

# **RADIO TEST REPORT**

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# Report No.: STS2009191W03

Issued for

**Excellus Communications, LLC** 

27298 Wetland Road, Suite 101 Harrisburg, SD 57032 USA

Product Name:	4G phone	
Brand Name:	Snapfon	
Model Name:	Snapfon ez4G	
Series Model:	N/A	
FCC ID:	2AW56-EZ4G	
Test Standard:	FCC Part 15.247	

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#### **TEST RESULT CERTIFICATION**

Applicant's Name:	Excellus Communications, LLC
Address	27298 Wetland Road, Suite 101 Harrisburg, SD 57032 USA
Manufacturer's Name:	Ying Tai Electronics Co., Ltd
Address	ROOM 803, CHEVALIER HOUSE 45-51 CHATHAM ROAD SOUTH, TSIM SHA TSUI, KOWLOON, HONG KONG
Product Description	
Product Name:	4G phone
Brand Name	Snapfon
Model Name:	Snapfon ez4G
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...... 07 Sept. 2020

Date (s) of performance of tests .: 07 Sept. 2020 ~ 26 Oct. 2020

Date of Issue ..... 26 Oct. 2020

Test Result ..... Pass

Testing Engineer

(Chris Chen)

(Sean she

Technical Manager

Authorized Signatory :

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7. HOPPING CHANNEL SEPARATION MEASUREMEN

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## **Revision History**

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	26 Oct. 2020	STS2009191W03	ALL	Initial Issue



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## 1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards: KDB 558074 D01 15.247 Meas Guidance v05r02.

	FCC Part 15.247,Subpart C		
Standard Section	Test Item	Judgment	Remark
15.207	Conducted Emission	PASS	
15.247(a)(1)	Hopping Channel Separation	PASS	
15.247(a)(1)&(b)(1)	Output Power	PASS	
15.209	Radiated Spurious Emission	PASS	
15.247(d)	Conducted Spurious & Band Edge Emission	PASS	
15.247(a)(1)(iii)	Number of Hopping Frequency	PASS	
15.247(a)(1)(iii)	Dwell Time	PASS	
15.247(a)(1)	Bandwidth	PASS	
15.205	Restricted bands of operation PASS		
Part 15.247(d)/part 15.209(a)	Band Edge Emission PASS		
15.203	Antenna Requirement PASS		

NOTE:

(1) 'N/A' denotes test is not applicable in this Test Report.

(2) All tests are according to ANSI C63.10-2013.



#### 1.1 TEST FACTORY

SHENZHEN STS TEST SERVICES CO., LTD Add. : A 1/F, Building B, Zhuoke Science Park, No.190 Chongqing Road, HepingShequ, Fuyong Sub-District, Bao'an District, Shenzhen, Guang Dong, China FCC test Firm Registration Number: 625569 IC test Firm Registration Number: 12108A A2LA Certificate No.: 4338.01

#### 1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement  $y \pm U$ , where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of **k=2**, providing a level of confidence of approximately **95** %.

No.	Item	Uncertainty
1	RF output power, conducted	±0.68dB
2	Unwanted Emissions, conducted	±2.988dB
3	All emissions, radiated 30-1GHz	±5.6dB
4	All emissions, radiated 1G-6GHz	±5.5dB
5	All emissions, radiated>6G	±5.8dB
6	6 Conducted Emission (9KHz-150KHz) ±3.37dE	
7	Conducted Emission (150KHz-30MHz)	±3.83dB



## 2. GENERAL INFORMATION

## 2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	4G phone
Trade Name	Snapfon
Model Name	Snapfon ez4G
Series Model	N/A
Model Difference	N/A
Channel List	Please refer to the Note 2.
Bluetooth	Frequency:2402 – 2480 MHz Modulation: GFSK(1Mbps), π/4-DQPSK(2Mbps), 8DPSK(3Mbps)
Bluetooth Version	4.2
Bluetooth Configuration	BR+EDR
Antenna Type	Please refer to the Note 3.
Adapter	Input: AC 100-240V 50/60Hz 0.2A Output: DC 5V 1A
Battery	Rated Voltage: 3.7V Charge Limit: 4.2V Capacity: 1500mAh
Hardware version number	G1-MB-V1.1
Software version number	Snapfon_ez4G_v2.0_20200821_1249
Connecting I/O Port(s)	Please refer to the Note 1.

Note:

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





2.

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

#### 3. Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	Snapfon	Snapfon ez4G	PIFA	N/A	0.5 dBi	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/8DPS	
Mode 9	TX CH78 3 Mbps/8DPS	
Mode 10	Hopping GFSK	
Mode 11	Hopping π/4-DQPSK	
Mode 12	Hopping 8DPSK	

Note:

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

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

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

For AC Conducted Emission

	Test Case
AC Conducted Emission	Mode 13 : Keeping BT TX

#### 2.3 FREQUENCY HOPPING SYSTEM REQUIREMENTS

(1)Standard and Limit

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

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



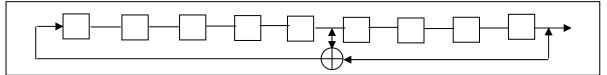
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The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping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

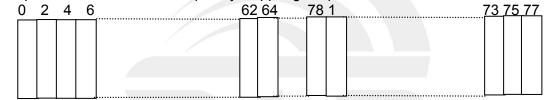
(2)The Pseudorandom sequence may be generated in a nin-stage shift register whose  $5^{th}$  and  $9^{th}$  stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones: i.e. the shift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

Numver of shift register stages:9

Length of pseudo-random sequence:2<sup>9</sup>-1=511bits Longest sequence of zeros: 8(non-inverted signal)



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



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

(3)Frequency Hopping System

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

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

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

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



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

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

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

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

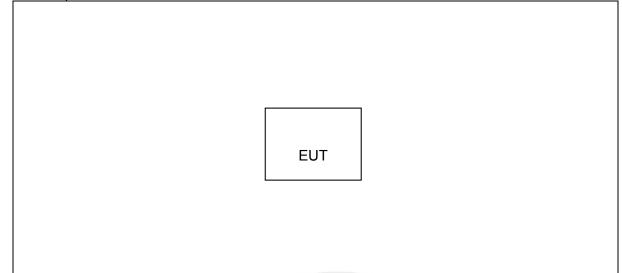


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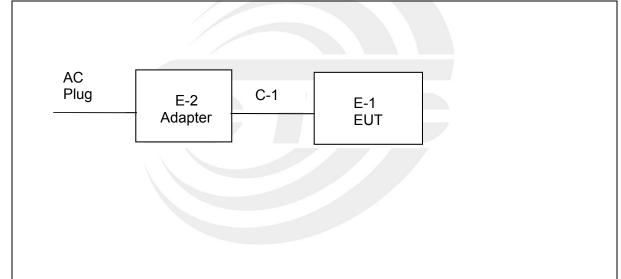


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2.5 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED Radiated Spurious Emission Test



Conducted Emission Test



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#### 2.6 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

	Necessary accessories					
Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note	
E-2	Adapter	N/A	HJ-0501000E1-US	N/A	N/A	
C-1	DC Cable	N/A	N/A	100cm	N/A	

#### Support units

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

Note:

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



## 2.7 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.	l ast calibration	Calibrated until	
	Manalaotarer	Type No.	Condinito.	Last sansiation		
			MY55520005	2020.10.10	2021.10.09	
MIMO Power	Kovoight		MY55520006	2020.10.10	2021.10.09	
measurement test Set	Keysight t	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				0000 40 40	0004 40 00	
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.

FREQUENCY (MHz)	Conducted Emissionlimit (dBuV)		
FREQUENCT (MIDZ)	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.

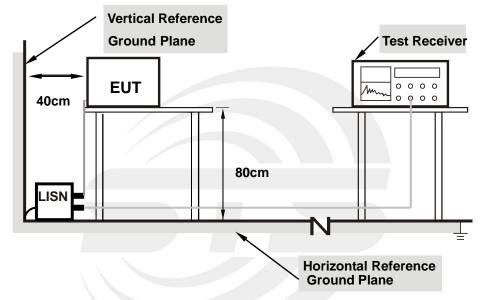
The following table is the setting of the receiver

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.

