



TEST Report

Applicant: Shenzhen seven star technology co.,LTD

Address of Applicant: 5/f, building 3,no.17 industrial road, sha jing, baoan district, shenzhen, China

Manufacturer : Shenzhen seven star technology co.,LTD

Address of Manufacturer : 5/f, building 3,no.17 industrial road, sha jing, baoan district, shenzhen, China

Equipment Under Test (EUT)

Product Name: Portable Mini Printer

Model No.: X5

Series model: X1, X2, X3, X6, X 7, X8, X9

Trade Mark: 书包郎

FCC ID: 2A5WI-X5

Applicable standards: FCC CFR Title 47 Part 15 Subpart C Section 15.247

Date of sample receipt: Mar.10,2022

Date of Test: Mar.10,2022- Mar.25,2022

Date of report issued: Mar.25,2022

Test Result : PASS *

* In the configuration tested, the EUT complied with the standards specified above.



1. Version

Version No.	Date	Description
00	Mar.25,2022	Original

Tested/ Prepared By Ervin Xu **Date:** Mar.25,2022
Project Engineer

Check By: Bruce Zhu **Date:** Mar.25,2022
Reviewer

Approved By : Kevin Yang **Date:** Mar.25,2022
Authorized Signature



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3. Test Summary

Test Item	Section in CFR 47	Result
Antenna Requirement	15.203/15.247 (c)	Pass
AC Power Line Conducted Emission	15.207	Pass
Conducted Peak Output Power	15.247 (b)(1)	Pass
20dB Occupied Bandwidth	15.247 (a)(1)	Pass
Carrier Frequencies Separation	15.247 (a)(1)	Pass
Hopping Channel Number	15.247 (a)(1)(iii)	Pass
Dwell Time	15.247 (a)(1)(iii)	Pass
Radiated Emission	15.205/15.209	Pass
Band Edge	15.247(d)	Pass

Remarks:

1. *Pass: The EUT complies with the essential requirements in the standard.*
2. *Test according to ANSI C63.10:2013*

Measurement Uncertainty

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	9k~30MHz	3.17 dB	(1)
Radiated Emission	30~1000MHz	3.45 dB	(1)
Radiated Emission	1~6GHz	3.54 dB	(1)
Radiated Emission	>6GHz	4.89dB	(1)
Conducted Disturbance	0.15~30MHz	2.66 dB	(1)
RF power, conducted	/	0.16 dB	(1)
Spurious emissions, conducted	/	0.21dB	(1)

Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.



4. General Information

4.1. General Description of EUT

Product Name:	Portable Mini Printer
Model No.:	X5
Series model:	X1, X2, X3, X6, X 7, X8, X9
Model Difference	All the model are the same circuit and RF module, except the model name and colour.
Operation Frequency:	2402MHz~2480MHz
Channel numbers:	79
Channel separation:	1MHz
Modulation type:	GFSK, $\pi/4$ -DQPSK, 8QPSK
Antenna Type:	PCB Antenna
Antenna gain:	1.0dBi
Power supply:	DC 3.7V/800mAh Form Battery and DC 5V From External Circuit
Adapter Information (auxiliary test equipment supplied by test Lab)	N/A



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:

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



4.2. Test mode

Transmitting mode	Keep the EUT in continuously transmitting mode.
<i>Remark: During the test, the test voltage was tuned from 85% to 115% of the nominal rated supply voltage, and found that the worst case was under the nominal rated supply condition. So the report just shows that condition's data.</i>	

4.3. Description of Support Units

None.

4.4. Deviation from Standards

None.

4.5. Abnormalities from Standard Conditions

None.

4.6. Test Facility

<p>The test facility is recognized, certified, or accredited by the following organizations:</p> <p>FCC-Registration No.: 779513 Designation Number: CN1319 Shenzhen HTT Technology Co.,Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.</p> <p>A2LA-Lab Cert. No.: 6435.01 Shenzhen HTT Technology Co.,Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.</p> <p>The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010.</p>

4.7. Test Location

All tests were performed at:
Shenzhen HTT Technology Co.,Ltd. 1F, Building B, Huafeng International Robotics Industrial Park, Hangcheng Road,Nanchang Community, Xixiang Street, Bao'an District, Shenzhen, Guangdong, China Tel: 0755-23595200 Fax: 0755-23595201

4.8. Additional Instructions

Test Software	Special AT test command provided by manufacturer to Keep the EUT in continuously transmitting mode and hopping mode
Power level setup	Default



5. Test Instruments list

Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	3m Semi- Anechoic Chamber	Shenzhen C.R.T technology co., LTD	9*6*6	HTT-E028	Aug. 10 2020	Aug. 09 2024
2	Control Room	Shenzhen C.R.T technology co., LTD	4.8*3.5*3.0	HTT-E030	Aug. 10 2020	Aug. 09 2024
3	EMI Test Receiver	Rohde&Schwar	ESCI7	HTT-E022	May 21 2021	May 20 2022
4	Spectrum Analyzer	Rohde&Schwar	FSP	HTT-E037	May 21 2021	May 20 2022
5	Coaxial Cable	ZDecl	ZT26-NJ-NJ-0.6M	HTT-E018	May 21 2021	May 20 2022
6	Coaxial Cable	ZDecl	ZT26-NJ-SMAJ-2M	HTT-E019	May 21 2021	May 20 2022
7	Coaxial Cable	ZDecl	ZT26-NJ-SMAJ-0.6M	HTT-E020	May 21 2021	May 20 2022
8	Coaxial Cable	ZDecl	ZT26-NJ-SMAJ-8.5M	HTT-E021	May 21 2021	May 20 2022
9	Composite logarithmic antenna	Schwarzbeck	VULB 9168	HTT-E017	Aug. 22 2021	Aug. 21 2022
10	Horn Antenna	Schwarzbeck	BBHA9120D	HTT-E016	Aug. 22 2021	Aug. 21 2022
11	Loop Antenna	Zhinan	ZN30900C	HTT-E039	Aug. 22 2021	Aug. 21 2022
12	Horn Antenna	Beijing Hangwei Dayang	OBH100400	HTT-E040	Aug. 22 2021	Aug. 21 2022
13	low frequency Amplifier	Sonoma Instrument	310	HTT-E015	May 21 2021	May 20 2022
14	high-frequency Amplifier	HP	8449B	HTT-E014	May 21 2021	May 20 2022
15	Variable frequency power supply	Shenzhen Anbiao Instrument Co., Ltd	ANB-10VA	HTT-082	May 21 2021	May 20 2022
16	EMI Test Receiver	Rohde & Schwarz	ESCS30	HTT-E004	May 21 2021	May 20 2022
17	Artificial Mains	Rohde & Schwarz	ESH3-Z5	HTT-E006	May 21 2021	May 20 2022
18	Artificial Mains	Rohde & Schwarz	ENV-216	HTT-E038	May 21 2021	May 20 2022
19	Cable Line	Robinson	Z302S-NJ-BNCJ-1.5M	HTT-E001	May 21 2021	May 20 2022
20	Attenuator	Robinson	6810.17A	HTT-E007	May 21 2021	May 20 2022
21	Variable frequency power supply	Shenzhen Yanghong Electric Co., Ltd	YF-650 (5KVA)	HTT-E032	May 21 2021	May 20 2022
22	Control Room	Shenzhen C.R.T technology co., LTD	8*4*3.5	HTT-E029	May 21 2021	May 20 2022
23	DC power supply	Agilent	E3632A	HTT-E023	May 21 2021	May 20 2022
24	EMI Test Receiver	Agilent	N9020A	HTT-E024	May 21 2021	May 20 2022
25	Analog signal generator	Agilent	N5181A	HTT-E025	May 21 2021	May 20 2022
26	Vector signal generator	Agilent	N5182A	HTT-E026	May 21 2021	May 20 2022
27	Power sensor	Keysight	U2021XA	HTT-E027	May 21 2021	May 20 2022
28	Temperature and humidity meter	Shenzhen Anbiao Instrument Co., Ltd	TH10R	HTT-074	May 21 2021	May 20 2022



6. Test results and Measurement Data

6.1. Conducted Emissions

Test Requirement:	FCC Part15 C Section 15.207					
Test Method:	ANSI C63.10:2013					
Test Frequency Range:	150KHz to 30MHz					
Class / Severity:	Class B					
Receiver setup:	RBW=9KHz, VBW=30KHz, Sweep time=auto					
Limit:	Frequency range (MHz)		Limit (dBuV)			
			Quasi-peak		Average	
	0.15-0.5		66 to 56*		56 to 46*	
	0.5-5		56		46	
	5-30		60		50	
* Decreases with the logarithm of the frequency.						
Test setup:						
	<p>Remark: E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m</p>					
Test procedure:	<ol style="list-style-type: none"> 1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10:2013 on conducted measurement. 					
Test Instruments:	Refer to section 6.0 for details					
Test mode:	Refer to section 5.2 for details					
Test environment:	Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar
Test voltage:	AC 120V, 60Hz					
Test results:	Pass					

