FCC / ISED – TEST REPORT

Report Number	:	**60.790.23.023.01R01**	Date of Issue: **September 12, 2023**
Model/HVIN	:	**AURORA V2.2**	
Product Type	:	Retail IoT Sensor	
Applicant	:	RetailNext Inc.	
Address	:	60 S Market St, 3rd Floor, Suite 310, San Jose, California 95113, United States	
Manufacturer	:	Altek Coroporation	
Address	:	No.12, Lixing Road, East District, Hsinchu City, Taiwan	
Test Result	:	**n Positive** o Negative	
Total pages including Appendices	:	**49**	

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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 518052 P.R. China
Telephone:	86 755 8828 6998
Fax:	86 755 8828 5299
FCC Registration No.:	514049
FCC Deignation No.:	CN5009
IC Registration No.:	10320A
ISED CAB Identifier:	CN0077

3 Description of the Equipment Under Test

Product:	Retail IoT Sensor
Model no.:	AURORA V2.2
Hardware Version Identification No. (HVIN)	AURORA V2.2
Product Marketing Name (PMN)	AURORA V2.2
Brand name:	RetailNext
FCC ID:	2AFSV-AURORA-V2-2
IC:	30959-AURORAV22
Rating:	36 – 57 VDC, 15.4W (POE802.3af)
RF Transmission Frequency:	2402MHz-2480MHz
No. of Operated Channel:	40
Modulation:	GFSK
Antenna Type:	FPC PIFA
Antenna	Gain: 4.06 dBi max (2.4GHz)
Description of the EUT:	The Equipment Under Test (EUT) is a Retail IoT Sensor which support Bluetooth function and Wi-Fi operated at 5GHz and 2.4GHz. Only Bluetooth Low Energy included in this report.

NOTE:

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

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4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2021 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators
RSS-Gen Issue 5 April 2018 + Amendment 1 March 2019 + Amendment 2 February 2021	General Requirements for Compliance of Radio Apparatus
RSS-247 Issue 3 August 2023	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 C63.10-2020.

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5 Summary of Test Results

Technical Requirements						
FCC Part 15 Subpart C/ RSS-247 Issue 3 / RSS-Gen Issue 5 + A1 + A2						
Test Condition		Test Site	Test Result			Test Environment
			Pass	Fail	N/A	
§15.207 & RSS-GEN 8.8	Conducted emission AC power port	Site 1	☒	☐	☐	T: 24.8℃ H: 53.7%
§15.247 (b) (3) & RSS-247 5.4(d)	Conducted peak output power	Site 1	☒	☐	☐	T: 24.8℃ H: 53.7%
RSS-247 5.4(d)	Equivalent Isotropic Radiated Power	Site 1	☒	☐	☐	T: 24.8℃ H: 53.7%
§15.247(a)(2) & RSS-247 5.2(a) & RSS-GEN 6.7	6dB bandwidth and 99% Occupied Bandwidth	Site 1	☒	☐	☐	T: 24.8℃ H: 53.7%
§15.247(e) & RSS-247 5.2(b)	Power spectral density	Site 1	☒	☐	☐	T: 24.8℃ H: 53.7%
§15.247(d) & RSS-247 5.5	Spurious RF conducted emissions	Site 1	☒	☐	☐	T: 24.8℃ H: 53.7%
§15.247(d) & RSS-247 5.5	Band edge	Site 1	☒	☐	☐	T: 24.8℃ H: 53.7%
§15.247(d) & §15.209 & §15.205 & RSS-247 5.5 & RSS-Gen 6.13	Spurious radiated emissions for transmitter	Site 1	☒	☐	☐	T: 24.7℃ H: 49.3%
§15.203 & RSS-Gen 6.8	Antenna requirement	See note 2	☒	☐	☐	--

Note 1: N/A=Not Applicable.
Note 2: The EUT uses a FPC PIFA antenna, which gain is 4.06 dBi. In accordance to §15.203 & RSS-Gen 6.8, it is considered sufficiently to comply with the provisions of this section.
Note 3: T :Temperature, H: Humidity

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6 General Remarks

Remarks

This submittal(s) (test report) is intended for **FCC ID: 2AFSV-AURORA-V2-2**, **IC: 30959-AURORAV22**, complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C rules and RSS-247, RSS-GEN.

SUMMARY:

All tests according to the regulations cited on page 5 were

n - Performed

o - **Not** Performed

The Equipment under Test

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

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

Sample Received Date:	July 10, 2023
Testing Start Date:	July 11, 2023
Testing End Date:	August 29, 2023

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

Reviewed by:	Prepared by:	Tested by:
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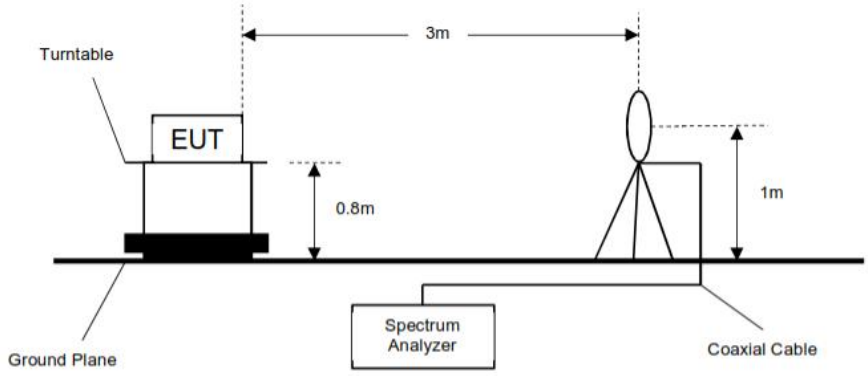
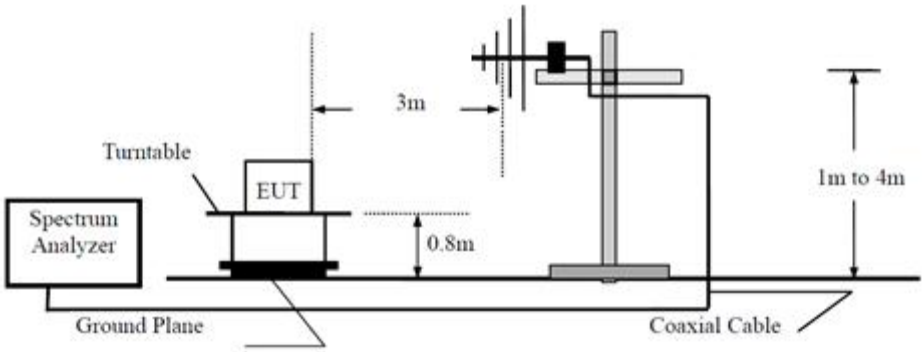
7 Test Setups

7.1 Radiated test setups

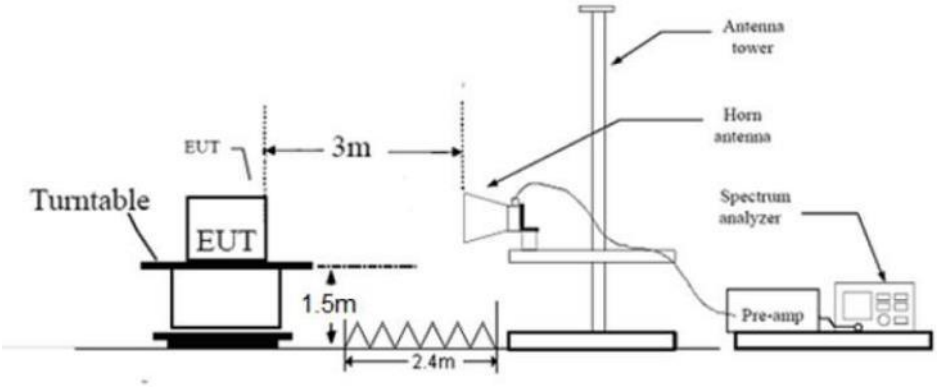
9kHz - 30MHz



30MHz - 1GHz



Above 1GHz



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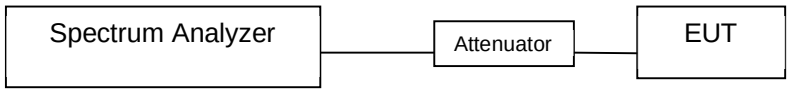
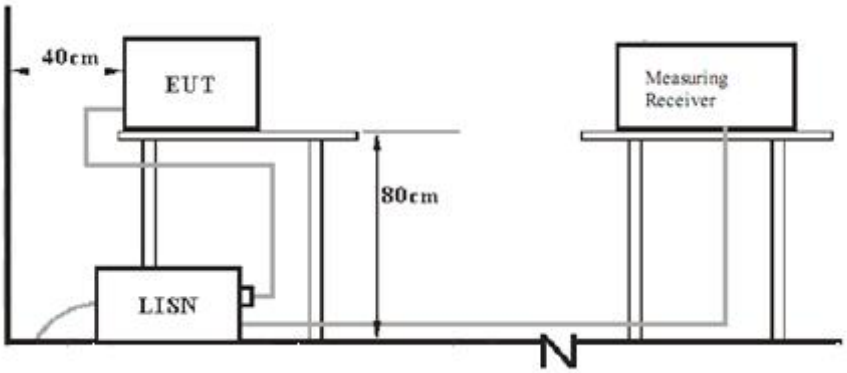
7.2 Conducted RF test setup



7.3 AC Power Line Conducted Emission test setups



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8 Systems Test Configuration

Auxiliary Equipment Used during Test:

Description	Manufacturer	Model NO.	Remark
Laptop	Thinkpad	T460S	---
Router	D-Link corporation	DIR-605L	---
AC/DC Adaptor	TP-Link Corporation Ltd	T480050-2D1	Input: 100-240 VAC 0.8A Output: 48 VDC 0.5A, 24.0W
POE Injector	TP-Link Corporation Ltd	TL-POE150S	Input: 48 VDC, 0.5A Output: 48 VDC 0.35A

Cables Used During Test:

Cable	Length	Shielded/unshielded	With / without ferrite
Connection Cable	1.0m	Shielded	Without ferrite

The system was configured to non-hopping mode, testing channel 0, 19, 39.

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

The transmitter rate 1Mbps and 2Mbps mode are tested, only the worst case transmitter rate data mode is recorded in the report.

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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

According to §15.207 & RSS-GEN 8.8, conducted emissions limit as below:

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

*Decreasing linearly with logarithm of the frequency

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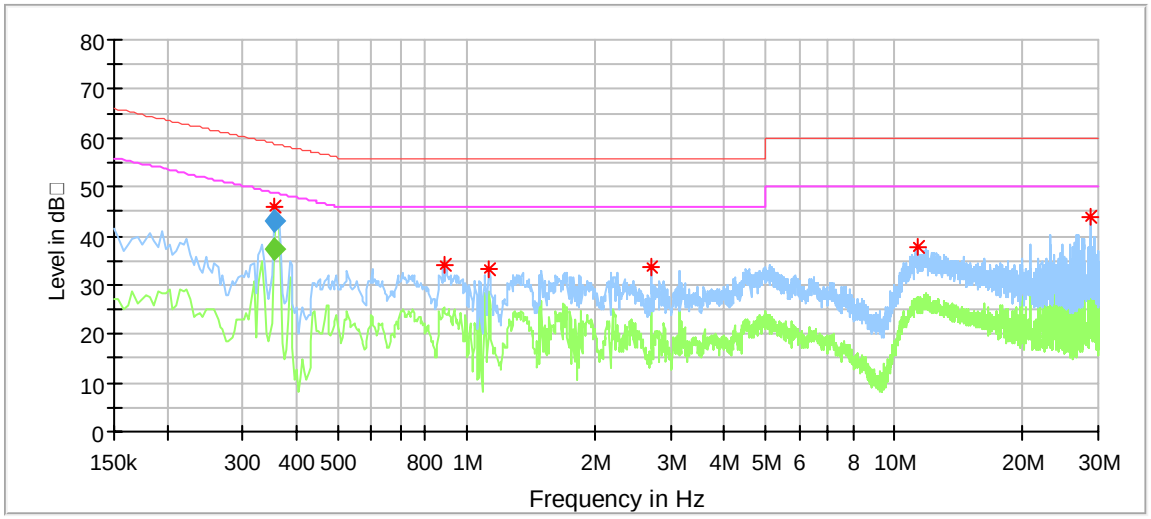
Conducted Emission

Product Type	:	Retail IoT Sensor
M/N	:	AURORA V2.2
Operating Condition	:	Normal Working
Test Specification	:	Line
Comment	:	AC 120V/60Hz



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.357500	45.78	---	58.68	12.90	L1	9.61
0.886000	34.16	---	56.00	21.84	L1	9.64
1.134000	33.30	---	56.00	22.70	L1	9.64
2.702000	33.52	---	56.00	22.48	L1	9.68
11.338000	37.57	---	60.00	22.43	L1	9.93
28.806000	44.06	---	60.00	15.94	L1	10.03

