ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Applicant:	Qualcomm Technologies, Inc. 5775 Morehouse Drive, San Diego, CA 92121-1714, United States
Manufacturer:	Qualcomm Technologies, Inc. 5775 Morehouse Drive, San Diego, CA 92121-1714, United States
Product Name:	Tri-Radio LGA Module for IoT applications
Brand Name:	Qualcomm
Model No.:	QCC744M-0
Report Number:	TERF2411003345E2
FCC ID	J9C-QCC744M0
Date of EUT Received:	Nov. 06, 2024
Date of Test:	Nov. 07, 2024～Nov. 29, 2024
Issue Date:	Dec. 13, 2024

Approved By _____
Jay Lin

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2020 and the energy emitted by the sample EUT comply with FCC rule part §15.247.

The results of this report relate only to the sample identified in this report.

Revision History

Report Number	Revision	Description	Issue Date	Revised By	Remark
TERF2411003345E2	00	Original	Dec. 09, 2024	Yami Kuo	
TERF2411003345E2	01	Revise address	Dec. 13, 2024	Yami Kuo	*

Note:

1、 The remark "*" indicates modification of the report upon requests from certification body.

Table of Contents

1 GENERAL INFORMATION

1.1 Product Description

Product Name:	Tri-Radio LGA Module for IoT applications
Brand Name:	Qualcomm
Model No.:	QCC744M-0
HW SKU:	QCC744M-0U, QCC744M-0B, QCC748M-0U, QCC748M-0B
Hardware Version:	N/A
Firmware Version:	N/A
EUT Series No.:	03B221949800GL
Power Supply:	3.3Vdc
Test Software (Name/Version)	QConn RCT 1.8.9

1.2 RF Specification

Radio Technology:	BLE
Frequency Range:	2402 – 2480MHz
Channel number:	40 channels
Modulation type:	GFSK
Transmit Power:	BLE 1M: 19.51 dBm BLE 2M: 19.54 dBm BLE 125K: 14.74 dBm BLE 500K: 14.77 dBm

1.3 HW SKU Difference Table:

HW SKU	Antenna Type	Impedance	Chip design
QCC744M-0U	3 types: PIFA, Monopole, Dipole	C21=1.86pF, C20=1.89pF	Does not support USB pinout
QCC744M-0B	1 type: PCB	C21=1.52pF, C20=2.05pF	Does not support USB pinout
QCC748M-0U	3 types: PIFA, Monopole, Dipole	C21=1.86pF, C20=1.89pF	Support USB pinout
QCC748M-0B	1 type: PCB	C21=1.52pF, C20=2.05pF	Support USB pinout

1.4 Antenna Designation

Antenna Type	Antenna Model No.	Freq. (MHz)	Peak Antenna Gain (dBi)
PCB Antenna	RFIQM0744010NB001	2.4GHz	2.52
PIFA Antenna	RFPCA441010EMABY01		3.19
Dipole Antenna	RFPCA521010EMABY01		3.37
Monopole Antenna	RFPCA501010EMABY01		3.12

Note:

1. Pre-scanned was done on the above antennas, measurements were demonstrated by using the antenna with the highest gain as the worst case scenarios.
2. Antenna information is provided by the applicant.

1.5 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247
FCC KDB 558074 D01 15.247 Meas Guidance v05r02
ANSI C63.10:2020

1.6 Test Facility

Laboratory	Test Site Address	Test Site Name	FCC Designation number	IC CAB identifier
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan.	SAC 1	TW0027	TW3702
		SAC 2		
		SAC 3		
		Conduction 1		
		Conducted 1		
		Conducted 2		
		Conducted 3		
		Conducted 4		
		Conducted 5		
		Conducted 6		
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction C	TW0028	
		SAC C		
		SAC D		
		SAC G		
		Conducted A		
		Conducted B		
		Conducted C		
		Conducted D		
		Conducted E		
		Conducted F		
		Conducted G		

Note: Test site name is remarked on the equipment list in each section of this report as an indication where measurements occurred in specific test site and address.

1.7 Special Accessories

There are no special accessories used while test was conducted.

1.8 Equipment Modifications

There was no modification incorporated into the EUT.

2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz. The CISPR Quasi-Peak and Average detector mode is employed. The two LISNs provide 50uH/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

2.3.3 Radiated Emissions

The EUT is a placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.

2.4 Measurement Results Explanation Example

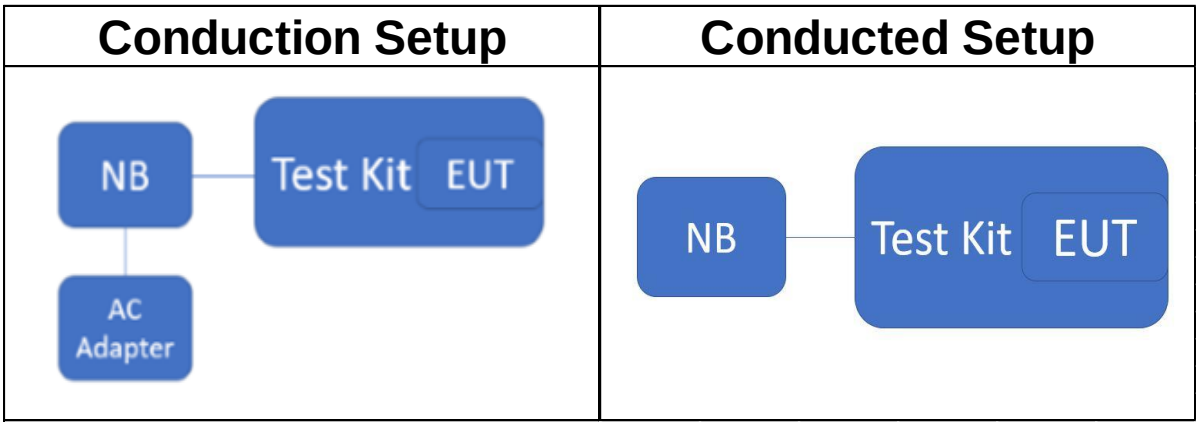
2.4.1 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

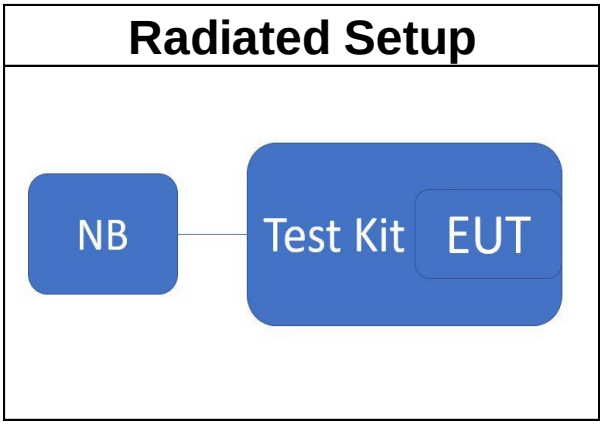
Radiated emission below 30MHz is measured in a 9m*6m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.
There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

2.4.2 For all conducted test items:

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

2.5 Test Configuration





2.6 Control Unit(s)

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Notebook	Lenovo	T470	P0001293	N/A	N/A
Adapter	Lenovo	ADLX65YLC3D	N/A	N/A	N/A
QCC74X Module Development Kit Board	Walsin	QCC744-DVK	N/A	N/A	N/A
USB Cable	Fong Hua	USB-C18	128342	N/A	N/A

Conducted Emission Test Site: Conducted C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
Notebook	Lenovo	T14	P0003332	N/A	N/A
USB Cable	Mcdodo	CA-6390	N/A	N/A	N/A
QCC74X Module Development Kit Board	Walsin	QCC744-DVK	N/A	N/A	N/A

Radiated Emission Test Site: SAC D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Notebook	Lenovo	T470	P0001293	N/A	N/A
QCC74X Module Development Kit Board	Walsin	QCC744-DVK	N/A	N/A	N/A
USB Cable	Fong Hua	USB-C18	128342	N/A	N/A

3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	Peak Output Power	Compliant
§15.247(a)(2)	Emission Bandwidth	Compliant
§15.247(d) §15.209	Conducted Band Edge and Spurious Emission	Compliant
§15.247(d) §15.209	Radiated Spurious Emission	Compliant
§15.205	Restricted Bands	Compliant
§15.247(e)	Peak Power Density	Compliant
§15.203	Antenna Requirement	Compliant

4 DESCRIPTION OF TEST MODES

4.1 Operating Frequencies

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

4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
3. The field strength of radiation emission was measured as the EUT positioned in different orthogonal planes (E1/E2/H) based on actual usage of the EUT to pre-scan the emissions for determining the worst case scenario.
4. Investigation has been done on all the possible configurations for searching the worst case.

CONDUCTED TEST				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	0,20,38,39	GFSK	1
Bluetooth LE	0 to 39	0,20,38,39	GFSK	2
Bluetooth LE	0 to 39	0,20,38,39	GFSK	0.125
Bluetooth LE	0 to 39	0,20,38,39	GFSK	0.5

TRANSMIT EMISSION TEST (BELOW 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	20	GFSK	1
TRANSMIT EMISSION TEST (ABOVE 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	0,20,39	GFSK	1
Bluetooth LE	0 to 39	0,20,39	GFSK	2
Bluetooth LE	0 to 39	0,20,39	GFSK	0.125
Bluetooth LE	0 to 39	0,20,39	GFSK	0.5
NOTE:				
1.The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for channel Low, Mid and High, the worst case position was reported. 2.Radiated test was done with 50ohm terminator on antenna port				

5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty		
AC Power Line Conducted Emission	+/-	1.54	dB
Output Power measurement	+/-	0.97	dB
Emission Bandwidth	+/-	1.38	Hz
Conducted emission measurement	+/-	0.77	dB
Peak Power Density	+/-	0.61	dB
Temperature	+/-	0.6	°C
Humidity	+/-	3	%
DC / AC Power Source	+/-	1	%

Radiated Spurious Emission Measurement Uncertainty				
Polarization: Vertical	**+/-**	**1.89**	**dB**	9kHz~30MHz
	+/-	**4.15**	**dB**	30MHz - 1000MHz
	+/-	**3.43**	**dB**	1GHz - 18GHz
	+/-	**3.86**	**dB**	18GHz - 40GHz
Polarization: Horizontal	**+/-**	**1.89**	**dB**	9kHz~30MHz
	+/-	**4.02**	**dB**	30MHz - 1000MHz
	+/-	**3.43**	**dB**	1GHz - 18GHz
	+/-	**3.86**	**dB**	18GHz - 40GHz
Radiated Spurious Emission	**+/-**	**2**	**dB**	33GHz-50GHz
	+/-	**1.59**	**dB**	50GHz-60GHz
	+/-	**1.7**	**dB**	60GHz-90GHz
	+/-	**1.64**	**dB**	90GHz-140GHz
	+/-	**3.83**	**dB**	140GHz-220GHz

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

6 MEASUREMENT EQUIPMENT USED

6.1 Emission from AC power line

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Coaxial Cable	EC Lab	RF-HY-CAB-250	RF-HY-CAB-250-01	03/27/2024	03/26/2025
EMI Test Receiver	R&S	ESCI	101342	04/29/2024	04/28/2025
LISN	SCHWARZBECK Mess-Elektronik	NSLK8127	973	04/22/2024	04/21/2025
Pulse Limiter	EC Lab	VTSD 9561F-N	485	03/27/2024	03/26/2025
TEMPERATURE	N/A	EC-RFHY-05	N/A	05/22/2024	05/21/2025
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R

6.2 Conducted Measurement

Conducted Emission Test Site: Conducted C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
Attenuator	Woken	WATT-218FS-10	RF19	11/15/2023	11/14/2024
Attenuator	Woken	WATT-218FS-10	RF19	11/14/2024	11/13/2025
DC Block	PASTERNACK	PE8210	RF155	11/15/2023	11/14/2024
DC Block	PASTERNACK	PE8210	RF155	11/14/2024	11/13/2025
Power Meter	Anritsu	ML2496A	1804002	04/26/2024	04/25/2025
Power Sensor	Anritsu	MA2411B	1726105	04/26/2024	04/25/2025
Power Sensor	Anritsu	MA2411B	1726106	04/26/2024	04/25/2025
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071570	06/25/2024	06/24/2025
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N.C.R	N.C.R

