

S

T

S

L

A

B




RADIO TEST REPORT

Report No:STS1906071W01

Issued for

HANYIN ELECTRONICS(HONG KONG) CO.,LIMITED

5FLOOR 6BUILDING,TONGFUYU XUFA,518107
SHENZHENCITY,CHINA

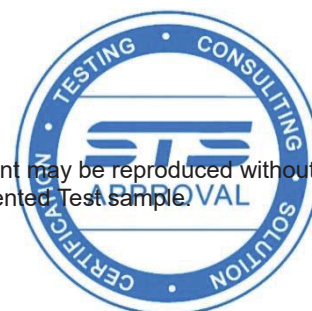
Product Name:	Wireless mouse
Brand Name:	
Model Name:	S1000
Series Model:	HM01, HM02, HM03, HM05, HM06, HM07, HM08, HM09, HM10, S1000Plus, HM11, HM12, HM13, HM15, HM16, HM17, HM18, HM19, HM20
FCC ID:	2ATQWS1000
Test Standard:	FCC Part 15.247

Any reproduction of this document must be done in full. No single part of this document may be reproduced without permission from STS, All Test Data Presented in this report is only applicable to presented Test sample.

Shenzhen STS Test Services Co., Ltd.

1/F., Building B, Zhuoke Science Park, No.190, Chongqing Road,
Fuyong Street, Bao'an District, Shenzhen, Guangdong, China


TEL: +86-755 3688 6288 FAX: +86-755 3688 6277 E-mail:sts@stsapp.com



**TEST RESULT CERTIFICATION**

Applicant's Name: HANYIN ELECTRONICS(HONG KONG) CO.,LIMITED
Address: 5FLOOR 6BUILDING,TONGFUYU XUFA,518107
SHENZHENCITY,CHINA
Manufacture's Name: SHENZHEN HANYIN TECHNOLOGY DEVELOPMENT CO.,LTd.
Address: 5FLOOR 6BUILDING,TONGFUYU XUFA,518107
SHENZHENCITY,CHINA

Product Description

Product Name: Wireless mouse
Brand Name: 
Model Name: S1000
Series Model: HM01, HM02, HM03, HM05, HM06, HM07, HM08, HM09, HM10,
S1000Plus, HM11, HM12, HM13, HM15, HM16, HM17, HM18,
HM19, HM20
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.
This report shall not be reproduced except in full, without the written approval of STS, this document may be altered or revised by STS, personal only, and shall be noted in the revision of the document..

Date of Test.....:

Date (s) of performance of tests.: 26 June 2019 ~ 27 June 2019

Date of Issue: 27 June 2019

Test Result: Pass

Testing Engineer :



(Chris Chen)

Technical Manager :



(Sunday Hu)

Authorized Signatory :



(Vita Li)





Table of Contents	Page
1. SUMMARY OF TEST RESULTS	6
1.1 TEST FACTORY	7
1.2 MEASUREMENT UNCERTAINTY	7
2. GENERAL INFORMATION	8
2.1 GENERAL DESCRIPTION OF THE EUT	8
2.2 DESCRIPTION OF THE TEST MODES	10
2.3 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED	10
2.4 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS	11
2.5 EQUIPMENTS LIST	12
3. EMC EMISSION TEST	13
3.1 CONDUCTED EMISSION MEASUREMENT	13
3.2 RADIATED EMISSION MEASUREMENT	15
4. CONDUCTED SPURIOUS & BAND EDGE EMISSION	26
4.1 LIMIT	26
4.2 TEST PROCEDURE	26
4.3 TEST SETUP	26
4.4 EUT OPERATION CONDITIONS	26
4.5 TEST RESULTS	27
5. NUMBER OF HOPPING CHANNEL	31
5.1 LIMIT	31
5.2 TEST PROCEDURE	31
5.3 TEST SETUP	31
5.4 EUT OPERATION CONDITIONS	31
5.5 TEST RESULTS	32
6. AVERAGE TIME OF OCCUPANCY	33
6.1 LIMIT	33
6.2 TEST PROCEDURE	33
6.3 TEST SETUP	33
6.4 EUT OPERATION CONDITIONS	33
6.5 TEST RESULTS	34
7. HOPPING CHANNEL SEPARATION MEASUREMENT	38
7.1 LIMIT	38
7.2 TEST PROCEDURE	38



Table of Contents	Page
7.3 TEST SETUP	38
7.4 EUT OPERATION CONDITIONS	38
7.5 TEST RESULTS	39
8. BANDWIDTH TEST	41
8.1 LIMIT	41
8.2 TEST PROCEDURE	41
8.3 TEST SETUP	41
8.4 EUT OPERATION CONDITIONS	41
8.5 TEST RESULTS	42
9. OUTPUT POWER TEST	44
9.1 LIMIT	44
9.2 TEST PROCEDURE	44
9.3 TEST SETUP	44
9.4 EUT OPERATION CONDITIONS	44
9.5 TEST RESULTS	45
10. ANTENNA REQUIREMENT	46
10.1 STANDARD REQUIREMENT	46
10.2 EUT ANTENNA	46

**Revision History**

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	27 June 2019	STS1906071W01	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	N/A	--
15.247(a)(1)	Hopping Channel Separation	PASS	--
15.247(a)(1)&(b)(1)	Output Power	PASS	--
15.205 15.209	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 15.209	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. : 1/F., Building B, Zhuoke Science Park, No.190, Chongqing Road,
Fuyong Street, Bao'an District, Shenzhen, Guangdong, China

FCC test Firm Registration Number: 625569

A2LA Certificate No.: 4338.01;

1.2 MEASUREMENT UNCERTAINTY


The reported uncertainty of measurement $y \pm U$, 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	$\pm 0.71\text{dB}$
2	Unwanted Emissions, conducted	$\pm 0.63\text{dB}$
3	All emissions, radiated 30-200MHz	$\pm 3.43\text{dB}$
4	All emissions, radiated 200MHz-1GHz	$\pm 3.57\text{dB}$
5	All emissions, radiated >1G	$\pm 4.13\text{dB}$
6	Conducted Emission (9KHz-150KHz)	$\pm 3.18\text{dB}$
7	Conducted Emission (150KHz-30MHz)	$\pm 2.70\text{dB}$



2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	Wireless mouse
Trade Name	
Model Name	S1000
Series Model	HM01, HM02, HM03, HM05, HM06, HM07, HM08, HM09, HM10, S1000Plus, HM11, HM12, HM13, HM15, HM16, HM17, HM18, HM19, HM20
Model Difference	Product appearance is different, internal PCBA is the same
Channel List	Please refer to the Note 2.
Operation Frequency	2402.85-2480.85MHz
Modulation Type	GFSK
Power Rating	Input: DC 1.5V from battery AA
Hardware version number	V1.3
Software version number	V2.3
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)	Channel	Frequency (MHz)
1	2402.85	7	2445.85	13	2419.85
2	2426.85	8	2466.85	14	2439.85
3	2441.85	9	2414.85	15	2453.85
4	2463.85	10	2436.85	16	2480.85
5	2407.82	11	2459.85		
6	2422.85	12	2473.85		

3. Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1		S1000	PCB	NA	-0.61	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	1Mbps/GFSK
Mode 2	TX CH03	1Mbps/GFSK
Mode 3	TX CH16	1Mbps/GFSK

Note:

1. The measurements are performed at all Bit Rate of Transmitter, the worst data was reported
2. New battery is used during all test.

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

E-1
EUT



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
N/A	N/A	N/A	N/A	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	2019.10.12
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	2020.11.01
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-3G Hz)	EM	EM330	060665	2018.10.13	2019.10.12
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK201808090 1	2018.10.13	2019.10.12
Temperature & Humidity	HH660	Mieo	N/A	2018.10.11	2019.10.10
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	2019.10.12
Signal Analyzer	Agilent	N9020A	MY49100060	2018.10.13	2019.10.12
Temperature & Humidity	HH660	Mieo	N/A	2018.10.11	2019.10.10
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.

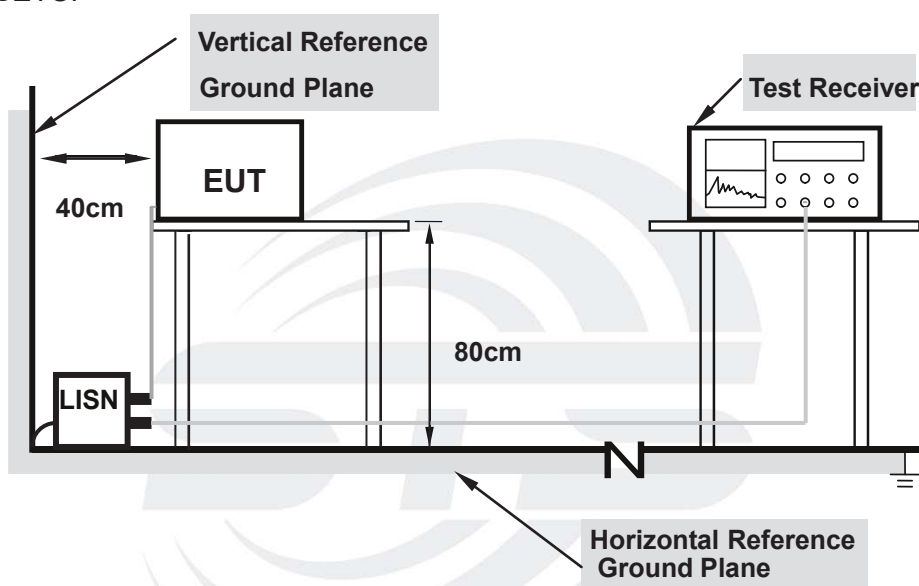
The following table is the setting of the receiver

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

3.1.2 TEST PROCEDURE

- 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.
- 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 at least 80 cm from nearest part of EUT chassis.
- 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

3.1.4 TEST RESULT

Temperature:	25.2°C	Relative Humidity:	64%
Test Voltage:	N/A	Phase:	L/N
Test Mode:	N/A		

Note: EUT is only power by battery, So it is not applicable for this test.



