Shenzhen Huatongwei International Inspection Co., Ltd.
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TEST REPORT

Report Reference No. ..... :	**TRE1711009001**	R/C…….: 98058
FCC ID ..... :	**YAMMD61XVHF**	
Applicant's name ..... :	**Hytera Communications Corporation Limited**	
Address.....:	Hytera Tower, Hi-Tech Industrial Park North,9108# Beihuan Road, Nanshan District, Shenzhen, China	
Manufacturer.....:	Hytera Communications Corporation Limited	
Address.....:	Hytera Tower, Hi-Tech Industrial Park North,9108# Beihuan Road, Nanshan District, Shenzhen, China	
Test item description ..... :	**Digital Mobile Radio**	
Trade Mark .....:	Hytera	
Model/Type reference.....:	MD615 VHF	
Listed Model(s) .....:	MD612 VHF, MD616 VHF, MD618 VHF	
Standard ..... :	**FCC CFR Title 47 Part 15 Subpart C Section 15.247**	
Date of receipt of test sample…….....:	Nov. 16, 2017	
Date of testing……..:	Nov. 17, 2017 – Jan. 19, 2018	
Date of issue……....:	Jan. 19, 2018	
Result..... ……..:	**PASS**	

Compiled by (Position+Printed name+Signature):	File administrators Shayne Zhu	
Supervised by (Position+Printed name+Signature):	Project Engineer Cary Luo	
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

Contents

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 forTesting Unlicensed Wireless Devicese

1.2. Report version information

Revision No.	Date of issue	Description
N/A	2018-01-19	Original

2. TEST DESCRIPTION

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

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

3. SUMMARY

3.1. Client Information

Applicant:	Hytera Communications Corporation Limited
Address:	Hytera Tower, Hi-Tech Industrial Park North,9108# Beihuan Road, Nanshan District, Shenzhen, China
Manufacturer:	Hytera Communications Corporation Limited
Address:	Hytera Tower, Hi-Tech Industrial Park North,9108# Beihuan Road, Nanshan District, Shenzhen, China

3.2. Product Description

Name of EUT:	Digital Mobile Radio
Trade Mark:	Hytera
Model No.:	MD615 VHF
Listed Model(s):	MD612 VHF, MD616 VHF, MD618 VHF
Power supply:	DC 13.6V
Adapter information:	-
Hardware version:	A
Software version:	V1.01.13.001
Bluetooth	
Version:	Supported BT4.0+EDR
Modulation:	GFSK, π/4DQPSK, 8DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	Internal Antenna
Antenna gain:	0dBi

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

	/	Manufacturer:	/
		Model No.:	/
	/	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 with Registration No. 762235.

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.

4.1. Equipments Used during the Test

Conducted Emissions						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal. (mm-dd-yy)	Next Cal. (mm-dd-yy)
1	EMI Test Receiver	R&S	ESCI	101247	11/11/2017	11/10/2018
2	Artificial Mains	SCHWARZBECK	NNLK 8121	573	11/11/2017	11/10/2018
3	2-Line V-Network	R&S	ESH3-Z5	100049	11/11/2017	11/10/2018
4	Pulse Limiter	R&S	ESH3-Z2	101488	11/11/2017	11/10/2018
5	RF Connection Cable	HUBER+SUHNER	EF400	N/A	11/21/2017	11/20/2018
6	Test Software	R&S	ES-K1	N/A	N/A	N/A

Radiated Emissions						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal. (mm-dd-yy)	Next Cal. (mm-dd-yy)
1	EMI Test Receiver	R&S	ESCI	101247	11/11/2017	11/10/2018
2	Loop Antenna	R&S	HFH2-Z2	100020	11/20/2017	11/19/2018
3	Ultra-Broadband Antenna	SCHWARZBECK	VULB9163	538	4/5/2017	4/4/2018
4	Preamplifier	SCHWARZBECK	BBV 9743	9743-0022	10/18/2017	10/17/2018
5	RF Connection Cable	HUBER+SUHNER	RE-7-FL	N/A	11/21/2017	11/20/2018
6	EMI Test Software	R&S	ESK1	N/A	N/A	N/A
7	Spectrum Analyzer	R&S	FSP40	100597	11/11/2017	11/10/2018
8	Horn Antenna	SCHWARZBECK	9120D	1011	3/27/2017	3/26/2018
9	Horn Antenna	SCHWARZBECK	BBHA9170	25841	3/27/2017	3/26/2018
10	Broadband Preamplifier	SCHWARZBECK	BBV 9718	9718-248	10/18/2017	10/17/2018
11	High pass filter	Compliance Direction systems	BSU-6	34202	11/11/2017	11/10/2018
12	RF Connection Cable	HUBER+SUHNER	RE-7-FH	N/A	11/21/2017	11/20/2018
13	EMI Test Software	Audix	E3	N/A	N/A	N/A
14	Turntable	MATURO	TT2.0	/	N/A	N/A
15	Antenna Mast	MATURO	TAM-4.0-P	/	N/A	N/A

RF Conducted Test						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal. (mm-dd-yy)	Next Cal. (mm-dd-yy)
1	Spectrum Analyzer	R&S	FSV40	100048	11/11/2017	11/10/2018
2	EXA Signal Analyzer	Agilent	N9020A	184247	9/22/2017	9/21/2018
3	Power Meter	Agilent	U2021XA	178231	9/22/2017	9/21/2018
4	OSP	R&S	OSP120	101317	N/A	N/A

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 anantenna 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.

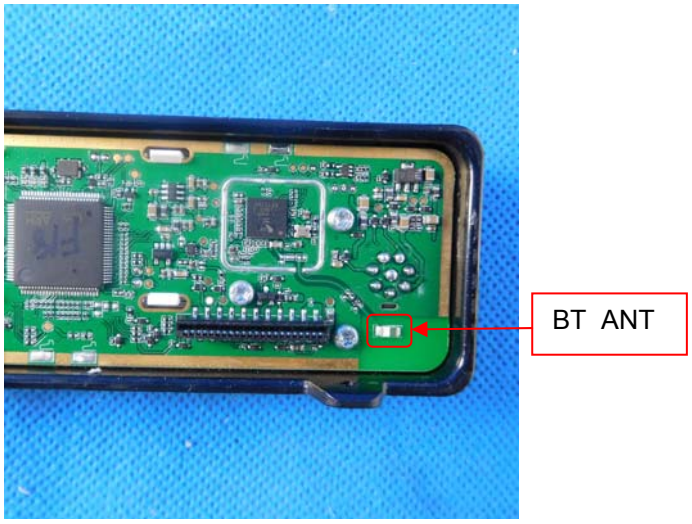
FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1)(i):

(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 0 dBi, please refer to the below antenna photo.



5.2. Conducted Emissions (AC Main)

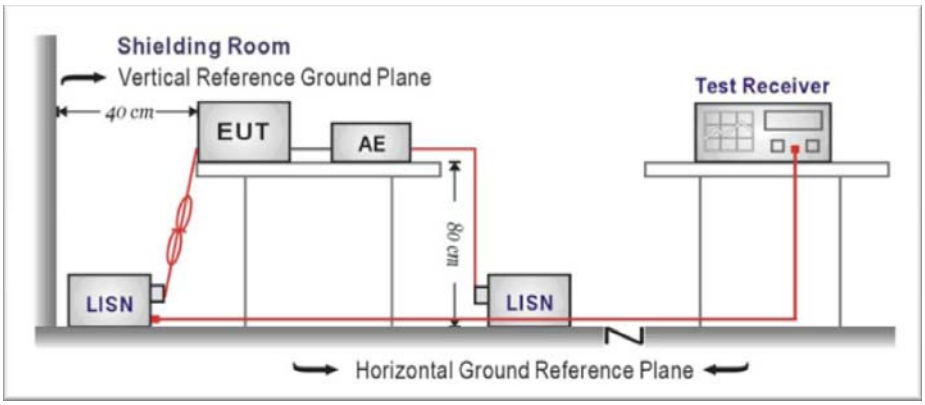
LIMIT

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

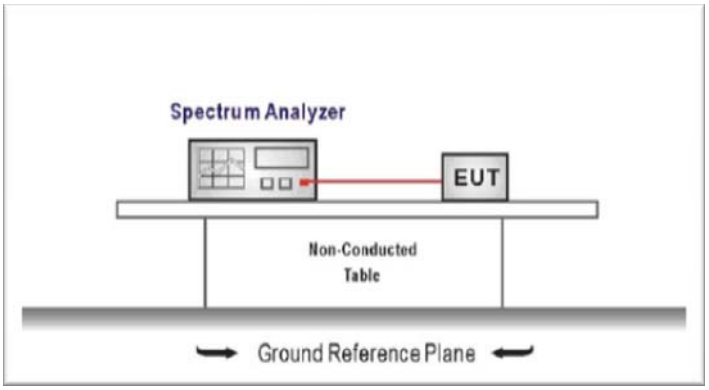
☐ **Passed** ☒ **Not Applicable**

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≥ the 20 dB bandwidth of the emission being measured, VBW≥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

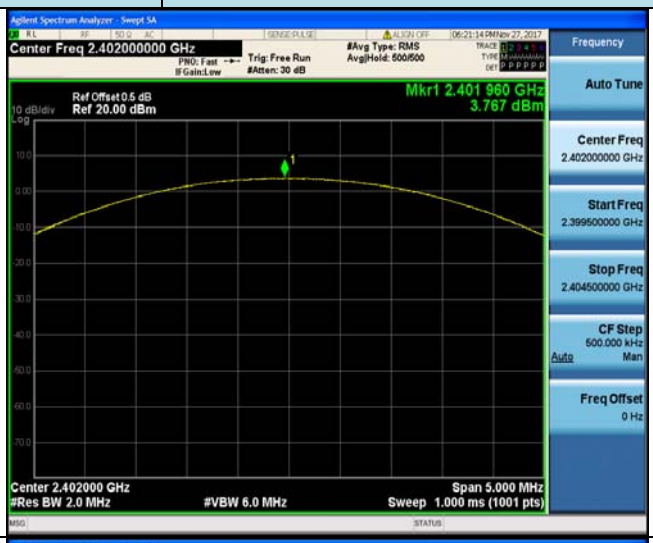
TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Modulation type	Channel	Output power (dBm)	Limit (dBm)	Result
GFSK	00	4.78	≤ 30.00	Pass
	39	5.34		
	78	5.15		
π/4DQPSK	00	3.48	≤ 21.00	Pass
	39	4.35		
	78	3.82		
8DPSK	00	3.77	≤ 21.00	Pass
	39	4.52		
	78	4.04		

Modulation Type:		GFSK	
CH00			
CH39			
CH78			

Modulation Type:		π/4DQPSK	
CH00			
CH39			
CH78			

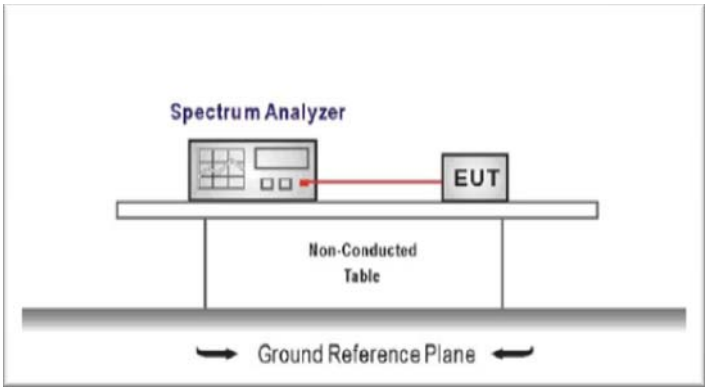
Modulation Type:		8DPSK	
CH00			
CH39			
CH78			

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 ≥ 1% of the 20 dB bandwidth, VBW ≥ 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

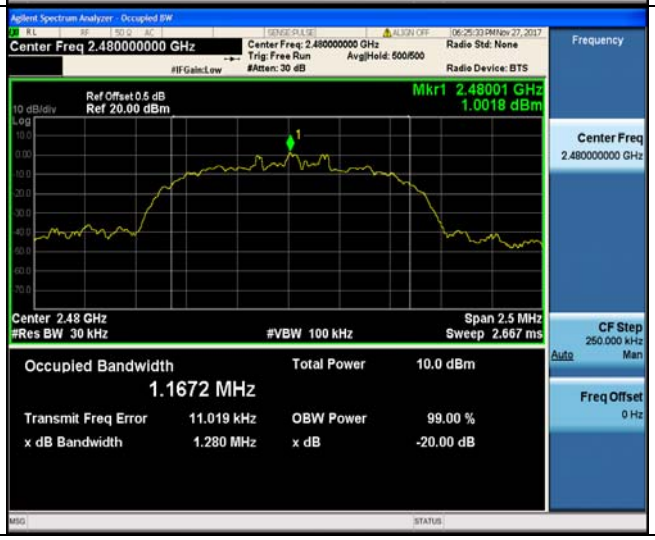
TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Modulation type	Channel	20 dB Bandwidth (MHz)	Limit (MHz)	Result
GFSK	00	0.92	-	Pass
	39	0.92		
	78	0.92		
π/4DQPSK	00	1.23	-	Pass
	39	1.23		
	78	1.23		
8DPSK	00	1.26	-	Pass
	39	1.29		
	78	1.28		

Modulation Type:	GFSK
CH00	
CH39	
CH78	

Modulation Type:		π/4DQPSK	
CH00			
CH39			
CH78			

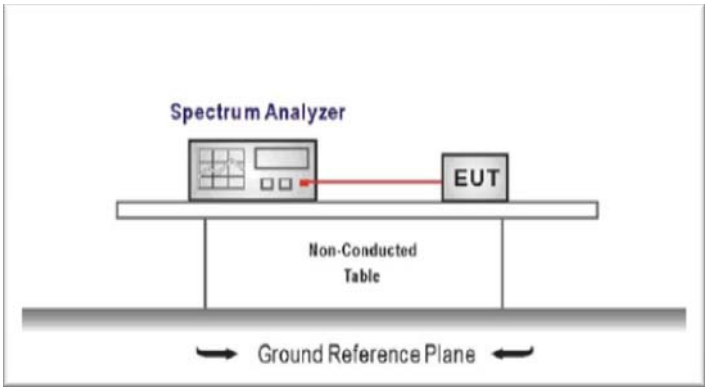
Modulation Type:		8DPSK	
CH00			
CH39			
CH78			

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*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 ≥ 1% of the span, VBW ≥ 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	1.00	≥0.61	Pass
π/4DQPSK	39	1.00	≥0.82	Pass
8DPSK	39	1.00	≥0.86	Pass

Note:
*: GFSK limit =2/3 * The maximum 20 dB Bandwidth for GFSK modulation on the section 5.4.
π/4DQPSK limit = 2/3 * The maximum 20 dB Bandwidth for π/4DQPSK modulation on the section 5.4.
8DPSK limit = 2/3 * The maximum 20 dB Bandwidth for 8DPSK modulation on the section 5.4

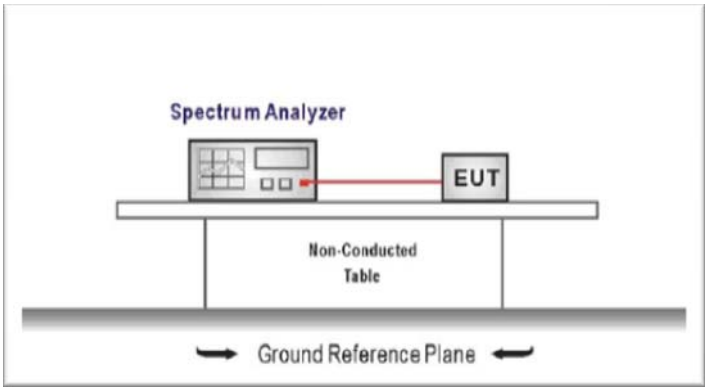
GFSK		
π/4DQPSK		
8DPSK		

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 ≥ 1% of the span, VBW ≥ RBW
   Sweep = auto, Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

