



FCC RF Test Report

APPLICANT : CHEP
EQUIPMENT : Asset Tracker
BRAND NAME : CHEP
MODEL NAME : Gen 4 Ultra Short
FCC ID : 2APRD-GEN4SHORT
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DTS) Digital Transmission System
TEST DATE(S) : Jul. 29, 2024 ~ Jul. 30, 2024

We, Sporton International Inc. (Shenzhen), would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Shenzhen), the test report shall not be reproduced except in full.

Jason Jia

Approved by: Jason Jia



Sporton International Inc. (ShenZhen)

1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen, 518055

People's Republic of China



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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR470213A	Rev. 01	Initial issue of report	Aug. 23, 2024



SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(2)	6dB Bandwidth	$\geq 0.5\text{MHz}$	Pass	-
3.1	-	99% Bandwidth	-	Pass	-
3.2	15.247(b)(3)	Peak Output Power	$\leq 30\text{dBm}$	Pass	-
3.3	15.247(e)	Power Spectral Density	$\leq 8\text{dBm}/3\text{kHz}$	Pass	-
3.4	15.247(d)	Conducted Band Edges and Spurious Emission	$\leq 20\text{dBc}$	Pass	-
3.5	15.247(d)	Radiated Band Edges and Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 11.78 dB at 2496.12 MHz
-	15.207	AC Conducted Emission	15.207(a)	Not Applicable	Not connect to AC Mains
3.6	15.203 & 15.247(b)	Antenna Requirement	15.203 & 15.247(b)	Pass	-

Conformity Assessment Condition:

1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacture who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. The measurement uncertainty please refer to each test result in the section "Measurement Uncertainty"

Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.



1 General Description

1.1 Applicant

CHEP

2901 Tasman Drive Suite 101 Santa Clara, CA 95054

1.2 Manufacturer

MINEWING VIET NAM ELECTRONICS CO., LTD

Lot CN2, Yen Phong industrial park, Dong Phong commune and, Long Chau commune, Yen Phong District, Bac Ninh province, Vietnam

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Asset Tracker
Brand Name	CHEP
Model Name	Gen 4 Ultra Short
FCC ID	2APRD-GEN4SHORT
IMEI Code	Conducted: 866901063561692 Radiation: 866901066268204
HW Version	v14
SW Version	v10.00.0002
EUT Stage	Production Unit

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

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	2402 MHz ~ 2480 MHz
Number of Channels	40
Carrier Frequency of Each Channel	40 Channel (37 hopping + 3 advertising channel)
Maximum Output Power to Antenna	BLE 1Mbps: -8.86 dBm (0.0001 W) BLE 2Mbps: -8.88 dBm (0.0001 W)
99% Occupied Bandwidth	BLE 1Mbps: 1.045 MHz BLE 2Mbps: 2.042 MHz
Antenna Type / Gain	Chip Antenna with gain 2.8 dBi
Type of Modulation	Bluetooth LE : GFSK

1.5 Modification of EUT

No modifications are made to the EUT during all test items.



1.6 Testing Location

Sporton International Inc. (ShenZhen) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.01.

Test Firm	Sporton International Inc. (ShenZhen)		
Test Site Location	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen, 518055 People's Republic of China TEL: +86-755-86379589 FAX: +86-755-86379595		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	TH01-SZ	CN1256	421272

Test Firm	Sporton International Inc. (ShenZhen)		
Test Site Location	101, 1st Floor, Block B, Building 1, No. 2, Tengfeng 4th Road, Fenghuang Community, Fuyong Street, Baoan District, Shenzhen City, Guangdong Province 518103 People's Republic of China TEL: +86-755-86066985		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	03CH03-SZ	CN1256	421272

1.7 Test Software

Item	Site	Manufacturer	Name	Version
1.	03CH03-SZ	AUDIX	E3	6.2009-8-24

1.8 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR Part 15 Subpart C §15.247
- FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.



2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

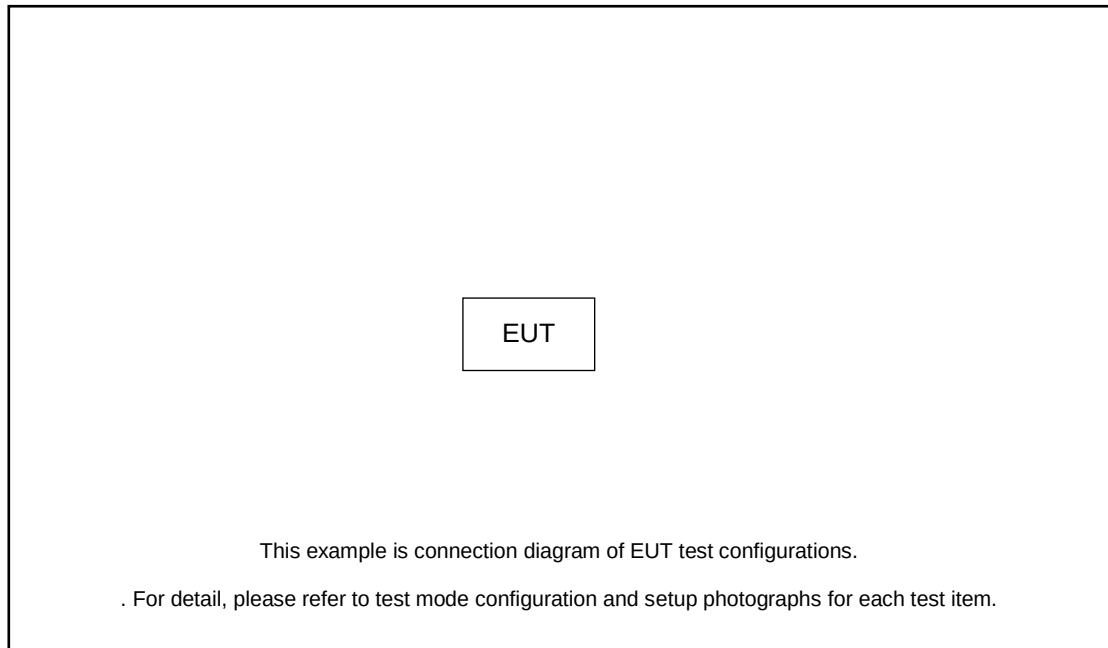
Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	0	2402	21	2444
	1	2404	22	2446
	2	2406	23	2448
	3	2408	24	2450
	4	2410	25	2452
	5	2412	26	2454
	6	2414	27	2456
	7	2416	28	2458
	8	2418	29	2460
	9	2420	30	2462
	10	2422	31	2464
	11	2424	32	2466
	12	2426	33	2468
	13	2428	34	2470
	14	2430	35	2472
	15	2432	36	2474
	16	2434	37	2476
	17	2436	38	2478
	18	2438	39	2480
	19	2440	-	-
	20	2442	-	-

2.2 Test Mode

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (X plane) were recorded in this report.
- b. The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases	
Test Item	Data Rate / Modulation
	Bluetooth – LE / GFSK
Conducted TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_BLE 1Mbps
	Mode 2: Bluetooth Tx CH19_2440 MHz_BLE 1Mbps
	Mode 3: Bluetooth Tx CH39_2480 MHz_BLE 1Mbps
	Mode 4: Bluetooth Tx CH00_2402 MHz _BLE 2Mbps
	Mode 5: Bluetooth Tx CH19_2440 MHz _BLE 2Mbps
	Mode 6: Bluetooth Tx CH39_2480 MHz _BLE 2Mbps
Radiated TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_BLE 1Mbps
	Mode 2: Bluetooth Tx CH19_2440 MHz_BLE 1Mbps
	Mode 3: Bluetooth Tx CH39_2480 MHz_BLE 1Mbps
	Mode 4: Bluetooth Tx CH00_2402 MHz _BLE 2Mbps
	Mode 5: Bluetooth Tx CH19_2440 MHz _BLE 2Mbps
	Mode 6: Bluetooth Tx CH39_2480 MHz _BLE 2Mbps

2.3 Connection Diagram of Test System



2.4 EUT Operation Test Setup

For BLE function, the engineering test program was provided and enabled to make EUT continuous transmit.

2.5 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example :

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 1.30 dB and 10dB attenuator.

$$\begin{aligned}\text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)} \\ &= 1.30 + 10 = 11.30 \text{ (dB)}\end{aligned}$$

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

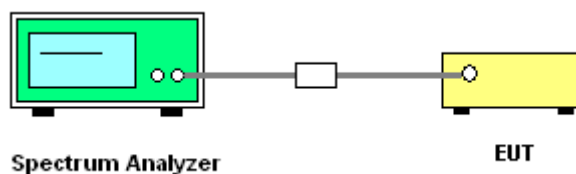
3.1.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.1.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 11.8
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1% to 5% of the 99% OBW and the VBW is set to 3 times of the RBW.
6. Measure and record the results in the test report.

3.1.4 Test Setup



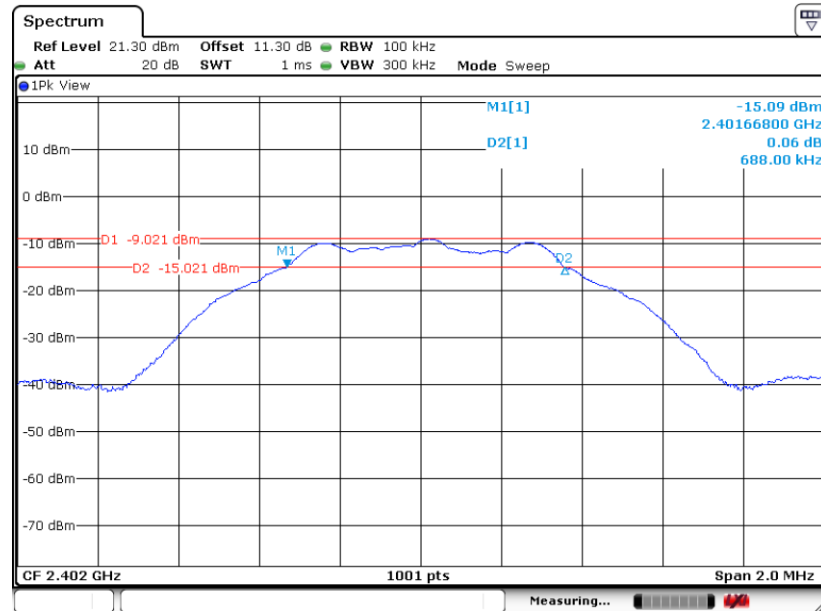


3.1.5 Test Result of 6dB Bandwidth

Please refer to Appendix A.

