

RADIO TEST REPORT

S T S

A

Report No.: STS2002171W21

Issued for

Winmate Inc.

9F, No.111-6, Shing-De Rd., San-Chung Dist., New Taipei City, 24158, Taiwan, R.O.C

Product Name:	Rugged Tablet PC
Brand Name:	Winmate
Model Name:	M133WK
Series Model:	M133WK-DW, M133XXXXXXXXXXX (Where X can be A-Z,a-z ,0-9, "-", Blank or Slash)
FCC ID:	PX9M133WK001
Test Standard:	FCC Part 15.247 RSS-247 Issue 2, February 2017

Any reproduction of this document must be done in full. No single part of this document may be reproduced wi permission from STS, All Test Data Presented in this report is only applicable to presented Test Sample VAL

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





Page 2 of 77 Report No

Report No.: STS2002171W21

TEST RESULT CERTIFICATION

Applicant's Name	Winmate Inc.
Address	9F, No.111-6, Shing-De Rd., San-Chung Dist., New Taipei City, 24158, Taiwan, R.O.C
Manufacture's Name:	Winmate Inc.
Address	9F, No.111-6, Shing-De Rd., San-Chung Dist., New Taipei City, 24158, Taiwan, R.O.C
Product Description	
Product Name:	Rugged Tablet PC
Brand Name	Winmate
Model Name:	M133WK
Series Model	M133WK-DW, M133XXXXXXXXXXX (Where X can be A-Z,a-z ,0-9, "-", Blank or Slash)
Test Standards	FCC Part15.247 RSS-247 Issue 2, February 2017 RSS-Gen Issue 5 ,March 2019
Test Procedure	ANSI C63.10-2013

This device described above has been tested by STS, the test results show that the equipment under test (EUT) is in compliance with the FCC/IC requirements. And it is applicable only to the tested sample identified in the report.

This report shall not be reproduced except in full, without the written approval of STS, this document may be altered or revised by STS, personal only, and shall be noted in the revision of the document.

Date of Test.....:

Date of receipt of test item: 24	Feb. 2020
----------------------------------	-----------

Date (s) of performance of tests : 24 Feb. 2020 ~ 28 Apr. 2020

:

Date of Issue: 29 Apr. 2020

Test Result Pass

Testing Engineer

Technical Manager

(Chris Chen)

(Sean she)

Authorized Signatory :

(Vita Li)

Shenzhen STS Test Services Co., Ltd.

Page 3 of 77 Report No.: STS2002171W21



Table of Contents	Page
1. SUMMARY OF TEST RESULTS	6
1.1 TEST FACTORY	7
1.2 MEASUREMENT UNCERTAINTY	7
2. GENERAL INFORMATION	8
2.1 GENERAL DESCRIPTION OF THE EUT	8
2.2 DESCRIPTION OF THE TEST MODES	10
2.3 FREQUENCY HOPPING SYSTEM REQUIREMENTS	10
2.4 TABLE OF PARAMETERS OF TEST SOFTWARE SETTING	12
2.5 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED	12
2.6 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS	13
2.7 EQUIPMENTS LIST	14
3. EMC EMISSION TEST	15
3.1 CONDUCTED EMISSION MEASUREMENT	15
3.2 RADIATED EMISSION MEASUREMENT	19
4. CONDUCTED SPURIOUS & BAND EDGE EMISSION	32
4.1 LIMIT	32
4.2 TEST PROCEDURE	32
4.3 TEST SETUP	32
4.4 EUT OPERATION CONDITIONS	32
4.5 TEST RESULTS	33
5. NUMBER OF HOPPING CHANNEL	48
5.1 LIMIT	48
5.2 TEST PROCEDURE	48
5.3 TEST SETUP	48
5.4 EUT OPERATION CONDITIONS	48
5.5 TEST RESULTS	49
6. AVERAGE TIME OF OCCUPANCY	50
6.1 LIMIT	50
6.2 TEST PROCEDURE	50
6.3 TEST SETUP	50
6.4 EUT OPERATION CONDITIONS	50
6.5 TEST RESULTS	51
7. HOPPING CHANNEL SEPARATION MEASUREMEN	57

Report No.: STS2002171W21



Table of Contents	Page
7.1 LIMIT	57
7.2 TEST PROCEDURE	57
7.3 TEST SETUP	57
7.4 EUT OPERATION CONDITIONS	57
7.5 TEST RESULTS	58
8. BANDWIDTH TEST	64
8.1 LIMIT	64
8.2 TEST PROCEDURE	64
8.3 TEST SETUP	64
8.4 EUT OPERATION CONDITIONS	64
8.5 TEST RESULTS	65
9. OUTPUT POWER TEST	71
9.1 LIMIT	71
9.2 TEST PROCEDURE	71
9.3 TEST SETUP	72
9.4 EUT OPERATION CONDITIONS	72
9.5 TEST RESULTS	73
10. ANTENNA REQUIREMENT	75
10.1 STANDARD REQUIREMENT	75
10.2 EUT ANTENNA	75
11. FREQUENCY STABILITY	76
11.1 LIMITS OF FREQUENCY STABILITY MEASUREMENT	76
11.2 TEST PROCEDURE	76
11.3 TEST RESULT	76

Page 4 of 77



Page 5 of 77 Report No.: STS2002171W21

Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	29 Apr. 2020	STS2002171W21	ALL	Initial Issue



Shenzhen STS Test Services Co., Ltd.

Π



1. SUMMARY OF TEST RESULTS

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

FCC Part 15.247,Subpart C RSS-247 Issue 2				
Standard Section	Test Item	Judgment	Remark	
15.207 RSS-Gen (8.8)	Conducted Emission	PASS		
15.247(a)(1) RSS-247 (5.1)	Hopping Channel Separation	PASS		
15.247(a)(1)&(b)(1) RSS-247 (5.1)	Output Power	PASS		
15.209 RSS-247 (5.5)	Radiated Spurious Emission	PASS		
15.247(d) RSS-247 (5.5)	Conducted Spurious & Band Edge Emission	PASS		
15.247(a)(iii) RSS-247 (5.1)	Number of Hopping Frequency	PASS		
15.247(a)(iii) RSS-247 (5.1)	Dwell Time	PASS		
15.247(a)(1) RSS-247 (5.1) RSS-Gen (6.7)	20dB Bandwidth 99% bandwidth	PASS		
15.205 RSS-Gen (8.9&8.10)	Restricted bands of operation	PASS		
Part 15.247(d)/part 15.209(a) RSS-247 (5.5)	Band Edge Emission	PASS		
15.203 RSS-Gen (6.8)	Antenna Requirement	PASS		
RSS-Gen (6.11&8.11)	Frequency Stability	PASS		

NOTE:

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

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



1.1 TEST FACTORY

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

1.2 MEASUREMENT UNCERTAINTY

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

No.	Item	Uncertainty
1	RF output power, conducted	±0.68dB
2	Unwanted Emissions, conducted	±2.988dB
3	All emissions, radiated 30-1GHz	±6.7dB
4	All emissions, radiated 1G-6GHz	±5.5dB
5	All emissions, radiated>6G	±5.8dB
6	Conducted Emission (9KHz-150KHz)	±4.43dB
7	Conducted Emission (150KHz-30MHz)	±5dB



2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	Rugged Tablet PC
Trade Name	Winmate
Model Name	M133WK
Series Model	M133WK-DW, M133XXXXXXXXXXX (Where X can be A-Z,a-z ,0-9, "-", Blank or Slash)
Model Difference	Only for marketing purpose
Channel List	Please refer to the Note 2.
Bluetooth	Frequency:2402 – 2480 MHz Modulation: GFSK(1Mbps), π/4-DQPSK(2Mbps), 8DPSK(3Mbps)
Bluetooth Version	5.0
BR+EDR	BR+EDR
Please see Note 3.	Please refer to the Note 3.
Adapter	Input: AC 100-240V, 1.7A, 50-60Hz Output: DC 19V, 3.42A
Battery	Rated Voltage: 15.4V Charge Limit: 17.6V Capacity: 5900mAh
Hardware version number	M133DA-100
Software version number	20.90.0
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.

Shenzhen STS Test Services Co., Ltd.





2.

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

3. Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	Winmate	M133WK	PIFA	N/A	1.46 dBi	BT Antenna



2.2 DESCRIPTION OF THE TEST MODES

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

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



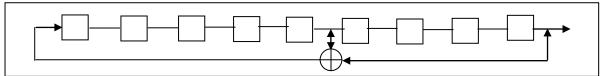
Page 11 of 77 Report No.: STS2002171W21

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

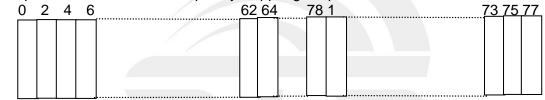
(2)The Pseudorandom sequence may be generated in a nin-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones: i.e. the shift register is initialized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

Numver of shift register stages:9

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



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



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

(3)Frequency Hopping System

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

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

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

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



Page 12 of 77 Report No.: STS2002171W21

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.

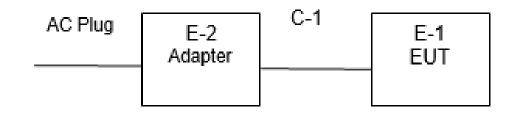
Test software Version	Test program: Bluetooth				
(Power control software) Parameters(1/2/3Mbps)	Power class: Power class: Power class:				

RF Function	Туре	Mode Or Modulation type	Ant Gain(dBi)	Power Class	Software For Testing
		GFSK	1.46	8	
BT	BR+EDR	π/4-DQPSK	1.46	5	DRTU
		8DPSK	1.46	5	

2.5 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Radiated Spurious Emission Test

Conducted Emission Test



Shenzhen STS Test Services Co., Ltd.



