



TEST REPORT

APPLICANT : Bullitt Group

PRODUCT NAME : 4G Mobile Phone

MODEL NAME : S62

BRAND NAME : CAT

FCC ID : ZL5S62

STANDARD(S) : 47 CFR Part 15 Subpart C

RECEIPT DATE : 2020-10-10

TEST DATE : 2020-10-30 to 2021-01-26

ISSUE DATE : 2021-02-19

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DIRECTORY

1. Technical Information.....	3
1.1. Applicant and Manufacturer Information.....	3
1.2. Equipment Under Test (EUT) Description.....	3
1.3. Test Standards and Results.....	4
1.4. Environmental Conditions.....	4
2. 47 CFR Part 15C Requirements.....	5
2.1. Antenna requirement.....	5
2.2. Peak Output Power.....	6
2.3. 6dB Bandwidth.....	11
2.4. Conducted Spurious Emissions and Band Edge.....	16
2.5. Power spectral density (PSD).....	27
2.6. Restricted Frequency Bands.....	32
2.7. Conducted Emission.....	39
2.8. Radiated Emission.....	43
Annex A Test Uncertainty.....	65
Annex B Testing Laboratory Information.....	66

Change History		
Version	Date	Reason for change
1.0	2021-02-19	First edition



1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

Applicant:	Bullitt Group
Applicant Address:	One Valpy, Valpy Street, Reading, Berkshire, RG1 1AR, United Kingdom
Manufacturer:	Bullitt Group
Manufacturer Address:	One Valpy, Valpy Street, Reading, Berkshire, RG1 1AR, United Kingdom

1.2. Equipment Under Test (EUT) Description

Product Name:	4G Mobile Phone
Serial No:	(N/A, marked #1 by test site)
Hardware Version:	Q190_V1
Software Version:	LTE_S02111.10_N_S62_0
Modulation Type:	GFSK
Operating Frequency Range:	2402MHz - 2480MHz (40 channels, at intervals of 2MHz);
Bluetooth Version:	Bluetooth 5.1 LE
Bluetooth Specification:	Bluetooth 5.1 LE 1M PHY Bluetooth 5.1 LE 2M PHY
Antenna Type:	PIFA Antenna
Antenna Gain:	0.18dBi

Note 1: The EUT contains Bluetooth Module operating at 2.4GHz ISM band; the frequencies is $F(\text{MHz})=2402+2*n$ ($0 \leq n \leq 39$). The lowest, middle, highest channel numbers of the Bluetooth Module used and tested in this report are separately 0 (2402MHz), 19 (2440MHz) and 39 (2480MHz).

Note 2: Bluetooth 5.1 LE support 1M PHY, 2M PHY.

Note 3: The EUT connected to the serial port of the computer with a serial communication cable, we use the dedicated software to control the EUT continuous transmission.

Note 4: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.



1.3. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C (Bluetooth, 2.4GHz ISM band radiators) for the EUT FCC ID Certification:

No	Identity	Document Title
1	47 CFR Part 15	Radio Frequency Devices

Test detailed items/section required by FCC rules and results are as below:

No.	Section	Description	Test Date	Test Engineer	Result
1	15.203	Antenna Requirement	N/A	N/A	<u>PASS</u>
2	15.247(b)	Peak Output Power	Jan 20, 2021	Stefan Sun	<u>PASS</u>
3	15.247(a)	Bandwidth	Jan 20, 2021	Stefan Sun	<u>PASS</u>
4	15.247(d)	Conducted Spurious Emission and Band Edge	Jan 20, 2021	Stefan Sun	<u>PASS</u>
5	15.247(e)	Power spectral density (PSD)	Jan 20, 2021	Stefan Sun	<u>PASS</u>
6	15.247(d)	Restricted Frequency Bands	Oct 30, 2020	Yaming Luo	<u>PASS</u>
7	15.207	Conducted Emission	Jan 26, 2021	Yaming Luo	<u>PASS</u>
8	15.209, 15.247(d)	Radiated Emission	Dec 05, 2020	Yaming Luo	<u>PASS</u>

Note: The tests were performed according to the method of measurements prescribed in ANSIC63.10-2013 and 558074 D01 15.247 Meas Guidance v05r02.

1.4. Environmental Conditions

During the measurement, the environmental conditions were within the listed ranges:

Temperature (°C):	15 - 35
Relative Humidity (%):	30 -60
Atmospheric Pressure (kPa):	86-106



2. 47 CFR Part 15C Requirements

2.1. Antenna requirement

2.1.1. Applicable Standard

According to FCC 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.

2.1.2. Result: Compliant

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

2.2. Peak Output Power

2.2.1. Requirement

According to FCC section 15.247(b)(3), For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: The maximum peak conducted output power of the intentional radiator shall not exceed 1 Watt.

2.2.2. Test Description

The measure output power was calculated by the reading of the spectrum

A. Test Setup:



The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

B. Equipments List:

Please refer ANNEX B(4).

2.2.3. Test procedure

The measured output power was calculated by the reading of the spectrum analyzer and calibration. Following is the test procedure for Peak Output Power test on the spectrum analyzer:

- a) Set analyzer center frequency to channel center frequency.
- b) Set the RBW to 3MHz
- c) Set VBW to 8MHz
- d) Set span to 6MHz
- e) Sweep time to auto couple.
- f) Detector=peak.
- g) Trace mode=max hold.
- h) Allow trace to fully stabilize.

- i) Use peak marker function to determine the peak amplitude level.

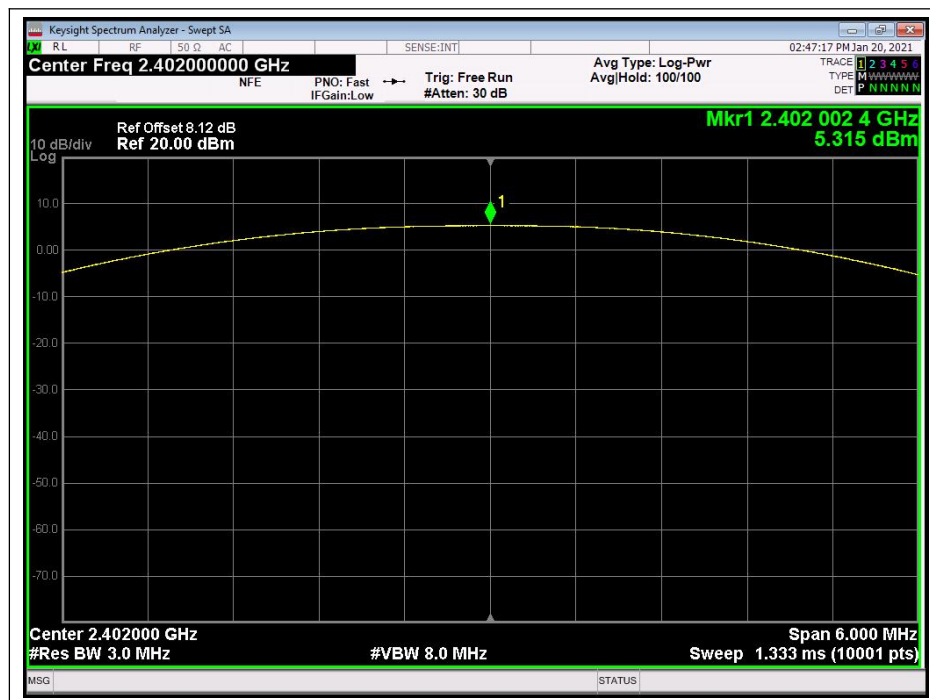
2.2.4. Test Result

The lowest, middle and highest chnnels are selected to perform testing to verify the conducted RF output peak power of the Module.

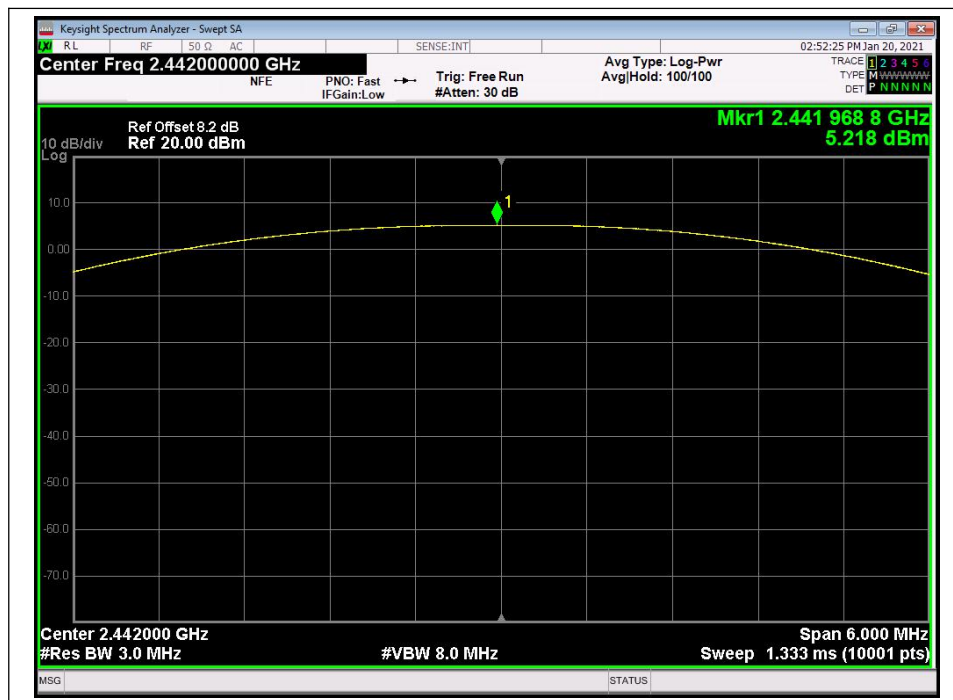
A. Test Verdict:

Mode	Channel	Frequency (MHz)	Measured Output Peak Power		Limit		Verdict
			dBm	W	dBm	W	
1M PHY	0	2402	5.315	0.003	30	1	PASS
	19	2440	5.218	0.003	30	1	PASS
	39	2480	5.668	0.004	30	1	PASS
2M PHY	0	2402	5.437	0.003	30	1	PASS
	19	2440	4.974	0.003	30	1	PASS
	39	2480	5.847	0.004	30	1	PASS

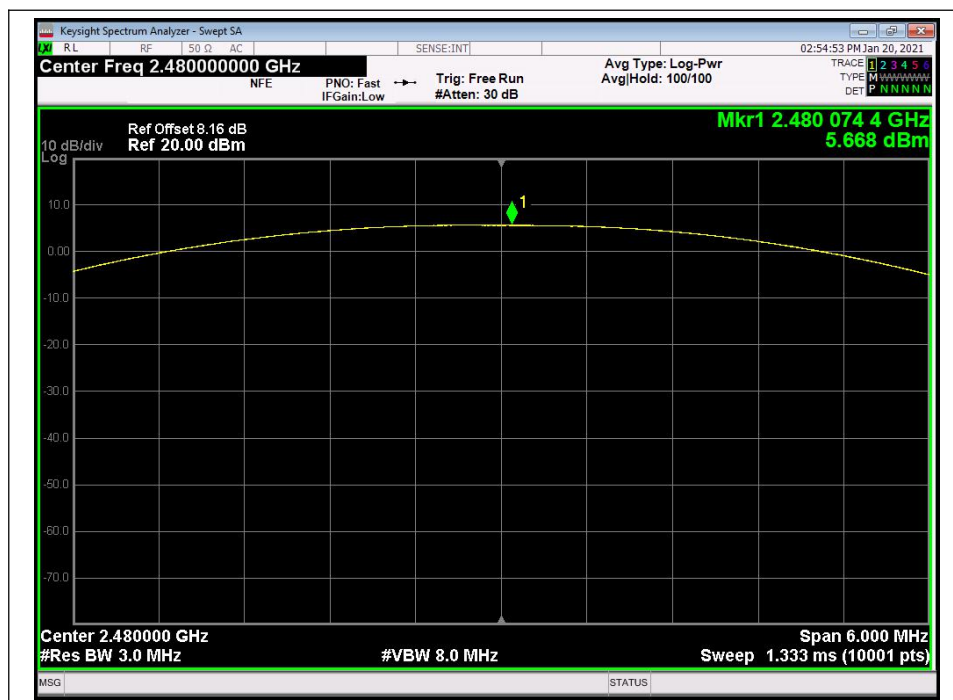
B. Test Plots:



(Bluetooth 5.1 LE 1M PHY Channel 0, 2402MHz)



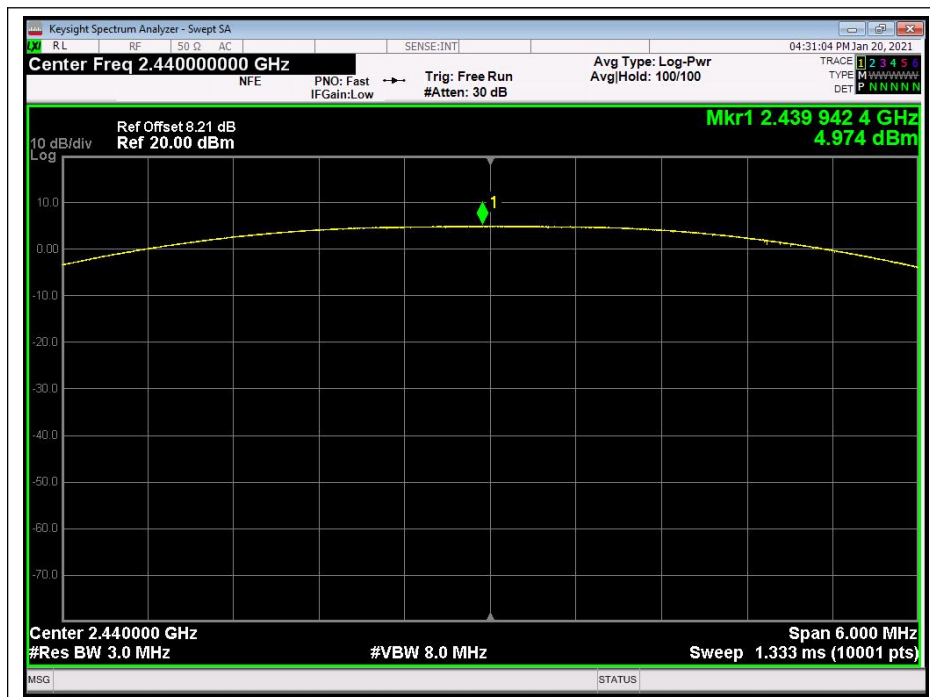
(Bluetooth 5.1 LE 1M PHY Channel 19, 2440MHz)