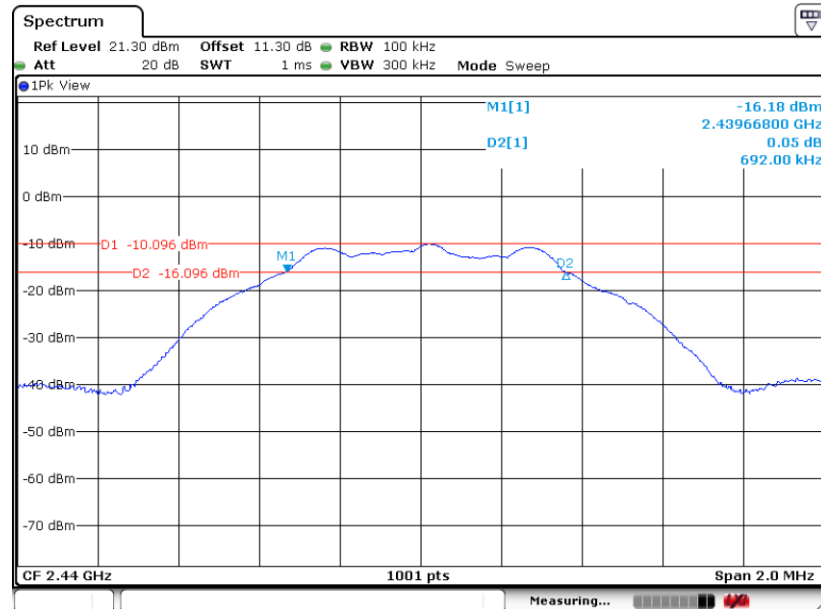
BLE 1Mbps

6 dB Bandwidth Plot on Channel 00



Date: 30 JUL 2024 15:38:33

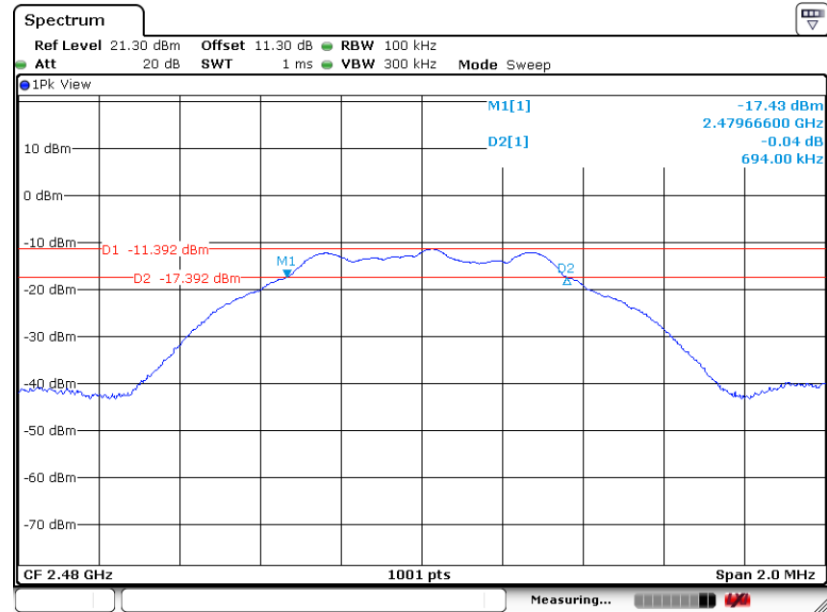
6 dB Bandwidth Plot on Channel 19



Date: 30 JUL 2024 15:36:05



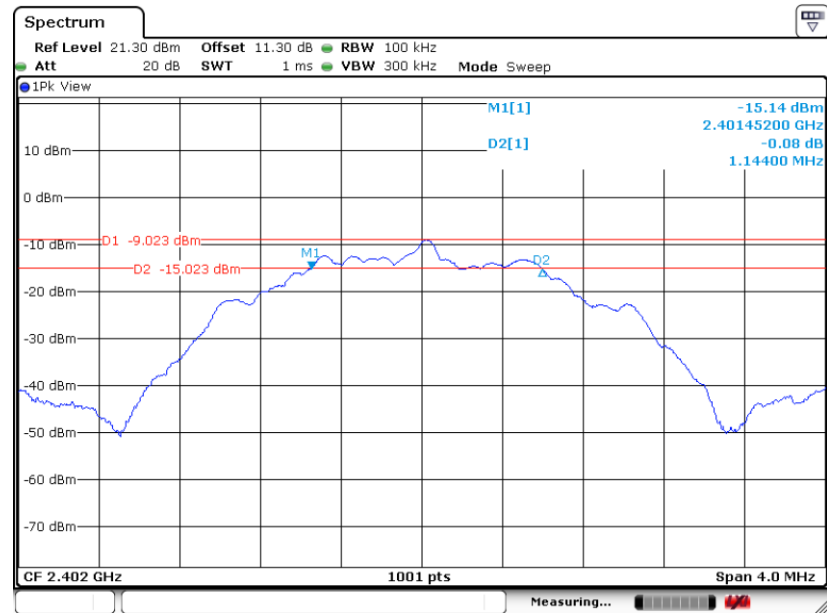
6 dB Bandwidth Plot on Channel 39



Date: 30 JUL 2024 15:34:20

BLE 2Mbps

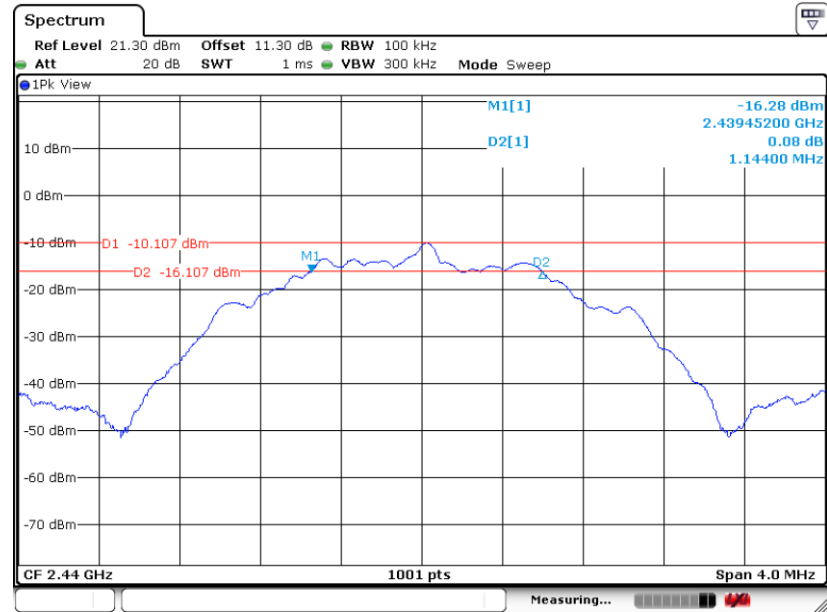
6 dB Bandwidth Plot on Channel 00



Date: 30 JUL 2024 15:30:31

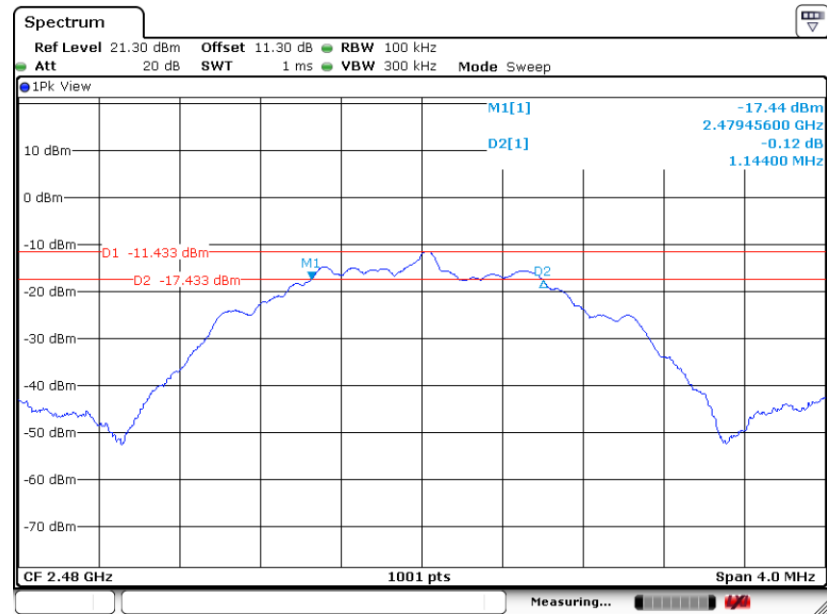


6 dB Bandwidth Plot on Channel 19



Date: 30 JUL 2024 15:24:53

6 dB Bandwidth Plot on Channel 39



Date: 30 JUL 2024 15:02:24

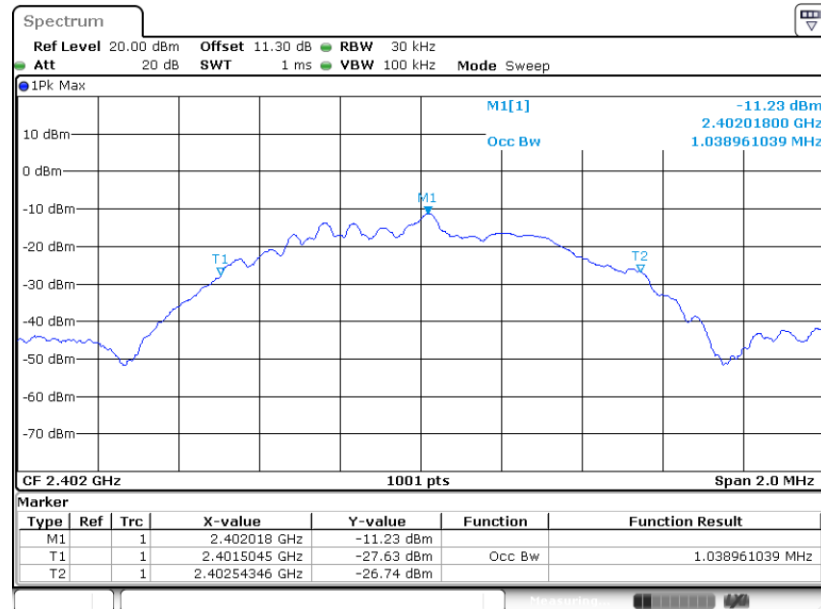


3.1.6 Test Result of 99% Occupied Bandwidth

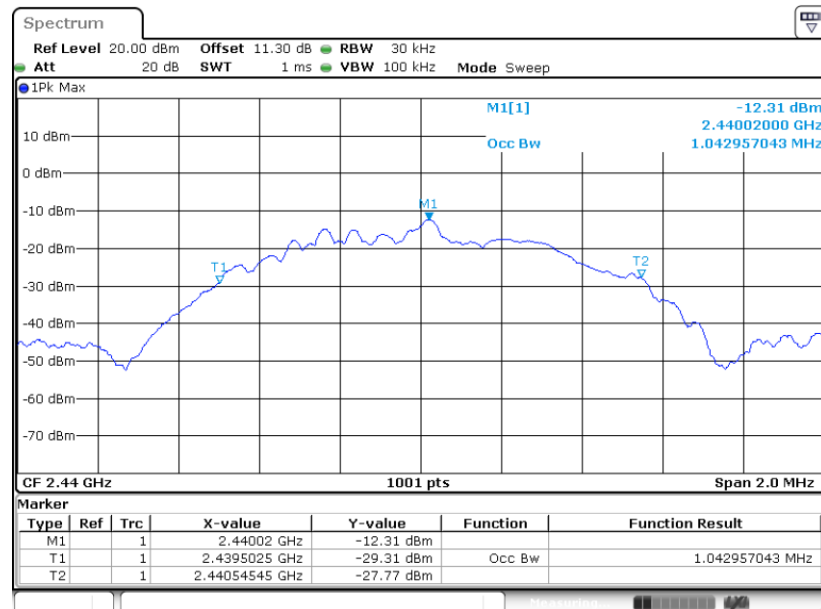
Please refer to Appendix A.

BLE 1Mbps

99% Occupied Bandwidth Plot on Channel 00

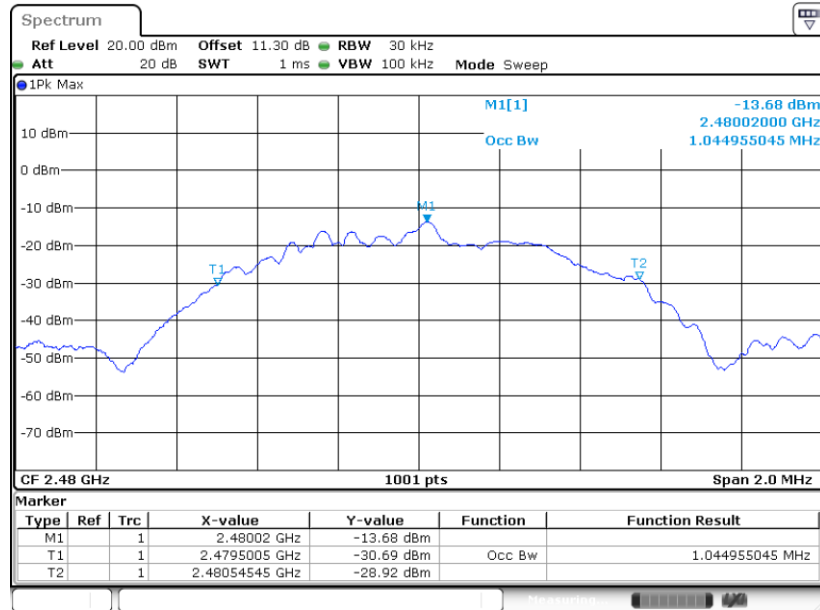


99% Occupied Bandwidth Plot on Channel 19



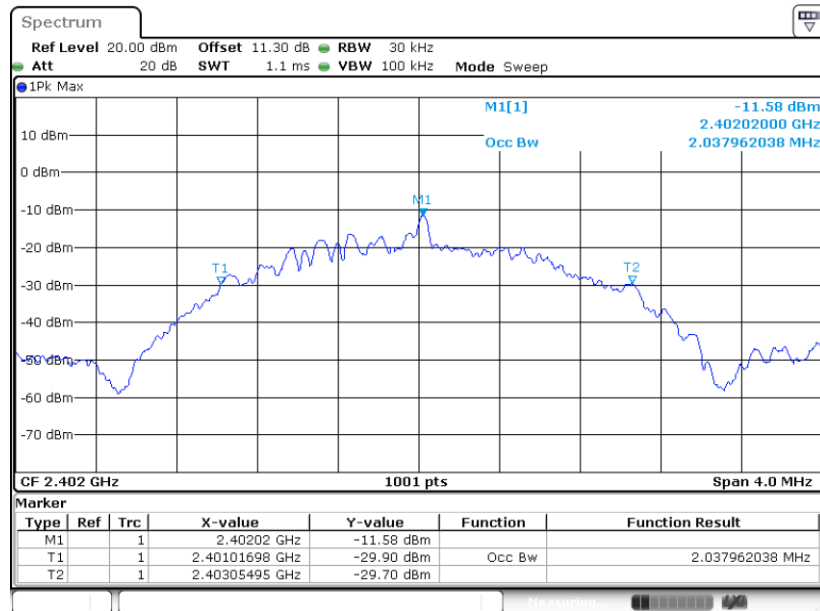


99% Occupied Bandwidth Plot on Channel 39



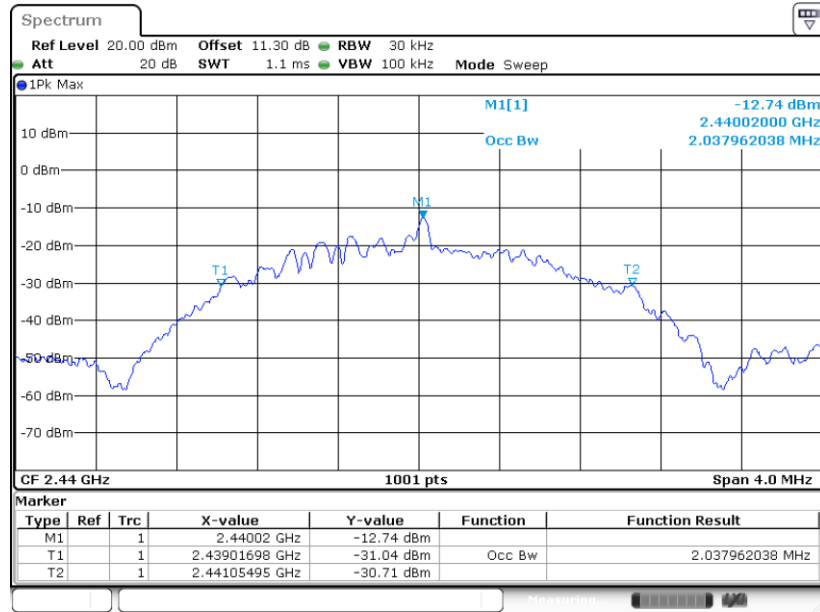
BLE 2Mbps

99% Occupied Bandwidth Plot on Channel 00



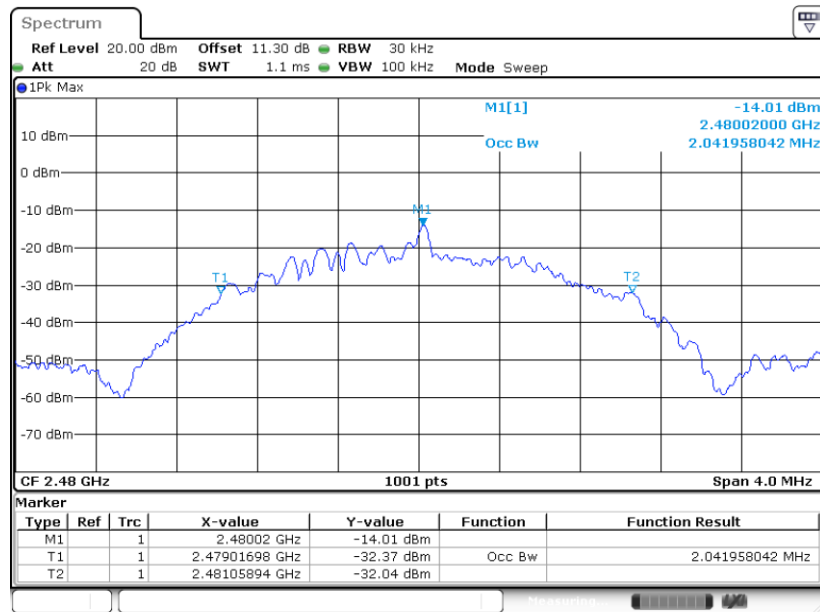


99% Occupied Bandwidth Plot on Channel 19



Date: 30 JUL 2024 15:04:38

99% Occupied Bandwidth Plot on Channel 39



Date: 30 JUL 2024 15:02:13

Note : The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

3.2 Output Power Measurement

3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

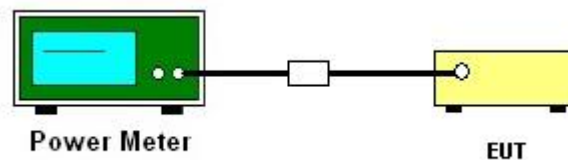
3.2.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.2.3 Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 clause 11.9.1.3 PKPM1 Peak power meter or ANSI C63.10-2013 clause 11.9.2.3.1 Method AVGPM method.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Peak Output Power

Please refer to Appendix A.

3.2.6 Test Result of Average Output Power (Reporting Only)

Please refer to Appendix A.

