FCC PART 15 SUBPART C

CERTIFICATION TEST REPORT

For

LED Lamp

MODEL NUMBER: MK-020011002123,
100022465, 100022467

FCC ID: 2AY5GMK020011002123

REPORT NUMBER: 4789738938.2-2

ISSUE DATE: Mar 05, 2021

Prepared for

Zhejiang MEKA Electric Co.,Ltd
NO.8 Canghai Road,Lihai Town,Binhai New City,Shaoxing,zhejiang Province

Prepared by

UL-CCIC COMPANY LIMITED
No. 2, Chengwan Road, Suzhou Industrial Park, People's Republic of China
Tel: +86 769 22038881
Fax: +86 769 33244054
Website: www.ul.com

The results reported herein have been performed in accordance with the laboratory's terms of accreditation. This report shall not be reproduced except in full without the written approval of the Laboratory. The results in this report apply to the test sample(s) mentioned above at the time of the testing period only and are not to be used to indicate applicability to other similar products. This report does not imply that the product(s) has met the criteria for certification.

Revision History

Rev.	Issue Date	Revisions	Revised By
--	03/05/2021	Initial Issue	--

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

Summary of Test Results			
Clause	Test Items	FCC Rules	Test Results
1	6dB Bandwidth	FCC Part 15.247 (a) (2)	Pass
2	Peak Conducted Output Power	FCC Part 15.247 (b) (3)	Pass
3	Power Spectral Density	FCC Part 15.247 (e)	Pass
4	Conducted Band edge And Spurious emission	FCC Part 15.247 (d)	Pass
5	Radiated Bandedge and Spurious Emission	FCC Part 15.247 (d) FCC Part 15.209 FCC Part 15.205	Pass
6	Conducted Emission Test For AC Power Port	FCC Part 15.207	Pass
7	Antenna Requirement	FCC Part 15.203	Pass
Remark: 1) The measurement result for the sample received is <Pass> according to < CFR 47 FCC PART 15 SUBPART C, when <Accuracy Method> decision rule is applied.			

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

TABLE OF CONTENTS

ATTESTATION OF TEST RESULTS **6**

1. TEST METHODOLOGY **7**

2. FACILITIES AND ACCREDITATION **7**

3. CALIBRATION AND UNCERTAINTY **8**

3.1. MEASURING INSTRUMENT CALIBRATION *8*

3.2. MEASUREMENT UNCERTAINTY *8*

4. EQUIPMENT UNDER TEST **9**

4.1. DESCRIPTION OF EUT *9*

4.2. MAXIMUM OUTPUT POWER *9*

4.3. CHANNEL LIST *9*

4.4. TEST CHANNEL CONFIGURATION *10*

4.5. THE WORSE CASE POWER SETTING PARAMETER *10*

4.6. DESCRIPTION OF AVAILABLE ANTENNAS *10*

4.7. WORST-CASE CONFIGURATIONS *10*

4.8. DESCRIPTION OF TEST SETUP *11*

5. MEASURING INSTRUMENT AND SOFTWARE USED **12**

6. MEASUREMENT METHODS **14**

7. ANTENNA PORT TEST RESULTS **15**

7.1. ON TIME AND DUTY CYCLE *15*

7.2. 6 dB BANDWIDTH *17*

7.3. PEAK CONDUCTED OUTPUT POWER *20*

7.4. POWER SPECTRAL DENSITY *21*

7.5. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS *24*

8. RADIATED TEST RESULTS **29**

8.1. LIMITS AND PROCEDURE *29*

8.2. RESTRICTED BANDEDGE *35*

8.3. SPURIOUS EMISSIONS 30MHz-1GHz *39*

8.4. SPURIOUS EMISSIONS Above 1 GHz *41*

8.5. SPURIOUS EMISSIONS BELOW 30M *47*

9. AC POWER LINE CONDUCTED EMISSIONS **48**

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

10. ANTENNA REQUIREMENTS..... 51

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

ATTESTATION OF TEST RESULTS

Applicant Information

Company Name:	Zhejiang MEKA Electric Co.,Ltd
Address:	NO.8 Canghai Road,Lihai Town,Binhai New City,Shaoxing,zhejiang Province

Manufacturer Information

Company Name:	Zhejiang MEKA Electric Co.,Ltd
Address:	NO.8 Canghai Road,Lihai Town,Binhai New City,Shaoxing,zhejiang Province

EUT Description

EUT Name:	LED Lamp
Brand Name:	MKOPTO, onn.
Model:	MK-020011002123, 100022465, 100022467
Model Difference	Only the model name is different, the others are the same.
Sample Status:	Normal
Sample Received Date:	Feb 25, 2021
Date of Tested:	Feb 25, 2021 ~ Mar 04, 2021

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC Part 15 Subpart C	**PASS**

Prepared By:

Jason Yang

Jason Yang
Engineer

Reviewed By:

Tom Tang

Tom Tang
Associate Project Engineer

Authorized By:

Chris Zhong

Chris Zhong
Laboratory Manager

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

1. TEST METHODOLOGY

The tests documented in this report were performed in accordance with 558074 D01 15.247 Meas Guidance v05r02, 414788 D01 Radiated Test Site v01r01, FCC CFR 47 Part 2, FCC CFR 47 Part 15 ANSI C63.10-2013.

2. FACILITIES AND ACCREDITATION

Accreditation Certificate	**A2LA (Certificate No.: 4338.01)** Shenzhen STS Test Services Co., Ltd. has been assessed and proved to be in compliance with A2LA**.** **CNAS (Registration No.: L7649)** Shenzhen STS Test Services Co., Ltd. has been assessed and proved to be in compliance with CNAS. **FCC (FCC Designation No.: 625569)** Shenzhen STS Test Services Co., Ltd. has been recognized to perform compliance testing on equipment subject to the Commission's Delcaration of Conformity (DoC) and Certification rules **IC(Company No.: 12108A)** Shenzhen STS Test Services Co., Ltd. has been registered and fully described in a report filed with Industry Canada. The Company Number is 12108A.

Note: All tests measurement facilities use to collect the measurement data are located at A 1/F, Building B, Zhuoke Science Park, No.190 Chongqing Road, HepingShequ, Fuyong Sub-District, Bao'an District, Shenzhen, Guang Dong, China

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

3. CALIBRATION AND UNCERTAINTY

3.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

3.2. MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement **y** ± **U**, where expended uncertainty **U** is based on a standard uncertainty multiplied by a coverage factor of **k=2**, providing a level of confidence of approximately **95** %.

No.	Item	Uncertainty
1	RF output power, conducted	±0.7dB
2	Unwanted Emissions, conducted	±3.0dB
3	All emissions, radiated 9K-30MHz	±2.7dB
4	All emissions, radiated 30M-1GHz	±4.4dB
5	All emissions, radiated 1G-6GHz	±5.1dB
6	All emissions, radiated>6G	±5.5dB
7	Conducted Emission (9KHz-150KHz)	±2.8dB
8	Conducted Emission (150KHz-30MHz)	±2.8dB

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

4. EQUIPMENT UNDER TEST

4.1. DESCRIPTION OF EUT

EUT Name	LED Lamp	
EUT Description	The EUT is a LED Lamp	
Model	MK-020011002123	
Product Description (Bluetooth)	Operation Frequency	2402 MHz ~ 2480 MHz
	Modulation Type	Data Rate
	GFSK	1Mbps
Power Parameter	Input: AC 110-130V 60Hz	
Bluetooth Version	4.2	
Bluetooth Configuration	LE	
Hardware Version	1.0.3	
Software Version	2.9.12	

4.2. MAXIMUM OUTPUT POWER

Frequency Range (MHz)	Number of Transmit Chains (NTX)	Bluetooth Mode	Frequency (MHz)	Channel Number	Max PK Conducted Power (dBm)
2400-2483.5	1	BLE	2402-2480	0-39[40]	5.41

4.3. CHANNEL LIST

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

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

4.4. TEST CHANNEL CONFIGURATION

Test Mode	Test Channel	Frequency
GFSK	CH 00, CH 19, CH 39	2402MHz, 2440MHz, 2480MHz

4.5. THE WORSE CASE POWER SETTING PARAMETER

The Worse Case Power Setting Parameter under 2400 ~ 2483.5MHz Band				
Modulation Type	Transmit Antenna Number	Test Channel		
		CH 00	CH 19	CH 39
GFSK	1	3	3	3

4.6. DESCRIPTION OF AVAILABLE ANTENNAS

Ant.	Frequency (MHz)	Antenna Type	Antenna Gain (dBi)
1	2402-2480	PCB Antenna	1

Test Mode	Transmit and Receive Mode	Description
GFSK	☒1TX, 1RX	Chain 1 can be used as transmitting/receiving antenna.

4.7. WORST-CASE CONFIGURATIONS

Bluetooth Mode	Modulation Technology	Modulation Type	Data Rate (Mbps)
BLE	DTS	GFSK	1Mbit/s

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

4.8. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Item	Equipment	Brand Name	Model Name	P/N
1	PC	LENOVO	ThinkPad E470	N/A

I/O CABLES

Cable No	Port	Connector Type	Cable Type	Cable Length(cm)	Remarks
1	USB Cable	N/A	N/A	150cm	N/A

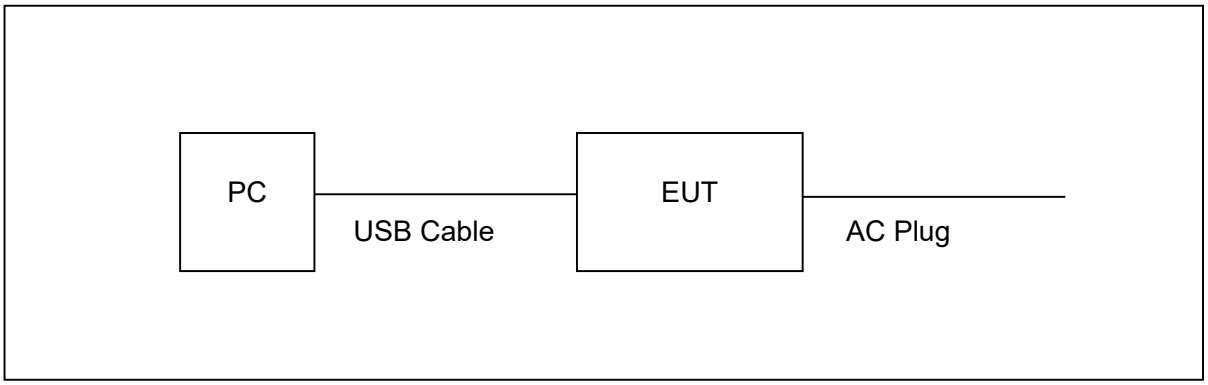
ACCESSORY

Item	Accessory	Brand Name	Model Name	Description
1	N/A	N/A	N/A	N/A

TEST SETUP

The EUT can work in an engineer mode with a software through a Laptop.

SETUP DIAGRAM FOR TESTS



This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

5. MEASURING INSTRUMENT AND SOFTWARE USED

Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	ESCI	101427	2020.10.12	2021.10.11
Signal Analyzer	R&S	FSV 40-N	101823	2020.10.10	2021.10.09
Active loop Antenna	ZHINAN	ZN30900C	16035	2019.07.11	2021.07.10
Bilog Antenna	TESEQ	CBL6111D	34678	2020.10.12	2022.10.11
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	2019.10.15	2021.10.14
SHF-EHF Horn Antenna (18G-40GHz)	A-INFO	LB-180400-KF	J211020657	2020.10.12	2022.10.11
Pre-Amplifier (0.1M-3GHz)	EM	EM330	060665	2020.10.12	2021.10.11
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK2018080901	2020.10.12	2021.10.11
Pre-Amplifier (18G-40GHz)	SKET	LNPA-1840-50	SK2018101801	2020.10.10	2021.10.09
Temperature & Humidity	HH660	Mieo	N/A	2020.10.12	2021.10.11
Turn table	EM	SC100_1	60531	N/A	N/A
Antenna mast	EM	SC100	N/A	N/A	N/A
Band Reject Filter (2.4-2.5GHz)	COM-MW	ZBSF-2400-2500	N/A	2020.10.12	2021.10.11
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)			

Conduction Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	ESCI	101427	2020.10.12	2021.10.11
LISN	R&S	ENV216	101242	2020.10.12	2021.10.11
LISN	EMCO	3810/2NM	23625	2020.10.12	2021.10.11
Temperature & Humidity	HH660	Mieo	N/A	2020.10.13	2021.10.12
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)			

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Power Sensor	Keysight	U2021XA	MY55520005	2020.10.10	2021.10.09
			MY55520006	2020.10.10	2021.10.09
			MY56120038	2020.10.10	2021.10.09
			MY56280002	2020.10.10	2021.10.09
Signal Analyzer	Agilent	N9020A	MY51110105	2020.03.05	2021.03.04
Temperature & Humidity	HH660	Mieo	N/A	2020.10.13	2021.10.12
MIMO Power measurement test Set	Keysight	U2021XA	MY55520005	2020.10.10	2021.10.09
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)			