6.3 Radiated Measurement

Radiated Emission Test Site: SAC D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
3m Site NSA	SGS	966 chamber D	N/A	04/30/2024	04/29/2025
Active Loop Antenna	COM-POWER	AL-130R	10160105	12/04/2023	12/03/2024
Attenuator	Woken	WATT-218FS-10	RF17	11/14/2024	11/13/2025
Band Rejection Filter	Micro-Tronics	G008	RF205	11/14/2024	11/13/2025
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-617	12/14/2023	12/13/2024
Coaxial Cable	Huber+Suhner	EMC106-SM-SM-7200	150703	11/14/2024	11/13/2025
Coaxial Cable	Huber+Suhner	RG 214/U	W21.01	11/14/2024	11/13/2025
Highpass Filter	R&S	F13 HPF 3GHz	RF175	11/14/2024	11/13/2025
Horn Antenna	Schwarzbeck	BBHA9120D	1341	05/30/2024	05/29/2025
Horn Antenna	Schwarzbeck	BBHA9170	184	12/28/2023	12/27/2024
Lowpass Filter	Woken	EWT-56-0019	RF173	11/14/2024	11/13/2025
Pre-Amplifier	EMC Instruments	EMC12630SE	980273	11/14/2024	11/13/2025
Pre-Amplifier	EMC Instruments	EMC9135	980234	11/14/2024	11/13/2025
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120200	04/03/2024	04/02/2025
SMA Termination	RF Microwave WOKEN	WTER-18S2	N/A	N/A	N/A
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R

NOTE: *N.C.R refers to Not Calibrated Required.*

7 CONDUCTED EMISSION TEST

7.1 Standard Applicable:

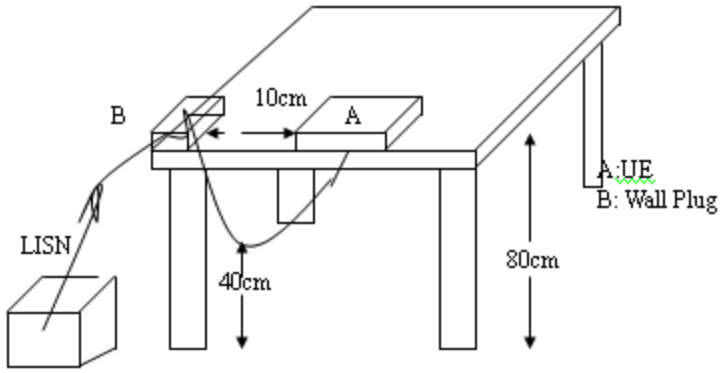
Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

7.2 EUT Setup:

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2020.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

7.3 Test Setup



7.4 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

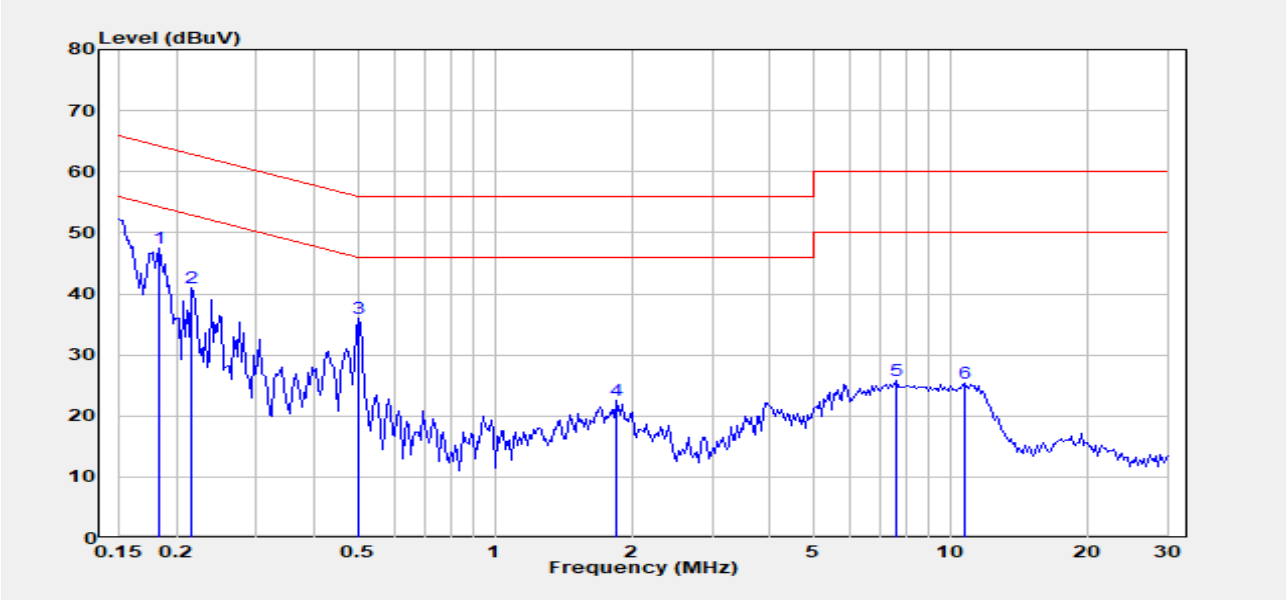
7.5 Measurement Result:

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closest to the limit.

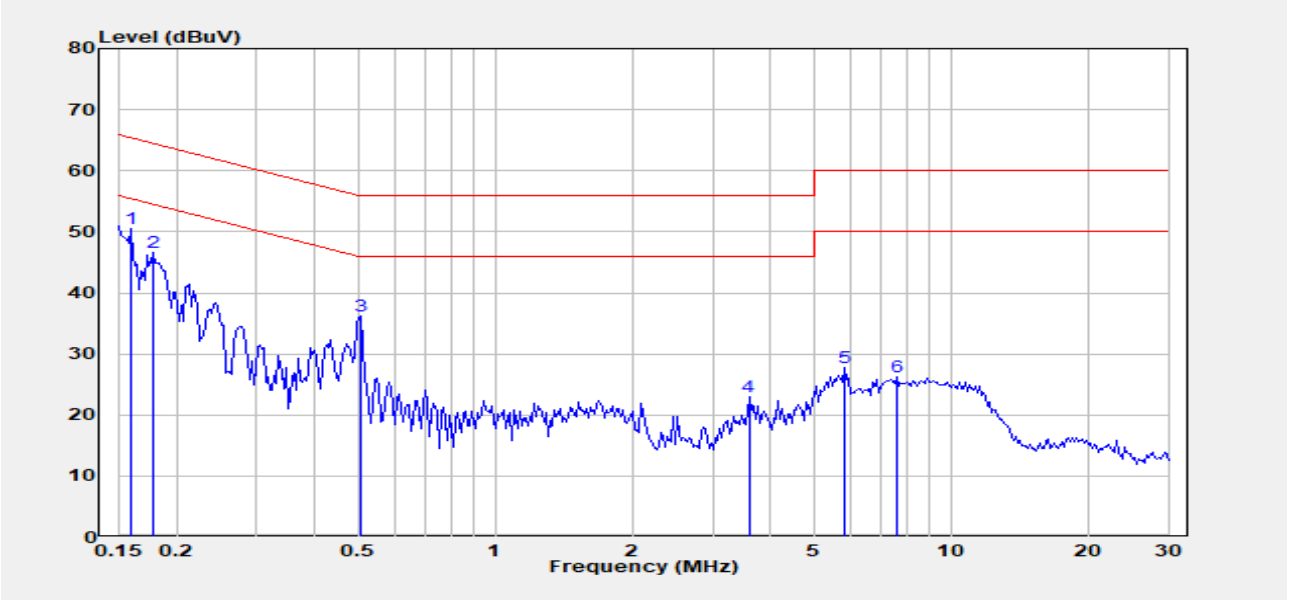
AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number	:TERF2411003345E2	Test Site	:Conduction C
Test Mode	:BLE 2M	Test Date	:2024-11-18
Power	:120V/60Hz	Temp./Humi.	:21.5℃/62%
Probe	:L1	Engineer	:Pony Chen



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
0.183	Peak	36.88	10.65	47.53	64.33	-16.80
0.215	Peak	30.31	10.65	40.96	63.01	-22.05
0.502	Peak	25.27	10.62	35.88	56.00	-20.12
1.848	Peak	11.70	10.76	22.46	56.00	-33.54
7.646	Peak	14.89	10.96	25.85	60.00	-34.15
10.733	Peak	14.48	10.98	25.46	60.00	-34.54

Report Number	:TERF2411003345E2	Test Site	:Conduction C
Test Mode	:BLE 2M	Test Date	:2024-11-18
Power	:120V/60Hz	Temp./Humi.	:21.5℃/62%
Probe	:N	Engineer	:Pony Chen



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
0.158	Peak	39.88	10.66	50.54	65.56	-15.02
0.178	Peak	35.96	10.65	46.61	64.59	-17.98
0.507	Peak	25.56	10.60	36.16	56.00	-19.84
3.603	Peak	12.08	10.86	22.94	56.00	-33.06
5.867	Peak	16.80	10.94	27.74	60.00	-32.26
7.646	Peak	15.25	10.94	26.20	60.00	-33.80

8 PEAK OUTPUT POWER MEASUREMENT

8.1 Standard Applicable:

8.1.1 Duty Cycle

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle.

All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

8.1.2 FCC

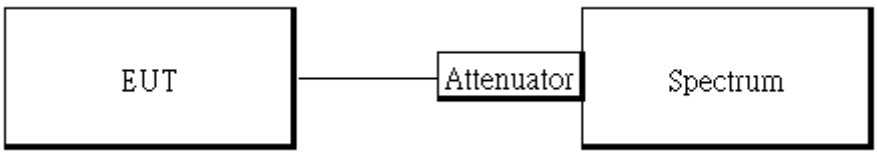
For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt.

If the transmitting antenna of directional gain greater than 6dBi are used the peak output power form the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

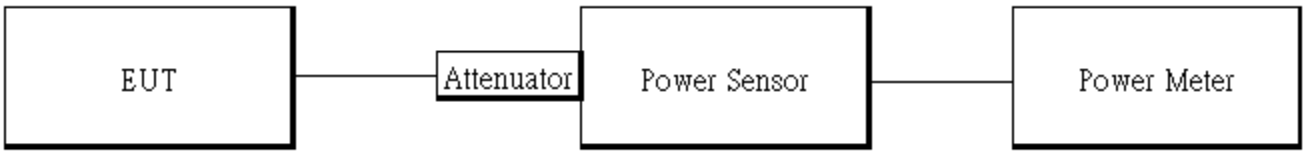
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

8.2 Test Setup

8.2.1 Duty Cycle



8.2.2 Output Power



8.3 Measurement Procedure:

8.3.1 Duty Cycle

1. Place the EUT on the table and set it in transmitting mode.
2. Set span = Zero
3. RBW = 8MHz, VBW = 8MHz,
4. Detector = Peak

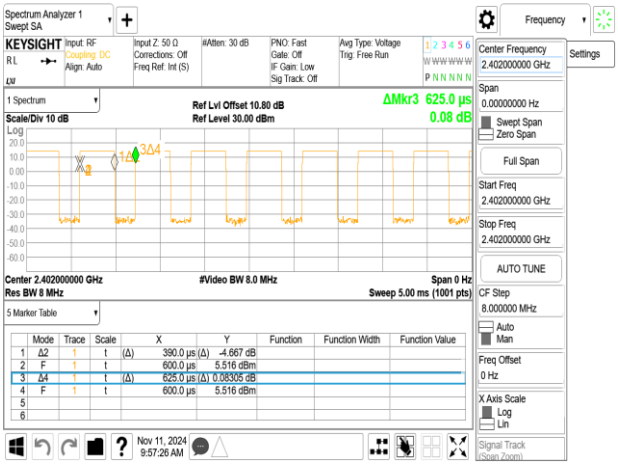
8.3.2 Output Power

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.
4. Record the max. Reading as observed from Power Meter.
5. Repeat above procedures until all test default channel measured was complete.