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

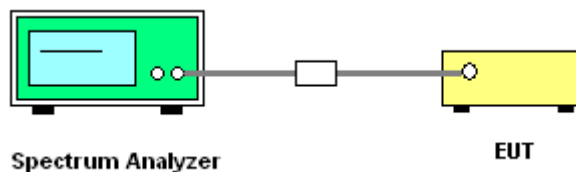
3.3.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.3.3 Test Procedures

1. The testing follows Measurement Procedure of ANSI C63.10-2013 clause 11.10.2 Method PKPSD.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.
7. The Measured power density (dBm)/ 100kHz is a reference level and used as 20dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

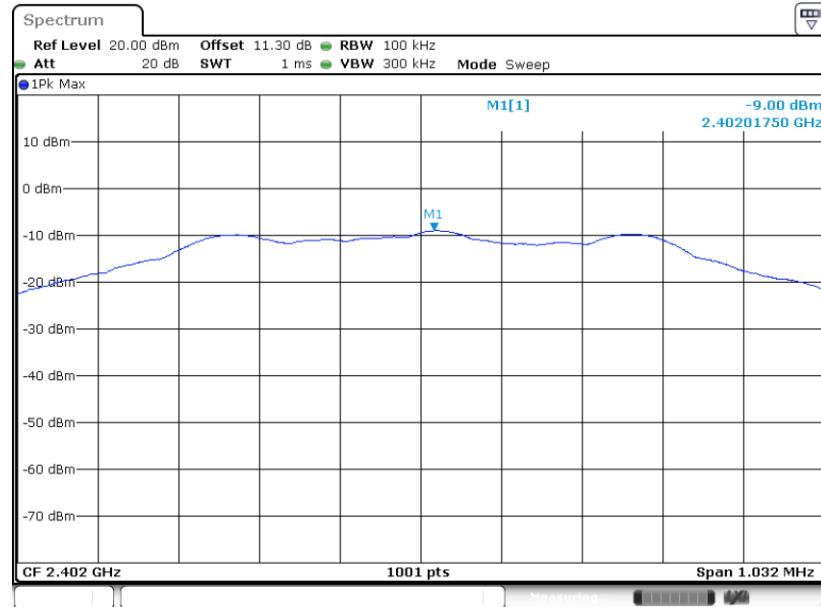
Please refer to Appendix A.



