RADIO TEST REPORT

Report No: STS1908284W04

Issued for

FrSky Electronic Co., Ltd.

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

Product Name:	Digital Telemetry Radio System
Brand Name:	FrSky
Model Name:	Taranis X9D Plus SE 2019
Series Model:	Taranis X9D Plus 2019 , Taranis X9 Lite,Taranis X9 Lite Pro, Taranis X9 Lite S, Taranis X9E ACCESS,Taranis Q X7 ACCESS,Taranis Q X7S ACCESS
FCC ID:	XYFX9X7DLSP
Test Standard:	FCC Part 15.247

Shenzhen STS Test Services Co., Ltd.
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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 .....:	Digital Telemetry Radio System
Brand Name .....:	FrSky
Model Name.....:	Taranis X9D Plus SE 2019
Series Model .....:	Taranis X9D Plus 2019 , Taranis X9 Lite,Taranis X9 Lite Pro, Taranis X9 Lite S, Taranis X9E ACCESS,Taranis Q X7 ACCESS,Taranis Q X7S ACCESS
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.
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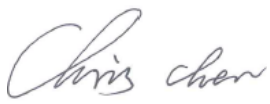
Date of Test.....:

Date (s) of performance of tests :	23 Aug. 2019 ~ 14 Oct. 2019
Date of Issue .....:	14 Oct. 2019
Test Result .....:	Pass

Testing Engineer : 

(Chris Chen)

Technical Manager : 

(Sunday Hu)

Authorized Signatory : 

(Vita Li)

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Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	14 Oct. 2019	STS1908284W04	ALL	Initial Issue

1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:
KDB 558074 D01 15.247 Meas Guidance v05r01

FCC Part 15.247,Subpart C			
Standard Section	Test Item	Judgment	Remark
15.207	Conducted Emission	N/A	--
15.247(a)(1)	Hopping Channel Separation	PASS	--
15.247(a)(1)&(b)(1)	Output Power	PASS	--
15.247(c)	Radiated Spurious Emission	PASS	--
15.247(d)	Conducted Spurious & Band Edge Emission	PASS	--
15.247(a)(iii)	Number of Hopping Frequency	PASS	--
15.247(a)(iii)	Dwell Time	PASS	--
15.247(a)(1)	Bandwidth	PASS	--
15.205	Restricted Band Edge Emission	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. : A 1/F, Building B, Zhuoke Science Park, No.190 Chongqing Road, HepingShequ, Fuyong 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	±0.71dB
2	Unwanted Emissions, conducted	±0.63dB
3	All emissions, radiated 30-200MHz	±3.43dB
4	All emissions, radiated 200MHz-1GHz	±3.57dB
5	All emissions, radiated>1G	±4.13dB
6	Conducted Emission (9KHz-150KHz)	±3.18dB
7	Conducted Emission (150KHz-30MHz)	±2.70dB

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	Digital Telemetry Radio System
Trade Name	FrSky
Model Name	Taranis X9D Plus SE 2019
Series Model	Taranis X9D Plus 2019 , Taranis X9 Lite,Taranis X9 Lite Pro, Taranis X9 Lite S, Taranis X9E ACCESS,Taranis Q X7 ACCESS,Taranis Q X7S ACCESS
Model Difference	The model name and size of appearance are different.
Channel List	Please refer to the Note 2.
Operation Frequency	2405.5~2474.00 MHz
Modulation Type	FSK
Number Of Channel	47CH
Power Rating	DC 6.5V-8.4V, 130mA(Normal: DC 7V)
Hardware version number	X9DP2019-RF_REV0.41
Software version number	V1.0
Connecting I/O Port(s)	Please refer to the User's Manual

Note:

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

2.

Channel List			
Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2405.50	25	2441.00
2	2406.46	26	2442.48
3	2407.91	27	2444.53
4	2409.49	28	2445.38
5	2410.94	29	2446.95
6	2412.39	30	2448.40
7	2413.96	31	2449.97
8	2415.41	32	2451.42
9	2416.98	33	2452.87
10	2418.43	34	2454.44
11	2419.88	35	2455.89
12	2421.45	36	2457.46
13	2422.90	37	2458.91
14	2424.47	38	2460.48
15	2425.92	39	2461.93
16	2427.49	40	2463.38
17	2428.94	41	2464.95
18	2430.39	42	2466.40
19	2432.08	43	2467.97
20	2433.41	44	2469.42
21	2434.98	45	2470.87
22	2436.43	46	2472.44
23	2437.88	47	2474.00
24	2439.45	/	/

3. Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	FrSky	Taranis X9D Plus SE 2019	DIPOLE Antenna	N/A	2dBi,	2.4G Antenna

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 CH24	FSK
Mode 3	TX CH47	FSK

Note:

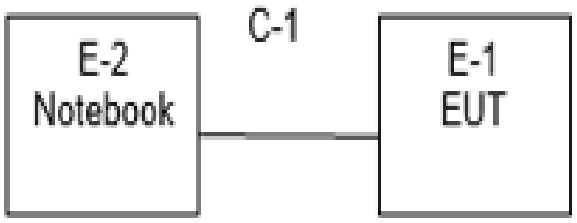
(1) The measurements are performed at all Bit Rate of Transmitter, the worst data was reported

(2) We have be tested for all avaiable 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

2.3 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters of FHSS

Radiated Spurious Emission Test



2.4 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.	Serial No.	Note
N/A	N/A	N/A	N/A	N/A	N/A

Support units

Item	Equipment	Mfr/Brand	Model/Type No.	Serial No.	Note
E-2	Notebook	HP	500-320cx	N/A	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.

(3) “YES” is means “shielded” “with core”; “NO” is means “unshielded” “without core”.

2.5 EQUIPMENTS LIST

Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	ESCI	101427	2018.10.13 2019.10.09	2019.10.12, 2020.10.08
Signal Analyzer	Agilent	N9020A	MY51110105	2019.03.02	2020.03.01
Active loop Antenna	ZHINAN	ZN30900C	16035	2018.03.11	2021.03.10
Bilog Antenna	TESEQ	CBL6111D	34678	2017.11.02	2020.11.1
Horn Antenna	SCHWARZBECK	BBHA 9120D(1201)	9120D-1343	2018.10.19	2021.10.18
SHF-EHF Horn Antenna (18G-40GHz)	A-INFO	LB-180400-KF	J211020657	2018.03.11	2021.03.10
Pre-Amplifier(0.1M-3GHz)	EM	EM330	060665	2018.10.13 2019.10.09	2019.10.12, 2020.10.08
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK2018080901	2018.10.13 2019.10.09	2019.10.12, 2020.10.08
Temperature & Humidity	HH660	Mieo	N/A	2018.10.11 2019.10.09	2019.10.10, 2020.10.08
turn table	EM	SC100_1	60531	N/A	N/A
Antenna mast	EM	SC100	N/A	N/A	N/A
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)			

RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
USB RF power sensor	DARE	RPR3006W	15I00041SNO03	2018.10.13 2019.10.09	2019.10.12, 2020.10.08
Signal Analyzer	Agilent	N9020A	MY49100060	2018.10.13 2019.10.09	2019.10.12, 2020.10.08
Temperature & Humidity	HH660	Mieo	N/A	2018.10.11 2019.10.09	2019.10.10, 2020.10.08
Test SW	FARAD	LZ-RF /LzRf-3A3			

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) limit in the table below has to be followed.

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.

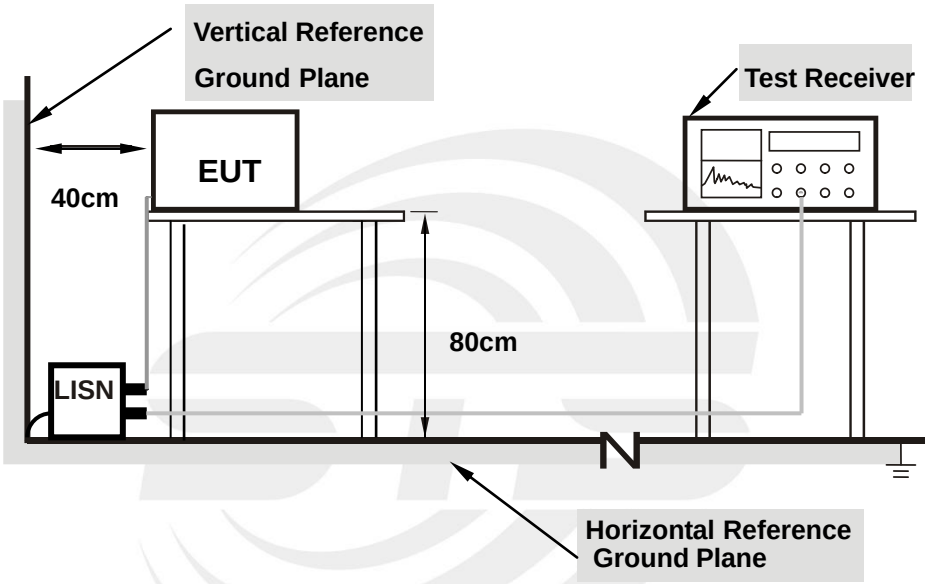
The following table is the setting of the receiver

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 was 0.8 meters from the horizontal ground plane and 0.4 meters from the vertical ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 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 at least 80 cm from 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 from other units and other metal planes

3.1.5 TEST RESULT

Temperature:	24(C)	Relative Humidity:	59.8%RH
Test Voltage:	N/A	Phase:	L/N
Test Mode:	N/A		

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).

For Radiated Emission

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)	PK=1MHz / 1MHz, AV=1 MHz /10 Hz

For Band edge

Spectrum Parameter	Setting
Detector	Peak/AV
Start/Stop Frequency	Lower Band Edge: 2300 to 2403 MHz Upper Band Edge: 2479 to 2500 MHz
RB / VB (emission in restricted band)	PK=1MHz / 1MHz, AV=1 MHz / 10 Hz

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 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 test site. 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 QuasiPeak 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:

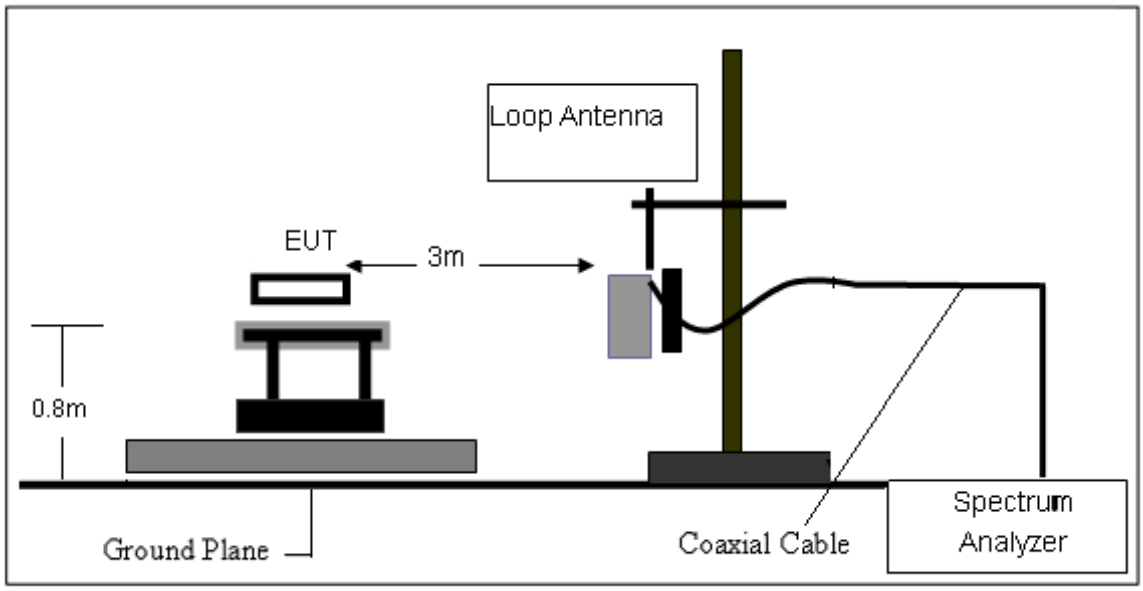
Both horizontal and vertical antenna polarities were tested
and performed pretest to three orthogonal axis. The worst case emissions were reported