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
Start Frequency	1000 MHz(Peak)
Stop Frequency	10th carrier hamonic(Peak)
RB / VB (emission in restricted band)	PK=1MHz / 1MHz, AV=1 MHz /10 Hz

For Band edge

Spectrum Parameter	Setting
Detector	Peak
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/9kHz 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

- 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 test site. 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 QuasiPeak 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:

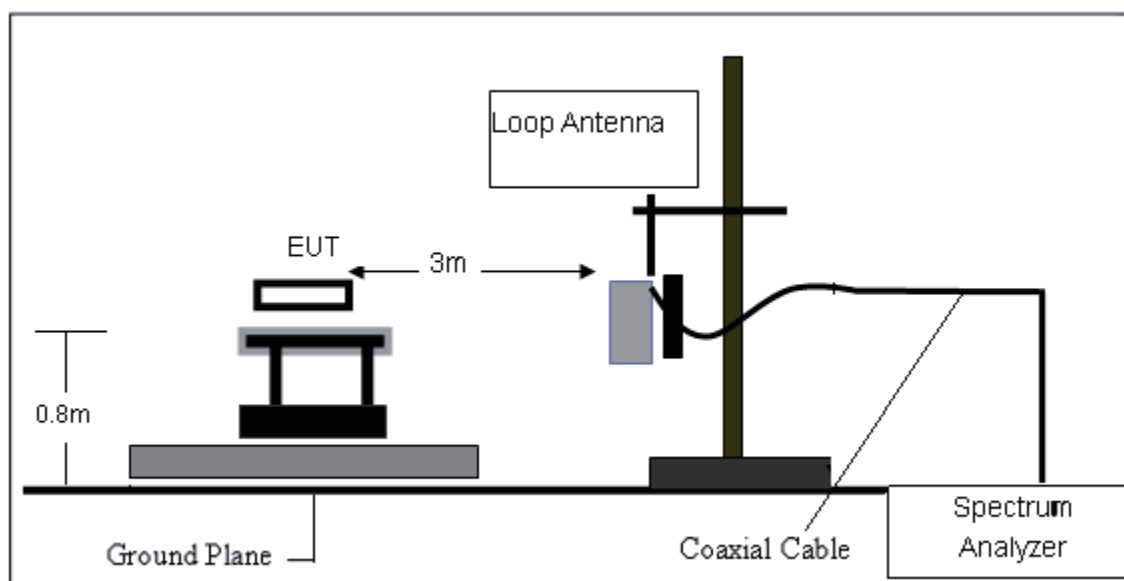
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported

3.2.3 DEVIATION FROM TEST STANDARD

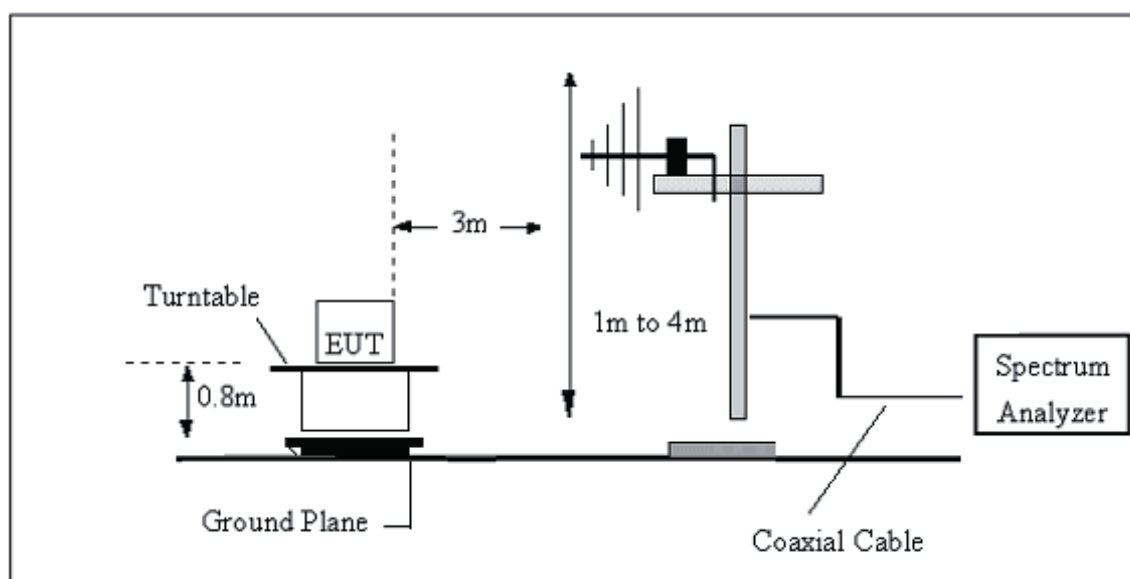
No deviation

3.2.4 TESTSETUP

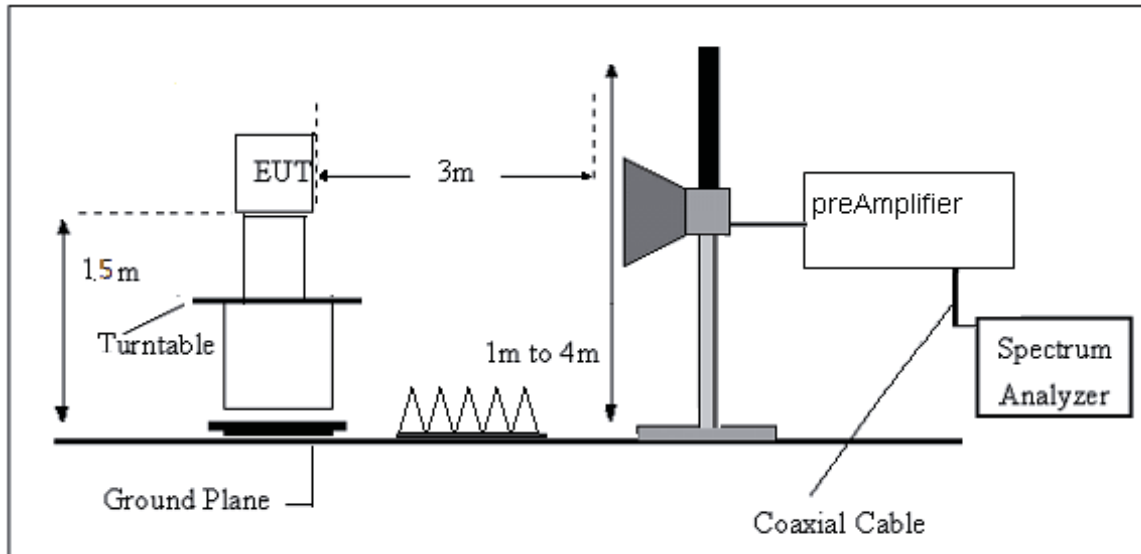
(A) Radiated Emission Test-Up Frequency Below 30MHz



(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

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



3.2.7 TEST RESULTS

(9KHz-30MHz)

Temperature:	22.7 °C	Relative Humidity:	61%
Test Voltage:	DC 1.5V	Test Mode:	TX Mode

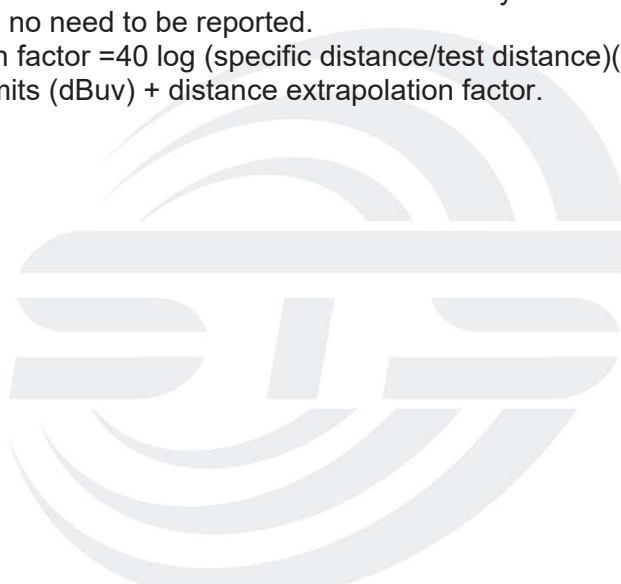
Freq.	Reading	Limit	Margin	State	Test Result
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F	
--	--	--	--	--	PASS
--	--	--	--	--	PASS

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

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





(30MHz-1000MHz)

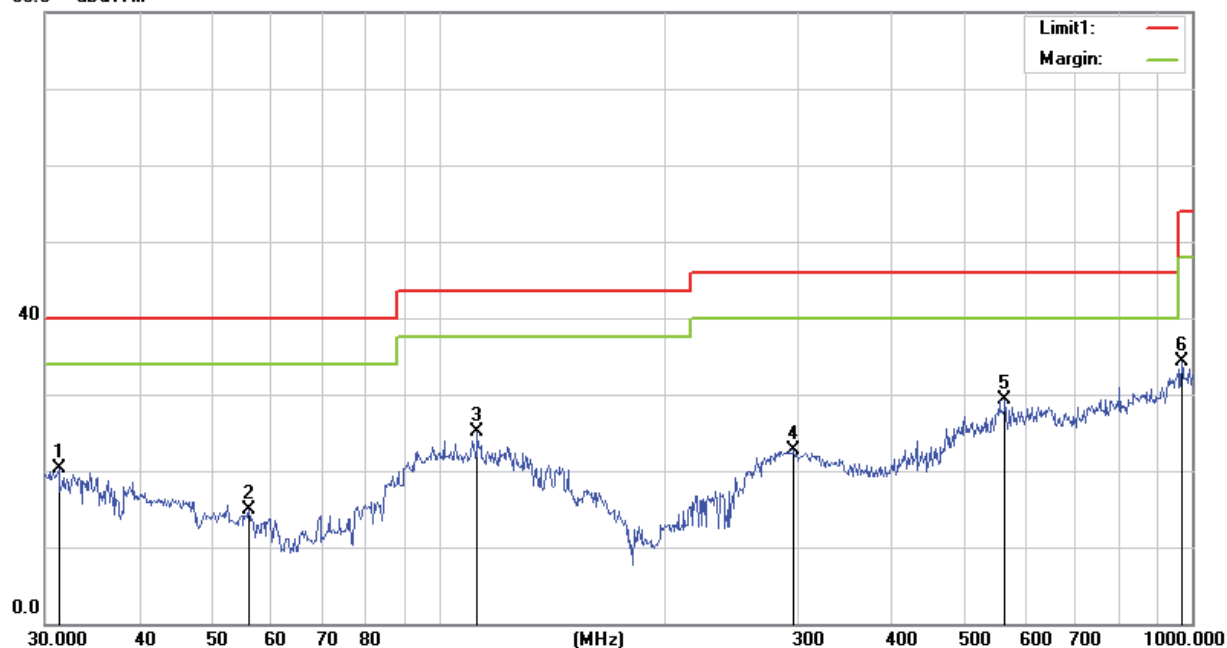
Temperature:	22.7 °C	Relative Humidity:	61%
Test Voltage:	DC 1.5V	Phase:	Horizontal
Test Mode:	Mode 1/2/3 (Mode 1 worst mode)		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	31.2893	33.31	-13.05	20.26	40.00	-19.74	QP
2	56.0007	39.87	-24.99	14.88	40.00	-25.12	QP
3	112.5241	44.01	-18.91	25.10	43.50	-18.40	QP
4	296.1836	38.48	-15.79	22.69	46.00	-23.31	QP
5	564.6390	36.47	-7.17	29.30	46.00	-16.70	QP
6	968.9338	34.58	-0.35	34.23	54.00	-19.77	QP

