



**Shenzhen Global Test Service Co.,Ltd.**

No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

## FCC PART 15 SUBPART C TEST REPORT

### FCC PART 15.247

**Report Reference No.**.....: **GTS20190329001-1-37**

**FCC ID**..... : **2AQAA-EZBOXZ8**

Compiled by

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Date of issue.....: Jun. 18, 2019

**Representative Laboratory Name .:** **Shenzhen Global Test Service Co.,Ltd.**

Address.....: No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

**Applicant's name**.....: **SHENZHEN JUMPER TECHNOLOGY CO.,LTD**

Address .....: 101,102,201,301 No.13-2 Pingxi South Rd.,Pingxi Community,Pingdi Street,Longgang District, Shenzhen, China

**Test specification** .....

Standard.....: **FCC Part 15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz**

TRF Originator.....: Shenzhen Global Test Service Co.,Ltd.

Master TRF.....: Dated 2014-12

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**Test item description** .....

Trade Mark .....

Manufacturer .....

Model/Type reference.....

Listed Models .....

Modulation Type .....

Operation Frequency.....

Hardware Version .....

Software Version .....

Rating .....

Result.....: **PASS**

# TEST REPORT

<b>Test Report No. :</b>	<b>GTS20190329001-1-37</b>	Jun. 18, 2019
		Date of issue

Equipment under Test : MINI PC

Model /Type : EZbox Z8

Listed Models : N/A

**Applicant** : SHENZHEN JUMPER TECHNOLOGY CO.,LTD

Address : 101,102,201,301 No.13-2 Pingxi South Rd.,Pingxi Community,Pingdi Street,Longgang District, Shenzhen, China

**Manufacturer** : SHENZHEN JUMPER TECHNOLOGY CO.,LTD

Address : 101,102,201,301 No.13-2 Pingxi South Rd.,Pingxi Community,Pingdi Street,Longgang District, Shenzhen, China

<b>Test Result:</b>	<b>PASS</b>
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The test report merely corresponds to the test sample.  
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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## 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.

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

[KDB558074 D01 v05r02](#): Guidance for Compliance Measurements on Digital Transmission Systems (DTS) ,Frequency Hopping Spread Spectrum System(HFSS), and Hybrid System Devices Operating Under §15.247 of The FCC rules.

## 2. SUMMARY

### 2.1. General Remarks

Date of receipt of test sample	:	May. 12, 2019
Testing commenced on	:	May. 28, 2019
Testing concluded on	:	Jun. 18, 2019

### 2.2. Product Description

Product Name:	<b>MINI PC</b>
Trade Mark:	/
Model/Type reference:	EZbox Z8
Antenna Type	FPC antenna
Power supply:	DC 12V from adapter
Adapter information:	Model: JHD-AP024U-120200BA-A Input: AC 100-240V~50/60Hz 0.45A Output:DC 12V/2A
<b>WIFI</b>	
WLAN	Supported 802.11 a/b/g/n
Modulation Type	IEEE 802.11a: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK,BPSK) IEEE 802.11n HT40: OFDM (64QAM, 16QAM, QPSK,BPSK)
Operation frequency	IEEE 802.11a:5180-5240MHz,5745-5825MHz IEEE 802.11b:2412-2472MHz IEEE 802.11g:2412-2472MHz IEEE 802.11n HT20:2412-2472MHz, 5180-5240MHz,5745-5825MHz IEEE 802.11n HT40:2422-2462MHz, 5190-5230MHz,5755-5795MHz
Antenna gain	1.82dBi for 2.4G WIFI/1.23dBi for 5G WIFI
<b>BT/EDR</b>	
Modulation Type	GFSK,8DPSK, $\pi/4$ -DQPSK
Operation frequency	2402-2480MHz
Antenna gain	1.82dBi Max
<b>BLE</b>	
Modulation Type	GFSK
Operation frequency	2402-2480MHz
Antenna gain	1.82dBi Max

### 2.3. Equipment Under Test

#### Power supply system utilised

Power supply voltage	:	<input type="radio"/> 230V / 50 Hz	<input type="radio"/> 120V / 60Hz
		<input type="radio"/> 12 V DC	<input type="radio"/> 24 V DC
		<input checked="" type="radio"/> Other (specified in blank below)	

DC 12V from adapter

### 2.4. Short description of the Equipment under Test (EUT)

This is a MINI PC

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

### 2.5. EUT operation mode

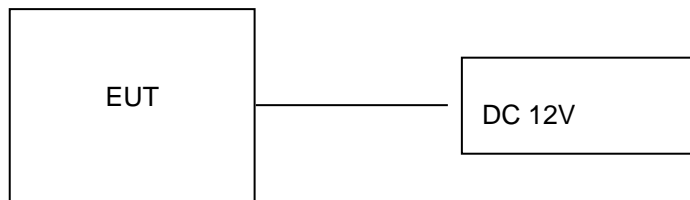
The Applicant provides communication tools software to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing .There are 79 channels provided to the EUT.

Channel 00/38/78 was selected to test.

Channel	Frequency(MHz)	Channel	Frequency(MHz)
00	2402	40	2442
01	2403	41	2443
02	2404	42	2444
03	2405	43	2445
04	2406	44	2446
05	2407	45	2447
06	2408	46	2448
07	2409	47	2449
08	2410	48	2450
09	2411	49	2451
10	2412	50	2452
11	2413	51	2453
12	2414	52	2454
13	2415	53	2455
14	2416	54	2456
15	2417	55	2457
16	2418	56	2458
17	2419	57	2459
18	2420	58	2460
19	2421	59	2461
20	2422	60	2462
21	2423	61	2463
22	2424	62	2464
23	2425	63	2465
24	2426	64	2466
25	2427	65	2467
26	2428	66	2468
27	2429	67	2469
28	2430	68	2470
29	2431	69	2471
30	2432	70	2472
31	2433	71	2473
32	2434	72	2474
33	2435	73	2475

34	2436	74	2476
35	2437	75	2477
36	2438	76	2478
37	2439	77	2479
<b>38</b>	2440	<b>78</b>	<b>2480</b>
39	<b>2441</b>		

**2.6. Block Diagram of Test Setup**



**2.7. Related Submittal(s) / Grant (s)**

This submittal(s) (test report) is intended for **FCC ID: 2AQAA-EZBOXZ8** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

**2.8. Special Accessories**

Manufacturer	Description	Model	Serial Number	Certificate
AOC	HDMI display	Satellite S40Dt-A	D26T	DOC

**2.9. Modifications**

No modifications were implemented to meet testing criteria.

### **3. TEST ENVIRONMENT**

#### **3.1. Address of the test laboratory**

**Shenzhen Global Test Service Co.,Ltd.**

No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

#### **3.2. Test Facility**

The test facility is recognized, certified, or accredited by the following organizations:

CNAS (No. CNAS L8169)

Shenzhen Global Test Service Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2019 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA (Certificate No. 4758.01)

Shenzhen Global Test Service Co., Ltd. has been assessed by the American Association for Laboratory Accreditation (A2LA). Certificate No. 4758.01.

#### **3.3. Environmental conditions**

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

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	950-1050mbar



## 3.4. Summary of measurement results

Test Specification clause	Test case	Test Mode	Test Channel	Recorded In Report		Pass	Fail	NA	NP	Remark
§15.247(b)(4)	Antenna gain	GFSK	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	GFSK	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(e)	Power spectral density	-/-	-/-	-/-	-/-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Not applicable for FHSS
§15.247(a)(1)	Carrier Frequency separation	GFSK π/4DQPSK 8DPSK	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	GFSK π/4DQPSK 8DPSK	<input checked="" type="checkbox"/> Middle	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(a)(1)	Number of Hopping channels	GFSK π/4DQPSK 8DPSK	<input checked="" type="checkbox"/> Full	GFSK π/4DQPSK 8DPSK	<input checked="" type="checkbox"/> Full	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(a)(1)	Time of Occupancy (dwell time)	GFSK π/4DQPSK 8DPSK	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	GFSK π/4DQPSK 8DPSK	<input checked="" type="checkbox"/> Middle	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(a)(1)	Spectrum bandwidth of a FHSS system 20dB bandwidth	GFSK π/4DQPSK 8DPSK	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	GFSK π/4DQPSK 8DPSK	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(b)(1)	Maximum output power	GFSK π/4DQPSK 8DPSK	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	GFSK π/4DQPSK 8DPSK	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(d)	Band edge compliance conducted	GFSK π/4DQPSK 8DPSK	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Highest	GFSK π/4DQPSK 8DPSK	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Highest	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.205	Band edge compliance radiated	GFSK π/4DQPSK 8DPSK	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Highest	GFSK	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Highest	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(d)	TX spurious emissions conducted	-/-	-/-	-/-	-/-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(d)	TX spurious emissions radiated	GFSK 8DPSK	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	GFSK	<input checked="" type="checkbox"/> Lowest <input checked="" type="checkbox"/> Middle <input checked="" type="checkbox"/> Highest	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.109	RX spurious emissions radiated	-/-	-/-	-/-	-/-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	complies
§15.209(a)	TX spurious Emissions radiated < 30 MHz	-/-	-/-	-/-	-/-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.107(a) §15.207	Conducted Emissions < 30 MHz	GFSK	-/-	GFSK	-/-	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies

## Remark:

1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed
3. We tested all test mode and recorded worst case in report
4. For π/4 QPSK its same modulation type with 8-DPSK, and based exploratory test, there is no significant difference of that two types test result, so except output power, all other items final test were only performed with the worse case 8-DPSK and GFSK.

### 3.5. 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 Global Test Service 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.

Hereafter the best measurement capability for Shenzhen GTS laboratory is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.10 dB	(1)
Radiated Emission	1~18GHz	4.32 dB	(1)
Radiated Emission	18-40GHz	5.54 dB	(1)
Conducted Disturbance	0.15~30MHz	3.12 dB	(1)

- (1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

### 3.6. Equipments Used during the Test

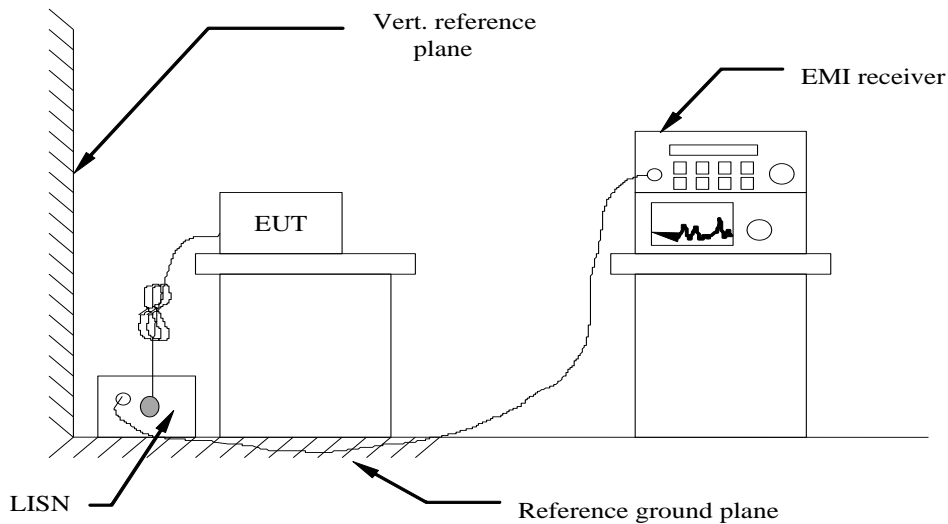
Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.08	2018/09/28	2019/09/27
LISN	R&S	ESH2-Z5	893606/008	2018/09/27	2019/09/26
By-log Antenna	SCHWARZBECK	VULB9163	000976	2018/09/29	2019/09/28
EMI Test Receiver	R&S	ESCI	101102	2018/09/26	2019/09/25
Spectrum Analyzer	Agilent	N9020A	MY48010425	2018/09/17	2019/09/16
Spectrum Analyzer	R&S	FSV40-N	101800	2018/09/17	2019/09/16
Controller	EM Electronics	Controller EM 1000	N/A	2018/09/21	2019/09/20
Double Ridged Horn Antenna (1~18GHz)	SCHWARZBECK	BBHA 9120D	01622	2018/09/19	2019/09/18
Double Ridged Horn Antenna	Rohde&Schwarz	HF907	100265	2018/09/19	2019/09/18
Active Loop Antenna	SCHWARZBECK	FMZB1519	1519-037	2018/09/19	2019/09/18
Horn Antenna (18GHz~40GHz)	ETS	3116	00086467	2018/12/29	2019/12/28
Amplifier (26.5GHz~40GHz)	EMCI	EMC2654045	980028	2018/09/18	2019/09/17
Amplifier (0.1GHz~26.5GHz)	EMCI	EMC012645SE	980355	2018/09/19	2019/09/18
Temperature/Humidity Meter	Gangxing	CTH-608	02	2018/09/20	2019/09/19
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	N/A	2018/09/20	2019/09/19
High-Pass Filter	K&L	41H10-1375/U12750-O/O	N/A	2018/09/20	2019/09/19
Data acquisition card	Agilent	U2531A	TW53323507	2018/09/20	2019/09/19
Power Sensor	Agilent	U2021XA	MY5365004	2018/09/20	2019/09/19
RF Cable	HUBER+SUHNER	RG214	N/A	2018/09/20	2019/09/19
Conducted Emission Test Software	ES-K1	V1.71	N/A	N/A	N/A
Radiated Emission Test Software	JS32-RE	V2.5.0.9	N/A	N/A	N/A

Note: The Cal.Interval was one year.

## 4. TEST CONDITIONS AND RESULTS

### 4.1. AC Power Conducted Emission

#### 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 EUT received DC 5V power, the adapter received AC120V/60Hz or AC 240V/50Hz 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.

#### AC Power Conducted Emission Limit

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following :

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 RESULTS

Remark: We measured Conducted Emission at GFSK,  $\pi/4$  DQPSK and 8DPSK mode in AC 120V/60Hz and AC 240V/50Hz, the worst case was recorded .

