

# **RADIO TEST REPORT**

S T S

## Report No.: STS2204018W01

Issued for

Shenzhen Joway Power Supply Co., Ltd.

Blog 10th & 11th, Antuoshan High-Tech Industrial Park, Shajing Street, Shenzhen, China

Product Name:	TWS Bluetooth Earphone		
Brand Name:	JOWAY		
Model Name:	H112		
Series Model:	N/A		
FCC ID:	2AEZ4-H112		
Test Standard:	FCC Part 15.247		

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APPROVA

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#### **TEST RESULT CERTIFICATION**

Applicant's Name:	Shenzhen Joway Power Supply Co., Ltd.
Address	Blog 10th & 11th, Antuoshan High-Tech Industrial Park, Shajing Street, Shenzhen, China
Manufacturer's Name:	Shenzhen Joway Power Supply Co., Ltd.
Address	Blog 10th & 11th, Antuoshan High-Tech Industrial Park, Shajing Street, Shenzhen, China
Product Description	
Product Name:	TWS Bluetooth Earphone
Brand Name:	JOWAY
Model Name:	H112
Series Model:	N/A
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 of receipt of test item:	01 Apr. 2022
Date (s) of performance of tests .:	01 Apr. 2022 ~ 21 Apr. 2022
Date of Issue	21 Apr. 2022
Test Result	Pass

Testing Engineer : Technical Manager : Authorized Signatory : Testing Engineer : Chris Chen) Sean She (Sean she) Torwy Yung

(Bovey Yang)

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#### **Revision History**

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	21 Apr. 2022	STS2204018W01	ALL	Initial Issue



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## 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. : 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  $y \pm U$ , 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	±0.87dB
2	Unwanted Emissions, conducted	±2.895dB
3	All emissions, radiated 9K-30MHz	±3.80dB
4	All emissions, radiated 30M-1GHz	±4.09dB
5	All emissions, radiated 1G-6GHz	±4.92dB
6	All emissions, radiated>6G	±5.49dB
7	Conducted Emission (9KHz-30MHz)	±2.73dB



### 2. GENERAL INFORMATION

#### 2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	TWS Bluetooth Earphone
Trade Name	JOWAY
Model Name	H112
Series Model	N/A
Model Difference	N/A
Channel List	Please refer to the Note 2.
Bluetooth	Frequency:2402 – 2480 MHz Modulation: GFSK(1Mbps), π/4-DQPSK(2Mbps), 8DPSK(3Mbps)
Bluetooth Version	5.0
Bluetooth Configuration	BR+EDR
Antenna Type	Please refer to the Note 3.
Adapter	Input: 5V/0.5A Output: 5V/0.1A
Battery	Rated Voltage: 3.7V Charge Limit Voltage: 4.2V Capacity: 38mAh
Hardware version number	V3.1
Software version number	V1
Connecting I/O Port(s)	Please refer to the Note 1.

Note:

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





2.

Channel List					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	27	2429	54	2456
01	2403	28	2430	55	2457
02	2404	29	2431	56	2458
03	2405	30	2432	57	2459
04	2406	31	2433	58	2460
05	2407	32	2434	59	2461
06	2408	33	2435	60	2462
07	2409	34	2436	61	2463
08	2410	35	2437	62	2464
09	2411	36	2438	63	2465
10	2412	37	2439	64	2466
11	2413	38	2440	65	2467
12	2414	39	2441	66	2468
13	2415	40	2442	67	2469
14	2416	41	2443	68	2470
15	2417	42	2444	69	2471
16	2418	43	2445	70	2472
17	2419	44	2446	71	2473
18	2420	45	2447	72	2474
19	2421	46	2448	73	2475
20	2422	47	2449	74	2476
21	2423	48	2450	75	2477
22	2424	49	2451	76	2478
23	2425	50	2452	77	2479
24	2426	51	2453	78	2480
25	2427	52	2454		
26	2428	53	2455		

#### 3. Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	JOWAY	H112	Ceramic antenna	N/A	2.5 dBi	BT Antenna

Note: 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.



#### 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 CH00	1Mbps/GFSK
Mode 2	TX CH39	1Mbps/GFSK
Mode 3	TX CH78	1Mbps/GFSK
Mode 4	TX CH00	2 Mbps/π/4-DQPSK
Mode 5	TX CH39	2 Mbps/π/4-DQPSK
Mode 6	TX CH78	2 Mbps/π/4-DQPSK
Mode7	TX CH00	3 Mbps/8DPSK
Mode 8	TX CH39	3 Mbps/8DPSK
Mode 9	TX CH78	3 Mbps/8DPSK
Mode 10	Hopping	GFSK
Mode 11	Hopping	π/4-DQPSK
Mode 12	Hopping	8DPSK

Note:

The measurements are performed at all Bit Rate of Transmitter, the worst data was reported.
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 13 : Keeping BT TX	

#### 2.3 FREQUENCY HOPPING SYSTEM REQUIREMENTS

#### (1)Standard and Limit

According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

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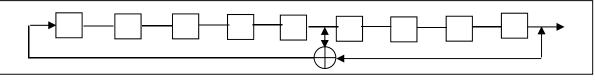


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(2)The Pseudorandom sequence may be generated in a nin-stage shift register whose 5<sup>th</sup> and 9<sup>th</sup> stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones: i.e. the shift register is initialized with nine ones.

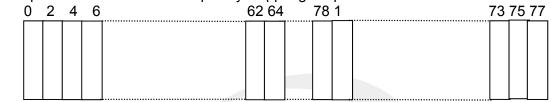
Numver of shift register stages:9

Length of pseudo-random sequence:29-1=511bits Longest sequence of zeros: 8(non-inverted signal)



Liner Feedback Shift Register for Generator of the PRBS sequence

An example of Pseudorandom Frequency Hoppong Sequence as follow:



Each frequency used equally on th average by each transmitter. The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies ini synchronization with the transmitted signals.

(3)Frequency Hopping System

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule.

This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

This device was tested with a bluetooth system receiver to check that the device maintained hopping synchronization, and the device complied with these requirements FCC Part 15.247 rule.

#### 2.4 TABLE OF PARAMETERS OF TEST SOFTWARE SETTING

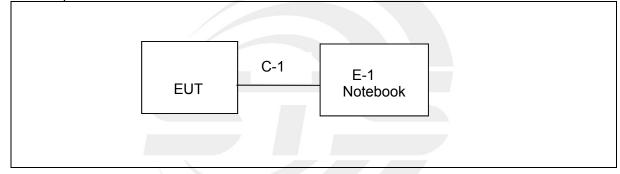
During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final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



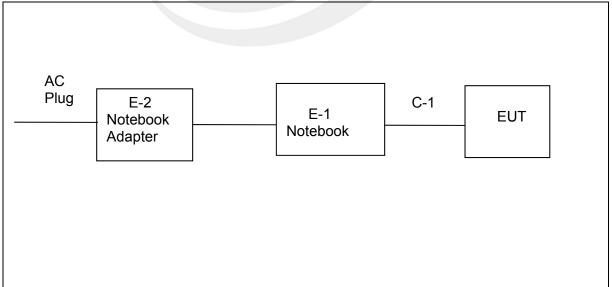
Test software Version	Test program: Bluetooth				
(Power control software) Parameters(1/2/3Mbps)	Power class: DH1 rate:4:27 2DH1 rate:20:54 3DH1 rate:24:83	Power class: DH3 rate:11:183 2DH3 rate:26:367 3DH3 rate:27:552	Power class: DH5 rate:15:339 2DH5 rate:30:679 3DH5 rate:31:1021		

RF Function	Туре	Mode Or Modulation type	ANT Gain(dBi)	Power Class	Software For Testing	
		GFSK	2.5	0x00		
BT	BR+EDR	π/4-DQPSK	2.5	0x00	AWRDLABV2	
		8DPSK	2.5	0x00		

#### 2.5 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED Radiated Spurious Emission Test



Conducted Emission Test



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#### 2.6 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.

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

#### Necessary accessories

#### Support units

Item	Equipment	Mfr/Brand Model/Type No.		Length	Note
E-2	Notebook Adapter	LENOVO	ADLX45DLC3A	N/A	N/A
E-1	Notebook	LENOVO	Think Pad E470	N/A	N/A
C-1	USB Cable	N/A	N/A	150cm	NO

Note:

- (1) For detachable type I/O cable should be specified the length in cm in <sup>r</sup>Length <sup>a</sup> column.
- (2) "YES" is means "with core"; "NO" is means "without core".



## 2.7 EQUIPMENTS LIST

#### Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until		
Test Receiver	R&S	ESCI	101427	2021.09.30	2022.09.29		
Signal Analyzer	R&S	FSV 40-N	101823	2021.09.30	2022.09.29		
Active loop Antenna	ZHINAN	ZN30900C	16035	2021.04.11	2023.04.10		
Bilog Antenna	TESEQ	CBL6111D	34678	2020.10.12	2022.10.11		
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	2021.10.11	2023.10.10		
SHF-EHF Horn Antenna (18G- 40GHz)	A-INFO	LB-180400-KF	J211020657	2020.10.12	2022.10.11		
Pre-Amplifier (0.1M- 3GHz)	EM	EM330	060665	2021.10.08	2022.10.07		
Pre-Amplifier (1G- 18GHz)	SKET	LNPA-01018G-45	SK2018080901	2021.09.30	2022.09.29		
Pre-Amplifier (18G- 40GHz)	SKET	LNPA-1840-50	SK2018101801	2021.09.28	2022.09.27		
Temperature & Humidity	HH660	Mieo	N/A	2021.10.09	2022.10.08		
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)					

#### **Conduction Test equipment**

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	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	
	Test Receiver	R&S	ESCI	101427	2021.09.30	2022.09.29	
	LISN	R&S	ENV216	101242	2021.09.30	2022.09.29	
ſ	LISN	EMCO	3810/2NM	23625	2021.09.30	2022.09.29	
	Temperature & Humidity	HH660	Mieo	N/A	2021.10.09	2022.10.08	
	Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)				

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#### **RF** Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	
Power Sensor	Keysight	U2021XA	MY55520005	2021.09.30	2022.09.29	
			MY55520006	2021.09.30	2022.09.29	
			MY56120038	2021.09.30	2022.09.29	
			MY56280002	2021.09.30	2022.09.29	
Signal Analyzer	Agilent	N9020A	MY51110105	2022.03.01	2023.02.28	
Temperature & Humidity	HH660	Mieo	N/A	2021.10.09	2022.10.08	
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)				



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#### 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.

