

RADIO TEST REPORT

S T S

Report No.: STS2008280W02

Issued for

Binatone Electronics International Limited

Floor 23A, 9 Des Voeux Road West, Sheung Wan Hong Kong, China

Product Name:	Bluetooth earphone			
Brand Name:	Motorola			
Model Name:	SH064			
Series Model:	N/A			
FCC ID:	VLJ-SH064			
IC:	4522A-SH064			
Test Standard:	FCC Part 15.247 RSS-247 Issue 2, February 2017			

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TEST RESULT CERTIFICATION

Applicant's Name	Binatone Electronics International Limited
Address	Floor 23A, 9 Des Voeux Road West, Sheung Wan Hong Kong, China
Manufacture's Name:	Binatone Electronics International Limited
Address	Floor 23A, 9 Des Voeux Road West, Sheung Wan Hong Kong, China
Product Description	
Product Name	Bluetooth earphone
Brand Name	Motorola
Model Name:	SH064
Series Model	N/A
Test Standards	FCC Part15.247 RSS-247 Issue 2, February 2017 RSS-Gen Issue 5, March 2019
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/IC 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: 02 Sept. 2020

Date (s) of performance of tests : 02 Sept. 2020 ~ 11 Sept. 2020

Date of Issue: 11 Sept. 2020

Test Result Pass

Testing Engineer : Technical Manager : Authorized Signatory : Marken Chris Chen) Seem She (Sean she) Marken Chris Chen) (Sean she) (Sean she) (Sean she)

(Vita Li)

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Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	11 Sept. 2020	STS2008280W02	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 RSS-247 Issue 2				
Standard Section	Test Item	Judgment	Remark	
15.207 RSS-Gen (8.8&7.2)	Conducted Emission	PASS		
15.247(a)(1) RSS-247 (5.1)	Hopping Channel Separation	PASS		
15.247(a)(1)&(b)(1) RSS-247 (5.1)	Output Power	PASS		
15.209 RSS-247 (5.5)	Radiated Spurious Emission	PASS		
15.247(d) RSS-247 (5.5)	Conducted Spurious & Band Edge Emission	PASS		
15.247(a)(iii) RSS-247 (5.1)	Number of Hopping Frequency	PASS		
15.247(a)(iii) RSS-247 (5.1)	Dwell Time	PASS		
15.247(a)(1) RSS-247 (5.1) RSS-Gen (6.7)	20dB Bandwidth 99% Bandwidth	PASS		
15.205 RSS-Gen (8.9&8.10)	Restricted bands of operation	PASS		
Part 15.247(d)/part 15.209(a) RSS-247 (5.5)	Band Edge Emission	PASS		
15.203 RSS-Gen (6.8)	Antenna Requirement	PASS		
RSS-Gen (6.11&8.11)	Frequency Stability	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	±6.7dB
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



2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	Bluetooth earphone
Trade Name	Motorola
Model Name	SH064
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
BR+EDR	BR+EDR
Please see Note 3.	Please refer to the Note 3.
Earphone	Battery(rating): Rated Voltage: 3.7V Charge Limit: 4.2V Capacity: 35mAh
Charging Box	Battery(rating): Rated Voltage: 3.7V Charge Limit: 4.2V Capacity: 600mAh Input: DC 5V 1A Output: DC 5V 250mA
Hardware version number	V1.3
Software version number	V0.11
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

. 1		D		A (a		
	Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
	1	Motorola	SH064	PCB	N/A	1.79dBi	BT Antenna



2.2 DESCRIPTION OF THE TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Worst Mode	Description	Data Rate/Modulation
Mode 1	TX 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 have be tested for all avaiable 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.

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.



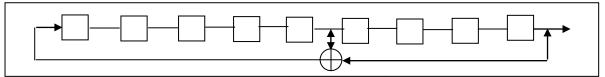
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The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping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

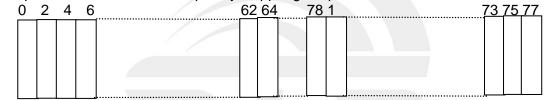
(2)The Pseudorandom sequence may be generated in a nin-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones: i.e. the shift register is initialized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



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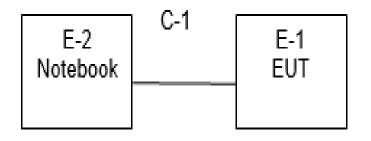
2.4 TABLE OF PARAMETERS OF TEST SOFTWARE SETTING

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.

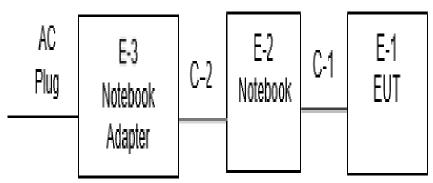
Test software Version	Test program: Bluetooth				
(Power control software) Parameters(1/2/3Mbps)	Power class: DH1 rate:4:27 2DH1 rate:20:54 3DH1 rate:24:83	Power class: DH3 rate:11:183 2DH3 rate:26:367 3DH3 rate:27:552	Power class: DH5 rate:15:339 2DH5 rate:30:679 3DH5 rate:31:1021		

RF Function	Туре	Mode Or Modulation type	Ant Gain(dBi)	Power Class	Software For Testing
		GFSK			
ВТ	BR+EDR	π/4-DQPSK	1.79	Default	Airoha.Tool.Kit
		8DPSK			

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



Conducted Emission Test



Shenzhen STS Test Services Co., Ltd.



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-2	Notebook	DELL	VOSTRO.3800	N/A	N/A
E-3	Notebook Adapter	DELL	HA45NM140	N/A	N/A
C-1	USB Cable	N/A	N/A	100cm	N/A
C-2	DC Cable	N/A	N/A	110cm	N/A

Note:

(1) For detachable type I/O cable should be specified the length in cm in ^CLength₂ column.



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	2019.10.09	2020.10.08		
Signal Analyzer	Agilent	N9020A	MY51110105	2020.03.05	2021.03.04		
Active loop Antenna	ZHINAN	ZN30900C	16035	2018.03.11	2021.03.10		
Bilog Antenna	TESEQ	CBL6111D	34678	2017.11.02	2020.11.01		
Horn Antenna	SCHWARZBECK	BBHA 9120D(1201)	9120D-1343	2018.10.19	2021.10.18		
SHF-EHF Horn Antenna (18G-40GHz)	A-INFO	LB-180400-KF	J211020657	2018.03.11	2021.03.10		
Pre-Amplifier(0.1M-3G Hz)	EM	EM330	060665	2019.10.09	2020.10.08		
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK201808090 1	2019.10.12	2020.10.11		
Pre-Amplifier (18G-40GHz)	SKET	LNPA-1840-50	SK201810180 1	2019.10.12	2020.10.11		
Temperature & Humidity	HH660	Mieo	N/A	2019.10.17	2020.10.16		
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	2019.10.09	2020.10.08
LISN	R&S	ENV216	101242	2019.10.09	2020.10.08
LISN	EMCO	3810/2NM	23625	2019.10.09	2020.10.08
Temperature & Humidity	HH660	Mieo	N/A	2019.10.17	2020.10.16
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 CE)			

RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
USB RF power sensor	DARE	RPR3006W	15I00041SNO03	2019.10.09	2020.10.08
Signal Analyzer	Agilent	N9020A	MY49100060	2019.10.09	2020.10.08
Temperature & Humidity	HH660	Mieo	N/A	2019.10.17	2020.10.16
Test SW	FARAD	LZ-RF /LzRf-3A3			

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3. EMC EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

Operating frequency band. In case the emission fall within the restricted band specified on Part 207(a)&RSS-Gen limit in the table below has to be followed.

	Conducted Emissionlimit (dBuV)		
FREQUENCY (MHz)	Quasi-peak	Average	
0.15 -0.5	66 - 56 *	56 - 46 *	
0.50 -5.0	56.00	46.00	
5.0 -30.0	60.00	50.00	

Note:

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

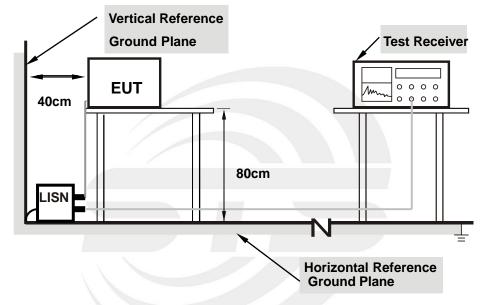
The following table is the setting of the receiver

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



3.1.2 TEST PROCEDURE

- a. The EUT was 0.8 meters from the horizontal ground plane and 0.4 meters from the vertical ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- 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 at least 80 cm from 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

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:	26.8(C)	Relative Humidity:	70%RH
Test Voltage:	AC 120V/60Hz	Phase:	L
Test Mode:	Mode 13		