#### 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:	27.0(C)	Relative Humidity:	67%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	26.62	20.20	46.82	65.78	-18.96	QP
2	0.1540	10.22	20.20	30.42	55.78	-25.36	AVG
3	0.4380	22.92	20.49	43.41	57.10	-13.69	QP
4	0.4380	11.44	20.49	31.93	47.10	-15.17	AVG
5	0.8220	21.40	20.23	41.63	56.00	-14.37	QP
6	0.8220	7.02	20.23	27.25	46.00	-18.75	AVG
7	1.5300	20.98	20.16	41.14	56.00	-14.86	QP
8	1.5300	4.84	20.16	25.00	46.00	-21.00	AVG
9	3.0820	21.55	20.08	41.63	56.00	-14.37	QP
10	3.0820	4.92	20.08	25.00	46.00	-21.00	AVG
11	7.3020	22.15	19.90	42.05	60.00	-17.95	QP
12	7.3020	6.80	19.90	26.70	50.00	-23.30	AVG

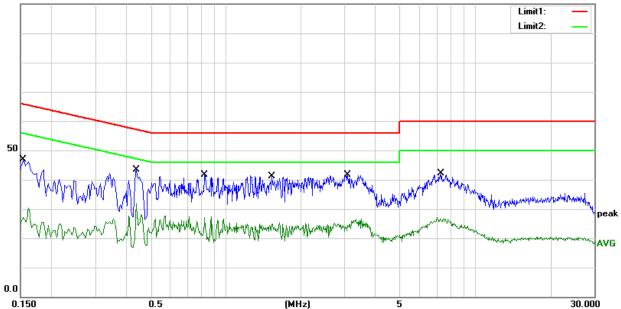
#### Remark:

1. All readings are Quasi-Peak and Average values

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

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

100.0 dBuV



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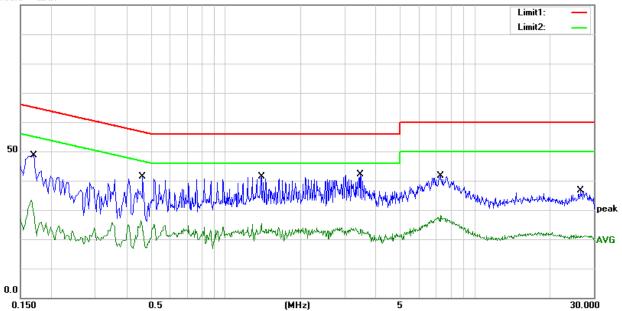
Temperature:	27.0(C)	Relative Humidity:	67%RH
Test Voltage:	AC 120V/60Hz	Phase:	N
Test Mode:	Mode 13		

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.1700	28.36	20.24	48.60	64.96	-16.36	QP
2	0.1700	13.21	20.24	33.45	54.96	-21.51	AVG
3	0.4660	20.97	20.46	41.43	56.58	-15.15	QP
4	0.4660	5.81	20.46	26.27	46.58	-20.31	AVG
5	1.3940	21.15	20.16	41.31	56.00	-14.69	QP
6	1.3940	5.15	20.16	25.31	46.00	-20.69	AVG
7	3.4820	21.94	20.07	42.01	56.00	-13.99	QP
8	3.4820	3.28	20.07	23.35	46.00	-22.65	AVG
9	7.2740	21.62	19.90	41.52	60.00	-18.48	QP
10	7.2740	8.23	19.90	28.13	50.00	-21.87	AVG
11	26.6020	15.87	20.78	36.65	60.00	-23.35	QP
12	26.6020	0.43	20.78	21.21	50.00	-28.79	AVG

#### Remark:

1. All readings are Quasi-Peak and Average values

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



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## 3.2 RADIATED EMISSION MEASUREMENT

## 3.2.1 RADIATED EMISSION LIMITS

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the Restricted band specified on Part15.205 (a)&209(a) limit in the table and according to ANSI C63.10-2013 below has to be followed.

#### LIMITS OF RADIATED EMISSION MEASUREMENT (0.009MHz - 1000MHz)

	· · · · · · · · · · · · · · · · · · ·	
Frequencies	Field Strength	Measurement Distance
(MHz)	(micorvolts/meter)	(meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

LIMITS OF RADIATED EMISSION MEASUREMENT (1GHz-25 GHz)

	(dBuV/m) (at 3M)			
FREQUENCY (MHz)	PEAK	AVERAGE		
Above 1000	74	54		
Above 1000	74	54		

Notes:

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

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

## LIMITS OF RESTRICTED FREQUENCY BANDS

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

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For Radiated Emission

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

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

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

For Restricted band

Spectrum Parameter	Setting		
Detector	Peak/AV		
Start/Stan Fraguanay	Lower Band Edge: 2310 to 2410 MHz		
Start/Stop Frequency	Upper Band Edge: 2475 to 2500 MHz		
	1 MHz / 3 MHz(Peak)		
RB / VB	1 MHz/1/T MHz(AVG)		

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Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~90kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	90kHz~110kHz / RB 200Hz for QP
Start ~ Stop Frequency	110kHz~490kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	490kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

#### 3.2.2 TEST PROCEDURE

- a. The measuring distance at 3 m shall be used for measurements at frequency 0.009MHz up to 1GHz, and above 1GHz.
- b. The EUT was placed on the top of a rotating table 0.8 m (above 1GHz is 1.5 m) above the ground at a 3 m anechoic chamber test site. The table was rotated 360 degree to determine the position of the highest radiation.
- c. The height of the equipment shall be 0.8 m (above 1GHz is 1.5 m); the height of the test antenna shall vary between 1 m to 4 m. Horizontal and vertical polarization of the antenna are set to make the measurement.
- d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and QuasiPeak detector mode will be re-measured.
- e. If the Peak Mode measured value is compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and no additional QP Mode measurement was performed.
- f. For the actual test configuration, please refer to the related Item –EUT Test Photos. Note:

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

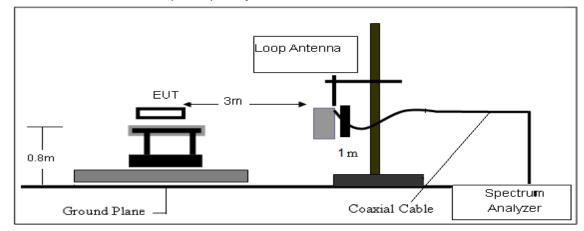
3.2.3 DEVIATION FROM TEST STANDARD

No deviation.

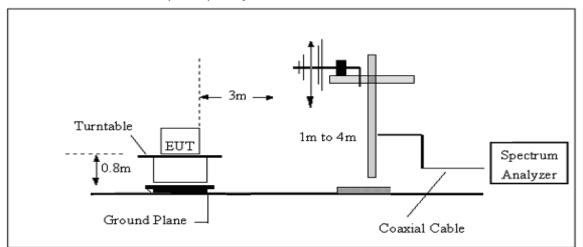


## 3.2.4 TESTSETUP

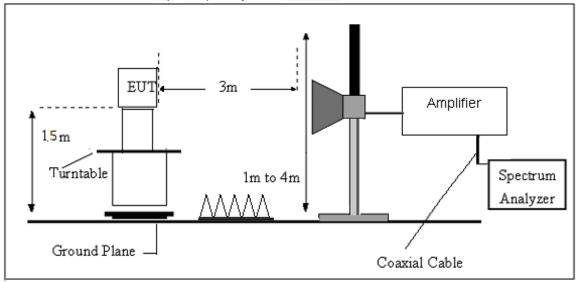
(A) Radiated Emission Test-Up Frequency Below 30MHz



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



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



## 3.2.5 EUT OPERATING CONDITIONS

Please refer to section 2.4 of this report.



## 3.2.6 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG Where FS = Field Strength CL = Cable Attenuation Factor (Cable Loss) RA = Reading Amplitude AG = Amplifier Gain AF = Antenna Factor

For example

Frequency	FS	RA	AF	CL	AG	Factor
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(dB)	(dB)	(dB)
300	40	58.1	12.2	1.6	31.9	-18.1

Factor=AF+CL-AG



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## 3.2.7 TEST RESULTS

#### (9KHz-30MHz)

Temperature:	23.2(C)	Relative Humidity:	61%RH
Test Voltage:	DC 3.7V	Test Mode:	TX Mode

Freq.	Reading	Limit	Margin	State		
(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.





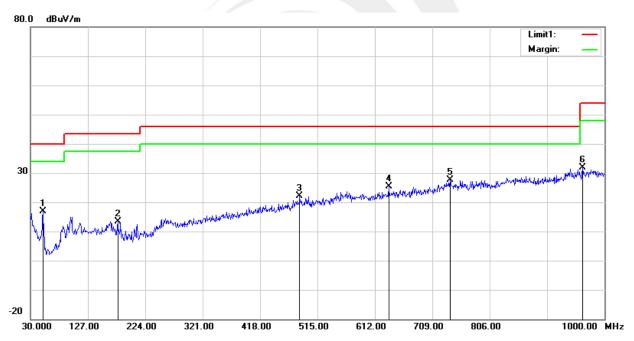
(30MHz-1000MHz)

Temperature:	23.2(C)	Relative Humidity:	61%RH		
Test Voltage:	DC 3.7V	Phase:	Horizontal		
Test Mode:	Mode 1/2/3/4/5/6/7/8/9(Mode 1 worst mode)				

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	51.3400	40.75	-23.82	16.93	40.00	-23.07	QP
2	177.4400	33.50	-20.03	13.47	43.50	-30.03	QP
3	484.9300	30.69	-8.44	22.25	46.00	-23.75	QP
4	635.2800	30.24	-4.93	25.31	46.00	-20.69	QP
5	739.0700	29.79	-2.15	27.64	46.00	-18.36	QP
6	963.1400	29.93	1.84	31.77	54.00	-22.23	QP

