

Test Report

Verified code: 939632

Report No.: E20230512370501-1

Customer: Wuxi Auto-Link World Information Technology Co., Ltd.

Address: No. 8, Huayun road, Wuxi city, Jiangsu Province, P.R.China

Sample Name: BYD Di5.0F

Sample Model: MTCA05

Receive Sample Date: May.16,2023

Test Date: May.19,2023 ~ Jun.09,2023

Reference Document: CFR 47, FCC Part 15 Subpart C
RADIO FREQUENCY DEVICES:Subpart C—Intentional Radiators

Test Result: Pass

Prepared by: Lu Wei

Lu Wei

Reviewed by: Jiang Tao

Jiang Tao

Approved by: Xiao Liang

Xiao Liang

GRG METROLOGY & TEST GROUP CO., LTD.

Issued Date: 2023-06-27

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REPORT ISSUED HISTORY

Report Version	Report No.	Description	Compile Date
1.0	E20230512370501-1	Original Issue	2023-06-09

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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.The EUT is power by DC source, not applicable.

2.The EUT antenna is PCB antenna. The max gain of Antenna is 3.16dBi 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: Wuxi Auto-Link World Information Technology Co., Ltd.
Address: No. 8, Huayun road, Wuxi city, Jiangsu Province, P.R.China

2.2 MANUFACTURER

Name: Wuxi Auto-Link World Information Technology Co., Ltd.
Address: No. 8, Huayun road, Wuxi city, Jiangsu Province, P.R.China

2.3 FACTORY

Name: Wuxi Auto-Link World Information Technology Co., Ltd.
Address: No. 8, Huayun road, Wuxi city, Jiangsu Province, P.R.China

2.4 BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment: BYD Di5.0F
Model No.: MTCA05
Adding Model: /
Trade Name: 
FCC ID: 2BBDI20003502MTCA05
Power supply: DC 12.0V
Frequency Band: 2402MHz – 2480MHz
Transmit Power: GFSK for 1Mbps:-4.81dBm
GFSK for 2Mbps:-4.71dBm
Modulation type: Bluetooth LE with 1M and 2M:GFSK
Channel space: 2MHz
Antenna Specification: PCB antenna 3.16dBi
Temperature Range: -30~+70℃
Hardware Version: 0.0.6
Software Version: 4.00.3

Sample No: E20230512370501-0001, E20230512370501-0002

Note: The EUT antenna gain is provided by the applicant. This report is made solely on the basis of such data and/or information. We accept no responsibility for the authenticity and completeness of the above data and information and the validity of the results and/or conclusions.

2.5 CHANNELIST

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

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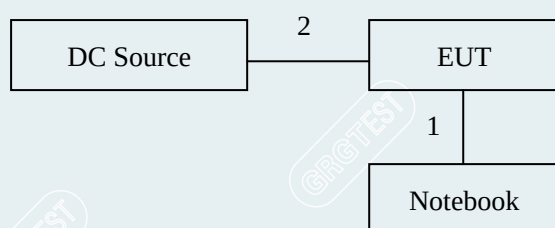
2.7 LOCAL SUPPORTIVE

Name of equipment	Manufacturer	Model	Serial number	Note
Notebook	LENOVO	TianYi 310-14ISK	MP18DLC6	/
DC Source	Keysight	E36131A	/	/

No.	Cable Type	Qty.	Shielded Type	Ferrite Core(Qty.)	Length
1	USB to USB cable	1	No	0	1.0m
2	DC cable	1	No	0	1.2m

2.8 CONFIGURATION OF SYSTEM UNDER TEST

For Conducted Emission, 6dB bandwidth, Maximum Peak Output Power, Power Spectral Density, Conducted band edges and Spurious Emission measurement , Radiated Spurious Emission, Restricted bands of operation



Test software:

Software version	Test level
QRCT.win.4.0	Default (Max)

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2.9 DUTY CYCLE

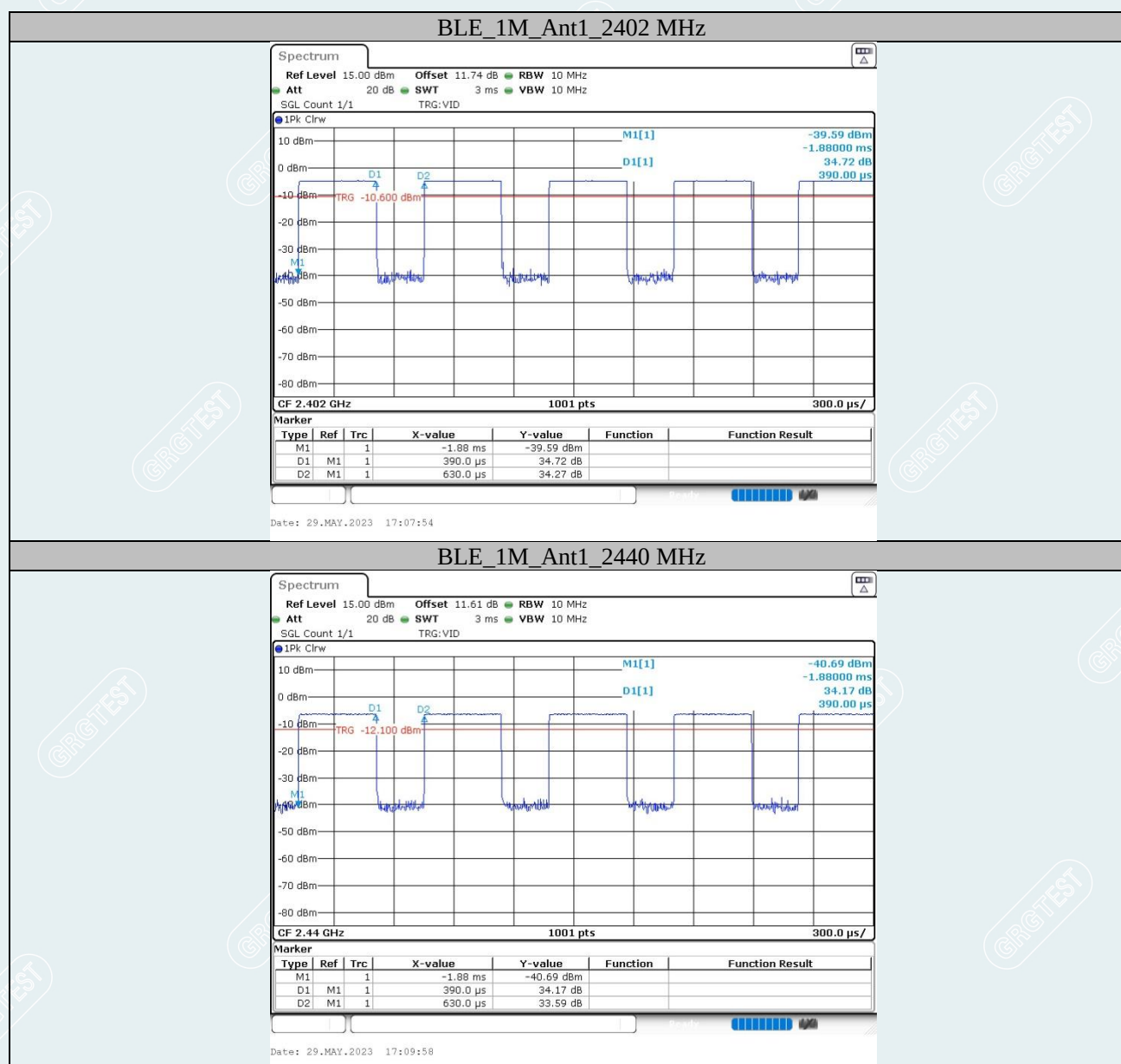
Environment: 25.2°C/61%RH/101.0kPa

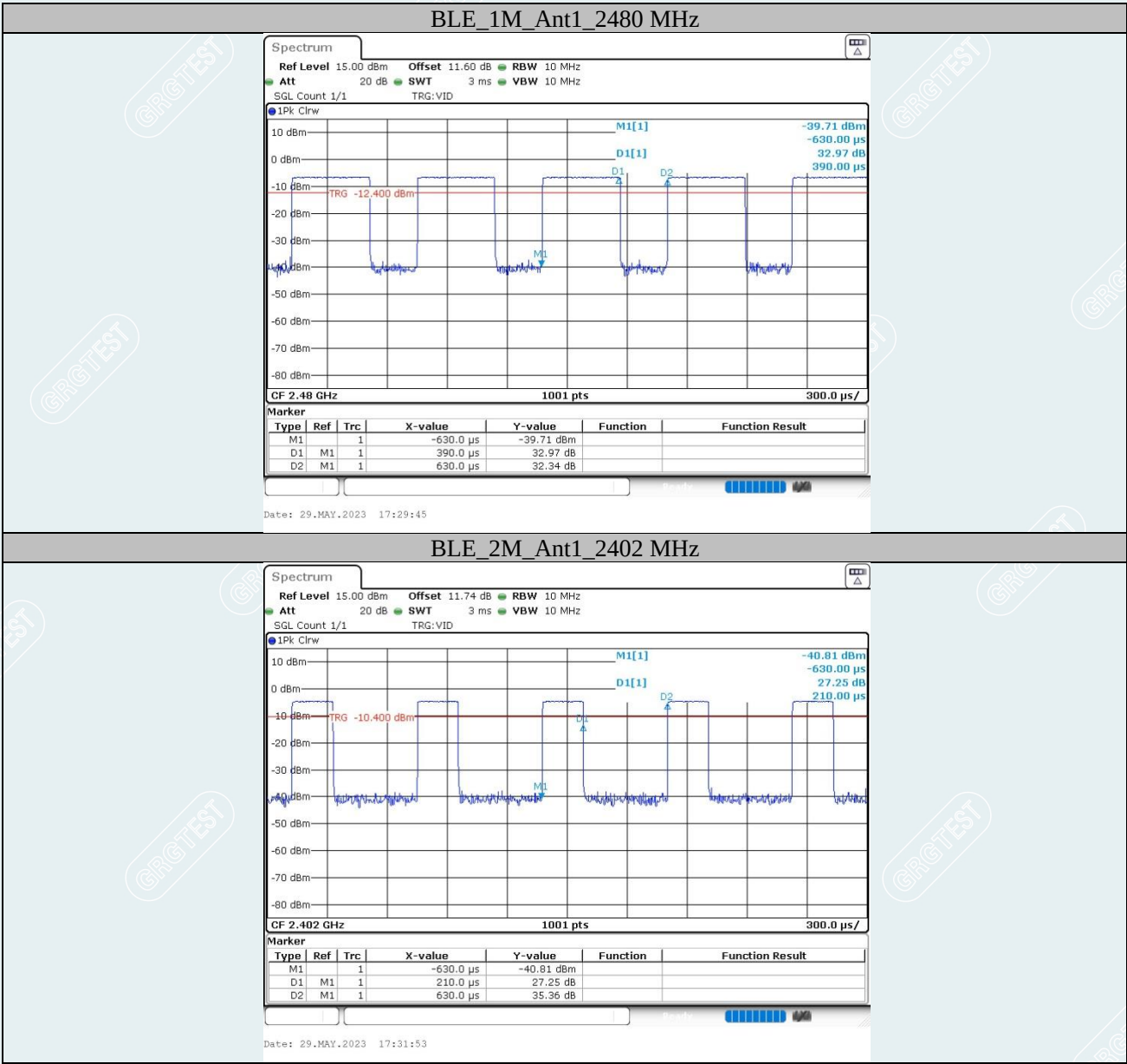
Voltage: DC 12V

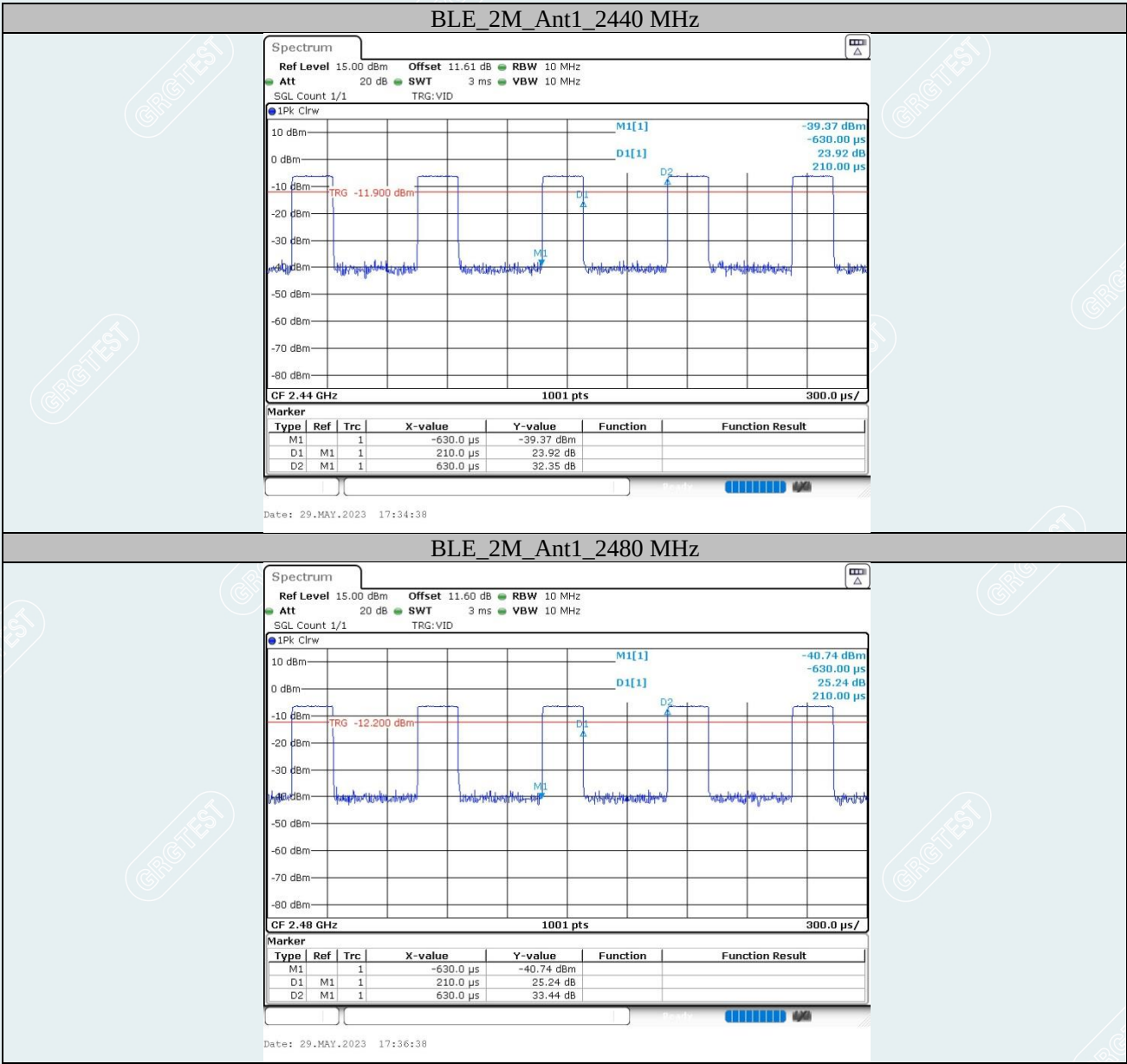
Tested By: Qin Tingting

Date: 2023-05-29

TestMode	Antenna	Freq[MHz]	ON Time [ms]	Period [ms]	DC[%]	T[s]
BLE_1M	Ant1	2402	0.39	0.63	61.90	0.00039
		2440	0.39	0.63	61.90	0.00039
		2480	0.39	0.63	61.90	0.00039
BLE_2M	Ant1	2402	0.21	0.63	33.33	0.00021
		2440	0.21	0.63	33.33	0.00021
		2480	0.21	0.63	33.33	0.00021







3. LABORATORY AND ACCREDITATIONS

3.1 LABORATORY

The tests & measurements refer to this report were performed by Shenzhen EMC Laboratory of GRG METROLOGY & TEST GROUP CO., LTD.

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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,
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3.3 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 ¹⁾
		30MHz~200MHz	4.5dB ¹⁾
		200MHz~1000MHz	4.4dB ¹⁾
		1GHz~18GHz	5.6dB ¹⁾
		18GHz~26.5GHz	3.7dB ¹⁾
	Vertical	9kHz~30MHz	5.1dB ¹⁾
		30MHz~200MHz	4.4dB ¹⁾
		200MHz~1000MHz	4.5dB ¹⁾
		1GHz~18GHz	5.6dB ¹⁾
		18GHz~26.5GHz	3.7dB ¹⁾
Conduction Emission		150kHz~30MHz	3.40dB ¹⁾

Measurement	Uncertainty
RF frequency	6.0×10^{-6}
RF power conducted	0.78dB
Power spectral density	0.78dB
Occupied channel bandwidth	0.4dB
Unwanted emission, conducted	0.68dB
Humidity	6%
Temperature	2°C

Note:

- ¹⁾ This uncertainty represents an expanded uncertainty expressed at approximately the 95%.
This uncertainty represents an expanded uncertainty factor of $k=2$.

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4. LIST OF USED TEST EQUIPMENT AT GRGT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
6dB Bandwidth&Conducted band edges and Spurious Emission&Power Spectral Density				
Spectrum Analyzer	R&S	FSV30	104381	2023-11-17
Automatic power measuring unit	TONSCEND	JS0806-2	21B8060365	2023-11-17
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	2024-02-06
Bi-log Antenna	TESEQ	CBL6143A	26039	2024-10-23
Loop Antenna	Schwarzbeck	FMZB 1513-60	1513-60-56	2023-08-06
Test Receiver	R&S	ESR26	101758	2023-10-27
Horn Antenna	Schwarzbeck	BBHA9120D	02143	2023-10-15
Board-Band Horn Antenna	Schwarzbeck	BBHA 9170	BBHA 9170-497	2023-10-14
Amplifier	Tonscend	TAP01018048	AP20E8060075	2024-04-11
Amplifier	Tonscend	TAP184050	AP20E806071	2024-04-16
Amplifier	SHIRONG ELECTRONIC	DLNA-1G18G-G4 0	20200928005	2023-08-27
Test S/W	Tonscend	JS36-RE/2.5.1.5		
Maximum Peak Output Power				
Pulse power sensor	Anritsu	MA2411B	1126150	2024-02-12
Power meter	Anritsu	ML2495A	1204003	2024-02-12

Note: The calibration interval of the above test instruments is 12 months except Bi-log Antenna, The calibration interval of the Bi-log Antenna is 24 months.

5. RADIATED SPURIOUS EMISSIONS

5.1 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 20 dB 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($\mu\text{V/m}$)	Measurement distance(m)	Quasi-peak(dB $\mu\text{V/m}$)@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 PeakLimit=74+20*log(3/1)=83.54 (dB $\mu\text{V/m}$).
The Avg Limit=54+20*log(3/1)=63.54 (dB $\mu\text{V/m}$).

5.2 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 0.8 m height is used.

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

--- Use serial board or connecting line to make EUT and notebook to communicate, according to the actual need to make EUT send constant frequency signal continuously.

--- The EUT is placed on a desktop position in the center of the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Pre measurement:

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

--- The antenna height is 1.0 meter.

--- 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 0.8 m 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.

--- Use serial board or connecting line to make EUT and notebook to communicate, according to the actual need to make EUT send constant frequency signal continuously.

--- The EUT is placed on a desktop position in the center of the turntable.

--- 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 premeasurement 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 premeasurement 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 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Use serial board or connecting line to make EUT and notebook to communicate, according to the actual need to make EUT send constant frequency signal continuously.
- The EUT is placed on a desktop position in the center of the turntable.
- 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 premeasurement 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.
- Use serial board or connecting line to make EUT and notebook to communicate, according to the actual need to make EUT send constant frequency signal continuously.
- The EUT is placed on a desktop position in the center of the turntable.
- The measurement distance is 1 meter.
- The EUT was set into operation.

