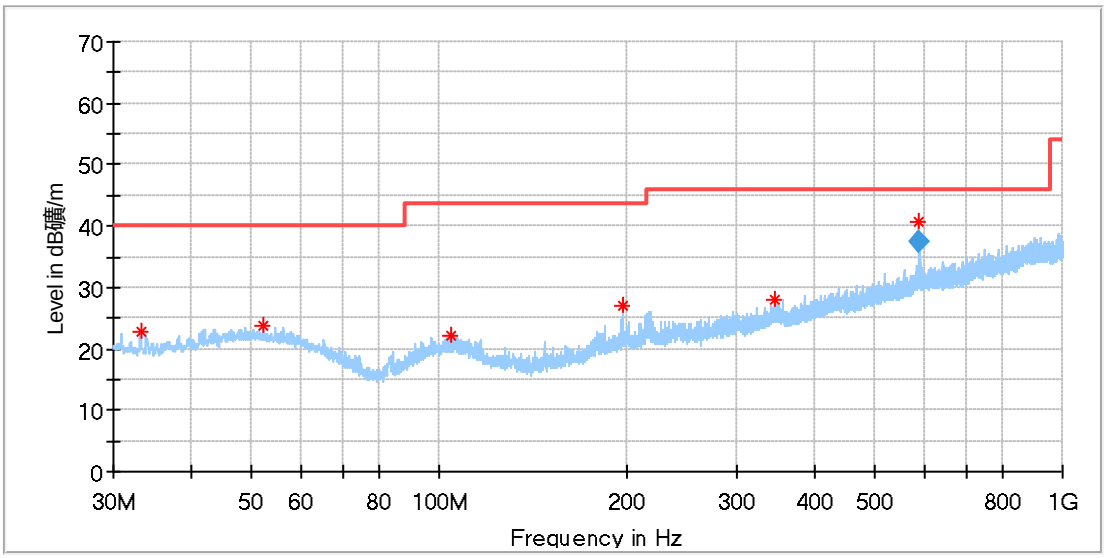
Spurious radiated emissions for transmitter

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

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

30MHz to 1000MHz:



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
33.152500	22.65	40.00	17.35	200.0	H	283.0	17.63
52.067500	23.78	40.00	16.22	200.0	H	119.0	20.67
104.811250	22.20	43.50	21.30	200.0	H	283.0	19.02
196.658125	26.87	43.50	16.63	100.0	H	0.0	19.16
345.674375	28.06	46.00	17.94	200.0	H	41.0	23.16
589.811250	40.78	46.00	5.22	100.0	H	308.0	27.89

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
589.811250	37.50	46.00	8.50	100.0	H	308.0	27.89

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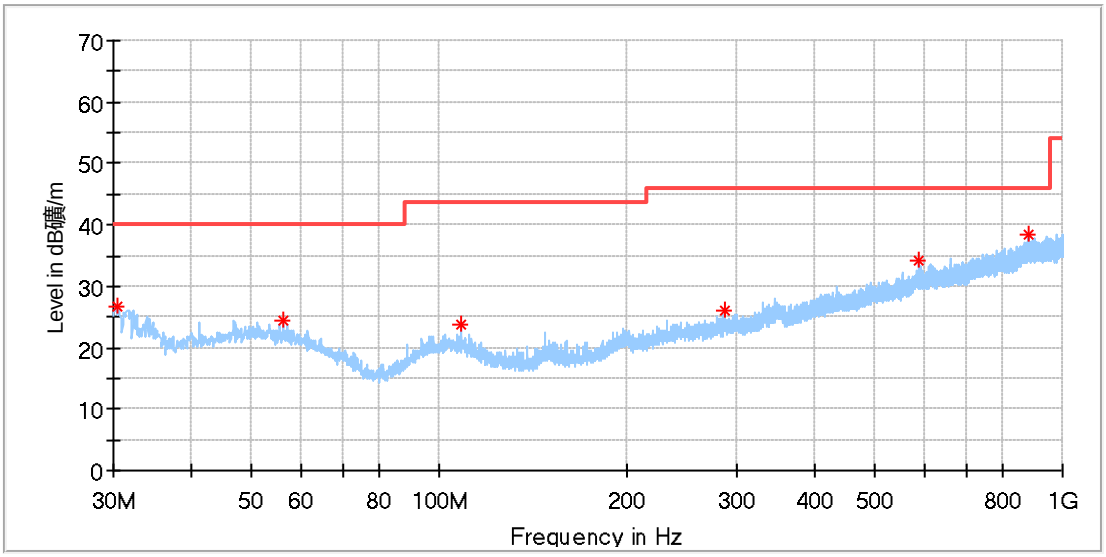

Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.363750	26.69	40.00	13.31	100.0	V	311.0	18.05
56.190000	24.50	40.00	15.50	200.0	V	0.0	20.38
108.509375	23.61	43.50	19.89	100.0	V	177.0	18.68
286.807500	25.93	46.00	20.07	200.0	V	0.0	21.07
589.811250	34.08	46.00	11.92	200.0	V	213.0	27.89
884.812500	38.54	46.00	7.46	200.0	V	0.0	31.80

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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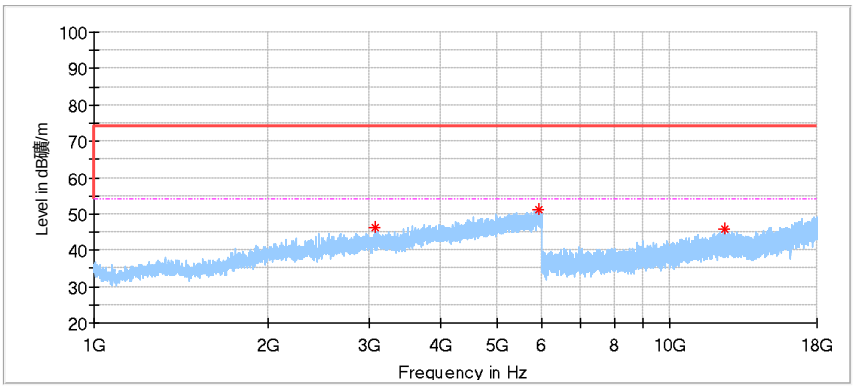
1GHz -18GHz:

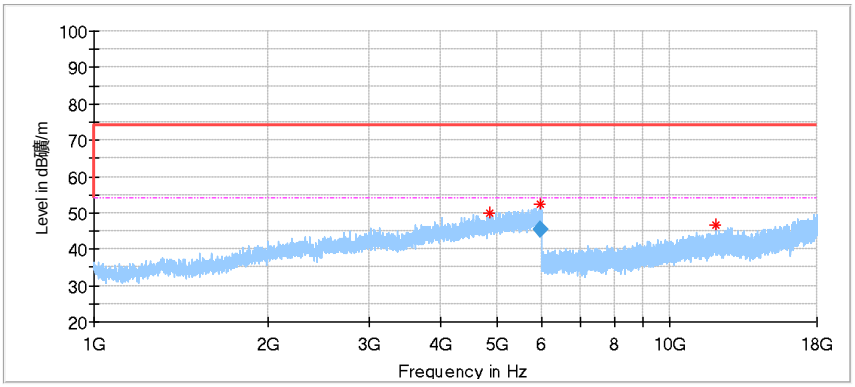
FSK _2402MHz

Horizontal:



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3072.000000	46.19	74.00	27.81	150.0	H	336.0	0.68
5930.000000	51.28	74.00	22.72	150.0	H	142.0	8.73
12441.500000	45.96	74.00	28.04	150.0	H	290.0	16.02

Vertical



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4876.000000	50.05	74.00	23.95	150.0	V	151.0	5.99
5958.000000	52.26	74.00	21.74	150.0	V	17.0	8.77
11996.000000	46.81	74.00	27.19	150.0	V	294.0	16.28
Frequency	**Average**	**Limit**	**Margin**	**Height**	**Pol**	**Azimuth**	**Corr.**
5958.000000	45.32	54.00	8.68	150.0	V	17.0	8.77

