

RADIO TEST REPORT

S T S

Report No.: STS2003156W04

Issued for

RISCO LTD.

14 Hachoma Street, Rishon Lezion, 75655, Israel

Product Name:	RisControl IPS Touchscreen Keypad
Brand Name:	RISCO
Model Name:	RP432KPT
Series Model:	N/A
FCC ID:	JE4RP432KPT
Test Standard:	FCC Part 15.247

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Shenzhen STS Test Services Co., Ltd. A 1/F, Building B, Zhuoke Science Park, No.190 Chongqing Road, HepingShequ, Fuyong Sub-District, Bao'an District, Shenzhen, Guang Dong, China TEL: +86-755 3688 6288 FAX: +86-755 3688 6277 E-mail:sts@stsapp.com





TEST RESULT CERTIFICATION

Applicant's Name:	RISCO LTD.
Address	14 Hachoma Street, Rishon Lezion, 75655, Israel
Manufacture's Name:	Guangzhou MCOHome Technology Co.,Ltd
Address	Room 1504-1505, Building No.23 Tianan Headquarter Center, No.555 Panyu Avenue North, DongHuan street, Panyu, Guangzhou 511400, China
Product Description	
Product Name:	RisControl IPS Touchscreen Keypad
Brand Name	RISCO
Model Name:	RP432KPT
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:	03 Mar. 2020
Date (s) of performance of tests .:	03 Mar. 2020 ~ 09 June 2020

Date of Issue	11	June 2020
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Test Result Pass

Testing Engineer :	Chins cher	
	(Chris Chen)	
Technical Manager :	Sean She	GILITING
	(Sean she)	3
Authorized Signatory :	Virtali NO	
	(Vita Li)	

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7. HOPPING CHANNEL SEPARATION MEASUREMEN

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Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	11 June 2020	STS2003156W04	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)(iii)	Number of Hopping Frequency	PASS		
15.247(a)(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	±6.7dB
4	All emissions, radiated 1G-6GHz	±5.5dB
5	All emissions, radiated>6G	±5.8dB
6	Conducted Emission (9KHz-150KHz)	±4.43dB
7	Conducted Emission (150KHz-30MHz)	±5dB



2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	RisControl IPS Touchscreen Keypad
Trade Name	RISCO
Model Name	RP432KPT
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	4.0
BR+EDR	BR+EDR
Please see Note 3.	Please refer to the Note 3.
Power Rating	Input: DC 12V
Hardware version number	V1.2
Software version number	V1.0.0
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	RISCO	RP432KPT	PIFA	N/A	3dBi	BT Antenna



2.2 DESCRIPTION OF THE TEST MODES

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

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

Note:

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

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

For AC Conducted Emission

Test Case		
AC Conducted Emission	Mode 13 : Keeping BT TX	

2.3 FREQUENCY HOPPING SYSTEM REQUIREMENTS

(1)Standard and Limit

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

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



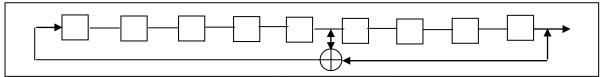
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The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping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

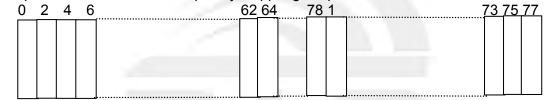
(2)The Pseudorandom sequence may be generated in a nin-stage shift register whose 5^{th} and 9^{th} stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones: i.e. the shift register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

Numver of shift register stages:9

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



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



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

(3)Frequency Hopping System

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

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

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

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

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2.4 TABLE OF PARAMETERS OF TEST SOFTWARE SETTING

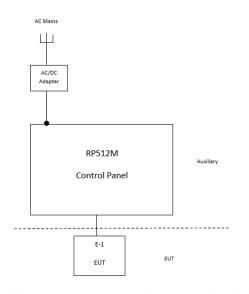
During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final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

Test software Version	Test program: Bluetooth		
(Power control software) Parameters(1/2/3Mbps)	Power class:Power class:Power class:Power cDH1 rate:4:27DH3 rate:11:183DH5 rate2DH1 rate:20:542DH3 rate:26:3672DH5 rate		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	3	Default	
ВТ	BR+EDR	π/4-DQPSK	3	Default	ADB Command
		8DPSK	3	Default	

2.5 BLOCK DIGRAM 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.	Serial No.	Note		
N/A	N/A	N/A	N/A	N/A	N/A		

Support units

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

Note:

(1) The support equipment was authorized by Declaration of Confirmation.

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



2.7 EQUIPMENTS LIST

Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	ESCI	101427	2019.07.29	2020.07.28
Signal Analyzer	Agilent	N9020A	MY51110105	2020.03.05	2021.03.04
Active loop Antenna	ZHINAN	ZN30900C	16035	2018.03.11	2021.03.10
Bilog Antenna	TESEQ	CBL6111D	34678	2017.11.02	2020.11.01
Horn Antenna	SCHWARZBECK	BBHA 9120D(1201)	9120D-1343	2018.10.19	2021.10.18
SHF-EHF Horn Antenna (18G-40GHz)	A-INFO	LB-180400-KF	J211020657	2018.03.11	2021.03.10
Pre-Amplifier(0.1M-3G Hz)	EM	EM330	060665	2019.10.09	2020.10.08
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK201808090 1	2019.10.12	2020.10.11
Pre-Amplifier (18G-40G)	SKET	LNPA_1840-50	SK201810180 1	2019.10.22	2020.10.21
Temperature & Humidity	HH660	Mieo	N/A	2019.10.12	2020.10.11
Turn table	EM	SC100_1	60531	N/A	N/A
Antenna mast	EM	SC100	N/A	N/A	N/A
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)			

Conduction Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	ESCI	101427	2019.07.29	2020.07.28
LISN	R&S	ENV216	101242	2019.10.09	2020.10.08
LISN	EMCO	3810/2NM	23625	2019.10.09	2020.10.08
Temperature & Humidity	HH660	Mieo	N/A	2019.10.12	2020.10.11
Test SW FARAD EZ-EMC(Ver.STSLAB-03A1 CE)					

RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
USB RF power sensor	DARE	RPR3006W	15100041SNO03	2019.10.09	2020.10.08
Signal Analyzer	Agilent	N9020A	MY49100060	2019.10.09	2020.10.08
Temperature & Humidity	HH660	Mieo	N/A	2019.10.12	2020.10.11
Test SW FARAD			LZ-RF /L	zRf-3A3	



3. EMC EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

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

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

Note:

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

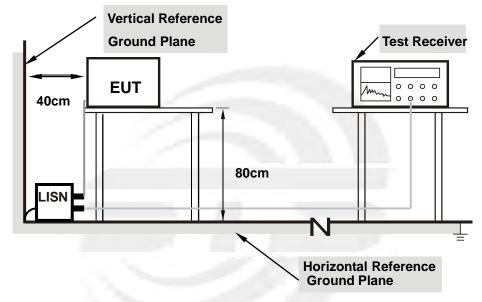
The following table is the setting of the receiver

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



3.1.2 TEST PROCEDURE

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



3.1.3 TEST SETUP

Note: 1.Support units were connected to second LISN. 2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

3.1.4 EUT OPERATING CONDITIONS

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



3.1.5 TEST RESULT

Temperature:	23.4(C)	Relative Humidity:	49%RH
Test Voltage:	AC 120V/60Hz	Phase:	L
Test Mode:	Mode 13		

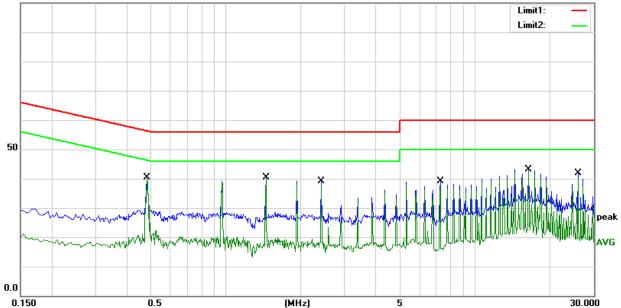
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.4820	20.22	20.03	40.25	56.30	-16.05	QP
2	0.4820	19.99	20.03	40.02	46.30	-6.28	AVG
3	1.4500	20.60	19.79	40.39	56.00	-15.61	QP
4	1.4500	20.22	19.79	40.01	46.00	-5.99	AVG
5	2.4180	19.31	19.80	39.11	56.00	-16.89	QP
6	2.4180	18.10	19.80	37.90	46.00	-8.10	AVG
7	7.2540	19.26	19.91	39.17	60.00	-20.83	QP
8	7.2540	17.79	19.91	37.70	50.00	-12.30	AVG
9	16.4420	22.88	20.30	43.18	60.00	-16.82	QP
10	16.4420	22.39	20.30	42.69	50.00	-7.31	AVG
11	25.9100	21.61	20.18	41.79	60.00	-18.21	QP
12	25.9100	20.12	20.18	40.30	50.00	-9.70	AVG

Remark:

1. All readings are Quasi-Peak and Average values

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

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



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Temperature:	23.4(C)	Relative Humidity:	49%RH
Test Voltage:	AC 120V/60Hz	Phase:	Ν
Test Mode:	Mode 13		

