



# **TEST REPORT**

Report No.:	E20190319	0694002-1	Application No.:	E20190319694002
Applicant:	GEMMY I	NDUSTRIES (H	K)LIMITED BVI	
Address:	No.301 on Kong	3rd Floor, East O	cean Centre,No.98	Granville Road,Kowloon,Hong
Sample Description:	AppLights	Lightshow String	5	
Model:	116480			
Adding Model:	116482			
FCC ID:	GPO11648	30		
Test Specification:	FCC 47 C	FR Part 15 Subpa	ırt C	
Test Date:	2019-04-10	) to 2019-04-18		
Issue Date:	2019-04-30	)		
Test Result:	PASS			
Prepared By:		<b>Reviewed By:</b>		Approved By:
Darry Wu / Test Eng	ineer	Eve Wang /Tec	hnical Manager	Tony Han / Manager
Dary w	U	Eve. Wa		Torry Han
Date:2019-04-30		Date:2019-04-3	0	Date:2019-04-30
Other Aspects:				
/				
<b>Abbreviations:</b> $ok / P = passed; j$	fail / $F = failed; n.a$	N = not applicable		
The test result in this test repor approval of GRGT.	t refers exclusively	to the presented test san	ple. This report shall not be	e reproduced except in full, without the written
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# **DIRECTIONS OF TEST**

- 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

	Section B of FCC	Part 15.247:2012	
Standard	Item	Limit / Severity	Result
	Antenna Requirement	§15.203	PASS
	Conducted Emissions	§15.207 (a)	PASS
	Radiated Spurious Emission	§15.247(d)	PASS
FCC Part 15,Subpart C	6 dB Bandwidth	§15.247 (a)(2)	PASS
(15.247)	Maximum Peak Output Power	§15.247(b)(3)	PASS
	Power Spectral Density	§15.247(e)	PASS
	Conducted band edges and Spurious Emission	§15.247(d)	PASS
	Restricted bands of operation	§15.205	PASS

#### 2. GENERAL DESCRIPTION OF EUT

## **2.1. APPLICANT**

Name:	GEMMY	INC	USTF	RIES (HK	K)LIMI	TED BV	[	
Address:	No.301 Road,Ko			<i>,</i>	East	Ocean	Centre,No.98	Granville

## 2.2. MANUFACTURER

Name:	GEMMY	IND	USTF	RIES (HK	K)LIMI	TED BV	[	
Address:	No.301 Road,Ko				East	Ocean	Centre,No.98	Granville

# 2.3. FACTORY

Factory 1	
Name :	ZAIXING ELECTRONIC (SHENZHEN)CO., LTD.
Address :	3#, 1st Road Yang Yong, Shapu Community, Songgang, Baoan District, Shenzhen City, Guangdong Province, China.
Factory 2	
Name :	DynaTech Co. Ltd
Address :	259-261 Xincheng Road, Qiaotou Town, Dongguan, Guangdong, China
Factory 3	
Name :	YUAN HONG CO., LTD
Address :	No. 3, meichun A industrial zone, meichun fang, fumei city, Ba Ria Vung Tau Province, Vietnam.

# 2.4. BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment:	AppLights-Lightshow String
Model No.:	116480
Adding Model:	116482
Model Discrepancy: Trade Name:	They are the same circuit and RF module except the different appearance shape and color.
Power supply:	AC120V/60Hz
Frequency Range:	2402 ~ 2480 MHz
Transmit Power:	0.16dBm
Modulation type:	GFSK for 1Mbps
Channel space:	2MHz
Antenna	Monopole PCB snake antenna with 4.0dBi gain (Max)

Specification:

Temperature	-20~70°C
Range:	
Hardware	116480-USA (V1)
Version:	
Software	116480-USA (V1)
Version:	
Note:	/

# 2.5. TEST OPERATION MODE

Test Item	Mode No.	Description of the modes
Conducted Emission	1	Four color lights flashing
Radiated Emission	1	Continuously Transmitting

# **2.6. LOCAL SUPPORTIVE**

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

Test software:

Software version	Test level
BTOOL	40

# 3. LABORATORY AND ACCREDITATIONS

# **3.1. LABORATORY**

The tests and measurements refer to this report were performed by EMC Laboratory of GRG METROLOGY & TEST (SHENZHEN) CO., LTD

Add.:No.1301 Guanguang Road Xinlan Community, Guanlan Street, Longhua<br/>District Shenzhen, 518110, People's Republic of ChinaTelephone:+86-755-61180008Fax:/

## **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:

Measuren	nent	Frequency	Uncertainty
	Horizontal	$30 MHz \sim 1000 MHz$	4.8dB
Radiated	Horizontal	1GHz~26.5GHz	5.8dB
Emission	Vertical	30MHz~1000MHz	4.8dB
	vertical	1GHz~26.5GHz	5.9dB
Conducted Emission		9kHz~30MHz	3.5dB

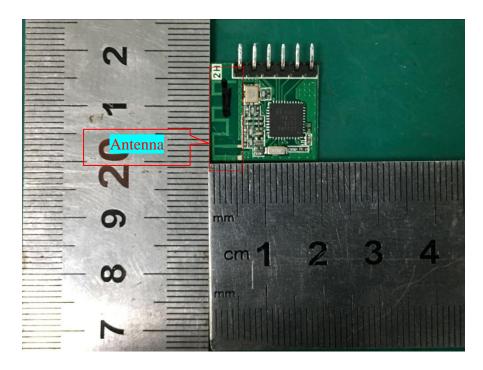
This uncertainty represents an expanded uncertainty factor of k=2.