Remark:

1. Margin = Result (Result = Reading + Factor)-Limit

80.0 dBuV/m





Temperature:	22.7 °C	Relative Humidity:	61%
Test Voltage:	DC 1.5V	Phase:	Vertical
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	31.2893	33.31	-13.05	20.26	40.00	-19.74	QP
2	66.4990	40.49	-25.33	15.16	40.00	-24.84	QP
3	105.2716	43.20	-19.66	23.54	43.50	-19.96	QP
4	264.7456	36.26	-15.46	20.80	46.00	-25.20	QP
5	554.8251	37.89	-7.21	30.68	46.00	-15.32	QP
6	958.7943	33.90	-0.52	33.38	46.00	-12.62	QP

Remark:

1. Margin = Result (Result = Reading + Factor) - Limit





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

GFSK

Frequency (MHz)	Meter Reading (dBμV)	Amplifier (dB)	Loss (dB)	Antenna Factor (dB/m)	Orrected Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type	Comment
Low Channel (2402.85 MHz)										
3265.93	62.12	44.70	6.70	28.20	-9.80	52.32	74.00	-21.68	PK	Vertical
3265.93	50.76	44.70	6.70	28.20	-9.80	40.96	54.00	-13.04	AV	Vertical
3265.98	61.83	44.70	6.70	28.20	-9.80	52.03	74.00	-21.97	PK	Horizontal
3265.98	50.38	44.70	6.70	28.20	-9.80	40.58	54.00	-13.42	AV	Horizontal
4806.11	59.18	44.20	9.04	31.60	-3.56	55.62	74.00	-18.38	PK	Vertical
4806.11	49.52	44.20	9.04	31.60	-3.56	45.96	54.00	-8.04	AV	Vertical
4806.17	59.48	44.20	9.04	31.60	-3.56	55.92	74.00	-18.08	PK	Horizontal
4806.17	49.92	44.20	9.04	31.60	-3.56	46.36	54.00	-7.64	AV	Horizontal
5361.51	49.43	44.20	9.86	32.00	-2.34	47.09	74.00	-26.91	PK	Vertical
5361.51	40.30	44.20	9.86	32.00	-2.34	37.96	54.00	-16.04	AV	Vertical
5361.51	47.08	44.20	9.86	32.00	-2.34	44.74	74.00	-29.26	PK	Horizontal
5361.51	38.85	44.20	9.86	32.00	-2.34	36.51	54.00	-17.49	AV	Horizontal
7208.38	54.80	43.50	11.40	35.50	3.40	58.20	74.00	-15.80	PK	Vertical
7208.38	43.81	43.50	11.40	35.50	3.40	47.21	54.00	-6.79	AV	Vertical
7208.40	53.98	43.50	11.40	35.50	3.40	57.38	74.00	-16.62	PK	Horizontal
7208.40	44.01	43.50	11.40	35.50	3.40	47.41	54.00	-6.59	AV	Horizontal
Middle Channel (2441.85 MHz)										
3265.92	62.23	44.70	6.70	28.20	-9.80	52.43	74.00	-21.57	PK	Vertical
3265.92	49.86	44.70	6.70	28.20	-9.80	40.06	54.00	-13.94	AV	Vertical
3265.73	60.89	44.70	6.70	28.20	-9.80	51.09	74.00	-22.91	PK	Horizontal
3265.73	50.90	44.70	6.70	28.20	-9.80	41.10	54.00	-12.90	AV	Horizontal
4884.26	58.50	44.20	9.04	31.60	-3.56	54.94	74.00	-19.06	PK	Vertical
4884.26	49.75	44.20	9.04	31.60	-3.56	46.19	54.00	-7.81	AV	Vertical
4884.08	58.15	44.20	9.04	31.60	-3.56	54.59	74.00	-19.41	PK	Horizontal
4884.08	49.60	44.20	9.04	31.60	-3.56	46.04	54.00	-7.96	AV	Horizontal
5361.50	48.88	44.20	9.86	32.00	-2.34	46.54	74.00	-27.46	PK	Vertical
5361.50	39.71	44.20	9.86	32.00	-2.34	37.37	54.00	-16.63	AV	Vertical
5361.66	47.95	44.20	9.86	32.00	-2.34	45.61	74.00	-28.39	PK	Horizontal
5361.66	38.25	44.20	9.86	32.00	-2.34	35.91	54.00	-18.09	AV	Horizontal
7326.23	54.89	43.50	11.40	35.50	3.40	58.29	74.00	-15.71	PK	Vertical
7326.23	44.60	43.50	11.40	35.50	3.40	48.00	54.00	-6.00	AV	Vertical
7326.27	53.94	43.50	11.40	35.50	3.40	57.34	74.00	-16.66	PK	Horizontal
7326.27	44.82	43.50	11.40	35.50	3.40	48.22	54.00	-5.78	AV	Horizontal



High Channel (2480.85 MHz)										
3265.79	61.21	44.70	6.70	28.20	-9.80	51.41	74.00	-22.59	PK	Vertical
3265.79	50.00	44.70	6.70	28.20	-9.80	40.20	54.00	-13.80	AV	Vertical
3265.97	62.18	44.70	6.70	28.20	-9.80	52.38	74.00	-21.62	PK	Horizontal
3265.97	50.71	44.70	6.70	28.20	-9.80	40.91	54.00	-13.09	AV	Horizontal
4962.06	59.24	44.20	9.04	31.60	-3.56	55.68	74.00	-18.32	PK	Vertical
4962.06	49.51	44.20	9.04	31.60	-3.56	45.95	54.00	-8.05	AV	Vertical
4962.28	59.40	44.20	9.04	31.60	-3.56	55.84	74.00	-18.16	PK	Horizontal
4962.28	49.34	44.20	9.04	31.60	-3.56	45.78	54.00	-8.22	AV	Horizontal
5361.48	48.49	44.20	9.86	32.00	-2.34	46.15	74.00	-27.85	PK	Vertical
5361.48	39.61	44.20	9.86	32.00	-2.34	37.27	54.00	-16.73	AV	Vertical
5361.64	48.53	44.20	9.86	32.00	-2.34	46.19	74.00	-27.81	PK	Horizontal
5361.64	39.27	44.20	9.86	32.00	-2.34	36.93	54.00	-17.07	AV	Horizontal
7442.33	54.15	43.50	11.40	35.50	3.40	57.55	74.00	-16.45	PK	Vertical
7442.33	43.81	43.50	11.40	35.50	3.40	47.21	54.00	-6.79	AV	Vertical
7442.24	53.75	43.50	11.40	35.50	3.40	57.15	74.00	-16.85	PK	Horizontal
7442.24	43.97	43.50	11.40	35.50	3.40	47.37	54.00	-6.63	AV	Horizontal

Note:

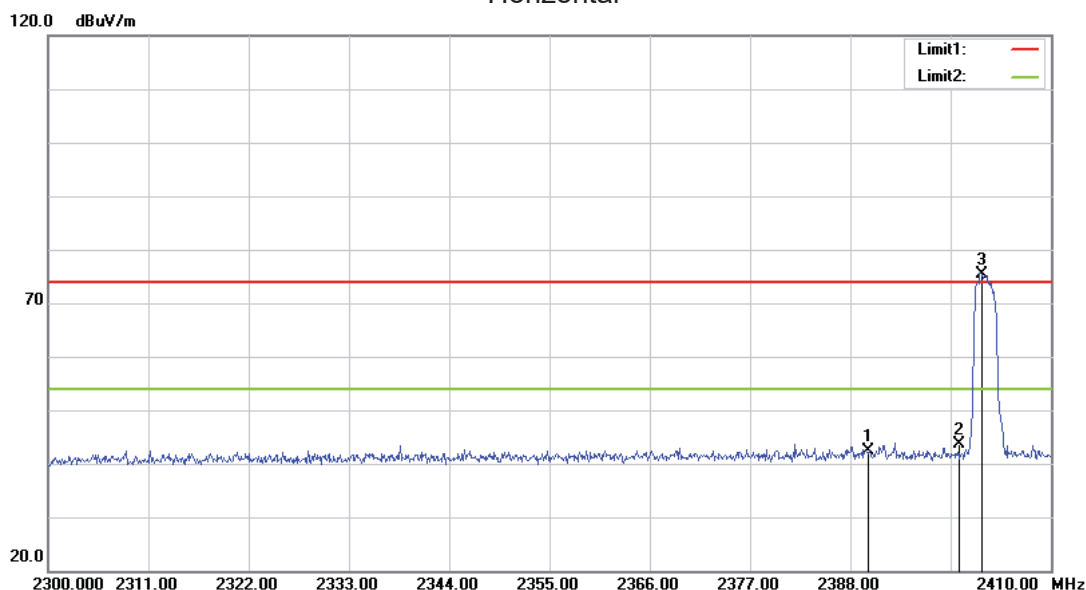
- 1) Factor = Antenna Factor + Cable Loss – Pre-amplifier.

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.