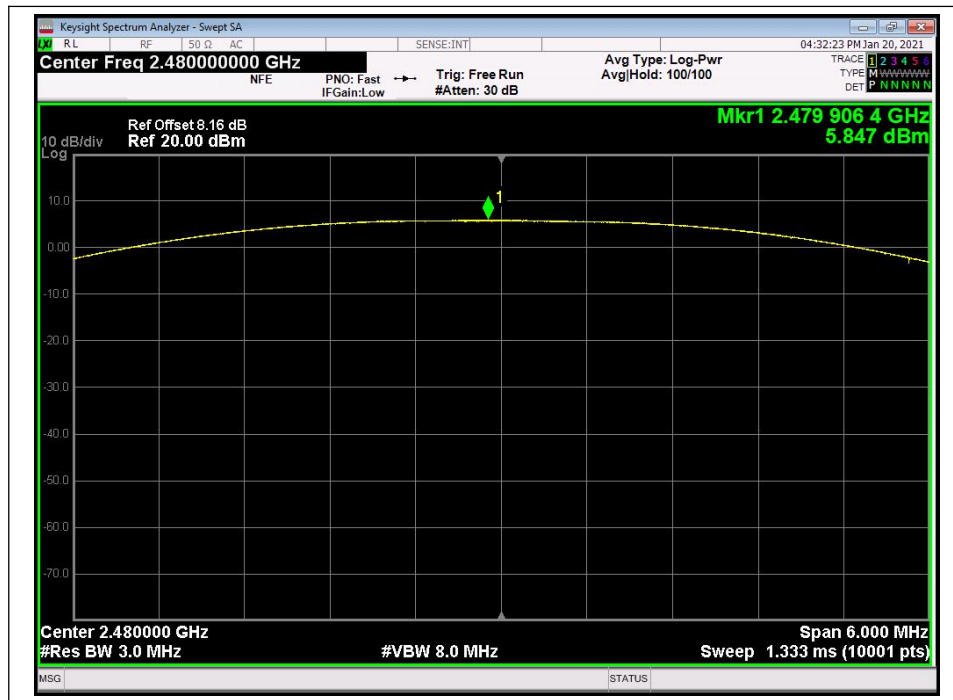
(Bluetooth 5.1 LE 1M PHY Channel 39, 2480MHz)



(Bluetooth 5.1 LE 2M PHY Channel 0, 2402MHz)



(Bluetooth 5.1 LE 2M PHY Channel 19, 2440MHz)



(Bluetooth 5.1 LE 2M PHY Channel 39, 2480MHz)

2.3.6dB Bandwidth

2.3.1. Requirement

According to FCC section 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.

2.3.2. Test Description

A. Test Set:



The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

B. Equipments List:

Please refer ANNEX B(4).

2.3.3. Test procedure

The steps for the first option are as follows:

- (1) Set analyzer center frequency to channel center frequency.
 - a) Set RBW=100kHz
 - b) Set the VBW=300 kHz
 - c) Detector=peak
 - d) Trace mode=max hold.
 - e) Sweep = auto couple
 - f) Allow trace to fully stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.



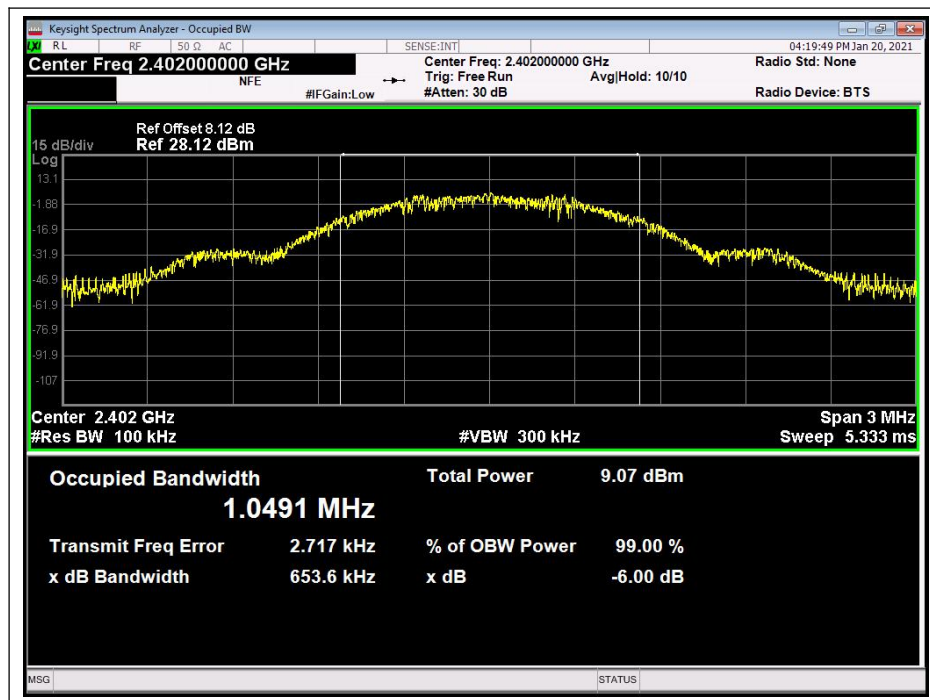
- (2) The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described in 11.8.1(i.e. RBW=100 kHz, VBW $\geq 3 \times$ RBW, and peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

2.3.4. Test Result

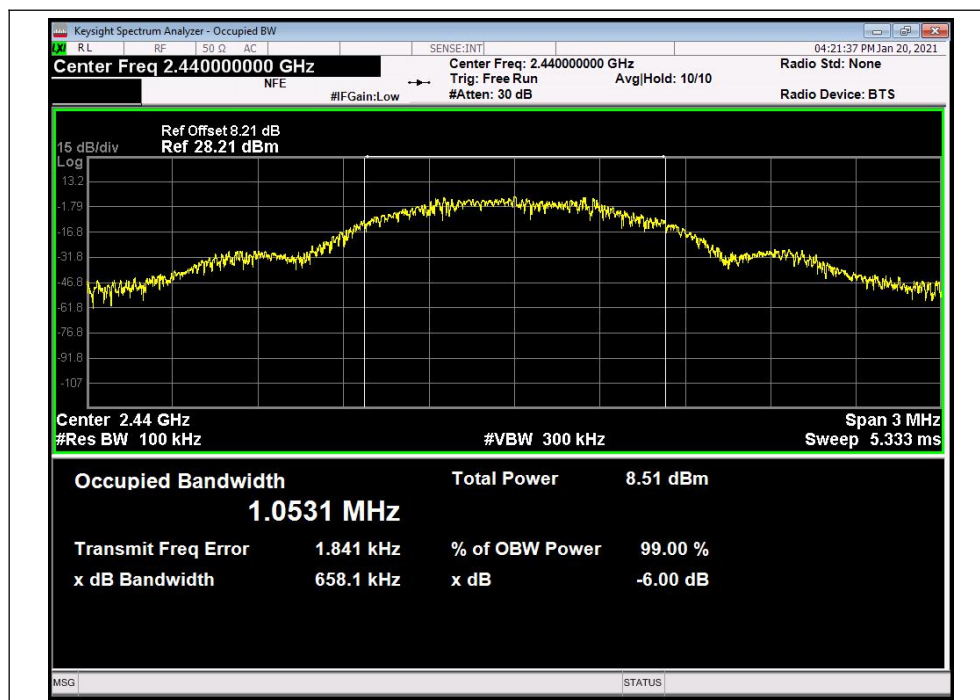
The lowest, middle and highest channels are selected to perform testing to record the 6 dB bandwidth of the module.

A. Test Verdict:

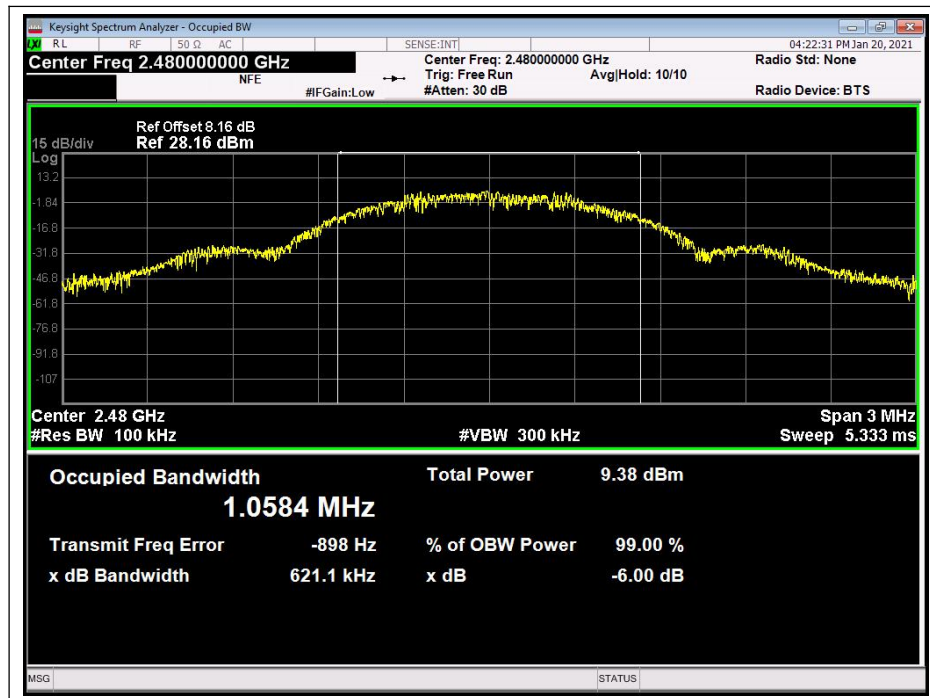
Mode	Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limits(kHz)	Result
1M PHY	0	2402	0.653	≥ 500	PASS
	19	2440	0.658	≥ 500	PASS
	39	2480	0.621	≥ 500	PASS
2M PHY	0	2402	1.070	≥ 500	PASS
	19	2440	1.215	≥ 500	PASS
	39	2480	1.116	≥ 500	PASS

**B. Test Plots**

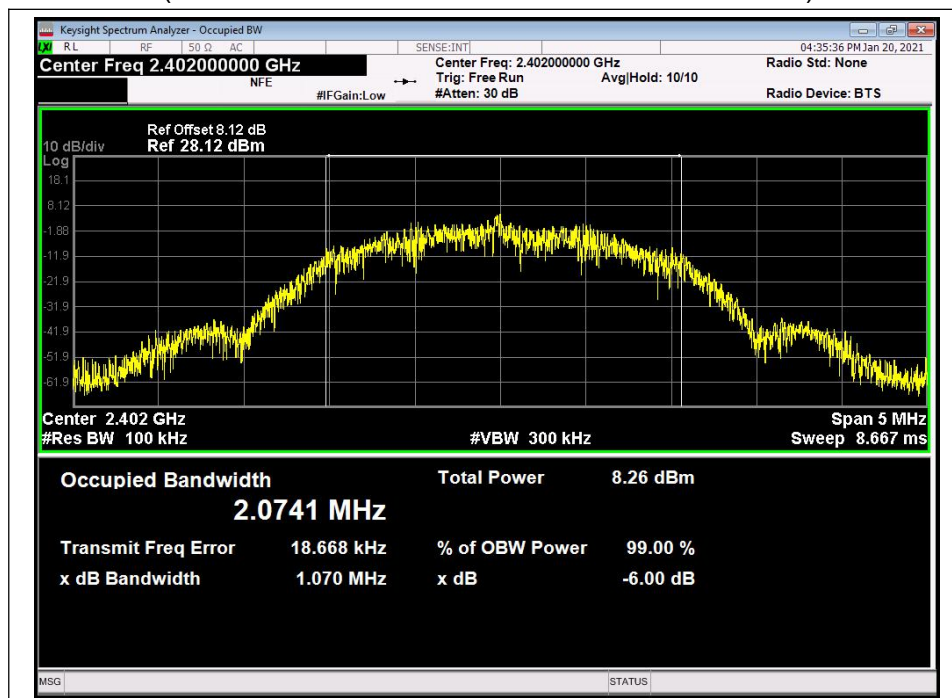
(Bluetooth 5.1 LE 1M PHY Channel 0: 2402MHz)



