

RADIO TEST REPORT

Report No.: STS2011141W01

Issued for

Tectronics Global Limited

Rm 2106, 21/F, Kwong Kin Trade Centre, No.5, Kin Fat Stre et, Tuen Mun, HONG KONG

Product Name:	BT&NC Headphone			
Brand Name:	Tsound			
Model Name:	Tsound02240			
Series Model:	N/A			
FCC ID:	2AQSM-TSOUND02240			
Test Standard:	FCC Part 15.247			

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L A R

S T S



TEST RESULT CERTIFICATION

Applicant's Name:	Tectronics Global Limited
Address	Rm 2106, 21/F, Kwong Kin Trade Centre, No.5, Kin Fat Street, Tu en Mun, HONG KONG
Manufacturer's Name:	Honsenn Technology Co.,Ltd
Address	No.230,Er Heng Road ,Wentang Zhuanyao Industrial Zone,Dongcheng District,Do ngguan City,Guangdong province, China
Product Description	
Product Name:	BT&NC Headphone
Brand Name	Tsound
Model Name:	Tsound02240
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:	18 Nov. 2020
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Date (s) of performance of tests : 18 Nov. 2020 ~ 16 Dec. 2020

Date of Issue: 16 Dec. 2020

Test Result Pass

Testing Engineer (Chris Chen) **Technical Manager** : (Sean she Authorized Signatory : (Vita Li)

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Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	16 Dec. 2020	STS2011141W01	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	±4.39dB
4	All emissions, radiated 1G-6GHz	±5.10dB
5	All emissions, radiated>6G	±5.48dB
6	Conducted Emission (9KHz-150KHz)	±2.79dB
7	Conducted Emission (150KHz-30MHz)	±2.80dB



2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	BT&NC Headphone		
Trade Name	Tsound		
Model Name	Tsound02240		
Series Model	N/A		
Model Difference	N/A		
Channel List	Please refer to the Note 2.		
Bluetooth	Frequency:2402 – 2480 MHz Modulation: GFSK(1Mbps), π/4-DQPSK(2Mbps), 8DPSK(3Mbps)		
Bluetooth Version	5.0		
Bluetooth Configuration	BR+EDR		
Antenna Type	Please refer to the Note 3.		
Power Rating	Input: DC 5V		
Battery	Rated Voltage:3.7V Capacity: 550mAh		
Hardware version number	REV:2.0		
Software version number	V1.8		
Connecting I/O Port(s)	Please refer to the Note 1.		

Note:

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





2.

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

3. Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	Tsound	Tsound02240	PCB	N/A	1.5dBi	BT Antenna

Note: The antenna information refer the manufacturer provide report, applicable only to the tested sample identified in the report.

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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.



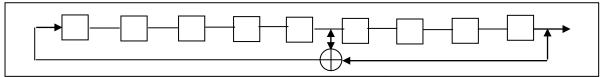
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The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping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

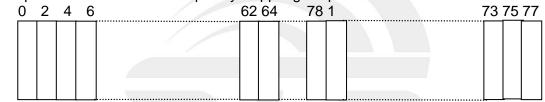
(2)The Pseudorandom sequence may be generated in a nin-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones: i.e. the shift register is initialized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

Numver of shift register stages:9

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



Liner Feedback Shift Register for Generator of the PRBS sequence An example of Pseudorandom Frequency Hoppong Sequence as follow:



Each frequency used equally on 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.



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	

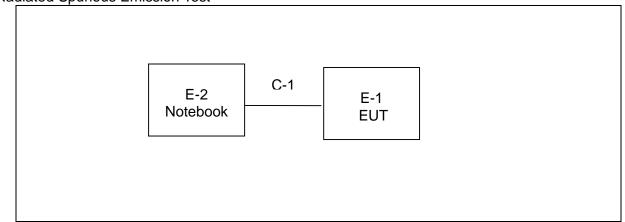
RF Function	Туре	Mode Or Modulation type	Ant Gain(dBi)	Power Class	Software For Testing
		GFSK	1.5	8	
ВТ	BR+EDR	π/4-DQPSK	1.5	8	AWRDLAB_R_1_0_4_173
		8DPSK	1.5	8	



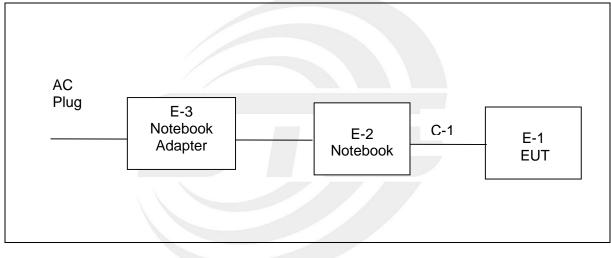
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2.5 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED Radiated Spurious Emission Test



Conducted Emission Test





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 Notebook **LENOVO** N/A E-3 ADLX45DLC3A N/A Adapter E-2 Notebook LENOVO ThinkPad E470 N/A N/A C-1 **USB** Cable N/A N/A N/A 150cm

Note:

- (1) For detachable type I/O cable should be specified the length in cm in ^CLength₂ 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	2020.10.12	2021.10.11	
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	2021.10.11	
LISN	R&S	ENV216	101242	2020.10.12	2021.10.11	
LISN	EMCO	3810/2NM	23625	2020.10.12	2021.10.11	
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	
			MY55520005	2020.10.10	2021.10.09	
Power Sensor			MY55520006	2020.10.10	2021.10.09	
Power Sensor	Keysight	U2021XA	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 Emiss	sionlimit (dBuV)
FREQUENCY (MHz)	Quasi-peak	Average
0.15 -0.5	66 - 56 *	56 - 46 *
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00

Note:

- (1) The tighter limit applies at the band edges.
- (2) The limit of "*" marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

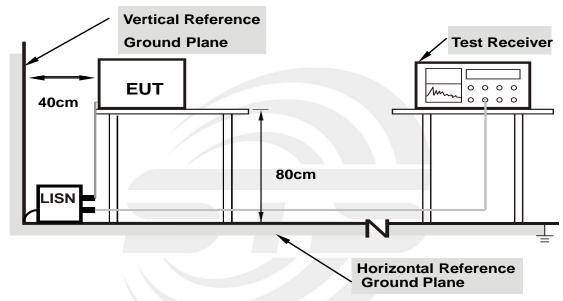
The following table is the setting of the receiver

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



3.1.2 TEST PROCEDURE

- a. The EUT is 0.8 m from the horizontal ground plane and 0.4 m from the vertical ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments are powered from additional LISN(s). The LISN provides 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- d. LISN is at least 80 cm from the nearest part of EUT chassis.
- e. For the actual test configuration, please refer to the related Item -EUT Test Photos.



3.1.3 TEST SETUP

Note: 1. Support units were connected to second LISN.

2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes support units.

3.1.4 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.



3.1.5 TEST RESULT

Temperature:	25.1(C)	Relative Humidity:	52%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	0.1540	38.77	20.23	59.00	65.78	-6.78	QP
2	0.1540	17.92	20.23	38.15	55.78	-17.63	AVG
3	0.5500	14.58	20.42	35.00	56.00	-21.00	QP
4	0.5500	2.65	20.42	23.07	46.00	-22.93	AVG
5	1.5220	18.06	20.11	38.17	56.00	-17.83	QP
6	1.5220	10.31	20.11	30.42	46.00	-15.58	AVG
7	5.0900	11.44	19.94	31.38	60.00	-28.62	QP
8	5.0900	-0.62	19.94	19.32	50.00	-30.68	AVG
9	10.8020	7.14	20.13	27.27	60.00	-32.73	QP
10	10.8020	-3.73	20.13	16.40	50.00	-33.60	AVG
11	22.3180	9.70	20.59	30.29	60.00	-29.71	QP
12	22.3180	-2.17	20.59	18.42	50.00	-31.58	AVG

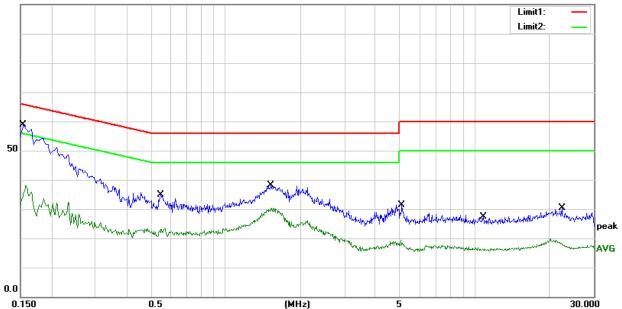
Remark:

1. All readings are Quasi-Peak and Average values

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

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







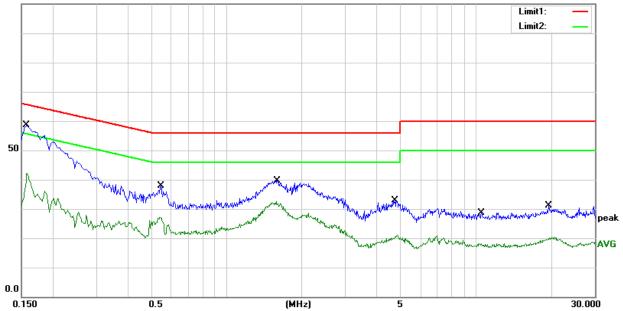
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Temperature:	25.1(C)	Relative Humidity:	52%RH
Test Voltage:	AC 120V/60Hz	Phase:	Ν
Test Mode:	Mode 13		

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.1580	38.32	20.23	58.55	65.57	-7.02	QP
2	0.1580	21.94	20.23	42.17	55.57	-13.40	AVG
3	0.5460	17.32	20.43	37.75	56.00	-18.25	QP
4	0.5460	6.79	20.43	27.22	46.00	-18.78	AVG
5	1.5940	19.47	20.10	39.57	56.00	-16.43	QP
6	1.5940	12.47	20.10	32.57	46.00	-13.43	AVG
7	4.7340	12.92	19.95	32.87	56.00	-23.13	QP
8	4.7340	0.75	19.95	20.70	46.00	-25.30	AVG
9	10.5380	8.49	20.13	28.62	60.00	-31.38	QP
10	10.5380	-1.96	20.13	18.17	50.00	-31.83	AVG
11	19.5820	10.51	20.60	31.11	60.00	-28.89	QP
12	19.5820	-0.51	20.60	20.09	50.00	-29.91	AVG

Remark:

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



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^{1.} All readings are Quasi-Peak and Average values



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)			
FREQUENCT (MITZ)	PEAK	AVERAGE		
Above 1000	74	54		

Notes:

(1) The limit for radiated test was performed according to FCC PART 15C.

- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (uV/m).

LIMITS OF RESTRICTED FREQUENCY BANDS

FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (GHz)
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

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For Radiated Emission

Spectrum Parameter	Setting		
Attenuation	Auto		
Detector	Peak/QP/AV		
Start Frequency	9 KHz/150KHz(Peak/QP/AV)		
Stop Frequency	150KHz/30MHz(Peak/QP/AV)		
	200Hz (From 9kHz to 0.15MHz)/		
RB / VB (emission in restricted	9KHz (From 0.15MHz to 30MHz);		
band)	200Hz (From 9kHz to 0.15MHz)/		
	9KHz (From 0.15MHz to 30MHz)		

Spectrum Parameter	Setting	
Attenuation	Auto	
Detector	Peak/QP	
Start Frequency	30 MHz(Peak/QP)	
Stop Frequency	1000 MHz (Peak/QP)	
RB / VB (emission in restricted		
band)	120 KHz / 300 KHz	

Spectrum Parameter	Setting		
Attenuation	Auto		
Detector	Peak/AV		
Start Frequency	1000 MHz(Peak/AV)		
Stop Frequency	10th carrier hamonic(Peak/AV)		
RB / VB (emission in restricted	1 MHz / 3 MHz(Peak)		
band)	1 MHz/1/T MHz(AVG)		

For Restricted band

Spectrum Parameter	Setting		
Detector	Peak/AV		
	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.

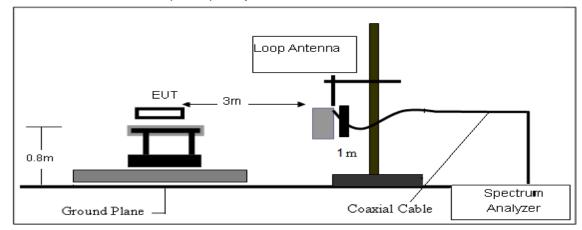
3.2.3 DEVIATION FROM TEST STANDARD

No deviation.

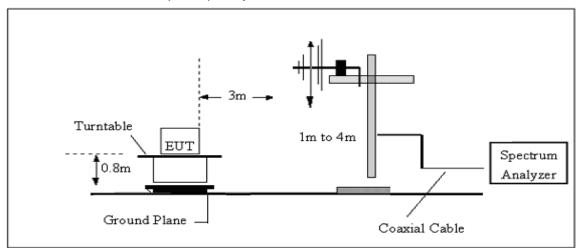


3.2.4 TESTSETUP

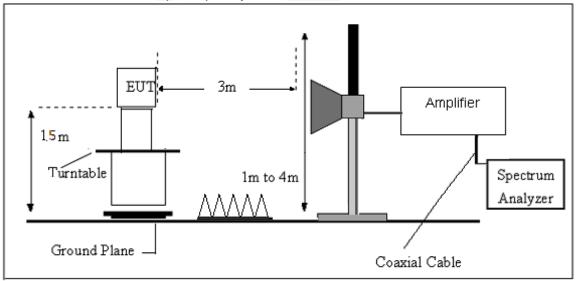
(A) Radiated Emission Test-Up Frequency Below 30MHz

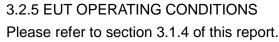


(B) Radiated Emission Test-Up Frequency 30MHz~1GHz



(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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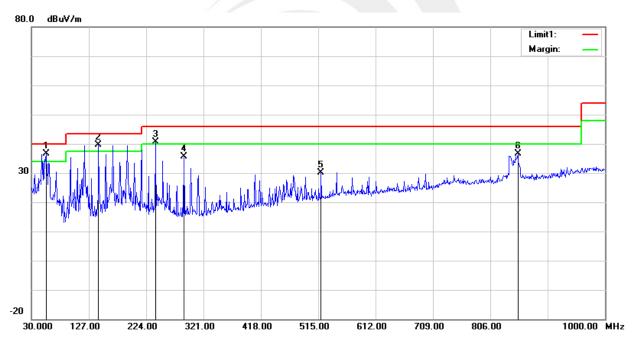
(30MHz-1000MHz)

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 7 worst mode)			

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	55.2200	61.71	-25.04	36.67	40.00	-3.33	QP
2	143.4900	57.97	-18.23	39.74	43.50	-3.76	QP
3	239.5200	58.76	-18.10	40.66	46.00	-5.34	QP
4	288.0200	51.00	-15.26	35.74	46.00	-10.26	QP
5	519.8500	38.05	-7.82	30.23	46.00	-15.77	QP
6	852.5600	37.25	-0.67	36.58	46.00	-9.42	QP

Remark:

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





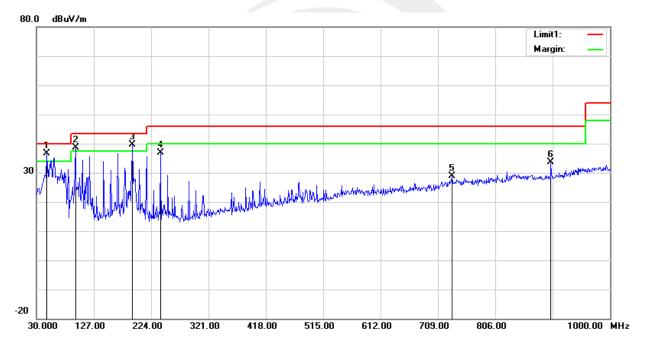
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Temperature:	23.1(C)	Relative Humidity:	60%RH	
Test Voltage:	DC 3.7V	Phase:	Vertical	
Test Mode:	Mode 1/2/3/4/5/6/7/8/9(Mode 7 worst mode)			

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	47.4600	58.43	-21.92	36.51	40.00	-3.49	QP
2	95.9600	59.31	-20.67	38.64	43.50	-4.86	QP
3	191.9900	60.78	-21.04	39.74	43.50	-3.76	QP
4	239.5200	54.91	-18.10	36.81	46.00	-9.19	QP
5	733.2500	31.21	-2.35	28.86	46.00	-17.14	QP
6	900.0900	34.04	-0.45	33.59	46.00	-12.41	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	Corrected Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBµV)	(dB)	(dB)	(dB/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре	
				Low Ch	annel (8DPSK/	/2402 MHz)				
3264.71	61.13	44.70	6.70	28.20	-9.80	51.33	74.00	-22.67	PK	Vertical
3264.71	51.62	44.70	6.70	28.20	-9.80	41.82	54.00	-12.18	AV	Vertical
3264.84	61.62	44.70	6.70	28.20	-9.80	51.82	74.00	-22.18	PK	Horizontal
3264.84	50.16	44.70	6.70	28.20	-9.80	40.36	54.00	-13.64	AV	Horizontal
4804.46	59.51	44.20	9.04	31.60	-3.56	55.95	74.00	-18.05	PK	Vertical
4804.46	50.22	44.20	9.04	31.60	-3.56	46.66	54.00	-7.34	AV	Vertical
4804.33	58.63	44.20	9.04	31.60	-3.56	55.07	74.00	-18.93	PK	Horizontal
4804.33	49.75	44.20	9.04	31.60	-3.56	46.19	54.00	-7.81	AV	Horizontal
5359.63	48.61	44.20	9.86	32.00	-2.34	46.27	74.00	-27.73	PK	Vertical
5359.63	39.17	44.20	9.86	32.00	-2.34	36.83	54.00	-17.17	AV	Vertical
5359.64	48.20	44.20	9.86	32.00	-2.34	45.86	74.00	-28.14	PK	Horizontal
5359.64	38.31	44.20	9.86	32.00	-2.34	35.97	54.00	-18.03	AV	Horizontal
7205.87	54.95	43.50	11.40	35.50	3.40	58.35	74.00	-15.65	PK	Vertical
7205.87	43.60	43.50	11.40	35.50	3.40	47.00	54.00	-7.00	AV	Vertical
7205.78	54.62	43.50	11.40	35.50	3.40	58.02	74.00	-15.98	PK	Horizontal
7205.78	44.85	43.50	11.40	35.50	3.40	48.25	54.00	-5.75	AV	Horizontal
				Middle C	hannel (8DPSk	2441 MHz)</td <td></td> <td></td> <td></td> <td></td>				
3264.72	61.59	44.70	6.70	28.20	-9.80	51.79	74.00	-22.21	PK	Vertical
3264.72	50.93	44.70	6.70	28.20	-9.80	41.13	54.00	-12.87	AV	Vertical
3264.58	61.36	44.70	6.70	28.20	-9.80	51.56	74.00	-22.44	PK	Horizontal
3264.58	50.41	44.70	6.70	28.20	-9.80	40.61	54.00	-13.39	AV	Horizontal
4882.54	58.87	44.20	9.04	31.60	-3.56	55.31	74.00	-18.69	PK	Vertical
4882.54	49.11	44.20	9.04	31.60	-3.56	45.55	54.00	-8.45	AV	Vertical
4882.40	58.81	44.20	9.04	31.60	-3.56	55.25	74.00	-18.75	PK	Horizontal
4882.40	49.20	44.20	9.04	31.60	-3.56	45.64	54.00	-8.36	AV	Horizontal
5359.69	49.29	44.20	9.86	32.00	-2.34	46.95	74.00	-27.05	PK	Vertical
5359.69	39.48	44.20	9.86	32.00	-2.34	37.14	54.00	-16.86	AV	Vertical
5359.69	47.07	44.20	9.86	32.00	-2.34	44.73	74.00	-29.27	PK	Horizontal
5359.69	38.87	44.20	9.86	32.00	-2.34	36.53	54.00	-17.47	AV	Horizontal
7323.73	54.31	43.50	11.40	35.50	3.40	57.71	74.00	-16.29	PK	Vertical
7323.73	43.68	43.50	11.40	35.50	3.40	47.08	54.00	-6.92	AV	Vertical
7323.81	54.52	43.50	11.40	35.50	3.40	57.92	74.00	-16.08	PK	Horizontal
7323.81	44.03	43.50	11.40	35.50	3.40	47.43	54.00	-6.57	AV	Horizontal