Remark:

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



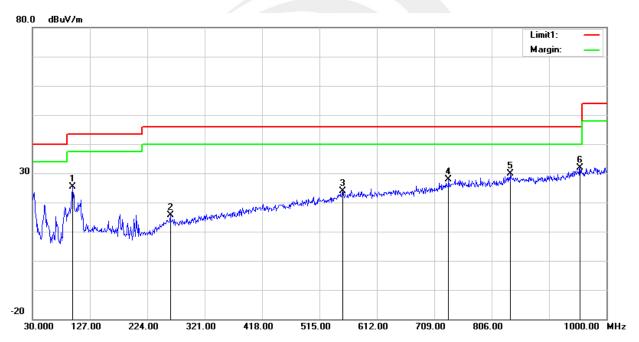


Temperature:	23.2(C)	Relative Humidity:	61%RH	
Test Voltage:	DC 3.7V	Phase:	Vertical	
Test Mode:	Mode 1/2/3/4/5/6/7/8/9(Mode 1 worst mode)			

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	97.9000	45.78	-20.46	25.32	43.50	-18.18	QP
2	262.8000	30.28	-14.76	15.52	46.00	-30.48	QP
3	554.7700	29.60	-5.63	23.97	46.00	-22.03	QP
4	733.2500	30.31	-2.35	27.96	46.00	-18.04	QP
5	838.0100	30.29	-0.42	29.87	46.00	-16.13	QP
6	955.3800	30.12	1.68	31.80	46.00	-14.20	QP

Remark:

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



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## (1GHz~25GHz) Spurious emission Requirements

Frequency	Meter Reading	Amplifier	Loss	Antenna Factor	Orrected Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBµV)	(dB)	(dB)	(dB/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре	
				Low Char	nel (GFSK/24	402 MHz)			•	
3264.73	60.97	44.70	6.70	28.20	-9.80	51.17	74.00	-22.83	PK	Vertical
3264.73	50.90	44.70	6.70	28.20	-9.80	41.10	54.00	-12.90	AV	Vertical
3264.73	61.15	44.70	6.70	28.20	-9.80	51.35	74.00	-22.65	PK	Horizontal
3264.73	50.13	44.70	6.70	28.20	-9.80	40.33	54.00	-13.67	AV	Horizontal
4804.39	58.39	44.20	9.04	31.60	-3.56	54.83	74.00	-19.17	PK	Vertical
4804.39	49.83	44.20	9.04	31.60	-3.56	46.27	54.00	-7.73	AV	Vertical
4804.37	58.97	44.20	9.04	31.60	-3.56	55.41	74.00	-18.59	PK	Horizontal
4804.37	50.56	44.20	9.04	31.60	-3.56	47.00	54.00	-7.00	AV	Horizontal
5359.66	49.33	44.20	9.86	32.00	-2.34	46.99	74.00	-27.01	PK	Vertical
5359.66	39.79	44.20	9.86	32.00	-2.34	37.45	54.00	-16.55	AV	Vertical
5359.69	48.49	44.20	9.86	32.00	-2.34	46.15	74.00	-27.85	PK	Horizontal
5359.69	38.47	44.20	9.86	32.00	-2.34	36.13	54.00	-17.87	AV	Horizontal
7205.71	54.54	43.50	11.40	35.50	3.40	57.94	74.00	-16.06	PK	Vertical
7205.71	43.85	43.50	11.40	35.50	3.40	47.25	54.00	-6.75	AV	Vertical
7205.80	54.23	43.50	11.40	35.50	3.40	57.63	74.00	-16.37	PK	Horizontal
7205.80	44.77	43.50	11.40	35.50	3.40	48.17	54.00	-5.83	AV	Horizontal
			/	Middle Cha	annel (GFSK/	2441 MHz)		•	•	
3264.82	61.39	44.70	6.70	28.20	-9.80	51.59	74.00	-22.41	PK	Vertical
3264.82	51.42	44.70	6.70	28.20	-9.80	41.62	54.00	-12.38	AV	Vertical
3264.59	60.81	44.70	6.70	28.20	-9.80	51.01	74.00	-22.99	PK	Horizontal
3264.59	50.41	44.70	6.70	28.20	-9.80	40.61	54.00	-13.39	AV	Horizontal
4882.33	59.30	44.20	9.04	31.60	-3.56	55.74	74.00	-18.26	PK	Vertical
4882.33	50.32	44.20	9.04	31.60	-3.56	46.76	54.00	-7.24	AV	Vertical
4882.37	59.52	44.20	9.04	31.60	-3.56	55.96	74.00	-18.04	PK	Horizontal
4882.37	49.58	44.20	9.04	31.60	-3.56	46.02	54.00	-7.98	AV	Horizontal
5359.72	48.84	44.20	9.86	32.00	-2.34	46.50	74.00	-27.50	PK	Vertical
5359.72	39.40	44.20	9.86	32.00	-2.34	37.06	54.00	-16.94	AV	Vertical
5359.63	47.36	44.20	9.86	32.00	-2.34	45.02	74.00	-28.98	PK	Horizontal
5359.63	39.44	44.20	9.86	32.00	-2.34	37.10	54.00	-16.90	AV	Horizontal
7323.76	54.31	43.50	11.40	35.50	3.40	57.71	74.00	-16.29	PK	Vertical
7323.76	44.76	43.50	11.40	35.50	3.40	48.16	54.00	-5.84	AV	Vertical
7323.91	53.52	43.50	11.40	35.50	3.40	56.92	74.00	-17.08	PK	Horizontal
7323.91	44.51	43.50	11.40	35.50	3.40	47.91	54.00	-6.09	AV	Horizontal



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				High Char	nel (GFSK/	2480 MHz)				
3264.89	61.84	44.70	6.70	28.20	-9.80	52.04	74.00	-21.96	PK	Vertical
3264.89	51.28	44.70	6.70	28.20	-9.80	41.48	54.00	-12.52	AV	Vertical
3264.81	61.53	44.70	6.70	28.20	-9.80	51.73	74.00	-22.27	PK	Horizontal
3264.81	49.84	44.70	6.70	28.20	-9.80	40.04	54.00	-13.96	AV	Horizontal
4960.34	58.78	44.20	9.04	31.60	-3.56	55.22	74.00	-18.78	PK	Vertical
4960.34	49.31	44.20	9.04	31.60	-3.56	45.75	54.00	-8.25	AV	Vertical
4960.49	58.56	44.20	9.04	31.60	-3.56	55.00	74.00	-19.00	PK	Horizontal
4960.49	49.28	44.20	9.04	31.60	-3.56	45.72	54.00	-8.28	AV	Horizontal
5359.69	48.20	44.20	9.86	32.00	-2.34	45.86	74.00	-28.14	PK	Vertical
5359.69	39.38	44.20	9.86	32.00	-2.34	37.04	54.00	-16.96	AV	Vertical
5359.71	47.28	44.20	9.86	32.00	-2.34	44.94	74.00	-29.06	PK	Horizontal
5359.71	38.52	44.20	9.86	32.00	-2.34	36.18	54.00	-17.82	AV	Horizontal
7439.73	53.62	43.50	11.40	35.50	3.40	57.02	74.00	-16.98	PK	Vertical
7439.73	43.91	43.50	11.40	35.50	3.40	47.31	54.00	-6.69	AV	Vertical
7439.70	53.69	43.50	11.40	35.50	3.40	57.09	74.00	-16.91	PK	Horizontal
7439.70	43.98	43.50	11.40	35.50	3.40	47.38	54.00	-6.62	AV	Horizontal

Note:

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

Emission Level = Reading + Factor

3) The frequency emission of peak points that did not show above the forms are at least 20dB below the limit, the frequency

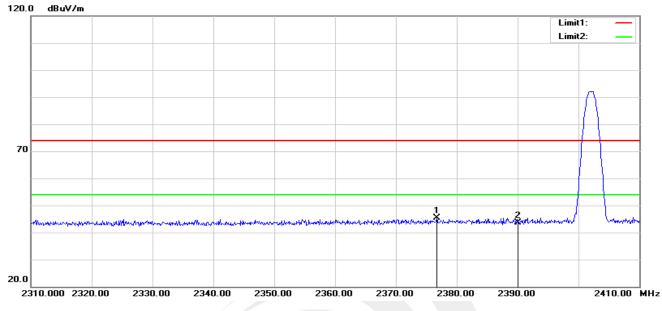
emission is mainly from the environment noise.