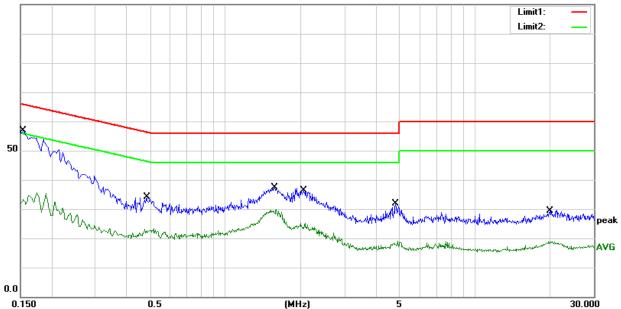
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.1540	36.58	20.20	56.78	65.78	-9.00	QP
2	0.1540	13.10	20.20	33.30	55.78	-22.48	AVG
3	0.4820	13.57	20.44	34.01	56.30	-22.29	QP
4	0.4820	2.28	20.44	22.72	46.30	-23.58	AVG
5	1.5700	17.15	20.15	37.30	56.00	-18.70	QP
6	1.5700	9.77	20.15	29.92	46.00	-16.08	AVG
7	2.0580	16.35	20.14	36.49	56.00	-19.51	QP
8	2.0580	4.87	20.14	25.01	46.00	-20.99	AVG
9	4.8140	11.89	20.03	31.92	56.00	-24.08	QP
10	4.8140	-0.98	20.03	19.05	46.00	-26.95	AVG
11	19.9500	8.82	20.65	29.47	60.00	-30.53	QP
12	19.9500	-1.84	20.65	18.81	50.00	-31.19	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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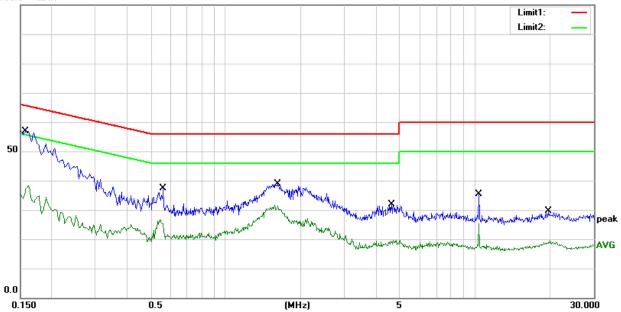
Temperature:	26.8(C)	Relative Humidity:	70%RH
Test Voltage:	AC 120V/60Hz	Phase:	Ν
Test Mode:	Mode 13		

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.1580	36.78	20.21	56.99	65.57	-8.58	QP
2	0.1580	17.85	20.21	38.06	55.57	-17.51	AVG
3	0.5620	16.97	20.38	37.35	56.00	-18.65	QP
4	0.5620	5.02	20.38	25.40	46.00	-20.60	AVG
5	1.6140	18.81	20.15	38.96	56.00	-17.04	QP
6	1.6140	11.13	20.15	31.28	46.00	-14.72	AVG
7	4.6420	11.76	20.03	31.79	56.00	-24.21	QP
8	4.6420	-0.32	20.03	19.71	46.00	-26.29	AVG
9	10.3820	15.59	19.86	35.45	60.00	-24.55	QP
10	10.3820	5.45	19.86	25.31	50.00	-24.69	AVG
11	19.6740	9.00	20.62	29.62	60.00	-30.38	QP
12	19.6740	-0.91	20.62	19.71	50.00	-30.29	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)





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), RSS-Gen Issue 5 and RSS-247 Issue 2, February 2017 (5.5) 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

FCC:

00.			
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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IC:

FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (GHz)
0.090 - 0.110	149.9 - 150.05	9.0 - 9.2
0.495 - 0.505	156.52475 - 156.52525	9.3 - 9.5
2.1735 - 2.1905	156.7 - 156.9	10.6 - 12.7
3.020 - 3.026	162.0125 - 167.17	13.25 - 13.4
4.125 - 4.128	167.72 - 173.2	14.47 - 14.5
4.17725 - 4.17775	240 – 285	15.35 - 16.2
4.20725 - 4.20775	322 - 335.4	17.7 - 21.4
5.677 - 5.683	399.9 - 410	22.01 - 23.12
6.215 - 6.218	608 - 614	23.6 - 24.0
6.26775 - 6.26825	960 - 1427	31.2 - 31.8
6.31175 - 6.31225	1435 - 1626.5	36.43 - 36.5
8.291 - 8.294	1645.5 - 1646.5	Above 38.6
8.362 - 8.366	1660 - 1710	
8.37625 - 8.38675	1718.8 - 1722.2	
8.41425 - 8.41475	2200 - 2300	
12.29 - 12.293	2310 - 2390	
12.51975 - 12.52025	2483.5 - 2500	
12.57675 - 12.57725	2655 - 2900	
13.36 - 13.41	3260 – 3267	
16.42 - 16.423	3332 - 3339	
16.69475 - 16.69525	3345.8 - 3358	
16.80425 - 16.80475	3500 - 4400	
25.5 - 25.67	4500 - 5150	
37.5 - 38.25	5350 - 5460	
73 - 74.6	7250 - 7750	
74.8 - 75.2	8025 - 8500	
108 – 138		



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: 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 of 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 meters (above 1GHz is 1.5 m) above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- 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 polarizations 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 then QuasiPeak detector mode re-measured.
- e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
- f. For the actual test configuration, please refer to the related Item –EUT Test Photos. Note:

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

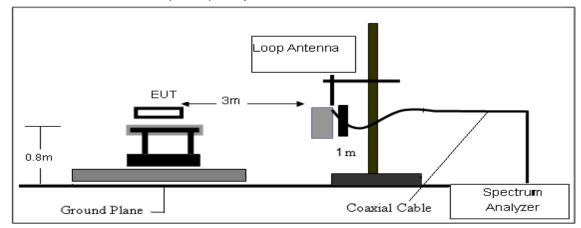
3.2.3 DEVIATION FROM TEST STANDARD

No deviation.

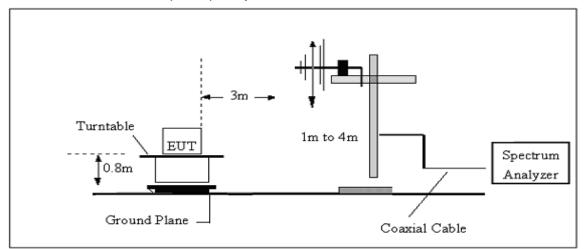


3.2.4 TESTSETUP

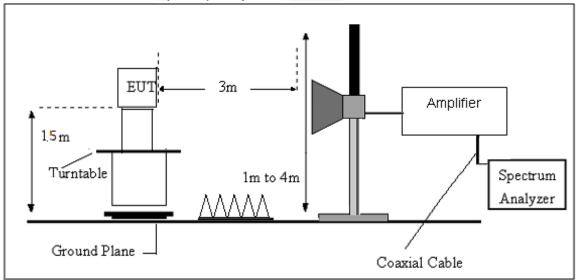
(A) Radiated Emission Test-Up Frequency Below 30MHz



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



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



3.2.5 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

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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:	23.0(C)	Relative Humidity:	58%RH
Test Voltage:	DC 3.7V	Test Mode:	TX Mode

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

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor =40 log (specific distance/test distance)(dB);

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





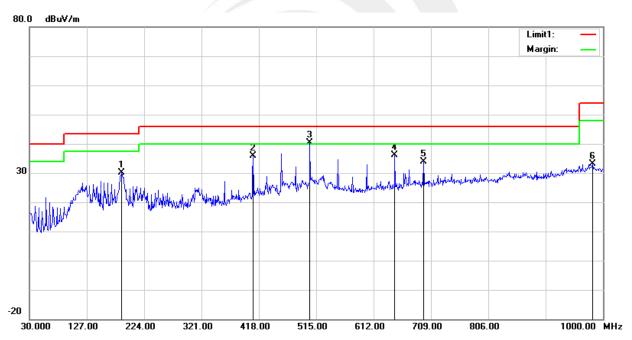
(30MHz-1000MHz)

Temperature:	23.0(C)	Relative Humidity:	58%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	186.1700	50.66	-20.53	30.13	43.50	-13.37	QP
2	408.3000	46.57	-10.66	35.91	46.00	-10.09	QP
3	504.3300	48.40	-7.98	40.42	46.00	-5.58	QP
4	647.8900	41.08	-4.88	36.20	46.00	-9.80	QP
5	696.3900	38.03	-4.23	33.80	46.00	-12.20	QP
6	982.5400	30.52	2.52	33.04	54.00	-20.96	QP

Remark:

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



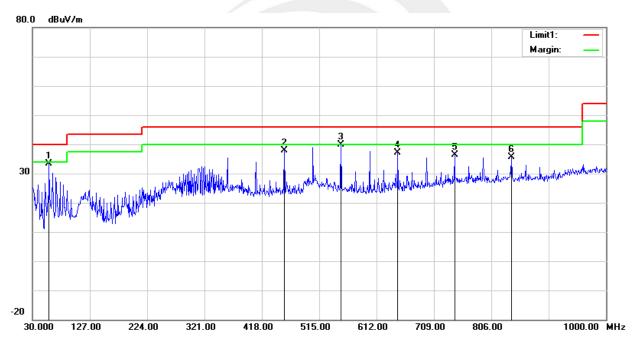


Temperature:	23.0(C)	Relative Humidity:	58%RH		
Test Voltage:	DC 3.7V	Phase:	Vertical		
Test Mode:	Mode 1/2/3/4/5/6/7/8/9(Mode 7 worst mode)				

