

FCC TEST REPORT FCC ID:2AQ4R-HP-H006

Report Number. ZKT-220602L3721 Date of Test. May. 26, 2022 to Jun. 07, 2022 Date of issue. Jun. 08, 2022 Total number of pages. 69 Test Result PASS Testing Laboratory. Shenzhen ZKT Technology Co., Ltd. Address //F. No. 101, Building B, No. 6, Tangwei Community Industrial Avenue, Fuhai Street, Bao'an District, Shenzhen, China Applicant's name Haiping Industry Co., Ltd. Address 3F, Building C, NO.68, Hongshi Road Buxin, Fenggang Town Dongguan, Guangdong China Maufacturer's name Haiping Industry Co., Ltd. Address 3F, Building C, NO.68, Hongshi Road Buxin, Fenggang Town Dongguan, Guangdong China Test specification: Stendard. Standard FCC CFR Title 47 Part 15 Subpart C Section 15.247 ANSI C63.10:2013 Y Test procedure. / Non-standard test method N/A Test Report Form No. TRF-EL-111_VO Test Report Form(s) Originator ZKT Testing Master TRF Dated: 2020-01-06 This device described above has been tested by ZKT, and 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 t		•
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Master TRF	Test Report Form No	.: TRF-EL-111_V0
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Trademark N/A Model/Type reference	test (EUT) is in compliance with the identified in the report. This report shall not be reproduced	he FCC requirements. And it is applicable only to the tested sample except in full, without the written approval of ZKT, this document may
Model/Type reference		-
from "0" to "9" or blank.)		
Ratings: DC 12V/1.5A from adapter	Model/Type reference	LS-410AAAA(A call be replaced by letter from A to Z, fulliber
	Ratings	.: DC 12V/1.5A from adapter

Shenzhen ZKT Technolgy Co., Ltd.

1/F, No. 101, Building B, No. 6, Tangwei Community Industrial Avenue, Fuhai Street, Bao'an District, Shenzhen, China







Testing procedure and testing location:			
Testing Laboratory	Shenzhen ZKT Techn	ology Co., Ltd.	
Address:	1/F, No. 101, Building B, No. 6, Tangwei Community Industrial Avenue, Fuhai Street, Bao'an District, Shenzhen, China		
Tested by (name + signature):	Alen He	Aron. Ne	
Reviewer (name + signature):	Joe Liu	Joe. Lin.	
Approved (name + signature):	Lake Xie	DALARed The	





Table of Contents

	I
	ΜΑΤΙΟΝ
Manufacturer:Brigh	tpower Optoelectronic Technology Co., Ltd
3.2 Test Setup Config	guration
3.3 Support Equipme	nt
3.4 Test Mode	
	ST FOR ALL TEST ITEMS
4. EMC EMISSION T	EST
	ions
4.1.1 POWER LINE	CONDUCTED EMISSION Limits
4.1.2 TEST PROCED)URE
	OM TEST STANDARD
	NG CONDITIONS
	ns
	sion Limits
	DURE
	ROM TEST STANDARD
4 2 4 TEST SETUP	
4 2 5 FUT OPERATI	NG CONDITIONS
	S
	t:
-	IRE
	M TEST STANDARD
	G CONDITIONS
	ND EDGE AND SPURIOUS EMISSION
•	
	M STANDARD
	•••
	н
	• • • • • • • • • • • • • • • • • • • •
ZKT Technolgy Co., Ltd.	





7.4 DEVIATION FROM STANDARD	40
7.5 Test Result	
8. MAXIMUM PEAK OUTPUT POWER	46
8.1 Block Diagram Of Test Setup	
8.2 Limit	
8.3 Test procedure	
8.4 DEVIATION FROM STANDARD	
8.5 Test Result	
9. HOPPING CHANNEL SEPARATION	
9.1 Test Setup	
9.2 Test procedure	
9.3 DEVIATION FROM STANDARD	
9.4 Test Result	
10.NUMBER OF HOPPING FREQUENCY	
10.1 Test Setup	
10.2 Test procedure	
10.3 DEVIATION FROM STANDARD	
10.4 Test Result	
11. DWELL TIME	
11.1 Test Setup	
11.2 Test procedure	
11.3 DEVIATION FROM STANDARD	
11.4 Test Result	
12. ANTENNA REQUIREMENT	
13. TEST SETUP PHOTO	





1. VERSION

Report No.	Version	Description	Approved
ZKT-220602L3721	Rev.01	Initial issue of report	Jun. 08, 2022







2. TEST SUMMARY

Test procedures according to the technical standards:

	FCC Part15 (15.247) , Subpart C						
Standard Section	Test Item	Result	Remark				
15.203/15.247 (c)	Antenna Requirement	PASS					
15.207	AC Power Line Conducted Emission	PASS					
15.247 (b)(1)	Conducted Peak Output Power	PASS					
15.247 (a)(1)	20dB Occupied Bandwidth	PASS					
15.247 (a)(1)	Carrier Frequencies Separation	PASS					
15.247 (a)(1)(iii)	Hopping Channel Number	PASS					
15.247 (a)(1)(iii)	Dwell Time	PASS					
15.205/15.209	Radiated Emission and Restricted Bands	PASS					
15.247(d)	Conducted Unwanted emissions and Bandedge	PASS					

NOTE:

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







2.1 TEST FACILITY

Shenzhen ZKT Technology Co., Ltd. Add. : 1/F, No. 101, Building B, No. 6, Tangwei Community Industrial Avenue, Fuhai Street, Bao'an District, Shenzhen, China

FCC Test Firm Registration Number: 692225 Designation Number: CN1299 IC Registered No.: 27033 Test lab CAB identifier:CN0110

2.2 MEASUREMENT UNCERTAINTY

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

No.	Item	Uncertainty
1	Conducted Emission Test	±1.38dB
2	RF power conducted	±0.16dB
3	Spurious emissions conducted	±0.21dB
4	All emissions radiated(<1G)	±4.68dB
5	All emissions radiated(>1G)	±4.89dB
6	Temperature	±0.5°C
7	Humidity	±2%



3. GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

Product Name:	Turntable Player
Model No.:	HP-H006-MA
Sample ID:	ZKT220328L1926-1#
Serial No.:	HP-H006-XX, HP-H006X-XX, LS-410XX, LS-410XXXX("X" can be replaced by letter from "A" to "Z", number from "0" to "9" or blank.)
Model Different.:	Except the model number, color and brand are different, everything else is the same.
Hardware Version:	V1.0
Software Version:	V1.0
Sample(s) Status:	Engineer sample
Channel numbers:	79
Channel separation:	2402MHz~2480MHz
Modulation technology:	GFSK, π/4-DQPSK, 8-DPSK
Antenna Type:	Internal antenna
Antenna gain:	1.2dBi
Power supply:	DC 12V/1.5A from adapter
Adapter Information	Manufacturer:Brightpower Optoelectronic Technology Co., Ltd Model: SW1200500-N04
	Input: AC 100-240V, 50/60Hz Max. 500mA
	Output:DC 12V/1.5A

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2402MHz	21	2422MHz	41	2442MHz	61	2462MHz
2	2403MHz	22	2423MHz	42	2443MHz	62	2463MHz
3	2404MHz	23	2424MHz	43	2444MHz	63	2464MHz
4	2405MHz	24	2425MHz	44	2445MHz	64	2465MHz
5	2406MHz	25	2426MHz	45	2446MHz	65	2466MHz
6	2407MHz	26	2427MHz	46	2447MHz	66	2467MHz
7	2408MHz	27	2428MHz	47	2448MHz	67	2468MHz
8	2409MHz	28	2429MHz	48	2449MHz	68	2469MHz
9	2410MHz	29	2430MHz	49	2450MHz	69	2470MHz
10	2411MHz	30	2431MHz	50	2451MHz	70	2471MHz
11	2412MHz	31	2432MHz	51	2452MHz	71	2472MHz
12	2413MHz	32	2433MHz	52	2453MHz	72	2473MHz
13	2414MHz	33	2434MHz	53	2454MHz	73	2474MHz
14	2415MHz	34	2435MHz	54	2455MHz	74	2475MHz





15	2416MHz	35	2436MHz	55	2456MHz	75	2476MHz
16	2417MHz	36	2437MHz	56	2457MHz	76	2477MHz
17	2418MHz	37	2438MHz	57	2458MHz	77	2478MHz
18	2419MHz	38	2439MHz	58	2459MHz	78	2479MHz
19	2420MHz	39	2440MHz	59	2460MHz	79	2480MHz
20	2421MHz	40	2441MHz	60	2461MHz		

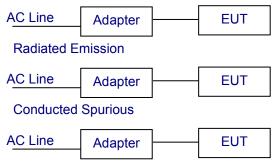
Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Test channel	Frequency
The lowest channel	2402MHz
The middle channel	2441MHz
The Highest channel	2480MHz

3.2 Test Setup Configuration

Conducted Emission



3.3 Support Equipment

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.	Series No.	Note
E-1	Turntable Player	N/A	HP-H006-MA	N/A	EUT
AE	Notebook	lenovo	B40-80	MP07F6JD	AE

Item	Shielded Type	Ferrite Core	Length	Note

Note:

- (1) The support equipment was authorized by Declaration of Confirmation.
- (2) For detachable type I/O cable should be specified the length in cm in ^[]Length ^[] column.





Transmitting mode	Keep the EUT in continuously transmitting mode.
0	, the test voltage was tuned from 85% to 115% of the nominal rated supply the worst case was under the nominal rated supply condition. So the report n's data.