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.357500	43.12	---	58.79	15.67	L1	9.61
0.357500	---	37.48	48.79	11.31	L1	9.61

Remark:
Max Peak= Read level + Corrector factor
Correct factor=cable loss + LISN factor
(The Reading Level is recorded by software which is not shown in the sheet)

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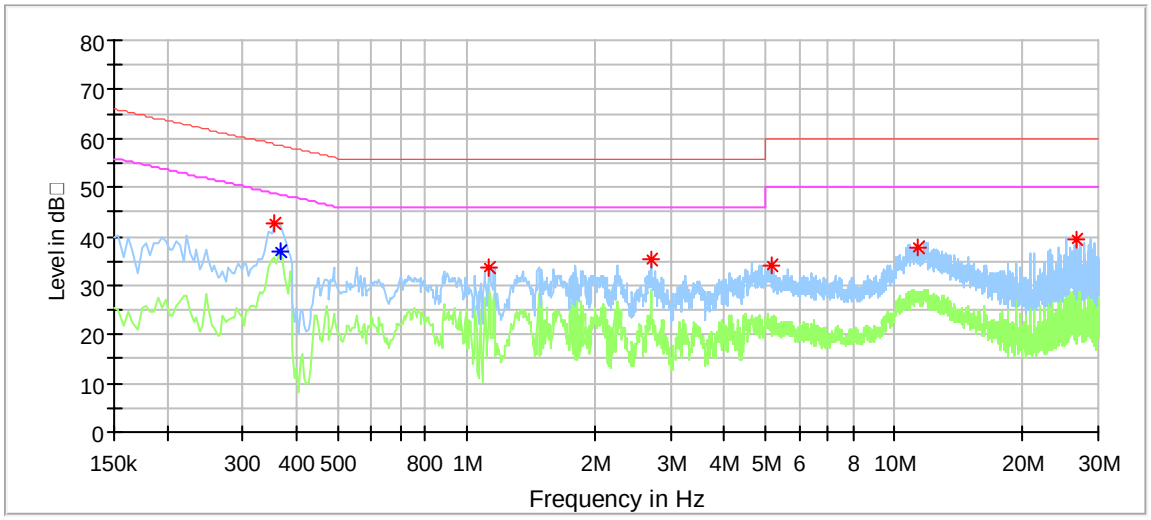
Conducted Emission

Product Type	:	Retail IoT Sensor
M/N	:	AURORA V2.2
Operating Condition	:	Normal Working
Test Specification	:	Neutral
Comment	:	AC 120V/60Hz



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.354000	42.68	---	58.87	16.19	N	9.61
0.366000	---	36.94	48.59	11.65	N	9.61
1.134000	33.48	---	56.00	22.53	N	9.64
2.698000	35.12	---	56.00	20.88	N	9.68
5.194000	34.06	---	60.00	25.94	N	9.78
11.306000	37.89	---	60.00	22.11	N	9.93
26.610000	39.57	---	60.00	20.43	N	10.08

Remark:
Max Peak= Read level + Corrector factor
Correct 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 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 6dB bandwidth, centered on a channel need to test.
   RBW > the 6dB bandwidth of the emission being measured, 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. 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) (3) & RSS-247 5.4(d), 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(d), 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

Frequency MHz	Mode	Conducted Peak Output Power dBm	Antenna Gain dBi	EIRP dBm	Result
Bottom channel 2402MHz	LE 1M	1.97	4.06	6.06	Pass
Middle channel 2440MHz	LE 1M	3.58	4.06	7.64	Pass
Top channel 2480MHz	LE 1M	4.04	4.06	8.10	Pass
Bottom channel 2402MHz	LE 2M	2.11	4.06	6.16	Pass
Middle channel 2440MHz	LE 2M	3.73	4.06	7.79	Pass
Top channel 2480MHz	LE 2M	4.14	4.06	8.20	Pass

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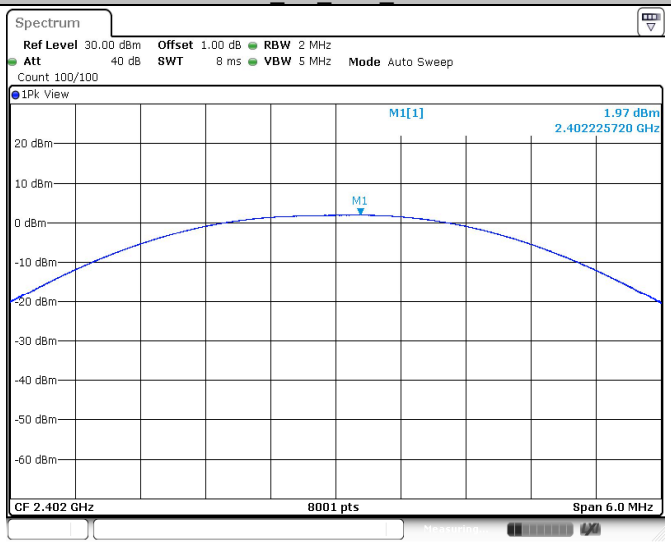
BLE_1M_Ant1_2402



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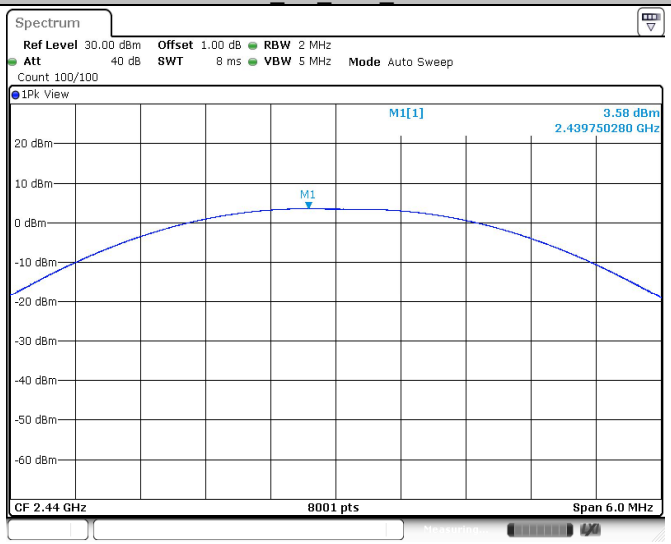

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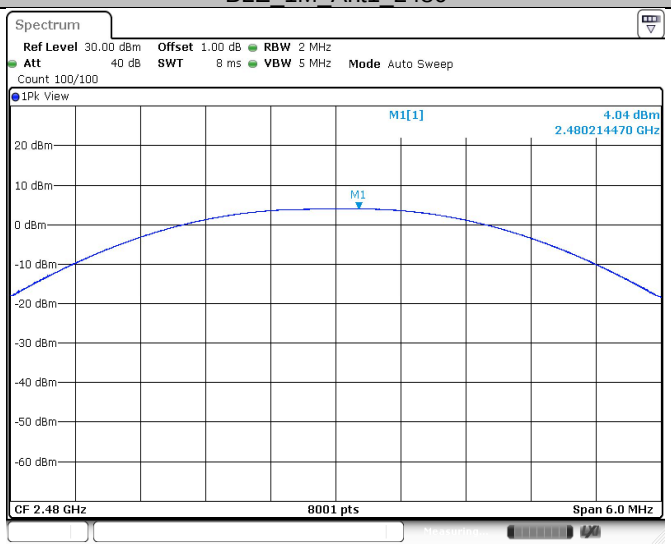

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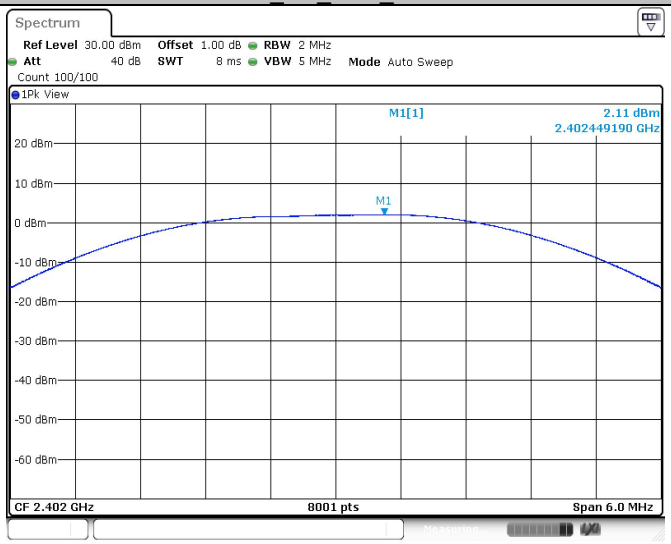
BLE_2M_Ant1_2402



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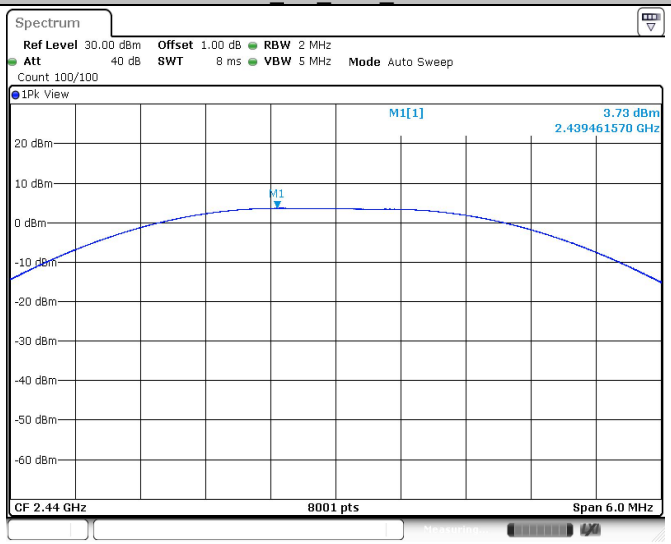

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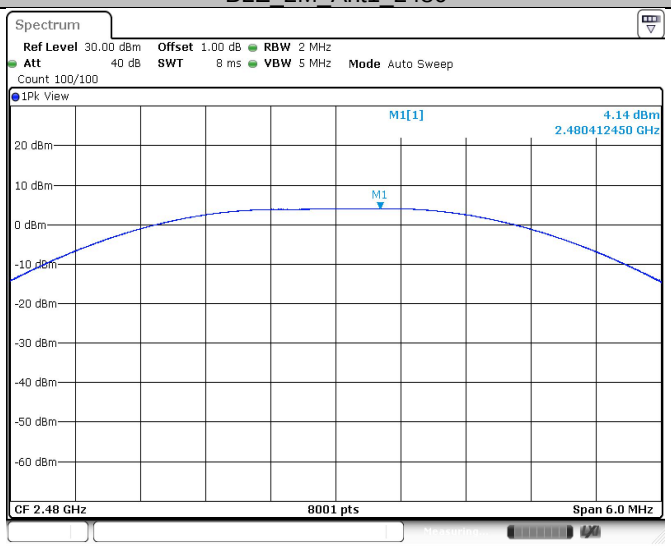

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9.3 Power Spectral Density

Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

1. The RF output of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
4. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz, VBW≥3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
5. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
6. Repeat above procedures until other frequencies measured were completed.

