

RADIO TEST REPORT

Report No.: STS2007223W04

Issued for

Klipsch L.L.C.

3502 Woodview Trace, Suite 200, Indianapolis, Indiana, United States

Product Name:	Bluetooth earphone
Brand Name:	Klipsch
Model Name:	Klipsch T5 II True Wireless Sport
Series Model:	Klipsch T5 II True Wireless Sport McLaren Klipsch T5 II True Wireless
FCC ID:	STI-T5IITWS
IC:	5788A-T5IITWS
Test Standard:	FCC Part 15.247 RSS-247 Issue 2, February 2017

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TEST RESULT CERTIFICATION

Applicant's Name:	Klipsch L.L.C.
Address	3502 Woodview Trace, Suite 200, Indianapolis, Indiana, United States
Manufacture's Name:	XIAMEN ACOUSYCOM ELECTRONIC CO.,LTD
Address	NO.268-269 TONG-AN GARDEN, TONG-AN INDUSTRIAL PARK , TONG-AN, XIAMEN, FUJIAN, CHINA
Product Description	
Product Name:	Bluetooth earphone
Brand Name	Klipsch
Model Name:	Klipsch T5 II True Wireless Sport
Series Model	Klipsch T5 II True Wireless Sport McLaren Klipsch T5 II True Wireless
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 l	econ tootod by CTC, the test recults about that the service result

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.

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Date of Test.....

Date of receipt of test item	:	13 July 2020	

Date (s) of performance of tests .: 13 July 2020 ~ 11 Aug. 2020

Date of Issue 11 Aug. 2020

Test Result Pass

Testing Engineer (Chris Chen) **Technical Manager** (Sean she)

Authorized Signatory :

(Vita Li)

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7. HOPPING CHANNEL SEPARATION MEASUREMEN

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Revision History

Rev. Issue Date		Report NO.	Effect Page	Contents
00	11 Aug. 2020	STS2007223W04	ALL	Initial Issue



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1. SUMMARY OF TEST RESULTS

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

FCC Part 15.247,Subpart C RSS-247 Issue 2					
Standard Section	Test Item	Judgment	Remark		
15.207 RSS-Gen (8.8&7.2)	Conducted Emission	N/A			
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) 20dB Bandwidth RSS-247 (5.1) 99% Bandwidth RSS-Gen (6.7) 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

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2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	Bluetooth earphone
Trade Name	Klipsch
Model Name	Klipsch T5 II True Wireless Sport
Series Model	Klipsch T5 II True Wireless Sport McLaren Klipsch T5 II True Wireless
Model Difference	Please refer to the model difference table in next page.
Channel List	Please refer to the Note 2.
Bluetooth	Frequency:2402 – 2480 MHz Modulation: GFSK(1Mbps), π/4-DQPSK(2Mbps), 8DPSK(3Mbps)
Bluetooth Version	5.1
BR+EDR	BR+EDR
Please see Note 3.	Please refer to the Note 3.
Charging Box	Input: DC 5 V Output: DC 3.7V
Battery	Battery for Earphone Model: LIR1240 Capacity: 55mAh Rated Voltage: 3.7V Battery for Klipsch T5 II True Wireless Sport base Model: ZWD532626K Capacity: 360mAh Rated Voltage: 3.7V Battery for Klipsch T5 II True Wireless base Model: ZWD602129K Capacity: 350mAh Rated Voltage: 3.7V
Hardware version number	V0
Software version number	T5_TWS_Sport_L_v0.3.2 T5_TWS_Sport_R_v0.3.2
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.



Model difference table:

Klipsch T5 II True Wireless Sport	Klipsch T5 II True Wireless Sport McLaren	Klipsch T5 II True Wireless		
	Charging Base			
Kips	Klipsch McLaren	Klipsk Istatistic 1946 - 554		
With wireless charging function	With wireless charging function	Without wireless charging function		
Different appearance, The electrica internal v	Different appearance, electrical circuit design, layout, components used and internal wiring			
Earphone				
With hanging ear Without hanging ear				
The electrical circuit design, layout, components used and internal wiring are identical				

$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	Frequency (MHz)
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	2456
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	2457
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	2458
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	2459
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	2460
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	2461
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	2462
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	2463
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	2464
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	2465
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	2466
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	2467
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	2468
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	2469
1524174224446916241843244570172419442446711824204524477219242146244873	2470
16 2418 43 2445 70 17 2419 44 2446 71 18 2420 45 2447 72 19 2421 46 2448 73	2471
17 2419 44 2446 71 18 2420 45 2447 72 19 2421 46 2448 73	2472
18 2420 45 2447 72 19 2421 46 2448 73	2473
<u>19 2421 46 2448 73</u>	2474
	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.

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	Klipsch	Klipsch T5 II True Wireless Sport	Loop antenna	N/A	-1 dBi	BT Antenna

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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 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.

2.3 FREQUENCY HOPPING SYSTEM REQUIREMENTS

(1)Standard and Limit

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

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

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



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(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 th 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	-1	0	
ВТ	BR+EDR	π/4-DQPSK	-1	0	USBDebug_103.0.0(1)
		8DPSK	-1	0	

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



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2.6 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

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

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

Support units

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
E-2	Notebook	DELL	Inspiron 13-3467	N/A	N/A
C-1	USB Cable	N/A	N/A	110cm	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 ^rLength ^a 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	2019.10.09	2020.10.08
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-40GHz)	SKET	LNPA-1840-50	SK201810180 1	2019.10.12	2020.10.11
Temperature & Humidity	HH660	Mieo	N/A	2019.10.17	2020.10.16
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	2019.10.09	2020.10.08
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	2019.10.17	2020.10.16
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	2019.10.17	2020.10.16
Test SW	FARAD	LZ-RF /LzRf-3A3			

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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)		
FREQUENCI (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 TEST RESULT

Temperature:	25.7(C)	Relative Humidity:	53%RH
Test Voltage:	N/A	Phase:	L/N
Test Mode:	N/A		

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



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 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)		
	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	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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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		



For Radiated Emission

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

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

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

For Restricted band

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

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

3.2.2 TEST PROCEDURE

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

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

3.2.3 DEVIATION FROM TEST STANDARD

No deviation.



