

TEST REPORT

Verified code: 033126

Report No.:	E202003308361-3	Application No.:	E202003308361
Client:	Shenzhen Malide Technology Co., Ltd		
Address:	Room 201, No.26A, Xin'E Industrial Zone, E'GongLing, Pinghu Street, Longgang District, Shenzhen, Guangdong Province		
Sample Description:	BLE Internal TPMS		
Model:	MLD-B02		
Test Location:	Guangzhou GRG Metrology&Test Co., Ltd.		
Test Specification:	CFR 47 FCC Part 15 Subpart C 10-1-2019 Edition KDB 558074 DO1: DTS measurement guidance v0502 ANSI C63.10:2013		
Issue Date:	2020/06/23		
Test Result:	PASS		
Prepared By: Test Engineer 	Reviewed By: Technical Manager 	Approved By: Manager  	
Other Aspects:			
Note: /			
Abbreviations: ok / P = passed; fail / F = failed; n.a. / N = not applicable;			
The test result in this test report refers exclusively to the presented test sample. This report shall not be reproduced except in full, without the written approval of GRGT.			



DIRECTIONS OF TEST

1. This company carries out test task according to the national regulation of verifications which can be traced to National Primary Standards and BIPM.
2. The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test result without the written permission of the test laboratory.
3. If there is any objection concerning the test, the client should inform the laboratory within 15 days from the date of receiving the test report.

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1. TEST RESULT SUMMARY

Technical Requirements			
FCC Part 15 Subpart C			
Test Condition		Verdict	Page
§15.207	Conducted emission AC power port	N/A	Note 1
§15.247(b)(1)	Conducted output power for FHSS	N/A	--
§15.247(b)(3)	Conducted output power for DTS	Pass	Page 26
§15.247(e)	Power spectral density	Pass	Page 27
§15.247(a)(2)	6dB bandwidth	Pass	Page 23
§15.247(a)(1)	20dB Occupied bandwidth	N/A	--
--	99% Occupied Bandwidth	N/A	--
§15.247(a)(1)	Carrier frequency separation	N/A	--
§15.247(a)(1)(iii)	Number of hopping frequencies	N/A	--
§15.247(a)(1)(iii)	Dwell Time	N/A	--
§15.247(d)	Spurious RF conducted emissions	Pass	Page 30
§15.247(d)	Band edge	Pass	Page 34
§15.247(d) & §15.209 & §15.205	Spurious radiated emissions for transmitter	Pass	Page 10
§15.203	Antenna requirement	Pass	--

note: [1] : The power supply of the EUT is DC 3.0V.

The EUT has one antenna. The antenna is internal antenna.

The max gain of antenna is -4.51dBi .which accordance 15.203.is considered sufficient to comply with the provisions of this section.

2. GENERAL DESCRIPTION OF EUT

2.1. APPLICANT

Name: Shenzhen Malide Technology Co., Ltd
Address: Room 201, No.26A, Xin'E Industrial Zone, E'GongLing, Pinghu Street,
Longgang District, Shenzhen, Guangdong Province

2.2. MANUFACTURER

Name: Shenzhen Malide Technology Co., Ltd
Address: Room 201, No.26A, Xin'E Industrial Zone, E'GongLing, Pinghu Street,
Longgang District, Shenzhen, Guangdong Province

2.3. FACTORY

Name : Shenzhen Malide Technology Co., Ltd
Address : Room 201, No.26A, Xin'E Industrial Zone, E'GongLing, Pinghu Street,
Longgang District, Shenzhen, Guangdong Province

2.4. BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment: BLE Internal TPMS
Model No.: MLD-B02
Adding Model: /
Trade Name: Malide
FCC ID: 2AV7VMLD-B02
Power supply: DC 3V powered by 1*DC 3V type“CR2450HR” battery.
Frequency Range: 2402 ~ 2480MHz
Transmit Power: -2.83dBm
Modulation type: GFSK for 1Mbps
Channel space: 2MHz
Antenna Specification: Internal antenna with -4.51dBi gain (Max)
Temperature Range: -40 ℃ ~ +125 ℃
Hardware Version: V2.0
Software Version: V3.0
Note: N/A

2.5. TEST OPERATION MODE

Test Item	Mode No.	Description of the modes
Conducted Emission	1	Continuously Transmitting
Radiated Emission	1	Continuously Transmitting

2.6. LOCAL SUPPORTIVE

Name of Equipment	Manufacturer	Model	Serial Number	Note
/	/	/	/	/
/	/	/	/	/
Cable				
/	/	/	/	/
/	/	/	/	/

Test software:

Software version	Test level
SSCOM V5.13.1	Default

3. LABORATORY AND ACCREDITATIONS

3.1. LABORATORY

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

Add : Address: No.1301 Guanguang Road Xinlan Community, Guanlan Street,
Longhua District Shenzhen, 518110, People's Republic of China

P.C. : 518000

Tel : 0755-61180008

Fax : 0755-61180008

3.2. ACCREDITATIONS

A2LA	Certificate Number 2861.01
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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	30MHz~1000MHz	4.3dB
		1GHz~18GHz	5.6dB
	Vertical	30MHz~1000MHz	4.3dB
		1GHz~18GHz	5.6dB

This uncertainty represents an expanded uncertainty factor of $k=2$.

4. LIST OF USED TEST EQUIPMENT AT GRGT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Conducted Emissions				
EMI TEST RECEIVER	ROHDE&SCHWARE	ESCI	100783	2020-11-27
LISN(EUT)	ROHDE&SCHWARE	ENV216	101543	2021-03-24
Test S/W	FARAD	EZ-EMC/ CCS-3A1-CE		
Radiated Spurious Emission& Restricted bands of operation				
EMI TEST Receiver	ROHDE&SCHWARZ	ESU26	EMC26-G260	2020-07-16
EXA signal analyzer	Agilent	N9010A	MY52221469	2021-05-16
Bilog Antenna	Schwarzbeck	VULB9160	VULB9160-3401	2020-11-27
Horn Antenna	Schwarzbeck	BBHA9120	D286	2020-11-27
Horn Antenna	Schwarzbeck	BBHA9170	BBHA9170-497	2020-11-30
Amplifier	tonscend	TAP9E6343	AP20E806065	/
Amplifier	tonscend	TAP01018048	AP20E806075	/
High Noise Amplifier	Agilent	8449B	3008A02060	2020-11-18
Test S/W	FARAD	LZ-RF / CCS-SZ-3A2		
6 dB Bandwidth				
EXA signal analyzer	Agilent	N9010A	MY52221469	2021-05-16
Peak Output Power				
Pulse Power Sentor	Agilent	MA2411B	1126150	2021-04-13
Power Meter	Anritsu	ML2495A	1204003	2021-04-13
Conducted band edges and Spurious Emission				
EXA signal analyzer	Agilent	N9010A	MY52221469	2021-05-16
Peak Output Spectral Density Measurement				
EXA signal analyzer	Agilent	N9010A	MY52221469	2021-05-16

5. CONDUCTED EMISSION MEASUREMENT

5.1. LIMITS

Frequency range	Limits (dBμV)	
	Quasi-peak	Average
150kHz ~ 0.5MHz	66~56	56~46
0.5 MHz ~ 5 MHz	56	46
5 MHz ~ 30 MHz	60	50

NOTE: (1) The lower limit shall apply at the transition frequencies.

(2) The limit decreases in line with the logarithm of the frequency in the range of 150 kHz to 0.5MHz.

5.2. TEST PROCEDURES

Procedure of Preliminary Test

Test procedures follow ANSI C63.4:2014.

For measurement of the disturbance voltage the equipment under test (EUT) is connected to the power supply mains and any other extended network via one or more artificial network(s). An EUT, whether intended to be grounded or not, and which is to be used on a table is configured as follows:

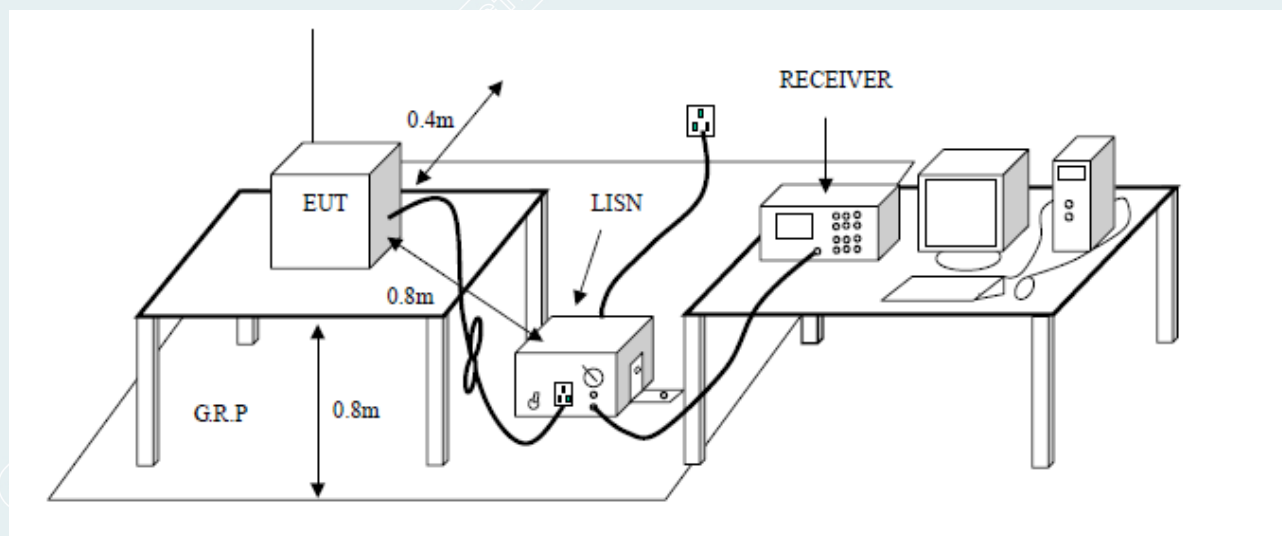
- Either the bottom or the rear of the EUT shall be at a controlled distance of 40 cm from a reference ground plane. This ground plane is normally the wall or floor of a shielded room. It may also be a grounded metal plane of at least 2 m by 2 m. This is physically accomplished as follows:
 - 1) place the EUT on a table of non-conducting material which is at least 80 cm high. Place the EUT so that it is 40 cm from the wall of the shielded room, or
 - 2) place the EUT on a table of non-conducting material which is 40 cm high so that the bottom of the EUT is 40 cm above the ground plane;
- All other conductive surfaces of the EUT shall be at least 80 cm from the reference ground plane;
- The EUT are placed on the floor that one side of the housings is 40 cm from the vertical reference ground plane and other metallic parts;
- Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth forming a bundle 30 cm to 40 cm long, hanging approximately in the middle between the ground plane and the table.
- I/O cables that are connected to a peripheral shall be bundled in the centre. The end of the cable may be terminated if required using correct terminating impedance. The total length shall not exceed 1 m.

