

# RADIO TEST REPORT

S T S

Report No.: STS2204016W01

Issued for

Shenzhen TwoMonkeys Technology Co.,Ltd.

1201, 12/F, Dachong Building(Shangmei Keji), Yuehai Street, Nanshan District, Shenzhen, China

Product Name:	Dosmono Scanning pen		
Brand Name:	DOSMONO		
Model Name:	C501B		
Series Model:	N/A		
FCC ID:	2A33K-C501B		
Test Standard:	FCC Part 15.247		

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APPROVA

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# **TEST RESULT CERTIFICATION**

Applicant's Name	Shenzhen TwoMonkeys Technology Co.,Ltd.
Address	1201, 12/F, Dachong Building(Shangmei Keji), Yuehai Street, Nanshan District, Shenzhen, China
Manufacturer's Name:	Shenzhen TwoMonkeys Technology Co.,Ltd.
Address	Room 1201, 12 / F, Dachong Building(Shangmei Keji), Dachong Community, Yuehai Street, Nanshan District, Shenzhen, China
Product Description	
Product Name	Dosmono Scanning pen
Brand Name	DOSMONO
Model Name:	C501B
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 ~ 13 Apr. 2022
Date of Issue:	13 Apr. 2022
	_

Test Result ..... Pass

Testing Engineer : Chris Chen (Chris Chen) Technical Manager : Series Chen

Authorized Signatory :

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# **Revision History**

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	13 Apr. 2022	STS2204016W01	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

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# 2. GENERAL INFORMATION

# 2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	Dosmono Scanning pen
Trade Name	DOSMONO
Model Name	C501B
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	4.2
Bluetooth Configuration	BR+EDR
Antenna Type	Please refer to the Note 3.
Battery	Rated Voltage:3.7V Charge Limit Voltage:4.2V Capacity: 1200mAh
Hardware version number	S1208_MB_V1.1
Software version number	V1.0.0
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

А	nt.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
	1	N/A	C501B	PIFA	N/A	0.5 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:

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

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

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

For AC Conducted Emission

Test Case		
AC Conducted Emission	Mode 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.



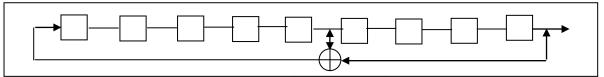
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The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping 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.

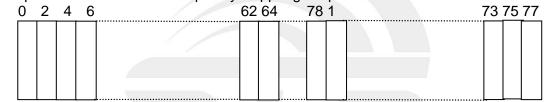
(2)The Pseudorandom sequence may be generated in a nin-stage shift register whose 5<sup>th</sup> and 9<sup>th</sup> stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones: i.e. the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

Numver of shift register stages:9

Length of pseudo-random sequence:2<sup>9</sup>-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 the 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.



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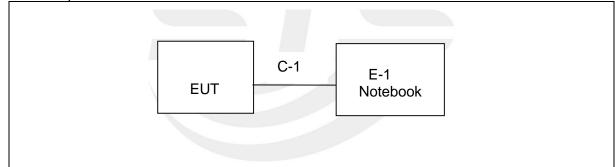
# 2.4 TABLE OF PARAMETERS OF TEST SOFTWARE SETTING

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.

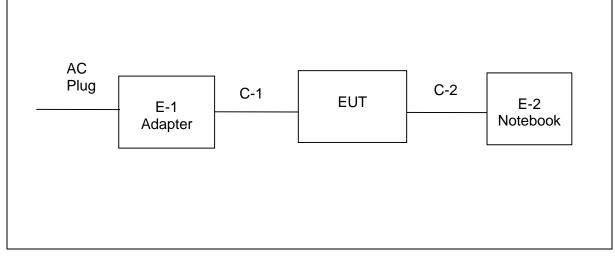
Test software Version	Test program: Bluetooth				
(Power control software) Parameters(1/2/3Mbps)	Power class: DH1 rate:4:27 2DH1 rate:20:54 3DH1 rate:24:83	Power class: DH3 rate:11:183 2DH3 rate:26:367 3DH3 rate:27:552	Power class: DH5 rate:15:339 2DH5 rate:30:679 3DH5 rate:31:1021		

RF Function	Туре	Mode Or Modulation type	ANT Gain(dBi)	Power Class	Software For Testing
		GFSK	0.5	default	
BT	BR+EDR	π/4-DQPSK	0.5	default	Engineering mode
		8DPSK	0.5	default	

# 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. Necessary

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
C-1	USB Cable	N/A	N/A	85cm	NO

# Support units

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
E-2	Notebook	LENOVO	ThinkPad E470	N/A	N/A
C-2	USB Cable	N/A	N/A	150cm	NO
E-1	Adapter	HUAWEI	HW-050450C00	N/A	N/A

Note:

- (1) For detachable type I/O cable should be specified the length in cm in <sup>®</sup> Length <sup></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

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
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	
			U2021XA	MY55520005	2021.09.30	2022.09.29	
	Power Sensor Ke			MY55520006	2021.09.30	2022.09.29	
		Keysight		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.
  - Vertical Reference Ground Plane EUT 40cm EUT 80cm N Horizontal Reference Ground Plane

# 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		

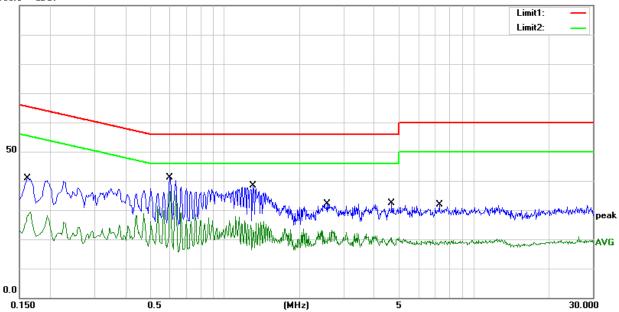
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.1620	20.61	20.33	40.94	65.36	-24.42	QP
2	0.1620	9.15	20.33	29.48	55.36	-25.88	AVG
3	0.6020	20.64	20.44	41.08	56.00	-14.92	QP
4	0.6020	15.99	20.44	36.43	46.00	-9.57	AVG
5	1.3020	18.05	20.30	38.35	56.00	-17.65	QP
6	1.3020	5.90	20.30	26.20	46.00	-19.80	AVG
7	2.5820	11.75	20.33	32.08	56.00	-23.92	QP
8	2.5820	2.74	20.33	23.07	46.00	-22.93	AVG
9	4.6820	12.03	20.44	32.47	56.00	-23.53	QP
10	4.6820	0.20	20.44	20.64	46.00	-25.36	AVG
11	7.2620	11.14	20.64	31.78	60.00	-28.22	QP
12	7.2620	-1.00	20.64	19.64	50.00	-30.36	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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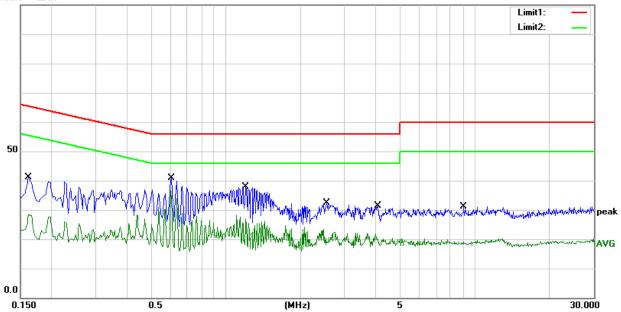
Temperature:	23.2(C)	Relative Humidity:	62%RH
Test Voltage:	AC 120V/60Hz	Phase:	Ν
Test Mode:	Mode 13		

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.1620	19.68	20.32	40.00	65.36	-25.36	QP
2	0.1620	8.95	20.32	29.27	55.36	-26.09	AVG
3	0.6060	20.20	20.43	40.63	56.00	-15.37	QP
4	0.6060	15.53	20.43	35.96	46.00	-10.04	AVG
5	1.2100	17.89	20.31	38.20	56.00	-17.80	QP
6	1.2100	6.57	20.31	26.88	46.00	-19.12	AVG
7	2.6380	12.15	20.43	32.58	56.00	-23.42	QP
8	2.6380	3.29	20.43	23.72	46.00	-22.28	AVG
9	4.6460	10.78	20.52	31.30	56.00	-24.70	QP
10	4.6460	0.16	20.52	20.68	46.00	-25.32	AVG
11	8.9900	9.83	20.81	30.64	60.00	-29.36	QP
12	8.9900	-1.21	20.81	19.60	50.00	-30.40	AVG

#### Remark:

1. All readings are Quasi-Peak and Average values

- 2. Margin = Result (Result = Reading + Factor )-Limit
- 3. Factor=LISN factor+Cable loss+Limiter (10dB)
- 100.0 dBu¥



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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 AVERA	AGE			
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		
Start/Stop Fraguapay	Lower Band Edge: 2310 to 2410 MHz		
Start/Stop Frequency	Upper Band Edge: 2476 to 2500 MHz		
	1 MHz / 3 MHz(Peak)		
RB / 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.

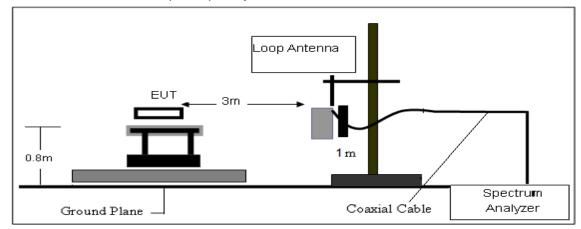
# 3.2.3 DEVIATION FROM TEST STANDARD

No deviation.