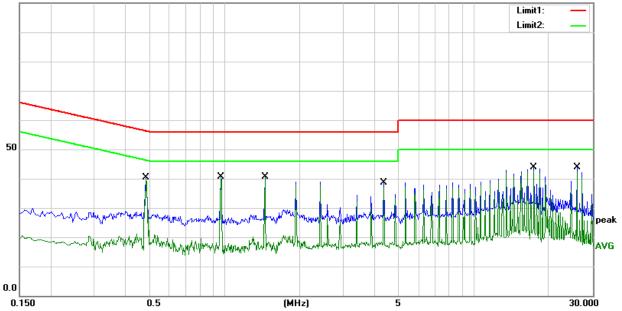
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.4820	20.26	20.03	40.29	56.30	-16.01	QP
2	0.4820	9.91	20.03	29.94	46.30	-16.36	AVG
3	0.9660	20.73	19.81	40.54	56.00	-15.46	QP
4	0.9660	20.44	19.81	40.25	46.00	-5.75	AVG
5	1.4500	20.93	19.79	40.72	56.00	-15.28	QP
6	1.4500	20.60	19.79	40.39	46.00	-5.61	AVG
7	4.3540	18.68	19.84	38.52	56.00	-17.48	QP
8	4.3540	17.08	19.84	36.92	46.00	-9.08	AVG
9	17.4100	23.56	20.34	43.90	60.00	-16.10	QP
10	17.4100	22.58	20.34	42.92	50.00	-7.08	AVG
11	25.9260	23.75	20.18	43.93	60.00	-16.07	QP
12	25.9260	22.23	20.18	42.41	50.00	-7.59	AVG

Remark:

1. All readings are Quasi-Peak and Average values

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

100.0 dBu¥



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^{2.} Margin = Result (Result = Reading + Factor)–Limit



3.2 RADIATED EMISSION MEASUREMENT

3.2.1 RADIATED EMISSION LIMITS

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

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

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

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

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

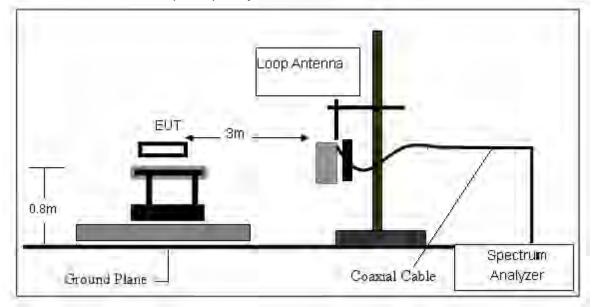
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

3.2.3 DEVIATION FROM TEST STANDARD

No deviation.

3.2.4 TESTSETUP

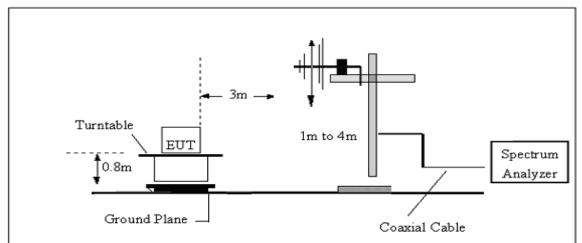
(A) Radiated Emission Test-Up Frequency Below 30MHz



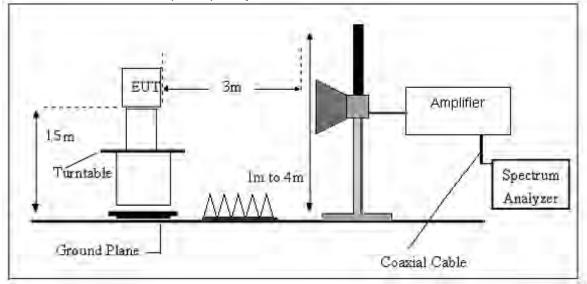
Shenzhen STS Test Services Co., Ltd.



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



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



3.2.5 EUT OPERATING CONDITIONS

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

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3.2.6 FIELD STRENGTH CALCULATION

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

FS = RA + AF + CL - 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:	54%RH
Test Voltage:	DC 12V	Test Mode:	TX Mode

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

Note:

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

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

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





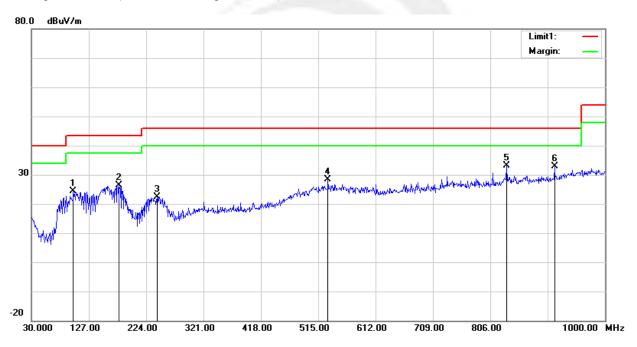
(30MHz-1000MHz)

Temperature:	23.2(C)	Relative Humidity:	54%RH			
Test Voltage:	DC 12V	Phase:	Horizontal			
Test Mode:	Mode 1/2/3/4/5/6/7/8/9(Mode 7 worst mode)					

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	100.8100	44.33	-20.04	24.29	43.50	-19.21	QP
2	178.4100	46.37	-20.02	26.35	43.50	-17.15	QP
3	242.4300	39.82	-17.52	22.30	46.00	-23.70	QP
4	531.4900	35.76	-7.37	28.39	46.00	-17.61	QP
5	833.1600	33.77	-0.62	33.15	46.00	-12.85	QP
6	914.6400	32.96	-0.10	32.86	46.00	-13.14	QP

Remark:

^{1.} Margin = Result (Result = Reading + Factor)-Limit



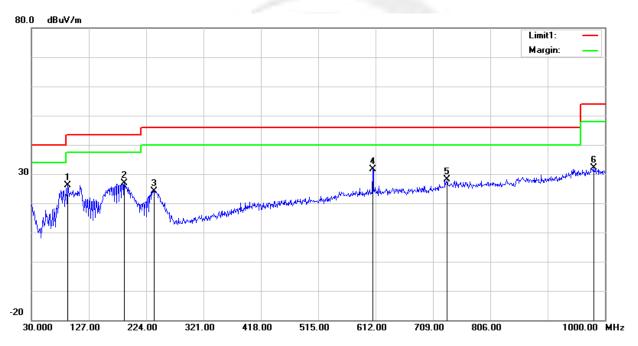


Temperature:	23.2(C)	Relative Humidity:	54%RH		
Test Voltage:	DC 12V	Phase:	Vertical		
Test Mode:	Mode 1/2/3/4/5/6/7/8/9(Mode 7 worst mode)				

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	91.1100	47.49	-21.31	26.18	43.50	-17.32	QP
2	187.1400	47.63	-20.64	26.99	43.50	-16.51	QP
3	237.5800	42.58	-18.35	24.23	46.00	-21.77	QP
4	607.1500	37.35	-5.60	31.75	46.00	-14.25	QP
5	733.2500	30.55	-2.35	28.20	46.00	-17.80	QP
6	980.6000	29.60	2.63	32.23	54.00	-21.77	QP

Remark:

1. Margin = Result (Result =Reading + Factor)–Limit



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(1GHz~25GHz) Spurious emission Requirements

Frequency	Meter Reading	Amplifier	Loss	Antenna Factor	Orrected Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBµV)	(dB)	(dB)	(dB/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре	
	•	•		Low Chan	nel (8DPSK/2	402 MHz)				
3264.78	61.22	44.70	6.70	28.20	-9.80	51.42	74.00	-22.58	PK	Vertical
3264.78	51.45	44.70	6.70	28.20	-9.80	41.65	54.00	-12.35	AV	Vertical
3264.63	61.02	44.70	6.70	28.20	-9.80	51.22	74.00	-22.78	PK	Horizontal
3264.63	50.59	44.70	6.70	28.20	-9.80	40.79	54.00	-13.21	AV	Horizontal
4804.46	59.44	44.20	9.04	31.60	-3.56	55.88	74.00	-18.12	PK	Vertical
4804.46	49.96	44.20	9.04	31.60	-3.56	46.40	54.00	-7.60	AV	Vertical
4804.53	59.32	44.20	9.04	31.60	-3.56	55.76	74.00	-18.24	PK	Horizontal
4804.53	50.30	44.20	9.04	31.60	-3.56	46.74	54.00	-7.26	AV	Horizontal
5359.74	48.50	44.20	9.86	32.00	-2.34	46.16	74.00	-27.84	PK	Vertical
5359.74	40.13	44.20	9.86	32.00	-2.34	37.79	54.00	-16.21	AV	Vertical
5359.85	47.64	44.20	9.86	32.00	-2.34	45.29	74.00	-28.71	PK	Horizontal
5359.85	38.50	44.20	9.86	32.00	-2.34	36.16	54.00	-17.84	AV	Horizontal
7205.77	54.41	43.50	11.40	35.50	3.40	57.81	74.00	-16.19	PK	Vertical
7205.77	44.52	43.50	11.40	35.50	3.40	47.92	54.00	-6.08	AV	Vertical
7205.85	54.90	43.50	11.40	35.50	3.40	58.30	74.00	-15.70	PK	Horizontal
7205.85	43.90	43.50	11.40	35.50	3.40	47.30	54.00	-6.70	AV	Horizontal
	•	•		Middle Cha	nnel (8DPSK/	/2441 MHz)		•	•	
3264.87	61.08	44.70	6.70	28.20	-9.80	51.28	74.00	-22.72	PK	Vertical
3264.87	50.43	44.70	6.70	28.20	-9.80	40.63	54.00	-13.37	AV	Vertical
3264.60	61.98	44.70	6.70	28.20	-9.80	52.18	74.00	-21.82	PK	Horizontal
3264.60	50.75	44.70	6.70	28.20	-9.80	40.95	54.00	-13.05	AV	Horizontal
4882.57	58.72	44.20	9.04	31.60	-3.56	55.16	74.00	-18.84	PK	Vertical
4882.57	50.18	44.20	9.04	31.60	-3.56	46.62	54.00	-7.38	AV	Vertical
4882.61	59.17	44.20	9.04	31.60	-3.56	55.61	74.00	-18.39	PK	Horizontal
4882.61	49.93	44.20	9.04	31.60	-3.56	46.37	54.00	-7.63	AV	Horizontal
5359.85	48.55	44.20	9.86	32.00	-2.34	46.21	74.00	-27.79	PK	Vertical
5359.85	40.05	44.20	9.86	32.00	-2.34	37.71	54.00	-16.29	AV	Vertical
5359.58	48.55	44.20	9.86	32.00	-2.34	46.21	74.00	-27.79	PK	Horizontal
5359.58	38.52	44.20	9.86	32.00	-2.34	36.17	54.00	-17.83	AV	Horizontal
7323.87	53.54	43.50	11.40	35.50	3.40	56.94	74.00	-17.06	PK	Vertical
7323.87	43.77	43.50	11.40	35.50	3.40	47.17	54.00	-6.83	AV	Vertical
7323.95	53.78	43.50	11.40	35.50	3.40	57.18	74.00	-16.82	PK	Horizontal
7323.95	43.64	43.50	11.40	35.50	3.40	47.04	54.00	-6.96	AV	Horizontal