Test Software	BT_Tool.exe
Power level setup	<7dBm



3.5 EQUIPMENTS LIST FOR ALL TEST ITEMS

Radiation & RF Conducted Test equipment

Item	Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
1	Spectrum Analyzer (9kHz-26.5GHz)	KEYSIGHT	9020A	MY45109572	Sep. 21, 2021	Sep. 20, 2022
2	Spectrum Analyzer (1GHz-40GHz)	Agilent	E4446A	100363	Sep. 21, 2021	Sep. 20, 2022
3	Test Receiver (9kHz-7GHz)	R&S	ESCI7	101169	Sep. 21, 2021	Sep. 20, 2022
4	Bilog Antenna (30MHz-1400MHz)	Schwarzbeck	VULB9168	00877	Sep. 21, 2021	Sep. 20, 2022
5	Horn Antenna (1GHz-18GHz)	SCHWARZBEC K	BBHA9120D	1541	Sep. 21, 2021	Sep. 20, 2022
6	Horn Antenna (18GHz-40GHz)	A.H. System	SAS-574	588	Sep. 21, 2021	Sep. 20, 2022
7	Amplifier (30-1000MHz)	EM Electronics	EM330 Amplifier	N/A	Sep. 21, 2021	Sep. 20, 2022
8	Amplifier (1GHz-40GHz)	全聚达	DLE-161	097	Sep. 21, 2021	Sep. 20, 2022
9	Loop Antenna (9KHz-30MHz)	SCHWARZBEC K	FMZB1519B	014	Sep. 21, 2021	Sep. 20, 2022
10	RF cables1 (9kHz-30MHz)	N/A	9kHz-30MHz	N/A	Sep. 21, 2021	Sep. 20, 2022
11	RF cables2 (30MHz-1GHz)	N/A	30MHz-1GHz	N/A	Sep. 21, 2021	Sep. 20, 2022
12	RF cables3 (1GHz-40GHz)	N/A	1GHz-40GHz	N/A	Sep. 21, 2021	Sep. 20, 2022
13	CMW500 Test	R&S	CMW500	106504	Sep. 21, 2021	Sep. 20, 2022
14	ESG Signal Generator	Agilent	E4421B	GB40051203	Sep. 21, 2021	Sep. 20, 2022
15	Signal Generator	Agilent	N5182A	MY47420215	Sep. 21, 2021	Sep. 20, 2022
16	Power Meter	Anritsu	ML2495A	N/A	Sep. 21, 2021	Sep. 20, 2022
17	D.C. Power Supply	LongWei	TPR-6405D	١	١	١
18	Software	Audix	E3	6.101223a	١	١

Conduction Test equipment

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
1	LISN	R&S	ENV216	101471	Sep. 21, 2021	Sep. 20, 2022
2	LISN	CYBERTEK	EM5040A	E1850400149	Sep. 21, 2021	Sep. 20, 2022
3	Test Cable	N/A	C01	N/A	Sep. 21, 2021	Sep. 20, 2022
4	Test Cable	N/A	C02	N/A	Sep. 21, 2021	Sep. 20, 2022
5	EMI Test Receiver	R&S	ESRP3	101946	Sep. 21, 2021	Sep. 20, 2022
6	Absorbing Clamp	DZ	ZN23201	N/A	Sep. 21, 2021	Sep. 20, 2022
7	Software	Audix	E3	6.101223a	١	١











4. EMC EMISSION TEST

4.1 Conducted emissions

Test Requirement:	FCC Part15 C Section 15.207
Test Method:	ANSI C63.10:2013
Test Frequency Range:	150KHz to 30MHz
Receiver setup:	RBW=9KHz, VBW=30KHz, Sweep time=auto

4.1.1 POWER LINE CONDUCTED EMISSION Limits

FREQUENCY (MHz)	Limit (Standard	
	Quasi-peak	Average	Stanuaru
0.15 -0.5	66 - 56 *	56 - 46 *	FCC
0.50 -5.0	56.00	46.00	FCC
5.0 -30.0	60.00	50.00	FCC

Note:

(1) *Decreases with the logarithm of the frequency.

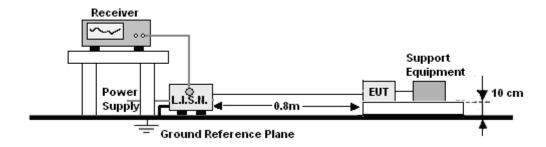
4.1.2 TEST PROCEDURE

- a. The EUT was placed 0.1 meters from the horizontal 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.

4.1.3 DEVIATION FROM TEST STANDARD No deviation







4.1.5 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.

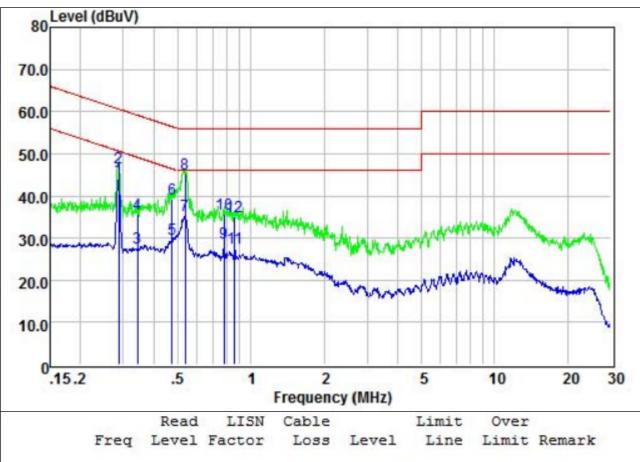
We pretest AC 120V and AC 230V, the worst voltage was AC 120V and the data recording in the report.





4.1.6 Test Result

Temperature :	26 ℃	Relative Humidity:	54%
Pressure :	101kPa	Phase :	L
Test Voltage :	AC 120V/60Hz		



	4							
-	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.29	34.46	9.62	0.05	44.13	50.63	-6.50	Average
2	0.29	36.92	9.62	0.05	46.59	60.63	-14.04	QP
3	0.34	18.03	9.64	0.05	27.72	49.13	-21.41	Average
4	0.34	26.00	9.64	0.05	35.69	59.13	-23.44	QP
5	0.48	20.14	9.69	0.05	29.88	46.41	-16.53	Average
6	0.48	29.37	9.69	0.05	39.11	56.41	-17.30	QP
7	0.54	25.61	9.68	0.05	35.34	46.00	-10.66	Average
8	0.54	35.51	9.68	0.05	45.24	56.00	-10.76	QP
9	0.78	19.04	9.63	0.05	28.72	46.00	-17.28	Average
10	0.78	26.01	9.63	0.05	35.69	56.00	-20.31	QP
11	0.86	18.00	9.62	0.05	27.67	46.00	-18.33	Average
12	0.86	25.52	9.62	0.05	35.19	56.00	-20.81	QP

Notes:

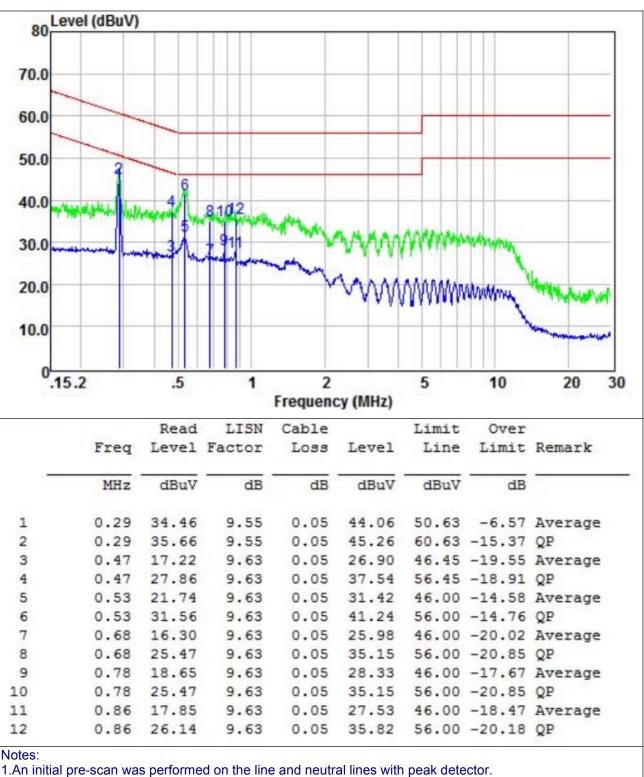
1.An initial pre-scan was performed on the line and neutral lines with peak detector.

2.Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.3.Mesurement Level = Reading level + Correct Factor





Temperature :	26 ℃	Relative Humidity:	54%
Pressure :	101kPa	Phase :	Ν
Test Voltage :	AC 120V/60Hz		



2.Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
 3.Mesurement Level = Reading level + Correct Factor

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4.2 Radiated emissions

Test Method:ANSI C63.10:2013Test Frequency Range:9kHz to 25GHzTest site:Measurement Distance: 3mReceiver setup:FrequencyDetectorRBWVBWVa	FCC Part15 C Section 15.209					
Test site: Measurement Distance: 3m						
	9kHz to 25GHz					
Receiver setup: Frequency Detector RBW VBW Value	Measurement Distance: 3m					
	ue					
9KHz-150KHz Quasi-peak 200Hz 600Hz Quas	-peak					
150KHz-30MHz Quasi-peak 9KHz 30KHz Quasi	-peak					
30MHz-1GHz Quasi-peak 100KHz 300KHz Quas	-peak					
Above 1GHz Peak 1MHz 3MHz Pe	ak					
Peak 1MHz 1/T Ave	age					

4.2.1 Radiated Emission Limits

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (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

FREQUENCY (MHz)	Limit (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).

4.2.2 TEST PROCEDURE

Below 1GHz test procedure as below:

- a. The EUT was placed on the top of a rotating table 0.1 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.





- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Above 1GHz test procedure as below:

- g. Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 metre to 1.5 metre(Above 18GHz the distance is 1 meter and table is 1.5 metre).
- h. Test the EUT in the lowest channel ,the middle channel ,the Highest channel

Note:

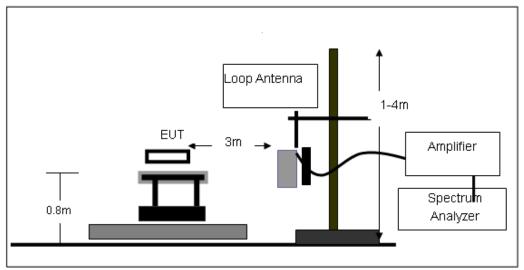
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported

4.2.3 DEVIATION FROM TEST STANDARD

No deviation

4.2.4 TEST SETUP

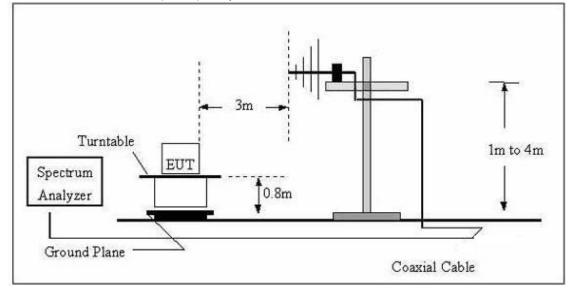
(A) Radiated Emission Test-Up Frequency Below 30MHz



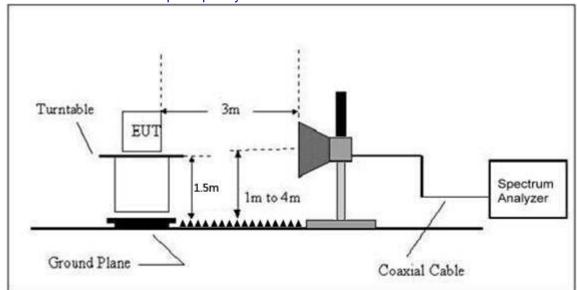




(B) Radiated Emission Test-Up Frequency 30MHz~1GHz



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



4.2.5 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.







4.2.6 TEST RESULTS

Between 9KHz – 30MHz

The emission from 9 kHz to 30MHz was pre-tested and found the result was 20dB lower than the limit, and according to 15.31(o) & RSS-Gen 6.13, the test result no need to reported.

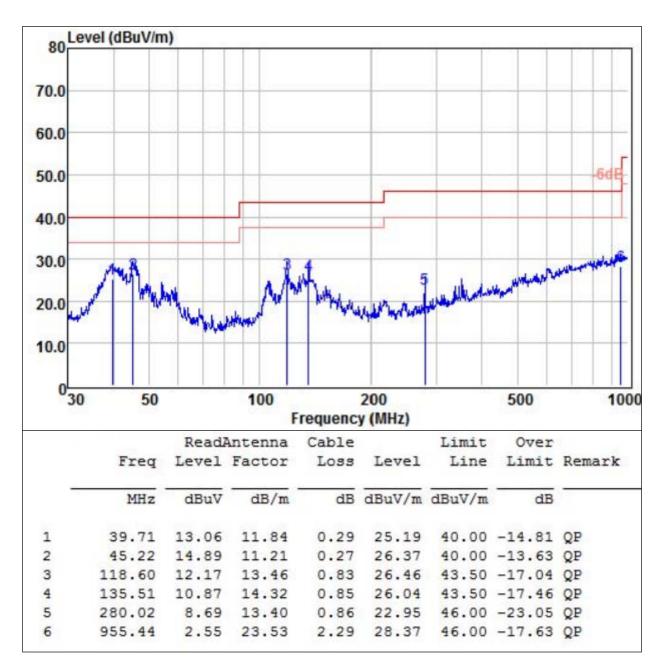






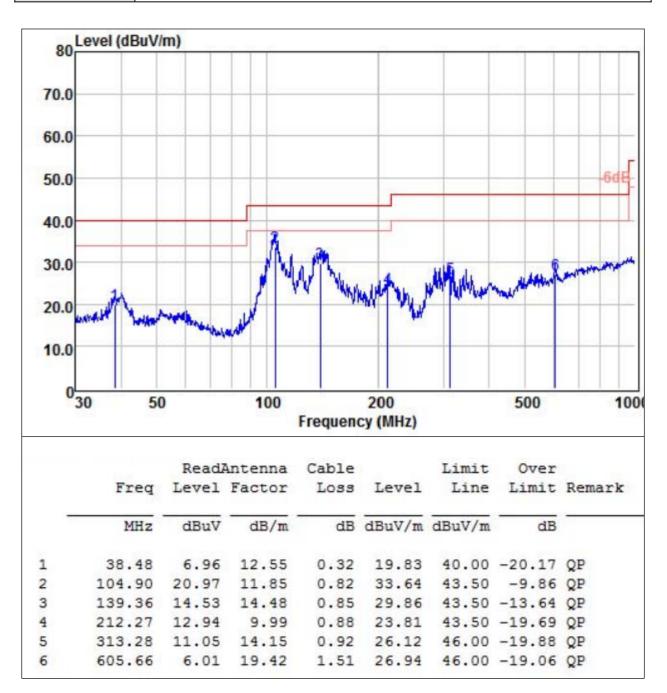
Between 30MHz - 1GHz

Temperature:	26 ℃	Relative Humidity:	54%
Pressure:	101 kPa	Polarization:	Horizontal
Test Voltage:	AC 120V/60Hz		





Temperature:	26 ℃	Relative Humidity:	54%
Pressure:	101kPa	Polarization:	Vertical
Test Voltage:	AC 120V/60Hz		



Remarks:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss

2. The emission levels of other frequencies are very lower than the limit and not show in test report.

3. The test data shows only the worst case GFSK mode





Above 1 GHz Test Results (GFSK Worst Case): 1GHz~25GHz

				(GFSK				
Polar	Frequency	Meter Reading	Pre-ampli fier	Cable Loss	Antenna Factor	Emission Level	Limits	Margin	Detector
(H/V)	(MHz)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Туре
				Low Cha	nnel:2402M	Hz			
V	4804.00	55.06	30.55	5.77	24.66	54.94	74.00	-19.06	Pk
V	4804.00	45.32	30.55	5.77	24.66	45.2	54.00	-8.8	AV
V	7206.00	53.12	30.33	6.32	24.55	53.66	74.00	-20.34	Pk
V	7206.00	/	30.33	6.32	24.55	/	54.00	/	AV
V	9608.00	51.63	30.85	7.45	24.69	52.92	74.00	-21.08	Pk
V	9608.00	/	30.85	7.45	24.69	/	54.00	/	AV
V	12010.00	50.27	31.02	8.99	25.57	53.81	74.00	-20.19	Pk
V	12010.00	/	31.02	8.99	25.57	/	54.00	/	AV
Н	4804.00	54.83	30.55	5.77	24.66	54.71	74.00	-19.29	Pk
Н	4804.00	44.72	30.55	5.77	24.66	44.6	54.00	-9.4	AV
Н	7206.00	52.83	30.33	6.32	24.55	53.37	74.00	-20.63	Pk
Н	7206.00	/	30.33	6.32	24.55	/	54.00	/	AV
Н	9608.00	51.23	30.85	7.45	24.69	52.52	74.00	-21.48	Pk
Н	9608.00	1	30.85	7.45	24.69	/	54.00	1	AV
Н	12010.00	49.86	31.02	8.99	25.57	53.4	74.00	-20.6	Pk
Н	12010.00	/	31.02	8.99	25.57	1	54.00	/	AV

Polar	Frequency	Meter Reading	Pre-ampli fier	Cable Loss	Antenna Factor	Emission Level	Limits	Margin	Detector
(H/V)	(MHz)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Туре
				Aiddle Ch	nannel:2441	MHz			
V	4882.00	54.74	30.55	5.77	24.66	54.62	74.00	-19.38	Pk
V	4882.00	44.23	30.55	5.77	24.66	44.11	54.00	-9.89	AV
V	7323.00	52.39	30.33	6.32	24.55	52.93	74.00	-21.07	Pk
V	7323.00	/	30.33	6.32	24.55	/	54.00	/	AV
V	9764.00	51.27	30.85	7.45	24.69	52.56	74.00	-21.44	Pk
V	9764.00	/	30.85	7.45	24.69	/	54.00	/	AV
V	12205.00	49.28	31.02	8.99	25.57	52.82	74.00	-21.18	Pk
V	12205.00	/	31.02	8.99	25.57	/	54.00	/	AV
Н	4882.00	54.63	30.55	5.77	24.66	54.51	74.00	-19.49	Pk
Н	4882.00	44.08	30.55	5.77	24.66	43.96	54.00	-10.04	AV
Н	7323.00	52.63	30.33	6.32	24.55	53.17	74.00	-20.83	Pk
Н	7323.00	/	30.33	6.32	24.55	/	54.00	/	AV
Н	9764.00	51.12	30.85	7.45	24.69	52.41	74.00	-21.59	Pk
Н	9764.00	/	30.85	7.45	24.69	/	54.00	/	AV
Н	12205.00	49.66	31.02	8.99	25.57	53.2	74.00	-20.8	Pk
Н	12205.00	/	31.02	8.99	25.57	/	54.00	/	AV



Polar	Frequency	Meter Reading	Pre-ampli fier	Cable Loss	Antenna Factor	Emission Level	Limits	Margin	Detector
(H/V)	(MHz)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Туре
				High Cha	nnel:2480N	IHz			
V	4960.00	54.32	30.55	5.77	24.66	54.2	74.00	-19.8	Pk
V	4960.00	44.01	30.55	5.77	24.66	43.89	54.00	-10.11	AV
V	7440.00	53.23	30.33	6.32	24.55	53.77	74.00	-20.23	Pk
V	7440.00	/	30.33	6.32	24.55	/	54.00	1	AV
V	9920.00	51.37	30.85	7.45	24.69	52.66	74.00	-21.34	Pk
V	9920.00	/	30.85	7.45	24.69	/	54.00	1	AV
V	12400.00	49.53	31.02	8.99	25.57	53.07	74.00	-20.93	Pk
V	12400.00	/	31.02	8.99	25.57	/	54.00	1	AV
Н	4960.00	55.21	30.55	5.77	24.66	55.09	74.00	-18.91	Pk
Н	4960.00	45.26	30.55	5.77	24.66	45.14	54.00	-8.86	AV
H	7440.00	53.61	30.33	6.32	24.55	54.15	74.00	-19.85	Pk
Н	7440.00	/	30.33	6.32	24.55	/	54.00	1	AV
Н	9920.00	51.43	30.85	7.45	24.69	52.72	74.00	-21.28	Pk
Н	9920.00	/	30.85	7.45	24.69	/	54.00	/	AV
Н	12400.00	49.38	31.02	8.99	25.57	52.92	74.00	-21.08	Pk
Н	12400.00	/	31.02	8.99	25.57	1	54.00	/	AV

Remark:

1. Emission Level = Meter Reading + Antenna Factor + Cable Loss – Pre-amplifier,

- Margin= Emission Level Limit
- 2. If peak below the average limit, the average emission was no test.
- 3. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.