# 4. LIST OF USED TEST EQUIPMENT AT GRGT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Conducted Emissions				
EMI TEST Receiver	ROHDE&SCHWARZ	ESCI	100783	2020-01-10
LISN(EUT)	ROHDE&SCHWARZ	ENV216	101543	2020-01-10
Hygrothermograph	VICTOR	HTC-1	N/A	2019-12-25
Test S/W	FARAD	EZ	Z-EMC/ CCS-3A	1-CE
Radiated Spurious En	nission& Restricted ban	ds of operatio	n	
ESPI Test Receiver	ROHDE&SCHWARZ	ESPI	101026	2020-01-09
EXA signal analyzer	Agilent	N9010A	MY52221469	2020-01-10
Bilog Antenna	Schwarzbeck	VULB 9160	9160-3401	2019-12-21
Horn Antenna	Schwarzbeck	BBHA9120	D286	2019-12-21
Board-Band Horn Antenna	Schwarzbeck	BBHA 9170	9170-497	2020-01-15
Active Loop Antenna	COM-POWER	AL-130	121044	2019-12-27
Amplifier	EM Electronics Corporation	EM330	060661	2019-12-21
High Noise Amplifier	Agilent	8449B	3008A02060	2019-12-21
Hygrothermograph	VICTOR	HTC-1	NA	2019-12-24
Test SW	FARAD	EZ	Z-EMC/ CCS-3A	AI-CE
6 dB Bandwidth				
EXA signal analyzer	Agilent	N9010A	MY52221469	2020-01-10
Maximum Peak Outp	ut Power			
EXA signal analyzer	Agilent	N9010A	MY52221469	2020-01-10
Conducted band edge	es and Spurious Emissio	n		
EXA signal analyzer	Agilent	N9010A	MY52221469	2020-01-10
Power Spectral Densit	ty			
EXA signal analyzer	Agilent	N9010A	MY52221469	2020-01-10

# 5. ANTENNA REQUIREMENT

The EUT has one antenna. The antenna is Monopole PCB snake antenna. The max gain of antenna is 4dBi .which accordance 15.203.is considered sufficient to comply with the provisions of this section



# 6. CONDUCTED EMISSION MEASUREMENT

## 6.1. LIMITS

Eroquonov rongo	Limits (dBµV)				
Frequency range	Quasi-peak	Average			
$150 \mathrm{kHz} \sim 0.5 \mathrm{MHz}$	$66{\sim}56$	56~46			
$0.5~\mathrm{MHz}\sim 5~\mathrm{MHz}$	56	46			
$5~\mathrm{MHz}\sim30~\mathrm{MHz}$	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.

#### **6.2. 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.

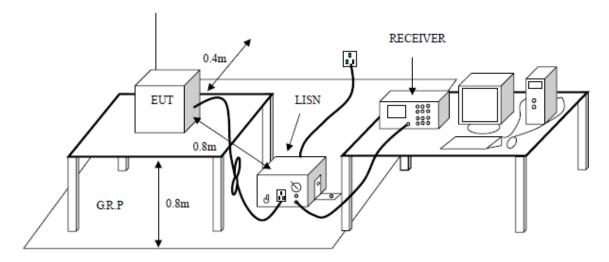
- I/O cables that are connected to a peripheral shall be bundled in the centre. The end of the cable may be terminated if required using correct terminating impedance. The total length shall not exceed 1 m.

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.

## 6.3. TEST SETUP



# 6.4. 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

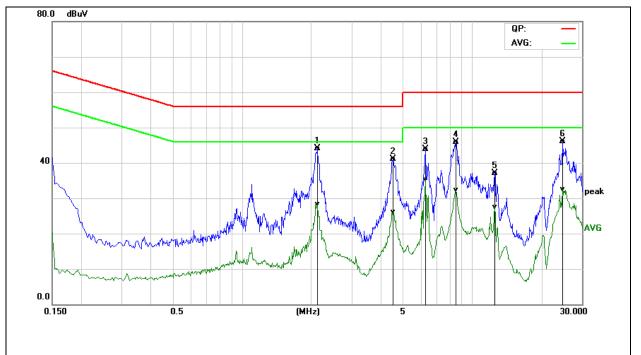
Limit = Limit stated in standard

Margin = Result (dBuV) - Limit (dBuV)

# 6.5. TEST RESULTS

Model No.	116480	RBW,VBW	9 kHz
Environmental Conditions	26°C, 60%RH	Test Mode	Mode 1
Tested By	Luja Huang	Line	L
Tested Date	2019-04-18	Test Voltage	AC120V/60Hz

(The chart below shows the highest readings taken from the final data.)

