



TEST REPORT

Test report
On Behalf of
Mitek Corp
For
BT SOURCE CONTROLL
Model No.: AWBTSW

FCC ID: 2AAOY- AWBTSW
IC:22793- AWBTSW

Prepared for : Mitek Corp
1 Mitek Plaza, Winslow, Illinois, United States

Prepared By : Shenzhen HUAKE Testing Technology Co., Ltd.
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TEST REPORT

Applicant's name : Mitek Corp
Address : 1 Mitek Plaza, Winslow, Illinois, United States
Manufacture's Name : Mitek Corp
Address : 1 Mitek Plaza, Winslow, Illinois, United States

Product description

Trade Mark: MTX AUDIO
Product name..... : BT SOURCE CONTROLL
Model and/or type reference : AWBTSW
Standards : **47 CFR FCC Part 15 Subpart C 15.247**
RSS 247 Issue 2, February 2017

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Date of Test

Date (s) of performance of tests... Jan.08,2019 ~ Jan.21,2019

Date of Issue..... Jan.21,2019

Test Result..... **Pass**

Testing Engineer :



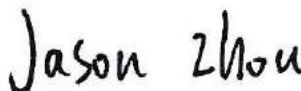
(Gary Qian)

Technical Manager :



(Eden Hu)

Authorized Signatory :



(Jason Zhou)

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1. SUMMARY

1.1. TEST STANDARDS

The tests were performed according to following standards:

[FCC Rules Part 15.247](#): Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

[KDB558074 D01](#): Digital Transmission Systems (DTS) and Frequency Hopping measurement procedures

[ANSI C63.10: 2013](#): American National Standard for Testing Unlicensed Wireless Devices

[RSS-247-Issue 2](#): Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.

[RSS-Gen Issue 4](#): General Requirements for Compliance of Radio Apparatus

1.2. Test Description

FCC PART 15.247 & RSS 247		
FCC Part 15.207 RSS-Gen 8.8	AC Power Conducted Emission	N/A
FCC Part 15.247(a)(1)(i) RSS 247 5.1 (1) RSS-Gen 4.6	20dB Bandwidth& 99% Bandwidth	PASS
FCC Part 15.247(d) RSS 247 5.5	Spurious RF Conducted Emission	PASS
FCC Part 15.247(b) RSS 247 5.4 (2)	Maximum Peak Output Power	PASS
FCC Part 15.247(b) RSS 247 5.1 (1)	Pseudorandom Frequency Hopping Sequence	PASS
FCC Part 15.247(a)(1)(iii) RSS 247 5.1 (4)	Number of hopping frequency& Time of Occupancy	PASS
FCC Part 15.247(a)(1) RSS 247 5.1 (2)	Frequency Separation	PASS
FCC Part 15.205/15.209 RSS-Gen 8.9	Radiated Emissions	PASS
FCC Part 15.247(d) RSS-Gen 8.10	Band Edge Compliance of RF Emission	PASS

Note: N/A stand for “not applicable”

1.3. Test Facility

1.3.1 Address of the test laboratory

Shenzhen HUAK Testing Technology Co., Ltd.

1F, B2 Building, Junfeng Zhongcheng Zhizao Innovation Park, Fuhai Street, Bao'an District, Shenzhen City, China

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

1.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements" and is documented in the Shenzhen HUAK Testing Technology Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Measurement Uncertainty

Conducted Emission Expanded Uncertainty	= 2.23dB, k=2
Radiated emission expanded uncertainty(9kHz-30MHz)	= 3.08dB, k=2
Radiated emission expanded uncertainty(30MHz-1000MHz)	= 4.42dB, k=2
Radiated emission expanded uncertainty(Above 1GHz)	= 4.06dB, k=2

2. GENERAL INFORMATION

2.1. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Normal Temperature:	25°C
Relative Humidity:	55 %
Air Pressure:	101 kPa

2.2. General Description of EUT

Product Name:	BT SOURCE CONTROLL
Model/Type reference:	AWBTSW
Power supply:	DC 12V
Bluetooth :	
Supported type:	Bluetooth BR/EDR
Modulation:	GFSK, $\pi/4$ DQPSK, 8DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	PCB antenna
Antenna gain:	0dBi

Note: For more details, please refer to the user's manual of the EUT.

2.3. Description of Test Modes and Test Frequency

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing .There are 79 channels provided to the EUT and Channel 00/39/78 were selected to test.

Operation Frequency :

Channel	Frequency (MHz)
00	2402
01	2403
⋮	⋮
38	2440
39	2441
40	2442
⋮	⋮
77	2479
78	2480

Preliminary tests were performed in each mode and packet length of BT, and found worst case as bellow, finally test were conducted at those mode and recorded in this report.

Test Items	Worst case
Conducted Emissions	DH5 Middle channel
Radiated Emissions and Band Edge	DH5
Maximum Conducted Output Power	DH5/2DH5/3DH5
20dB Bandwidth	DH5/2DH5/3DH5
Frequency Separation	DH5/2DH5/3DH5 Middle channel
Number of hopping frequency	DH5/2DH5/3DH5
Time of Occupancy (Dwell Time)	DH1/DH3/DH5 Middle channel 2DH1/2DH3/2DH5 Middle channel 3DH1/3DH3/3DH5 Middle channel
Out-of-band Emissions	DH5/2DH5/3DH5

2.4. Equipments Used during the Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	L.I.S.N. Artificial Mains Network	R&S	ENV216	HKE-002	Dec. 28, 2018	1 Year
2.	Receiver	R&S	ESCI 7	HKE-010	Dec. 28, 2018	1 Year
3.	RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 28, 2018	1 Year
4.	Spectrum analyzer	R&S	FSP40	HKE-025	Dec. 28, 2018	1 Year
5.	Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 28, 2018	1 Year
6.	Preamplifier	Schwarzbeck	BBV 9743	HKE-006	Dec. 28, 2018	1 Year
7.	EMI Test Receiver	Rohde & Schwarz	ESCI 7	HKE-010	Dec. 28, 2018	1 Year
8.	Bilog Broadband Antenna	Schwarzbeck	VULB9163	HKE-012	Dec. 28, 2018	1 Year
9.	Loop Antenna	Schwarzbeck	FMZB 1519 B	HKE-014	Dec. 28, 2018	1 Year
10.	Horn Antenna	Schwarzbeck	9120D	HKE-013	Dec. 28, 2018	1 Year
11.	Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	HKE-017	Dec. 28, 2018	1 Year
12.	Pre-amplifier	EMCI	EMC051845SE	HKE-015	Dec. 28, 2018	1 Year
13.	Pre-amplifier	Agilent	83051A	HKE-016	Dec. 28, 2018	1 Year
14.	EMI Test Software EZ-EMC	Tonscend	JS1120-B Version	HKE-083	Dec. 28, 2018	N/A
15.	Power Sensor	Agilent	E9300A	HKE-086	Dec. 28, 2018	1 Year
16.	Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 28, 2018	1 Year
17.	Signal generator	Agilent	N5182A	HKE-029	Dec. 28, 2018	1 Year
18.	Signal Generator	Agilent	83630A	HKE-028	Dec. 28, 2018	1 Year
19.	Shielded room	Shiel Hong	4*3*3	HKE-039	Dec. 28, 2018	3 Year
20.	RF Cable(below 1GHz)	HUBER+SUHNER	RG214	HKE-055	Dec. 28, 2018	1 Year
21.	RF Cable(above 1GHz)	HUBER+SUHNER	RG214	HKE-056	Dec. 28, 2018	1 Year

The calibration interval was one year

2.5. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended to comply with Section 15.247 of the FCC Part 15, Subpart C Rules , RSS Gen and RSS 247 Rules.

2.6. Modifications

No modifications were implemented to meet testing criteria.

3. TEST CONDITIONS AND RESULTS

3.1. Conducted Emissions Test

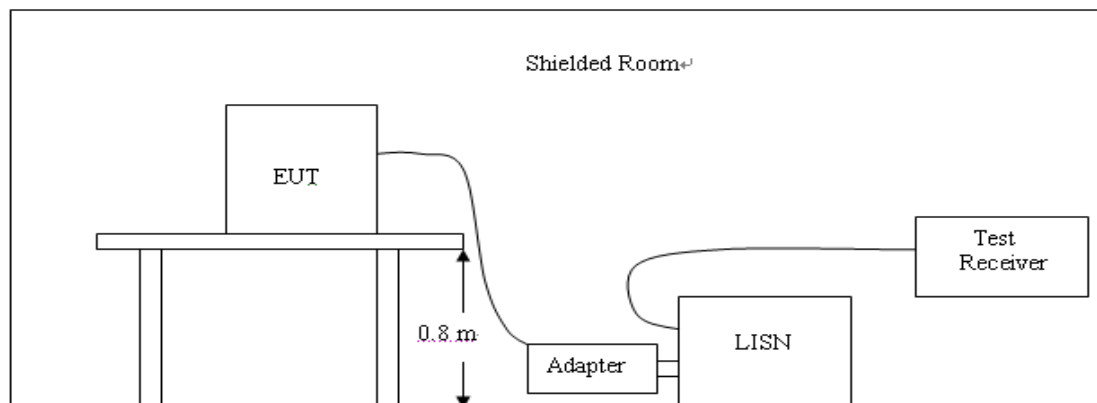
LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.207 and RSS–Gen 8.8.

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 CONFIGURATION



TEST PROCEDURE

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10:2013.
2. Support equipment, if needed, was placed as per ANSI C63.10:2013.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10:2013.
4. The adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipments received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

TEST RESULTS

Not applicable

3.2. Radiated Emissions and Band Edge

Limit

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission out of authorized band shall not exceed the following table at a 3 meters measurement distance.