3.2.3 DEVIATION FROM TEST STANDARD

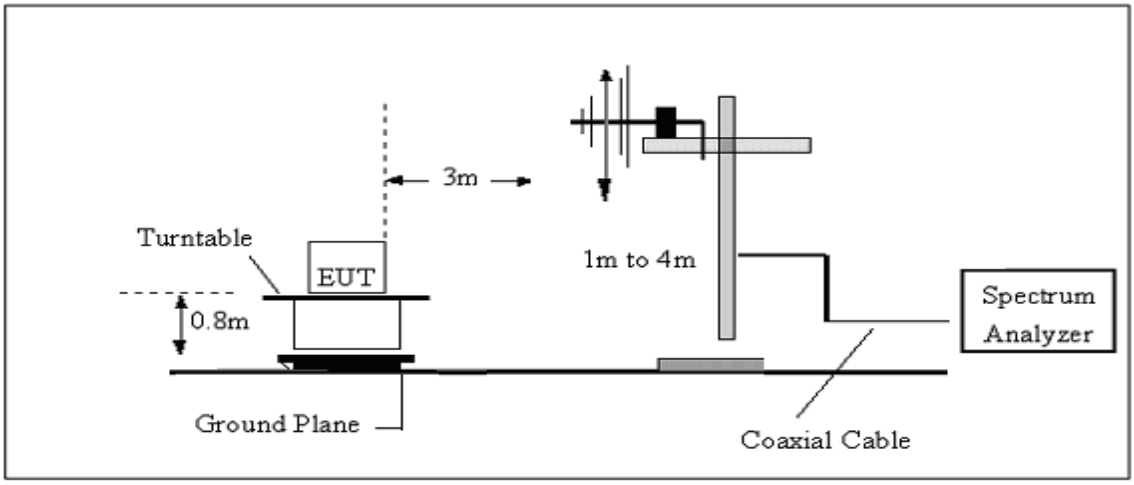
No deviation

3.2.4 TESTSETUP

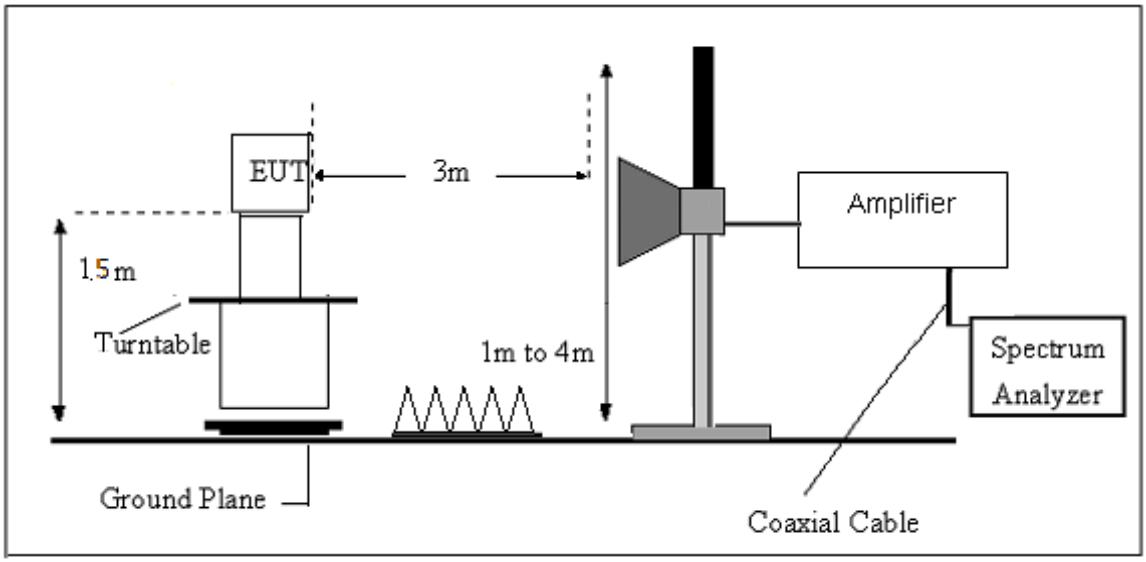
（A）Radiated Emission Test-Up Frequency Below 30MHz



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



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



3.2.5 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

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:	25.2(C)	Relative Humidity:	61%RH
Test Voltage:	DC 7V	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);

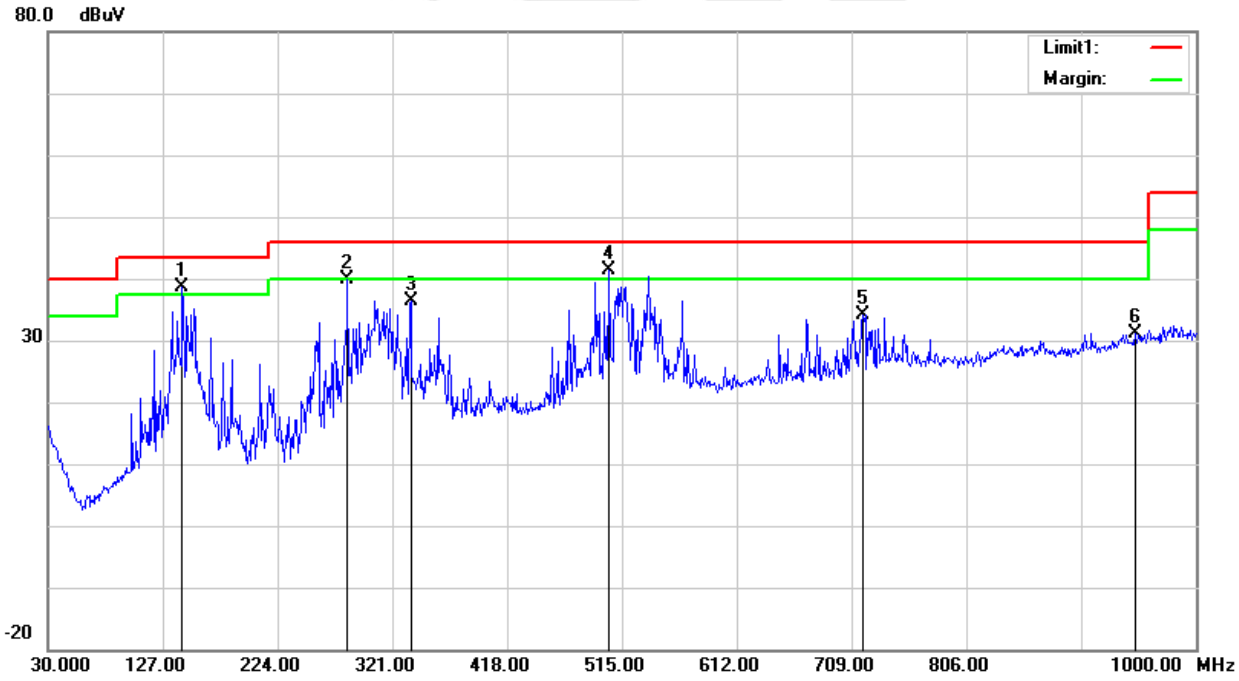
Limit line = specific limits(dBuv) + distance extrapolation factor.

(30MHz-1000MHz)

Temperature:	25.2(C)	Relative Humidity:	61%RH
Test Voltage:	DC 7V	Phase:	Horizontal
Test Mode:	Mode 1/2/3 (Mode 1 worst mode)		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	143.4900	56.92	-18.23	38.69	43.50	-4.81	QP
2	283.1700	55.38	-15.50	39.88	46.00	-6.12	QP
3	336.5200	49.83	-13.51	36.32	46.00	-9.68	QP
4	504.3300	49.25	-7.98	41.27	46.00	-4.73	QP
5	718.7000	37.51	-3.33	34.18	46.00	-11.82	QP
6	948.5900	29.60	1.56	31.16	46.00	-14.84	QP

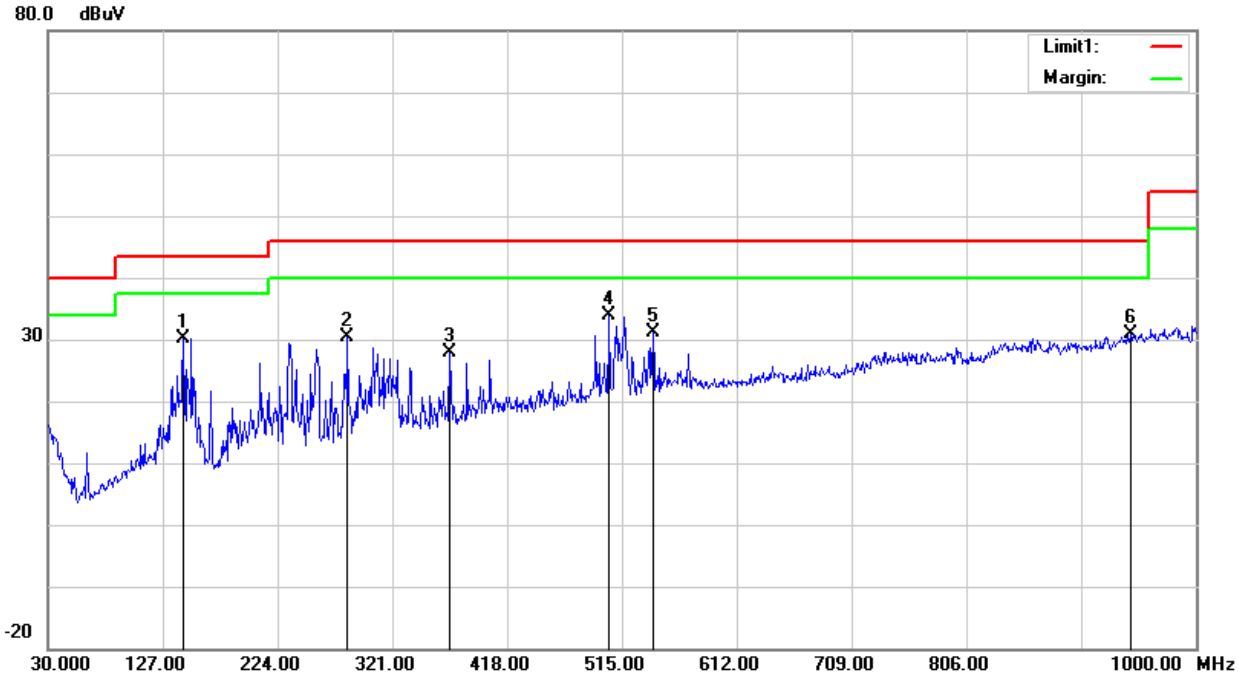
Remark:
1. Margin = Result (Result =Reading + Factor)–Limit



