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CNAS L0446



Certified # 2861.01

GRGTEST

TEST REPORT

Verified Code: 300142

Report No.:	E20210426746801-10		Application No.:	E20210426746801
Client:	Lumi United Technology Co., Ltd.			
Address:	8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave, Taoyuan Residential District, Nanshan District, Shenzhen, China			
Sample Description:	Camera Hub G3			
Model:	CH-H03			
Test Specification:	CFR 47, FCC Part 15 Subpart C RADIO FREQUENCY DEVICES:Subpart C—Intentional Radiators			
Receipt Date:	2021-06-09			
Test Date:	2021-07-30 to 2021-08-28			
Issue Date:	2021-09-07			
Test Result:	Pass			
Prepared By: Test Engineer Yang Zhaoyun	Reviewed By: Technical Manager Wu Haotong	Approved By: Manager John Lee		
Other Aspects:				
Note: 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 station carries out test task according to the national regulation of verification 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		
CFR 47, FCC Part 15 Subpart C (§15.247)		
Limit / Severity	Item	Result
§15.207	Conducted emission AC power port	Pass
§15.247(b)(1)	Conducted output power for FHSS	N/A
§15.247(b)(3)	Conducted output power for DTS	Pass
§15.247(e)	Power spectral density	Pass
§15.247(a)(2)	6dB bandwidth	Pass
§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
§15.247(d)	Band edge	Pass
§15.247(d) & §15.209 & §15.205	Spurious radiated emissions for transmitter	Pass
§15.203	Antenna requirement	Pass

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

The max gain of antenna is 2dBi which accordance 15.203 is considered sufficient to comply with the provisions of this section.

2. GENERAL DESCRIPTION OF EUT

2.1 APPLICANT

Name: Lumi United Technology Co., Ltd.
Address: 8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave, Taoyuan Residential District, Nanshan District, Shenzhen.China

2.2 MANUFACTURER

Name: Lumi United Technology Co., Ltd.
Address: 8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave, Taoyuan Residential District, Nanshan District, Shenzhen.China

2.3 BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment: Camera Hub G3
Model No.: CH-H03
Adding Model: /
Trade Name: Aqara
FCC ID: 2AKIT-CHH03
Power Supply: DC5V power supplied by adapter
Adapter Specification: Adapter 1-US Plug
Model: A8A-050200U-US1
Input: 100-240V~ 50/60Hz 0.35A
Output: 5.0V ~~---~~ 2.0A
Frequency Range: 2405MHz-2475MHz
Transmit Power: 7.58dBm
Modulation type: OQPSK
Antenna Specification: Internal antenna 2dBi gain (Max.)
Temperature Range: -10°C~40°C
Hardware Version: A20-GHC01-MIAN-X4
Software Version: 3.2.8_0003.0004
Sample No: E20210426746801-0005, E20210426746801-0008
Note: /

2.4 TEST OPERATION MODE

Test Item	Mode No.	Description of the modes
Conducted Emission	1	Zigbee TX mode
Radiated Emission	1	Zigbee TX mode

2.5 LOCAL SUPPORTIVE

Name of Equipment	Manufacturer	Model	Serial Number	Note
Notebook	LENOVO	TianYi 310-14ISK	MP18DLC6	/
/	/	/	/	/
Cable				
/	/	/	/	/

Note :The notebook is just used to produce fixed frequency transmitting.

Test software:

Software version	Test level
QCOM_V1.0	80

3. LABORATORY AND ACCREDITATIONS

3.1 LABORATORY

The tests & measurements refer to this report were performed by ShenzhenEMC 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

Our laboratories are accredited and approved by the following approval agencies according to GB/T 27025(ISO/IEC 17025:2017)

USA A2LA(Certificate#:2861.01)
China CNAS(L0446)

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

Canada Industry Canada (Company Number: 24897)
USA FCC

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

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
		1GHz~18GHz
		18GHz~26.5GHz
	Vertical	30MHz~1000MHz
		1GHz~18GHz
		18GHz~26.5GHz
Conduction Emission	9 kHz ~ 150 kHz	2.8 dB
	150 kHz ~ 10 MHz	2.8 dB
	10 MHz ~ 30 MHz	2.2 dB

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	R&S	ESCI	100783	2021-10-08
LISN(EUT)	R&S	ENV216	101543	2022-03-21
EZ-EMC	EZ	CCS-3A1-CE	/	/
Radiated Spurious Emission&Restricted bands of operation				
Spectrum Analyzer	Agilent	N9010A	MY52221469	2022-04-16
Horn Antenna	Schwarzbeck	BBHA9120D	286	2021-10-08
Bi-log Antenna	Schwarzbeck	BBHA 9170	BBHA 9170-497	2021-11-05
Amplifier	Tonscend	TAP01018048	AP20E8060075	2022-06-07
Amplifier	Tonscend	TAP184050	AP20E806071	2022-05-17
Test Receiver	R&S	ESCI	100088	2021-11-14
Preamplifier	EMEC	EM330	/	2022-03-21
Bi-log Antenna	TESEQ	CBL6143A	32399	2021-11-25
Test S/W	Tonscend	JS32-RE/2.5.1.5		
Test S/W	EZ	CCS-2ANT		
6 dB Bandwidth				
Spectrum Analyzer	R&S	FSV30	104381	2022-02-21
Maximum Peak Output Power				
Pulse power sensor	Agilent	MA2411B	1126150	2022-03-21
Power meter	Anritsu	ML2495A	1204003	2022-03-21
Conducted band edges and Spurious Emission				
Spectrum Analyzer	R&S	FSV30	104381	2022-02-21
Peak Output Spectral Density Measurement				
Spectrum Analyzer	R&S	FSV30	104381	2022-02-21

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

5. CONDUCTED EMISSION MEASUREMENT

5.1 LIMITS

Frequency range	Limits (dB μ V)	
	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:

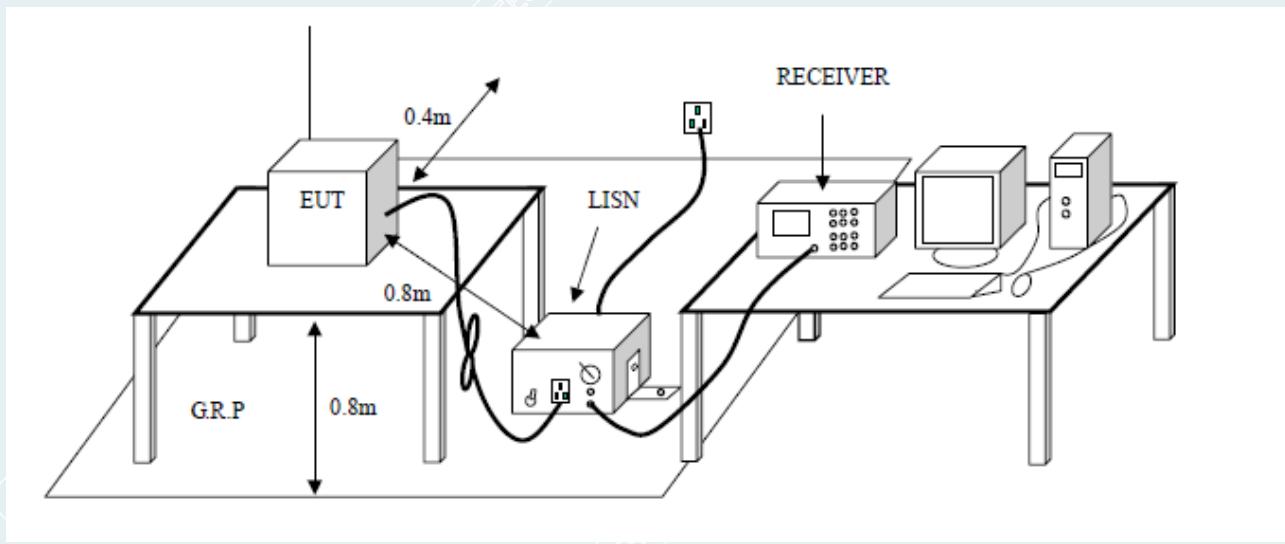
- Either the bottom or the rear of the EUT shall be at a controlled distance of 40 cm from a reference ground plane. This ground plane is normally the wall or floor of a shielded room. It may also be a grounded metal plane of at least 2 m by 2 m. This is physically accomplished as follows:
 - 1) place 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

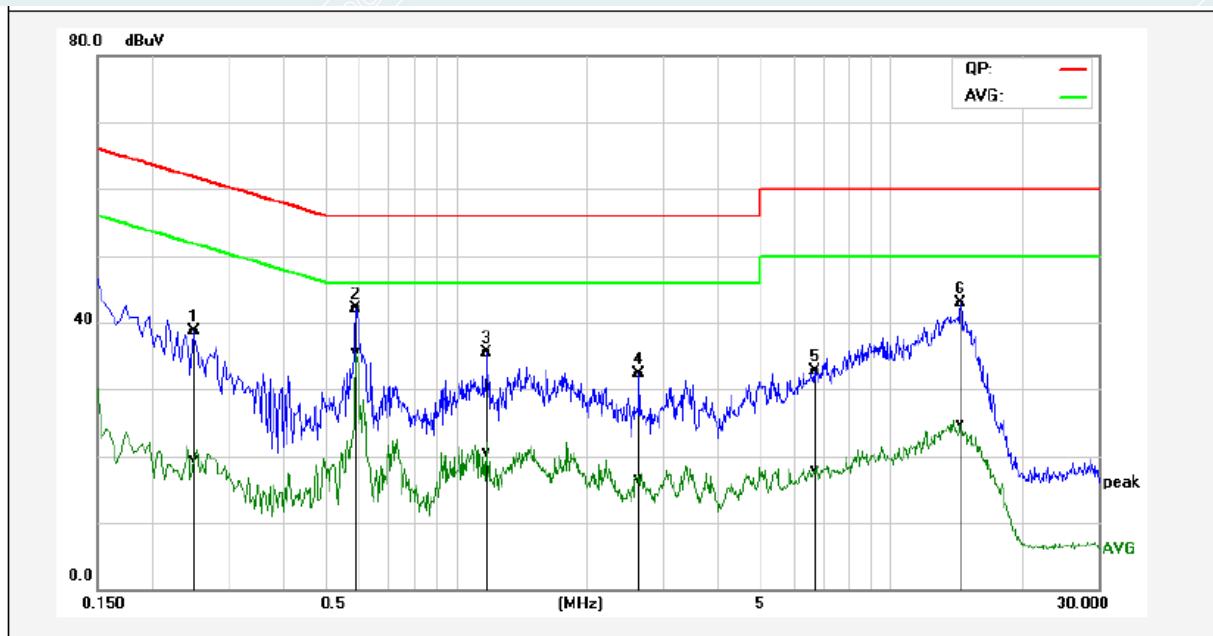
Limit = Limit stated in standard

Margin = Result (dBuV) – Limit (dBuV)

5.5 TEST RESULTS

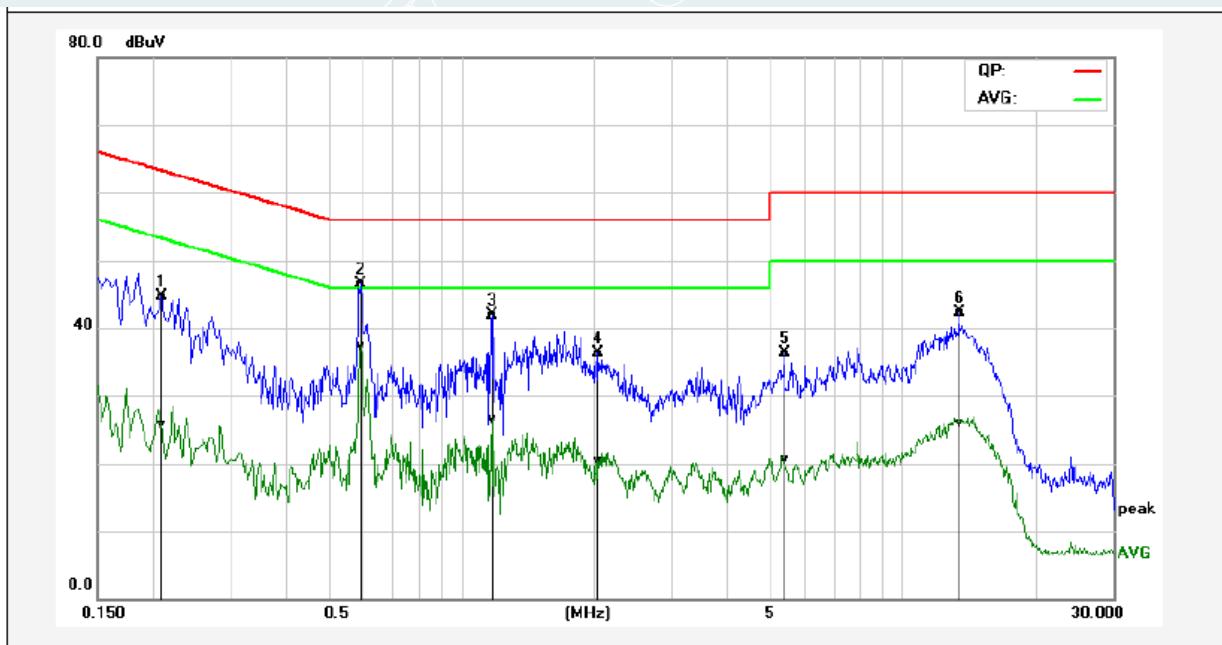
Recorded the worst case results in this report (2405MHz)