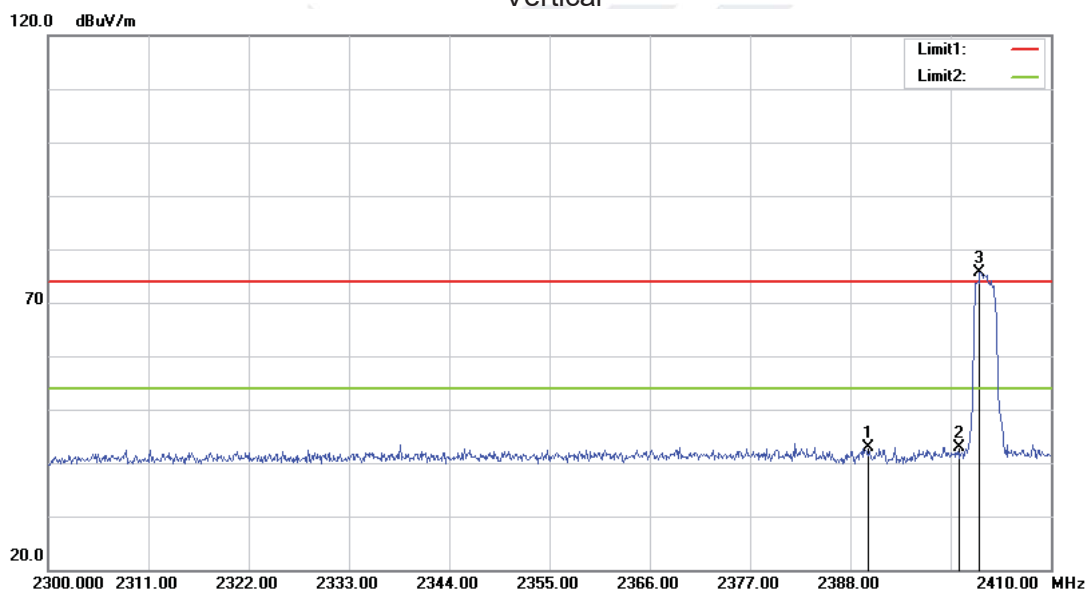


Restricted band Requirements

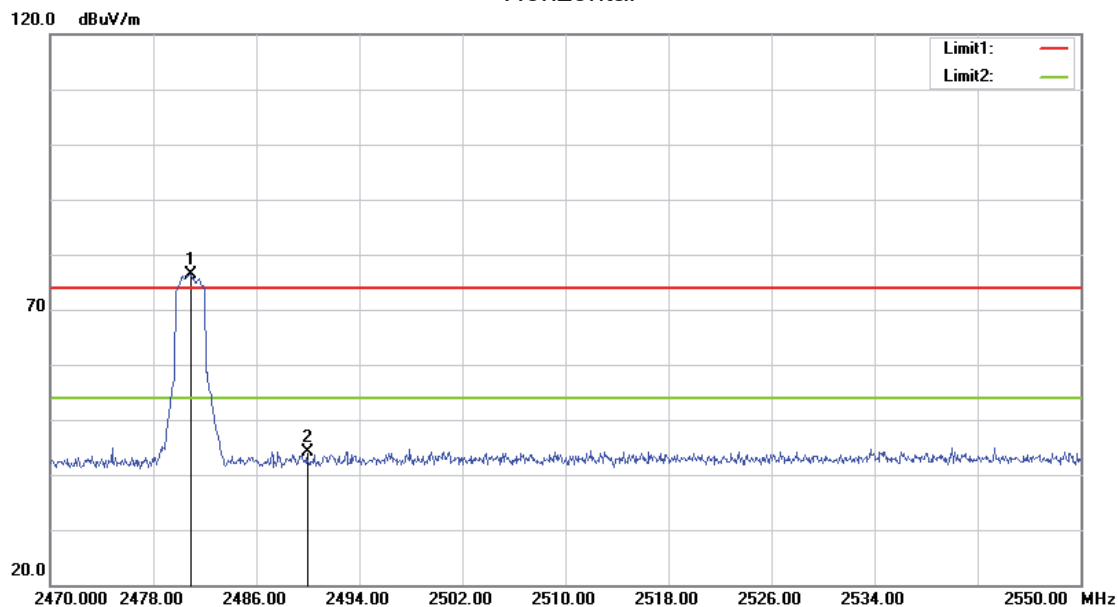
GFSK-Low
Horizontal

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2390.000	56.94	-14.50	42.44	74.00	-31.56	peak
2	2400.000	57.97	-14.44	43.53	74.00	-30.47	peak
3	2402.410	89.77	-14.42	75.35	N/A	N/A	peak

Vertical

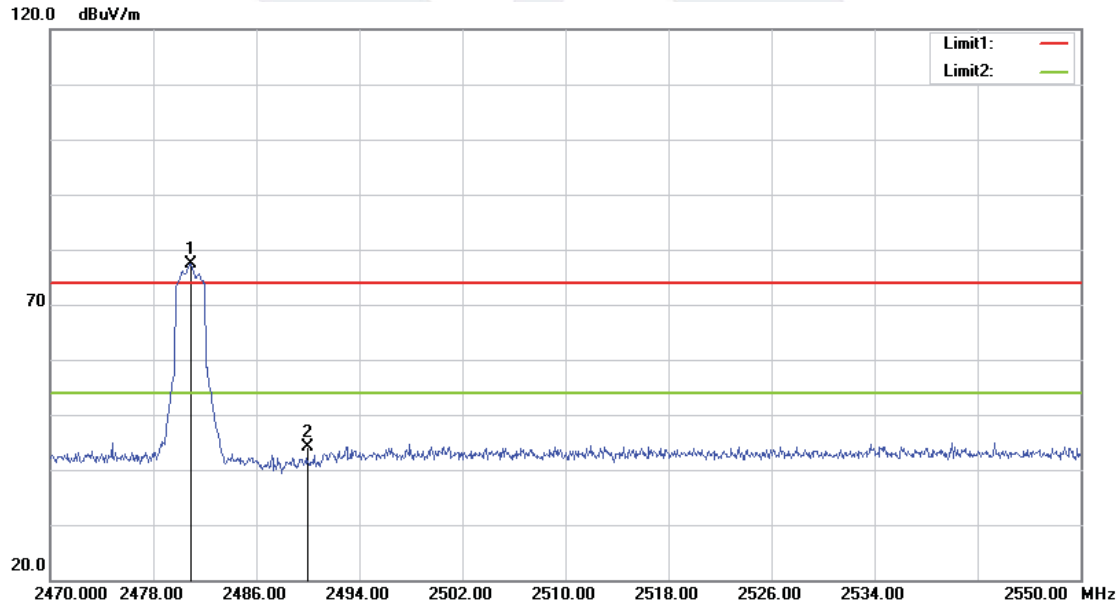


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2390.000	57.44	-14.50	42.94	74.00	-31.06	peak
2	2400.000	57.38	-14.44	42.94	74.00	-31.06	peak
3	2402.190	90.17	-14.42	75.75	N/A	N/A	peak

**GFSK-High**
Horizontal

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2480.960	90.29	-13.95	76.34	N/A	N/A	peak
2	2490.000	57.95	-13.90	44.05	74.00	-29.95	peak

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2480.960	91.29	-13.95	77.34	N/A	N/A	peak
2	2490.000	57.95	-13.90	44.05	74.00	-29.95	peak

Note: GFSK of the nohopping and hopping mode all have been test, the worst case is GFSK of 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

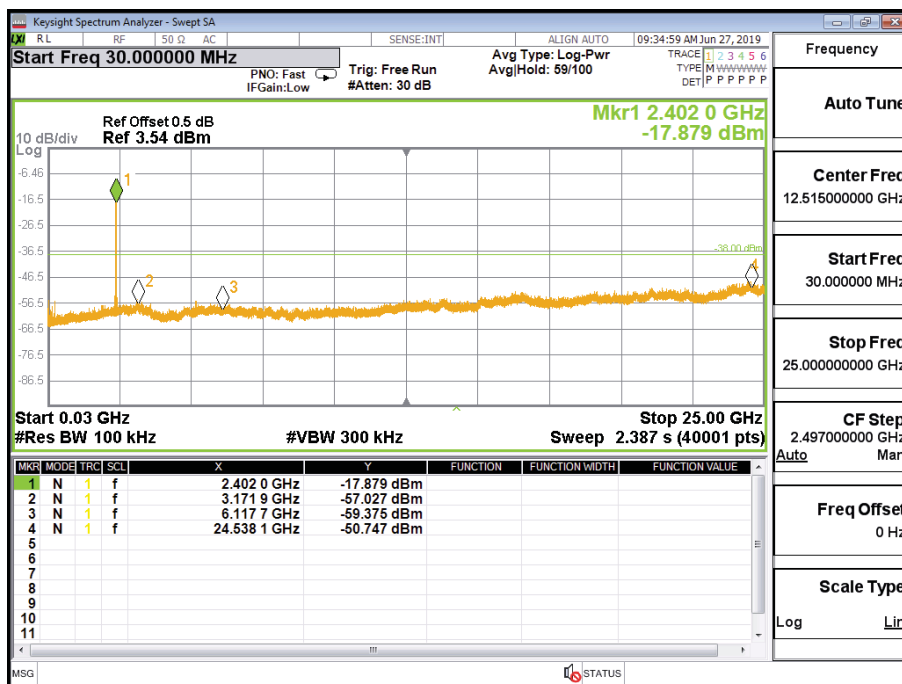
The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.