Pre measurement:

- The pre measurement distance is 1 meter.
- 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 at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak detector.
- The final measurement distance is 3 meter.
- According to the maximum antenna and turntable positions of premeasurement 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 levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

NOTE:

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

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5.3 TEST SETUP

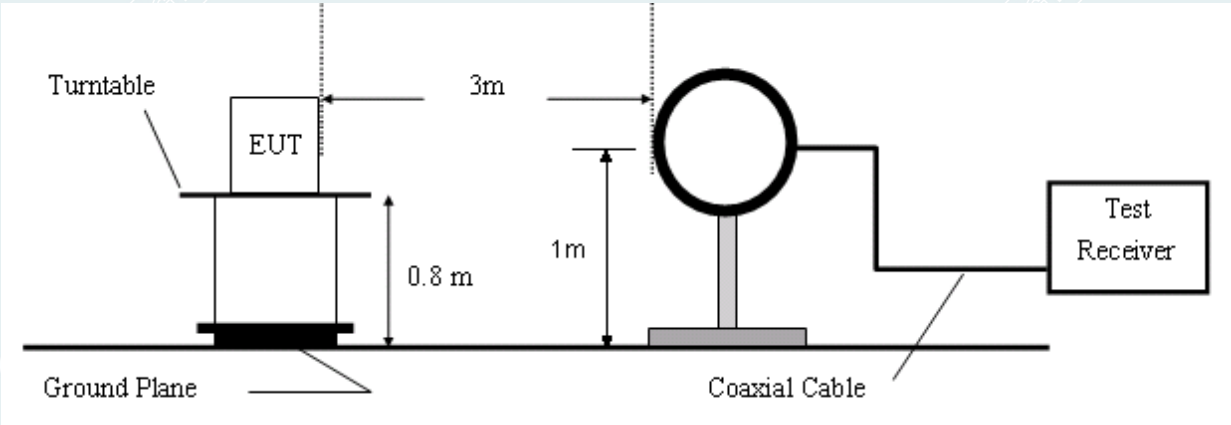


Figure 1. 9kHz to 30MHz radiated emissions test configuration

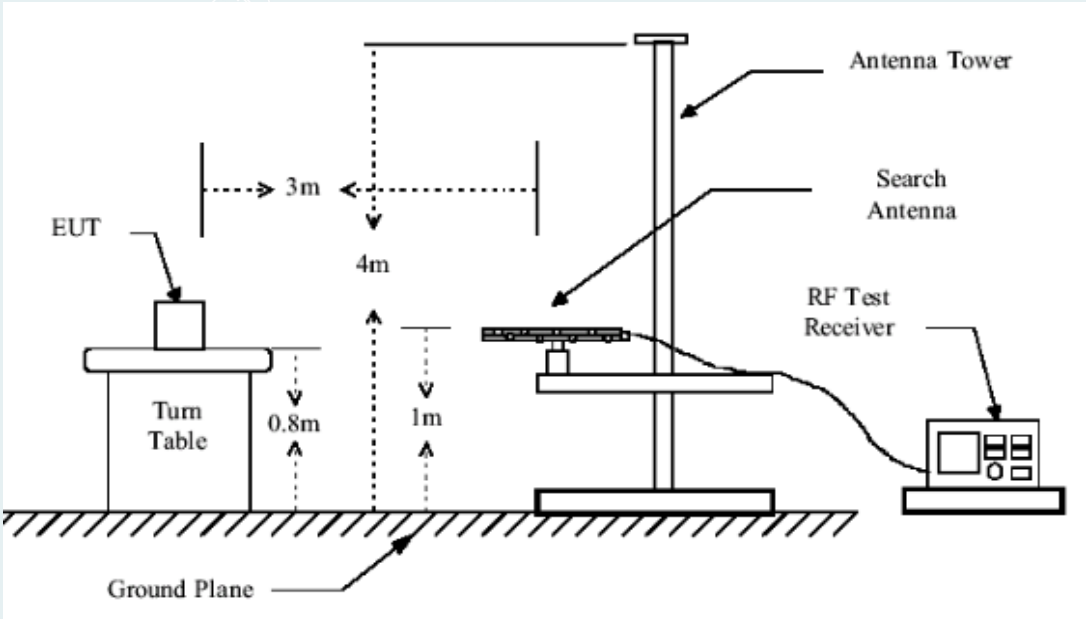


Figure 2. 30MHz to 1GHz radiated emissions test configuration

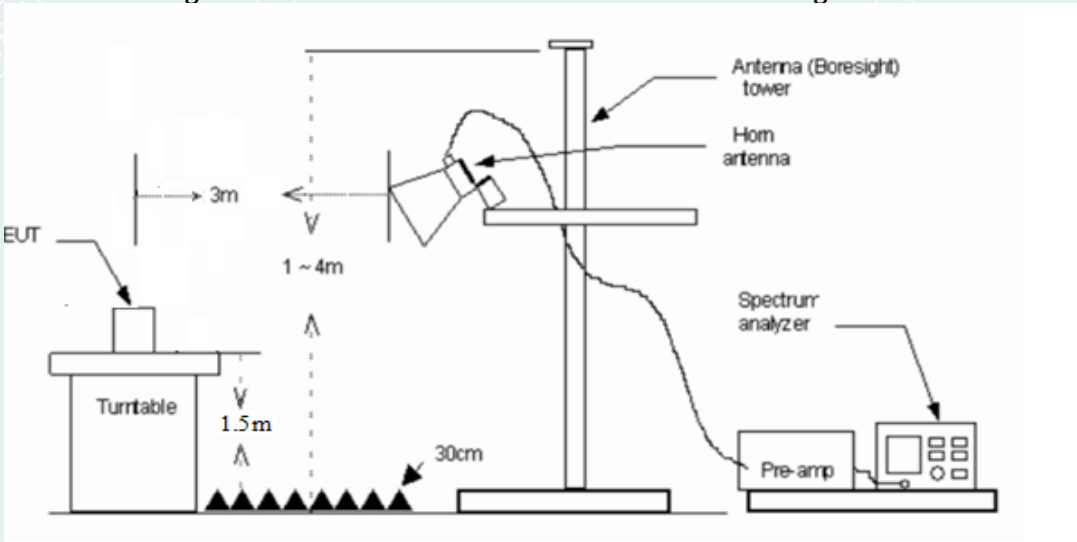


Figure 3. 1GHz to 18GHz radiated emissions test configuration

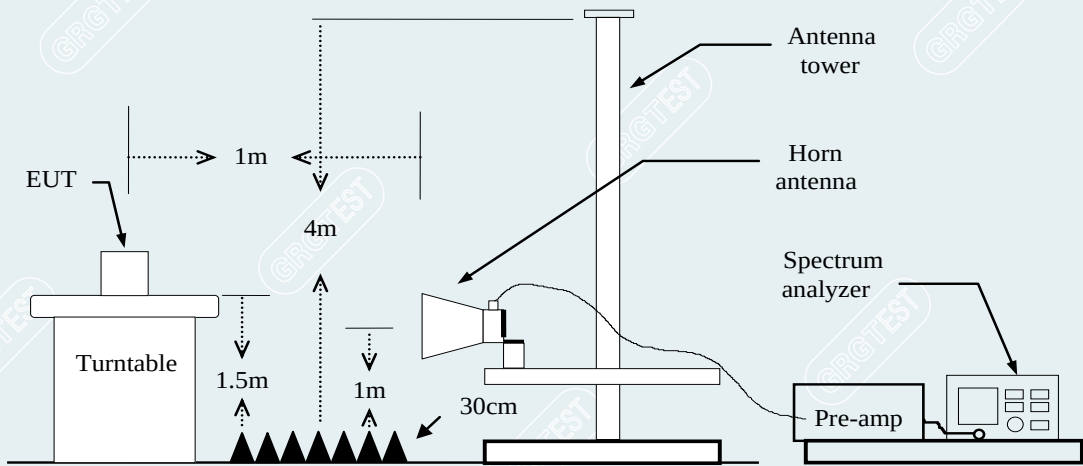


Figure 4. 18GHz to 26.5GHz radiated emissions test configuration

5.4 DATA SAMPLE

30MHz to 1GHz

No.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
xxx	XXXX	63.53	36.38	-27.15	43.50	7.12	0	100	Horizontal

- Frequency (MHz)
- = Emission frequency in MHz
- Reading (dBuV/m)
- = Uncorrected Analyzer / Receiver reading
- Level (dBuV/m)
- = Reading (dBuV) + Factor (dB)
- Limit (dBuV/m)
- = Limit stated in standard
- Margin (dB)
- = Limit(dBuV/m) – Level (dBuV/m)
- Polarity
- = Antenna polarization

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

1GHz-18GHz

No.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Remark
xxx	xxxx	78.01	55.30	-22.71	74.00	18.70	100	50	Horizontal	Peak
xxx	xxxx	66.37	43.66	-22.71	54.00	10.34	100	50	Horizontal	AVG

Above 18GHz

No.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Remark
xxx	xxxx	54.49	42.38	-12.11	83.54	41.16	100	211	Vertical	Peak
xxx	xxxx	43.99	31.88	-12.11	63.54	31.66	100	211	Vertical	AVG

Frequency (MHz)	= Emission frequency in MHz
Reading (dBuV/m)	= Uncorrected Analyzer / Receiver reading
Factor (dB)	= Antenna factor + Cable loss – Amplifier gain
Level (dBuV/m)	= Reading (dBuV/m) + Factor (dB)
Limit (dBuV/m)	= Limit stated in standard
Margin (dB)	= Limit (dBuV/m) – Level (dBuV/m)
Polarity	= Antenna polarization
Peak	= Peak Reading
AVG	= Average Reading

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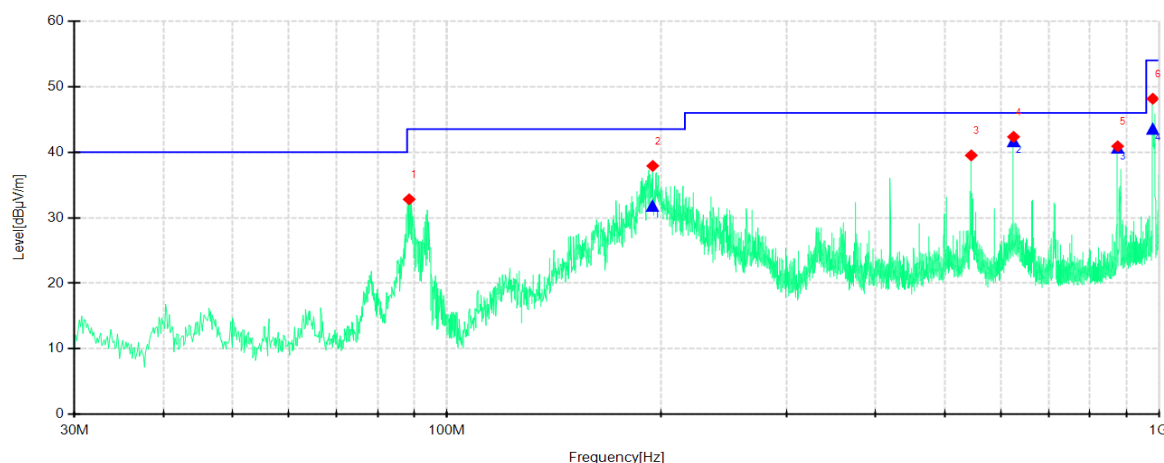
5.5 TEST RESULTS

Pre-scan all mode and recorded the worst case results in this report (Middle Channel(1Mbps))

Below 1GHz

EUT Name	BYD Di5.0F	Model	MTCA05
Environmental Conditions	22.6°C /65%RH/101.0kPa	Test Voltage	DC 12V
Test Mode	TX/ BLE_1M (2440MHz)	Polarity	Horizontal
Tested By	Zhang Zishan	Tested Date	2023-05-26

Test Graph



Suspected Data List

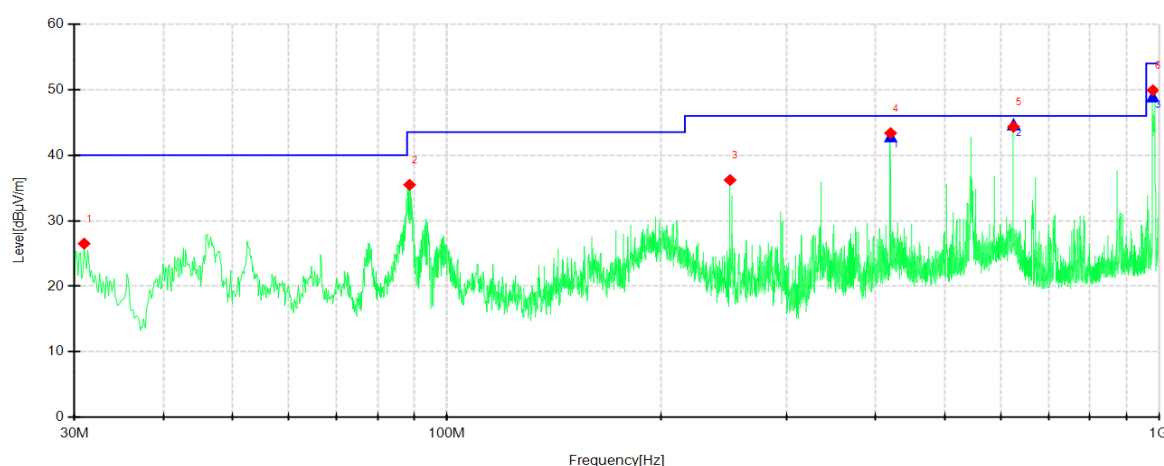
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	88.571	68.58	32.82	-35.76	43.50	10.68	200	36	Horizontal
2	194.678	71.68	37.91	-33.77	43.50	5.59	100	139	Horizontal
3	545.134	63.27	39.51	-23.76	46.00	6.49	100	323	Horizontal
4	625.048	64.33	42.34	-21.99	46.00	3.66	100	19	Horizontal
5	875.096	59.71	40.91	-18.80	46.00	5.09	100	323	Horizontal
6	980.355	66.30	48.15	-18.15	54.00	5.85	100	344	Horizontal

Final Data List

NO.	Freq. [MHz]	Factor [dB]	QP Reading [dBμV/m]	Level [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity
1	194.4582	-33.77	65.58	31.81	43.50	11.69	113	124.4	Horizontal
2	625.020	-21.99	63.65	41.66	46.00	4.34	102	17.5	Horizontal
3	875.0334	-18.80	59.45	40.65	46.00	5.35	100	250.5	Horizontal
4	980.2842	-18.15	61.70	43.55	54.00	10.45	101	342.4	Horizontal

EUT Name	BYD Di5.0F	Model	MTCA05
Environmental Conditions	22.6°C/65%RH/101.0kPa	Test Voltage	DC 12V
Test Mode	TX/ BLE_1M (2440MHz)	Polarity	Vertical
Tested By	Zhang Zishan	Tested Date	2023-05-26

Test Graph



Suspected Data List

NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	30.970	57.48	26.51	-30.97	40.00	13.49	100	16	Vertical
2	88.692	71.25	35.49	-35.76	43.50	8.01	100	117	Vertical
3	249.974	68.28	36.21	-32.07	46.00	9.79	100	255	Vertical
4	419.988	69.98	43.37	-26.61	46.00	2.63	100	57	Vertical
5	625.048	66.31	44.32	-21.99	46.00	1.68	100	204	Vertical
6	980.718	68.05	49.90	-18.15	54.00	4.10	100	16	Vertical

Final Data List

NO.	Freq. [MHz]	Factor [dB]	QP Reading [dBμV/m]	Level [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity
1	420.0131	-26.61	69.47	42.86	46.00	3.14	100	54.6	Vertical
2	625.020	-21.99	66.66	44.67	46.00	1.33	100	220.6	Vertical
3	980.1652	-18.15	67.08	48.93	54.00	5.07	114	343.6	Vertical

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:

Mode: TX/ BLE_1M

Lowest Frequency (2402MHz)

Environment: 22.7°C/57%RH/101.0kPa

Tested By:Zhang Qiang

Voltage: DC 12V

Date: 2023-05-19

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1163.4	72.20	49.50	-22.70	74.00	24.50	100	143	Horizontal
2	1662.8	69.92	48.31	-21.61	74.00	25.69	200	81	Horizontal
3	2497.8	61.41	46.34	-15.07	74.00	27.66	100	345	Horizontal
4	4999.5	59.47	48.90	-10.57	74.00	25.10	100	176	Horizontal
5	9237	49.80	48.83	-0.97	74.00	25.17	100	57	Horizontal
6	15597	44.97	53.39	8.42	74.00	20.61	100	86	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	1165.8	71.13	47.61	-23.52	74.00	26.39	200	9	Vertical
2	2000.4	69.18	48.24	-20.94	74.00	25.76	200	141	Vertical
3	4795.5	58.42	46.47	-11.95	74.00	27.53	100	138	Vertical
4	4999.5	63.47	52.70	-10.77	74.00	21.30	200	158	Vertical
5	5976	59.23	51.22	-8.01	74.00	22.78	100	208	Vertical
6	15015	45.20	51.21	6.01	74.00	22.79	100	351	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	5000.1515	-10.77	58.61	47.84	54.00	6.16	159	153.7	Vertical
2	6000.215	-8.01	49.22	41.21	54.00	12.79	107	248.7	Vertical

Mode: TX/ BLE_1M

Middle Frequency (2440MHz)

Environment: 22.7°C/57%RH/101.0kPa

Tested By:Zhang Qiang

Voltage: DC 12V

Date: 2023-05-19

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1164.8	69.99	47.29	-22.70	74.00	26.71	100	152	Horizontal
2	1659.8	68.76	47.14	-21.62	74.00	26.86	200	323	Horizontal
3	2498	60.47	45.41	-15.06	74.00	28.59	100	343	Horizontal
4	4999.5	58.26	47.69	-10.57	74.00	26.31	100	177	Horizontal
5	12847.5	46.17	51.48	5.31	74.00	22.52	100	289	Horizontal
6	15831	44.48	52.15	7.67	74.00	21.85	200	342	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	15831	7.67	35.24	42.91	54.00	11.09	200	342	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	1200	74.31	51.53	-22.78	74.00	22.47	200	345	Vertical
2	1990	67.52	46.60	-20.92	74.00	27.40	100	154	Vertical
3	3330	61.97	46.24	-15.73	74.00	27.76	100	148	Vertical
4	4999.5	63.33	52.56	-10.77	74.00	21.44	100	178	Vertical
5	9195	48.37	48.21	-0.16	74.00	25.79	200	291	Vertical
6	13860	45.25	51.65	6.40	74.00	22.35	200	291	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	1199.219	-22.78	61.72	38.94	54.00	15.06	200	0.1	Vertical
2	5000.1515	-10.77	59.57	48.80	54.00	5.20	113	171.8	Vertical
3	13860	6.40	34.25	40.65	54.00	13.35	200	291	Vertical

Mode: TX/ BLE_1M

Highest Frequency (2480MHz)

Environment: 22.7°C/57%RH/101.0kPa

Tested By:Zhang Qiang

Voltage: DC 12V

Date: 2023-05-19

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1163.2	70.26	47.56	-22.70	74.00	26.44	100	148	Horizontal
2	1662.6	70.40	48.79	-21.61	74.00	25.21	200	87	Horizontal
3	2497.8	60.97	45.90	-15.07	74.00	28.10	200	36	Horizontal
4	4999.5	59.70	49.13	-10.57	74.00	24.87	100	181	Horizontal
5	9687	49.01	48.89	-0.12	74.00	25.11	100	152	Horizontal
6	15649.5	44.49	52.44	7.95	74.00	21.56	200	254	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	1662.6	-21.61	60.25	38.64	54.00	15.36	200	87	Horizontal
2	4999.5	-10.57	55.21	44.64	54.00	9.36	100	181	Horizontal
3	15649.5	7.95	35.55	43.50	54.00	10.50	200	254	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	1197.8	74.37	51.54	-22.83	74.00	22.46	200	15	Vertical
2	1998.2	70.48	49.53	-20.95	74.00	24.47	100	137	Vertical
3	2666.4	63.13	45.61	-17.52	74.00	28.39	100	126	Vertical
4	4999.5	64.63	53.86	-10.77	74.00	20.14	100	172	Vertical
5	6000	58.93	50.62	-8.31	74.00	23.38	100	275	Vertical
6	13864.5	45.44	51.82	6.38	74.00	22.18	200	152	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	1197.8	-22.83	60.36	37.53	54.00	16.47	200	15	Vertical
2	5000.0785	-10.77	60.73	49.96	54.00	4.04	134	173.8	Vertical
3	5999.826	-8.31	50.61	42.30	54.00	11.70	100	246.5	Vertical
4	13864.5	6.38	34.57	40.95	54.00	13.05	200	152	Vertical

