Test Report

Verified code: 968603

Report No.: E202208182570-2

Customer:	Blueiot (Beijing) Technology Co., Ltd.
Address:	10/F,Tower A,TusPark Innovation Plaza, Haidian District, Beijing, China
Sample Name:	Blueiot RTLS Tag
Sample Model:	BT2000-z
Receive Sample Date:	Aug.30,2022
Test Date:	Aug.31,2022 ~ Sep.23,2022
Reference Document:	CFR 47, FCC Part 15 Subpart C RADIO FREQUENCY DEVICES:Subpart C—Intentional Radiators
Test Result:	Pass

Prepared by: Reviewed by: Wu Haoting Approved by:

GUANGZHOU GRG METROLOGY & TEST CO., LTD

Issued Date: 2022-11-16

GUANGZHOU GRG METROLOGY & TEST CO., LTD.
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Statement

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5. Without the agreement of the laboratory, the client is not authorized to use the test results for unapproved propaganda.

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REPORT ISSUED HISTORY

Report Version	Report No.	Description	Compile Date
1.0	E202208182570-2	Original Issue	2022-09-26

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1. TEST RESULT SUMMARY

Technical Requirements		
FCC 47 CFR Part 15 Subpart C 15.247 ANSI C63.10-2013 KDB 558074 D01 15.247 measurement guidance v05r02		
Limit / Severity	**Item**	**Result**
§15.203	Antenna Requirement	Pass
§15.207(a)	Conducted Emission	Not Applicable
§15.247(d)&15.205& 15.209	Radiated Spurious Emission	Pass
§15.247(b)(3)	Maximum Peak Output Power	Pass
§15.247(e)	Power Spectral Density	Pass
§15.247(a)(2)	6dB bandwidth	Pass
§15.247(d)	Conducted band edges and Spurious Emission	Pass
§15.247(d)&15.205& 15.209	Restricted bands of operation	Pass

Note: 1) Not Applicable, the EUT is powered by batteries DC 3.6V.
2) The EUT is internal antennas. The max gain of antenna is 0.5dBi, which accordance 15.203. is considered sufficient to comply with the provisions of this section.

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2. GENERAL DESCRIPTION OF EUT

2.1 APPLICANT

Name:	Blueiot (Beijing) Technology Co., Ltd.
Address:	10/F,Tower A,TusPark Innovation Plaza, Haidian District, Beijing, China

2.2 MANUFACTURER

Name:	Blueiot (Beijing) Technology Co., Ltd.
Address:	10/F,Tower A,TusPark Innovation Plaza, Haidian District, Beijing, China

2.3 FACTORY

Name:	Blueiot (Beijing) Technology Co., Ltd.
Address:	10/F,Tower A,TusPark Innovation Plaza, Haidian District, Beijing, China

2.4 BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment:	Blueiot RTLS Tag
Model No.:	BT2000-z
Adding Model:	/
Trade Name:	Blueiot
FCC ID:	2AZOM-BT2000Z
Power supply:	DC 3.6V power supplied by battery
Battery Specification:	Model:ER14250 Nominal Voltage:3.6Vdc
Frequency Band:	2402-2480MHz
Transmit Power:	BLE_1MHz: 9.34dBm
Modulation type:	GFSK for 1Mbps
Channel space:	2MHz
Antenna Specification:	Internal antenna with 0.5dBi gain (Max.)
Temperature Range:	-20℃~70 ℃
Hardware Version:	V0.1.1
Software Version:	V1020
Sample No:	E202208182570-0001, E202208182570-0002
Note:	/

2.5 CHANNELLIST

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

* is the test frequency

2.6 TEST OPERATION MODE

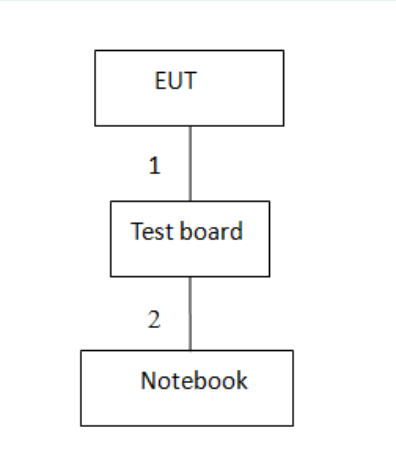
Mode No.	Description of the modes
1	Bluetooth (BLE) fixed frequency transmitting

2.7 LOCAL SUPPORTIVE

Name of equipment	Manufacturer	Model	Serial number	Note
Notebook	LENOVO	TianYi 310-14ISK	MP18DLC6	/
Test board	/	/	/	/

No.	Cable Type	Qty.	Shielded Type	Ferrite Core(Qty.)	Length
1	DC cable	1	No	0	0.15m
2	USB extension cable	1	No	0	1m

2.8 CONFIGURATION OF SYSTEM UNDER TEST



Test software:

Software version	Test level
nRF connect	8

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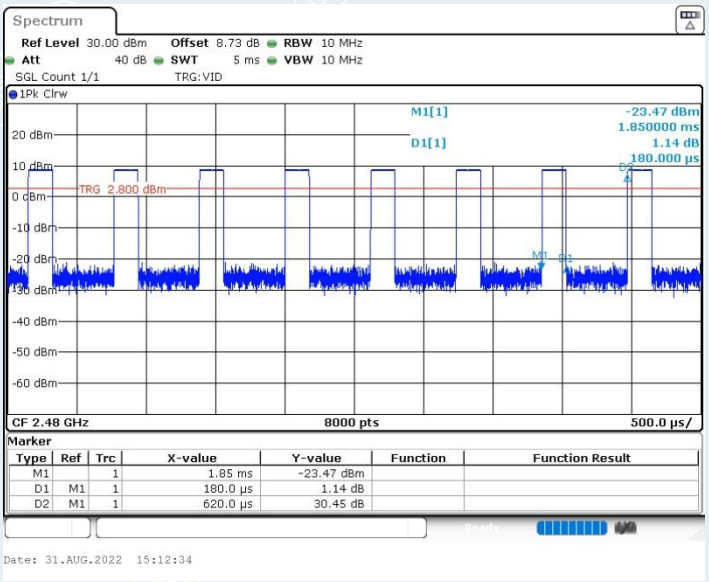
2.9 DUTY CYCLE

Environment: 25.8℃/60%RH/101.0kPa Voltage: DC 3.6V
Tested By: Qin Tingting Date: 2022-08-31

Test Mode	Antenna	Frequency [MHz]	ON Time [ms]	Period [ms]	DC [%]	T [s]
BLE_1M	Ant1	2480	0.18	0.62	29.03	0.00018

BLE_1M _2480MHz



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3. LABORATORY AND ACCREDITATIONS

3.1 LABORATORY

The tests & measurements refer to this report were performed by Shenzhen EMC Laboratory of Guangzhou GRG Metrology & Test Co., Ltd.

Add.:	No.1301 Guanguang Road Xinlan Community, Guanlan Street, Longhua District Shenzhen, 518110, People's Republic of China
P.C.:	518110
Tel :	0755-61180008
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3.2 ACCREDITATIONS

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

USA	A2LA(Certificate #2861.01)

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

Canada	ISED (Company Number: 24897, CAB identifier:CN0069)
USA	FCC (Registration Number: 759402, Designation Number:CN1198)

Copies of granted accreditation certificates are available for downloading from our web site, http://www.grgtest.com

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4. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement		Frequency	Uncertainty
Radiated Emission	Horizontal	9kHz～30MHz	5.1dB
		30MHz～200MHz	4.5dB
		200MHz～1000MHz	4.4dB
		1GHz～18GHz	5.6dB
		18GHz～26.5GHz	3.7dB
	Vertical	9kHz～30MHz	5.1dB
		30MHz～200MHz	4.4dB
		200MHz～1000MHz	4.5dB
		1GHz～18GHz	5.6dB
		18GHz～26.5GHz	3.7dB

Measurement	Uncertainty
RF frequency	6.0×10^{-6}
RF power conducted	0.8dB
Unwanted emission, conducted	0.7dB
Humidity	6%
Temperature	2℃
Note: 1) This uncertainty represents an expanded uncertainty factor of *k*=2.	

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5. LIST OF USED TEST EQUIPMENT AT GRGT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Radiated Spurious Emission&Restricted bands of operation				
Test S/W	EZ	CCS-03A1		
Test Receiver	R&S	ESR7	102444	2023-09-02
Preamplifier	EMEC	EM330	I00426	2023-03-05
Bi-log Antenna	Schwarzbeck	VULB9160	VULB9160-3401	2022-10-24
LoopAntenna	TESEQ	HLA6121	52599	2023-04-02
Spectrum Analyzer	KEYSIGHT	N9010A	MY52221469	2023-06-29
Horn Antenna	Schwarzbeck	BBHA9120D	02143	2022-10-16
Board-Band Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170-497	2022-10-22
Amplifier	Tonscend	TAP01018048	AP20E8060075	2023-05-05
Amplifier	Tonscend	TAP184050	AP20E806071	2023-05-05
Test S/W	Tonscend	JS36-RE/2.5.1.5		
6dB Bandwidth&Conducted band edges and Spurious Emission&Power Spectral Density				
Spectrum Analyzer	R&S	FSV30	104381	2022-12-10
BT/WIFI System	Tonscend	JS1120-3		
Maximum Peak Output Power				
Pulse power sensor	Anritsu	MA2411B	1126150	2023-03-01
Power meter	Anritsu	ML2495A	1204003	2023-02-28

Note: The calibration interval of the above test instruments is 12 months.

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6. RADIATED SPURIOUS EMISSIONS

6.1 LIMITS

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, 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 30dB instead of 20dB. Attenuation below the general limits specified in §15.209(a) is not required.

Frequency (MHz)	Quasi-peak(μV/m)	Measurement distance(m)	Quasi-peak(dBμV/m)@distance 3m
0.009-0.490	2400/F(kHz)	300	128.5~93.8
0.490-1.705	24000/F(kHz)	30	73.8~63
1.705-30.0	30	30	69.5
30 ~ 88	100	3	40
88~216	150	3	43.5
216 ~ 960	200	3	46
Above 960	500	3	54

NOTE:

(1) The emission limits for the ranges 9-90kHz and 110-490kHz are based on measurements employing a linear average detector.

(2) The lower limit shall apply at the transition frequencies.

(3) Above 18GHz test distance is 1m, so the Peak Limit=74+20*log(3/1)=83.54 (dBμV/m). The Avg Limit=54+20*log(3/1)=63.54 (dBμV/m).

6.2 TEST PROCEDURES

1) Sequence of testing 9kHz to 30MHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 0.8m height is used.

--- If the EUT is a floor standing device, it is placed on the ground.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions.

--- The measurement distance is 3meter.

--- The EUT was set into operation.

Pre measurement:

--- The turntable rotates from 0 °to 360 °.

--- The antenna height is 1.0 meter.

--- The antenna is polarized X,Y and Z.

--- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

--- Identified emissions during the pre measurement the software maximizes by rotating the turntable position (0 °to 360 °) and by rotating the elevation axes (0 °to 360 °).

--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QP detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the pre measurement and the limit will be stored.

2) Sequence of testing 30MHz to 1GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a table with 0.8m height is used, which is placed on the ground plane.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Pre measurement:

--- The turntable rotates from 0 °to 360 °.

--- The antenna is polarized vertical and horizontal.

--- The antenna height changes from 1 to 4 meter.

--- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of pre measurement the software maximize the peaks by changing turntable rotates from 0 °to 360 °and antenna movement between 1 and 4 meter.

--- The final measurement will be done with QP detector with an EMI receiver.

--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the pre measurement with marked maximum final measurements and the limit will be stored.

3) Sequence of testing 1GHz to 18GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Pre measurement:

--- The turntable rotates from 0 °to 360 °.