Power supply:

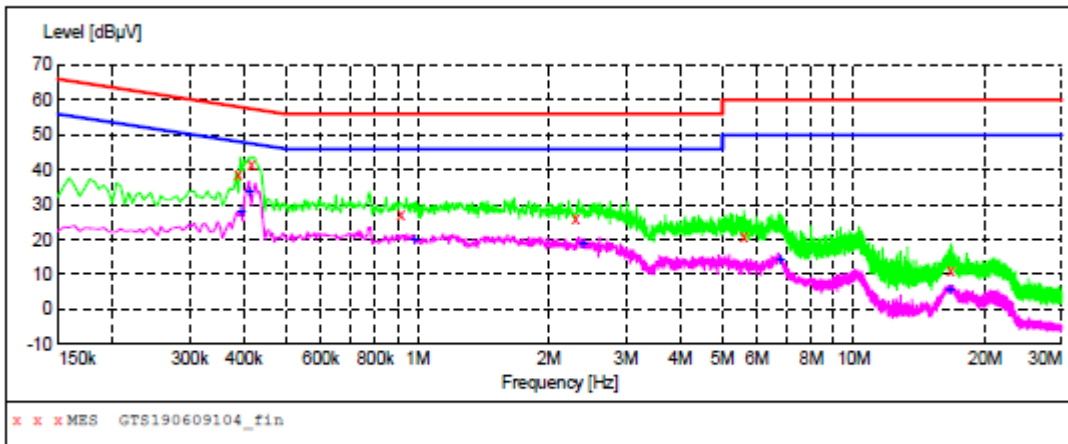
AC 120V/60Hz

Polarization

L

**SCAN TABLE: "Voltage (9K-30M)FIN"**

Short Description: 150K-30M Voltage



**MEASUREMENT RESULT: "GTS190609104\_fin"**

6/6/2019 9:02AM

Frequency MHz	Level dBuV	Transd dB	Limit dBuV	Margin dB	Detector	Line	PE
0.388500	38.40	9.8	58	19.7	QP	L1	GND
0.415500	41.70	9.8	58	15.8	QP	L1	GND
0.915000	27.30	9.6	56	28.7	QP	L1	GND
2.305500	25.90	9.5	56	30.1	QP	L1	GND
5.599500	21.10	9.2	60	38.9	QP	L1	GND
16.732500	11.20	7.7	60	48.8	QP	L1	GND

**MEASUREMENT RESULT: "GTS190609104\_fin2"**

6/6/2019 9:02AM

Frequency MHz	Level dBuV	Transd dB	Limit dBuV	Margin dB	Detector	Line	PE
0.393000	28.20	9.8	48	19.8	AV	L1	GND
0.411000	33.90	9.8	48	13.7	AV	L1	GND
0.982500	20.40	9.6	46	25.6	AV	L1	GND
2.391000	19.40	9.5	46	26.6	AV	L1	GND
6.774000	14.50	9.1	50	35.5	AV	L1	GND
16.588500	5.80	7.8	50	44.2	AV	L1	GND

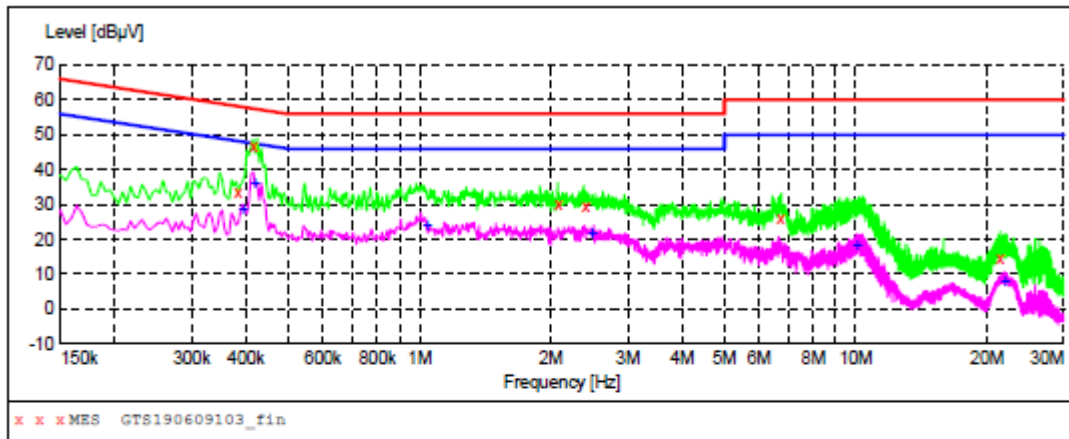
Power supply:

AC 120V/60Hz

Polarization

N

**SCAN TABLE: "Voltage (9K-30M)FIN"**  
 Short Description: 150K-30M Voltage



**MEASUREMENT RESULT: "GTS190609103\_fin"**

6/6/2019 8:59AM

Frequency MHz	Level dBuV	Transd dB	Limit dBuV	Margin dB	Detector	Line	PE
0.384000	33.40	9.8	58	24.8	QP	N	GND
0.415500	46.70	9.8	58	10.8	QP	N	GND
2.080500	29.80	9.5	56	26.2	QP	N	GND
2.409000	29.40	9.5	56	26.6	QP	N	GND
6.724500	25.90	9.1	60	34.1	QP	N	GND
21.444000	14.50	7.0	60	45.5	QP	N	GND

**MEASUREMENT RESULT: "GTS190609103\_fin2"**

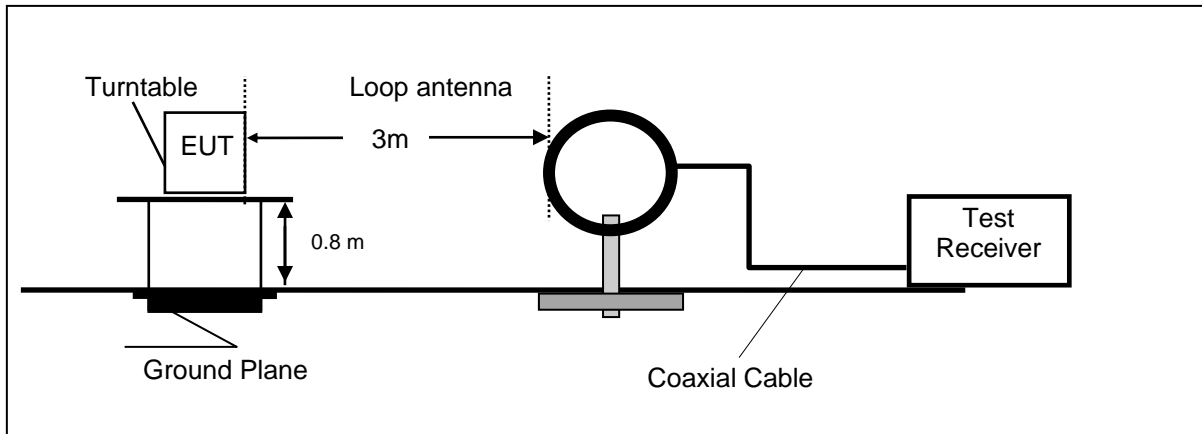
6/6/2019 8:59AM

Frequency MHz	Level dBuV	Transd dB	Limit dBuV	Margin dB	Detector	Line	PE
0.393000	28.90	9.8	48	19.1	AV	N	GND
0.420000	36.30	9.8	47	11.1	AV	N	GND
1.041000	24.30	9.6	46	21.7	AV	N	GND
2.481000	22.20	9.5	46	23.8	AV	N	GND
10.068000	18.50	8.9	50	31.5	AV	N	GND
22.006500	8.10	7.0	50	41.9	AV	N	GND

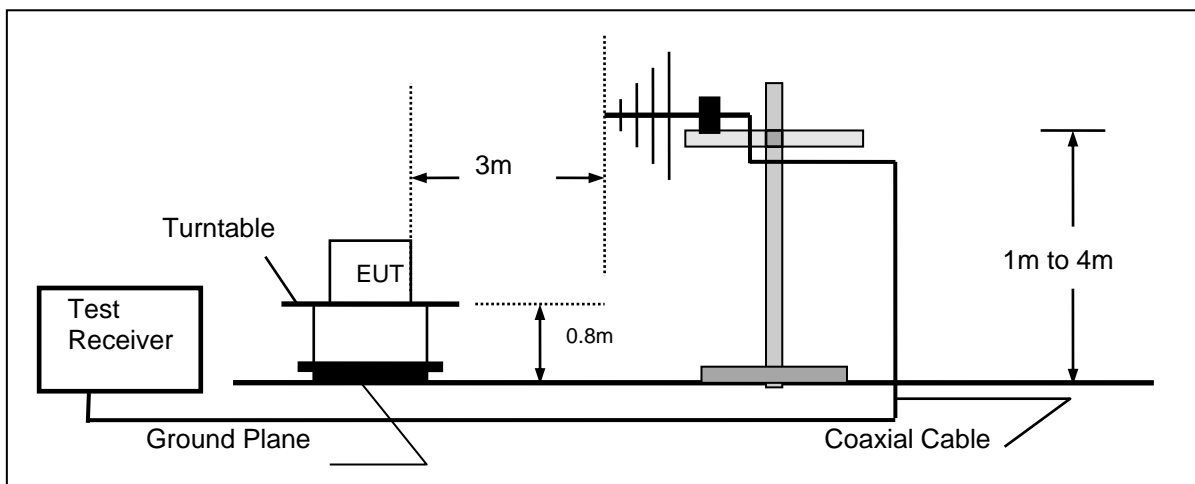
### 4.2. Radiated Emission

#### TEST CONFIGURATION

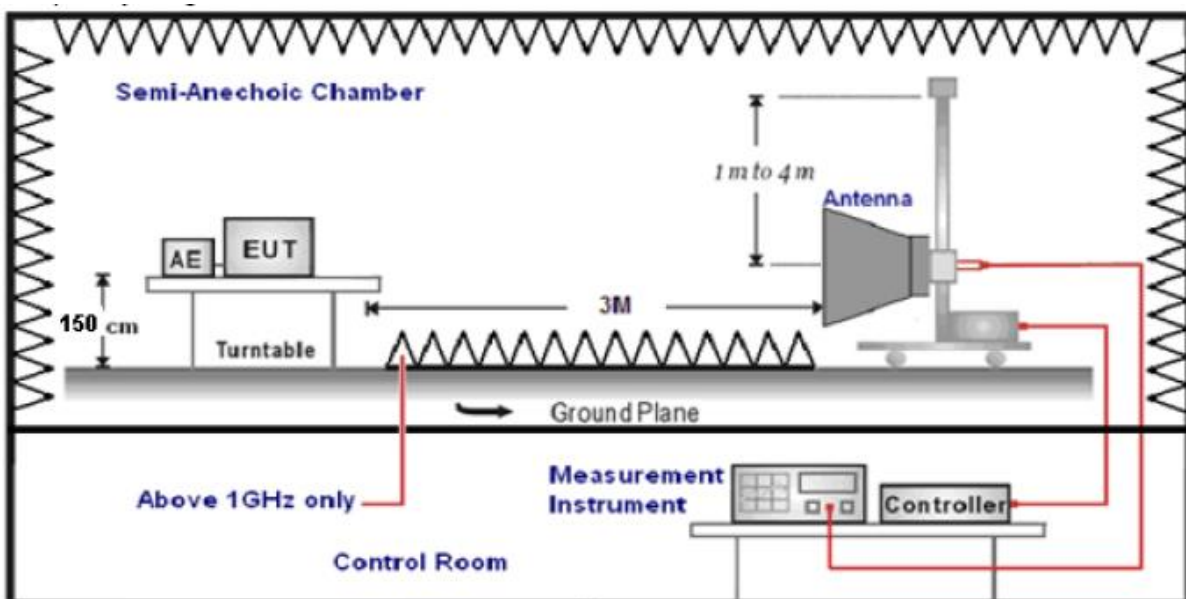
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



**TEST PROCEDURE**

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz;the EUT was placed on a turn table which is 1.5m above ground plane when testing frequency range 1GHz – 25GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° 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.
5. The EUT minimum operation frequency was 32.768KHz and maximum operation frequency was 2480MHz.so radiated emission test frequency band from 9KHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Ultra-Broadband Antenna	3
1GHz-18GHz	Double Ridged Horn Antenna	3
18GHz-25GHz	Horn Antenna	1

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

**Field Strength Calculation**

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

$$FS = RA + AF + CL - AG$$

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

$$Transd=AF +CL-AG$$

**RADIATION LIMIT**

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the100kHz bandwidth within the band that contains the highest level of desired power.

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

Frequency (MHz)	Distance (Meters)	Radiated (dBµV/m)	Radiated (µV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(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 RESULTS**

Remark: We measured Radiated Emission at GFSK,  $\pi/4$  DQPSK and 8DPSK mode from 30MHz to 25GHz and recorded worst case at GFSK mode.

**For 30MHz-1GHz**



## For 1GHz to 25GHz

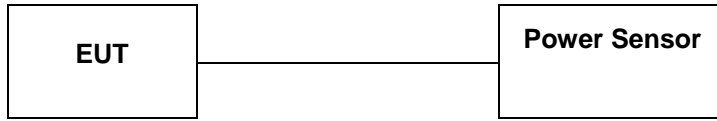
Frequency	Meter Reading	Antenna Factor	Cable loss	Preamp factor	Emission Level	Limits	Margin	Detector Type	Comment
(MHz)	(dB $\mu$ V)	(dB)	(dB)	(dB)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB)		
TX-2402									
4804	46.42	32.44	30.25	7.95	56.56	74	-17.44	Pk	Vertical
4804	35.18	32.44	30.25	7.95	45.32	54	-8.68	AV	Vertical
4804	41.61	32.44	30.25	7.95	51.75	74	-22.25	Pk	Horizontal
4804	31.2	32.44	30.25	7.95	41.34	54	-12.66	AV	Horizontal
TX-2441									
4882	47.11	32.52	30.31	8.12	57.44	74	-16.56	Pk	Vertical
4882	35.46	32.52	30.31	8.12	45.79	54	-8.21	AV	Vertical
4882	38.52	32.52	30.31	8.12	48.85	74	-25.15	Pk	Horizontal
4882	31.24	32.52	30.31	8.12	41.57	54	-12.43	AV	Horizontal
TX-2480									
4960	44.88	32.68	30.27	7.88	55.17	74	-18.83	Pk	Vertical
4960	35.06	32.68	30.27	7.88	45.35	54	-8.65	AV	Vertical
4960	39.63	32.68	30.27	7.88	49.92	74	-24.08	Pk	Horizontal
4960	30.62	32.68	30.27	7.88	40.91	54	-13.09	AV	Horizontal

## REMARKS:

1. Emission level (dB $\mu$ V/m) =Raw Value (dB $\mu$ V)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

### 4.3. Maximum Peak Output Power

#### TEST CONFIGURATION



#### TEST PROCEDURE

According to ANSI C63.10:2013 Maximum peak conducted output power for HFSS devices:  
 The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the HFSS bandwidth and shall utilize a fast-responding diode detector.  
 The maximum Average conducted output power may be measured using a wideband RF power meter with a thermocouple detector or equivalent. The power meter shall have a video bandwidth that is greater than or equal to the HFSS bandwidth and shall utilize a fast-responding diode detector.

#### 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.

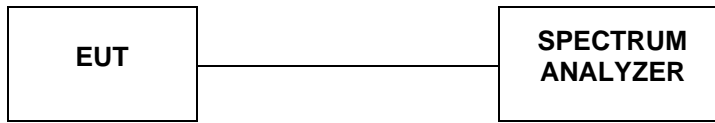
#### TEST RESULTS

Type	Channel	Peak Output power (dBm)	Limit (dBm)	Result
GFSK	00	1.70	21	Pass
	39	1.18		
	78	-0.19		
π/4DQPSK	00	-1.90	21	Pass
	39	-2.52		
	78	-3.97		
8DPSK	00	-1.68	21	Pass
	39	-2.26		
	78	-3.79		

Note: The test results including the cable lose.