	Conducted Emissionlimit (dBuV)		
FREQUENCY (MHz)	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.

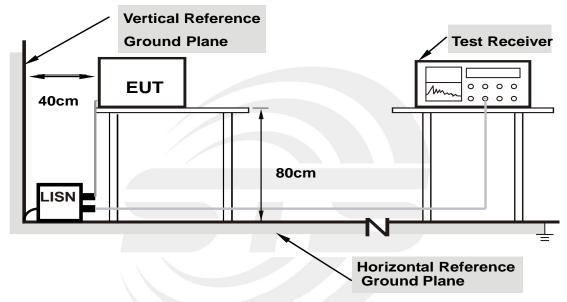
#### The following table is the setting of the receiver

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:	23.2(C)	Relative Humidity:	62%RH
Test Voltage:	AC 120V/60Hz	Phase:	L
Test Mode:	Mode 13		

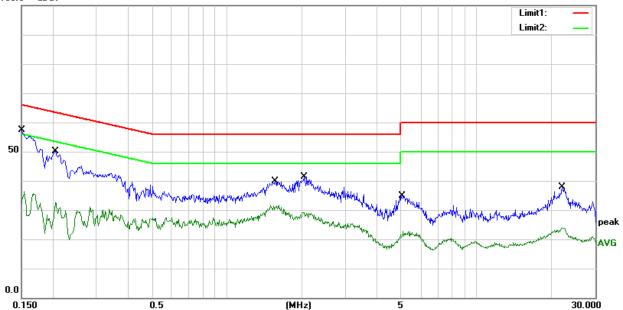
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.1500	36.94	20.33	57.27	66.00	-8.73	QP
2	0.1500	16.09	20.33	36.42	56.00	-19.58	AVG
3	0.2060	29.75	20.34	50.09	63.37	-13.28	QP
4	0.2060	12.20	20.34	32.54	53.37	-20.83	AVG
5	1.5620	19.48	20.30	39.78	56.00	-16.22	QP
6	1.5620	11.36	20.30	31.66	46.00	-14.34	AVG
7	2.0420	21.10	20.30	41.40	56.00	-14.60	QP
8	2.0420	8.91	20.30	29.21	46.00	-16.79	AVG
9	5.0540	14.42	20.46	34.88	60.00	-25.12	QP
10	5.0540	2.34	20.46	22.80	50.00	-27.20	AVG
11	22.1660	15.05	22.77	37.82	60.00	-22.18	QP
12	22.1660	1.18	22.77	23.95	50.00	-26.05	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)



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Temperature:	23.2(C)	Relative Humidity:	62%RH
Test Voltage:	AC 120V/60Hz	Phase:	N
Test Mode:	Mode 13		

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.1540	36.71	20.30	57.01	65.78	-8.77	QP
2	0.1540	16.20	20.30	36.50	55.78	-19.28	AVG
3	0.3580	22.73	20.66	43.39	58.77	-15.38	QP
4	0.3580	7.80	20.66	28.46	48.77	-20.31	AVG
5	0.7300	16.27	20.36	36.63	56.00	-19.37	QP
6	0.7300	6.71	20.36	27.07	46.00	-18.93	AVG
7	2.0140	21.97	20.39	42.36	56.00	-13.64	QP
8	2.0140	8.97	20.39	29.36	46.00	-16.64	AVG
9	5.2460	15.51	20.54	36.05	60.00	-23.95	QP
10	5.2460	3.40	20.54	23.94	50.00	-26.06	AVG
11	22.5180	14.98	22.82	37.80	60.00	-22.20	QP
12	22.5180	1.79	22.82	24.61	50.00	-25.39	AVG

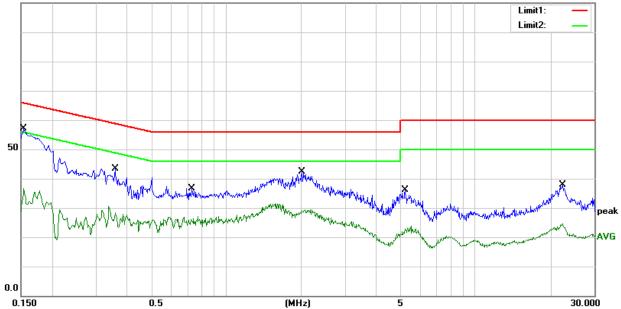
#### Remark:

1. All readings are Quasi-Peak and Average values

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

3. Factor=LISN factor+Cable loss+Limiter (10dB)

100.0 dBuV



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#### 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	Field Strength	Measurement Distance
(MHz)	(micorvolts/meter)	(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			

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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)		
	200Hz (From 9kHz to 0.15MHz)/		
RB / VB (emission in restricted	9KHz (From 0.15MHz to 30MHz);		
band)	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	1 MHz / 3 MHz(Peak)		
band)	1 MHz/1/T MHz(AVG)		

#### For Restricted band

Spectrum Parameter	Setting		
Detector	Peak/AV		
Stort/Stop Eroguopov	Lower Band Edge: 2310 to 2410 MHz		
Start/Stop Frequency	Upper Band Edge: 2476 to 2500 MHz		
RB / VB	1 MHz / 3 MHz(Peak)		
KD/VB	1 MHz/1/T MHz(AVG)		



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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.

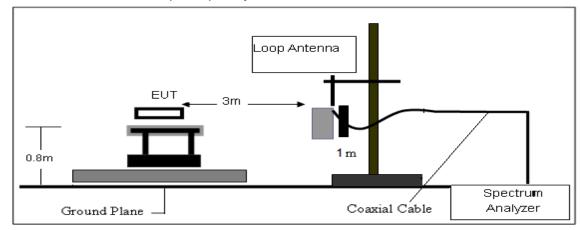
## 3.2.3 DEVIATION FROM TEST STANDARD

No deviation.

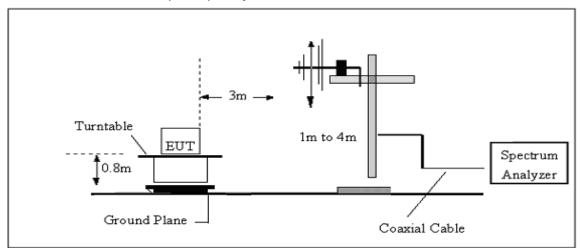


#### 3.2.4 TESTSETUP

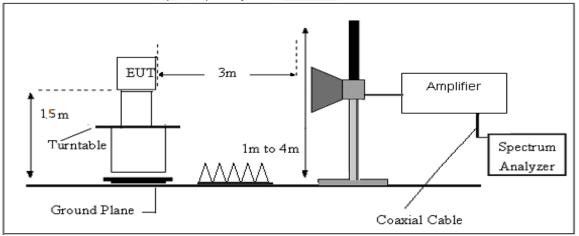
(A) Radiated Emission Test-Up Frequency Below 30MHz



#### (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:	DC 3.7V	Test Mode:	TX Mode

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





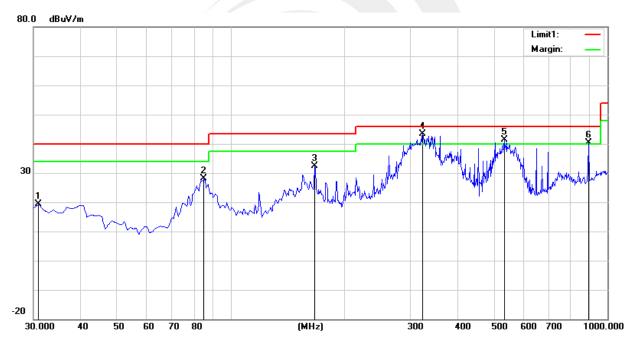
(30MHz-1000MHz)

Temperature:	23.1(C)	Relative Humidity:	60%RH			
Test Voltage:	DC 3.7V	Phase:	Horizontal			
Test Mode:	Mode 1/2/3/4/5/6/7/8/9(Mode 7 worst mode)					

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	30.9700	32.64	-13.35	19.29	40.00	-20.71	peak
2	85.2900	50.25	-22.13	28.12	40.00	-11.88	peak
3	167.7400	51.91	-19.58	32.33	43.50	-11.17	peak
4	323.9100	57.26	-13.88	43.38	46.00	-2.62	peak
5	533.4300	48.74	-7.25	41.49	46.00	-4.51	peak
6	893.3000	41.06	-0.61	40.45	46.00	-5.55	peak

Remark:

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





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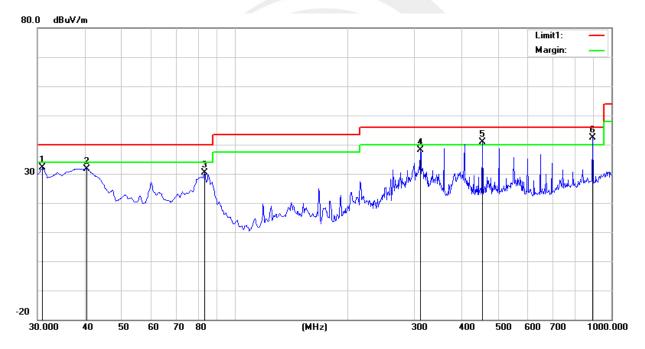
Temperature:	23.1(C)	Relative Humidity:	60%RH		
Test Voltage:	DC 3.7V	Phase:	Vertical		
Test Mode:	Mode 1/2/3/4/5/6/7/8/9(Mode 7 worst mode)				