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				High Chan	nel (8DPSK/	/2480 MHz)				
3264.85	61.44	44.70	6.70	28.20	-9.80	51.64	74.00	-22.36	PK	Vertical
3264.85	51.09	44.70	6.70	28.20	-9.80	41.29	54.00	-12.71	AV	Vertical
3264.78	61.09	44.70	6.70	28.20	-9.80	51.29	74.00	-22.71	PK	Horizontal
3264.78	50.10	44.70	6.70	28.20	-9.80	40.30	54.00	-13.70	AV	Horizontal
4960.40	59.09	44.20	9.04	31.60	-3.56	55.53	74.00	-18.47	PK	Vertical
4960.40	50.35	44.20	9.04	31.60	-3.56	46.79	54.00	-7.21	AV	Vertical
4960.53	59.46	44.20	9.04	31.60	-3.56	55.90	74.00	-18.10	PK	Horizontal
4960.53	49.70	44.20	9.04	31.60	-3.56	46.14	54.00	-7.86	AV	Horizontal
5359.60	48.26	44.20	9.86	32.00	-2.34	45.92	74.00	-28.08	PK	Vertical
5359.60	39.82	44.20	9.86	32.00	-2.34	37.48	54.00	-16.52	AV	Vertical
5359.58	48.26	44.20	9.86	32.00	-2.34	45.92	74.00	-28.08	PK	Horizontal
5359.58	39.20	44.20	9.86	32.00	-2.34	36.86	54.00	-17.14	AV	Horizontal
7439.77	53.63	43.50	11.40	35.50	3.40	57.03	74.00	-16.97	PK	Vertical
7439.77	44.97	43.50	11.40	35.50	3.40	48.37	54.00	-5.63	AV	Vertical
7439.78	54.33	43.50	11.40	35.50	3.40	57.73	74.00	-16.27	PK	Horizontal
7439.78	44.23	43.50	11.40	35.50	3.40	47.63	54.00	-6.37	AV	Horizontal

Note:

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

Emission Level = Reading + Factor

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

emission is mainly from the environment noise.

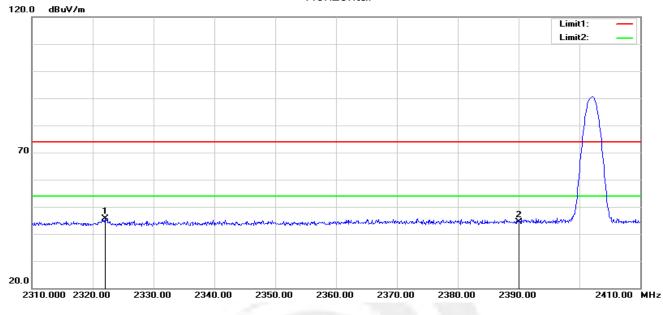


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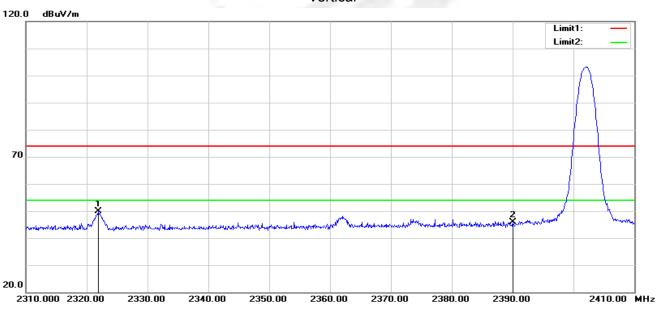


Restricted band Requirements

8DPSK-Low Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2322.000	42.06	3.58	45.64	74.00	-28.36	peak
2	2390.000	40.13	4.34	44.47	74.00	-29.53	peak



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2321.900	46.18	3.58	49.76	74.00	-24.24	peak
2	2390.000	41.46	4.34	45.80	74.00	-28.20	peak

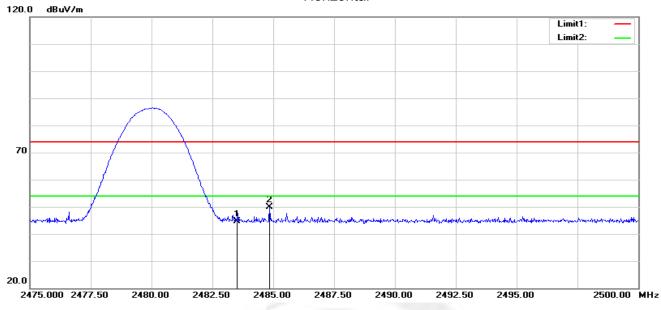
Vertical



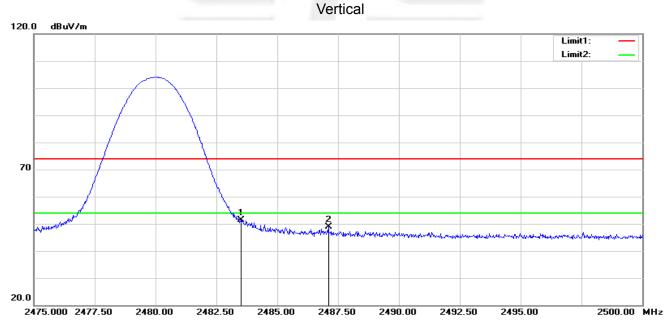
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8DPSK-High Horizontal



No.	Frequency	Reading	ing Correct Result		Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	39.94	4.60	44.54	74.00	-29.46	peak
2	2484.850	45.32	4.61	49.93	74.00	-24.07	peak



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	46.89	4.60	51.49	74.00	-22.51	peak
2	2487.100	44.22	4.62	48.84	74.00	-25.16	peak

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

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4. CONDUCTED SPURIOUS & BAND EDGE EMISSION

4.1 LIMIT

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

4.2 TEST PROCEDURE

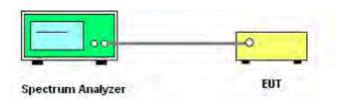
Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	30 MHz to 10th carrier harmonic
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

For Band edge

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

Spectrum Parameter	Setting
Detector	Peak
Start/Stan Fraguenay	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

4.3 TEST SETUP



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

4.4 EUT OPERATION CONDITIONS

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

Shenzhen STS Test Services Co., Ltd.



