

# **RADIO TEST REPORT**

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# Report No.: STS2010120W01

Issued for

Ningbo Tonwel Audio Co., LTD

No. 28 Xiyi Road, Jiangshan Town, Yinzhou, Ningbo, China.

Product Name:	ACTIVE SPEAKER			
Brand Name:	SIMMONS			
Model Name:	DA2110			
Series Model:	DA2108			
FCC ID:	2AIQW-DA2110			
Test Standard:	FCC Part 15.247			

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# **TEST RESULT CERTIFICATION**

Applicant's Name	Ningbo Tonwel Audio Co., LTD
Address	No. 28 Xiyi Road, Jiangshan Town, Yinzhou, Ningbo, China.
Manufacturer's Name:	Ningbo Tonwel Audio Co., LTD
Address	No. 500 Qihang Road, Zhanqi Town, Yinzhou, NINGBO Zhejiang, China.
Product Description	
Product Name:	ACTIVE SPEAKER
Brand Name	SIMMONS
Model Name	DA2110
Series Model	DA2108
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 .....: 22 Oct. 2020

Date (s) of performance of tests : 22 Oct. 2020 ~ 29 Oct. 2020

Date of Issue .....: 29 Oct. 2020

Test Result ..... Pass

Testing Engineer :	Chins cher	
	(Chris Chen)	
Technical Manager :	Sean She	
	(Sean she)	
Authorized Signatory :	Vitali . 101	
	(Vita Li)	

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7. HOPPING CHANNEL SEPARATION MEASUREMEN

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# **Revision History**

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	29 Oct. 2020	STS2010120W01	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	±0.68dB
2	Unwanted Emissions, conducted	±2.988dB
3	All emissions, radiated 30-1GHz	±5.6dB
4	All emissions, radiated 1G-6GHz	±5.5dB
5	All emissions, radiated>6G	±5.8dB
6	Conducted Emission (9KHz-150KHz)	±3.37dB
7	Conducted Emission (150KHz-30MHz)	±3.83dB

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# 2. GENERAL INFORMATION

# 2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	ACTIVE SPEAKER
Trade Name	SIMMONS
Model Name	DA2110
Series Model	DA2108
Model Difference	Both of models have the same circuit schematic, construction, PCB Lavout and critical components. The difference is horn size and lead to different power, function and configuration are different therefore model name is different.
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.
Power Ratin	Input: AC 100-120 50/60Hz
Hardware version number	N/A
Software version number	N/A
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.

		Chanr	nel 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	(SIMMONS)	DA2110	PCB	N/A	0 dBi	BT Antenna

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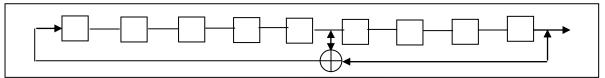
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The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping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

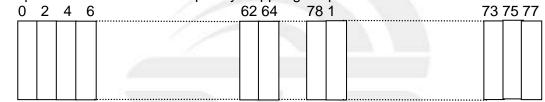
(2)The Pseudorandom sequence may be generated in a nin-stage shift register whose 5<sup>th</sup> and 9<sup>th</sup> stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones: i.e. the 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	7	
BT	BR+EDR	π/4-DQPSK	0	7	BT Tool
		8DPSK	0	7	

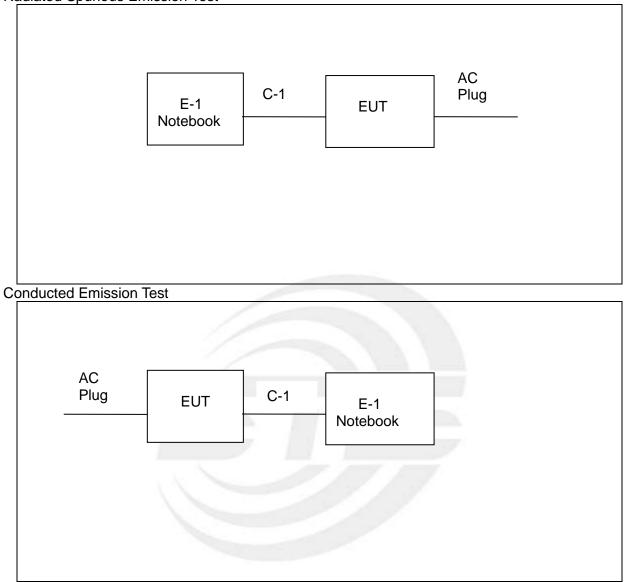


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# 2.5 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED Radiated Spurious Emission Test



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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

#### Support units

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
E-1	Notebook	LENOVO	ThinkPad E470	N/A	N/A
C-1	Fixed frequency LINE	N/A	N/A	1.5M	N/A

Note:

(1) For detachable type I/O cable should be specified the length in cm in <sup>C</sup>Length<sub>2</sub> column.

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# 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	2020.10.12	2022.10.11		
Signal Analyzer	R&S	FSV 40-N	101823	2020.10.10	2021.10.09		
Active loop Antenna	ZHINAN	ZN30900C	16035	2019.07.11	2021.07.10		
Bilog Antenna	TESEQ	CBL6111D	34678	2020.10.12	2022.10.11		
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	2019.10.15	2021.10.14		
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	2020.10.12	2021.10.11		
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK2018080901	2020.10.12	2021.10.11		
Pre-Amplifier (18G-40GHz)	SKET	LNPA-1840-50	SK2018101801	2020.10.10	2021.10.09		
Temperature & Humidity	HH660	Mieo	N/A	2020.10.13	2021.10.12		
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	2020.10.12	2022.10.11	
LISN	R&S	ENV216	101242	2020.10.12	2022.10.11	
LISN	EMCO	3810/2NM	23625	2020.10.12	2022.10.11	
Temperature & Humidity	HH660	Mieo	N/A	2020.10.13	2021.10.12	
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		
	Keysight	U2021XA	MY55520005	2020.10.10	2021.10.09		
MIMO Power measurement test Set			MY55520006	2020.10.10	2021.10.09		
			MY56120038	2020.10.10	2021.10.09		
			MY56280002	2020.10.10	2021.10.09		
Signal Analyzer	Agilent	N9020A	MY51110105	2020.03.05	2021.03.04		
Temperature & Humidity	HH660	Mieo	N/A	2020.10.13	2021.10.12		
MIMO Power measurement test Set	Keysight	U2021XA	MY55520005	2020.10.10	2021.10.09		
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

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# 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.