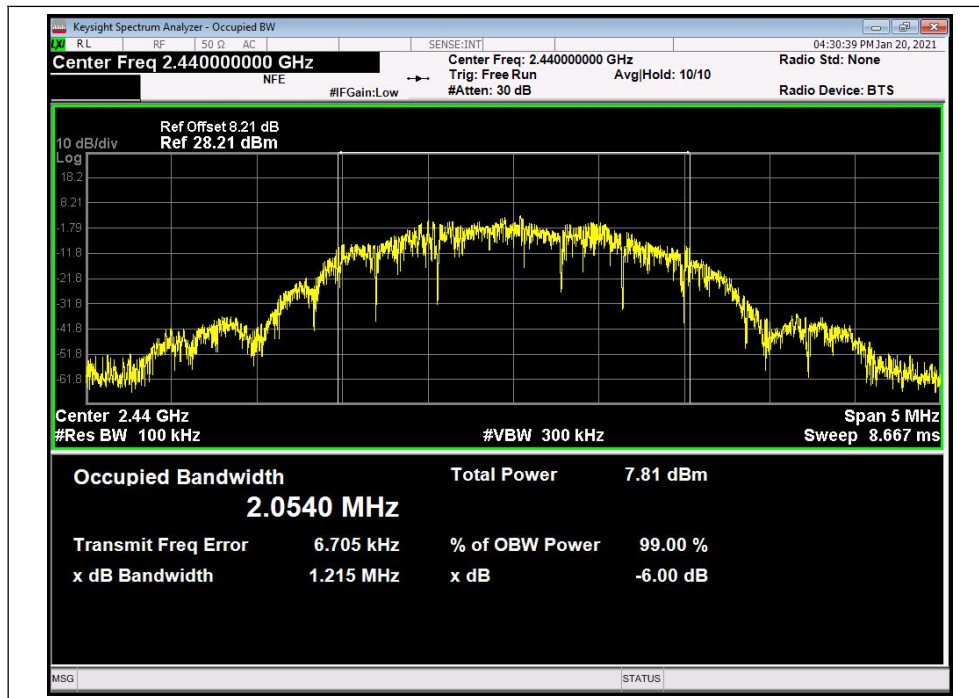
(Bluetooth 5.1 LE 1M PHY Channel 19: 2440 MHz)



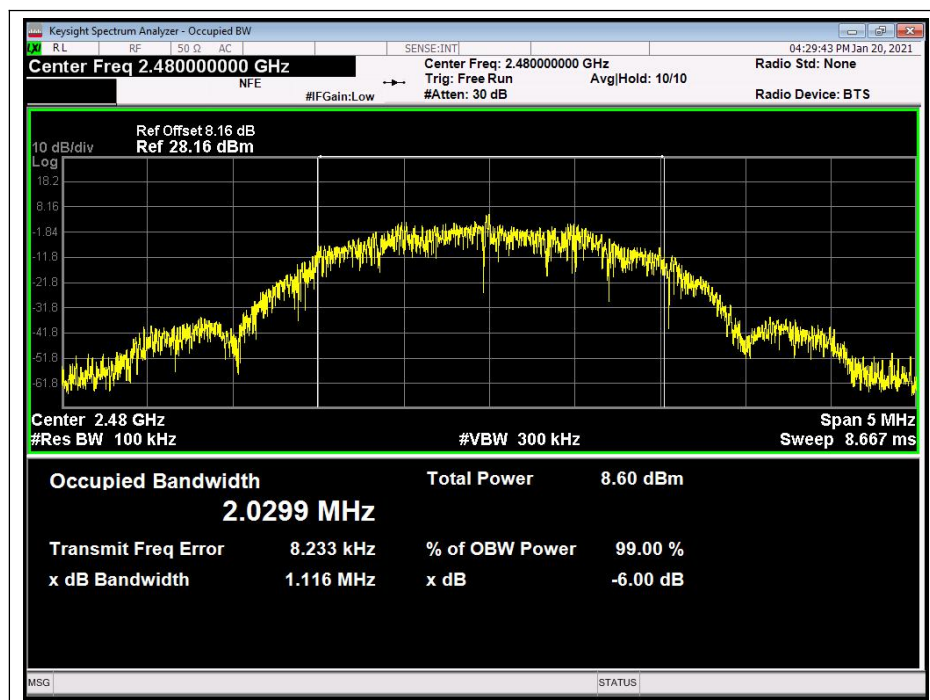
(Bluetooth 5.1 LE 1M PHY Channel 39: 2480MHz)



(Bluetooth 5.1 LE 2M PHY Channel 0: 2402MHz)



(Bluetooth 5.1 LE 2M PHY Channel 19: 2440 MHz)



(Bluetooth 5.1 LE 2M PHY Channel 39: 2480MHz)

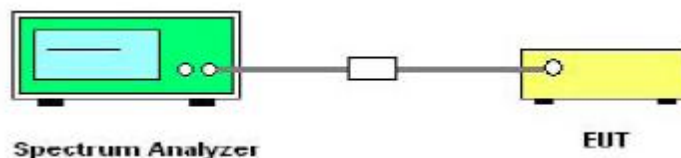
2.4. Conducted Spurious Emissions and Band Edge

2.4.1. Requirement

According to FCC section 15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

2.4.2. Test Description

A. Test Set:



The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

B. Equipments List:

Please refer ANNEX B (4).

2.4.3. Test Procedure

The transmitter output was connected to the spectrum analyzer via a low lose cable. Set both RBW and VBW of spectrum analyzer to 100kHz and 300kHz with suitable frequency span including 100 MHz bandwidth from band edge. The band edges was measured and recorded.

2.4.4. Test Result

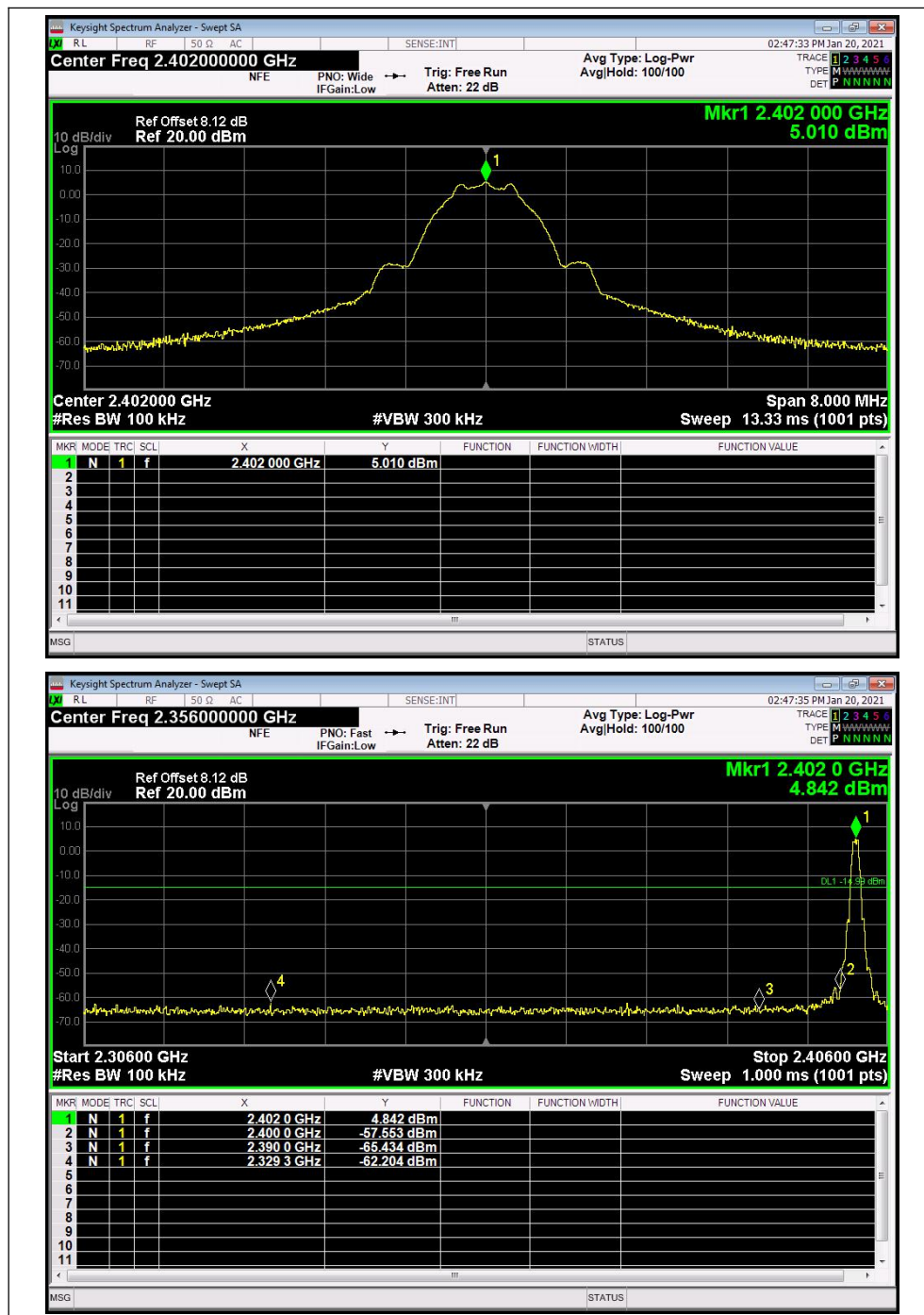
The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions.

**A. Test Plots:**

Note: the power of the Module transmitting frequency should be ignored.



(LE 1M PHY _ Conducted Spurious Emissions _ Channel = 0, 30MHz to 25GHz)



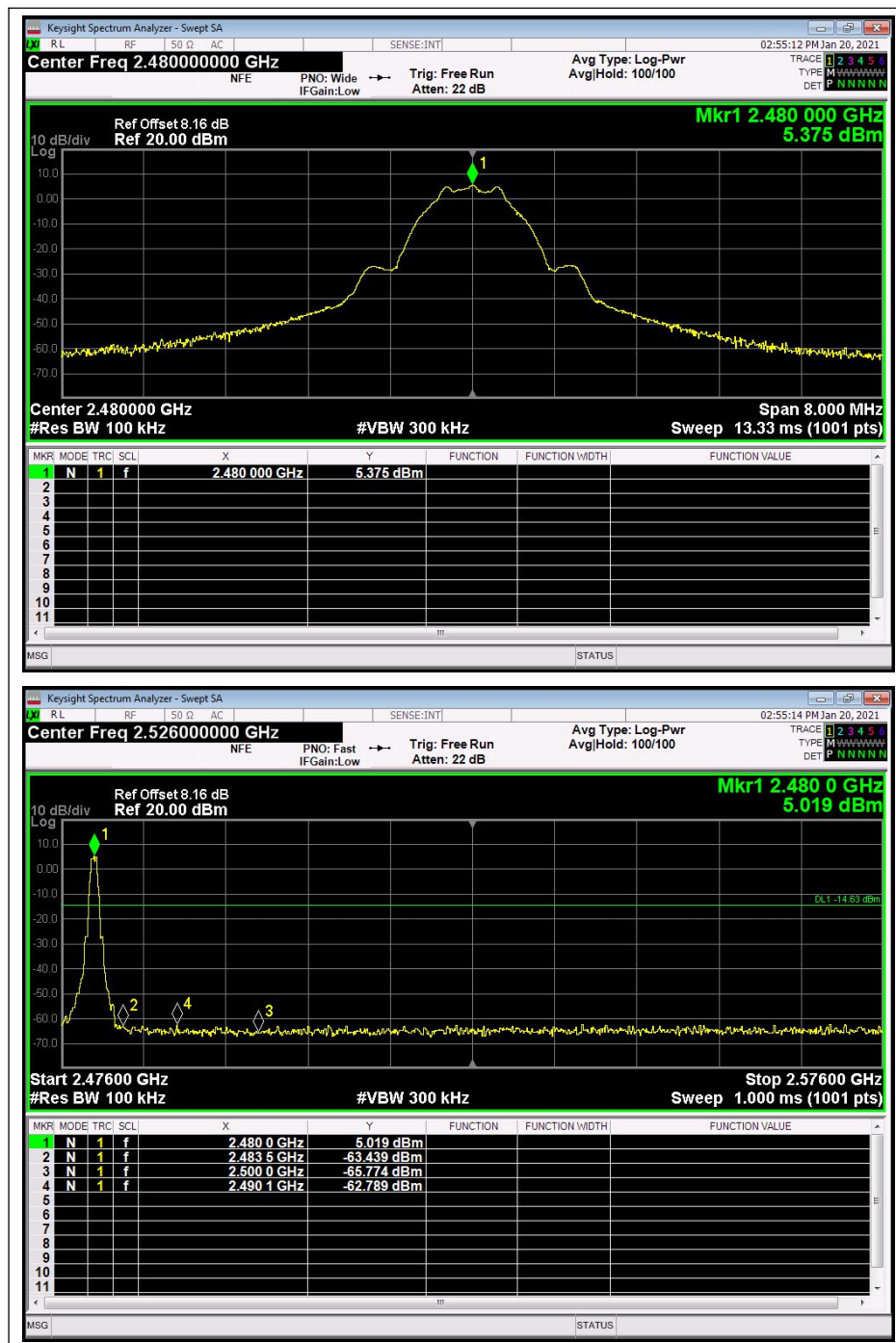
(LE 1M PHY _ Bandedge, Channel = 0)



(LE 1M PHY _ Conducted Spurious Emissions _ Channel = 19, 30MHz to 25GHz)



