



RADIO TEST REPORT

Report No.: SHATBL2203027W02

Applicant:

FrSky Electronic Co., Ltd.

Address:

F-4, Building C, Zhongxiu Technology Park, No.3 Yuanxi Road, Wuxi,
214125, Jiangsu, China

Product Name : Tandem digital radio system

Brand Name : FRSKY

Model Name : TANDEM X18

Series Model : TANDEM X18S, TANDEM X18SE, TANDEM X18PRO

Test Standard : FCC Part 15.247

FCC ID : XYFTDX18HDS

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TEST RESULT CERTIFICATION

Applicant's Name.....: FrSky Electronic Co., Ltd.
Address.....: F-4, Building C, Zhongxiu Technology Park, No.3 Yuanxi Road, Wuxi,
214125, Jiangsu, China
Manufacture's Name.....: FrSky Electronic Co., Ltd.
Address.....: F-4, Building C, Zhongxiu Technology Park, No.3 Yuanxi Road, Wuxi,
214125, Jiangsu, China

Product Description

Product Name.....: Tandem digital radio system
Brand Name: FRISKY
Model Name.....: TANDEM X18
Series Model.....: TANDEM X18S, TANDEM X18SE, TANDEM X18PRO
Test Standards.....: FCC Part15.247

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.

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Date of Test.....:

Date of receipt of test item.....: 23 Mar. 2022

Date (s) of performance of tests.....: 23 Mar. 2022~24 Apr. 2022

Date of Issue.....: 24 Apr. 2022

Test Result.....: Pass

Report Prepared by :

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Ghost Li.

(Ghost.Li)

Authorized Signatory :

Terry yang

(Terry yang)



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Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	24 Apr. 2022	SHATBL2203027W02	ALL	Initial Issue

1. SUMMARY OF TEST RESULTS

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

FCC Part15.247			
Standard Section	Test Item	Judgment	Remark
15.207	Conducted Emission	PASS	--
15.247 (a)(2)	6dB&99% Bandwidth	PASS	--
15.247 (b)(3)	Output Power	PASS	--
15.247(d) & 15.209 & 15.205	Radiated Spurious Emission	PASS	--
15.247(d) & 15.205	Conducted Spurious & Band Edge Emission	PASS	--
15.247 (e)	Power Spectral Density	PASS	--
15.205	Restricted bands of operation	PASS	--
15.203	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	Tandem digital radio system	
Trade Name	FRSKY	
Model Name	TANDEM X18	
Series Model	TANDEM X18S, TANDEM X18SE, TANDEM X18PRO	
Model Difference	Different product models only represent different appearance and color of products	
Product Description	The EUT is a Tandem digital radio system	
	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 dBi
Channel List	Please refer to the Note 2.	
Power Rating	DC 7.4v	
Battery	Model: GRP9240078-1C-7.4V 4000mAh Brand: SHENZHEN GREPOW BATTERY CO., LTD Rated Voltage: 7.4v 29.6Wh Charge Limit Voltage: 8.4v Capacity: 4000mAh	
Hardware version number	1.0.0	
Software version number	ETHOS 1.1.1	
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)
37	2402	09	2422	18	2442	28	2462
00	2404	10	2424	19	2444	29	2464
01	2406	38	2426	20	2446	30	2466
02	2408	11	2428	21	2448	31	2468
03	2410	12	2430	22	2450	32	2470
04	2412	13	2432	23	2452	33	2472
05	2414	14	2434	24	2454	34	2474
06	2416	15	2436	25	2456	35	2476
07	2418	16	2438	26	2458	36	2478
08	2420	17	2440	27	2460	39	2480

3.

Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	FRSKY	TANDEM X18	Single-band Antenna	N/A	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 CH37(2402MHz)	1 Mbps/GFSK
Mode 2	TX CH17(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.

For Conducted Emission

Test Case	
Conducted Emission	Mode 4: Keeping BT TX

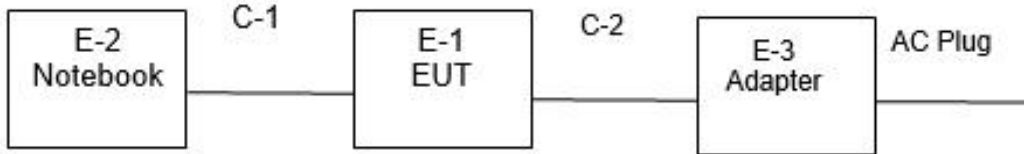
2.3 TEST SOFTWARE AND POWER LEVEL

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

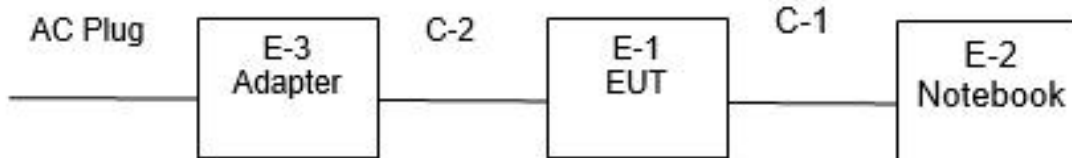
RF Function	Type	Mode Or Modulation type	Ant Gain(dBi)	Power Class	Software For Testing
BLE	BLE	GFSK	2	default	SmartRF Studio 7

2.4 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Radiated Spurious Emission Test



Conduction 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
E-3	Adapter	N/A	A-938-120100W-US1	N/A	N/A
C-2	DC Cable	N/A	N/A	110cm	N/A

Support units

Item	Equipment	Mfr/Brand	Model	Type No.	Note
E-2	Notebook	Lenovo	DESKTOP-USDEO09	/	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
The FCC Registration Number (FRN):	0031025281
A2LA Number:	6184.01
CNAS Number:	CNAS L14531

2.7 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement $y \pm U$, where expanded 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	$\pm 0.962\text{dB}$
2	Conducted spurious emissions	$\pm 2.986\text{dB}$
3	All emissions, radiated 30MHz-1GHz	$\pm 2.49\text{dB}$
4	All emissions, radiated 1GHz-18GHz	$\pm 3.50\text{dB}$
5	Occupied bandwidth	$\pm 2.336\text{dB}$
6	Power spectral density	$\pm 0.866\text{dB}$

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	2022.10.07
Pre-Amplifier (1G-18GHz)	JPT	JPA0118-55-303A	1910001800055000	SHATBL-E006	2022.07.13
Temperature & Humidity	DeLi	DeLi	N/A	SHATBL-E016	2022.10.08
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	2022.10.07
			RPR6W-20001005	SHATBL-W013	2022.10.07
Signal Analyzer	Agilent	N9020A	MY57300196	SHATBL-W004	2022.10.07
Signal Generator	Agilent	N5182B	MY46240556	SHATBL-W005	2022.10.07
Wireless Communications Test Set	R&S	CMW500	101331	SHATBL-W007	2022.10.07
Temperature & Humidity	Deli	deli	N/A	SHATBL-W011	2022.10.07
Attenuator	Agilent	8494B	DC-18G	SHATBL-W009	2022.10.07
Attenuator	Agilent	8496B	DC-18G	SHATBL-W010	2022.10.07
power splitter	MNK	MPD-DC/6-2S	62315 G51	SHATBL-W015	2022.10.07
			62315 G52	SHATBL-W016	2022.10.07
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	2023.01.17
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.

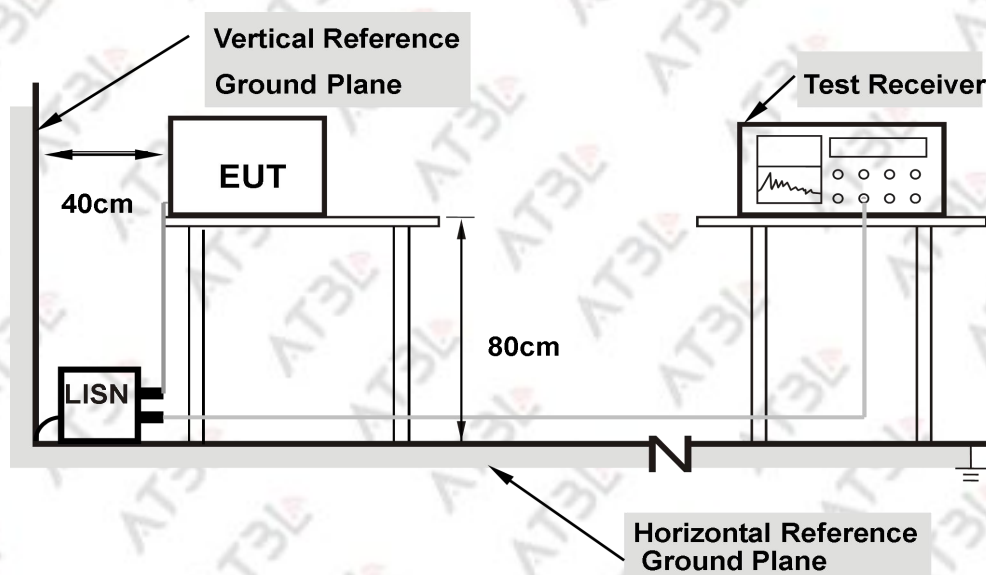
The following table is the setting of the receiver

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

3.2 TEST PROCEDURE

- 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.
- 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.
- 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.
- LISN is at least 80 cm from the nearest part of EUT chassis.
- 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 °C	Relative Humidity:	54%
Test Voltage:	N/A	Phase:	N/A
Test Mode :	N/A		

Note:The EUT is power by DC,this test item is not apply.

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			

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

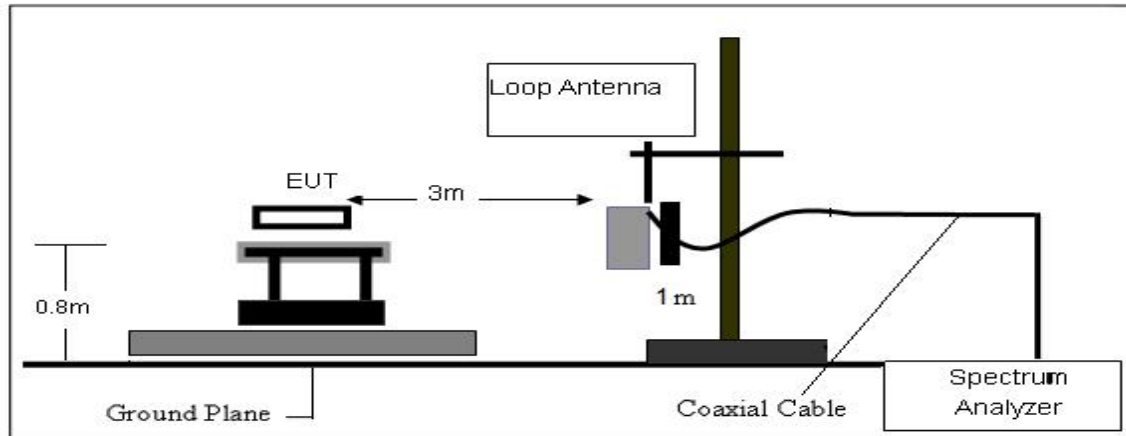
- The measuring distance of at 3 m shall be used for measurements at frequency 0.009MHz up to 1GHz, and above 1GHz.
- The EUT was placed on the top of a rotating table 0.8 meters(above 1GHz is 1.5 m) above the ground at a 3 meter anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- 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.
- 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 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.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

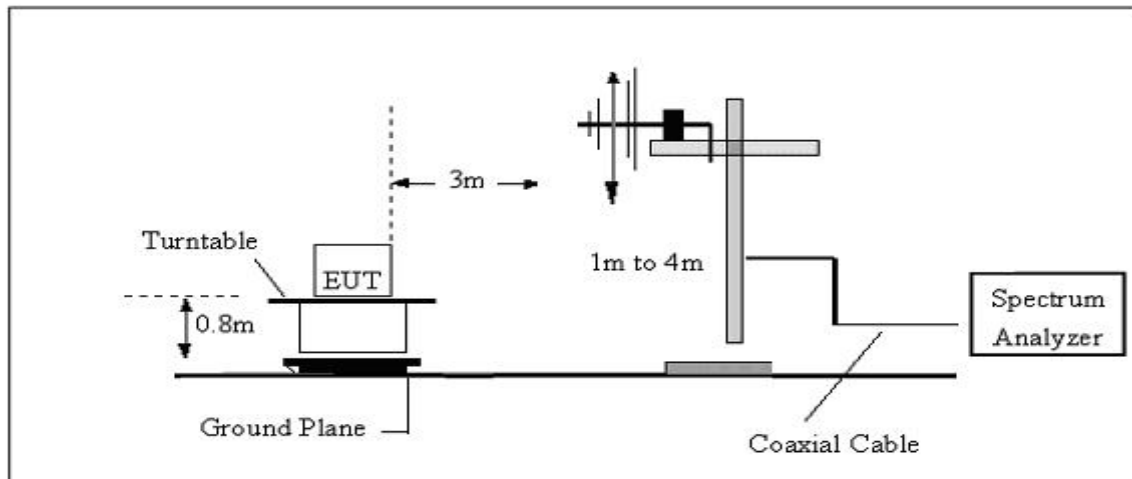
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

