

RADIO TEST REPORT

Report No.: STS2109158W01

Issued for

Shenzhen Freesun Technology Co.,Ltd

3rd Floor, Yingdefeng Building, Hourui, Aimin Road, Hangcheng Street, Bao an, Shenzhen, China

Product Name:	Ditto Projector	
Brand Name:	Joann	
Model Name:	DT01	
Series Model:	N/A	
FCC ID:	2AYJ8-DITTO	
Test Standard:	FCC Part 15.247	

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TEST RESULT CERTIFICATION

Applicant's Name:	Shenzhen Freesun Technology Co.,Ltd
Address	3rd Floor, Yingdefeng Building, Hourui, Aimin Road, Hangcheng Street, Bao an, Shenzhen, China
Manufacturer's Name:	Shenzhen Freesun Technology Co.,Ltd
Address	3rd Floor, Yingdefeng Building, Hourui, Aimin Road, Hangcheng Street, Bao an, Shenzhen, China
Product Description	
Product Name:	Ditto Projector
Brand Name	Joann
Model Name:	DT01
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: 22 Sept. 2021

Date (s) of performance of tests : 22 Sept. 2021 ~ 13 Oct. 2021

Date of Issue 13 Oct. 2021

Test Result Pass

 Testing Engineer
 :
 Chris Chen

 (Chris Chen)
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 :

 Technical Manager
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 :

 Authorized Signatory :
 :
 :

(Vita Li)

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Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	13 Oct. 2021	STS2109158W01	ALL	Initial Issue



Shenzhen STS Test Services Co., Ltd.



1. SUMMARY OF TEST RESULTS

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

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

NOTE:

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

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



1.1 TEST FACTORY

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

1.2 MEASUREMENT UNCERTAINTY

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

No.	Item	Uncertainty
1	RF output power, conducted	±0.68dB
2	Unwanted Emissions, conducted	±2.988dB
3	All emissions, radiated 9K-30MHz	±2.84dB
4	All emissions, radiated 30M-1GHz	±4.39dB
5	All emissions, radiated 1G-6GHz	±5.10dB
6	All emissions, radiated>6G	±5.48dB
7	Conducted Emission (9KHz-150KHz)	±2.79dB
8	Conducted Emission (150KHz-30MHz)	±2.80dB



2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	Ditto Projector
Trade Name	Joann
Model Name	DT01
Series Model	N/A
Model Difference	N/A
Channel List	Please refer to the Note 2.
Bluetooth	Frequency:2402 – 2480 MHz Modulation: GFSK(1Mbps), π/4-DQPSK(2Mbps), 8DPSK(3Mbps)
Bluetooth Version	5.0
Bluetooth Configuration	BR+EDR
Antenna Type	Please refer to the Note 3.
Adapter	Input: 100-240V~50/60Hz 0.7A Output: DC 5.0V 3.0A 15.0W
Hardware version number	5071B
Software version number	20210916
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.

	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	Joann	DT01	PIFA	N/A	3dBi	BT Antenna

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

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2.2 DESCRIPTION OF THE TEST MODES

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

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

Note:

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

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

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

For AC Conducted Emission

	Test Case
AC Conducted Emission	Mode 13 : Keeping BT TX

2.3 FREQUENCY HOPPING SYSTEM REQUIREMENTS

(1)Standard and Limit

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

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



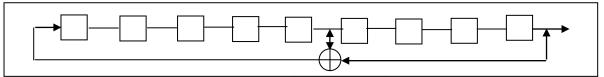
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The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping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

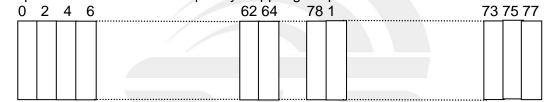
(2)The Pseudorandom sequence may be generated in a nin-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones: i.e. the shift register is initialized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

Numver of shift register stages:9

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



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



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

(3) Frequency Hopping System

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

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

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

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



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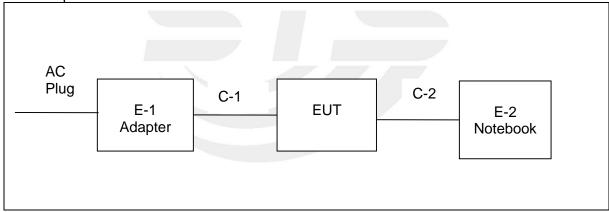
2.4 TABLE OF PARAMETERS OF TEST SOFTWARE SETTING

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

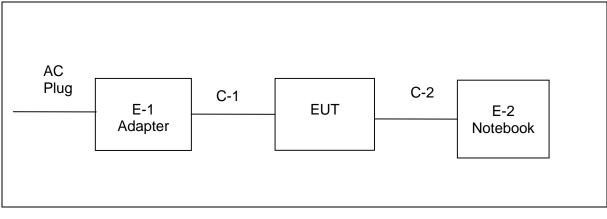
Test software Version	Test program: Bluetooth			
(Power control software) Parameters(1/2/3Mbps)	Power class: DH1 rate:4:27 2DH1 rate:20:54 3DH1 rate:24:83	Power class: DH3 rate:11:183 2DH3 rate:26:367 3DH3 rate:27:552	Power class: DH5 rate:15:339 2DH5 rate:30:679 3DH5 rate:31:1021	

RF Function	Туре	Mode Or Modulation type	ANT Gain(dBi)	Power Class	Software For Testing
		GFSK	3	Default	
BT	BR+EDR	π/4-DQPSK	3	Default	RF_Test Tool
		8DPSK	3	Default	

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



Conducted Emission Test





2.6 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

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

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
E-1	Adapter	N/A	MD30A-0500300-T	N/A	N/A
C-1	DC Cable	N/A	N/A	285cm	NO

Support units

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
E-2	Notebook	LENOVO	ThinkPad E470	N/A	N/A
C-2	USB Cable	N/A	N/A	150cm	NO

Note:

- (1) For detachable type I/O cable should be specified the length in cm in $\[\]$ Length $\[\]$ column.
- (2) "YES" is means "with core"; "NO" is means "without core".



2.7 EQUIPMENTS LIST

Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	
Test Receiver	R&S	ESCI	101427	2021.09.30	2022.09.29	
Signal Analyzer	R&S	FSV 40-N	101823	2021.09.30	2022.09.29	
Active loop Antenna	ZHINAN	ZN30900C	16035	2021.04.11	2023.04.10	
Bilog Antenna	TESEQ	CBL6111D	34678	2020.10.12	2022.10.11	
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	2021.10.11	2023.10.10	
SHF-EHF Horn Antenna (18G-40GHz)	A-INFO	LB-180400-KF	J211020657	2020.10.12	2022.10.11	
Pre-Amplifier(0.1M-3 GHz)	EM	EM330	060665	2021.10.08	2022.10.07	
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK2018080901	2021.09.30	2022.09.29	
Pre-Amplifier (18G-40GHz)	SKET	LNPA-1840-50	SK2018101801	2021.09.28	2022.09.27	
Temperature & Humidity	HH660	Mieo	N/A	2021.10.09	2022.10.08	
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	2021.09.30	2022.09.29	
LISN	R&S	ENV216	101242	2021.09.30	2022.09.29	
LISN	EMCO	3810/2NM	23625	2021.09.30	2022.09.29	
Temperature & Humidity	HH660	Mieo N/A 2021.10.09 2022.10.08				
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)				



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RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
			MY55520005	2021.09.30	2022.09.29
Dower Concor	Kovojaht	U2021XA	MY55520006	2021.09.30	2022.09.29
Power Sensor	Keysight		MY56120038	2021.09.30	2022.09.29
			MY56280002	2021.09.30	2022.09.29
Signal Analyzer	Agilent	N9020A	MY51110105	2021.03.04	2022.03.03
Temperature & Humidity	HH660	Mieo	N/A	2021.10.09	2022.10.08
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)			



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3. EMC EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

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

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

Note:

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

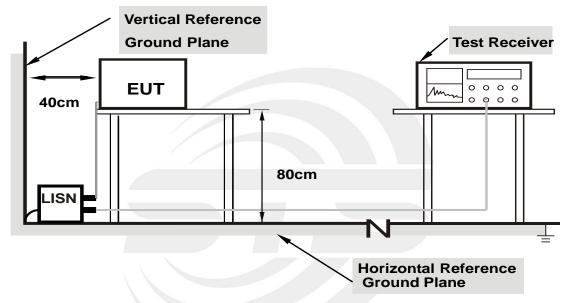
The following table is the setting of the receiver

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



3.1.2 TEST PROCEDURE

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



3.1.3 TEST SETUP

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

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

3.1.4 EUT OPERATING CONDITIONS

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



3.1.5 TEST RESULT

Temperature:	21.8(C)	Relative Humidity:	54%RH
Test Voltage:	AC 120V/60Hz	Phase:	L
Test Mode:	Mode 13		