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)

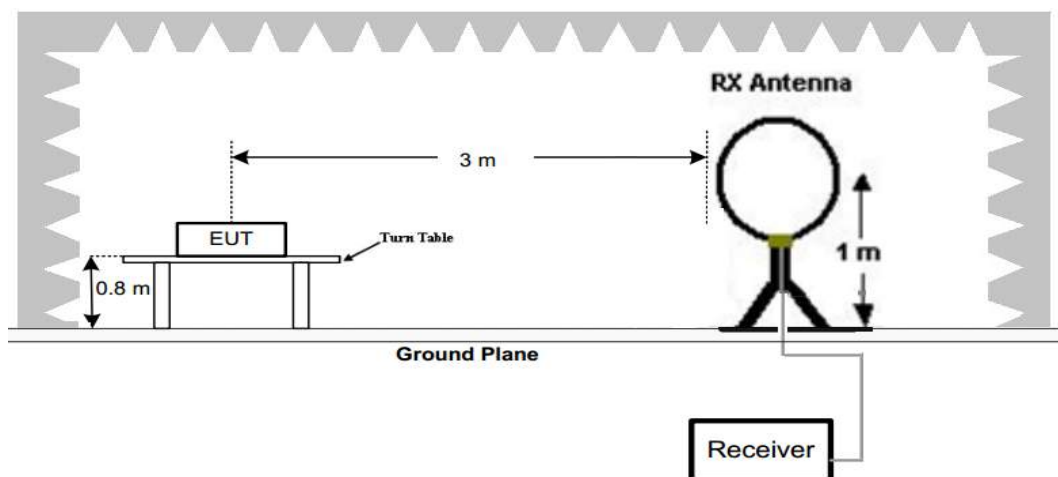
Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission. Unwanted emissions that fall into restricted bands shall comply with the limits specified in RSS-Gen; and Unwanted emissions that do not fall within the restricted frequency bands shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

Radiated emission limits

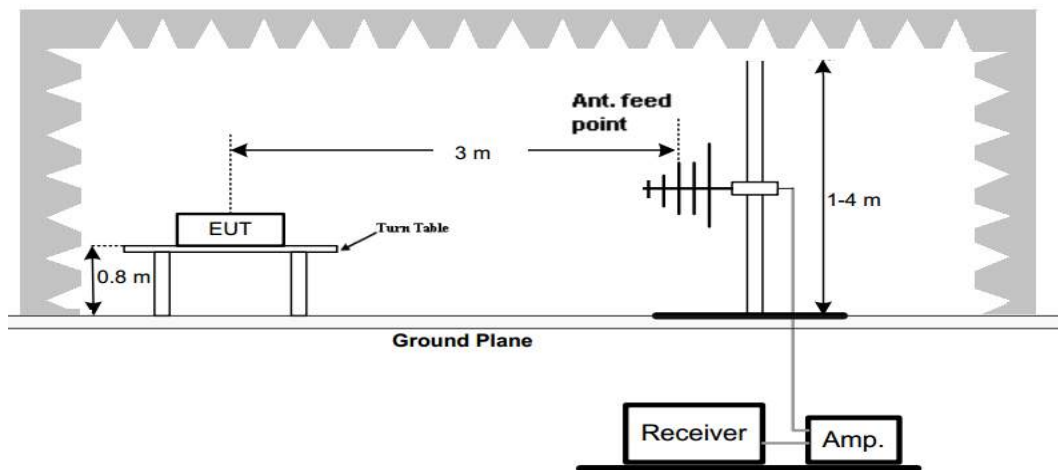
Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	$20\log(2400/F(\text{KHz}))+40\log(300/3)$	$2400/F(\text{KHz})$
0.49-1.705	3	$20\log(24000/F(\text{KHz}))+40\log(30/3)$	$24000/F(\text{KHz})$
1.705-30	3	$20\log(30)+40\log(30/3)$	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

TEST CONFIGURATION

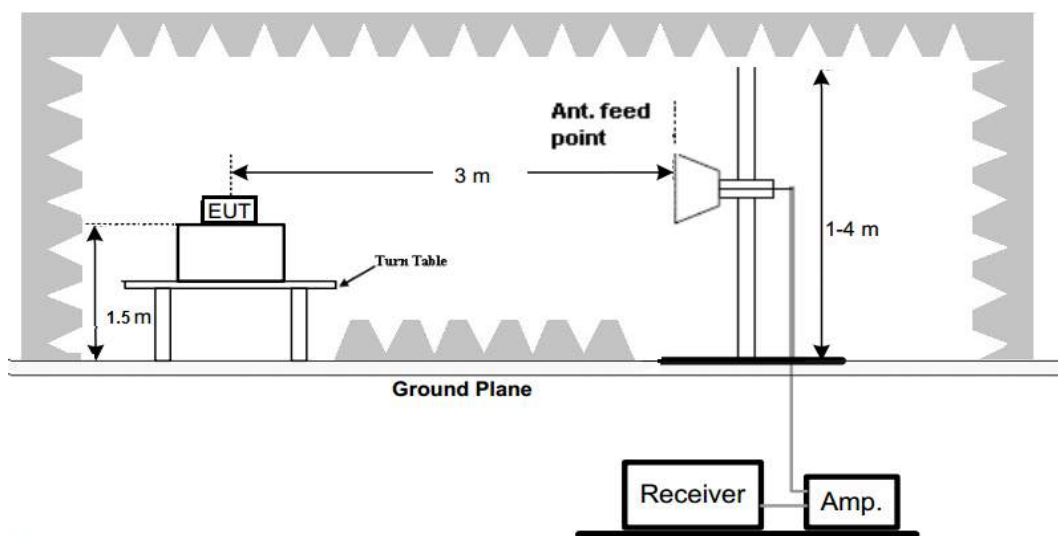
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



Test Procedure

1. Below 1GHz measurement the EUT is placed on a turntable which is 0.8m above ground plane, and above 1GHz measurement EUT was placed on a low permittivity and low loss tangent turn table which is 1.5m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0°C to 360°C to acquire the highest emissions from EUT
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.

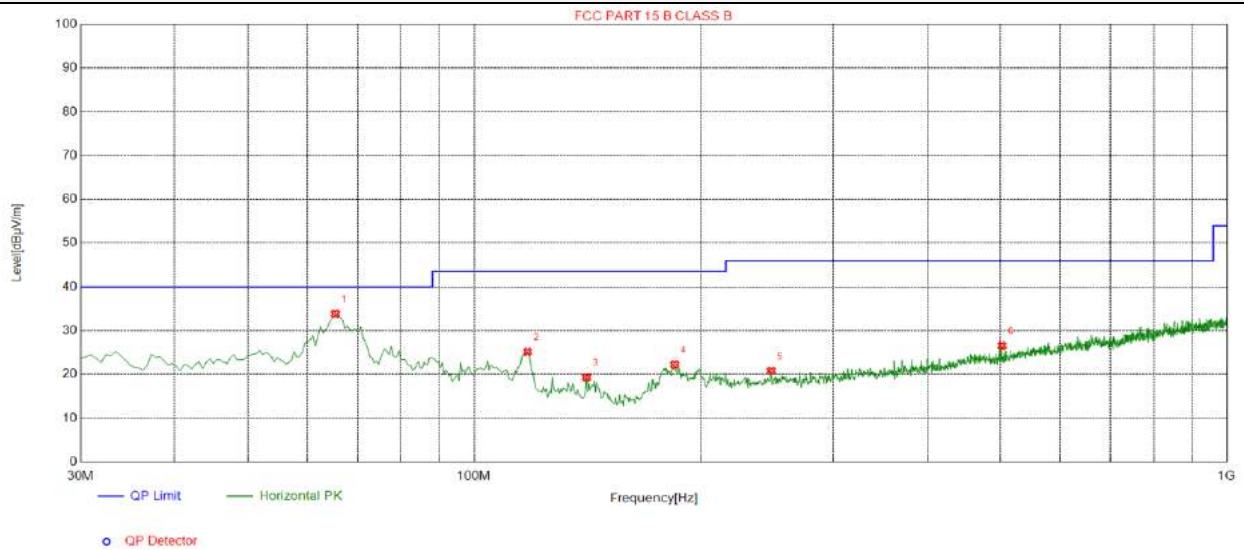
TEST RESULTS

Remark:

1. We measured Radiated Emission at GFSK, $\pi/4$ DQPSK and 8DPSK mode from 9 KHz to 25GHz and recorded worst case at GFSK DH5 mode.
2. For below 1GHz testing recorded worst at GFSK DH5 low channel.
3. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

For 30MHz-1GHz

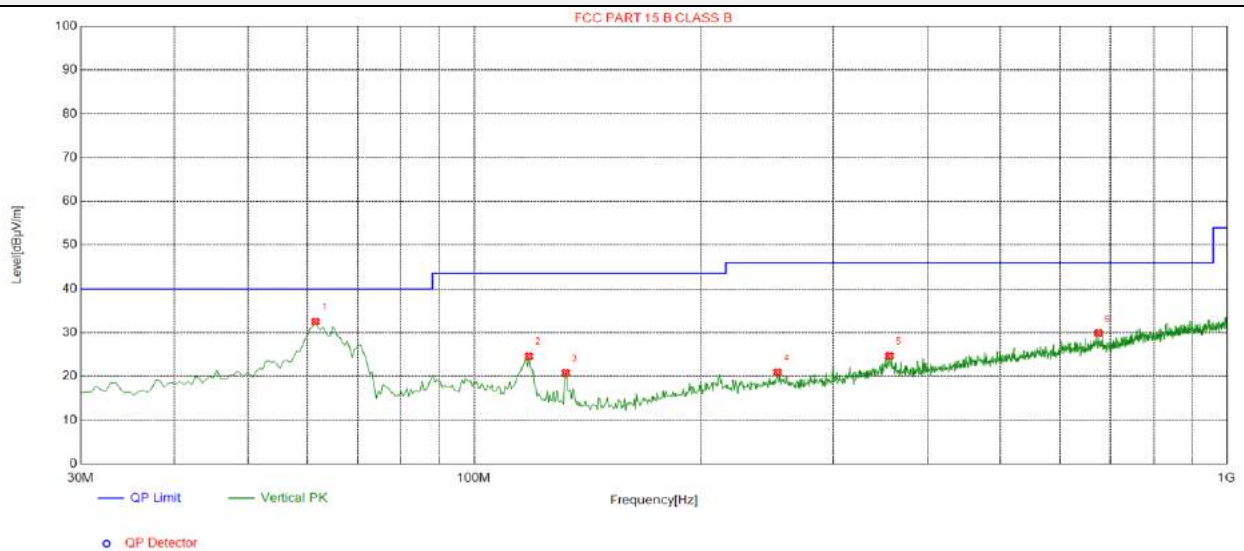
Horizontal



Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	65.4050	33.83	-16.52	40.00	6.17	100	76	Horizontal
2	117.785	25.17	-16.73	43.50	18.33	100	240	Horizontal
3	141.065	19.32	-19.15	43.50	24.18	100	328	Horizontal
4	184.715	22.24	-16.46	43.50	21.26	100	97	Horizontal
5	248.250	20.81	-13.47	46.00	25.19	100	348	Horizontal
6	502.875	26.56	-8.22	46.00	19.44	100	138	Horizontal

Vertical



Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	61.5250	32.51	-15.54	40.00	7.49	100	240	Vertical
2	118.270	24.61	-16.81	43.50	18.89	100	196	Vertical
3	132.335	20.81	-18.71	43.50	22.69	100	206	Vertical
4	253.100	20.94	-13.43	46.00	25.06	100	155	Vertical
5	356.405	24.69	-11.47	46.00	21.31	100	97	Vertical
6	675.535	29.91	-4.74	46.00	16.09	100	56	Vertical

For 1GHz to 25GHz

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

CH Low (2402MHz)

Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4804	60.85	-3.64	57.21	74	-16.79	peak
4804	46.76	-3.64	43.12	54	-10.88	AVG
7206	56.63	-0.95	55.68	74	-18.32	peak
7206	42.55	-0.95	41.6	54	-12.4	AVG
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Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4804	61.73	-3.64	58.09	74	-15.91	peak
4804	44.81	-3.64	41.17	54	-12.83	AVG
7206	55.95	-0.95	55	74	-19	peak
7206	42.63	-0.95	41.68	54	-12.32	AVG
---	---	---	---	---	---	---
---	---	---	---	---	---	---

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

CH High (2480MHz)

Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4960	59.35	-3.43	55.92	74	-18.08	peak
4960	45.46	-3.43	42.03	54	-11.97	AVG
7440	55.79	-0.75	55.04	74	-18.96	peak
7440	41.83	-0.75	41.08	54	-12.92	AVG
---	---	---	---	---	---	---
---	---	---	---	---	---	---

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

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4960	59.76	-3.43	56.33	74	-17.67	peak
4960	46.49	-3.43	43.06	54	-10.94	AVG
7440	56.57	-0.75	55.82	74	-18.18	peak
7440	41.73	-0.75	40.98	54	-13.02	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.