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	30.9700	45.55	-13.35	32.20	40.00	-7.80	peak
2	40.6700	50.14	-18.40	31.74	40.00	-8.26	peak
3	83.3500	52.90	-22.52	30.38	40.00	-9.62	peak
4	311.3000	52.53	-14.40	38.13	46.00	-7.87	peak
5	455.8300	50.31	-9.55	40.76	46.00	-5.24	peak
6	893.3000	43.05	-0.61	42.44	46.00	-3.56	peak

Remark:

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

2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain



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#### (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)	Туре	
				Low Ch	annel (8DPSK/	2402 MHz)				
3264.79	62.23	44.70	6.70	28.20	-9.80	52.43	74.00	-21.57	PK	Vertical
3264.79	51.71	44.70	6.70	28.20	-9.80	41.91	54.00	-12.09	AV	Vertical
3264.84	60.82	44.70	6.70	28.20	-9.80	51.02	74.00	-22.98	PK	Horizontal
3264.84	50.60	44.70	6.70	28.20	-9.80	40.80	54.00	-13.20	AV	Horizontal
4804.36	58.43	44.20	9.04	31.60	-3.56	54.87	74.00	-19.13	PK	Vertical
4804.36	50.48	44.20	9.04	31.60	-3.56	46.92	54.00	-7.08	AV	Vertical
4804.38	58.56	44.20	9.04	31.60	-3.56	55.00	74.00	-19.00	PK	Horizontal
4804.38	49.53	44.20	9.04	31.60	-3.56	45.97	54.00	-8.03	AV	Horizontal
5359.86	48.56	44.20	9.86	32.00	-2.34	46.21	74.00	-27.79	PK	Vertical
5359.86	38.98	44.20	9.86	32.00	-2.34	36.64	54.00	-17.36	AV	Vertical
5359.64	47.58	44.20	9.86	32.00	-2.34	45.24	74.00	-28.76	PK	Horizontal
5359.64	38.78	44.20	9.86	32.00	-2.34	36.43	54.00	-17.57	AV	Horizontal
7205.73	54.96	43.50	11.40	35.50	3.40	58.36	74.00	-15.64	PK	Vertical
7205.73	43.98	43.50	11.40	35.50	3.40	47.38	54.00	-6.62	AV	Vertical
7205.68	54.47	43.50	11.40	35.50	3.40	57.87	74.00	-16.13	PK	Horizontal
7205.68	44.25	43.50	11.40	35.50	3.40	47.65	54.00	-6.35	AV	Horizontal
	•			Middle C	hannel (8DPSł	(/2441 MHz)			•	
3264.78	61.80	44.70	6.70	28.20	-9.80	52.00	74.00	-22.00	PK	Vertical
3264.78	51.35	44.70	6.70	28.20	-9.80	41.55	54.00	-12.45	AV	Vertical
3264.66	61.87	44.70	6.70	28.20	-9.80	52.07	74.00	-21.93	PK	Horizontal
3264.66	50.67	44.70	6.70	28.20	-9.80	40.87	54.00	-13.13	AV	Horizontal
4882.50	59.20	44.20	9.04	31.60	-3.56	55.64	74.00	-18.36	PK	Vertical
4882.50	50.35	44.20	9.04	31.60	-3.56	46.79	54.00	-7.21	AV	Vertical
4882.35	58.84	44.20	9.04	31.60	-3.56	55.28	74.00	-18.72	PK	Horizontal
4882.35	49.99	44.20	9.04	31.60	-3.56	46.43	54.00	-7.57	AV	Horizontal
5359.87	48.93	44.20	9.86	32.00	-2.34	46.59	74.00	-27.41	PK	Vertical
5359.87	39.86	44.20	9.86	32.00	-2.34	37.52	54.00	-16.48	AV	Vertical
5359.72	48.37	44.20	9.86	32.00	-2.34	46.03	74.00	-27.97	PK	Horizontal
5359.72	38.18	44.20	9.86	32.00	-2.34	35.84	54.00	-18.16	AV	Horizontal
7323.97	54.17	43.50	11.40	35.50	3.40	57.57	74.00	-16.43	PK	Vertical
7323.97	44.23	43.50	11.40	35.50	3.40	47.63	54.00	-6.37	AV	Vertical
7323.77	54.23	43.50	11.40	35.50	3.40	57.63	74.00	-16.37	PK	Horizontal
7323.77	43.91	43.50	11.40	35.50	3.40	47.31	54.00	-6.69	AV	Horizontal



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				High Chann	el (8DPSK/	2480 MHz)				
3264.63	61.78	44.70	6.70	28.20	-9.80	51.98	74.00	-22.02	PK	Vertical
3264.63	50.65	44.70	6.70	28.20	-9.80	40.85	54.00	-13.15	AV	Vertical
3264.63	61.99	44.70	6.70	28.20	-9.80	52.19	74.00	-21.81	PK	Horizontal
3264.63	50.06	44.70	6.70	28.20	-9.80	40.26	54.00	-13.74	AV	Horizontal
4960.56	59.25	44.20	9.04	31.60	-3.56	55.69	74.00	-18.31	PK	Vertical
4960.56	50.37	44.20	9.04	31.60	-3.56	46.81	54.00	-7.19	AV	Vertical
4960.59	58.39	44.20	9.04	31.60	-3.56	54.83	74.00	-19.17	PK	Horizontal
4960.59	49.60	44.20	9.04	31.60	-3.56	46.04	54.00	-7.96	AV	Horizontal
5359.65	48.76	44.20	9.86	32.00	-2.34	46.42	74.00	-27.58	PK	Vertical
5359.65	39.23	44.20	9.86	32.00	-2.34	36.89	54.00	-17.11	AV	Vertical
5359.63	47.55	44.20	9.86	32.00	-2.34	45.21	74.00	-28.79	PK	Horizontal
5359.63	38.64	44.20	9.86	32.00	-2.34	36.30	54.00	-17.70	AV	Horizontal
7439.72	54.25	43.50	11.40	35.50	3.40	57.65	74.00	-16.35	PK	Vertical
7439.72	44.93	43.50	11.40	35.50	3.40	48.33	54.00	-5.67	AV	Vertical
7439.89	53.68	43.50	11.40	35.50	3.40	57.08	74.00	-16.92	PK	Horizontal
7439.89	44.41	43.50	11.40	35.50	3.40	47.81	54.00	-6.19	AV	Horizontal

Note:

- 1) Scan with GFSK,  $\pi$ /4-DQPSK, 8DPSK, the worst case is GFSK Mode.
- 2) Factor = Antenna Factor + Cable Loss Pre-amplifier.

Emission Level = Reading + Factor

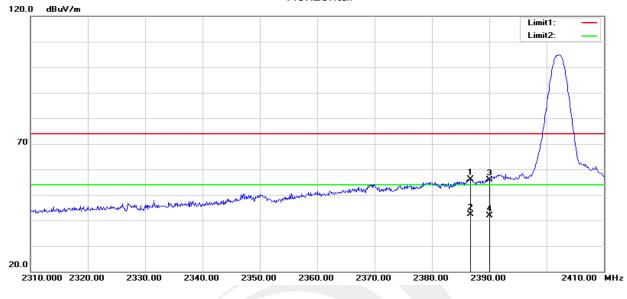
3) The frequency emission of peak points that did not show above the forms are at least 20dB below the limit, the frequency emission is mainly from the environment noise.



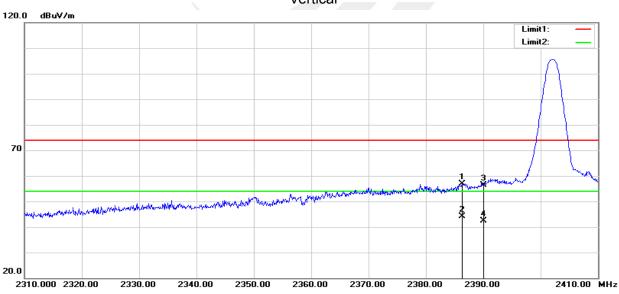


#### **Restricted band Requirements**

**GFSK-Low** Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2386.700	51.80	4.29	56.09	74.00	-17.91	peak
2	2386.700	38.05	4.29	42.34	54.00	-11.66	AVG
3	2390.000	51.62	4.34	55.96	74.00	-18.04	peak
4	2390.000	37.50	4.34	41.84	54.00	-12.16	AVG



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2386.300	52.59	4.28	56.87	74.00	-17.13	peak
2	2386.300	39.77	4.28	44.05	54.00	-9.95	AVG
3	2390.000	52.11	4.34	56.45	74.00	-17.55	peak
4	2390.000	38.00	4.34	42.34	54.00	-11.66	AVG

Vertical

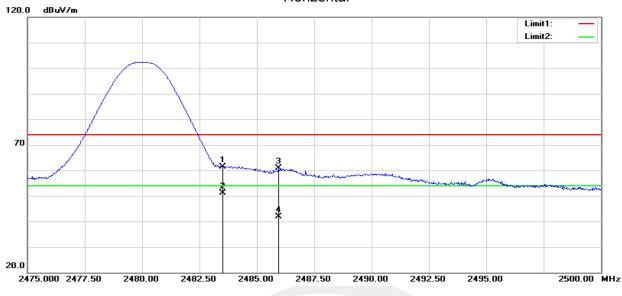
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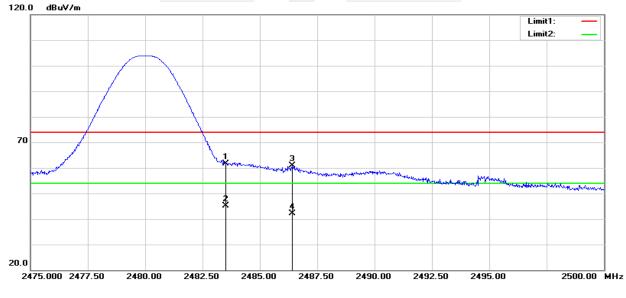
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#### **GFSK-High** Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	56.69	4.60	61.29	74.00	-12.71	peak
2	2483.500	46.55	4.60	51.15	54.00	-2.85	AVG
3	2485.950	56.17	4.61	60.78	74.00	-13.22	peak
4	2485.950	37.27	4.61	41.88	54.00	-12.12	AVG

Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	56.95	4.60	61.55	74.00	-12.45	peak
2	2483.500	40.43	4.60	45.03	54.00	-8.97	AVG
3	2486.425	56.15	4.61	60.76	74.00	-13.24	peak
4	2486.425	37.47	4.61	42.08	54.00	-11.92	AVG

Note: GFSK,  $\pi$ /4-DQPSK, 8DPSK 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.

