TEST REPORT

Report No. ..... :	**CHTEW20010182** Report Verification:
Project No.....:	**SHT1912069305EW**
FCC ID..... :	**2AVIMA102**
Applicant's name..... :	**CHINA HAINERGY NEW ENERGY CORP.,LIMITED**
Address.....:	Unit 1908,19/F,Harbour Centre,25 Harbour Road,Wan Chai,HongKong
Manufacturer.....:	CHINA HAINERGY NEW ENERGY CORP.,LIMITED
Address.....:	Unit 1908,19/F,Harbour Centre,25 Harbour Road,Wan Chai,HongKong
Test item description ..... :	**Tablet PC**
Trade Mark .....:	Plan Ceibal
Model/Type reference.....:	ACRUX
Listed Model(s) .....:	A102
Standard ..... :	**FCC CFR Title 47 Part 15 Subpart C Section 15.247**
Date of receipt of test sample.....:	Dec.27,2019
Date of testing.....:	Dec.27,2019 ~ Jan.17,2020
Date of issue.....:	Jan.19,2020
Result.....:	**PASS**

Compiled by (Position+Printed name+Signature):	File administrator Yueming Li	Yueming.Li
Supervised by (Position+Printed name+Signature):	Project Engineer Kiki Kong	Kiki Kong
Approved by (Position+Printed name+Signature):	RF Manager Hans Hu	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 for Testing Unlicensed Wireless Devices

– KDB 558074 D01 15.247 Meas Guidance v05r02: Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating under Section 15.247 of The FCC Rules

1.2. Report version

Revision No.	Date of issue	Description
N/A	2020-01-19	Original

2. TEST DESCRIPTION

Report clause	Test Items	Standard Requirement	Result
5.1	Antenna Requirement	15.203/15.247 (c)	PASS
5.2	AC Conducted Emission	15.207	PASS
5.3	Peak Output Power	15.247 (b)(1)	PASS
5.4	20 dB Bandwidth	15.247 (a)(1)	PASS
5.5	99% Occupied Bandwidth	-	PASS*1
5.6	Carrier Frequency Separation	15.247 (a)(1)	PASS
5.7	Hopping Channel Number	15.247 (a)(1)	PASS
5.8	Dwell Time	15.247 (a)(1)	PASS
5.9	Duty Cycle Correction Factor	-	PASS*1
5.10	Pseudorandom Frequency Hopping Sequence	15.247(b)(4)	PASS
5.11	Conducted Band Edge and Spurious Emission	15.247(d)/15.205	PASS
5.12	Radiated Band Edge Emission	15.205/15.209	PASS
5.13	Radiated Spurious Emission	15.247(d)/15.205/15.209	PASS

Note:

– The measurement uncertainty is not included in the test result.

– *1: No requirement on standard, only report these test data.

3. SUMMARY

3.1. Client Information

Applicant:	CHINA HAINERGY NEW ENERGY CORP.,LIMITED
Address:	Unit 1908,19/F,Harbour Centre,25 Harbour Road,Wan Chai,HongKong
Manufacturer:	CHINA HAINERGY NEW ENERGY CORP.,LIMITED
Address:	Unit 1908,19/F,Harbour Centre,25 Harbour Road,Wan Chai,HongKong

3.2. Product Description

Name of EUT:	Tablet PC
Trade Mark:	Plan Ceibal
Model No.:	ACRUX
Listed Model(s):	A102
Power supply:	DC 3.7V
Adapter information:	Model: XHY050200UE Input: 100-240Va.c., 50/60Hz, 0.3A Output: 5.0Vd.c., 2.0A
Hardware version:	EM_T8611B-V6.0
Software version:	Ceibal_ACRUX_20200106_SV2.0

3.3. Radio Specification Description

Bluetooth version:	V4.0
Support function*2:	EDR
Modulation:	GFSK, π/4DQPSK, 8DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	FPC Antenna
Antenna gain:	1.85dBi

Note:

*2: only show the RF function associated with this report.

3.4. Testing Laboratory Information

Laboratory Name	Shenzhen Huatongwei International Inspection Co., Ltd.	
Laboratory Location	1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China	
Qualifications	Type	Accreditation Number
	CNAS	L1225
	A2LA	3902.01
	FCC	762235
	Canada	5377A

4. TEST CONFIGURATION

4.1. Test frequency list

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

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

4.2. Descriptions of Test mode

Preliminary tests were performed in different data rates and recorded the RF output power in the clause 5.3

Note:

1) The manufacturer declare that the maximum power value of the product is set as a default value in the enter test mode software.
2) All the test data for each data rate were verified, found GSFK Modulation which is worse case mode

4.3. Test mode

For RF test items:			
The engineering test program was provided and enabled to make EUT continuous transmitting.			
Test Item	Modulation / Data Rate		
	GFSK 1Mbps	π/4DQPSK 2Mbps	8DPSK 3Mbps
Conducted test item	✓	✓	✓
Radiated test item	✓	-	-

Remark:

– For radiated test item, the worst mode data rate 3Mbps was reported only, because this data rate has the highest RF output power at preliminary tests.
– The EUT in each of three orthogonal axis emissions had been tested, but only the worst case (X axis) data recorded in the report.

4.4. Support unit used in test configuration and system

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

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

Whether support unit is used?					
✓ No					
Item	Equipement	Trade Name	Model No.	FCC ID	Power cord
1					
2					

4.5. Testing environmental condition

Type	Requirement	Actual
Temperature:	15~35°C	25°C
Relative Humidity:	25~75%	50%
Air Pressure:	860~1060mbar	1000mbar

4.6. Measurement uncertainty

Test Item	Measurement Uncertainty
AC Conducted Emission (150kHz~30MHz)	3.02 dB
Radiated Emission (30MHz~1000MHz	4.90 dB
Radiated Emissions (1GHz~25GHz)	4.96 dB
Peak Output Power	0.51 dB
Power Spectral Density	0.51 dB
Conducted Spurious Emission	0.51 dB
6dB Bandwidth	70 Hz

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

4.7. Equipment Used during the Test

● Conducted Emission							
Used	Test Equipment	Manufacturer	Equipment No.	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Shielded Room	Albatross projects	HTWE0114	N/A	N/A	2018/09/28	2023/09/27
●	EMI Test Receiver	R&S	HTWE0111	ESCI	101247	2019/10/26	2020/10/25
●	Artificial Mains	SCHWARZBECK	HTWE0113	NNLK 8121	573	2019/10/23	2020/10/22
●	Pulse Limiter	R&S	HTWE0033	ESH3-Z2	100499	2019/10/23	2020/10/22
●	RF Connection Cable	HUBER+SUHNER	HTWE0113-02	ENVIROFLEX_142	EF-NM-BNCM-2M	2019/10/23	2020/10/22
●	Test Software	R&S	N/A	ES-K1	N/A	N/A	N/A

● Radiated emission-6th test site							
Used	Test Equipment	Manufacturer	Equipment No.	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Semi-Anechoic Chamber	Albatross projects	HTWE0127	SAC-3m-02	C11121	2018/09/30	2021/09/29
●	EMI Test Receiver	R&S	HTWE0099	ESCI	100900	2019/10/26	2020/10/25
●	Loop Antenna	R&S	HTWE0170	HFH2-Z2	100020	2018/04/02	2021/04/01
●	Ultra-Broadband Antenna	SCHWARZBECK	HTWE0119	VULB9163	546	2017/04/05	2020/04/04
●	Pre-Amplifer	SCHWARZBECK	HTWE0295	BBV 9742	N/A	2019/11/14	2020/11/13
●	RF Connection Cable	HUBER+SUHNER	HTWE0062-01	N/A	N/A	2019/08/21	2020/08/20
●	RF Connection Cable	HUBER+SUHNER	HTWE0062-02	SUCOFLEX 104	501184/4	2019/05/27	2020/05/26
●	Test Software	R&S	N/A	ES-K1	N/A	N/A	N/A

● Radiated emission-7th test site							
Used	Test Equipment	Manufacturer	Equipment No.	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Semi-Anechoic Chamber	Albatross projects	HTWE0122	SAC-3m-01	N/A	2018/09/27	2021/09/26
●	Spectrum Analyzer	R&S	HTWE0098	FSP40	100597	2019/10/26	2020/10/25
●	Horn Antenna	SCHWARZBECK	HTWE0126	9120D	1011	2017/04/01	2020/03/31
●	Horn Antenna	SCHWARZBECK	HTWE0103	BBHA9170	25841	2017/03/27	2020/03/26
●	Broadband Horn Antenna	SCHWARZBECK	HTWE0103	BBHA9170	BBHA9170472	2018/10/11	2021/10/10
●	Pre-amplifier	CD	HTWE0071	PAP-0102	12004	2019/11/14	2020/11/13
●	Broadband Pre-amplifier	SCHWARZBECK	HTWE0201	BBV 9718	9718-248	2019/05/23	2020/05/22
●	RF Connection Cable	HUBER+SUHNER	HTWE0120-01	6m 18GHz S Serisa	N/A	2019/05/10	2020/05/09
●	RF Connection Cable	HUBER+SUHNER	HTWE0120-02	6m 3GHz RG Serisa	N/A	2019/05/10	2020/05/09
●	RF Connection Cable	HUBER+SUHNER	HTWE0120-03	6m 3GHz RG Serisa	N/A	2019/05/10	2020/05/09
●	RF Connection Cable	HUBER+SUHNER	HTWE0120-04	6m 3GHz RG Serisa	N/A	2019/05/10	2020/05/09
●	RF Connection Cable	HUBER+SUHNER	HTWE0121-01	6m 18GHz S Serisa	N/A	2019/05/10	2020/05/09
●	Test Software	Audix	N/A	E3	N/A	N/A	N/A

●	RF Conducted Method					
Used	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
●	Signal and spectrum Analyzer	R&S	FSV40	100048	2019/10/26	2020/10/25
●	Spectrum Analyzer	Agilent	N9020A	MY50510187	2019/10/26	2020/10/25
○	Power Meter	Anritsu	ML249A	N/A	2019/10/26	2020/10/25
○	Radio communication tester	R&S	CMW500	137688-Lv	2019/10/26	2020/10/25

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.

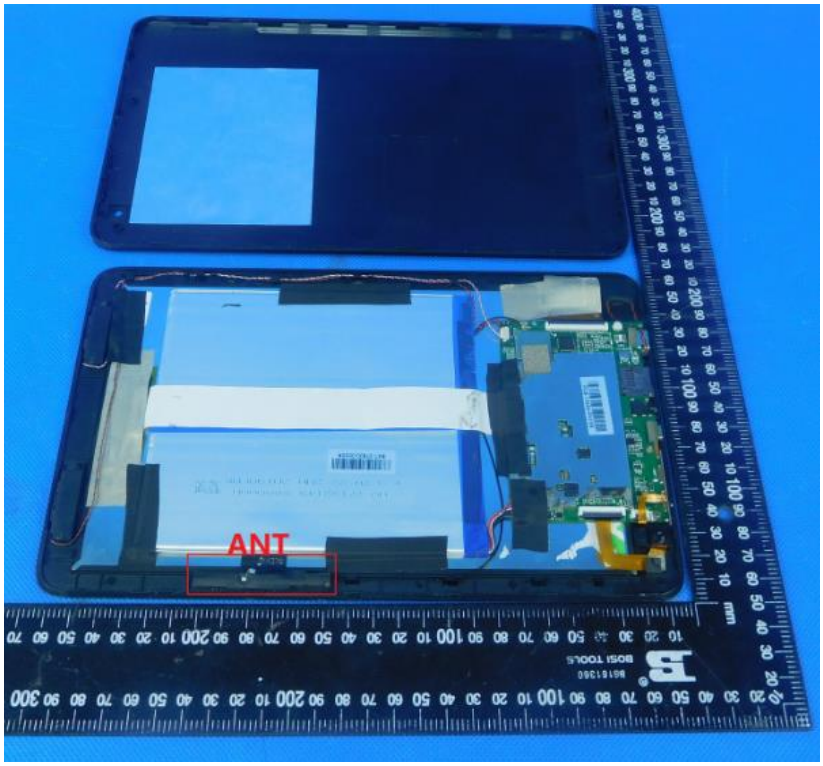
FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1)(i):

(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 antenna type is a FPC antenna, the directional gain of the antenna less than 6 dBi, please refer to the below antenna photo.



5.2. AC Conducted Emission

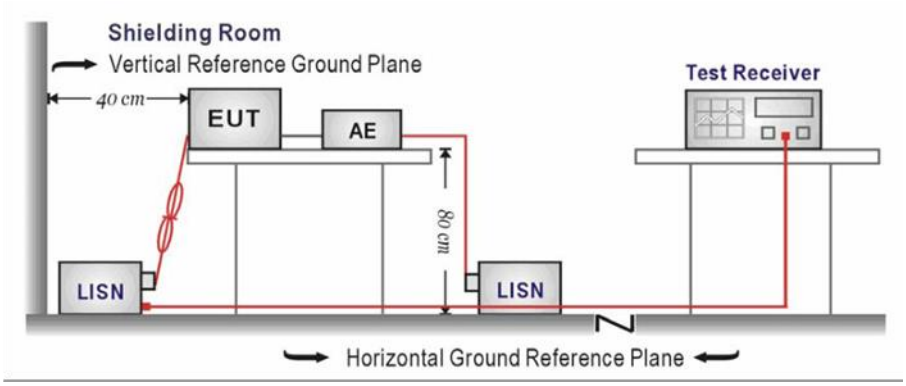
LIMIT

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 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.