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	58.1300	58.97	-25.58	33.39	40.00	-6.61	QP
2	455.8300	47.41	-9.55	37.86	46.00	-8.14	QP
3	551.8600	45.67	-5.72	39.95	46.00	-6.05	QP
4	647.8900	41.89	-4.88	37.01	46.00	-8.99	QP
5	743.9200	38.41	-2.13	36.28	46.00	-9.72	QP
6	839.9500	35.91	-0.34	35.57	46.00	-10.43	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)	(dB)	(dB)	(dB/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре	
				Low Chan	nel (8DPSK/2	2402 MHz)				
3264.88	61.98	44.70	6.70	28.20	-9.80	52.18	74.00	-21.82	PK	Vertical
3264.88	50.98	44.70	6.70	28.20	-9.80	41.18	54.00	-12.82	AV	Vertical
3264.75	61.97	44.70	6.70	28.20	-9.80	52.17	74.00	-21.83	PK	Horizontal
3264.75	50.17	44.70	6.70	28.20	-9.80	40.37	54.00	-13.63	AV	Horizontal
4804.48	58.43	44.20	9.04	31.60	-3.56	54.87	74.00	-19.13	PK	Vertical
4804.48	49.24	44.20	9.04	31.60	-3.56	45.68	54.00	-8.32	AV	Vertical
4804.31	58.82	44.20	9.04	31.60	-3.56	55.26	74.00	-18.74	PK	Horizontal
4804.31	49.18	44.20	9.04	31.60	-3.56	45.62	54.00	-8.38	AV	Horizontal
5359.70	48.35	44.20	9.86	32.00	-2.34	46.01	74.00	-27.99	PK	Vertical
5359.70	40.04	44.20	9.86	32.00	-2.34	37.70	54.00	-16.30	AV	Vertical
5359.66	47.32	44.20	9.86	32.00	-2.34	44.98	74.00	-29.02	PK	Horizontal
5359.66	38.23	44.20	9.86	32.00	-2.34	35.89	54.00	-18.11	AV	Horizontal
7205.96	54.77	43.50	11.40	35.50	3.40	58.17	74.00	-15.83	PK	Vertical
7205.96	43.97	43.50	11.40	35.50	3.40	47.37	54.00	-6.63	AV	Vertical
7205.96	54.43	43.50	11.40	35.50	3.40	57.83	74.00	-16.17	PK	Horizontal
7205.96	44.61	43.50	11.40	35.50	3.40	48.01	54.00	-5.99	AV	Horizontal
	•	•		Middle Cha	nnel (8DPSK	/2441 MHz)		•	•	•
3264.67	61.25	44.70	6.70	28.20	-9.80	51.45	74.00	-22.55	PK	Vertical
3264.67	50.95	44.70	6.70	28.20	-9.80	41.15	54.00	-12.85	AV	Vertical
3264.85	62.23	44.70	6.70	28.20	-9.80	52.43	74.00	-21.57	PK	Horizontal
3264.85	50.31	44.70	6.70	28.20	-9.80	40.51	54.00	-13.49	AV	Horizontal
4882.56	58.44	44.20	9.04	31.60	-3.56	54.88	74.00	-19.12	PK	Vertical
4882.56	50.59	44.20	9.04	31.60	-3.56	47.03	54.00	-6.97	AV	Vertical
4882.51	58.22	44.20	9.04	31.60	-3.56	54.66	74.00	-19.34	PK	Horizontal
4882.51	49.21	44.20	9.04	31.60	-3.56	45.65	54.00	-8.35	AV	Horizontal
5359.86	48.03	44.20	9.86	32.00	-2.34	45.69	74.00	-28.31	PK	Vertical
5359.86	39.54	44.20	9.86	32.00	-2.34	37.20	54.00	-16.80	AV	Vertical
5359.74	47.70	44.20	9.86	32.00	-2.34	45.36	74.00	-28.64	PK	Horizontal
5359.74	39.32	44.20	9.86	32.00	-2.34	36.98	54.00	-17.02	AV	Horizontal
7323.80	54.61	43.50	11.40	35.50	3.40	58.01	74.00	-15.99	PK	Vertical
7323.80	43.98	43.50	11.40	35.50	3.40	47.38	54.00	-6.62	AV	Vertical
7323.93	54.00	43.50	11.40	35.50	3.40	57.40	74.00	-16.60	PK	Horizontal
7323.93	44.74	43.50	11.40	35.50	3.40	48.14	54.00	-5.86	AV	Horizontal



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				High Chan	nel (8DPSK	/2480 MHz)				
3264.74	61.36	44.70	6.70	28.20	-9.80	51.56	74.00	-22.44	PK	Vertical
3264.74	51.41	44.70	6.70	28.20	-9.80	41.61	54.00	-12.39	AV	Vertical
3264.72	61.04	44.70	6.70	28.20	-9.80	51.24	74.00	-22.76	PK	Horizontal
3264.72	50.43	44.70	6.70	28.20	-9.80	40.63	54.00	-13.37	AV	Horizontal
4960.55	58.40	44.20	9.04	31.60	-3.56	54.84	74.00	-19.16	PK	Vertical
4960.55	49.17	44.20	9.04	31.60	-3.56	45.61	54.00	-8.39	AV	Vertical
4960.40	58.33	44.20	9.04	31.60	-3.56	54.77	74.00	-19.23	PK	Horizontal
4960.40	50.27	44.20	9.04	31.60	-3.56	46.71	54.00	-7.29	AV	Horizontal
5359.66	49.28	44.20	9.86	32.00	-2.34	46.94	74.00	-27.06	PK	Vertical
5359.66	38.96	44.20	9.86	32.00	-2.34	36.62	54.00	-17.38	AV	Vertical
5359.84	48.55	44.20	9.86	32.00	-2.34	46.21	74.00	-27.79	PK	Horizontal
5359.84	38.11	44.20	9.86	32.00	-2.34	35.77	54.00	-18.23	AV	Horizontal
7439.87	53.63	43.50	11.40	35.50	3.40	57.03	74.00	-16.97	PK	Vertical
7439.87	43.55	43.50	11.40	35.50	3.40	46.95	54.00	-7.05	AV	Vertical
7439.95	54.64	43.50	11.40	35.50	3.40	58.04	74.00	-15.96	PK	Horizontal
7439.95	44.09	43.50	11.40	35.50	3.40	47.49	54.00	-6.51	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

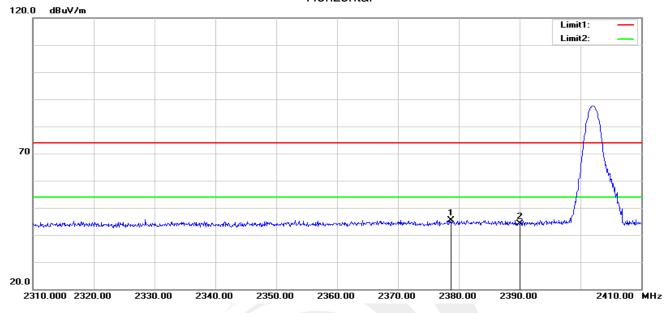
emission is mainly from the environment noise.



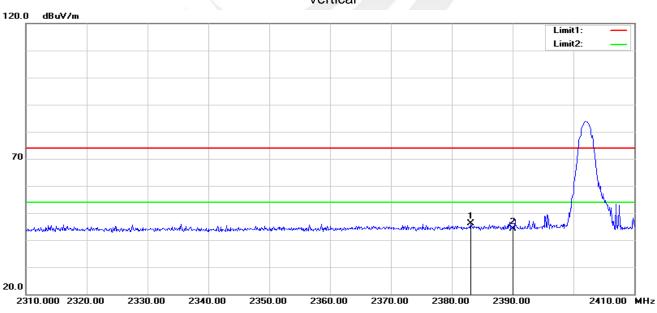


Restricted band Requirements

8DPSK-Low Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2378.700	41.24	4.17	45.41	74.00	-28.59	peak
2	2390.000	39.73	4.34	44.07	74.00	-29.93	peak



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2383.100	42.02	4.23	46.25	74.00	-27.75	peak
2	2390.000	39.81	4.34	44.15	74.00	-29.85	peak

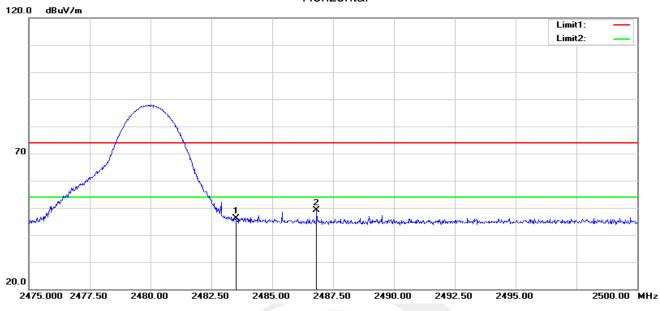
Vertical



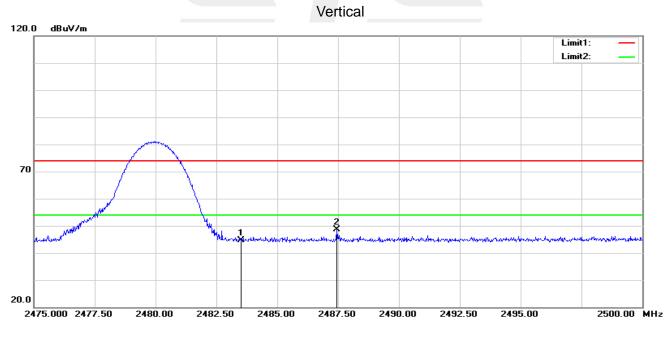
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8DPSK-High Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	41.52	4.60	46.12	74.00	-27.88	peak
2	2486.825	44.62	4.62	49.24	74.00	-24.76	peak



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	40.13	4.60	44.73	74.00	-29.27	peak
2	2487.450	44.00	4.62	48.62	74.00	-25.38	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.

Shenzhen STS Test Services Co., Ltd.



Report No.: STS2008280W02

4. CONDUCTED SPURIOUS & BAND EDGE EMISSION

4.1 LIMIT

According to FCC section 15.247(d)&RSS-247 Issue 2, February 2017 (5.5), 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

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

4.3 TEST SETUP



The EUT is connected to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 500hm; the path loss as the factor is calibrated to correct the reading. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

4.4 EUT OPERATION CONDITIONS

Trace-Mode:

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

Shenzhen STS Test Services Co., Ltd.

