RADIO TEST REPORT

Report No.: SHATBL2109019W01

Applicant:
IDEAL INDUSTRIES LIGHTING LLC, DBA CREE LIGHTING

Address:
4401 SILICON DRIVE DURHAM, NC 27703 USA

Product Name	:	Wireless Controller
Brand Name	:	CREE LIGHTING
Model Name	:	CMACC-CMSC-UNV-WH
Series Model	:	CMACC-CMWD-UNV-WH
Test Standard	:	FCC Part15.247 RSS-247 Issue 2, February 2017 RSS-Gen Issue 5 ,March 2019

"Shanghai ATBL Technology Co., Ltd." hereby certifies that according to actual testing conditions. The test results or observations are provided in accordance with measured value, without taking risks caused by uncertainty into account. Without explicit stipulation in special agreements, standards or regulations, ATBL shall not assume any responsibility. The test results or observations are applicable only to tested sample. Client shall be responsible for representativeness of the sample and authenticity of the material. This report will be void without authorized signature or special seal for testing report. Do not copied without authorization.

TEST RESULT CERTIFICATION

Applicant's Name.....:	IDEAL INDUSTRIES LIGHTING LLC, DBA CREE LIGHTING
Address .....:	4401 SILICON DRIVE DURHAM, NC 27703 USA
Manufacture's Name.....:	MCWONG LIGHTING SHANGHAI CO LTD
Address .....:	159 FULIAN YI RD GU CUN INDUSTRIAL PARK,BAO SHAN DISTRICT SHANGHAI, 201906 China

Product Description

Product Name.....:	Wireless Controller
Brand Name .....:	CREE LIGHTING
Model Name .....:	CMACC-CMSC-UNV-WH
Series Model.....:	CMACC-CMWD-UNV-WH
Test Standards.....:	FCC Part15.247 RSS-247 Issue 2, February 2017 RSS-Gen Issue 5 ,March 2019
Test Procedure .....:	ANSI C63.10-2013

This device described above has been tested by ATBL, the test results show that the equipment under test (EUT) is in compliance with the FCC/IC requirements. And it is applicable only to the tested sample identified in the report.
This report shall not be reproduced except in full, without the written approval of ATBL, this document may be altered or revised by ATBL, personal only, and shall be noted in the revision of the document.

Date of Test.....:	
Date of receipt of test item .....:	14 Sep. 2021
Date (s) of performance of tests .....:	14 Sep. 2021 ~ 16 Sep. 2021
Date of Issue.....:	17 Sep. 2021
Test Result.....:	**Pass**

Report Prepared by : (Roean wei)

Report Approved by : (Chopin Xiao)

Authorized Signatory : (Terry yang)

Table of Contents

1. SUMMARY OF TEST RESULTS **6**

2. GENERAL INFORMATION **7**

2.1 GENERAL DESCRIPTION OF THE EUT 7

2.2 DESCRIPTION OF THE TEST MODES 9

2.3 TEST SOFTWARE AND POWER LEVEL 9

2.4 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED 10

2.5 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS 11

2.6 LABORATORY INFORMATION 11

2.7 MEASUREMENT UNCERTAINTY 11

2.8 EQUIPMENTS LIST 12

3. EMC EMISSION TEST **13**

3.1 CONDUCTED EMISSION MEASUREMENT 13

3.2 TEST PROCEDURE 14

3.3 TEST SETUP 14

3.4 EUT OPERATING CONDITIONS 14

3.5 TEST RESULTS 15

4. RADIATED EMISSION MEASUREMENT **17**

4.1 RADIATED EMISSION LIMITS 17

4.2 TEST PROCEDURE 20

4.3 TEST SETUP 21

4.4 EUT OPERATING CONDITIONS 21

4.5 FIELD STRENGTH CALCULATION 22

4.6 TEST RESULTS 23

5. CONDUCTED SPURIOUS & BAND EDGE EMISSION **26**

5.1 LIMIT 26

5.2 TEST PROCEDURE 26

5.3 TEST SETUP 26

5.4 EUT OPERATION CONDITIONS 26

5.5 TEST RESULTS 27

6. POWER SPECTRAL DENSITY TEST **31**

6.1 LIMIT 31

6.2 TEST PROCEDURE 31

6.3 TEST SETUP 31

Table of Contents

6.4 EUT OPERATION CONDITIONS 31
6.5 TEST RESULTS 32
7. BANDWIDTH TEST 34
7.1 LIMIT 34
7.2 TEST PROCEDURE 34
7.3 TEST SETUP 34
7.4 EUT OPERATION CONDITIONS 34
7.5 TEST RESULTS 35
8. PEAK OUTPUT POWER TEST 39
8.1 LIMIT 39
8.2 TEST PROCEDURE 39
8.3 TEST SETUP 39
8.4 EUT OPERATION CONDITIONS 40
8.5 TEST RESULTS 40
APPENDIX-PHOTOS OF TEST SETUP 42

Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	17 Sep. 2021	SHATBL2109019W01	ALL	Initial Issue

1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:
KDB 558074 D01 15.247 Meas Guidance v05r02.

FCC Part 15.247,Subpart C RSS-247 Issue 2 RSS-Gen Issue 5			
Standard Section	Test Item	Judgment	Remark
15.207 RSS-Gen 8.8	Conducted Emission	PASS	--
15.247 (a)(2) RSS-Gen 6.7 RSS-247 5.2 (a)	6dB&99% Bandwidth	PASS	--
15.247 (b)(3) RSS-247 5.4 (d)	Output Power	PASS	--
15.247(d) & 15.209 & 15.205 RSS-247 Clause 5.5 & RSS-GEN 6.13 RSS-GEN 8.9 RSS-GEN 8.10	Radiated Spurious Emission	PASS	--
15.247(d) & 15.205 RSS-247 Clause 5.5 RSS-GEN 8.10	Conducted Spurious & Band Edge Emission	PASS	--
15.247 (e) RSS-247 5.2 (b)	Power Spectral Density	PASS	--
15.205 RSS-Gen 8.9/8.10	Restricted bands of operation	PASS	--
15.203 RSS-Gen 6.8	Antenna Requirement	PASS	--

NOTE:

(1) 'N/A' denotes test is not applicable in this Test Report.

(2) All tests are according to ANSI C63.10-2013.

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	Wireless Controller
Trade Name	CREE LIGHTING
Model Name	CMACC-CMSC-UNV-WH
Series Model	CMACC-CMWD-UNV-WH
Model Difference	The electrical circuit design, layout, components used, and internal wiring are identical. Only model name and appearance is different.
Product Description	The EUT is a Video Doorbell Operation Frequency: 2402~2480 MHz Modulation Type: GFSK Radio Technology: BLE Bluetooth Version: 5.0 Bluetooth Configuration: LE(Support 1M PHY) Number Of Channel: 40 Antenna Designation: Please refer to the Note 3. Antenna Gain (dBi) 2.2 dBi
Channel List	Please refer to the Note 2.
Power Rating	DC 3.3V
Battery	None
Hardware version number	N/A
Software version number	N/A
Connecting I/O Port(s)	Please refer to the Note 1.

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User Manual.

2.

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

3.

Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	CREE LIGHTING	CMACC-CMSC-UNV-WH	PBC	N/A	2.2 dBi	BLE ANT

2.2 DESCRIPTION OF THE TEST MODES

For conducted test items and radiated spurious emissions
Each of these EUT operation mode(s) or test configuration mode(s) mentioned below was evaluated respectively.

Worst Mode	Description	Data/Modulation
Mode 1	TX CH00(2402MHz)	1 Mbps/GFSK
Mode 2	TX CH19(2440MHz)	1 Mbps/GFSK
Mode 3	TX CH39(2480MHz)	1 Mbps/GFSK

Note:

(1) The measurements are performed at all Bit Rate of Transmitter, the worst data was reported.

(2) The battery is fully-charged during the radited and RF conducted test.

For AC Conducted Emission

Test Case	
AC Conducted Emission	Mode 4 : Keeping BT TX

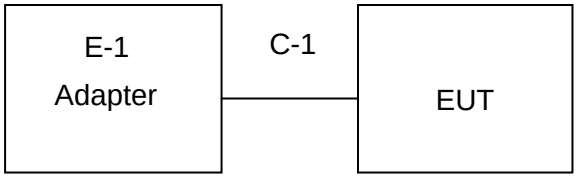
2.3 TEST SOFTWARE AND POWER LEVEL

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level.

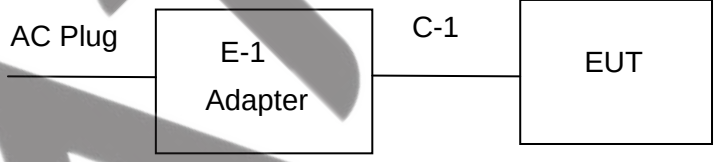
RF Function	Type	Mode Or Modulation type	Ant Gain(dBi)	Power Class	Software For Testing
BLE	BLE	GFSK	2.2	default	QRCT

2.4 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Radiated Spurious Emission Test



Conducted Emission Test



2.5 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Necessary accessories

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
N/A	N/A	N/A	N/A	N/A	N/A

Support units

Item	Equipment	Mfr/Brand	Model	Type No.	Note
E-2	Notebook	Lenovo	DESKTOP-USDEO09	00326-10000-00000-AA636	N/A
C-1	USB Cable	N/A	100cm	N/A	N/A

Note:

(1) The support equipment was authorized by Declaration of Confirmation.
(2) For detachable type I/O cable should be specified the length in cm in『Length』column.