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				High Chan	nel (8DPSK	/2480 MHz)				
3264.60	61.45	44.70	6.70	28.20	-9.80	51.65	74.00	-22.35	PK	Vertical
3264.60	50.70	44.70	6.70	28.20	-9.80	40.90	54.00	-13.10	AV	Vertical
3264.81	61.07	44.70	6.70	28.20	-9.80	51.27	74.00	-22.73	PK	Horizontal
3264.81	50.97	44.70	6.70	28.20	-9.80	41.17	54.00	-12.83	AV	Horizontal
4960.45	58.80	44.20	9.04	31.60	-3.56	55.24	74.00	-18.76	PK	Vertical
4960.45	49.95	44.20	9.04	31.60	-3.56	46.39	54.00	-7.61	AV	Vertical
4960.40	58.25	44.20	9.04	31.60	-3.56	54.69	74.00	-19.31	PK	Horizontal
4960.40	50.57	44.20	9.04	31.60	-3.56	47.01	54.00	-6.99	AV	Horizontal
5359.72	48.09	44.20	9.86	32.00	-2.34	45.75	74.00	-28.25	PK	Vertical
5359.72	39.55	44.20	9.86	32.00	-2.34	37.21	54.00	-16.79	AV	Vertical
5359.68	48.38	44.20	9.86	32.00	-2.34	46.04	74.00	-27.96	PK	Horizontal
5359.68	39.11	44.20	9.86	32.00	-2.34	36.77	54.00	-17.23	AV	Horizontal
7439.88	54.14	43.50	11.40	35.50	3.40	57.54	74.00	-16.46	PK	Vertical
7439.88	44.39	43.50	11.40	35.50	3.40	47.79	54.00	-6.21	AV	Vertical
7439.76	53.91	43.50	11.40	35.50	3.40	57.31	74.00	-16.69	PK	Horizontal
7439.76	43.55	43.50	11.40	35.50	3.40	46.95	54.00	-7.05	AV	Horizontal

Note:

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

Emission Level = Reading + Factor

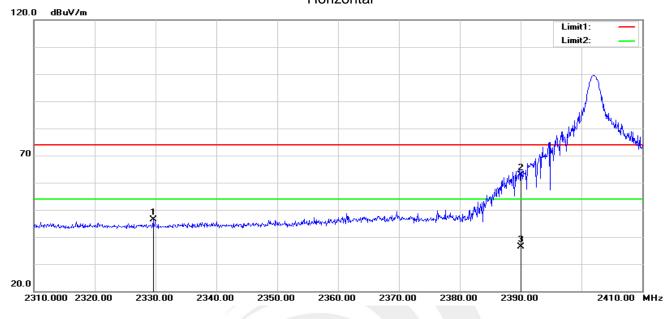
3) The frequency emission of peak points that did not show above the forms are at least 20dB below the limit, the frequency emission is mainly from the environment noise.



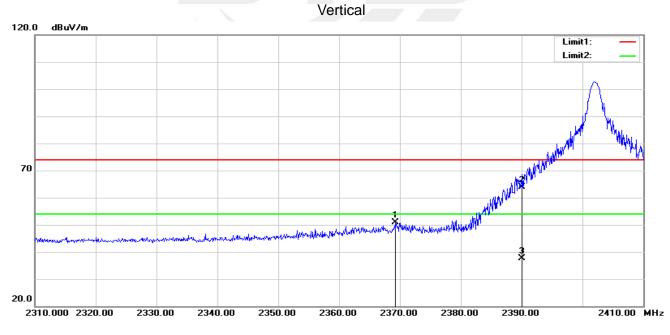


Restricted band Requirements

8DPSK-Low Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2329.600	42.74	3.63	46.37	74.00	-27.63	peak
2	2390.000	58.58	4.34	62.92	74.00	-11.08	peak
3	2390.000	32.00	4.34	36.34	54.00	-17.66	AVG



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2369.300	46.79	4.03	50.82	74.00	-23.18	peak
2	2390.000	59.60	4.34	63.94	74.00	-10.06	peak
3	2390.000	33.30	4.34	37.64	54.00	-16.36	AVG

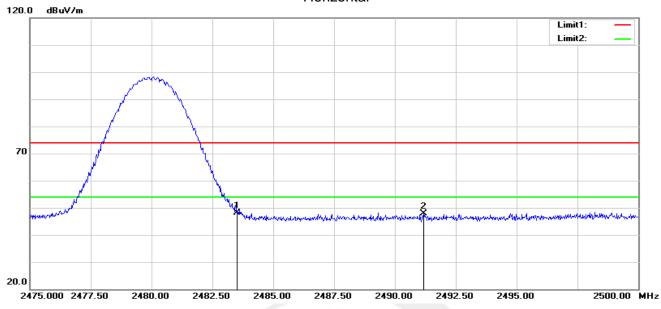
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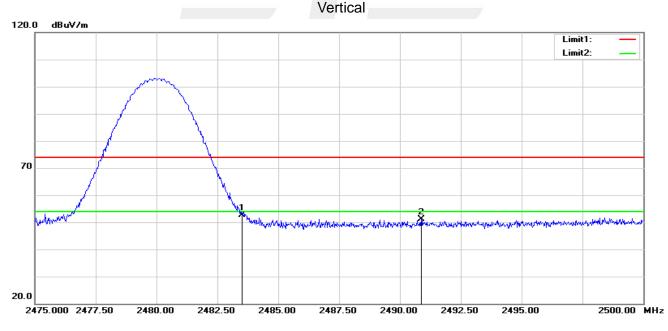
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8DPSK-High Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	43.58	4.60	48.18	74.00	-25.82	peak
2	2491.175	43.25	4.63	47.88	74.00	-26.12	peak



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	48.06	4.60	52.66	74.00	-21.34	peak
2	2490.875	46.48	4.63	51.11	74.00	-22.89	peak

Note: GFSK, π /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

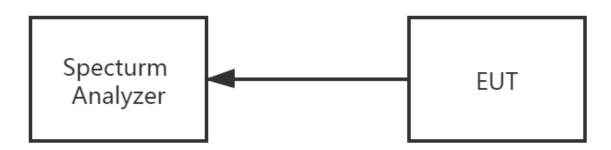
Spectrum Parameter	Setting
Detector	Peak
Stort/Stop Eroguopou	Lower Band Edge: 2300 – 2407 MHz
Start/Stop Frequency	Upper Band Edge: 2475 – 2500 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

For Hopping Band edge

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







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



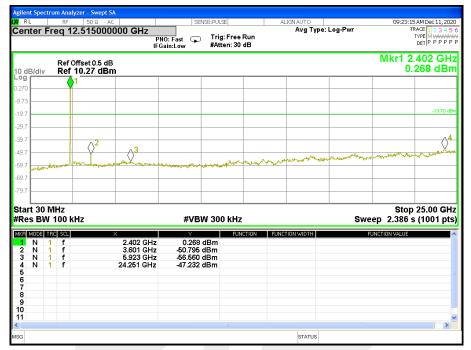
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4.5 TEST RESULTS