The test mode(s) described in Item 2.4 were scanned during the preliminary test. After the preliminary scan, we found the test mode described in Item 2.4 producing the highest emission level. The EUT configuration and cable configuration of the above highest emission levels were recorded for reference of the final test.

Procedure of Final Test

EUT and support equipment were set up on the test bench as per the configuration with highest emission level in the preliminary test. A scan was taken on both power lines, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. The test data of the worst-case condition(s) was recorded.

5.3. TEST SETUP



5.4. DATA SAMPLE

Frequency (MHz)	QuasiPeak Reading (dBuV)	Average Reading (dBuV)	Correction Factor (dB)	QuasiPeak Result (dBuV)	Average Result (dBuV)	QuasiPeak Limit (dBuV)	Average Limit (dBuV)	QuasiPeak Margin (dB)	Average Margin (dB)	Remark (Pass/Fail)
X.XXXX	32.69	25.65	11.52	44.21	37.17	65.78	55.79	-21.57	-18.62	Pass

Factor = Insertion loss of LISN + Cable Loss

Result = Quasi-peak Reading/ Average Reading + Factor

Limit = Limit stated in standard

Margin = Result (dBuV) – Limit (dBuV)

5.5. TEST RESULTS

N/A.

The power supply of the EUT is DC 3.0V.

6. RADIATED SPURIOUS EMISSIONS

6.1. LIMITS

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

Frequency (MHz)	Quasi-peak($\mu\text{V/m}$)	Measurement distance(m)	Quasi-peak($\text{dB}\mu\text{V/m}$)@distance 3m
0.009-0.490	2400/F(kHz)	300	53.8~88.5
0.490-1.705	24000/F(kHz)	30	43~53.8
1.705-30.0	30	30	49.5
30 ~ 88	100	3	40
88~216	150	3	43.5
216 ~ 960	200	3	46
Above 960	500	3	54

NOTE: (1) The lower limit shall apply at the transition frequencies.

6.2. TEST PROCEDURES (please refer to measurement standard)

1) Sequence of testing 9 kHz to 30 MHz

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.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Pre measurement:

- The turntable rotates from 0 ° to 315 ° using 45 ° steps.
- The antenna height is 0.8 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 QPK 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 30 MHz to 1 GHz**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.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Pre measurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 to 3 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 position ($\pm 45^\circ$) 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 1 GHz to 18 GHz**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 AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Pre measurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height scan range is 1 meter to 2.5 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 position ($\pm 45^\circ$) 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 18 GHz**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 AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- 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 premeasurements 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 premeasurement and the limit will be stored.

NOTE: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average (Duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor ($10 \log(1/\text{duty cycle})$).

6.3. TEST SETUP

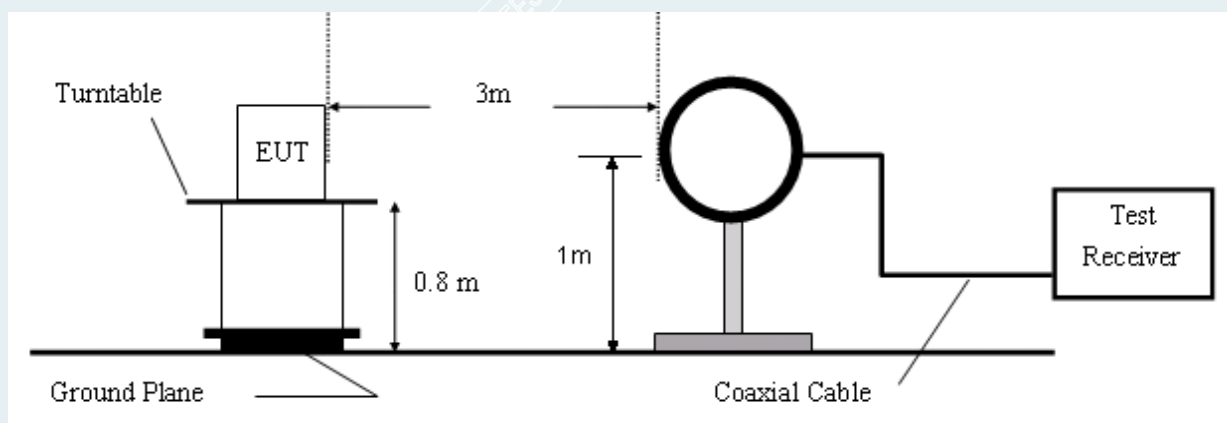


Figure 1. 9KHz to 30MHz radiated emissions test configuration

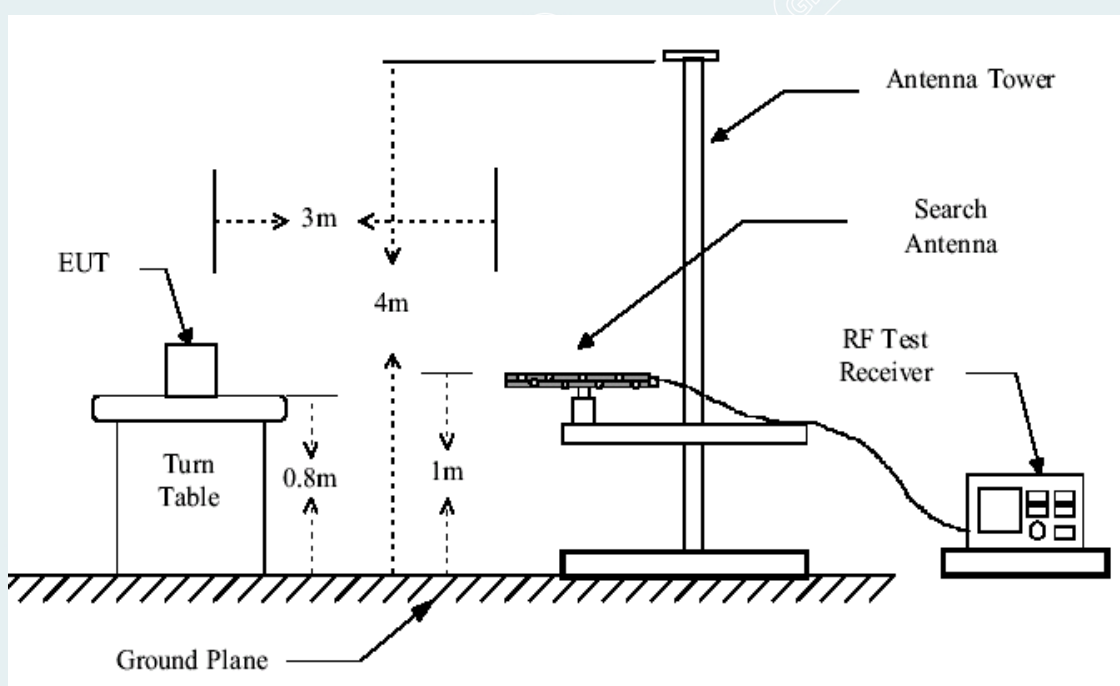


Figure 2. 30MHz to 1GHz radiated emissions test configuration

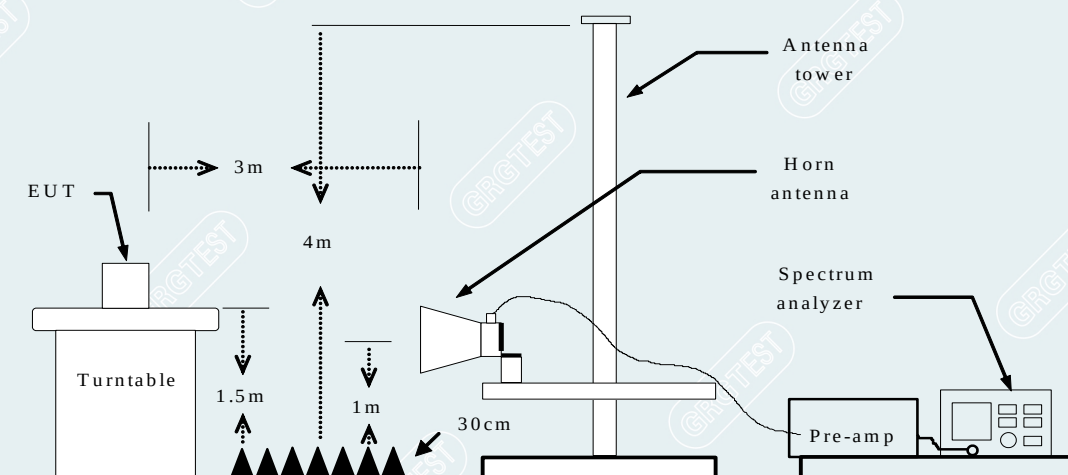


Figure 3. Above 1GHz radiated emissions test configuration

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

Above 1 GHz

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

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

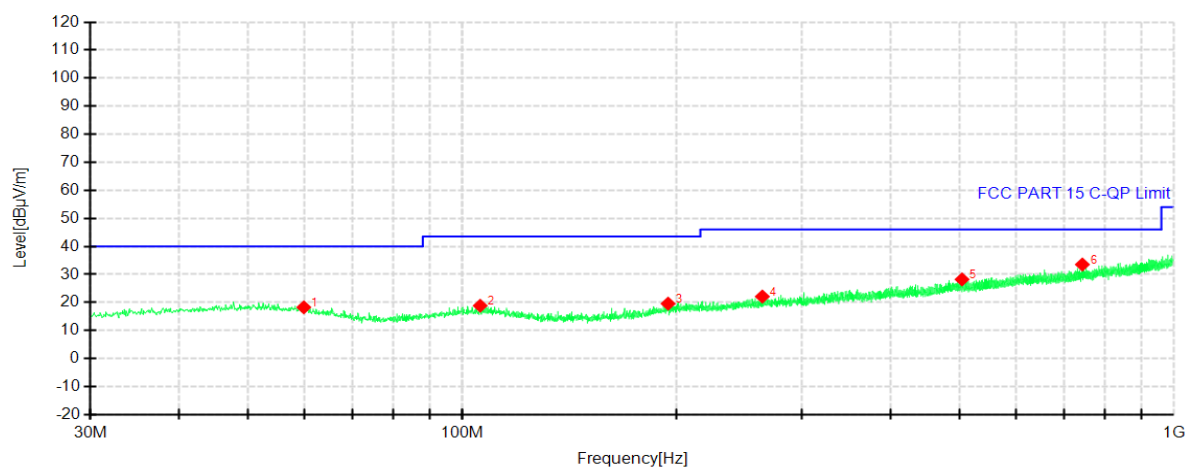
= Average Reading

6.5. TEST RESULTS

30MHz to 1GHz:

Mode: TX

Lowest channel (2402MHz)

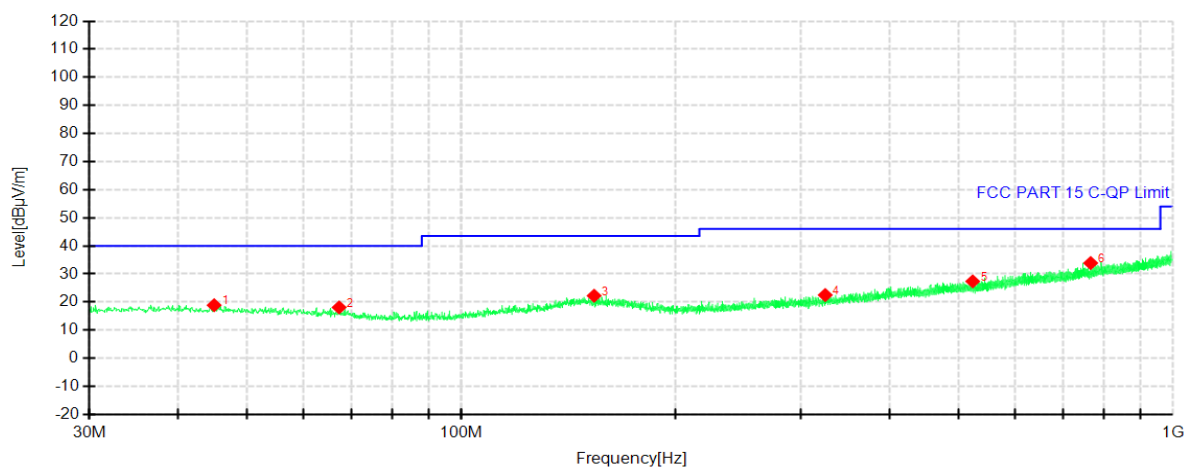


Suspected Data List

NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	59.8760	47.94	18.28	-29.66	40.00	21.72	150	360	Horizontal
2	105.9510	48.70	18.84	-29.86	43.50	24.66	150	306	Horizontal
3	194.6090	48.56	19.59	-28.97	43.50	23.91	150	184	Horizontal
4	263.9640	48.90	22.12	-26.78	46.00	23.88	150	149	Horizontal
5	503.7480	49.18	28.23	-20.95	46.00	17.77	150	3	Horizontal
6	743.6290	50.23	33.55	-16.68	46.00	12.45	150	188	Horizontal

Mode: TX

Lowest channel (2402MHz)

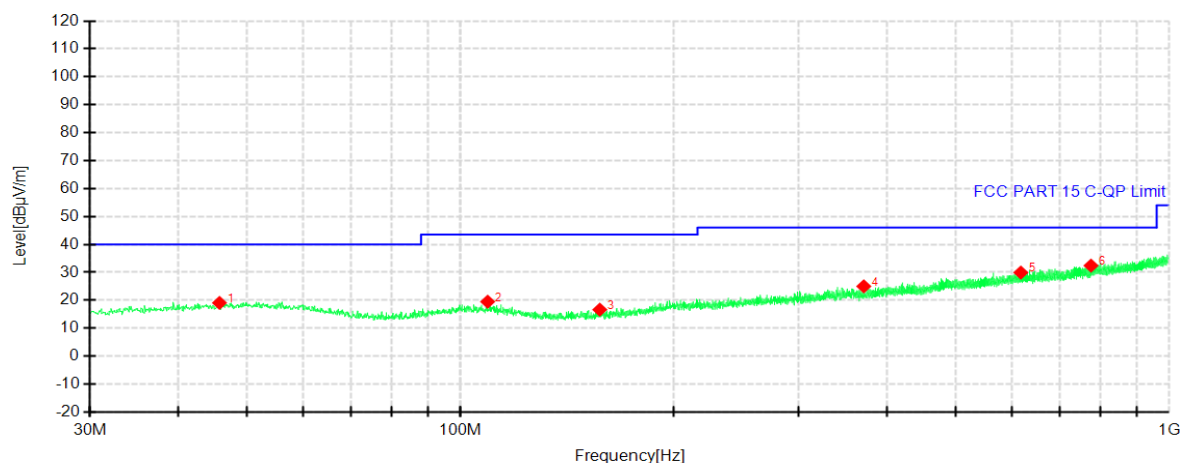


Suspected Data List

NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	44.9380	48.68	18.88	-29.80	40.00	21.12	150	280	Vertical
2	67.3450	49.39	18.11	-31.28	40.00	21.89	150	246	Vertical
3	153.6750	48.67	22.26	-26.41	43.50	21.24	150	284	Vertical
4	324.5890	48.30	22.50	-25.80	46.00	23.5	150	147	Vertical
5	523.1480	48.41	27.37	-21.04	46.00	18.63	150	330	Vertical
6	766.2300	49.98	33.90	-16.08	46.00	12.1	150	40	Vertical

Mode: TX

Lowest channel (2480MHz)

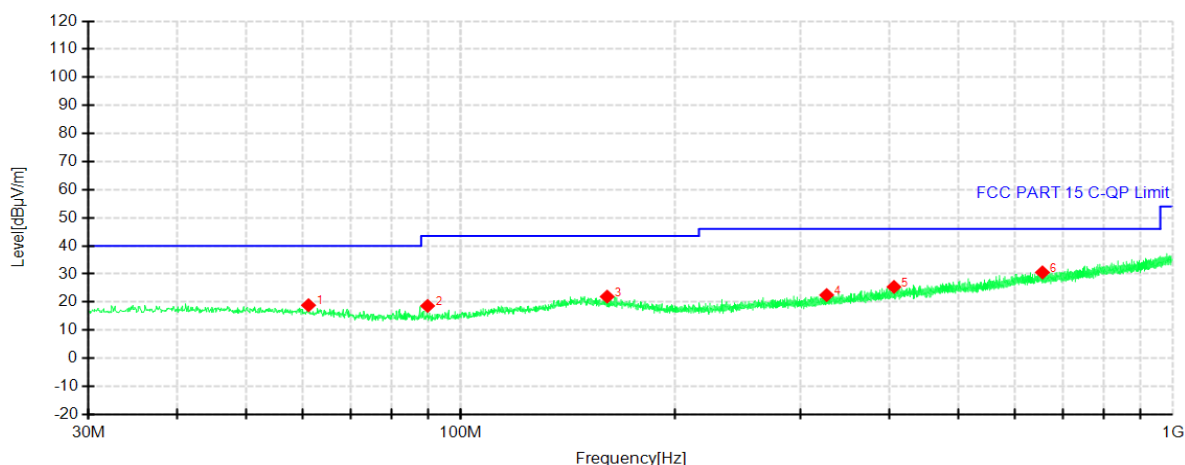


Suspected Data List

NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	45.7140	48.14	19.07	-29.07	40.00	20.93	150	359	Horizontal
2	109.2490	49.34	19.50	-29.84	43.50	24.00	150	38	Horizontal
3	157.2640	48.44	16.66	-31.78	43.50	26.84	150	360	Horizontal
4	370.7610	49.18	25.00	-24.18	46.00	21.00	150	206	Horizontal
5	617.5290	48.30	29.94	-18.36	46.00	16.06	150	198	Horizontal
6	775.7360	49.03	32.42	-16.61	46.00	13.58	150	191	Horizontal

Mode: TX

Highest channel (2480MHz)



Suspected Data List

NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	61.1370	49.58	18.87	-30.71	40.00	21.13	150	292	Vertical
2	89.8490	50.80	18.64	-32.16	43.50	24.86	150	4	Vertical
3	160.5620	48.59	21.95	-26.64	43.50	21.55	150	119	Vertical
4	326.4320	48.22	22.49	-25.73	46.00	23.51	150	12	Vertical
5	405.8750	48.75	25.41	-23.34	46.00	20.59	150	1	Vertical
6	655.9410	48.30	30.57	-17.73	46.00	15.43	150	172	Vertical

Remark:

- 1 No emission found between lowest internal used/generated frequency to 30MHz.
- 2 Pre-scan all mode and recorded the worst case results in this report (BT LE (High Channel))
- 3 Radiated emissions measured in frequency range from 9 kHz to 1GHz were made with an instrument using Quasi-peak detector mode.
- 4 Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 5 The IF bandwidth of Receiver between 30MHz to 1GHz was 120 kHz.

Above 1GHz:

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

Lowest channel (2402MHz)

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Detector	Polarity
1	1169.6000	33.16	-23.94	74.00	40.84	PK	Vertical
2	1542.0000	36.92	-22.63	74.00	37.08	PK	Vertical
3	1748.6000	37.06	-21.70	74.00	36.94	PK	Vertical
4	1961.4000	33.98	-20.89	74.00	40.02	PK	Vertical
5	2668.4000	37.32	-18.16	74.00	36.68	PK	Vertical
6	4803.0000	41.62	-10.33	74.00	32.38	PK	Vertical
7	7204.5000	46.83	-2.14	74.00	27.17	PK	Vertical
8	9609.0000	48.58	2.96	74.00	25.42	PK	Vertical
9	11049.0000	48.62	6.44	74.00	25.38	PK	Vertical
10	13411.5000	50.03	9.49	74.00	23.97	PK	Vertical
11	15126.0000	50.10	9.75	74.00	23.90	PK	Vertical
12	1251.2000	35.18	-23.66	74.00	38.82	PK	Vertical

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Detector	Polarity
1	1438.0000	40.39	-22.88	74.00	33.61	PK	Horizontal
2	1746.8000	40.21	-21.71	74.00	33.79	PK	Horizontal
3	2175.0000	35.17	-20.13	74.00	38.83	AV	Horizontal
4	2665.4000	39.32	-18.18	74.00	34.68	PK	Horizontal
5	4803.0000	47.37	-10.33	74.00	26.63	AV	Horizontal
6	7206.0000	49.04	-2.16	74.00	24.96	PK	Horizontal
7	9607.5000	49.36	2.96	74.00	24.64	PK	Horizontal
8	11551.5000	48.90	7.23	74.00	25.10	PK	Horizontal
9	14623.5000	51.61	11.80	74.00	22.39	PK	Horizontal

Remark:

- 1 Measuring frequencies from 1 GHz 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 Data of measurement within this frequency range shown “ --- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 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.