3.2.4 TESTSETUP

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



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



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



3.2.5 EUT OPERATING CONDITIONS

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

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3.2.6 FIELD STRENGTH CALCULATION

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

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

For example

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

Factor=AF+CL-AG



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3.2.7 TEST RESULTS

(9KHz-30MHz)

Temperature:	23.2(C)	Relative Humidity:	54%RH
Test Voltage:	DC 3.7V	Test Mode:	TX Mode

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

Note:

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

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

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





(30MHz-1000MHz)

Temperature:	23.2(C)	Relative Humidity:	54%RH	
Test Voltage:	DC 3.7V	Phase:	Horizontal	
Test Mode:	Mode 1/2/3/4/5/6/7/8/9(Mode 9 worst mode)			

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	131.8500	39.96	-18.20	21.76	43.50	-21.74	QP
2	259.8900	41.98	-14.79	27.19	46.00	-18.81	QP
3	371.4400	50.71	-12.46	38.25	46.00	-7.75	QP
4	487.8400	39.53	-8.32	31.21	46.00	-14.79	QP
5	564.4700	36.73	-5.54	31.19	46.00	-14.81	QP
6	956.3500	30.43	1.70	32.13	46.00	-13.87	QP

Remark:

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





Temperature:	23.2(C)	Relative Humidity:	54%RH			
Test Voltage:	DC 3.7V	Phase:	Vertical			
Test Mode:	Mode 1/2/3/4/5/6/7/8/9(Mode 9 worst mode)					

No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	59.1000	44.02	-25.73	18.29	40.00	-21.71	QP
2	209.4500	41.45	-20.38	21.07	43.50	-22.43	QP
3	284.1400	39.88	-15.46	24.42	46.00	-21.58	QP
4	536.3400	38.78	-7.08	31.70	46.00	-14.30	QP
5	868.0800	30.62	-0.51	30.11	46.00	-15.89	QP
6	988.3600	28.74	2.15	30.89	54.00	-23.11	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) # purious emission Requirements

Frequency	Meter Reading	Amplifier	Loss	Antenna Factor	Orrected Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBµV)	(dB)	(dB)	(dB/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	Туре	-
			•	Low Chan	nel (8DPSK/2	2402 MHz)		•		
3264.80	61.80	44.70	6.70	28.20	-9.80	52.00	74.00	-22.00	PK	Vertical
3264.80	49.90	44.70	6.70	28.20	-9.80	40.10	54.00	-13.90	AV	Vertical
3264.80	62.12	44.70	6.70	28.20	-9.80	52.32	74.00	-21.68	PK	Horizontal
3264.80	50.59	44.70	6.70	28.20	-9.80	40.79	54.00	-13.21	AV	Horizontal
4804.47	58.57	44.20	9.04	31.60	-3.56	55.01	74.00	-18.99	PK	Vertical
4804.47	49.70	44.20	9.04	31.60	-3.56	46.14	54.00	-7.86	AV	Vertical
4804.61	58.89	44.20	9.04	31.60	-3.56	55.33	74.00	-18.67	PK	Horizontal
4804.61	49.74	44.20	9.04	31.60	-3.56	46.18	54.00	-7.82	AV	Horizontal
5359.75	49.05	44.20	9.86	32.00	-2.34	46.71	74.00	-27.29	PK	Vertical
5359.75	39.07	44.20	9.86	32.00	-2.34	36.73	54.00	-17.27	AV	Vertical
5359.84	47.54	44.20	9.86	32.00	-2.34	45.20	74.00	-28.80	PK	Horizontal
5359.84	38.56	44.20	9.86	32.00	-2.34	36.22	54.00	-17.78	AV	Horizontal
7205.94	54.76	43.50	11.40	35.50	3.40	58.16	74.00	-15.84	PK	Vertical
7205.94	44.16	43.50	11.40	35.50	3.40	47.56	54.00	-6.44	AV	Vertical
7205.72	53.71	43.50	11.40	35.50	3.40	57.11	74.00	-16.89	PK	Horizontal
7205.72	44.65	43.50	11.40	35.50	3.40	48.05	54.00	-5.95	AV	Horizontal
	•		2	Middle Cha	nnel (8DPSK	/2441 MHz)			•	•
3264.90	61.31	44.70	6.70	28.20	-9.80	51.51	74.00	-22.49	PK	Vertical
3264.90	50.82	44.70	6.70	28.20	-9.80	41.02	54.00	-12.98	AV	Vertical
3264.86	61.11	44.70	6.70	28.20	-9.80	51.31	74.00	-22.69	PK	Horizontal
3264.86	50.20	44.70	6.70	28.20	-9.80	40.40	54.00	-13.60	AV	Horizontal
4882.45	58.71	44.20	9.04	31.60	-3.56	55.15	74.00	-18.85	PK	Vertical
4882.45	49.53	44.20	9.04	31.60	-3.56	45.97	54.00	-8.03	AV	Vertical
4882.52	58.98	44.20	9.04	31.60	-3.56	55.42	74.00	-18.58	PK	Horizontal
4882.52	50.43	44.20	9.04	31.60	-3.56	46.87	54.00	-7.13	AV	Horizontal
5359.85	48.72	44.20	9.86	32.00	-2.34	46.38	74.00	-27.62	PK	Vertical
5359.85	40.19	44.20	9.86	32.00	-2.34	37.85	54.00	-16.15	AV	Vertical
5359.75	47.21	44.20	9.86	32.00	-2.34	44.87	74.00	-29.13	PK	Horizontal
5359.75	38.74	44.20	9.86	32.00	-2.34	36.40	54.00	-17.60	AV	Horizontal
7323.93	54.03	43.50	11.40	35.50	3.40	57.43	74.00	-16.57	PK	Vertical
7323.93	43.89	43.50	11.40	35.50	3.40	47.29	54.00	-6.71	AV	Vertical
7323.83	53.95	43.50	11.40	35.50	3.40	57.35	74.00	-16.65	PK	Horizontal
7323.83	43.50	43.50	11.40	35.50	3.40	46.90	54.00	-7.10	AV	Horizontal



