Radio Test Report

Report No.:STS2312315W03

Issued for

FrSky Electronic Co., Ltd.

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

Product Name:	Twin digital radio system
Brand Name:	FRSKY
Model Name:	TWIN X14
Series Model(s):	TWIN X14S,TWIN X14SE,TWIN X18, TWINX18S,TWINX18SE,TWSR6,TWR10, TWSR10,TWR12,TWSR12
FCC ID:	XYFTWINX14SP
Test Standards:	FCC Part15.247

TEST REPORT

Applicant's Name ..... :	FrSky Electronic Co., Ltd.
Address ..... :	F-4, Building C, Zhongxiu Technology Park, No.3 Yuanxi Road, Wuxi, 214125, Jiangsu, China
Manufacturer'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 ..... :	Twin digital radio system
Brand Name ..... :	FRSKY
Model Name ..... :	TWIN X14
Series Model(s) ..... :	TWIN X14S,TWIN X14SE,TWIN X18, TWINX18S,TWIN X18SE.TWSR6.TWR10.TWSR10.TWR12.TWSR12
Test Standards ..... :	FCC Part15.247
Test Procedure ..... :	ANSI C63.10-2013

This device described above has been tested by STS, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.
The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Shenzhen STS Test Services Co., Ltd.

Date of Test ..... :

Date of receipt of test item ..... :	13 Dec. 2023
Date (s) of performance of tests :	28 Dec. 2023 ~ 09 Jan. 2024
Date of Issue ..... :	09 Jan. 2024
Test Result ..... :	Pass

Testing Engineer : Aaron Bu

(Aaron Bu)

Technical Manager : Chris Chen

(Chris Chen)

Authorized Signatory : Bovey Yang

(Bovey Yang)

SHENZHEN STS TEST SERVICES CO.,LTD. TESTING APPROVAL

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Revision History

Rev.	Issue Date	Report No.	Effect Page	Contents
00	09 Jan. 2024	STS2312315W03	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			
Standard Section	Test Item	Judgment	Remark
15.207	Conducted Emission	PASS	--
15.247(a)(1)	Hopping Channel Separation	PASS	--
15.247(a)(1)&(b)(1)	Output Power	PASS	--
15.209	Radiated Spurious Emission	PASS	--
15.247(d)	Conducted Spurious & Band Edge Emission	PASS	--
15.247(a)(1)(iii)	Number of Hopping Frequency	PASS	--
15.247(a)(1)(iii)	Dwell Time	PASS	--
15.247(a)(1)	Bandwidth	PASS	--
15.205	Restricted bands of operation	PASS	--
Part 15.247(d)/part 15.209(a)	Band Edge Emission	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.

1.1 TEST FACTORY

SHENZHEN STS TEST SERVICES CO., LTD

Add. : 101, Building B, Zhuoke Science Park, No.190 Chongqing Road, ZhanChengShequ, Fuhai Sub-District, Bao'an District, Shenzhen, Guang Dong, China

FCC test Firm Registration Number: 625569

IC test Firm Registration Number: 12108A

A2LA Certificate No.: 4338.01

1.2 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	±0.755dB
2	Unwanted Emissions, conducted	±2.874dB
3	All emissions, radiated 9K-30MHz	±3.80dB
4	All emissions, radiated 30M-1GHz	±4.18dB
5	All emissions, radiated 1G-6GHz	±4.90dB
6	All emissions, radiated>6G	±5.24dB
7	Conducted Emission (9KHz-150KHz)	±2.19dB
8	Conducted Emission (150KHz-30MHz)	±2.53dB
9	Occupied Channel Bandwidth	±3.5%
10	Power Spectral Density, conducted	±1.245dB
11	Duty Cycle	±3.2%

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	Twin digital radio system
Brand Name	FRSKY
Model Name	TWIN X14
Series Model(s)	TWIN X14S,TWIN X14SE,TWIN X18, TWINX18S,TWIN X18SE,TWSR6,TWR10,TWSR10,TWR12,TWSR12
Model Difference	Only difference in model.
Channel List	Please refer to the Note 3.
Operation Frequency	2401.5-2482MHz
Modulation Type	FSK
Antenna Type	Monopole
Antenna Gain	1.7 dBi
Rating	Input: DC 7.4V
Hardware version number	Rev0.2
Software version number	1.4.14
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. The antenna information refer the manufacturer provide report, applicable only to the tested sample identified in the report. Due to the incorrect antenna information, a series of problems such as the accuracy of the test results will be borne by the customer.
3.

Channel List							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
01	2401.5	--	--	87	2444.5	--	--
02	2402	--	--	88	2445	--	--
03	2402.5	--	--	89	2445.5	--	--
04	2403	80	2441	90	2446	156	2479
05	2403.5	81	2441.5	91	2446.5	157	2479.5
06	2404	82	2442	92	2447	158	2480
07	2404.5	83	2442.5	93	2447.5	159	2480.5
--	--	84	2443	--	--	160	2481
--	--	85	2443.5	--	--	161	2481.5
--	--	86	2444	--	--	162	2482

2.2 DESCRIPTION OF THE TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Worst Mode	Description	Data Rate/Modulation
Mode 1	TX CH01	FSK
Mode 2	TX CH82	FSK
Mode 3	TX CH162	FSK

Note:

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

(2) We tested for all available U.S. voltage and frequencies (For 120V, 50/60Hz and 240V, 50/60Hz) for which the device is capable of operation, and the worst case of 120V/ 60Hz is shown in the report.

(3) The battery is fully-charged during the radiated and RF conducted test.

For AC Conducted Emission

Test Case	
AC Conducted Emission	Mode 4: Keeping TX

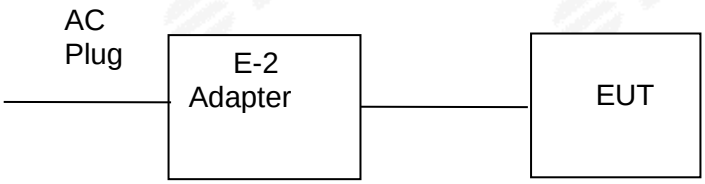
2.3 TEST SOFTWARE AND POWER LEVEL

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

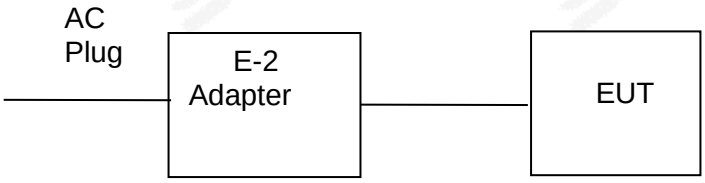
RF Function	Type	Mode Or Modulation type	ANT Gain(dBi)	Power Class	Software For Testing
SRD	2.4G	FSK	1.7	Default	The EUT has signal transmission when it is powered on

2.4 BLOCK DIAGRAM 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

Support units

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
	DC Supply	HONGSHENGFENC	QJ6005E	N/A	N/A
	USB Cable	N/A	N/A	150cm	NO
	Adapter	HUAWEI	HW-050450C00	N/A	N/A

Note:

(1) For detachable type I/O cable should be specified the length in cm in『Length』column.

(2) “YES” is means “with core”; “NO” is means “without core”.

2.6 EQUIPMENTS LIST

RF Radiation Test Equipment					
Kind of Equipment	**Manufacturer**	**Type No.**	**Serial No.**	**Last Calibration**	**Calibrated Until**
Temperature & Humidity	SW-108	SuWei	N/A	2023.03.03	2024.03.02
Pre-Amplifier(0.1M-3GHz)	EM	EM330	060665	2023.02.28	2024.02.27
Pre-Amplifier(1G-18GHz)	SKET	LNPA-01018G-45	SK2018080901	2023.09.26	2024.09.25
Pre-Amplifier(18G-40GHz)	SKET	LNPA_1840-50	SK2018101801	2023.03.06	2024.03.05
Active loop Antenna	ZHINAN	ZN30900C	16035	2023.02.28	2024.02.27
Bilog Antenna	TESEQ	CBL6111D	34678	2022.09.30	2024.09.29
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	2023.09.24	2025.09.23
Horn Antenna	A-INFOMW	LB-180400-KF	J211020657	2023.10.10	2025.10.09
Positioning Controller	MF	MF-7802	MF-780208587	N/A	N/A
Signal Analyzer	R&S	FSV 40-N	101823	2023.09.26	2024.09.25
Switch Control Box	N/A	N/A	N/A	N/A	N/A
Filter Box	BALUN Technology	SU319E	BL-SZ1530051	N/A	N/A
Antenna Mast	MF	MFA-440H	N/A	N/A	N/A
Turn Table	MF	SC100_1	60531	N/A	N/A
AC Power Source	APC	KDF-11010G	F214050035	N/A	N/A
DC power supply	HONGSHENGFENG	DPS-305AF	17064939	2023.09.26	2024.09.25
Test SW	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	2023.09.25	2024.09.24
LISN	R&S	ENV216	101242	2023.09.25	2024.09.24
LISN	EMCO	3810/2NM	23625	2023.09.25	2024.09.24
Temperature & Humidity	SW-108	SuWei	N/A	2023.03.03	2024.03.02
Test SW	EZ-EMC	Ver.STSLAB-03A1 CE			
RF Connected Test					
Kind of Equipment	**Manufacturer**	**Type No.**	**Serial No.**	**Last calibration**	**Calibrated until**
Signal Analyzer	Agilent	N9020A	MY51510623	2023.03.01	2024.02.28
Power Sensor	Keysight	U2021XA	MY55520005	2023.09.26	2024.09.25
Temperature & Humidity	SW-108	SuWei	N/A	2023.03.03	2024.03.02
Test SW	MW	MTS 8310_2.0.0.0			

3. EMC EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

The radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table.

FREQUENCY (MHz)	Conducted Emissionlimit (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.

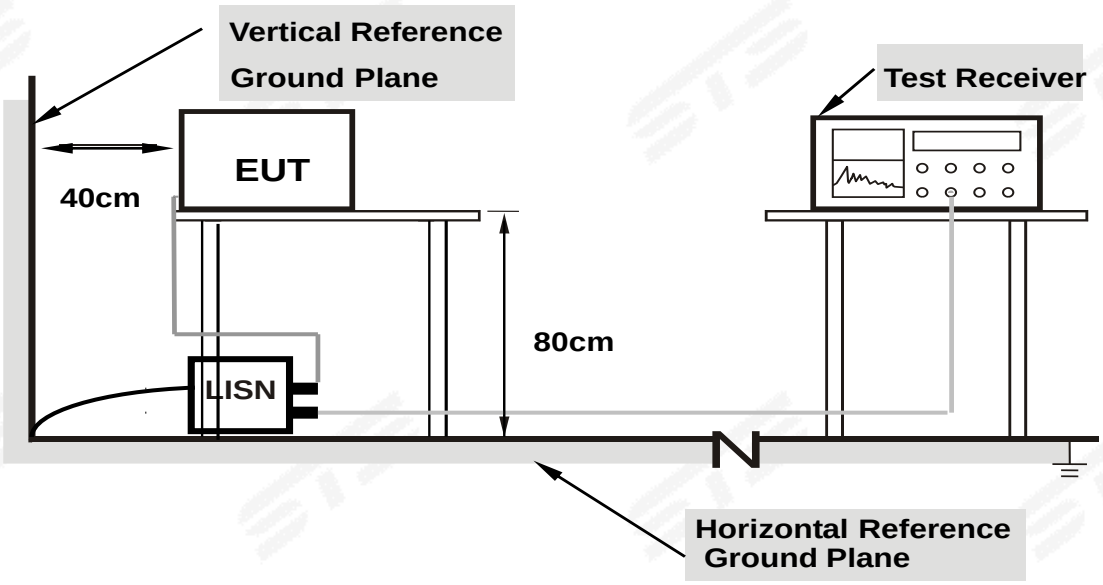
The following table is the setting of the receiver

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

3.1.2 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.

3.1.3 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 units.

3.1.4 EUT OPERATING CONDITIONS

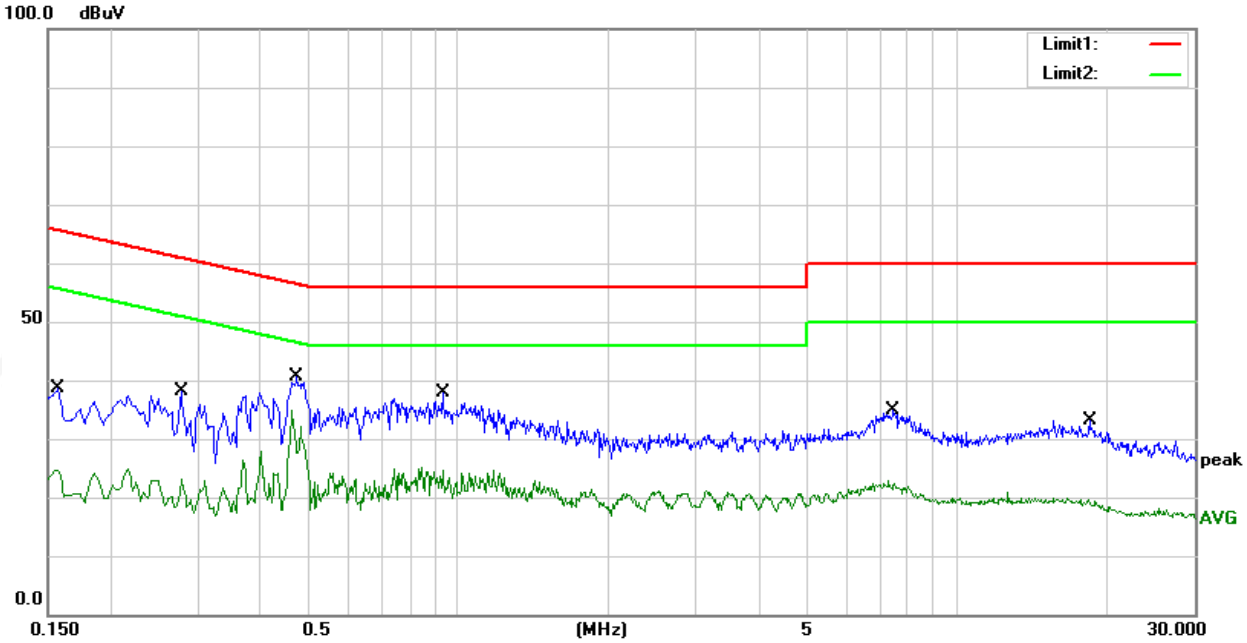
The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

3.1.5 TEST RESULT

Temperature:	26.2(C)	Relative Humidity:	54%RH
Test Voltage:	AC 120V/60Hz	Phase:	L
Test Mode:	Mode 4		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1580	18.79	19.77	38.56	65.57	-27.01	QP
2	0.1580	4.94	19.77	24.71	55.57	-30.86	AVG
3	0.2780	18.09	20.11	38.20	60.88	-22.68	QP
4	0.2780	6.19	20.11	26.30	50.88	-24.58	AVG
5	0.4740	20.69	20.00	40.69	56.44	-15.75	QP
6	0.4740	14.81	20.00	34.81	46.44	-11.63	AVG
7	0.9300	18.09	19.77	37.86	56.00	-18.14	QP
8	0.9300	4.94	19.77	24.71	46.00	-21.29	AVG
9	7.4540	14.90	19.97	34.87	60.00	-25.13	QP
10	7.4540	2.87	19.97	22.84	50.00	-27.16	AVG
11	18.4780	12.74	20.43	33.17	60.00	-26.83	QP
12	18.4780	-0.60	20.43	19.83	50.00	-30.17	AVG

