



TEST REPORT

Report Reference No...... : **TRE1710008301** R/C.....: 62200

FCC ID..... : **2AN7Q-BT-90D**

Applicant's name..... : **Dongguan kangbo Garment Co.,Ltd**

Address.....: Jiuwei,8Hao,Xiapengcun,Libeiling,Dalang,Dongguan,Guangdong,China

Manufacturer.....: Shenzhen Smart Technology Co.,Ltd

Address.....: 3F B1 YuetongshitoulingIndustrial Park Sanlian Village LonghuaDistric Shenzhen Guangdong China 518109

Test item description : **Bluetooth Hat**

Trade Mark: NINE BULL

Model/Type reference.....: BT-90D

Listed Model(s).....: -

Standard : **FCC CFR Title 47 Part 15 Subpart C Section 15.247**

Date of receipt of test sample.....: Oct.18,2017

Date of testing.....: Oct.19,2017-Nov.08,2017

Date of issue.....: Nov.09,2017

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

Compiled by
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Approved by
(Position+Printed name+Signature): RF Manager Hans Hu

Testing Laboratory Name : **Shenzhen Huatongwei International Inspection Co., Ltd.**

Address.....: 1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China

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The test report merely correspond to the test sample.

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1. TEST STANDARDS AND REPORT VERSION

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

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

1.2. Report version

Version No.	Date of issue	Description
00	Nov.09,2017	Original

2. TEST DESCRIPTION

Test Item	Section in CFR 47	Result	Test Engineer
Antenna Requirement	15.203/15.247 (c)	Pass	William Wang
AC Power Line Conducted Emissions	15.207	Pass	William Wang
Conducted Peak Output Power	15.247 (b)(1)	Pass	William Wang
20 dB Bandwidth	15.247 (a)(1)	Pass	William Wang
Carrier Frequencies Separation	15.247 (a)(1)	Pass	William Wang
Hopping Channel Number	15.247 (a)(1)	Pass	William Wang
Dwell Time	15.247 (a)(1)	Pass	William Wang
Pseudorandom Frequency Hopping Sequence	15.247(b)(4)	Pass	William Wang
Restricted band	15.247(d)/15.205	Pass	William Wang
Radiated Emissions	15.247(d)/15.209	Pass	William Wang

Note: The measurement uncertainty is not included in the test result.

3. SUMMARY

3.1. Client Information

Applicant:	Dongguan kangbo Garment Co.,Ltd
Address:	Jiuwei,8Hao,Xiapengcun,Libeiling,Dalang,Dongguan, Guangdong,China
Manufacturer:	Shenzhen Smart Technology Co.,Ltd
Address:	3F B1 YuetongshitoulingIndustrial Park Sanlian Village LonghuaDistric Shenzhen Guangdong China 518109

3.2. Product Description

Name of EUT:	Bluetooth Hat
Trade Mark:	NINE BULL
Model No.:	BT-90D
Listed Model(s):	-
Power supply:	DC 3.7V From internal battery
Adapter information:	-
Hardware version:	1.0
Software version:	2.0
Bluetooth	
Version:	Supported BT4.2+EDR
Modulation:	GFSK, $\pi/4$ DQPSK, 8DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	Integral Antenna
Antenna gain:	-0.3 dBi

3.3. Operation state

➤ Test frequency list

According to section 15.31(m), regards to the operating frequency range over 10 MHz, must select three channel which were tested. the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, please see the above gray bottom.

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

➤ TEST MODE

For RF test items:
The engineering test program was provided and enabled to make EUT continuous transmit
For AC power line conducted emissions:
The EUT was set to connect with the Bluetooth instrument under large package sizes transmission.
For Radiated suprious emissions test item:
The EUT in each of three orthogonal axis emissions had been tested ,but only the worst case (X axis) data recorded in the report.

3.4. EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

- - supplied by the manufacturer
- - supplied by the lab

○	AC Adapter	Model No.:	GTM46101-1005-USB
		Input:	100-240Va.c., 50-60Hz, 0.3A
		Output:	5Vd.c., 2.0A
	/	Manufacturer:	/
		Model No.:	/

3.5. Modifications

No modifications were implemented to meet testing criteria.

4. TEST ENVIRONMENT

4.1. Address of the test laboratory

Laboratory: Shenzhen Huatongwei International Inspection Co., Ltd.

Address: 1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China

4.2. Test Facility

CNAS-Lab Code: L1225

Shenzhen Huatongwei International Inspection Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA-Lab Cert. No.: 3902.01

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

FCC-Registration No.: 762235

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files.

IC-Registration No.:5377B-1

Two 3m Alternate Test Site of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No.: 5377B-1.

ACA

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory can also perform testing for the Australian C-Tick mark as a result of our A2LA accreditation.

4.3. Environmental conditions

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

Temperature:	15~35°C
Relative Humidity:	30~60 %
Air Pressure:	950~1050mba

4.4. 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 in calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report according to TR-100028-01 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2" and is documented in the Shenzhen Huatongwei International Inspection Co., Ltd. quality system according to 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.

Here after the best measurement capability for Shenzhen Huatongwei International Inspection Co., Ltd. is reported:

Test Items	Measurement Uncertainty	Notes
Transmitter power conducted	0.57 dB	(1)
Transmitter power Radiated	2.20 dB	(1)
Conducted spurious emissions 9kHz~40GHz	1.60 dB	(1)
Radiated spurious emissions 9kHz~40GHz	2.20 dB	(1)
Conducted Emissions 9kHz~30MHz	3.39 dB	(1)
Radiated Emissions 30~1000MHz	4.24 dB	(1)
Radiated Emissions 1~18GHz	5.16 dB	(1)
Radiated Emissions 18~40GHz	5.54 dB	(1)
Occupied Bandwidth	-----	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

4.5. Equipments Used during the Test

Conducted Emissions					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal.
1	Artificial Mains	Rohde&Schwarz	ESH2-Z5	100028	2016/11/13
2	EMI Test Receiver	Rohde&Schwarz	ESCI3	100038	2016/11/13
3	Pulse Limiter	Rohde&Schwarz	ESHSZ2	100044	2016/11/13
4	EMI Test Software	Rohde&Schwarz	ES-K1 V1.71	-	-

Radiated Emissions					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal.
1	EMI test receiver	Rohde&Schwarz	ESI 26	100009	2016/11/13
2	Loop Antenna	Rohde&Schwarz	HFH2-Z2	100020	2016/11/13
3	Ultra-Broadband Antenna	ShwarzBeck	VULB9163	538	2016/11/13
4	Horn antenna	ShwarzBeck	9120D	1011	2016/11/13
5	Horn Antenna	SCHWARZBECK	BBHA9170	25841	2016/11/13
6	Amplifier	Sonoma	310N	E009-13	2016/11/13
7	JS Amplifier	Rohde&Schwarz	JS4-00101800-28-5A	F201504	2016/11/13
8	Amplifier	Compliance Direction systems	PAP1-4060	120	2016/11/13
9	High pass filter	Compliance Direction systems	BSU-6	34202	2016/11/13
10	EMI test Software	Rohde&Schwarz	ESK1	-	-
11	EMI test Software	Audix	E3	-	-
12	TURNTABLE	MATURO	TT2.0	-	-
13	ANTENNA MAST	MATURO	TAM-4.0-P	-	-

RF Conducted methods					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal.
1	Spectrum Analyzer	Rohde&Schwarz	FSP	1164.4391.40	2016/11/13
2	MXA Signal Analyzer	Agilent Technologies	N9020A	MY5050187	2016/11/13

The Cal.Interval was one year.

5. TEST CONDITIONS AND RESULTS

5.1. Antenna requirement

Requirement

FCC CFR Title 47 Part 15 Subpart C 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

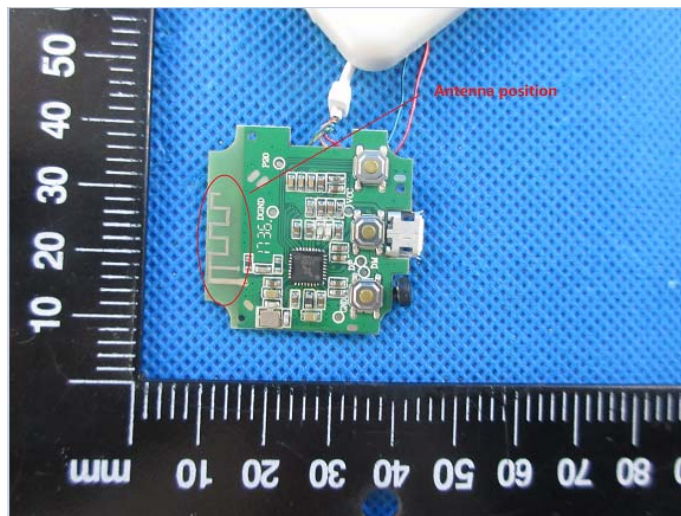
FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1)(i):

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

Test Result:

☒ **Passed** ☐ **Not Applicable**

The directional gain of the antenna less than 6 dBi, please refer to the below antenna photo.



5.2. Conducted Emissions (AC Main)

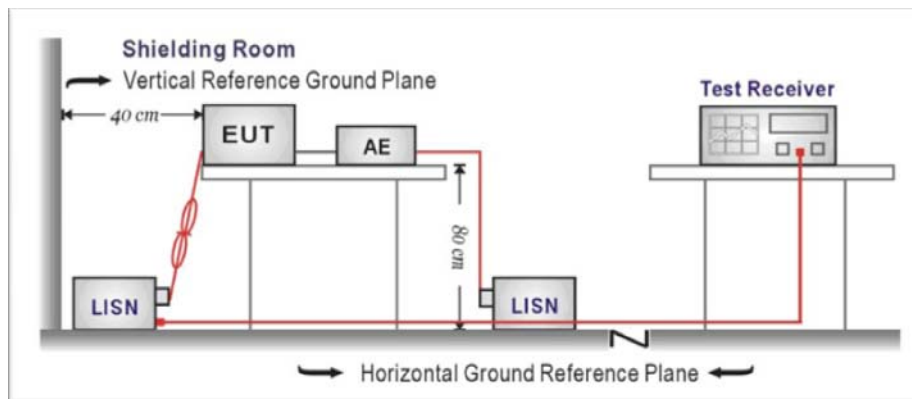
LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.207

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 EUT was setup according to ANSI C63.10:2013 requirements.
2. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface.
3. The EUT and simulators are connected to the main power through a line impedances stabilization network (LISN). The LISN provides a 50 ohm /50uH coupling impedance for the measuring equipment.
4. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs)
5. Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.
6. The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.
7. Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.
8. During the above scans, the emissions were maximized by cable manipulation.

TEST RESULTS

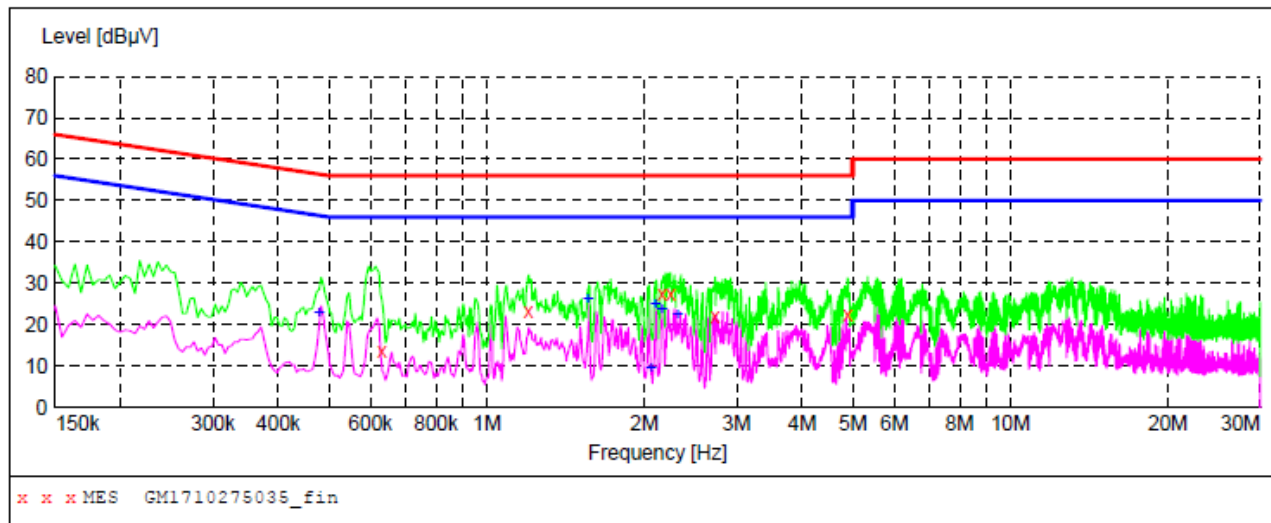
☒ Passed ☐ Not Applicable

Note:

- 1) Transd= Cable lose + Pulse Limiter Factor + Artificial Mains Factor
- 2) Margin= Limit - Level

Test Line:

L

**MEASUREMENT RESULT: "GM1710275035_fin"**

10/27/2017 2:19PM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.631500	13.60	10.2	56	42.4	QP	L1	GND
1.203000	23.30	10.2	56	32.7	QP	L1	GND
2.161500	27.20	10.2	56	28.8	QP	L1	GND
2.247000	27.40	10.2	56	28.6	QP	L1	GND
2.733000	21.80	10.2	56	34.2	QP	L1	GND
4.888500	22.20	10.3	56	33.8	QP	L1	GND

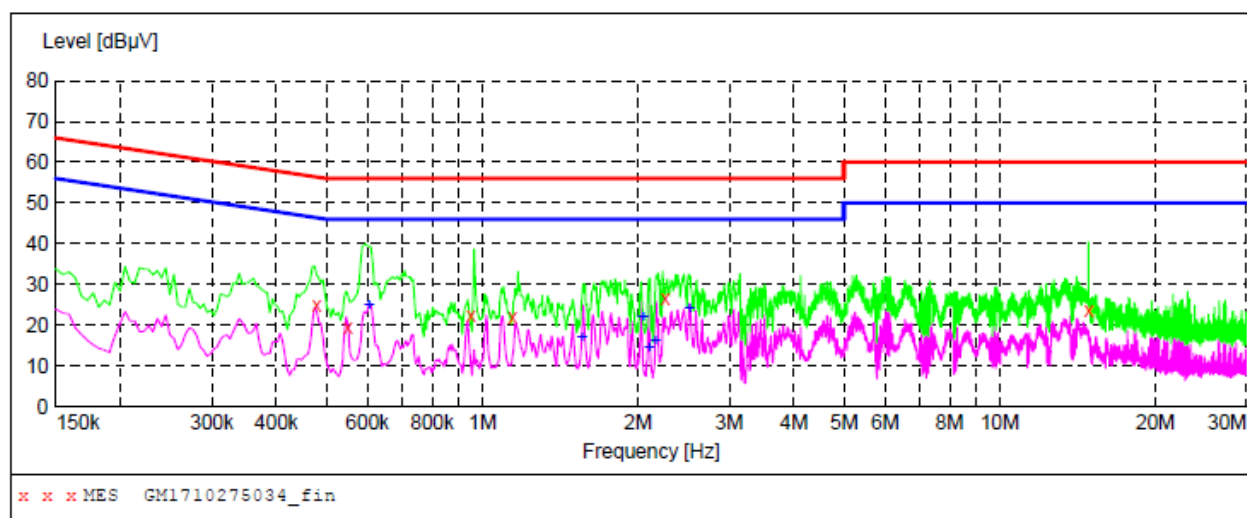
MEASUREMENT RESULT: "GM1710275035_fin2"

10/27/2017 2:19PM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.478500	23.00	10.2	46	23.4	AV	L1	GND
1.563000	26.20	10.2	46	19.8	AV	L1	GND
2.058000	9.60	10.2	46	36.4	AV	L1	GND
2.098500	25.00	10.2	46	21.0	AV	L1	GND
2.157000	23.70	10.2	46	22.3	AV	L1	GND
2.314500	22.20	10.2	46	23.8	AV	L1	GND

Test Line:

N

**MEASUREMENT RESULT: "GM1710275034_fin"**

10/27/2017 2:15PM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.478500	24.90	10.2	56	31.5	QP	N	GND
0.550500	19.30	10.2	56	36.7	QP	N	GND
0.951000	22.20	10.2	56	33.8	QP	N	GND
1.144500	21.90	10.2	56	34.1	QP	N	GND
2.256000	26.50	10.2	56	29.5	QP	N	GND
14.874000	23.80	10.5	60	36.2	QP	N	GND

MEASUREMENT RESULT: "GM1710275034_fin2"

10/27/2017 2:15PM

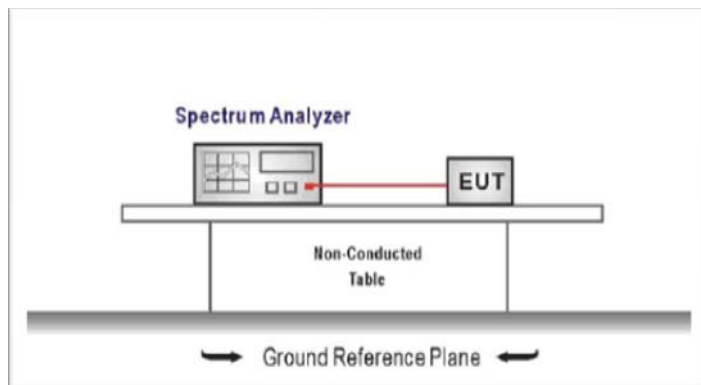
Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.604500	24.80	10.2	46	21.2	AV	N	GND
1.558500	17.10	10.2	46	28.9	AV	N	GND
2.049000	21.90	10.2	46	24.1	AV	N	GND
2.098500	14.30	10.2	46	31.7	AV	N	GND
2.161500	16.30	10.2	46	29.7	AV	N	GND
2.512500	24.00	10.2	46	22.0	AV	N	GND