5. RADIATED BAND EMISSION MEASUREMENT

5.1 Test Requirement:

Test Requirement:	FCC Part15 C Section 15.209 and 15.205						
Test Method:	ANSI C63.10: 2013						
Test Frequency Range:	All of the restrict bands were tested, only the worst band's (2310MHz to 2500MHz) data was showed.						
Test site:	Measurement Distance: 3m						
Receiver setup:	Frequency	Detector	RBW	VBW	Value		
	Above	Peak	1MHz	3MHz	Peak		
	1GHz	Average	1MHz	1/T	Average		

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	Limit (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).

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	2300MHz
Stop Frequency	2520
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / 1/T for Average

5.2 TEST PROCEDURE

Above 1GHz test procedure as below:

- a. 1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- g. Test the EUT in the lowest channel,the Highest channel

Note:

Both horizontal and vertical antenna polarities were tested

and performed pretest to three orthogonal axis. The worst case emissions were reported



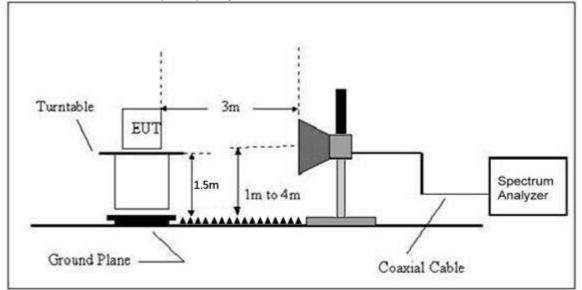




5.3 DEVIATION FROM TEST STANDARD No deviation

5.4 TEST SETUP

Radiated Emission Test-Up Frequency Above 1GHz



5.5 EUT OPERATING CONDITIONS

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







5.6 TEST RESULT

PASS

Remark: All modes of GFSK, $\pi/4$ DQPSK, 8DPSK were tested, only the worst result of GFSK was reported as below.

	Polar	Frequenc	Meter	Pre-	Cable	Antenna	Emission	Limit	Detec		
	(H/V)	y (MHz)	Reading (dBuV)	amplifier (dB)	Loss (dB)	Factor (dB/m)	level (dBuV/m)	(dBuV /m)	tor Type	Result	
				Low	Channe	I: 2402MHz	<u>.</u>				
ſ	Н	2390.00	54.49	30.22	4.85	23.98	53.1	74.00	PK	PASS	
Γ	Η	2390.00	44.63	30.22	4.85	23.98	43.24	54.00	AV	PASS	
Ī	Н	2400.00	53.72	30.22	4.85	23.98	52.33	74.00	PK	PASS	
Γ	Н	2400.00	/	30.22	4.85	23.98	/	54.00	AV	PASS	
Ī	V	2390.00	54.27	30.22	4.85	23.98	52.88	74.00	PK	PASS	
Ī	V	2390.00	44.58	30.22	4.85	23.98	43.19	54.00	AV	PASS	
ſ	V	2400.00	53.46	30.22	4.85	23.98	52.07	74.00	PK	PASS	
GFSK	V	2400.00	/	30.22	4.85	23.98	/	54.00	AV	PASS	
GFSK	High Channel: 2480MHz										
ſ	Н	2483.50	53.74	30.22	4.85	23.98	52.35	74.00	PK	PASS	
Ī	Н	2483.50	/	30.22	4.85	23.98	/	54.00	AV	PASS	
Ī	Н	2483.50	52.46	30.22	4.85	23.98	51.07	74.00	PK	PASS	
ſ	Н	2483.50	/	30.22	4.85	23.98	/	54.00	AV	PASS	
Γ	V	2483.50	53.61	30.22	4.85	23.98	52.22	74.00	PK	PASS	
ſ	V	2483.50	/	30.22	4.85	23.98	/	54.00	AV	PASS	
Ī	V	2483.50	52.49	30.22	4.85	23.98	51.1	74.00	PK	PASS	
Ī	V	2483.50	/	30.22	4.85	23.98	/	54.00	AV	PASS	



6. CONDUCTED BAND EDGE AND SPURIOUS EMISSION

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	KDB558074 D0115.247 Meas Guidancev05r02

Project No.: ZKT-220602L3721

Page 27 of 69

6.1 Limit

Regulation 15.247 (d),In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

6.2 Test Setup



6.3 Test procedure

Using the following spectrum analyzer setting:

- A) Set the RBW = 100KHz.
- B) Set the VBW = 300KHz.
- C) Sweep time = auto couple.
- D) Detector function = peak.
- E) Trace mode = max hold.
- F) Allow trace to fully stabilize.

6.4 DEVIATION FROM STANDARD

No deviation.







6.5 Test Result

Remark: Spurious Emission all modes of GFSK, $\pi/4$ DQPSK, 8DPSK were tested, only the worst result of GFSK

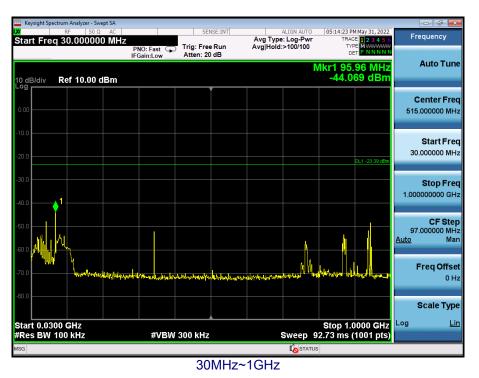
was reported	as	below:
GFSK mode:		

Test channel:





CH:2402MHz











Keysight Spectrum Analyzer - Swept SA					- 7
₩ RF 50 Ω AC Start Freq 1.000000000 C		SENSE:INT	ALIGN AUTO Avg Type: Log-Pwr Avg Hold:>100/100	05:15:18 PM May 31, 2022 TRACE 1 2 3 4 5 6 TYPE M WWWWW	Frequency
	PNO: Fast IFGain:Low	Atten: 20 dB	Avg Hold:>100/100	DET PNNNNN	Auto Turo
10 dB/div Ref 10.00 dBm			N	/kr3 9.616 GHz -51.798 dBm	Auto Tune
Log 0.00 -10.0 -20.0				DL1 -23 -39 uBm	Center Freq 13.000000000 GHz
-30.0	3		Mundal and a start of the start	an part and a second	Start Freq 1.000000000 GHz
-60.0	warden and a street	nor range and the street			Stop Freq 25.00000000 GHz
Start 1.00 GHz #Res BW 1.0 MHz	#VBW 3		Sweep 6	Stop 25.00 GHz 0.00 ms (1001 pts)	CF Step 2.40000000 GHz <u>Auto</u> Man
1 N 1 f 2 N 1 f 3 N 1 f 4 5 6 9	1.768 GHz -	-3.153 dBm 26.705 dBm 51.798 dBm		E CONTRACTOR	Freq Offset 0 Hz
7 8 9 10 11				-	Scale Type Log <u>Lin</u>
MSG		m	STATU:	<u>ه</u>	

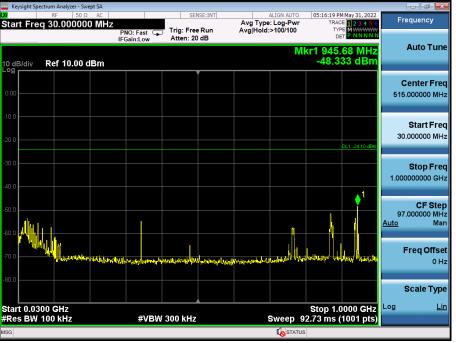
1MHz~25GHz



Middle channel







30MHz~1GHz







Keysight Spectrum Analyzer - Swept SA					- # *
KF 50 Ω AC Start Freg 1.000000000 G	iHz		ALIGN AUTO Avg Type: Log-Pwr	05:17:42 PM May 31, 2022 TRACE 1 2 3 4 5 6	Frequency
10 dB/div Ref 10.00 dBm	PNO: East 🕟 Tr	ig: Free Run / iten: 20 dB	Avg Hold:>100/100	TYPE MWWWW DET P NNNNN Ikr3 9.760 GHz -50.809 dBm	Auto Tune
Log1				DL1 -24.10 dBm	Center Freq 13.000000000 GHz
-30.0 -40.0 -50.0	3	and a star for a star a star	لىرىنى الىلانىيە مىرى مىرى بىرى الىرى	-changer and	Start Freq 1.000000000 GHz
-60.0					Stop Freq 25.000000000 GHz
Start 1.00 GHz #Res BW 1.0 MHz	#VBW 3.0			Stop 25.00 GHz 0.00 ms (1001 pts)	CF Step 2.40000000 GHz Auto Man
2 N 1 f	1.744 GHz -39.	Y FUNCTIO 839 dBm 699 dBm 809 dBm	N FUNCTION WIDTH	FUNCTION VALUE	Freq Offset 0 Hz
7 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9					Scale Type Log <u>Lin</u>
MSG			K STATUS		

1GHz~25GHz



Highest channel



CH:2480MHz



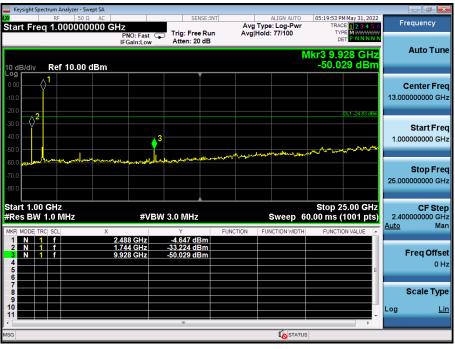
30MHz~1GHz

Shenzhen ZKT Technolgy Co., Ltd. 1/F, No. 101, Building B, No. 6, Tangwei Community Industrial Avenue, Fuhai Street, Bao'an District, Shenzhen,China