Results of Band Edges Test (Radiated)

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

Operation Mode: GFSK TX Low channel(2402MHz)

Horizontal (Worst case)

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2390	55.43	-5.81	49.62	74	-24.38	peak
2390	38.52	-5.81	32.71	54	-21.29	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2390	57.62	-5.81	51.81	74	-22.19	peak
2390	40.73	-5.81	34.92	54	-19.08	AVG

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

Operation Mode: GFSK TX High channel (2480MHz)

Horizontal (Worst case)

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.5	56.86	-5.65	51.21	74	-22.79	peak
2483.5	40.79	-5.65	35.14	54	-18.86	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.5	57.53	-5.65	51.88	74	-22.12	peak
2483.5	41.71	-5.65	36.06	54	-17.94	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						
Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.						

3.3. Maximum Peak Output Power

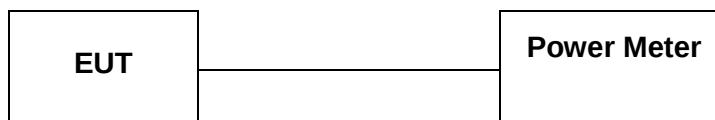
Limit

The Maximum Peak Output Power Measurement is 125mW(20.97).

Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Power Meter.

Test Configuration



Test Results

Type	Channel	Output power (dBm)	Limit (dBm)	Result
GFSK	00	0.443	20.97	Pass
	39	0.987		
	78	-0.051		
$\pi/4$ DQPSK	00	-0.316	20.97	Pass
	39	1.922		
	78	1.017		
8DPSK	00	-0.094	20.97	Pass
	39	1.323		
	78	1.022		

Note: 1.The test results including the cable lose.

3.4. 20dB and 99%Bandwidth

Limit

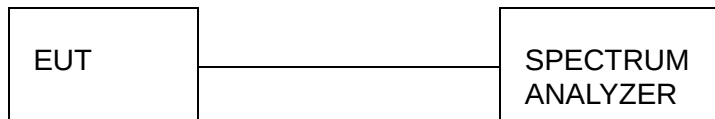
For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwidth.

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 30 KHz RBW and 100 KHz VBW.

The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

Test Configuration



Test Results

Modulation	Channel	20dB bandwidth (MHz)	99% OBW (MHz)	Result
GFSK	CH00	0.9085	0.83766	Pass
	CH39	0.8781	0.83186	
	CH78	0.8848	0.83221	
$\pi/4$ DQPSK	CH00	1.215	1.1595	
	CH39	1.220	1.1619	
	CH78	1.221	1.1643	
8DPSK	CH00	1.205	1.1446	
	CH39	1.209	1.1422	
	CH78	1.205	1.1432	

Test plot as follows:

GFSK Modulation	
	
CH00	
	
CH39	
	
CH78	

$\pi/4$ DQPSK Modulation



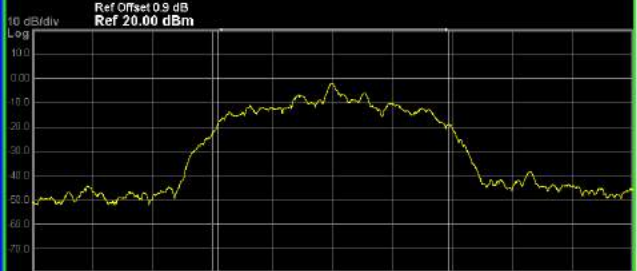
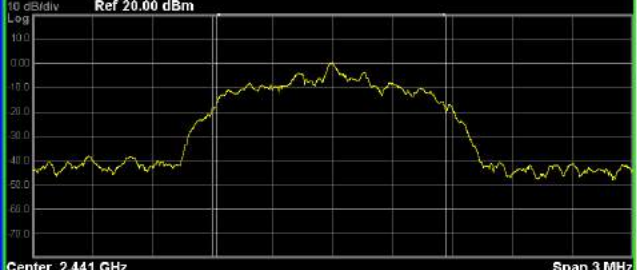
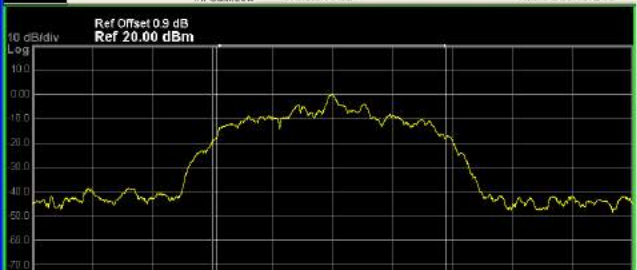
CH00



CH39



CH78

8DPSK Modulation	
Agilent Spectrum Analyzer - Occupied BW Center Freq 2.402000000 GHz Center Freq: 2.402000000 GHz Trig: Free Run Avg/Hold: 10/10 Radio Std: None #IF Gain: Low #Atten: 30 dB Radio Device: BTS Ref Offset 0.9 dB Ref 20.00 dBm 10 dB/div Log  Center 2.402 GHz #Res BW 30 kHz #VBW 100 kHz Span 3 MHz Sweep 3.2 ms Occupied Bandwidth 1.1446 MHz Total Power 5.40 dBm Transmit Freq Error 2.533 kHz OBW Power 99.00 % x dB Bandwidth 1.205 MHz x dB -20.00 dB MSG STATUS Frequency Center Freq 2.402000000 GHz CF Step 300.000 kHz Man Auto Freq Offset 0 Hz	
CH00	
Agilent Spectrum Analyzer - Occupied BW Center Freq 2.441000000 GHz Center Freq: 2.441000000 GHz Trig: Free Run Avg/Hold: 10/10 Radio Std: None #IF Gain: Low #Atten: 30 dB Radio Device: BTS Ref Offset 0.9 dB Ref 20.00 dBm 10 dB/div Log  Center 2.441 GHz #Res BW 30 kHz #VBW 100 kHz Span 3 MHz Sweep 3.2 ms Occupied Bandwidth 1.1422 MHz Total Power 7.91 dBm Transmit Freq Error -8.636 kHz OBW Power 99.00 % x dB Bandwidth 1.209 MHz x dB -20.00 dB MSG STATUS Frequency Center Freq 2.441000000 GHz CF Step 300.000 kHz Man Auto Freq Offset 0 Hz	
CH39	
Agilent Spectrum Analyzer - Occupied BW Center Freq 2.480000000 GHz Center Freq: 2.480000000 GHz Trig: Free Run Avg/Hold: 10/10 Radio Std: None #IF Gain: Low #Atten: 30 dB Radio Device: BTS Ref Offset 0.9 dB Ref 20.00 dBm 10 dB/div Log  Center 2.48 GHz #Res BW 30 kHz #VBW 100 kHz Span 3 MHz Sweep 3.2 ms Occupied Bandwidth 1.1432 MHz Total Power 7.64 dBm Transmit Freq Error -5.039 kHz OBW Power 99.00 % x dB Bandwidth 1.205 MHz x dB -20.00 dB MSG STATUS Frequency Center Freq 2.480000000 GHz CF Step 300.000 kHz Man Auto Freq Offset 0 Hz	
CH78	

3.5. Frequency Separation

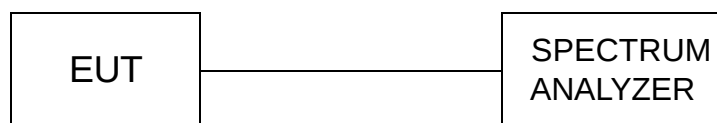
LIMIT

According to 15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the $2/3 \times 20\text{dB}$ bandwidth of the hopping channel, whichever is greater.

TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 KHz RBW and 300 KHz VBW.

TEST CONFIGURATION



TEST RESULTS

Modulation	Channel	Channel Separation (MHz)	Limit(MHz)	Result
GFSK	CH39	1.159	25KHz or $2/3 \times 20\text{dB}$ bandwidth	Pass
	CH40			
$\pi/4$ DQPSK	CH39	1.181	25KHz or $2/3 \times 20\text{dB}$ bandwidth	Pass
	CH40			
8DPSK	CH39	1.152	25KHz or $2/3 \times 20\text{dB}$ bandwidth	Pass
	CH40			

Note:

We have tested all mode at high, middle and low channel, and recorded worst case at middle

Test plot as follows:

GFSK Modulation

 $\pi/4$ DQPSK Modulation

8DPSK Modulation



3.6. Number of hopping frequency

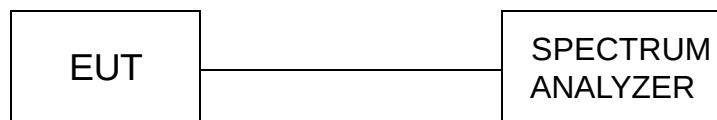
Limit

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. Set spectrum analyzer start 2400MHz to 2483.5MHz with 100 KHz RBW and 300 KHz VBW.