4.3 TEST SETUP

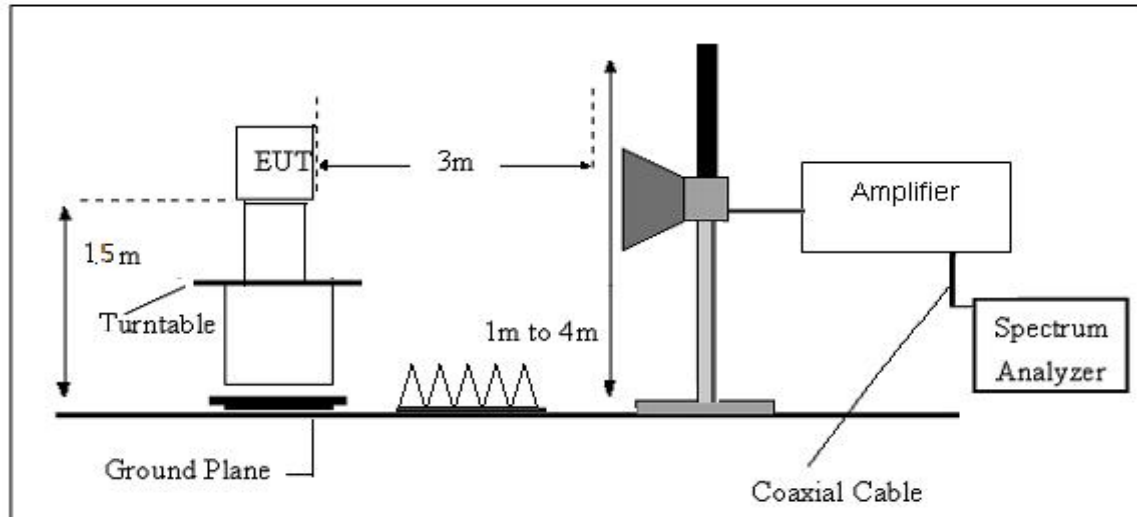
(A) Radiated Emission Test-Up Frequency Below 30MHz



(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

$$\text{Factor} = \text{AF} + \text{CL} - \text{AG}$$

4.6 TEST RESULTS

Temperature:	23.0℃	Relative Humidity:	59%RH
Test Voltage:	DC 7.4V	Polarization:	--
Test Mode:	TX Mode1/2/3		

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

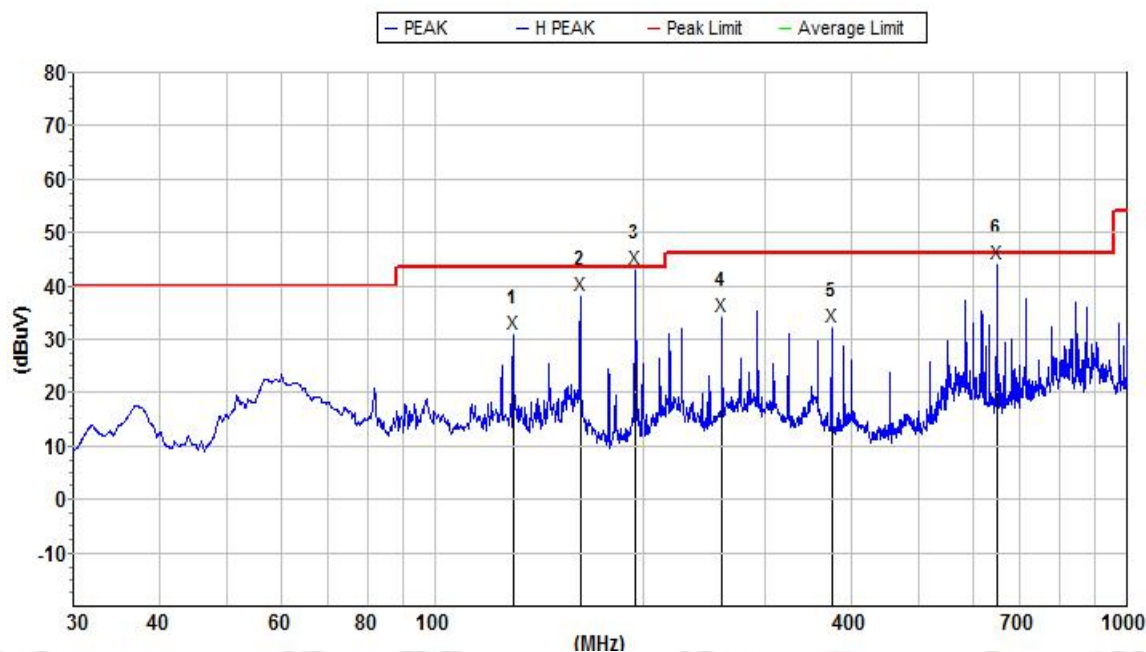
Distance extrapolation factor = $40 \log (\text{specific distance/test distance})$ (dB);

Limit line = specific limits(dBuV) + distance extrapolation factor.

(30MHz -1000MHz)

Temperature	26 ℃	Relative Humidity	56%
Test Voltage	DC 7.4V	Polarization	Horizontal
Test Mode	Mode 1		

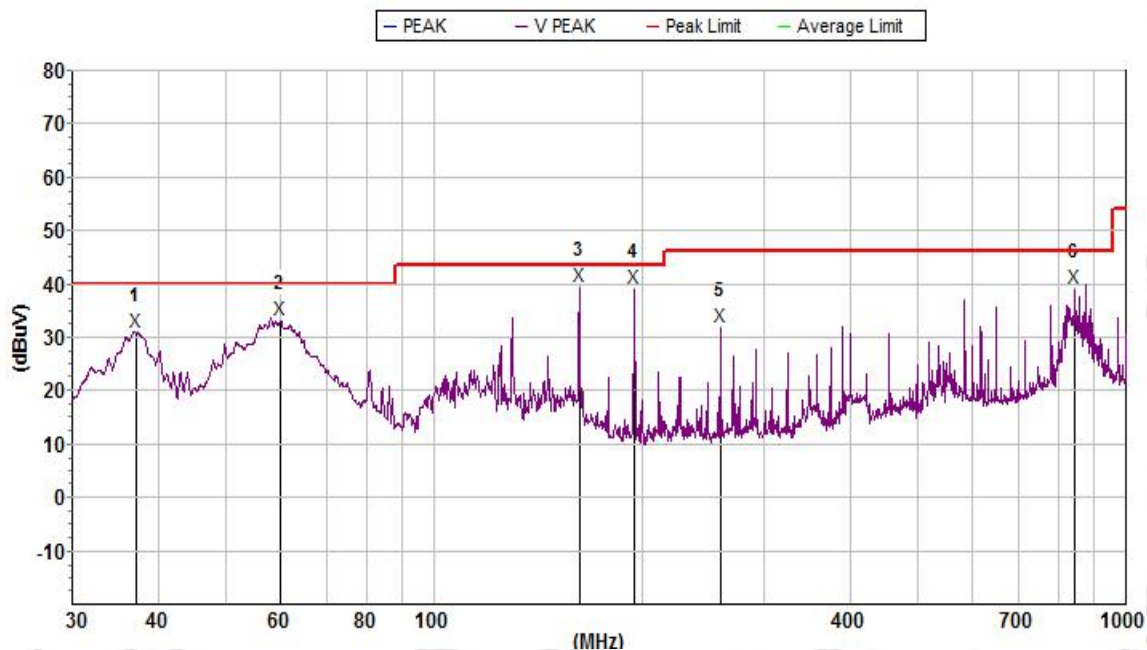
Mode 1- Horizontal



Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin (dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
1	129.694969	31.0	43.5	12.5	12.8	32.9	1.4	H
2	162.325732	38.3	43.5	5.2	13.9	32.9	1.6	H
3	194.794668	43.0	43.5	0.5	10.2	32.8	2.2	H
4	259.688742	34.4	46.0	11.6	11.8	32.8	2.6	H
5	374.622581	32.3	46.0	13.7	13.6	32.4	2.7	H
6	649.659681	44.1	46.0	1.9	16.2	32.3	3.4	H

Temperature	26 °C	Relative Humidity	56%
Test Voltage	DC 7.4V	Polarization	Vertical
Test Mode	Mode 1		

Mode 1- Vertical

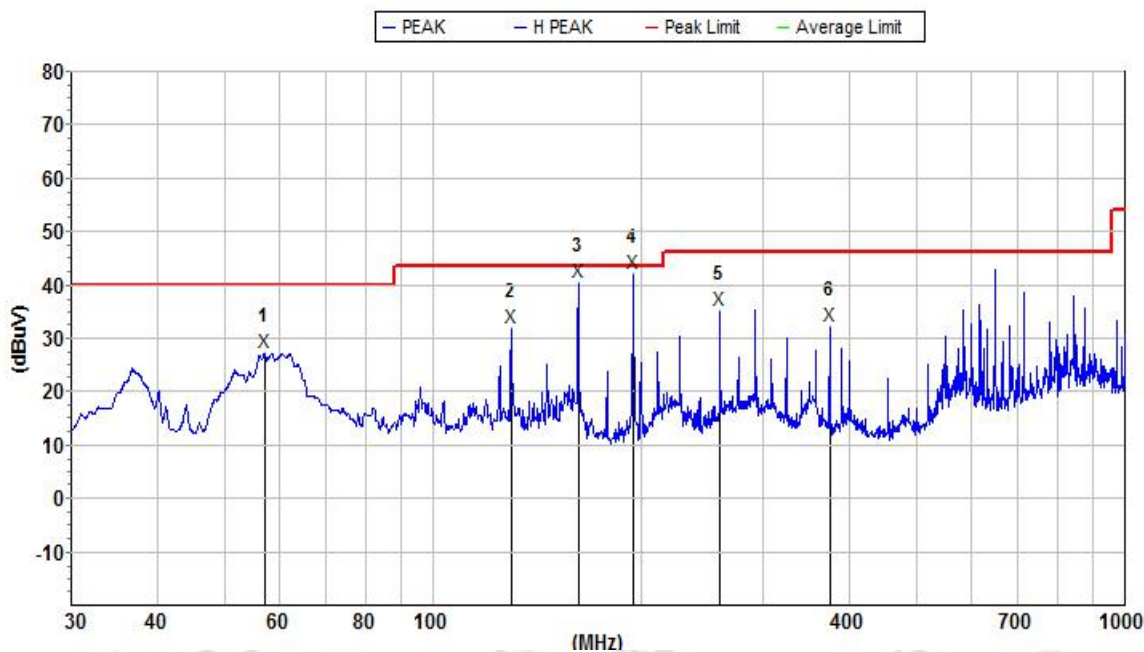


Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin (dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
1	37.154965	31.0	40.0	9.0	13.7	32.3	0.8	V
2	60.069117	33.3	40.0	6.7	12.7	32.7	0.8	V
3	162.325732	39.7	43.5	3.8	13.9	32.9	1.6	V
4	194.794668	39.2	43.5	4.3	10.2	32.8	2.2	V
5	259.688742	32.0	46.0	14.0	11.8	32.8	2.6	V
6	843.607400	39.3	46.0	6.7	21.0	31.9	3.6	V

(30MHz -1000MHz)

Temperature	26 °C	Relative Humidity	56%
Test Voltage	DC 7.4V	Polarization	Horizontal
Test Mode	Mode 2		

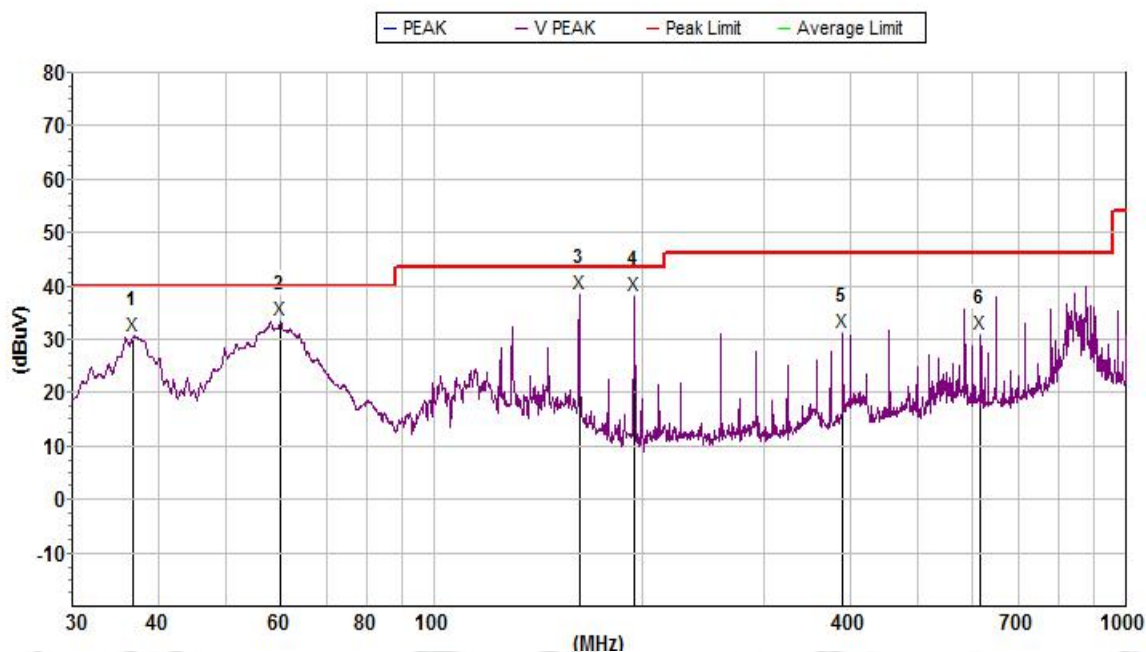
Mode 2- Horizontal



Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin (dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
1	57.091244	27.3	40.0	12.7	13.0	32.7	0.8	H
2	129.694969	31.9	43.5	11.6	12.8	32.9	1.4	H
3	162.325732	40.6	43.5	2.9	13.9	32.9	1.6	H
4	194.794668	42.1	43.5	1.4	10.2	32.8	2.2	H
5	259.688742	35.3	46.0	10.7	11.8	32.8	2.6	H
6	374.622581	32.2	46.0	13.8	13.6	32.4	2.7	H

Temperature	26 °C	Relative Humidity	56%
Test Voltage	DC 7.4V	Polarization	Vertical
Test Mode	Mode 2		