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# 3.1.5 TEST RESULT

Temperature:	26.8(C)	Relative Humidity:	66%RH
Test Voltage:	AC 120V/60Hz	Phase:	L
Test Mode:	Mode 13		

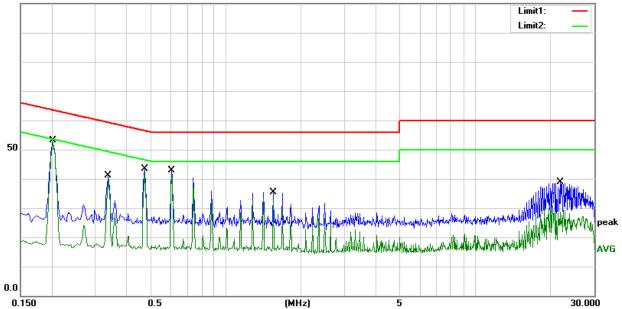
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.2020	32.01	20.34	52.35	63.53	-11.18	QP
2	0.2020	30.18	20.34	50.52	53.53	-3.01	AVG
3	0.3380	20.56	20.67	41.23	59.25	-18.02	QP
4	0.3380	19.20	20.67	39.87	49.25	-9.38	AVG
5	0.4740	22.93	20.45	43.38	56.44	-13.06	QP
6	0.4740	22.01	20.45	42.46	46.44	-3.98	AVG
7	0.6060	22.40	20.35	42.75	56.00	-13.25	QP
8	0.6060	21.28	20.35	41.63	46.00	-4.37	AVG
9	1.5500	15.18	20.16	35.34	56.00	-20.66	QP
10	1.5500	12.49	20.16	32.65	46.00	-13.35	AVG
11	21.8500	18.15	20.64	38.79	60.00	-21.21	QP
12	21.8500	8.73	20.64	29.37	50.00	-20.63	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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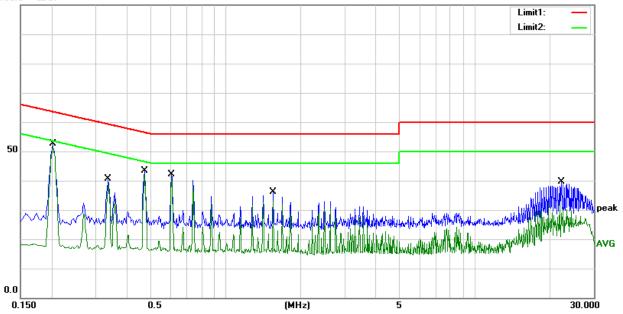
Temperature:	26.8(C)	Relative Humidity:	66%RH
Test Voltage:	AC 120V/60Hz	Phase:	Ν
Test Mode:	Mode 13		

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.2020	31.52	20.34	51.86	63.53	-11.67	QP
2	0.2020	29.68	20.34	50.02	53.53	-3.51	AVG
3	0.3380	19.91	20.67	40.58	59.25	-18.67	QP
4	0.3380	18.35	20.67	39.02	49.25	-10.23	AVG
5	0.4740	22.81	20.45	43.26	56.44	-13.18	QP
6	0.4740	21.80	20.45	42.25	46.44	-4.19	AVG
7	0.6060	21.83	20.35	42.18	56.00	-13.82	QP
8	0.6060	20.84	20.35	41.19	46.00	-4.81	AVG
9	1.5500	16.02	20.16	36.18	56.00	-19.82	QP
10	1.5500	13.05	20.16	33.21	46.00	-12.79	AVG
11	22.1940	19.07	20.64	39.71	60.00	-20.29	QP
12	22.1940	11.82	20.64	32.46	50.00	-17.54	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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# 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)

	(dBuV/m) (at 3M)		
FREQUENCY (MHz)	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	120 KHz / 300 KHz	
band)		

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 Frequency	Lower Band Edge: 2310 to 2410 MHz		
Start/Stop Frequency	Upper Band Edge: 2475 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.

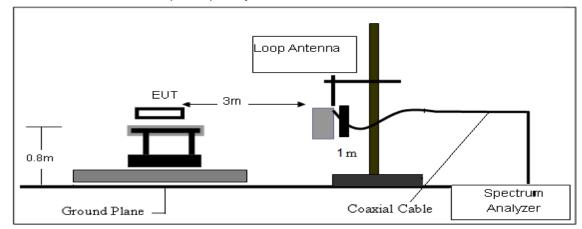
# 3.2.3 DEVIATION FROM TEST STANDARD

No deviation.

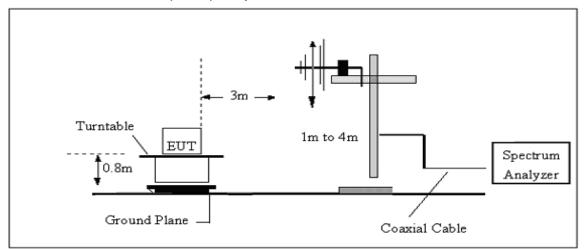


# 3.2.4 TESTSETUP

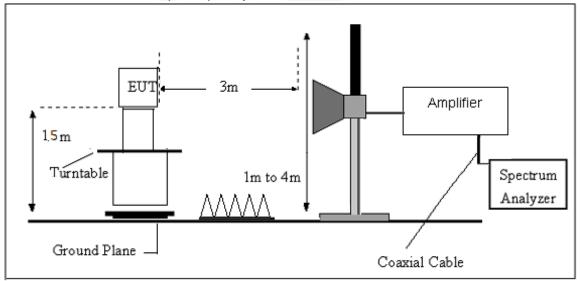
(A) Radiated Emission Test-Up Frequency Below 30MHz

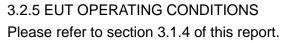


# (B) Radiated Emission Test-Up Frequency 30MHz~1GHz



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





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# 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:	23.3(C)	Relative Humidity:	61%RH
Test Voltage:	AC 120V/60Hz	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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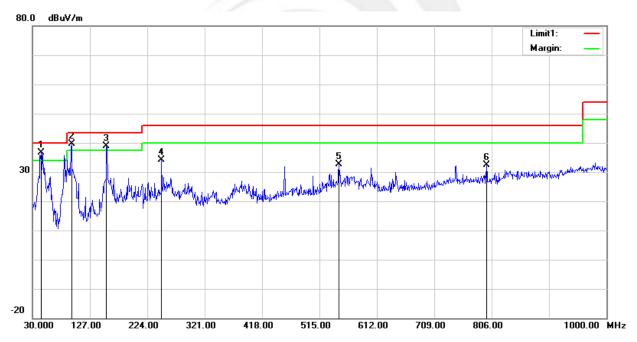
(30MHz-1000MHz)

Temperature:	23.3(C)	Relative Humidity:	61%RH			
Test Voltage:	AC 120V/60Hz	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	44.5500	57.18	-20.43	36.75	40.00	-3.25	QP
2	95.9600	60.33	-20.67	39.66	43.50	-3.84	QP
3	155.1300	57.57	-18.63	38.94	43.50	-4.56	QP
4	248.2500	50.67	-16.43	34.24	46.00	-11.76	QP
5	547.9800	38.74	-5.99	32.75	46.00	-13.25	QP
6	797.2700	34.31	-2.03	32.28	46.00	-13.72	QP

Remark:

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



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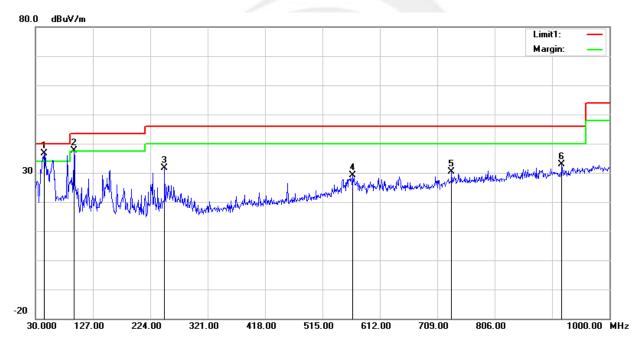
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Temperature:	23.3(C)	Relative Humidity:	61%RH		
Test Voltage:	AC 120V/60Hz	Phase:	Vertical		
Test Mode:	Mode 1/2/3/4/5/6/7/8/9(Mode 7 worst mode)				