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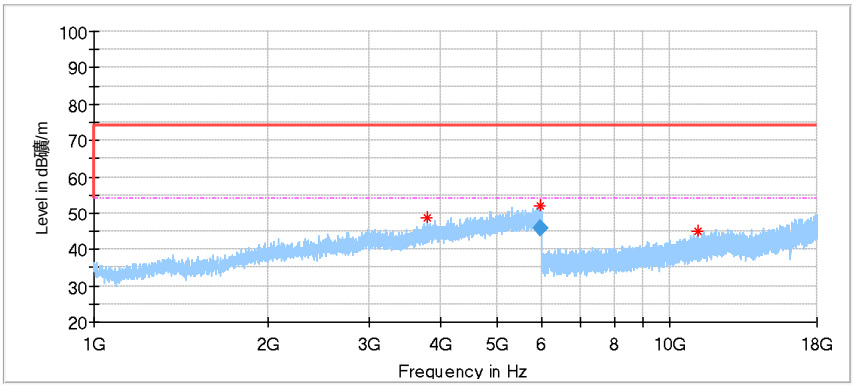
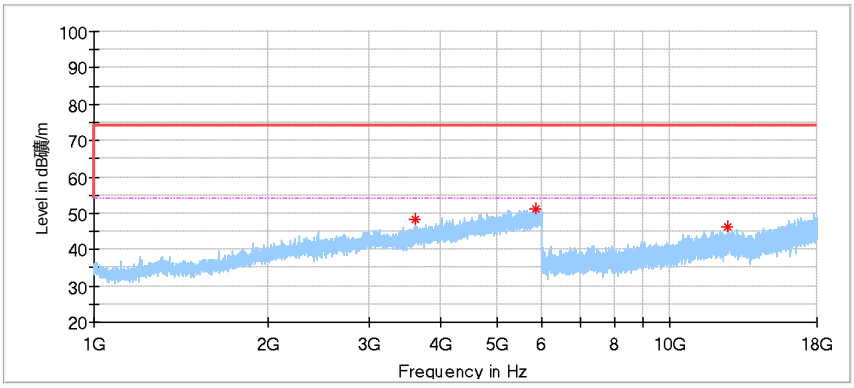
FSK _2438.9MHz
Horizontal:



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3792.000000	48.65	74.00	25.35	150.0	H	217.0	2.96
5937.500000	52.04	74.00	21.96	150.0	H	0.0	8.73
11160.000000	44.97	74.00	29.03	150.0	H	112.0	14.56
Frequency	**Average**	**Limit**	**Margin**	**Height**	**Pol**	**Azimuth**	**Corr.**
5937.500000	45.80	54.00	8.20	150.0	H	0.0	8.73

Vertical



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3604.500000	48.14	74.00	25.86	150.0	V	144.0	2.32
5857.500000	51.13	74.00	22.87	150.0	V	225.0	8.59
12634.500000	46.06	74.00	27.94	150.0	V	215.0	16.46

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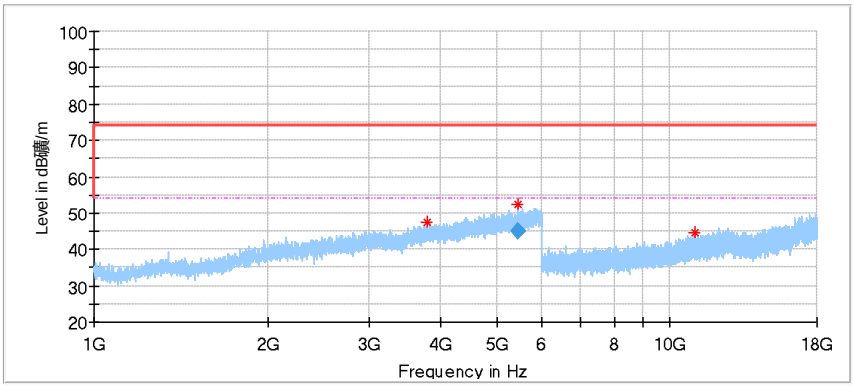
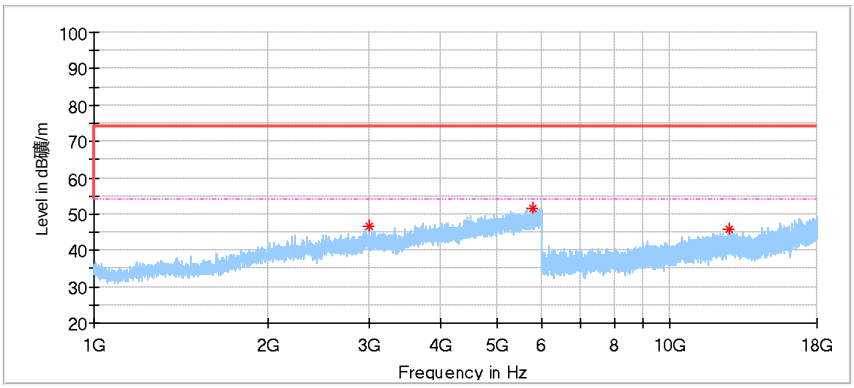
FSK _2477.3MHz
Horizontal:



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3788.500000	47.62	74.00	26.38	150.0	H	68.0	2.96
5456.500000	52.39	74.00	21.61	150.0	H	42.0	7.91
11033.000000	44.78	74.00	29.22	150.0	H	27.0	14.23

Vertical



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2997.500000	46.64	74.00	27.36	150.0	V	84.0	0.53
5790.000000	51.62	74.00	22.38	150.0	V	312.0	8.32
12685.000000	45.65	74.00	28.35	150.0	V	154.0	16.34

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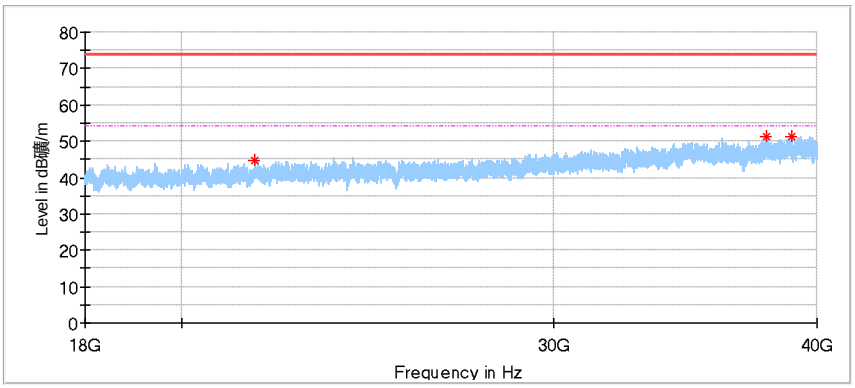
Above 18GHz:

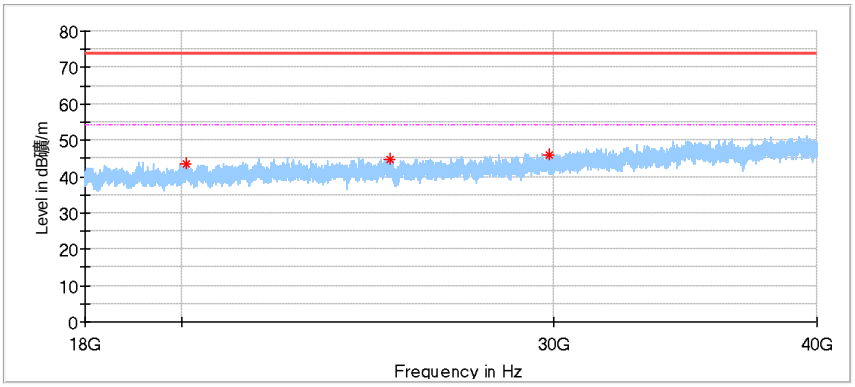
FSK_2402MHz

Horizontal:



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
21665.062500	44.59	74.00	29.41	150.0	H	142.0	1.6
37839.875000	51.47	74.00	22.53	150.0	H	356.0	8.7
38893.125000	51.18	74.00	22.82	150.0	H	188.0	9.8

Vertical



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
20095.500000	43.66	74.00	30.34	150.0	V	82.0	-0.1
25094.312500	44.89	74.00	29.11	150.0	V	355.0	3.5
29844.250000	46.10	74.00	27.90	150.0	V	17.0	3.7