3.3.6 Test Result of Power Spectral Density Plots (100kHz)

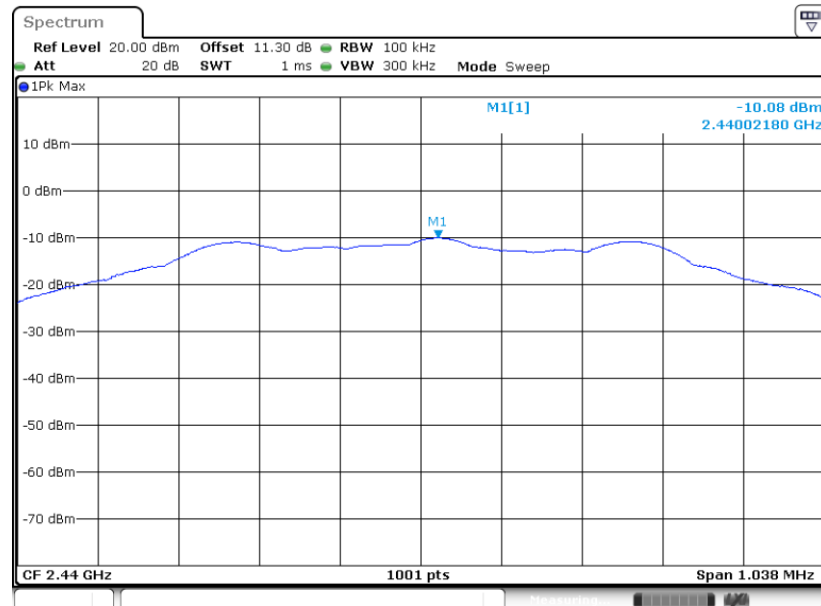
BLE 1Mbps

PSD 100kHz Plot on Channel 00



Date: 30 JUL 2024 15:38:58

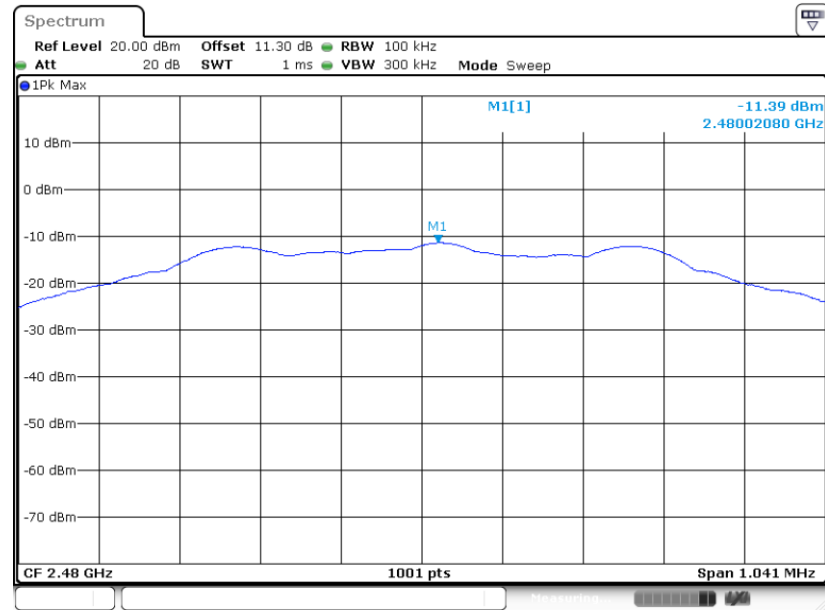
PSD 100kHz Plot on Channel 19



Date: 30 JUL 2024 15:36:38



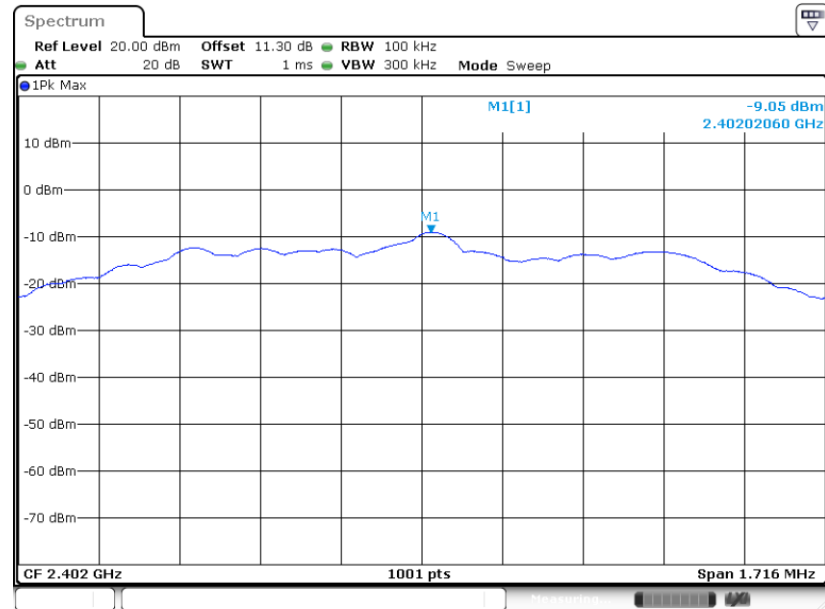
PSD 100kHz Plot on Channel 39



Date: 30 JUL 2024 15:34:45

BLE 2Mbps

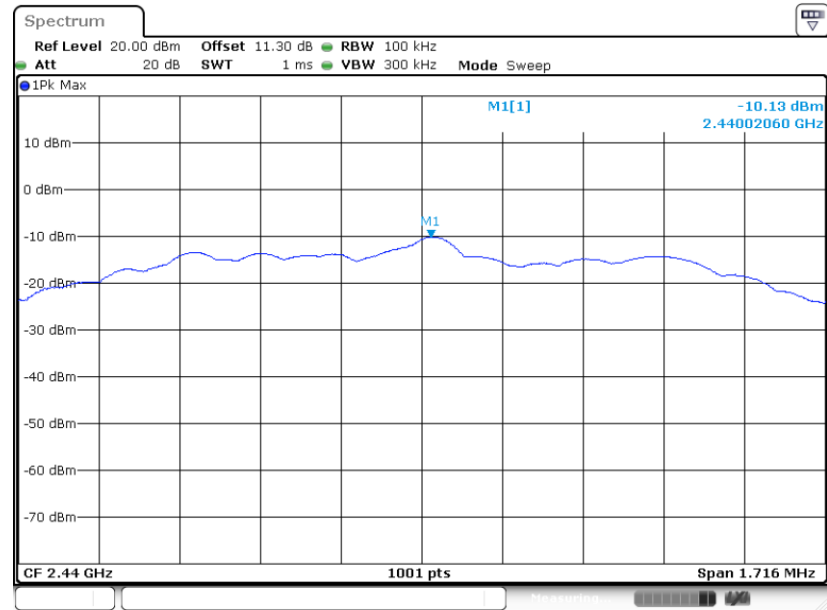
PSD 100kHz Plot on Channel 00



Date: 30 JUL 2024 15:31:00

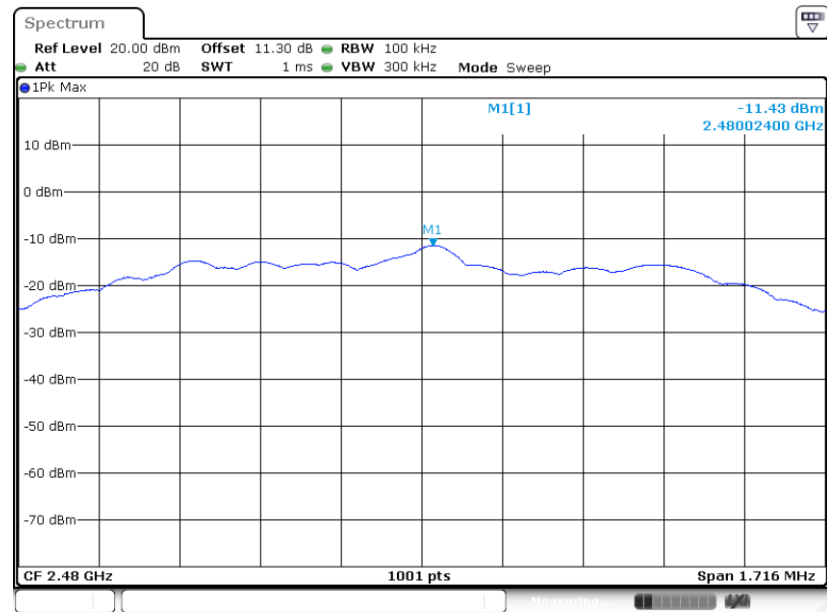


PSD 100kHz Plot on Channel 19



Date: 30 JUL 2024 15:25:27

PSD 100kHz Plot on Channel 39



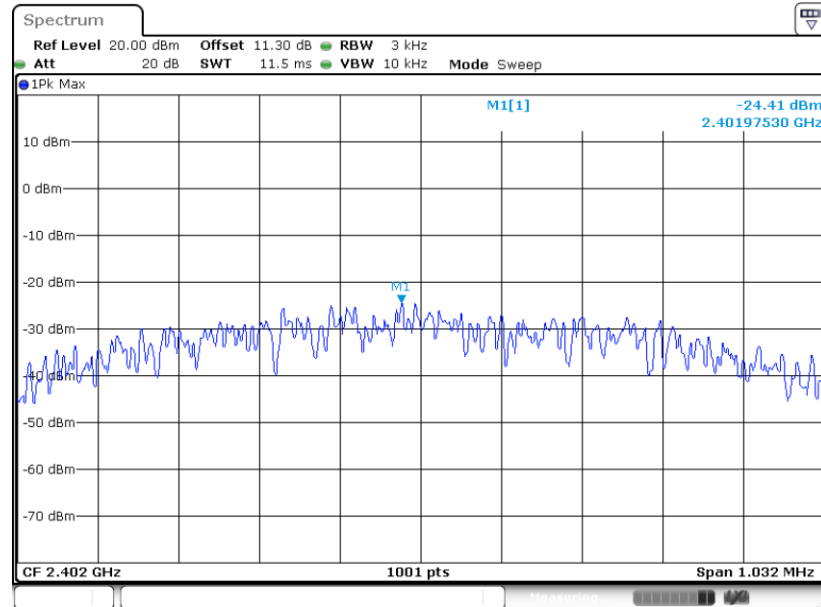
Date: 30 JUL 2024 15:02:51



3.3.7 Test Result of Power Spectral Density Plots (3kHz)

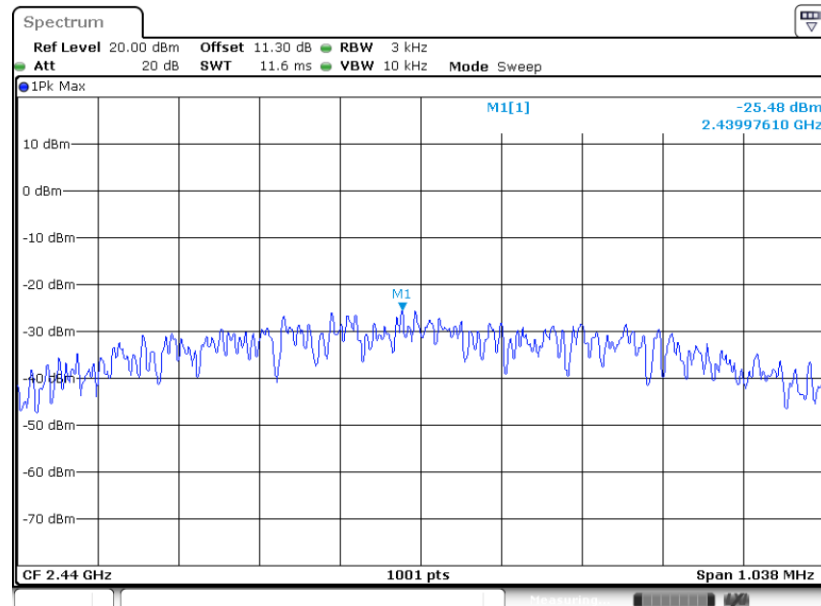
BLE 1Mbps

PSD 3kHz Plot on Channel 00



Date: 30 JUL 2024 15:38:42

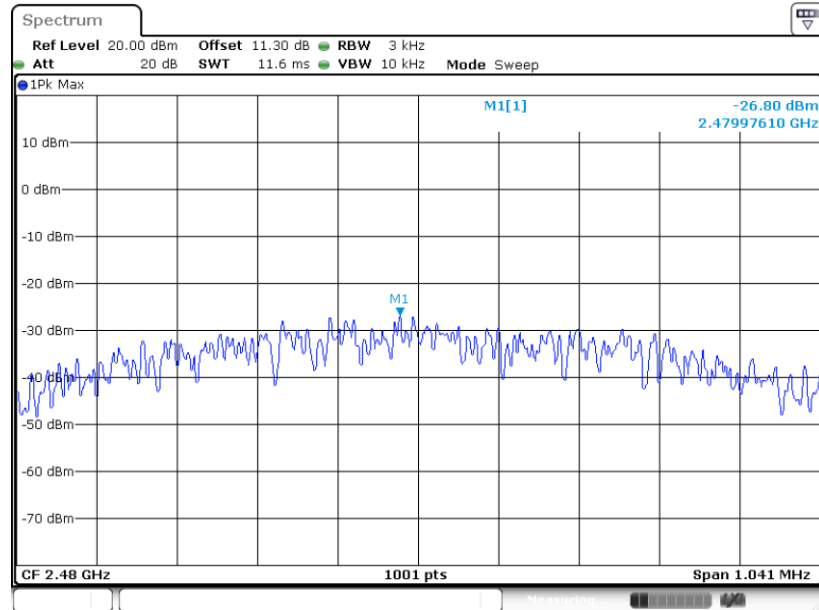
PSD 3kHz Plot on Channel 19



Date: 30 JUL 2024 15:36:18



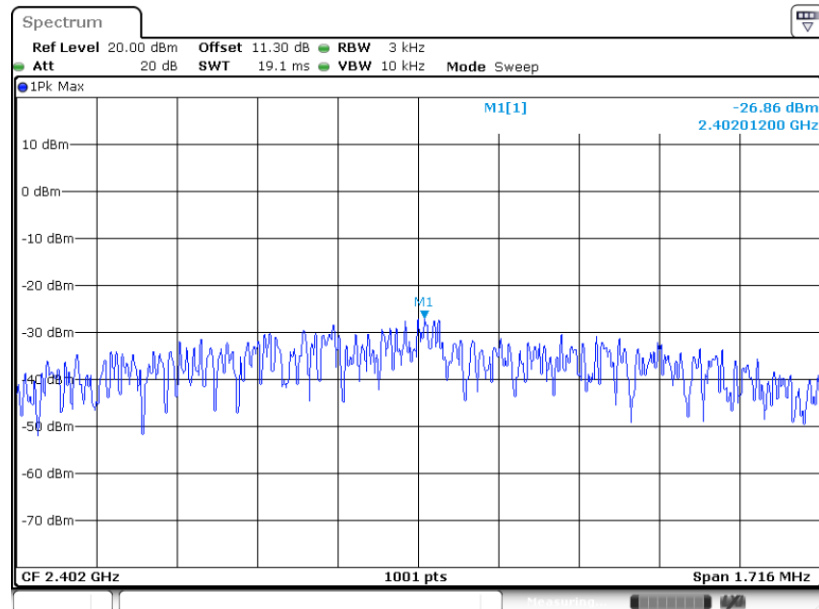
PSD 3kHz Plot on Channel 39



Date: 30 JUL 2024 15:34:29

BLE 2Mbps

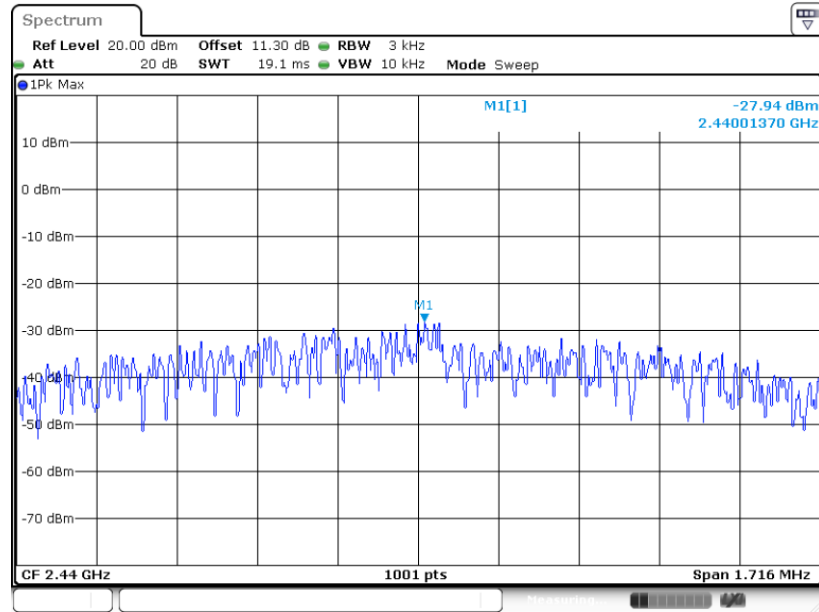
PSD 3kHz Plot on Channel 00



Date: 30 JUL 2024 15:30:41

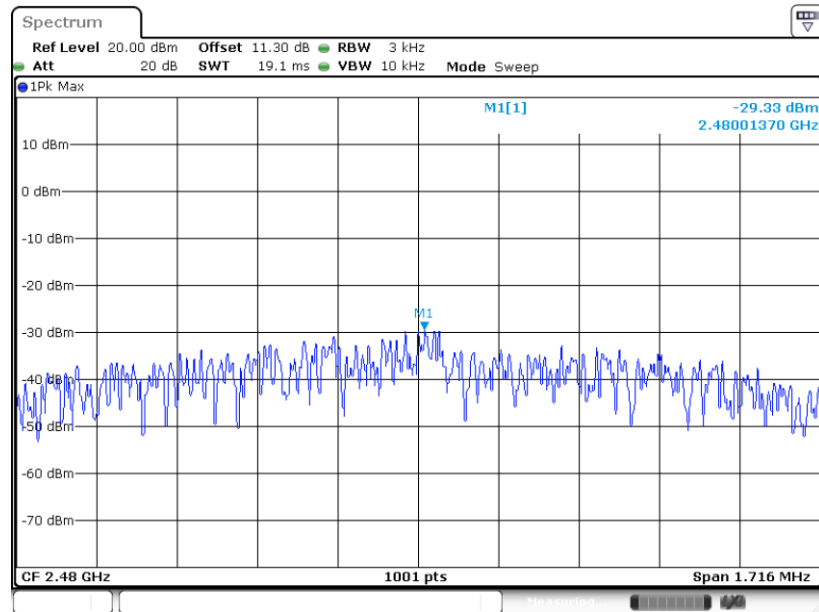


PSD 3kHz Plot on Channel 19



Date: 30 JUL 2024 15:25:08

PSD 3kHz Plot on Channel 39



Date: 30 JUL 2024 15:02:35

3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission

All harmonics/spurious must be at least 20 dB down from the highest emission level within the authorized band.

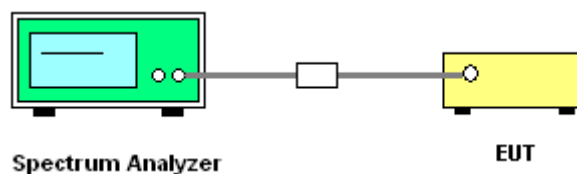
3.4.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.4.3 Test Procedure

1. The testing follows ANSI C63.10-2013 clause 11.13
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. 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.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.4.4 Test Setup

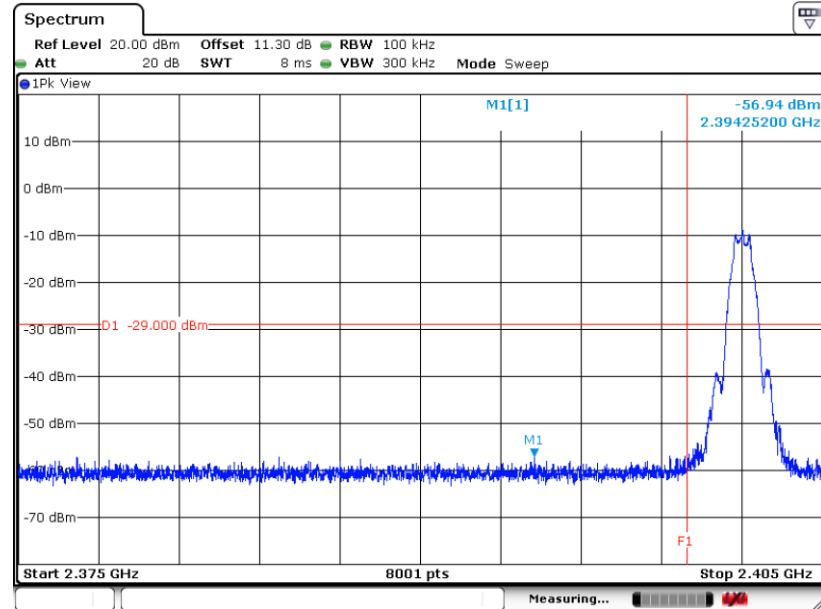




3.4.5 Test Result of Conducted Band Edges Plots

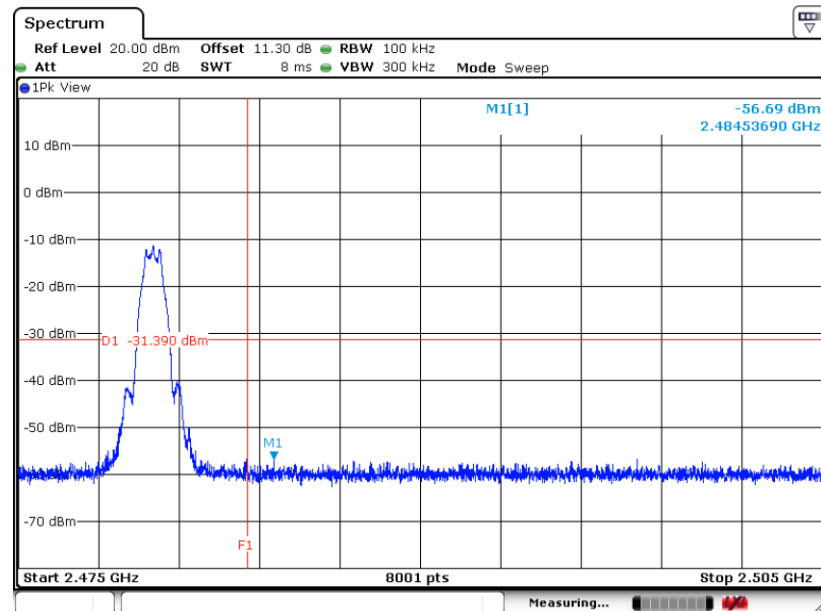
BLE 1Mbps

Low Band Edge Plot on Channel 00



Date: 30.JUL.2024 15:39:50

High Band Edge Plot on Channel 39

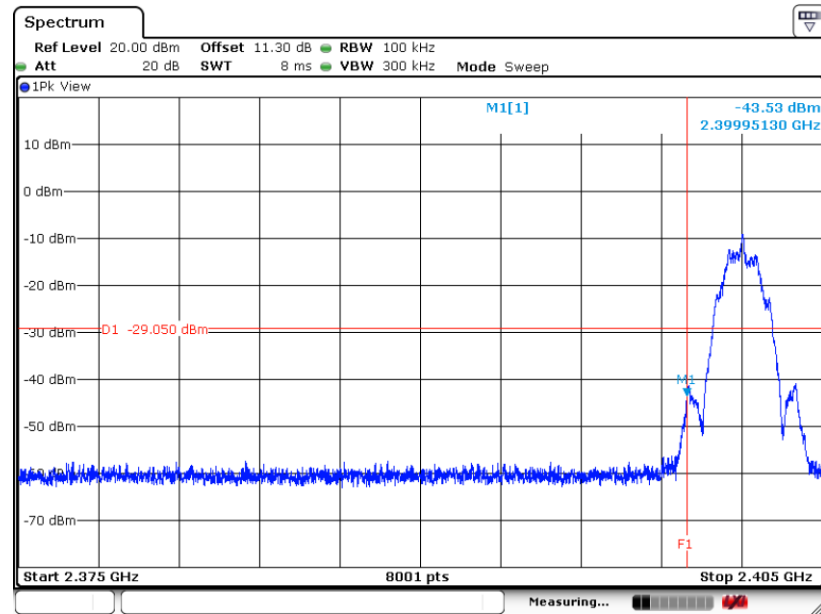


Date: 30.JUL.2024 15:35:32



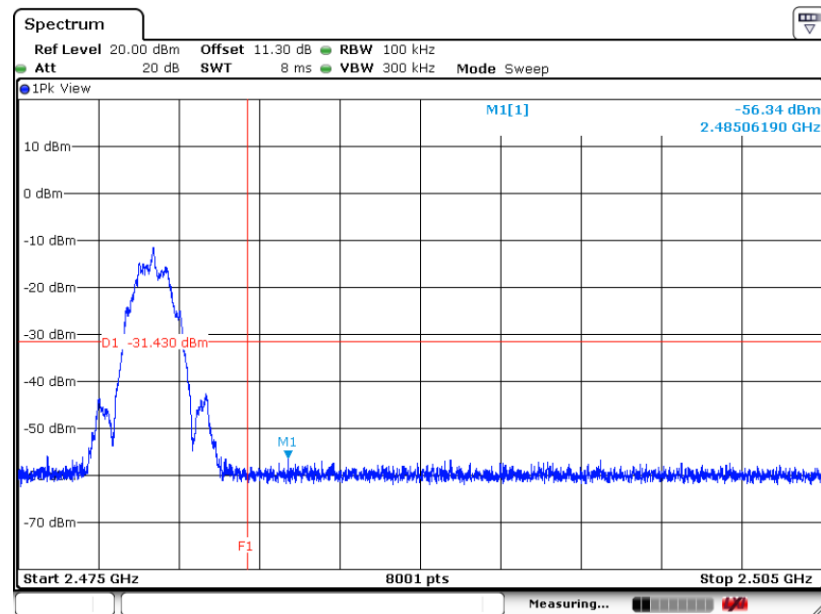
BLE 2Mbps

Low Band Edge Plot on Channel 00



Date: 30 JUL 2024 15:33:09

High Band Edge Plot on Channel 39

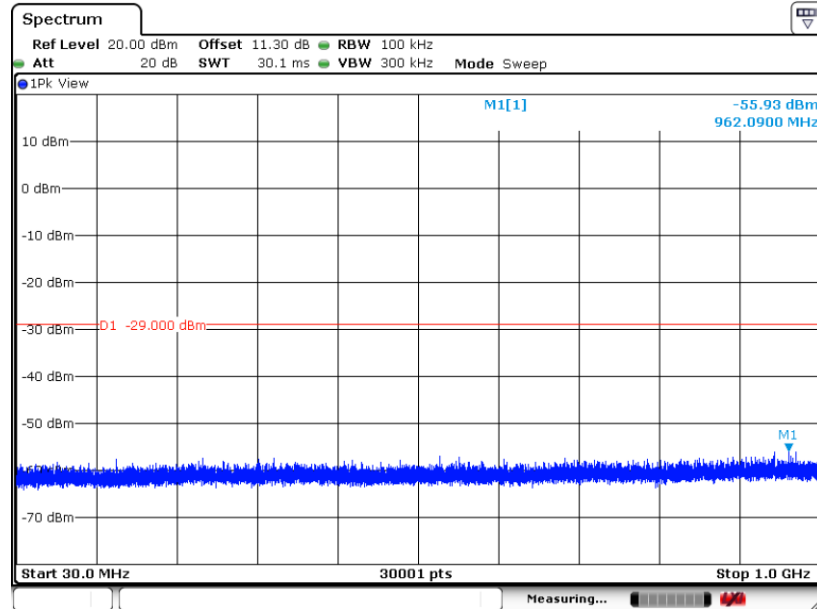


Date: 30 JUL 2024 15:04:04



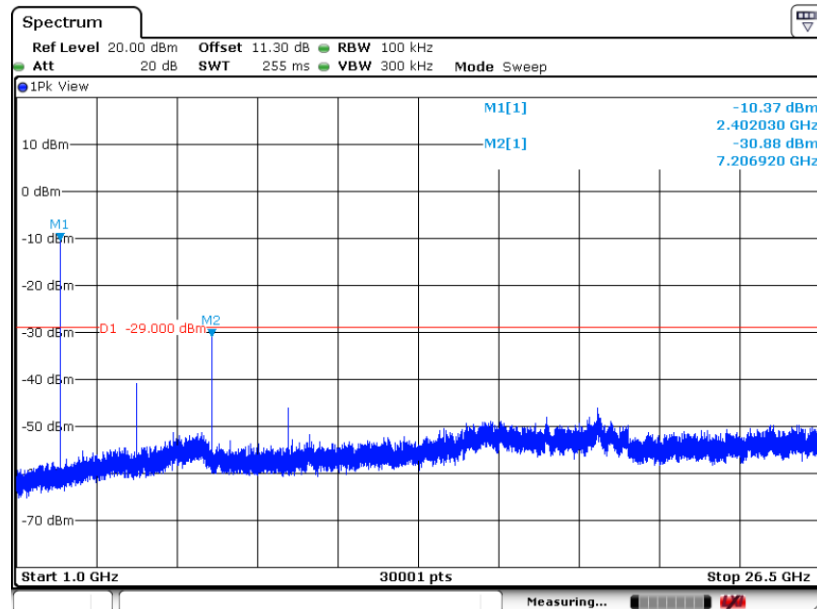
3.4.6 Test Result of Conducted Spurious Emission Plots