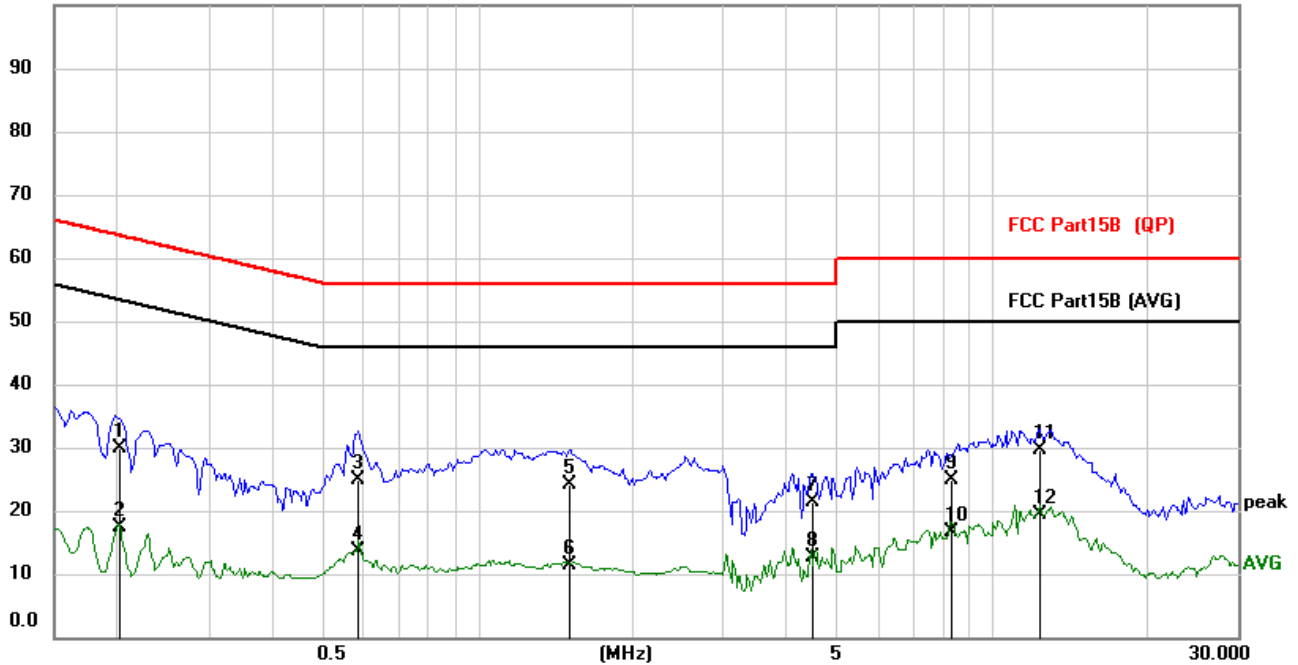
Remark: Both high and low voltages have been tested to show only the worst low voltage test data.



Measurement data:

Line:

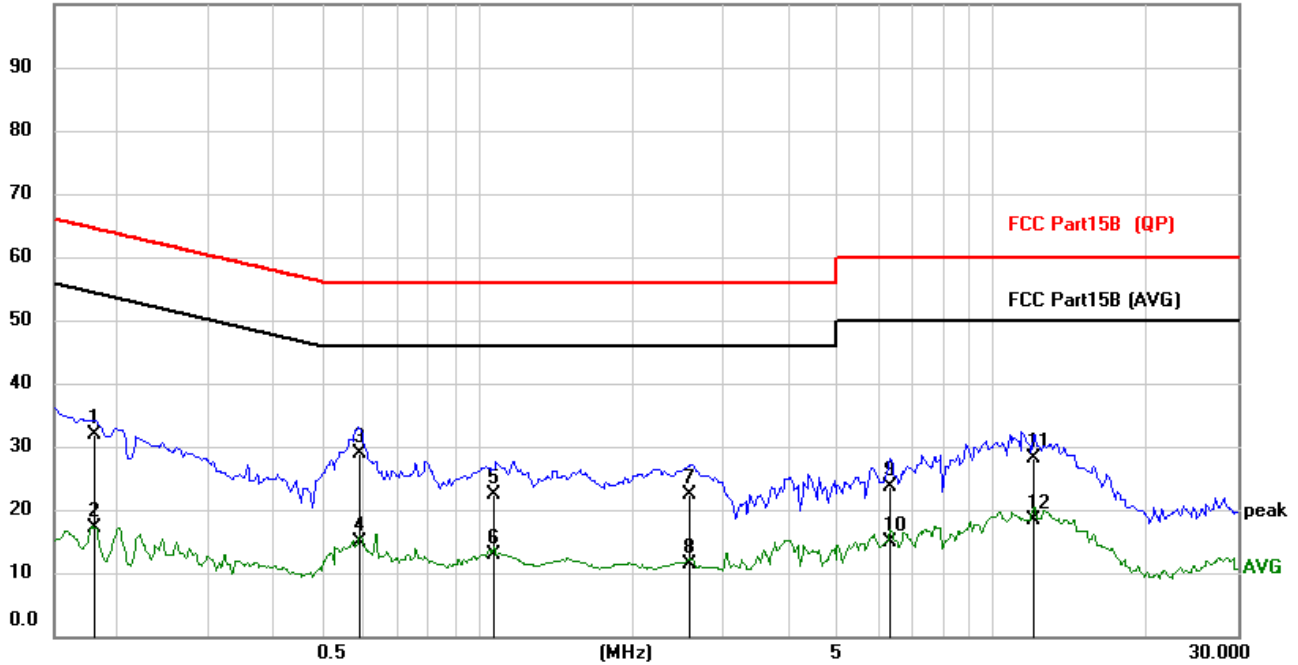
100.0 dBuV



No.	Mk.	Freq.	Reading	Correct	Measurement	Limit	Over	
		MHz	dBuV	Factor	dB	dBuV	dB	Detector
1		0.2007	19.80	10.20	30.00	63.58	-33.58	QP
2		0.2007	7.30	10.20	17.50	53.58	-36.08	AVG
3		0.5868	14.46	10.48	24.94	56.00	-31.06	QP
4		0.5868	3.23	10.48	13.71	46.00	-32.29	AVG
5		1.5072	13.27	10.81	24.08	56.00	-31.92	QP
6		1.5072	0.56	10.81	11.37	46.00	-34.63	AVG
7		4.4625	10.61	10.88	21.49	56.00	-34.51	QP
8		4.4625	1.66	10.88	12.54	46.00	-33.46	AVG
9		8.3228	13.65	11.18	24.83	60.00	-35.17	QP
10		8.3228	5.57	11.18	16.75	50.00	-33.25	AVG
11	*	12.3522	17.77	11.83	29.60	60.00	-30.40	QP
12		12.3522	7.64	11.83	19.47	50.00	-30.53	AVG



Neutral:
100.0 dBuV

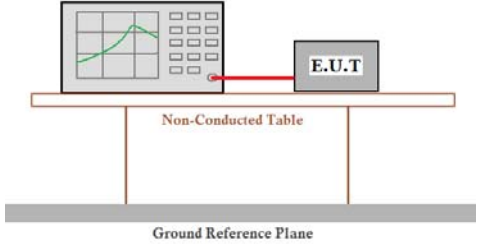


No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.1796	21.63	10.23	31.86	64.50	-32.64	QP
2		0.1796	6.95	10.23	17.18	54.50	-37.32	AVG
3	*	0.5907	18.47	10.48	28.95	56.00	-27.05	QP
4		0.5907	4.48	10.48	14.96	46.00	-31.04	AVG
5		1.0743	11.53	10.80	22.33	56.00	-33.67	QP
6		1.0743	2.05	10.80	12.85	46.00	-33.15	AVG
7		2.5807	11.65	10.84	22.49	56.00	-33.51	QP
8		2.5807	0.52	10.84	11.36	46.00	-34.64	AVG
9		6.3345	12.73	10.92	23.65	60.00	-36.35	QP
10		6.3345	3.90	10.92	14.82	50.00	-35.18	AVG
11		12.0596	16.41	11.79	28.20	60.00	-31.80	QP
12		12.0596	6.48	11.79	18.27	50.00	-31.73	AVG

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.

6.2. Conducted Peak Output Power

Test Requirement:	FCC Part15 C Section 15.247 (b)(3)				
Test Method:	ANSI C63.10:2013				
Limit:	30dBm(for GFSK),20.97dBm(for EDR)				
Test setup:	<p>Power sensor and Spectrum analyzer</p>  <p>Non-Conducted Table</p> <p>Ground Reference Plane</p>				
Test Instruments:	Refer to section 6.0 for details				
Test mode:	Refer to section 5.2 for details				
Test results:	Pass				
Test environment:	Temp.:	25 °C	Humid.:	52%	Press.: 1012mbar

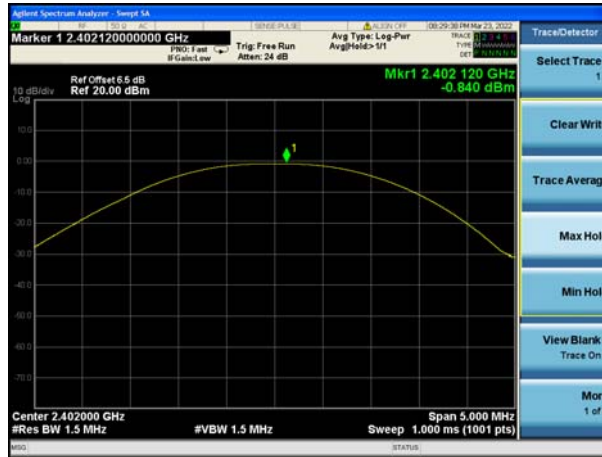
Measurement Data

Mode	Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
GFSK	Lowest	-0.840	30.00	Pass
	Middle	-1.265		
	Highest	-2.321		
$\pi/4$ -DQPSK	Lowest	1.389	20.97	Pass
	Middle	1.071		
	Highest	-0.097		
8QPSK	Lowest	2.161	20.97	Pass
	Middle	1.899		
	Highest	0.697		



Test plot as follows:

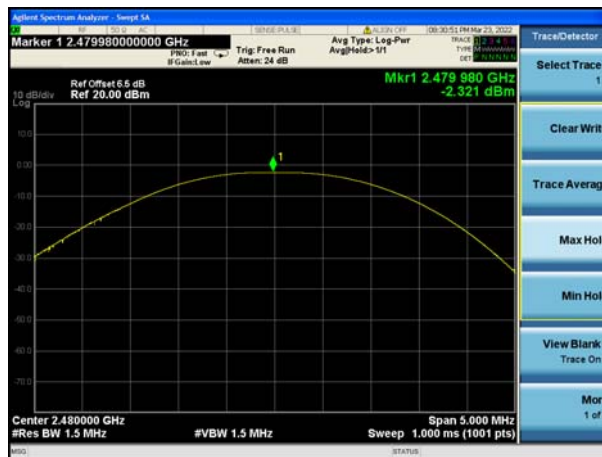
Test mode:	GFSK mode
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Lowest channel



