



FCC TEST REPORT

FCC ID: 2A9IP-IP13-61

Product	:	INKZONE smartphone case
Model Name	:	iPhone 13-6.1
Brand	:	N/A
Report No.	:	PTC22093000602E-FC01
Sample ID	:	PTC22093000602E-01#
Prepared for		
Shenzhen Hanhongda Electronic Technology Co., LTD		
Room 510-512, Building C, Qianwan hard Science and Technology Industrial Park, Gushu Road, Baoan District, Shenzhen City		
Prepared by		
Precise Testing & Certification Co., Ltd.		
Building 1, No.6 Tongxin Road, Dongcheng Street, Dongguan,China		



1 TEST RESULT CERTIFICATION

Applicant's name : Shenzhen Hanhongda Electronic Technology Co., LTD

Address : Room 510-512, Building C, Qianwan hard Science and Technology Industrial Park, Gushu Road, Baoan District, Shenzhen City

Manufacture's name : Shenzhen Hanhongda Electronic Technology Co., LTD

Address : Room 510-512, Building C, Qianwan hard Science and Technology Industrial Park, Gushu Road, Baoan District, Shenzhen City

Product name : INKZONE smartphone case

Model name : iPhone 13-6.1

Standards : FCC CFR47 Part 15 Section 15.247

Test procedure : ANSI C63.10:2013

Test Date : Nov. 09, 2022 to Nov. 11, 2022

Date of Issue : Nov. 14, 2022

Test Result : Pass

This device described above has been tested by PTC, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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Test Engineer:

A handwritten signature in black ink, appearing to read 'Simon Pu'.

Simon Pu / Engineer

Technical Manager:

A handwritten signature in black ink, appearing to read 'Ronnie Liu'.

Ronnie Liu / Manager



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2 Test Summary

Test Items	Test Requirement	Result
Conduct Emission	15.207	N/A
Radiated Spurious Emissions	15.205(a) 15.209 15.247(d)	PASS
Conducted Spurious Emission	15.247(d)	PASS
Band edge	15.247(d) 15.205(a)	PASS
6dB Bandwidth	15.247(a)(2)	PASS
Maximum Peak Output Power	15.247(b)(1)	PASS
Power Spectral Density	15.247(e)	PASS
Antenna Requirement	15.203	PASS

Remark:

1. The EUT is powered by full-charged battery during the test.



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2.1 Test Site

Precise Testing & Certification Co., Ltd.

Address: Building 1, No.6 Tongxin Road, Dongcheng Street, Dongguan, China

FCC Registration Number: 790290

Designation Number: CN1219

A2LA Certificate No.: 4408.01

IC Registration Number: 12191A

CAB identifier: CN0080



3 General Information

3.1 General Description of E.U.T.

Product Name	:	INKZONE smartphone case
Model Name	:	iPhone 13-6.1
Version	:	5.0LE
Operating frequency	:	2402-2480MHz
Number of Channels	:	40
Type of Modulation	:	GFSK
Antenna installation	:	Pcb Antenna
Antenna Gain	:	-0.68 dBi
Power supply	:	DC 3.82V, 3327mAh Battery by iphone 13
Hardware Version	:	1.2
Software Version	:	3.1



3.2 Channel List

The EUT has been tested under its typical operating condition. Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting. Only the worst case data were reported.

The EUT has been associated with peripherals pursuant to ANSI C63.10-2013 and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation (9 KHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

The details of test channels and bandwidth were for RF conductive measurement.

Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	14	2430	28	2458
01	2404	15	2432	29	2460
02	2406	16	2434	30	2462
03	2408	17	2436	31	2464
04	2410	18	2438	32	2466
05	2412	19	2440	33	2468
06	2414	20	2442	34	2470
07	2416	21	2444	35	2472
08	2418	22	2446	36	2474
09	2420	23	2448	37	2476
10	2422	24	2450	38	2478
11	2424	25	2452	39	2480
12	2426	26	2454		
13	2428	27	2456		

Note:

1. Test of channel was included the lowest 2402MHz, middle 2440MHz and highest frequency 2480MHz in highest data rate and to perform the test, then record on this report.



4 Equipment During Test

4.1 Equipments List

RF Conducted Test

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
MXG Signal Analyzer	Agilent	N9020A	MY56070279	10Hz-30GHz	Aug21,2023
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	Aug21,2023
Antenna Connector	Florida RF Labs	N/A	RF01#	N/A	Aug21,2023
Scope	Tektronix	TDS3032B	B014131	300MHz BW; 2 way scope	Aug21,2023
DC power	eTOMENS	eTM-1560	--	15V 60A	Aug21,2023

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

Radiated Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Aug21,2023
Loop Antenna	Schwarzbeck	FMZB 1519	012	9 KHz -30MHz	Aug21,2023
Bilog Antenna	SCHWARZBECK	VULB9160	9160-3355	25MHz-2GHz	Aug21,2023
Preamplifier (low frequency)	SCHWARZBECK	BBV 9475	9745-0013	1MHz-1GHz	Aug21,2023
Cable	Schwarzbeck	PLF-100	549489	9KHz-3GHz	Aug21,2023
Spectrum Analyzer	Agilent	E4407B	MY45109572	9KHz-40GHz	Aug21,2023
Horn Antenna	SCHWARZBECK	9120D	9120D-1246	1GHz-18GHz	Aug21,2023
High NOISE AMPLIFIER	ZHINAN	ZN3380C	15002	10KHz-18GHz	Aug21,2023
Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	Aug21,2023
Spectrum Analyzer	Rohde&Schwarz	FSVR40	101003	10Hz-40GHz	Aug21,2023
Horn Antenna	SCHWARZBECK	BBHA9170	01066	15GHZ-40GHZ	Aug21,2023



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Preamplifier	SCHWARZBECK	BBV-9721	81	18GHZ-40GHZ	Aug21,2023
Test S/W	Tonscend	JS32-RE/4.0.0.0			

Conducted Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Aug21,2023
Artificial Mains Network	Rohde&Schwarz	BS ENV216	102453	9KHz-300MHz	Aug21,2023
Test S/W	Tonscend	JS32-CE/4.0.0.3			



4.2 Measurement Uncertainty

Parameter	Uncertainty
RF output power, conducted	$\pm 1.0\text{dB}$
Power Spectral Density, conducted	$\pm 2.2\text{dB}$
Radio Frequency	$\pm 1 \times 10^{-6}$
Bandwidth	$\pm 1.5 \times 10^{-6}$
Time	$\pm 2\%$
Duty Cycle	$\pm 2\%$
Temperature	$\pm 1^{\circ}\text{C}$
Humidity	$\pm 5\%$
DC and low frequency voltages	$\pm 3\%$
Conducted Emissions (150kHz~30MHz)	$\pm 3.64\text{dB}$
Radiated Emission(30MHz~1GHz)	$\pm 5.03\text{dB}$
Radiated Emission(1GHz~25GHz)	$\pm 4.74\text{dB}$
Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%	



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4.3 Description of Support Units

Equipment	Model No.	Series No.
phone	Iphone 13	P627Y2V429

5 Conducted Emission

Test Requirement	:	FCC CFR 47 Part 15 Section 15.207
Test Method	:	ANSI C63.10: 2013
Test Result	:	PASS
Frequency Range	:	150kHz to 30MHz
Class/Severity	:	Class B

5.1 E.U.T. Operation

Operating Environment :

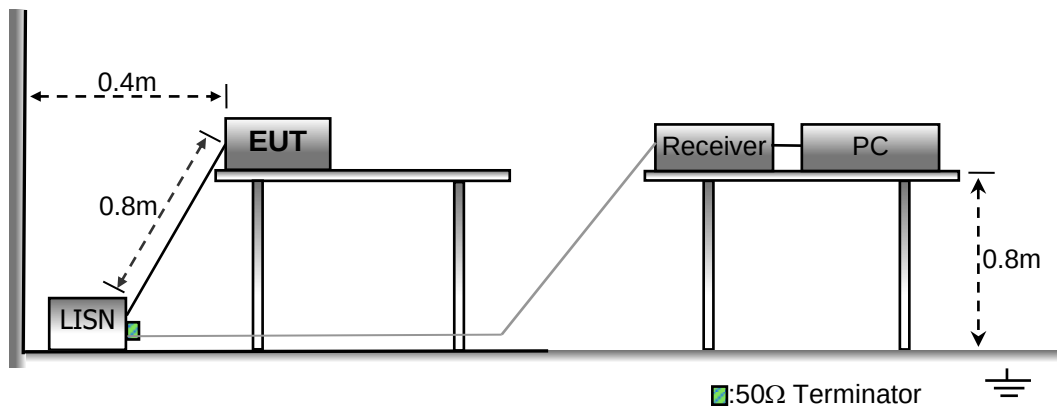
Temperature : 25.5 °C

Humidity : 51 % RH

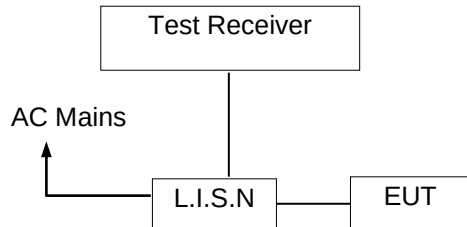
Atmospheric Pressure : 101.2kPa

5.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10:2013.



5.3 Test SET-UP (Block Diagram of Configuration)



5.4 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 frequency measured was complete.

5.5 Conducted Emission Limit

Conducted Emission

Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note:

1. The lower limit shall apply at the transition frequencies
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

5.6 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

5.7 Conducted Emission Test Result

N/A

The EUT is power by battery of iphone port. So it is not need test.



6 Radiated Spurious Emissions

Test Requirement : FCC CFR47 Part 15 Section 15.209 & 15.247
 Test Method : ANSI C63.10:2013
 Test Result : PASS
 Measurement Distance : 3m
 Limit : See the follow table

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	$2400/F(\text{kHz})$	300	$10000 * 2400/F(\text{kHz})$	$20\log^{(2400/F(\text{kHz}))} + 80$
0.490 ~ 1.705	$24000/F(\text{kHz})$	30	$100 * 24000/F(\text{kHz})$	$20\log^{(24000/F(\text{kHz}))} + 40$
1.705 ~ 30	30	30	$100 * 30$	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

6.1 EUT Operation

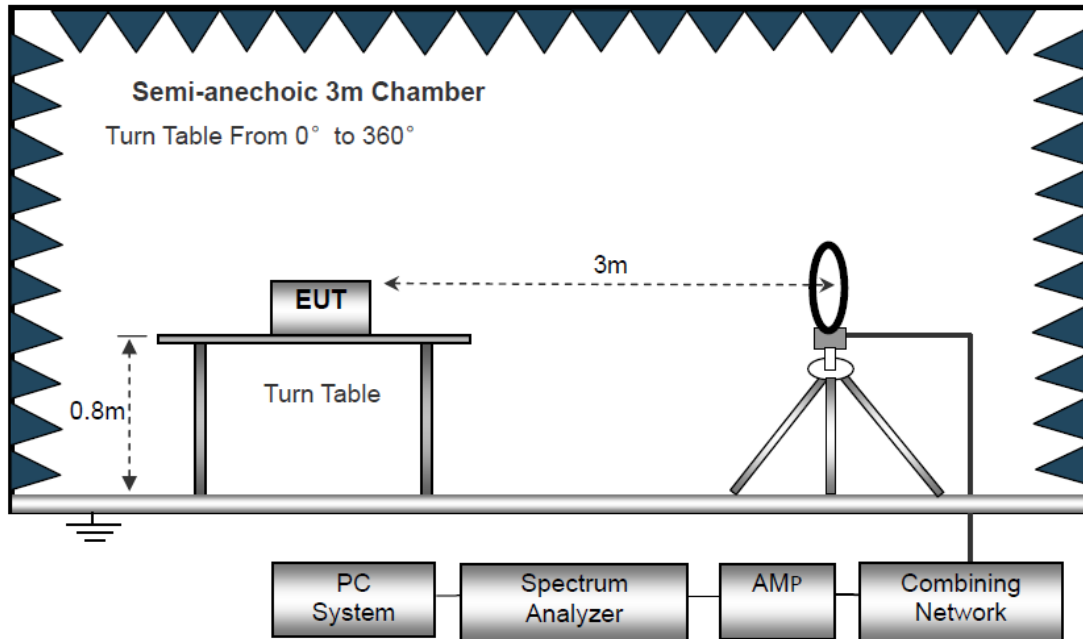
Operating Environment :