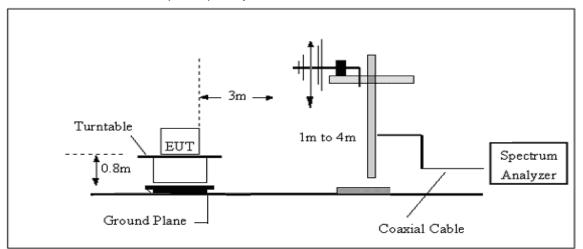


# 3.2.4 TESTSETUP

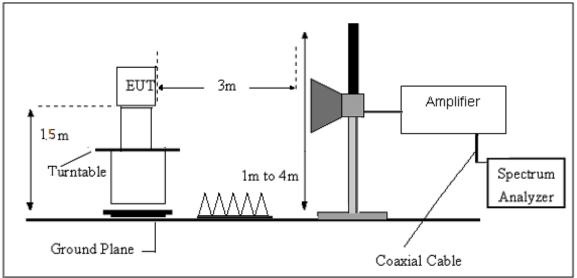
(A) Radiated Emission Test-Up Frequency Below 30MHz

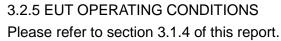


# (B) Radiated Emission Test-Up Frequency 30MHz~1GHz



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







# 3.2.6 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 - AGWhere 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



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# 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.



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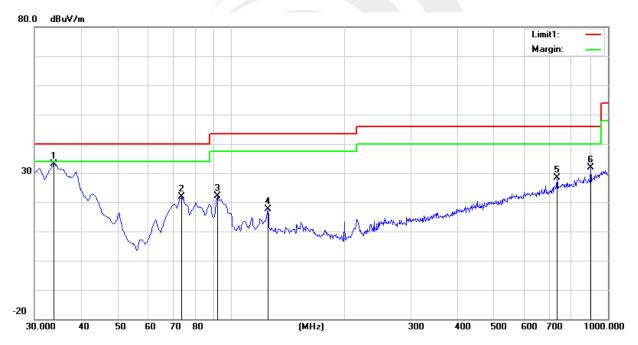
(30MHz-1000MHz)

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 3 worst mode)					

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	33.8800	48.03	-14.80	33.23	40.00	-6.77	peak
2	73.6500	46.07	-24.20	21.87	40.00	-18.13	peak
3	92.0800	43.39	-21.20	22.19	43.50	-21.31	peak
4	125.0600	35.74	-18.22	17.52	43.50	-25.98	peak
5	733.2500	30.84	-2.35	28.49	46.00	-17.51	peak
6	902.0300	32.19	-0.40	31.79	46.00	-14.21	peak

Remark:

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





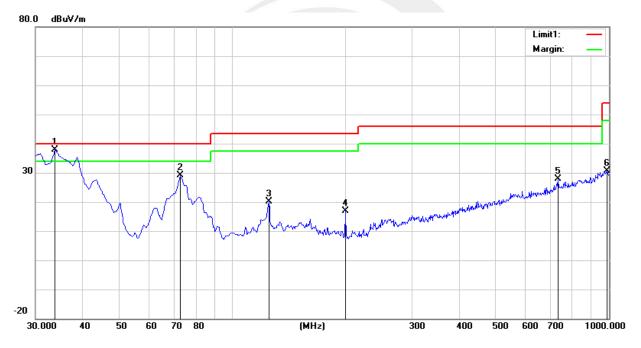
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Temperature:	23.1(C)	Relative Humidity:	60%RH			
Test Voltage:	DC 3.7V	Phase:	Vertical			
Test Mode:	Mode 1/2/3/4/5/6/7/8/9(Mode 3 worst mode)					

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	33.8800	52.66	-14.80	37.86	40.00	-2.14	peak
2	72.6800	53.43	-24.37	29.06	40.00	-10.94	peak
3	125.0600	38.38	-18.22	20.16	43.50	-23.34	peak
4	199.7500	38.08	-21.11	16.97	43.50	-26.53	peak
5	733.2500	30.33	-2.35	27.98	46.00	-18.02	peak
6	988.3600	28.52	2.15	30.67	54.00	-23.33	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	nannel (GFSK/2	2402 MHz)				
3264.76	61.70	44.70	6.70	28.20	-9.80	51.90	74.00	-22.10	PK	Vertical
3264.76	49.96	44.70	6.70	28.20	-9.80	40.16	54.00	-13.84	AV	Vertical
3264.58	62.05	44.70	6.70	28.20	-9.80	52.25	74.00	-21.75	PK	Horizontal
3264.58	50.85	44.70	6.70	28.20	-9.80	41.05	54.00	-12.95	AV	Horizontal
4804.45	59.01	44.20	9.04	31.60	-3.56	55.45	74.00	-18.55	PK	Vertical
4804.45	50.31	44.20	9.04	31.60	-3.56	46.75	54.00	-7.25	AV	Vertical
4804.38	59.51	44.20	9.04	31.60	-3.56	55.95	74.00	-18.05	PK	Horizontal
4804.38	50.08	44.20	9.04	31.60	-3.56	46.52	54.00	-7.48	AV	Horizontal
5359.72	48.54	44.20	9.86	32.00	-2.34	46.20	74.00	-27.80	PK	Vertical
5359.72	40.33	44.20	9.86	32.00	-2.34	37.99	54.00	-16.01	AV	Vertical
5359.64	47.66	44.20	9.86	32.00	-2.34	45.31	74.00	-28.69	PK	Horizontal
5359.64	39.04	44.20	9.86	32.00	-2.34	36.70	54.00	-17.30	AV	Horizontal
7205.90	54.80	43.50	11.40	35.50	3.40	58.20	74.00	-15.80	PK	Vertical
7205.90	44.85	43.50	11.40	35.50	3.40	48.25	54.00	-5.75	AV	Vertical
7205.90	54.80	43.50	11.40	35.50	3.40	58.20	74.00	-15.80	PK	Horizontal
7205.90	44.37	43.50	11.40	35.50	3.40	47.77	54.00	-6.23	AV	Horizontal
				Middle C	Channel (GFSK	(/2441 MHz)				
3264.61	60.95	44.70	6.70	28.20	-9.80	51.15	74.00	-22.85	PK	Vertical
3264.61	51.57	44.70	6.70	28.20	-9.80	41.77	54.00	-12.23	AV	Vertical
3264.59	60.93	44.70	6.70	28.20	-9.80	51.13	74.00	-22.87	PK	Horizontal
3264.59	50.32	44.70	6.70	28.20	-9.80	40.52	54.00	-13.48	AV	Horizontal
4882.35	59.22	44.20	9.04	31.60	-3.56	55.66	74.00	-18.34	PK	Vertical
4882.35	49.39	44.20	9.04	31.60	-3.56	45.83	54.00	-8.17	AV	Vertical
4882.32	59.52	44.20	9.04	31.60	-3.56	55.96	74.00	-18.04	PK	Horizontal
4882.32	49.55	44.20	9.04	31.60	-3.56	45.99	54.00	-8.01	AV	Horizontal
5359.73	48.41	44.20	9.86	32.00	-2.34	46.07	74.00	-27.93	PK	Vertical
5359.73	40.21	44.20	9.86	32.00	-2.34	37.87	54.00	-16.13	AV	Vertical
5359.65	47.41	44.20	9.86	32.00	-2.34	45.07	74.00	-28.93	PK	Horizontal
5359.65	38.24	44.20	9.86	32.00	-2.34	35.90	54.00	-18.10	AV	Horizontal
7323.91	54.80	43.50	11.40	35.50	3.40	58.20	74.00	-15.80	PK	Vertical
7323.91	44.72	43.50	11.40	35.50	3.40	48.12	54.00	-5.88	AV	Vertical
7323.80	54.96	43.50	11.40	35.50	3.40	58.36	74.00	-15.64	PK	Horizontal
7323.80	44.77	43.50	11.40	35.50	3.40	48.17	54.00	-5.83	AV	Horizontal



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				High Char	nnel (GFSK/	2480 MHz)				
3264.81	62.10	44.70	6.70	28.20	-9.80	52.30	74.00	-21.70	PK	Vertical
3264.81	50.31	44.70	6.70	28.20	-9.80	40.51	54.00	-13.49	AV	Vertical
3264.76	60.83	44.70	6.70	28.20	-9.80	51.03	74.00	-22.97	PK	Horizontal
3264.76	50.00	44.70	6.70	28.20	-9.80	40.20	54.00	-13.80	AV	Horizontal
4960.41	58.57	44.20	9.04	31.60	-3.56	55.01	74.00	-18.99	PK	Vertical
4960.41	49.56	44.20	9.04	31.60	-3.56	46.00	54.00	-8.00	AV	Vertical
4960.43	58.34	44.20	9.04	31.60	-3.56	54.78	74.00	-19.22	PK	Horizontal
4960.43	49.76	44.20	9.04	31.60	-3.56	46.20	54.00	-7.80	AV	Horizontal
5359.70	49.19	44.20	9.86	32.00	-2.34	46.84	74.00	-27.16	PK	Vertical
5359.70	40.00	44.20	9.86	32.00	-2.34	37.66	54.00	-16.34	AV	Vertical
5359.63	47.73	44.20	9.86	32.00	-2.34	45.39	74.00	-28.61	PK	Horizontal
5359.63	38.82	44.20	9.86	32.00	-2.34	36.47	54.00	-17.53	AV	Horizontal
7439.76	54.47	43.50	11.40	35.50	3.40	57.87	74.00	-16.13	PK	Vertical
7439.76	44.59	43.50	11.40	35.50	3.40	47.99	54.00	-6.01	AV	Vertical
7439.84	54.81	43.50	11.40	35.50	3.40	58.21	74.00	-15.79	PK	Horizontal
7439.84	44.50	43.50	11.40	35.50	3.40	47.90	54.00	-6.10	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.