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	44.5500	57.12	-20.43	36.69	40.00	-3.31	QP
2	94.9900	58.33	-20.78	37.55	43.50	-5.95	QP
3	248.2500	48.16	-16.43	31.73	46.00	-14.27	QP
4	566.4100	34.78	-5.57	29.21	46.00	-16.79	QP
5	733.2500	32.64	-2.35	30.29	46.00	-15.71	QP
6	919.4900	32.83	-0.03	32.80	46.00	-13.20	QP

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	Orrected Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBµV)	( <b>dB</b> )	( <b>dB</b> )	( <b>dB/m</b> )	( <b>dB</b> )	(dBµV/m)	(dBµV/m)	(dB)	Туре	
				Low Chan	nel (8DPSK/2	2402 MHz)				
3264.88	61.62	44.70	6.70	28.20	-9.80	51.82	74.00	-22.18	PK	Vertical
3264.88	51.71	44.70	6.70	28.20	-9.80	41.91	54.00	-12.09	AV	Vertical
3264.68	60.87	44.70	6.70	28.20	-9.80	51.07	74.00	-22.93	PK	Horizontal
3264.68	50.49	44.70	6.70	28.20	-9.80	40.69	54.00	-13.31	AV	Horizontal
4804.57	58.93	44.20	9.04	31.60	-3.56	55.37	74.00	-18.63	PK	Vertical
4804.57	50.04	44.20	9.04	31.60	-3.56	46.48	54.00	-7.52	AV	Vertical
4804.59	58.63	44.20	9.04	31.60	-3.56	55.07	74.00	-18.93	PK	Horizontal
4804.59	50.46	44.20	9.04	31.60	-3.56	46.90	54.00	-7.10	AV	Horizontal
5359.81	48.89	44.20	9.86	32.00	-2.34	46.55	74.00	-27.45	PK	Vertical
5359.81	40.25	44.20	9.86	32.00	-2.34	37.91	54.00	-16.09	AV	Vertical
5359.76	48.04	44.20	9.86	32.00	-2.34	45.70	74.00	-28.30	PK	Horizontal
5359.76	39.15	44.20	9.86	32.00	-2.34	36.81	54.00	-17.19	AV	Horizontal
7205.85	54.95	43.50	11.40	35.50	3.40	58.35	74.00	-15.65	PK	Vertical
7205.85	44.15	43.50	11.40	35.50	3.40	47.55	54.00	-6.45	AV	Vertical
7205.70	54.26	43.50	11.40	35.50	3.40	57.66	74.00	-16.34	PK	Horizontal
7205.70	44.20	43.50	11.40	35.50	3.40	47.60	54.00	-6.40	AV	Horizontal
				Middle Cha	nnel (8DPSK	/2441 MHz)				
3264.69	62.27	44.70	6.70	28.20	-9.80	52.47	74.00	-21.53	PK	Vertical
3264.69	50.57	44.70	6.70	28.20	-9.80	40.77	54.00	-13.23	AV	Vertical
3264.57	62.23	44.70	6.70	28.20	-9.80	52.43	74.00	-21.57	PK	Horizontal
3264.57	51.21	44.70	6.70	28.20	-9.80	41.41	54.00	-12.59	AV	Horizontal
4882.56	58.93	44.20	9.04	31.60	-3.56	55.37	74.00	-18.63	PK	Vertical
4882.56	50.45	44.20	9.04	31.60	-3.56	46.89	54.00	-7.11	AV	Vertical
4882.31	59.06	44.20	9.04	31.60	-3.56	55.50	74.00	-18.50	PK	Horizontal
4882.31	49.99	44.20	9.04	31.60	-3.56	46.43	54.00	-7.57	AV	Horizontal
5359.87	49.28	44.20	9.86	32.00	-2.34	46.94	74.00	-27.06	PK	Vertical
5359.87	39.78	44.20	9.86	32.00	-2.34	37.44	54.00	-16.56	AV	Vertical
5359.71	47.39	44.20	9.86	32.00	-2.34	45.05	74.00	-28.95	PK	Horizontal
5359.71	38.38	44.20	9.86	32.00	-2.34	36.04	54.00	-17.96	AV	Horizontal
7323.76	54.55	43.50	11.40	35.50	3.40	57.95	74.00	-16.05	PK	Vertical
7323.76	44.64	43.50	11.40	35.50	3.40	48.04	54.00	-5.96	AV	Vertical
7323.85	54.20	43.50	11.40	35.50	3.40	57.60	74.00	-16.40	PK	Horizontal
7323.85	43.48	43.50	11.40	35.50	3.40	46.88	54.00	-7.12	AV	Horizontal

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				High Chan	nel (8DPSK	/2480 MHz)				
3264.71	61.93	44.70	6.70	28.20	-9.80	52.13	74.00	-21.87	PK	Vertical
3264.71	50.44	44.70	6.70	28.20	-9.80	40.64	54.00	-13.36	AV	Vertical
3264.68	61.92	44.70	6.70	28.20	-9.80	52.12	74.00	-21.88	PK	Horizontal
3264.68	50.37	44.70	6.70	28.20	-9.80	40.57	54.00	-13.43	AV	Horizontal
4960.42	58.29	44.20	9.04	31.60	-3.56	54.73	74.00	-19.27	PK	Vertical
4960.42	49.62	44.20	9.04	31.60	-3.56	46.06	54.00	-7.94	AV	Vertical
4960.58	58.64	44.20	9.04	31.60	-3.56	55.08	74.00	-18.92	PK	Horizontal
4960.58	49.48	44.20	9.04	31.60	-3.56	45.92	54.00	-8.08	AV	Horizontal
5359.63	48.76	44.20	9.86	32.00	-2.34	46.42	74.00	-27.58	PK	Vertical
5359.63	40.36	44.20	9.86	32.00	-2.34	38.02	54.00	-15.98	AV	Vertical
5359.79	47.38	44.20	9.86	32.00	-2.34	45.04	74.00	-28.96	PK	Horizontal
5359.79	39.48	44.20	9.86	32.00	-2.34	37.14	54.00	-16.86	AV	Horizontal
7439.87	54.05	43.50	11.40	35.50	3.40	57.45	74.00	-16.55	PK	Vertical
7439.87	43.72	43.50	11.40	35.50	3.40	47.12	54.00	-6.88	AV	Vertical
7439.66	53.49	43.50	11.40	35.50	3.40	56.89	74.00	-17.11	PK	Horizontal
7439.66	44.94	43.50	11.40	35.50	3.40	48.34	54.00	-5.66	AV	Horizontal

Note:

- 1) Scan with GFSK,  $\pi$ /4-DQPSK, 8DPSK, the worst case is 8DPSK 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.