Mode: TX
Mid channel (2440MHz)

NO.	Freq. [MHz]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Detector	Polarity
1	1132.8000	33.84	-24.04	74.00	40.16	PK	Vertical
2	1265.0000	33.48	-23.61	74.00	40.52	PK	Vertical
3	1547.6000	37.74	-22.63	74.00	36.26	PK	Vertical
4	1758.0000	37.40	-21.63	74.00	36.60	PK	Vertical
5	1980.0000	33.62	-20.67	74.00	40.38	PK	Vertical
6	3564.0000	38.29	-14.10	74.00	35.71	PK	Vertical
7	4878.0000	43.33	-9.08	74.00	30.67	PK	Vertical
8	7318.5000	49.22	-2.92	74.00	24.78	PK	Vertical
9	9759.0000	47.92	3.03	74.00	26.08	PK	Vertical
10	10911.0000	48.90	6.29	74.00	25.10	PK	Vertical
11	14581.5000	52.23	11.93	74.00	21.77	PK	Vertical
12	1326.0000	33.23	-23.36	74.00	40.77	PK	Vertical

NO.	Freq. [MHz]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Detector	Polarity
1	1439.2000	38.12	-22.87	74.00	35.88	PK	Vertical
2	1530.2000	37.19	-22.63	74.00	36.81	PK	Vertical
3	1935.2000	33.91	-21.21	74.00	40.09	PK	Vertical
4	4080.0000	37.54	-12.16	74.00	36.46	PK	Vertical
5	4879.5000	47.61	-9.05	74.00	26.39	PK	Vertical
6	7318.5000	51.14	-2.92	74.00	22.86	PK	Vertical
7	7911.0000	44.80	-1.47	74.00	29.20	PK	Vertical
8	11652.0000	48.97	7.45	74.00	25.03	PK	Vertical
9	14520.0000	52.06	11.69	74.00	21.94	PK	Vertical

Remark:

- 1 Measuring frequencies from 1 GHz 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 Data of measurement within this frequency range shown “ --- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 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.

Mode: TX

Highest channel (2480MHz)

NO.	Freq. [MHz]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Detector	Polarity
1	1255.0000	34.01	-23.65	74.00	39.99	PK	Vertical
2	1530.6000	38.43	-22.63	74.00	35.57	PK	Vertical
3	1747.2000	37.64	-21.71	74.00	36.36	PK	Vertical
4	1962.4000	34.83	-20.88	74.00	39.17	PK	Vertical
5	2714.8000	37.16	-18.09	74.00	36.84	PK	Vertical
6	4959.0000	42.64	-8.50	74.00	31.36	PK	Vertical
7	7438.5000	50.01	-1.90	74.00	23.99	PK	Vertical
8	9090.0000	46.06	1.55	74.00	27.94	PK	Vertical
9	11121.0000	48.41	6.76	74.00	25.59	PK	Vertical
10	14451.0000	50.51	10.75	74.00	23.49	PK	Vertical
11	17008.5000	51.84	12.27	74.00	22.16	PK	Vertical

NO.	Freq. [MHz]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Detector	Polarity
1	1164.2000	33.95	-23.95	74.00	40.05	PK	Horizontal
2	1329.6000	33.67	-23.34	74.00	40.33	PK	Horizontal
3	1540.0000	39.36	-22.63	74.00	34.64	PK	Horizontal
4	1747.8000	38.19	-21.70	74.00	35.81	PK	Horizontal
5	2253.2000	33.70	-19.95	74.00	40.30	PK	Horizontal
6	4279.5000	39.05	-12.51	74.00	34.95	PK	Horizontal
7	4959.0000	46.21	-8.50	74.00	27.79	PK	Horizontal
8	7438.5000	51.96	-1.90	74.00	22.04	PK	Horizontal
9	10888.5000	49.62	6.25	74.00	24.38	PK	Horizontal
10	13506.0000	50.26	9.55	74.00	23.74	PK	Horizontal
11	17010.0000	50.98	12.25	74.00	23.02	PK	Horizontal

Remark:

- 1 Measuring frequencies from 1 GHz 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 Data of measurement within this frequency range shown “ --- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 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.

7. 6DB BANDWIDTH

7.1. LIMITS

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

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) $\geq 3 \times$ 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.

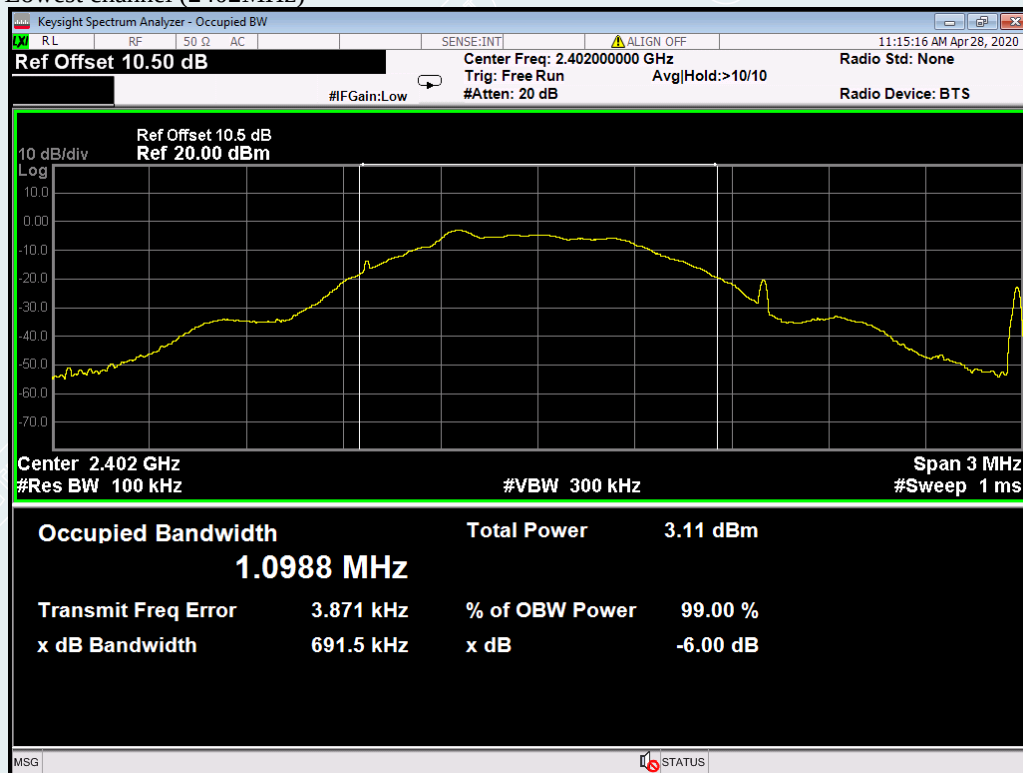
7.3. TEST SETUP



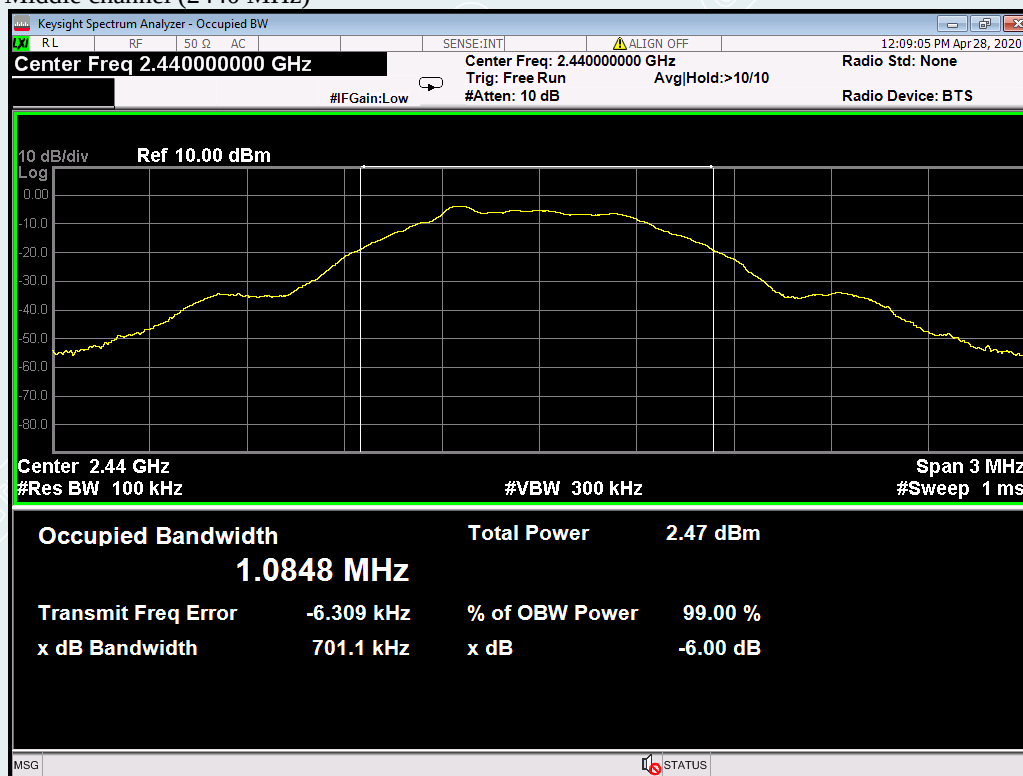
7.4. TEST RESULTS

Channel	Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Test Result
Lowest	2402	691.5	>500	PASS
Middle	2440	701.1		PASS
Highest	2480	683.0		PASS