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

00 CH



39 CH

Agilent Spectr	rum Analyze	er - Swept S	A							
LXI RL	RF	50 Q AC		SEI	ISE:PULSE		ALIGNAUTO			0 AM Dec 11, 202
Center F	req 12.	515000	Р	NO: Fast 😱 Gain:Low	Trig: Free #Atten: 30		Avg Type	: Log-Pwr	I	TYPE MUMMAN DET PPPP
10 dB/div		set 0.5 dB 49 dBm								.452 GH .512 dBr
-1.51	1									
-11.5										-19.47 df
-21.5										-19.47 db
-31.5		2								
-41.5		$\hat{\mathbf{Q}}$	3						144.00	- mi
61.5	monum	Many County Play	a walnument	how have	maland	manno	man and the second	A realized and and and a		
71.5										
-81.5										
Start 30 M #Res BW		z		#VB	N 300 kHz			Sw	Stop eep 2.386	o 25.00 GH s (1001 pt
MKR MODE 11 1 N 1 2 N 1 3 N 1	f f		× 2.452 GHz 3.651 GHz	-1.512 -49.699	dBm dBm	CTION FUI	NCTION WIDTH		FUNCTION VALUE	
4 N 1 5			5.748 GHz 24.625 GHz	-55.687 -47.192						
6 7 8										
9										
11										>
SG							STATUS			



78 CH

:L RF 50 G	vept SA Ω AC	SENSE:PULSE	ALIGNA		09:33:22 AM Dec 11, ;
ter Freq 12.515	PN	D: Fast Trig: Fr in:Low #Atten:	ee Run	vg Type: Log-Pwr	TRACE 1 2 3 TYPE MWAAN DET P P P
Ref Offset 0. B/div Ref 8.78 d					Mkr1 2.477 G -1.216 dE
↓ 1					
					-19.65
2 2	3		many mar ma	when the way we have a state of a	ster warman and the second
	her hard and hard and her hard and her hard and her	had in the share of the second second	e control studies.		
rt 30 MHz es BW 100 kHz		#VBW 300 ki	Hz	S⊎	Stop 25.00 G veep 2.386 s (1001 p
	×	Y F	FUNCTION FUNCTION V	VIDTH	FUNCTION VALUE
MODE TRC SCL N 1 f N 1 f N 1 f N 1 f	2.477 GHz 3.051 GHz 5.698 GHz 24.301 GHz	-1.216 dBm -56.816 dBm -56.849 dBm -48.173 dBm			
N 1 f N 1 f	2.477 GHz 3.051 GHz 5.698 GHz	-56.816 dBm -56.849 dBm			
N 1 f N 1 f N 1 f	2.477 GHz 3.051 GHz 5.698 GHz	-56.816 dBm -56.849 dBm			



Shenzhen STS Test Services Co., Ltd.



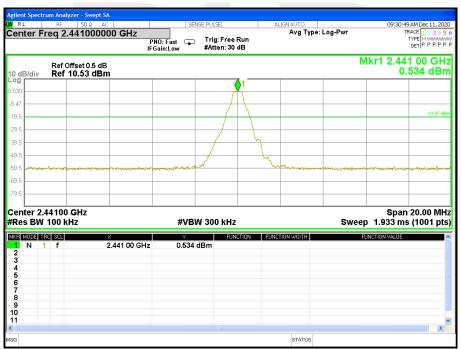


For Band edge(it's also the reference level for conducted spurious emission)



00 CH

39 CH





78 CH

	ectrur		lyzer - Swept S								
enter	Fre	RF 2.	50 Ω AC .4875000	00 GHz P	NO: Fast Gain:Low	NSE:PULSE Trig: Fre #Atten: 3	e Run	ALIGNAUTO Avg Type: I			52 AM Dec 11, 202 TRACE 1 2 3 4 5 TYPE MWAAAAA DET P P P P
) dB/di			Offset 0.5 dB 10.31 dBn						М	kr1 2.480 0) 000 GH .310 dBr
310				1							
.69				1							-19.69 dE
9.7											
.7			_/_	<u>\</u>			0.3				
1.7	mada	~~~	m	- Low	2	And and the star	A and a second	-		et mana	- American
.7											
.7											
art 2. les B					#VB	W 300 kH	z		Swee	Stop 2 p 2.400 m	2.50000 GH s (1001 pt
R MODE	TRC	SCL f		× .480 000 GHz	Y 0.310		JNCTION FUN	ICTION WIDTH		FUNCTION VALUE	
2 N 3 N 4 N	1 1 1	f f f	2.	.483 500 GHz .488 300 GHz .498 275 GHz	-59.614 -58.163 -58.176	dBm dBm					
5 7 3											
)) 											
								STATUS			
G								STATUS			



Shenzhen STS Test Services Co., Ltd.





For Hopping Band edge

GFSK

lent Spec	e <mark>trum Anal</mark> RF	<mark>yzer - Swept S</mark> 50 Ω AC								
		50 Ω AC .3515000	00 GHz	PNO: Fast Gain:Low	NSE:PULSE Trig: Free I #Atten: 30	Run	Avg Type:		TRA T` I	M Dec 11, 20 CE 1 2 3 4 YPE M MANANA DET P P P P
dB/div)ffset 0.5 dB 10.26 dBn						MI	kr1 2.402 8 0.2	397 GH 58 dB
60										
74										
.7										-19.74 c
.7										
.7										
.7 .7			a man de tra const		ale an ellarana	alter Da ver en seder Dise estere	-		\wedge^2	
7										
9.7										
	30000 G V 100 k			#VB	W 300 kHz			Sweep	Stop 2.4 p 9.867 ms	
BMODE N 2 N 3 N	TRC SCL 1 f 1 f 1 f	2	× 402 897 GHz 390 022 GHz 400 013 GHz	0.258 -59.686 -58.328	dBm dBm	CTION FUNC	CTION WIDTH	H	UNCTION VALUE	
5 N 5 5		2	400 013 6Hz	-00.020	ubiii					
) 7 }										
á										
										>

	RF	50 Ω A		SENSE	PULSE	ALIGN AUTO			AM Dec 11, 20
nter	Freq 2	2.4895000	P	NO: Fast 😱 Gain:Low	Trig: Free Run #Atten: 30 dB	AVg I	ype: Log-Pwr	Т	ACE 1 2 3 4 YPE MWAAA DET P P P P
lB/di		Offset 0.5 di 10.25 dB					N	1kr1 2.479 0.1	861 GI 254 dB
	\0 1								
Γ <u>μ</u>	\cap								
	$\langle \chi \rangle$								-19.75
I									
					. 3				
		My	$\langle \rangle^2$. N
				Contraction of String Street		Without See Survey Servey Servey			and hitsections
rt 2.	47900	GHz						Stop 2.5	50000 G I
es B	W 100	kHz		#VBW	300 kHz		Swe	ep 2.067 ms	(1001 p
	TRC SCL		X	Y	FUNCTION	FUNCTION WIDTH	1	FUNCTION VALUE	
	1 f		2.479 861 GHz 2.483 515 GHz	0.254 dE -59.209 dE					
N			2.488 744 GHz	-57.218 dE					
N N N	1 f								
Ň	1 f								
N	1 f								
Ň	1 f								
Ň	1 f								
N	1 f								



Page 40 of 76 Report No.: STS2011141W01

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

RL		50 Ω AC	SENSE	:PULSE	ALIGNAUTO		09:52:50 AM Dec 11, 2
nter F	req 12.5 <i>°</i>			Trig: Free Run #Atten: 30 dB	Avg Type:	Log-Pwr	TRACE 1 2 3 4 TYPE M WAAAA DET P P P P
dB/div	Ref Offse Ref 9.94						Mkr1 2.402 GI -0.059 dB
	0 1						
							-19.71
		^2					,
		()⁻3				of Andrewson	and the second states and
and the	munder	and a marked was	and the second second	manne	men man man and and and and and and and and and a	and the second	
<u> </u>							
<u> </u>							
L rt 30 I							Stop 25.00 G
	100 kHz		#VBW	300 kHz		Swee	ep 2.386 s (1001 p
MODE T		×	Y	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE
N N	1 f 1 f 1 f 1 f	2.402 GH 3.601 GH 5.024 GH 24.451 GH	z -50.844 dB z -55.862 dB	im Im			
							1

00 CH

30	CH
23	OL

RL	RF	yzer - Swept S		SE	NSE:PULSE	4	LIGNAUTO		09:55	:25 AM Dec 11, 2
nter F	req 1	2.515000	Р	NO: Fast 🖵 Gain:Low	Trig: Free #Atten: 30		Avg Type	: Log-Pwr		TRACE 1 2 3 4 TYPE MWWW DET P P P F
dB/div)ffset 0.5 dB 7. <u>53 dBm</u>								2.452 G 2.467 dB
7		1								
5										-19.47
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urt 30 M es BW		Hz		#VB	W 300 kHz			Swe	Sto eep 2.386	p 25.00 G s (1001 p
MODE TR	RC SCL		× 2.452 GHz	-2.467		CTION FUN	CTION WIDTH		FUNCTION VALUE	
N 1			3.651 GHz 5.523 GHz	-49.747 -56.125						
N 1	f		24.326 GHz	-47.602	dBm					

Shenzhen STS Test Services Co., Ltd.