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

6. MEASUREMENT METHODS

No.	Test Item	KDB Name	Section
1	6dB Bandwidth	558074 D01 15.247 Meas Guidance v05r02	8.2
2	Peak Output Power	558074 D01 15.247 Meas Guidance v05r02	8.1.3
3	Power Spectral Density	558074 D01 15.247 Meas Guidance v05r02	8.4
4	Out-of-band emissions in non-restricted bands	558074 D01 15.247 Meas Guidance v05r02	8.5
5	Out-of-band emissions in restricted bands	558074 D01 15.247 Meas Guidance v05r02	8.6
6	Band-edge	558074 D01 15.247 Meas Guidance v05r02	8.7
7	Conducted Emission Test For AC Power Port	ANSI C63.10-2013	6.2

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

7. ANTENNA PORT TEST RESULTS

7.1. ON TIME AND DUTY CYCLE

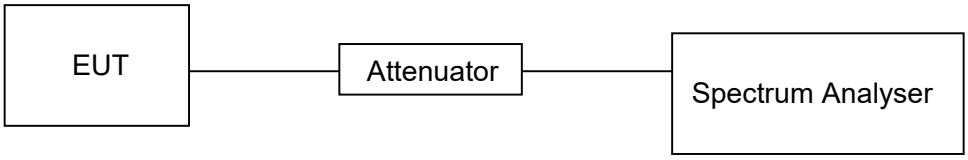
LIMITS

None; for reporting purposes only

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method

TEST SETUP



TEST ENVIRONMENT

Temperature	25°C	Relative Humidity	60%
Atmosphere Pressure	101kPa	Test Voltage	AC 120V/60Hz

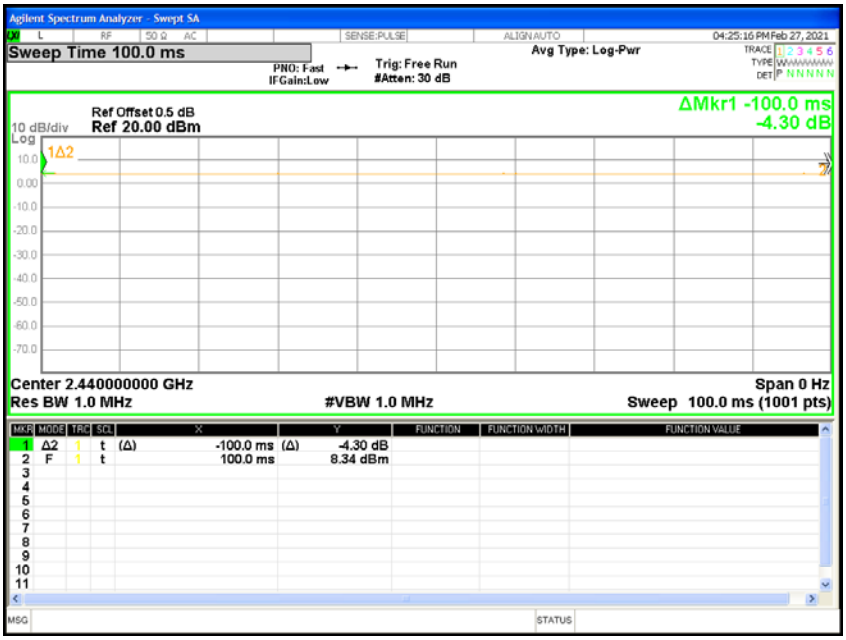
RESULTS

Mode	On Time (msec)	Period (msec)	Duty Cycle x (Linear)	Duty Cycle (%)	Duty Cycle Correction Factor (db)	1/B Minimum VBW (KHz)
GFSK	100.000	100.000	1	100.00	0.00	0.01

Note: Duty Cycle Correction Factor=10log(1/x).
Where: x is Duty Cycle(Linear)
Where: B is On Time
Duty Cycle > 98%, set the final test VBW = 10KHz (VBW ⩽ RBW/100)

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

ON TIME AND DUTY CYCLE MID CH



This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

7.2. 6 dB BANDWIDTH

LIMITS

FCC Part15 (15.247) Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
FCC 15.247(a)(2)	6dB Bandwidth	>= 500KHz	2400-2483.5

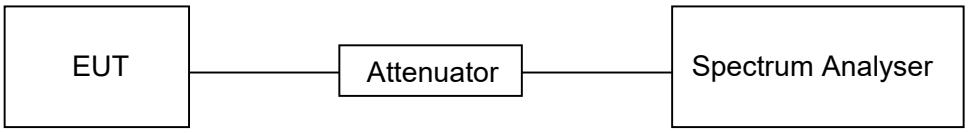
TEST PROCEDURE

Connect the UUT to the spectrum analyser and use the following settings:

Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	For 6 dB Bandwidth :100K
VBW	For 6dB Bandwidth : ≥3 × RBW
Trace	Max hold
Sweep	Auto couple

Allow the trace to stabilize and measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

TEST SETUP



This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

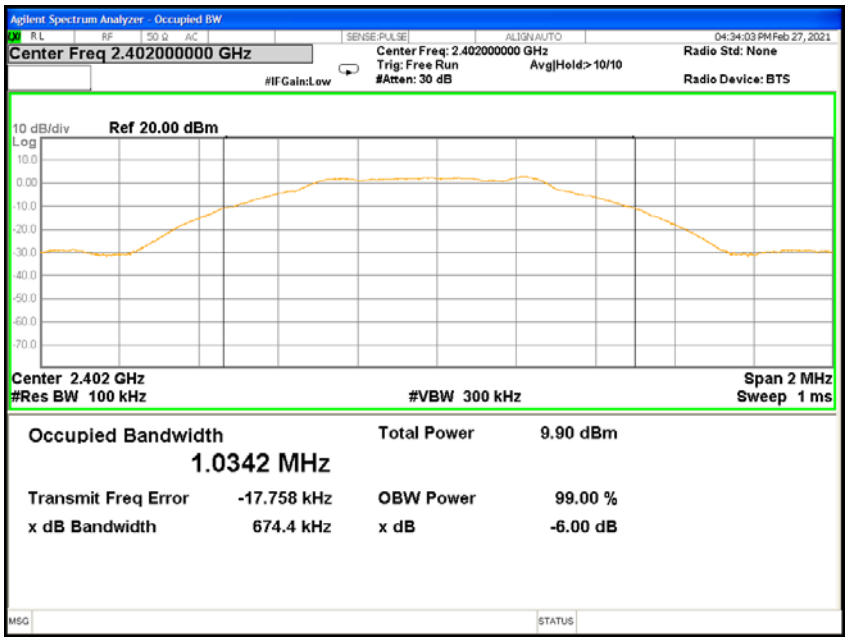
TEST ENVIRONMENT

Temperature	25°C	Relative Humidity	60%
Atmosphere Pressure	101kPa	Test Voltage	AC 120V/60Hz

RESULTS

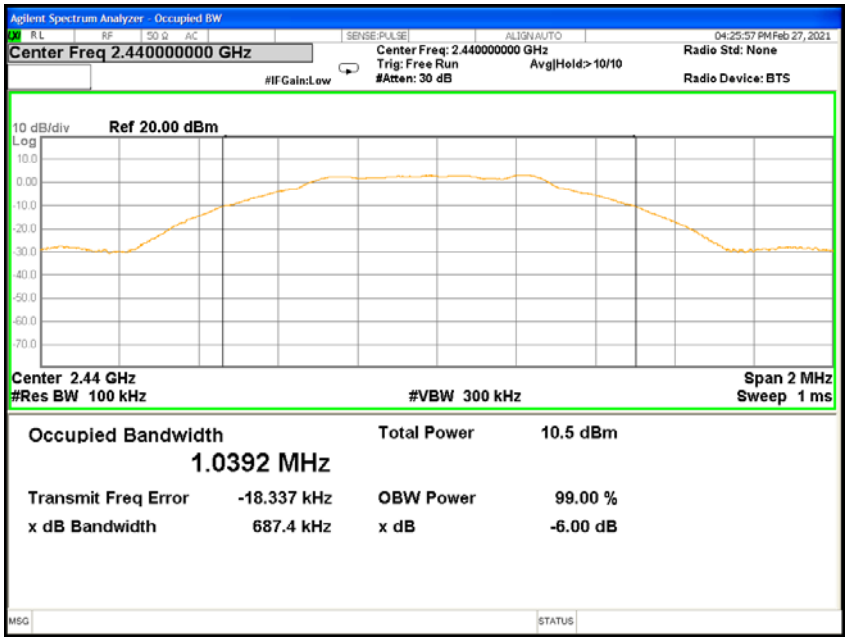
Channel	Frequency (MHz)	6dB bandwidth (KHz)	Limit (kHz)	Result
Low	2402	674.400	≥500KHz	Pass
Middle	2440	687.400	≥500KHz	Pass
High	2480	675.800	≥500KHz	Pass

6 dB BANDWIDTH LOW CH

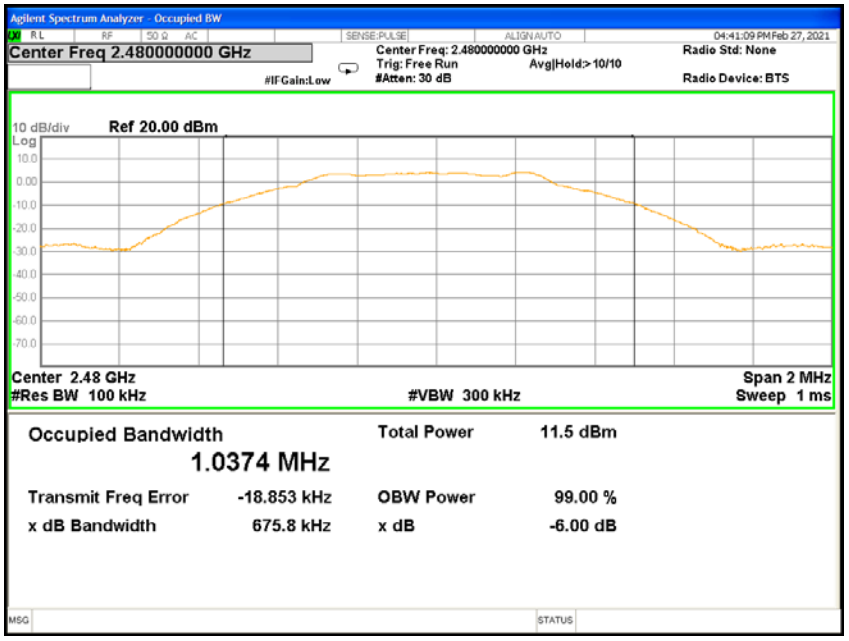


This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

6 dB BANDWIDTH MID CH



6 dB BANDWIDTH HIGH CH



This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

7.3. PEAK CONDUCTED OUTPUT POWER

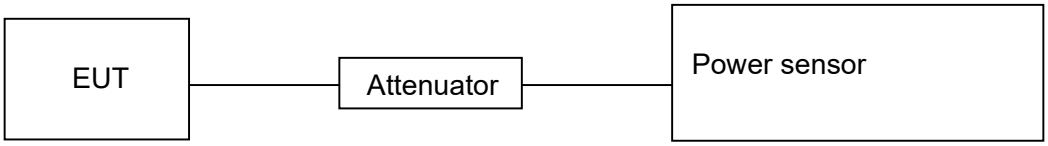
LIMITS

FCC Part15 (15.247) , Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
FCC 15.247(b)(3)	Peak Output Power	1 watt or 30dBm	2400-2483.5

TEST PROCEDURE

Place the EUT on the table and set it in the transmitting mode.
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Power sensor.
Measure peak power each channel.

TEST SETUP



TEST ENVIRONMENT

Temperature	25°C	Relative Humidity	60%
Atmosphere Pressure	101kPa	Test Voltage	AC 120V/60Hz

RESULTS

Test Channel	Frequency	Maximum Conducted Output Power(PK)	LIMIT
	(MHz)	(dBm)	dBm
Low	2402	3.96	30
Middle	2440	4.22	30
High	2480	5.41	30

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

7.4. POWER SPECTRAL DENSITY

LIMITS

FCC Part15 (15.247) , Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
FCC §15.247 (e)	Power Spectral Density	8 dBm in any 3 kHz band	2400-2483.5

TEST PROCEDURE

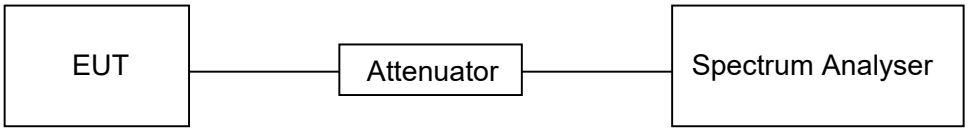
Connect the UUT to the spectrum analyser and use the following settings:

Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	3 kHz ≤ RBW ≤ 100kHz
VBW	≥3 × RBW
Span	1.5 x DTS bandwidth
Trace	Max hold
Sweep time	Auto couple.