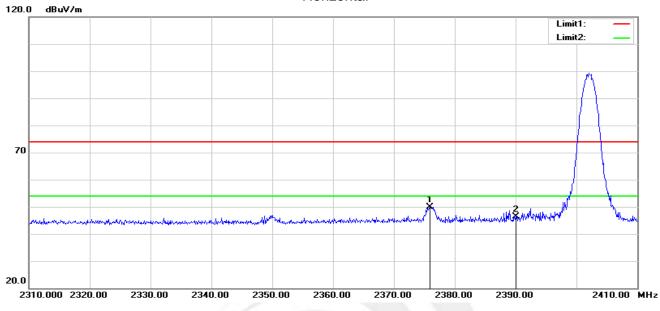
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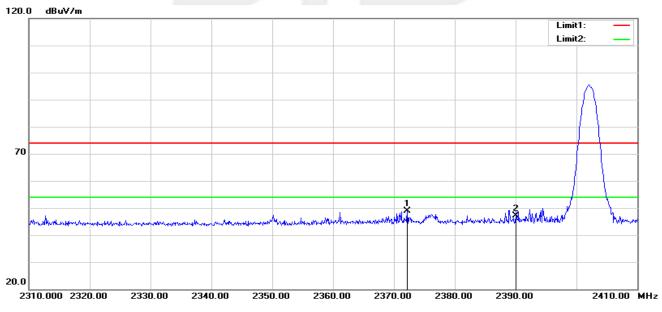
#### **Restricted band Requirements**

8DPSK-Low Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2375.900	45.82	4.13	49.95	74.00	-24.05	peak
2	2390.000	41.96	4.34	46.30	74.00	-27.70	peak

Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2372.200	44.73	4.08	48.81	74.00	-25.19	peak
2	2390.000	42.74	4.34	47.08	74.00	-26.92	peak

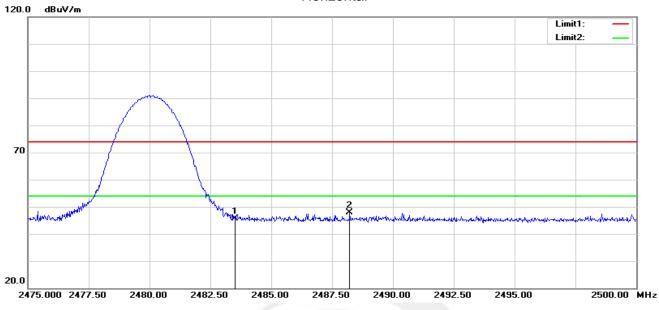
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Page 32 of 76

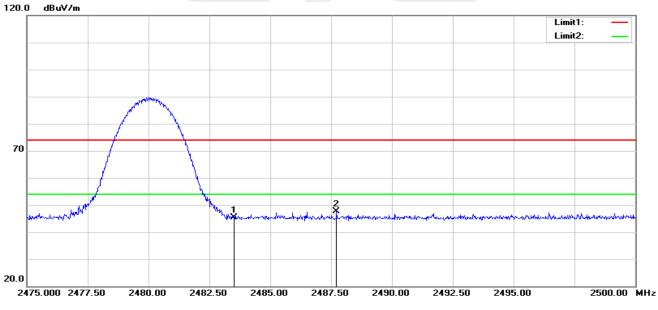
Report No.: STS2010120W01

#### 8DPSK-High Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	41.02	4.60	45.62	74.00	-28.38	peak
2	2488.225	43.20	4.62	47.82	74.00	-26.18	peak





No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	40.67	4.60	45.27	74.00	-28.73	peak
2	2487.725	42.90	4.62	47.52	74.00	-26.48	peak

Note: GFSK,  $\pi/4$ -DQPSK, 8DPSK of the nohopping and hopping mode all have been test, the worst case is 8DPSK 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		
	Upper Band Edge: 2475 – 2500 MHz		
RB / VB (emission in restricted band)	100 KHz/300 KHz		
Trace-Mode:	Max hold		

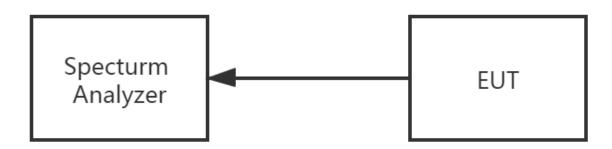
# For Hopping Band edge

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		

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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.

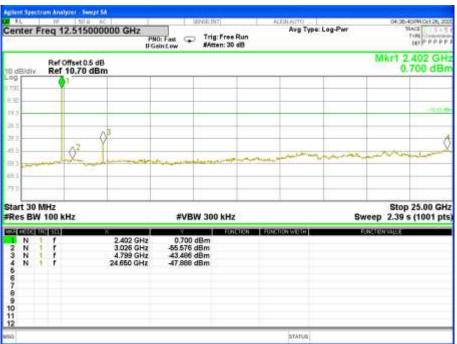


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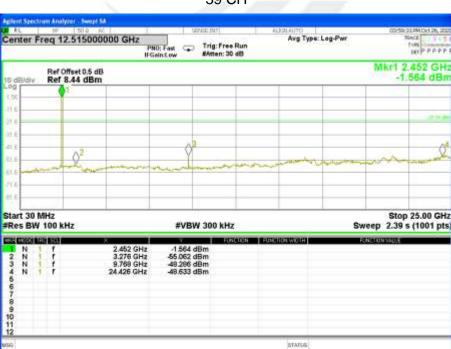


# 4.5 TEST RESULTS

Temperature:	<b>25</b> ℃	Relative Humidity:	50%
Test Mode:	GFSK(1Mbps)-00/39/78 CH	Test Voltage:	AC 120V/60Hz



# 00 CH



39 CH

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# 78 CH

enter	Freq		00000 GHz	D: Fast Trig: F SinLow SAtten	ree Run 30 dB	Aug Type: Log-Pwr	19246	MOH 26, 20 S PPPPPP
dBidiv.		f Offset 0.5 of 7.93 dB					Mkr1 2.4 -2.0	77 GH 74 dBr
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21 4240		- Andre						
2)-		-	_		-			
tart 30 Res BV				#VBW 300 k	Hz	s	Stop 2 weep 2.39 s (	5.00 GH 1001 pt
2 Diel	10111		8		FUNCTION		RENIGHOW WALLE	_
NNNN 234667890			2.477 GHz 3.026 GHz 9.918 GHz 24.426 GHz	-2.074 dBm -55.397 dBm -49.082 dBm -47.808 dBm				
7 8 9 0 1 2								
q						STATUS		



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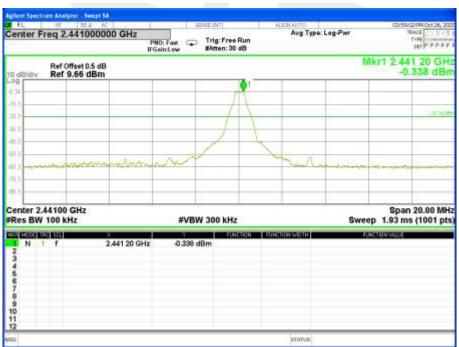


#### For Band edge(it's also the reference level for conducted spurious emission)



00 CH

39 CH



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### 78 CH

enter Freq 2.48750	00000 GHz PHO: IFGeir	Fast Trig: Free Run Low SAtten: 30 dB	Aug Type: Log-Pwr	D4:01:30 PM Ort 26, 30 TRACE
Ref Offset 0.5				Mkr1 2.480 200 GH -0.982 dBr
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1.0	1			200
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10 months	- AL	02 03		04
0				
1.0				
tart 2.47500 GHz Res BW 100 kHz		#VBW 300 kHz	Sv	Stop 2.50000 GH veep 2.40 ms (1001 pt
			FORCIDO WORH	CONTRACTOR NO.
N 1 F 3 N 1 F 4 N 1 F	2.480 200 GHz 2.483 500 GHz 2.485 075 GHz 2.496 500 GHz	-0.902 dBm -59.543 dBm -57.764 dBm -59.683 dBm		
6 6 7 8 9 9				
1				