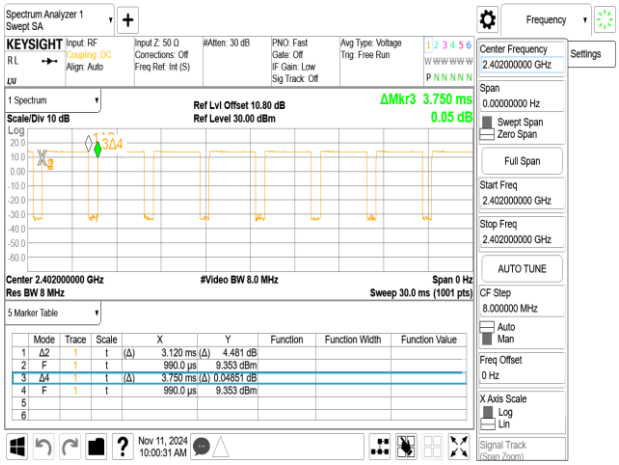
8.4 Duty Factor:

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)
BLE 1M	62.40	2.05	2.56
BLE 2M	32.80	4.84	4.88
BLE 125k	83.20	0.80	0.32
BLE 500k	57.14	2.43	0.93

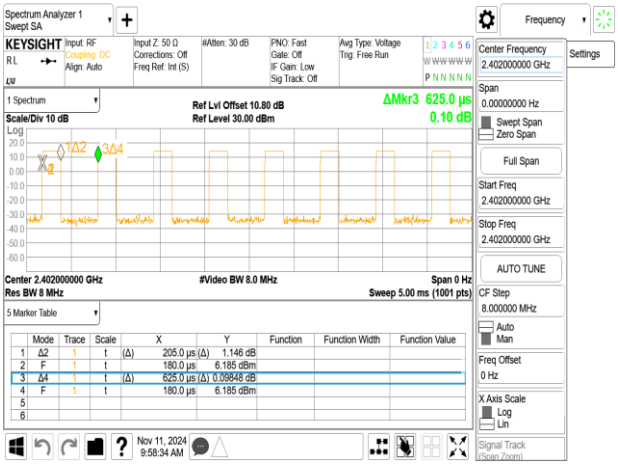
BLE_1M_LowCH00-2402



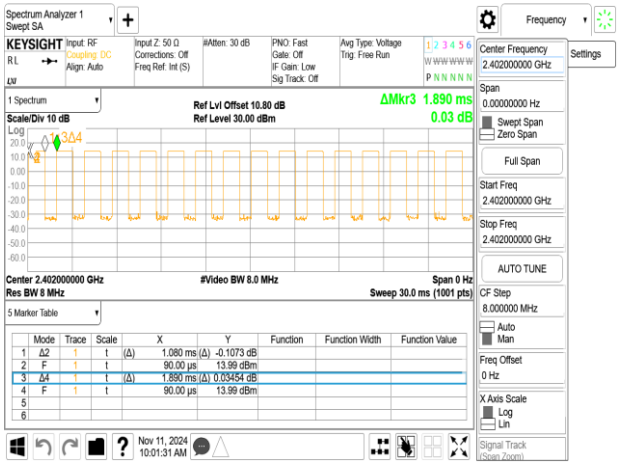
BLE_125k_LowCH00-2402



BLE_2M_LowCH00-2402



BLE_500k_LowCH00-2402



8.5 Output Power:

8.5.1 Peak & Avg

BLE 1M mode:

CH	Frequency (MHz)	Power Setting	Peak Output Power (dBm)	Required Limit (dBm)
0	2402	20	19.38	30
20	2442	20	**19.51**	30
38	2478	20	18.80	30
39	2480	12	11.62	30
CH	**Frequency (MHz)**	**Power Setting**	**Avg. Output Power (dBm)**	**Required Limit (dBm)**
0	2402	20	19.28	30
20	2442	20	19.47	30
38	2478	20	18.74	30
39	2480	12	11.42	30

Note:

1.Measured by power meter, cable loss 10.8 dB + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

BLE 2M mode:

CH	Frequency (MHz)	Power Setting	Peak Output Power (dBm)	Required Limit (dBm)
0	2402	20	19.35	30
20	2442	20	**19.54**	30
38	2478	20	18.88	30
39	2480	11	10.63	30
CH	**Frequency (MHz)**	**Power Setting**	**Avg. Output Power (dBm)**	**Required Limit (dBm)**
0	2402	20	19.30	30
20	2442	20	19.48	30
38	2478	20	18.38	30
39	2480	11	10.49	30

Note:

1.Measured by power meter, cable loss 10.8 dB + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

BLE 125k mode(Payload S=8):

CH	Frequency (MHz)	Power Setting	Peak Output Power (dBm)	Required Limit (dBm)
0	2402	15	14.54	30
20	2442	15	**14.74**	30
38	2478	15	14.52	30
39	2480	14	13.62	30
CH	**Frequency (MHz)**	**Power Setting**	**Avg. Output Power (dBm)**	**Required Limit (dBm)**
0	2402	15	14.38	30
20	2442	15	14.45	30
38	2478	15	14.30	30
39	2480	14	13.52	30

Note:

1.Measured by power meter, cable loss 10.8 dB + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

BLE 500k mode(Payload S=2):

CH	Frequency (MHz)	Power Setting	Peak Output Power (dBm)	Required Limit (dBm)
0	2402	15	14.41	30
20	2442	15	**14.77**	30
38	2478	15	14.56	30
39	2480	14	13.63	30
CH	**Frequency (MHz)**	**Power Setting**	**Avg. Output Power (dBm)**	**Required Limit (dBm)**
0	2402	15	14.21	30
20	2442	15	14.60	30
38	2478	15	14.52	30
39	2480	14	13.56	30

Note:

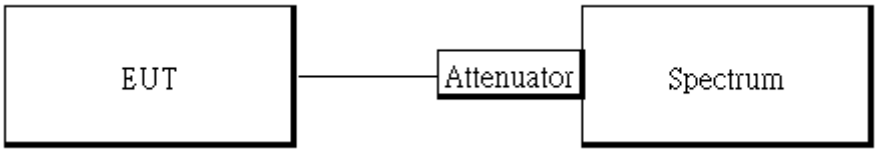
1.Measured by power meter, cable loss 10.8 dB + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

9 EMISSION BANDWIDTH MEASUREMENT

9.1 Standard Applicable

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

9.2 Test Setup



9.3 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

9.3.1 6dB BW measurements

1. The testing follows the Measurement Procedure of the KDB 558074 D01.
2. Set the spectrum analyzer as
   RBW= 100 kHz ,
   VBW = 3 X RBW,
   Span= 2 to 5 times of the OBW,
   Sweep=auto, Detector = Peak, and Max hold.
3. Mark the upper and lower frequencies of -6dB.
4. Repeat above procedures until all test default channel is completed.

9.3.2 99% BW measurements

1. The testing follows the Measurement Procedure of the RSS-Gen section 6.7.
2. Set the spectrum analyzer as
   RBW= 1 % to 5% of 99%,
   VBW ≥ 3 X RBW,
   Span= large enough to capture all products of the modulation process
   Sweep=auto, Detector = Peak, and Max hold.
3. Mark the upper and lower frequencies of 99%.
4. Repeat above procedures until all test default channel is completed.

9.4 Measurement Result:

9.4.1 6dB BW measurements

BLE 1M mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	0.6814	≧ 0.5	PASS
2442	0.6788	≧ 0.5	PASS
2480	0.6835	≧ 0.5	PASS

BLE 2M mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	1.165	≧ 0.5	PASS
2442	1.163	≧ 0.5	PASS
2480	1.168	≧ 0.5	PASS

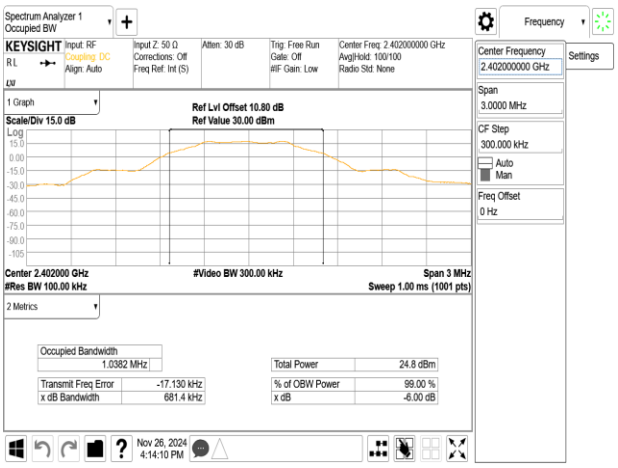
BLE 125k mode(Payload S=8)

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	0.675	≧ 0.5	PASS
2442	0.6796	≧ 0.5	PASS
2480	0.679	≧ 0.5	PASS

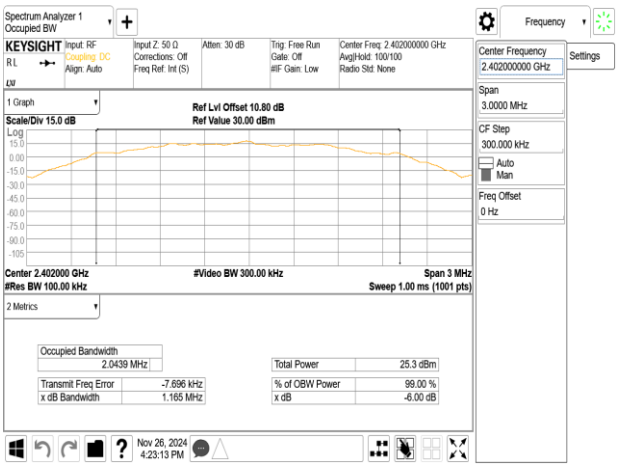
BLE 500k mode(Payload S=2)

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	0.6647	≧ 0.5	PASS
2442	0.6634	≧ 0.5	PASS
2480	0.6664	≧ 0.5	PASS