Temperature:	25.2(C)	Relative Humidity:	61%RH
Test Voltage:	DC 7V	Phase:	Vertical
Test Mode:	Mode 1/2/3 (Mode 1 worst mode)		

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	144.4600	48.43	-18.29	30.14	43.50	-13.36	QP
2	283.1700	45.96	-15.50	30.46	46.00	-15.54	QP
3	369.5000	40.45	-12.51	27.94	46.00	-18.06	QP
4	504.3300	41.81	-7.98	33.83	46.00	-12.17	QP
5	541.1900	37.91	-6.73	31.18	46.00	-14.82	QP
6	944.7100	29.41	1.48	30.89	46.00	-15.11	QP

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit



(1GHz~25GHz) Restricted band and Spurious emission Requirements

Frequency	Meter Reading	Amplifier	Loss	Antenna Factor	Orrected Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBμV)	（dB）	（dB）	（dB/m）	（dB）	(dBμV/m)	(dBμV/m)	(dB)	Type	
Low Channel (2405.5 MHz)										
3269.58	65.23	44.70	6.70	28.20	-9.80	55.43	74.00	-18.57	PK	Vertical
3269.58	55.41	44.70	6.70	28.20	-9.80	45.61	54.00	-8.39	AV	Vertical
3269.50	63.90	44.70	6.70	28.20	-9.80	54.10	74.00	-19.90	PK	Horizontal
3269.50	54.08	44.70	6.70	28.20	-9.80	44.28	54.00	-9.72	AV	Horizontal
4811.30	62.38	44.20	9.04	31.60	-3.56	58.82	74.00	-15.18	PK	Vertical
4811.30	52.56	44.20	9.04	31.60	-3.56	49.00	54.00	-5.00	AV	Vertical
4811.57	62.01	44.20	9.04	31.60	-3.56	58.45	74.00	-15.55	PK	Horizontal
4811.57	52.19	44.20	9.04	31.60	-3.56	48.63	54.00	-5.37	AV	Horizontal
5367.52	52.38	44.20	9.86	32.00	-2.34	50.04	74.00	-23.96	PK	Vertical
5367.52	42.56	44.20	9.86	32.00	-2.34	40.22	54.00	-13.78	AV	Vertical
5367.60	50.63	44.20	9.86	32.00	-2.34	48.29	74.00	-25.71	PK	Horizontal
5367.60	40.81	44.20	9.86	32.00	-2.34	38.47	54.00	-15.53	AV	Horizontal
7216.18	54.91	43.50	11.40	35.50	3.40	58.31	74.00	-15.69	PK	Vertical
7216.18	45.09	43.50	11.40	35.50	3.40	48.49	54.00	-5.51	AV	Vertical
7216.44	55.51	43.50	11.40	35.50	3.40	58.91	74.00	-15.09	PK	Horizontal
7216.44	45.69	43.50	11.40	35.50	3.40	49.09	54.00	-4.91	AV	Horizontal
Middle Channel (2439.45 MHz)										
3262.81	64.59	44.70	6.70	28.20	-9.80	54.79	74.00	-19.21	PK	Vertical
3262.81	54.77	44.70	6.70	28.20	-9.80	44.97	54.00	-9.03	AV	Vertical
3262.64	65.08	44.70	6.70	28.20	-9.80	55.28	74.00	-18.72	PK	Horizontal
3262.64	55.26	44.70	6.70	28.20	-9.80	45.46	54.00	-8.54	AV	Horizontal
4879.46	62.24	44.20	9.04	31.60	-3.56	58.68	74.00	-15.32	PK	Vertical
4879.46	52.42	44.20	9.04	31.60	-3.56	48.86	54.00	-5.14	AV	Vertical
4879.48	62.07	44.20	9.04	31.60	-3.56	58.51	74.00	-15.49	PK	Horizontal
4879.48	52.25	44.20	9.04	31.60	-3.56	48.69	54.00	-5.31	AV	Horizontal
5356.32	50.95	44.20	9.86	32.00	-2.34	48.61	74.00	-25.39	PK	Vertical
5356.32	41.13	44.20	9.86	32.00	-2.34	38.79	54.00	-15.21	AV	Vertical
5356.42	50.55	44.20	9.86	32.00	-2.34	48.21	74.00	-25.79	PK	Horizontal
5356.42	40.73	44.20	9.86	32.00	-2.34	38.39	54.00	-15.61	AV	Horizontal
7319.23	55.55	43.50	11.40	35.50	3.40	58.95	74.00	-15.05	PK	Vertical
7319.23	45.73	43.50	11.40	35.50	3.40	49.13	54.00	-4.87	AV	Vertical
7319.15	55.53	43.50	11.40	35.50	3.40	58.93	74.00	-15.07	PK	Horizontal
3262.81	64.59	44.70	6.70	28.20	-9.80	54.79	74.00	-19.21	AV	Horizontal

High Channel (2474 MHz)										
3256.89	64.77	44.70	6.70	28.20	-9.80	54.97	74.00	-19.03	PK	Vertical
3256.89	54.95	44.70	6.70	28.20	-9.80	45.15	54.00	-8.85	AV	Vertical
3256.81	64.22	44.70	6.70	28.20	-9.80	54.42	74.00	-19.58	PK	Horizontal
3256.81	54.40	44.70	6.70	28.20	-9.80	44.60	54.00	-9.40	AV	Horizontal
4948.51	62.56	44.20	9.04	31.60	-3.56	59.00	74.00	-15.00	PK	Vertical
4948.51	52.74	44.20	9.04	31.60	-3.56	49.18	54.00	-4.82	AV	Vertical
4948.41	62.54	44.20	9.04	31.60	-3.56	58.98	74.00	-15.02	PK	Horizontal
4948.41	52.72	44.20	9.04	31.60	-3.56	49.16	54.00	-4.84	AV	Horizontal
5346.83	52.16	44.20	9.86	32.00	-2.34	49.82	74.00	-24.18	PK	Vertical
5346.83	42.34	44.20	9.86	32.00	-2.34	40.00	54.00	-14.00	AV	Vertical
5346.90	50.92	44.20	9.86	32.00	-2.34	48.58	74.00	-25.42	PK	Horizontal
5346.90	41.10	44.20	9.86	32.00	-2.34	38.76	54.00	-15.24	AV	Horizontal
7421.85	55.54	43.50	11.40	35.50	3.40	58.94	74.00	-15.06	PK	Vertical
7421.85	45.72	43.50	11.40	35.50	3.40	49.12	54.00	-4.88	AV	Vertical
7421.70	55.40	43.50	11.40	35.50	3.40	58.80	74.00	-15.20	PK	Horizontal
7421.70	45.58	43.50	11.40	35.50	3.40	48.98	54.00	-5.02	AV	Horizontal

Note:

1) Scan with GFSK, π/4-DQPSK, the worst case is GFSK Mode

2) Factor = Antenna Factor + Cable Loss – Pre-amplifier.

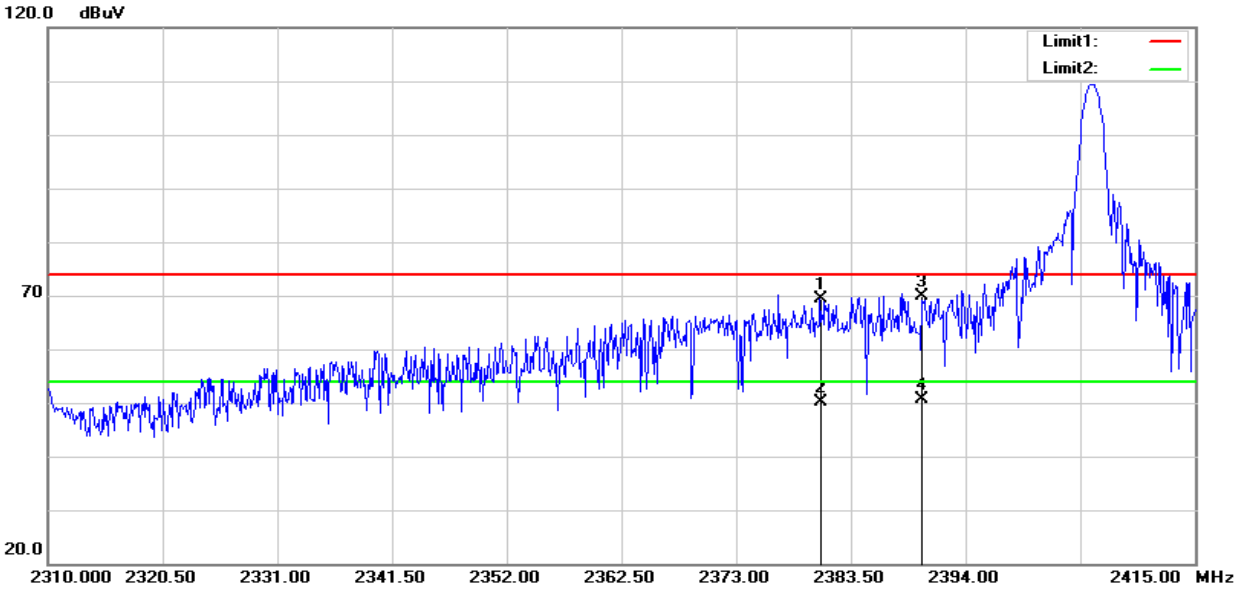
Emission Level = Reading + Factor

3) 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

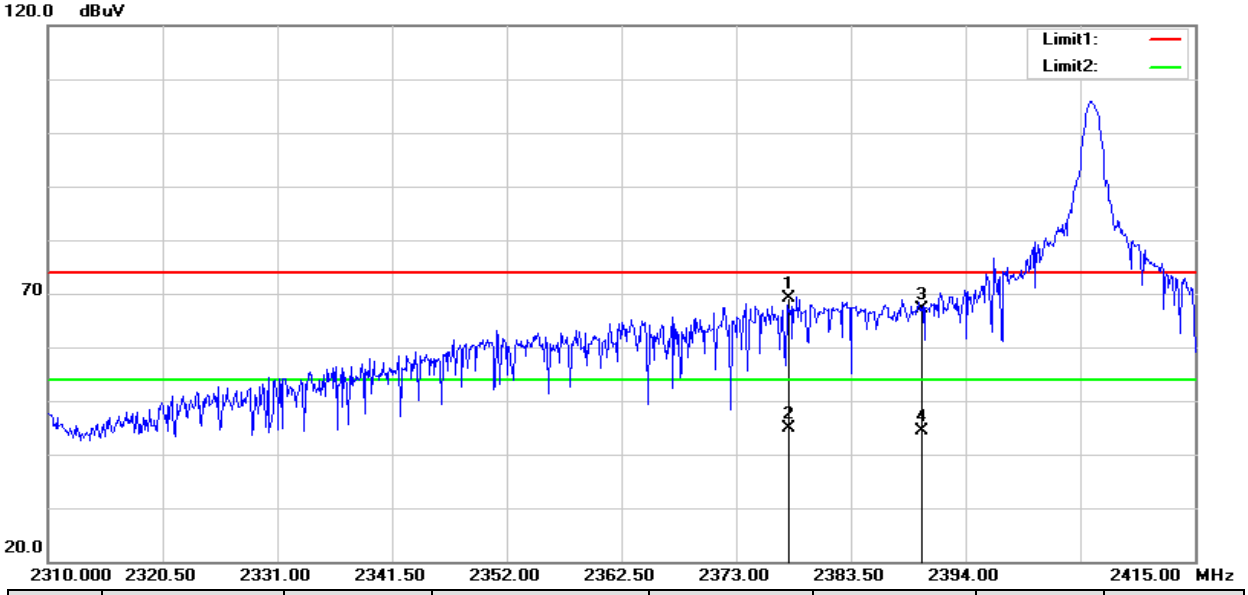
FSK-Low

Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2380.725	65.27	4.20	69.47	74.00	-4.53	peak
2	2380.725	45.95	4.20	50.15	54.00	-3.85	AVG
3	2390.000	65.64	4.34	69.98	74.00	-4.02	peak
4	2390.000	46.23	4.34	50.57	54.00	-3.43	AVG