5.3. Conducted Peak Output Power

LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (b)(1): 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 CONFIGURATION



TEST PROCEDURE

1. The transmitter output was connected to the spectrum analyzer through an attenuator, the pathloss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:
 Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
 RBW $\geq$ the 20 dB bandwidth of the emission being measured, VBW $\geq$ RBW
 Sweep = auto, Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

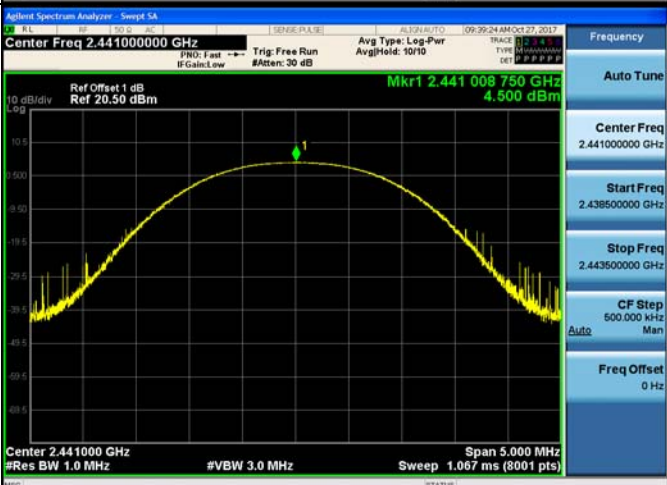
TEST MODE:

Please refer to the clause 3.3

TEST RESULTS

☒ Passed ☐ Not Applicable

Modulation type	Channel	Output power (dBm)	Limit (dBm)	Result
GFSK	00	5.465	≤ 30.00	Pass
	39	4.500		
	78	3.819		
$\pi/4$ DQPSK	00	3.498	≤ 21.00	Pass
	39	2.247		
	78	1.449		
8DPSK	00	3.814	≤ 21.00	Pass
	39	2.550		
	78	1.711		

Modulation Type:		GFSK
CH00		
CH39		
CH78		

Modulation Type:		$\pi/4$ DQPSK
CH00		
CH39		
CH78		

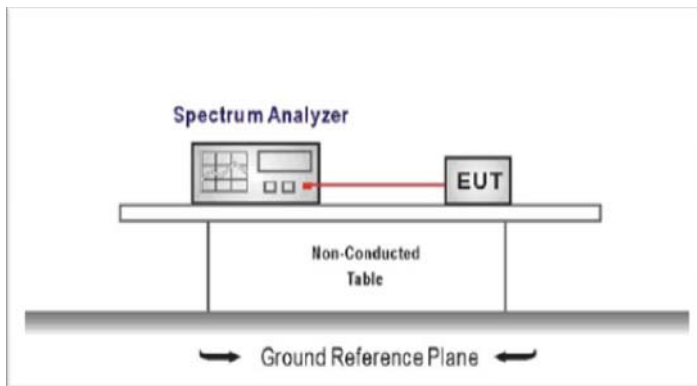
Modulation Type:		8DPSK
CH00		
CH39		
CH78		

5.4. 20 dB Bandwidth

LIMIT

N/A

TEST CONFIGURATION



TEST PROCEDURE

1. The transmitter output was connected to the spectrum analyzer through an attenuator, the path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:
 Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
 RBW $\geq$ 1% of the 20 dB bandwidth, VBW $\geq$ RBW
 Sweep = auto, Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

TEST MODE:

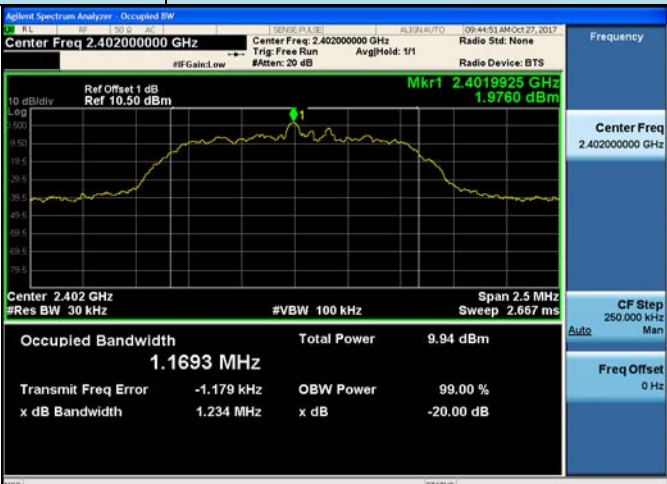
Please refer to the clause 3.3

TEST RESULTS

☒ Passed ☐ Not Applicable

Modulation type	Channel	20 dB Bandwidth (MHz)	Limit (MHz)	Result
GFSK	00	0.7847	-	Pass
	39	0.7892		
	78	1.004		
$\pi/4$ DQPSK	00	1.234	-	Pass
	39	1.264		
	78	1.266		
8DPSK	00	1.260	-	Pass
	39	1.257		
	78	1.270		

Modulation Type:		GFSK	
CH00			
CH39			
CH78			

Modulation Type:		$\pi/4$ DQPSK
CH00		
CH39		
CH78		

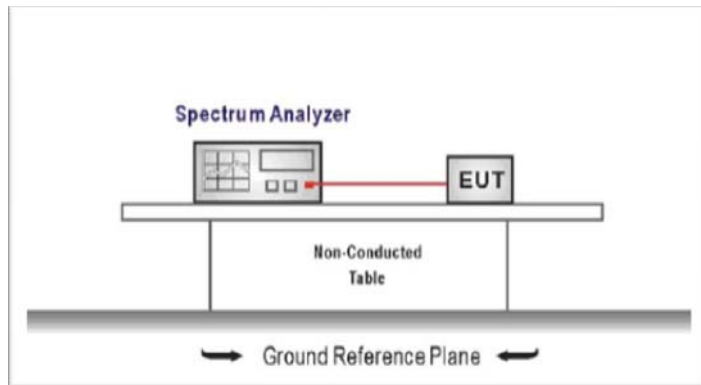
Modulation Type:		8DPSK
CH00		
CH39		
CH78		

5.5. Carrier Frequencies Separation

LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(1): Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25 kHz or the $2/3 \times 20$ dB bandwidth of the hopping channel, whichever is greater.

TEST CONFIGURATION



TEST PROCEDURE

1. The transmitter output was connected to the spectrum analyzer through an attenuator, the path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:
Span = wide enough to capture the peaks of two adjacent channels
RBW $\geq 1\%$ of the span, VBW $\geq$ RBW
Sweep = auto, Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

TEST MODE:

Please refer to the clause 3.3

TEST RESULTS

☒ Passed ☐ Not Applicable

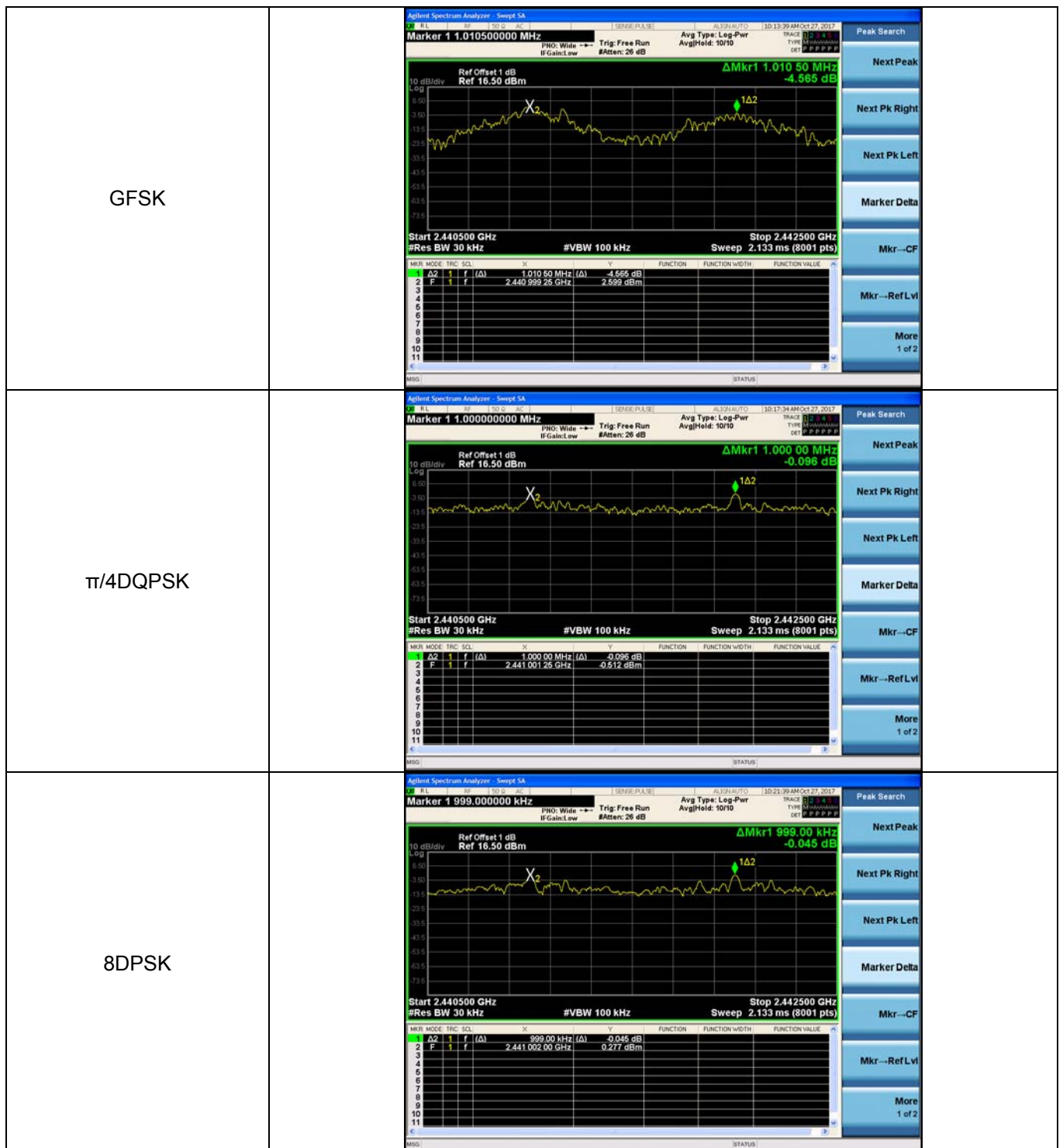
Modulation type	Channel	Carrier Frequencies Separation (MHz)	Limit (MHz) *	Result
GFSK	39	1.011	≥ 1.004	Pass
$\pi/4$ DQPSK	39	1.000	≥ 0.844	Pass
8DPSK	39	0.999	≥ 0.847	Pass

Note:

*: GFSK limit = The maximum 20 dB Bandwidth for GFSK modulation on the section 5.4.

$\pi/4$ DQPSK limit = $2/3 \times$ The maximum 20 dB Bandwidth for $\pi/4$ DQPSK modulation on the section 5.4.

8DPSK limit = $2/3 \times$ The maximum 20 dB Bandwidth for 8DPSK modulation on the section 5.4

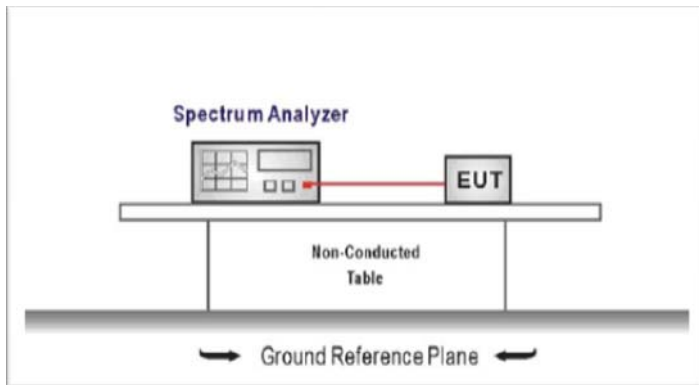


5.6. Hopping Channel Number

LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(1): Frequency hopping systems in the 2400–2483.5 MHz band shall use at least **15** channels.

TEST CONFIGURATION



TEST PROCEDURE

1. The transmitter output was connected to the spectrum analyzer through an attenuator, the path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:
 Span = the frequency band of operation
 RBW $\geq$ 1% of the span, VBW $\geq$ RBW
 Sweep = auto, Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

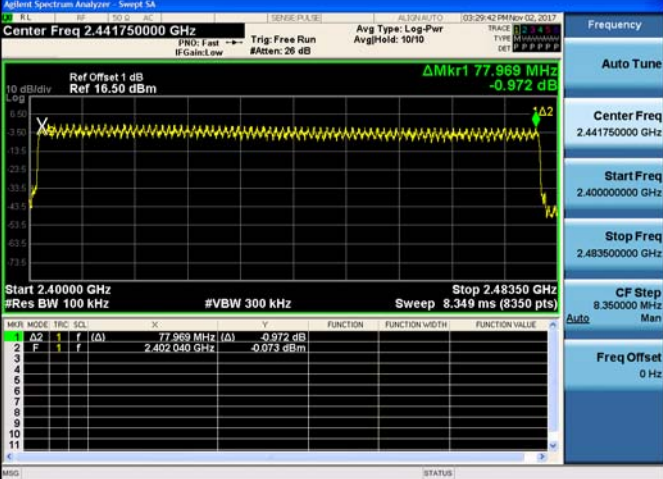
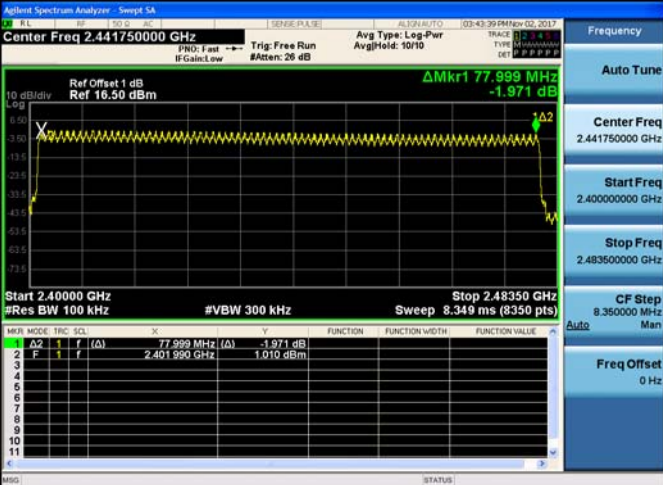
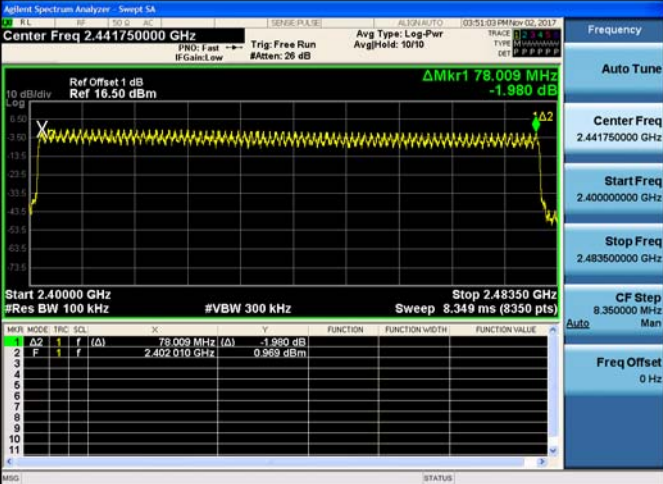
TEST MODE:

Please refer to the clause 3.3

TEST RESULTS

☒ Passed ☐ Not Applicable

Modulation type	Channel number	Limit	Result
GFSK	79	≥ 15.00	Pass
$\pi/4$ DQPSK	79		
8DPSK	79		