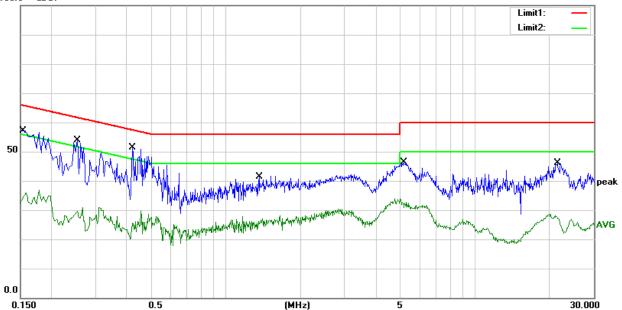
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.1540	36.90	20.33	57.23	65.78	-8.55	QP
2	0.1540	15.66	20.33	35.99	55.78	-19.79	AVG
3	0.2540	33.26	20.54	53.80	61.63	-7.83	QP
4	0.2540	10.31	20.54	30.85	51.63	-20.78	AVG
5	0.4220	30.78	20.54	51.32	57.41	-6.09	QP
6	0.4220	5.64	20.54	26.18	47.41	-21.23	AVG
7	1.3620	20.96	20.30	41.26	56.00	-14.74	QP
8	1.3620	6.81	20.30	27.11	46.00	-18.89	AVG
9	5.1820	25.79	20.47	46.26	60.00	-13.74	QP
10	5.1820	13.36	20.47	33.83	50.00	-16.17	AVG
11	21.3980	23.37	22.82	46.19	60.00	-13.81	QP
12	21.3980	5.20	22.82	28.02	50.00	-21.98	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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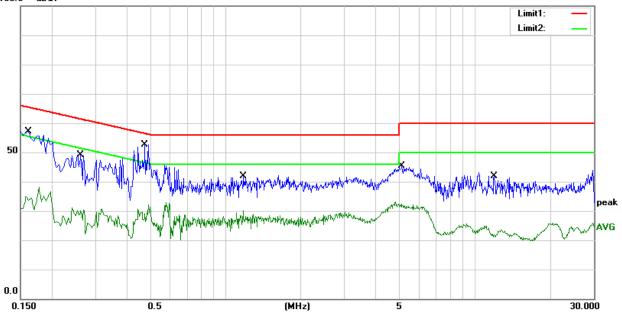
Temperature:	21.8(C)	Relative Humidity:	54%RH
Test Voltage:	AC 120V/60Hz	Phase:	Ν
Test Mode:	Mode 13		

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.1620	36.88	20.33	57.21	65.36	-8.15	QP
2	0.1620	14.61	20.33	34.94	55.36	-20.42	AVG
3	0.2620	28.57	20.58	49.15	61.37	-12.22	QP
4	0.2620	9.76	20.58	30.34	51.37	-21.03	AVG
5	0.4740	32.02	20.54	52.56	56.44	-3.88	QP
6	0.4740	9.12	20.54	29.66	46.44	-16.78	AVG
7	1.1820	21.57	20.30	41.87	56.00	-14.13	QP
8	1.1820	7.94	20.30	28.24	46.00	-17.76	AVG
9	5.0900	24.90	20.46	45.36	60.00	-14.64	QP
10	5.0900	11.82	20.46	32.28	50.00	-17.72	AVG
11	11.9820	20.49	21.41	41.90	60.00	-18.10	QP
12	11.9820	0.61	21.41	22.02	50.00	-27.98	AVG

Remark:

1. All readings are Quasi-Peak and Average values

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





3.2 RADIATED EMISSION MEASUREMENT

3.2.1 RADIATED EMISSION LIMITS

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the Restricted band specified on Part15.205 (a)&209(a) 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)	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)		

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

3.2.2 TEST PROCEDURE

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

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

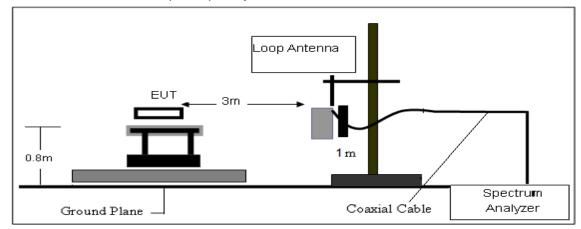
3.2.3 DEVIATION FROM TEST STANDARD

No deviation.

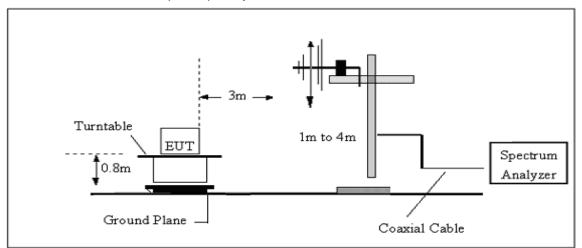


3.2.4 TESTSETUP

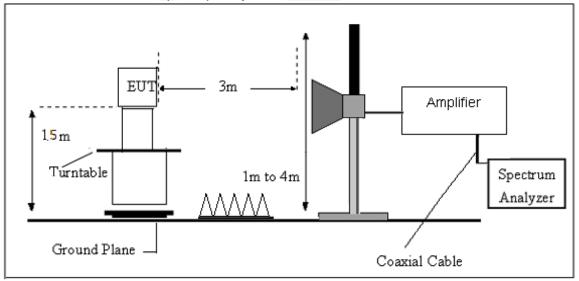
(A) Radiated Emission Test-Up Frequency Below 30MHz



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



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







3.2.6 FIELD STRENGTH CALCULATION

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

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

For example

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

Factor=AF+CL-AG



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3.2.7 TEST RESULTS

(9KHz-30MHz)

Temperature:	23.1(C)	Relative Humidity:	60%RH
Test Voltage:	AC 120V/60Hz	Test Mode:	TX Mode

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

Note:

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

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



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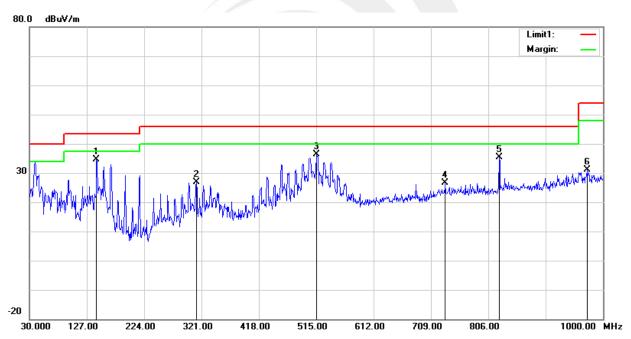
(30MHz-1000MHz)

Temperature:	23.1(C)	Relative Humidity:	60%RH		
Test Voltage:	AC 120V/60Hz	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	143.4900	52.74	-18.23	34.51	43.50	-8.99	QP
2	312.2700	41.30	-14.36	26.94	46.00	-19.06	QP
3	515.9700	44.36	-7.87	36.49	46.00	-9.51	QP
4	733.2500	28.90	-2.35	26.55	46.00	-19.45	QP
5	824.4300	36.72	-1.42	35.30	46.00	-10.70	QP
6	972.8400	28.98	2.19	31.17	54.00	-22.83	QP

Remark:

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





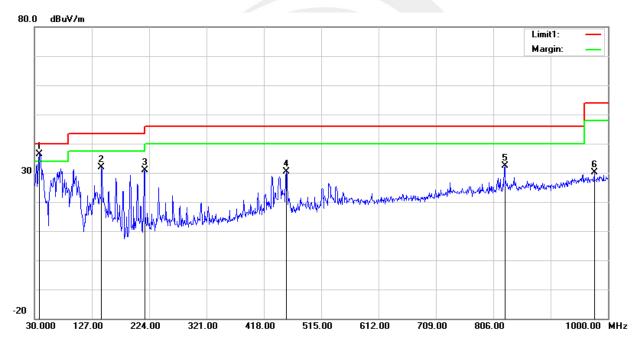
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Temperature:	23.1(C)	Relative Humidity:	60%RH	
Test Voltage:	AC 120V/60Hz	Phase:	Vertical	
Test Mode:	Mode 1/2/3/4/5/6/7/8/9 (Mode 7 worst mode)			

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	38.7300	53.81	-17.36	36.45	40.00	-3.55	QP
2	143.4900	50.06	-18.23	31.83	43.50	-11.67	QP
3	216.2400	50.89	-20.05	30.84	46.00	-15.16	QP
4	455.8300	40.00	-9.55	30.45	46.00	-15.55	QP
5	825.4000	33.75	-1.31	32.44	46.00	-13.56	QP
6	976.7200	27.67	2.45	30.12	54.00	-23.88	QP

Remark:

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



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(1GHz~25GHz) Spurious emission Requirements