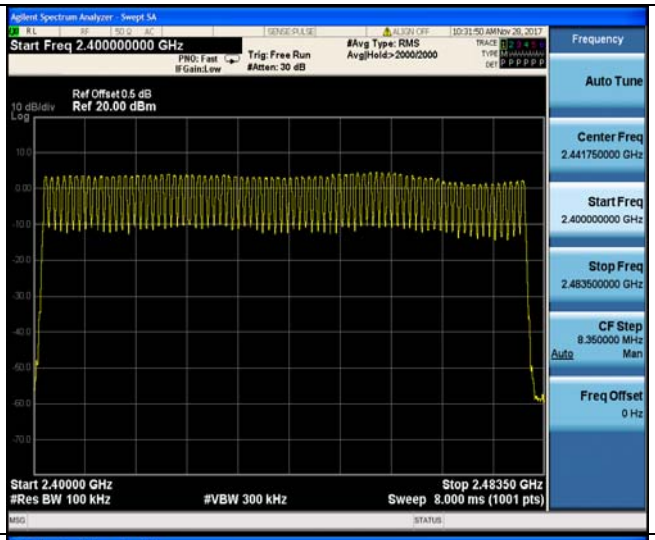
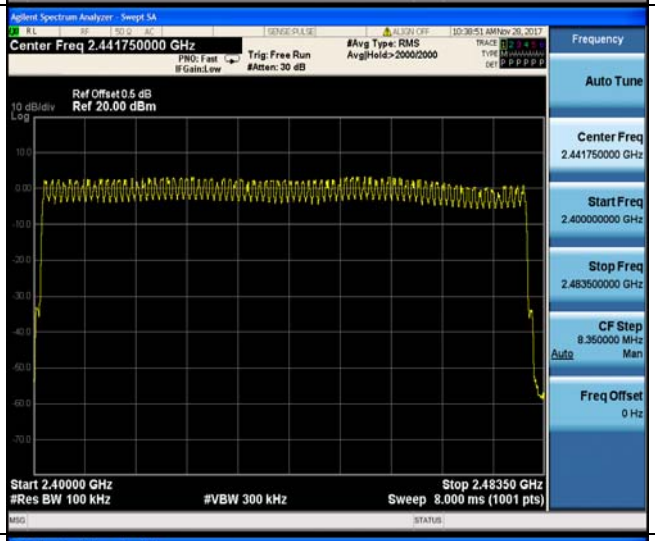
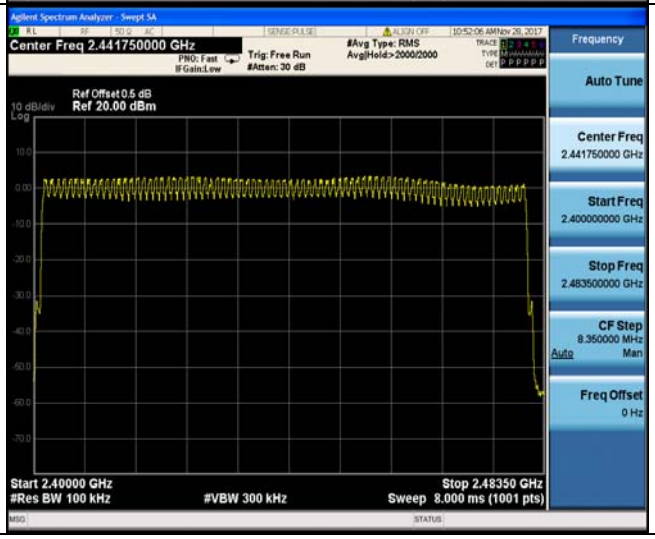
TEST MODE:

Please refer to the clause 3.3

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

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

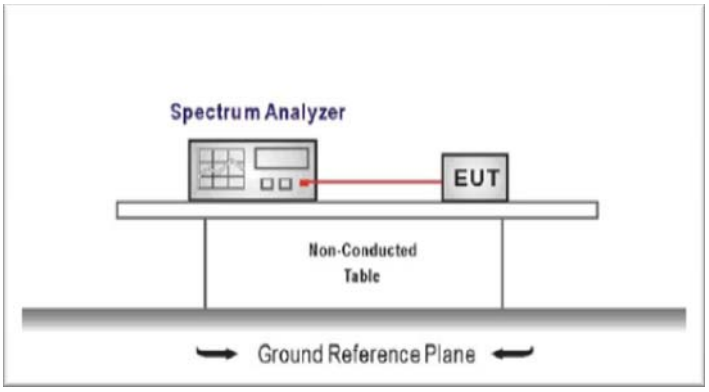
GFSK			
π/4DQPSK			
8DPSK			

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

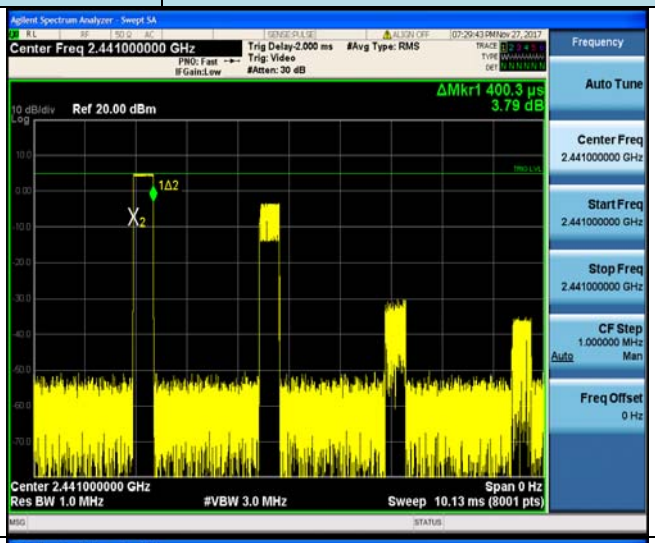
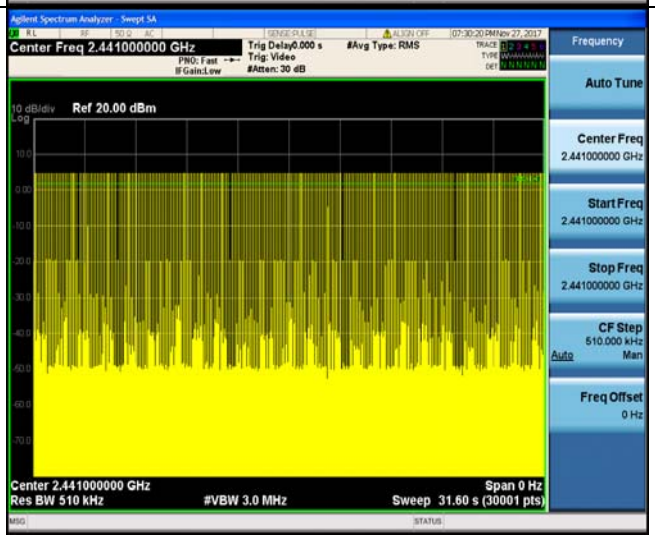
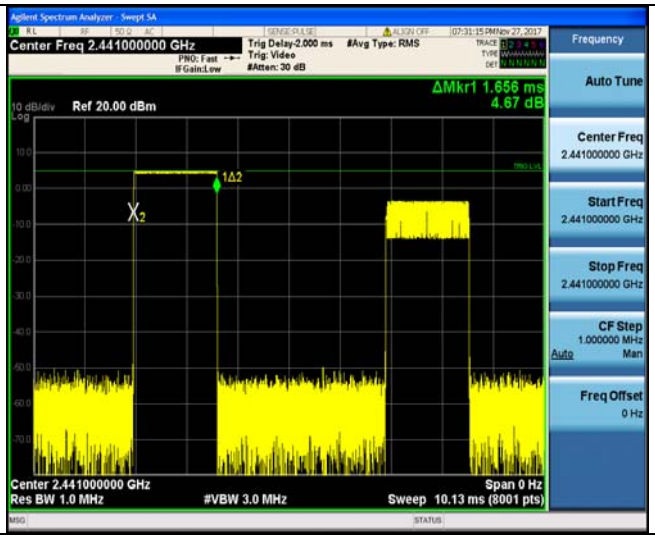
TEST RESULTS

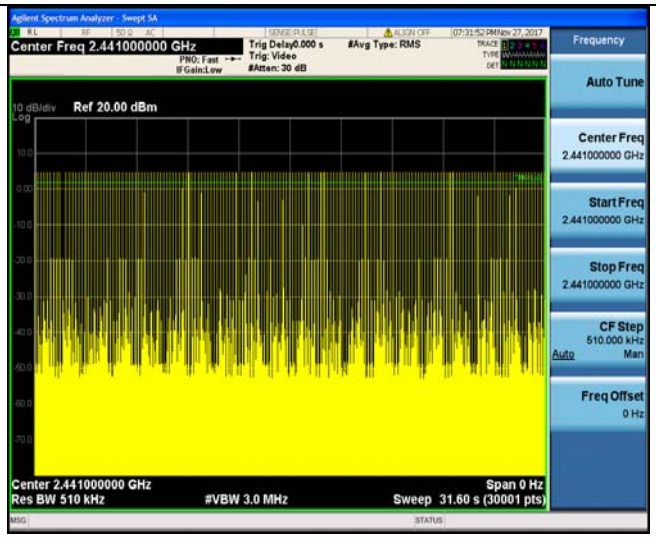
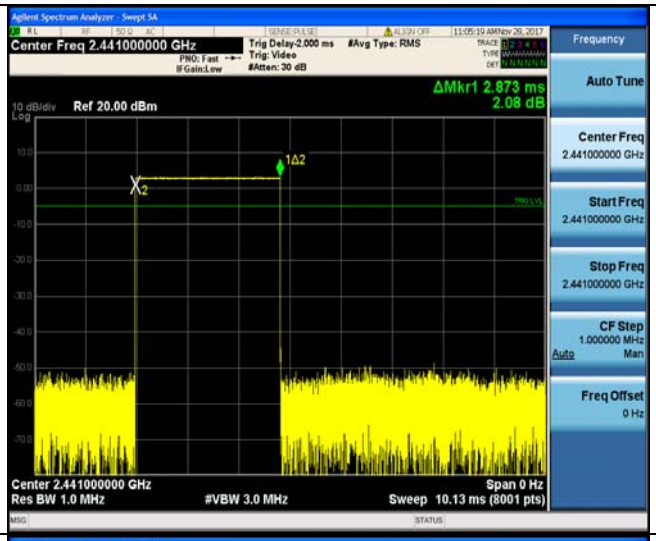
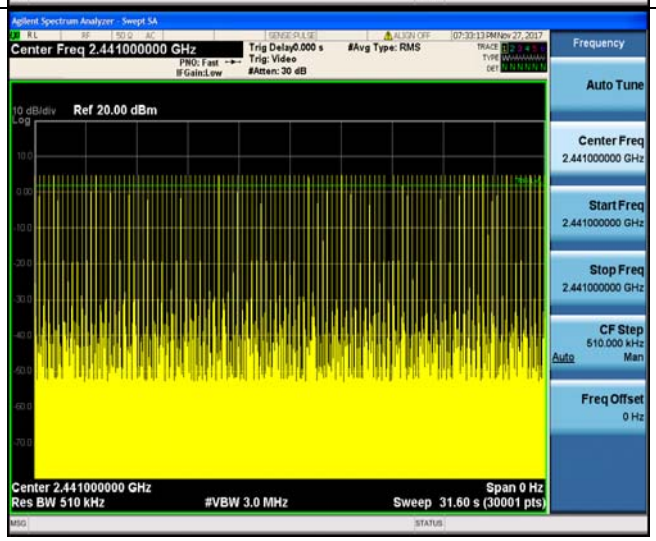
☒ **Passed** ☐ **Not Applicable**

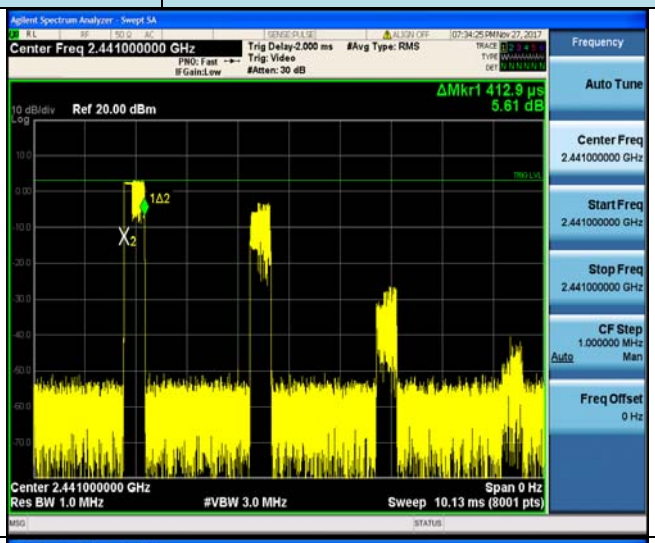
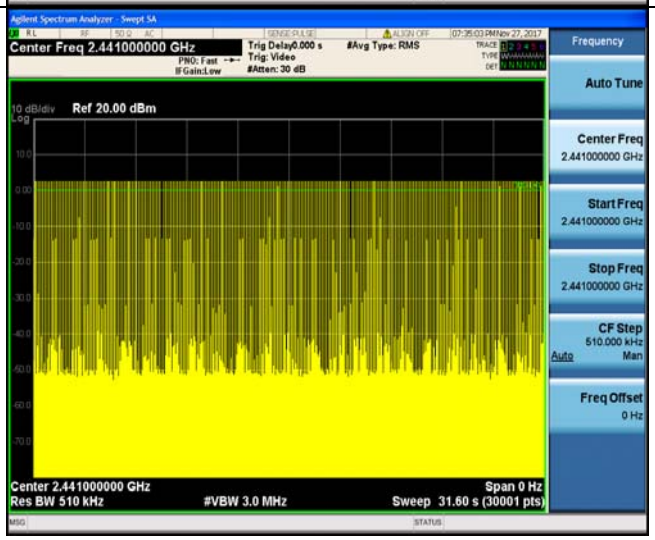
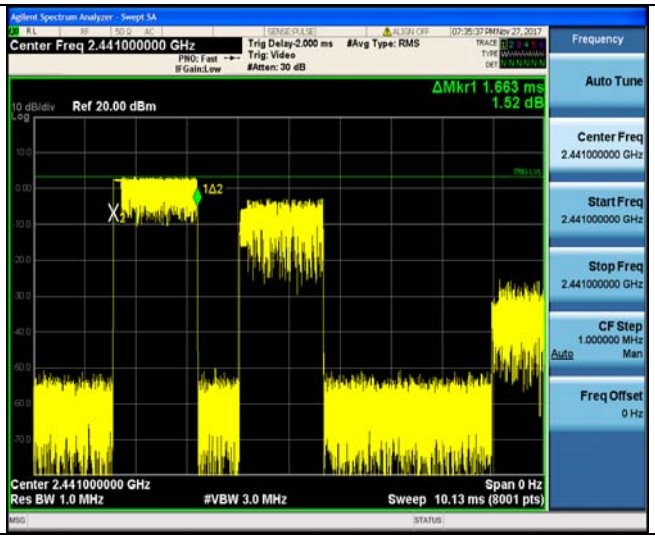
Modulation type	Channel	Burst Width [ms/hop/ch]	Total Hops[hop*ch]	Dwell time (Second)	Limit (Second)	Result
GFSK	DH1	0.40	322.00	0.13	≤ 0.40	Pass
	DH3	1.66	169.00	0.28		
	DH5	2.87	123.00	0.32		
π/4DQPSK	2DH1	0.41	320.00	0.13	≤ 0.40	Pass
	2DH3	1.66	161.00	0.27		
	2DH5	2.91	110.00	0.32		
8DPSK	3DH1	0.41	318.00	0.13	≤ 0.40	Pass
	3DH3	1.63	157.00	0.26		
	3DH5	2.88	110.00	0.32		