Temperature : 23.5 °C
 Humidity : 51.1 % RH
 Atmospheric Pressure : 101.2kPa

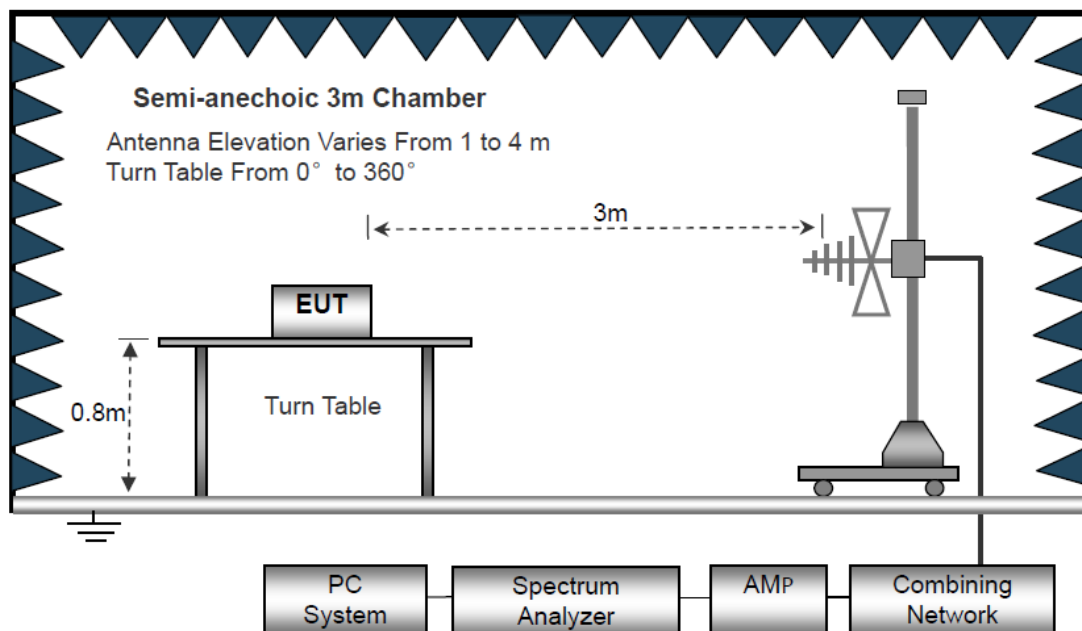
6.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site

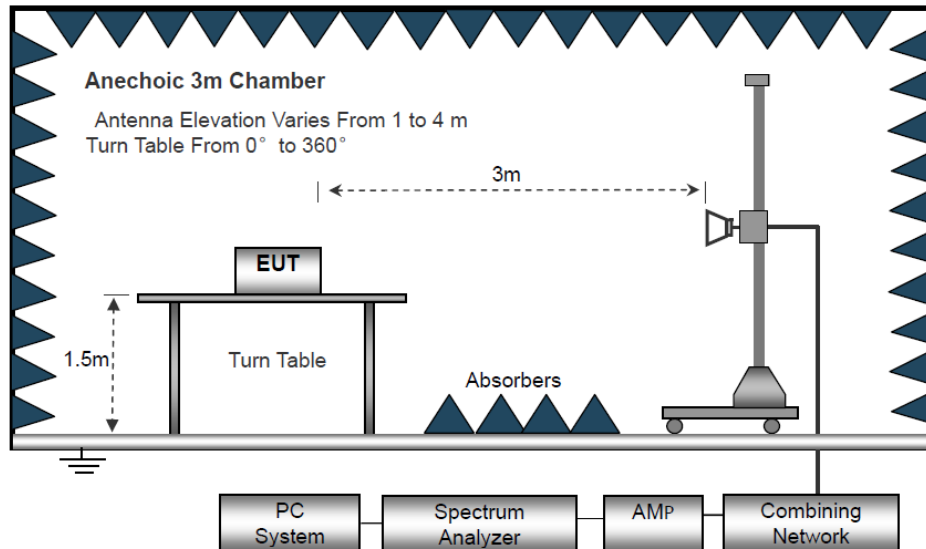
The test setup for emission measurement below 30MHz



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz



6.3 Spectrum Analyzer Setup

Receiver Setup	Frequency	Detector	RBW	VBW	Remark
	Below 30MHz	--	10kHz	10kHz	--
	30MHz ~ 1GHz	Quasi-peak	120kHz	300kHz	Quasi-peak Value
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
		RMS	1MHz	3MHz	Average Value



6.4 Test Procedure

1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10-2013.
2. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane.
3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (From 1m to 4m) and turntable (from 0 degree to 360 degree) 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 to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Final measurement (Above 1GHz): The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1MHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 degree to 360 degree in order to have the antenna inside the cone of radiation.
7. Test Procedure of measurement (For Above 1GHz):
 - 1) Monitor the frequency range at horizontal polarization and move the antenna over all sides of the EUT(if necessary move the EUT to another orthogonal axis).
 - 2) Change the antenna polarization and repeat 1) with vertical polarization.
 - 3) Make a hardcopy of the spectrum.
 - 4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
 - 5) Change the analyser mode to Clear/ Write and found the cone of emission.
 - 6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3m and the antenna will be still inside the cone of emission.
 - 7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarization and azimuth and the peak and average detector, which causes the maximum emission.
 - 8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.
8. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.



For Average Measurement:

VBW=10Hz, 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.

Band	Duty Cycle(%)	T(μ s)	1/T(KHz)	Average Correction Factor	VBW Setting
2402-2480	100	-	-	0	10Hz



6.5 Summary of Test Results

Test Frequency: 9KHz-30MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level (dBuV/m)	Limit 3m (dBuV/m)	Over (dB)
--	--	--	--	>20

Note:

The amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

Distance extrapolation factor = $40\log(\text{Specific distance} / \text{test distance})$ (dB);

Limit line = Specific limits (dBuV) + distance extrapolation factor.

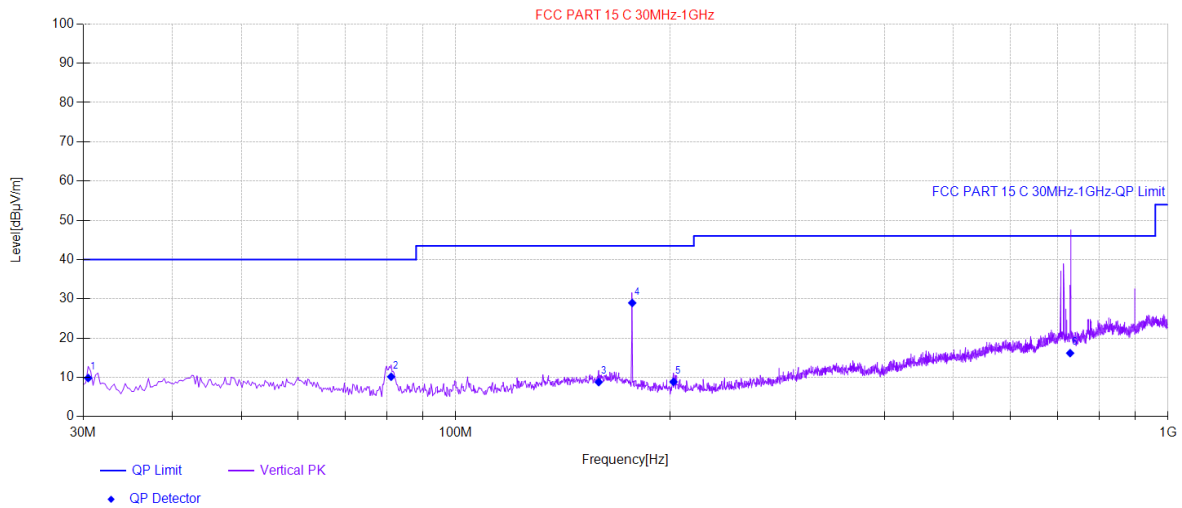
Test Frequency: 30MHz ~ 1GHz

Pass.

Please refer to the following test plots for the worst test mode (GFSK (CH00: 2402MHz)).



Antenna Polarization: Horizontal GFSK(CH00: 2402MHz)



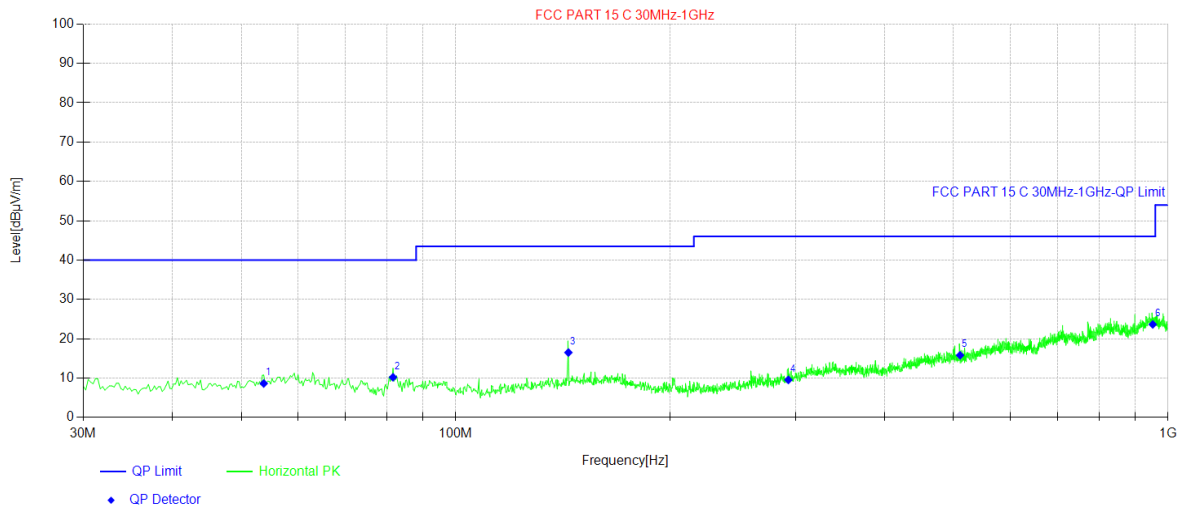
Final Data List[QP]

NO.	Freq. [MHz]	QP Reading [dBμV/m]	Factor [dB]	QP Value [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Polarity
1	30.49	28.16	-18.32	9.84	40.00	30.16	Vertical
2	81.17	31.35	-21.18	10.17	40.00	29.83	Vertical
3	158.77	24.72	-15.91	8.81	43.50	34.69	Vertical
4	176.96	45.82	-16.86	28.96	43.50	14.54	Vertical
5	202.18	27.66	-18.79	8.87	43.50	34.63	Vertical
6	728.84	22.05	-5.87	16.18	46.00	29.82	Vertical

Remark:Emission Level=Reading+Cable Loss+ANT Factor-AMP Factor



Antenna Polarization: Vertical GFSK(CH00: 2402MHz)



Final Data List[QP]

NO.	Freq. [MHz]	QP Reading [dBμV/m]	Factor [dB]	QP Value [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Polarity
1	53.77	26.49	-17.84	8.65	40.00	31.35	Horizontal
2	81.65	31.37	-21.15	10.22	40.00	29.78	Horizontal
3	143.98	32.97	-16.46	16.51	43.50	26.99	Horizontal
4	293.11	25.31	-15.75	9.56	46.00	36.44	Horizontal
5	510.64	26.27	-10.46	15.81	46.00	30.19	Horizontal
6	951.99	25.83	-2.18	23.65	46.00	22.35	Horizontal