4.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	50%
Test Mode:	GFSK(1Mbps)-00/39/78 CH	Test Voltage:	DC 12V

Swept SA :50:19 PM Jun 09, 2020 TRACE 1 2 3 4 5 6 TYPE WWWWWW DET P P P P F RL Center Freq 12.515000000 GHz Avg Type: Log-Pwr Trig: Free Run #Atten: 30 dB PNO: Fast 😱 IFGain:Low Mkr1 2.402 GHz 6.100 dBm Ref Offset 0.5 dB Ref 16.06 dBm 10 dB/div \mathcal{A}^{4} $\langle \rangle^3$ $\langle \rangle^2$ Start 30 MHz #Res BW 100 kHz Stop 25.00 GHz Sweep 2.386 s (1001 pts) #VBW 300 kHz MKR MODE TRC SCL 1 N 1 f 2 N 1 f 3 N 1 f 4 N 1 f 5 2.402 GHz 3.201 GHz 6.897 GHz 24.426 GHz 6.100 dBm -55.570 dBm -55.765 dBm -47.866 dBm 2 3 4 5 6 7 8 9 10 STATUS

00 CH

39 CH

RL	rum Ana RF	lyzer - Swept S/ 50 Ω AC			VSE:PULSE	1110	VAUTO		10:50	10 DM 3 m 00, 01
		2.5150000	000 GHz	IO: Fast 🖵	Trig: Free Rui #Atten: 30 dB		Avg Type:	Log-Pwr		TRACE 1 2 3 4 TYPE MWWW DET P P P P
dB/div		Offset 0.5 dB 14.51 dBm								2.452 GI .739 dB
		1								
5										-14.49
		2								
		V	\bigcirc		un manser and	All Ale	the shade	naturaline	announ	al marin
	unklamak	and a manufactures	the stand and the state of the	and a start of the	and the second second	and the second s				
rt 30 I es BW		Hz		#VB	N 300 kHz			Sw	Stoj eep 2.386	o 25.00 G s (1001 p
MODE T			×	Y	FUNCTIO	N FUNCTIO	NWIDTH		FUNCTION VALUE	
	1 f 1 f		2.452 GHz 2.527 GHz	4.739 -50.053	dBm					
	1 f 1 f		7.196 GHz 24.825 GHz	-56.133 -47.913						
				.1.510						
					ш					



78 CH

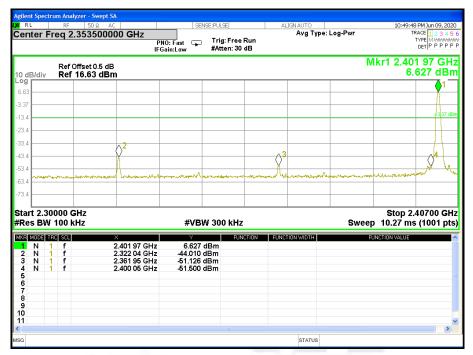
ent Spectrum Analyzer - Sv					
nter Freq 12.515	000000 GHz	SENSE:PULSE		: Log-Pwr	11:11:47 PM Jun 09, 20 TRACE 1 2 3 4 TYPE Ministra
	PN0 IFGa): Fast 😱 Trig: Free in:Low #Atten: 30			DET PPP
Ref Offset 0 dB/div Ref 13.72					Mkr1 2.477 GF 3.718 dB
28					
.3					-16.04 o
.3					
.3					
.3	\bigcirc^3		1 and 1	mare marine and a second	and the way
3 mentersoner themene	marker and remainstration	and all and the south the and the second			
.3					
art 30 MHz					Stop 25.00 Gł
es BW 100 kHz		#VBW 300 kHz	:	Sweep	2.386 s (1001 p
	X	V		FUNC	TION VALUE
R MODE TRC SCL			ICTION FUNCTION WIDTH	TONC	HUN VALUE
N 1 f N 1 f N 1 f N 1 f	2.477 GHz 2.552 GHz 5.848 GHz 24.276 GHz	3.718 dBm -53.384 dBm -55.815 dBm -47.550 dBm	ICTION FUNCTION WIDTH	TONC	HON VALUE
N 1 f N 1 f N 1 f N 1 f	2.477 GHz 2.552 GHz 5.848 GHz	3.718 dBm -53.384 dBm -55.815 dBm	ICTION FUNCTION WIDTH		
N 1 f N 1 f N 1 f N 1 f	2.477 GHz 2.552 GHz 5.848 GHz	3.718 dBm -53.384 dBm -55.815 dBm	CTION FUNCTION WIDTH	TONE	IUN VALUE
N 1 f N 1 f N 1 f	2.477 GHz 2.552 GHz 5.848 GHz	3.718 dBm -53.384 dBm -55.815 dBm -47.550 dBm	FUNCTION WIDTH		
N 1 f N 1 f N 1 f	2.477 GHz 2.552 GHz 5.848 GHz	3.718 dBm -53.384 dBm -55.815 dBm	ICTION FUNCTION WIDTH		NUN V2301-



Shenzhen STS Test Services Co., Ltd.

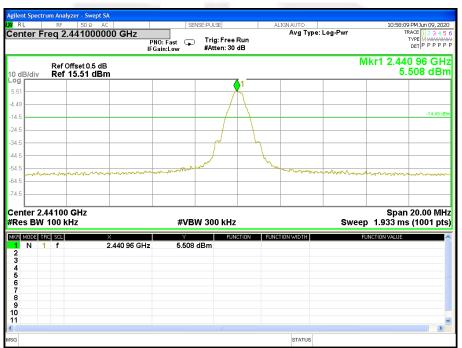


For Band edge(it's also the reference level for conducted spurious emission)



00 CH

39 CH





78 CH

	m Analyzer - Swe							
enter Fre	RF 50 Ω eq 2.48750	00000 GHz		PULSE Trig: Free Run #Atten: 30 dB	ALIGNAUTO Avg Typ	e: Log-Pwr	Т	7 PM Jun 09, 202 RACE 1 2 3 4 5 TYPE MWWWWM DET P P P P F
dB/div	Ref Offset 0.6 Ref 13.96 (M	lkr1 2.479 3.	950 GH 957 dBr
96		1						
04								-16.04 dt
i.0		$/ \land$						
.0		1 4						
i.0			$\wedge^2 \wedge^3$					
6.0	- Marrin		montenar	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	www.www.		mmuhan	Marken
art 2.475 Res BW 1			#VBW :	300 kHz		Swee	Stop 2.	.50000 GH s (1001 pt
art 2.475 Res BW 1	100 kHz	*	Y	FUNCTION	FUNCTION WIDTH			
art 2.475 Res BW 1 R MODE FRO N 1 2 N 1 3 N 1 4 N 1 5	100 kHz	X 2.479 950 GHz 2.483 500 GHz 2.484 500 GHz 2.493 300 GHz	#VBW : 3.957 dB -57.019 dB -55.574 dB -57.364 dB	Function m m m	FUNCTION WIDTH		ep 2.400 ms	
art 2.475 tes BW 1 2 MODE FR N 1 2 N 1 3 N 1 4 N 1 5	100 kHz f f f	2.479 950 GHz 2.483 500 GHz 2.484 500 GHz	3.957 dB -57.019 dB -55.574 dB	Function m m m	FUNCTION WIDTH		ep 2.400 ms	
art 2.475 les BW 1 N 1 N 1 N 1 N 1 N 1	100 kHz f f f	2.479 950 GHz 2.483 500 GHz 2.484 500 GHz	3.957 dB -57.019 dB -55.574 dB	Function m m m	FUNCTION WIDTH		ep 2.400 ms	



Shenzhen STS Test Services Co., Ltd.



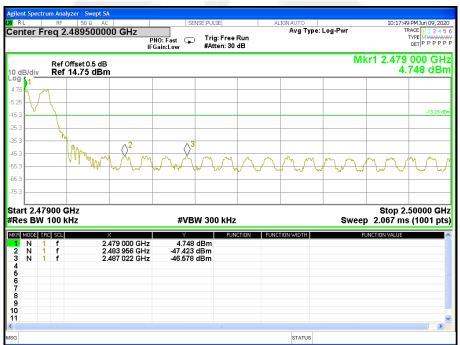


For Hopping Band edge

00 CH

		ctrur	m Ana	lyzer - Swept SA															
LXI R	L		RF	50 Ω AC			SE	NSE:PUL	SE		AL	IGN AUTO					10:15:26		
Cer	iter	Fre	eq 2	.35150000		PNO: Fast Gain:Lov	Ģ	Tris #Ati	g: Free ten: 30	Run dB		Avg 1	Гуре:	Log-Pwr				RACE 1 2 TYPE M& DET P F	2 3 4 5 6
10 d	B/div			Offset 0.5 dB 17.26 dBm	1										M	(r1 2			GHz dBm
Log 7.26																			
-2.74																			
-12.7																		-	12.74 dBm
-22.7	⊢																		\rightarrow
-32.7	\vdash																2		-7 <mark>8</mark>
-42.7	\vdash				0.03.08.04.00	ሳሌሌልላለ	14647	0104	ስለስለ	ስልያትው	14444	50506	1000	14040A	16680	10040	40004	NAAA	n Al
-52.7	m	بمبلين	Jun,	Manman	, WWWWWWWW	HANAAA	AAAA	YYYYY	u a a a a a a a a a a a a a a a a a a a	WYYYV	YYYY	WWW	WW	YVVYYV	ΨVV	HAAAAAA	MARAI	<u>hhan</u> i	Щл — I
-62.7																			
-72.7																			
Stai #Re							#VB	W 30	0 kHz					S	weep				0 GHz 1 pts)
_	MODE			×			Y		FUN	CTION	FUNCT	TION WIDTH	1		Fl	JNCTION	VALUE		^
1 2 3	N N	1	f f	2.3	401 970 GHz 390 022 GHz	-4	5.933												
	Ν	1	f	2.3	399 910 GHz	-4:	2.564	dBm											
5 6																			
4 5 7 8 9																			
9 10																			
11																			>
MSG												STATI	US						

78 CH



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Page 37 of 73 Report No.: STS2003156W04

Temperature:	25 ℃	Relative Humidity:	50%
LOST MICCO.	π/4-DQPSK(2Mbps)– 00/39/78 CH	Test Voltage:	DC 12V

