FCC TEST REPORT

FCC ID: 2BNOX-A1-C1

Report No.	:	SSP25090174-1E
Applicant	:	TSN(TITAN) PTE LTD
Product Name	:	A1-C1 Electronic Cam Lock
Model Name	:	A1-C1
Test Standard	:	FCC Part 15.247
Date of Issue	:	2025-09-28

Shenzhen CCUT Quality Technology Co., Ltd.
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This test report is limited to the above client company and the product model only. It may not be duplicated without prior permitted by Shenzhen CCUT Quality Technology Co., Ltd.

Test Report Basic Information

Applicant.....:	TSN(TITAN) PTE LTD
Address of Applicant.....:	1 SCOTTS RD, #24-10, SHAW CENTRE, Singapore, 228208
Manufacturer.....:	TSN(TITAN) PTE LTD
Address of Manufacturer.....:	1 SCOTTS RD, #24-10, SHAW CENTRE, Singapore, 228208
Product Name.....:	A1-C1 Electronic Cam Lock
Brand Name.....:	A1OTC
Main Model.....:	A1-C1
Series Models.....:	See section 1.1(page 5)
Test Standard.....:	FCC Part 15 Subpart C KDB 558074 D01 15.247 Meas Guidance v05r02 ANSI C63.4-2014 ANSI C63.10-2013
Date of Test .....:	2025-09-19 to 2024-09-28
Test Result.....:	PASS
Tested By .....:	Leonis Cai (Leonis Cai)
Reviewed By.....:	Lorzix Luo (Lorzix Luo)
Authorized Signatory.....:	Lahm Peng (Lahm Peng)

Shenzhen CCUT Quality Technology Co., Ltd. APPROVED

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Revision History

Revision	Issue Date	Description	Revised By
V1.0	2025-09-28	Initial Release	Lahm Peng

1. General Information

1.1 Product Information

Product Name:	A1-C1 Electronic Cam Lock
Trade Name:	A1OTC
Test Model:	A1-C1
Series Models:	-
Rated Voltage:	DC 5V by USB charging Type-C Input: 5V/1A USB-A Input: 5V/1A
Test Sample No:	SSP25090174-1
Hardware Version:	V1.0
Software Version:	V1.0.00
Note 1: The test data is gathered from a production sample, provided by the manufacturer.	

Wireless Specification	
Wireless Standard:	Bluetooth BLE
Operating Frequency:	2402MHz ~ 2480MHz
RF Output Power:	-4.79dBm
Number of Channel:	40
Channel Separation:	2MHz
Modulation:	GFSK
Antenna Gain:	2.5dBi
Type of Antenna:	PCB Antenna
Type of Device:	☐ Portable Device ☒ Mobile Device ☐ Modular Device

1.2 Test Setup Information

List of Test Modes		
Test Mode	Description	Remark
TM1	BLE_1Mbps	2402/2440/2480MHz
TM2	BLE_2Mbps	2402/2440/2480MHz

List and Details of Auxiliary Cable			
Description	Length (cm)	Shielded/Unshielded	With/Without Ferrite
USB-A Cable	100	Unshielded	Without Ferrite

List and Details of Auxiliary Equipment			
Description	Manufacturer	Model	Serial Number
Adapter	XIAOMI	MDY-14-EU	HC78E2N6A23645
-	-	-	-

List of Channels							
No. of Channel	Frequency (MHz)	No. of Channel	Frequency (MHz)	No. of Channel	Frequency (MHz)	No. of Channel	Frequency (MHz)
01	2402	11	2422	21	2442	31	2462
02	2404	12	2424	22	2444	32	2464
03	2406	13	2426	23	2446	33	2466
04	2408	14	2428	24	2448	34	2468
05	2410	15	2430	25	2450	35	2470
06	2412	16	2432	26	2452	36	2472
07	2414	17	2434	27	2454	37	2474
08	2416	18	2436	28	2456	38	2476
09	2418	19	2438	29	2458	39	2478
10	2420	20	2440	30	2460	40	2480

1.3 Compliance Standards

Compliance Standards	
FCC Part 15 Subpart C	FEDERAL COMMUNICATIONS COMMISSION, RADIO FREQUENCY DEVICES, Intentional Radiators
All measurements contained in this report were conducted with all above standards	
According to standards for test methodology	
FCC Part 15 Subpart C	FEDERAL COMMUNICATIONS COMMISSION, RADIO FREQUENCY DEVICES, Intentional Radiators
KDB 558074 D01 15.247 Meas Guidance v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES
ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Maintenance of compliance is the responsibility of the manufacturer or applicant. Any modification of the product, which result is lowering the emission, should be checked to ensure compliance has been maintained.	

1.4 Test Facilities

Laboratory Name:	**Shenzhen CCUT Quality Technology Co., Ltd.** 1F, Building 35, Changxing Technology Industrial Park, Yutang Street, Guangming District, Shenzhen, Guangdong, China
CNAS Laboratory No.:	L18863
A2LA Certificate No.:	6983.01
FCC Registration No:	583813
FCC Designation No.:	CN1373
ISED Registration No.:	CN0164

1.5 List of Measurement Instruments

Description	Manufacturer	Model	Serial Number	Cal. Date	Due. Date
Conducted Emissions					
AMN	ROHDE&SCHWARZ	ENV216	101097	2025-07-15	2026-07-14
EMI Test Receiver	ROHDE&SCHWARZ	ESPI	100242	2025-07-15	2026-07-14
Test Cable	N/A	Cable 5	N/A	2025-07-15	2026-07-14
EMI Test Software	FARA	EZ-EMC	EMEC-3A1+	N/A	N/A
Radiated Emissions					
EMI Test Receiver	ROHDE&SCHWARZ	ESPI	100154	2025-07-15	2026-07-14
Spectrum Analyzer	KEYSIGHT	N9020A	MY48030972	2025-07-15	2026-07-14
Spectrum Analyzer	ROHDE&SCHWARZ	FSV40-N	101692	2025-07-15	2026-07-14
Amplifier	SCHWARZBECK	BBV 9743B	00251	2025-07-15	2026-07-14
Amplifier	HUABO	YXL0518-2.5-45	--	2025-07-15	2026-07-14
Amplifier	COM-MW	DLAN-18G-4G-02	10229104	2025-07-15	2026-07-14
Loop Antenna	DAZE	ZN30900C	21104	2025-07-12	2026-07-11
Broadband Antenna	SCHWARZBECK	VULB 9168	01320	2025-07-12	2026-07-11
Horn Antenna	SCHWARZBECK	BBHA 9120D	02553	2025-07-12	2026-07-11
Horn Antenna	COM-MW	ZLB7-18-40G-950	12221225	2025-07-12	2026-07-11
Attenuator	QUANJUDA	6dB	220731	2025-07-15	2026-07-14
Test Cable	N/A	Cable 1	N/A	2025-07-15	2026-07-14
Test Cable	N/A	Cable 2	N/A	2025-07-15	2026-07-14
Test Cable	N/A	Cable 3	N/A	2025-07-15	2026-07-14
Test Cable	N/A	Cable 4	N/A	2025-07-15	2026-07-14
Test Cable	N/A	Cable 8	N/A	2025-07-15	2026-07-14
Test Cable	N/A	Cable 9	N/A	2025-07-15	2026-07-14
EMI Test Software	FARA	EZ-EMC	FA-03A2 RE+	N/A	N/A
Conducted RF Testing					
RF Test System	MWRFTest	MW100-RFCB	220418SQS-37	2025-07-16	2026-07-15
Spectrum Analyzer	KEYSIGHT	N9020A	ATO-90521	2025-07-16	2026-07-15
RF Test Software	MWRFTest	MTS 8310	N/A	N/A	N/A
Laptop	Lenovo	ThlnkPad E15 Gen 3	SPPOZ22485	N/A	N/A

1.6 Measurement Uncertainty

Test Item	Conditions	Uncertainty
Conducted Emissions	9kHz ~ 30MHz	±1.64 dB
Radiated Emissions	9kHz ~ 30MHz	±2.88 dB
	30MHz ~ 1GHz	±3.32 dB
	1GHz ~ 18GHz	±3.50 dB
	18GHz ~ 40GHz	±3.66 dB
Conducted Output Power	9kHz ~ 26GHz	±0.50 dB
Occupied Bandwidth	9kHz ~ 26GHz	±4.0 %
Conducted Spurious Emission	9kHz ~ 26GHz	±1.32 dB
Power Spectrum Density	9kHz ~ 26GHz	±0.62 dB

2. Summary of Test Results

FCC Rule	Description of Test Item	Result
FCC Part 15.203	Antenna Requirement	Passed
FCC Part 15.247(i)	RF Exposure(see the RF exposure report)	Passed
FCC Part 15.207	Conducted Emissions	Passed
FCC Part 15.209, 15.247(d)	Radiated Emissions	Passed
FCC Part 15.247(d)	Band-edge Emissions(Radiated)	Passed
FCC Part 15.247(b)(3)	Maximum Conducted Output Power	Passed
FCC Part 15.247(a)(2)	Occupied Bandwidth	Passed
FCC Part 15.247(e)	Maximum Power Spectral Density	Passed
FCC Part 15.247(d)	Band-edge Emissions(Conducted)	Passed
FCC Part 15.247(d)	Conducted RF Spurious Emissions	Passed
Passed: The EUT complies with the essential requirements in the standard Failed: The EUT does not comply with the essential requirements in the standard N/A: Not applicable		

3. Antenna Requirement

3.1 Standard and Limit

According to FCC Part 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. 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 provisions of this section.