Mode 2-Vertical

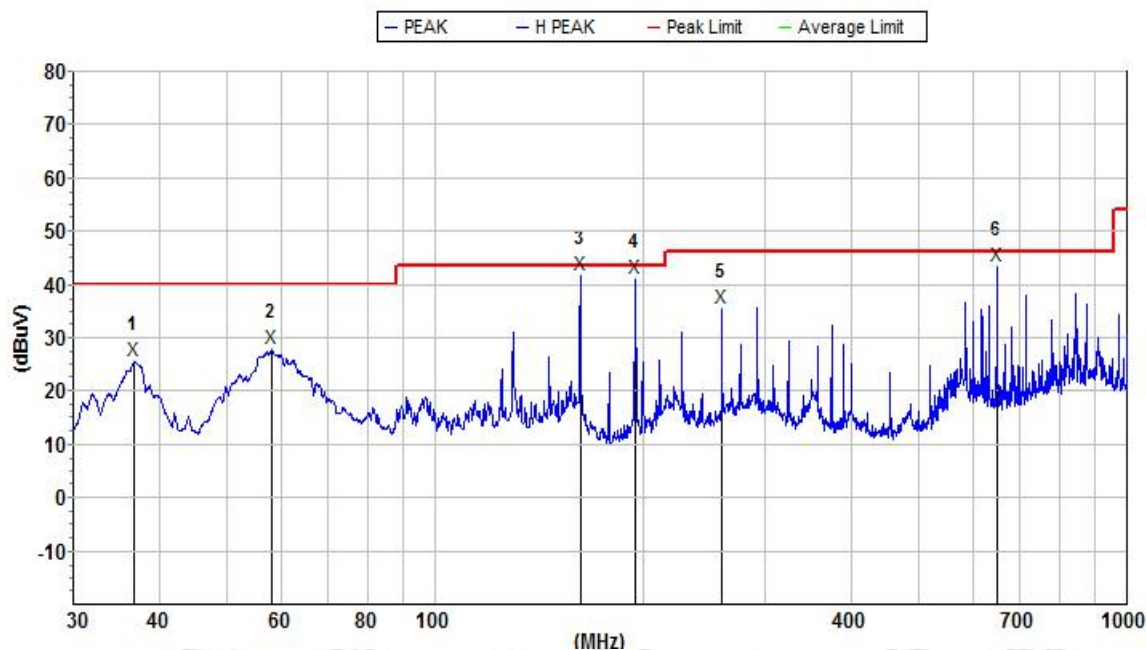


Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin (dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
1	36.830674	30.6	40.0	9.4	13.6	32.3	0.8	V
2	60.069117	33.5	40.0	6.5	12.7	32.7	0.8	V
3	162.325732	38.7	43.5	4.8	13.9	32.9	1.6	V
4	194.794668	38.1	43.5	5.4	10.2	32.8	2.2	V
5	389.354876	31.2	46.0	14.8	14.5	32.4	2.7	V
6	616.371761	31.1	46.0	14.9	18.7	32.3	3.4	V

(30MHz -1000MHz)

Temperature	26 °C	Relative Humidity	56%
Test Voltage	DC 7.4V	Polarization	Horizontal
Test Mode	Mode 3		

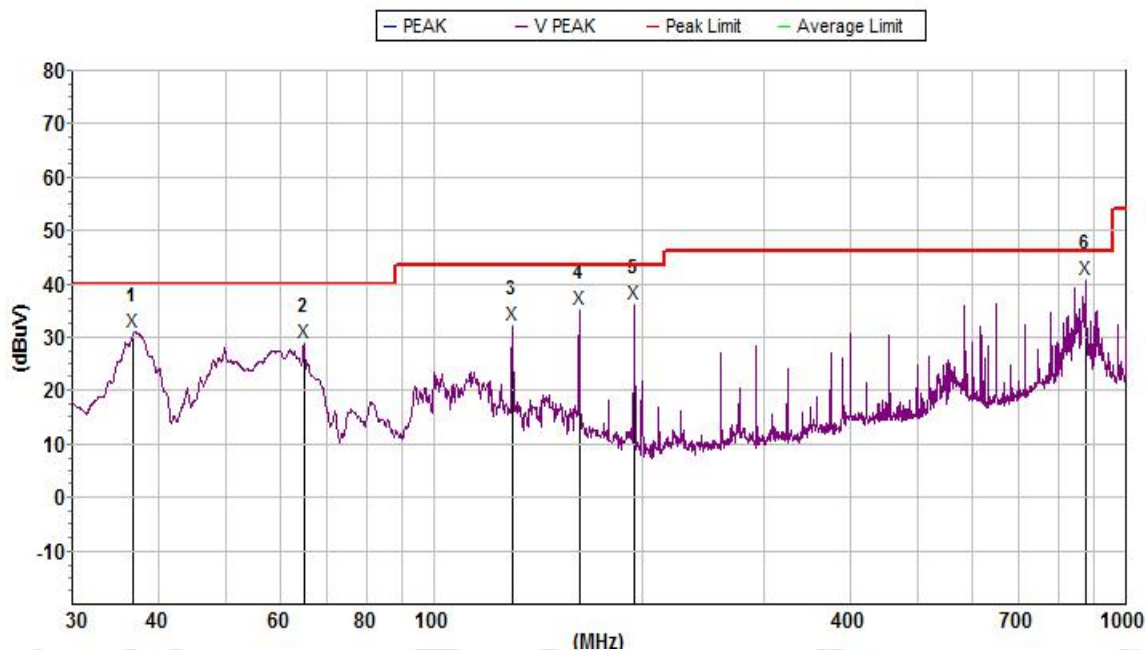
Mode 3- Horizontal



Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin (dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
1	36.766156	25.8	40.0	14.2	13.6	32.3	0.8	H
2	58.101039	28.0	40.0	12.0	12.9	32.7	0.8	H
3	162.325732	41.7	43.5	1.8	13.9	32.9	1.6	H
4	194.794668	41.3	43.5	2.2	10.2	32.8	2.2	H
5	259.688742	35.5	46.0	10.5	11.8	32.8	2.6	H
6	649.659681	43.4	46.0	2.6	16.2	32.3	3.4	H

Temperature	26 °C	Relative Humidity	56%
Test Voltage	DC 7.4V	Polarization	Vertical
Test Mode	Mode 3		

Mode 3-Vertical

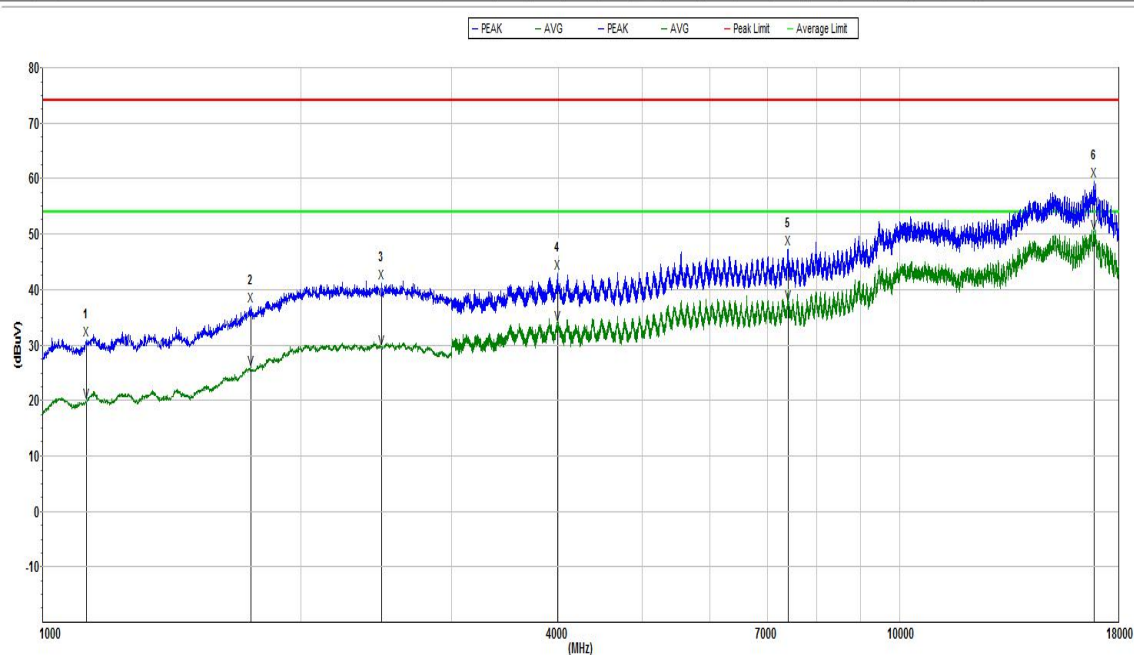


Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin (dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
1	36.766156	31.0	40.0	9.0	13.6	32.3	0.8	V
2	64.886534	29.0	40.0	11.0	11.8	32.8	0.8	V
3	129.694969	32.2	43.5	11.3	12.8	32.9	1.4	V
4	162.325732	35.4	43.5	8.1	13.9	32.9	1.6	V
5	194.794668	36.1	43.5	7.4	10.2	32.8	2.2	V
6	873.713746	40.7	46.0	5.3	21.3	31.8	3.6	V

(1000MHz -18000MHz)

Temperature	26 °C	Relative Humidity	56%
Test Voltage	DC 7.4V	Polarization	Horizontal
Test Mode	Mode 1		

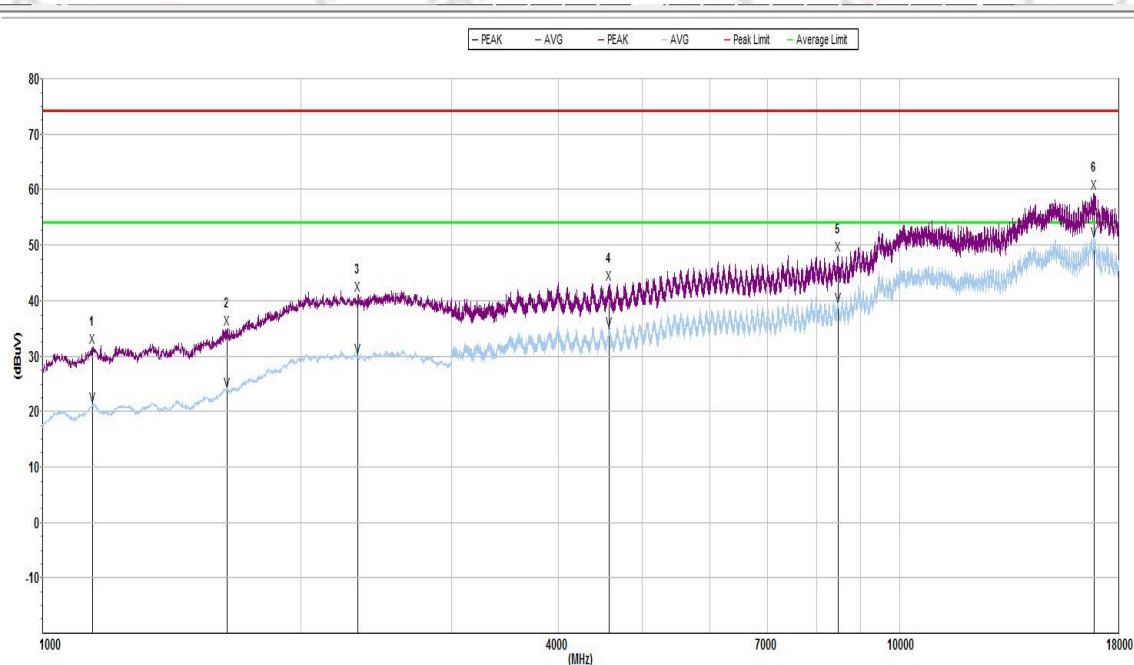
Mode1-Horizontal



Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dB uV/m)	Margin (dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
Peak								
1	1126.000000	30.9	74.0	43.1	20.6	57.3	2.2	H
2	1751.000000	37.2	74.0	36.8	21.6	53.7	2.6	H
3	2488.000000	41.2	74.0	32.8	22.9	50.2	2.8	H
4	3986.250000	43.1	74.0	30.9	24.3	50.1	3.3	H
5	7407.750000	47.4	74.0	26.6	25.7	48.8	4.6	H
6	16841.250000	59.6	74.0	14.4	30.9	47.4	6.8	H
Avg								
1	1126.000000	19.9	54.0	34.1	20.6	57.3	2.2	H
2	1751.000000	25.8	54.0	28.2	21.6	53.7	2.6	H
3	2488.000000	29.5	54.0	24.5	22.9	50.2	2.8	H
4	3986.250000	33.9	54.0	20.1	24.3	50.1	3.3	H
5	7407.750000	37.6	54.0	16.4	25.7	48.8	4.6	H
6	16841.250000	50.2	54.0	3.8	30.9	47.4	6.8	H

Temperature	26 °C	Relative Humidity	56%
Test Voltage	DC 7.4V	Polarization	Vertical
Test Mode	Mode 1		