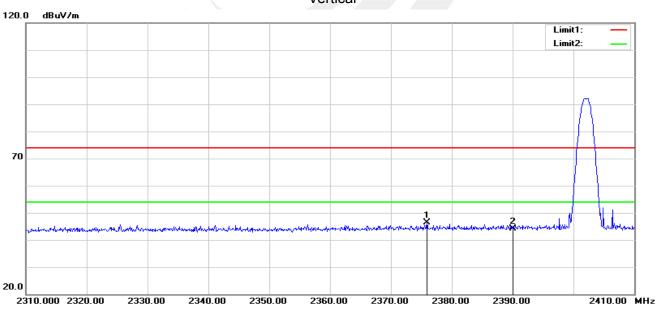


#### **Restricted band Requirements**

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



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2376.700	41.19	4.14	45.33	74.00	-28.67	peak
2	2390.000	39.17	4.34	43.51	74.00	-30.49	peak



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2375.900	42.21	4.13	46.34	74.00	-27.66	peak
2	2390.000	39.78	4.34	44.12	74.00	-29.88	peak

Vertical

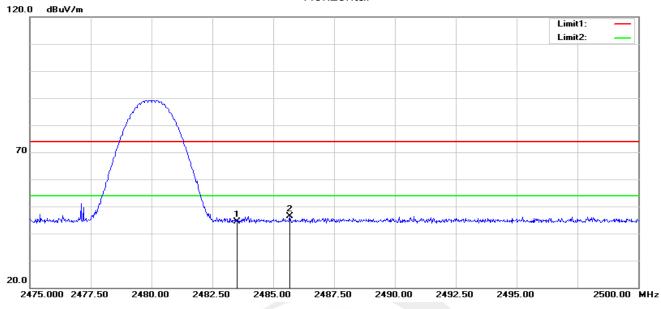
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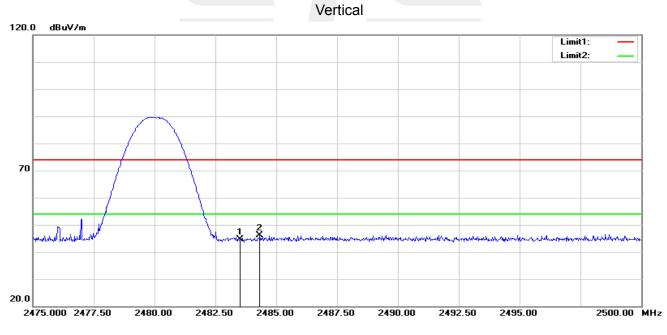
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#### **GFSK-High** Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	39.78	4.60	44.38	74.00	-29.62	peak
2	2485.675	41.70	4.61	46.31	74.00	-27.69	peak



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	39.96	4.60	44.56	74.00	-29.44	peak
2	2484.325	41.49	4.61	46.10	74.00	-27.90	peak

Note: GFSK,  $\pi$ /4-DQPSK, 8DPSK of the nohopping and hopping mode all have been test, the worst case is GFSK of the nohopping mode, this report only show the worst case.

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## 4. CONDUCTED SPURIOUS & BAND EDGE EMISSION

## 4.1 LIMIT

According to FCC section 15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

#### 4.2 TEST PROCEDURE

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	30 MHz to 10th carrier harmonic
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

#### For Band edge

Spectrum Parameter	Setting
Detector	Peak
Ctart/Stan Exerciserov	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
or 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
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.





#### 4.5 TEST RESULTS

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

#### 00 CH



#### 39 CH

		RF	50 Q AC	SENSE:PULS	Æ	ALIGNAUTO		09:54:5	0 AM Sep 11, 20
enter	r Fre	eq 12.5	15000000 GHz PI		: Free Run en: 30 dB	Avg Type	Log-Pwr	т	TYPE MUMM DET P P P P
) dB/di		Ref Offs Ref 8.9	et 0.5 dB 10 dBm						.452 GH 099 dBi
10 g		<b>0</b> 1							
.1									-17.38 d
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1		_							
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		00 kHz		#VBW 300	) kHz		SW	ceb 1.000 .	
es B	3W 1	00 kHz	×	Y		FUNCTION WIDTH		FUNCTION VALUE	
es B	3W 1	00 kHz f	× 2.452 GHz 2.652 GHz	-1.099 dBm -56.757 dBm		FUNCTION WIDTH			
es B NOOD N N N	3W 1	00 kHz	× 2.452 GHz	Y -1.099 dBm		FUNCTION WIDTH			
es B NOOD N N N N	SW 1	00 kHz f f	× 2.452 GHz 2.652 GHz 5.498 GHz	-1.099 dBm -56.757 dBm -56.711 dBm		FUNCTION WIDTH			
N N N N N N	SW 1	00 kHz f f	× 2.452 GHz 2.652 GHz 5.498 GHz	-1.099 dBm -56.757 dBm -56.711 dBm		FUNCTION WIDTH			
es B	SW 1	00 kHz f f	× 2.452 GHz 2.652 GHz 5.498 GHz	-1.099 dBm -56.757 dBm -56.711 dBm		FUNCTION WIDTH			

П



## 78 CH

L RF 50 Ω		SENSE:PULSE		ALIGNAUTO Avg Type: Log		9:43 PM Sep 11,3 TRACE 1 2 3
ter Freq 12.5150	PNO	): Fast 😱 Trig: in:Low #Atte	Free Run n: 30 dB	Avg Type: Log	-P Wr	TYPE MWW DET P P P
Ref Offset 0.5 B/div Ref 9.76 dE						2.477 G 0.241 dE
1						
						-19.63
02	3					$\Diamond$
amunda	man en	-	man	mannon	and a second and a second a s	-landar de
				-		
rt 30 MHz is BW 100 kHz		#VBW 300	kHz		Sweep 2.38	op 25.00 G 6 s (1001 p
MODE TRC SCL	×	Y	FUNCTION	UNCTION WIDTH	FUNCTION VALU	E
N 1 f N 1 f N 1 f N 1 f	2.477 GHz 3.176 GHz 7.072 GHz 24.076 GHz	-0.241 dBm -56.640 dBm -55.921 dBm -47.314 dBm				



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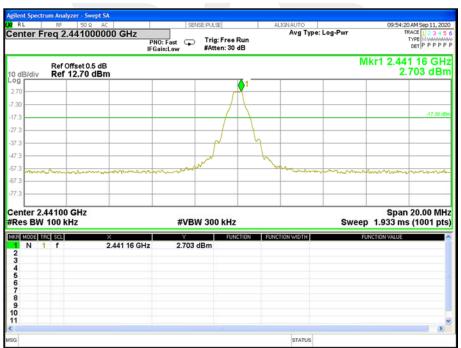


### For Band edge(it's also the reference level for conducted spurious emission)

		ctru		lyzer - Swept SA							
XU R		-	RF	50 Q AC	SE	INSE:PULSE		ALIGNAUTO Avg Type	Los Pur		DPM Sep 11, 2020
Cen	ter	Fre	eq 2		PNO: Fast 🕞	Trig: Fre #Atten: 3		Avg Type	Log-Pwr		TYPE MWWWWW DET P P P P P
10 d	B/div			Offset 0.5 dB 13.07 dBm					М		2 19 GHz 138 dBm
Log 3.07											<b></b> 1
-6.93											
16.9	⊢										-16,93 dBr
26.9	$\vdash$										
36.9	$\vdash$										
46.9	$\vdash$					2 (	3				
56.9 66.9	***		non	where we had a strain or the second	goneships	an american	heren	where when when a	and the second second	and the section of	and ha
76.9											
	L										
			00 C		#VB	W 300 kH	z		Sweep		40700 GH: 6 (1001 pts
MKR	MODE	TRC	SCL	×	Y		INCTION	FUNCTION WIDTH	FU	NCTION VALUE	-
1 2	NN	1	f	2.402 19 GHz 2.343 12 GHz		dBm					
23456789	N	1	f	2.352 11 GHz	-58.113	dBm					
4	Ν	1	f	2.400 05 GHz	-54.395	dBm					
6											
8											
9											
10 11											
											>
sG								STATUS			

#### 00 CH

39 CH





# 78 CH

RL	r <mark>um Anal</mark> RF	yzer - Swept SA 50 Q AC		SEI	NSE:PULSE	ALIGNAUTO		02:19:1	3PM Sep 11, 20
enter F	req 2.	.48750000	Р	NO: Fast 😱 Gain:Low	Trig: Free Run #Atten: 30 dB	Аvg Туре	: Log-Pwr	1	TYPE MUMMUM DET P P P P
dB/div		offset 0.5 dB 10.37 dBm	-				1	/lkr1 2.480 0	150 GH .367 dB
70		r	1						
63		/							-19.63 d
									-15.050
.6		/	h						
.6		. /	- h	<mark>2</mark>	3		04		
.6	-merel	ww	Men	- to Harry	- h-m-m		- Alman	where and when a	
.6									
art 2.47 tes BW				#VB	W 300 kHz		Swe	Stop 2 ep 2.400 m	.50000 GH s (1001 pt
R MODE TR	f		80 150 GHz	Y 0.367		FUNCTION WIDTH		FUNCTION VALUE	
	f f f	2.4	183 500 GHz 185 500 GHz 192 800 GHz	-58.530 -56.682 -56.940	dBm				
						STATUS			>
3						STATUS			