Limit

Limit [dBm]
≤8

Test result

Frequency MHz	Mode	Power spectral density dBm/3kHz	Result
Bottom channel 2402MHz	LE 1M	-13.00	Pass
Middle channel 2440MHz	LE 1M	-11.39	Pass
Top channel 2480MHz	LE 1M	-10.85	Pass
Bottom channel 2402MHz	LE 2M	-16.66	Pass
Middle channel 2440MHz	LE 2M	-14.92	Pass
Top channel 2480MHz	LE 2M	-14.49	Pass

Test Graphs as below:

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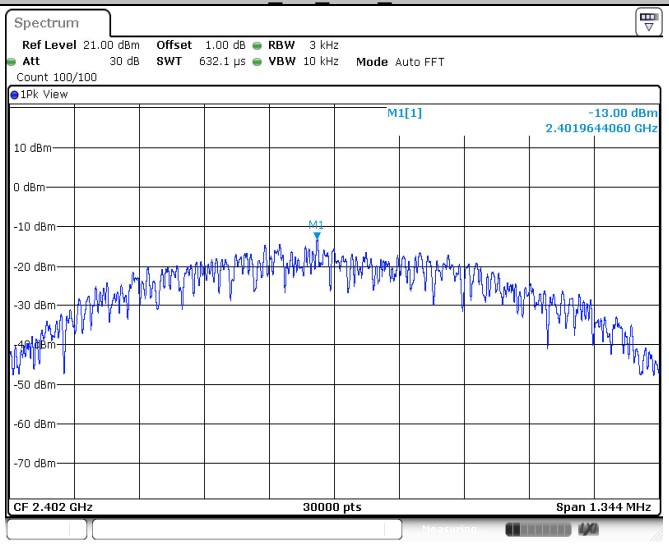
BLE_1M_Ant0_2402



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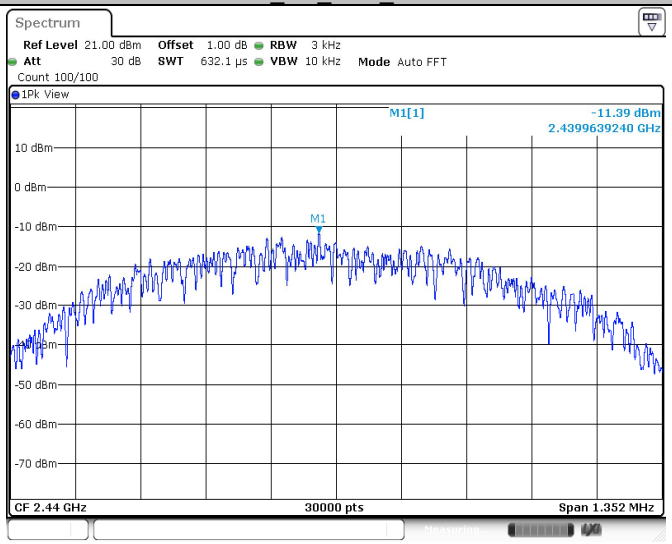

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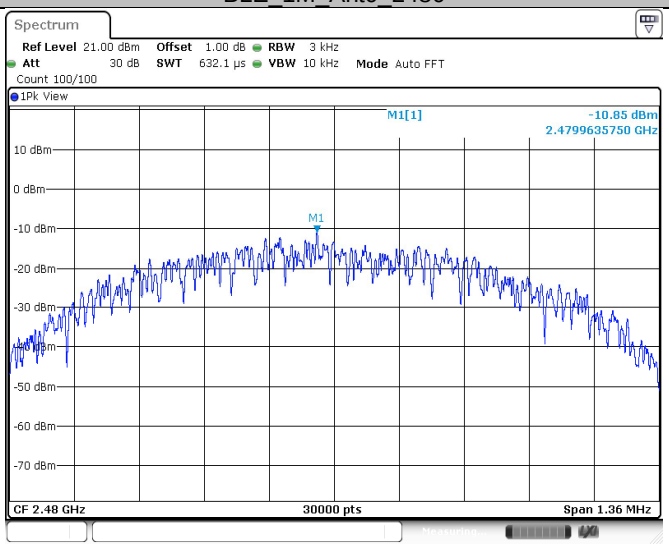
BLE_1M_Ant0_2480



Date: 29.JUL.2023 12:13:49

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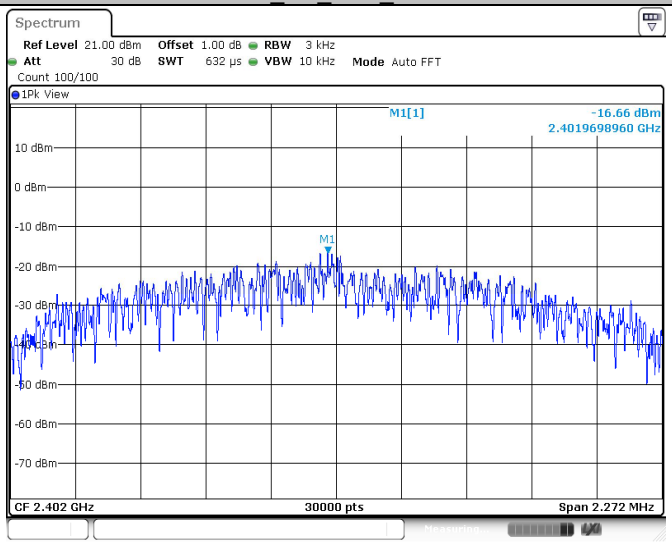
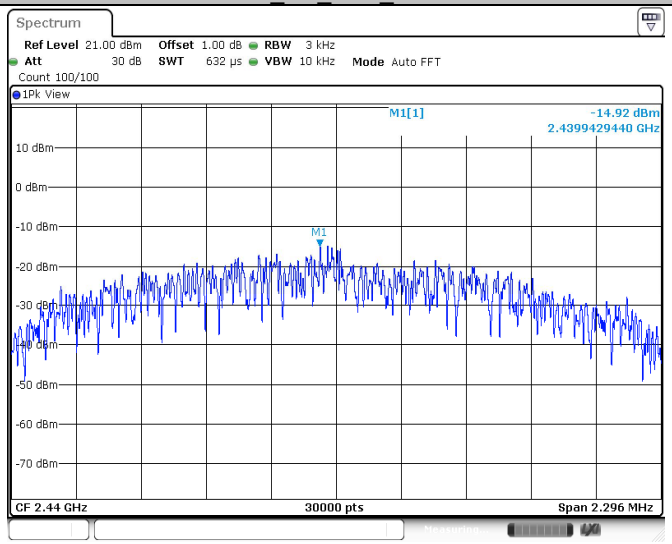
BLE_2M_Ant0_2402



Date: 29.JUL.2023 12:15:37

BLE_2M_Ant0_2440



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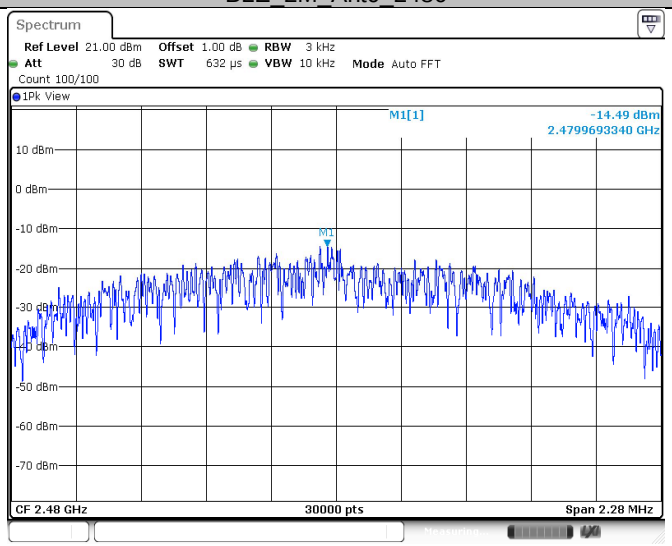

Date: 29.JUL.2023 12:18:44

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9.4 6 dB Bandwidth

Test Method

1. The RF output of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
   RBW=100KHz, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Use the automatic bandwidth measurement capability of an instrument, use the X dB bandwidth mode with X set to 6 dB.
5. Allow the trace to stabilize, record the 6 dB Bandwidth value.

Limit

Limit [kHz]
≥500

Test result

Frequency MHz	Mode	6dB bandwidth MHz	Result
Bottom channel 2402MHz	LE 1M	0.672	Pass
Middle channel 2440MHz	LE 1M	0.676	Pass
Top channel 2480MHz	LE 1M	0.680	Pass
Bottom channel 2402MHz	LE 2M	1.136	Pass
Middle channel 2440MHz	LE 2M	1.148	Pass
Top channel 2480MHz	LE 2M	1.140	Pass

Test Graphs as below:

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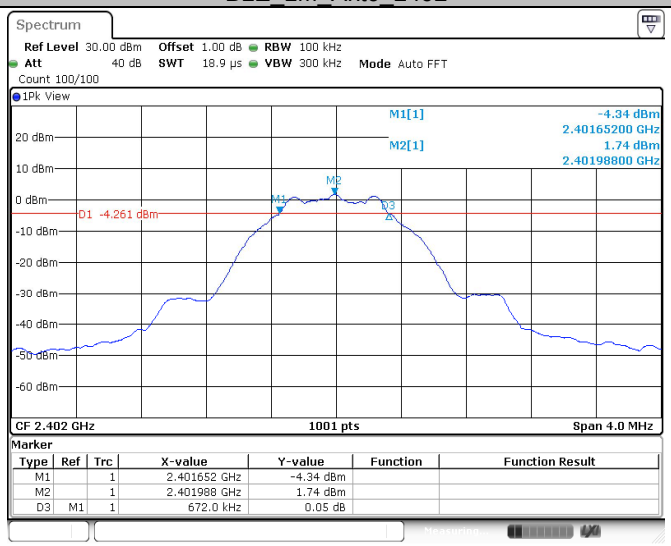
BLE_1M_Ant0_2402



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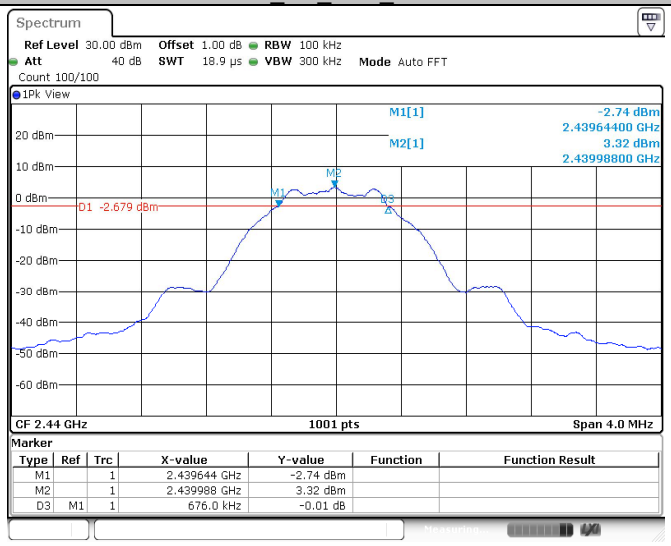
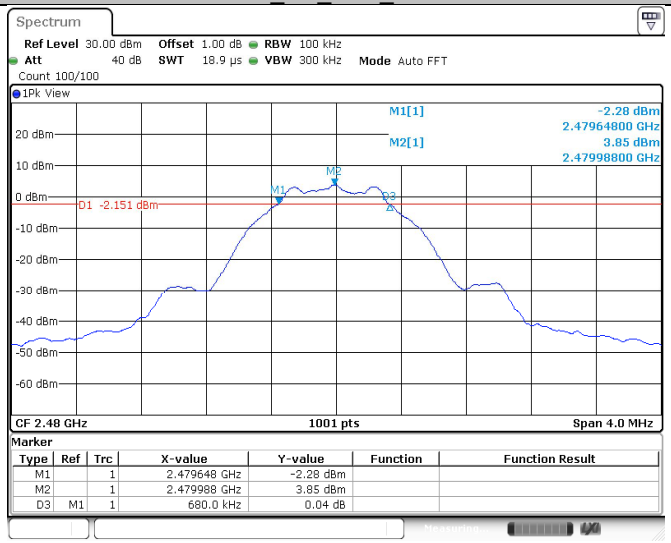


Date: 29.JUL.2023 12:11:49

BLE_1M_Ant0_2480



Date: 29.JUL.2023 12:13:26

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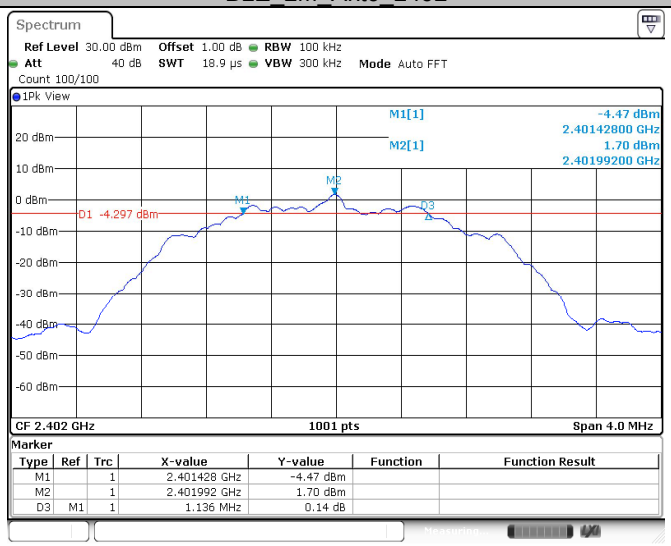
BLE_2M_Ant0_2402



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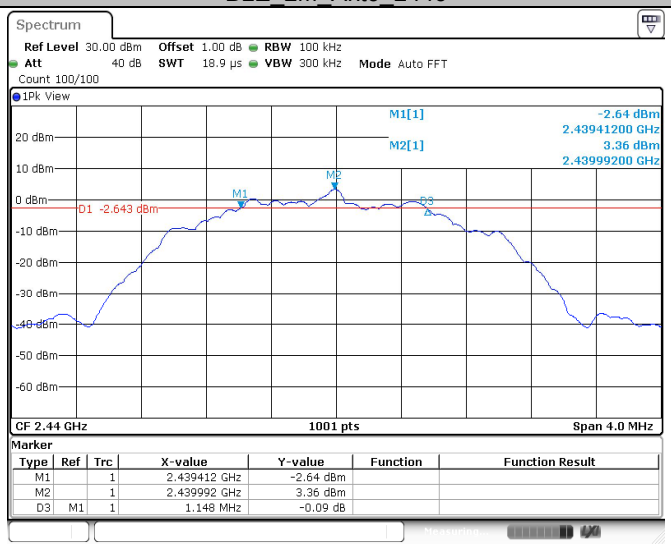