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## 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

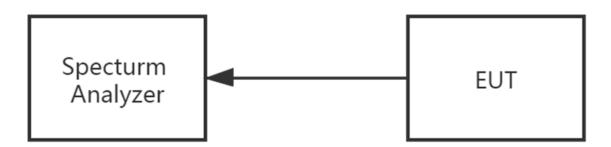
Spectrum Parameter	Setting		
Detector	Peak		
Start/Stop Frequency	Lower Band Edge: 2300 – 2407 MHz		
Start/Stop Frequency	Upper Band Edge: 2475 – 2500 MHz		
RB / VB (emission in restricted band)	100 KHz/300 KHz		
Trace-Mode:	Max hold		

#### For Hopping Band edge

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







The EUT is connected to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 500hm; 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.

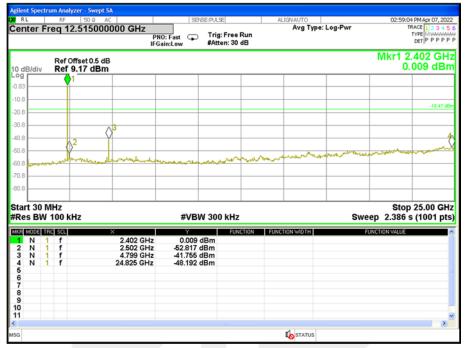




#### 4.5 TEST RESULTS

Temperature:	<b>25</b> ℃	Relative Humidity:	50%
Test Mode:	GFSK(1Mbps)-00/39/78 CH	Test Voltage:	DC 3.7V

#### 00 CH



#### 39 CH

RL		RF	yzer - Swept S		SEN	SE:PULSE	ALIGN AUTO		03:03:04	PM Apr 07, 202
ente	er Fr	eq 1	2.515000	PI	NO: Fast 😱 Gain:Low	Trig: Free Run #Atten: 30 dB	Avg	Type: Log-Pwr		ACE 1 2 3 4 1
) dB/d	div		offset 0.5 dB 10.89 dBn						Mkr1 2. 0.3	452 GH 890 dB
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11 -										
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a										
	30 M	IHz 100 F	Ш7		#\/B\	V 300 kHz		Sw	Stop eep 2.386 s	25.00 G
	DETR			x	** <b>*</b>	FUNCTION	N FUNCTION WIDT		FUNCTION VALUE	(1001 p
		f f f		2.452 GHz 2.527 GHz 4.874 GHz 24.750 GHz	0.890 ( -51.634 ( -43.874 ( -47.451 (	dBm dBm dBm				
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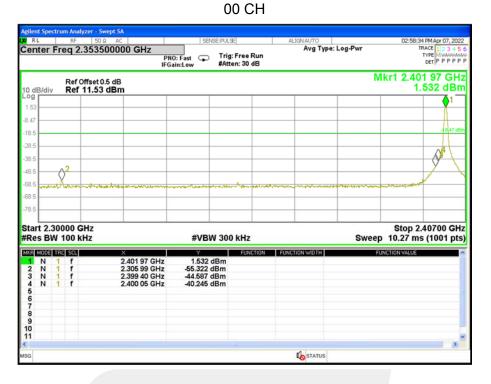
#### 78 CH

03:05:29 PM Apr 07, 20		ALIGN AI	JLSE	SENSE:PU	IC I	50 Q AC	RF			RL
TRACE 1 2 3 4	/g Type: Log-Pwr	A			0000 GHz	.515000	eq 12.	Fre	ter	en
DET P P P P			ig: Free Run tten: 30 dB	):Fast 😱 Tri in:Low #A						
Mkr1 2.477 GF					_					
-0.907 dB						ffset 0.5 dB <b>).09 dBm</b>			3/div	dE
						1	<b>(</b> 1			g
							Ť			91
-18.85 d							-		-	.9
									_	.9
					A3	/	-			.9
					Y	(	-			.9
mannente	1 marter marter					<mark>∕2</mark>	$\rightarrow$			.9
	Messinghetin	warme -	manner	manyment	deman my my	an produced	w will	ماليد	we have	.9
									-	.9
										.9
Stop 25.00 GH veep 2.386 s (1001 pt	Swa		00 447	#VBW 30		47	HZ 00 kH		t 30	
				#4844.30				_	_	
FUNCTION VALUE	NDTH FL	FUNCTION W	FUNCTION	-0.907 dBm	× 2.477 GHz		SCL	1	N	
			i l	-56.051 dBm -41.243 dBm	2.677 GHz 4.949 GHz		f	1	NN	2
				-47.556 dBm	24.076 GHz		f	1	N	ì
										t
										)
>										

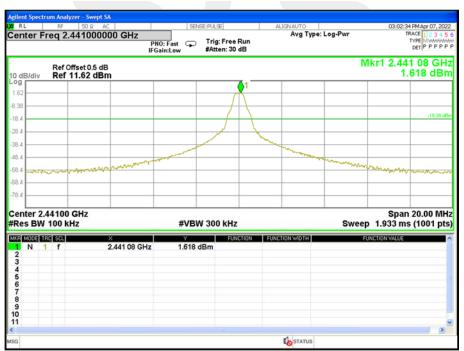
Shenzhen STS Test Services Co., Ltd.



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



39 CH



Shenzhen STS Test Services Co., Ltd.



## 78 CH

RL	rum Ana RE	lyzer - Swept SA 50 Ω AC		65	NSE:PULSE		ALIGN AUTO		03:0	1:59 PM Apr 07, 20
		.48750000	00 GHz	PNO: Fast Gain:Low		Run	Avg Type:	_		TRACE 1 2 3 4 9 TYPE MWWW DET P P P P
dB/div		Offset 0.5 dB 11.15 dBm	<u> </u>					M	kr1 2.48	0 075 GH 1.149 dBi
15			1							
.9		/	$\backslash$							-18.85 d
.9										
.9				$Q^2 Q^3$					4	
.9					man	wportunitor		yh <del>y horyanto</del> o	Y	
1.9										
art 2.47 Res BW				#VB	W 300 kH	z		Swee	Stop p 2.400 i	2.50000 GH ns (1001 pt
R MODE T			×	Υ Y		NCTION FUR	NCTION WIDTH		FUNCTION VALU	Ε
N 1 2 N 1 3 N 1 4 N 1	f f f	2.	480 075 GHz 483 500 GHz 484 075 GHz 495 075 GHz	-48.254 -49.709	dBm					
N 1										
3										
8 9 0										>



Shenzhen STS Test Services Co., Ltd.



## For Hopping Band edge

GFSK

	rum Analyze							
enter F	⊮F Freq 2.35		PNO: Fast	NSE:PULSE Trig: Free Run #Atten: 30 dB	ALIGN AUTO	Type: Log-Pwr	т	SPM Apr 07, 20 RACE 1 2 3 4 TYPE MWWWW DET P P P P
dB/div		set 0.5 dB .43 dBm				N	1kr1 2.403 1.	000 GH 430 dB
g 43								
.6								-18.57 d
.6								
.6								X
	Arran	mmmmm	wannan	mannen	ananana	unananan	represented	multim
б б								-
	0000 GH	-					Oton 2	40300 GI
	100 GH		#VB	W 300 kHz		Swee	ep 9.867 ms	
N N N N	RC SCL 1 f 1 f 1 f	× 2.403 000 GHz 2.390 022 GHz 2.400 013 GHz	-58.411	dBm	FUNCTION WID	TH	FUNCTION VALUE	
								>
					To STA	TUS		

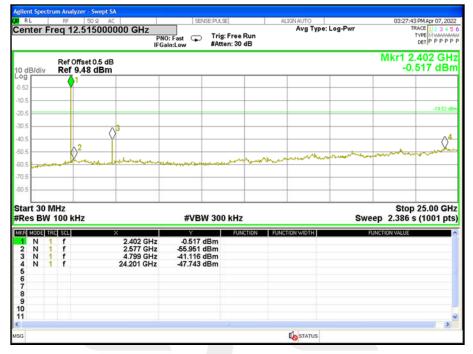
	g: Free Run ten: 30 dB	Avg Type: Lo	g-Pwr	TRACE 1 2 3 4 5 TYPE MWWWW
				DET PPPP
			Mkr1 2.	479 063 GH 1.230 dBi
				-18.77 d
				^3
ha Asia				2 0
M Dry War war war	man mar	anound	handhand	mar har Th
#VBW 30	0 kHz			op 2.50000 GH 7 ms (1001 pt
Y	FUNCTION	FUNCTION WIDTH	FUNCTION V	ALUE
5 GHz -49.375 dBm				
15 GHZ -51.430 dBm				
				>
	3 GHz 1.230 dBm	#VBW 300 kHz #UBW 300 kHz S3 GHz 1.230 dBm 5 GHz 4.9.375 dBm	#VBW 300 kHz #VBW 300 kHz 53 GHz 1.230 dBm 5 5 GHz 4.9.375 dBm 5	#VBW 300 kHz     Stress       #VBW 300 kHz     Sweep 2.06       3 GHz     1.230 dBm       5 GHz     49.375 dBm