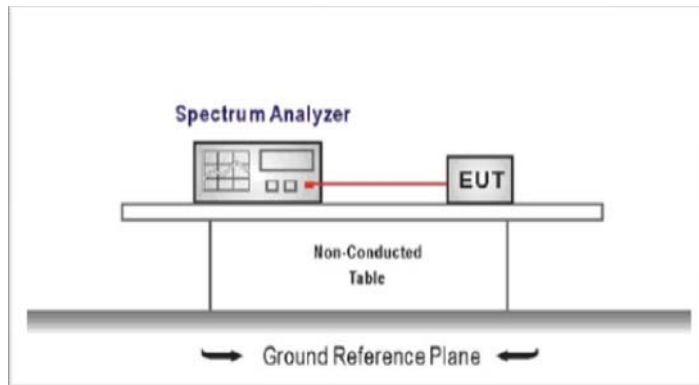
GFSK	 Agilent Spectrum Analyzer - Sweep 5A Center Freq 2.441750000 GHz Ref Offset: 1 dB Ref 16.50 dBm ΔMkr1 77.969 MHz -0.972 dB Start 2.40000 GHz #Res BW 100 kHz Stop 2.48350 GHz Sweep 8.349 ms (8350 pts) #VBW 300 kHz Function: F Function Value: -0.972 dB Function Width: 2.402040 GHz Function: F Function Value: -0.073 dBm Function Width: 2.402040 GHz Frequency Auto Tune Center Freq 2.441750000 GHz Start Freq 2.400000000 GHz Stop Freq 2.483500000 GHz CF Step 8.350000 MHz Freq Offset 0 Hz
$\pi/4$ DQPSK	 Agilent Spectrum Analyzer - Sweep 5A Center Freq 2.441750000 GHz Ref Offset: 1 dB Ref 16.50 dBm ΔMkr1 77.999 MHz -1.971 dB Start 2.40000 GHz #Res BW 100 kHz Stop 2.48350 GHz Sweep 8.350 ms (8350 pts) #VBW 300 kHz Function: F Function Value: -1.971 dB Function Width: 2.401990 GHz Function: F Function Value: 1.010 dBm Function Width: 2.401990 GHz Frequency Auto Tune Center Freq 2.441750000 GHz Start Freq 2.400000000 GHz Stop Freq 2.483500000 GHz CF Step 8.350000 MHz Freq Offset 0 Hz
8DPSK	 Agilent Spectrum Analyzer - Sweep 5A Center Freq 2.441750000 GHz Ref Offset: 1 dB Ref 16.50 dBm ΔMkr1 78.009 MHz -1.980 dB Start 2.40000 GHz #Res BW 100 kHz Stop 2.48350 GHz Sweep 8.349 ms (8350 pts) #VBW 300 kHz Function: F Function Value: -1.980 dB Function Width: 2.402010 GHz Function: F Function Value: 0.969 dBm Function Width: 2.402010 GHz Frequency Auto Tune Center Freq 2.441750000 GHz Start Freq 2.400000000 GHz Stop Freq 2.483500000 GHz CF Step 8.350000 MHz Freq Offset 0 Hz

5.7. Dwell Time

LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(1): 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 CONFIGURATION



TEST PROCEDURE

1. The transmitter output was connected to the spectrum analyzer through an attenuator, the path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:
Span = zero span, centered on a hopping channel, RBW= 1 MHz, VBW ≥ RBW
Sweep = as necessary to capture the entire dwell time per hopping channel,
Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

TEST MODE:

Please refer to the clause 3.3

TEST RESULTS

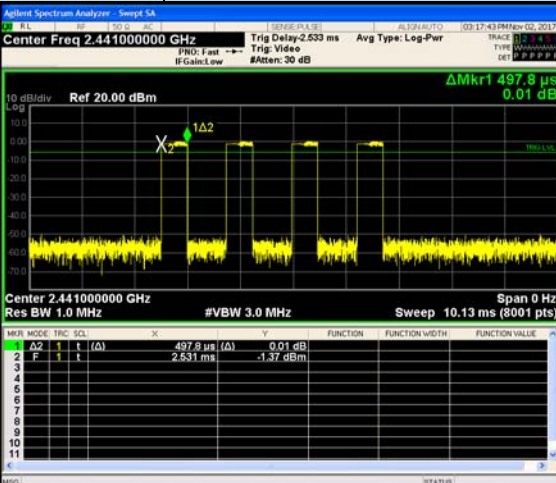
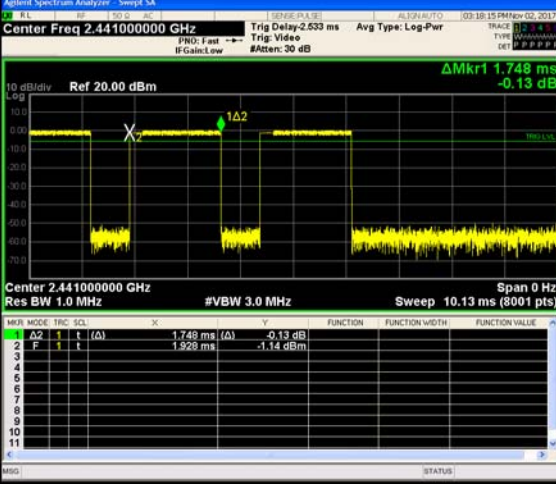
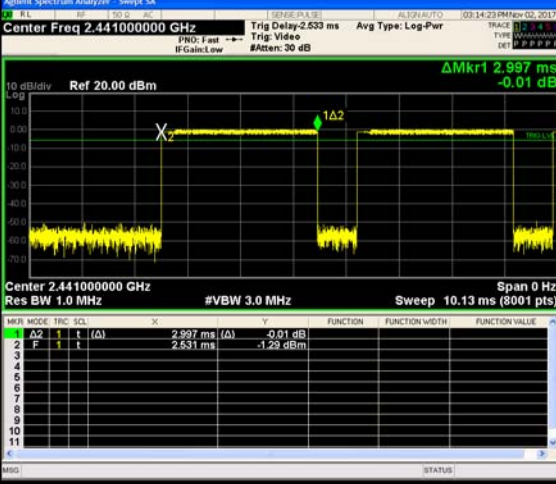
☒ Passed ☐ Not Applicable

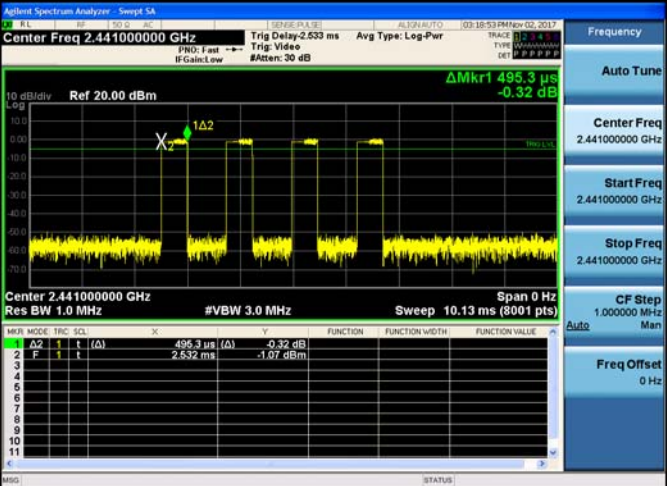
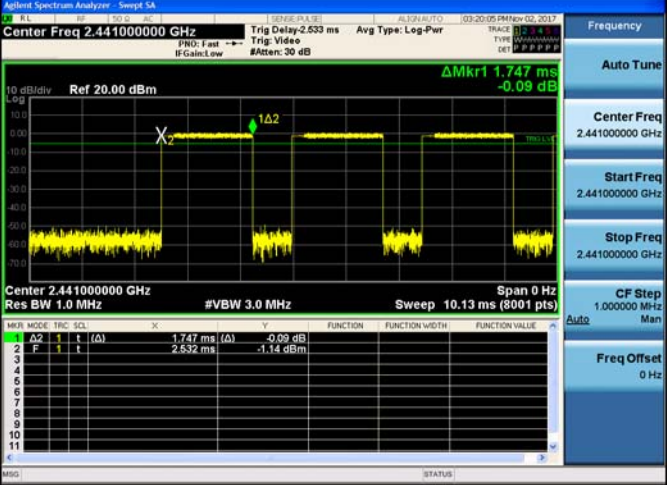
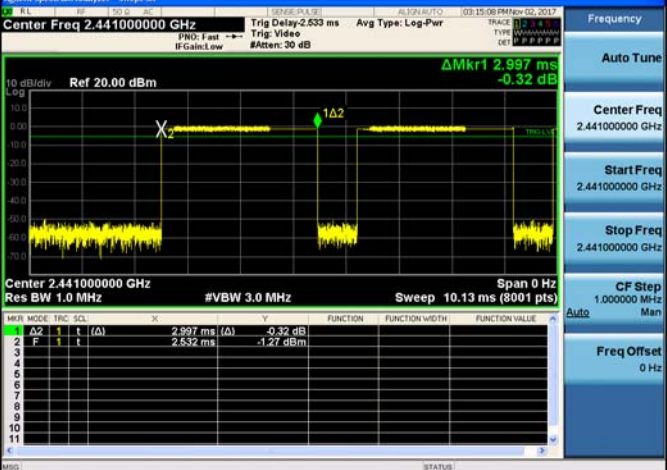
Modulation type	Channel	Dwell time (Second)	Limit (Second)	Result
GFSK	DH1	0.157	≤ 0.40	Pass
	DH3	0.278		
	DH5	0.319		
π/4DQPSK	2DH1	0.16	≤ 0.40	Pass
	2DH3	0.28		
	2DH5	0.32		
8DPSK	3DH1	0.16	≤ 0.40	Pass
	3DH3	0.28		
	3DH5	0.32		

Note:

1. We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.
2. Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second for DH1, 2DH1, 3DH1
Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second for DH3, 2DH3, 3DH3
Dwell time=Pulse time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second for DH5, 2DH5, 3DH5

Modulation Type:		GFSK	
DH1			

Modulation Type:		$\pi/4$ DQPSK
2DH1		Frequency Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz CF Step 1.000000 MHz Freq Offset 0 Hz
2DH3		Frequency Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz CF Step 1.000000 MHz Freq Offset 0 Hz
2DH5		Frequency Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz CF Step 1.000000 MHz Freq Offset 0 Hz

Modulation Type:		8DPSK	
3DH1			
3DH3			
3DH5			

5.8. Pseudorandom Frequency Hopping Sequence

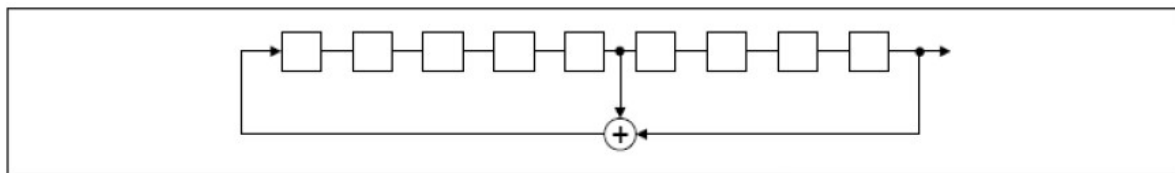
LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(1): 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.

TEST RESULTS

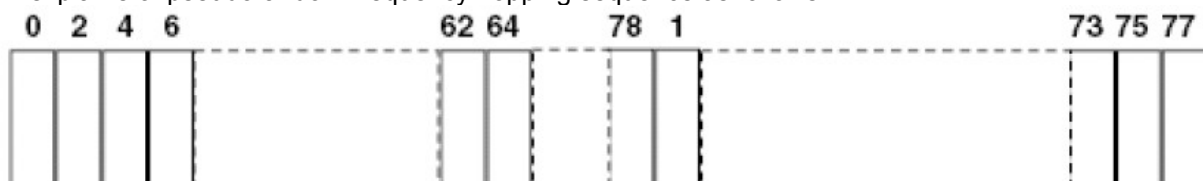
The pseudorandom frequency hopping sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones, for example: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

- Number of shift register stages: 9
- Length of pseudo-random sequence: $2^9 - 1 = 511$ 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 on the average by each transmitter.

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

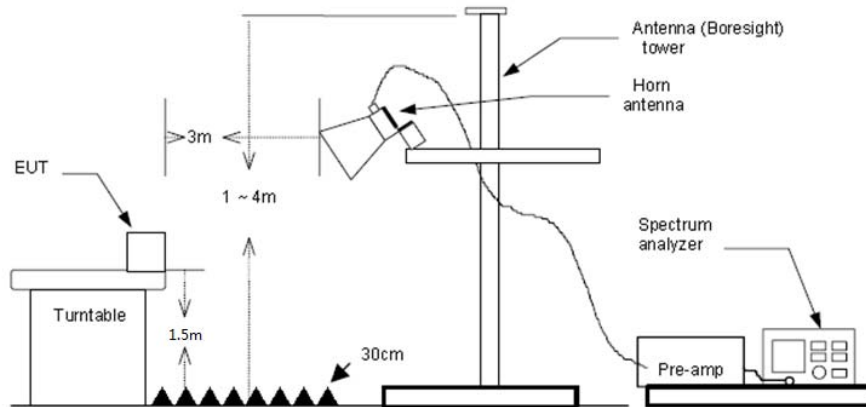
5.9. Restricted band (radiated)

LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, Radiated Emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the Radiated Emissions limits specified in §15.209(a) (see §15.205(c)).

TEST CONFIGURATION



TEST PROCEDURE

1. The EUT was setup and tested according to ANSI C63.10:2013 for compliance to FCC 47CFR 15.247 requirements.
2. The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.
5. The receiver set as follow:
RBW=1 MHz, VBW=3 MHz Peak detector for Peak value
RBW=1 MHz, VBW=10 Hz Peak detector for Average value.

TEST MODE:

Please refer to the clause 3.3

TEST RESULTS

☒ Passed ☐ Not Applicable

Note:

- 1) Final level= Read level + Antenna Factor+ Cable Loss- Preamp Factor
- 2) Have pre-scan all modulation mode, found the GFSK modulation which it was worst case, so only the worst case's data on the test report.
- 3) The peak level is lower than average limit(54 dBuV/m), this data is the too weak instrument of signal is unable to test.

CH00									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization	Test value
2483.50	35.04	27.26	6.83	37.87	31.26	74.00	-42.74	Vertical	Peak
2498.47	51.58	27.21	6.84	37.87	47.76	74.00	-26.24	Vertical	Peak
2500.00	33.17	27.20	6.84	37.87	29.34	74.00	-44.66	Vertical	Peak
2483.50	34.33	27.26	6.83	37.87	30.55	74.00	-43.45	Horizontal	Peak
2500.00	34.49	27.20	6.84	37.87	30.66	74.00	-43.34	Horizontal	Peak
2310.00	21.96	28.05	6.62	37.65	18.98	54.00	-35.02	Vertical	Average
2390.03	22.28	27.65	6.75	37.87	18.81	54.00	-35.19	Vertical	Average
2310.00	22.38	28.05	6.62	37.65	19.40	54.00	-34.60	Horizontal	Average
2390.03	22.15	27.65	6.75	37.87	18.68	54.00	-35.32	Horizontal	Average

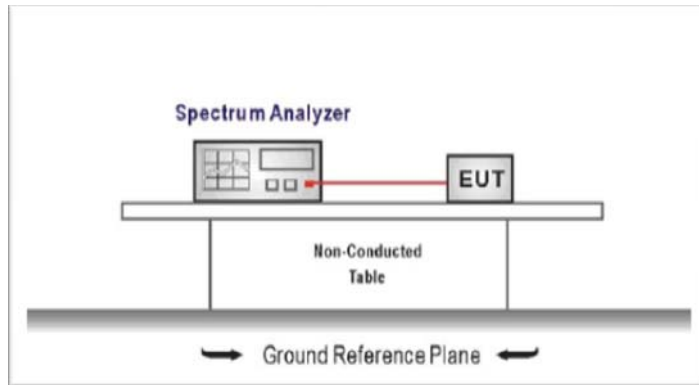
CH78									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization	Test value
2310.00	33.99	28.05	6.62	37.65	31.01	74.00	-42.99	Vertical	Peak
2390.03	49.43	27.65	6.75	37.87	45.96	74.00	-28.04	Vertical	Peak
2310.00	34.03	28.05	6.62	37.65	31.05	74.00	-42.95	Horizontal	Peak
2389.93	41.47	27.65	6.75	37.87	38.00	74.00	-36.00	Horizontal	Peak
2483.50	21.66	27.26	6.83	37.87	17.88	54.00	-36.12	Vertical	Average
2500.00	21.55	27.20	6.84	37.87	17.72	54.00	-36.28	Vertical	Average
2483.50	22.10	27.26	6.83	37.87	18.32	54.00	-35.68	Horizontal	Average
2500.00	23.13	27.20	6.84	37.87	19.30	54.00	-34.70	Horizontal	Average

5.10. Band edge and Spurious Emissions (conducted)

LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d): 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 CONFIGURATION