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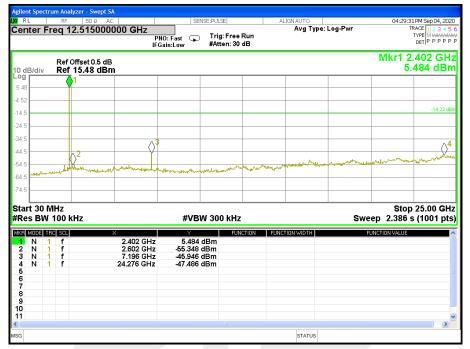
Max hold



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

RL	um Analyzer							
156	RF	50 Ω AC	SENSE:PU	.SE	ALIGN AUTO		04:32:0	3 PM Sep 04, 20
enter F	req 12.5			g: Free Run ten: 30 dB	Avg Typ	e: Log-Pwr		RACE 1 2 3 4 5 TYPE MWWWW DET P P P P
0 dB/div	Ref Offs Ref_15.	et 0.5 dB .73 dBm						.452 GH 730 dBi
og 5.73	1							
.27								
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4.3		3						
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4.3	. Lether	ma hurreletermaneret	and the stand and the stand and the	-	way war water	and the second s	mont market pres	mound
4.3	And prover			· ·				
4.3								
art 30 M Res BW	/IHz 100 kHz		#VBW 30	0 kHz		Swe	Stop eep 2.386 s	
Res BW	100 kHz	×	Y	0 kHz Function	FUNCTION WIDTH			
Res BW R MODE TR N 1 2 N 1	100 kHz 70 301 f f	× 2.452 GHz 2.627 GHz	5.730 dBm -55.269 dBm		FUNCTION WIDTH		eep 2.386 s	25.00 G s (1001 p
Res BW Mode H N 1 N 1 N 1 N 1 N 1	100 kHz 70 501 f f f	× 2.452 GHz	5.730 dBm -55.269 dBm -38.706 dBm		FUNCTION WIDTH		eep 2.386 s	
Res BW R MODE 11 R M	100 kHz 70 501 f f f	× 2.452 GHz 2.627 GHz 4.874 GHz	5.730 dBm -55.269 dBm -38.706 dBm		FUNCTION WIDTH		eep 2.386 s	
Res BW Mode 16 N 1 2 N 1 3 N 1 4 N 1 5 5 7 8 9	100 kHz 70 501 f f f	× 2.452 GHz 2.627 GHz 4.874 GHz	5.730 dBm -55.269 dBm -38.706 dBm		FUNCTION WIDTH		eep 2.386 s	
Res BW R MODE H N 1 2 N 1 3 N 1	100 kHz 70 501 f f f	× 2.452 GHz 2.627 GHz 4.874 GHz	5.730 dBm -55.269 dBm -38.706 dBm		FUNCTION WIDTH		eep 2.386 s	

П



78 CH

nt Spectrum Analyzer - Swept SA	SENSE:PULS	E ALIGNAUTO	04:36:42 PM Sep 04, 2
nter Freq 12.5150000	00 GHz PNO East Trig	Avg Type: Free Run en: 30 dB	
Ref Offset 0.5 dB B/div Ref 15.23 dBm			Mkr1 2.477 G 5.230 dE
3			
3			-14.72
3			
2 	3 minutes and	man have her and have have	new way was a service of the service
8			
rt 30 MHz es BW 100 kHz	#VBW 300	∣ kHz	Stop 25.00 G Sweep 2.386 s (1001 p
MODE TRC SCL X N 1 f f N 1 f f N 1 f f N 1 f f	2.477 GHz 5.230 dBm 2.577 GHz -55.261 dBm 5.548 GHz -55.941 dBm 24.401 GHz -47.440 dBm	FUNCTION FUNCTION WIDTH	FUNCTION VALUE



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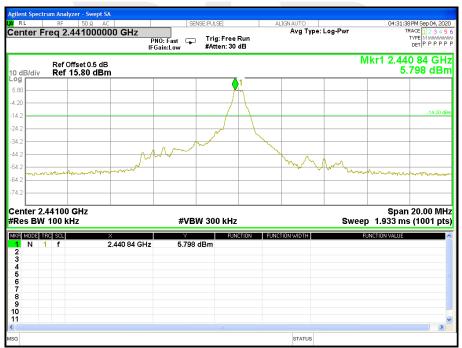


For Band edge(it's also the reference level for conducted spurious emission)

Agiler	nt Spe	ctrur	n An	alyzer - Swept S/	۱.								
LXI R			RF	50 Ω AC		SE	NSE:PULSE		ALIGN AUT		_		1 PM Sep 04, 2020
Cer	iter	Fre	q 2	2.35350000	00 GHz	PNO: Fast	Trig: Free	Run	Avg	g Type: L	_og-Pwr		RACE 1 2 3 4 5 6 TYPE M WANNAMA
						Gain:Low	#Atten: 30	dB					DETPPPPP
			Ref	Offset 0.5 dB							IV		2 19 GHz
10 d Log	B/div	/	Ref	15.84 dBn	1							5.	844 dBm
5.84													1
-4.16													
-14.10													-14.23 dBm
-24.2													.3
-34.2													.√8 ⁴ ∖_
-44.2		~	2										M/ 4
-54.2		X		deal on the basis	a de March Array and March	munun	and the subsection of the		ماله بعاليمالية	ert at a finde	Alanti na Allera rate	alman lune ma	
-64.2	-												
-74.2	⊢												
Cto.	L	200	00	GHz								Ctop 3	40700 GHz
#Re						#VB	W 300 kHz				Sweer		40700 GHZ s (1001 pts)
	MODE				×				FUNCTION WID	NTH I	•	UNCTION VALUE	- (,
1	Ν	1	f		2.402 19 GHz		dBm	CHON	FORCTION WIL	200			
2	N	1	f		2.305 78 GHz 2.398 87 GHz	-56.894 -40.031							
4	N	1	f		2.400 05 GHz	-44.567							
5 6													
7													
8 9													
10 11													
<							III						>
MSG									ST/	ATUS			

00 CH

39 CH





78 CH

	ım Analyzer - Swe								
enter Fr	RF 50 Ω req 2.48750	00000 GHz	PNO: Fast FGain:Low	ISE:PULSE Trig: Free R #Atten: 30 di	un	IGN AUTO Avg Type:	Log-Pwr	TR	PM Sep 04, 202 ACE 1 2 3 4 5 TYPE M WWWW DET P P P P P
dB/div	Ref Offset 0.5 Ref 15.28 d						M	(r1 2.479 5.:	850 GH 281 dBn
.28									
72		/							-14.72 dE
.7	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	$/ \$							
.7	Ant		^ 2 () ³						
7			WAN	march	Ale-Idea da				⁴
.7								at a color of a color of	
							0		50000 GH
art 2.47. Res BW	500 GHz 100 kHz		#VB\	N 300 kHz			Sweet	2.400 ms	(1001 pt
Res BW MODE TR N 1 2 N 1 3 N 1 4 N 1	100 kHz	× 2.479 850 GHz 2.483 500 GHz 2.484 025 GHz 2.499 100 GHz	z 5.281 z -48.571 z -46.186	dBm dBm dBm	ion Funct	ION WIDTH		NCTION VALUE	(1001 pt
Res BW MODE TR N 1 N 1 N 1 N 1 N 1 N 1 N 1 N 1	100 kHz G SCL f f f	2.479 850 GHz 2.483 500 GHz 2.484 025 GHz	z 5.281 z -48.571 z -46.186	dBm dBm dBm	ION FUNC	ION WIDTH			
Res BW R Mode TR N 1 2 N 1 3 N 1	100 kHz G SCL f f f	2.479 850 GHz 2.483 500 GHz 2.484 025 GHz	z 5.281 z -48.571 z -46.186	dBm dBm dBm	ION FUNCT	ION WIDTH			



Shenzhen STS Test Services Co., Ltd.





For Hopping Band edge

GFSK

		yzer - Swept SA								
enter F	_{RF} req 2.	50 Ω AC 35150000	00 GHz	PNO: Fast FGain:Low	ENSE:PULSE Trig: Fre #Atten: 3	e Run	IGNAUTO Avg Type:	Log-Pwr	TR	PM Sep 04, 20 ACE 1 2 3 4 YPE MWWWW DET P P P P
dB/div)ffset 0.5 dB 1 5.84 dBr r						MI	kr1 2.402 5.8	176 G⊦ 344 dB
84										
16										-14.16 d
1.2										-14.10 0
.2										
.2									<u>^2</u>	- Mr
.2	rahr	Mun	windahar	unand	en martin	munn	www.www.	maladah	()	mont
.2										
								Sweet	Stop 2.4 9.867 ms	0300 GH
				#VE	3W 300 kH	z		Sweet		(p.
art 2.30 Res BW B MODE H N 1 2 N 1	100 k 10 sou	Hz 2.	× 402 176 GHz 390 022 GHz	5.84	4 dBm		TION WIDTH		UNCTION VALUE	(1001 pt
N 1 N 1 N 1 N 1	100 k 100 scu f f	Hz 2. 2.	402 176 GHz	5.84 57.83	4 dBm 7 dBm		TION WIDTH			(1001 p
Res BW R MODE TO N 1 N 1	100 k 100 scu f f	Hz 2. 2.	402 176 GHz 390 022 GHz	5.84 57.83	4 dBm 7 dBm		TIONWIDTH			(
es BW N 1 N 1 N 1 N 1 N 1	100 k 100 scu f f	Hz 2. 2.	402 176 GHz 390 022 GHz	5.84 57.83	4 dBm 7 dBm		TIONWIDTH			(
Res BW	100 k 100 scu f f	Hz 2. 2.	402 176 GHz 390 022 GHz	5.84 57.83	4 dBm 7 dBm		TION WIDTH			

RL R			SEN	SE:PULSE	ALIGNAUTO		04:44:03 PM Sep 04, 20
enter Freq	2.4895000	PI	NO: Fast 🖵 Gain:Low	Trig: Free Run #Atten: 30 dB	Avg Type	e: Log-Pwr	TRACE 1 2 3 4 5 TYPE M MMMM DET P P P P
	ef Offset 0.5 dE ef 15.23 dBi					M	(r1 2.480 008 GF 5.232 dB
$\bigvee \setminus$							-14.77 c
3	Mr.	2					
	A. W. M	man					
			er no an	and the stand of the	and and and and and and and and and a second se	Marcharo	month for the
3							
urt 2.47900 es BW 100			#VBV	V 300 kHz		Sweep	Stop 2.50000 Gl 2.067 ms (1001 pt
MODE TRC SC N 1 f		× 2.480 008 GHz	Y 5.232 (FUNCTION WIDTH	FL	JNCTION VALUE
N 1 f	2	2.483 515 GHz 2.499 034 GHz	-51.961 c	Bm			
							>