Frequency	Meter Reading	Amplifier	Loss	Antenna Factor	Corrected Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBµV)	(dB)	(dB)	(dB/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре	
				Low Ch	annel (8DPSK/	/2402 MHz)				
3264.85	62.08	44.70	6.70	28.20	-9.80	52.28	74.00	-21.72	PK	Vertical
3264.85	51.39	44.70	6.70	28.20	-9.80	41.59	54.00	-12.41	AV	Vertical
3264.73	62.18	44.70	6.70	28.20	-9.80	52.38	74.00	-21.62	PK	Horizontal
3264.73	50.49	44.70	6.70	28.20	-9.80	40.69	54.00	-13.31	AV	Horizontal
4804.39	58.91	44.20	9.04	31.60	-3.56	55.35	74.00	-18.65	PK	Vertical
4804.39	50.05	44.20	9.04	31.60	-3.56	46.49	54.00	-7.51	AV	Vertical
4804.37	58.67	44.20	9.04	31.60	-3.56	55.11	74.00	-18.89	PK	Horizontal
4804.37	50.34	44.20	9.04	31.60	-3.56	46.78	54.00	-7.22	AV	Horizontal
5359.84	48.98	44.20	9.86	32.00	-2.34	46.64	74.00	-27.36	PK	Vertical
5359.84	39.85	44.20	9.86	32.00	-2.34	37.50	54.00	-16.50	AV	Vertical
5359.73	47.21	44.20	9.86	32.00	-2.34	44.87	74.00	-29.13	PK	Horizontal
5359.73	39.13	44.20	9.86	32.00	-2.34	36.79	54.00	-17.21	AV	Horizontal
7205.95	53.99	43.50	11.40	35.50	3.40	57.39	74.00	-16.61	PK	Vertical
7205.95	43.71	43.50	11.40	35.50	3.40	47.11	54.00	-6.89	AV	Vertical
7205.76	53.49	43.50	11.40	35.50	3.40	56.89	74.00	-17.11	PK	Horizontal
7205.76	44.58	43.50	11.40	35.50	3.40	47.98	54.00	-6.02	AV	Horizontal
				Middle C	hannel (8DPSł	2441 MHz)</td <td></td> <td></td> <td></td> <td></td>				
3264.89	62.11	44.70	6.70	28.20	-9.80	52.31	74.00	-21.69	PK	Vertical
3264.89	50.52	44.70	6.70	28.20	-9.80	40.72	54.00	-13.28	AV	Vertical
3264.61	61.67	44.70	6.70	28.20	-9.80	51.87	74.00	-22.13	PK	Horizontal
3264.61	50.81	44.70	6.70	28.20	-9.80	41.01	54.00	-12.99	AV	Horizontal
4882.45	59.04	44.20	9.04	31.60	-3.56	55.48	74.00	-18.52	PK	Vertical
4882.45	49.12	44.20	9.04	31.60	-3.56	45.56	54.00	-8.44	AV	Vertical
4882.60	59.51	44.20	9.04	31.60	-3.56	55.95	74.00	-18.05	PK	Horizontal
4882.60	49.29	44.20	9.04	31.60	-3.56	45.73	54.00	-8.27	AV	Horizontal
5359.82	48.23	44.20	9.86	32.00	-2.34	45.88	74.00	-28.12	PK	Vertical
5359.82	39.23	44.20	9.86	32.00	-2.34	36.89	54.00	-17.11	AV	Vertical
5359.79	47.58	44.20	9.86	32.00	-2.34	45.23	74.00	-28.77	PK	Horizontal
5359.79	38.85	44.20	9.86	32.00	-2.34	36.51	54.00	-17.49	AV	Horizontal
7323.85	53.77	43.50	11.40	35.50	3.40	57.17	74.00	-16.83	PK	Vertical
7323.85	44.39	43.50	11.40	35.50	3.40	47.79	54.00	-6.21	AV	Vertical
7323.73	54.02	43.50	11.40	35.50	3.40	57.42	74.00	-16.58	PK	Horizontal
7323.73	43.79	43.50	11.40	35.50	3.40	47.19	54.00	-6.81	AV	Horizontal



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				High Chan	nel (8DPSK	(2480 MHz)				
3264.85	61.11	44.70	6.70	28.20	-9.80	51.31	74.00	-22.69	PK	Vertical
3264.85	50.90	44.70	6.70	28.20	-9.80	41.10	54.00	-12.90	AV	Vertical
3264.74	61.96	44.70	6.70	28.20	-9.80	52.16	74.00	-21.84	PK	Horizontal
3264.74	50.04	44.70	6.70	28.20	-9.80	40.24	54.00	-13.76	AV	Horizontal
4960.28	59.39	44.20	9.04	31.60	-3.56	55.83	74.00	-18.17	PK	Vertical
4960.28	50.29	44.20	9.04	31.60	-3.56	46.73	54.00	-7.27	AV	Vertical
4960.33	58.42	44.20	9.04	31.60	-3.56	54.86	74.00	-19.14	PK	Horizontal
4960.33	50.48	44.20	9.04	31.60	-3.56	46.92	54.00	-7.08	AV	Horizontal
5359.63	48.52	44.20	9.86	32.00	-2.34	46.18	74.00	-27.82	PK	Vertical
5359.63	40.14	44.20	9.86	32.00	-2.34	37.80	54.00	-16.20	AV	Vertical
5359.64	47.07	44.20	9.86	32.00	-2.34	44.73	74.00	-29.27	PK	Horizontal
5359.64	39.06	44.20	9.86	32.00	-2.34	36.71	54.00	-17.29	AV	Horizontal
7439.72	54.72	43.50	11.40	35.50	3.40	58.12	74.00	-15.88	PK	Vertical
7439.72	43.81	43.50	11.40	35.50	3.40	47.21	54.00	-6.79	AV	Vertical
7439.86	54.07	43.50	11.40	35.50	3.40	57.47	74.00	-16.53	PK	Horizontal
7439.86	44.68	43.50	11.40	35.50	3.40	48.08	54.00	-5.92	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.



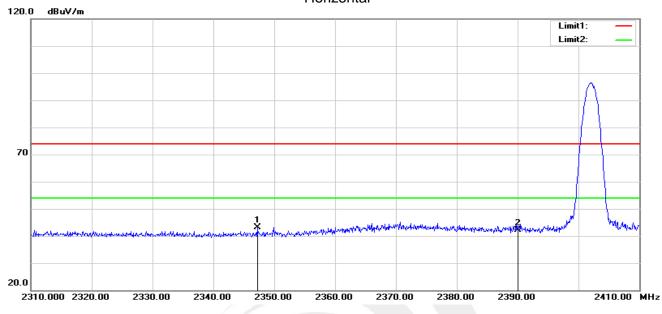
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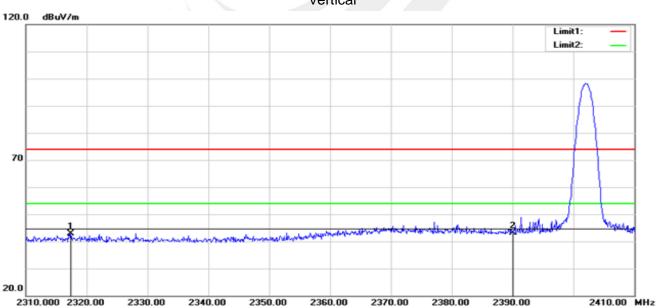


Restricted band Requirements

8DPSK-Low Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2347.200	39.35	3.72	43.07	74.00	-30.93	peak
2	2390.000	37.76	4.34	42.10	74.00	-31.90	peak



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2317.400	39.25	3.56	42.81	74.00	-31.19	peak
2	2390.000	38.69	4.34	43.03	74.00	-30.97	peak

Vertical

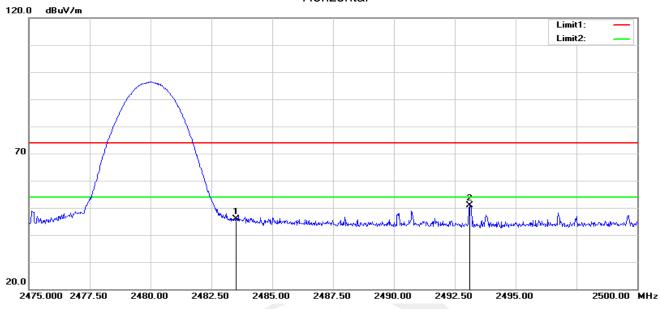
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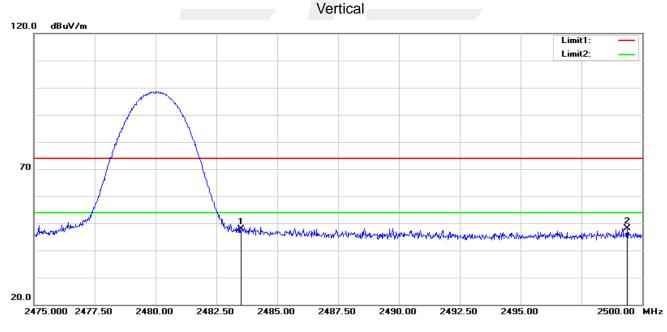
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8DPSK-High Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	41.34	4.60	45.94	74.00	-28.06	peak
2	2493.125	46.23	4.64	50.87	74.00	-23.13	peak



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	43.40	4.60	48.00	74.00	-26.00	peak
2	2499.375	43.38	4.65	48.03	74.00	-25.97	peak

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

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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 Eroguopou	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/Stop Eraguapay	Lower Band Edge: 2300– 2403 MHz
Start/Stop Frequency	Upper Band Edge: 2479 – 2500 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold







The EUT is connected to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading. Tune the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, the span is set to be greater than RBW.

4.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.