EUT Name	Camera Hub G3	Model	CH-H03
Environmental Conditions	21.1 °C/40% RH	Test Mode	Mode 1
Tested By	Wang Xinyuan	Line	L
Tested Date	2021/08/16	Test Voltage	AC120V/60Hz



No.	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
1	0.2500	29.10	9.84	9.63	38.73	19.47	61.75	51.76	-23.02	-32.29	Pass
2*	0.5899	32.49	25.78	9.67	42.16	35.45	56.00	46.00	-13.84	-10.55	Pass
3	1.1820	25.85	10.89	9.67	35.52	20.56	56.00	46.00	-20.48	-25.44	Pass
4	2.6460	22.63	6.80	9.67	32.30	16.47	56.00	46.00	-23.70	-29.53	Pass
5	6.6740	22.96	8.05	9.79	32.75	17.84	60.00	50.00	-27.25	-32.16	Pass
6	14.4580	32.96	14.85	9.94	42.90	24.79	60.00	50.00	-17.10	-25.21	Pass

EUT Name	Camera Hub G3	Model	CH-H03
Environmental Conditions	21.1 °C/40% RH	Test Mode	Mode 1
Tested By	Wang Xinyuan	Line	N
Tested Date	2021/08/16	Test Voltage	AC120V/60Hz



No.	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
1	0.2100	35.18	16.10	9.62	44.80	25.72	63.20	53.21	-18.40	-27.49	Pass
2*	0.5940	36.88	27.65	9.67	46.55	37.32	56.00	46.00	-9.45	-8.68	Pass
3	1.1740	32.15	16.83	9.67	41.82	26.50	56.00	46.00	-14.18	-19.50	Pass
4	2.0380	26.62	10.74	9.66	36.28	20.40	56.00	46.00	-19.72	-25.60	Pass
5	5.4180	26.54	10.67	9.75	36.29	20.42	60.00	50.00	-23.71	-29.58	Pass
6	13.4660	32.36	15.90	9.92	42.28	25.82	60.00	50.00	-17.72	-24.18	Pass

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

NOTE: (2) Above 18G Limit=74+20log(3/1)=83.54 (dB μ V/m).

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 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 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 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 position (± 45 °) 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 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 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

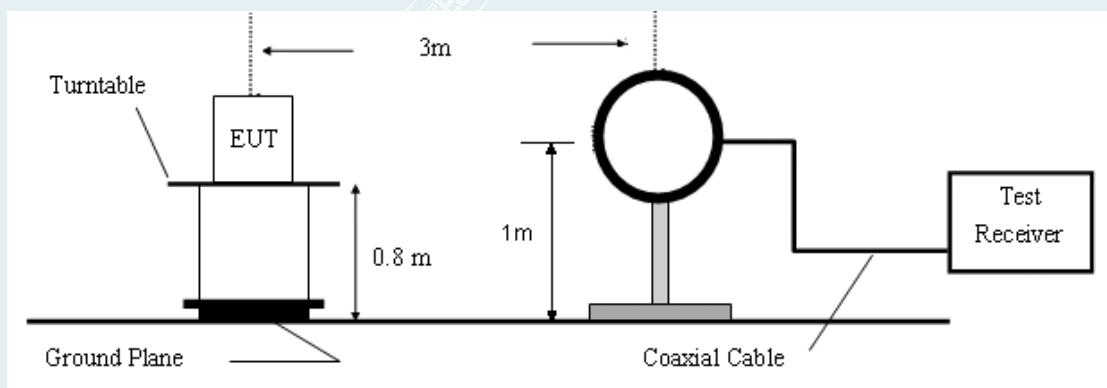


Figure 1. 9 KHz to 30MHz radiated emissions test configuration

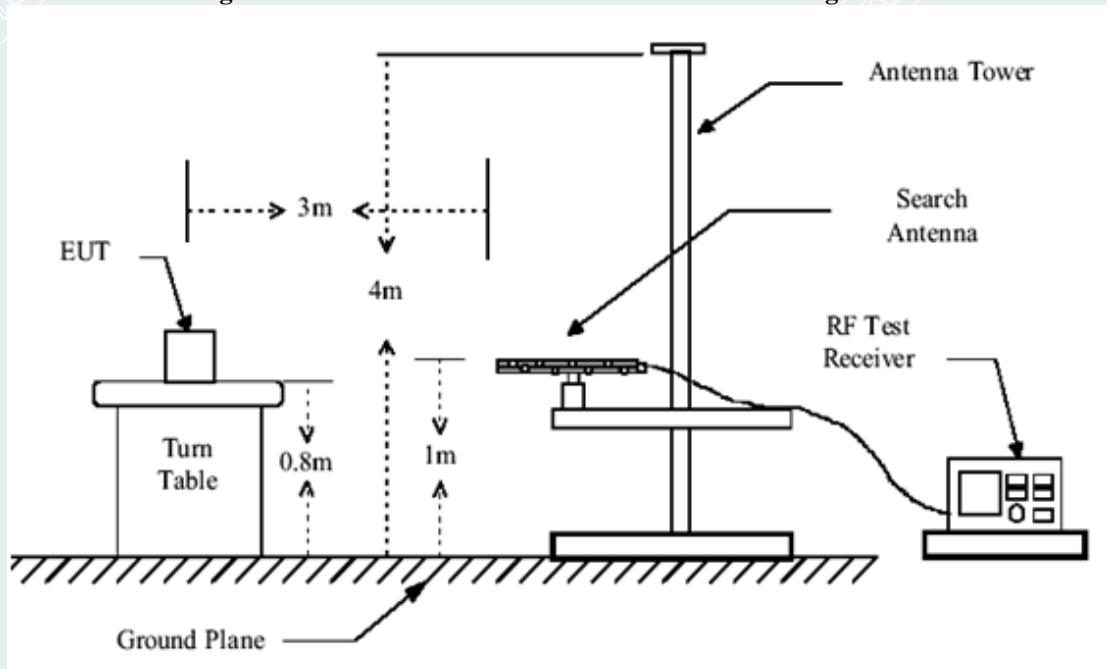


Figure 2. 30MHz to 1GHz radiated emissions test configuration

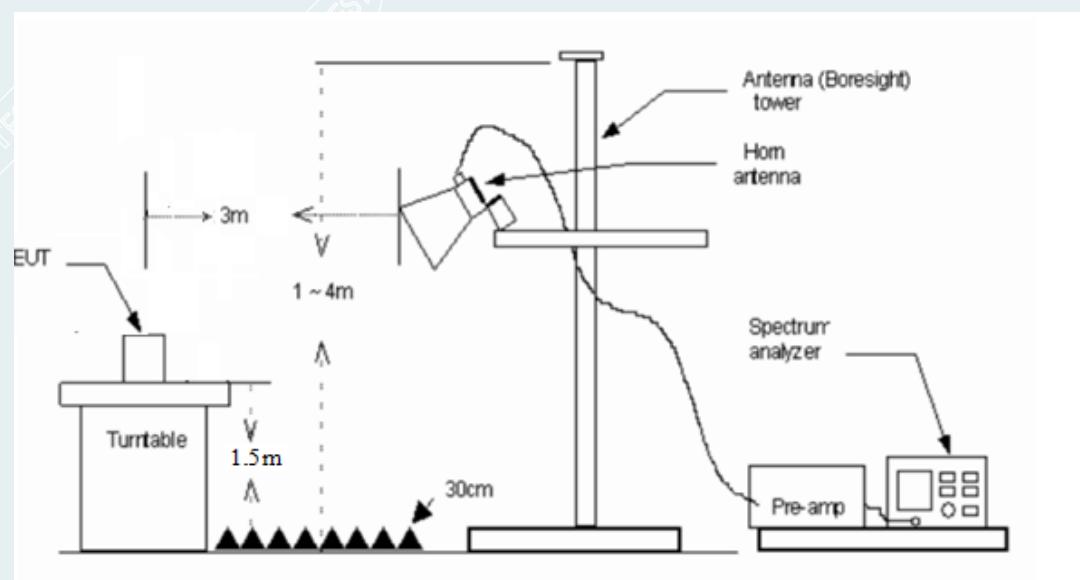


Figure 3. Above 1GHz-18GHz radiated emissions test configuration

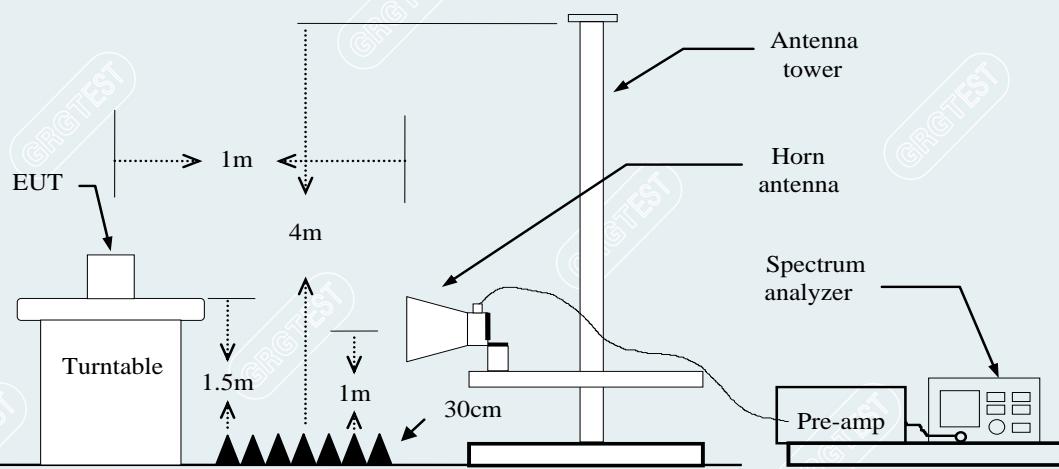


Figure 4. Above 18GHz-26.5GHz radiated emissions test configuration

6.4 DATA SAMPLE

30MHz to 1GHz

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

Above 1 GHz

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark	Pole
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)		
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

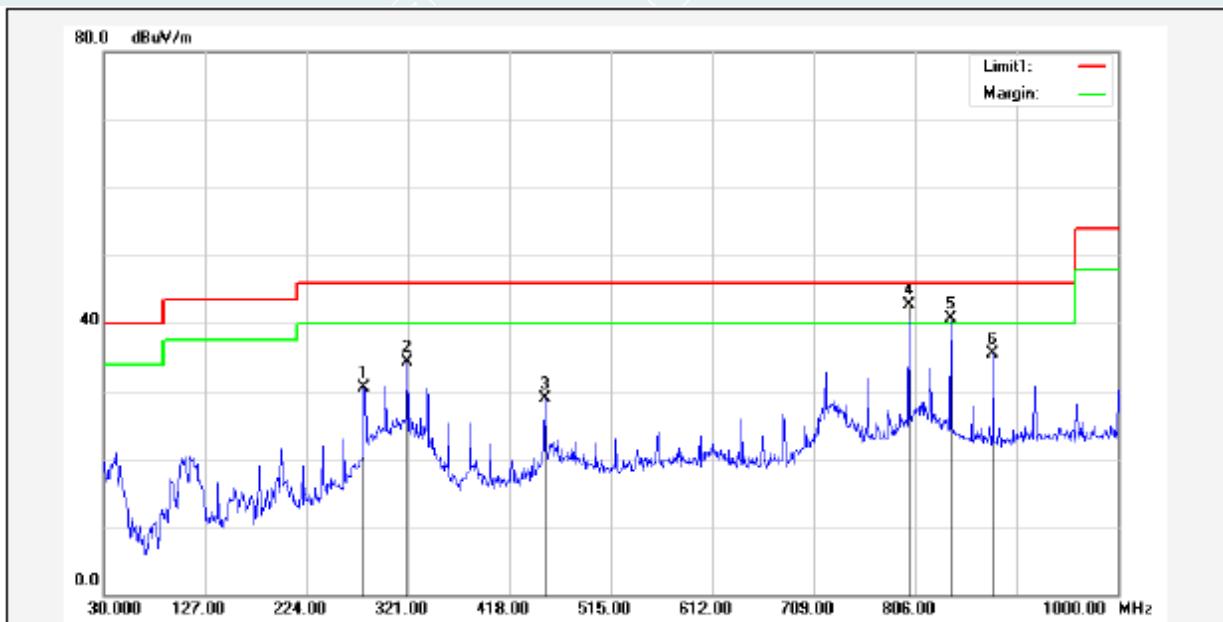
Mode: Mode 1

Lowest channel (2405MHz)