Mode: TX/ BLE_2M

Lowest Frequency (2402MHz)

Environment: 22.7°C/57%RH/101.0kPa

Tested By:Zhang Qiang

Voltage: DC 12V

Date: 2023-05-19

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1196.2	69.85	47.08	-22.77	74.00	26.92	100	42	Horizontal
2	1665.2	69.93	48.32	-21.61	74.00	25.68	100	142	Horizontal
3	2303.8	62.77	45.48	-17.29	74.00	28.52	200	344	Horizontal
4	4999.5	58.23	47.66	-10.57	74.00	26.34	100	176	Horizontal
5	10537.5	47.79	49.09	1.30	74.00	24.91	100	35	Horizontal
6	13873.5	45.04	51.06	6.02	74.00	22.94	100	136	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	1665.2	-21.61	60.22	38.61	54.00	15.39	100	142	Horizontal
2	13873.5	6.02	35.25	41.27	54.00	12.73	100	136	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	1199.2	74.60	51.80	-22.80	74.00	22.20	200	171	Vertical
2	1988.4	71.08	50.16	-20.92	74.00	23.84	200	142	Vertical
3	2656	66.32	48.81	-17.51	74.00	25.19	100	40	Vertical
4	4999.5	62.55	51.78	-10.77	74.00	22.22	200	159	Vertical
5	10509	47.91	49.80	1.89	74.00	24.20	200	117	Vertical
6	15073.5	45.11	52.09	6.98	74.00	21.91	100	217	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	5000.1515	-10.77	59.05	48.28	54.00	5.72	165	155.6	Vertical
2	15073.5	6.98	35.69	42.67	54.00	11.33	100	217	Vertical

Mode: TX/ BLE_2M

Middle Frequency (2440MHz)

Environment: 22.7°C/57%RH/101.0kPa

Tested By:Zhang Qiang

Voltage: DC 12V

Date: 2023-05-19

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1166.6	69.19	46.49	-22.70	74.00	27.51	100	147	Horizontal
2	1660	69.46	47.84	-21.62	74.00	26.16	200	87	Horizontal
3	2315.4	63.94	46.42	-17.52	74.00	27.58	100	126	Horizontal
4	4999.5	59.27	48.70	-10.57	74.00	25.30	200	194	Horizontal
5	10555.5	48.33	49.60	1.27	74.00	24.40	200	42	Horizontal
6	15606	43.72	52.14	8.42	74.00	21.86	100	33	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	15606	8.42	35.24	43.66	54.00	10.34	100	33	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	1197.6	73.86	51.03	-22.83	74.00	22.97	200	16	Vertical
2	1666.8	69.95	47.54	-22.41	74.00	26.46	100	126	Vertical
3	3981	62.16	47.40	-14.76	74.00	26.60	100	113	Vertical
4	4999.5	63.85	53.08	-10.77	74.00	20.92	100	163	Vertical
5	6000	56.31	48.00	-8.31	74.00	26.00	100	275	Vertical
6	13467	44.49	51.08	6.59	74.00	22.92	100	163	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	1197.843	-22.83	62.41	39.58	54.00	14.42	165	16.6	Vertical
2	5000.0065	-10.77	60.46	49.69	54.00	4.31	162	172.6	Vertical
3	13467	6.59	36.66	43.25	54.00	10.75	100	163	Vertical

Mode: TX/ BLE_2M

Highest Frequency (2480MHz)

Environment: 22.7°C/57%RH/101.0kPa

Tested By:Zhang Qiang

Voltage: DC 12V

Date: 2023-05-19

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1164.6	69.90	47.20	-22.70	74.00	26.80	200	146	Horizontal
2	1666.2	69.86	48.25	-21.61	74.00	25.75	200	85	Horizontal
3	2301.4	65.10	47.86	-17.24	74.00	26.14	100	138	Horizontal
4	3328.5	60.71	44.56	-16.15	74.00	29.44	100	141	Horizontal
5	4999.5	59.80	49.23	-10.57	74.00	24.77	100	183	Horizontal
6	15672	44.78	52.28	7.50	74.00	21.72	100	162	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	5000.1515	-10.57	57.44	46.87	54.00	7.13	112	176.3	Horizontal
2	15672	7.50	35.26	42.76	54.00	11.24	100	162	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	1196	73.00	50.13	-22.87	74.00	23.87	200	14	Vertical
2	1997	68.79	47.85	-20.94	74.00	26.15	200	148	Vertical
3	3319.5	63.34	47.46	-15.88	74.00	26.54	100	131	Vertical
4	4999.5	64.04	53.27	-10.77	74.00	20.73	100	172	Vertical
5	6000	57.83	49.52	-8.31	74.00	24.48	100	243	Vertical
6	15058.5	45.41	52.04	6.63	74.00	21.96	200	50	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	1196	-22.87	61.25	38.38	54.00	15.62	200	14	Vertical
2	5000.1515	-10.77	59.97	49.20	54.00	4.80	133	174.6	Vertical
3	15058.5	6.63	34.58	41.21	54.00	12.79	200	50	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-scan all modes and recorded the worst case results in this report (BLE_1M). The peak test results is less than the average limits, so the average test results had not reported.

Mode: TX/ BLE_1M
Lowest Frequency (2402MHz)
Environment: 21.5℃/65%RH/101.0kPa
Tested By: Zhang Zishan

Voltage: DC 12.0V
Date: 2023-05-20

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	18663.425	52.00	34.63	-17.37	83.54	48.91	150	344	Horizontal
2	19683	51.42	34.66	-16.76	83.54	48.88	150	234	Horizontal
3	22074.475	49.43	33.74	-15.69	83.54	49.80	150	44	Horizontal
4	23347.775	50.30	35.38	-14.92	83.54	48.16	150	30	Horizontal
5	25121.3	46.86	32.95	-13.91	83.54	50.59	150	141	Horizontal
6	26132.375	47.39	33.06	-14.33	83.54	50.48	150	266	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	18969.85	51.90	34.83	-17.07	83.54	48.71	150	16	Vertical
2	19986.875	51.36	34.57	-16.79	83.54	48.97	150	79	Vertical
3	21204.925	49.90	33.83	-16.07	83.54	49.71	150	236	Vertical
4	23348.2	51.87	36.99	-14.88	83.54	46.55	150	31	Vertical
5	25158.7	47.44	33.34	-14.10	83.54	50.20	150	315	Vertical
6	25593.9	47.68	33.58	-14.10	83.54	49.96	150	188	Vertical

Note: The pre measurement result margin is greater than 20dB, and final measurement is not required

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

Mode: TX/ BLE_1M
Middle Frequency (2440MHz)
Environment: 21.5°C/65%RH/101.0kPa
Tested By: Zhang Zishan

Voltage: DC 12.0V
Date: 2023-05-20

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	18821.1	51.62	34.43	-17.19	83.54	49.11	150	171	Horizontal
2	19951.6	51.14	34.61	-16.53	83.54	48.93	150	157	Horizontal
3	21059.15	50.04	34.03	-16.01	83.54	49.51	150	234	Horizontal
4	23012.45	48.57	33.83	-14.74	83.54	49.71	150	314	Horizontal
5	23348.2	51.17	36.25	-14.92	83.54	47.29	150	31	Horizontal
6	25119.6	46.74	32.83	-13.91	83.54	50.71	150	14	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	18011.475	52.93	34.53	-18.40	83.54	49.01	150	30	Vertical
2	18969.85	53.53	36.46	-17.07	83.54	47.08	150	77	Vertical
3	20430.15	50.76	34.02	-16.74	83.54	49.52	150	328	Vertical
4	21645.225	49.30	33.40	-15.90	83.54	50.14	150	313	Vertical
5	23347.35	50.29	35.41	-14.88	83.54	48.13	150	45	Vertical
6	25491.9	46.99	32.94	-14.05	83.54	50.60	150	140	Vertical

Note: The pre measurement result margin is greater than 20dB, and final measurement is not required

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

Mode: TX/ BLE_1M
Highest Frequency (2480MHz)
Environment: 21.5℃/65%RH/101.0kPa
Tested By: Zhang Zishan

Voltage: DC 12.0V
Date: 2023-05-20

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	18911.625	52.66	35.59	-17.07	83.54	47.95	150	344	Horizontal
2	19536.375	51.97	35.13	-16.84	83.54	48.41	150	218	Horizontal
3	21164.125	49.32	33.40	-15.92	83.54	50.14	150	171	Horizontal
4	23347.35	50.41	35.49	-14.92	83.54	48.05	150	28	Horizontal
5	25018.875	48.13	34.28	-13.85	83.54	49.26	150	0	Horizontal
6	25736.275	47.28	32.99	-14.29	83.54	50.55	150	0	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	18534.65	51.62	34.13	-17.49	83.54	49.41	150	32	Vertical
2	19484.95	51.66	34.58	-17.08	83.54	48.96	150	110	Vertical
3	21027.7	50.25	34.11	-16.14	83.54	49.43	150	329	Vertical
4	22998.425	48.23	33.50	-14.73	83.54	50.04	150	267	Vertical
5	23348.2	51.05	36.17	-14.88	83.54	47.37	150	32	Vertical
6	25080.925	47.00	32.99	-14.01	83.54	50.55	150	110	Vertical

Note: The pre measurement result margin is greater than 20dB, and final measurement is not required

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6. 6dB BANDWIDTH

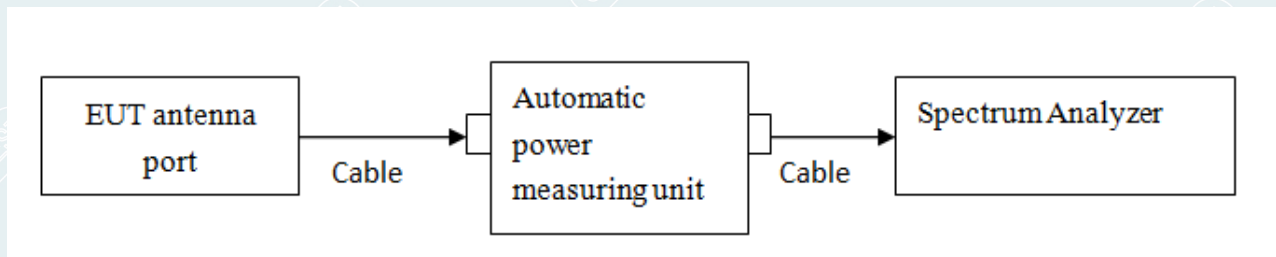
6.1 LIMITS

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.

6.2 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) $\geq 3 \times$ 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.

6.3 TEST SETUP



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

6.4 TEST RESULTS

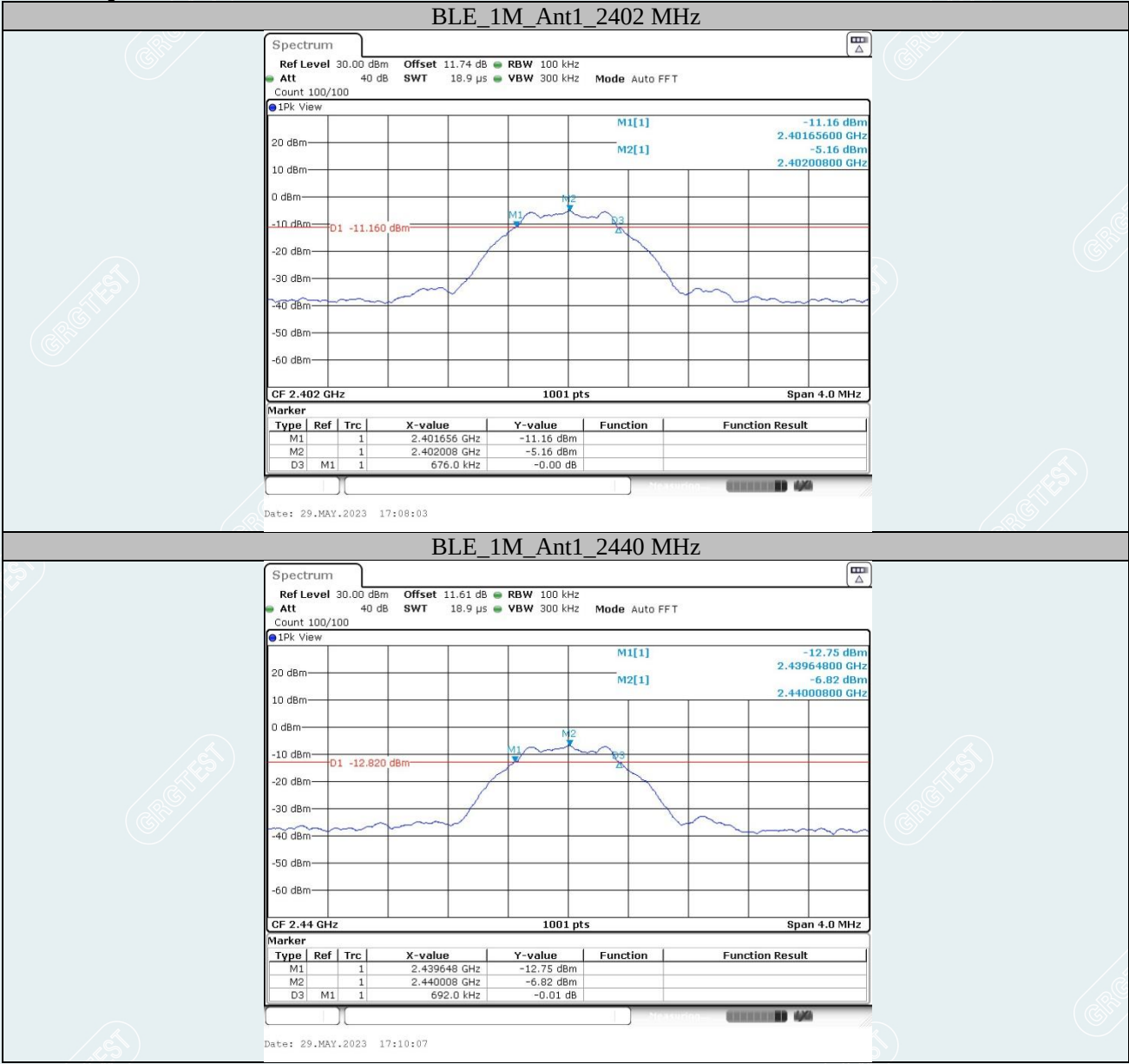
Environment: 25.2℃/61%RH/101.0kPa
Tested By: Qin Tingting

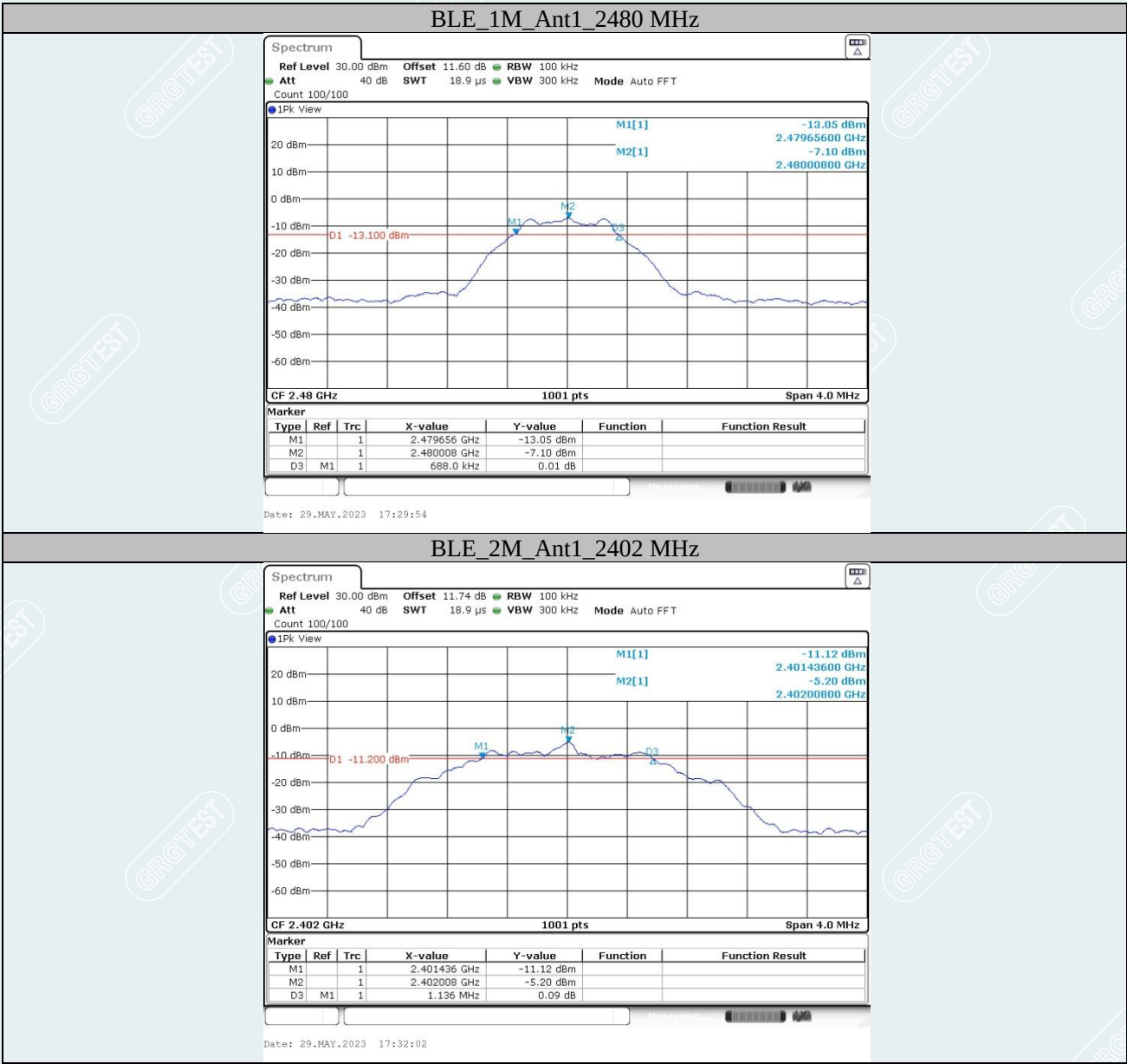
Voltage: DC 12V
Date: 2023-05-29

TestMode	Antenna	Freq(MHz)	Bandwidth[kHz]	Limit[kHz]	Verdict
BLE_1M	Ant1	2402	676	≥500	PASS
		2440	692		PASS
		2480	688		PASS
BLE_2M	Ant1	2402	1136		PASS
		2440	1148		PASS
		2480	1144		PASS

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

Test Graphs







7. MAXIMUM PEAK OUTPUT POWER

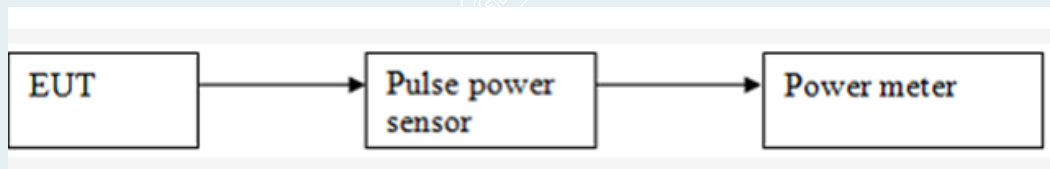
7.1 LIMITS

The maximum Peak output power measurement is 1W

7.2 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.