4.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	50%
Test Mode:	GFSK(1Mbps)-00/39/78 CH	Test Voltage:	AC 120V/60Hz

00 CH

RL			50 Ω AC			SENSE:PUL	Æ	AL	IGN AUTO		06:35	:54 PM Oct 11, 20
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N	1	f		24.076 GHz	-47.7	67 dBm						
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39 CH

Agilon	t Spe	octruu	n An	alyzer - Swept S								
LX/ R			RF			SE	NSE:PULSE		ALIGN AUTO		06:38:5	2 PM Oct 11, 2021
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10 dl	B/div			Offset 0.5 dE 16.76 dBr								.452 GHz 755 dBm
Log 6.76			•	1								
-3.24	⊢									_		
-13.2	⊢											-12.35 dBm
-23.2 -33.2												
-43.2					3							4
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Star #Re				kHz		#VB	W 300 kHz	:		Sw	Stop eep 2.386	25.00 GHz 6 (1001 pts)
MKR 1	MODE N	TRC	SCL f		× 2.452 GHz	Y 6.755		ICTION	FUNCTION WIDTH		FUNCTION VALUE	^
2	N	1	f		2.452 GHz 2.677 GHz 5.923 GHz	-57.179	dBm					
4	Ň	1	ŕ		24.576 GHz	-47.418						
6 7												
8 9												
10 11												~
MSG									STATUS			

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78 CH

		yzer - Swept S								
nter F	RF Trea 12	50 Q A		SE SE	INSE:PULSE		IGNAUTO Avg Type:	Log-Pwr		09 PM Oct 11, 202
				PNO: Fast 🖵 FGain:Low	Trig: Free Ri #Atten: 30 di					DET PPP
dB/div)ffset 0.5 dB 16.46 dBr								2.477 GH .456 dB
16		1								
.4										
5										-12.33 d
5										
5										
5		2		A 3						
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5										
art 30 I es BW		Hz		#VB	W 300 kHz			Sw	Stoj eep 2.386	o 25.00 GH s (1001 p1
N MODE T			×	Y	FUNCT	ION FUNC	TION WIDTH		FUNCTION VALUE	
N ⁴	1 f 1 f 1 f		2.477 GHz 2.502 GHz 7.446 GHz 24.301 GHz	-56.653 -56.549	dBm					
										>
										2



Shenzhen STS Test Services Co., Ltd.



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

		nalyzer - Swe	ept SA										
LXI RL		KF 50 Ω	AC	SE	NSE:PULSE	AL	IGN AUTO	e: Log-Pwr		4 PM Oct 11, 2021 RACE 1 2 3 4 5 6			
Cent	er Freq	2.35350	0000 GHz	PNO: Fast	Trig: Free		Avg typ	e. Log-Fwi		TYPE MWAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA			
				Gain:Low	#Atten: 30	dB							
	Ref Offset 0.5 dB Mkr1 2.402 19 GHz dB/div Ref 17 49 dBm 7.487 dBm												
10 dE Log r	l/div R	ef 17.49 c	lBm			1			7.	487 aBm			
7.49										1			
-2.51													
-12.5										-12,51 dBm			
-22.5													
-32.5													
-42.5													
-42.5	∧2									(S) ²⁴ \			
	molenne	and stand and stand	math all all and a los	al mount of the second	Mar My ar Mar	mandymme	m Ing strange	hemment	remandance	month by			
-62.5													
-72.5													
Start	2.30000	GHz				1			Stop 2.	40700 GHz			
#Res	5 BW 10) kHz		#VB	W 300 kHz			Swee		s (1001 pts)			
MKR M	IODE TRC SI	a	×	Y	FUN	CTION FUNC	TION WIDTH	F	UNCTION VALUE	~			
	N 1 f N 1 f		2.402 19 GHz 2.304 17 GHz										
3	N 1 f	,	2.399 40 GHz	-54.412	dBm								
	N 1 f		2.400 05 GHz	-53.047	dBm								
5 6 7													
8													
9 10													
11										~			
<							OTATUO			>			
MSG							STATUS						

00 CH

39 CH





78 CH

RL	ctrum Anal RF	lyzer - Swept SA 50 Ω AC		SEN	SE:PULSE	ALIGNAUTO		06:52:39	PM Oct 11, 202
enter I	Freq 2	.48750000	F	PNO: Fast 🖵 Gain:Low	Trig: Free Run #Atten: 30 dB	Avg Ty	pe: Log-Pwr		ACE 1 2 3 4 5 TYPE MWMMM DET P P P P P
dB/div		Offset 0.5 dB 17.71 dBm					MI	(r1 2.480 7.	150 GH 707 dBr
2 g .71			0 1						
29		/	$\left\{ \right.$						-12.33 di
.3									
.3		/	4						
.3		l	h						
.3	mm	monto	North Contraction	2 3		mon har hour har	man and a		
2.3							I Defense after brakfarr	Alle Inclus Acres 4 mars	and and a second
								Stop 2	50000 G H
	17500 C V 100 k			#VBV	V 300 kHz		Sweej	2.400 ms	
les BV	V 100 k	(Hz	X 490 150 CH7	Y	FUNCTION	FUNCTION WIDTH			
Res BV	V 100 k	(Hz 2. 2. 2. 2.	× 480 150 GHz 483 500 GHz 484 150 GHz 494 525 GHz	#VBV 7.707 (-57.556 -56.968 (-57.765 (FUNCTION IBm IBm IBm	FUNCTION WIDTH		2.400 ms	
es BV	V 100 k 1 f 1 f 1 f 1 f	(Hz 2. 2. 2. 2.	480 150 GHz 483 500 GHz 484 150 GHz	7.707 c -57.556 c -56.968 c	FUNCTION IBm IBm IBm	FUNCTION WIDTH		2.400 ms	
Res BV	V 100 k 1 f 1 f 1 f 1 f	(Hz 2. 2. 2. 2.	480 150 GHz 483 500 GHz 484 150 GHz	7.707 c -57.556 c -56.968 c	FUNCTION IBm IBm IBm	FUNCTION WIDTH		2.400 ms	
Res BV R MODE N 2 N 3 N	V 100 k 1 f 1 f 1 f 1 f	(Hz 2. 2. 2. 2.	480 150 GHz 483 500 GHz 484 150 GHz	7.707 c -57.556 c -56.968 c	FUNCTION IBm IBm IBm	FUNCTION WIDTH		2.400 ms	



Shenzhen STS Test Services Co., Ltd.





For Hopping Band edge

GFSK

ent Spect R L		/zer - Swept								
	 Freq 2.			PNO: Fast Gain:Low	NSE:PULSE Trig: Free #Atten: 30		ALIGNAUTO Avg Type:		т	ACE 1 2 3 4 TYPE MWWW DET P P P P
dB/div		offset 0.5 di 17.46 dB						M	kr1 2.401 7.	867 GH 456 dB
16										
i4										
5										-12.54 c
.5										
5										
5									2	0
5	noun		a marine a m	- ales Minder a	- many which many	mount	entry which we also we also which the	man	mandula	ad march
5										
	0000 G 100 k			#VB	W 300 kHz	:		Swee	Stop 2. p 9.867 ms	40300 GI s (1001 p1
	1 f 1 f		× 2.401 867 GHz 2.390 022 GHz	7.456 -59.651	dBm dBm	ICTION	FUNCTION WIDTH		UNCTION VALUE	
N	1 f		2.400 013 GHz	-55.550	dBm					
										>
							STATUS			

otor	RF	50 Q AC		SET	ISE:PULSE	ALIGNAUTO Ava Tva	e: Log-Pwr	07:12:20 PM TRACE	
11.61	FIEQ 2	-40930000	PI	10: Fast 😱 Gain:Low	Trig: Free Run #Atten: 30 dB			TYP	
IB/div		Offset 0.5 dB 17.57 dBn					М	kr1 2.479 1 7.56	68 GI 67 dB
1	m								
H	LL_								
	\rightarrow								-12.43 (
\vdash	\rightarrow								
\vdash	- Y	1							
		Mr.	A2			3			
		moun	Marman	mann	mannow		manna	man-man	a man
	17900 (<u></u>						Otem 2 50	
	N 100			#VB	N 300 kHz		Swee	Stop 2.50 p 2.067 ms (1	000 G
	TRC SCL		×	Y	FUNCTION	FUNCTION WIDTH		FUNCTION VALUE	
N N	1 f 1 f	2	.479 168 GHz .483 515 GHz	7.567 -58.159	dBm				
Ν	1 f	2.	.492 692 GHz	-57.371	dBm				
									>



Page 39 of 75 Report No.: STS2109158W01

Temperature:	25 ℃	Relative Humidity:	50%
	π/4-DQPSK(2Mbps)– 00/39/78 CH	Test Voltage:	AC 120V/60Hz

RF 50	Q AC	SEN	SE:PULSE	AL	IGNAUTO		07:15:28 PM	Oct 11.
ter Freq 12.51	PN	IO: Fast	Trig: Free Ru		Avg Type:	Log-Pwr	TRACE	123 MWM PPPP
	IFG	ain:Low	#Atten: 30 dB	3			DE	TIPPP
Ref Offset 3/div Ref 13.2							Mkr1 2.40 3.25	
(1								
ĭ								
								-12.5
<u>2</u>								-10 ⁻⁰⁰
- Human	man month of the start	And the second second	moder in her and	and an and and	deadly to Mary	and the second	manner annaly	
And the second s		- distant, da						
t 30 MHz s BW 100 kHz		#VBV	V 300 kHz			Swe	Stop 25 ep 2.386 s (1	5.00 (001
10DE TRC SCL	×	Y	FUNCT	ON FUNC	TION WIDTH	;	UNCTION VALUE	
N 1 f N 1 f	2.402 GHz 2.652 GHz	3.254 (-56.939 (
N 1 f	5.623 GHz	-56.401 c	:lBm					
N 1 f	24.501 GHz	-48.090 (lBm					
					STATUS			