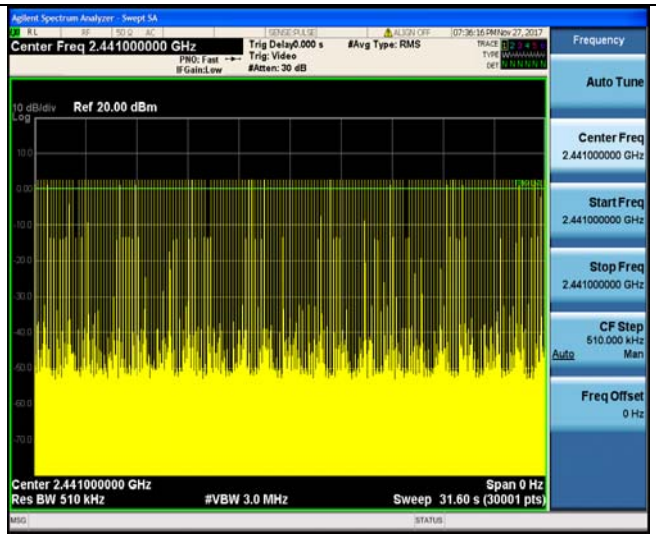
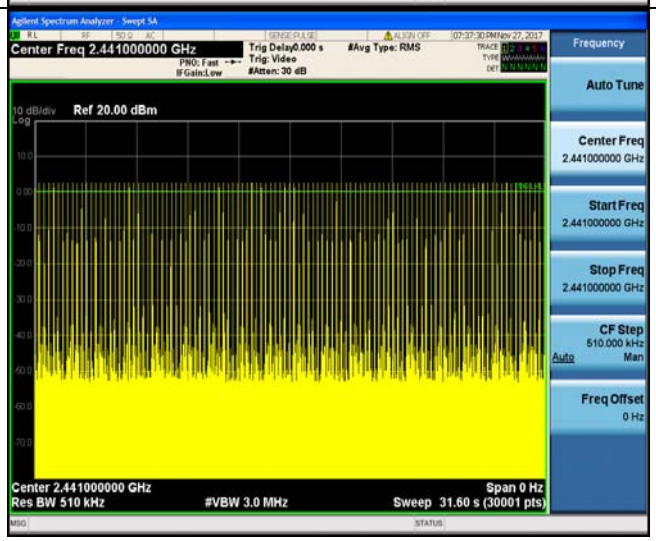
Note:

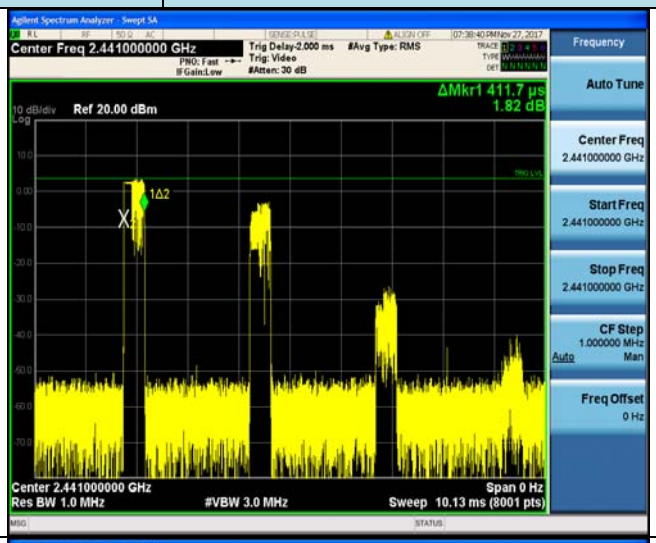
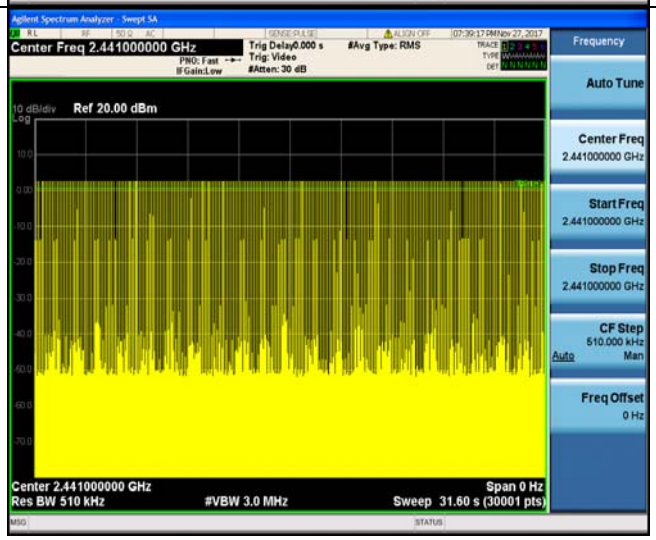
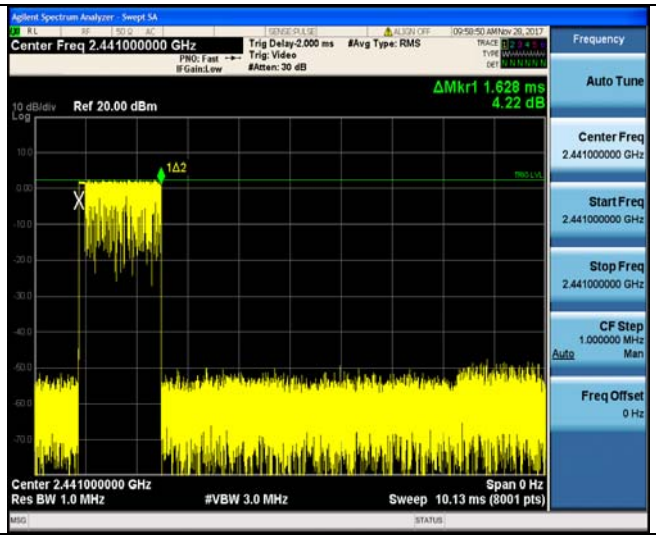
1. We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.
2. Dwell time= Burst Width [ms/hop/ch]* Total Hops[hop*ch]

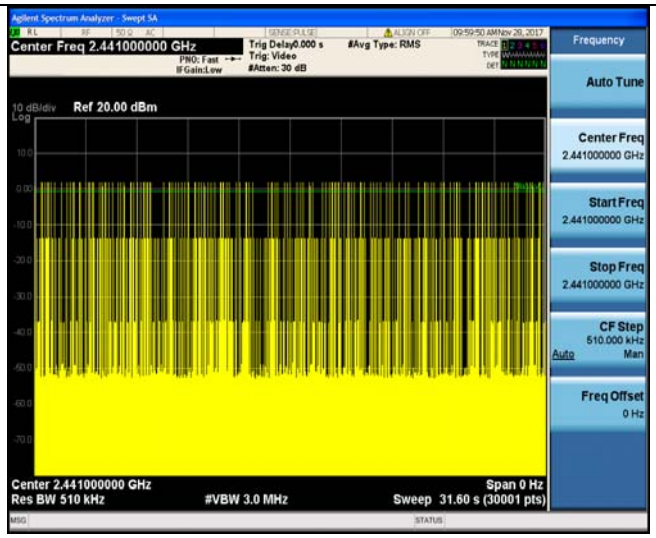
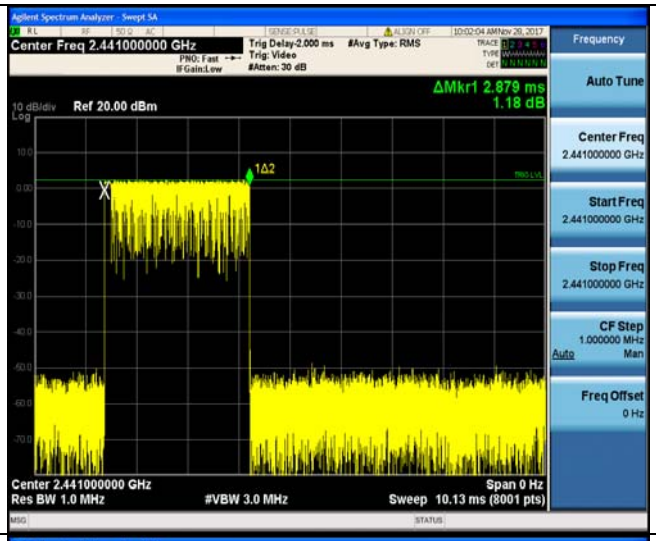
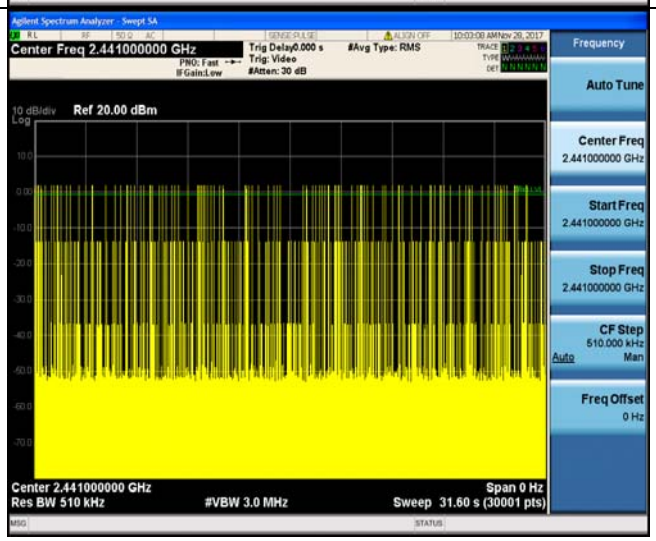
Modulation Type:		GFSK
DH1		
		
DH3		

		 Agilent Spectrum Analyzer - Swept SA Center Freq 2.441000000 GHz PNO: Fast IFGain:Low Trig Delay 0.000 s Trig: Video #Avg Type: RMS #Atten: 30 dB 07:31:52 PM Nov 27, 2017 Frequency 10 dB/div Log Ref 20.00 dBm Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz CF Step 510.000 kHz Auto Man Freq Offset 0 Hz Center 2.441000000 GHz Res BW 510 kHz #VBW 3.0 MHz Span 0 Hz Sweep 31.60 s (30001 pts)
DH5		 Agilent Spectrum Analyzer - Swept SA Center Freq 2.441000000 GHz PNO: Fast IFGain:Low Trig Delay 2.000 ms Trig: Video #Avg Type: RMS #Atten: 30 dB 11:05:19 AM Nov 28, 2017 Frequency ΔMkr1 2.873 ms 2.08 dB 10 dB/div Log Ref 20.00 dBm 1Δ2 X2 Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz CF Step 1.000000 MHz Auto Man Freq Offset 0 Hz Center 2.441000000 GHz Res BW 1.0 MHz #VBW 3.0 MHz Span 0 Hz Sweep 10.13 ms (8001 pts)
		 Agilent Spectrum Analyzer - Swept SA Center Freq 2.441000000 GHz PNO: Fast IFGain:Low Trig Delay 0.000 s Trig: Video #Avg Type: RMS #Atten: 30 dB 07:33:13 PM Nov 27, 2017 Frequency 10 dB/div Log Ref 20.00 dBm Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz CF Step 510.000 kHz Auto Man Freq Offset 0 Hz Center 2.441000000 GHz Res BW 510 kHz #VBW 3.0 MHz Span 0 Hz Sweep 31.60 s (30001 pts)

Modulation Type:		π/4DQPSK
2DH1		
		
2DH3		

		 Agilent Spectrum Analyzer - Swept SA Center Freq 2.441000000 GHz PNO: Fast IFGain:Low Trig Delay 0.000 s Trig: Video #Avg Type: RMS #Atten: 30 dB 07:36:16 PM Nov 27, 2017 10 dB/div Log Ref 20.00 dBm Center 2.441000000 GHz Res BW 510 kHz #VBW 3.0 MHz Span 0 Hz Sweep 31.60 s (30001 pts) Frequency Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz CF Step 510.000 kHz Auto Man Freq Offset 0 Hz
2DH5		 Agilent Spectrum Analyzer - Swept SA Center Freq 2.441000000 GHz PNO: Fast IFGain:Low Trig Delay -2.000 ms Trig: Video #Avg Type: RMS #Atten: 30 dB 07:36:53 PM Nov 27, 2017 ΔMkr1 2.912 ms 13.28 dB 10 dB/div Log Ref 20.00 dBm 1Δ2 Center 2.441000000 GHz Res BW 1.0 MHz #VBW 3.0 MHz Span 0 Hz Sweep 10.13 ms (8001 pts) Frequency Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz CF Step 1.000000 MHz Auto Man Freq Offset 0 Hz
		 Agilent Spectrum Analyzer - Swept SA Center Freq 2.441000000 GHz PNO: Fast IFGain:Low Trig Delay 0.000 s Trig: Video #Avg Type: RMS #Atten: 30 dB 07:37:30 PM Nov 27, 2017 10 dB/div Log Ref 20.00 dBm Center 2.441000000 GHz Res BW 510 kHz #VBW 3.0 MHz Span 0 Hz Sweep 31.60 s (30001 pts) Frequency Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz CF Step 510.000 kHz Auto Man Freq Offset 0 Hz

Modulation Type:		8DPSK
3DH1	
	
3DH3	

		 Agilent Spectrum Analyzer - Swept SA Center Freq 2.441000000 GHz PNO: Fast IFGain:Low Trig Delay 0.000 s Trig: Video #Avg Type: RMS #Atten: 30 dB 10 dB/div Log Ref 20.00 dBm Center 2.441000000 GHz Res BW 510 kHz #VBW 3.0 MHz Span 0 Hz Sweep 31.60 s (30001 pts) Frequency Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz CF Step 510.000 kHz Auto Man Freq Offset 0 Hz
3DH5		 Agilent Spectrum Analyzer - Swept SA Center Freq 2.441000000 GHz PNO: Fast IFGain:Low Trig Delay 2.000 ms Trig: Video #Avg Type: RMS #Atten: 30 dB ΔMkr1 2.879 ms 1.18 dB 10 dB/div Log Ref 20.00 dBm 1Δ2 Center 2.441000000 GHz Res BW 1.0 MHz #VBW 3.0 MHz Span 0 Hz Sweep 10.13 ms (8001 pts) Frequency Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz CF Step 1.000000 MHz Auto Man Freq Offset 0 Hz
		 Agilent Spectrum Analyzer - Swept SA Center Freq 2.441000000 GHz PNO: Fast IFGain:Low Trig Delay 0.000 s Trig: Video #Avg Type: RMS #Atten: 30 dB 10 dB/div Log Ref 20.00 dBm Center 2.441000000 GHz Res BW 510 kHz #VBW 3.0 MHz Span 0 Hz Sweep 31.60 s (30001 pts) Frequency Auto Tune Center Freq 2.441000000 GHz Start Freq 2.441000000 GHz Stop Freq 2.441000000 GHz CF Step 510.000 kHz Auto Man Freq Offset 0 Hz

5.8. Pseudorandom Frequency Hopping Sequence

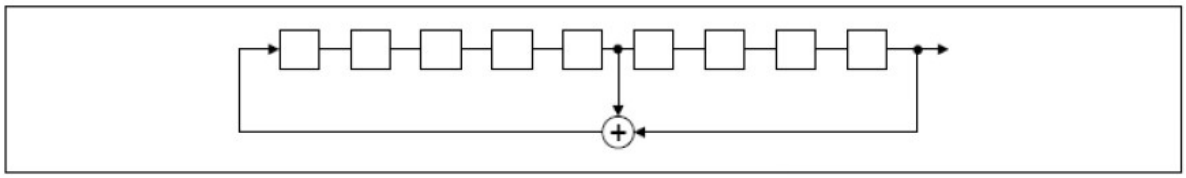
LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(1):Frequency hopping systems shall have hopping channel carrier fre-quencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping channel, whichever is greater. Al-ternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier fre-quencies 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 chan-nel frequencies that are selected at the system hopping rate from a pseudo ran-domly ordered list of hopping fre-quencies. Each frequency must be used equally on the average by each trans-mitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their cor-responding transmitters and shall shift frequencies in synchronization with the transmitted signals.