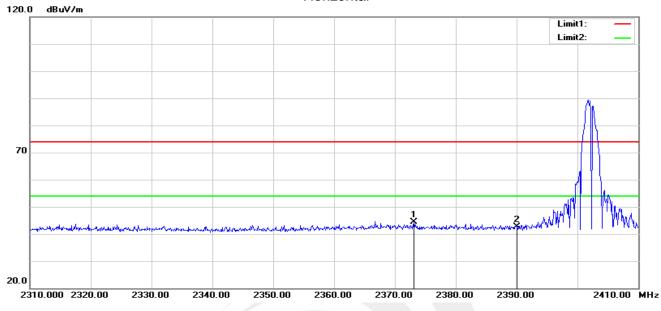


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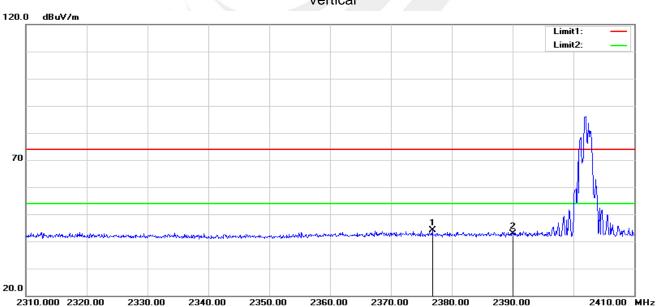


# **Restricted band Requirements**

#### **GFSK-Low** Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2373.100	40.26	4.09	44.35	74.00	-29.65	peak
2	2390.000	38.22	4.34	42.56	74.00	-31.44	peak



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2376.800	39.87	4.14	44.01	74.00	-29.99	peak
2	2390.000	38.59	4.34	42.93	74.00	-31.07	peak

Vertical

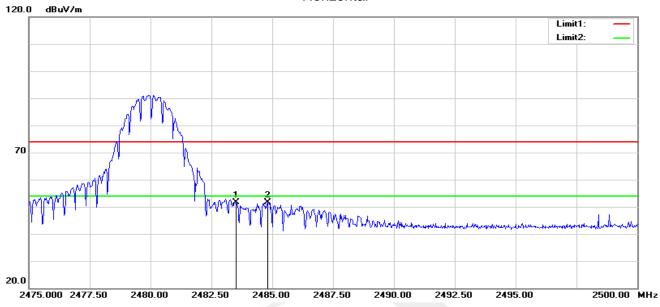
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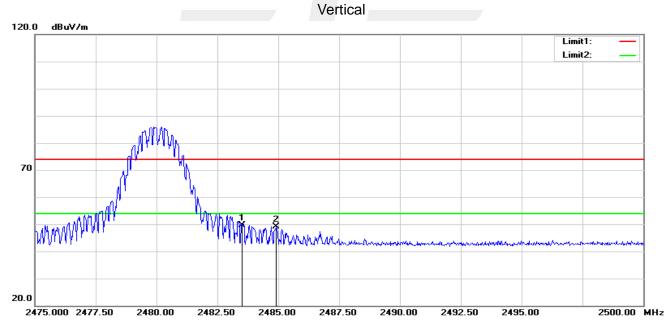
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# **GFSK-High** Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	47.06	4.60	51.66	74.00	-22.34	peak
2	2484.825	46.92	4.61	51.53	74.00	-22.47	peak



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	44.97	4.60	49.57	74.00	-24.43	peak
2	2484.925	44.45	4.61	49.06	74.00	-24.94	peak

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

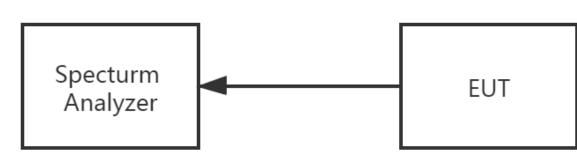
#### For Band edge

Spectrum Parameter	Setting			
Detector	Peak			
Stort/Stop Eroguopou	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/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			





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

# 4.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.



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# 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

gilent Spectrum Analyzer - Swi RL RF 50 Ω						01.45.00	
enter Freq 12.5150			Free Run n: 30 dB	ALIGN AUTO Avg Type	: Log-Pwr	TR	9 PM Apr 03, 20 ACE 1 2 3 4 5 YPE M WWWW DET P P P P F
Ref Offset 0.5						Mkr1 2. 4.	402 GH 758 dBr
4.76							
5.24							-14.46 d
5.2							
5.2							
5.2				ulen war we	hours	mound	Marally Marall
5.2 south and the second line	and the second and th	war have mente	and the second	why John .			
5.2							
tart 30 MHz Res BW 100 kHz		#VBW 300	kHz		Sv	Stop /eep 2.39 s	25.00 GH (1001 pt
KR MODE TRC SCL 1 N 1 f	× 2.402 GHz	¥ 4.758 dBm	FUNCTION	FUNCTION WIDTH	Ħ	JNCTION VALUE	
2 N 1 f 3 N 1 f	3.601 GHz 9.618 GHz	-47.989 dBm -50.738 dBm					
4 N 1 f 5 6	24.725 GHz	-47.493 dBm					
6 7 8							
9							
1 2							
G				STATUS			

# 39 CH

		yzer - Swept SJ	٨							
RL	RF	50 Ω AC			SENSE:INT		ALIGNAUTO			23 PM Apr 03, 2
enter F	req 1	2.515000	Р	NO: Fast 🕞 Gain:Low	Trig: Free   #Atten: 30		Avg Type:	Log-Pwr	Т	RACE 1 2 3 4 TYPE MWWW DET P P P P
0 dB/div		Offset 0.5 dB 15.17 dBn								.452 GH 166 dB
<b>og</b> 5.17		1								
.83										-14.05
1.8										
4.8										
.8		$\langle \rangle^2$			3		montering	A. In markey	mont	manun
1.8 <b>1.8</b>	Not a second s	montenan	Ramlerstration and	manumle	ىدىرىيەر بىلىرىيەر <sub>يەر م</sub> ىرى	all and the second second				
4.8										
art 30 M les BW		Hz		#VB	W 300 kHz			S	Stop weep 2.39	25.00 G s (1001 p
R MODE TI			×	Ŷ	FUNC	TION FU	NCTION WIDTH		FUNCTION VALUE	
	f		2.452 GHz 3.651 GHz 9.768 GHz 24.700 GHz	5.166 -50.932 -51.777 -48.327	dBm dBm					
à							STATUS			



# 78 CH

ent Spectrum Analyzer - Swe RL RF 50 Ω		SENSE:INT	ALIGN AUTO	04:5	52:26 PM Apr 03, 2
nter Freq 12.5150	00000 GHz	D: Fast Trig: Free ain:Low #Atten: 30	Avg Type: Run		TRACE 1 2 3 4 TYPE MWWW DET P P P P
Ref Offset 0.5 dB/div Ref 15.90 c					2.477 GI 5.899 dB
0					-13.29
.1					
1					
	and manufactured a		and the second second second second	manna	magnam
1 mound manufactures for	Contraction of the Contraction o	Marchen March M			
.1					
art 30 MHz es BW 100 kHz		#VBW 300 kHz	!	Steep 2.3	op 25.00 <b>G</b> 9 s (1001 p
R MODE TRC SCL	×		CTION FUNCTION WIDTH	FUNCTION VALUE	E
N 1 f N 1 f	2.477 GHz 3.726 GHz	5.899 dBm -51.630 dBm			
N 1 F	9.918 GHz 24.625 GHz	-52.737 dBm -47.820 dBm			
	24.625 GHZ	-47.820 dBm			



Shenzhen STS Test Services Co., Ltd.



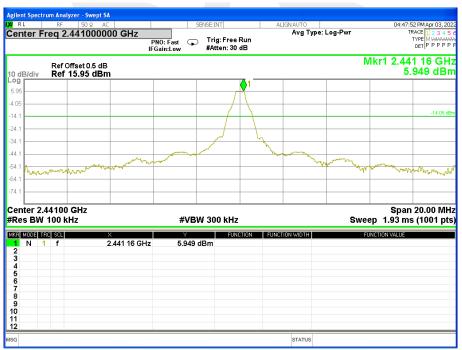


# For Band edge(it's also the reference level for conducted spurious emission)

		lyzer - Swept							
RL enter F	RF Freq 2	50 Ω / 2.3535000	DOO GHz	SENSE		ALIGN AUTO Avg Type:	Log-Pwr	TF	i8 PM Apr 03, RACE <mark>1 2 3</mark>
			Р		rig: Free Run Atten: 30 dB				DET P P P
dB/div		Offset 0.5 dl 15.54 dB					1	0 Mkr1 2.40 5.	1 97 G 539 di
	- Nor	10.04 00							<u>(</u> 1
4									Ň
									-144
									A A
		2						1	war
mm		mulan	والسويوسية المعرب يقاربوني مسراليها	ipateration and the second	man		-	unnormalite	
	0000 ( / 100			#VBW 3	00 kHz		Swe	Stop 2. ep 10.3 ms	40700 <b>(</b> : (1001
MODE 1			X	Ŷ	FUNCTION	FUNCTION WIDTH		UNCTION VALUE	
Ν	1 f		2.401 97 GHz	5.539 dBn	1				
Ň	1 f 1 f		2.314 55 GHz 2.399 40 GHz	-57.809 dBm -43.327 dBm					
N	1 f		2.400 05 GHz	-39.046 dBm	1				
N N N									
						STATUS			

#### 00 CH

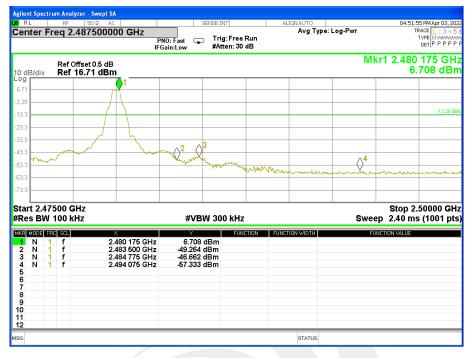
39 CH



Shenzhen STS Test Services Co., Ltd.