Remark:Emission Level=Reading+Cable Loss+ANT Factor-AMP Factor



Test Frequency 1GHz-25GHz:

GFSK Low Channel (2402MHz)

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4804	28.43	AV	V	16.84	8.22	16.04	37.45	54	-16.55
4804	27.95	AV	H	16.84	8.22	16.04	36.97	54	-17.03
4804	30.42	PK	V	16.84	8.22	16.04	35.2	74	-38.8
4804	31.58	PK	H	16.84	8.22	16.04	36.07	74	-37.93
17358	29.34	AV	V	20.17	8.46	19.34	38.63	54	-15.37
17358	30.11	AV	H	20.17	8.46	19.34	39.4	54	-14.6
17358	31.55	PK	V	20.17	8.46	19.34	38.75	74	-35.25
17358	33.24	PK	H	20.17	8.46	19.34	40.37	74	-33.63

GFSK Middle Channel (2440MHz)

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4880	28.44	AV	V	15.32	7.14	16.34	34.46	54	-19.54
4880	29.06	AV	H	15.32	7.14	16.34	35.17	54	-18.83
4880	31.32	PK	V	15.32	7.14	16.34	36.45	74	-37.55
4880	32.57	PK	H	15.32	7.14	16.34	33.58	74	-40.42
16753	27.49	AV	V	24.08	8.25	21.49	42.1	54	-11.9
16753	28.05	AV	H	24.08	8.25	21.49	38.3	54	-15.7
16753	33.26	PK	V	24.08	8.25	21.49	39.89	74	-34.11
16753	35.08	PK	H	24.08	8.25	21.49	41.52	74	-32.48

GFSK High Channel (2480MHz)

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4960	27.63	AV	V	14.05	7.86	13.64	35.9	54	-18.1
4960	28.04	AV	H	14.05	7.86	13.64	36.31	54	-17.69
4960	30.11	PK	V	14.05	7.86	13.64	37.41	74	-36.59
4960	32.69	PK	H	14.05	7.86	13.64	34.31	74	-39.69
17248	28.49	AV	V	20.47	8.83	20.44	39.04	54	-14.96
17248	29.15	AV	H	20.47	8.83	20.44	38.35	54	-15.65
17248	31.62	PK	V	20.47	8.83	20.44	36.9	74	-37.1
17248	32.57	PK	H	20.47	8.83	20.44	38.04	74	-35.96

Note: 1. The testing has been conformed to 10*2480MHz=24800MHz.

2. All other emissions more than 30dB below the limit.
3. Factor = Antenna Factor + Cable Loss – Pre-amplifier.
Emission Level = Reading + Factor
Margin=Emission Level-Limit



Spurious Emission in Restricted Band 2310-2390MHz and 2483.5-2500MHz

TestMode	Antenna	Channel Name	Frequency [MHz]	Detector	Freq [MHz]	Result [dBm]	Limit [dBm]	Result [dBuV/m]	Limit [dBuV/m]	Verdict
BLE_1M	Ant1	Low	2402	Peak	2390.000	-36.84	≤-21.20	58.36	≤74	PASS
BLE_1M	Ant1	Low	2402	Peak	2310.000	-37.81	≤-21.20	57.39	≤74	PASS
BLE_1M	Ant1	Low	2402	Peak	2387.990	-32.94	≤-21.20	62.26	≤74	PASS
BLE_1M	Ant1	Low	2402	AV	2390.000	-45.02	≤-41.20	50.18	≤54	PASS
BLE_1M	Ant1	Low	2402	AV	2310.000	-45.55	≤-41.20	49.65	≤54	PASS
BLE_1M	Ant1	Low	2402	AV	2354.075	-44.54	≤-41.20	50.66	≤54	PASS
BLE_1M	Ant1	High	2480	Peak	2483.500	-21.37	≤-21.20	73.83	≤74	PASS
BLE_1M	Ant1	High	2480	Peak	2500.000	-38.24	≤-21.20	56.96	≤74	PASS
BLE_1M	Ant1	High	2480	Peak	2483.520	-21.37	≤-21.20	73.83	≤74	PASS
BLE_1M	Ant1	High	2480	AV	2483.500	-42.67	≤-41.20	52.53	≤54	PASS
BLE_1M	Ant1	High	2480	AV	2500.000	-45.02	≤-41.20	50.18	≤54	PASS
BLE_1M	Ant1	High	2480	AV	2483.520	-42.67	≤-41.20	52.53	≤54	PASS
BLE_2M	Ant1	Low	2402	Peak	2390.000	-32.08	≤-21.20	63.12	≤74	PASS
BLE_2M	Ant1	Low	2402	Peak	2310.000	-37.39	≤-21.20	57.81	≤74	PASS
BLE_2M	Ant1	Low	2402	Peak	2389.565	-31.42	≤-21.20	63.78	≤74	PASS
BLE_2M	Ant1	Low	2402	AV	2390.000	-44.92	≤-41.20	50.28	≤54	PASS
BLE_2M	Ant1	Low	2402	AV	2310.000	-45.33	≤-41.20	49.87	≤54	PASS
BLE_2M	Ant1	Low	2402	AV	2353.970	-44.74	≤-41.20	50.46	≤54	PASS
BLE_2M	Ant1	High	2480	Peak	2483.500	-23.34	≤-21.20	71.86	≤74	PASS
BLE_2M	Ant1	High	2480	Peak	2500.000	-36.62	≤-21.20	58.58	≤74	PASS
BLE_2M	Ant1	High	2480	Peak	2483.840	-22.66	≤-21.20	72.54	≤74	PASS
BLE_2M	Ant1	High	2480	AV	2483.500	-42.25	≤-41.20	52.95	≤54	PASS
BLE_2M	Ant1	High	2480	AV	2500.000	-44.93	≤-41.20	50.27	≤54	PASS
BLE_2M	Ant1	High	2480	AV	2483.520	-42.25	≤-41.20	52.95	≤54	PASS

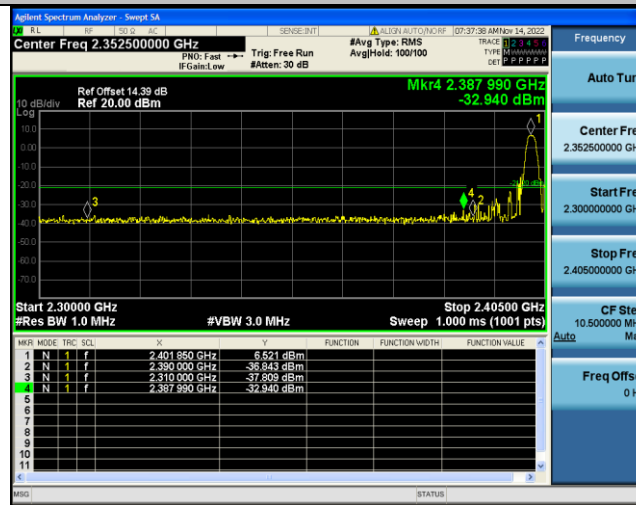
Note:

1. The Antenna Gain is compensated in the graph.

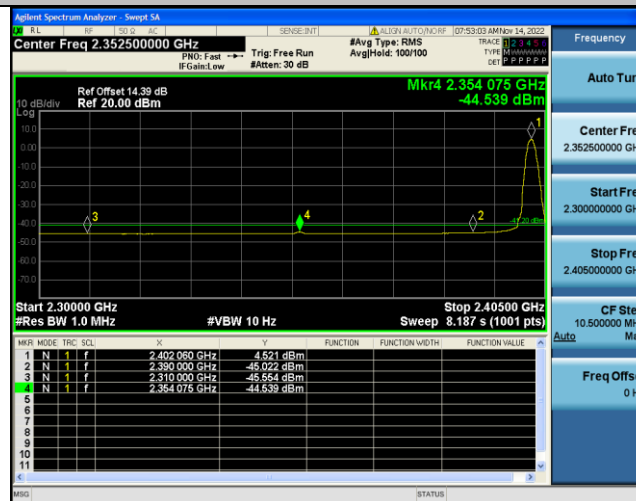
The limit in dBm for average detector is conversion from 54dBuV/m, according to 15.209(a). The limit in dBm for peak detector is 20dB above the limit of average detector in dBm.