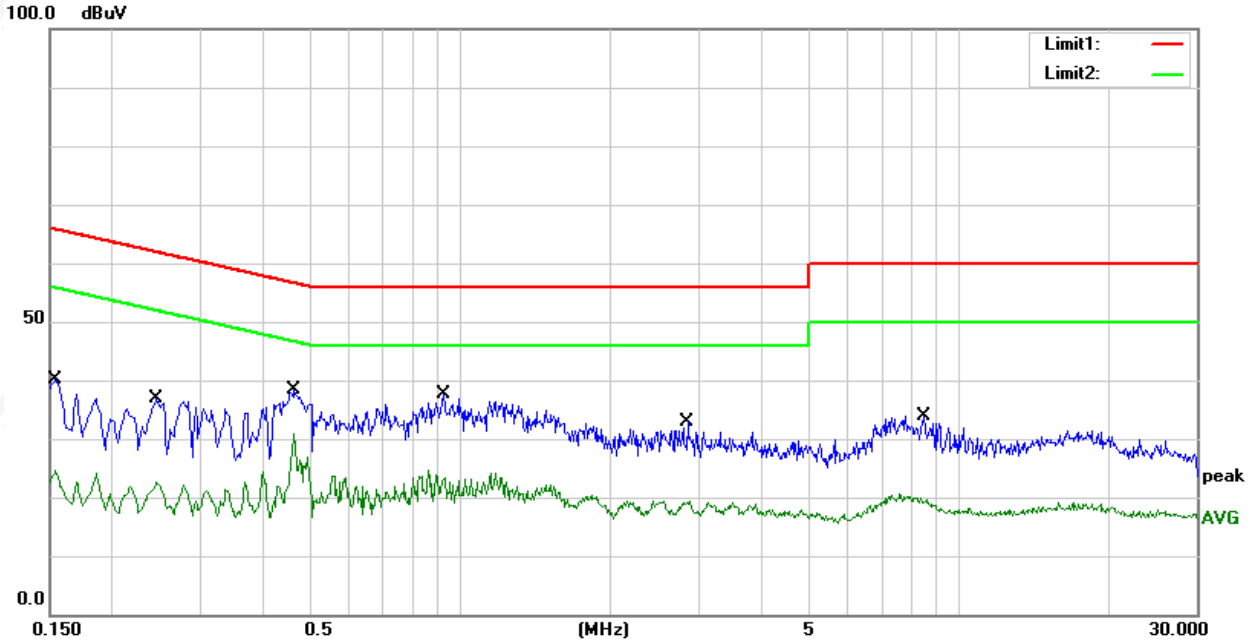
Remark:
1. All readings are Quasi-Peak and Average values
2. Margin = Result (Result =Reading + Factor)–Limit
3. Factor=LISN factor+Cable loss+Limiter (10dB)



Temperature:	26.2(C)	Relative Humidity:	54%RH
Test Voltage:	AC 120V/60Hz	Phase:	N
Test Mode:	Mode 4		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1540	20.44	19.77	40.21	65.78	-25.57	QP
2	0.1540	4.81	19.77	24.58	55.78	-31.20	AVG
3	0.2460	16.97	19.97	36.94	61.89	-24.95	QP
4	0.2460	2.60	19.97	22.57	51.89	-29.32	AVG
5	0.4660	18.33	20.00	38.33	56.58	-18.25	QP
6	0.4660	10.85	20.00	30.85	46.58	-15.73	AVG
7	0.9260	17.97	19.77	37.74	56.00	-18.26	QP
8	0.9260	4.89	19.77	24.66	46.00	-21.34	AVG
9	2.8620	13.14	19.78	32.92	56.00	-23.08	QP
10	2.8620	-0.39	19.78	19.39	46.00	-26.61	AVG
11	8.5020	13.76	20.16	33.92	60.00	-26.08	QP
12	8.5020	0.44	20.16	20.60	50.00	-29.40	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)



3.2 RADIATED EMISSION MEASUREMENT

3.2.1 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) limit in the table and according to ANSI C63.10-2013 below has to be followed.

LIMITS OF RADIATED EMISSION MEASUREMENT (0.009MHz - 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 (1GHz-25 GHz)

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

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: 2476 to 2500 MHz
RB / VB	1 MHz / 3 MHz(Peak) 1 MHz/1/T MHz(AVG)

Receiver Parameter	Setting
Attenuation	Auto
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

3.2.2 TEST PROCEDURE

a. The measuring distance 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 m (above 1GHz is 1.5 m) above the ground at a 3 m anechoic chamber test site. The table was rotated 360 degree 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 polarization 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 QuasiPeak detector mode will be re-measured.
e. If the Peak Mode measured value is compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and no additional QP Mode measurement was performed.
f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

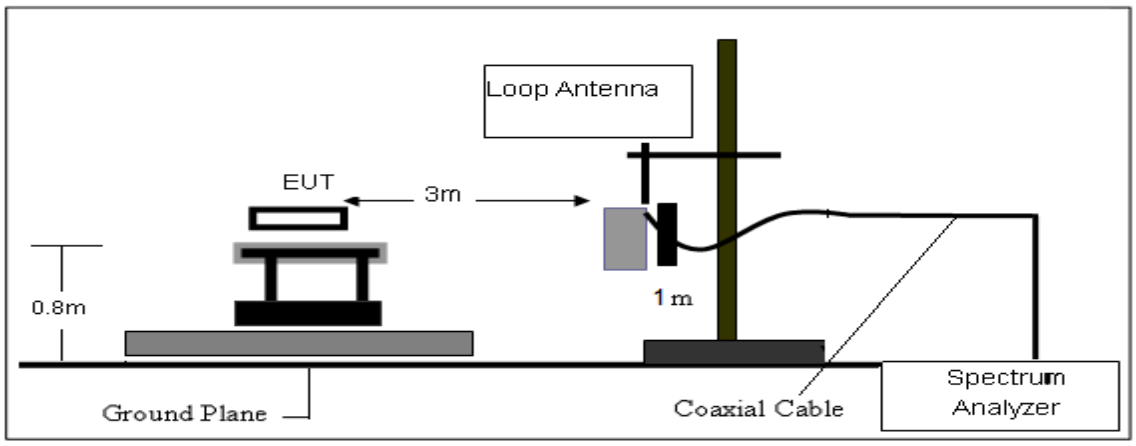
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

3.2.3 DEVIATION FROM TEST STANDARD

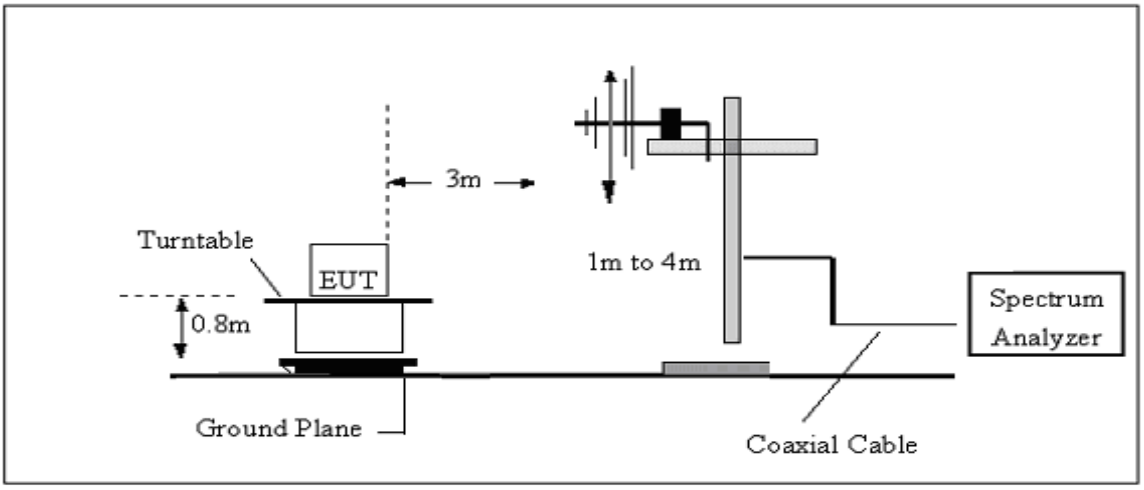
No deviation.

3.2.4 TESTSETUP

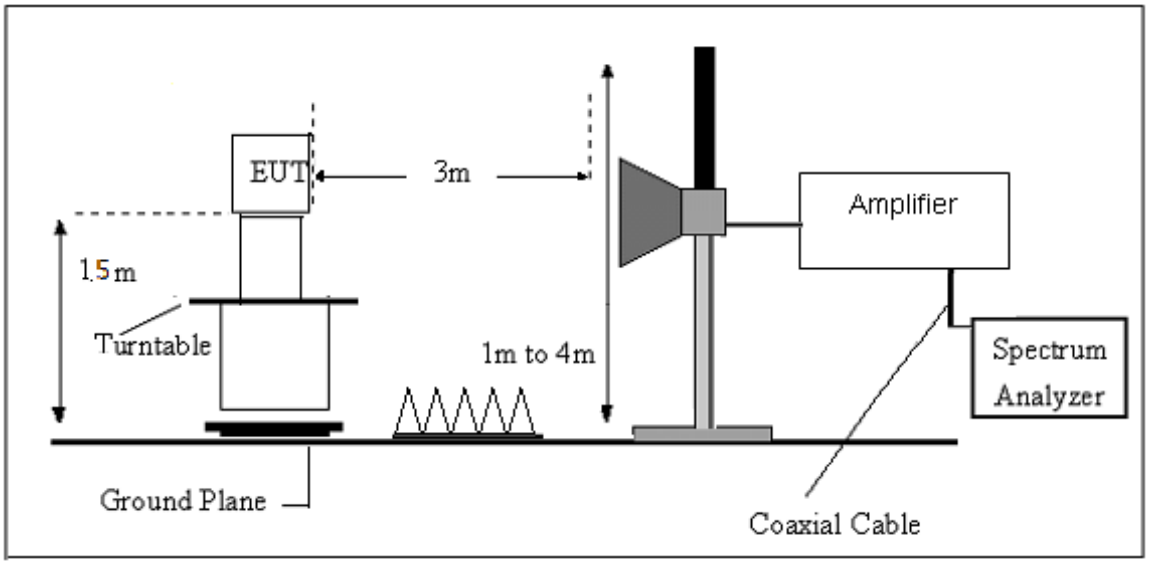
(A) Radiated Emission Test-Up Frequency Below 30MHz



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



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



3.2.5 EUT OPERATING CONDITIONS

Please refer to section 3.1.4 of this report.

3.2.6 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

3.2.7 TEST RESULTS

(9KHz-30MHz)

Temperature:	23.1(C)	Relative Humidity:	60%RH
Test Voltage:	AC 120V/60Hz	Test Mode:	TX Mode

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

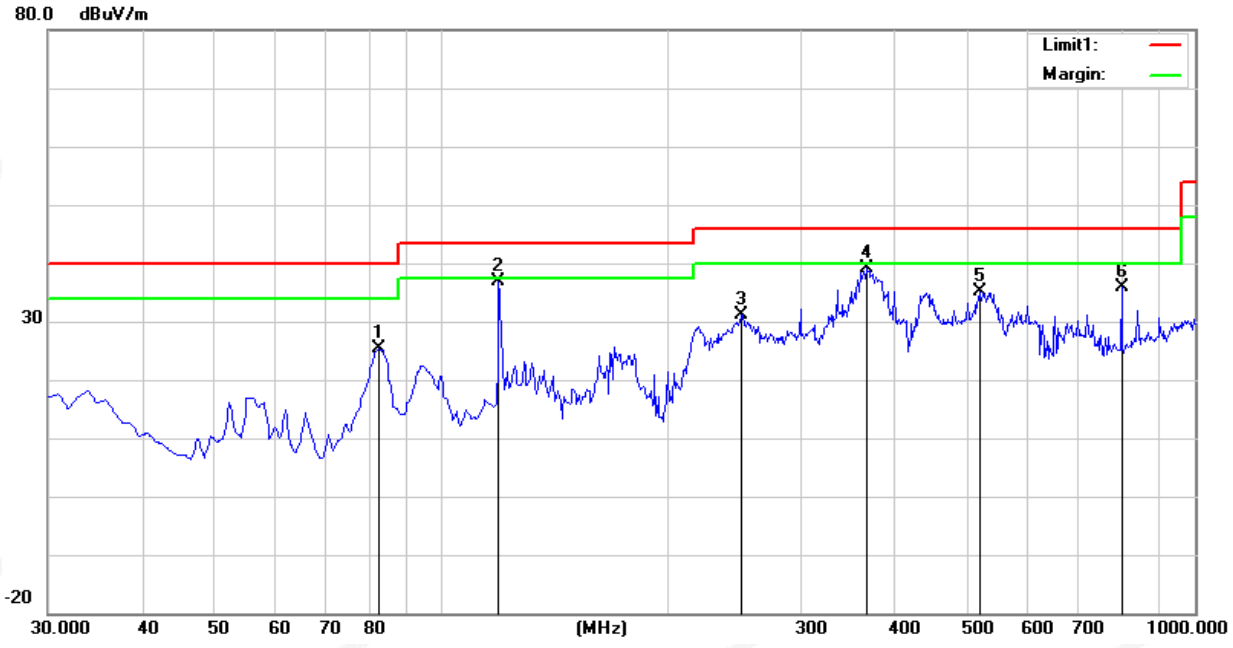
Note:
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
Distance extrapolation factor =40 log (specific distance/test distance)(dB);
Limit line = specific limits (dBuv) + distance extrapolation factor.

(30MHz-1000MHz)

Temperature:	23.1(C)	Relative Humidity:	60%RH
Test Voltage:	AC 120V/60Hz	Phase:	Horizontal
Test Mode:	Mode 1/2/3 (Mode 3 worst mode)		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	82.3800	47.94	-22.68	25.26	40.00	-14.74	peak
2	119.2400	55.31	-18.38	36.93	43.50	-6.57	peak
3	251.1600	47.09	-15.95	31.14	46.00	-14.86	peak
4	367.5600	51.70	-12.58	39.12	46.00	-6.88	peak
5	519.8500	43.01	-7.82	35.19	46.00	-10.81	peak
6	800.1800	37.82	-2.05	35.77	46.00	-10.23	peak

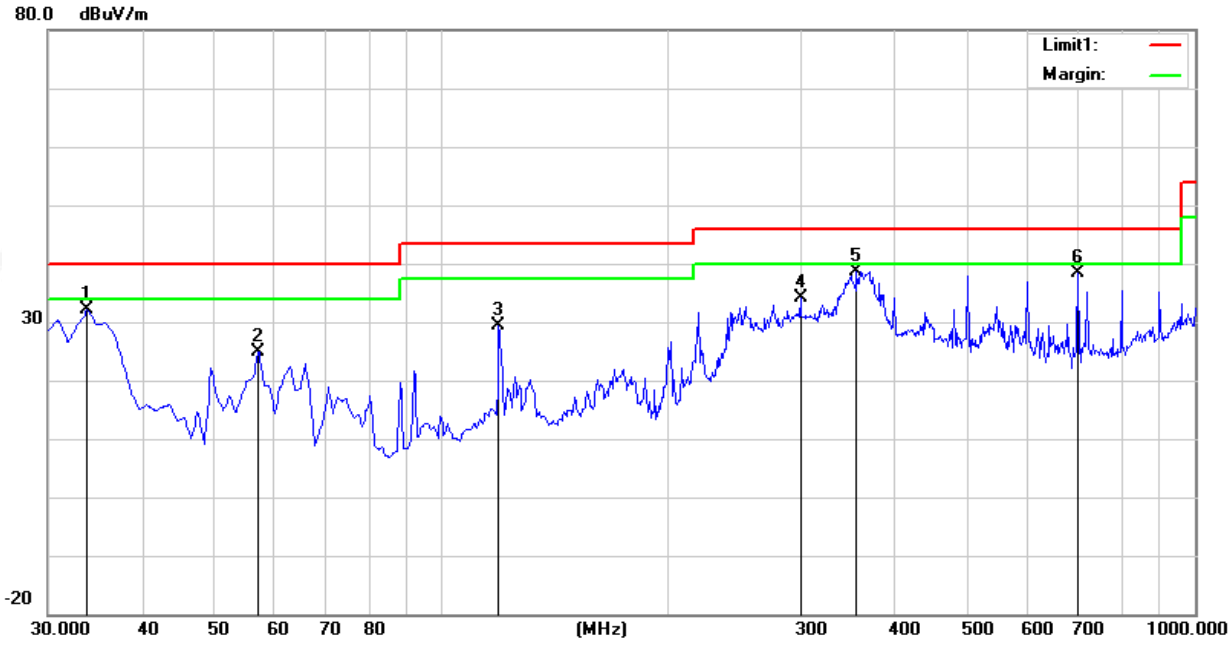
Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain
3. All modes have been tested,only show the worst case.



