

# **RADIO TEST REPORT**

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# Report No.: STS2106039W02

Issued for

Shenzhen Feng Jing Sheng Electronics Technology Co.,Ltd

501, building 5, No 36, Dafu Road, Zhangge community, Fucheng Street, Longhua District, Shenzhen City, Gunagdong China.

Product Name:	Bluetooth handsfree car kit	
Brand Name:	sunitec	
Model Name:	BC920	
Series Model:	BC920S, BC920SA, BC920P	
FCC ID:	2AWTE-BC920	
Test Standard:	FCC Part 15.247	

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# **TEST RESULT CERTIFICATION**

Applicant's Name:	Shenzhen Feng Jing Sheng Electronics Technology Co.,Ltd
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Manufacturer's Name:	Shenzhen Feng Jing Sheng Electronics Technology Co.,Ltd
Address	501, building 5, No 36, Dafu Road, Zhangge community, Fucheng Street, Longhua District, Shenzhen City, Gunagdong China.
Product Description	
Product Name:	Bluetooth handsfree car kit
Brand Name:	sunitec
Model Name:	BC920
Series Model:	BC920S, BC920SA, BC920P
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:	08 June 2021
Date (s) of performance of tests .:	08 June 2021 ~ 17 June 2021
Date of Issue:	17 June 2021

Test Result ..... Pass

 Testing Engineer
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 Chris Chen)

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 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	17 June 2021	STS2106039W02	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 9K-30MHz	±2.84dB
4	All emissions, radiated 30M-1GHz	±4.39dB
5	All emissions, radiated 1G-6GHz	±5.10dB
6	All emissions, radiated>6G	±5.48dB
7	Conducted Emission (9KHz-150KHz)	±2.79dB
8	Conducted Emission (150KHz-30MHz)	±2.80dB



# 2. GENERAL INFORMATION

# 2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	Bluetooth handsfree car kit
Trade Name	sunitec
Model Name	BC920
Series Model	BC920S, BC920SA, BC920P
Model Difference	Only the model naming is different
Channel List	Please refer to the Note 2.
Bluetooth	Frequency:2402 – 2480 MHz Modulation: GFSK(1Mbps), π/4-DQPSK(2Mbps), 8DPSK(3Mbps)
Bluetooth Version	5.0
Bluetooth Configuration	BR+EDR
Antenna Type	Please refer to the Note 3.
Adapter	Input: DC 12-24V Output: DC 5V 500mA
Battery	Rated Voltage:3.7V Charge Limit Voltage: 4.2V Capacity: 630mAh
Hardware version number	PCB_BC920_V1.2
Software version number	98CB78ED_98DC2825
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.

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2.

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

#### 3. Table for Filed Antenna

An	. Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	sunitec	BC920	PCB	N/A	0dBi	BT Antenna

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

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#### 2.2 DESCRIPTION OF THE TEST MODES

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

Worst Mode	Description	Data Rate/Modulation
Mode 1	TX CH00	1Mbps/GFSK
Mode 2	TX CH39	1Mbps/GFSK
Mode 3	TX CH78	1Mbps/GFSK
Mode 4	TX CH00	2 Mbps/π/4-DQPSK
Mode 5	TX CH39	2 Mbps/π/4-DQPSK
Mode 6	TX CH78	2 Mbps/π/4-DQPSK
Mode7	TX CH00	3 Mbps/8DPSK
Mode 8	TX CH39	3 Mbps/8DPSK
Mode 9	TX CH78	3 Mbps/8DPSK
Mode 10	Hopping	GFSK
Mode 11	Hopping	π/4-DQPSK
Mode 12	Hopping	8DPSK

Note:

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

#### 2.3 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.

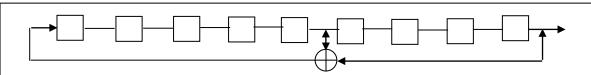
The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping on occupied channels is permitted. The coordination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

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

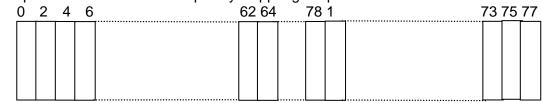
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Numver of shift register stages:9 Length of pseudo-random sequence:2<sup>9</sup>-1=511bits Longest sequence of zeros: 8(non-inverted signal)



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.



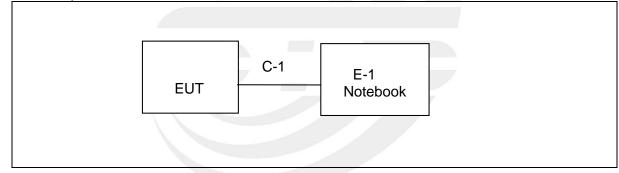
#### 2.4 TABLE OF PARAMETERS OF TEST SOFTWARE SETTING

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	1	Fest program: Bluetooth	1
(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	255,80	
BT	BR+EDR	π/4-DQPSK	0	255,80	Blue Test 3
		8DPSK	0	255,80	

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





# 2.6 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

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

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

#### Support units

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
E-1	Notebook	LENOVO	ThinkPad E470	N/A	N/A
C-1	USB Cable	N/A	N/A	150cm	N/A

Note:

- (1) For detachable type I/O cable should be specified the length in cm in <sup>C</sup>Length<sub>2</sub> column.
- (2) "YES" is means "with core"; "NO" is means "without core".



# 2.7 EQUIPMENTS LIST

#### Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	ESCI	101427	2020.10.12	2021.10.11
Signal Analyzer	R&S	FSV 40-N	101823	2020.10.10	2021.10.09
Active loop Antenna	ZHINAN	ZN30900C	16035	2019.07.11	2021.07.10
Bilog Antenna	TESEQ	CBL6111D	34678	2020.10.12	2022.10.11
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	2019.10.15	2021.10.14
SHF-EHF Horn Antenna (18G-40GHz)	A-INFO	LB-180400-KF	J211020657	2020.10.12	2022.10.11
Pre-Amplifier (0.1M-3GHz)	EM	EM330	060665	2020.10.12	2021.10.11
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK2018080901	2020.10.12	2021.10.11
Pre-Amplifier (18G-40GHz)	SKET	LNPA-1840-50	SK2018101801	2020.10.10	2021.10.09
Temperature & Humidity	HH660	Mieo	N/A	2020.10.13	2021.10.12
Turn table	EM	SC100_1	60531	N/A	N/A
Antenna mast	EM	SC100	N/A	N/A	N/A
Test SW	FARAD	E	Z-EMC(Ver.STS	LAB-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	E	Z-EMC(Ver.STS	LAB-03A1 RE)	



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#### **RF** Connected Test

 ••••••					
Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
			MY55520005	2020.10.10	2021.10.09
Power Sensor	Kovojaht	U2021XA	MY55520006	2020.10.10	2021.10.09
Power Sensor	Keysight	U2021XA	MY56120038	2020.10.10	2021.10.09
			MY56280002	2020.10.10	2021.10.09
Signal Analyzer	Agilent	N9020A	MY51110105	2021.03.04	2022.03.03
Temperature & Humidity	HH660	Mieo	N/A	2020.10.13	2021.10.12
Test SW	FARAD	E	Z-EMC(Ver.STS	LAB-03A1 RE)	



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#### 3. EMC EMISSION TEST

# 3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

The radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table.

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

Note:

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

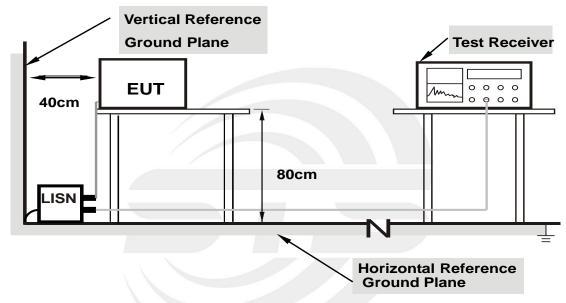
#### The following table is the setting of the receiver

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



#### 3.1.2 TEST PROCEDURE

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



#### 3.1.3 TEST SETUP

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

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

#### 3.1.4 EUT OPERATING CONDITIONS

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



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# 3.1.5 TEST RESULT

Temperature:	26.0(C)	Relative Humidity:	58%RH
Test Voltage:		Phase:	L/N
Test Mode:			

Note: EUT is only power by battery, So it is not applicable for this test.



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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)

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

Notes:

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

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

## LIMITS OF RESTRICTED FREQUENCY BANDS

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

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For Radiated Emission

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

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

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

For Restricted band

Spectrum Parameter	Setting	
Detector	Peak/AV	
Stort/Stop Fraguapay	Lower Band Edge: 2310 to 2410 MHz	
Start/Stop Frequency	Upper Band Edge: 2476 to 2500 MHz	
	1 MHz / 3 MHz(Peak)	
RB / VB	1 MHz/1/T MHz(AVG)	

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

#### 3.2.2 TEST PROCEDURE

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

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

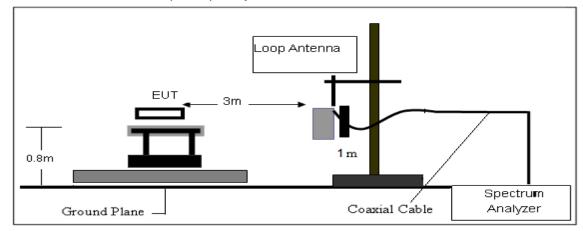
# 3.2.3 DEVIATION FROM TEST STANDARD

No deviation.