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### For Hopping Band edge

GFSK

			Analyzer															
RL				50 Q /	 000 GH	7		SENSE:P	PULSE		AL	IGN AUTO	Type: Lo	g-Pwr		10:04	:11 AM TRACE	Sep 11, 202
		100	1 2.00	1000		PI	NO: Fast Gain:Low		rig: Free Atten: 30								DE	
	3/div		ef Offse ef 12.												Mkr			97 GH:  5 dBn
.og 2.72																		1
7.28																		
7.3					_										_		_	-17.28 da
7.3			_												_		_	
7.3	-														-		+	
7.3																~	2	A3
7.3	~~	ليهاري	*****	a dadama		maria	y and a grade and the					- alor tor	mande	at warmen as		V		mark
7.3																		
	-																	
			0 GHz 0 kHz				#	VBW 3	00 kHz	1				Swe	eep			300 GH 1001 pts
KR N		TRC			×			Y		CTION	FUNC	TION WIDTH	1		FUNC	TION VALUE		
1 2 3 4	ZZZ		f f f		2.402 897 2.390 022 2.400 013	2 GHz	-59	.715 dBr .629 dBr .601 dBr	n									
5																		
57																		
8 9																		
1																		
																		>
3												STATU	JS					



П



Page 40 of 76 Report No.: STS2009191W03

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

۱.	RF	50 Q /	AC	S	ENSE:PULSE		ALIGN AUTO		10:37:4	9 AM Sep 11, 20
nter F	req 1	2.51500	0000 GHz	PNO: Fast G	⊃ Trig: Free #Atten: 30	Run dB	Avg Type:	Log-Pwr	т	TYPE MUMM DET P P P P
dB/div		Offset 0.5 d 6.39 dBn								.402 GH 606 dB
	(	1								
6 <u> </u>										-18.74 (
6										
6 <b> </b>										
6		^2	• 3							
s		2 	3			N K.L	Manana and and and and and and and and an	mound	and and the second	an and
mon	and a second	and a company	when when the	and a second a second	Balludur and	1 mm				
; <b> </b>										
s —										
art 30 es BW	MHz ( 100 k	κHz		#VE	3W 300 kHz	!		Swe	Stop ep 2.386 s	25.00 GI s (1001 pi
	1 f 1 f 1 f 1 f 1 f		× 2.402 GHz 3.576 GHz 5.973 GHz 24.326 GHz	-56.843 -56.614	3 dBm 3 dBm 4 dBm	ICTION F	UNCTION WIDTH	F	UNCTION VALUE	
										>

### 00 CH

39	CH
23	OIT

RL		RF	50 Q /	AC	SENSE:PU	LSE	ALIGN AUTO		02:22:12	PM Sep 11, 20
enter	Fre	eq 1:	2.51500			g: Free Run tten: 30 dB	Avg Type	: Log-Pwr		ACE 1 2 3 4 TYPE M WAAWA DET P P P P
dB/di			)ffset 0.5 d 6.50 dBn						Mkr1 2. -3.5	452 GH 503 dB
50			1							
.5		_								-18.15
.5										
5										
.5			. 2							
5 -		_	<sup>2</sup>	3		11. Hala . /	how we have the way to be a set of the set o	mannan	and the second second	show and
5 44	phly m	a san an a	- and grouped			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~				
5								-		
5										
Ĩ										
art 3 es B			Hz		#VBW 30	10 kHz		Swe	Stop 2.386 s	25.00 G (1001 p
MOD	E TRC			×	Y	FUNCTION	FUNCTION WIDTH	f	FUNCTION VALUE	
N	1	f		2.452 GHz 3.301 GHz	-3.503 dBm -57.307 dBm					
N	1	f		5.973 GHz	-56.823 dBm					
N	1	T		24.226 GHz	-47.633 dBm					



# 78 CH

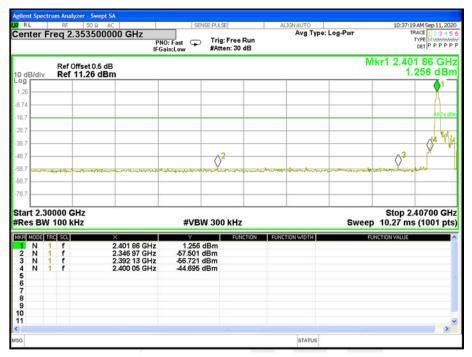
L RF	50 R AC		ISE:PULSE	ALIGNAUTO Avg Type:	Log-Pwr	10:48:01 AM TRACE	
ter Fred 12.	515000000 GH	PNO: Fast IFGain:Low	Trig: Free Run #Atten: 30 dB	Cig Type.	Logital	TYPE	
	set 0.5 dB 11 dBm					Mkr1 2.47 -1.88	
							-21.4
	2			har and the same the same	war and a start of the start of	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	have
angermant	and the second of the second	-ty waters	monoren	Martinet .			
t 30 MHz s BW 100 kH	z	#VBI	N 300 kHz		Swe	Stop 25 ep 2.386 s (1	
MODE TRC SCL	×	Y	FUNCTION	FUNCTION WIDTH	FL	INCTION VALUE	
N 1 f N 1 f N 1 f N 1 f	2.477 0 2.702 0 5.798 0 24.126 0	Hz -57.060 Hz -56.326	dBm dBm				
				STATUS			



Shenzhen STS Test Services Co., Ltd.

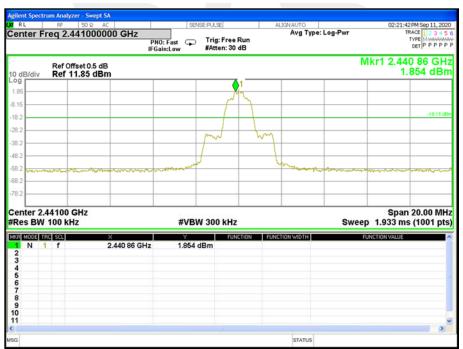


#### For Band edge(it's also the reference level for conducted spurious emission)



#### 00 CH

39 CH





# 78 CH

RL	RF	50 Q AC		SE	VSE:PULSE		ALIGNAUTO			31 AM Sep 11, 20
enter Fr	eq 2.48	750000	F	PNO: Fast 😱	Trig: Free Ru #Atten: 30 dB	in B	Avg Type:	Log-Pwr		TYPE MWWWM DET P P P P
dB/div	Ref Offs Ref 8.5	et 0.5 dB 2 dBm						N	lkr1 2.479 -1	850 GH .482 dB
48			۱ ۲							
.5										-21.48 d
.5		M	hy							
.5	manual		- Lung	2	An marine	3	ulmm	mm		men
.5	_									
art 2.47 Res BW				#VBI	W 300 kHz			Swee	Stop 2 p 2.400 m	.50000 GH s (1001 pt
N 1 N 1 N 1 N 1 N 1	f f f f	2.4 2.4	79 850 GHz 83 500 GHz 88 475 GHz 95 950 GHz	-1.482 -59.125 -58.156 -57.947	dBm dBm	ON FUN	CTION WIDTH		FUNCTION VALUE	
										>
							STATUS			



Shenzhen STS Test Services Co., Ltd.





# For Hopping Band edge

### π/4-DQPSK

		er - Swept SA						
enter F	RF req 2.3	50 x AC 51500000 GHz	PNO: Fast IFGain:Low	NSE:PULSE Trig: Free Run #Atten: 30 dB	ALIGNAUTO Avg Type:	Log-Pwr	TR 1	AM Sep 11, 202 ACE 1 2 3 4 5 YPE M 444 DET P P P P P
) dB/div		set 0.5 dB I.49 dBm				M	kr1 2.402 1.4	897 GH: 187 dBn
.49								1
.51								-18.51 dB
3.5								
.5								رم ۲
8.5		and particular and an and a particular and a		- change - codda			$\downarrow$	- U
8.5								
8.5								
	0000 GH		#VB	W 300 kHz		Swee	Stop 2.4 p 9.867 ms	10300 GH (1001 pts
R MODE T	RC SCL	×	Y	FUNCTION	FUNCTION WIDTH	1	UNCTION VALUE	
1 N 2 N 3 N 4	f f f	2.402 897 GH 2.390 022 GH 2.400 013 GH	z -58.117	dBm				
4 5 7 8 9								
1								>
G					STATUS			