2.6 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

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

Item	Equipment	Mfr/Brand Model/Type No.		Serial No.	Note
E-2	Adapter	Chicony	A18-065N3A	N/A	N/A
C-1	DC Cable	N/A	110cm	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 ^[] Length ^[] 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 /LzRf-3A3					

П



3. EMC EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

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

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

Note:

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

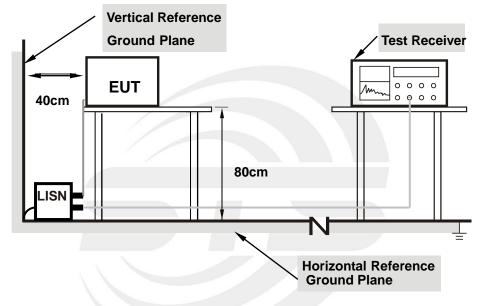
The following table is the setting of the receiver

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



3.1.2 TEST PROCEDURE

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



3.1.3 TEST SETUP

Note: 1.Support units were connected to second LISN. 2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 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:	23.5(C)	Relative Humidity:	62%RH
Test Voltage:	AC 120V/60Hz	Phase:	L
Test Mode:	Mode 13		

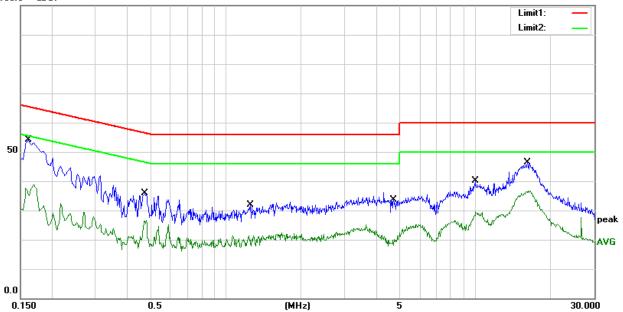
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.1620	34.46	19.79	54.25	65.36	-11.11	QP
2	0.1620	17.95	19.79	37.74	55.36	-17.62	AVG
3	0.4740	15.95	20.03	35.98	56.44	-20.46	QP
4	0.4740	6.53	20.03	26.56	46.44	-19.88	AVG
5	1.2580	12.21	19.79	32.00	56.00	-24.00	QP
6	1.2580	1.60	19.79	21.39	46.00	-24.61	AVG
7	4.7100	13.87	19.85	33.72	56.00	-22.28	QP
8	4.7100	1.60	19.85	21.45	46.00	-24.55	AVG
9	9.9860	19.83	20.21	40.04	60.00	-19.96	QP
10	9.9860	9.33	20.21	29.54	50.00	-20.46	AVG
11	16.1940	26.16	20.29	46.45	60.00	-13.55	QP
12	16.1940	16.34	20.29	36.63	50.00	-13.37	AVG

Remark:

1. All readings are Quasi-Peak and Average values.

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







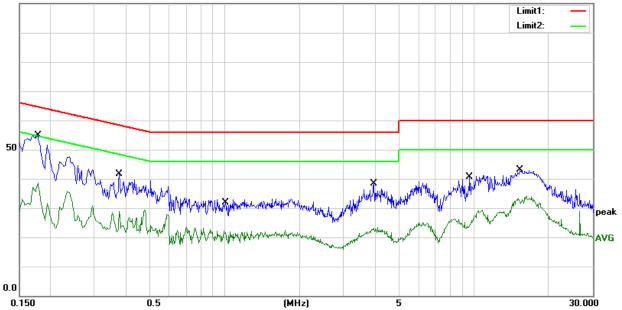
Page 18 of 77 Report No.: STS2002171W21

Temperature:	23.5(C)	Relative Humidity:	62%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	0.1780	35.04	19.78	54.82	64.58	-9.76	QP
2	0.1780	18.94	19.78	38.72	54.58	-15.86	AVG
3	0.3780	21.58	20.08	41.66	58.32	-16.66	QP
4	0.3780	8.78	20.08	28.86	48.32	-19.46	AVG
5	1.0100	12.04	19.80	31.84	56.00	-24.16	QP
6	1.0100	2.40	19.80	22.20	46.00	-23.80	AVG
7	3.9700	18.47	19.83	38.30	56.00	-17.70	QP
8	3.9700	2.82	19.83	22.65	46.00	-23.35	AVG
9	9.6060	20.41	20.17	40.58	60.00	-19.42	QP
10	9.6060	5.96	20.17	26.13	50.00	-23.87	AVG
11	15.3580	22.85	20.25	43.10	60.00	-16.90	QP
12	15.3580	13.11	20.25	33.36	50.00	-16.64	AVG

Remark:

All readings are Quasi-Peak and Average values.
Margin = Result (Result =Reading + Factor)–Limit 100.0 dBuV



Shenzhen STS Test Services Co., Ltd.

Page 19 of 77 Report No.: STS2002171W21



3.2 RADIATED EMISSION MEASUREMENT

3.2.1 RADIATED EMISSION LIMITS

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the Restricted band specified on Part15.205 (a)&209(a)& RSS-Gen Issue 5, Amendment 1, March 2019 and RSS-247 Issue 2, February 2017 (5.5) limit in the table and according to ANSI C63.10-2013 below has to be followed.

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

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

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

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

Notes:

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

(2) The tighter limit applies at the band edges.

(3) Emission level (dBuV/m)=20log Emission level (uV/m).

LIMITS OF RESTRICTED FREQUENCY BANDS

FCC:

•••			
FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (GHz)
0.090-0.110	0.090-0.110 16.42-16.423		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			

Shenzhen STS Test Services Co., Ltd.



Page 20 of 77 Report No.: STS2002171W21

IC:

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



Page 21 of 77 Report No.: STS2002171W21

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 / 200 KHz		
band)	120 KHz / 300 KHz		

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

For Restricted band

Spectrum Parameter	Setting		
Detector	Peak/AV		
Stort/Stop Fraguenov	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)		

Shenzhen STS Test Services Co., Ltd.

Π



Page 22 of 77 Report No.: STS2002171W21

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

3.2.2 TEST PROCEDURE

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

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

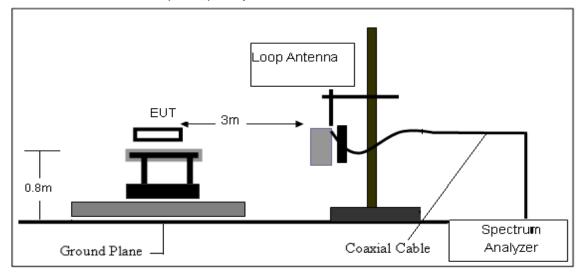
3.2.3 DEVIATION FROM TEST STANDARD

No deviation.

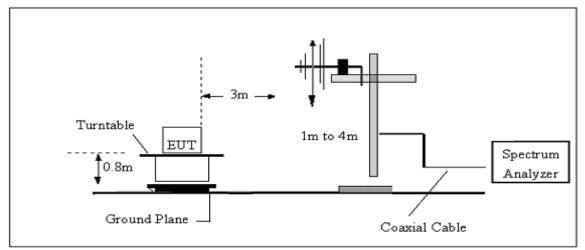


3.2.4 TESTSETUP

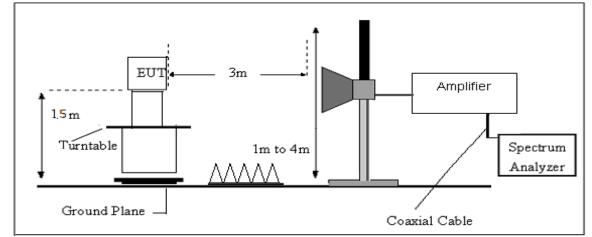
(A) Radiated Emission Test-Up Frequency Below 30MHz



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



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



3.2.5 EUT OPERATING CONDITIONS

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

Shenzhen STS Test Services Co., Ltd.



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



Shenzhen STS Test Services Co., Ltd.



3.2.7 TEST RESULTS

(9KHz-30MHz)

Temperature:	22.9(C)	Relative Humidity:	52%RH
Test Voltage:	DC 15.4V	Test Mode:	TX Mode

Freq.	Reading	Limit	Margin	State	Test Result
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F	iesi kesuli
					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.





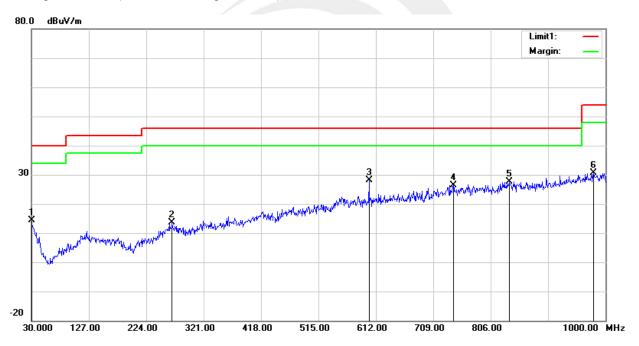
(30MHz-1000MHz)

Temperature:	22.9(C)	Relative Humidity:	52%RH				
Test Voltage:	DC 15.4V	Phase:	Horizontal				
Test Mode:	Mode 1/2/3/4/5/6/7/8/9(Mode 3 worst mode)						

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	30.0000	27.33	-12.85	14.48	40.00	-25.52	QP
2	267.6500	28.57	-15.06	13.51	46.00	-32.49	QP
3	600.3600	33.86	-5.84	28.02	46.00	-17.98	QP
4	742.9500	28.56	-2.13	26.43	46.00	-19.57	QP
5	837.0400	28.19	-0.46	27.73	46.00	-18.27	QP
6	979.6300	28.08	2.65	30.73	54.00	-23.27	QP

Remark:

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



Shenzhen STS Test Services Co., Ltd.