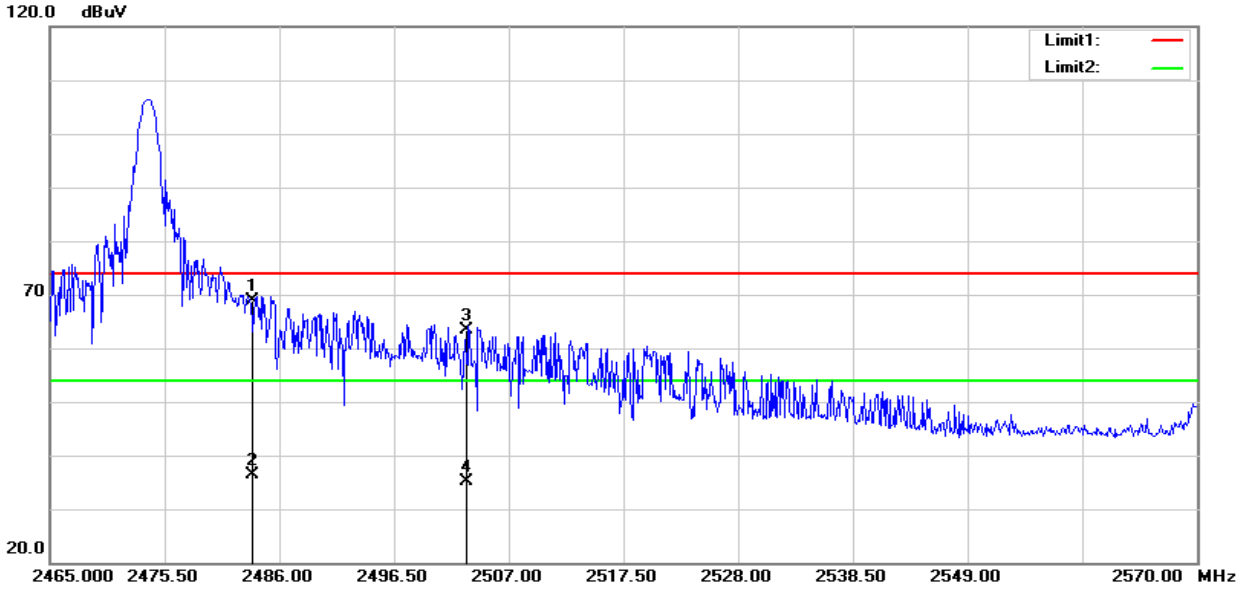
Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2377.780	64.96	4.15	69.11	74.00	-4.89	peak
2	2377.780	40.67	4.15	44.82	54.00	-9.18	AVG
3	2390.000	62.76	4.34	67.10	74.00	-6.90	peak
4	2390.000	40.06	4.34	44.40	54.00	-9.60	AVG

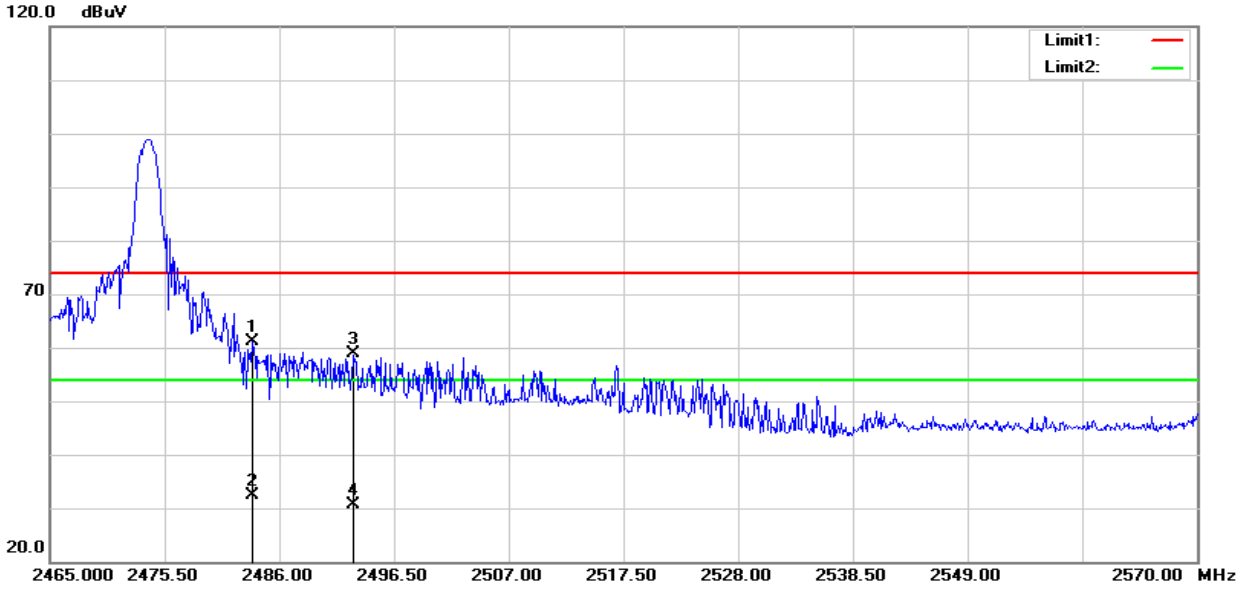
FSK-High

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	64.36	4.60	68.96	74.00	-5.04	peak
2	2483.500	31.76	4.60	36.36	54.00	-17.64	AVG
3	2503.195	58.61	4.67	63.28	74.00	-10.72	peak
4	2503.195	30.42	4.67	35.09	54.00	-18.91	AVG

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	56.47	4.60	61.07	74.00	-12.93	peak
2	2483.500	27.67	4.60	32.27	54.00	-21.73	AVG
3	2492.825	54.23	4.64	58.87	74.00	-15.13	peak
4	2492.825	25.87	4.64	30.51	54.00	-23.49	AVG

Note: The nohopping and hopping mode all have been test, the worst case is the nohopping mode, this report only show the worst case.

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– 2403 MHz Upper Band Edge: 2479 – 2500 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

Remark : Hopping on and Hopping off mode all have been tested,only worst case hopping off is reported.

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. 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.

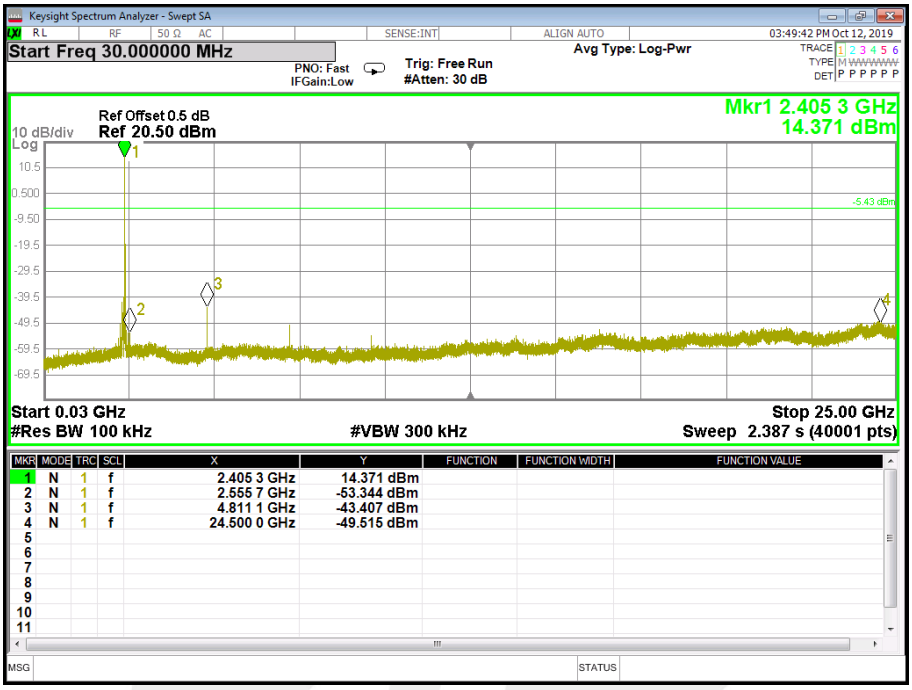
4.4 EUT OPERATION CONDITIONS

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.