7.3 TEST SETUP



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

7.4 TEST RESULTS

Environment: 25.2°C/61%RH/101.0kPa
Tested By: Qin Tingting

Voltage: DC 12V
Date: 2023-05-29

BLE_1M

Channel	Frequency (MHz)	Measured Channel Power (dBm)	Limit	Peak/ Average	Result
Lowest	2402	-4.81	1W (30dBm)	Peak	Pass
Middle	2440	-5.44			Pass
Highest	2480	-6.11			Pass

BLE_2M

Channel	Frequency (MHz)	Measured Channel Power (dBm)	Limit	Peak/ Average	Result
Lowest	2402	-4.71	1W (30dBm)	Peak	Pass
Middle	2440	-5.13			Pass
Highest	2480	-6.05			Pass

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8. POWER SPECTRAL DENSITY

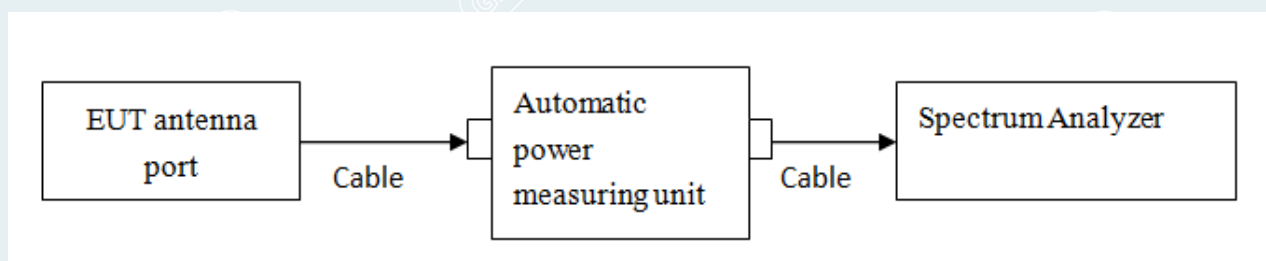
8.1 LIMITS

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.

8.2 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 $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$. Set the VBW $\geq [3 \times \text{RBW}]$. 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.

8.3 TEST SETUP



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

8.4 TEST RESULTS

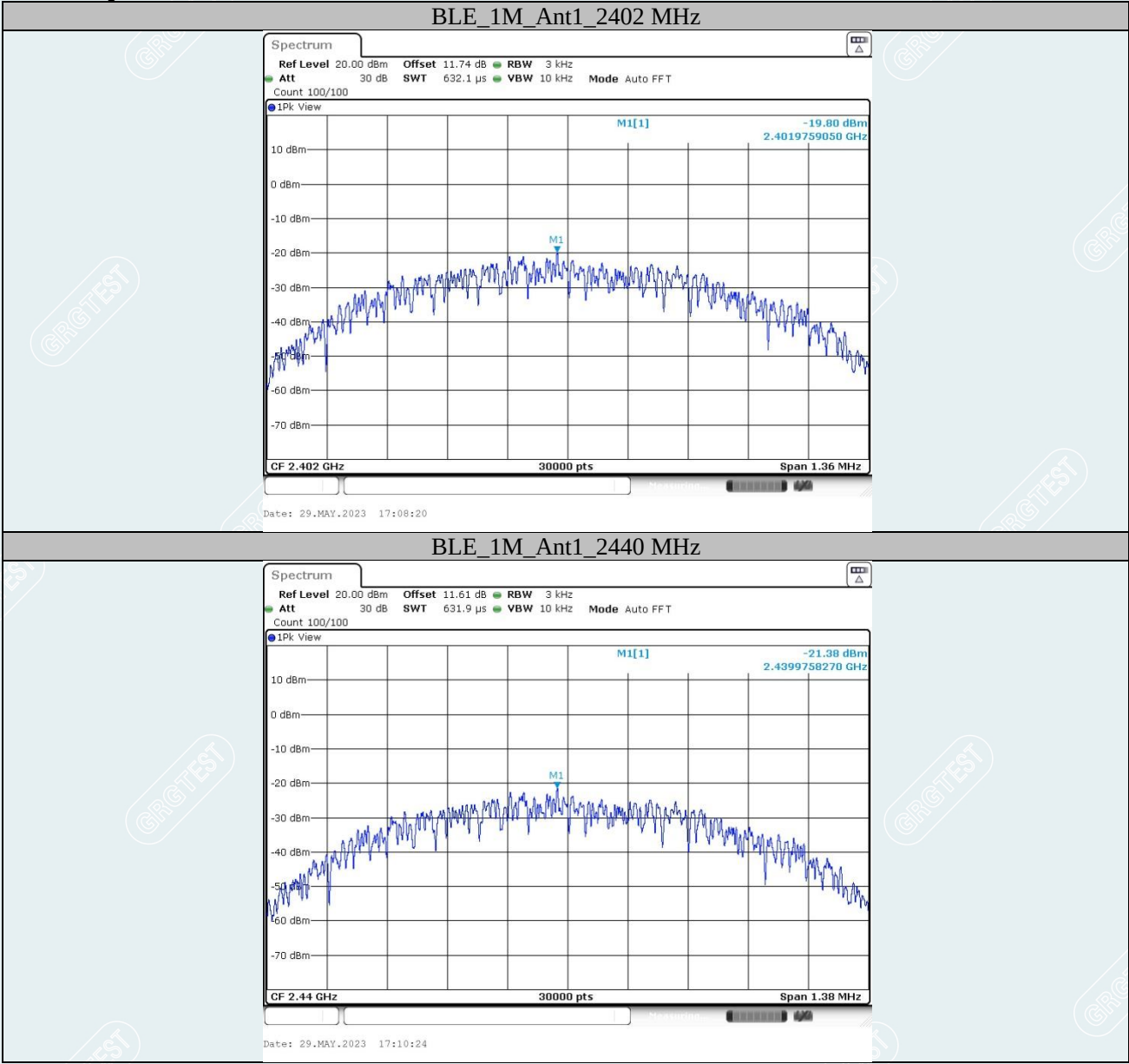
Environment: 25.2℃/61%RH/101.0kPa
Tested By: Qin Tingting

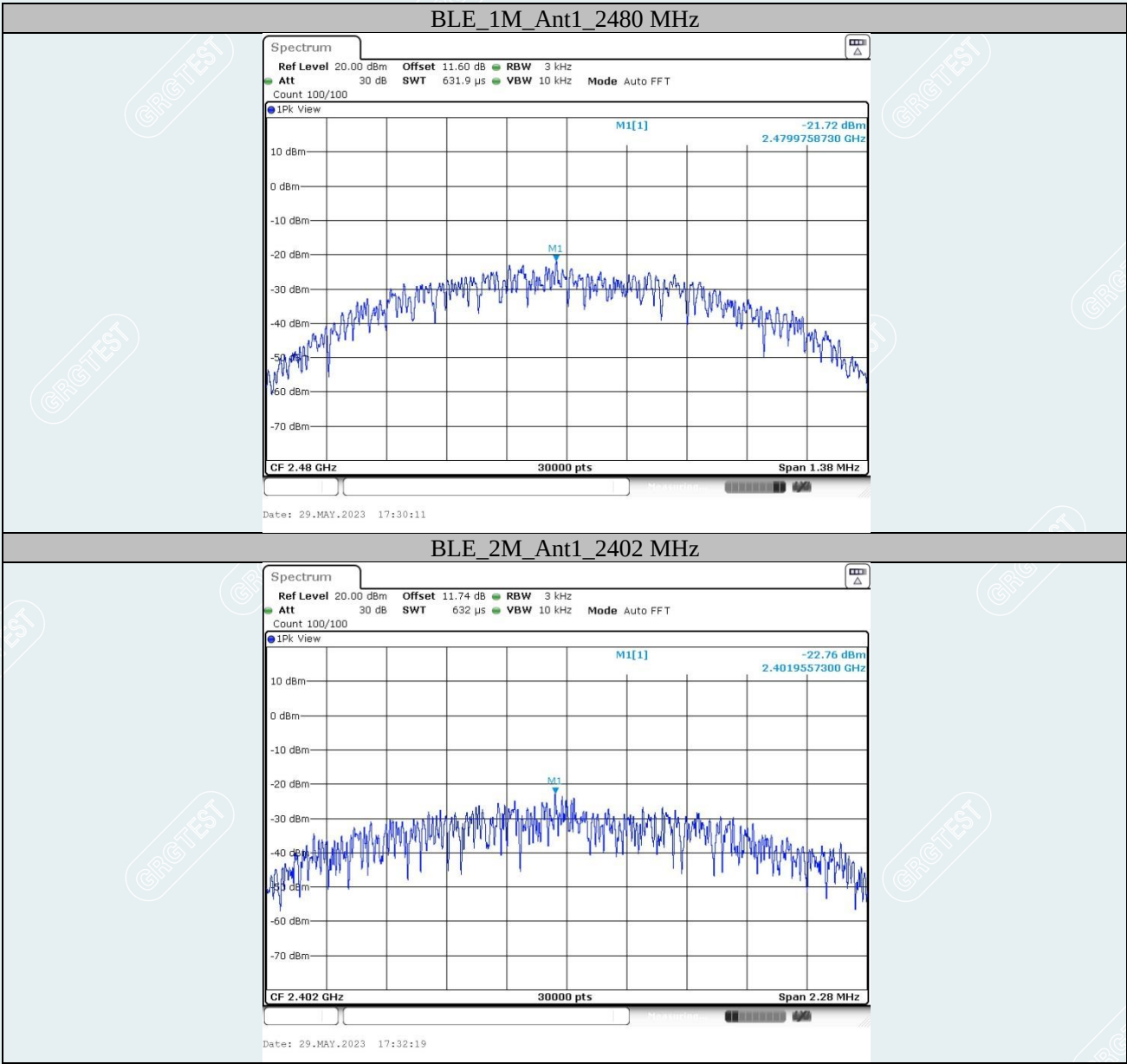
Voltage: DC 12V
Date: 2023-05-29

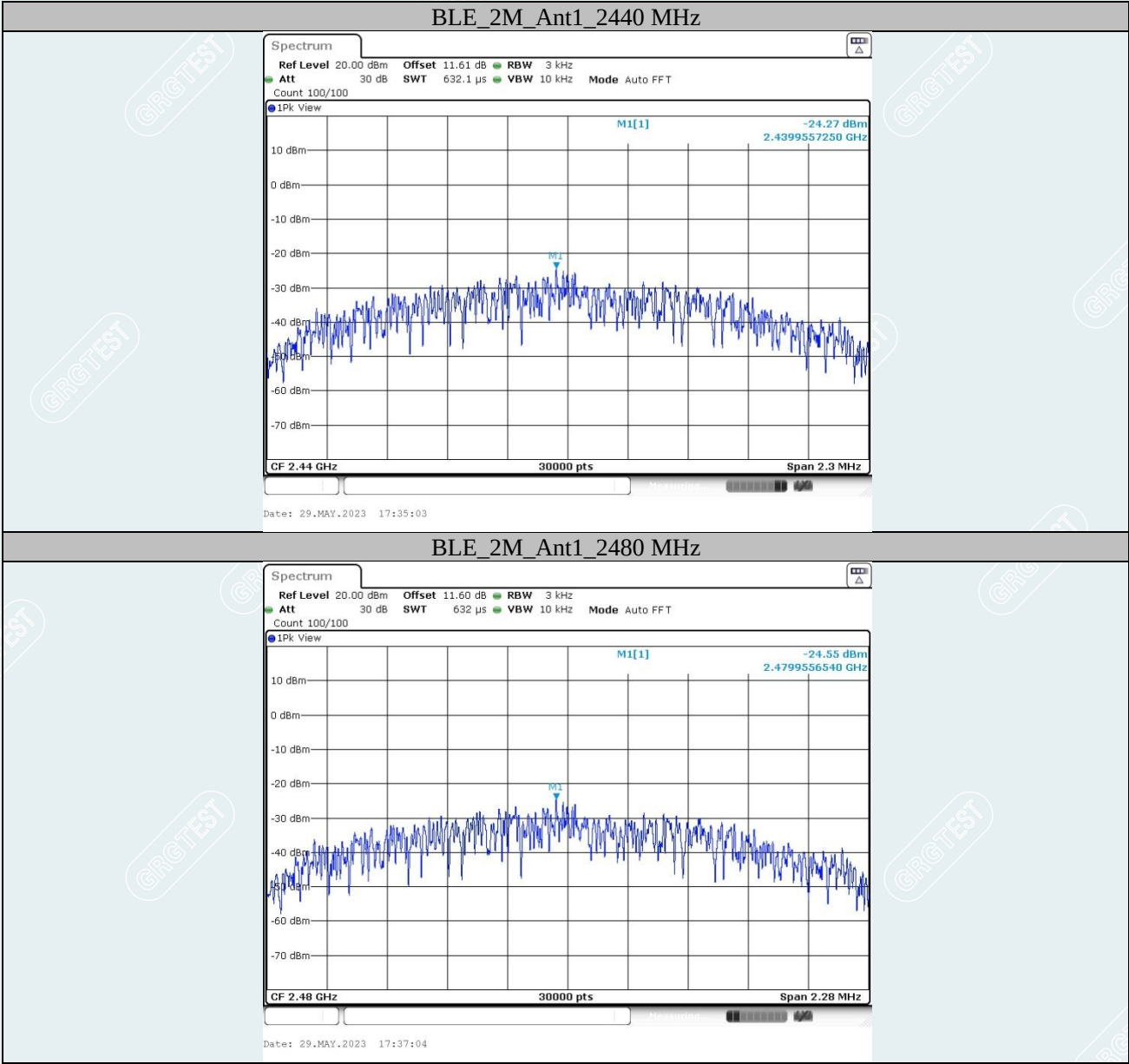
TestMode	Antenna	Freq(MHz)	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
BLE_1M	Ant1	2402	-19.80	≤8.00	PASS
		2440	-21.38	≤8.00	PASS
		2480	-21.72	≤8.00	PASS
BLE_2M	Ant1	2402	-22.76	≤8.00	PASS
		2440	-24.27	≤8.00	PASS
		2480	-24.55	≤8.00	PASS

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

Test Graphs







9. CONDUCTED BAND EDGES AND SPURIOUS EMISSIONS

9.1 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.

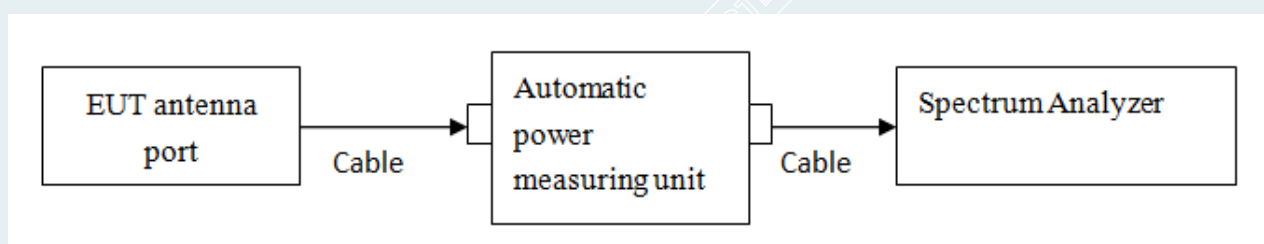
9.2 TEST PROCEDURES

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.

9.3 TEST SETUP



9.4 TEST RESULTS

Environment: 25.2°C/61%RH/101.0kPa

Voltage: DC 12V

Tested By: Qin Tingting

Date: 2023-05-29

Band edge

TestMode	Antenna	ChName	Freq(MHz)	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	Low	2402	-5.27	-43.96	≤-25.27	PASS
		High	2480	-7.17	-44.1	≤-27.17	PASS
BLE_2M	Ant1	Low	2402	-5.30	-44.76	≤-25.3	PASS
		High	2480	-7.10	-44.06	≤-27.1	PASS