Mode 1- Vertical

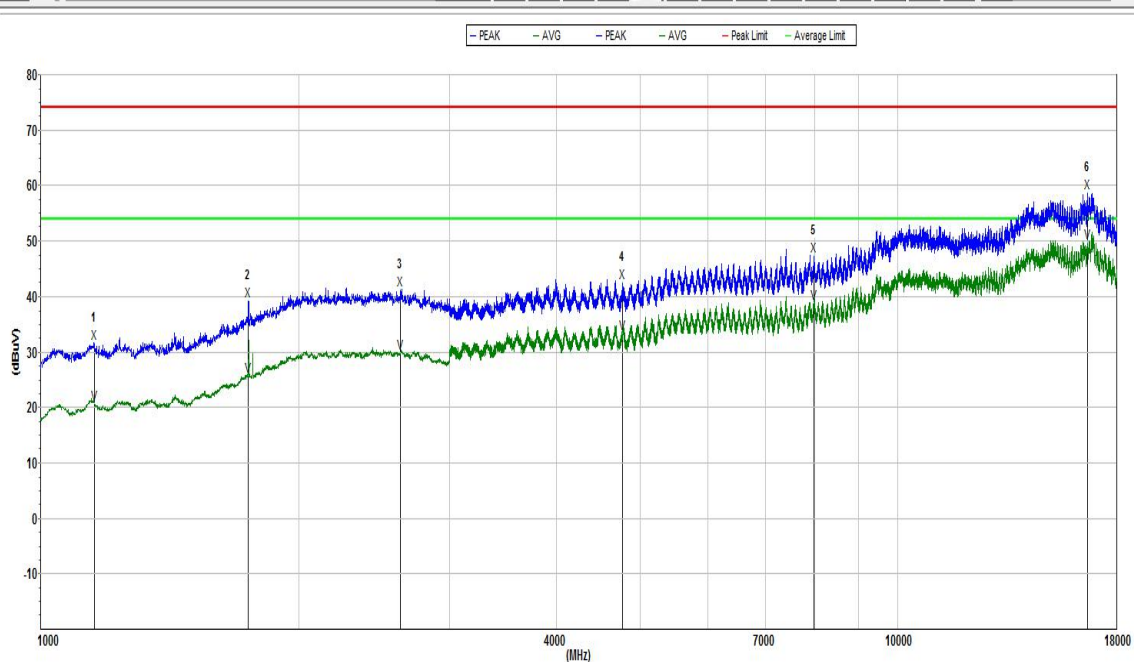


Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dB uV/m)	Margin (dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
Peak								
1	1143.000000	31.7	74.0	42.3	20.7	57.3	2.2	V
2	1640.000000	35.0	74.0	39.0	21.3	55.3	2.5	V
3	2331.000000	41.1	74.0	32.9	23.0	50.2	2.8	V
4	4584.000000	43.1	74.0	30.9	25.0	49.9	3.6	V
5	8477.250000	48.2	74.0	25.8	27.1	48.6	5.1	V
6	16835.250000	59.4	74.0	14.6	31.4	47.4	6.8	V
Avg								
1	1143.000000	21.1	54.0	32.9	20.7	57.3	2.2	V
2	1640.000000	23.7	54.0	30.3	21.3	55.3	2.5	V
3	2331.000000	29.8	54.0	24.2	23.0	50.2	2.8	V
4	4584.000000	34.6	54.0	19.4	25.0	49.9	3.6	V
5	8477.250000	39.1	54.0	14.9	27.1	48.6	5.1	V
6	16835.250000	50.9	54.0	3.1	31.4	47.4	6.8	V

(1000MHz -18000MHz)

Temperature	26 °C	Relative Humidity	56%
Test Voltage	DC 7.4V	Polarization	Horizontal
Test Mode	Mode 2		

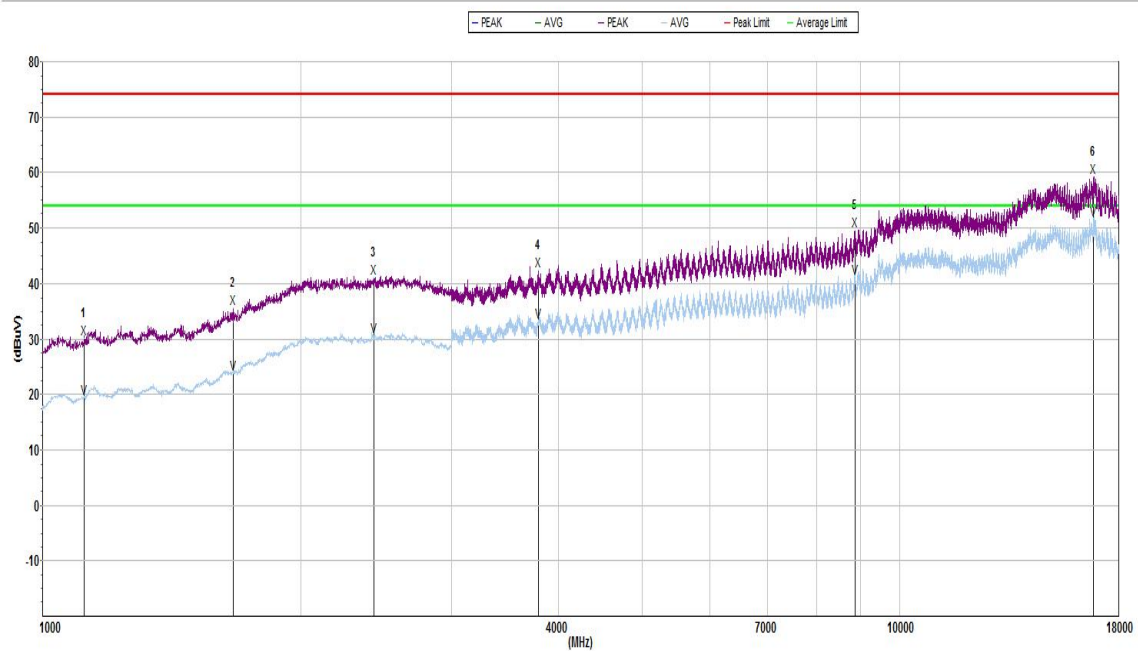
Mode2-Horizontal



Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dB uV/m)	Margin (dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
Peak								
1	1155.000000	31.7	74.0	42.3	20.8	57.3	2.2	H
2	1747.000000	39.2	74.0	34.8	21.6	53.7	2.6	H
3	2630.000000	41.3	74.0	32.7	23.2	50.6	2.9	H
4	4770.750000	42.5	74.0	31.5	24.7	49.6	3.6	H
5	7979.250000	47.5	74.0	26.5	26.1	48.6	4.9	H
6	16633.500000	58.7	74.0	15.3	30.9	47.7	6.8	H
Avg								
1	1155.000000	20.6	54.0	33.4	20.8	57.3	2.2	H
2	1747.000000	25.7	54.0	28.3	21.6	53.7	2.6	H
3	2630.000000	29.9	54.0	24.1	23.2	50.6	2.9	H
4	4770.750000	33.4	54.0	20.6	24.7	49.6	3.6	H
5	7979.250000	38.8	54.0	15.2	26.1	48.6	4.9	H
6	16633.500000	49.9	54.0	4.1	30.9	47.7	6.8	H

Temperature	26 °C	Relative Humidity	56%
Test Voltage	DC 7.4V	Polarization	Vertical
Test Mode	Mode 2		

Mode2-Vertical

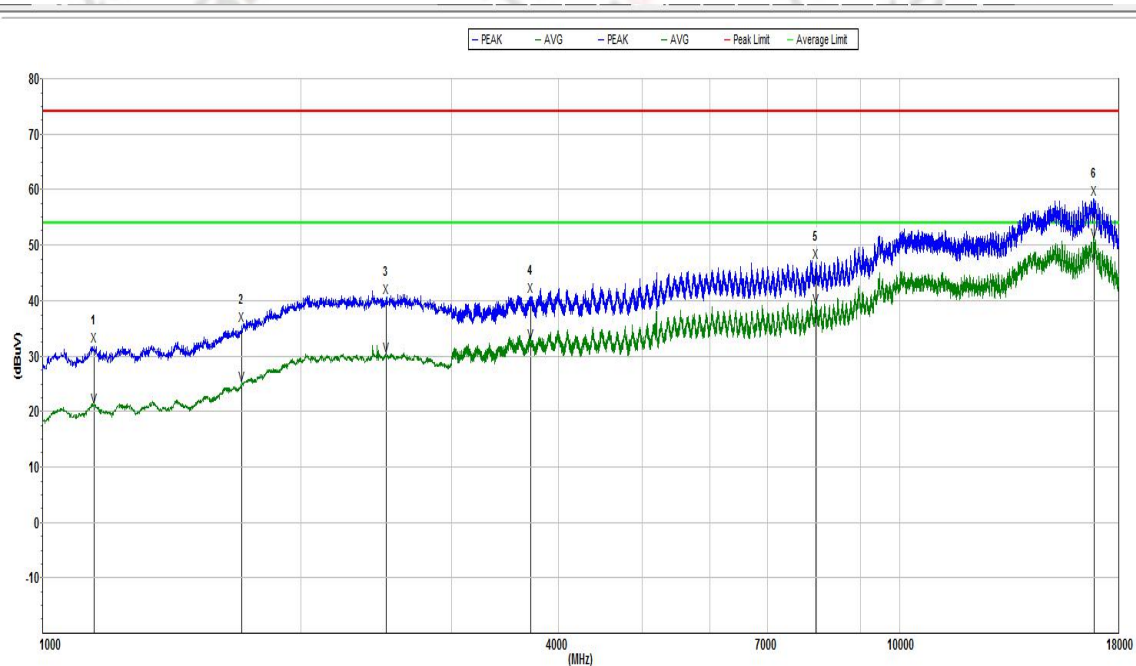


Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin (dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
Peak								
1	1117.350034	30.1	74.0	43.9	20.5	57.3	2.2	V
2	1668.000000	35.6	74.0	38.4	21.4	54.9	2.5	V
3	2435.000000	41.0	74.0	33.0	23.2	50.2	2.8	V
4	3789.000000	42.3	74.0	31.7	24.7	50.3	3.2	V
5	8861.250000	49.6	74.0	24.4	27.4	48.6	5.3	V
6	16826.250000	59.2	74.0	14.8	31.4	47.4	6.8	V
Avg								
1	1117.350034	19.4	54.0	34.6	20.5	57.3	2.2	V
2	1668.000000	23.7	54.0	30.3	21.4	54.9	2.5	V
3	2435.000000	30.6	54.0	23.4	23.2	50.2	2.8	V
4	3789.000000	33.1	54.0	20.9	24.7	50.3	3.2	V
5	8861.250000	41.1	54.0	12.9	27.4	48.6	5.3	V
6	16826.250000	51.5	54.0	2.5	31.4	47.4	6.8	V

(1000MHz -18000MHz)

Temperature	26 °C	Relative Humidity	56%
Test Voltage	DC 7.4V	Polarization	Horizontal
Test Mode	Mode 3		

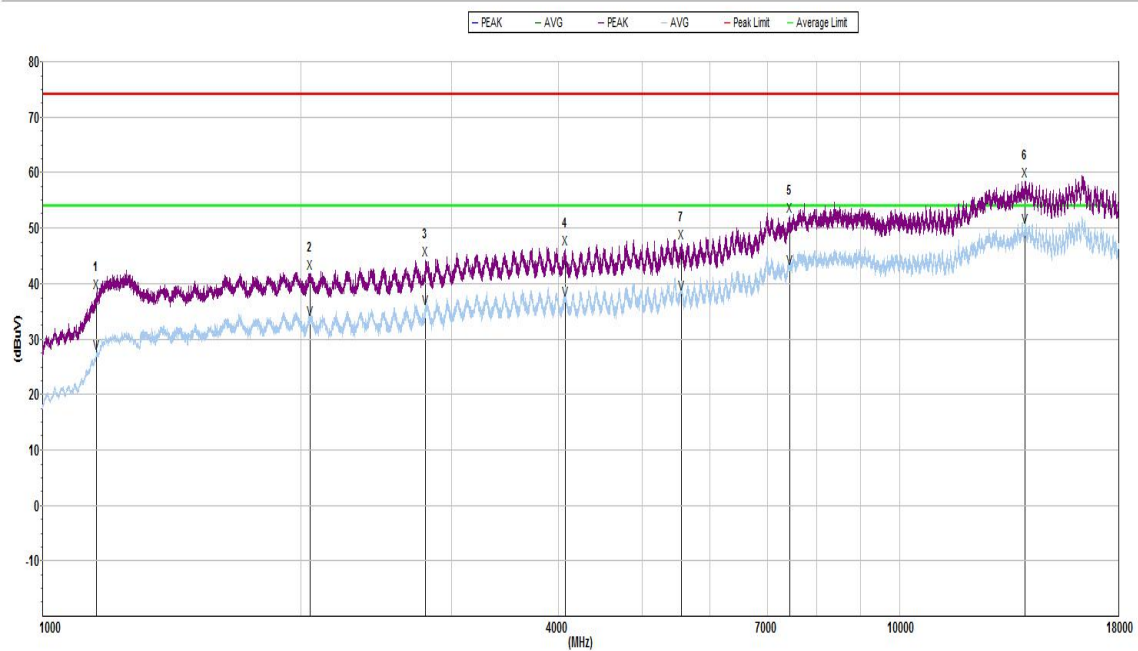
Mode 3- Horizontal



Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dB uV/m)	Margin (dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
Peak								
1	1149.000000	31.9	74.0	42.1	20.8	57.3	2.2	H
2	1707.000000	35.5	74.0	38.5	21.4	54.3	2.6	H
3	2514.000000	40.7	74.0	33.3	22.9	50.2	2.8	H
4	3706.653671	40.8	74.0	33.2	24.3	50.3	3.2	H
5	7979.250000	47.0	74.0	27.0	26.1	48.6	4.9	H
6	16833.750000	58.4	74.0	15.6	30.9	47.4	6.8	H
Avg								
1	1149.000000	21.0	54.0	33.0	20.8	57.3	2.2	H
2	1707.000000	24.8	54.0	29.2	21.4	54.3	2.6	H
3	2514.000000	30.2	54.0	23.8	22.9	50.2	2.8	H
4	3706.653671	32.6	54.0	21.4	24.3	50.3	3.2	H
5	7979.250000	38.9	54.0	15.1	26.1	48.6	4.9	H
6	16833.750000	50.7	54.0	3.3	30.9	47.4	6.8	H