00 CH

30	CH
23	OIT

unter I	RF	50 Q AC		SENSE:PU	.9E	ALIGN AUTO		07:18:07	PM Oct 11, 20
nierr	req '	12.5150000	PI		g: Free Run ten: 30 dB	Avg Type	: Log-Pwr	-	ACE 1 2 3 4 YPE MWAAAAA DET P P P P
dB/div		Offset 0.5 dB f 14.55 dBm	ı					Mkr1 2. 4.	452 GH 548 dB
		1							
.5									
5									-12.34
5									
5									
5 									
		2	3				1.4	a duaman	1 martha
	mane	and were have me	menning many	mound	when more	May we wanted the set	a mon short maple	Charles and	and and a
i									
rt 30	MHz							Stop	25.00 G
	v 100	kHz		#VBW 30	0 kHz		Swe	ep 2.386 s	(1001 p
C2 DV			x I	Y	FUNCTION	FUNCTION WIDTH	ł	UNCTION VALUE	
	TRC SCL								
MODE N	1 f		2.452 GHz	4.548 dBm					
MODE N N	1 f 1 f 1 f		2.802 GHz 6.472 GHz	-56.855 dBm -56.905 dBm					
MODE N N	1 f 1 f		2.802 GHz	-56.855 dBm					
MODE N N	1 f 1 f 1 f		2.802 GHz 6.472 GHz	-56.855 dBm -56.905 dBm					
MODE N N	1 f 1 f 1 f		2.802 GHz 6.472 GHz	-56.855 dBm -56.905 dBm					
MODE N N	1 f 1 f 1 f		2.802 GHz 6.472 GHz	-56.855 dBm -56.905 dBm					
MODE N N N	1 f 1 f 1 f		2.802 GHz 6.472 GHz	-56.855 dBm -56.905 dBm					>



78 CH

nt Spectrum Analyzer - Swe		SENSE:PULSE	AI	IGNAUTO		07(21)02	PM Oct 11, 2
nter Freq 12.5150	00000 GHz PNO	: Fast Trig: Fre in:Low #Atten: 3	e Run	Avg Type: L	og-Pwr	TR	ACE 1 2 3 4 YPE MWAAV DET P P P F
Ref Offset 0.5						Mkr1 2. 6.	477 GI 030 dB
3 							
7 							-12.35
)							
2 na standardinalistication	3 auntum manan	verone free rear and	have the work	www.wetater	here and the second	and and a stand of the stand of	- Martin Martin
rt 30 MHz es BW 100 kHz		#VBW 300 kH	Iz		Swe	Stop ep 2.386 s	25.00 G (1001 p
MODE TRC SCL N 1 f N 1 f N 1 f N 1 f N 1 f	× 2.477 GHz 2.677 GHz 5.973 GHz 24.700 GHz	6.030 dBm -56.283 dBm -56.294 dBm -48.192 dBm	UNCTION FUNCT	ION WIDTH	FL	INCTION VALUE	
				STATUS			



Shenzhen STS Test Services Co., Ltd.

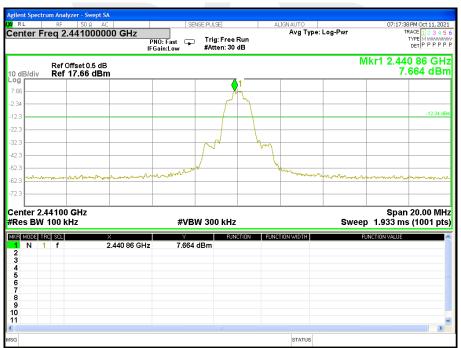


For Band edge(it's also the reference level for conducted spurious emission)

	Analyzer - Swept S	ł							
LXI RL	RF 50 Ω AC		SE	NSE:PULSE	A	LIGNAUTO Avg Type	l e a Dum		BPM Oct 11, 2021
Center Fre	q 2.3535000	P	'NO: Fast 🖵 Gain:Low	Trig: Free #Atten: 30		Avg Type	. Log-Pwr		TYPE MWAAAAAAA DET P P P P P P
10 dB/div	Ref Offset 0.5 dB Ref 17.47 dBn						IV		1 86 GHz 470 dBm
Log									1
7.47									Ă.
-2.53									-12 53 dBm
-12.5									
-22.5									
-32.5									1.1
-42.5		2							
-52.5	mannaman	and a second state of the	مى مەرىپىرىيە مەرىپىرىيە مەرىپىرىيە مەرىپىرىيە	-	-	annormany	and the second second second	mandun	and the
-62.5									
-72.5									
Start 2.3000 #Res BW 10			#VB	W 300 kHz			Sweep	Stop 2. 5 10.27 ms	40700 GHz 5 (1001 pts)
MKR MODE TRC		× 2.401 86 GHz	Y 7.470		CTION FUNC	TION WIDTH	Ħ	UNCTION VALUE	<u> </u>
2 N 1 3 N 1		2.320 44 GHz 2.399 40 GHz	-57.741 -53.812						
4 N 1		2.400 05 GHz	-52.375						
5 6 7									
7									
8 9 10									
10									~
<				Ш					>
MSG						STATUS			

00 CH

39 CH





78 CH

RL	rum Analyze RF	er - Swept SA 50 Ω AC		SEN	SE:PULSE	ALIGNAUTO	1	07:20:33 PM Oct 11, 2
enter F	req 2.4	8750000	00 GHz	PNO: Fast 😱 Gain:Low	Trig: Free Run #Atten: 30 dB		Type: Log-Pwr	TRACE 1 2 3 4 TYPE MWWW DET P P P F
dB/div		set 0.5 dB 7.65 dBm	ı				IV	1kr1 2.479 850 G 7.645 dE
65								
35			1					-12.35
2.4								
		m	m					
4				3	;		4	
2.4	nar longer		~	mound	www.www.	Manny Warner	marilin	man and a second and the second se
2.4								
	'500 GH 100 kH			#VBV	V 300 kHz		Swee	Stop 2.50000 G ep 2.400 ms (1001 p
R MODE TR	RC SCL		× 479 850 GHz	Y 7.645	FUNCTION	FUNCTION WIDT	H	FUNCTION VALUE
2 N 1	f	2. 2.	483 500 GHz 484 775 GHz 493 200 GHz	-56.593 (-57.021 (-58.484 (dBm dBm			
IN 1	f	2.	400 200 0112					
N 1	f	2.						
N 1	f	2.						
3 N 1 4 N 1 5 7 8 9 9 9	f	2.				STAT		



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For Hopping Band edge

π/4-DQPSK

RL	n Analyzer - Swep RF 50 Ω	AC AC	SEA	ISE:PULSE	ALIGN	AUTO		00:07:50.0	4 Oct 11, 202
	eq 2.351500	0000 GHz	PNO: Fast Gain:Low	Trig: Free Run #Atten: 30 dB		Avg Type: I	₋og-Pwr	TRA TY	
	Ref Offset 0.5 Ref 17.33 d						М	kr1 2.402 (7.3	173 GH 29 dBr
33									
67									-12.67 d
.7									
.7									
.7									
7	man	shamant mana	unentronome	when when here have	munn	warden the M		2 numerica	manne
.7									
art 2.300 es BW 1			#VB\	W 300 kHz			Swee	Stop 2.4 p 9.867 ms (
R MODE TRC	SCL f	× 2.402 073 GHz	Y 7.329	FUNCTION	FUNCTION	WIDTH	ł	UNCTION VALUE	
2 N 1 8 N 1	f	2.390 022 GHz 2.400 013 GHz	-57.940 -53.240						
1									
í									>

er Fr		ο Ω Ας 500000 GHz	PNO: Fast	SE:PULSE Trig: Free Run #Atten: 30 dB	ALIGNAUTO Avg Typ	e: Log-Pwr	TY	M Oct 11, 2 CE 1 2 3 PE M WAAA ET P P P
B/div	Ref Offset Ref 17.2	0.5 dB	IFGain:Low	#Atten: 50 dB		М	kr1 2.479 8	
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mar	hy							
								-12.73
,								
	han							
,								
	\	2						
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·								
rt 2 47	900 GHz						Stop 2.5	nnnn c
	100 kHz		#VBV	V 300 kHz		Swee	p 2.067 ms (
MODE TR		×	Y	FUNCTION	FUNCTION WIDTH	1	FUNCTION VALUE	
N 1 N 1	f f	2.479 861 GH 2.483 515 GH	z -58.679 d	Bm				
N 1	f	2.486 917 GH	z -56.752 d	lBm				
					STATUS			



Page 44 of 75 Report No.: STS2109158W01

Temperature:	25 ℃	Relative Humidity:	50%
Test Mode:	8DPSK(3Mbps) -00/39/78 CH	Test Voltage:	AC 120V/60Hz

00 CH

RL	um Analyzer - Sw RF 50 Ω		SENSE:PU	LSE	ALIGN AUTO		08:57:55	AM Oct 12, 202
enter Fi		000000 GHz	IO: East 😱 Tri	g: Free Run tten: 30 dB	Avg Type:	Log-Pwr	TF	ACE 1 2 3 4 5 TYPE M WARANA DET P P P P F
) dB/div	Ref Offset 0. Ref 10.16							402 GH 163 dBr
60	1							
.84								-12.00 dE
9.8								
9.8								
9.8		-						(
9.8	() ²	3			a martalan and sugar	and all you have been and	Marked Winger	and a second
3.8 a.s.e.s h	at and we have the	and the second	and the state of the second second	Mar and Mar and a start				
9.8								
9.0								
tart 30 N Res BW	/IHz 100 kHz		#VBW 30	0 kHz		Swe	Stop ep 2.386 s	25.00 GH (1001 pt
KR MODE TH		× 2.402 GHz	v 0.163 dBm	FUNCTION	FUNCTION WIDTH	F	UNCTION VALUE	
2 N 1 3 N 1 4 N 1 5	f	2.627 GHz 5.523 GHz 24.576 GHz	-56.825 dBm -55.734 dBm -47.192 dBm					
5 5 7								
3								
3 9 0 1								
3 9 0					STATUS			