Test Configuration

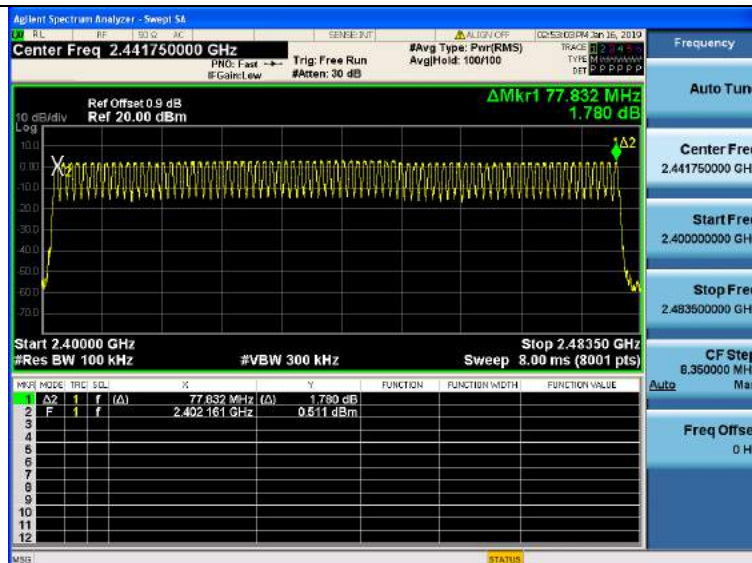
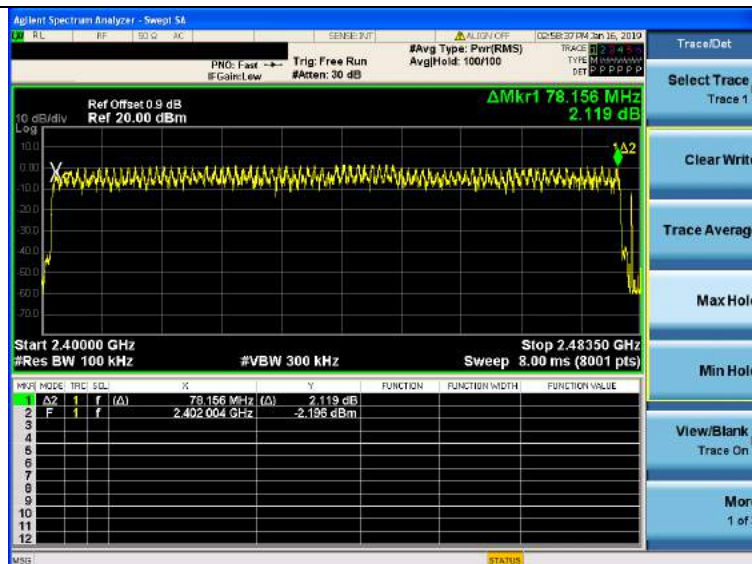


Test Results

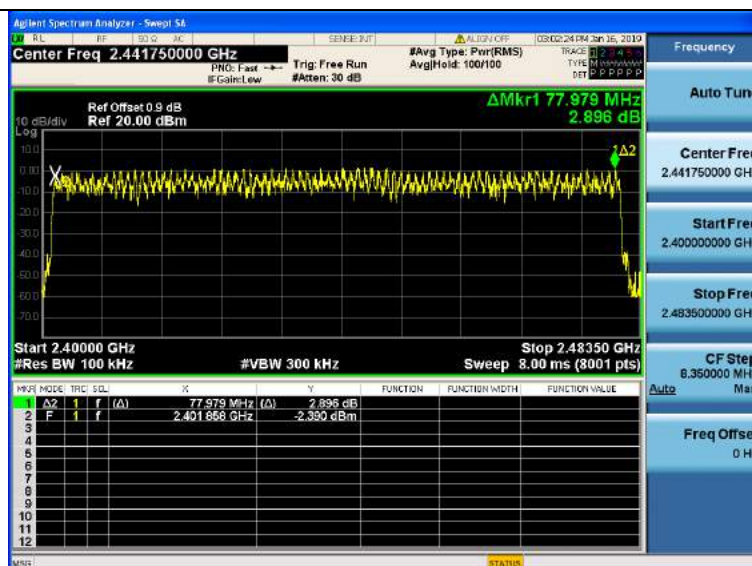
Modulation	Number of Hopping Channel	Limit	Result
GFSK	79	≥15	Pass
$\pi/4$ DQPSK	79		
8DPSK	79		

Test plot as follows:

GFSK Modulation

 $\pi/4$ DQPSK Modulation

8DPSK Modulation



3.7. Time of Occupancy (Dwell Time)

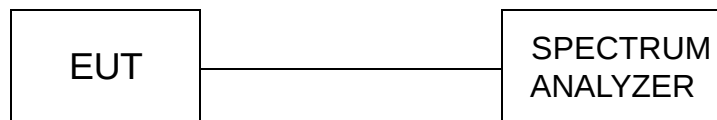
Limit

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with 1MHz RBW and 1MHz VBW, Span 0Hz.

Test Configuration



Test Results

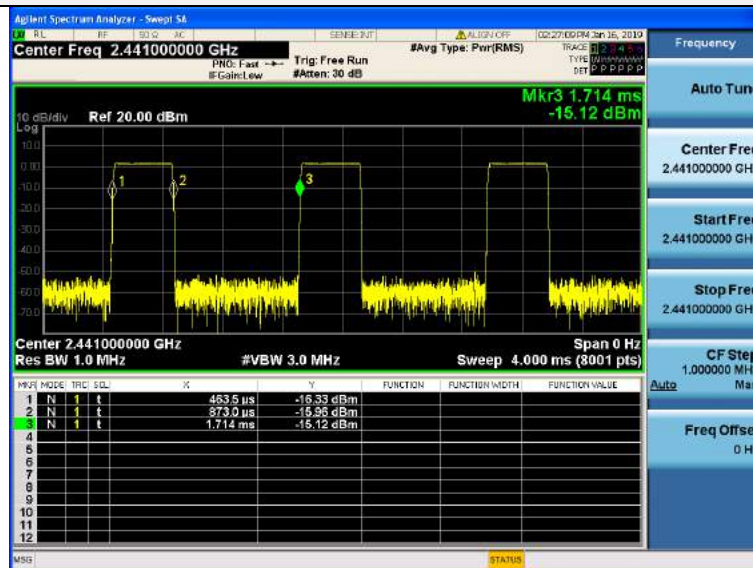
Modulation	Packet	Pulse time (ms)	Dwell time (ms)	Limit (s)	Result
GFSK	DH1	0.410	131.20	0.40	Pass
	DH3	1.665	266.40		
	DH5	2.911	310.51		
π/4DQPSK	2-DH1	0.421	134.72	0.40	Pass
	2-DH3	1.672	267.52		
	2-DH5	2.919	311.36		
8DPSK	3-DH1	0.421	134.72	0.40	Pass
	3-DH3	1.670	267.20		
	3-DH5	2.921	311.57		

Note:

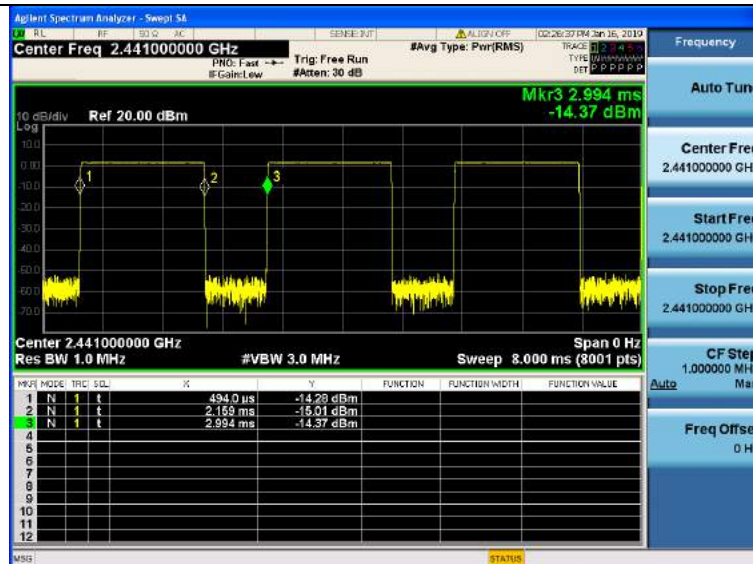
- We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.
- $\text{Dwell time} = \text{Pulse time (ms)} \times (1600 \div 2 \div 79) \times 31.6$ Second for DH1, 2-DH1, 3-DH1
 $\text{Dwell time} = \text{Pulse time (ms)} \times (1600 \div 4 \div 79) \times 31.6$ Second for DH3, 2-DH3, 3-DH3
 $\text{Dwell time} = \text{Pulse time (ms)} \times (1600 \div 6 \div 79) \times 31.6$ Second for DH5, 2-DH5, 3-DH5

Test plot as follows:

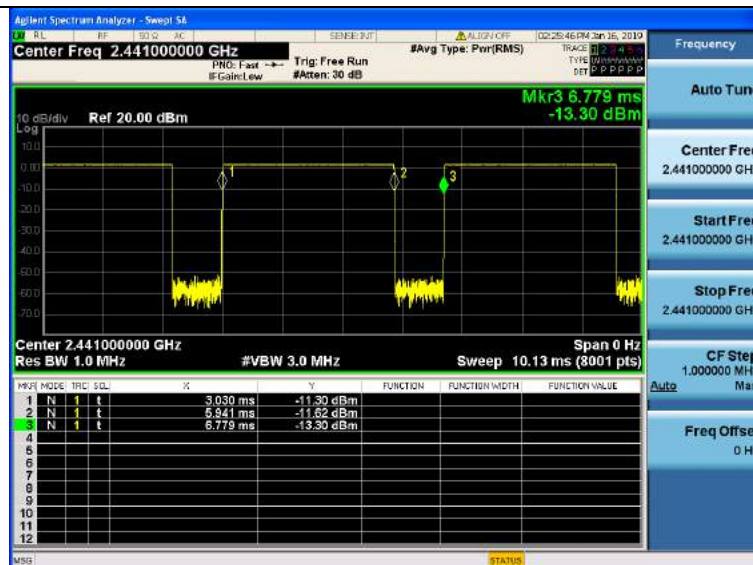
GFSK Modulation



DH1

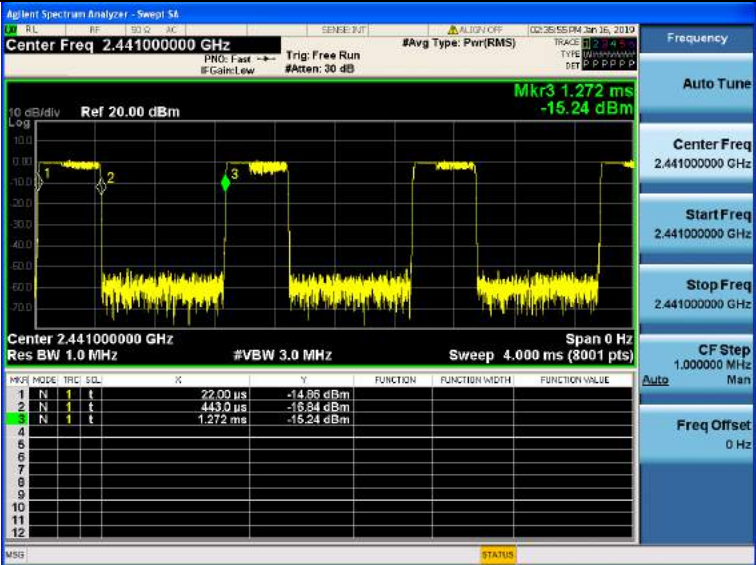


DH3

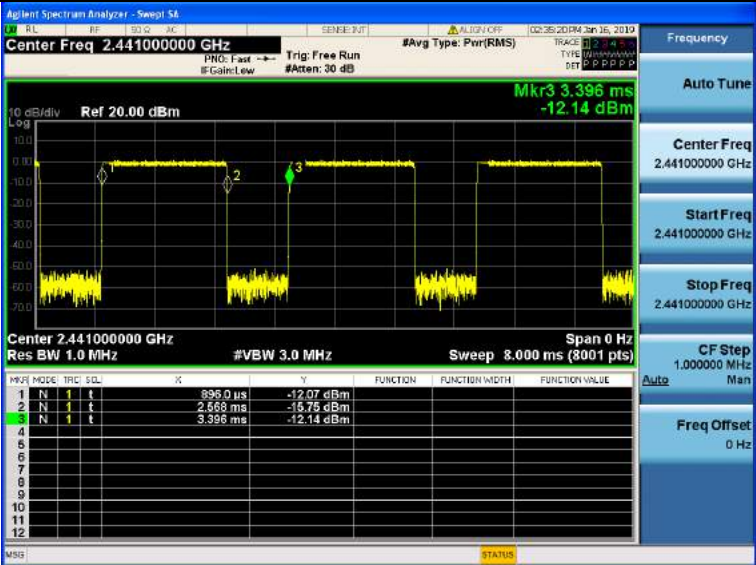


DH5

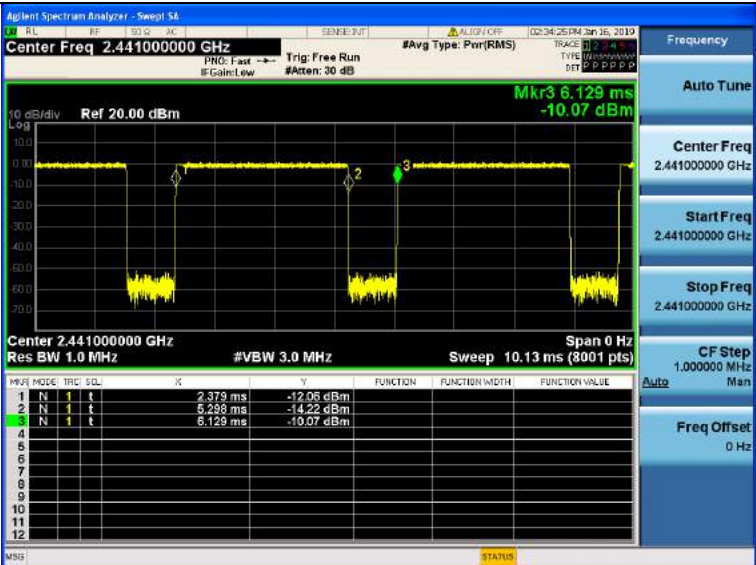
$\pi/4$ DQPSK Modulation



2-DH1

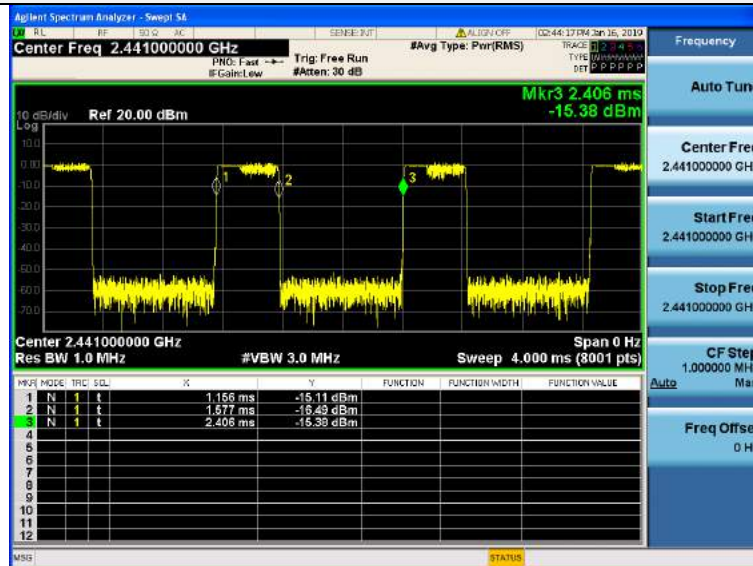


2-DH3

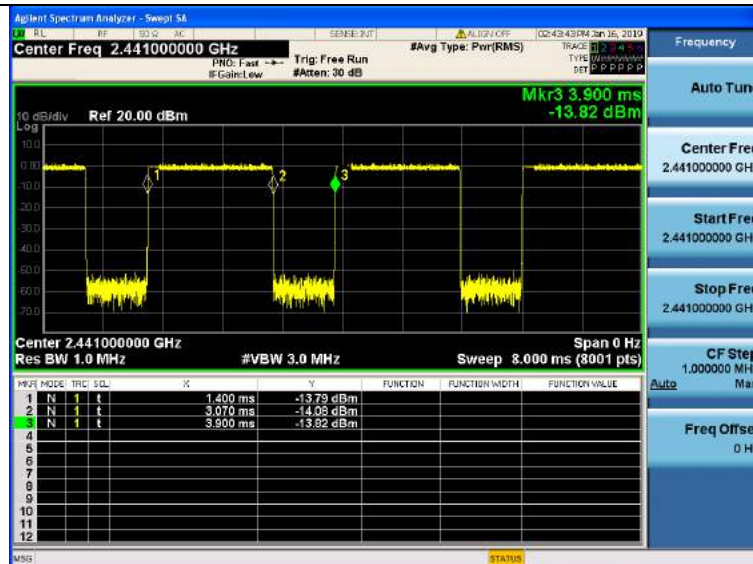


2-DH5

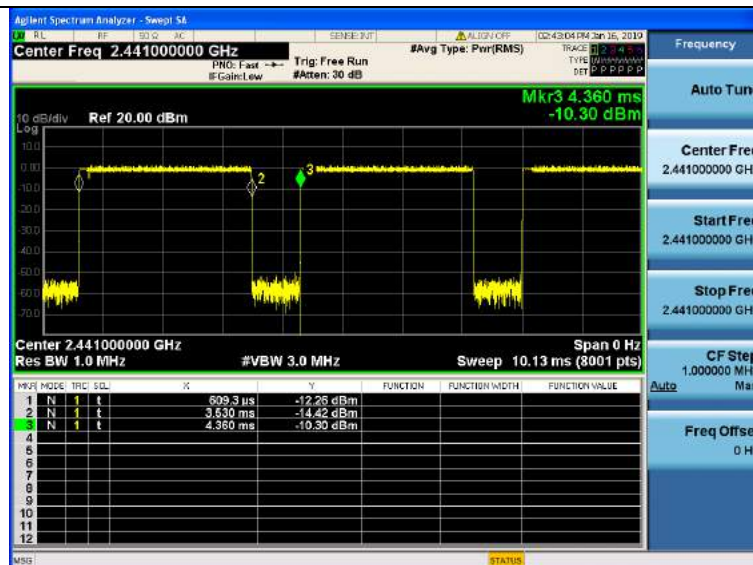
8DPSK Modulation



3-DH1



3-DH3



3-DH5

3.8. Out-of-band Emissions

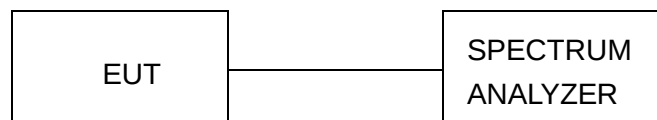
Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section (b)(3) of §15.247 and RSS 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in §15.209(a) and RSS-Gen are not required.

Test Procedure

Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector , and max hold. Measurements utilizing these setting are made of the in-band reference level, bandedge and out-of-band emissions.

Test Configuration



Test Results

Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandage measurement data.

We measured all conditions (DH1, DH3, DH5) and recorded worst case at DH5

Test plot as follows:

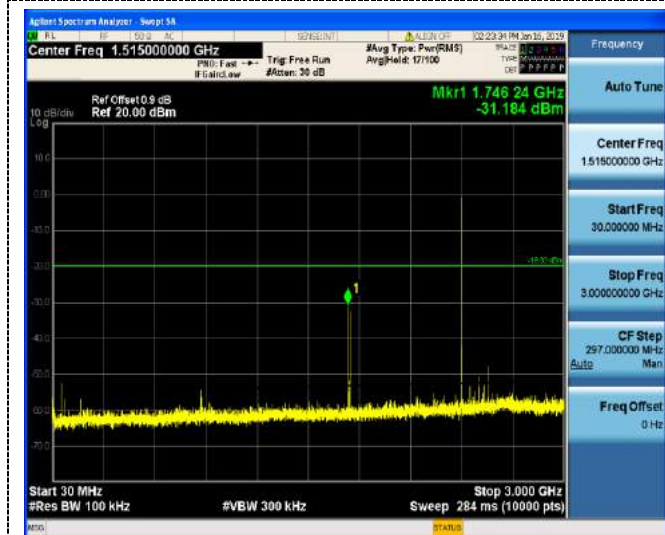
GFSK CH00



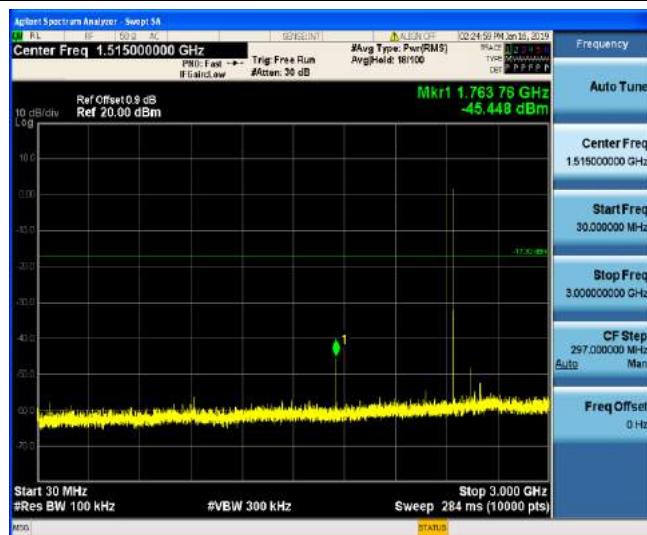
GFSK CH39



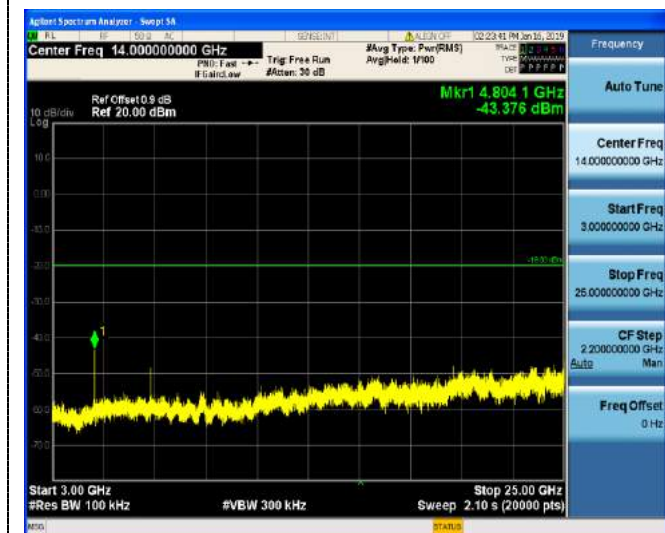
Reference



Reference



30MHz-3GHz



30MHz-3GHz



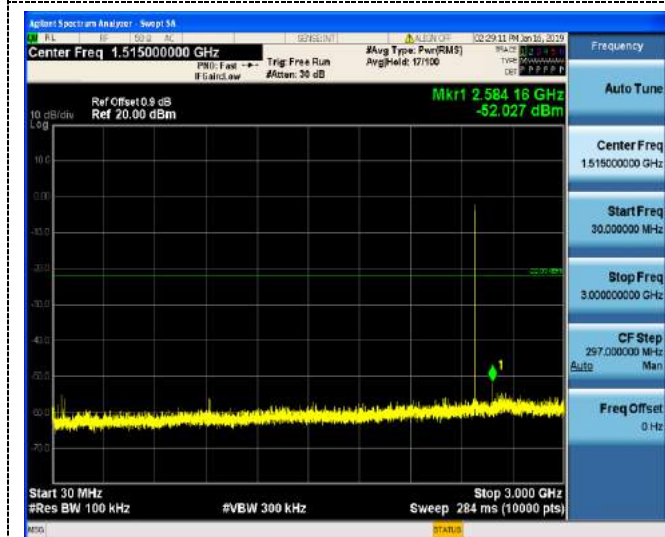
3GHz-25GHz

3GHz-25GHz

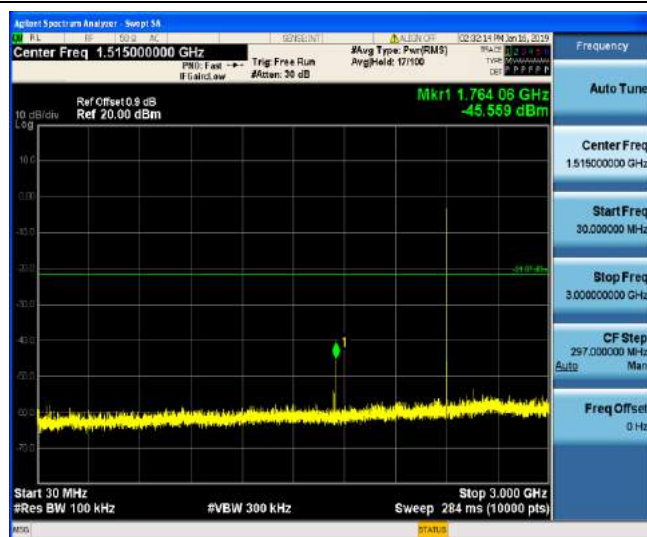
GFSK CH78

 $\pi/4$ QPSK CH01

Reference



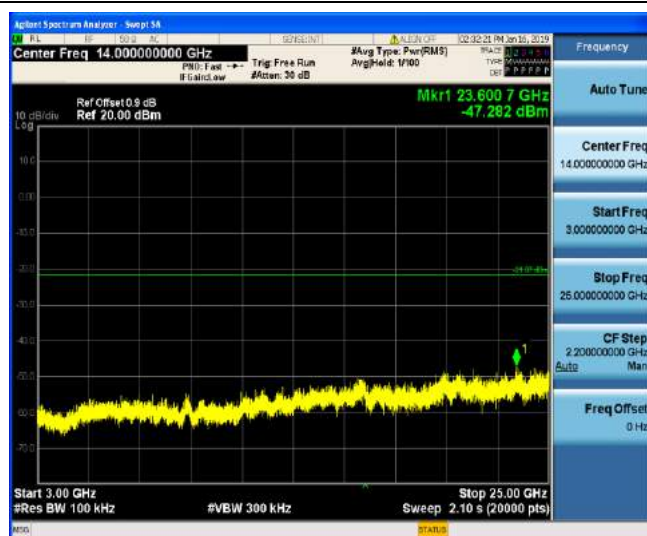
Reference



30MHz-3GHz



30MHz-3GHz

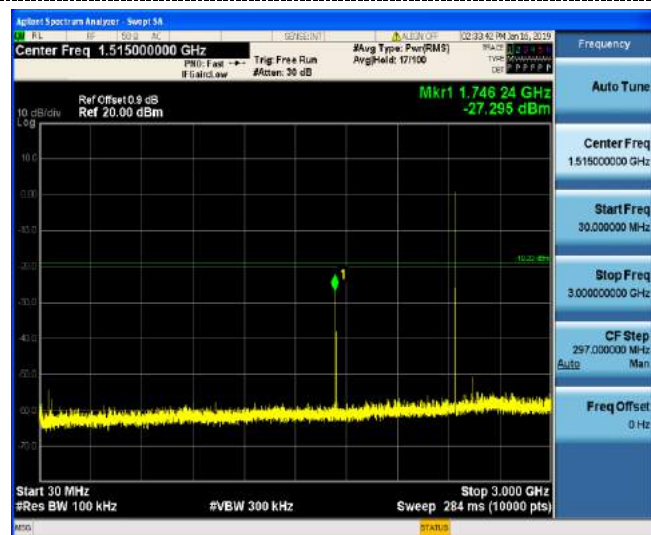


3GHz-25GHz

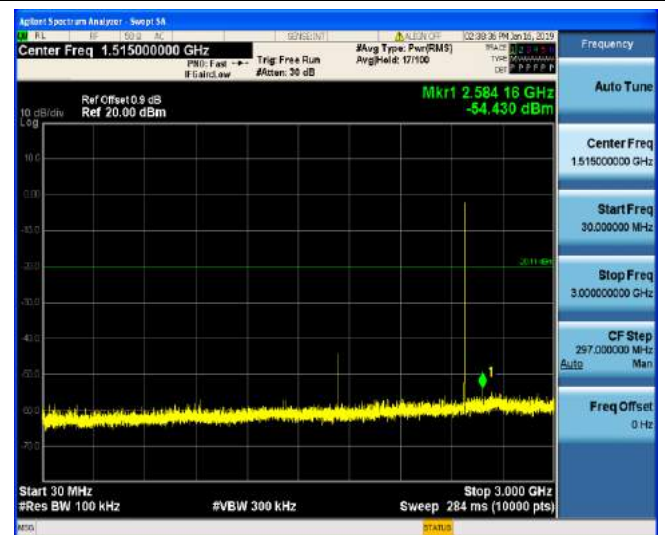
3GHz-25GHz

$\pi/4$ DQPSK CH39 $\pi/4$ DQPSK CH78

Reference



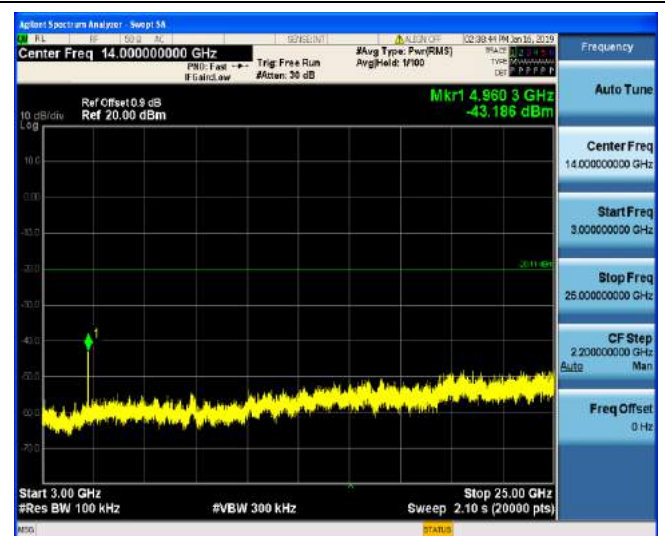