2.6 LABORATORY INFORMATION

Company Name:	Shanghai ATBL Technology Co., Ltd.
Address:	Building 8, No. 160, Basheng Road, Waigaoqiao Free Trade Zone, Pudong New Area, Shanghai
Telephone:	+86(0)21-51298625

2.7 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	±0.958dB
2	Conducted spurious emissions	±2.988dB
3	All emissions, radiated 30MHz-1GHz	±2.50dB
4	All emissions, radiated 1GHz-18GHz	±3.51dB
5	Occupied bandwidth	±23.20dB
6	Power spectral density	±0.886dB

2.8 EQUIPMENTS LIST

2.8.1 Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Management number	Calibrated until
Test Receiver	R&S	ESCI	100469	SHATBL-E003	2022.07.13
Spectrum Analyzer	Agilent	N9020A	MY50200811	SHATBL-E017	2022.07.13
Bilog Antenna	SCHWARZBECK	VLUB 9168	01174	SHATBL-E008	2023.09.27
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	SHATBL-E009	2023.09.27
Pre-Amplifier (0.1M-3GHz)	JPT	JPA-10M1G35	21010100035001	SHATBL-E005	2021.07.22
Pre-Amplifier (1G-18GHz)	JPT	JPA0118-55-303A	1910001800055000	SHATBL-E006	2022.07.13
Temperature & Humidity	DeLi	DeLi	N/A	SHATBL-E016	2021.10.13
Antenna/Turntable Controller	Brilliant	N/A	N/A	SHATBL-E007	N/A
Test SW	FALA	EMC-RI(Ver.4A2)		SHATBL-E046	N/A

2.8.2 RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	equipment number	Calibrated until
MIMO Power measurement test Set	DARE	RPR3006W	16I00054SN016	SHATBL-W006	2021.10.13
			RPR6W-20001005	SHATBL-W013	2021.10.13
Signal Analyzer	Agilent	N9020A	MY57300196	SHATBL-W004	2021.10.13
Signal Generator	Agilent	N5182B	MY46240556	SHATBL-W005	2021.10.13
Wireless Communications Test Set	R&S	CMW500	101331	SHATBL-W007	2021.10.13
Temperature & Humidity	Deli	deli	N/A	SHATBL-W011	2021.10.13
Attenuator	Agilent	8494B	DC-18G	SHATBL-W009	2021.10.13
Attenuator	Agilent	8496B	DC-18G	SHATBL-W010	2021.10.13
power splitter	MNK	MPD-DC/6-2S	62315 G51	SHATBL-W015	2021.11.27
			62315 G52	SHATBL-W016	2021.11.27
Filter	Chengdu kangmaiwei	ZBSF-C2400-2483.5-T3	N/A	SHATBL-W021	N/A
Constant temperature and humidity box	KSON	THS-B6C-150	6159K	SHATBL-W019	2022.01.26
Test SW	FALA	LZ-RF(Ver.LzRF-03A3.1)		SHATBL-W020	N/A

3. EMC EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

Operating frequency band. In case the emission fall within the restricted band specified on Part 207(a)&RSS-Gen Issue 5 limit in the table below has to be followed.

FREQUENCY (MHz)	Conducted Emission limit (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

Note:

(1) The tighter limit applies at the band edges.

(2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

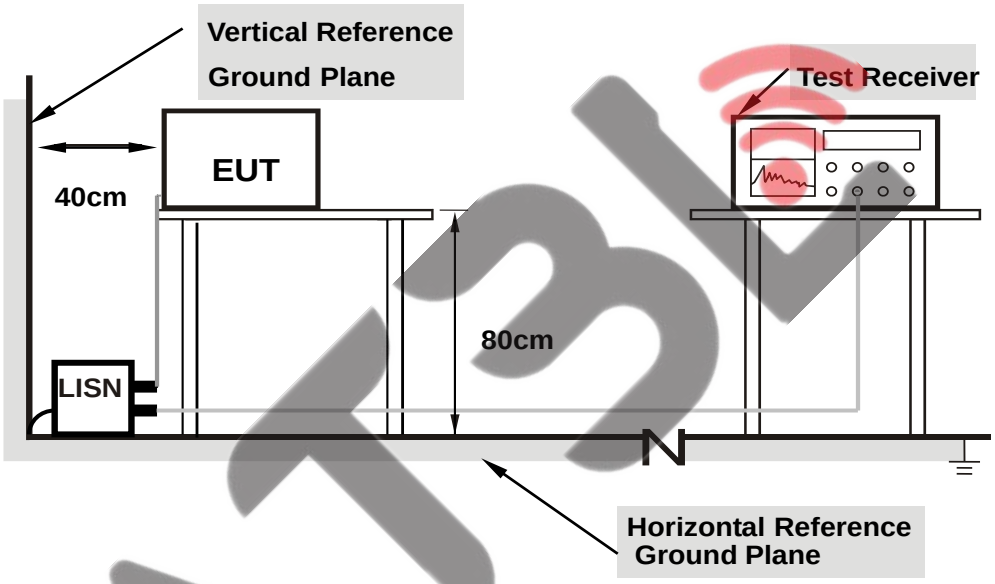
The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

3.2 TEST PROCEDURE

a. The EUT is 0.8 m from the horizontal ground plane and 0.4 m from the vertical ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments are powered from additional LISN(s). The LISN provides 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
d. LISN is at least 80 cm from the nearest part of EUT chassis.
e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.3 TEST SETUP



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

3.4 EUT OPERATING CONDITIONS

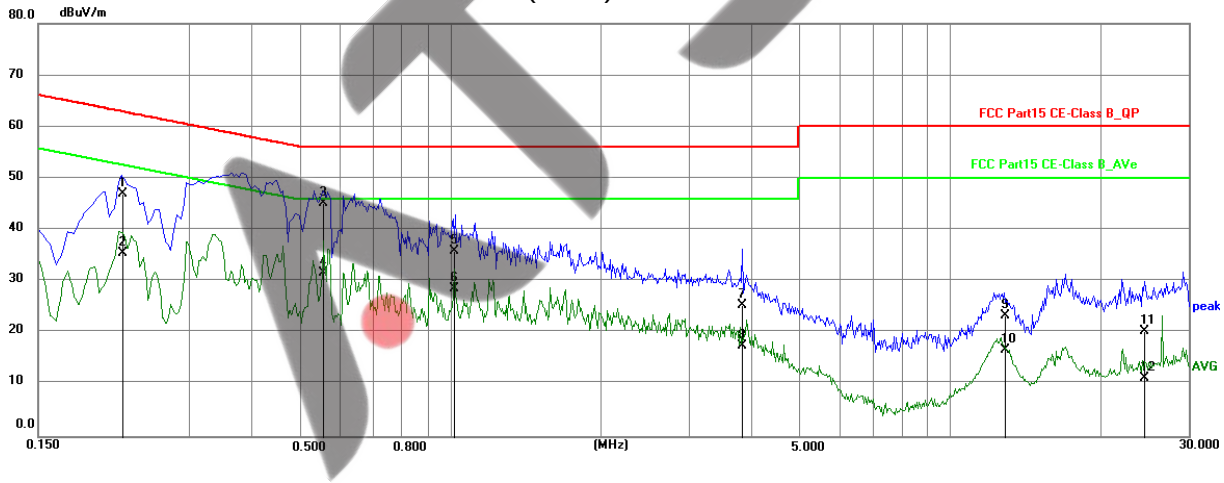
The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

3.5 TEST RESULTS

Temperature:	26.8(C)	Relative Humidity:	66%RH
Test Voltage:	DC 3.3V	Phase:	L
Test Mode:	Mode 4		

No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.2210	36.98	10.08	47.06	62.78	-15.72	QP
2	0.2210	25.54	10.08	35.62	52.78	-17.16	AVG
3	0.5570	35.34	9.97	45.31	56.00	-10.69	QP
4	0.5570	21.78	9.97	31.75	46.00	-14.25	AVG
5	1.0180	26.04	9.94	35.98	56.00	-20.02	QP
6	1.0180	18.70	9.94	28.64	46.00	-17.36	AVG
7	3.8390	15.52	10.03	25.55	56.00	-30.45	QP
8	3.8390	7.62	10.03	17.65	46.00	-28.35	AVG
9	12.8920	12.97	10.54	23.51	60.00	-36.49	QP
10	12.8920	6.38	10.54	16.92	50.00	-33.08	AVG
11	24.5260	9.41	11.04	20.45	60.00	-39.55	QP
12	24.5260	0.27	11.04	11.31	50.00	-38.69	AVG

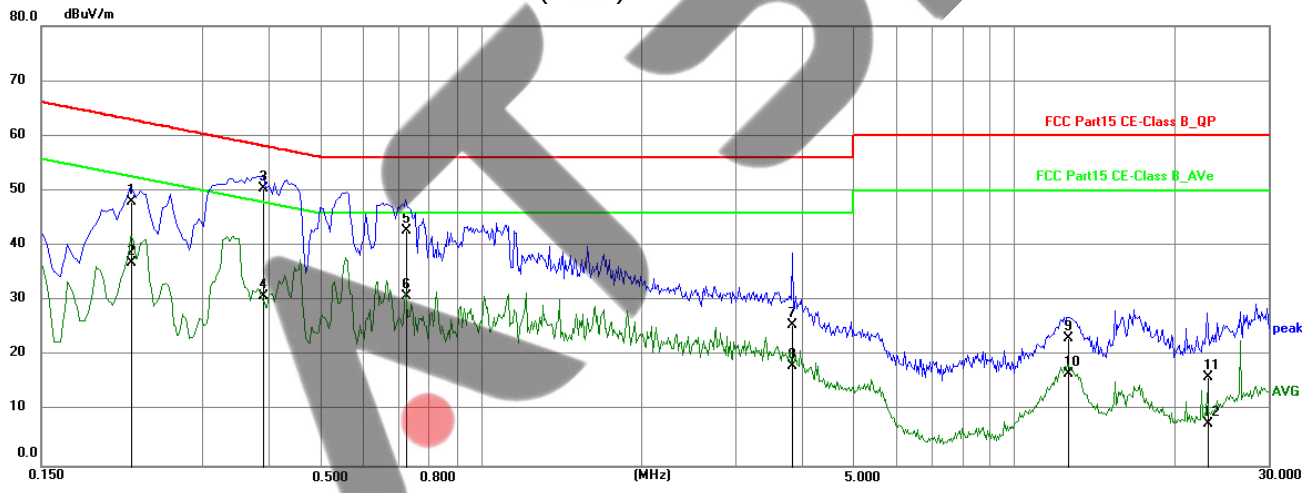
Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit.
3. Factor=LISN factor+Cable loss+Limiter (10dB)



Temperature:	26.2(C)	Relative Humidity:	53%RH
Test Voltage:	AC 120V/60Hz	Phase:	N
Test Mode:	Mode 4		

No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.2210	37.63	10.36	47.99	62.78	-14.79	QP
2	0.2210	26.57	10.36	36.93	52.78	-15.85	AVG
3	0.3910	40.22	10.28	50.50	58.04	-7.54	QP
4	0.3910	20.58	10.28	30.86	48.04	-17.18	AVG
5	0.7240	32.72	10.14	42.86	56.00	-13.14	QP
6	0.7240	20.87	10.14	31.01	46.00	-14.99	AVG
7	3.8350	15.48	10.24	25.72	56.00	-30.28	QP
8	3.8350	7.97	10.24	18.21	46.00	-27.79	AVG
9	12.6120	12.96	10.24	23.20	60.00	-36.80	QP
10	12.6120	6.56	10.24	16.80	50.00	-33.20	AVG
11	23.1120	5.37	10.78	16.15	60.00	-43.85	QP
12	23.1120	-3.10	10.78	7.68	50.00	-42.32	AVG

Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit.
3. Factor=LISN factor+Cable loss+Limiter (10dB)



4. RADIATED EMISSION MEASUREMENT

4.1 RADIATED EMISSION LIMITS

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the Restricted band specified on Part15.205(a)&209(a), RSS-Gen Issue 5 and RSS-247 Issue 2, February 2017 (5.5) limit in the table and according to ANSI C63.10-2013 below has to be followed.