Polarity

Date: 2021-08-09

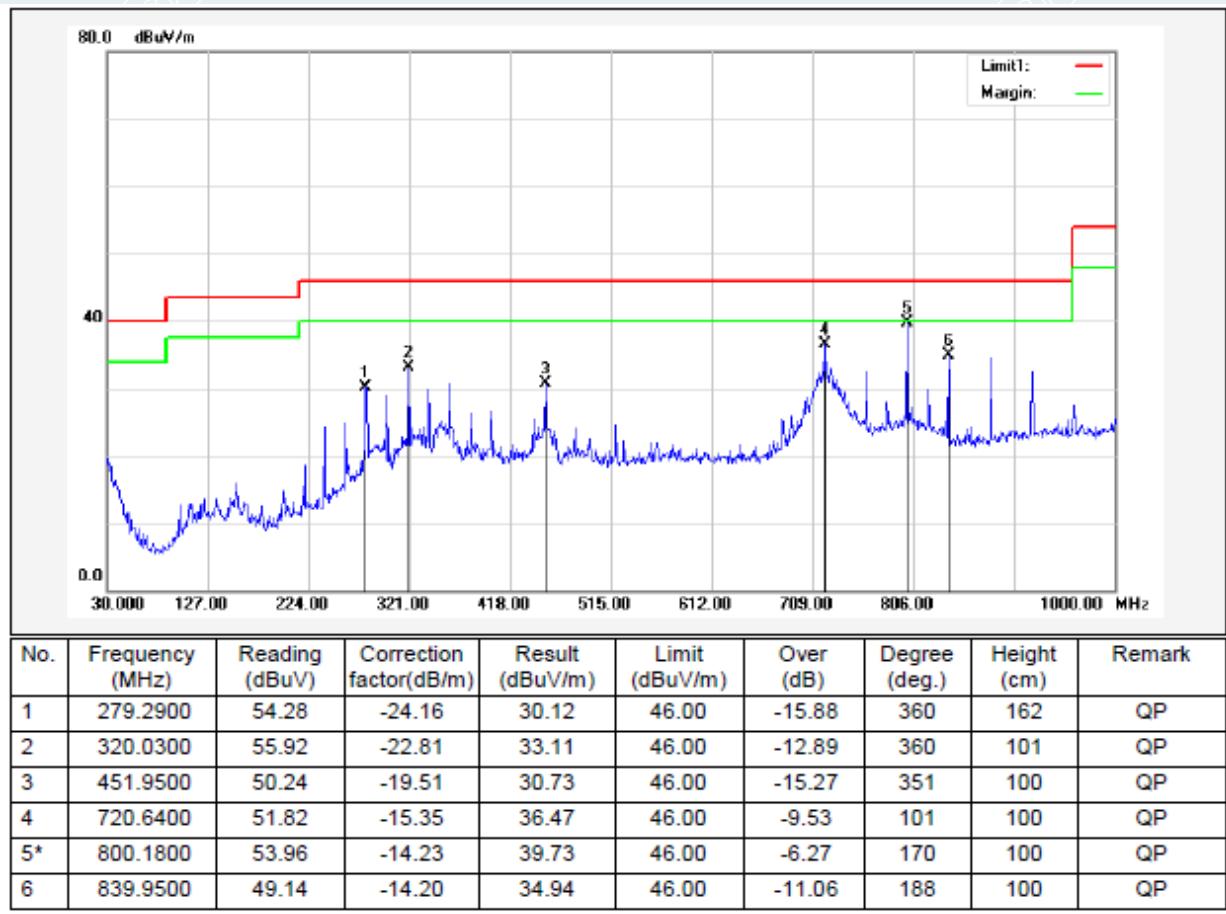
Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correction factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over (dB)	Degree (deg.)	Height (cm)	Remark
1	279.2900	54.72	-24.16	30.56	46.00	-15.44	91	200	QP
2	320.0300	57.07	-22.81	34.26	46.00	-11.74	360	105	QP
3	451.9500	48.36	-19.51	28.85	46.00	-17.15	133	200	QP
4*	800.1800	57.03	-14.23	42.80	46.00	-3.20	360	133	QP
5!	839.9500	55.00	-14.20	40.80	46.00	-5.20	165	200	QP
6	880.6900	49.11	-13.66	35.45	46.00	-10.55	176	100	QP

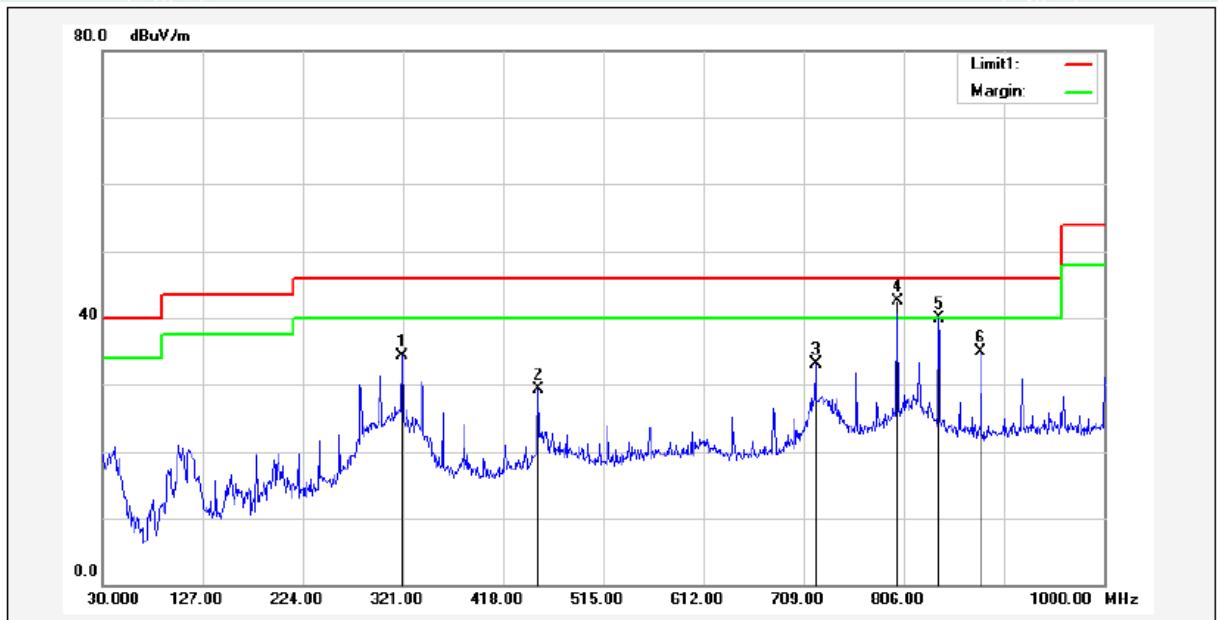
Mode: Mode 1
Lowest channel (2405MHz)
Polarity

Date: 2021-08-09
Horizontal



Mode: Mode 1
 Middle channel (2440MHz)
 Polarity

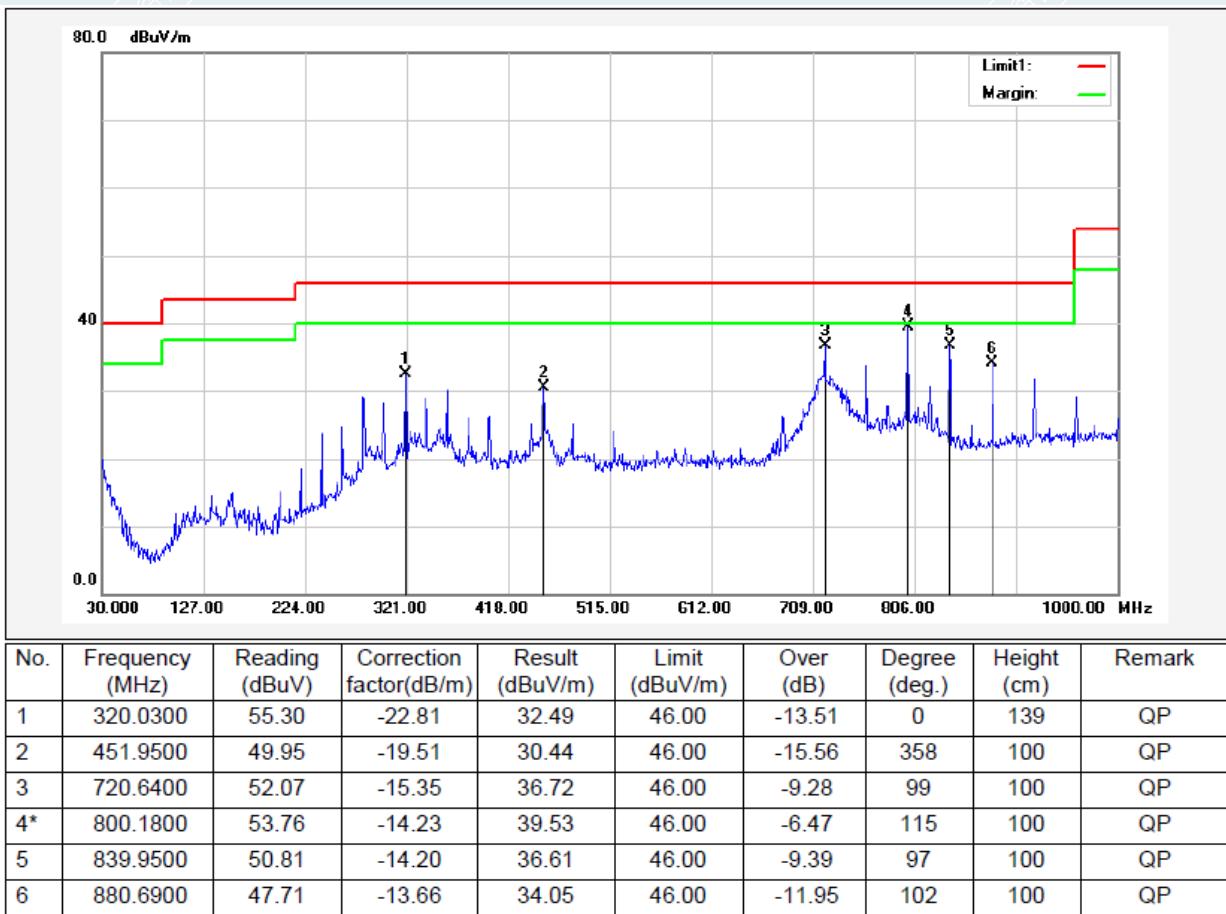
Date: 2021-08-09
 Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correction factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over (dB)	Degree (deg.)	Height (cm)	Remark
1	320.0300	57.03	-22.81	34.22	46.00	-11.78	0	100	QP
2	451.9500	48.89	-19.51	29.38	46.00	-16.62	150	200	QP
3	720.6400	48.44	-15.35	33.09	46.00	-12.91	221	100	QP
4*	800.1800	56.83	-14.23	42.60	46.00	-3.40	0	138	QP
5	839.9500	54.17	-14.20	39.97	46.00	-6.03	171	200	QP
6	880.6900	48.57	-13.66	34.91	46.00	-11.09	178	100	QP

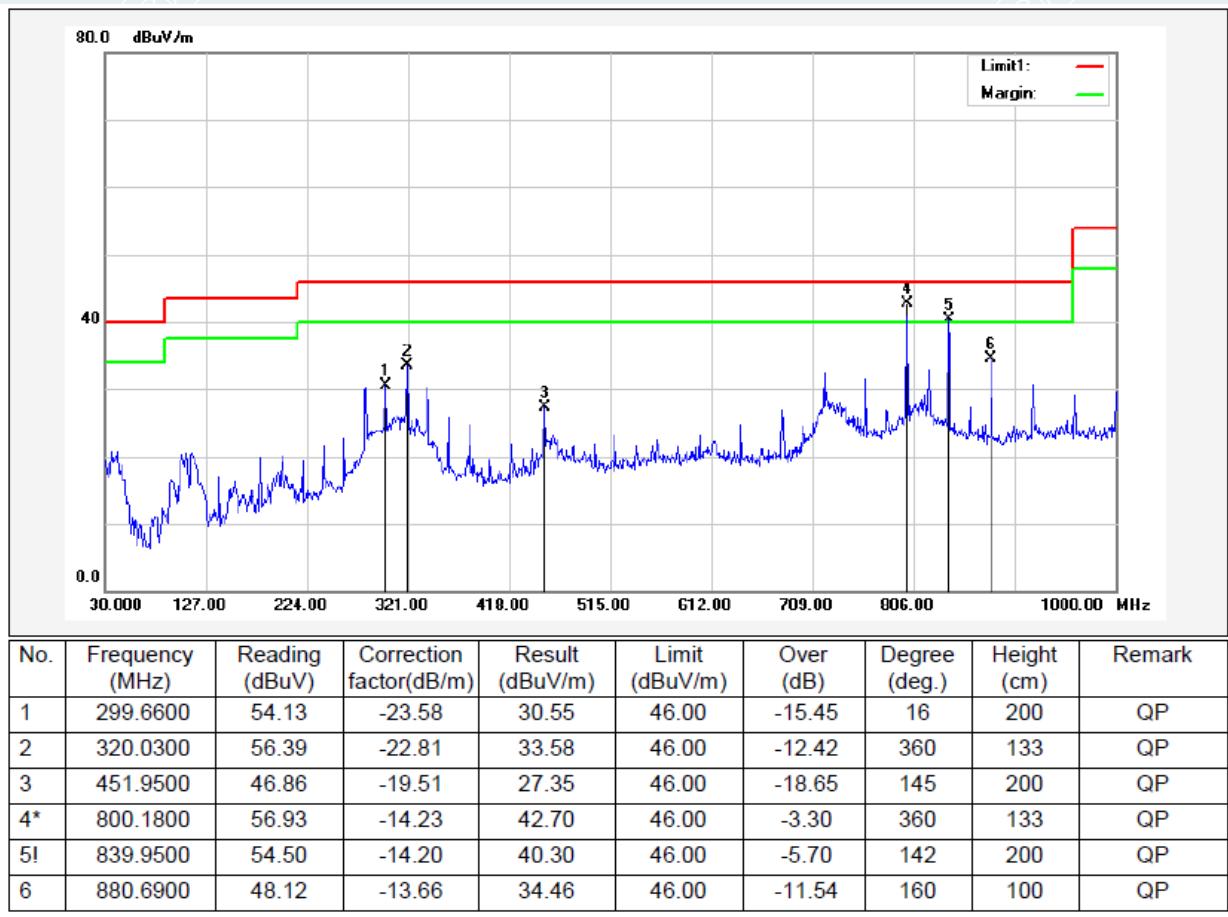
Mode: Mode 1
Middle channel (2440MHz)
Polarity