Reference



30MHz-3GHz



30MHz-3GHz



3GHz-25GHz

3GHz-25GHz

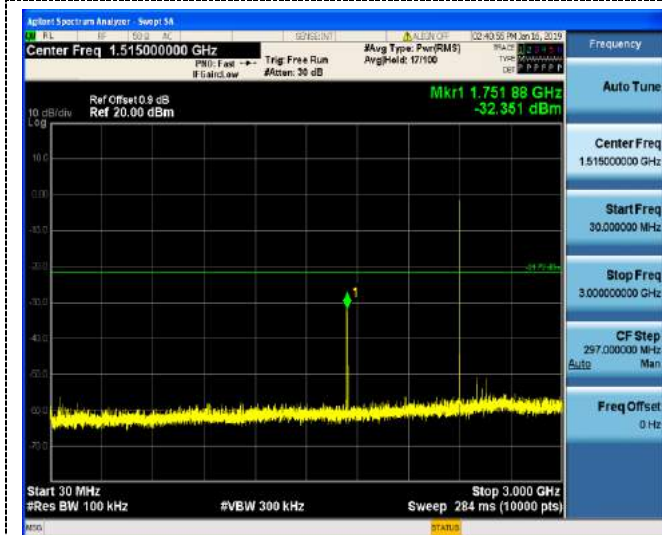
8DPSK CH00



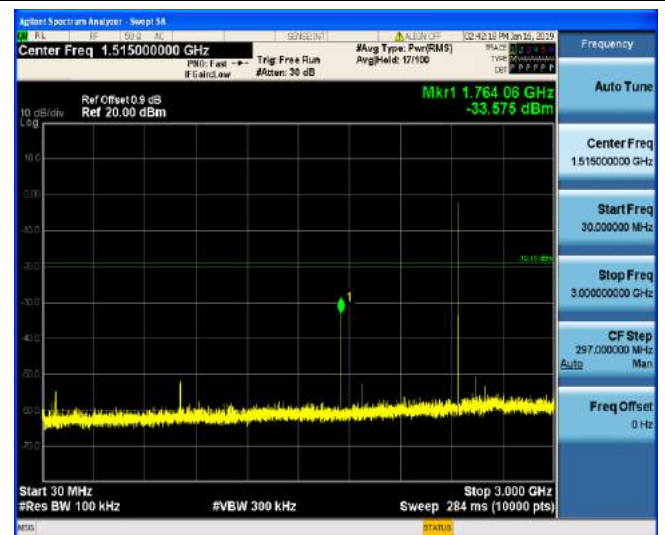
8DPSK CH39



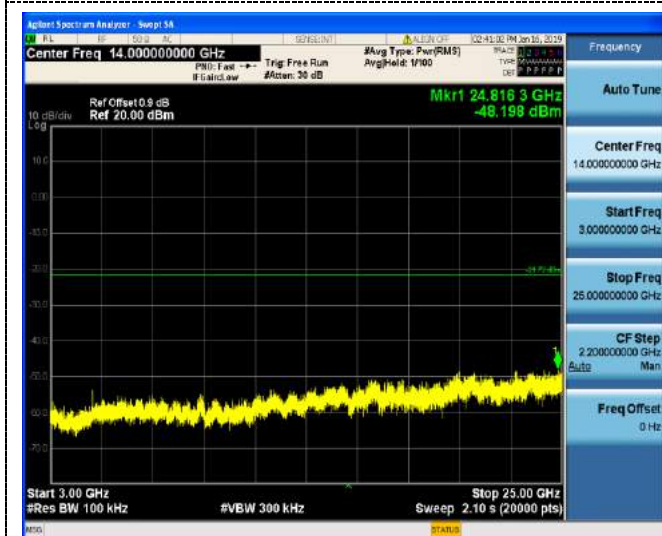
Reference



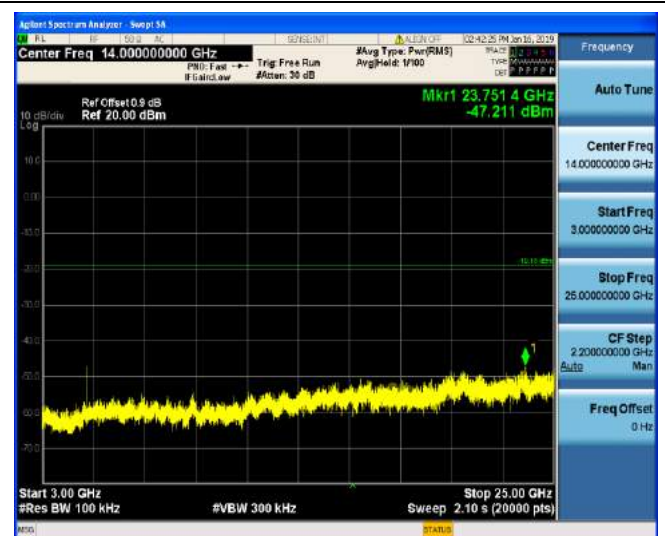
Reference



30MHz-3GHz

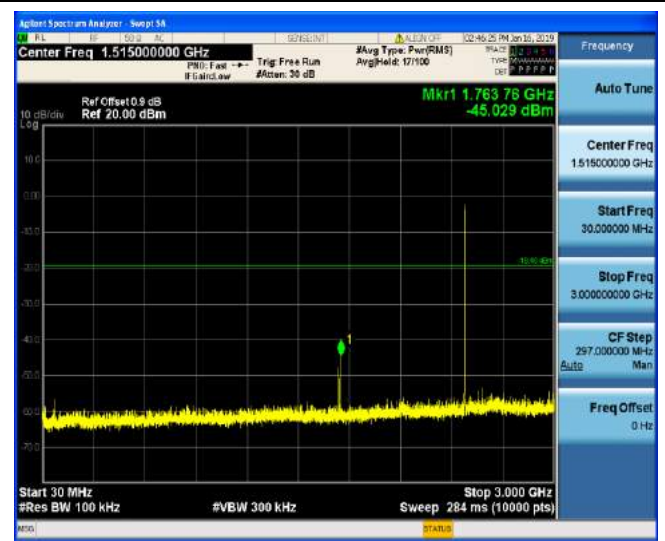


30MHz-3GHz



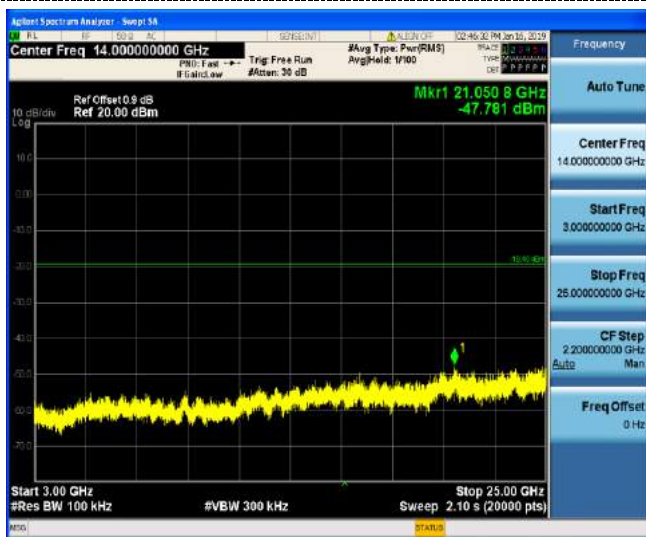
3GHz-25GHz

3GHz-25GHz

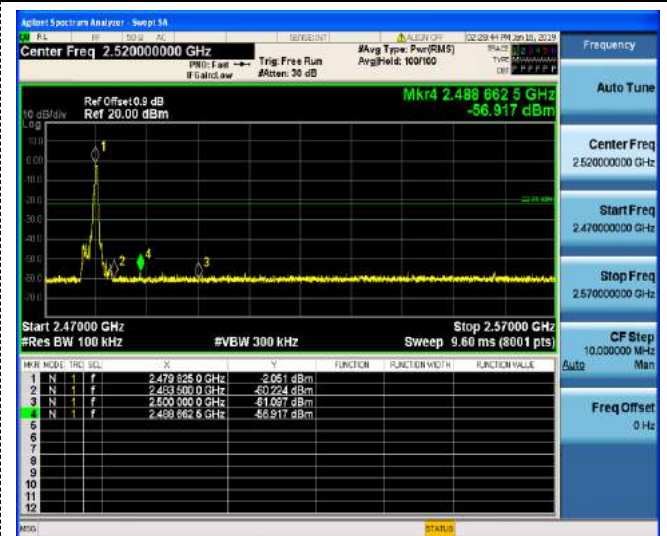
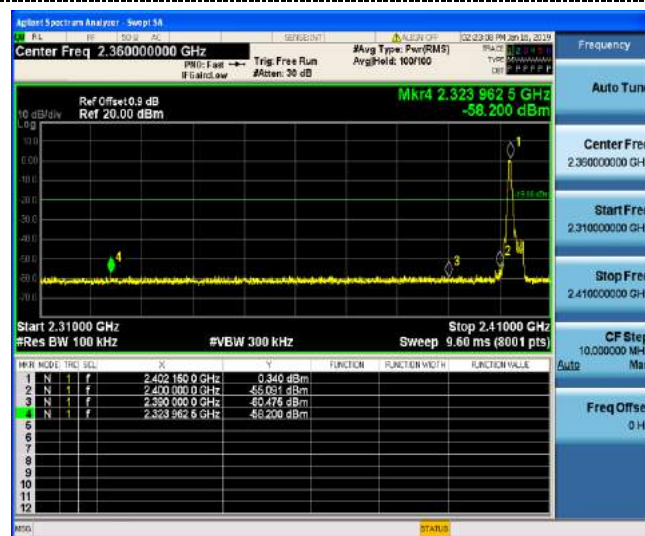
8DPSK CH78

Reference

30MHz-3GHz

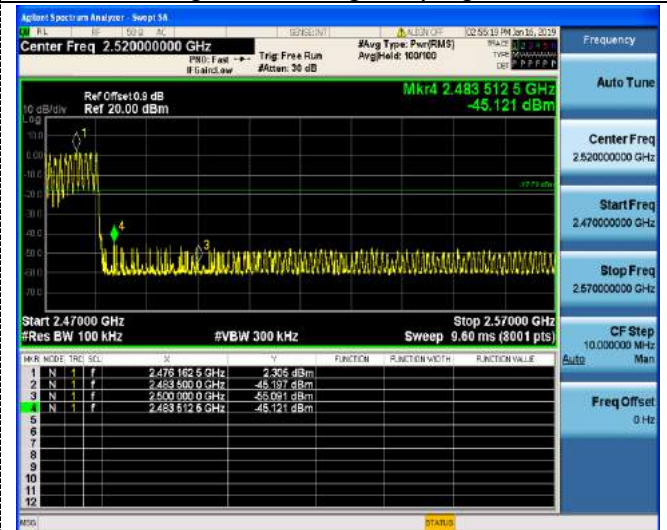
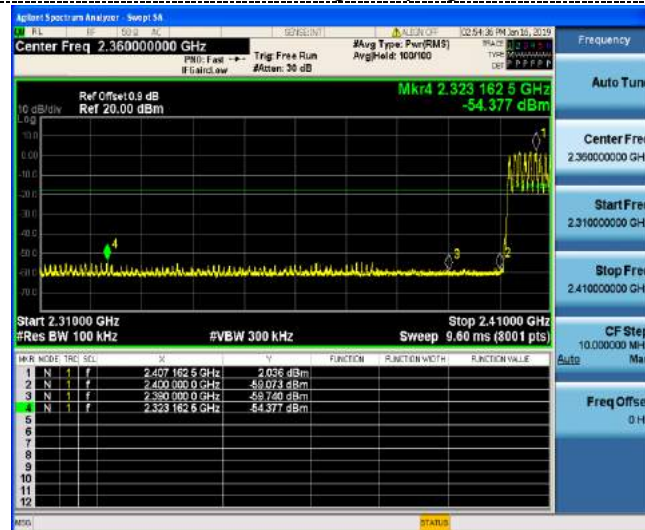