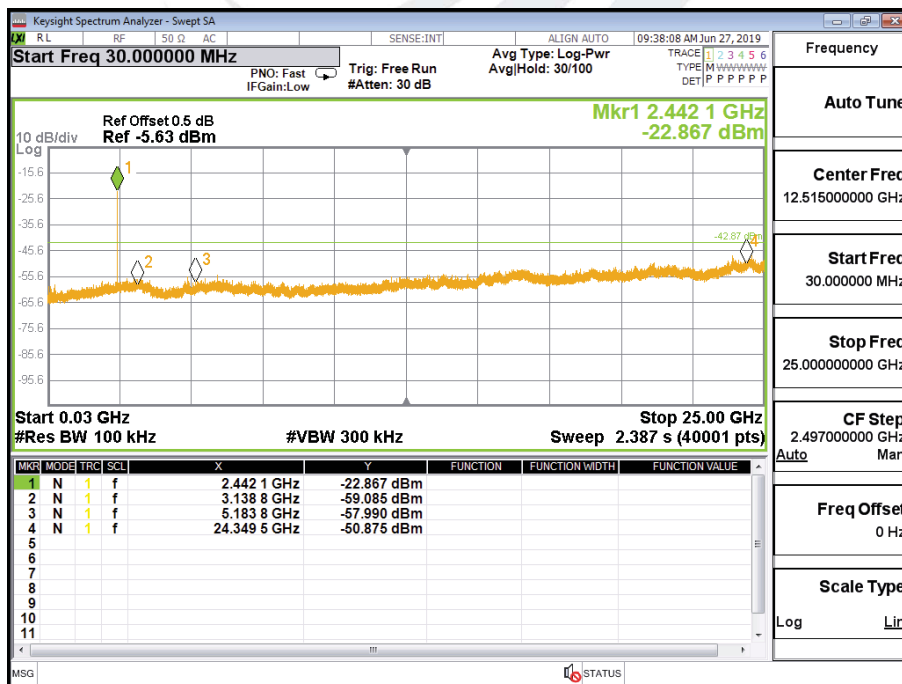
4.5 TEST RESULTS

Temperature:	25°C	Relative Humidity:	50%
Test Mode:	GFSK(1Mbps)-01/03/16 CH	Test Voltage:	DC 1.5V

00 CH

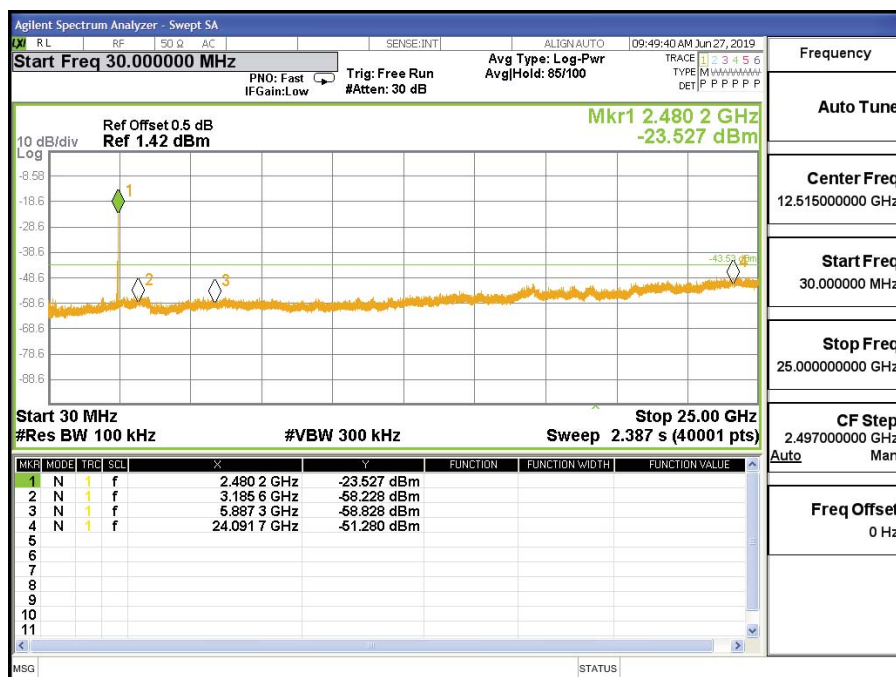


03 CH





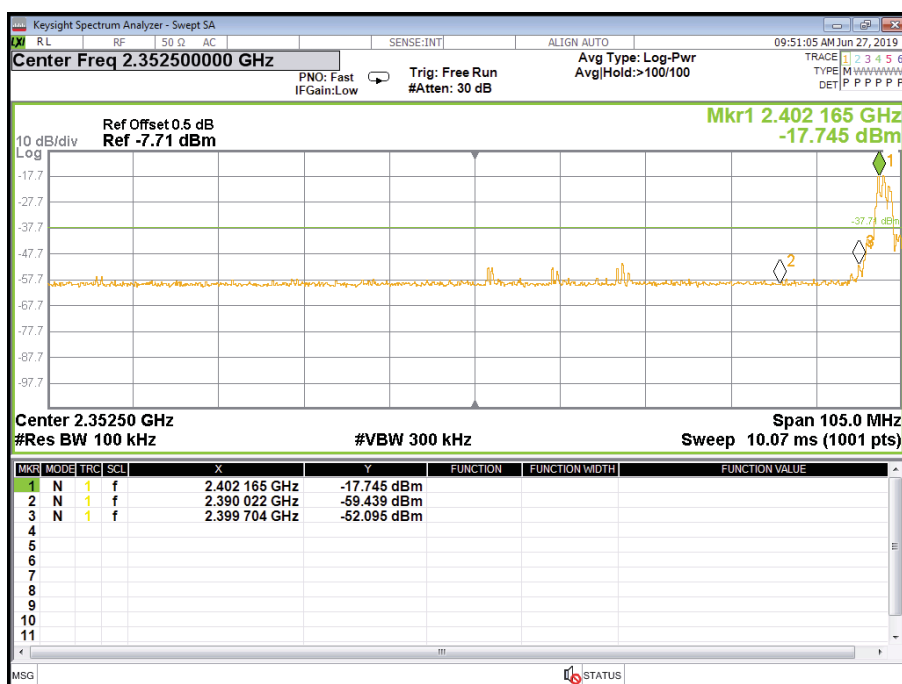
16 CH



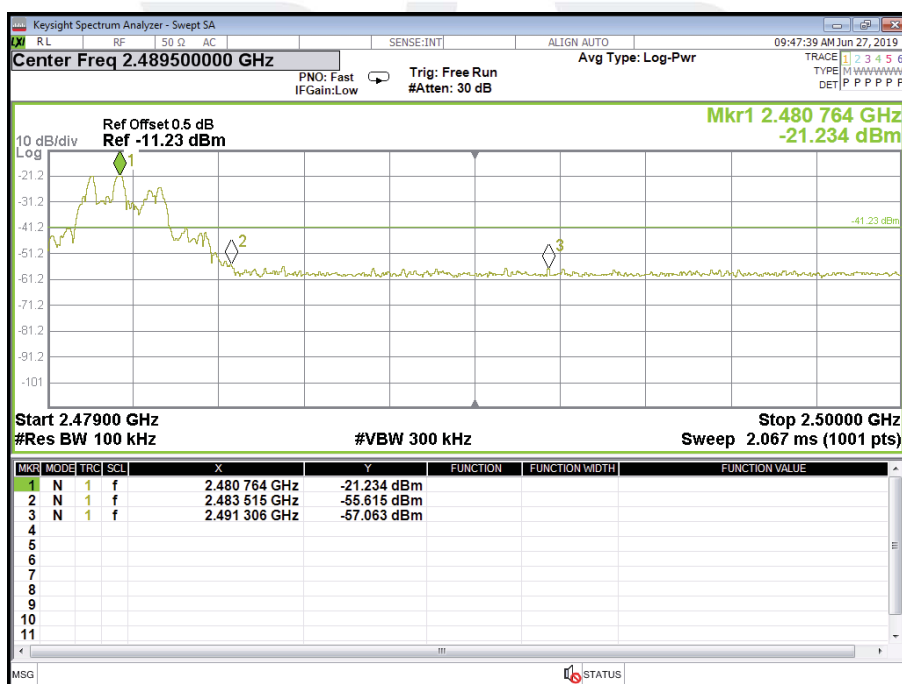


For Band edge

01 CH



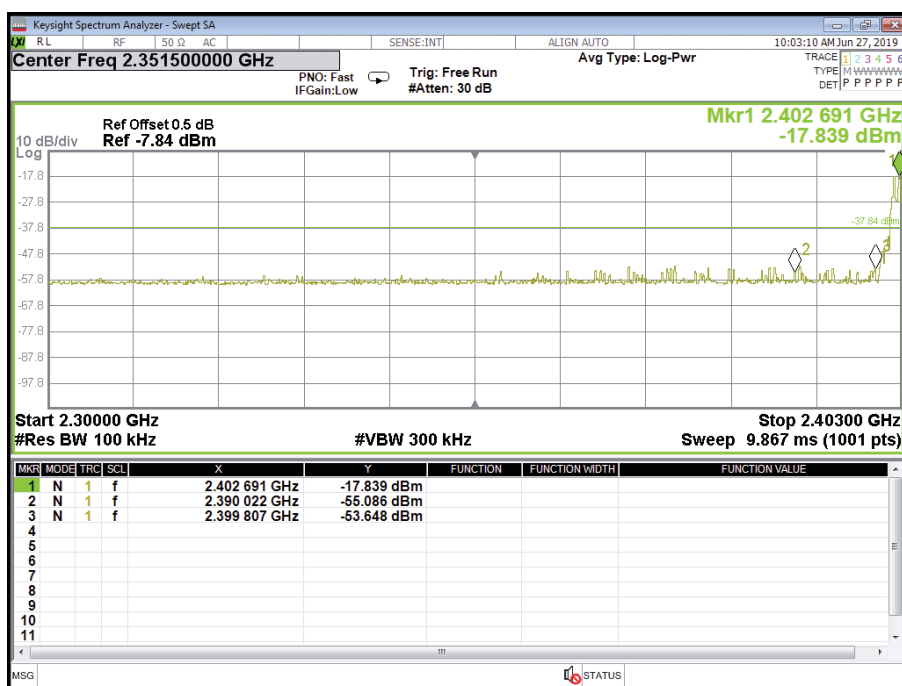
16 CH



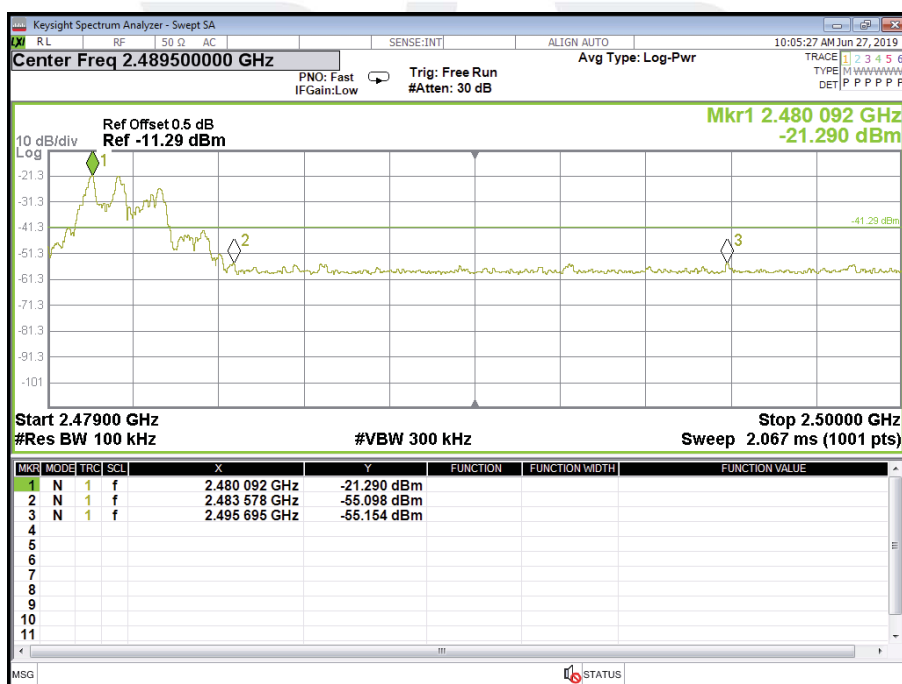


For Hopping Band edge

01 CH



16 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	300KHz
VB	300KHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