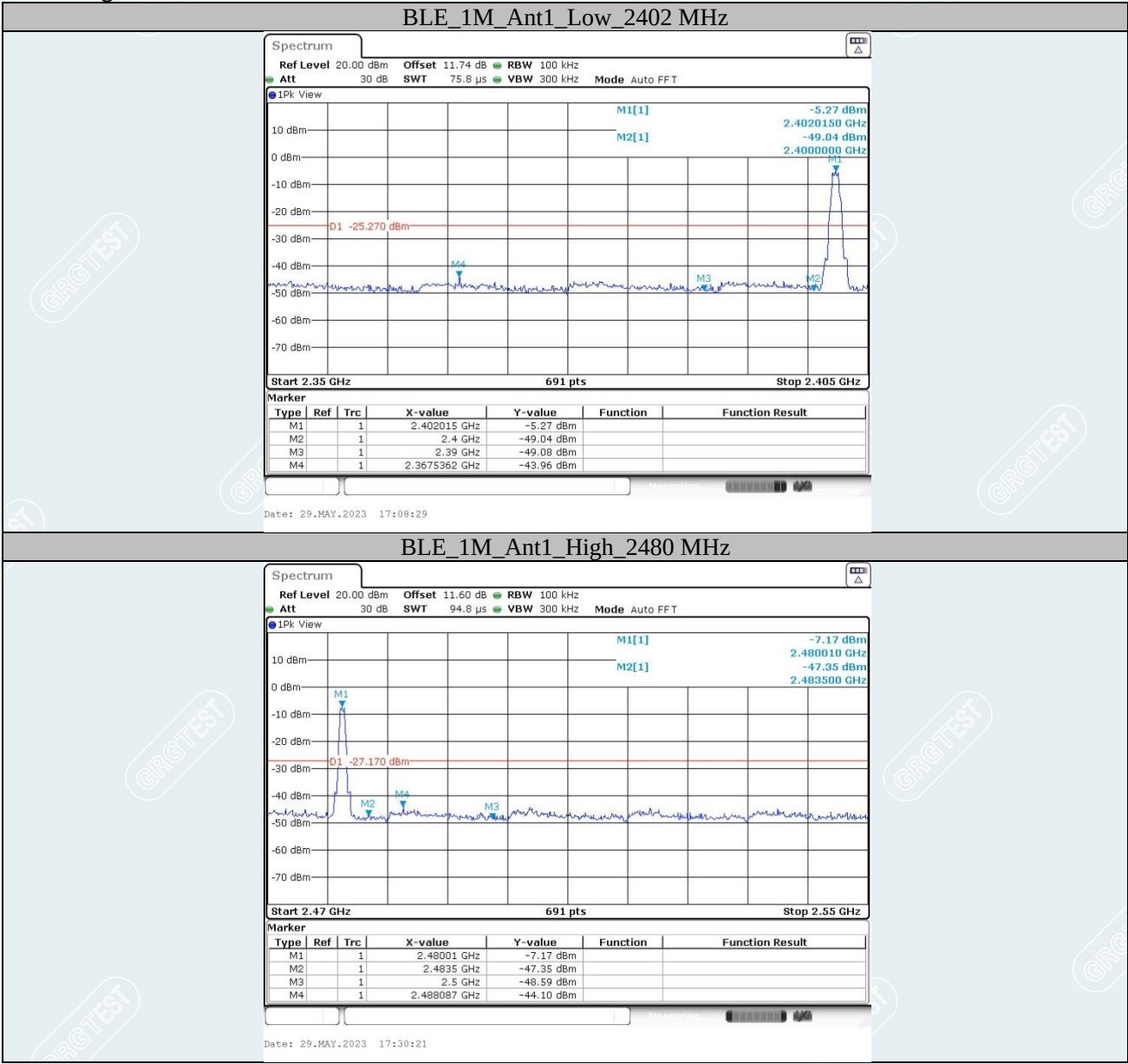
Conducted Spurious Emission

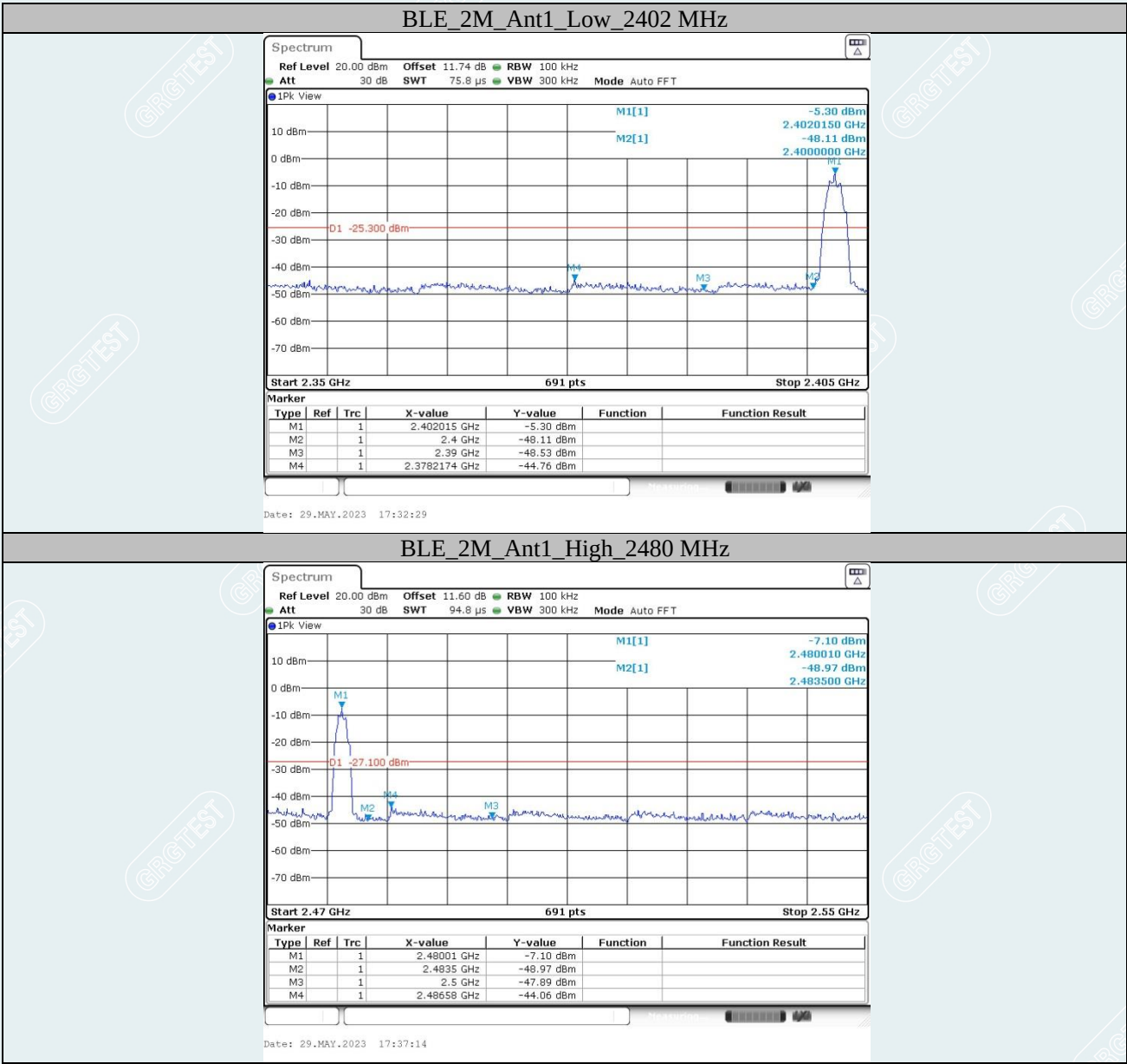
TestMode	Antenna	Freq(MHz)	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	Reference	-5.19	-5.19	---	PASS
			30~1000	-5.19	-54.99	≤-25.19	PASS
			1000~26500	-5.19	-41.11	≤-25.19	PASS
		2440	Reference	-6.80	-6.80	---	PASS
			30~1000	-6.80	-55.49	≤-26.8	PASS
			1000~26500	-6.80	-41.35	≤-26.8	PASS
		2480	Reference	-7.16	-7.16	---	PASS
			30~1000	-7.16	-55.2	≤-27.16	PASS
			1000~26500	-7.16	-41.32	≤-27.16	PASS
BLE_2M	Ant1	2402	Reference	-5.23	-5.23	---	PASS
			30~1000	-5.23	-55.55	≤-25.23	PASS
			1000~26500	-5.23	-41.44	≤-25.23	PASS
		2440	Reference	-6.84	-6.84	---	PASS
			30~1000	-6.84	-54.47	≤-26.84	PASS
			1000~26500	-6.84	-41.57	≤-26.84	PASS
		2480	Reference	-7.14	-7.14	---	PASS
			30~1000	-7.14	-54.8	≤-27.14	PASS
			1000~26500	-7.14	-41.95	≤-27.14	PASS