## Page 39 of 73 Report No.: STS2204018W01

Temperature:	<b>25</b> ℃	Relative Humidity:	50%
	π/4-DQPSK(2Mbps)– 00/39/78 CH	Test Voltage:	DC 3.7V

# 00 CH



## 39 CH

RL		RF	50 Q /	AC	S	ENSE:PULSE	A	LIGN AUTO		03:30:	51 PM Apr 07, 202
enter	Fre	eq 12.	515000		PNO: Fast Gain:Low	Trig: Free F #Atten: 30 d	lun IB	Avg Type	: Log-Pwr		TYPE MWWW DET P P P P
dB/di			fset 0.5 di .09 dBn								2.452 GH .912 dBi
		<b>(</b> 1									
9											
9											-19.51 d
_		-									
		-0	2 Y			-		mm		manuman	man
, <b> </b>	<u> ۲۰</u> ۰۰ در طور	North	Man mar	and a second and a s	mangaber	menersonon	www				
-				-					_		
-										-	
rt 3		lz 00 kH	z		#VE	W 300 kHz			Sw	Sto eep 2.386	o 25.00 GI s (1001 pi
MODE	EL TRC	SCL		×	Y	FUNC	TION FUNC	TION WIDTH		FUNCTION VALUE	· ·
NN	1	f		2.452 GHz 2.677 GHz		dBm	1				
NN	1	f		4.075 GHz 24.700 GHz		dBm					
IN	1	1		24.700 GHZ	-47.904	abm					
								STATUS			>

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Π



## 78 CH

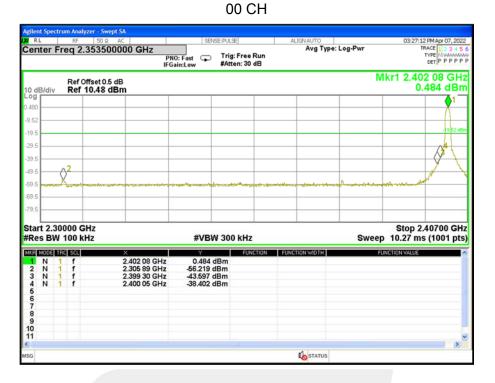
۲L.		RF	50 Q AC		SEI	VSE:PULSE	ALI	IGN AUTO		03:32:	53 PM Apr 07, 20
nter	Fre	q 12.5	5150000		NO: Fast	Trig: Free Run		Avg Type	: Log-Pwr		TYPE MWWW
					Sain:Low	#Atten: 30 dB					DET P P P P
dB/div			et 0.5 dB 4 <b>dBm</b>								2.477 GI 2.563 dB
		<b>(</b> 1									
6 —		_									
		+									-19.97 (
5 <b> </b>		-		3							
		2	Y								
		- Sear		manderly	www.entres	mulanter	mo	ala marken	mar	and the second	www.wer
es BV		z )0 kHz			#VB	W 300 kHz			Sw	Sto eep 2.386	p 25.00 G s (1001 p
MODE	TRC		×		Y	FUNCTION	FUNCT	ION WIDTH		FUNCTION VALUE	
NNNN	1 1 1	f f f		2.477 GHz 2.502 GHz 4.949 GHz 24.276 GHz	-2.563 -56.042 -42.943 -47.909	dBm dBm					
	-										



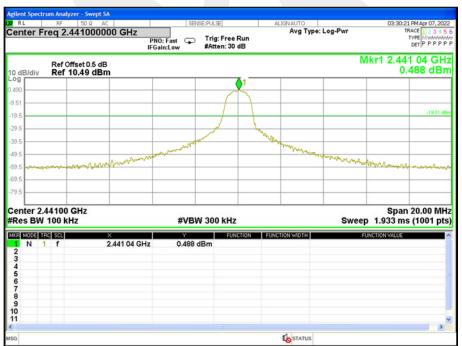
Shenzhen STS Test Services Co., Ltd.



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



39 CH



Shenzhen STS Test Services Co., Ltd.



## 78 CH

nter Freq 2.48750000		SENSE:PULSE	ALIGN AUTO Avg Type: Log-P	03:32:22 PM Apr 07, 20
iter Freq 2.48750000	PNO: Fast IFGain:Low	Trig: Free Run #Atten: 30 dB	nig 196. 2091	TYPE MWWW DET P P P
Ref Offset 0.5 dB				Mkr1 2.480 050 G 0.033 dE
	1			
				.19.97
				-19.97
	Window O2	2		
		)°		
		mannen		an mar
0				
rt 2.47500 GHz es BW 100 kHz	#	VBW 300 kHz		Stop 2.50000 G Sweep 2.400 ms (1001 p
MODE TRC SCL		Y FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
N 1 f 24 N 1 f 24	483 500 GHz -49 484 125 GHz -50	033 dBm 853 dBm 064 dBm 398 dBm		



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## For Hopping Band edge

## π/4-DQPSK

	rum Analyzer - Si							
enter F			NO: Fast	:PULSE Trig: Free Run #Atten: 30 dB	ALIGN AUTO Avg Type:	Log-Pwr	TR. T	PM Apr 07, 202 ACE 1 2 3 4 5 YPE MWWWWW DET P P P P P
0 dB/div	Ref Offset 0 Ref 9.52 (					MI	kr1 2.403 -0.4	000 GH: 183 dBn
.48								1
0.5								-20.48 dB
0.5								-20,46 dp
0.5								
0.5							2	- di
1.5	wednessewher	en ser and the service of the	المرواد المحمد المراجع المراجع	manulan	mansenser	nat contraction	manthe	n. Mil
0.5								
							Stop 2.4	0300 GH
tart 2.3	0000 GHz							
	0000 GHz / 100 kHz		#VBW	300 kHz		Sweep	9.867 ms	(1001 pts
Res BW	100 kHz	X	Y	FUNCTION	FUNCTION WIDTH		0 9.867 ms	(1001 pts
Res BW 7000000000000000000000000000000000000	100 kHz	2:403 000 GHz 2:390 022 GHz 2:400 013 GHz	a	FUNCTION	FUNCTION WIDTH		9.867 ms	(1001 pt:
Res BW	/ 100 kHz RC SCL 1 f 1 f	2.403 000 GHz 2.390 022 GHz	-0.483 dE -58.748 dE	FUNCTION	FUNCTION WADTH		9.867 ms	(1001 pts

	F 50 Q AC		SENSE:PI	JLSE	ALIGN AUTO	e: Log-Pwr	03:56:16 PM Apr 07, TRACE 1 2 3
iter Freq	2.48950000	PN	0: Fast 😱 Ti ain:Low #4	rig: Free Run Atten: 30 dB	Avg Typ	e: Log-rwr	TYPE MWW DET P P
	ef Offset 0.5 dB ef 9.92 dBm					M	kr1 2.480 050 G -0.080 dl
$\sim$							
							-20.0
L	MARA.						
L	- VI WANNA	10 <sup>2</sup>					
		Waymar and	monnoh	m	mmm	m	with my have
-							
	-						
							Stop 2.50000 0
rt 2.47900	GHz						p 2.067 ms (1001
			#VBW 3	00 kHz		Swee	p 2.007 ms (1001
S BW 100	) kHz	×	Y	FUNCTION	FUNCTION WIDTH		UNITION WALUE
SBW 100 MODE TRO SO N 1 f N 1 f	2.4 2.4 2.4 2.4	480 050 GHz 483 515 GHz	-0.080 dBm -57.716 dBm	FUNCTION	FUNCTION WIDTH		
N 1 F	2.4 2.4 2.4 2.4	480 050 GHz	Y -0.080 dBm	FUNCTION	FUNCTION WIDTH		
SBW 100 MODE TRO SO N 1 f	2.4 2.4 2.4 2.4	480 050 GHz 483 515 GHz	-0.080 dBm -57.716 dBm	FUNCTION	FUNCTION WIDTH		
SBW 100 MODE TRO SO N 1 f	2.4 2.4 2.4 2.4	480 050 GHz 483 515 GHz	-0.080 dBm -57.716 dBm	FUNCTION	FUNCTION WIDTH		
SBW 100 MODE TRO SO N 1 f	2.4 2.4 2.4 2.4	480 050 GHz 483 515 GHz	-0.080 dBm -57.716 dBm	FUNCTION	FUNCTION WIDTH		
N 1 f	2.4 2.4 2.4 2.4	480 050 GHz 483 515 GHz	-0.080 dBm -57.716 dBm	FUNCTION	FUNCTION WIDTH		



# Page 44 of 73 Report No.: STS2204018W01

Temperature:	<b>25</b> ℃	Relative Humidity:	50%
Test Mode:	8DPSK(3Mbps) -00/39/78 CH	Test Voltage:	DC 3.7V

RL			RF	50	Ω A0			SEN	ISE:PULSE		AL	IGN AUTO			03:59:00 P	M Apr 07, 2022
ent	er	Fre	eq 1	2.515	5000	000 GHz		] ast 🖵 Low	Trig: Fre #Atten: 3	e Run 0 dB		Avg Ty	pe: Log-Pwr		TV	CE 12345 PE MWWWW ET P P P P P
) dE	Idis			Offset ( 8.67										MI		102 GHz 77 dBm
<sup>pg</sup>	// 6// 1			1	<b>aB</b> <i>iii</i>											
.33			Ť													
1.3										-						-19.65 dBr
1.3																
1.3					^3											. 4
1.3				2	Υ					-						Ô.
1.3				$\geq$		have			مىرىنى مەرىپى مەلمەرمەدىمەم	hund	and the second	mount	man	marker	- and the second	a service
1.3	لرجير	ليشعرن	human		والعسورامة		- Marcana	er anna	and a start of the	-			_			
1.3	_						-			-			_			
1.3																
		) MI W 1	Hz 00 k	Hz				#VB\	V 300 kH	z			s	weep 2	Stop 2 .386 s (	5.00 GHz 1001 pts
		TRC	SCL			X		Y		INCTION	FUNCT	TION WIDTH		FUNCTION	VALUE	1
2 3	N N N	1	f f f			2.402 G 2.552 G 4.000 G	Hz Hz	-0.177 -56.436 -43.446	dBm dBm							
5	N	1	f			24.301 G	Hz	-48.020	dBm							
3																
																>
												<b>K</b> STATUS				