TEST PROCEDURE

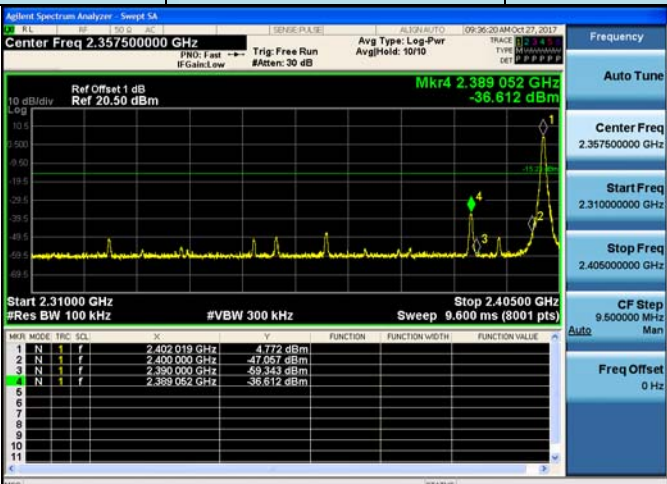
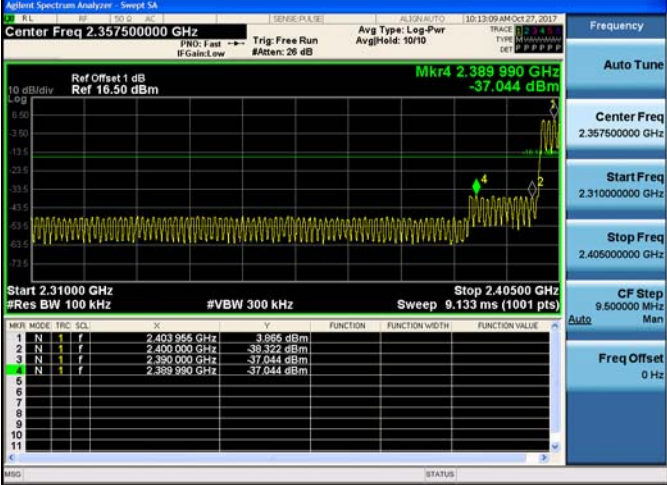
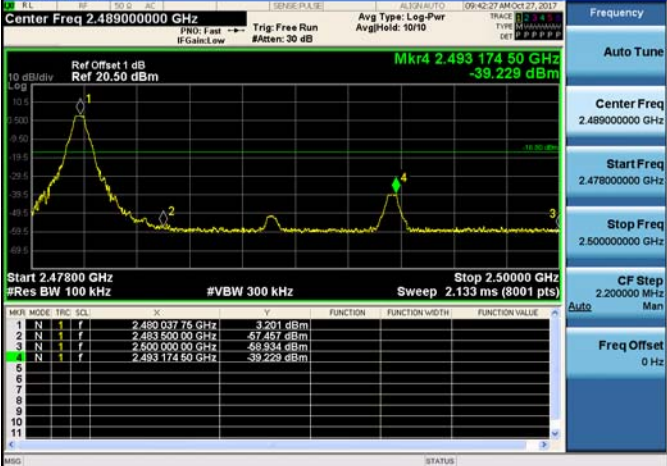
1. The transmitter output was connected to the spectrum analyzer through an attenuator, the path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:
RBW = 100 kHz, VBW $\geq$ RBW
Sweep = auto, Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

TEST MODE:

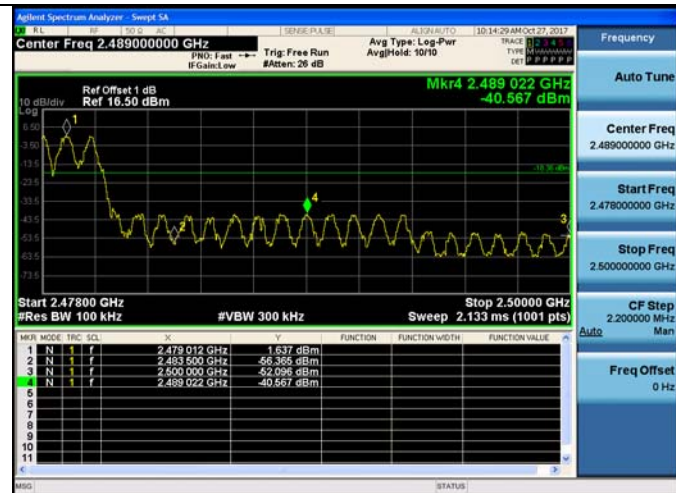
Please refer to the clause 3.3

TEST RESULTS

☒ Passed ☐ Not Applicable

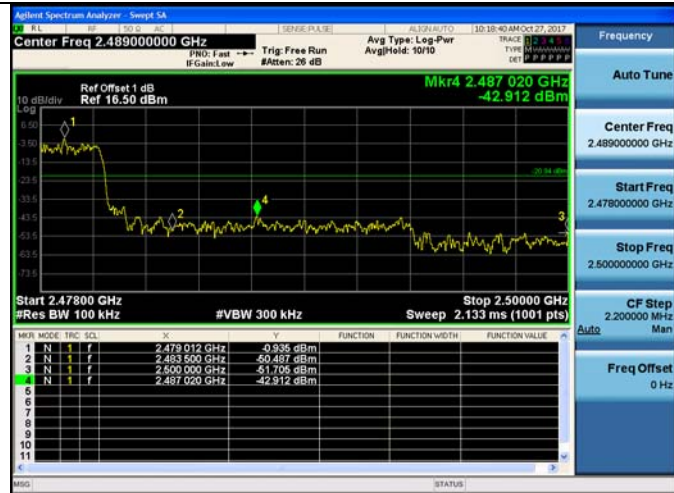
Test Item:	Band edge	Modulation type:	GFSK
CH00 No hopping mode			
CH00 Hopping mode			
CH78 No hopping mode			

CH78
Hopping mode



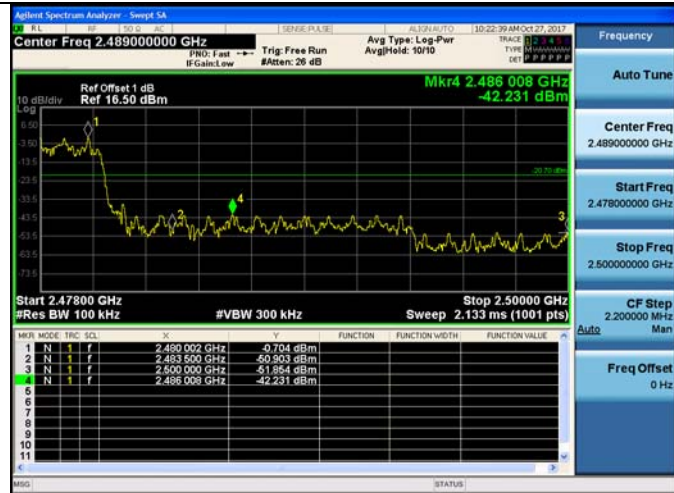
Test Item:	Band edge	Modulation type:	$\pi/4$ DQPSK
CH00 No hopping mode			
CH00 Hopping mode			
CH78 No hopping mode			

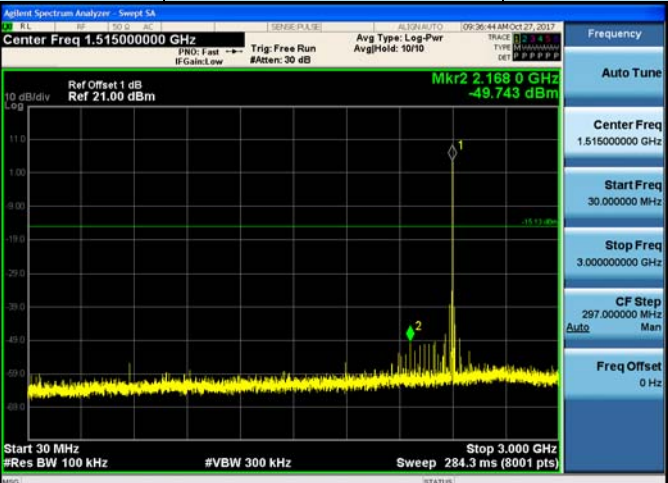
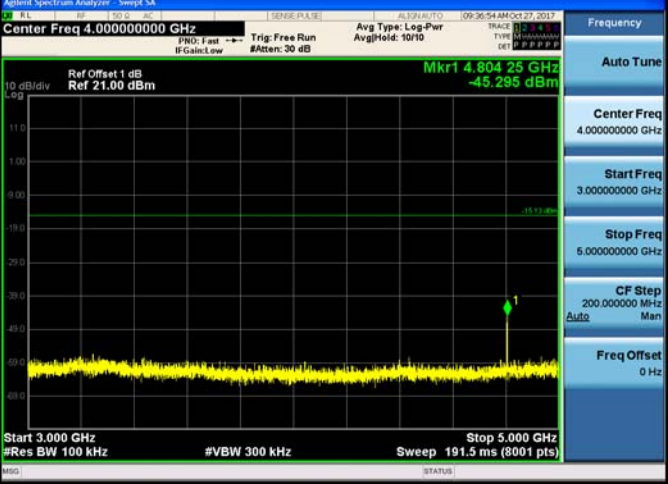
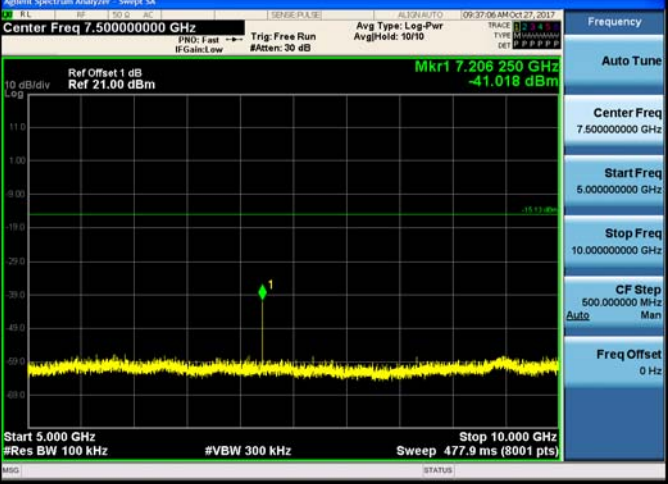
CH78
Hopping mode

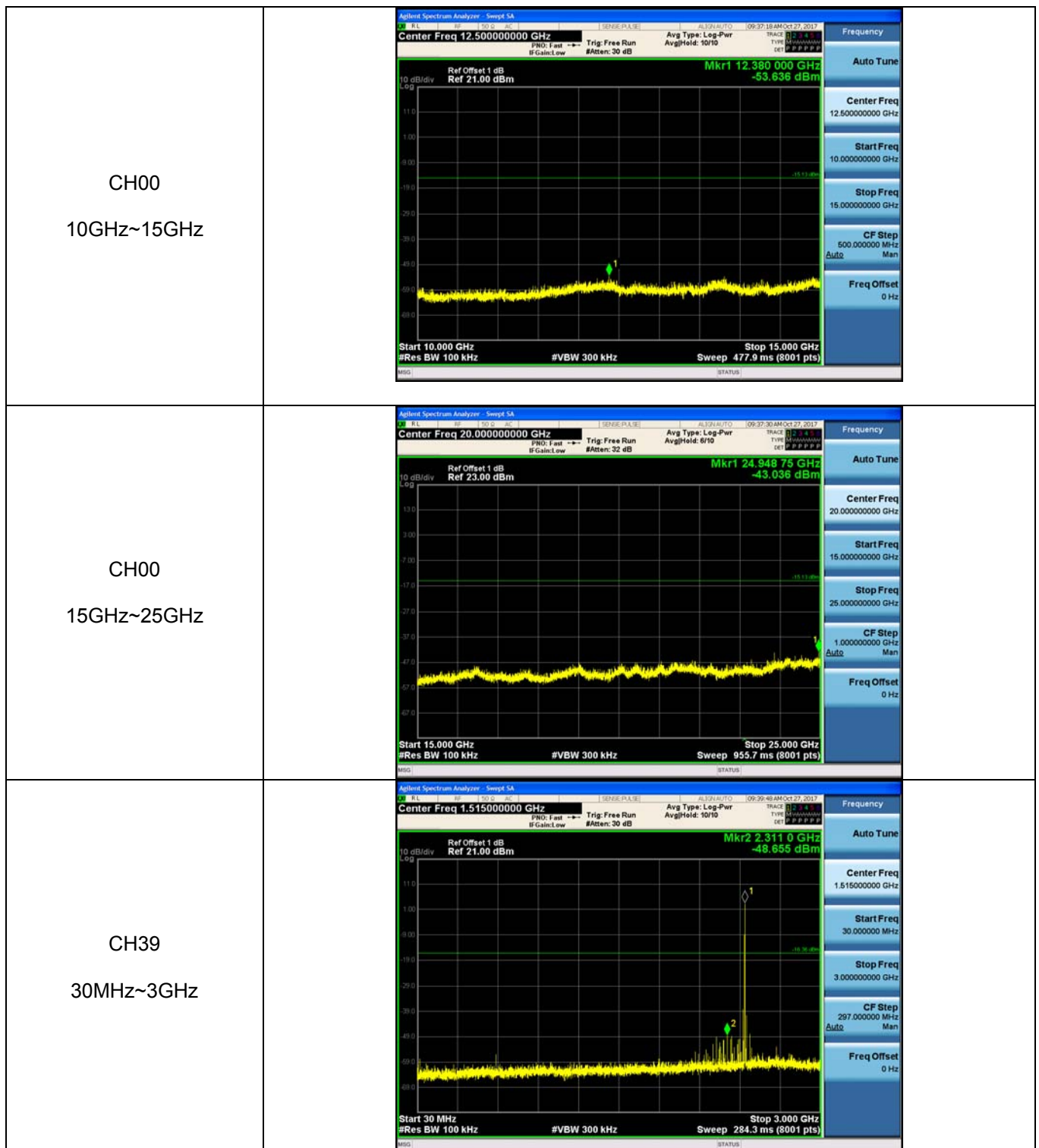


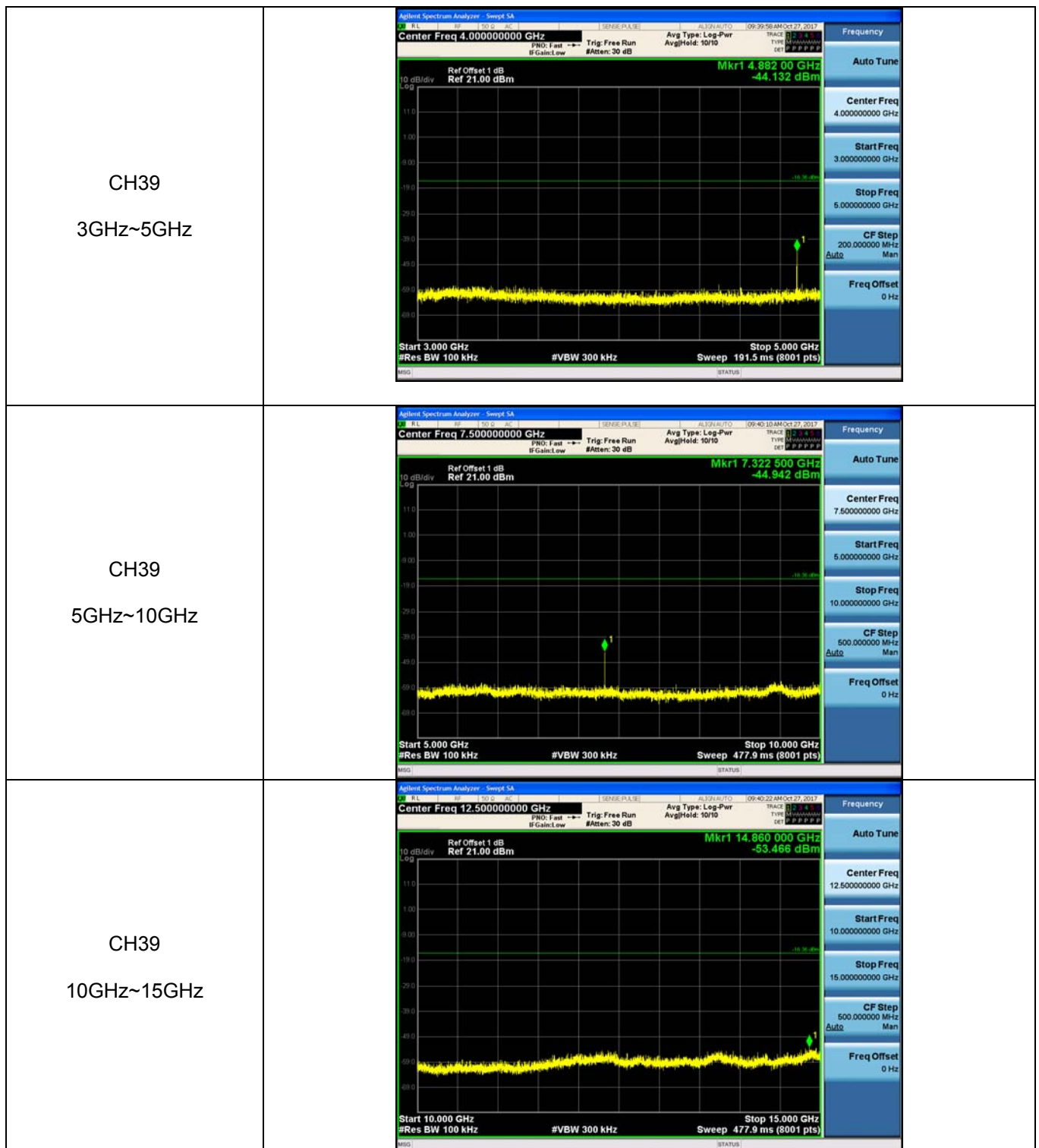
Test Item:	Band edge	Modulation type:	8DPSK
CH00 No hopping mode			
CH00 Hopping mode			
CH78 No hopping mode			