78 CH

	Ω AC	SENSE:PULSE		ALIGNAUTO		19:58:07 AM Dec 11,
ter Freq 12.515	PN	NO: Fast 😱 Trig: Gain:Low #Atte	Free Run n: 30 dB	Avg Type: Log	3-Pwr	TRACE 1 2 3 TYPE MWW DET P P P
Ref Offset 0 B/div Ref 9.91 d					Mk	r1 2.477 G -0.086 dI
						-19.7
	2					
- manun	2 3	un and and and and and and and and and an	monument	more wall wall was	al water and the second	and man
where the other and the						
rt 30 MHz s BW 100 kHz		#VBW 300	kHz			Stop 25.00 G 386 s (1001
Mode TRC SCL	× 2.477 GHz	-0.086 dBm	FUNCTION FL	UNCTION WIDTH	FUNCTION V	ALUE
N 1 f N 1 f N 1 f	3.726 GHz 5.873 GHz 24.276 GHz	-50.330 dBm -56.080 dBm -47.187 dBm				



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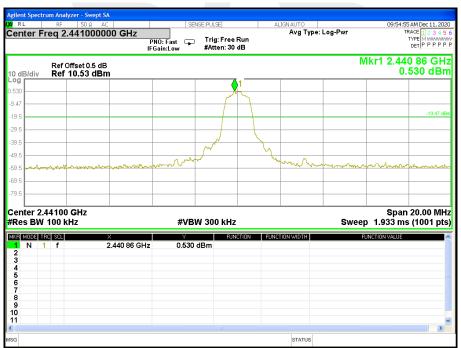


For Band edge(it's also the reference level for conducted spurious emission)

Agilent Spectrum Analyzer - Sw	ept SA			
LXI RL RF 50 Ω		SENSE:PULSE	ALIGNAUTO	09:52:20 AM Dec 11, 2020
Center Freq 2.35350	DOOOO GHz PNO: Fast IFGain:Lov		Avg Type: Log 1	-Pwr TRACE 1 2 3 4 5 6 TYPE M WWWWWW DET P P P P P P
Ref Offset 0. 10 dB/div Ref 10.30				Mkr1 2.401 97 GHz 0.295 dBm
0.300				
-9.70				-1971 dBm
-29.7				
-49.7		^2		and the second s
-59.7 ethodo-matrix-mana conterm	water and the second second	ware and a land	چەتتەمەر ە ھەرەدەر مەلسەلەر بەرە مەلمۇەرىيالىي	apananan an
-79.7				
Start 2.30000 GHz #Res BW 100 kHz		#VBW 300 kHz		Stop 2.40700 GHz Sweep 10.27 ms (1001 pts)
MKR MODE TRC SCL 1 N 1 f 2 N 1 f		Y FUNCTIO 0.295 dBm 7.791 dBm	N FUNCTION WIDTH	FUNCTION VALUE
3 N 1 f 4 N 1 f	2.399 19 GHz -3	2.579 dBm 0.390 dBm		
5 6 7 8 9				
9 10 11				
<				×
MSG			STATUS	

00 CH

39 CH





78 CH

RL	n Analyzer - Swept S RF 50 Ω A		SENS	E:PULSE	ALIGNAUTO		09:57:37	AM Dec 11, 202
enter Fre	q 2.4875000	F	PNO: Fast 🖵 Gain:Low	Trig: Free Run #Atten: 30 dB	Avg Type:	Log-Pwr	TR. T	ACE 1 2 3 4 5 YPE MWWWW DET P P P P
	Ref Offset 0.5 dE Ref 10.30 dBr					Mk	r1 2.479 0.2	850 GH 298 dBi
00	(1						
70								-19.70 d
.7								
9.7	- N	6	A2 A3	,				
9.7 9.7 mm mm	mm	have		, none and the sould		whenman	monum	-harman Ma
.7								
.7								
art 2.4750 Res BW 10			#VBW	/ 300 kHz		Sweep	Stop 2.5 2.400 ms	
art 2.4750 tes BW 10	00 kHz	×	Y	FUNCTION	FUNCTION WIDTH	· · ·		
art 2.4750 Res BW 10 N 1 N 1 N 1 N 1 N 1	00 kHz f 2 f 2 f 2	× 2.479 850 GHz 2.483 500 GHz 2.484 925 GHz 2.491 550 GHz		FUNCTION Bm Bm Bm	FUNCTION WIDTH	· · ·	2.400 ms	
art 2.4750 les BW 10 N 1 N 1 N 1 N 1	00 kHz f 2 f 2 f 2	2.479 850 GHz 2.483 500 GHz 2.484 925 GHz	0.298 d -55.847 d -56.015 d	FUNCTION Bm Bm Bm	FUNCTION WIDTH	· · ·	2.400 ms	
art 2.4750 Res BW 10 R MODE TRO N 1 N 1 N 1 N 1	00 kHz f 2 f 2 f 2	2.479 850 GHz 2.483 500 GHz 2.484 925 GHz	0.298 d -55.847 d -56.015 d	FUNCTION Bm Bm Bm	FUNCTION WIDTH	· · ·	2.400 ms	50000 GH (1001 pt



Shenzhen STS Test Services Co., Ltd.

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For Hopping Band edge

π/4-DQPSK

	um Analyzer -							
RL POTER Fr		ο Ω ΑC 500000 GHz	SE	NSE:PULSE	ALIGNAUTO Avg Type:	Log-Pwr	TR	AM Dec 11, 202 ACE 1 2 3 4 5
	04 2.001		PNO: Fast 😱 IFGain:Low	Trig: Free Run #Atten: 30 dB	0 //	•	-	DET PPPP
dB/div	Ref Offset Ref 10.2					М	kr1 2.401 0.:	867 GH 280 dBr
g 30								(
72								(
.7								-19.72 d
.7								
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.7							and a bar	()
.7		معرور محمد المراجع المستركر ومعرضو المري	aliyenadalaya (aliya dan saka ba	inter da anterna en la participa.	aller souther approximation of the design of	Januar Charles Dilling Harrison		
.7								
	000 GHz 100 kHz		#VBI	W 300 kHz		Swee	stop 2.4 p 9.867 ms	10300 GH (1001 pt
R MODE TRI		X	Y	FUNCTION	FUNCTION WIDTH	i	UNCTION VALUE	
N 1 N 1 N 1		2.401 867 GHz 2.390 022 GHz 2.400 013 GHz	-58.842	dBm				
:								

L	RF	50 Ω A0		9	ENSE:PULSE		ALIG	INAUTO		10:05	5:47 AM Dec 11, 20
nter Fr	req 2.	.4895000		PNO: Fast G FGain:Low		Free Run n: 30 dB		Avg Type	: Log-Pwr		TRACE 1 2 3 4 TYPE MWAAAA DET P P P P
IB/div		0ffset 0.5 dB 10.25 dBr							IV		9 000 GH 0.246 dB
1	1										
~~											-19.75
											-15,750
	h										
		h.	<u>2</u>	(3						
		m	1 mm	Lawrange	homen	-m-	www.w	al shares have	mm	mon	mannon
<u> </u>											
					_						
rt 2.47 s BW				#VI	3W 300	kHz			Swee	Stop ep 2.067 r	2.50000 G ns (1001 p
MODE TF			X	Y		FUNCTION	FUNCTIO	N WIDTH		FUNCTION VALU	
N 1 N 1 N 1	f f f	2	.479 000 GHz .483 515 GHz .487 148 GHz	-57.58							
											>



Page 45 of 76 Report No.: STS2011141W01

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

00 CH

RL	RF	50 Q	AC	SEN	ISE:PULSE	ALI	GNAUTO			59 AM Dec 11, 203
enter l	Freq '	12.51500		0: Fast 🖵 ain:Low	Trig: Free Run #Atten: 30 dB		Avg Type:	Log-Pwr	-	TYPE MWWWW DET P P P P
dB/div		Offset 0.5 d								.402 GH .530 dBi
.53		1								
2.5										
2.5										-19.69 di
2.5										
2.5										
2.5			3		and the second second	man	mohrana	and the stand of t	and the second and the second	and the second
	مريعه المالي	and a second second second		have and the second	Sandby Alasta					
2.5										
2.5										
art 30 Res BV		kHz		#VB\	N 300 kHz	·		Swe	Stop eep 2.386	o 25.00 GH s (1001 pt
R MODE	TRC SCL 1 f		× 2.402 GHz	-2.530	FUNCTION	FUNCTI	ON WIDTH		FUNCTION VALUE	
2 N 3 N	1 f 1 f 1 f		3.176 GHz 5.873 GHz 24.276 GHz	-57.188 -56.318 -47.680	dBm dBm					
5										
3										
3 9 0 1										>

39 CH

Agilent S	Spectru	m Ana	lyzer - Swept S	٨							
LXI RL		RF	50 Ω AC		SEN	ISE:PULSE	4	LIGNAUTO		10:20:1	2 AM Dec 11, 2020
Cente	er Fre		2.515000	000 GHz P	NO: Fast 🖵 Gain:Low	Trig: Free #Atten: 30	Run	Avg Type	: Log-Pwr		RACE 1 2 3 4 5 6 TYPE MWWWWWW DET P P P P P
10 dB/			Offset 0.5 dB 8.09 dBm								.452 GHz .909 dBm
Log -1.91		_	1								
-11.9 —											-19,49 dBm
-21.9 —		_									-13.43 GDM
-31.9			. 2								
-41.9 -			\wedge	<u>3</u>					Andrew and a state	-	muli
-61.9 🕶	when when	week	monument	marken and subser	mount	and well wanter the	marin	person may	have and		
-71.9 —											
-81.9 —											
Start #Res			۲		#VBI	N 300 kHz		1	Swe		25.00 GHz s (1001 pts)
MKR MO		SCL f		× 2.452 GHz	-1.909	dBm	CTION FUN	CTION WIDTH	F	UNCTION VALUE	^
2 N 3 N	i 1	f f		3.651 GHz 5.598 GHz	-49.968 -56.743	dBm					
4 N 5	J 1	f		24.326 GHz	-47.805	dBm					
6 7											
8 9 10											
10											~
<											