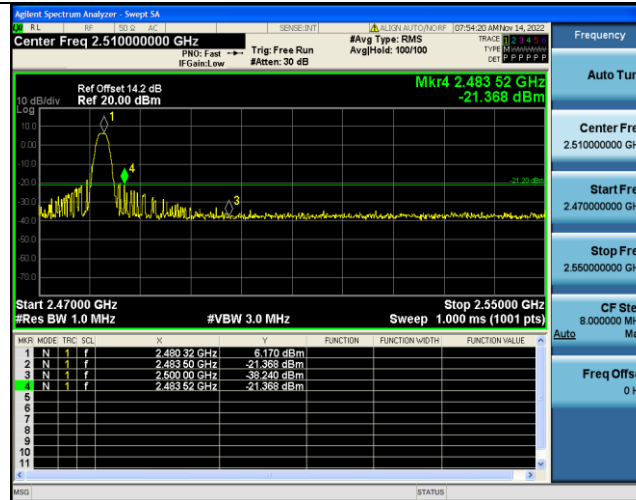
BLE_1M-Ant1-Low-2402-Peak-2390.000



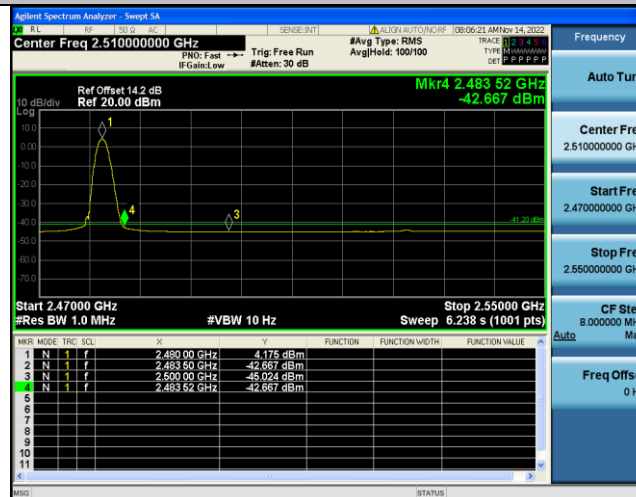
BLE_1M-Ant1-Low-2402-AV-2390.000



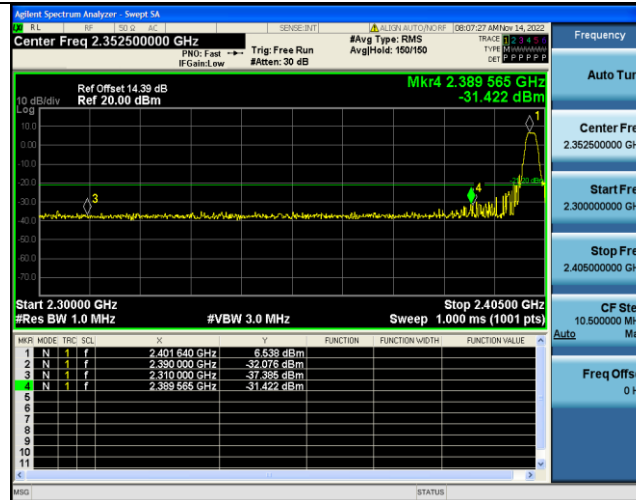
BLE_1M-Ant1-High-2480-Peak-2483.500



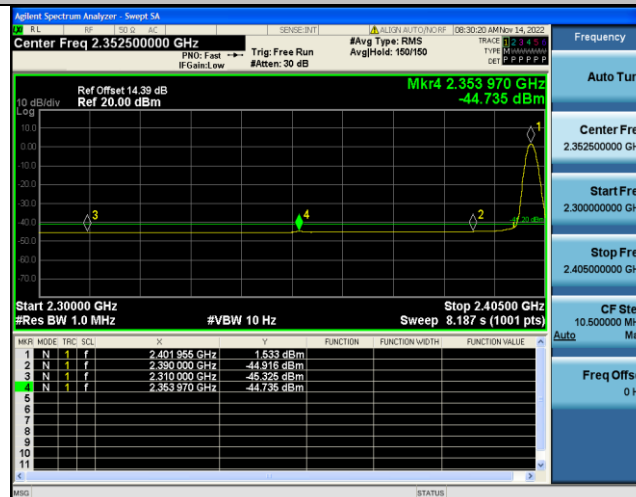
BLE_1M-Ant1-High-2480-AV-2483.500



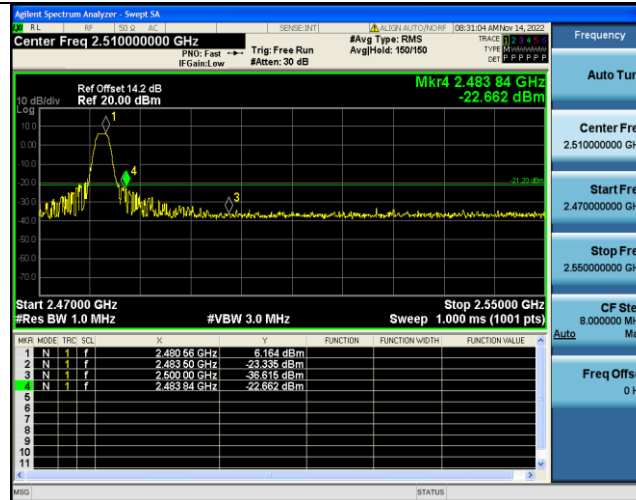
BLE_2M-Ant1-Low-2402-Peak-2390.000



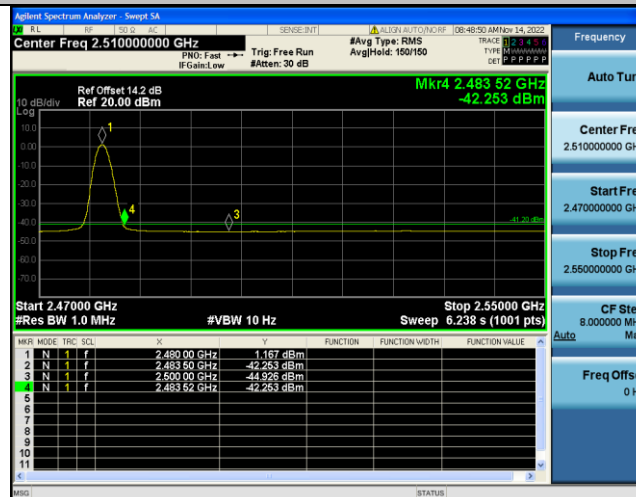
BLE_2M-Ant1-Low-2402-AV-2390.000



BLE_2M-Ant1-High-2480-Peak-2483.500



BLE_2M-Ant1-High-2480-AV-2483.500



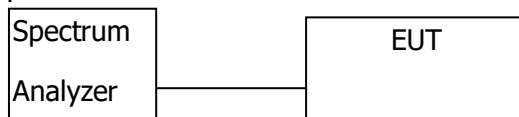


7 Band Edge Measurement

Test Requirement	: Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).
Test Method	: ANSI C63.10:2013
Test Limit	: Regulation 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)).

7.1 Test Procedure

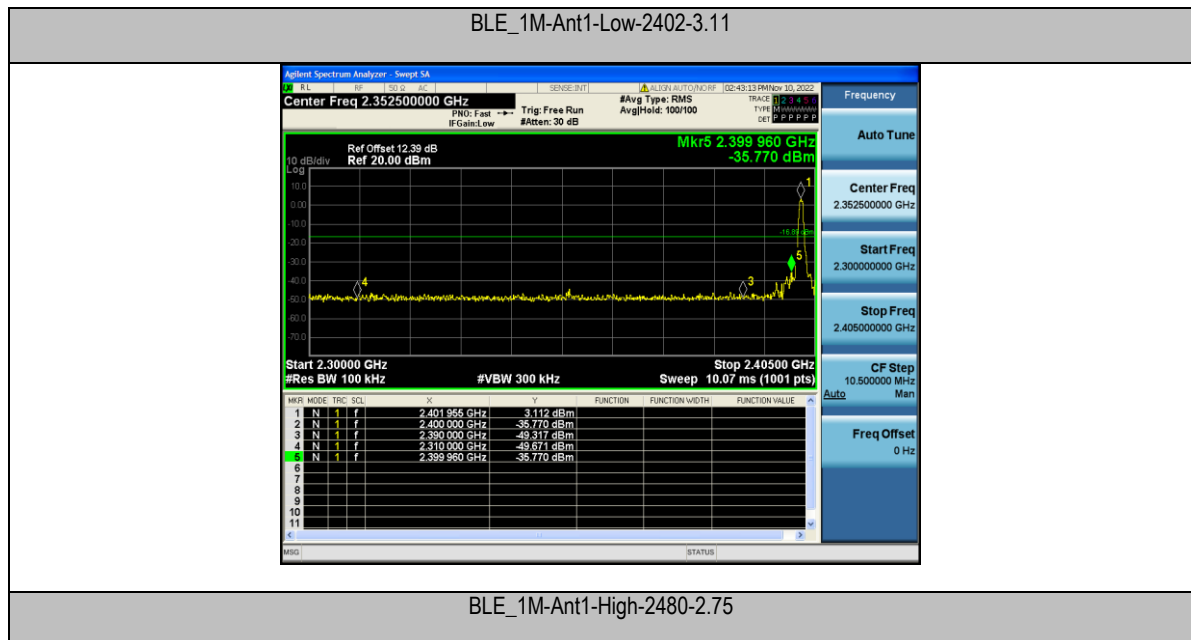
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto
Detector function = peak, Trace = max hold
2. Set up:





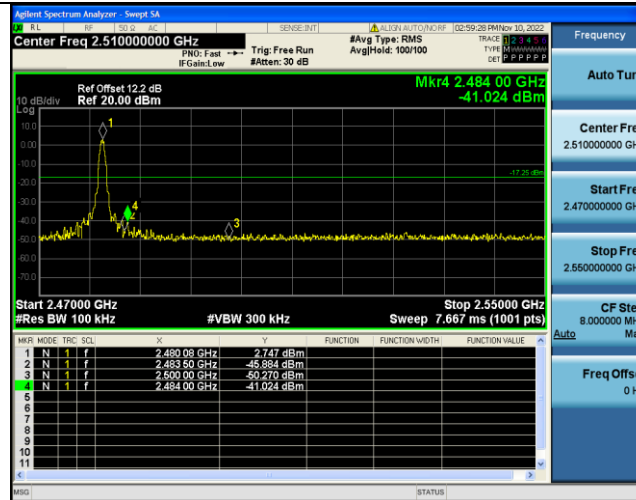
7.2 Test Result

TestMode	Antenna	ChName	Frequency[MHz]	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	Low	2402	3.11	-35.77	≤-16.89	PASS
BLE_1M	Ant1	High	2480	2.75	-41.02	≤-17.25	PASS
BLE_2M	Ant1	Low	2402	3.20	-32.67	≤-16.8	PASS
BLE_2M	Ant1	High	2480	2.76	-42.4	≤-17.24	PASS