Date: 2021-08-09
Horizontal



Mode:Mode 1
 Highest channel (2475MHz)
 Polarity

Date: 2021-08-09
 Vertical



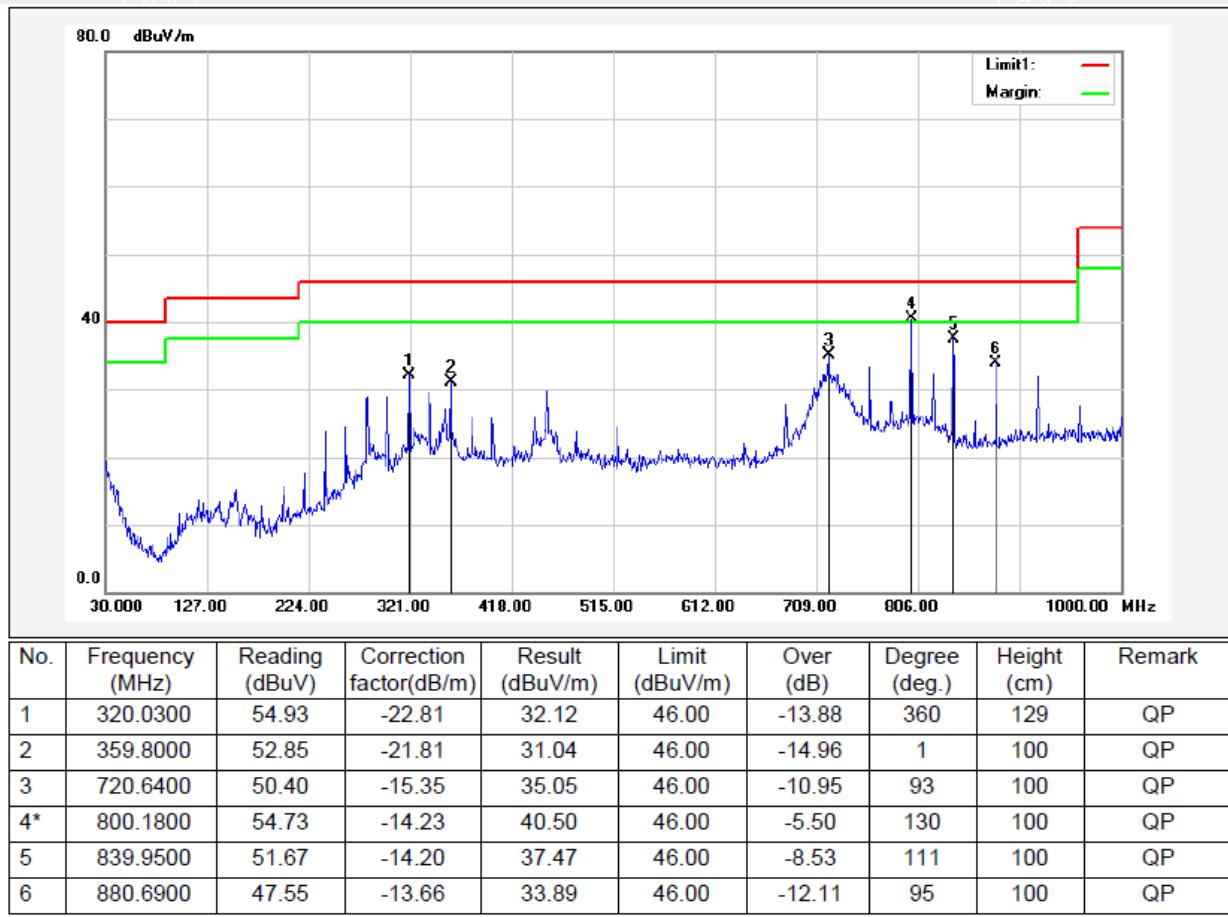
Mode: Mode 1

Highest channel (2475MHz)

Polarity

Date: 2021-08-09

Horizontal

**Remark:**

- 1 No emission found between lowest internal used/generated frequency to 30MHz.
- 2 Data of measurement within this frequency range in the table above the reading of PK detector are more 6dB than QP limit, therefore it's unnecessary to performed QP scan.
- 3 The IF bandwidth of Receiver between 30MHz to 1GHz was 120 kHz.

Above 1GHz-18GHz:

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

Mode: Mode 1

Lowest channel (2405MHz)

Date:2021-08-09

Suspected Data List									
NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1000.0000	61.79	36.63	-25.16	74.00	37.37	200	286	Vertical
2	1499.8125	62.30	39.41	-22.89	74.00	34.59	100	328	Vertical
3	1901.3627	57.26	35.38	-21.88	74.00	38.62	100	274	Vertical
4	2405.4257	83.22	63.34	-19.88	74.00	10.66	200	14	Vertical
5	4811.4764	54.86	45.10	-9.76	74.00	28.90	200	72	Vertical
6	7213.6517	56.27	52.99	-3.28	74.00	21.01	100	359	Vertical

PK Final Data List					
NO.	Freq. [MHz]	Factor [dB]	Height [cm]	Angle [°]	Polarity
1	7216.1765	-3.28	136	0	Vertical

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dB μ V/m]	AV Value [dB μ V/m]	AV Limit [dB μ V/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	7216.1765	-3.28	45.89	42.61	54.00	11.39	136	0	Vertical

Remark:

1. The frequency 2405.4257MHz is fundamental frequency signal..

Suspected Data List									
NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1050.2563	60.71	35.64	-25.07	74.00	38.36	100	246	Horizontal
2	1809.3512	59.01	36.99	-22.02	74.00	37.01	100	289	Horizontal
3	2405.6757	74.74	54.86	-19.88	74.00	19.14	100	151	Horizontal
4	3495.0619	54.79	39.40	-15.39	74.00	34.60	100	202	Horizontal
5	4811.4764	55.62	45.86	-9.76	74.00	28.14	200	13	Horizontal
6	7217.4022	55.60	52.28	-3.32	74.00	21.72	100	298	Horizontal

PK Final Data List					
NO.	Freq. [MHz]	Factor [dB]	Height [cm]	Angle [°]	Polarity
1	7213.5770	-3.32	102	308	Horizontal

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dB μ V/m]	AV Value [dB μ V/m]	AV Limit [dB μ V/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	7213.5770	-3.32	45.28	41.96	54.00	12.04	102	308	Horizontal

Remark:

1. The frequency 2405.6757 MHz is fundamental frequency signal.

Mode: Mode 1
Middle channel (2440MHz)

Date: 2021-08-09

Suspected Data List									
NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1040.0050	62.32	37.23	-25.09	74.00	36.77	200	1	Vertical
2	1335.7920	61.29	37.49	-23.80	74.00	36.51	100	48	Vertical
3	1896.8621	58.56	36.68	-21.88	74.00	37.32	200	21	Vertical
4	2439.4299	72.70	53.01	-19.69	74.00	20.99	200	8	Vertical
5	4878.9849	57.38	47.50	-9.88	74.00	26.50	200	108	Vertical
6	7318.6648	54.45	50.26	-4.19	74.00	23.74	200	13	Vertical

PK Final Data List					
NO.	Freq. [MHz]	Factor [dB]	Height [cm]	Angle [°]	Polarity
1	4880.9853	-9.88	179	115	Vertical
2	7321.3727	-4.19	122	2	Vertical

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dB μ V/m]	AV Value [dB μ V/m]	AV Limit [dB μ V/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	4880.9853	-9.88	49.83	39.95	54.00	14.05	179	115	Vertical
2	7321.3727	-4.19	44.87	40.68	54.00	13.32	122	2	Vertical

Remark:

1. The frequency 2439.4299MHz is fundamental frequency signal..

Suspected Data List									
NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1054.2568	61.65	36.60	-25.05	74.00	37.40	100	219	Horizontal
2	1360.0450	59.73	36.04	-23.69	74.00	37.96	100	360	Horizontal
3	1660.0825	57.90	35.40	-22.50	74.00	38.60	100	151	Horizontal
4	2439.4299	70.86	51.17	-19.69	74.00	22.83	100	34	Horizontal
5	3748.2185	54.68	40.07	-14.61	74.00	33.93	200	210	Horizontal
6	4880.8601	58.04	48.15	-9.89	74.00	25.85	200	0	Horizontal

PK Final Data List					
NO.	Freq. [MHz]	Factor [dB]	Height [cm]	Angle [°]	Polarity
1	4880.8113	-9.90	174	7	Horizontal

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dB μ V/m]	AV Value [dB μ V/m]	AV Limit [dB μ V/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	4880.8113	-9.90	49.57	39.67	54.00	14.33	174	7	Horizontal

Remark:

1. The frequency 2439.4299MHz is fundamental frequency signal..

Mode: Mode 1
Highest channel (2475MHz)

Date:2021-08-09

Suspected Data List									
NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1000.2500	61.30	36.14	-25.16	74.00	37.86	200	246	Vertical
2	1267.0334	60.45	36.36	-24.09	74.00	37.64	200	239	Vertical
3	1893.3617	57.91	36.03	-21.88	74.00	37.97	100	34	Vertical
4	2475.6845	82.03	62.43	-19.60	74.00	11.57	200	20	Vertical
5	4950.2438	59.39	49.32	-10.07	74.00	24.68	200	114	Vertical
6	7423.6780	53.75	50.16	-3.59	74.00	23.84	200	359	Vertical

PK Final Data List					
NO.	Freq. [MHz]	Factor [dB]	Height [cm]	Angle [°]	Polarity
1	4950.9863	-10.07	157	110	Vertical
2	7423.6038	-3.59	197	4	Vertical

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dB μ V/m]	AV Value [dB μ V/m]	AV Limit [dB μ V/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	4950.9863	-10.07	50.53	40.46	54.00	13.54	157	110	Vertical
2	7423.6038	-3.59	43.89	40.30	54.00	13.70	197	4	Vertical

Remark:

1. The frequency 2475.6845MHz is fundamental frequency signal..

Suspected Data List									
NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1049.0061	60.69	35.62	-25.07	74.00	38.38	100	253	Horizontal
2	1359.7950	60.06	36.37	-23.69	74.00	37.63	100	82	Horizontal
3	1809.8512	57.25	35.23	-22.02	74.00	38.77	100	287	Horizontal
4	2474.4343	78.31	58.70	-19.61	74.00	15.30	100	157	Horizontal
5	3305.6632	54.70	38.82	-15.88	74.00	35.18	200	148	Horizontal
6	4948.3685	56.70	46.63	-10.07	74.00	27.37	200	18	Horizontal

PK Final Data List					
NO.	Freq. [MHz]	Factor [dB]	Height [cm]	Angle [°]	Polarity
1	4950.8922	-10.07	178	334	Horizontal

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dB μ V/m]	AV Value [dB μ V/m]	AV Limit [dB μ V/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	4950.8922	-10.07	48.46	38.39	54.00	15.61	178	334	Horizontal

Remark:

1. The frequency 2474.4343MHz is fundamental frequency signal..

Above 18GHz-26.5GHz:

Recorded the worst case results in this report (2475MHz)

Mode: Mode 1

Highest channel (2475MHz)

Date: 2021-07-30

Suspected Data List									
NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	18320.0250	57.71	46.15	-11.56	83.50	37.35	100	5	Vertical
2	19393.5750	60.28	49.30	-10.98	83.50	34.20	100	245	Vertical
3	20478.6000	56.11	45.61	-10.50	83.50	37.89	100	257	Vertical
4	21817.3500	55.63	45.68	-9.95	83.50	37.82	100	173	Vertical
5	23423.4250	55.54	46.79	-8.75	83.50	36.71	100	161	Vertical
6	26204.6250	55.75	47.84	-7.91	83.50	35.66	100	331	Vertical

Suspected Data List									
NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	18467.9250	57.99	46.50	-11.49	83.50	37.00	100	120	Horizontal
2	19394.0000	61.99	51.01	-10.98	83.50	32.49	100	54	Horizontal
3	21119.0750	56.72	46.43	-10.29	83.50	37.07	100	297	Horizontal
4	21817.7750	58.65	48.70	-9.95	83.50	34.80	100	1	Horizontal
5	25626.6250	55.43	47.51	-7.92	83.50	35.99	100	108	Horizontal
6	26221.6250	54.65	46.78	-7.87	83.50	36.72	100	208	Horizontal

7. 6dB BANDWIDTH

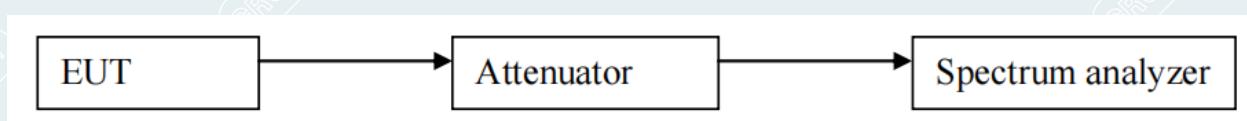
7.1. LIMITS

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.