### 78 CH





Shenzhen STS Test Services Co., Ltd.

П



# For Hopping Band edge

GFSK

	RF	50 Ω AC			SENSE:INT	AL	IGNAUTO			3 AM Apr 06, 3
nter l	Freq 2.3	5150000		PNO: Fast Gain:Low	Trig: Free #Atten: 30	Run dB	Avg Type:	Log-Pwr	1	ACE 1 2 3 4 YPE MWWW DET P P P F
dB/div		set 0.5 dB 5 <b>.39 dBm</b>	ı					М	(r1 2.401 5.3	970 G 387 dE
g 39										
61										
.6										-14.61
.6										
6										
6									2	- (
6	www.ullung	Andrewster	والمعطاط والمعطاط	water water was	and a strategy and a state	an martine land	بمرادر حميراهم ومروحهم	Angoong and a strategy of a	www.me	-LIMMAN
6										
6										
	0000 GH: V 100 kHz		1	#VB	W 300 kHz	1		Swee	Stop 2.4 ep 9.87 ms	10300 G (1001 p
es BV	V TOO KI12									
MODE	TRC SCL		× 401.970.CHz	Y 5 397		CTION FUNCT	ION WIDTH	FL	NCTION VALUE	
NODE N N	TRC SCL 1 f 1 f	2. 2.	401 970 GHz 390 022 GHz	5.387 -59.082	dBm dBm	CTION FUNCT	ION WIDTH	FL	NCTION VALUE	
NODE N N	TRC SCL 1 f	2. 2.	401 970 GHz	5.387	dBm dBm	CTION FUNCT	IUN WIDTH	FL	NCTION VALUE	
NODE N N	TRC SCL 1 f 1 f	2. 2.	401 970 GHz 390 022 GHz	5.387 -59.082	dBm dBm	CTION FUNCT	ION WIDTH	FL	NCTION VALUE	
NODE N N N	TRC SCL 1 f 1 f	2. 2.	401 970 GHz 390 022 GHz	5.387 -59.082	dBm dBm	CTION FUNCT		FL	NCTION VALUE	
N N N N	TRC SCL 1 f 1 f	2. 2.	401 970 GHz 390 022 GHz	5.387 -59.082	dBm dBm			FL	NCTION VALUE	
N N N N	TRC SCL 1 f 1 f	2. 2.	401 970 GHz 390 022 GHz	5.387 -59.082	dBm dBm			FL	NCTION VALUE	
N N N N	TRC SCL 1 f 1 f	2. 2.	401 970 GHz 390 022 GHz	5.387 -59.082	dBm dBm		STATUS	FL	NCTION VALUE	

RL		AC	SE	NSE:INT	ALIGN AUTO			:43 AM Apr 06, 20
enter Fr	eq 2.48950		PNO: Fast 😱 -Gain:Low	Trig: Free Run #Atten: 30 dB	Ауд Туре	: Log-Pwr		TYPE M WWWW DET P P P P
) dB/div	Ref Offset 0.5 Ref 16.61 d					MI		0 176 GH .606 dB
.61	1							
39								
								-13.39
3.4								
.4	<u> </u>							
.4	- lm		A3					
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5.4								
	100 GH7						Ston 2	50000 GI
art 2.479 Res BW 1			#VBW	/ 300 kHz		Swee	Stop 2 ep 2.07 m	2.50000 GI Is (1001 pt
art 2.479 Res BW 1	IOO kHz	×	Y	FUNCTION	FUNCTION WIDTH			
art 2.479 Res BW 1 B MODE HE N 1 2 N 1	IOO KHZ SCL f f	2.480 176 GHz 2.483 515 GHz	6.606 d -59.173 d	FUNCTION Bm Bm	FUNCTION WIDTH		ep 2.07 m	
art 2.479 tes BW 1 B MODE 1180 N 1 2 N 1 3 N 1	100 kHz scu	2.480 176 GHz	Y 6.606 d	FUNCTION Bm Bm	FUNCTION WIDTH		ep 2.07 m	
art 2.479 Res BW 1 N 1 N 1 N 1 N 1 N 1 N 1	IOO KHZ SCL f f	2.480 176 GHz 2.483 515 GHz	6.606 d -59.173 d	FUNCTION Bm Bm	FUNCTION WIDTH		ep 2.07 m	
art 2.479 Res BW 1 R MODE TRO N 1 2 N 1 3 N 1 4 5 5 7	IOO KHZ SCL f f	2.480 176 GHz 2.483 515 GHz	6.606 d -59.173 d	FUNCTION Bm Bm	FUNCTION WIDTH		ep 2.07 m	
art 2.479 Res BW 1 N 1 N 1 N 1 N 1 N 1 N 1 A N 1 A N 1 A A N 1	IOO KHZ SCL f f	2.480 176 GHz 2.483 515 GHz	6.606 d -59.173 d	FUNCTION Bm Bm	FUNCTION WIDTH		ep 2.07 m	
art 2.479 Res BW 1 N	IOO KHZ SCL f f	2.480 176 GHz 2.483 515 GHz	6.606 d -59.173 d	FUNCTION Bm Bm	FUNCTION WIDTH		ep 2.07 m	



# Page 39 of 73 Report No.: STS2204016W01

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

RL		RF	50 Ω AC		S	ENSE:INT	Â	IGNAUTO		05:05:	55 PM Apr 03, 20
	Fre		2.51500000	PN	0: Fast 😱 ain:Low	Trig: Free R #Atten: 30 d	un	Avg Type:	Log-Pwr	Т	RACE 1 2 3 4 5 TYPE MWWWA DET P P P P P
) dB/di	v		Offset 0.5 dB 10.67 dBm								.402 GH .668 dBr
570			1								
.33											-15.33 d
.3											
.3											ļ,
.3 —			$\langle \rangle^2$					- maneral Mark	June Mary	- marker	Lever and
- T - 1	and a second second		in work war a second	and and a start of the start of	Management Hards	and an and	and the first state of the second state of the				
.3											
art 30 tes B			kHz		#VB\	V 300 kHz			S	Stop weep 2.39	25.00 GH s (1001 pt
NODE N	1 1 1 1	f f f f		2.402 GHz 3.601 GHz 9.618 GHz 24.576 GHz	0.668 c -53.513 c -54.806 c -47.277 c	lBm IBm	ION FUNC	TION WIDTH	F	FUNCTION VALUE	
N		r.		4.570 GHZ	-47.2110	IDIII					

### 00 CH

39	CH
23	OIT

RL RF 50 Ω	2 AC	SENSE:INT	ALIGN AUTO		05:01:43 PM Apr 03
nter Freq 12.515	PNO	: Fast 😱 Trig: Free n:Low #Atten: 30	Run	e: Log-Pwr	TRACE 1 2 3 TYPE MWW DET P P P
Ref Offset 0. dB/div Ref 10.71	5 dB dBm				Mkr1 2.452 G 0.705 dl
29					-15.0
.3					
3					
3		3			
3 martine and a starting		Inder mananemer	ham Manager and marking	wanwardhad	www.www.and.and.
3	· • • • • • • • • • • • • • • • • • • •				
.3					
art 30 MHz					Stop 25.00 C
es BW 100 kHz		#VBW 300 kHz			eep 2.39 s (1001
3 MODE TRC SCL N 1 f N 1 f N 1 f N 1 f	× 2.452 GHz 3.151 GHz 9.768 GHz 24.825 GHz	0.705 dBm -55.736 dBm -53.271 dBm -47.382 dBm	CTION FUNCTION WIDTH	FU	NCTION VALUE



# 78 CH

RL	RF	50 Ω A	c		SENSE:INT		ALIGN AUTO		04:58	:18 PM Apr 03, 2
nter F	req 12	2.515000	000 GHz	PNO: Fast Gain:Low	Trig: Fre #Atten: 3		Avg Typ	e: Log-Pwr		TRACE 1 2 3 4 TYPE MWWW DET P P P F
dB/div		ffset0.5dE 11.84dBr								2.477 G .839 dE
g 34	- 🔶	1								
6										-14.38
.2										
.2										
2		A2	,	3						
2	-	La la	and and the second second	Longe martin	and the second	mumber	al manus and	have a server and	war	and and a second and
.2		0.000								
2										
art 30 M es BW		Hz		#VB	W 300 kH	z		s	Sto weep 2.39	p 25.00 G s (1001 p
R MODE TI			X	Y		NCTION	FUNCTION WIDTH		FUNCTION VALUE	
N 1 N 1	f		2.477 GHz 3.151 GHz	1.839 -55.578	dBm					
N 1			7.496 GHz 24.675 GHz	-55.758 -47.989						
i										
I										



Shenzhen STS Test Services Co., Ltd.