5.2 TEST PROCEDURE

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



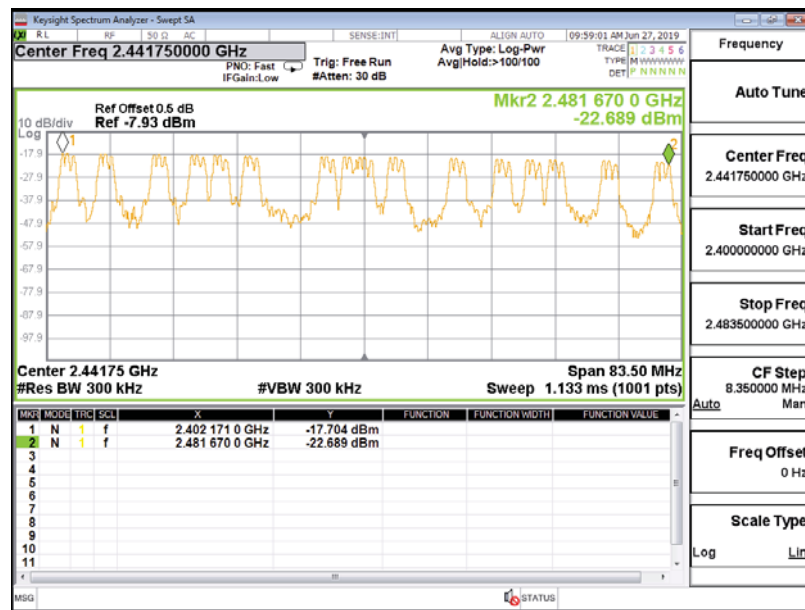
5.5 TEST RESULTS

Temperature:	25°C	Relative Humidity:	60%
Test Mode:	Hopping Mode -GFSK Mode	Test Voltage:	DC 1.5V

Number of Hopping Channel

16

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

- The transmitter output (antenna port) was connected to the spectrum analyzer
- Set RBW =1MHz/VBW =3MHz.
- Use a video trigger with the trigger level set to enable triggering only on full pulses.
- Sweep Time is more than once pulse time.
Set the center frequency on any frequency would be measure and set the frequency span to
- zero span.
- Measure the maximum time duration of one single pulse.
- Set the EUT for DH5, DH3 and DH1 packet transmitting.
- Measure the maximum time duration of one single pulse.
- DH5 Packet permit maximum $1600 / 79 / 6 = 3.37$ hops per second in each channel (5 time slots RX, 1 time slot TX). So the dwell time is the time duration of the pulse times $3.37 \times 31.6 = 106.6$ within 31.6 seconds.
- DH3 Packet permit maximum $1600 / 79 / 4 = 5.06$ hops per second in each channel (3 time slots RX, 1 time slot TX). So the dwell time is the time duration of the pulse times $5.06 \times 31.6 = 160$ within 31.6 seconds.
- 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 $10.12 \times 31.6 = 320$ 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:	GFSK	Test Voltage:	DC 1.5V

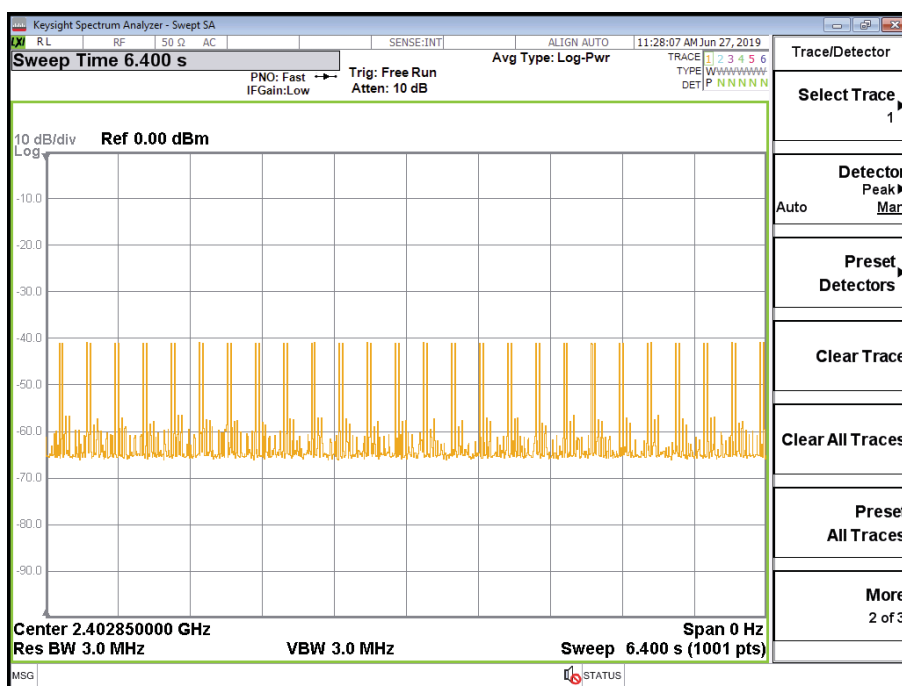
Modulation	Channel	burst number	pulse time(ms)	Dwell Time(s)	Limits(s)
GFSK	CH01	52.000	0.122	0.0063	0.4
	CH03	104.000	0.123	0.0128	0.4
	CH16	52.000	0.119	0.0062	0.4