LIMITS OF RADIATED EMISSION MEASUREMENT (Frequency Range 9kHz-1000MHz)

Frequencies (MHz)	Field Strength (micorvolts/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
Above 960	500	3

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	(dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

(1) The limit for radiated test was performed according to FCC PART 15C.

(2) The tighter limit applies at the band edges.

(3) Emission level (dBuV/m)=20log Emission level (uV/m).

LIMITS OF RESTRICTED FREQUENCY BANDS

FCC:

FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (GHz)
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
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	Above 38.6
13.36-13.41			

IC:

FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (GHz)
0.090 - 0.110	149.9 - 150.05	9.0 - 9.2
0.495 - 0.505	156.52475 - 156.52525	9.3 - 9.5
2.1735 - 2.1905	156.7 - 156.9	10.6 - 12.7
3.020 - 3.026	162.0125 - 167.17	13.25 - 13.4
4.125 - 4.128	167.72 - 173.2	14.47 - 14.5
4.17725 - 4.17775	240 – 285	15.35 - 16.2
4.20725 - 4.20775	322 - 335.4	17.7 - 21.4
5.677 - 5.683	399.9 - 410	22.01 - 23.12
6.215 - 6.218	608 - 614	23.6 - 24.0
6.26775 - 6.26825	960 - 1427	31.2 - 31.8
6.31175 - 6.31225	1435 - 1626.5	36.43 - 36.5
8.291 - 8.294	1645.5 - 1646.5	Above 38.6
8.362 - 8.366	1660 - 1710	
8.37625 - 8.38675	1718.8 - 1722.2	
8.41425 - 8.41475	2200 - 2300	
12.29 - 12.293	2310 - 2390	
12.51975 - 12.52025	2483.5 - 2500	
12.57675 - 12.57725	2655 - 2900	
13.36 - 13.41	3260 – 3267	
16.42 - 16.423	3332 - 3339	
16.69475 - 16.69525	3345.8 - 3358	
16.80425 - 16.80475	3500 - 4400	
25.5 - 25.67	4500 - 5150	
37.5 - 38.25	5350 - 5460	
73 - 74.6	7250 - 7750	
74.8 - 75.2	8025 – 8500	
108 – 138		

For Radiated Emission

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/QP/AV
Start Frequency	9 KHz/150KHz(Peak/QP/AV)
Stop Frequency	150KHz/30MHz(Peak/QP/AV)
RB / VB (emission in restricted band)	200Hz (From 9kHz to 0.15MHz)/ 9KHz (From 0.15MHz to 30MHz); 200Hz (From 9kHz to 0.15MHz)/ 9KHz (From 0.15MHz to 30MHz)

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/QP
Start Frequency	30 MHz(Peak/QP)
Stop Frequency	1000 MHz (Peak/QP)
RB / VB (emission in restricted band)	120 KHz / 300 KHz

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/AV
Start Frequency	1000 MHz(Peak/AV)
Stop Frequency	10th carrier hamonic(Peak/AV)
RB / VB (emission in restricted band)	1 MHz / 3 MHz(Peak) 1 MHz/1/T MHz(AVG)

For Restricted band

Spectrum Parameter	Setting
Detector	Peak/AV
Start/Stop Frequency	Lower Band Edge: 2310 to 2410 MHz Upper Band Edge: 2475 to 2500 MHz
RB / VB	1 MHz / 3 MHz(Peak) 1 MHz/1/T MHz(AVG)

Receiver Parameter	Setting
Start ~ Stop Frequency	9kHz~90kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	90kHz~110kHz / RB 200Hz for QP
Start ~ Stop Frequency	110kHz~490kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	490kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

4.2 TEST PROCEDURE

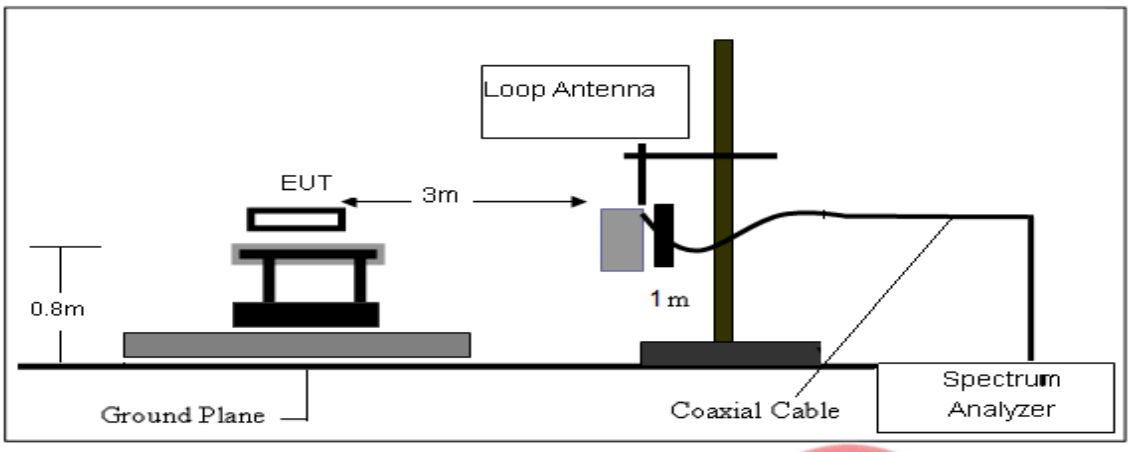
a. The measuring distance of at 3 m shall be used for measurements at frequency 0.009MHz up to 1GHz, and above 1GHz.
b. The EUT was placed on the top of a rotating table 0.8 meters(above 1GHz is 1.5 m) above the ground at a 3 meter anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
c. The height of the equipment shall be 0.8 m(above 1GHz is 1.5 m); the height of the test antenna shall vary between 1 m to 4 m. Horizontal and vertical polarizations of the antenna are set to make the measurement.
d. 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.
e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

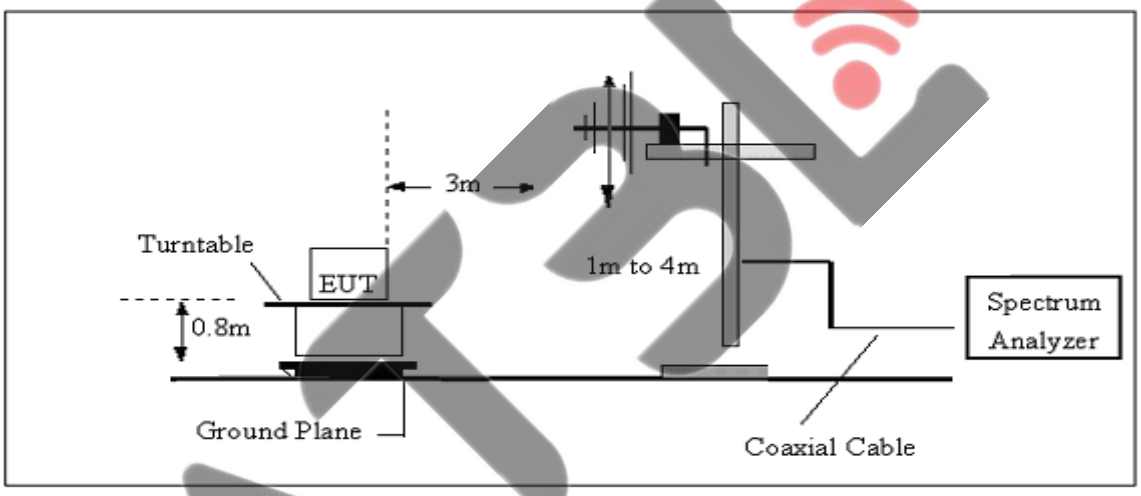
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

4.3 TEST SETUP

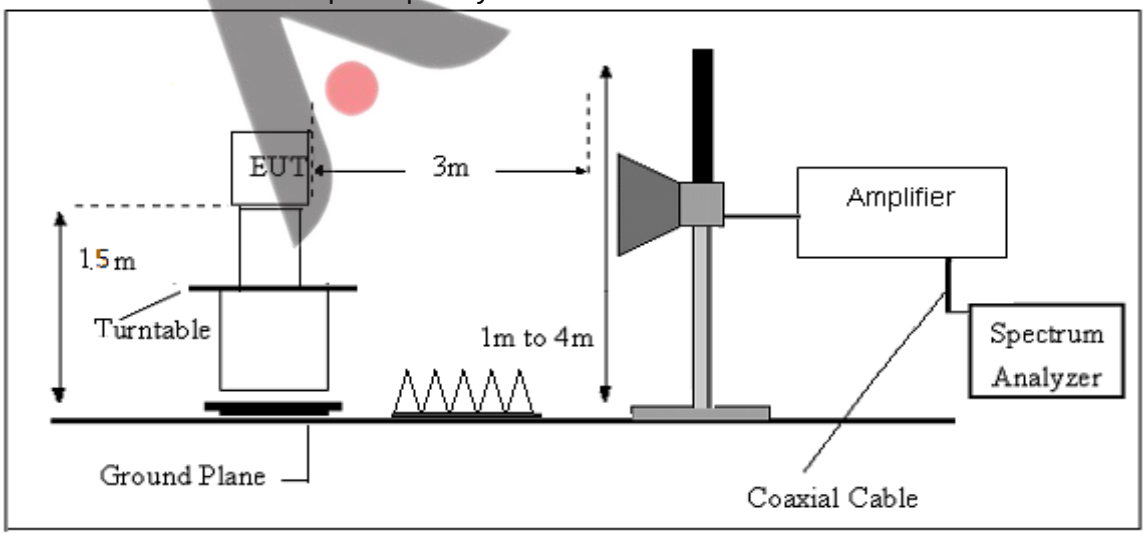
(A) Radiated Emission Test-Up Frequency Below 30MHz



(B) Radiated Emission Test-Up Frequency 30MHz~1GHz



(C) Radiated Emission Test-Up Frequency Above 1GHz



4.4 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

4.5 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where

FS = Field Strength

CL = Cable Attenuation Factor (Cable Loss)

RA = Reading Amplitude

AG = Amplifier Gain

AF = Antenna Factor

For example

Frequency	FS	RA	AF	CL	AG	Factor
(MHz)	(dBμV/m)	(dBμV/m)	(dB)	(dB)	(dB)	(dB)
300	40	58.1	12.2	1.6	31.9	-18.1

Factor=AF+CL-AG

4.6 TEST RESULTS

Temperature:	23.0(C)	Relative Humidtity:	59%RH
Test Voltage:	DC 3.3V	Polarization:	--
Test Mode:	TX Mode		