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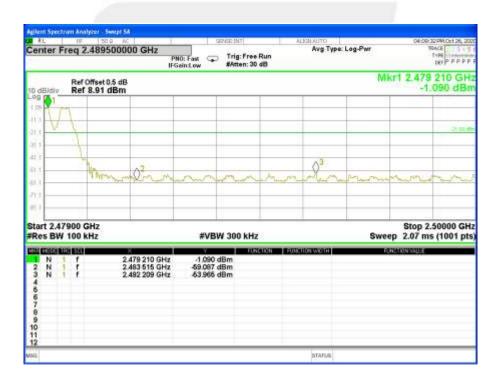
A 1/F, Building B, Zhuoke Science Park, No.190 Chongqing Road, HepingShequ, Fuyong Sub-District, Bao'an District, Shenahen, Guang Dong, China Tel: +86-755 3688 6288 Fax:+86-755 3686 6277 Http://www.stsapp.com E-mail: sts@stsapp.com



#### For Hopping Band edge

GFSK

ente		2.3515000	00 GHz	HO: Fast	Trig: Free #Atten: 30	Run	ALEGNALITO Avg Type	: Log-Pwr	194	PM Oct 26, 20
D dEM		f Offset 0.5 dB	1	GeinLow	Antien: Ju	40		M	1kr1 2.401 8	867 GH
700										
1.22										
19.3		_				-	_	-		TREE
07						-		-		_
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82 -							nasanasaana	Adity Ang Children	Uponnana hada	onnutv.
19.7 -										
ni)										
72										
tart 2	2.30000 BW 100			#VBV	V 300 kHz	6		Swe	Stop 2.4 eep 9.87 ms	
Res I	BW 100	kHz			EU.	-	NCTION WIDTH			
Res I	BW 100	2 2 2	2.401 967 GHz 390 022 GHz 2.400 013 GHz	#VBV 0.779 d -54.553 d -51.406 d	Bm Bm	-	NCTION WIGTH		eep 9.87 ms	
tart 2 Res i	BW 100	2 2 2	401 867 GHz 390 022 GHz	0.779 d -54.553 d	Bm Bm	-	ACTER WORTH		eep 9.87 ms	



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### Page 40 of 76 Report No.: STS2010120W01

Temperature:	<b>25</b> ℃	Relative Humidity:	50%
Test Mode:	π/4-DQPSK(2Mbps)– 00/39/78 CH	Test Voltage:	AC 120V/60Hz

RL	-	10	50.9 //		-	ARVER INT	ALIXIN AUTO	Log-Pwr		OPM Out 26, 20
enter	FR	eq 1	2.515000	000 GHz	0: Fast	Trig: Free Run #Atten: 30 dB	Avg type	Log-rwr		DET P P P P T
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4.0			040		0					
4.0		1	Contra to a	Line - alle	Y	-	mann		- share	- w
1.0	100									
4D										
tart 3 Res B			Hz		#VB	W 300 kHz		S	weep 2.39 s	25.00 GH
E IDE	110						FUNCTION WOTH		STREET, MARKEN WARDS	
NNNN 234667890				2.402 GHz 2.577 GHz 9.618 GHz 24.675 GHz	4,010 -54,943 -48,774 -47,881	dBm dBm				
67										
9										
1 2										
4	-						STATUS			

#### 00 CH

00	011
39	CH
00	

enter		12.5150	00000 GHz		Free Run	Avg Type: L	og-Pwr	10	INPROPERTY OF PERFORMANCE
		of Offset 0.5	dB	in1.ow #Atte	n: 30 dB			Mkr1 2	452 GH
dEldi	R	ef 8.79 dB	im:					-	- 14 00
		-							-2143
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-		02	\ <sup>3</sup>						
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2					_	_			
art 30	MHz							Stop	25.00 G
Res B	W 100	0 kHz		#VBW 300	kHz		Swe	ep 2.39 s	
	ALC: NO	0.	2.452 GHz	-1,214 dBm	RUNCIDN	FUNCTION WOTH	68	SOUNDO:	
2 N	1		3.301 GHz 7.022 GHz	-55,418 dBm -55,546 dBm					
4 N.	1 1		24.700 GHz	-48.007 dBm					
5									
8									
2									
						STATUS			

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## 78 CH

enter	Fre	eq 1			0: Fast 🗣	Trig: Free #Atten: 30	Run	Autoliauto Avg Type:	.og-Pwr	194	PM Oct 28, 20 CE PE EI P P P P P
delide	v:	Ref Ref	Offset 0.5 7.87 dE	dB Sm						Mkr1 2.4 -2.1	177 GH 33 dBr
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21	-	-									2111
-12		-	2	Q2							-
21	-	1-m	there are		-il-inite		man stan	and the second	Print Laboratory	plant of the second	A.a.T
tart 30 Res B			KHZ		#VBV	/ 300 kHz		1	S	Stop 2 weep 2.39 s	5.00 GH
SI EDRO		-						HERWICE H		SUMMER	
N 2 N 3 N 4 N 6 7		1 1 1 1		2.477 GHz 2.652 GHz 4.949 GHz 24.675 GHz	-2.133 d -55.440 d -49.006 d -48.537 d	Bm Bm Bm					
8 9 0											
2	-	-					_	STATUS			



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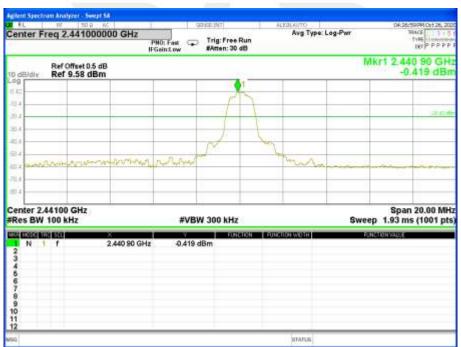


#### For Band edge(it's also the reference level for conducted spurious emission)



00 CH

39 CH



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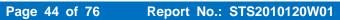
### 78 CH

enter Freq 2.48750000			Avg Type: Log-Pwr	043	IRACE TYPE DEF P P P P
Ref Offset 0.5 dB	1			Mkr1 2.47	9 900 GH 1.011 dBr
					284
	L ma	0ª		0 <sup>4</sup>	
10	Town May	¥>			
tart 2.47500 GHz Res BW 100 kHz		#VBW 300 kHz	s	Stop weep 2.40 r	2.50000 GH ns (1001 pt
2 N F 24 3 N F 24 4 N F 24 6 6 7	83 500 GHz -55 87 125 GHz -56	.011 dBm .846 dBm .495 dBm .261 dBm	ENCOLOUMON I	KINCTON/AUX	
6 9 0 1					



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### For Hopping Band edge

#### $\pi/4$ -DQPSK

enter	Fre	q 2	3515000	00 GHz	10: Fast 🗭	Trig: Free Run #Atten: 30 dB		Type: Log-Pwr	16.6	PHIOLET 28, 200 PHIOLET 28, 20
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16										111.01
0.0										1
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00-0						Allandy	ushtmanlalah	Landon Wyatso	NWANNA AND	MARK!
0.0 1.0										
tart 2. Res B					#VBW	/ 300 kHz	-	Swe	Stop 2.40 ep 9.87 ms (	
CE EDIO	110						AUXCIDIN WORK		SHEROWARDS	
NNN 2346678		ţ	2	401 867 GHz 390 022 GHz 400 013 GHz	0.378 d -55.384 d -54.348 d	Bm				
8 9 0 1 2							STATU	6		