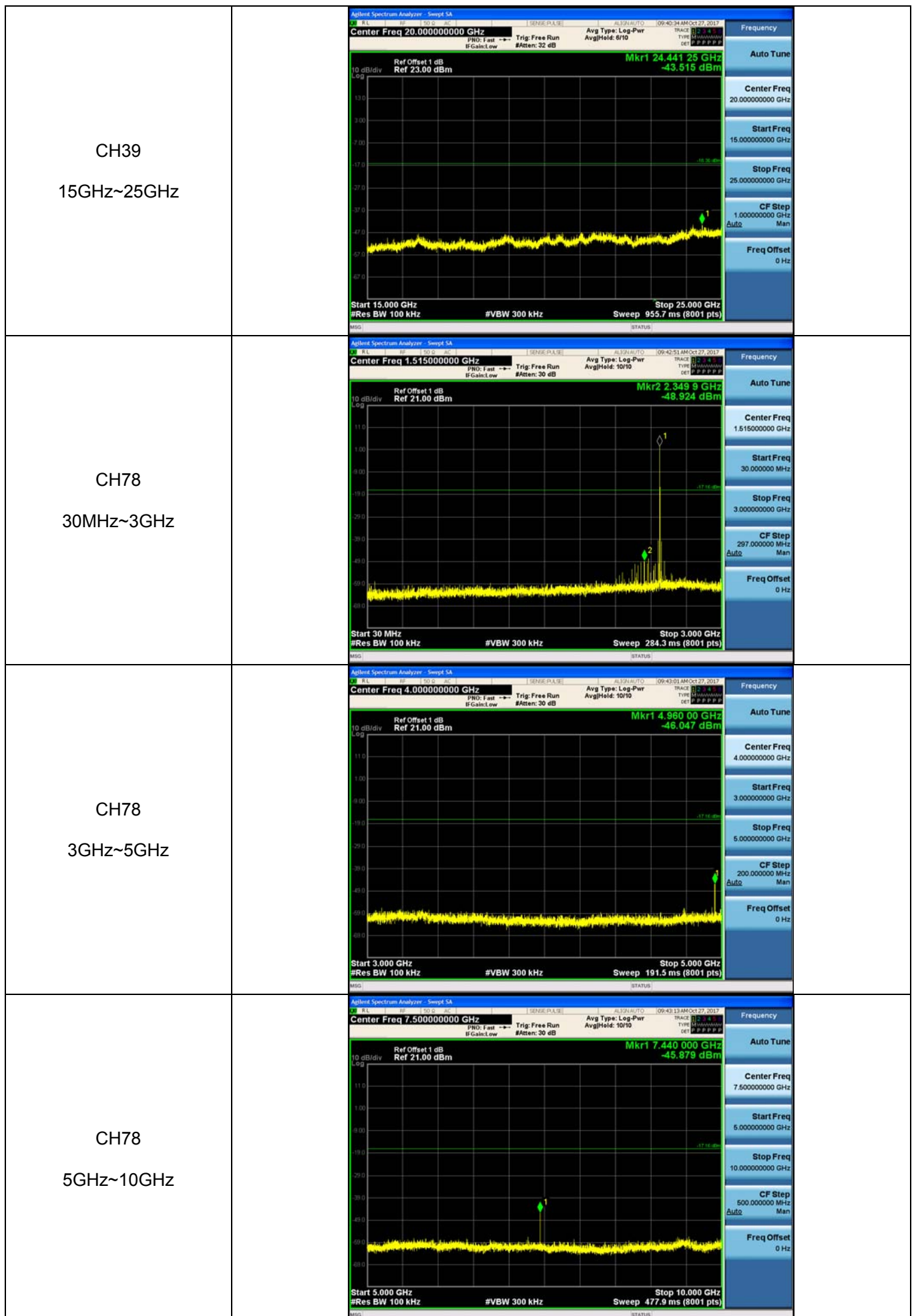
CH78
Hoppig mode

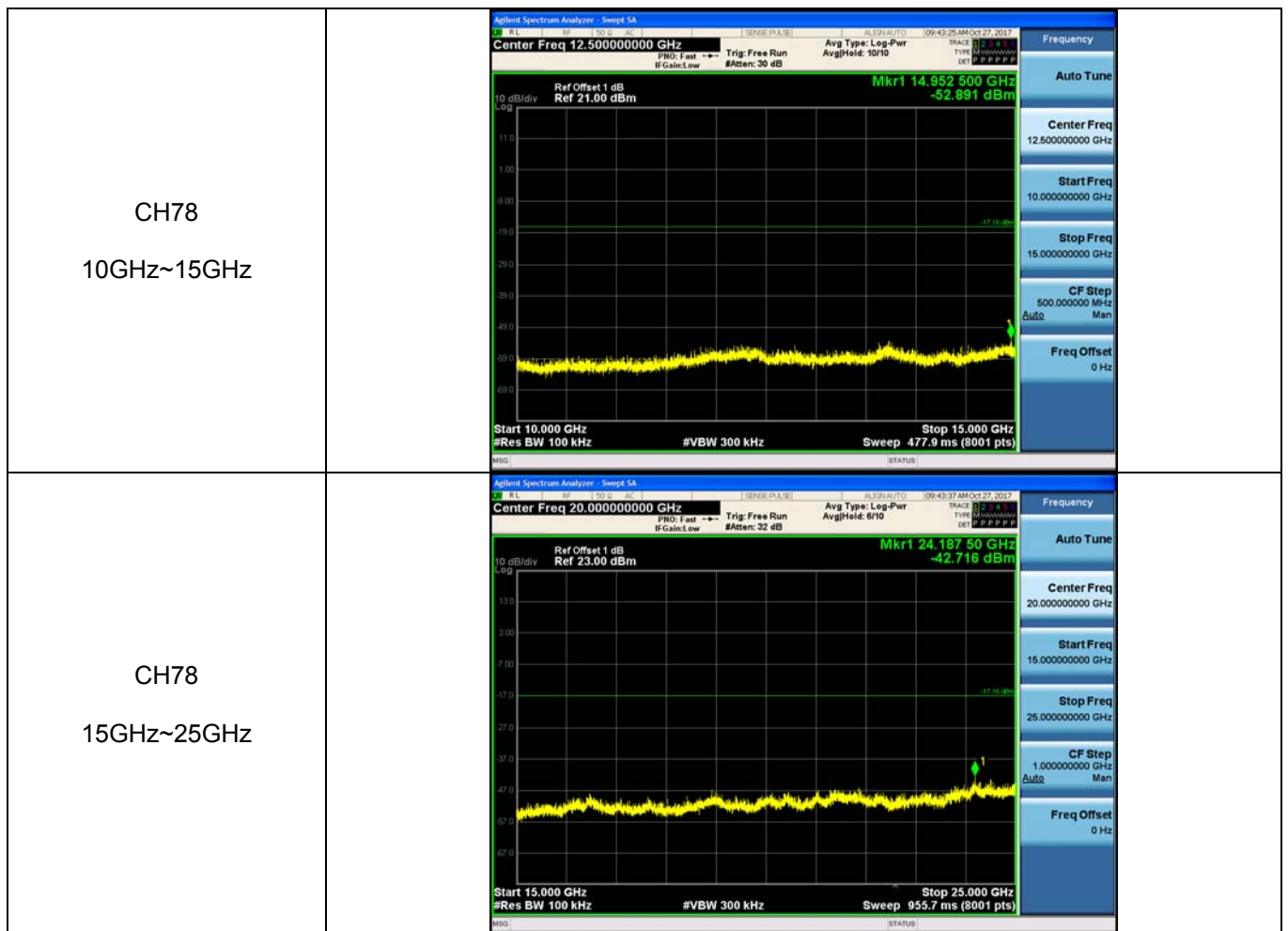


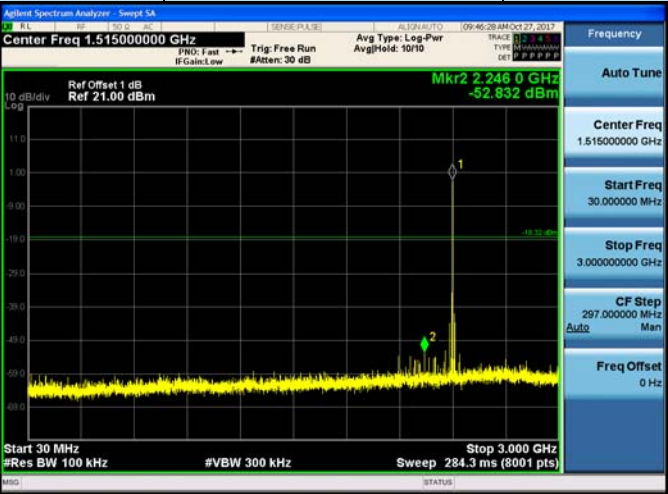
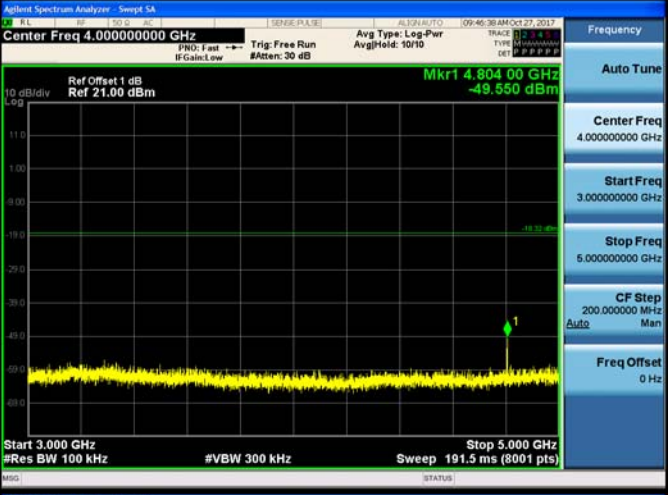
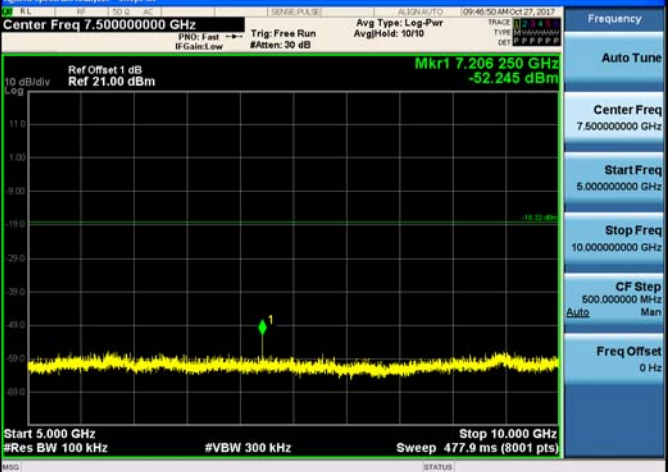
Test Item:	SE	Modulation type:	GFSK
CH00 30MHz~3GHz			
CH00 3GHz~5GHz			
CH00 5GHz~10GHz			