Middle channel



Highest channel



Test mode: $\pi/4$ -DQPSK mode



Lowest channel



Middle channel



Highest channel



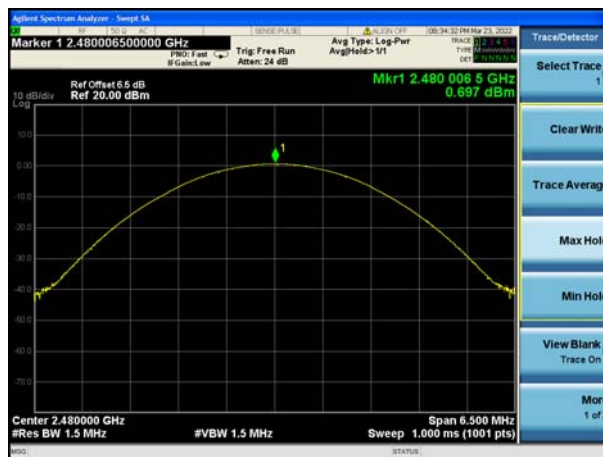
Test mode: 8QPSK mode



Lowest channel

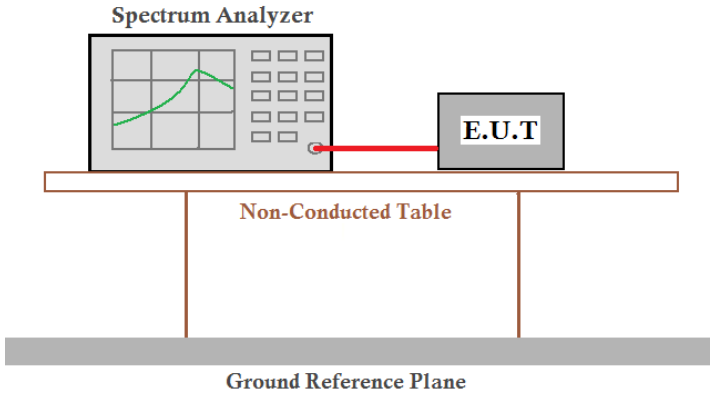


Middle channel



Highest channel

6.3. 20dB Emission Bandwidth

Test Requirement:	FCC Part15 C Section 15.247 (a)(2)					
Test Method:	ANSI C63.10:2013					
Limit:	N/A					
Test setup:						
Test Instruments:	Refer to section 6.0 for details					
Test mode:	Refer to section 5.2 for details					
Test results:	Pass					
Test environment:	Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar

Measurement Data

Mode	Test channel	20dB Emission Bandwidth (MHz)	Result
GFSK	Lowest	0.884	Pass
	Middle	0.883	
	Highest	0.882	
8QPSK	Lowest	1.251	Pass
	Middle	1.245	
	Highest	1.223	



Test plot as follows:

Test mode:	GFSK mode
------------	-----------



Lowest channel



Middle channel



Highest channel



Test mode: 8QPSK mode



Lowest channel

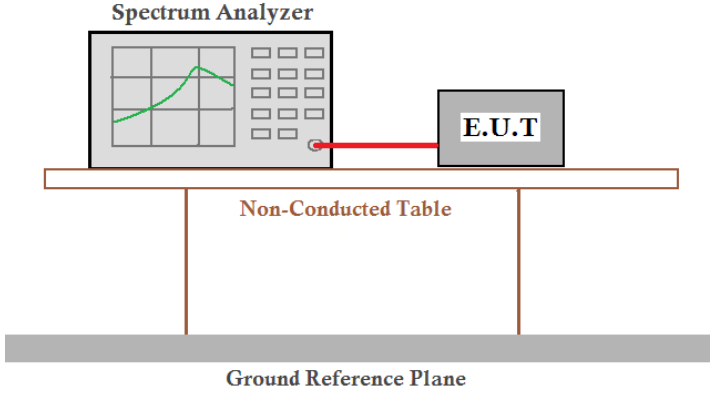


Middle channel



Highest channel

6.4. Frequencies Separation

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)					
Test Method:	ANSI C63.10:2013					
Receiver setup:	RBW=300KHz, VBW=1MHz, detector=Peak					
Limit:	GFSK: 20dB bandwidth 8QPSK : 0.025MHz or 2/3 of the 20dB bandwidth (whichever is greater)					
Test setup:						
Test Instruments:	Refer to section 6.0 for details					
Test mode:	Refer to section 5.2 for details					
Test results:	Pass					
Test environment:	Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar

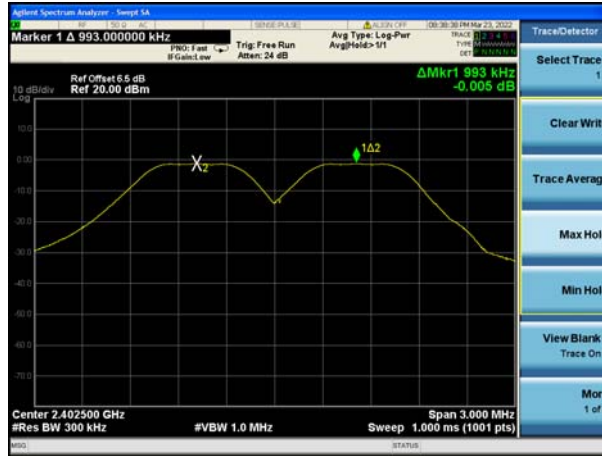
Measurement Data

Mode	Test channel	Frequencies Separation (MHz)	Limit (kHz)	Result
GFSK	Low	0.993	20dB bandwidth	Pass
	Middle	1.011		
	High	1.002		
8QPSK	Low	1.014	25KHz or 2/3*20dB bandwidth	Pass
	Middle	1.005		
	High	1.005		

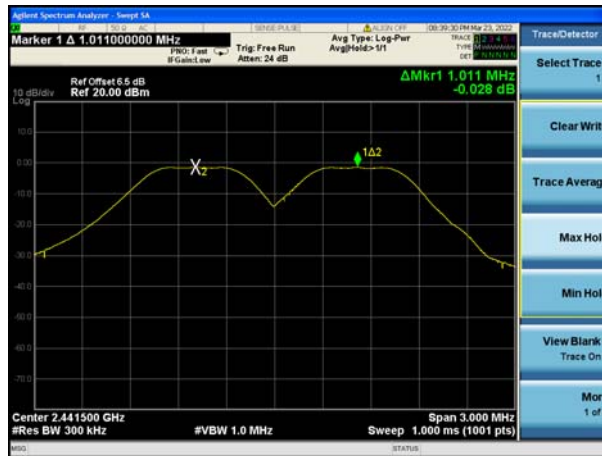


Test plot as follows:

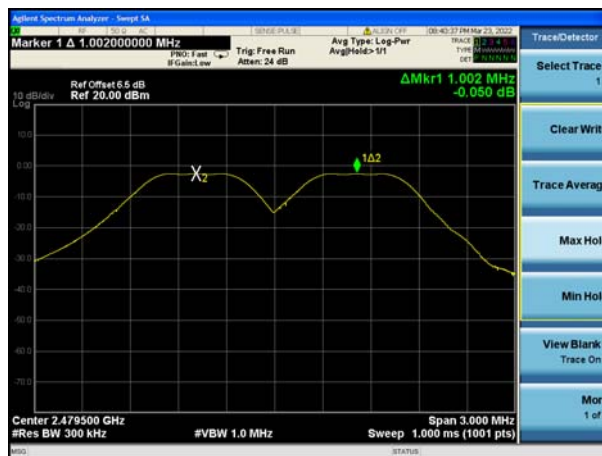
Test mode:	GFSK mode
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Lowest channel



Middle channel



Highest channel



Test mode: 8QPSK mode



Lowest channel

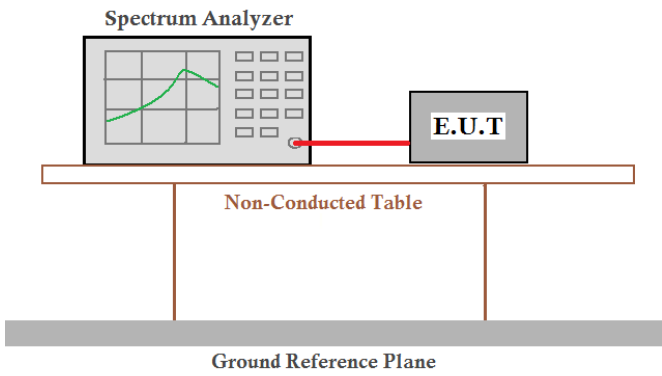


Middle channel



Highest channel

6.5. Hopping Channel Number

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)(iii)				
Test Method:	ANSI C63.10:2013				
Receiver setup:	RBW=300kHz, VBW=1MHz, Frequency range=2400MHz-2483.5MHz, Detector=Peak				
Limit:	15 channels				
Test setup:	 <p>The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.</p>				
Test Instruments:	Refer to section 6.0 for details				
Test mode:	Refer to section 5.2 for details				
Test results:	Pass				
Test environment:	Temp.:	25 °C	Humid.:	52%	Press.: 1012mbar