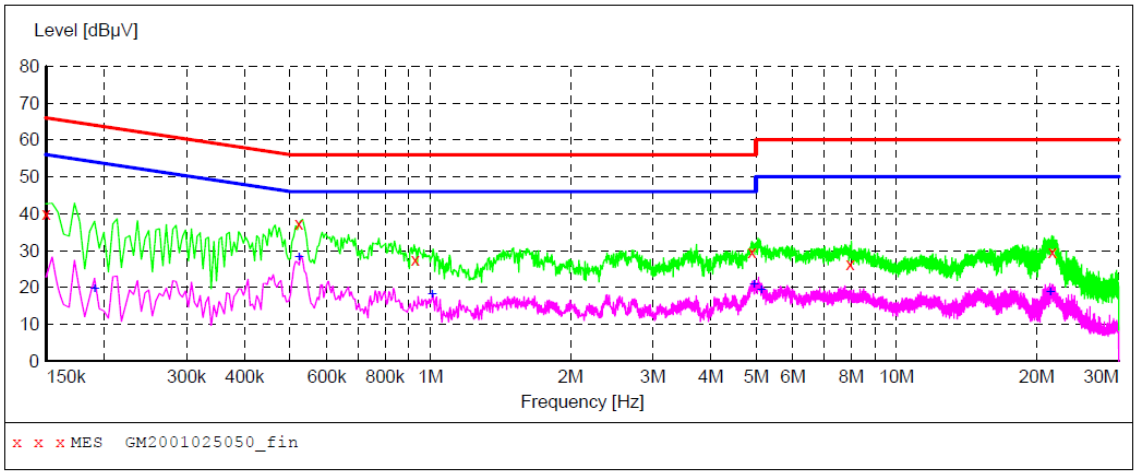
TEST MODE:

Please refer to the clause 4.3

TEST RESULT

☒ **Passed** ☐ **Not Applicable**

Test Line:	L



MEASUREMENT RESULT: "GM2001025050_fin"

1/2/2020 5:08PM

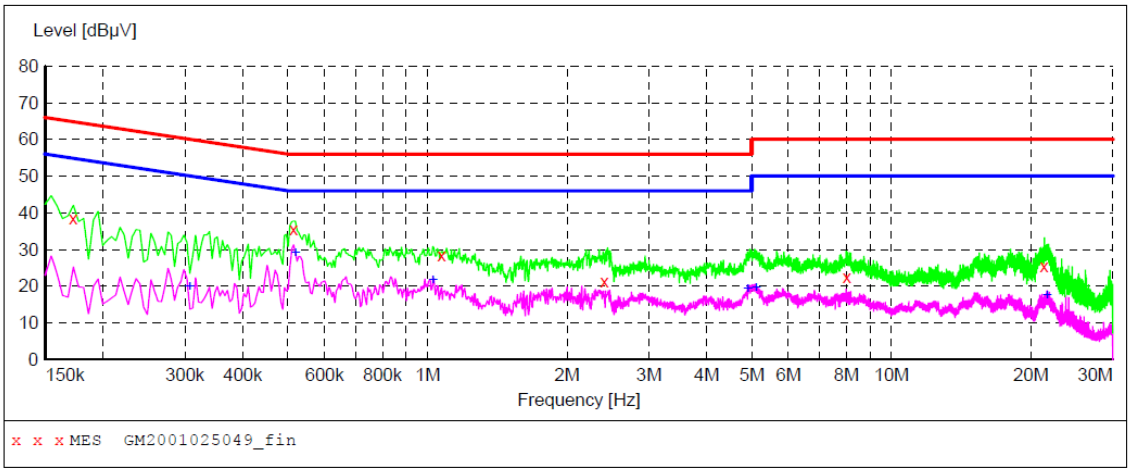
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.150000	40.10	10.1	66	25.9	QP	L1	GND
0.523500	37.40	10.1	56	18.6	QP	L1	GND
0.928500	27.60	10.1	56	28.4	QP	L1	GND
4.906500	29.60	10.1	56	26.4	QP	L1	GND
7.957500	26.40	10.2	60	33.6	QP	L1	GND
21.588000	29.50	10.2	60	30.5	QP	L1	GND

MEASUREMENT RESULT: "GM2001025050_fin2"

1/2/2020 5:08PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.190500	19.60	10.1	54	34.4	AV	L1	GND
0.523500	28.10	10.1	46	17.9	AV	L1	GND
1.009500	17.90	10.1	46	28.1	AV	L1	GND
4.947000	20.60	10.1	46	25.4	AV	L1	GND
5.127000	19.30	10.2	50	30.7	AV	L1	GND
21.376500	18.60	10.2	50	31.4	AV	L1	GND

Test Line:	N



MEASUREMENT RESULT: "GM2001025049_fin"

1/2/2020 5:06PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.172500	38.60	10.1	65	26.2	QP	N	GND
0.514500	35.60	10.1	56	20.4	QP	N	GND
1.072500	28.30	10.1	56	27.7	QP	N	GND
2.404500	21.30	10.1	56	34.7	QP	N	GND
8.025000	22.60	10.2	60	37.4	QP	N	GND
21.349500	25.50	10.2	60	34.5	QP	N	GND

MEASUREMENT RESULT: "GM2001025049_fin2"

1/2/2020 5:06PM

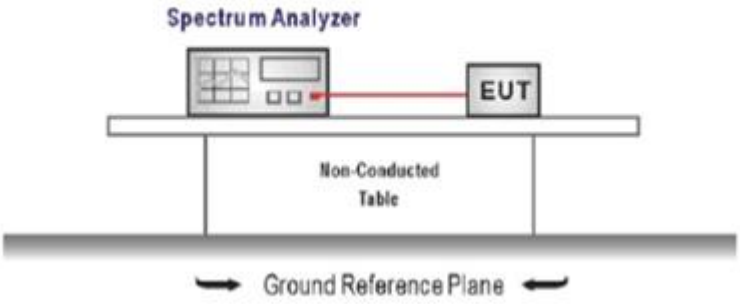
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.307500	19.90	10.1	50	30.1	AV	N	GND
0.519000	29.00	10.1	46	17.0	AV	N	GND
1.027500	21.70	10.1	46	24.3	AV	N	GND
4.897500	19.30	10.1	46	26.7	AV	N	GND
5.109000	19.50	10.1	50	30.5	AV	N	GND
21.633000	17.40	10.2	50	32.6	AV	N	GND

5.3. 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 4.3

TEST RESULT

☒ **Passed** ☐ **Not Applicable**

TEST Data

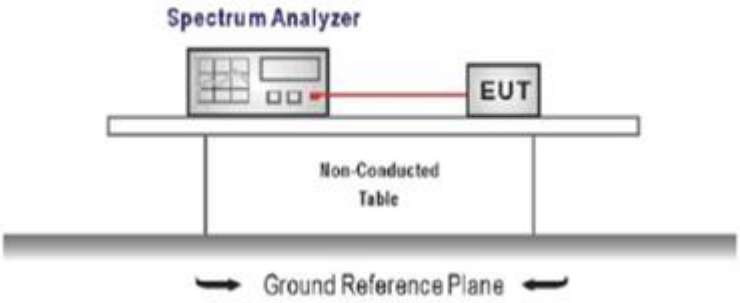
Please refer to appendix A on the appendix report

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 4.3

TEST RESULT

☒ **Passed** ☐ **Not Applicable**

TEST Data

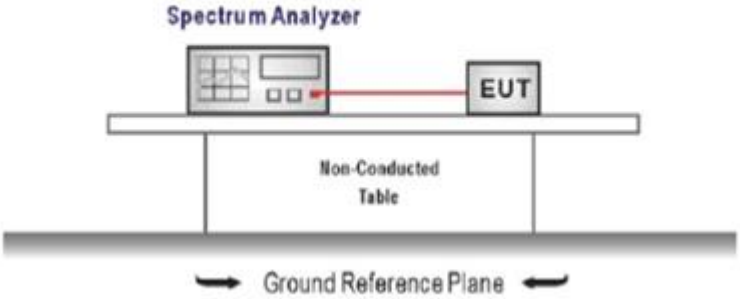
Please refer to appendix B on the appendix report

5.5. 99% Occupied Bandwidth

LIMIT

N/A

TEST CONFIGURATION



TEST PROCEDURE

1. Connect the antenna port(s) to the spectrum analyzer input.
2. Configure the spectrum analyzer as shown below (enter all losses between the transmitter output andthe spectrum analyzer).
   Center Frequency =channel center frequency
   Span≥1.5 x OBW
   RBW = 1%~5%OBW
   VBW ≥ 3 × RBW
   Sweep time= auto couple
   Detector = Peak
   Trace mode = max hold
3. Place the radio in continuous transmit mode, allow the trace to stabilize, view the transmitter waveform on the spectrum analyzer.

TEST MODE:

Please refer to the clause 4.3

TEST RESULT

☒ **Passed** ☐ **Not Applicable**

TEST Data

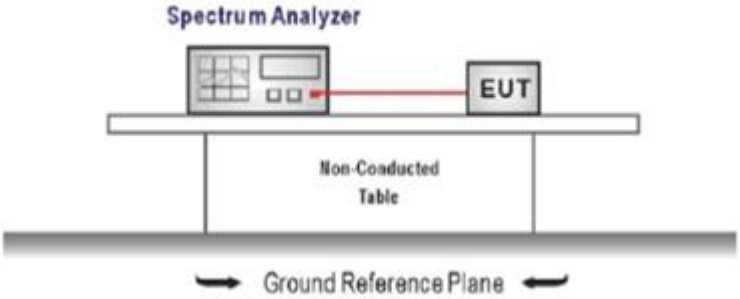
Please refer to appendix C on the appendix report

5.6. 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 a minimum of 25kHz 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.

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 4.3

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

TEST Data

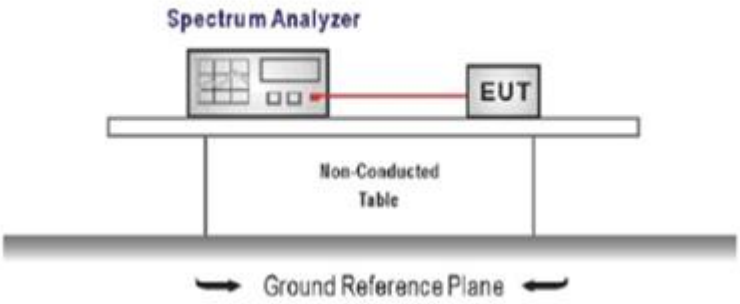
Please refer to appendix D on the appendix report

5.7. 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 4.3

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

TEST Data

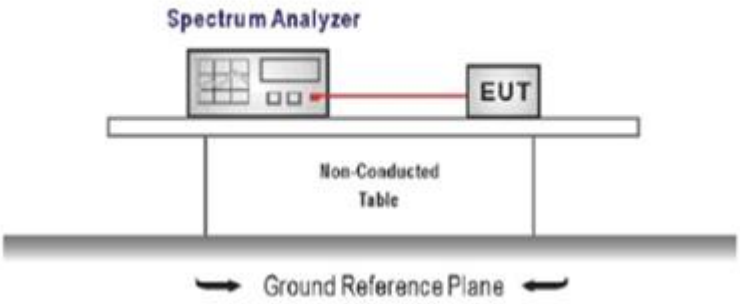
Please refer to appendix E on the appendix report

5.8. 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 4.3

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

TEST Data

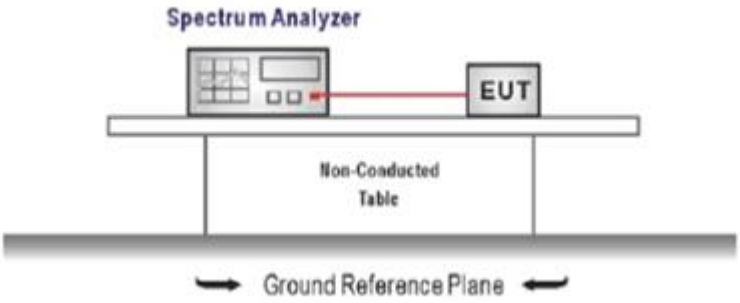
Please refer to appendix F on the appendix report

5.9. Duty Cycle Correction Factor (DCCF)

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 = 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, Trigger mode
4. Measure and record the duty cycle data

TEST MODE:

Please refer to the clause 4.3

TEST Data

Please refer to appendix G on the appendix report

5.10. Pseudorandom Frequency Hopping Sequence

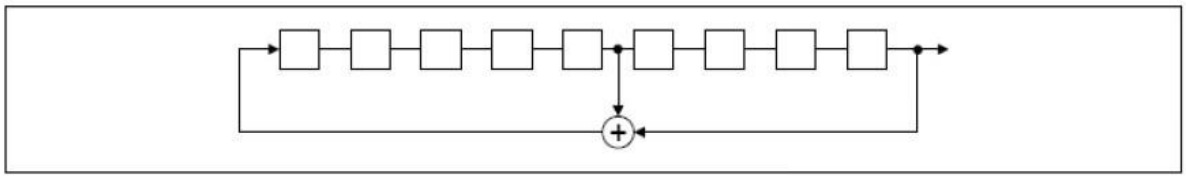
LIMIT

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

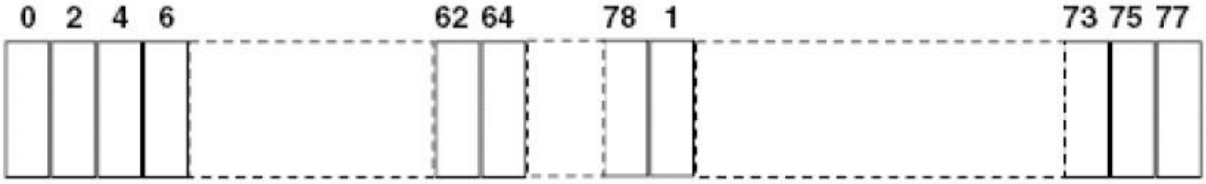
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage.And the result is fed back to the input of the friststage.The sequence begins with the frist one of 9 consecutive ones,forexample:the shift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



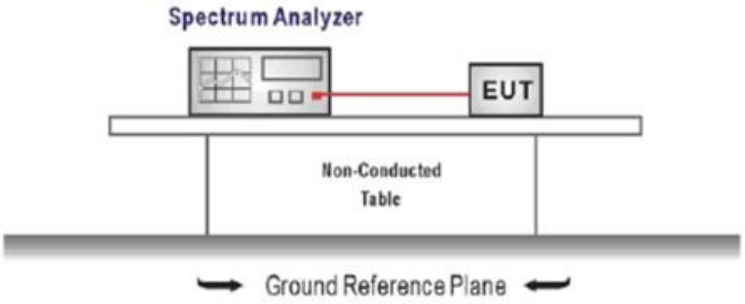
Each frequency used equally one the average by each transmitter.
The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.

5.11. Conducted Band edge and Spurious Emission

LIMIT

FCC CFR Title 47 Part 15 Subpart C Section15.247 (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. Connect the antenna port(s) to the spectrum analyzer input.
2. Establish a reference level by using the following procedure
   Center frequency=DTS channel center frequency
   The span = 1.5 times the DTS bandwidth.
   RBW = 100 kHz, VBW ≥ 3 x RBW
   Detector = peak, Sweep time = auto couple, Trace mode = max hold
   Allow trace to fully stabilize
   Use the peak marker function to determine the maximum PSD level

   Note that the channel found to contain the maximum PSD level can be used to establish the reference level.
3. Emission level measurement
   Set the center frequency and span to encompass frequency range to be measured
   RBW = 100 kHz, VBW ≥ 3 x RBW
   Detector = peak, Sweep time = auto couple, Trace mode = max hold
   Allow trace to fully stabilize
   Use the peak marker function to determine the maximum amplitude level.
4. Place the radio in continuous transmit mode, allow the trace to stabilize, view the transmitter waveform on the spectrum analyzer.
5. Ensure that the amplitude of all unwanted emission outside of the authorized frequency band excluding restricted frequency bands) are attenuated by at least the minimum requirements specified (at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz). Report the three highest emission relative to the limit.