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tart							#VBW	300 kH	z		Sw	Stop 2 tep 2.07 m	.50000 GH
	<b>ECH</b>	1125	-	_	2.42	9 169 GHz	-1.245 di		NCION I H	HEOWERINGER		STATUTE STATUTE	
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4			-										
6670													
890													
1													
4										STATUS			

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Page 45 of 76 Report No.: STS2010120W01

Temperature:	<b>25</b> ℃	Relative Humidity:	50%
Test Mode:	8DPSK(3Mbps) -00/39/78 CH	Test Voltage:	AC 120V/60Hz

	IL.		107	150.0 /	1		EPAGE INT		ALESIALITO	1000000	04:40:3	0.PM Oct 26, 203
er	nter	Fre	eq 1	2.515000		0: Fast	Trig: Free #Atten: 30	Run	Avg Type	Log-Pwr	10	NCE DET PPPPP
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10.1			t	0 <sup>2</sup>		03						Q
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11								-				
	rt 3		Hz 100 l	kHz		#VB	N 300 kHz			s	Stop weep 2.39 s	25.00 GH (1001 pt
	ID HO		-	-				100	HOROLOGICAL MICHAEL		RENIGION VILLER	
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2346678901												
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### 00 CH

39	CH
00	OII

Cen		Fre	q 1	2.51500	00000 GHz	0: Fast 🗣	Trig: Free Run	ALESIALTO Avg Type: L	og-Pwr	16	IPM Oct 26, 20 ACE
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Star	t 30 5 B1		Hz 00 k	Hz		#VBV	/ 300 kHz		Swe	Stop 2.39 s	25.00 GH (1001 pt
	Dici	110	<b>10</b>			-1,181 d		FORCHOR WORK	F38	LALON WILLIE	
200	ZZZZ				2.452 GHz 3.251 GHz 9.768 GHz 24.625 GHz	-55,483 d -49,496 d -47,738 d	Bm Bm				
4667890											
10											
à l								STATUS			

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## 78 CH

enter Fi	req 12	2.51500	0000 GHz	0: Fast 🗣	Trig: Free R #Atten: 30 d	un	Avg Type: I	Log-Pwr	194	PM Cel 28, 20 CE PE ET P P P P P
o dElidiv		ffset 0.5 d 7.95 dBn							Mkr1 2.4 -1.0	177 GH 92 dBi
2.1										291
43 6.1		02		0.	-				44.	Q
21	man	Les		tourking		الرمله فاعمرهم		i yezeren		41.5
tart 30 M Res BW		Hz		#VBW	300 kHz			S	Stop 2 weep 2.39 s (	25.00 GH
CE IDECI NO						ION FUNC	ION WOTH		SHADAWARE	
2346 7890	ł		2.477 GHz 3.326 GHz 9.618 GHz 24.426 GHz	-1.092 d -55.347 d -53.782 d -47.942 d	Bm Bm					
8 9 0 1 2										
9							STATUS			



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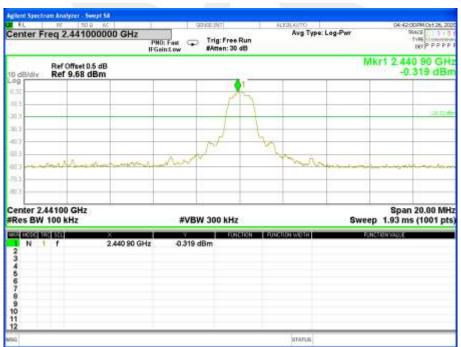


#### For Band edge(it's also the reference level for conducted spurious emission)



#### 00 CH

39 CH



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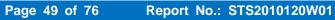
## 78 CH

enter Freq 2.487500000 G	Hz PNO: Fast IFGeint.cw Trig: Free R #Atten: 30 d	Avg Type: Log-Pwr tun 8	D4-44-31 PM Cut 26, 20 NoACE
Ref Offset 0.5 dB			Mkr1 2.479 900 GH -1.007 dBr
			2014
ne	mar O2	Q <sup>3</sup>	
10 10			
tart 2.47500 GHz Res BW 100 kHz	#VBW 300 kHz	s	Stop 2.50000 GH weep 2.40 ms (1001 pt
COCC 103 510 00 1 N 1 f 2479 9 2 N 1 f 2479 3 3 N 1 f 2493 5 3 N 1 f 2490 0 4 N 1 f 2490 0 6 6 7	00 GHz -1.007 dBm 00 GHz -59,705 dBm 00 GHz -59,206 dBm	ICH RUICHIGH WICHH	Restorionivalue
/ 9 0 1			



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## For Hopping Band edge

8DPSK

RL.	1.0	FF 50	0 10		I	3768	2.0MT		ADDIN	UT0	A DESCRIPTION OF	:04:	50:10 PM 0	126,20
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tart 2. Res B	W 10	0 kHz		2 007 CU			00 kHz				Sw	Stop	2.4030 ms (10	10 GI
tart 2. Res B	W 10	0 kHz	2.40	2 897 GHz 0 022 GHz	t 0. 55.	898 dBn 103 dBn	00 kHz				Sw	Stop eep 9.87	2.4030 ms (10	10 GI
tart 2. Res B	W 10	0 kHz	2.40		t 0. 55.	999 dBn	00 kHz				Sw	Stop eep 9.87	2.4030 ms (10	10 GI
tart 2. Res B 2000 1 N 2 N 3 N 4	W 10	0 kHz	2.40	0 022 GHz	t 0. 55.	898 dBn 103 dBn	00 kHz				Sw	Stop eep 9.87	2.4030 ms (10	10 GI
tart 2. Res B 2 010 1 N 2 N 3 N 4 5 5 7	W 10	0 kHz	2.40	0 022 GHz	t 0. 55.	898 dBn 103 dBn	00 kHz				Sw	Stop eep 9.87	2.4030 ms (10	10 GI
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## 5. NUMBER OF HOPPING CHANNEL

5.1 LIMIT

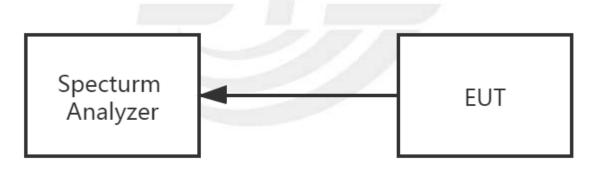
FCC Part 15.247,Subpart C					
Section	Test Item	Limit	FrequencyRange (MHz)	Result	
15.247 (a)(1)(iii)	Number of Hopping Channel	≥15	2400-2483.5	PASS	

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:	AC 120V/60Hz

## Number of Hopping Channel

79

# Hopping channel

Trig:Fre		Avg Type:		2 2.480	160 0 GH
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AVRW 300 FH			Dava		2.48350 GI
	The second second second	NOTWOOD .		A designation of the second	is (roor p
0.99 dBm					
		0.99 dBm	0.99 dBm	0.99 dBm 4.82 dBm	PVBW 300 kHz Sweep 1.13 m s and a consistent for some of the consistent of the cons

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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). Sothe dwell time is the time duration of the pulse times 3.37 x 31.6 = 106.6 within 31.6 seconds.
- j. DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots RX, 1 time slot TX). So he dwell time is the time duration of the pulse times  $5.06 \times 31.6 = 160$  within 31.6 seconds.
- k. DH1 Packet permit maximum 1600 / 79 /2 = 10.12 hops per second in each channel (1 time slot RX, 1 time slot TX). So the dwell time is the time duration of the pulse times 10.12 x 31.6 = 320 within 31.6 seconds.