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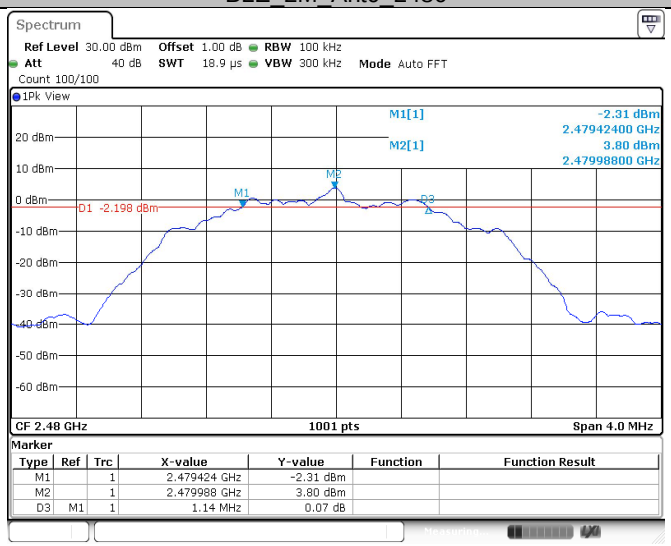

Date: 29.JUL.2023 12:18:21

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9.5 99% bandwidth

Test Method

1. Connect EUT test port to spectrum analyzer.
2. Use the following spectrum analyzer settings:
   RBW=1% to 5% of the actual occupied, VBW≥3RBW, Sweep = auto,
   Detector function = peak, Trace = max hold
3. Use the occupied bandwidth measurement capability of test receiver.
4. Allow the trace to stabilize, record the occupied bandwidth value.

Limit

Limit [kHz]
--

Test result

Frequency MHz	Mode	99% bandwidth MHz	Result
Bottom channel 2402MHz	LE 1M	1.131	Pass
Middle channel 2440MHz	LE 1M	1.143	Pass
Top channel 2480MHz	LE 1M	1.135	Pass
Bottom channel 2402MHz	LE 2M	2.198	Pass
Middle channel 2440MHz	LE 2M	2.226	Pass
Top channel 2480MHz	LE 2M	2.186	Pass

Test Graphs as below:

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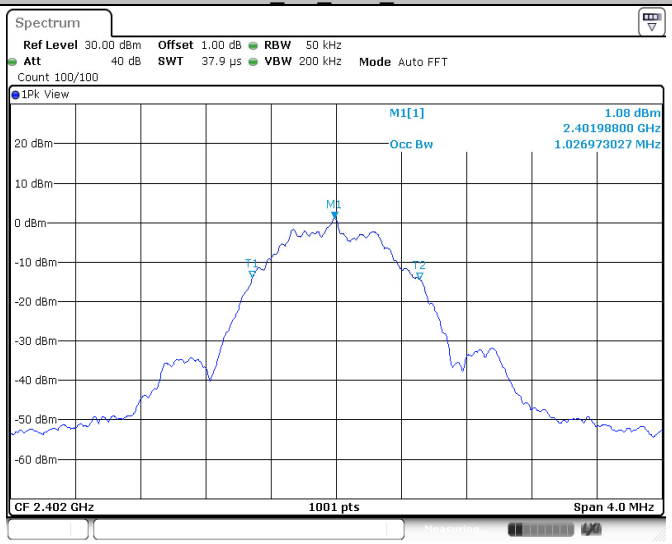
BLE_1M_Ant0_2402



Date: 29.JUL.2023 12:10:35

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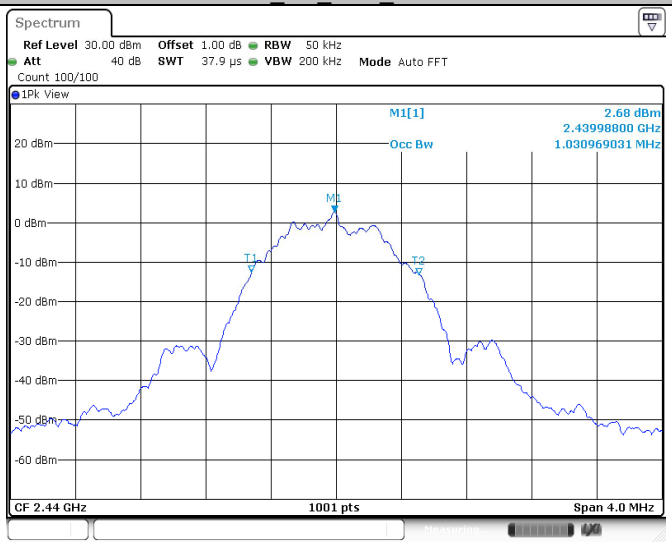
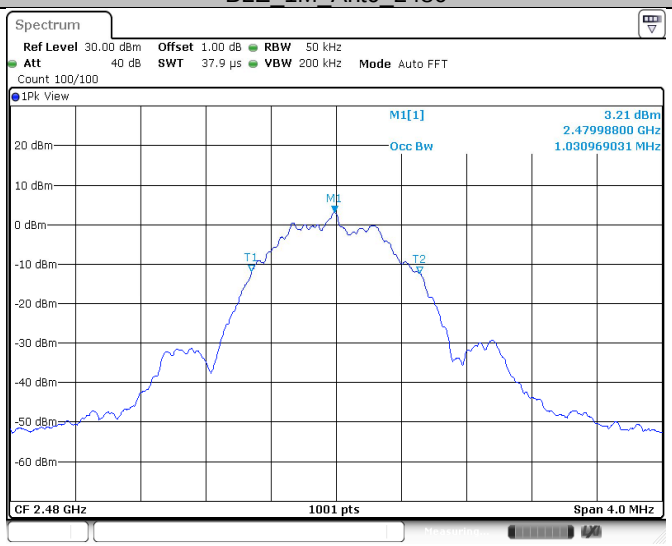


Date: 29.JUL.2023 12:12:00

BLE_1M_Ant0_2480



Date: 29.JUL.2023 12:13:36

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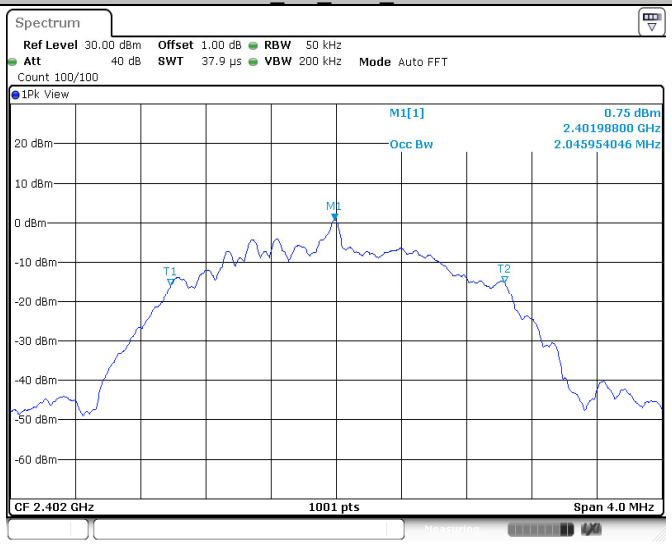
BLE_2M_Ant0_2402



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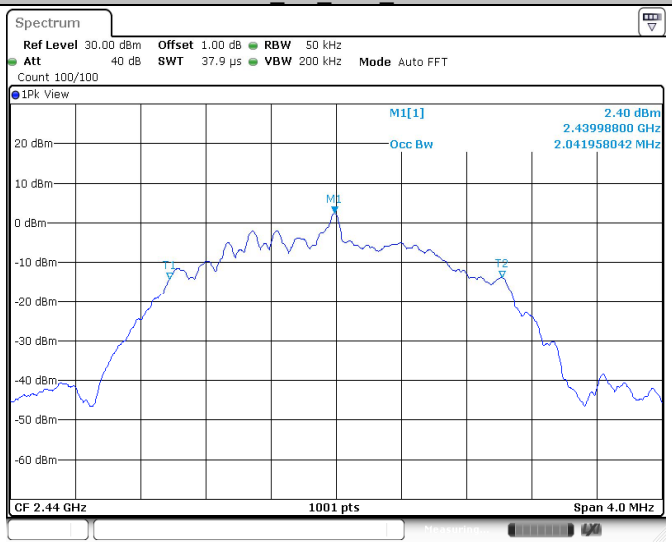

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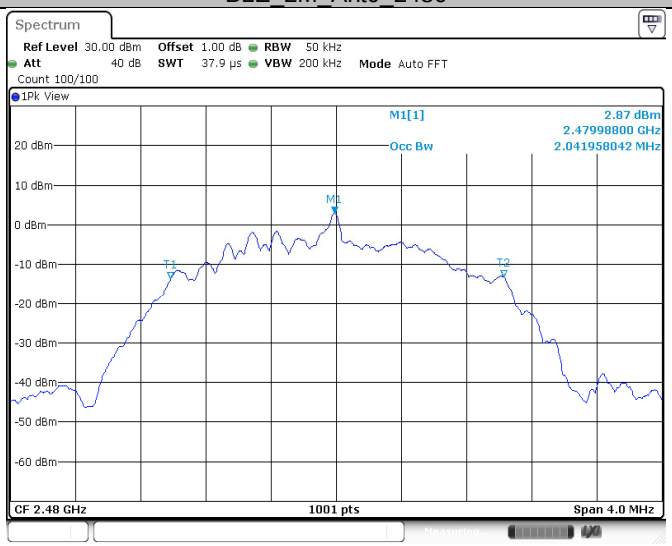

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9.6 Spurious RF Conducted Emissions

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, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
   RBW = 100 kHz, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
5. The level displayed must comply with the limit specified in this Section. Submit these plots.
6. Repeat above procedures until all frequencies measured were complete.

Limit

In any 100 kHz 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under § 15.247(b)(3) and RSS 247 section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB.

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

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Spurious RF conducted emissions

Test Mode	Antenna	Channel (MHz)	Frequency Range (MHz)	Reference Level	Result (dBm)	Limit (dBm)	Verdict
BLE_1M	Ant0	2402	Reference	1.68	1.68	---	PASS
			30~1000	30~1000	-68.56	<=-18.32	PASS
			1000~26500	1000~26500	-47.33	<=-18.32	PASS
		2440	Reference	3.19	3.19	---	PASS
			30~1000	30~1000	-67.26	<=-16.81	PASS
			1000~26500	1000~26500	-52.58	<=-16.81	PASS
		2480	Reference	3.82	3.82	---	PASS
			30~1000	30~1000	-68.37	<=-16.18	PASS
			1000~26500	1000~26500	-52.32	<=-16.18	PASS
BLE_2M	Ant0	2402	Reference	1.69	1.69	---	PASS
			30~1000	30~1000	-67.63	<=-18.31	PASS
			1000~26500	1000~26500	-32.21	<=-18.31	PASS
		2440	Reference	3.25	3.25	---	PASS
			30~1000	30~1000	-67.6	<=-16.75	PASS
			1000~26500	1000~26500	-52.54	<=-16.75	PASS
		2480	Reference	3.82	3.82	---	PASS
			30~1000	30~1000	-68.22	<=-16.18	PASS
			1000~26500	1000~26500	-52.38	<=-16.18	PASS

Remark: - The emissions exceed limit is fundamental signal.