Allow trace to fully stabilize and use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

TEST SETUP



This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

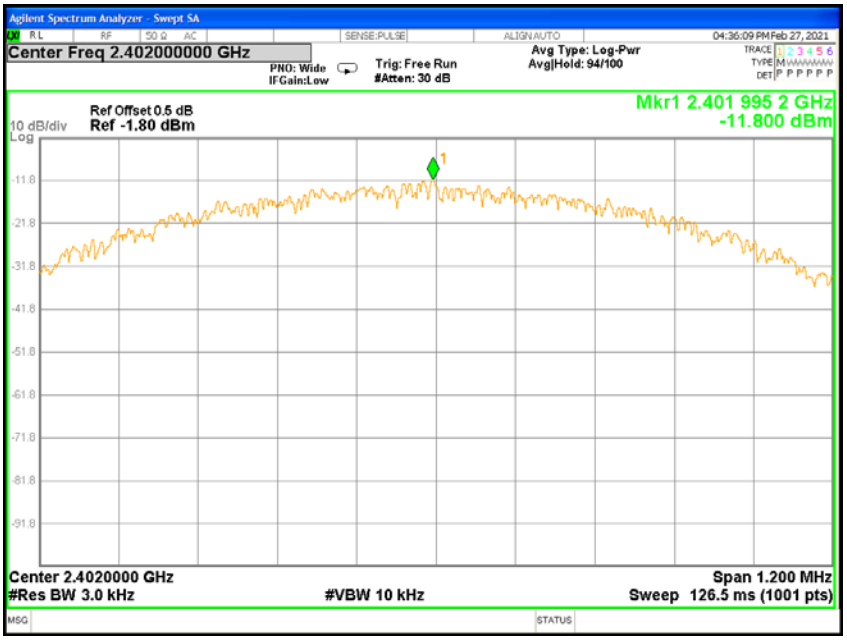
TEST ENVIRONMENT

Temperature	25°C	Relative Humidity	60%
Atmosphere Pressure	101kPa	Test Voltage	AC 120V/60Hz

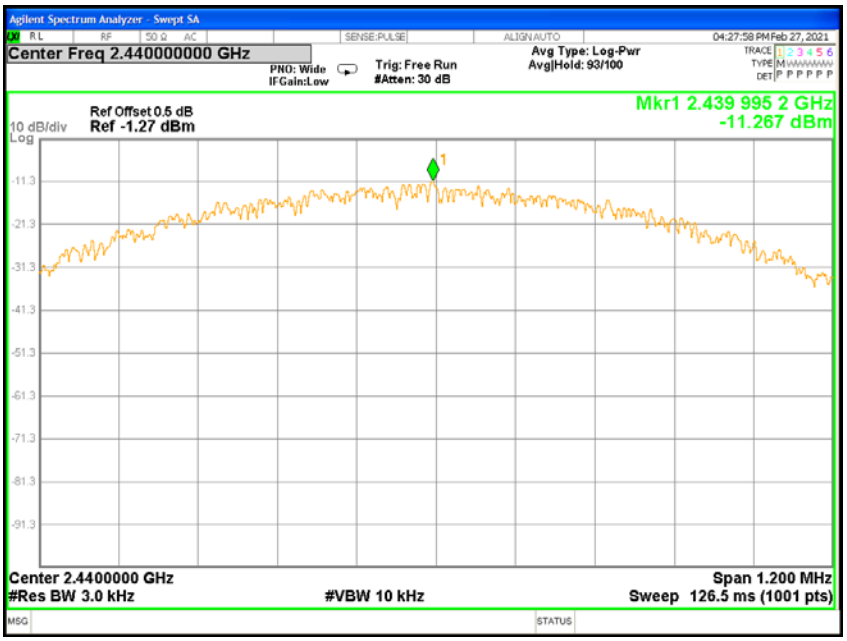
RESULTS

Test Channel	Frequency	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
Low	2402 MHz	-11.800	≤8	PASS
Middle	2440 MHz	-11.267	≤8	PASS
High	2480 MHz	-10.174	≤8	PASS

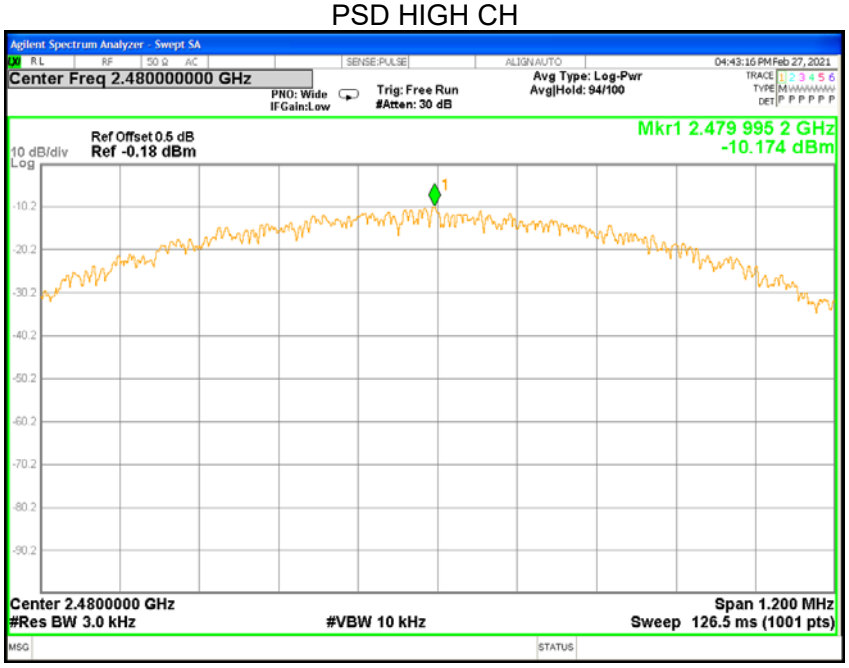
PSD LOW CH



PSD MID CH



PSD HIGH CH



This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

7.5. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

LIMITS

FCC Part15 (15.247) , Subpart C		
Section	Test Item	Limit
FCC §15.247 (d)	Conducted Bandedge and Spurious Emissions	at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power

TEST PROCEDURE

Connect the UUT to the spectrum analyser and use the following settings:

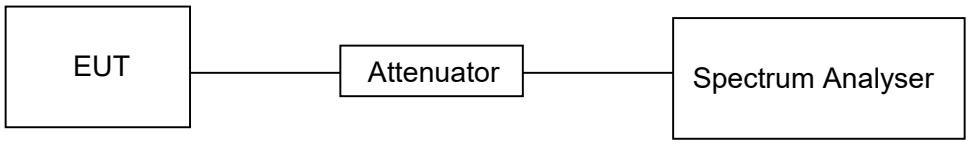
Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	100K
VBW	≥3 × RBW
Span	1.5 x DTS bandwidth
Trace	Max hold
Sweep time	Auto couple.

Use the peak marker function to determine the maximum PSD level.

Span	Set the center frequency and span to encompass frequency range to be measured
Detector	Peak
RBW	100K
VBW	≥3 × RBW
measurement points	≥span/RBW
Trace	Max hold
Sweep time	Auto couple.

Use the peak marker function to determine the maximum amplitude level.

TEST SETUP



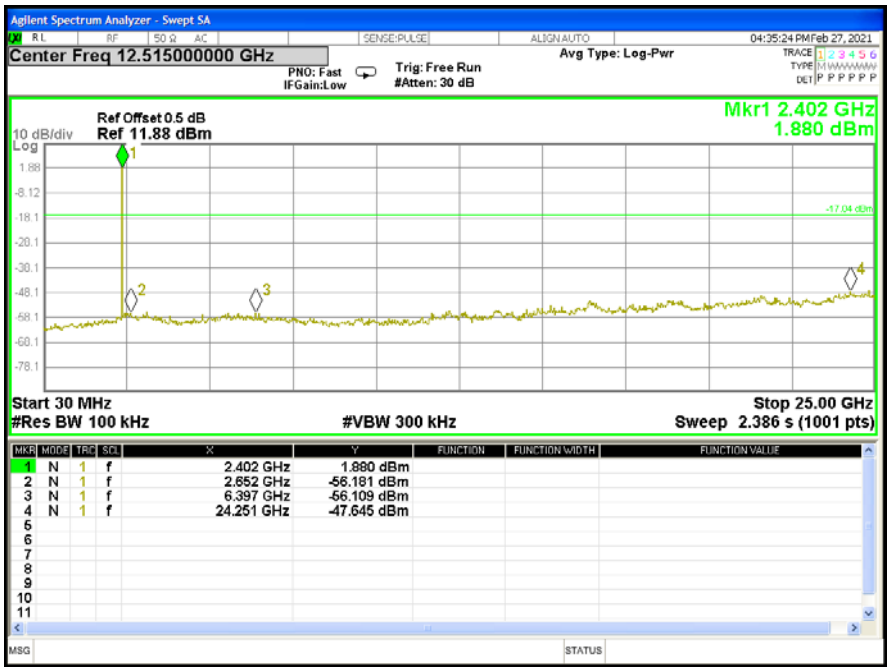
This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

TEST ENVIRONMENT

Temperature	25°C	Relative Humidity	60%
Atmosphere Pressure	101kPa	Test Voltage	AC 120V/60Hz