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	High Channel (8DPSK/2480 MHz)									
3264.89	61.29	44.70	6.70	28.20	-9.80	51.49	74.00	-22.51	PK	Vertical
3264.89	50.39	44.70	6.70	28.20	-9.80	40.59	54.00	-13.41	AV	Vertical
3264.69	61.48	44.70	6.70	28.20	-9.80	51.68	74.00	-22.32	PK	Horizontal
3264.69	51.24	44.70	6.70	28.20	-9.80	41.44	54.00	-12.56	AV	Horizontal
4960.53	58.23	44.20	9.04	31.60	-3.56	54.67	74.00	-19.33	PK	Vertical
4960.53	49.39	44.20	9.04	31.60	-3.56	45.83	54.00	-8.17	AV	Vertical
4960.45	58.31	44.20	9.04	31.60	-3.56	54.75	74.00	-19.25	PK	Horizontal
4960.45	49.59	44.20	9.04	31.60	-3.56	46.03	54.00	-7.97	AV	Horizontal
5359.69	49.37	44.20	9.86	32.00	-2.34	47.03	74.00	-26.97	PK	Vertical
5359.69	40.12	44.20	9.86	32.00	-2.34	37.78	54.00	-16.22	AV	Vertical
5359.74	47.24	44.20	9.86	32.00	-2.34	44.90	74.00	-29.10	PK	Horizontal
5359.74	39.31	44.20	9.86	32.00	-2.34	36.97	54.00	-17.03	AV	Horizontal
7439.73	54.20	43.50	11.40	35.50	3.40	57.60	74.00	-16.40	PK	Vertical
7439.73	44.55	43.50	11.40	35.50	3.40	47.95	54.00	-6.05	AV	Vertical
7439.76	54.78	43.50	11.40	35.50	3.40	58.18	74.00	-15.82	PK	Horizontal
7439.76	43.77	43.50	11.40	35.50	3.40	47.17	54.00	-6.83	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	2317.900	42.24	3.57	45.81	74.00	-28.19	peak
2	2390.000	40.29	4.34	44.63	74.00	-29.37	peak

Vertical

120.0 dBuV/m



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2363.700	41.90	3.95	45.85	74.00	-28.15	peak
2	2390.000	40.28	4.34	44.62	74.00	-29.38	peak



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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	40.71	4.60	45.31	74.00	-28.69	peak
2	2484.900	44.04	4.61	48.65	74.00	-25.35	peak

Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2483.500	41.26	4.60	45.86	74.00	-28.14	peak
2	2484.925	44.62	4.61	49.23	74.00	-24.77	peak

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

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4. CONDUCTED SPURIOUS & BAND EDGE EMISSION

4.1 LIMIT

According to FCC section 15.247(d)&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

Spectrum Parameter	Setting		
Detector	Peak		
Start/Stan Fraguenov	Lower Band Edge: 2300 – 2407 MHz		
Start/Stop Frequency	Upper Band Edge: 2475 – 2500 MHz		
RB / VB (emission in restricted band)	100 KHz/300 KHz		
Trace-Mode:	Max hold		
For Hopping Band edge			
Spectrum Parameter	Setting		
Detector	Peak		
Start/Stan Fraguenov	Lower Band Edge: 2300– 2403 MHz		
Start/Stop Frequency	Upper Band Edge: 2479 – 2500 MHz		

43	FST	SFT	UP



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

RB / VB (emission in restricted band)

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 3686 6288 Fax:+86-755 3686 6277 Http://www.stsapp.com E-mail: sts@stsapp.com

100 KHz/300 KHz

Max hold



4.5 TEST RESULTS

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

00 CH



39 CH

Agile	nt Spe	ectru	m Ani	alyzer - Swept SA							
wµ Cer	L nter	Fre	RF eq 1	50 Ω AC 12.515000000 GHz	PNO: Fast Gain:Low	Trig: Free #Atten: 30	Run dB	ALIGNAUTO Avg Type:	Log-Pwr	08:53:46 Ti	AM 3.123, 2020 RACE 1 2 3 4 5 6 TYPE MUMMUM DET P P P P P P
10 d	B/di	v	Ref Ref	Offset 0.5 dB 15.70 dBm						Mkr1 2 5.	.452 GHz 702 dBm
5.70				1							
-4.30 -14.3											-14.31 dBm
-24.3	\vdash										
-34.3				A ² A ³						-	4
-54.3 -64.3			مىلىر	and marked and and	man	mund		manunder	man and a star	And Concerning the	Martin Contraction
-74.3	-										-
Sta #Re	rt 30 s B	0 M W 1	Hz 100	kHz	#VBI	N 300 kH	z		Sw	Stop eep 2.386 s	25.00 GHz (1001 pts)
MKR	MODE	TRC	SCL	×	Y	FUI	NCTION	FUNCTION WIDTH		FUNCTION VALUE	^
1 2 3 4 5	ZZZZ	1 1 1 1	f f f f	2.452 GHz 3.176 GHz 4.874 GHz 24.825 GHz	5.702 -54.534 -56.161 -46.923	dBm dBm dBm dBm					
6 7 8 9											
11						-22					×
MSG								STATUS			