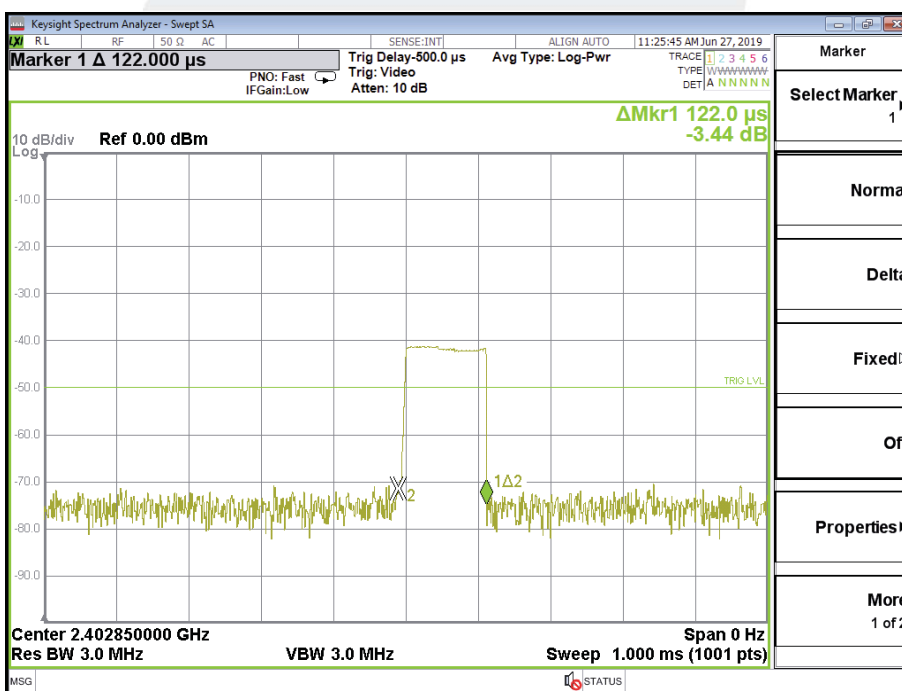


00 CH

Dwell time



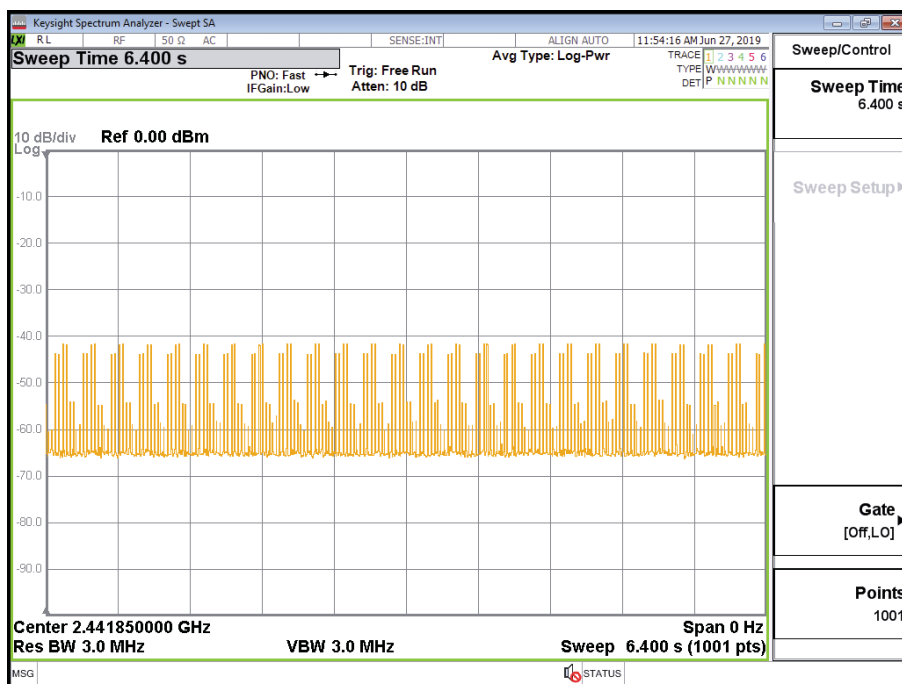
One pulse



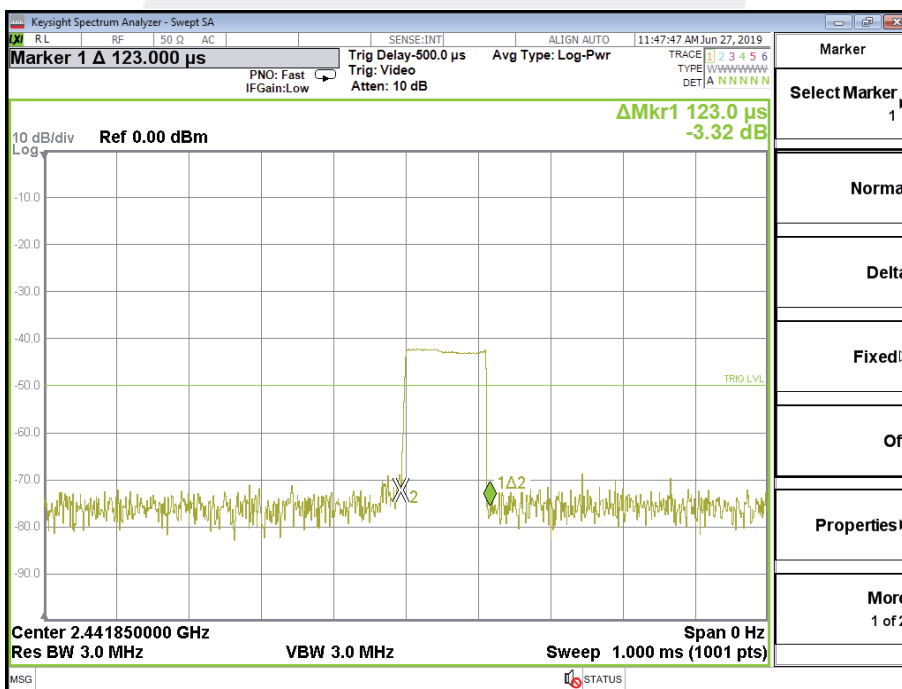


03 CH

Dwell time



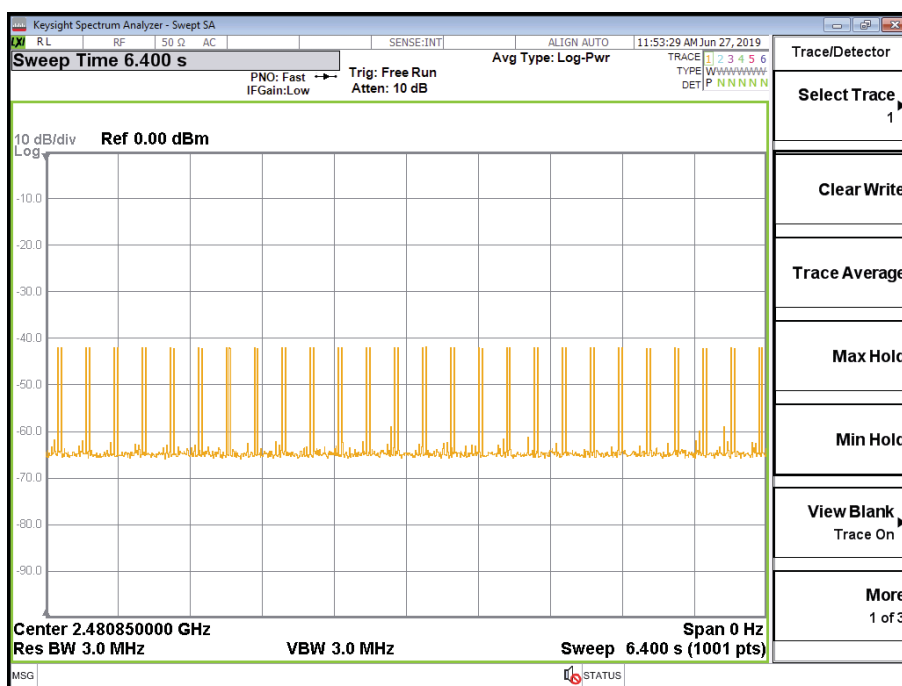
One pulse



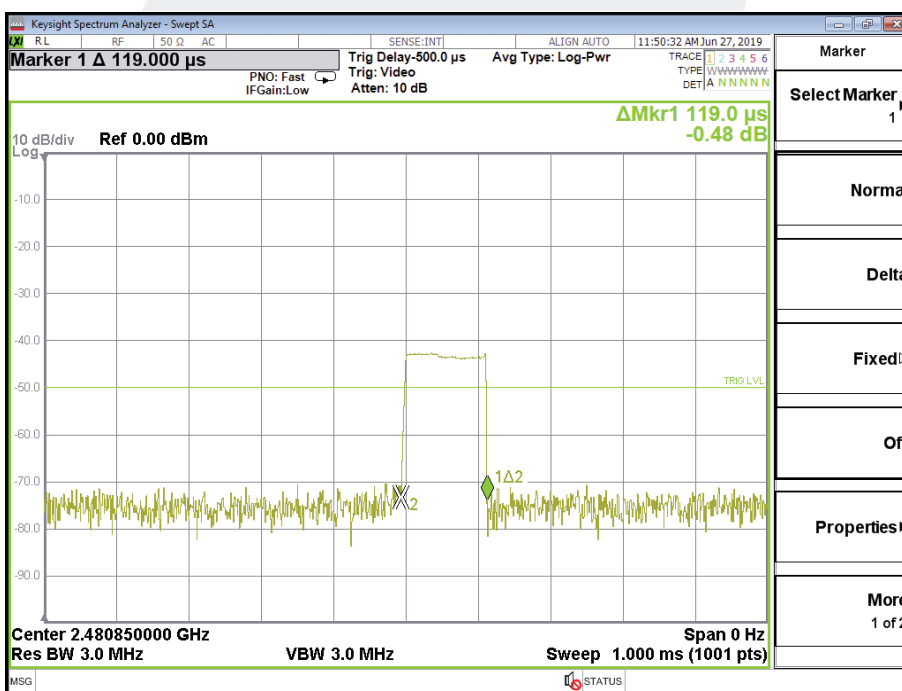


16 CH

Dwell time



One pulse



7. HOPPING CHANNEL SEPARATION MEASUREMENT

7.1 LIMIT

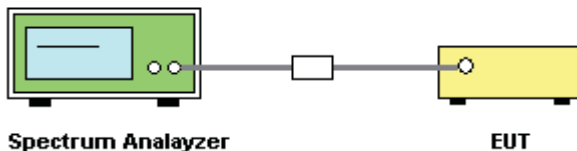
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that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

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



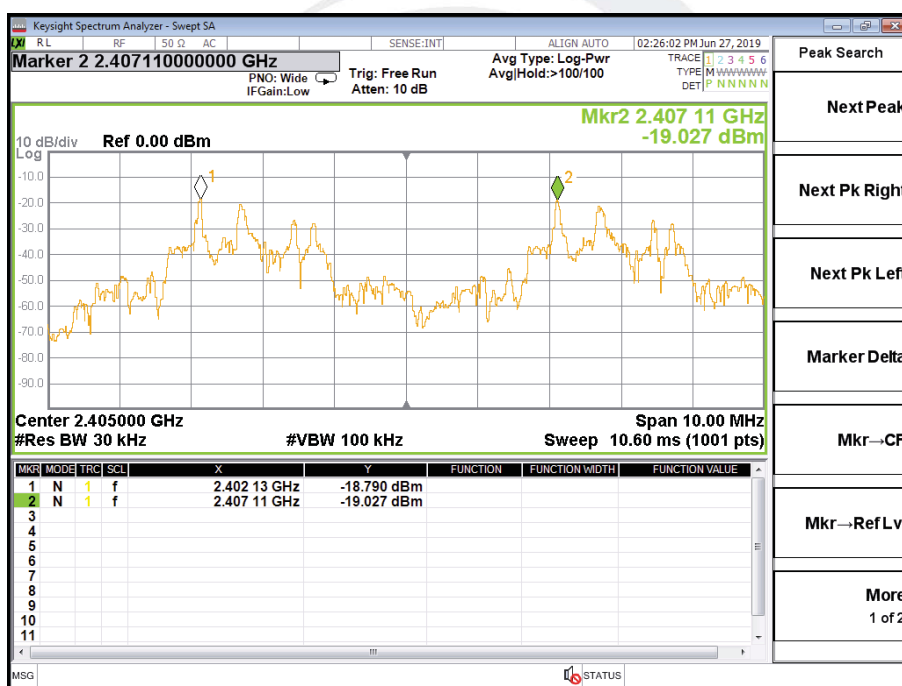
7.5 TEST RESULTS

Temperature:	25°C	Relative Humidity:	50%
Test Mode:	CH01 / CH03 / CH16 (GFSK(1Mbps) Mode)	Test Voltage:	DC 1.5V

Frequency	Ch. Separation (MHz)	Limit (MHz)	Result
2402.85 MHz	4.980	1.448	Complies
2441.85 MHz	2.010	1.437	Complies
2480.85MHz	6.990	1.439	Complies

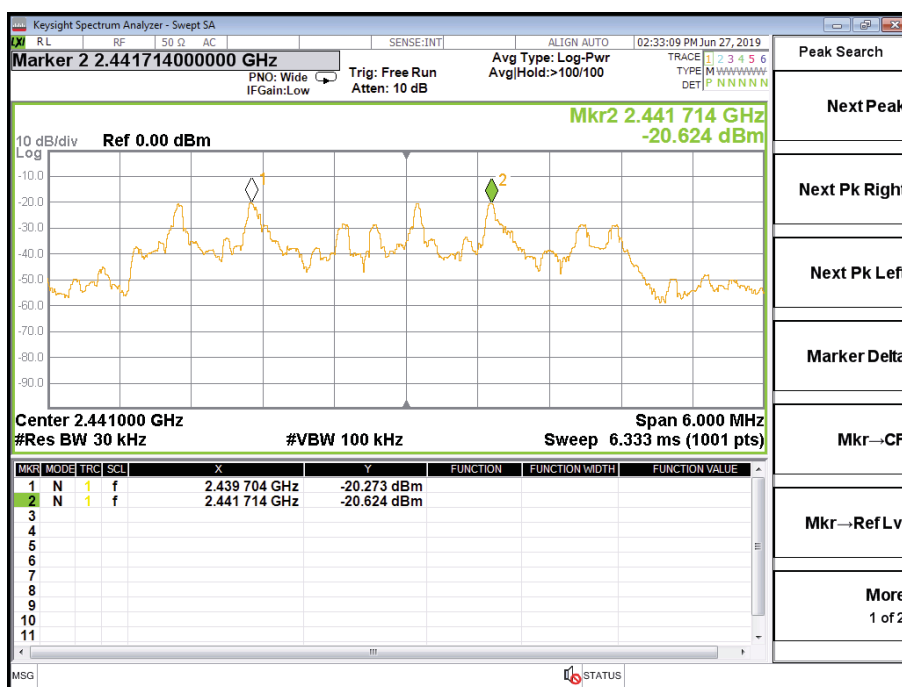
For GFSK: Ch. Separation Limits: > two-thirds 20dB bandwidth