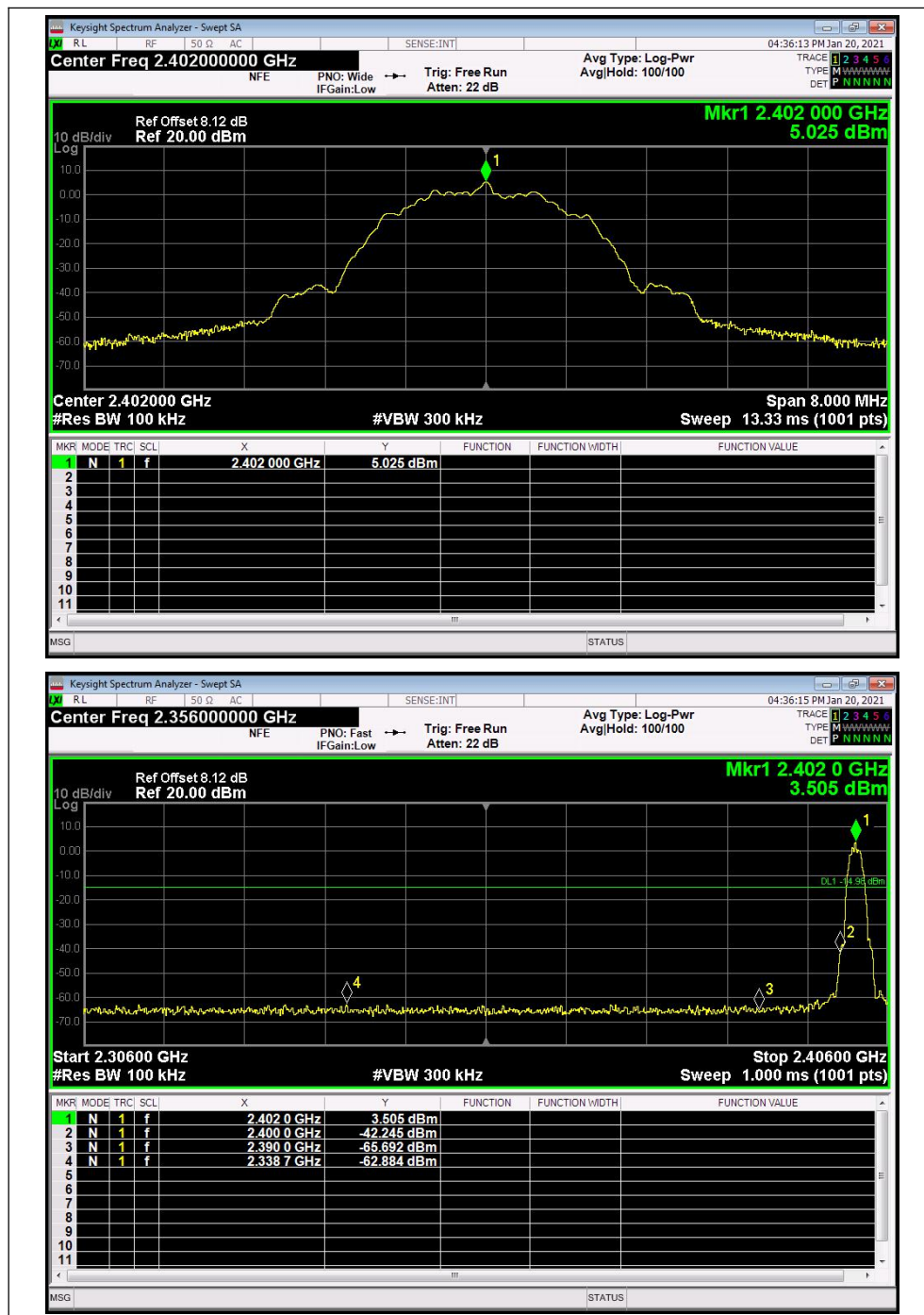
(LE 1M PHY _ Conducted Spurious Emissions _ Channel = 39, 30MHz to 25GHz)



(LE 1M PHY _ Bandedge, Channel = 39)



(LE 2M PHY _ Conducted Spurious Emissions _ Channel = 0, 30MHz to 25GHz)



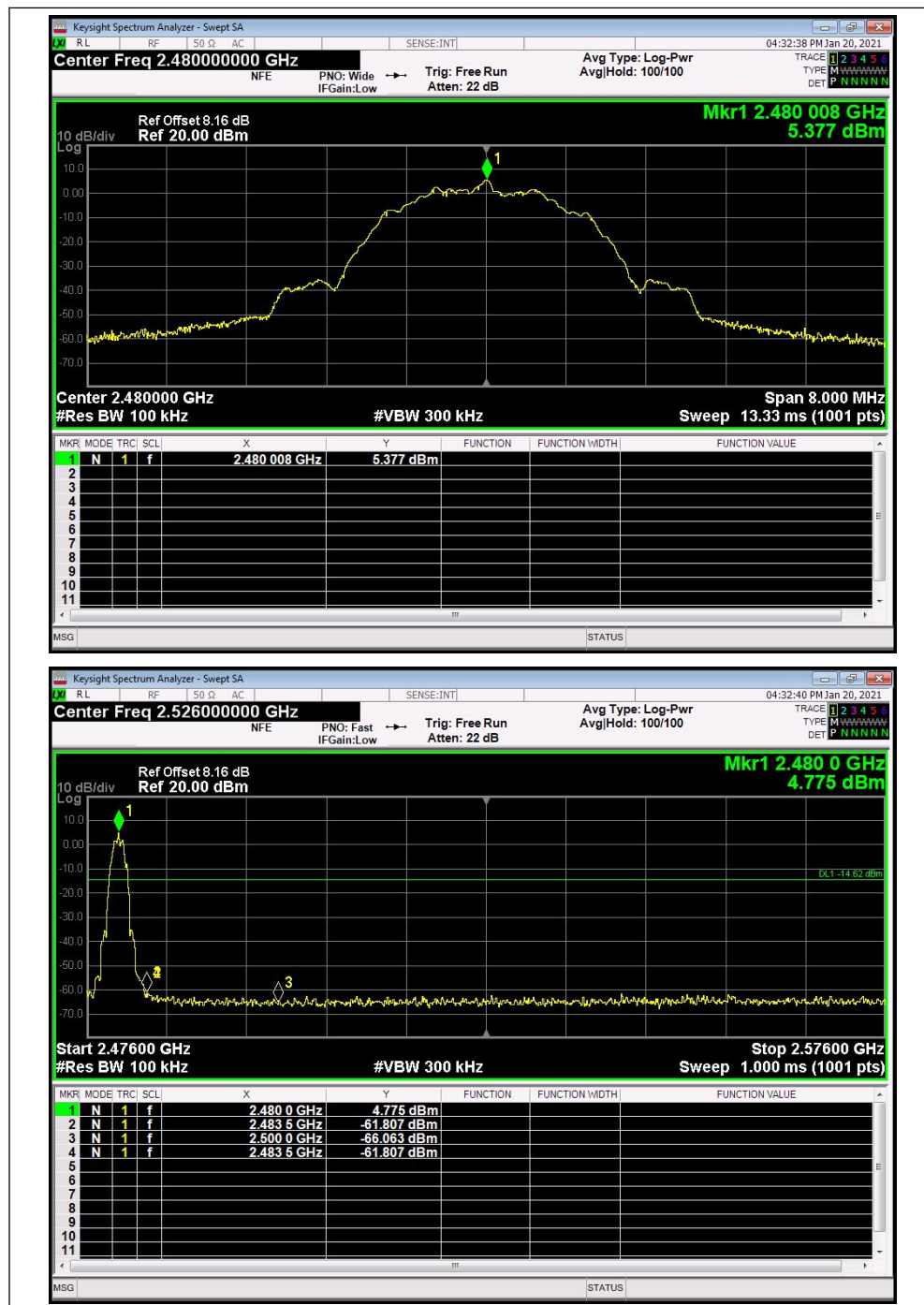
(LE 2M PHY _ Bandedge, Channel = 0)



(LE 2M PHY _ Conducted Spurious Emissions _ Channel = 19, 30MHz to 25GHz)



(LE 2M PHY _ Conducted Spurious Emissions _ Channel = 39, 30MHz to 25GHz)



(LE 2M PHY_ Bandedge, Channel = 39)

2.5. Power spectral density (PSD)

2.5.1. Requirement

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.

2.5.2. Test Description

A. Test Set:



The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

B. Equipments List:

Please refer ANNEX B (4).

2.5.3. Test procedure

The measured power spectral density was calculated by the reading of the spectrum analyzer and calibration. Following is the test procedure for PSD test:

- Set analyzer center frequency to channel center frequency.
- Set the span to 1.5 times DTS
- Set the RBW to 3 kHz
- Set VBW to 10 kHz
- Sweep time to auto couple.
- Detector = peak.
- Trace mode=max hold.
- Allow trace to fully stabilize.
- Use peak marker function to determine the maximum amplitude within the RBW.

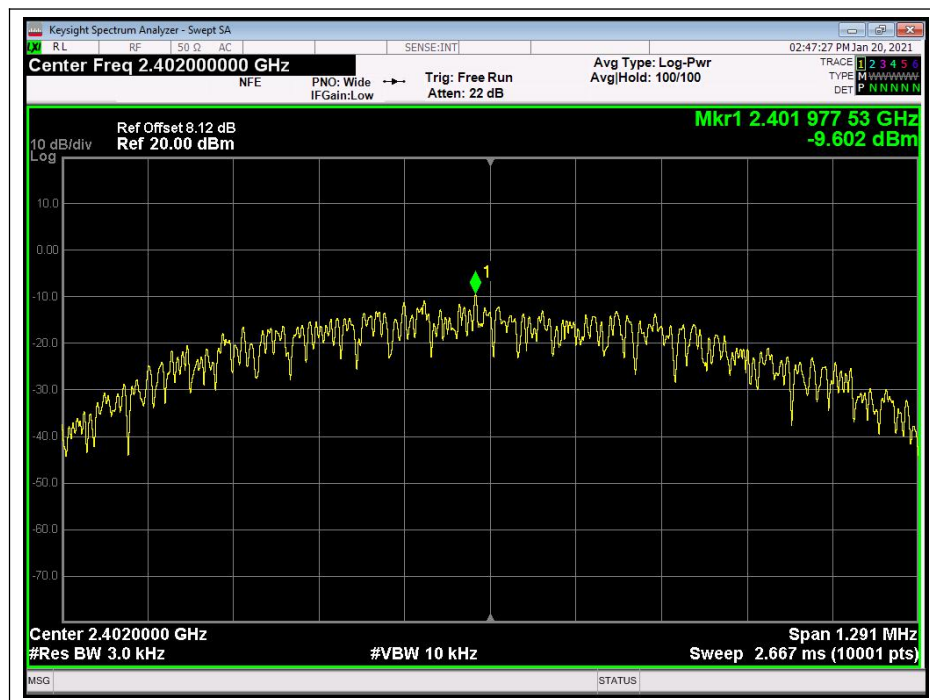
2.5.4. Test Result

The lowest, middle and highest channels are tested.

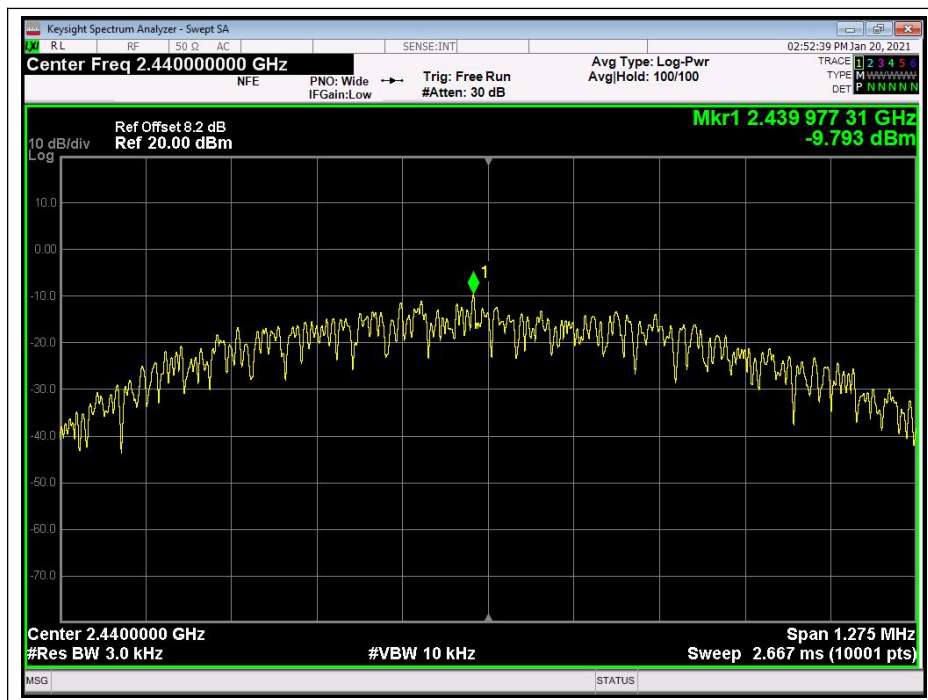
A. Test Verdict:

Mode	Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
1M PHY	0	2402	-9.602	8	PASS
	19	2440	-9.793	8	PASS
	39	2480	-9.273	8	PASS
2M PHY	0	2402	-13.084	8	PASS
	19	2440	-13.680	8	PASS
	39	2480	-12.761	8	PASS