78 CH

	Swept SA		0175		10,00,01,00,0
enter Freq 12.51	5000000 GHz	SENSE:PULSE NO: Fast Trig: Fr Gain:Low #Atten:	ee Run	Avg Type: Log-Pwr	10:22:04 AM Dec 11, 20 TRACE 1 2 3 4 TYPE MWMM DET P P P
Ref Offset dB/div Ref 8.88					Mkr1 2.477 GF -1.122 dB
12					
L1					-19.72 c
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.1	$\sqrt{2}$ $\sqrt{3}$			han you and the factor and the factor	March of march and the second date
1 and malander thank	and the second and a second and the second s	Uniterent gelander and	and the second and th	multink, u , skridens	
.1					
art 30 MHz les BW 100 kHz		#VBW 300 k	Hz	ş	Stop 25.00 GF Sweep 2.386 s (1001 pt
R MODE TRC SCL N 1 f 3 N 1 f 4 N 1 f	× 2.477 GHz 3.726 GHz 5.973 GHz 24.276 GHz	¥ -1.122 dBm -49.676 dBm -56.610 dBm -46.954 dBm	FUNCTION FUNCTIO	JN WIDTH	FUNCTION VALUE
5 5 6 1 1 1 1 1 1 1 1 1 1 1 1 1					



Shenzhen STS Test Services Co., Ltd.

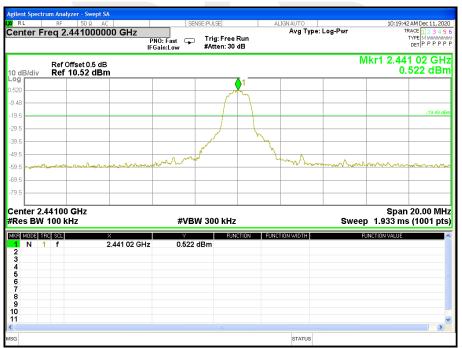


For Band edge(it's also the reference level for conducted spurious emission)

Agile	nt Spe	ectru	m Ana	alyzer - Swept SA								
LXI R			RF	50 Ω AC		SE	NSE:PULSE		ALIGNAUTO			8 AM Dec 11, 2020
Cer	nter	Fre	ed 7	2.35350000	Р	'NO: Fast 😱	Trig: Free F		Avg Type	: Log-Pwr		TYPE MWWWWW DET P P P P P P
_					IF	Gain:Low	#Atten: 30	38				,
	B/di			Offset 0.5 dB 10.31 dBm	n					r		1 86 GHz .305 dBm
Log												1
0.310	I											Å
-9.69												-19)69 dBm
-19.7	\vdash											- 19,69 (16)(1
-29.7	\vdash											
-39.7	\vdash											1/3
-49.7	b^2											
-59.7	μ	e-ontro	wardward a	and the state of the second	maturentheter	ather and the owned	and shared and the second s	مەرەر مەرەپىرىلىر.	ه جا حسيم المستقد الم	all and the second second	และกุละกิสาวกระดวการีด้างกา	nuh m
-69.7	\vdash											
-79.7	⊢											
Cto.	L_	200	00	GHz							Oton 3	.40700 GHz
	s B					#VB	W 300 kHz			Swee	p 10.27 m	s (1001 pts)
MKR	MODE	TRC	SCL		<	Y		TION FL	JNCTION WIDTH		FUNCTION VALUE	^
1	N N	1	f		2.401 86 GHz 2.300 75 GHz	0.305						
3	Ν	1	f	2	2.399 40 GHz	-52.710	dBm					
4 5 6 7 8 9	Ν	1	f	2	2.400 05 GHz	-51.579	dBm					
6												
8												
9 10												
11												~
MSG									STATUS			>
MSG									STATUS			

00 CH

39 CH





78 CH

		r - Swept SA								
RL	RF ea 2.41	50Ω AC 8750000		SE	NSE:PULSE		IGNAUTO Avg Type:	Log-Pwr	TRA	M Dec 11, 202
	0 q 2.4		F	NO: Fast 🖵 Gain:Low	Trig: Free F #Atten: 30 d			-		
dB/div		set 0.5 dB 0.28 dBm	ı					MI	(r1 2.480 (0.2	000 GH 76 dBr
80		(1							
72		الم ا	Y							
7										-19.72 d
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	-			- Processing	of Arrest Arrest	and the second se	and the second se	and a construction of the second		19 - Vill Galanda
.7										
.7										
art 2.47	500 GH	z							Stop 2.5	0000 GH
les BW 1	100 kHz	2		#VB	W 300 kHz			Sweep	o 2.400 ms	(1001 pt
R MODE TRO			×	Y	FUNC	TION FUNC	TION WIDTH	f	UNCTION VALUE	
N 1 N 1 N 1	f f f	2.4	480 000 GHz 483 500 GHz 484 975 GHz	0.276 -55.836 -53.293	dBm					
IN 1	f	2.	497 125 GHz	-55.579	dBm					
5 5 7 8										
							STATUS			



Shenzhen STS Test Services Co., Ltd.





For Hopping Band edge

8DPSK

ilent Spectr	um Analyzer - S	wept SA Ω AC	OTHOUGH I				10.07.16	AM D 44, 001
		500000 GHz		≊ j: Free Run œn: 30 dB	ALIGN AUTO Avg Type	-	TR 1	AM Dec 11, 20 ACE 1 2 3 4 5 YPE M WWWW DET P P P P
dB/div	Ref Offset (Ref 10.25					M	kr1 2.401 0.1	867 GH 253 dBi
9 50								
75								-19.75 d
.8								
.8								
.8					Men - Carlo marine	4	2	han we have a feature of the second s
.8 8.								
.8								
	000 GHz 100 kHz		#VBW 30) kHz		Swee	Stop 2.4 p 9.867 ms	10300 GH (1001 pt
R MODE TR		× 2.401 867 GHz	Y 0.253 dBm	FUNCTION	FUNCTION WIDTH		FUNCTION VALUE	
N 1	f	2.390 022 GHz 2.400 013 GHz	-57.728 dBm -53.864 dBm					
								>
					STATUS			

	RF 50 Ω		SENSE:PUL	3E	ALIGNAUTO	D	10:29:34 AM Dec 11, 2 TRACE 1 2 3 4
nter Fr	eq 2.489500	PN		g: Free Run :en: 30 dB	Avg Type: L	og-rwr	TRACE 1 2 3 TYPE MWWW DET P P F
dB/div	Ref Offset 0.5 Ref 9.81 dB					Mk	r1 2.479 861 G -0.188 dE
¦1							
2 WWW Y	η						
							-20.19
	ha.						
	N.	2			3		
	- han	mound	mmannon	under anon	minhormation	mannohud	moundand
	900 GHz 100 kHz		#VBW 30	0 kHz		Sweep	Stop 2.50000 G 2.067 ms (1001 p
MODEL TRO		×	× · · · · · · · ·	FUNCTION	FUNCTION WIDTH		NCTION VALUE
	f	2.479 861 GHz	-0.188 dBm	Tononon			
N 1	f	2.483 515 GHz 2.491 642 GHz	-58.163 dBm -55.118 dBm				
N 1 N 1 N 1							
N 1							
N 1							
N 1							
N 1							
N 1							

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

Shenzhen STS Test Services Co., Ltd.