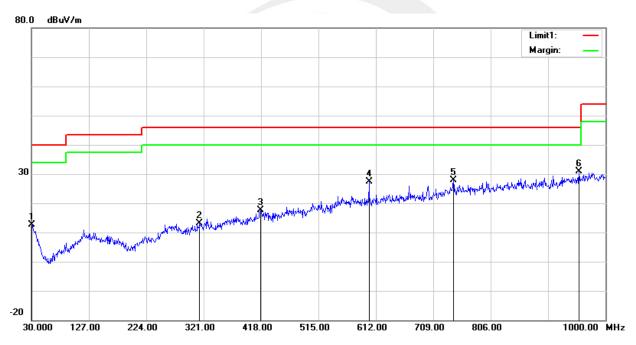


Temperature:	22.9(C)	Relative Humidity:	52%RH			
Test Voltage:	DC 15.4V	Phase:	Vertical			
Test Mode:	Mode 1/2/3/4/5/6/7/8/9(Mode 3 worst mode)					

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	30.0000	25.40	-12.85	12.55	40.00	-27.45	QP
2	314.2100	27.33	-14.26	13.07	46.00	-32.93	QP
3	417.0300	27.81	-10.24	17.57	46.00	-28.43	QP
4	600.3600	33.13	-5.84	27.29	46.00	-18.71	QP
5	742.9500	30.00	-2.13	27.87	46.00	-18.13	QP
6	955.3800	29.30	1.68	30.98	46.00	-15.02	QP

Remark:

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



Page 28 of 77 Report No.: STS2002171W21



(1GHz~25GHz) Spurious emission Requirements

Frequency	Meter Reading	Amplifier	Loss	Antenna Factor	Orrected Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBµV)	(dB)	(dB)	(dB/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре	
				Low Char	nnel (GFSK/24	402 MHz)				
3264.89	61.27	44.70	6.70	28.20	-9.80	51.47	74.00	-22.53	PK	Vertical
3264.89	50.18	44.70	6.70	28.20	-9.80	40.38	54.00	-13.62	AV	Vertical
3264.86	61.05	44.70	6.70	28.20	-9.80	51.25	74.00	-22.75	PK	Horizontal
3264.86	50.76	44.70	6.70	28.20	-9.80	40.96	54.00	-13.04	AV	Horizontal
4804.42	58.72	44.20	9.04	31.60	-3.56	55.16	74.00	-18.84	PK	Vertical
4804.42	49.16	44.20	9.04	31.60	-3.56	45.60	54.00	-8.40	AV	Vertical
4804.36	59.09	44.20	9.04	31.60	-3.56	55.53	74.00	-18.47	PK	Horizontal
4804.36	49.30	44.20	9.04	31.60	-3.56	45.74	54.00	-8.26	AV	Horizontal
5359.80	48.00	44.20	9.86	32.00	-2.34	45.66	74.00	-28.34	PK	Vertical
5359.80	39.59	44.20	9.86	32.00	-2.34	37.25	54.00	-16.75	AV	Vertical
5359.76	47.48	44.20	9.86	32.00	-2.34	45.13	74.00	-28.87	PK	Horizontal
5359.76	38.67	44.20	9.86	32.00	-2.34	36.32	54.00	-17.68	AV	Horizontal
7205.79	54.25	43.50	11.40	35.50	3.40	57.65	74.00	-16.35	PK	Vertical
7205.79	44.17	43.50	11.40	35.50	3.40	47.57	54.00	-6.43	AV	Vertical
7205.88	53.89	43.50	11.40	35.50	3.40	57.29	74.00	-16.71	PK	Horizontal
7205.88	44.45	43.50	11.40	35.50	3.40	47.85	54.00	-6.15	AV	Horizontal
			1	Middle Cha	annel (GFSK/	2441 MHz)				
3264.61	61.28	44.70	6.70	28.20	-9.80	51.48	74.00	-22.52	PK	Vertical
3264.61	50.51	44.70	6.70	28.20	-9.80	40.71	54.00	-13.29	AV	Vertical
3264.62	61.19	44.70	6.70	28.20	-9.80	51.39	74.00	-22.61	PK	Horizontal
3264.62	50.77	44.70	6.70	28.20	-9.80	40.97	54.00	-13.03	AV	Horizontal
4882.41	58.52	44.20	9.04	31.60	-3.56	54.96	74.00	-19.04	PK	Vertical
4882.41	49.97	44.20	9.04	31.60	-3.56	46.41	54.00	-7.59	AV	Vertical
4882.32	58.59	44.20	9.04	31.60	-3.56	55.03	74.00	-18.97	PK	Horizontal
4882.32	49.99	44.20	9.04	31.60	-3.56	46.43	54.00	-7.57	AV	Horizontal
5359.68	48.74	44.20	9.86	32.00	-2.34	46.40	74.00	-27.60	PK	Vertical
5359.68	39.87	44.20	9.86	32.00	-2.34	37.53	54.00	-16.47	AV	Vertical
5359.58	47.37	44.20	9.86	32.00	-2.34	45.03	74.00	-28.97	PK	Horizontal
5359.58	39.29	44.20	9.86	32.00	-2.34	36.95	54.00	-17.05	AV	Horizontal
7323.86	54.46	43.50	11.40	35.50	3.40	57.86	74.00	-16.14	PK	Vertical
7323.86	43.96	43.50	11.40	35.50	3.40	47.36	54.00	-6.64	AV	Vertical
7323.75	53.96	43.50	11.40	35.50	3.40	57.36	74.00	-16.64	PK	Horizontal
7323.75	44.88	43.50	11.40	35.50	3.40	48.28	54.00	-5.72	AV	Horizontal



Page 29 of 77 Report No.: STS2002171W21

				High Char	nnel (GFSK/	2480 MHz)				
3264.62	61.46	44.70	6.70	28.20	-9.80	51.66	74.00	-22.34	PK	Vertical
3264.62	50.47	44.70	6.70	28.20	-9.80	40.67	54.00	-13.33	AV	Vertical
3264.59	61.38	44.70	6.70	28.20	-9.80	51.58	74.00	-22.42	PK	Horizontal
3264.59	49.87	44.70	6.70	28.20	-9.80	40.07	54.00	-13.93	AV	Horizontal
4960.50	59.33	44.20	9.04	31.60	-3.56	55.77	74.00	-18.23	PK	Vertical
4960.50	50.54	44.20	9.04	31.60	-3.56	46.98	54.00	-7.02	AV	Vertical
4960.48	59.27	44.20	9.04	31.60	-3.56	55.71	74.00	-18.29	PK	Horizontal
4960.48	50.59	44.20	9.04	31.60	-3.56	47.03	54.00	-6.97	AV	Horizontal
5359.64	48.90	44.20	9.86	32.00	-2.34	46.55	74.00	-27.45	PK	Vertical
5359.64	39.37	44.20	9.86	32.00	-2.34	37.03	54.00	-16.97	AV	Vertical
5359.83	48.34	44.20	9.86	32.00	-2.34	46.00	74.00	-28.00	PK	Horizontal
5359.83	38.47	44.20	9.86	32.00	-2.34	36.13	54.00	-17.87	AV	Horizontal
7439.76	54.08	43.50	11.40	35.50	3.40	57.48	74.00	-16.52	PK	Vertical
7439.76	44.28	43.50	11.40	35.50	3.40	47.68	54.00	-6.32	AV	Vertical
7439.86	53.56	43.50	11.40	35.50	3.40	56.96	74.00	-17.04	PK	Horizontal
7439.86	44.16	43.50	11.40	35.50	3.40	47.56	54.00	-6.44	AV	Horizontal

Note:

- 1) Scan with GFSK, π /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.

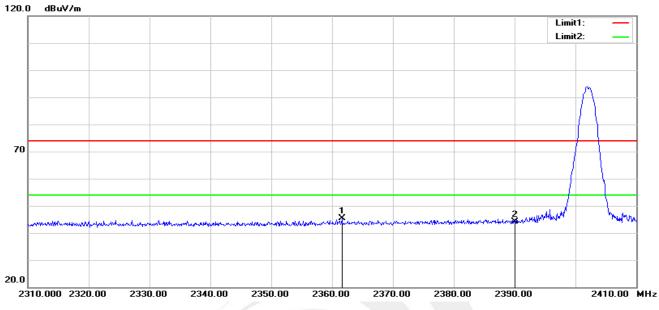


Page 30 of 77



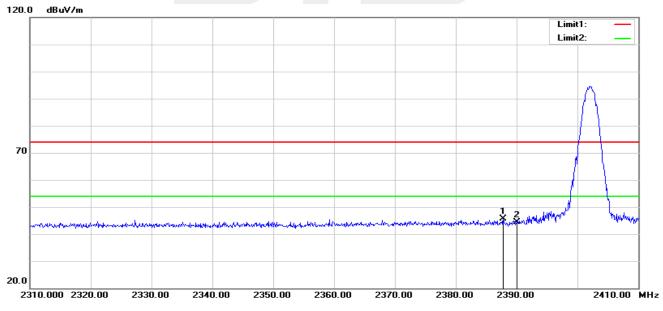
Restricted band Requirements

GFSK-Low Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2361.600	41.40	3.91	45.31	74.00	-28.69	peak
2	2390.000	39.73	4.34	44.07	74.00	-29.93	peak

Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2387.800	41.20	4.31	45.51	74.00	-28.49	peak
2	2390.000	40.04	4.34	44.38	74.00	-29.62	peak

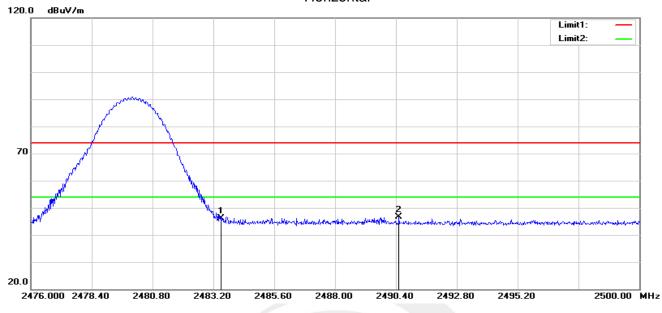
Shenzhen STS Test Services Co., Ltd.



Page 31 of 77

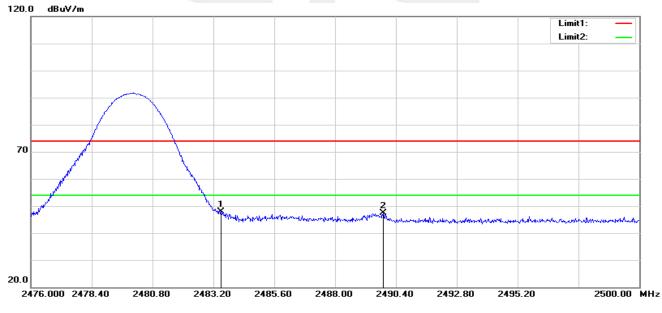
Report No.: STS2002171W21

GFSK-High Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	41.65	4.60	46.25	74.00	-27.75	peak
2	2490.520	41.96	4.63	46.59	74.00	-27.41	peak





No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	43.30	4.60	47.90	74.00	-26.10	peak
2	2489.896	42.78	4.63	47.41	74.00	-26.59	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.



Report No.: STS2002171W21

4. CONDUCTED SPURIOUS & BAND EDGE EMISSION

4.1 LIMIT

According to FCC section 15.247(d)&RSS-247 Issue 2, February 2017 (5.5), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

4.2 TEST PROCEDURE

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

For Band edge

FUI Danu euge	
Spectrum Parameter	Setting
Detector	Peak
Stort/Stop Frequency	Lower Band Edge: 2300 – 2407 MHz
Detector Start/Stop Frequency B / VB (emission in restricted band) Trace-Mode:	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
Chart/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

4.3 TEST SETUP



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

4.4 EUT OPERATION CONDITIONS

Trace-Mode:

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

Shenzhen STS Test Services Co., Ltd.