Temperature:	23.1(C)	Relative Humidity:	60%RH
Test Voltage:	AC 120V/60Hz	Phase:	Vertical
Test Mode:	Mode 1/2/3 (Mode 3 worst mode)		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	33.8800	46.82	-14.80	32.02	40.00	-7.98	peak
2	57.1600	50.40	-25.45	24.95	40.00	-15.05	peak
3	119.2400	47.82	-18.38	29.44	43.50	-14.06	peak
4	299.6600	48.92	-14.82	34.10	46.00	-11.90	peak
5	355.9200	51.60	-12.95	38.65	46.00	-7.35	peak
6	700.2700	42.51	-4.16	38.35	46.00	-7.65	peak

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain



(1GHz~25GHz) Spurious emission Requirements

Frequency	Meter Reading	Amplifier	Loss	Antenna Factor	Corrected Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBμV)	(dB)	(dB)	(dB/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type	
Low Channel (FSK/2401.5 MHz)										
3264.81	61.20	44.70	6.70	28.20	-9.80	51.40	74.00	-22.60	PK	Vertical
3264.81	50.56	44.70	6.70	28.20	-9.80	40.76	54.00	-13.24	AV	Vertical
3264.60	61.71	44.70	6.70	28.20	-9.80	51.91	74.00	-22.09	PK	Horizontal
3264.60	50.41	44.70	6.70	28.20	-9.80	40.61	54.00	-13.39	AV	Horizontal
4804.33	58.45	44.20	9.04	31.60	-3.56	54.89	74.00	-19.11	PK	Vertical
4804.33	50.04	44.20	9.04	31.60	-3.56	46.48	54.00	-7.52	AV	Vertical
4804.39	59.43	44.20	9.04	31.60	-3.56	55.87	74.00	-18.13	PK	Horizontal
4804.39	50.34	44.20	9.04	31.60	-3.56	46.78	54.00	-7.22	AV	Horizontal
5359.78	48.23	44.20	9.86	32.00	-2.34	45.89	74.00	-28.11	PK	Vertical
5359.78	39.60	44.20	9.86	32.00	-2.34	37.26	54.00	-16.74	AV	Vertical
5359.61	48.43	44.20	9.86	32.00	-2.34	46.09	74.00	-27.91	PK	Horizontal
5359.61	39.12	44.20	9.86	32.00	-2.34	36.78	54.00	-17.22	AV	Horizontal
7205.71	54.86	43.50	11.40	35.50	3.40	58.26	74.00	-15.74	PK	Vertical
7205.71	44.70	43.50	11.40	35.50	3.40	48.10	54.00	-5.90	AV	Vertical
7205.95	53.49	43.50	11.40	35.50	3.40	56.89	74.00	-17.11	PK	Horizontal
7205.95	44.62	43.50	11.40	35.50	3.40	48.02	54.00	-5.98	AV	Horizontal
Middle Channel (FSK/2442 MHz)										
3264.87	62.14	44.70	6.70	28.20	-9.80	52.34	74.00	-21.66	PK	Vertical
3264.87	50.41	44.70	6.70	28.20	-9.80	40.61	54.00	-13.39	AV	Vertical
3264.60	60.98	44.70	6.70	28.20	-9.80	51.18	74.00	-22.82	PK	Horizontal
3264.60	50.09	44.70	6.70	28.20	-9.80	40.29	54.00	-13.71	AV	Horizontal
4882.39	58.98	44.20	9.04	31.60	-3.56	55.42	74.00	-18.58	PK	Vertical
4882.39	49.50	44.20	9.04	31.60	-3.56	45.94	54.00	-8.06	AV	Vertical
4882.37	58.41	44.20	9.04	31.60	-3.56	54.85	74.00	-19.15	PK	Horizontal
4882.37	50.08	44.20	9.04	31.60	-3.56	46.52	54.00	-7.48	AV	Horizontal
5359.63	49.38	44.20	9.86	32.00	-2.34	47.04	74.00	-26.96	PK	Vertical
5359.63	39.03	44.20	9.86	32.00	-2.34	36.69	54.00	-17.31	AV	Vertical
5359.86	47.93	44.20	9.86	32.00	-2.34	45.59	74.00	-28.41	PK	Horizontal
5359.86	38.66	44.20	9.86	32.00	-2.34	36.32	54.00	-17.68	AV	Horizontal
7323.84	54.59	43.50	11.40	35.50	3.40	57.99	74.00	-16.01	PK	Vertical
7323.84	43.86	43.50	11.40	35.50	3.40	47.26	54.00	-6.74	AV	Vertical
7323.94	54.29	43.50	11.40	35.50	3.40	57.69	74.00	-16.31	PK	Horizontal
7323.94	44.56	43.50	11.40	35.50	3.40	47.96	54.00	-6.04	AV	Horizontal

High Channel (FSK/2482 MHz)										
3264.89	61.70	44.70	6.70	28.20	-9.80	51.90	74.00	-22.10	PK	Vertical
3264.89	51.40	44.70	6.70	28.20	-9.80	41.60	54.00	-12.40	AV	Vertical
3264.77	61.71	44.70	6.70	28.20	-9.80	51.91	74.00	-22.09	PK	Horizontal
3264.77	51.25	44.70	6.70	28.20	-9.80	41.45	54.00	-12.55	AV	Horizontal
4960.31	59.23	44.20	9.04	31.60	-3.56	55.67	74.00	-18.33	PK	Vertical
4960.31	50.41	44.20	9.04	31.60	-3.56	46.85	54.00	-7.15	AV	Vertical
4960.46	58.33	44.20	9.04	31.60	-3.56	54.77	74.00	-19.23	PK	Horizontal
4960.46	50.13	44.20	9.04	31.60	-3.56	46.57	54.00	-7.43	AV	Horizontal
5359.66	48.65	44.20	9.86	32.00	-2.34	46.31	74.00	-27.69	PK	Vertical
5359.66	39.55	44.20	9.86	32.00	-2.34	37.21	54.00	-16.79	AV	Vertical
5359.82	47.58	44.20	9.86	32.00	-2.34	45.24	74.00	-28.76	PK	Horizontal
5359.82	38.51	44.20	9.86	32.00	-2.34	36.17	54.00	-17.83	AV	Horizontal
7439.92	53.59	43.50	11.40	35.50	3.40	56.99	74.00	-17.01	PK	Vertical
7439.92	44.83	43.50	11.40	35.50	3.40	48.23	54.00	-5.77	AV	Vertical
7439.89	54.19	43.50	11.40	35.50	3.40	57.59	74.00	-16.41	PK	Horizontal
7439.89	44.05	43.50	11.40	35.50	3.40	47.45	54.00	-6.55	AV	Horizontal

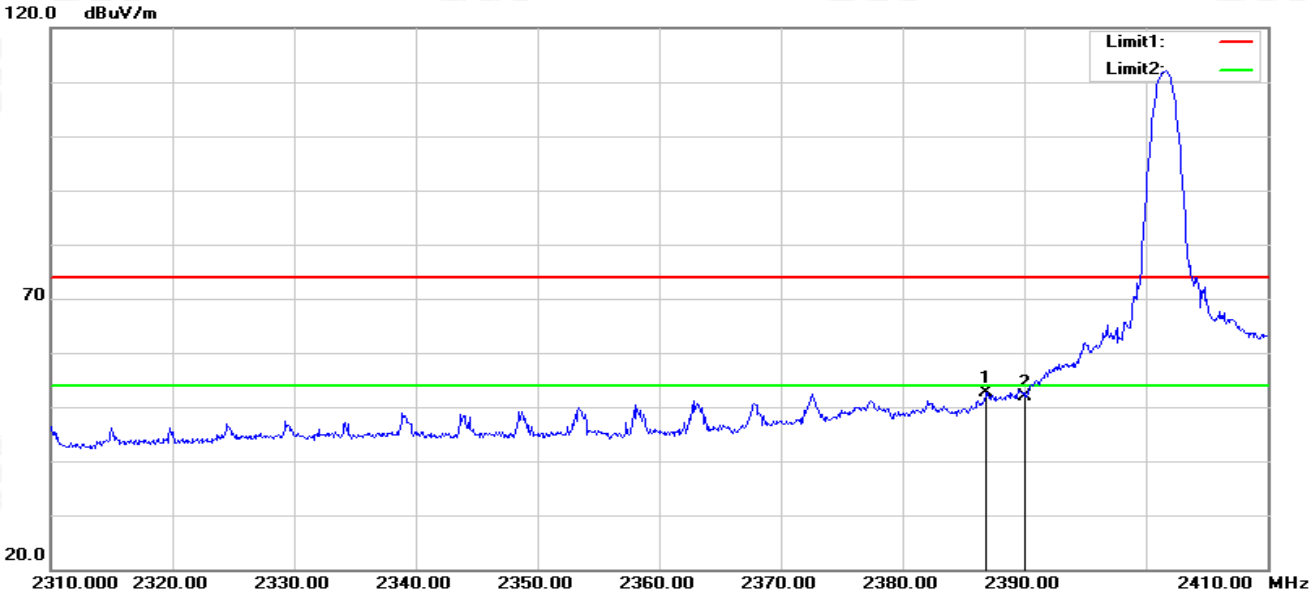
Note:

1) Factor = Antenna Factor + Cable Loss – Pre-amplifier.
   Emission Level = Reading + Factor
2) The frequency emission of peak points that did not show above the forms are at least 20dB below the limit, the frequency emission is mainly from the environment noise.

Restricted band Requirements

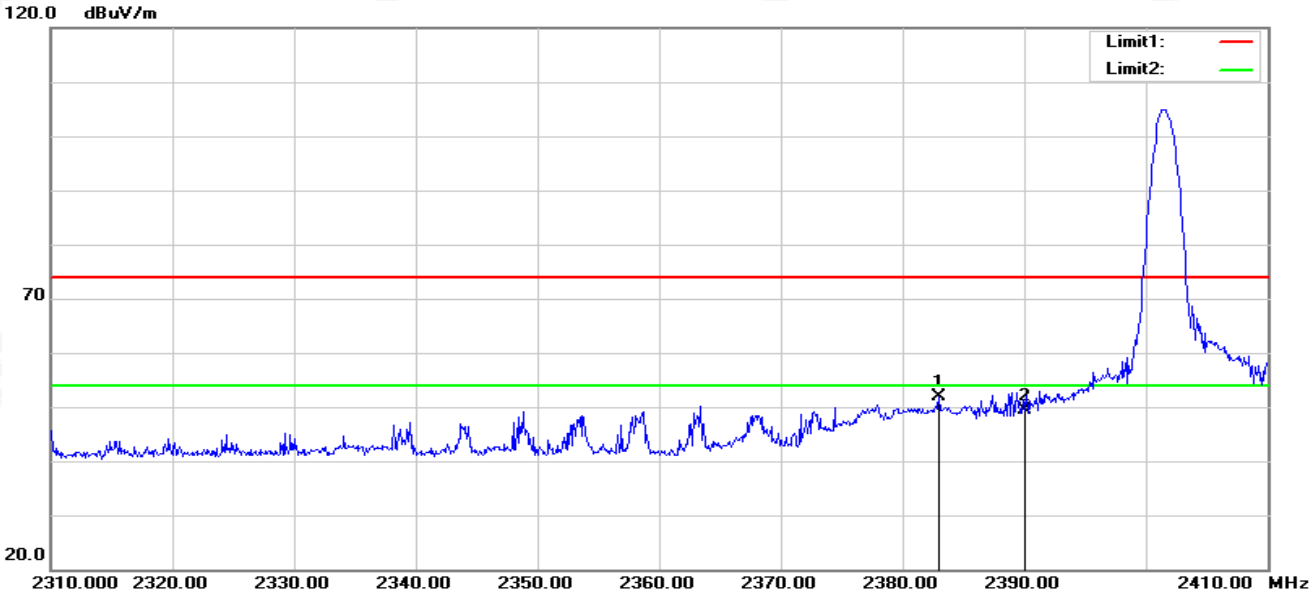
2.4G-FSK -Low

Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2386.900	48.33	4.30	52.63	74.00	-21.37	peak
2	2390.000	47.44	4.34	51.78	74.00	-22.22	peak

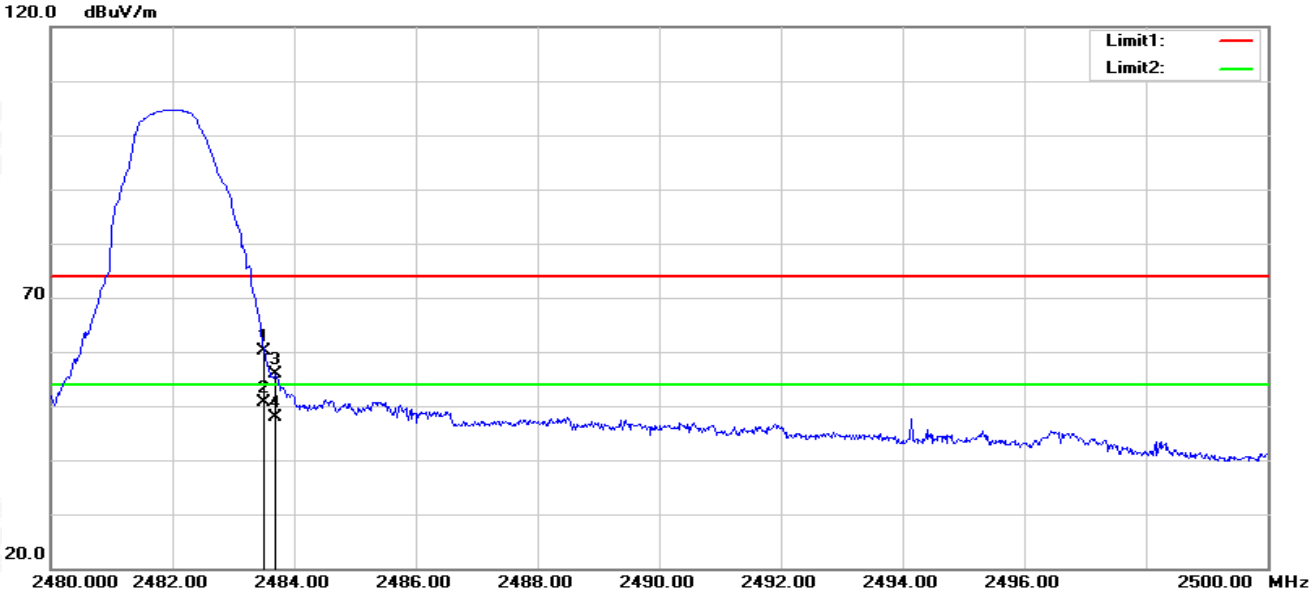
Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2383.000	47.58	4.23	51.81	74.00	-22.19	peak
2	2390.000	45.11	4.34	49.45	74.00	-24.55	peak