3.2 Test Result

This product has an PCB antenna, fulfill the requirement of this section.

4. Conducted Emissions

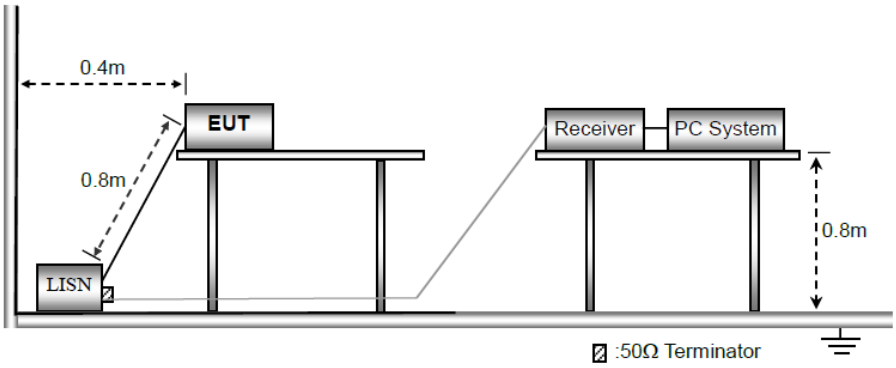
4.1 Standard and Limit

According to the rule FCC Part 15.207, Conducted emissions limit, the limit for a wireless device as below:

Frequency of Emission (MHz)	Conducted emissions (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50
Note 1: Decreases with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz Note 2: The lower limit applies at the band edges		

4.2 Test Procedure

Test is conducting under the description of ANSI C63.10 - 2013 section 6.2.



Test Setup Block Diagram

a) The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

b) The following is the setting of the receiver
Attenuation: 10dB
Start Frequency: 0.15MHz
Stop Frequency: 30MHz
IF Bandwidth: 9kHz

c) The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

d) Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
e) I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

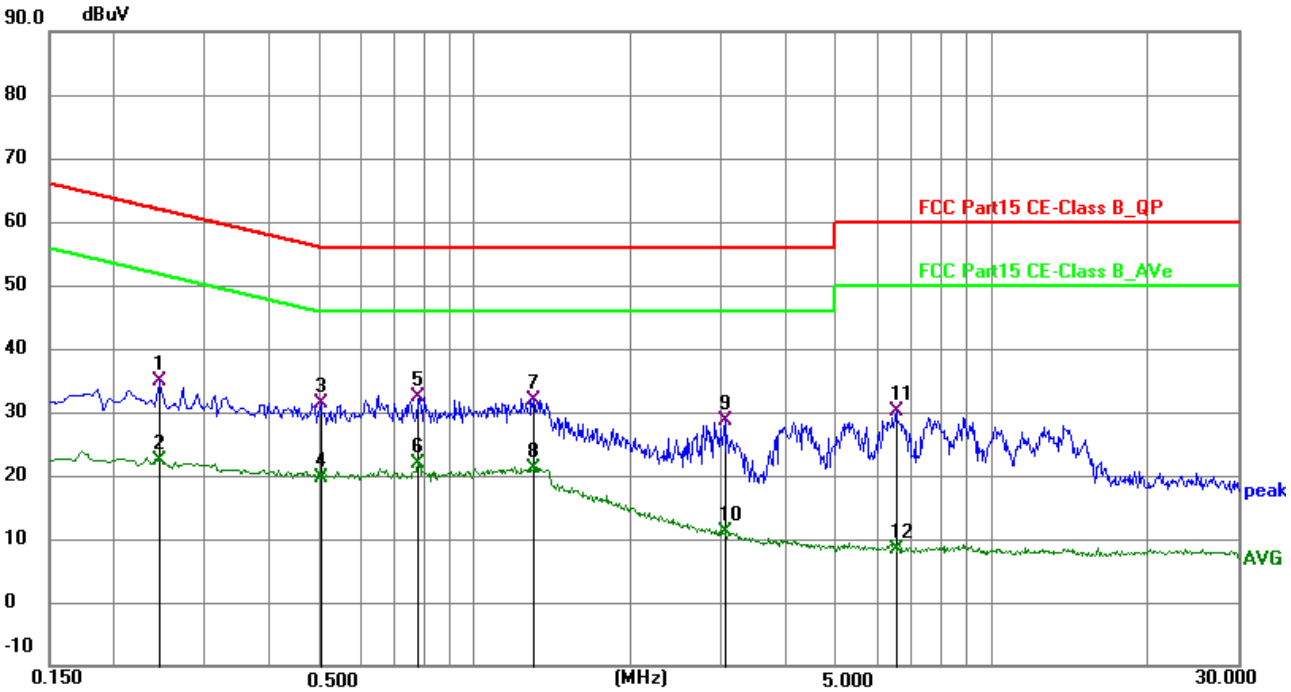
f) LISN is at least 80 cm from nearest part of EUT chassis.

g) For the actual test configuration, please refer to the related Item - photographs of the test setup.

4.3 Test Data and Results

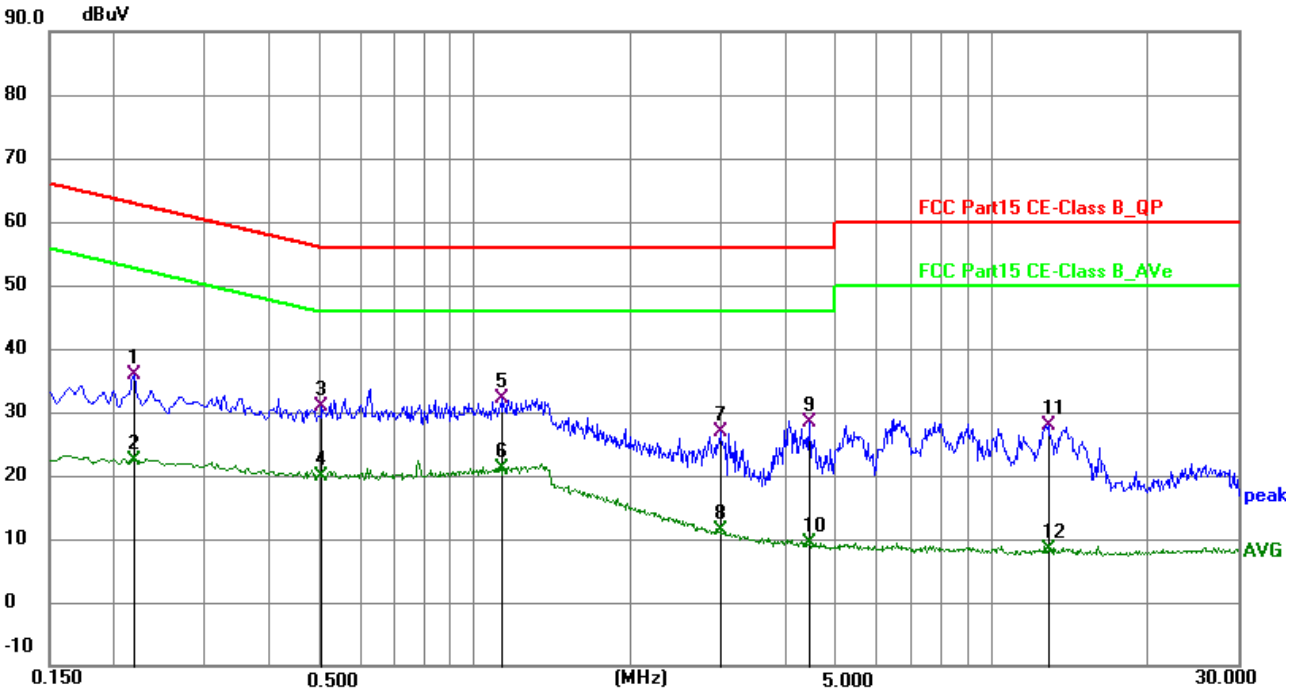
All of the BLE_1Mbps, BLE_2Mbps modes have been tested, the EUT complied with the FCC Part 15.207 standard limit for a wireless device, and with the worst case BLE_1Mbps 2402MHz as below:
Remark: Level = Reading + Factor, Margin = Level - Limit

Test Plots and Data of Conducted Emissions	
Tested Mode:	TM1
Test Voltage:	AC 120V/60Hz
Test Power Line:	Neutral
Remark:	