Temperature	26 °C	Relative Humidity	56%
Test Voltage	DC 7.4V	Polarization	Vertical
Test Mode	Mode 3		

Mode 3- Vertical



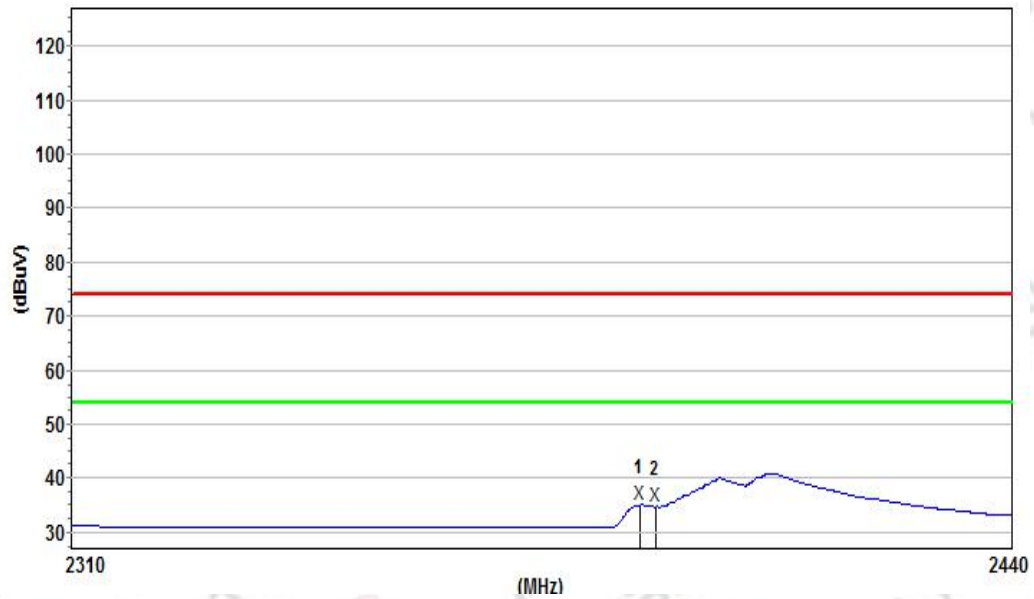
Mk.	Freq.(MHz)	Level(dBuV/m)	Limit(dBuV/m)	Margin (dB)	Ant.F/G.(dB/m)	Amp.G.(dB)	Cbl.L.(dB)	Pol.
Peak								
1	1156.394380	38.5	74.0	35.5	20.8	57.3	2.2	V
2	2051.395192	41.9	74.0	32.1	22.2	50.1	2.7	V
3	2798.188786	44.4	74.0	29.6	24.0	51.2	2.9	V
4	4066.901254	46.4	74.0	27.6	24.8	50.1	3.3	V
5	7442.686001	52.3	74.0	21.7	26.5	48.8	4.6	V
6	14001.607942	58.5	74.0	15.5	30.7	47.4	6.2	V
Avg								
1	1156.394380	27.5	54.0	26.5	20.8	57.3	2.2	V
2	2051.395192	33.6	54.0	20.4	22.2	50.1	2.7	V
3	2798.188786	35.5	54.0	18.5	24.0	51.2	2.9	V
4	4066.901254	37.1	54.0	16.9	24.8	50.1	3.3	V
5	7442.686001	42.9	54.0	11.1	26.5	48.8	4.6	V
6	14001.607942	50.3	54.0	3.7	30.7	47.4	6.2	V

Note:

1. Factor=Ant.Factor+cable loss-Amp.Gain .
2. Level contains the factor; Margin=Limit-Level.
3. Other 18G-25G Emission detected are more than 20dB below the limit.

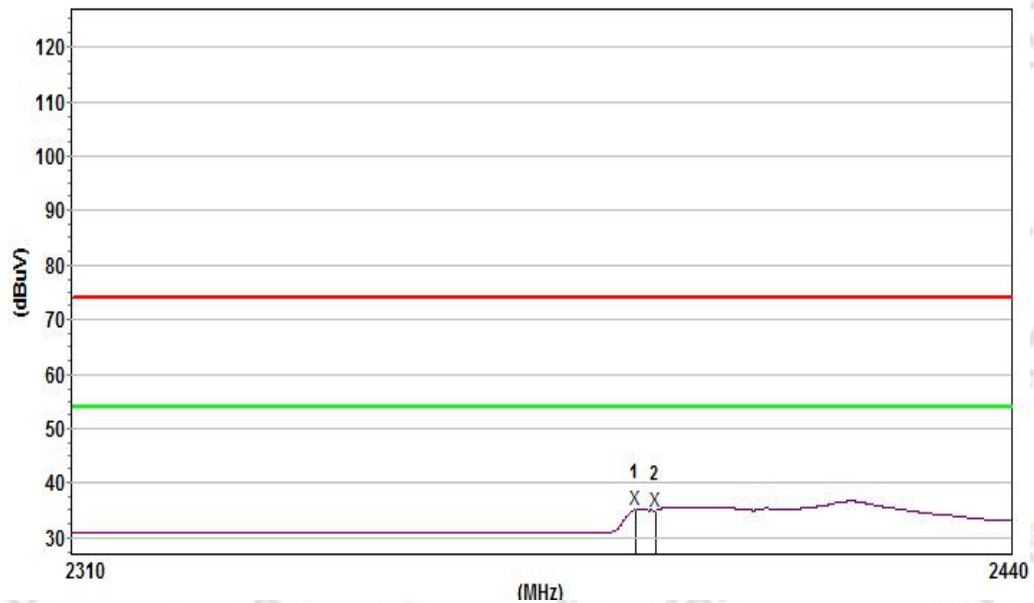
4.6 TEST RESULTS (Restricted Bands Requirements)

GFSK-Low Horizontal



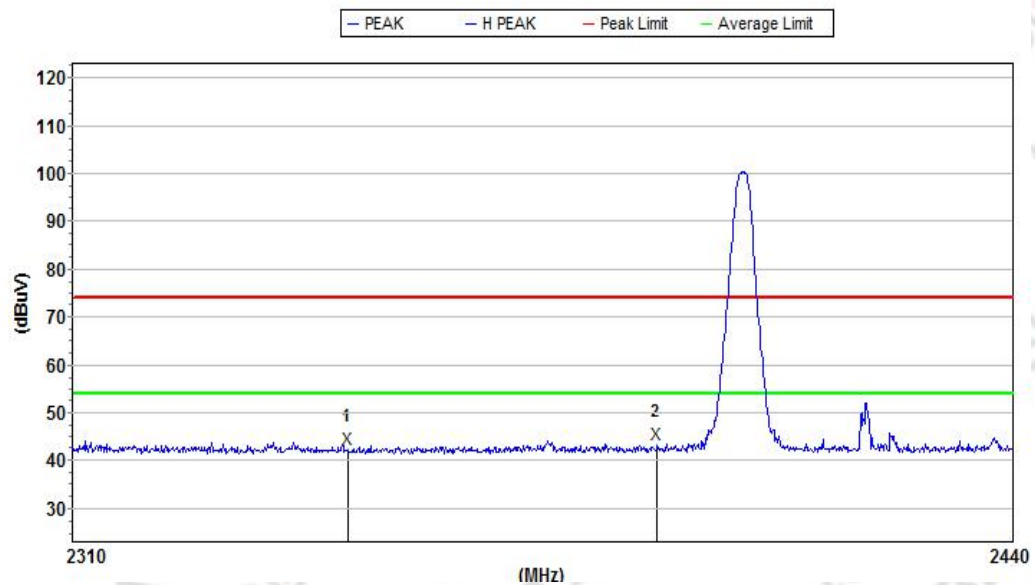
Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
AVG								
1	2387.797961	35.1	54.0	18.9	22.8	50.2	2.8	H
2	2390.000000	34.8	54.0	19.2	22.8	50.2	2.8	H

Vertical



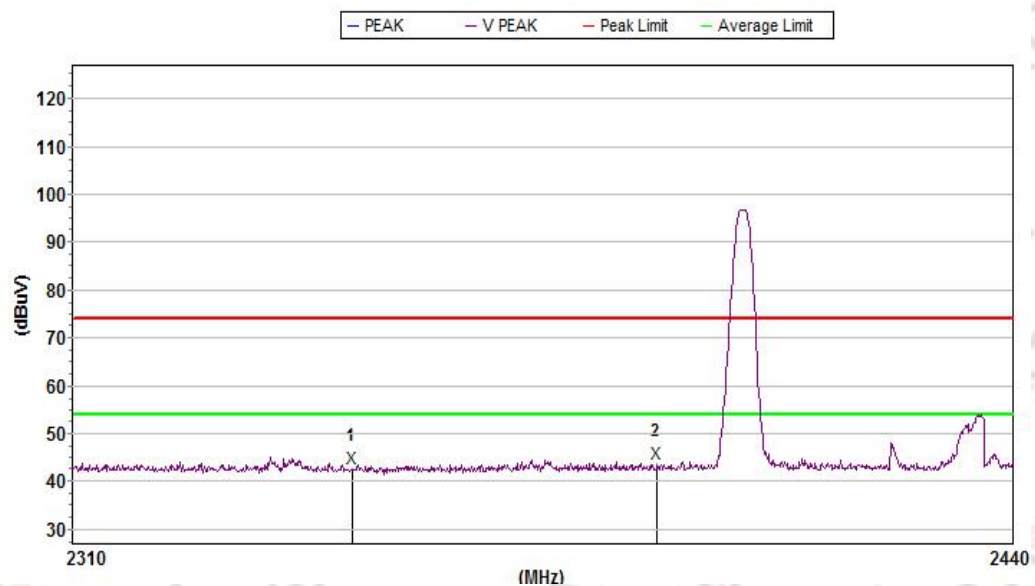
Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
AVG								
1	2387.144385	35.3	54.0	18.7	23.1	50.2	2.8	V
2	2390.000000	35.0	54.0	19.0	23.1	50.2	2.8	V

GFSK-Low Horizontal



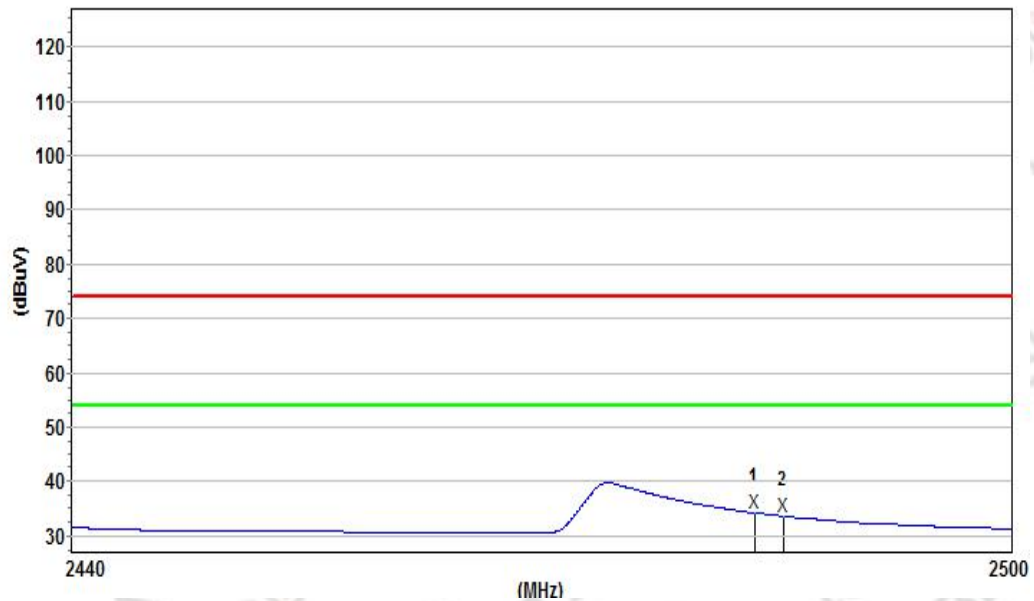
Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
Peak:								
1	2347.355617	42.3	74.0	31.7	22.7	50.2	2.8	H
2	2390.000000	43.5	74.0	30.5	22.8	50.2	2.8	H

Vertical



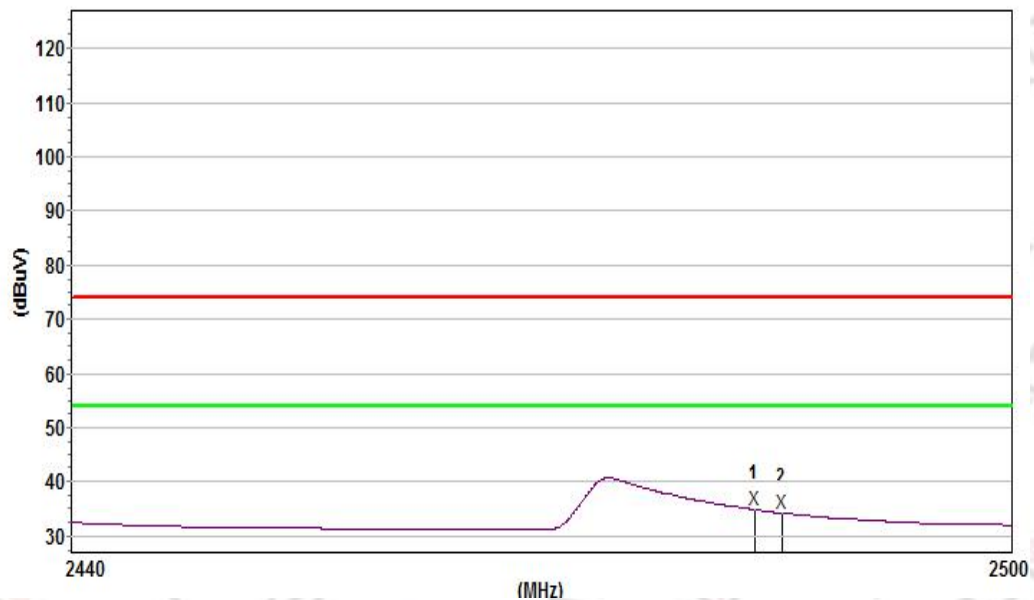
Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
Peak:								
1	2347.869749	42.7	74.0	31.3	23.0	50.2	2.8	V
2	2390.000000	43.7	74.0	30.3	23.1	50.2	2.8	V