#### 4.4. 20dB Bandwidth

#### TEST CONFIGURATION



#### 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 RBW=30KHz and VBW=100KHz. The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

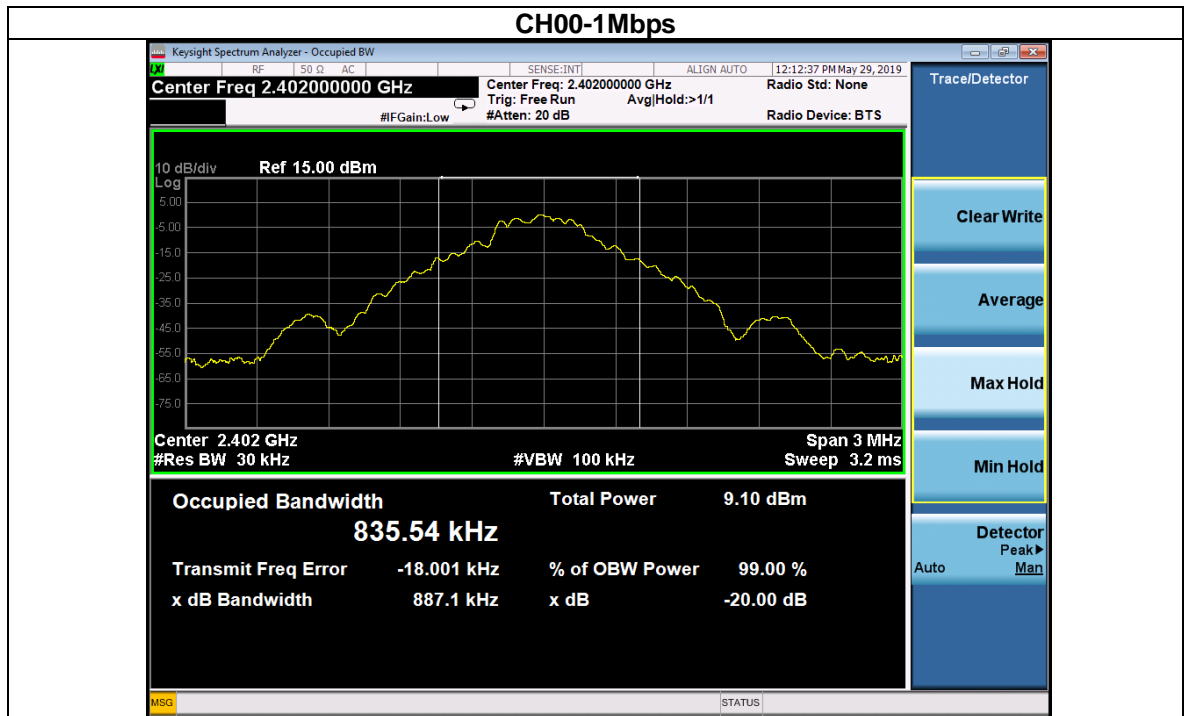
#### LIMIT

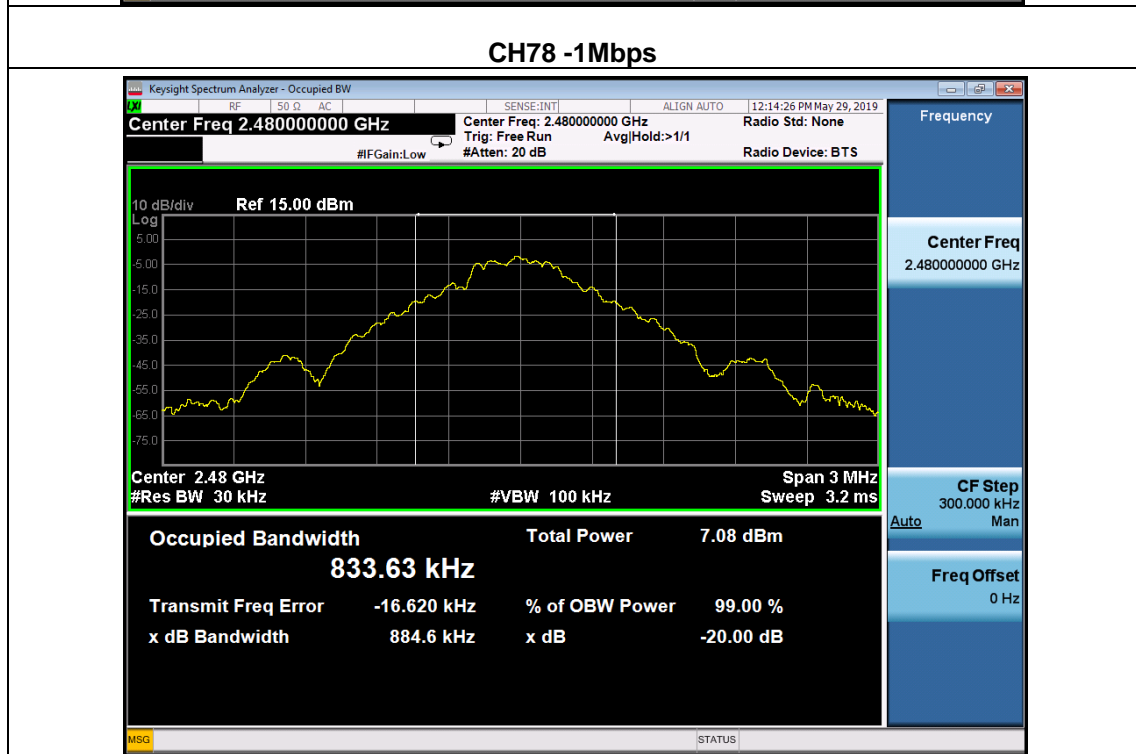
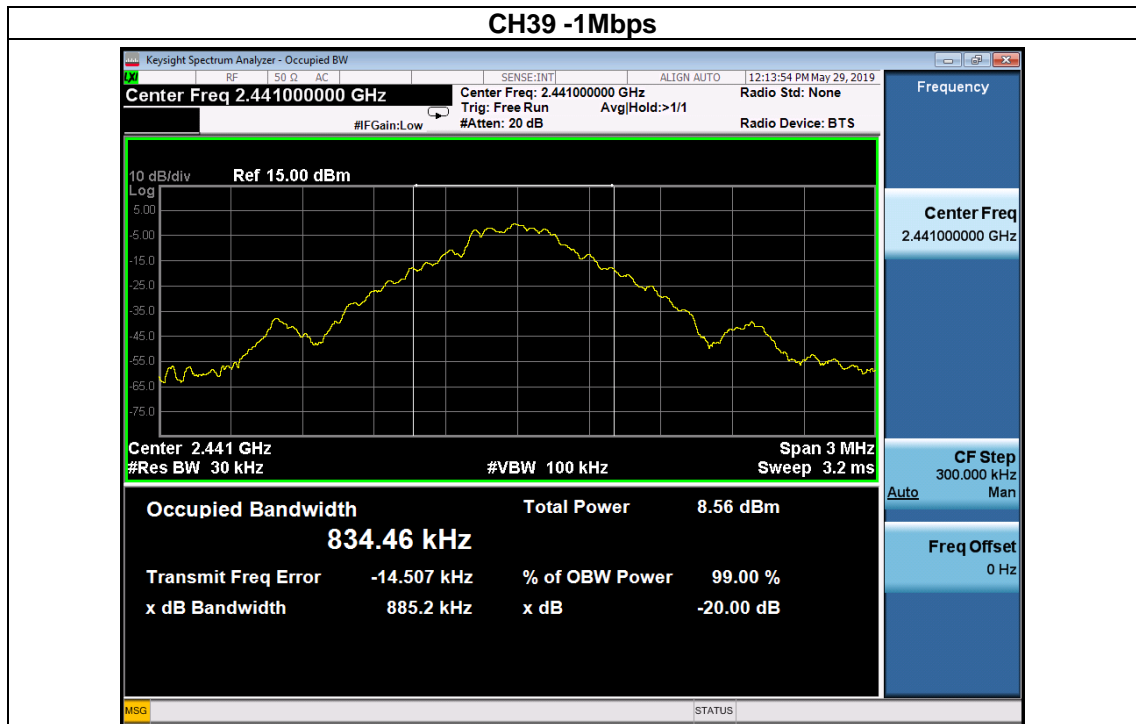
For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwidth.

#### TEST RESULTS

	Frequency	20dB Bandwidth (kHz)	Result
GFSK	2402 MHz	887.1	PASS
	2441 MHz	885.2	PASS
	2480 MHz	884.6	PASS

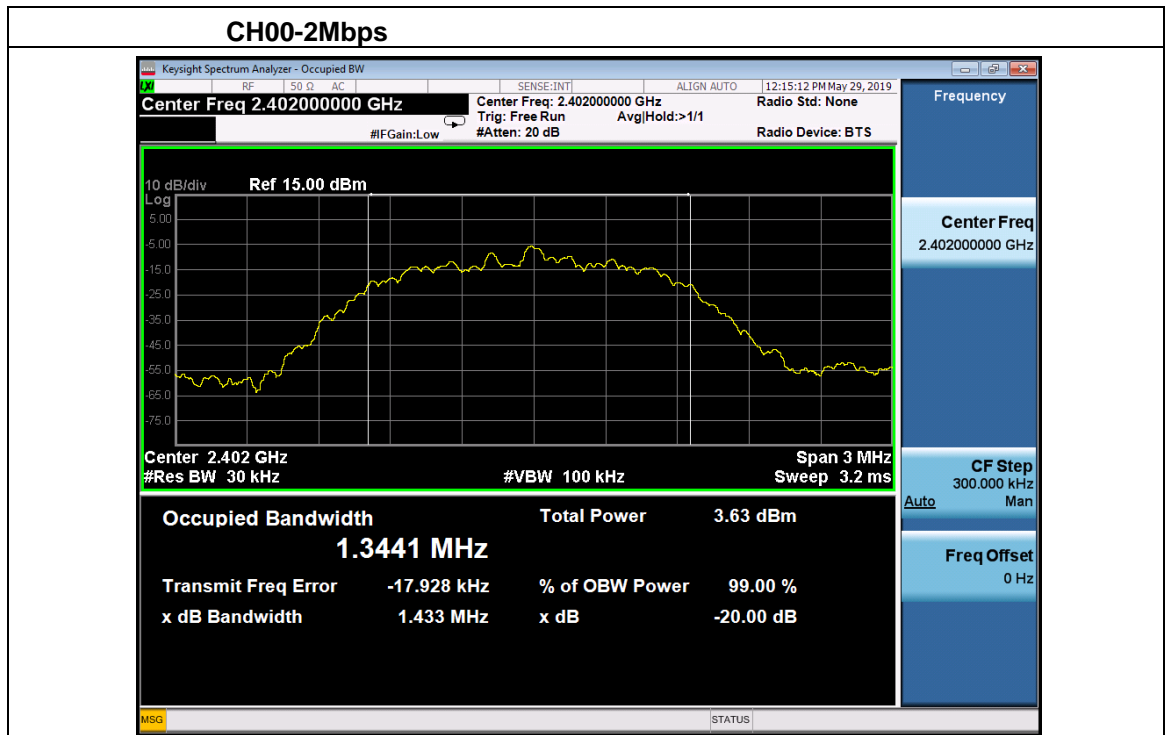
Test plot as follows:





	Frequency	20dB Bandwidth (MHz)	Result
π /4-DQPSK	2402 MHz	1.433	PASS
	2441 MHz	1.433	PASS
	2480 MHz	1.431	PASS

Test plot as follows:



### CH39-2Mbps

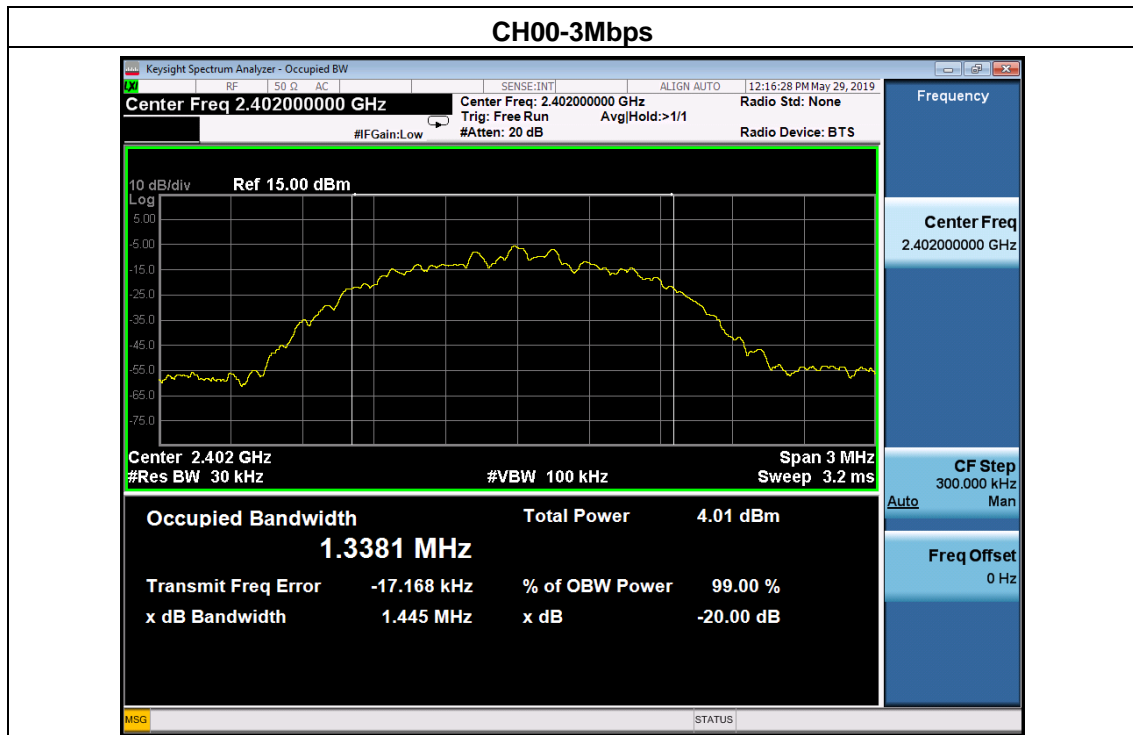


### CH78-2Mbps



	Frequency	20dB Bandwidth (MHz)	Result
8-DPSK	2402 MHz	1.445	PASS
	2441 MHz	1.446	PASS
	2480 MHz	1.453	PASS

Test plot as follows:





### CH39-3Mbps

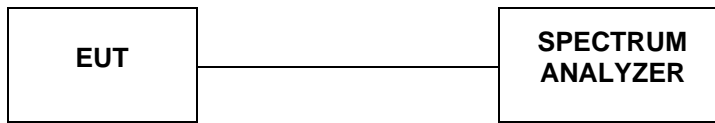


### CH78-3Mbps



### 4.5. Frequency Separation

#### TEST CONFIGURATION



#### 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 RBW=30KHz and VBW=100KHz.

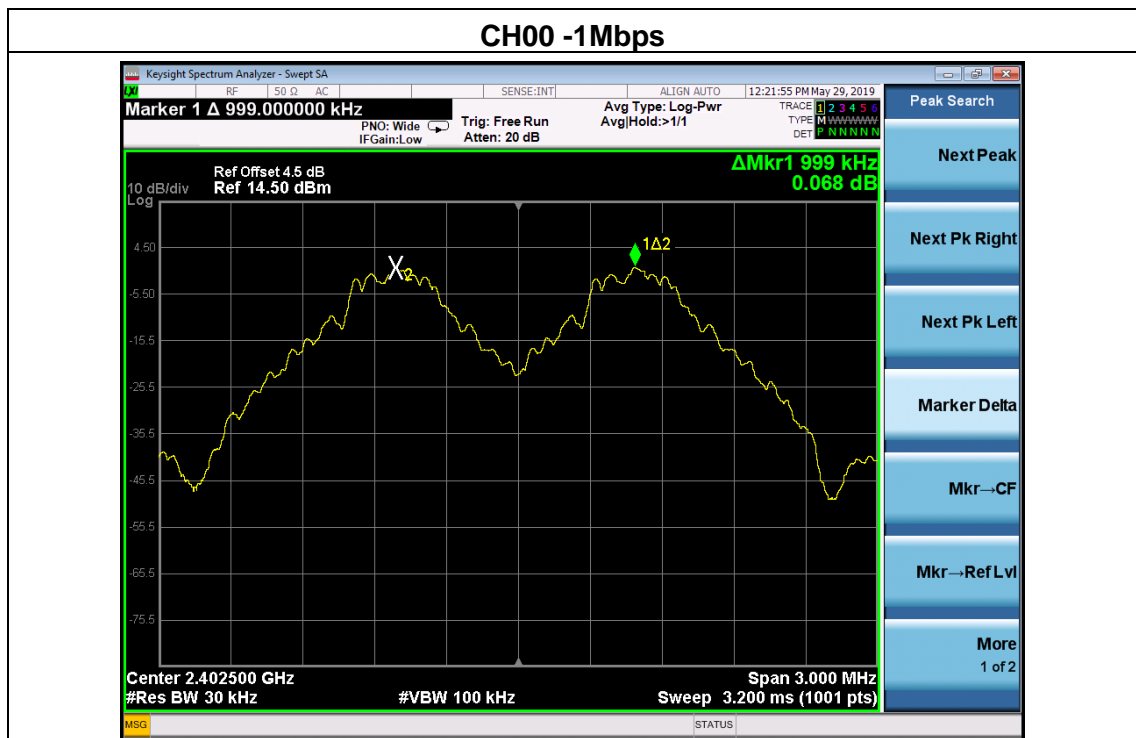
#### LIMIT

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

#### TEST RESULTS

	Frequency	Ch. Separation (MHz)	Limit (MHz)	Result
GFSK	2402.5 MHz	0.999	0.59	Complies
	2441.5 MHz	1.002	0.59	Complies
	2479.5 MHz	0.999	0.59	Complies

Ch. Separation Limits: > 2/3 of 20dB bandwidth



### CH39-1Mbps

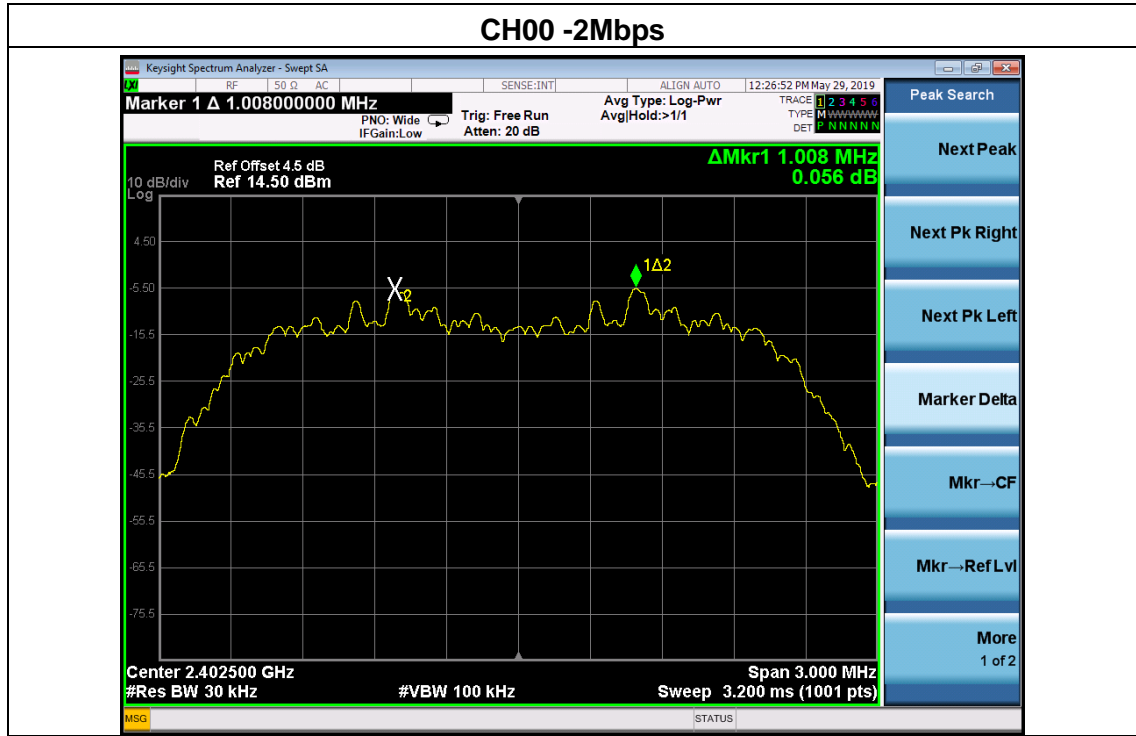


### CH78-1Mbps



	Frequency	Ch. Separation (MHz)	Limit (MHz)	Result
π/4-DQPSK	2402.5 MHz	1.008	0.96	Complies
	2441.5 MHz	0.999	0.96	Complies
	2479.5 MHz	0.999	0.95	Complies

Ch. Separation Limits: >2/3 of 20dB bandwidth.



### CH39 -2Mbps

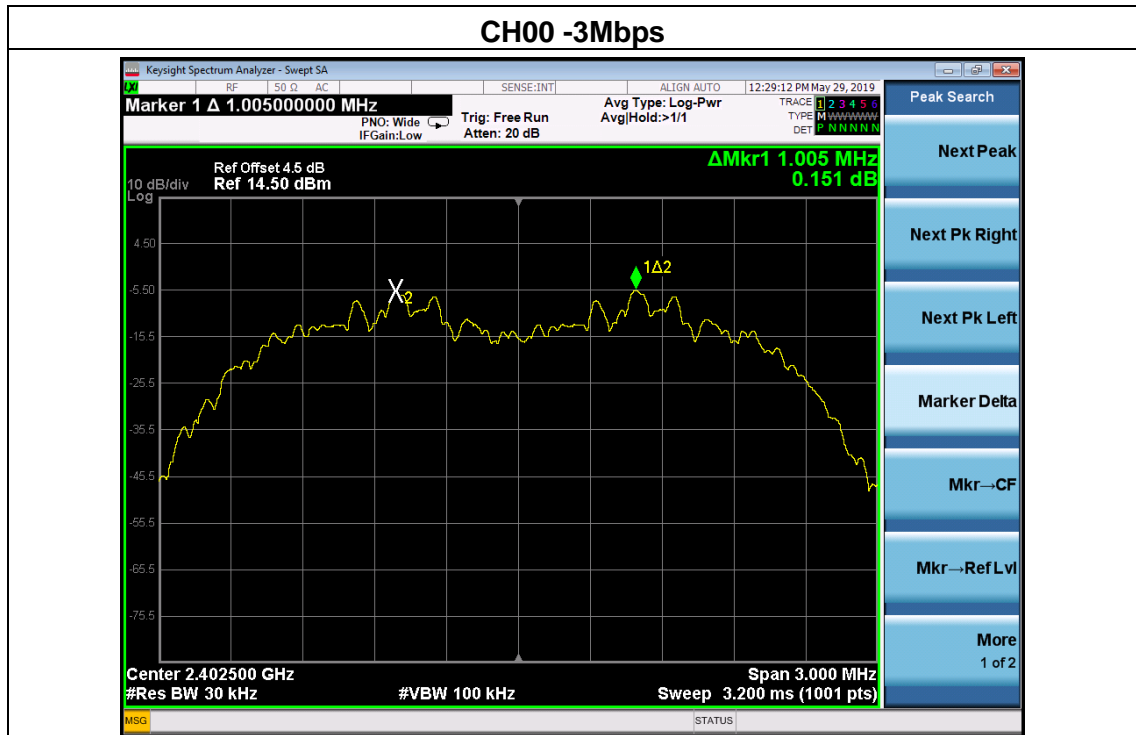


### CH78 -2Mbps



	Frequency	Ch. Separation (MHz)	Limit (KHz)	Result
8-DPSK	2402 MHz	1.005	0.96	Complies
	2441 MHz	0.999	0.96	Complies
	2480 MHz	0.996	0.97	Complies

Ch. Separation Limits: >2/3 of 20dB bandwidth.



### CH39 -3Mbps



### CH78 -3Mbps



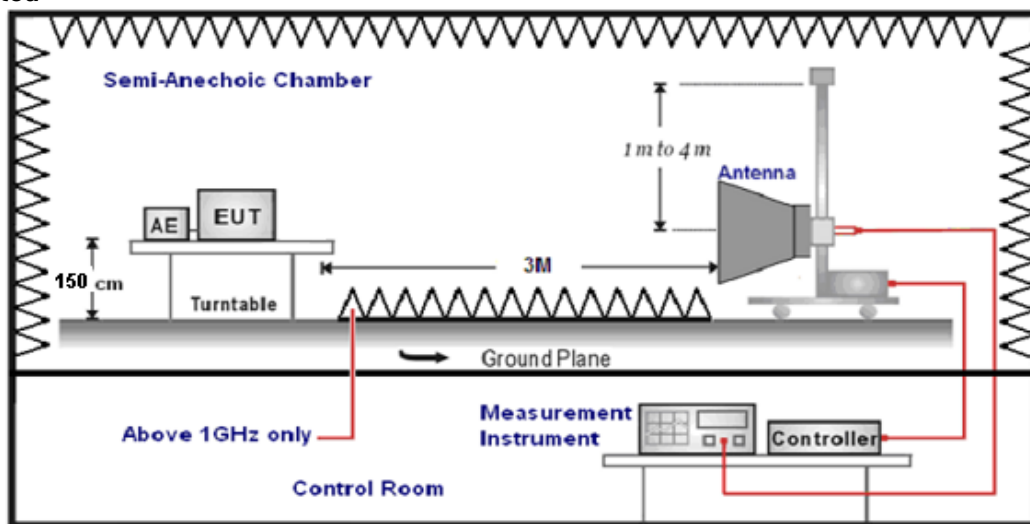
### 4.6. Band Edge Compliance of RF Emission

#### TEST REQUIREMENT

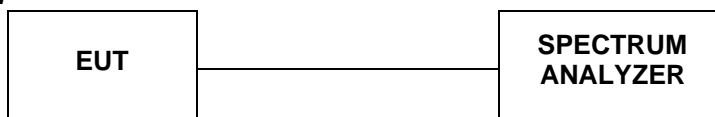
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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)).

#### TEST CONFIGURATION

##### For Radiated



##### For Conducted



#### TEST PROCEDURE

1. The EUT was placed on a 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° to 360° 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..
5. The distance between test antenna and EUT was 3 meter:
6. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

#### LIMIT

Below -20dB of the highest emission level in operating band.

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)



**TEST RESULTS**

Remark: we measured all conditions(DH1,DH3,DH5) and recorded worst case at DH1.

**4.6.1 For Radiated Bandedge Measurement**

Remark: we tested radiated bandedge at both hopping and no-hopping modes,recorded worst case at no-hopping mode

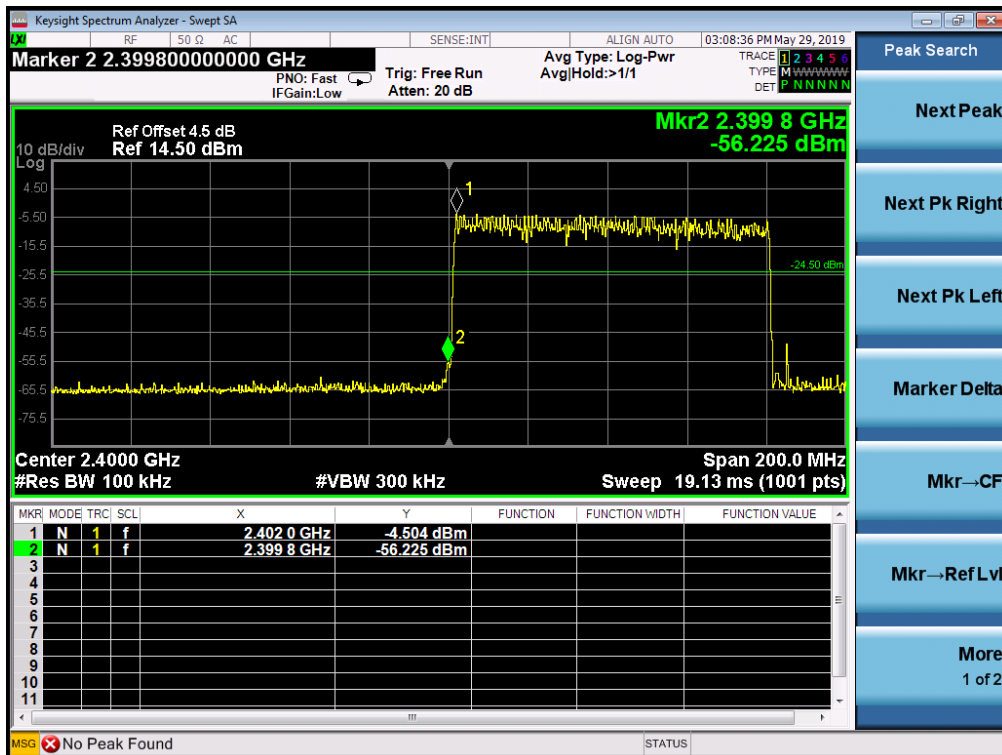
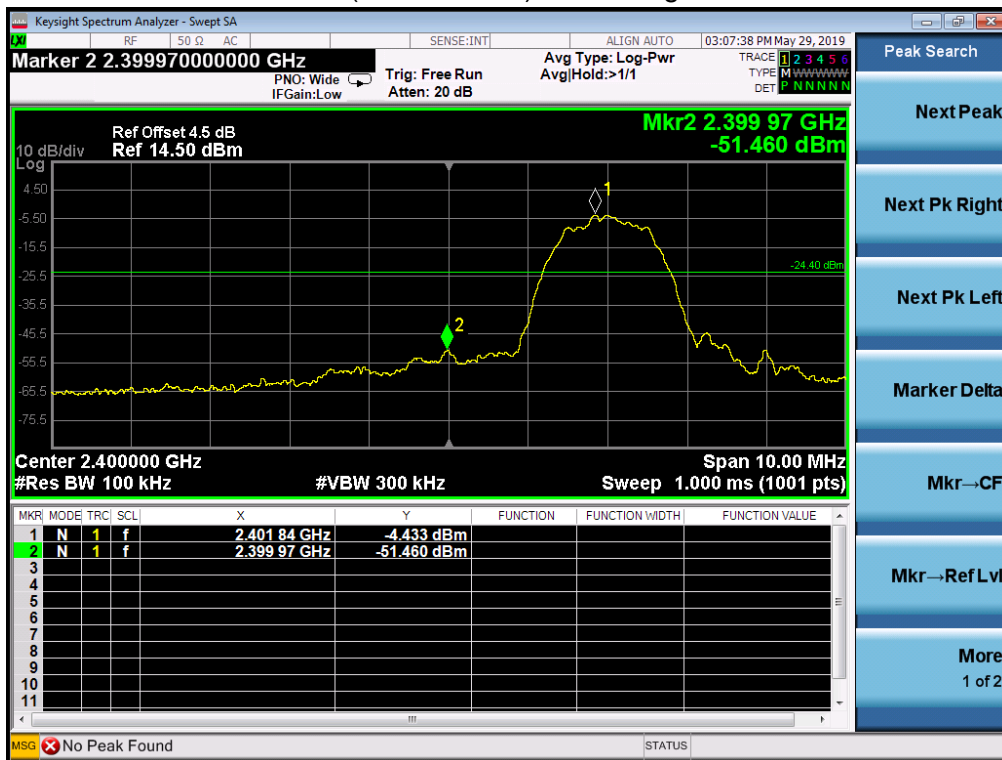
**GFSK**