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.2445	25.49	9.29	34.78	61.94	-27.16	QP	P	
2	0.2445	13.07	9.29	22.36	51.94	-29.58	AVG	P	
3	0.5010	21.98	9.39	31.37	56.00	-24.63	QP	P	
4	0.5010	10.28	9.39	19.67	46.00	-26.33	AVG	P	
5 *	0.7799	22.96	9.41	32.37	56.00	-23.63	QP	P	
6	0.7799	12.49	9.41	21.90	46.00	-24.10	AVG	P	
7	1.2975	22.40	9.44	31.84	56.00	-24.16	QP	P	
8	1.2975	11.63	9.44	21.07	46.00	-24.93	AVG	P	
9	3.0570	19.16	9.50	28.66	56.00	-27.34	QP	P	
10	3.0570	1.62	9.50	11.12	46.00	-34.88	AVG	P	
11	6.5400	20.49	9.57	30.06	60.00	-29.94	QP	P	
12	6.5400	-1.11	9.57	8.46	50.00	-41.54	AVG	P	

Test Plots and Data of Conducted Emissions	
Tested Mode:	TM1
Test Voltage:	AC 120V/60Hz
Test Power Line:	Live
Remark:	



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.2175	26.37	9.43	35.80	62.91	-27.11	QP	P	
2	0.2175	12.98	9.43	22.41	52.91	-30.50	AVG	P	
3	0.5055	21.20	9.58	30.78	56.00	-25.22	QP	P	
4	0.5055	10.21	9.58	19.79	46.00	-26.21	AVG	P	
5 *	1.1310	22.48	9.62	32.10	56.00	-23.90	QP	P	
6	1.1310	11.61	9.62	21.23	46.00	-24.77	AVG	P	
7	2.9895	17.14	9.69	26.83	56.00	-29.17	QP	P	
8	2.9895	1.65	9.69	11.34	46.00	-34.66	AVG	P	
9	4.4430	18.64	9.74	28.38	56.00	-27.62	QP	P	
10	4.4430	-0.31	9.74	9.43	46.00	-36.57	AVG	P	
11	12.8760	18.18	9.74	27.92	60.00	-32.08	QP	P	
12	12.8760	-1.48	9.74	8.26	50.00	-41.74	AVG	P	

5. Radiated Emissions

5.1 Standard and Limit

According to §15.247(d), 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. 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) (see § 15.205(c)).

According to the rule FCC Part 15.209, Radiated emission limit for a wireless device as below:

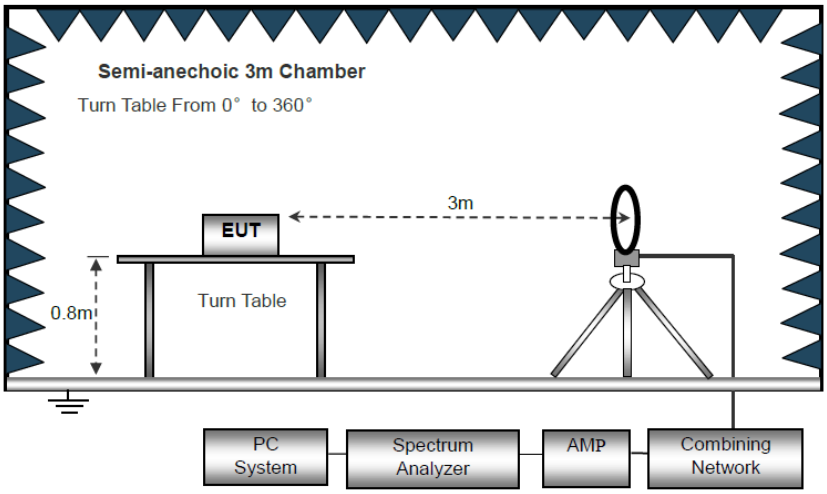
Frequency of Emission (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3
Note: The more stringent limit applies at transition frequencies.		

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

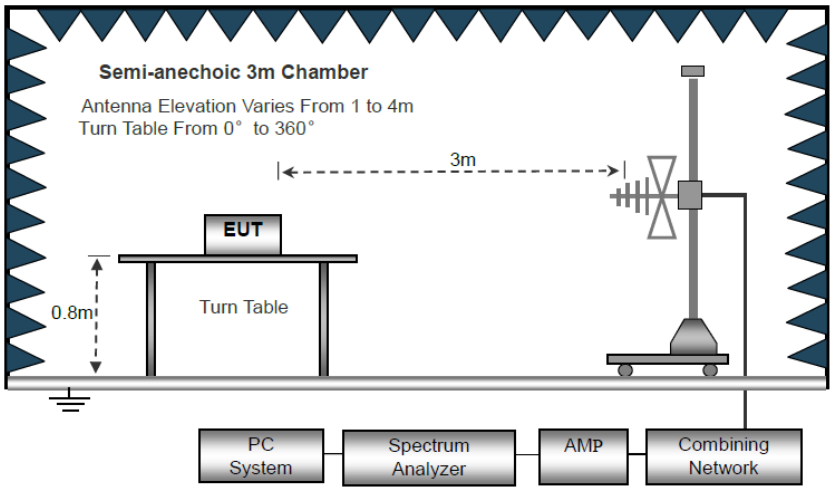
Note: Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

5.2 Test Procedure

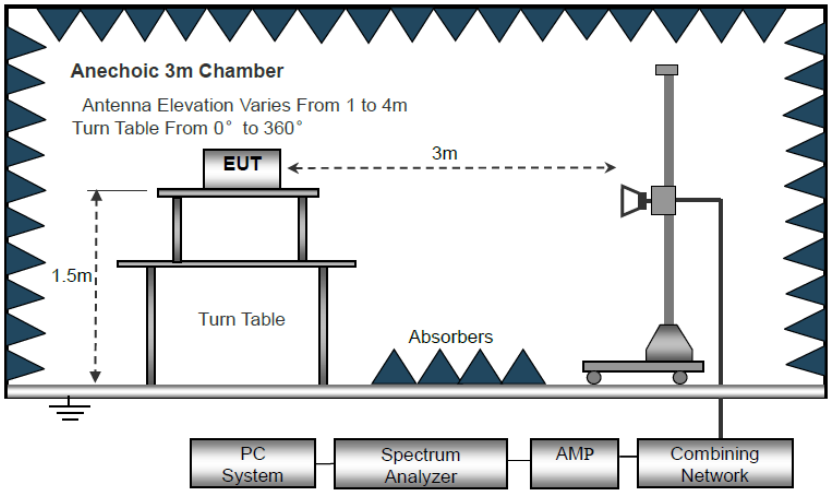
Test is conducting under the description of ANSI C63.10 - 2013 section 6.3 to 6.6.



Block Diagram of Radiated Emission Below 30MHz



Block Diagram of Radiated Emission From 30MHz to 1GHz



Block Diagram of Radiated Emission Above 1GHz

a) The EUT is placed on a turntable, which is 0.8m above ground plane for test frequency range blew 1GHz, and 1.5m above ground plane for test frequency range above 1GHz.

b) EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.

c) Use the following spectrum analyzer settings:
Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1GHz, 100 kHz for f < 1 GHz, 10kHz for f < 30MHz
VBW ≥ RBW, Sweep = auto
Detector function = peak
Trace = max hold

d) Follow the guidelines in ANSI C63.4-2014 with respect to maximizing the emission by rotating the EUT, adjusting the measurement antenna height and polarization, etc. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, submit this data. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

e) The peak level, once corrected, must comply with the limit specified in Section 15.209. Set the RBW = 1MHz, VBW = 10Hz, Detector = PK for AV value, while maintaining all of the other instrument settings.

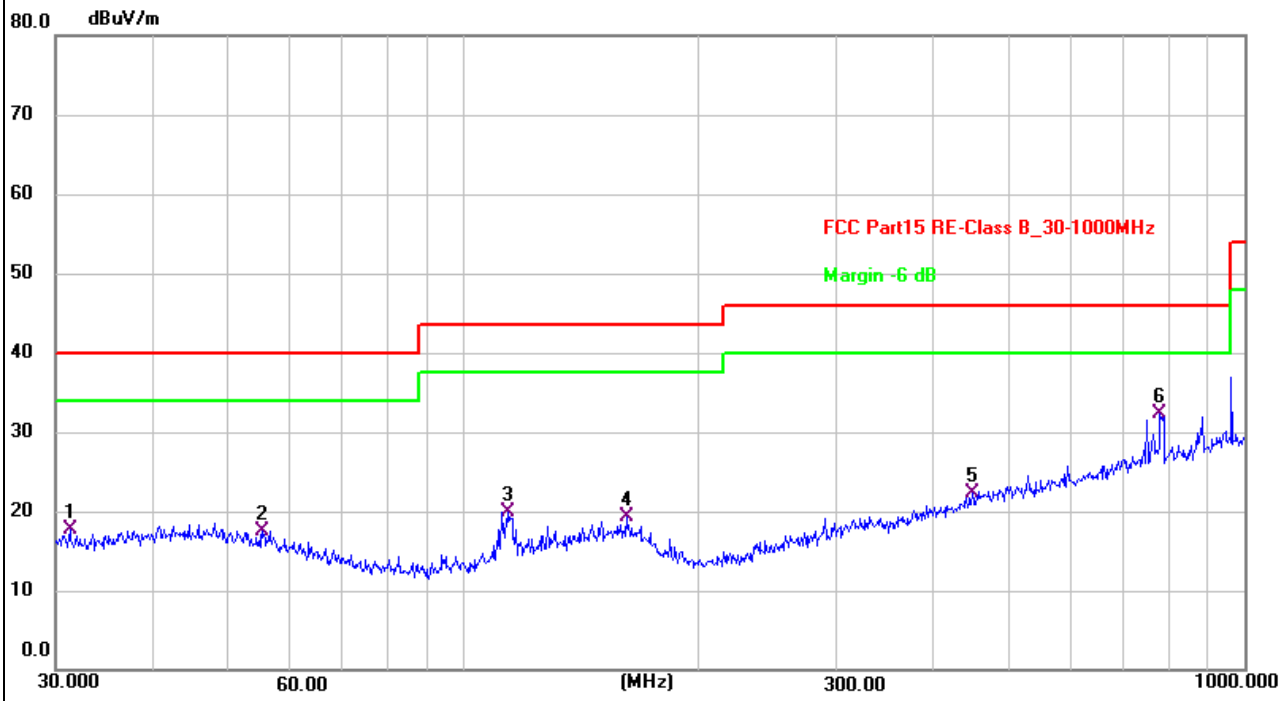
f) For the actual test configuration, please refer to the related item - EUT test photos.