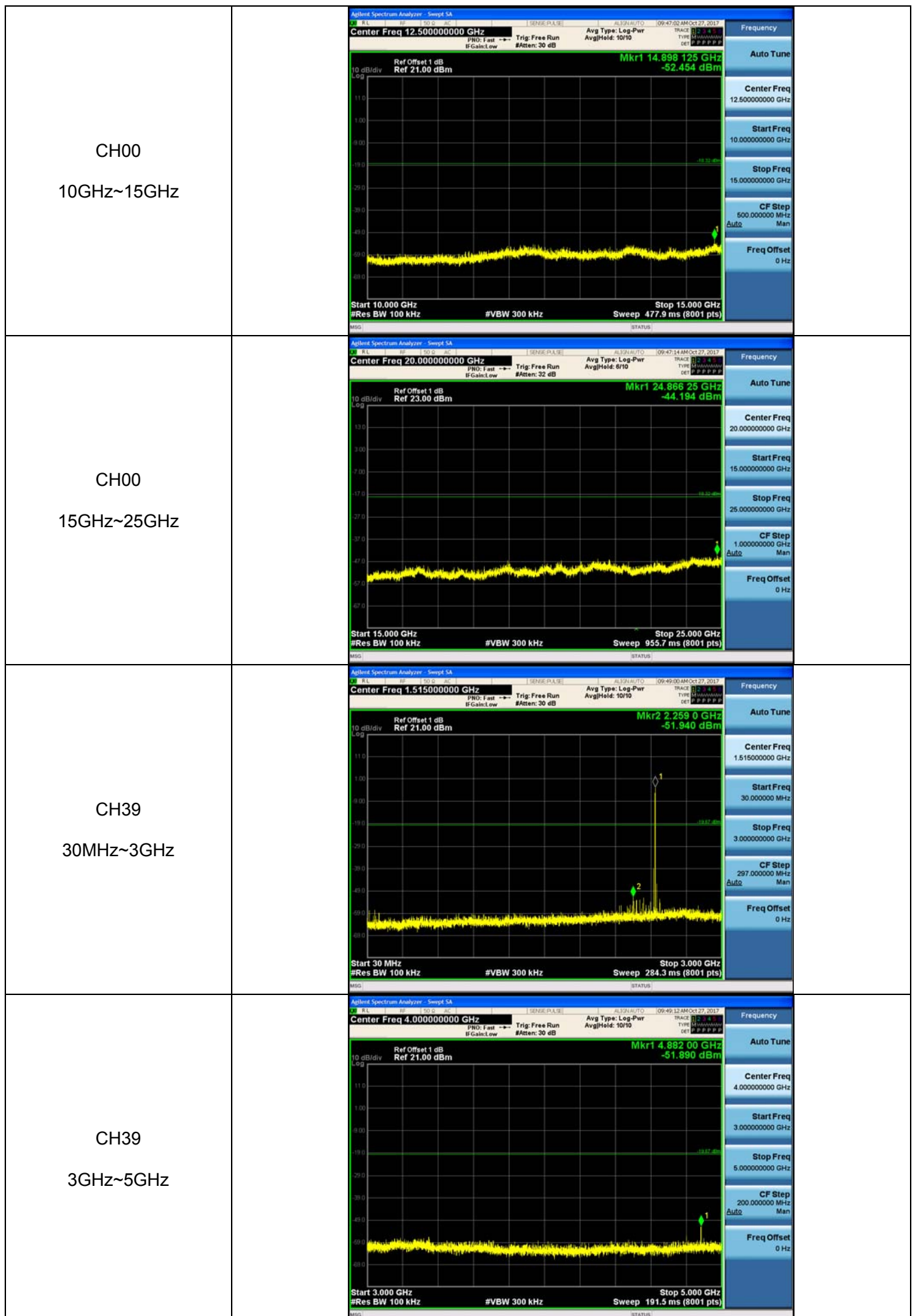


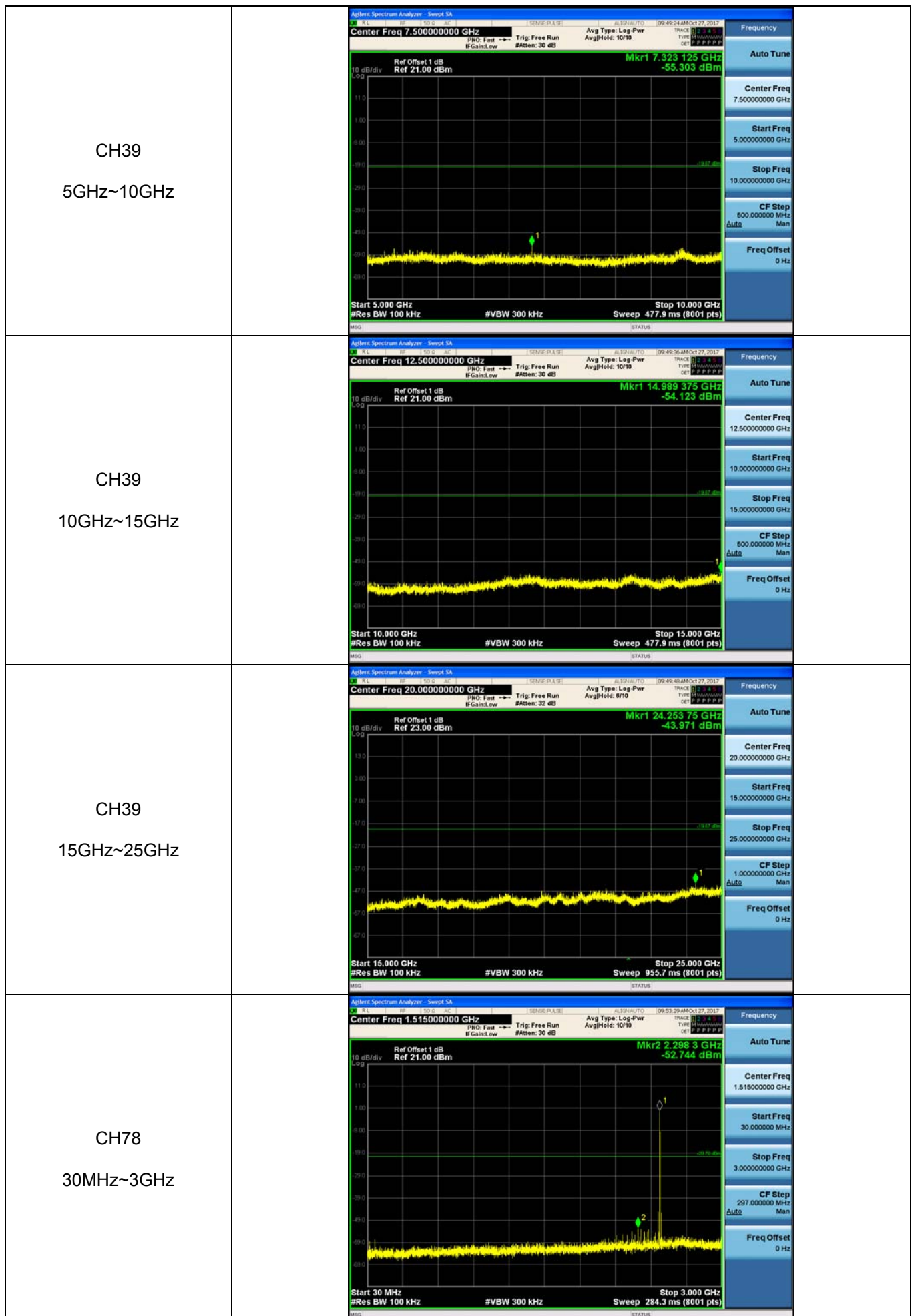


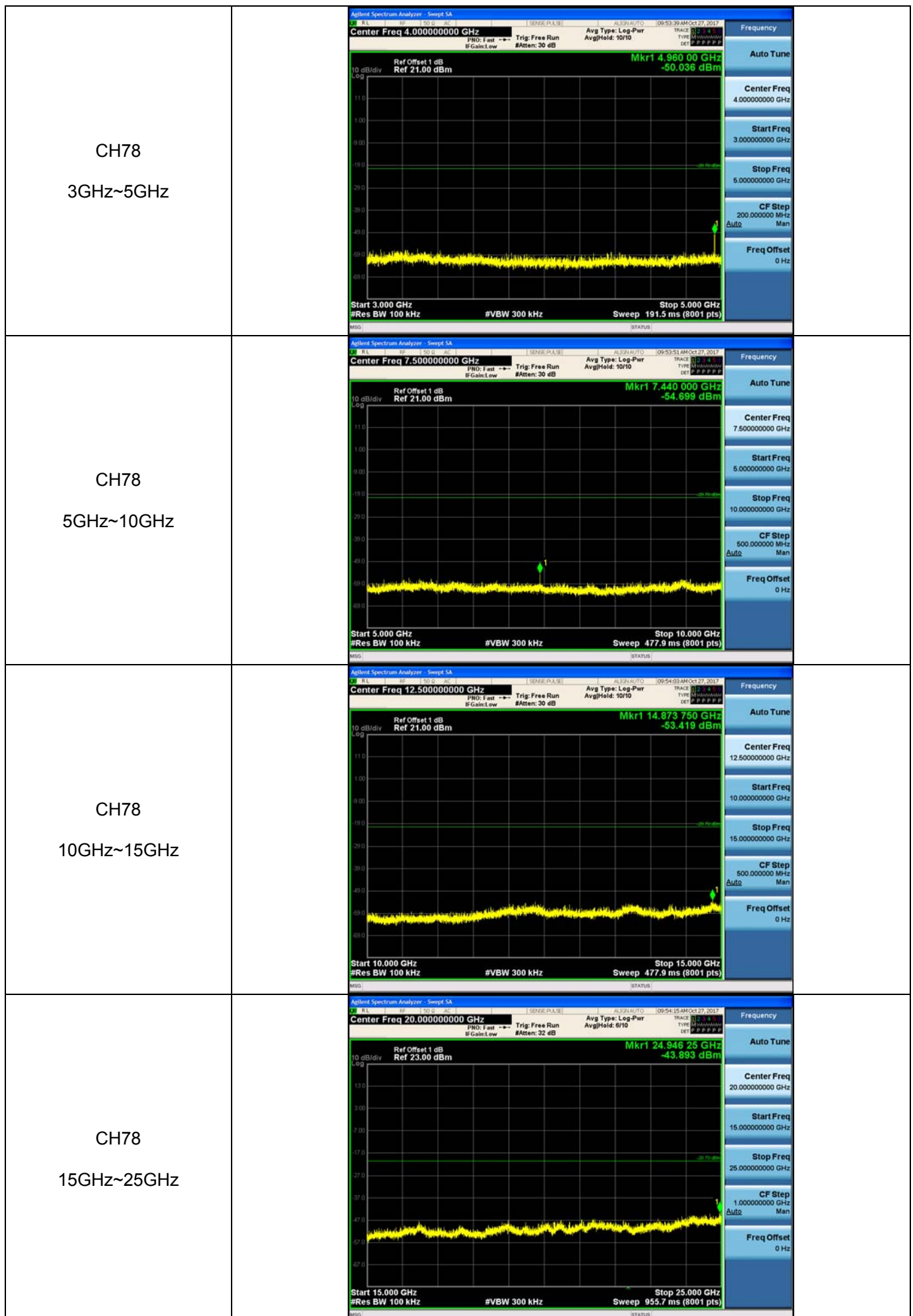


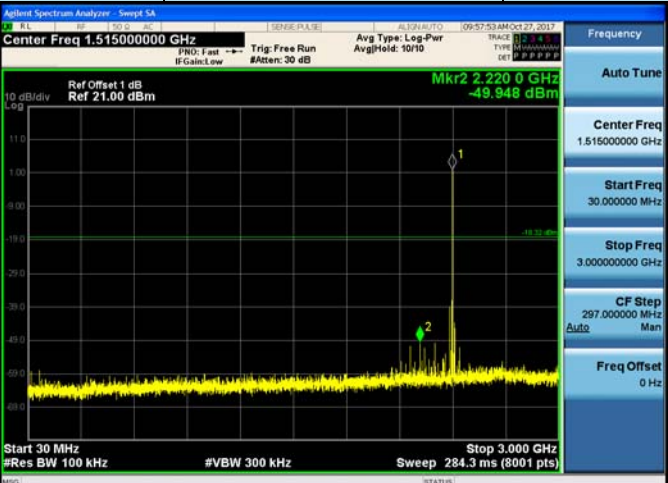
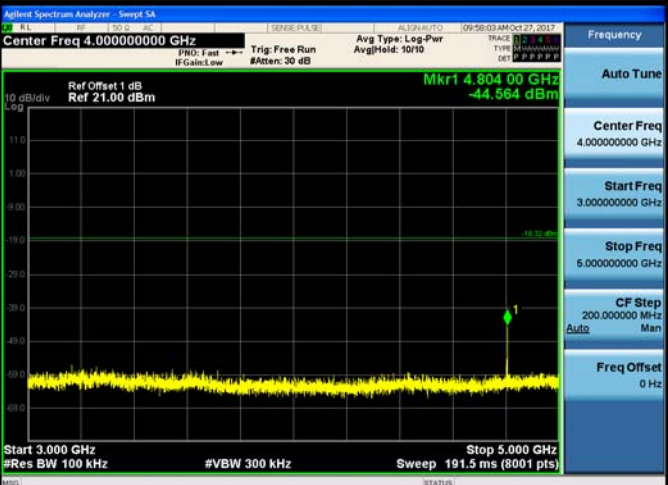
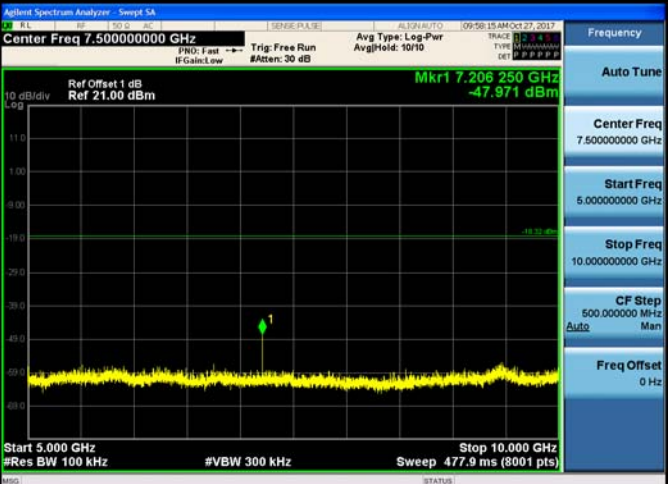


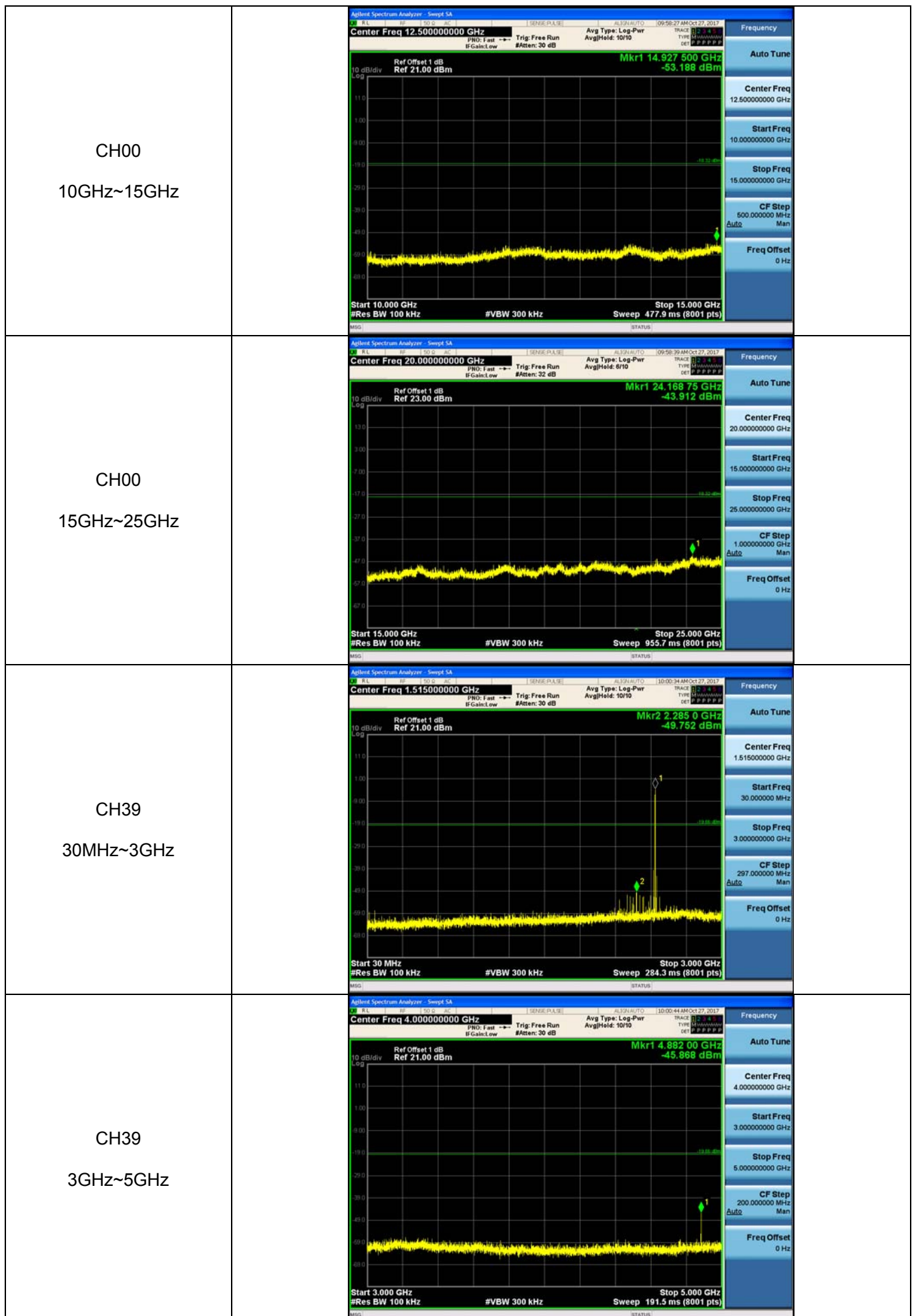
Test Item:	SE	Modulation type:	$\pi/4$ DQPSK
CH00 30MHz~3GHz			
CH00 3GHz~5GHz			
CH00 5GHz~10GHz			

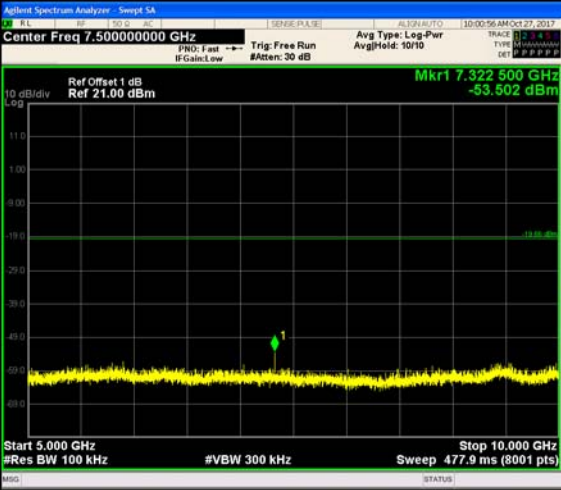
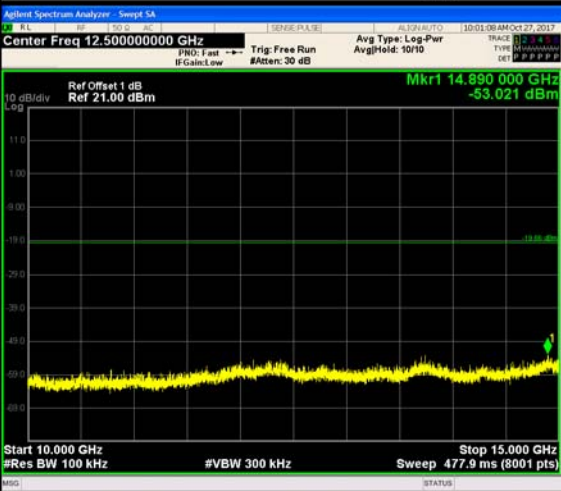
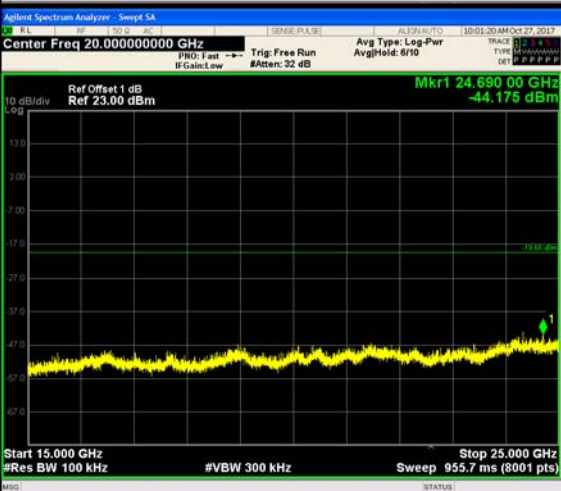
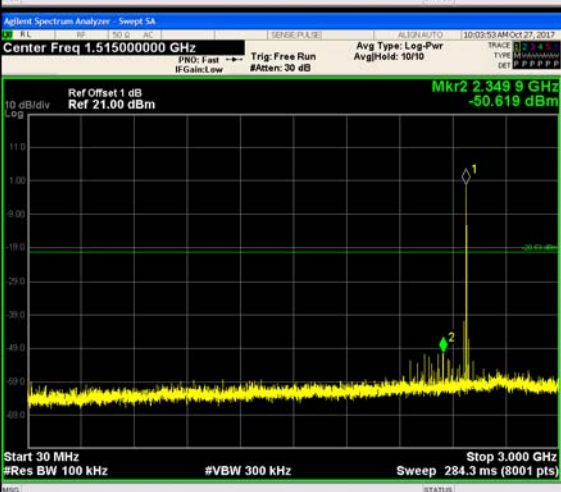