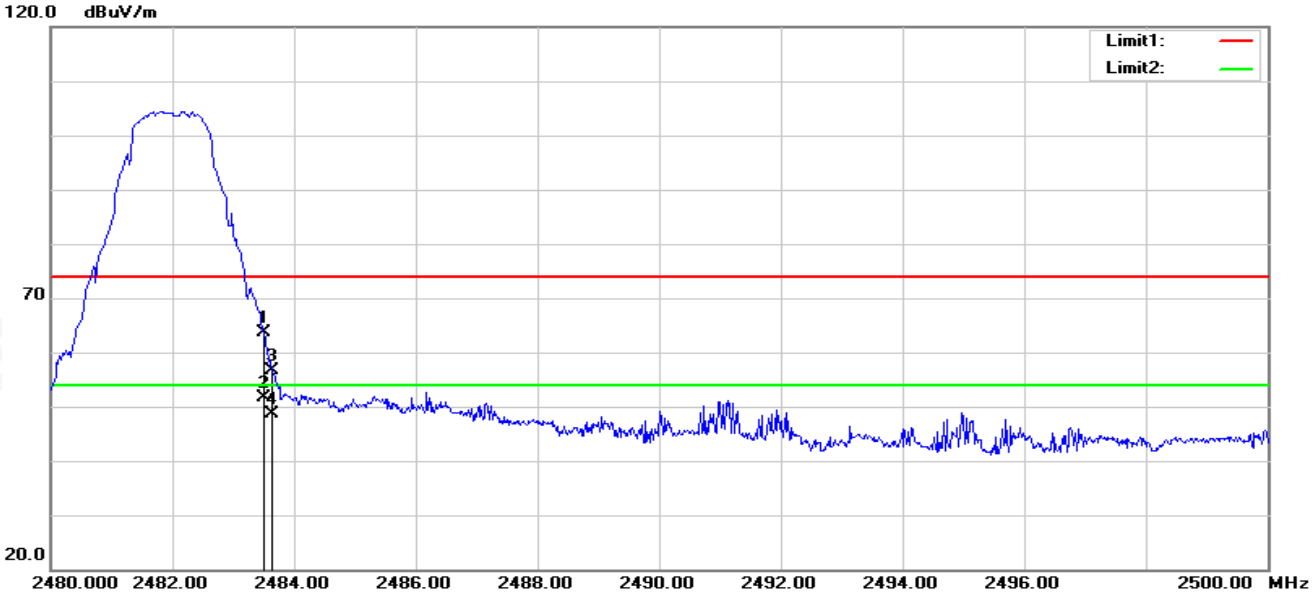
2.4G-FSK-High

Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	55.46	4.60	60.06	74.00	-13.94	peak
2	2483.500	46.04	4.60	50.64	54.00	-3.36	AVG
3	2483.700	51.29	4.60	55.89	74.00	-18.11	peak
4	2483.700	43.35	4.60	47.95	54.00	-6.05	AVG

Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	58.97	4.60	63.57	74.00	-10.43	peak
2	2483.500	47.09	4.60	51.69	54.00	-2.31	AVG
3	2483.640	52.03	4.60	56.63	74.00	-17.37	peak
4	2483.640	43.97	4.60	48.57	54.00	-5.43	AVG

4. CONDUCTED SPURIOUS & BAND EDGE EMISSION

4.1 LIMIT

According to FCC section 15.247(d), 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.

4.2 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

For Hopping Band edge

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	Lower Band Edge: 2300– 2403 MHz Upper Band Edge: 2479 – 2500 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

4.3 TEST SETUP

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

4.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.

4.5 TEST RESULTS

Note: The test data please refer to APPENDIX 1.

5. NUMBER OF HOPPING CHANNEL

5.1 LIMIT

FCC Part 15.247,Subpart C				
Section	Test Item	Limit	FrequencyRange (MHz)	Result
15.247 (a)(1)(iii)	Number of Hopping Channel	≥15	2400-2483.5	PASS

Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	> Operating FrequencyRange
RB	100KHz
VB	300KHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

5.2 TEST PROCEDURE

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Spectrum Setting: RBW= 100KHz, VBW=300KHz, Sweep time = Auto.

5.3 TEST SETUP

5.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.

5.5 TEST RESULTS

Note: The test data please refer to APPENDIX 1.

6. AVERAGE TIME OF OCCUPANCY

6.1 LIMIT

FCC Part 15.247,Subpart C				
Section	Test Item	Limit	FrequencyRange (MHz)	Result
15.247 (a)(1)(iii)	Average Time of Occupancy	0.4sec	2400-2483.5	PASS

6.2 TEST PROCEDURE

a. The transmitter output (antenna port) was connected to the spectrum analyzer.
b. Set RBW =1MHz/VBW =3MHz.
c. Use a video trigger with the trigger level set to enable triggering only on full pulses.
d. Sweep Time is more than once pulse time.
e. Set the center frequency on any frequency would be measure and set the frequency span to zero span.
f. Measure the maximum time duration of one single pulse.
g. Set the EUT for Hopping packet transmitting.
h. Measure the maximum time duration of one single pulse.

6.3 TEST SETUP

6.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.

6.5 TEST RESULTS

Note: The test data please refer to APPENDIX 1.

7. HOPPING CHANNEL SEPARATION MEASUREMEN

7.1 LIMIT

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> 20 dB Bandwidth or Channel Separation
RB	30 kHz (20dB Bandwidth) / 30 kHz (Channel Separation)
VB	100 kHz (20dB Bandwidth) / 100 kHz (Channel Separation)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

7.2 TEST PROCEDURE

a. The transmitter output (antenna port) was connected to the spectrum analyser in peak hold mode.
b. The resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilised for 20 dB bandwidth measurement.
c. The resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilised for channel separation measurement.

7.3 TEST SETUP

7.4 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

7.5 TEST RESULTS

Note: The test data please refer to APPENDIX 1.

8. BANDWIDTH TEST

8.1 LIMIT

FCC Part15 15.247,Subpart C				
Section	Test Item	Limit	FrequencyRange (MHz)	Result
15.247 (a)(1)	Bandwidth	N/A	2400-2483.5	PASS

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> Measurement Bandwidth or Channel Separation
RB	30 kHz (20dB Bandwidth) / 30 kHz (Channel Separation)
VB	100 kHz (20dB Bandwidth) / 100 kHz (Channel Separation)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

8.2 TEST PROCEDURE

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Spectrum Setting: RBW= 30KHz, VBW=100KHz, Sweep time = Auto.

8.3 TEST SETUP

8.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.

8.5 TEST RESULTS

Note: The test data please refer to APPENDIX 1.

9. OUTPUT POWER TEST

9.1 LIMIT

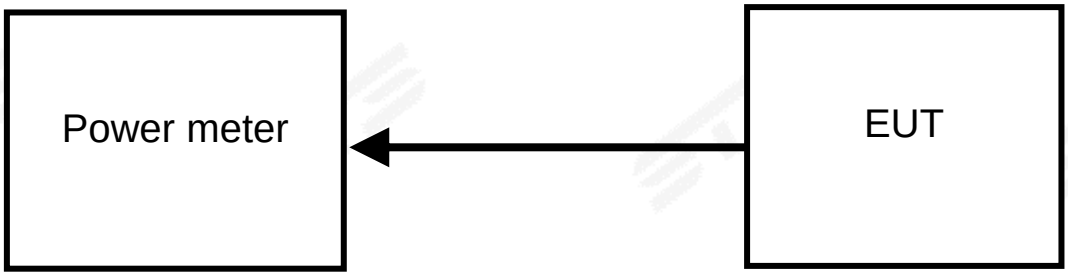
FCC Part 15.247,Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247 (a)(1)&(b)(1)	Output Power	1 W or 0.125W if channel separation > 2/3 bandwidthprovided thesystems operatewith an output power no greater than125 mW(20.97dBm)	2400-2483.5	PASS

9.2 TEST PROCEDURE

This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

a) Use the following spectrum analyzer settings:
1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
2) RBW > 20 dB bandwidth of the emission being measured.
3) VBW ≥ RBW.
4) Sweep: Auto.
5) Detector function: Peak.
6) Trace: Max hold.
b) Allow trace to stabilize.
c) Use the marker-to-peak function to set the marker to the peak of the emission.
d) The indicated level is the peak output power, after any corrections for external attenuators and cables.
e) A plot of the test results and setup description shall be included in the test report.
NOTE—A peak responding power meter may be used, where the power meter and sensor system video bandwidth is greater than the occupied bandwidth of the unlicensed wireless device, rather than a spectrum analyzer.
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 DSS bandwidth and shall use a fast-responding diode detector.

9.3 TEST SETUP



9.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.

9.5 TEST RESULTS

Note: The test data please refer to APPENDIX 1.

10. ANTENNA REQUIREMENT

10.1 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.

10.2 EUT ANTENNA

The EUT antenna is Monopole Antenna. It comply with the standard requirement.

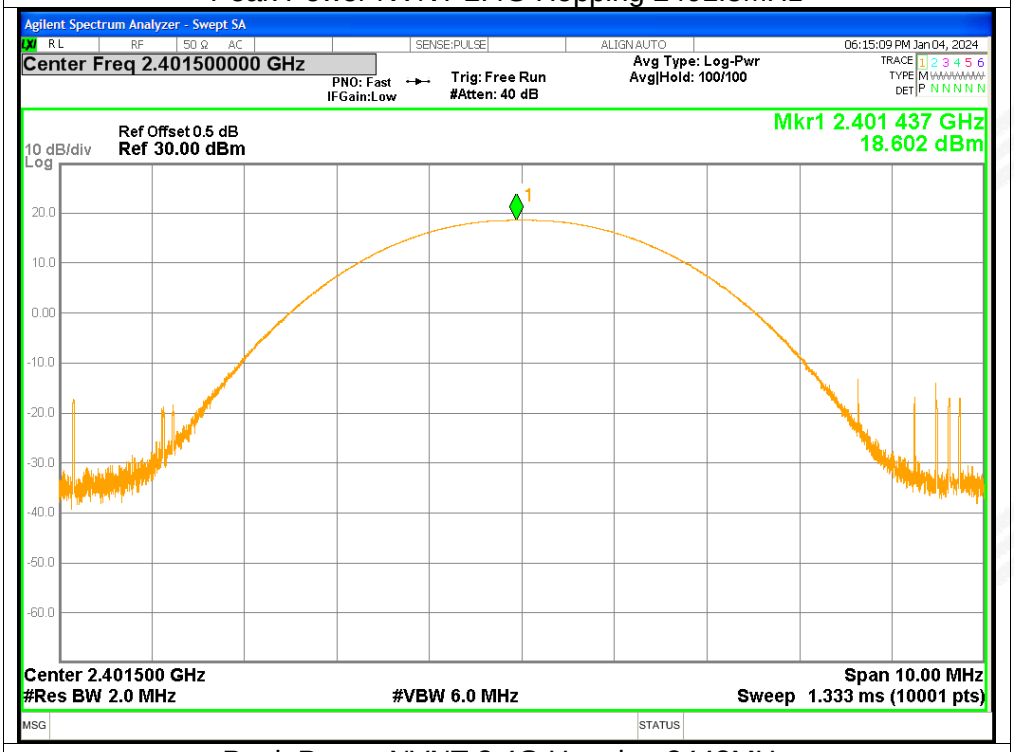
APPENDIX 1-TEST DATA

1. Maximum Peak Conducted Output Power

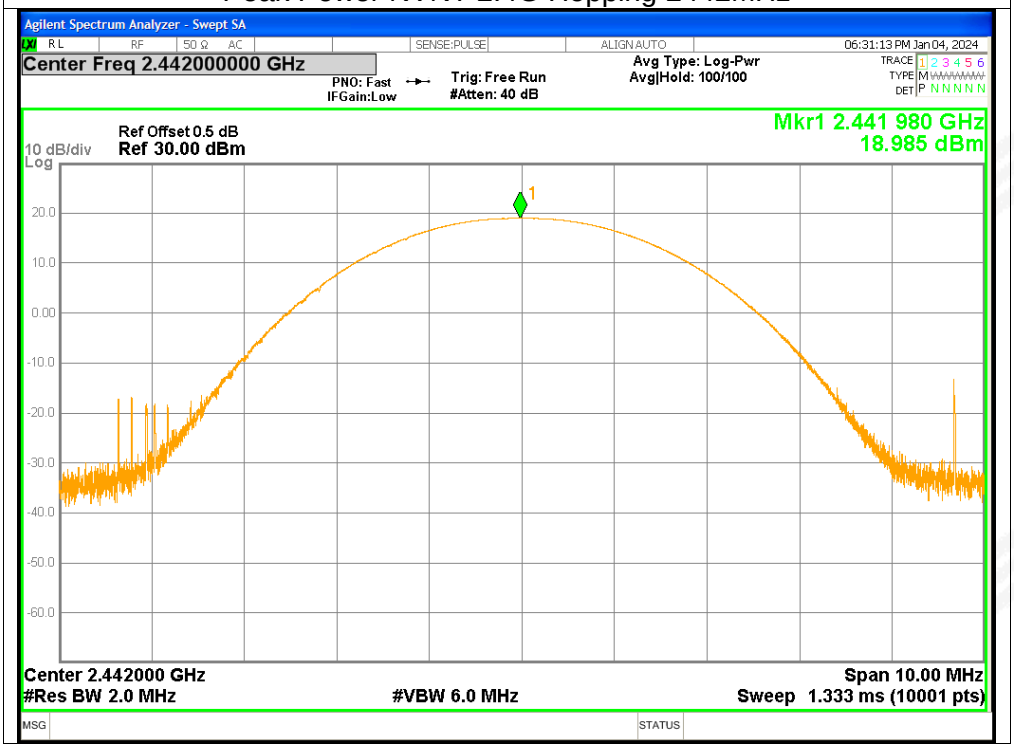
Condition	Mode	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Verdict
NVNT	2.4G Hopping	2401.5	18.6	<=20.97	Pass
NVNT	2.4G Hopping	2442	18.99	<=20.97	Pass
NVNT	2.4G Hopping	2482	19.13	<=20.97	Pass