5.3 Test Data and Results

All of the BLE_1Mbps, BLE_2Mbps modes have been tested, the EUT complied with the FCC Part 15.247 standard limit for a wireless device, and with the worst case BLE_1Mbps 2402MHz as below:

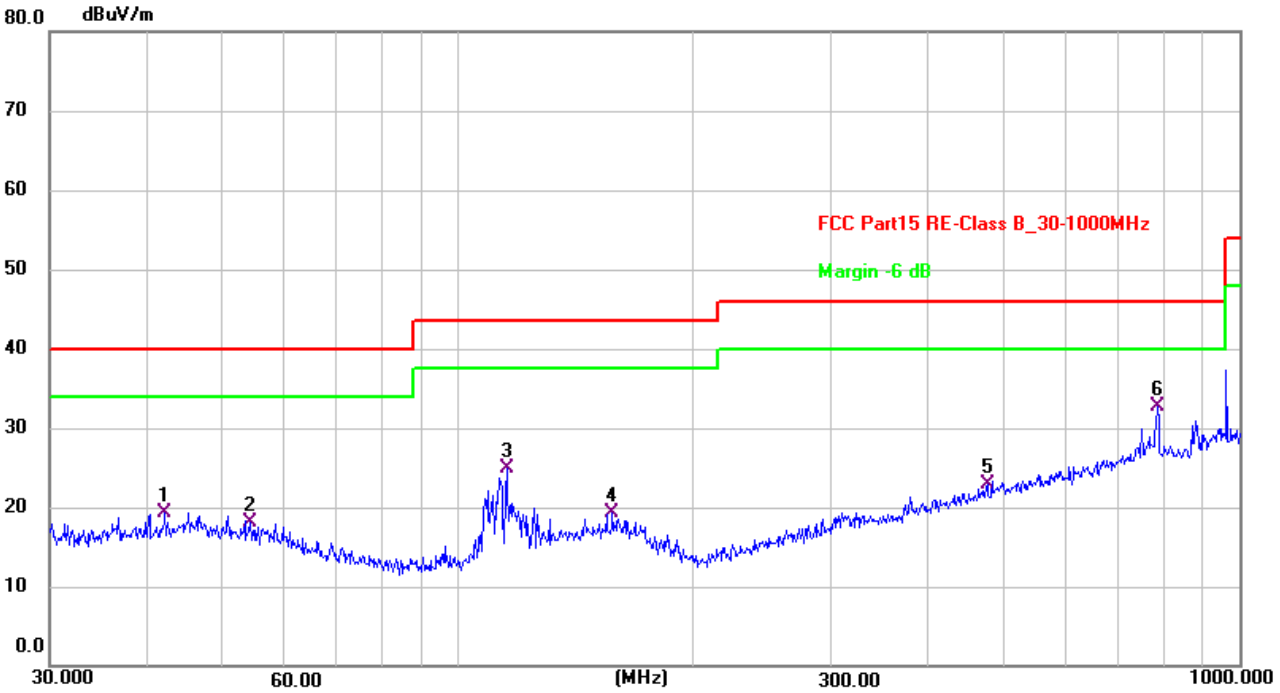
Remark: Level = Reading + Factor, Margin = Level - Limit

Radiated Emission Test Data (30MHz to 1GHz)	
Tested Mode:	TM1
Test Antenna Polarization:	Horizontal
Remark:	



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	31.2893	26.59	-8.95	17.64	40.00	-22.36	QP	100	0	P	
2	55.2207	26.77	-9.20	17.57	40.00	-22.43	QP	100	0	P	
3	114.1138	30.42	-10.43	19.99	43.50	-23.51	QP	100	0	P	
4	161.4742	27.36	-8.01	19.35	43.50	-24.15	QP	100	0	P	
5	447.9822	26.80	-4.57	22.23	46.00	-23.77	QP	100	0	P	
6 *	779.6068	30.98	1.26	32.24	46.00	-13.76	QP	100	0	P	

Radiated Emission Test Data (30MHz to 1GHz)	
Tested Mode:	TM1
Test Antenna Polarization:	Vertical
Remark:	



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	42.1542	27.58	-8.29	19.29	40.00	-20.71	QP	100	360	P	
2	54.2610	27.20	-9.07	18.13	40.00	-21.87	QP	100	360	P	
3	115.3205	35.13	-10.29	24.84	43.50	-18.66	QP	100	360	P	
4	157.5588	27.05	-7.84	19.21	43.50	-24.29	QP	100	360	P	
5	475.4991	26.75	-3.87	22.88	46.00	-23.12	QP	100	360	P	
6 *	785.0935	31.39	1.33	32.72	46.00	-13.28	QP	100	360	P	

Radiated Emission Test Data (Above 1GHz)							
Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
MHz	dBuV/m	dB/m	dBuV/m	dBuV/m	dB	H/V	PK/AV
Lowest Channel (2402MHz)							
4804	75.88	-14.72	61.16	74	-12.84	H	PK
4804	60.25	-14.72	45.53	54	-8.47	H	AV
7206	63.72	-8.41	55.31	74	-18.69	H	PK
7206	47.24	-8.41	38.83	54	-15.17	H	AV
4804	74.86	-14.72	60.14	74	-13.86	V	PK
4804	57.31	-14.72	42.59	54	-11.41	V	AV
7206	63.81	-8.41	55.4	74	-18.6	V	PK
7206	47.84	-8.41	39.43	54	-14.57	V	AV
Middle Channel (2440MHz)							
4880	75.42	-14.64	60.78	74	-13.22	H	PK
4880	62.77	-14.64	48.13	54	-5.87	H	AV
7320	62.28	-8.28	54	74	-20	H	PK
7320	46.5	-8.28	38.22	54	-15.78	H	AV
4880	75.18	-14.64	60.54	74	-13.46	V	PK
4880	59.65	-14.64	45.01	54	-8.99	V	AV
7320	64.56	-8.28	56.28	74	-17.72	V	PK
7320	49.22	-8.28	40.94	54	-13.06	V	AV
Highest Channel (2480MHz)							
4960	79.69	-14.53	65.16	74	-8.84	H	PK
4960	62.76	-14.53	48.23	54	-5.77	H	AV
7440	65.45	-8.13	57.32	74	-16.68	H	PK
7440	49.28	-8.13	41.15	54	-12.85	H	AV
4960	77.59	-14.53	63.06	74	-10.94	V	PK
4960	60.9	-14.53	46.37	54	-7.63	V	AV
7440	62.15	-8.13	54.02	74	-19.98	V	PK
7440	50.95	-8.13	42.82	54	-11.18	V	AV

Note 1: All of the BLE_1Mbps, BLE_2Mbps modes have been tested,this EUT was tested in 3 orthogonal positions, with the X-axis being the worst, and the worst case position data BLE_1Mbps was reported.

Note 2: Testing is carried out with frequency rang 9kHz to the tenth harmonics. The measurements greater than 20dB below the limit from 9kHz to 30MHz.

Note 3: Other emissions are attenuated 20dB below the limits from 9kHz to 30MHz, so it does not recorded report, 18GHz-26GHz not recorded for no spurious point have a margin of less than 20 dB with respect to the limits.