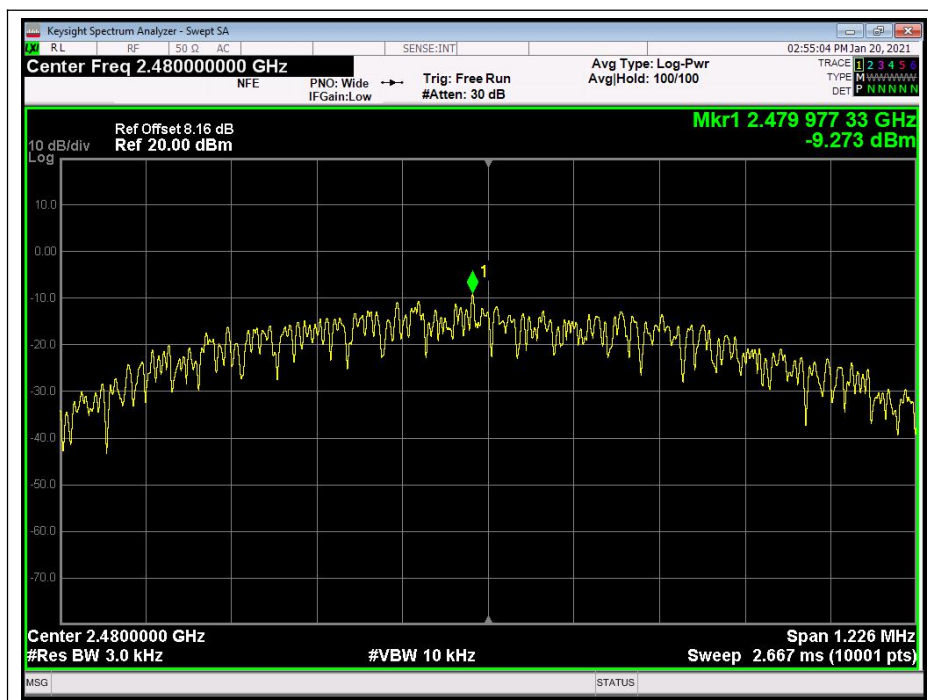
B. Test Plots



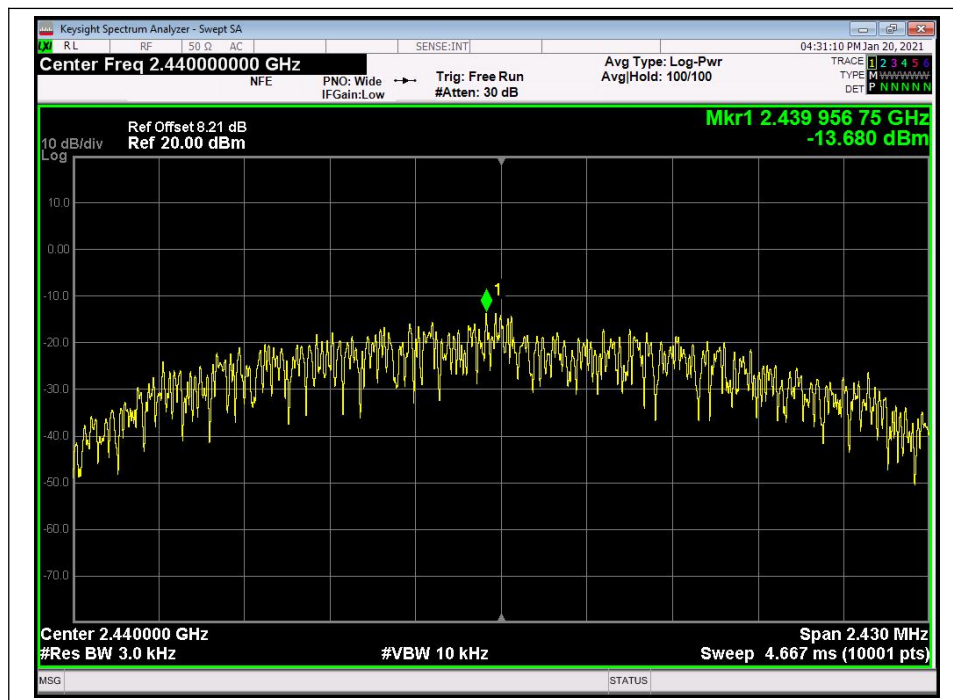
(LE 1M PHY _ Channel = 0, 2402MHz)



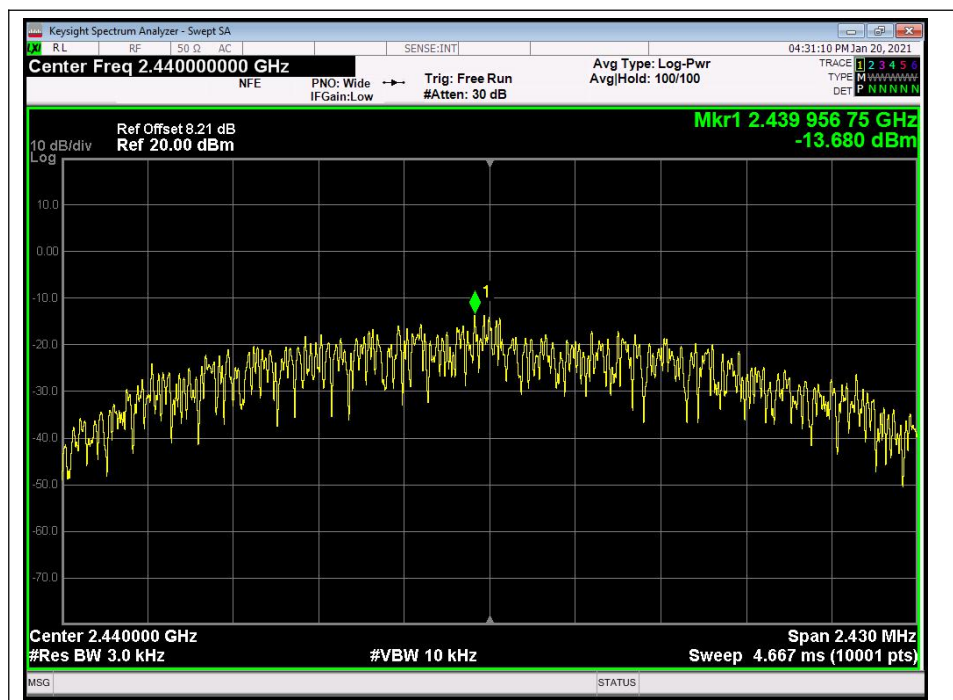
(LE 1M PHY _ Channel = 19, 2440MHz)



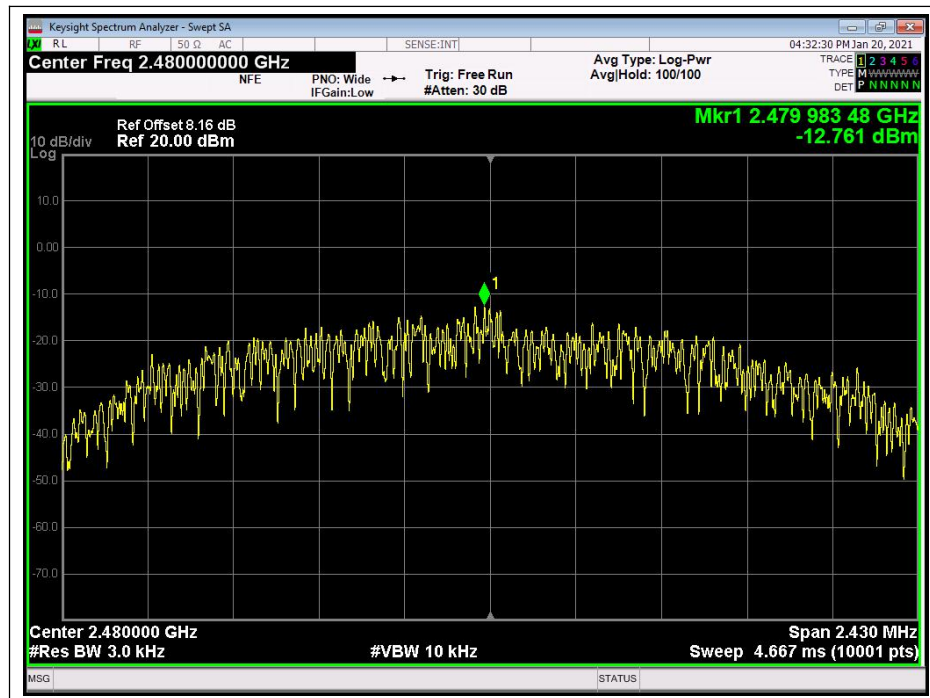
(LE 1M PHY _ Channel = 39, 2480MHz)



(LE 2M PHY_ Channel = 0, 2402MHz)



(LE 2M PHY_ Channel = 19, 2440MHz)



(LE 2M PHY_ Channel = 39, 2480MHz)

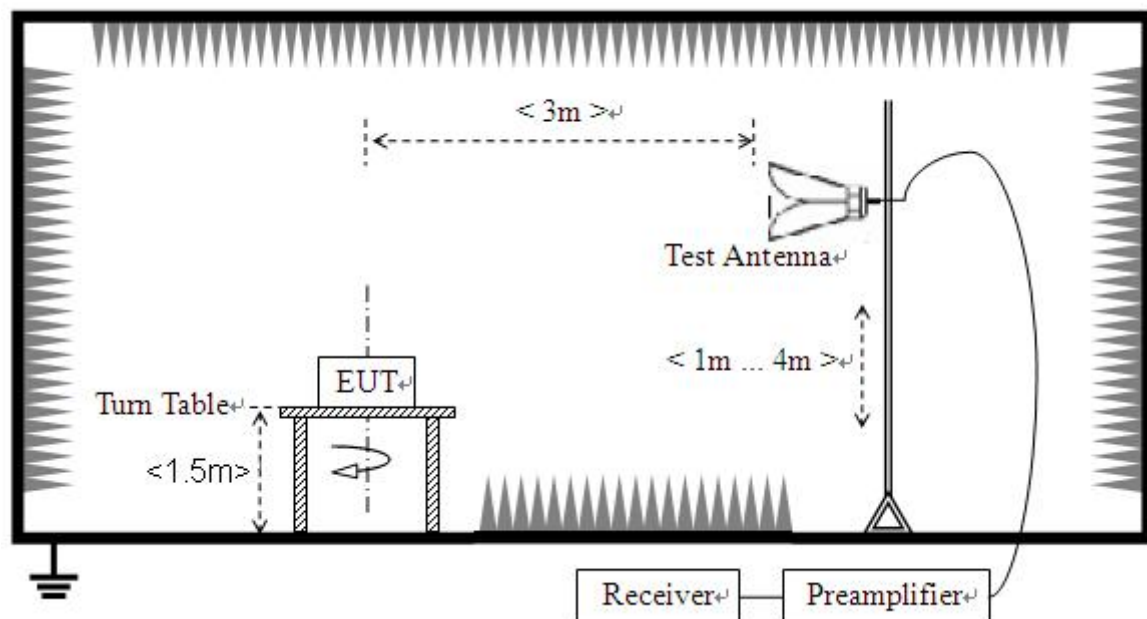
2.6. Restricted Frequency Bands

2.6.1. Requirement

According to FCC section 15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power. 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).

2.6.2. Test Description

A. Test Setup



- The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.



- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

- 1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasipeak detection (QP) at frequency below 1GHz.
- 2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
- 3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle $< 98\%$) or 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.
- 4. All modes of operation were investigated and the worst-case emissions are reported.

B. Equipments List:

Please refer ANNEX B(4).



2.6.3. Test Result

The lowest and highest channels are tested to verify Restricted Frequency Bands.

The measurement results are obtained as below:

$$E [\text{dB}\mu\text{V/m}] = U_R + A_T + A_{\text{Factor}} [\text{dB}]; A_T = L_{\text{Cable loss}} [\text{dB}] - G_{\text{preamp}} [\text{dB}]$$

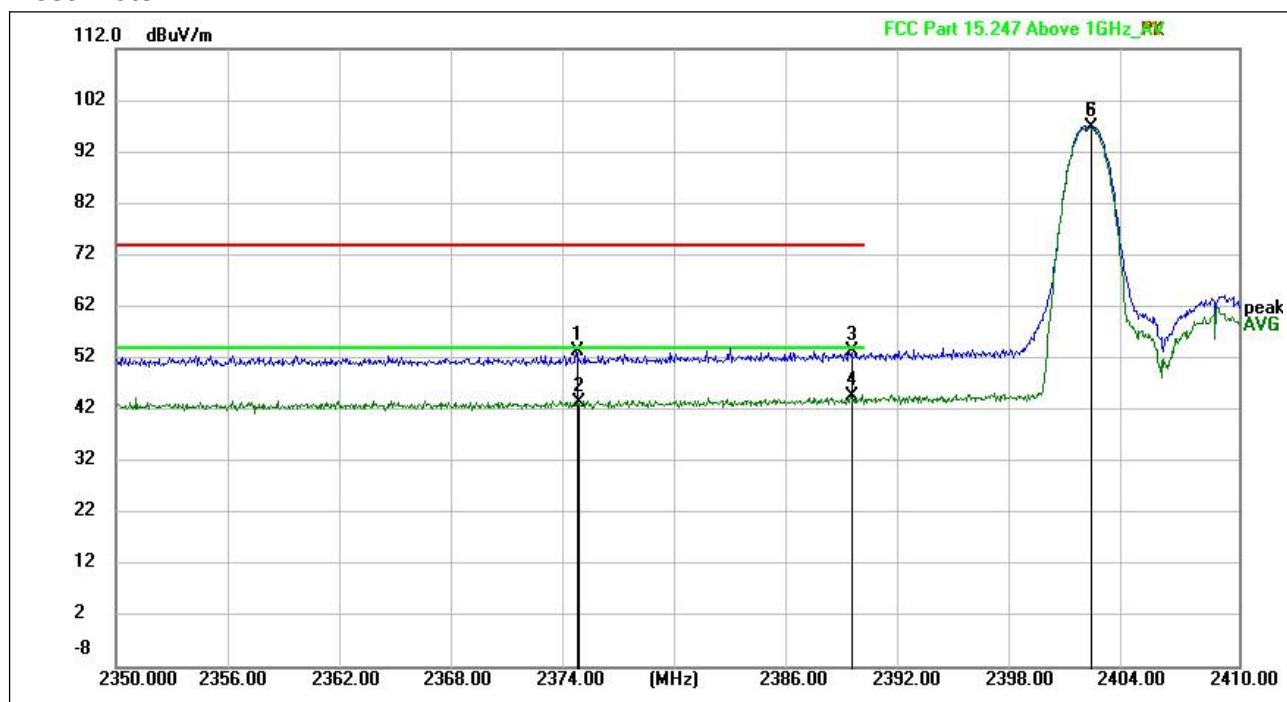
A_T : Total correction Factor except Antenna