# 00 CH

## 39 CH

-		RF	50 Q AC	SENSE:	PULSE	ALIGN AUTO		04:01:01	PM Apr 07, 202
ente	er Fr	eq 1	2.515000000 GHz		Trig: Free Run Atten: 30 dB	Avg Type: L	.og-Pwr	TF	TYPE MUMMUM DET P P P P P
0 dB/	div		Offset 0.5 dB 9.55 dBm						.452 GH 450 dBr
<sup>og</sup>		~	1						
10.5 -									-19.58 dt
0.5		_							
0.5			3						
0.5		_	.2						- O
0.5		_				mummen	مليون مالا معرب يعليه	and the second police	man
0.5 🗖	No.	ممم	and the second and the second s	resolder and when the second					
0.5									
30.5 -									
tart	30 N	1H7						Stop	25.00 GH
		100	KHz	#VBW 3	300 kHz		Swe	ep 2.386 s	(1001 pt
Res KR MO	BW	100	×	Y	FUNCTION	FUNCTION WIDTH			: (1001 pt
Res	BW DE TO	100	× 2.452 Gł	Hz -0.450 dBr	FUNCTION	FUNCTION WIDTH		ep 2.386 s	i (1001 pt
Res 1 N 2 N 3 N		100   f f	× 2.452 Gł 3.151 Gł 4.874 Gł	Hz -0.450 dBr Hz -55.812 dBr Hz -41.134 dBr	FUNCTION m m	FUNCTION WIDTH		ep 2.386 s	: (1001 pt
Res 1 N 2 N 3 N 4 N 5		100   100   100   100	× 2.452 Gł 3.151 Gł	Hz -0.450 dBr Hz -55.812 dBr Hz -41.134 dBr	FUNCTION m m	FUNCTION WIDTH		ep 2.386 s	: (1001 pt
Res 1 N 2 N 3 N 4 N 5		100   f f	× 2.452 Gł 3.151 Gł 4.874 Gł	Hz -0.450 dBr Hz -55.812 dBr Hz -41.134 dBr	FUNCTION m m	FUNCTION WIDTH		ep 2.386 s	: (1001 pt
Res 1 N 2 N 3 N 4 N 5		100   f f	× 2.452 Gł 3.151 Gł 4.874 Gł	Hz -0.450 dBr Hz -55.812 dBr Hz -41.134 dBr	FUNCTION m m	FUNCTION WIDTH		ep 2.386 s	: (1001 pt
Res 1 N 2 N 3 N 4 N 5 6 7 8 9 0		100   f f	× 2.452 Gł 3.151 Gł 4.874 Gł	Hz -0.450 dBr Hz -55.812 dBr Hz -41.134 dBr	FUNCTION m m	FUNCTION WIDTH		ep 2.386 s	: (1001 pt
Res 1 N 2 N 3 N 4 N		100   f f	× 2.452 Gł 3.151 Gł 4.874 Gł	Hz -0.450 dBr Hz -55.812 dBr Hz -41.134 dBr	FUNCTION m m	FUNCTION WIDTH		ep 2.386 s	: (1001 pt

П



## 78 CH

Ient Spectrum Analyzer - S RL RF SD	wept SA Ω AC	SENSE:PULSE		ALIGNAUTO		04:03:40 PM Apr 07, 2
enter Freq 12.515	5000000 GHz		ree Run 30 dB	Avg Type: L	og-Pwr	TRACE 1234 TYPE WWWW DET P P P
Ref Offset 0						Mkr1 2.477 GI -0.249 dB
25						
).3						-20.13
0.3						
	A3					
1.3 1.3		and a life from the load	and	and and a stand and a stand	- July market	and the second and the second s
).3			-			
1.3			_			
art 30 MHz Res BW 100 kHz		#VBW 300 k	Hz		Sweep	Stop 25.00 G 2.386 s (1001 p
R MODE TRC SCL	×	Y	FUNCTION FU	NCTION WIDTH	FUNC	TION VALUE
N 1 f 2 N 1 f 3 N 1 f 4 N 1 f 5 5 7	2.477 GHz 2.652 GHz 4.874 GHz 24.351 GHz	-0.249 dBm -56.411 dBm -54.965 dBm -47.513 dBm				
3 9 0						
				41 1		1.0
3				STATUS		

Shenzhen STS Test Services Co., Ltd.





#### For Band edge(it's also the reference level for conducted spuriousemission)

	ctrum Ar	nalyzer - Swept SA				
X RL	Ri			ISE:PULSE	ALIGN AUTO	03:58:30 PM Apr 07, 2022
Center	Freq	2.353500000 GH	PNO: Fast IFGain:Low	Trig: Free Run #Atten: 30 dB	Avg Type: Lo	g-Pwr TRACE 12345 TYPE MWWWWW DET P P P P P
10 dB/div	Re Re	f Offset 0.5 dB ef 10.35 dBm				Mkr1 2.402 08 GHz 0.346 dBm
						<b>≬</b> 1
).350						n i n
9.65						-19.65 dBr
-19.7						- 1905 000
29.7						
-39.7	-					
49.7						
59.7	arter	of encoderated as a set of the se				and a second and the
69.7						
79.7						
Start 2.3 #Res BV			#VB	V 300 kHz		Stop 2.40700 GH Sweep 10.27 ms (1001 pts
MKR MODE			Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1 N 2 N		2.402 08 2.306 10				
3 N	1 f	2.399 40	GHz -43.503 (	dBm		
4 N 5	1 f	2.400 05	GHz -39.127	dBm		
6						
8						
2 N 3 4 5 6 7 8 9 10						
11						
¢					41	>
SG					STATUS	

#### 00 CH

39 CH





## 78 CH

	RF	50 Q AC		SE	NSE:PULSE	ALIGN AUTO			M Apr 07, 20
ter Fi	req 2.4	48750000	F	PNO: Fast 😱 Gain:Low	Trig: Free Run #Atten: 30 dB	Avg Type: Lo	og-Pwr	TRA TY D	CE 1 2 3 4 PE MWAAW ET P P P P
B/div		ffset 0.5 dB 0.87 dBm					Mk	1 2.480 1 -0.1	00 GH 33 dB
			<mark>ן 1</mark>						
									-20.13 d
<u> </u>		and	h						
	my	and a	JAN A	$\sqrt{2}^{3}$					
VANA				- Carlor	manna				
-									
	500 GI 100 kH			#VB	W 300 kHz		Sweep	Stop 2.5 2.400 ms (	
MODE TH		×		N 100		FUNCTION WIDTH	FUN	ICTION VALUE	
N 1 N 1 N 1 N 1	f f f	2.4	80 100 GHz 83 500 GHz 84 000 GHz 92 175 GHz	-0.133 -49.125 -51.100 -58.148	dBm dBm				
					1				>
						TATUS			



Shenzhen STS Test Services Co., Ltd.



## For Hopping Band edge

8DPSK

		er - Swept SA								
enter F	<sup>RF</sup> req 2.3	50 Q AC		PNO: Fast G FGain:Low	Trig: Free #Atten: 3		ALIGN AUTO Avg Typ	e: Log-Pwr		7 PM Apr 07, 202 RACE 1 2 3 4 5 TYPE MWWW DET P P P P F
) dB/div		fset 0.5 dB <b>.58 dBm</b>						N	1kr1 2.402 -0.	794 GH 423 dBr
.42										
0.4										-20.42 d
).4										
.4										Ŷ
).4 ).4	num	man	and a second sub-	umpeles	man	woman	more allerand	une-mound	manual	mush
0.4										-
.4										
	100 GH			#V	BW 300 kH	z		Swe	Stop 2. ep 9.867 m	.40300 GH s (1001 pt
R MODE T	RC SCL	2/	102 794 GHz	-0.42	3 dBm	NCTION	FUNCTION WIDTH		FUNCTION VALUE	
2 N 3 N	† †	2.3	890 022 GHz 100 013 GHz	-58.05	0 dBm 7 dBm					
3										
										>

L RF 50 Ω AC	SENSE:PULS	ε	ALIGN AUTO	05:08:47 PM Apr	
iter Freq 2.489500000 GHz	PNO: Fast 🖵 Trig IFGain:Low #Atto	: Free Run en: 30 dB	Avg Type: Log-F	Pwr TRACE 1 TYPE M DET P	234 PPP
Ref Offset 0.5 dB IB/div Ref 9.64 dBm				Mkr1 2.479 126 -0.357	
mon					
					20.36 d
h					
	3				
TPI MININA DAMA &					
1.1.1.0.0.4.4.M	Marrow war	- marine	mannon	Mr. marman	
rt 2.47900 GHz	#VBW 300	) kHz		Stop 2.5000 Sweep 2.067 ms (100	
rt 2.47900 GHz Is BW 100 kHz MODE TRO SCL X	Y		FUNCTION WIDTH		
rt 2.47900 GHz s BW 100 kHz	z -0.357 dBm z -50.908 dBm		FUNCTION WIDTH	Sweep 2.067 ms (100	
N 1 f 2.479 126 GHz N 1 f 2.483 515 GHz	z -0.357 dBm z -50.908 dBm		FUNCTION WIDTH	Sweep 2.067 ms (100	
rt 2.47900 GHz s BW 100 kHz N 1 f 2.479 126 GHz N 1 f 2.433 515 GHz	z -0.357 dBm z -50.908 dBm		FUNCTION WIDTH	Sweep 2.067 ms (100	
rt 2.47900 GHz s BW 100 KHz N 1 f 2.479 126 GHz N 1 f 2.433 515 GHz	z -0.357 dBm z -50.908 dBm		FUNCTION WIDTH	Sweep 2.067 ms (100	
rt 2.47900 GHz s BW 100 KHz N 1 f 2.479 126 GHz N 1 f 2.433 515 GHz	z -0.357 dBm z -50.908 dBm		FUNCTION WIDTH	Sweep 2.067 ms (100	