CH01 -1Mbps

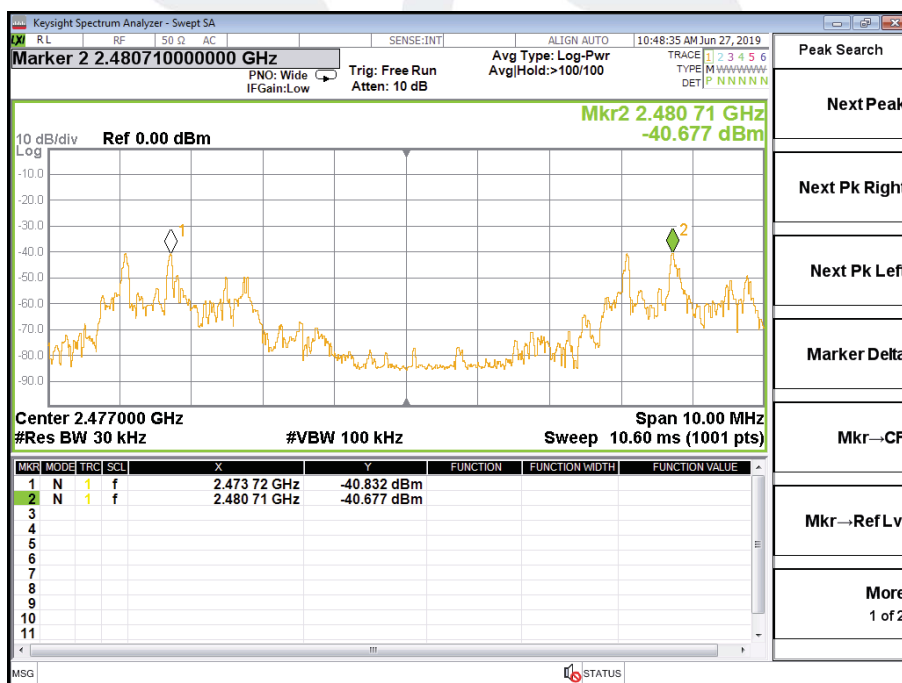




CH03 -1Mbps



CH16 -1Mbps





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

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
- 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.

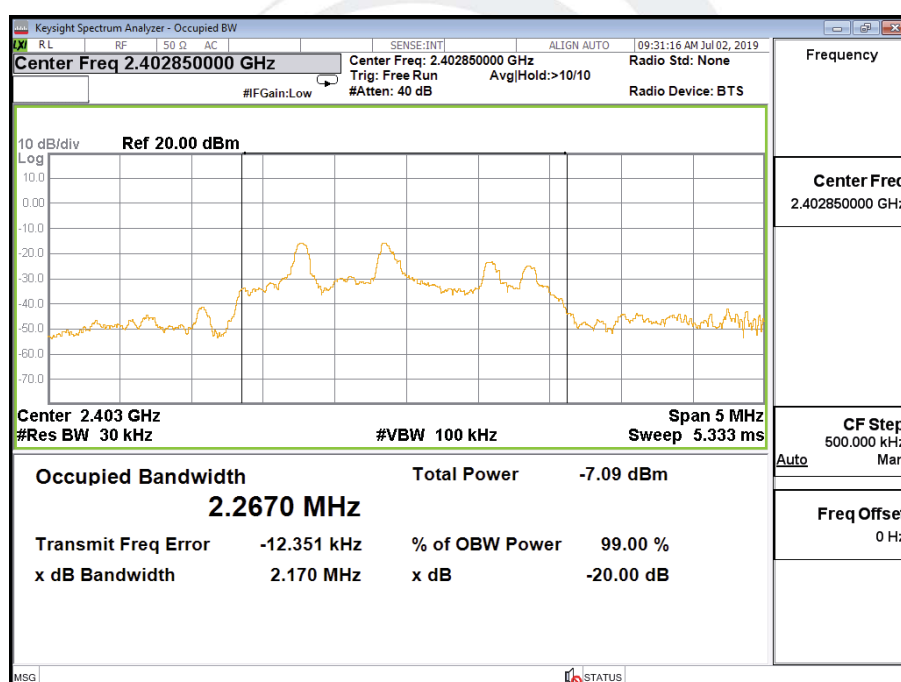


8.5 TEST RESULTS

Temperature:	25°C	Relative Humidity:	50%
Test Mode:	GFSK(1Mbps) CH01 / CH03 / C16	Test Voltage:	DC 1.5V

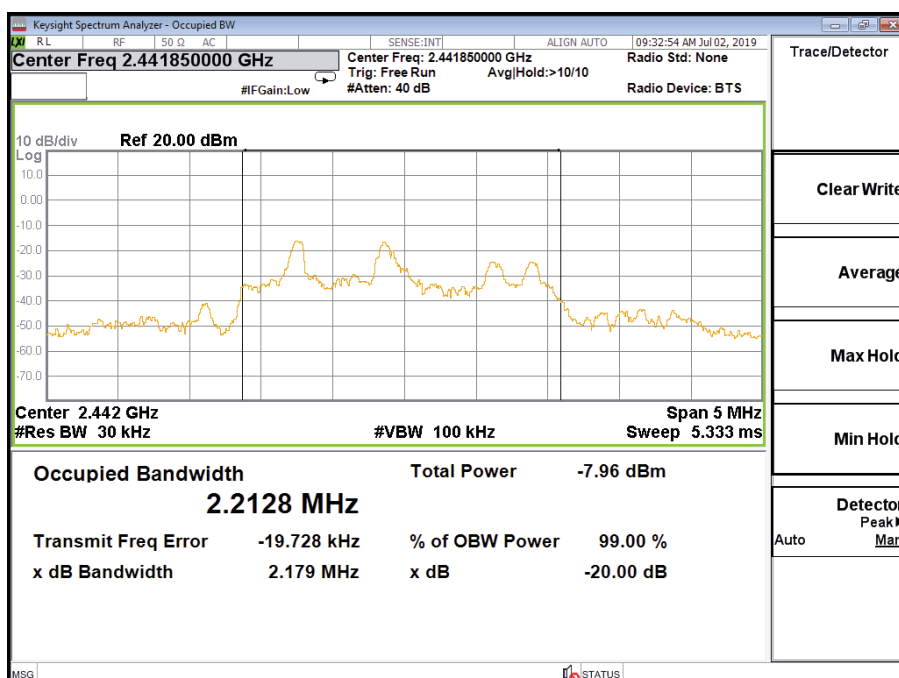
Frequency	20dB Bandwidth (MHz)	Result
2402.85 MHz	2.170	PASS
2441.85 MHz	2.179	PASS
2480.85 MHz	2.189	PASS

CH01 -1Mbps

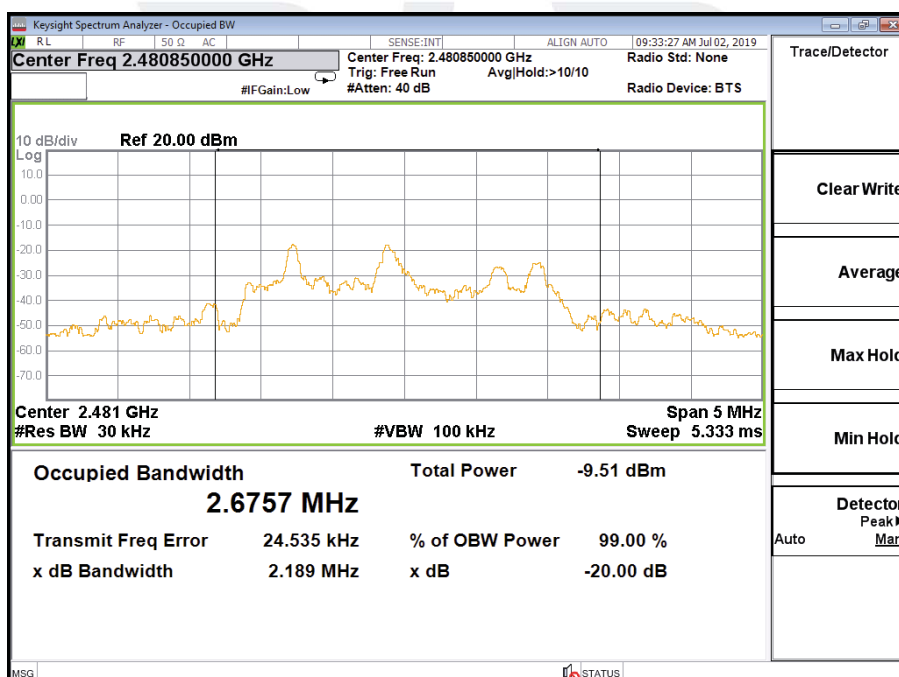




CH03 -1Mbps



CH16 -1Mbps





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	2400-2483.5	PASS
		if channel separation > 2/3 bandwidth provided the systems operate with an output power no greater than 125 mW (20.97 dBm)		

9.2 TEST PROCEDURE

- a. The EUT was directly connected to the Power Sensor & PC

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°C	Relative Humidity:	60%
Test Voltage:	DC 1.5V		

Mode	Channel Number	Frequency (MHz)	Peak Power	Average Power	Limit
			(dBm)	(dBm)	(dBm)
GFSK(1M)	01	2402.85	-15.91	-38.56	20.97
	03	2441.85	-18.89	-38.96	20.97
	16	2480.85	-19.91	-39.73	20.97

Note: the channel separation >2/3 20dB bandwidth





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 PCB 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※※※※※