Page 38 of 76 Report No.: STS2008280W02

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

	RF 50	Q AC	SENSE:PULSE		ALIGN AUTO		05:02:55 P	M Sep 04, 202
ter F		000000 GHz		ree Run :: 30 dB	Avg Type	: Log-Pwr	TRA	CE 1 2 3 4 9 PE M WAAAAA ET P P P P I
B/div	Ref Offset 0 Ref 12.41						Mkr1 2.4 2.4	02 GH 06 dB
	1							
L								
								-14.16 c
-								
<u> </u>	^2	Y				A AMA	manut	mandant
	molthe	man and a second starting of the second start	manuto manufactor and	w Aller when the	man paner and	~ Maria and a second		
t 30 M s BW	/IHz 100 kHz		#VBW 300 I	(Hz		Swe	Stop 2 ep 2.386 s	5.00 GH 1001 pt
MODE TH		× 2.402 GHz	2.406 dBm	FUNCTION	FUNCTION WIDTH	FL	INCTION VALUE	
N 1 N 1 N 1	f	2.602 GHz 7.196 GHz 24.975 GHz	-55.890 dBm -45.042 dBm -47.601 dBm					
								>

00 CH

39	СН	

RL	RF	50 Q AC		SEN	NSE:PULSE		ALIGNAUTO		04:59:0	4 PM Sep 04, 2
nter F	req 1	2.5150000	Р	NO: Fast 😱 Gain:Low	Trig: Free #Atten: 30		Avg Type	: Log-Pwr	I	TYPE MWWW DET P P P P
dB/div		Offset 0.5 dB 13.61 dBm	1							.452 GI .606 dB
	(1								
1										
9										-14.10
4										
1										
<u>ال</u>				_						Δ
		<u>∧2</u>		3						
		M	Ϋ́				manahan	and the same	and a second when	haven
and and	and second second	Martin Jacob 1644	- marine ways	mummerhave	aparter and a state of	Auronal Auro				
1										
4 										
nt 30 I es BW		kHz	·	#VBI	N 300 kHz			Sw	Stop eep 2.386	o 25.00 G s (1001 p
	RC SCL	>		Y		CTION FU	INCTION WIDTH		FUNCTION VALUE	
N ·	1 f 1 f		2.452 GHz 2.727 GHz	3.606 -54.136						
	1 f 1 f		7.321 GHz	-50.162						
N	1 f		24.201 GHz	-47.701	авт					



78 CH

nt Spectrum Analyzer						
			E Free Run en: 30 dB	ALIGNAUTO Avg Type: Log		TRACE 1 2 3 TYPE MWMA DET P P P
Ref Offs B/div Ref 9.6	et 0.5 dB	FGain:Low #Atto			Mkr1	2.477 G 5.125 dE
1						
						-14.62
3						
	A 3					
A2						. A.
	Alla and and and and and and and and and an	La rengement in survey of	mark and mark and	we man have ment	god and and a section	we the proversion
rt 30 MHz es BW 100 kHz		#VBW 300	kHz		St Sweep 2.38	op 25.00 G 6 s (1001 p
MODE TRC SCL	×	Y S 105 JB	FUNCTION	FUNCTION WIDTH	FUNCTION VAL	UE
N 1 f N 1 f N 1 f N 1 f	2.477 GHz 2.677 GHz 4.949 GHz 23.851 GHz	-56.860 dBm -46.083 dBm				
				STATUS		
				011100		



Shenzhen STS Test Services Co., Ltd.



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

		ctrur		alyzer - Swept SA									
Cen		Fre	RF	50 Q AC	0 GHz	SE	NSE:PULSE		ALIG	AUTO AVG Type:	Log-Pwr		FPM Sep 04, 2020
			<u> </u>		F	PNO: Fast 🖵 Gain:Low	Trig: Free #Atten: 30				-		DET P P P P P
10 d	B/div			Offset 0.5 dB 15.84 dBm	1						N	1kr1 2.40 5.	1 97 GHz 837 dBm
Log 5.84													1
-4.16													A
-14.2													-14,16 dBm
-24.2													
-34.2													
-44.2	L-	0	2										WAY W
-54.2		$\overline{\langle}$	÷		mondumen						and the state of t	W	
-64.2		19-44 1		and and whether the state of the	and a look of the second s	Contraction de la Contraction	and the second se			And do no so . Marth	Could on Law Caroling Bolt of		
-74.2													
Stai #Re				GHz kHz		#VB	W 300 kHz	:			Swee	Stop 2. p 10.27 ms	40700 GHz s (1001 pts)
MKR		TRC				Y 5.837		ICTION	FUNCTIO	N WIDTH	F	UNCTION VALUE	_
1	N N	1	f f	2	.401 97 GHz .305 99 GHz	-56.606	dBm						
3 4	N N	1	f f		.398 87 GHz .400 05 GHz	-40.014 -44.679							
5 6 7 8 9													Ξ.
7													
9 10													
11													~
MSG										STATUS			

00 CH

39 CH





78 CH

	ectru		lyzer - Swept S								
enter	Fre	RF eq 2	50 Ω AC 2.4875000	00 GHz	NO: Fast Gain:Low	NSE:PULSE Trig: Free #Atten: 30	Run	IGNAUTO Avg Type:	-		5:20 PM Sep 04, 202 TRACE 1 2 3 4 5 TYPE MWWWW DET P P P P F
dB/di	v		Offset 0.5 dB 15.38 dBn						M	(r1 2.47	9 850 GH 5.379 dBr
38				1 1							
52			ſ								-14.62 dB
.6											
.6	<u>م ا</u>	\sim	N	- North	$\langle \chi \rangle^3$						
.6	100	<u> </u>		vv	WWW	manne	ماسر مندي الدين الم	a-railing and a second	, 	4	An of the free provides to
.6											
art 2.	.475	i00 (GHz							Stop	2.50000 GH
tes B						W 300 kHz					ns (1001 pt
IIN 2N 3N	1 1 1 1	f f f f	2 2 2	× .479 850 GHz .483 500 GHz .484 000 GHz .495 125 GHz	5.379 -49.540 -45.721 -57.512	dBm dBm dBm	ICTION FUNC	TION WIDTH	F	UNCTION VALU	E
4 N											
4 N 5 7 3 9 0											



Shenzhen STS Test Services Co., Ltd.





For Hopping Band edge

$\pi/4$ -DQPSK

RL RF	zer - Swept SA 50 Ω AC		SENSE:PULSE		IGNAUTO		05:11:00	DM 0 04 00
	351500000 G		Trin: Ene o Du	in	Avg Type: I	_og-Pwr	TR	PM Sep 04, 20 ACE 1 2 3 4 YPE MWWWW DET P P P P
	ffset 0.5 dB 5.85 dBm					MI	kr1 2.401 5.8	970 GH 345 dB
35								
2								-14.15 d
2								
2								DAX
2			ب ب م اید مادارد.		1 No 1 Adv. 100 No. 11	un sulture na cal	$\langle \rangle^2$	NILL.
2		na contrara la televica de la consecta de la consec		filmenting and second end	0.00.00.000			
2	U-7						Stop 2 /	0300 GI
es BW 100 kl		#V	BW 300 kHz			Swee	9.867 ms	
MODE TRC SCL N 1 f N 1 f N 1 f	× 2.401 9 2.390 0 2.400 0	22 GHz -58.74	5 dBm 9 dBm 2 dBm	ON FUNCT	TION WIDTH	F	UNCTION VALUE	

	RF 50 Ω		SENSE:PUL:	E	ALIGNAUTO Avg Type: L	on Pur	05:13:09 PM Sep 04, 20 TRACE 1 2 3 4
nter Fre	q 2.4895			: Free Run en: 30 dB	Avg type.	.og-r wi	TYPE MWAMMA DET P P P P
dB/div	Ref Offset 0. Ref 15.36					Mkr1	2.479 840 GH 5.355 dB
$\frac{1}{4}$	ς						
6							-14.64 c
- 							
	ha						
	h	2					
	• •••	man					Q°
		VV. Sol	manne have	where where we want the second		and the second second	von marcharthanthan
rt 2.4790 es BW 10			#VBW 300			Sween 2	Stop 2.50000 Gi .067 ms (1001 pi
			#VBW 30				
MODE TRC	f	× 2.479 840 GHz	5.355 dBm	FUNCTION	FUNCTION WIDTH	FUNCTIO	DN VALUE
N 1 N 1	f f	2.483 515 GHz 2.497 837 GHz	-51.378 dBm -54.287 dBm				
		2.437 037 012	-04.207 dBill				
					STATUS		



Page 43 of 76 Report No.: STS2008280W02

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

00 CH

L	RF 50 Q	AC	SEN	SE:PULSE	ALIGN AUTO		05:31:29 PM Sep 04, 2
nter Fre	q 12.5150		NO: Fast 😱 Gain:Low	Trig: Free Run #Atten: 30 dB	Avg Type:	Log-Pwr	TRACE 1 2 3 4 TYPE M WARA DET P P P P
	Ref Offset 0.6 Ref 0.88 dl						Mkr1 2.402 GI -9.119 dB
2							-14.17
1							
		∧3					
	0.2	Y					
	and a start			maning we	monormen	And and particulations	and the second of the second second
Marmorton	Carrier and		- Second and all the second and all the second and a second	And a family of the second			
1							
rt 30 MH es BW 1			#VBV	V 300 kHz		Swee	Stop 25.00 G p 2.386 s (1001 p
MODE TRC	SCL	×	Y	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE
N 1 N 1 N 1 N 1	f f f	2.402 GHz 2.652 GHz 4.799 GHz 24.600 GHz	-9.119 c -56.986 c -44.346 c -47.622 c	IBm IBm			
)