Frequency(MHz):			2402			Polarity:			HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
2390	48.54	PK	74	25.46	1	176	53.85	27.49	3.32	36.12	-5.31
2390	38.73	AV	54	15.27	1	176	44.04	27.49	3.32	36.12	-5.31
Frequency(MHz):			2402			Polarity:			VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
2390	48.81	PK	74	25.19	1	329	54.12	27.49	3.32	36.12	-5.31
2390	39.11	AV	54	14.89	1	329	44.42	27.49	3.32	36.12	-5.31
Frequency(MHz):			2480			Polarity:			HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
2483.5	48.22	PK	74	24.67	1	102	53.94	27.45	3.38	36.55	-5.72
2483.5	37.62	AV	54	12.37	1	102	43.34	27.45	3.38	36.55	-5.72
Frequency(MHz):			2480			Polarity:			VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
2483.5	48.31	PK	74	24.67	1	218	54.03	27.45	3.38	36.55	-5.72
2483.5	37.96	AV	54	12.37	1	218	43.68	27.45	3.38	36.55	-5.72



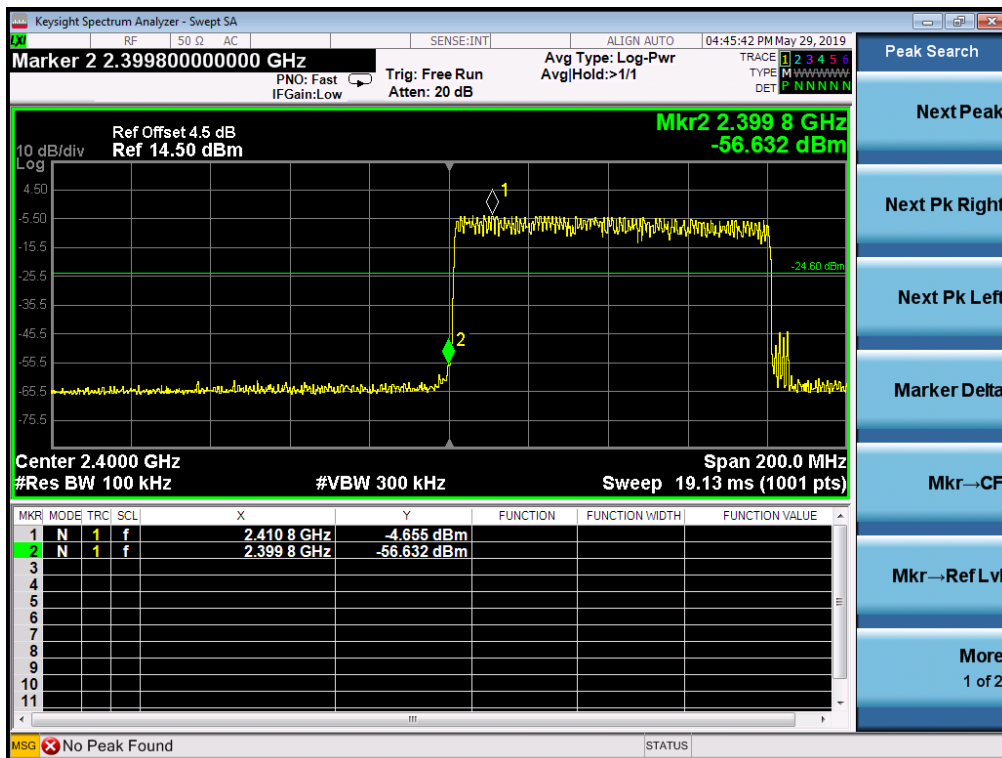
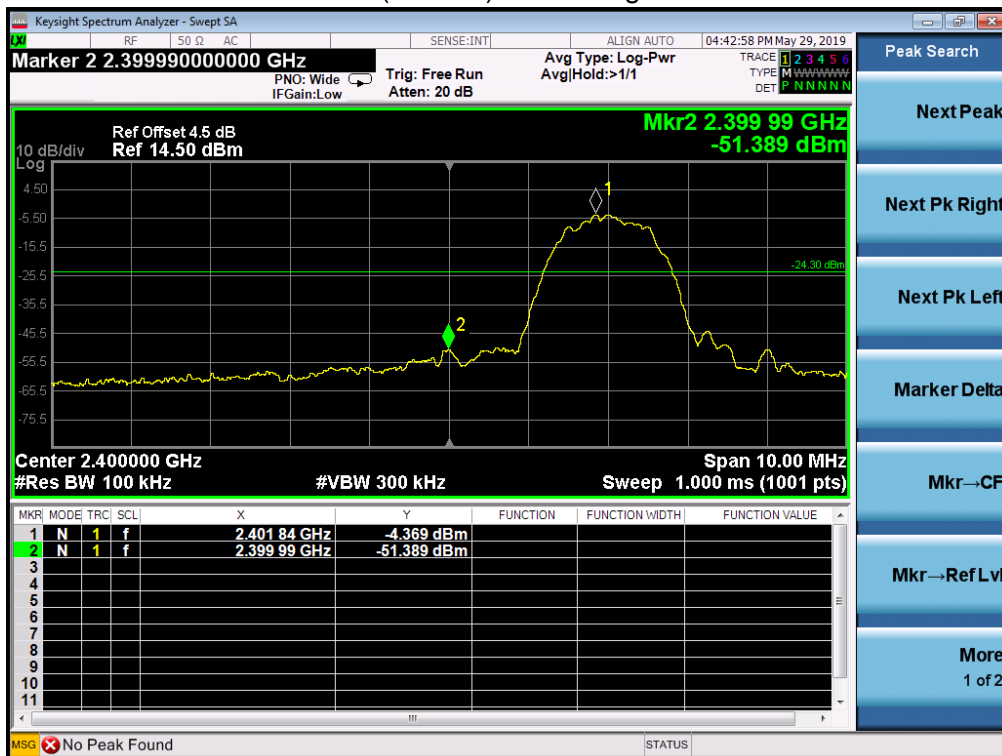


EDR mode ( $\pi/4$ -DQPSK): Band Edge-Left Side

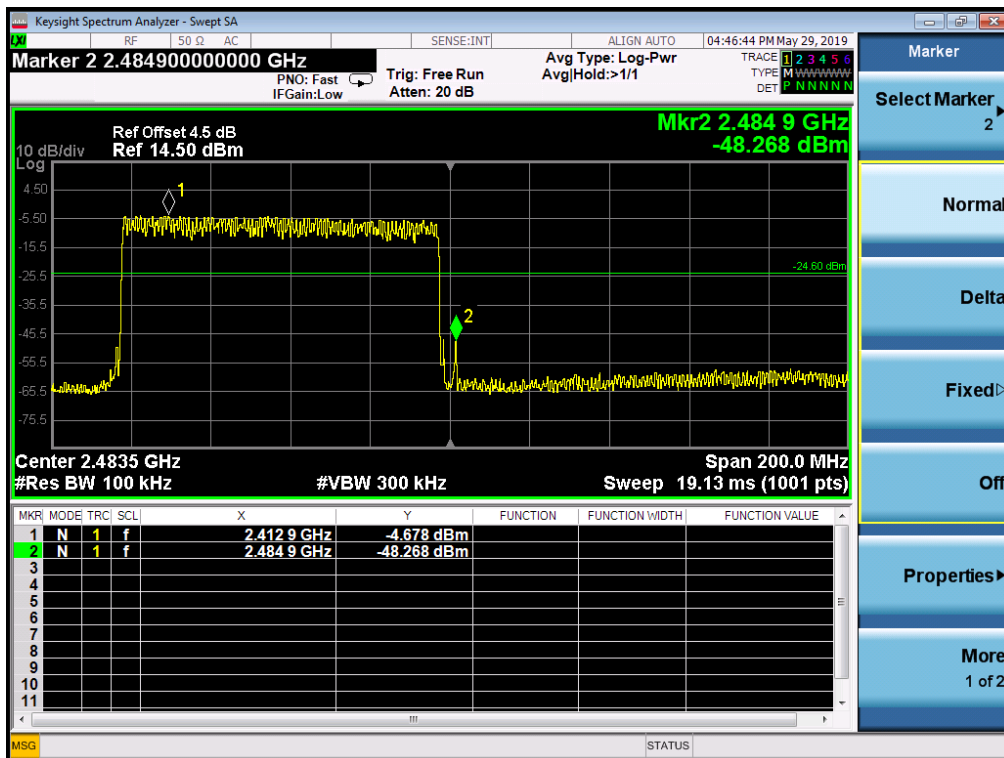
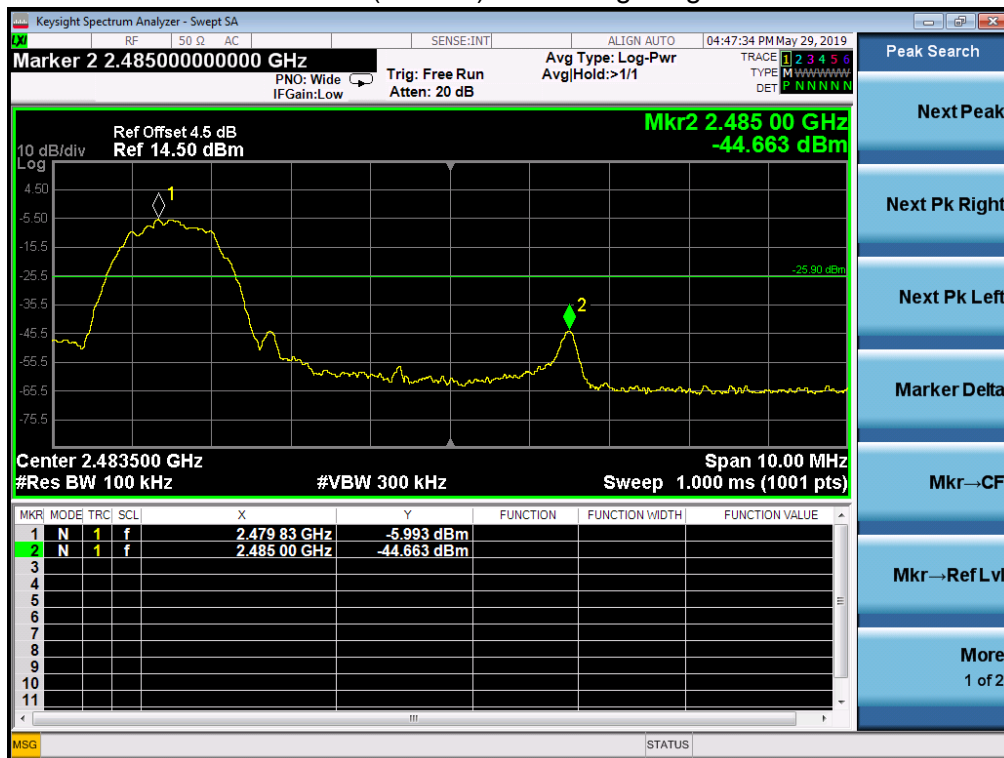




EDR mode(8DPSK): Band Edge-Left Side



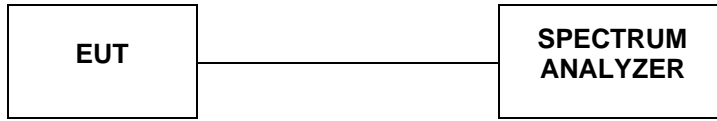
EDR mode(8DPSK): Band Edge-Right Side



NOTE: Hopping enabled and disabled have evaluated, and the worst data was reported.

### 4.7. Number of hopping frequency

#### TEST CONFIGURATION



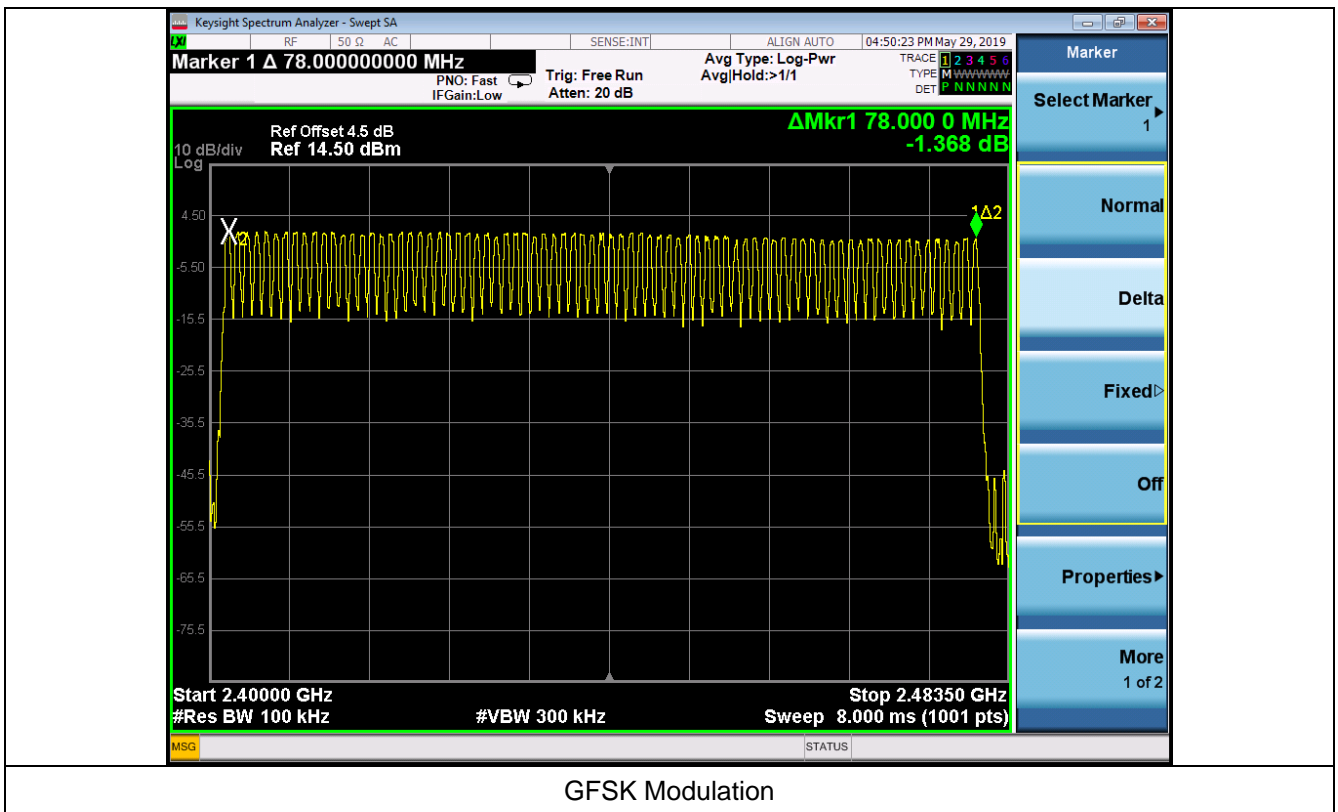
#### TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. Set spectrum analyzer start 2400MHz to 2483.5MHz with RBW=1MHz and VBW=3MHz.