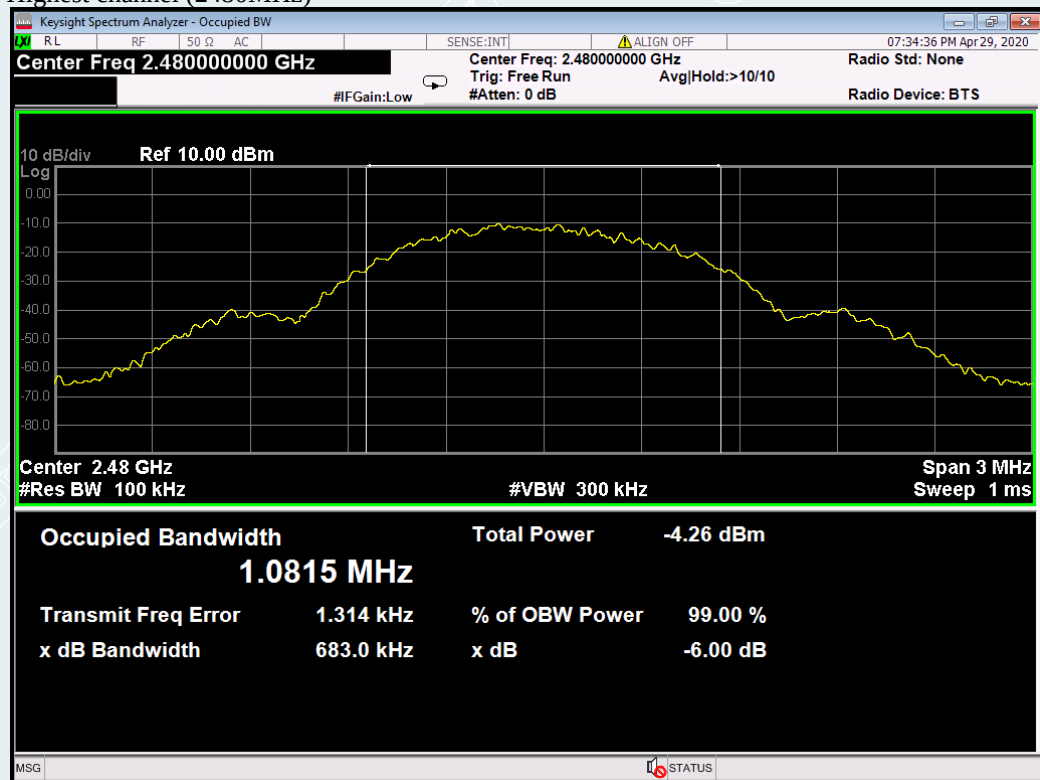
Lowest channel (2402MHz)



Middle channel (2440 MHz)



Highest channel (2480MHz)



8. MAXIMUM PEAK OUTPUT POWER

8.1.LIMITS

The maximum Peak output power measurement is 1W

8.2.TEST PROCEDURES

- 1) Place the EUT on a bench and set it in transmitting mode.
- 2) Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to an EMI Test Receiver.
- 3) The spectrum analyzer resolution bandwidth that is $\leq$ EBW. So we test the Maximum Conducted Output Power —Integrated band power method.
- 4) Set the analyzer span $\geq 1.5 \times$ DTS bandwidth. Set the RBW = 1 MHz. Set the VBW ≥ 3 MHz. Sweep time = auto couple. Detector = peak. Allow trace to fully stabilize.

8.3.TEST SETUP



8.4.TEST RESULTS

Channel	Frequency (MHz)	Measured Channel Power (dBm)	Limit	Peak/ Average	Result
Lowest	2402	-2.83	1W (30dBm)	Peak	Pass
Middle	2440	-3.36			Pass
Highest	2480	-4.01			Pass

9. POWER SPECTRAL DENSITY

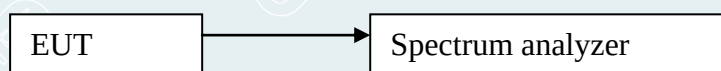
9.1. LIMITS

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

9.2. TEST 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 = 3 kHz. Set the VBW ≥ 3 RBW. Detector = peak. Ensure that the number of measurement points in the sweep $\geq 2 \times$ span/RBW (use of a greater number of measurement points than this minimum requirement is recommended).
- 4) Repeat above procedures until all frequencies measured were complete.

9.3. TEST SETUP



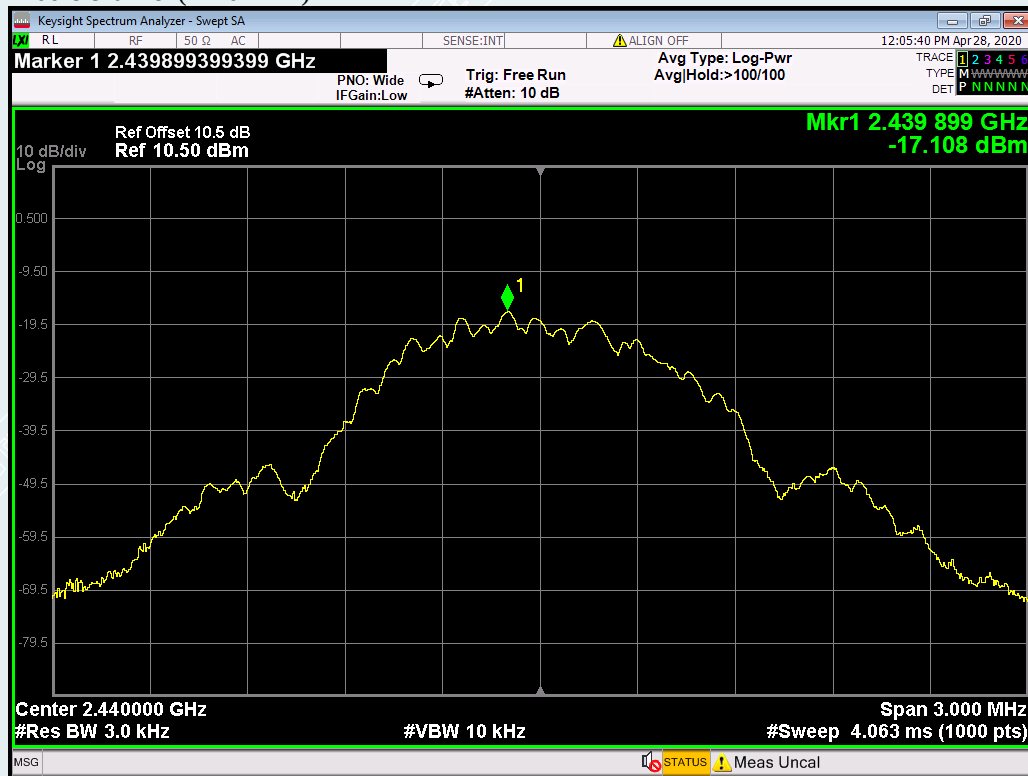
9.4. TEST RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm/3kHz)	Test Result
Lowest	2402	-16.387	8	PASS
Middle	2440	-17.108		PASS
Highest	2480	-18.903		PASS

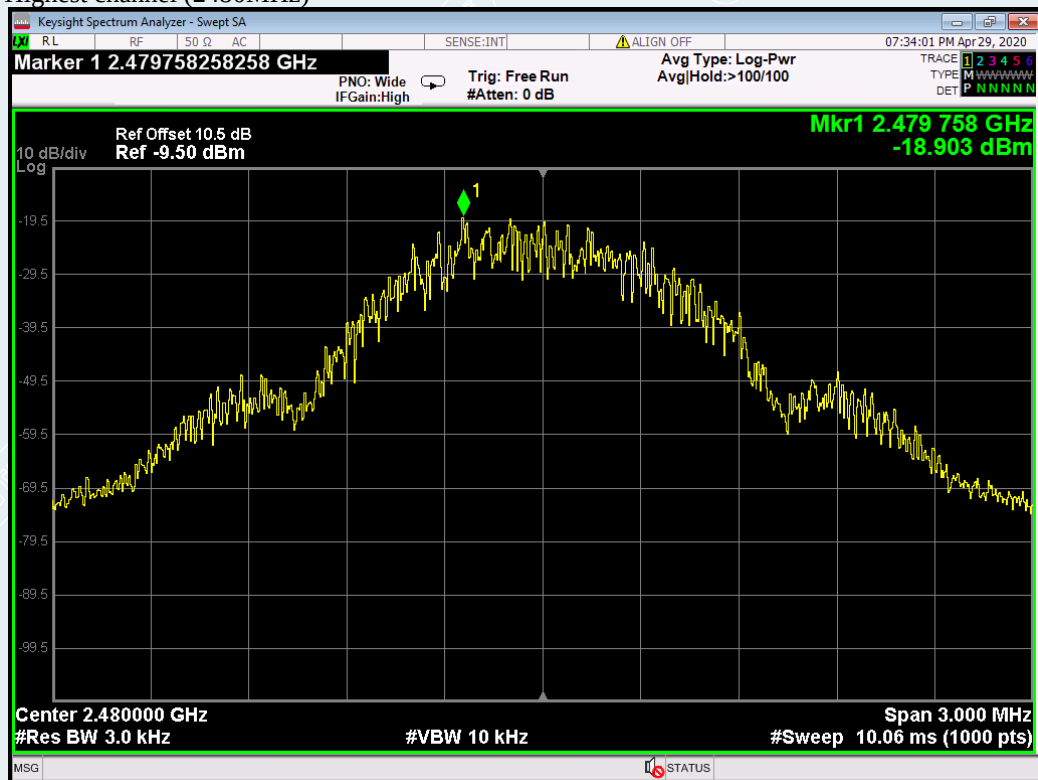
Lowest channel (2402MHz)



Middle channel (2440 MHz)



Highest channel (2480MHz)



10. CONDUCTED BAND EDGES AND SPURIOUS EMISSIONS

10.1. LIMITS

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

10.2. TEST PROCEDURES

Test procedures follow KDB 558074 D01 DTS Measurement Guidance v03r01.

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, Span = 10MHz to 26GHz; 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.