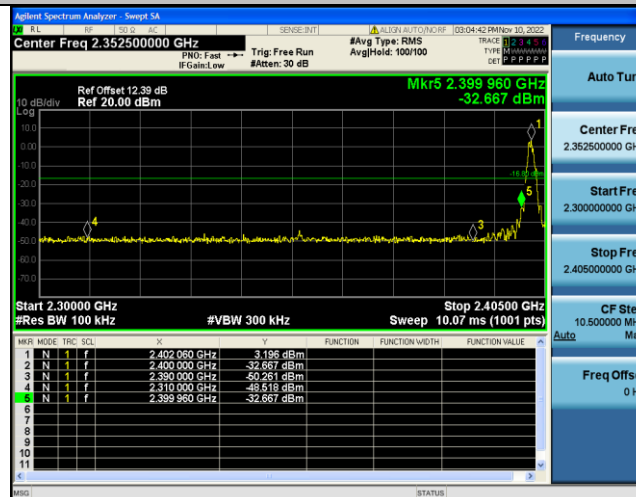




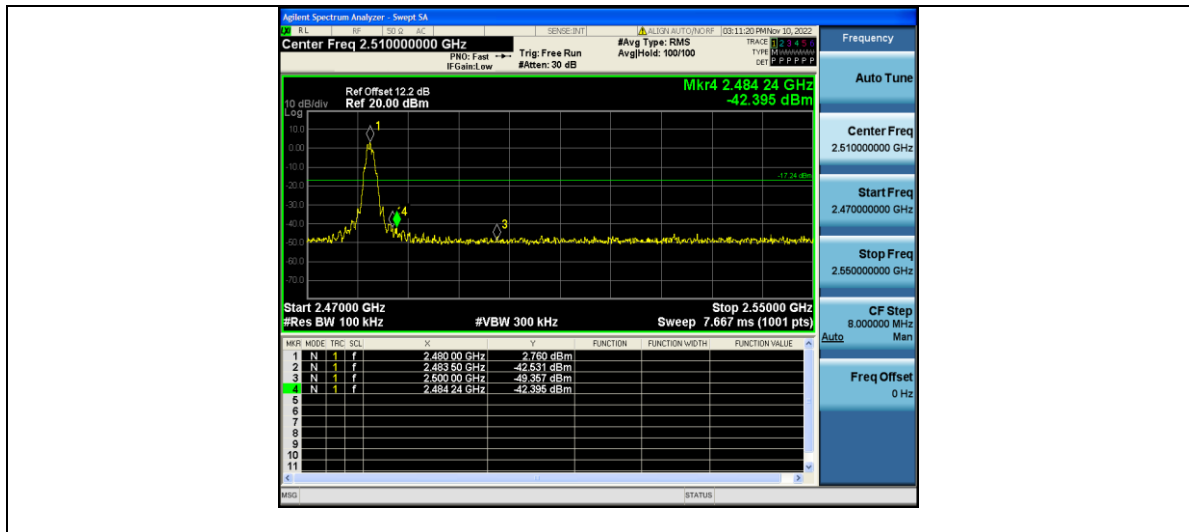
Report No.: PTC22093000602E-FC01



BLE_2M-Ant1-Low-2402-3.20



BLE_2M-Ant1-High-2480-2.76



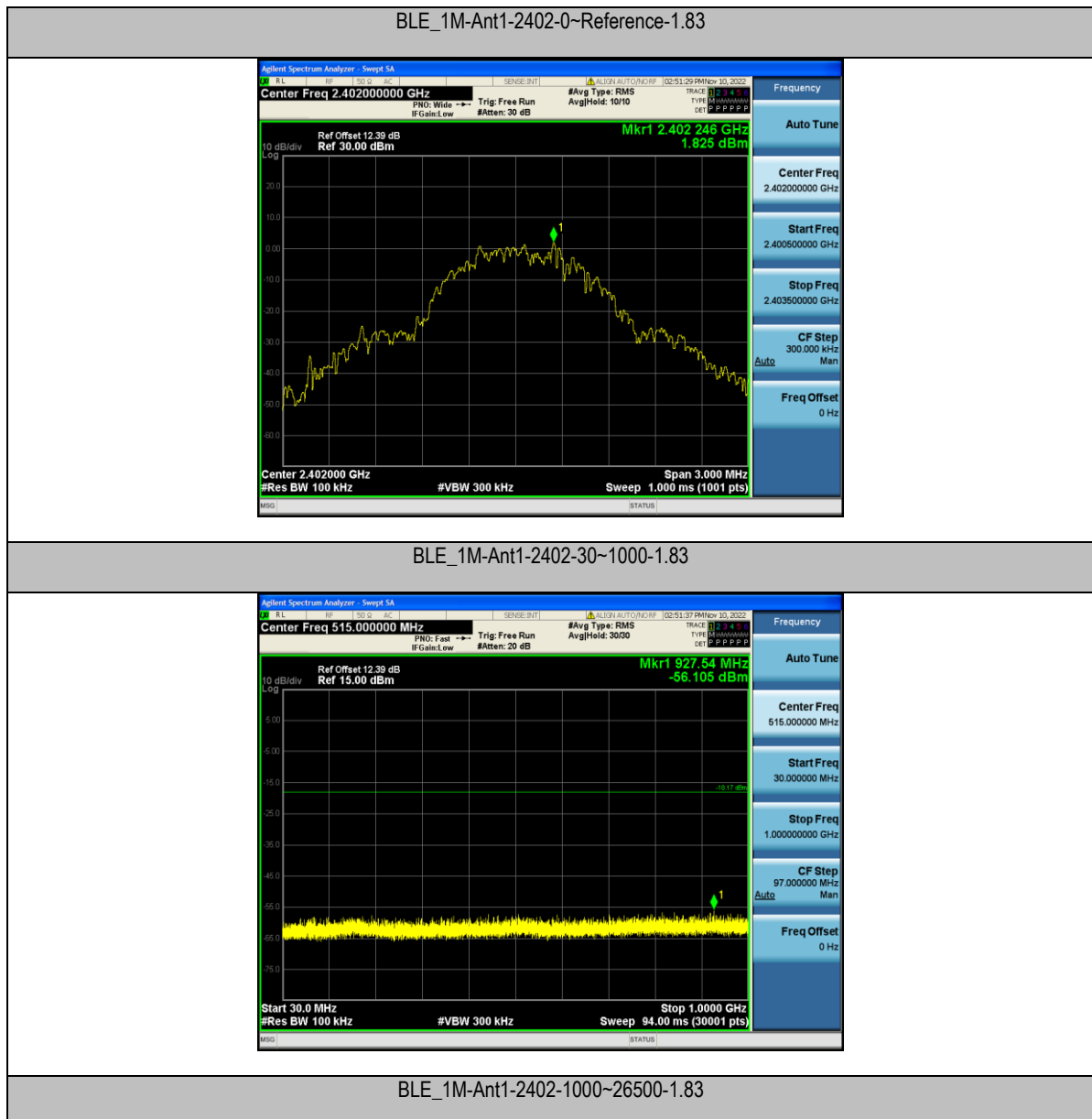
Conducted Spurious Emission

TestMode	Antenna	Frequency[MHz]	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	0~Reference	1.83	1.83	---	PASS
BLE_1M	Ant1	2402	30~1000	1.83	-56.11	≤-18.17	PASS
BLE_1M	Ant1	2402	1000~26500	1.83	-37.09	≤-18.17	PASS
BLE_1M	Ant1	2440	0~Reference	1.29	1.29	---	PASS
BLE_1M	Ant1	2440	30~1000	1.29	-56.39	≤-18.71	PASS
BLE_1M	Ant1	2440	1000~26500	1.29	-37.58	≤-18.71	PASS
BLE_1M	Ant1	2480	0~Reference	2.77	2.77	---	PASS
BLE_1M	Ant1	2480	30~1000	2.77	-56.93	≤-17.23	PASS
BLE_1M	Ant1	2480	1000~26500	2.77	-37.68	≤-17.23	PASS
BLE_2M	Ant1	2402	0~Reference	1.75	1.75	---	PASS
BLE_2M	Ant1	2402	30~1000	1.75	-56.34	≤-18.25	PASS
BLE_2M	Ant1	2402	1000~26500	1.75	-35.76	≤-18.25	PASS
BLE_2M	Ant1	2440	0~Reference	2.43	2.43	---	PASS
BLE_2M	Ant1	2440	30~1000	2.43	-57.62	≤-17.57	PASS



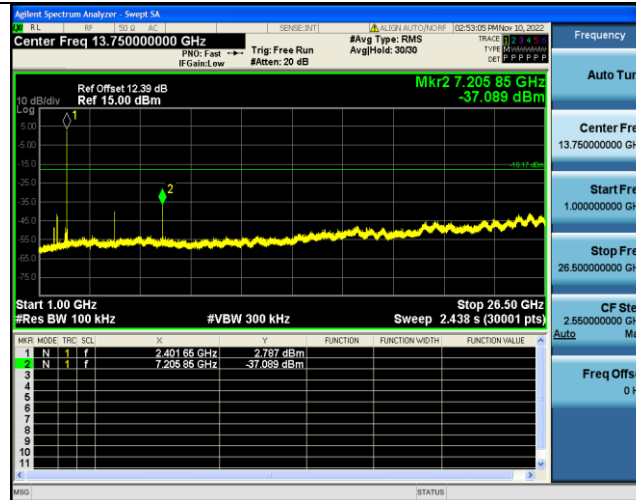
Report No.: PTC22093000602E-FC01

BLE_2M	Ant1	2440	1000~26500	2.43	-34.7	≤-17.57	PASS
BLE_2M	Ant1	2480	0~Reference	2.82	2.82	---	PASS
BLE_2M	Ant1	2480	30~1000	2.82	-58	≤-17.18	PASS
BLE_2M	Ant1	2480	1000~26500	2.82	-34.24	≤-17.18	PASS