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 Http://www.stsapp.com E-mail: sts@stsapp.com

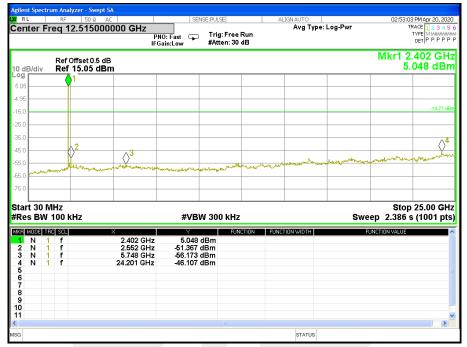
Max hold



4.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	50%
Test Mode:	GFSK(1Mbps)-00/39/78 CH	Test Voltage:	DC 15.4V

00 CH



39 CH

Agilent Spect	rum Analyzer - S	wept SA						
LX/RL	RF 50		SENSE:PUL	SE	ALIGN AUTO		02:56:34	PM Apr 20, 2020
Center F	req 12.51		NO: Fast 😱 Trig Gain:Low #Att	j: Free Run :en: 30 dB	Avg Type	: Log-Pwr		ACE 1 2 3 4 5 TYPE MWWWW DET P P P P P
10 dB/div	Ref Offset (Ref 15.59							452 GHz 589 dBm
5.59	1							
-4.41								
-14.4								-13.81 dBr
-24.4								
-44.4	<u>2</u>							
-54.4	hune		hormon the many attributes	W Hart Manager of	manderman	and a second	as all marker where	www.and
-64.4		The state of the s	and a shirt for a second for the second	PV T				
-74.4								
Start 30 I #Res BW	MHz 100 kHz		#VBW 30	0 kHz		Sw	Stop eep 2.386 s	25.00 GHz (1001 pts
MKR MODE T	RC SCL	× 2.452 GHz	Y 5,589 dBm	FUNCTION	FUNCTION WIDTH		FUNCTION VALUE	-
2 N '	1 f 1 f	2.602 GHz 5.448 GHz	-53.688 dBm -56.499 dBm					
4 N '	1 f	24.251 GHz	-47.341 dBm					
4 N 5 6 7	1 f	24.251 GHz	-47.341 dBm					
4 N 5 6 7 8 9	1 f	24.251 GHz	-47.341 dBm					
4 N 5 6 7 8	1 f	24.251 GHz	-47.341 dBm					

Shenzhen STS Test Services Co., Ltd.

П



78 CH

ent Spectrum Analyzer - Swe RL RF 50 Q	AC	SENSE:PULSE	ALI	GNAUTO	03:01:11 PM Apr 20,
nter Freq 12.5150	DOOOOO GHz		ee Run	Avg Type: Log-Pw	
Ref Offset 0.9					Mkr1 2.477 G 4.182 dl
3 1					
2					-14.2
1					
02					
	3			Marthe Martin and Martin and Martin	manger and and a second
1 why mense water the store when the	ald a service and and	hansen manunature	and a second and a second		
1					
rt 30 MHz es BW 100 kHz		#VBW 300 k	Hz		Stop 25.00 C Sweep 2.386 s (1001
MODE TRC SCL	×		FUNCTION FUNCTI	ON WIDTH	FUNCTION VALUE
N 1 f N 1 f N 1 f	2.477 GHz 2.627 GHz 7.446 GHz 24.176 GHz	4.182 dBm -52.394 dBm -54.299 dBm -48.153 dBm			
N 1 f					
N 1 f					
N 1 f					



Shenzhen STS Test Services Co., Ltd.

Π



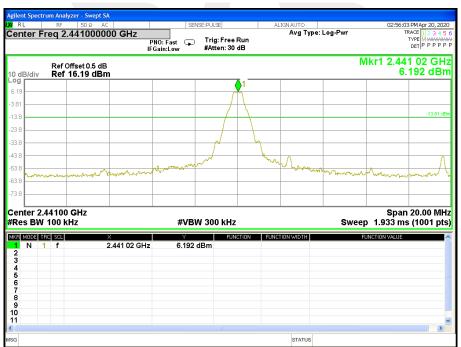


For Band edge(it's also the reference level for conducted spurious emission)

		nalyzer - Swept	t SA							
L <mark>XI</mark> RL	F		AC	SE	NSE:PULSE		ALIGN AUTO			2 PM Apr 20, 2020
Center	Freq	2.353500		PNO: Fast 😱 Gain:Low	Trig: Free F #Atten: 30 d		Avg Type	:: Log-Pwr		TYPE MWWWWWW DET P P P P P P
10 dB/div		of Offset 0.5 d of 15.23 dE						N	/lkr1 2.40 5.	1 97 GHz 228 dBm
5.23										1
-4.77										
-14.8										-14,77 dBm
-24.8										
-34.8										~4
-44.8			²							. V V
-64.8	لسرعمواهم والأمر	menne	mantimen	dumment with		merrow	and the second	way a second and the second	- and the second second	all the
-74.8										
Start 2.3										40700 GHz
#Res BV	N 100) kHz		#VB	W 300 kHz				p 10.27 ms	s (1001 pts)
MKR MODE 1 N 2 N	1 f 1 f		2.401 97 GHz 2.325 25 GHz	-57.113	dBm	TION FU	NCTION WIDTH	i	UNCTION VALUE	<u>^</u>
3 N 4 N	1 f 1 f		2.399 40 GHz 2.400 05 GHz							
6										
5 6 7 8 9										
10 11										
<										×
MSG							STATUS			

00 CH

39 CH





78 CH

Ref Offset 0.5 dB Mkr1 2.480 02 OdB/div Mkr1 2.480 02 0 dB/div Mkr1 2.480 02 0 dB/div Ref 15.74 dBm 5.738 0 dB/div 0 0 0 0 0 dB/div 0 0 0 0 0 0 dB/div 0 0 0 0 0 0 0 dB/div 0 0 0 0 0 0 0 0 0 dB/div 0<					lyzer - Swept SA		ctrur		
B/div Ref 15.74 dBm 5.734 GB/div Ref 15.74 dBm 1 GB/div Ref 16.57 dBm 1 GB/div Ref 16.57 dBm 1 GB/div Ref 15.73 dBm 1 GB/div Ref	ee Run Tyre Mwww 30 dB DET PPPF	Trig: Free Run	PNO: Fast	00 GHz	50 Ω AC .48750000	RF ∋q 2 .	Fre		
74 74 74 74 26 26 27 28 29 24 30 28 28 28 29 24 30 28 28 29 24 30 28 28 29 24 30 38 </th <th>Mkr1 2.480 025 GH 5.738 dBr</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>3/div</th> <th></th>	Mkr1 2.480 025 GH 5.738 dBr							3/div	
3 4 4 3 4 4 3 4 4 3 4 4 4 4 4									74
Image: Star Image: Star Star Star Image: Star	-14.26 dB			\backslash	/				
3 4 3 4 4 4									
3.3 3.3 <td></td> <td></td> <td>^2</td> <td>h.</td> <td>and</td> <td></td> <td></td> <td></td> <td></td>			^2	h.	and				
3 Stop 2.500 art 2.47500 GHz #VBW 300 kHz Stop 2.500 8 Model Tact #VBW 300 kHz Sweep 2.400 ms (10 8 Model Tact 5.738 dBm Function width Function watter 1 f 2.483 500 GHz 54.945 dBm Function watter 3 1 f 2.498 600 GHz 43.420 dBm Function watter 1 1 f 2.498 750 GHz 54.945 dBm Function watter		and the second	Marson from mark for	///**	ng J TT	Nahangang	Nrm	m	
Xes BW 100 kHz #VBW 300 kHz Sweep 2.400 ms (10 Image: SEL X Y FUNCTION FUNCTION WIDTH FUNCTION WIDTH N 1 f 2.480 025 GHz 5.738 dBm 5 FUNCTION WIDTH FUNCTION WIDTH FUNCTION WALLE 2 N 1 f 2.489 600 GHz -54.945 dBm 5 3 N 1 f 2.498 950 GHz -57.986 dBm 5 4 N 1 f 2.494 875 GHz -57.986 dBm 5									
N 1 f 2.480 025 GHz 5.738 dBm N 1 f 2.483 500 GHz -54.945 dBm N 1 f 2.489 600 GHz -43.420 dBm N 1 f 2.494 875 GHz -57.685 dBm	Stop 2.50000 GH Hz Sweep 2.400 ms (1001 pt	300 kHz	#VBI						
	FUNCTION FUNCTION WIDTH FUNCTION VALUE	3m 3m 3m	5.738 -54.945 -43.420	480 025 GHz 483 500 GHz 489 600 GHz	2.4 2.4 2.4	f f f	1 1 1	N N N	2 3 4 5
									7 3 9
STATUS	STATUS								



Shenzhen STS Test Services Co., Ltd.