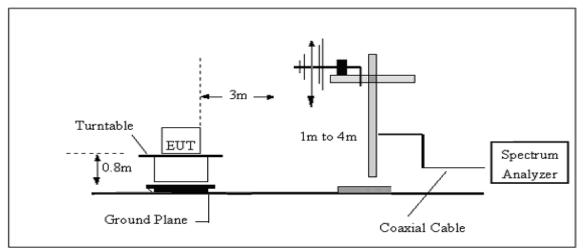


# 3.2.4 TESTSETUP

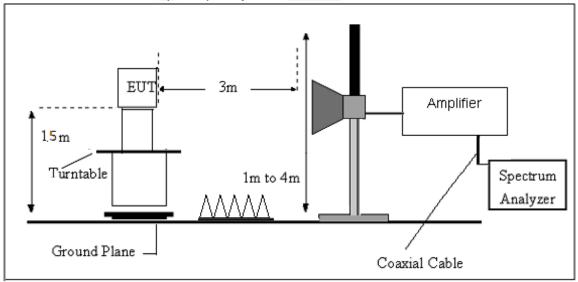
(A) Radiated Emission Test-Up Frequency Below 30MHz

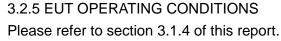


## (B) Radiated Emission Test-Up Frequency 30MHz~1GHz



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







# 3.2.6 FIELD STRENGTH CALCULATION

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

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

For example

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

Factor=AF+CL-AG



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# 3.2.7 TEST RESULTS

#### (9KHz-30MHz)

Temperature:	23.1(C)	Relative Humidity:	60%RH
Test Voltage:	DC 3.7V	Test Mode:	TX Mode

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

Note:

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

Distance extrapolation factor =40 log (specific distance/test distance)(dB); Limit line = specific limits (dBuv) + distance extrapolation factor.



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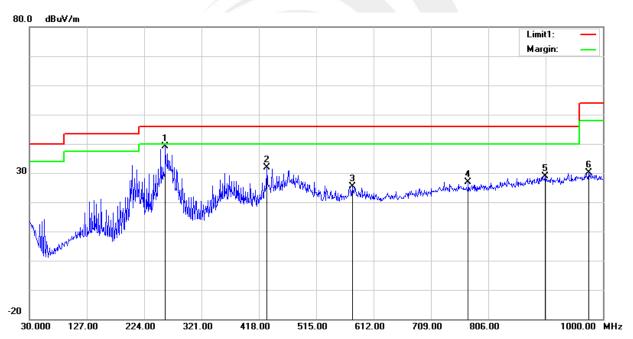
(30MHz-1000MHz)

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

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	259.8900	54.04	-14.79	39.25	46.00	-6.75	QP
2	431.5800	42.03	-10.13	31.90	46.00	-14.10	QP
3	576.1100	31.04	-5.70	25.34	46.00	-20.66	QP
4	772.0500	29.26	-2.31	26.95	46.00	-19.05	QP
5	902.0300	29.35	-0.40	28.95	46.00	-17.05	QP
6	975.7500	27.67	2.38	30.05	54.00	-23.95	QP

Remark:

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



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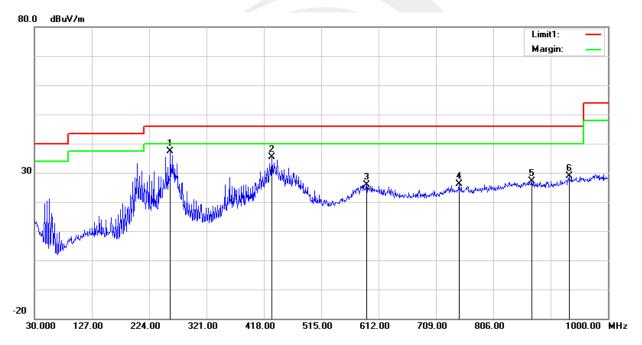
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Temperature:	23.1(C)	Relative Humidity:	60%RH		
Test Voltage:	DC 3.7V	Phase:	Vertical		
Test Mode:	Mode 1/2/3/4/5/6/7/8/9 (Mode 2 worst mode)				

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	259.8900	52.22	-14.79	37.43	46.00	-8.57	QP
2	431.5800	45.60	-10.13	35.47	46.00	-10.53	QP
3	591.6300	31.61	-5.82	25.79	46.00	-20.21	QP
4	747.8000	28.31	-2.15	26.16	46.00	-19.84	QP
5	870.9900	27.75	-0.55	27.20	46.00	-18.80	QP
6	934.0400	27.92	0.89	28.81	46.00	-17.19	QP

Remark:

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



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# (1GHz~25GHz) Spurious emission Requirements

Frequency	Meter Reading	Amplifier	Loss	Antenna Factor	Corrected Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBµV)	(dB)	(dB)	(dB/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре	
	Low Channel (GFSK/2402 MHz)									
3264.82	61.95	44.70	6.70	28.20	-9.80	52.15	74.00	-21.85	PK	Vertical
3264.78	51.56	44.70	6.70	28.20	-9.80	41.76	54.00	-12.24	AV	Vertical
3264.76	61.12	44.70	6.70	28.20	-9.80	51.32	74.00	-22.68	PK	Horizontal
3264.61	51.09	44.70	6.70	28.20	-9.80	41.29	54.00	-12.71	AV	Horizontal
4804.56	59.12	44.20	9.04	31.60	-3.56	55.56	74.00	-18.44	PK	Vertical
4804.32	49.91	44.20	9.04	31.60	-3.56	46.35	54.00	-7.65	AV	Vertical
4804.46	59.41	44.20	9.04	31.60	-3.56	55.85	74.00	-18.15	PK	Horizontal
4804.36	49.51	44.20	9.04	31.60	-3.56	45.95	54.00	-8.05	AV	Horizontal
5359.59	48.32	44.20	9.86	32.00	-2.34	45.98	74.00	-28.02	PK	Vertical
5359.76	39.18	44.20	9.86	32.00	-2.34	36.84	54.00	-17.16	AV	Vertical
5359.79	48.29	44.20	9.86	32.00	-2.34	45.94	74.00	-28.06	PK	Horizontal
5359.68	38.92	44.20	9.86	32.00	-2.34	36.58	54.00	-17.42	AV	Horizontal
7205.84	53.85	43.50	11.40	35.50	3.40	57.25	74.00	-16.75	PK	Vertical
7205.90	43.58	43.50	11.40	35.50	3.40	46.98	54.00	-7.02	AV	Vertical
7205.92	54.26	43.50	11.40	35.50	3.40	57.66	74.00	-16.34	PK	Horizontal
7205.76	43.87	43.50	11.40	35.50	3.40	47.27	54.00	-6.73	AV	Horizontal
				Middle C	Channel (GFSK	/2441 MHz)				
3264.62	62.13	44.70	6.70	28.20	-9.80	52.33	74.00	-21.67	PK	Vertical
3264.62	50.62	44.70	6.70	28.20	-9.80	40.82	54.00	-13.18	AV	Vertical
3264.76	61.41	44.70	6.70	28.20	-9.80	51.61	74.00	-22.39	PK	Horizontal
3264.76	50.59	44.70	6.70	28.20	-9.80	40.79	54.00	-13.21	AV	Horizontal
4882.53	58.51	44.20	9.04	31.60	-3.56	54.95	74.00	-19.05	PK	Vertical
4882.53	49.95	44.20	9.04	31.60	-3.56	46.39	54.00	-7.61	AV	Vertical
4882.37	59.02	44.20	9.04	31.60	-3.56	55.46	74.00	-18.54	PK	Horizontal
4882.37	50.37	44.20	9.04	31.60	-3.56	46.81	54.00	-7.19	AV	Horizontal
5359.74	48.73	44.20	9.86	32.00	-2.34	46.39	74.00	-27.61	PK	Vertical
5359.74	39.99	44.20	9.86	32.00	-2.34	37.65	54.00	-16.35	AV	Vertical
5359.67	47.33	44.20	9.86	32.00	-2.34	44.99	74.00	-29.01	PK	Horizontal
5359.67	38.04	44.20	9.86	32.00	-2.34	35.69	54.00	-18.31	AV	Horizontal
7323.93	54.87	43.50	11.40	35.50	3.40	58.27	74.00	-15.73	PK	Vertical
7323.93	43.75	43.50	11.40	35.50	3.40	47.15	54.00	-6.85	AV	Vertical
7323.86	53.79	43.50	11.40	35.50	3.40	57.19	74.00	-16.81	PK	Horizontal
7323.86	43.59	43.50	11.40	35.50	3.40	46.99	54.00	-7.01	AV	Horizontal



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				High Char	nnel (GFSK/	2480 MHz)				
3264.76	61.72	44.70	6.70	28.20	-9.80	51.92	74.00	-22.08	PK	Vertical
3264.76	50.58	44.70	6.70	28.20	-9.80	40.78	54.00	-13.22	AV	Vertical
3264.65	61.65	44.70	6.70	28.20	-9.80	51.85	74.00	-22.15	PK	Horizontal
3264.65	50.41	44.70	6.70	28.20	-9.80	40.61	54.00	-13.39	AV	Horizontal
4960.36	59.46	44.20	9.04	31.60	-3.56	55.90	74.00	-18.10	PK	Vertical
4960.36	50.16	44.20	9.04	31.60	-3.56	46.60	54.00	-7.40	AV	Vertical
4960.58	59.08	44.20	9.04	31.60	-3.56	55.52	74.00	-18.48	PK	Horizontal
4960.58	49.16	44.20	9.04	31.60	-3.56	45.60	54.00	-8.40	AV	Horizontal
5359.65	48.79	44.20	9.86	32.00	-2.34	46.45	74.00	-27.55	PK	Vertical
5359.65	39.07	44.20	9.86	32.00	-2.34	36.72	54.00	-17.28	AV	Vertical
5359.59	48.42	44.20	9.86	32.00	-2.34	46.07	74.00	-27.93	PK	Horizontal
5359.59	39.12	44.20	9.86	32.00	-2.34	36.78	54.00	-17.22	AV	Horizontal
7439.90	54.92	43.50	11.40	35.50	3.40	58.32	74.00	-15.68	PK	Vertical
7439.90	44.48	43.50	11.40	35.50	3.40	47.88	54.00	-6.12	AV	Vertical
7439.86	54.28	43.50	11.40	35.50	3.40	57.68	74.00	-16.32	PK	Horizontal
7439.86	44.21	43.50	11.40	35.50	3.40	47.61	54.00	-6.39	AV	Horizontal