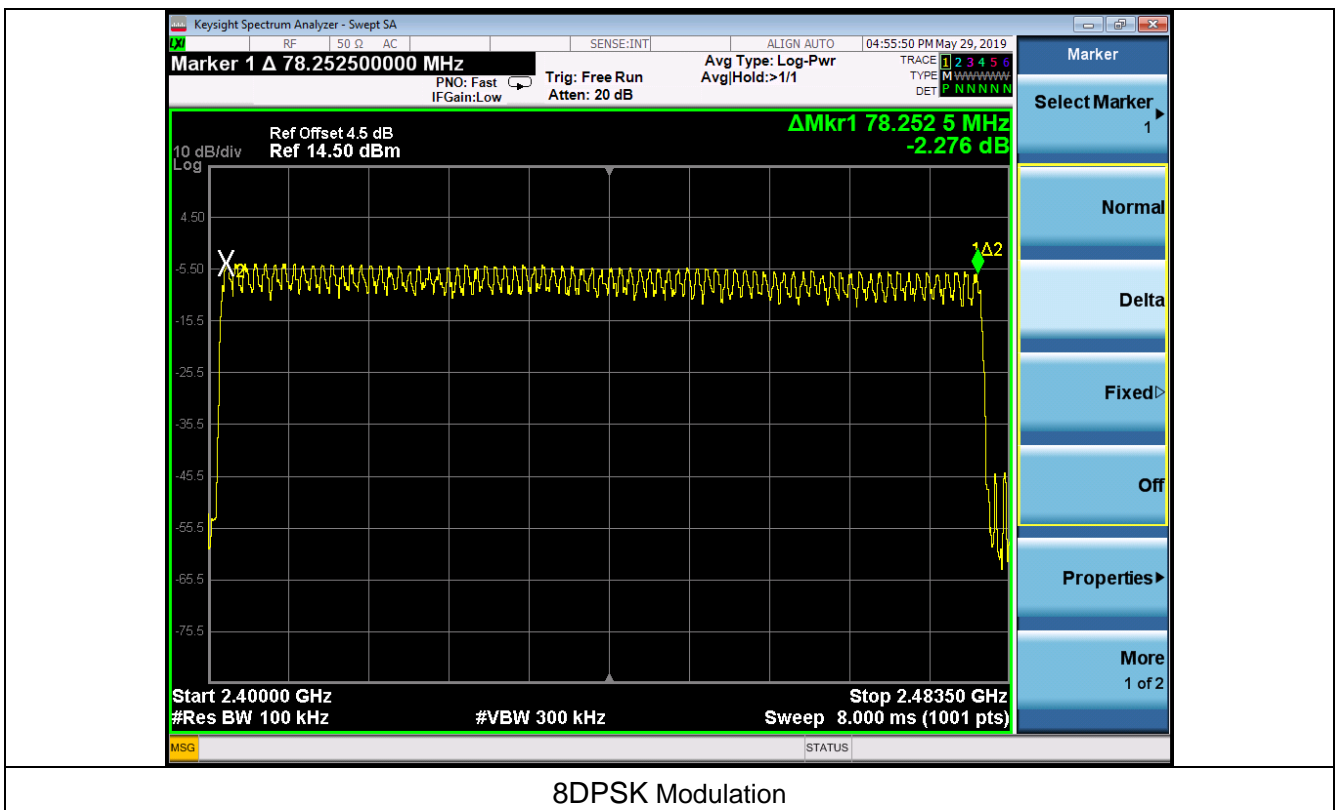
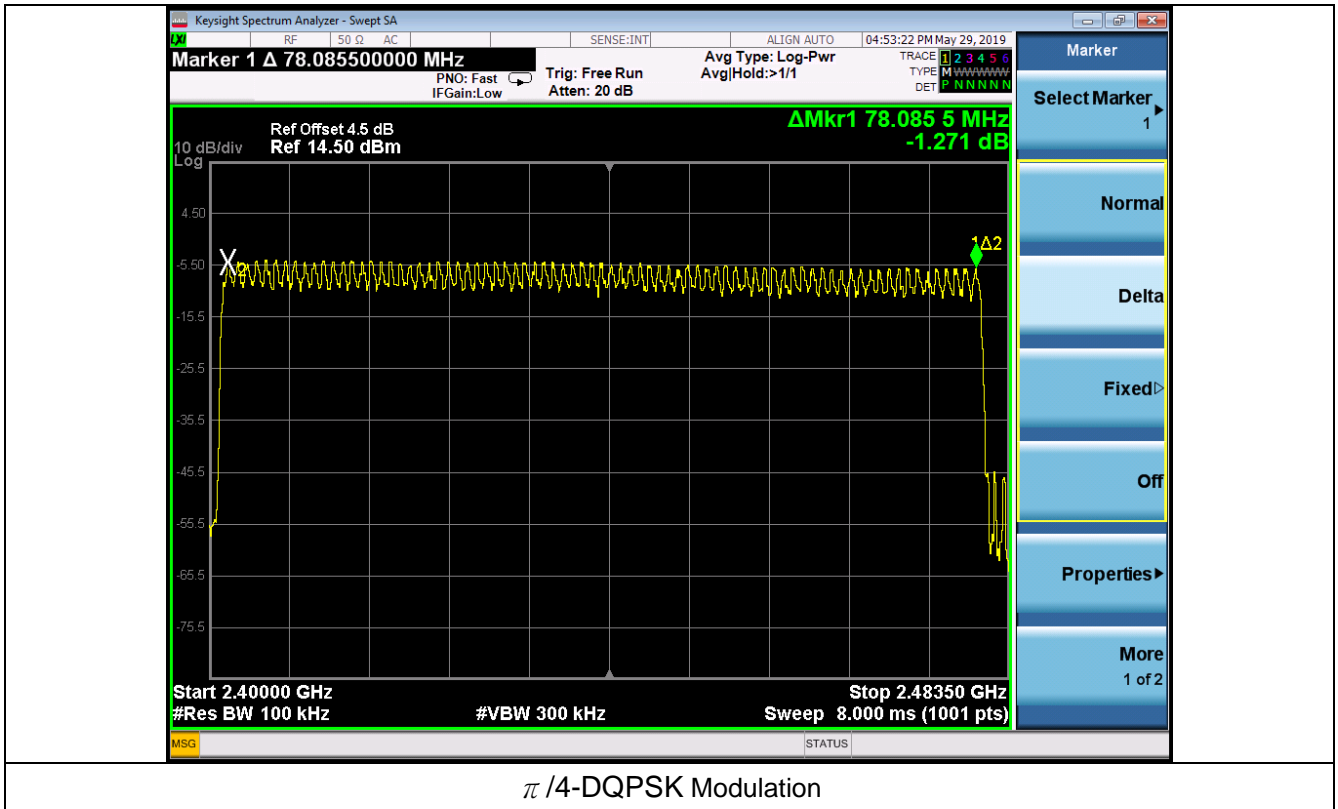
#### LIMIT

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

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

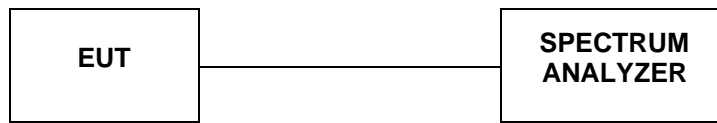






#### 4.8. Time Of Occupancy(Dwell Time)

##### TEST CONFIGURATION



##### TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with RBW=1MHz and VBW=3MHz,Span=0Hz.

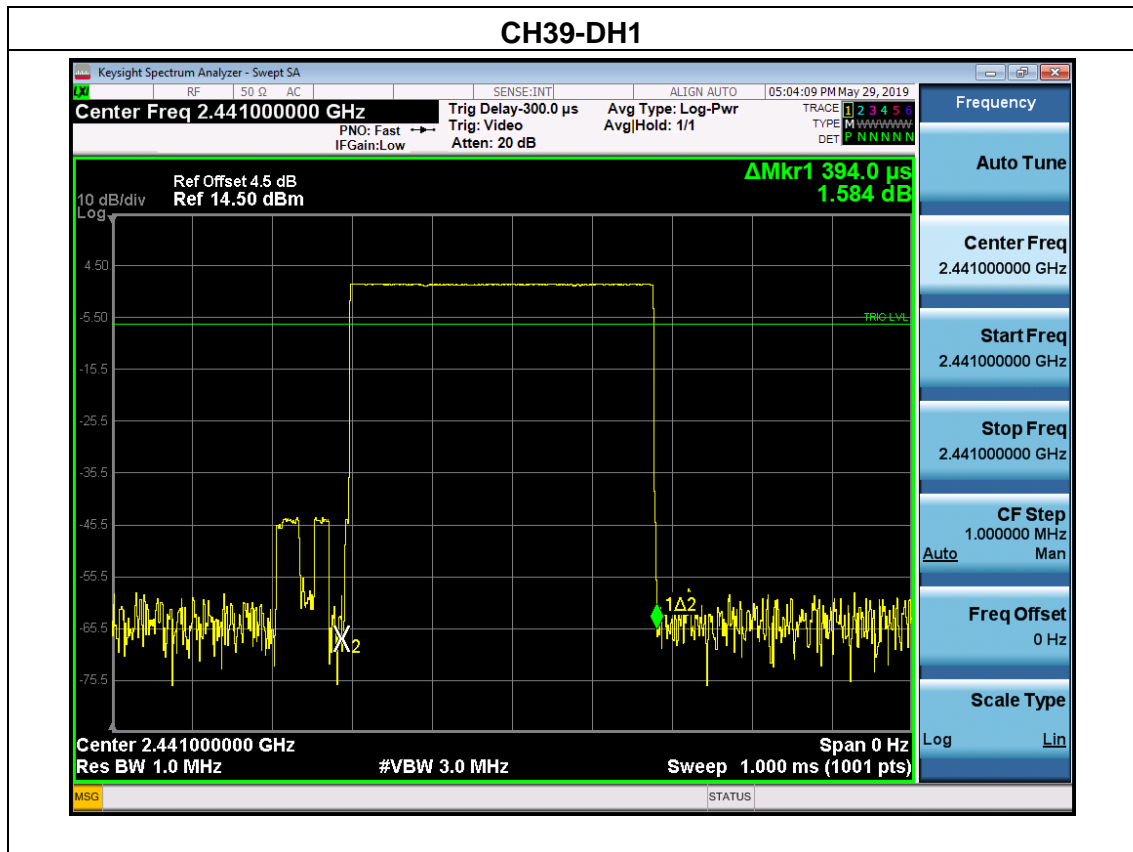
##### LIMIT

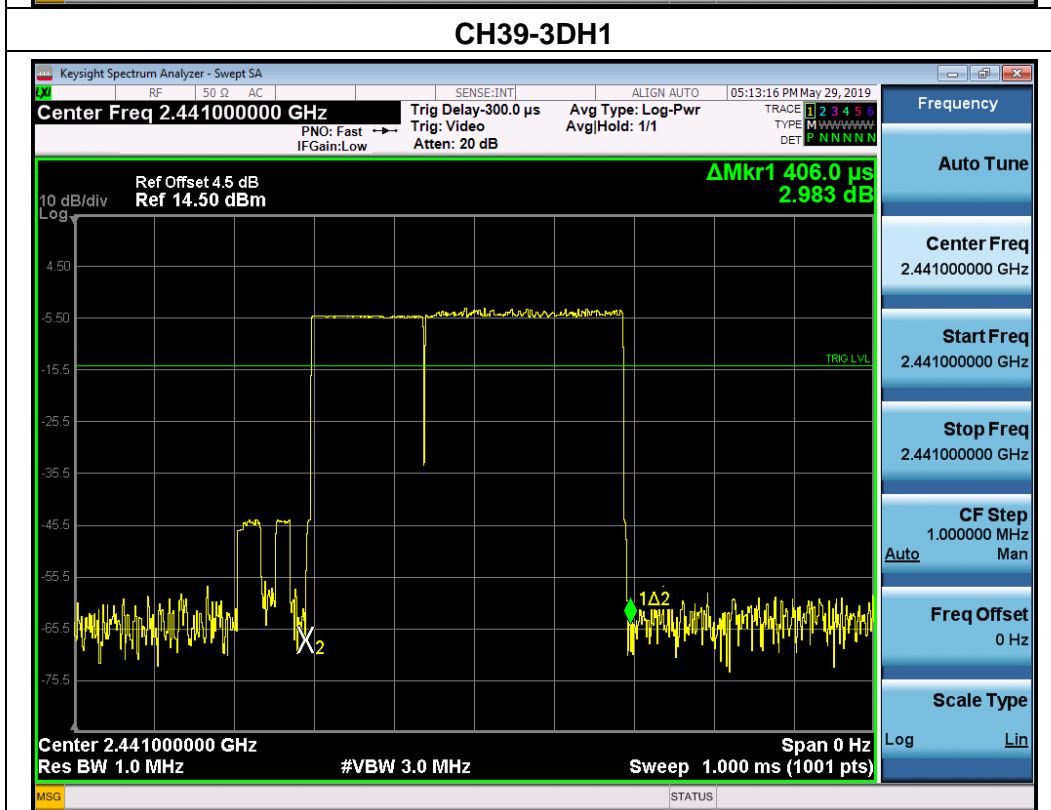
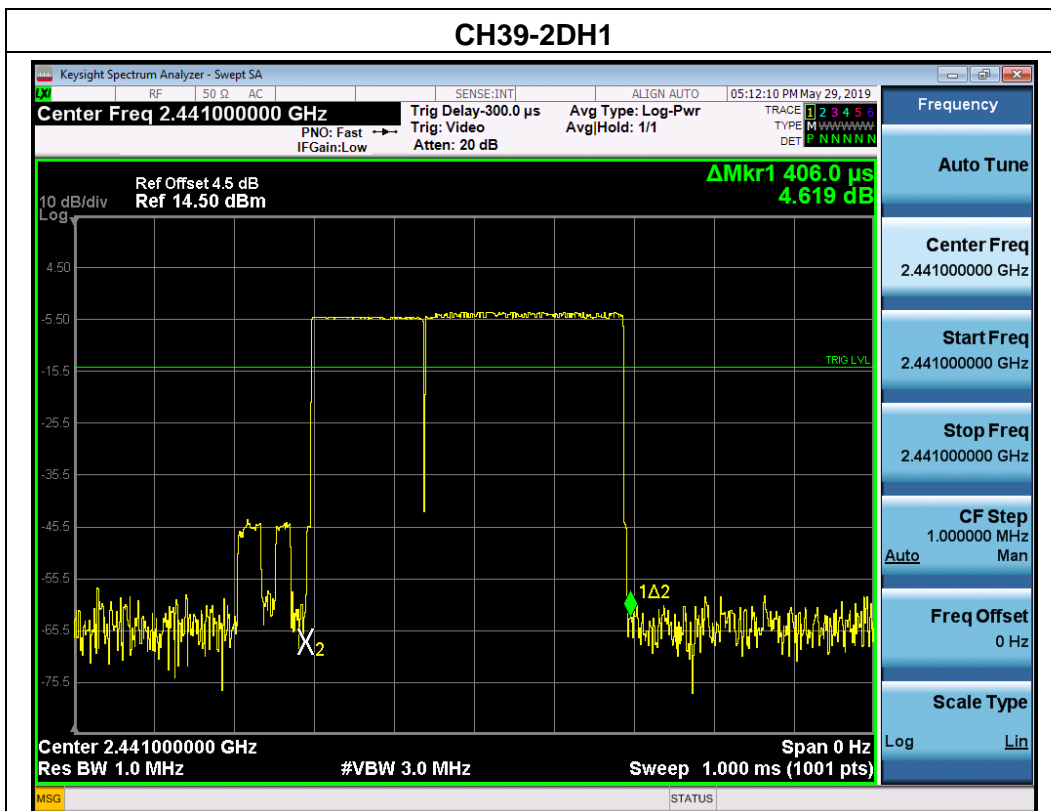
The average time of occupancy on any channel shall not be greater than 0.4 seconds within a pe-riod of 0.4 seconds multiplied by the number of hopping channels employed.