TEST MODE:

Please refer to the clause 4.3

TEST RESULT

☒ **Passed** ☐ **Not Applicable**

TEST Data

Please refer to appendix H on the appendix report

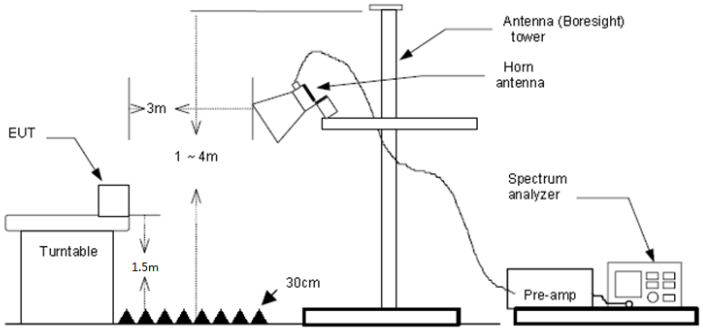
5.12. Radiated Band edge Emission

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 .
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 themaximum emission, all of the interface cables were manipulated according to ANSI C63.10 on radiated measurement.
5. Use the following spectrum analyzer settings:
   a) Span shall wide enough to fully capture the emission being measured
   b) Set RBW=100kHz for <1GHz, VBW=3*RBW, Sweep time=auto, Detector=peak, Trace=max hold
   c) Set RBW=1MHz, VBW=3MHz for >1GHz, Sweep time=auto, Detector=peak, Trace=max hold for Peak measurement

      For average measurement: use duty cycle correction factor method (DCCF)

      Averager level = Peak level + DCCF

TEST MODE:

Please refer to the clause 4.3

TEST RESULT

☒ **Passed** ☐ **Not Applicable**

Note:

1) Level= Reading + Factor; Factor =Antenna Factor+ Cable Loss- Preamp Factor
2) Margin = Limit – Level
3) Average measurement was not performed if peak level is lower than average limit(54 dBuV/m).

Test channel:	CH00	Polarity	Horizontal

Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Detector
1	2310.000	45.60	-2.34	43.26	74.00	30.74	Horizontal	PK
2	2390.000	44.63	-2.41	42.22	74.00	31.78	Horizontal	PK
1	2310.000	45.60	-27.16	18.44	54.00	35.56	Horizontal	AV
2	2390.000	44.63	-27.23	17.40	54.00	36.60	Horizontal	AV

Test channel:	CH00	Polarity	Vertical

Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Detector
1	2310.000	44.95	-2.34	42.61	74.00	31.39	Vertical	PK
2	2390.000	45.60	-2.41	43.19	74.00	30.81	Vertical	PK
1	2310.000	44.95	-27.16	17.79	54.00	36.21	Vertical	AV
2	2390.000	45.60	-27.23	18.37	54.00	35.63	Vertical	AV

Test channel:	CH78	Polarity	Horizontal

Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Detector
1	2483.500	44.52	-2.15	42.37	74.00	31.63	Horizontal	PK
2	2500.000	45.51	-2.10	43.41	74.00	30.59	Horizontal	PK
1	2483.500	44.52	-26.97	17.55	54.00	36.45	Horizontal	AV
2	2500.000	45.51	-26.92	18.59	54.00	35.41	Horizontal	AV

Test channel:	CH78	Polarity	Vertical

Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Detector
1	2483.500	44.83	-2.15	42.68	74.00	31.32	Vertical	PK
2	2500.000	44.36	-2.10	42.26	74.00	31.74	Vertical	PK
1	2483.500	44.83	-26.97	17.86	54.00	36.14	Vertical	AV
2	2500.000	44.36	-26.92	17.44	54.00	36.56	Vertical	AV

5.13. Radiated Spurious Emission

LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.209

Frequency	Limit (dBuV/m)	Value
0.009 MHz ~0.49 MHz	2400/F(kHz) @300m	Quasi-peak
0.49 MHz ~ 1.705 MHz	24000/F(kHz) @30m	Quasi-peak
1.705 MHz ~30 MHz	30 @30m	Quasi-peak

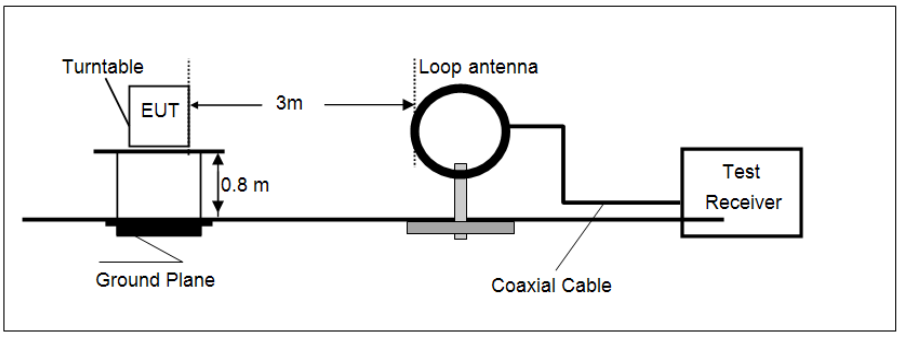
Note: Limit dBuV/m @3m = Limit dBuV/m @300m + 40*log(300/3)= Limit dBuV/m @300m +80,

Limit dBuV/m @3m = Limit dBuV/m @30m +40*log(30/3)= Limit dBuV/m @30m + 40.

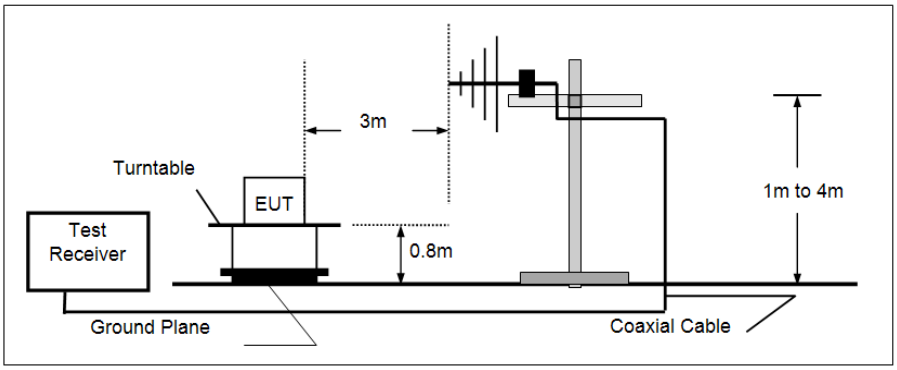
Frequency	Limit (dBuV/m @3m)	Value
30MHz~88MHz	40.00	Quasi-peak
88MHz~216MHz	43.50	Quasi-peak
216MHz~960MHz	46.00	Quasi-peak
960MHz~1GHz	54.00	Quasi-peak
Above 1GHz	54.00	Average
	74.00	Peak

TEST CONFIGURATION

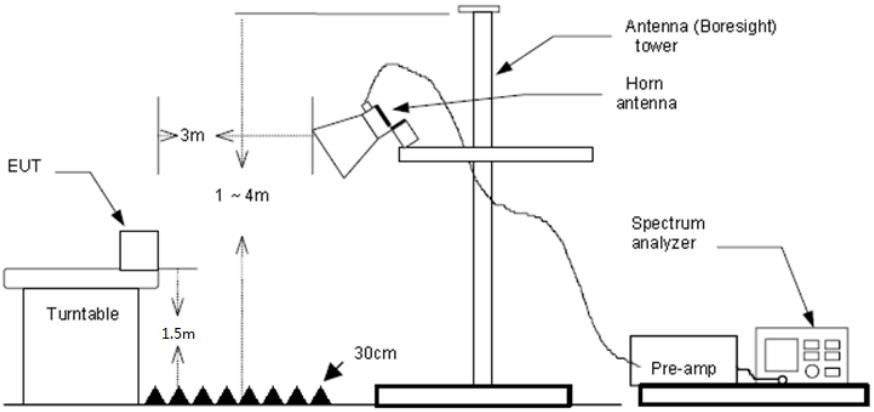
- 9 kHz ~ 30 MHz



- 30 MHz ~ 1 GHz



- Above 1 GHz



TEST PROCEDURE

1. The EUT was setup and tested according to ANSI C63.10 .
2. The EUT is placed on a turn table which is 0.8 meter above ground for below 1 GHz, and 1.5 m for above 1 GHz. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was set 3 meters from the receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Use the following spectrum analyzer settings
   a) Span shall wide enough to fully capture the emission being measured;
   b) 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.
   c) Set RBW=1MHz, VBW=3MHz for >1GHz, Sweep time=auto, Detector=peak, Trace=max hold for Peak measurement
      For average measurement: use duty cycle correction factor method (DCCF)
      Averager level = Peak level + DCCF

TEST MODE:

Please refer to the clause 4.3

TEST RESULT

☒ **Passed** ☐ **Not Applicable**

Note:

1) Level= Reading + Factor/Transd; Factor/Transd =Antenna Factor+ Cable Loss- Preamp Factor
2) Margin = Limit – Level
3) Average measurement was not performed if peak level is lower than average limit(54 dBuV/m) for above 1GHz.

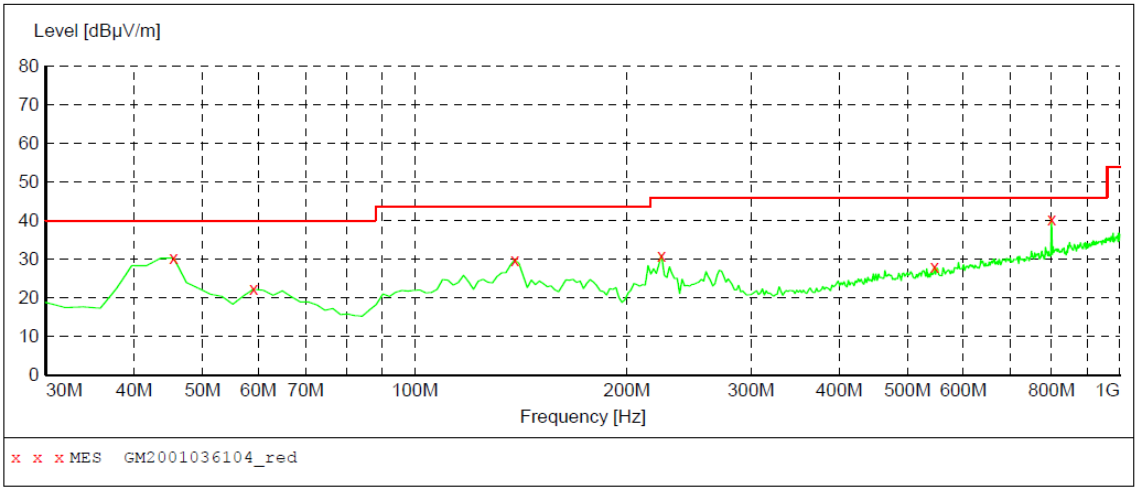
TEST DATA FOR 9 kHz ~ 30 MHz

The EUT was pre-scanned this frequency band, found the radiated level 20dB lower than the limit, so don't show data on this report.

TEST DATA FOR 30 MHz ~ 1000 MHz

Have pre-scan all test channel, found CH39 which it was worst case, so only show the worst case's data on this report.

Polarization:	Horizontal

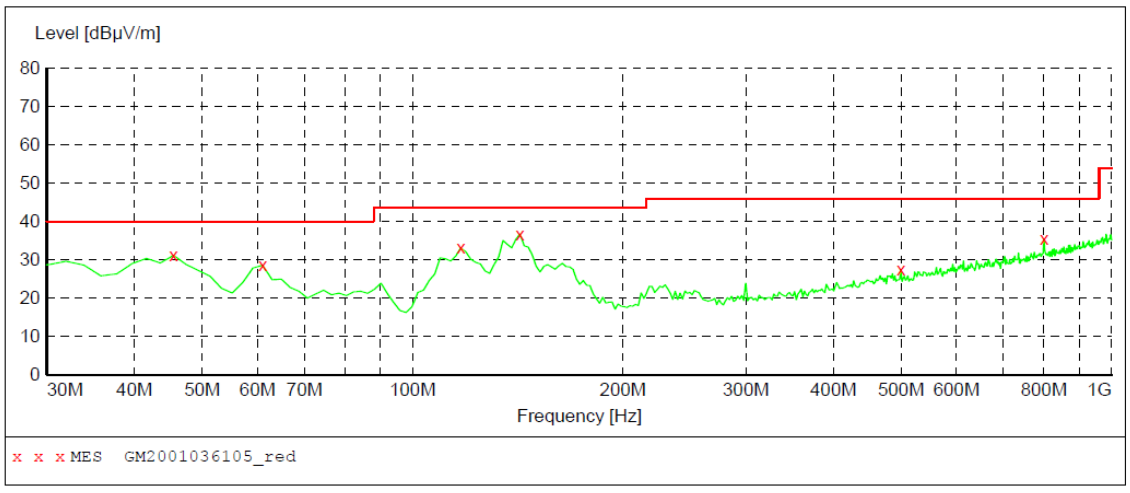


MEASUREMENT RESULT: "GM2001036104_red"

1/3/2020 7:58PM

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
45.520000	30.30	-8.4	40.0	9.7	QP	100.0	206.00	HORIZONTAL
59.100000	22.30	-9.1	40.0	17.7	QP	300.0	42.00	HORIZONTAL
138.640000	29.80	-13.5	43.5	13.7	QP	300.0	354.00	HORIZONTAL
224.000000	31.10	-9.2	46.0	14.9	QP	100.0	302.00	HORIZONTAL
546.040000	28.10	0.1	46.0	17.9	QP	300.0	114.00	HORIZONTAL
800.180000	40.40	5.7	46.0	5.6	QP	100.0	340.00	HORIZONTAL

Polarization:	Vertical



MEASUREMENT RESULT: "GM2001036105_red"

1/3/2020 8:01PM

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
45.520000	31.20	-8.4	40.0	8.8	QP	100.0	257.00	VERTICAL
61.040000	28.60	-9.7	40.0	11.4	QP	100.0	307.00	VERTICAL
117.300000	33.10	-11.3	43.5	10.4	QP	100.0	168.00	VERTICAL
142.520000	36.80	-13.6	43.5	6.7	QP	100.0	130.00	VERTICAL
499.480000	27.50	-1.5	46.0	18.5	QP	100.0	69.00	VERTICAL
800.180000	35.40	5.7	46.0	10.6	QP	100.0	44.00	VERTICAL

TEST DATA FOR 1 GHz ~ 25 GHz

Test channel	CH00

Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Detector
1	1226.187	33.29	-5.76	27.53	74.00	46.47	Horizontal	PK
2	3164.937	33.15	0.66	33.81	74.00	40.19	Horizontal	PK
3	8029.437	30.46	16.23	46.69	74.00	27.31	Horizontal	PK
4	9311.656	31.28	17.85	49.13	74.00	24.87	Horizontal	PK

Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Detector
1	1135.125	35.40	-6.52	28.88	74.00	45.12	Vertical	PK
2	3185.500	32.93	0.76	33.69	74.00	40.31	Vertical	PK
3	8058.812	30.60	16.28	46.88	74.00	27.12	Vertical	PK
4	10426.43	31.52	17.53	49.05	74.00	24.95	Vertical	PK

Test channel	CH39

Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Detector
1	1132.187	34.42	-6.55	27.87	74.00	46.13	Horizontal	PK
2	3173.750	31.62	0.70	32.32	74.00	41.68	Horizontal	PK
3	5109.562	30.17	8.82	38.99	74.00	35.01	Horizontal	PK
4	9590.718	31.26	17.18	48.44	74.00	25.56	Horizontal	PK

Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Detector
1	1180.656	34.13	-6.04	28.09	74.00	45.91	Vertical	PK
2	3150.250	32.66	0.58	33.24	74.00	40.76	Vertical	PK
3	8026.500	30.67	16.23	46.90	74.00	27.10	Vertical	PK
4	9230.875	31.46	17.07	48.53	74.00	25.47	Vertical	PK

Test channel	CH78

Suspected Data List

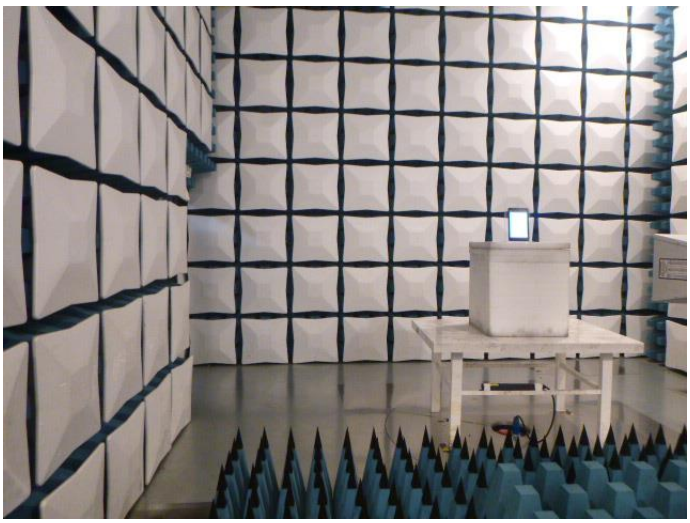
NO.	Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Detector
1	1192.406	34.68	-5.91	28.77	74.00	45.23	Horizontal	PK
2	3170.812	32.54	0.69	33.23	74.00	40.77	Horizontal	PK
3	7938.375	31.32	16.26	47.58	74.00	26.42	Horizontal	PK
4	9640.656	32.14	17.13	49.27	74.00	24.73	Horizontal	PK

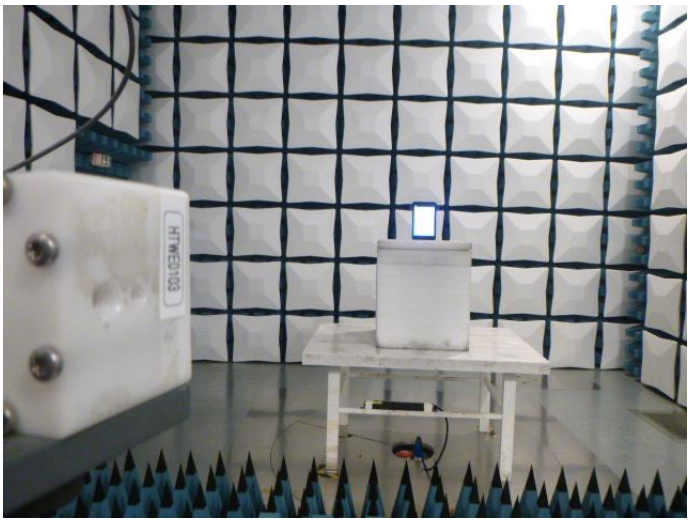
Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Factor [dB]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Polarity	Detector
1	1192.406	35.16	-5.91	29.25	74.00	44.75	Vertical	PK
2	3159.062	32.29	0.63	32.92	74.00	41.08	Vertical	PK
3	7322.968	30.77	15.12	45.89	74.00	28.11	Vertical	PK
4	9721.437	31.48	17.19	48.67	74.00	25.33	Vertical	PK

6. TEST SETUP PHOTOS

Radiated Emission





AC Conducted Emission

7. EXTERANAL AND INTERNAL PHOTOS

Reference to the test report No. : CHTEW20010180.

8. APPENDIX REPORT

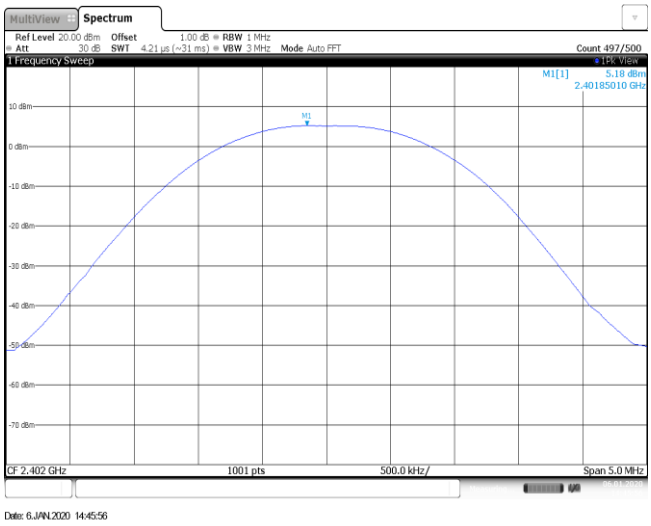
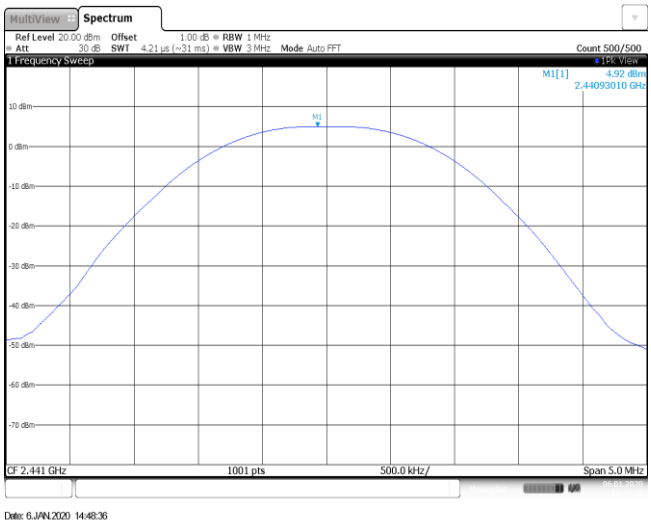
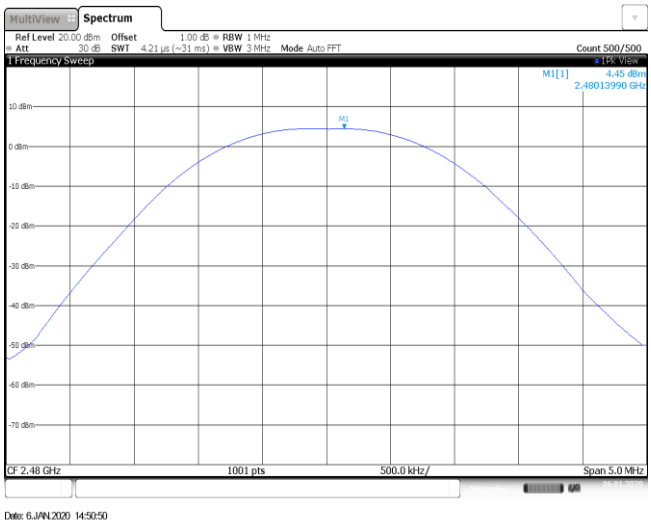
APPENDIX REPORT

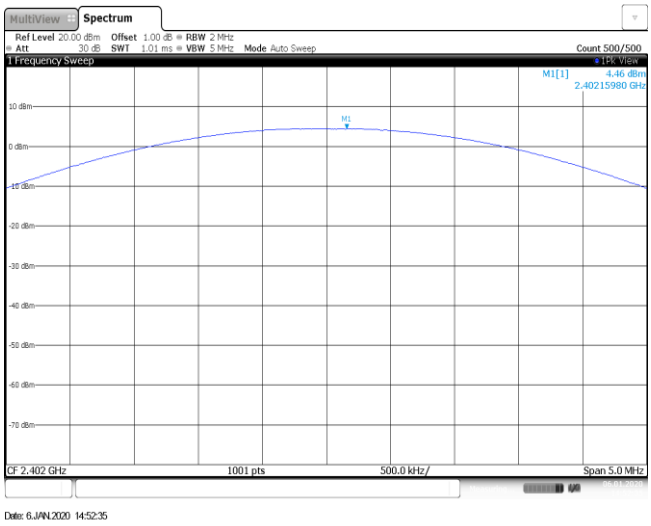
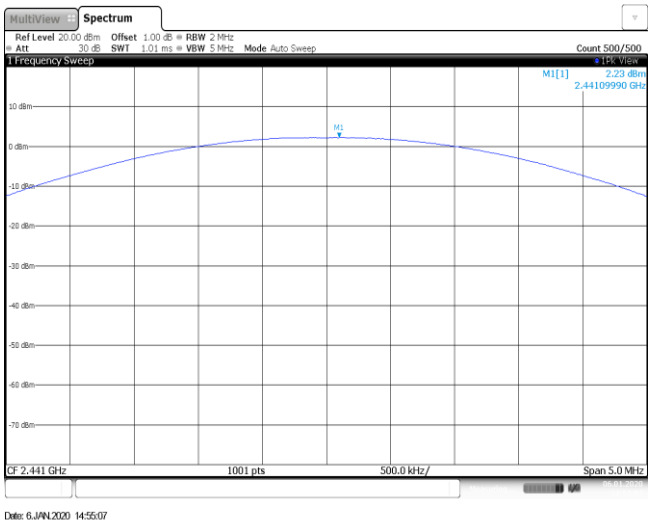
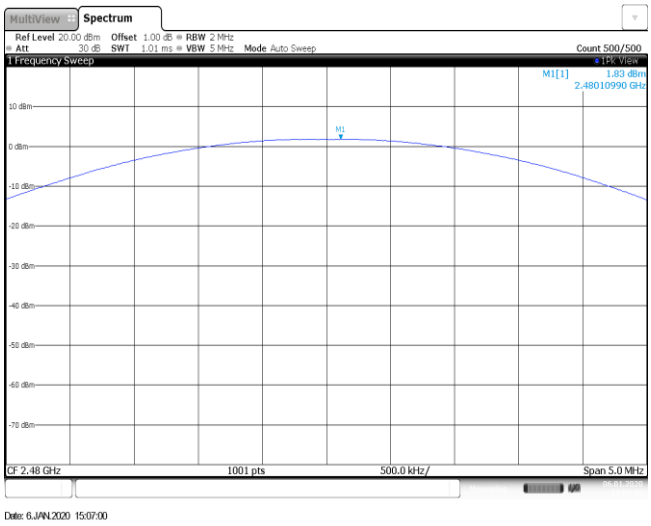
Project No.	SHT1912069305EW	Radio Specification	Bluetooth EDR
Test sample No.	YPHT19120693012	Model No.	ACRUX
Start test date	2020/1/6	Finish date	2020/1/6
Temperature	25°C	Humidity	50%
Test Engineer	Ximing Huang	Auditor	William.wang

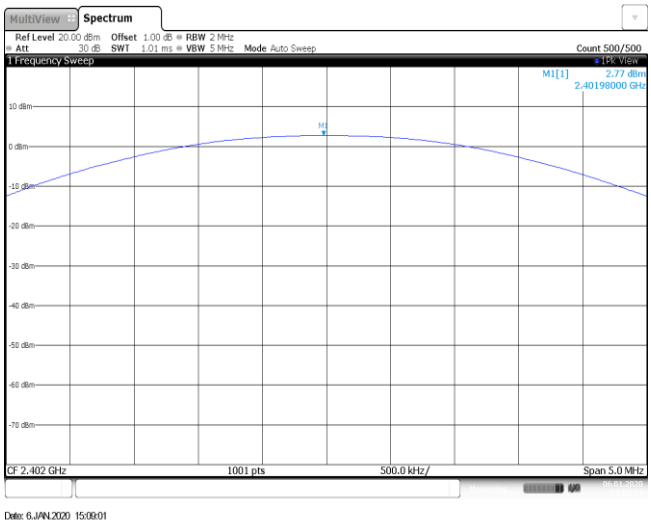
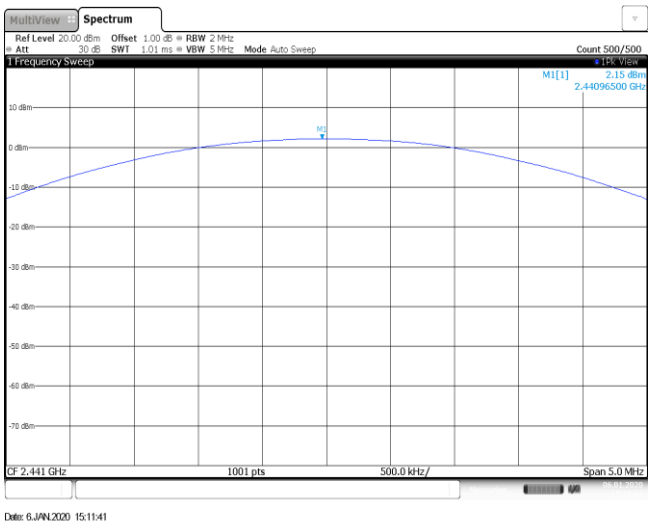
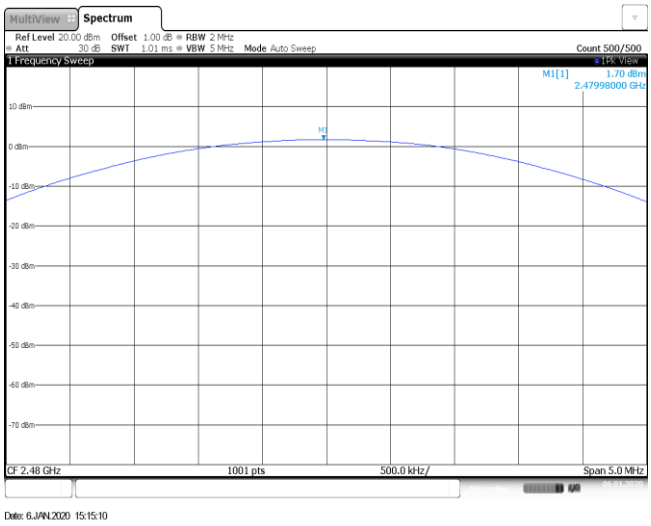
Appendix clause	Test item	Result
A	Peak Output Power	PASS
B	20 dB Bandwidth	PASS
C	99% Occupied Bandwidth	PASS
D	Carrier Frequencies Separation	PASS
E	Hopping Channel Number	PASS
F	Dwell Time	PASS
G	Duty Cycle Correction Factor (DCCF)	PASS
H	Band edge and Spurious Emissions(coducted)	PASS