Note:

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

Emission Level = Reading + Factor

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



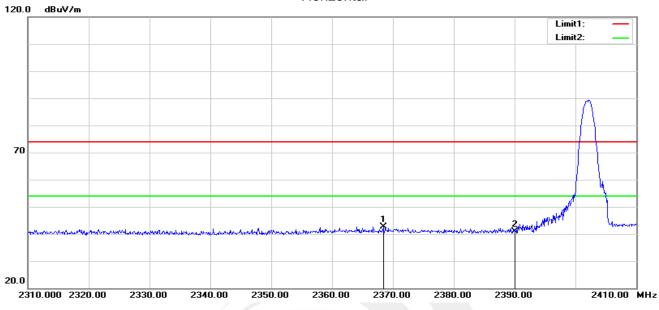
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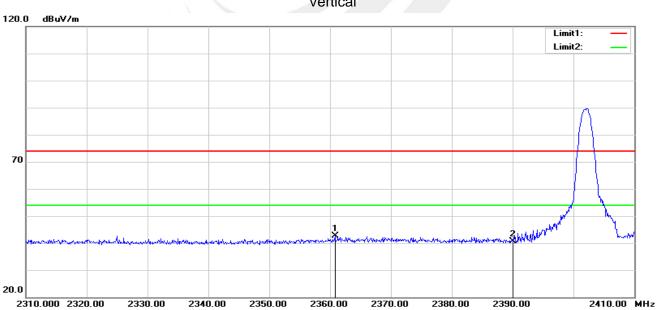


#### **Restricted band Requirements**

**GFSK-Low** Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2368.400	38.69	4.01	42.70	74.00	-31.30	peak
2	2390.000	36.53	4.34	40.87	74.00	-33.13	peak



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2360.800	38.63	3.91	42.54	74.00	-31.46	peak
2	2390.000	36.34	4.34	40.68	74.00	-33.32	peak

Vertical

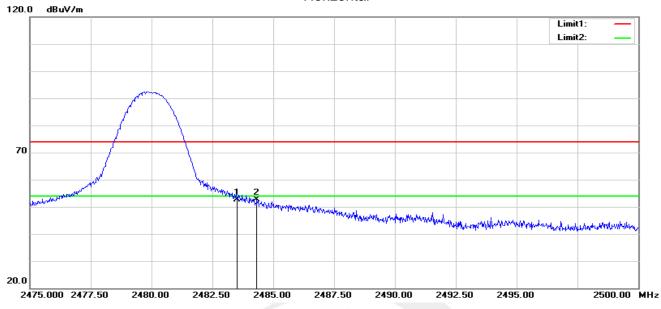
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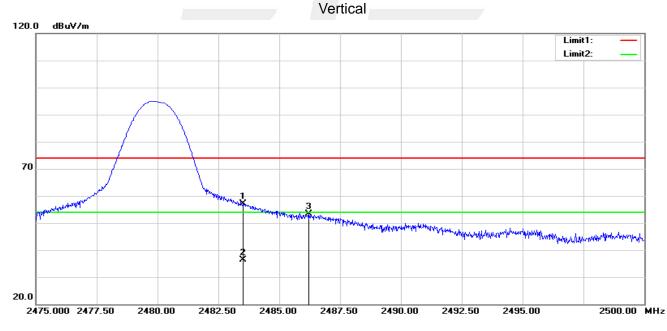
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#### **GFSK-High** Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	48.09	4.60	52.69	74.00	-21.31	peak
2	2484.325	47.93	4.61	52.54	74.00	-21.46	peak



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	52.46	4.60	57.06	74.00	-16.94	peak
2	2483.500	31.82	4.60	36.42	54.00	-17.58	AVG
3	2486.225	48.83	4.61	53.44	74.00	-20.56	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.

Shenzhen STS Test Services Co., Ltd.





# 4. CONDUCTED SPURIOUS & BAND EDGE EMISSION

#### 4.1 LIMIT

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

#### 4.2 TEST PROCEDURE

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

#### For Band edge

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

#### For Hopping Band edge

Spectrum Parameter	Setting
Detector	Peak
Stort/Stop Frequency	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.

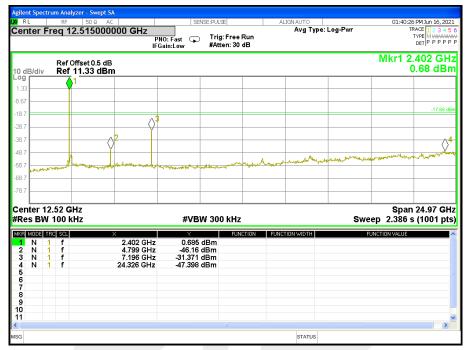




#### 4.5 TEST RESULTS

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

#### 00 CH



## 39 CH

Control File File Run       Trig: Free Run       PNO: Fast IF Gain: Low       Trig: Free Run       Ref Offset 0.5 dB       Mkr1 2.452 dL       1.10 cl       0 dB/div       Ref Offset 0.5 dB       Mkr1 2.452 dL       1.10 cl       2.38 d       2.38 d       2.452 GHz       FUNCTION FOR FOR FOR FOR SCI       FUNCTION FOR	2 AC SENSE:PULSE ALIGN AUTO 000000 GHZ AVg Type: Lo PNO: East Trig: Free Run	
Center Freq 12.515000000 GHz         Trig: Free Run IFGaint.ow         Avg Type: Log-Pwr         Trace Free Trace Free Matter: 30 dB           Ref Offset 0.5 dB         Mkr1 2.452 0 1.10 c         Mkr1 2.452 0 1.10 c         Mkr1 2.452 0 1.10 c           10 dB/div         Ref 11.59 dBm         1         -         -           8.41         -         -         -         -           8.41         -         -         -         -           8.44         -         -         -         -         -           8.44         -         -         -         -         -           8.44         -         -         -         -         -           8.44         -         -         -         -         -           8.44         -         -         -         -         -           8.44         -         -         -         -         -           8.44         -         -         -         -         -         -           8.44         -         -         -         -         -         -         -           6.4         -         -         -         -         -         -         - <th>000000 GHz Avg Type: Lo</th> <th>01-11-11-01216-002</th>	000000 GHz Avg Type: Lo	01-11-11-01216-002
PN0:Fast IFGaint.ow         Trig: Free Run #Atten: 30 dB         Trig: Free Run #Atten: 30 dB         Trig: Free Run #Atten: 30 dB           0 dB/div         Ref Offset 0.5 dB Ref 11.59 dBm         Mkr1 2.452 db 1.10 c         1.10 c           1 59         1	PNO: Fast Trig: Free Run	
Ref 11.59 dBm     1.10 c       1.59     1.59       1.59     1.59       1.64     1.59       -28.4     1.10 c       -38.4     1.10 c       -38.4     1.10 c       -28.4     1.10 c       -38.4     1.10 c       -28.4     1.10 c       -38.4     1.10 c       -38.4     1.10 c       -28.4     1.10 c       -38.4     1.10 c       -38.4     1.10 c       -38.4     1.10 c       -38.4     1.10 c       -20.4     1.10 c       -38.4     2.10 c       -38.4     2.10 c       -38.4     2.10 c       -48.4     2.10 c       -58.4     2.10 c       -68.4     2.10 c       -78.4     1.10 c		TYPE MWWWWW DET P P P P P
Log 1.59 8.41 1.64 1.64 1.64 1.64 1.64 1.64 1.64 1.64 1.64 1.64 1.64 1.64 1.64 1.64 1.64 1.64 1.64 1.64 1.64 1.65 1.05 1		Mkr1 2.452 GH 1.10 dBn
8.41		
18.4     .16       22.4     .16       33.4     .16       34.4     .16		
18.4         3         3         4         2         4         1         f         2         9         96         1         1         6         1         1         1         6         1         1         1         1         1         1         1         1         1         1         1         1 <th1< th="">         1         1         1</th1<>		
All A         All A <th< td=""><td></td><td>-16.98 dE</td></th<>		-16.98 dE
Kei         Kei <td></td> <td></td>		
Kei         Kei <td>A2</td> <td></td>	A2	
Sea 4         Sea 4         Sea 4           68.4	Y IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	
Kest         Kest         Kest         Kest         Span 24.97           Center 12.52 GHz         #VBW 300 kHz         Span 24.97           %Res BW 100 kHz         #VBW 300 kHz         Sweep 2.386 s (1001           1         N         1         f         2.452 GHz         1.102 dBm           1         N         1         f         2.487 GHz         4.874 GHz         4.86 dBm           3         N         1         f         7.321 GHz         -29.967 dBm         -           4         N         1         f         24.326 GHz         17.929 dBm         -	I a manufacture	when men and served when the water the
Krst         Krst         Y         Function width         Function width           1         N         1         f         2.452         GHz         Span 24.97           1         N         1         f         2.452         GHz         Function width         Function width           2         N         1         f         2.452         GHz         4.426         GBm           3         N         1         f         7.321         GHz         -29.967         dBm           4         N         1         f         24.326         GHz         -29.967         dBm	for hard a serie was a serie and the series when the series and the se	
Center 12.52 GHz         Span 24.97           #VBW 300 kHz         Span 24.97           Sweep         2.386 s (1001           Mss Moog Tage Sci         X         Y         Function width         Function value           1         N         1         f         2.452 GHz         1.102 dBm           2         N         1         f         2.452 GHz         4.486 dBm           3         N         1         f         7.321 GHz         -29.967 dBm           4         N         1         f         24.326 GHz         47.929 dBm		
#Res BW 100 kHz         #VBW 300 kHz         Sweep         2.386 s (1001           MME MODE TRC SCL         X         Y         FUNCTION WIDTH         FUNCTION WIDTH           N         1         f         2.452 GHz         1.102 dBm           2         N         1         f         4.874 GHz         -44.86 dBm           3         N         1         f         7.321 GHz         -29.967 dBm           4         N         1         f         24.326 GHz         47.929 dBm		
#Res BW 100 kHz         #VBW 300 kHz         Sweep         2.386 s (1001           MME MODE TRC SCL         X         Y         FUNCTION WIDTH         FUNCTION WIDTH           N         1         f         2.452 GHz         1.102 dBm           2         N         1         f         4.874 GHz         -44.86 dBm           3         N         1         f         7.321 GHz         -29.967 dBm           4         N         1         f         24.326 GHz         47.929 dBm		Onen 24.07 Oli
I         N         1         f         2.452 GHz         1.102 dBm           2         N         1         f         4.874 GHz         -44.96 dBm           3         N         1         f         7.321 GHz         -29.967 dBm           4         N         1         f         24.326 GHz         -47.929 dBm	#VBW 300 kHz	Sweep 2.386 s (1001 pts
2         N         1         f         4.874 GHz         -44.86 dBm           3         N         1         f         7.321 GHz         -29.967 dBm           4         N         1         f         24.326 GHz         -47.929 dBm		FUNCTION VALUE
3 N 1 f 7.321 GHz -29.967 dBm 4 N 1 f 24.326 GHz -47.929 dBm		
	7.321 GHz -29.967 dBm	
5	24.326 GHz -47.929 dBm	
6		
8		
9		
10 11		
SG STATUS		