39 CH

RL		Analyzer - Swej RF 50 Ω	AC	SENSE:PUL	9E	ALIGN AUTO		09.00.1	9 AM Oct 12, 2
			00000 GHz Pr	10: East 🕞 Trig	g: Free Run ten: 30 dB		: Log-Pwr		TYPE MWMMM DET P P P P
dB/di		ef Offset 0.5 ef_14.92 d							.452 GI .924 dB
		1							
18									-12.41
1									
1			3						
1		2 2	man werken werken	wanese to an	بمريالين المقاسمة وليو	muter man and	and the second second	her the second when	www.
	0 MHz W 10	<u>z</u> 0 kHz		#VBW 30	0 kHz		Swe	Stop eep 2.386) 25.00 G s (1001 p
MODE N		CL f	× 2.452 GHz	Y 4,924 dBm	FUNCTION	FUNCTION WIDTH		FUNCTION VALUE	
N	1 t	f f	3.151 GHz 5.698 GHz	-57.246 dBm -56.721 dBm					
		f	24.825 GHz	-47.704 dBm					
N									
N									
N									



78 CH

nt Spectrum Analyzer - Sw L RF 50 Q	AC	SENSE:PULSE	ALIGN 4		09:02:31 AM Oct 12,3
ter Freq 12.5150	DOOOOO GHz): Fast Trig: Fre in:Low #Atten: 3	e Run	wg Type: Log-Pwr	TRACE 1 2 3 TYPE MWWM DET P P
Ref Offset 0.9					Mkr1 2.477 G 4.578 dE
1					
					-12.4
\wedge^2	3			and the spectrum and the second	a construction of the second second
remander when	menter and marked	wannahara and	Philippine Contraction	And a state of the second s	
rt 30 MHz es BW 100 kHz		#VBW 300 kH	lz	5	Stop 25.00 G weep 2.386 s (1001 p
MODE TRC SCL	×		UNCTION FUNCTION	WIDTH	FUNCTION VALUE
N 1 f N 1 f N 1 f N 1 f	2.477 GHz 3.101 GHz 5.523 GHz 24.351 GHz	4.578 dBm -56.726 dBm -56.194 dBm -47.252 dBm			



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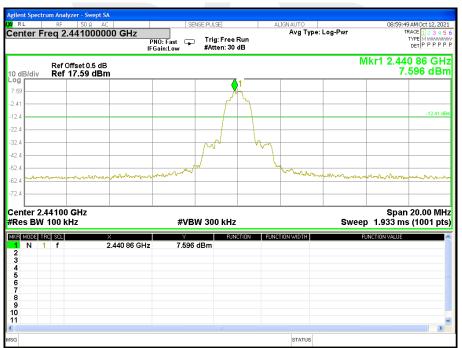


For Band edge(it's also the reference level for conducted spurious emission)

		ctrun		lyzer - Swept SA									
LXI RI		-	RF	50 Q AC		SE	NSE:PULSE		AL		: Log-Pwr		25 AM Oct 12, 2021
Cen	ter	Fre	≥q ∠	2.35350000	F	PNO: Fast 🖵 Gain:Low	Trig: Free #Atten: 30			Avg type	. Log-r wi		TYPE MWAAAAAAA DET P P P P P P
						Gam.cow						Mkr1 2 4(02 08 GHz
	B/div			Offset 0.5 dB 17.32 dBm	1								.373 dBm
Log 7.32													1
-2.68													
-12.7													-12,68 dBm
-22.7													
-32.7								_					
-42.7	<u> </u>												4
-52.7	<u> </u>			²									↓ Ŷ° ↓
-62.7	~~~	موار ورار. م	dren	Consultant and	man and the state		anner an	muchy	more	non and and and and a	and the second states of the second	mennelum	veren and
-72.7	<u> </u>												
Star	L	300	00 (GH7								Stop 2	.40700 GHz
#Re						#VB	W 300 kH	z			Swe		s (1001 pts)
	MODE	TRC	SCL		<	Y		INCTION	FUNCT	ION WIDTH		FUNCTION VALUE	<u>^</u>
1	N N	1	f	2	2.402 08 GHz 2.312 95 GHz	7.373 -58.174	dBm						
3	N N	1	f		2.399 40 GHz 2.400 05 GHz	-55.546 -49.589							
5													Ξ.
5 6 7 8 9													
9													
10 11													~
<													>
MSG										STATUS			

00 CH

39 CH





78 CH

RL RF	er - Swept SA		u ce l			20-20-2	
	50 Ω AC 87500000 GHz		rig: Free Run Atten: 30 dB	ALIGNAUTO Avg Type:	_	T	1 AM Oct 12, 20 RACE 1 2 3 4 TYPE MWWW DET P P P P
	set 0.5 dB 7.55 dBm				N	/kr1 2.479 7.	850 GH 550 dB
55							
5							-12.45 d
5							
5	Mr han						
5 American	N ha	when 2	manlim	www.wanterforder.com.March	4	and with more the second	mphan Ma
5							
art 2.47500 GH es BW 100 kH;		#VBW 3	00 kHz		Swe	Stop 2 ep 2.400 m	.50000 GI s (1001 pt
MODE TRC SCL N 1 f N 1 f N 1 f N 1 f	× 2.479 850 GH 2.483 500 GH 2.485 525 GH 2.492 925 GH	z -57.893 dBm z -56.970 dBm	1	FUNCTION WIDTH		FUNCTION VALUE	



Shenzhen STS Test Services Co., Ltd.





For Hopping Band edge

8DPSK

	rum Analyzer							
enter F		50 Ω AC 1500000 GHz Pi IFG		≊ j: Free Run sen: 30 dB	ALIGN AUTO Avg Type	Log-Pwr	TF	AM Oct 12, 202 ACE 1 2 3 4 5 FYPE M MANANA DET P P P P F
dB/div	Ref Offse Ref 17.3					М	kr1 2.401 7.	867 GH 372 dBr
37								
63								
.6								-12.63 d
.6								
.6								
.6							<mark>∂</mark> 2)
.6	American	www.weinterner.	lower mouth warder and	manghaller	memoryducordelaw	an salar stranger the same	plant mendom	want
.6								
	0000 GHz 100 kHz		#VBW 30) kHz		Swee	Stop 2. p 9.867 ms	40300 GH (1001 pt
R MODE TR		× 2.401 867 GHz	7.372 dBm	FUNCTION	FUNCTION WIDTH		FUNCTION VALUE	
N 1	f	2.390 022 GHz 2.400 013 GHz	-59.194 dBm -52.016 dBm					
				111				
					STATUS			

ntor Fre	RF 50 Ω		SENSE:	PULSE	ALIGNAUTO Avg Type:	Log-Pwr	09:42:03 A TRA	M Oct 12, 20
	rq 2.409500	PI		Trig: Free Run #Atten: 30 dB			TY	ET P P P P
dB/div	Ref Offset 0.5 Ref 17.27 di					Mł	(r1 2.480 1 7.2	55 GH 71 dB
7	1							
\mathbb{N}^{1}	~							
,								-12.73 c
·								
<u> </u>	how							
	- hom			3				
		and the grad and an	www.weeder.com	~~mallwater	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	har water and	have to have a second	مسمعموم
<u> </u>								
L	00 GHz						Stop 2.5	
es BW 1	00 kHz		#VBW	300 kHz		Sweep	2.067 ms	(1001 p
MODE TRC		× 2.480 155 GHz	7.271 dB	FUNCTION	FUNCTION WIDTH	FL	JNCTION VALUE	
N 1	f f	2.483 515 GHz	-58.678 dB	m				
N 1	f	2.488 870 GHz	-57.252 dB	m				
				III				



5. NUMBER OF HOPPING CHANNEL

5.1 LIMIT

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

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

5.2 TEST PROCEDURE

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



5.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.



5.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	60%
Test Mode:	Hopping Mode -GFSK Mode	Test Voltage:	AC 120V/60Hz

Number of Hopping Channel

79

Hopping channel

RL			JΩ AC				SE	VSE:PUL	SE .			ALIG	SN AUTO				0		PM Oct 1	
enter	Free	q 2.441	75000	0 GHz	P	NO: Fast Gain:Low	Ģ		g: Free ten: 30				Avg	Туре:	Log-Pw	r			ACE 12 INPE MW DET P P	LABAR
0 dB/di	vF	Ref Offset Ref 17.8	0.5 dB 5 dBm	1												Mkr:	2 2.47		93 0 .73 c	
°g 7.85 	>1 VVVV	www	ww	YYYYY	W	WWW	w	ww	nnn	m	w.	W	ww	NYY	ww	YYYY	YYYY	WW	ww	2
2.15																				
2.2												_								+
2.2												+								
2.2																				1
2.2												_								
72.2												+								
		0 GHz 0 kHz				:	#VBI	W 30	0 kHz						s	weep	Sto 1.13	op 2.4 3 ms	48350 (1001	GI I pi
KR MODE			>				Y 7.66		FUN	CTION	FU	NCTIO	ON WIDT	н		Fl	UNCTION W	NLUE		
1 N 2 N 3 4 5		f f	2.40	2 171 0 0 9 993 0 0	9HZ 9HZ			dBm dBm												
6 7																				
8 9 0																				
0																				>
0																				/

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6. AVERAGE TIME OF OCCUPANCY

6.1 LIMIT

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

6.2 TEST PROCEDURE

- a. The transmitter output (antenna port) was connected to the spectrum analyzer.
- b. Set RBW =1MHz/VBW =3MHz.
- c. Use a video trigger with the trigger level set to enable triggering only on full pulses.
- d. Sweep Time is more than once pulse time.
- Set the center frequency on any frequency would be measure and set the frequency span to e. zero span.
- f. Measure the maximum time duration of one single pulse.
- g. Set the EUT for DH5, DH3 and DH1 packet transmitting.
- h. Measure the maximum time duration of one single pulse.
- i. DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots RX, 1 time slot TX). So the number of pulses in the observation period of 31.6 seconds is $3.37 \times 31.6 = 106.6$.
- j. DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots RX, 1 time slot TX). So the number of pulses in the observation period of 31.6 seconds is $5.06 \times 31.6 = 160$.
- k. DH1 Packet permit maximum 1600 / 79 / 2 = 10.12 hops per second in each channel (1 time slot RX, 1 time slot TX). So the number of pulses in the observation period of 31.6 seconds is 10.12 x 31.6 = 320.