TEST RESULTS

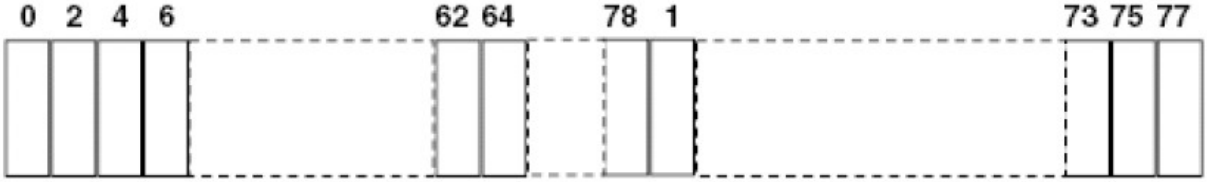
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage.And the result is fed back to the input of the friststage.The sequence begins with the frist one of 9 consecutive ones,forexample:the shift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

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



Linear Feedback Shift Register for Generation of the PRBS sequence

An explame of pseudorandom frequency hopping sequence as follows:



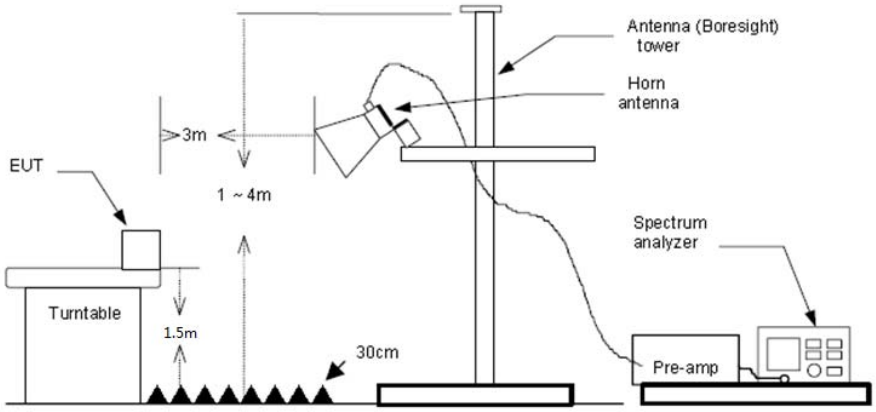
Each frequency used equally one the average by each transmitter.
The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.

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 waspositioned 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. Thisis 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)	Margin Limit (dB)	Polarization	Test value
2310.00	33.84	28.05	6.62	37.65	30.86	74.00	-43.14	Vertical	Peak
2389.83	47.09	27.65	6.75	37.87	43.62	74.00	-30.38	Vertical	
2310.00	33.69	28.05	6.62	37.65	30.71	74.00	-43.29	Horizontal	
2390.13	36.86	27.65	6.75	37.87	33.39	74.00	-40.61	Horizontal	

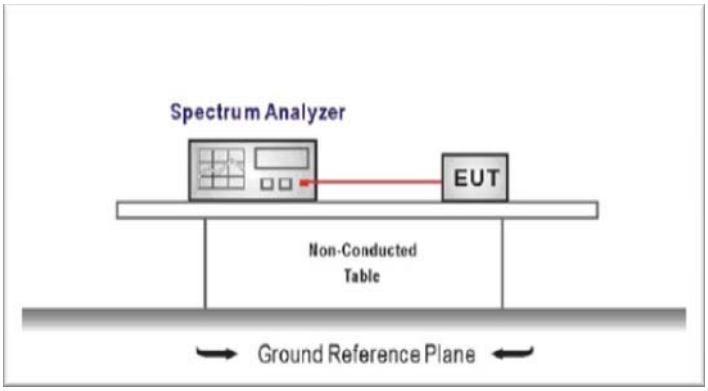
CH78									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin Limit (dB)	Polarization	Test value
2483.50	47.14	27.26	6.83	37.87	43.36	74.00	-30.64	Vertical	Peak
2486.89	73.76	27.25	6.83	37.87	69.97	74.00	-4.03	Vertical	
2500.00	35.93	27.20	6.84	37.87	32.10	74.00	-41.90	Vertical	
2483.50	40.24	27.26	6.83	37.87	36.46	74.00	-37.54	Horizontal	
2487.42	55.29	27.25	6.83	37.87	51.50	74.00	-22.50	Horizontal	
2500.00	32.79	27.20	6.84	37.87	28.96	74.00	-45.04	Horizontal	
2483.497	25.74	27.26	6.83	37.87	21.96	54.00	-32.04	Horizontal	Average
2500.00	21.49	27.2	6.84	37.87	17.66	54.00	-36.34	Horizontal	
2483.497	26.65	27.26	6.83	37.87	22.87	54.00	-31.13	Vertical	
2500.00	21.78	27.2	6.84	37.87	17.95	54.00	-36.05	Vertical	

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

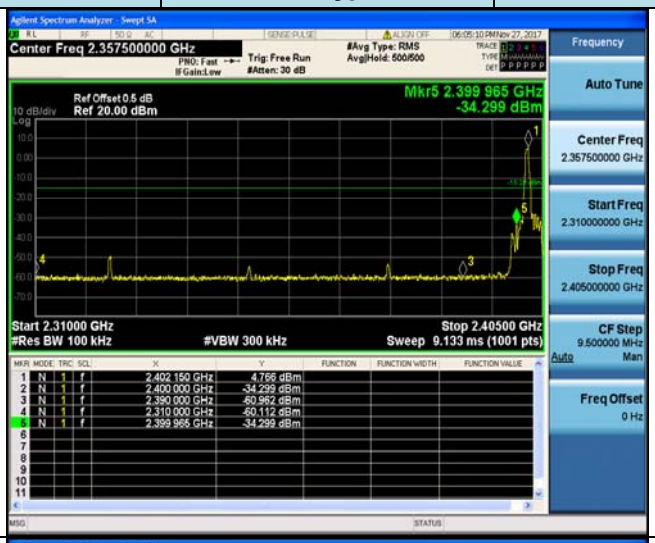
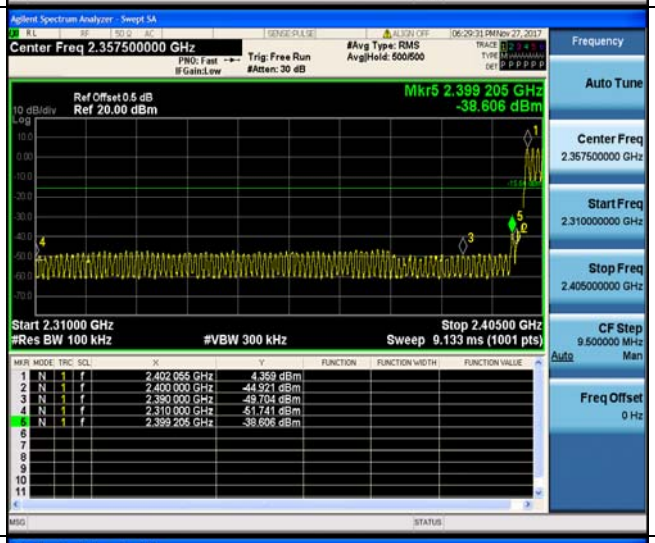
1. The transmitter output was connected to the spectrum analyzer through an attenuator, the path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:
   RBW = 100 kHz, VBW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

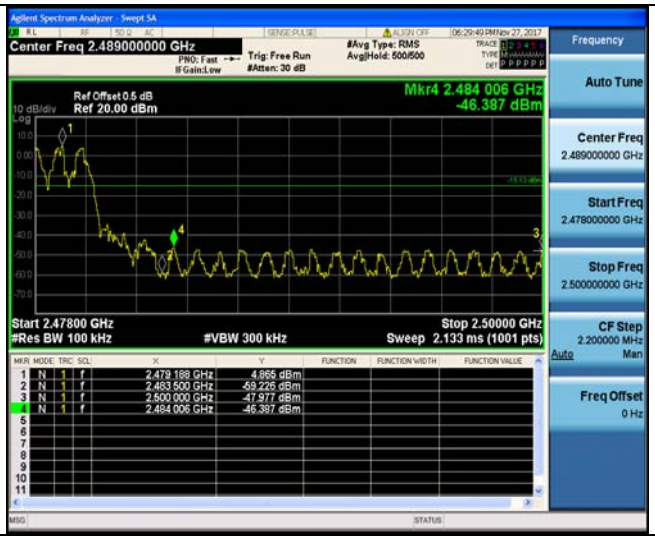
TEST MODE:

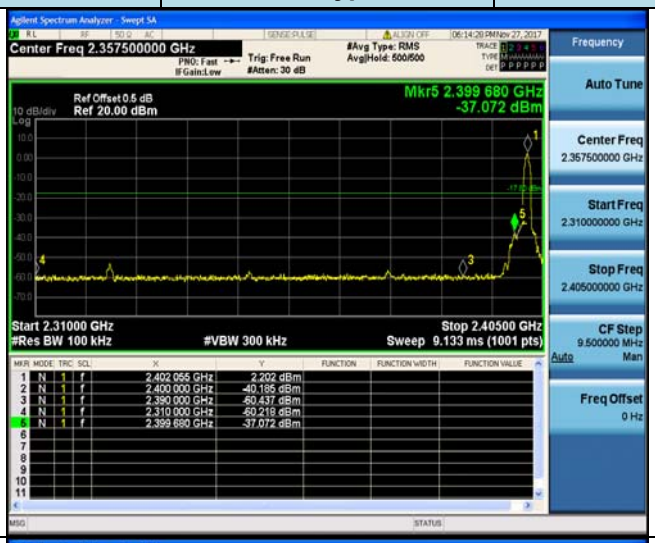
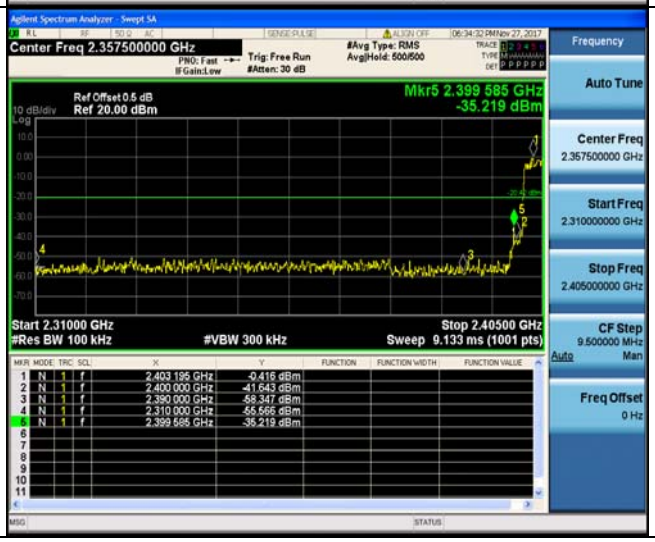
Please refer to the clause 3.3

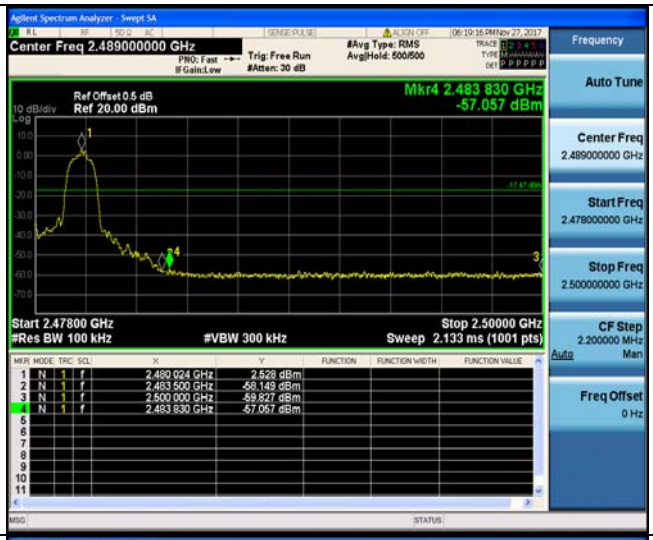
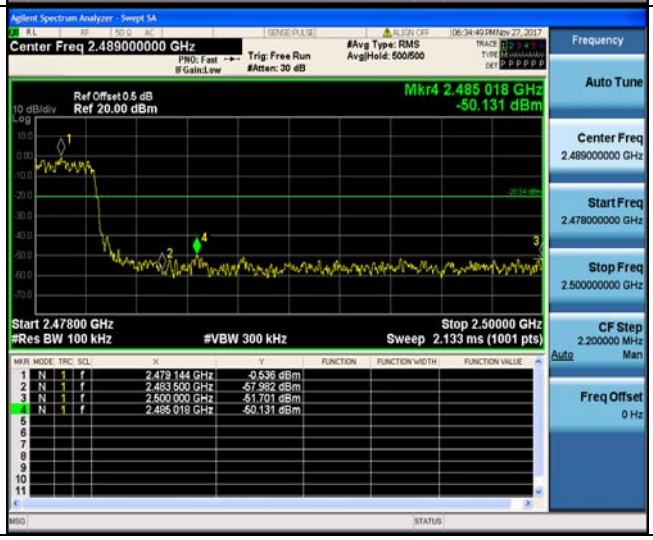
TEST RESULTS