П



# 78 CH

t Spectrum Analyzer - Sv RF 50 S		SENSE:PULSE		ALIGNAUTO		01:49:09	M Jun 16
ter Freg 12.515				Avg Type	Log-Pwr	TRA	ACE 1 2 3
•		): Fast 😱 Trig: Fro in:Low #Atten: 3				T I	VPE MWW DET PPP
						Mkr1 2.4	477 0
Ref Offset 0 Bidiy Ref 12.99							81 d
<u></u> 1							
	/3						-16.8
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	Y						
and	way work water a water of the second	and and the design and all	man and for the start way	and an and the set	- And and a second	and the market of the second	pages.
Magness and		and the factor in the second s					
						_	
ter 12.52 GHz s BW 100 kHz		#VBW 300 ki	47		SW	Span : eep 2.386 s	
ADDE TRC SCL	×			NCTION WIDTH		EUNCTION VALUE	(1001
N 1 f	2.477 GHz	3.081 dBm	ONCTION	NCTION WIDTH		FONCTION VALUE	
N 1 f N 1 f	4.949 GHz 7.446 GHz	-47.688 dBm -28.360 dBm					
	24.301 GHz	-48.078 dBm					
N 1 f							
N 1 f							
N 1 f							
N 1 f							
N 1 f							
N 1 f							



Shenzhen STS Test Services Co., Ltd.

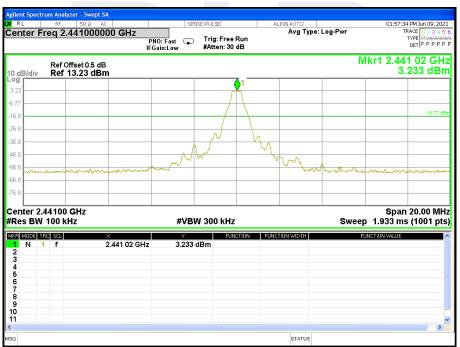


#### For Band edge(it's also the reference level for conducted spurious emission)

	um Analyzer - S						
LX/RL	RF 50		SENS	E:PULSE	ALIGNAUTO	· _	01:53:47 PM Jun 09, 2021
Center Fi	req 2.353	500000 GHz	PNO: Fast 😱 FGain:Low	Trig: Free Run #Atten: 30 dB	Avg Typ	e: Log-Pwr	TRACE 1 2 3 4 5 6 TYPE MWWWWWW DET P P P P P P
10 dB/div	Ref Offset Ref 10.40					N	/kr1 2.402 19 GHz 0.400 dBm
Log 0.400							<b>1</b>
-9.60							
-19.6							-19,60 dBm
-29.6							
-39.6							− − − KS <sup>#</sup> h
-49.6							
-59.6	Romantionportunality	man Armond	- Phyperson and a strength	water hat a second	rel-uptown marked and	and the second states	- With the second se
-69.6							
-79.6							
Start 2.30 #Res BW			#VBW	300 kHz		Swee	Stop 2.40700 GHz p  10.27 ms (1001 pts)
MKR MODE TF 1 N 1 2 N 1 3 N 1	f f	× 2.402 19 GHz 2.323 97 GHz 2.399 19 GHz	-55.689 d	Bm	FUNCTION WIDTH	F	
4 N 1		2.400 05 GHz					
5 6 7 8 9							
10							
11 <							×
MSG					STATUS		

#### 00 CH

39 CH





# 78 CH

		- Swept SA						
nter Fr		50 Ω AC 7500000 GHz		SENSE:PULSE		ALIGNAUTO Avg Type: Log		2:00:08 PM Jun 09, 202 TRACE 1 2 3 4 5 TYPE MWWWW
			IFGain:Low	#Atten: 30				DETPPPF
dB/div	Ref Offse Ref 13.	et 0.5 dB 30 dBm					Mkr1 2.4	480 150 GH 3.298 dBi
		<b>1</b>						
		/\						
,								-16.70 d
,								
,		Nh						
	M	N S						
march	ww			AN AN AN AN AN		Anna and a start and a		(\ <sup>4</sup>
				ne want		an Die maning and a maning and a maning	and a second second second	
, <u> </u>								
	500 GHz 100 kHz		#\	/BW 300 kH:	z		Sto Sweep 2.400	p 2.50000 GH ) ms (1001 pt
	RC SCL	×	Ŷ		NCTION FUN	CTION WIDTH	FUNCTION VA	LUE
MODE TR N 1 N 1 N 1	RC SCL f f	2.480 150 2.483 500	GHz 3.2 GHz -57.9	98 dBm 83 dBm	NCTION FUN	CTION WIDTH	FUNCTION V	LUE
N 1	RC SCL f f f	2.480 150	GHz 3.2 GHz -57.9 GHz -53.2	98 dBm	NCTION FUN	CTION WIDTH	FUNCTION V/	LUE
N 1 N 1 N 1	RC SCL f f f	2.480 150 2.483 500 2.484 025	GHz 3.2 GHz -57.9 GHz -53.2	298 dBm 83 dBm 217 dBm	NCTION FUN	CTION WIDTH	FUNCTION V2	ALUE
N 1 N 1 N 1	RC SCL f f f	2.480 150 2.483 500 2.484 025	GHz 3.2 GHz -57.9 GHz -53.2	298 dBm 83 dBm 217 dBm	NCTION FUN	CTION WIDTH	FUNCTION V	LUE.
N 1 N 1 N 1	RC SCL f f f	2.480 150 2.483 500 2.484 025	GHz 3.2 GHz -57.9 GHz -53.2	298 dBm 83 dBm 217 dBm	NCTION FUN	CTION WIDTH	FUNCTION V2	LUE
N 1 N 1 N 1	RC SCL f f f	2.480 150 2.483 500 2.484 025	GHz 3.2 GHz -57.9 GHz -53.2	98 dBm 83 dBm 17 dBm 07 dBm	NCTION FUN	CTION WIDTH	FUNCTION V2	LUE
N 1 N 1 N 1	RC SCL f f f	2.480 150 2.483 500 2.484 025	GHz 3.2 GHz -57.9 GHz -53.2	298 dBm 83 dBm 217 dBm	FUN FUN	STATUS	FUNCTION V2	



Shenzhen STS Test Services Co., Ltd.

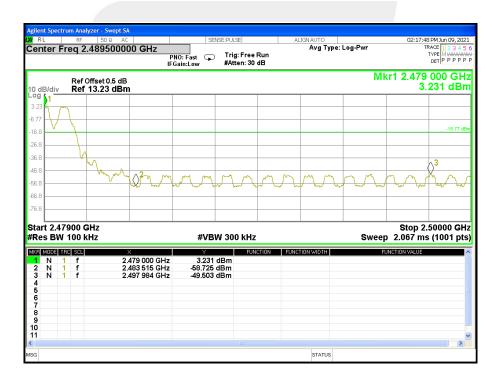




### For Hopping Band edge

GFSK

<mark>ilent Spect</mark> r R L	r <mark>um Analy</mark> RF	<mark>/zer - Swept</mark> 9 50 Ω A			NSE:PULSE		IGN AUTO		00:15:0	6 PM Jun 09, 202
		3515000	000 GHz	PNO: Fast Gain:Low	TrimEnce	Run	Avg Type:	-	Т	RACE 1 2 3 4 5 TYPE MMMMM DET P P P P P
) dB/div		offset 0.5 dB 12.81 dB						M	kr1 2.403 2.	000 GH 813 dBr
.81										
19										-17.19 d
.2 .2										
.2										
.2	10.0 0.0 0	101000000	mmmmm	4444000000	054464464	000000000000	56566666670	1064050440		IABADAA N
.2 <del>джряц</del> 7.2	งงุญงาย	UUVVUVUU	MANANANAN	anahanahana	<u>ARNAGRAA</u> da	AAAAAAAAAAAA	16AAAAAAAAAAAAA	<u>AAAAAAAAAAA</u>	1000000000	UUUUUVY
7.2										
art 2.30 Res BW				#VB	W 300 kHz	:		Swee	Stop 2. p 9.867 m	.40300 GH s (1001 pts
R MODE T			Х	Y		ICTION FUNC	TION WIDTH		UNCTION VALUE	<u> </u>
N 1 2 N 1 3 N 1	f	1	2.403 000 GHz 2.390 022 GHz 2.400 013 GHz	-53.253						
i i										
3 9 1										
							STATUS			>
							STATUS			