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 00



Date: 30.JUL.2024 15:39:15

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 00

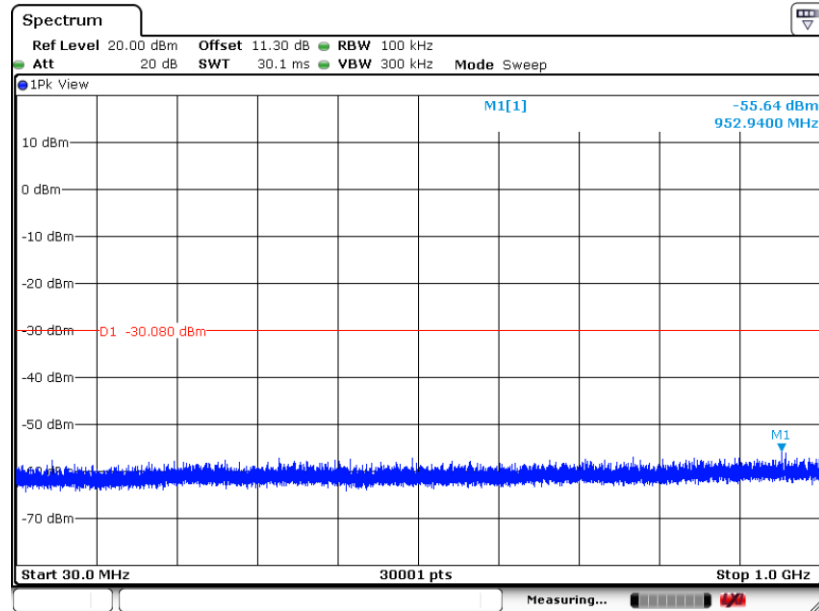


Date: 30.JUL.2024 15:39:39



Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

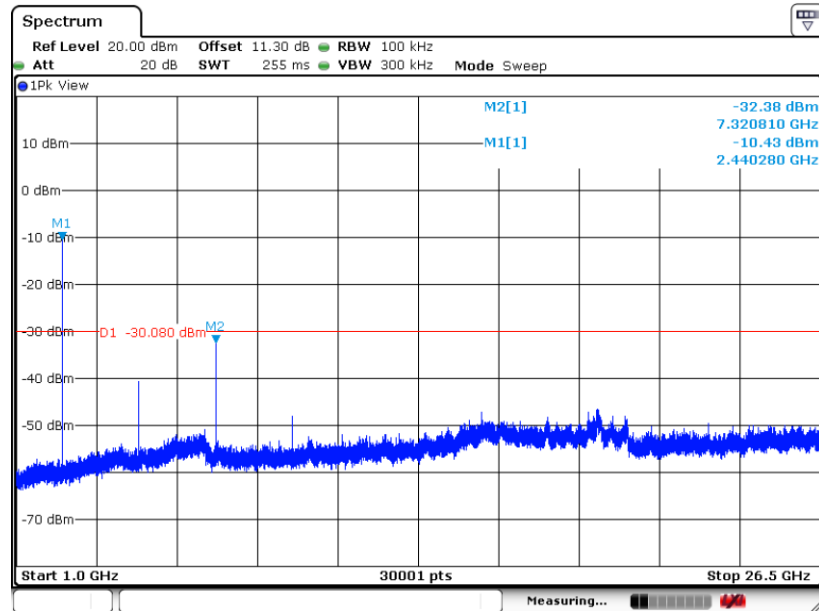
GFSK Channel 19



Date: 30 JUL 2024 15:36:57

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

GFSK Channel 19

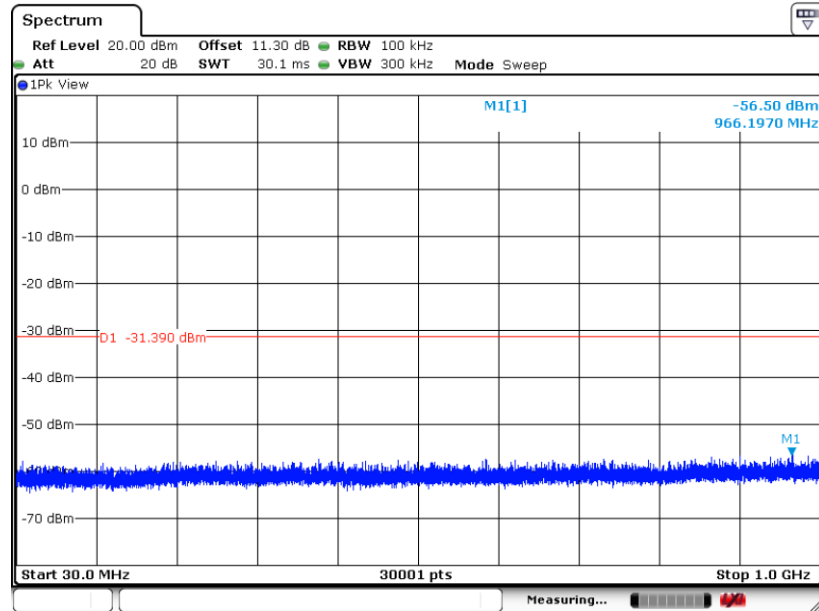


Date: 30 JUL 2024 15:37:43



Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

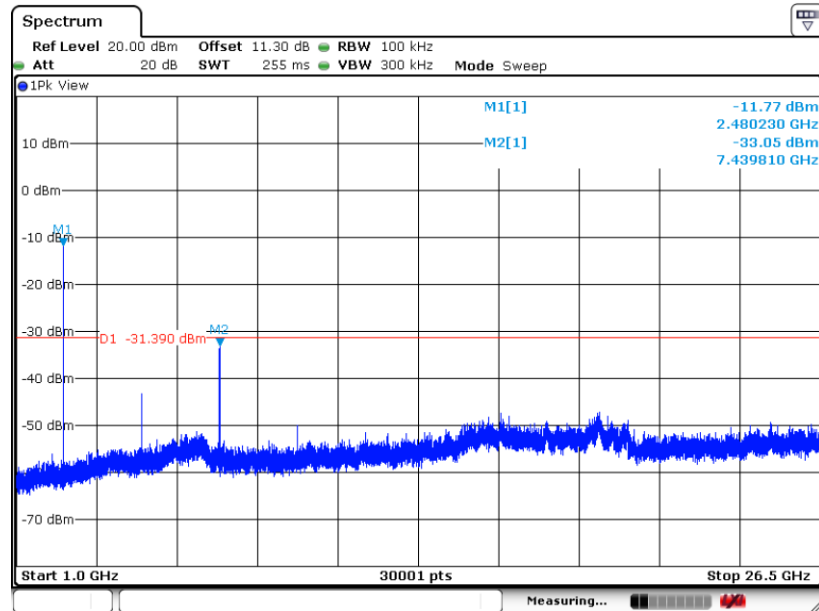
GFSK Channel 39



Date: 30 JUL 2024 15:35:01

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

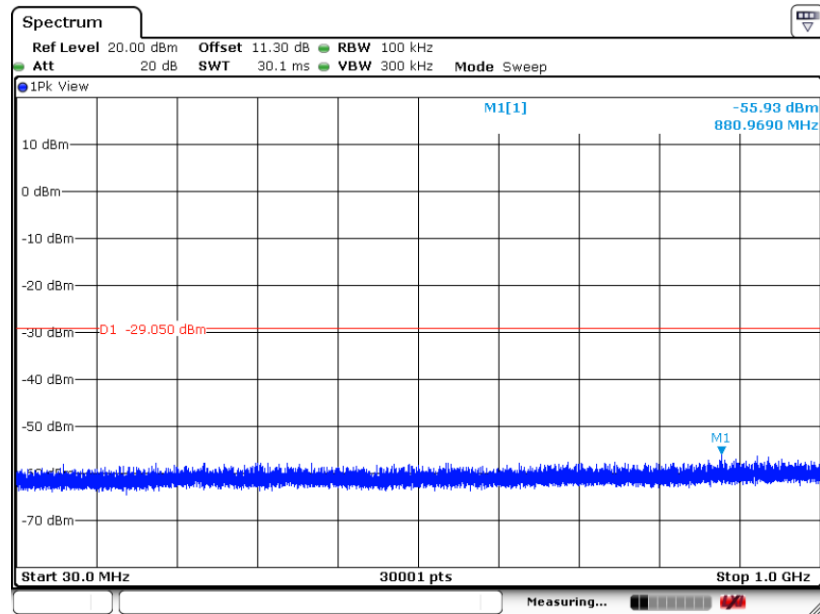
GFSK Channel 39



Date: 30 JUL 2024 15:35:20

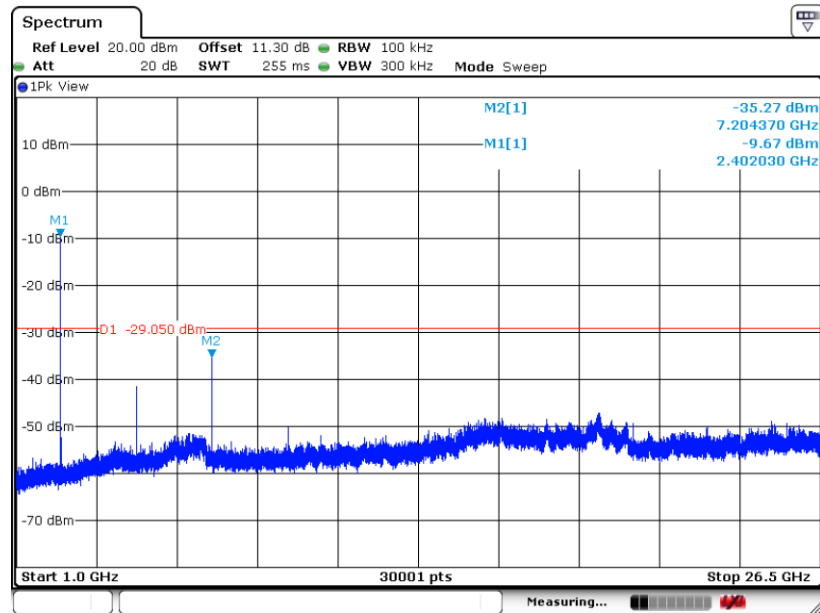


Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 00



Date: 30 JUL 2024 15:31:17

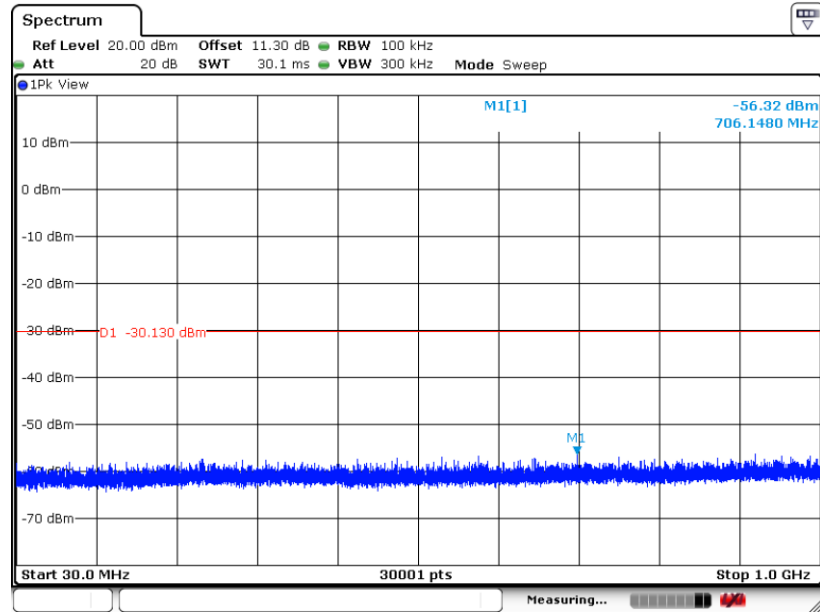
Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 00