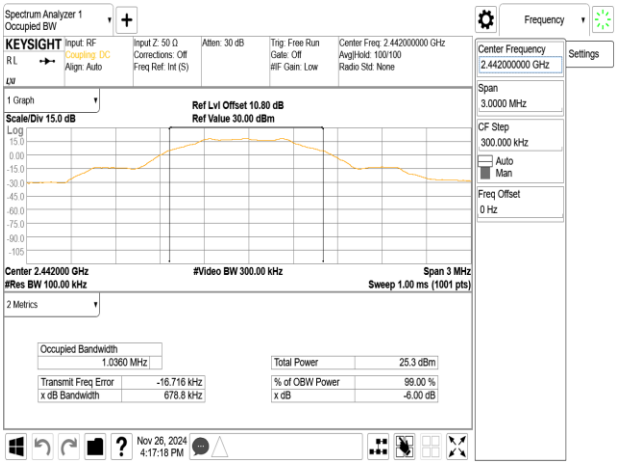
OBW_BLE 1M_LowCH00-2402MHz



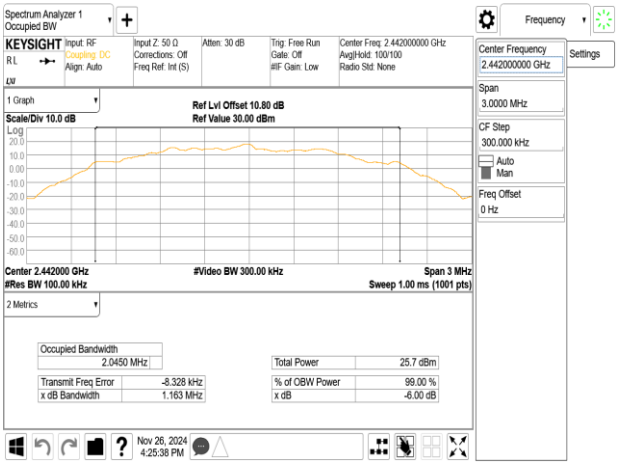
OBW_BLE 2M_LowCH00-2402MHz



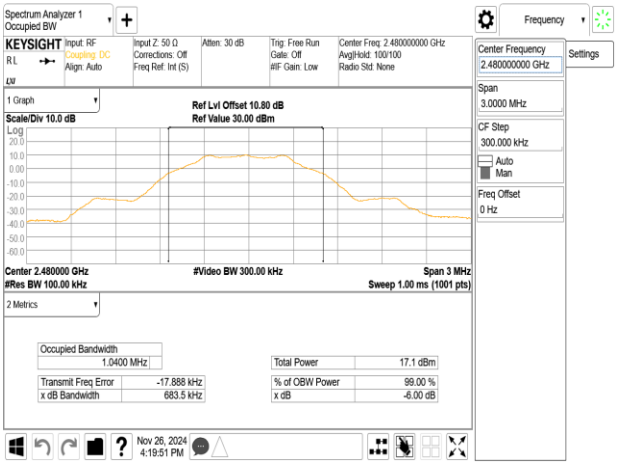
OBW_BLE 1M_MidCH20-2442MHz



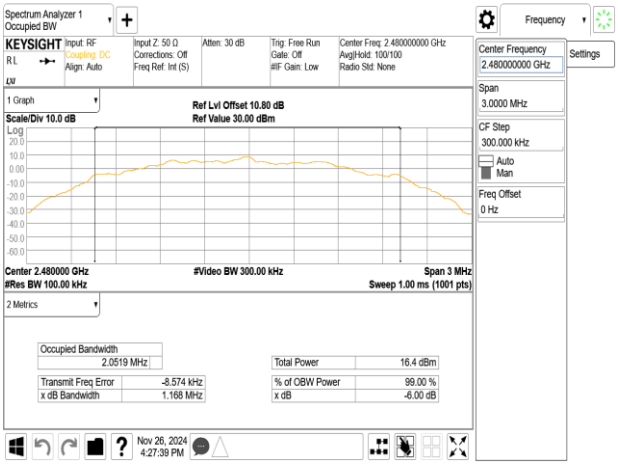
OBW_BLE 2M_MidCH20-2442MHz



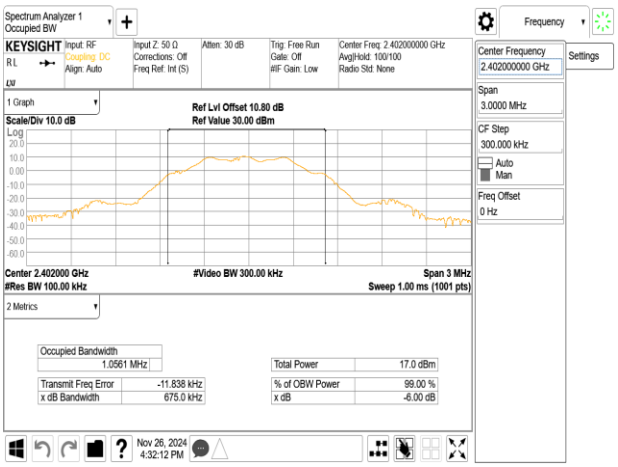
OBW_BLE 1M_HighCH39-2480MHz



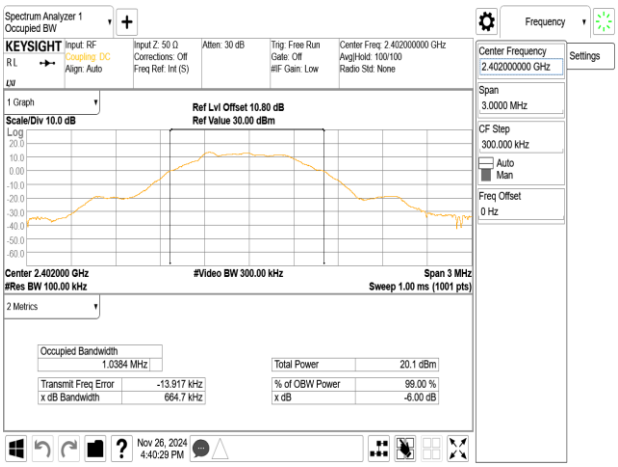
OBW_BLE 2M_HighCH39-2480MHz



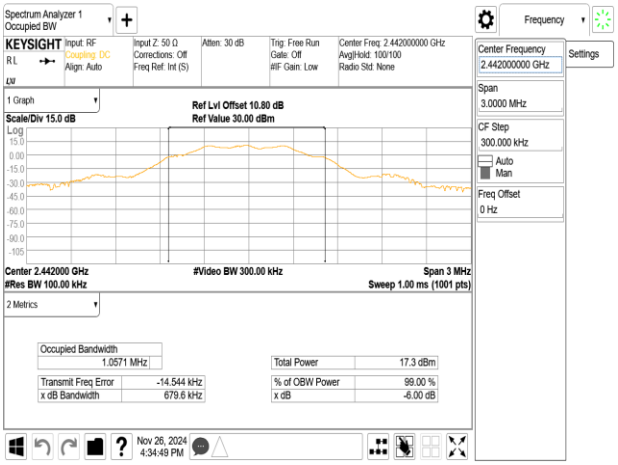
OBW_BLE 125k_LowCH00-2402MHz



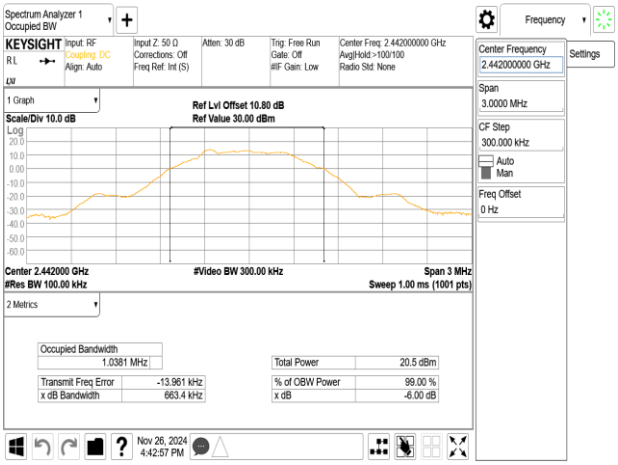
OBW_BLE 500k_LowCH00-2402MHz



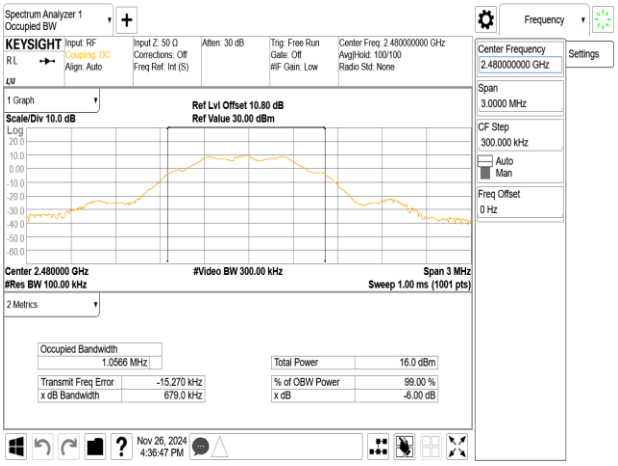
OBW_BLE 125k_MidCH20-2442MHz



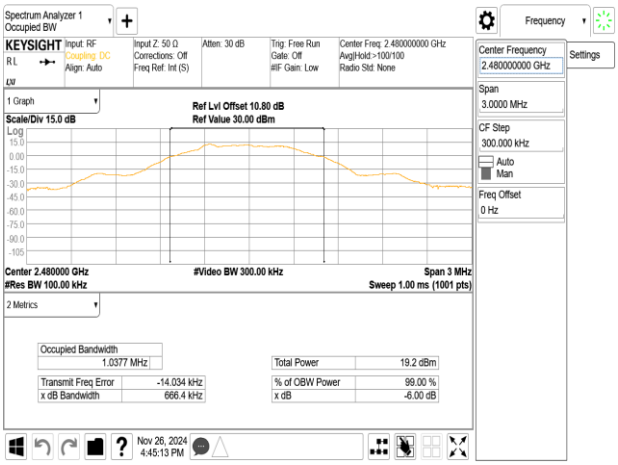
OBW_BLE 500k_MidCH20-2442MHz



OBW_BLE 125k_HighCH39-2480MHz



OBW_BLE 500k_HighCH39-2480MHz



9.4.2 99% Bandwidth

BLE 1M mode

Frequency (MHz)	99%Bandwidth (MHz)
2402	1.0239
2442	1.0208
2480	1.0237

BLE 2M mode

Frequency (MHz)	99%Bandwidth (MHz)
2402	2.0487
2442	2.0492
2480	2.0554

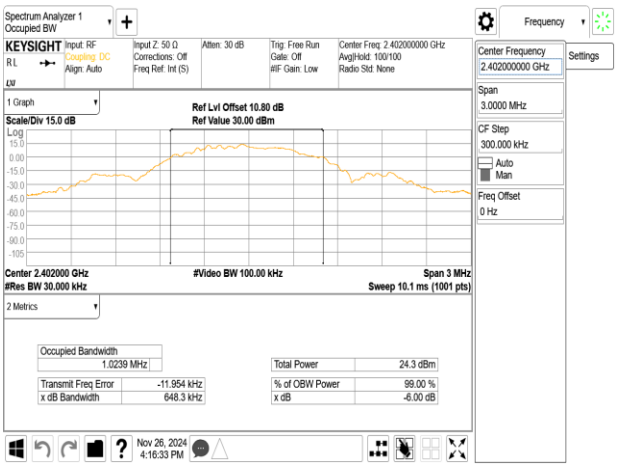
BLE 125k mode(Payload S=8)

Frequency (MHz)	99%Bandwidth (MHz)
2402	1.0472
2442	1.046
2480	1.0454

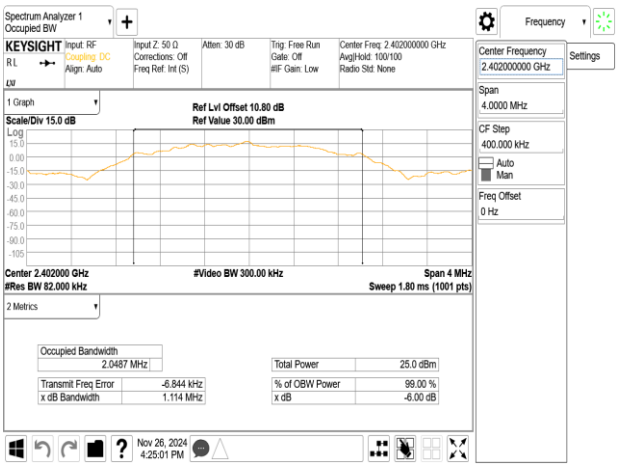
BLE 500k mode(Payload S=2)