GFSK-High Horizontal



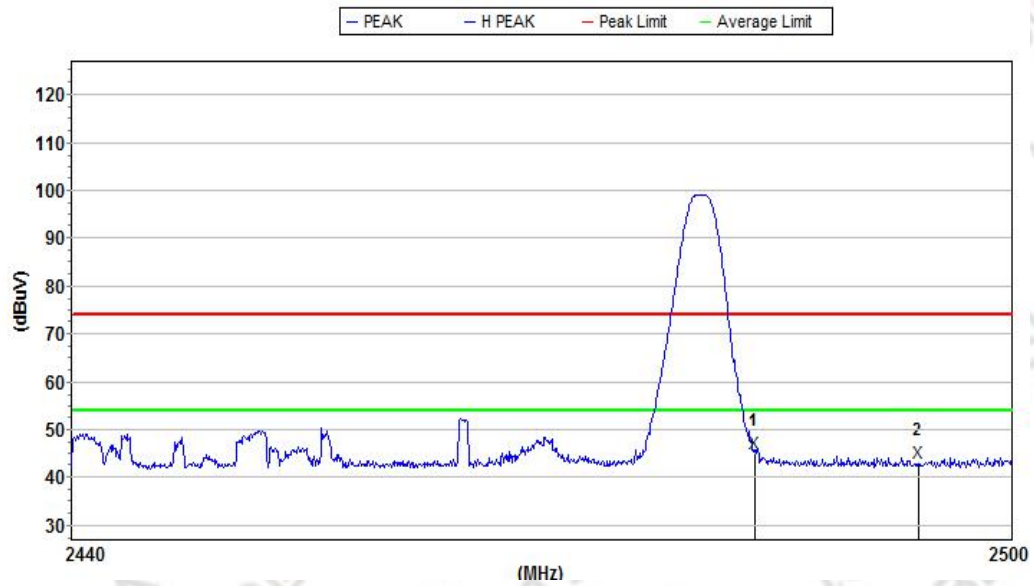
Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
AVG								
1	2483.500000	34.2	54.0	19.8	22.9	50.2	2.8	H
2	2485.285662	33.6	54.0	20.4	22.9	50.2	2.8	H

Vertical



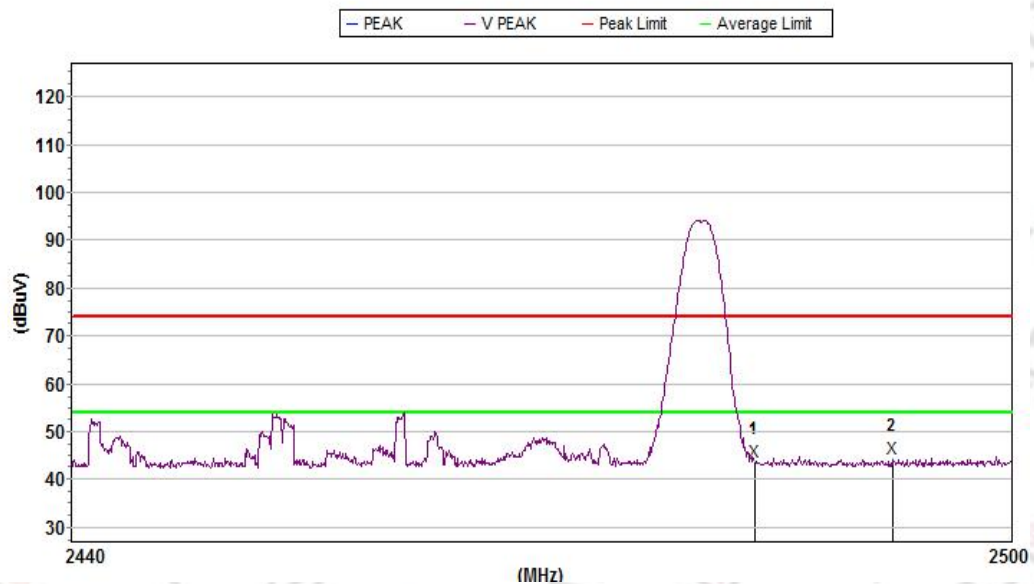
Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
AVG								
1	2483.500000	34.9	54.0	19.1	23.3	50.2	2.8	V
2	2485.225289	34.3	54.0	19.7	23.3	50.2	2.8	V

GFSK-High Horizontal



Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
Peak:								
1	2483.500000	45.2	74.0	28.8	2.8	22.9	50.2	H
2	2493.934198	43.0	74.0	31.0	2.8	22.9	50.2	H

Vertical



Mk.	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Ant.F/G. (dB/m)	Amp.G. (dB)	Cbl.L. (dB)	Pol.
Peak:								
1	2483.500000	43.8	74.0	30.2	23.3	50.2	2.8	V
2	2492.298956	44.3	74.0	29.7	23.3	50.2	2.8	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.

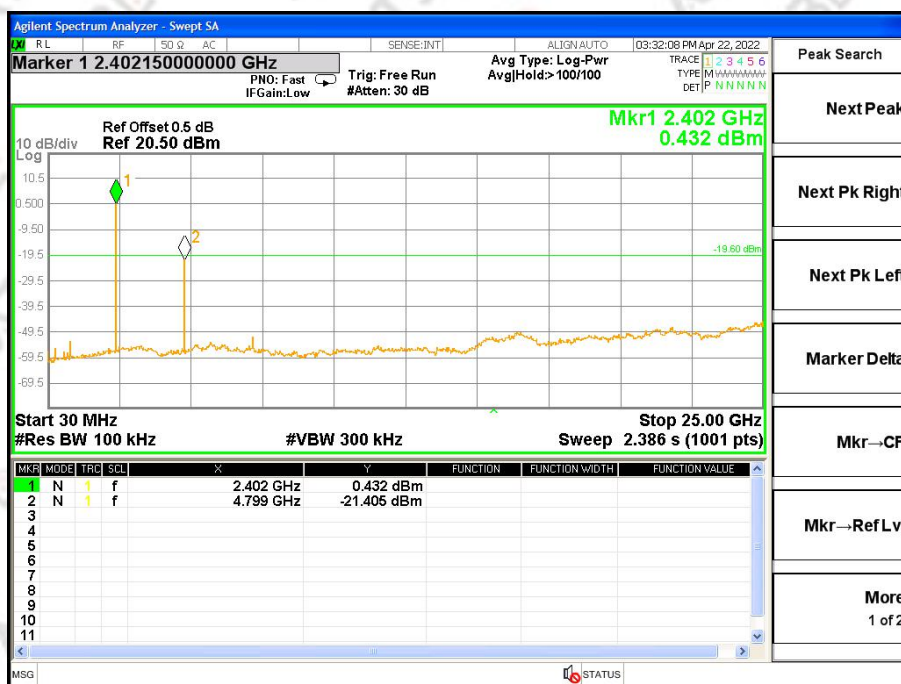
5.4 EUT OPERATION CONDITIONS

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.

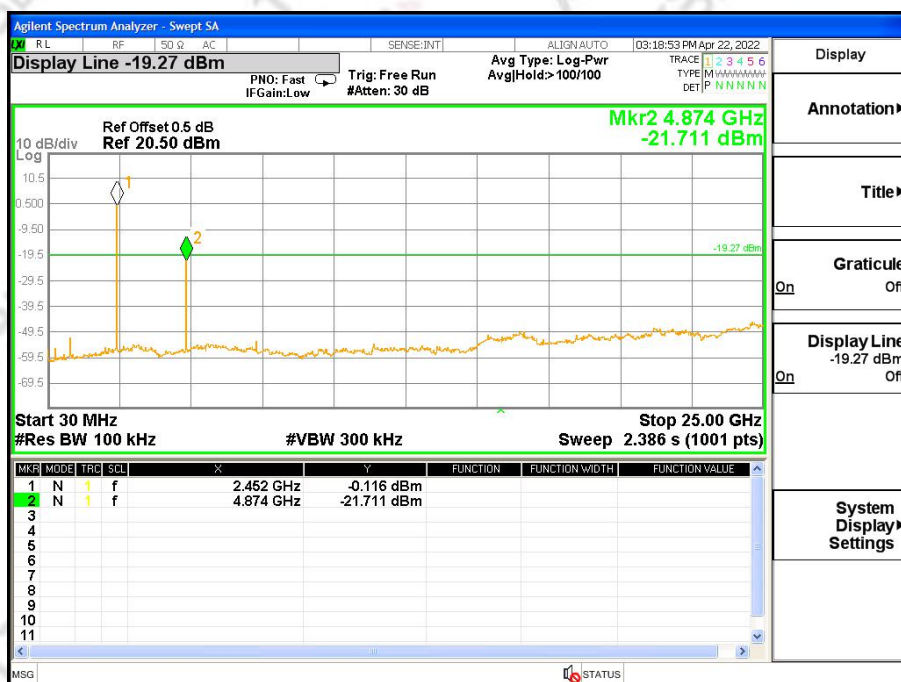
5.5 TEST RESULTS

Temperature:	25 °C	Relative Humidity:	50%RH
Test Voltage:	DC 7.4V	Test Mode:	TX Mode 1/2/3