39 CH

	RF	50 Q AC	SENSE:PU	.SE	ALIGN AUTO		05:28:46	PM Sep 04, 2
enter F	req 12.5	15000000 GHz		g: Free Run ten: 30 dB	Avg Type	: Log-Pwr	TR	ACE 1 2 3 4 YPE MWWW DET P P P P
dB/div		et 0.5 dB .36 dBm					Mkr1 2. 1.	452 GI 355 dB
36	(1							
64								-14.15
.6								-14.15
6		A3						
.6	2							$\langle \rangle$
6	P.		hun hallow has	and the same the	un marchan	an all press	and the management	Vagene de
6	en an and		And a construction of the second					
6								
art 30 I	MHz						Stop	25.00 G
			#\/D\M 20	0 kHz		Swe	ep 2.386 s	(1001 p
	100 kHz		#VDVV JU					
es BW	RC SCL	×	Y	FUNCTION	FUNCTION WIDTH	f	UNCTION VALUE	
es BW Model T N	RC SCL 1 f 1 f	× 2.452 GH: 2.727 GH:	z 1.355 dBm z -54.549 dBm		FUNCTION WIDTH	F	UNCTION VALUE	
es BW Model T N N	RC SCL 1 f 1 f	× 2.452 GH:	z 1.355 dBm z -54.549 dBm z -43.772 dBm		FUNCTION WIDTH	F	UNCTION VALUE	
es BW Model T N N	RC SCL 1 f 1 f 1 f	× 2.452 GH: 2.727 GH: 4.874 GH:	z 1.355 dBm z -54.549 dBm z -43.772 dBm		FUNCTION WIDTH	F	UNCTION VALUE	
es BW Model T N N	RC SCL 1 f 1 f 1 f	× 2.452 GH: 2.727 GH: 4.874 GH:	z 1.355 dBm z -54.549 dBm z -43.772 dBm		FUNCTION WIDTH	F	UNCTION VALUE	
es BW Model T N N	RC SCL 1 f 1 f 1 f	× 2.452 GH: 2.727 GH: 4.874 GH:	z 1.355 dBm z -54.549 dBm z -43.772 dBm		FUNCTION WIDTH	5	UNCTION VALUE	



78 CH

t Spectrum Analyzer - Sv RF 50 g		SENSE:PULSE		ALIGNAUTO		05:34:03	PM Sep 04,
ter Freg 12.515				Avg Type:	Log-Pwr	TR	ACE 1 2 3
•		0: Fast 🖵 Trig: Fr ain:Low #Atten:				T	DET P P P
	IFG	sm.cow written.				Mkr1 2.	A77.C
Ref Offset 0 B/div Ref 13.56							562 d
B/div Ref 13.56	abm						
<u> </u>							
							-14.6
	$\langle \rangle^3$						
02	Y I						
\sum				at the	and the second second	aque man man	March
any marked the mon	en any har we beling more the	m but and when a magness of the	where he part there is	Julia ling in the local			
t 30 MHz						Ston	25.00 0
s BW 100 kHz		#VBW 300 k	Hz		Sw	eep 2.386 s	
MODE TRC SCL	×	Y	FUNCTION F	UNCTION WIDTH		FUNCTION VALUE	
N 1 f	2.477 GHz	3.562 dBm					
N 1 f N 1 f	2.777 GHz 4.949 GHz	-53.401 dBm -38.556 dBm					
N 1 f	24.576 GHz	-47.704 dBm					



Shenzhen STS Test Services Co., Ltd.

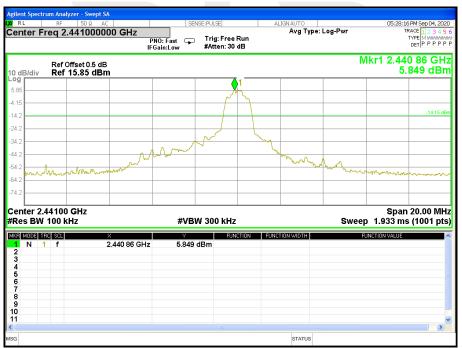


For Band edge(it's also the reference level for conducted spurious emission)

		ctrun		lyzer - Swept SA	l								
LXI RI		_	RF	50 Ω AC		SE	NSE:PULSE		ALIG	NAUTO AVg Type:	Len Dum		9 PM Sep 04, 2020 RACE 1 2 3 4 5 6
Cen	ter	Fre	q 2	2.35350000	F	PNO: Fast 🖵	Trig: Free			Avg type:	Log-Pwr		TYPE MWWWWWW DET P P P P P P
_					IF	Gain:Low	#Atten: 30	ав					,
10 di	3/div			Offset 0.5 dB 15.83 dBm	ı						N		1 97 GHz 832 dBm
Log													1
5.83													Å
-4.17													-14,17 dBm
-14.2													
-24.2													- 2
-34.2													- Q84 h
-44.2			2										MAX W
-54.2		X		Lund New yestable		An and a subservate Decemb	hunderman	A		man for the state of the	Control Control Control	more	(
-64.2	-												
-74.2	-												
Star	+ 2 '	300	00.0	247								Stop 2	40700 GHz
#Re						#VB	W 300 kHz	:			Swee	5 10.27 ms	s (1001 pts)
MKR	MODE	TRC	SCL		x	Y	FUN	ICTION	FUNCTIO	N WIDTH	F	UNCTION VALUE	~
1 2	N N	1	f f		2.401 97 GHz 2.305 78 GHz	5.832 -56.457							
3	Ν	1	f	2	2.398 87 GHz	-40.381	dBm						
4	Ν	1	f	2	2.400 05 GHz	-44.110	dBm						
5 6 7 8 9													
8													
9 10													
11													~
< MSG										STATUS			>
Mag										STATUS			

00 CH

39 CH





78 CH

		Analyzer - Swep								
enter		RF 50 Ω 2.487500		PNO: Fast FGain:Low	NSE:PULSE Trig: Free F #Atten: 30 d	Run	IGNAUTO Avg Type:	Log-Pwr		2 PM Sep 04, 202 RACE 1 2 3 4 5 TYPE MWWW DET P P P P
dB/div		ef Offset 0.5 (ef 15.33 di						MI	(r1 2.480 5	000 GH .330 dBr
33			1							
67										-14.67 di
1.7										
1.7		- M	- m	$(1)^3$						
	har			Why	4					⊘ ⁴
1.7					agandran and phile	and the second sec	Mary Marmala	~p~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	a the and the second
1.7										
art 2. Res B		0 GHz 0 kHz		#VBI	N 300 kHz			Sweep	Stop 2 2.400 m	.50000 GH s (1001 pt
R MODE	TRC S		× 2.480 000 GHz	Y 5,330	FUNC	TION FUNC	TION WIDTH	FL	UNCTION VALUE	
2 N 3 N 4 N	1 1 1	F F	2.483 500 GHz 2.484 000 GHz 2.497 850 GHz	-50.329 -45.802	dBm dBm					
5 7										
5 7 3										
5 7 3 9 0 1										



Shenzhen STS Test Services Co., Ltd.





For Hopping Band edge

8DPSK

L pecu	um Analyzer RF	- Swept SA 50 Ω AC		CENC	PULSE		IGN AUTO		05:17:50	PM Sep 04, 2
		1500000 G	Hz PNO: F IFGain:I	ast 😱	Trig: Free Ru #Atten: 30 dB	n	Avg Type:	Log-Pwr	TR/ T	ACE 1 2 3 4 YPE M WAAA DET P P P F
B/div	Ref Offse Ref 15.							М	kr1 2.403 (5.8	000 G 389 dE
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<u> </u>										
	000 GHz								Stop 2.4	
	100 kHz			#VBW	300 kHz				p 9.867 ms	(1001 p
MODE TH	f SCL	2,403 0	00 GHz	5.889 dE	FUNCTI 3m	DN FUNC	TION WIDTH		FUNCTION VALUE	
N 1 N 1		2.390 0	22 GHz	-58.641 dE -39.871 dE	8m					
		2.400 0	13 912	-53.07 T UE	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					
)
					III		STATUS			

	50Ω AC	SENSE:PULS	E	ALIGNAUTO		05:20:10 PM Sep 04, 20
ter Freq 2.48			: Free Run en: 30 dB	Avg Type: Lo	og-Pwr	TRACE 1 2 3 4 TYPE MWWWW DET P P P P
Ref Offse B/div Ref 15.	et 0.5 dB 29 dBm				Mkr1 2.	480 008 GI 5.293 dB
1 1						
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,		Mar and the set	mm. mm.mm	Mar Commence	mennenstructure	mmmm
rt 2.47900 GHz es BW 100 kHz		#VBW 300) kHz			op 2.50000 G 7 ms (1001 p
MODE TRC SCL N 1 f	× 2.480 008 GHz	7 5,293 dBm	FUNCTION	FUNCTION WIDTH	FUNCTION	ALUE
N 1 f N 1 f	2.483 515 GHz 2.498 005 GHz	-53.578 dBm				



5. NUMBER OF HOPPING CHANNEL

5.1 LIMIT

	FCC Part 15.247,Subpart C										
	RSS-247 Issue 2										
Section	Test Item	Limit	FrequencyRange (MHz)	Result							
15.247 (a)(1)(iii) RSS-247	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

EUT	SPECTRUM
	ANALYZER

5.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.