Frequency (MHz)	99%Bandwidth (MHz)
2402	1.018
2442	1.0161
2480	1.0127

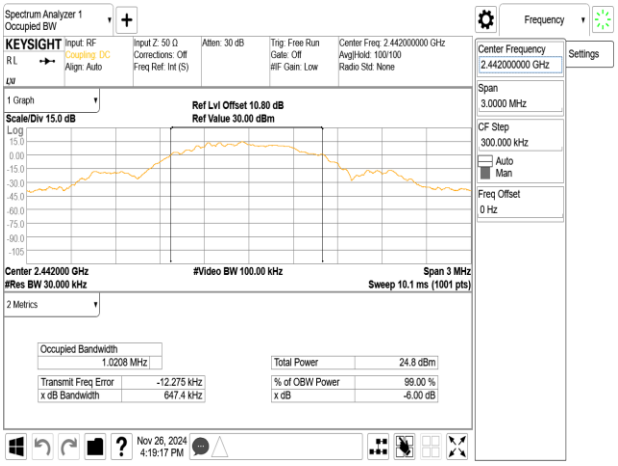
IC OBW_BLE 1M_LowCH00-2402MHz



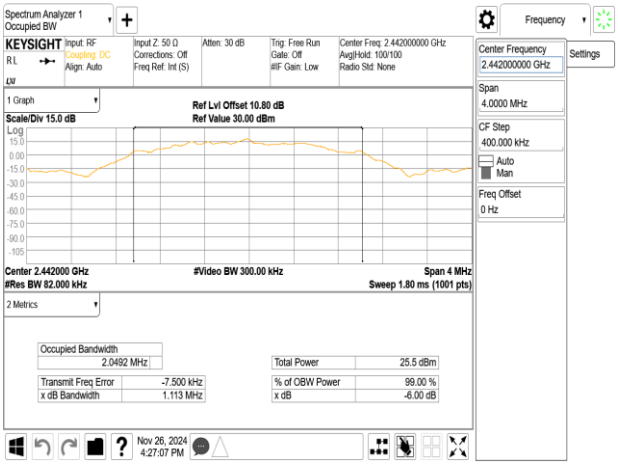
IC OBW_BLE 2M_LowCH00-2402MHz



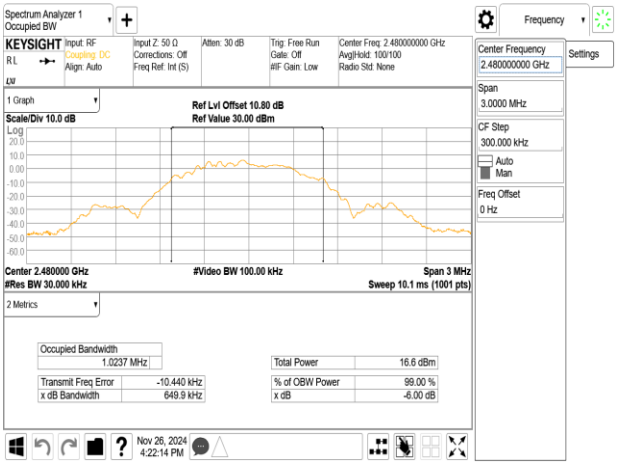
IC OBW_BLE 1M_MidCH20-2442MHz



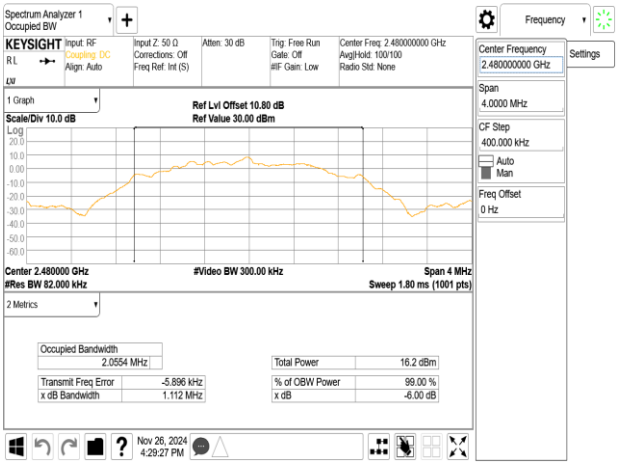
IC OBW_BLE 2M_MidCH20-2442MHz



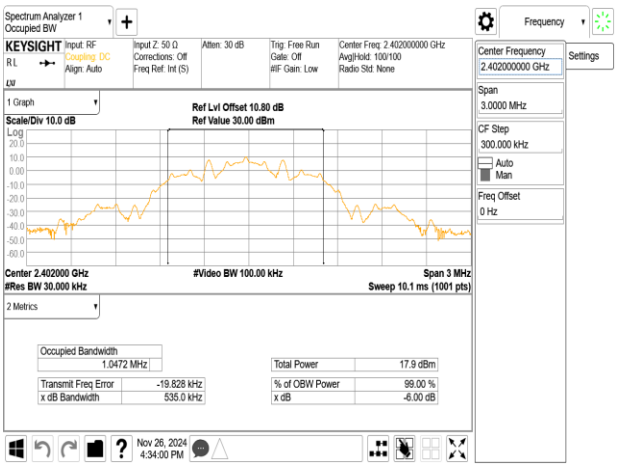
IC OBW_BLE 1M_HighCH39-2480MHz



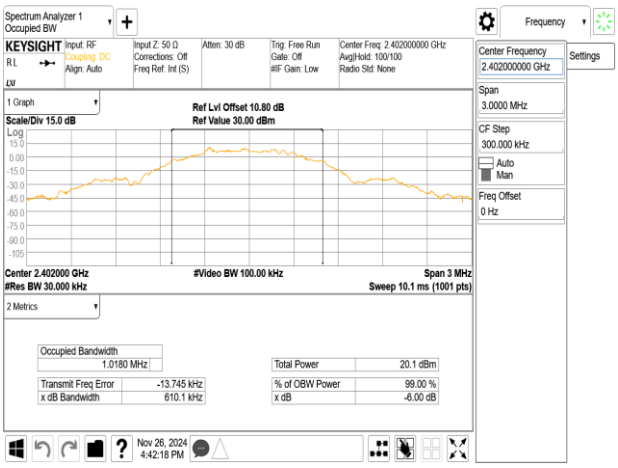
IC OBW_BLE 2M_HighCH39-2480MHz



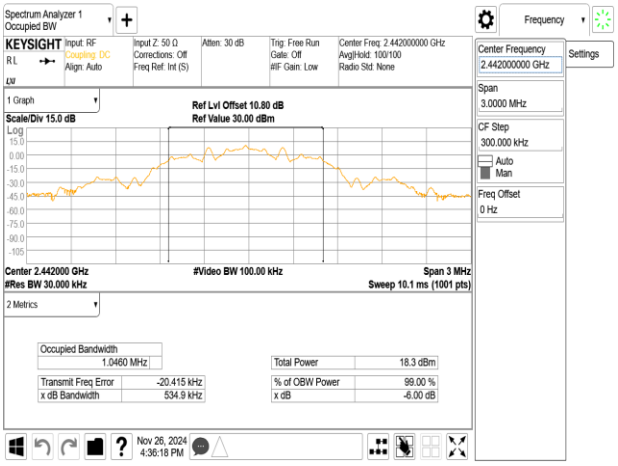
IC OBW_BLE 125k_LowCH00-2402MHz



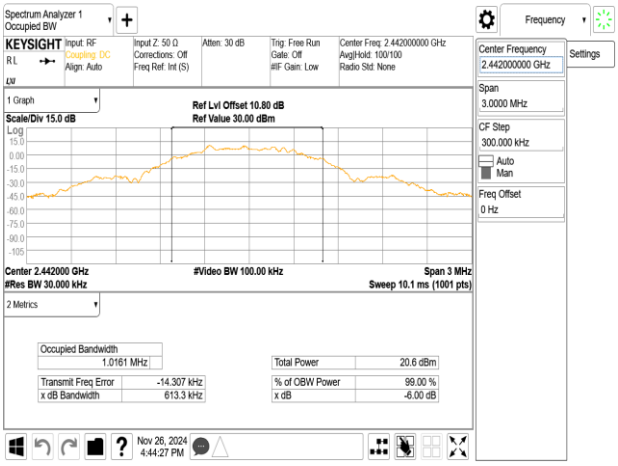
IC OBW_BLE 500k_LowCH00-2402MHz



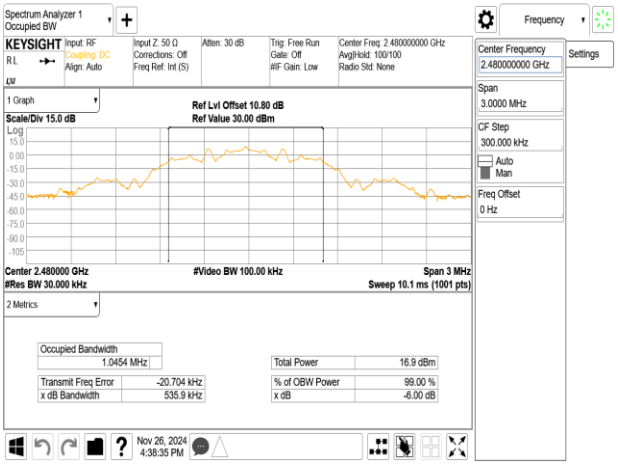
IC OBW_BLE 125k_MidCH20-2442MHz



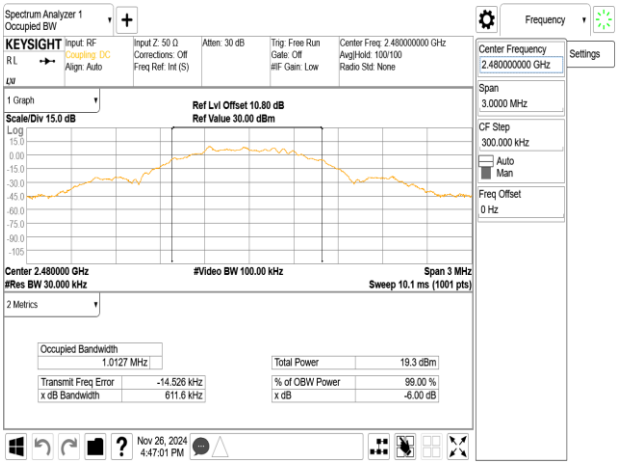
IC OBW_BLE 500k_MidCH20-2442MHz



IC OBW_BLE 125k_HighCH39-2480MHz



IC OBW_BLE 500k_HighCH39-2480MHz

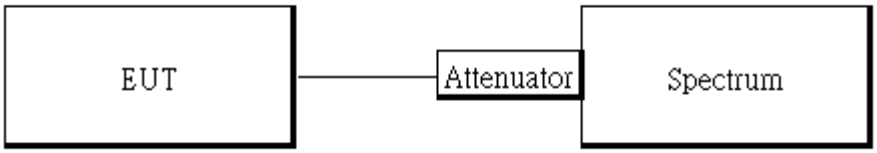


10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

10.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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 the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

10.2 Test Setup



10.3 Measurement Procedure

10.3.1 Reference Level of Emission Limit:

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 100kHz & VBW = 300 kHz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.

10.3.2 Conducted Band Edge:

In any 100 kHz bandwidth outside the frequency band

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass the spectrum to be examined.
5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Detector = Peak, Sweep = auto
6. Set DL as the limit = reading on marker of reference level measurement – 20dBm
7. Mark the highest readings of the emissions outside of 2400MHz~2483.5MHz.
8. Repeat above procedures until all default test channel (low and high) was complete.

10.3.3 Conducted Spurious Emission:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set RBW = 100 kHz & VBW=300 kHz, Detector =Peak, Sweep = Auto
4. Allow trace to fully stabilize.
5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
6. Repeat above procedures until all default test channel measured were complete.

10.4 Measurement Result

BLE 1M_Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	17.79	-2.21
2442	18.30	-1.70
2480	10.04	-9.96

Note:
1.cable loss as 10.8dB that offsets in the spectrum
2.Refer to next page for plots.

BLE 2M_Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	17.80	-2.20
2442	18.27	-1.73
2480	8.95	-11.05

Note:
1.cable loss as 10.8dB that offsets in the spectrum
2.Refer to next page for plots.

BLE 125k(Payload S=8)_Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	10.55	-9.45
2442	10.93	-9.07
2480	9.57	-10.43

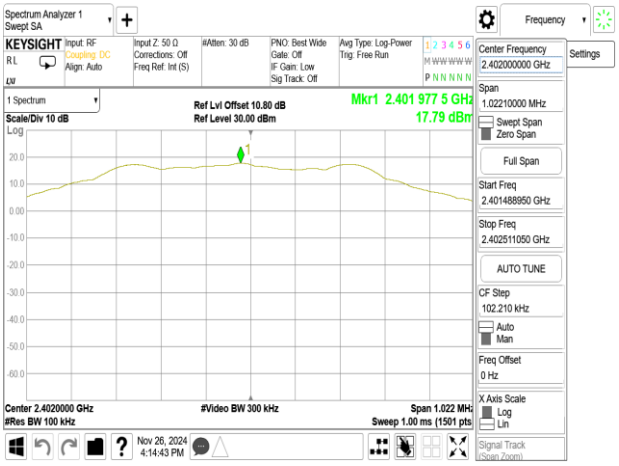
Note:
1.cable loss as 10.8dB that offsets in the spectrum
2.Refer to next page for plots.

BLE 500k(Payload S=2)_Reference Level of Limit

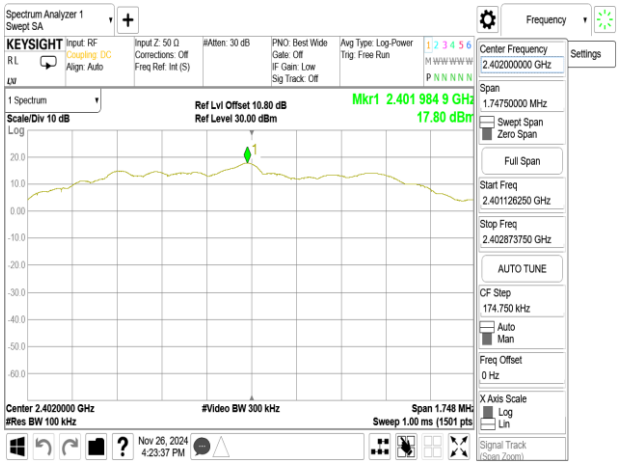
Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	13.55	-6.45
2442	13.96	-6.04
2480	12.62	-7.38

Note:
1.cable loss as 10.8dB that offsets in the spectrum
2.Refer to next page for plots.