Π



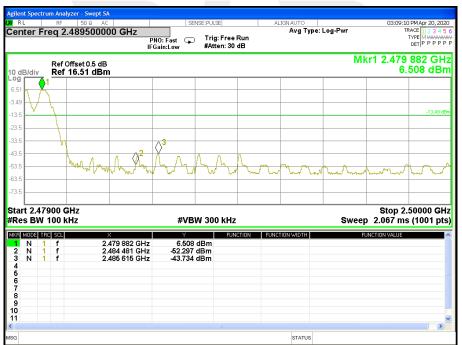


For Hopping Band edge

00 CH

	Mkr	03:06:48 PM TRACE TRACE TRACE TRACE TRACE TRACE TRACE TRACE
/div Ref 14.94 dBm		4.94
2.30000 GHz	lonhanod	portuge and the day
2.30000 GHz	burnarad	or work where
2.30000 GHz	lanhanad	nt
2.30000 GHz	Low Low A	2 Marila
2.30000 GHz	l.t.h.n.a.	monderland
2.30000 GHz	l.t.h.n.m.hl	n an
2.30000 GHz	lonnanad	mmm
2.30000 GHz 5 BW 100 kHz #VBW 300 kHz		
	Sweep	Stop 2.40 9.867 ms (1
TODE TRC SCL X Y FUNCTION FUNCTION WIDTH	FUN	ICTION VALUE
N 1 f 2.403 000 GHz 4.941 dBm N 1 f 2.390 022 GHz -594 29 dBm N 1 f 2.399 601 GHz -53.122 dBm		

78 CH





Page 38 of 77 Report No.: STS2002171W21

Temperature:	25 ℃	Relative Humidity:	50%
	π/4-DQPSK(2Mbps)– 00/39/78 CH	Test Voltage:	DC 15.4V

RL		RF	50 Q AC		SENS	E:PULSE	ALIGNA	UTO		03:20	58 PM Apr 20, 202
	Fre		2.51500000	PNO): Fast 😱	Trig: Free Run #Atten: 30 dB		vg Type: I	_og-Pwr	03.20	TRACE 1 2 3 4 5 TYPE MWWWW DET P P P P P
) dB/di	v		9ffset 0.5 dB 9.00 dBm								2.402 GH 1.000 dBn
.00			1								
1.0											
1.0											-17.20 dB
1.0											
			~								
1.0		(× ²	۸3							\sum
1.0		J,	when a sur	ma when		under work and work	mon	and marke	And a	Mar Mar Marthan	- Martine
i1.0	/ and the	and the second			nh chaight i Charles	water the second se					
71.0											
31.0											
tart 3 Res B			Hz		#VBW	300 kHz			Sw	Sto eep 2.386	p 25.00 GH s (1001 pts
KR MODI			Х		Y	FUNCTION	FUNCTION	MDTH		FUNCTION VALUE	
1 N 2 N 3 N 4 N	1 1 1	f f f	:	2.402 GHz 2.552 GHz 7.246 GHz 4.326 GHz	-1.000 di -49.977 di -57.007 di -48.494 di	3m 3m					
5 6 7 8 9 0											
1											
											>

00 CH

20	CU
00	OH

L	RF	50 Q AC		SE	NSE:PULSE		ALIGNAUTO		03:25	:56 PM Apr 20,
ter F	req ′	12.515000	F	PNO: Fast 🖵 Gain:Low	Trig: Free #Atten: 30		Avg Type	: Log-Pwr		TRACE 1 2 3 TYPE MWAA DET P P P
B/div		Offset 0.5 dB f 6.97 dBm								2.452 G 3.032 d
	(0 1								
		1								
										-16.4
\vdash										
<u> </u>										
		_	0							
		() ²	$\langle \rangle^3$					- m	manyth	man and and
man		Hummonut	had set a have a great of	montheterenter	ward and the second	mand	asul lunger of the second			
1										
rt 30 M s BW		kHz	1	#VB	W 300 kHz			Sw	reep 2.386	p 25.00 (s (1001
MODE T			× 2.452 GHz	-3.032		ICTION FU	INCTION WIDTH		FUNCTION VALUE	
N 1			2.452 GHZ 2.602 GHZ	-55.522						
N 1			5.923 GHz 24.226 GHz	-56.032 -47.917						
IN			24.220 GHZ	-41.911	ubm					

Π



78 CH

t Spectrum Analyzer - S	wept SA	SENSE:PULSE		ALIGNAUTO	03:29:56 PM Apr
ter Freg 12.51				AUGNAUTO Avg Type: Log-P	Wr TRACE 1
	Р		Free Run 1:30 dB		DET P F
	IF				Mkr1 2.477
Ref Offset B/div Ref 7.97					-2.030
Y.					
. () ²	3		whent	- anoran themply the any	and the property and the second second
and have a set the second	Manakaranakaran	white was made and and	when		
t 30 MHz s BW 100 kHz		#VBW 300	kH7		Stop 25.00 Sweep 2.386 s (100
ADDE TRC SCL	×	Y		JNCTION WIDTH	EUNOTION VALUE
N 1 f	2.477 GHz	-2.030 dBm	TONCTION	SACHON WIDTH	TORCHON WALSE
N 1 f N 1 f	3.201 GHz 5.773 GHz	-57.642 dBm -56.721 dBm			
N 1 f	24.750 GHz	-48.744 dBm			
				STATUS	

Shenzhen STS Test Services Co., Ltd.

Π

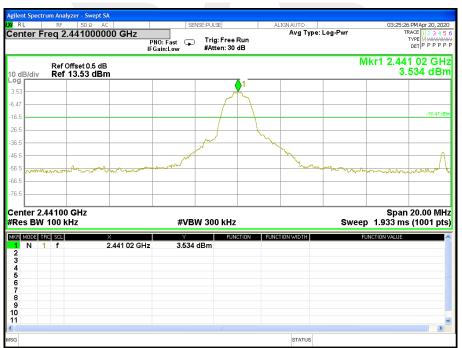


For Band edge(it's also the reference level for conducted spurious emission)

		ectrur		alyzer - Swept SA									
LXI R		_	RF	50 Ω AC		SEI	VSE:PULSE		ALIG	AUTO	Dum		PM Apr 20, 2020
Cer	nter	Fre	eq 2	2.353500000		Fast 🖵 n:Low	Trig: Free #Atten: 30			Avg Type: I	Log-Pwr		TYPE M WAAAAAAAA DET P P P P P P
10 d	B/di			Offset 0.5 dB 12.84 dBm							N		1 97 GHz 835 dBm
Log 2.84													1
-7.16													
-17.2	I												-17 20 dBm
-27.2	L												
-37.2													4
-47.2						0.2							∕³
-57.2			1 - m Pr -		Number of the state	$\sum_{i=1}^{n}$	بالمراجع المراجع الروا	ubsection	unte moterali	AND IN A DRAW AND	nh ray angle and the state	Mar Mar mar store	and he
-67.2													
-77.2	\vdash												
Sta #Re				GHz kHz		#VB	W 300 kHz				Sweep		40700 GHz (1001 pts)
MKR 1 2	MODE N N	1 1	SCL f f	× 2.401 2.333	97 GHz 13 GHz	2.835 -57.837	dBm	CTION	FUNCTIO	NWIDTH	FL	UNCTION VALUE	<u> </u>
3	N	1	f	2.399	40 GHz 05 GHz	-50.191 -44.067							
5		-		2.400	00 0112	-44.007	abiii						=
5 6 7 8 9													
9													
10 11													~
<							Ш						
MSG										STATUS			

00 CH

39 CH





78 CH

	Analyzer - Swept S RF 50 Ω AC		SENSE	:PULSE	ai T	GNAUTO		03:29:25	5 PM Apr 20, 202
	2.4875000	00 GHz	NO: East	Trig: Free Run #Atten: 30 dB		Avg Type:	Log-Pwr	TF	RACE 1 2 3 4 5 TYPE MWWWW DET P P P P P
	ef Offset 0.5 dB ef 13.24 dBn						MI	kr1 2.480 3.	000 GH 235 dBr
.24									
76 5.8									-16.77 d
5.8									
i.8					() ³				
i.8	work	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	$\sqrt{2}$		Â			4	
i.8			and the second second	VWW Marter Contra	moles he	and and a start of the	Martin - Harden and and	torn when the or	hartoner
5.8									
art 2.4750 Res BW 10			#VBW	300 kHz			Swee	Stop 2.	50000 GH ; (1001 pt
R MODE TRC S		×	Y	FUNCTION	FUNCT	ION WIDTH		UNCTION VALUE	(1
2 N 1 3 N 1 4 N 1 5	f 2 f 2	.480 000 GHz .483 500 GHz .489 625 GHz .496 550 GHz	3.235 dE -57.495 dE -43.739 dE -56.308 dE	lm Im					
5 7 3 9									
6 7 8 9 0 1									>



Shenzhen STS Test Services Co., Ltd.

Π



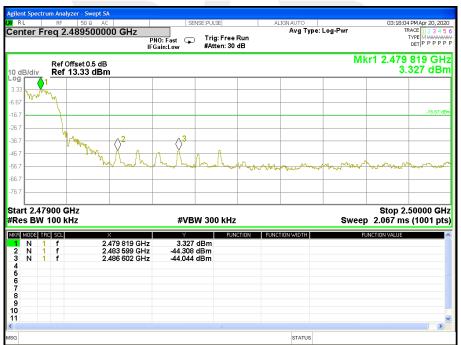


For Hopping Band edge

00 CH

lent Spectr	um Analyzer - Sv RE 504						00.45.4	
		Ω AC 000000 GHz	PNO: Fast	ENSE:PULSE Trig: Free Run #Atten: 30 dB	ALIGNAUTO Avg Type:	Log-Pwr	Т	3 PM Apr 20, 20 RACE 1 2 3 4 TYPE M MMMM DET P P P P
dB/div	Ref Offset 0 Ref 12.64					Mk	r1 2.401 2.	867 GH 642 dB
54								
36								-17.36 c
4								-17.35 0
4								1
4							^ 2	Y Y
4 martin	an and a second	- the man and the second	no as shown	ware and the second	- Almon Agel May Marker	a second and a second	mannen	monormy
4								
4								
	000 GHz 100 kHz		#VE	W 300 kHz		Sweep	Stop 2. 9.867 ms	40300 GH s (1001 p1
MODE TE N 1 N 1 N 1	f f	× 2.401 867 GF 2.390 022 GF 2.399 910 GF	-1z -58.850		FUNCTION WIDTH	FL	INCTION VALUE	
				ш				
					STATUS			

78 CH





Page 43 of 77 Report No.: STS2002171W21

Temperature:	25 ℃	Relative Humidity:	50%
Test Mode:	8DPSK(3Mbps) -00/39/78 CH	Test Voltage:	DC 15.4V

00 CH

	F 50 Ω	AC	SENS	SE:PULSE	ALIGNAUTO			5 PM Apr 20, 202
nter Freq	12.51500	00000 GHz PN IFG	0:Fast 🖵 ain:Low	Trig: Free Run #Atten: 30 dB	Avg Typ	e: Log-Pwr		RACE 1 2 3 4 TYPE M WARANA DET P P P P
dB/div Re	ef Offset 0.5 ef 1.35 dB						Mkr1 2 -8.	.402 GF 655 dB
6	^ 1							
7	+							-17.19 d
7	-							
7	2						- shylen har may age	. H . ANTAN
7 where marges	- Korren		rolyna ywady Maradia	monthe	mandamanna	me Marran Marrin Marrie	- Contraction and and and and and and and and and an	
7								
7								
art 30 MHz es BW 100			#VBW	/ 300 kHz		Swe	ep 2.386 s	25.00 GH (1001 pt
N 1 f		× 2.402 GHz	-8.655 d	FUNCTION	FUNCTION WIDTH	f	UNCTION VALUE	
N 1 f N 1 f N 1 f		2.652 GHz 5.424 GHz 24.775 GHz	-56.555 d -57.192 d -47.115 d	Bm Bm				