--- The antenna is polarized vertical and horizontal.

--- The antenna height scan range is 1 meter to 4 meter.

--- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of pre measurement the software maximize the peaks by changing turntable rotates from 0 °to 360 °and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.

--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.
--- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the pre measurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18GHz
Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The measurement distance is 1 meter.

--- The EUT was set into operation.

Pre measurement:

--- The antenna is moved spherical over the EUT in different polarisations of the antenna.

Final measurement:

--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the pre measurements with Peak and Average detector.
--- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the pre measurement and the limit will be stored.

NOTE:
(a).The frequency from 9kHz to 150kHz, Set RBW=300Hz(for Peak & AVG), VBW=300Hz(for Peak & AVG). The frequency from 150kHz to 30MHz, Set RBW=9kHz, VBW=9kHz, (for QP Detector).
(b).The frequency from 30MHz to 1GHz, Set RBW=120kHz, VBW=300kHz, (for QP Detector).
(c).The frequency above 1GHz, for Peak detector: Set RBW=1MHz,VBW=3MHz.
(d). The frequency above 1GHz, for Avg detector: Set RBW=1MHz,if the EUT is configured to transmit with duty cycle ≥98%，set VBW≤RBW/100 (i.e.,10kHz) but not less than 10 Hz. If the EUT duty cycle is ＜98%，set VBW≥1/T, Where T is defined in section 2.9.

6.3 TEST SETUP

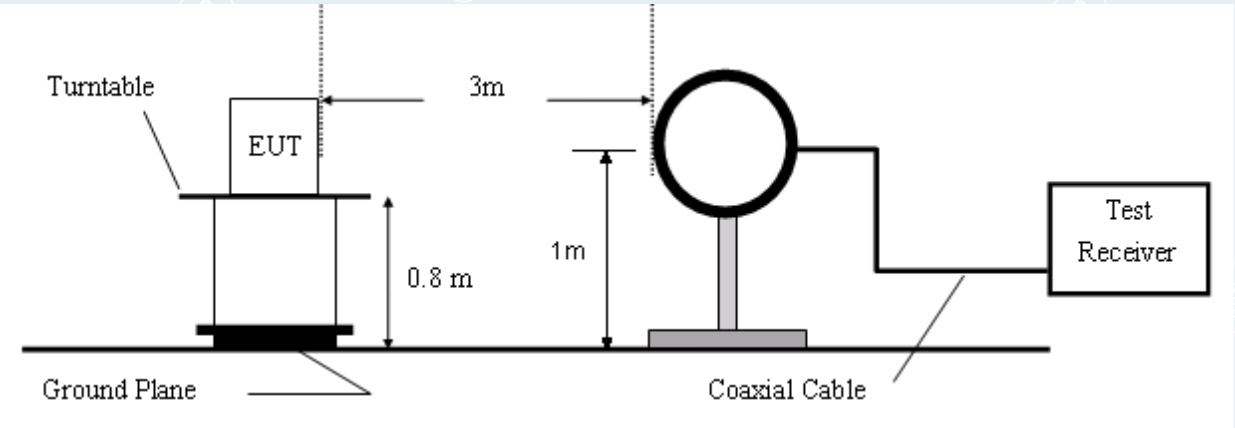


Figure 1. 9kHz to 30MHz radiated emissions test configuration

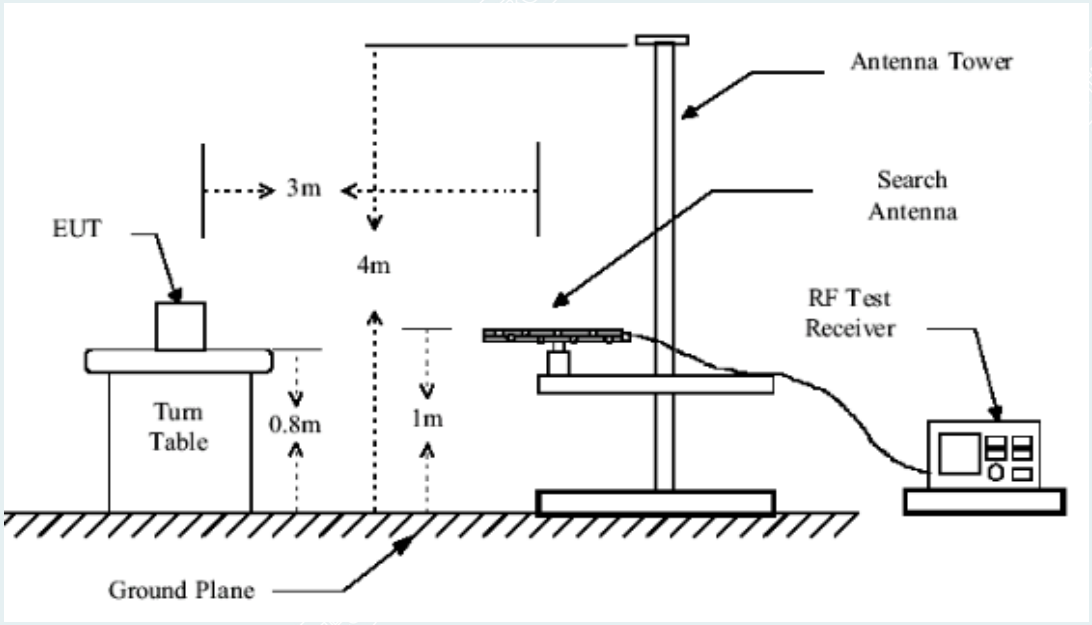


Figure 2. 30MHz to 1GHz radiated emissions test configuration

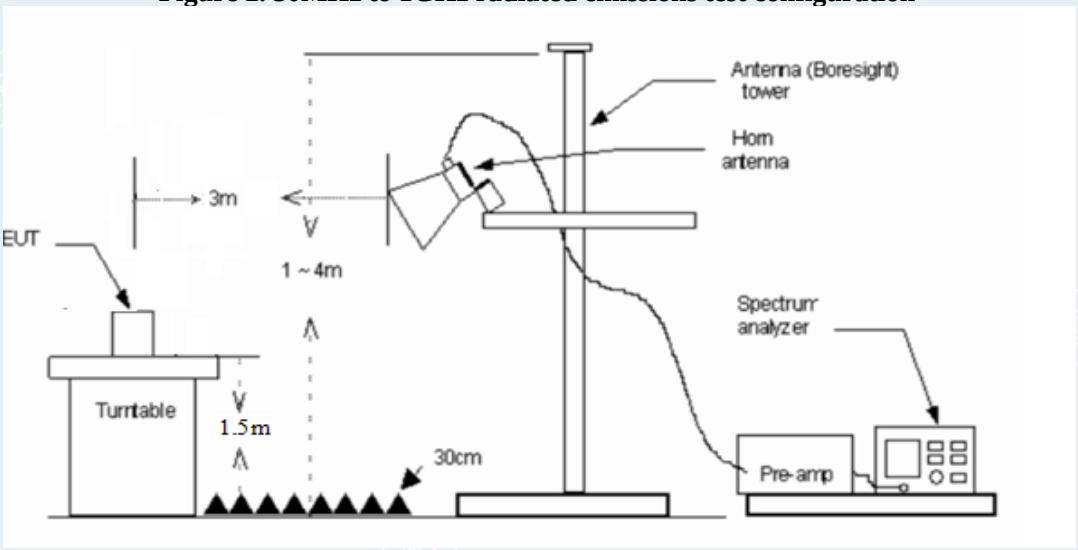


Figure 3. 1GHz to 18GHz radiated emissions test configuration

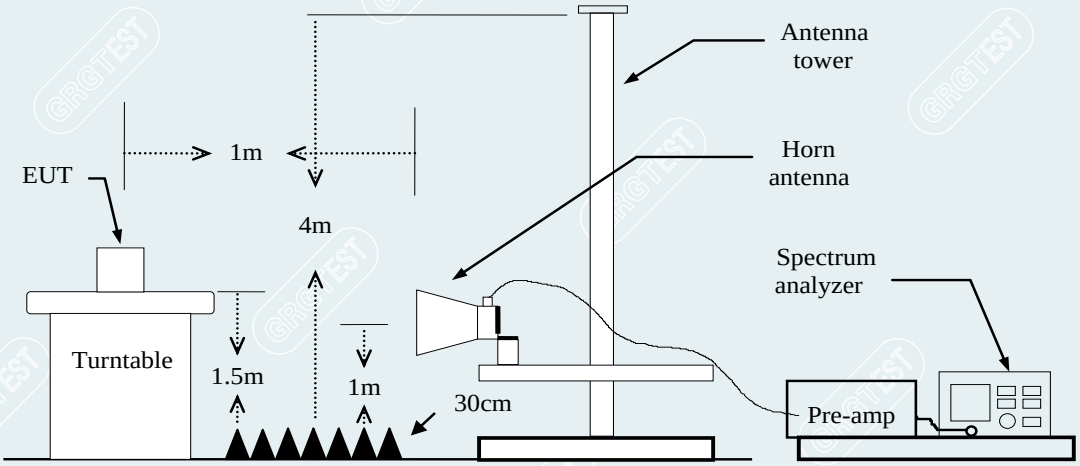


Figure 4. 18GHz to 26.5GHz radiated emissions test configuration

6.4 DATA SAMPLE

30MHz to 1GHz

No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
xxx	xxx	37.06	-15.48	21.58	40.00	-18.42	QP	Vertical

1GHz to 18GHz

No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
xxx	xxx	65.45	-11.12	54.33	74.00	-19.67	Peak	Vertical
xxx	xxx	63.00	-11.12	51.88	54.00	-2.12	AVG	Vertical

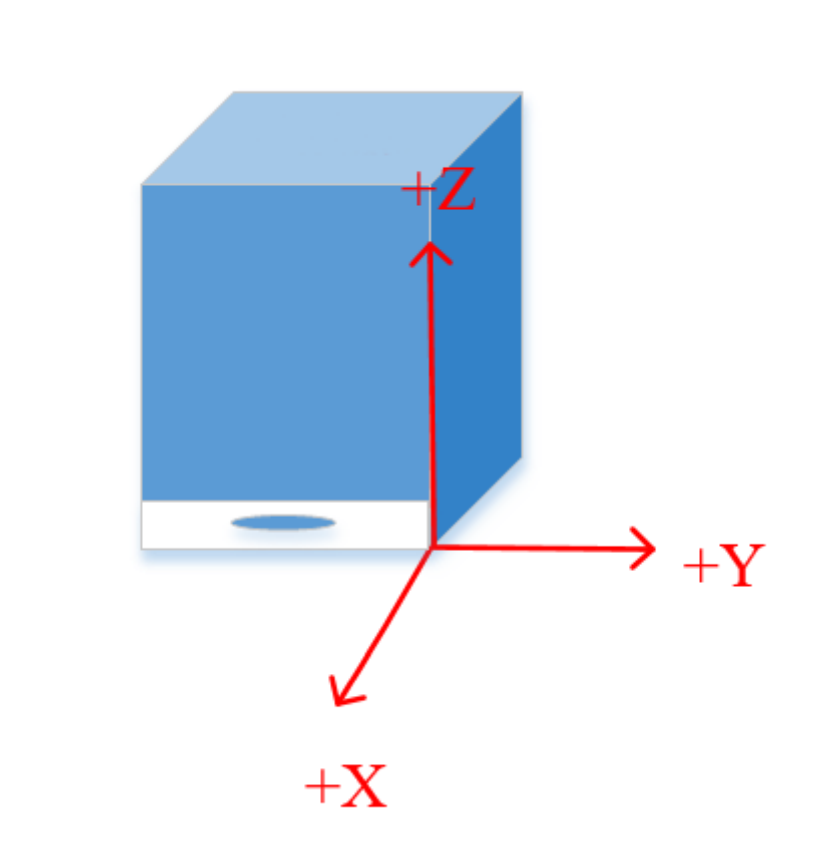
Above 18GHz

No.	Frequency (MHz)	Reading (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
xxx	xxx	68.86	57.66	-11.20	83.54	25.88	peak	Vertical
xxx	xxx	68.89	-11.20	57.69	63.54	5.85	AVG	Vertical

Frequency (MHz)	= Emission frequency in MHz
Ant.Pol. (H/V)	= Antenna polarization
Reading (dBuV)	= Uncorrected Analyzer / Receiver reading
Correction Factor (dB/m)	= Antenna factor + Cable loss – Amplifier gain
Result (dBuV/m)	= Reading (dBuV) + Correction Factor (dB/m)
Limit (dBuV/m)	= Limit stated in standard
Margin (dB)	= Remark Result (dBuV/m) – Limit (dBuV/m)
Peak	= Peak Reading
QP	= Quasi-peak Reading
AVG	= Average Reading

6.5 TEST RESULTS

The test are 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 the X position only.