5.5 TEST RESULTS

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

Number of Hopping Channel

79

Hopping channel

ent		Fre	RF Pq 2	50 Ω .4417500		PNO: Fast		EPULSE	Run	AL	Avg Type:	Log-Pwr		36 PM Sep 04, 20 TRACE 1 2 3 4 TYPE MWAAAA
						IFGain:Low	<u> </u>	#Atten: 30	dB					DETPPP
0 dE	3/div			Offset 0.5 d 16.20 dB								Mkr	2 2.479 9	909 5 GH 5.32 dB
og 5.20	$\langle \rangle$	1												2
	Ń	W	WY	MMM	NYNYN	YMYYYY	WW	www	MMM	W	WWWW	mmm	mm	mm
3.80	11													*****
3.8	+													
3.8	+													
3.8	1													
13.8	V.													
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			00 (00 F			+	£VRM	300 kHz				Swee	Stop 2 p 1.133 m	2.48350 G
	_	_	SCU	(112	×	,				TINC	ION WIDTH			3 (1001 p
	N	1	f	2,	402 254 5 GH	z	6.00 dE		CHON	TONCI			ONCTION WALCE	
	Ν	1	f	2.	479 909 5 GH	z	5.32 dE	3m						
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6. AVERAGE TIME OF OCCUPANCY

6.1 LIMIT

FCC Part 15.247,Subpart C					
RSS-247 Issue 2					
Section Test Item Limit FrequencyRange (MHz) Result					
15.247 (a)(1)(iii) RSS-247	Average Time of Occupancy	0.4sec	2400-2483.5	PASS	

6.2 TEST PROCEDURE

- a. The transmitter output (antenna port) was connected to the spectrum analyzer.
- b. Set RBW =1MHz/VBW =3MHz.
- c. Use a video trigger with the trigger level set to enable triggering only on full pulses.
- d. Sweep Time is more than once pulse time.
- Set the center frequency on any frequency would be measure and set the frequency span to e. zero span.
- f. Measure the maximum time duration of one single pulse.
- g. Set the EUT for DH5, DH3 and DH1 packet transmitting.
- \tilde{h} . Measure the maximum time duration of one single pulse.
- i. DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots RX, 1 time slot TX). 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 $10.12 \times 31.6 = 320$ within 31.6 seconds.

6.3 TEST SETUP



6.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.



6.5 TEST RESULTS

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

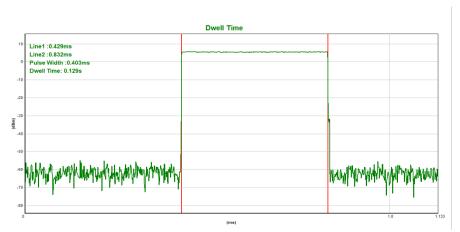
Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
DH1	middle	0.403	0.129	0.4
DH3	middle	1.662	0.266	0.4
DH5	middle	2.916	0.311	0.4



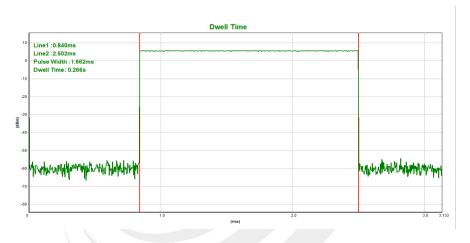
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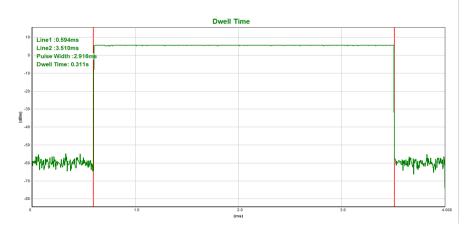
CH39-DH1



CH39-DH3







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

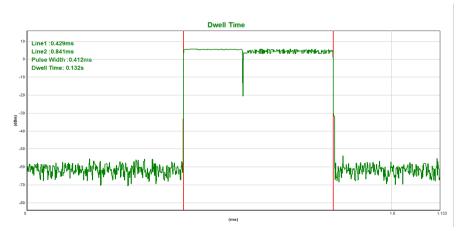
Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
2DH1	middle	0.412	0.132	0.4
2DH3	middle	1.665	0.266	0.4
2DH5	middle	2.917	0.311	0.4



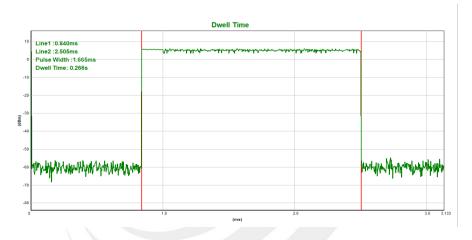
Shenzhen STS Test Services Co., Ltd.



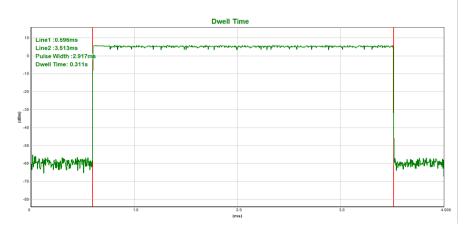
CH39-2DH1



CH39-2DH3







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

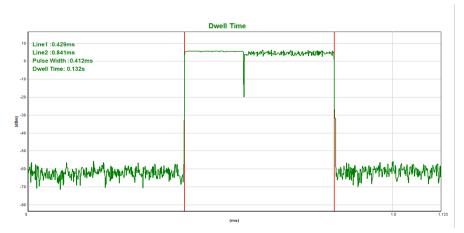
Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
3DH1	middle	0.412	0.132	0.4
3DH3	middle	1.665	0.266	0.4
3DH5	middle	2.925	0.312	0.4



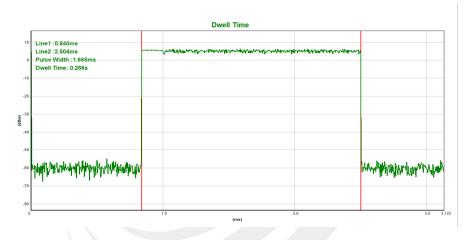
Shenzhen STS Test Services Co., Ltd.



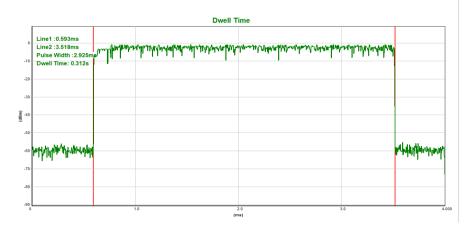
CH39-3DH1



CH39-3DH3



CH39-3DH5



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7. HOPPING CHANNEL SEPARATION MEASUREMEN

7.1 LIMIT

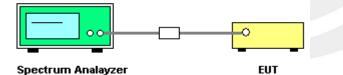
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that 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 Separatio			
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	2401.996	2402.998	1.002	0.832	Complies
2441 MHz	2440.996	2441.995	0.999	0.835	Complies
2480 MHz	2478.996	2479.998	1.002	0.828	Complies