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П



78 CH

UXI RI												
_	-		RF	50 Q AC		SEP	ISE:PULSE		ALIGNAUTO		08:57:43	3 AM Jul 23, 2020
Cen	ter	Fre	eq 1	2.5150000	DOO GHZ PN IFG	IO: Fast 😱 ain:Low	Trig: Free #Atten: 30	Run dB	Avg Type:	Log-Pwr	T	TYPE MWMMMM DET P P P P P
10 dE	3/div	,	Ref Ref	Offset 0.5 dB 15.28 dBm	1						Mkr1 2 5.	.477 GHz 282 dBm
5.28				1								
-4.72	\vdash											-14.08 dBm
-14.7												
-34.7	-											4
-44.7				2	3						man	manner
-64.7		محه	لمعجد	hunderener	andana	and the second second	www.www.	and make	A Real and a real of the second			
-74.7	-											
Star #Re:	t 30 s BV	MI N 1	Hz 00 I	kHz		#VB	N 300 kHz			Swe	Stop eep 2.386 s	25.00 GHz (1001 pts)
MKR I	MODE	TRC	SCL	· · · · · · · · · · · · · · · · · · ·	K I	Y	FUN	ICTION FUN	CTION WIDTH		FUNCTION VALUE	^
1234	2222	1 1 1 1	f f f		2.477 GHz 2.502 GHz 5.873 GHz 24.825 GHz	5.282 -56.898 -56.744 -46.501	dBm dBm dBm dBm					
67												
8 9 10												
11 <							10					>
MSG									STATUS			



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



00 CH

39 CH





78 CH

Agilent Spec	trum An	alyzer - Swept SA								
X RL	RF	50 Q AC		SENS	SE:PULSE	4	LIGNAUTO		08:57:12	AM Jul 23, 2020
Center F	Freq	2.487500000	GHz		Taias Free De	-	Avg Type: L	og-Pwr	TF	ACE 1 2 3 4 5 6
			PNO	:Fast 🖵	#Atten: 30 dF	in t				DETPPPPP
			iroai	11.1.0	written. oo uu	·				
	Ref	f Offset 0.5 dB						M	kr1 2.480	025 GHz
10 dB/div	Re	f 15.92 dBm							5.	923 dBm
Log		<u></u> 1								
5.92		- A								
-4.08		/1								
										-14.08 dBm
-14.1										
-24.1										
-34.1		- N	1							
						A 3				
-44.1		M	h	^2		0	4			
-54.1	h		man	Manna	mail and a start	A	8			
-64.1							all reserves and		arminan	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
74.1										
1/4.1										
Start 2.4	7500	CH2							Stop 2	50000 CH2
#Res BW	V 100	kHz		#VBW	/ 300 kHz			Swee	p 2.400 ms	(1001 pts)
MKRI MODEL	TRCI SCL	×		Y	FUNCT	ON FUN	CTION WIDTH	f	UNCTION VALUE	
1 N	1 f	2,480	025 GHz	5.923 d	IBm					
2 N	1 f	2.483	500 GHz	-55.706 d	Bm					
3 N	1 1	2.488	025 GHz	-51.134 d	Bm					
5	1 1	2.491	725 GHZ	-00.743 0	Bm					
6										
7										
8										
10										
11										~
<										>
MSG							STATUS			
						_			_	



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For Hopping Band edge

00 CH



78 CH





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

Agile	nt Spe	ectru	m Ana	lyzer - Swept Si								
Cer	nter	Fre	eq 1	2.515000	DOO GHz	NO: Fast Gain:Low	Trig: Fr #Atten:	ee Run 30 dB	Avg Type	e: Log-Pwr	09:55:57 TF	AM 30123, 2020 ACE 1 2 3 4 5 6 TYPE MUMANANA DET P P P P P P
10 d	B/di	v	Ref Ref	Offset 0.5 dB 13.53 dBn	1						Mkr1 2. 3.	402 GHz 528 dBm
3.53	_		_	1				_				
-6.47												-14.50 dBm
-16.5												
-36.5												/4
-46.5	\vdash			2 ²	3							- and the second
-56.5	w		and a	mont	- solon and a show a	bitter and the second	warene	han	An an aller a store	photo second		
-76.5												
Sta #Re	rt 30 es B	0 MI W 1	Hz 00	kHz		#VB	W 300 k	Hz		Sv	Stop weep 2.386 s	25.00 GHz (1001 pts)
MKE 1	MODE	TRC 1	SCL f		2.402 GHz	3.528	dBm	FUNCTION	FUNCTION WIDTH		FUNCTION VALUE	^
345	ZNZ	1	f		5.548 GHz 24.501 GHz	-56.625 -46.235	dBm dBm dBm					
67												
8												
10												
MSG									STATUS			
							20	сц				
							39	UT				

00 CH

20	CU
29	OL

Agile	nt Spe	ectru	m Ana	alyzer - Swept SA						
LXI R	L		RF	50 Q AC	SENSE:	PULSE	ALIGNAUTO		10:01:0	5 AM Jul 23, 2020
Cer	nter	Fre	eq '	12.515000000 GH	Z PNO: Fast 😱 1 IFGain:Low #	Trig: Free Run Atten: 30 dB	Avg Type	Log-Pwr	T	TYPE MWMMMM DET P P P P P
10 d	B/di	v	Ref Ref	Offset 0.5 dB 14.64 dBm					Mkr1 2 4.	.452 GHz 644 dBm
4.64				1						
-5.36	⊢									-14.08 dBm
-15.4										
-35.4										
-45.4	\vdash			$\wedge^2 \wedge^3$					a secondaria	- and the man
-55.4	al		معلمهم	mul man have have	marenner	- market and	montimeter	and the second		1
-75.4										
Sta #Re	rt 3 s B	0 M	Hz 100	kHz	#VBW 3	300 kHz		Sw	Stop eep 2.386 s	25.00 GHz (1001 pts
MKR	MODE	TRO	SCL	×	Y	FUNCTION	FUNCTION WIDTH		FUNCTION VALUE	~
234	ZZZZ	111	fff	2.452 (3.301 (4.874 (24.176 (Hz -56.682 dBr Hz -56.573 dBr Hz -47.258 dBr	m m m				
5										
7 8 9										
10 11										
MSG							STATUS			

Shenzhen STS Test Services Co., Ltd.