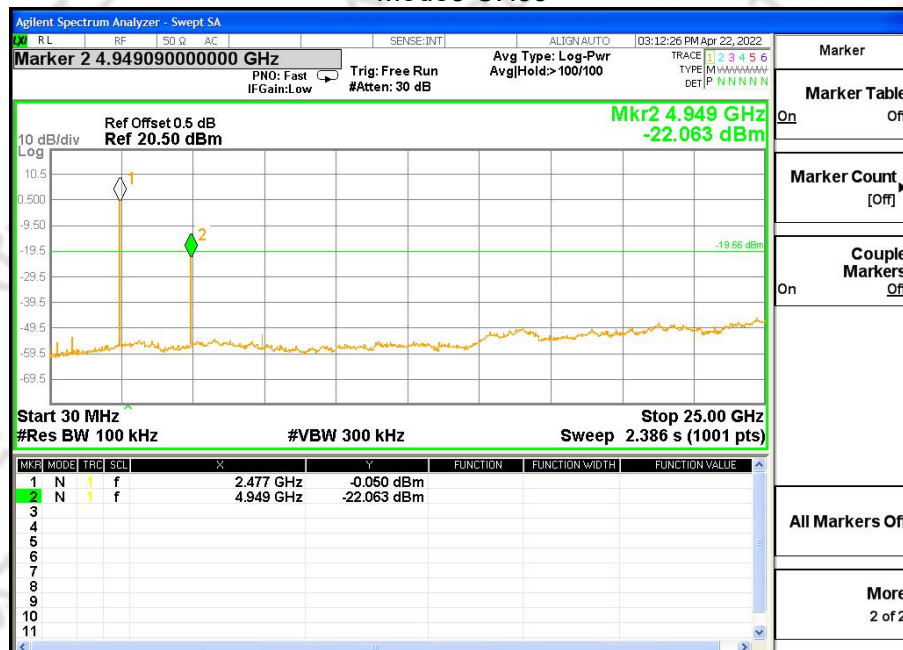
Mode1 CH37



Mode2 CH17

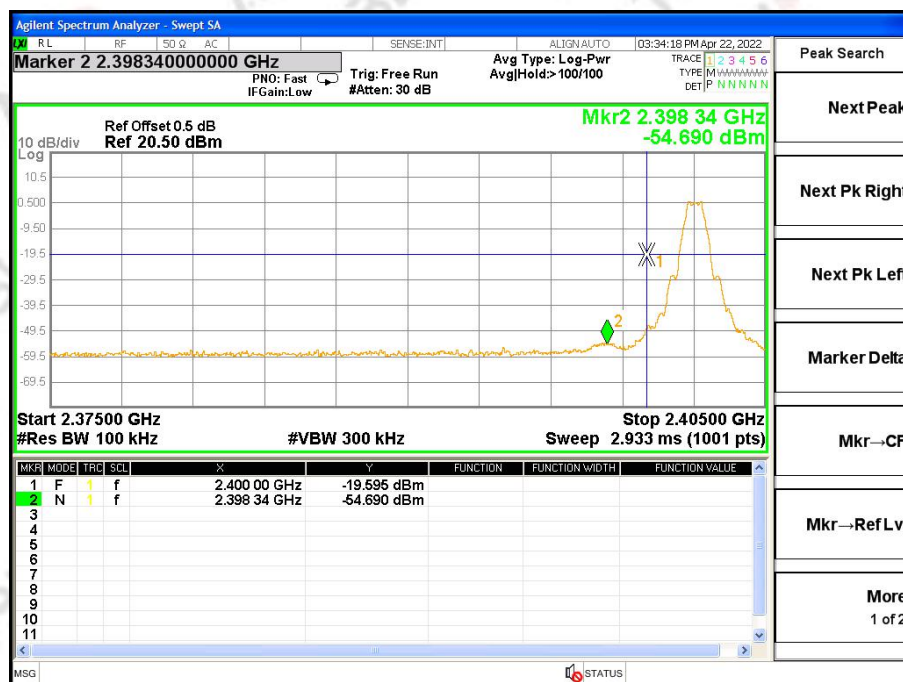


Mode3 CH39

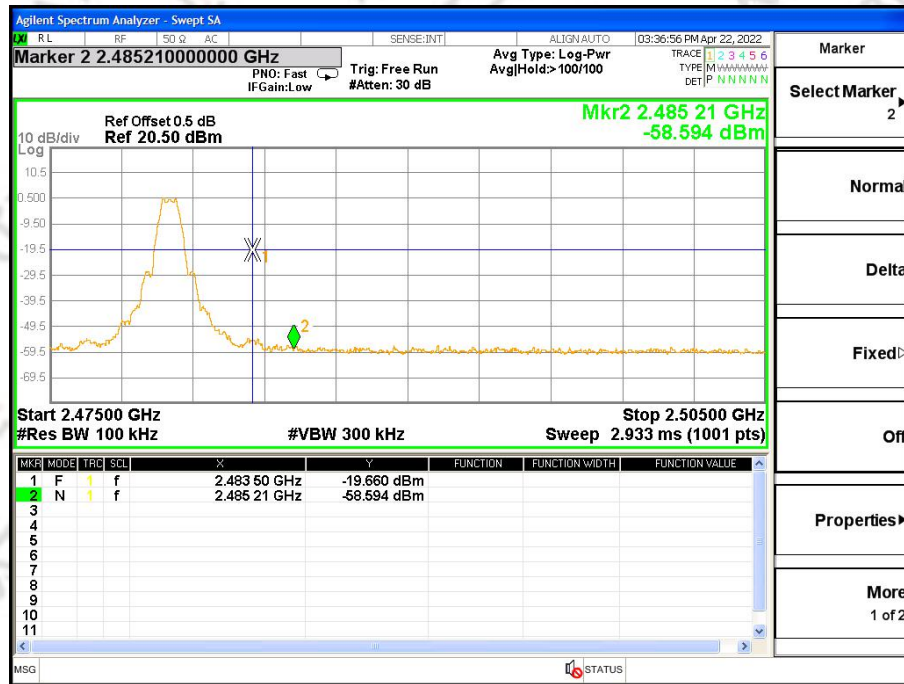


For Band edge(it's also the reference level for conducted spurious emission)

Mode1 CH37



Mode3 CH39



6. POWER SPECTRAL DENSITY TEST

6.1 LIMIT

FCC Part 15.247, Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(e) RSS-247 Clause 5.2(b)	Power Spectral Density	≤ 8 dBm (RBW ≥ 3 KHz)	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: $100 \text{ kHz} \geq \text{RBW} \geq 3 \text{ kHz}$.
4. Set the VBW $\geq 3 \times \text{RBW}$.
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

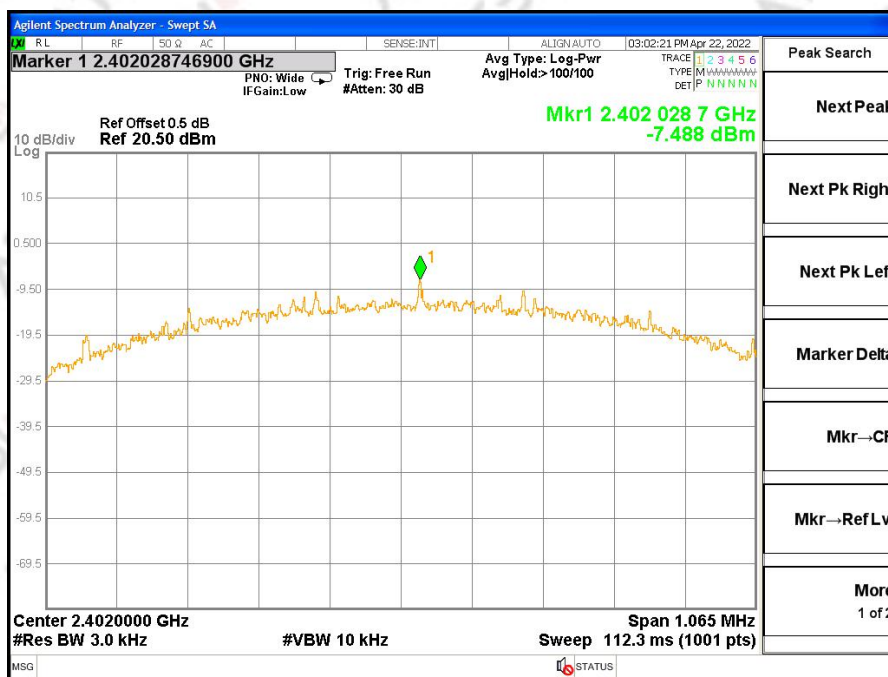
The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

6.5 TEST RESULTS

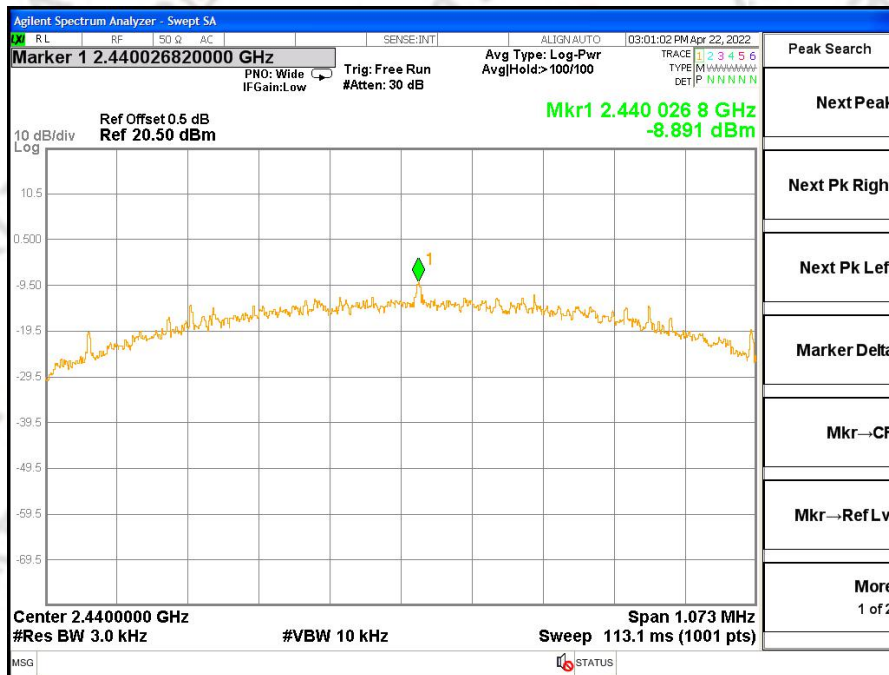
Temperature:	25 °C	Relative Humidity:	60%RH
Test Voltage:	DC 7.4V	Test Mode:	TX Mode1/2/3

Frequency	Power Density	Limit (3KHz/dBm)	Result
	(dBm/3kHz)		
2402 MHz	-7.488	≤8	PASS
2440 MHz	-8.891	≤8	PASS
2480 MHz	-11.119	≤8	PASS

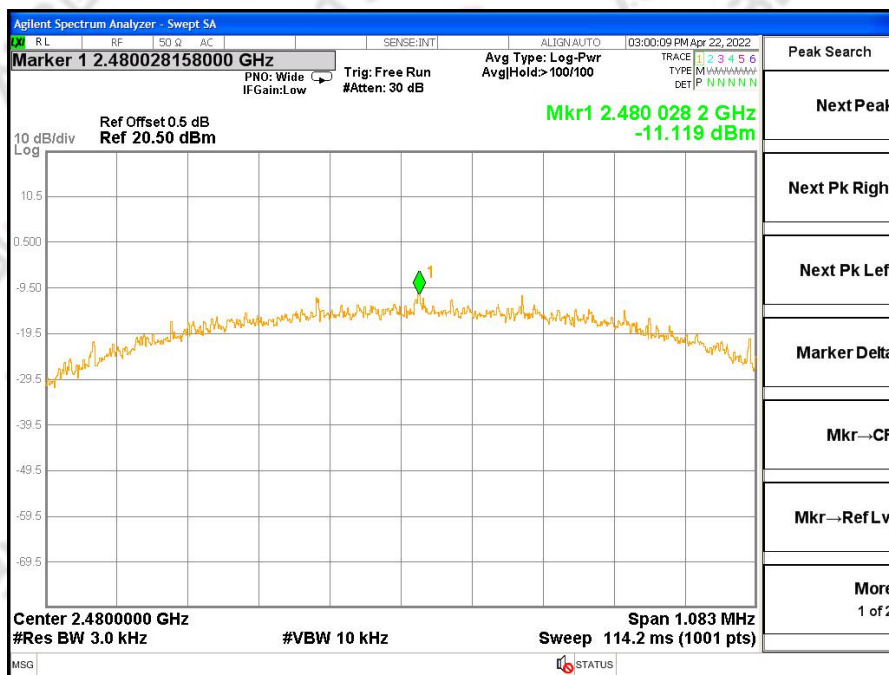
Mode1 CH37



Mode2 CH17



Mode3 CH39



7. BANDWIDTH TEST

7.1 LIMIT

FCC Part 15.247, Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(2)	Bandwidth	$\geq 500\text{KHz}$ (6dB bandwidth)	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 : $\geq 3 \times \text{RBW}$ For 99% Bandwidth : approximately $3 \times \text{RBW}$
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

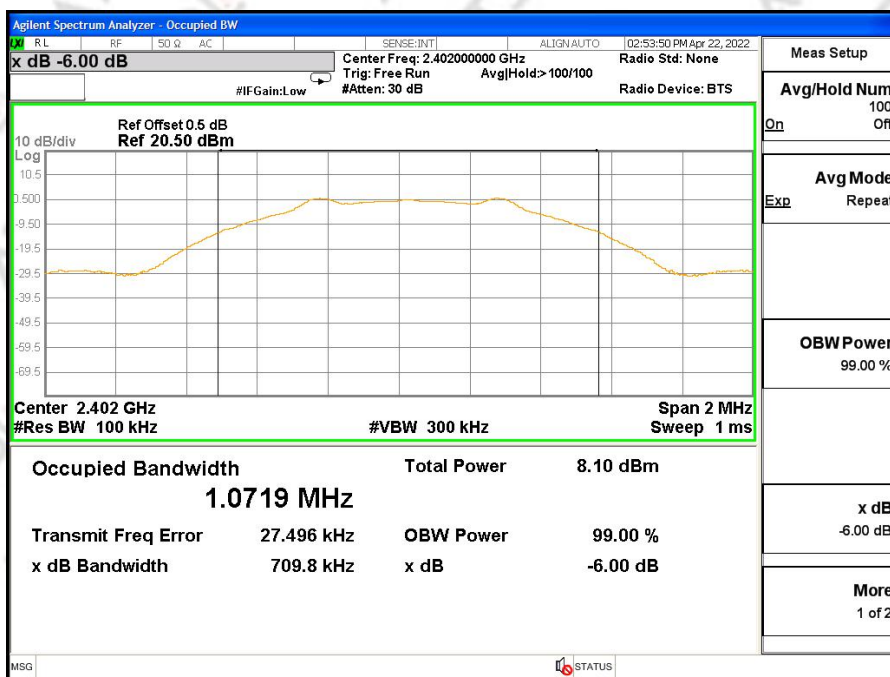
The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

7.5 TEST RESULTS

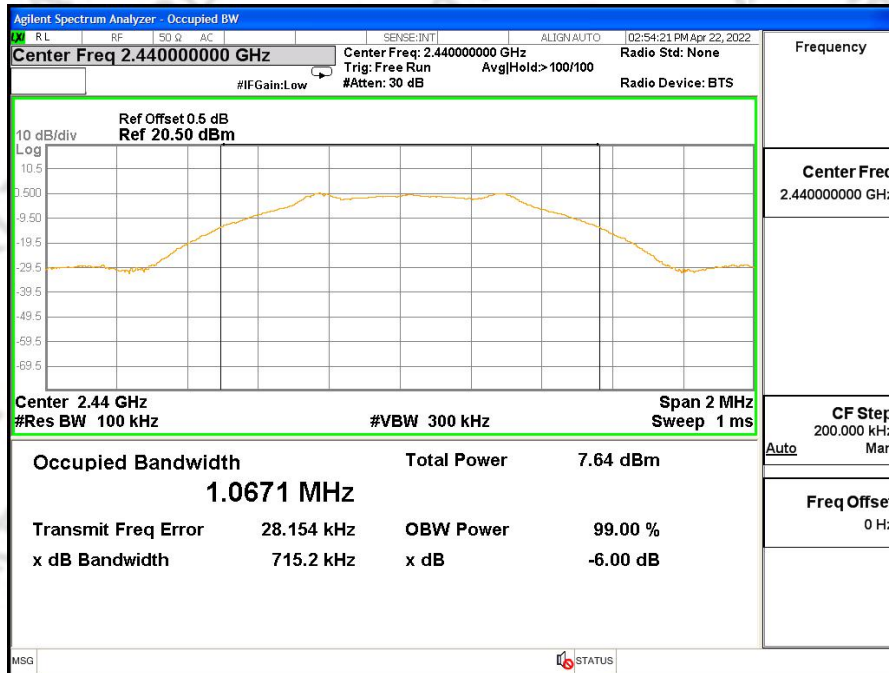
Temperature:	25 °C	Relative Humidity:	60%RH
Test Voltage:	DC 7.4V	Test Mode:	TX Mode1/2/3

Frequency	6dB Bandwidth (KHz)	99% Bandwidth (KHz)	6dB Bandwidth Limit(KHz)	Result
2402 MHz	709.8	1046.9	≥500KHz	PASS
2440 MHz	715.2	1052.0	≥500KHz	PASS
2480 MHz	722.0	1053.0	≥500KHz	PASS