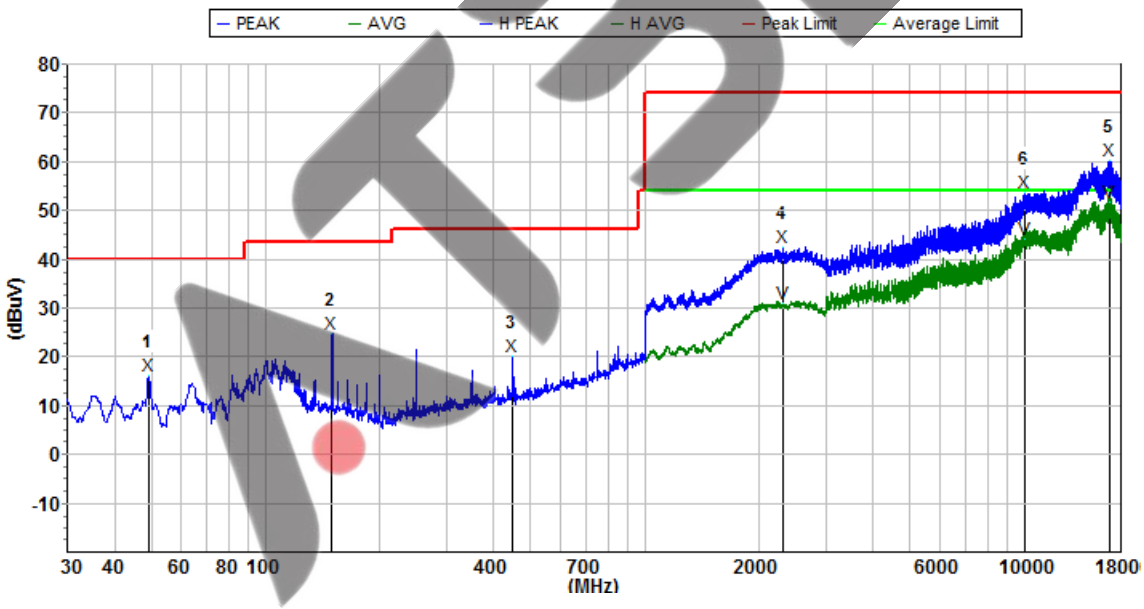
Note:

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.

(30MHz -18000MHz)

Temperature:	23.3(C)	Relative Humidity:	60%RH
Test Voltage:	DC 3.3V	Phase:	Horizontal
Test Mode:	Mode 1/2/3 (Mode 1 worst mode)		

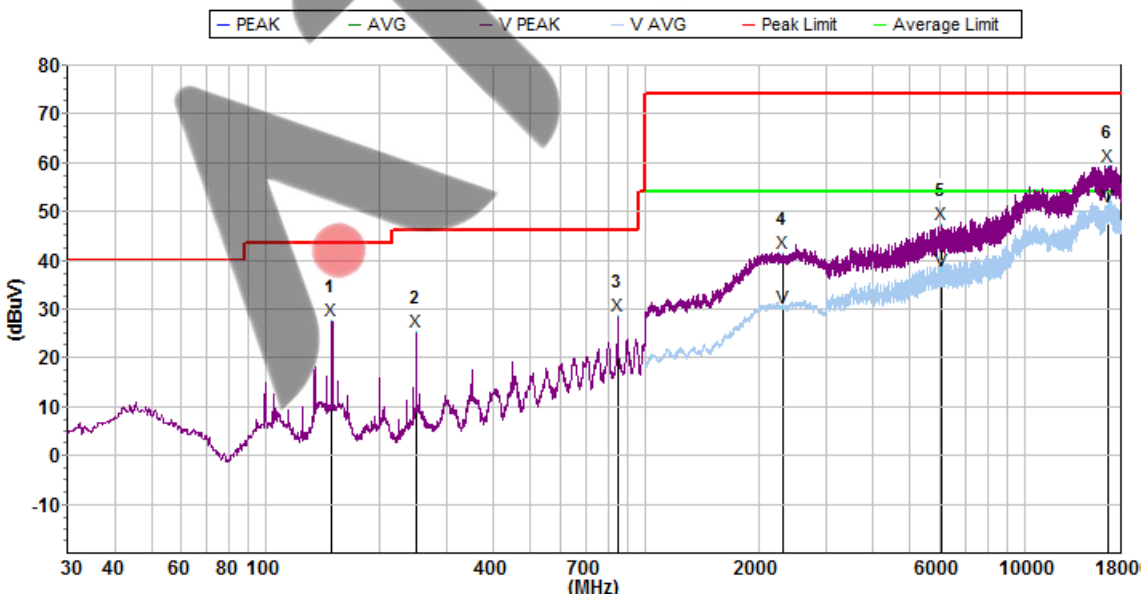
Horizontal



Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Pol.
Peak:							
1	49.359419	16.2	40.0	23.8	0.0	0.0	H
2	149.748044	24.9	43.5	18.6	0.0	0.0	H
3	449.555842	20.2	46.0	25.8	0.0	0.0	H
4	2313.00000	42.4	74.0	31.6	22.7	50.2	H
5	16845.0000	60.1	74.0	13.9	30.9	47.4	H
6	10092.0000	53.7	74.0	20.3	27.6	48.5	H
Avg							
4	2313.00000	31.0	54.0	23.0	22.7	50.2	H
5	16845.0000	51.6	54.0	2.4	30.9	47.4	H
6	10092.0000	44.0	54.0	10.0	27.6	48.5	H

Temperature:	23.0(C)	Relative Humidity:	59%RH
Test Voltage:	DC 3.3V	Phase:	Vertical
Test Mode:	Mode 1/2/3 (Mode 1 worst mode)		

Vertical



Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin(dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Pol.
Peak:							
1	149.748044	27.8	43.5	15.7	14.1	32.9	V
2	249.862716	25.5	46.0	20.5	11.6	32.8	V
3	849.544511	28.6	46.0	17.4	21.0	31.9	V
4	2304.000000	41.6	74.0	32.4	22.9	50.2	V
5	6034.500000	47.4	74.0	26.6	25.6	48.9	V
6	16648.500000	59.4	74.0	14.6	31.4	47.7	V
Avg							
4	2304.000000	30.3	54.0	23.7	22.9	50.2	V
5	6034.500000	37.8	54.0	16.2	25.6	48.9	V
6	16648.500000	51.0	54.0	3.0	31.4	47.7	V

5. CONDUCTED SPURIOUS & BAND EDGE EMISSION

5.1 LIMIT

According to FCC section 15.247(d)&RSS-247 Issue 2, in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

5.2 TEST PROCEDURE

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	30 MHz to 10th carrier harmonic
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

For Band edge

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	Lower Band Edge: 2300 – 2407 MHz Upper Band Edge: 2475 – 2500 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

5.3 TEST SETUP

The EUT which is powered by the Battery, is connected to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50 Ohm; the path loss as the factor is calibrated to correct the reading. Make the measurement with the spectrum analyzer's resolution bandwidth(RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

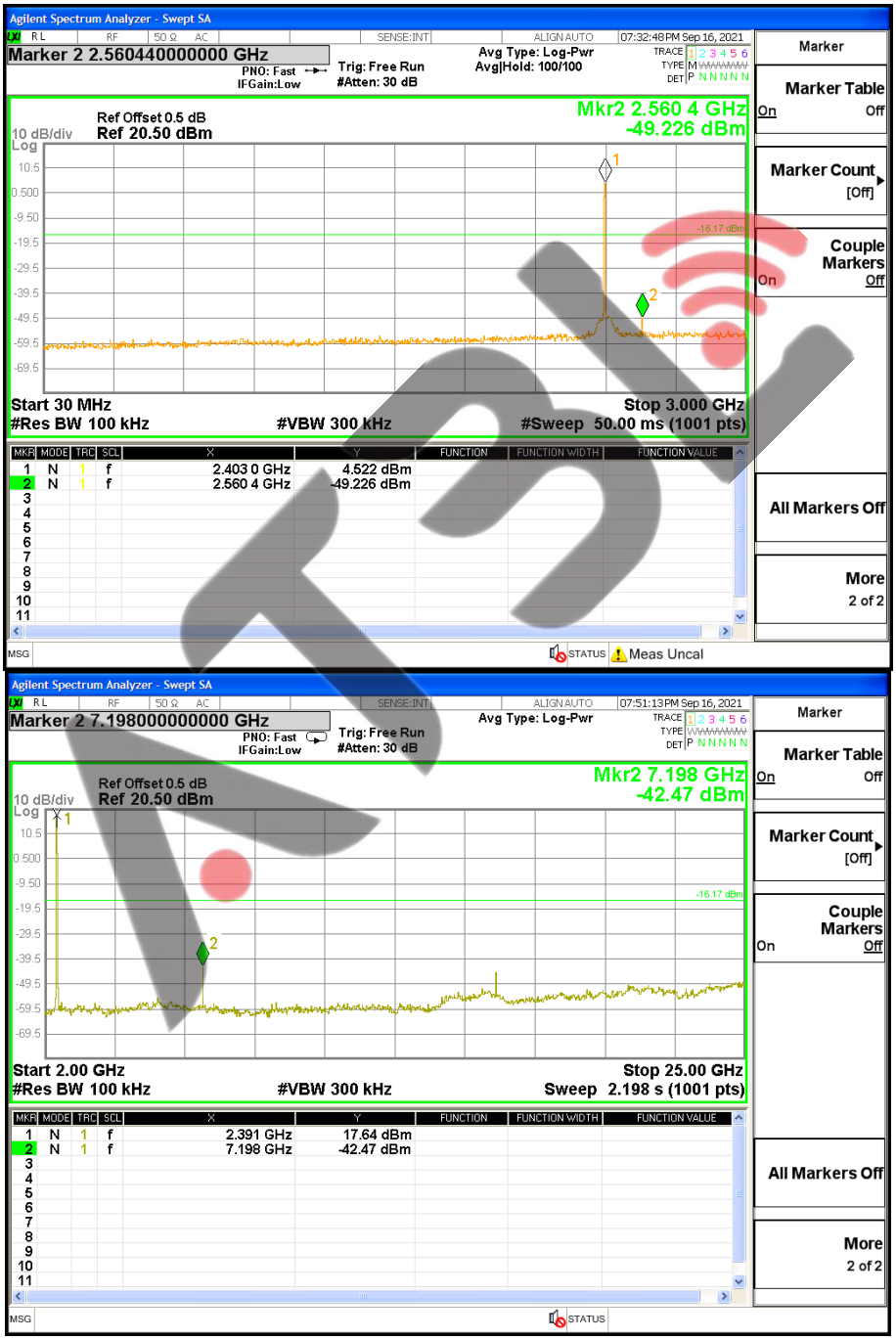
5.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