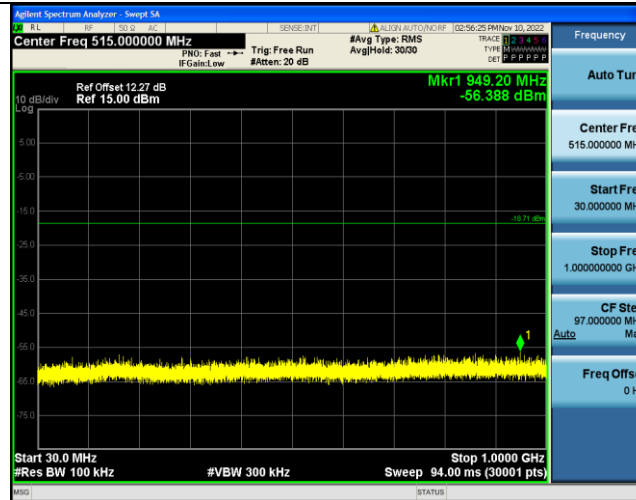
Report No.: PTC22093000602E-FC01



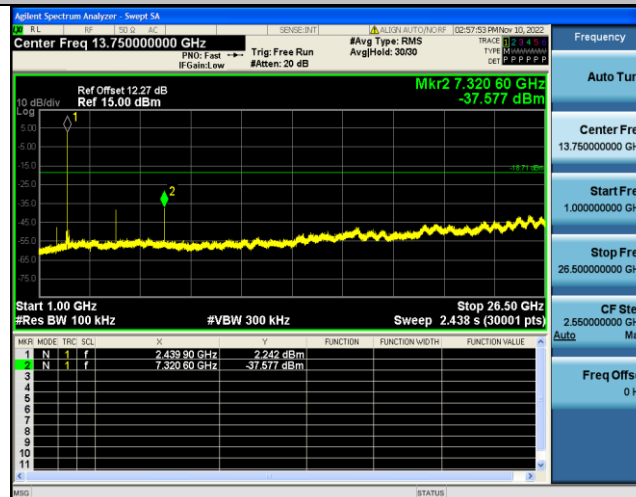
BLE_1M-Ant1-2440-0~Reference-1.29



BLE_1M-Ant1-2440-30~1000-1.29



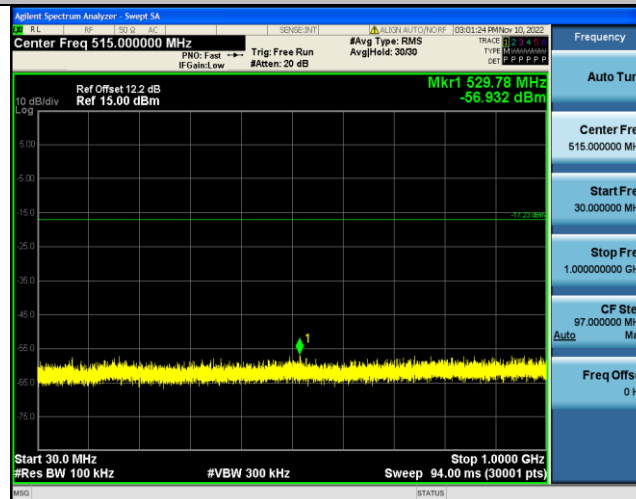
BLE_1M-Ant1-2440-1000~26500-1.29



BLE_1M-Ant1-2480-0~Reference-2.77



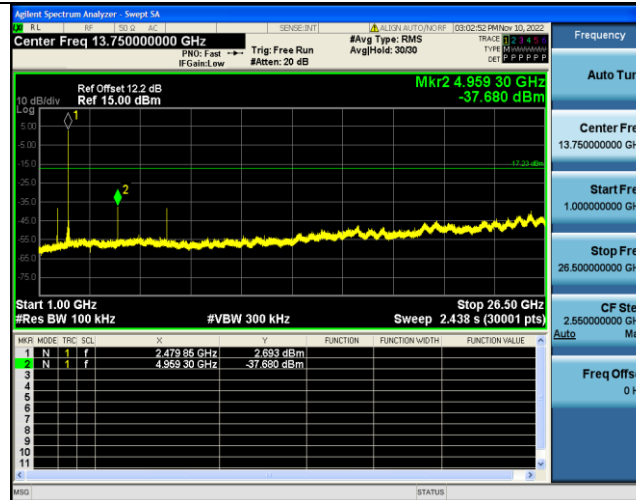
BLE_1M-Ant1-2480-30~1000-2.77



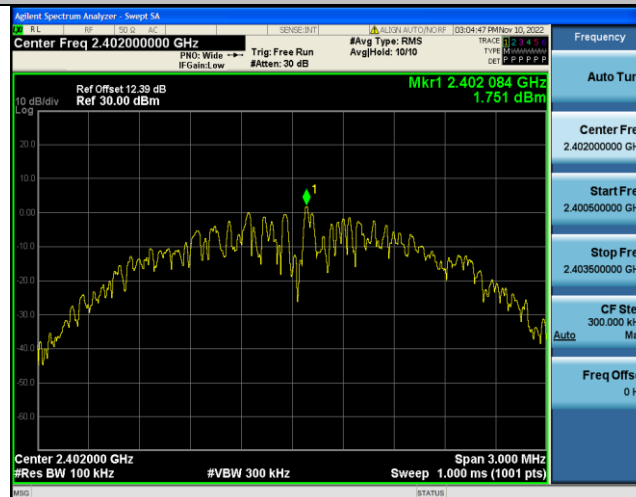
BLE_1M-Ant1-2480-1000~26500-2.77



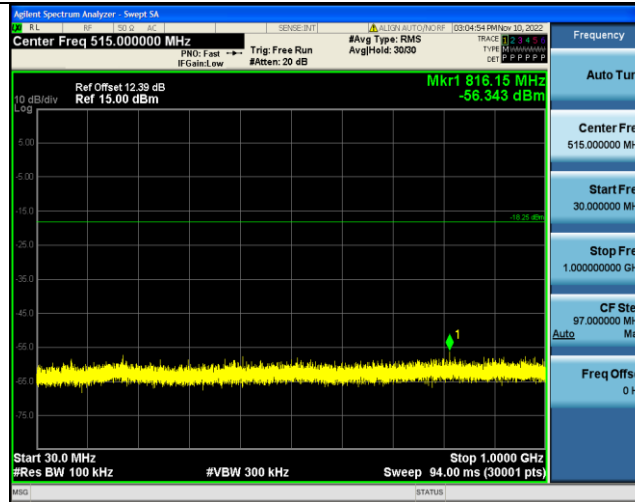
Report No.: PTC22093000602E-FC01



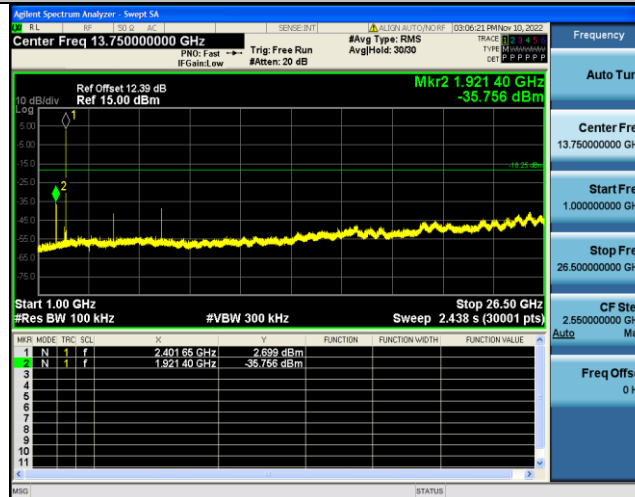
BLE_2M-Ant1-2402-0~Reference-1.75



BLE_2M-Ant1-2402-30~1000-1.75



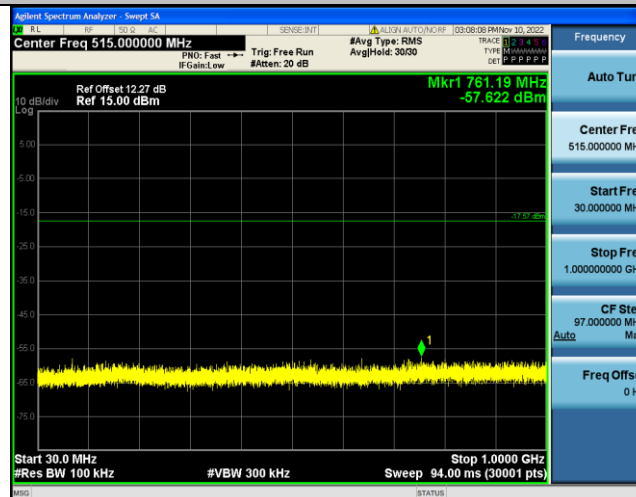
BLE_2M-Ant1-2402-1000~26500-1.75



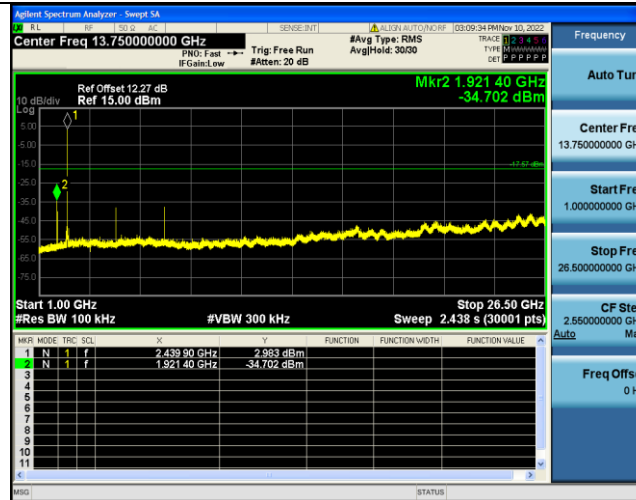
BLE_2M-Ant1-2440-0~Reference-2.43



BLE_2M-Ant1-2440-30~1000-2.43



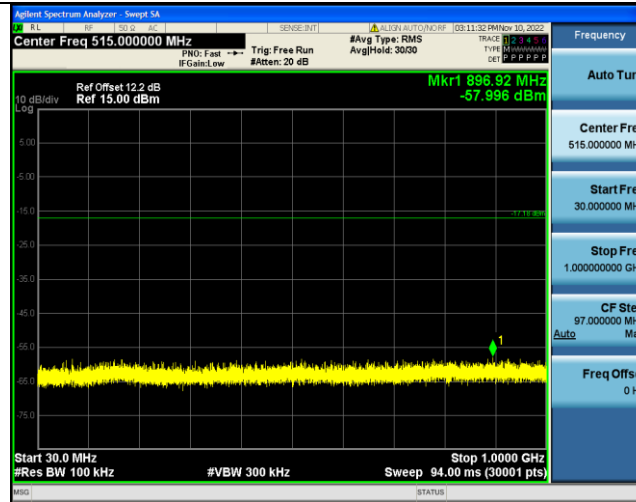
BLE_2M-Ant1-2440-1000~26500-2.43



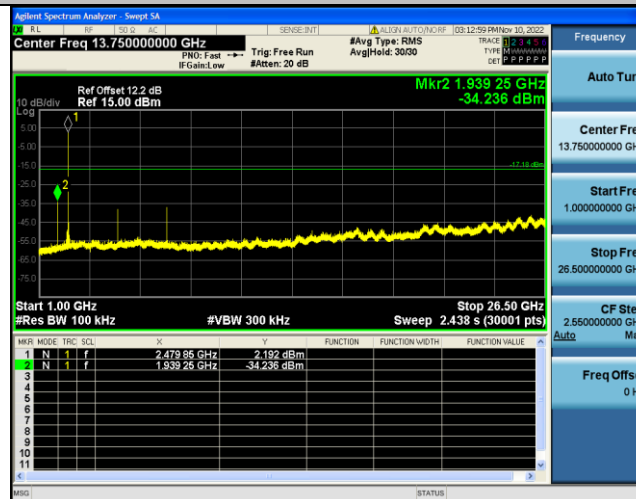
BLE_2M-Ant1-2480-0~Reference-2.82



BLE_2M-Ant1-2480-30~1000-2.82



BLE_2M-Ant1-2480-1000~26500-2.82





8 6dB Bandwidth Measurement

Test Requirement : FCC CFR47 Part 15 Section 15.247

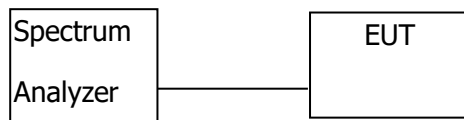
Test Method : ANSI C63.10:2013

Test Limit 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.

8.1 Test Procedure

1. 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.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100KHz, Set the Video Bandwidth(VBW)= 300KHz. In order to make an accurate measurement. The 6dB bandwidth must be greater than 500KHz.
4. Measure and record the results in the test report.

5. Test set up:

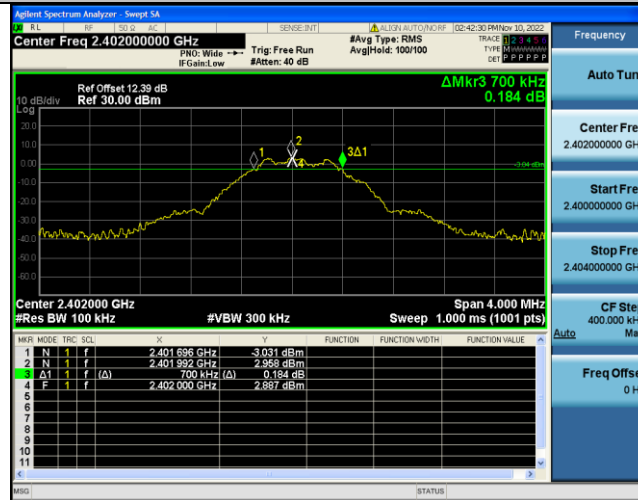


8.2 Test Result

TestMode	Antenna	Frequency[MHz]	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	0.700	2401.696	2402.396	0.5	PASS
BLE_1M	Ant1	2440	0.688	2439.696	2440.384	0.5	PASS
BLE_1M	Ant1	2480	0.660	2479.740	2480.400	0.5	PASS
BLE_2M	Ant1	2402	0.980	2401.564	2402.544	0.5	PASS
BLE_2M	Ant1	2440	1.000	2439.532	2440.532	0.5	PASS
BLE_2M	Ant1	2480	0.988	2479.524	2480.512	0.5	PASS