78 CH

Agilent Spectrum	n Analyzer - Swept SA					
UNI RL	RF 50 Ω AC		SENSE:PULSE	ALIGN AUTO		10:11:32 AM Jul 23, 2020
Center Fre	q 12.51500000	PNO: Fast IFGain:Low	Trig: Free Ri #Atten: 30 di	Avg Type un Avg Hold B	a: Log-Pwr : 30/100	TRACE 1 2 3 4 5 6 TYPE MMMMMMM DET P P P P P P
10 dB/div	Ref Offset 0.5 dB Ref_14.71 dBm				М	kr1 2.477 GHz 5.657 dBm
4.71						
-5.29						-13.99 dBm
-25.3						
-35.3						
-55.3	2 	2 ³	A have a second	- martin	and and and and and	un and the
-65.3						
Center 12.5 #Res BW 10	52 GHz 00 kHz		#VBW 300 kHz	X	Sweep 2	Span 24.97 GHz 2.386 s (1001 pts)
MKR MODE TRC	f 2 f	2.477 GHz 5	Y FUNCT 5.657 dBm 5.241 dBm	ION FUNCTION WIDTH	FUNCTION	NVALUE ^
3 N 1 4 N 1 5	f 6 f 24	.948 GHz -56 .351 GHz -48	5.166 dBm 9.563 dBm			
67						
9						
11 <						>
MSG				STATUS		



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

Agilent Spect	rum Ana	alyzer - Swept SA					
RL	RF	50 Q AC	SE	NSE:PULSE	ALIGNAUTO	1 D	09:55:26 AM Jul 23, 2020
Center F	req	2.353500000 GHz	PNO: Fast G	Trig: Free Run #Atten: 30 dB	Avg Type:	Log-Pwr	TYPE MUMMMM DET P P P P P
10 dB/div	Ref Ref	Offset 0.5 dB 15.50 dBm				М	kr1 2.401 97 GHz 5.499 dBm
og							1
5.50							Å
4.50							450.00
4.5							
4.5							
34.5							A_4 \
44.5							
54.5	mand	Angene Marine	monther	amound	man and a second		unal where the
64.5							
74.5				2			
start 2.30 Res BW	0000 1 100	GHz kHz	#VB	W 300 kHz		Sweep	Stop 2.40700 GH 10.27 ms (1001 pts
IKR MODE T	RC SCL	×	Y	FUNCTION	FUNCTION WIDTH	FU	NCTION VALUE
1 N 2 N		2.401 97 G	Hz 5.499	dBm			
3 N	1 f	2.398 55 G	Iz -47.735	dBm			
4 N 5	1 1	2.400 05 Gi	HZ -49.801	dBm			
6							
8							
9							
11							
80					STATIS		2 P.
13					STATUS		

00 CH

39 CH





78 CH

Agilent Spect	rum Ana	ilyzer - Swept SA								
RL	RF	50 Q AC		SEN	ISE:PULSE		ALIGNAUTO	_	10:09:30	AM Jul 23, 2020
Center F	req 2	2.487500000	GHz PN IFG	0: Fast 😱 ain:Low	Trig: Fre #Atten: 3	e Run 0 dB	Avg Type:	Log-Pwr	T	TYPE MUMANANA DET P P P P P P
10 dB/div	Ref Ref	Offset 0.5 dB 16.01 dBm						М	kr1 2.480 6.	025 GHz 013 dBm
6.01		1								
-3.99		$\int \int $								-13 00 dBm
-14.0										-15.55 (24)
-34.0			m			. 2				
-44.0	append	ru -	m	A land		1 A	4			
64.0					ann y	www.www.	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	un more	en and the second	~~~~~~
74.0										
Start 2.47 #Res BW	7500	GHz kHz		#VBV	V 300 KH	z		Swee	Stop 2. p 2.400 ms	50000 GHz (1001 pts)
MKR MODE T	RC SCL	2.480	025 GHz	6.013	dBm	JNCTION F	UNCTION WIDTH		FUNCTION VALUE	^
2 N 3 N 4 N	f f	2.483	975 GHz 225 GHz	-51.238 (-49.934 (-56.245 (iBm iBm iBm					
5										
8										
10 11										
ISG							STATUS			12
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Shenzhen STS Test Services Co., Ltd.



For Hopping Band edge

00 CH



78 CH





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



00 CH

39 CH

Agiler	nt Spe	ectru	m Ana	alyzer - Swept SA									
UXU R	L	_	RF	50 Q AC		SEN	SE:PULSE		ALI	GNAUTO	Les Dur	10:32:3	6 AM Jul 23, 2020
Cer	nter	Fre	eq 1	12.5150000	JUU GHZ PN IFG	0: Fast 🖵 ain:Low	Trig: Free #Atten: 30	Run dB		Avg Type:	Log-Pwr		TYPE MWWWWW DET P P P P P P
10 d	B/di	v	Ref Ref	Offset 0.5 dB 14.86 dBm	1							Mkr1 2 4.	.452 GHz 859 dBm
Log 4.86				1									
-5.14	⊢												
-15.1	╞												-14.07 dBm
-25.1	\vdash		_										
-35.1													()4
-55.1				\Diamond^2	aabaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa		العدر.		~~~~	un man	unoun	manum	approximation
-65.1	-	de se conse	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		m manale		and the second					-	
-75.1	F												
Sta #Re	rt 30 Is B	0 M W 1	Hz 00 I	kHz		#VBV	V 300 kH;	z			Sw	Stop eep 2.386	25.00 GHz s (1001 pts)
MKR	MODE	TRC	SCL	· · · · · · · · · · · · · · · · · · ·	<	Y	FUI	NCTION	FUNCTI	ON WIDTH		FUNCTION VALUE	~
1 2 3	NNN	1 1	f f f		2.452 GHz 3.126 GHz 5.948 GHz	4.859 c -57.401 c -56.355 c	dBm dBm dBm						
4	Ν	1	f		24.326 GHz	-46.968 c	lBm						
6 7													
89													
10 11													~
MSG										STATUS			<u> </u>