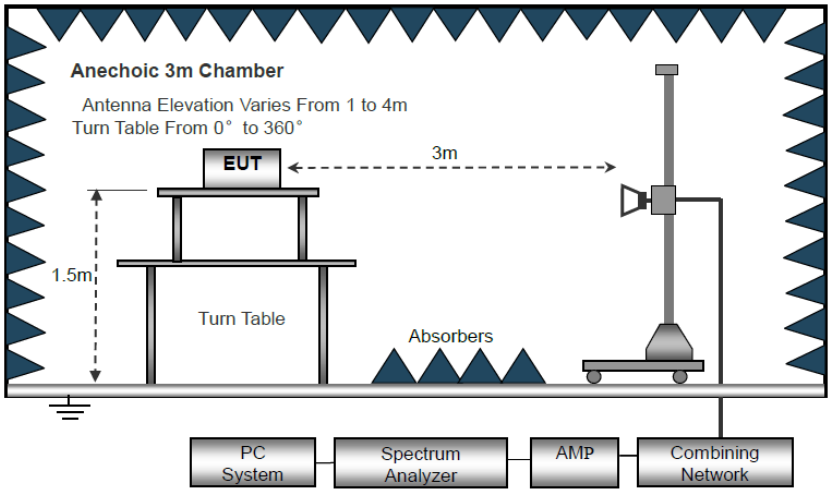
6. Band-edge Emissions(Radiated)

6.1 Standard and Limit

According to §15.247(d), 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. 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) (see § 15.205(c)).

6.2 Test Procedure

Test is conducting under the description of ANSI C63.10 - 2013 section 6.3 to 6.6 and section 6.10.



Test Setup Block Diagram

As the radiated emissions testing, set the Lowest and Highest Transmitting Channel, observed the outside band of 2310MHz to 2400MHz and 2483.5MHz to 2500MHz, than mark the higher-level emission for comparing with the FCC rules.

6.3 Test Data and Results

All of the BLE_1Mbps, BLE_2Mbps modes have been tested, the EUT complied with the FCC Part 15.247 standard limit, and with the worst case BLE_1Mbps as below:

Test Mode	Frequency	Limit	Result
	MHz	dBuV/dBc	
Lowest	2310.00	<54 dBuV	Pass
	2390.00	<54 dBuV	Pass
Highest	2483.50	<54 dBuV	Pass
	2500.00	<54 dBuV	Pass

Radiated Emission Test Data (Band edge emissions)							
Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
MHz	dBuV/m	dB/m	dBuV/m	dBuV/m	dB	H/V	PK/AV
Lowest Channel (2402MHz)							
2310	67.07	-21.34	45.73	74	-28.27	H	PK
2310	52.71	-21.34	31.37	54	-22.63	H	AV
2390	69.1	-20.96	48.14	74	-25.86	H	PK
2390	49.33	-20.96	28.37	54	-25.63	H	AV
2400	71.68	-20.91	50.77	74	-23.23	H	PK
2400	53.41	-20.91	32.5	54	-21.5	H	AV
2310	65.48	-21.34	44.14	74	-29.86	V	PK
2310	50.46	-21.34	29.12	54	-24.88	V	AV
2390	66.79	-20.96	45.83	74	-28.17	V	PK
2390	52.61	-20.96	31.65	54	-22.35	V	AV
2400	71.56	-20.91	50.65	74	-23.35	V	PK
2400	56.26	-20.91	35.35	54	-18.65	V	AV
Highest Channel (2480MHz)							
2483.50	70.55	-20.51	50.04	74	-23.96	H	PK
2483.50	56.11	-20.51	35.6	54	-18.4	H	AV
2500	68.8	-20.43	48.37	74	-25.63	H	PK
2500	52.37	-20.43	31.94	54	-22.06	H	AV
2483.50	68.55	-20.51	48.04	74	-25.96	V	PK
2483.50	55.01	-20.51	34.5	54	-19.5	V	AV
2500	68.49	-20.43	48.06	74	-25.94	V	PK
2500	49.22	-20.43	28.79	54	-25.21	V	AV

Remark: Level = Reading + Factor, Margin = Level - Limit

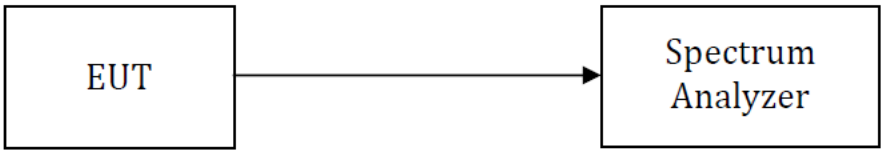
7. Maximum Peak Conducted Output Power

7.1 Standard and Limit

According to 15.247(b)(3). For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

7.2 Test Procedure

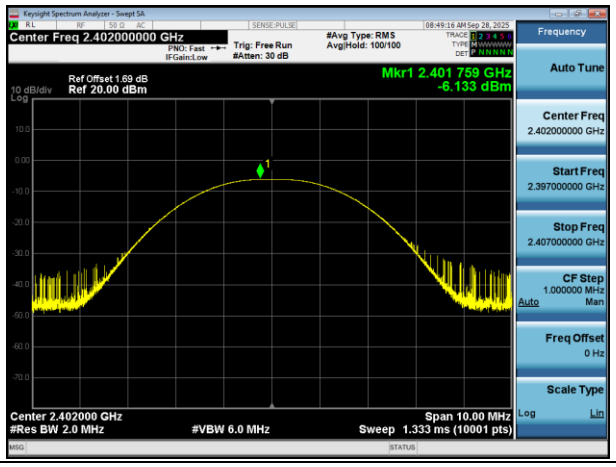
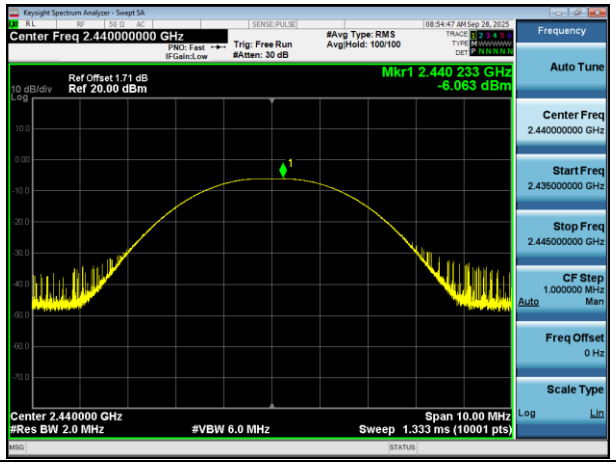
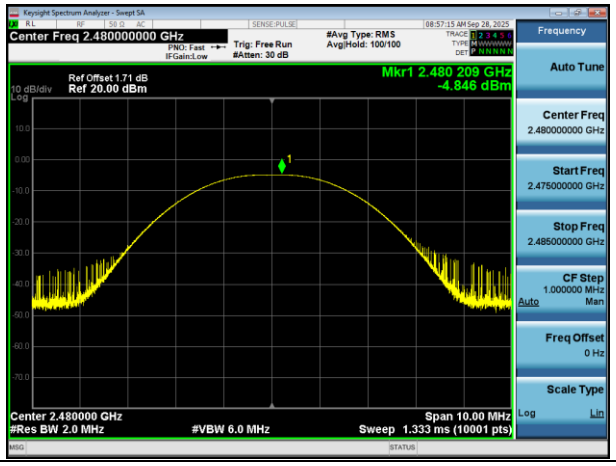
1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Set the spectrum analyzer to any one measured frequency within its operating range.
3) Set RBW = 2MHz, VBW = 6MHz, Sweep = Auto, Detector = Peak.
4) Measure the highest amplitude appearing on spectral display and mark the value.
5) Repeat the above procedures until all frequencies measured were complete.

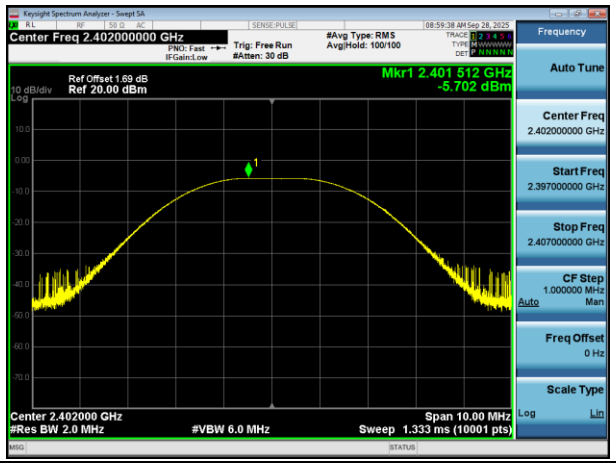
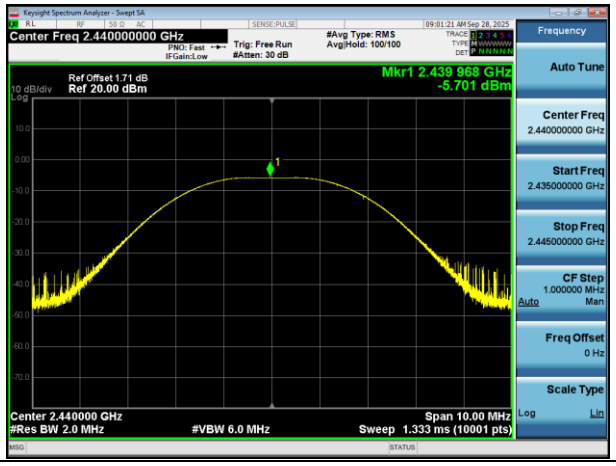
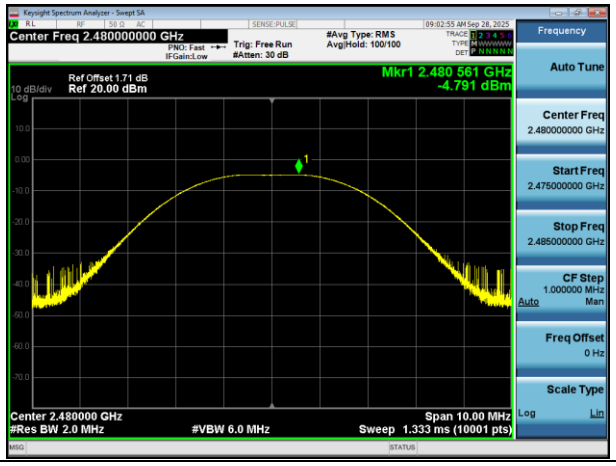