Test Graphs

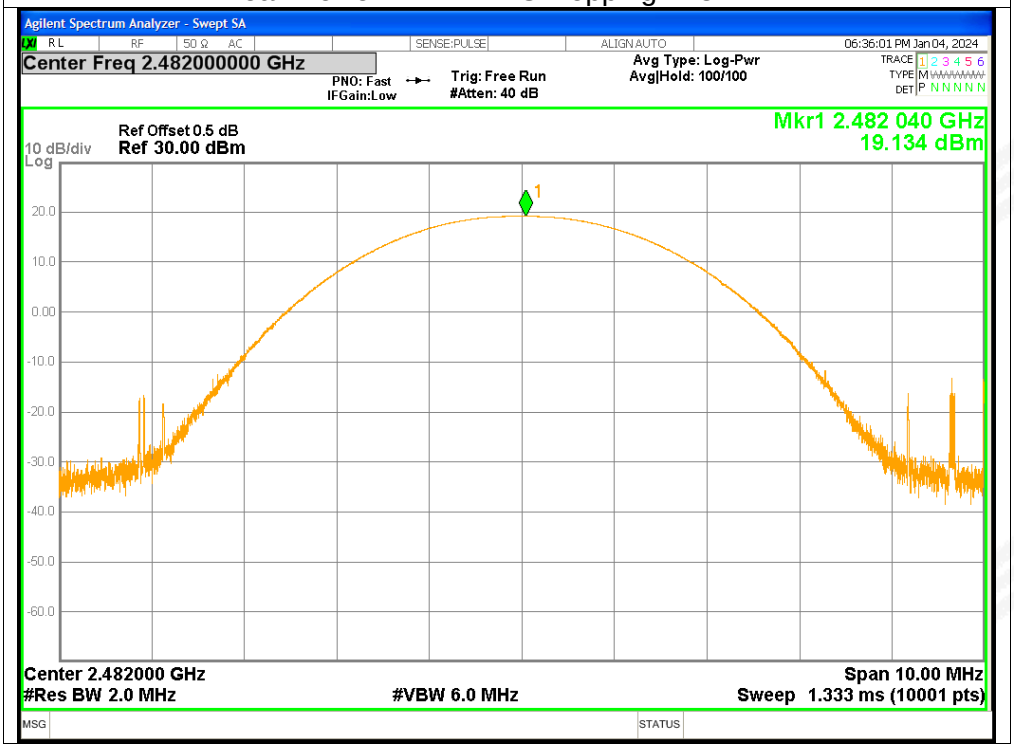
Peak Power NVNT 2.4G Hopping 2401.5MHz



Peak Power NVNT 2.4G Hopping 2442MHz



Peak Power NVNT 2.4G Hopping 2482MHz

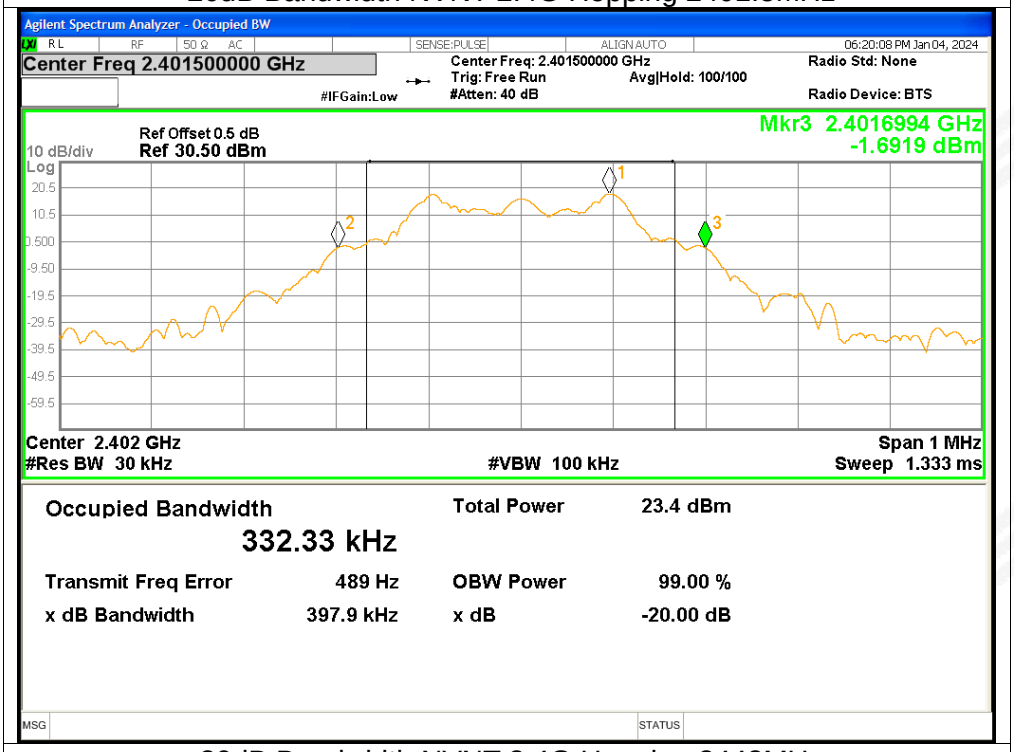


2. -20dB Bandwidth

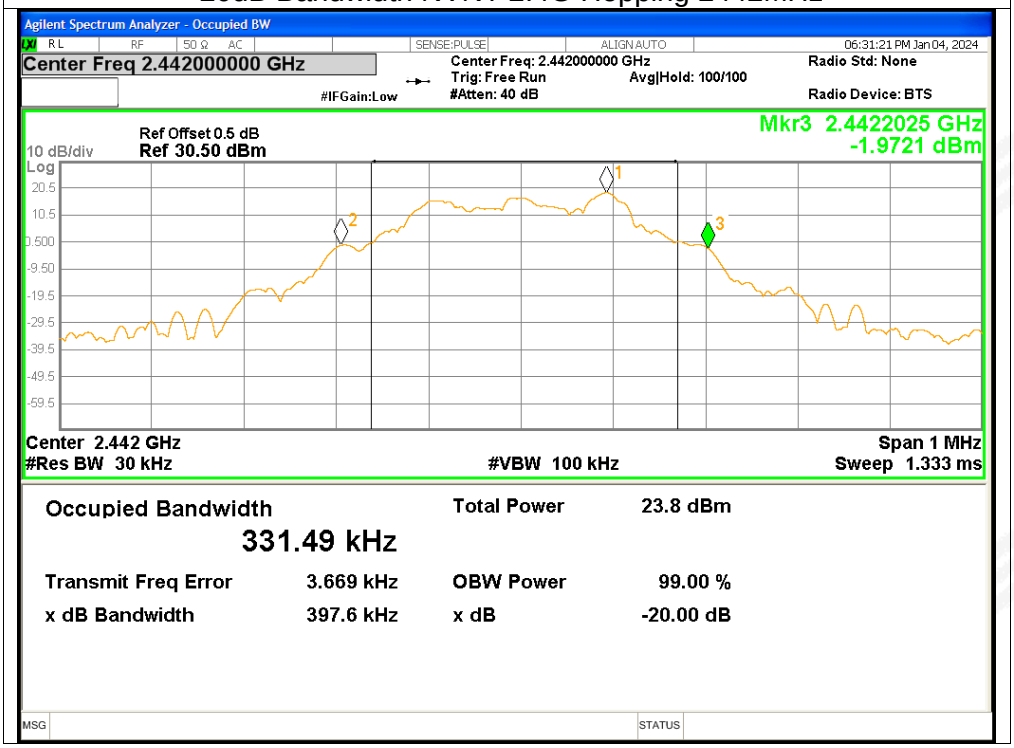
Condition	Mode	Frequency (MHz)	-20 dB Bandwidth (MHz)	Verdict
NVNT	2.4G Hopping	2401.5	0.3979	Pass
NVNT	2.4G Hopping	2442	0.3976	Pass
NVNT	2.4G Hopping	2482	0.3956	Pass

Test Graphs

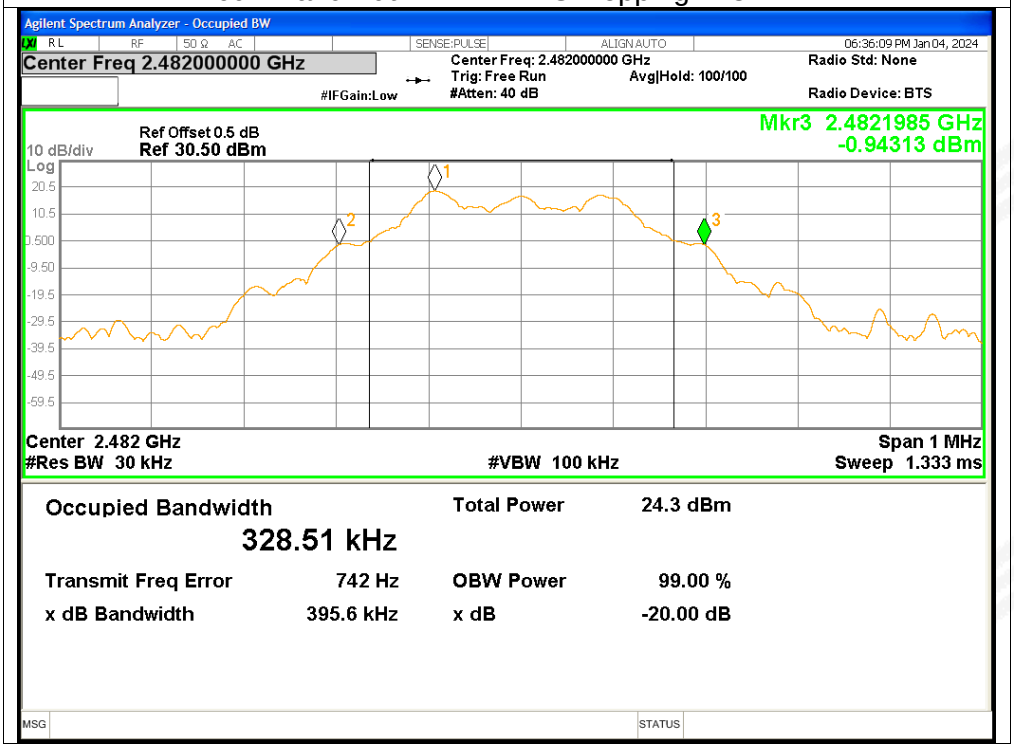
-20dB Bandwidth NVNT 2.4G Hopping 2401.5MHz



-20dB Bandwidth NVNT 2.4G Hopping 2442MHz



-20dB Bandwidth NVNT 2.4G Hopping 2482MHz

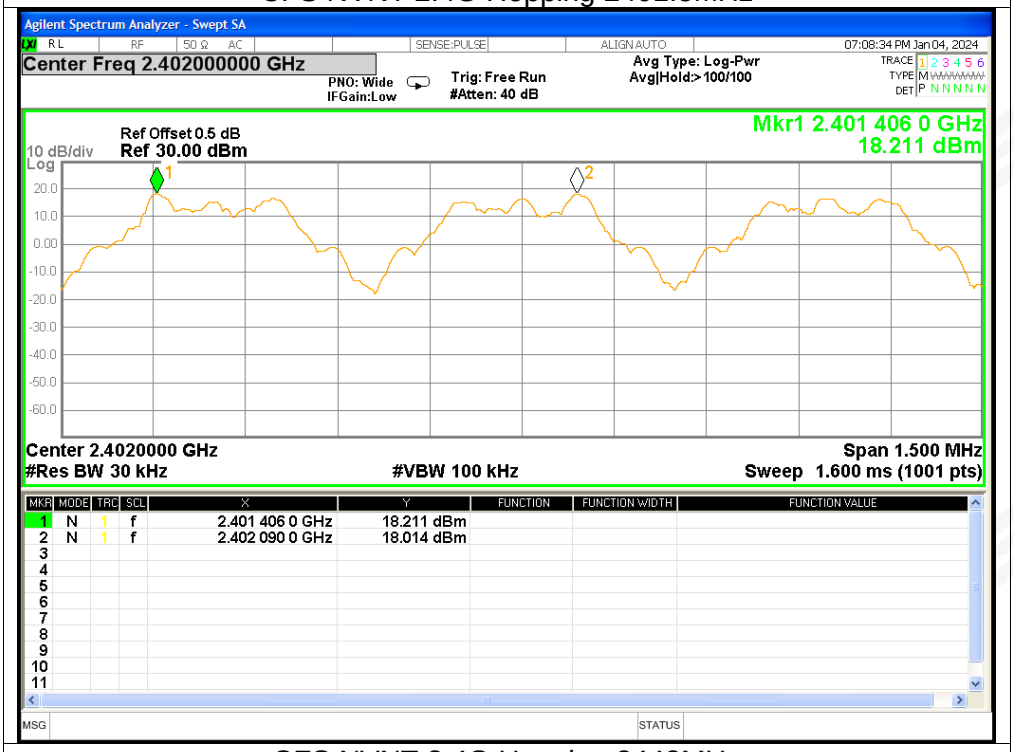


3. Carrier Frequencies Separation

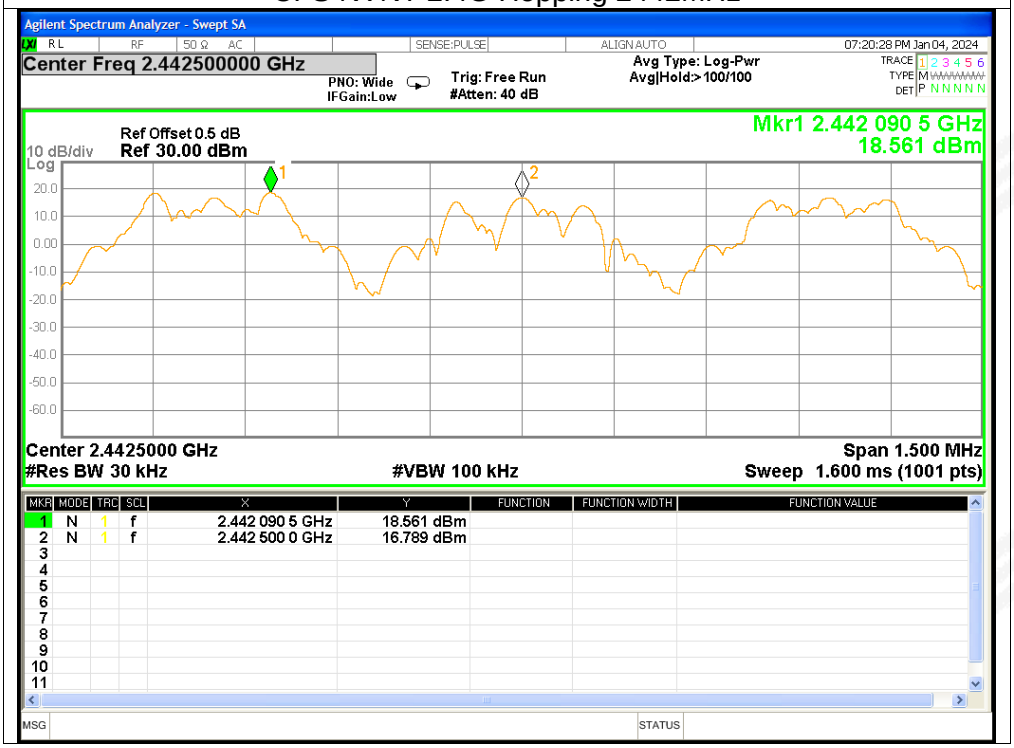
Condition	Mode	Hopping Freq1 (MHz)	Hopping Freq2 (MHz)	HFS (MHz)	Limit (MHz)	Verdict
NVNT	2.4G Hopping	2401.406	2402.09	0.684	>=0.265	Pass
NVNT	2.4G Hopping	2442.0905	2442.5	0.4095	>=0.265	Pass
NVNT	2.4G Hopping	2481.407	2481.902	0.495	>=0.264	Pass