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78 CH

Agilent	: Spec	ctrur	m Ana	lyzer - Swept SA									
K RL			RF	50 Ω AC			SENSE:PU	.SE	ALIGN	AUTO		10:40:52	2 AM Jul 23, 2020
Cent	ter	Fre	eq 1	2.5150000	000 GHz	PNO: Fast IFGain:Low	Tri #At	g: Free Run tten: 30 dB		Avg Type:	Log-Pwr	TF	TYPE MUMMUMM
10 dE	3/div	,	Ref Ref	Offset 0.5 dB 13.26 dBm	1							Mkr1 2. 3.	.477 GHz 260 dBm
3.26				1									
-6.74													-14.03 dBm
-16.7													
-36.7													4
-46.7				2	$\langle \rangle^3$						ale and ale a	manger	wenden
-56.7		~~~	war	Konstrant	- harrow	man	Margarente	en un better	and the second	*********			-
-76.7													
Stari #Res	t 30 5 BV	MI N 1	Hz 00 H	(Hz			#VBW 30	0 kHz			Swe	Stop eep 2.386 s	25.00 GHz (1001 pts)
MKR N	IODE	TRC	SCL	>	A 477 CU		Y	FUNCTION	FUNCTION	WIDTH	,	FUNCTION VALUE	^
2345	NNN	1 1 1	f f f		2.677 GH 5.498 GH 24.426 GH	z -56 z -55 z -47	.881 dBm .114 dBm .513 dBm						
6780													
10 11													
ISG										STATUS			>
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For Band edge(it's also the reference level for conducted spurious emission)

RL	RF	50 Q AC		SENS	E:PULSE		ALIGNAUTO		10:28:37 AM	1 Jul 23, 20
nter F	req 2	2.353500000	GHz PNO IFGai	: Fast 😱 n:Low	Trig: Free R #Atten: 30 d	un B	Avg Type	: Log-Pwr	TRAC TYP DE	E 1 2 3 4 E M WWW T P P P P
dB/div	Ref Ref	Offset 0.5 dB f 15.56 dBm						N	/kr1 2.401 5.56	86 G 64 dE
										0 1
										- 1
										-14:44
										N
									3	14
					2					LY I
ermone	-	and marker of	mound	man	marken	mphilipping	hannorm	manne	underentor	
·										
rt 2.30 es BW	0000	GHz kHz		#VBW	/ 300 kHz			Swee	Stop 2.40 p 10.27 ms (1	700 G 1001 p
MODE T	RC SCL	×	04.05.011-	Y E EEA A	FUNCT	ION FUN	CTION WIDTH	F	UNCTION VALUE	
N 1	1 f	2.4	48 47 GHz	-57.503 d	Bm					
N	1 f 1 f	2.3	93 95 GHz	-49.021 d	Bm Bm					
N 1										
N										
N										
N										
N										
N										

00 CH

39 CH





78 CH

Agilent Spect	rum Analyzer - Swept S	ίΑ				
RL	RF 50 Ω A	C	SENSE:PULSE		ALIGNAUTO	10:40:21 AM Jul 23, 2020
Center F	req 2.4875000	00 GHz PNC): Fast 🖵 Trig: Fi	ree Run 30 dB	Avg Type: Log-Pw	TRACE 1 2 3 4 5 6 TYPE M WARKANN DET P P P P P
10 dB/div	Ref Offset 0.5 dE Ref 15.97 dBr	3 n				Mkr1 2.479 850 GHz 5.972 dBm
5.97		1 1 1				
-4.03						-14.03 dBm
-24.0						
-34.0		My.	2	3	4	
-54.0			- Herman Marine	mort	Marshan Marshan	man all and any
-74.0						
Start 2.47 #Res BW	7500 GHz 100 kHz		#VBW 300 k	Hz	5	Stop 2.50000 GHz Sweep 2.400 ms (1001 pts)
MKR MODE T	RC SCL f 2	× .479 850 GHz	Y 5.972 dBm	FUNCTION FL	INCTION WIDTH	FUNCTION VALUE
2 N 3 N 4 N	f 2 f 2 f 2	2.483 500 GHz 2.488 000 GHz 2.491 225 GHz	-53.542 dBm -49.688 dBm -56.531 dBm			
67						
9 10						
<			11			×
MSG					STATUS	



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For Hopping Band edge

00 CH



78 CH





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 3.7V

Number of Hopping Channel

79

Hopping channel

gilent Spectrum Analyz	er - Swept SA					
enter Freq 2.4	41750000 GHz P	NO: Fast Gain:Low #Atto	E : Free Run en: 30 dB	ALIGNAUTO Avg Type: Log	g-Pwr	09:45:19 AM 3423, 20 TRACE 1 2 3 4 TYPE MWWW DET P P P P
Ref Off 0 dB/div Ref 1	/set 0.5 dB 6.26 dBm				Mkr2 2	.479 993 0 GH 6.17 dB
°g 5.26 3.74 13.7		MANANA MANA	YYYYYYYYY	<u>AAAAAAAAAAA</u> A	YYYYYYYY	
3.7 3.7 3.7						
3.7 i3.7 '3.7						
tart 2.40000 GH Res BW 300 kH	lz z	#VBW 300	kHz		Sweep 1	Stop 2.48350 G .133 ms (1001 p
R MODE TRE SC. 1 N 1 f 2 N 1 f 3 4 5 6	× 2.402 004 0 GHz 2.479 993 0 GHz	¥ 5.71 dBm 6.17 dBm	FUNCTION FUN	INCTION WIDTH	FUNCT	ION VALUE
7 8 9 0 1						6
G				STATUS		