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

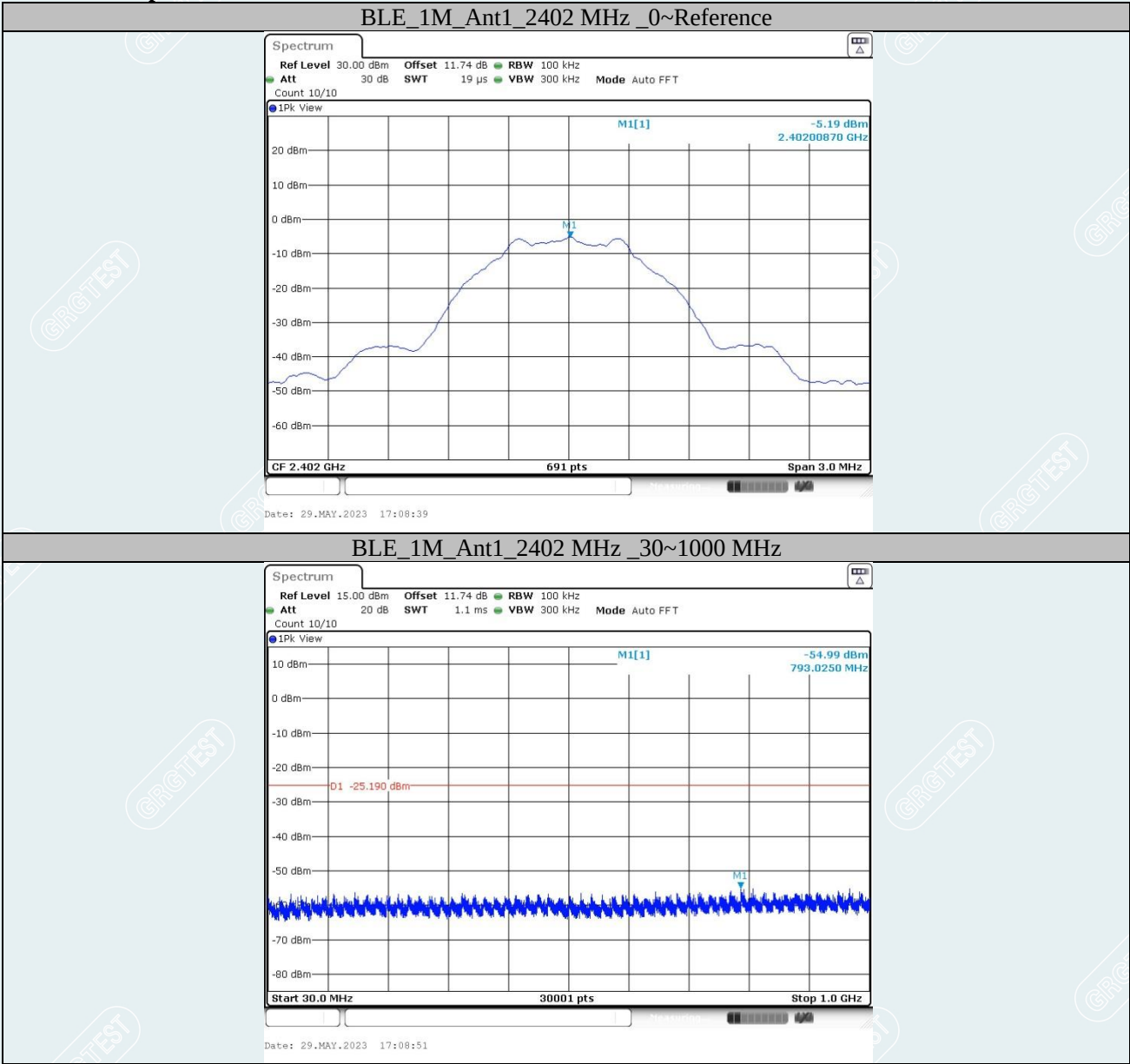
Test Graphs

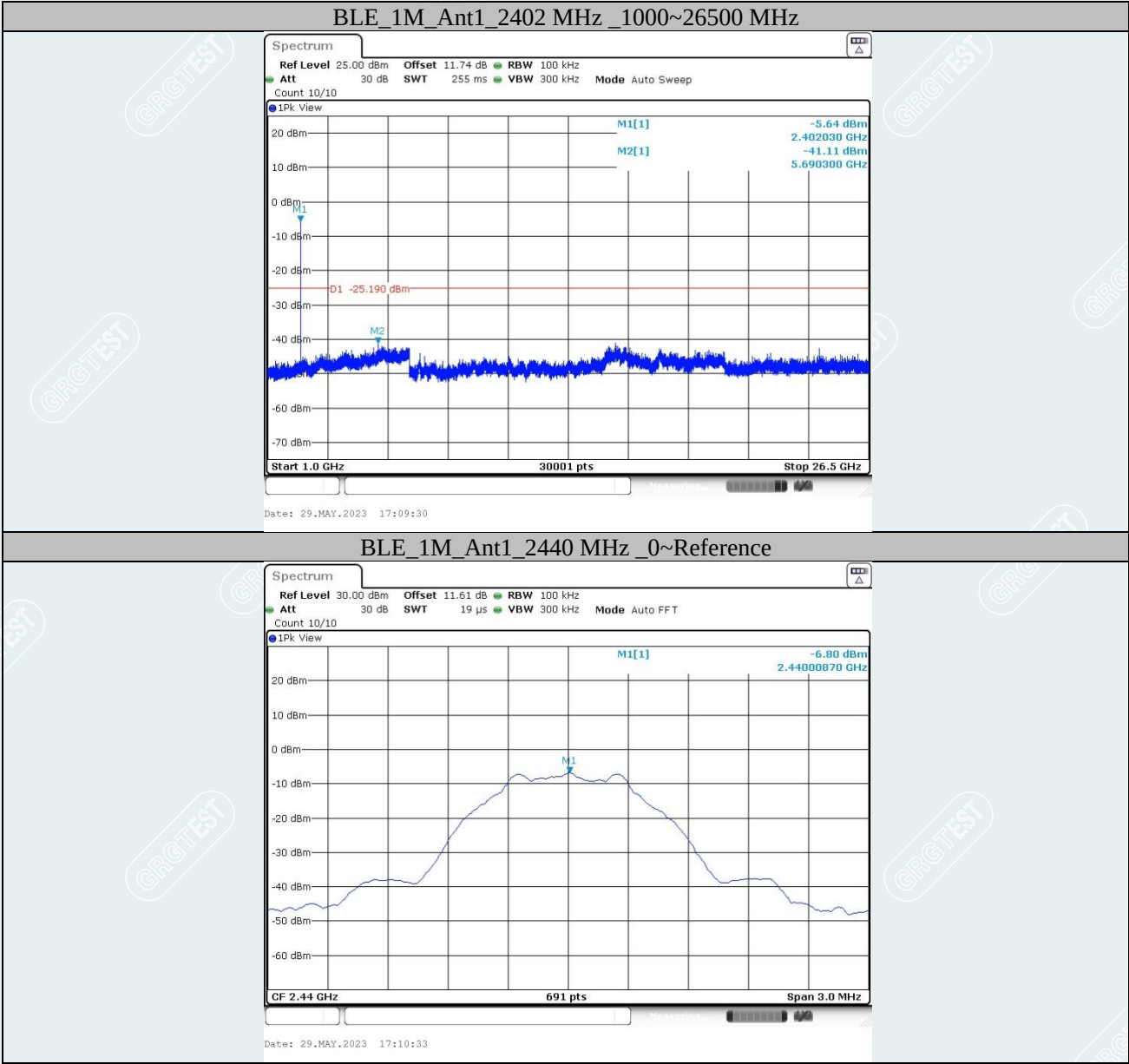
Band edge

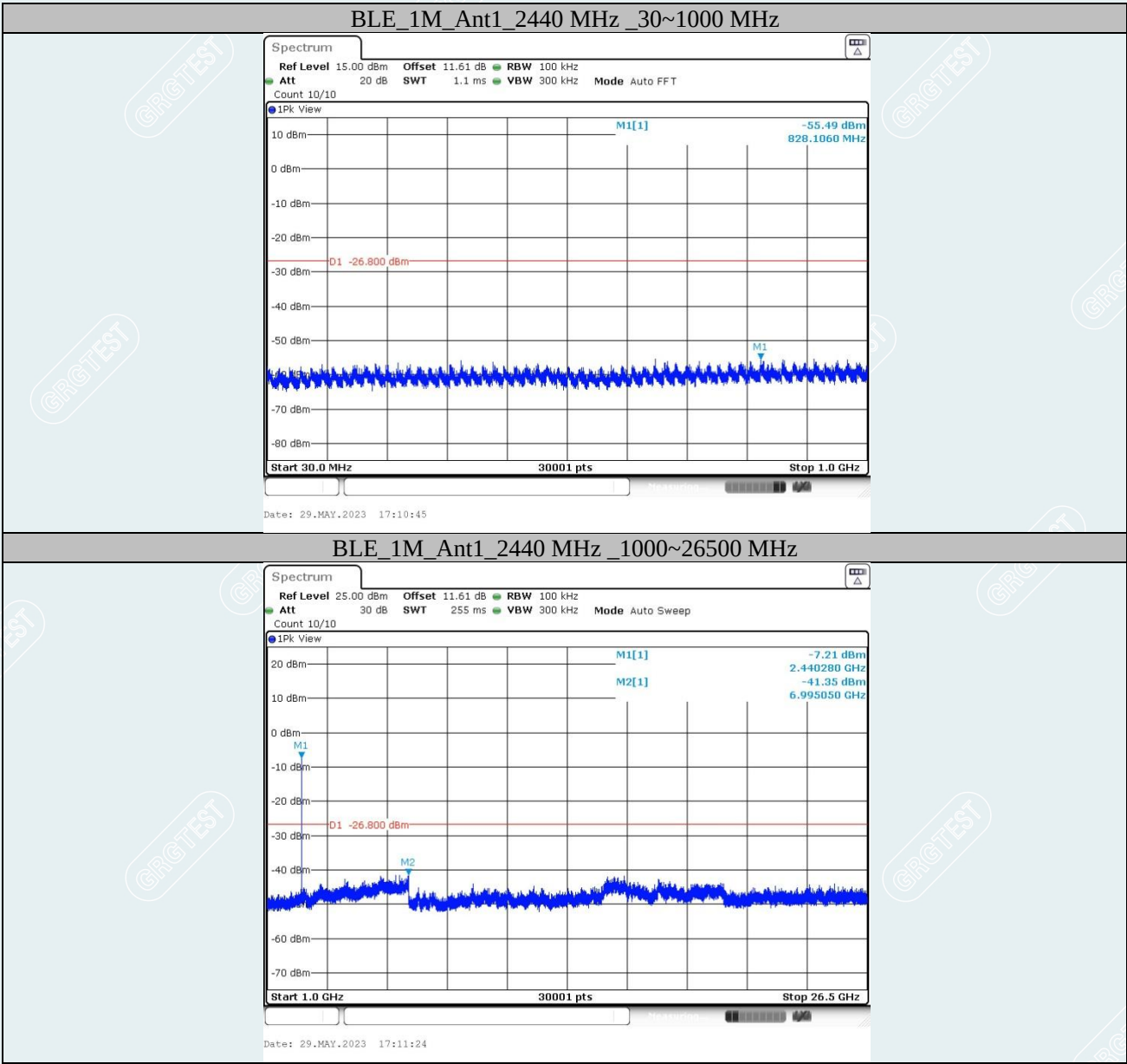


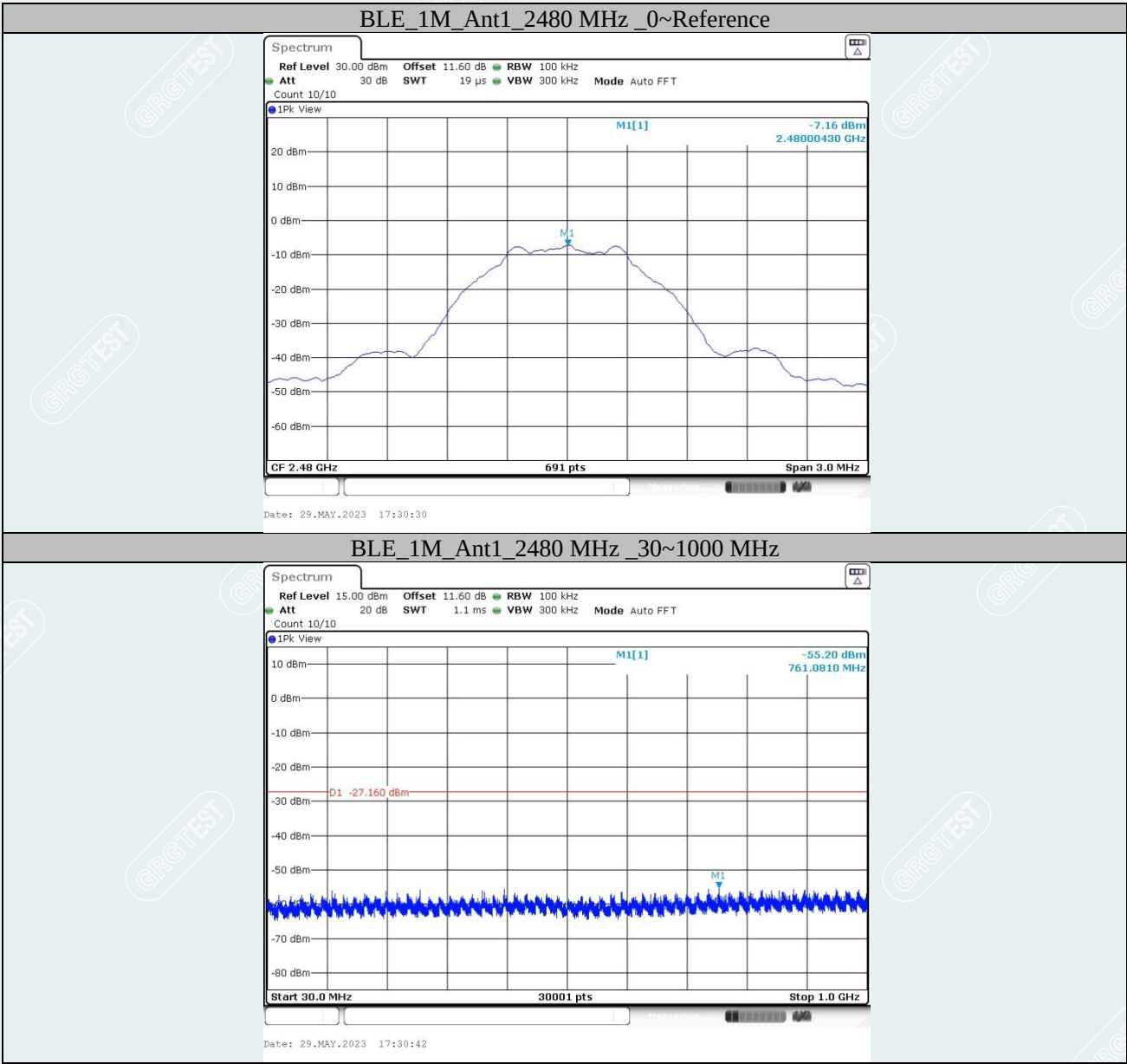


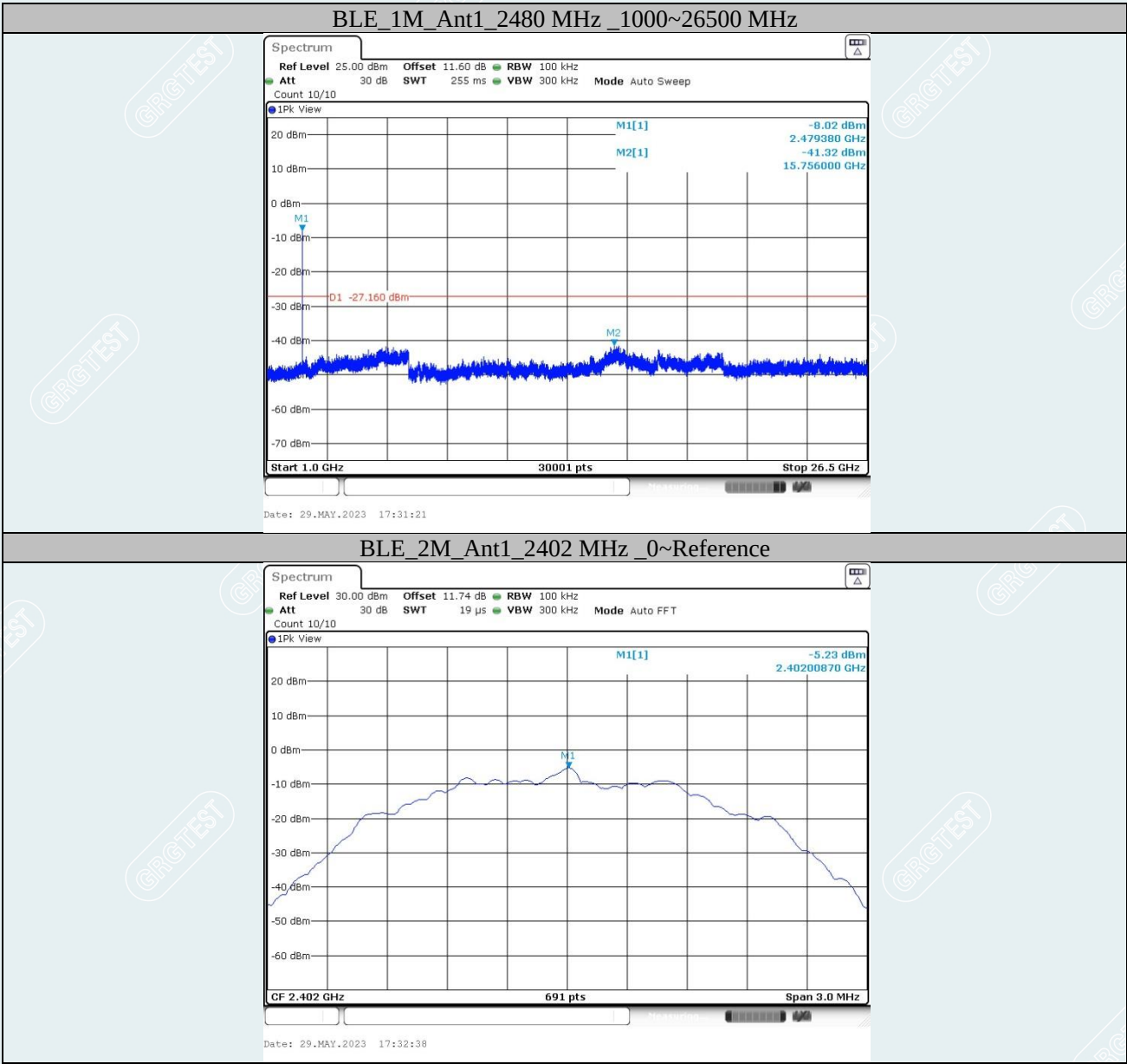
Conducted Spurious Emission

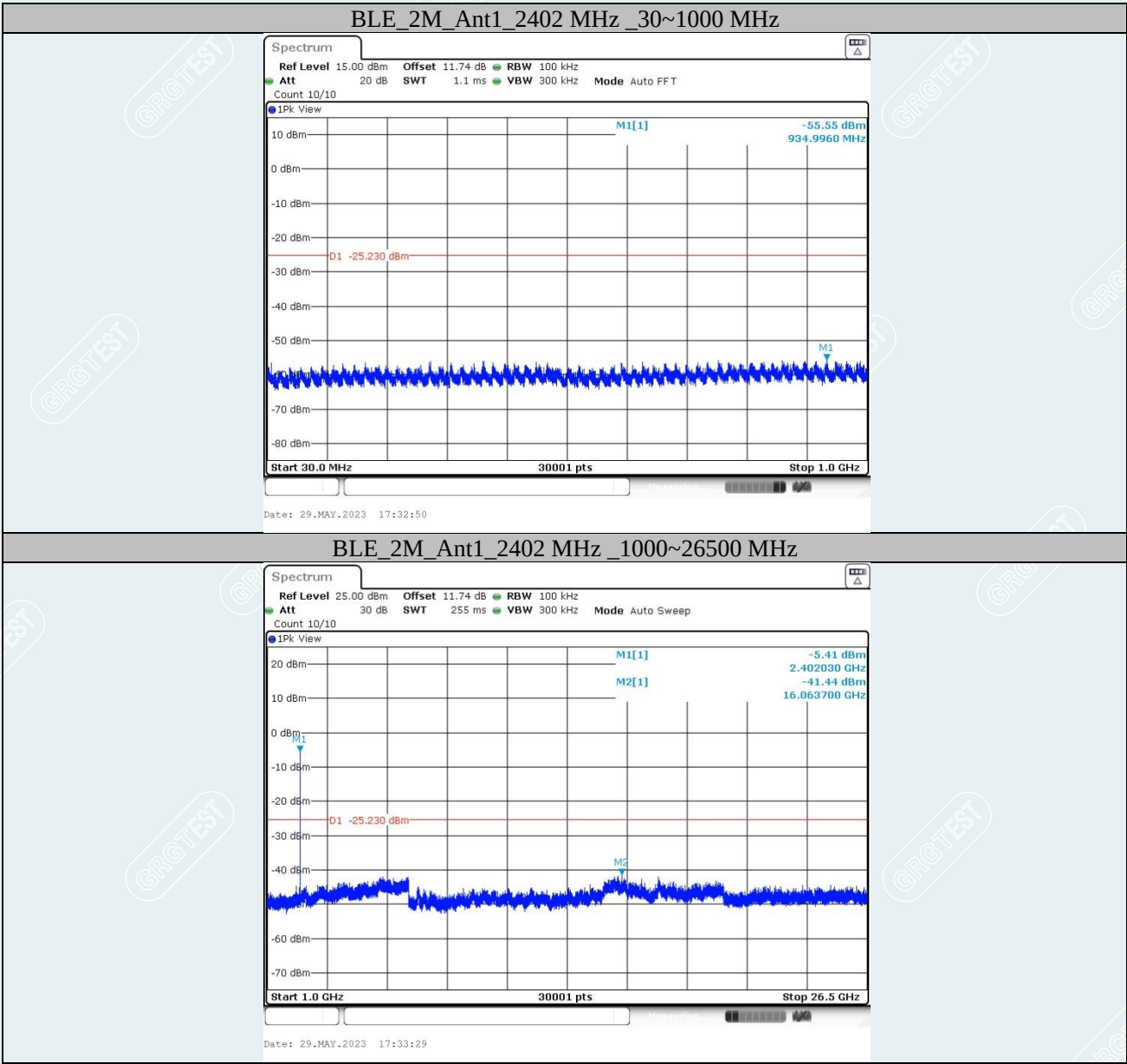


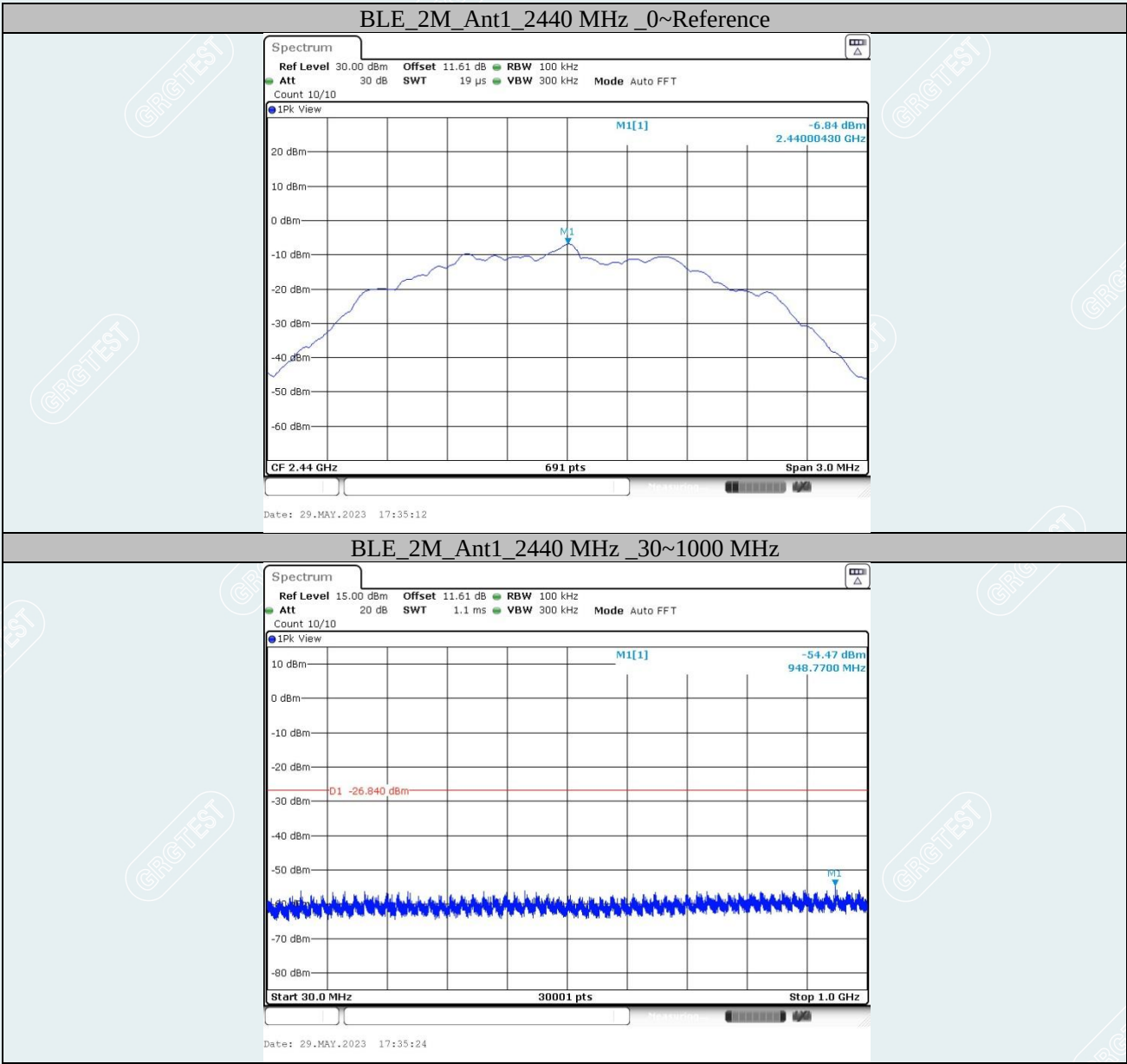


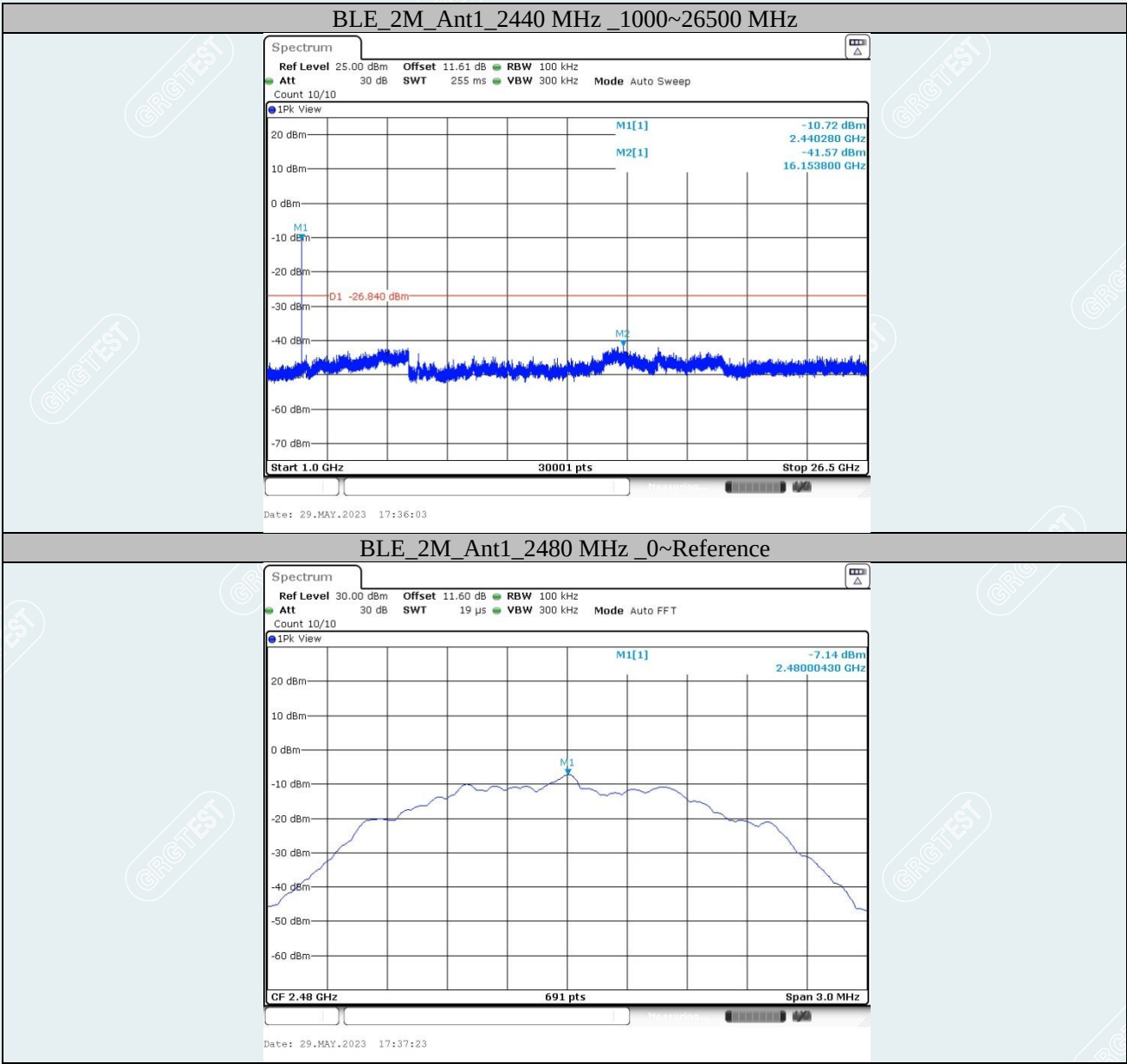


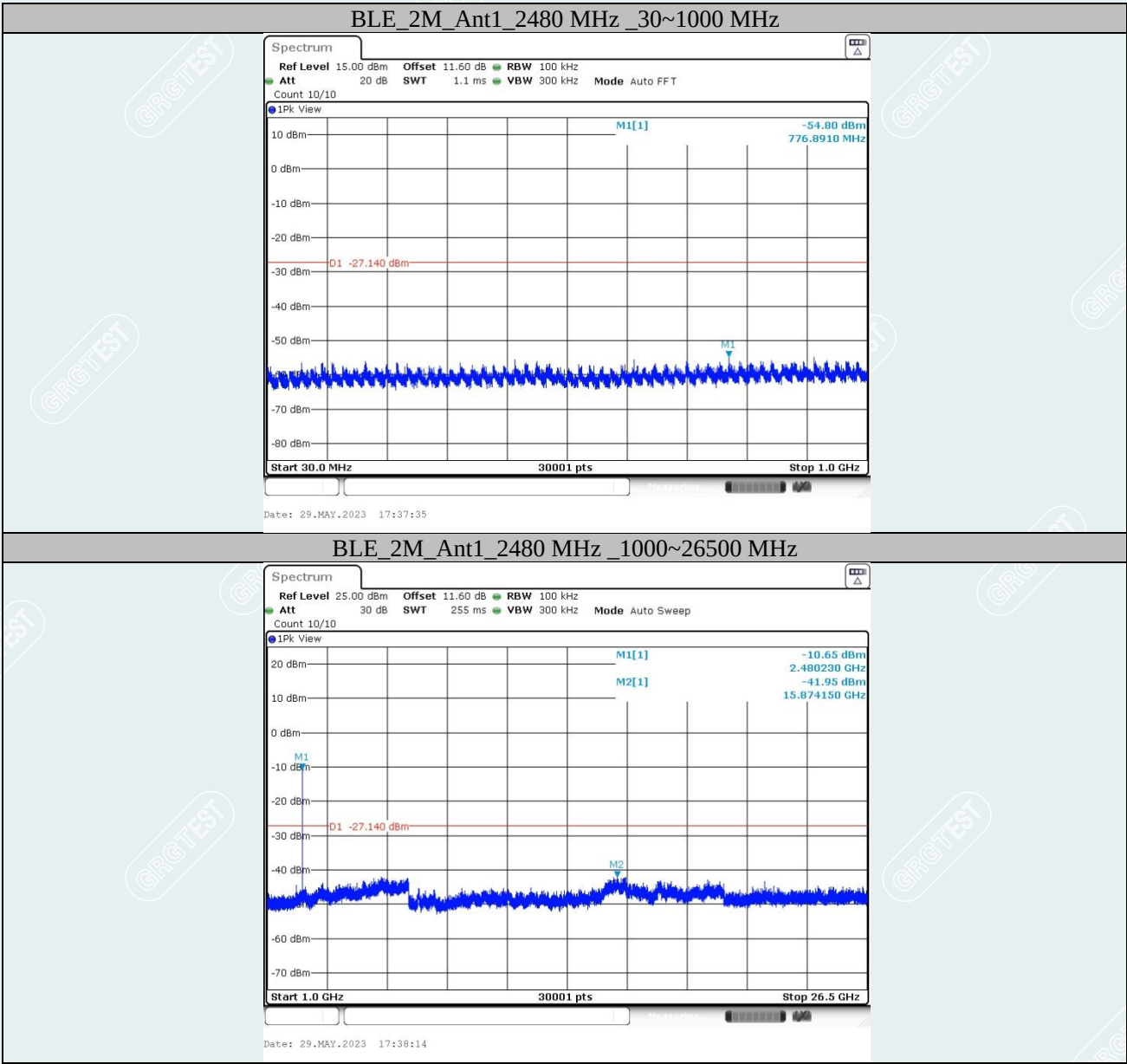












10. RESTRICTED BANDS OF OPERATION

10.1 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(μ V/m)	Measurement distance(m)	Quasi-peak(dB μ V/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

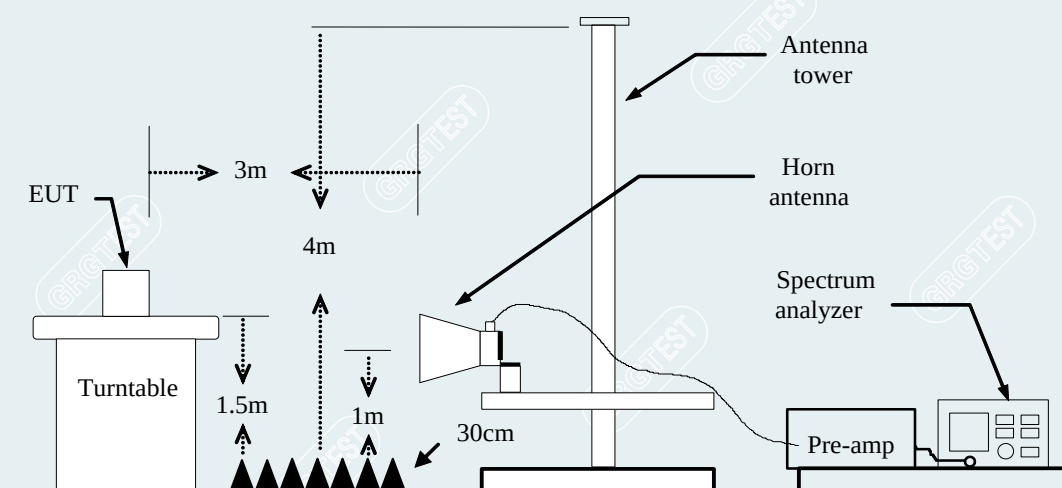
10.2 TEST PROCEDURES

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 $\geq 98\%$, set $VBW \leq RBW/100$ (i.e., 10kHz) but not less than 10 Hz. If the EUT duty cycle is $< 98\%$, set $VBW \geq 1/T$, Where T is defined in section 2.9.
- 5) Repeat the procedures until all the PEAK and AVERAGE versus polarization are measured.