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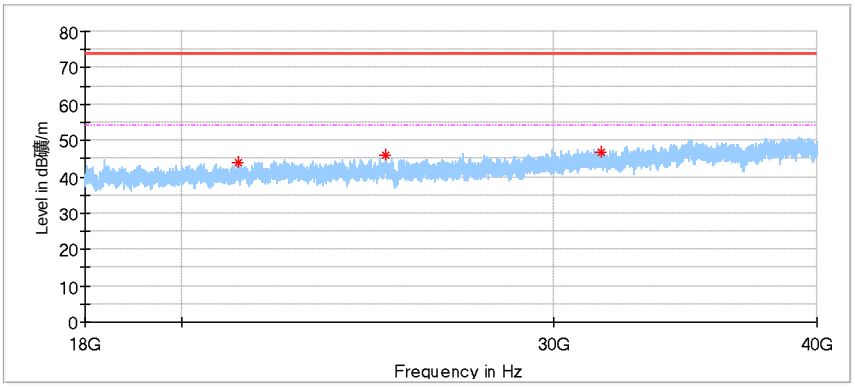
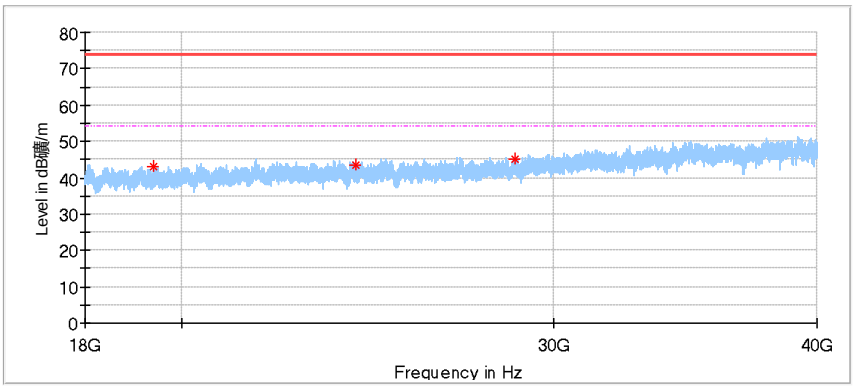
FSK_2438.9MHz
Horizontal:



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
21267.687500	43.70	74.00	30.30	150.0	H	15.0	1.3
24984.312500	46.00	74.00	28.00	150.0	H	75.0	3.7
31596.000000	46.63	74.00	27.37	150.0	H	295.0	4.4

Vertical



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19409.375000	43.06	74.00	30.95	150.0	V	285.0	-0.9
24177.875000	43.59	74.00	30.41	150.0	V	178.0	2.5
28784.125000	45.06	74.00	28.94	150.0	V	15.0	3.8

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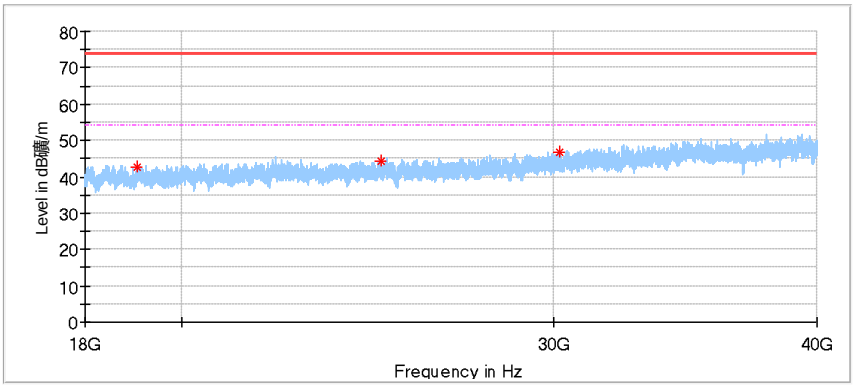
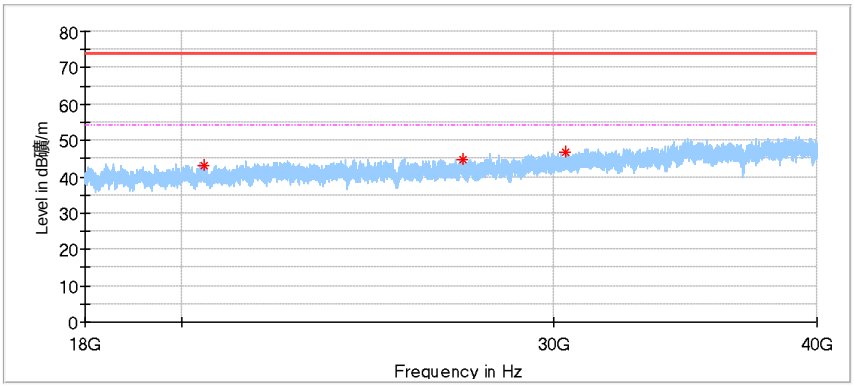
FSK_2477.3MHz
Horizontal:



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19066.312500	42.75	74.00	31.25	150.0	H	254.0	-0.8
24846.125000	44.38	74.00	29.62	150.0	H	15.0	3.5
30232.000000	46.76	74.00	27.24	150.0	H	359.0	3.8