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

CH00 -1Mbps

-	RF 50 Ω	AC	SEN:	SE:PULSE	ALIGN AUTO		04:30:15 P	M Sep 04, 20
ter Fr	eq 2.40250	PI	NO: Wide 😱 Gain:Low	Trig: Free Run #Atten: 30 dB	Avg Type:	Log-Pwr	TRA TY D	CE 1 2 3 4 PE MWWWW ET P P P P
B/div	Ref Offset 0.5 Ref 15.82 d					Mkr	2 2.402 9 5.7	98 GH 90 dB
			<u>\</u> 1		2			
		\sim	~m		m	\sim		
		~~~		m	<u></u>	~	~	
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<u> </u>								
<u> </u>								
ter 2.4	02500 GHz						Span 3	.000 MH
s BW 3	30 kHz		#VBV	V 100 kHz		Sweep	3.200 ms (	1001 pt
MODE TR		×	Y	FUNCTION	FUNCTION WIDTH	FUN	CTION VALUE	
N 1 N 1	f f	2.401 996 GHz 2.402 998 GHz	5.82 c 5.79 c					
								>

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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	2401.993	2402.995	1.002	0.799	Complies
2441 MHz	2440.993	2441.998	1.005	0.810	Complies
2480 MHz	2478.996	2479.998	1.002	0.809	Complies

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

RL	rum Analyzer -	iOΩ AC	SENSE:PULSE	<u> </u>	LIGNAUTO	05:03:36 PM Sep 04,	202
		2500000 GHz	): Wide 🕞 Trig: f	Free Run n: 30 dB	Avg Type: Log-Pwr	TRACE 1 2 3 TYPE MWW DET P P P	45
) dB/div	Ref Offset Ref 15.6					Mkr2 2.402 995 G 5.866 di	
.63			1		2		
.85		man		~~~~~	$\Lambda\Lambda$	$\sim$	
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1.4							
	402500 Gł 30 kHz	Hz	#VBW 100	kHz	Sv	Span 3.000 N   veep   3.200 ms (1001	
R MODE TH		×	Ŷ	FUNCTION FUNC	TION WIDTH	FUNCTION VALUE	
1 N 1 2 N 1		2.401 993 GHz 2.402 995 GHz	5.63 dBm 5.87 dBm				
3							
5							
5 7							
3							
5							
9							
3							2

## 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:	DC 3.7V

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2401.993	2402.998	1.005	0.793	Complies
2441 MHz	2440.996	2441.995	0.999	0.804	Complies
2480 MHz	2478.996	2479.995	0.999	0.805	Complies

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

CH00 -3Mbps

RL F	RF 50 Ω AC	SENSE:PULS	E ALIGN AUTO		05:32:05 PM Sep 04, 202
nter Freq	2.402500000 GHz	PNO: Wide 🍙 Trig: FGain:Low #Atte	Avg T Free Run en: 30 dB	ype: Log-Pwr	TRACE 1 2 3 4 5 TYPE MWWWW DET P P P P F
dB/div R	ef Offset 0.5 dB ef 15.71 dBm			Mkr2 2	2.402 998 GH 5.841 dBr
g ′1		1		2	
9	$\land$	man	Λ./	man a	
3	- manun 1		man .		~
3					5
3					L.
mun					m
3					
3					
nter 2.402 es BW 30		#VBW 100	kHz	Sweep 3.2	Span 3.000 MH 00 ms (1001 pt
MODE TRC S		Y	FUNCTION FUNCTION WIDTH	FUNCTION	I VALUE
N 1 f					
					>

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#### CH39 -3Mbps

RF 50 Ω AC	SENSE:PULSE	ALIGNAUTO	05:29:28 PM Sep
Freq 2.441500000 GHz	Z PNO: Wide 🍙 Trig: Free Run IFGain:Low #Atten: 30 dB	Avg Type: Log-Pwr	TRACE 1 TYPE M DET P
Ref Offset 0.5 dB v Ref 15.88 dBm		Mk	r2 2.441 995 5.918
	01	2	
		and he was	$\sim$
~~~			
-			~~~~
2.441500 GHz			Span 3.00
W 30 kHz	#VBW 100 kHz	Sweep	3.200 ms (100
E TRC SCL X	Y FUNCTION	•	NCTION VALUE
	GHz 5.88 dBm		
1 f 2.440 996	GHz 5.92 dBm		
	0.02 40.01		
1 f 2.440 996	0.02 0.02 0.01		
1 f 2.440 996			
1 f 2.440 996			
1 f 2.440 996			
1 f 2.440 996			
1 f 2.440 996			

CH78 -3Mbps



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8. BANDWIDTH TEST

8.1 LIMIT

FCC Part15 15.247,Subpart C RSS-247 Issue 2				
Section	Test Item	Limit	FrequencyRange (MHz)	Result
15.247(a)(1) RSS-247 5.1 (a) RSS-Gen 6.7	(20dB&99% bandwidth)	N/A	2400-2483.5	PASS

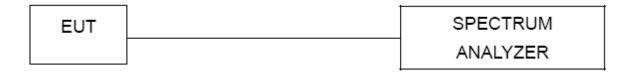
Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> Measurement Bandwidth or Channel Separation
RB	30 kHz (20dB Bandwidth) / 30 kHz (Channel Separation)
VB	100 kHz (20dB Bandwidth) / 100 kHz (Channel Separation)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

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

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.



8.5 TEST RESULTS

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

Frequency	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402 MHz	0.832	0.839	PASS
2441 MHz	0.835	0.839	PASS
2480 MHz	0.828	0.839	PASS

CH00 -1 Mbps

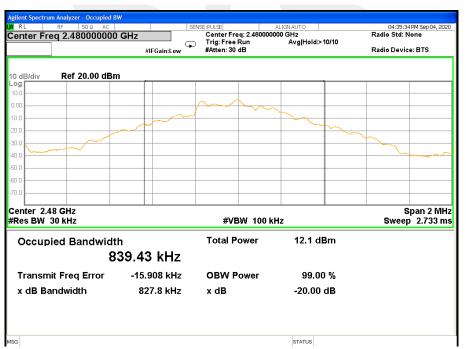
RL RF 50Ω AC			ALIGNAUTO	04:28:23 PM Sep 04, 202
enter Freq 2.402000000	GHz	Center Freq: 2.402000 Trig: Free Run	000 GHz Avg Hold:>10/10	Radio Std: None
	#IFGain:Low	#Atten: 30 dB		Radio Device: BTS
0 dB/div Ref 20.00 dBm				
10.0				
0.00		mont.		
10.0				
	\sim		- man	
20.0				
80.0				
40.0				
50.0				
50.0				
70.0				
Center 2.402 GHz				Span 2 MH
Res BW 30 kHz		#VBW 100 k	Hz	Sweep 2.733 m
Occupied Bandwidth	1	Total Power	12.6 dBm	
	39.42 kHz			
0.	5.42 KHZ			
Transmit Freq Error	-491 Hz	OBW Power	99.00 %	
x dB Bandwidth	832.1 kHz	x dB	-20.00 dB	
SG			STATUS	



CH39 -1Mbps



CH78 -1Mbps



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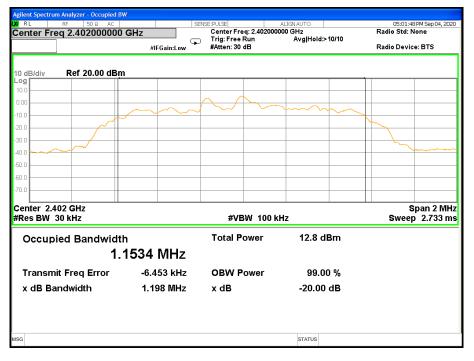
-

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

Frequency	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402 MHz	1.198	1.153	PASS
2441 MHz	1.215	1.155	PASS
2480 MHz	1.213	1.154	PASS

CH00 -2Mbps

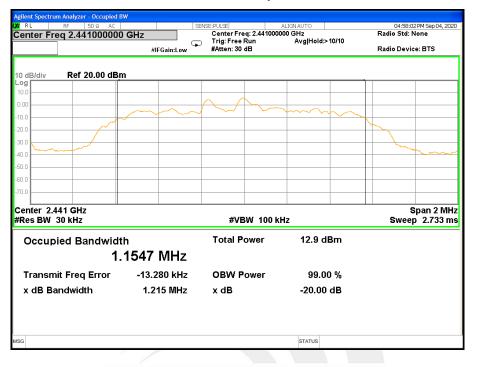


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CH39 -2Mbps



CH78 -2Mbps



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

Frequency	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402 MHz	1.189	1.1432	PASS
2441 MHz	1.206	1.1449	PASS
2480 MHz	1.207	1.1429	PASS

CH00 -3Mbps



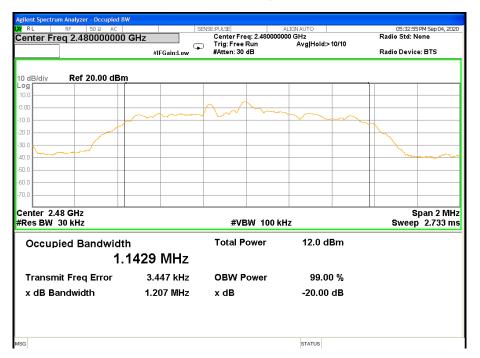
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CH39 -3Mbps



CH78 -3Mbps



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9. OUTPUT POWER TEST

9.1 LIMIT

FCC Part 15.247,Subpart C RSS-247 Issue 2				
Section	Test Item	Limit	FrequencyRange (MHz)	Result
15.247 (a)(1)&(b)(1) RSS-247	Output Power	1 W or 0.125W if channel separation > 2/3 bandwidthprovided thesystems operatewith an output power no greater than125 mW(20.97dBm)	2400-2483.5	PASS
RSS-247	EIRP	4W	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

EUT		Power sensor		PC
-----	--	--------------	--	----

9.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.



9.5 TEST RESULTS

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

Mode	Channel	Frequency	Peak Power	Average Power	Limit
Mode	Number	(MHz)	(dBm)	(dBm)	(dBm)
	0	2402	6.70	1.45	30.00
GFSK(1M)	39	2441	6.49	1.22	30.00
	78	2480	6.06	0.79	30.00

Note: the channel separation >20dB bandwidth

Mode	Channel	Frequency	Peak Power	Average Power	Limit	
Mode	Number	Number (MHz	(MHz)	(dBm)	(dBm)	(dBm)
	0	2402	7.68	0.77	20.97	
GFSK(1M)	39	2441	7.54	0.54	20.97	
	78	2480	7.22	0.09	20.97	

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

Mode	Channel	Frequency	Peak Power	Average Power	Limit
Mode	Number	(MHz)	(dBm)	(dBm)	(dBm)
	0	2402	7.95	0.79	20.97
8-DPSK(3M)	39	2441	7.71	0.54	20.97
	78	2480	7.31	0.11	20.97

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

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EIRP Power						
Mode	Channel	Frequency	Peak Power	Antenna Gain	EIRP Power	Limit
mode	Number	(MHz)	(dBm)	(dBi)	(dBm)	(dBm)
	0	2402	6.70	1.79	8.49	36.02
GFSK(1M)	39	2441	6.49	1.79	8.28	36.02
	78	2480	6.06	1.79	7.85	36.02
Mode	Channel	Frequency	Peak Power	Antenna Gain	EIRP Power	Limit
mode	Number	er (MHz)	(dBm)	(dBi)	(dBm)	(dBm)
	0	2402	7.68	1.79	9.47	36.02
π/4-DQPSK(2M)	39	2441	7.54	1.79	9.33	36.02
	78	2480	7.22	1.79	9.01	36.02
Mode	Channel	Frequency	Peak Power	Antenna Gain	EIRP Power	Limit
Mode	Number	(MHz)	(dBm)	(dBi)	(dBm)	(dBm)
	0	2402	7.95	1.79	9.74	36.02
8-DPSK(3M)	39	2441	7.71	1.79	9.50	36.02
	78	2480	7.31	1.79	9.10	36.02

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10. ANTENNA REQUIREMENT

10.1 STANDARD REQUIREMENT

15.203&RSS-Gen Issue 5 requirement: For intentional device, according to 15.203&RSS-Gen Issue 5: 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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11. FREQUENCY STABILITY

11.1 LIMITS OF FREQUENCY STABILITY MEASUREMENT

The frequency tolerance of the carrier signal shall be maintained within +/-0.02% of the operating frequency over a temperature variation of -30 degrees to 50 degrees C at normal supply voltage, and for a variation in primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees.

- 11.2 TEST PROCEDURE
- 1. The EUT was placed inside the environmental test chamber and powered by nominal DC voltage.
- 2. Turn the EUT on and couple its output to spectrum analyzer.
- 3. Turn the EUT off and set the chamber to the highest temperature specified.
- 4. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize,turn the EUT on and measure the operating frequency after 2,5,and 10 minutes.
- 5. Repeat step 2 and 3 with the temperature chamber set to the lowest temperature.
- 6. The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.

11.3 TEST RESULT

Channel 39 (2441MHz)

Voltage vs. Frequency Stability

Voltage(V)	Measurement Frequency(MHz)
4.255	2441.0016
3.7	2441.0014
3.145	2441.0014
Max.Deviation(MHz)	0.0016
Max.Deviation(ppm)	0.66

Rated working voltage: DC 3.7V

Temperature vs. Frequency Stability

Temperature(°C)	Measurement Frequency(MHz)
-30	2441.0019
-20	2441.0009
-10	2441.0017
0	2441.0017
10	2441.0013
20	2441.0013
30	2441.0013
40	2441.0009
50	2441.0013
Max.Deviation(MHz)	0.0019
Max.Deviation(ppm)	0.78



APPENDIX-PHOTOS OF TEST SETUP

Note: See test photos in setup photo document for the actual connections between Product and support equipment.



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