RL	RF			SENSE	PULSE	AL	IGN AUTO		11:43	:08 PM Jun 09, 20
nter	Freq '	12.515000	Р	NO: Fast 😱 Gain:Low	Trig: Free Run #Atten: 30 dB		Avg Type	: Log-Pwr		TYPE MWMM DET P P P
dB/div		Offset 0.5 dE								2.402 GH 4.096 dB
	() 1								
9										-15.49 c
9										
9										
9		<u>2</u>	<u>3</u>							400
9		Mary Manager	An annual aslance	weather and the state	when the way	W. W. Way	un man	and a start and a start and a start a st	menonality	way have the
9	^{يو} ور واله تدريد			and the state						
9										
	MHz N 100	kHz		#VBW	300 kHz			Sw	eep 2.386	p 25.00 GI i s (1001 pi
MODE	TRC SCL		X	Y	FUNCTION	FUNCT	TION WIDTH		FUNCTION VALUE	
N N N	1 f 1 f 1 f 1 f		2.402 GHz 3.026 GHz 5.523 GHz 24.850 GHz	4.096 dB -56.358 dB -56.349 dB -47.342 dB	m m					
										>

00 CH

		50 Q AC	4	SE	NSE:PULSE		ALIGN AUTO		11:4/:4	46 PM Jun 09, 20
enter F	req 1	12.5150000	P	PNO: Fast 😱 Gain:Low	Trig: Free #Atten: 30		Avg Ty	pe: Log-Pwr		TRACE 1 2 3 4 TYPE MWWW DET P P P P
dB/div		Offset 0.5 dB 12.86 dBm								2.452 GH .861 dB
g 36	(1								
4										
										-16.52
1										
1						1			-	
1										
1		² −−−−	<u>∂</u> 3				-		- Margar Margar	monum
1 mm	manuel	and and a strange	- martin and a martin and	Walnut man	Anna water	www.	manger	where any and the second		*
1										
1										
Int 30 M	<u></u>									
es BW		kHz		#VB	W 300 kHz	:		Sw	stoj veep 2.386	o 25.00 G s (1001 p
	RC SCL		×	Y		ICTION	FUNCTION WIDTH		FUNCTION VALUE	
N 1 N 1			2.452 GHz 2.527 GHz	2.861 -54.277						
N 1	f		5.573 GHz	-56.294	dBm					
N 1	f		24.675 GHz	-47.959	dBm					
										>

Shenzhen STS Test Services Co., Ltd.



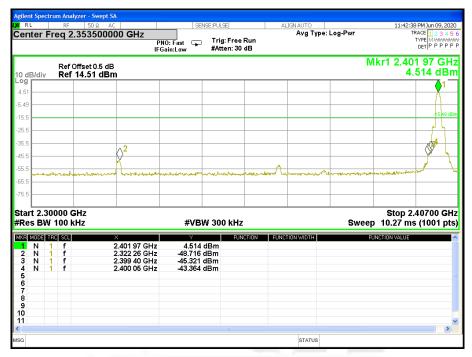
78 CH

	Analyzer - Swe							
	RF 50 Ω q 12.5150	00000 GHz		≊ g:FreeRun ten:30 dB	ALIGNAUTO Avg Type: I	Log-Pwr	т	5 PM Jun 09, 2 RACE 1 2 3 4 TYPE MWWW DET P P P F
	Ref Offset 0.5 Ref_11.24 d						Mkr1 2 1.	.477 G 242 dE
4	1							
8								-18.26
8								
8	2	3				all at the second second	and a strategy and a server	and the
8 www.mb	you have a series of the serie		and the second and the second s	- Marana Mar	were and the server	- are		
8								
es BW 10			#VBW 30	0 kHz		Swe	Stop ep 2.386 s	25.00 G s (1001 p
N 1 N 1	SCL f f f f	× 2.477 GHz 2.552 GHz 5.374 GHz 23.851 GHz	1.242 dBm -54.216 dBm -57.128 dBm -46.871 dBm	FUNCTION	FUNCTION WIDTH	F	UNCTION VALUE	
					STATUS			

Shenzhen STS Test Services Co., Ltd.

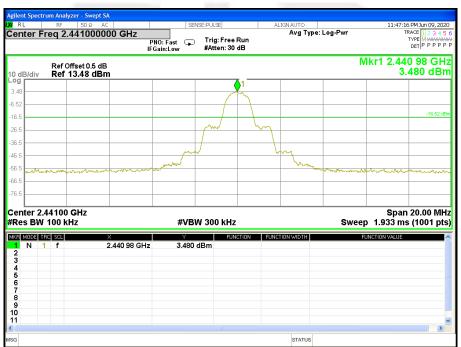


For Band edge(it's also the reference level for conducted spurious emission)



00 CH

39 CH





78 CH

RL	Analyzer - Swept S							
	RF 50 Ω A	DOO GHz	SENSE	E:PULSE	ALIGN AUTO Avg Type: L	_og-Pwr		1 2 3 4 5
			NO: Fast 😱 Gain:Low	Trig: Free Run #Atten: 30 dB			DET	PPPP
	Ref Offset 0.5 dB Ref 11.74 dBi					Mki	r1 2.479 95 1.737	0 GH ′ dBi
74		1						
26		γ						
.3								-18.26 d
1.3	m	- hm						
.3		line						
1.3	~~~	470	$\sqrt{2}^{3}$		\ ⁴			
1.3 - 1 - mar			- and all a second second		and the second	and a grant and a grant and a grant and a grant	an warmen white	anger and
1.3								
art 2.4750	10 CH7		#VBW	300 kHz		Sweep	Stop 2.500 2.400 ms (10	
tes BW 10								
es BW 10	00 kHz	X	Y	FUNCTION	FUNCTION WIDTH	<u> </u>	ICTION VALUE	
Res BW 10 N 1 N 1 N 1 N 1 N 1 N 1 N 1	00 kHz f 2 f 2 f 2	X 2.479 950 GHz 2.483 500 GHz 2.484 025 GHz 2.491 950 GHz	1.737 dE -57.276 dE -56.432 dE -57.126 dE	3m 3m 3m	FUNCTION WIDTH	<u> </u>	· · ·	
Res BW 10 N 1 N 1 N 1 N 1 N 1	00 kHz f 2 f 2 f 2	2.479 950 GHz 2.483 500 GHz 2.484 025 GHz	1.737 dE -57.276 dE -56.432 dE	3m 3m 3m	FUNCTION WIDTH	<u> </u>	· · ·	
Res BW 10 N 1 N 1 N 1 N 1 N 1 N 1 N 1 N 1 N 1 N 1 N 1 N 1	00 kHz f 2 f 2 f 2	2.479 950 GHz 2.483 500 GHz 2.484 025 GHz	1.737 dE -57.276 dE -56.432 dE	3m 3m 3m	FUNCTION WIDTH	<u> </u>	· · ·	
Research Tree N 1 2 N 3 N 4 N 5 - 7 - 3 -	00 kHz f 2 f 2 f 2	2.479 950 GHz 2.483 500 GHz 2.484 025 GHz	1.737 dE -57.276 dE -56.432 dE	3m 3m 3m	FUNCTION WIDTH	<u> </u>	· · ·	
Res BW 10 R M003 TR0 N 1 N 1 N 1 N 1 N 1 N 1 N 1 N 3 N 1 N 3 N 1 N 3	00 kHz f 2 f 2 f 2	2.479 950 GHz 2.483 500 GHz 2.484 025 GHz	1.737 dE -57.276 dE -56.432 dE	3m 3m 3m	FUNCTION WIDTH	<u> </u>	· · ·	8



Shenzhen STS Test Services Co., Ltd.



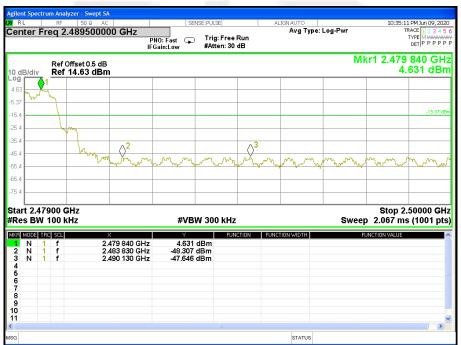


For Hopping Band edge

00 CH

nter Fre	RF 50 Ω AC								
	<u>eq 2.35150000</u>	F	NO: Fast Gain:Low	NSE:PULSE Trig: Free I #Atten: 30	Run	IGNAUTO Avg Type:	Log-Pwr	TR	PM Jun 09, 202 ACE 1 2 3 4 5 FYPE MWAAAAA DET P P P P F
	Ref Offset 0.5 dB Ref 17.27 dBm	1					MI	kr1 2.402 7.:	897 GH 275 dBr
27									
73									-12.72 d
7									-12.72 u
7									
.7		100000	had BANdan	A STRANTON	000800000	4580NB4088	1. Maria Nativa e c	2 พนางงางกัน	
.7 .7 marine	montan	, ya na haka a ha	<i>ትስ ት ነ</i> ። <i>ት ባ</i> ስ ሰ ሰ	ስአክልስስለብላለ	5 00 4 10 10 10 10 10 10 10 10 10 10 10 10 10	161660060	****	<u></u> άλη ο Αλάλου τ	«እለላለለ
.7									
art 2.300							_		40300 GH
es BW 1		×	#VB	W 300 kHz		TION WIDTH		o 9.867 ms	(1001 pt
N 1 N 1 N 1	f 2. f 2.	402 897 GHz 390 022 GHz 399 910 GHz	7.275 -47.032 -41.994	dBm dBm				ONCTION VALUE	
						STATUS			>

78 CH



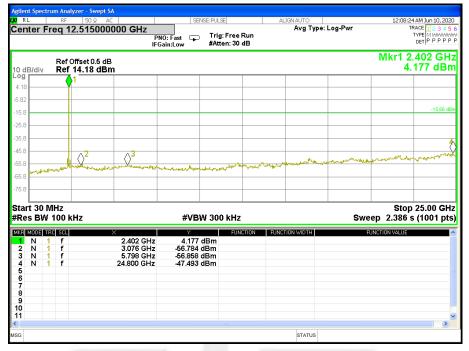
Shenzhen STS Test Services Co., Ltd.