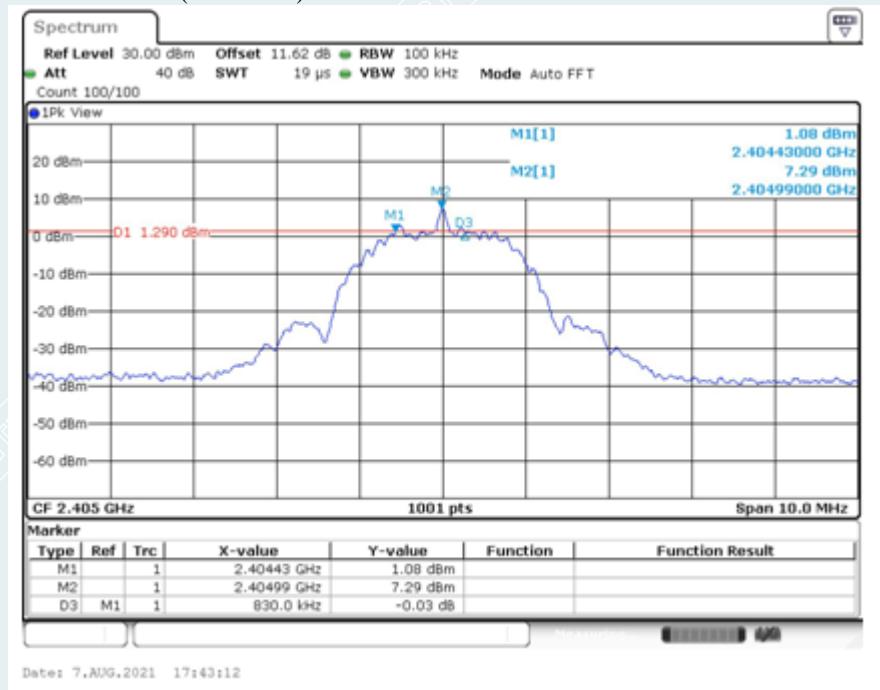
7.3. TEST SETUP



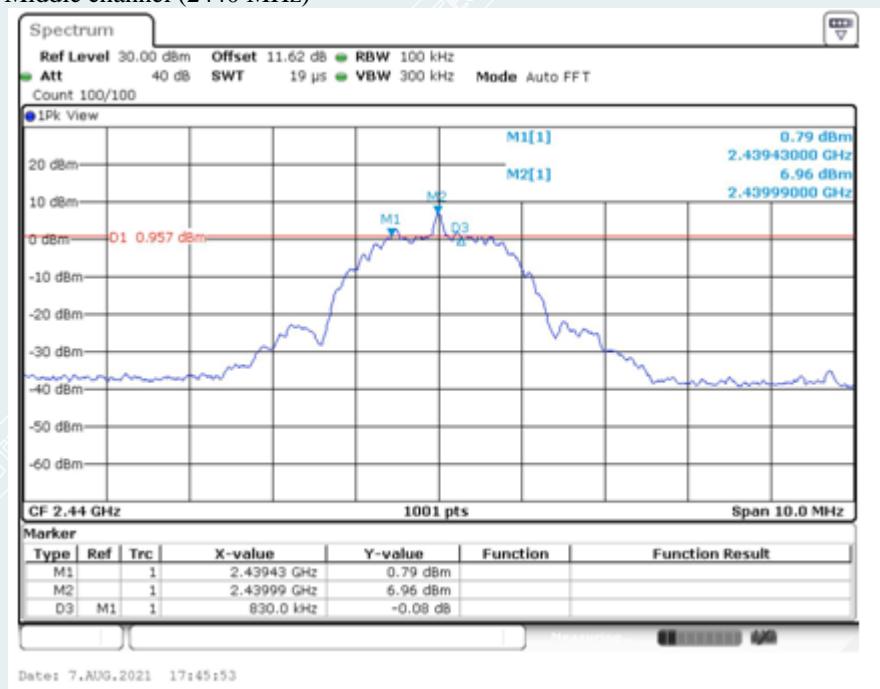
7.4. TEST RESULTS

Channel	Frequency (MHz)	Bandwidth [kHz]	Limit[kHz]	Verdict
Lowest	2405	830	>500	PASS
Middle	2440	830		PASS
Highest	2475	830		PASS

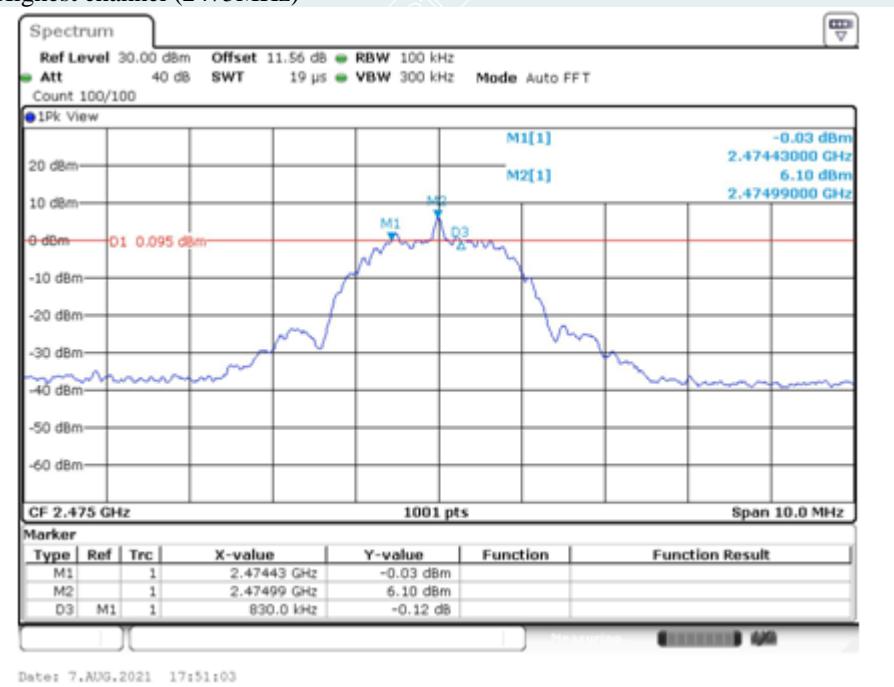
Lowest channel (2405MHz)



Middle channel (2440 MHz)



Highest channel (2475MHz)



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 the power meter.

8.3. TEST SETUP



8.4. TEST RESULTS

Channel	Frequency (MHz)	Measured Channel Power (dBm)	Limit	Peak/Average	Result
Lowest	2405	7.58	1W (30dBm)	Peak	Pass
Middle	2440	7.56			Pass
Highest	2475	7.45			Pass

9. POWER SPECTRAL DENSITY

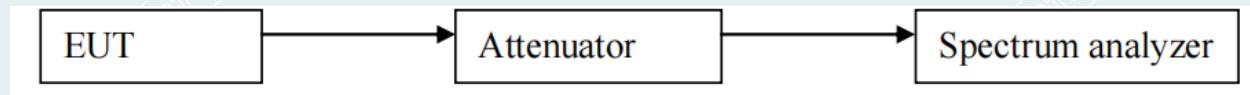
9.1. LIMITS

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

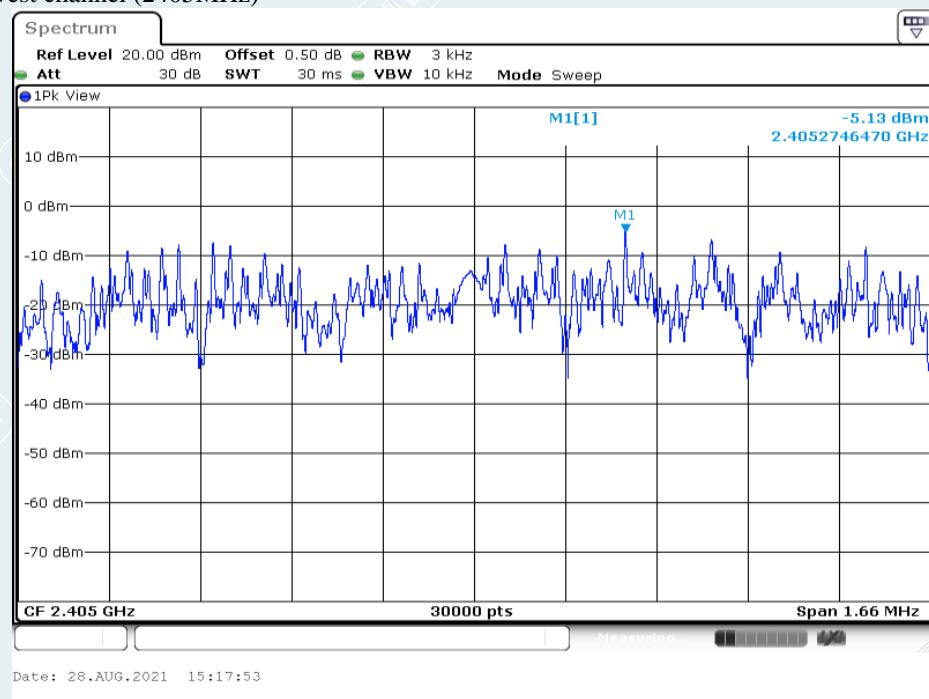


9.4. TEST RESULTS

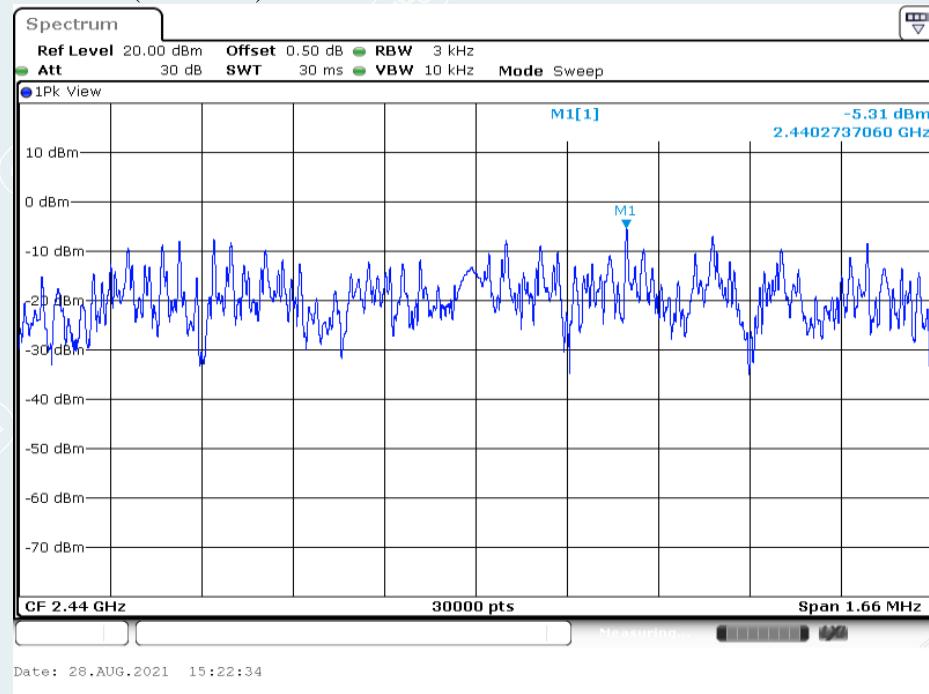
Duty Cycle Calculation			
ON Time(ms)	Total Time(ms)	Duty Cycle	Duty Factor
0.720	4.850	14.845%	8.28

Channel No.	Frequency (MHz)	PSD (dBm/3kHz)	Duty Factor	Total PSD with Duty Factor (dBm/3kHz)	Limit (dBm/3kHz)	Result
Lowest	2405	-5.13	8.28	3.15	8.00	Pass
Middle	2440	-5.31	8.28	2.97	8.00	Pass
Highest	2475	-5.45	8.28	2.83	8.00	Pass

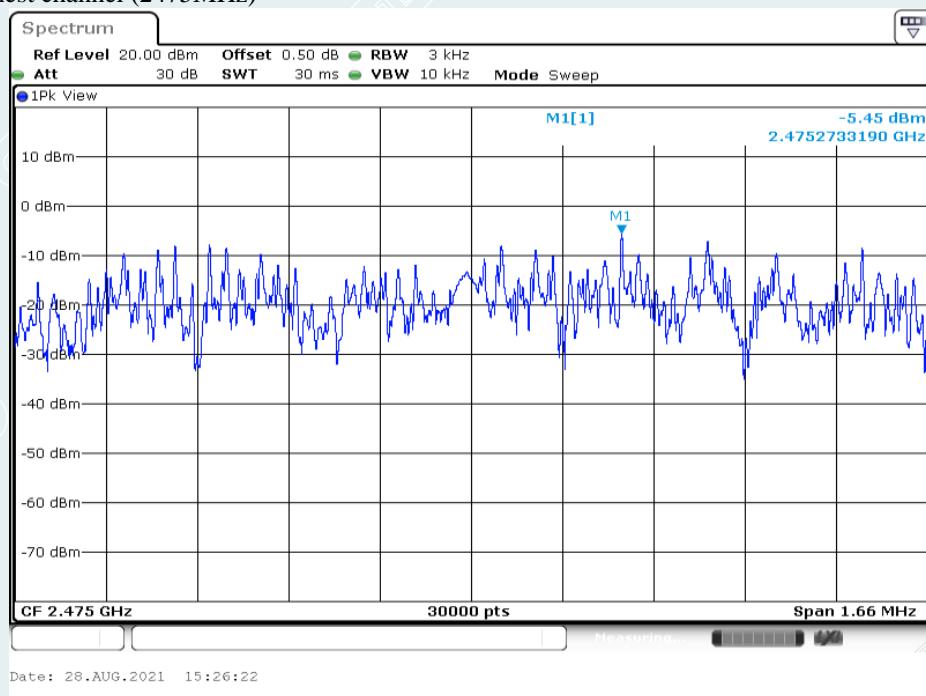
Lowest channel (2405MHz)



Middle channel (2440 MHz)



Highest channel (2475MHz)



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.