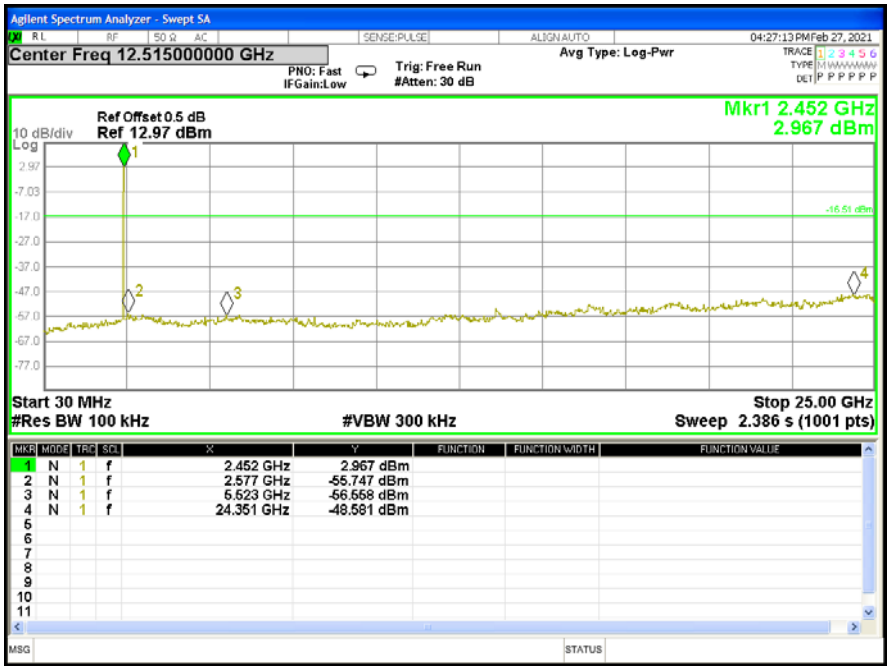
RESULTS

LOW CH SPURIOUS EMISSIONS 30M-25G

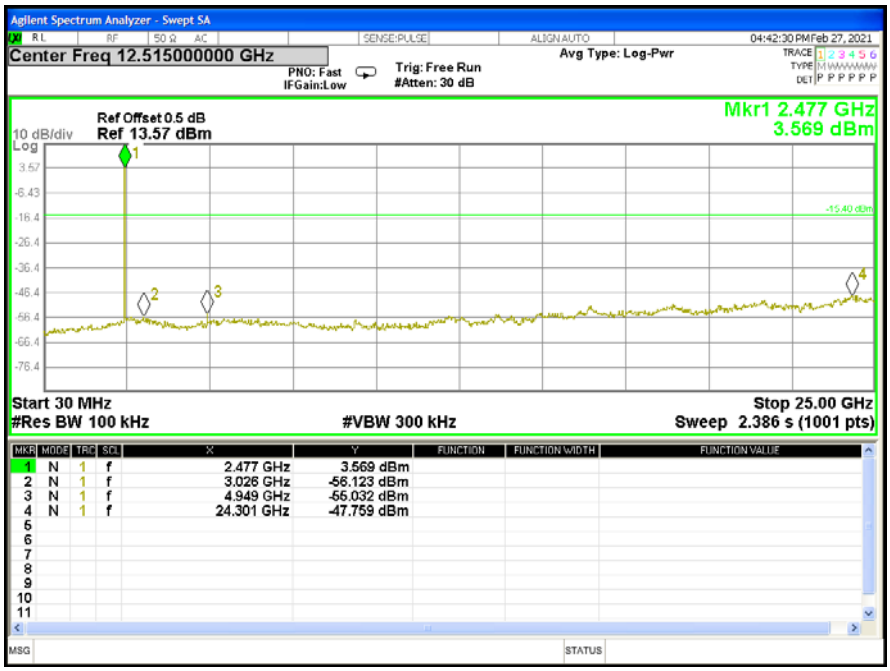


This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

MID CH SPURIOUS EMISSIONS 30M-25G

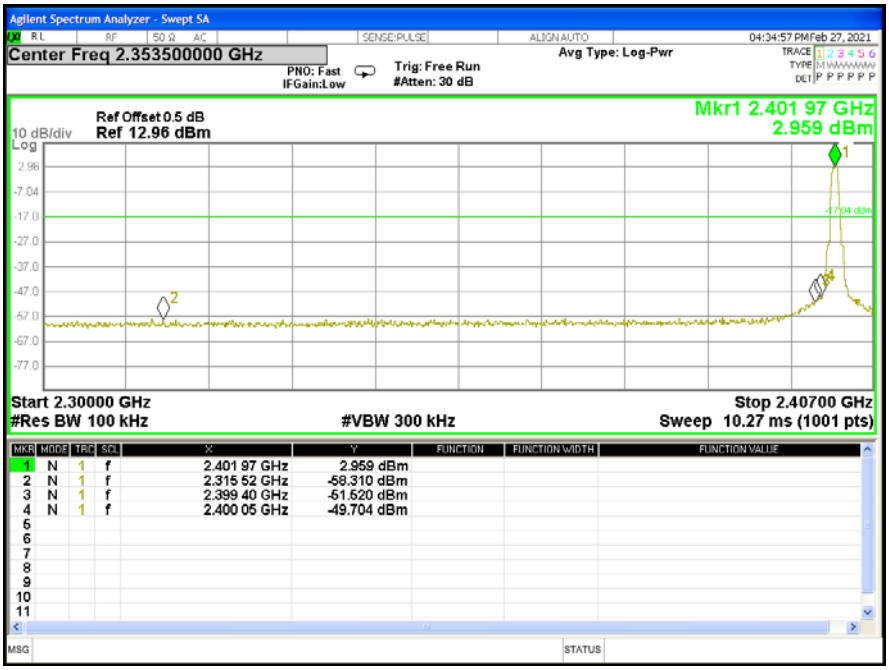


HIGH CH SPURIOUS EMISSIONS 30M-25G

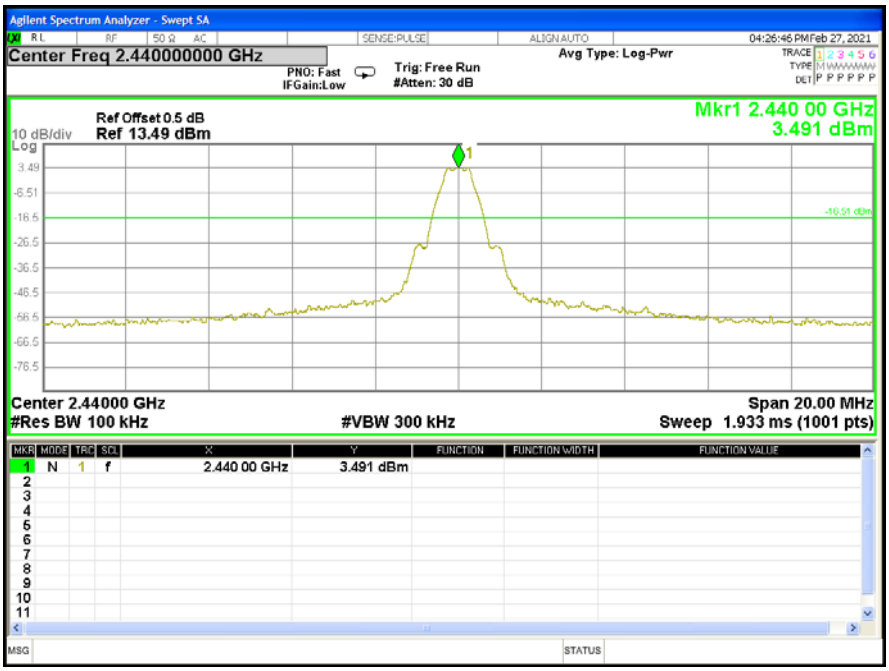


This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

LOW CH BANDEDGE

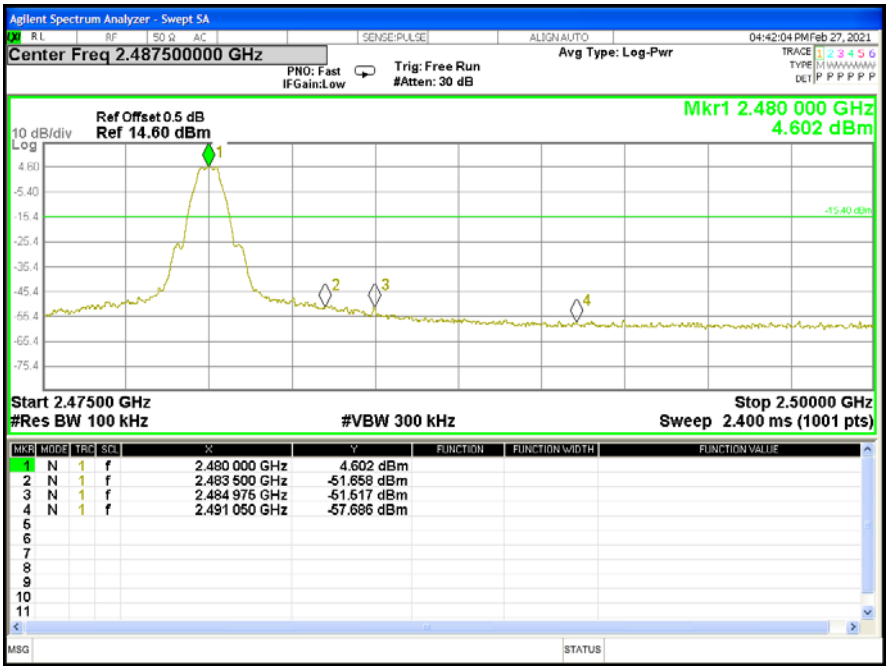


MID CH BANDEDGE



This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

HIGH CH BANDEDGE



This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

Please refer to FCC §15.205 and §15.209
Radiation Disturbance Test Limit for FCC (Class B)(9KHz-1GHz)

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
960~1000	500	3

Note: 1) At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. Measurements shall not be performed at a distance greater than 30 meters unless it can be further demonstrated that measurements at a distance of 30 meters or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

(2) At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). This paragraph (f) shall not apply to Access BPL devices operating below 30 MHz.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

Radiation Disturbance Test Limit for FCC (Above 1G)

Frequency (MHz)	dB(uV/m) (at 3 meters)	
	Peak	Average
Above 1000	74	54

Restricted bands of operation

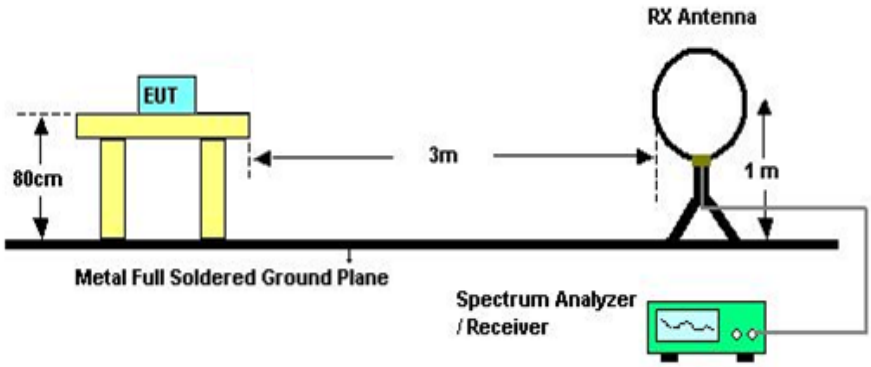
MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41			

Note: [1]Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
[2]Above 38.6c

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

TEST SETUP AND PROCEDURE

Below 30MHz



The setting of the spectrum analyser

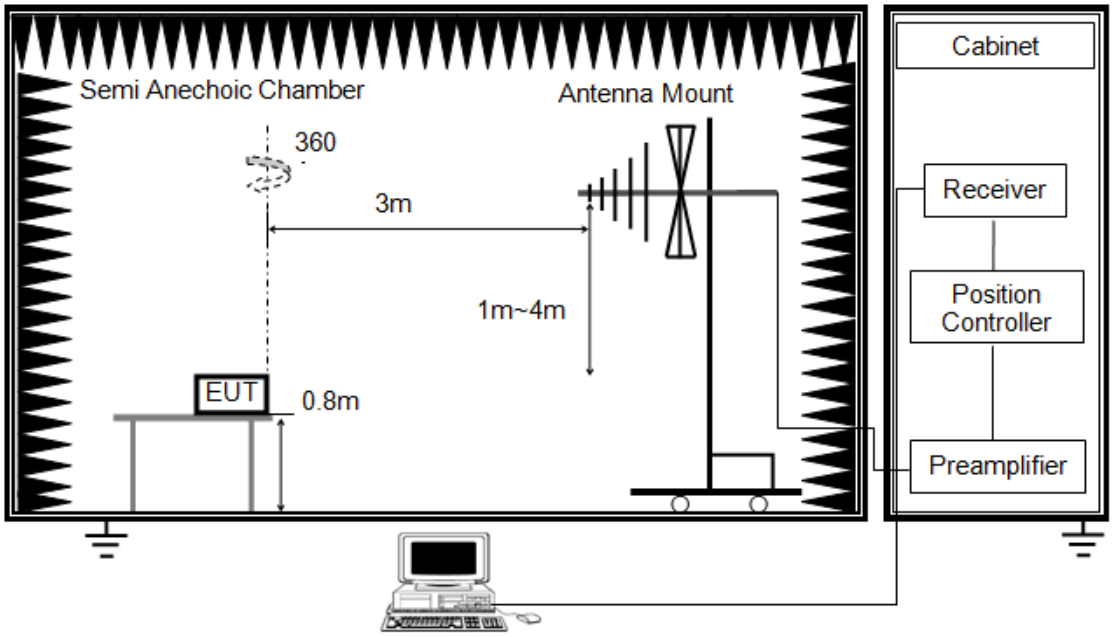
RBW	200Hz (From 9kHz to 0.15MHz)/ 9KHz (From 0.15MHz to 30MHz)
VBW	200Hz (From 9kHz to 0.15MHz)/ 9KHz (From 0.15MHz to 30MHz)
Sweep	Auto
Detector	Peak/QP/ Average
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013
2. The EUT was arranged to its worst case and then turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
3. The EUT was placed on a turntable with 0.8 meter above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. For measurement below 1GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
6. For the actual test configuration, please refer to the related item in this test report (Photographs of the Test Configuration)

Note: Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

Below 1G



The setting of the spectrum analyser

RBW	120K
VBW	300K
Sweep	Auto
Detector	Peak/QP
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013.

2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

3. The EUT was placed on a turntable with 0.8 meter above ground.

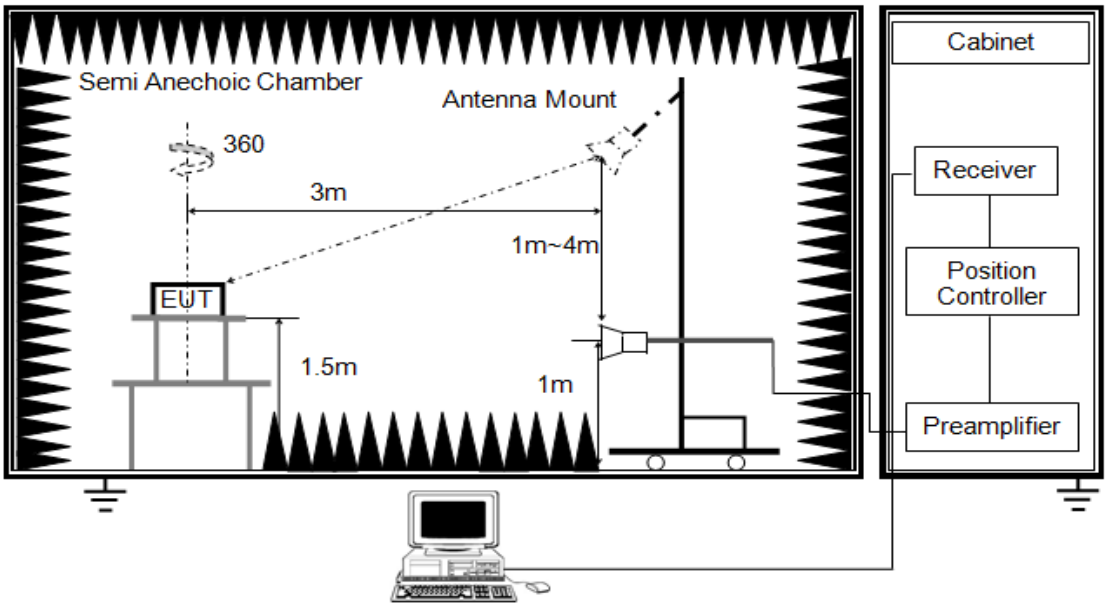
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.