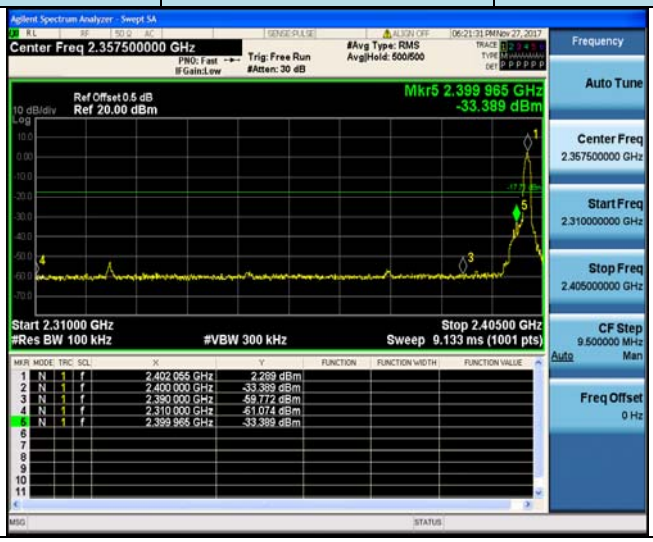
☒ **Passed** ☐ **Not Applicable**

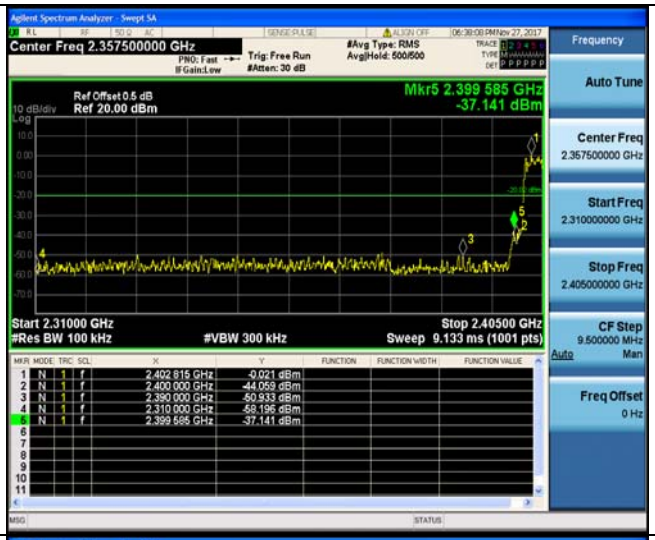
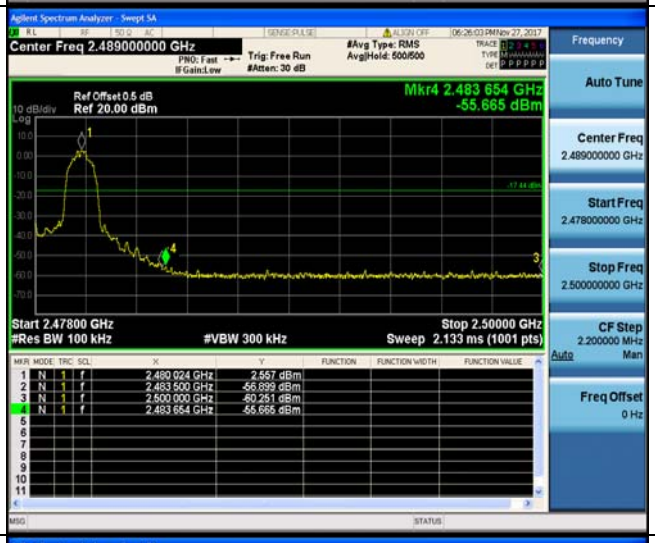
Test Item:	Band edge	Modulation type:	GFSK
CH00 No hopping mode			
CH00 Hopping mode			
CH78 No hopping mode			

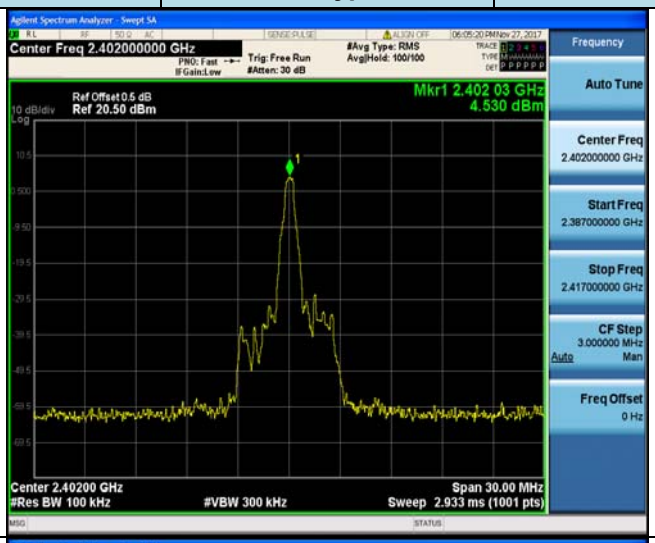
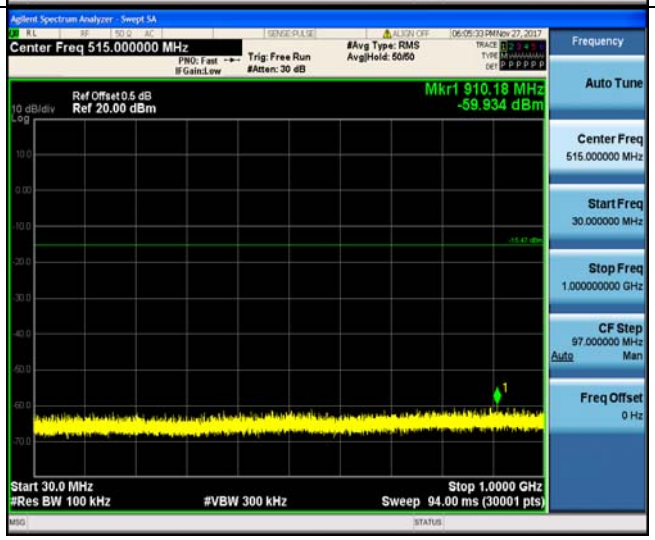
CH78 Hopping mode		

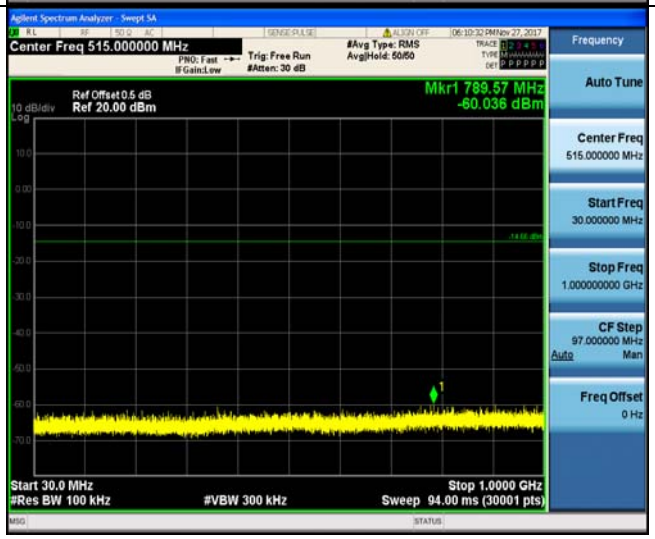
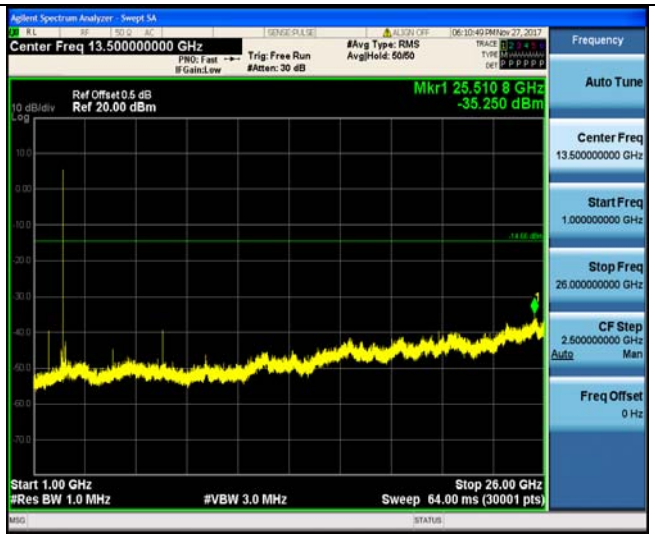
Test Item:	Band edge	Modulation type:	π/4DQPSK
CH00 No hopping mode			
CH00 Hopping mode			

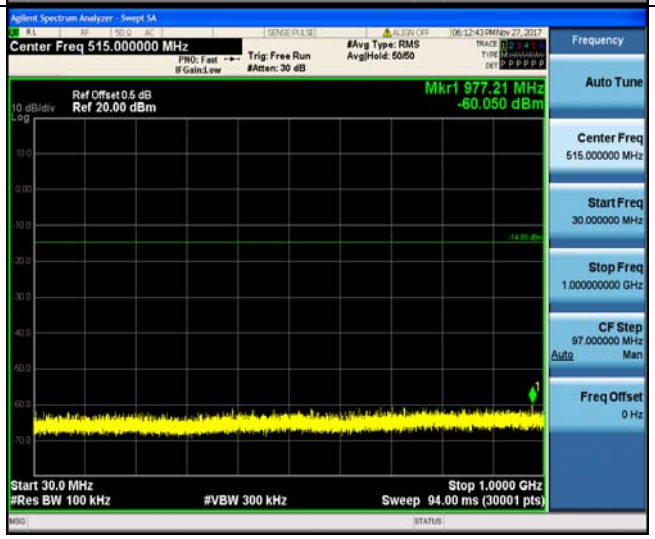
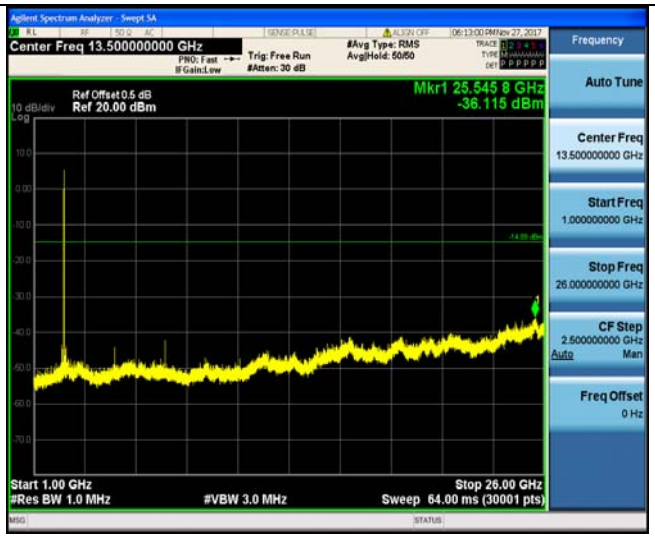
CH78 No hopping mode			
CH78 Hopping mode			

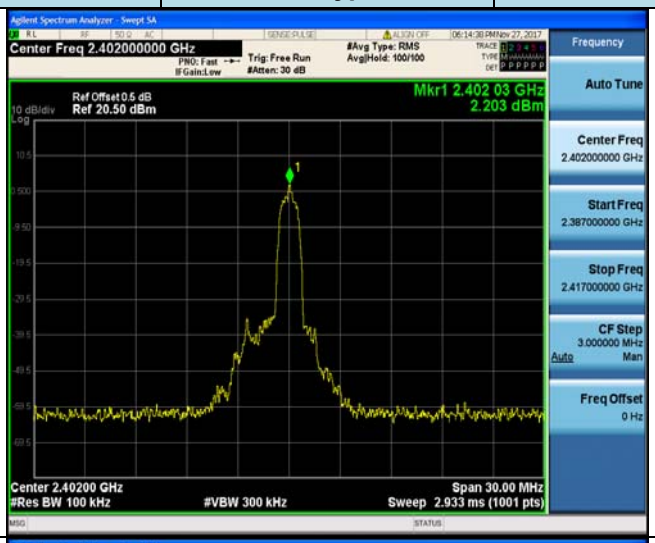
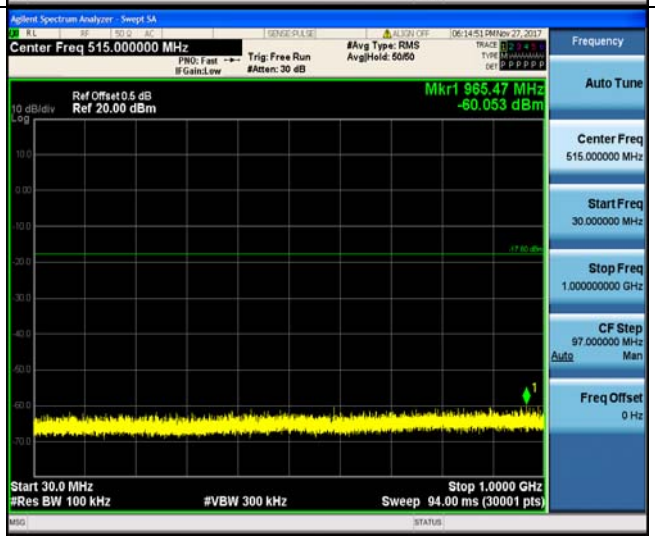
Test Item:	**Band edge**	**Modulation type:**	**8DPSK**
CH00 No hopping mode			

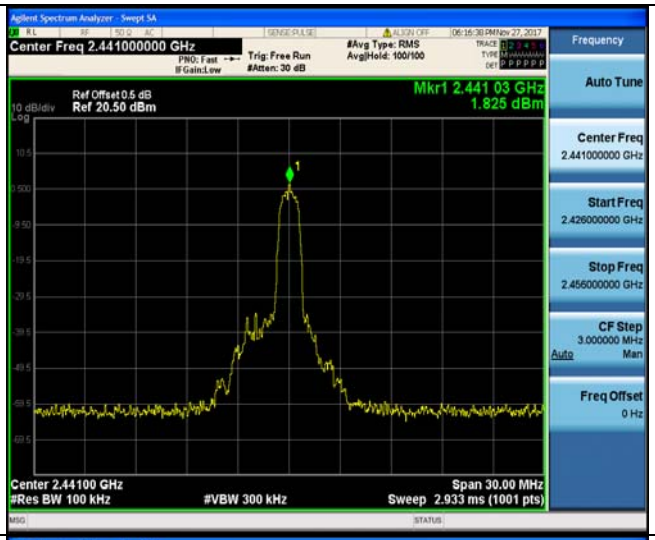
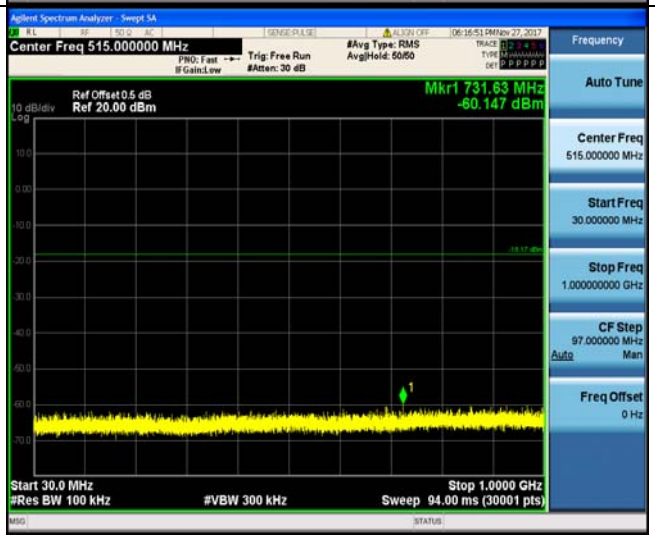
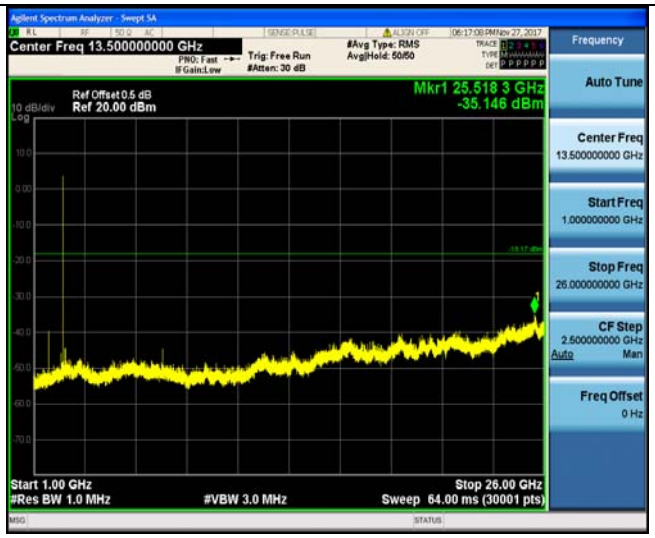
CH00 Hopping mode			
CH78 No hopping mode			
CH78 Hoppig mode			