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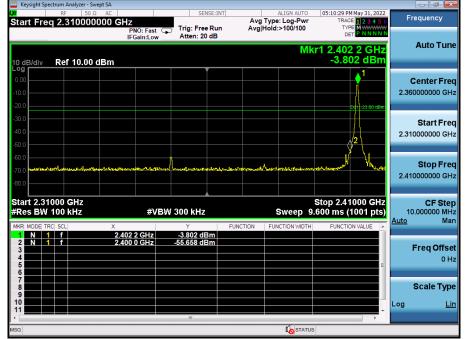
1GHz~25GHz

Conducted band edge Test result

Мо	dulation	Frequency Band	Delta Peak to band emission (dBc)	>Limit (dBc)	Result
	Non honning	Left Band	51.86	20	Pass
OFOK	Non-hopping	Right Band	59.58	20	Pass
GFSK	henning	Left Band	52.94	20	Pass
	hopping	Right Band	64.20	20	Pass
	Non honning	Left Band	51.82	20	Pass
	Non-hopping	Right Band	58.73	20	Pass
π/4DQPSK	hanning	Left Band	53.02	20	Pass
	hopping	Right Band	61.24	20	Pass
	Non honning	Left Band	50.18	20	Pass
	Non-hopping	Right Band	60.10	20	Pass
8DPSK	henning	Left Band	50.39	20	Pass
	hopping	Right Band	63.30	20	Pass



GFSK No-hopping Band edge-left side



GFSK Hopping Band edge-left side

Ox RF 50 Ω AC Start Freq 2.310000000 GHz FN0: FR0: IFGain 10 dB/div Ref 10.00 dBm 0.00 IFGain -10.0	Fast Fast Atten: 20 dE	Avg Typ an Avg Hold	ALIGN AUTO De: Log-Pwr d:>100/100	05:09:32 PMMay 31, 2022 TRACE 2 2 3 4 5 6 TYPE P NNNNN 1 2.405 0 GHz -4.105 dBm 1	
PNO: IFGain Log 000 -100		in Avg Hold	d:>100/100	TYPE MWWWW DET P NNNNN 1 2.405 0 GHz	
0.00				1	Conton Enor
					Center Freq 2.360000000 GHz
-30.0 -40.0 -50.0					Start Freq 2.310000000 GHz
.00.0 .70.0 <mark></mark>	MMMMMMMM	NAM WAAN	NAMANA		Stop Freq 2.410000000 GHz
Start 2.31000 GHz #Res BW 100 kHz	#VBW 300 kHz			top 2.41000 GHz 600 ms (1001 pts)	CF Step 10.000000 MHz Auto Man
MKR MODE TRC SCL X 1 N 1 f 2.405.0 G		FUNCTION FU	JNCTION WIDTH	FUNCTION VALUE	Auto Man
2 N 1 f 2.400 0 G 3 4 5 6 6 6 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	Hz -57.045 dBm			E	Freq Offset 0 Hz
7 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9					Scale Type
10 11					Log <u>Lin</u>
< MSG	m		I STATUS	4	





GFSK No-hopping Band edge-right side

Keysight Spectrum Analyzer - Swept SA					-
RF 50 Ω AC	GHz		ALIGN AUTO	05:03:25 PM May 31, 2022 TRACE 1 2 3 4 5 6	Frequency
0 dB/div Ref 10.00 dBm	PNO: East	ig: Free Run A Itten: 20 dB	vg Hold:>100/100 Mkr1	2.480 025 GHz -4.258 dBm	Auto Tun
				DL1 -24 26 dBm	Center Fre 2.487500000 G⊦
30.0				011-24-20 000	Start Fre 2.475000000 GH
60.0 70.0 80.0	w 22	m war an na h	L.BUTTERSA. 74-14-1-14946-14	tin y had to an	Stop Fre 2.500000000 GH
tart 2.47500 GHz Res BW 100 kHz	#VBW 300) KHz	Sweep 2.	Stop 2.50000 GHz 400 ms (1001 pts)	CF Ste 2.500000 Mi <u>Auto</u> Mi
1 N 1 f 2.48	30 025 GHz -4. 33 500 GHz -63.	258 dBm 834 dBm			Freq Offs 0 H
8 9 10 11					Scale Typ
GG		m	K STATUS	4	

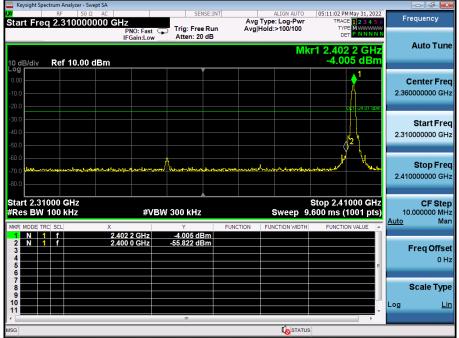
GFSK Hopping Band edge-right side

Keysight Spectrum Analyzer - Swept SA				- 6 🔀
RF 50 Ω AC Start Freq 2.475000000 GHz	SENSE:INT	ALIGN AUTO	05:04:02 PM May 31, 2022 TRACE 1 2 3 4 5 6	Frequency
PNO: Fast 😱	Trig: Free Run	Avg Hold:>100/100	TYPE MWWWWWW	
IFGain:Low	Atten: 20 dB			Auto Tune
		Mkr1	2.475 875 GHz -4.253 dBm	Auto Funo
10 dB/div Ref 10.00 dBm	•		-4.255 GBM	
				Center Freq
				2.487500000 GHz
-20.0				
-30.0			DL1 -24.25 dBm	
-40.0				Start Freq
				2.475000000 GHz
-50.0				
-60.0	MMMM	mm	1 m m m n r	Stop Freq
-70.0	we was the first that	war har far har har	مملك كملك كمعكما كمسلا كيمك	2.500000000 GHz
-80.0				
Start 2.47500 GHz	A		Stop 2.50000 GHz	CF Step
	300 kHz		.400 ms (1001 pts)	2.500000 MHz
MKR MODE TRC SCL X	Y FUNC	TION FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> Man
1 N 1 f 2.475 875 GHz	-4.253 dBm			
2 N 1 f 2.483 500 GHz	-68.456 dBm			Freq Offset
4				0 Hz
6				
7				Scale Type
9				Scale Type
10				Log <u>Lin</u>
	m		F F	
ISG		STATUS		





$\pi/4\text{-}DQPSK$ No-hopping Band edge-left side



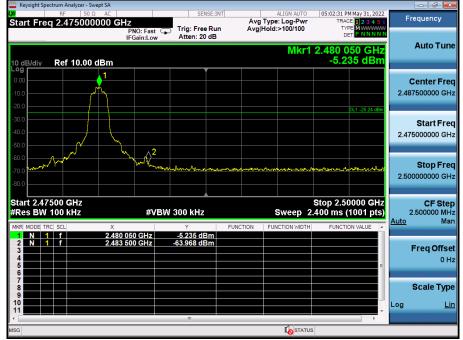
$\pi/4\text{-}DQPSK$ Hopping Band edge-left side

Keysight Spec	ctrum Analyzer - Swept SA									
X Start Fred	RF 50 Ω AC 2.310000000 G	iHz	SENSE		Avg Type	ALIGN AUTO	TRAC	M May 31, 2022	Frequ	ency
10 dB/div	Ref 10.00 dBm	PNO: Fast G IFGain:Low	Trig: Free R Atten: 20 d		Avg Hold		r1 2.404		Au	to Tune
Log 0.00 -10.0 -20.0									Cen 2.360000	t er Freq 1000 GHz
-30.0 -40.0 -50.0								×2	St 2.310000	art Freq 1000 GHz
-60.0 -70.0	ุลาการสารประการสารประการ	ahaan aha	<i>ի</i> կտուկեր Մահություն Մահությու Մահություն Ասություն Մահություն Մահություն Մահություն Մահություն Մահություն Մահություն Մահություն Մահություն Մահություն Մահություն Մահություն Մահություն Ասություն Ասություն Մահություն Մահություն Մահություն Մահություն Մահություն Մահություն Մահություն Մահություն Մահություն Մահություն Մահություն Մահություն Մահություն Մասուս Ասություն Մատություն Մա Ասուս Ասուս Ասուս Ասուտուս Ասուս Ասոս Ասուս Ասոս Ասուս Ասոս Ասո	Mary Mary MU	naManNN	hind and a second s	Woody WWW		St 2.410000	op Freq 1000 GHz
Start 2.310 #Res BW	100 kHz	#VBV	V 300 kHz	FUNC			Stop 2.41 .600 ms (CF Step 000 MHz Mar
1 N 1 2 N 1 3 4 5 6	f 2.	404 0 GHz 400 0 GHz	-3.951 dBm -56.970 dBm						Fre	q Offse 0 Hz
7 8 9 10									Sca Log	l e Type <u>Lir</u>
∢			Ш			I o STATUS	3	•		

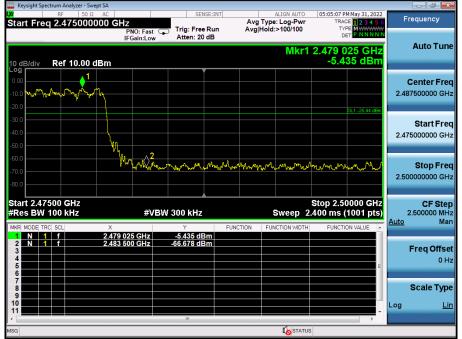




π/4-DQPSK No-hopping Band edge-right side



π /4-DQPSK Hopping Band edge-right side







8-DQPSK No-hopping Band edge-left side

K 1110						<u> </u>	
Keysight Spec	trum Analyzer - Swept SA RF 50 Ω AC		SENSE:II	NT	ALIGN AUTO	05:11:31 PM May 31, 2022	
tart Frod	2.310000000	CH-	SENSE:1		Type: Log-Pwr	TRACE 1 2 3 4 5 6	Frequency
	2.310000000	PNO: Fast G	Trig: Free Run Atten: 20 dB		Hold:>100/100	TYPE MWWWW DET PNNNN	Auto Tur
0 dB/div	Ref 10.00 dBm	<u> </u>			Mk	r1 2.402 0 GHz -3.759 dBm	
						≬ 1	Center Fre
0.0						Å	2.36000000 G
20.0						Dis1 -23.76 dBm	2.30000000 8
0.0							Start Fr
0.0							
50.0						^{1/2} h	2.310000000 G
0.0			A			ℓÅ \ı	
0.0	and the second	وساوموا والمارية والماستان والم	human	rennennen	Annonauman	alustration Weather	Stop Fr
80.0							2.410000000 G
tart 2.310					I	Stop 2.41000 GHz	CF St
Res BW	100 kHz	#VB\	V 300 kHz		Sweep 9	.600 ms (1001 pts)	10.00000 M
KR MODE TRO		K	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> M
1 N 1 2 N 1		2.402 0 GHz 2.400 0 GHz	-3.759 dBm -53.937 dBm				
3							Freq Offs
5						E	0
6							
8							Scale Ty
9							
1						-	Log <u>L</u>
			m			•	
G					🚺 STATUS		