Appendix A：Peak Output Power

Modulation type	Channel	Output power (dBm)	Average Output power (dBm)	Limit (dBm)	Result
GFSK	00	5.18	5.13	≤ 30.00	Pass
	39	4.92	4.87		
	78	4.45	4.42		
π/4DQPSK	00	4.46	3.95	≤ 21.00	Pass
	39	2.23	1.68		
	78	1.83	1.36		
8DPSK	00	2.77	2.21	≤ 21.00	Pass
	39	2.15	1.73		
	78	1.70	1.18		

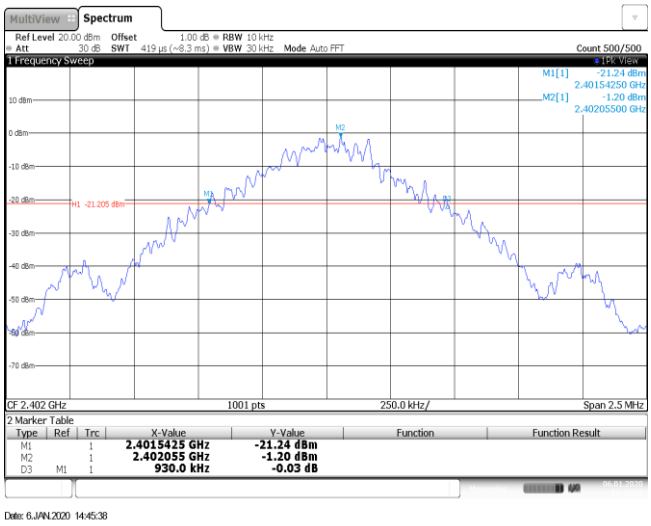
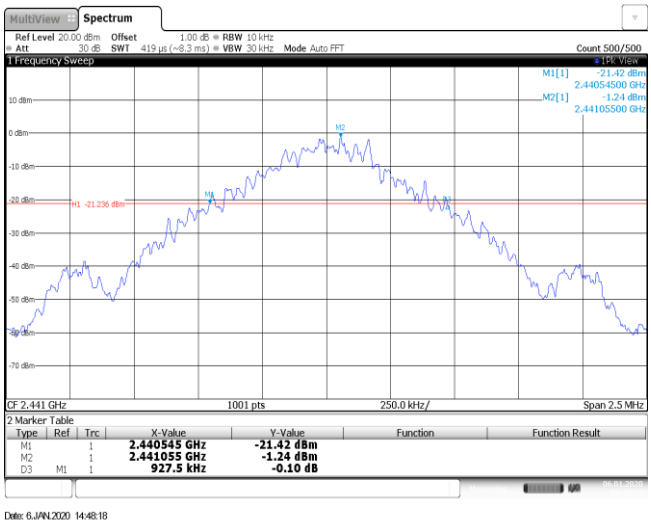
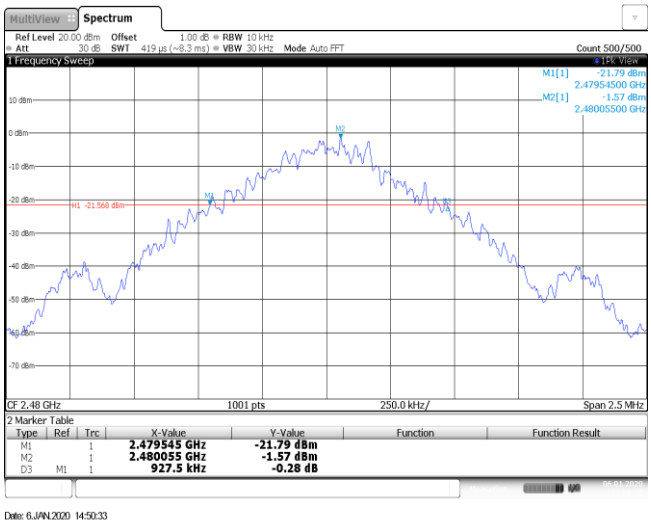
Modulation Type:	**GFSK**
CH00	
CH39	
CH78	

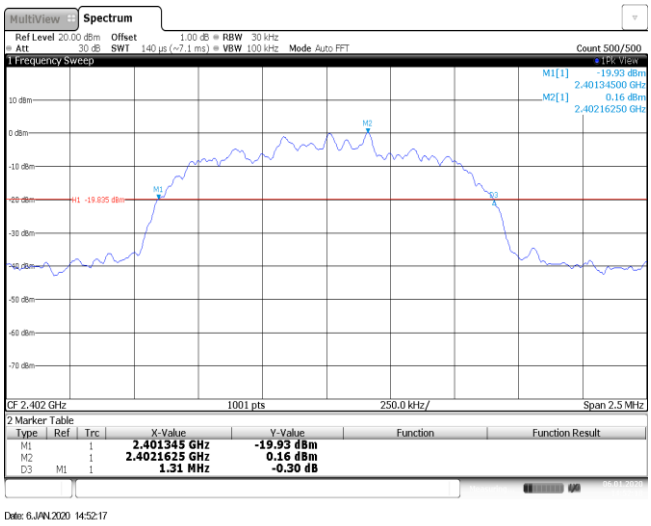
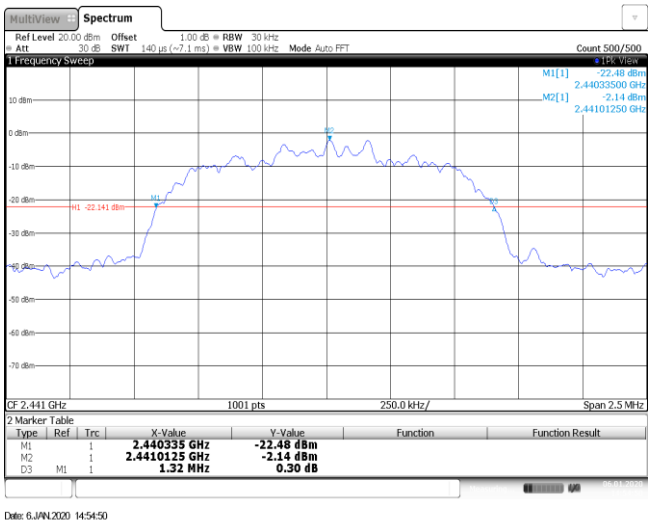
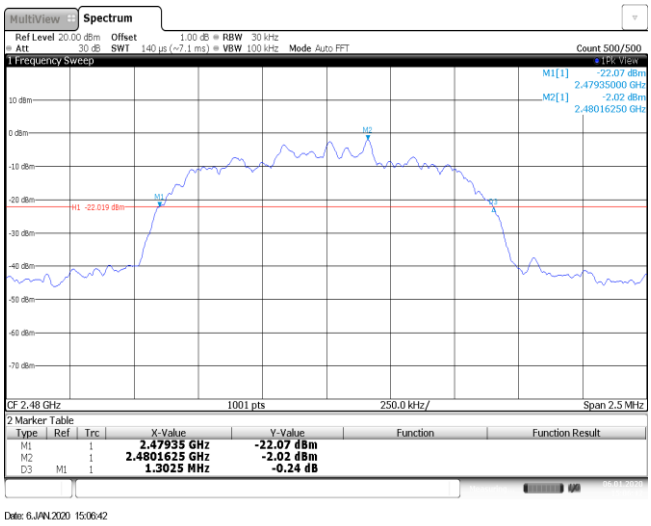
Modulation Type:	π/4DQPSK
CH00	
CH39	
CH78	

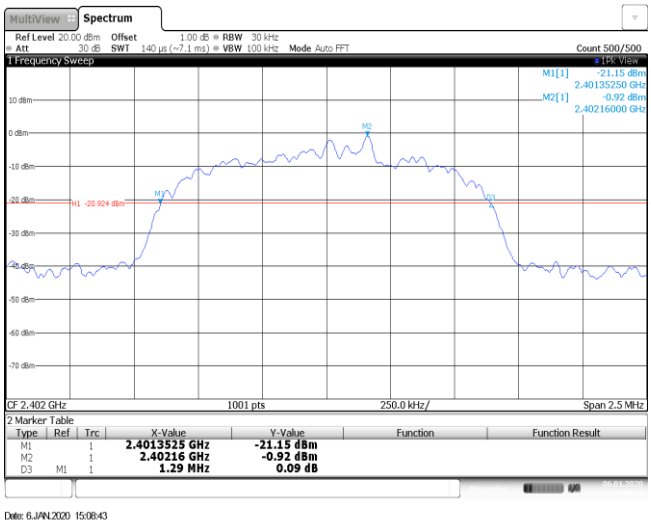
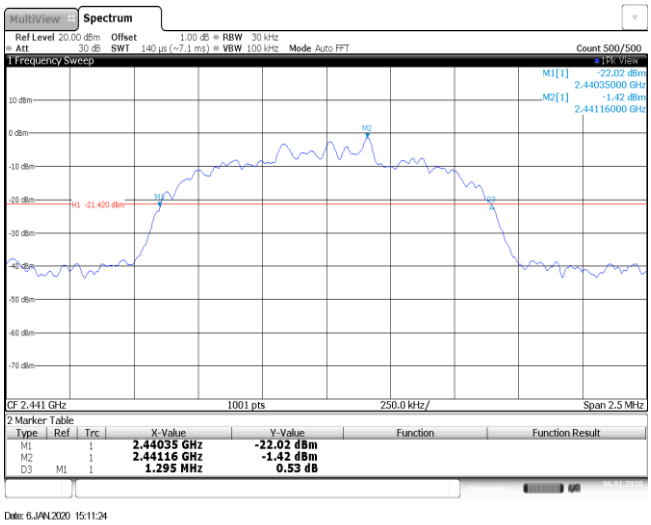
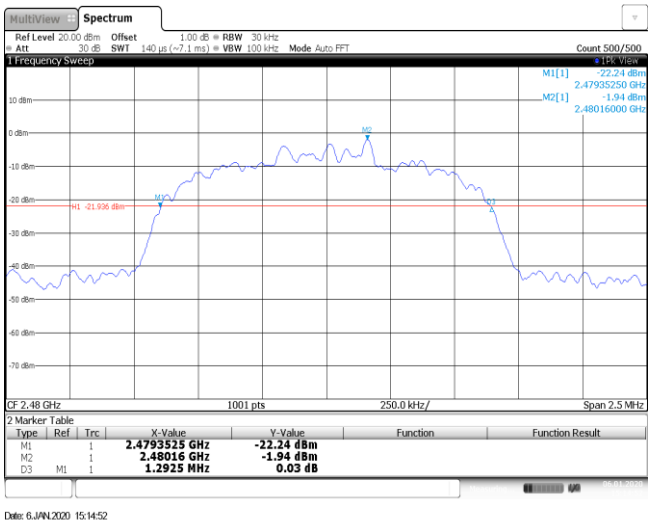
Modulation Type:	**8DPSK**
CH00	
CH39	
CH78	

Appendix B : 20 dB Bandwidth

Modulation type	Channel	20 dB Bandwidth (kHz)	Limit (kHz)	Result
GFSK	00	930.00	-	Pass
	39	927.50		
	78	927.50		
π/4DQPSK	00	1310.00	-	Pass
	39	1320.00		
	78	1302.50		
8DPSK	00	1290.00	-	Pass
	39	1295.00		
	78	1292.50		

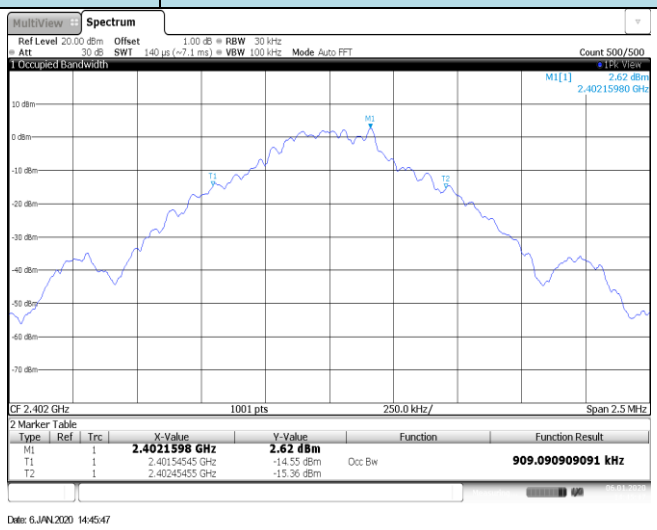
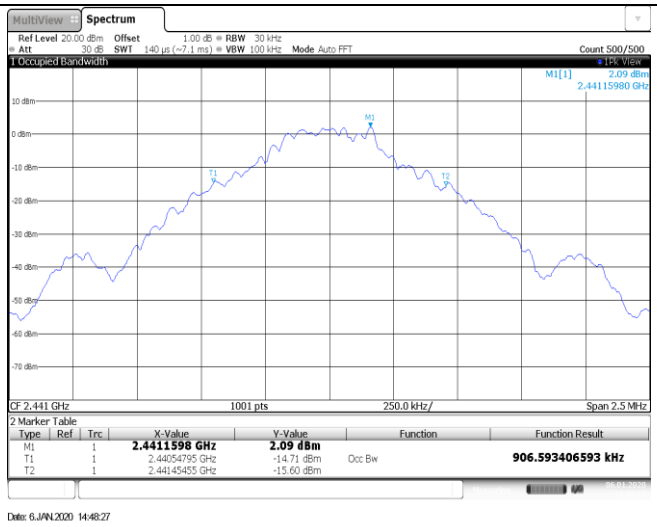
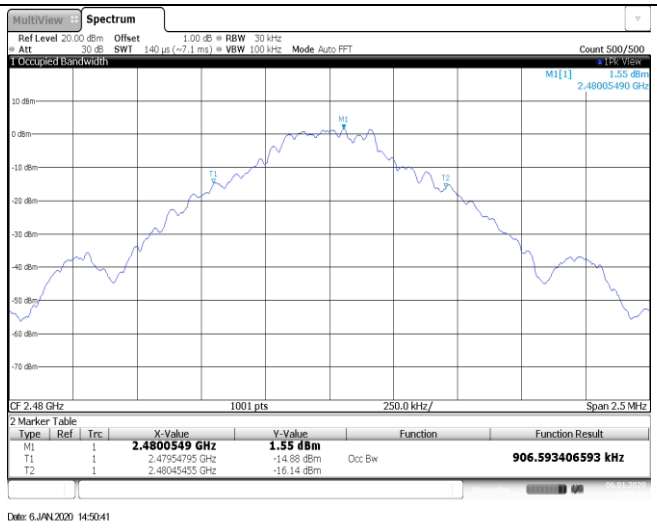
Modulation Type:	GFSK
CH00	
CH39	
CH78	