Ref Offset 0.5 dB Bddiv Ref 0.48 dBm -1. 	TYPE MWWW DET P P P F
BUdiv     Ref 8.48 dBm     -1.       BUdiv     Ref 8.48 dBm     -1.       Image: State of the state of	004 0
Image: Notes         Image: Notes<	520 dE
Model         Tel:         Stop 2:           Model         Tel:         <	
Model         Tell         Stop 2           Model         Tell         Tell         Tell           Model         Tell         Tell         Tell           N         1         f         2.479 861 GHz         58.871 dBm           N         1         f         2.479 861 GHz         58.871 dBm	-21.53
Image: Stop 2         Image: Stop 2         Stop 2           rt 2.47900 GHz         stop 2         stop 2           rs BW 100 kHz         #VBW 300 kHz         Sweep 2.067 ms           N 1 f         2.479 861 GHz         -1.520 dBm           N 1 f         2.479 861 GHz         -1.520 dBm	-21.55
Model Fiel         Stop 2         Manual Manu	
KINCE         KINCE         Stop 2           Is BW 100 KHz         #VBW 300 KHz         Sweep 2.067 ms           M000 IEE SCI         X         Y         Eunction width         Eunction width           N 1         f         2.493 515 GHz         -1.520 dBm         Function width         Eunction width           N 1         f         2.483 515 GHz         -58.871 dBm         Function width         Eunction width	
Kit         Kit <td>m</td>	m
Kore         X         X         Stop 2           N 1         f         2.479 861 GHz         -1.520 dBm           N 1         f         2.479 861 GHz         -1.520 dBm	
Image: SW 100 kHz         #VBW 300 kHz         Sweep 2.067 ms           Mode: Incl. Sci.         X         Y         Runction with         Runction with           N 1         f         2.479 861 GHz         -1.520 dBm         Function with         Runction with           N 1         f         2.483 515 GHz         -58.871 dBm         Function with         Function with	
N 1 f 2.479 861 GHz -1.520 dBm N 1 f 2.483 515 GHz -58.871 dBm	50000 G s (1001 p
N 1 f 2.483 515 GHz -58.871 dBm	
	110



Page 45 of 76 Report No.: STS2009191W03

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

#### 25 AM Sep 11, 2020 TRACE 1 2 3 4 5 TYPE MWWWW DET P P P P P Center Freq 12.515000000 GHz Avg Type: Log-Pwr PNO: Fast G Trig: Free Run #Atten: 30 dB Mkr1 2.402 GHz -0.062 dBm Ref Offset 0.5 dB Ref 9.94 dBm 10 dB/di 0.0 -20. -30. 40. $\partial^4$ \$2 {\}<sup>3</sup> -50.1 60. 70. an. Stop 25.00 GHz Sweep 2.386 s (1001 pts) Start 30 MHz #Res BW 100 kHz #VBW 300 kHz MKR MODE TRC SCL UNCTION VALUE FUNCTIO -0.062 dBm -57.235 dBm -56.913 dBm -46.675 dBm N N N 2.402 GHz 2.552 GHz 9.419 GHz 24.301 GHz 1 2 3 4 5 6 7 8 9 10 11 f 1 STATUS

# 00 CH

### 39 CH

RL		-	RF	lyzer - Swep 50 ຊ	AC	SENSE:PULS	e	ALIGN AUTO		11-20-1	1 AM Sep 11, 20
		Fre			DOOOO GHz	Trig	Free Run en: 30 dB		2: Log-Pwr		TAM SEP 11, 20 RACE 1 2 3 4 1 TYPE MWWW DET P P P P
0 dE	3/div			Offset 0.5 6.68 dB							.452 GH .324 dBi
og 1.32				1							
3.3											
3.3			_								-18.57
3.3			_								
3.3	_		_		^3						0
.3	_		_	$\langle \rangle^2$			and a second	and provident internet	10 mar merenne	marker where	ann
.3	~	and and a	a mark	and and an	all and the second and	under have					
3	-		_								
3.3	-										
		) MI W 1	Hz 00 H	Hz		#VBW 300	kHz		Sw	Stop eep 2.386	25.00 G s (1001 p
_		TRC	SCL		X	Y	FUNCTION	FUNCTION WIDTH		FUNCTION VALUE	
2	ZZZ	1	f f f		2.452 GHz 3.151 GHz 5.548 GHz	-3.324 dBm -57.364 dBm -55.273 dBm					
1	N	1	f		24.151 GHz	-47.465 dBm					
5											
3											
0											

П



# 78 CH

	SENSE:PULS	E	ALIGN AUTO		:25:01 AM Sep
PNO		Free Run en: 30 dB	Avg Type: Lo	g-Pwr	TYPE MY DET P P
				Mkr	1 2.477 -4.847 (
					-2
when the second	hander Alles and	moneyou	we know have have	and an and a start and	mon
		-			
	#VBW 300	kHz			top 25.00 86 s (100
2 477 GHz	4 847 dBm	FUNCTION	FUNCTION WIDTH	FUNCTION VA	LUE
2.702 GHz 5.498 GHz 24.301 GHz	-57.000 dBm -56.546 dBm -47.518 dBm				
	2.477 GHz 2.702 GHz 5.498 GHz	00000 GHz PN0: Fast IFGain:Low dB 3m 44tt dB 3m 44tt 48 3m 44tt 48 3m 44tt 48 48 48 48 48 48 48 48 48 48	00000 GHz PNO: Fast IFGain:Low #Atten: 30 dB dB 3m #VBW 300 kHz #VBW 300 kHz 2.477 GHz 2.477 GHz 2.477 GHz 4.847 dBm 2.702 GHz 5.7000 dBm	Avg Type: Lo, PNO: Fast PNO: Fast Arg Trig: Free Run #Atten: 30 dB dB 3m #VEW 300 kHz #VEW 300 kHz X 2.477 GHz 4.847 dBm 2.702 GHz 5.5.46 dBm	Avg Type: Log-Pwr PN0: Fast PN0: Fas



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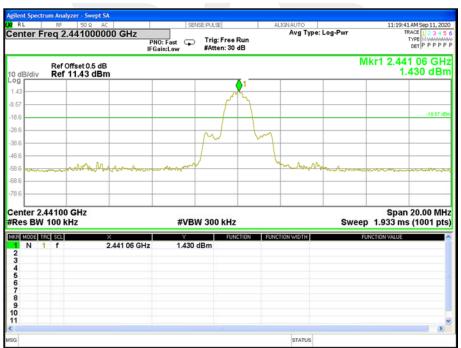


#### For Band edge(it's also the reference level for conducted spurious emission)



#### 00 CH

39 CH





# 78 CH

e <mark>nt Spectrum Analyzer - Swept S</mark> R L RF   50 ຊ AG		SENSE:PULSE	AL	IGNAUTO		31 AM Sep 11, 2
nter Freq 2.4875000	00 GHz PNO: I IFGain:		ree Run 30 dB	Avg Type: Log-	Pwr	TYPE MWWW DET P P P P
Ref Offset 0.5 dB					Mkr1 2.479 -1	9 850 GI 1.418 dB
2 4						
4						-21.42
4	Ly .	^ <del>2</del> 3				
4 minor market	And	Lenner Loss	an and the second s	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		m.
4						
es BW 100 kHz		#VBW 300 k	Hz	ini di	Stop 2 Sweep 2.400 m	2.50000 G ns (1001 p
N 1 f 2 N 1 f 2 N 1 f 2	8 .479 850 GHz .483 500 GHz .485 825 GHz .496 725 GHz	-1.418 dBm -60.317 dBm -58.090 dBm -57.825 dBm	FUNCTION FUNC	TION WIDTH	FUNCTION VALUE	
				STATUS		>



Shenzhen STS Test Services Co., Ltd.





# For Hopping Band edge

8DPSK

	Spec			er - Swep																
RL	_			50 Q				_	SENSE:PUL	.SE		AL	LIGN AUT		Log-Pw			11:41:08	AM Sep 1	
Cent	er F	-rec	12.3	51500	0000		PNO: IFGain		P Trig #At	g: Free ten: 30	Run dB		Avg	Type:	Log-Pw	ar			TYPE MH DET P P	345 PPPF
I0 dB	/div			set 0.5 d												M	kr1 2		000 061 d	
- <b>og</b> 1.06																				_1
8.94			_		_		_													_^
18.9			+				-				-								-4	8.94 dBn
28.9			-				-													_
38.9			+		-		+-				-									f.
48.9 58.9																		$\langle \rangle^2$		Ø
58.9 68.9	50	~,~~	-		-															
78.9			_		_		_		_											
			0 GH 0 kH					#V	BW 30	0 kHz						Swee	S1 p 9.80	top 2. 67 ms		
KR M	-	_			×						CTION	FUNC	TION WID	THI	_		UNCTION		(100	
1 2	NNN	1	f f f		2.403 2.390	000 GH 022 GH 013 GH	z	-58.90	51 dBm 07 dBm 70 dBm											
5 6 7																				
8																				
1																				
														71.0					1	>
G													STA	105						

RL	RF	50 Q AC	SEN	SE:PULSE	ALIGNAUTO		11:43:22 AM Sep 11, 20 TRACE 1 2 3 4
nter F	req 2.48	39500000 GHz	PNO: Fast IFGain:Low	Trig: Free Run #Atten: 30 dB	Avg Type:	Log-Pwr	TRACE 1 2 3 4 TYPE MWWW DET P P P P
dB/div		set 0.5 dB 14 dBm				MI	r1 2.479 021 GF -1.858 dB
9 hr	ĥ.						
9							-21.86 0
	- 44		-				
	'	$\Diamond^2$	3				
		- Manakanana	wannen an	munik	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
-							
	900 GH		#VBV	V 300 kHz		Sweep	Stop 2.50000 Gl
MODE TR		×	Y	FUNCTION	FUNCTION WIDTH	FL	UNCTION VALUE
N 1 N 1	f f f	2.479 021 GH 2.483 515 GH 2.486 203 GH	Iz -58.772 c	iBm			

Shenzhen STS Test Services Co., Ltd.