Page 42 of 73 Report No.: STS2003156W04

Temperature:	25 ℃	Relative Humidity:	50%
Test Mode:	8DPSK(3Mbps) -00/39/78 CH	Test Voltage:	DC 12V

00 CH



39 CH

Agiler	it Spe	ctrur	n Ana	lyzer - Swep	t SA							
LXI R			RF	50 Ω	AC	SEI	ISE:PULSE		ALIGNAUTO		12:04:3	4 AM Jun 10, 2020
Cen	ter	Fre	eq 1	2.51500		PNO: Fast 😱 Gain:Low	Trig: Free I #Atten: 30		Avg Typ	e: Log-Pwr		RACE 1 2 3 4 5 6 TYPE M WMMMM DET P P P P P P
10 d Log	B/div			Offset 0.5 12.94 di								.452 GHz .939 dBm
2.94	-			1								
-7.06	⊢											-16.69 dBm
-17.1 -27.1												-10.05 dbii
-37.1												,d
-47.1	<u> </u>		- (2						ي باب	MM	au hur wear
-57.1	, nor	وساميه	ww	and a start where the	www.	and an and a second	-	al marks	man when	adolated and a see		
-67.1												
Star	+ 20		12								Ctor	25.00 GHz
stai #Re				kHz		#VBI	N 300 kHz			Sw	eep 2.386	s (1001 pts)
MKR	MODE	TRC			×	Y		CTION	FUNCTION WIDTH		FUNCTION VALUE	~
1 2 3 4	N N N	1 1 1	f f f		2.452 GHz 2.527 GHz 5.723 GHz 24.600 GHz	2.939 -53.330 -55.912 -47.597	dBm dBm					
5 6 7 8												=
9 10												
11												×
MSG									STATUS			



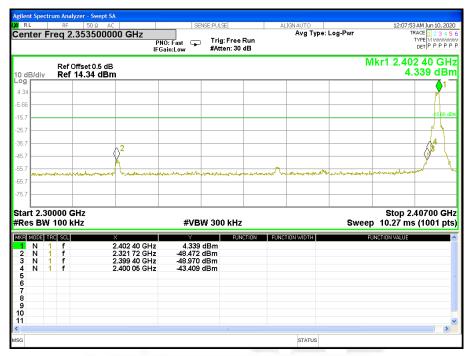
78 CH

Ref Offset 0.5 d Ref 10.13 dE 1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	PNO IFGai IB		g: Free Run ten: 30 dB		ype: Log-Pwr	Mkr1 2 0.	RACE 1 234 TYPE MANANA DET P P P P .477 GH .125 dB
dB/div Ref 10.13 dE	3m		a rubru range			0.	.125 dB
2 2 3 3 9 9 9 9 9 9 9 9 9 9 9 9 9			an allow and a	Served and a server of the ser			-18.40 (
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2 	3		بالسروار المحرور والمراسم	wallion and the	hours and the second	and	
art 30 MHz			mart and the second	mon	how many and the	warmon when	a marcal
9 9 9 art 30 MHz	the to be a service of the service o	have a second the second s	the second second	Photo -			
9art 30 MHz							
		#VBW 30	0 kHz		Sv	Stop veep 2.386 s	o 25.00 G s (1001 p
MODE TRC SCL N 1 f N 1 f N 1 f N 1 f	× 2.477 GHz 2.552 GHz 5.898 GHz 24.276 GHz	0.125 dBm -53.581 dBm -56.684 dBm -47.381 dBm	FUNCTION	FUNCTION WIDTH		FUNCTION VALUE	
				STATU	s)

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

	ectrun		er - Swept S/									
RL enter	Fre	RF q 2.4	50 Ω AC 875000	00 GHz		NSE:PULSE	Run	ALIGN	AUTO Avg Type:	Log-Pwr	12:00:	19 AM Jun 10, 20 TRACE 1 2 3 4 TYPE M MAAAAA
					PNO: Fast 🖵 Gain:Low	#Atten: 30	dB					DETPPP
dB/di			set 0.5 dB I.60 dBn							M	kr1 2.47 1	9 725 GH .601 dB
^g				1								
40			^									
.4												-18.40 d
1.4			~~~	- M								
.4		~	1	m.		2						
1.4	-	m			hand	`						4
1.4						1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1		and The second second	*******		and a series of the series of	
.4												
	476											
		00 GH 00 kH:			#VB	W 300 kH:	z			Swee	ep 2.400 m	2.50000 GH 1s (1001 pt
R MODE	TRC	SCL f		× .479 725 GHz	1.601		NCTION	FUNCTION	WIDTH		FUNCTION VALUE	
N 2 N	1	f f f	2.	.483 500 GHz .485 000 GHz .499 125 GHz	-56.499 -56.406 -57.957	dBm dBm						
3 N			۷.		-07.307	abiii						
3 N 1 N	1											
8 N 1 N 5	1											
8 N 4 N 5	1											
8 N 4 N 5												
8 N 4 N 5 7 8	1								STATUS			



Shenzhen STS Test Services Co., Ltd.



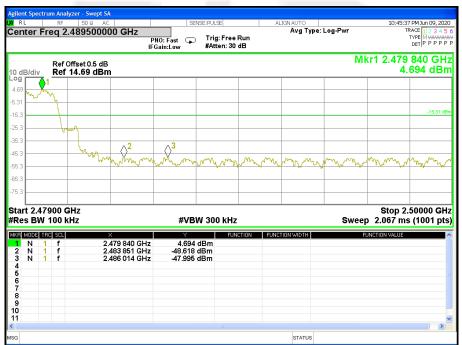


For Hopping Band edge

00 CH

		ectru		ilyzer - Swept SA										
l,XI R			RF	50 Ω AC		5	ENSE:PUL	SE		AL	IGN AUTO			i PM Jun 09, 2020
Cer	nter	Fre	eq 2	2.35150000			. .	-	_		Avg Type	: Log-Pwr		TYPE M WARAAAAA
						PNO: Fast G Gain:Low		g:Free ten:30						DETPPPPPP
						-Gain:Low	****	ten. 50	40					
			Ref	Offset 0.5 dB								M	kr1 2.402	
	B/div	v		17.36 dBm									7.	362 dBm
Log														1/
7.38	i													- N
-2.64														V .
														-12.64 dBm
-12.6														
-22.8							-							<mark>⊬</mark> _
-32.6														3
-42.6														V I
					maturala	MAAAAAA	MAAN	Awr.	MARN	ฟ.ศกเ	www.ww	ANAAAAAAA	mman	Markey
-52.8					10404-11-4		204201	TTY	******	* ())	ARALAILLE	ahoddaaadd	a ta ti ta ta a	411411
-62.8	white	الهرامر	*****	her and the state	N, San									
-72.8														
-r.2.0														
Sta	rt 2.	300	00.0	GHZ								1	Stop 2	40300 GHz
	s B					#\/I	BW 30	0 kH7				Swee	p 9.867 ms	
_			_				571 00						-	(1001 pcs)
MKR				>		Y		FUN	CTION	FUNCT	ION WIDTH		FUNCTION VALUE	<u>^</u>
1	N	1	f f		102 897 GHz 390 022 GHz		2 dBm 6 dBm							
3	Ň	1	f		399 498 GHz		7 dBm							
5														
4 5 6 7 8 9														
8														
9														
10														
<														×
MSG											STATUS			
Dem											514105			

78 CH



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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

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



5.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	60%
Test Mode:	Hopping Mode -GFSK Mode	Test Voltage:	DC 12V

Number of Hopping Channel

79

Hopping channel

enter Freq 2.	441750000 G	Hz	1 921	KE PURIT		Avg Type:	Log-Pwr	T	SPM Jun 09, 202 RACE
		PNO: F IFGain:		Trig: Free #Atten: 30	dB				DET P P P P P
o dB/div Ref	ffset 0.5 dB 17.28 dBm						Mkr	2 2.480 2	43 5 GH 4.76 dBr
								-	¢2
TP THINK	YYYYYYYYYYYY	WINNIN	NY YY Y	YYYYYY	mmm	WWWW	WWW	WWWWW	mm
18		100 C				1.	1.11.11.11.11.11	-	
1.0				_		-		_	1
21						_			1
2.7									
19									
17									
11						-			
			_		-				
tart 2.40000 G Res BW 300 k			#VB	N 300 kHz			Sweep	Stop 2. 1.133 ms	48350 GH s (1001 pt
KR MODE TRC SEL	×		Y.		CTION FUNC	TIONWIDTH	a	INCTION WALUE	_
	2.402 254 2.480 243		7.47	dBm dBm					
3		e one	4.10	abin					
5 6 7									
8 9 0									
0									
α						ETATUS			

Shenzhen STS Test Services Co., Ltd.