3GHz-25GHz

Band-edge Measurements for RF Conducted Emissions:**GFSK**

Left Band edge hopping off

Right Band edge hopping off

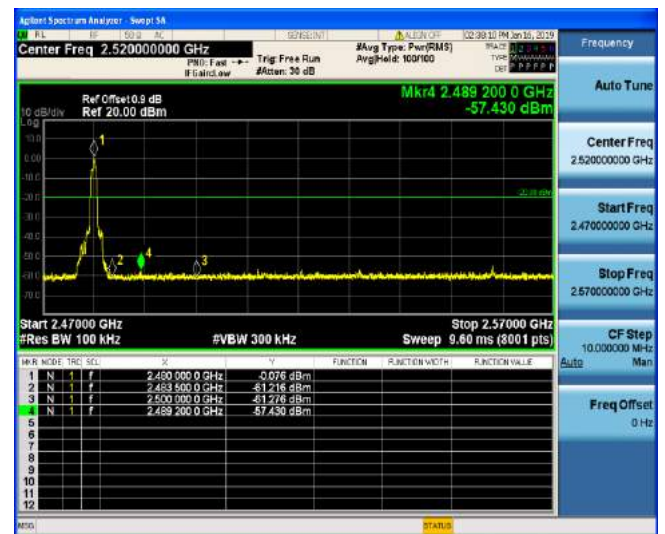


Left Band edge hopping on

Right Band edge hopping on

$\pi/4$ DQPSK

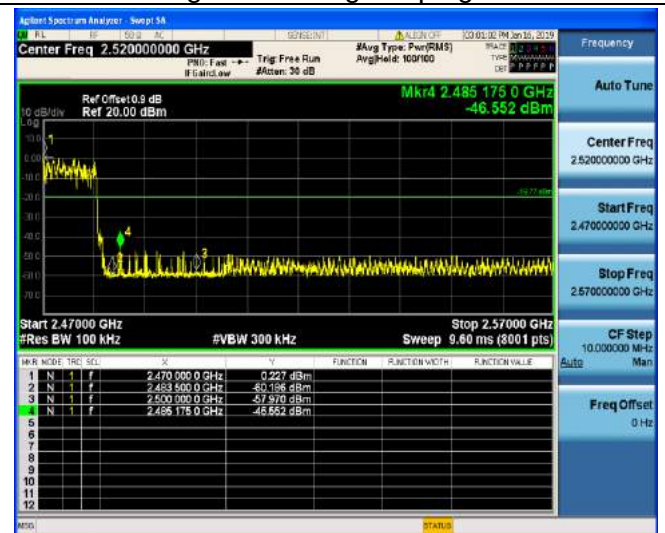
Left Band edge hopping off



Right Band edge hopping off

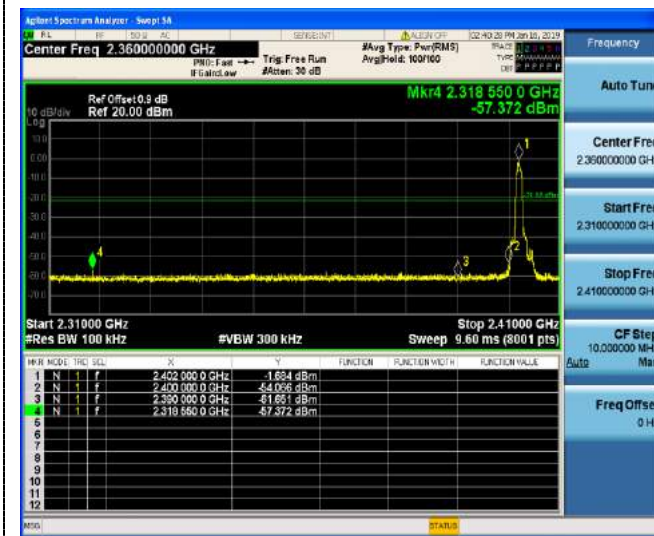


Left Band edge hopping on

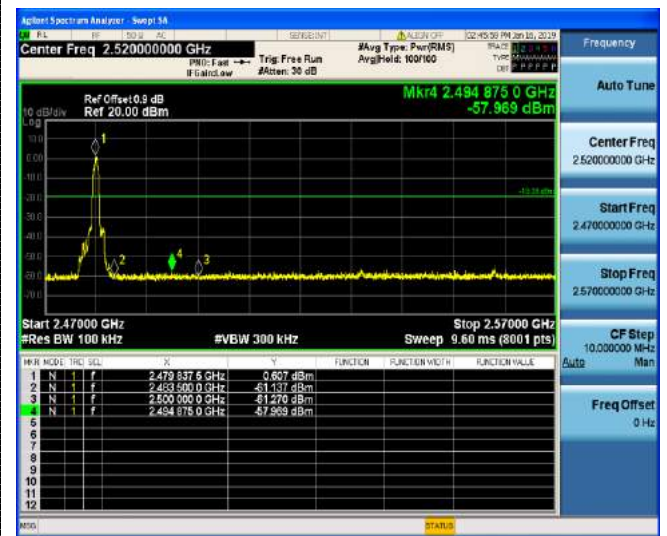


Right Band edge hopping on

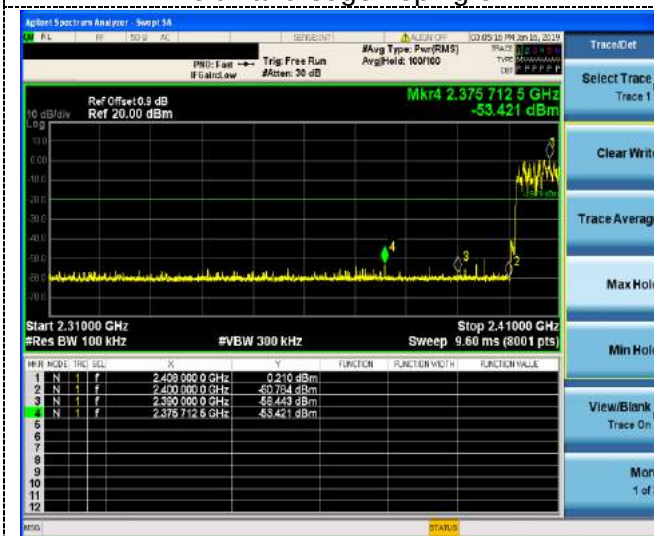
8DPSK



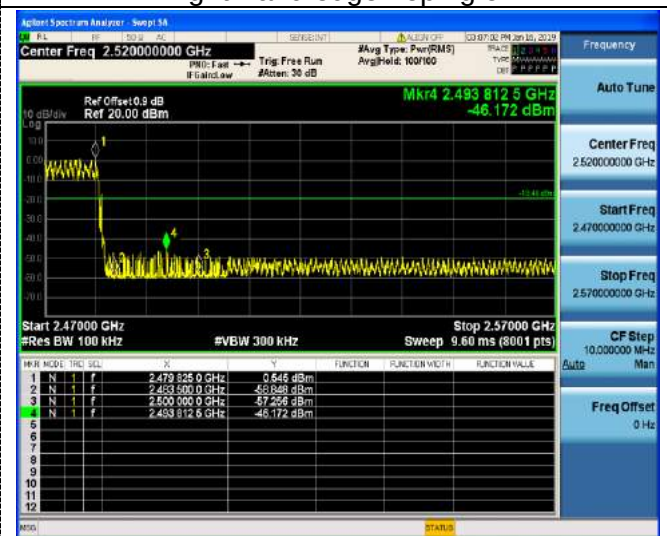
Left Band edge hopping off



Right Band edge hopping off



Left Band edge hopping on



Right Band edge hopping on

3.9. Pseudorandom Frequency Hopping Sequence

TEST APPLICABLE

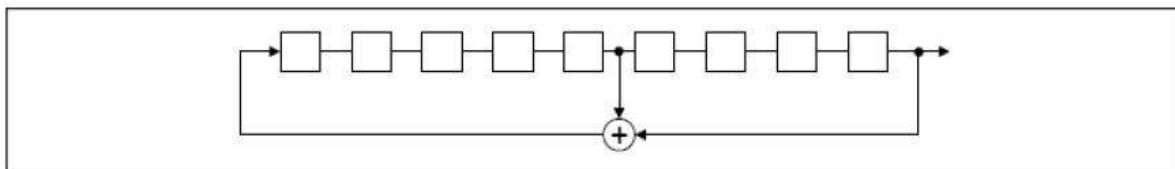
For 47 CFR Part 15C section 15.247 (a) (1) requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

EUT Pseudorandom Frequency Hopping Sequence Requirement

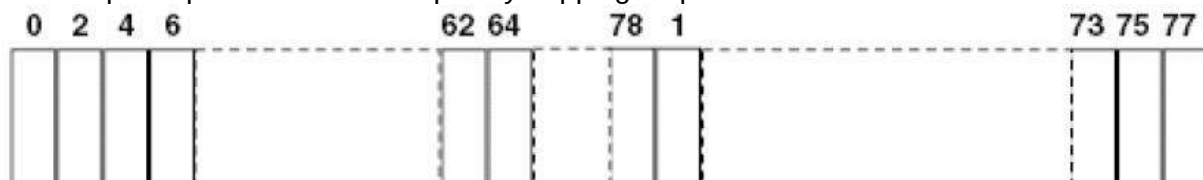
The pseudorandom frequency hopping sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones, for example: the shift register is initialized with nine ones.

- Number of shift register stages:9
- Length of pseudo-random sequence:29-1=511 bits
- Longest sequence of zeros:8(non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of pseudorandom frequency hopping sequence as follows:



Each frequency used equally one the average by each transmitter.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.

3.10. Antenna Requirement

Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to FCC 47 CFR Section 15.247 (c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

According to RSS-GEN Section 6.7:

As per RSP-100, each applicant for equipment certification must provide a list of all antenna types that maybe used with the transmitter, indicating the maximum permissible antenna gain (in dBi).

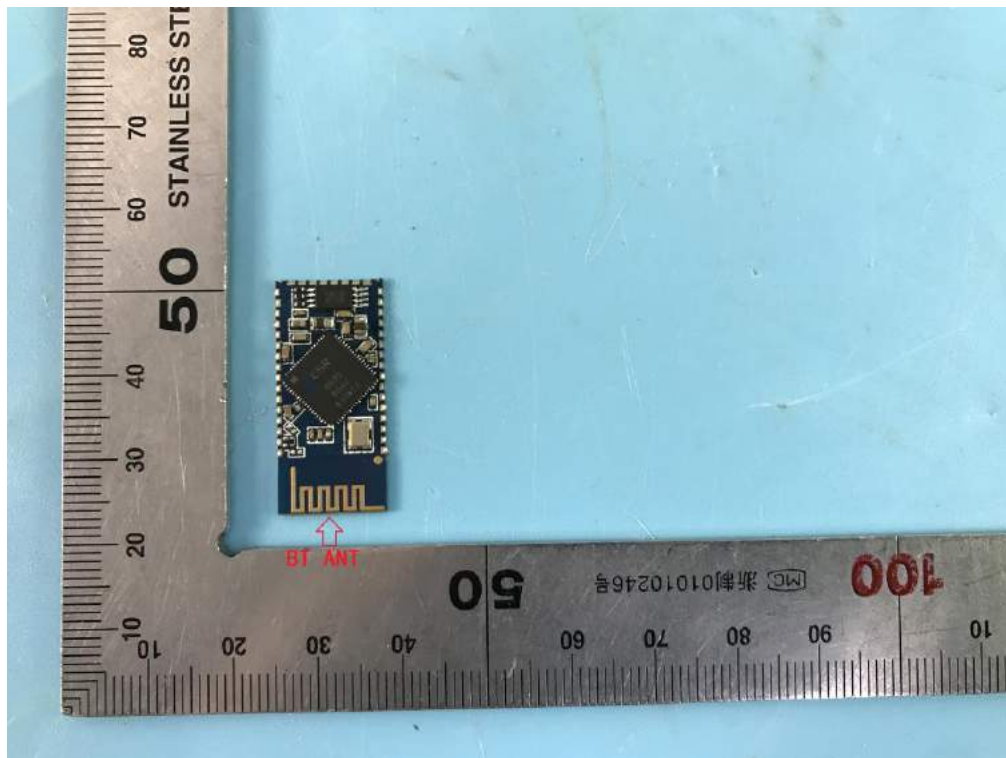
When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer. The test report shall state the RF power, output power setting and spurious emission measurements, including the antenna type used.

Refer to statement below for compliance

The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

Antenna Connected Construction

The maximum gain of antenna was 0dBi.



4. Test Setup Photos of the EUT



***** End of Report *****