6.3 TEST SETUP



6.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.



6.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	50%
Test Mode:	GFSK(1Mbps)-DH1/DH3/DH5	Test Voltage:	AC 120V/60Hz

Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
DH1	middle	0.379	0.121	0.4
DH3	middle	1.637	0.262	0.4
DH5	middle	2.886	0.308	0.4



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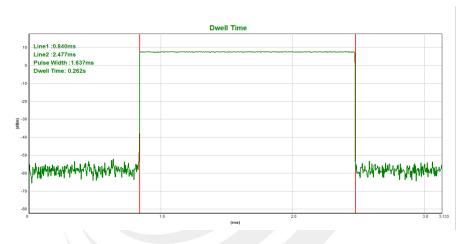
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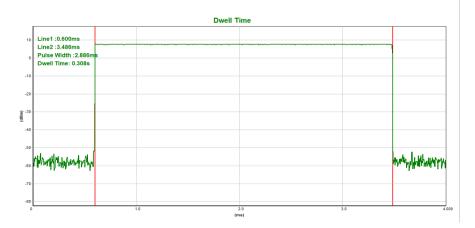
CH39-DH1



CH39-DH3







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Temperature:	25 ℃	Relative Humidity:	50%
	π/4-DQPSK(2Mbps)– 2DH1/2DH3/2DH5	Test Voltage:	AC 120V/60Hz

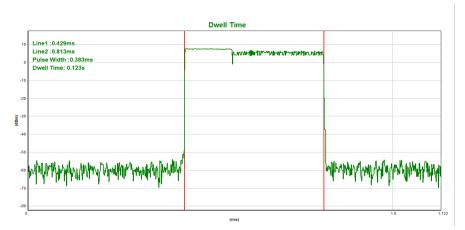
Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
2DH1	middle	0.383	0.123	0.4
2DH3	middle	1.638	0.262	0.4
2DH5	middle	2.884	0.308	0.4



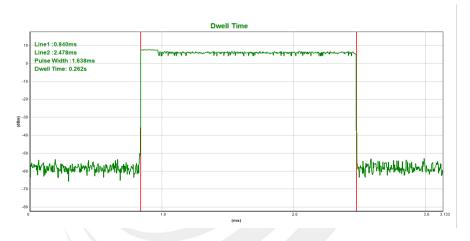
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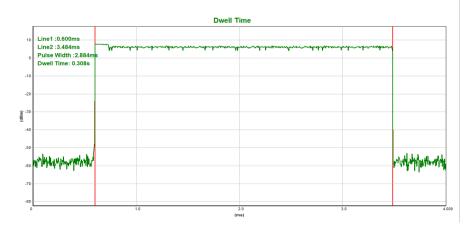
CH39-2DH1



CH39-2DH3



CH39-2DH5





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Temperature:	25 ℃	Relative Humidity:	50%
	8DPSK(3Mbps)– 3DH1/3DH3/3DH5	Test Voltage:	AC 120V/60Hz

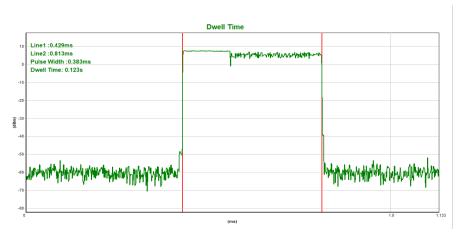
Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
3DH1	middle	0.383	0.123	0.4
3DH3	middle	1.636	0.262	0.4
3DH5	middle	2.888	0.308	0.4



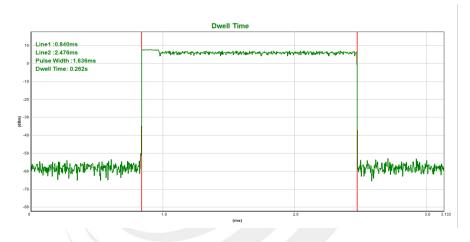
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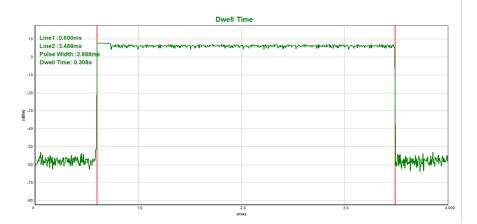
CH39-3DH1



CH39-3DH3



CH39-3DH5



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:	AC 120V/60Hz

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2401.843	2402.842	0.999	0.926	Complies
2441 MHz	2440.831	2441.848	1.017	0.925	Complies
2480 MHz	2478.837	2479.848	1.011	0.924	Complies

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

CH00 -1Mbps

RL RF	50 Ω AC	SENSE:PULSE	ALIGN AUTO	ſ	07:02:33 PM Oct 11, 202
	02500000 GHz	D: Wide 😱 Trig: Fre ain:Low #Atten: 3	Avg Type e Run	: Log-Pwr	TRACE 1 2 3 4 5 TYPE MWWWW DET P P P P P
dB/div Ref 13	set 0.5 dB 3.67 dBm			Mkr2 2.	402 842 GH 5.974 dBr
67	X	~~~~~	2 Mymmy		Arm
33				m m m	and
i.3	~~~~				~~~
.3	~~~~				
3 M _ / -					
.3					
.3					
.3					
enter 2.402500 Res BW 30 kHz	GHz	#VBW 100 kH	Iz	s Sweep 3.20	Span 3.000 MH 10 ms (1001 pt:
R MODE TRC SCL	Х		UNCTION FUNCTION WIDTH	FUNCTION	ALUE
N 1 f N 1 f	2.401 843 GHz 2.402 842 GHz	5.98 dBm 5.97 dBm			
·					
3					
)					
1					

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CH39 -1Mbps



CH78 -1Mbps



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Temperature:	25℃	Relative Humidity:	50%
Test Mode:	CH00 / CH39 / CH78 (π/4-DQPSK(2Mbps) Mode)	Test Voltage:	AC 120V/60Hz

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2401.840	2402.848	1.008	0.816	Complies
2441 MHz	2440.834	2441.845	1.011	0.816	Complies
2480 MHz	2478.840	2479.845	1.005	0.816	Complies

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

RL RF 50	OΩ AC	SENSE:PULSE	ALIGN AUTO	07:58:50 PM Oct 11, 202
nter Freq 2.402		Wide 😱 Trig: Free	Avg Type: L Run	
Ref Offset dB/div Ref 15.8				Mkr2 2.402 848 GH 5.609 dBi
2	N1	Maria		man
2 2 2 2				
2				
nter 2.402500 GH es BW 30 kHz	12	#VBW 100 kHz	2	Span 3.000 Mł Sweep 3.200 ms (1001 pt
NODE TRC SCL N 1 f N 1 f	X 2.401 840 GHz 2.402 848 GHz	FUN 6.00 dBm 5.61 dBm	NCTION FUNCTION WIDTH	FUNCTION VALUE

CH00 -2Mbps

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CH39 -2Mbps

RF	50 Ω AC		SENSE:PULSE		ALIGNAUTO			54 PM Oct 11, 2
er Freq 2.44	1500000 GH	lz PNO: Wid IFGain:Lo		ree Run : 30 dB	Avg Type:	Log-Pwr		TRACE 1 2 3 TYPE MWM DET P P P
	et 0.5 dB .84 dBm					М	kr2 2.44 ع	1 845 G 5.826 dE
		< <u>1</u>			2			
mm. a	_	MM	Am. a		A.	m. a		
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	arand y	~		munu	and And	- www.v	www	m
er 2.441500 ( BW 30 kHz	GHz		#VBW 100 k	H7		Swee	Spa 9 3.200 m	n 3.000 M
IDDE TRO SCL	×				UNCTION WIDTH		FUNCTIONVALUE	13 (1001
N 1 f	2.440 83		5.84 dBm					
N 1 f	2.441 84	5 GHz	5.83 dBm					

### CH78 -2Mbps



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Temperature:	25℃	Relative Humidity:	50%
	CH00 / CH39 / CH78 (8DPSK(3Mbps)Mode)	Test Voltage:	AC 120V/60Hz

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2401.837	2402.836	0.999	0.813	Complies
2441 MHz	2440.837	2441.836	0.999	0.813	Complies
2480 MHz	2478.837	2479.839	1.002	0.813	Complies