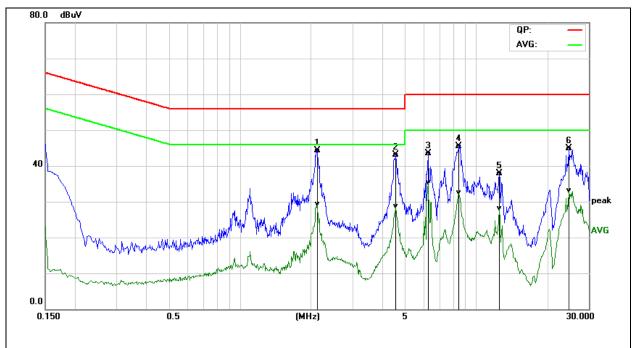


Frequency (MHz)	QuasiPeak Reading (dBuV)	Average Reading (dBuV)	Correction Factor (dB)	QuasiPeak Result (dBuV)	Average Result (dBuV)	QuasiPeak Limit (dBuV)	Average Limit (dBuV)	QuasiPeak Margin (dB)	Average Margin (dB)	Remark (Pass/Fail)
2.1340	34.00	18.24	10.12	44.12	28.36	56.00	46.00	-11.88	-17.64	Pass
4.5300	30.95	15.89	10.13	41.08	26.02	56.00	46.00	-14.92	-19.98	Pass
6.2780	33.78	25.09	10.13	43.91	35.22	60.00	50.00	-16.09	-14.78	Pass
8.5340	35.64	21.93	10.29	45.93	32.22	60.00	50.00	-14.07	-17.78	Pass
12.5659	26.86	17.27	10.33	37.19	27.60	60.00	50.00	-22.81	-22.40	Pass
24.7540	35.73	22.12	10.34	46.07	32.46	60.00	50.00	-13.93	-17.54	Pass

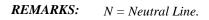


Model No.	116480	RBW,VBW	9 kHz
Environmental Conditions	25.3°C, 48%RH	Test Mode	Mode 1
Tested By	Luja Huang	Line	Ν
Tested Date	2019-04-18	Test Voltage	AC120V/60Hz

(The chart below shows the highest readings taken from the final data.)



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)
2.1220	34.27	19.16	10.12	44.39	29.28	56.00	46.00	-11.61	-16.72	Pass
4.5860	33.07	18.55	10.13	43.20	28.68	56.00	46.00	-12.80	-17.32	Pass
6.2819	33.45	25.10	10.13	43.58	35.23	60.00	50.00	-16.42	-14.77	Pass
8.4860	35.30	22.25	10.29	45.59	32.54	60.00	50.00	-14.41	-17.46	Pass
12.5659	27.49	17.82	10.33	37.82	28.15	60.00	50.00	-22.18	-21.85	Pass
24.7420	34.56	22.85	10.34	44.90	33.19	60.00	50.00	-15.10	-16.81	Pass



# 7. RADIATED SPURIOUS EMISSIONS

# **7.1. 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(µV/m)	Measurement distance(m)	Quasi-peak(dBµV/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.

#### 7.2. 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/duty ovelo))

log(1/duty cycle)).

#### 7.3. TEST SETUP

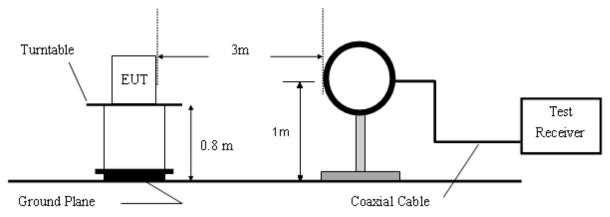


Figure 1. 9KHz to 30MHz radiated emissions test configuration

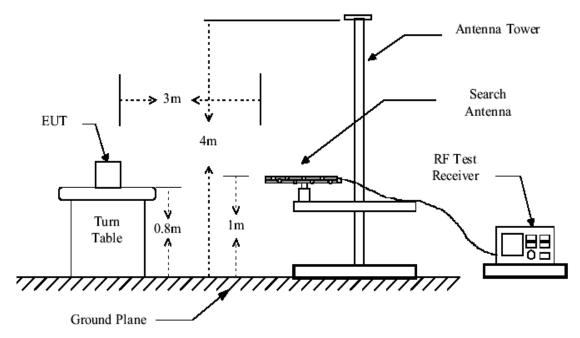
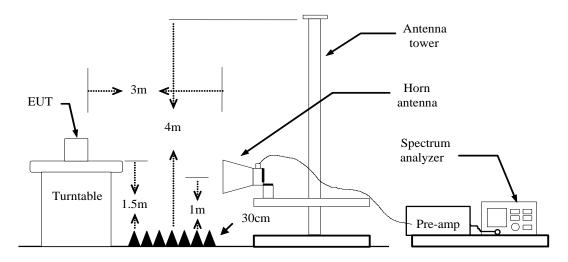