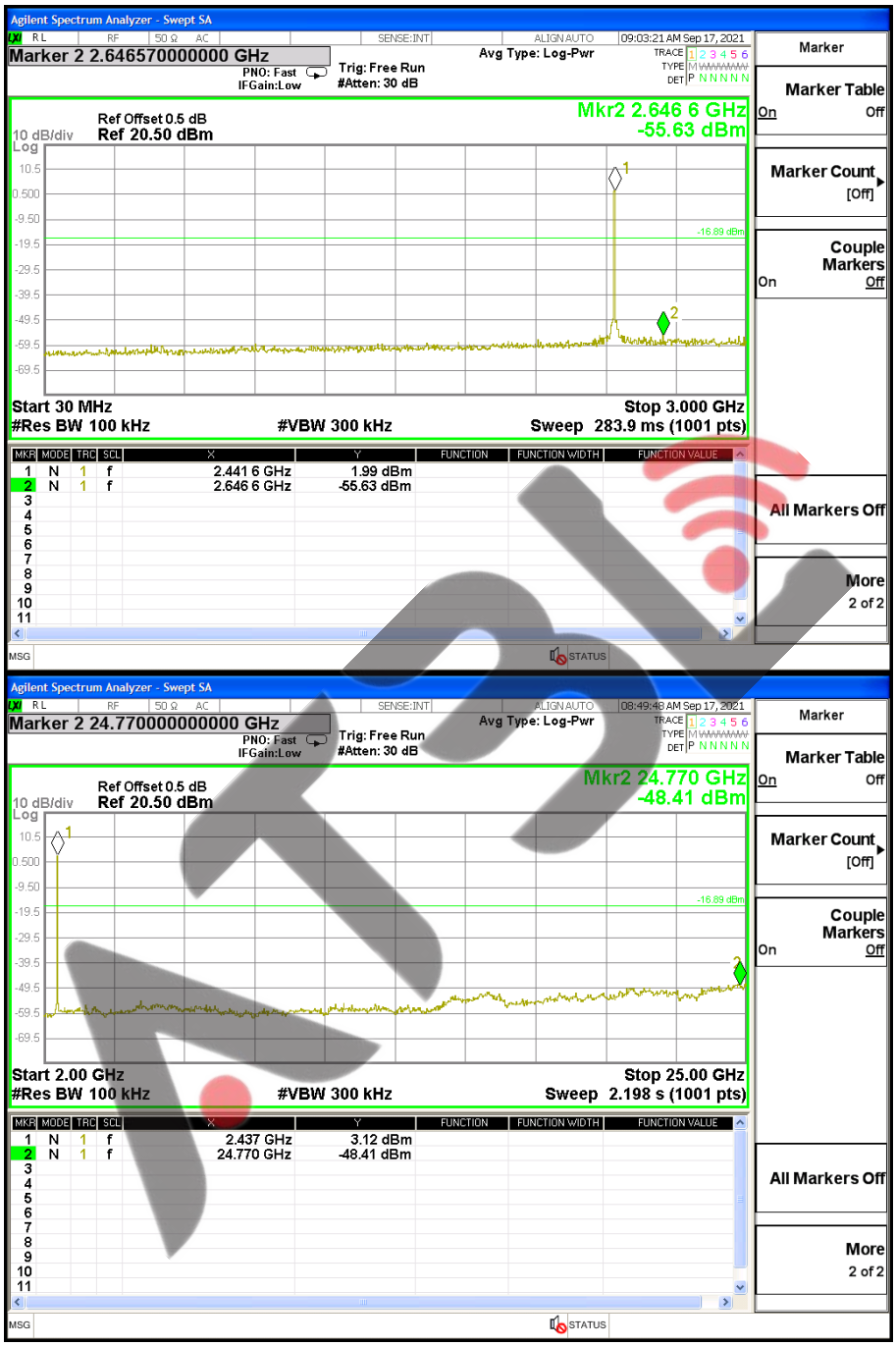
5.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	50%
Test Voltage:	DC 3.3V	Test Mode:	TX Mode /CH00, CH19, CH39

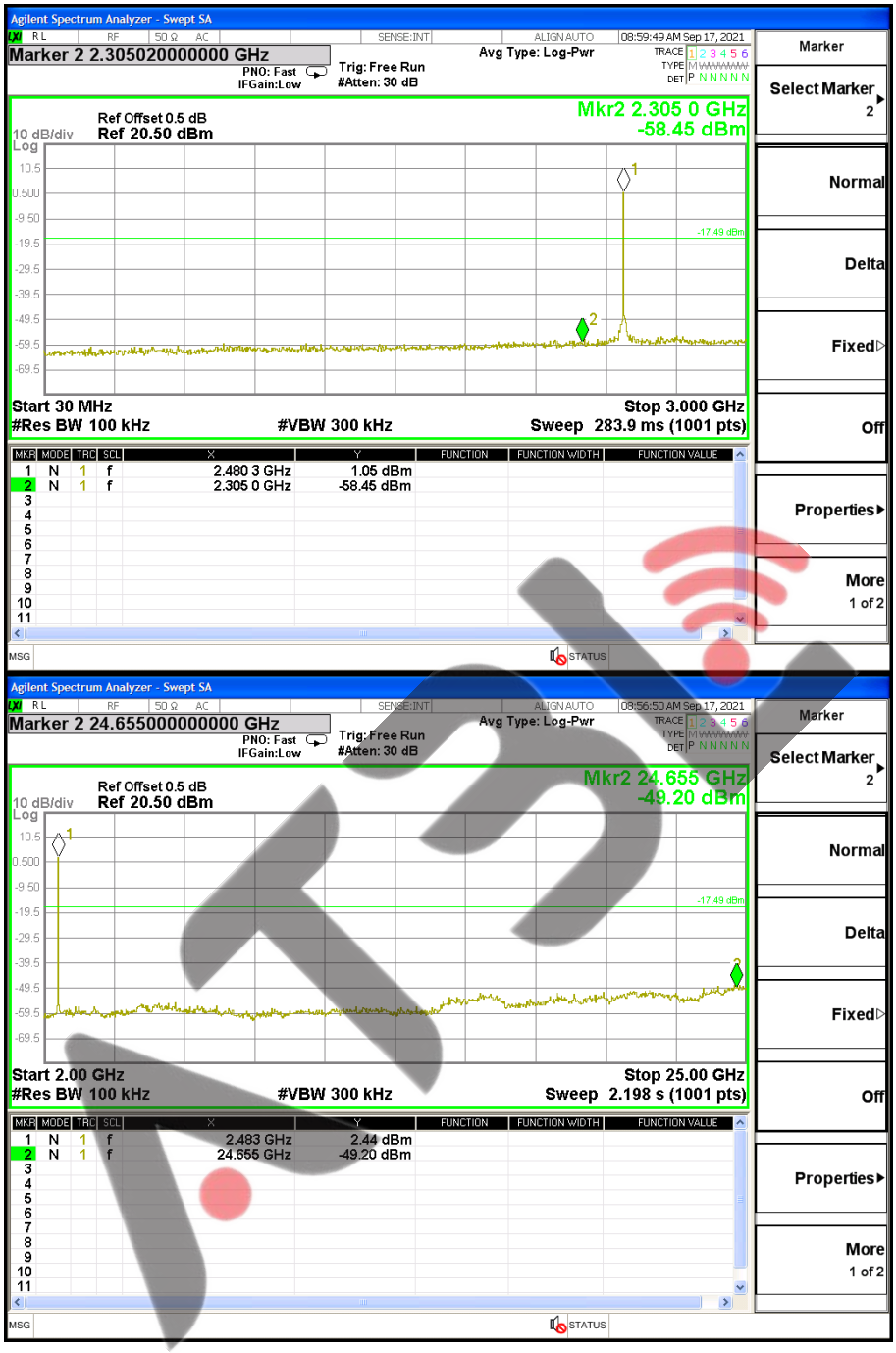
CH00



CH19

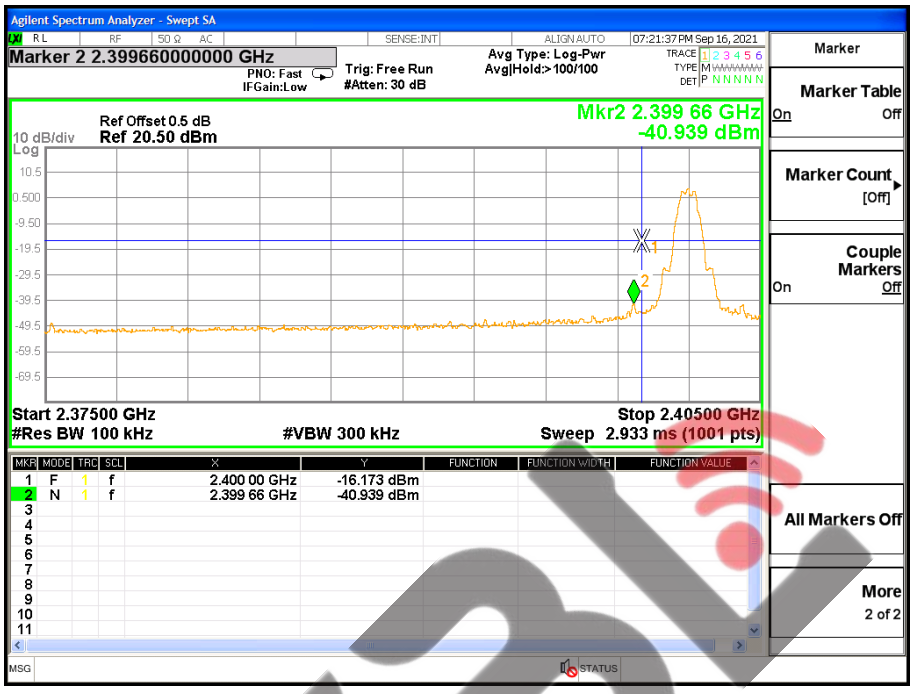

Agilent Spectrum Analyzer - Swept SA
Marker 2 2.646570000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
09:03:21 AM Sep 17, 2021
Ref Offset 0.5 dB
10 dB/div
Ref 20.50 dBm
Log
Mkr2 2.646 6 GHz
-55.63 dBm
-16.89 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 3.000 GHz
Sweep 283.9 ms (1001 pts)
1 N 1 f 2.441 6 GHz 1.99 dBm
2 N 1 f 2.646 6 GHz -55.63 dBm
Marker
Marker Table
On Off
Marker Count
[Off]
Couple Markers
On Off
All Markers Off
More
2 of 2
MSG
STATUS
Agilent Spectrum Analyzer - Swept SA
Marker 2 24.770000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
08:49:48 AM Sep 17, 2021
Ref Offset 0.5 dB
10 dB/div
Ref 20.50 dBm
Log
Mkr2 24.770 GHz
-48.41 dBm
-16.89 dBm
Start 2.00 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.198 s (1001 pts)
1 N 1 f 2.437 GHz 3.12 dBm
2 N 1 f 24.770 GHz -48.41 dBm
Marker
Marker Table
On Off
Marker Count
[Off]
Couple Markers
On Off
All Markers Off
More
2 of 2
MSG
STATUS