U_R : Receiver Reading

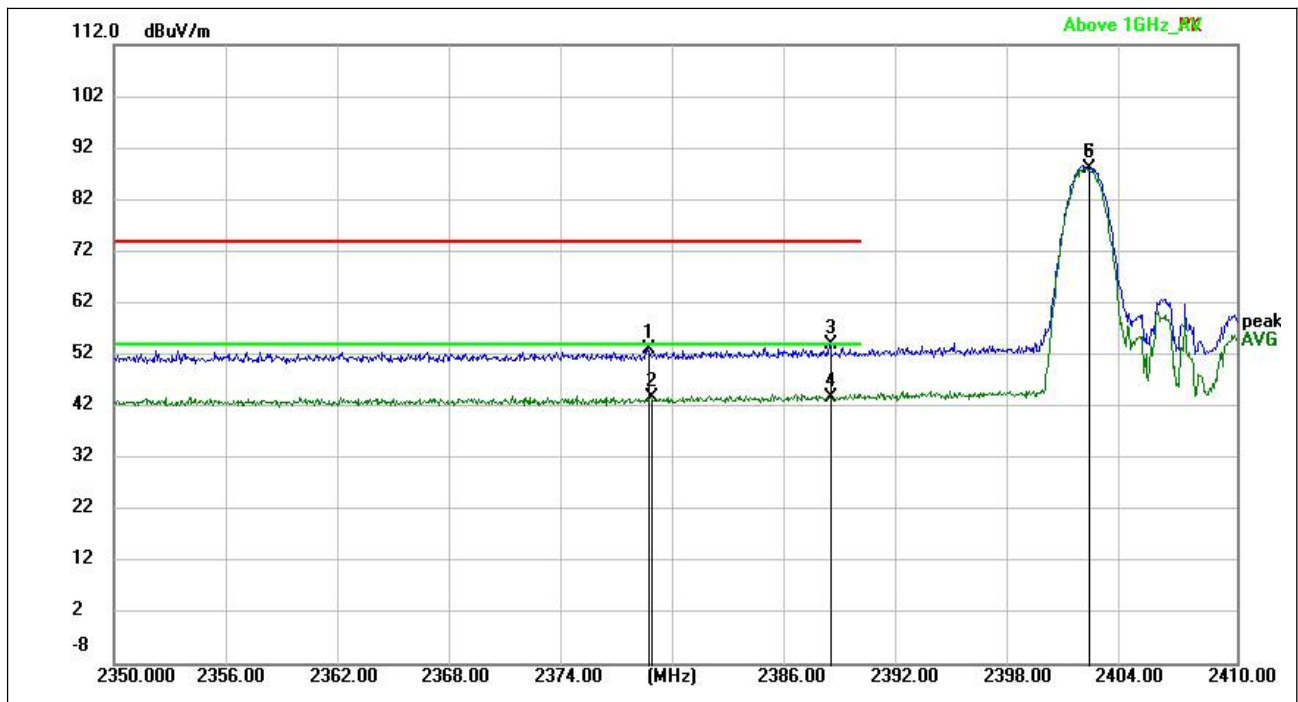
G_{preamp} : Preamplifier Gain

A_{Factor} : Antenna Factor at 3m

Test Plots:

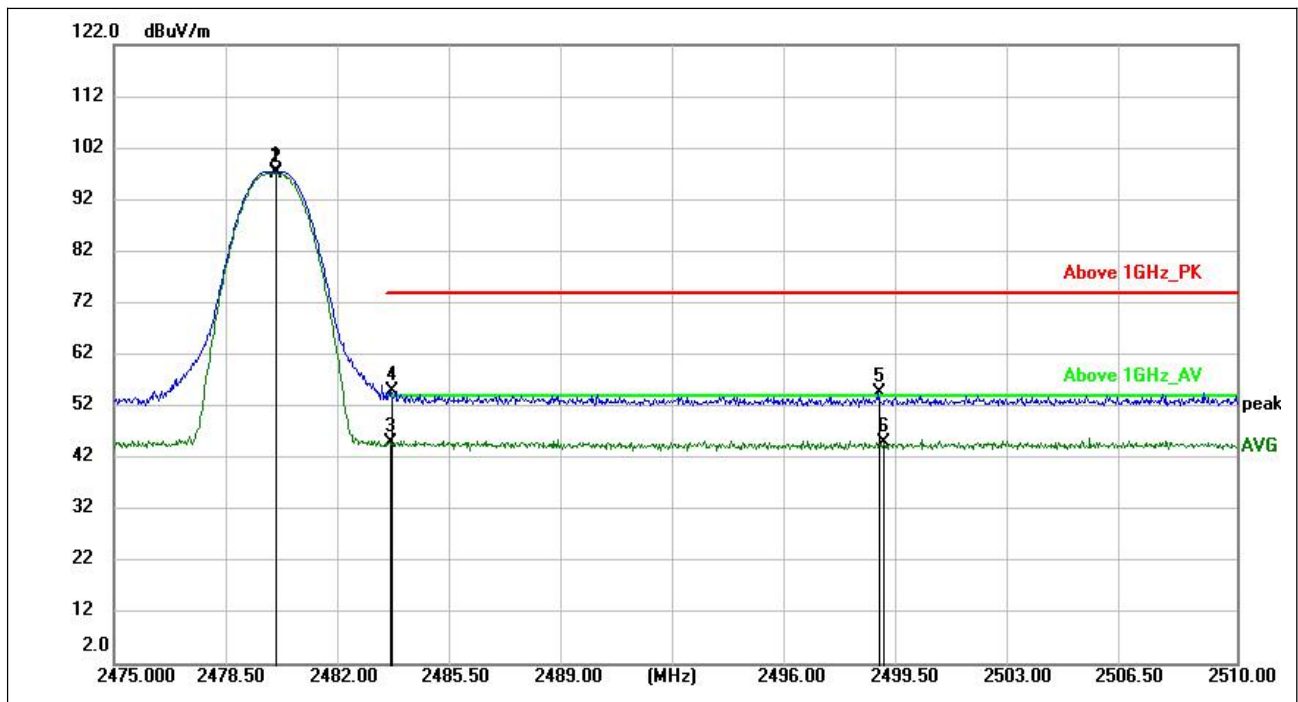


Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Corr. (dB/m)	Verdict
2374.648	53.24	---	74.00	-20.76	H	40.19	PASS
2374.723	---	43.31	54.00	-10.69	H	40.19	PASS
2389.246	53.44	---	74.00	-20.56	H	40.90	PASS
2389.276	---	44.52	54.00	-9.48	H	40.91	PASS
2402.065	96.91	---	---	---	H	41.60	PASS
2402.074	---	96.72	---	---	H	41.60	PASS



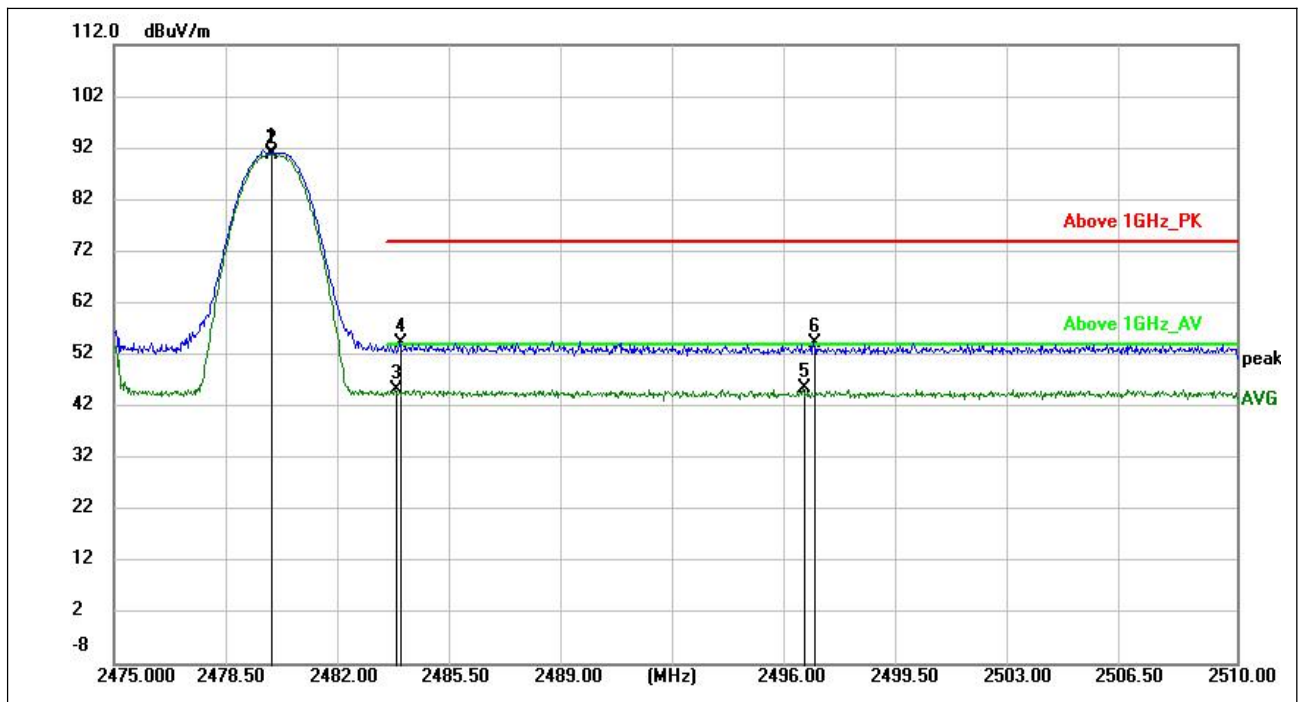
(LE 1M PHY_2402MHz, Antenna Vertical)

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB/m)	Verdict
2378.551	53.14	---	74.00	-20.86	V	40.21	PASS
2378.731	---	43.63	54.00	-10.37	V	40.21	PASS
2388.229	53.93	---	74.00	-20.07	V	40.83	PASS
2388.229	---	43.74	54.00	-10.26	V	40.83	PASS
2402.032	88.17	---	---	---	V	41.60	PASS
2402.032	---	87.94	---	---	V	41.60	PASS



(LE 1M PHY_2480MHz, Antenna Horizontal)

Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol	Corr. (dB/m)	Verdict
2480.014	97.30	---	---	---	H	41.77	PASS
2480.044	---	97.19	---	---	H	41.77	PASS
2483.645	---	45.04	54.00	-8.96	H	41.76	PASS
2483.668	54.93	---	74.00	-19.07	H	41.76	PASS
2498.867	54.73	---	74.00	-19.27	H	41.47	PASS
2499.003	---	45.07	54.00	-8.93	H	41.47	PASS



(LE 1M PHY_2480MHz, Antenna Vertical)

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB/m)	Verdict
2479.909	91.02	---	---	---	V	41.77	PASS
2479.909	---	90.72	---	---	V	41.77	PASS
2483.794	---	45.35	54.00	-8.65	V	41.76	PASS
2483.921	54.17	---	74.00	-19.83	V	41.75	PASS
2496.516	---	45.40	54.00	-8.60	V	41.46	PASS
2496.836	54.18	---	74.00	-19.82	V	41.46	PASS

2.7. Conducted Emission

2.7.1. Requirement

According to FCC section 15.207, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN).

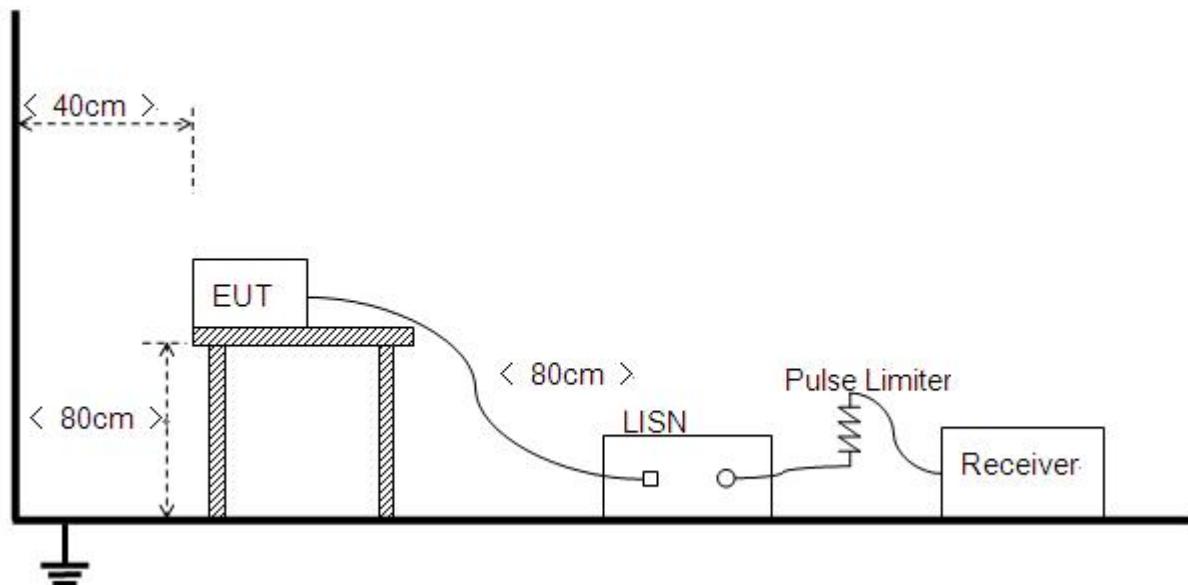
Frequency (MHz)	range	Conducted Limit (dB μ V)	
		Quai-peak	Average
0.15 - 0.50		66 to 56	56 to 46
0.50 - 5		56	46
5 - 30		60	50

NOTE:

- (a) The lower limit shall apply at the band edges.
- (b) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

2.7.2. Test Description

A. Test Setup:



The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.10: 2013.