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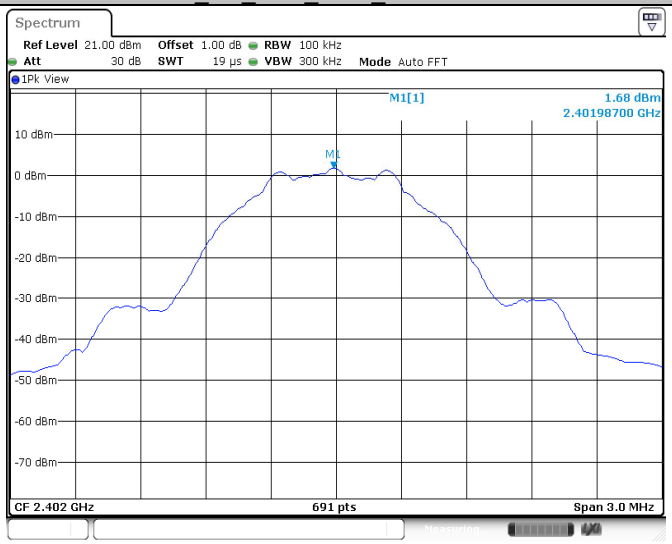
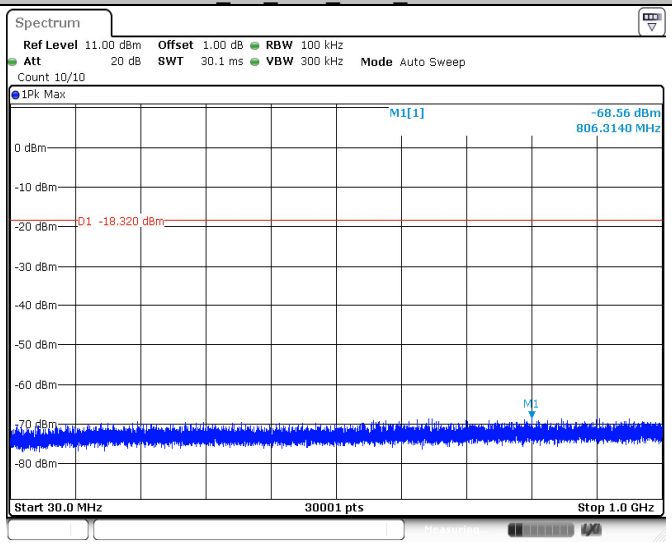
BLE_1M_Ant0_2402_0~Reference



Date: 29.JUL.2023 12:11:02

BLE_1M_Ant0_2402_30~1000



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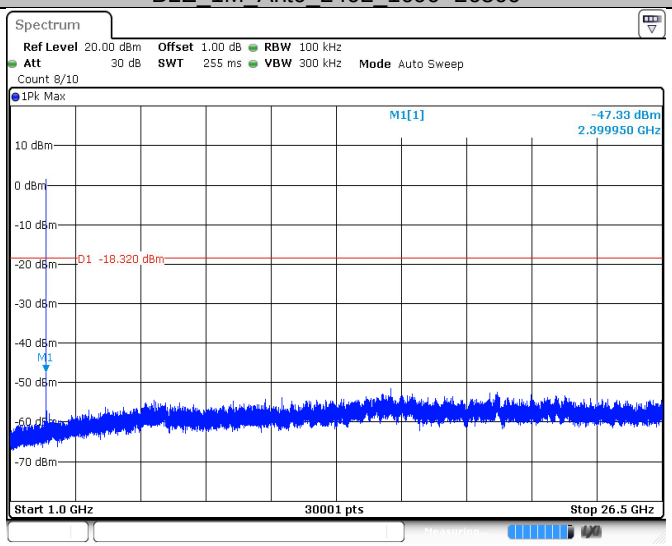

Date: 29.JUL.2023 12:11:16

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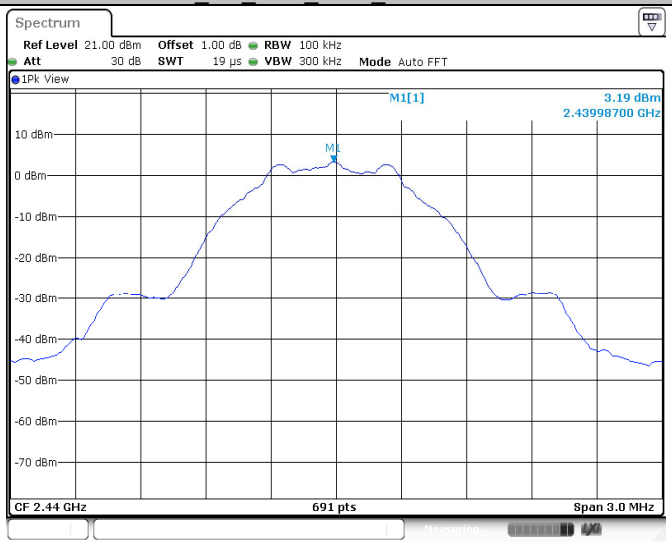
BLE_1M_Ant0_2440_0~Reference



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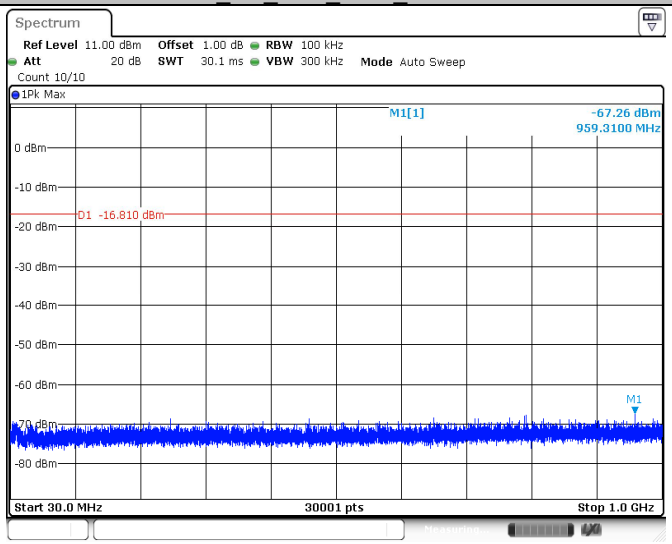

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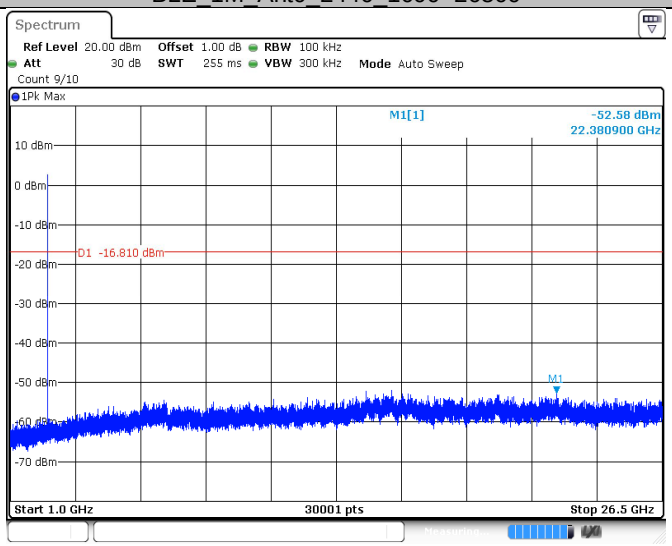
BLE_1M_Ant0_2440_1000~26500



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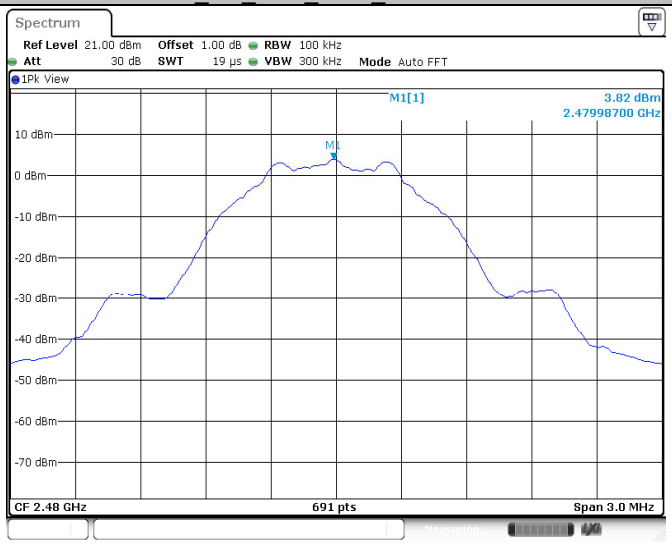
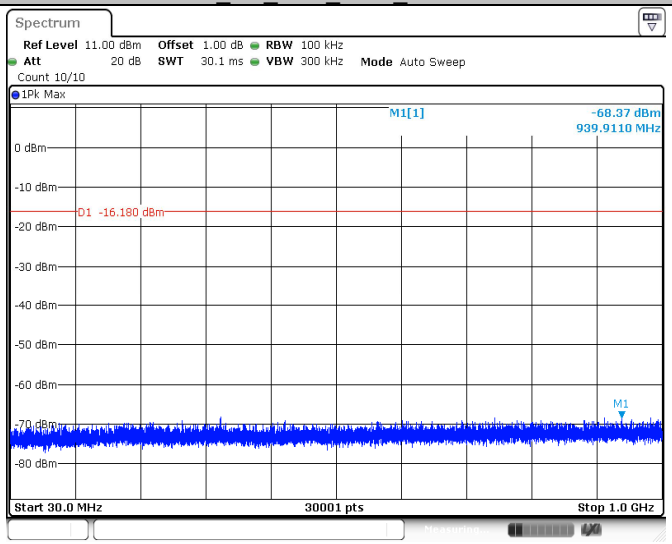
BLE_1M_Ant0_2480_0~Reference



Date: 29.JUL.2023 12:14:03

BLE_1M_Ant0_2480_30~1000



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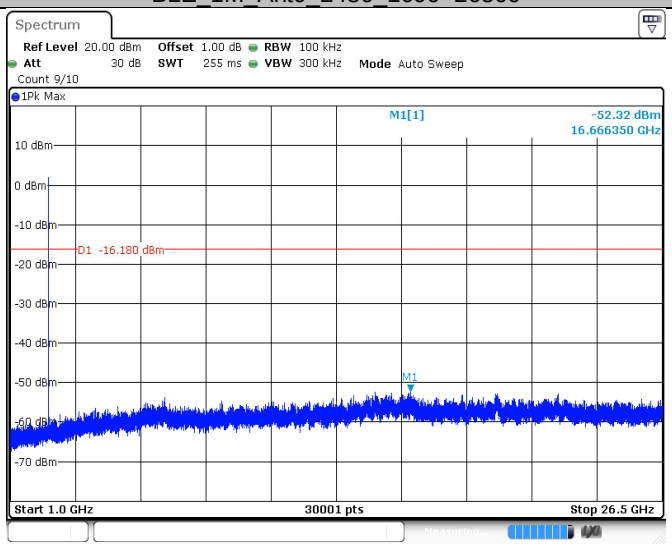

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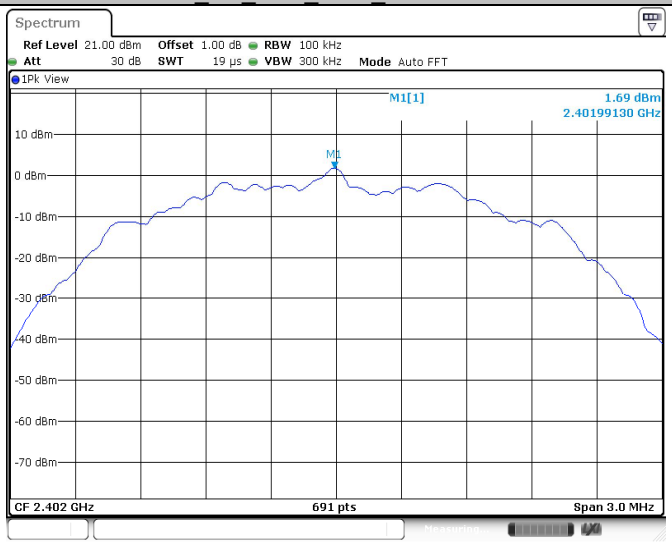
BLE_2M_Ant0_2402_0~Reference



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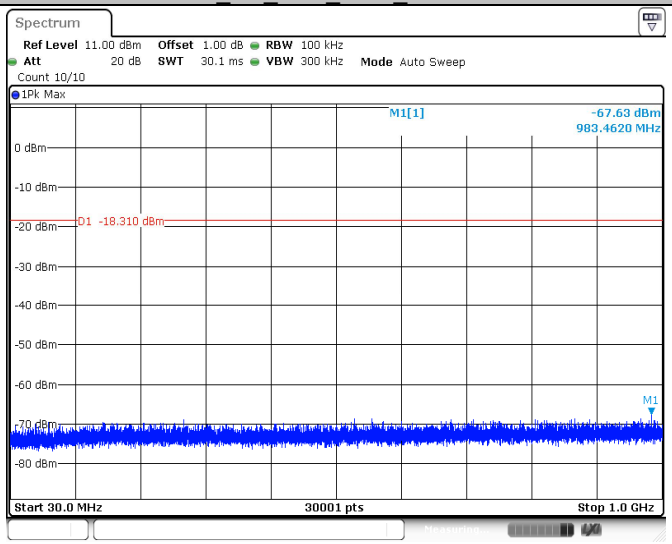
BLE_2M_Ant0_2402_30~1000