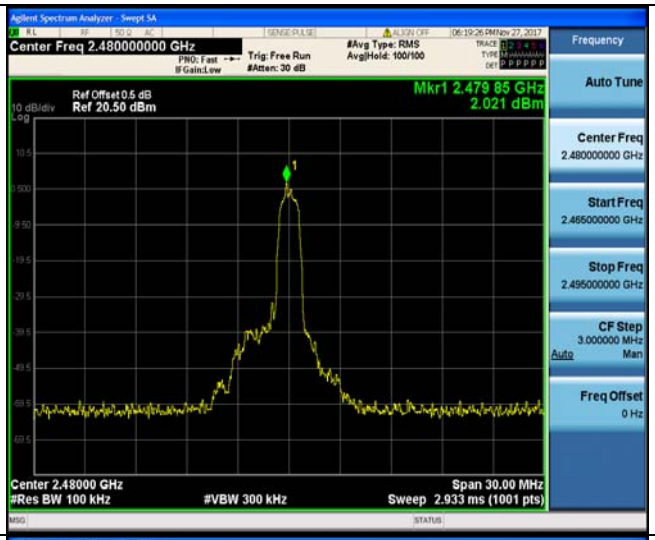
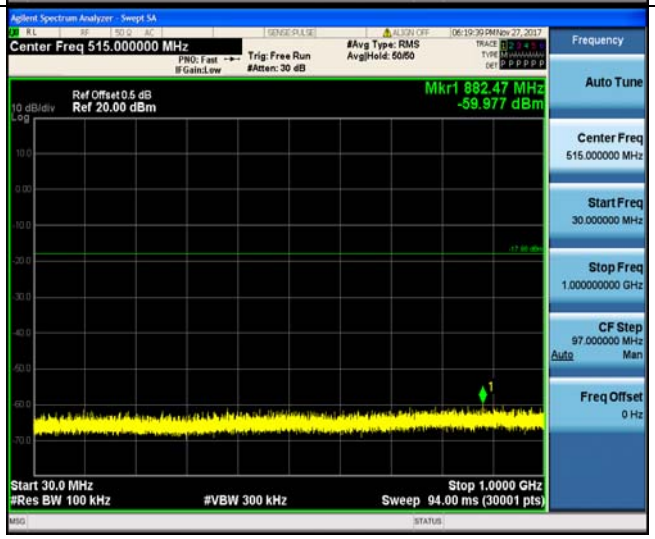
Test Item:	SE	Modulation type:	GFSK
reference level CH00			
CH00			
			

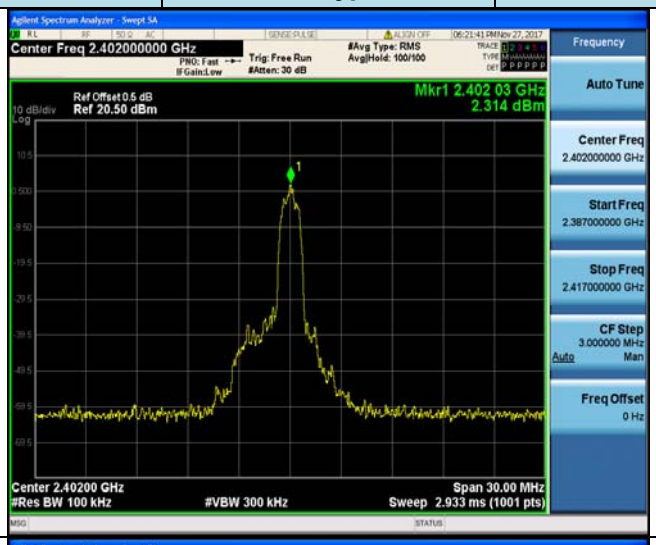
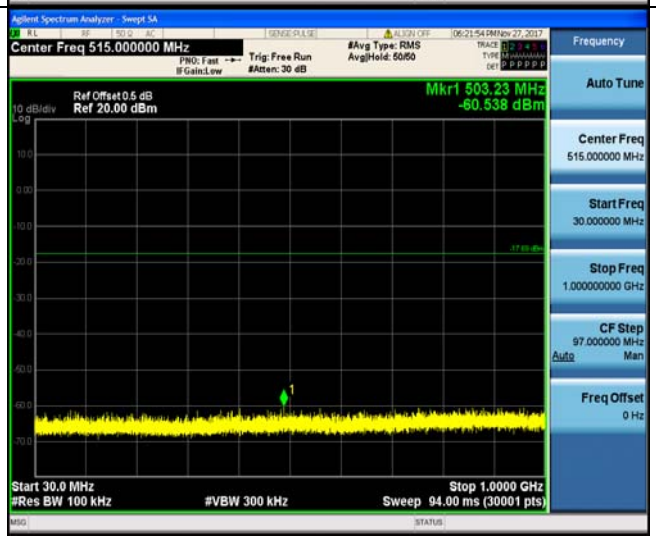
reference level CH39		
CH39		
		

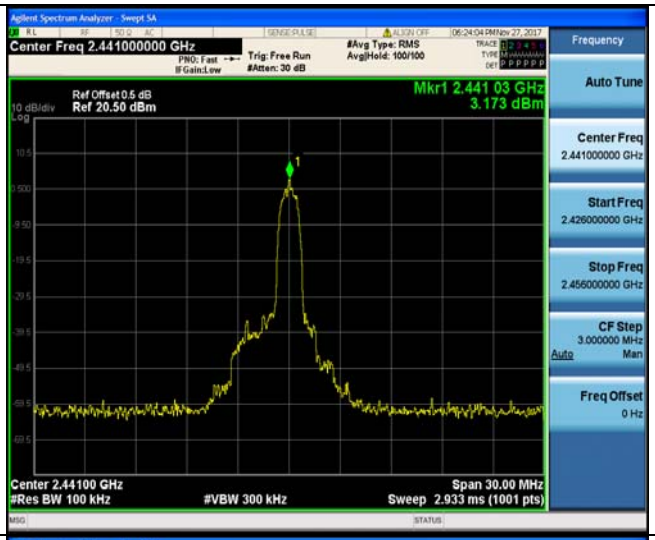
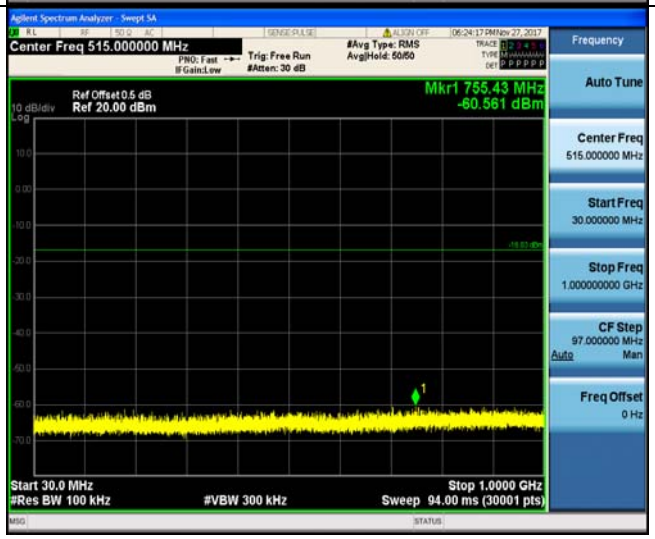
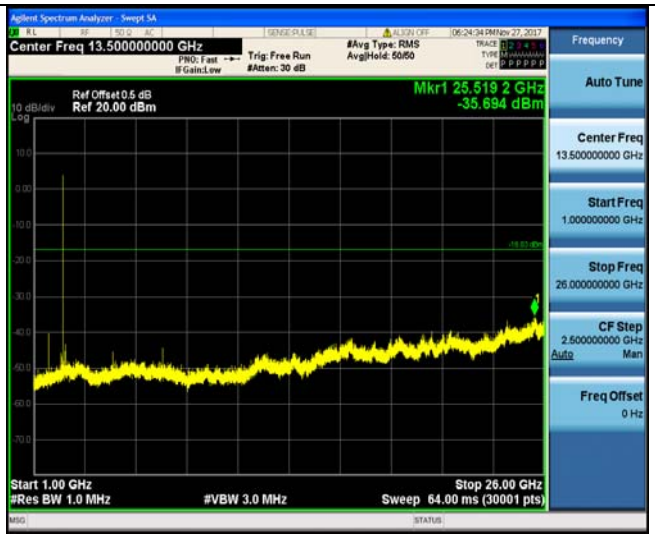
reference level CH78		
CH78		
		

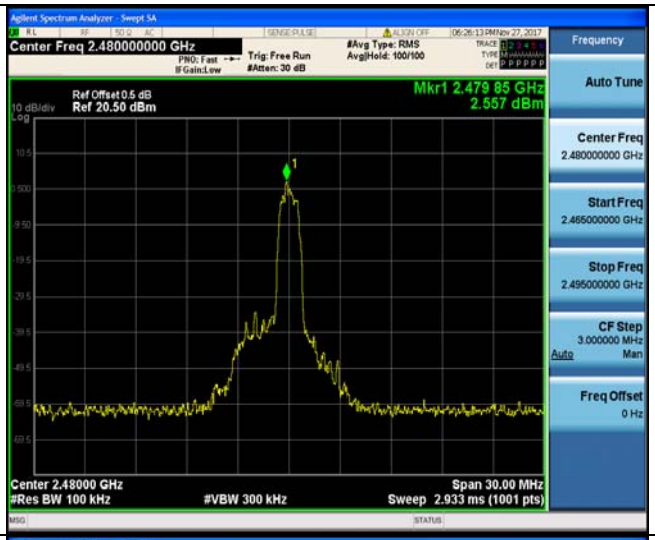
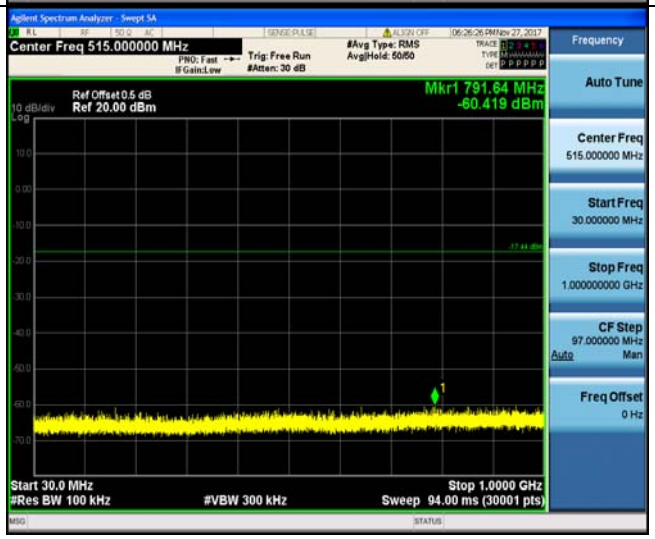
Test Item:	SE	Modulation type:	π/4DQPSK
reference level CH00			
CH00			
			

reference level CH39		
CH39		
		

reference level CH78		
CH78		
		

Test Item:	SE	Modulation type:	8DPSK
reference level CH00			
CH00			
			

reference level CH39		
CH39		
		

reference level CH78		
CH78		
		

5.11. Spurious Emissions (radiated)

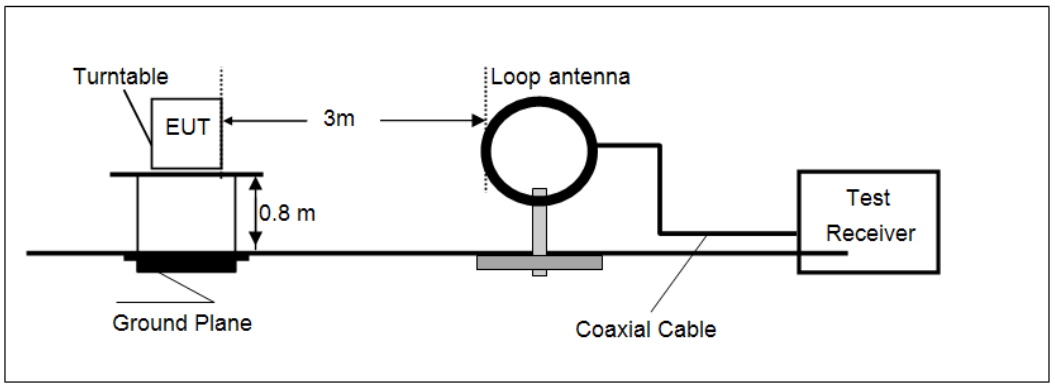
LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.209

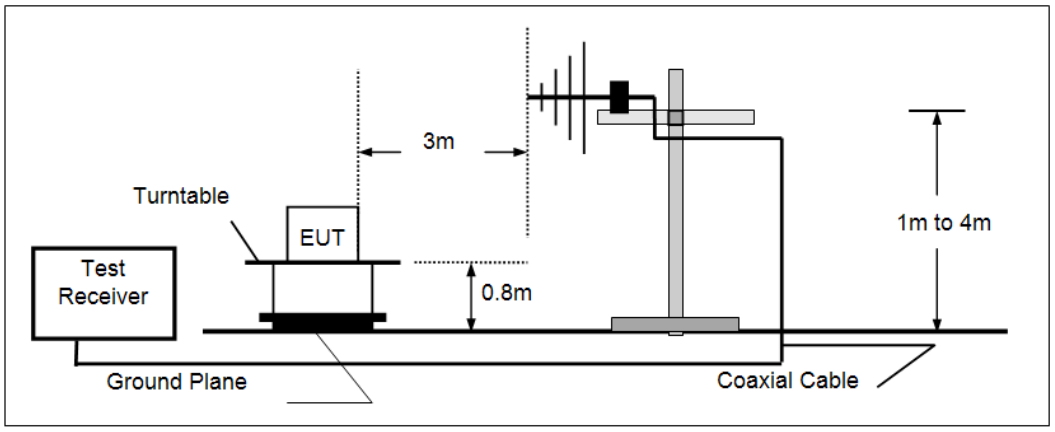
Frequency	Limit (dBuV/m @3m)	Value
30 MHz ~ 88 MHz	40.00	Quasi-peak
88 MHz ~ 216 MHz	43.50	Quasi-peak
216 MHz ~ 960 MHz	46.00	Quasi-peak
960 MHz ~ 1 GHz	54.00	Quasi-peak
Above 1 GHz	54.00	Average
	74.00	Peak

TEST CONFIGURATION

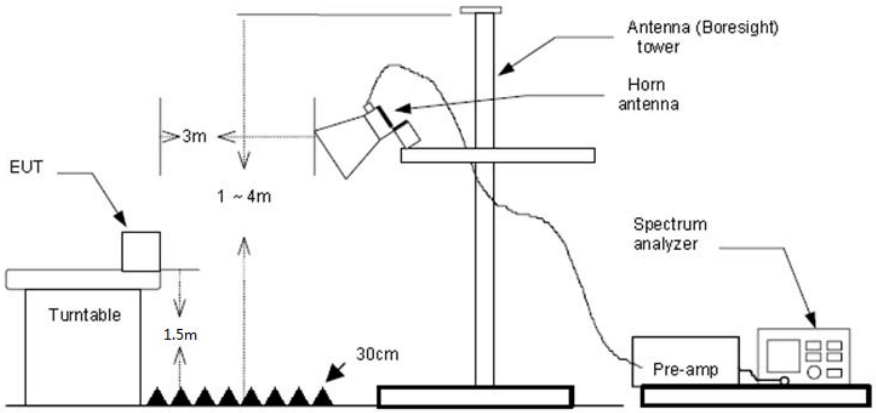
- Below 30 MHz



- 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 detectoris 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:

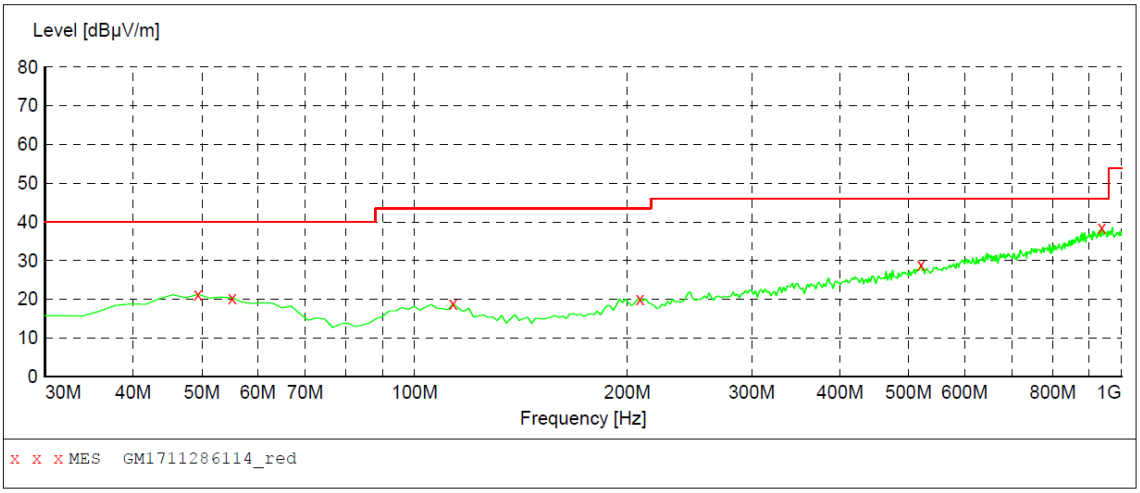
1) Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2) The emission levels of other frequencies are very lower than the limit and not show in test report.
3) Below 1 GHz,Have pre-scan all modulation mode, found the GFSK modulation High channel which it was worst case, 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**

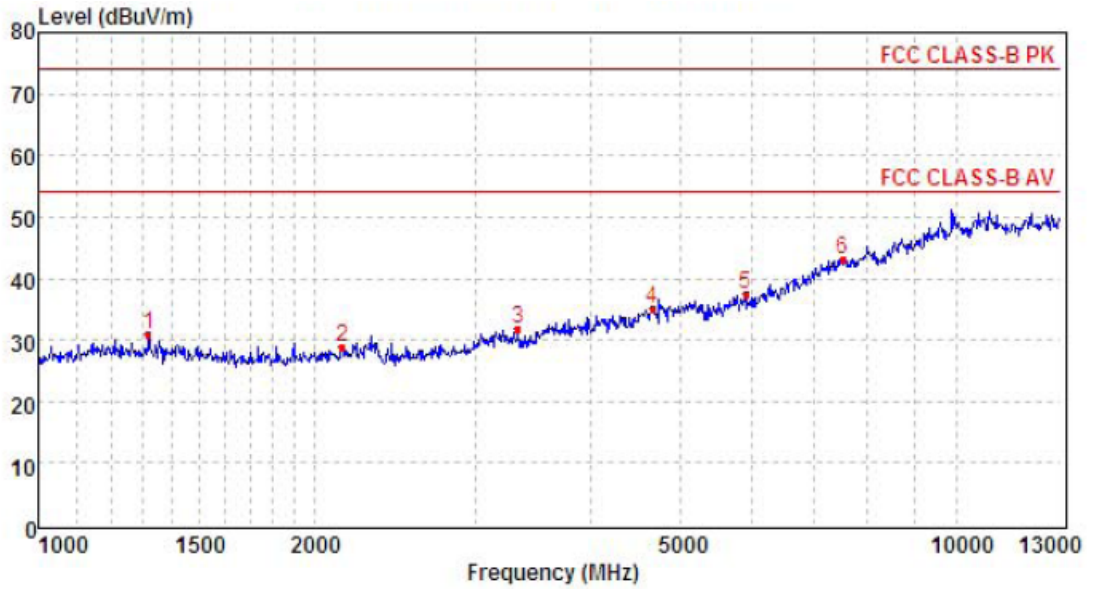
The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

➢ **30MHz ~ 1GHz**

Polarization:	Vertical

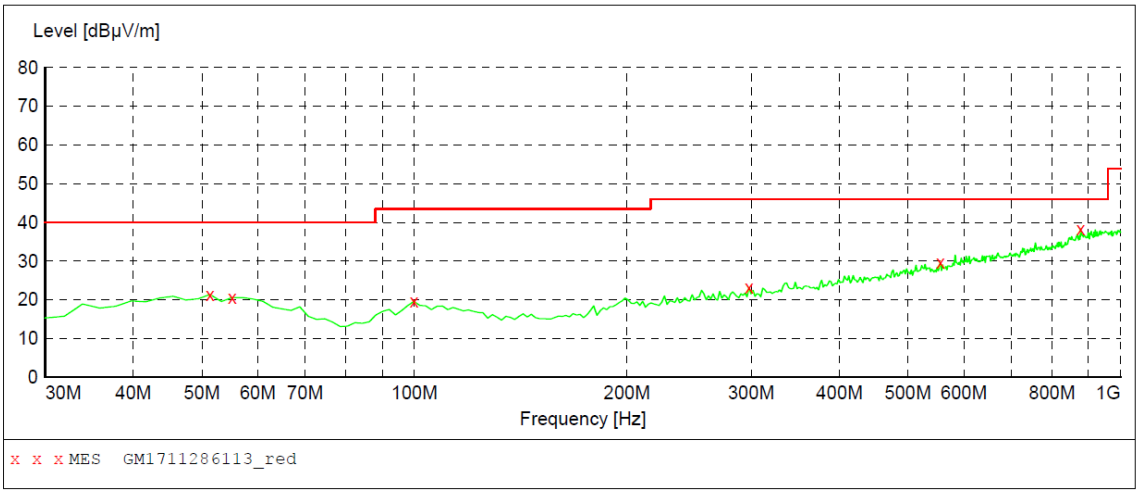


Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
49.400000	21.30	-8.7	40.0	18.7	QP	100.0	313.00	VERTICAL
55.220000	20.40	-9.2	40.0	19.6	QP	100.0	285.00	VERTICAL
113.420000	18.90	-11.3	43.5	24.6	QP	100.0	245.00	VERTICAL
208.480000	20.20	-10.5	43.5	23.3	QP	100.0	38.00	VERTICAL
520.820000	29.00	-1.3	46.0	17.0	QP	100.0	193.00	VERTICAL
937.920000	38.50	7.1	46.0	7.5	QP	100.0	0.00	VERTICAL

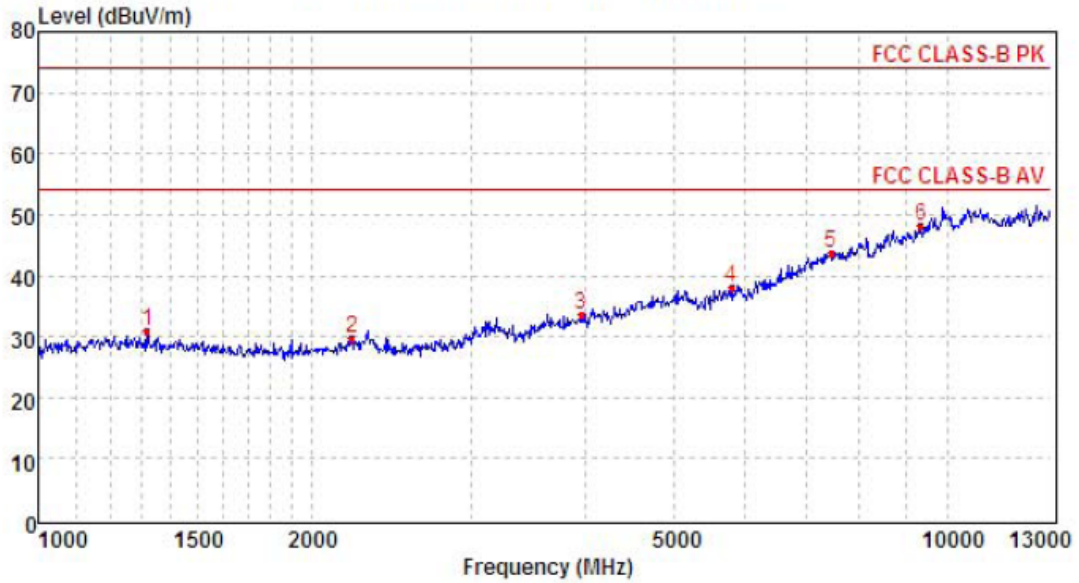


Mark	Frequency MHZ	Reading dbuv/m	Antenna db	Cable db	Preamp db	Level dbuv/m	Limit dbuv/m	Over limit	Remark
1	1319.19	36.3	26.1	4.9	36.5	30.8	74.0	-43.2	Peak
2	2142.11	32.8	27.0	6.4	37.3	28.9	74.0	-45.1	Peak
3	3329.96	34.1	28.2	7.9	38.4	31.8	74.0	-42.2	Peak
4	4671.75	31.7	31.1	9.5	37.1	35.2	74.0	-38.8	Peak
5	5899.96	30.0	32.3	10.6	35.4	37.5	74.0	-36.5	Peak
6	7527.89	29.5	36.1	12.5	34.9	43.2	74.0	-30.8	Peak

Polarization:	Horizontal



Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
51.340000	21.40	-8.8	40.0	18.6	QP	100.0	131.00	HORIZONTAL
55.220000	20.60	-9.2	40.0	19.4	QP	300.0	360.00	HORIZONTAL
99.840000	19.60	-10.6	43.5	23.9	QP	300.0	314.00	HORIZONTAL
297.720000	23.20	-7.3	46.0	22.8	QP	100.0	194.00	HORIZONTAL
555.740000	29.70	-0.6	46.0	16.3	QP	300.0	1.00	HORIZONTAL
877.780000	38.40	6.2	46.0	7.6	QP	300.0	245.00	HORIZONTAL



Mark	Frequency MHZ	Reading dbuv/m	Antenna db	Cable db	Preamp db	Level dbuv/m	Limit dbuv/m	Over limit	Remark
1	1319.19	36.3	26.1	4.9	36.5	30.8	74.0	-43.2	Peak
2	2214.74	33.1	27.6	6.5	37.4	29.8	74.0	-44.2	Peak
3	3954.34	33.4	29.7	8.7	38.1	33.7	74.0	-40.3	Peak
4	5794.97	30.7	32.1	10.6	35.3	38.1	74.0	-35.9	Peak
5	7451.05	30.3	36.2	12.2	34.9	43.8	74.0	-30.2	Peak
6	9361.78	30.9	39.1	13.7	35.4	48.3	74.0	-25.7	Peak

➢ **Above 1 GHz**

CH00 for GFSK									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin Limit (dB)	Polarization	Test value
1198.10	42.67	26.29	4.66	36.57	37.05	74.00	-36.95	Vertical	Peak
1933.42	45.58	25.64	6.17	37.25	40.14	74.00	-33.86	Vertical	
4809.50	47.11	31.58	9.55	36.93	51.31	74.00	-22.69	Vertical	
7209.02	41.62	36.21	11.87	35.07	54.63	74.00	-19.37	Vertical	
1195.05	44.14	26.26	4.65	36.57	38.48	74.00	-35.52	Horizontal	Peak
3291.39	38.11	28.25	7.83	38.36	35.83	74.00	-38.17	Horizontal	
4809.50	49.86	31.58	9.55	36.93	54.06	74.00	-19.94	Horizontal	
7209.02	44.37	36.21	11.87	35.07	57.38	74.00	-16.62	Horizontal	
4809.498	34.06	31.58	9.55	36.93	38.26	54.00	-15.74	Horizontal	Average
7209.016	24.55	36.21	11.87	35.07	37.56	54.00	-16.44	Horizontal	
4809.498	32.49	31.58	9.55	36.93	36.69	54.00	-17.31	Vertical	Average
7209.016	22.58	36.21	11.87	35.07	35.59	54.00	-18.41	Vertical	

CH39 for GFSK									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin Limit (dB)	Polarization	Test value
2097.51	43.25	26.69	6.35	37.32	38.97	74.00	-35.03	Vertical	Peak
3274.67	41.15	28.35	7.81	38.33	38.98	74.00	-35.02	Vertical	
4883.52	48.51	31.43	9.59	36.73	52.80	74.00	-21.20	Vertical	
7319.96	33.72	36.30	11.99	34.92	47.09	74.00	-26.91	Vertical	
1267.10	37.44	26.23	4.77	36.53	31.91	74.00	-42.09	Horizontal	Peak
3291.39	42.10	28.25	7.83	38.36	39.82	74.00	-34.18	Horizontal	
4883.52	51.86	31.43	9.59	36.73	56.15	74.00	-17.85	Horizontal	
7319.96	39.53	36.30	11.99	34.92	52.90	74.00	-21.10	Horizontal	
4883.519	35.98	31.43	9.59	36.73	40.27	54.00	-13.73	Horizontal	Average
7319.965	22.79	36.3	11.99	34.92	36.16	54.00	-17.84	Horizontal	
4883.518	29.16	31.43	9.59	36.73	33.45	54.00	-20.55	Vertical	Average
7319.964	21.99	36.3	11.99	34.92	35.36	54.00	-18.64	Vertical	

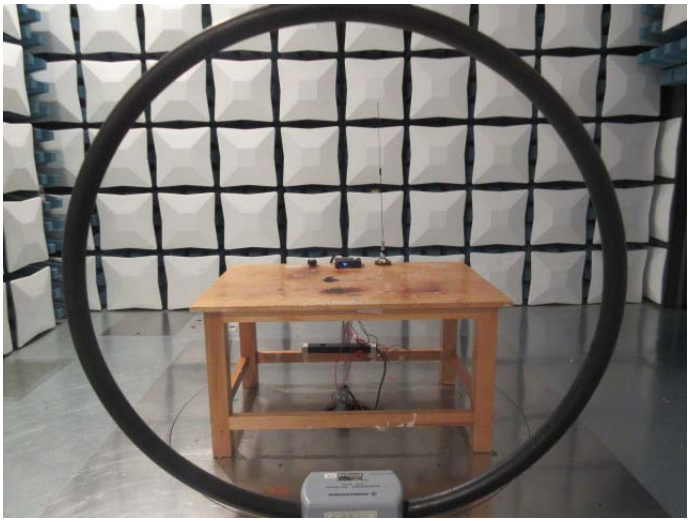
CH78 for GFSK									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin Limit (dB)	Polarization	Test value
1795.84	41.27	25.39	5.95	37.13	35.48	74.00	-38.52	Vertical	Peak
3700.26	36.34	29.30	8.39	38.25	35.78	74.00	-38.22	Vertical	
4958.68	54.97	31.46	9.64	36.52	59.55	74.00	-14.45	Vertical	
7451.57	35.68	36.20	12.24	34.86	49.26	74.00	-24.74	Vertical	
1198.10	42.05	26.29	4.66	36.57	36.43	74.00	-37.57	Horizontal	Peak
2092.18	43.41	26.67	6.35	37.32	39.11	74.00	-34.89	Horizontal	
4958.68	51.05	31.46	9.64	36.52	55.63	74.00	-18.37	Horizontal	
7451.57	31.38	36.20	12.24	34.86	44.96	74.00	-29.04	Horizontal	
4958.677	32.82	31.46	9.64	36.52	37.4	54.00	-16.6	Horizontal	Average
7451.567	31.38	36.2	12.24	34.86	44.96	54.00	-9.04	Horizontal	
4958.677	37.71	31.46	9.64	36.52	42.29	54.00	-11.71	Vertical	Average
7451.567	20.53	36.2	12.24	34.86	34.11	54.00	-19.89	Vertical	