Figure 2. 30MHz to 1GHz radiated emissions test configuration





#### 7.4. DATA SAMPLE

#### **30MHz to 1GHz**

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

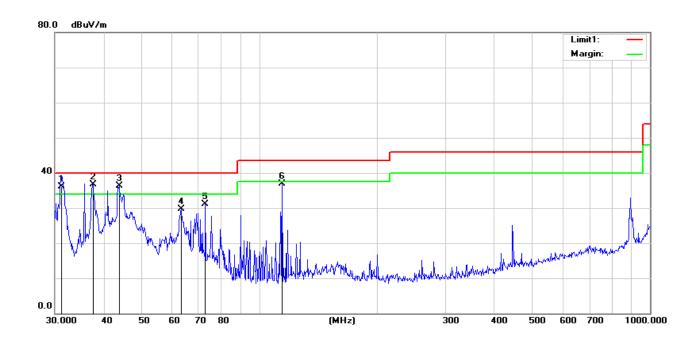
Frequency (MHz)	= Emission frequency in MHz
Ant.Pol. (H/V)	= Antenna polarization
Reading (dBuV)	= Uncorrected Analyzer / Receiver reading
Correction Factor (dB/m)	= Antenna factor + Cable loss - Amplifier gain
Result (dBuV/m)	= Reading (dBuV) + Correction Factor (dB/m)
Limit (dBuV/m)	= Limit stated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

# 7.5. TEST RESULTS

#### **30MHz to 1GHz:**

Pre-scan all modes and recorded the worst case results in this report (BT LE (Low Channel) Mode: TX Lowest channel (2402MHz) Dat

Date: 2019-04-18

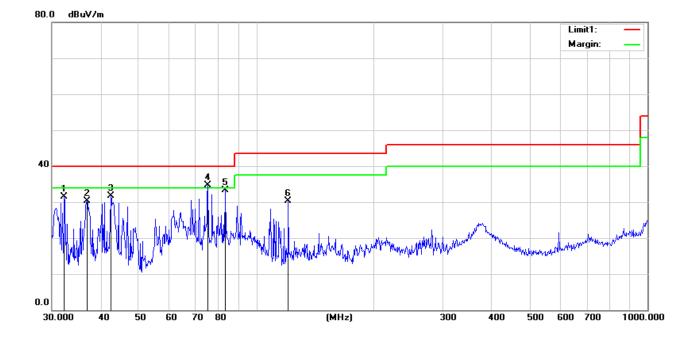


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark	Pole
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	( <b>dB</b> )		
1	31.1798	53.54	-17.34	36.20	40.00	-3.80	QP	Vertical
2	37.5480	54.39	-17.61	36.78	40.00	-3.22	QP	Vertical
3	43.8120	54.04	-17.73	36.31	40.00	-3.69	QP	Vertical
4	63.0916	48.01	-18.40	29.61	40.00	-10.39	QP	Vertical
5	72.8466	50.75	-19.60	31.15	40.00	-8.85	QP	Vertical
6	114.5146	54.37	-17.48	36.89	43.50	-6.61	QP	Vertical

FCC ID: GPO116480

#### Mode: TX Lowest channel (2402MHz)

Date: 2019-04-18



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark	Pole
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	( <b>dB</b> )		
1	32.2925	49.07	-17.47	31.60	40.00	-8.40	QP	Horizontal
2	36.8953	48.00	-17.66	30.34	40.00	-9.66	QP	Horizontal
3	42.4508	49.28	-17.65	31.63	40.00	-8.37	QP	Horizontal
4	75.1822	54.71	-20.10	34.61	40.00	-5.39	QP	Horizontal
5	83.2298	53.93	-20.55	33.38	40.00	-6.62	QP	Horizontal
6	120.6991	47.67	-17.32	30.35	43.50	-13.15	QP	Horizontal

#### Remark:

- 1 No emission found between lowest internal used/generated frequency to 30MHz.
- 2 Radiated emissions measured in frequency range from 9 kHz to 1GHz were made with an instrument using
- <sup>2</sup> Quasi-peak 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 The IF bandwidth of Receiver between 30MHz to 1GHz was 120 kHz.

#### Above 1GHz:

Mode: 7	ГΧ
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Lowest channel (2402MHz)

Low	est channel	Date	: 2019-04-10					
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark	Pole
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	( <b>dB</b> )		
1	1900.000	50.63	-2.95	47.68	74.00	-26.32	peak	Vertical
2	3790.000	43.53	1.31	44.84	74.00	-29.16	peak	Vertical
3	5761.000	42.81	4.50	47.31	74.00	-26.69	peak	Vertical
4	6013.000	43.00	5.28	48.28	74.00	-25.72	peak	Vertical
5	9010.000	41.73	9.34	51.07	74.00	-22.93	peak	Vertical
6	9343.000	41.46	9.98	51.44	74.00	-22.56	peak	Vertical
7	2134.000	49.06	-2.06	47.00	74.00	-27.00	peak	Horizontal
8	2611.000	45.39	-0.77	44.62	74.00	-29.38	peak	Horizontal
9	3745.000	43.75	1.24	44.99	74.00	-29.01	peak	Horizontal
10	5608.000	42.23	4.00	46.23	74.00	-27.77	peak	Horizontal
11	6202.000	41.14	5.56	46.70	74.00	-27.30	peak	Horizontal
12	8182.000	42.19	9.08	51.27	74.00	-22.73	peak	Horizontal