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#### Page 38 of 74 Report No.: STS2106039W02

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

RF 50 Ω	AC	SENSE:	PULSE	ALIGNAUTO		02:34:52 PM Jun 16, 3
Freq 30.00000	) MHz	0:East	[rig: Free Run	Avg Type: L	og-Pwr	TRACE 1 2 3 TYPE MWW DET P P P
		ain:Low #	Atten: 30 dB		n	/kr1 2.402 G
Ref Offset 0.5 B/div Ref 11.21 c						0.08 dI
<b>∲</b> 1						
						-19.8
	^ <b>1</b>					
	2					
	- <u>-</u>			and attraction	مراسبو المسارية المستم والمعادية	and the second and and and and and and and and and a
weekyent for all weeklessen	or a land and the second second	manufacture war	- marken	a company and	and the second sec	
t 30 MHz						Stop 25.00 C
s BW 100 kHz		#VBW (	300 kHz		Sweep	2.386 s (1001
MODE THE SEL	× 2.402 GHz	¥ 0.080 dBi	FUNCTION	FUNCTION WIDTH	FUNCT	ON VALUE
N 1 f	4.799 GHz	-48.67 dBi	m			
N 1 f N 1 f	7.196 GHz 24.700 GHz	-31.558 dBi -48.852 dBi				
				STATUS		

#### 00 CH

20	CI I
39	CH

RL	RF	50 Q AC		SE	NSE:PULSE		ALIGN AUTO		02:14:	01 PM Jun 16, 20
enter F	req 1	2.5150000	F	PNO: Fast 🖵 Gain:Low	Trig: Free #Atten: 30		Avg Type	: Log-Pwr		TRACE 1234 TYPE MWMMM DET PPPP
dB/div		Offset 0.5 dB 11.57 dBm								2.452 GH 0.85 dB
g		1								
57						-				
13										
.4										-18.09 c
4			A	3						
4			L Y	1						
		(	2							
4			1				man man and many	manne	howwww	when the man
4 Antres	للوسيده	Ab Margarlan and In	and the second s	and warden	معليه والمور المحاسلين	male form	And a			
4										
4										
nter 12 es BW				#VB	W 300 kH:	Z		Sw	Spa eep 2.386	n 24.97 G s (1001 p
	RC SCL		× 2.452 GHz	0.852		NCTION	FUNCTION WIDTH		FUNCTION VALUE	
N 1	f		4.874 GHz	-49.62	dBm					
	l f		7.321 GHz 24.501 GHz	-34.724 -49.336						
			24.001 0112	43.000	den.					

Shenzhen STS Test Services Co., Ltd.



## 78 CH

Spectrum Analyzer - Sv RF 50 (	wept SA Ω AC	SENSE:PULSE	AI TG	AUTO	01:54:26 PM Jun 1
er Freq 12.515	000000 GHz	D: Fast Trig: Frain:Low #Atten:	ee Run	Avg Type: Log-Pwr	TRACE 1 2 TYPE MM DET P P
Ref Offset 0 div Ref 11.05					Mkr1 2.477 1.598 c
1					
					-11
	() <sup>3</sup>				
	2				
h.	Y	Manda and and a characterization	margan	and the and the second second	and a start and a start of the
and the second		A STRUCT AND A S			
er 12.52 GHz BW 100 kHz		#VBW 300 kl	Hz	s	Span 24.97 weep 2.386 s (1007
ide TRC SCL N 1 f	× 2.477 GHz	1.598 dBm	FUNCTION FUNCTIO	N WIDTH	FUNCTION VALUE
N 1 f N 1 f N 1 f	4.949 GHz 7.446 GHz 24.326 GHz	-49.062 dBm -32.328 dBm -48.073 dBm			

Shenzhen STS Test Services Co., Ltd.



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

		yzer - Swept SA								
LXI RL	RF	50 Ω AC		SE	NSE:PULSE	A	LIGNAUTO	. I. a. a. Decar	02:21:5	1 PM Jun 09, 2021 RACE 1 2 3 4 5 6
Center F	req 2.	35350000	F	PNO: Fast	Trig: Free F		Avg Type	: Log-Pwr		TYPE MWWWWWW DET P P P P P P
			IF	Gain:Low	#Atten: 30 d	B				,
10 dB/div		)ffset 0.5 dB 10.29 dBm						n		1 97 GHz 289 dBm
Log										<u>1</u>
0.290										Ă
-9.71										-1971 dBm
-19.7										-19//1 dbm
-29.7										N. h
-39.7										
-49.7										₩ <u></u>
-59.7 <b>mahar</b>	appendiation of	connectorolaurre	- A	water the second se	war to man and the second of t		how when the states	and the second sprace		m h
-69.7										
-79.7										
									<b>6</b> to 0	40700 011-
Start 2.3 #Res BW				#VB	W 300 kHz			Swee		40700 GHz s (1001 pts)
MKR MODE T	TRC SCL	×		Y	FUNC	TION FUNC	TION WIDTH	ł	FUNCTION VALUE	~
1 N 2 N	1 f 1 f		.401 97 GHz .324 18 GHz	0.289						
3 N	1 f	2	.399 19 GHz	-48.350	dBm					
	1 f	2	.400 05 GHz	-45.681	dBm					=
5 6 7 8 9										
8										
9										
11										~
K MSG							STATUS			
mag							STATUS			