# 5. NUMBER OF HOPPING CHANNEL

5.1 LIMIT

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

Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	> Operating FrequencyRange
RB	300KHz
VB	300KHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

### 5.2 TEST PROCEDURE

- a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- b. Spectrum Setting: RBW= 300KHz, VBW=300KHz, Sweep time = Auto.

### 5.3 TEST SETUP



5.4 EUT OPERATION CONDITIONS Please refer to section 3.1.4 of this report.

Shenzhen STS Test Services Co., Ltd.



### 5.5 TEST RESULTS

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

# Number of Hopping Channel

#### 79

# Hopping channel

ŔL		RF			SENS	E:PULSE	4	LIGNAUTO			8 AM Sep 11, 202
ente	er F	req 3	2.441750000	PNO	: Fast 😱 n:Low	Trig: Free F #Atten: 30 d	Run IB	Avg Type:	Log-Pwr		RACE 1 2 3 4 5 TYPE MWWWW DET P P P P P
0 dB/	div		Offset 0.5 dB f 14.21 dBm						Mkr	2 2.480 2 -(	43 5 GH 0.03 dBr
og 1.21	<b>∆</b> <sup>1</sup>	2000	00000000				20000000	000000000	2.0.0		¢ <sup>2</sup>
.79	[]]]	IIII	(IIII)	MMMM	WWW	MAAAAAA	YYYYYY	****	mm	mmm	mm
5.8	-										
5.8	<u> </u>										$\vdash$
5.8											
5.8											
5.8											
5.8 -											
5.8											
Res	BW	0000 300	kHz		#VBW	/ 300 kHz			Swee	Stop 2. p 1.133 ms	.48350 GH s (1001 pt
IR MO		RC SCL		54 5 GHz	2.84 d		TION FUN	CTION WIDTH	f	FUNCTION VALUE	
2 N 3	i 1	f		43 5 GHz	-0.03 d						
4											
5 6 7											
7 8											
9											
1											
											>

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# 6. AVERAGE TIME OF OCCUPANCY

#### 6.1 LIMIT

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

### 6.2 TEST PROCEDURE

- a. The transmitter output (antenna port) was connected to the spectrum analyzer.
- b. Set RBW =1MHz/VBW =3MHz.
- c. Use a video trigger with the trigger level set to enable triggering only on full pulses.
- d. Sweep Time is more than once pulse time.
- Set the center frequency on any frequency would be measure and set the frequency span to e. zero span.
- f. Measure the maximum time duration of one single pulse.
- g. Set the EUT for DH5, DH3 and DH1 packet transmitting.
- $\tilde{h}$ . Measure the maximum time duration of one single pulse.
- i. DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots RX, 1 time slot TX). 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 x 31.6 = 160 within 31.6 seconds.
- k. DH1 Packet permit maximum 1600 / 79 /2 = 10.12 hops per second in each channel (1 time slot RX, 1 time slot TX). So the dwell time is the time duration of the pulse times 10.12 x 31.6 = 320 within 31.6 seconds.

6.3 TEST SETUP



### 6.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.



## 6.5 TEST RESULTS

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

Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
DH1	middle	0.380	0.122	0.4
DH3	middle	1.639	0.262	0.4
DH5	middle	2.892	0.308	0.4



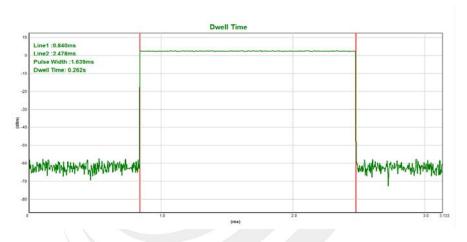
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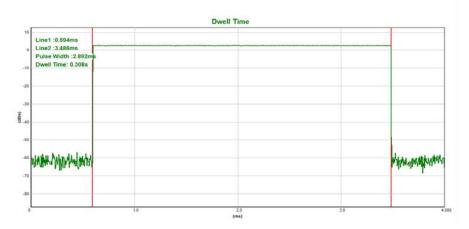
### CH39-DH1



### CH39-DH3







Shenzhen STS Test Services Co., Ltd.

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

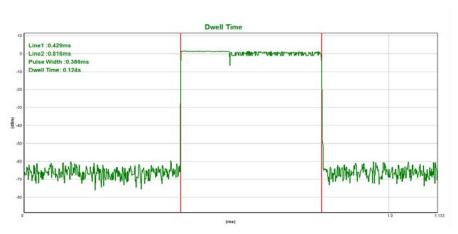
Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
2DH1	middle	0.386	0.124	0.4
2DH3	middle	1.644	0.263	0.4
2DH5	middle	2.895	0.309	0.4



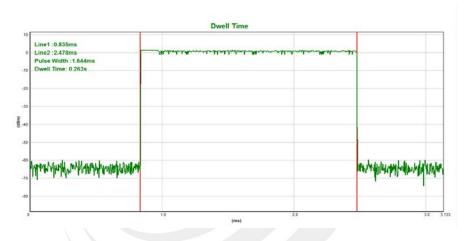
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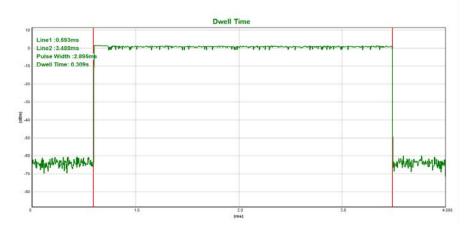
### CH39-2DH1











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

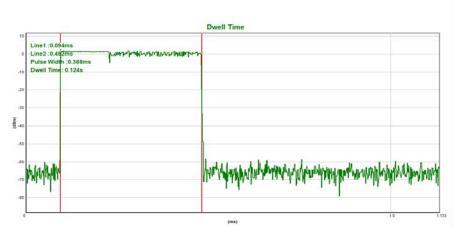
Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
3DH1	middle	0.388	0.124	0.4
3DH3	middle	1.642	0.263	0.4
3DH5	middle	2.893	0.309	0.4



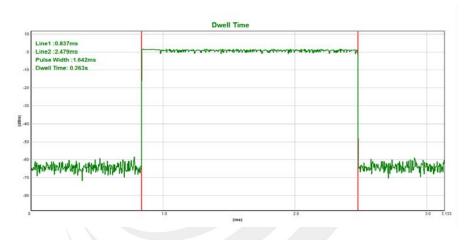
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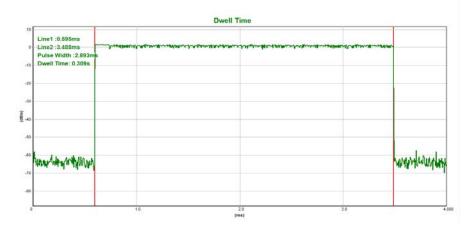
### CH39-3DH1



### CH39-3DH3



### CH39-3DH5



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# 7. HOPPING CHANNEL SEPARATION MEASUREMEN

7.1 LIMIT

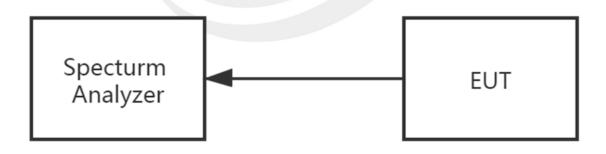
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that 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:	<b>25</b> ℃	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	2401.840	2402.839	0.999	0.925	Complies
2441 MHz	2440.840	2441.839	0.999	0.933	Complies
2480 MHz	2478.840	2479.839	0.999	0.926	Complies

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

### CH00 -1Mbps

RL	RF	50 Q AC	SENSE:PULS	ε	ALIGNAUTO		09:52:52 AM Sep 11, 202
enter		02500000 GHz	· Wide Trig	: Free Run en: 30 dB	Avg Type: L	og-Pwr	TRACE 1 2 3 4 5 TYPE MWWWWW DET P P P P P
0 dB/div		set 0.5 dB ).78 dBm				Mkr2	2.402 839 GH: 0.933 dBn
og 780 .22		<u></u>	$\sim$		2	M .	
9.2 <u> </u>							$\sim$
9.2							
9.2							
9.2							
	2.402500 W 30 kHz	GHz	#VBW 100	) kHz		Sweep 3	Span 3.000 MH 3.200 ms (1001 pt
1 N 2 N	TRC SCL 1 f 1 f	× 2.401 840 GHz 2.402 839 GHz	0.80 dBm 0.93 dBm	FUNCTION	FUNCTION WIDTH	FUNCT	ION VALUE
3 4 5 6 7							
7 8 9							
0							
							>