Test Graphs

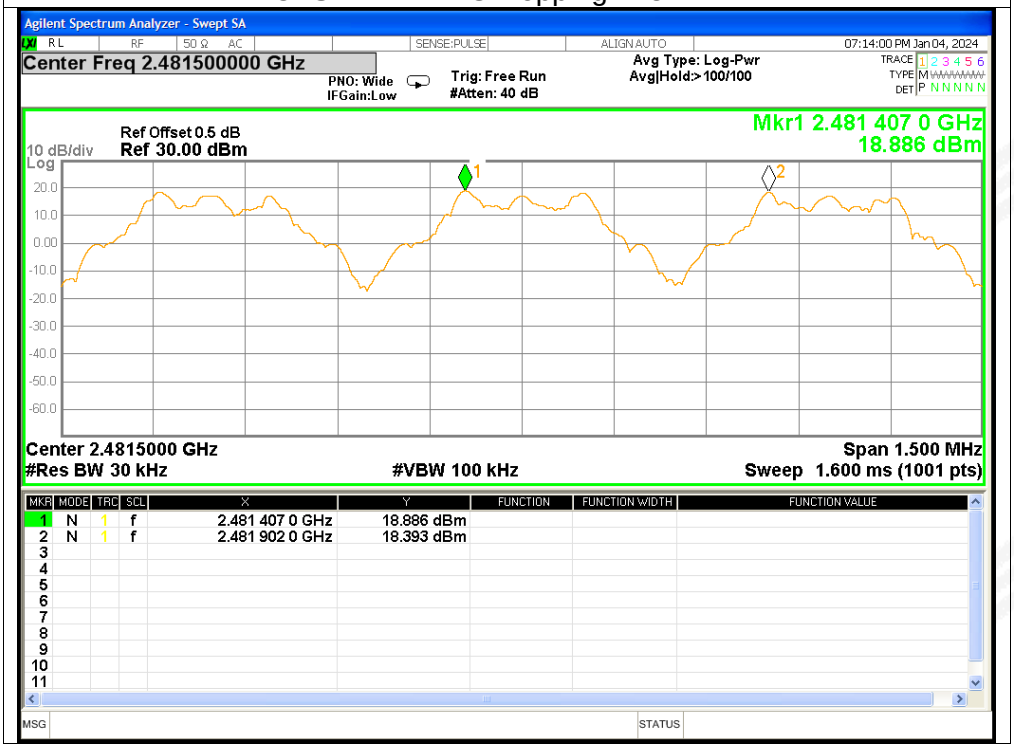
CFS NVNT 2.4G Hopping 2401.5MHz



CFS NVNT 2.4G Hopping 2442MHz



CFS NVNT 2.4G Hopping 2482MHz

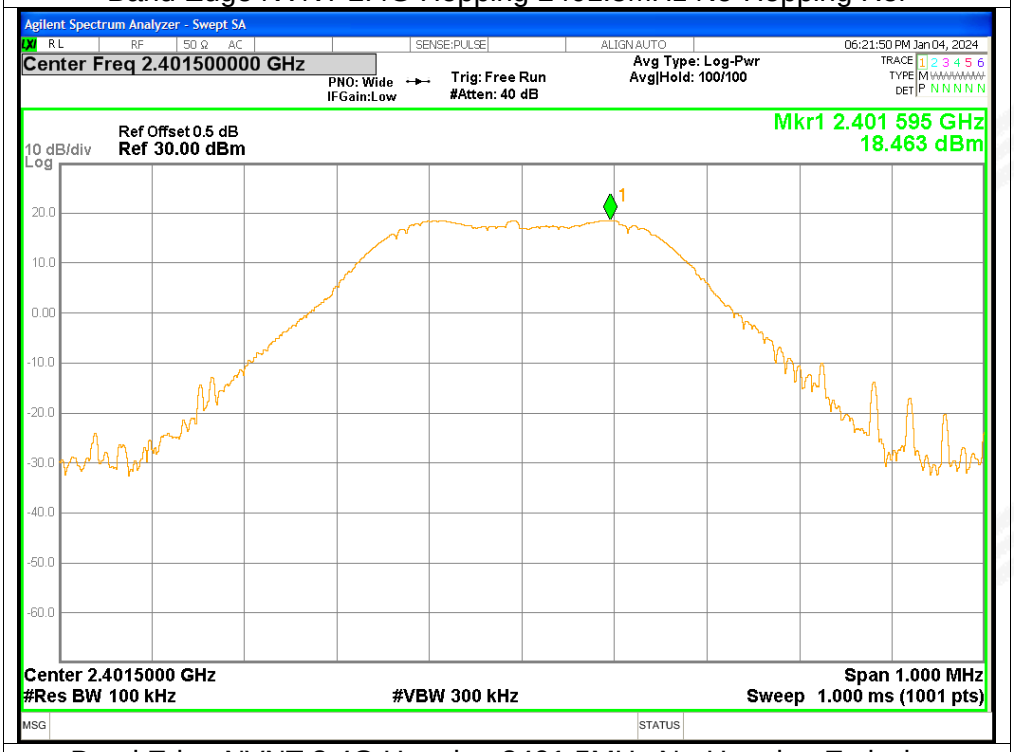


4. Band Edge

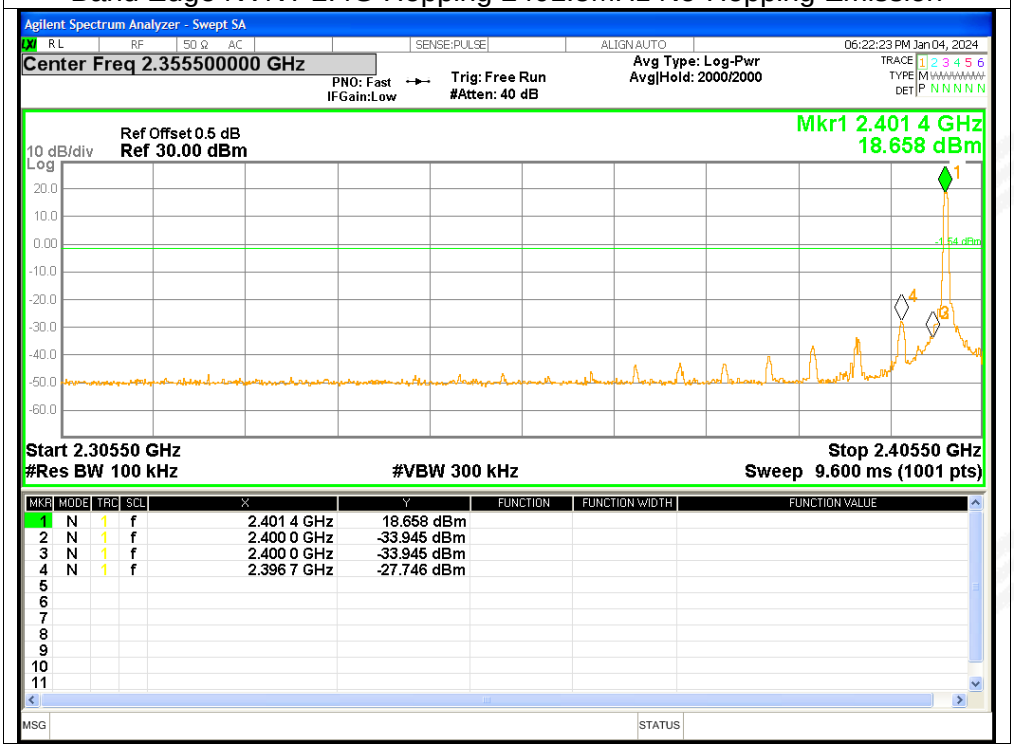
Condition	Mode	Frequency (MHz)	Hopping Mode	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	2.4G Hopping	2401.5	No-Hopping	-46.2	<=-20	Pass
NVNT	2.4G Hopping	2482	No-Hopping	-50.65	<=-20	Pass

Test Graphs

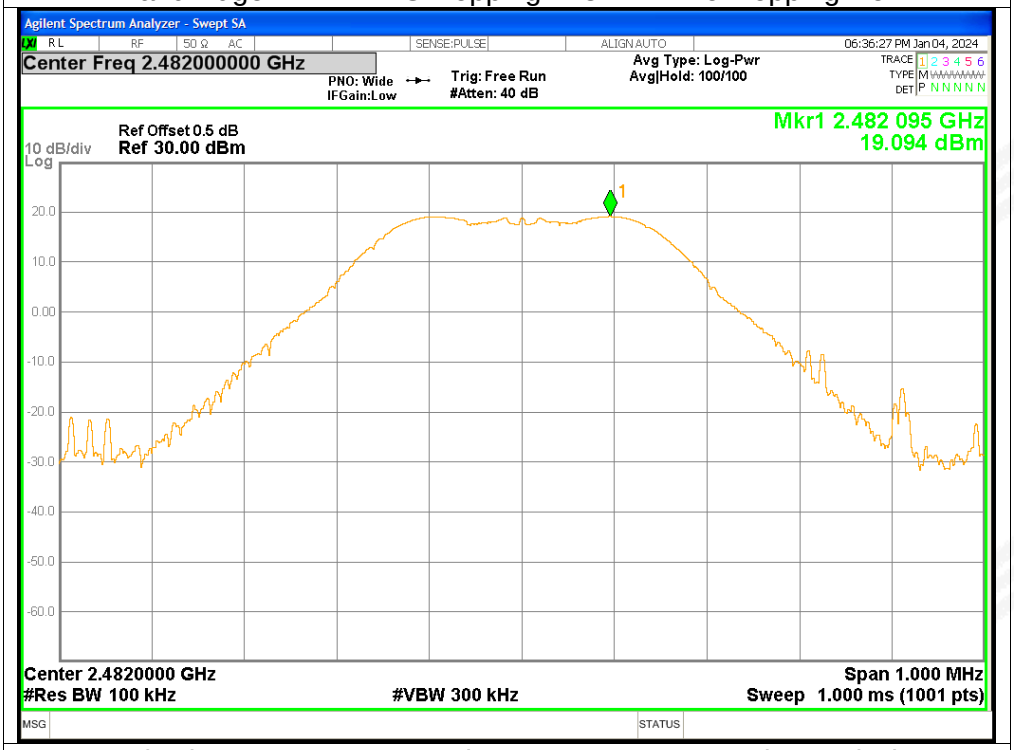
Band Edge NVNT 2.4G Hopping 2401.5MHz No-Hopping Ref



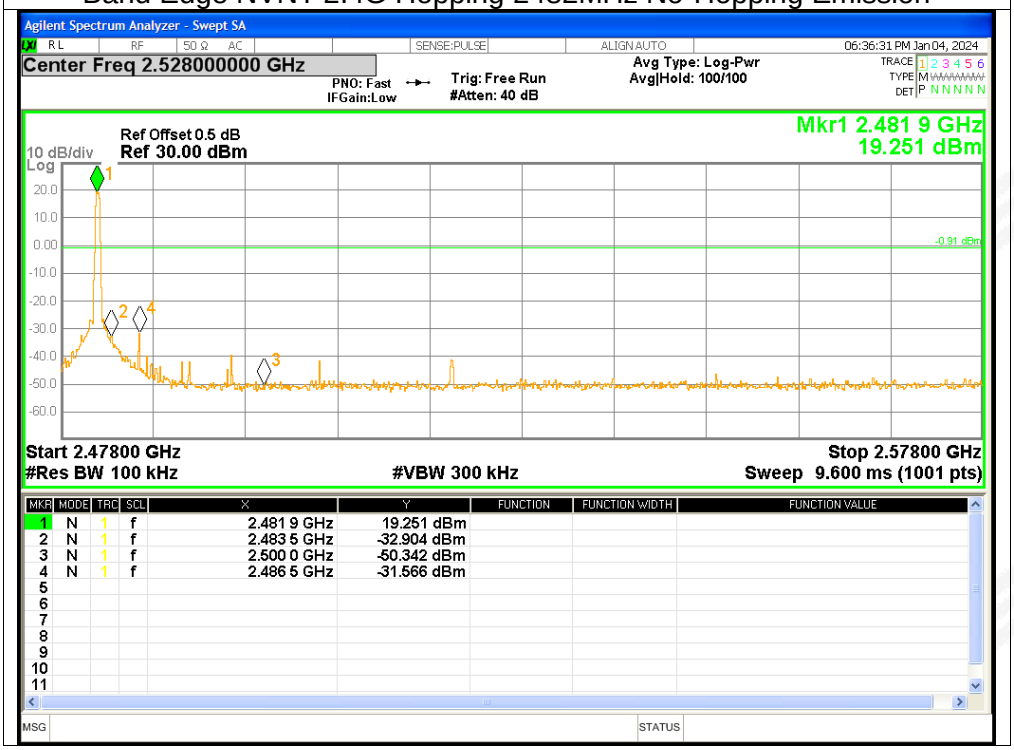
Band Edge NVNT 2.4G Hopping 2401.5MHz No-Hopping Emission



Band Edge NVNT 2.4G Hopping 2482MHz No-Hopping Ref



Band Edge NVNT 2.4G Hopping 2482MHz No-Hopping Emission

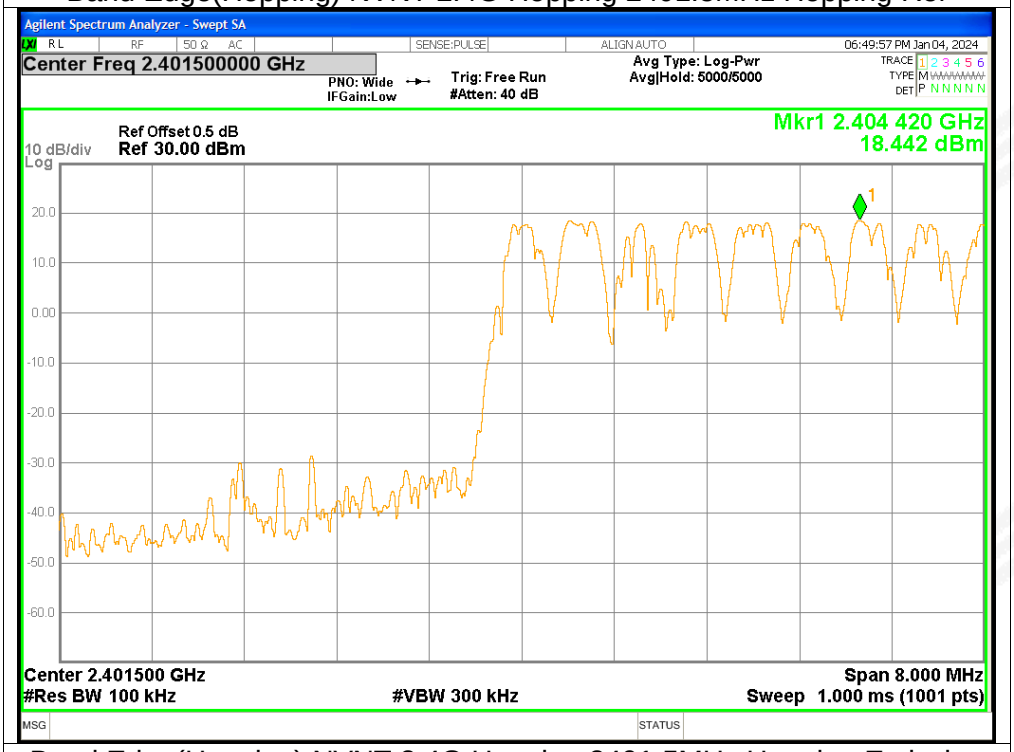


5. Band Edge(Hopping)

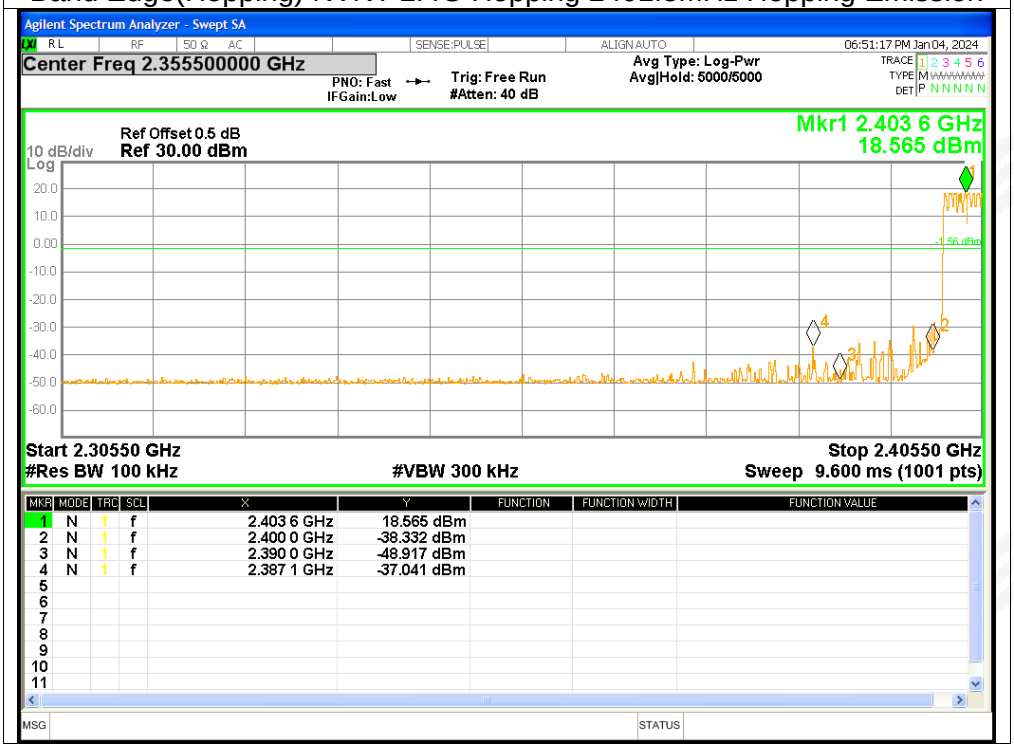
Condition	Mode	Frequency (MHz)	Hopping Mode	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	2.4G Hopping	2401.5	Hopping	-55.48	<=-20	Pass
NVNT	2.4G Hopping	2482	Hopping	-45.97	<=-20	Pass