5. NUMBER OF HOPPING CHANNEL

5.1 LIMIT

	FCC Pa	art 15.247,Subpa	rt 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:	25 ℃	Relative Humidity:	60%
Test Mode:	Hopping Mode -GFSK Mode	Test Voltage:	DC 3.7V

Number of Hopping Channel

79

Hopping channel

	Fre	RF	50 Ω AC	00 GHz		00	NSE:PULSE	_		LIGN AUTO Avg		Log-Pwr			15 AM Dec 11, TRACE 1 2 3
					PNO: Fa	ast ⊊ ow) Trig: F #Atten	ree Rui : 30 dB	1						DET P P P
		Ref Offs	et 0.5 dB	5								M	lkr2	2.480 2	
) dB/di	v	Ref 10	.60 dBr	'n											0.50 dl
) 1	00000	-	NACENAR		nnn	aaavaa		000000	00000	non	nnnn		0000000	00000
	YYY'	I I I I I I I I I I I I I I I I I I I	*****	11111111	*****	1111	****	YYYY	יעעעעי	1111	1111	*****	111	*****	VVVVVV
9.4															
9.4															
9.4															
9.4															
9.4															
9.4								_							
9.4					_								_		
		00 GH2 00 kH2				#VB	W 300 k	Hz				Sw	/eep	1.133 m	.48350 (s (1001
	TRC			×		Y		FUNCTIC	N FUNC	TION WID	TH		FU	NCTION VALUE	
KR MODE	1	f	2.4	02 171 0 GH 80 243 5 GH	-Iz		dBm dBm								
1 N				80 243 0 Gr	12	0.00	UDIII								
1 N 2 N 3	1	f	2.4												
1 N 2 N 3		f	2.4												
1 N 2 N 3		f	2.4												
1 N 2 N 3 4 5 6 7		f	2.7												
1 N 2 N 3 4 5 6 7 8 9		f													
1 N 2 N 3 4 5 6 7		f													

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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:	25 ℃	Relative Humidity:	50%
Test Mode:	GFSK(1Mbps)-DH1/DH3/DH5	Test Voltage:	DC 3.7V

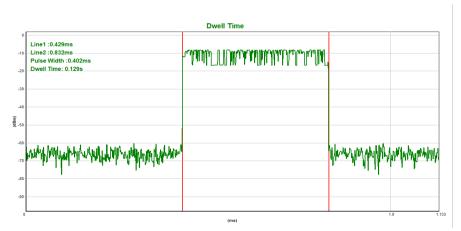
Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
DH1	middle	0.402	0.129	0.4
DH3	middle	1.673	0.268	0.4
DH5	middle	2.902	0.310	0.4



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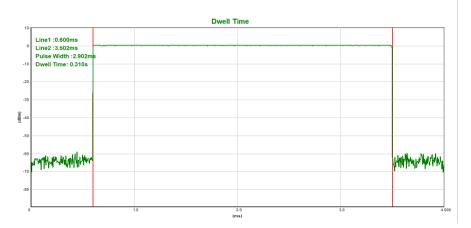
CH39-DH1



CH39-DH3



CH39-DH5



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Temperature:	25 ℃	Relative Humidity:	50%
	π/4-DQPSK(2Mbps)– 2DH1/2DH3/2DH5	Test Voltage:	DC 3.7V

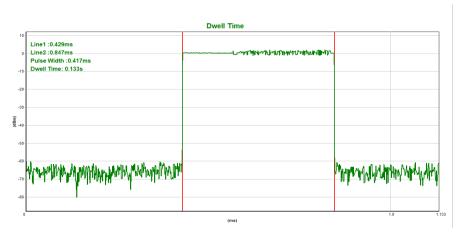
Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
2DH1	middle	0.417	0.133	0.4
2DH3	middle	1.691	0.271	0.4
2DH5	middle	2.912	0.311	0.4



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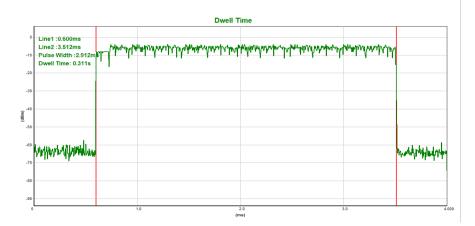
CH39-2DH1



CH39-2DH3



CH39-2DH5



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Temperature:	25 ℃	Relative Humidity:	50%
	8DPSK(3Mbps)– 3DH1/3DH3/3DH5	Test Voltage:	DC 3.7V

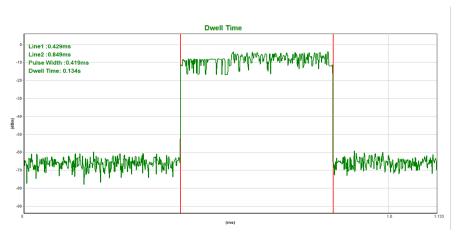
Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
3DH1	middle	0.419	0.134	0.4
3DH3	middle	1.691	0.271	0.4
3DH5	middle	2.920	0.311	0.4



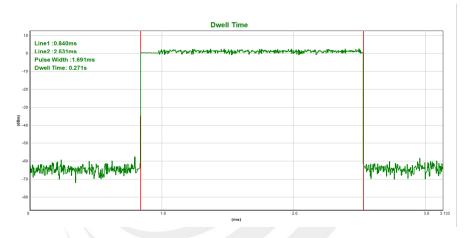
Shenzhen STS Test Services Co., Ltd.



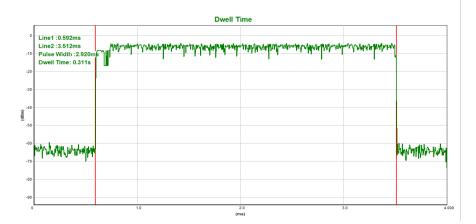
CH39-3DH1



CH39-3DH3



CH39-3DH5



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7. HOPPING CHANNEL SEPARATION MEASUREMEN

7.1 LIMIT

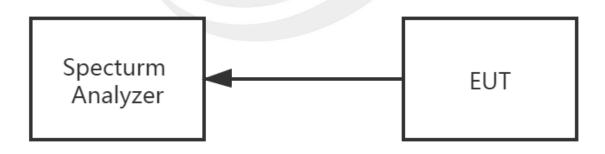
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that 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℃	Relative Humidity:	50%
	CH00 / CH39 / CH78 (GFSK(1Mbps) Mode)	Test Voltage:	DC 3.7V

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2401.837	2402.839	1.002	0.947	Complies
2441 MHz	2440.840	2441.839	0.999	0.954	Complies
2480 MHz	2478.837	2479.839	1.002	0.951	Complies

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

CH00 -1Mbps

RL RF	50 g AC	SENSE:PULSE	ALIGN AUTO	09:25:02 AM Dec 11, 202
enter Freq 2.4		0: Wide Trig: Free R ain:Low #Atten: 30 dl		TRACE 1 2 3 4 5 TYPE MWWWW DET P P P P
dB/div Ref 8	fset 0.5 dB .69 dBm			Mkr2 2.402 839 GH -1.329 dBr
31			2	
		m	mun	
.3	a man	m.	and the second	2
.3	~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		
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.3 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~				- have
.3				· · ·
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.3				
.3				
enter 2.402500 Res BW 30 kHz		#VBW 100 kHz	Sv	Span 3.000 MH weep 3.200 ms (1001 pts
R MODE TRC SCL	×	Y FUNCT	ION FUNCTION WIDTH	FUNCTION VALUE
1 N 1 f 2 N 1 f	2.401 837 GHz 2.402 839 GHz	-1.29 dBm -1.33 dBm		
3	2.402 655 6Hz	-1.55 0.511		
5				
3				
3				
)				
) i i i i i i i i i i i i i i i i i i i				
1				>

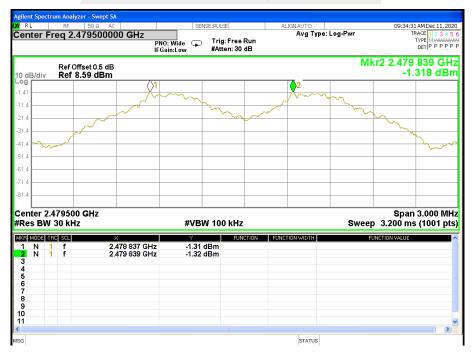
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CH39 -1Mbps



CH78 -1Mbps





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Temperature:	25℃	Relative Humidity:	50%
	CH00 / CH39 / CH78 (π/4-DQPSK(2Mbps) Mode)	Test Voltage:	DC 3.7V

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2401.840	2402.839	0.999	0.854	Complies
2441 MHz	2440.837	2441.839	1.002	0.860	Complies
2480 MHz	2478.840	2479.839	0.999	0.855	Complies

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

RL	RF 50	wept SA Ω AC	SENSE:PULSE		ALIGNAUTO		09:53:34 AM Dec 11, 202
		000000 GHz PNO:	Wide Trig: F	ree Run :: 30 dB	Aug Type: I	Log-Pwr	TRACE 1 2 3 4 5 TYPE WWWW DET P P P P P
) dB/div	Ref Offset (Ref 8.62 (Mkr2	2.402 839 GH: -1.331 dBn
.38					2		
1.4		mm	mmm	m	\sim	mm	~
1.4	~						m la
1.4	mww						
1.4							. var
1.4							
1.4							
1.4							
1.4							
enter 2. Res BW	402500 GH 30 kHz	Z	#VBW 100 I	(Hz		Sweep (Span 3.000 MH 3.200 ms (1001 pts
KR MODE TI		×	Y	FUNCTION	FUNCTION WIDTH	FUNC	TON VALUE
1 N 1 2 N 1		2.401 840 GHz 2.402 839 GHz	-1.38 dBm -1.33 dBm				
3							
5							
6 7							
8 9							
0							
1							
							>

CH00 -2Mbps

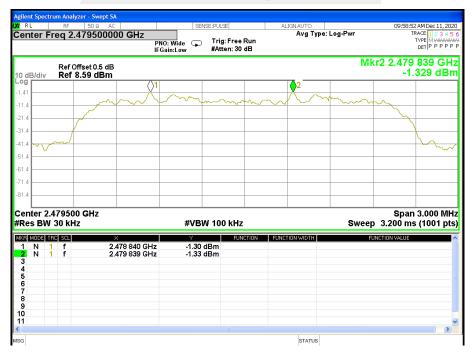
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CH39 -2Mbps