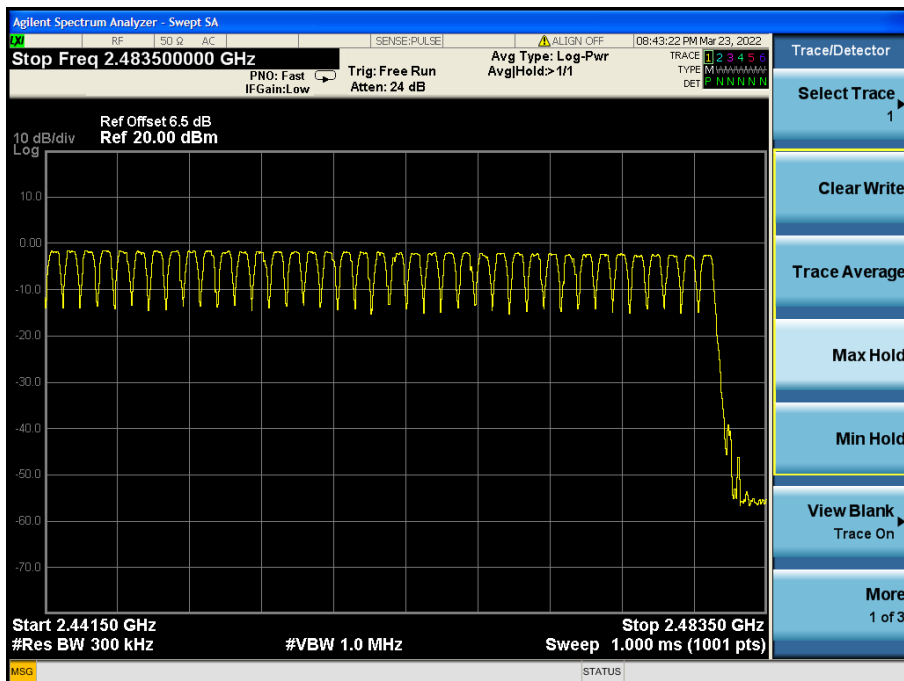
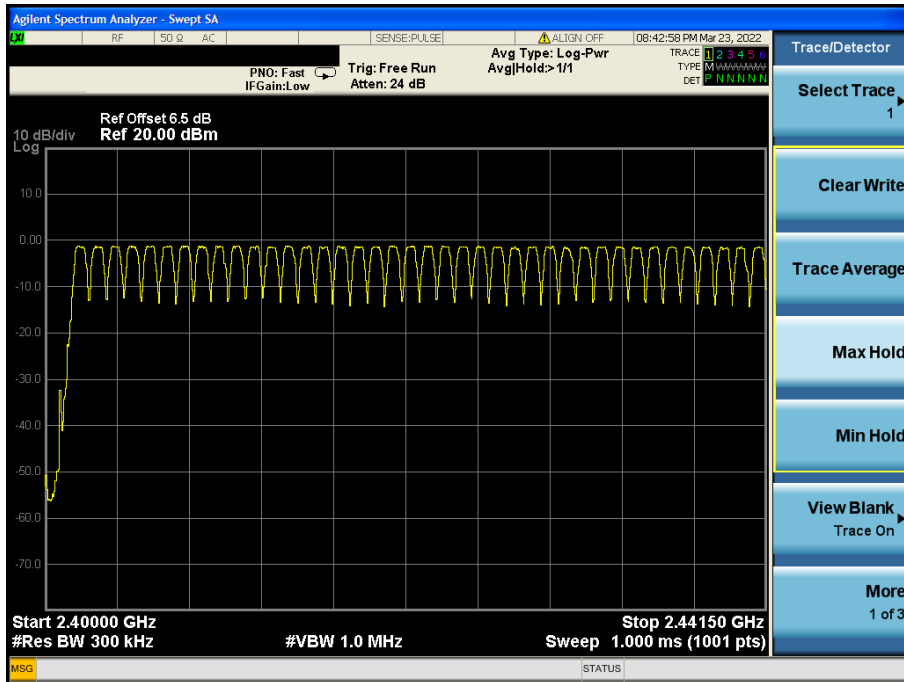
Measurement Data:

Mode	Hopping channel numbers	Limit	Result
GFSK	79	≥15	Pass
8QPSK	79		Pass



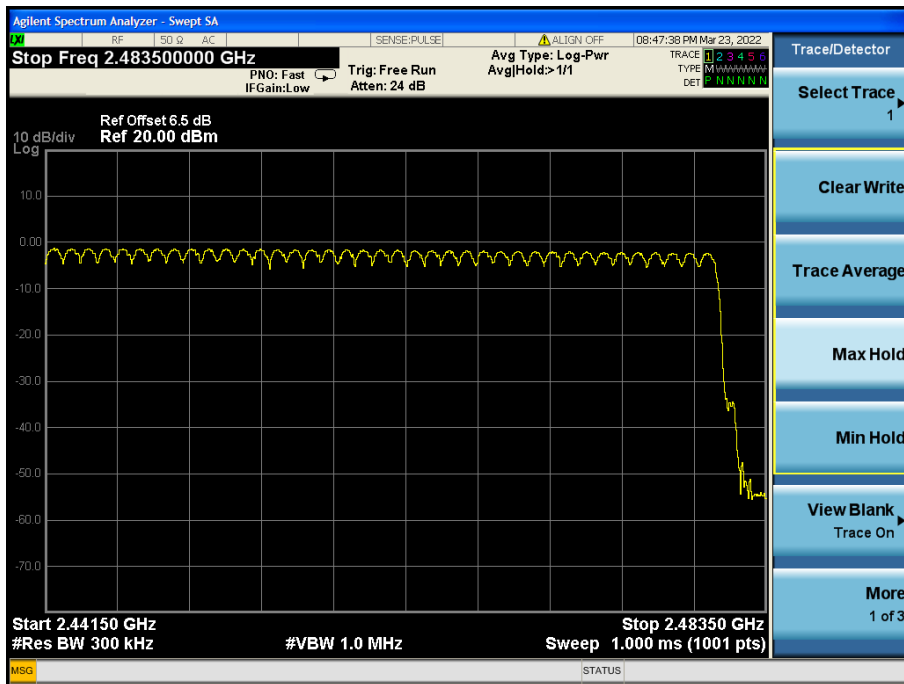
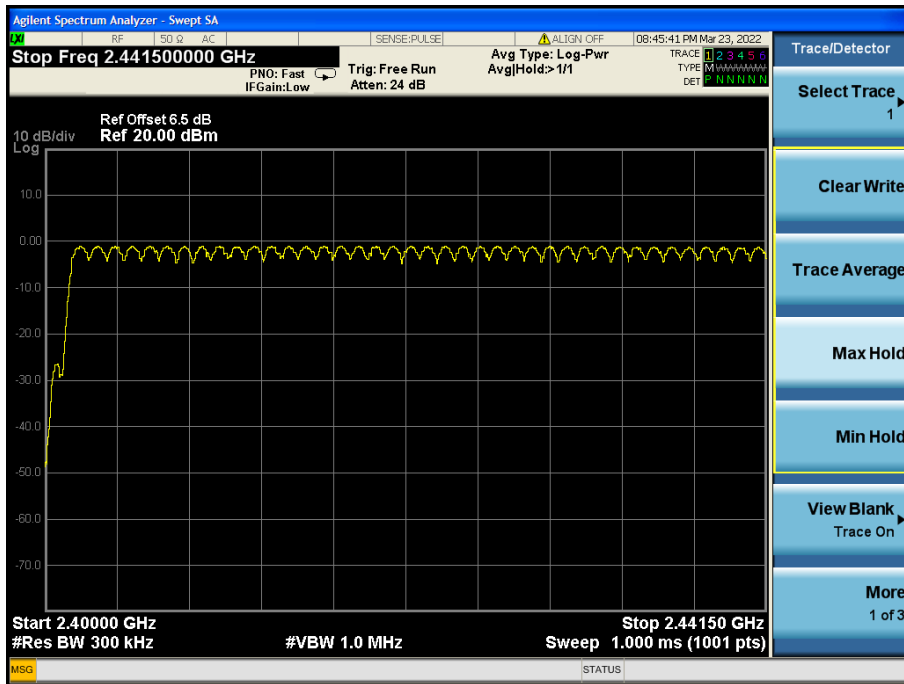
Test plot as follows:

Test mode: GFSK

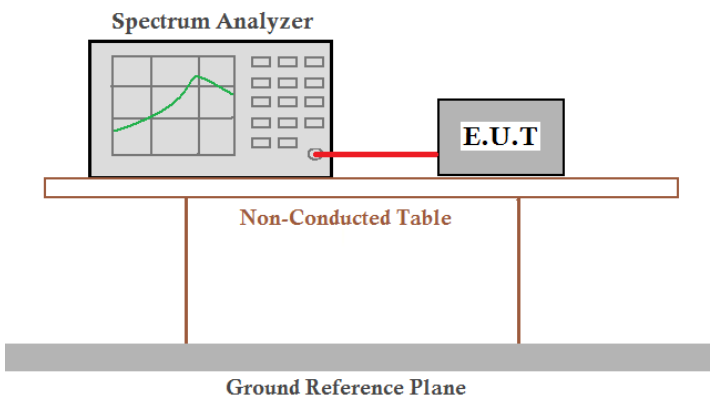




Test mode: 8QPSK



6.6. Dwell Time

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)(iii)					
Test Method:	ANSI C63.10:2013					
Receiver setup:	RBW=1MHz, VBW=1MHz, Span=0Hz, Detector=Peak					
Limit:	0.4 Second					
Test setup:	 <p>The diagram illustrates the test setup. A Spectrum Analyzer and an E.U.T. (Equipment Under Test) are placed on a Non-Conducted Table. The Spectrum Analyzer is on the left, and the E.U.T. is on the right. A red line connects the E.U.T. to the Spectrum Analyzer. Below the table is a Ground Reference Plane.</p>					
Test Instruments:	Refer to section 6.0 for details					
Test mode:	Refer to section 5.2 for details					
Test results:	Pass					
Test environment:	Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar

**Measurement Data****GFSK mode:**

Frequency	Packet	Pulse time (ms)	Dwell time(ms)	Limit(ms)	Result
Hopping	DH1	0.381	122	400	Pass
Hopping	DH3	1.635	262	400	Pass
Hopping	DH5	2.885	308	400	Pass

Note:We have tested all mode at high,middle and low channel,and recoreded worst case at Low channel.

Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second for DH1

Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second for DH3

Dwell time=Pulse time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second for DH5

8QPSK mode:

Frequency	Packet	Pulse time (ms)	Dwell time(ms)	Limit(ms)	Result
Hopping	3DH1	0.393	126	400	Pass
Hopping	3DH3	1.644	263	400	Pass
Hopping	3DH5	2.890	308	400	Pass

Note:We have tested all mode at high,middle and low channel,and recoreded worst case at Low channel.

Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second for 3-DH1

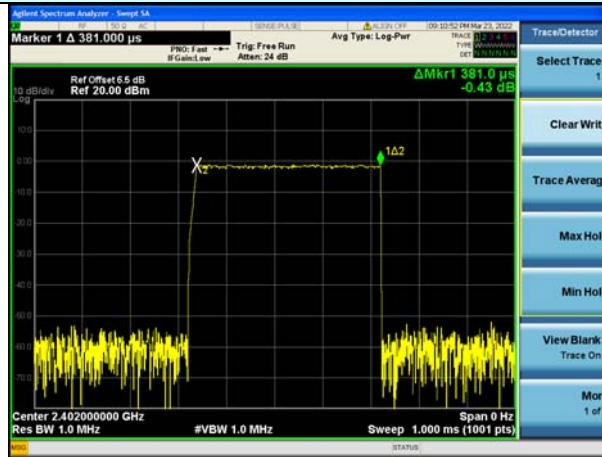
Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second for 3-DH3

Dwell time=Pulse time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second for 3-DH5

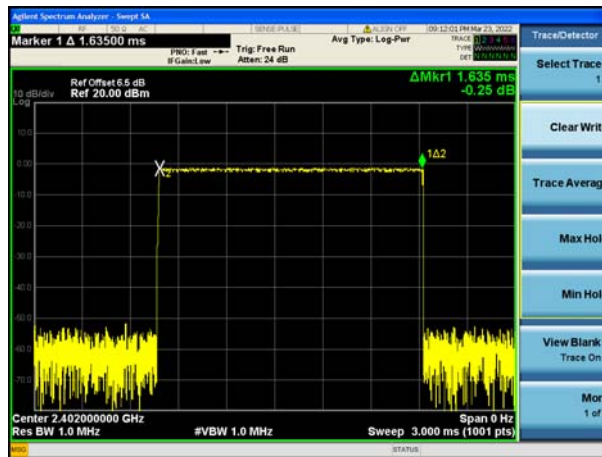


Test plot as follows:

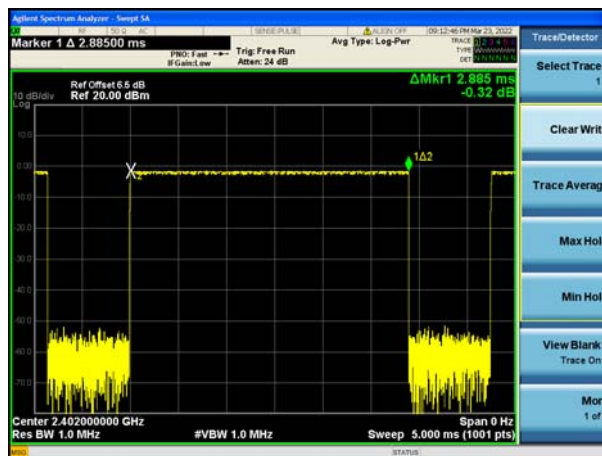
GFSK mode



DH1



DH3



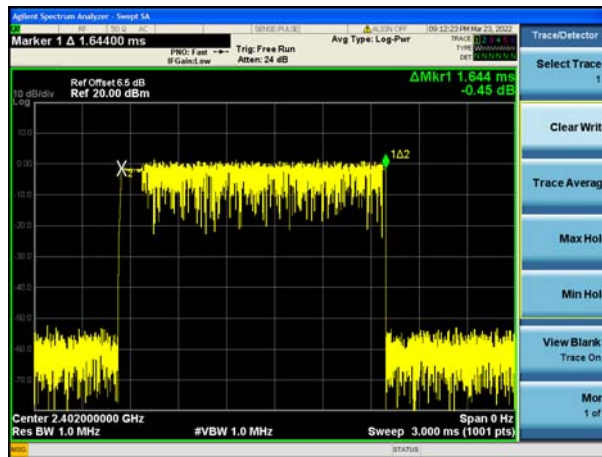
DH5



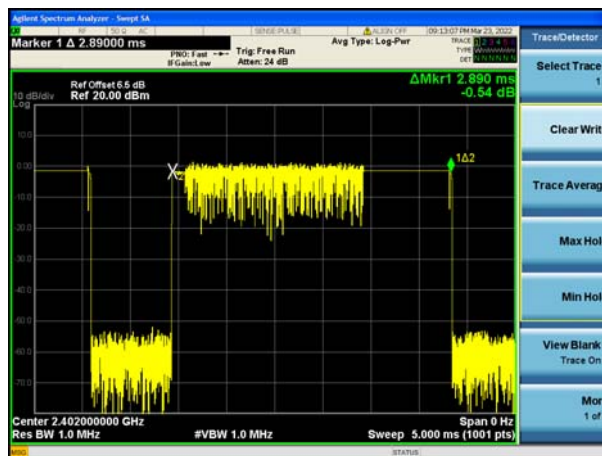
8QPSK mode



3DH1



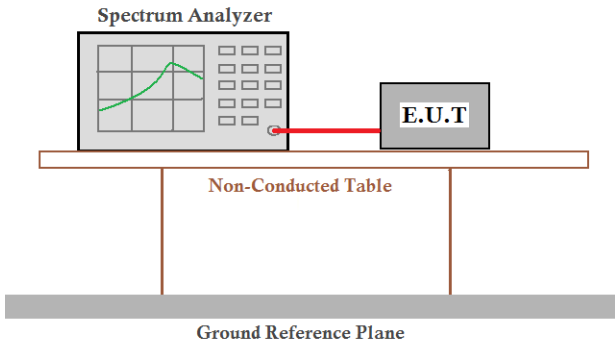
3DH3



3DH5

6.7. Band Edge

6.7.1. Conducted Emission Method

Test Requirement:	FCC Part15 C Section 15.247 (d)					
Test Method:	ANSI C63.10:2013					
Receiver setup:	RBW=100kHz, VBW=300kHz, Detector=Peak					
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.					
Test setup:	 <p>The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T. (Equipment Under Test) via a red cable. Both are placed on a Non-Conducted Table, which is supported by a Ground Reference Plane.</p>					
Test Instruments:	Refer to section 6.0 for details					
Test mode:	Refer to section 5.2 for details					
Test results:	Pass					
Test environment:	Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar



Frequency Band	Delta Peak to band emission (dBc)	>Limit (dBc)	Result
GFSK Non-hopping			
2400	47.95	20	Pass
2483.5	56.77	20	Pass

Frequency Band	Delta Peak to band emission (dBc)	>Limit (dBc)	Result
GFSK hopping			
2400	58.96	20	Pass
2483.5	58.43	20	Pass

Frequency Band	Delta Peak to band emission (dBc)	>Limit (dBc)	Result
8QPSK Non-hopping			
2400	50.54	20	Pass
2483.5	58.20	20	Pass

Frequency Band	Delta Peak to band emission (dBc)	>Limit (dBc)	Result
8QPSK hopping			
2400	50.71	20	Pass
2483.5	57.84	20	Pass

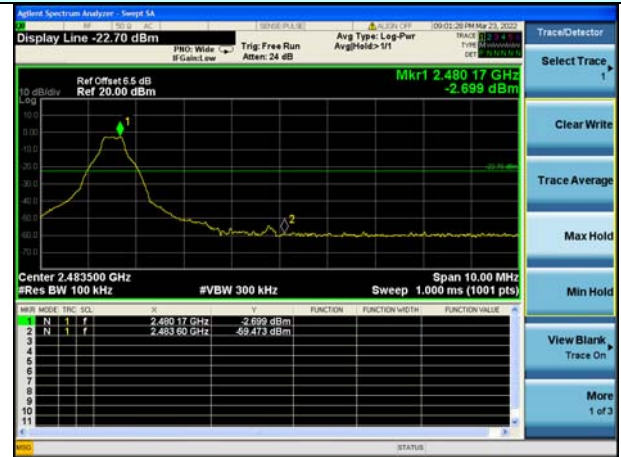


Test plot as follows:
GFSK Mode:

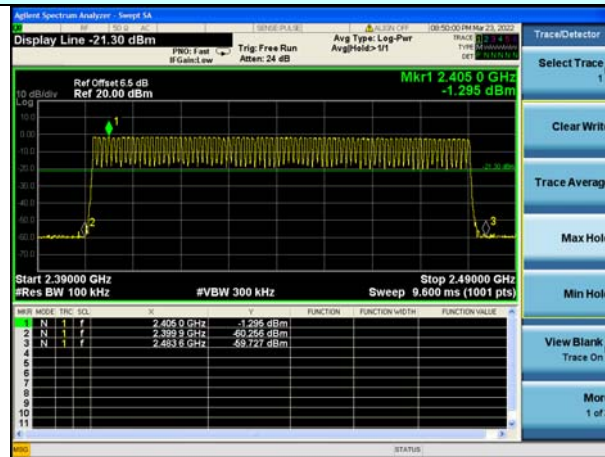
Lowest channel Highest channel



No-hopping mode

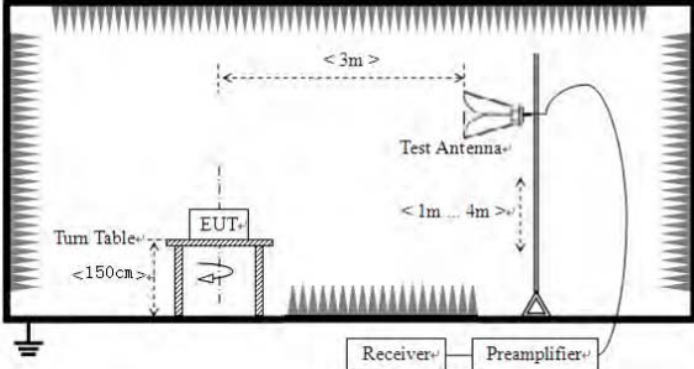


No-hopping mode



Hopping mode

6.7.2. Radiated Emission Method

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	Remark	
	Above 1GHz	Peak	1MHz	3MHz	Peak Value	
		Peak	1MHz	10Hz	Average Value	
Limit:	Frequency		Limit (dBuV/m @3m)		Remark	
	Above 1GHz		54.00		Average Value	
			74.00		Peak Value	
Test setup:						
Test Procedure:	<ol style="list-style-type: none"> 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. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 3. 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. 4. 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. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. 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. 					
Test Instruments:	Refer to section 6.0 for details					
Test mode:	Refer to section 5.2 for details					
Test results:	Pass					
Test environment:	Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar

**Measurement Data**

Remark: GFSK, Pi/4 DQPSK, 8QPSK all have been tested, only worse case 8QPSK is reported.