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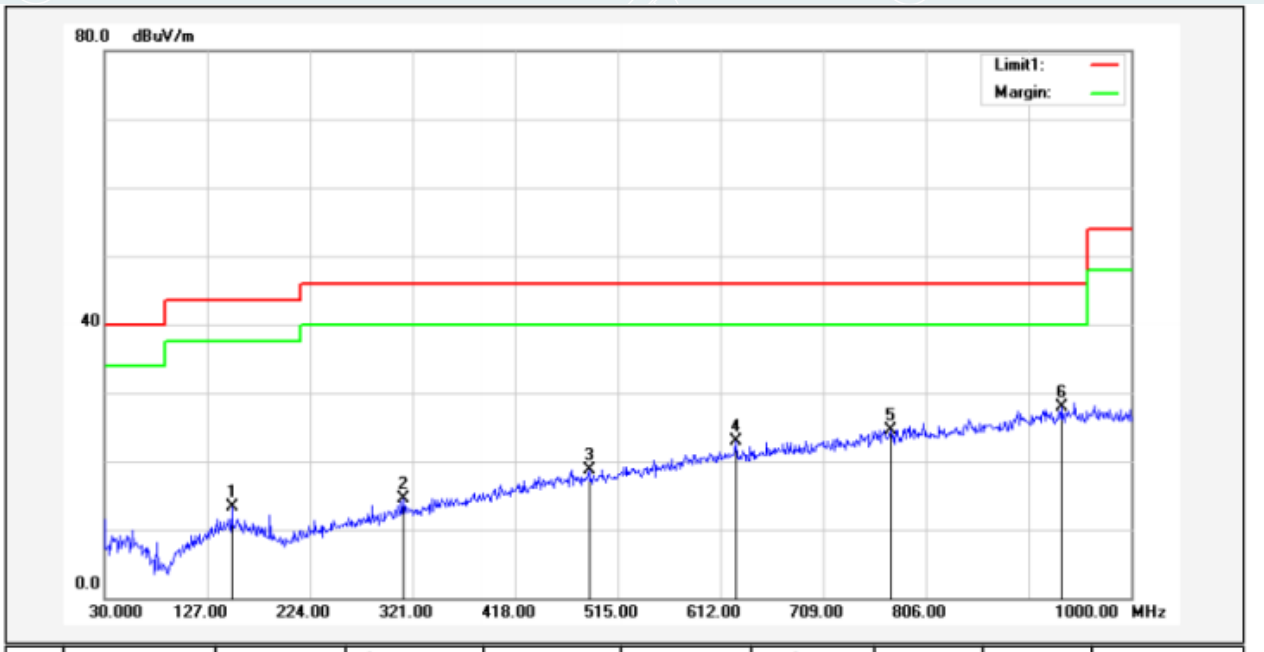
Below 1GHz

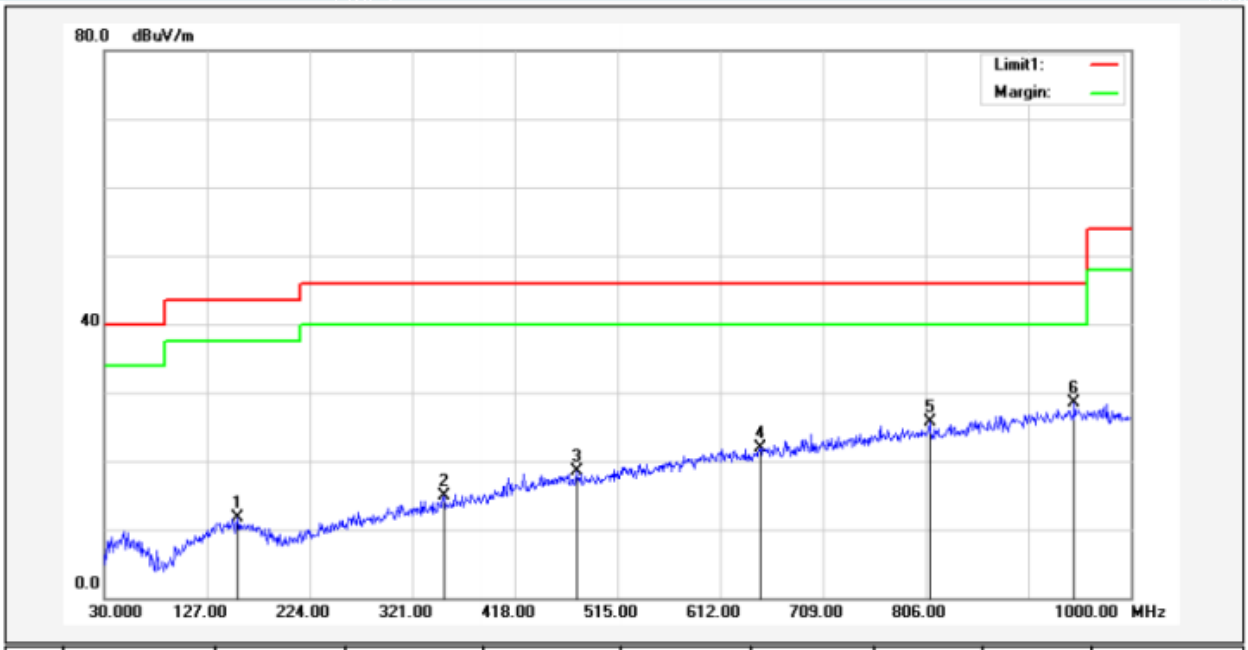
Pre-test all test mode and recorded the worst case BLE 1M 2480MHz test results in the report.

EUT Name	Blueiot RTLS Tag	**Model**	BT2000-z
Environmental Conditions	24.2℃/51%RH/101.0kPa	**Test Voltage**	DC 3.6V
Test Mode	TX/ BLE_1M (2480MHz)	**Polarity**	Vertical
Tested By	Tang Shenghui	**Tested Date**	2022-09-05



No.	Frequency (MHz)	Reading (dBuV)	Correction factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over (dB)	Degree (deg.)	Height (cm)	Remark
1	150.2800	38.03	-24.82	13.21	43.50	-30.29	0	212	QP
2	312.2700	37.81	-23.26	14.55	46.00	-31.45	356	300	QP
3	487.8400	36.81	-18.11	18.70	46.00	-27.30	45	200	QP
4	626.5500	37.59	-14.64	22.95	46.00	-23.05	109	300	QP
5	773.0200	36.52	-11.92	24.60	46.00	-21.40	297	100	QP
6*	934.0400	37.54	-9.63	27.91	46.00	-18.09	6	200	QP

EUT Name	Blueiot RTLS Tag	Model	BT2000-z
Environmental Conditions	24.2℃/51%RH/101.0kPa	Test Voltage	DC 3.6V
Test Mode	TX/ BLE_1M (2480MHz)	Polarity	Horizontal
Tested By	Tang Shenghui	Tested Date	2022-09-05



No.	Frequency (MHz)	Reading (dBuV)	Correction factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over (dB)	Degree (deg.)	Height (cm)	Remark
1	156.1000	36.55	-24.92	11.63	43.50	-31.87	282	299	QP
2	351.0700	37.17	-22.31	14.86	46.00	-31.14	360	159	QP
3	476.2000	36.82	-18.31	18.51	46.00	-27.49	139	399	QP
4	649.8300	36.21	-14.28	21.93	46.00	-24.07	135	399	QP
5	809.8800	37.09	-11.39	25.70	46.00	-20.30	95	399	QP
6*	946.6500	37.85	-9.44	28.41	46.00	-17.59	1	100	QP

Remark:

1 No emission found between lowest internal used/generated frequency to 30MHz.

2 Radiated emissions measured in frequency range from 9kHz to 1GHz were made with an instrument using Quasi-peak detector mode.

3 The IF bandwidth of Receiver between 30MHz to 1GHz was 120kHz.

1GHz-18GHz:
According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Mode: TX/ BLE_1M
Lowest Frequency (2402MHz)
Environment: 24℃/51%RH/101.0kPa Voltage: DC 3.6V
Tested By:Zhang Zishan Date: 2022-09-20

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1253.0316	59.54	37.58	-21.96	74.00	36.42	100	274	Horizontal
2	1507.0634	59.97	37.36	-22.61	74.00	36.64	100	234	Horizontal
3	2220.9026	59.50	41.30	-18.20	74.00	32.70	100	164	Horizontal
4	3199.5200	59.90	43.65	-16.25	74.00	30.35	200	106	Horizontal
5	4804.6805	65.74	53.68	-12.06	74.00	20.32	200	44	Horizontal
6	7204.9205	61.81	57.88	-3.93	74.00	16.12	100	126	Horizontal

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dBμV/m]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	4804.0078	-12.06	58.70	46.64	54.00	7.36	144	47.6	Horizontal
2	7205.2807	-3.93	50.75	46.82	54.00	7.18	101	46.7	Horizontal

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Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1087.5109	59.75	37.31	-22.44	74.00	36.69	200	25	Vertical
2	1424.8031	59.39	37.69	-21.70	74.00	36.31	100	346	Vertical
3	1749.0936	60.87	39.11	-21.76	74.00	34.89	100	236	Vertical
4	3148.5149	63.95	45.12	-18.83	74.00	28.88	100	64	Vertical
5	4804.6805	65.79	53.44	-12.35	74.00	20.56	100	0	Vertical
6	7206.4206	65.46	62.40	-3.06	74.00	11.60	100	115	Vertical

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dBμV/m]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	4803.9598	-12.35	55.93	43.58	54.00	10.42	128	328.7	Vertical
2	7205.4838	-3.06	52.69	49.63	54.00	4.37	100	93.4	Vertical

---------- The following blanks ----------

Mode: TX/ BLE_1M
Middle Frequency (2440MHz)
Environment: 24℃/51%RH/101.0kPa Voltage: DC 3.6V
Tested By: Zhang Zishan Date: 2022-09-20

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1547.3184	60.60	38.38	-22.22	74.00	35.62	200	242	Horizontal
2	2218.9024	58.70	40.53	-18.17	74.00	33.47	200	163	Horizontal
3	2846.7308	58.77	42.41	-16.36	74.00	31.59	100	271	Horizontal
4	4000.6001	57.94	41.70	-16.24	74.00	32.30	200	85	Horizontal
5	4879.6880	64.78	51.66	-13.12	74.00	22.34	200	43	Horizontal
6	7318.9319	62.66	59.57	-3.09	74.00	14.43	100	54	Horizontal

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dBμV/m]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	4879.9320	-13.12	55.85	42.73	54.00	11.27	145	48.1	Horizontal
2	7319.3710	-3.09	50.35	47.26	54.00	6.74	101	49.1	Horizontal