RF 50 Q AC	SENSE:PULSE	ALIGN AUTO	09:56:13 AM Dec
Freq 2.441500000 GHz PNO IFGa	: Wide 🖵 Trig: Free Run sin:Low #Atten: 30 dB	Avg Type: Log-Pwr	TRACE TYPE DET P
Ref Offset 0.5 dB v Ref 8.86 dBm		Iv	1kr2 2.441 839 -1.137
		<u>A</u> 2	
	mm.	X mm	
	- And Marken		m -
			No.
2.441500 GHz		_	Span 3.00
W 30 kHz	#VBW 100 kHz	Swe	ep 3.200 ms (100
TRC SCL X	Y FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1 f 2.440 837 GHz 1 f 2.441 839 GHz	-1.14 dBm -1.14 dBm		
2.441 000 0112	-1.14 4011		

CH78 -2Mbps



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Temperature:	25℃	Relative Humidity:	50%
	CH00 / CH39 / CH78 (8DPSK(3Mbps)Mode)	Test Voltage:	DC 3.7V

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2401.840	2402.839	0.999	0.861	Complies
2441 MHz	2440.837	2441.839	1.002	0.862	Complies
2480 MHz	2478.837	2479.839	1.002	0.861	Complies

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

CH00 -3Mbps

(L	RF 50 Ω	AC	SENSE:PULSE	ALIGN AUTO		10:15:21 AM Dec 11, 20
nter Fre	q 2.402500		Wide 🖵 Trig: Fro n:Low #Atten:	ee Run	pe: Log-Pwr	TRACE 1 2 3 4 TYPE MWAAA DET P P P P
dB/div	Ref Offset 0.5 d Ref 8.60 dBr				Mkr	2 2.402 839 GH -1.353 dB
		1		2		
		mmm	m	man har	mon	m.
4	N					July 1
4						
1						mr.
1						
4						
nter 2.40	2500 GHz					Span 3.000 M
es BW 3			#VBW 100 ki	łz	Sweep	3.200 ms (1001 p
MODE TRC	SCL	×	Y I F	UNCTION FUNCTION WIDTH	FUN	CTION VALUE
N 1 N 1		2.401 840 GHz	-1.40 dBm			
N 1	f	2.402 839 GHz	-1.35 dBm			

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CH39 -3Mbps

RF	50 Ω AC	5	ENSE:PULSE	ALIGNAUTO	10:18:4	6 AM Dec 11,
	41500000 GHz		Teles Free Dere	Avg Type: Log	-Pwr	TYPE MWWW DET P P P
	set 0.5 dB 88 d B m				Mkr2 2.441 -1	839 G .126 d
		()1		2		
		Am	more and	- Amon	$\sim \sim \sim$	
		·	and the second		the hard	
/	-					
						m
er 2.441500 (GHz					n 3.000 M
BW 30 kHz		#VI	3W 100 kHz		Sweep 3.200 m	s (1001
ODE TRC SCL	×	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	
N 1 f N 1 f	2.440 837 2.441 839		2 dBm 3 dBm			

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.



8.5 TEST RESULTS

Temperature:	25℃	Relative Humidity:	50%
	GFSK(1Mbps) CH00 / CH39 / C78	Test Voltage:	DC 3.7V

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	0.9468	PASS
2441 MHz	0.9543	PASS
2480 MHz	0.9505	PASS

CH00 -1Mbps

Agilent Spectrum Analyzer - Occupied BW	/			
Χ/ RL RF 50Ω AC			ALIGNAUTO	09:35:13 AM Dec 11, 2020
Center Freq 2.402000000		Center Freq: 2.402000 Trig: Free Run	000 GHz Avg Hold:>10/10	Radio Std: None
	#IFGain:Low	#Atten: 30 dB		Radio Device: BTS
10 dB/div Ref 20.00 dBm				
10.0				
0.00				
		m	~	
-10.0			ma	
-20.0	- market			~
-30.0				m
-40.0				- The second
-50.0				
-60.0				
-70.0				
Center 2.402 GHz #Res BW 30 kHz		#VBW 100 k	Hz	Span 2 MHz Sweep 2.733 ms
Occupied Bandwidth	1	Total Power	7.17 dBm	
88	3.76 kHz			
Transmit Freq Error	2.949 kHz	OBW Power	99.00 %	
x dB Bandwidth	946.8 kHz	x dB	-20.00 dB	
MSG			STATUS	

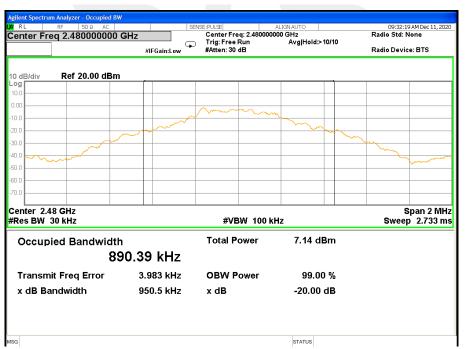
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CH39 -1Mbps



CH78 -1Mbps



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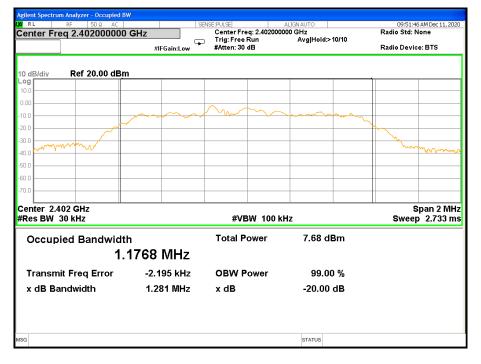


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Temperature:	25°C	Relative Humidity:	50%
	π/4-DQPSK(2Mbps) CH00 / CH39 / C78	Test Voltage:	DC 3.7V

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	1.2810	PASS
2441 MHz	1.2900	PASS
2480 MHz	1.2830	PASS

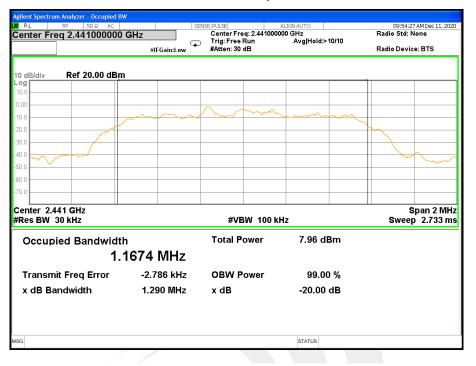
CH00 -2Mbps



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CH39 -2Mbps



CH78 -2Mbps





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Temperature:	25°C	Relative Humidity:	50%
	8DPSK(3Mbps) CH00 / CH39 / CH78	Test Voltage:	DC 3.7V

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	1.2920	PASS
2441 MHz	1.2930	PASS
2480 MHz	1.2910	PASS

CH00 -3Mbps

gilent Spectrum Analyzer - Occupied BV R L RF 50 Ω AC		ENSE:PULSE	ALIGNAUTO	10:12:55 AM Dec 11, 2020
enter Freq 2.402000000		Center Freq: 2.4020000	00 GHz	Radio Std: None
	#IFGain:Low) Trig: Free Run #Atten: 30 dB	Avg Hold:>10/10	Radio Device: BTS
0 dB/div Ref 20.00 dBm				
og				
0.0				
0.0		m	m mm .ma	
0.0				~~~
				- have a
0.0				
0.0				
70.0				
enter 2.402 GHz				Span 2 MH:
Res BW 30 kHz		#VBW 100 kl	Hz	Sweep 2.733 m
Occupied Bandwidth	ı	Total Power	7.81 dBm	
1.1	1757 MHz			
Transmit Freq Error	-185 Hz	OBW Power	99.00 %	
x dB Bandwidth	1.292 MHz	x dB	-20.00 dB	
G			STATUS	

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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:

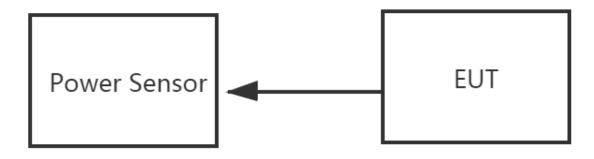
- a) Use the following spectrum analyzer settings:
- 1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
- 2) RBW > 20 dB bandwidth of the emission being measured.
- 3) VBW \geq RBW.
- 4) Sweep: Auto.
- 5) Detector function: Peak.
- 6) Trace: Max hold.
- b) Allow trace 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°C	Relative Humidity:	60%
Test Voltage:	DC 3.7V		

Mode Channel Number		Frequency	(dBm) (dBm) (dBr	Limit	
	Number	(MHz)		(dBm)	(dBm)
	0	2402	0.63	-1.20	30.00
GFSK(1M)	39	2441	0.64	-1.25	30.00
	78	2480	0.71	-2.80	30.00

Note: the channel separation >20dB bandwidth

N/OGA	Channel	Frequency	quency Peak Power Power	Average Power	Limit
	Number	(MHz)		(dBm)	(dBm)
π/4-DQPSK(2M)	0	2402	2.86	-1.28	20.97
	39	2441	2.84	-1.32	20.97
	78	2480	2.59	-1.55	20.97

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

Mode Channel Number		Frequency	Peak Power Average Power	Limit	
	(MHz)	(dBm)	(dBm)	(dBm)	
	0	2402	3.40	-1.26	20.97
8-DPSK(3M)	39	2441	3.34	-1.33	20.97
	78	2480	3.12	-1.53	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.



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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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