39 CH

	RF 50 Ω	AC	SENSE:PULS	E	ALIGNAUTO		03:40:26	PM Apr 20, 2
nter Fr	eq 12.5150			: Free Run en: 30 dB	Avg Type:	Log-Pwr		TYPE MWAA DET P P P
dB/div	Ref Offset 0.5 Ref 9.27 di						Mkr1 2. 0.	452 G 981 dE
3	\ 1							
7								-16.46
/								
·	٨2							<
/ <u> </u>	\ ?	3		. Alexandra	menennen	-	mound	A Martine
Norma	row of the second	man har allow march		Con name and a la				
′ 								
/								
rt 30 N			//) (T)		1	-	Stop	25.00 G
es BW	100 kHz		#VBW 300) KHZ		Swee	ep 2.386 s	(1001)
			× I	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE	
	C SCL	2.452.047	0.091 dBm					
N 1 N 1	f f	2.452 GHz 2.602 GHz	0.981 dBm -54.925 dBm					
N 1	f f f	2.452 GHz 2.602 GHz 5.973 GHz	-54.925 dBm -56.228 dBm					
N 1 N 1 N 1	f f f	2.452 GHz 2.602 GHz	-54.925 dBm					
N 1 N 1 N 1	f f f	2.452 GHz 2.602 GHz 5.973 GHz	-54.925 dBm -56.228 dBm					
N 1 N 1 N 1	f f f	2.452 GHz 2.602 GHz 5.973 GHz	-54.925 dBm -56.228 dBm					
N 1 N 1 N 1	f f f	2.452 GHz 2.602 GHz 5.973 GHz	-54.925 dBm -56.228 dBm					



78 CH

L RF 50 Ω	AC	SENSE:PULSE		ALIGNAUTO	03:5	3:31 PM Apr 20, 2
ter Freq 12.5150		Tala Fa		Avg Type: Log		TRACE 1 2 3
): Fast 😱 Trig: Fr in:Low #Atten:				DET P P P
					Mkr1	2.477 G
Ref Offset 0.5 B/div Ref 10.45 (WIKI I	0.445 dE
ii						-16.71
ii						-10.71
i						
i						p
2						
hours	- mannent a	Marriel March	summer	man marine	Not the same the stand	and a straight and a straight a s
ward all and a start and a start a						
rt 30 MHz						op 25.00 G
es BW 100 kHz		#VBW 300 ki	Hz		Sweep 2.38	6 s (1001 p
MODE TRC SCL	×		UNCTION FUN	CTION WIDTH	FUNCTION VALU	JE
N 1 f N 1 f	2.477 GHz 2.627 GHz	0.445 dBm -55.684 dBm				
	7.146 GHz	-56.975 dBm				
N 1 f		-47.452 dBm				
	24.201 GHz	47.402 dbm				
N 1 f	24.201 GHz	-47.402 dDm				
N 1 f	24.201 GHz	47.402 dBiii				
N 1 f	24.201 GHz	41.402 0.011				
N 1 f	24.201 GHz					
N 1 f	24.201 GHz			STATUS		

Shenzhen STS Test Services Co., Ltd.

Π



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

Agilent Spect	rum Analyzer - Sw	/ept SA					
L <mark>XI</mark> RL	RF 50 Ω		SEN	ISE:PULSE	ALIGN AUTO		03:36:24 PM Apr 20, 2020
Center F	req 2.3535		PNO: Fast 🖵 Gain:Low	Trig: Free Run #Atten: 30 dB	Avg Typ	e: Log-Pwr	TRACE 1 2 3 4 5 TYPE M WWWWW DET P P P P
10 dB/div	Ref Offset 0. Ref 12.81					N	/kr1 2.401 97 GHz 2.810 dBm
2.81							1
-7.19							
17.2							-17.19 dBr
-27.2							
-37.2							×3 \
47.2 57.2		\diamond^2					he was he
67.2	hallen setter same salah sed	Marine Malloner M	humand	and the part of the second	www.	herrow was also and a second	al marked and the second
77.2							
	0000 GHz 100 kHz		#VB\	V 300 kHz		Swee	Stop 2.40700 GHz p 10.27 ms (1001 pts
MKR MODE T	1 f	× 2.401 97 GHz			FUNCTION WIDTH		UNCTION VALUE
3 N 1	1 f 1 f 1 f	2.325 25 GHz 2.399 40 GHz 2.400 05 GHz	-49.522	dBm			
	1 1	2.400 05 GH2	-41.0971				
5 6 7							
8 9 10							
11							>
sg					STATUS		

00 CH

39 CH





78 CH

ilent Spectru										
enter Fro	RF eq 2.48	50Ω AC 8750000	00 GHz	PNO: Fast FGain:Low) Trig: Free R #Atten: 30 d	lun	IGNAUTO Avg Type:	_		01 PM Apr 20, 202 TRACE 1 2 3 4 5 TYPE M WAAAAA DET P P P P P
) dB/div		set 0.5 dB 8.29 dBm						M		0 025 GH 0.292 dBn
.29			1							
5.7										-16.71 dE
6.7										
6.7	~		- North Mark	1 <u>.</u> 2		$\langle \rangle$	s 			
5.7 mmmmm	~~			hardonom	and the second second	and the second		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	C Carlow Com	hennon
6.7										
art 2.475	500 GH	z							Stop 2	2.50000 GH
Res BW 1				#VB	W 300 kHz				p 2.400 m	
R MODE TRO N 1 2 N 1 3 N 1 4 N 1 5	f f f f	2. 2. 2.	× 480 025 GHz 483 500 GHz 489 600 GHz 491 575 GHz	-55.867 -43.503	dBm dBm	TION FUNC	TION WIDTH		FUNCTION VALUE	
5 7 3 9 0										
										>
1							STATUS			



Shenzhen STS Test Services Co., Ltd.

Π



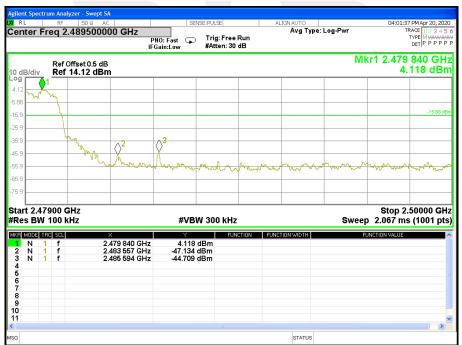


For Hopping Band edge

00 CH

nt Spectrum Analyz	zer - Swept SA 50 Ω AC	SE	NSE:PULSE	ALIGN AUTO		03:59:10	5 PM Apr 20, 2
nter Freq 2.3	351500000 GHz	PNO: Fast IFGain:Low		Avg Type:	Log-Pwr	Т	RACE 1 2 3 TYPE MWAAA DET P P P I
	fset 0.5 dB 2.71 dBm				М	kr1 2.403 2.	000 G 707 dE
							-17.25
							- 1
		mander of the second	artuuren kunsen maartud	anton and an and the second	وبيالوبيدال إيدادوها وم	monormation	and and and a state
rt 2.30000 GH s BW 100 kH		#VB	W 300 kHz		Swee	Stop 2. p 9.867 ms	40300 G s (1001 p
Mode tro scl N 1 f	× 2.403 000 GH			FUNCTION WIDTH		FUNCTION VALUE	
N 1 f N 1 f	2.390 022 GH 2.399 704 GH						
				STATUS			

78 CH



П



5. NUMBER OF HOPPING CHANNEL

5.1 LIMIT

FCC Part 15.247,Subpart C							
	RSS-247 Issue 2						
Section	Test Item	Limit	FrequencyRange (MHz)	Result			
15.247 (a)(1)(iii) RSS-247	Number of Hopping Channel	≥15	2400-2483.5	PASS			

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

5.2 TEST PROCEDURE

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

5.3 TEST SETUP

EUT	SPECTRUM
	ANALYZER

5.4 EUT OPERATION CONDITIONS

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



5.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	60%
Test Mode:	Hopping Mode -GFSK Mode	Test Voltage:	DC 15.4V

Number of Hopping Channel

79

Hopping channel

RL	RF				SENSE:PULSE		ALIGN AUTO				7 PM Apr 20, 20
ente	r Freq :	2.4417500		PNO: Fast FGain:Low	Trig: Fr #Atten:	ee Run 30 dB	Avg	Type: Log-F	'wr	Т	RACE 1 2 3 4 TYPE MWWW DET P P P P
) dB/d		Offset 0.5 dl f 16.75 dB							Mkr2	2.480 2	43 5 GH 6.87 dB
^g	<u></u>										2
.75	mm	nnnnn	nhnnnn	mm	MMMM	MMM	wwww	mmm	NYYYY	WWWW	WWW
.25				,,,,,,							
3.3											
3.3											
3.3 +											
1.3											
1.3 <mark>-</mark>											
3.3											
3.3											
art 2	.40000	GHz								Stop 2	.48350 GI
tes E	BW 300	kHz		#	/BW 300 k	Hz			Sweep	1.133 m	s (1001 pi
R MOD	E TRC SCL		× 402 171 0 GHz	5	.35 dBm	FUNCTION	FUNCTION WIDT	н	FU	NCTION VALUE	
2 N	1 f		480 243 5 GHz		.87 dBm						
3 4											
5											
7											
3											
											>
D 1											/

Shenzhen STS Test Services Co., Ltd.

П



6. AVERAGE TIME OF OCCUPANCY

6.1 LIMIT

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

6.2 TEST PROCEDURE

- a. The transmitter output (antenna port) was connected to the spectrum analyzer.
- b. Set RBW =1MHz/VBW =3MHz.
- c. Use a video trigger with the trigger level set to enable triggering only on full pulses.
- d. Sweep Time is more than once pulse time.
- Set the center frequency on any frequency would be measure and set the frequency span to e. zero span.
- f. Measure the maximum time duration of one single pulse.
- g. Set the EUT for DH5, DH3 and DH1 packet transmitting.
- \tilde{h} . Measure the maximum time duration of one single pulse.
- i. DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots RX, 1 time slot TX). 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 $5.06 \times 31.6 = 160$ within 31.6 seconds.
- k. DH1 Packet permit maximum 1600 / 79 / 2 = 10.12 hops per second in each channel (1 time slot RX, 1 time slot TX). So the dwell time is the time duration of the pulse times $10.12 \times 31.6 = 320$ within 31.6 seconds.