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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). Sothe dwell time is the time duration of the pulse times 3.37 x 31.6 = 106.6 within 31.6 seconds.
- j. DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots RX, 1 time slot TX). So he dwell time is the time duration of the pulse times 5.06 x 31.6 = 160 within 31.6 seconds.
- k. DH1 Packet permit maximum 1600 / 79 /2 = 10.12 hops per second in each channel (1 time slot RX, 1 time slot TX). So the dwell time is the time duration of the pulse times 10.12 x 31.6 = 320 within 31.6 seconds.

6.3 TEST SETUP



6.4 EUT OPERATION CONDITIONS

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 3.7V

Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
DH1	middle	0.388	0.124	0.4
DH3	middle	1.647	0.264	0.4
DH5	middle	2.898	0.309	0.4



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CH39-DH1



CH39-DH3







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

Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
2DH1	middle	0.399	0.128	0.4
2DH3	middle	1.651	0.264	0.4
2DH5	middle	2.901	0.309	0.4



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CH39-2DH1



CH39-2DH3







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

Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
3DH1	middle	0.398	0.127	0.4
3DH3	middle	1.648	0.264	0.4
3DH5	middle	2.900	0.309	0.4



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CH39-3DH1



CH39-3DH3







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7. HOPPING CHANNEL SEPARATION MEASUREMEN

7.1 LIMIT

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

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

7.2 TEST PROCEDURE

- a. The transmitter output (antenna port) was connected to the spectrum analyser in peak hold mode.
- b. The resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilised for 20 dB bandwidth measurement.
- c. The resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilised for channel separation measurement.

7.3 TEST SETUP



7.4 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.



7.5 TEST RESULTS

Temperature:	25 ℃	Relative Humidity:	50%
Test Mode:	CH00 / CH39 / CH78 (GFSK(1Mbps) Mode)	Test Voltage:	DC 3.7V

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2401.831	2402.830	0.999	0.922	Complies
2441 MHz	2440.831	2441.830	0.999	0.917	Complies
2480 MHz	2478.831	2479.830	0.999	0.917	Complies

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

CH00 -1Mbps



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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:	DC 3.7V

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2402.005	2402.995	0.990	0.887	Complies
2441 MHz	2441.008	2441.995	0.987	0.891	Complies
2480 MHz	2479.008	2479.995	0.987	0.887	Complies

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

Agilent Spectrum Analyzer - Swept SA					
Center Freq 2.402500000 G	SHZ PNO: Wide IFGain:Low	::PULSE Trig: Free Run #Atten: 30 dB	ALIGNAUTO Avg Type: Lo	09:57 >g-Pwr	224 AM Jul 23, 2020 TRACE 1 2 3 4 5 6 TYPE MWWWW DET P P P P P
Ref Offset 0.5 dB 10 dB/div Ref 13.03 dBm				Mkr2 2.40	2 995 GHz 5.406 dBm
Log 3.03 -6.97 -17.0	~~~~~	~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	m	
-27.0 -37.0 -47.0					h
67.0 67.0 77.0					
Center 2.402500 GHz #Res BW 30 kHz	#VBW	100 kHz		Spa Sweep 3.200 r	n 3.000 MHz ns (1001 pts
MXEF MXOE TRC SCL X 1 N 1 f 2.402 (2 N 1 f 2.402 (3 1 f 2.402 (4 5 6 6	005 GHz 3.03 df 995 GHz 5.41 df	FUNCTION 3m 3m	FUNCTION WIDTH	FUNCTION VALUE	
7 8 9 10 11					
MSG			STATUS		2

CH00 -2Mbps



CH39 -2Mbps



CH78 -2Mbps



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

Frequency	Mark1 Frequency (MHz)	Mark2 Frequency (MHz)	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	2402.005	2402.992	0.987	0.863	Complies
2441 MHz	2441.005	2441.995	0.990	0.864	Complies
2480 MHz	2479.005	2479.995	0.990	0.863	Complies

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

04 AM Jul 23, 2020 TRACE RL Center Freq 2.402500000 GHz Avg Type: Log-Pwr PNO: Wide Trig: Free Run IFGain:Low #Atten: 30 dB TYPE MWWWWWW DET P P P P P F Mkr2 2.402 992 GHz 5.489 dBm Ref Offset 0.5 dB Ref 13.12 dBm ⊘1 Center 2.402500 GHz #Res BW 30 kHz Span 3.000 MHz Sweep 3.200 ms (1001 pts) #VBW 100 kHz MKR MODE TRC SCL 2.402 005 GHz 2.402 992 GHz 3.12 dBm 5.49 dBm 1 N 2 N 1 f 1 f

STATUS

CH00 -3Mbps

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34567891011



CH39 -3Mbps



CH78 -3Mbps



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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	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

EUT	SPECTRUM
	ANALYZER

8.4 EUT OPERATION CONDITIONS

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



8.5 TEST RESULTS

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

Frequency	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402 MHz	0.922	0.847	PASS
2441 MHz	0.916	0.842	PASS
2480 MHz	0.917	0.839	PASS