Date: 30 JUL 2024 15:32:59

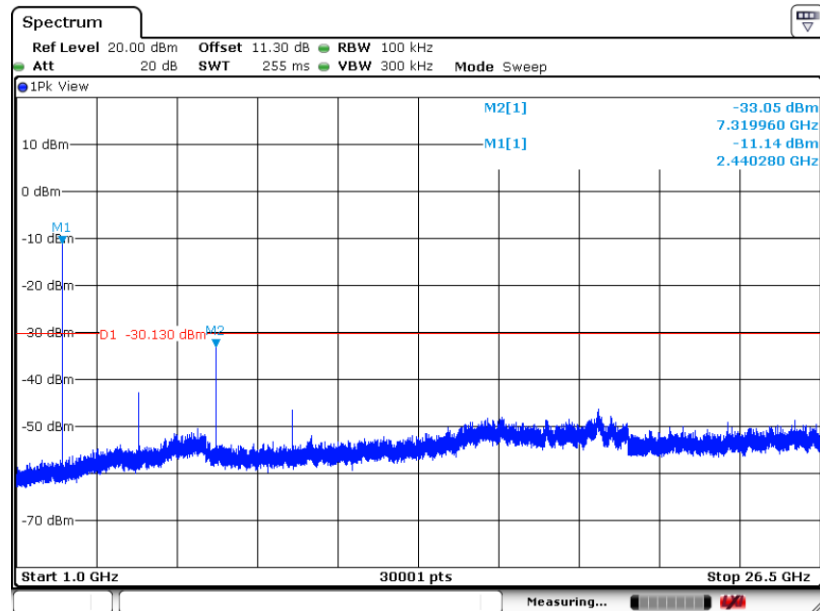


Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 19



Date: 30 JUL 2024 15:28:48

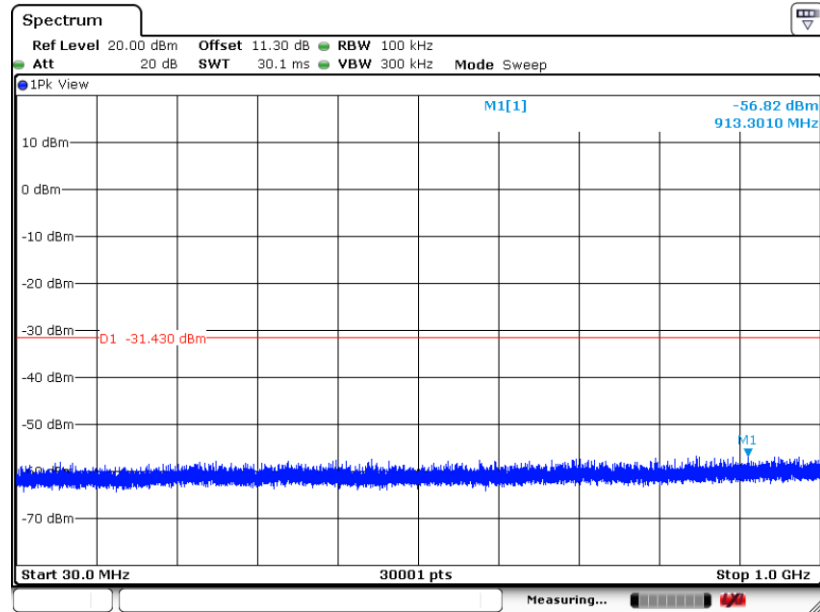
Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 19



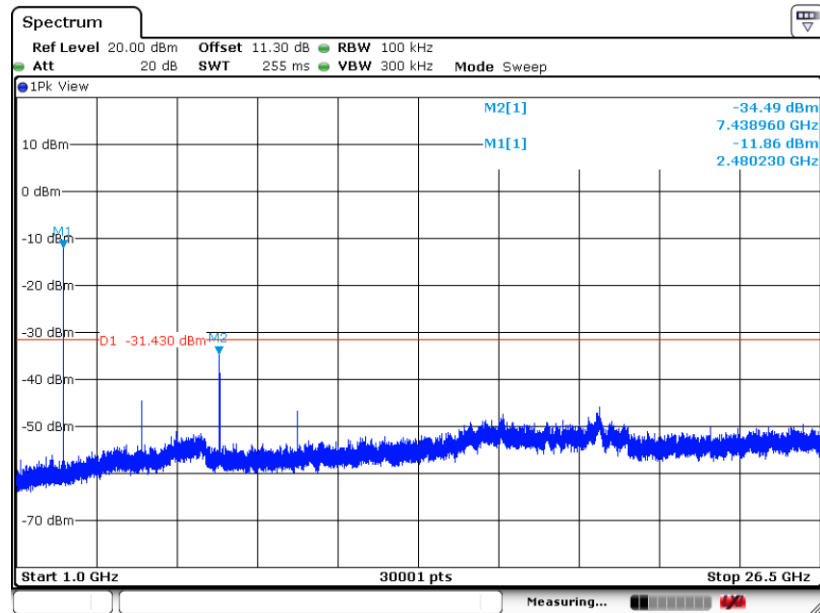
Date: 30 JUL 2024 15:29:49



Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 39



Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 39



3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

3.5.2 Measuring Instruments

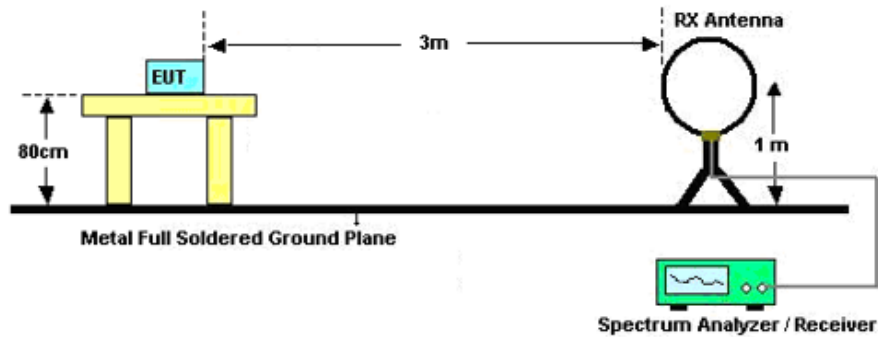
The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.5.3 Test Procedures

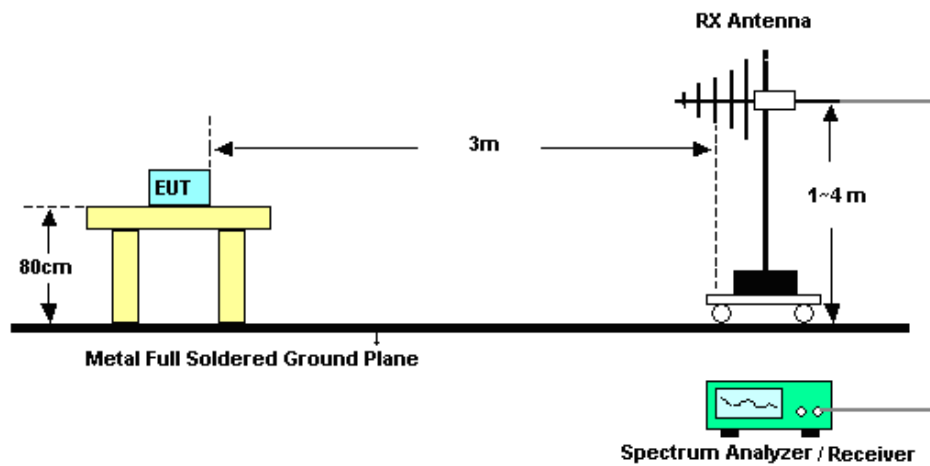
1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
8. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW=100 kHz for $f < 1$ GHz; $VBW \geq RBW$; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW= 3MHz for $f \geq 1$ GHz for peak measurement.
For average measurement:
 - $VBW = 10$ Hz, when duty cycle is no less than 98 percent.
 - $VBW \geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.5.4 Test Setup

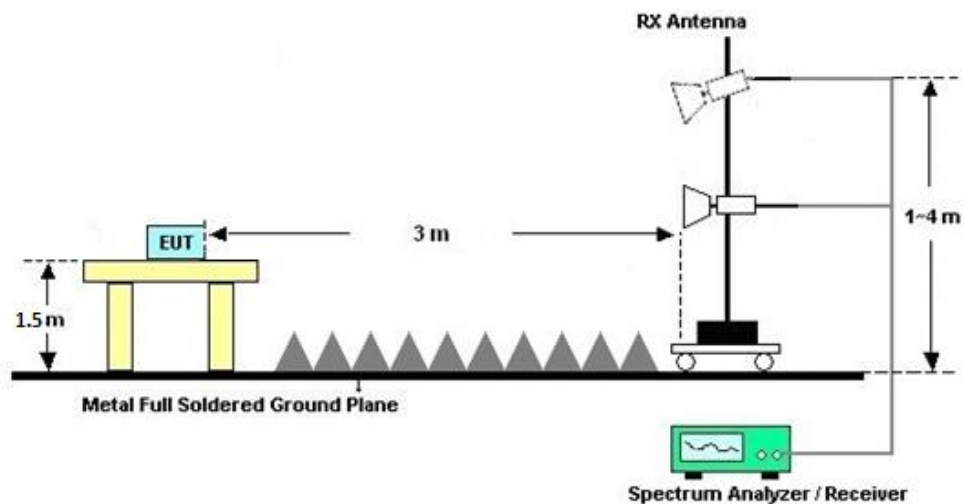
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



**3.5.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)**

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B.

3.5.7 Duty Cycle

Please refer to Appendix C.

3.5.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic or 40GHz, whichever is lower)

Please refer to Appendix B.



3.6 Antenna Requirements

3.6.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.6.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.6.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
EMI Test Receiver&SA	KEYSIGHT	N9038A	MY54450083	20Hz~8.4GHz	Apr. 09, 2024	Jul. 29, 2024~ Jul. 30, 2024	Apr. 08, 2025	Radiation (03CH03-SZ)
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY55150246	10Hz~44GHz;	Apr. 09, 2024	Jul. 29, 2024~ Jul. 30, 2024	Apr. 08, 2025	Radiation (03CH03-SZ)
Loop Antenna	R&S	HFH2-Z2	100354	9kHz~30MHz	Jul. 28, 2024	Jul. 29, 2024~ Jul. 30, 2024	Jul. 27, 2025	Radiation (03CH03-SZ)
Bilog Antenna	TeseQ	CBL6112D	35408	30MHz-2GHz	Aug. 20, 2023	Jul. 29, 2024~ Jul. 30, 2024	Aug. 19, 2025	Radiation (03CH03-SZ)
Double Ridge Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-1355	1GHz~18GHz	Apr. 09, 2024	Jul. 29, 2024~ Jul. 30, 2024	Apr. 08, 2025	Radiation (03CH03-SZ)
SHF-EHF Horn	com-power	AH-840	101071	18Ghz-40GHz	Apr. 09, 2024	Jul. 29, 2024~ Jul. 30, 2024	Apr. 08, 2025	Radiation (03CH03-SZ)
Amplifier	Burgeon	BPA-530	102211	0.01Hz ~3000MHz	Oct. 18, 2023	Jul. 29, 2024~ Jul. 30, 2024	Oct. 17, 2024	Radiation (03CH03-SZ)
HF Amplifier	MITEQ	AMF-7D-0010 1800-30-10P-R	1943528	1GHz~18GHz	Oct. 18, 2023	Jul. 29, 2024~ Jul. 30, 2024	Oct. 17, 2024	Radiation (03CH03-SZ)
Amplifier	Agilent Technologies	83017A	MY39501302	500MHz~26.5GHz	Dec. 27, 2023	Jul. 29, 2024~ Jul. 30, 2024	Dec. 26, 2024	Radiation (03CH03-SZ)
HF Amplifier	MITEQ	TTA1840-35-HG	1871923	18GHz~40GHz	Jul. 03, 2024	Jul. 29, 2024~ Jul. 30, 2024	Jul. 02, 2025	Radiation (03CH03-SZ)
AC Power Source	Chroma	61601	6160100027 29	N/A	Oct. 18, 2023	Jul. 29, 2024~ Jul. 30, 2024	Oct. 17, 2024	Radiation (03CH03-SZ)
Turn Table	EM	EM1000	N/A	0~360 degree	NCR	Jul. 29, 2024~ Jul. 30, 2024	NCR	Radiation (03CH03-SZ)
Antenna Mast	EM	EM1000	N/A	1 m~4 m	NCR	Jul. 29, 2024~ Jul. 30, 2024	NCR	Radiation (03CH03-SZ)
Spectrum Analyzer	R&S	FSV40	101078	10Hz~40GHz	Apr. 09, 2024	Jul. 30, 2024	Apr. 08, 2025	Conducted (TH01-SZ)
Pulse Power Sensor	Anritsu	MA2411B	1339473	30MHz~40GHz	Dec. 29, 2023	Jul. 30, 2024	Dec. 28, 2024	Conducted (TH01-SZ)
Power Meter	Anritsu	ML2495A	1218010	50MHz Bandwidth	Aug. 21, 2023	Jul. 30, 2024	Aug. 20, 2024	Conducted (TH01-SZ)
Thermo meter	Anymetre	JR593	#7	- 10℃ ~ 50℃ 10%RH~99%RH	Apr. 09, 2024	Jul. 30, 2024	Apr. 08, 2025	Conducted (TH01-SZ)

NCR: No Calibration Required

5 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of Conducted Measurement

Test Item	Uncertainty
Conducted Spurious Emission & Bandedge	±1.34 dB
Occupied Channel Bandwidth	±0.012 MHz
Conducted Power	±1.34 dB
Conducted Power Spectral Density	±1.32 dB
Frequency	±1.3 Hz

Uncertainty of Radiated Emission Measurement (9 KHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.0 dB
---	--------

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.0 dB
---	--------

Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	4.9 dB
---	--------

Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.0 dB
---	--------

----- THE END -----



Appendix A. Conducted Test Results

Appendix A. Test Result of Conducted Test Items

Test Engineer:	Sam Zheng	Temperature:	21~25	°C
Test Date:	2024/7/30	Relative Humidity:	51~54	%

TEST RESULTS DATA 6dB and 99% Occupied Bandwidth								
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
BLE	1Mbps	1	0	2402	1.039	0.688	0.50	Pass
BLE	1Mbps	1	19	2440	1.043	0.692	0.50	Pass
BLE	1Mbps	1	39	2480	1.045	0.694	0.50	Pass

TEST RESULTS DATA Peak Power Table											
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak Conducted Power (dBm)	Power Setting	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE	1Mbps	1	0	2402	-8.86	2.00	30.00	2.80	-6.06	36.00	Pass
BLE	1Mbps	1	19	2440	-9.55	2.00	30.00	2.80	-6.75	36.00	Pass
BLE	1Mbps	1	39	2480	-10.78	2.00	30.00	2.80	-7.98	36.00	Pass

TEST RESULTS DATA Average Power Table (Reference Only)												
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)	Power Setting	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE	1Mbps	1	0	2402	2.04	-9.30	2.00	30.00	2.80	-6.50	36.00	Pass
BLE	1Mbps	1	19	2440	2.04	-10.70	2.00	30.00	2.80	-7.90	36.00	Pass
BLE	1Mbps	1	39	2480	2.04	-11.90	2.00	30.00	2.80	-9.10	36.00	Pass

TEST RESULTS DATA Peak Power Density									
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
BLE	1Mbps	1	0	2402	-9.00	-24.41	2.80	8.00	Pass
BLE	1Mbps	1	19	2440	-10.08	-25.48	2.80	8.00	Pass
BLE	1Mbps	1	39	2480	-11.39	-26.80	2.80	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 20dBc limit.