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 he 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

EUT	SPECTRUM
	ANALYZER

6.4 EUT OPERATION CONDITIONS

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



6.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	50%
Test Mode:	GFSK(1Mbps)-DH1/DH3/DH5	Test Voltage:	DC 12V

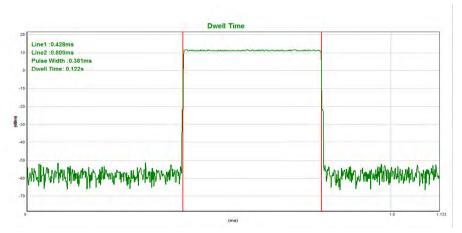
Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
DH1	middle	0.381	0.122	0.4
DH3	middle	1.639	0.262	0.4
DH5	middle	2.887	0.308	0.4



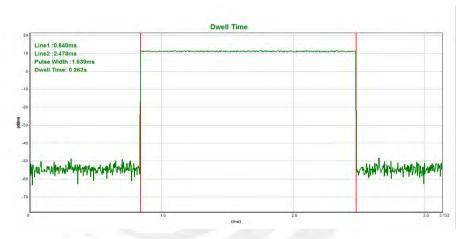
Shenzhen STS Test Services Co., Ltd.



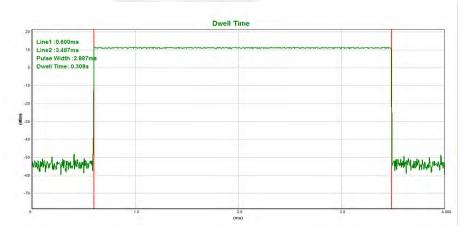
CH39-DH1



CH39-DH3



CH39-DH5



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Temperature:	25 ℃	Relative Humidity:	50%
LOGT MICCO.	π/4-DQPSK(2Mbps)– 2DH1/2DH3/2DH5	Test Voltage:	DC 12V

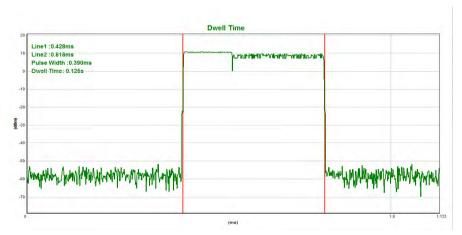
Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
2DH1	middle	0.390	0.125	0.4
2DH3	middle	1.639	0.262	0.4
2DH5	middle	2.888	0.308	0.4



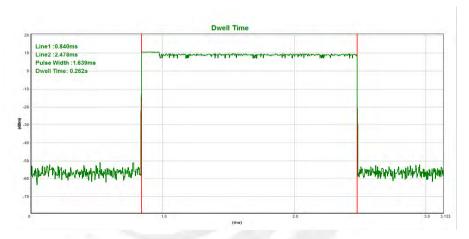
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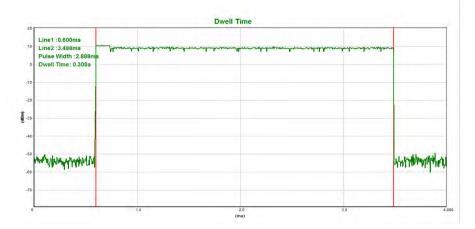
CH39-2DH1



CH39-2DH3



CH39-2DH5



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Temperature:	25 ℃	Relative Humidity:	50%
Test Mode:	8DPSK(3Mbps)– 3DH1/3DH3/3DH5	Test Voltage:	DC 12V

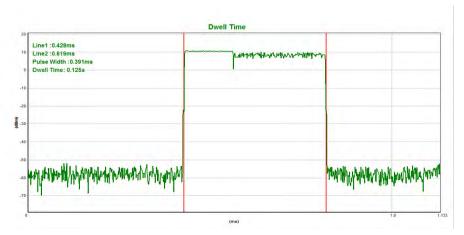
Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
3DH1	middle	0.391	0.125	0.4
3DH3	middle	1.640	0.262	0.4
3DH5	middle	2.892	0.308	0.4



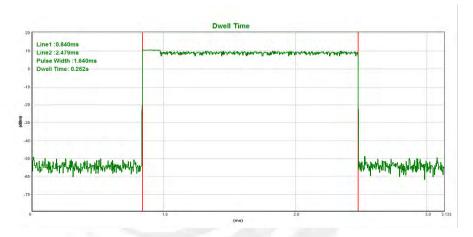
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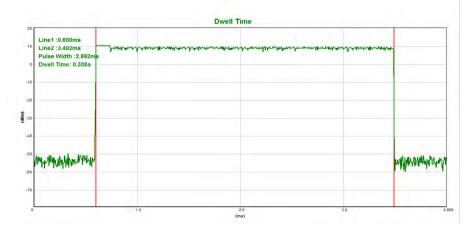
CH39-3DH1



CH39-3DH3



CH39-3DH5



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7. HOPPING CHANNEL SEPARATION MEASUREMEN

7.1 LIMIT

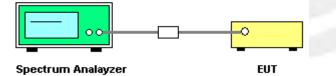
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that 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%
	CH00 / CH39 / CH78 (GFSK(1Mbps) Mode)	Test Voltage:	DC 12V

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2402.047	2403.052	1.005	0.693	Complies
2441 MHz	2441.044	2442.052	1.008	0.693	Complies
2480 MHz	2479.043	2480.043	1.000	0.693	Complies

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

CH00 -1Mbps

RL RF	50 Q AC	SENSE:PULSE	ALIGN AUTO	10:53:59 PM Jun 09, 202
enter Freq 2.402	2500000 GHz	Wide 😱 Trig: Free Rur	Avg Type: Log-Pwr	
Ref Offse dB/div Ref 12.3				Mkr2 2.403 052 GH 2.761 dBr
9 55 44 7.4 7.4 7.4 7.4 7.4 7.4 7.4				
7.4 enter 2.402500 G Res BW 30 kHz	Hz	#VBW 100 kHz	Si	Span 3.000 Mł weep 3.200 ms (1001 pt
KF MODE TRC SCL 1 N 1 f 2 N 1 f 3 - - - 5 - - - 6 - - - 7 - - - 9 - - - 0 - - -	× 2.402 047 GHz 2.403 052 GHz	Y FUNCTIO 2.57 dBm 2.76 dBm	N FUNCTION WIDTH	FUNCTION VALUE
1				

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CH39 -1Mbps



CH78 -1Mbps



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Temperature:	25℃	Relative Humidity:	50%
	CH00 / CH39 / CH78 (π/4-DQPSK(2Mbps) Mode)	Test Voltage:	DC 12V

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2401.762	2402.761	0.999	0.944	Complies
2441 MHz	2440.759	2441.761	1.002	0.944	Complies
2480 MHz	2478.759	2479.758	0.999	0.905	Complies

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

RL	RF 50 Ω /	AC	SENSE	PULSE	ALIGN AUTO)	11:45:0	1 PM Jun 09, 2020
enter Fr	eq 2.4025000	PN	0: Wide 😱 iain:Low	Trig: Free Run #Atten: 30 dB	Avg	Type: Log-Pwr	т	RACE 1 2 3 4 5 TYPE MWWWW DET P P P P P
) dB/div	Ref Offset 0.5 d Ref 8.84 dBn					Μ	1402 1.402 1kr2 -0.	761 GH 951 dBn
16					2			
1.2	$- \wedge$		~~~~				Th_	
.2	\sim							$\gamma \sim$
.2								- Cond - G
.2								
.2								
.2								
.2								
enter 2.4 Res BW 3	02500 GHz		#\/B\A	100 kHz		Swee	Spar sp 3.200 m	3.000 MH
R MODE TRU		X	#*0**	FUNCTION	FUNCTION WIDT		FUNCTION VALUE	s (1001 pt
N 1 N 1	f	2.401 762 GHz 2.402 761 GHz	-1.16 dE -0.95 dE	3m	FUNCTION WIDT		FONCTION VALUE	
3		2.402 701 0112	-0.55 U	2111				
4 5 6								
7								
9								
D 1								
								>

CH00 -2Mbps

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CH39 -2Mbps

F	RF 50 Ω AC		SENSE:PULSE		ALIGN AUTO		11:54:16 PM Jun 09, 2
ter Freq	2.441500000 G	Hz PNO: Wid IFGain:Lo	le 😱 Trig: Fr w #Atten:	ree Run 30 dB	Avg Type: L	og-Pwr	TRACE 1 2 3 4 TYPE MWWW DET P P F
	ef Offset 0.5 dB ef 7.79 dBm					Mkr2	2.441 761 G -2.005 dE
		⊘ 1			2		
		$\sim\sim\sim$	\sim		\sim	m	~
	1						1
					_		
nter 2.441 es BW 30			#VBW 100 k	Hz		Sweep 3	Span 3.000 M .200 ms (1001 p
MODE TRC S	al ×		Y	FUNCTION FL	INCTION WIDTH	FUNCTI	ON VALUE
N 1 1			-2.19 dBm				
N 1 1	2.441 7	61 GHZ	-2.01 dBm				