6.3 TEST SETUP



#### 6.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.



## 6.5 TEST RESULTS

Temperature:	<b>25</b> ℃	Relative Humidity:	50%
Test Mode:	GFSK(1Mbps)-DH1/DH3/DH5	Test Voltage:	AC 120V/60Hz

Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
DH1	middle	0.397	0.127	0.4
DH3	middle	1.655	0.265	0.4
DH5	middle	2.905	0.310	0.4



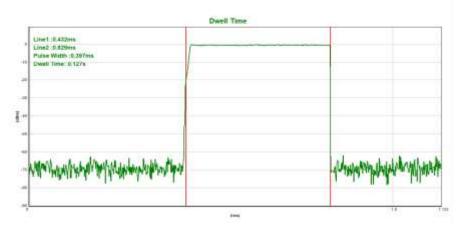
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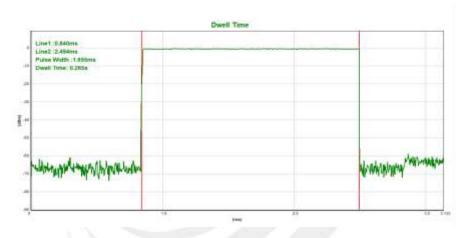
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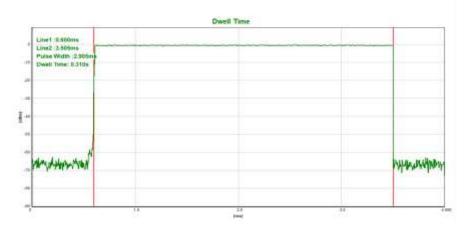
#### CH39-DH1



#### CH39-DH3







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Temperature:	<b>25</b> ℃	Relative Humidity:	50%
	π/4-DQPSK(2Mbps)– 2DH1/2DH3/2DH5	Test Voltage:	AC 120V/60Hz

Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
2DH1	middle	0.406	0.130	0.4
2DH3	middle	1.658	0.265	0.4
2DH5	middle	2.908	0.310	0.4



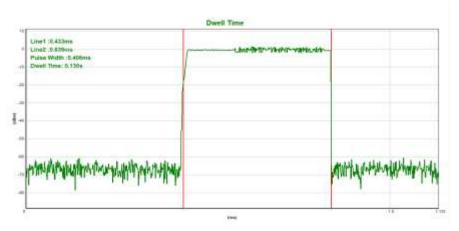
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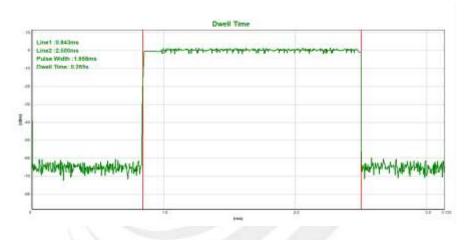
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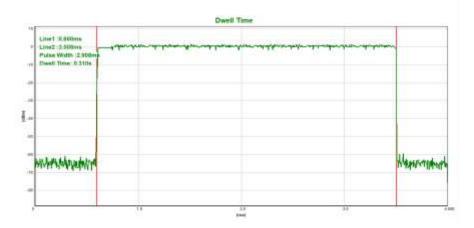
### CH39-2DH1











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Temperature:	<b>25</b> ℃	Relative Humidity:	50%
	8DPSK(3Mbps)– 3DH1/3DH3/3DH5	Test Voltage:	AC 120V/60Hz

Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
3DH1	middle	0.407	0.130	0.4
3DH3	middle	1.658	0.265	0.4
3DH5	middle	2.915	0.311	0.4



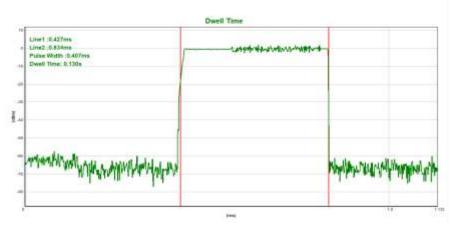
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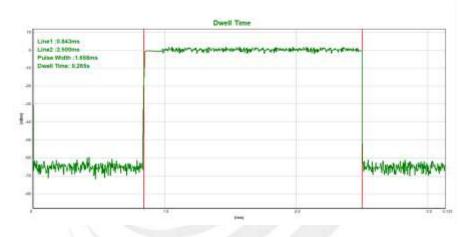
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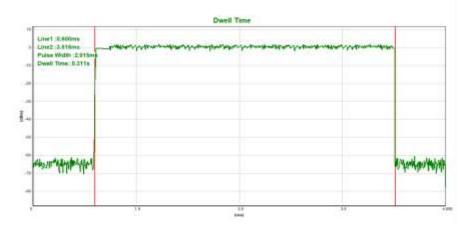
### CH39-3DH1



#### 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:	25℃	Relative Humidity:	50%
	CH00 / CH39 / CH78 (GFSK(1Mbps) Mode)	Test Voltage:	AC 120V/60Hz

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2401.882	2402.881	0.999	0.873	Complies
2441 MHz	2440.882	2441.881	0.999	0.870	Complies
2480 MHz	2478.882	2479.881	0.999	0.872	Complies

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

#### CH00 -1Mbps

RL 10 50 9 M	SERVER INT	ALIGNALITO	03:55:04 PM Oct 26, 20
	10: Wide 🖙 Trig: Free Run Seint.ow #Atten: 30 dB	Avg Type: Log-Pwr	TYPE DEPPP
Ref Offset 0.5 dB 0 dBidly Ref 9.23 dBm		M	412 2.402 881 GH -0.797 dBr
89 077	~~~~	2 miles	
08 08	-	and the	~
02			m
DE CONTRACTOR			
0.6			
enter 2.402500 GHz Res BW 30 kHz	#VBW 100 kHz	Swee	Span 3.000 MH p 3.20 ms (1001 pt
1 N 1 f 2.401 882 GHz	-0.77 dBm	E0000GWQC	04000000
2 N 1 f 2.402 881 GHz	-0.80 dBm		
6 7			
7 9 9			
11			
2			

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#### CH39 -1Mbps



CH78 -1Mbps



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Temperature:	25℃	Relative Humidity:	50%
	CH00 / CH39 / CH78 (π/4-DQPSK(2Mbps) Mode)	Test Voltage:	AC 120V/60Hz

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2401.879	2402.881	1.002	0.864	Complies
2441 MHz	2440.879	2441.878	0.999	0.863	Complies
2480 MHz	2478.882	2479.881	0.999	0.861	Complies

For  $\pi$ /4-DQPSK(2Mbps): Ch. Separation Limits: > two-thirds 20dB bandwidth

KL 107 50.0 M	1 987488-1MT	ALICINALITO	04:04:41/PM Oct 25, 202
Center Freq 2.402500000 GHz	PHO: Wide Trig: Free Run IFGaint.ow #Atten: 30 dB	Avg Type: Log-Pwr	TVPE LEADER
Ref Offset 0.5 dB Ref 8.65 dBm		Mk	r2 2.402 881 GH -1.374 dBr
89 (3)	-	- Com	
ne p			2
n.a			1a
1.4			
1 4			
Center 2.402500 GHz			Span 3.000 MH
Res BW 30 kHz	#VBW 100 kHz	Swee	p 3.20 ms (1001 pt
1 N 1 f 2.401 879 GH N 1 f 2.402 881 GH N 1 f 2.402 881 GH		RUNCTION WIGH	NAMES AND ADDRESS OF ADDRES
3			
6 6 7			
8			
10 11 12			
50		STATUS	