# Mode: TX

#### Middle channel (2440 MHz)

Date: 2019-04-10

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark	Pole
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	( <b>dB</b> )		
1	1900.000	51.22	-2.95	48.27	74.00	-25.73	peak	Vertical
2	2512.000	46.09	-1.19	44.90	74.00	-29.10	peak	Vertical
3	5761.000	44.61	4.50	49.11	74.00	-24.89	peak	Vertical
4	6013.000	42.20	5.28	47.48	74.00	-26.52	peak	Vertical
5	7390.000	41.36	8.01	49.37	74.00	-24.63	peak	Vertical
6	8173.000	41.25	9.09	50.34	74.00	-23.66	peak	Vertical
7	1900.000	48.07	-2.95	45.12	74.00	-28.88	peak	Horizontal
8	2557.000	45.63	-0.99	44.64	74.00	-29.36	peak	Horizontal
9	6094.000	41.66	5.40	47.06	74.00	-26.94	peak	Horizontal
10	6283.000	42.27	5.68	47.95	74.00	-26.05	peak	Horizontal
11	7741.000	40.70	8.72	49.42	74.00	-24.58	peak	Horizontal
12	8092.000	41.24	9.13	50.37	74.00	-23.63	peak	Horizontal

High	nest channel	Date	: 2019-04-10					
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark	Pole
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	( <b>dB</b> )		
1	1900.000	51.77	-2.95	48.82	74.00	-25.18	peak	Vertical
2	2872.000	44.79	0.36	45.15	74.00	-28.85	peak	Vertical
3	3214.000	44.01	0.92	44.93	74.00	-29.07	peak	Vertical
4	4582.000	42.54	2.49	45.03	74.00	-28.97	peak	Vertical
5	5761.000	44.92	4.50	49.42	74.00	-24.58	peak	Vertical
6	8650.000	41.51	9.02	50.53	74.00	-23.47	peak	Vertical
7	1306.000	50.91	-5.86	45.05	74.00	-28.95	peak	Horizontal
8	1468.000	49.77	-5.43	44.34	74.00	-29.66	peak	Horizontal
9	4456.000	42.71	2.46	45.17	74.00	-28.83	peak	Horizontal
10	6877.000	41.89	6.80	48.69	74.00	-25.31	peak	Horizontal
11	7156.000	41.34	7.43	48.77	74.00	-25.23	peak	Horizontal
12	9415.000	41.33	10.11	51.44	74.00	-22.56	peak	Horizontal

Mode: TX Highest channel (2480MHz

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 Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
- 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 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.

# 8. 6DB BANDWIDTH

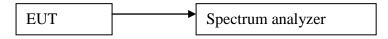
## 8.1. LIMITS

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.

#### 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.
- Set resolution bandwidth (RBW) = 100kHz.Set the video bandwidth (VBW) ≥ 3 x RBW. Detector = Peak. Trace mode = max hold. Sweep = auto couple. Allow the trace to stabilize, record 6dB bandwidth value.
- 3) Repeat above procedures until all frequencies measured were complete.

#### 8.3. TEST SETUP



# 8.4. TEST RESULTS

Channel	Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Test Result
Lowest	2402	685.2		PASS
Middle	2440	690.2	>500	PASS
Highest	2480	695.4		PASS

Lowest channel (2402MHz)

Keysight Spectrum Analyzer - Occupied B	W			
		SENSE:INT ALIG Center Freg: 2.4020000	N AUTO/NO RF	07:57:38 PM Apr 16, 2019 Radio Std: None
Center Freq 2.40200000	J GHZ	Trian Eres Dum	Avg Hold:>10/10	Radio Std. None
	#IFGain:Low	#Atten: 10 dB		Radio Device: BTS
10 dB/div Ref 20.00 dB	m			
Log				
10.0				
0.00		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		
-10.0				
-20.0				
-30.0				
-40.0				
-50.0				And the second
-60.0				
-70.0				
Center 2.402 GHz				Span 3 MHz
#Res BW 100 kHz		#VBW 300 kH	7	Sweep 1 ms
				on op i mo
Occupied Bandwid	th	Total Power	6.86 dBm	
	.0736 MHz			
Transmit Freq Error	-19.991 kHz	% of OBW Power	r 99.00 %	
x dB Bandwidth	685.2 kHz	x dB	-6.00 dB	
A dB Bandwidth	00 <b>5.2</b> KHZ	X UD	-0.00 ub	
MSG			STATUS	

#### Middle channel (2440 MHz)



Highest channel (2480MHz)