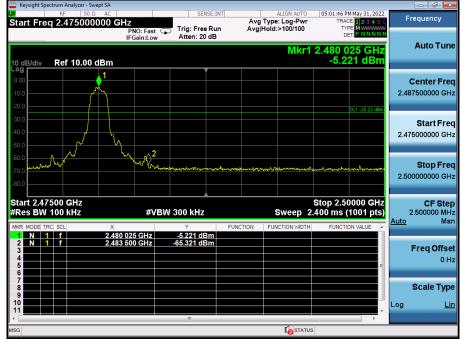
8-DQPSK Hopping Band edge-left side

Keysight Spectrum Analyzer - Swept SA						- đ ×
RF 50 Ω AC	Hz	SENSE:I		ALIGN AUTO	05:07:30 PM May 31, 2022 TRACE 1 2 3 4 5 6	Frequency
0 dB/div Ref 10.00 dBm	PNO: Fast IFGain:Low	Trig: Free Ru Atten: 20 dB	n Avg	Hold:>100/100	r1 2.405 0 GHz -4.057 dBm	Auto Tune
					1 <u> </u>	Center Free 2.360000000 GH:
30.0					¹²	Start Free 2.310000000 GH
60.0 70.0	appendiate of the second se	ungillunun	-hanthianu	hannerenghan	www.hahah	Stop Fre 2.410000000 GH
Start 2.31000 GHz Res BW 100 kHz	#VBW	300 kHz	FUNCTION		Stop 2.41000 GHz .600 ms (1001 pts)	CF Ste 10.000000 MH <u>Auto</u> Ma
1 N 1 f 2.4	05 0 GHz 00 0 GHz	-4.057 dBm -54.446 dBm	- Silon Silon		E	Freq Offse 0 H
7 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9						Scale Typ
11		m			-	
sg 🚺 File <1-2.png> saved					•	

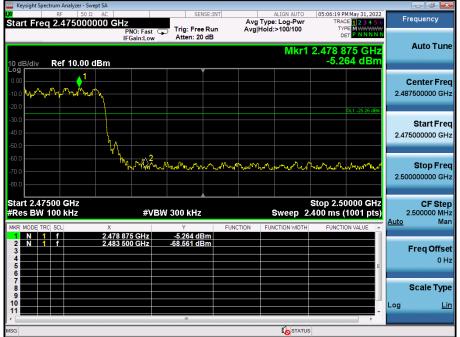




8-DQPSK No-hopping Band edge-right side



8-DQPSK Hopping Band edge-right side









7. 20DB BANDWIDTH

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013

7.1 Test Setup



7.2 Limit

N/A

7.3 Test procedure

- 1. Set RBW = 30 kHz.
- 2. Set the video bandwidth (VBW) \ge 3 x RBW.
- 3. Detector = Peak.
- 4. Trace mode = max hold.
- 5. Sweep = auto couple.
- 6. Allow the trace to stabilize.

7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

7.4 DEVIATION FROM STANDARD

No deviation.







7.5 Test Result

Mode	Test channel	20dB Emission Bandwidth (MHz)	Result
	Lowest	0.882	
GFSK	Middle	0.883	Pass
	Highest	0.881	
	Lowest	1.296	
π/4-DQPSK	Middle	1.297	Pass
	Highest	1.297	
	Lowest	1.251	
8-DPSK	Middle	1.249	Pass
	Highest	1.251	

Test plots

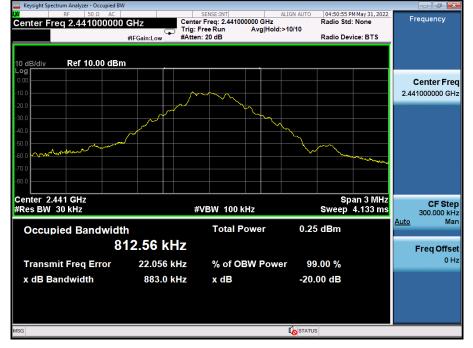
	GFS	SK Low Char	inei		
Keysight Spectrum Analyzer - Occupied BV					- 7
Center Freq 2.402000000		SENSE:INT Freq: 2.402000000 GHz	ALIGN AUTO	04:48:44 PM May 31, 2022 Radio Std: None	Frequency
Center Fred 2.40200000	Trig: F	ree Run Avg Ho	ld:>10/10		
	#IFGain:Low #Atten	: 20 dB		Radio Device: BTS	
10 dB/div Ref 10.00 dBn	n				
Log 0.00					0
-10.0					Center Freq
					2.402000000 GHz
-20.0		- h			
-30.0			\sim		
-40.0	\sim				
-50.0			+	~~	
-60.0				- manufactures	
-70.0					
-80.0					
Center 2.402 GHz				Span 3 MHz	CF Step
#Res BW 30 kHz	#	VBW 100 kHz		Sweep 4.133 ms	300.000 kHz
Occupied Bandwidt	h	Total Power	1.03	dBm	<u>Auto</u> Man
8	12.40 kHz				Freq Offset
Transmit Freq Error	22.794 kHz	% of OBW Pov	ver 99.	00 %	0 Hz
x dB Bandwidth	881.6 kHz	x dB	-20.0	U dB	
MSG			I o status		
			0		

GFSK Low Channel





GFSK Middle Channel



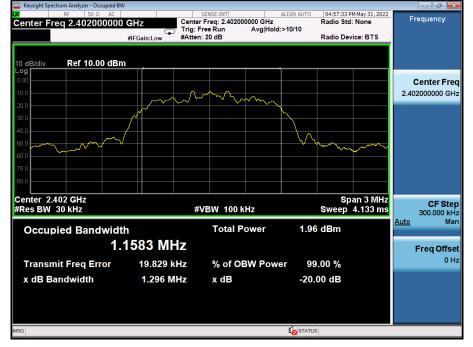
GFSK High Channel







π/4-DQPSK Low Channel



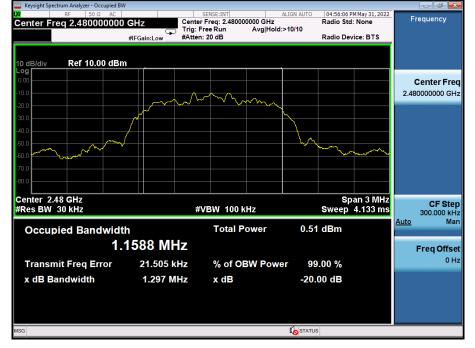
π /4-DQPSK Middle Channel







π/4-DQPSK High Channel



8-DPSK Low Channel







8-DPSK Middle Channel



8-DPSK High Channel







8. Maximum Peak Output Power

Test Requirement: FCC Part15 C Section 15.247 (b)(1)	
Test Method:	ANSI C63.10:2013
Limit:	20.97dBm(for GFSK), 20.97dBm(for EDR)

8.1 Block Diagram Of Test Setup



8.2 Limit

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

8.3 Test procedure

- 1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
- 2. Set the spectrum analyzer: RBW = 2MHz. VBW = 2MHz. Sweep = auto; Detector Function = Peak.
- 3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

8.4 DEVIATION FROM STANDARD

No deviation.

8.5 Test Result

Mode	Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
	Lowest	-1.964		
GFSK	Middle	-2.802	20.97	Pass
	Highest	-3.564		
	Lowest	-2.800		
π/4-DQPSK	Middle	-3.563	20.97	Pass
	Highest	-4.444		
	Lowest	-2.073		
8-DPSK	Middle	-2.942	20.97	Pass
	Highest	-3.746		

35









Test plots

GFSK Low Channel

Keysight Spectrum Analyzer - Swept SA				
	SENSE	E:INT ALIGN AUT Avg Type: Log-Pv		Frequency
zenter Preg 2.40200000	PNO: Fast Trig: Free F IFGain:Low Atten: 20 d	Run Avg Hold:>100/100	D TYPE MWWWWW DET P NNNNN	
0 dB/div Ref 10.00 dBm		Mk	r1 2.402 015 GHz -1.964 dBm	Auto Tune
0.00		1		Center Fred 2.402000000 GHz
10.0 2000				Start Fred 2.399500000 GHz
40.0				Stop Fred 2.404500000 GHz
50.0				CF Step 500.000 kH: <u>Auto</u> Mar
70.0				Freq Offse 0 H:
80.0				Scale Type
Center 2.402000 GHz Res BW 2.0 MHz	#VBW 2.0 MHz	Sweep	Span 5.000 MHz 1.000 ms (1001 pts)	Log <u>Lir</u>
SG		Ko st/	TUS	

GFSK Middle Channel



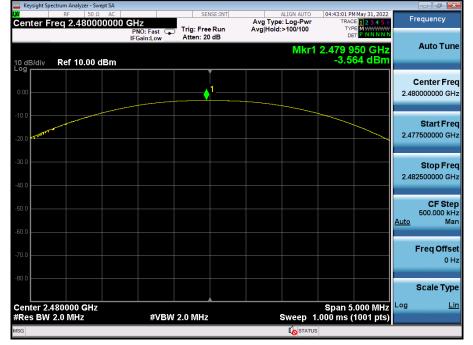
Shenzhen ZKT Technolgy Co., Ltd. 1/F, No. 101, Building B, No. 6, Tangwei Community Industrial Avenue, Fuhai Street, Bao'an District, Shenzhen, China