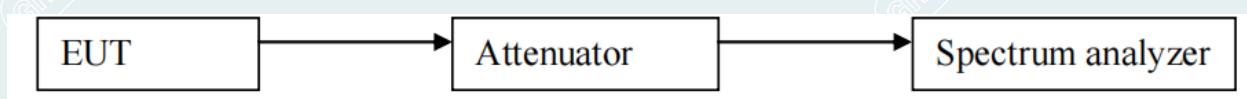
10.2. TEST PROCEDURES

Test procedures follow KDB 558074 D01 DTS Measurement Guidance 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, Span = 10MHz 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.
- 5) Measurements are made over the 9 kHz to 26GHz range with the transmitter set to the lowest, middle, and highest channels. No emission found between lowest internal used/generated frequency to 10MHz, it is only recorded 10MHz to 26GHz.

10.3. TEST SETUP



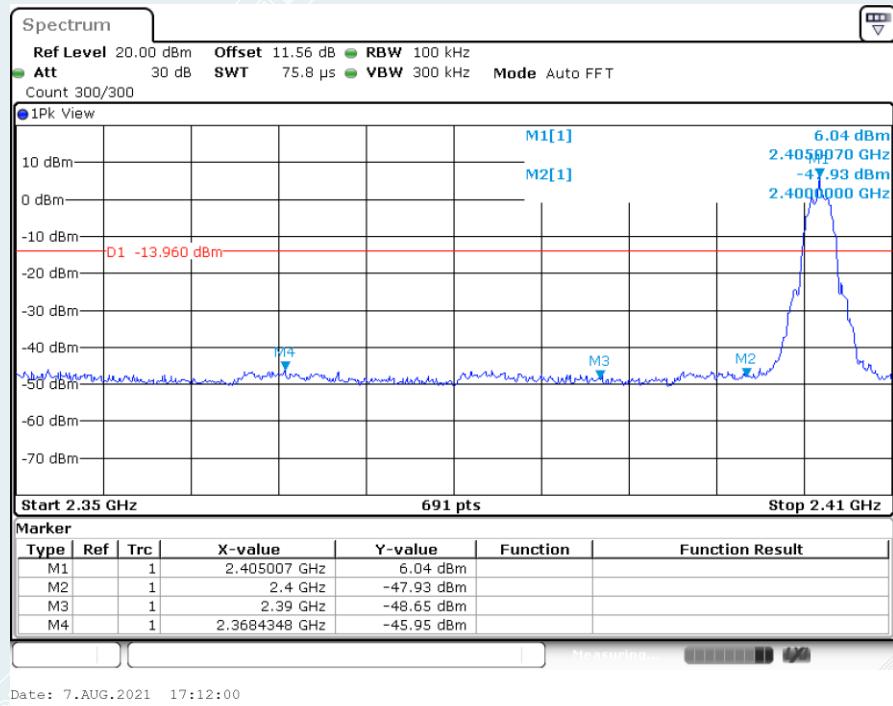
10.4. TEST RESULTS

Band edge

TestMode	Antenna	ChName	Channel	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
Zigbee	Ant1	Low	2405	6.04	-45.95	≤-13.96	PASS
		High	2475	5.62	-45.49	≤-14.38	PASS

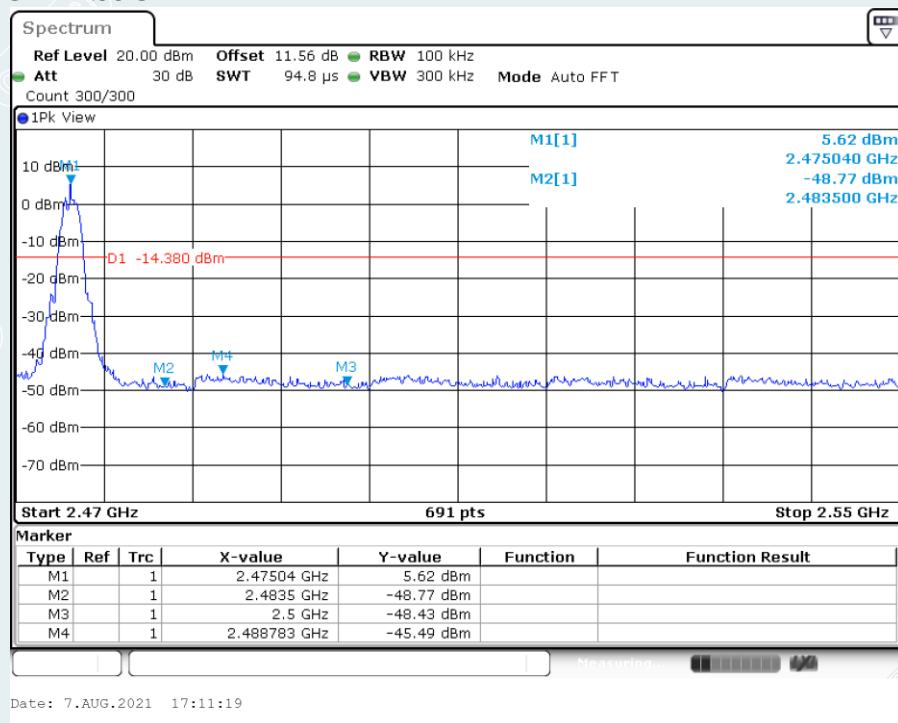
Lowest channel (2405MHz)

2.35GHz-2.405GHz



Highest channel (2475MHz)

2.47GHz-2.55GHz



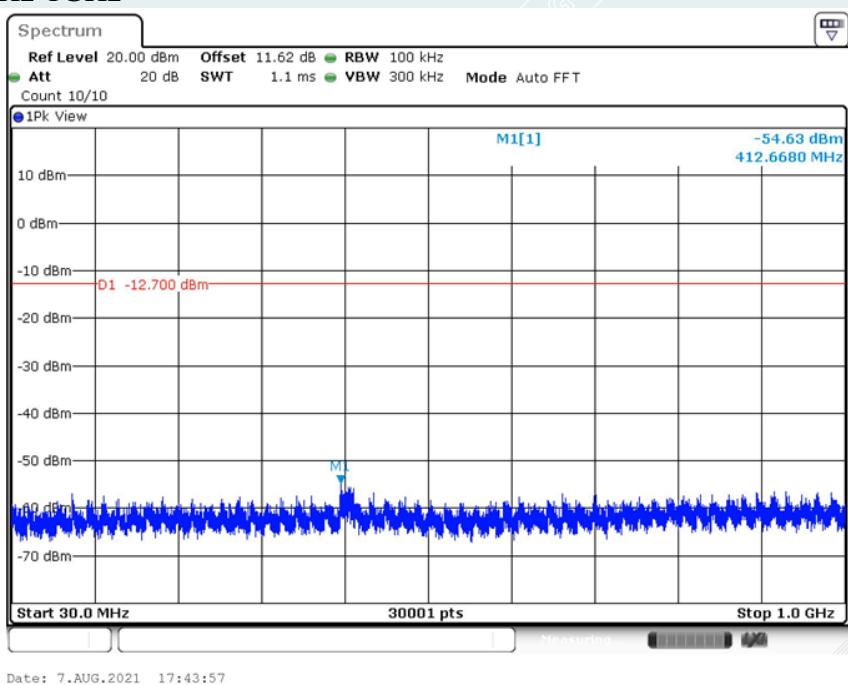
Conducted Spurious Emission

TestMode	Antenna	Channel	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
Zigbee	Ant1	2405	Reference	7.30	7.30	---	PASS
			30~1000	7.30	-54.63	≤ -12.7	PASS
			1000~26500	7.30	-52.2	≤ -12.7	PASS
		2440	Reference	6.98	6.98	---	PASS
			30~1000	6.98	-56.3	≤ -13.02	PASS
			1000~26500	6.98	-52.25	≤ -13.02	PASS
		2475	Reference	6.12	6.12	---	PASS
			30~1000	6.12	-56.18	≤ -13.88	PASS
			1000~26500	6.12	-51.7	≤ -13.88	PASS

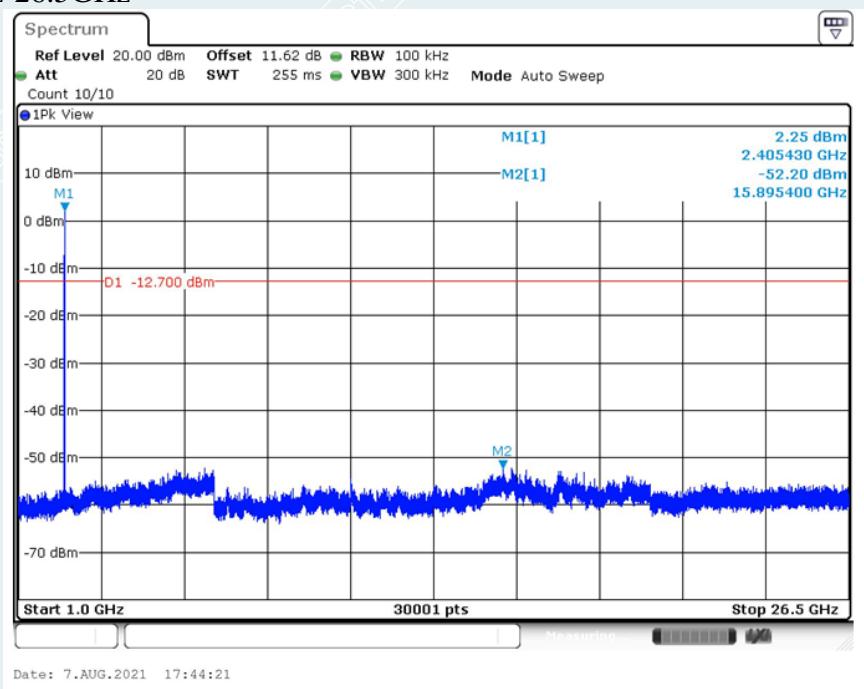
Lowest channel (2405MHz)