CH39

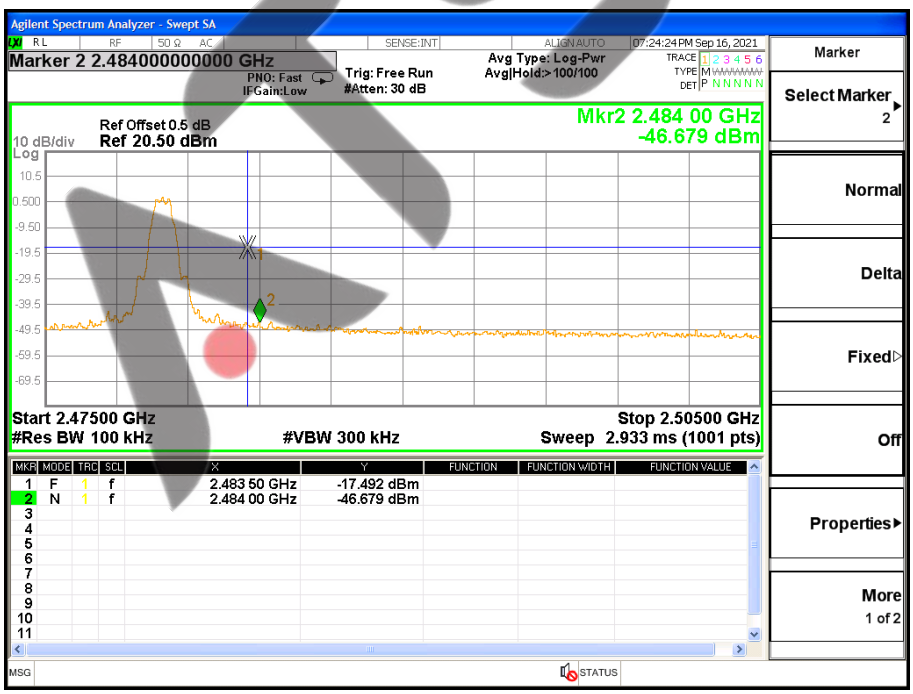

Agilent Spectrum Analyzer - Swept SA
Marker 2 2.305020000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
08:59:49 AM Sep 17, 2021
Ref Offset 0.5 dB
10 dB/div
Ref 20.50 dBm
Mkr2 2.305 0 GHz
-58.45 dBm
-17.49 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 3.000 GHz
Sweep 283.9 ms (1001 pts)
1 N 1 f 2.480 3 GHz 1.05 dBm
2 N 1 f 2.305 0 GHz -58.45 dBm
Marker
Select Marker 2
Normal
Delta
Fixed
Off
Properties
More 1 of 2
Agilent Spectrum Analyzer - Swept SA
Marker 2 24.655000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
08:56:50 AM Sep 17, 2021
Ref Offset 0.5 dB
10 dB/div
Ref 20.50 dBm
Mkr2 24.655 GHz
-49.20 dBm
-17.49 dBm
Start 2.00 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.198 s (1001 pts)
1 N 1 f 2.483 GHz 2.44 dBm
2 N 1 f 24.655 GHz -49.20 dBm
Marker
Select Marker 2
Normal
Delta
Fixed
Off
Properties
More 1 of 2

For Band edge(it's also the reference level for conducted spurious emission)

CH00



CH39



6. POWER SPECTRAL DENSITY TEST

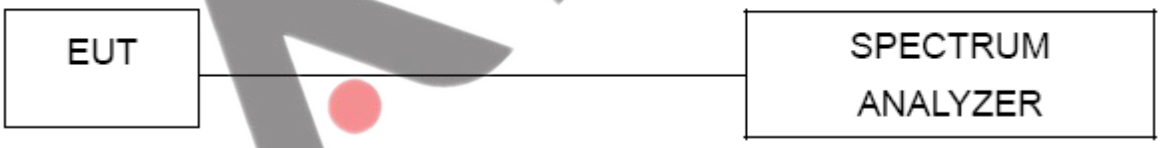
6.1 LIMIT

FCC Part 15.247,Subpart C RSS-247 Clause 5.2(b)				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(e) RSS-247 Clause 5.2(b)	Power Spectral Density	≤8 dBm (RBW≥3KHz)	2400-2483.5	PASS

6.2 TEST PROCEDURE

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS channel bandwidth.
3. Set the RBW to: 100 kHz ≥ RBW ≥ 3 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

6.3 TEST SETUP



6.4 EUT OPERATION CONDITIONS

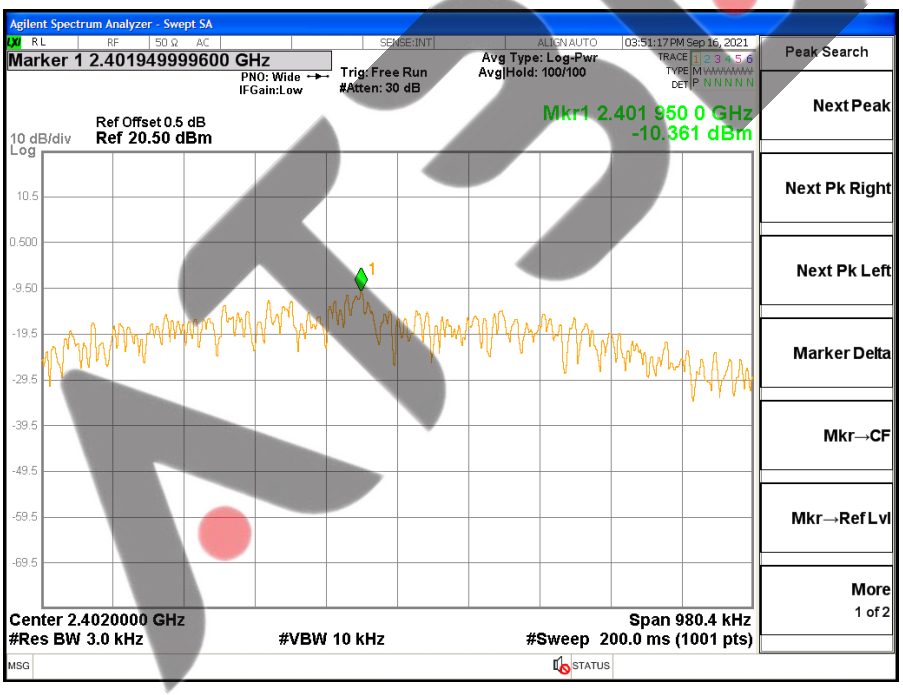
The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

6.5 TEST RESULTS

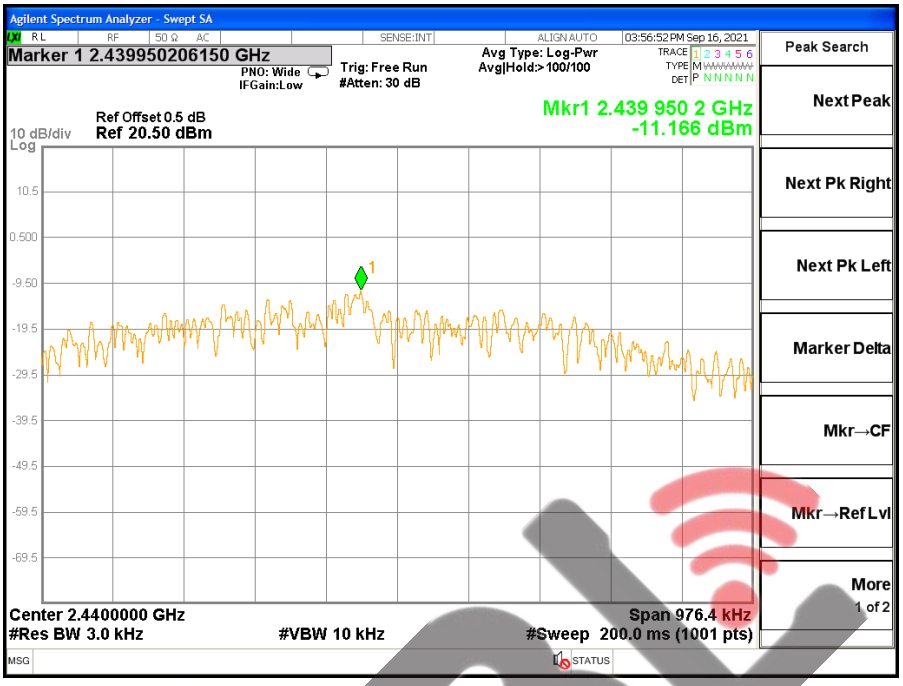
Temperature:	25 ℃	Relative Humidity:	60%
Test Voltage:	DC 3.3V	Test Mode:	TX Mode /CH00, CH19, CH39

Frequency	Power Density (dBm/3kHz)	Limit (3KHz/dBm)	Result
2402 MHz	-10.361	≤8	PASS
2440 MHz	-11.166	≤8	PASS
2480 MHz	-12.073	≤8	PASS

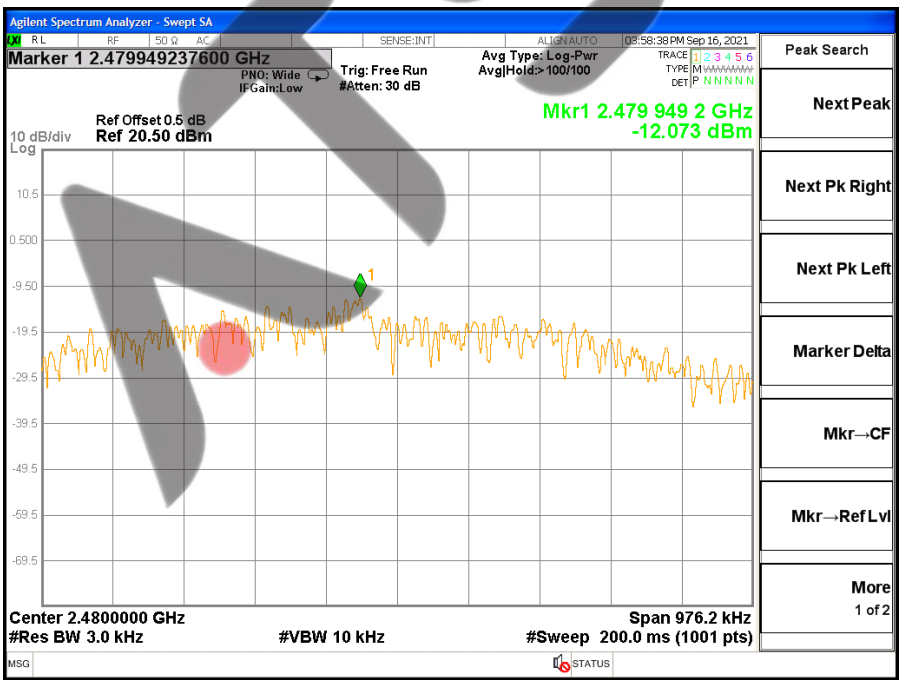
TX CH00



TX CH19



TX CH39



7. BANDWIDTH TEST

7.1 LIMIT

FCC Part 15.247,Subpart C RSS-Gen Clause 6.7				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(2) RSS-247 Clause 5.2(a)	Bandwidth	>= 500KHz (6dB bandwidth)	2400-2483.5	PASS
RSS-Gen Clause 6.7	99% Bandwidth	For reporting purposes only.	2400-2483.5	PASS

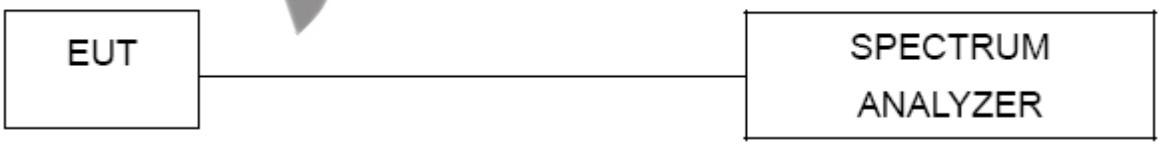
7.2 TEST PROCEDURE

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 :100KHz For 99% Bandwidth :1% to 5% of the occupied bandwidth
VBW	For 6dB Bandwidth : ≥3 × RBW For 99% Bandwidth : approximately 3×RBW
Trace	Max hold
Sweep	Auto

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 and 99% relative to the maximum level measured in the fundamental emission.