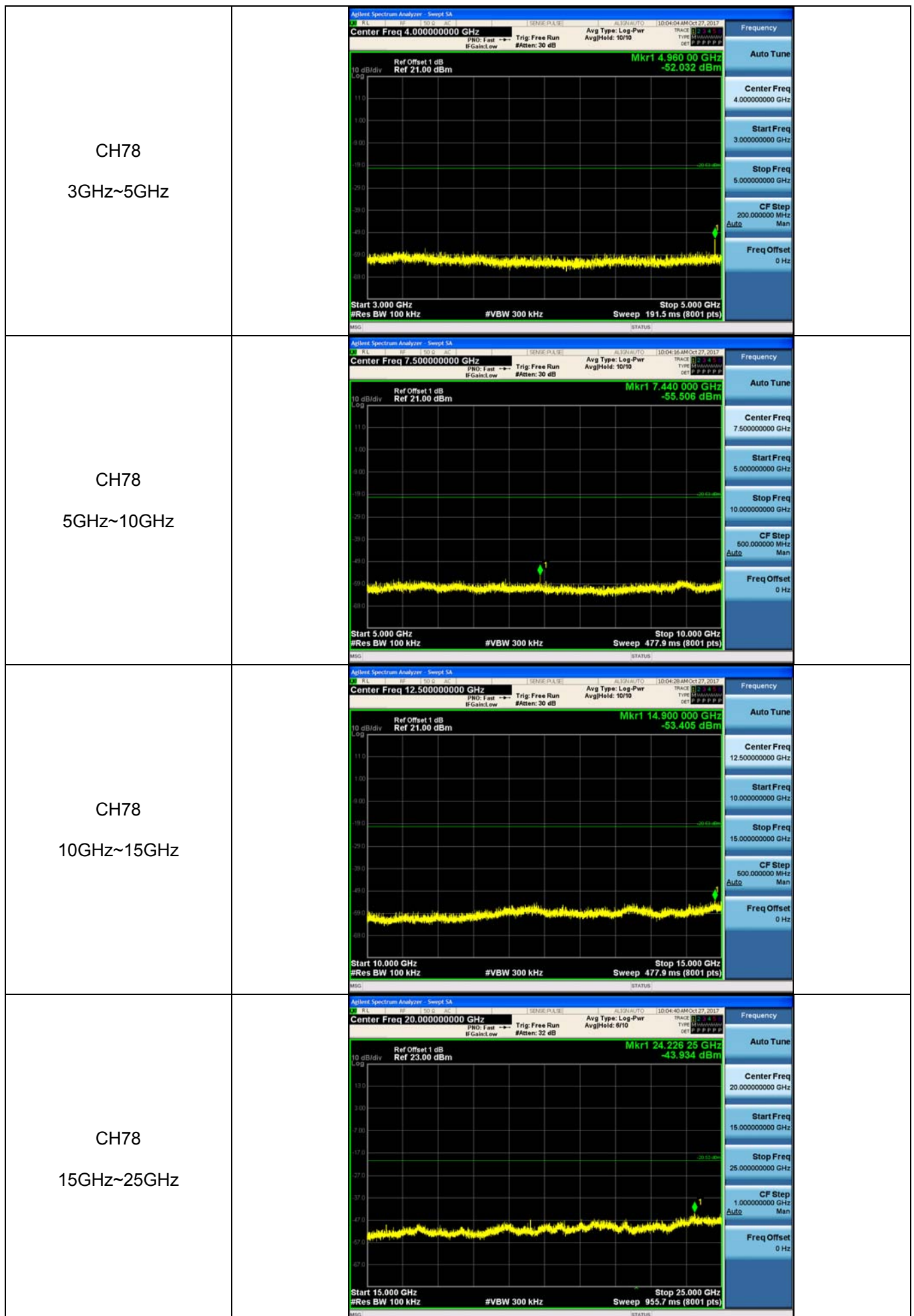




Test Item:	SE	Modulation type:	8DPSK
CH00 30MHz~3GHz			
CH00 3GHz~5GHz			
CH00 5GHz~10GHz			



CH39 5GHz~10GHz		Frequency Auto Tune Center Freq 7.500000000 GHz Start Freq 5.000000000 GHz Stop Freq 10.000000000 GHz CF Step 500.000000 MHz Auto Man Freq Offset 0 Hz
CH39 10GHz~15GHz		Frequency Auto Tune Center Freq 12.500000000 GHz Start Freq 10.000000000 GHz Stop Freq 15.000000000 GHz CF Step 500.000000 MHz Auto Man Freq Offset 0 Hz
CH39 15GHz~25GHz		Frequency Auto Tune Center Freq 20.000000000 GHz Start Freq 15.000000000 GHz Stop Freq 25.000000000 GHz CF Step 1.000000000 GHz Auto Man Freq Offset 0 Hz
CH78 30MHz~3GHz		Frequency Auto Tune Center Freq 1.515000000 GHz Start Freq 30.000000 MHz Stop Freq 3.000000000 GHz CF Step 297.000000 MHz Auto Man Freq Offset 0 Hz



5.11. Spurious Emissions (radiated)

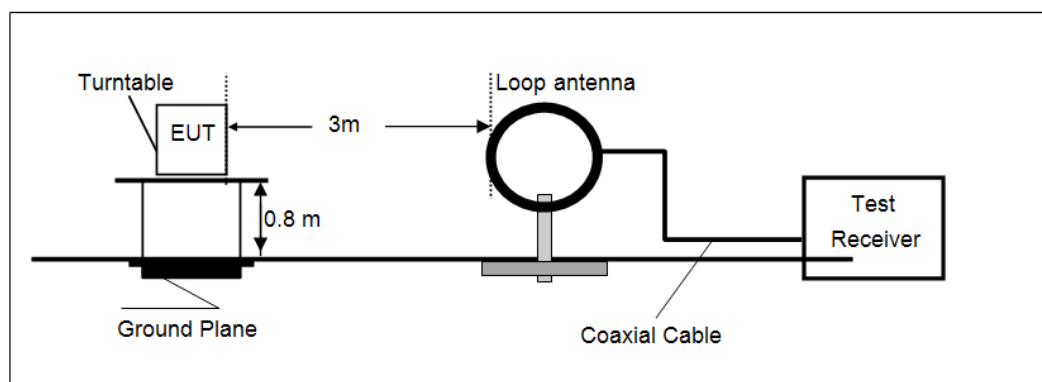
LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.209

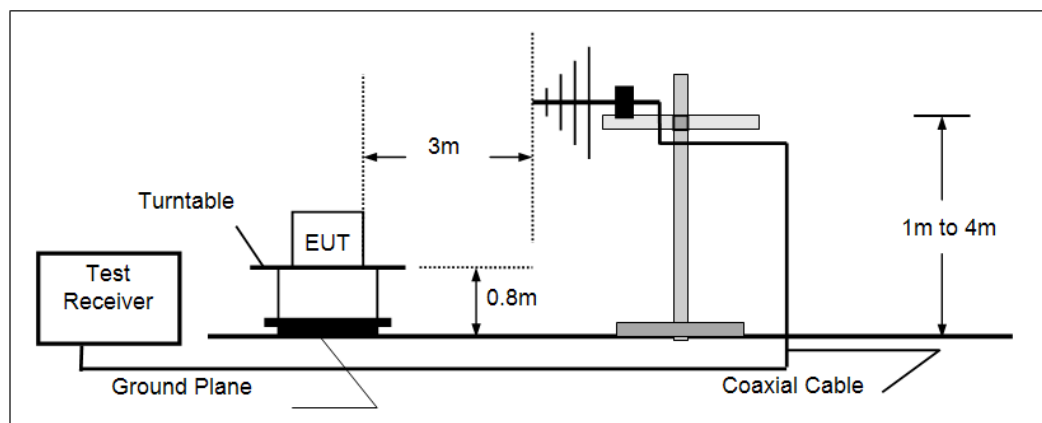
Frequency	Limit (dBuV/m @3m)	Value
30 MHz ~ 88 MHz	40.00	Quasi-peak
88 MHz ~ 216 MHz	43.50	Quasi-peak
216 MHz ~ 960 MHz	46.00	Quasi-peak
960 MHz ~ 1 GHz	54.00	Quasi-peak
Above 1 GHz	54.00	Average
	74.00	Peak

TEST CONFIGURATION

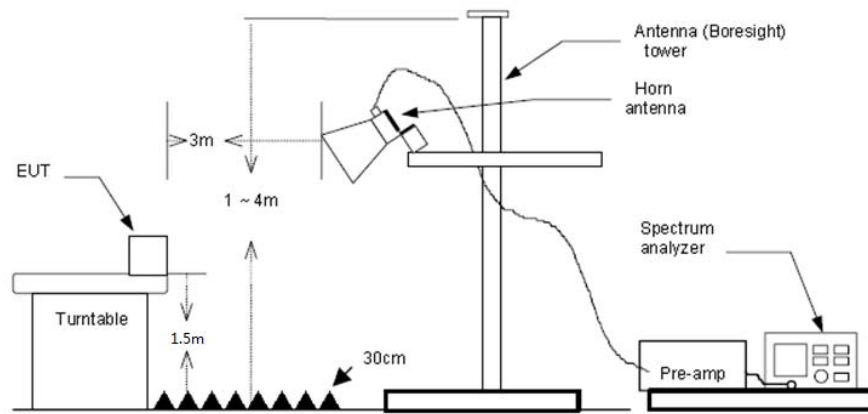
- Below 30 MHz



- 30 MHz ~1000 MHz



- Above 1 GHz



TEST PROCEDURE

1. The EUT was tested according to ANSI C63.10:2013.
2. The EUT is placed on a turn table which is 0.8 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna.
5. Use the following spectrum analyzer settings
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Below 1 GHz, RBW=120 kHz, VBW=300 kHz, Sweep=auto, Detector function=peak, Trace=max hold; If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
 - (3) Above 1 GHz, RBW=1 MHz, VBW=3 MHz Peak detector for Peak value
RBW=1 MHz, VBW=10 Hz Peak detector for Average value.

TEST MODE:

Please refer to the clause 3.3

TEST RESULTS

☒ Passed ☐ Not Applicable

Note:

- 1) Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
- 2) The emission levels of other frequencies are very lower than the limit and not show in test report.
- 3) Below 1 GHz, Have pre-scan all modulation mode, found the GFSK modulation High channel which it was worst case, so only the worst case's data on the test report.
- 4) Above 1 GHz, Have pre-scan all modulation mode, found the GFSK modulation which it was worst case, so only the worst case's data on the test report
- 5) The peak level is lower than average limit (54 dBuV/m), this data is the too weak instrument of signal is unable to test.

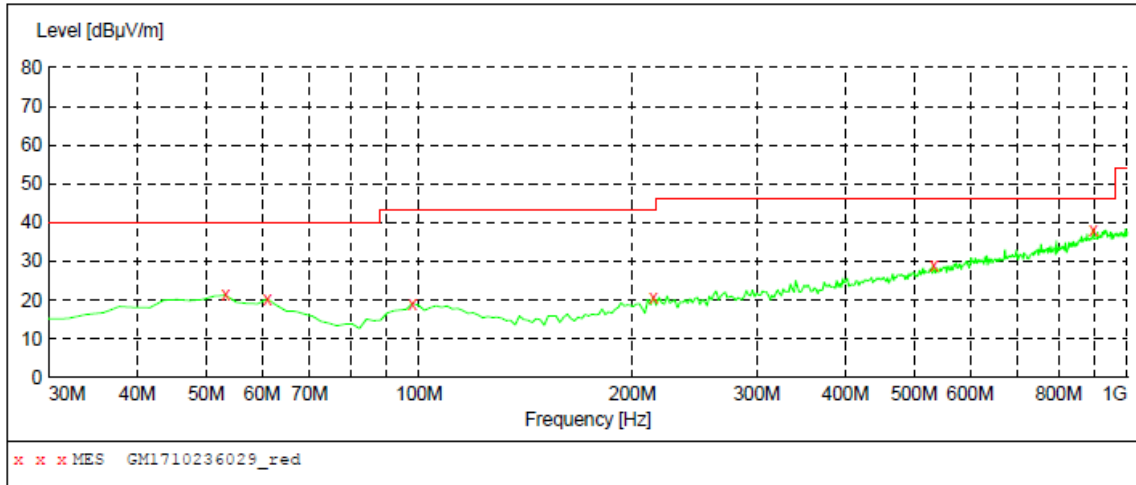
➤ 9 kHz ~ 30 MHz

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.

➤ 30 MHz ~ 1 GHz

Polarization:

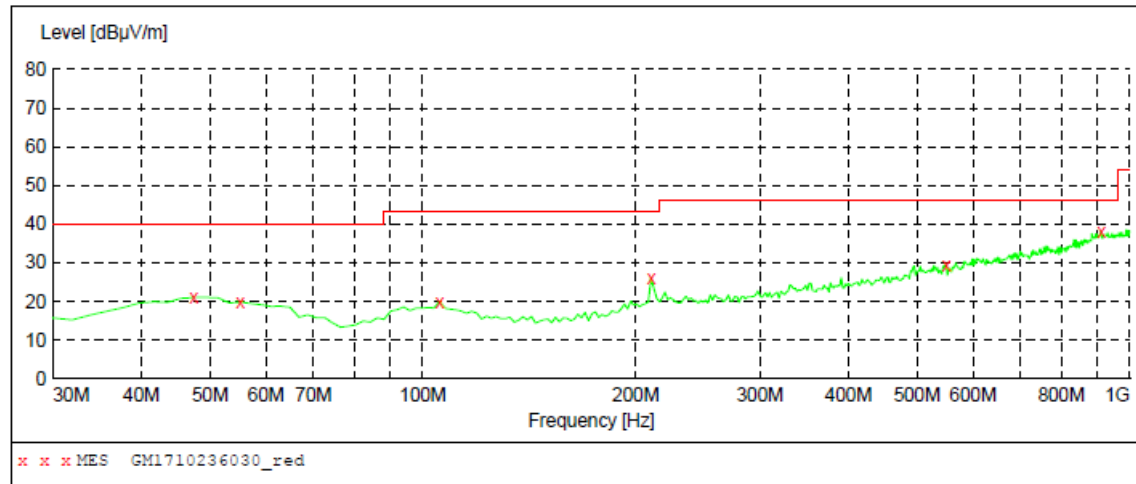
Vertical



Frequency MHz	Level dBμV/m	Transd dB	Limit dBμV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
53.280000	21.30	-9.0	40.0	18.7	QP	100.0	0.00	VERTICAL
61.040000	20.30	-10.3	40.0	19.7	QP	100.0	63.00	VERTICAL
97.900000	19.20	-10.8	43.5	24.3	QP	100.0	0.00	VERTICAL
214.300000	20.70	-10.3	43.5	22.8	QP	100.0	226.00	VERTICAL
532.460000	28.90	-1.1	46.0	17.1	QP	100.0	87.00	VERTICAL
895.240000	38.10	6.6	46.0	7.9	QP	100.0	157.00	VERTICAL

Polarization:

Horizontal



Frequency MHz	Level dBμV/m	Transd dB	Limit dBμV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
47.460000	21.10	-8.8	40.0	18.9	QP	100.0	268.00	HORIZONTAL
55.220000	19.90	-9.2	40.0	20.1	QP	300.0	212.00	HORIZONTAL
105.660000	20.00	-10.5	43.5	23.5	QP	100.0	109.00	HORIZONTAL
210.420000	26.10	-10.5	43.5	17.4	QP	100.0	53.00	HORIZONTAL
549.920000	29.40	-0.8	46.0	16.6	QP	100.0	174.00	HORIZONTAL
910.760000	38.10	6.9	46.0	7.9	QP	100.0	148.00	HORIZONTAL

➤ 1 GHz ~ 25 GHz

CH00									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization	Test value
2086.86	45.93	26.65	6.34	37.32	41.60	74.00	-32.40	Vertical	Peak
2691.80	48.76	28.08	7.12	38.08	45.88	74.00	-28.12	Vertical	Peak
3738.13	36.74	29.42	8.43	38.24	36.35	74.00	-37.65	Vertical	Peak
6251.26	32.43	33.00	11.00	35.30	41.13	74.00	-32.87	Vertical	Peak
1786.72	40.77	25.37	5.93	37.11	34.96	74.00	-39.04	Horizontal	Peak
3299.78	38.33	28.20	7.84	38.37	36.00	74.00	-38.00	Horizontal	Peak
4410.75	34.03	30.52	9.15	37.54	36.16	74.00	-37.84	Horizontal	Peak
6125.24	31.73	32.60	10.88	35.35	39.86	74.00	-34.14	Horizontal	Peak

CH39									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization	Test value
1676.56	38.50	25.13	5.72	36.88	32.47	74.00	-41.53	Vertical	Peak
3653.46	35.46	29.30	8.33	38.26	34.83	74.00	-39.17	Vertical	Peak
5151.68	32.58	31.69	9.79	36.25	37.81	74.00	-36.19	Vertical	Peak
8002.06	31.78	37.10	12.30	34.53	46.65	74.00	-27.35	Vertical	Peak
1782.18	44.70	25.37	5.93	37.10	38.90	74.00	-35.10	Horizontal	Peak
3283.02	42.15	28.30	7.82	38.35	39.92	74.00	-34.08	Horizontal	Peak
5009.43	32.70	31.54	9.68	36.39	37.53	74.00	-36.47	Horizontal	Peak
6662.01	32.36	34.20	11.43	35.25	42.74	74.00	-31.26	Horizontal	Peak

CH78									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization	Test value
2081.55	44.55	26.63	6.34	37.32	40.20	74.00	-33.80	Vertical	Peak
2691.80	48.45	28.08	7.12	38.08	45.57	74.00	-28.43	Vertical	Peak
2980.33	41.16	28.58	7.47	38.24	38.97	74.00	-35.03	Vertical	Peak
5821.21	33.19	32.14	10.60	35.33	40.60	74.00	-33.40	Vertical	Peak
2081.55	36.45	26.63	6.34	37.32	32.10	74.00	-41.90	Horizontal	Peak
3088.45	36.09	28.78	7.59	38.22	34.24	74.00	-39.76	Horizontal	Peak
4377.20	33.39	30.43	9.11	37.57	35.36	74.00	-38.64	Horizontal	Peak
6315.23	32.32	33.13	11.00	35.30	41.15	74.00	-32.85	Horizontal	Peak

Remark:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. The peak level is lower than average limit(54 dBuV/m), this data is the too weak instrument of signal is unable to test.
3. The emission levels of other frequencies(test frequency band is 1GHz to 25GHz) are very lower than the limit and not show in test report.