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1712.0890	59.55	38.10	-21.45	74.00	35.90	200	360	Vertical
2	2177.1471	60.30	40.48	-19.82	74.00	33.52	100	86	Vertical
3	3322.5323	61.81	44.24	-17.57	74.00	29.76	200	116	Vertical
4	3994.5995	65.60	49.70	-15.90	74.00	24.30	200	167	Vertical
5	4881.1881	65.22	52.13	-13.09	74.00	21.87	100	335	Vertical
6	7318.9319	65.82	62.76	-3.06	74.00	11.24	100	117	Vertical

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dBμV/m]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	4879.9678	-13.09	57.10	44.01	54.00	9.99	155	48.4	Vertical
2	7319.2978	-3.06	52.51	49.45	54.00	4.55	100	111.5	Vertical

Mode: TX/ BLE_1M
Highest Frequency (2480MHz)
Environment: 24℃/51%RH/101.0kPa Voltage: DC 3.6V
Tested By: Zhang Zishan Date: 2022-09-20

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1253.2817	58.99	37.03	-21.96	74.00	36.97	200	314	Horizontal
2	2217.1521	59.48	41.34	-18.14	74.00	32.66	100	216	Horizontal
3	2845.4807	58.09	41.70	-16.39	74.00	32.30	100	356	Horizontal
4	3982.5983	58.97	42.85	-16.12	74.00	31.15	200	53	Horizontal
5	4959.1959	66.90	55.09	-11.81	74.00	18.91	200	43	Horizontal
6	7440.4440	64.69	61.15	-3.54	74.00	12.85	100	51	Horizontal

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dBμV/m]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	4959.9894	-11.81	57.11	45.30	54.00	8.70	158	48.7	Horizontal
2	7439.4023	-3.54	52.98	49.44	54.00	4.56	107	46.9	Horizontal

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2010.3763	59.20	38.89	-20.31	74.00	35.11	100	165	Vertical
2	3298.5299	62.85	45.86	-16.99	74.00	28.14	200	273	Vertical
3	3982.5983	65.86	50.04	-15.82	74.00	23.96	200	199	Vertical
4	4959.1959	67.39	55.90	-11.49	74.00	18.10	100	344	Vertical
5	6636.3636	60.17	53.34	-6.83	74.00	20.66	100	344	Vertical
6	7440.4440	67.61	64.22	-3.39	74.00	9.78	100	116	Vertical

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dBμV/m]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	4959.9894	-11.49	56.31	44.82	54.00	9.18	157	110.2	Vertical
2	6643.9954	-6.83	41.96	35.13	54.00	18.87	148	17.5	Vertical
3	7439.3279	-3.39	55.06	51.67	54.00	2.33	107	110.3	Vertical

Remark:

1 Measuring frequencies from 1GHz to the 10th harmonic of highest fundamental frequency.
2 Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3 Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4 Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.

18GHz to 26.5GHz

Pre-test all test mode and recorded the worst case BLE_1M 2480MHz test results in the report.

Mode: TX/ BLE_1M
Lowest Frequency (2480MHz)
Environment: 24℃/51%RH/101.0kPa Voltage: DC 3.6V
Tested By: Zhang Zishan Date: 2022-09-20

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	18424.150	52.36	40.09	-12.27	83.54	43.45	150	177	Horizontal
2	18950.725	52.84	41.01	-11.83	83.54	42.53	150	48	Horizontal
3	19719.975	51.97	40.73	-11.24	83.54	42.81	150	258	Horizontal
4	20201.075	51.68	40.82	-10.86	83.54	42.72	150	209	Horizontal
5	21064.250	49.38	39.29	-10.09	83.54	44.25	150	97	Horizontal
6	22597.650	47.12	38.10	-9.02	83.54	45.44	150	112	Horizontal

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	18452.625	53.38	41.21	-12.17	83.54	42.33	150	166	Vertical
2	19236.325	51.08	39.46	-11.62	83.54	44.08	150	135	Vertical
3	20154.750	50.60	39.79	-10.81	83.54	43.75	150	118	Vertical
4	21222.350	50.07	40.13	-9.94	83.54	43.41	150	215	Vertical
5	21977.575	47.47	37.80	-9.67	83.54	45.74	150	118	Vertical
6	22598.075	46.72	37.70	-9.02	83.54	45.84	150	102	Vertical

---------- **The following blanks** ----------

7. 6dB BANDWIDTH

7.1 LIMITS

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

7.2 TEST PROCEDURES

1) Remove the antenna from the EUT, and then connect a low loss RF cable from antenna port to the spectrum analyzer**.**
2) Set resolution bandwidth (RBW) = 100kHz.Set the video bandwidth (VBW) ≥ 3 x RBW. Detector = Peak. Trace mode = max hold. Sweep = auto couple. Allow the trace to stabilize, record 6dB bandwidth value.
3) Repeat above procedures until all frequencies measured were complete.

7.3 TEST SETUP

7.4 TEST RESULTS

Environment: 25.8℃/60%RH/101.0kPa Voltage: DC 3.6V
Tested By: Qin Tingting Date: 2022-08-31

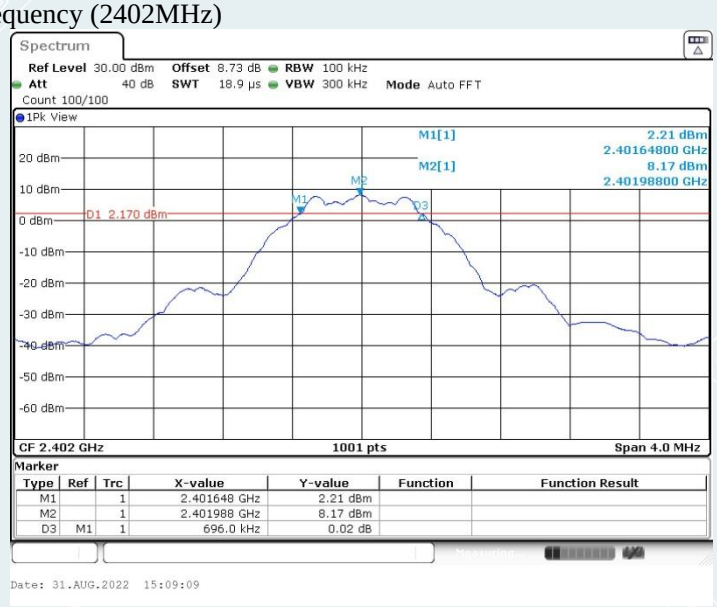
BLE_1M

Channel	Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Test Result
Lowest	2402	696	≥500	PASS
Middle	2440	700		PASS
Highest	2480	696		PASS

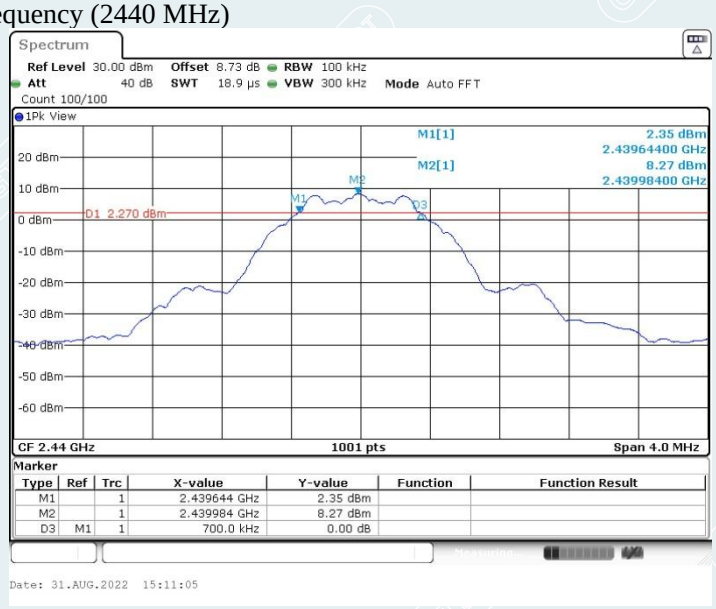
---------- **The following blanks** ----------

BLE_1M

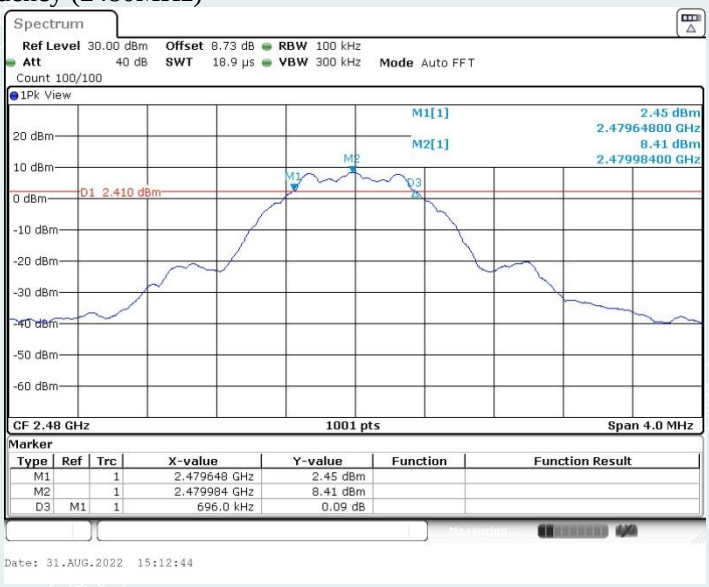
Lowest Frequency (2402MHz)



Middle Frequency (2440 MHz)



Highest Frequency (2480MHz)



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8. MAXIMUM PEAK OUTPUT POWER

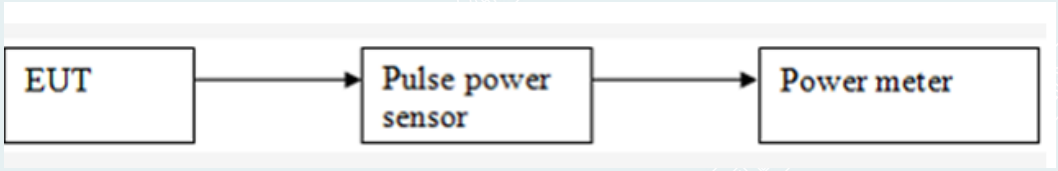
8.1 LIMITS

The maximum Peak output power measurement is 1W

8.2 TEST PROCEDURES

1) RF output of EUT was connected to the broadband peak RF power meter by RF cable. 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.

8.3 TEST SETUP



8.4 TEST RESULTS

Environment: 25.8℃/60%RH/101.0kPa Voltage: DC 3.6V
Tested By: Qin Tingting Date: 2022-08-31

BLE_1M

Channel	Frequency (MHz)	Maximum conducted Peak output Power (dBm)	Maximum conducted Average output Power (dBm)	Peak power Limit	Peak/ Average	Result
Lowest	2402	9.20	6.47	1W (30dBm)	Peak	Pass
Middle	2440	9.29	6.49			Pass
Highest	2480	9.34	6.74			Pass

---------- **The following blanks** ----------

9. POWER SPECTRAL DENSITY

9.1 LIMITS

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz 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 PROCEDURES

1) Remove the antenna from the EUT, and then connect a low loss RF cable from antenna port to the spectrum analyzer.
2) Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3) Set the analyzer span to 1.5 times the DTS bandwidth. Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz. Set the VBW ≥ [3 × RBW]. Detector = peak. Sweep time = auto couple.Trace mode = max hold. Allow trace to fully stabilize. Use the peak marker function to determine the maximum amplitude level within the RBW. If measured value exceeds requirement, then reduce RBW (but no less than 3kHz) and repeat.
4) Repeat above procedures until all frequencies measured were complete.