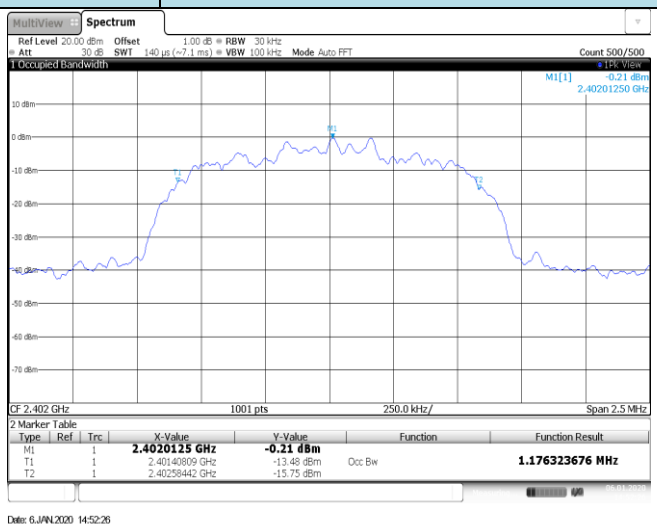
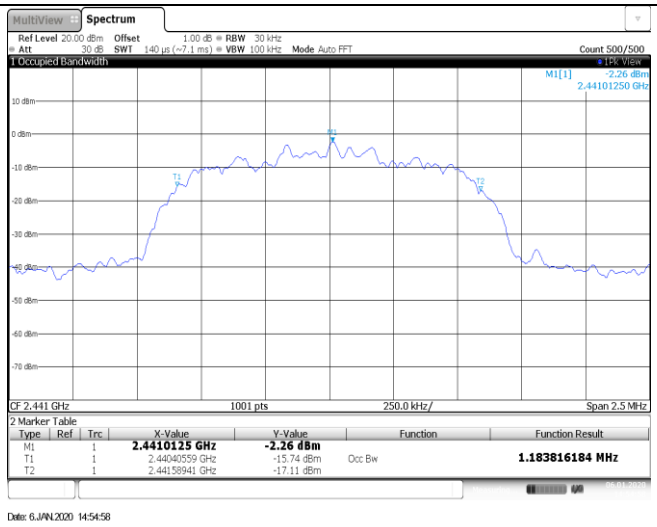
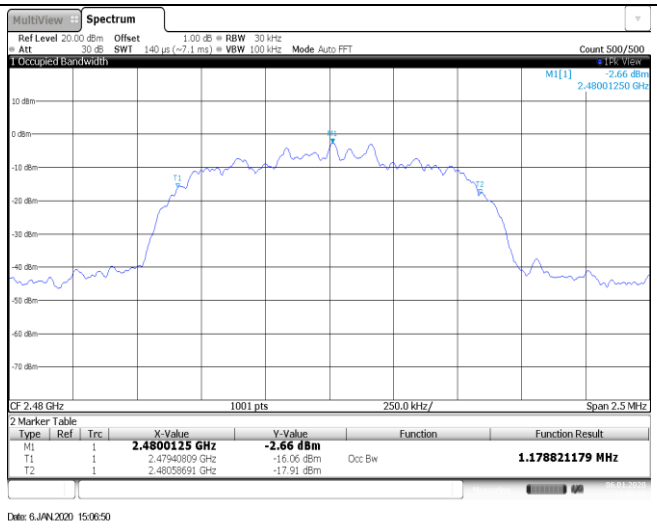
Modulation Type:	π/4DQPSK
CH00	
CH39	
CH78	

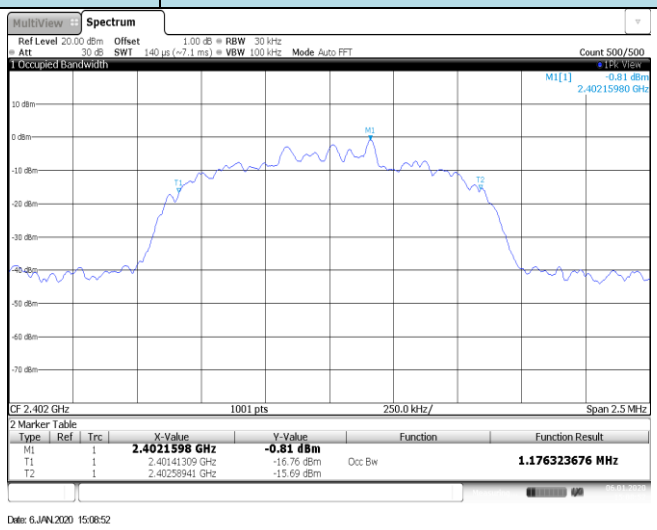
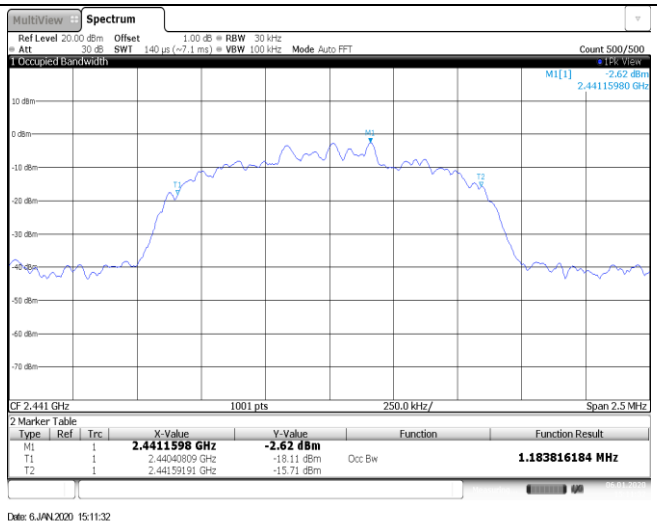
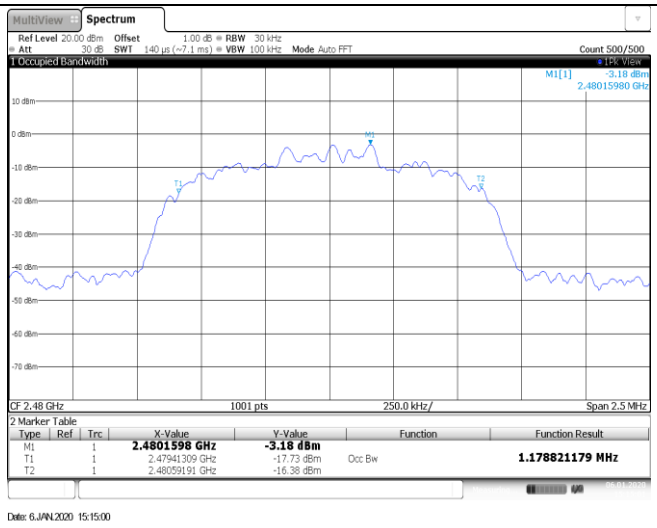
Modulation Type:	8DPSK
CH00	
CH39	
CH78	

Appendix C：99% Occupied Bandwidth

Modulation type	Channel	99% Occupied Bandwidth (MHz)	Limit (MHz)	Result
GFSK	00	0.91	-	Pass
	39	0.91		
	78	0.91		
π/4DQPSK	00	1.18	-	Pass
	39	1.18		
	78	1.18		
8DPSK	00	1.18	-	Pass
	39	1.18		
	78	1.18		

Modulation Type:	GFSK
CH00	
CH39	
CH78	

Modulation Type:	π/4DQPSK
CH00	
CH39	
CH78	

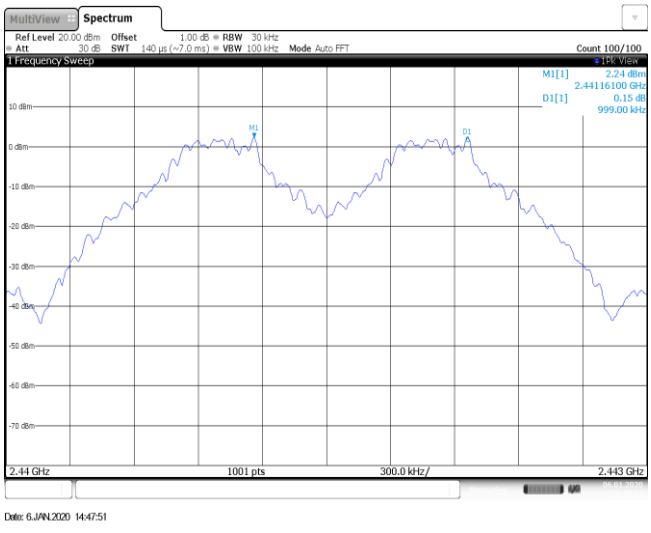
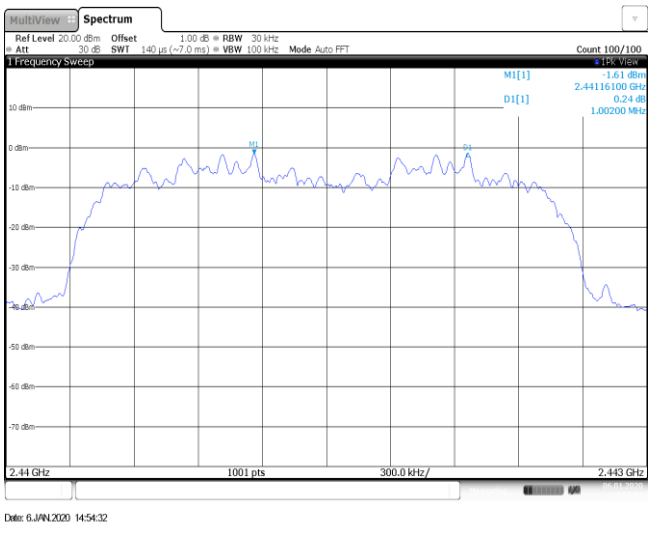
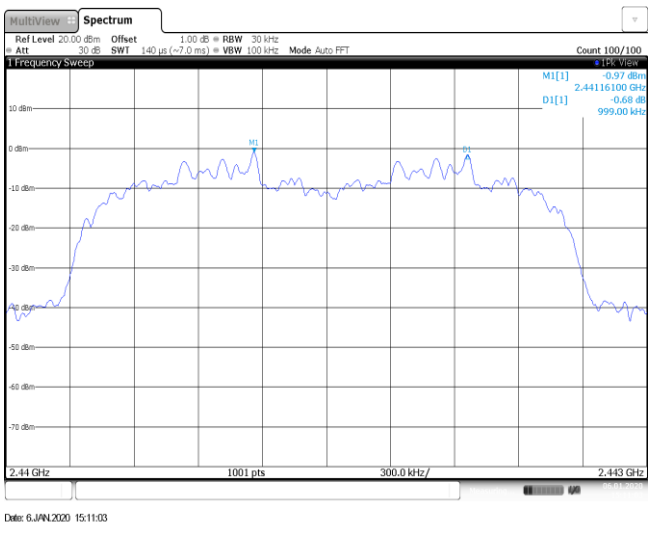
Modulation Type:	8DPSK
CH00	
CH39	
CH78	

Appendix D：Carrier Frequencies Separation

Modulation type	Channel	Carrier Frequencies Separation (MHz)	Limit (kHz) *	Result
GFSK	39	1.00	≥930.00	Pass
π/4DQPSK	39	1.00	≥880.00	Pass
8DPSK	39	1.00	≥863.33	Pass

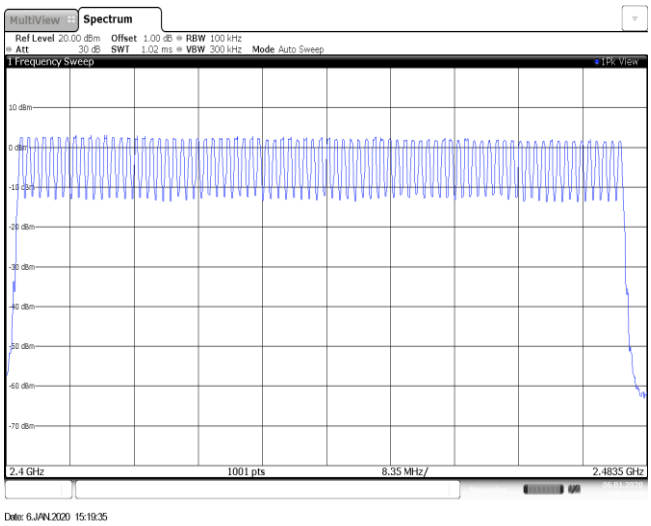
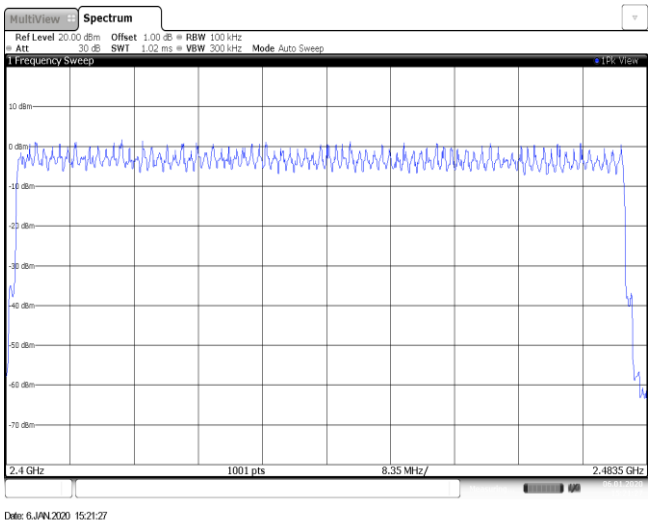
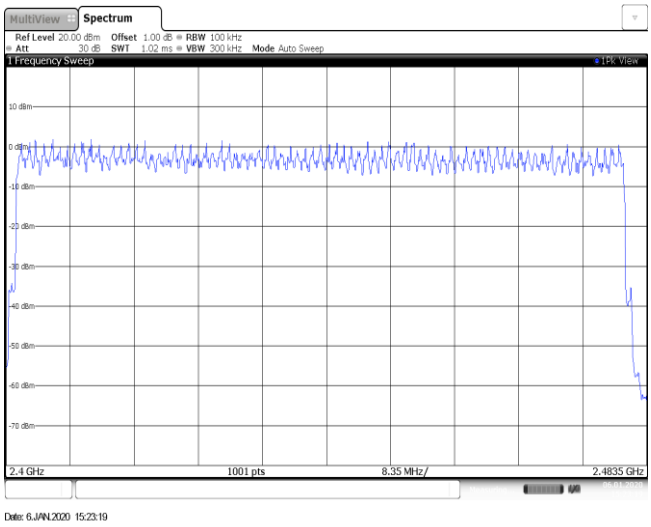
Note:

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

GFSK	
π/4DQPSK	
8DPSK	

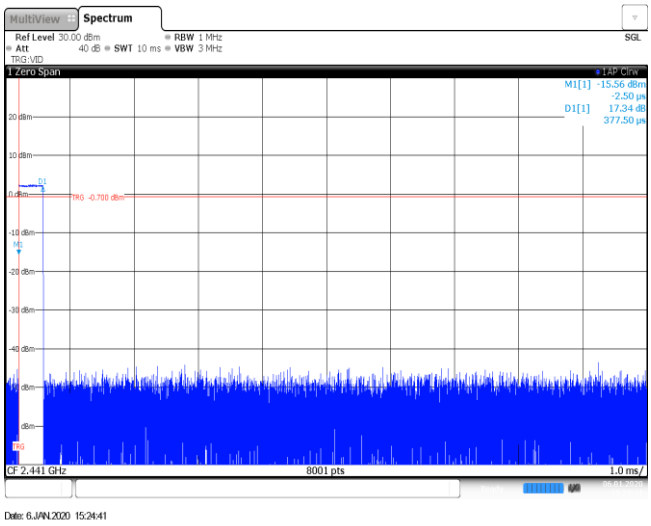
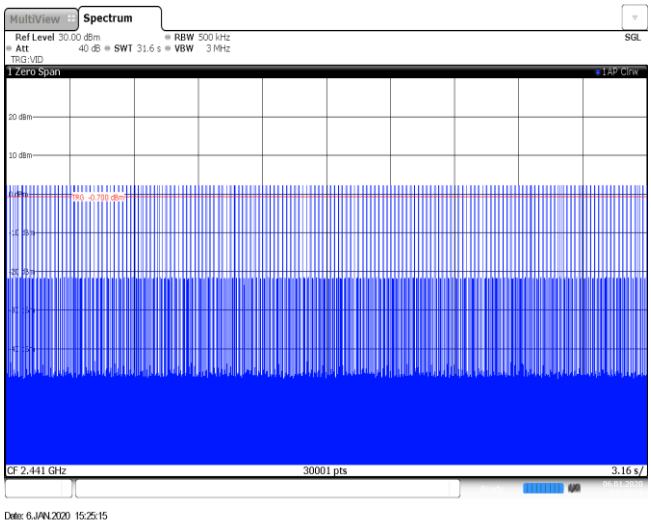
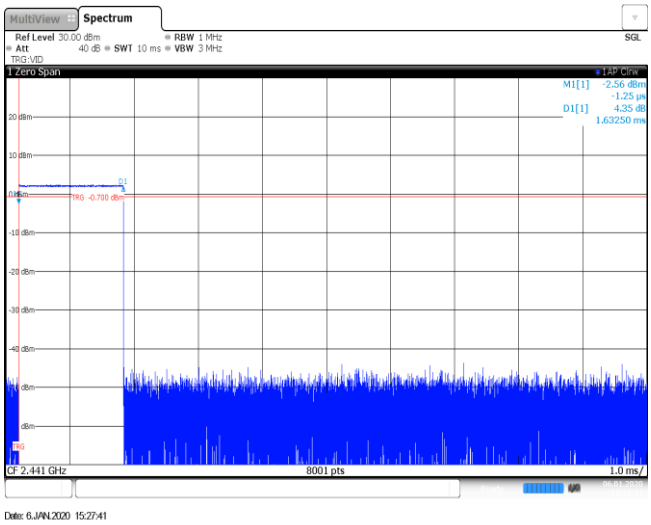
Appendix E：Hopping Channel Number

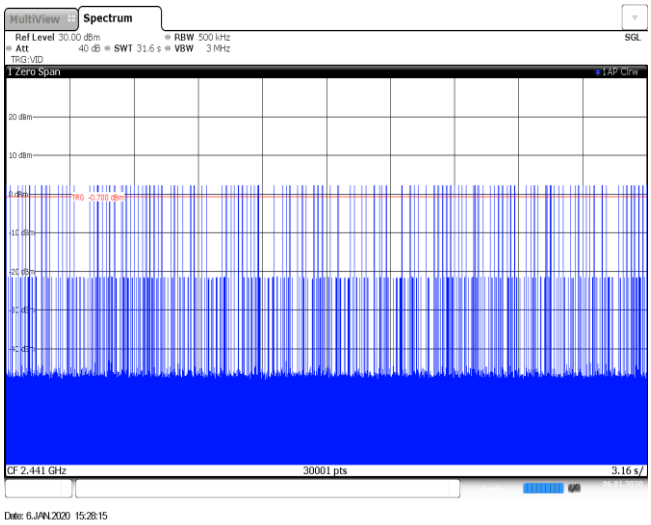
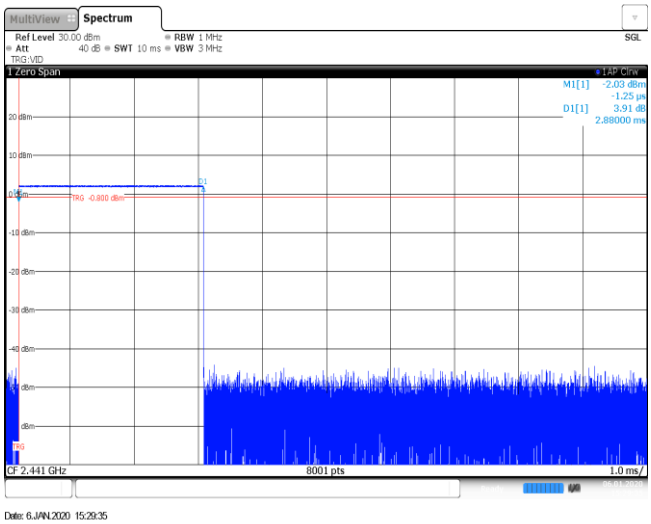
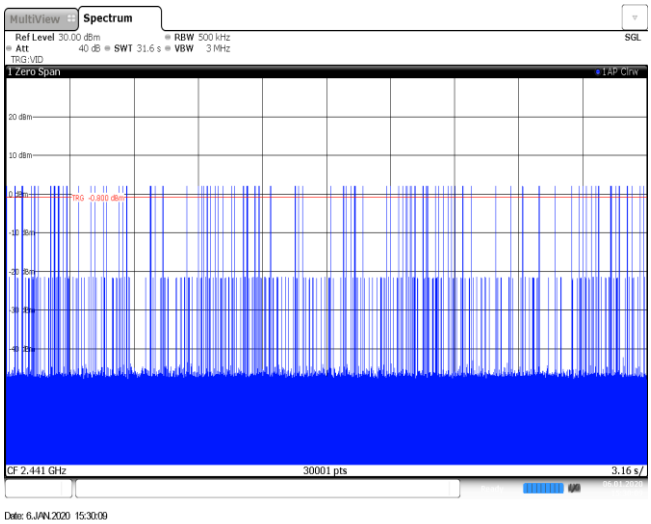
Modulation type	Channel number	Limit	Result
GFSK	79	≥15.00	Pass
π/4DQPSK	79		
8DPSK	79		

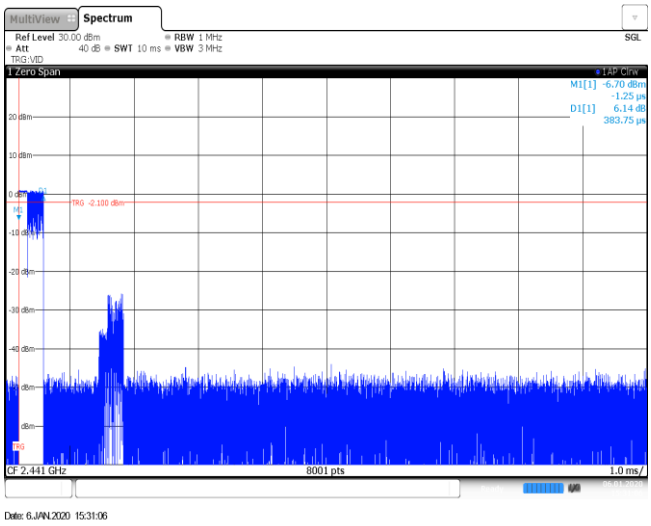
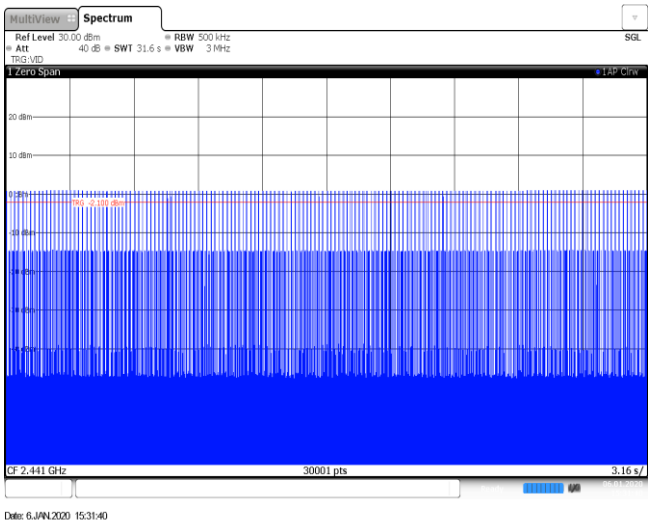
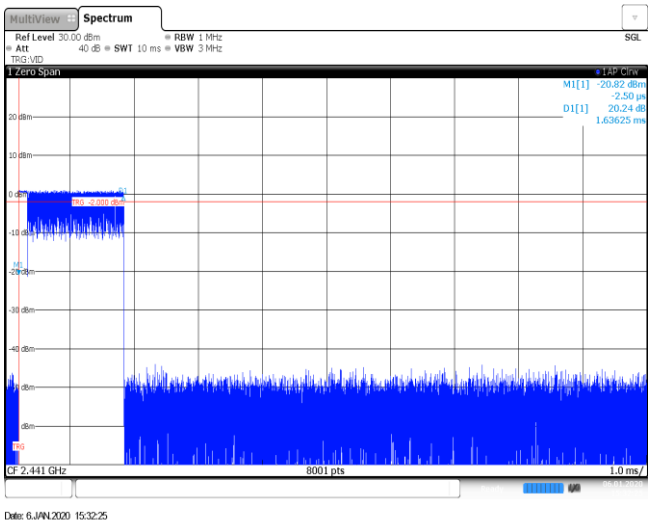
GFSK	
π/4DQPSK	
8DPSK	

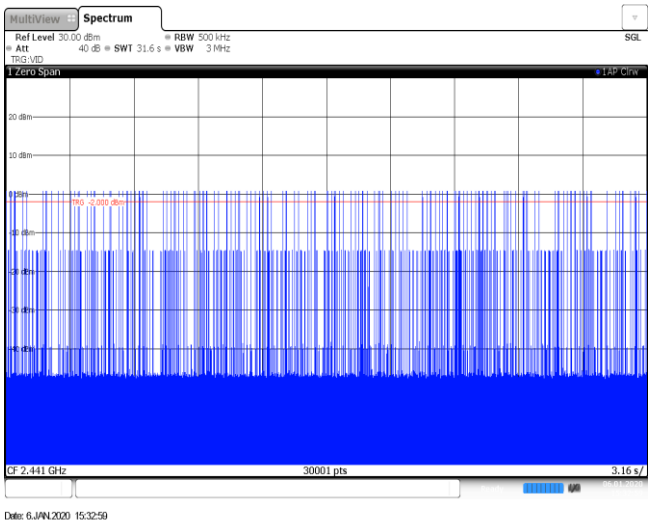
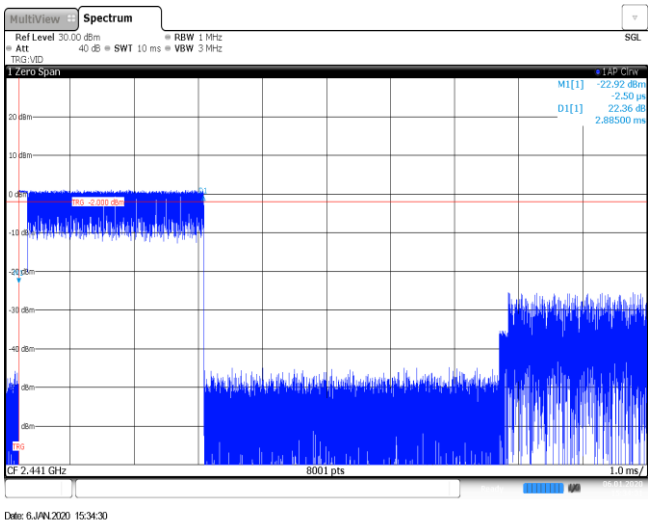
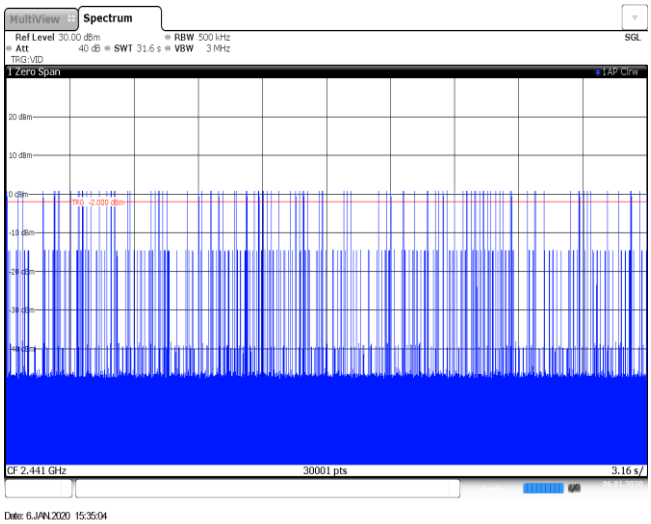
Appendix F：Dwell Time