10.3 TEST SETUP

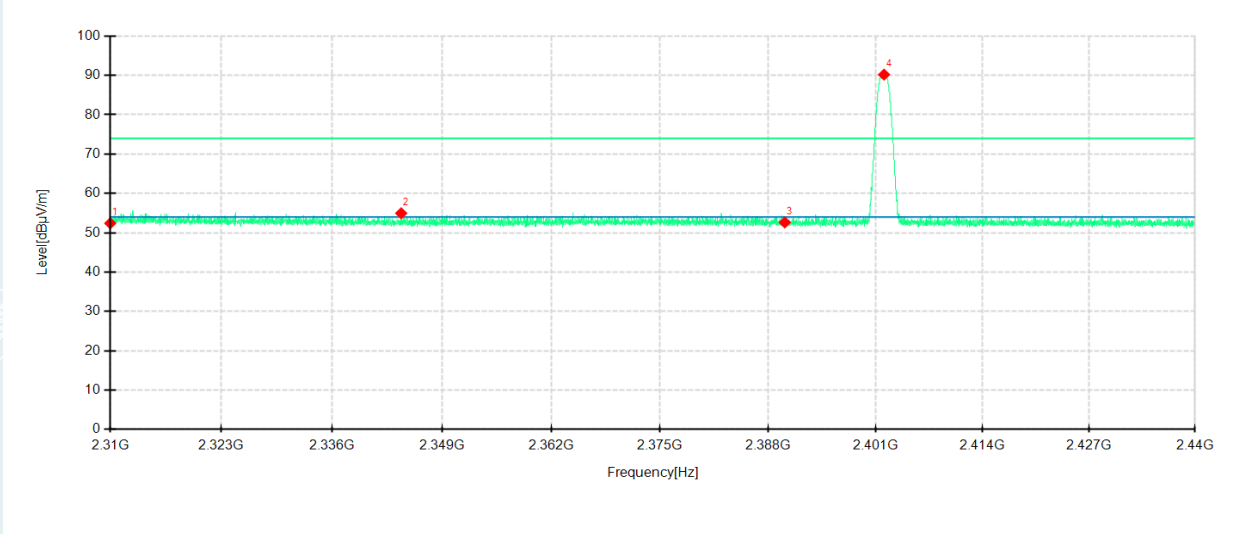


10.4 TEST RESULTS

Equipment:	BYD Di5.0F	Test Date	2023-05-29
Model No.:	MTCA05	Test Engineer:	Zhang Qiang
Test Voltage:	DC 12V	Environmental Conditions	22.6℃/65%RH/101.0kPa

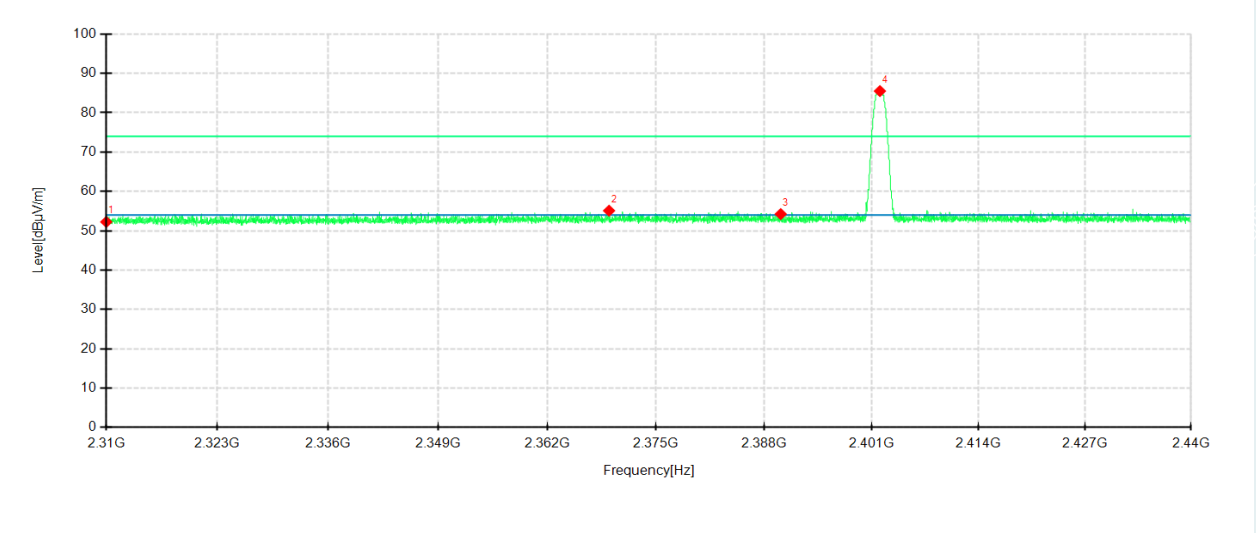
BLE 1M
Lowest Frequency
Frequency 2402MHz
Detector mode: Peak

Polarity: Horizontal



Detector mode: Peak

Polarity: Vertical



No.	Frequency MHz	Reading dB μ V/m	Level dB μ V/m	Factor dB	Limit dB μ V/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2310	42.64	52.41	9.77	74.00	21.59	100	285	Horizontal	/
2	2344.17375	45.83	54.96	9.13	74.00	19.04	100	40	Horizontal	/
3	2390	43.51	52.62	9.11	74.00	21.38	200	14	Horizontal	/
4	2402.0075	81.08	90.20	9.12	74.00	-16.20	100	158	Horizontal	No limit
1	2310	43.18	52.25	9.07	74.00	21.75	200	20	Vertical	/
2	2369.3775	45.78	55.10	9.32	74.00	18.90	200	1	Vertical	/
3	2390	44.71	54.24	9.53	74.00	19.76	100	253	Vertical	/
4	2401.99125	75.88	85.50	9.62	74.00	-11.50	200	275	Vertical	No limit

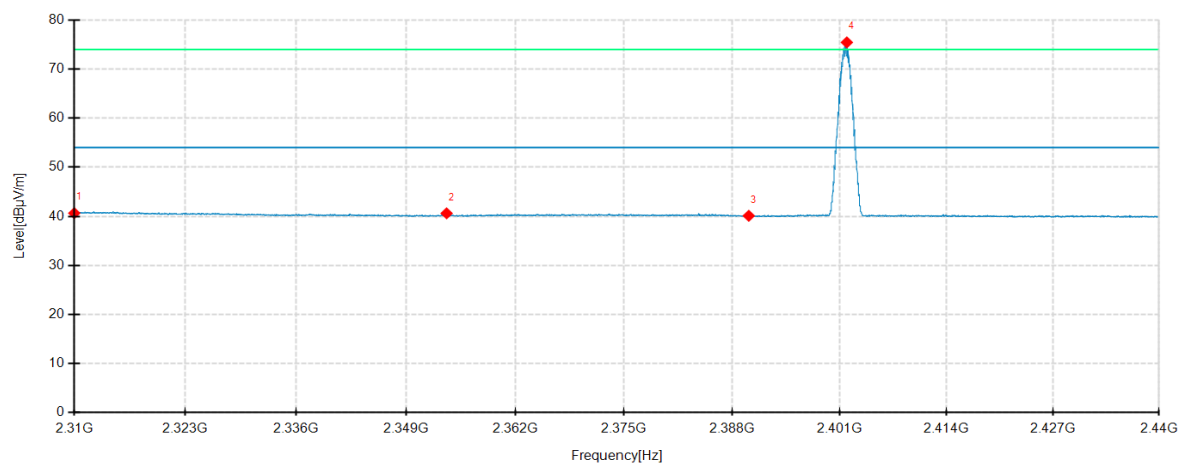
----- The following blanks -----

Lowest Frequency

Frequency 2402MHz

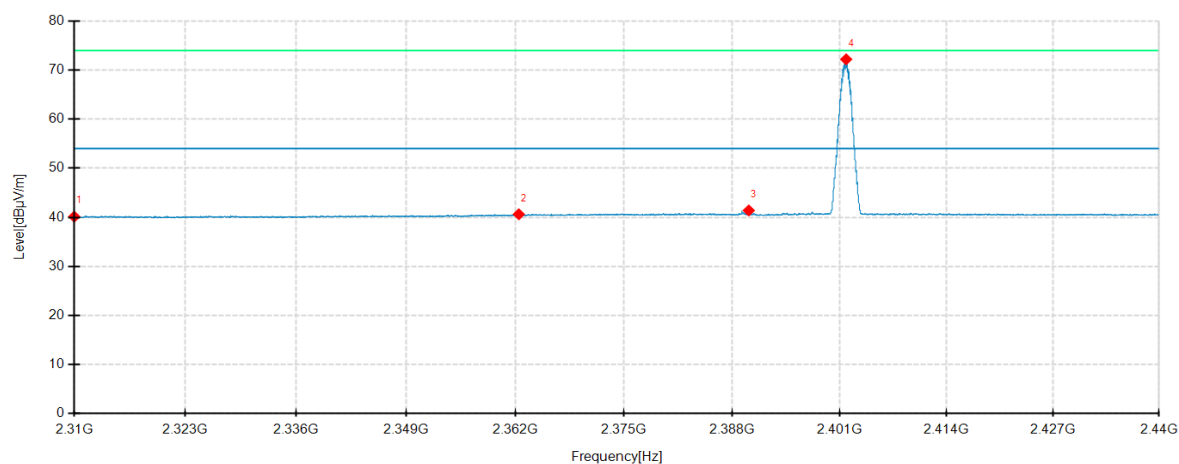
Detector mode: Average

Polarity: Horizontal



Detector mode: Average

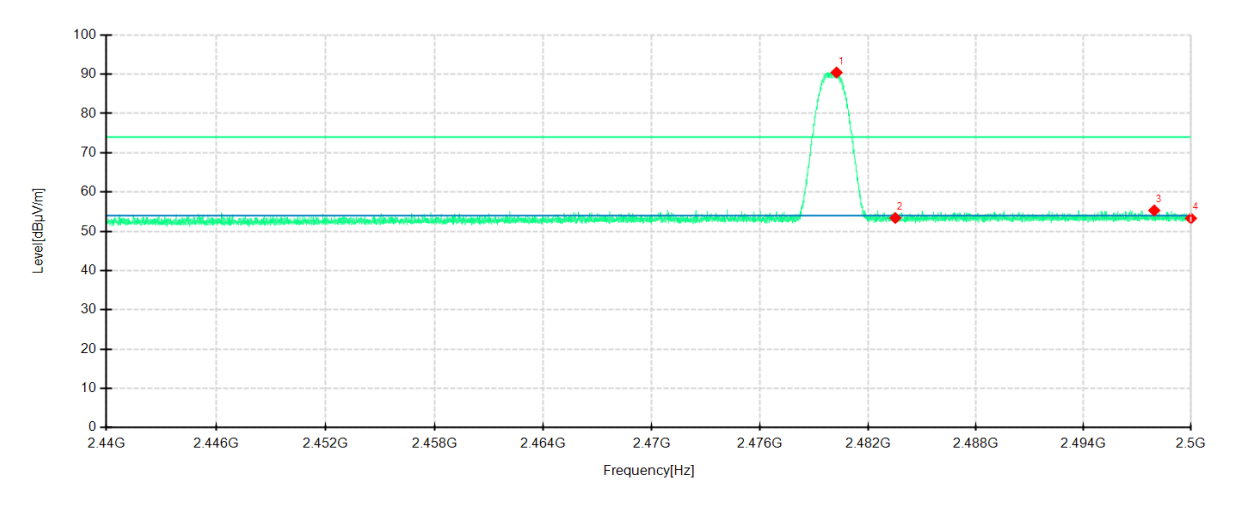
Polarity: Vertical



No.	Frequency MHz	Reading dBμV/m	Level dBμV/m	Factor dB	Limit dBμV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2310	30.87	40.64	9.77	54.00	13.36	100	286	Horizontal	/
2	2353.82625	31.59	40.61	9.02	54.00	13.39	100	169	Horizontal	/
3	2390	31.00	40.11	9.11	54.00	13.89	100	276	Horizontal	/
4	2401.86125	66.32	75.44	9.12	54.00	-21.44	100	159	Horizontal	No limit
1	2310	31.07	40.14	9.07	54.00	13.86	100	143	Vertical	/
2	2362.4225	31.37	40.62	9.25	54.00	13.38	200	78	Vertical	/
3	2390	31.87	41.40	9.53	54.00	12.60	100	212	Vertical	/
4	2401.78	62.57	72.19	9.62	54.00	-18.19	100	280	Vertical	No limit

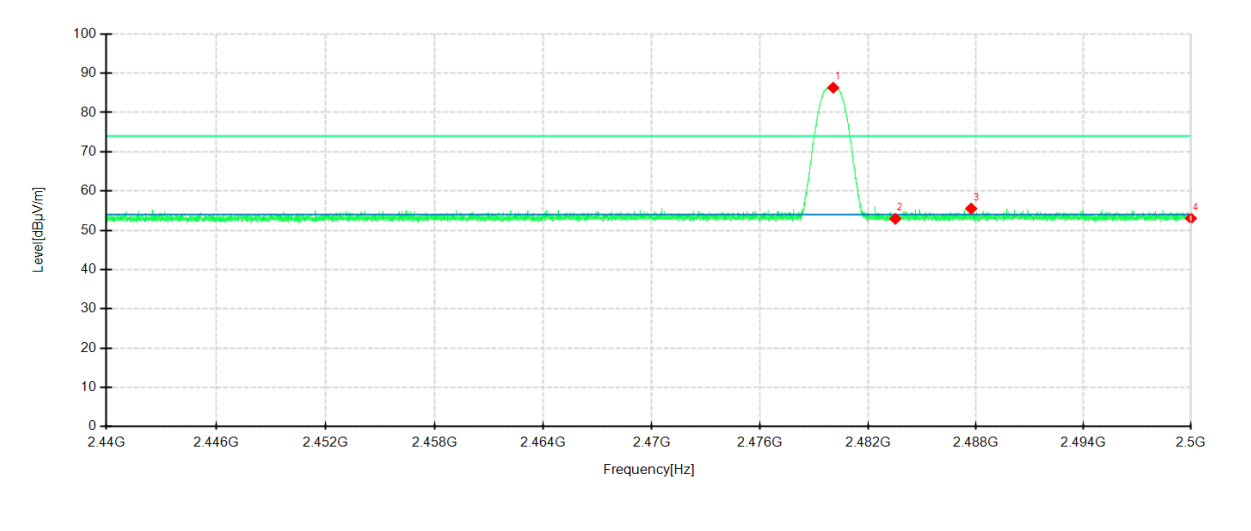
Highest Frequency
Frequency 2480MHz
Detector mode: Peak

Polarity: Horizontal



Detector mode: Peak

Polarity: Vertical



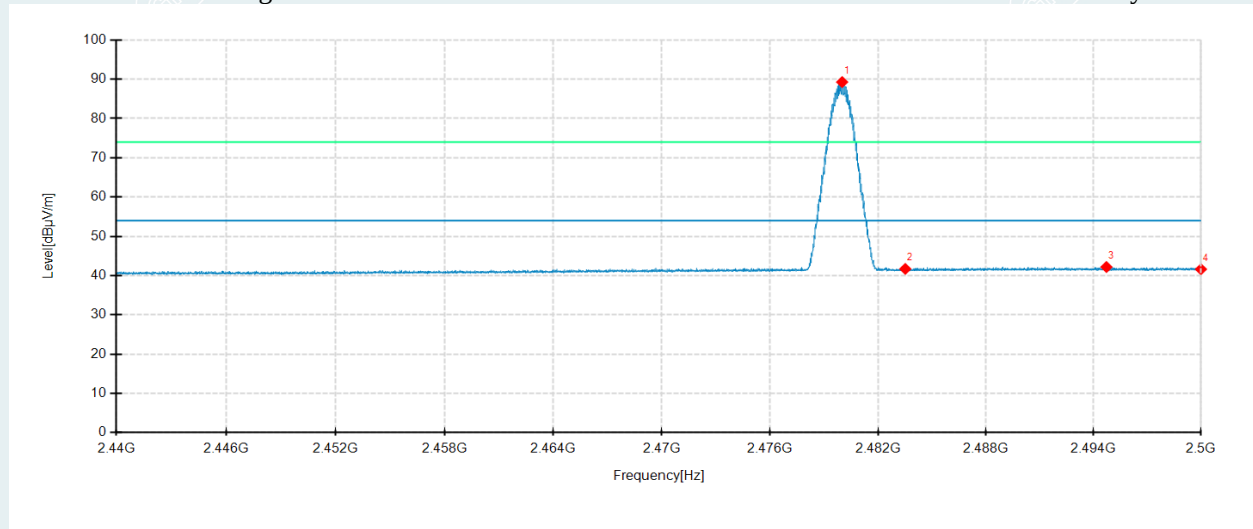
No.	Frequency MHz	Reading dBμV/m	Level dBμV/m	Factor dB	Limit dBuV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2480.2375	80.83	90.44	9.61	74.00	-16.44	100	294	Horizontal	No limit
2	2483.5	43.72	53.40	9.68	74.00	20.60	100	344	Horizontal	/
3	2497.945	45.33	55.33	10.00	74.00	18.67	200	83	Horizontal	/
4	2500	43.26	53.31	10.05	74.00	20.69	200	65	Horizontal	/
1	2480.05	76.59	86.32	9.73	74.00	-12.32	200	286	Vertical	No limit
2	2483.5	43.19	52.94	9.75	74.00	21.06	200	1	Vertical	/
3	2487.7225	45.75	55.53	9.78	74.00	18.47	200	345	Vertical	/
4	2500	43.20	53.05	9.85	74.00	20.95	200	10	Vertical	/

Highest Frequency

Frequency 2480MHz

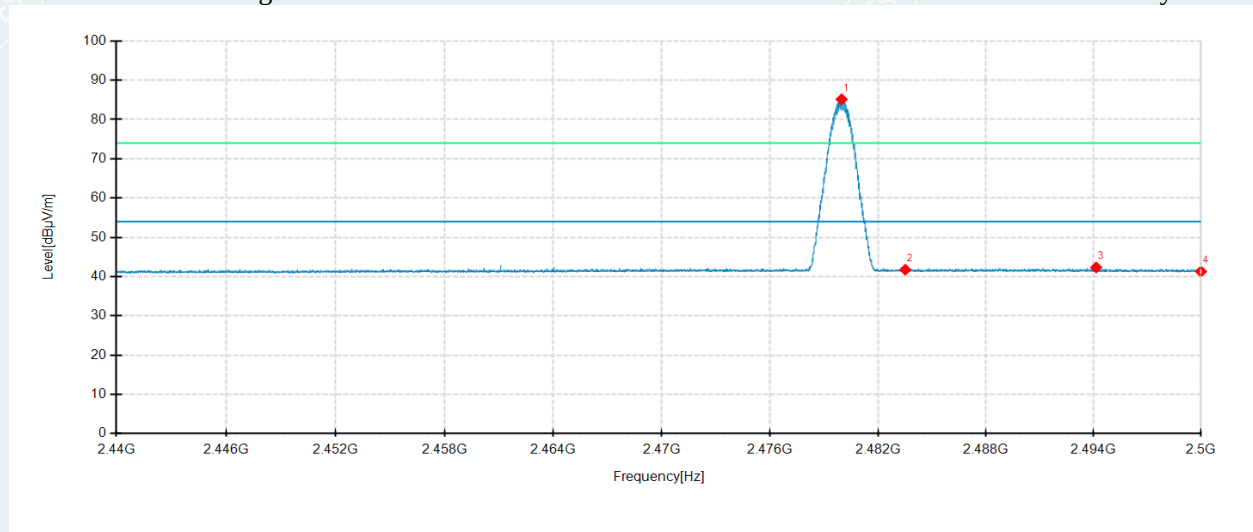
Detector mode: Average

Polarity: Horizontal



Detector mode: Average

Polarity: Vertical



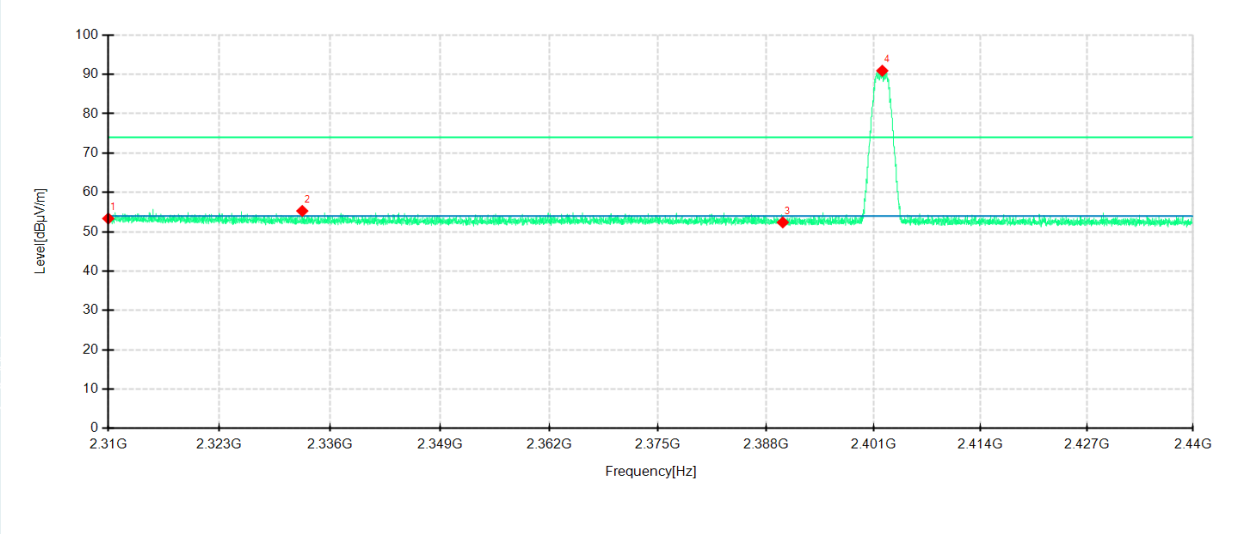
No.	Frequency MHz	Reading dBμV/m	Level dBμV/m	Factor dB	Limit dBμV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2479.99	79.68	89.29	9.61	54.00	-35.29	100	295	Horizontal	No limit
2	2483.5	32.02	41.70	9.68	54.00	12.30	200	358	Horizontal	/
3	2494.7125	32.26	42.19	9.93	54.00	11.81	100	30	Horizontal	/
4	2500	31.57	41.62	10.05	54.00	12.38	100	58	Horizontal	/
1	2479.96	75.42	85.15	9.73	54.00	-31.15	200	286	Vertical	No limit
2	2483.5	32.01	41.76	9.75	54.00	12.24	100	310	Vertical	/
3	2494.1425	32.50	42.32	9.82	54.00	11.68	100	310	Vertical	/
4	2500	31.44	41.29	9.85	54.00	12.71	100	172	Vertical	/