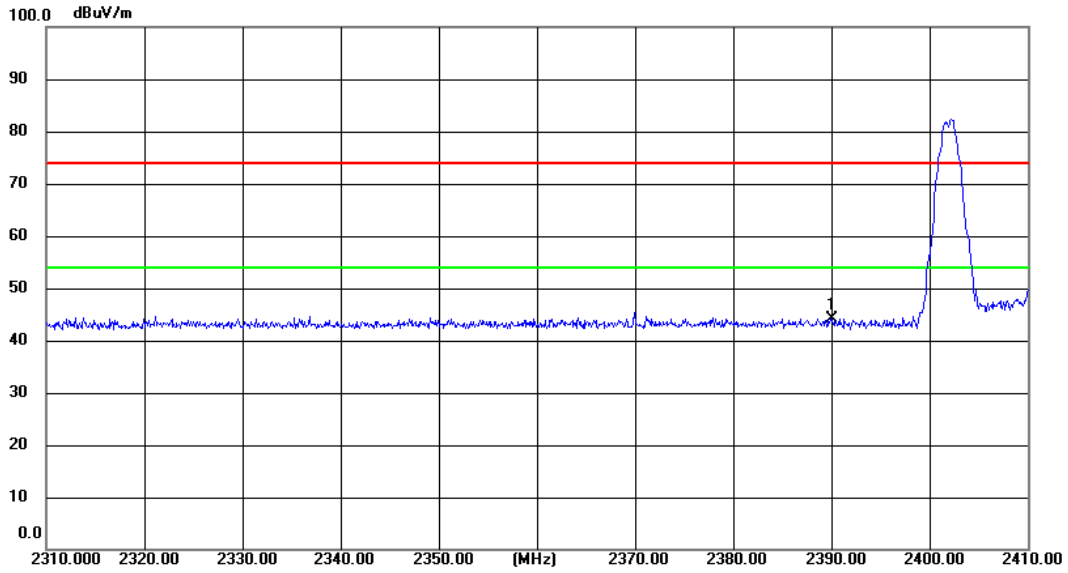
Operation Mode: 8QPSK TX Low channel

Freq. (MHz)	Ant.Pol. H/V	Reading		Ant/CF CF(dB)	Act		Limit		Note
		Peak (dBuv)	AV (dBuv)		Peak (dBuv/m)	AV (dBuv/m)	Peak (dBuv/m)	AV (dBuv/m)	
2390.00	H	49.89	--	-5.79	44.10	--	74.00	54.00	CH00
2390.00	V	49.25	--	-5.79	43.46	--	74.00	54.00	CH00
2483.50	H	48.50	--	-4.98	43.52	--	74.00	54.00	CH78
2483.50	V	48.89	--	-4.98	43.91	--	74.00	54.00	CH78

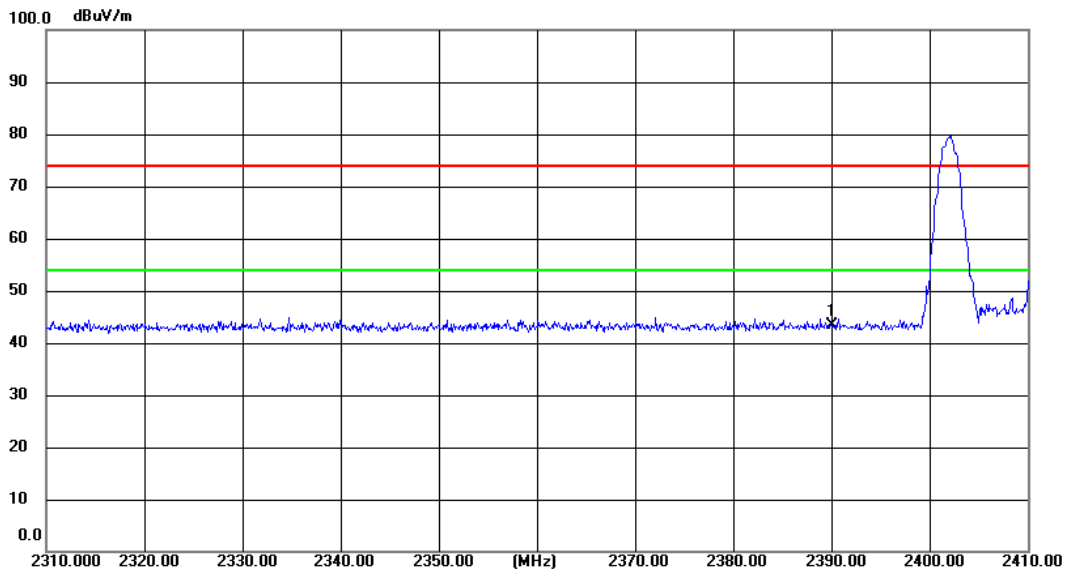
Corr.Factor = Antenna Factor + Cable Loss – Pre-amplifier.