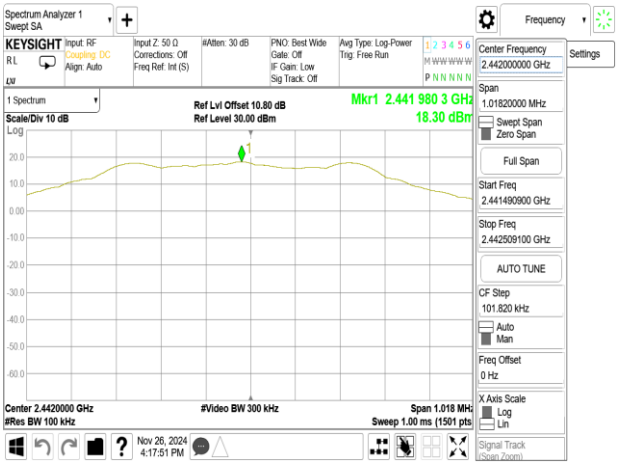
Reference Level_BLE 1M_LowCH00-2402MHz



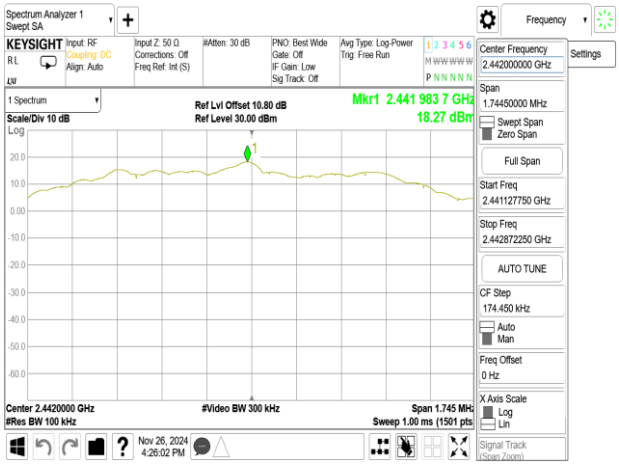
Reference Level_BLE 2M_LowCH00-2402MHz



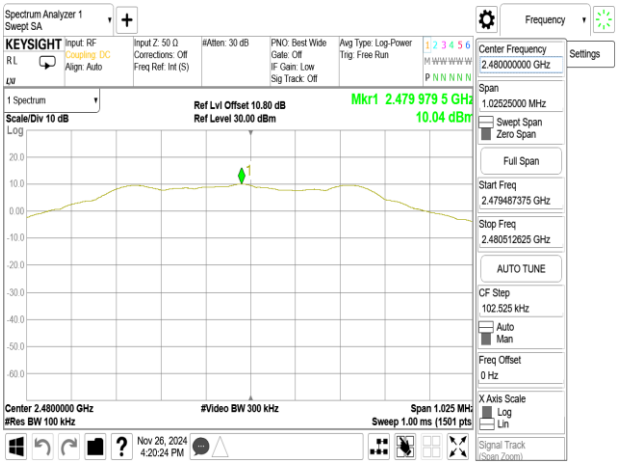
Reference Level_BLE 1M_MidCH20-2442MHz



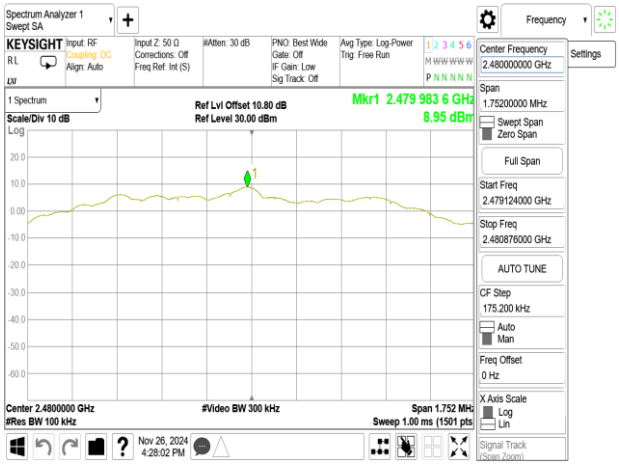
Reference Level_BLE 2M_MidCH20-2442MHz



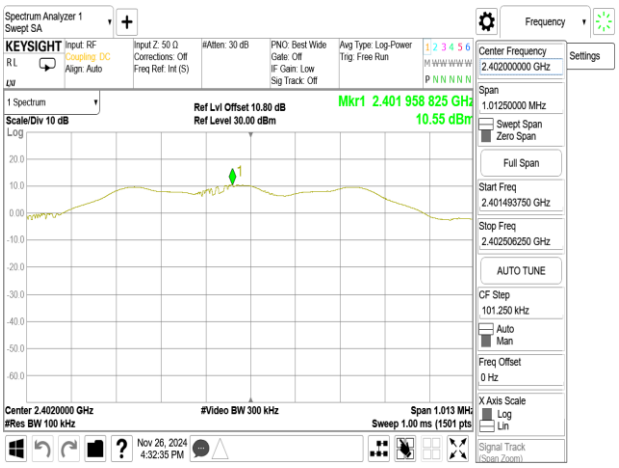
Reference Level_BLE 1M_HighCH39-2480MHz



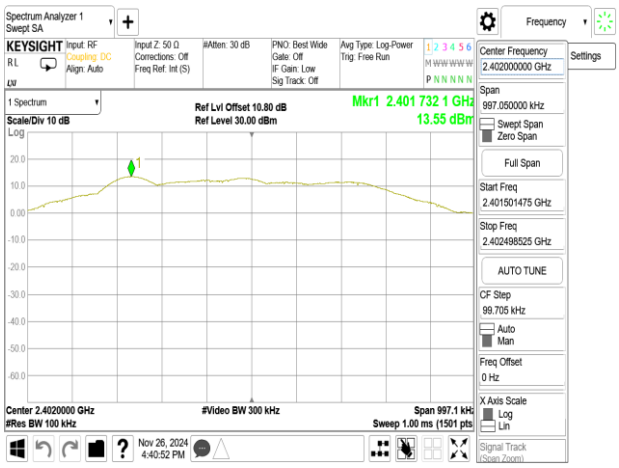
Reference Level_BLE 2M_HighCH39-2480MHz



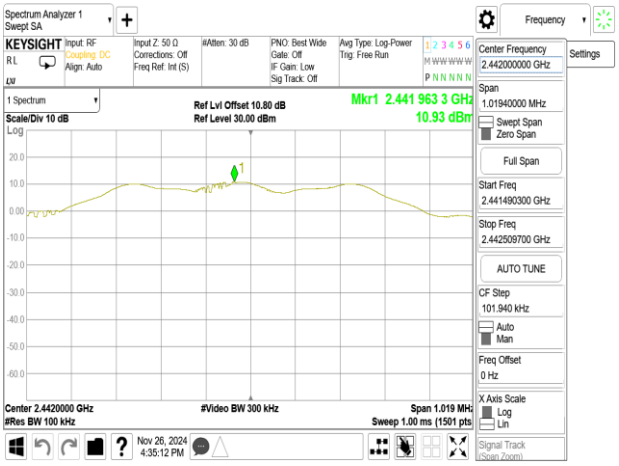
Reference Level_BLE 125k_LowCH00-2402MHz



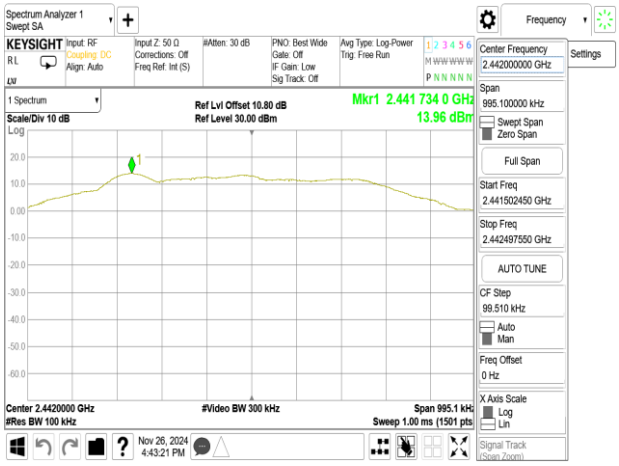
Reference Level_BLE 500k_LowCH00-2402MHz



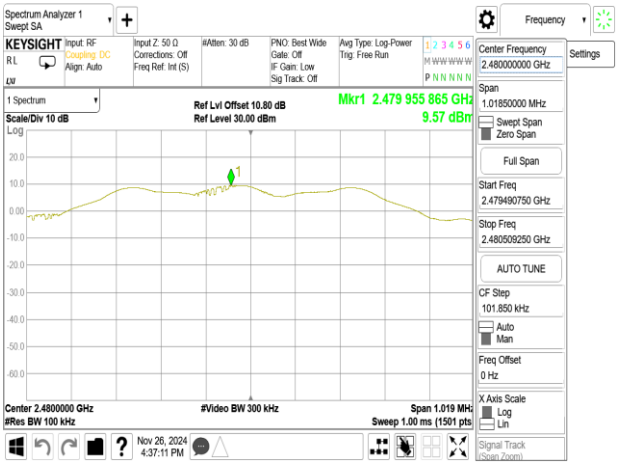
Reference Level_BLE 125k_MidCH20-2442MHz



Reference Level_BLE 500k_MidCH20-2442MHz



Reference Level_BLE 125k_HighCH39-2480MHz



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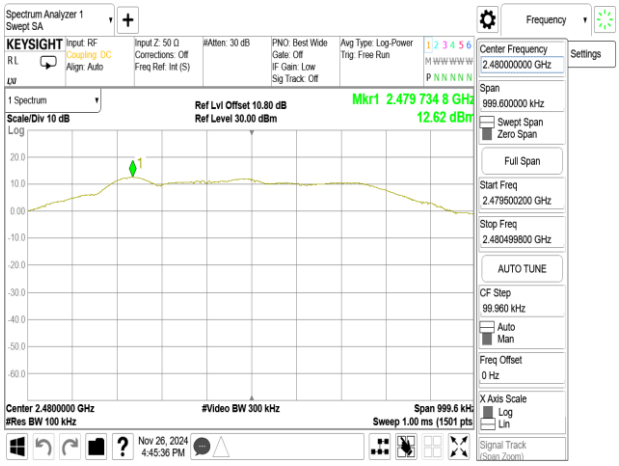
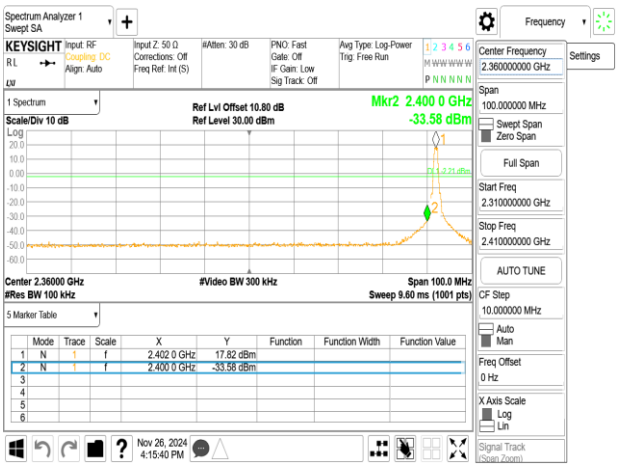


Band Edge_BLE 1M_LowCH00-2402MHz



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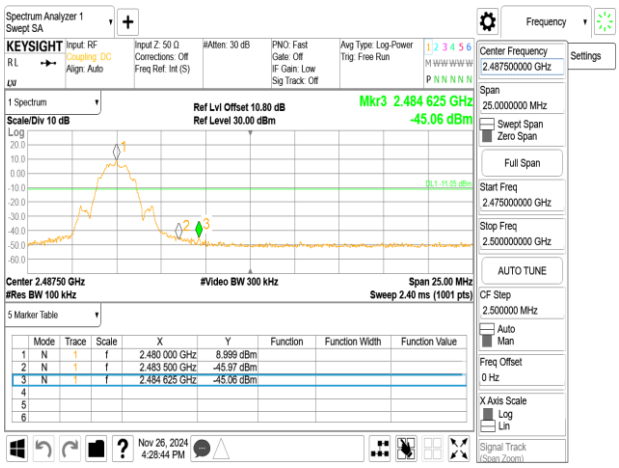
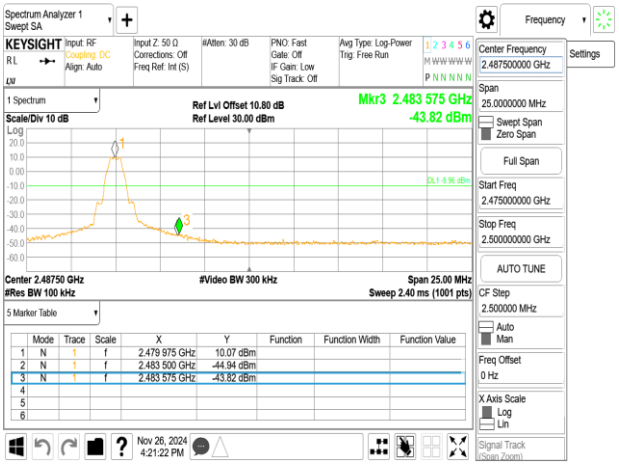
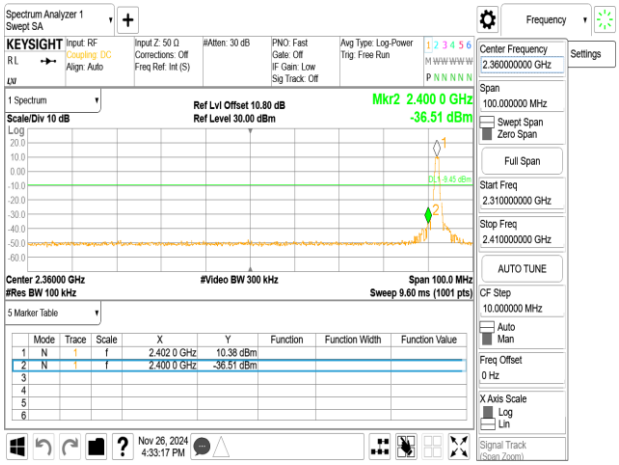