#### CH00 -2Mbps

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#### CH39 -2Mbps



#### CH78 -2Mbps



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Temperature:	25℃	Relative Humidity:	50%
	CH00 / CH39 / CH78 (8DPSK(3Mbps)Mode)	Test Voltage:	AC 120V/60Hz

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2401.882	2402.884	1.002	0.809	Complies
2441 MHz	2440.885	2441.884	0.999	0.810	Complies
2480 MHz	2478.885	2479.884	0.999	0.811	Complies

For 8DPSK(3Mbps):Ch. Separation Limits: > two-thirds 20dB bandwidth

CH00 -3Mbps

KL 11 50.0 M	SEVER INT	ALIXINAUTO	04:39:27PM Oct 26, 202
enter Freq 2.402500000	GHz PHO: Wide Trig: Free I IFGaint.ow #Atten: 30	Avg Type: Log-Pwr 80	TVPE DEPP
Ref Offset 0.5 dB dBidiy Ref 10.28 dBm		ľv	1kr2 2.402 884 GH 0.262 dBr
20	8 m	2 Ann	
172		and vitro	mal
n?			X
17			p
87			
0.7			
97			
enter 2.402500 GHz Res BW 30 kHz	#VBW 100 kHz	Sw	Span 3.000 MH eep 3.20 ms (1001 pt
	1 882 GHz 0.29 dBm	TCN FUNCTION WICH	FERRINA
	2 884 GHz 0.25 dBm		
4			
67			
9 10			
11			
8		STATUS	

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#### CH39 -3Mbps



#### CH78 -3Mbps



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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.

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### 8.5 TEST RESULTS

Temperature:	25℃	Relative Humidity:	50%
	GFSK(1Mbps) CH00 / CH39 / C78	Test Voltage:	AC 120V/60Hz

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	0.8729	PASS
2441 MHz	0.8703	PASS
2480 MHz	0.8721	PASS

#### CH00 -1Mbps



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#### CH39 -1Mbps



#### CH78 -1Mbps



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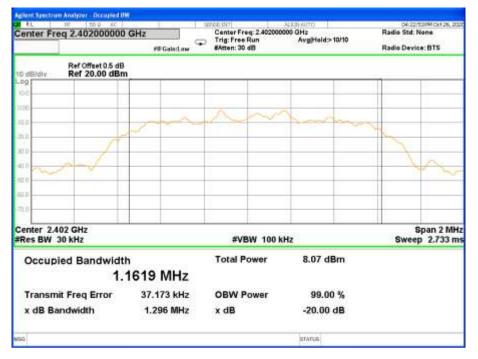


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Temperature:	25℃	Relative Humidity:	50%
	π/4-DQPSK(2Mbps) CH00 / CH39 / C78	Test Voltage:	AC 120V/60Hz

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	1.296	PASS
2441 MHz	1.294	PASS
2480 MHz	1.292	PASS

#### CH00 -2Mbps



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#### CH39 -2Mbps



#### CH78 -2Mbps



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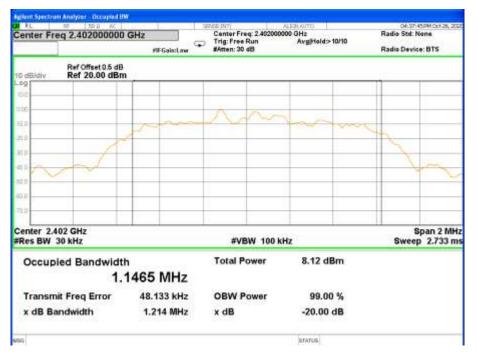


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Temperature:	25℃	Relative Humidity:	50%
	8DPSK(3Mbps) CH00 / CH39 / CH78	Test Voltage:	AC 120V/60Hz

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	1.214	PASS
2441 MHz	1.215	PASS
2480 MHz	1.216	PASS

### CH00 -3Mbps



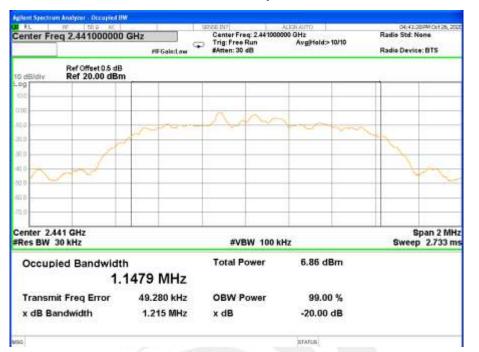
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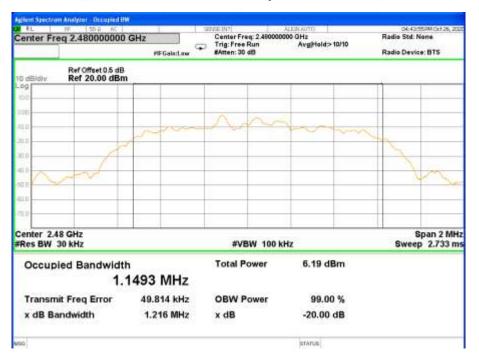
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#### CH39 -3Mbps



#### CH78 -3Mbps



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# 9. OUTPUT POWER TEST

### 9.1 LIMIT

FCC Part 15.247,Subpart C				
Section	Test Item	Limit	FrequencyRange (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.

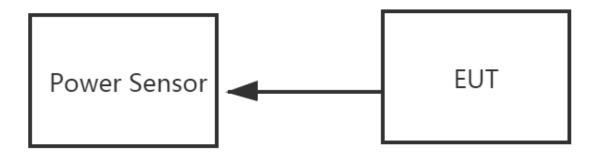
e) A plot of the test results and setup description shall be included in the test report.

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.

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#### 9.5 TEST RESULTS

Temperature:	25℃	Relative Humidity:	60%
Test Voltage:	AC 120V/60Hz		

Mode	Channel Frequency Number (MHz)	Peak Power	Average Power	Limit	
		(MHz)	(dBm)	(dBm)	(dBm)
GFSK(1M)	0	2402	0.96	-0.45	30.00
	39	2441	0.25	-0.98	30.00
	78	2480	-0.83	-1.91	30.00

Note: the channel separation >20dB bandwidth

Mode	Channel Frequency Number (MHz)		Peak Power	Average Power	Limit
		(dBm)	(dBm)	(dBm)	
π/4-DQPSK( 2M)	0	2402	3.49	-0.63	20.97
	39	2441	2.72	-1.38	20.97
	78	2480	1.60	-2.36	20.97

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

Mode	Channel Frequency Number (MHz)	Frequency	Peak Power	Average Power	Limit
		(MHz)	(dBm)	(dBm)	(dBm)
8-DPSK(3M)	0	2402	4.06	-0.66	20.97
	39	2441	3.23	-1.40	20.97
	78	2480	2.13	-2.44	20.97

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

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### 10. ANTENNA REQUIREMENT

#### 10.1 STANDARD REQUIREMENT

15.203 requirement: For intentional device, according to 15.203: an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

#### 10.2 EUT ANTENNA

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



Shenzhen STS Test Services Co., Ltd.

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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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