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### CH39 -1Mbps



#### CH78 -1Mbps



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Temperature:	<b>25</b> ℃	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	2402.842	1.002	0.835	Complies
2441 MHz	2440.840	2441.839	0.999	0.835	Complies
2480 MHz	2478.840	2479.839	0.999	0.835	Complies

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

L	RF	50 Q AC	SENSE:PUL!	Æ	ALIGNAUTO		10:42:1	7 AM Sep 11, 20
nter F	req 2.40			: Free Run en: 30 dB	Avg Type:	Log-Pwr		RACE 1 2 3 4 TYPE MWWW DET P P P P
B/div		set 0.5 dB 37 dBm				Mk	r2 2.402 -	842 GH
1		()1			<b>A</b> 2			
		- ×	$\sim$		1 Å~~~			
			· ~	m m	$\sim 1^{\circ}$	1 m	$\sim$	
	~							
s —								
	-							ha
								· w
								-
-								
	402500 ( 30 kHz	GHZ	#VBW 100	) kHz		Sweep	3.200 m	3.000 M s (1001 p
MODE T	RC SCL	× 2.401 840 GHz	-0.56 dBm	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
NN	f	2.401 840 GHz	-0.69 dBm					
								,

### CH00 -2Mbps

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### CH39 -2Mbps



#### CH78 -2Mbps



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Temperature:	<b>25</b> ℃	Relative Humidity:	50%
Test Mode:	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	0.842	Complies
2441 MHz	2440.837	2441.839	1.002	0.843	Complies
2480 MHz	2478.837	2479.839	1.002	0.842	Complies

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

CH00 -3Mbps

RL		RF 50 9	2 AC	SENSE:PULSE	ALIG	NAUTO		11:06:1	2 AM Sep 11, 202
enter	Fre		00000 GHz	Wide 😱 Trig: Fre		Avg Type: Log	j-Pwr	т	RACE 1 2 3 4 5 TYPE MUMUU DET P P P P P
0 dB/di		Ref Offset 0. Ref 7.95 d					Mki		839 GH 890 dBn
og 2.05				_		2			
2.1			$\sim$	$\sim$		$\sim\sim\sim$	$\sim$	~	
2.1			/ -					~~	
2.1								7	
2.1		<u> </u>							han
2.1	$\sim$	<b>*</b>							
2.1									
2.1									
21									
enter Res B		2500 GHz 0 kHz	:	#VBW 100 kH	łz		Sweep	Span 3.200 ms	3.000 MH s (1001 pt
KR MODE	TRC		×		UNCTION FUNCTIO	IN WIDTH	FUN	CTION VALUE	
1 N 2 N	1	f	2.401 840 GHz 2.402 839 GHz	-2.05 dBm -1.89 dBm					
3									
5									
6									
8 9									
0									
									>

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#### CH39 -3Mbps



#### CH78 -3Mbps



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# 8. BANDWIDTH TEST

# 8.1 LIMIT

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

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

### **8.2 TEST PROCEDURE**

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

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

#### 8.3 TEST SETUP



### 8.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.



### **8.5 TEST RESULTS**

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

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	0.9249	PASS
2441 MHz	0.9334	PASS
2480 MHz	0.9262	PASS

### CH00 -1Mbps

Agilent Spectrum Analyzer - Occupied BW	/			
<b>RL</b> RF 50Ω AC		ENSE:PULSE Center Freq: 2.4020000	ALIGNAUTO	09:50:28 AM Sep 11, 2020 Radio Std: None
Center Freq 2.402000000	GHZ	Trig: Free Run	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				
-10.0				
-20.0			~~~~~	
-30.0				$\sim$
40.0				
-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 Bondwidth		Total Power	9.26 dBm	
Occupied Bandwidth		Total Fower	5.20 UBIII	
84	12.05 kHz			
Transmit Freq Error	1.526 kHz	OBW Power	99.00 %	
x dB Bandwidth	924.9 kHz	x dB	-20.00 dB	
			2000 42	
MSG			STATUS	

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#### CH39 -1Mbps



CH78 -1Mbps



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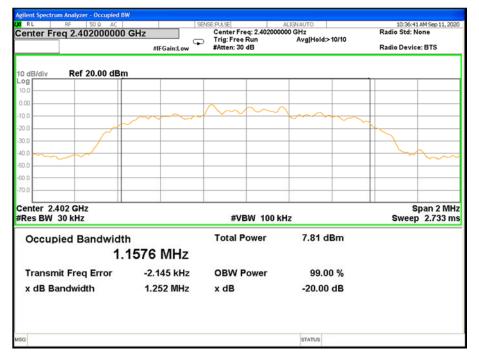


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Temperature:	<b>25</b> ℃	Relative Humidity:	50%
	π/4-DQPSK(2Mbps) CH00 / CH39 / C78	Test Voltage:	DC 3.7V

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	1.252	PASS
2441 MHz	1.253	PASS
2480 MHz	1.253	PASS

## CH00 -2Mbps

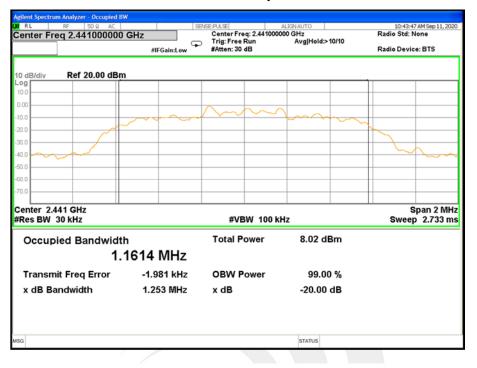


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#### CH39 -2Mbps



#### CH78 -2Mbps



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

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	1.263	PASS
2441 MHz	1.264	PASS
2480 MHz	1.263	PASS

## CH00 -3Mbps

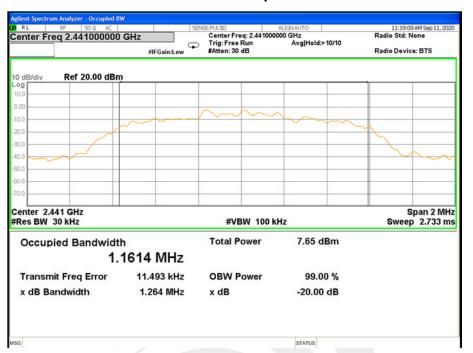
Agilent Spectrum Analyzer - Occupied BV				
Center Freq 2.402000000		Center Freg: 2.4020000		11:02:17 AM Sep 11, 2020 Radio Std: None
·	#IFGain:Low	⊃ Trig: Free Run #Atten: 30 dB	Avg Hold:>10/10	Radio Device: BTS
10 dB/div Ref 20.00 dBm	1			_
.og 10.0				
0.00				
0.0	~~~~~~	$\sim \sim \sim$		
0.0	-			
0.0				
0.0				
0.0				
0.0				
enter 2.402 GHz				Span 2 MH
Res BW 30 kHz		#VBW 100 k	Hz	Sweep 2.733 m
Occupied Bandwidt	'n	Total Power	7.46 dBm	
1.1	1573 MHz			
Transmit Freq Error	10.573 kHz	<b>OBW Power</b>	99.00 %	
x dB Bandwidth	1.263 MHz	x dB	-20.00 dB	
			aw 170 10	
ISG			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	
15.247 Output (a)(1)&(b)(1) Power		1 W or 0.125W		PASS	
	•	if channel separation > 2/3 bandwidthprovided thesystems operatewith an output power no greater than125 mW(20.97dBm)	2400-2483.5		

### 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.

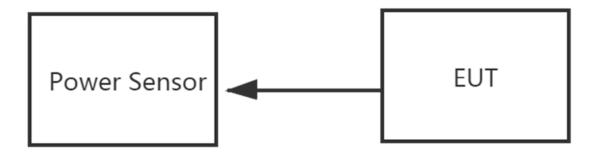
e) A plot of the test results and setup description shall be included in the test report.

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.



### 9.5 TEST RESULTS

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

Mode	Channel Frequency Number (MHz)	Frequency	Peak Power	Average Power	Limit
		(MHz)	(dBm)	(dBm)	(dBm)
GFSK(1M)	0	2402	2.70	1.27	30.00
	39	2441	2.34	0.92	30.00
	78	2480	-0.54	-2.06	30.00

Note: the channel separation >20dB bandwidth

Mode	Channel Frequency Number (MHz)	Frequency	Peak Power	Average Power	Limit
		(MHz)	(dBm)	(dBm)	(dBm)
π/4-DQPSK( 2M)	0	2402	2.19	-1.38	20.97
	39	2441	1.78	-1.51	20.97
	78	2480	1.44	-4.43	20.97

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

Mode	Channel Frequency Number (MHz)		Peak Power	Average Power	Limit
		(dBm)	(dBm)	(dBm)	
8-DPSK(3M)	0	2402	2.60	-2.15	20.97
	39	2441	2.26	-2.96	20.97
	78	2480	-0.72	-3.13	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 PIFA 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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