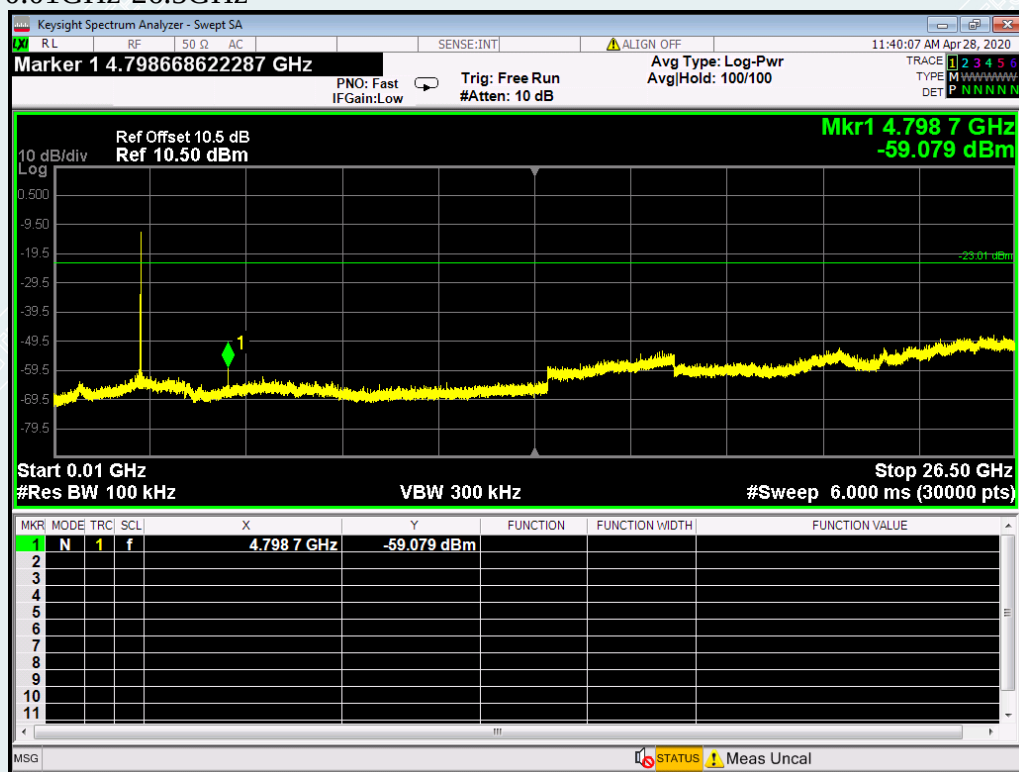
10.3. TEST SETUP



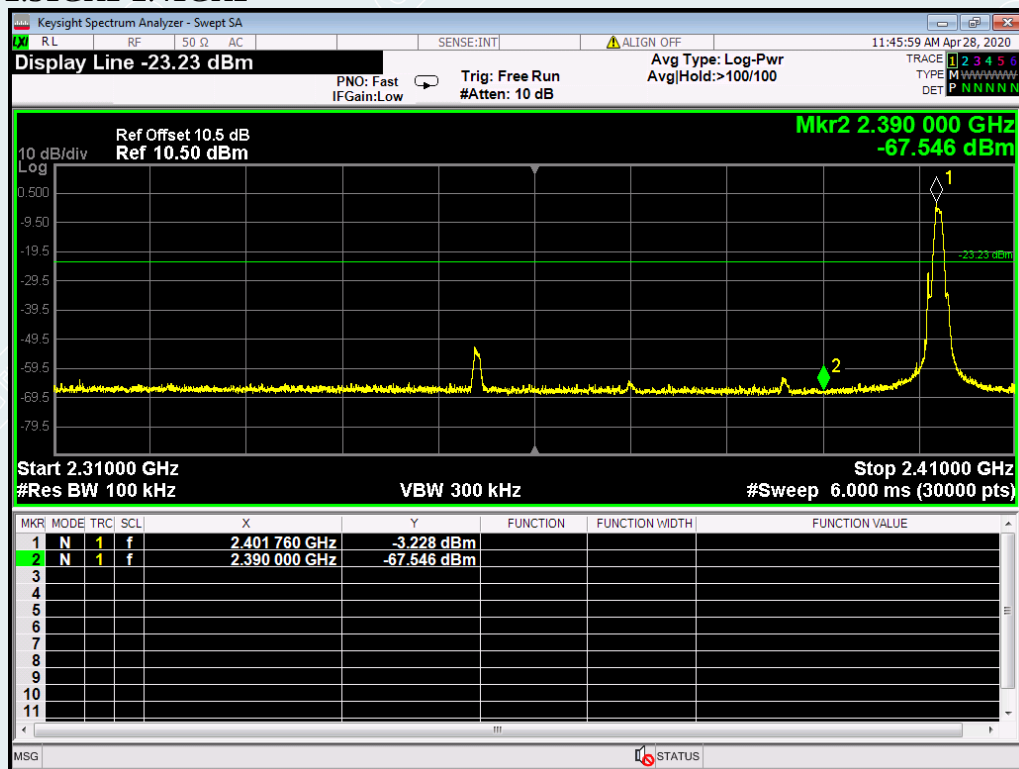
10.4. TEST RESULTS

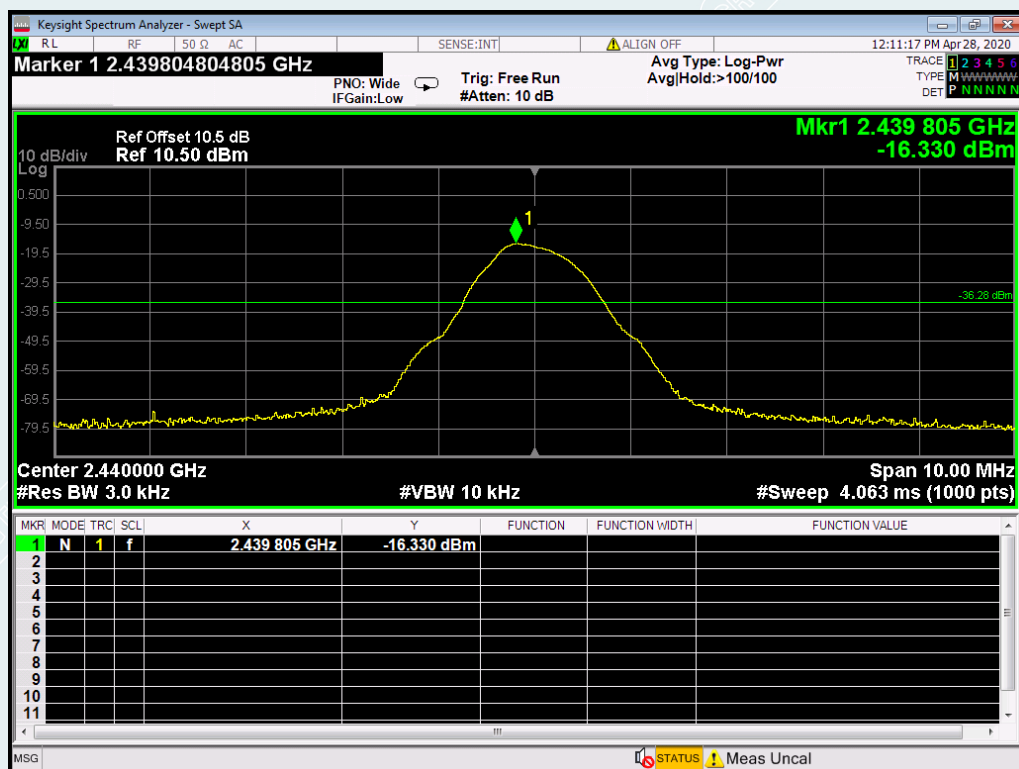
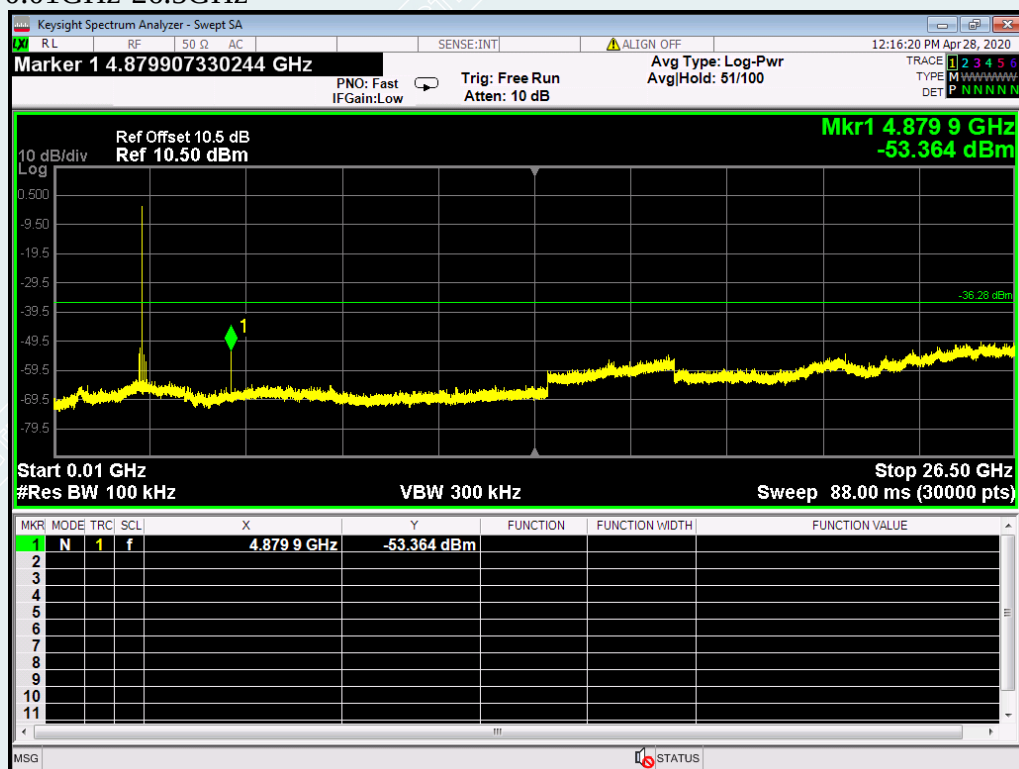
Lowest channel (2402MHz)