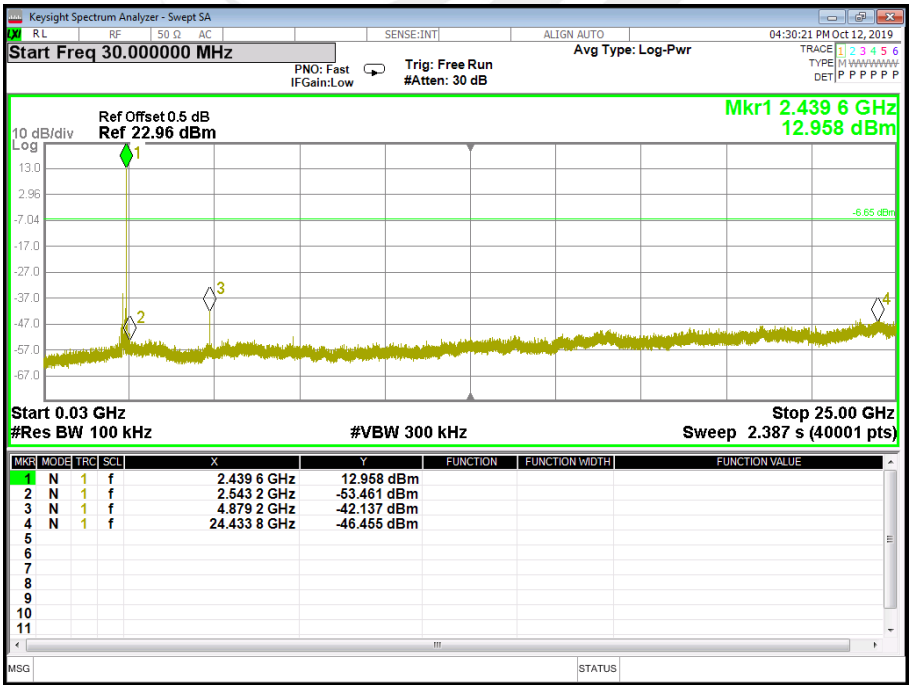
4.5 TEST RESULTS

Temperature:	25℃	Relative Humidity:	50%
Test Mode:	FSK-01/24/47 CH	Test Voltage:	DC 7V

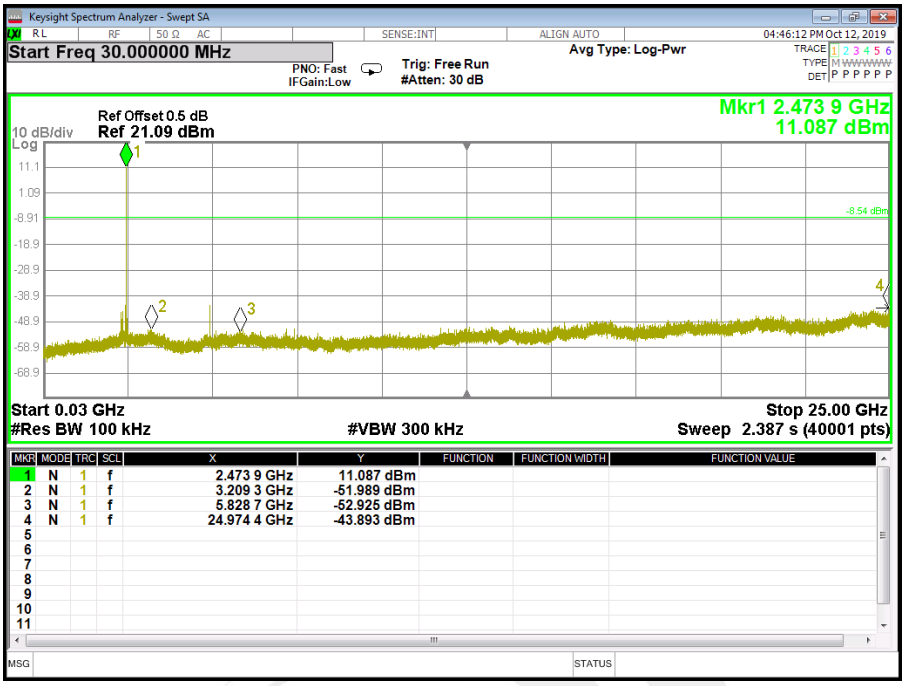
01 CH



24 CH

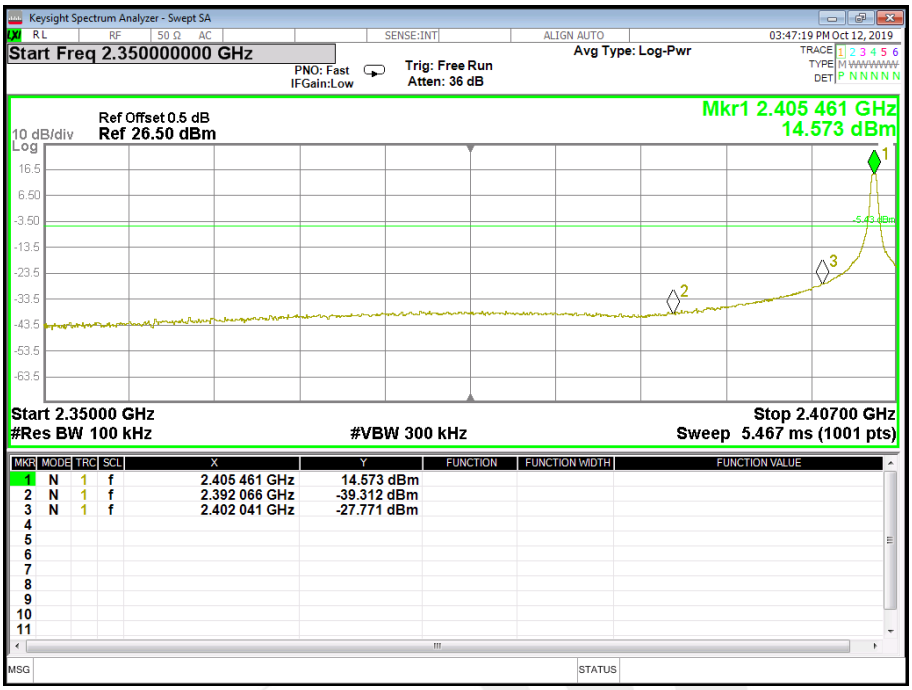


47 CH

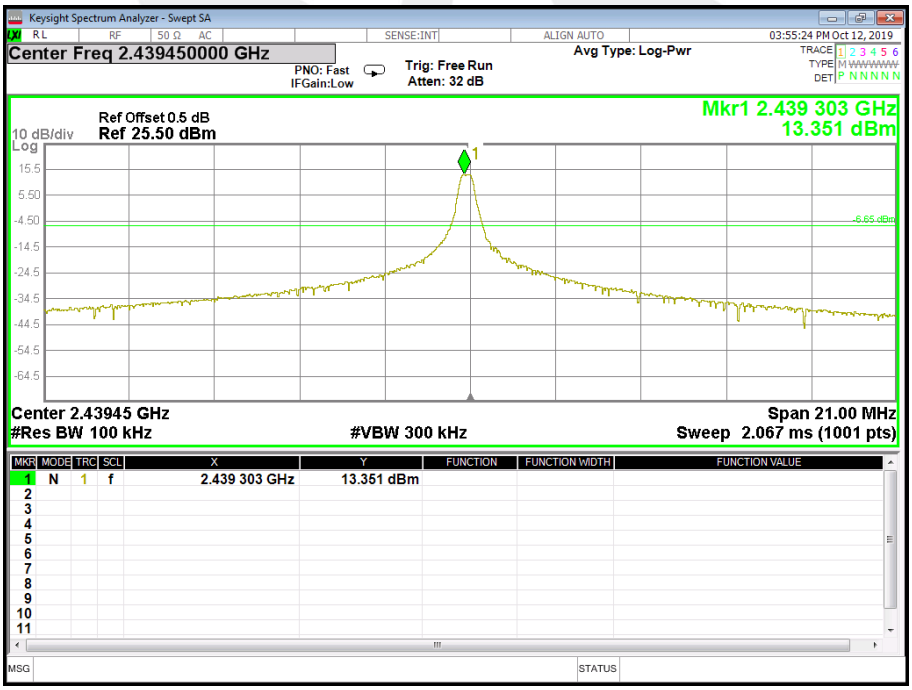

Keysight Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
04:46:12 PM Oct 12, 2019
Start Freq 30.000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P P P P P P
Ref Offset 0.5 dB
10 dB/div
Log
Ref 21.09 dBm
Mkr1 2.473 9 GHz
11.087 dBm
11.1
1.09
-8.91
-18.9
-28.9
-38.9
-48.9
-58.9
-68.9
-8.54 dBm
Start 0.03 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.387 s (40001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.473 9 GHz 11.087 dBm
2 N 1 f 3.209 3 GHz -51.989 dBm
3 N 1 f 5.828 7 GHz -52.925 dBm
4 N 1 f 24.974 4 GHz -43.893 dBm
MSG
STATUS