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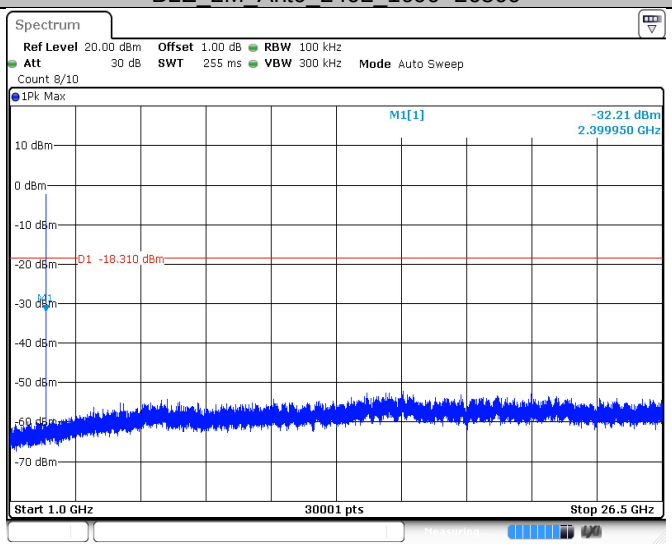
BLE_2M_Ant0_2402_1000~26500



Date: 29.JUL.2023 12:16:05

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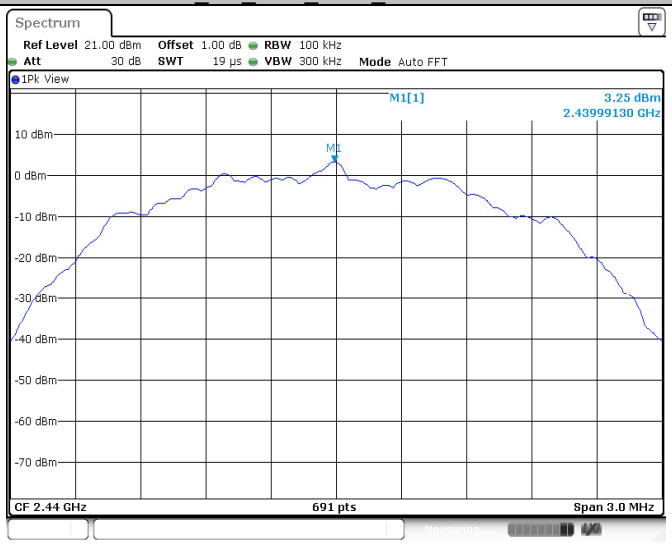
BLE_2M_Ant0_2440_0~Reference



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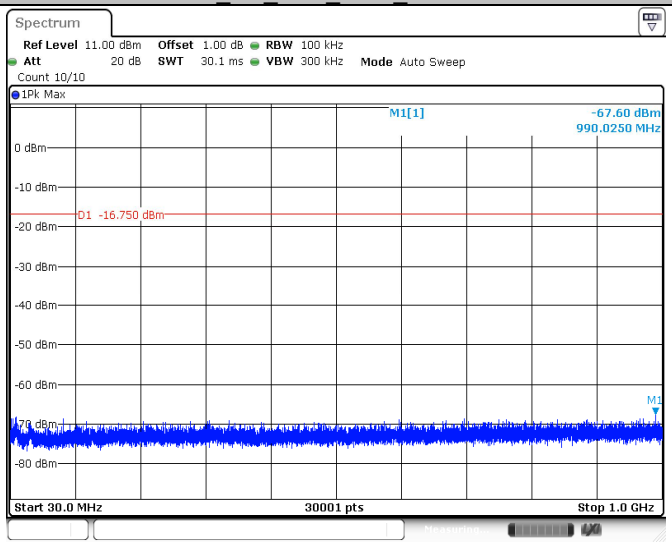

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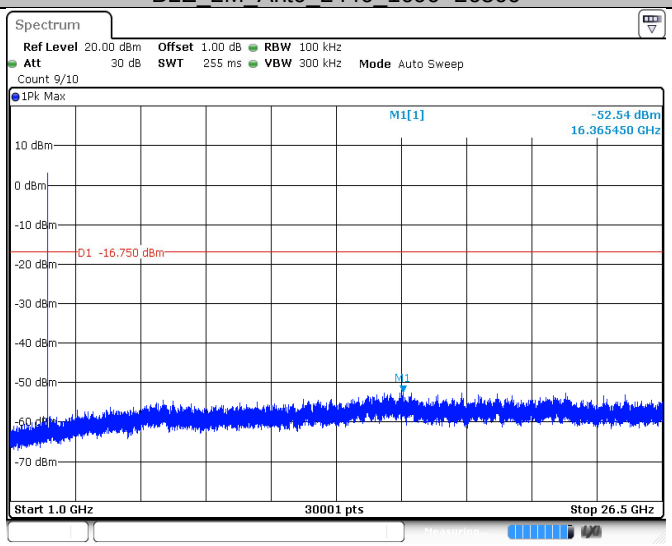

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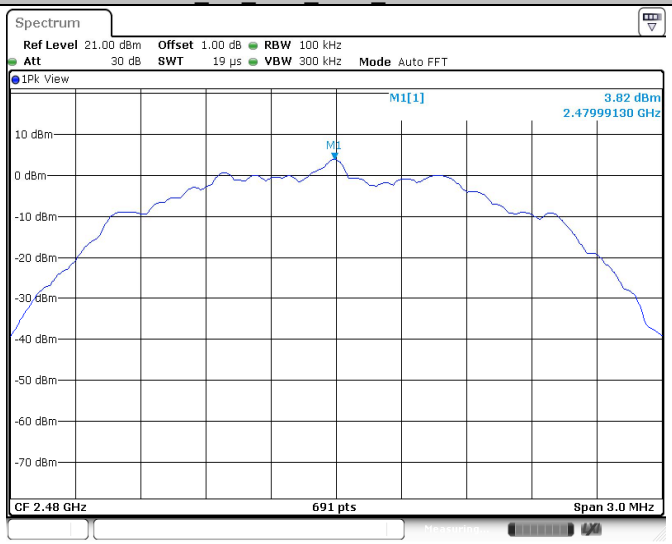
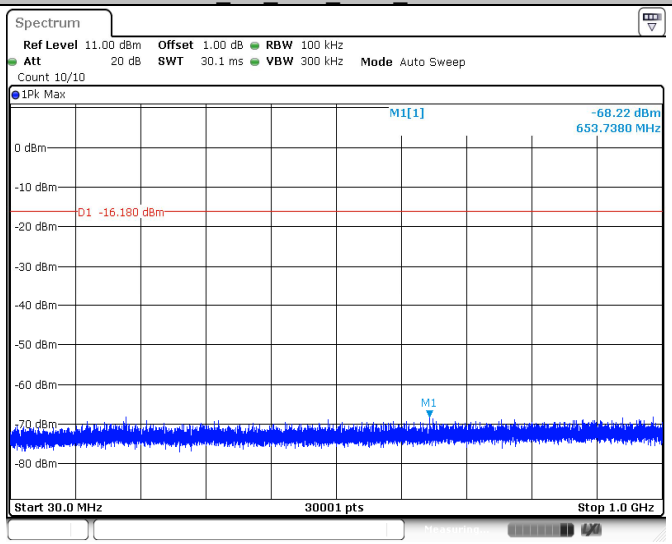
BLE_2M_Ant0_2480_0~Reference



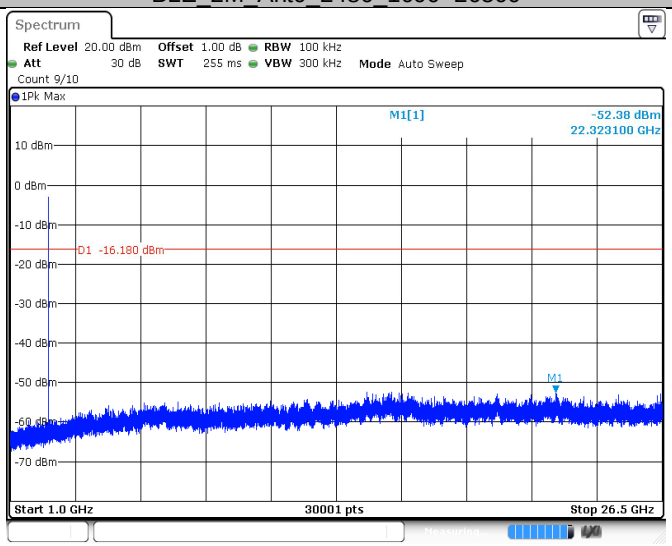
Date: 29.JUL.2023 12:18:58

BLE_2M_Ant0_2480_30~1000



Date: 29.JUL.2023 12:19:05

BLE_2M_Ant0_2480_1000~26500



Date: 29.JUL.2023 12:19:12

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9.7 Band Edge

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, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. 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, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize, use the peak and delta measurement to record the result.
5. The level displayed must comply with the limit specified in this Section.
6. Repeat above procedures until all frequencies measured were complete and submit all the plots.

Limit:

In any 100 kHz 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under § 15.247(b)(3) and RSS-247 section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB.

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

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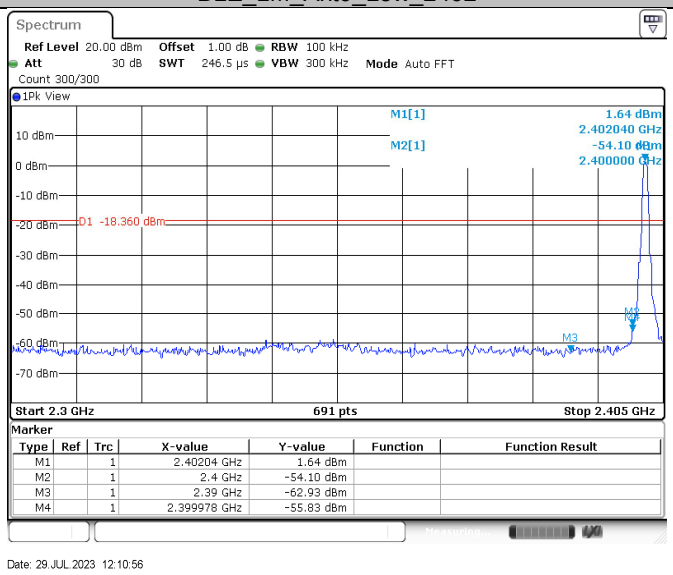
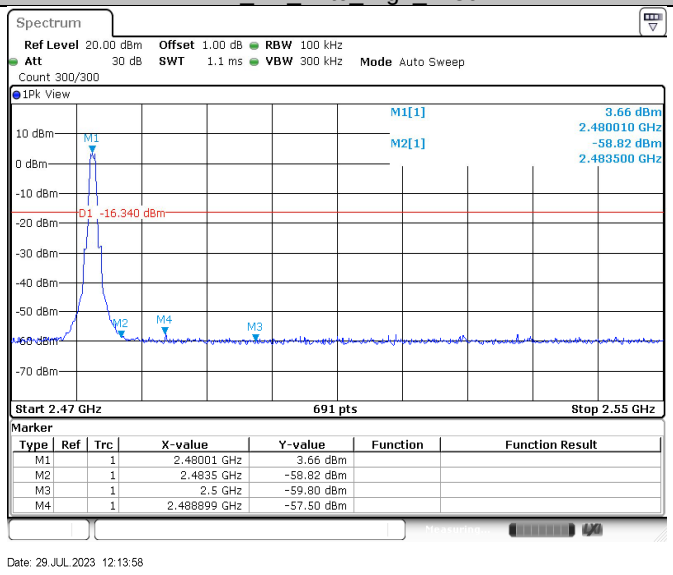
Band edge testing

Test Mode	Antenna	Channel	Channel (MHz)	Reference Level (dBm)	Result (dBm)	Limit (dBm)	Verdict
BLE_1M	Ant0	Low	2402	1.64	-55.83	<=-18.36	PASS
		High	2480	3.66	-57.50	<=-16.34	PASS
BLE_2M	Ant0	Low	2402	1.44	-47.14	<=-18.56	PASS
		High	2480	3.66	-57.12	<=-16.34	PASS

BLE_1M_Ant0_Low_2402



BLE_1M_Ant0_High_2480



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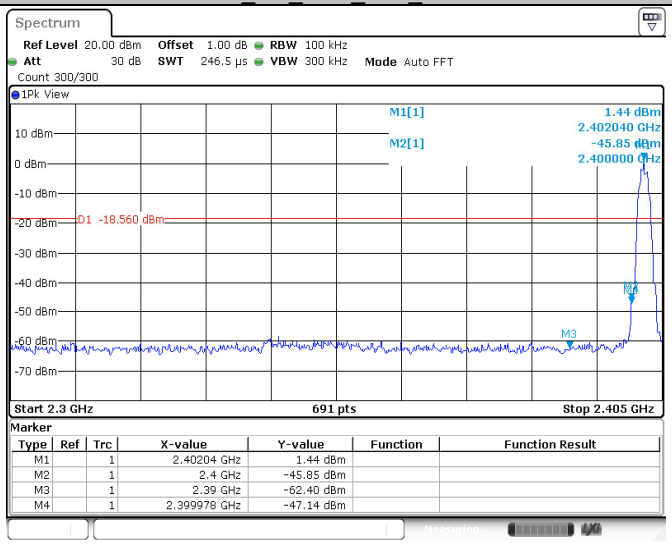
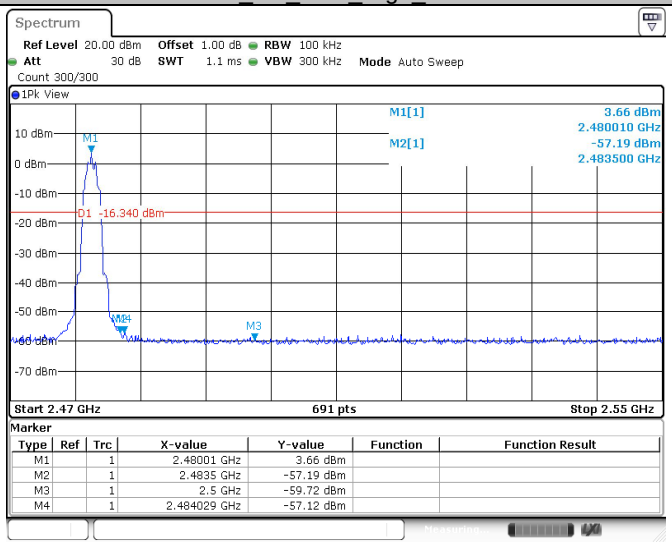
BLE_2M_Ant0_Low_2402