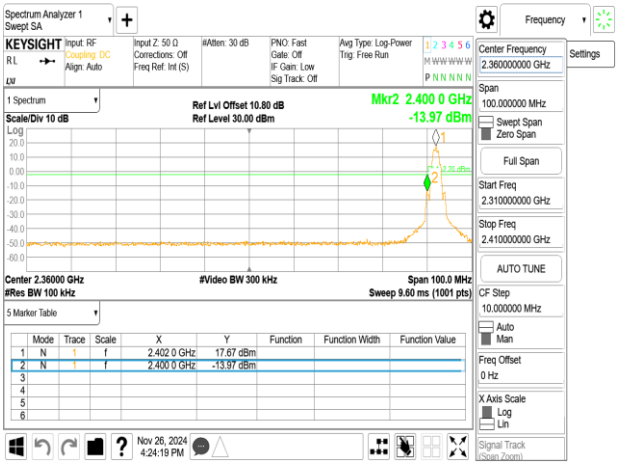
Band Edge_BLE 1M_HighCH39-2480MHz



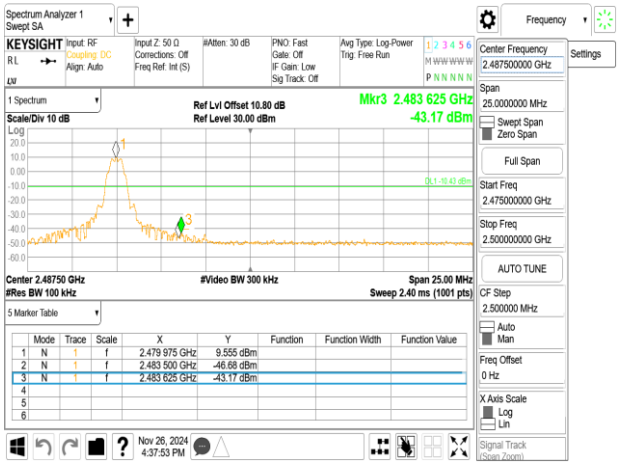
Band Edge_BLE 125k_LowCH00-2402MHz



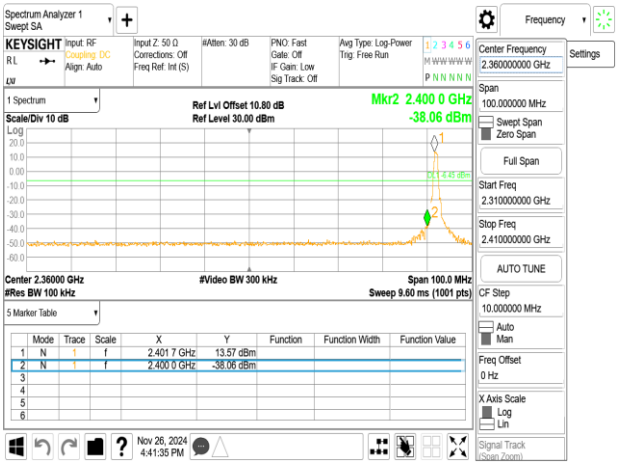
Band Edge_BLE 2M_LowCH00-2402MHz



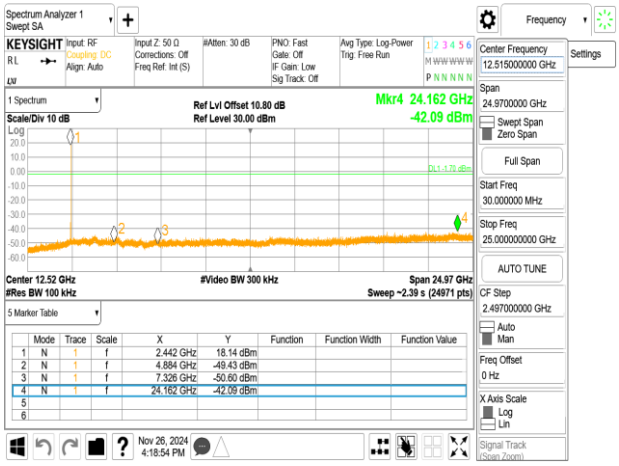
Band Edge_BLE 125k_HighCH39-2480MHz



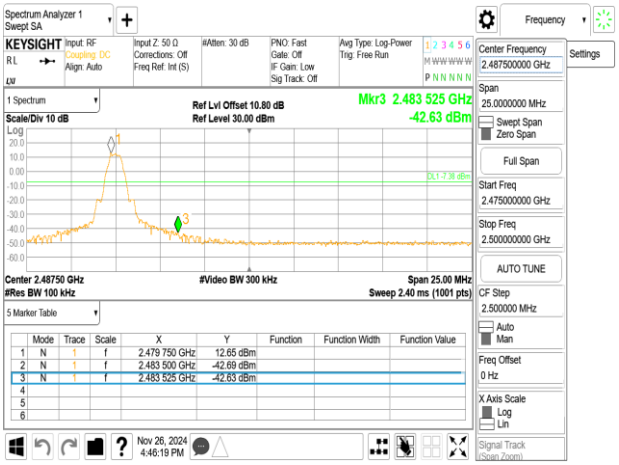
Band Edge_BLE 500k_LowCH00-2402MHz



Spurious Emission_BLE 1M_MidCH20-2442MHz



Band Edge_BLE 500k_HighCH39-2480MHz



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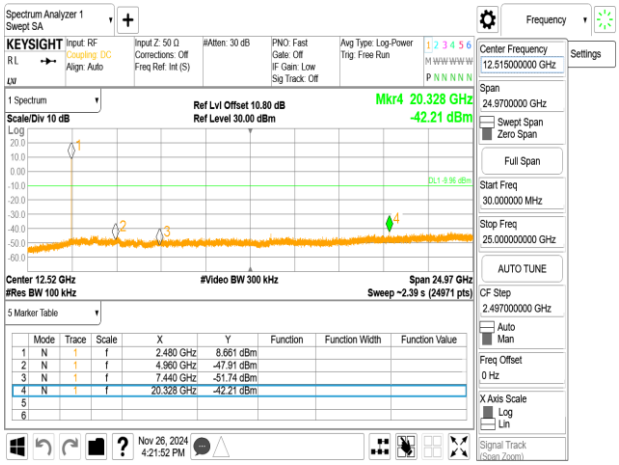

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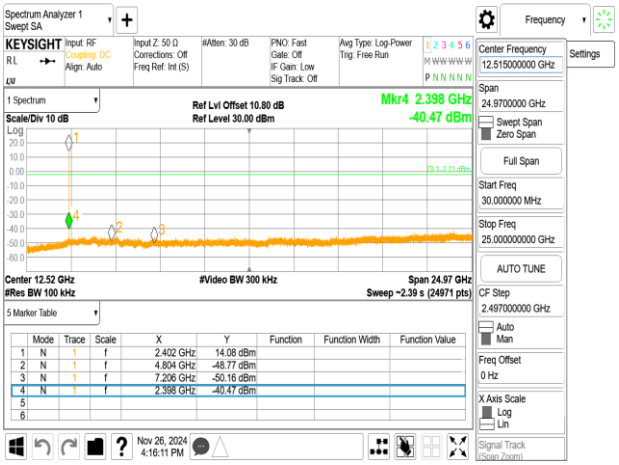

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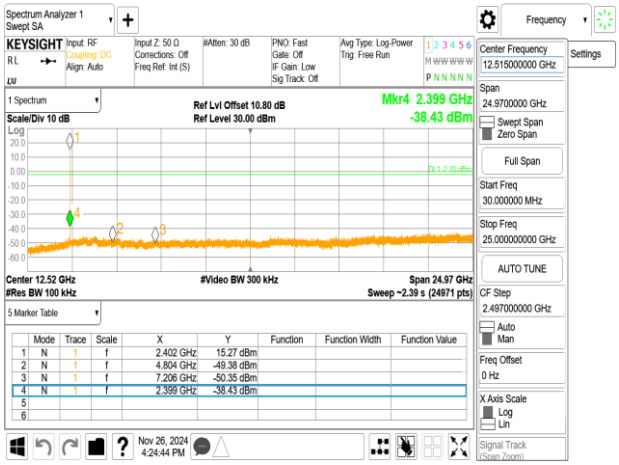

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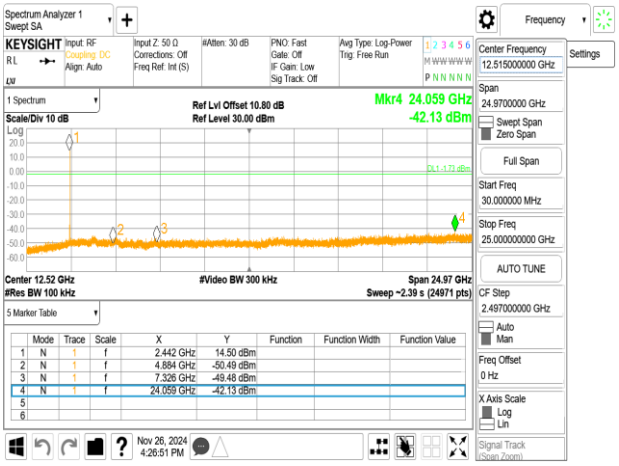
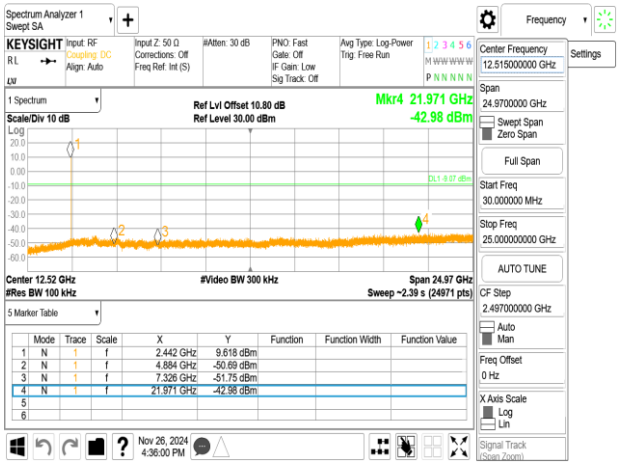
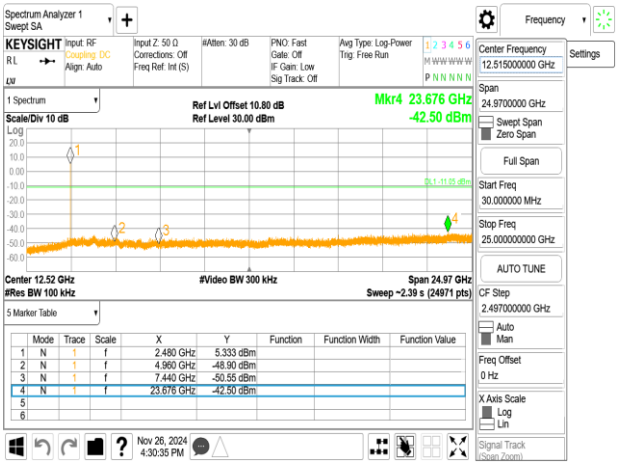