Test Graphs

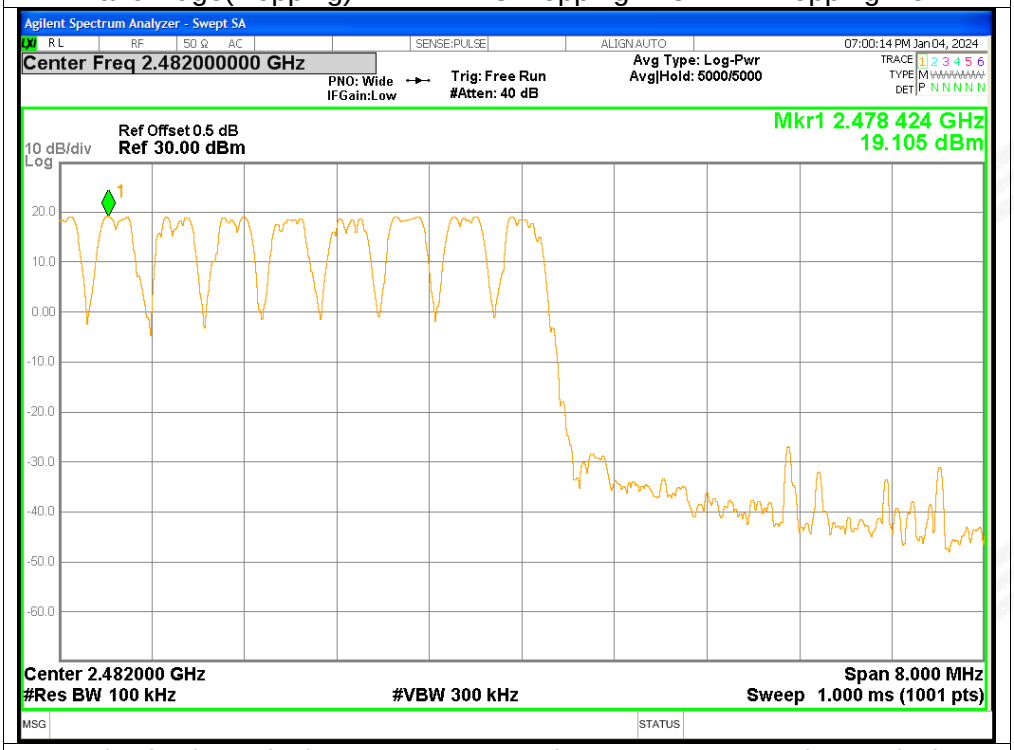
Band Edge(Hopping) NVNT 2.4G Hopping 2401.5MHz Hopping Ref



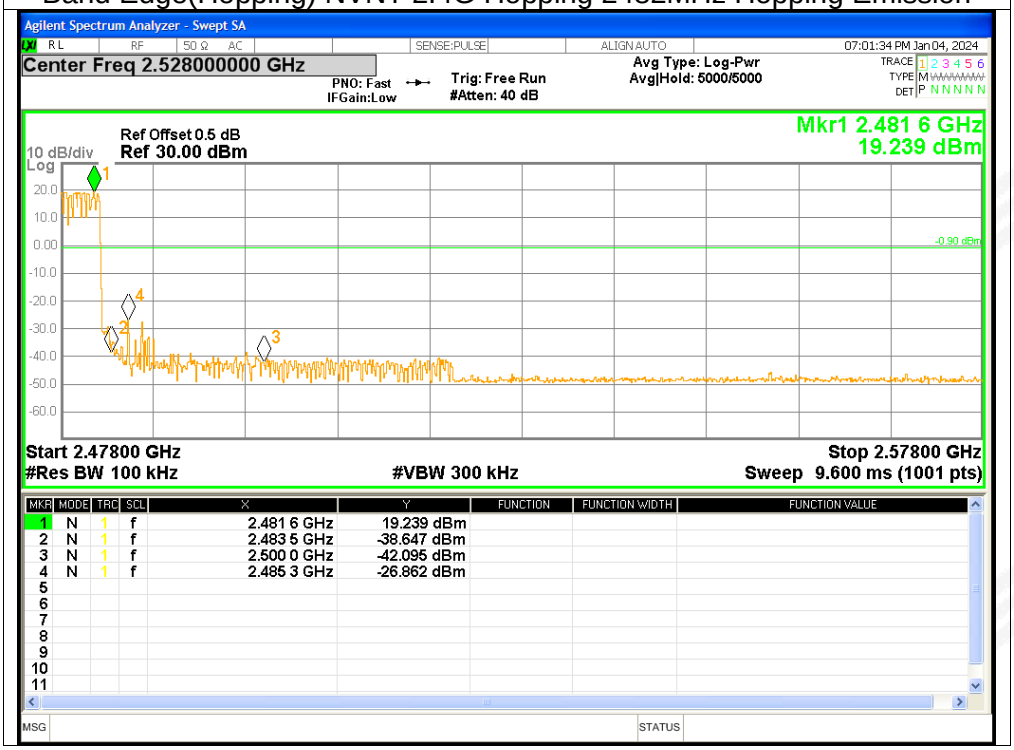
Band Edge(Hopping) NVNT 2.4G Hopping 2401.5MHz Hopping Emission



Band Edge(Hopping) NVNT 2.4G Hopping 2482MHz Hopping Ref



Band Edge(Hopping) NVNT 2.4G Hopping 2482MHz Hopping Emission

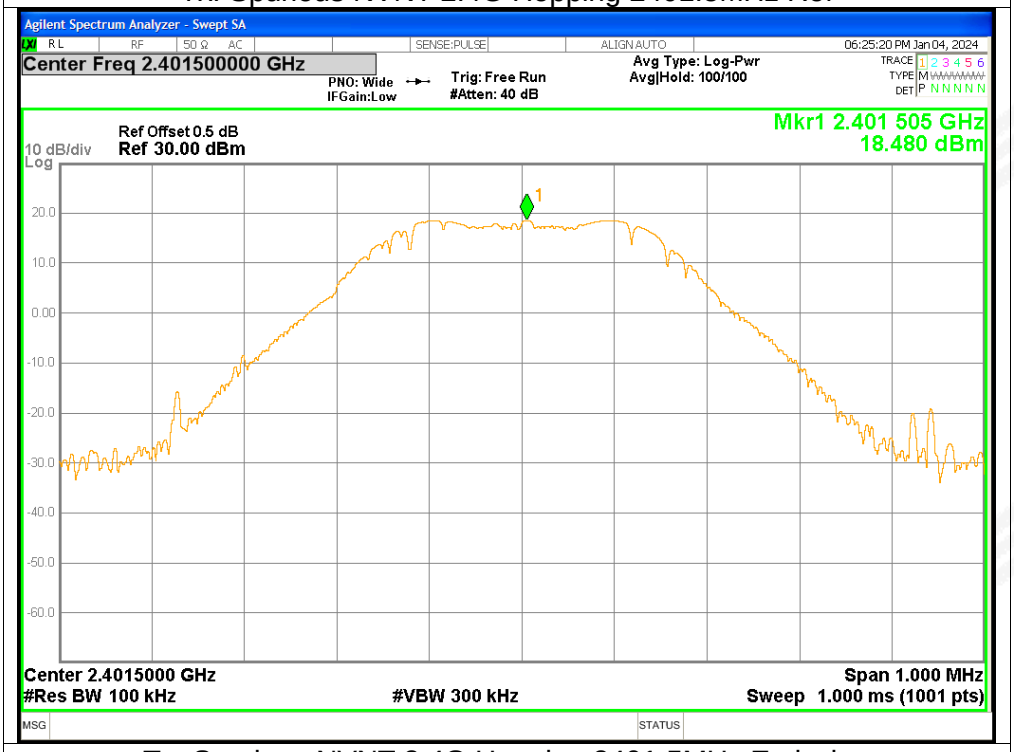


6. Conducted RF Spurious Emission

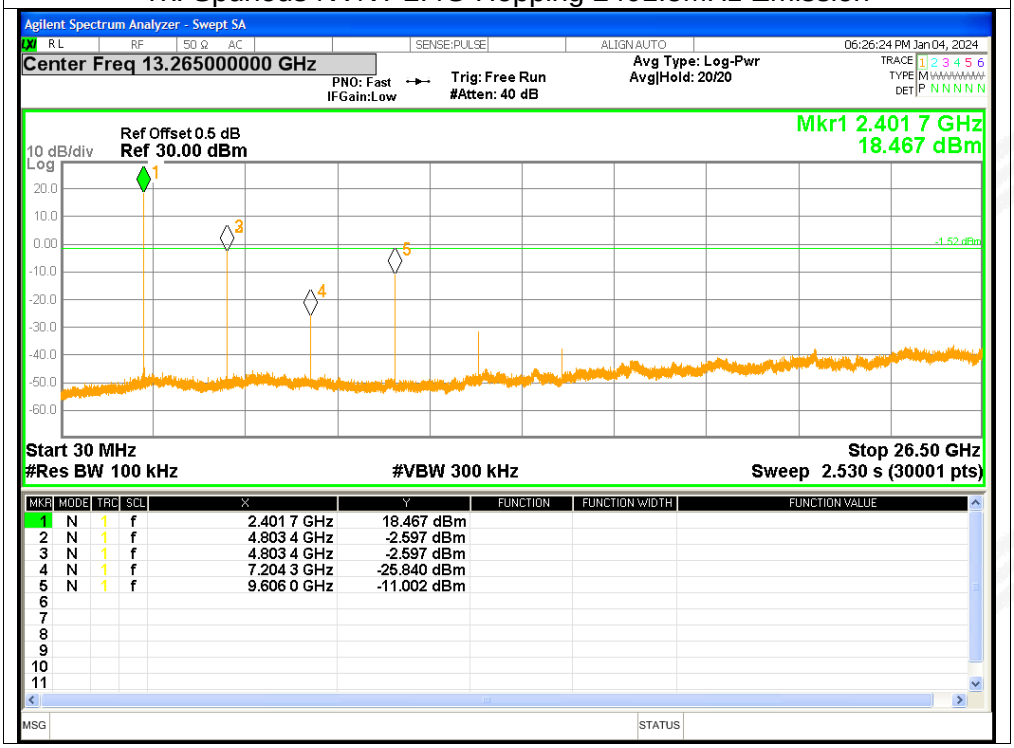
Condition	Mode	Frequency (MHz)	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	2.4G Hopping	2401.5	-21.07	<=-20	Pass
NVNT	2.4G Hopping	2442	-26.21	<=-20	Pass
NVNT	2.4G Hopping	2482	-28.48	<=-20	Pass

Test Graphs

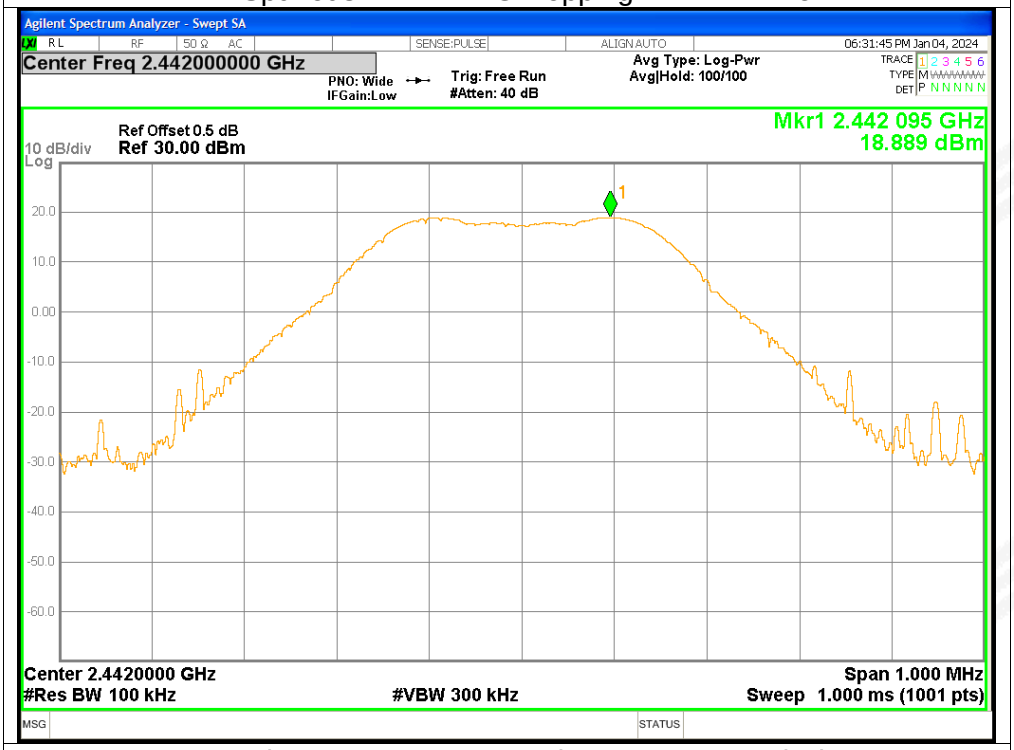
Tx. Spurious NVNT 2.4G Hopping 2401.5MHz Ref