5. For measurement below 1GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

6. For the actual test configuration, please refer to the related Item in this test report (Photographs of the Test Configuration)

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

ABOVE 1G



The setting of the spectrum analyser

RBW	1M
VBW	PEAK: 3M AVG: see note 6
Sweep	Auto
Detector	Peak
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013.

2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

3. The EUT was placed on a turntable with 1.5m above ground.

4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.

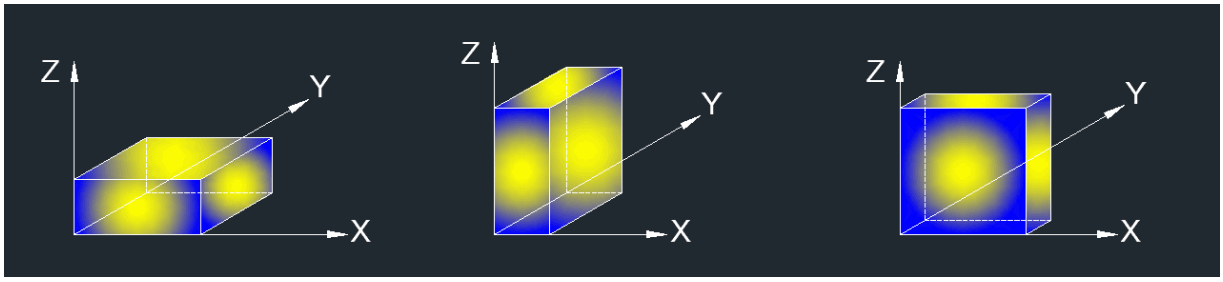
5. For measurement above 1GHz, the emission measurement will be measured by the peak detector. This peak level, once corrected, must comply with the limit specified in Section 15.209.

6. For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 10KHz video bandwidth with peak detector for average measurements.

7. For the actual test configuration, please refer to the related item in this test report (Photographs of the Test Configuration)

X axis, Y axis, Z axis positions:

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.



8. The EUT as shown in Figure 1 is the worst mode, the report only shown the worst mode data.

TEST ENVIRONMENT

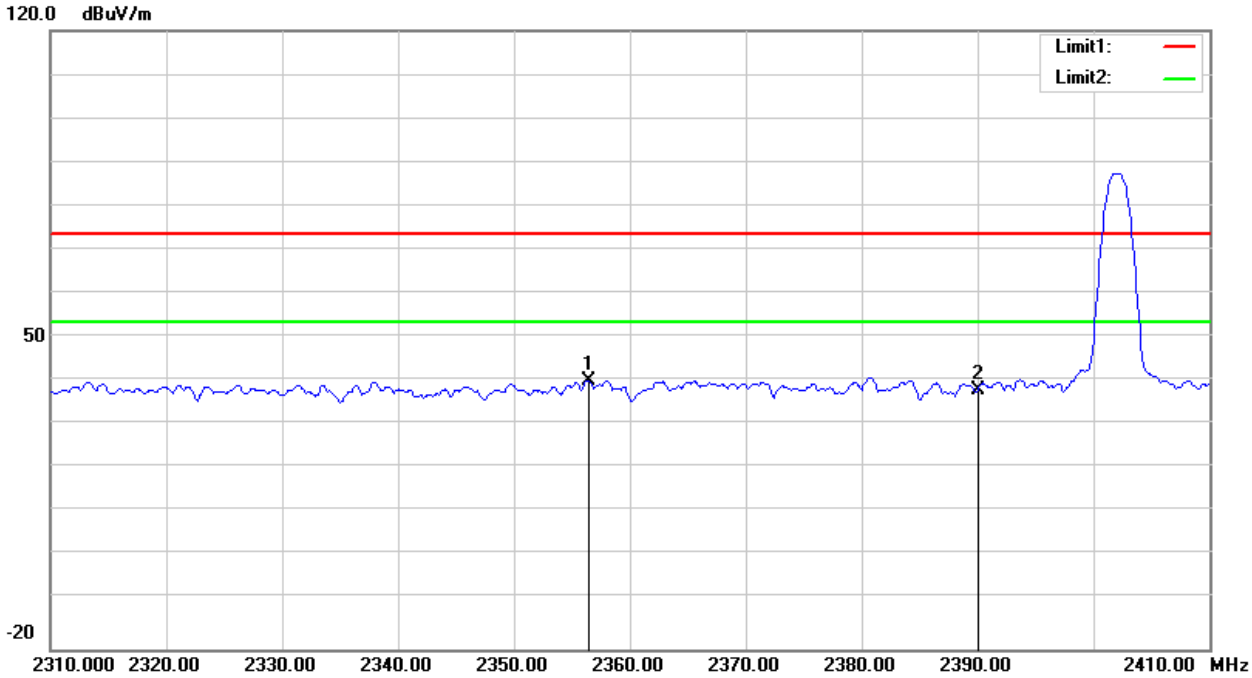
Temperature	25C	Relative Humidity	60%
Atmosphere Pressure	101kPa	Test Voltage	AC 120V/60Hz

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

8.2. RESTRICTED BANDEDGE

GFSK

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

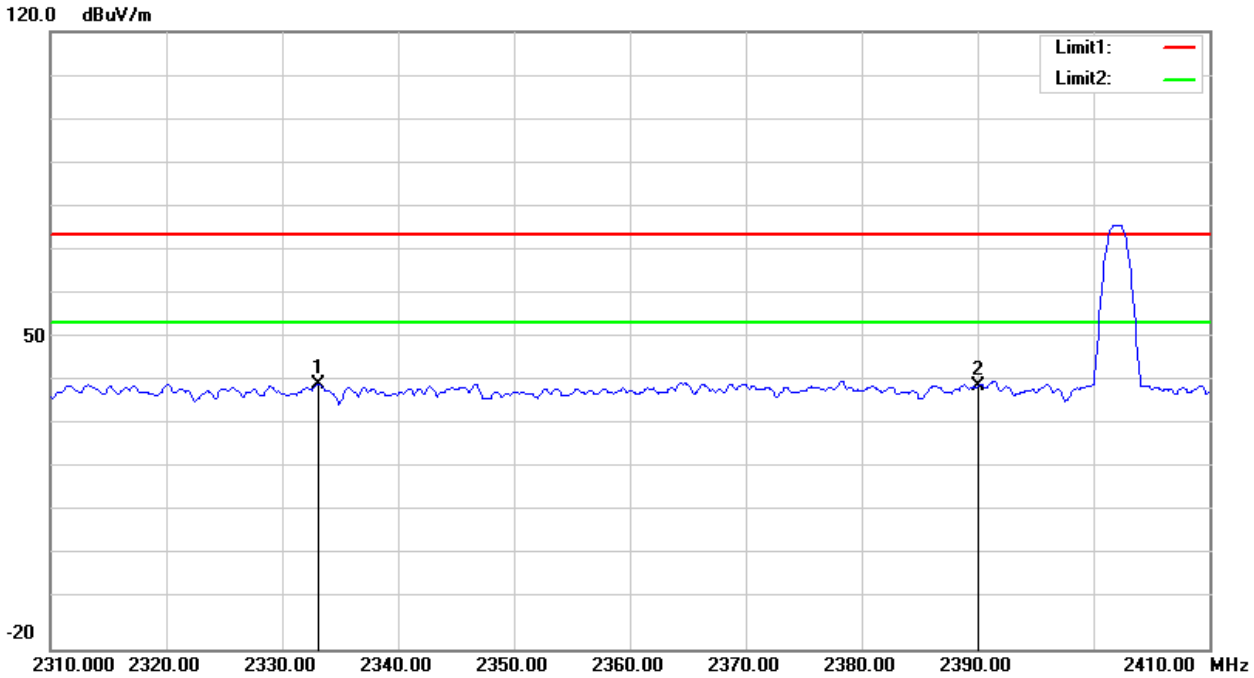


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2356.400	36.98	3.83	40.81	74.00	-33.19	peak
2	2390.000	34.46	4.34	38.80	74.00	-35.20	peak

Note: Measurement = Reading Level + Correct Factor.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

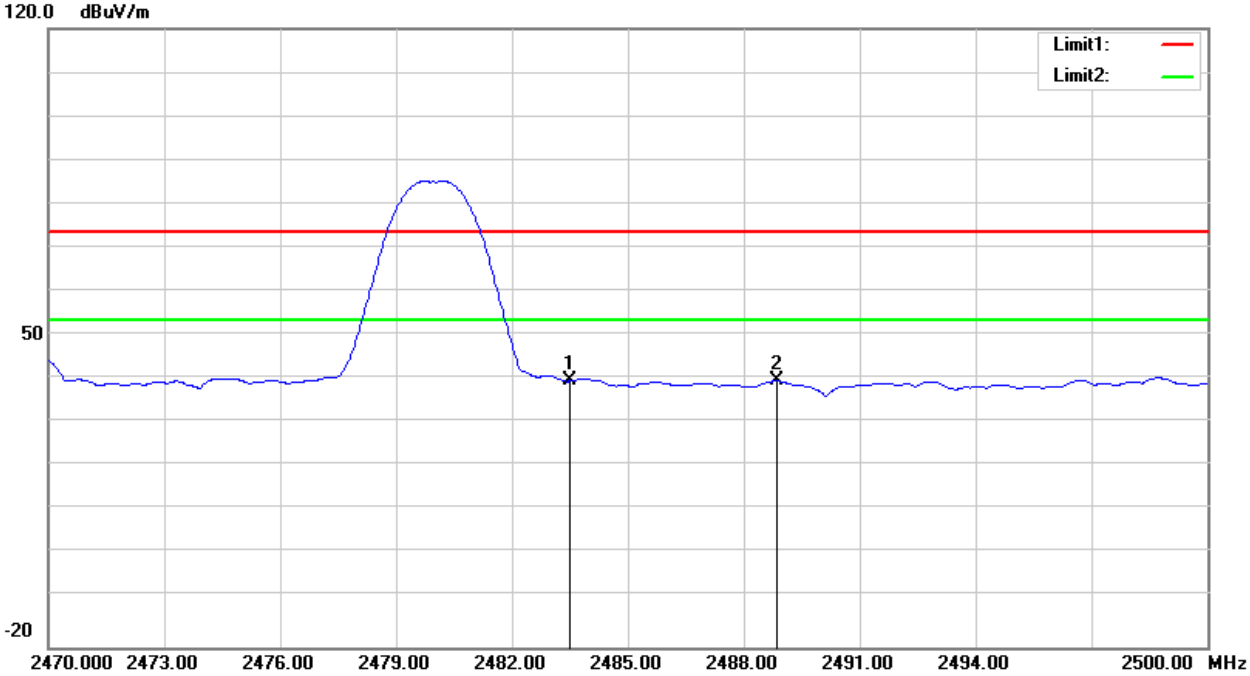


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2333.100	36.34	3.65	39.99	74.00	-34.01	peak
2	2390.000	35.18	4.34	39.52	74.00	-34.48	peak

Note: Measurement = Reading Level + Correct Factor.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)

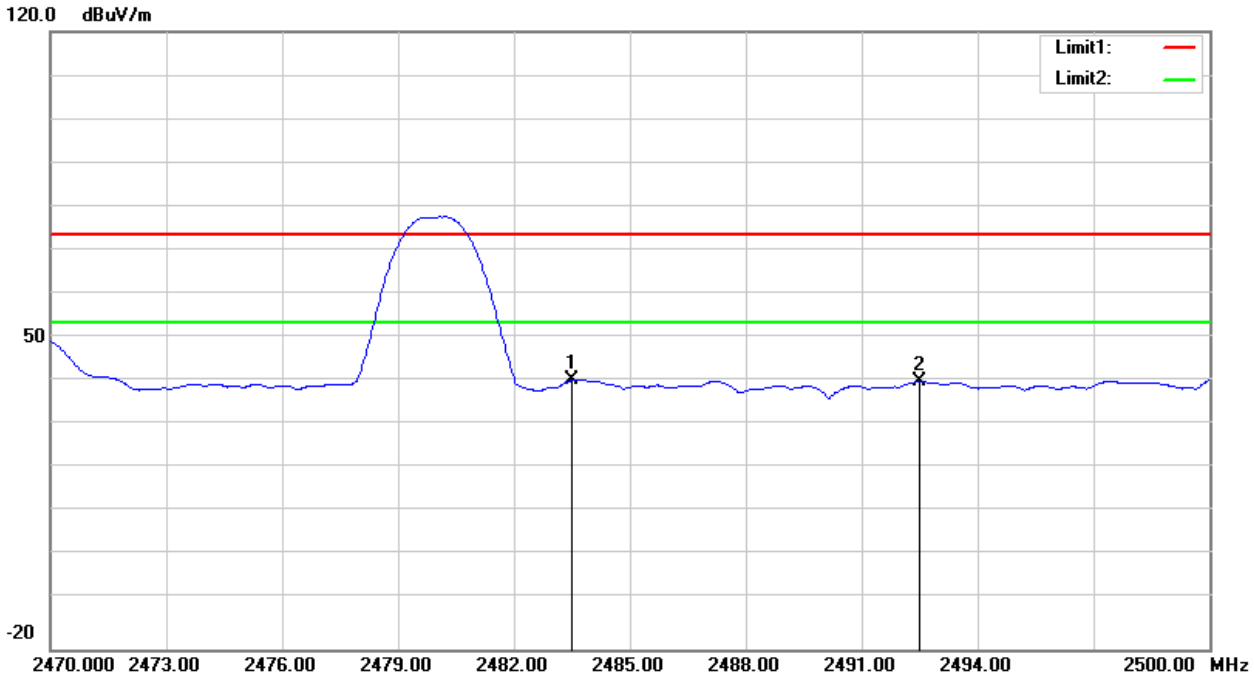


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	35.70	4.60	40.30	74.00	-33.70	peak
2	2488.840	35.61	4.62	40.23	74.00	-33.77	peak