Spurious Emission_BLE 125k_MidCH20-2442MHz



Spurious Emission_BLE 2M_HighCH39-2480MHz



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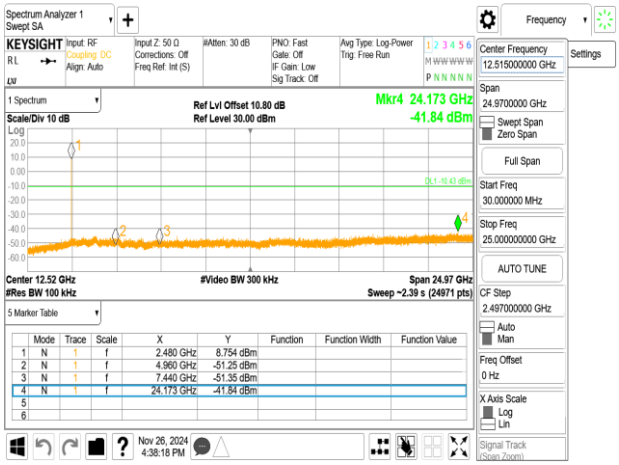
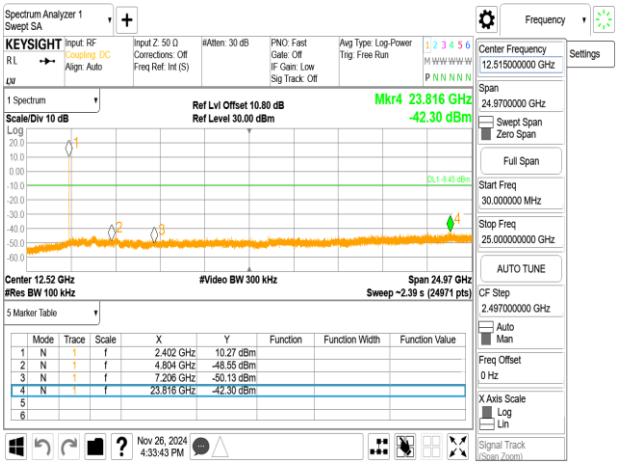
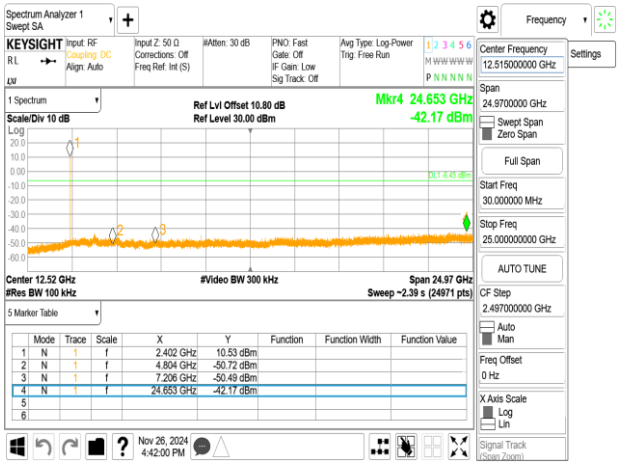


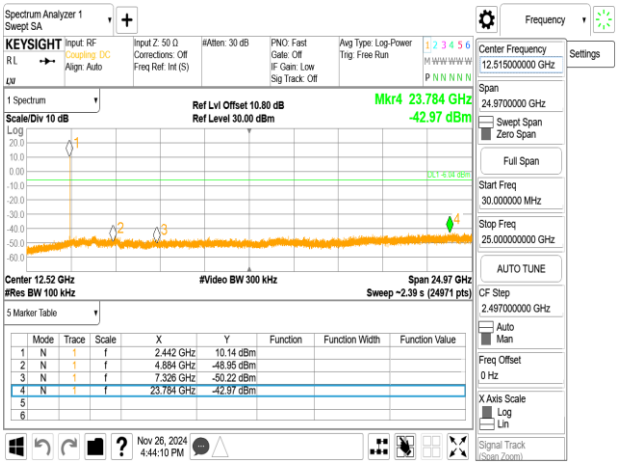
Spurious Emission_BLE 125k_LowCH00-2402MHz



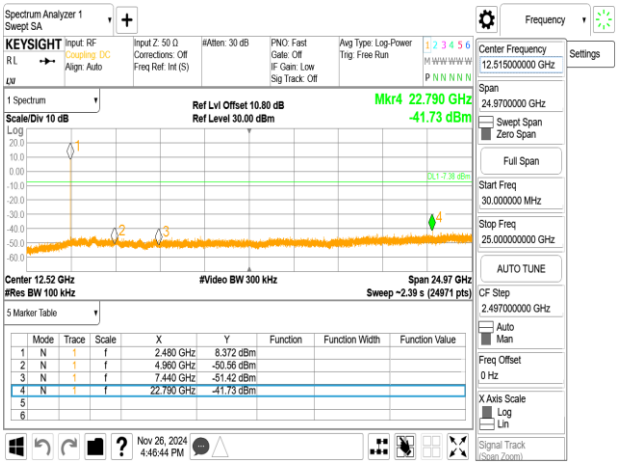
Spurious Emission_BLE 500k_LowCH00-2402MHz



Spurious Emission_BLE 500k_MidCH20-2442MHz



Spurious Emission_BLE 500k_HighCH39-2480MHz



11 BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

11.1 Standard Applicable

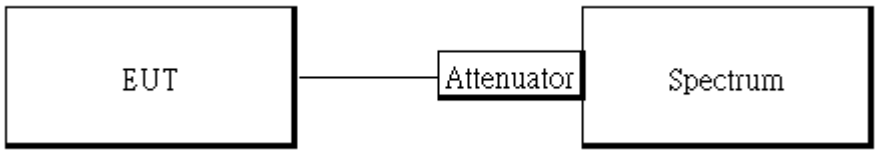
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 limit as below.

And according to §15.33(a) (1) for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

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

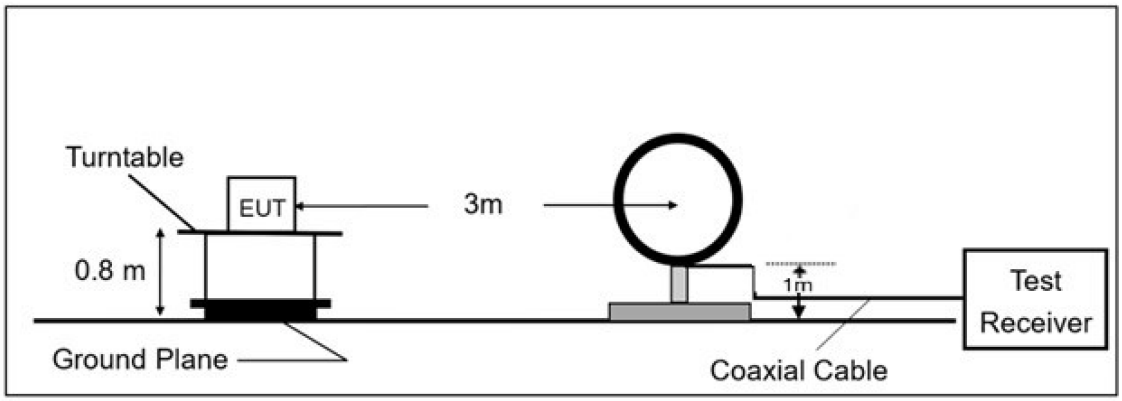
Note: The lower limit shall apply at the transition frequencies.

11.1.1 Bandedge & Emission

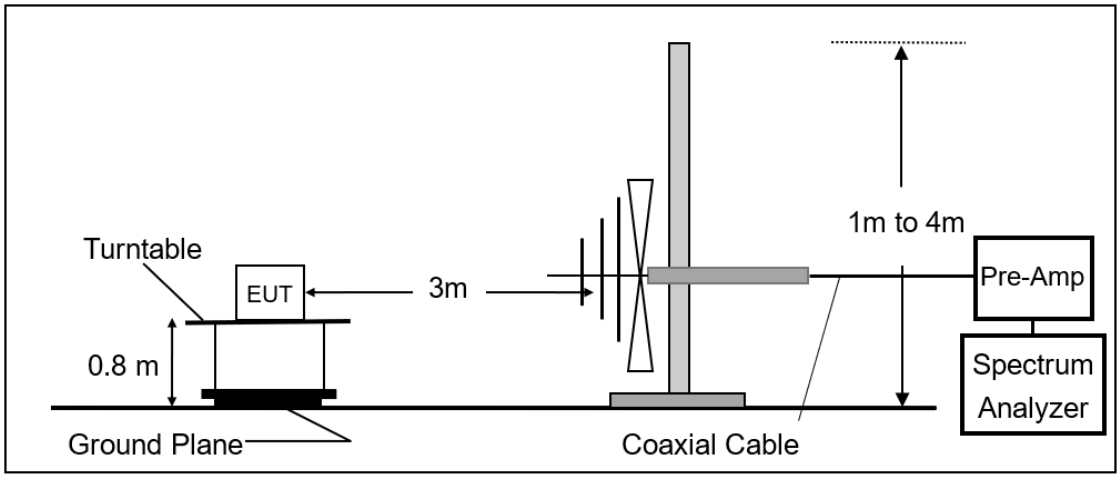


11.1.2 Radiated Spurious Emission

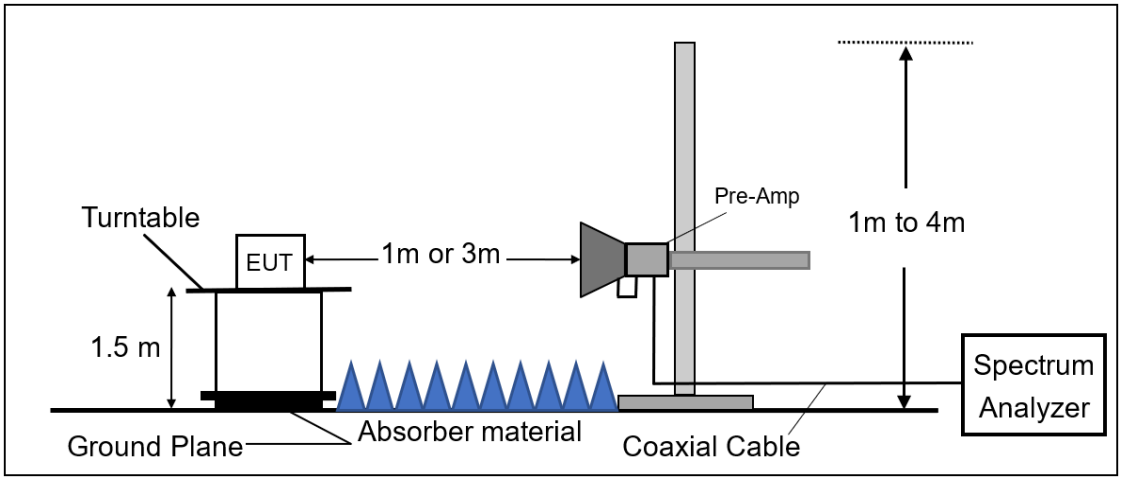
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz.



(B) Radiated Emission Test Set-Up, Frequency From 30MHz to 1000MHz.



(C) Radiated Emission Test Set-Up, Frequency Above 1GHz.



11.2 Measurement Procedure

11.2.1 Band edge measurements

1. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz, Detector = Peak for Maximum Emission Measurements at frequency above 1 GHz, Sweep time = No faster than coupled (auto) time ,Trace mode = max-hold ,Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time and number of sweep points may be lengthened for low duty cycle applications.)
2. Set the spectrum analyzer as RBW=100 KHz, VBW=300KHz, Detector = RMS for Maximum Emission Measurements at frequency above 1 GHz, Sweep time = AUTO
3. Compute the power by integrating the spectrum over 1 MHz using the instrument's band-power measurement function with band limits set equal to the emission frequency (femission) ± 0.5 MHz. If the spectrum analyzer does not have a band-power function, then sum the amplitude levels (in power units) at 100 kHz intervals extending across the 1 MHz spectrum defined by femission ± 0.5 MHz.
4. 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.

11.2.2 Radiated emissions measurements

1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
2. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 1.5m for frequency> 1GHz above ground plane.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
5. Set the spectrum analyzer as RBW=100 kHz and VBW=300 kHz for Peak Detector (PK) at frequency between 30MHz and 1 GHz.
6. Use receiver mode as RBW=120 kHz for Quasi-peak (QP) at frequency between 30MHz and 1 GHz.
7. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Maximum Emission Measurements at frequency above 1 GHz.
8. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Emission Measurements at frequency above 1 GHz.
9. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization

oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

10. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
11. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
12. Repeat above procedures until all default test channel measured were complete.

11.3 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where *FS = Field Strength* *CL = Cable Attenuation Factor (Cable Loss)*
RA = Reading Amplitude *AG = Amplifier Gain*
AF = Antenna Factor

*The limit of the emission level is expressed in dBuV/m, which converts 20*log(uV/m)*

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

11.4 Test Results of Radiated Spurious Emissions from 9 kHz to 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 per 15.31(o) was not reported.