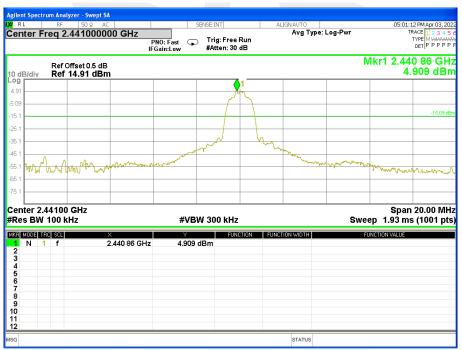


#### For Band edge(it's also the reference level for conducted spurious emission)

RL	RF	50 Ω AC		CET	NSE:INT	ALIGNAUTO		05:05:24 PM.	Apr 02
nter F		353500000	F	PNO: Fast Gain:Low	Trig: Free Run #Atten: 30 dB		: Log-Pwr	TRACE TYPE	
dB/div		ffset 0.5 dB  4.67 dBm					M	1 kr1 2.401 4.674	
									61
7									X
									$\cap$
									-153
									2 <sup>4</sup>
								<	γ <u>«</u>
			(	) <sup>2</sup>				w	
-	- Anna ann ann an Anna	Alexandren	hourseas	montestantes	the general state of the second state of the s	and the state of the second	and and a start and a start a s	en dran with	
	0000 GI / 100 kH			#VBW	300 kHz		Swee	Stop 2.407 p 10.3 ms (10	
SDW									
MODE -	TRC SCL	×		Y	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
MODE	1 f	2.40	1 86 GHz	4.674 di -58 555 di	3m	FUNCTION WIDTH	FU	NCTION VALUE	
MODE N	1 f 1 f 1 f	2.40 2.33 2.39	81 99 GHz 9 40 GHz	-58.555 dE -49.103 dE	3m 3m 3m	FUNCTION WIDTH	FU	NCTION VALUE	
NODE N N N	1 f 1 f	2.40 2.33 2.39	81 99 GHz	-58.555 dE	3m 3m 3m	FUNCTION WIDTH	FU	NCTION VALUE	
MODE	1 f 1 f 1 f	2.40 2.33 2.39	81 99 GHz 9 40 GHz	-58.555 dE -49.103 dE	3m 3m 3m	FUNCTION WIDTH	FU	NCTION VALUE	
MODE	1 f 1 f 1 f	2.40 2.33 2.39	81 99 GHz 9 40 GHz	-58.555 dE -49.103 dE	3m 3m 3m	FUNCTION WIDTH	FU	NCTION VALUE	
MODE	1 f 1 f 1 f	2.40 2.33 2.39	81 99 GHz 9 40 GHz	-58.555 dE -49.103 dE	3m 3m 3m	FUNCTION WIDTH	FU	NCTION VALUE	
N N N	1 f 1 f 1 f	2.40 2.33 2.39	81 99 GHz 9 40 GHz	-58.555 dE -49.103 dE	3m 3m 3m	FUNCTION WIDTH	fIJ	NCTION VALUE	
MODE	1 f 1 f 1 f	2.40 2.33 2.39	81 99 GHz 9 40 GHz	-58.555 dE -49.103 dE	3m 3m 3m	FUNCTION W/DTH	fU	NCTION VALUE	

#### 00 CH

39 CH



Shenzhen STS Test Services Co., Ltd.

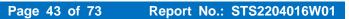


# 78 CH

	RF	zer - Swept SA 50 Ω AC		S	ENSE:INT	AL	IGNAUTO		04:57	:46 PM Apr 03, 2
enter Fr	eq 2.	48750000	F	PNO: Fast Gain:Low	Trig: Free F #Atten: 30 d		Avg Type:	Log-Pwr		TRACE 1 2 3 4 TYPE M WAAWA DET P P P P
dB/div		ffset 0.5 dB 15.62 dBm	I					М	kr1 2.479 5	9 850 GH .616 dB
<b>g</b> 62		<b>&gt;</b>	1							
38										-14.38 (
.4										
4			h	2.0						
.4	~~~	/	- Vor	$2^2$					4	
.4					popland plant	mallenglennes	whoman	www.w.mlh	monterm	humana
art 2.47: tes BW				#VB\	V 300 kHz			Swe	Stop 2 ep 2.40 m	2.50000 GI Is (1001 p
R MODE TR	C SCL	*		Y	FUNC	TION FUNCT	ION WIDTH		UNCTION VALUE	· ·
N 1 N 1 N 1	f f f	2.4	479 850 GHz 483 500 GHz 484 075 GHz 495 750 GHz	5.616 c -47.568 c -47.911 c -57.606 c	lBm IBm					
N 1										



Shenzhen STS Test Services Co., Ltd.





# For Hopping Band edge

### π/4-DQPSK

	Analyzer - Swe		SENSE:	INT	ALIGNAUTO		09:56:20	AM Apr 06, 2
		0000 GHz	PNO: East Tr	ig: Free Run tten: 30 dB	Avg Type:	Log-Pwr	TR/ T	ACE 1 2 3 4 YPE M WWWW DET P P P P
	tef Offset 0.5 Ref 13.76 d					М	kr1 2.401 3.7	867 GH 762 dB
76								
.2								-16.24 (
2								
.2							<u>∧2</u>	. 10
.2	ener an	porterent	purson of the second	eventuring and and	Langer of the provider allows	don ha an	man	will
.2								
art 2.3000 es BW 10			#VBW 30	0 kHz	·	Swe	Stop 2.4 ep 9.87 ms	
R MODE TRC S	SCL	× 2.401 867 GHz	¥ 3.762 dBm	FUNCTION	FUNCTION WIDTH	F	JNCTION VALUE	
N 1	f f	2.390 022 GHz 2.400 013 GHz	-58.870 dBm -47.189 dBm					
k k 								

enter Freq 2	50 Ω AC 2.489500000 GHz		g: Free Run	ALIGN AUTO Avg Type	: Log-Pwr		30 AM Apr 06, 2 IRACE 1 2 3 4 TYPE MUMANA DET P P P P
dB/div Ref	Offset 0.5 dB f 15.45 dBm	IFGain:Low #A	tten: 30 dB		М	kr1 2.480 5	,
is more thank							
.6							-14.55
6							
6							
6	2 Arwinny Vorte drift and	A3					
6	" "may way drift of	Margare - and an					
6		r uprenovin-north.com	and a fail of the second of	- And Andreas	and a construction of the second s		
6							
	<b>CU</b> 2					04em 2	.50000 G
		#VBW 30	0 kHz		Swe	ep 2.07 m	
es BW 100	kHz ×	Y	0 kHz	FUNCTION WIDTH			
es BW 100 MODE TRE SCI N 1 f N 1 f	KHZ 2.480 029 GH 2.483 515 GH	z 5.447 dBm z -51.032 dBm		FUNCTION WIDTH		ep 2.07 m	
NODE TRO SCI	KHz 2.480 029 GH	z 5.447 dBm z -51.032 dBm		FUNCTION WIDTH		ep 2.07 m	
es BW 100 NODE TRE SCI N 1 f N 1 f	KHZ 2.480 029 GH 2.483 515 GH	z 5.447 dBm z -51.032 dBm		FUNCTION WIDTH		ep 2.07 m	
es BW 100 MODE THE SCL N 1 f N 1 f N 1 f	KHZ 2.480 029 GH 2.483 515 GH	z 5.447 dBm z -51.032 dBm		FUNCTION WIDTH		ep 2.07 m	
es BW 100 Note TRC Sct N 1 f N 1 f N 1 f	KHZ 2.480 029 GH 2.483 515 GH	z 5.447 dBm z -51.032 dBm		FUNCTION WIDTH		ep 2.07 m	
N 1 f	KHZ 2.480 029 GH 2.483 515 GH	z 5.447 dBm z -51.032 dBm		FUNCTION WIDTH		ep 2.07 m	

Shenzhen STS Test Services Co., Ltd.



Page 44 of 73 Report No.: STS2204016W01

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

# 00 CH

	RF 50 9	Q AC	SENSE:INT		ALIGN AUTO		05:09	18 PM Apr 03, 21
enter F	req 12.515	000000 GHz P		ree Run : 30 dB	Avg Type:	Log-Pwr		TYPE MWWW DET P P P P
0 dB/div	Ref Offset 0 Ref 9.37 c							2.402 GH .635 dB
.63	<b>0</b> 1							
0.6								-15.47
0.6								
).6								
0.6	<u>م</u>		3					
0.6	marker	Bernow manually	warden warmen	manne	man manus and	and and the second second	ver when	mouther
1.6								
0.6								
						-		
	100 kHz		#VBW 300 I				weep 2.39	
Res BW (1 N 2 N 3 N 4 N	100 kHz	× 2.402 GHz 2.552 GHz 9.618 GHz 24.725 GHz	#VBW 300 I -0.635 dBm -55.004 dBm -53.309 dBm -47.909 dBm		NCTION WIDTH			
Res BW 1 N 2 N 3 N 4 N 5 6 7 8	100 kHz RC SCL 1 f 1 f 1 f	2.402 GHz 2.552 GHz 9.618 GHz	-0.635 dBm -55.004 dBm -53.309 dBm		NCTION WIDTH		weep 2.39	
Res BW 11 N 2 N 3 N	100 kHz RC SCL 1 f 1 f 1 f	2.402 GHz 2.552 GHz 9.618 GHz	-0.635 dBm -55.004 dBm -53.309 dBm		NCTION WIDTH		weep 2.39	o 25.00 <b>Gi</b> s (1001 p