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GFSK High Channel



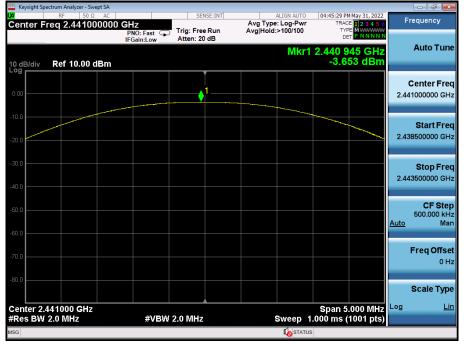
π/4-DQPSK Low Channel







π/4-DQPSK Middle Channel



π/4-DQPSK High Channel







8-DPSK Low Channel



8-DPSK Middle Channel

Keysight Spe	ectrum Analyzer - Swept SA					
X/ Center E	RF 50 Ω AC req 2.441000000		SENSE:INT	ALIGN AUTO Avg Type: Log-Pwr	04:46:33 PM May 31, 2022 TRACE 1 2 3 4 5 6	Frequency
Genter	164 2.44 100000	PNO: Fast IFGain:Low	Trig: Free Run Atten: 20 dB	Avg Hold:>100/100	2.440 960 GHz	Auto Tune
0 dB/div	Ref 10.00 dBm				-2.942 dBm	
0.00			1			Center Freq 2.441000000 GHz
-10.0						
-20.0						Start Freq 2.438500000 GHz
30.0						Stop Freq
-40.0						2.443500000 GHz
-60.0						CF Step 500.000 kHz <u>Auto</u> Man
-70.0						Freq Offset 0 Hz
-80,0						Scale Type
Center 2.4 #Res BW	441000 GHz 2.0 MHz	#VBW	2.0 MHz	Sweep 1	Span 5.000 MHz .000 ms (1001 pts)	Log <u>Lin</u>
MSG				K STATUS		





8-DPSK High Channel







9. HOPPING CHANNEL SEPARATION

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=100KHz, VBW=300KHz, detector=Peak
Limit:	GFSK: 20dB bandwidth $\pi/4$ -DQPSK & 8DPSK: 0.025MHz or 2/3 of the 20dB bandwidth (whichever is greater)

9.1 Test Setup

EUT	SPECTRUM
	ANALYZER

9.2 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port

to the spectrum.

2. Set the spectrum analyzer: RBW = 100kHz. VBW = 300kHz , Span = 3.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

9.3 DEVIATION FROM STANDARD No deviation.





9.4 Test Result

Modulation	Test Channel	Separation (MHz)	Limit(MHz)	Result
GFSK	Low	0.996	0.882	PASS
GFSK	Middle	1.011	0.883	PASS
GFSK	High	0.996	0.881	PASS
π/4-DQPSK	Low	1.002	0.864	PASS
π/4-DQPSK	Middle	0.999	0.865	PASS
π/4-DQPSK	High	0.993	0.865	PASS
8-DPSK	Low	0.999	0.834	PASS
8-DPSK	Middle	0.999	0.834	PASS
8-DPSK	High	0.999	0.833	PASS

Test plots GFSK Low Channel







GFSK Middle Channel

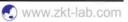


GFSK High Channel



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π/4-DQPSK Low Channel



π/4-DQPSK Middle Channel



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π/4-DQPSK High Channel



8-DPSK Low Channel







8-DPSKMiddle Channel

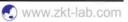


8-DPSK High Channel



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10.NUMBER OF HOPPING FREQUENCY

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)(iii)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=100kHz, VBW=300kHz, Frequency range=2400MHz-2483.5MHz, Detector=Peak
Limit:	15 channels

10.1 Test Setup

EUT	SPECTRUM
	ANALYZER

10.2 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 100kHz. VBW = 300kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.

4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.4835GHz. Sweep=auto;

10.3 DEVIATION FROM STANDARD No deviation.





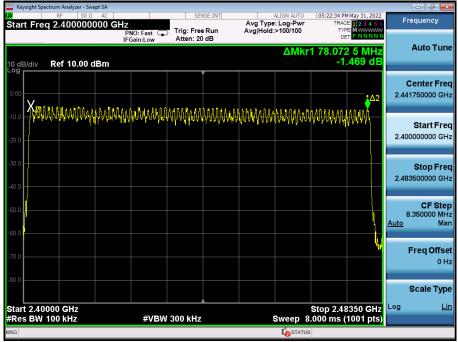


10.4 Test Result

Test Plots: 79 Channels in total GFSK



π/4-DQPSK









					0-L	PSK					
Keysight S	pectrum Analyzer - Sv RF 50 Ω				or we		ALIGN AUTO	05.00.01.0			
art Fre	eq 2.400000	000 GHz	NO: Fast 🕞 Gain:Low				: Log-Pwr	TRAC TYP	May 31, 2022 E 1 2 3 4 5 6 M M M M M M F P N N N N N	F	requency
dB/div	Ref 10.00	dBm					ΔMkr	1 78.07 -3	2 5 MHz .577 dB		Auto Tun
											Center Fre 1750000 GH
.0	VAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA		MWW	MANA AN	WWWWW		A.A.AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA				Start Fre
.0										2.40	00000000 GH
.0										2.48	Stop Fre 3500000 GH
											CF Ste
.0									, i	<u>Auto</u>	B.350000 MH Ma
.0									4		Freq Offse
.0											
art 2.4	0000 GHz							Stop 2.4	3350 GHz	Log	Scale Typ
	v 100 kHz		#VBW	/ 300 kHz			Sweep 8	.000 ms (1001 pts)		

8-DPSK



11. DWELL TIME

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)(iii)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=1MHz, VBW=3MHz, Span=0Hz, Detector=Peak
Limit:	0.4 Second

11.1 Test Setup

EUT	SPECTRUM
	ANALYZER

11.2 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set spectrum analyzer span = 0Hz;

3. Set RBW = 1MHz and VBW = 3MHz.Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.

4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

11.3 DEVIATION FROM STANDARD No deviation.







11.4 Test Result

GFSK DH5 mode:

Frequency	Packet	Dwell time(ms)	Limit(ms)	Result
2402MHz	2402MHz DH5		311.15 400	
2441MHz	DH5	311.15	400	Pass
2480MHz	DH5	312.00	400	Pass

Remarks:

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

Test channel: as blow

CH:2402MHz time slot=2.917(ms)*(1600/ (6*79))*31.6=311.15ms

CH:2441MHz time slot=2.917(ms)*(1600/ (6*79))*31.6=311.15ms

CH:2480MHz time slot=2.925(ms)*(1600/ (6*79))*31.6=312.00ms

π/4-DQPSK mode:

Frequency Packet		Dwell time(ms)	Limit(ms)	Result
2402MHz	2DH5	314.67	400	Pass
2441MHz	2DH5	313.81	400	Pass
2480MHz	2DH5	312.85	400	Pass

Remarks:

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s Test channel: as blow CH:2402MHz time slot=2.950(ms)*(1600/ (6*79))*31.6=314.67ms CH:2441MHz time slot=2.942(ms)*(1600/ (6*79))*31.6=313.81ms CH:2480MHz time slot=2.933(ms)*(1600/ (6*79))*31.6=312.85ms

8-DPSK mode:

Frequency	FrequencyPacket2480MHz3DH5		Limit(ms)	Result
2480MHz			400	Pass
2480MHz	2480MHz 3DH5		400	Pass
2480MHz	3DH5	312.85	400	Pass

Remarks:

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s Test channel: as blow CH:2402MHz time slot=2.942(ms)*(1600/ (6*79))*31.6=313.81ms CH:2441MHz time slot=2.933(ms)*(1600/ (6*79))*31.6=312.85ms CH:2480MHz time slot=2.933(ms)*(1600/ (6*79))*31.6=312.85ms





Test Plots

GFSK 2402MHz

🔤 Keysight Sp	ectrum Analyzer - Swept SA								- 6 ×
<mark>,X/</mark>	RF 50 Ω AC		SENSE:INT	Avg Type	ALIGN AUTO		M May 31, 2022	E	requency
Center F	req 2.402000000	PNO: Fast +++ Trig: F	ree Run	Avgiype	: Log-Pwr	TYP	DE 123456		,,
		IFGain:Low Atten:	30 dB			DE	P NNNN		
					/	AMkr1 2			Auto Tune
10 dB/div	Ref 20.00 dBm						2.44 dB		
Log									
									Center Freq
10.0								2.40	2000000 GHz
0.00									
									Start Free
10.0								2.40	02000000 GHz
-20.0									Stop Free
								2.40	2000000 GHz
-30.0								2.40	52000000 GH2
40.0									CF Step
								Auto	1.000000 MHz Mar
50.0				142				Auto	IVIAN
	Heller and a half be			I de la Maria de Al	hand the state	. North and the	ha and back		
-60.0	Manual Manual And Manual 2			de la subsection de la su	dia Mila. A lla.	httel the state	MANANGTAN		Freq Offset
									0 Hz
70.0									
70.0									Scale Type
J									ocure rype
Center 2.	402000000 GHz					s	pan 0 Hz	Log	Lin
Res BW 1		#VBW 3.0 MH	IZ	\$	Sweep	8.333 ms (1001 pts)		
ISG					I STATL	IS			
								_	

GFSK 2441MHz

Keysight Sp	ectrum Analyzer - Swept SA					- 7 💌
XI Center E	RF 50 Ω AC req 2.441000000	GHz	SENSE:INT	ALIGN /		
ochter i	1000000	PNO: Fast ++ IFGain:Low	 Trig: Free Run Atten: 30 dB 		TYPE WWWW DET P N N N	N N
10 dB/div Log	Ref 20.00 dBm				∆Mkr1 2.917 n -0.97 c	ns Auto Tune B
10.0						Center Freq 2.441000000 GHz
0.00						
-10.0						Start Freq 2.441000000 GHz
20.0						Stop Freq
30.0						2.441000000 GHz
-40.0						CF Step 1.000000 MHz
-50.0	childen och start st	llen()pt/lip/mygel	hingddigerhengle fan y gegynede	M X 2		Auto Man Freq Offset
60.0						0 Hz
-70.0						Scale Type
Center 2.4 Res BW 1	441000000 GHz I.0 MHz	#VBW	3.0 MHz	Swee	Span 0 l p 8.333 ms (1001 p	Hz ^{Log <u>Lin</u> ts)}
ISG					STATUS	