Keysight Spectrum Analyzer - Occupied BW	·			
M         RL         RF         50 Ω         AC           Center Freq 2.480000000		Center Freq: 2.480000000		07:58:11 PM Apr 16, 2019 Radio Std: None
	#IFGain:Low	Trig: Free Run #Atten: 10 dB	Avg Hold:>10/10	Radio Device: BTS
10 dB/div Ref 20.00 dBm				
Log				
10.0				
0.00				
-10.0				
-20.0				
-30.0				
-40.0				
-60.0				
-70.0				
Center 2.48 GHz #Res BW 100 kHz		#VBW 300 kHz		Span 3 MHz Sweep 1 ms
Occupied Bandwidth	1	Total Power	6.81 dBm	
1.0	)758 MHz			
Transmit Freq Error	-21.962 kHz	% of OBW Power	99.00 %	
x dB Bandwidth	695.4 kHz	x dB	-6.00 dB	
MSG			STATUS	

# 9. MAXIMUM PEAK OUTPUT POWER

## 9.1 LIMITS

The maximum Peak output power measurement is 1W

# 9.2 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 ≤EBW. So we test the Maximum Conducted Output Power ——Integrated band power method.
- 4) Set the analyzer span  $\geq 1.5 \text{ x DTS}$  bandwidth. Set the RBW = 1 MHz. Set the VBW  $\geq 3 \text{ MHz}$ . Sweep time = auto couple. Detector = peak. Allow trace to fully stabilize.

#### 9.3 TEST SETUP



## 9.4 TEST RESULTS

Channel	Frequency (MHz)	Measured Channel Power (dBm)	Limit	Peak/ Average	Result
Lowest	2402	0.15			Pass
Middle	2440	0.16		Peak	Pass
Highest	2480	0.04	$1 \mathbf{W}$		Pass
Lowest	2402	0.07	(30dBm)		Pass
Middle	2440	0.08		Average	Pass
Highest	2480	0.01			Pass

#### **10. POWER SPECTRAL DENSITY**

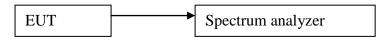
## **10.1 LIMITS**

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.

## **10.2 TEST PROCEDURES**

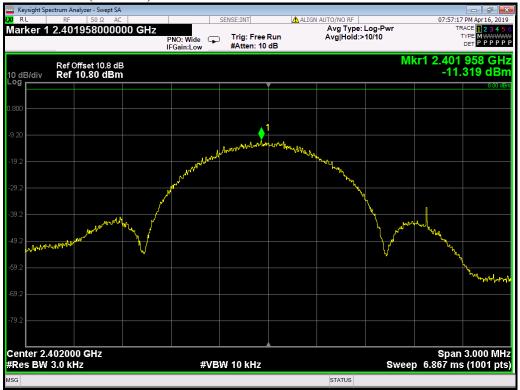
- 1) Remove the antenna from the EUT, and then connect a low loss RF cable from antenna port to the spectrum analyzer.
- 2) Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set 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  $\ge$ 3 RBW. Detector = peak. Ensure that the number of measurement points in the sweep  $\ge$  2 x 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.

#### **10.3 TEST SETUP**



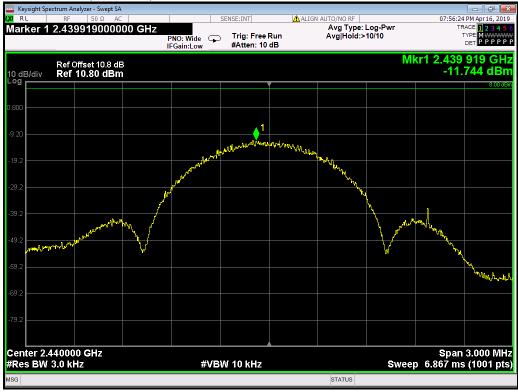
#### **10.4 TEST RESULTS**

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Test Result
Lowest	2402	-11.319		PASS
Middle	2440	-11.744	8	PASS
Highest	2480	-11.582		PASS



Lowest channel (2402MHz)

Middle channel (2440 MHz)



Highest channel (2480MHz)



# 11. CONDUCTED BAND EDGES AND SPURIOUS EMISSIONS 11.2. 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.

# **11.3. 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.

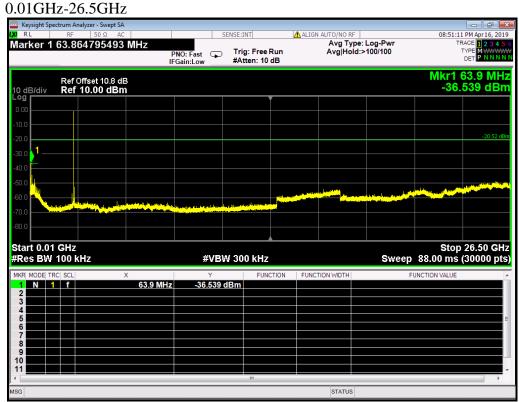
- 1) Remove the antenna from the EUT and then connect a low attenuation cable from the antenna port to the spectrum.
- 2) Set the spectrum analyzer: RBW =100KHz; VBW =300KHz, Span = 10MHz to 26GHz; Sweep = auto; Detector Function = Peak. Trace = Max, hold.
- 3) Measure and record the results in the test report.
- 4) The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