Vertical



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
20501.125000	43.09	74.00	30.91	150.0	V	109.0	0.3
27163.687500	44.85	74.00	29.15	150.0	V	216.0	3.9
30422.437500	46.70	74.00	27.30	150.0	V	1.0	3.9

Remark:

(1) Data of measurement within frequency range 9kHz-30MHz are the noise floor or attenuated more than 20dB below the permissible limits or the field strength is too small to be measured, so test data does not present in this report.
(2) Data of measurement within this frequency range shown “--” in the table above means the reading of emissions are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.
(3) Level= Reading Level + Correction Factor
(4) Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
(The Reading Level is recorded by software which is not shown in the sheet)

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10 Test Equipment List

Radiated Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	68-4-74-14-002	101269	1	2023-5-28
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9162	68-4-80-19-003	284	1	2023-7-12
Loop Antenna	Rohde & Schwarz	HFH2-Z2	68-4-80-14-006	100398	1	2023-8-17
Wave Guide Antenna	ETS	3117	68-4-80-19-001	00218954	1	2023-5-9
Pre-amplifier	Rohde & Schwarz	SCU 18F	68-4-29-19-001	100745	1	2023-5-28
Pre-amplifier	Rohde & Schwarz	SCU 18F	68-4-29-19-002	100746	1	2023-5-28
Sideband Horn Antenna	Q-PAR	QWH-SL-18-40-K-SG	68-4-80-14-008	12827	1	2023-7-12
Pre-amplifier	Rohde & Schwarz	SCU 40A	68-4-29-14-002	100432	1	2023-7-27
Attenuator	Mini-circuits	UNAT-6+	68-4-81-21-002	15542	1	2023-5-27
3m Semi-anechoic chamber	TDK	SAC-3 #2	68-4-90-19-006	----	2	2023-5-28
Test software	Rohde & Schwarz	EMC32	68-4-90-19-006-A01	Version10.35.02	N/A	N/A

Conducted Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 3	68-4-74-19-002	102590	1	2023-5-27
LISN	Rohde & Schwarz	ENV216	68-4-87-19-001	102472	1	2023-5-27
Attenuator	Shanghai Huaxiang	TS2-26-3	68-4-81-16-003	080928189	1	2023-5-27
Test software	Rohde & Schwarz	EMC32	68-4-90-19-005-A01	Version10.35.02	N/A	N/A
Shielding Room	TDK	CSR #2	68-4-90-19-005	----	3	2025-10-15

Conducted RF Test System

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
Signal Analyzer	Rohde & Schwarz	FSV40	68-4-74-14-004	101030	1	2023-5-27
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	68-4-93-14-003	101226/100851	1	2023-5-27
Power Splitter	Weinschel	1580	68-4-85-14-001	SC319	1	2023-5-28
10dB Attenuator	Weinschel	4M-10	68-4-81-14-003	43152	1	2023-5-28
10dB Attenuator	R&S	DNF	68-4-81-14-004	DNF-001	1	2023-5-27
10dB Attenuator	R&S	DNF	68-4-81-14-005	DNF-002	1	2023-5-27
10dB Attenuator	R&S	DNF	68-4-81-14-006	DNF-003	1	2023-5-27
10dB Attenuator	R&S	DNF	68-4-81-14-007	DNF-004	1	2023-5-27
Test software	Tonscend	System for BT/WIFI	68-4-74-14-006-A13	Version 2.6.77.0518	N/A	N/A
Shielding Room	TDK	TS8997	68-4-90-19-003	----	3	2025-10-15

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11 System Measurement Uncertainty

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

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Conducted Emission 150kHz-30MHz (for test using AMN ENV432 or ENV4200)	3.15dB
Uncertainty for Radiated Emission in 3m chamber 9kHz-30MHz	4.70dB
Uncertainty for Radiated Spurious Emission 25MHz-3000MHz	Horizontal: 4.64dB; Vertical: 4.79dB;
Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz	Horizontal: 5.08dB; Vertical: 5.09dB;
Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 4.52dB; Vertical: 4.51dB;
Uncertainty for Conducted RF test with TS 8997	RF Power Conducted: 1.31dB Frequency test involved: 0.6×10-8 or 1%

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2021, clause 4.4.3 and 4.5.1.

---The End---

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