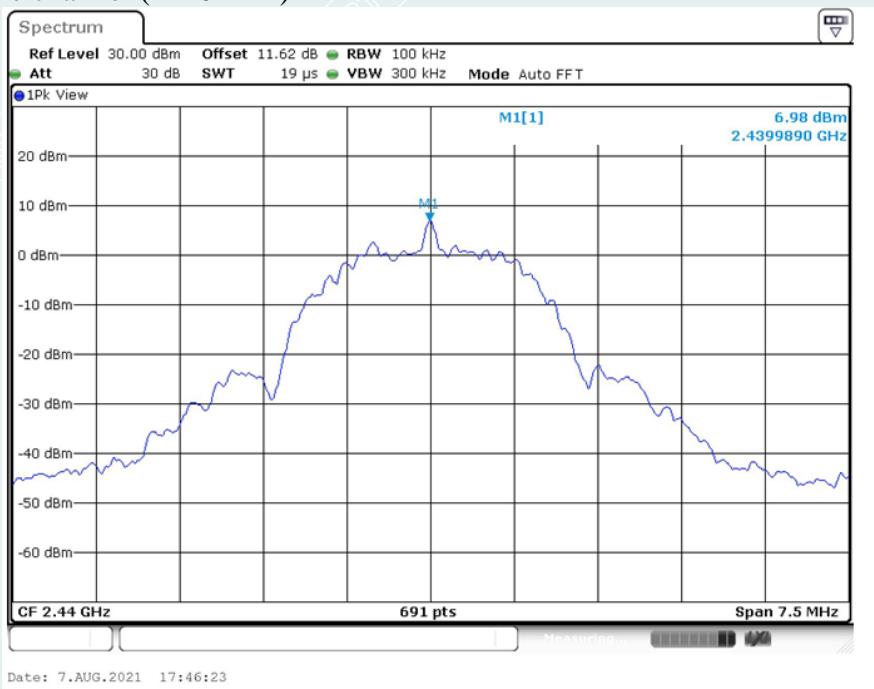
0.03GHz-1GHz



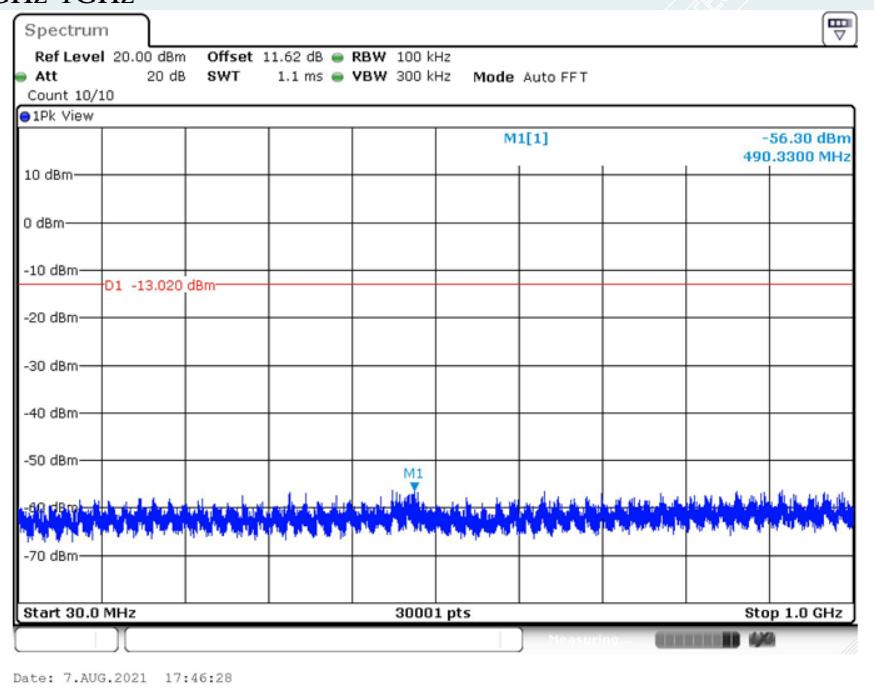
1GHz-26.5GHz



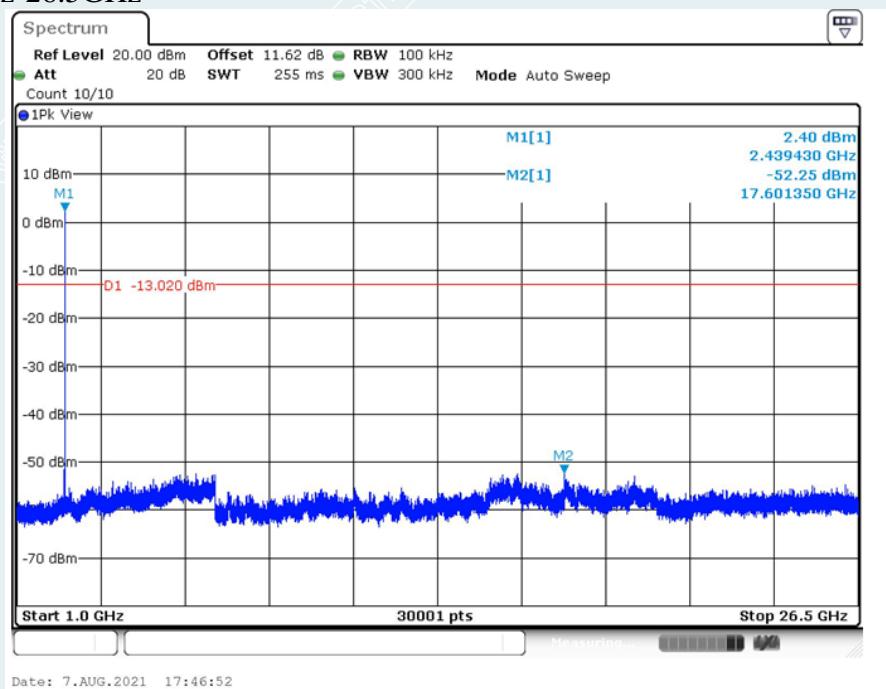
Middle channel (2440MHz)



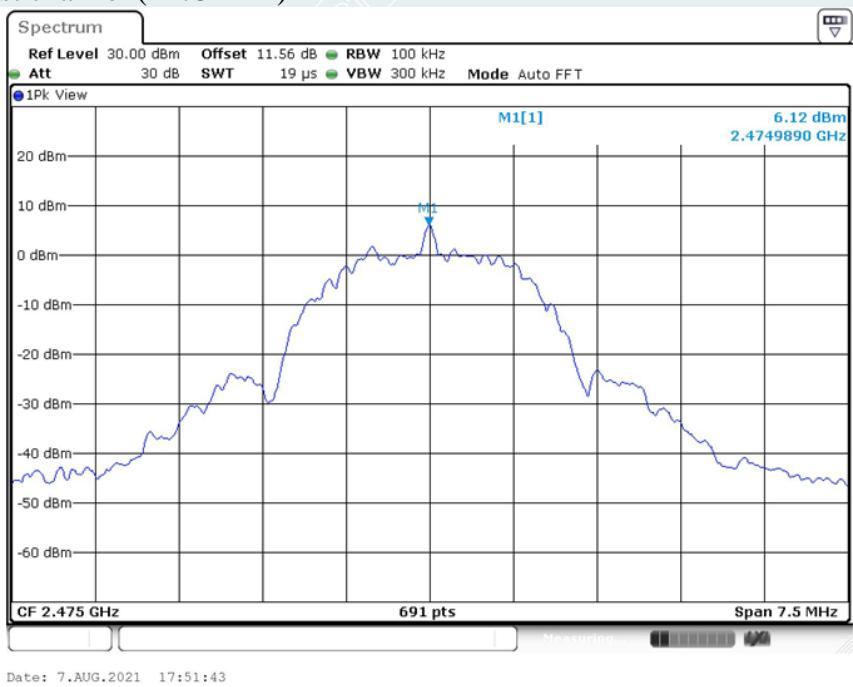
0.03GHz-1GHz



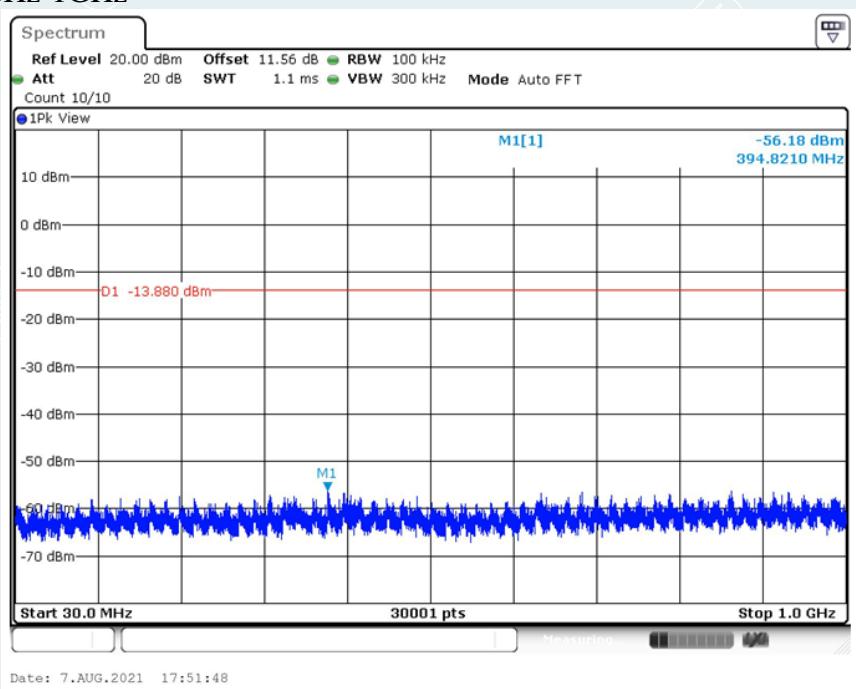
1GHz-26.5GHz



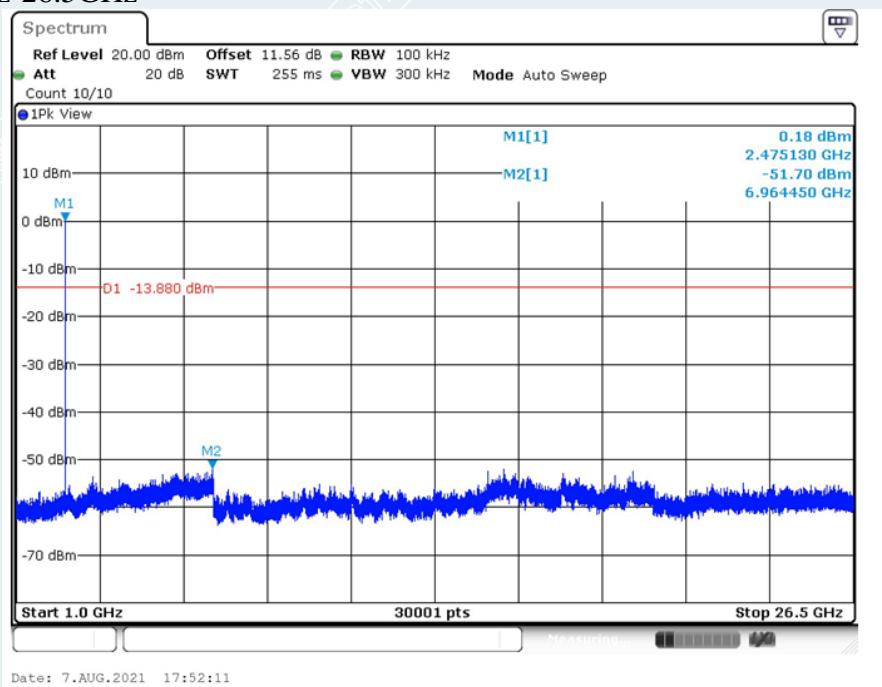
Highest channel (2475MHz)



0.03GHz-1GHz



1GHz-26.5GHz



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)).

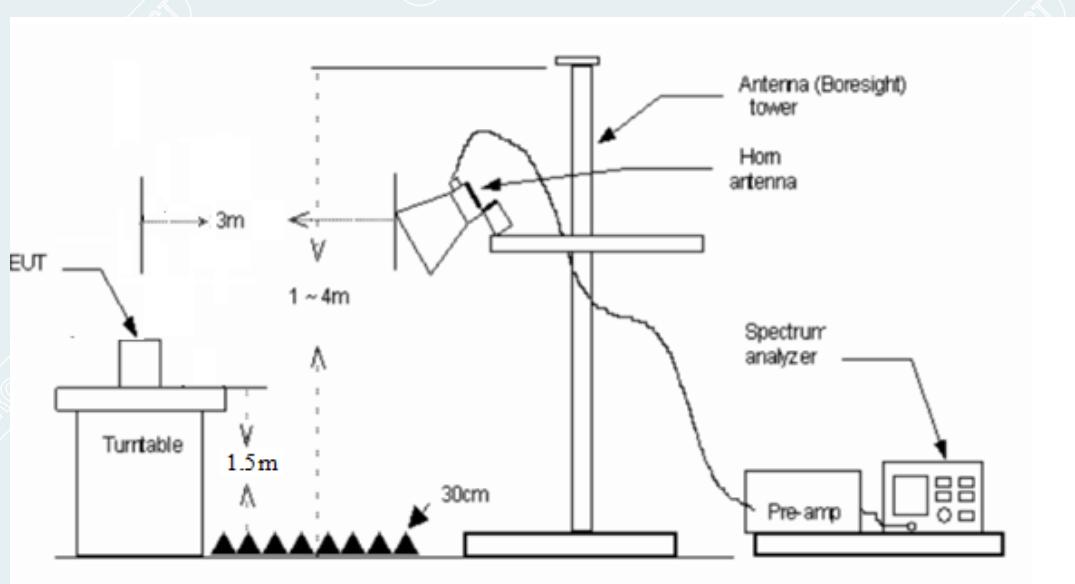
MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 -	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.69525	960 - 1240	7.25 - 7.75
4.125 - 4.128	16.80425 -	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	16.80475	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	25.5 - 25.67	1645.5 - 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