BLE_1M-Ant1-2402



BLE_1M-Ant1-2440



BLE_1M-Ant1-2480



Report No.: PTC22093000602E-FC01



BLE_2M-Ant1-2402



BLE_2M-Ant1-2440



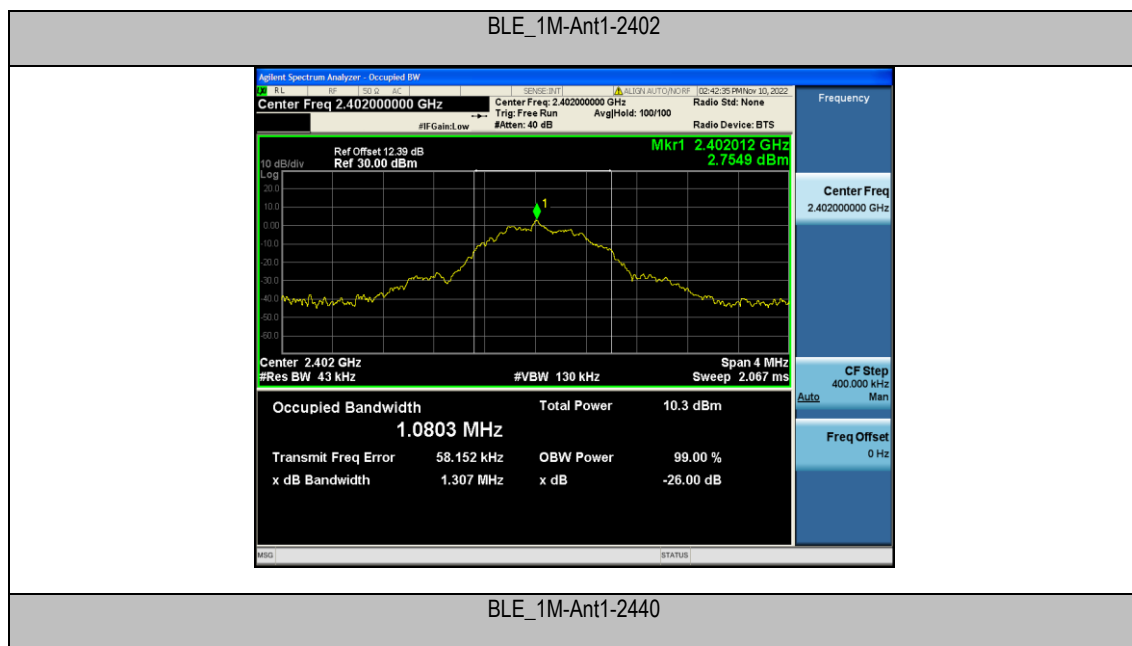
BLE_2M-Ant1-2480

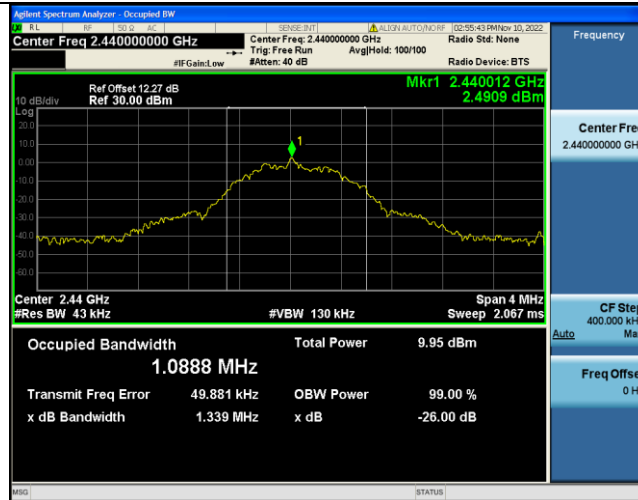




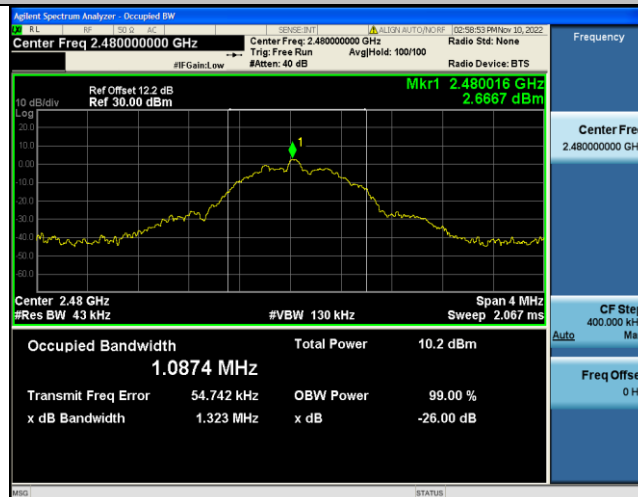
Occupied Channel Bandwidth

TestMode	Antenna	Frequency[MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	1.0803	2401.5180	2402.5983	---	---
BLE_1M	Ant1	2440	1.0888	2439.5055	2440.5943	---	---
BLE_1M	Ant1	2480	1.0874	2479.5110	2480.5984	---	---
BLE_2M	Ant1	2402	1.9955	2401.0752	2403.0707	---	---
BLE_2M	Ant1	2440	1.9238	2439.0795	2441.0033	---	---
BLE_2M	Ant1	2480	2.0012	2479.0707	2481.0719	---	---





BLE_1M-Ant1-2480



BLE_2M-Ant1-2402



BLE_2M-Ant1-2440



BLE_2M-Ant1-2480





9 Maximum Peak Output Power

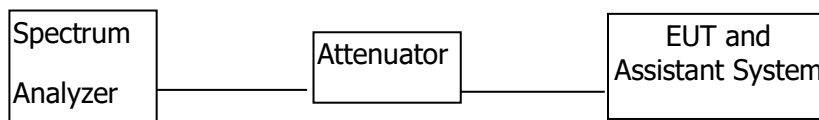
Test Requirement : FCC CFR47 Part 15 Section 15.247

Test Method : ANSI C63.10:2013

Test Limit : Regulation 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.

9.1 Test Procedure

1. 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.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Measure the conducted output power and record the results in the test report.
4. Test set-up:

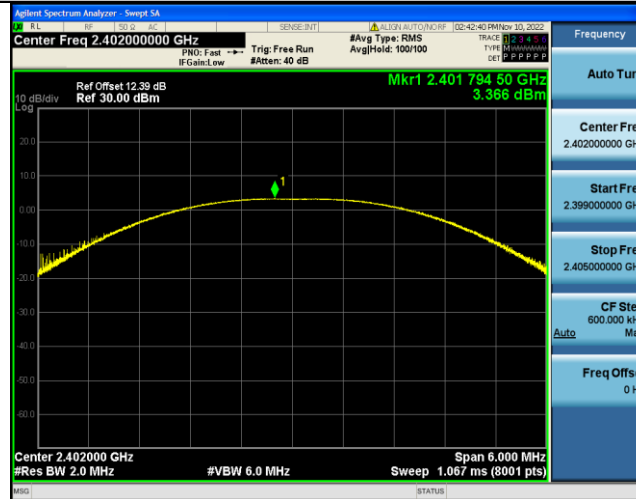


9.2 Test Result

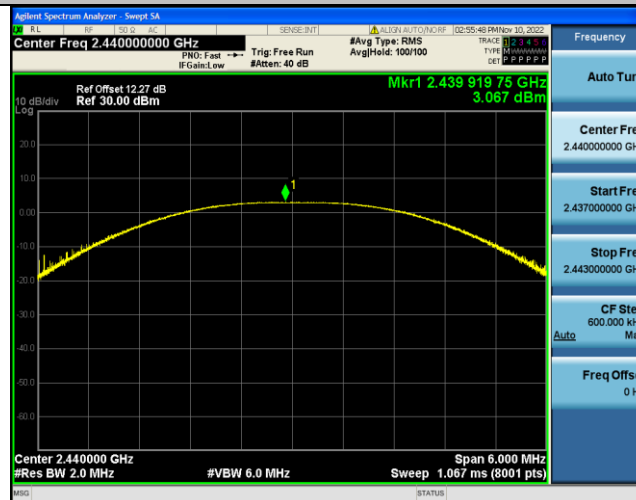
TestMode	Antenna	Frequency[MHz]	Conducted Peak Power[dBm]	Conducted Limit[dBm]	EIRP[dBm]	EIRP Limit[dBm]	Verdict
BLE_1M	Ant1	2402	3.37	≤30	3.37	≤36	PASS
BLE_1M	Ant1	2440	3.07	≤30	3.07	≤36	PASS
BLE_1M	Ant1	2480	3.13	≤30	3.13	≤36	PASS
BLE_2M	Ant1	2402	3.36	≤30	3.36	≤36	PASS
BLE_2M	Ant1	2440	3.07	≤30	3.07	≤36	PASS
BLE_2M	Ant1	2480	3.21	≤30	3.21	≤36	PASS



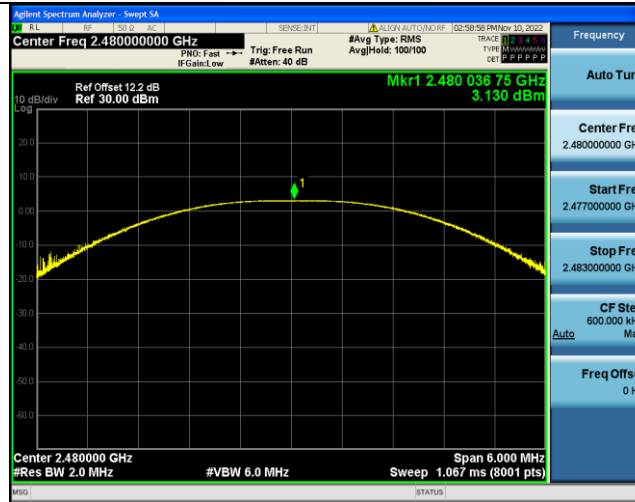
BLE_1M-Ant1-2402



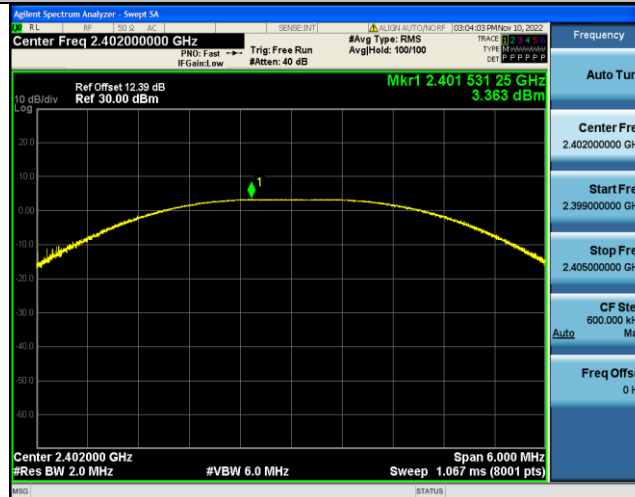
BLE_1M-Ant1-2440



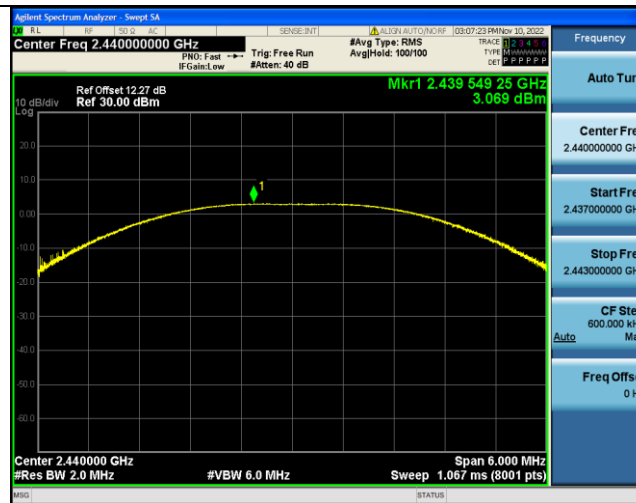
BLE_1M-Ant1-2480



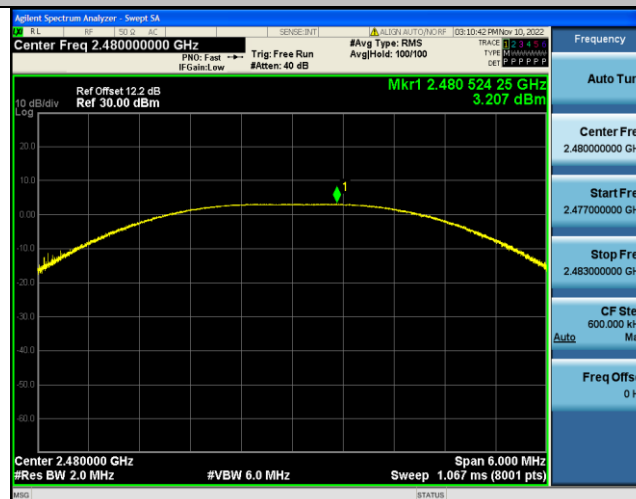
BLE_2M-Ant1-2402



BLE_2M-Ant1-2440



BLE_2M-Ant1-2480



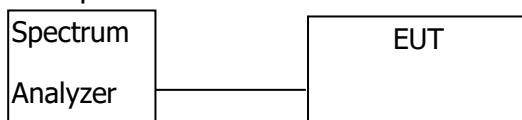


10 Power Spectral density

Test Requirement	: FCC CFR47 Part 15 Section 15.247
Test Method	: ANSI C63.10:2013
Test Limit	: Regulation 15.247(f) The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

10.1 Test Procedure

1. 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.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW0 = 3KHz, Video Bandwidth (VBW) = 10KHz, in order to make an accurate measurement, set the span to 1.5 times DTS channel bandwidth.
4. 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.
5. Measure and record the result in the test report.
6. Test set up:

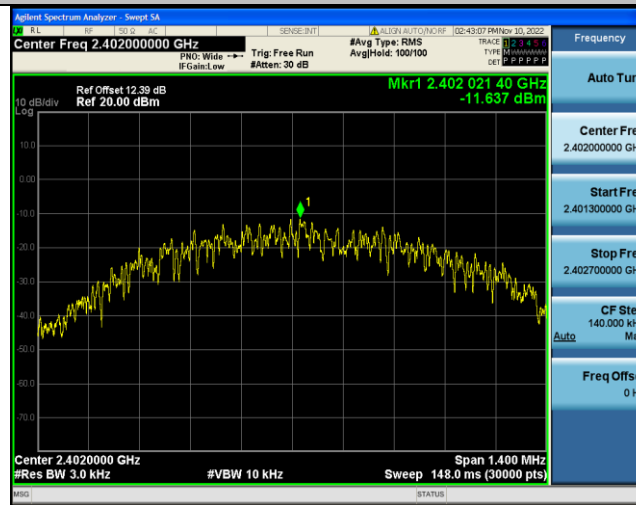


10.2 Test Result

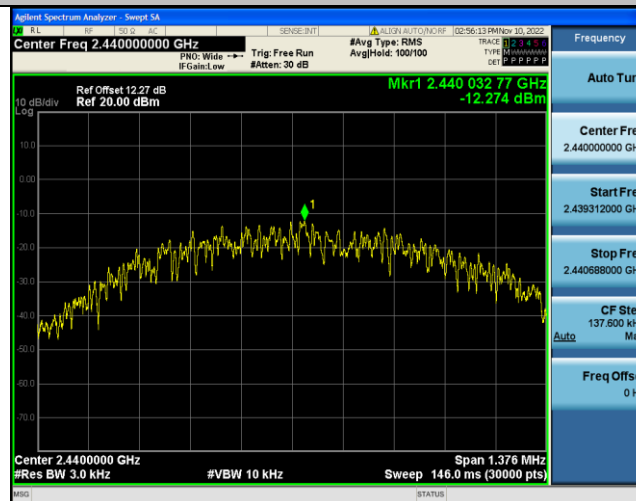
TestMode	Antenna	Frequency[MHz]	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
BLE_1M	Ant1	2402	-11.64	≤8.00	PASS
BLE_1M	Ant1	2440	-12.27	≤8.00	PASS
BLE_1M	Ant1	2480	-11.95	≤8.00	PASS
BLE_2M	Ant1	2402	-11.45	≤8.00	PASS
BLE_2M	Ant1	2440	-11.28	≤8.00	PASS
BLE_2M	Ant1	2480	-10.96	≤8.00	PASS