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

CH00 -3Mbps

R L RF	50 Ω AC	SENSE:PULSE	ALIGNAUTO	09:32:03 AM Oct 12, 202
enter Freq 2.4	102500000 GHz PNO IFG	): Wide Trig: Free R ain:Low #Atten: 30 d		TRACE 1 2 3 4 5 TYPE MWWWW DET P P P P P
dB/div Ref 1	fset 0.5 dB 4.74 dBm			Mkr2 2.402 836 GH 4.972 dBr
pg	()1		<b>2</b>	
.74		mm	1 mm	^~
26	and the second of	h survey	man and the second seco	Jun Marine M
5.3				
5.3				
5.3 m ~				
5.3 ~~~				
5.3				
5.3				
5.3				
0.3				
enter 2.402500				Span 3.000 MH
Res BW 30 kH:	2	#VBW 100 kHz	Sw	reep 3.200 ms (1001 pt
R MODE TRC SCL	×	Y FUNC	TION FUNCTION WIDTH	FUNCTION VALUE
1 N 1 f 2 N 1 f	2.401 837 GHz 2.402 836 GHz	5.05 dBm 4.97 dBm		
3	2.402 636 GHZ	4.97 UDIII		
5				
5				
6 7				
6 7 8 9				
6 7 8 9 0				
6 7 8 9				

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#### CH39 -3Mbps

RF	50 Ω AC		SENSE:PULSE		IAUTO		09:33:33 AM Oct 12, 20
ter Freq 2.4	41500000 GH	Z PNO: Wide IFGain:Lov	, 🖵 Trig: Free , #Atten: 30	Run	Avg Type: Log	-Pwr	TRACE 1 2 3 4 TYPE M WWW DET P P P
	set 0.5 dB 3.53 dBm					Mkr2 :	2.441 836 GH 5.245 dB
		$\langle \rangle^1$			2		
Mr. Marine	· · · · · · · · · · · · · · · · · · ·	J. J.	man	hand	my my m	mm	mander
	Ser and i		- h./h	2000		· · · · · ·	
ter 2.441500	GHz		4) (D.W. 400 L.U.			•	Span 3.000 M
s BW 30 kHz			#VBW 100 kH:				200 ms (1001 p
MODE TRC SCL N 1 f	× 2.440 83	C GHz	Y FU 5.24 dBm	NCTION FUNCTION	IWIDTH	FUNCTIO	N VALUE
N 1 f	2.441 83		5.25 dBm				
							>

### CH78 -3Mbps



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# 8. BANDWIDTH TEST

# 8.1 LIMIT

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

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

### 8.2 TEST PROCEDURE

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

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

### 8.3 TEST SETUP



### 8.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.



### **8.5 TEST RESULTS**

Temperature:	25℃	Relative Humidity:	50%
	GFSK(1Mbps) CH00 / CH39 / C78	Test Voltage:	AC 120V/60Hz

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	0.9255	PASS
2441 MHz	0.9254	PASS
2480 MHz	0.9237	PASS

### CH00 -1Mbps

Agilent Spectrum Analyzer - Occupied	BW			
XIRL RF 50Ω AC			ALIGNAUTO	06:34:46 PM Oct 11, 2021
Center Freq 2.4020000	0 GHz	Center Freq: 2.402000 Trig: Free Run	Avg Hold:>10/10	Radio Std: None
	#IFGain:Low	#Atten: 30 dB		Radio Device: BTS
10 dB/div Ref 20.00 dB Log	m			
10.0				
0.00		m	<b>_</b>	
-10.0	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	4		
-20.0	~~~			~
-30.0	Č			
-40.0				
-50.0				$\sim$
-60.0				
-70.0				
Center 2.402 GHz				Span 2 MHz
#Res BW 30 kHz		#VBW 100 k	HZ	Sweep 2.733 ms
Occupied Bandwid	th	Total Power	13.9 dBm	
8	859.17 kHz			
Transmit Freq Error	-995 Hz	OBW Power	99.00 %	
x dB Bandwidth	925.5 kHz	x dB	-20.00 dB	
ISG			STATUS	

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#### CH39 -1Mbps



CH78 -1Mbps



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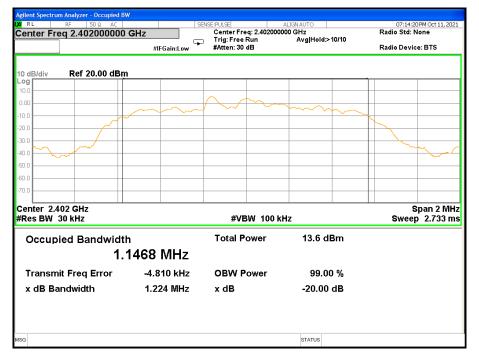


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Temperature:	25°C	Relative Humidity:	50%
	π/4-DQPSK(2Mbps) CH00 / CH39 / C78	Test Voltage:	AC 120V/60Hz

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

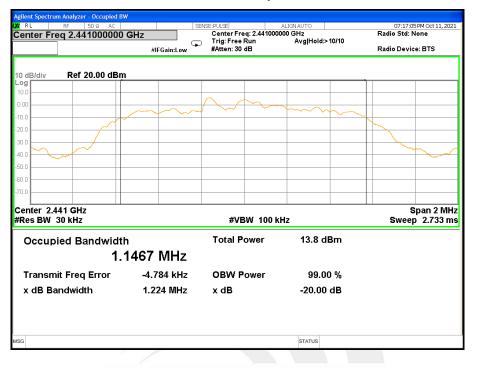
### CH00 -2Mbps



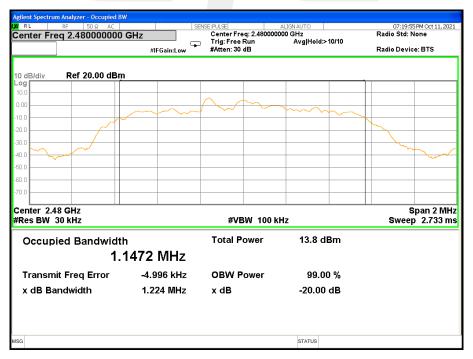
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#### CH39 -2Mbps



### CH78 -2Mbps



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Temperature:	25°C	Relative Humidity:	50%
	8DPSK(3Mbps) CH00 / CH39 / CH78	Test Voltage:	AC 120V/60Hz

Frequency	20dB Bandwidth (MHz)	Result
2402 MHz	1.219	PASS
2441 MHz	1.219	PASS
2480 MHz	1.22	PASS

## CH00 -3Mbps

gilent Spectrum Analyzer - Occupied B RL RF 50 Ω AC Center Freq 2.402000000	S	ENSE:PULSE Center Freg: 2.4020000		08:56:47 AM Oct 12, 2021 Radio Std: None
	#IFGain:Low	Talas Fast a Disa	Avg Hold:>10/10	Radio Device: BTS
0 dB/div Ref 20.00 dBm	<u>1</u>			-
.00		$\sim$		
.0	~~~~~			
0				
0				
0				
0				
enter 2.402 GHz tes BW 30 kHz		#VBW 100 k	Hz	Span 2 MH Sweep   2.733 m
Occupied Bandwidt	h	Total Power	13.2 dBm	
1.	1362 MHz			
Transmit Freq Error	12.369 kHz	OBW Power	99.00 %	
x dB Bandwidth	1.219 MHz	x dB	-20.00 dB	
3			STATUS	

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### CH39 -3Mbps



CH78 -3Mbps



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# 9. OUTPUT POWER TEST

### 9.1 LIMIT

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

### 9.2 TEST PROCEDURE

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

- a) Use the following spectrum analyzer settings:
- 1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
- 2) RBW > 20 dB bandwidth of the emission being measured.

3) VBW  $\geq$  RBW.

4) Sweep: Auto.

5) Detector function: Peak.

6) Trace: Max hold.

b) Allow trace to stabilize.

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

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

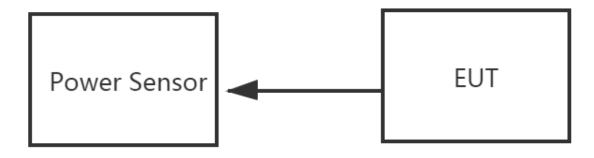
e) A plot of the test results and setup description shall be included in the test report.

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

PKPM1 Peak power meter method:

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

9.3 TEST SETUP



### 9.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.

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### 9.5 TEST RESULTS

Temperature:	25°C	Relative Humidity:	60%
Test Voltage:	AC 120V/60Hz		

Mode	Channel	Frequency	(dBm) (dBm) (dBm	Limit	
	Number	(MHz)		(dBm)	(dBm)
	0	2402	7.84	6.44	30.00
GFSK(1M)	39	2441	7.75	6.41	30.00
	78	2480	7.79	6.33	30.00

Note: the channel separation >20dB bandwidth

	Channel	Frequency	Peak PowerAverage Power(dBm)(dBm)	Limit	
	Number	(MHz)		(dBm)	(dBm)
π/4-DQPSK( 2M)	0	2402	7.77	4.10	20.97
	39	2441	7.75	4.13	20.97
	78	2480	7.66	4.10	20.97

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

Mode Channel Number		Frequency	Power	Limit	
	Number	(MHz)		(dBm)	
	0	2402	7.88	4.19	20.97
8-DPSK(3M)	39	2441	7.82	4.11	20.97
	78	2480	7.76	4.05	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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