Horizontal

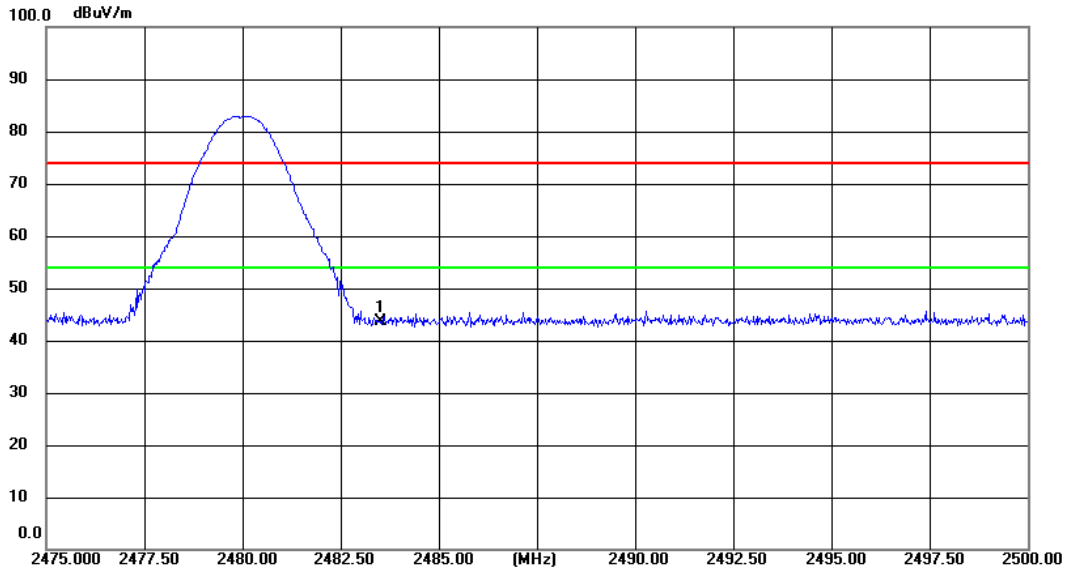


Vertical

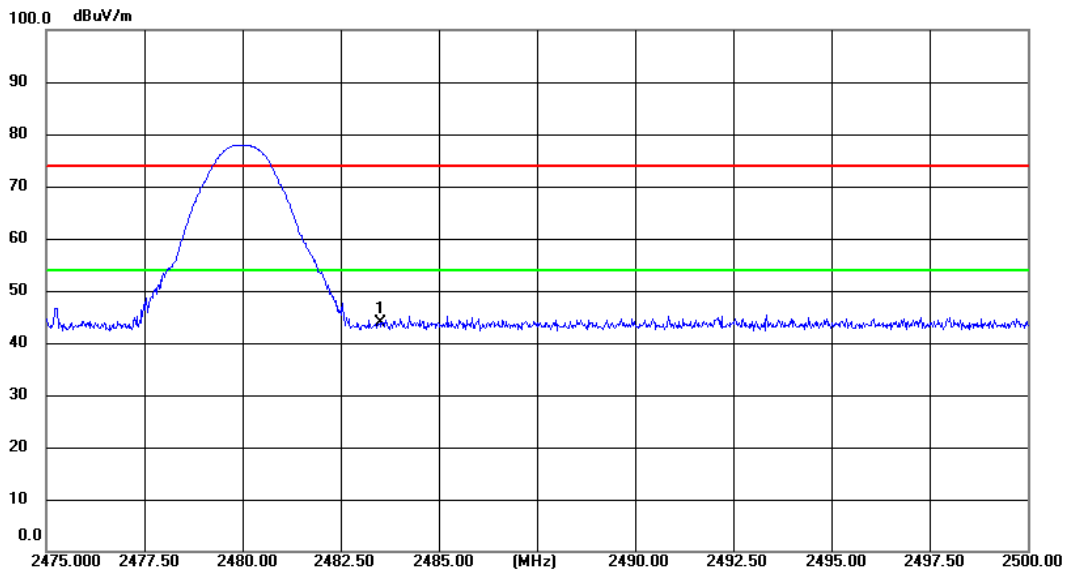




Horizontal

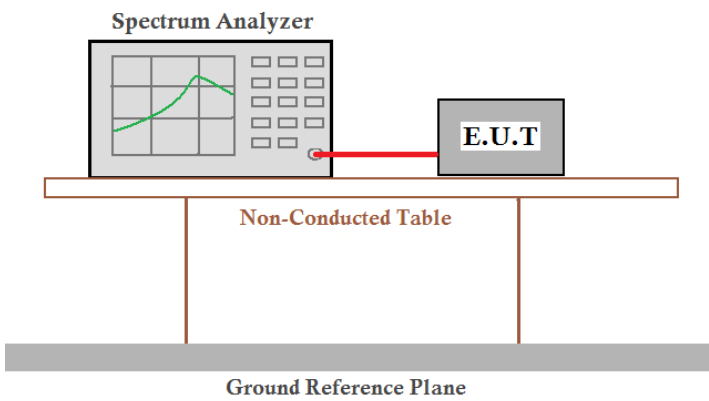


Vertical

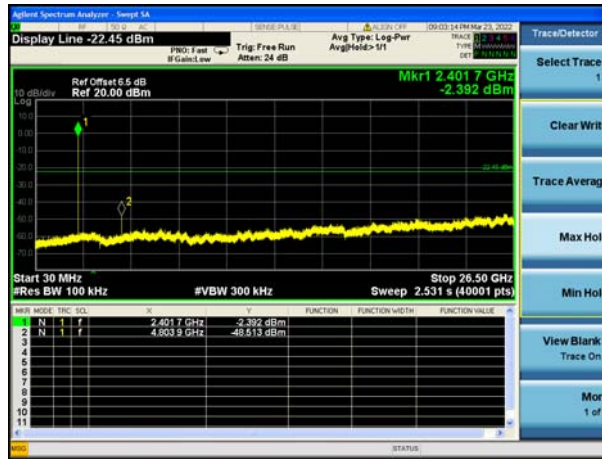


6.8. Spurious Emission

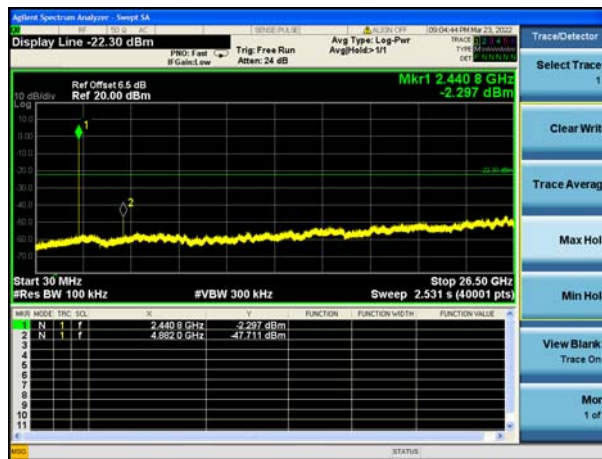
6.8.1. Conducted Emission Method

Test Requirement:	FCC Part15 C Section 15.247 (d)					
Test Method:	ANSI C63.10:2013					
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.					
Test setup:						
Test Instruments:	Refer to section 6.0 for details					
Test mode:	Refer to section 5.2 for details					
Test results:	Pass					
Test environment:	Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar

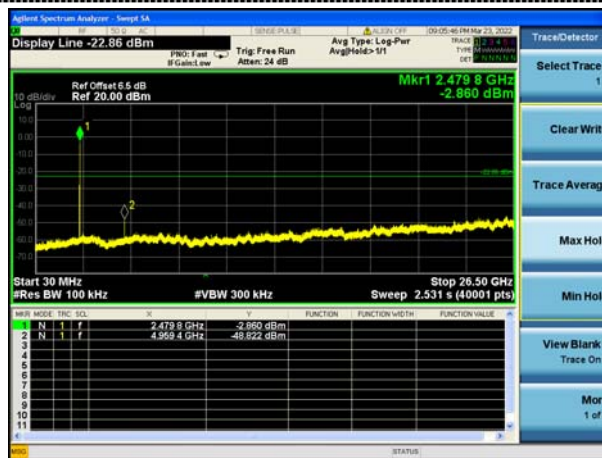
GFSK



CH00

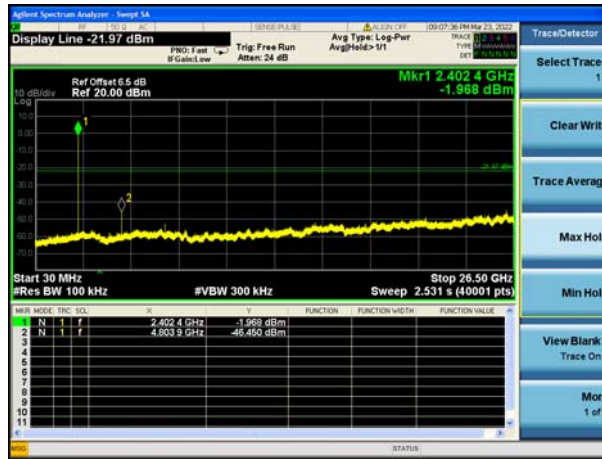


CH39

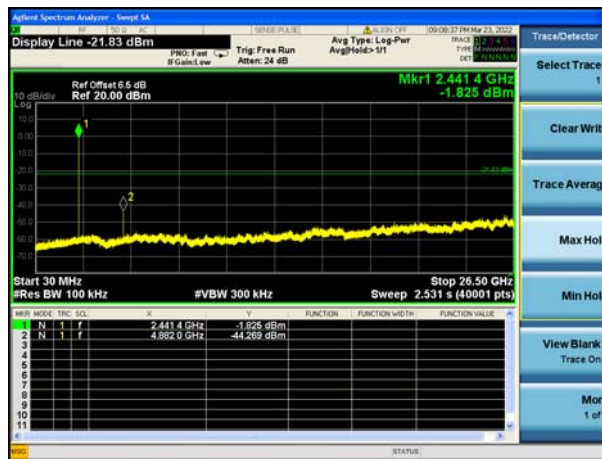


CH78

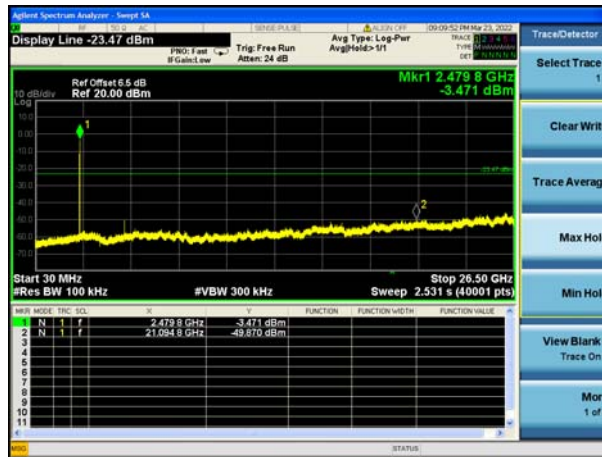
8QPSK



CH00

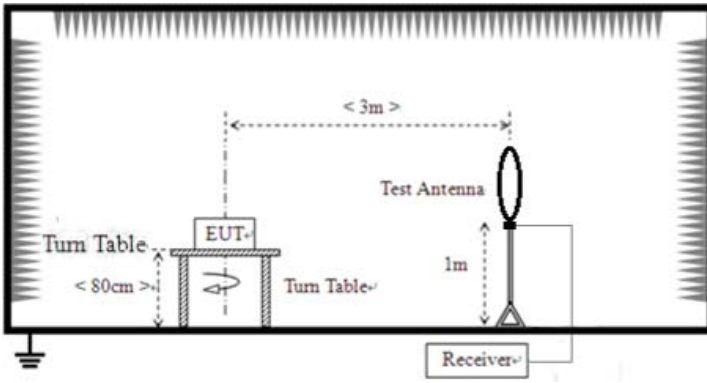


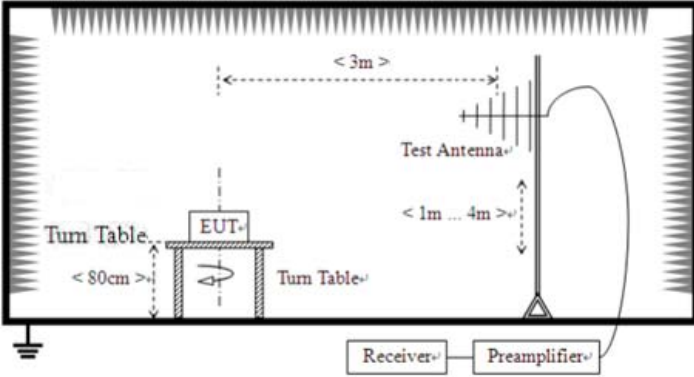
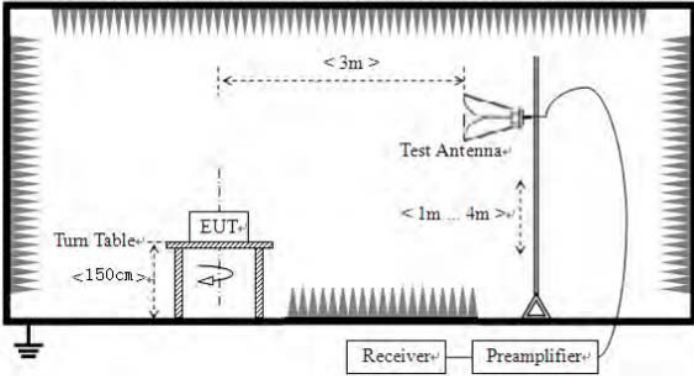
CH39