CH78 -2Mbps



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Temperature:	25℃	Relative Humidity:	50%
Lest Mode.	CH00 / CH39 / CH78 (8DPSK(3Mbps)Mode)	Test Voltage:	DC 12V

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2401.687	2402.689	1.002	0.916	Complies
2441 MHz	2440.687	2441.689	1.002	0.916	Complies
2480 MHz	2478.690	2479.686	0.996	0.917	Complies

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

CH00 -3Mbps

Intor	RF	50 Ω AC		SEN	E:PULSE	AL	IGNAUTO			AM Jun 10, 202
mer	[•] Freq 2	2.4025000	Р	NO: Wide 😱 Gain:Low	Trig: Free Rur #Atten: 30 dB	1	Avg Type:	Log-Pwr		RACE 1 2 3 4 5 TYPE MWWWW DET P P P P
dB/di		Offset 0.5 dB 10.65 dBn						М	kr2 2.402 0.	689 GH 776 dBi
50			2h	\sim		2	\sim	\sim		
35									"h	ζ
9.4 <mark>~</mark>	\sim									~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
.4										
1.4 <u> </u>										
9.4										
	2.4025 W 30 k			#VBV	/ 100 kHz			Swee	Span p 3.200 ms	3.000 Mi ; (1001 pt
les B				V V	FUNCTIO	N FUNCT	TION WIDTH	F	UNCTION VALUE	
R MODE N	e TRC SCL 1 f 1 f	2	× .401 687 GHz .402 689 GHz	0.69 c 0.78 c						
R MODE N N N S	1 f	2	.401 687 GHz							
R MODE N N N S S S S	1 f	2	.401 687 GHz							
R MODE	1 f	2	.401 687 GHz							

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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	(20dB bandwidth)	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

EUT	SPECTRUM
	ANALYZER

8.4 EUT OPERATION CONDITIONS

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



8.5 TEST RESULTS

Temperature:	25℃	Relative Humidity:	50%
	GFSK(1Mbps) CH00 / CH39 / C78	Test Voltage:	DC 12V

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	1.040	PASS
2441 MHz	1.039	PASS
2480 MHz	1.040	PASS

CH00 -1Mbps

ilent Spectrum Analyzer - Occupi				
RL RF 50 Ω A enter Freq 2.4020000		ENSE:PULSE Center Freq: 2.402000	ALIGNAUTO DOO GHz	10:49:09 PM Jun 09, 2020 Radio Std: None
	#IFGain:Low	─ Trig: Free Run #Atten: 30 dB	Avg Hold≫10/10	Radio Device: BTS
dB/div Ref 20.00 c	IBm			
og 0.0				
.00				
1.0			\sim	
.0				
				_ m
0				
0				
enter 2.402 GHz Res BW 30 kHz		#VBW 100 k	Hz	Span 2 MH Sweep 2.733 m
Occupied Bandw	idth	Total Power	11.6 dBm	
	926.09 kHz			
Transmit Freq Error	6.416 kHz	OBW Power	99.00 %	
x dB Bandwidth	1.040 MHz	x dB	-20.00 dB	
			STATUS	

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CH39 -1Mbps



CH78 -1Mbps



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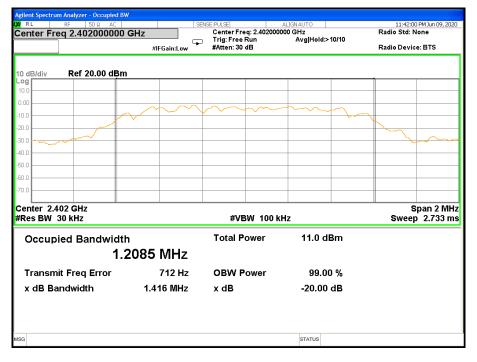


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Temperature:	25°C	Relative Humidity:	50%
	π/4-DQPSK(2Mbps) CH00 / CH39 / C78	Test Voltage:	DC 12V

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	1.416	PASS
2441 MHz	1.416	PASS
2480 MHz	1.358	PASS

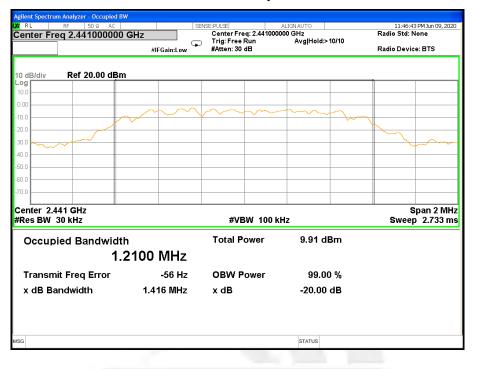
CH00 -2Mbps



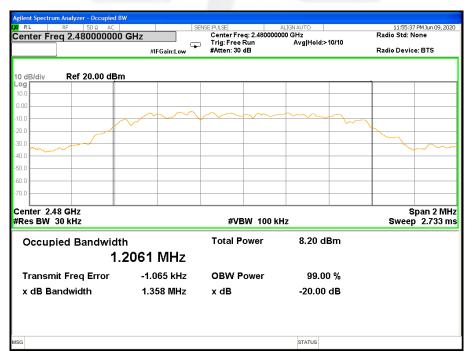
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CH39 -2Mbps



CH78 -2Mbps



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Temperature:	25°C	Relative Humidity:	50%
	8DPSK(3Mbps) CH00 / CH39 / CH78	Test Voltage:	DC 12V

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	1.374	PASS
2441 MHz	1.374	PASS
2480 MHz	1.375	PASS

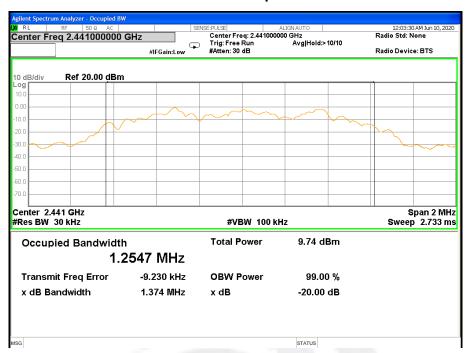
CH00 -3Mbps

Agilent Spectrum Analyzer - Occupied XI RL RF 50 Ω AC				
X RL RF 50 Ω AC Center Freq 2.40200000		Center Freq: 2.402000		12:07:15 AM Jun 10, 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 dB	m	1		
10.0				
0.00				
10.0				~
20.0	<u> </u>			
80.0				
50.0				
50.0				
70.0				
Center 2.402 GHz #Res BW 30 kHz		#VBW 100 k	Hz	Span 2 MHz Sweep 2.733 ms
Occupied Bandwid	th	Total Power	10.7 dBm	
1	.2518 MHz			
Transmit Freq Error	-9.245 kHz	OBW Power	99.00 %	
x dB Bandwidth	1.374 MHz	x dB	-20.00 dB	
SG			STATUS	

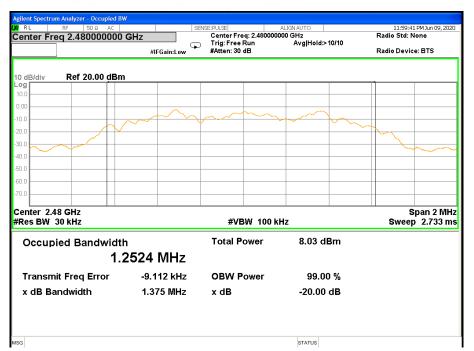
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CH39 -3Mbps



CH78 -3Mbps





9. OUTPUT POWER TEST

9.1 LIMIT

FCC Part 15.247,Subpart C				
Section	Test Item	Limit	FrequencyRange (MHz)	Result
15.247	Output	1 W or 0.125W		
(a)(1)&(b)(1)	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 \square RBW.

4) Sweep: Auto.

5) Detector function: Peak.

6) Trace: Max hold.

b) Allow trace to stabilize.

c) Use the marker-to-peak function to set the marker to the peak of the emission.

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

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

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

PKPM1 Peak power meter method:

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

9.3 TEST SETUP

EUT	Power sensor	PC

9.4 EUT OPERATION CONDITIONS

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



9.5 TEST RESULTS

Temperature:	25°C	Relative Humidity:	60%
Test Voltage:	DC 12V		

Mode	Channel Frequency Number (MHz)	Frequency	Peak Power	Average Power	Limit
		(MHz)	(dBm)	(dBm)	(dBm)
GFSK(1M)	0	2402	7.52	6.97	20.97
	39	2441	5.98	5.64	20.97
	78	2480	4.83	4.30	20.97

Note: the channel separation >20dB bandwidth

Mode	Channel Frequency Number (MHz)		Peak Power	Average Power	Limit
		(dBm)	(dBm)	(dBm)	
π/4-DQPSK(2M)	0	2402	8.01	6.31	20.97
	39	2441	6.63	4.98	20.97
	78	2480	5.22	3.35	20.97

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

Mode	Channel Frequency Number (MHz)	Frequency	Peak Power	Average Power	Limit
		(MHz)	(dBm)	(dBm)	(dBm)
8-DPSK(3M)	0	2402	8.15	6.40	20.97
	39	2441	6.72	5.01	20.97
	78	2480	5.29	3.36	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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