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

Equipment:	BYD Di5.0F	Test Date	2023-05-29
Model No.:	MTCA05	Test Engineer:	Zhang Qiang
Test Voltage:	DC 12.0V	Environmental Conditions	22.6℃/65%RH/101.0kPa

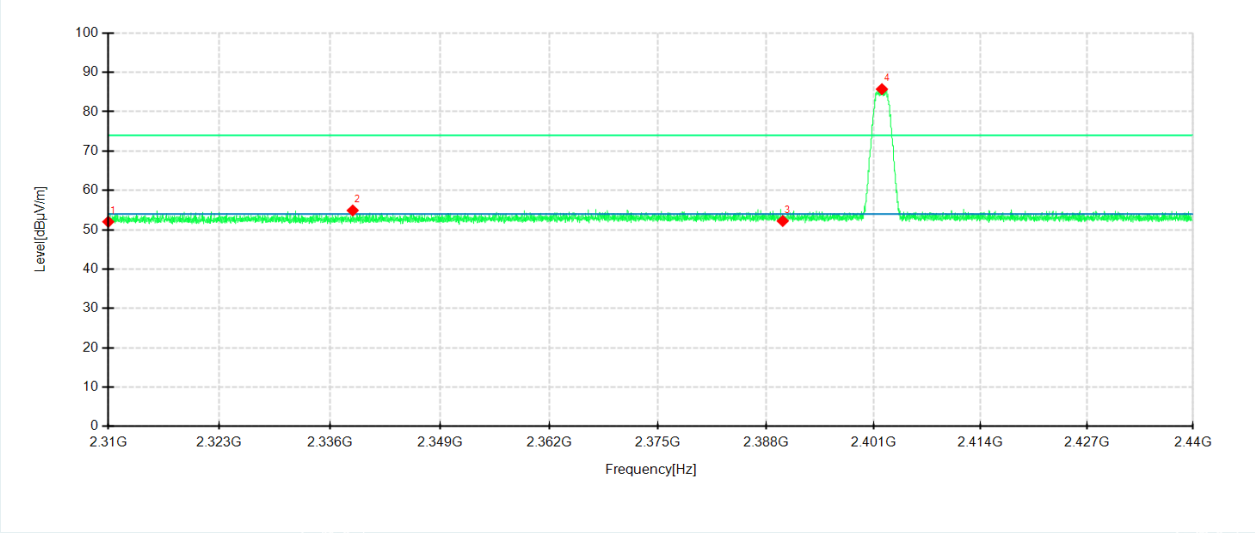
BLE 2M
Lowest Frequency
Frequency 2402MHz
Detector mode: Peak

Polarity: Horizontal



Detector mode: Peak

Polarity: Vertical



No.	Frequency MHz	Reading dB μ V/m	Level dB μ V/m	Factor dB	Limit dB μ V/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2310	43.60	53.37	9.77	74.00	20.63	100	81	Horizontal	/
2	2332.73375	45.94	55.29	9.35	74.00	18.71	200	55	Horizontal	/
3	2390	43.27	52.38	9.11	74.00	21.62	200	114	Horizontal	/
4	2402.04	81.81	90.93	9.12	74.00	-16.93	100	159	Horizontal	No limit
1	2310	42.96	52.03	9.07	74.00	21.97	200	31	Vertical	/
2	2338.68125	45.80	54.91	9.11	74.00	19.09	200	1	Vertical	/
3	2390	42.70	52.23	9.53	74.00	21.77	100	16	Vertical	/
4	2401.99125	76.12	85.74	9.62	74.00	-11.74	100	272	Vertical	No limit

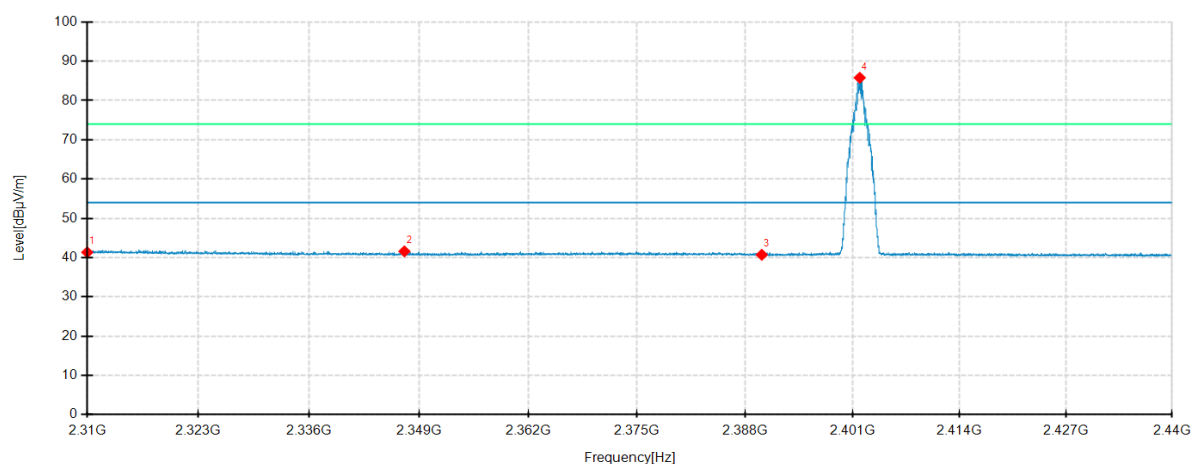
----- The following blanks -----

Lowest Frequency

Frequency 2402MHz

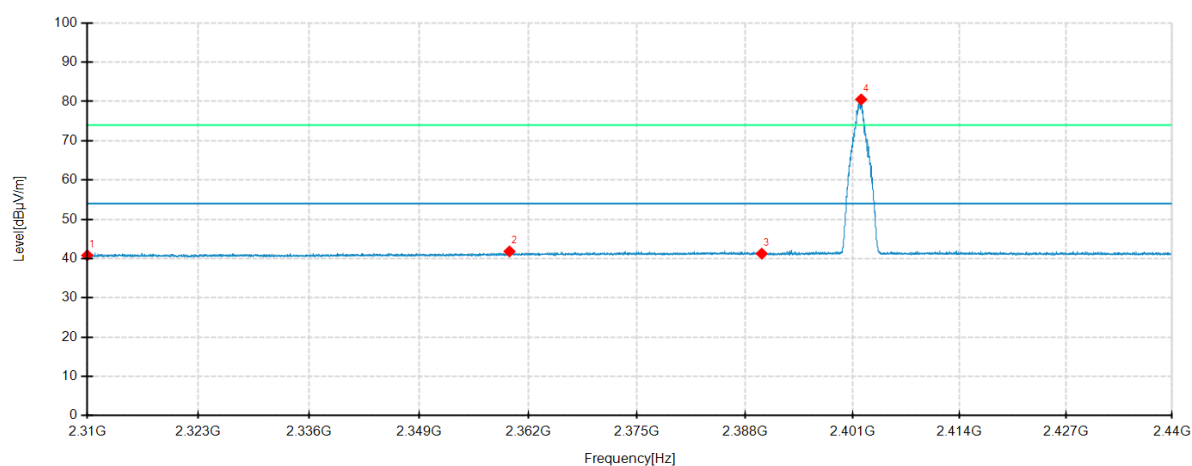
Detector mode: Average

Polarity: Horizontal



Detector mode: Average

Polarity: Vertical



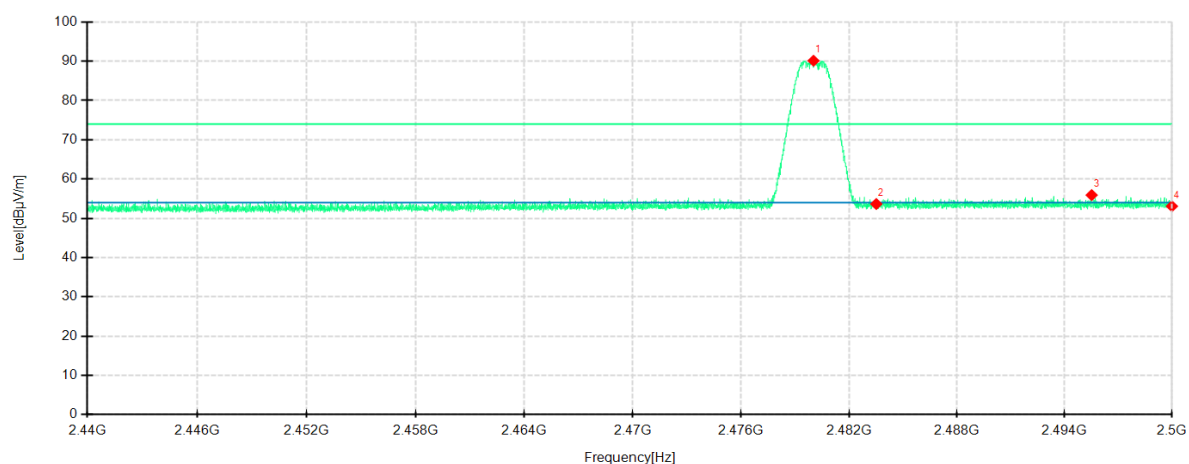
No.	Frequency MHz	Reading dBμV/m	Level dBμV/m	Factor dB	Limit dBμV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2310	31.57	41.34	9.77	54.00	12.66	200	64	Horizontal	/
2	2347.2775	32.52	41.59	9.07	54.00	12.41	200	172	Horizontal	/
3	2390	31.61	40.72	9.11	54.00	13.28	100	237	Horizontal	/
4	2401.845	76.67	85.79	9.12	54.00	-31.79	100	157	Horizontal	No limit
1	2310	31.76	40.83	9.07	54.00	13.17	200	256	Vertical	/
2	2359.7575	32.60	41.82	9.22	54.00	12.18	200	336	Vertical	/
3	2390	31.73	41.26	9.53	54.00	12.74	200	177	Vertical	/
4	2402.02375	70.91	80.53	9.62	54.00	-26.53	100	280	Vertical	No limit

Highest Frequency

Frequency 2480MHz

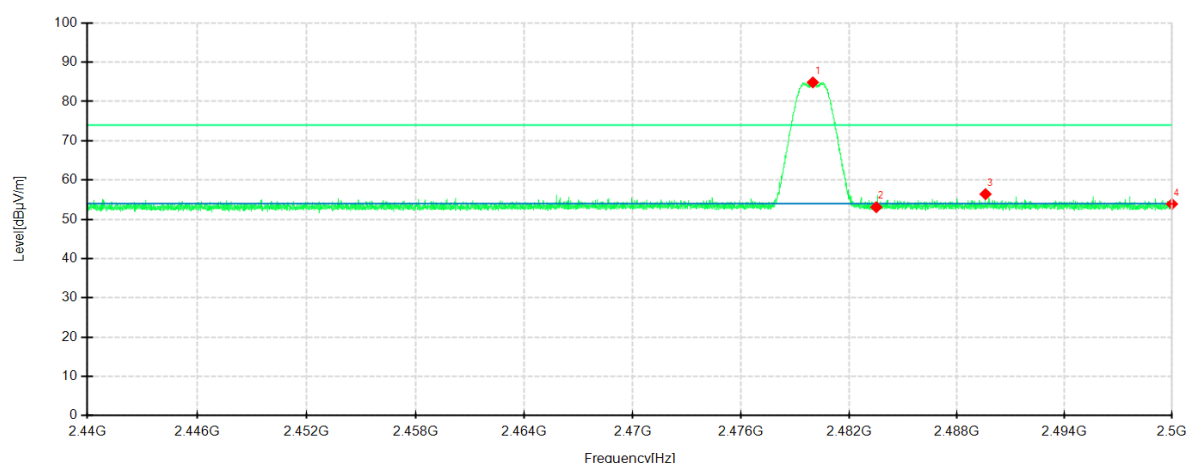
Detector mode: Peak

Polarity: Horizontal



Detector mode: Peak

Polarity: Vertical



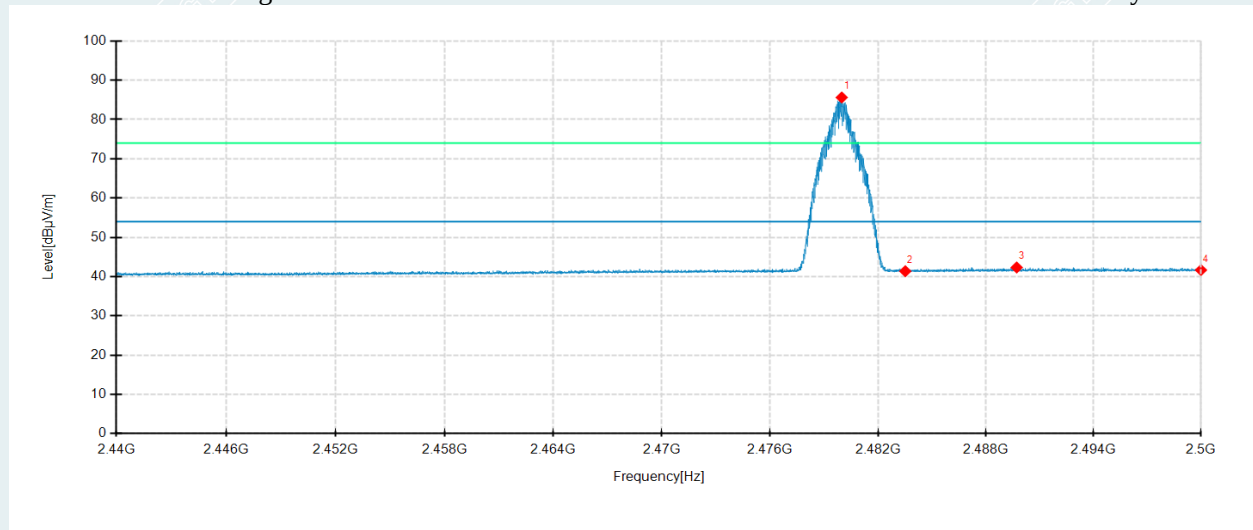
No.	Frequency MHz	Reading dBμV/m	Level dBμV/m	Factor dB	Limit dBμV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2480.0125	80.52	90.13	9.61	74.00	-16.13	100	286	Horizontal	No limit
2	2483.5	43.97	53.65	9.68	74.00	20.35	200	15	Horizontal	/
3	2495.5075	45.97	55.92	9.95	74.00	18.08	200	104	Horizontal	/
4	2500	43.03	53.08	10.05	74.00	20.92	100	336	Horizontal	/
1	2479.975	75.14	84.87	9.73	74.00	-10.87	100	279	Vertical	No limit
2	2483.5	43.34	53.09	9.75	74.00	20.91	100	75	Vertical	/
3	2489.5825	46.63	56.42	9.79	74.00	17.58	100	14	Vertical	/
4	2500	44.05	53.90	9.85	74.00	20.10	200	149	Vertical	/

Highest Frequency

Frequency 2480MHz

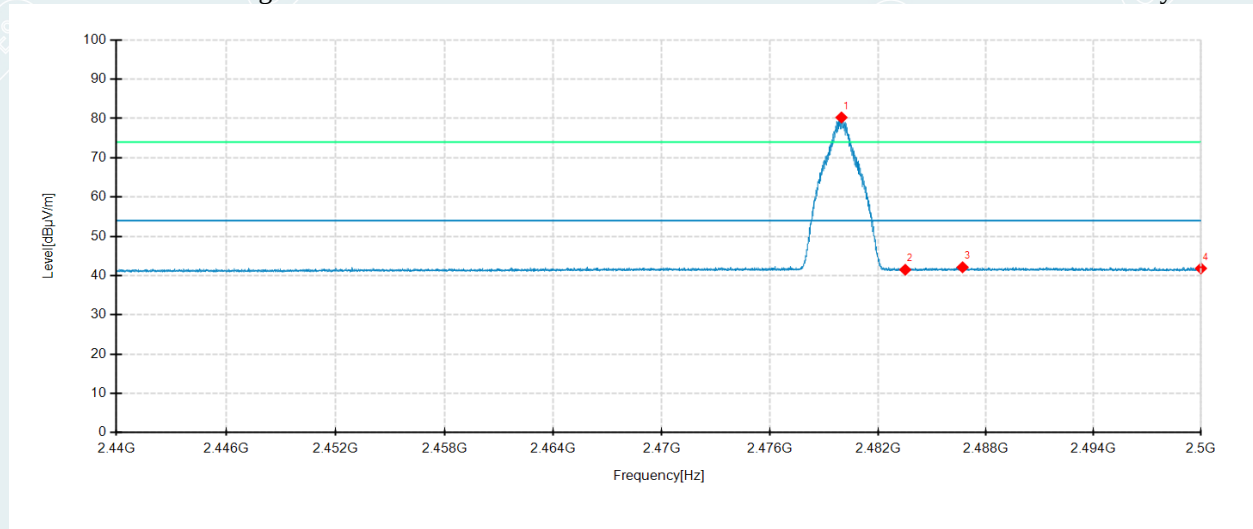
Detector mode: Average

Polarity: Horizontal



Detector mode: Average

Polarity: Vertical



No.	Frequency MHz	Reading dBμV/m	Level dBμV/m	Factor dB	Limit dBμV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2479.9675	76.01	85.62	9.61	54.00	-31.62	100	295	Horizontal	No limit
2	2483.5	31.70	41.38	9.68	54.00	12.62	100	344	Horizontal	/
3	2489.7025	32.51	42.33	9.82	54.00	11.67	100	88	Horizontal	/
4	2500	31.61	41.66	10.05	54.00	12.34	200	44	Horizontal	/
1	2479.9525	70.54	80.27	9.73	54.00	-26.27	100	283	Vertical	No limit
2	2483.5	31.74	41.49	9.75	54.00	12.51	100	263	Vertical	/
3	2486.6875	32.36	42.12	9.76	54.00	11.88	200	51	Vertical	/
4	2500	31.98	41.83	9.85	54.00	12.17	100	263	Vertical	/

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

APPENDIX A. PHOTOGRAPH OF THE TEST CONNECTION DIAGRAM

Please refer to the attached document E20230512370501-8-Test Photo.

APPENDIX B. PHOTOGRAPH OF THE EUT

Please refer to the attached document E20230512370501-9-EUT Photo.

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