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
BLE	2Mbps	1	0	2402	2.038	1.144	0.50	Pass
BLE	2Mbps	1	19	2440	2.038	1.144	0.50	Pass
BLE	2Mbps	1	39	2480	2.042	1.144	0.50	Pass

TEST RESULTS DATA
Peak Power Table

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak Conducted Power (dBm)	Power Setting	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE5.0	2Mbps	1	0	2402	-8.88	2.00	30.00	2.80	-6.08	36.00	Pass
BLE5.0	2Mbps	1	19	2440	-9.64	2.00	30.00	2.80	-6.84	36.00	Pass
BLE5.0	2Mbps	1	39	2480	-10.83	2.00	30.00	2.80	-8.03	36.00	Pass

TEST RESULTS DATA
Average Power Table
(Reference Only)

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)	Power Setting	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE	2Mbps	1	0	2402	4.83	-9.40	2.00	30.00	2.80	-6.60	36.00	Pass
BLE	2Mbps	1	19	2440	4.83	-10.80	2.00	30.00	2.80	-8.00	36.00	Pass
BLE	2Mbps	1	39	2480	4.83	-12.00	2.00	30.00	2.80	-9.20	36.00	Pass

TEST RESULTS DATA
Peak Power Density

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
BLE	2Mbps	1	0	2402	-9.05	-26.86	2.80	8.00	Pass
BLE	2Mbps	1	19	2440	-10.13	-27.94	2.80	8.00	Pass
BLE	2Mbps	1	39	2480	-11.43	-29.33	2.80	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 20dBc limit.



Appendix B Radiated Spurious Emission Test Data

Test Engineer :	Reid Huang	Relative Humidity :	48~49%
		Temperature :	24-25°C

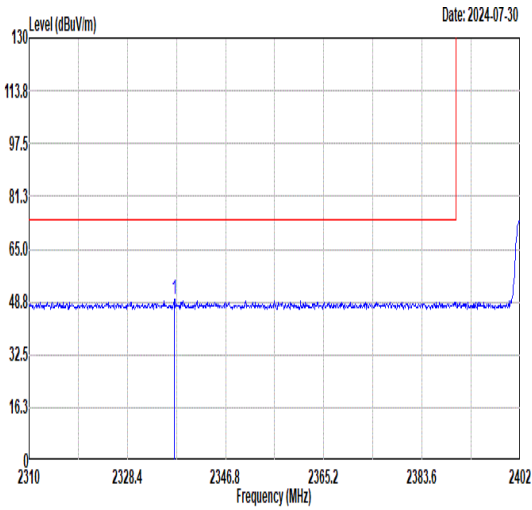
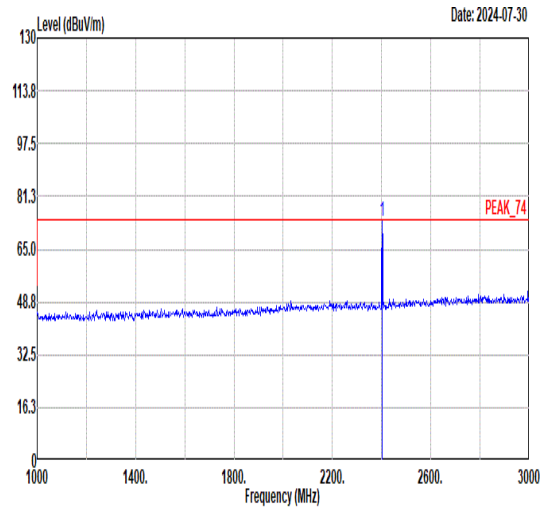
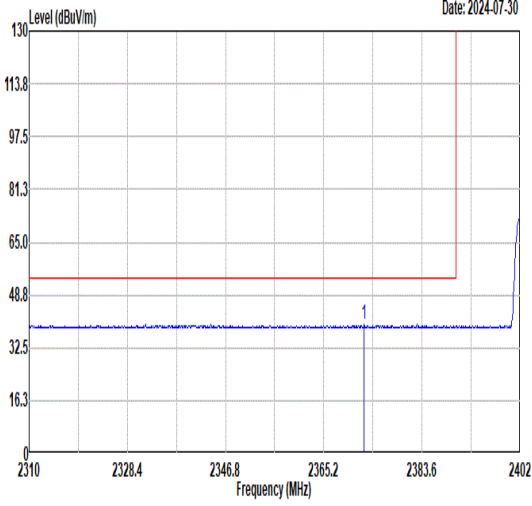
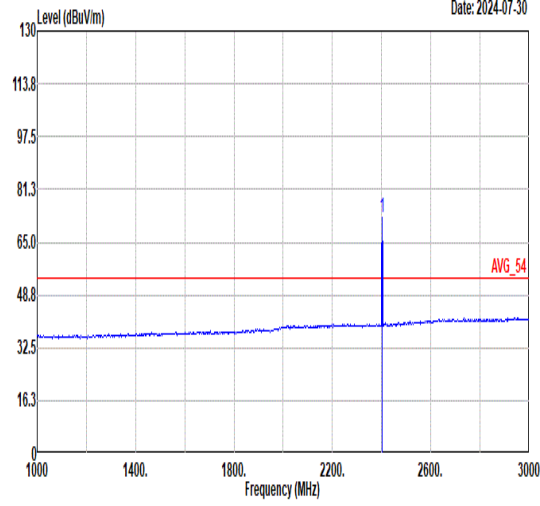
Radiated Spurious Emission Test Modes

Mode	Band (MHz)	Antenna	Modulation	Channel	Frequency	Data Rate	RU	Remark
Mode 1	2400-2483.5	SISO	Bluetooth-LE_GSKF	00	2402	1Mbps	-	-
Mode 2	2400-2483.5	SISO	Bluetooth-LE_GSKF	19	2440	1Mbps	-	-
Mode 3	2400-2483.5	SISO	Bluetooth-LE_GSKF	39	2480	1Mbps	-	-
Mode 4	2400-2483.5	SISO	Bluetooth-LE_GSKF	00	2402	2Mbps	-	-
Mode 5	2400-2483.5	SISO	Bluetooth-LE_GSKF	39	2480	2Mbps	-	-
Mode 6	2400-2483.5	SISO	Bluetooth-LE_GSKF	39	2480	1Mbps	-	LF

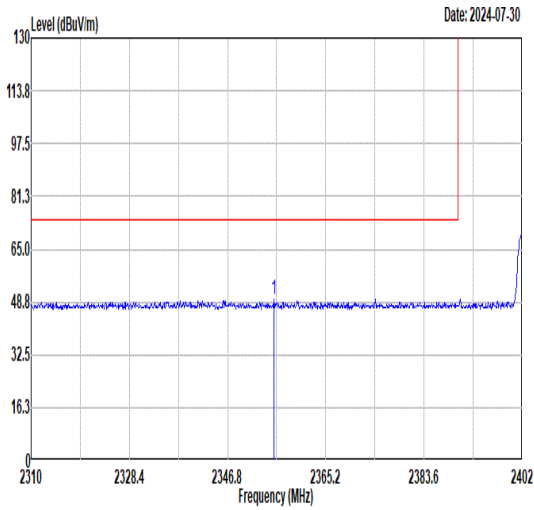
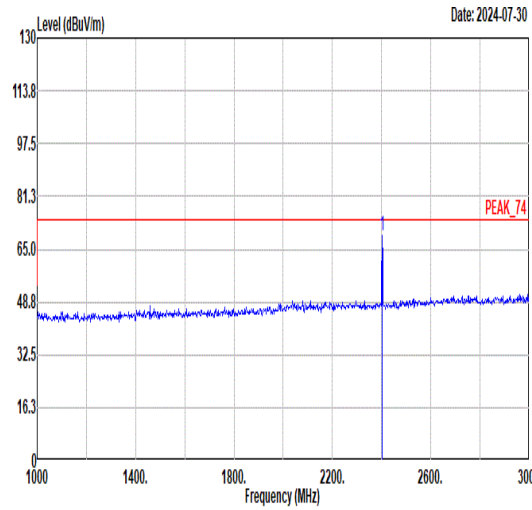
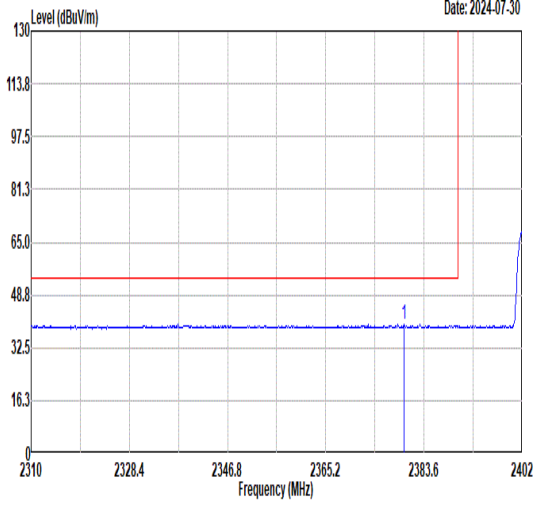
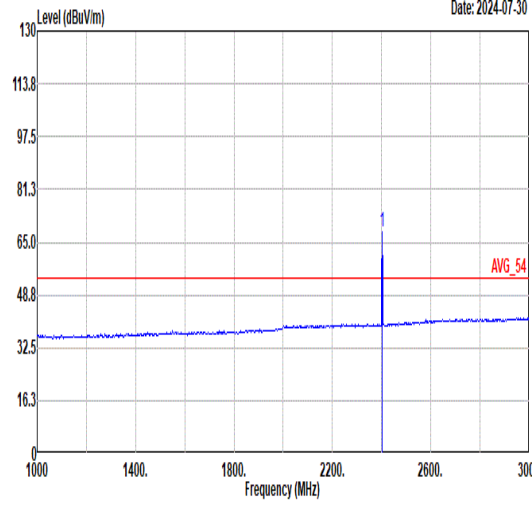
Summary of each worse mode

Mode	Modulation	Ch.	Freq. (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol.	Peak Avg.	Result	Remark
1	Bluetooth-LE_GSKF	00	2379.92	39.79	54.00	-14.21	V	AVERAGE	Pass	Band Edge
1	Bluetooth-LE_GSKF	00	4804.00	41.45	74.00	-32.55	H	Peak	Pass	Harmonic
2	Bluetooth-LE_GSKF	19	-	-	-	-	-	-	-	Band Edge
2	Bluetooth-LE_GSKF	19	7320.00	44.16	74.00	-29.84	H	Peak	Pass	Harmonic
3	Bluetooth-LE_GSKF	39	2486.40	40.33	54.00	-13.67	V	AVERAGE	Pass	Band Edge
3	Bluetooth-LE_GSKF	39	7440.00	44.53	74.00	-29.47	V	Peak	Pass	Harmonic
4	Bluetooth-LE_GSKF	00	2388.48	41.55	54.00	-12.45	H	AVERAGE	Pass	Band Edge
4	Bluetooth-LE_GSKF	00	-	-	-	-	-	-	-	Harmonic
5	Bluetooth-LE_GSKF	39	2496.12	42.22	54.00	-11.78	V	AVERAGE	Pass	Band Edge
5	Bluetooth-LE_GSKF	39	7440	44.24	74	-29.76	H	Peak	Pass	Harmonic
6	Bluetooth-LE_GSKF	39	948.59	31.41	46	-14.59	V	Peak	Pass	LF



Mode	1																																																																																														
	Band Edge																																																																																														
	2400-2483.5_Bluetooth-LE_GSKF_CH00_2402MHz																																																																																														
ANT	SISO																																																																																														
Pol.	Horizontal						Fundamental																																																																																								
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1	4880.00	41.75	74.00	-32.25	64.89	34.34	7.77	65.25	--	--	Peak																																																																																																																							
2	7320.00	43.26	74.00	-30.74	63.50	35.44	8.96	64.64	--	--	Peak																																																																																																																							



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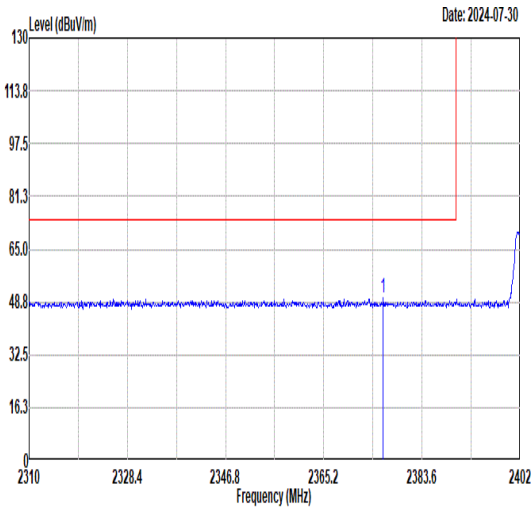
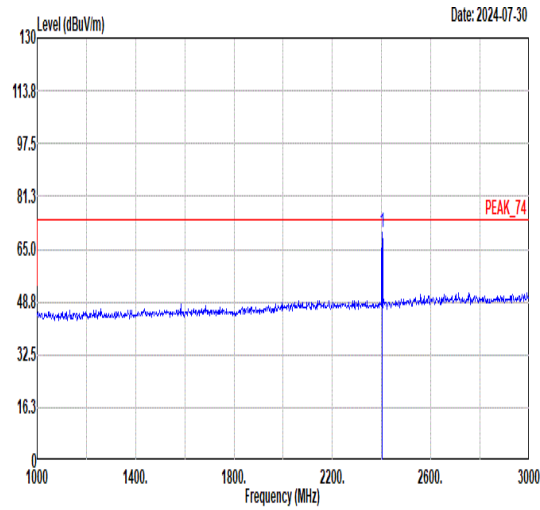
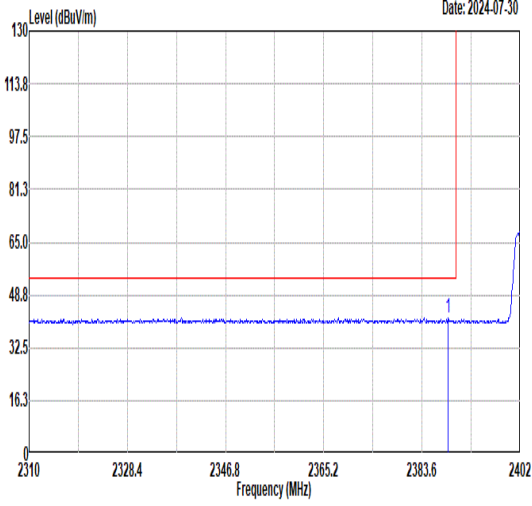
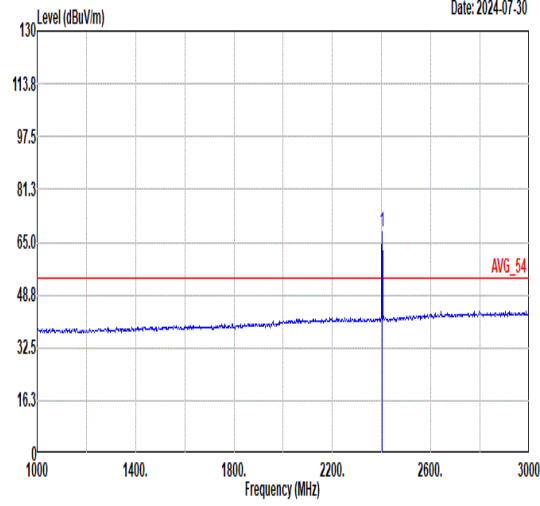