Test Setup Block Diagram

7.3 Test Data and Results

Test Mode	Test Channel MHz	Conducted Output Power (dBm)	Limit (dBm)	Test Result
BLE_1Mbps	2402	-6.13	30	Pass
	2440	-6.06	30	Pass
	2480	-4.85	30	Pass
BLE_2Mbps	2402	-5.7	30	Pass
	2440	-5.7	30	Pass
	2480	-4.79	30	Pass

BLE_1Mbps
2402MHz 
2440MHz 
2480MHz 

BLE_2Mbps
2402MHz 
2440MHz 
2480MHz 

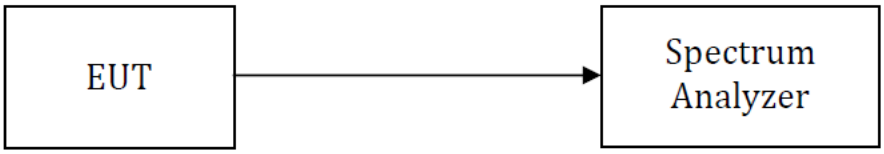
8. Occupied Bandwidth

8.1 Standard and Limit

According to 15.247(a)(2), Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.2 Test Procedure

According to the ANSI 63.10-2013, section 6.9, the emission bandwidth test method as follows.
1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Set the spectrum analyzer to any one measured frequency within its operating range.
3) Set RBW = 100kHz, VBW = 300kHz, Sweep = Auto.
4) Set a reference level on the measuring instrument equal to the highest peak value.
5) Measure the frequency difference of two frequencies that were attenuated 6dB from the reference level. Record the frequency difference as the emission bandwidth.
6) Repeat the above procedures until all frequencies measured were complete.

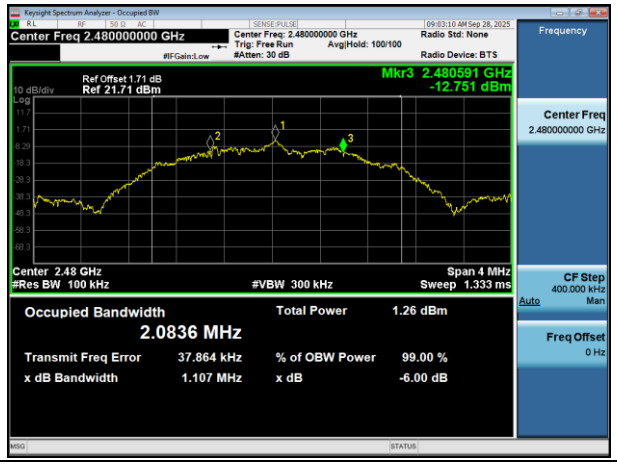


Test Setup Block Diagram

8.3 Test Data and Results

Test Mode	Test Channel (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	6 dB Bandwidth Limit (MHz)	Test Result
BLE_1Mbps	2402	0.674	1.0508	0.5	Pass
	2440	0.678	1.0558	0.5	Pass
	2480	0.675	1.0573	0.5	Pass
BLE_2Mbps	2402	1.049	2.0636	0.5	Pass
	2440	1.085	2.0672	0.5	Pass
	2480	1.107	2.0707	0.5	Pass

BLE_1Mbps	
6dB bandwidth	99% bandwidth
2402MHz	2402MHz
2440MHz	2440MHz
2480MHz	2480MHz

BLE_2Mbps	
6dB bandwidth	99% bandwidth
2402MHz 	2402MHz
2440MHz 	2440MHz
2480MHz  	2480MHz

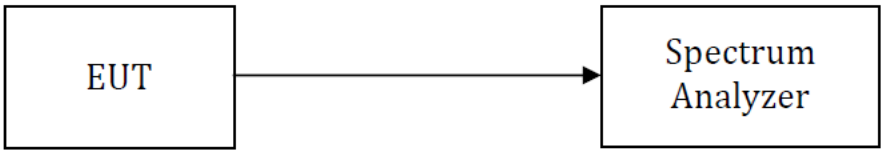
9. Maximum Power Spectral Density

9.1 Standard and Limit

According to FCC 15.247(e), For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

9.2 Test Procedure

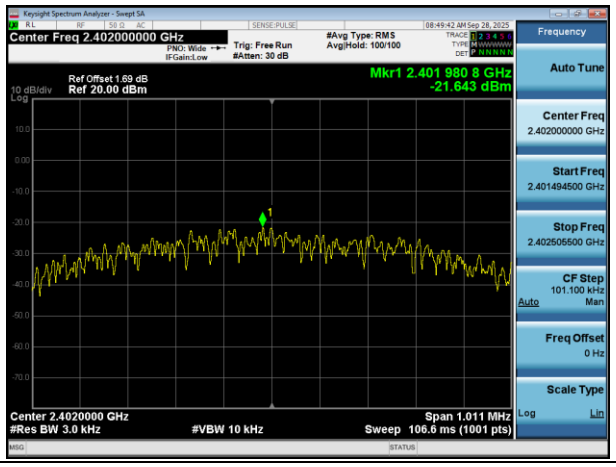
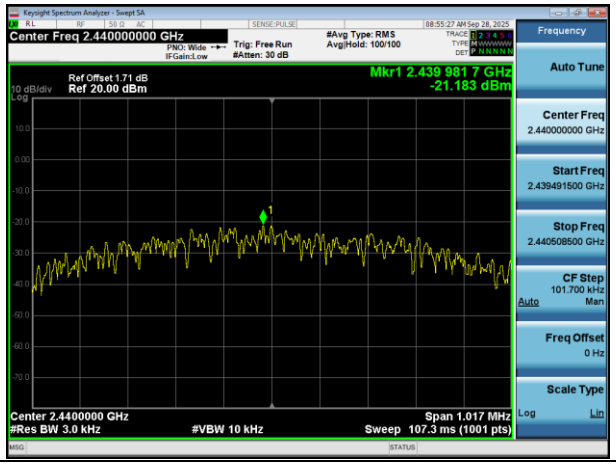
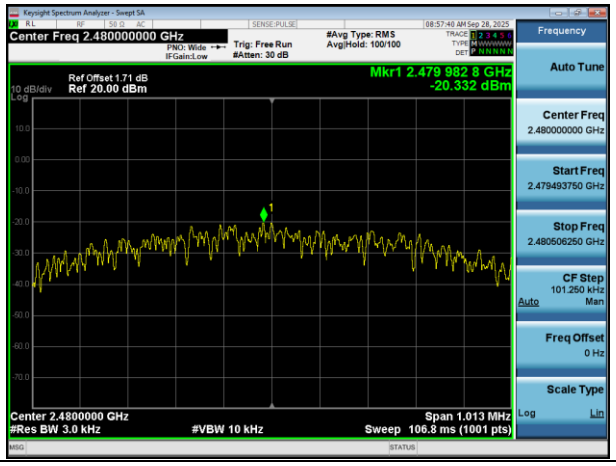
1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Set the spectrum analyzer to any one measured frequency within its operating range.
3) Set RBW = 3kHz, VBW = 10kHz, Sweep = Auto, Detector = Peak.
4) Measure the highest amplitude appearing on spectral display and mark the value.
5) Repeat above procedures until all frequencies measured were complete.