Note: Measurement = Reading Level + Correct Factor.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	36.45	4.60	41.05	74.00	-32.95	peak
2	2492.500	35.99	4.63	40.62	74.00	-33.38	AVG

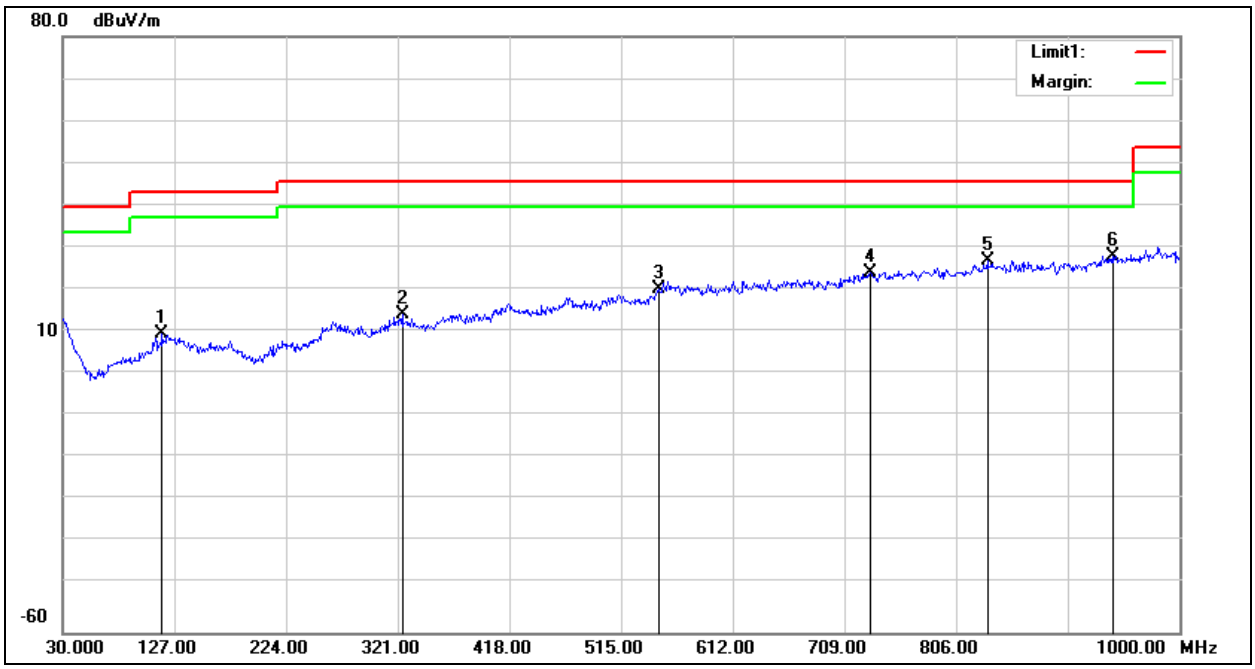
Note: Measurement = Reading Level + Correct Factor.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

8.3. SPURIOUS EMISSIONS 30MHz-1GHz

Note: All the channels had been tested, but only the worst data recorded in the report.

HARMONICS AND SPURIOUS EMISSIONS (HORIZONTAL)

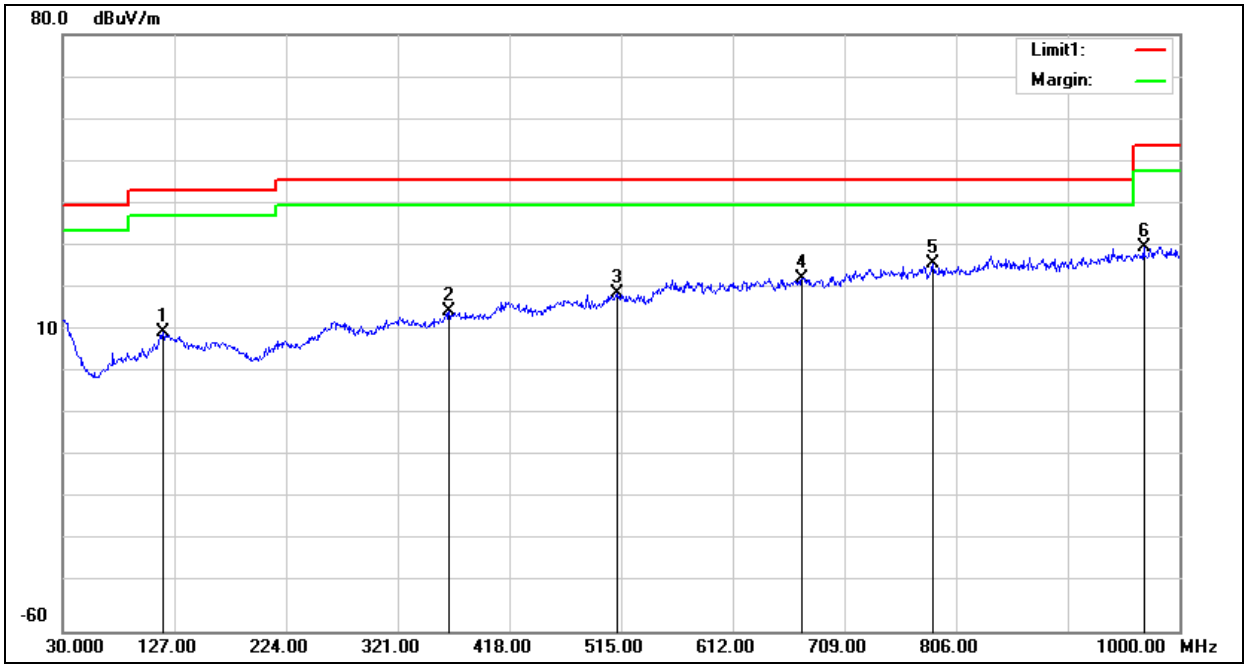


No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	116.3300	28.54	-18.51	10.03	43.50	-33.47	QP
2	324.8800	28.66	-13.85	14.81	46.00	-31.19	QP
3	547.9800	26.83	-5.99	20.84	46.00	-25.16	QP
4	731.3100	26.84	-2.42	24.42	46.00	-21.58	QP
5	833.1600	27.99	-0.62	27.37	46.00	-18.63	QP
6	941.8000	27.03	1.42	28.45	46.00	-17.55	QP

Note: Measurement = Reading Level + Correct Factor.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

HARMONICS AND SPURIOUS EMISSIONS (VERTICAL)



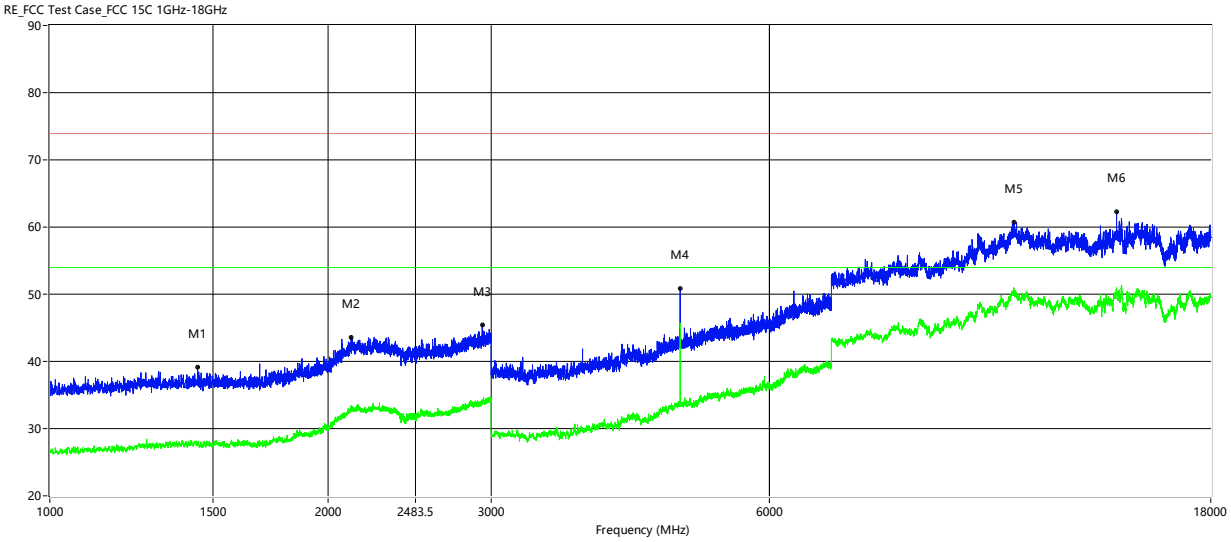
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	117.3000	28.80	-18.47	10.33	43.50	-33.17	QP
2	365.6200	27.81	-12.66	15.15	46.00	-30.85	QP
3	512.0900	27.21	-7.92	19.29	46.00	-26.71	QP
4	672.1400	27.46	-4.52	22.94	46.00	-23.06	QP
5	785.6300	28.44	-2.07	26.37	46.00	-19.63	QP
6	968.9600	28.19	1.97	30.16	54.00	-23.84	QP

Note: Measurement = Reading Level + Correct Factor.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

8.4. SPURIOUS EMISSIONS Above 1 GHz

HARMONICS AND SPURIOUS EMISSIONS (LOW CHANNEL, HORIZONTAL)

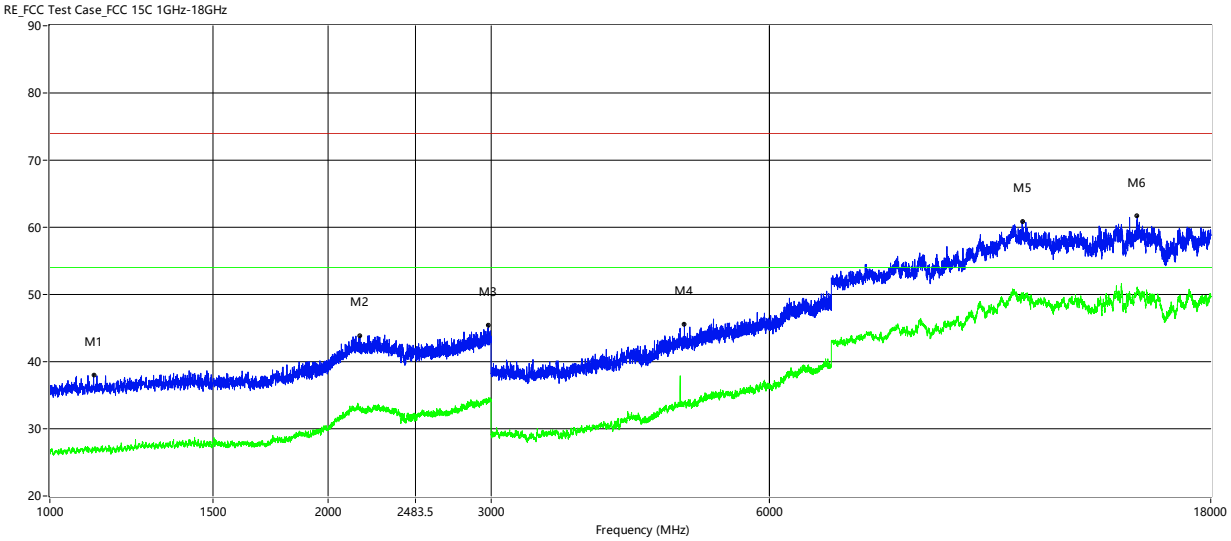


Frequency (MHz)	Peak Level (dBuV/m)	Average Level (dBuV/m)	Factor (dB)	PK Limit (dBuV/m)	AV Limit (dBuV/m)	Over Limit (dB)	ANT	Verdict
1444.500	39.16	27.62	-0.59	74.0	54.0	-26.38	Horizontal	Pass
2117.000	43.61	33.38	4.08	74.0	54.0	-20.62	Horizontal	Pass
2934.000	45.49	33.80	5.80	74.0	54.0	-20.20	Horizontal	Pass
4804.000	50.91	45.70	-6.96	74.0	54.0	-8.30	Horizontal	Pass
11028.750	60.69	50.68	10.06	74.0	54.0	-3.32	Horizontal	Pass
14240.750	62.29	50.97	11.28	74.0	54.0	-3.03	Horizontal	Pass