GFSK 2480MHz

🚥 Keysight Sp	pectrum Analyzer - Swept SA					- J J X
× Center F	RF 50 Ω AC req 2.480000000	GHz	SENSE:INT	ALIGN AUTO Avg Type: Log-Pwr	05:40:04 PM May 31, 2022 TRACE 1 2 3 4 5 6	Frequency
		PNO: Fast ↔ IFGain:Low	Trig: Free Run Atten: 30 dB		TYPE WWWWWW DET PNNNNN ΔMkr1 2.925 ms 1.66 dB	• • • • • • • • •
10 dB/div	Ref 20.00 dBm					Center Free 2.480000000 GH;
0.00						Start Free
20.0						2.480000000 GH
30.0						Stop Fre 2.480000000 GH
40.0				102		CF Ste 1.000000 MH <u>Auto</u> Ma
50.0	yerhillynnisch ynwningerr	×2		Antonia (Arthough Antonia) Antonia Antoni Antonia Antonia Antonia Antonia Antonia Antonia Antonia An	Athological film frank	Freq Offse 0 H
70.0						Scale Type
Center 2. Res BW	.480000000 GHz 1.0 MHz	#VBW (3.0 MHz	Sweep	Span 0 Hz 8.333 ms (1001 pts)	Log <u>Lii</u>
SG				STATU	IS	

π/4-DQPSK 2402MHz

Keysight Spectrum Analyzer - Swe					
Center Freq 2.40200		SENSE:INT	ALIGN AUTO Avg Type: Log-Pwr	05:41:39 PM May 31, 2022 TRACE 1 2 3 4 5 6	Frequency
	PNO: Fast ++ IFGain:Low	. Trig: Free Run Atten: 30 dB		TYPE WWWWWW DET PNNNNN	Auto Tuno
10 dB/div Ref 20.00 d	Bm		Δ	Mkr1 2.950 ms 0.08 dB	Auto Tune
10.0					Center Freq
					2.402000000 GHz
0.00			- Participation and the second second	ninghthe date in the date of t	Start Freq
-10.0					2.402000000 GHz
-20.0					Stop Freq
-30.0					2.402000000 GHz
-40.0					CF Step 1.000000 MHz
-50.0	La hal also ada	المراجعة والمراجع		1/1/2	<u>Auto</u> Man
-60.0	hodovilaniyye tayan ^a lifad yilad ka	Machtennerster	X ₂		Freq Offset
-70.0					0 Hz
					Scale Type
Center 2.402000000 G Res BW 1.0 MHz		3.0 MHz	Sweep 8	Span 0 Hz 333 ms (1001 pts).	Log <u>Lin</u>
MSG					

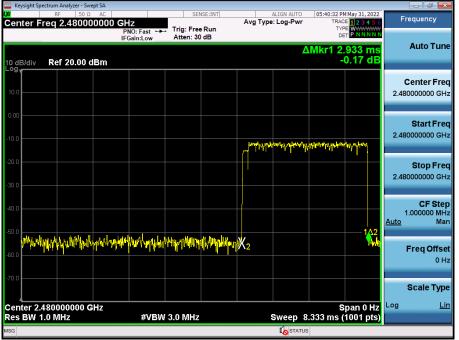




π/4-DQPSK 2441MHz

Keysight S	pectrum Analyzer - Swept SA					- 6 - X
<u>XI</u>	RF 50 Ω AC		SENSE:INT	ALIGN AUTO	05:40:56 PM May 31, 2022	Frequency
Center I	Freq 2.441000000	CHZ PNO: Fast ↔→	Trig: Free Run	Avg Type: Log-Pwr	TRACE 1 2 3 4 5 6 TYPE WWWWW DET P N N N N N	
	_	IFGain:Low	Atten: 30 dB		DET P NNNN	
				Δ	Mkr1 2.942 ms	Auto Tune
10 dB/div	Ref 20.00 dBm				-2.26 dB	
Log						
						Center Freq
10.0						2.441000000 GHz
0.00						
		مېرىكەيسىر.	maninamanan	www.www.wy		Start Freq
-10.0						2.441000000 GHz
-20.0						Oton Eron
						Stop Freq 2.441000000 GHz
-30.0						2.441000000 GHz
40 0 1111	alphylichin gran a					CF Step
and the state	Max, to Make, to all that dol					1.000000 MHz Auto Man
-50.0						<u>Auto</u> Man
30.0	he His				the she had a life of the label in	
-60.0	الدهرا	የመግመፖላ2		Aults and a dedaced	4~mh/4/10/10/10/10/10/10/14	Freq Offset
-00.0						0 Hz
-70.0						
-70.0						Scale Type
						ocure rype
Center 2	.441000000 GHz				Span 0 Hz	Log <u>Lin</u>
Res BW	1.0 MHz	#VBW	3.0 MHz	Sweep 8	.333 ms (1001 pts)	
ISG				STATUS		

π/4-DQPSK 2480MHz



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8-DPSK 2402MHz

Keysight Sp	ectrum Analyzer - Swept SA								- 6	×
<u>//</u>	RF 50 Ω AC		SEN	SE:INT		ALIGN AUTO		M May 31, 2022	Frequency	
enter F	req 2.40200000	PNO: Fast ++-	Trig: Free		Avg Type	Log-Fwi	TY	PE WWWWWW		
		IFGain:Low	Atten: 30	dB			D	T P NNNNN	A	
						Δ		.942 ms	Auto Tu	un
0 dB/div	Ref 20.00 dBm							1.41 dB		
°g										
40.0									Center F	
10.0									2.402000000	G⊦
0.00				والا المالي	where the second states of the	the advectories at so that	to do contractor		Start F	re
						and a state the	1.1.121		2.402000000	
10.0										
										-
20.0									Stop F	re
									2.402000000	G⊦
30.0										
									CF S	te
40.0									1.000000	
									Auto I	Ma
50.0	. In a station of the second	بابرال الد بار	k alter i sea					1 <u>4</u> 2 J Lu		
M.MY	humun human human	ned have been all the	WINNAN	WY.				AMP WAY	Freq Off	fs
50.0	· · · · ·									0 -
70.0										
									Scale Ty	уp
enter 2	402000000 GHz						5	pan 0 Hz	Log	Li
les BW 1		#VBW	3.0 MHz			Sweep 8		1001 pts)		
sg						I STATUS		للخاد المعمد		-
30						No STATUS				_

8-DPSK 2441MHz

Keysight Specific Control	ectrum Analyzer - Swept SA									
XI Center E	RF 50 Ω AC req 2.441000000	GH7	SEI	NSE:INT		ALIGN AUTO		May 31, 2022	Fr	equency
	100000	PNO: Fast +> IFGain:Low	. Trig: Free Atten: 30				Mkr1 2	933 ms		Auto Tune
10 dB/div Log	Ref 20.00 dBm							1.23 dB		
										enter Freq
10.0									2.44	1000000 GHz
0.00										Start Freq
-10.0				/*** I PM**	and the state of the	veren alentress as	174~hP		2.44	1000000 GHz
-20.0										Stop Freq
-30.0									2.44	1000000 GHz
-40.0									1	CF Step .000000 MHz
-50.0	Le ri Haral a di sa	1 1 . 1 . 1					1Δ2		<u>Auto</u>	Man
-60.0	aladiya Andreha mana yananga	rand and a straight	wWWWWWWW	۲ <mark>2</mark>			YM W	n an		Freq Offset
-70.0										0 Hz
										Scale Type
Center 2.4 Res BW 1	441000000 GHz .0 MHz	#VBW	/ 3.0 MHz			Sweep 8	S .333 ms (pan 0 Hz 1001 pts)	Log	<u>Lin</u>
MSG						STATUS				



8-DPSK 2480MHz

Keysight Sp	ectrum Analyzer - Swep	ot SA										
<mark>«</mark> Center F	RF 50 Ω req 2.48000	AC 0000 G	Hz		ISE:INT	Avg Type	ALIGN AU		TRAC	May 31, 2022	F	requency
10 dB/div	Ref 20.00 dl		PNO: Fast ↔ Gain:Low	Trig: Free Atten: 30				Δ	Mkr1 2.	933 ms 1.71 dB		Auto Tune
.og												Center Free 80000000 GH
10.0					Prodest Apply Pro	ระฟุตุโหร ^เ ลสิตุปโปร	~& #####				2.4	Start Fre 80000000 GH
20.0 30.0											2.4	Stop Fre 80000000 GH
40.0											<u>Auto</u>	CF Ste 1.000000 MH Ma
60.0	orthlagetapoelooph	91 1 9014	ylutyrytunglys	⟨ 2				1 <u>4</u> 2	y martha	Hilliyadaya		Freq Offse 0 H
70.0	480000000 GI	47								pan 0 Hz	Log	Scale Type
Res BW 1			#VBW	3.0 MHz					333 ms (pan 0 H2 1001 pts)		
SG							Г <mark>ю</mark> s	TATUS				







12. Antenna Requirement

Standard requirement:	FCC Part15 C Section 15.203 /247(c)						
15.203 requirement:	15.203 requirement:						
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall							

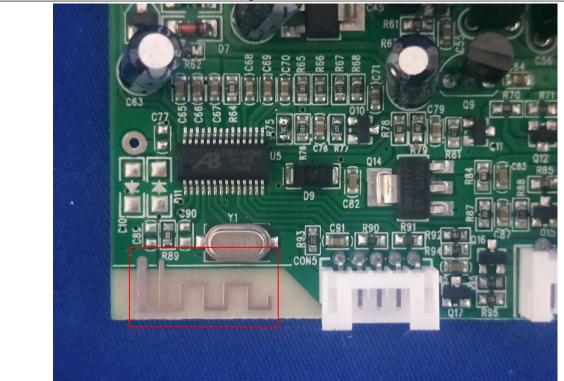
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(c) (1)(i) requirement:

(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

EUT Antenna:

The antennas are Internal antenna, the best case gain of the antennas are 1.2dBi.









Reference to the **appendix I** for details.

14. EUT Constructional Details

Reference to the appendix II for details.

***** END OF REPORT *****