#### 00 CH

39 CH





## 78 CH

	AC	SENSE:PULSE	ALI	GNAUTO	02:31:48 PM	1 Jun 09, 20'
ter Freq 2.487500		] ast		Avg Type: Log-Pw	TYP	E 1 2 3 4 E M WAANA T P P P P
Ref Offset 0.5 d					Mkr1 2.480 0 2.30	00 GH 56 dB
/	<b>1</b>					
						-17.63 c
	- VM-					
		-				
mm	m	<sup>2</sup> /3				
~~~	- ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	W.			- martine -	
				and you want would would would should be a standay		Condon Ann
rt 2.47500 GHz				_	Stop 2.50	
		#VBW 300 k	Hz	5	Sweep 2.400 ms (	1001 p
es BW 100 kHz		Y	FUNCTION FUNCT	ION WIDTH	FUNCTION VALUE	
MODE TRC SCL	X					
es BW 100 kHz Mode TRC SCL N 1 f N 1 f	2.480 000 GHz	2.366 dBm -52.089 dBm				
MODE TRC SCL N 1 f N 1 f N 1 f	2.480 000 GHz 2.483 500 GHz 2.484 025 GHz	2.366 dBm -52.089 dBm -53.258 dBm				
MODE TRC SCL N 1 f N 1 f	2.480 000 GHz 2.483 500 GHz	2.366 dBm -52.089 dBm				
MODE TRC SCL N 1 f N 1 f N 1 f	2.480 000 GHz 2.483 500 GHz 2.484 025 GHz	2.366 dBm -52.089 dBm -53.258 dBm				
MODE TRC SCL N 1 f N 1 f N 1 f	2.480 000 GHz 2.483 500 GHz 2.484 025 GHz	2.366 dBm -52.089 dBm -53.258 dBm				
MODE TRC SCL N 1 f N 1 f N 1 f	2.480 000 GHz 2.483 500 GHz 2.484 025 GHz	2.366 dBm -52.089 dBm -53.258 dBm				
MODE TRC SCL N 1 f N 1 f N 1 f	2.480 000 GHz 2.483 500 GHz 2.484 025 GHz	2.366 dBm -52.089 dBm -53.258 dBm				



Shenzhen STS Test Services Co., Ltd.

Page 42 of 74 Report No.: STS2106039W02



## For Hopping Band edge

#### π/4-DQPSK

R L RF	zer - Swept SA 50 Ω AC	SEI	VSE:PULSE	ALIGN AUTO		02:49:17 F	M Jun 09, 202
nter Freq 2.3	351500000 GHz	PNO: Fast	Trig: Free Run #Atten: 30 dB	Ауд Туре	: Log-Pwr	ΤY	CE 1 2 3 4 5 PE MWAAAA ET P P P P P
	ffset 0.5 dB 10.26 dBm				MI	kr1 2.403 ( 0.2	000 GH 61 dBi
<b>8</b>							
74							
7							-19.74 d
7							A.
7							{V
	ehenne warmand	mound	murmm	manand	manna		www
7							
.7							
art 2.30000 Gl es BW 100 kl		#VB	W 300 kHz		Swee	Stop 2.4 p 9.867 ms (	
N 1 f	× 2.403 000 GH			FUNCTION WIDTH	F	UNCTION VALUE	
	2.390 022 GH 2.400 013 GH		dBm dBm				
	2.400 013 GH						
N 1 f	2.400 0 13 6H						
N 1 f	2.400 013 6H						
N 1 f	2.400 013 GH						
	2.400 013 6H						>

ter Fr	RF	50 Ω AC		SE	NSE:PULSE		ALIGNAUTO Avg Type	e: Log-Pwr		28 PM Jun 09, 20 TRACE 1 2 3 4
	oq 2.7	1000000	F	PNO: Fast 🖵 Gain:Low	) Trig: Free #Atten: 30	Run dB	0 //	5		DET P P P P
B/div		fset 0.5 dB 2.36 dBn						Μ	kr1 2.479 2	9 000 GI .361 dB
1										
- war	7									
<u> </u>										-17.64
	- hm	4								
<u> </u>									3	
<u> </u>		- Word Why	$\int_{-\infty}^{2}$	L. M. L. M.	man	m d	he who who	. M M	NI M	n .r.
<u> </u>			Che College	₩ <u>~</u> / V\/V <sup></sup> "	my way	w wy	·	Ma white of		d. where
rt 2.479 es BW 1				#VB	W 300 kH:	,		Swee	Stop 2 p 2.067 m	2.50000 G
MODEL TRO			×	<i></i>		-	UNCTION WIDTH		FUNCTION VALUE	ю (1001 р
N 1	f	2.	479 000 GHz	2.361	dBm					
N 1 N 1	f f		483 515 GHz 496 178 GHz	-54.708 -50.228						
										>



Page 43 of 74 Report No.: STS2106039W02

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

RL		RF	Iyzer - Swept SA 50 Q AC		SENSE:PULSE		ALIGNAUTO		02/20/	42 PM Jun 16, 202
	Fre		2.515000000 GH	Z PNO: Fast IFGain:Low		ree Run 30 dB		be: Log-Pwr	02:39:	TRACE 1 2 3 4 5 TYPE MWWWW DET P P P P
dB/di	v		Offset 0.5 dB 10.84 dBm						Mkr1 :	2.402 GH 0.24 dBr
		-	1							
40 -		Ť								
6						_				
2										-19.81 d
2										
2										
2						A	and a some home	down when a strength when the second	Well and White Marine	and the state of t
2 wh	Month	-month	and the second state of th	And a state of the	New Warden Constrained	NP THAT WAR				
.2 —										
.2										
enter tes B				#	VBW 300 k	Hz		Sw	Spa eep 2.386	n 24.97 GH s (1001 pt
MOD	e  Tro		X			FUNCTION	FUNCTION WIDTH		FUNCTION VALUE	
N N	1	f	2.402 0 4.799 0		239 dBm .35 dBm					
N	1	f	7.196 (	GHz -31.0	348 dBm					
N	1	f	24.675 0	GHz -48.9	958 dBm					
										>

## 00 CH

## 39 CH

	RF	50 Ω AC		SENSE:PU	LSE	ALIGN AUTO		02:44:54 F	MJun 16,2
enter F	req 1	2.515000	Р		g: Free Run tten: 30 dB	Аvg Тур	e: Log-Pwr	TY	CE 1 2 3 4 PE MWWW ET P P P P
dB/div		Offset 0.5 dB 10.47 dBm						Mkr1 2.4 1.	52 G 90 dE
g	(	)1							
~~									
3									-17.99
5				3					-17.95
5			I Y						
5		(	2						,
6			1						کر ہے۔ سرچہ میں ا
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- Andrews	and the second second			and the second s					
5									
5									
nter 1	2.52 0	Hz						Span 2	24.97 <b>G</b>
es BW				#VBW 30	0 kHz		Swe	eep 2.386 s	1001
MODE 1	TRC SCL		×	Y	FUNCTION	FUNCTION WIDTH		FUNCTION VALUE	
N N	1 f 1 f		2.452 GHz 4.874 GHz	1.904 dBm -44.51 dBm					
N	1 f		7.321 GHz	-29.815 dBm					
Ν	1 f		24.326 GHz	-47.847 dBm					

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## 78 CH

- RF 50 G	vept SA	SENSE:PULSE	ALIGNAUTO		2:47:17 PM Jun 16,
ter Freq 12.515	000000 GHz	): Fast	Avg Typ Run	e: Log-Pwr	TRACE 1 2 3 TYPE MWAA DET P P P
Ref Offset 0. B/div Ref 13.83				Mki	1 2.477 G 2.11 dl
<sup>1</sup>					
					-17.6
	2				
					- Arr
mounderstand	un manun	المرجع المروح والمتعالية ويعادوه والمعالية و	meno any any and meno	ward warden and and the second	when when the
ter 12.52 GHz s BW 100 kHz		#VBW 300 kHz	z	Sweep 2.3	Span 24.97 ( 386 s (1001
MODE TRC SCL N 1 f	× 2.477 GHz	2.113 dBm	NCTION FUNCTION WIDTH	FUNCTION V.	ALUE
	4.949 GHz 7.446 GHz	-45.84 dBm -36.760 dBm			
N 1 f N 1 f N 1 f	24.625 GHz	-48.317 dBm			
N 1 f N 1 f					
N 1 f N 1 f					
N 1 f N 1 f			Istatus		



Shenzhen STS Test Services Co., Ltd.

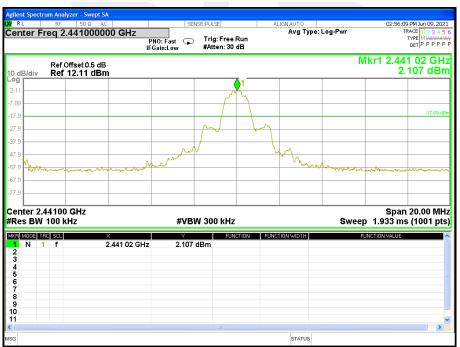


### For Band edge(it's also the reference level for conducted spurious emission)

		alyzer - Swept SA					
IXI RL	RF	50 Ω AC	SENSE	:PULSE	ALIGNAUTO	e: Log-Pwr	02:53:53 PM Jun 09, 2021 TRACE 1 2 3 4 5 (
Center F	req 2	2.353500000 GHz	PNO: Fast 😱 IFGain:Low	Trig: Free Run #Atten: 30 dB	Avgiy	be: Log-Pwr	TYPE MWWWWW DET P P P P P
10 dB/div		Offset 0.5 dB * 10.30 dBm				Ν	/lkr1 2.401 97 GHz 0.295 dBm
Log 0.300							1
-9.70							A
							-19,70 dBm
-19.7							
-39.7							
-49.7		2					
-49.7				. A.		my Mullinstran	
-69.7	and a second	and and a start of the start of	ant and the second s	and a start of the second s	alata Dantan a a a a a b	- Arthur - maller and realized	
-79.7							
-75.7							
Start 2.3 #Res BW			#VBW	300 kHz		Swee	Stop 2.40700 GHz p 10.27 ms (1001 pts)
MKR MODE T	_	Х	Y	FUNCTION	FUNCTION WIDTH	ŀ	UNCTION VALUE
	1 f 1 f	2.401 97 GH 2.324 08 GH	z -55.157 dB	m			
	1 f 1 f	2.399 19 GH 2.400 05 GH					
		2.400 00 011.	40.020 42				
5 6 7 8 9							
8							
10 11							
<							
MSG					STATUS		

#### 00 CH

39 CH





## 78 CH

ilent Spectrum Analyzer - Swept SA			
RL RF 50 Ω AC enter Freq 2.487500000 GHz	PNO: Fast IFGain:Low IFGain:Cow		02:58:23 PM Jun 09, 2021 TRACE 1 2 3 4 5 TYPE MWWWW DET P P P P
Ref Offset 0.5 dB dB/div Ref 12.50 dBm			1kr1 2.479 850 GHz 2.502 dBm
.50			
7.5			-17.50 dB
7.5			
7.5 7.5 7.5 7.5 7.5 7.5 7.5 7.5 7.5 7.5	multi		<b>↓</b>
7.5		aloun and the second and a second	all the second
7.5 tart 2.47500 GHz			Stop 2.50000 GH
Res BW 100 kHz	#VBW 300 kHz		ep 2.400 ms (1001 pt