9.3 TEST SETUP

9.4 TEST RESULTS

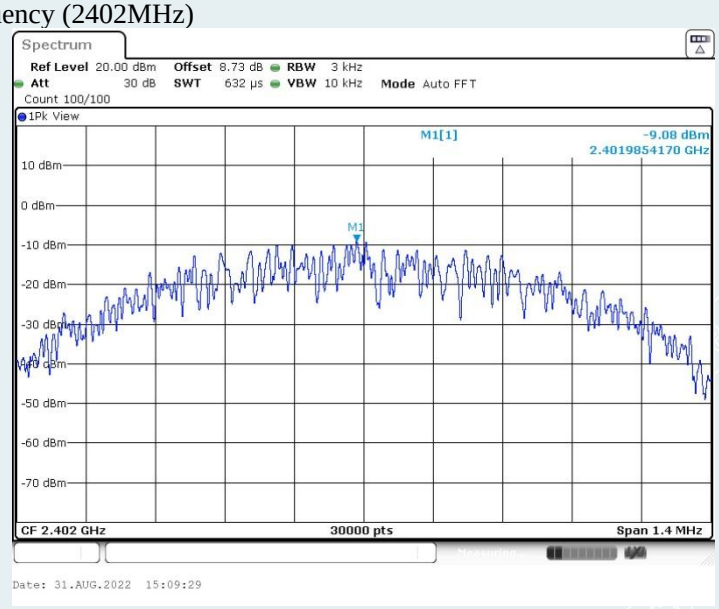
Environment: 25.8℃/60%RH/101.0kPa Voltage: DC 3.6V
Tested By: Qin Tingting Date: 2022-08-31

BLE_1M

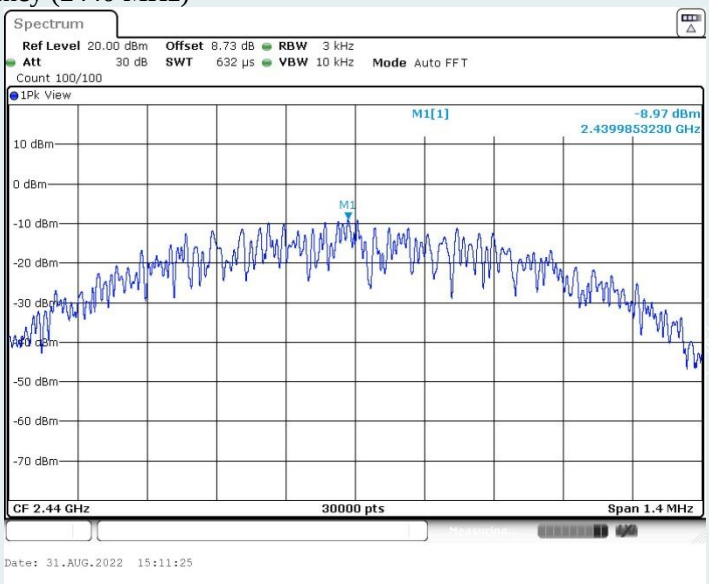
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Test Result
Lowest	2402	-9.08	8.00	PASS
Middle	2440	-8.97		PASS
Highest	2480	-8.87		PASS

BLE_1M

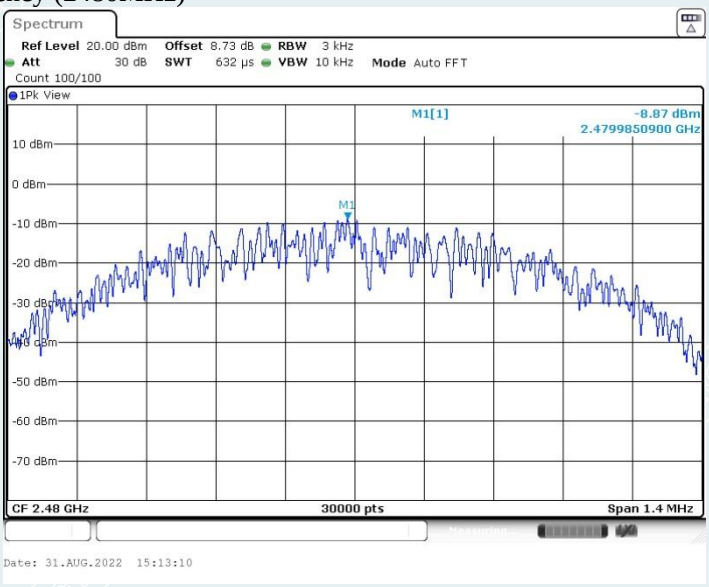
Lowest Frequency (2402MHz)



Middle Frequency (2440 MHz)



Highest Frequency (2480MHz)



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10. CONDUCTED BAND EDGES AND SPURIOUS EMISSIONS

10.1 LIMITS

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, 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 30dB instead of 20dB.

10.2 TEST PROCEDURES

Test procedures follow KDB 558074 D01 15.247 Measurement Guidance v05r02.

Remove the antenna from the EUT and then connect a low attenuation cable from the antenna port to the spectrum.

1) Remove the antenna from the EUT and then connect a low attenuation cable from the antenna port to the spectrum.
2) Set the spectrum analyzer: RBW =100kHz; VBW =300kHz, Frequency range = 30MHz to 26.5GHz; Sweep = auto; Detector Function = Peak. Trace = Max, hold.
3) Measure and record the results in the test report.
4) The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

10.3 TEST SETUP

---------- **The following blanks** ----------

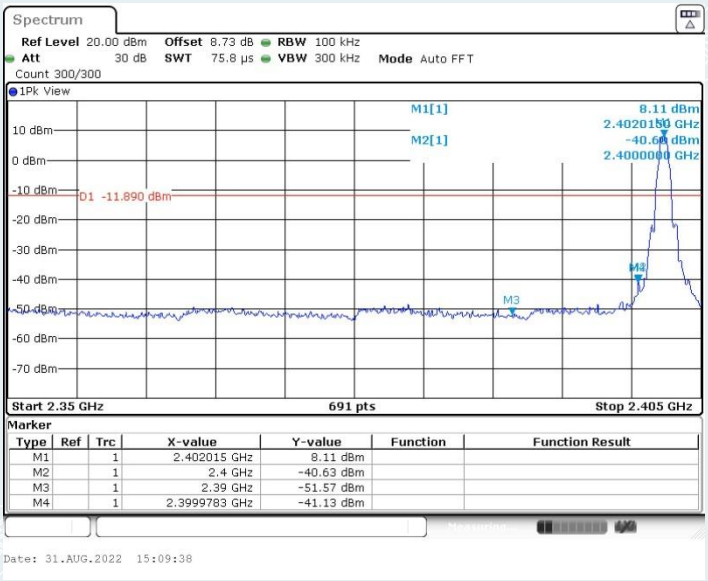
10.4 TEST RESULTS

Environment: 25.8℃/60%RH/101.0kPa Voltage: DC 3.6V
Tested By: Qin Tingting Date: 2022-08-31

Band edge measurements

BLE_1M

Lowest Frequency (2402MHz)
2.35GHz-2.405GHz



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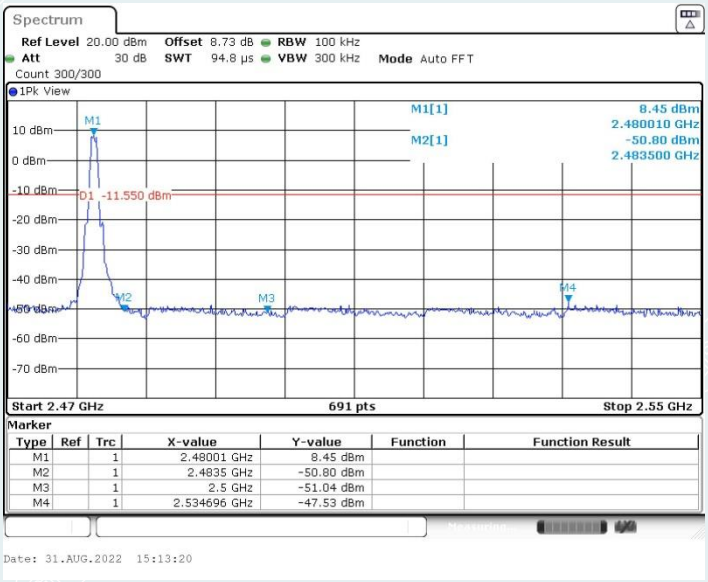
Highest Frequency (2480MHz)
2.47GHz-2.55GHz



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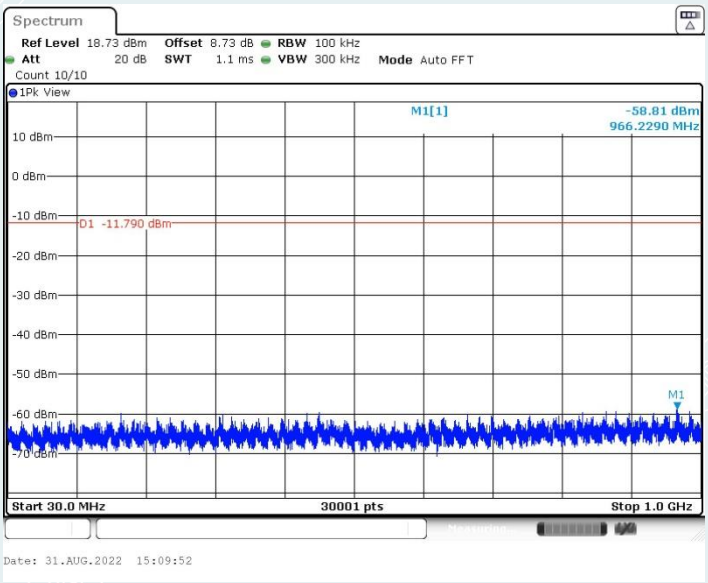
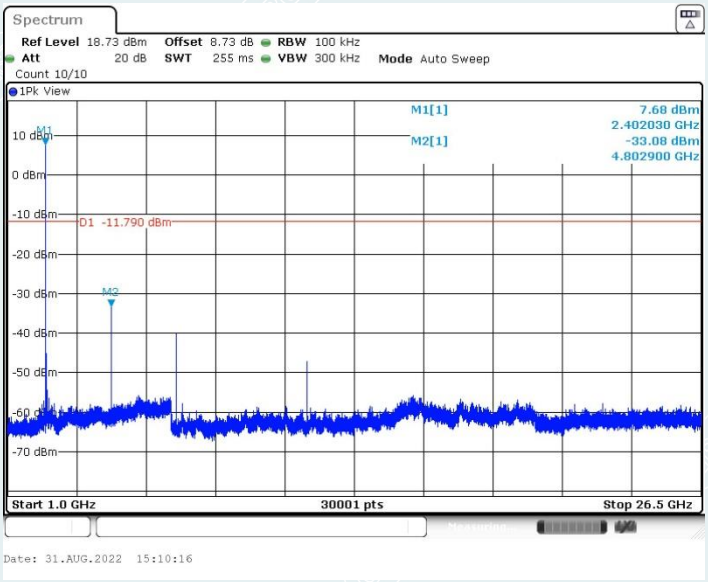
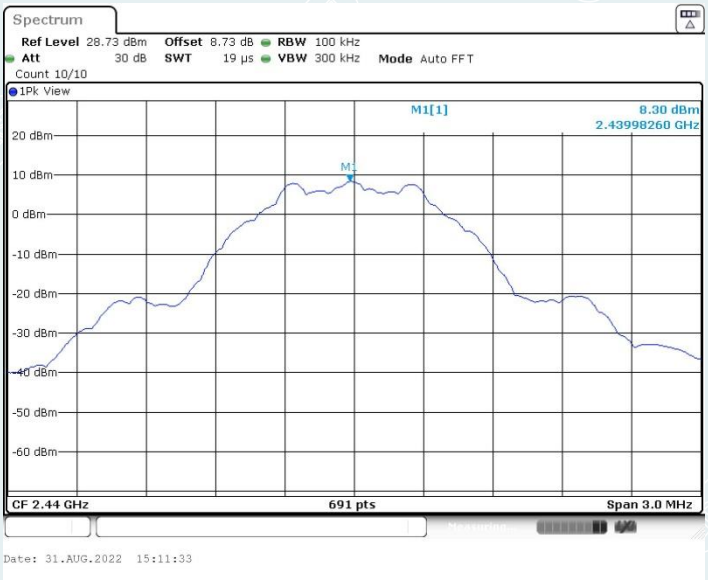
Conducted Spurious Emission
BLE_1M