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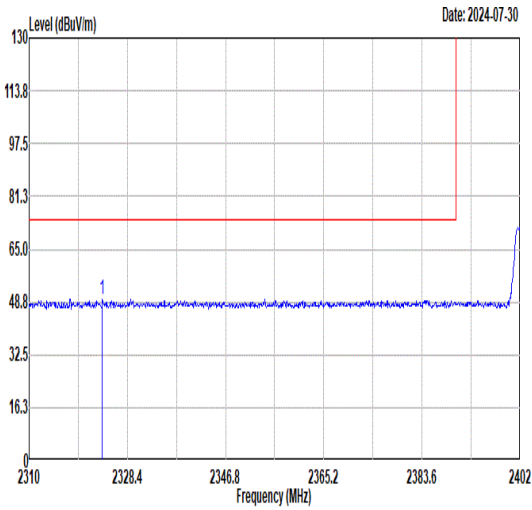
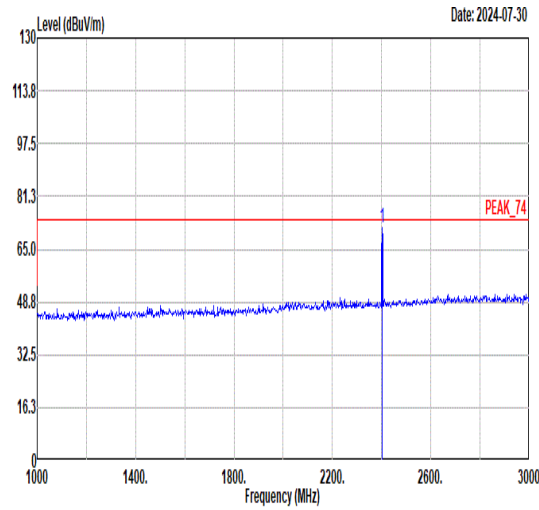
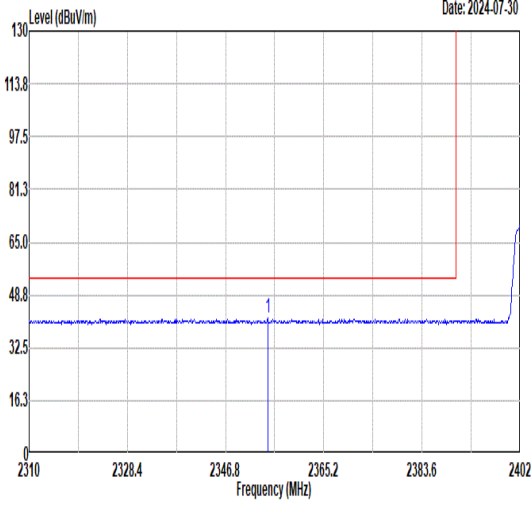
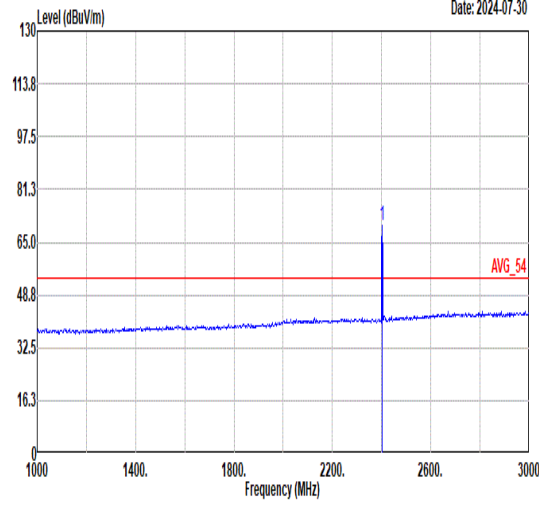


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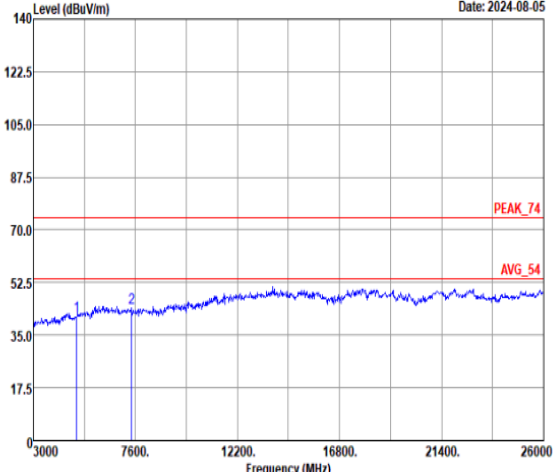
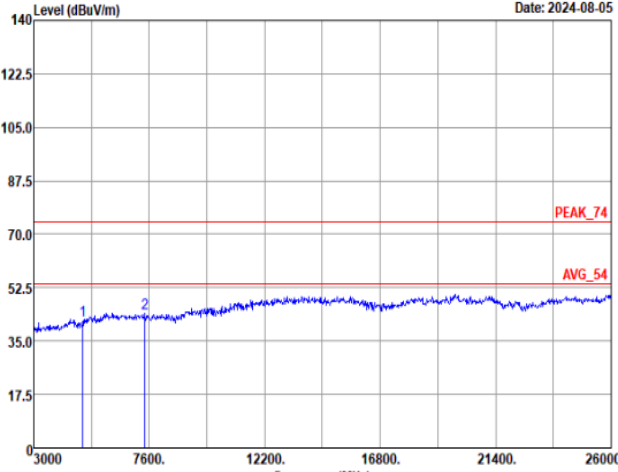
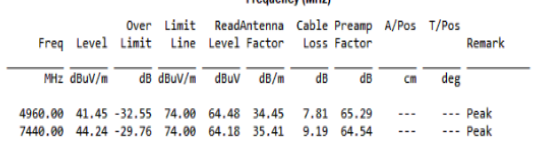
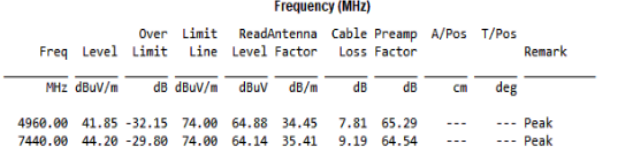


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Peak	Level (dBuV/m) Date: 2024-07-30 PEAK_BE_74 <table><tr><th>Freq</th><th>Level</th><th>Limit</th><th>Read</th><th>Ant</th><th>Cable</th><th>Preamp</th><th>APos</th><th>TPos</th><th>Remark</th></tr><tr><th>MHz</th><th>dBuV/m</th><th>dBuV/m</th><th>dB</th><th>dBuV</th><th>dB/m</th><th>dB</th><th>dB</th><th>cm</th><th>deg</th></tr><tr><td>1</td><td>2499.44</td><td>50.32</td><td>74.00</td><td>-23.68</td><td>47.96</td><td>30.92</td><td>4.94</td><td>33.50</td><td>400</td><td>274</td><td>PEAK</td></tr></table>					Freq	Level	Limit	Read	Ant	Cable	Preamp	APos	TPos	Remark	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	cm	deg	1	2499.44	50.32	74.00	-23.68	47.96	30.92	4.94	33.50	400	274	PEAK	Level (dBuV/m) Date: 2024-07-30 PEAK_74 <table><tr><th>Freq</th><th>Level</th><th>Limit</th><th>Read</th><th>Ant</th><th>Cable</th><th>Preamp</th><th>APos</th><th>TPos</th><th>Remark</th></tr><tr><th>MHz</th><th>dBuV/m</th><th>dBuV/m</th><th>dB</th><th>dBuV</th><th>dB/m</th><th>dB</th><th>dB</th><th>cm</th><th>deg</th></tr><tr><td>1</td><td>2480.00</td><td>75.30</td><td>-----</td><td>-----</td><td>73.05</td><td>30.84</td><td>4.92</td><td>33.51</td><td>400</td><td>274</td><td>PEAK</td></tr></table>					Freq	Level	Limit	Read	Ant	Cable	Preamp	APos	TPos	Remark	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	cm	deg	1	2480.00	75.30	-----	-----	73.05	30.84	4.92	33.51	400	274	PEAK
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Avg	Level (dBuV/m) Date: 2024-07-30 AVG_BE_54 <table><tr><th>Freq</th><th>Level</th><th>Limit</th><th>Read</th><th>Ant</th><th>Cable</th><th>Preamp</th><th>APos</th><th>TPos</th><th>Remark</th></tr><tr><th>MHz</th><th>dBuV/m</th><th>dBuV/m</th><th>dB</th><th>dBuV</th><th>dB/m</th><th>dB</th><th>dB</th><th>cm</th><th>deg</th></tr><tr><td>1</td><td>2496.12</td><td>42.22</td><td>54.00</td><td>-11.78</td><td>39.88</td><td>30.90</td><td>4.94</td><td>33.50</td><td>400</td><td>274</td><td>AVERAGE</td></tr></table>					Freq	Level	Limit	Read	Ant	Cable	Preamp	APos	TPos	Remark	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	cm	deg	1	2496.12	42.22	54.00	-11.78	39.88	30.90	4.94	33.50	400	274	AVERAGE	Level (dBuV/m) Date: 2024-07-30 AVG_54 <table><tr><th>Freq</th><th>Level</th><th>Limit</th><th>Read</th><th>Ant</th><th>Cable</th><th>Preamp</th><th>APos</th><th>TPos</th><th>Remark</th></tr><tr><th>MHz</th><th>dBuV/m</th><th>dBuV/m</th><th>dB</th><th>dBuV</th><th>dB/m</th><th>dB</th><th>dB</th><th>cm</th><th>deg</th></tr><tr><td>1</td><td>2480.00</td><td>73.39</td><td>-----</td><td>-----</td><td>71.14</td><td>30.84</td><td>4.92</td><td>33.51</td><td>400</td><td>274</td><td>AVERAGE</td></tr></table>					Freq	Level	Limit	Read	Ant	Cable	Preamp	APos	TPos	Remark	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	cm	deg	1	2480.00	73.39	-----	-----	71.14	30.84	4.92	33.51	400	274	AVERAGE
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	<table><tr><th></th><th>Freq</th><th>Level</th><th>Over</th><th>Limit</th><th>ReadAntenna</th><th>Cable</th><th>Preamp</th><th>A/Pos</th><th>T/Pos</th><th>Remark</th></tr><tr><th></th><th>MHz</th><th>dBuV/m</th><th>dB</th><th>dBuV/m</th><th>dBuV</th><th>dB/m</th><th>dB</th><th>dB</th><th>cm</th><th>deg</th></tr><tr><td>1</td><td>4960.00</td><td>41.45</td><td>-32.55</td><td>74.00</td><td>64.48</td><td>34.45</td><td>7.81</td><td>65.29</td><td>---</td><td>---</td><td>Peak</td></tr><tr><td>2</td><td>7440.00</td><td>44.24</td><td>-29.76</td><td>74.00</td><td>64.18</td><td>35.41</td><td>9.19</td><td>64.54</td><td>---</td><td>---</td><td>Peak</td></tr></table>							Freq	Level	Over	Limit	ReadAntenna	Cable	Preamp	A/Pos	T/Pos	Remark		MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	cm	deg	1	4960.00	41.45	-32.55	74.00	64.48	34.45	7.81	65.29	---	---	Peak	2	7440.00	44.24	-29.76	74.00	64.18	35.41	9.19	64.54	---	---	Peak	<table><tr><th></th><th>Freq</th><th>Level</th><th>Over</th><th>Limit</th><th>ReadAntenna</th><th>Cable</th><th>Preamp</th><th>A/Pos</th><th>T/Pos</th><th>Remark</th></tr><tr><th></th><th>MHz</th><th>dBuV/m</th><th>dB</th><th>dBuV/m</th><th>dBuV</th><th>dB/m</th><th>dB</th><th>dB</th><th>cm</th><th>deg</th></tr><tr><td>1</td><td>4960.00</td><td>41.85</td><td>-32.15</td><td>74.00</td><td>64.88</td><td>34.45</td><td>7.81</td><td>65.29</td><td>---</td><td>---</td><td>Peak</td></tr><tr><td>2</td><td>7440.00</td><td>44.20</td><td>-29.80</td><td>74.00</td><td>64.14</td><td>35.41</td><td>9.19</td><td>64.54</td><td>---</td><td>---</td><td>Peak</td></tr></table>						Freq	Level	Over	Limit	ReadAntenna	Cable	Preamp	A/Pos	T/Pos	Remark		MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	cm	deg	1	4960.00	41.85	-32.15	74.00	64.88	34.45	7.81	65.29	---	---	Peak	2	7440.00	44.20	-29.80	74.00	64.14	35.41	9.19	64.54	---	---	Peak
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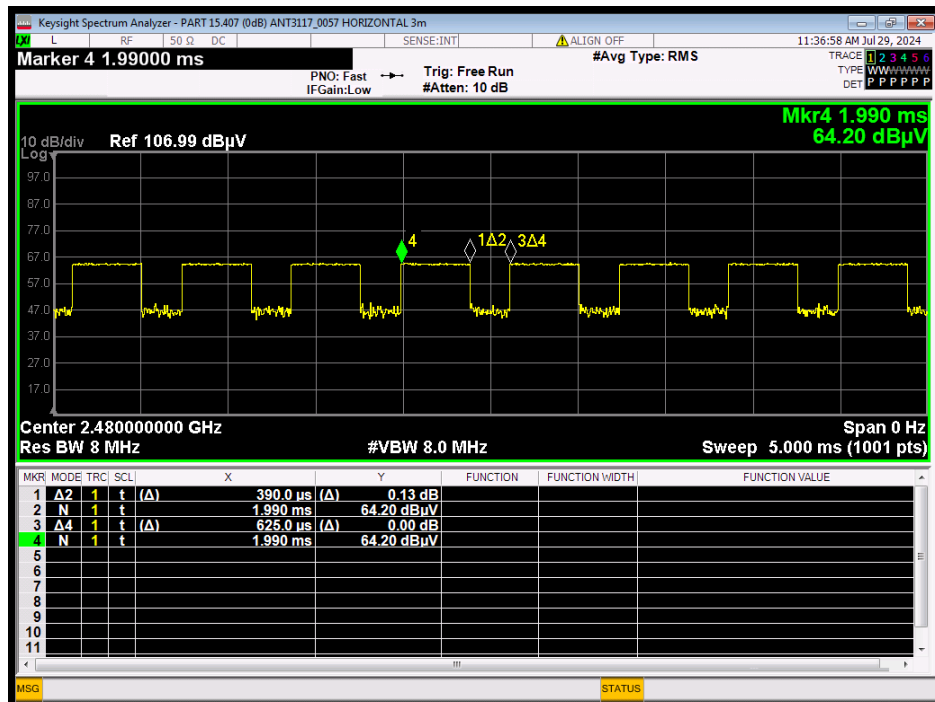


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Appendix C. Duty Cycle Plots

Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
Bluetooth LE 1Mbps	62.4	0.39	2.564	3KHz
Bluetooth LE 2Mbps	32.8	0.205	4.878	10KHZ

Bluetooth LE 1Mbps





Bluetooth LE 2Mbps