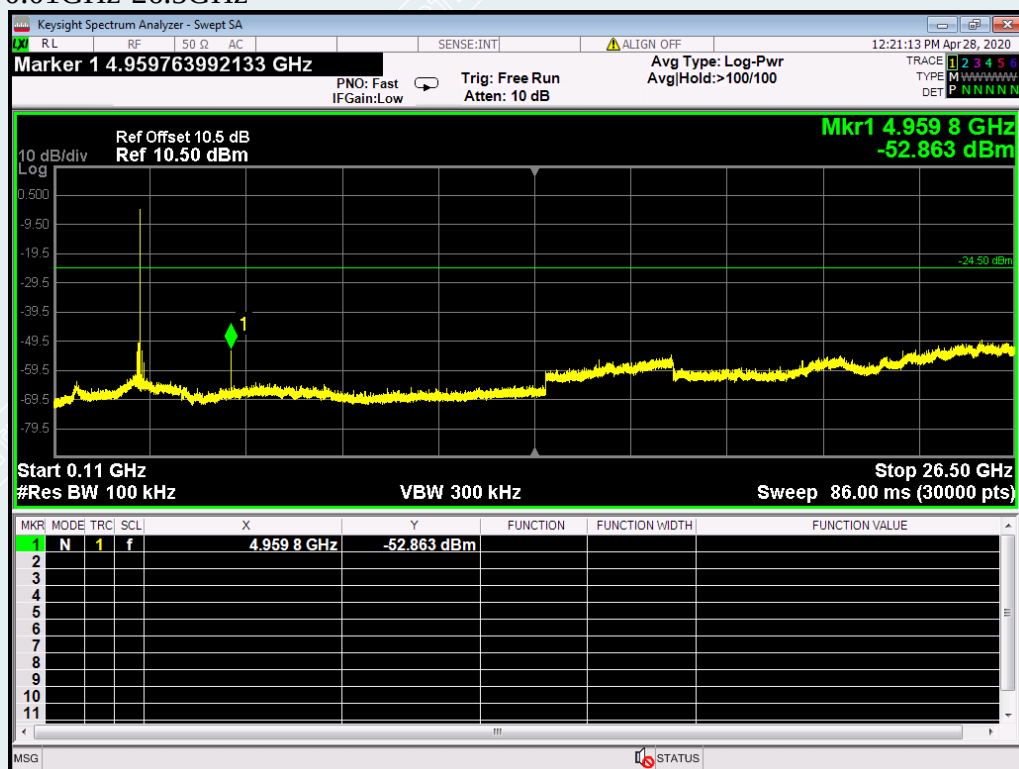
0.01GHz-26.5GHz



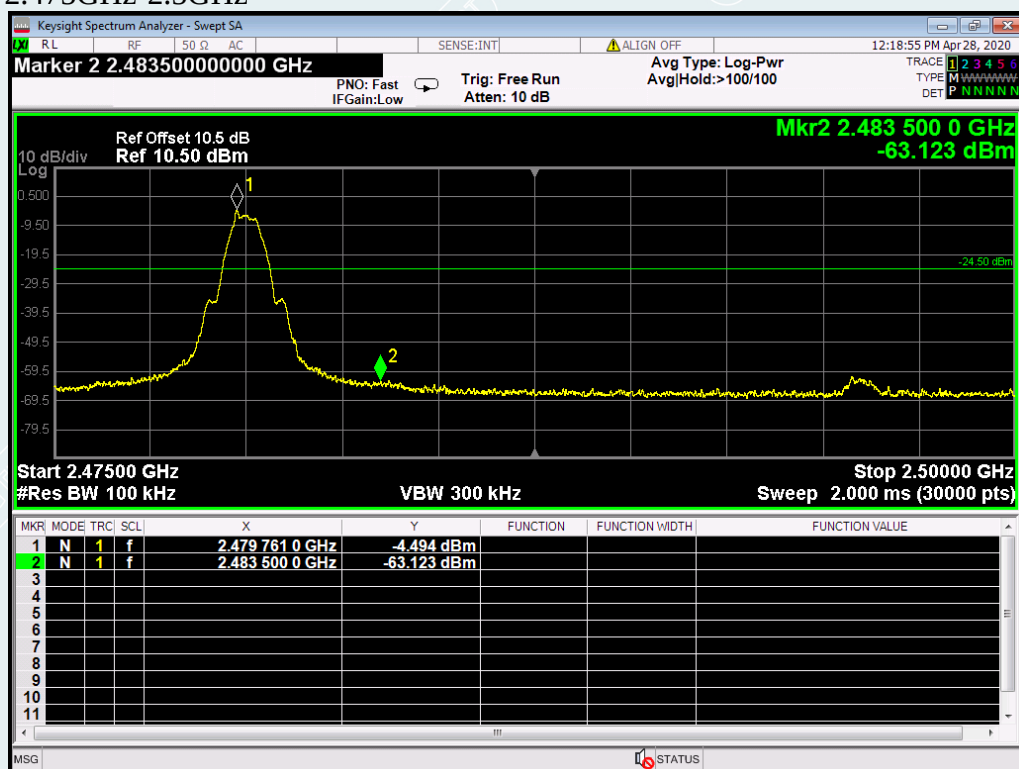
2.31GHz-2.41GHz



Middle channel (2440 MHz)
0.01GHz-26.5GHz

Highest channel (2480MHz)
0.01GHz-26.5GHz

2.475GHz-2.5GHz



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)).

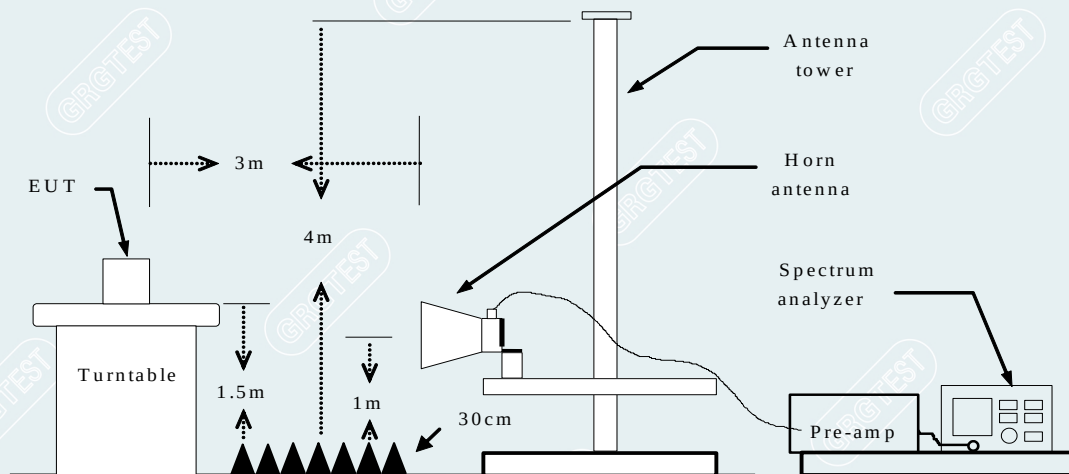
MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 -	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.69525	960 - 1240	7.25 - 7.75
4.125 - 4.128	16.80425 -	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	16.80475	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	25.5 - 25.67	1645.5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

11.2.TEST PROCEDURES

Test procedures follow KDB 558074 D01 DTS Meas Guidance v03r01.

- 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
- 5) Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

11.3.TEST SETUP

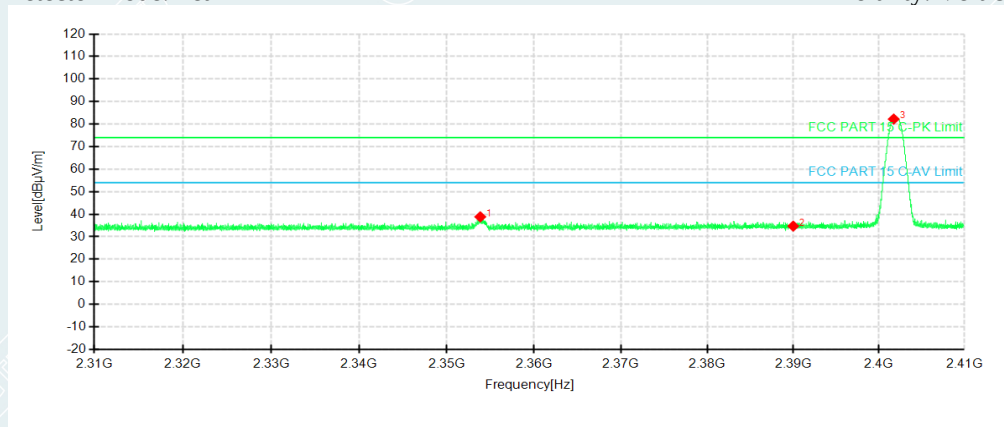


11.4.TEST RESULTS

Lowest Channel

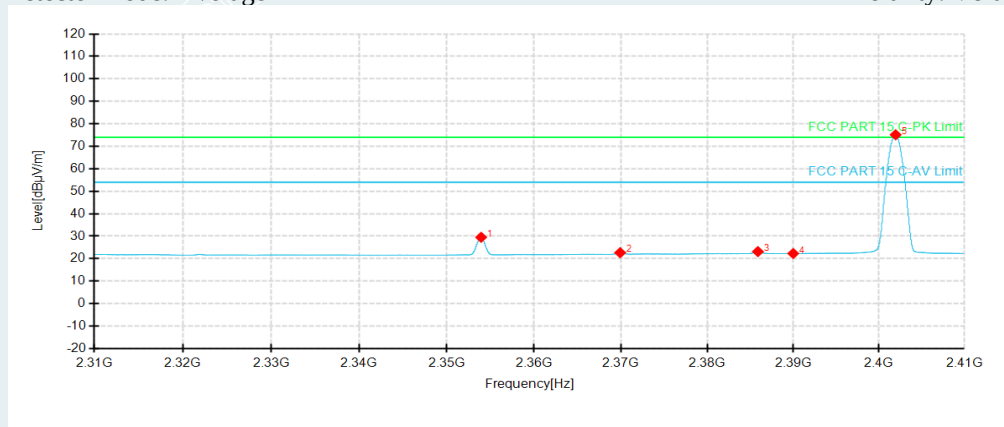
Detector mode: Peak

Polarity: Vertical



Detector mode: Average

Polarity: Vertical

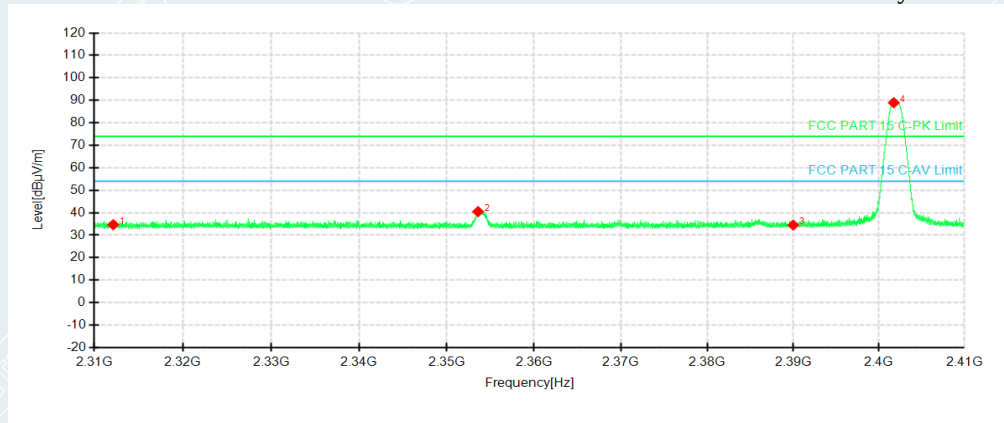


NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Remark	Pole
1	2353.8500	38.82	-19.58	74.00	35.18	Peak	Vertical
2	2390.0000	34.72	-19.42	74.00	39.28	Peak	Vertical
1	2353.9500	29.50	-19.58	54.00	24.50	Average	Vertical
2	2369.9400	22.66	-19.51	54.00	31.34	Average	Vertical
3	2385.8900	23.15	-19.44	54.00	30.85	Average	Vertical
4	2390.0000	22.29	-19.42	54.00	31.71	Average	Vertical