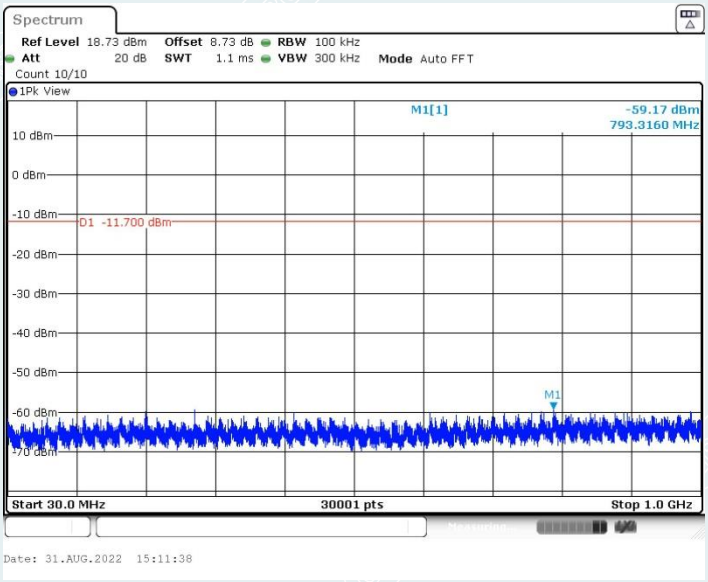
Lowest Frequency (2402MHz)

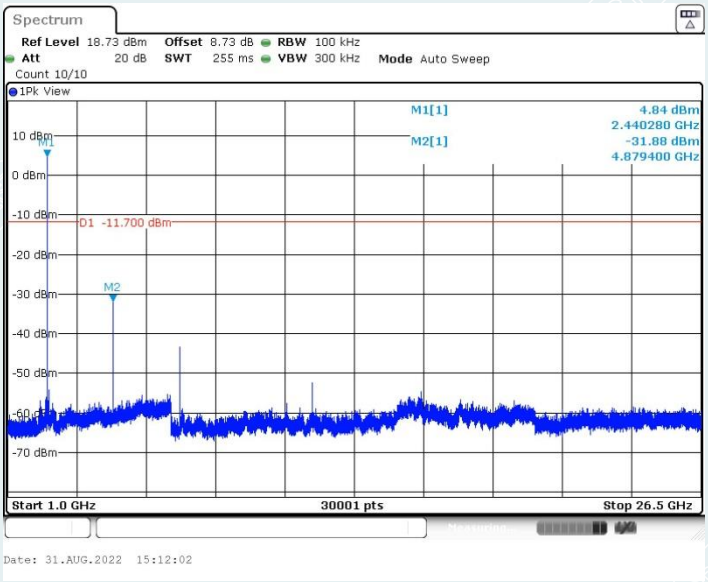




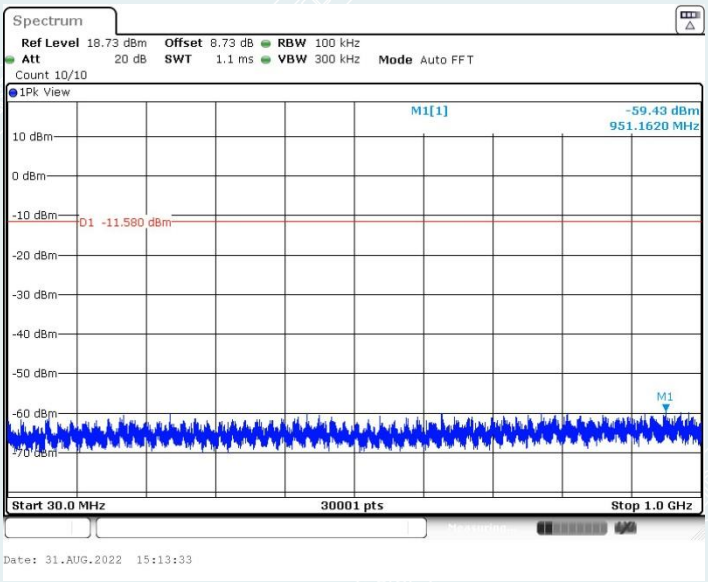
Middle Frequency (2440MHz)

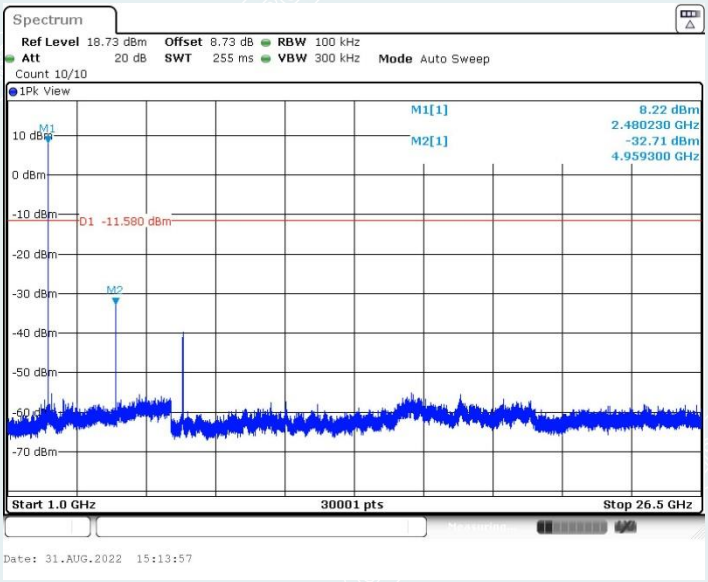



Spectrum
Ref Level 18.73 dBm Offset 8.73 dB RBW 100 kHz
Att 20 dB SWT 1.1 ms VBW 300 kHz Mode Auto FFT
Count 10/10
1Pk View
M1[1] -59.17 dBm
793.3160 MHz
10 dBm
0 dBm
-10 dBm
D1 -11.700 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
Start 30.0 MHz
30001 pts
Stop 1.0 GHz
Date: 31.AUG.2022 15:11:38


Spectrum
Ref Level 18.73 dBm Offset 8.73 dB RBW 100 kHz
Att 20 dB SWT 255 ms VBW 300 kHz Mode Auto Sweep
Count 10/10
1Pk View
M1[1] 4.84 dBm
2.440280 GHz
M2[1] -31.88 dBm
4.879400 GHz
10 dBm
M1
0 dBm
-10 dBm
D1 -11.700 dBm
-20 dBm
M2
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
Start 1.0 GHz
30001 pts
Stop 26.5 GHz
Date: 31.AUG.2022 15:12:02

Highest Frequency (2480MHz)





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11. RESTRICTED BANDS OF OPERATION

11.1 LIMITS

Section 15.247(d) 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)).

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	
13.36 - 13.41			

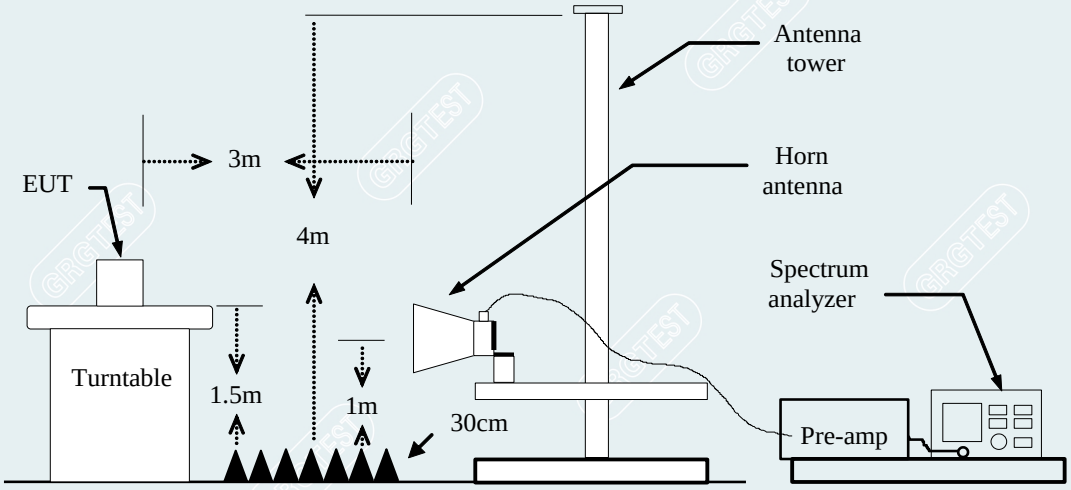
Frequency (MHz)	Quasi-peak(μV/m)	Measurement distance(m)	Quasi-peak(dBμV/m)@distance 3m
0.009-0.490	2400/F(kHz)	300	128.5~93.8
0.490-1.705	24000/F(kHz)	30	73.8~63
1.705-30.0	30	30	69.5
30 ~ 88	100	3	40
88~216	150	3	43.5
216 ~ 960	200	3	46
Above 960	500	3	54

11.2 TEST PROCEDURES

Test procedures follow KDB 558074 D01 15.247 Meas Guidance v05r02.

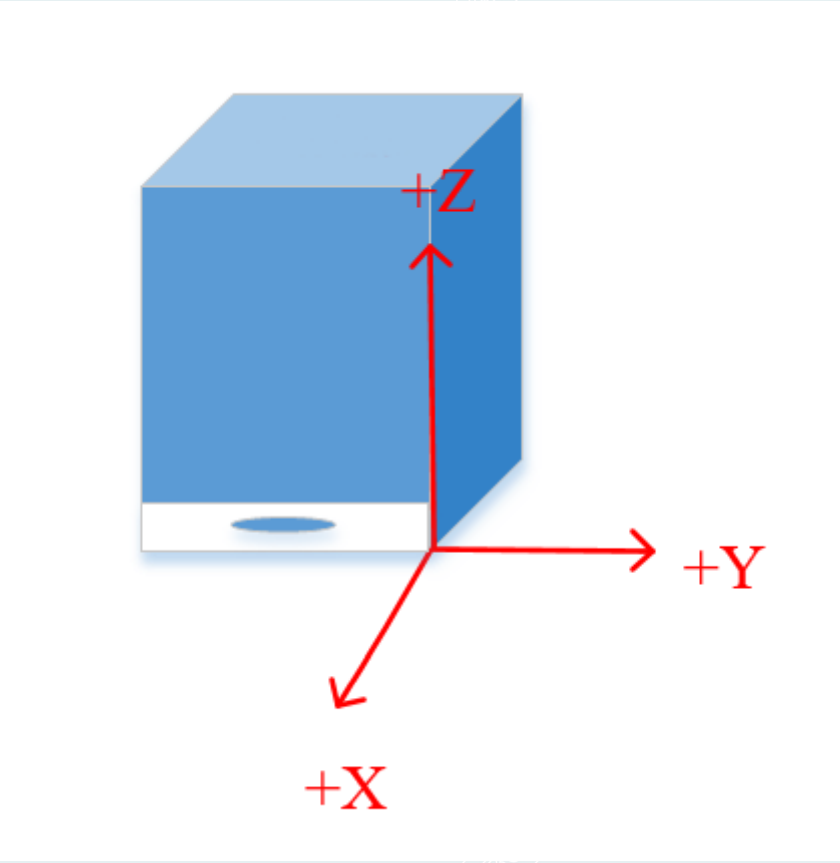
1) The EUT is placed on a turntable, which is 1.5m above the ground plane.
2) The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3) EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4) Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
   a) PEAK: RBW=1MHz / VBW=1MHz / Sweep=AUTO.
   b) AVERAGE: RBW=1MHz / VBW=1/T / Sweep=AUTO.
   If the EUT is configured to transmit with duty cycle ≥98%，set VBW≤RBW/100 (i.e.,10kHz) but not less than 10 Hz. If the EUT duty cycle is ＜98%，set VBW≥1/T, Where T is defined in section 2.9.
5) Repeat the procedures until all the PEAK and AVERAGE versus polarization are measured.