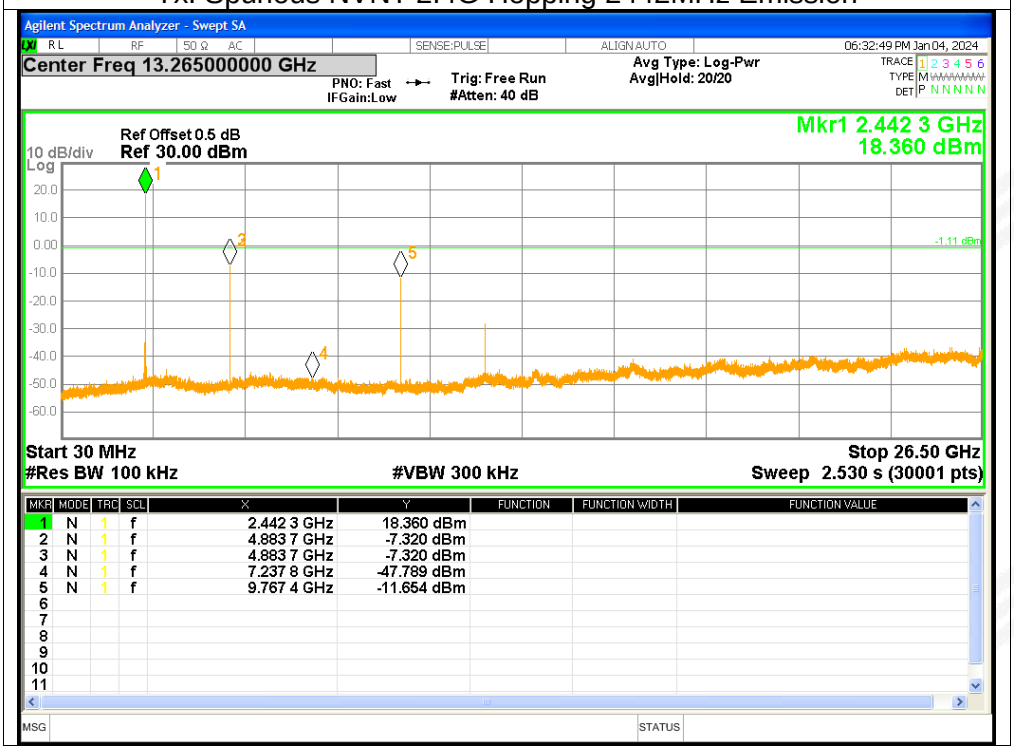
Tx. Spurious NVNT 2.4G Hopping 2401.5MHz Emission



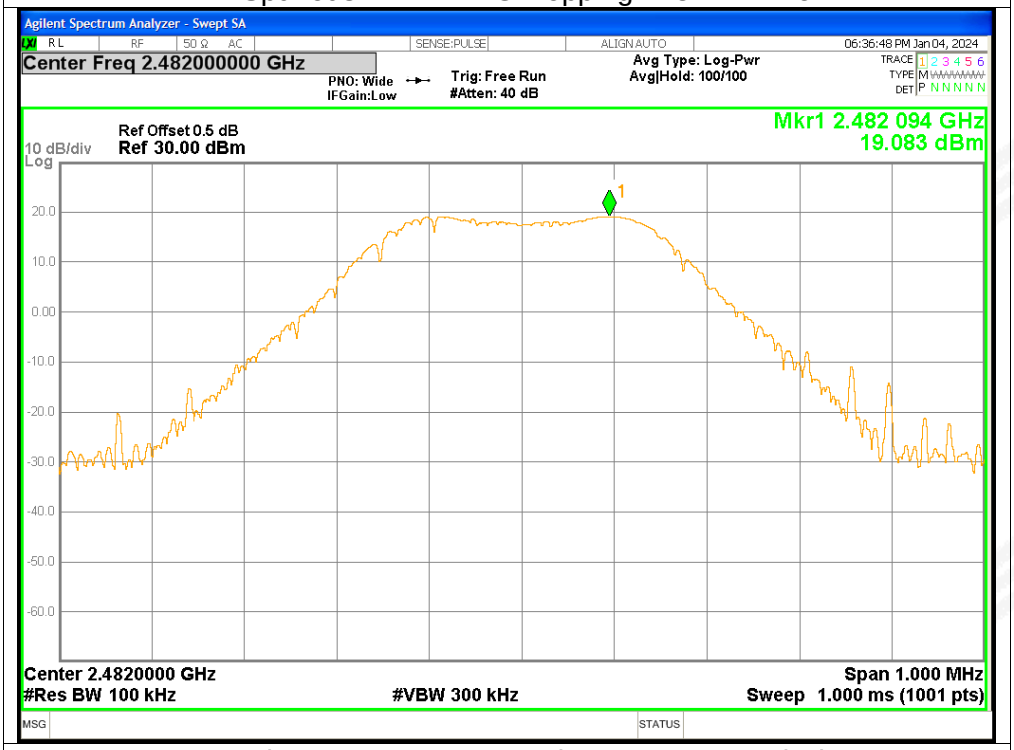
Tx. Spurious NVNT 2.4G Hopping 2442MHz Ref



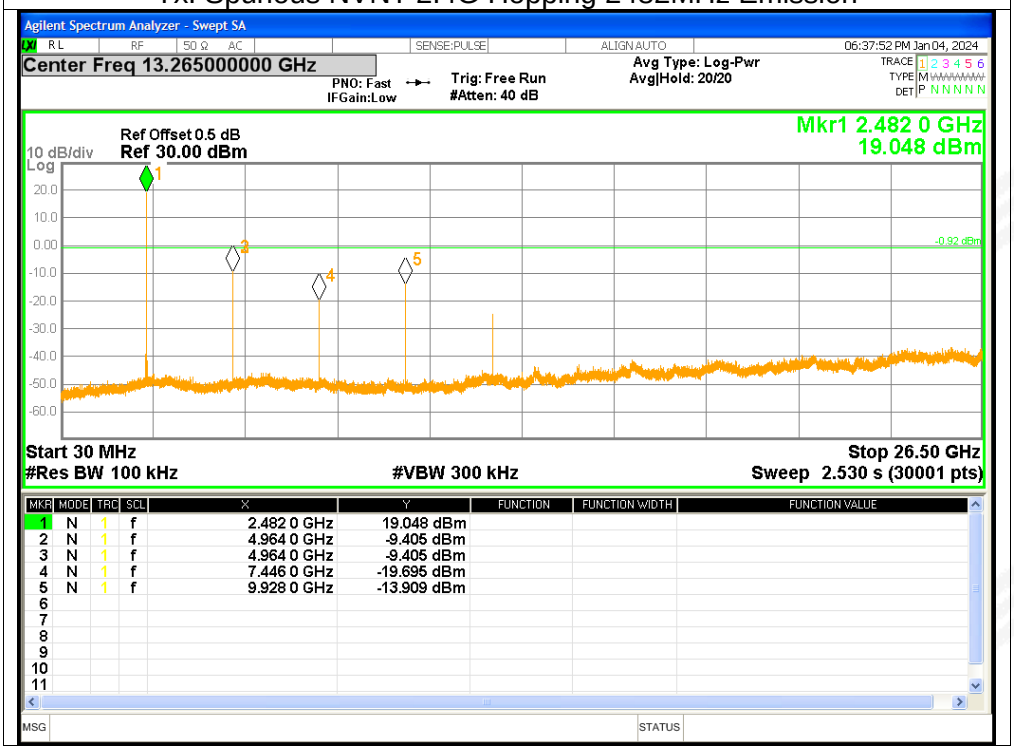
Tx. Spurious NVNT 2.4G Hopping 2442MHz Emission



Tx. Spurious NVNT 2.4G Hopping 2482MHz Ref



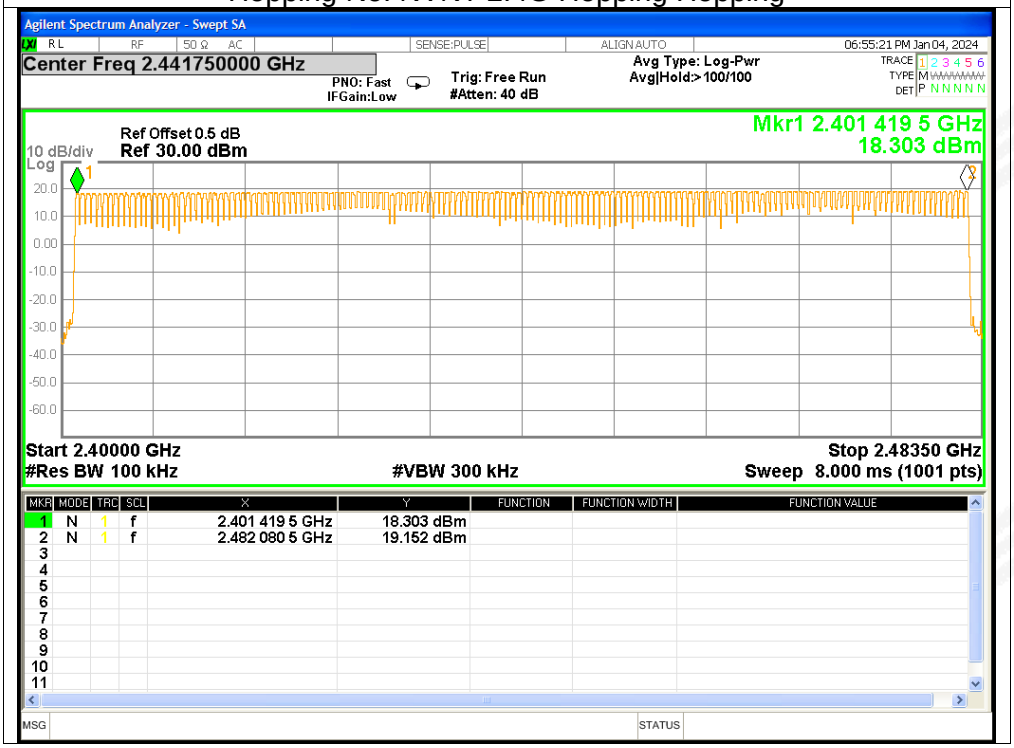
Tx. Spurious NVNT 2.4G Hopping 2482MHz Emission



7. Number of Hopping Channel

Condition	Mode	Hopping Number	Limit	Verdict
NVNT	2.4G Hopping	162	>=15	Pass

Test Graphs
Hopping No. NVNT 2.4G Hopping Hopping

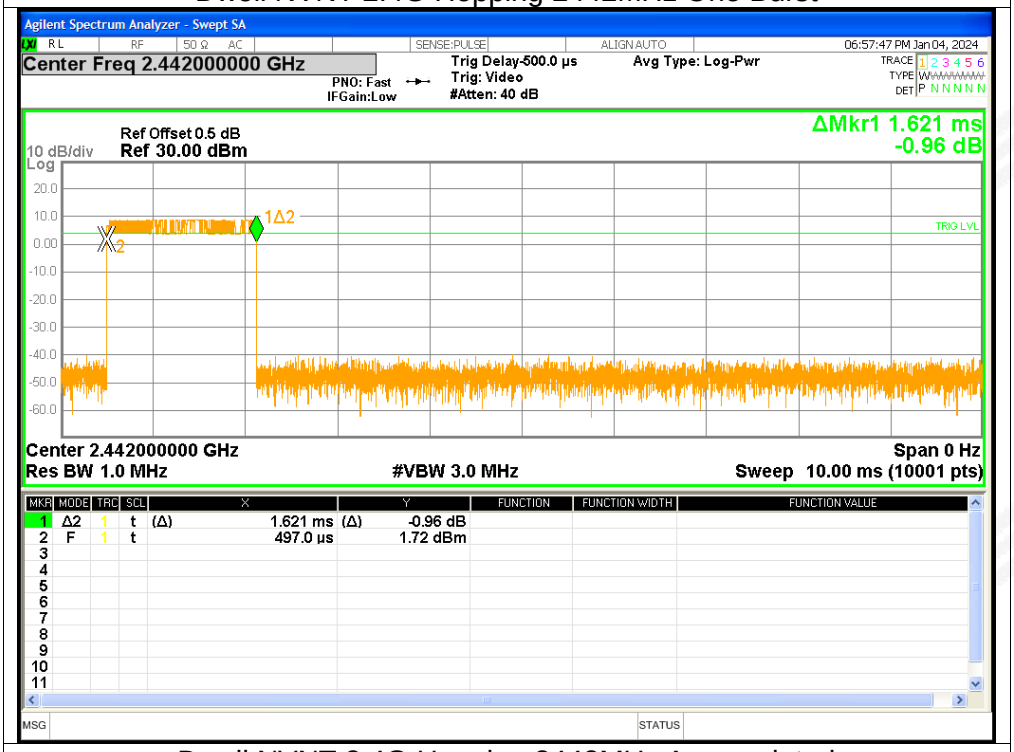


8. Dwell Time

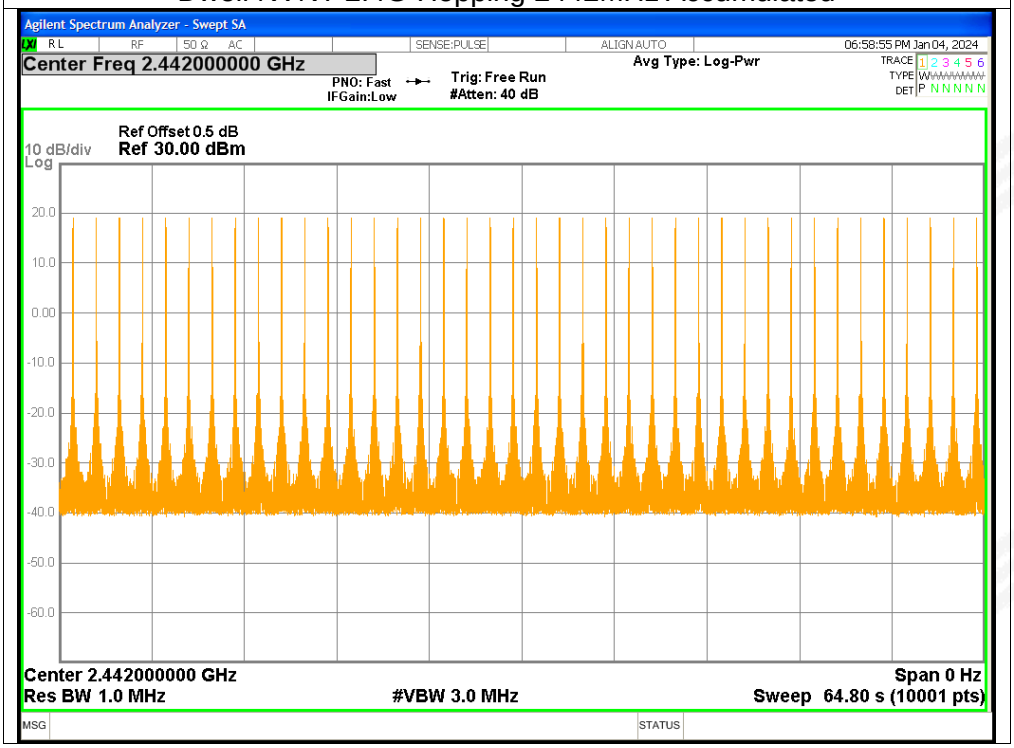
Condition	Mode	Frequency (MHz)	Pulse Time (ms)	Total Dwell Time (ms)	Burst Count	Period Time (ms)	Limit (ms)	Verdict
NVNT	2.4G Hopping	2442	1.621	64.84	40	64800	<=400	Pass

Test Graphs

Dwell NVNT 2.4G Hopping 2442MHz One Burst



Dwell NVNT 2.4G Hopping 2442MHz Accumulated



APPENDIX 2-PHOTOS OF TEST SETUP

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

※※※※※END OF THE REPORT※※※※※