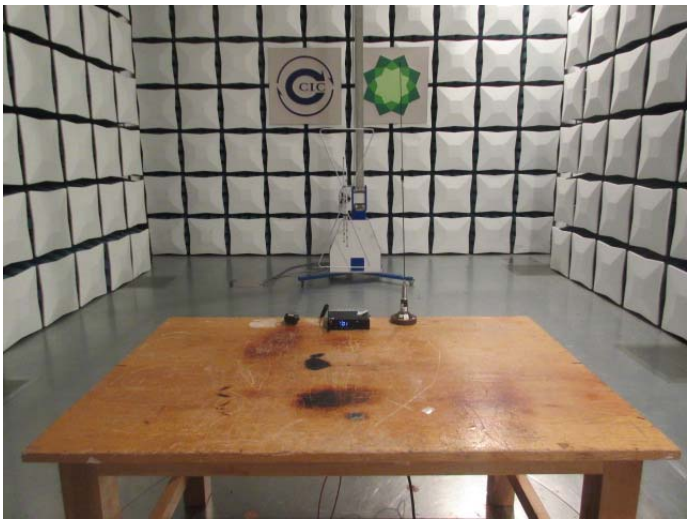
- Remark:

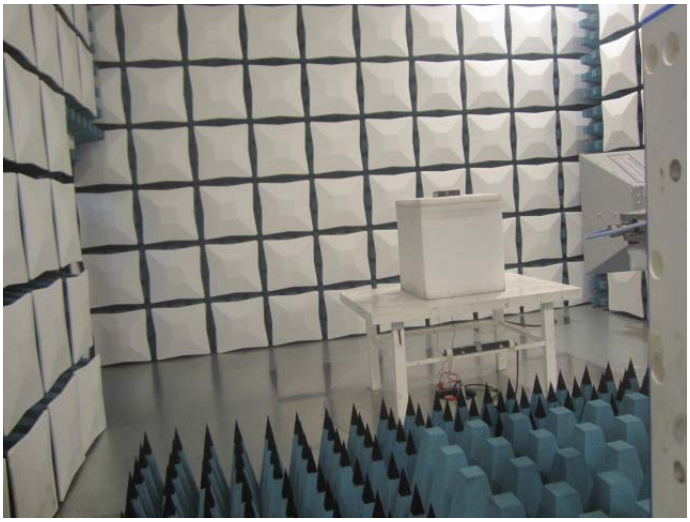
1. Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. The peak level is lower than average limit(54dBuV/m), this data is the too weak instrument of signal is unable to test. The emission levels of other frequencies are very lower than the limit and not show in test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

6. TEST SETUP PHOTOS

Radiated Emission:

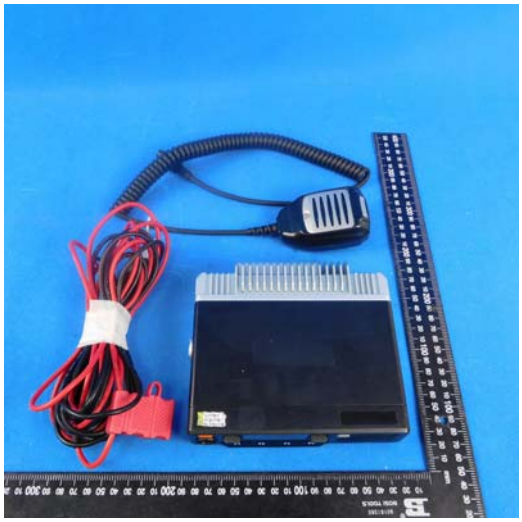


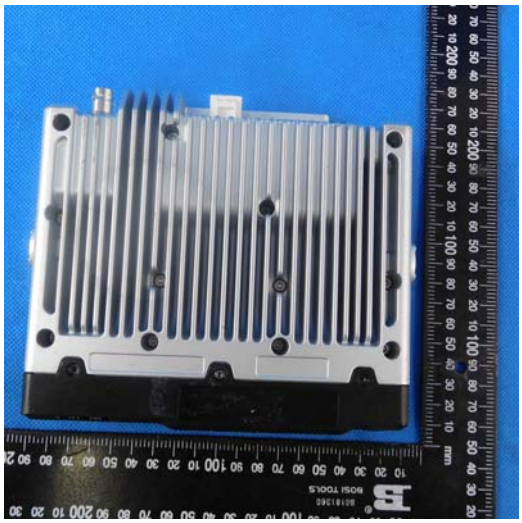




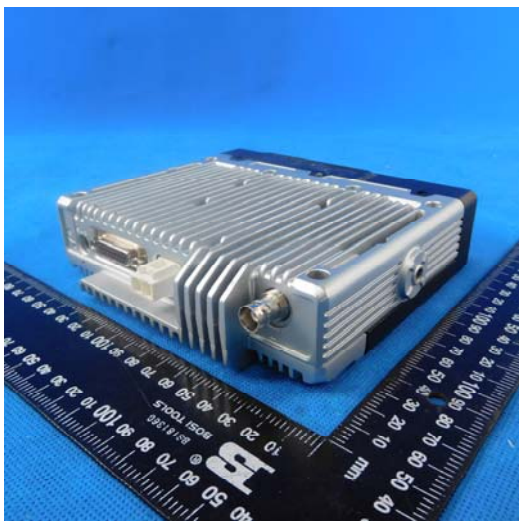
7. EXTERANAL AND INTERNAL PHOTOS

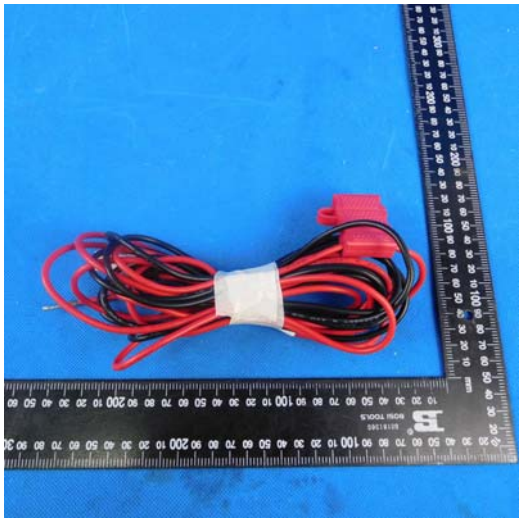
External Photos of the EUT



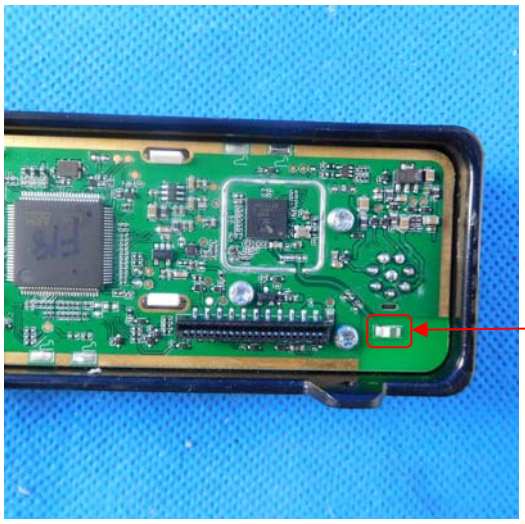


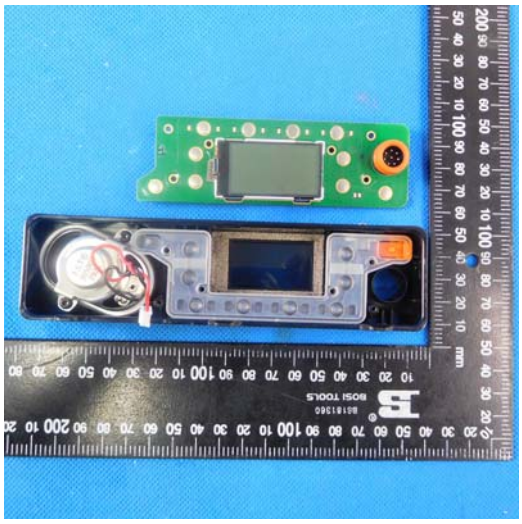

P1
P2
P3
P4

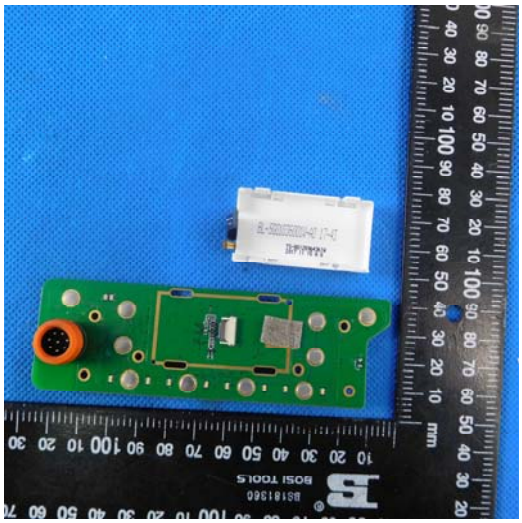


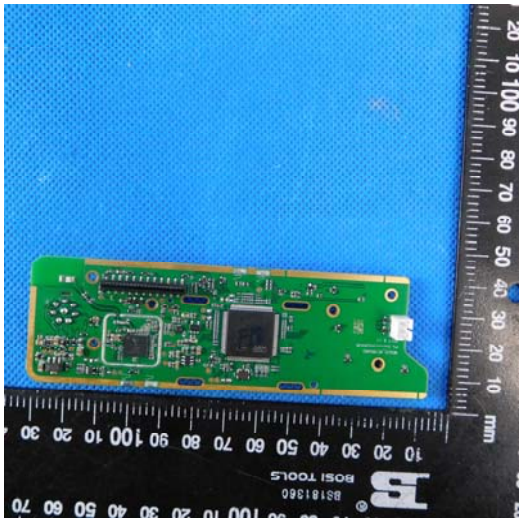


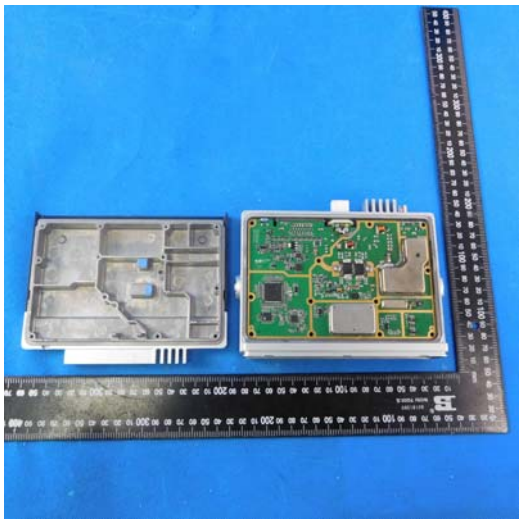
Internal Photos of the EUT

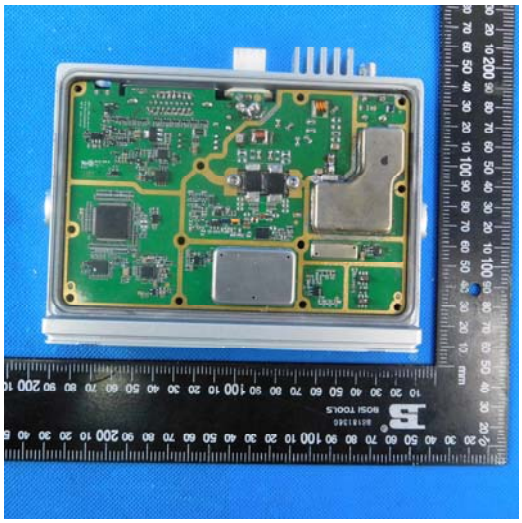


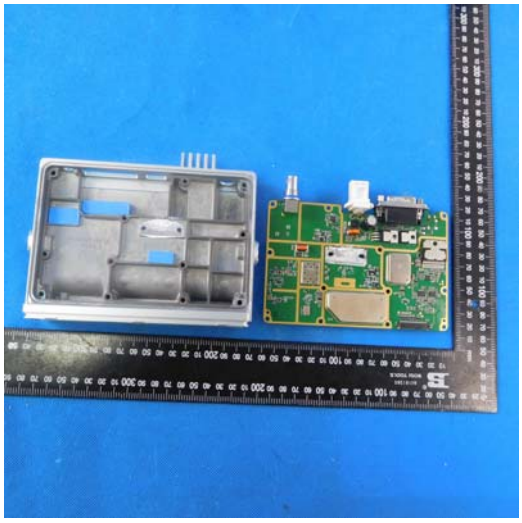


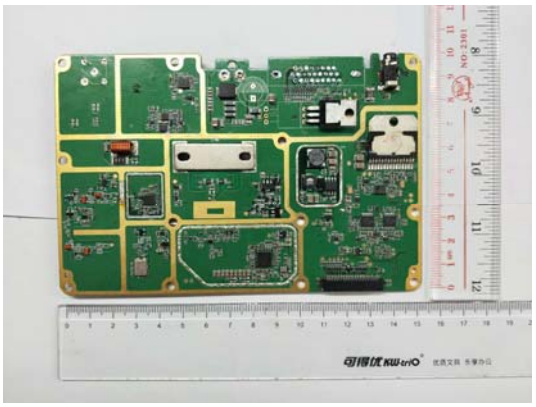


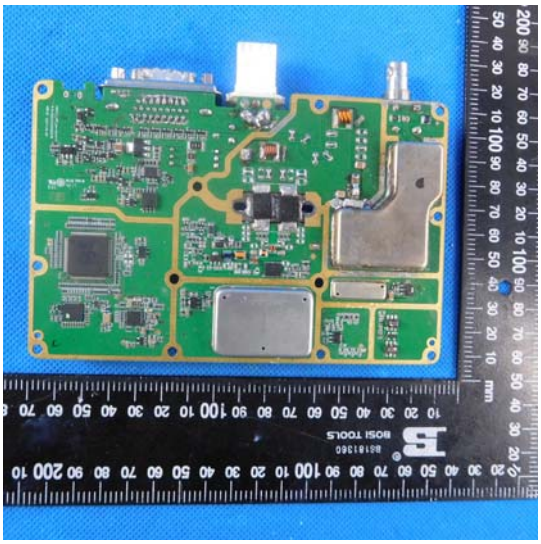


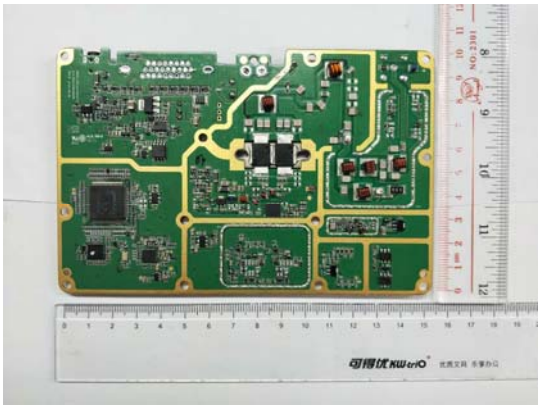












----------End of Report----------