11.3 TEST SETUP



11.4 TEST RESULTS

The test are 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 the X position only.



---------- **The following blanks** ----------

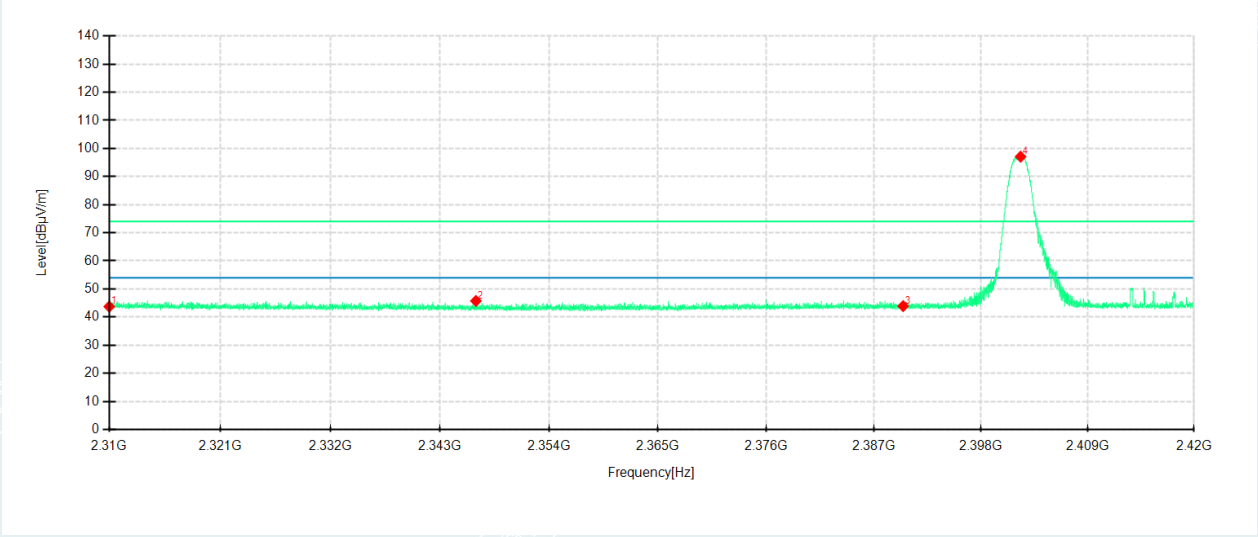
Equipment:	Blueiot RTLS Tag	Test Date	2022-09-13
Model No.:	BT2000-z	Test Engineer:	Zhang Qiang
Test Voltage:	DC 3.6V	Environment:	24℃/51%RH/101.0kPa

BLE 1M

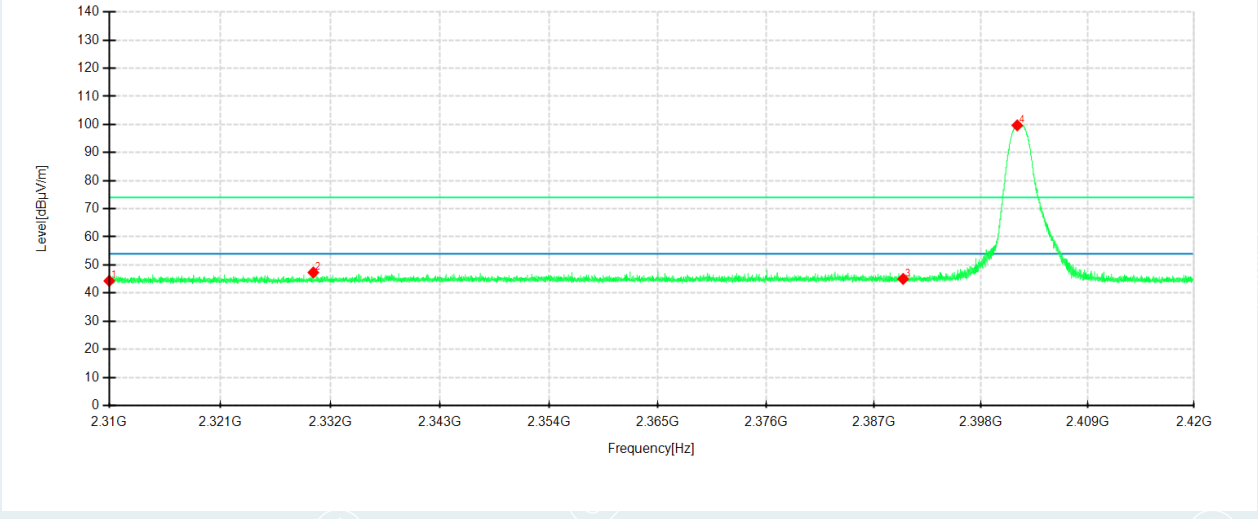
Lowest Frequency

Frequency 2402MHz

Detector mode: Peak Polarity: Horizontal



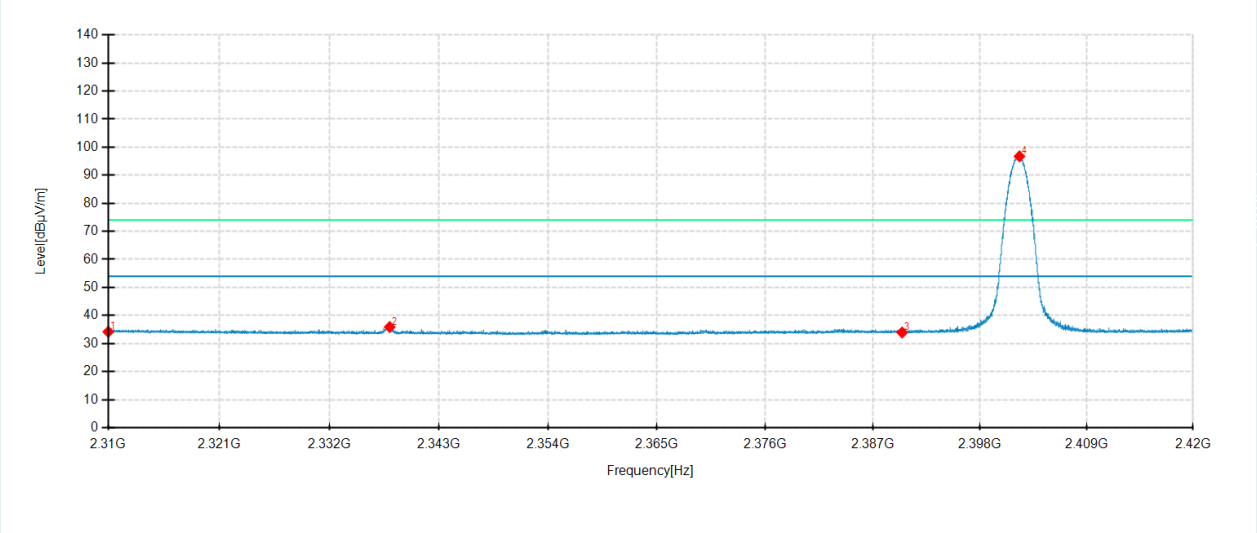
Detector mode: Peak Polarity: Vertical



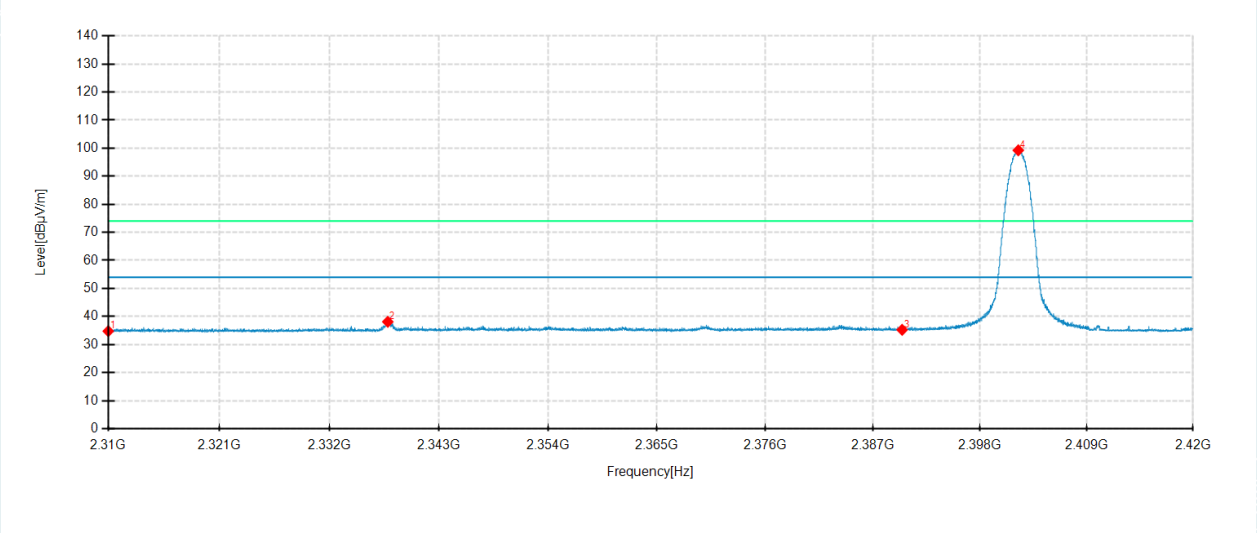
No.	Frequency MHz	Reading dBμV/m	Level dBμV/m	Factor dB	Limit dBuV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2310.000	53.68	43.73	-9.95	74.00	30.27	100	189	Horizontal	/
2	2346.608	56.51	45.74	-10.77	74.00	28.26	100	189	Horizontal	/
3	2390.000	54.06	43.91	-10.15	74.00	30.09	100	189	Horizontal	/
4	2402.070	107.03	97.07	-9.96	74.00	-23.07	100	147	Horizontal	No limit
1	2310.000	53.69	44.32	-9.37	74.00	29.68	100	172	Vertical	/
2	2330.306	56.58	47.32	-9.26	74.00	26.68	200	188	Vertical	/
3	2390.000	54.04	45.03	-9.01	74.00	28.97	100	172	Vertical	/
4	2401.729	108.68	99.68	-9.00	74.00	-25.68	100	172	Vertical	No limit