Lowest Channel

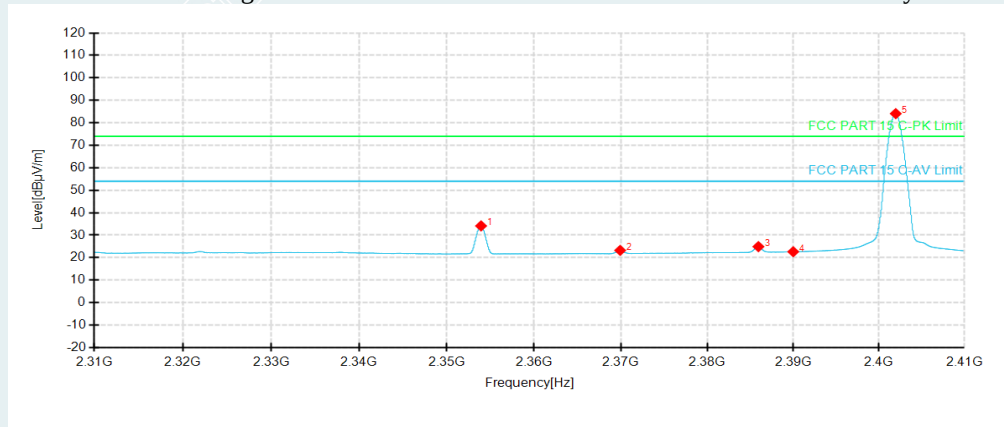
Detector mode: Peak

Polarity: Horizontal



Detector mode: Average

Polarity: Horizontal

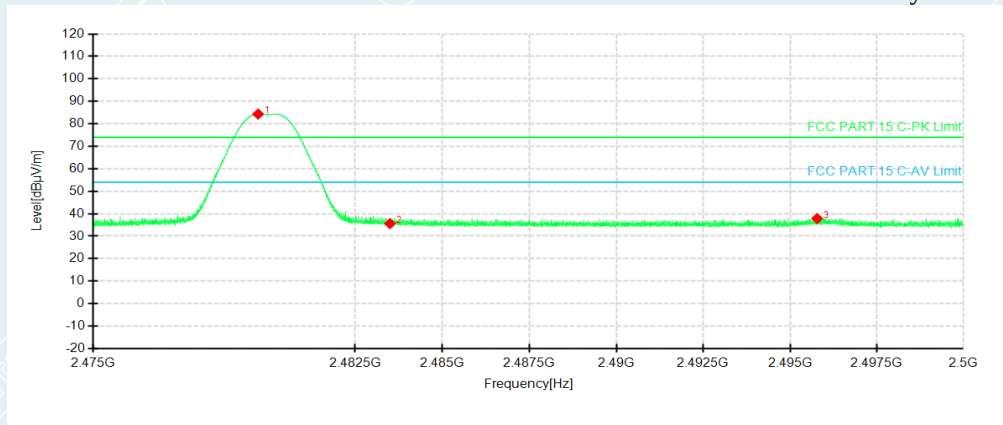


NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Remark	Pole
1	2312.1500	34.68	-19.77	74.00	39.32	Peak	Horizontal
2	2353.5900	40.49	-19.58	74.00	33.51	Peak	Horizontal
3	2390.0000	34.50	-19.42	74.00	39.50	Peak	Horizontal
1	2353.9400	34.12	-19.58	54.00	19.88	Average	Horizontal
2	2369.9400	23.25	-19.51	54.00	30.75	Average	Horizontal
3	2385.9500	24.90	-19.44	54.00	29.10	Average	Horizontal
4	2390.0000	22.63	-19.42	54.00	31.37	Average	Horizontal

Highest channel

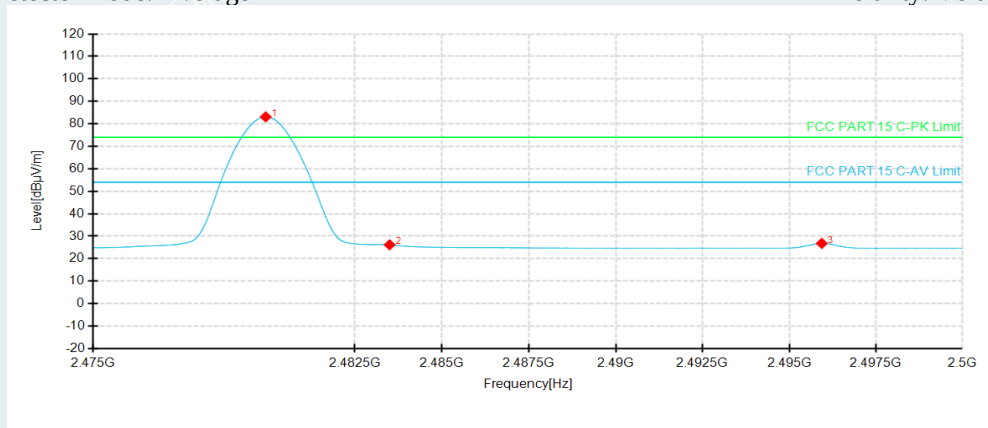
Detector mode: Peak

Polarity: Vertical



Detector mode: Average

Polarity: Vertical

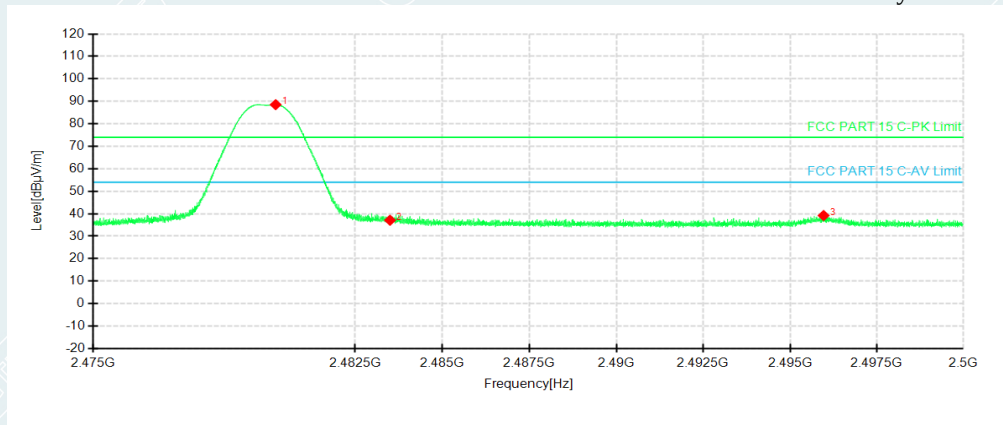


NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Remark	Pole
2	2483.5000	35.59	-18.72	74.00	38.41	Peak	Vertical
3	2495.7825	37.84	-18.62	74.00	36.16	Peak	Vertical
2	2483.5000	26.16	-18.72	54.00	27.84	Average	Vertical
3	2495.9400	26.79	-18.62	54.00	27.21	Average	Vertical

Highest channel

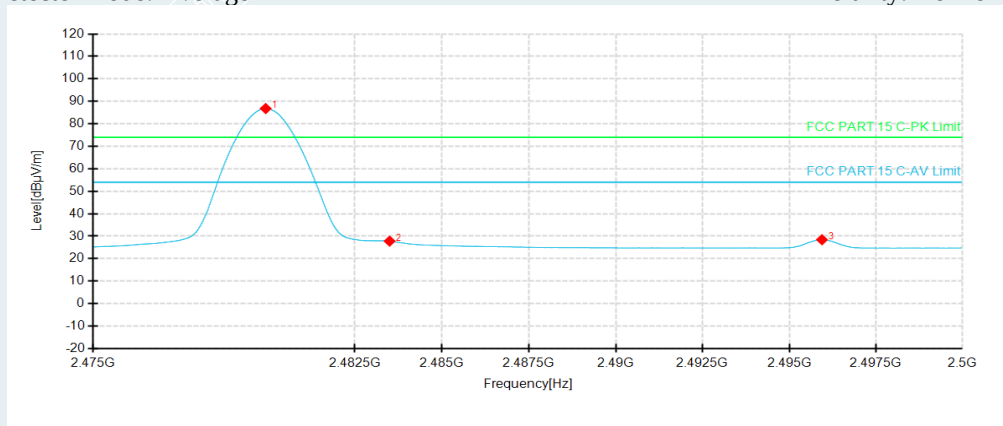
Detector mode: Peak

Polarity: Horizontal



Detector mode: Average

Polarity: Horizontal

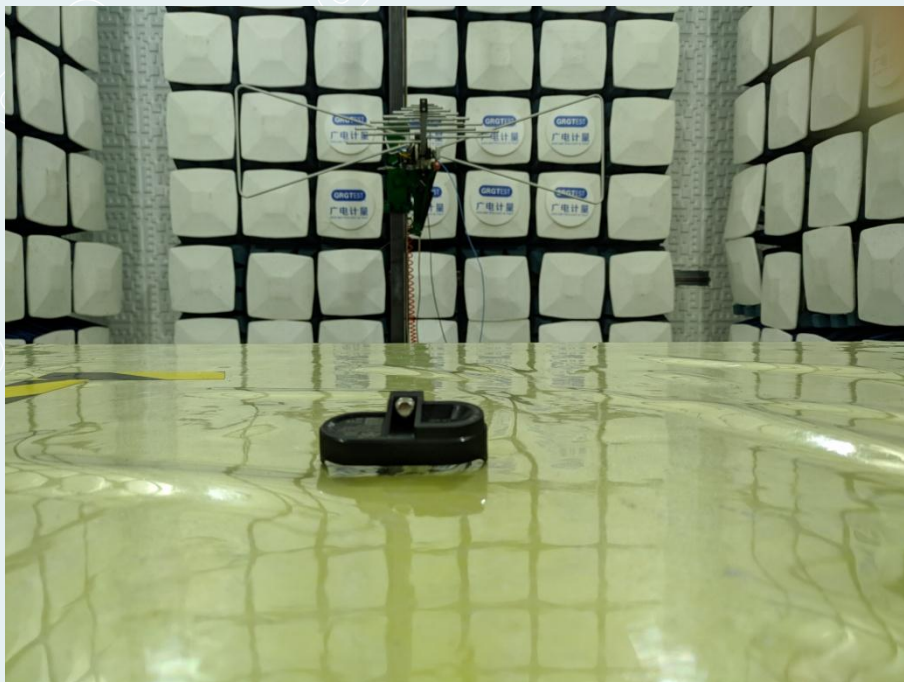


NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Remark	Pole
2	2483.5000	37.09	-18.72	74.00	36.91	Peak	Horizontal
3	2495.9675	39.19	-18.62	74.00	34.81	Peak	Horizontal
2	2483.5000	27.79	-18.72	54.00	26.21	Average	Horizontal
3	2495.9450	28.42	-18.62	54.00	25.58	Average	Horizontal

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 ARRANGEMENT

RSE (Below 1GHz)



RSE (Above 1GHz)



-----This is the last page of the report. -----