CH00 -1Mbps

Agilent Spectrum Analyzer - Occupied BV	N			
	CH 2	ENSE:PULSE Center Freg: 2.402000	ALIGNAUTO 000 GHz	06:57:30 PM Jul 22, 2020 Radio Std: None
Center Fred 2.40200000		Trig: Free Run	Avg Hold>10/10	
	#IFGain:Low	#Atten: 30 dB		Radio Device: BTS
10 dB/div Ref 20.00 dBm	<u>ا را ا</u>			
10.0				
0.00		mon		
-10.0				
-20.0			~~~~	
-30.0				
-40.0				
-50.0				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
-60.0				
-70.0				
Center 2.402 GHz #Res BW 30 kHz		#VBW 100 k	Hz	Span 2 MHz Sweep 2,733 ms
		# 1211 100 K		
Occupied Bandwidt	h	Total Power	11.9 dBm	
84	46.99 kHz			
Transmit Freq Error	-7.009 kHz	OBW Power	99.00 %	
x dB Bandwidth	922.0 kHz	x dB	-20.00 dB	
MSG			STATUS	
1			1	

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CH39 -1Mbps



CH78 -1Mbps



Shenzhen STS Test Services Co., Ltd.



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

Frequency	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402 MHz	1.331	1.185	PASS
2441 MHz	1.336	1.186	PASS
2480 MHz	1.33	1.187	PASS

CH00 -2Mbps



Shenzhen STS Test Services Co., Ltd.

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CH39 -2Mbps



CH78 -2Mbps



Shenzhen STS Test Services Co., Ltd.



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

Frequency	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402 MHz	1.294	1.1691	PASS
2441 MHz	1.296	1.17	PASS
2480 MHz	1.295	1.1694	PASS

CH00 -3Mbps

Agilent Spectrum Analyzer - Occu	upied BW			
RL RF 50 Q	AC S	ENSE:PULSE Center Freg: 2 402000	ALIGNAUTO	10:27:53 AM Jul 23, 2020 Radio Std: None
Center Freq 2.40200		Trig: Free Run	Avg Hold:>10/10	
	#IFGain:Low	#Atten: 30 dB		Radio Device: BTS
10 dB/div Ref 20.00) dBm			
10.0				
0.00				
-10.0			m.	
-20.0				
30.0				
-40.0				
-50.0				~
60.0				
-70.0				
Center 2.402 GHz				Span 2 MHz
#Res BW 30 kHz		#VBW 100 k	Hz	Sweep 2.733 ms
Occupied Bandy	width	Total Power	12.5 dBm	
eccupied Bailai	4 4004 MU-			
Transmit Freq Erro	or 5.739 kHz	OBW Power	99.00 %	
x dB Bandwidth	1.294 MHz	x dB	-20.00 dB	
X db ballandin	11207 11112		20.00 42	
MSG			STATUS	
			Particol	1

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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						
		RSS-247 Issue 2				
Section	Test Item	Limit	FrequencyRange (MHz)	Result		
		1 W or 0.125W				
15.247 (a)(1)&(b)(1) RSS-247	Output Power	if channel separation > 2/3 bandwidthprovided thesystems operatewith an output power no greater than125 mW(20.97dBm)	2400-2483.5	PASS		
RSS-247	EIRP	4W	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

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



9.5 TEST RESULTS

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

Mode	Channel Fred Number (N	Frequency	Peak Power	Average Power	Limit
		(MHz)	(dBm)	(dBm)	(dBm)
GFSK(1M)	0	2402	5.82	4.52	30.00
	39	2441	6.01	4.75	30.00
	78	2480	6.15	4.91	30.00

Note: the channel separation >20dB bandwidth

Mode	Channel	Frequency	Peak Power	Average Power	Limit
	Number (MHz)		(dBm)	(dBm)	(dBm)
π/4-DQPSK(2M)	0	2402	5.86	4.53	20.97
	39	2441	8.66	4.71	20.97
	78	2480	8.87	4.83	20.97

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

Mode	Channel	Frequency	Peak Power	Average Power	Limit
	Number	(MHz)	(dBm)	(dBm)	(dBm)
8-DPSK(3M)	0	2402	9.01	4.45	20.97
	39	2441	9.23	4.70	20.97
	78	2480	9.39	4.82	20.97

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

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EIRP Power							
Mode	Channel	Frequency	Peak Power	Antenna Gain	EIRP Power	Limit	
Mode	Number (MHz)		(dBm)	(dBi)	(dBm)	(dBm)	
	0	2402	5.82	-1.00	4.82	36.02	
GFSK(1M)	39	2441	6.01	-1.00	5.01	36.02	
	78	2480	6.15	-1.00	5.15	36.02	
Mode	Channel	Frequency (MHz)	Peak Power	Antenna Gain	EIRP Power	Limit	
	Number		(dBm)	(dBi)	(dBm)	(dBm)	
	0	2402	8.56	-1.00	7.56	36.02	
π/4-DQPSK(2M)	39	2441	8.66	-1.00	7.66	36.02	
	78	2480	8.87	-1.00	7.87	36.02	
Mode	Channel F Number	Frequency	Peak Power	Antenna Gain	EIRP Power	Limit	
		(MHz)	(dBm)	(dBi)	(dBm)	(dBm)	
8-DPSK(3M)	0	2402	9.01	-1.00	8.01	36.02	
	39	2441	9.23	-1.00	8.23	36.02	
	78	2480	9.39	-1.00	8.39	36.02	

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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 Loop antenna. It comply with the standard requirement.



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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 Frequency(MHz)
4.255	2441.0035
3.7	2441.0035
3.145	2441.0033
Max.Deviation(MHz)	0.0035
Max.Deviation(ppm)	1.43

Rated working voltage: DC 3.7V

Temperature vs. Frequency Stability

Temperature(℃)	Measurement Frequency(MHz)
-30	2441.0042
-20	2441.0039
-10	2441.0042
0	2441.0042
10	2441.0034
20	2441.0042
30	2441.0034
40	2441.0032
50	2441.0038
Max.Deviation(MHz)	0.0042
Max.Deviation(ppm)	1.72

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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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