# 39 CH

RL	um Analyzer - RF 5	Ω AC			SENSE:INT		ALIGN A	UTO		05:1	.2:12 PM Apr 03,
	req 12.51	500000	PI	NO: Fast G Gain:Low	Tui u Fue		A	vg Type:	Log-Pwr		TRACE 1 2 3 4 TYPE MWWW DET P P P F
dB/div	Ref Offset Ref_10.7										2.452 G 0.761 dE
	<b>1</b>										
4											-15.1
2											
	-	2		$\longrightarrow$	3			- Martin	a super subserverse	wwwwwww	an weeks mind
	how and the former of the state	and the second	will when the second	Mary Mary Market	الارد العالي العالي المحالي (1994) المحالي العالي المحالي (1994) المحالي العالي (1994)	Contraction of	and the				
rt 30 N											op 25.00 G
	100 kHz				W 300 kH					weep 2.39	
MODE TF   N 1   N 1   N 1   N 1   N 1	f f f	×	2.452 GHz 3.276 GHz 9.768 GHz 25.000 GHz	0.761 -54.784 -54.111 -47.605	dBm dBm dBm	INCTION	FUNCTION W	VIDTH		FUNCTION VALUE	



# 78 CH

RL RF 50Ω	AC	SENSE:INT	ALIGN AUTO		05:15:12 PM Apr 03, 2
nter Freq 12.5150	PN	D: Fast 🕞 Trig: Free in:Low #Atten: 30	Run	: Log-Pwr	TRACE 1 2 3 4 TYPE MMMM DET P P P P
Ref Offset 0.5 B/div Ref 12.60 d				n	//kr1 2.477 GI 2.604 dB
0					-14.36
4					
4					4
4 <del>2</del>				di un democración de	My Manual man and and
4 martin and the state of the second state of	and the second second second second	مرحامهم وياليها والاستهدا والمستهدي	and the second of the second	A Dense	
4					
art 30 MHz es BW 100 kHz		#VBW 300 kHz		Swee	Stop 25.00 G p 2.39 s (1001 p
MODE TRC SCL	× 2.477 GHz	Y FUND 2.604 dBm	CTION FUNCTION WIDTH	FUNCTI	ON VALUE
N 1 F N 1 F N 1 F N 1 F	3.126 GHz 6.198 GHz 21.579 GHz	-56.212 dBm -55.449 dBm -47.944 dBm			



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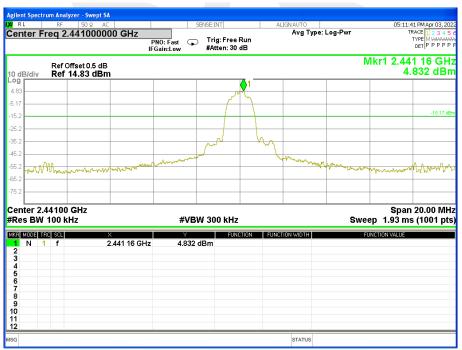


#### For Band edge(it's also the reference level for conducted spurious emission)

		er - Swept SA								
RL	RF	50 Q AC			SENSE:INT			: Log-Pwr		47 PM Apr 03, RACE 1 2 3 4
enterr	red 2.3	5550000		PNO: Fast Gain:Low	Trig: Free #Atten: 30		ang type			DET P P P
) dB/div		fset 0.5 dB 4.53 dBm							Mkr1 2.40 4.	2 08 G 530 dE
<sup>og</sup>										<b>1</b>
.53										Å
.47										-15,47
i.5										
.5										
.5										
.5			2							my l
5 margar	manum	mound	makanton	montes	Andingonlya	m	worth man the shall be	mahara	annon envirenter and	1.0
.5										
.5										
	0000 GH				1					40700 G
les BW	/ 100 kH	IZ		#VB	W 300 kHz			Sw	eep 10.3 m	s (1001 p
R MODE 1		>		Y		CTION	FUNCTION WIDTH		FUNCTION VALUE	
	1 f 1 f		.402 08 GHz .319 90 GHz	4.530 -58.446						
N	1 f	2	.399 30 GHz	-49.361	dBm					
N	1 f	2	.400 05 GHz	-42.522	авт					
l I										
2										
2							STATUS			

#### 00 CH

39 CH



Shenzhen STS Test Services Co., Ltd.



# 78 CH

RL	RF	er - Swept SA 50 Ω AC		SE	NSE:INT	A	LIGN AUTO		05:1	4:41 PM Apr 03, 20
enter Fi	req 2.4	8750000	F	PNO: Fast 😱 Gain:Low	Trig: Free #Atten: 30		Avg Type:	Log-Pwr		TYPE M MAAAAA DET P P P P
dB/div		fset 0.5 dB 5.64 dBm	L					IV		0 175 GF 5.640 dB
64		<u>م</u>	<b>0</b> 1							
36		-	7							-14.36 d
.4										
		N	h.							
.4	~			$\Lambda^2 \Lambda^3$				4		
.4 month	- marine			my how to	- Marthanalanani	Murun	www.	-	~~~~low_	Lawm Lawrence
.4										
.4										
art 2.47 Res BW				#VBV	/ 300 kHz			Sw	Stop eep 2.40 r	2.50000 GI ns (1001 pi
R MODE TR	C SCL	×		Y		CTION FUNC	TION WIDTH		FUNCTION VALUE	
N 1 N 1			480 175 GHz 483 500 GHz	5.640 d -53.127 d						
3 N 1 4 N 1			484 775 GHz 493 475 GHz	-52.390 d -57.028 d						
5			400 470 0112	-07.020 u	UIII					
7										
3										
)										
)										
)							STATUS			



Shenzhen STS Test Services Co., Ltd.





# For Hopping Band edge

8DPSK

RL		iO Ω AC	SENS	EINT	ALIGN AUTO		06:13:50 P	
nter Fr	eq 2.351			rig: Free Run Atten: 30 dB	Avg Type	: Log-Pwr	TY	Е <mark>1234</mark> ЕМ <del>ИЛИИ</del> ТРРРР
dB/div	Ref Offset Ref 13.4					Mk	r1 2.403 0 3.4	00 GI 81 dB
g 18								
52								
.5								-16.52
5								
5								G
5							$\wedge^2$	J.
5 maryna	www.www.ww	an concerned and a second state	เป็นของการที่เราสารากการที่การเรา	mennener	verter and the second	and an and a second	anno Anna	<b>MLAN</b>
5								
5								
	000 GHz 100 kHz	i	#VBW 3	00.1411-		0	Stop 2.40	
NODE TR		×	#VBW 3	FUNCTION	FUNCTION WIDTH		ep 9.87 ms( Nomonivatur	1001 p
N 1 N 1 N 1	f f	2.403 000 GHz 2.390 022 GHz 2.400 013 GHz	3.481 dBr -58.590 dBr -46.793 dBr	n n			ACTION VALUE	
					STATUS			_

		Ω AC	SENSE:I	NT	ALIGN AUTO		06:16:01 PM Apr 03, 2
	req 2.489			g: Free Run ten: 30 dB	Avg Type	: Log-Pwr	TRACE 1 2 3 4 TYPE M WWWW DET P P P P
B/div	Ref Offset 0 Ref 15.58					Mk	r1 2.480 176 GF 5.578 dB
	<b>≬</b> 1						
·w	·"\						
<u> </u>							-14.42
-	- Www.	AM A A2					3
	` `	HIM MY -					
		Marmary	Mwww.mww.	hanna	Marman		roman have been
	7900 GHz 100 kHz		#VBW 30	0 kHz		Swee	Stop 2.50000 G p 2.07 ms (1001 p
		X	Y	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE
MODE T							
MODE T N 1 N 1	1 f 1 f	2.480 176 GHz 2.483 515 GHz	5.578 dBm -49.408 dBm				
NODE TI N 1 N 1	1 f						
MODE T N 1 N 1	1 f 1 f	2.483 515 GHz	-49.408 dBm				
MODE T N 1 N 1	1 f 1 f	2.483 515 GHz	-49.408 dBm				
MODE T N 1 N 1	1 f 1 f	2.483 515 GHz	-49.408 dBm				
NODE T N 1 N 1	1 f 1 f	2.483 515 GHz	-49.408 dBm				



# 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	RF	50 Ω AC			SENSE:INT		ALIO	GNAUTO			22 AM Apr 06, 2
enter	Freq 2	.44175000		PNO: Fast G FGain:Low	Trig: Fro #Atten:	ee Run 30 dB		Avg Type:	-		TYPE MWWW DET P P P P
) dB/div		Offset 0.5 dB 16.87 dBm							Mkı	2 2.480 (	076 5 GI 6.93 dE
13 Y		mm	, mm	mm	mm	www	ww	MMM	mmm	www	vvvvv
3.1 3.1											
3.1 3.1											
3.1											
tart 2.4 Res BV	V 300 H	KHZ			3W 300 KI					ep 1.13 m	.48350 G s (1001 p
3 4	TRC SCL 1 f 1 f		1 920 5 GHz 0 076 5 GHz		5 dBm 3 dBm	UNCTION	FUNCTI	ON WIDTH	F	UNCTION VALUE	
5											
5 6 7 8 9 0 1 2											

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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.
- 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  $3.37 \times 31.6 = 106.6$ .
- 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  $5.06 \times 31.6 = 160$ .
- 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