##### TEST RESULTS

	Data Packet	Frequency	Pulse Duration	Dwell Time	Limits
			(ms)	(s)	(s)
GFSK	DH1	2441 MHz	0.394	0.13	0.4
	2DH1	2441 MHz	0.406	0.13	0.4
	3DH1	2441 MHz	0.406	0.13	0.4

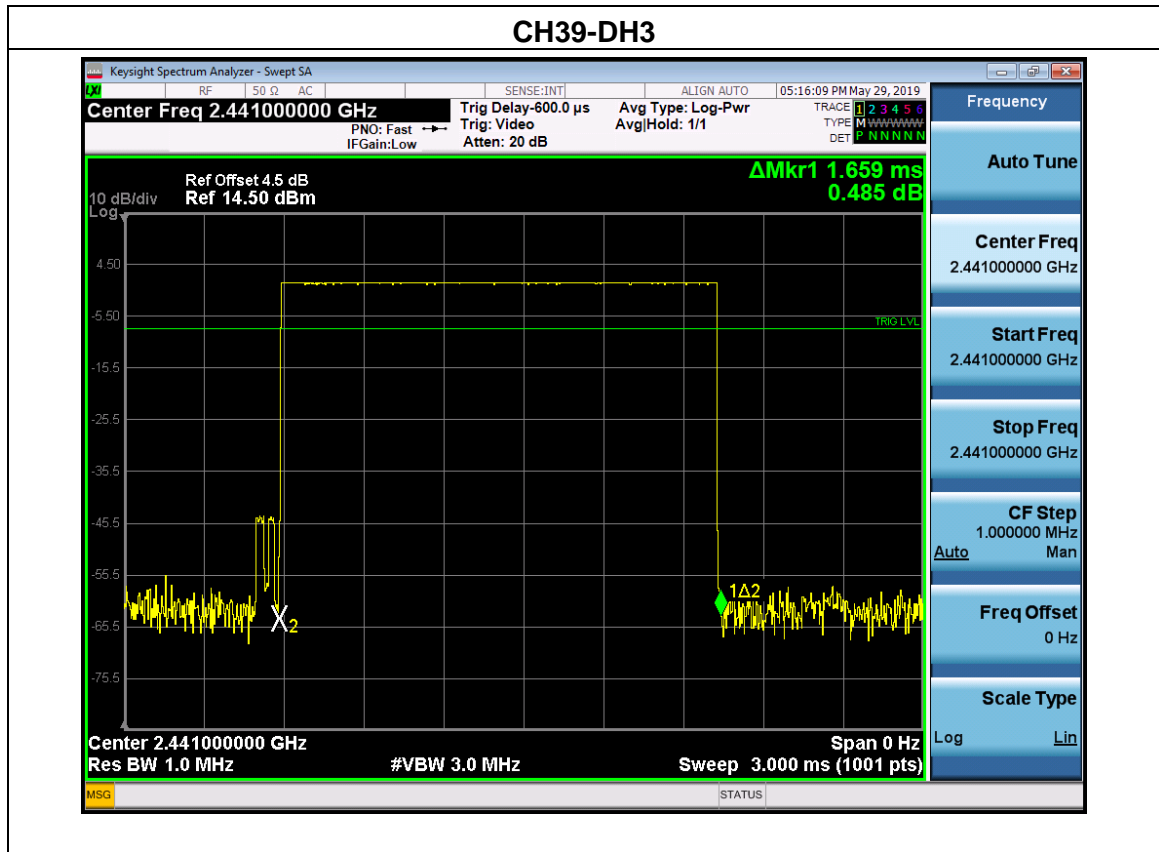
Test plot as follows:

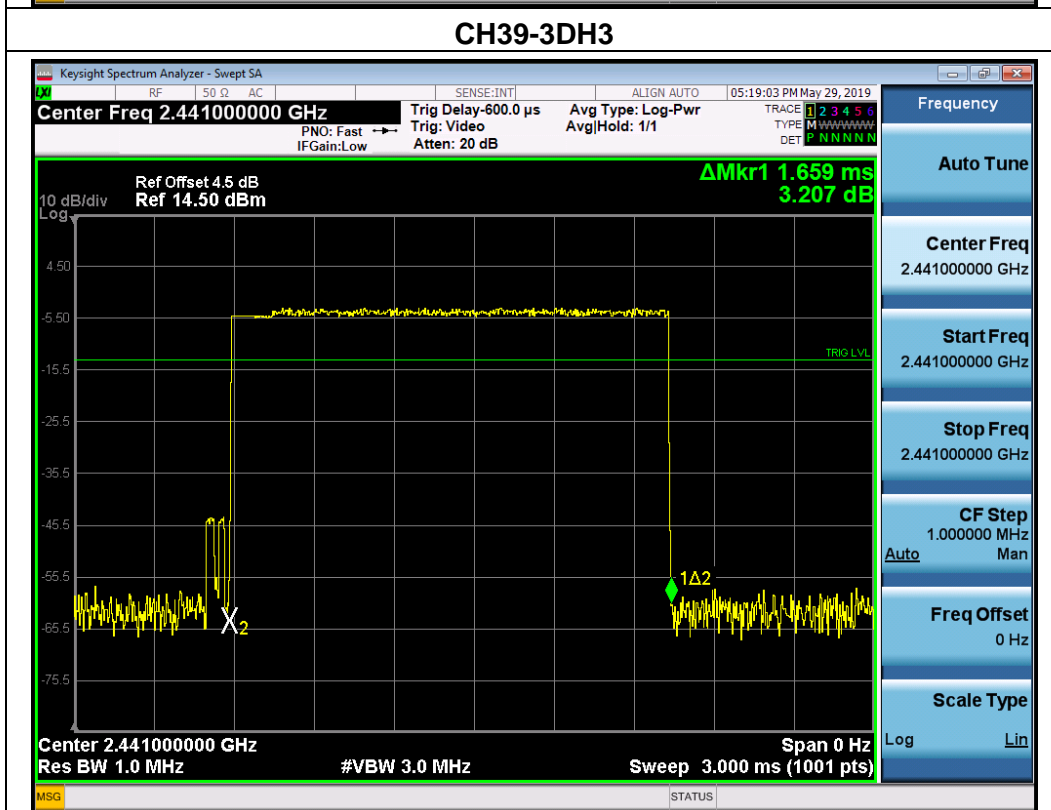
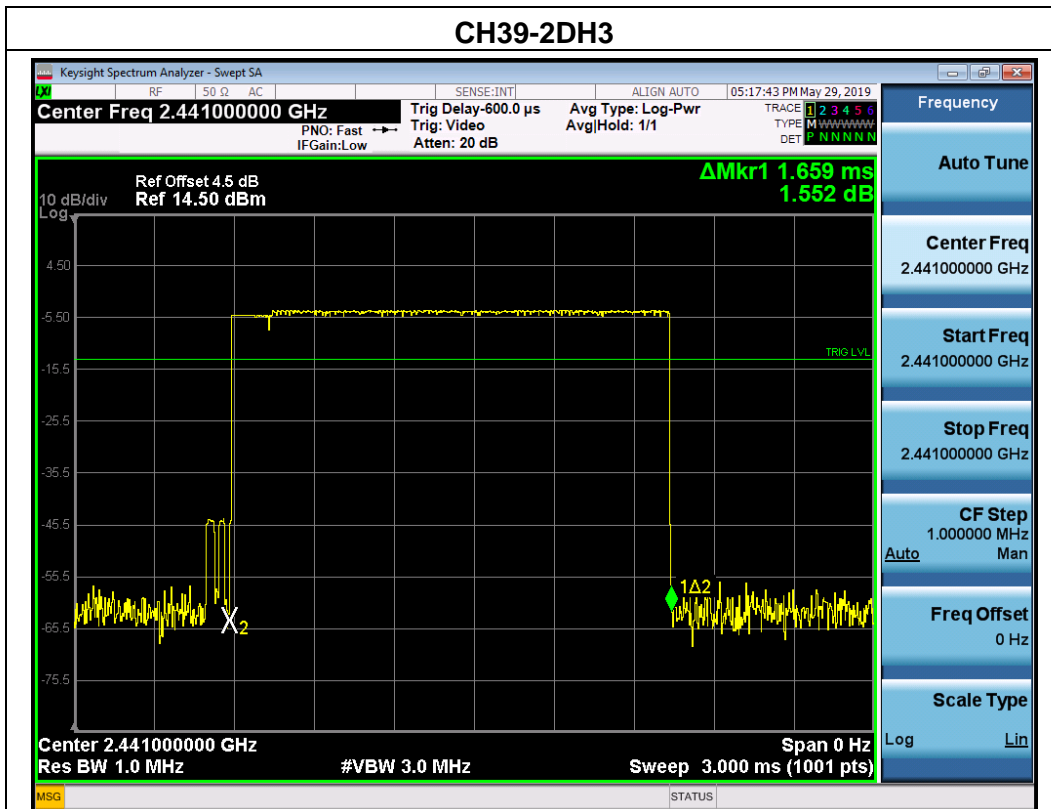




	Data Packet	Frequency	Pulse Duration	Dwell Time	Limits
			(ms)	(s)	(s)
π/4DQPSK	DH3	2441 MHz	1.659	0.27	0.4
	2DH3	2441 MHz	1.659	0.27	0.4
	3DH3	2441 MHz	1.659	0.27	0.4

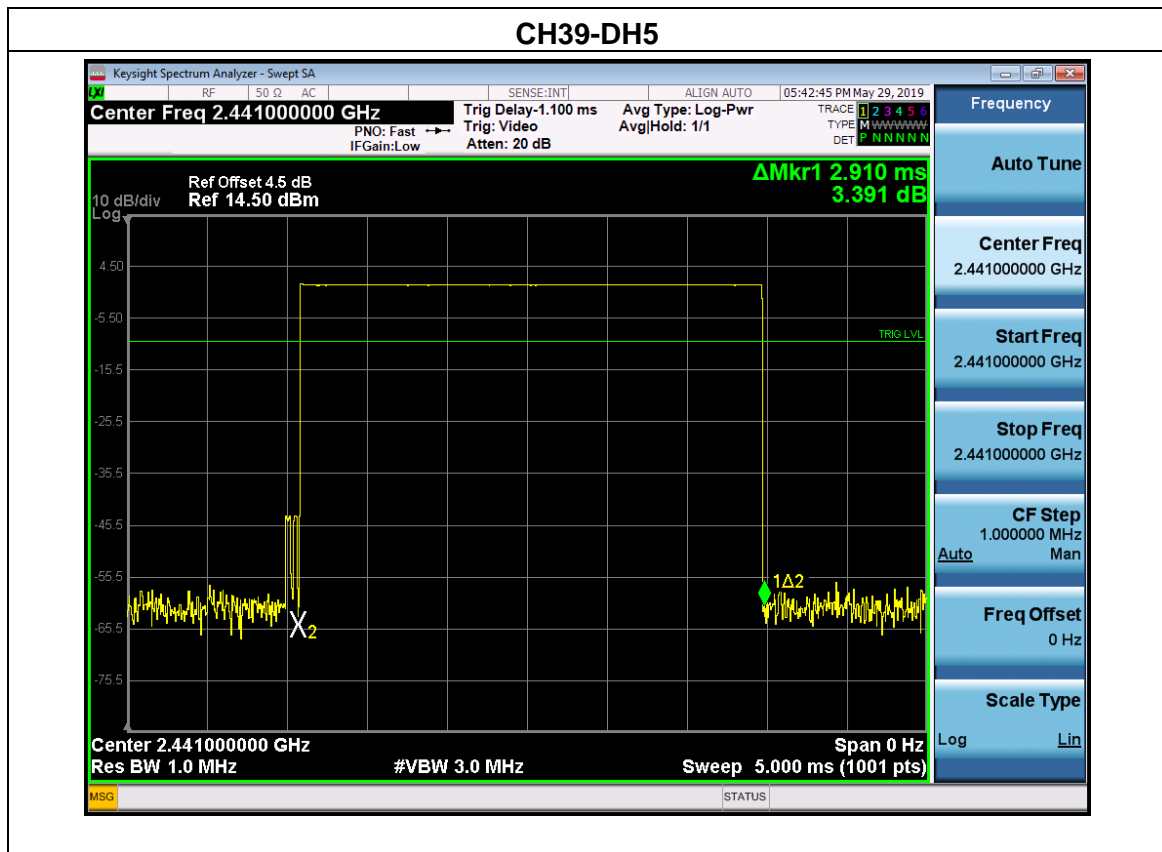
Test plot as follows:

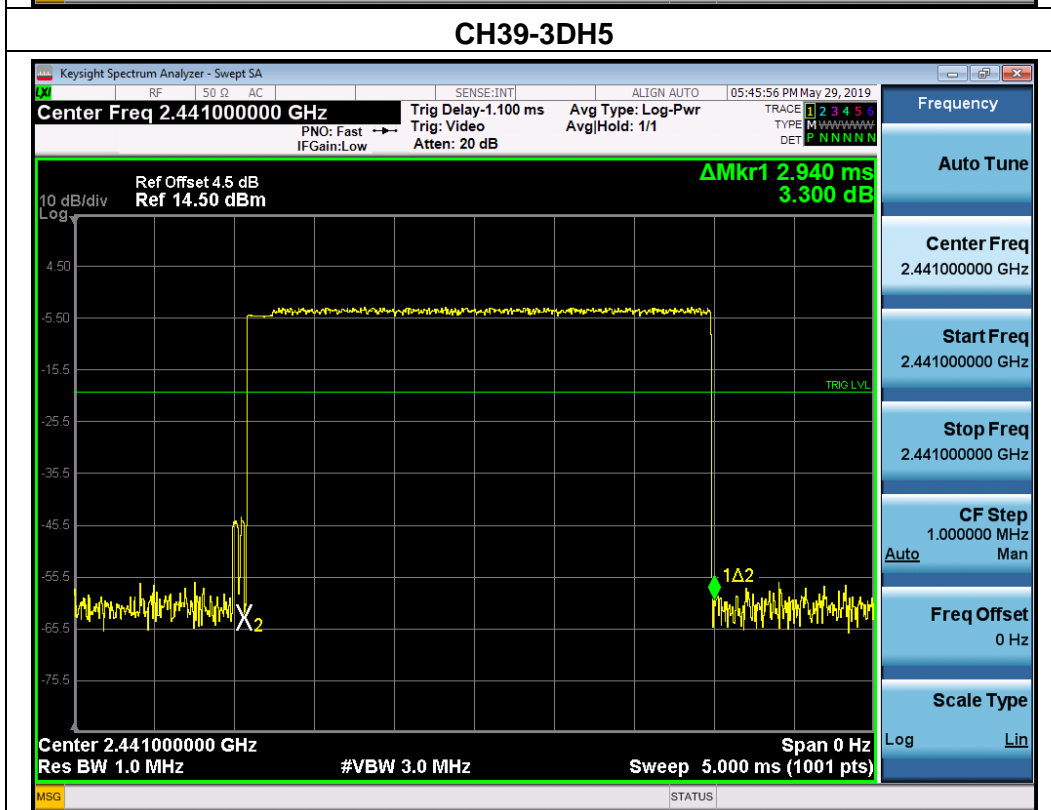
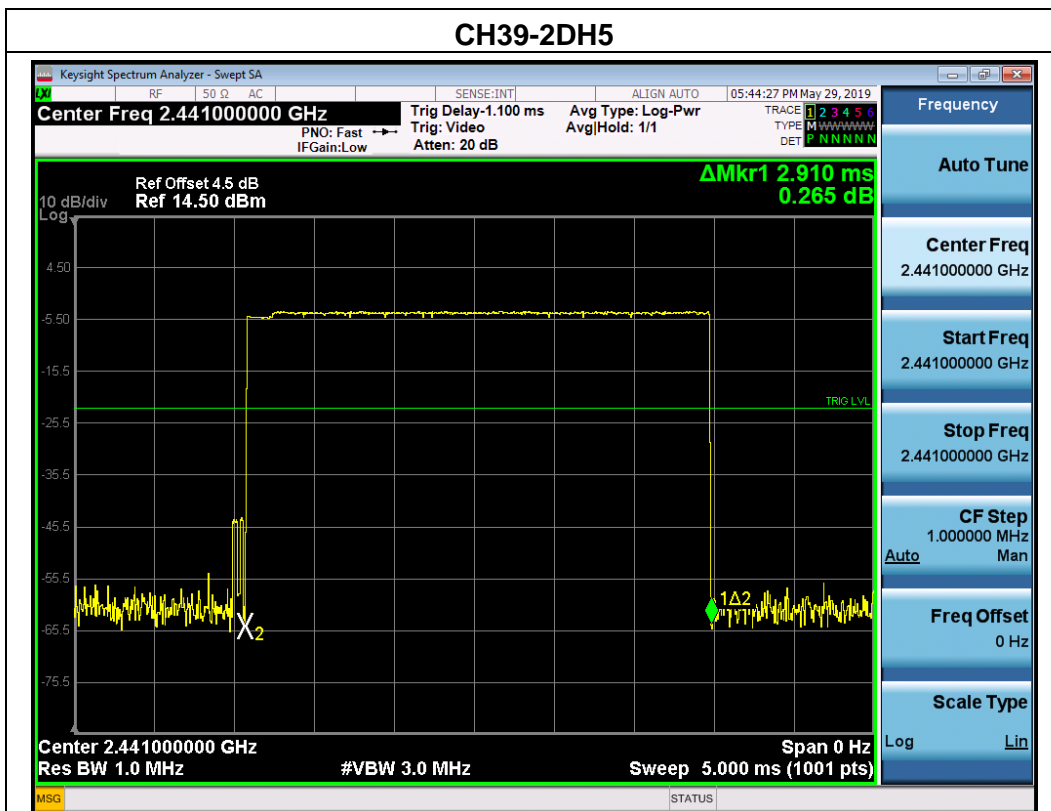




	Data Packet	Frequency	Pulse Duration	Dwell Time	Limits
			(ms)	(s)	(s)
8-DPSK	DH5	2441 MHz	2.91	0.31	0.4
	2DH5	2441 MHz	2.91	0.31	0.4
	3DH5	2441 MHz	2.94	0.31	0.4

Test plot as follows:







### 4.9. Pseudorandom Frequency Hopping Sequence

#### TEST APPLICABLE

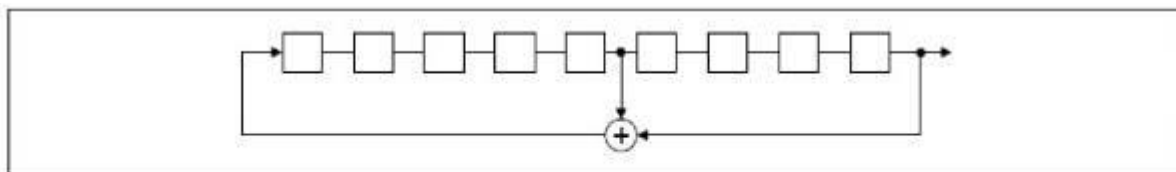
For 47 CFR Part 15C section 15.247 (a)(1) requirement:

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

#### EUT Pseudorandom Frequency Hopping Sequence Requirement

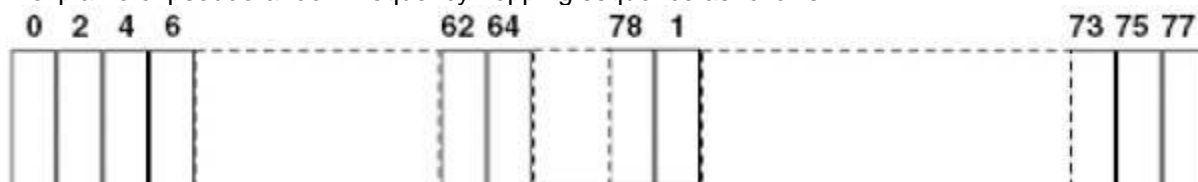
The pseudorandom frequency hopping sequence may be generated in a nine-stage shift register whose 5<sup>th</sup> and 9<sup>th</sup> stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive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

- Number of shift register stages:9
- Length of pseudo-random sequence:2<sup>9</sup>-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.

#### 4.10. Antenna Requirement

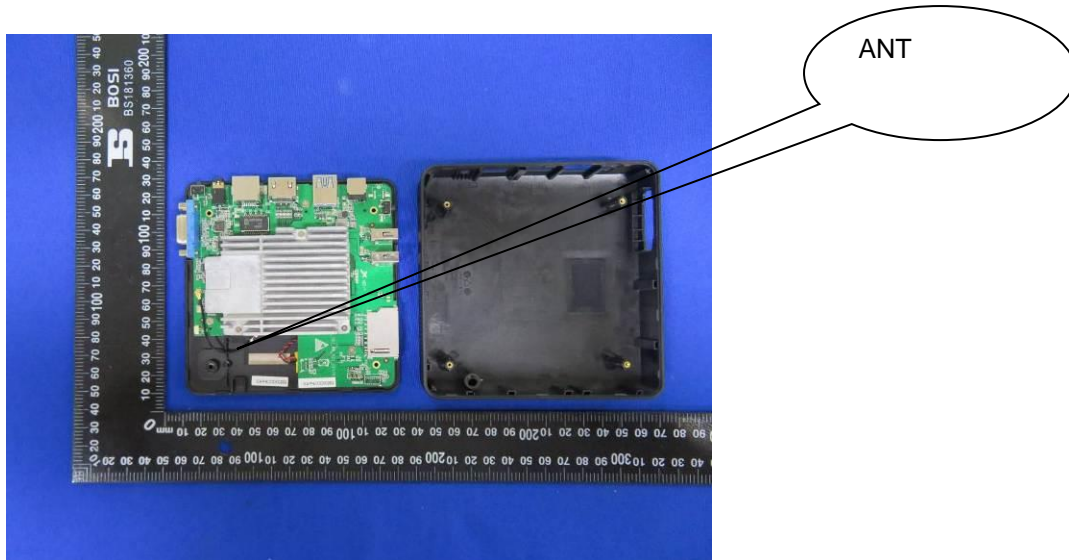
##### Standard Applicable

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.

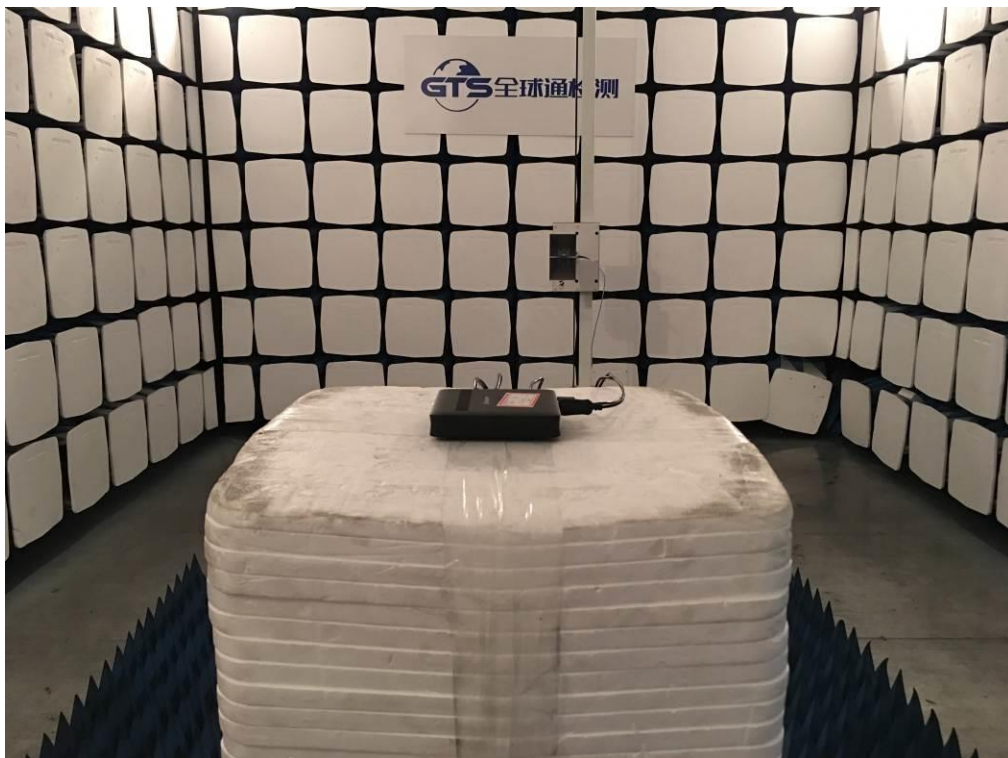
##### Test Result

The antenna used for this product is Internal Antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only 1.82dBi.



## 5. Test Setup Photos of the EUT

Radiated Emission Test



Conducted Emission





## 6. External and Internal Photos of the EUT

External



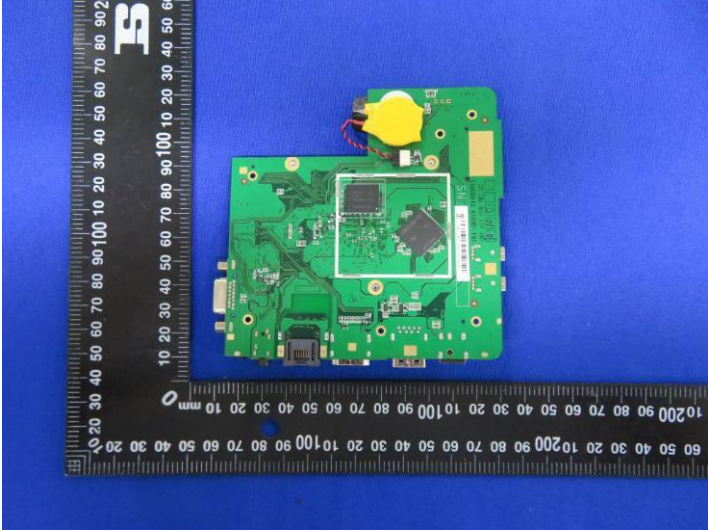
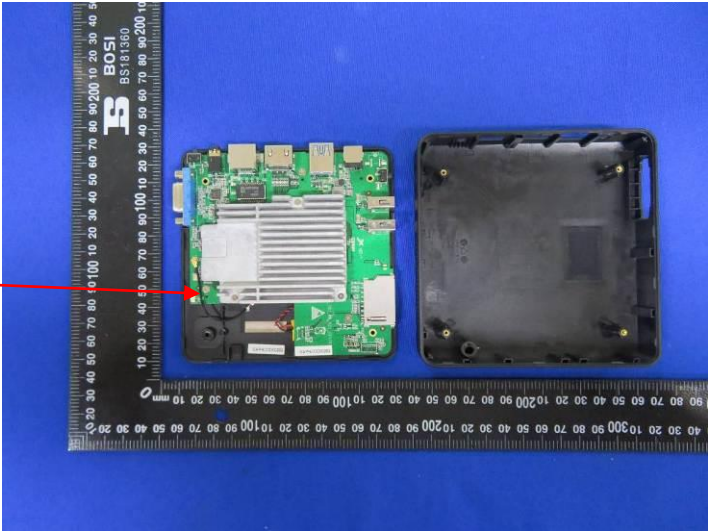






Internal Photos

Ant



.....End of Report.....