Remark:
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier + BRF Factor.
2. Margin = Limit - Emission Level
3. Tests were performed in three frequency range 1GHz~3GHz, 3GHz~13GHz, 13GHz~18GHz.
4. Above 18GHz emissions are mainly from the environment noise, not show in report.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

HARMONICS AND SPURIOUS EMISSIONS (LOW CHANNEL, VERTICAL)

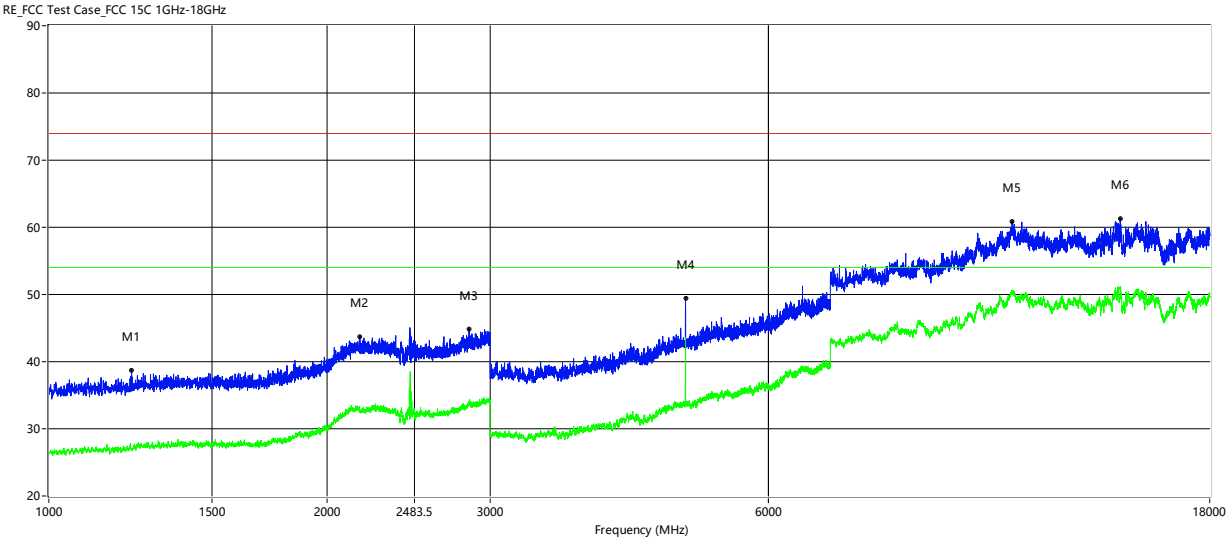


Frequency (MHz)	Peak Level (dBuV/m)	Average Level (dBuV/m)	Factor (dB)	PK Limit (dBuV/m)	AV Limit (dBuV/m)	Over Limit (dB)	ANT	Verdict
1115.000	38.03	27.12	-1.45	74.0	54.0	-26.88	Vertical	Pass
2163.500	43.82	32.89	4.49	74.0	54.0	-21.11	Vertical	Pass
2979.500	45.40	34.31	6.02	74.0	54.0	-19.69	Vertical	Pass
4855.000	45.59	34.10	-6.66	74.0	54.0	-19.90	Vertical	Pass
11257.000	60.87	49.60	9.56	74.0	54.0	-4.40	Vertical	Pass
14988.750	61.70	50.78	10.34	74.0	54.0	-3.22	Vertical	Pass

Remark:
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier + BRF Factor.
2. Margin = Limit - Emission Level
3. Tests were performed in three frequency range 1GHz~3GHz, 3GHz~13GHz, 13GHz~18GHz.
4. Above 18GHz emissions are mainly from the environment noise, not show in report.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

HARMONICS AND SPURIOUS EMISSIONS (MID CHANNEL, HORIZONTAL)

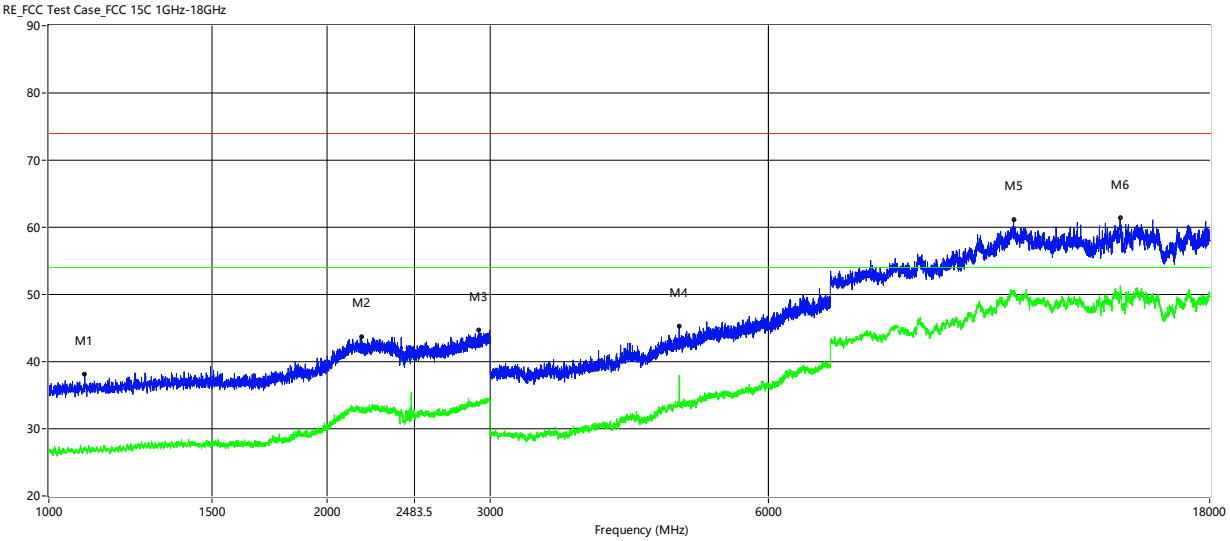


Frequency (MHz)	Peak Level (dBuV/m)	Average Level (dBuV/m)	Factor (dB)	PK Limit (dBuV/m)	AV Limit (dBuV/m)	Over Limit (dB)	ANT	Verdict
1228.500	38.78	26.78	-1.04	74.0	54.0	-27.22	Horizontal	Pass
2166.000	43.73	33.00	4.46	74.0	54.0	-21.00	Horizontal	Pass
2846.000	44.80	33.62	5.58	74.0	54.0	-20.38	Horizontal	Pass
4880.000	49.44	43.55	-6.51	74.0	54.0	-10.45	Horizontal	Pass
11004.000	60.89	50.44	10.20	74.0	54.0	-3.56	Horizontal	Pass
14405.750	61.28	50.76	11.36	74.0	54.0	-3.24	Horizontal	Pass

Remark:
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier + BRF Factor.
2. Margin = Limit - Emission Level
3. Tests were performed in three frequency range 1GHz~3GHz, 3GHz~13GHz, 13GHz~18GHz.
4. Above 18GHz emissions are mainly from the environment noise, not show in report.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

HARMONICS AND SPURIOUS EMISSIONS (MID CHANNEL, VERTICAL)

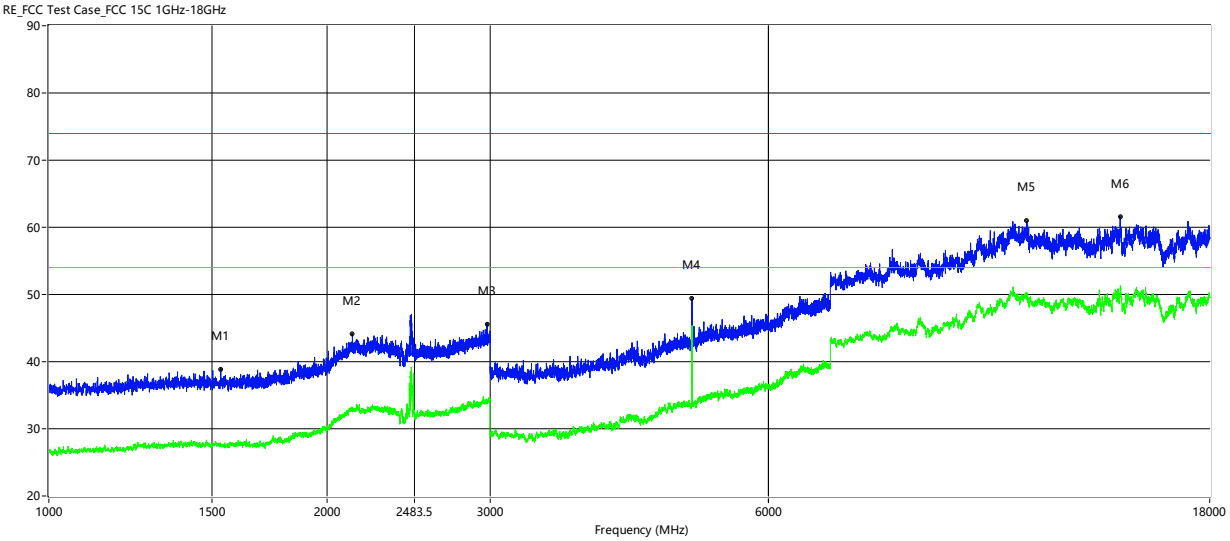


Frequency (MHz)	Peak Level (dBuV/m)	Average Level (dBuV/m)	Factor (dB)	PK Limit (dBuV/m)	AV Limit (dBuV/m)	Over Limit (dB)	ANT	Verdict
1093.500	38.08	27.18	-1.53	74.0	54.0	-26.82	Vertical	Pass
2178.000	43.78	33.02	4.34	74.0	54.0	-20.98	Vertical	Pass
2916.000	44.71	33.38	5.70	74.0	54.0	-20.62	Vertical	Pass
4804.000	45.31	37.94	-6.96	74.0	54.0	-16.06	Vertical	Pass
11045.250	61.19	50.28	9.98	74.0	54.0	-3.72	Vertical	Pass
14400.250	61.40	51.11	11.42	74.0	54.0	-2.89	Vertical	Pass

Remark:
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier + BRF Factor.
2. Margin = Limit - Emission Level
3. Tests were performed in three frequency range 1GHz~3GHz, 3GHz~13GHz, 13GHz~18GHz.
4. Above 18GHz emissions are mainly from the environment noise, not show in report.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

HARMONICS AND SPURIOUS EMISSIONS (HIGH CHANNEL, HORIZONTAL)

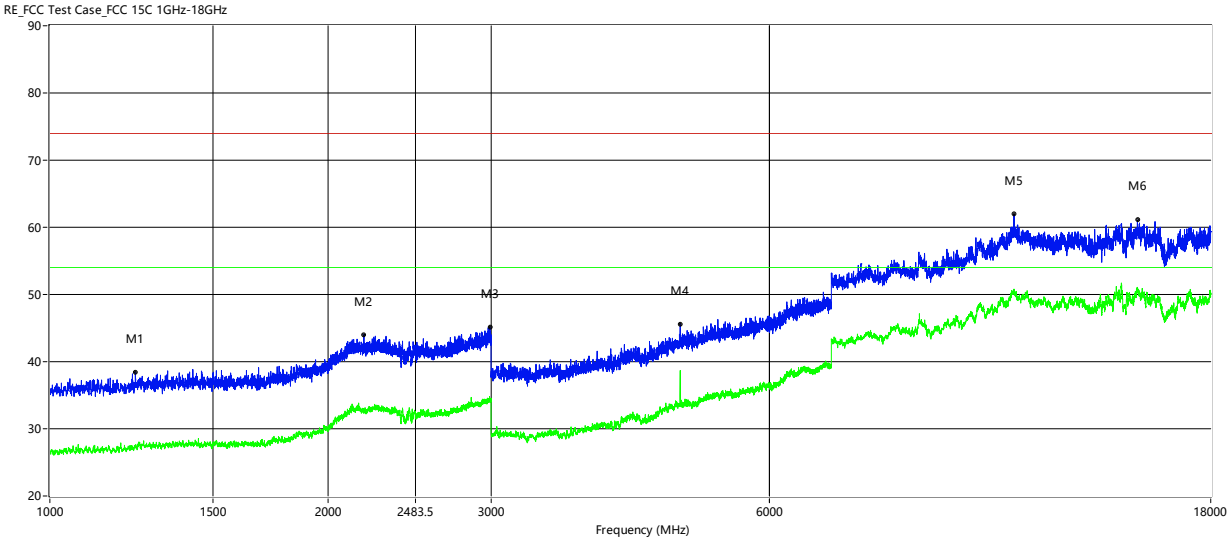


Frequency (MHz)	Peak Level (dBuV/m)	Average Level (dBuV/m)	Factor (dB)	PK Limit (dBuV/m)	AV Limit (dBuV/m)	Over Limit (dB)	ANT	Verdict
1534.000	38.88	27.46	-0.60	74.0	54.0	-26.54	Horizontal	Pass
2129.500	44.11	32.88	4.29	74.0	54.0	-21.12	Horizontal	Pass
2976.500	45.58	34.06	6.01	74.0	54.0	-19.94	Horizontal	Pass
4960.000	49.36	45.38	-6.38	74.0	54.0	-8.62	Horizontal	Pass
11419.250	60.93	49.75	9.78	74.0	54.0	-4.25	Horizontal	Pass
14400.250	61.61	50.88	11.42	74.0	54.0	-3.12	Horizontal	Pass