---------- The following blanks ----------

Lowest Frequency
Frequency 2402MHz
Detector mode: Average Polarity: Horizontal

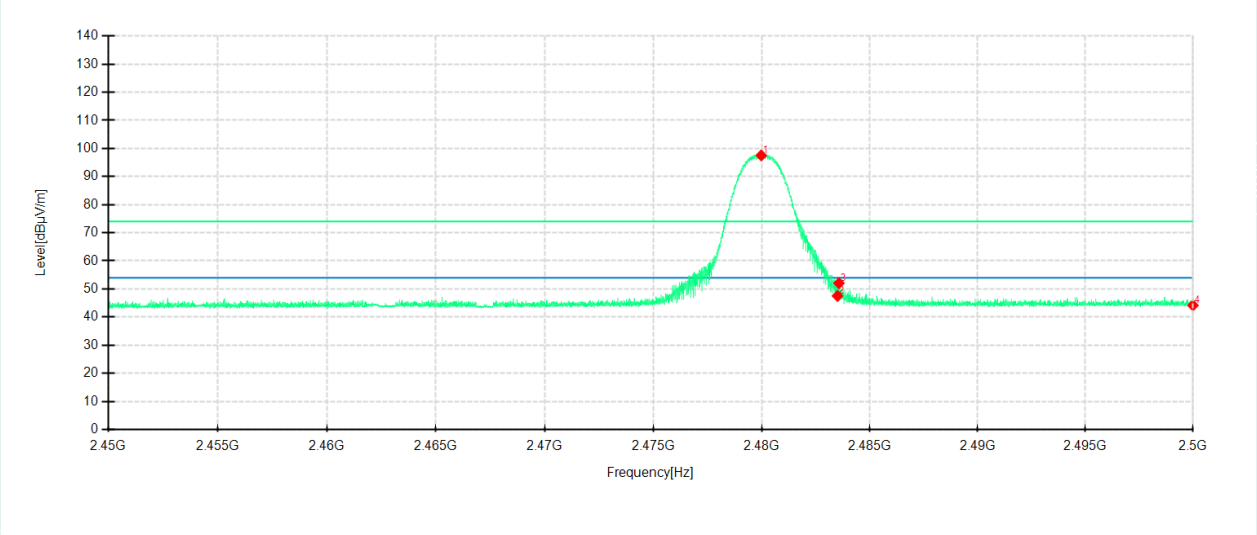


Detector mode: Average Polarity: Vertical

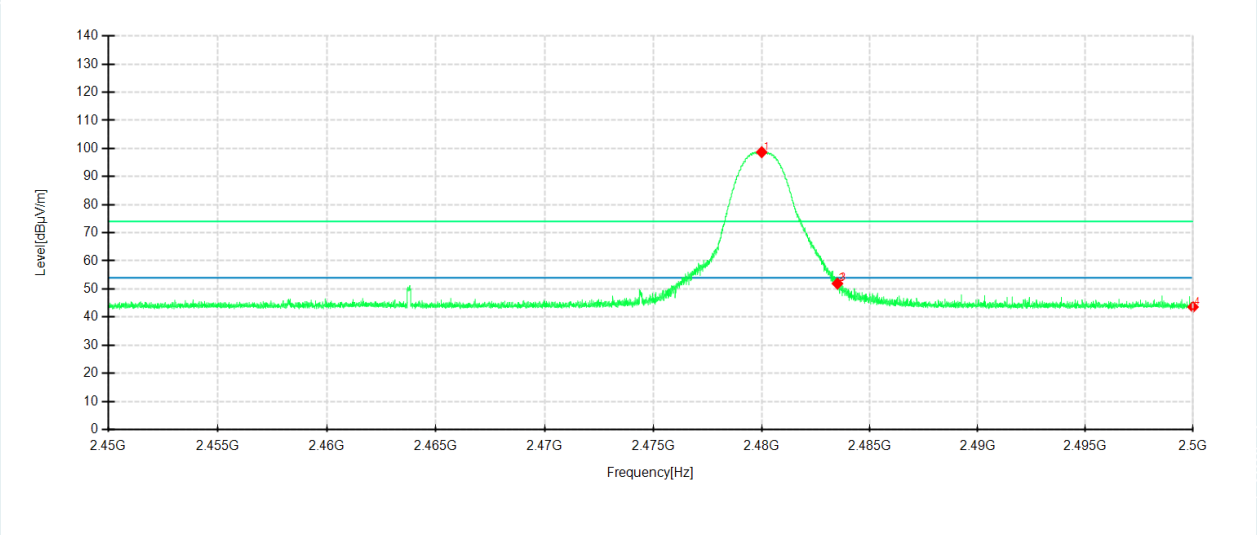


No.	Frequency MHz	Reading dBµV/m	Level dBµV/m	Factor dB	Limit dBuV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2310.000	44.14	34.19	-9.95	54.00	19.81	100	189	Horizontal	/
2	2338.050	46.46	35.88	-10.58	54.00	18.12	100	117	Horizontal	/
3	2390.000	44.09	33.94	-10.15	54.00	20.06	200	265	Horizontal	/
4	2402.059	106.70	96.74	-9.96	54.00	-42.74	100	146	Horizontal	No limit
1	2310.000	44.13	34.76	-9.37	54.00	19.24	100	234	Vertical	/
2	2337.863	47.31	38.10	-9.21	54.00	15.90	100	172	Vertical	/
3	2390.000	44.26	35.25	-9.01	54.00	18.75	100	172	Vertical	/
4	2401.938	108.26	99.25	-9.01	54.00	-45.25	100	172	Vertical	No limit

Highest Frequency
Frequency 2480MHz
Detector mode: Peak Polarity: Horizontal

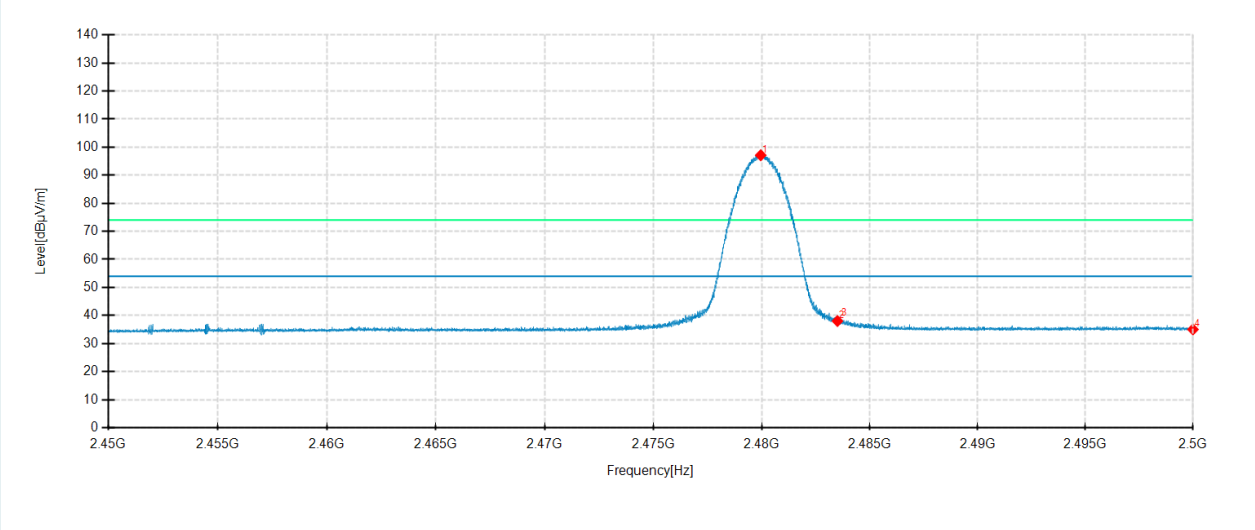


Detector mode: Peak Polarity: Vertical

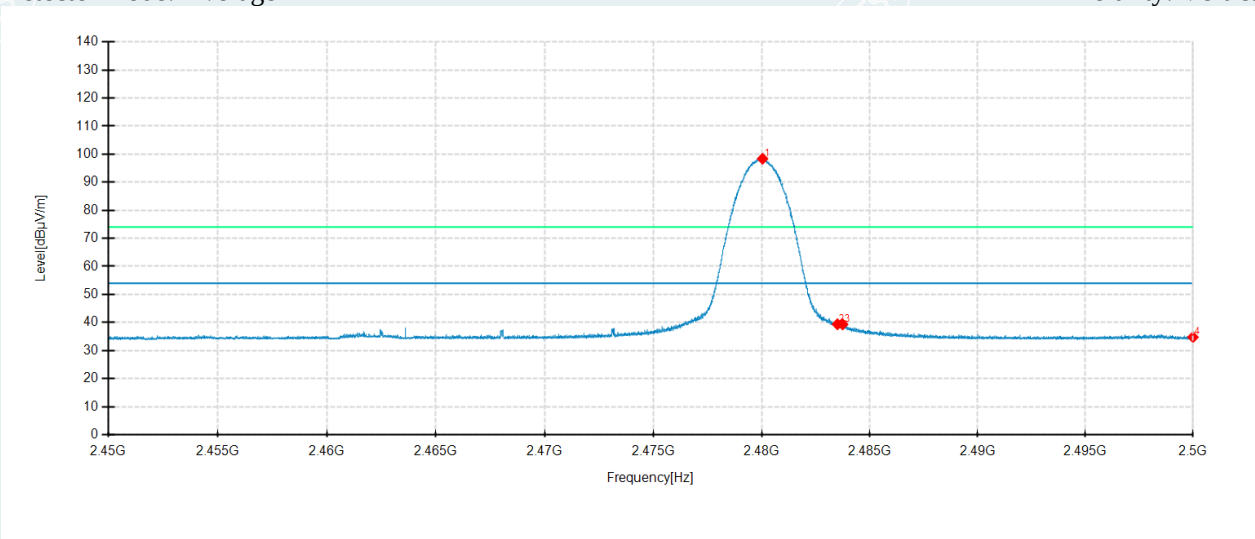


No.	Frequency MHz	Reading dBµV/m	Level dBµV/m	Factor dB	Limit dBuV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2479.980	106.81	97.54	-9.27	74.00	-23.54	100	126	Horizontal	No limit
2	2483.500	56.74	47.52	-9.22	74.00	26.48	100	188	Horizontal	/
3	2483.570	61.28	52.06	-9.22	74.00	21.94	200	173	Horizontal	/
4	2500.000	53.19	44.16	-9.03	74.00	29.84	100	74	Horizontal	/
1	2480.000	108.53	98.68	-9.85	74.00	-24.68	100	172	Vertical	No limit
2	2483.500	61.79	51.93	-9.86	74.00	22.07	200	187	Vertical	/
3	2483.570	62.05	52.19	-9.86	74.00	21.81	200	53	Vertical	/
4	2500.000	53.51	43.58	-9.93	74.00	30.42	100	357	Vertical	/

Highest Frequency
Frequency 2480MHz
Detector mode: Average Polarity: Horizontal



Detector mode: Average Polarity: Vertical



No.	Frequency MHz	Reading dBµV/m	Level dBµV/m	Factor dB	Limit dBuV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2479.955	106.40	97.13	-9.27	54.00	-43.13	100	126	Horizontal	No limit
2	2483.500	47.25	38.03	-9.22	54.00	15.97	100	116	Horizontal	/
3	2483.610	48.21	38.99	-9.22	54.00	15.01	100	126	Horizontal	/
4	2500.000	44.06	35.03	-9.03	54.00	18.97	200	172	Horizontal	/
1	2480.040	108.23	98.38	-9.85	54.00	-44.38	100	172	Vertical	No limit
2	2483.500	49.22	39.36	-9.86	54.00	14.64	100	316	Vertical	/
3	2483.740	49.20	39.34	-9.86	54.00	14.66	200	188	Vertical	/
4	2500.000	44.70	34.77	-9.93	54.00	19.23	200	22	Vertical	/

Remark: Max field strength in 3m distance. No any other emission which falls in restricted bands can be found.

APPENDIX A. PHOTOGRAPH OF THE TEST CONNECTION DIAGRAM

Please refer to the attached document E202208182570-4-Test Photo.

APPENDIX B. PHOTOGRAPH OF THE EUT

Please refer to the attached document E202208182570-5-EUT Photo.

---------- End of Report ----------