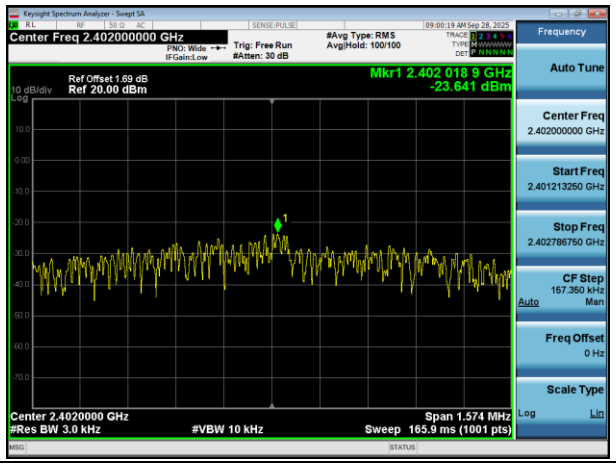
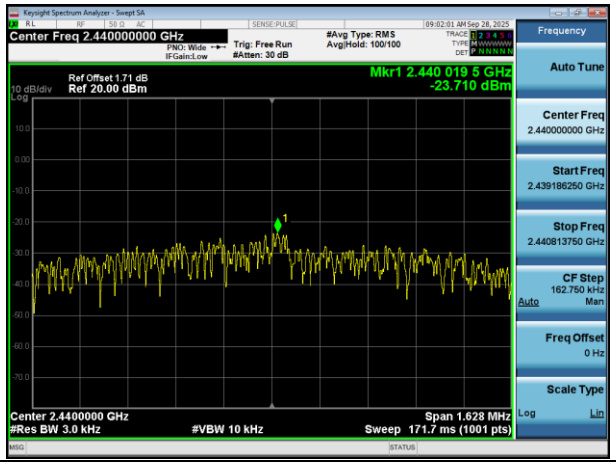
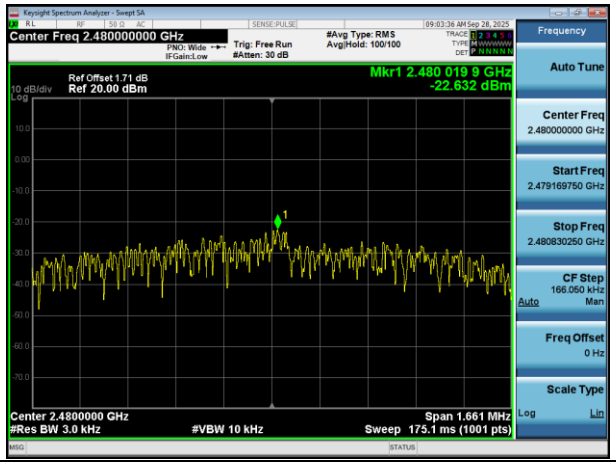


Test Setup Block Diagram

9.3 Test Data and Results

Test Mode	Test Channel MHz	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)	Test Result
BLE_1Mbps	2402	-21.64	8	Pass
	2440	-21.18	8	Pass
	2480	-20.33	8	Pass
BLE_2Mbps	2402	-23.64	8	Pass
	2440	-23.71	8	Pass
	2480	-22.63	8	Pass

BLE_1Mpbs
2402MHz 
2440MHz 
2480MHz 

BLE_2Mpbs
2402MHz 
2440MHz 
2480MHz 

10. Band-edge Emission(Conducted)

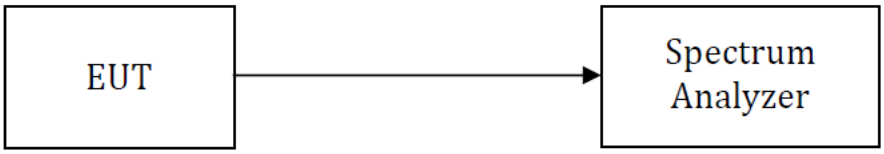
10.1 Standard and Limit

According to §15.247(d), 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. 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) (see § 15.205(c)).

10.2 Test Procedure

Test is conducting under the description of ANSI C63.10 - 2013 section 6.10.

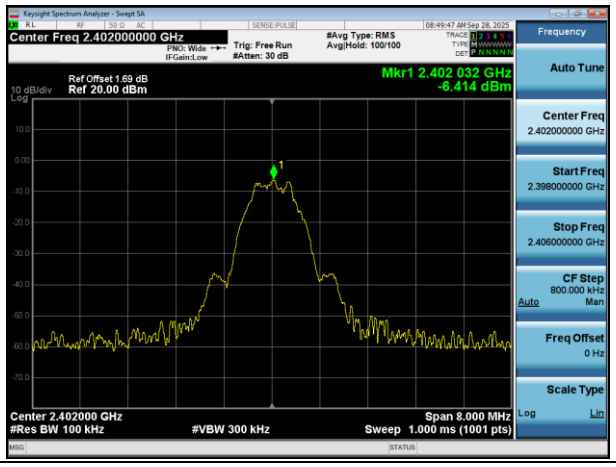
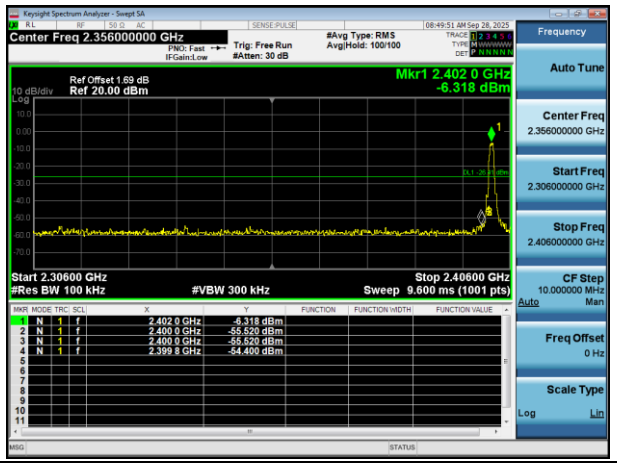
1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Set the spectrum analyzer to any one measured frequency within its operating range.
3) Set RBW = 100kHz, VBW = 300kHz, Sweep = Auto, Detector = Peak.
4) Measure the highest amplitude appearing on spectral display and set it as a reference level.
5) Set a convenient frequency span including 100 kHz bandwidth from band edge.
6) Measure the emission and marking the edge frequency.
7) Repeat above procedures until all frequencies measured were complete.

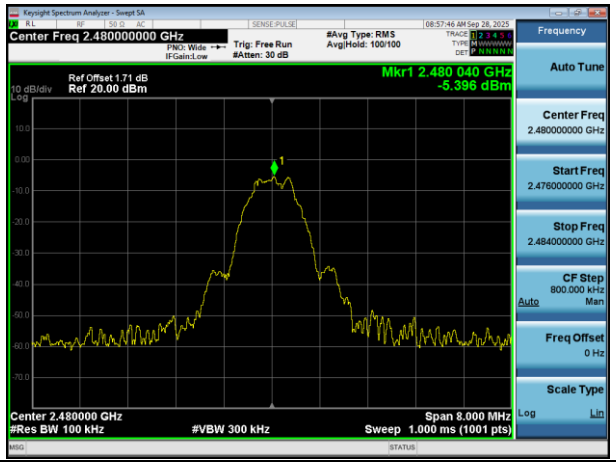
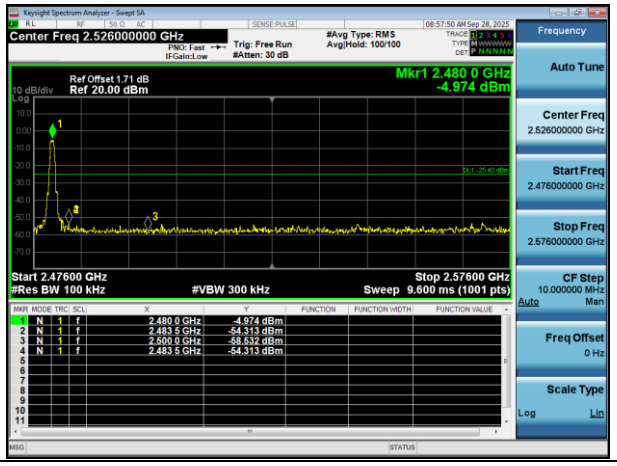


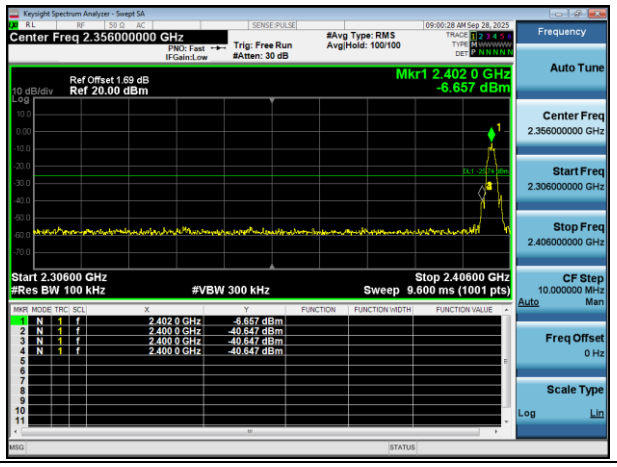
Test Setup Block Diagram

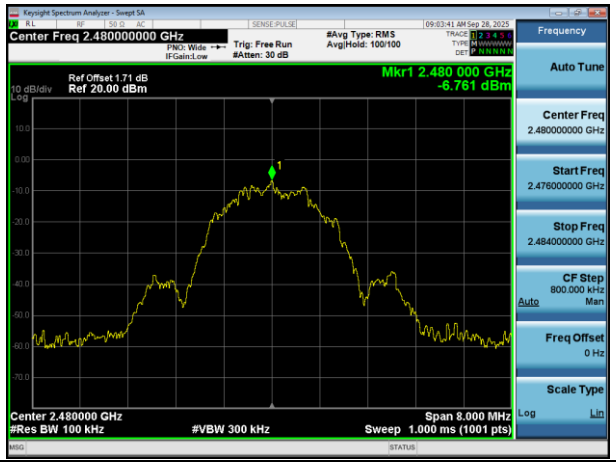
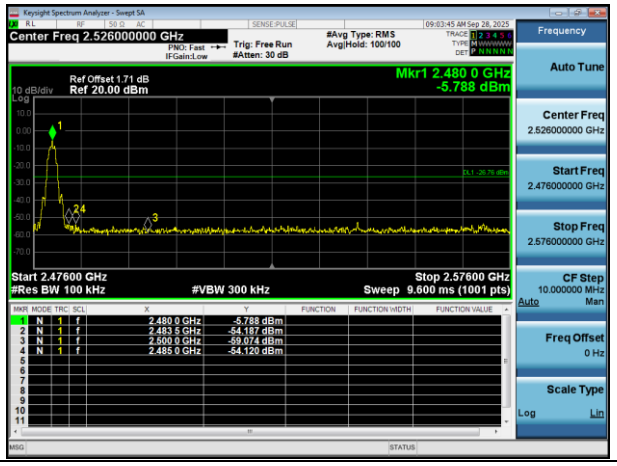
10.3 Test Data and Results