# 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

- 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= 300KHz, 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

Temperature:	<b>25</b> ℃	Relative Humidity:	60%
Test Mode:	Hopping Mode -GFSK Mode	Test Voltage:	DC 3.7V

## Number of Hopping Channel

79

## Hopping channel

RL	R			SENSE:PU	LSE	ALIGNAUTO			15 PM Apr 07, 20
enter	Freq	2.44175000	PNO:	Fast Tr n:Low #A	ig: Free Run tten: 30 dB	Avg Typ	e: Log-Pwr	1	TYPE MWMM DET P P P P
) dB/div		f Offset 0.5 dB f 12.16 dBm					Mkr	2 2.479 9	93 0 GH 1.72 dB
99   .16   .84   7.8   7.8   7.8   7.8   7.8   7.8   7.8   7.8   7.8   7.8   7.8   7.8   7.8	1 YYYY 								2 //////
7.8 7.8 tart 2.4 Res BV	N 300	kHz		#VBW 30				p 1.133 m	.48350 Gi s (1001 pi
2 N 2 N 3 4 5 6 6 7 8 9 9 0 1	1 f	2.40	2 087 5 GHz 9 993 0 GHz	2.06 dBm 1.72 dBm		FUNCTION WIDTH		FUNCTION VALUE	

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# 6. AVERAGE TIME OF OCCUPANCY

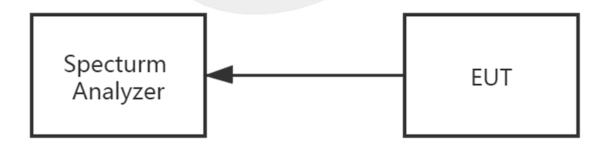
## 6.1 LIMIT

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.
- Set the center frequency on any frequency would be measure and set the frequency span to e. zero span.
- f. Measure the maximum time duration of one single pulse.
- g. Set the EUT for DH5, DH3 and DH1 packet transmitting.
- $\tilde{h}$ . 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). So the number of pulses in the observation period of 31.6 seconds is 3.37 x 31.6 = 106.6.
- j. 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 number of pulses in the observation period of 31.6 seconds is 5.06 x 31.6 = 160.
- 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 number of pulses in the observation period of 31.6 seconds is 10.12 x 31.6 = 320.

6.3 TEST SETUP



6.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.



## 6.5 TEST RESULTS

Temperature:	<b>25</b> ℃	Relative Humidity:	50%
Test Mode:	GFSK/ π/4-DQPSK/ 8DPSK	Test Voltage:	DC 3.7V

Modulation	Pocket Type	Frequency (MHz)	Single Pulse Time (ms)	Dwell Time (s)	Limit (s)	Result
	DH1	2441	0.373	0.119	0.4	Pass
GFSK	DH3	2441	1.629	0.261	0.4	Pass
	DH5	2441	2.876	0.307	0.4	Pass
	2DH1	2441	0.382	0.122	0.4	Pass
π/4DQPSK	2DH3	2441	1.633	0.261	0.4	Pass
	2DH5	2441	2.880	0.307	0.4	Pass
	3DH1	2441	0.382	0.122	0.4	Pass
8DPSK	3DH3	2441	1.632	0.261	0.4	Pass
	3DH5	2441	2.884	0.308	0.4	Pass

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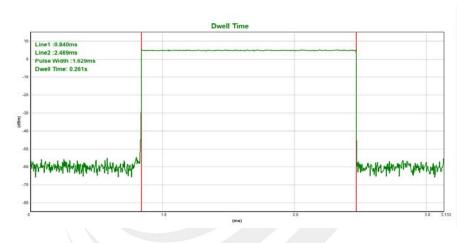


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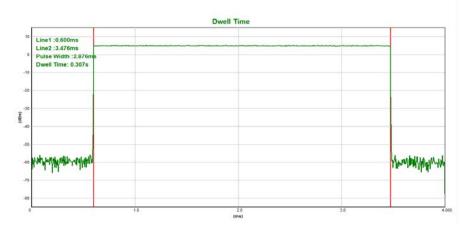
## CH39-DH1



## CH39-DH3



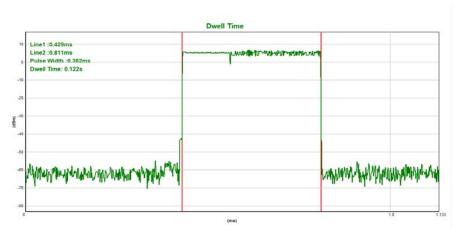




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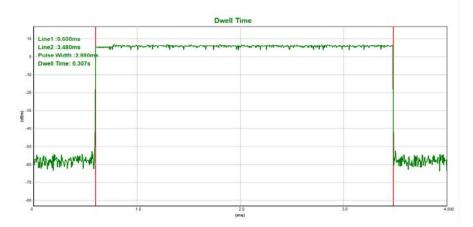
## CH39-2DH1







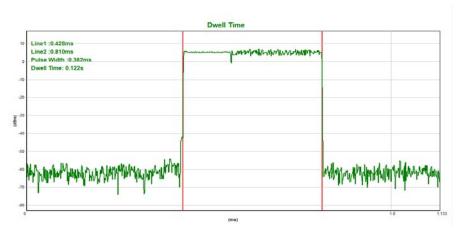




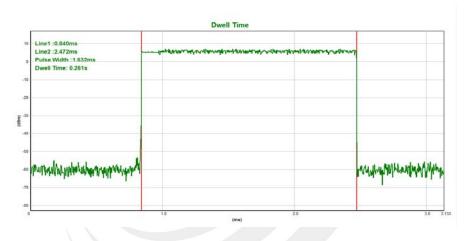
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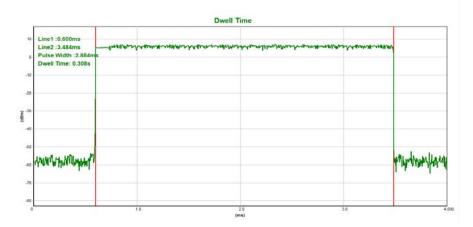
## CH39-3DH1



## CH39-3DH3







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# 7. HOPPING CHANNEL SEPARATION MEASUREMEN

7.1 LIMIT

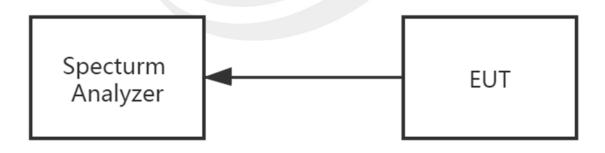
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that 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:	<b>25</b> ℃	Relative Humidity:	50%
Test Mode:	GFSK/π/4-DQPSK/8DPSK	Test Voltage:	DC 3.7V

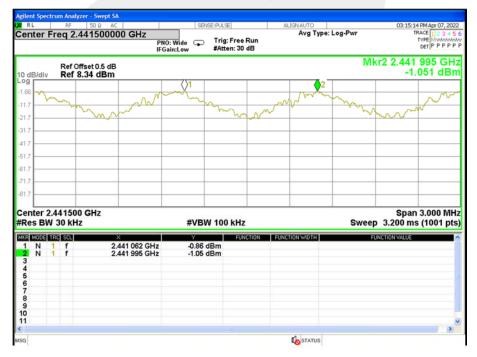
Modulation	Frequency (MHz)	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)	Result
	2402	2401.978	2402.998	1.020	0.685	Pass
GFSK	2441	2441.062	2441.995	0.933	0.686	Pass
	2480	2478.996	2480.067	1.071	0.686	Pass
	2402	2401.819	2402.983	1.164	0.903	Pass
π/4DQPSK	2441	2440.875	2441.989	1.114	0.903	Pass
	2480	2478.993	2480.067	1.074	0.902	Pass
	2402	2402.128	2403.112	0.984	0.898	Pass
8DPSK	2441	2441.140	2442.109	0.969	0.895	Pass
	2480	2479.113	2480.142	1.029	0.896	Pass



#### CH00 -1Mbps



#### CH39 -1Mbps



Shenzhen STS Test Services Co., Ltd.



## CH78 -1Mbps



#### CH00 -2Mbps

		er - Swept SA						
enter Fr	⊮ req 2.4		): Wide - Trig ain:Low #Att	≡ :Free Run en:30 dB	ALIGN AUTO Avg Type	≥: Log-Pwr		8 PM Apr 07, 20 RACE 1 2 3 4 TYPE MWWW DET P P P P
) dB/div		fset 0.5 dB . <b>64 dBm</b>				Μ	kr2 2.402 -4	983 GH 836 dB
36 5.4		mannin		m	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	u	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	www
5.4 5.4 5.4	$\sim$							
i.4 i.4								
enter 2.4	102500	GH7					Spar	1 3.000 MI
Res BW			#VBW 100	) kHz		Swee	p 3.200 m	
E MODE TR 1 N 1 2 N 1 3	f f	X 2.401 819 GHz 2.402 983 GHz	4.70 dBm -4.84 dBm	FUNCTION	FUNCTION WIDTH		FUNCTION VALUE	
5 7 8 9								
1								>
G					10 STATUS			

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#### CH39 -2Mbps

nter F	req	50 Q AC   2.441500000 GH		NSE:PULSE	ALIGN AUTO		03:47:38 PM Apr (	
		2.441500000 GH	Z PNO: Wide IFGain:Low	Trig: Free Run #Atten: 30 dB	Avg Type:	Log-Pwr	TRACE 12 TYPE MY DET P P	
dB/div		Offset 0.5 dB f 5.36 dBm				Mki	2 2.441 989 -4.607	
4			Q1		2			
6 m	$\sim$	m	w march	m	en march	mm	m	$\sim$
6								
6								
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nter 2. es BW		00 GHz Hz	#VB	W 100 kHz		Sweep	Span 3.000 3.200 ms (100	) MH
MODE T	RC SCL		Y		FUNCTION WIDTH	FUN	CTION VALUE	
NN		2.440 876 2.441 989						
					<b>STATUS</b>			>

#### CH78 -2Mbps



Shenzhen STS Test Services Co., Ltd.