# **11.4. TEST SETUP**

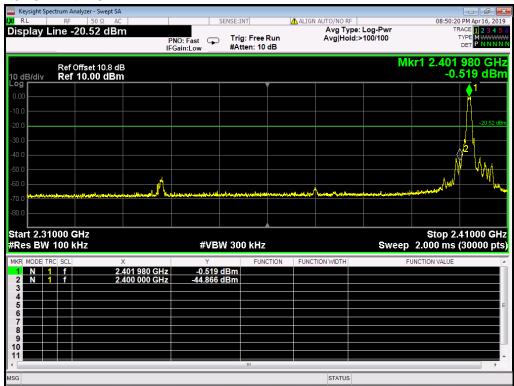


# **11.5. TEST RESULTS**

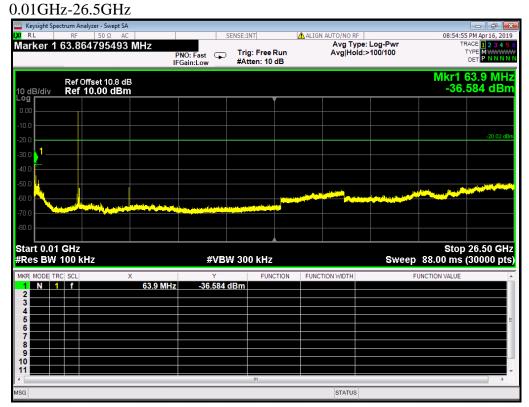
Lowest channel (2402MHz)



#### 2.31GHz-2.41GHz

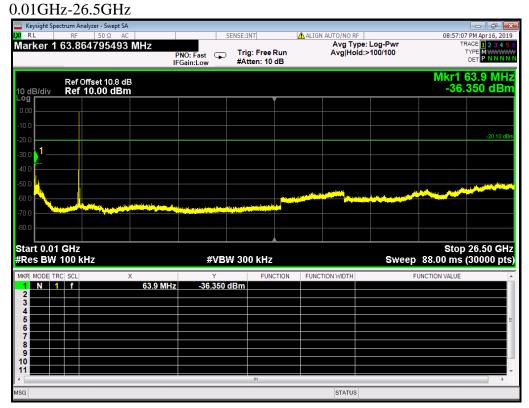


## Middle channel (2440 MHz)





# Highest channel (2480MHz)



#### 2.475GHz-2.5GHz



## **12. RESTRICTED BANDS OF OPERATION**

# **12.1.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)).

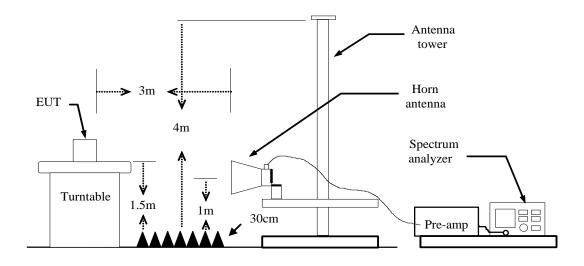
MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
<sup>1</sup> 0.495 - 0.505	16.69475 -	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.69525	960 - 1240	7.25 - 7.75
4.125 - 4.128	16.80425 -	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	16.80475	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	25.5 -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

#### **12.2.TEST PROCEDURES**

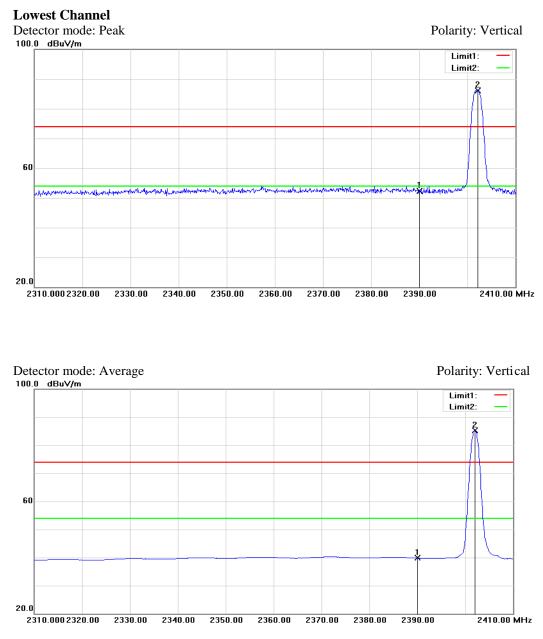
Test procedures follow KDB 558074 D01 DTS Meas Guidance v03r01.

- 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.