Test Mode	Band-edge	Test Channel (MHz)	Max. Value (dBc)	Limit (dBc)	Test Result
BLE_1Mbps	Lowest	2402	-47.98	-20	Pass
	Highest	2480	-48.91	-20	Pass
BLE_2Mbps	Lowest	2402	-34.9	-20	Pass
	Highest	2480	-47.35	-20	Pass

BLE_1Mbps Lowest	
Reference Power	Band-edge Emission
	

BLE_1Mbps Highest	
Reference Power	Band-edge Emission
	

BLE_2Mbps Lowest	
Reference Power	Band-edge Emission
	

BLE_2Mbps Highest	
Reference Power	Band-edge Emission
	

11. Conducted RF Spurious Emissions

11.1 Standard and Limit

According to §15.247(d), 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. 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) (see § 15.205(c)).

11.2 Test Procedure

Test is conducting under the description of ANSI C63.10 - 2013 section 6.7.

1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Set the spectrum analyzer to any one measured frequency within its operating range.
3) Set RBW = 100kHz, VBW = 300kHz, Sweep = Auto, Detector = Peak.
4) Measure the highest amplitude appearing on spectral display and set it as a reference level.
5) Measure the spurious emissions with frequency range from 9kHz to 26.5GHz.
6) Repeat above procedures until all measured frequencies were complete.

Test Setup Block Diagram

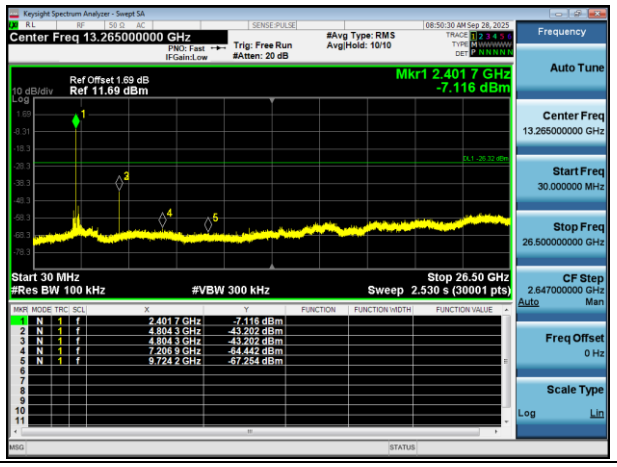
11.3 Test Data and Results

Note: The measurement frequency range is from 9kHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions measurement data.

BLE_1Mbps Lowest

Reference Power

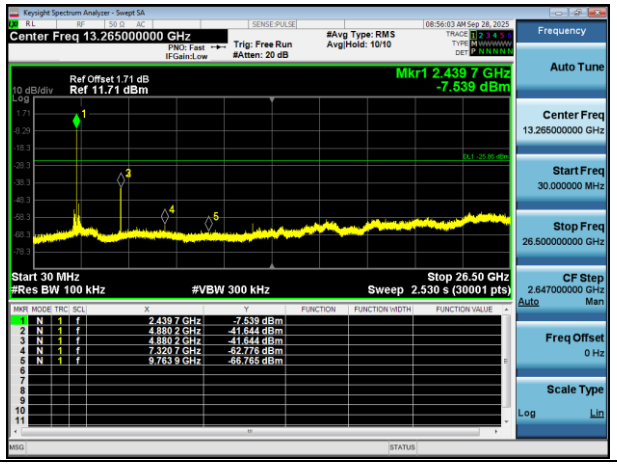
Spurious Emissions



BLE_1Mbps Middle

Reference Power

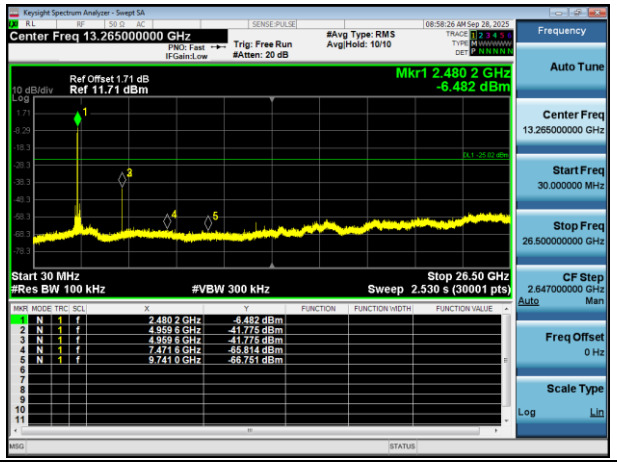
Spurious Emissions



BLE_1Mbps Highest

Reference Power

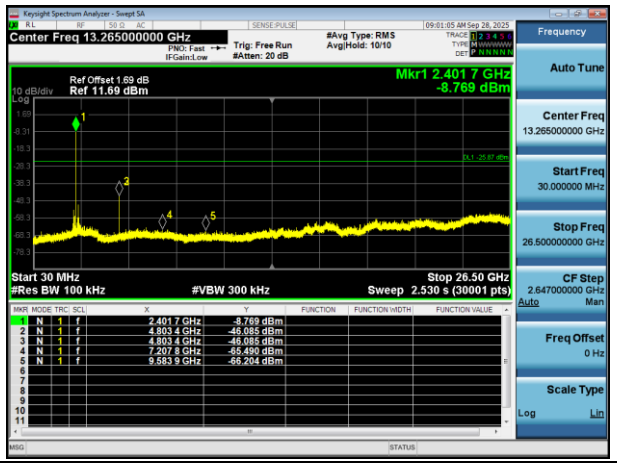
Spurious Emissions



BLE_2Mbps Lowest

Reference Power

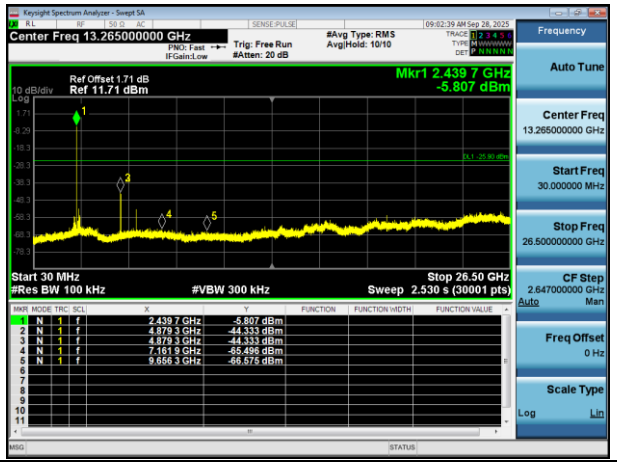
Spurious Emissions



BLE_2Mbps Middle

Reference Power

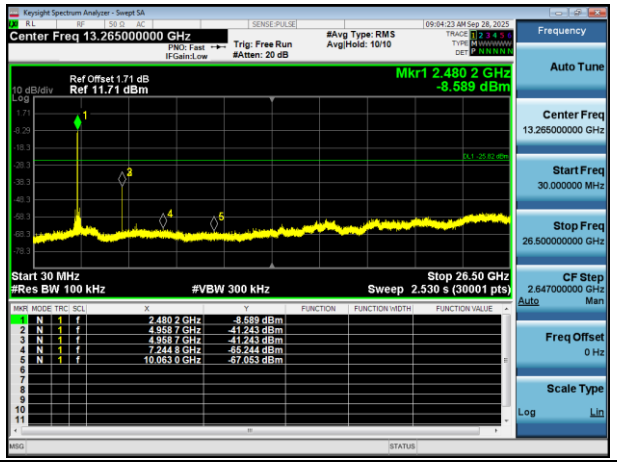
Spurious Emissions



BLE_2Mbps Highest

Reference Power

Spurious Emissions



******* END OF REPORT *******