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#### CH00 -3Mbps

Spectrum Analyzer - Swept SA RF 50 Q AC	SENSE:PULSE	ALIGNAUTO	04:57:31 PM Apr
	): Wide Trig: Free Run ain:Low #Atten: 30 dB	Avg Type: Log-Pwr	TRACE 1 TYPE M DET P
Ref Offset 0.5 dB /div Ref 4.32 dBm		Μ	kr2 2.403 112 -4.251
- mmmmm		man 22 m	mm
			un in
n. M			
1			
er 2.402500 GHz BW 30 kHz	#VBW 100 kHz	Swee	Span 3.00 p 3.200 ms (100
ODE TRC SCL	Y FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
N 1 f 2.402 128 GHz N 1 f 2.403 112 GHz	-4.23 dBm -4.25 dBm		
		<b>K</b> STATUS	

## CH39 -3Mbps

gilent Spectrum Analyze	er - Swept SA						
RL RF	50 Q AC	SENSE:PULS		ALIGN AUTO			PM Apr 07, 202
enter Freq 2.4	41500000 GHz PNO IFGa	): Wide 🖵 Trig: ain:Low #Atte	Free Run m: 30 dB	Avg Type:	Log-Pwr		ACE 1 2 3 4 5 YPE MWWW DET P P P P F
	set 0.5 dB 35 dBm				Mk	r2 2.442 -4.(	109 GH 070 dBi
og	55 dBm	()1			<b>2</b>		
.65	- mmw	mar and		mm	-		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
4.7	when a marked when the		Vmvr v -		~ ~	Mr. M. M. M.	
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4.7							
4.7							
4.7							
151				<u>(</u>			
enter 2.441500 Res BW 30 kHz	GHz	#VBW 100	kHz		Sweep	Span 3.200 ms	3.000 Mi (1001 pt
R MODE TRC SCL	×	Y	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
1 N 1 f 2 N 1 f	2.441 140 GHz	-4.37 dBm					
2 N 1 f 3	2.442 109 GHz	-4.07 dBm					
4							
5 5 7							
8 9							
0							
1							
							>
G				STATUS			

Shenzhen STS Test Services Co., Ltd.



## CH78 -3Mbps

RL		RF	50 Q AC		SEN	ISE:PULSE		ALIGN AUTO		05:02:0	4 PM Apr 07, 202
enter	Fre	eq 2.	479500000	PNO	:Wide 🖵	Trig: Fre #Atten: 3		Avg Type	: Log-Pwr	т	RACE 12345 TYPE MWWW DET PPPPP
dB/di	v		offset 0.5 dB 5.41 dBm						M	1kr2 2.480 -4.	142 GH 953 dBn
59	m				()1			0 M -	2		
4.6	- 1	$\sim$	m	June	www.ww		-m	www.w.w.	- mar	m	
4.6											
.6											M
.6											
.6											
4.6											
enter Res B			0 GHz Iz		#VB\	N 100 kH	z		Swee	span sp 3.200 m	s (1001 pts
R MODE	TRO		×		Y		NCTION	FUNCTION WIDTH		FUNCTION VALUE	_
1 N 2 N 3 4	1	f		9 113 GHz 0 142 GHz	-4.40 -4.95	dBm dBm					
5 5 7 8											
Ď											>
3								STATUS			



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# 8. BANDWIDTH TEST

## 8.1 LIMIT

FCC Part15 15.247,Subpart C						
Section	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

Temperature:	<b>25</b> ℃	Relative Humidity:	50%
Test Mode:	GFSK/π/4-DQPSK/8DPSK	Test Voltage:	DC 3.7V

Modulation	Frequency (MHz)	-20 dB Bandwidth (MHz)	Result
	2402	1.028	Pass
GFSK	2441	1.029	Pass
	2480	1.029	Pass
	2402	1.354	Pass
π/4DQPSK	2441	1.355	Pass
	2480	1.353	Pass
	2402	1.347	Pass
8DPSK	2441	1.343	Pass
	2480	1.344	Pass



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#### CH00 -1Mbps



CH39 -1 Mbps



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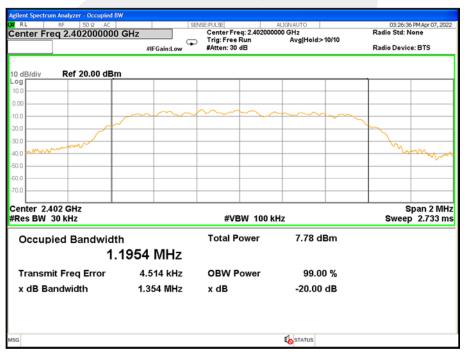


#### CH78 -1Mbps



#### CH00 -2Mbps

**K**STATUS



Shenzhen STS Test Services Co., Ltd. Tel: +86-755 3688 6288 Fax: +86-755 3688 6277 Http://www.stsapp.com E-mail: sts@stsapp.com

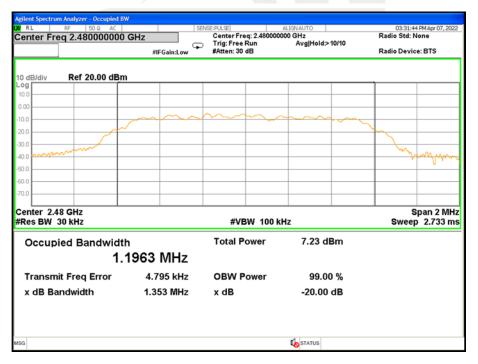


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#### CH39 -2Mbps

RL RF 50 Q AC	S	ENSE:PULSE	ALIGNAUTO	03:29:48 PM Apr 07, 2022	
enter Freq 2.441000000 GHz		Center Freq: 2.4410000		Radio Std: None	
	#IFGain:Low	Trig: Free Run #Atten: 30 dB	Avg Hold>10/10	Radio Device: BTS	
0 dB/div Ref 20.00 dBm					
0.0					
.00		mon			
0.0					
0.0					
0.0 anone market				mon	
0.0				· · · · ·	
0.0					
0.0					
enter 2.441 GHz				Span 2 MH	
Res BW 30 kHz		#VBW 100 kHz		Sweep 2.733 m	
Occupied Bandwidth	ı	<b>Total Power</b>	7.79 dBm		
1.1	1938 MHz				
Transmit Freq Error	4.784 kHz	<b>OBW Power</b>	99.00 %		
x dB Bandwidth	1.355 MHz	x dB	-20.00 dB		
G			STATUS		

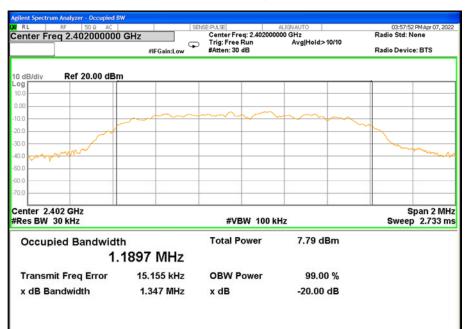
#### CH78 -2Mbps



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#### CH00 -3Mbps



#### CH39 -3Mbps

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## CH78 -3Mbps

Agilent Spectrum Analyzer - Occupied BV XI RL RF 50 Ω AC		NSE:PULSE	ALIGN AUTO	04:02:32 PM Apr 07, 2022
Center Freq 2.48000000	GHz #IFGain:Low	Center Freq: 2.480000 Trig: Free Run #Atten: 30 dB		Radio Std: None Radio Device: BTS
10 dB/div Ref 20.00 dBm	۱ <u> </u>			
10.0				
0.00				
10.0	~~~~~~			~
30.0				
40.0 www.www.				- marine and a second
-50.0				
60.0		· · · · ·		
-70.0				
Center 2.48 GHz #Res BW 30 kHz		#VBW 100 k	Hz	Span 2 MHz Sweep 2.733 ms
Occupied Bandwidth	n	Total Power	7.32 dBm	
	1892 MHz			
Transmit Freq Error	15.505 kHz	OBW Power	99.00 %	
x dB Bandwidth	1.344 MHz	x dB	-20.00 dB	
X dB Bandwidth	1.344 WHZ	хав	-20.00 dB	
			4	
ISG			STATUS	



# 9. OUTPUT POWER TEST

## 9.1 LIMIT

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

## 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  $\geq$  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.

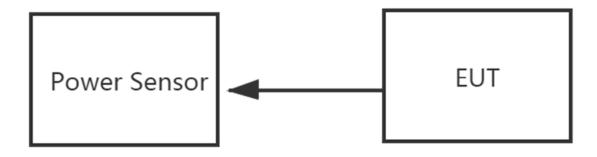
e) A plot of the test results and setup description shall be included in the test report.

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.

Shenzhen STS Test Services Co., Ltd.



## 9.5 TEST RESULTS

Temperature:	<b>25</b> ℃	Relative Humidity:	60%
Test Voltage:	DC 3.7V		

Modulation	Frequency (MHz)	Peak Power (dBm)	Average Power (dBm)	Limit (dBm)
GFSK (1M)	2402	2.87	0.47	20.97
	2441	2.68	0.40	20.97
	2480	2.58	0.28	20.97
π/4-DQPSK (2M)	2402	3.47	-1.04	20.97
	2441	3.58	-0.91	20.97
	2480	3.62	-0.81	20.97
8-DPSK (3M)	2402	3.63	-0.03	20.97
	2441	3.60	-0.23	20.97
	2480	3.50	-0.41	20.97



## 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 Ceramic antenna Antenna. It comply with the standard requirement.



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## **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 \* \* \* \*



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