7.3 TEST SETUP



7.4 EUT OPERATION CONDITIONS

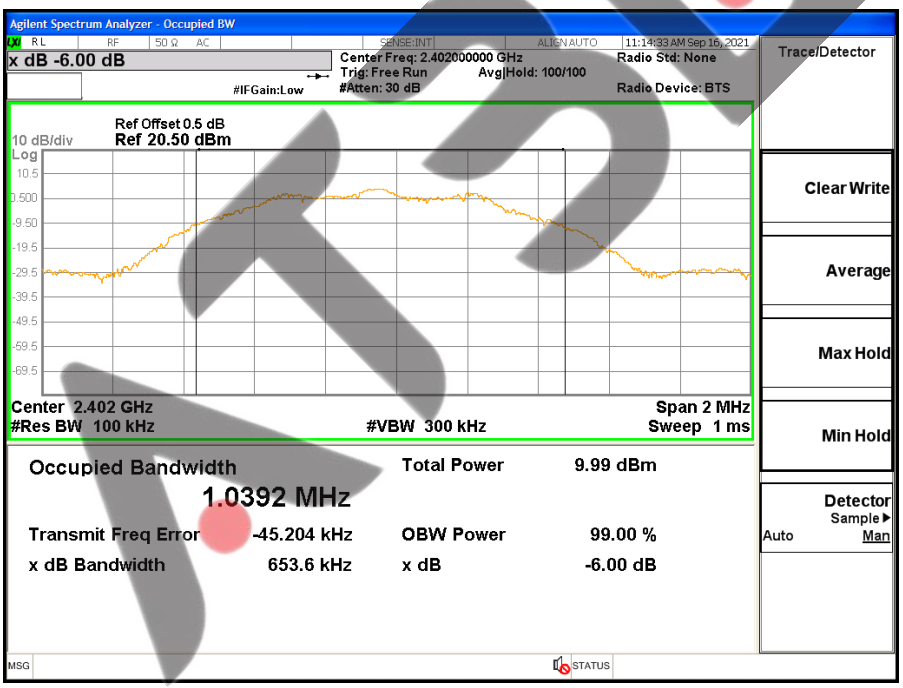
The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

7.5 TEST RESULTS

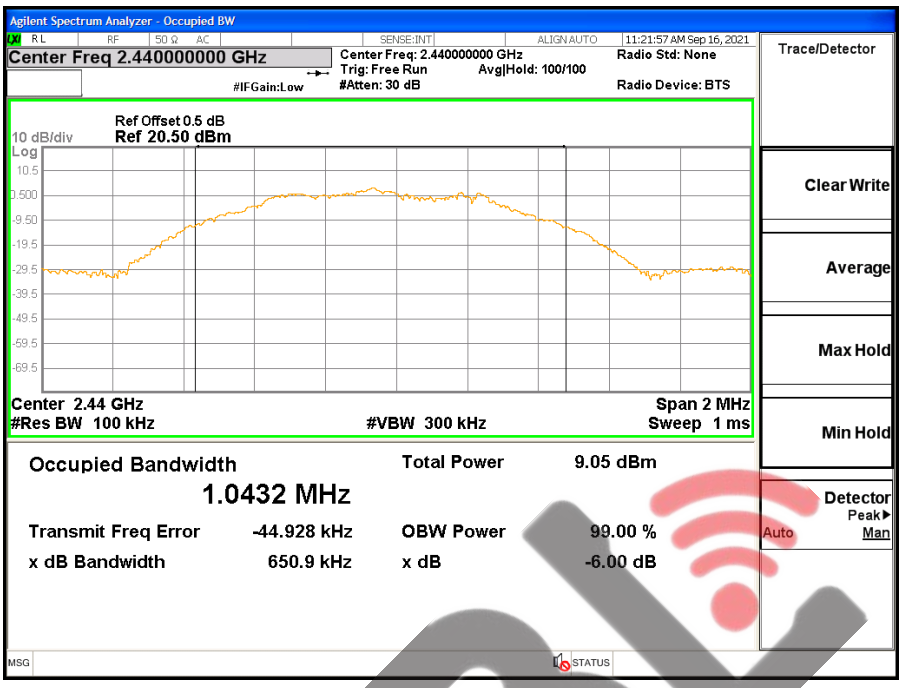
Temperature:	25 ℃	Relative Humidity:	60%
Test Voltage:	DC 3.3V	Test Mode:	TX Mode /CH00, CH19, CH39

Frequency	6dB Bandwidth (KHz)	99% Bandwidth (KHz)	Channel Separation (KHz)	Result
2402 MHz	653.6	1016.4	≥500KHz	PASS
2440 MHz	650.9	1020.3	≥500KHz	PASS
2480 MHz	650.8	1015.0	≥500KHz	PASS