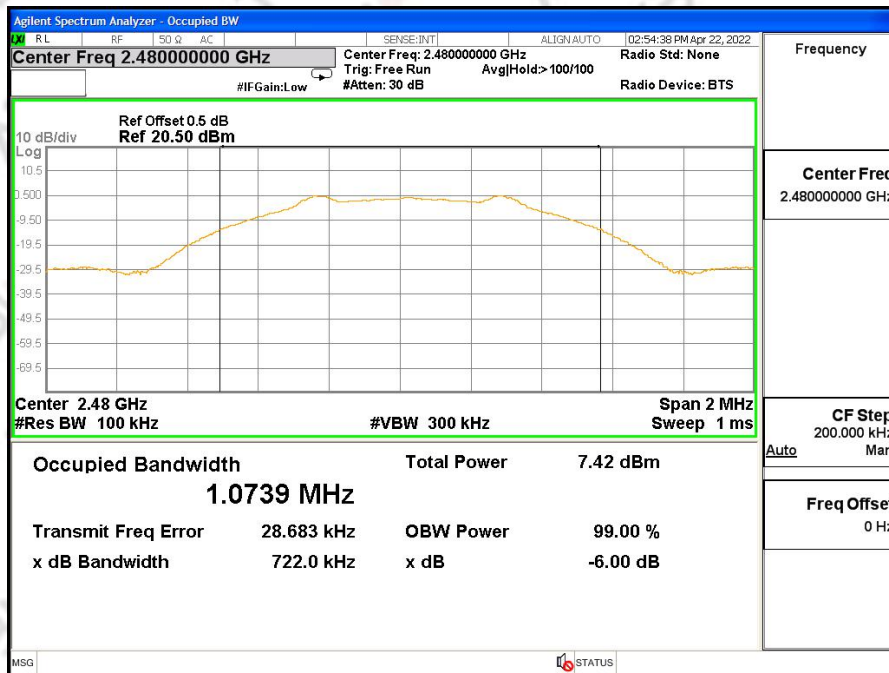
6dB Bandwidth Mode1 CH37



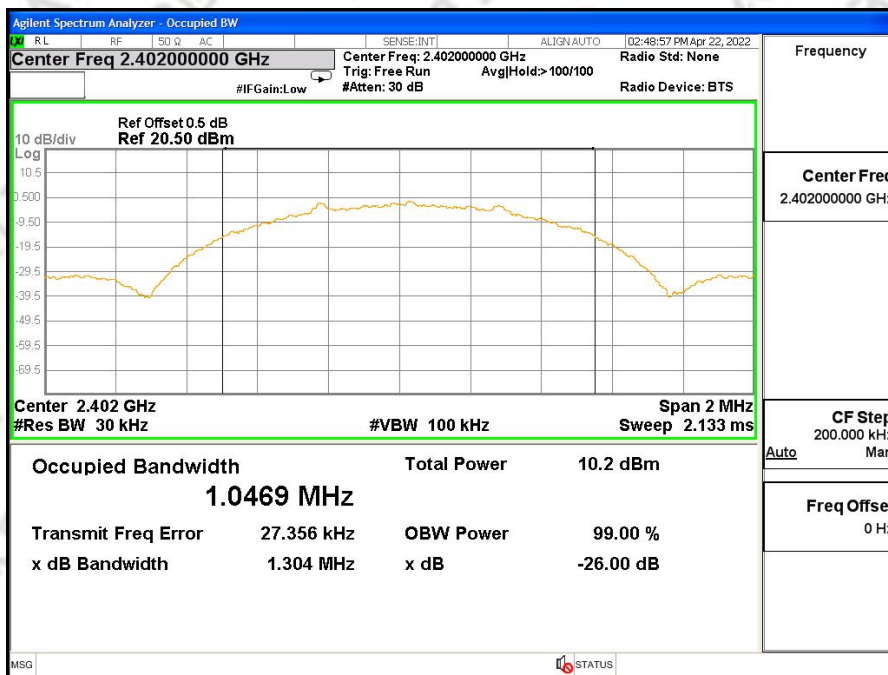
6dB Bandwidth Mode2 CH17



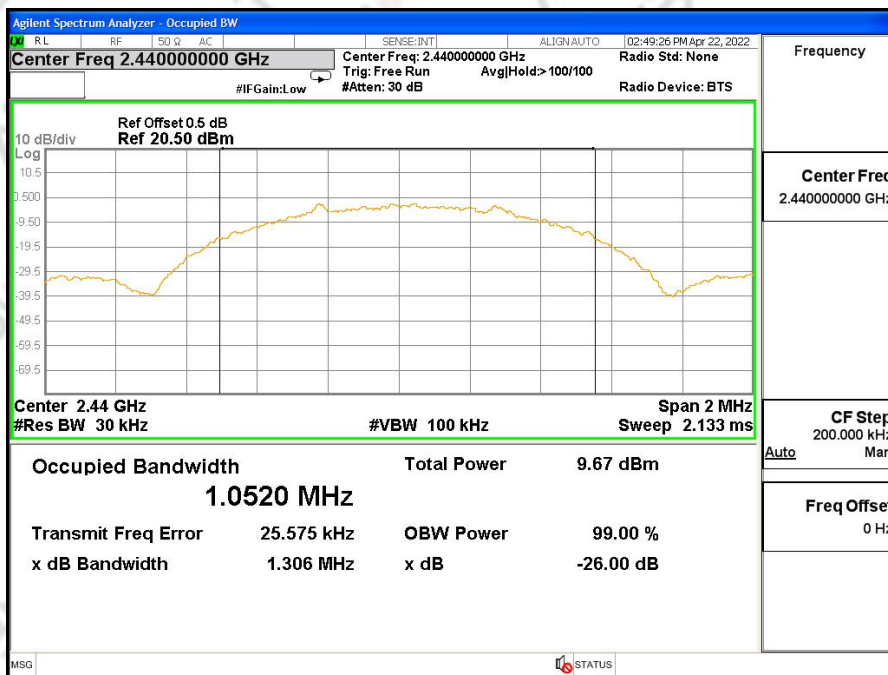
6dB Bandwidth Mode3 CH39



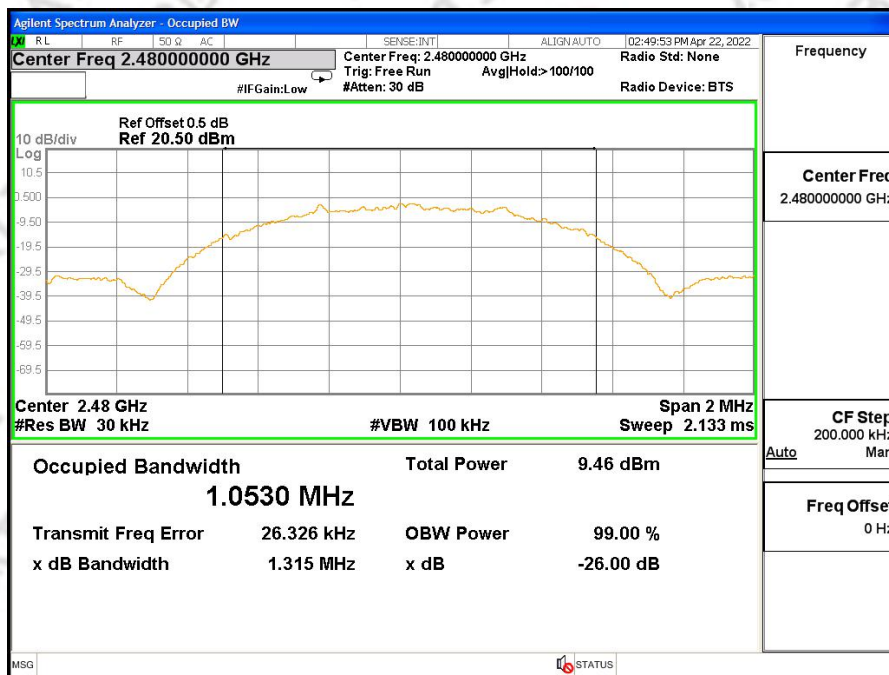
99% Bandwidth Mode1 CH37



99% Bandwidth Mode2 CH17



99% Bandwidth Mode3 CH39



8. PEAK OUTPUT POWER TEST

8.1 LIMIT

FCC Part15.247				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(3)	Output Power	1 watt or 30dBm	2400-2483.5	PASS

8.2 TEST PROCEDURE

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 °C	Relative Humidity:	60%RH
Test Voltage:	DC 7.4V	Test Mode:	TX Mode1/2/3

Test Channel	Frequency	Peak Conducted Output Power	Average Conducted Output Power	LIMIT
	(MHz)	(dBm)	(dBm)	dBm
Mode1 CH37	2402	0.45	0.38	30
Mode2 CH17	2440	0.32	0.25	30
Mode3 CH39	2480	0.25	0.16	30

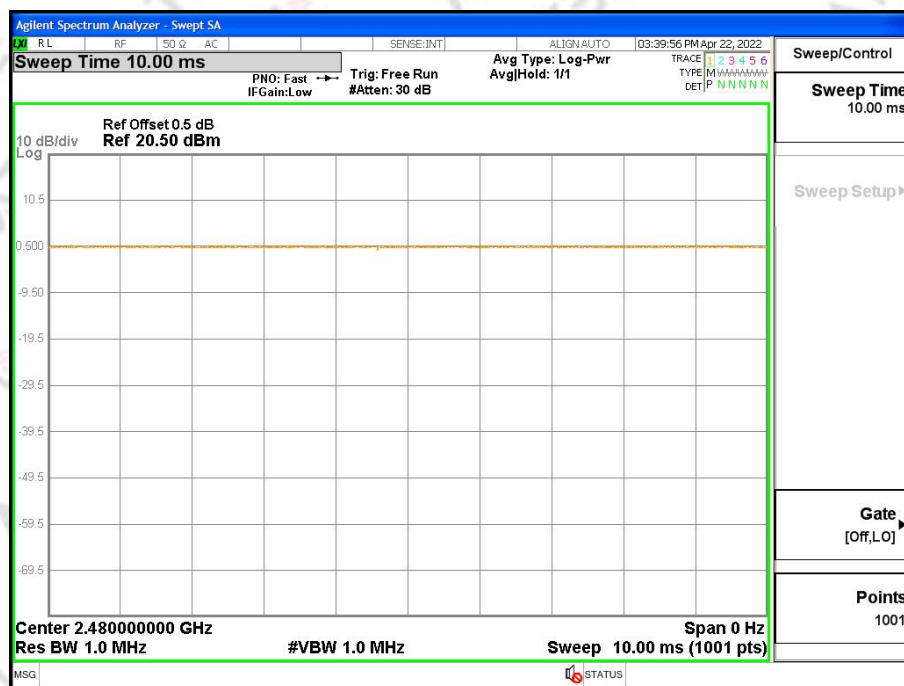
EIRP Power

Test Channel	Frequency	Peak Conducted Output Power	Antenna Gain	EIRP Power	LIMIT
	(MHz)	(dBm)	(dBi)	(dBm)	dBm
Mode1 CH00	2402	0.45	2	2.45	36

Mode2 CH19	2440	0.32	2	2.32	36
Mode3 CH39	2480	0.25	2	2.25	36

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.

Duty cycle



Ton	Tp	Duty cycle(%)	Duty factor(dB)
/	/	100	0

9. ANTENNA REQUIREMENT

9.1 STANDARD REQUIREMENT

15.203 requirement: For intentional device, according to 15.203: an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

9.2 EUT ANTENNA

The EUT antenna is Single-band Antenna. It comply with the standard requirement.

APPENDIX-PHOTOS OF TEST SETUP

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

Conducted for RF



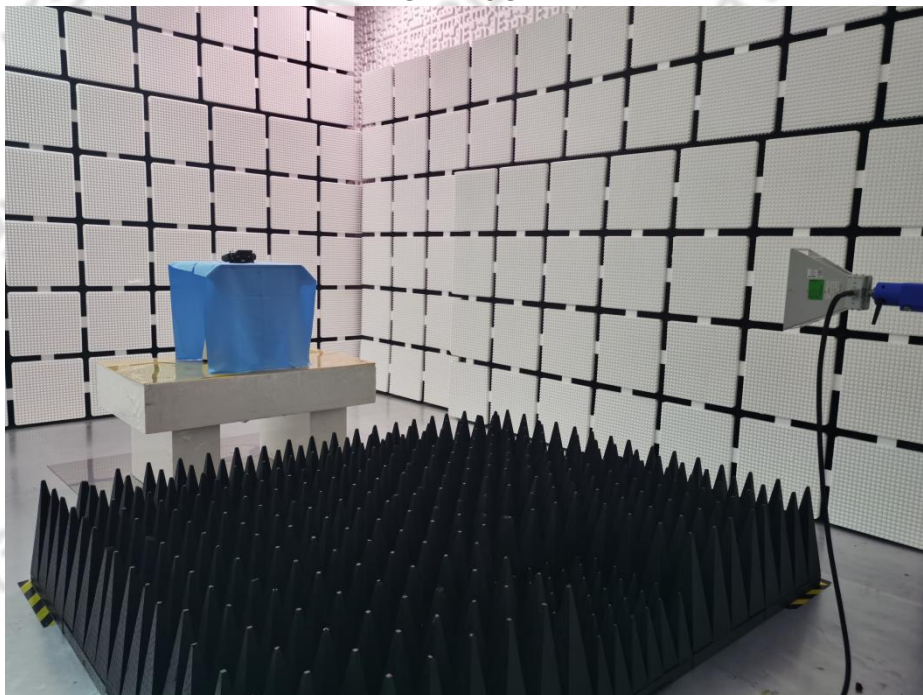
Radiation Emission
30MHz-1000MHz



Radiated Spurious Emission
30MHz-1000MHz



1GHz-18GHz



*****END OF THE REPORT*****