For Band edge

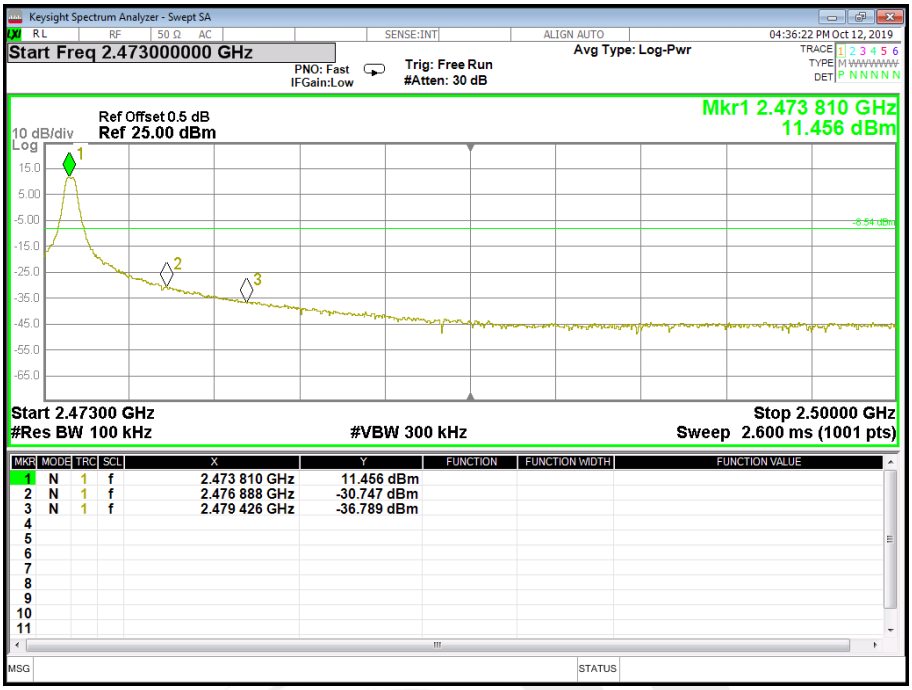
01 CH



24 CH

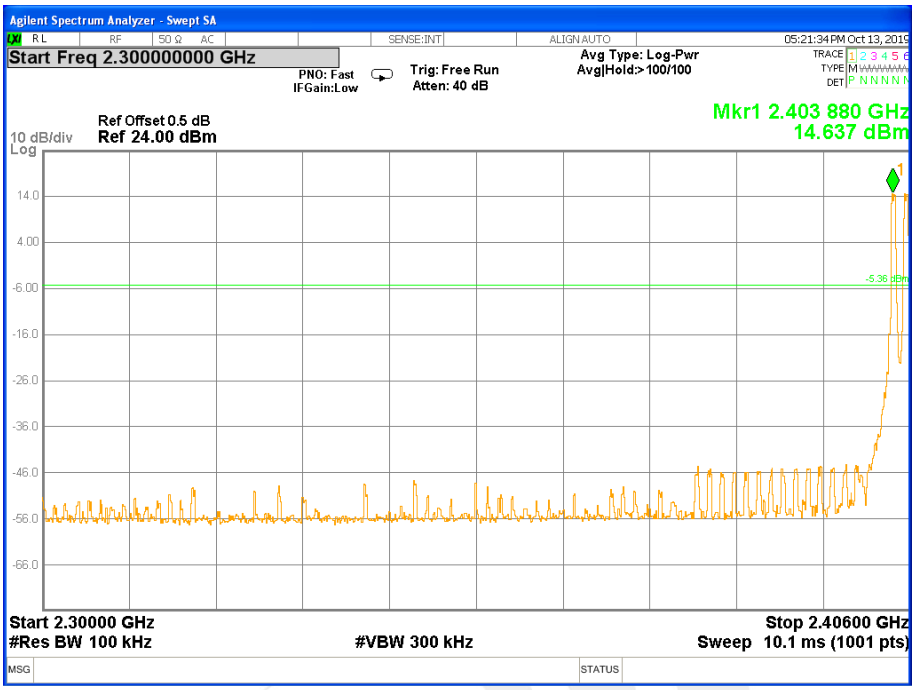


47 CH

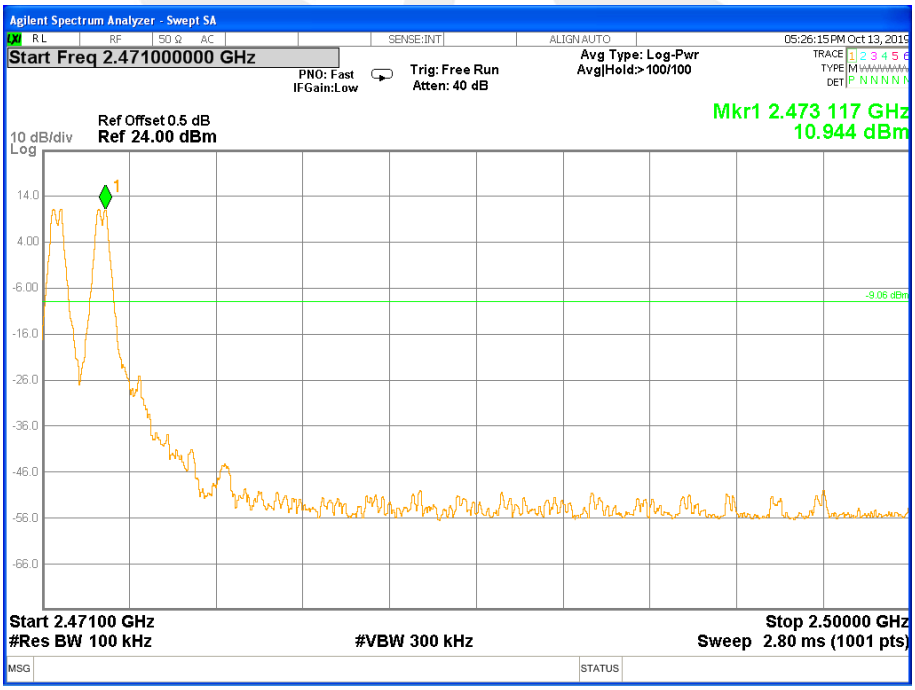

Keysight Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
04:36:22 PM Oct 12, 2019
Start Freq 2.473000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Mkr1 2.473 810 GHz
11.456 dBm
Ref Offset 0.5 dB
10 dB/div
Ref 25.00 dBm
Log
15.0
5.00
-5.00
-15.0
-25.0
-35.0
-45.0
-55.0
-65.0
-8.54 dBm
Start 2.47300 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.50000 GHz
Sweep 2.600 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.473 810 GHz 11.456 dBm
2 N 1 f 2.476 888 GHz -30.747 dBm
3 N 1 f 2.479 426 GHz -36.789 dBm
MSG
STATUS

For Hopping Band edge

07 CH



47 CH



5. NUMBER OF HOPPING CHANNEL

5.1 LIMIT

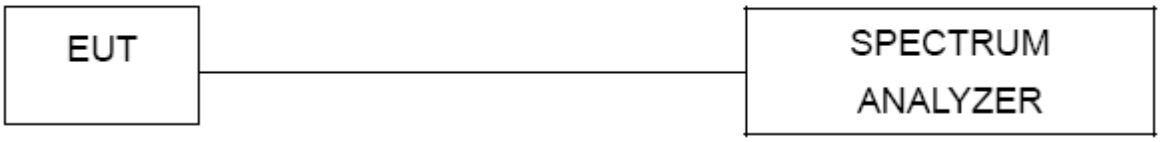
FCC Part 15.247,Subpart C				
Section	Test Item	Limit	FrequencyRange (MHz)	Result
15.247 (a)(1)(iii)	Number of Hopping Channel	≥15	2400-2483.5	PASS

Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	> Operating FrequencyRange
RB	100KHz
VB	100KHz
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=100KHz, Sweep time = Auto.

5.3 TEST SETUP



5.4 EUT OPERATION CONDITIONS

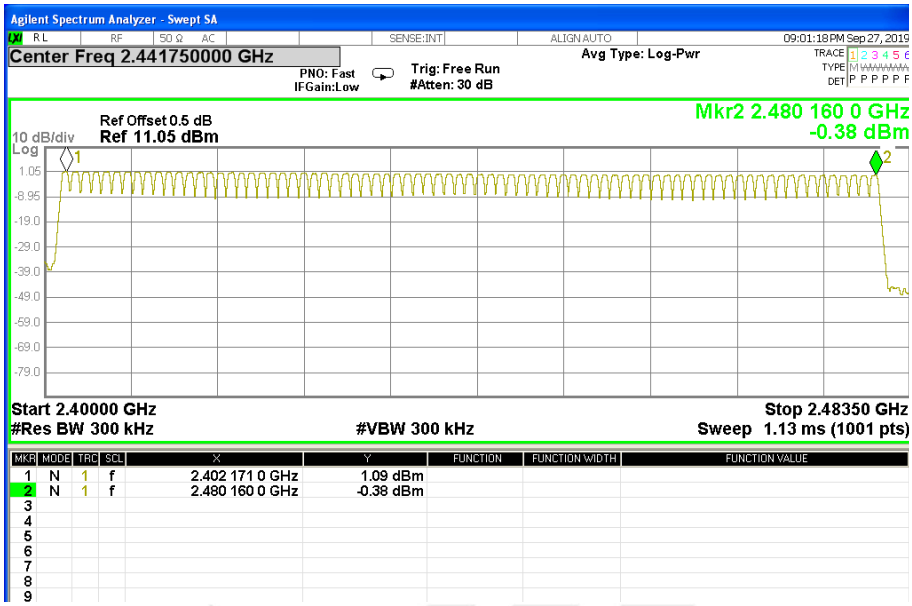
The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

5.5 TEST RESULTS

Temperature:	25℃	Relative Humidity:	60%
Test Mode:	Hopping Mode -FSK Mode	Test Voltage:	DC 7V

Number of Hopping Channel 47

Hopping channel



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 DH5, DH3 and DH1 packet transmitting.
h. Measure the maximum time duration of one single pulse.
i. DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots RX, 1 time slot TX). Sothe dwell time is the time duration of the pulse times 3.37 x 31.6 = 106.6 within 31.6 seconds.
j. DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots RX, 1 time slot TX). Sothe dwell time is the time duration of the pulse times 5.06 x 31.6 = 160 within 31.6 seconds.
k. DH1 Packet permit maximum 1600 / 79 /2 = 10.12 hops per second in each channel (1 time slot RX, 1 time slot TX). So the dwell time is the time duration of the pulse times 10.12 x 31.6 = 320 within 31.6 seconds.

6.3 TEST SETUP

6.4 EUT OPERATION CONDITIONS

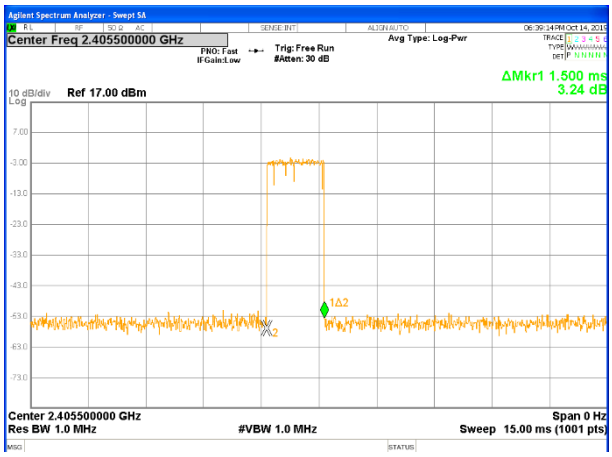
The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

6.5 TEST RESULTS

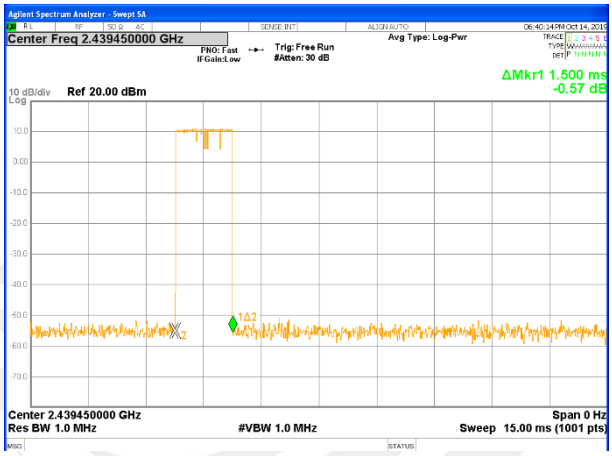
Temperature:	25℃	Relative Humidity:	50%
Test Mode:	FSK-CH01/CH24/CH47	Test Voltage:	DC 7V

Frequency (MHz)	Channel	Pulse time(ms)	Dwell Time(s)	Limits(s)	Sweep Time (s)	Burst Number	Verdict
2405.5	lower	1.500	0.041	0.4	18.8	27	Pass
2439.45	middle	1.500	0.041	0.4	18.8	27	Pass
2474	higher	1.500	0.041	0.4	18.8	27	Pass