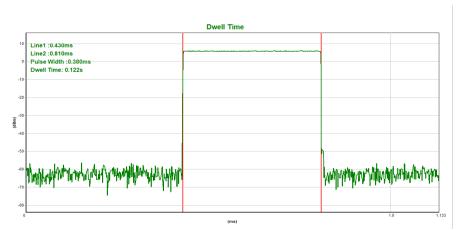
Modulation	Pocket Type	Frequency (MHz)	Single Pulse Time (ms)	Dwell Time (s)	Limit (s)	Result
	DH1	2441	0.380	0.122	0.4	Pass
GFSK	DH3	2441	1.639	0.262	0.4	Pass
	DH5	2441	2.884	0.308	0.4	Pass
	2DH1	2441	0.388	0.124	0.4	Pass
π/4DQPSK	2DH3	2441	1.639	0.262	0.4	Pass
	2DH5	2441	2.888	0.308	0.4	Pass
	3DH1	2441	0.388	0.124	0.4	Pass
8DPSK	3DH3	2441	1.639	0.262	0.4	Pass
	3DH5	2441	2.893	0.309	0.4	Pass

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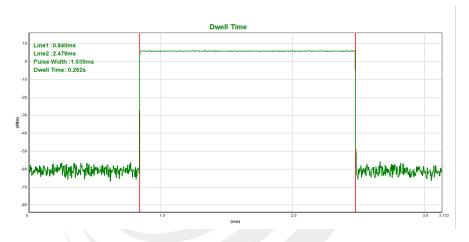


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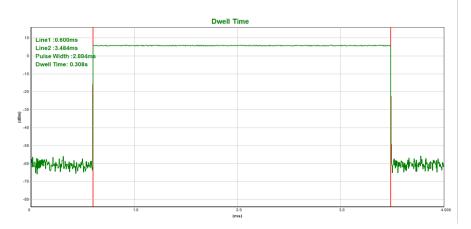
## CH39-DH1



### CH39-DH3



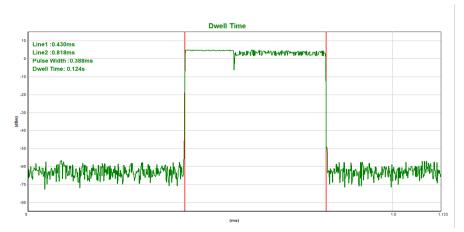




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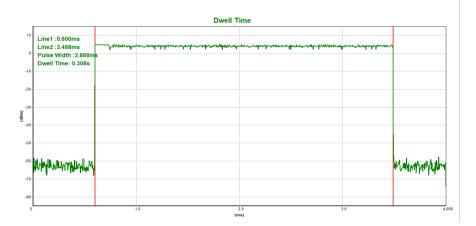
#### CH39-2DH1



#### CH39-2DH3

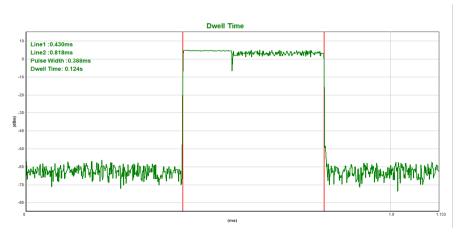


#### CH39-2DH5

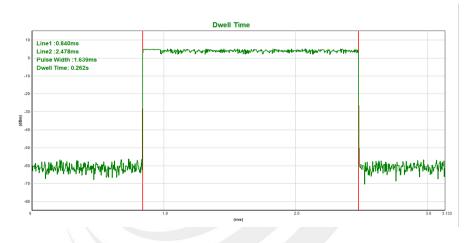




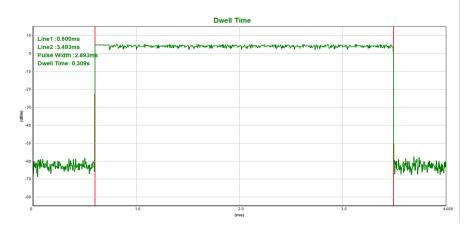
### CH39-3DH1



#### CH39-3DH3



#### CH39-3DH5



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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:	25°C	Relative Humidity:	50%
Test Mode:	GFSK/π/4-DQPSK/8DPSK	Test Voltage:	DC 3.7V

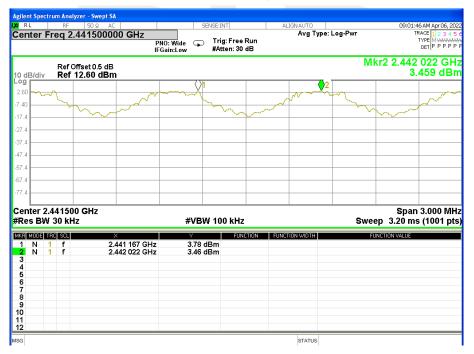
Modulation	Frequency (MHz)	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)	Result
	2402	2402.020	2403.172	1.152	0.685	Pass
GFSK	2441	2441.167	2442.022	0.855	0.689	Pass
	2480	2479.173	2480.169	0.996	0.685	Pass
	2402	2402.167	2403.169	1.002	0.856	Pass
π/4DQPSK	2441	2441.170	2442.165	0.995	0.854	Pass
	2480	2479.170	2480.172	1.002	0.855	Pass
	2402	2402.179	2403.169	0.990	0.854	Pass
8DPSK	2441	2441.158	2442.169	1.011	0.853	Pass
	2480	2479.167	2480.166	0.999	0.853	Pass



#### CH00 -1Mbps

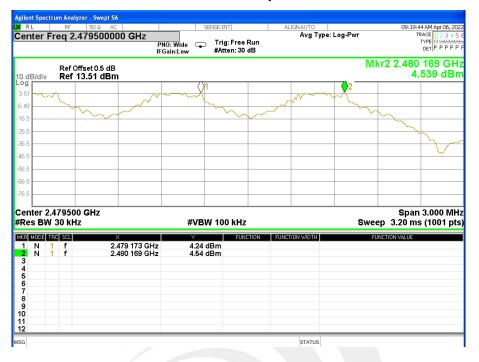


#### CH39 -1Mbps





#### CH78 -1Mbps



#### CH00 -2Mbps

nemi spectrum Anatyz	er - Swept SA					
RL RF	50 Ω AC	SENSE:IN	Г	LIGN AUTO		09:38:14 AM Apr 06,
enter Freq 2.4		NO: Wide 😱 Trig Gain:Low #Atte	Free Run en: 30 dB	Avg Type: Log	-Pwr	TRACE 1 2 3 4 TYPE M WWWW DET P P P F
dB/div Ref 1	fset 0.5 dB 1.53 dBm				Mkr2 :	2.403 169 G 1.795 dE
53				m	2	
.5						
.5						
5						
5						
nter 2.402500 es BW 30 kHz		#VBW 100	kHz		Sweep 3	Span 3.000 M .20 ms (1001 p
NODE TRC SCL N 1 f N 1 f	× 2.402 167 GHz 2.403 169 GHz	1.76 dBm 1.79 dBm	FUNCTION FUNC	TION WIDTH	FUNCTION	VALUE

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## CH39 -2Mbps

RL RF	50 Ω AC	SENSE:INT	ALIGN AUTO	09:44:18 AM Apr 06, 2
nter Freq 2.4	41500000 GHz		Avg Type: Log-Pwi	TRACE 1 2 3 4
		:Wide 😱 Trig:FreeRi in:Low #Atten:30 di	un B	DET P P P P
	IFGa	III.LOW WINCON		Miles 0 440 400 CI
	set 0.5 dB			Mkr2 2.442 166 GH 1.412 dB
dB/div Ref 6.	34 dBm			1.412 UD
	^	$\mathcal{M}$	mant	
7			~~ ~ ~	
7				
7				
7				
.7				
.7				
.7				
7				
nter 2.441500	GHz			Span 3.000 M
es BW 30 kHz		#VBW 100 kHz		Sweep 3.20 ms (1001 p
R MODE TRC SCL	X	Y FUNCT	ION FUNCTION WIDTH	FUNCTION VALUE
N 1 f	2.441 170 GHz	1.53 dBm		
N 1 f	2.442 166 GHz	1.41 dBm		
I				

# CH78 -2Mbps

L RF	er - Swept SA 50 Ω AC	SENSE:I	NT	ALIGN AUTO		09:51:3	1 AM Apr 06,
nter Freq 2.4	79500000 GHz	PNO: Mide Tri	g: Free Run ten: 30 dB	Avg Type:	Log-Pwr	TF	TYPE MWWW DET P P P
B/div Ref 9.4	set 0.5 dB 40 dBm				Mk	r2 2.480 2.	172 G 592 di
	m	mm	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	$\sim$	2 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	$\sim$	
i							
							m
j							
nter 2.479500 es BW 30 kHz	GHz	#VBW 10	0 kHz		Swee	Span p 3.20 ms	3.000 N ; (1001
Mode TRC SCL N 1 f N 1 f	× 2.479 170 GHz 2.480 172 GHz		FUNCTION F	UNCTION WIDTH	FUN	ICTION VALUE	

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#### CH00 -3Mbps

	RF 50 Ω AC		SENSE:INT	A	.IGN AUTO	06:0	1:14 PM Apr 03
ter Freq	2.40250000	PNO	): Wide 🕞 Trig: I	Free Run n: 30 dB	Avg Type: Log-		TRACE 1 2 3 TYPE MWW DET P P P
	ef Offset 0.5 dB					Mkr2 2.40	13 169 G 1.038 d
B/div <b>R</b> e	ef 9.60 dBm		()1			2	
		1	ma		- mm	2	- M
		www.	· · · · · · · · · · · · · · · · · · ·	m		m	~~~.
	$\sim$						
	1						
and	~						
www							
		+					
L		+					
tor 2 402	500 GHz					Spa	an 3.000 f
1101 2.402	kH7		#VBW 100	kHz		Sweep 3.20 r	
				FUNCTION FUNC	TION WIDTH	FUNCTION VALUE	
s BW 30		×	Y				
es BW 30 MODE 1160 50 N 1 f	CL	.402 179 GHz	0.85 dBm				
es BW 30 Mode tre so	CL						
SBW 30 1005 116 50 N 1 f	CL	.402 179 GHz	0.85 dBm				
SBW 30	CL	.402 179 GHz	0.85 dBm				
SBW 30	CL	.402 179 GHz	0.85 dBm				
SBW 30	CL	.402 179 GHz	0.85 dBm				
SBW 30	CL	.402 179 GHz	0.85 dBm				
SBW 30 1005 116 50 N 1 f	CL	.402 179 GHz	0.85 dBm				
SBW 30 1005 166 50 N 1 f	CL	.402 179 GHz	0.85 dBm				