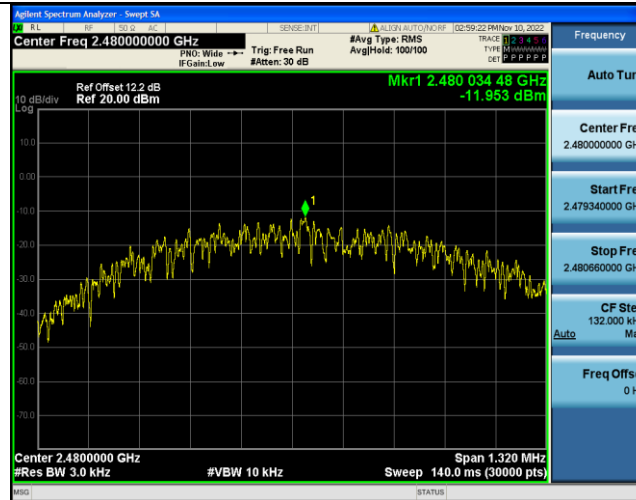
BLE_1M-Ant1-2402--11.64-0.00-0.00-0.00



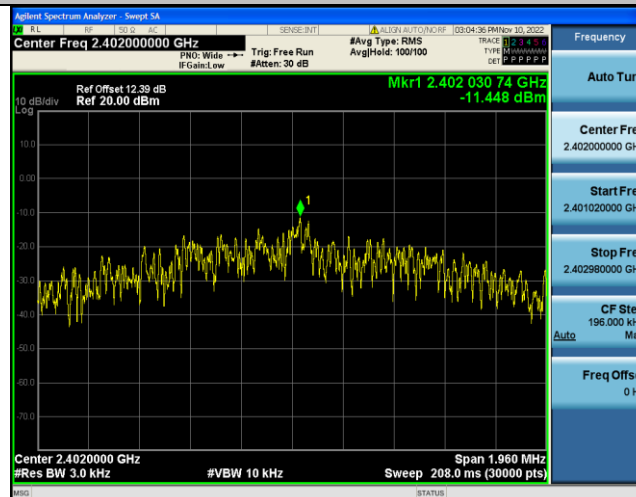
BLE_1M-Ant1-2440--12.27-0.00-0.00-0.00



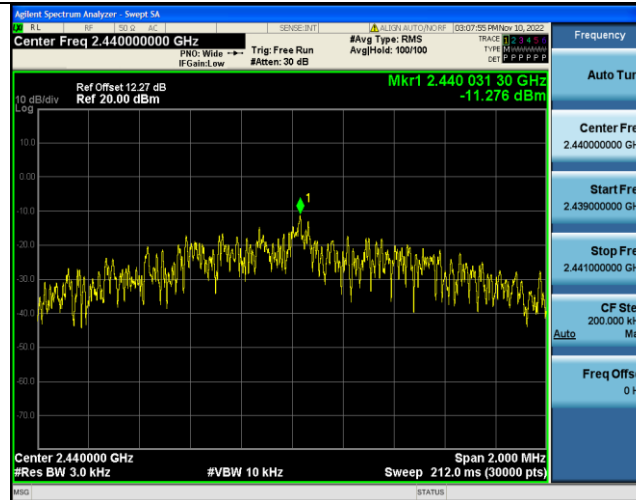
BLE_1M-Ant1-2480--11.95-0.00-0.00-0.00



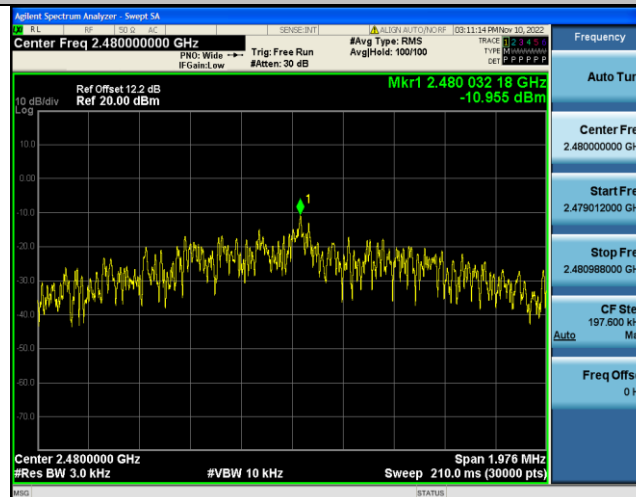
BLE_2M-Ant1-2402--11.45-0.00-0.00-0.00



BLE_2M-Ant1-2440--11.28-0.00-0.00-0.00



BLE_2M-Ant1-2480--10.96-0.00-0.00-0.00





11 Antenna Application

11.1 Antenna Requirement

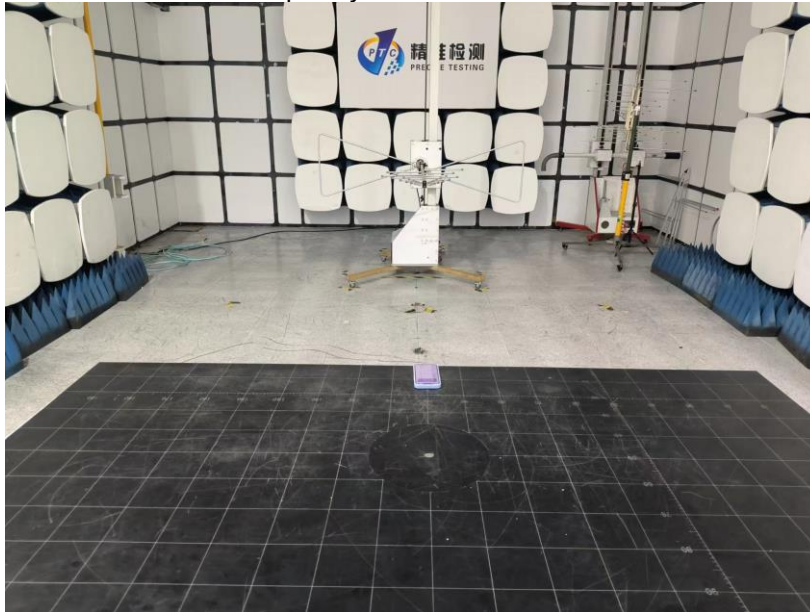
For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

11.2 Result

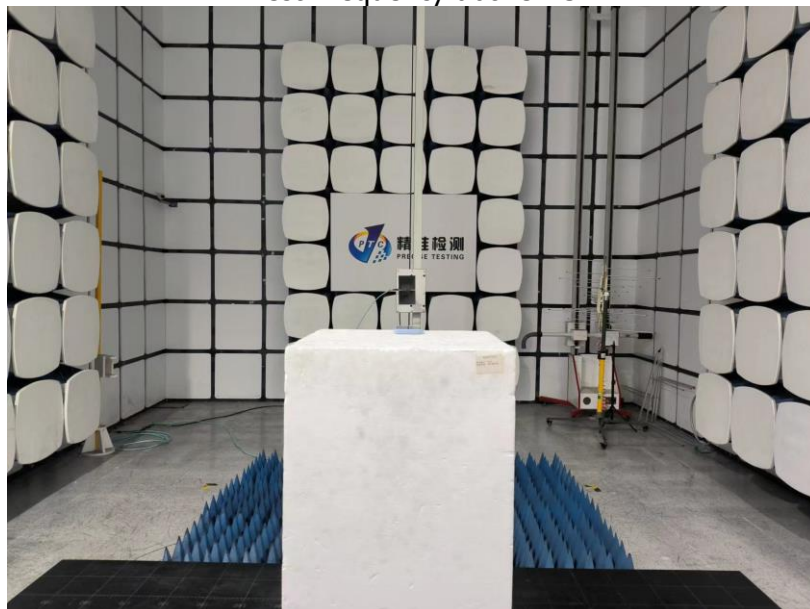
The EUT'S antenna, permanent attached antenna, is pcb antenna. The antenna's gain is -0.68dBi and meets the requirement.

12 Test Setup

Radiated Spurious Emissions
Test Frequency From 30MHz-1000MHz



Test Frequency above 1G

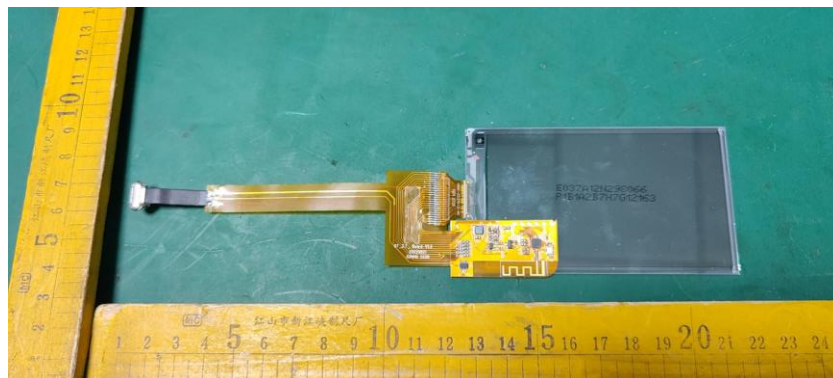


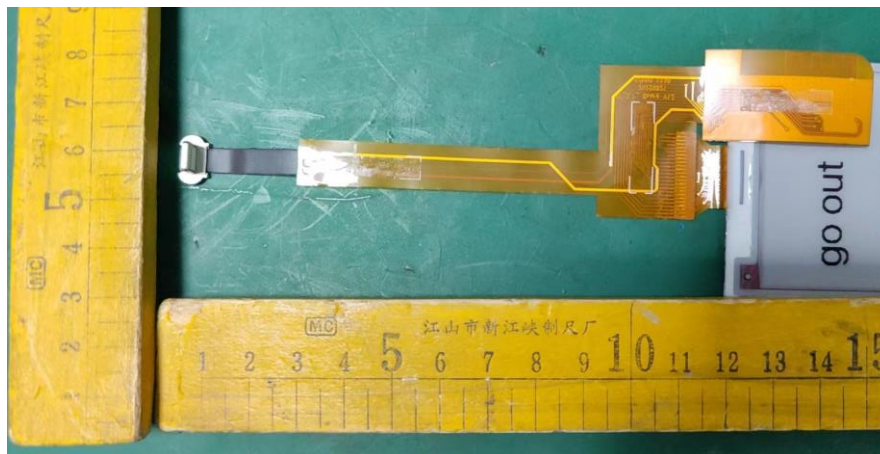
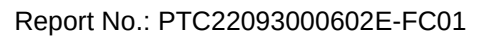


13 EUT Photos









*****THE END REPORT*****