Date: 29.JUL.2023 12:15:46

BLE_1M_Ant0_High_2480



Date: 29.JUL.2023 12:18:53

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9.8 Spurious Radiated Emissions for Transmitter

Test Method

1: The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
3: The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4: For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5: Use the following spectrum analyzer settings According to C63.10:
For Below 1GHz
Use the following spectrum analyzer settings:

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

For Peak unwanted emissions Above 1GHz:

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

Procedures for average unwanted emissions measurements above 1000 MHz

a) RBW = 1MHz.
b) VBW \ [3 × RBW].
c) Detector = RMS (power averaging), if [span / (# of points in sweep)] \ RBW / 2. Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.
d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)
e) Sweep time = auto.
f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of 1 / D, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)
g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is [10 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB shall be added to the measured emission levels.
2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is [20 log (1 / D)], where D is the duty cycle. For example, if the transmit duty

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cycle was 50%, then 6 dB shall be added to the measured emission levels.
3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission (AV) at frequency above 1GHz.

Limit

In any 100 kHz 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under § 15.247(b)(3) and RSS 247 section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in § 15.209(a) and RSS-Gen is not required. In addition, radiated emissions which fall in the restricted bands, as defined in§ 15.205(a) and RSS-Gen scetion8.9, must also comply with the radiated emission limits specified in § 15.209(a) and RSS-Gen section 8.10.

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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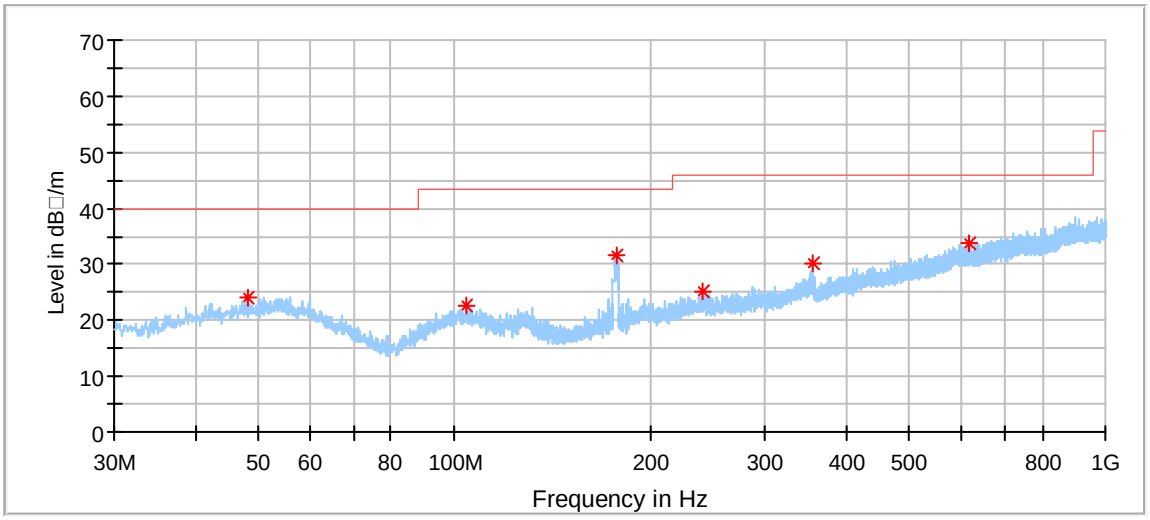
Spurious radiated emissions for transmitter

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 (1 Mbps) test result is listed in the report.

Transmitting spurious emission test result as below:

Test data_30MHz to 1000MHz
BLE_1Mbps:



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
48.106667	24.08	40.00	15.92	200.0	H	146.0	17.94
104.690000	22.51	43.50	20.99	100.0	H	205.0	16.34
177.493889	31.74	43.50	11.76	200.0	H	256.0	14.04
241.190556	24.98	46.00	21.02	200.0	H	302.0	17.53
356.620556	30.19	46.00	15.81	100.0	H	45.0	20.32
617.227222	33.77	46.00	12.23	100.0	H	239.0	25.78

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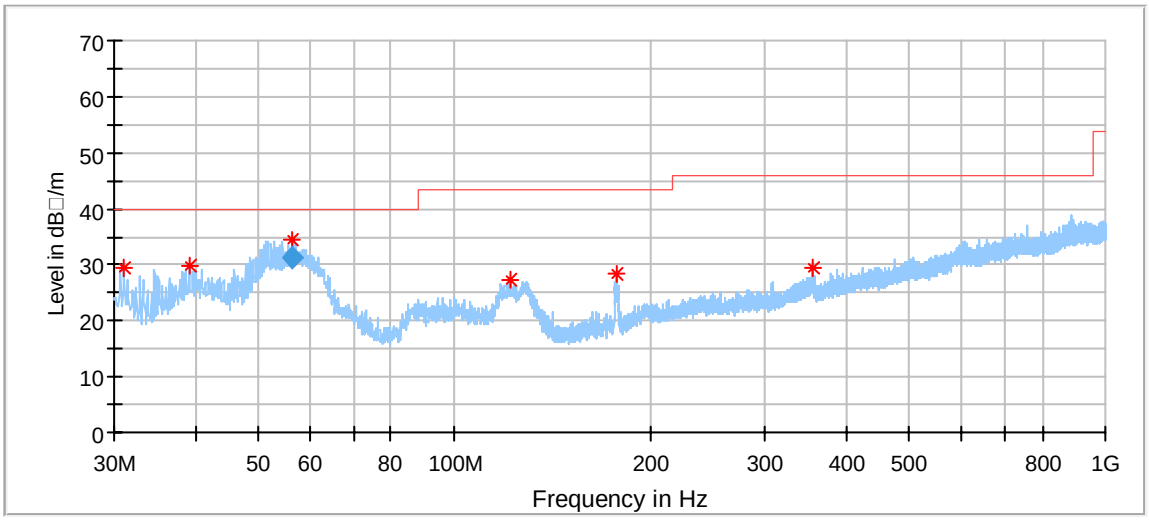
Test data_30MHz to 1000MHz
BLE_1Mbps:



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
31.131667	29.42	40.00	10.58	100.0	V	0.0	13.84
39.215000	29.74	40.00	10.26	100.0	V	38.0	16.33
56.208845	34.42	40.00	5.58	104.0	V	175.0	17.43
121.718889	27.41	43.50	16.09	100.0	V	356.0	13.77
177.170556	28.29	43.50	15.21	200.0	V	344.0	14.01
356.512778	29.31	46.00	16.69	100.0	V	292.0	20.33

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
56.208845	31.27	40.00	8.73	104.0	V	175.0	17.54

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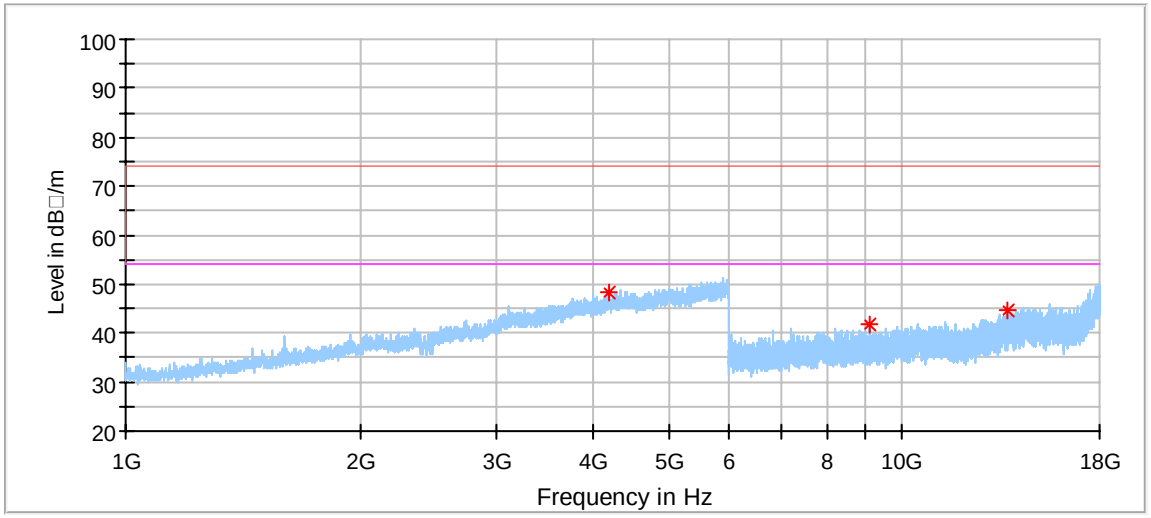
Test data 1GHz to 18GHz:
BLE_1Mbps_Low Channel:



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4182.000000	48.47	74.00	25.53	150.0	H	239.0	3.66
9075.000000	41.72	74.00	32.28	150.0	H	175.0	10.20
13705.500000	44.79	74.00	29.21	150.0	H	255.0	15.11

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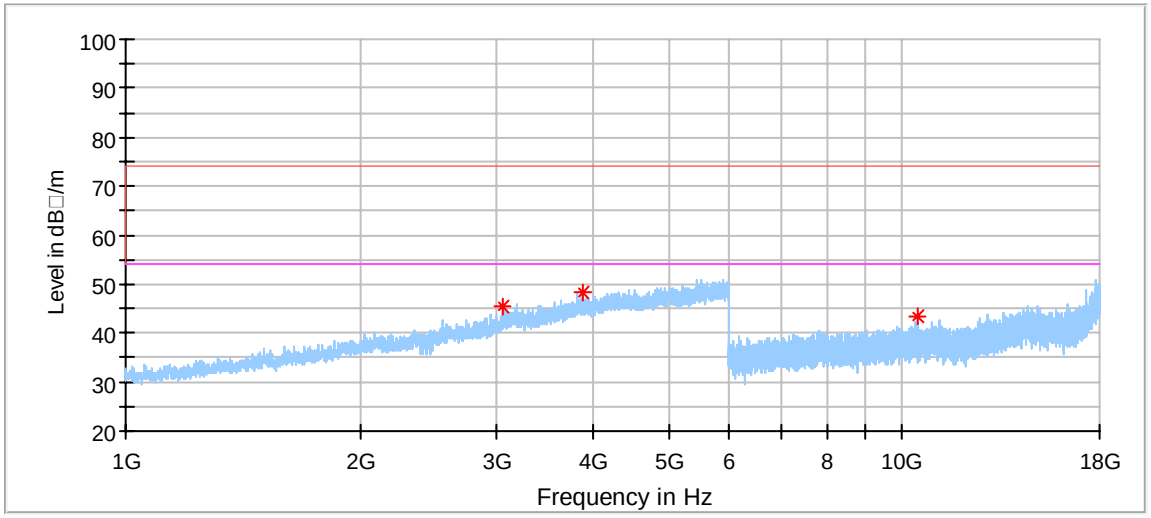
Test data 1GHz to 18GHz:
BLE_1Mbps_Low Channel:



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3052.500000	45.48	74.00	28.52	150.0	V	171.0	-0.63
3883.500000	48.12	74.00	25.88	150.0	V	48.0	2.91
10507.000000	43.39	74.00	30.61	150.0	V	354.0	11.77