## CH39 -3Mbps

Agilent Spectrum Analyzer - Swept SA			
LV RL RF 50 Q AC	SENSE:		06:07:05 PM Apr 03, 2
Center Freq 2.441500000	PNO: Mide Tri	Avg Ty ig: Free Run tten: 30 dB	ype: Log-Pwr TRACE 1234 TYPE MUMUM DET P P P
Ref Offset 0.5 dB 10 dB/div Ref 8.17 dBm			Mkr2 2.442 169 GI 2.698 dB
-1.83	mm	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~ X <sup>2</sup>
-21.8			
-31.8			
-41.8			
-61.8			
-71.8			
-81.8			
Center 2.441500 GHz #Res BW 30 kHz	#VBW 10	10 kHz	Span 3.000 M Sweep 3.20 ms (1001 p
MKR MODE TRC SCL X	Y	FUNCTION FUNCTION WIDTH	FUNCTION VALUE
2 N 1 f 2.442	1 158 GHz 1.71 dBm 2 169 GHz 2.70 dBm		
3 4			
5 6 7			
8 9 10			
10 11			
12			
MSG		STATUS	

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## CH78 -3Mbps

RF	50 Ω AC	SENSE:INT	ALIGN AUTO	06:09:04 PM Apr 0
er Freq 2.47	9500000 GHz	Tria: Fr	Avg Type: ree Run	TYPE MAA
		PNO: Wide 😱 Trig: Fi FGain:Low #Atten:	30 dB	DET P P
Ref Offse	t05dB			Mkr2 2.480 166 (
div Ref 10.				3.423 c
		X1		2
m	mont	man	- man man	the hard man
er 2.479500 G	iHz			Span 3.000
BW 30 kHz		#VBW 100 k	Hz	Sweep 3.20 ms (1001
DDE TRC SCL	×	Y I	FUNCTION FUNCTION WIDTH	FUNCTION VALUE
N 1 f N 1 f	2.479 167 GHz 2.480 166 GHz	3.42 dBm 3.42 dBm		
N I I	2.460 166 GHZ	3.42 dBm		



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# 8. BANDWIDTH TEST

# 8.1 LIMIT

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

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

### 8.2 TEST PROCEDURE

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

b. Spectrum Setting: RBW= 30KHz, VBW=100KHz, Sweep time = Auto.

#### 8.3 TEST SETUP



## 8.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.



## 8.5 TEST RESULTS

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

Modulation	Frequency (MHz)	-20 dB Bandwidth (MHz)	Result
	2402	1.0280	Pass
GFSK	2441	1.0330	Pass
	2480	1.0280	Pass
	2402	1.284	Pass
π/4DQPSK	2441	1.281	Pass
	2480	1.282	Pass
	2402	1.281	Pass
8DPSK	2441	1.279	Pass
	2480	1.280	Pass





## CH00 -1Mbps



CH39 -1Mbps



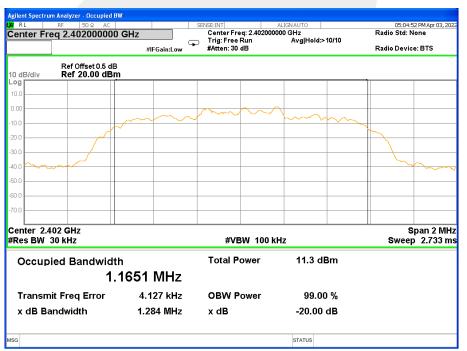
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#### CH78 -1Mbps

RL	RF 50 Ω AC		SENSE:INT	ALIGNAUTO	04:51:23 PM Apr 03, 20
enter Fr	eq 2.48000000	GHz	Center Freq: 2.480000		Radio Std: None
	]	#IFGain:Low	Trig: Free Run #Atten: 30 dB	Avg Hold:>10/10	Radio Device: BTS
dB/div	Ref Offset 0.5 dB Ref 20.00 dBm				
g .0					
10			m		
			$\gamma$	m l	
o 		~~~~			~
	~~~				June -
m					4
	~				
0					
0					
0					
nter 2.4					Span 2 MH
les BW	30 kHz		#VBW 100 k	Hz	Sweep 2.733 n
Occup	ied Bandwidt	h	Total Power	13.7 dBm	
		99.42 kHz			
Transm	nit Freq Error	10.168 kHz	OBW Power	99.00 %	
x dB Ba	andwidth	1.028 MHz	x dB	-20.00 dB	
	-				

#### CH00 -2Mbps

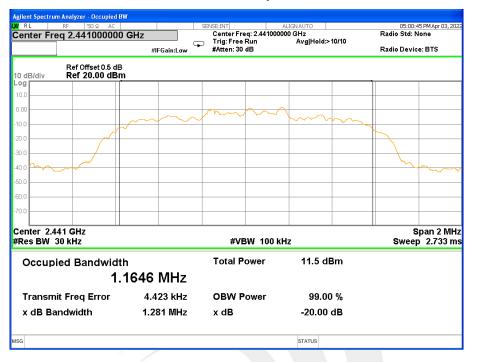


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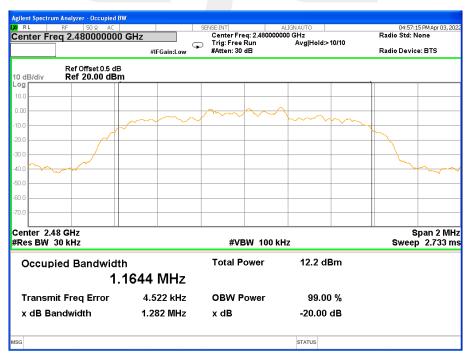
П



#### CH39 -2Mbps

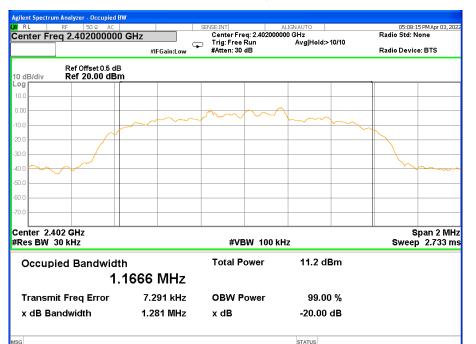


#### CH78 -2Mbps

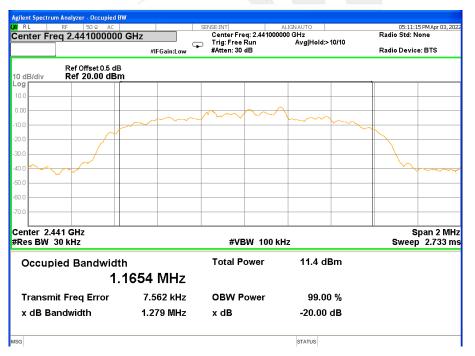




#### CH00 -3Mbps

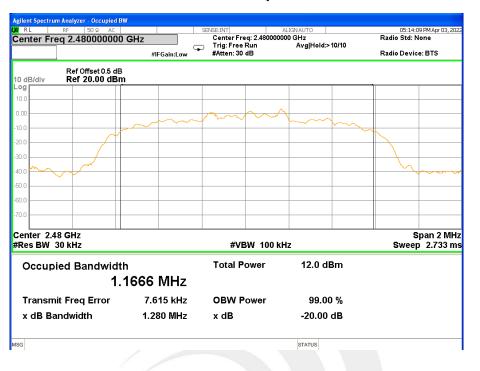


#### CH39 -3Mbps





## CH78 -3Mbps







# 9. OUTPUT POWER TEST

### 9.1 LIMIT

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

### 9.2 TEST PROCEDURE

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

- a) Use the following spectrum analyzer settings:
- 1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
- 2) RBW > 20 dB bandwidth of the emission being measured.

3) VBW  $\geq$  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.

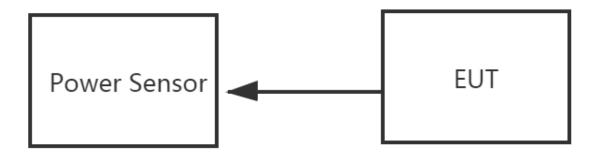
e) A plot of the test results and setup description shall be included in the test report.

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:	25°C	Relative Humidity:	60%
Test Voltage:	DC 3.7V		

Modulation	Frequency (MHz)	Peak Power (dBm)	Average Power (dBm)	Limit (dBm)
	2402	5.75	4.29	20.97
GFSK (1M)	2441	6.26	4.83	20.97
	2480	6.60	5.09	20.97
π/4-DQPSK (2M)	2402	5.63	1.78	20.97
	2441	6.11	2.80	20.97
	2480	6.43	2.47	20.97
8-DPSK (3M)	2402	5.74	1.81	20.97
	2441	6.27	2.20	20.97
	2480	6.55	2.47	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 PIFA Antenna. It comply with the standard requirement.



Shenzhen STS Test Services Co., Ltd.



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



Shenzhen STS Test Services Co., Ltd.