Remark:
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier + BRF Factor.
2. Margin = Limit - Emission Level
3. Tests were performed in three frequency range 1GHz~3GHz, 3GHz~13GHz, 13GHz~18GHz.
4. Above 18GHz emissions are mainly from the environment noise, not show in report.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

HARMONICS AND SPURIOUS EMISSIONS (HIGH CHANNEL, VERTICAL)



Frequency (MHz)	Peak Level (dBuV/m)	Average Level (dBuV/m)	Factor (dB)	PK Limit (dBuV/m)	AV Limit (dBuV/m)	Over Limit (dB)	ANT	Verdict
1237.000	38.40	27.58	-0.99	74.0	54.0	-26.42	Vertical	Pass
2185.500	44.06	32.86	4.26	74.0	54.0	-21.14	Vertical	Pass
2991.000	45.11	34.41	6.07	74.0	54.0	-19.59	Vertical	Pass
4804.000	45.62	38.69	-6.96	74.0	54.0	-15.31	Vertical	Pass
11031.500	61.97	50.61	10.05	74.0	54.0	-3.39	Vertical	Pass
14997.000	61.07	51.03	10.38	74.0	54.0	-2.97	Vertical	Pass

Remark:
1. Factor = Antenna Factor + Cable Loss – Pre-amplifier + BRF Factor.
2. Margin = Limit - Emission Level
3. Tests were performed in three frequency range 1GHz~3GHz, 3GHz~13GHz, 13GHz~18GHz.
4. Above 18GHz emissions are mainly from the environment noise, not show in report.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

8.5. SPURIOUS EMISSIONS BELOW 30M

Freq.	Reading	Limit	Margin	State	Test Result
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F	
--	--	--	--	--	PASS
--	--	--	--	--	PASS

Note:
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
Distance extrapolation factor =40 log (specific distance/test distance)(dB);
Limit line = specific limits (dBuv) + distance extrapolation factor.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

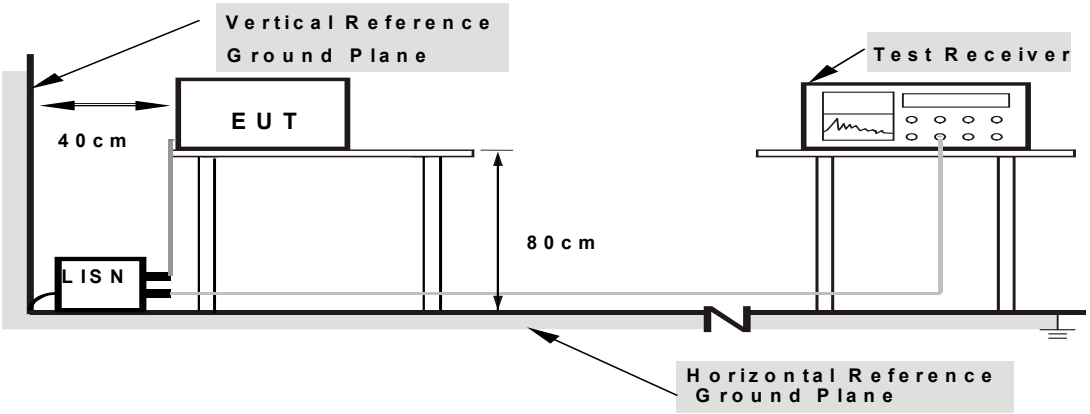
9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

Please refer to FCC §15.207 (a)

FREQUENCY (MHz)	Class B (dBuV)	
	Quasi-peak	Average
0.15 -0.5	66 - 56 *	56 - 46 *
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00

TEST SETUP AND PROCEDURE



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

The EUT is put on a table of non-conducting material that is 80cm high. The vertical conducting wall of shielding is located 40cm to the rear of the EUT. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.). A EMI Measurement Receiver (R&S Test Receiver ESR3) is used to test the emissions from both sides of AC line. According to the requirements in Section 7 and 13 of ANSI C63.10-2013.Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and average detector mode. The bandwidth of EMI test receiver is set at 9kHz.

The arrangement of the equipment is installed to meet the standards and operating in a manner, which tends to maximize its emission characteristics in a normal application.

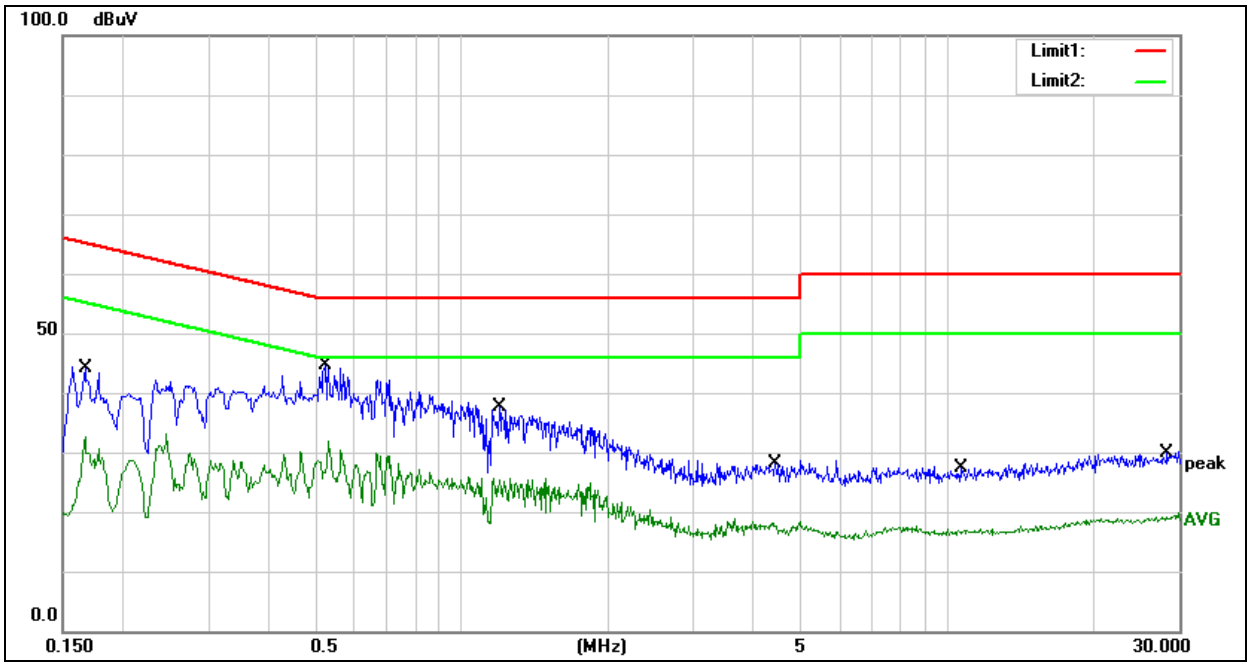
TEST ENVIRONMENT

Temperature	22.0°C	Relative Humidity	36%
Atmosphere Pressure	101kPa	Test Voltage	AC 120V/60Hz

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

TEST RESULTS

Neutral N RESULTS

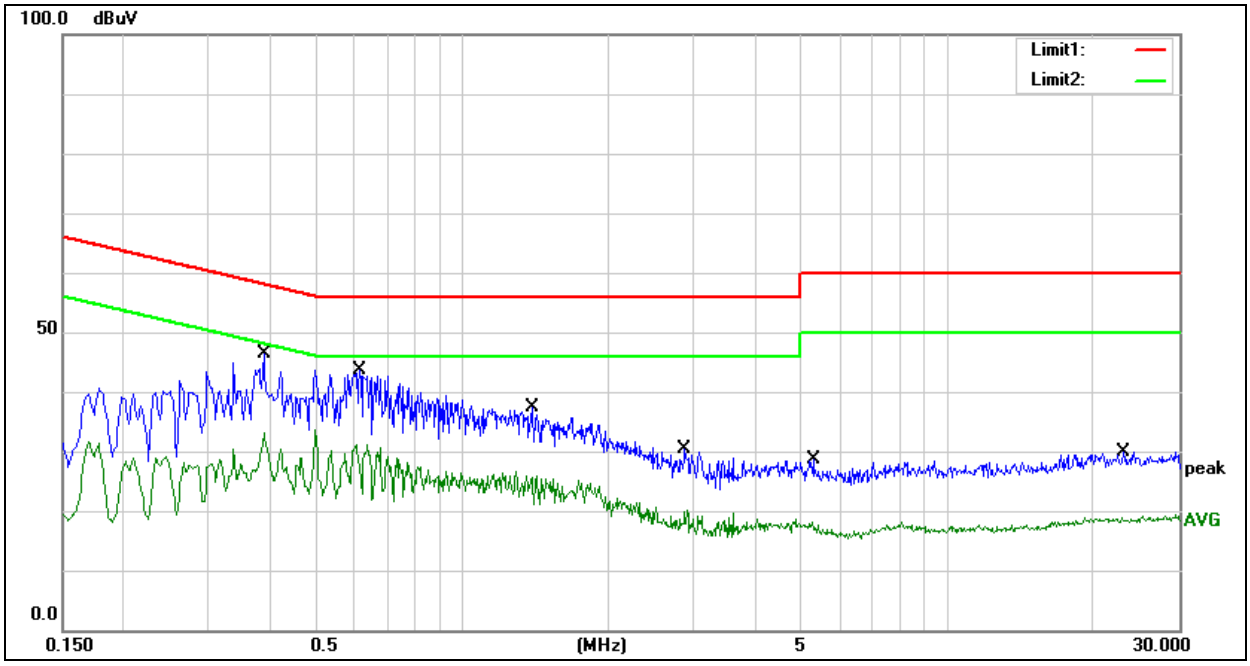


No.	Frequency (MHz)	Reading (dBuV)	Correct dB	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1668	23.83	20.33	44.16	65.12	-20.96	QP
2	0.1668	12.24	20.33	32.57	55.12	-22.55	AVG
3	0.5220	24.00	20.52	44.52	56.00	-11.48	QP
4	0.5220	11.24	20.52	31.76	46.00	-14.24	AVG
5	1.1940	17.35	20.30	37.65	56.00	-18.35	QP
6	1.1940	5.10	20.30	25.40	46.00	-20.60	AVG
7	4.4260	7.60	20.42	28.02	56.00	-27.98	QP
8	4.4260	-2.91	20.42	17.51	46.00	-28.49	AVG
9	10.6740	6.07	21.27	27.34	60.00	-32.66	QP
10	10.6740	-4.51	21.27	16.76	50.00	-33.24	AVG
11	28.3540	6.93	22.82	29.75	60.00	-30.25	QP
12	28.3540	-3.71	22.82	19.11	50.00	-30.89	AVG

Note: 1. Result = Reading +Correct Factor.
2. If QP Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 200 Hz (9 kHz—150 kHz), 9 kHz (150 kHz—30 MHz).
4. Step size: 80Hz (0.009MHz-0.15MHz), 4 kHz (0.15MHz-30MHz), Scan time: auto.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

LINE L RESULTS



No.	Frequency (MHz)	Reading (dBuV)	Correct dB	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.3900	25.78	20.56	46.34	58.06	-11.72	QP
2	0.3900	12.47	20.56	33.03	48.06	-15.03	AVG
3	0.6140	23.09	20.43	43.52	56.00	-12.48	QP
4	0.6140	10.81	20.43	31.24	46.00	-14.76	AVG
5	1.3940	17.04	20.30	37.34	56.00	-18.66	QP
6	1.3940	5.49	20.30	25.79	46.00	-20.21	AVG
7	2.8700	9.95	20.35	30.30	56.00	-25.70	QP
8	2.8700	-0.27	20.35	20.08	46.00	-25.92	AVG
9	5.2780	8.04	20.47	28.51	60.00	-31.49	QP
10	5.2780	-2.41	20.47	18.06	50.00	-31.94	AVG
11	23.0540	7.27	22.72	29.99	60.00	-30.01	QP
12	23.0540	-3.88	22.72	18.84	50.00	-31.16	AVG

Note: 1. Result = Reading +Correct Factor.
2. If QP Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 200 Hz (9 kHz—150 kHz), 9 kHz (150 kHz—30 MHz).
4. Step size: 80Hz (0.009MHz-0.15MHz), 4 kHz (0.15MHz-30MHz), Scan time: auto.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

10. ANTENNA REQUIREMENTS

APPLICABLE REQUIREMENTS

Please refer to FCC §15.203

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the FCC rule.

ANTENNA CONNECTOR

EUT has a PCB Antenna without antenna connector.

ANTENNA GAIN

The antenna gain of EUT is less than 6 dBi.

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.

Test photos

Note: See test photos in setup photo document for the actual connections between Product and support equipment.

END OF REPORT

This report shall not be reproduced except in full, without the written approval of UL-CCIC COMPANY LIMITED.