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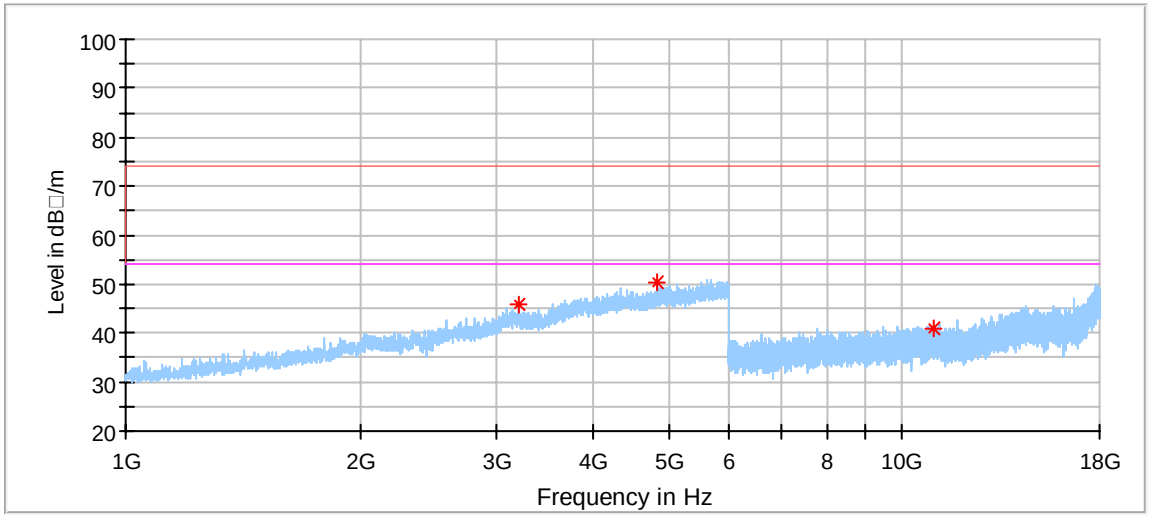
Test data 1GHz to 18GHz:
BLE_1Mbps _Middle Channel:



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3201.000000	45.81	74.00	28.19	150.0	H	75.0	-0.23
4828.000000	50.46	74.00	23.54	150.0	H	347.0	5.28
11000.000000	41.10	74.00	32.90	150.0	H	32.0	12.20

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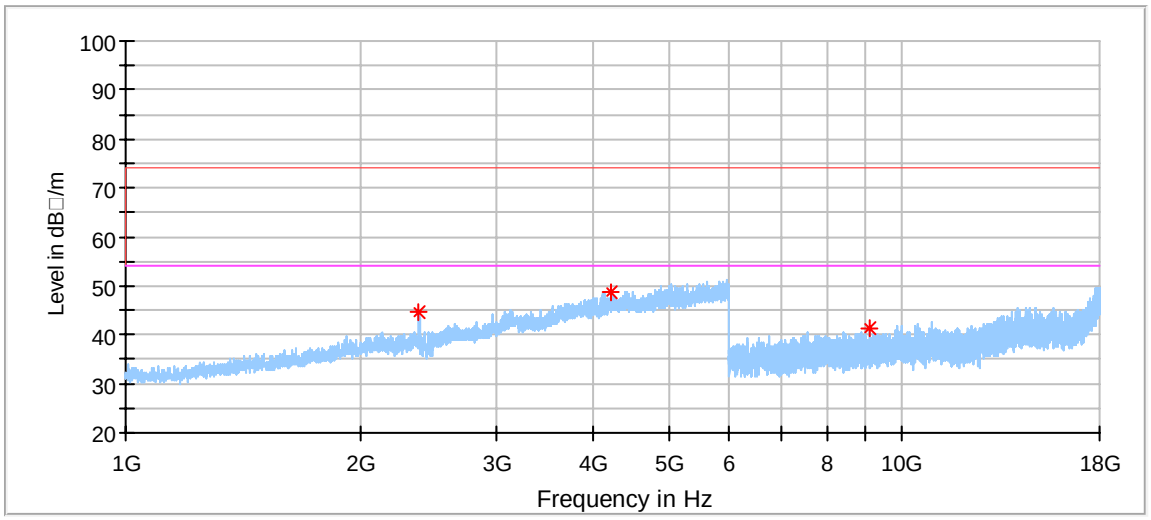
Test data 1GHz to 18GHz:
BLE_1Mbps _Middle Channel:



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2389.000000	44.52	74.00	29.48	150.0	V	10.0	-4.72
4216.500000	48.80	74.00	25.20	150.0	V	280.0	3.81
9093.000000	41.24	74.00	32.76	150.0	V	145.0	10.24

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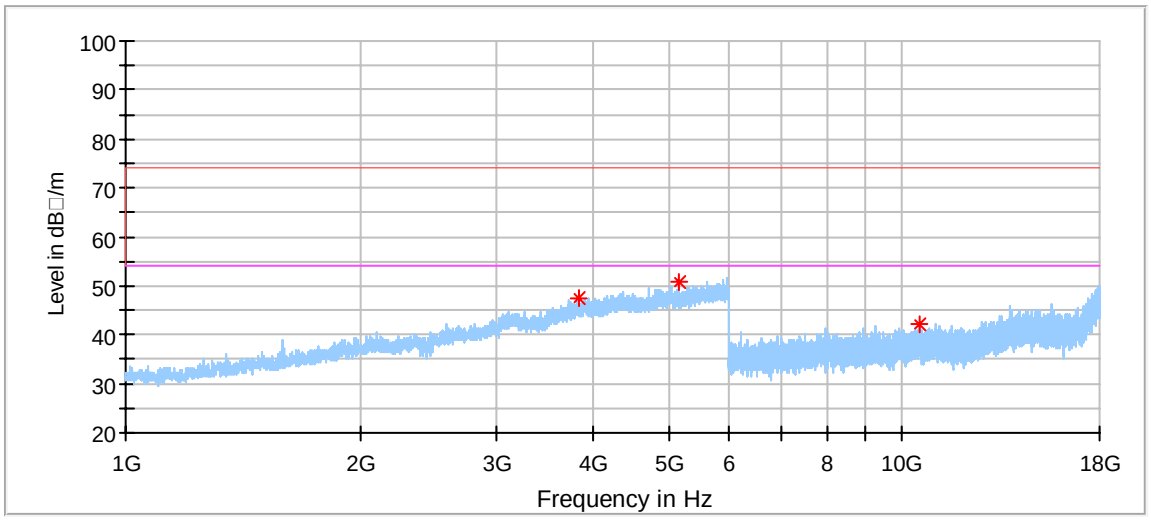
Test data 1GHz to 18GHz:
BLE_1Mbps _High Channel:



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3840.500000	47.59	74.00	26.41	150.0	H	236.0	2.75
5149.500000	50.64	74.00	23.36	150.0	H	345.0	5.84
10521.000000	42.09	74.00	31.91	150.0	H	145.0	11.77

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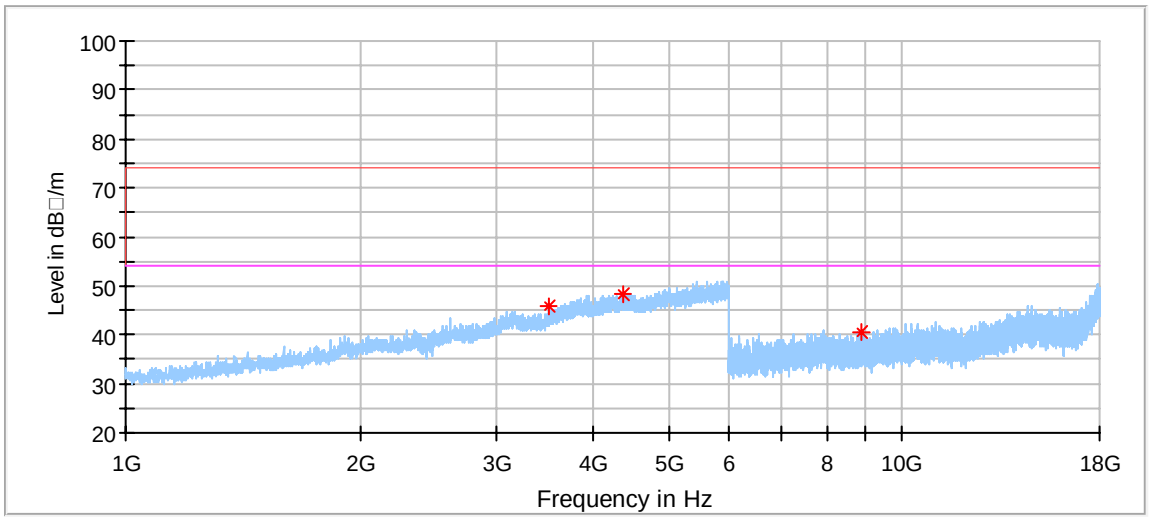
Test data 1GHz to 18GHz:
BLE_1Mbps _High Channel:



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3508.500000	45.76	74.00	28.24	150.0	V	335.0	0.80
4377.000000	48.26	74.00	25.74	150.0	V	335.0	4.25
8853.000000	40.54	74.00	33.46	150.0	V	203.0	10.45

Remark:

(1) Data of measurement within frequency range 9kHz-30MHz, 18-26GHz are the noise floor or attenuated more than 20dB below the permissible limits or the field strength is too small to be measured, so test data does not present in this report.
(2) We test both rates for Low channel, Middle channel and High channel separately, only the worst case recorded in this report.
(3) Corrected Amplitude = Read level + Corrector factor
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

List of Test Instruments

Radiated Emission Test 1# (9kHz – 1GHz)

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	68-4-74-14-002	101269	2024-5-20
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9162	68-4-80-19-003	284	2024-3-5
Loop Antenna	Rohde & Schwarz	HFH2-Z2	68-4-80-14-006	100398	2024-8-7
Pre-amplifier	Rohde & Schwarz	SCU 18F	68-4-29-19-001	100745	2024-5-19
Sideband Horn Antenna	Q-PAR	QWH-SL-18-40-K-SG	68-4-80-14-008	12827	2024-7-11
Pre-amplifier	Rohde & Schwarz	SCU 40A	68-4-29-14-002	100432	2024-8-1
Attenuator	Mini-circuits	UNAT-6+	68-4-81-21-002	15542	2024-5-19
3m Semi-anechoic chamber	TDK	SAC-3 #2	68-4-90-19-006	----	2024-5-28
Test software	Rohde & Schwarz	EMC32	68-4-90-19-006-A01	Version10.35.02	N/A

Radiated Emission 2# Test (1GHz – 40GHz)

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	68-4-74-14-002	101269	2024-5-20
Wave Guide Antenna	ETS	3117	68-4-80-19-001	00218954	2024-4-26
Pre-amplifier	Rohde & Schwarz	SCU 18F	68-4-29-19-002	100746	2024-5-19
Sideband Horn Antenna	Q-PAR	QWH-SL-18-40-K-SG	68-4-80-14-008	12827	2024-7-11
Pre-amplifier	Rohde & Schwarz	SCU 40A	68-4-29-14-002	100432	2024-8-1
Attenuator	Mini-circuits	UNAT-6+	68-4-81-21-002	15542	2024-5-19
3m Semi-anechoic chamber	TDK	SAC-3 #2	68-4-90-19-006	----	2024-5-28
Test software	Rohde & Schwarz	EMC32	68-4-90-19-006-A01	Version10.35.02	N/A

Conducted RF Test System

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL. DUE DATE
Signal Analyzer	Rohde & Schwarz	FSV40	68-4-74-14-004	101030	2024-5-19
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157W	68-4-93-14-003	101226/100929	2024-5-20
Power Splitter	Weinschel	1580	68-4-85-14-001	SC319	2024-5-20
10dB Attenuator	Weinschel	4M-10	68-4-81-14-003	43152	2024-5-19
10dB Attenuator	R&S	DNF	68-4-81-14-004	DNF-001	2024-5-19
10dB Attenuator	R&S	DNF	68-4-81-14-005	DNF-002	2024-5-19
10dB Attenuator	R&S	DNF	68-4-81-14-006	DNF-003	2024-5-19
10dB Attenuator	R&S	DNF	68-4-81-14-007	DNF-004	2024-5-19
Test software	Tonscend	System for BT/WIFI	68-4-74-14-006-A13	Version 2.6.77.0518	N/A
Shielding Room	TDK	TS8997	68-4-90-19-003	----	2025-10-15

Conducted Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 3	68-4-74-14-001	101782	2024-5-20
LISN	Rohde & Schwarz	ENV432	68-4-87-16-001	101318	2024-5-20
Test software	Rohde & Schwarz	EMC32	68-4-90-14-003-A10	Version9.15.00	N/A
Shielding Room	TDK	CSR #1	68-4-90-19-004	----	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)	3.57dB
Uncertainty for Radiated Emission in 3m chamber 9kHz-30MHz	4.70dB
Uncertainty for Radiated Emission in new 3m chamber 30MHz-1000MHz	Horizontal: 4.59dB; Vertical: 4.75dB
Uncertainty for Radiated Emission in new 3m 1000MHz-18000MHz	Horizontal: 5.08dB; Vertical: 5.09dB;
Uncertainty for Radiated Emission 18000MHz-40000MHz	Horizontal: 4.52dB; Vertical: 4.51dB
Uncertainty for Conducted RF test	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: 2023, clause 4.3.3 and 4.3.4.

---THE END OF REPORT---

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