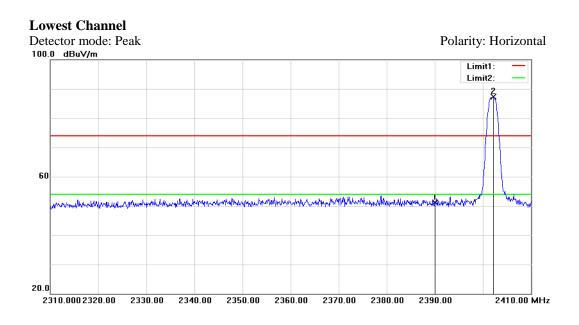
# **12.3.TEST SETUP**

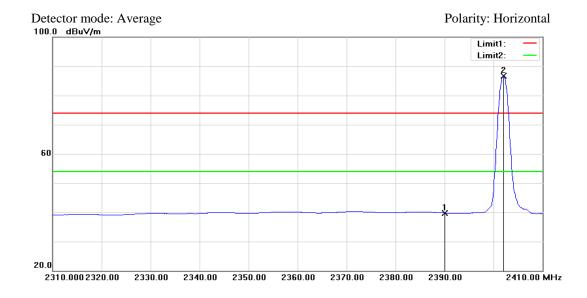


# **12.4.TEST RESULTS**



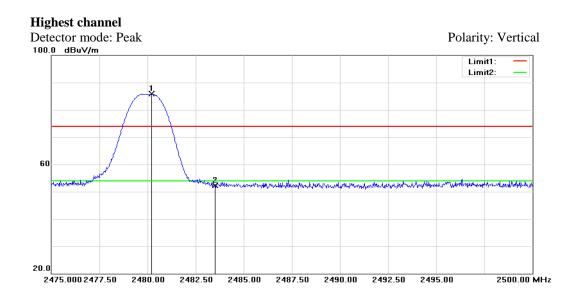
No.	Frequency	Reading	Factor	Result	Limit	Margin	Remark	Pole
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB		
1	2390.000	53.73	-1.48	52.25	74.00	-21.75	Peak	Vertical
2	2402.200	87.55	-1.45		74.00		Peak	Vertical
1	2390.000	41.29	-1.48	39.81	54.00	-14.19	Average	Vertical
2	2402.000	86.85	-1.46		54.00		Average	Vertical

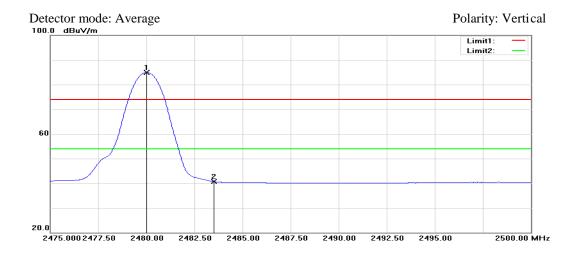




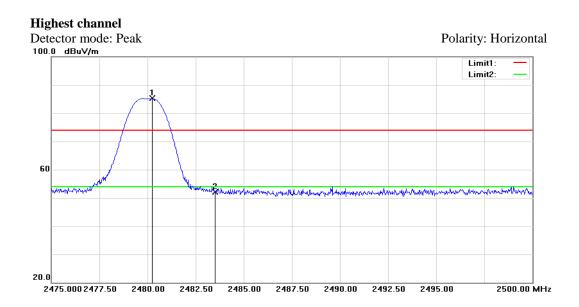
No.	Frequency	Reading	Factor	Result	Limit	Margin	Remark	Pole
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB		
1	2390.000	52.50	-1.48	51.02	74.00	-22.98	Peak	Horizontal
2	2402.200	88.68	-1.45		74.00		Peak	Horizontal
1	2390.000	41.28	-1.48	39.80	54.00	-14.20	Average	Horizontal
2	2402.000	88.08	-1.46		54.00		Average	Horizontal

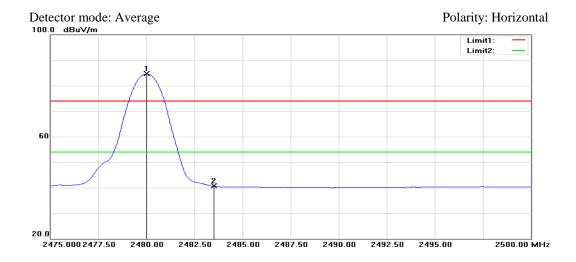
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No.	Frequency	Reading	Factor	Result	Limit	Margin	Remark	Pole
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB		
1	2480.200	87.10	-1.28		74.00		Peak	Vertical
2	2483.500	53.54	-1.27	52.27	74.00	-21.73	Peak	Vertical
1	2480.025	86.26	-1.28		54.00		Average	Vertical
2	2483.500	41.96	-1.27	40.69	54.00	-13.31	Average	Vertical





No.	Frequency	Reading	Factor	Result	Limit	Margin	Remark	Pole
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB		
1	2480.250	86.52	-1.28		74.00		Peak	Horizontal
2	2483.500	53.40	-1.27	52.13	74.00	-21.87	Peak	Horizontal
1	2480.000	85.89	-1.28		54.00		Average	Horizontal
2	2483.500	41.90	-1.27	40.63	54.00	-13.37	Average	Horizontal

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