CH 01

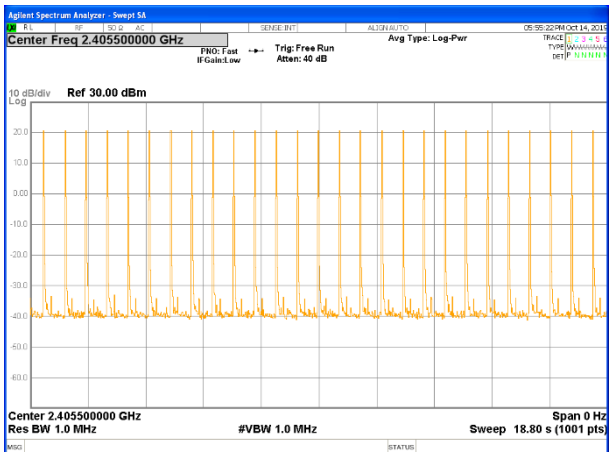


CH 24

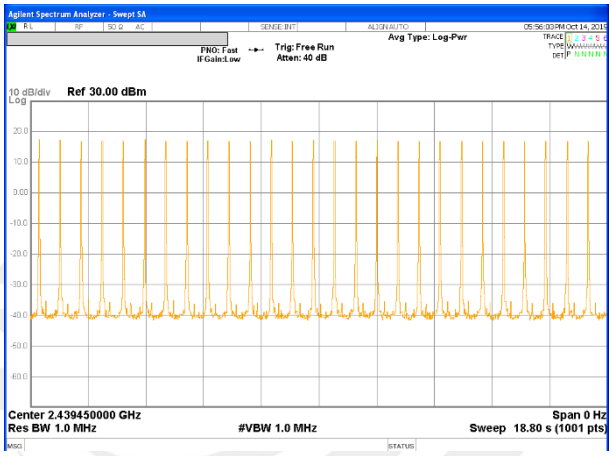


CH 47

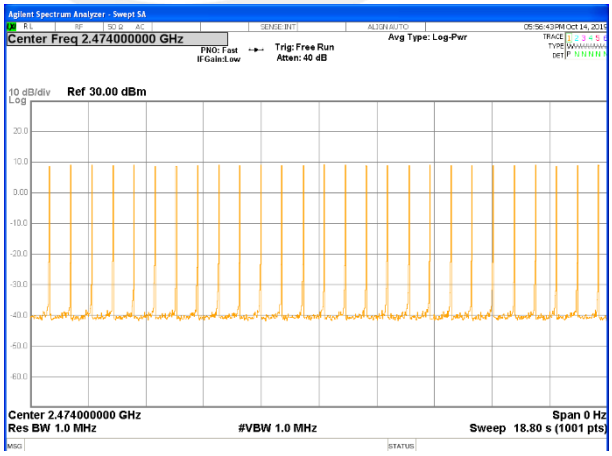
CH 01



CH 24



CH 47



7. HOPPING CHANNEL SEPARATION MEASUREMEN

7.1 LIMIT

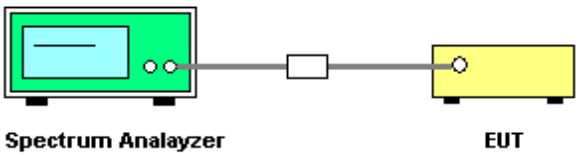
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that 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.

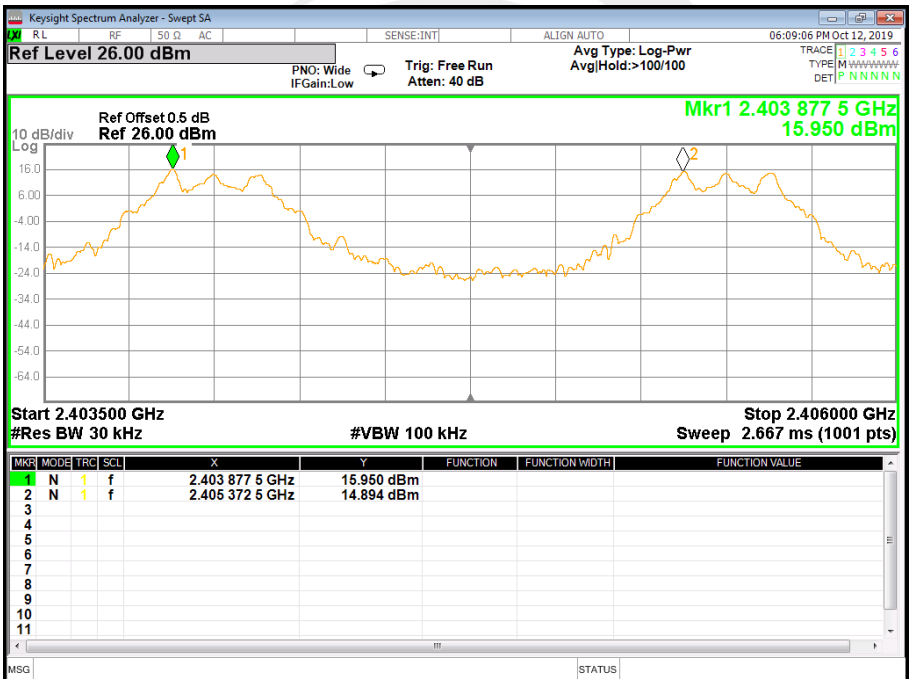
7.5 TEST RESULTS

Temperature:	25℃	Relative Humidity:	50%
Test Mode:	CH01 / CH24 / CH47 (FSK Mode)	Test Voltage:	DC 7V

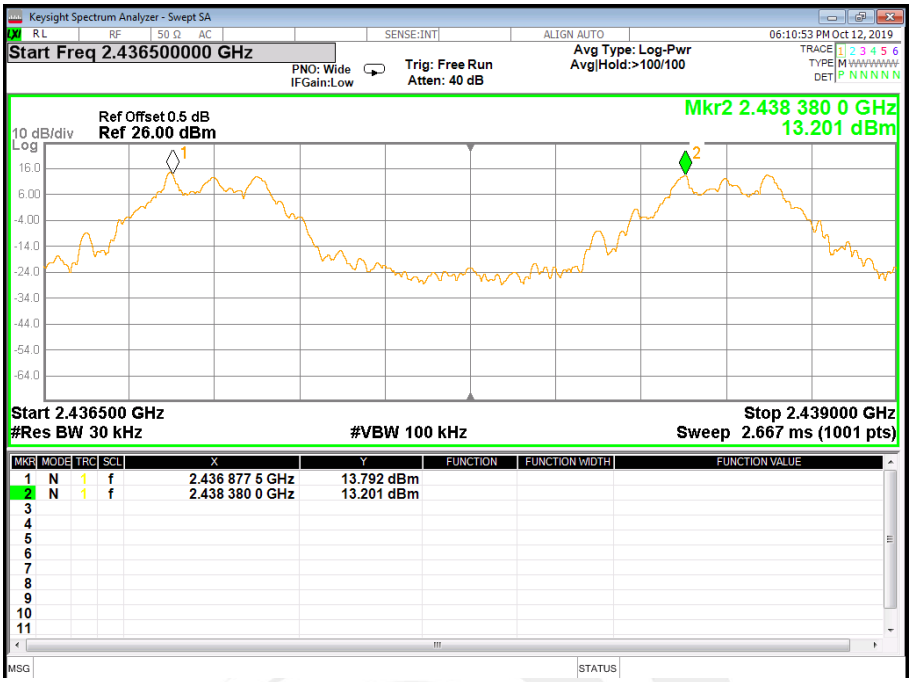
Frequency	Mark1 Frequency （MHz）	Mark2 Frequency （MHz）	Ch. Separation (MHz)
2405.5 MHz	2403.878	2405.373	1.495
2439.45 MHz	2436.878	2438.380	1.503
2474 MHz	2471.372	2472.875	1.503

For FSK: Ch. Separation Limits: > 20dB bandwidth

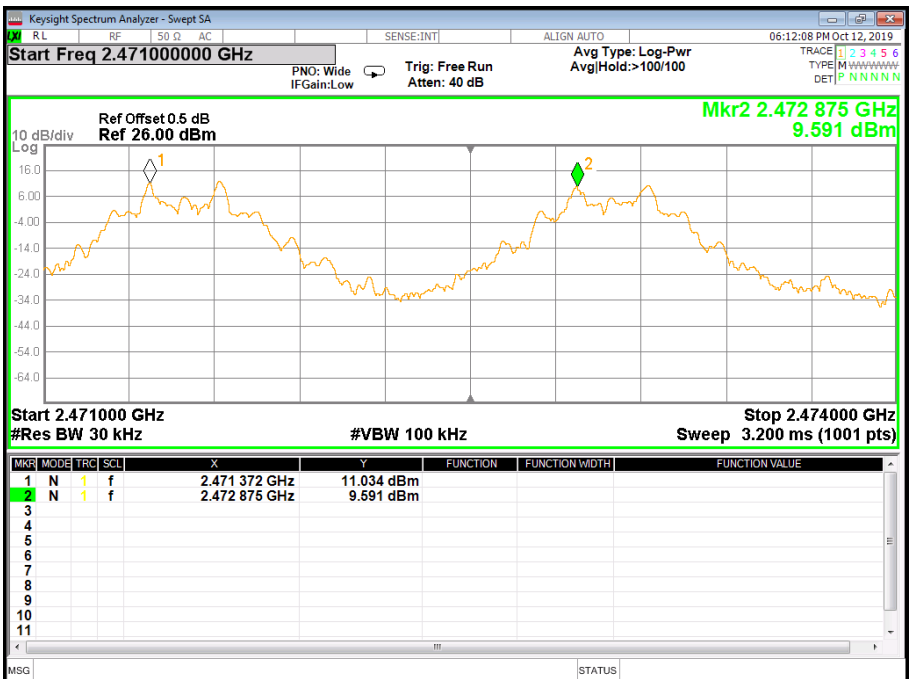
CH 01



CH 24


Keysight Spectrum Analyzer - Swept SA
Start Freq 2.436500000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 40 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
06:10:53 PM Oct 12, 2019
Ref Offset 0.5 dB
10 dB/div
Ref 26.00 dBm
Log
Mkr2 2.438 380 0 GHz
13.201 dBm
Start 2.436500 GHz
#Res BW 30 kHz
#VBW 100 kHz
Stop 2.439000 GHz
Sweep 2.667 ms (1001 pts)
1 N 1 f 2.436 877 5 GHz 13.792 dBm
2 N 1 f 2.438 380 0 GHz 13.201 dBm

CH 47


Keysight Spectrum Analyzer - Swept SA
Start Freq 2.471000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 40 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
06:12:08 PM Oct 12, 2019
Ref Offset 0.5 dB
10 dB/div
Ref 26.00 dBm
Log
Mkr2 2.472 875 GHz
9.591 dBm
Start 2.471000 GHz
#Res BW 30 kHz
#VBW 100 kHz
Stop 2.474000 GHz
Sweep 3.200 ms (1001 pts)
1 N 1 f 2.471 372 GHz 11.034 dBm
2 N 1 f 2.472 875 GHz 9.591 dBm

8. BANDWIDTH TEST

8.1 LIMIT

FCC Part15 15.247,Subpart C				
Section	Test Item	Limit	FrequencyRange (MHz)	Result
15.247 (a)(1)	Bandwidth	(20dB bandwidth)	2400-2483.5	PASS

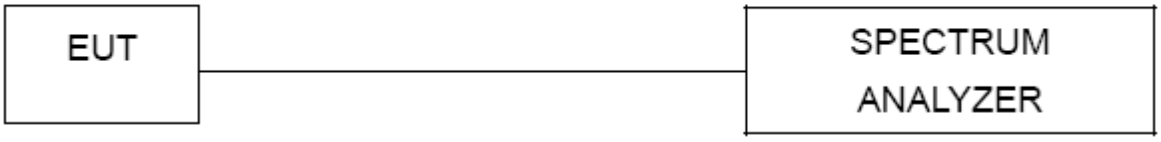
Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> Measurement Bandwidth or Channel Separation
RB	30 kHz (20dB Bandwidth) / 30 kHz (Channel Separation)
VB	100 kHz (20dB Bandwidth) / 100 kHz (Channel Separation)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