6.3 TEST SETUP

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 15.4V

Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
DH1	middle	0.382	0.122	0.4
DH3	middle	1.640	0.262	0.4
DH5	middle	2.894	0.309	0.4



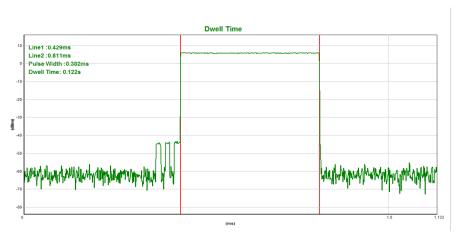
Shenzhen STS Test Services Co., Ltd.

Ш

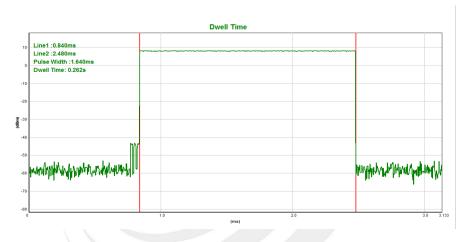


Page 52 of 77 Report No.: STS2002171W21

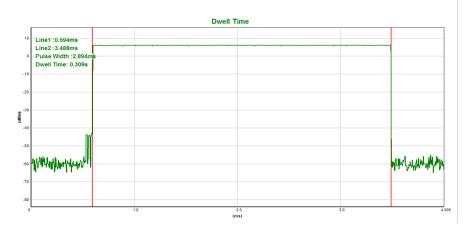
CH39-DH1



CH39-DH3







Shenzhen STS Test Services Co., Ltd.



Page 53 of 77 Report No.: STS2002171W21

Temperature:	25 ℃	Relative Humidity:	50%
	π/4-DQPSK(2Mbps)– 2DH1/2DH3/2DH5	Test Voltage:	DC 15.4V

Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
2DH1	middle	0.391	0.125	0.4
2DH3	middle	1.646	0.263	0.4
2DH5	middle	2.901	0.309	0.4

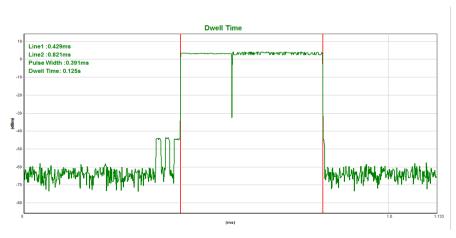


Shenzhen STS Test Services Co., Ltd.

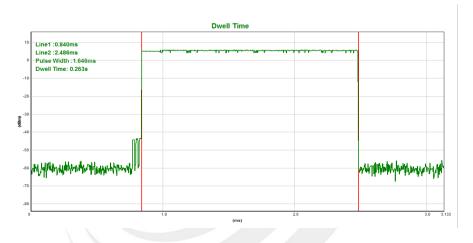
Ш



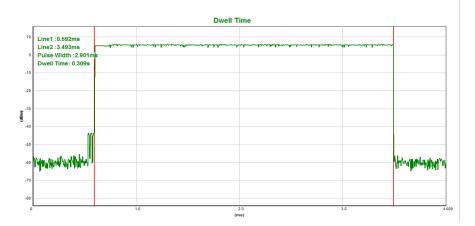
CH39-2DH1



CH39-2DH3



CH39-2DH5



Shenzhen STS Test Services Co., Ltd.



Page 55 of 77 Report No.: STS2002171W21

Temperature:	25 ℃	Relative Humidity:	50%
	8DPSK(3Mbps)– 3DH1/3DH3/3DH5	Test Voltage:	DC 15.4V

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	2.898	0.309	0.4



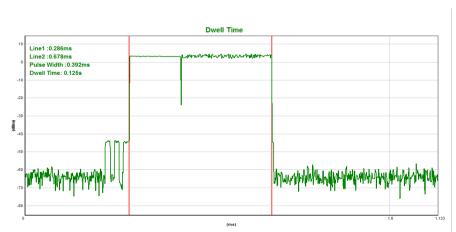
Shenzhen STS Test Services Co., Ltd.

Π

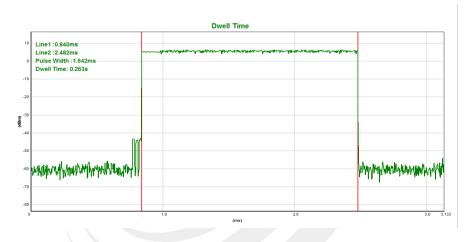


Page 56 of 77 Report No.: STS2002171W21

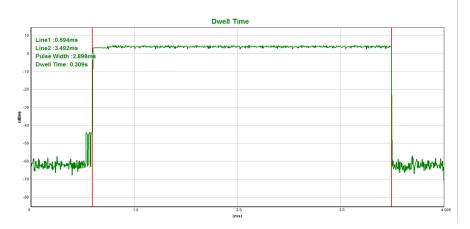
CH39-3DH1



CH39-3DH3







Shenzhen STS Test Services Co., Ltd.



7. HOPPING CHANNEL SEPARATION MEASUREMEN

7.1 LIMIT

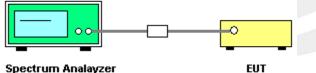
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that 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



Spectrum Analayzer

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 15.4V

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2402.014	2403.013	0.999	0.908	Complies
2441 MHz	2441.017	2442.016	0.999	0.911	Complies
2480 MHz	2479.011	2480.016	1.005	0.909	Complies

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

CH00 -1Mbps

L RF 50 Q AC		SENSE:PULSE	ALIGN AUTO	02:53:56 PM Apr 20, 20
ter Freq 2.402500000) GHz PNO: Wide IFGain:Low	👝 Trig: Free Run	Avg Type: Log-Pwr	TRACE 1 2 3 4 TYPE MWMM DET P P P
Ref Offset 0.5 dB B/div Ref 13.41 dBm				Mkr2 2.403 013 GF 3.409 dB
	1		2	
	\sim			
	~	- have a second		
\sim				
ter 2.402500 GHz				Span 3.000 MI
es BW 30 kHz		#VBW 100 kHz	Sw	eep 3.200 ms (1001 p
MODE TRC SCL X		Y FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
	02 014 GHz 03 013 GHz	3.41 dBm 3.41 dBm		
				>

Shenzhen STS Test Services Co., Ltd.

Π



CH39 -1Mbps



CH78 -1Mbps





Page 60 of 77 Report No.: STS2002171W21

Temperature:	25 ℃	Relative Humidity:	50%
Test Mode:	CH00 / CH39 / CH78 (π/4-DQPSK(2Mbps) Mode)	Test Voltage:	DC 15.4V

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2402.017	2403.013	0.996	0.951	Complies
2441 MHz	2441.017	2442.016	0.999	0.953	Complies
2480 MHz	2479.011	2480.019	1.008	0.952	Complies

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

RL	RF 50 Ω	AC	SENSE:PUL	ge I	ALIGN AUTO		03:23:55	PM Apr 20, 202
	req 2.40250	0000 GHz): Wide 👝 Trig	g: Free Run ten: 30 dB		: Log-Pwr	TR	ACE 1 2 3 4 5 YPE M MMMM DET P P P P P
) dB/div	Ref Offset 0.5 Ref 9.08 dB					Mk	r2 2.403 1.0	013 GH 077 dBr
.92			λ^1					
0.9	~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		mm	\sim	- m	m	
1.9								~
.9	~							- ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
1.9								· · · · · · · · · · · · · · · · · · ·
1.9								
1.9								
1.9								
).9								
	402500 GHz 30 kHz		#VBW 10	0 kHz		Sweep	Span 3.200 ms	3.000 MH (1001 pts
R MODE T	RC SCL	× 2.402 017 GHz	Y 0.99 dBm	FUNCTION	FUNCTION WIDTH	EU	NCTION VALUE	
2 N 1	f	2.403 013 GHz	1.08 dBm					
3								
5 5								
7								
a D								
i								
								>

CH00 -2Mbps



CH39 -2Mbps



CH78 -2Mbps



Shenzhen STS Test Services Co., Ltd.



Page 62 of 77 Report No.: STS2002171W21

Temperature:	25 ℃	Relative Humidity:	50%
	CH00 / CH39 / CH78 (8DPSK(3Mbps)Mode)	Test Voltage:	DC 15.4V

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2402.014	2403.010	0.996	0.961	Complies
2441 MHz	2441.014	2442.013	0.999	0.959	Complies
2480 MHz	2479.014	2480.019	1.005	0.962	Complies