CH78

6.8.2. Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209				
Test Method:	ANSI C63.10:2013				
Test Frequency Range:	9kHz to 25GHz				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Value
	9KHz-150KHz	Quasi-peak	200Hz	600Hz	Quasi-peak
	150KHz-30MHz	Quasi-peak	9KHz	30KHz	Quasi-peak
	30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak
	Above 1GHz	Peak	1MHz	3MHz	Peak
Peak		1MHz	10Hz	Average	
Limit:	Frequency	Limit (uV/m)	Value	Measurement Distance	
	0.009MHz-0.490MHz	2400/F(KHz)	QP	300m	
	0.490MHz-1.705MHz	24000/F(KHz)	QP	30m	
	1.705MHz-30MHz	30	QP	30m	
	30MHz-88MHz	100	QP	3m	
	88MHz-216MHz	150	QP		
	216MHz-960MHz	200	QP		
	960MHz-1GHz	500	QP		
	Above 1GHz	500	Average		
		5000	Peak		
Test setup:	For radiated emissions from 9kHz to 30MHz				
	 <p>The diagram illustrates the test setup for radiated emissions. An Equipment Under Test (EUT) is placed on a turntable, which is positioned on another turntable. The distance between the EUT and the Test Antenna is 3m. The Test Antenna is mounted on a stand that is 1m high. A Receiver is connected to the Test Antenna. The distance between the EUT and the Receiver is less than 80cm. The ground symbol is shown at the bottom left of the diagram.</p>				

	<p>For radiated emissions from 30MHz to 1GHz</p>  <p>For radiated emissions above 1GHz</p> 						
<p>Test Procedure:</p>	<ol style="list-style-type: none"> 1. The EUT was placed on the top of a rotating table (0.8m for below 1G and 1.5m for above 1G) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 3. 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. 4. 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. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. 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. 						
<p>Test Instruments:</p>	<p>Refer to section 6.0 for details</p>						
<p>Test mode:</p>	<p>Refer to section 5.2 for details</p>						
<p>Test environment:</p>	<table border="1"> <tr> <td>Temp.:</td> <td>25 °C</td> <td>Humid.:</td> <td>52%</td> <td>Press.:</td> <td>1012mbar</td> </tr> </table>	Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar
Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar		



Report No.: HTT202203179F01

Test voltage:	DC 3.7V
Test results:	Pass

Measurement data:

Remarks:

- 1. During the test, pre-scan the GFSK, $\pi/4$ -DQPSK, 8QPSK modulation, and found the 8QPSK modulation which it is worse case.*
- 2. Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.*

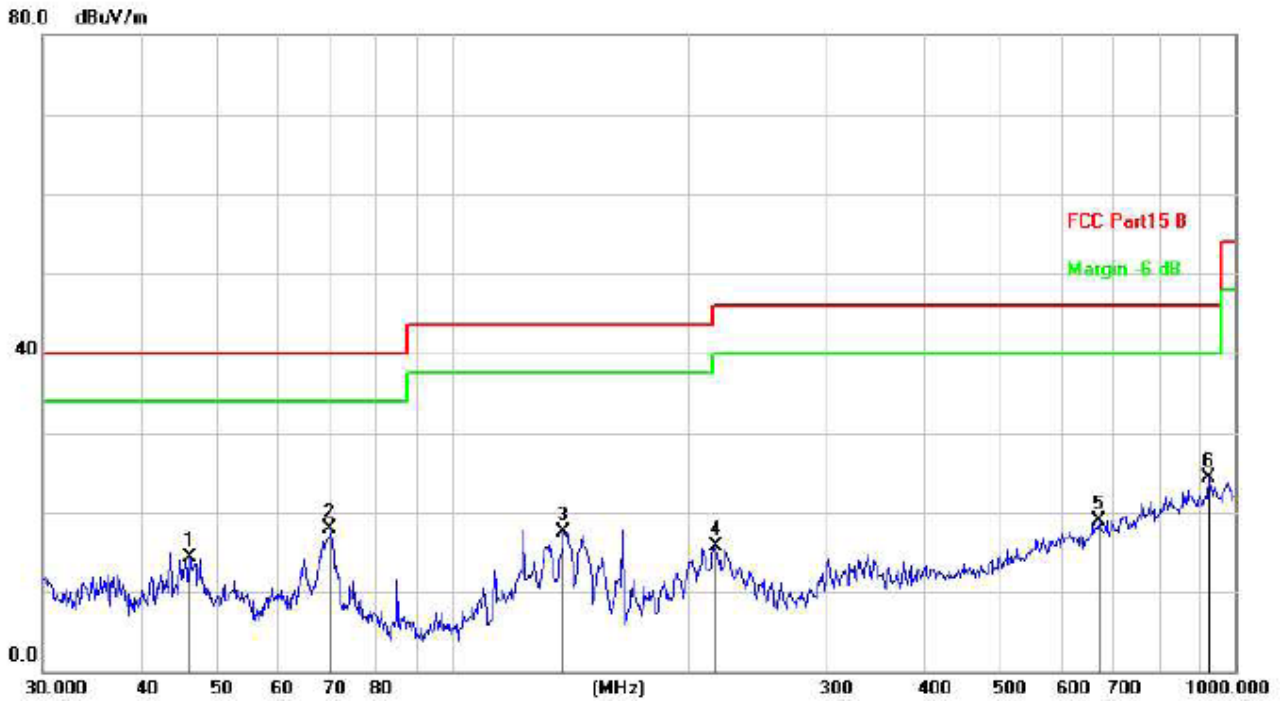
■ **9kHz~30MHz**

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.



For 30MHz-1GHz

Horizontal



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dB/m	Over dB	Detector
1		46.1779	31.49	-17.21	14.28	40.00	-25.72	QP
2		69.8450	37.80	-19.94	17.86	40.00	-22.14	QP
3		138.8735	35.48	-17.97	17.51	43.50	-25.99	QP
4		216.7828	35.72	-20.01	15.71	46.00	-30.29	QP
5		670.4893	28.38	-9.40	18.98	46.00	-27.02	QP
6	*	925.7563	28.94	-4.66	24.28	46.00	-21.72	QP

Final Level =Receiver Read level + Correct Factor



Vertical



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dB/m	Over dB	Detector
1	*	30.5306	47.24	-18.54	28.70	40.00	-11.30	QP
2		37.1550	44.13	-17.79	26.34	40.00	-13.66	QP
3		47.8260	44.88	-17.29	27.59	40.00	-12.41	QP
4		64.2074	44.28	-18.90	25.38	40.00	-14.62	QP
5		139.8508	38.67	-17.84	20.83	43.50	-22.67	QP
6		938.8326	27.84	-5.00	22.84	46.00	-23.16	QP

Final Level =Receiver Read level + Correct Factor



For 1GHz to 25GHz

Remark: For test above 1GHz GFSK , Pi/4 DQPSK and 8QPSK were test at Low, Middle, and High channel; only the worst result of 8QPSK was reported as below:

CH Low (2402MHz)

Horizontal:

Frequency	Meter Reading	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4804	50.02	31.40	8.18	31.50	58.10	74.00	-15.90	peak
4804	34.56	31.40	8.18	31.50	42.64	54.00	-11.36	AVG
7206	40.05	35.80	10.83	31.40	55.28	74.00	-18.72	peak
7206	24.08	35.80	10.83	31.40	39.31	54.00	-14.69	AVG
---	---			---	---	---	---	---
---	---			---	---	---	---	---

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Vertical:

Frequency	Meter Reading	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB/m)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4804	50.52	31.40	8.18	31.50	58.60	74.00	-15.40	peak
4804	34.76	31.40	8.18	31.50	42.84	54.00	-11.16	AVG
7206	41.12	35.80	10.83	31.40	56.35	74.00	-17.65	peak
7206	25.52	35.80	10.83	31.40	40.75	54.00	-13.25	AVG
---	---			---	---	---	---	---
---	---			---	---	---	---	---

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.



CH Middle (2441MHz)

Horizontal:

Frequency	Meter Reading	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB/m)	(dB)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
4882	50.13	31.40	9.17	32.10	58.60	74.00	-15.40	peak
4882	35.47	31.40	9.17	32.10	43.94	54.00	-10.06	AVG
7323	40.52	35.80	10.83	31.40	55.75	74.00	-18.25	peak
7323	25.58	35.80	10.83	31.40	40.81	54.00	-13.19	AVG
---	---			---	---	---	---	---
---	---			---	---	---	---	---

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Vertical:

Frequency	Meter Reading	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB/m)	(dB)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
4882	50.85	31.40	9.17	32.10	59.32	74.00	-14.68	peak
4882	35.42	31.40	9.17	32.10	43.89	54.00	-10.11	AVG
7323	40.39	35.80	10.83	31.40	55.62	74.00	-18.38	peak
7323	25.07	35.80	10.83	31.40	40.30	54.00	-13.70	AVG
---	---			---	---	---	---	---
---	---			---	---	---	---	---

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.



CH High (2480MHz)

Horizontal:

Frequency	Meter Reading	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB/m)	(dB)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
4960	50.13	31.40	9.17	32.10	58.6	74	-15.4	peak
4960	35.52	31.40	9.17	32.10	43.99	54	-10.01	AVG
7440	40.26	35.80	10.83	31.40	55.49	74	-18.51	peak
7440	25.57	35.80	10.83	31.40	40.8	54	-13.2	AVG
---	---			---	---	---	---	---
---	---			---	---	---	---	---

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Vertical:

Frequency	Meter Reading	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB/m)	(dB)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
4960	50.13	31.40	9.17	32.10	58.6	74	-15.4	peak
4960	34.12	31.40	9.17	32.10	42.59	54	-11.41	AVG
7440	39.23	35.80	10.83	31.40	54.46	74	-19.54	peak
7440	24.47	35.80	10.83	31.40	39.7	54	-14.3	AVG
---	---			---	---	---	---	---
---	---			---	---	---	---	---

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Remark:

- (1) Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (2) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed.



7. Test Setup Photo

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

8. EUT Constructional Details

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

-----End-----