B. Equipments List:

Please refer ANNEX B(4).

2.7.3. Test Result

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

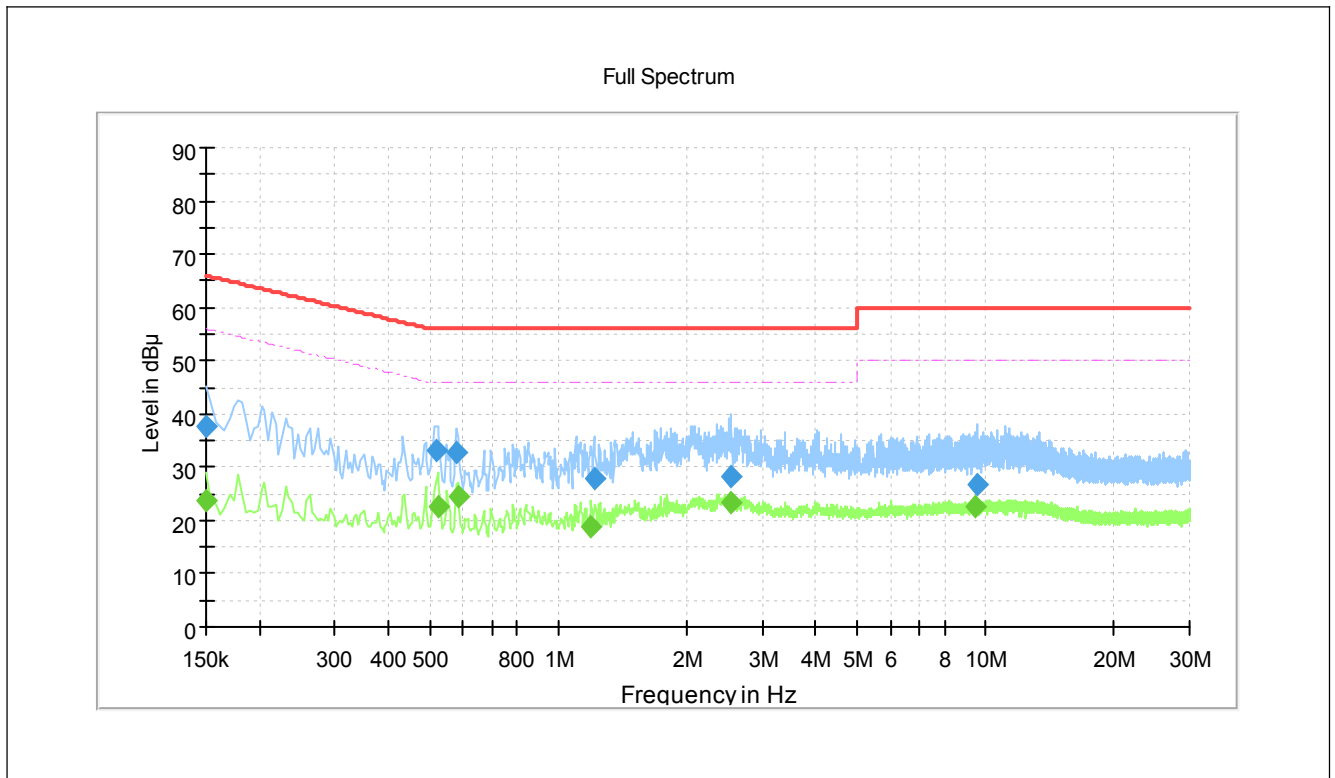
Note: Both of the test voltage AC 120V/60Hz and AC 230V/50Hz were considered and tested respectively, only the results of the worst case AC 120V/60Hz were recorded in this report.

A. Test setup:

The EUT configuration of the emission tests is Charging +BLE Link.

Note: The test voltage is AC 120V/60Hz.

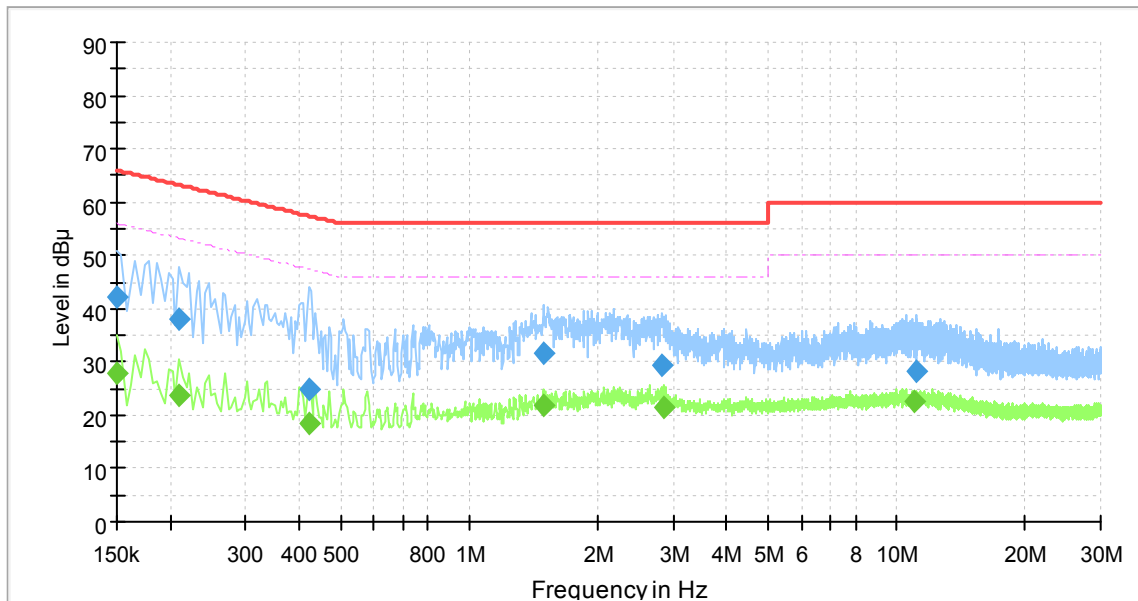
B. Test Plots:



(Plot A: L Phase)

Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)	Verdict
0.150000	---	23.63	56.00	32.37	L	10.2	PASS
0.150000	37.68	---	66.00	28.32	L	10.2	PASS
0.518000	33.29	---	56.00	22.71	L	10.2	PASS
0.522000	---	22.45	46.00	23.55	L	10.2	PASS
0.578000	32.73	---	56.00	23.27	L	10.2	PASS
0.582000	---	24.51	46.00	21.49	L	10.2	PASS
1.190000	---	18.88	46.00	27.12	L	10.3	PASS
1.214000	27.76	---	56.00	28.24	L	10.3	PASS
2.538000	28.29	---	56.00	27.71	L	10.3	PASS
2.542000	---	23.39	46.00	22.61	L	10.3	PASS
9.494000	---	22.41	50.00	27.59	L	10.6	PASS
9.558000	26.75	---	60.00	33.25	L	10.6	PASS

Full Spectrum



(Plot A: N Phase)

Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)	Verdict
0.150000	---	28.00	56.00	28.00	N	10.2	PASS
0.150000	42.02	---	66.00	23.98	N	10.2	PASS
0.210000	---	23.83	53.21	29.37	N	10.2	PASS
0.210000	38.07	---	63.21	25.14	N	10.2	PASS
0.422000	---	18.47	47.41	28.94	N	10.2	PASS
0.422000	24.99	---	57.41	32.41	N	10.2	PASS
1.486000	---	21.97	46.00	24.03	N	10.3	PASS
1.490000	31.73	---	56.00	24.27	N	10.3	PASS
2.814000	29.39	---	56.00	26.61	N	10.3	PASS
2.850000	---	21.37	46.00	24.63	N	10.3	PASS
10.946000	---	22.77	50.00	27.23	N	10.6	PASS
11.066000	28.36	---	60.00	31.64	N	10.6	PASS

2.8. Radiated Emission

2.8.1. Requirement

According to FCC section 15.247(d), radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$)	Measurement Distance (m)
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:

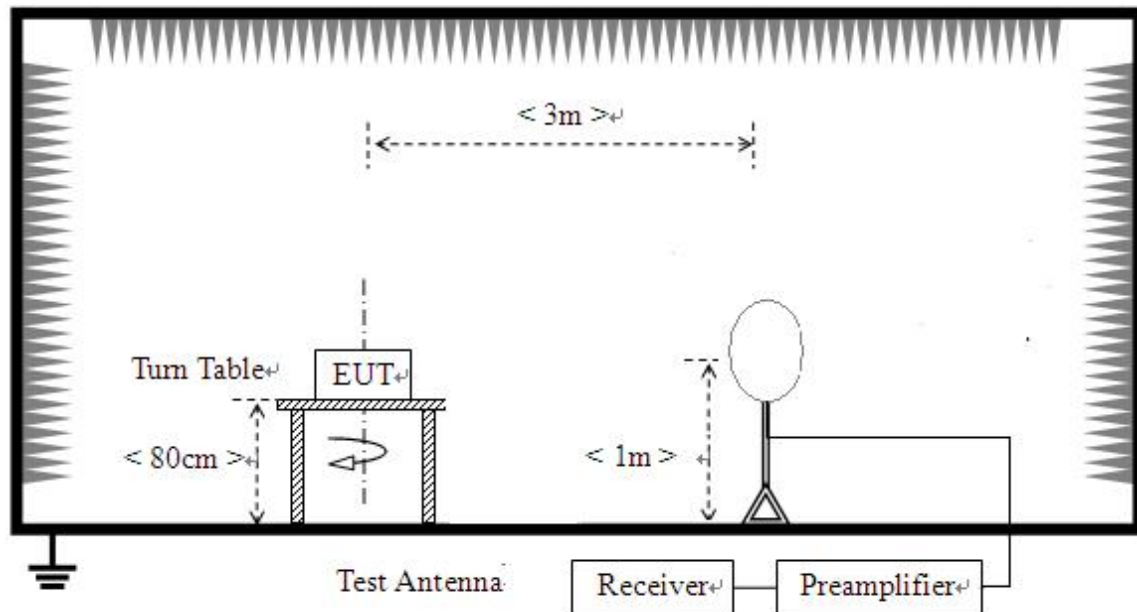
1. For Above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
2. For above 1000MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK)

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table)

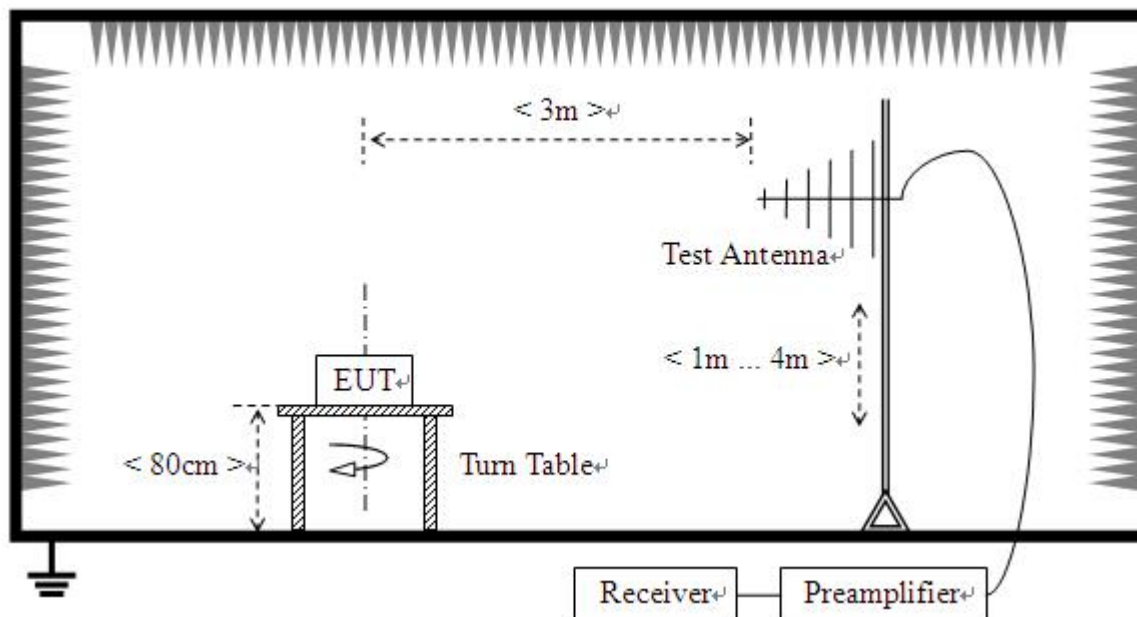
2.8.2. Test Description

A. Test Setup:

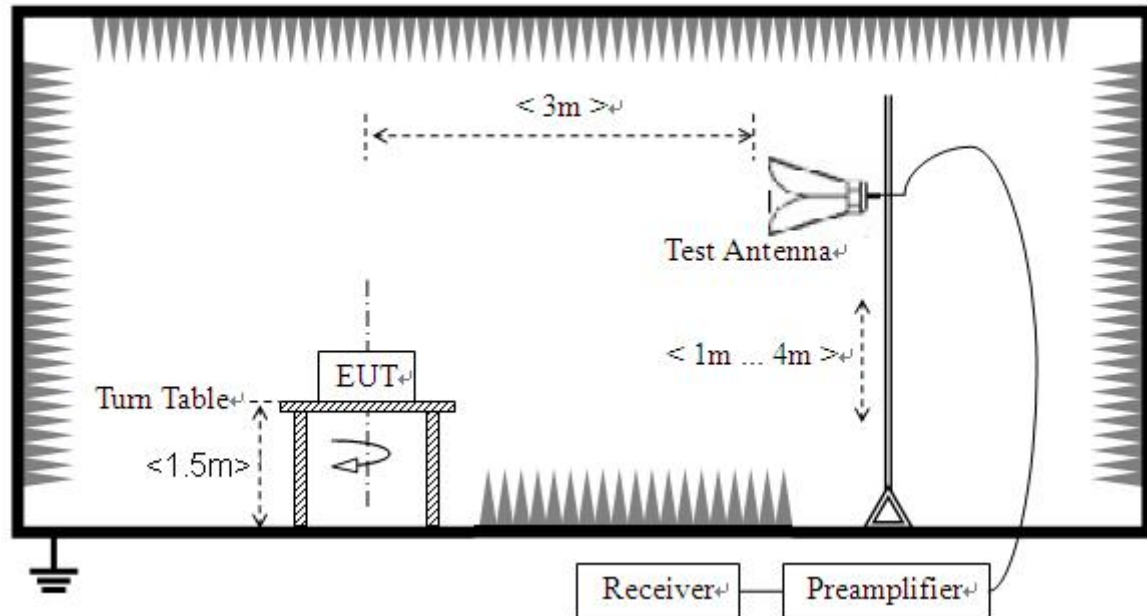
- 1) For radiated emissions from 9kHz to 30MHz



- 2) For radiated emissions from 30MHz to 1GHz



3) For radiated emissions above 1GHz



The RF absorbing material used on the reference ground plane and on the turntable have a maximum height (thickness) of 30 cm (12 in) and have a minimum-rated attenuation of 20 dB at all frequencies from 1 GHz to 18 GHz. Test site have a minimum area of the ground plane covered with RF absorbing material as specified in Figure 6 of ANSI C63.4: 2014.