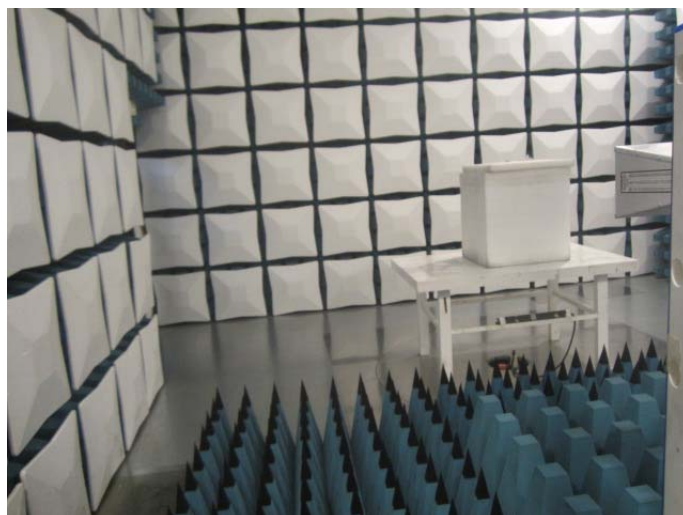
6. TEST SETUP PHOTOS

Conducted Emissions (AC Mains)



Radiated Emissions



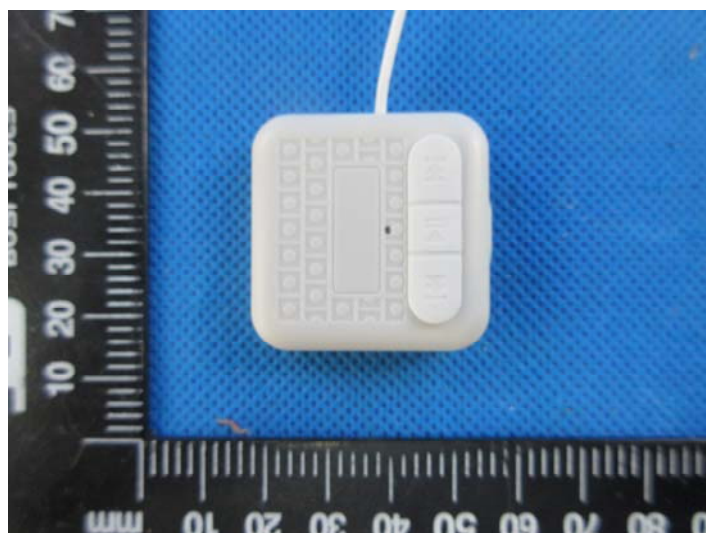
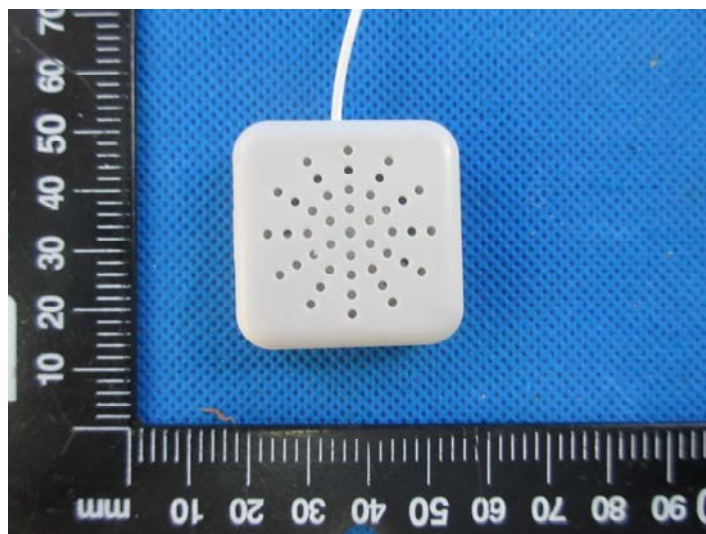


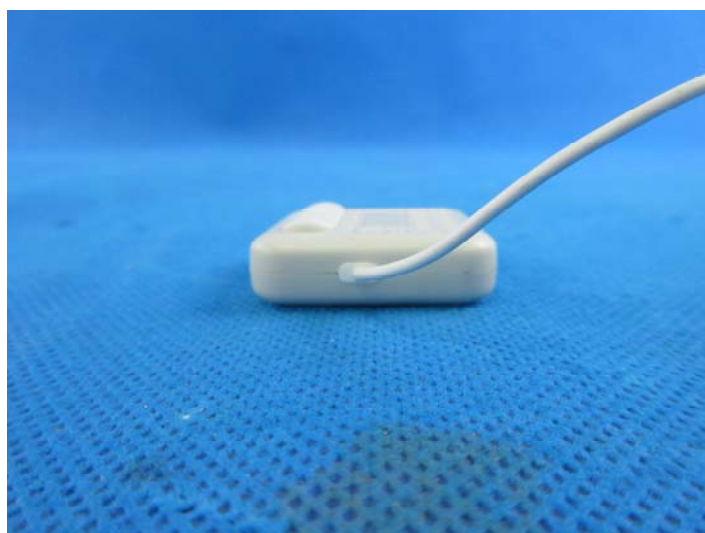
7. EXTERNAL AND INTERNAL PHOTOS

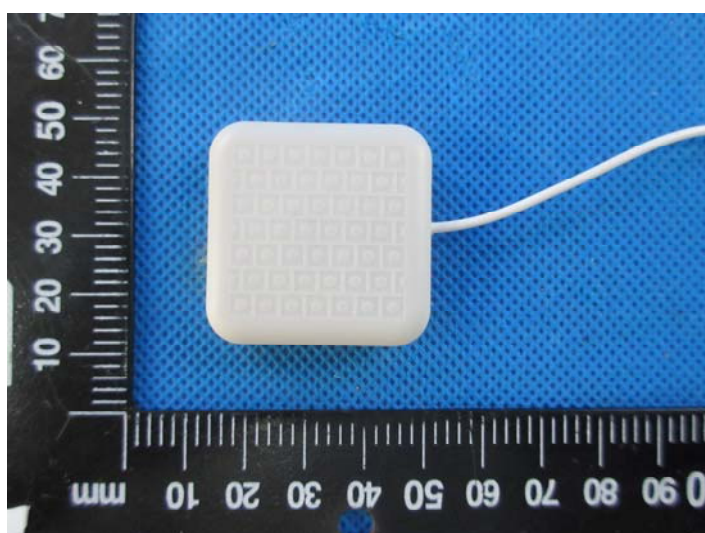
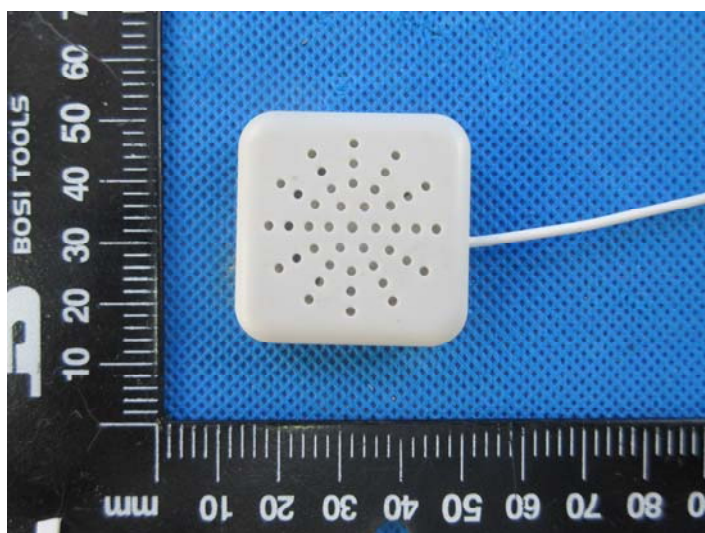
External photos of the EUT

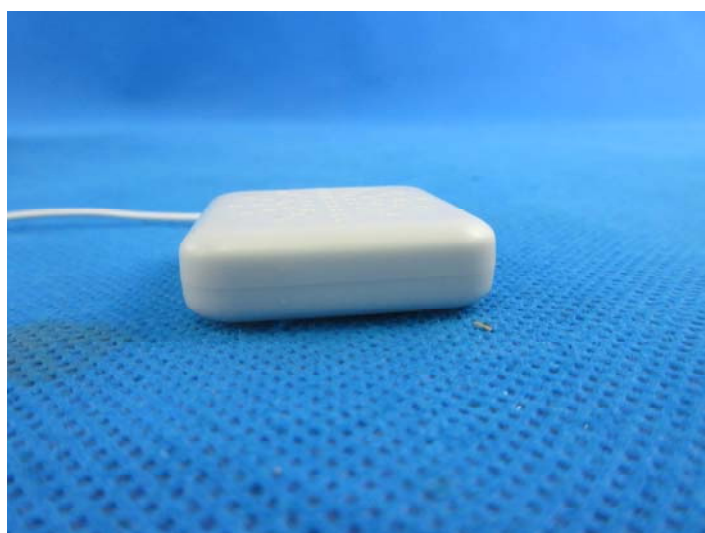


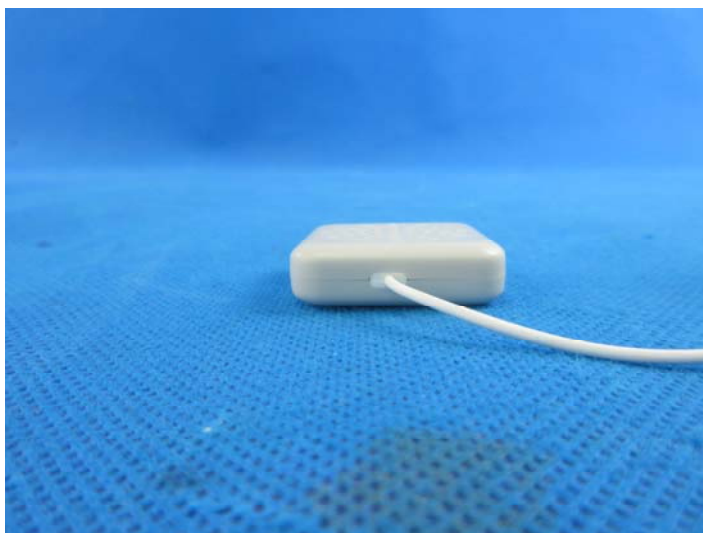


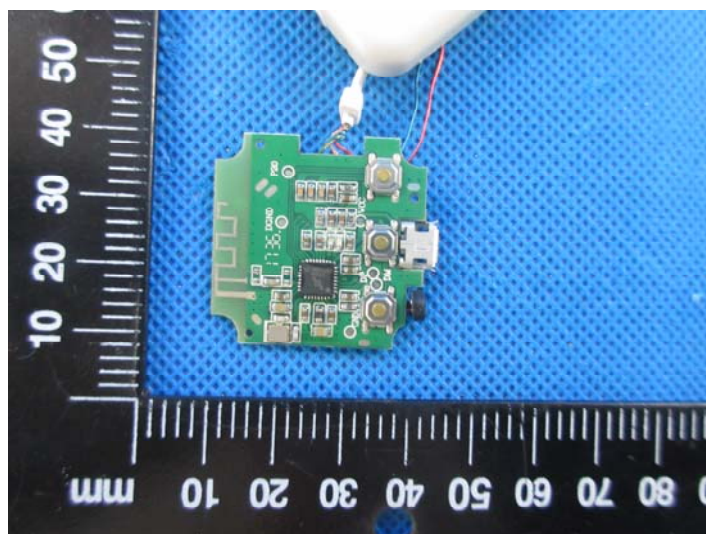
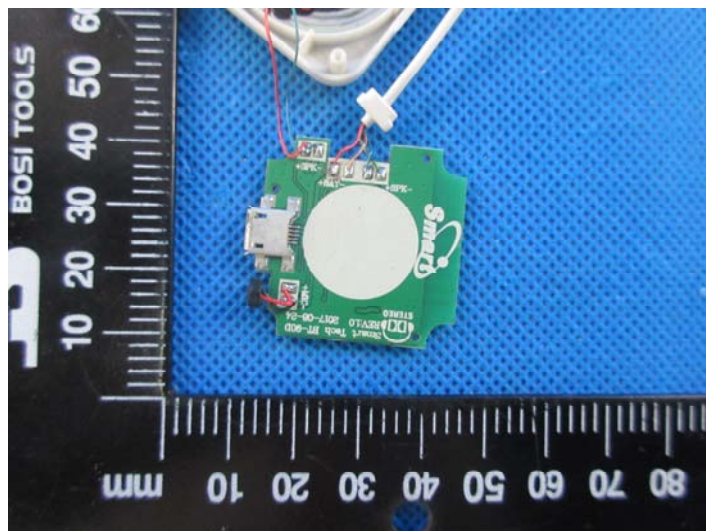
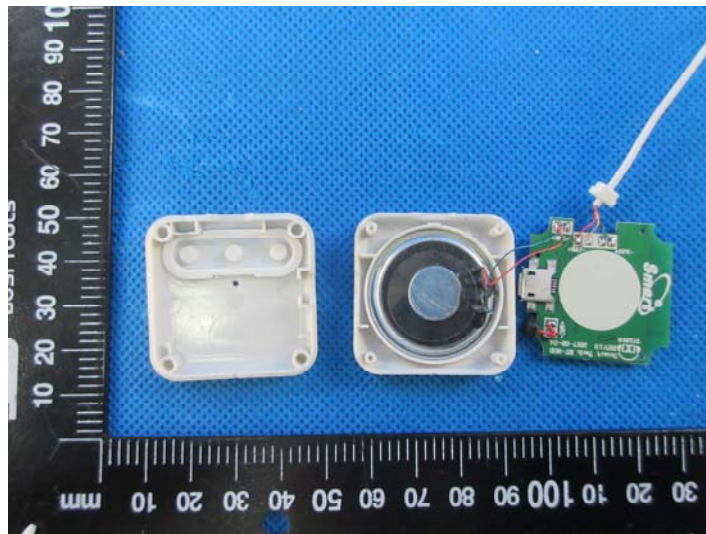


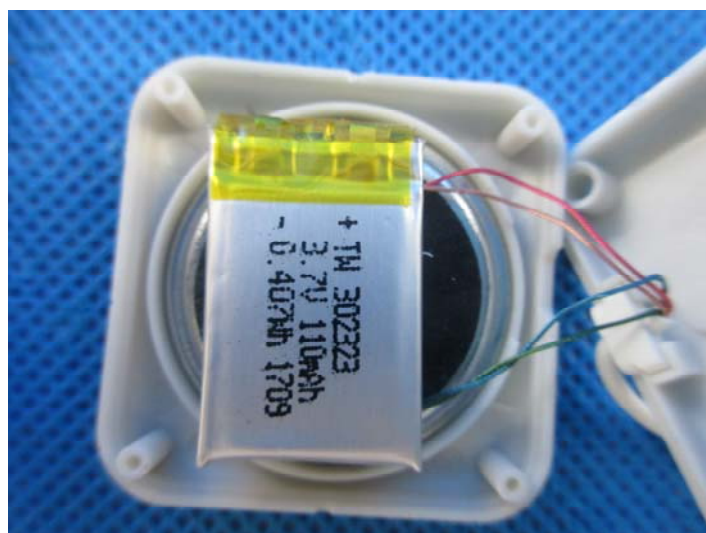
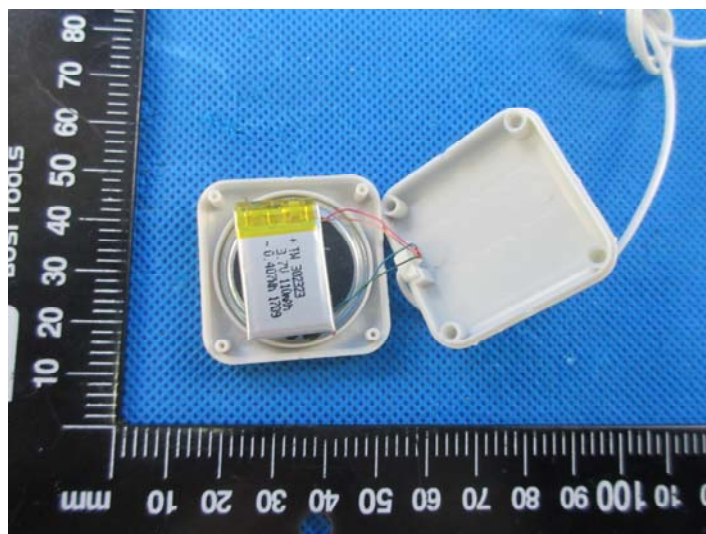
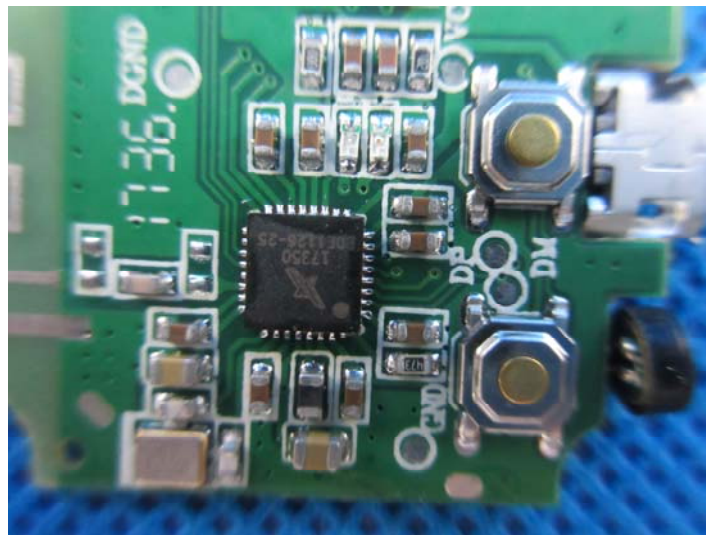








Internal photos of the EUT



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