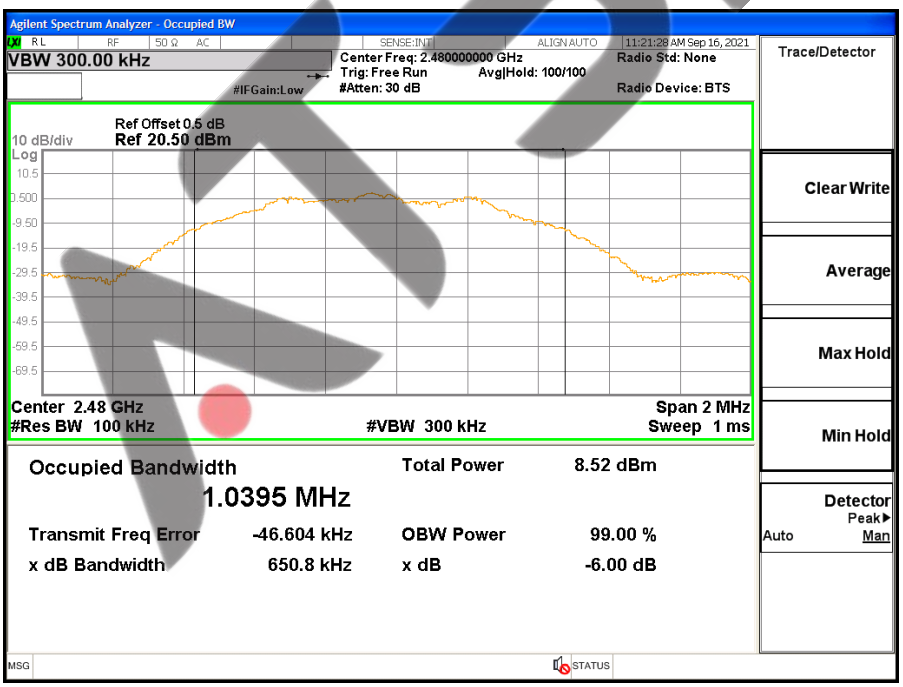
6dB Bandwidth TX CH 00



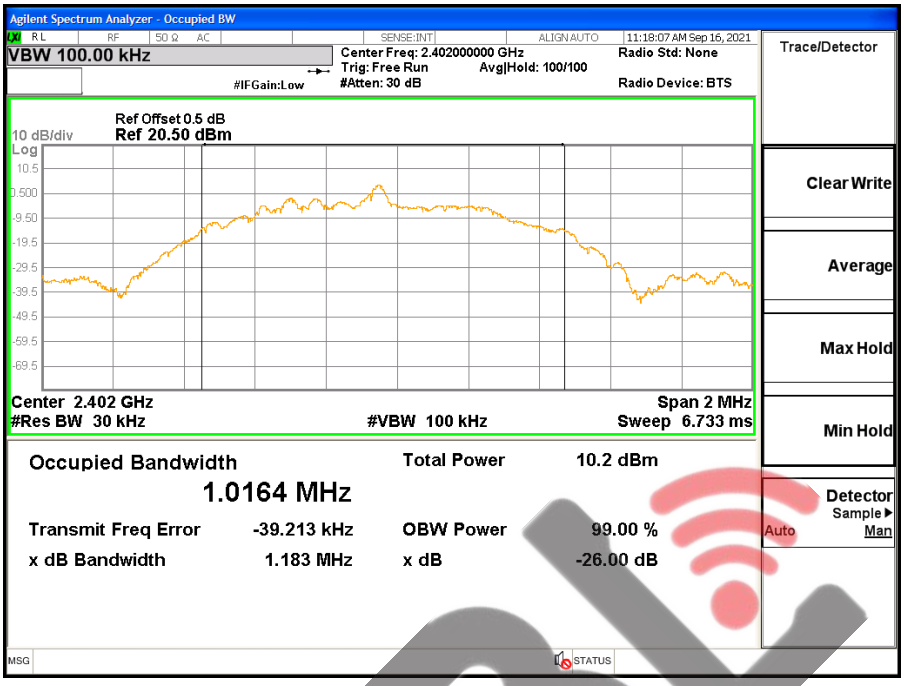
6dB Bandwidth TX CH 19



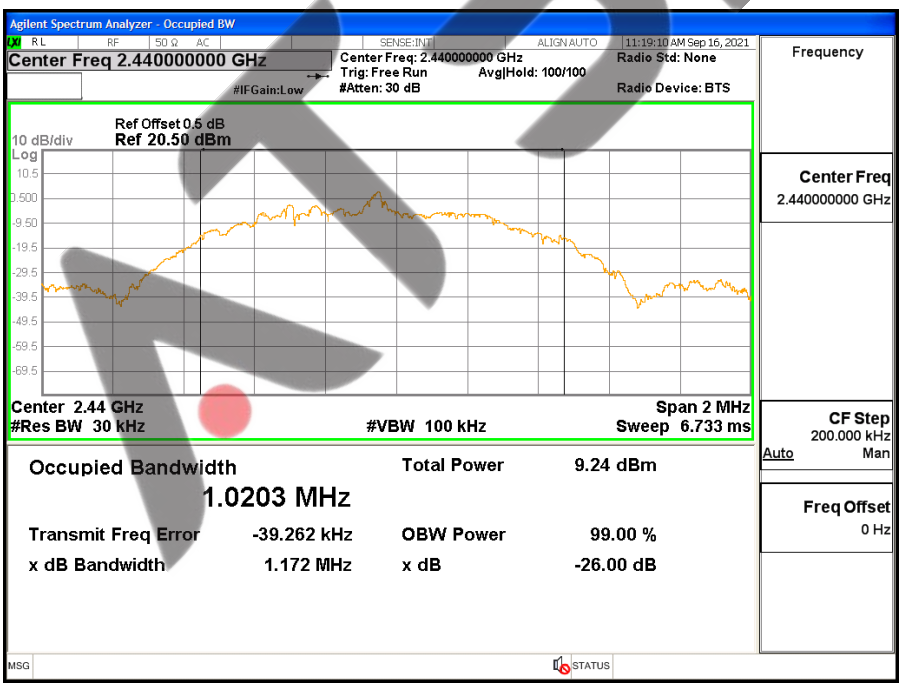
6dB Bandwidth TX CH 39



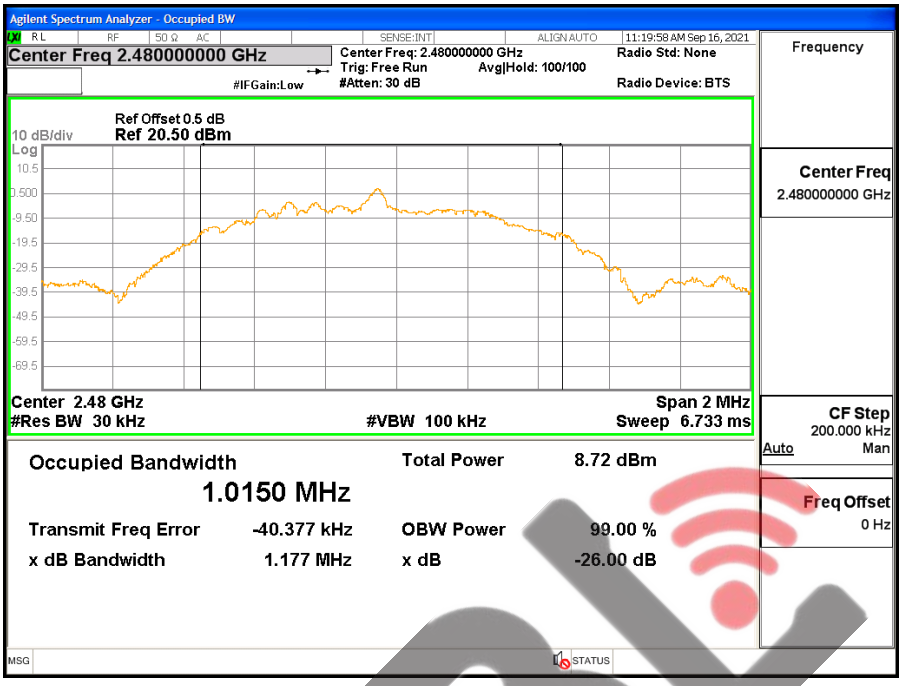
99% Bandwidth TX CH 00



99% Bandwidth TX CH 19



99% Bandwidth TX CH 39



8. PEAK OUTPUT POWER TEST

8.1 LIMIT

FCC Part 15.247,Subpart C RSS-247 Clause 5.4(d)				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(3) RSS-247 Clause 5.4(d)	Output Power	1 watt or 30dBm	2400-2483.5	PASS
RSS-247	EIRP	4W	2400-2483.5	PASS

8.2 TEST PROCEDURE

One of the following procedures may be used to determine the maximum peak conducted output power of a DTS EUT.

RBW ≥ DTS bandwidth

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

a) Set the RBW ≥ DTS bandwidth.
b) Set VBW ≥ [3 × RBW].
c) Set span ≥ [3 × RBW].
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

Integrated band power method:

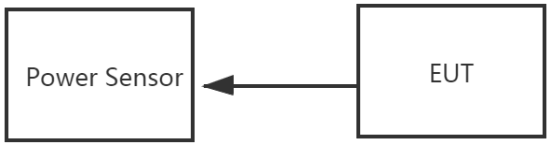
The following procedure can be used when the maximum available RBW of the instrument is less than the
DTS bandwidth:

a) Set the RBW = 1 MHz.
b) Set the VBW ≥ [3 × RBW].
c) Set the span ≥ [1.5 × DTS bandwidth].
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges (for some instruments, this may require a manual override to select the peak detector). If the instrument does not have a band power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the DTS channel bandwidth.

PKPM1 Peak power meter method:

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall use a fast-responding diode detector.

8.3 TEST SETUP



8.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

8.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	60%
Test Voltage:	DC 3.3V	Test Mode:	TX Mode /CH00, CH19, CH39

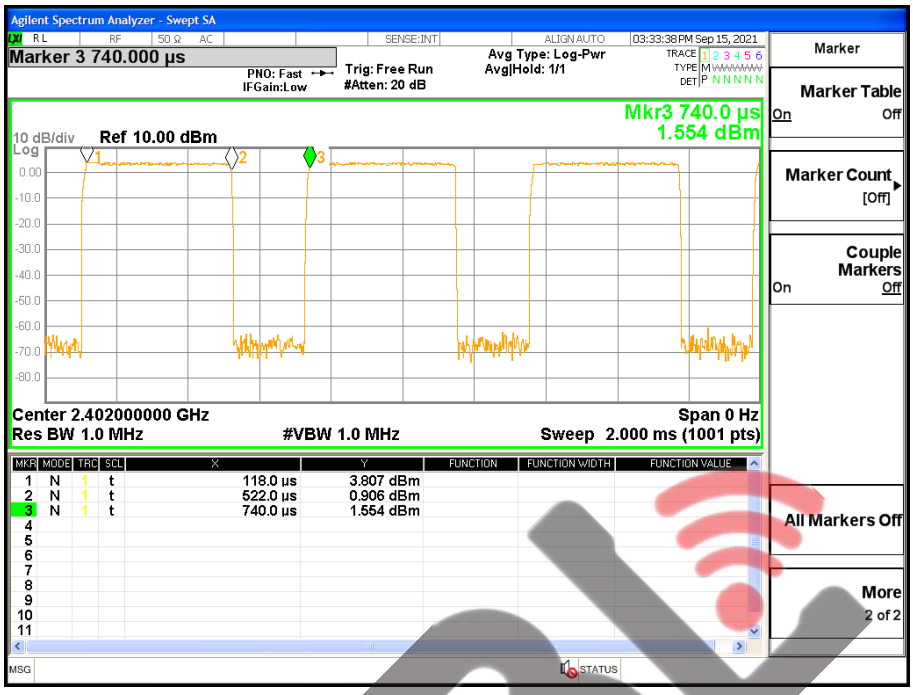
Test Channel	Frequency	Peak Conducted Output Power	Average Conducted Output Power	LIMIT
	(MHz)	(dBm)	(dBm)	dBm
CH00	2402	10.69	3.90	30
CH19	2440	9.73	2.98	30
CH39	2480	8.91	2.16	30

Note: Our power sensor test AVG power has no duty cycle display. The power sensor measures AVG power is Burst power. The software has considered the factor of the duty cycle factor, so it is unnecessary to add it again.

EIRP Power

Test Channe	Frequency	Peak Conducted Output Power	Antenna Gain	EIRP Power	LIMIT
	(MHz)	(dBm)	(dBi)	(dBm)	dBm
CH0	2402	10.69	2.2	12.89	36.02
CH19	2440	9.73	2.2	11.93	36.02
CH39	2480	8.91	2.2	11.11	36.02

Duty cycle

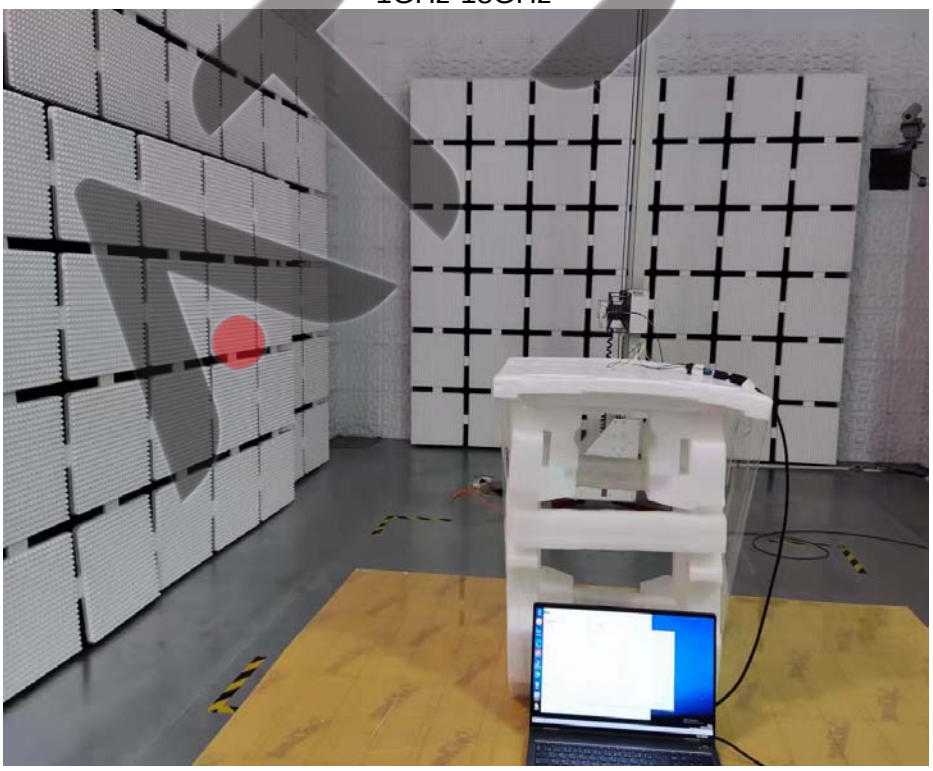


Ton	Tp	Duty cycle(%)	Duty factor(dB)
404	622	64.95	1.87

APPENDIX-PHOTOS OF TEST SETUP

30MHz-1000MHz

1GHz-18GHz



※※※※※END OF THE REPORT※※※※※