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4dB according to the standards: ANSI C63.10:2013. For radiated emissions below or equal to 1GHz, The EUT was set-up on insulator 80cm above the Ground Plane, For radiated emissions above 1GHz, The EUT was set-up on insulator 150cm above the Ground Plane. The set-up and test methods were according to ANSI C63.10:2013.

For Radiated emission below 30MHz:

- The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with



Maximum Hold Mode.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz:

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasipeak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle $< 98\%$) or 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

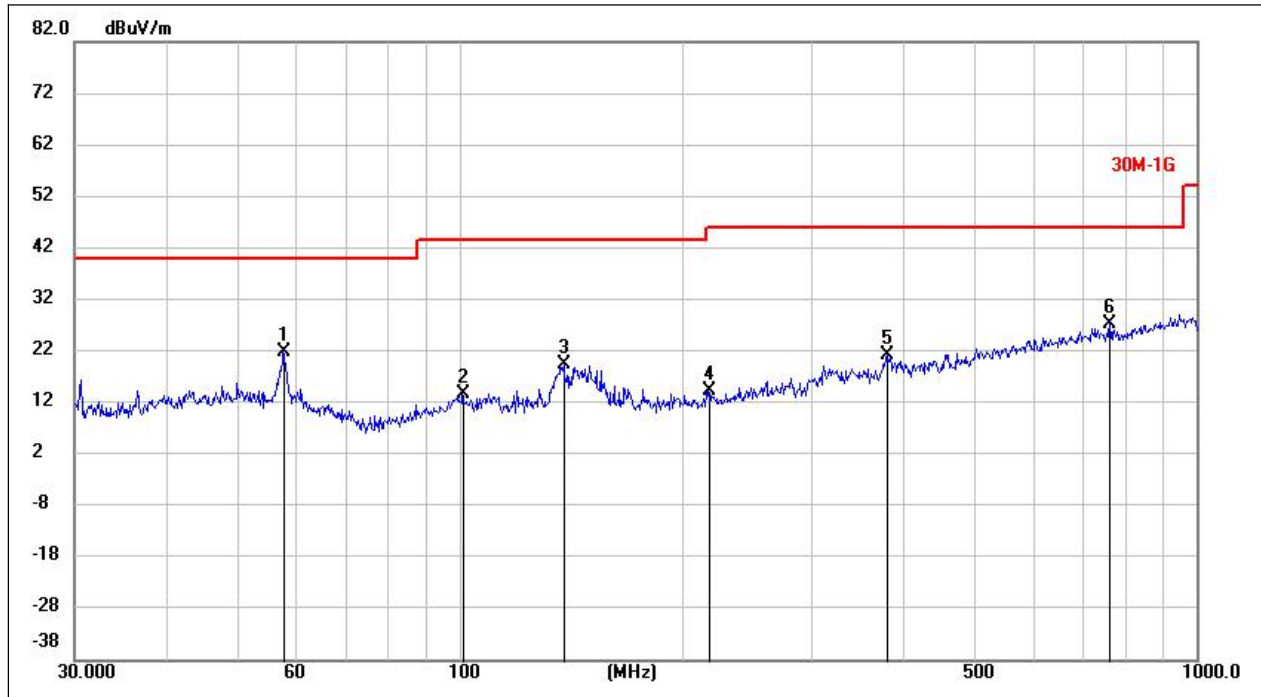
B. Equipments List:

Please refer ANNEX B(4).

2.8.3. Test Result

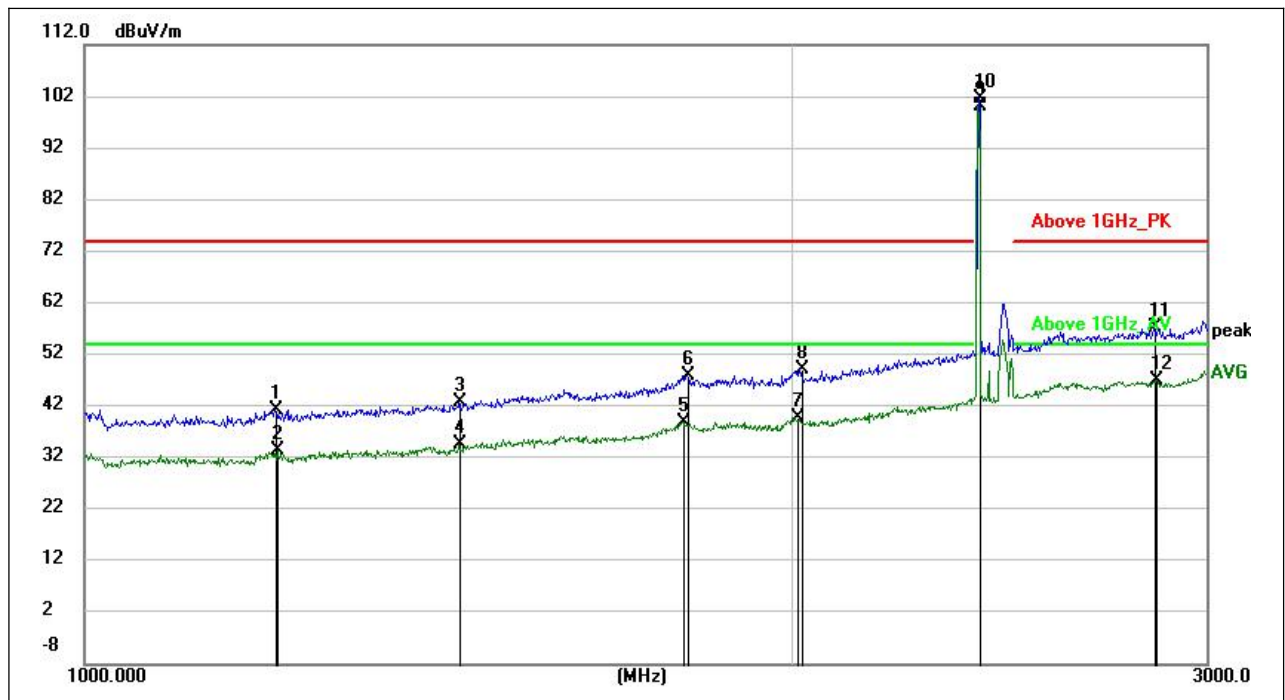
Note1: For the frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

Note2: For the frequency, which started from 18GHz to 40GHz, was pre-scanned and the result which was 10dB lower than the limit was not recorded.



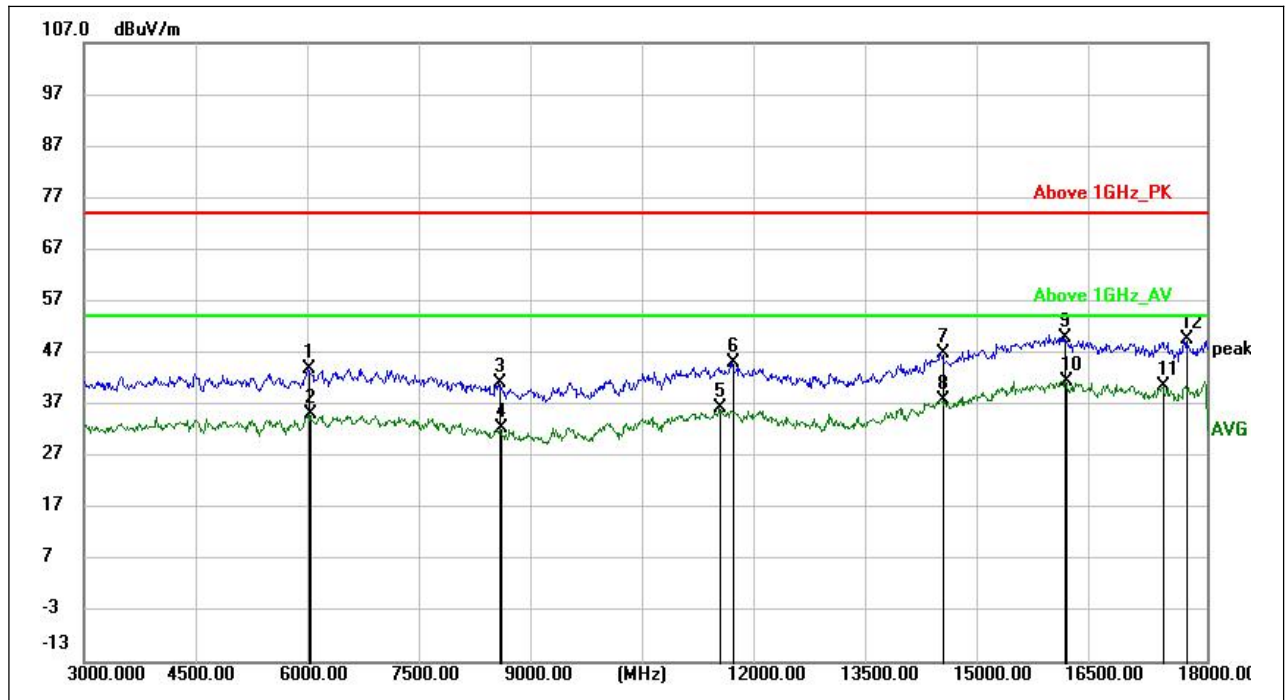
(LE 1M PHY_2402MHz, Antenna Horizontal, 30MHz to 1GHz)

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB/m)	Verdict
57.7760	7.64	40.00	-18.02	H	14.34	PASS
101.0934	-1.34	40.00	-29.88	H	14.96	PASS
138.7761	7.65	43.50	-24.17	H	11.68	PASS
217.6969	0.22	43.50	-31.72	H	14.06	PASS
380.8478	2.01	46.00	-24.89	H	19.10	PASS
763.3757	1.06	46.00	-18.69	H	26.25	PASS



(LE 1M PHY _2402MHz, Antenna Horizontal, 1GHz to 3GHz)

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB/m)	Verdict
1206.336	---	33.31	54.00	-20.69	H	30.38	PASS
1208.924	41.30	---	74.00	-32.70	H	30.27	PASS
1444.099	42.74	---	74.00	-31.26	H	31.69	PASS
1444.099	---	34.69	54.00	-19.31	H	31.69	PASS
1799.453	38.80	---	74.00	-15.20	H	36.74	PASS
1805.691	---	48.05	54.00	-25.95	H	36.40	PASS
2009.405	---	39.92	54.00	-14.08	H	37.09	PASS
2018.809	49.04	---	74.00	-24.96	H	36.57	PASS
2402.015	---	100.09		---	H	41.60	PASS
2402.543	101.50	---		---	H	41.58	PASS
2852.315	57.26	---	74.00	-16.74	H	43.75	PASS
2856.392	---	46.95	54.00	-7.05	H	43.90	PASS



(LE 1M PHY_2402MHz, Antenna Horizontal, 3GHz to 18GHz)

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB/m)	Verdict
6002.250	43.73	---	74.00	-30.27	H	-2.86	PASS
6029.250	---	35.17	54.00	-18.83	H	-2.35	PASS
8552.250	41.21	---	74.00	-32.79	H	1.16	PASS
8567.250	---	32.45	54.00	-21.55	H	1.15	PASS
11501.250	---	36.40	54.00	-17.60	H	3.50	PASS
11674.500	45.09	---	74.00	-28.91	H	3.76	PASS
14469.000	47.00	---	74.00	-27.00	H	8.11	PASS
14469.000	---	37.87	54.00	-16.13	H	8.11	PASS
16097.250	49.94	---	74.00	-24.06	H	11.15	PASS
16118.250	---	41.46	54.00	-12.54	H	11.06	PASS
17426.250	---	40.56	54.00	-13.44	H	13.31	PASS
17718.000	49.68	---	74.00	-24.32	H	14.66	PASS