XB         MODE         TFC         SEL         X           1         N         1         f         2.479         850         GI           2         N         1         f         2.479         850         GI           3         N         1         f         2.483         500         GI           4         N         1         f         2.484         000         GI           4         N         1         f         2.494         775         GI           5          5          5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5         5	lz -51.313 dBm lz -53.984 dBm	N FUNCTION WIDTH	FUNCTION VALUE
5 77 77 77 77 77 77 77 77 77 77 77 77 77			
3		STATUS	



Shenzhen STS Test Services Co., Ltd.

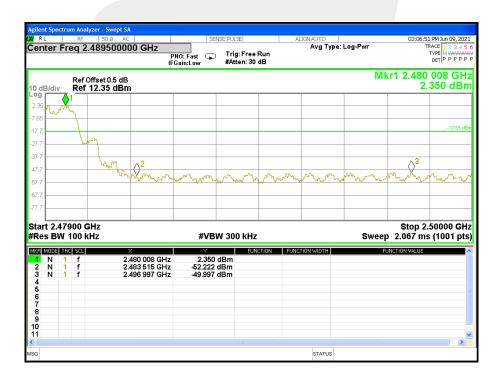




## For Hopping Band edge

8DPSK

gilent Spectrum Ana									
RL RF Center Freq 2	50 Ω AC .35150000	P	NO: Fast 😱 Gain:Low	NSE:PULSE Trig: Free R #Atten: 30 d	lun	IGN AUTO Avg Type:		т	9 PM Jun 09, 2021 RACE 1 2 3 4 5 TYPE MWWWWW DET P P P P P
0 dB/div Ref	Offset 0.5 dB 11.22 dBm						М		000 GHz 220 dBr
-og 1.22									1.
8.78									-18.78 dBr
28.8									
48.8									No.
58.8 <mark></mark>	Andaranda	frankrik h	Adaman	MhanadM	warded and	Mathinna	haddoora	Manakka	harrent
78.8									
tart 2.30000 0 Res BW 100 k			#VB	W 300 kHz			Swee	Stop 2 p 9.867 m	.40300 GHz s (1001 pts
<mark>1 N 1 f</mark> 2 N 1 f 3 N 1 f	2.3	103 000 GHz 190 022 GHz 100 013 GHz	1.220 -55.000 -47.279	dBm	TION FUNC	TION WIDTH	F	UNCTION VALUE	
4 5 6	<b>_</b>		41.210						
8 8 9									
9 0 1									
3				Ш		STATUS			>



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## 5. NUMBER OF HOPPING CHANNEL

5.1 LIMIT

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

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

### 5.2 TEST PROCEDURE

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



## 5.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.



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#### 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

## Hopping channel

		RF	50 Q A			SENSE:PULSE		AL	IGNAUTO			25 PM Jun 09, 202
ente	r Fi	req 2	2.4417500		PNO: Fast IFGain:Low	⊊ Trig: #Atte	Free Run n: 30 dB		Avg Type:	Log-Pwr		TYPE MWWWW DET P P P P
0 dB/d	liv		Offset 0.5 dE 13.39 dBr							Mkr		243 5 GH 3.43 dBr
og 3.39 5.61		m	WWW		WWW	WWW	YYYYYY	AAAAA	WWWW	*****	WWWW	
16.6 26.6 36.6												
16.6 <mark>/</mark> 56.6 —												
6.6												
tart 2 Res E	зw	300			#	VBW 300					o 1.133 m	.48350 GH s (1001 pt
1 N 2 N 3 4	1	f	2.4	× 102 171 0 GHz 180 243 5 GHz		2.65 dBm 9.43 dBm	FUNCTION	FUNC	TION WIDTH	F	UNCTION VALUE	
5 6 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). So the number of pulses in the observation period of 31.6 seconds is  $3.37 \times 31.6 = 106.6$ .
- j. DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots RX, 1 time slot TX). So the number of pulses in the observation period of 31.6 seconds is  $5.06 \times 31.6 = 160$ .
- k. DH1 Packet permit maximum 1600 / 79 / 2 = 10.12 hops per second in each channel (1 time slot RX, 1 time slot TX). So the number of pulses in the observation period of 31.6 seconds is 10.12 x 31.6 = 320.

6.3 TEST SETUP



#### 6.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.



## 6.5 TEST RESULTS

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

Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
DH1	middle	0.382	0.122	0.4
DH3	middle	1.639	0.262	0.4
DH5	middle	2.889	0.308	0.4

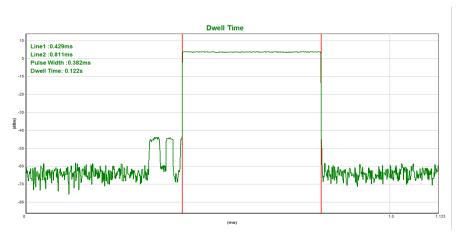


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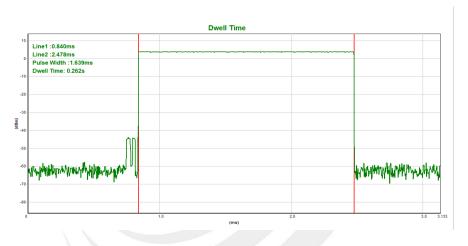
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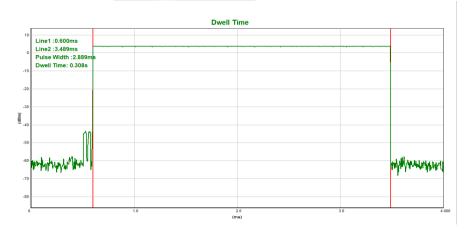
## CH39-DH1



## CH39-DH3



#### CH39-DH5





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

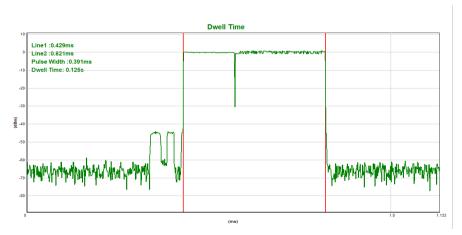
Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
2DH1	middle	0.391	0.125	0.4
2DH3	middle	1.645	0.263	0.4
2DH5	middle	2.893	0.309	0.4



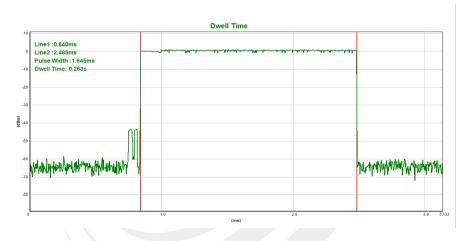
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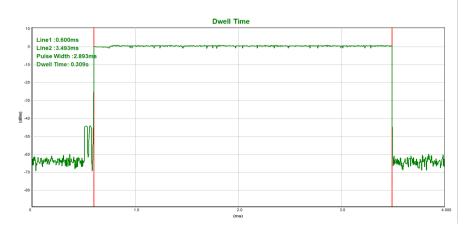
## CH39-2DH1



#### CH39-2DH3



#### CH39-2DH5



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

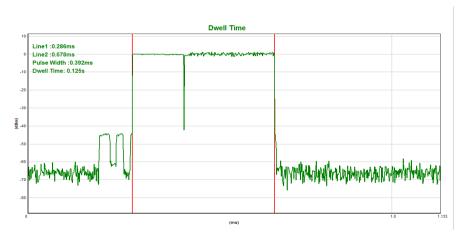
Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
3DH1	middle	0.392	0.125	0.4
3DH3	middle	1.642	0.263	0.4
3DH5	middle	2.892	0.308	0.4



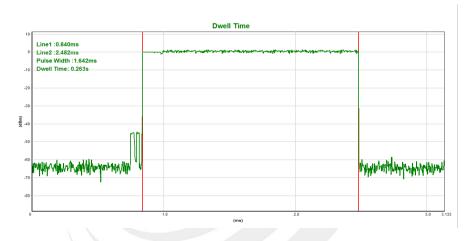
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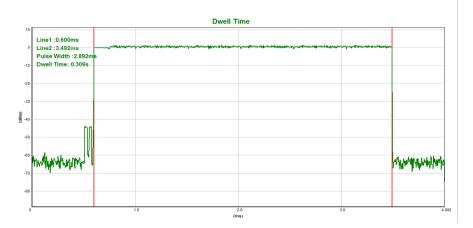
## CH39-3DH1



#### 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:	25℃	Relative Humidity:	50%
LOCT MINDAD.	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	2402.005	2403.004	0.999	0.865	Complies
2441 MHz	2441.005	2442.001	0.996	0.867	Complies
2480 MHz	2478.996	2480.001	1.005	0.862	Complies

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

### CH00 -1Mbps

RF 50 Ω AC	SENSE:PULSE	ALIGNAUTO	02:06:02 PM Jun 0
er Freq 2.402500000 GHz	PNO: Wide Trig: Free IFGain:Low #Atten: 30	Avg Type: Log-Pwr Run dB	TRACE 1 2 TYPE MW DET P P
Ref Offset 0.5 dB div Ref 8.98 dBm			Mkr2 2.403 004 0 1.994 c
	$\sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i$	2	
	va m	- m	
			· max
m			
er 2.402500 GHz BW 30 kHz	#VBW 100 kHz	z Si	Span 3.000 weep 3.200 ms (1001
de tro sol ×		NCTION FUNCTION WIDTH	FUNCTION VALUE
I 1 f 2.402 005 G			

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### CH39 -1Mbps

L RF 50Ω /	AC	SENSE:PULSE	ALIGN AUTO	02:08:57 PM Jun 09, 202
ter Freq 2.4415000		ide 🥁 Trig: Free Ru .ow #Atten: 30 dB	Avg Type: Log n	I-Pwr TRACE 1 2 3 4 TYPE MWWWW DET P P P P
Ref Offset 0.5 d B/div Ref 10.09 dB				Mkr2 2.442 001 GH 2.439 dBi
m	- max	1 mm	2 miles	
- Thomas	v~~	- Maria	~~ .	mont
nter 2.441500 GHz es BW 30 kHz		#VBW 100 kHz		Span 3.000 Mł Sweep  3.200 ms (1001 pt
	× 2.441 005 GHz	Y FUNCTIO 2.27 dBm	DN FUNCTION WIDTH	FUNCTION VALUE
N 1 f	2.442 001 GHz	2.44 dBm		
				>

#### 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	2402.002	2403.001	0.999	0.813	Complies
2441 MHz	2441.002	2441.998	0.996	0.815	Complies
2480 MHz	2478.987	2479.992	1.005	0.816	Complies

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

RL	RF	50 Ω AC		SE	NSE:PULSE		ALIGN AUTO		02:41:19	9 PM Jun 09, 202
enter l	Freq 2.4	0250000	DO GHz	NO: Wide 🍙 Gain:Low	Trig: Free F #Atten: 30 d	Run IB	Avg Type	: Log-Pwr	TF	RACE 1 2 3 4 5 TYPE MWWWW DET P P P P F
dB/div		fset 0.5 dB . <b>02 dB</b> m						MI	(r2 2.403 0.	001 GH 726 dBr
98				$\langle \rangle^1$			2			
2.0			$\sim \sim$	$\sim \sim \sim$	m	$\sim$	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	how	mm	$\sim$
2.0		~			~				· · ·	
	/	5								
2.0	- 5									
.0 -~~~										
2.0										
.0										
2.0										
2.0										
	2.402500	<u></u>							Onen	2.000 841
	V 30 kHz			#VB	W 100 kHz			Swee	3.200 ms	3.000 MH (1001 pt) 3
R MODE	TRC SCL		×	Y	FUNC	TION FUI	NCTION WIDTH	F	UNCTION VALUE	
1 N 2 N	1 f 1 f		402 002 GHz	-0.31	dBm					
2 N 3	1 f	2.	403 001 GHz	0.73	dBm					
5										
3										
7 3										
9										