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

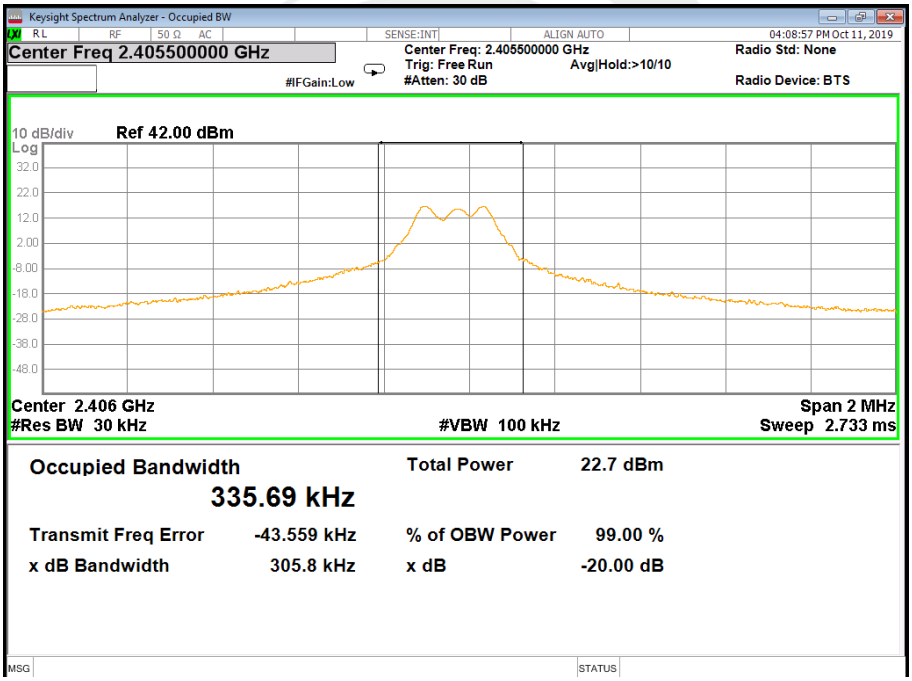
The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

8.5 TEST RESULTS

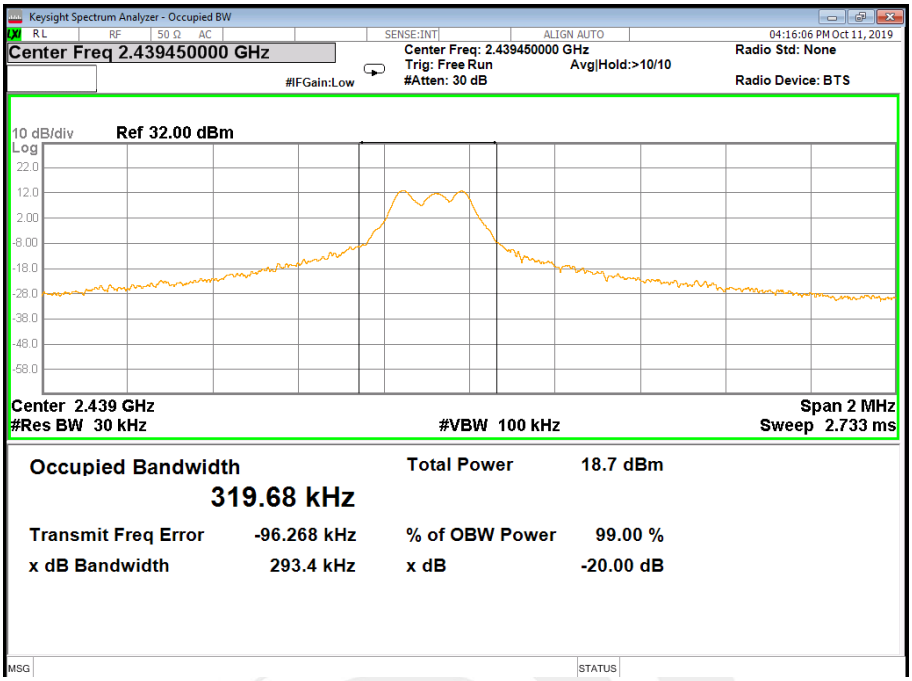
Temperature:	25℃	Relative Humidity:	50%
Test Mode:	FSK CH01 / CH24 / CH47	Test Voltage:	DC 7V

Frequency	20dB Bandwidth (MHz)	Result
2405.5 MHz	0.3058	PASS
2439.45 MHz	0.2934	PASS
2474 MHz	0.2815	PASS

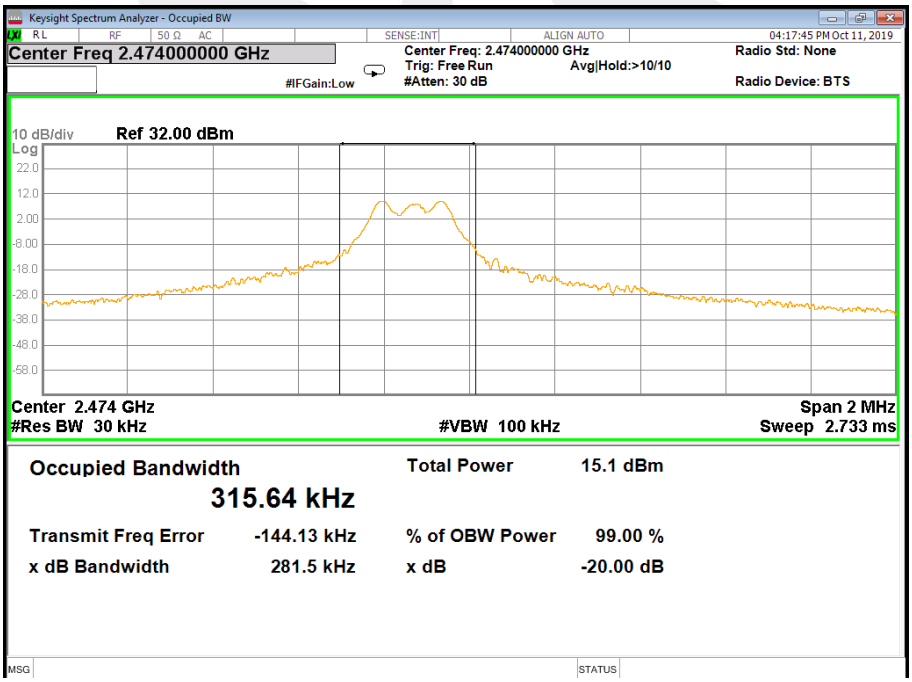
CH 01



CH 24


Keysight Spectrum Analyzer - Occupied BW
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
04:16:06 PM Oct 11, 2019
Center Freq 2.439450000 GHz
Center Freq: 2.439450000 GHz
Trig: Free Run
Avg|Hold:>10/10
#IFGain:Low
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
10 dB/div
Ref 32.00 dBm
Log
22.0
12.0
2.00
-8.00
-18.0
-28.0
-38.0
-48.0
-58.0
Center 2.439 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 2 MHz
Sweep 2.733 ms
Occupied Bandwidth
319.68 kHz
Total Power
18.7 dBm
Transmit Freq Error
-96.268 kHz
% of OBW Power
99.00 %
x dB Bandwidth
293.4 kHz
x dB
-20.00 dB
MSG
STATUS

CH 49


Keysight Spectrum Analyzer - Occupied BW
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
04:17:45 PM Oct 11, 2019
Center Freq 2.474000000 GHz
Center Freq: 2.474000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#IFGain:Low
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
10 dB/div
Ref 32.00 dBm
Log
22.0
12.0
2.00
-8.00
-18.0
-28.0
-38.0
-48.0
-58.0
Center 2.474 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 2 MHz
Sweep 2.733 ms
Occupied Bandwidth
315.64 kHz
Total Power
15.1 dBm
Transmit Freq Error
-144.13 kHz
% of OBW Power
99.00 %
x dB Bandwidth
281.5 kHz
x dB
-20.00 dB
MSG
STATUS

9. OUTPUT POWER TEST

9.1 LIMIT

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

9.2 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:

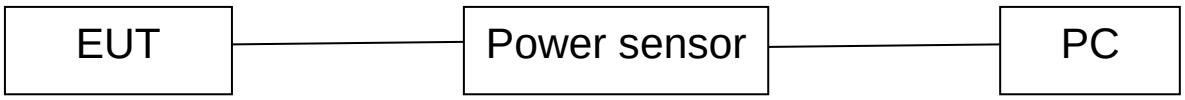
The following procedure can be used when the maximum available RBW of the instrument is less than the
DTS bandwidth:

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.

9.3 TEST SETUP



9.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

9.5 TEST RESULTS

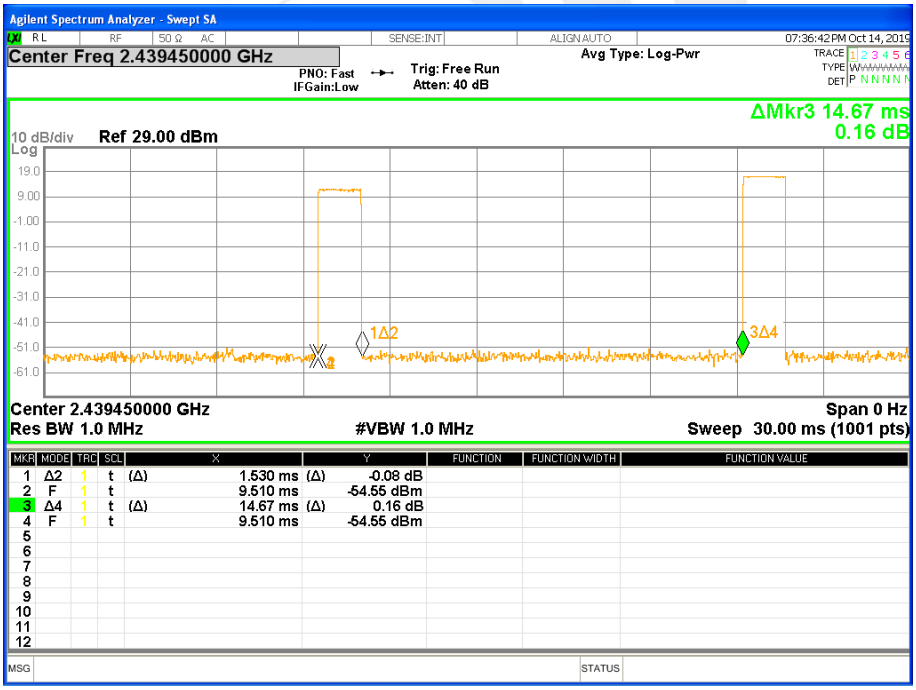
Temperature:	25℃	Relative Humidity:	60%
Test Voltage:	DC 7V		

Frequency (MHz)	Peak Power (dBm)	Duty Factor (dB)	Average Power (dBm)	Limit (dBm)
2405.5	15.06	9.82	5.24	30.00
2439.45	13.97	9.82	4.15	30.00
2474	12.58	9.82	2.76	30.00

Note: the channel separation >20dB bandwidth

Duty cycle

Ton（ms）	Tp（ms）	Duty cycle(%)	Duty factor(dB)
1.530	14.670	10.43%	9.82



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 Dipole 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.

※※※※※END OF THE REPORT※※※※※