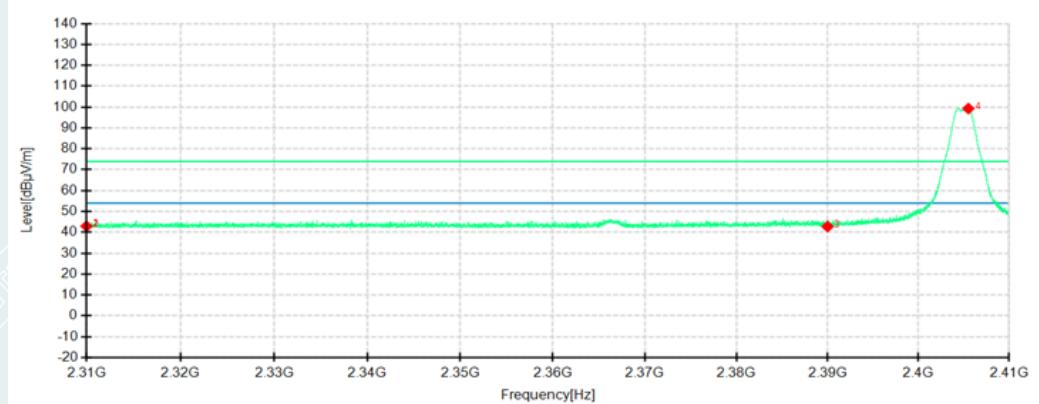
11.4. TEST RESULTS

Lowest Channel

Channel 2405MHz

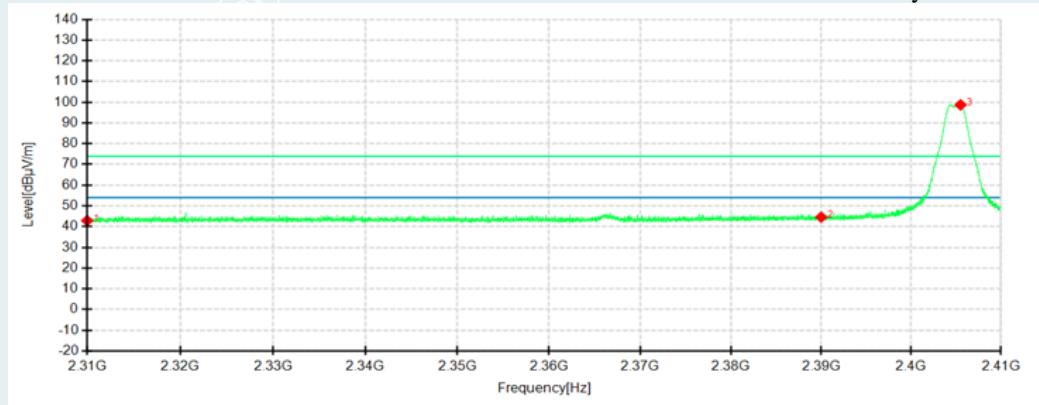
Detector mode: Peak

Polarity: Horizontal



Detector mode: Peak

Polarity: Vertical



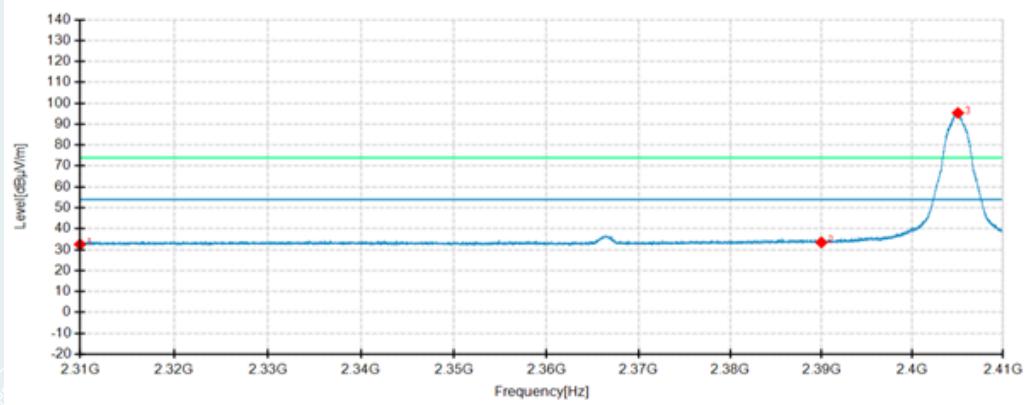
No.	Frequency MHz	Reading dB μ V/m	Level dB μ V/m	Factor dB	Limit dB μ V/m	Margin dB	Height cm	Angle °	Pole	Comment
1	2310.0000	39.43	42.91	3.48	74.00	31.09	200	180	Horizontal	/
2	2310.0000	39.43	42.91	3.48	74.00	31.09	200	180	Horizontal	/
3	2390.0000	38.93	42.74	3.81	74.00	31.26	100	270	Horizontal	
4	2405.5125	95.27	99.28	4.01	74.00	-25.28	100	270	Horizontal	N/A
1	2310.0000	39.38	42.86	3.48	74.00	31.14	100	90	Vertical	/
2	2390.0000	40.75	44.56	3.81	74.00	29.44	100	270	Vertical	/
3	2405.5000	94.70	98.71	4.01	74.00	-24.71	200	0	Vertical	N/A

Lowest Channel

Channel 2405MHz

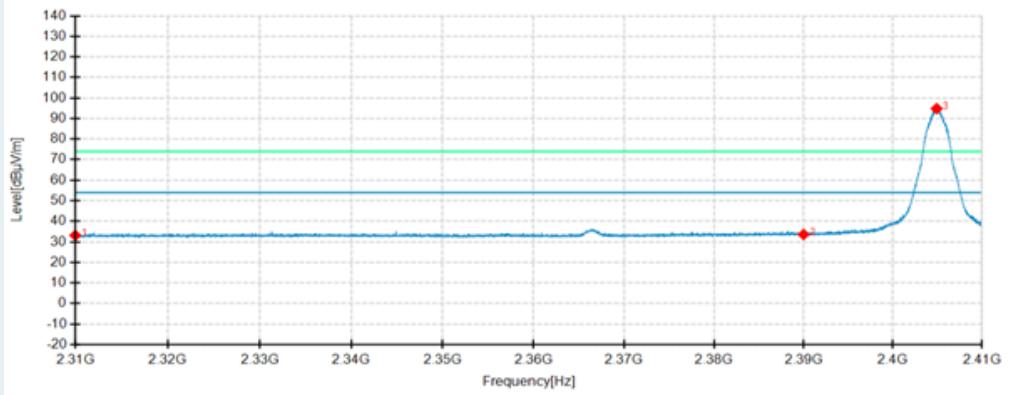
Detector mode: Average

Polarity: Horizontal



Detector mode: Average

Polarity: Vertical



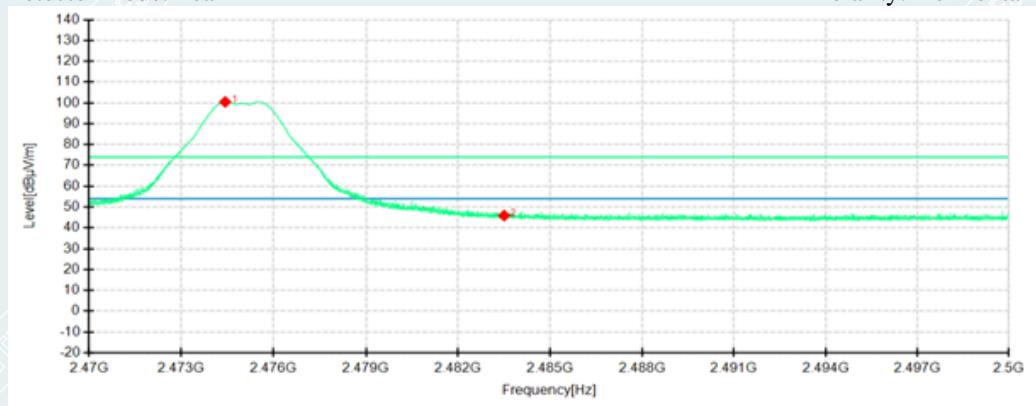
No.	Frequency MHz	Reading dB μ V/m	Level dB μ V/ m	Factor dB	Limit dB μ V/m	Margin dB	Height cm	Angle °	Pole	Comment
1	2310.0000	29.05	32.53	3.48	54.00	21.47	200	360	Horizontal	/
2	2390.0000	29.64	33.45	3.81	54.00	20.55	100	360	Horizontal	/
3	2405.0375	91.35	95.36	4.01	54.00	-41.36	100	270	Horizontal	N/A
1	2310.0000	29.63	33.11	3.48	54.00	20.89	200	90	Vertical	/
2	2390.0000	29.77	33.58	3.81	54.00	20.42	200	0	Vertical	/
3	2404.9125	90.83	94.83	4.00	54.00	-40.83	200	360	Vertical	N/A

Highest Channel

Channel 2475MHz

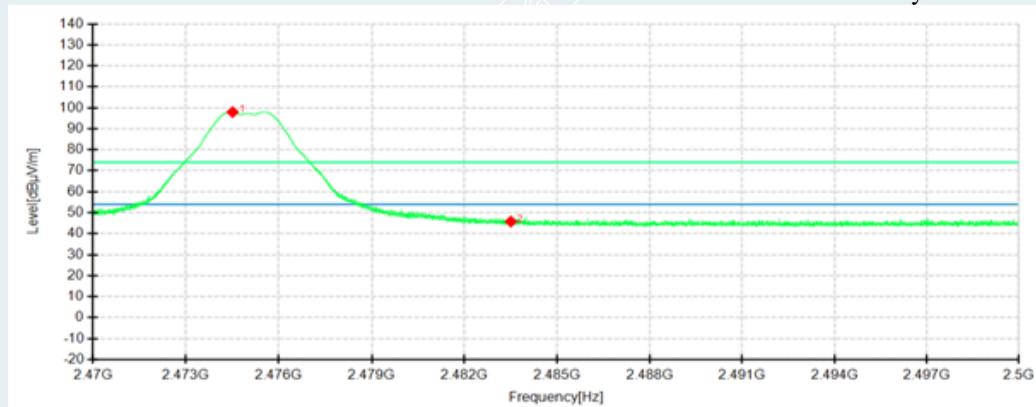
Detector mode: Peak

Polarity: Horizontal



Detector mode: Peak

Polarity: Vertical



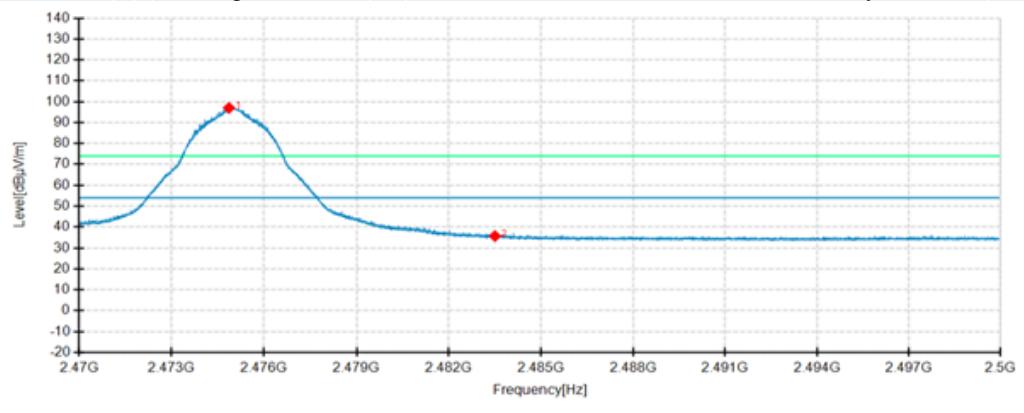
No.	Frequency MHz	Reading dB μ V/m	Level dB μ V/m	Factor dB	Limit dBuV/m	Margin dB	Height cm	Angle °	Pole	Comment
1	2474.4250	96.17	100.47	4.30	74.00	-26.47	100	270	Horizontal	N/A
2	2483.5000	41.56	45.89	4.33	74.00	28.11	100	0	Horizontal	/
1	2474.5075	93.63	97.93	4.30	74.00	-23.93	200	360	Vertical	N/A
2	2483.5000	41.43	45.76	4.33	74.00	28.24	200	0	Vertical	/

Highest Channel

Channel 2475MHz

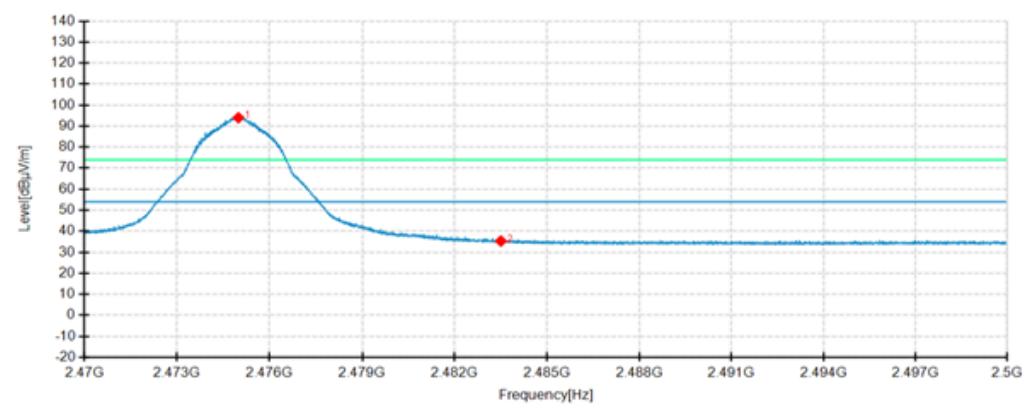
Detector mode: Average

Polarity: Horizontal



Detector mode: Average

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	Comment
1	2474.8600	92.70	97.00	4.30	54.00	-43.00	100	270	Horizontal	N/A
2	2483.5000	31.33	35.66	4.33	54.00	18.34	200	270	Horizontal	/
1	2474.9875	89.69	93.99	4.30	54.00	-39.99	200	360	Vertical	N/A
2	2483.5000	30.98	35.31	4.33	54.00	18.69	100	360	Vertical	/

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

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