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

CH00 -3Mbps

R L RF	50 Ω AC	SENSE:PULSE	ALIGN AUTO		03:38:20 PM Apr 20, 202
enter Freq 2.	402500000 GHz	PNO: Wide Trig: FGain:Low #Atte	Avg Typ Free Run n: 30 dB	e: Log-Pwr	TRACE 1 2 3 4 5 TYPE MWWWW DET P P P P
	Offset 0.5 dB 11.02 dBm			Mkr2 2	.403 010 GH 1.120 dBi
g 12				2	
38	~~~~~	m	\sim	man and a second	
	~~~				m
.0					<u> </u>
0					
0					
0					
0					
nter 2.40250 es BW 30 kH		#VBW 100	kHz	Sweep 3.20	Span 3.000 MH 00 ms (1001 pt
R MODE TRC SCL	×	Y	FUNCTION FUNCTION WIDTH	FUNCTION	VALUE
N 1 f N 1 f	2.402 014 GHz 2.403 010 GHz				
·					

Shenzhen STS Test Services Co., Ltd.



#### CH39 -3Mbps



#### CH78 -3Mbps



Shenzhen STS Test Services Co., Ltd.



# 8. BANDWIDTH TEST

### 8.1 LIMIT

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

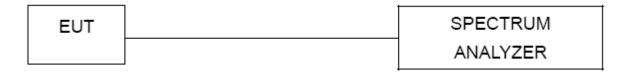
Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> Measurement Bandwidth or Channel Separation
RB	30 kHz (20dB Bandwidth) / 30 kHz (Channel Separation)
VB	100 kHz (20dB Bandwidth) / 100 kHz (Channel Separation)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

### **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



### 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:	<b>25</b> ℃	Relative Humidity:	50%
	GFSK(1Mbps) CH00 / CH39 / C78	Test Voltage:	DC 15.4V

Frequency	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402 MHz	0.908	0.851	PASS
2441 MHz	0.911	0.848	PASS
2480 MHz	0.909	0.847	PASS

### CH00 -1Mbps

	m Analyzer - Occupied BV				
(XIRL Center Fre	RF 50 Ω AC eq 2.402000000		ENSE: PULSE Center Freg: 2.402000	ALIGNAUTO	02:50:31 PM Apr 20, 2020 Radio Std: None
	]	#IFGain:Low	Trig: Free Run #Atten: 30 dB	Avg Hold:>10/10	Radio Device: BTS
10 dB/div Log	Ref 20.00 dBm	· .			
10.0					
0.00			$\sim$		
-10.0					
-20.0					
-30.0					
-40.0	compter .				www.
-50.0					
-60.0					
-70.0					
Center 2.4 #Res BW ⇒			#VBW 100 k	Hz	Span 2 MHz Sweep   2.733 ms
Occup	ied Bandwidth	 າ	Total Power	14.2 dBm	
	8	50.53 kHz			
Transm	nit Freq Error	-4.441 kHz	OBW Power	99.00 %	
x dB Ba	andwidth	908.1 kHz	x dB	-20.00 dB	
MSG				STATUS	

Shenzhen STS Test Services Co., Ltd.



### CH39 -1Mbps



#### CH78 -1Mbps



Shenzhen STS Test Services Co., Ltd.

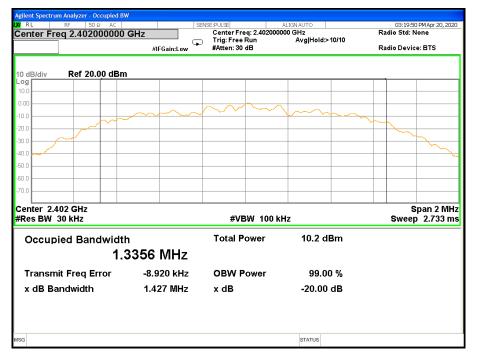




Temperature:	<b>25</b> ℃	Relative Humidity:	50%
	π/4-DQPSK(2Mbps) CH00 / CH39 / C78	Test Voltage:	DC 15.4V

Frequency	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402 MHz	1.427	1.336	PASS
2441 MHz	1.43	1.335	PASS
2480 MHz	1.428	1.335	PASS

### CH00 -2Mbps

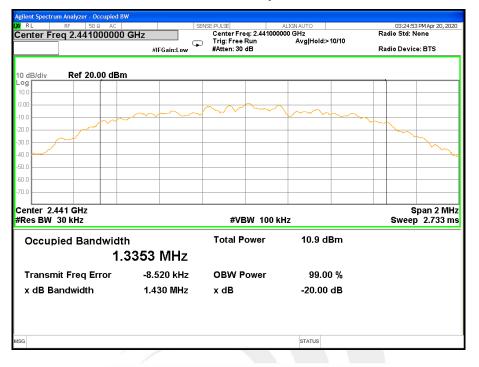


Shenzhen STS Test Services Co., Ltd.

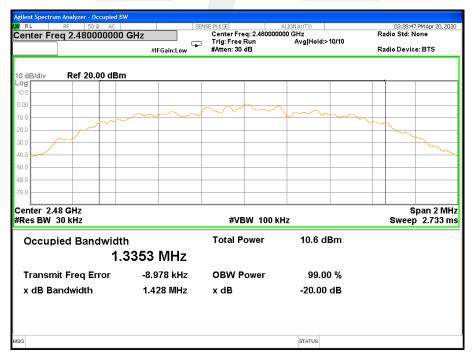
П



#### CH39 -2Mbps



#### CH78 -2Mbps



Shenzhen STS Test Services Co., Ltd.



Page 69 of 77 Report No.: STS2002171W21

Temperature:	<b>25</b> ℃	Relative Humidity:	50%
	8DPSK(3Mbps) CH00 / CH39 / CH78	Test Voltage:	DC 15.4V

Frequency	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402 MHz	1.441	1.345	PASS
2441 MHz	1.438	1.343	PASS
2480 MHz	1.443	1.346	PASS

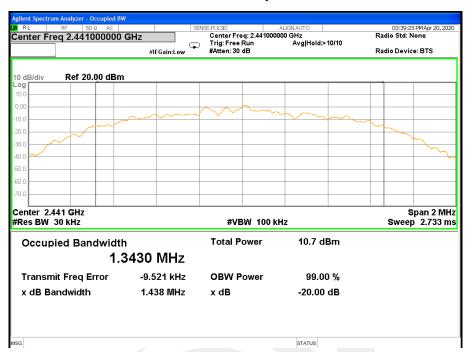
### CH00 -3Mbps



Shenzhen STS Test Services Co., Ltd.



### CH39 -3Mbps



CH78 -3Mbps



Shenzhen STS Test Services Co., Ltd.



# 9. OUTPUT POWER TEST

### 9.1 LIMIT

FCC Part 15.247,Subpart C RSS-247 Issue 2					
Section	Test Item	Limit	FrequencyRange (MHz)	Result	
output power no greater		1 W or 0.125W			
		2/3 bandwidthprovided thesystems operatewith an	2400-2483.5	PASS	
RSS-247	EIRP	4W	2400-2483.5	PASS	

### 9.2 TEST PROCEDURE

One of the following procedures may be used to determine the maximum peak conducted output power of a DTS EUT.

 $RBW \ge DTS$  bandwidth

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

a) Set the RBW  $\geq$  DTS bandwidth.

b) Set VBW  $\geq$  [3 × RBW].

c) Set span  $\geq$  [3  $\times$  RBW].

d) Sweep time = auto couple.

e) Detector = peak.

f) Trace mode = max hold.

g) Allow trace to fully stabilize.

h) Use peak marker function to determine the peak amplitude level.

Integrated band power method:

The following procedure can be used when the maximum available RBW of the instrument is less than the

DTS bandwidth:

a) Set the RBW = 1 MHz.

b) Set the VBW  $\geq$  [3 × RBW].

c) Set the span  $\geq$  [1.5 × DTS bandwidth].

d) Detector = peak.

e) Sweep time = auto couple.

f) Trace mode = max hold.

g) Allow trace to fully stabilize.

h) Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges (for some instruments, this may require a manual override to select the peak detector). If the instrument does not have a band power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the DTS channel bandwidth.

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 DTS bandwidth and shall use a fast-responding diode detector.

Shenzhen STS Test Services Co., Ltd.



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.



Shenzhen STS Test Services Co., Ltd.



### 9.5 TEST RESULTS

Temperature:	<b>25℃</b>	Relative Humidity:	60%
Test Voltage:	DC 15.4V		

Mode	Channel	Frequency	Peak Power	Average Power	Limit
Number		(MHz)	(dBm)	(dBm)	(dBm)
	0	2402	5.48	4.24	30.00
GFSK(1M)	39	2441	6.27	4.95	30.00
	78	2480	6.93	5.12	30.00

Note: the channel separation >20dB bandwidth

Mode	Channel Frequency		Peak Power	Average Power	Limit
Numbe	Number	(MHz)	(dBm)	(dBm)	(dBm)
π/4-DQPSK( 2M)	0	2402	5.90	2.36	20.97
	39	2441	5.78	2.26	20.97
	78	2480	5.81	2.34	20.97

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

Mode	Channel Frequency		Peak Power	Average Power	Limit
Number		(MHz)	(dBm)	(dBm)	(dBm)
	0	2402	6.14	2.36	20.97
8-DPSK(3M)	39	2441	6.02	2.26	20.97
	78	2480	6.03	2.31	20.97

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

П



Page 74 of 77

Report No.: STS2002171W21

EIRP Power						
Mode	Channel	Frequency	Peak Power	Antenna Gain	EIRP Power	Limit
Mode	Number	(MHz)	(dBm)	(dBi)	(dBm)	(dBm)
	0	2402	5.48	1.46	6.94	36.00
GFSK(1M)	39	2441	6.27	1.46	7.73	36.00
	78	2480	6.93	1.46	8.39	36.00
Mode	Channel	Frequency	Peak Power	Antenna Gain	EIRP Power	Limit
	Number (MHz)	(dBm)	(dBi)	(dBm)	(dBm)	
	0	2402	5.90	1.46	7.36	36.00
π/4-DQPSK(2	39	2441	5.78	1.46	7.24	36.00
M)	78	2480	5.81	1.46	7.27	36.00
Mode	Channel	Frequency	Peak Power	Antenna Gain	EIRP Power	Limit
	Number	(MHz)	(dBm)	(dBi)	(dBm)	(dBm)
	0	2402	6.14	1.46	7.60	36.00
8-DPSK(3M)	39	2441	6.02	1.46	7.48	36.00
	78	2480	6.03	1.46	7.49	36.00

EIRP Power



### **10. ANTENNA REQUIREMENT**

### **10.1 STANDARD REQUIREMENT**

15.203&RSS-Gen Issue 5 requirement: For intentional device, according to 15.203&RSS-Gen Issue 5: an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

#### 10.2 EUT ANTENNA

The EUT antenna is PIFA Antenna, the antenna connection port is located inside the product casing that will not be easily opened. It comply with the standard requirement. You can refer to KDB353028 D01 Antennas Part 15 Transmitters v01 (II. A. 2. b).



Shenzhen STS Test Services Co., Ltd.

Page 76 of 77 Report No.: STS2002171W21



## 11. FREQUENCY STABILITY

11.1 LIMITS OF FREQUENCY STABILITY MEASUREMENT

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

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

11.3 TEST RESULT

Channel 39 (2441MHz)

Voltage vs. Frequency Stability

Voltage(V)	Measurement	
3.( )	Frequency(MHz)	
17.71	2441.0025	
15.4	2441.0024	
13.09	2441.0020	
Max.Deviation(MHz)	0.0025	
Max.Deviation(ppm)	1.02	

Rated working voltage: DC 15.4V

Temperature vs. Frequency Stability

	Measurement
Temperature(℃)	Frequency(MHz)
-30	2441.0033
-20	2441.0032
-10	2441.0029
0	2441.0026
10	2441.0025
20	2441.0031
30	2441.0032
40	2441.0023
50	2441.0027
Max.Deviation(MHz)	0.0033
Max.Deviation(ppm)	1.35



### **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 * * * * *



Shenzhen STS Test Services Co., Ltd.