1										
										>

#### CH00 -2Mbps

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#### CH39 -2Mbps



#### CH78 -2Mbps



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Temperature:	25℃	Relative Humidity:	50%
LOCT MINDAD.	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	2401.999	2402.992	0.993	0.805	Complies
2441 MHz	2440.993	2442.004	1.011	0.805	Complies
2480 MHz	2479.005	2480.004	0.999	0.806	Complies

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

CH00 -3Mbps

RL RF	50 Ω AC	SENSE:PULSE	ALIGN AUTO	03:08:56 PM Jun 09, 202
enter Freq 2.4	02500000 GHz PNO: IFGa	Wide Trig: Free Run n:Low #Atten: 30 dB	Avg Type: Log-Pwr	TRACE 1 2 3 4 5 TYPE MWAAAAA DET P P P P P
dB/div Ref 6.	set 0.5 dB . <b>39 dBm</b>			Mkr2 2.402 992 GH -0.179 dBr
og		∑1	2	
.61		mmm	man har man	man - man
3.6	Mar Martin	- V money		
3.6				
3.6				
3.6				
3.6				
3.6				
3.6				
3.6				
3.6				
enter 2.402500 Res BW 30 kHz		#VBW 100 kHz	Sw	Span 3.000 MH eep   3.200 ms (1001 pts
KR MODE TRC SCL 1 N 1 f	× 2.401 999 GHz	Y FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
2 N 1 f	2.402 992 GHz	-0.18 dBm		
3 4				
5				
6 7				
6 7 8				
6 7 8 9 0				
6 7 8 9 0 1				

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#### CH39 -3Mbps

RF	r - Swept SA 50 Ω AC	SENSE:PULSE	ALIGN AUTO	03:10:52 PM Jun 09,3
	1500000 GHz	0: Wide 😱 Trig: Free ain:Low #Atten: 30	Avg Type: Log-F Run	
	et 0.5 dB .42 dBm			Mkr2 2.442 004 G 1.635 dI
		()1	2	
Inna	Λ.	Man	0 mm	Λ
A. M. Marin	man pr	man	man and a second	www.www.
ter 2.441500 ( s BW 30 kHz	GHz	#VBW 100 kHz		Span 3.000 N Sweep 3.200 ms (1001 )
MODE TRC SCL	×		CTION FUNCTION WIDTH	FUNCTION VALUE
N 1 f	2.440 993 GHz	0.74 dBm	CHON FONCTION WIDTH	FONCTION VALUE
N 1 f	2.442 004 GHz	1.64 dBm		

#### CH78 -3Mbps



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## 8. BANDWIDTH TEST

## 8.1 LIMIT

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

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

#### 8.2 TEST PROCEDURE

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

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

#### 8.3 TEST SETUP



## 8.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.



### **8.5 TEST RESULTS**

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

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	0.8652	PASS
2441 MHz	0.8668	PASS
2480 MHz	0.8615	PASS

#### CH00 -1Mbps

Center Fre	RF 50 Ω AC	3			
Center Fro			ENSE:PULSE Center Freq: 2.402000	ALIGNAUTO	01:51:54 PMJun 09, 2021 Radio Std: None
	eq 2.40200000		Trig: Free Run	Avg Hold:>10/10	
		#IFGain:Low	#Atten: 30 dB		Radio Device: BTS
10 dB/div Log	Ref 20.00 dBm				
10.0					
0.00					
-10.0			$\sim\sim\sim$		
-20.0				2	
-30.0		~~~		~	~
-40.0	~				
-50.0					Sec.
-60.0	~~~				
-70.0					
Center 2.4 #Res BW			#VBW 100 k	U-	Span 2 MHz
#Res BW	JU KHZ		#VBW 100K	HZ	Sweep 2.733 ms
Occup	ied Bandwidth	1	Total Power	7.04 dBm	
		34.75 kHz			
	0.				
Transm	nit Freq Error	2.438 kHz	OBW Power	99.00 %	
x dB Ba	andwidth	865.2 kHz	x dB	-20.00 dB	
MSG				STATUS	

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#### CH39 -1Mbps



#### CH78 -1Mbps



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

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	1.219	PASS
2441 MHz	1.222	PASS
2480 MHz	1.224	PASS

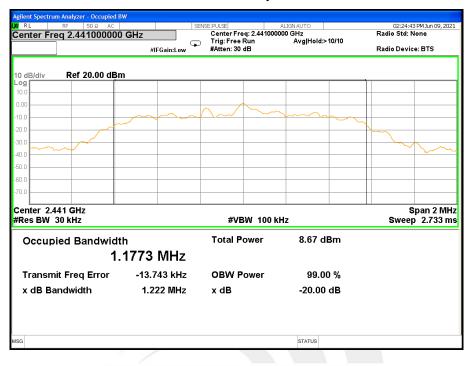
## CH00 -2Mbps



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#### CH39 -2Mbps



#### CH78 -2Mbps





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

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	1.207	PASS
2441 MHz	1.207	PASS
2480 MHz	1.209	PASS

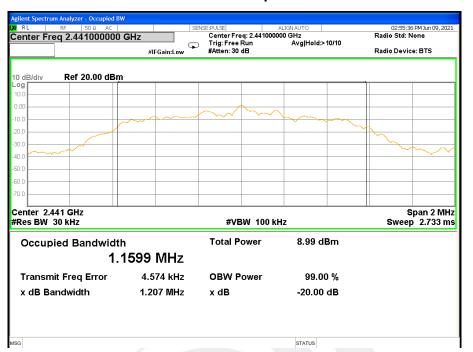
## CH00 -3Mbps

gilent Spectrum Analyzer - Occupied B\ RL RF 50 Ω AC		ENSE:PULSE	ALIGN AUTO	02:53:15 PM Jun 09, 2021
enter Freq 2.40200000		Center Freq: 2.4020000 Trig: Free Run	000 GHz Avg Hold:>10/10	Radio Std: None
	#IFGain:Low	#Atten: 30 dB	Arginelas lerie	Radio Device: BTS
0 dB/div Ref 20.00 dBm				-
0.0				
.00				
0.0	~~~~~	$\sim \sim$		
1.0			<u> </u>	$\sim$
0.0				
0.0				
0.0				
0.0				
D.0				
enter 2.402 GHz				Span 2 MH
Res BW 30 kHz		#VBW 100 k	Hz	Sweep 2.733 m
Occupied Bandwidt	า	Total Power	7.09 dBm	
•	1500 MHz			
Transmit Freq Error	13.066 kHz	OBW Power	99.00 %	
x dB Bandwidth	1.207 MHz	x dB	-20.00 dB	
3			STATUS	

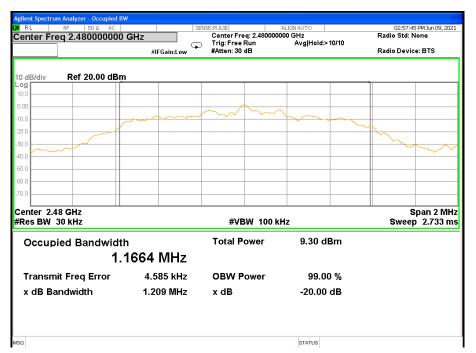
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#### CH39 -3Mbps



#### CH78 -3Mbps



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# 9. OUTPUT POWER TEST

### 9.1 LIMIT

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

#### 9.2 TEST PROCEDURE

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

- a) Use the following spectrum analyzer settings:
- 1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
- 2) RBW > 20 dB bandwidth of the emission being measured.
- 3) VBW  $\geq$  RBW.
- 4) Sweep: Auto.
- 5) Detector function: Peak.
- 6) Trace: Max hold.
- b) Allow trace to stabilize.
- c) Use the marker-to-peak function to set the marker to the peak of the emission.

d) The indicated level is the peak output power, after any corrections for external attenuators and cables.

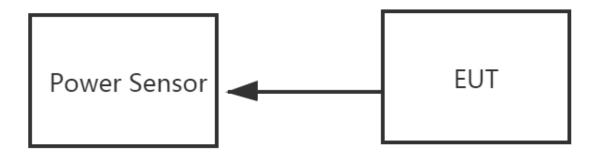
e) A plot of the test results and setup description shall be included in the test report.

NOTE—A peak responding power meter may be used, where the power meter and sensor system video bandwidth is greater than the occupied bandwidth of the unlicensed wireless device, rather than a spectrum analyzer.

PKPM1 Peak power meter method:

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DSS bandwidth and shall use a fast-responding diode detector.

9.3 TEST SETUP



## 9.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.

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### 9.5 TEST RESULTS

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

Mode Channel Number		Peak Power	Average Power	Limit	
	(MHz)	(dBm)	(dBm)	(dBm)	
GFSK(1M)	0	2402	2.82	-2.61	30.00
	39	2441	4.11	-1.79	30.00
	78	2480	3.47	-1.60	30.00

Note: the channel separation >20dB bandwidth

Mode Channel Number		Peak Power	Average Power	Limit	
	(MHz)	(dBm)	(dBm)	(dBm)	
π/4-DQPSK( 2M)	0	2402	1.45	-5.24	20.97
	39	2441	2.73	-3.33	20.97
	78	2480	2.99	-2.93	20.97

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

Mode Channel Number		Peak Power	Average Power	Limit	
	(MHz)	(dBm)	(dBm)	(dBm)	
	0	2402	1.67	-5.25	20.97
8-DPSK(3M)	39	2441	2.83	-3.32	20.97
	78	2480	3.06	-2.93	20.97

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

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## 10. ANTENNA REQUIREMENT

### **10.1 STANDARD REQUIREMENT**

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

### 10.2 EUT ANTENNA

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



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## **APPENDIX-PHOTOS OF TEST SETUP**

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

\* \* \* \* \* END OF THE REPORT \* \* \* \* \*



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