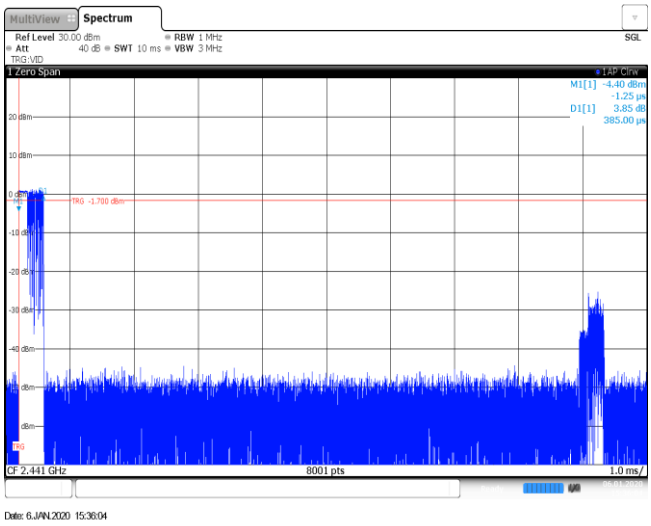
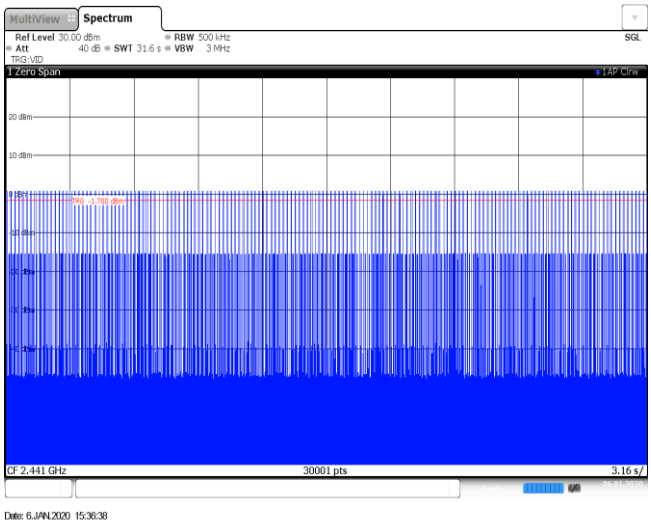
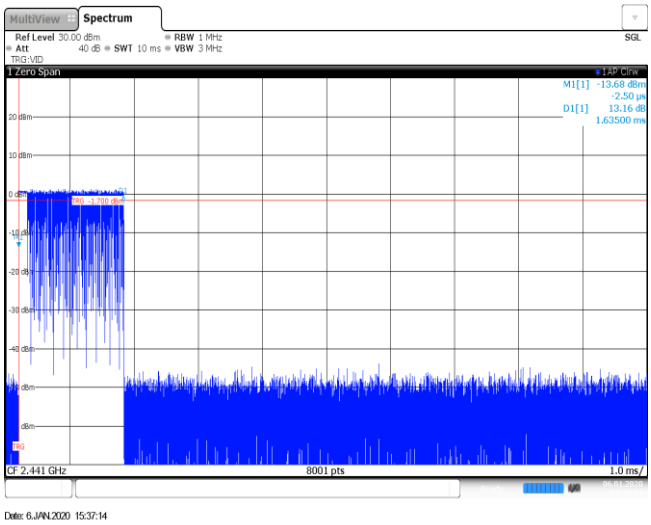
Modulation type	Packet	Burst Width [ms]	Total Hops[hop*ch]	Dwell time (Second)	Limit (Second)	Result
GFSK	DH1	0.38	314	0.12	≤ 0.40	Pass
	DH3	1.63	167	0.27		
	DH5	2.88	108	0.31		
π/4DQPSK	2DH1	0.38	314	0.12	≤ 0.40	Pass
	2DH3	1.64	158	0.26		
	2DH5	2.89	106	0.31		
8DPSK	3DH1	0.38	313	0.12	≤ 0.40	Pass
	3DH3	1.64	159	0.26		
	3DH5	2.89	105	0.30		

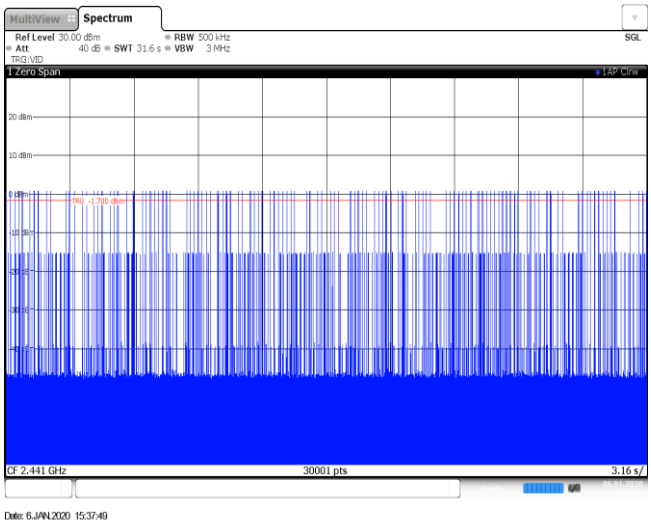
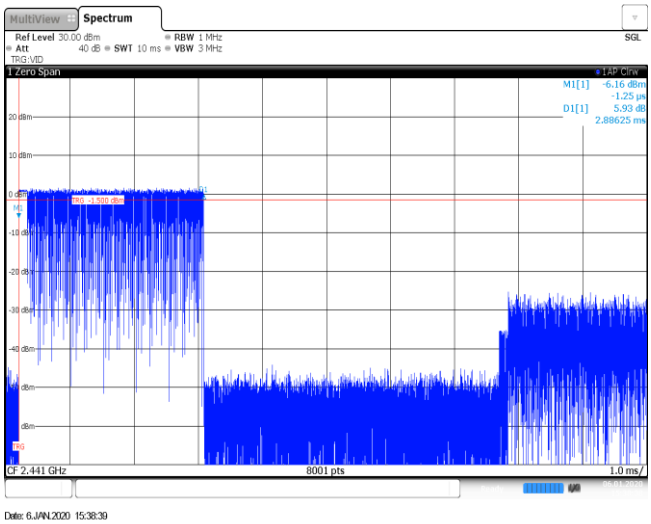
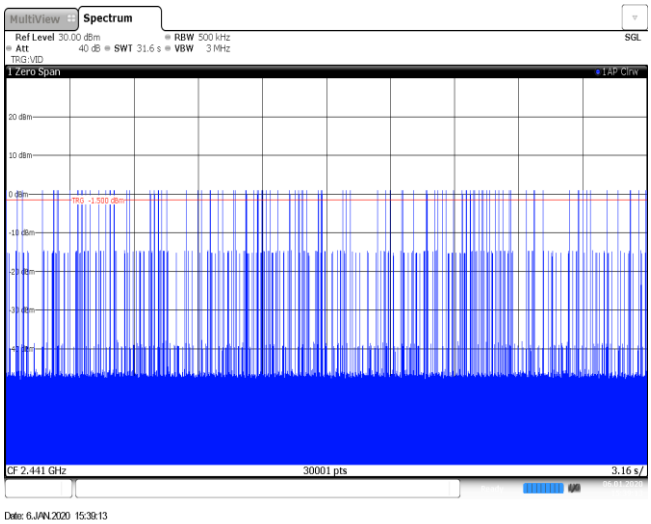
Modulation Type:	**GFSK**
DH1 Burst width	
DH1 Burst number	
DH3 Burst width	

DH3 Burst number	
DH5 Burst width	
DH5 Burst number	

Modulation Type:	π/4DQPSK
2DH1 Burst width	
2DH1 Burst number	
2DH3 Burst width	

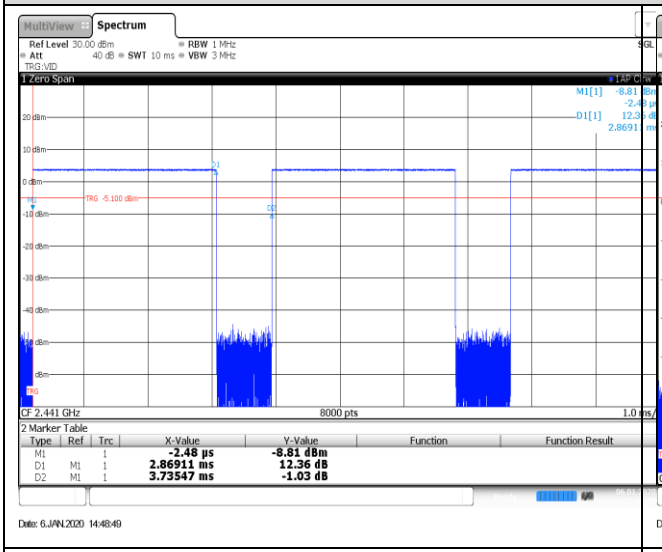
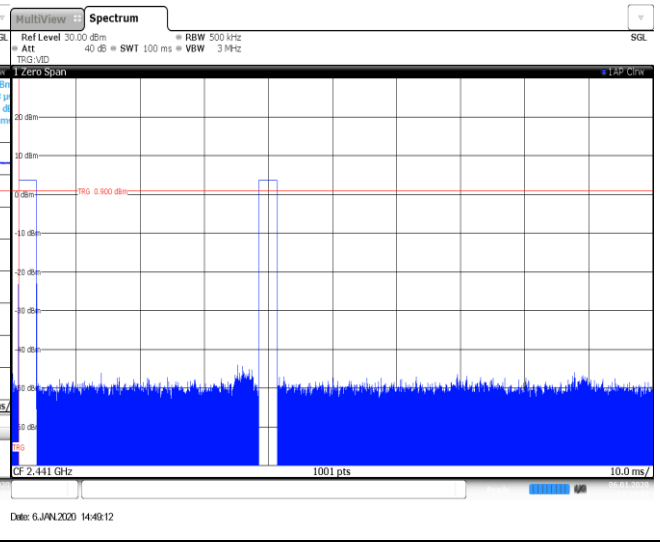
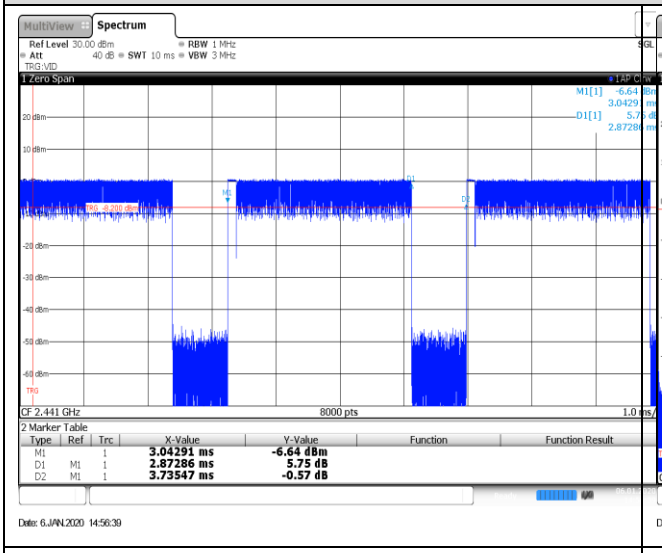
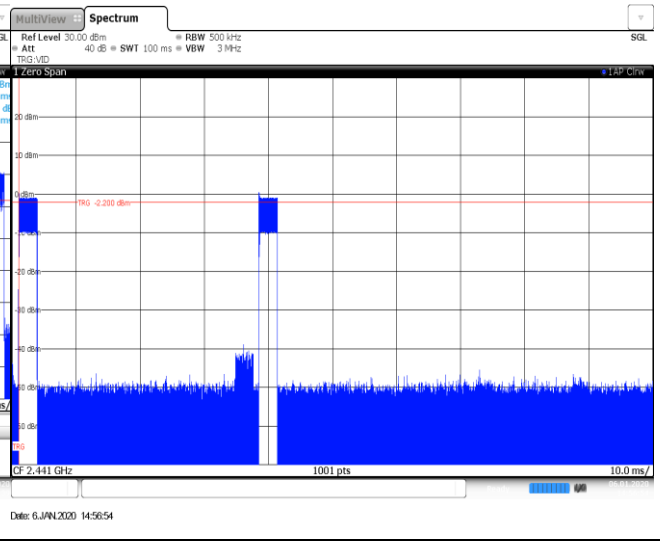
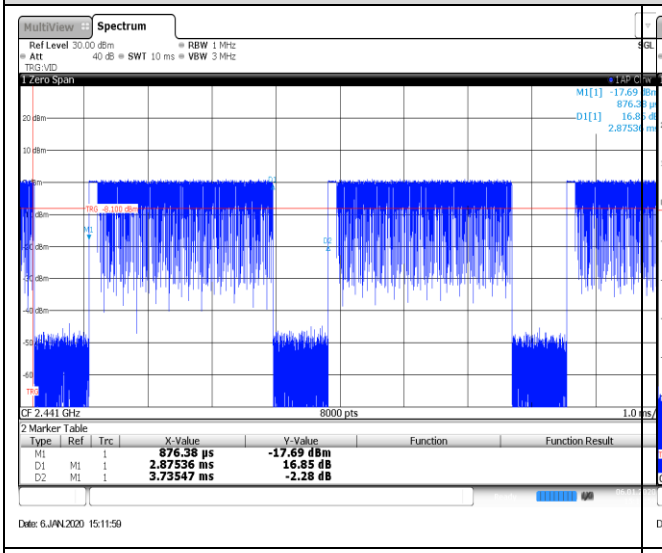
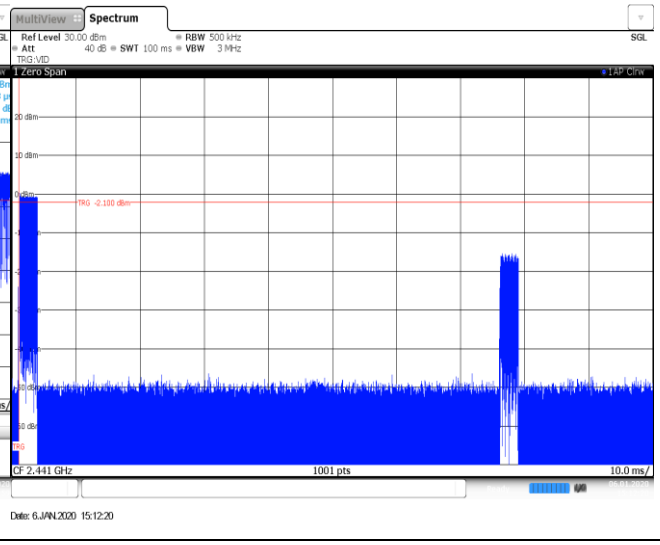
2DH3 Burst number	
2DH5 Burst width	
2DH5 Burst number	

Modulation Type:	8DPSK
3DH1 Burst width	
3DH1 Burst number	
3DH3 Burst width	

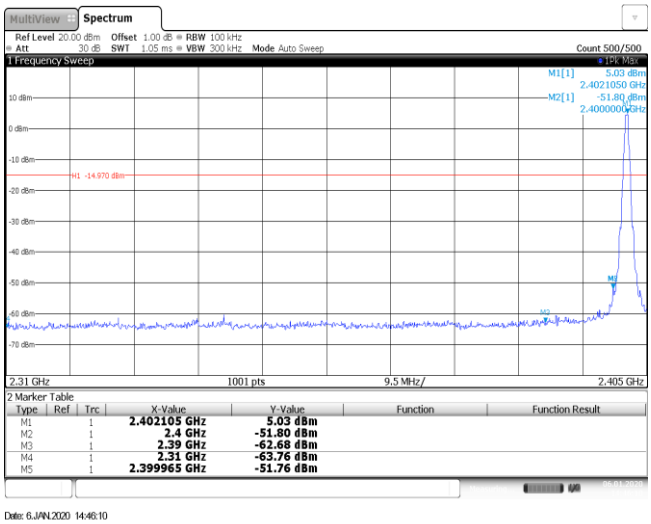
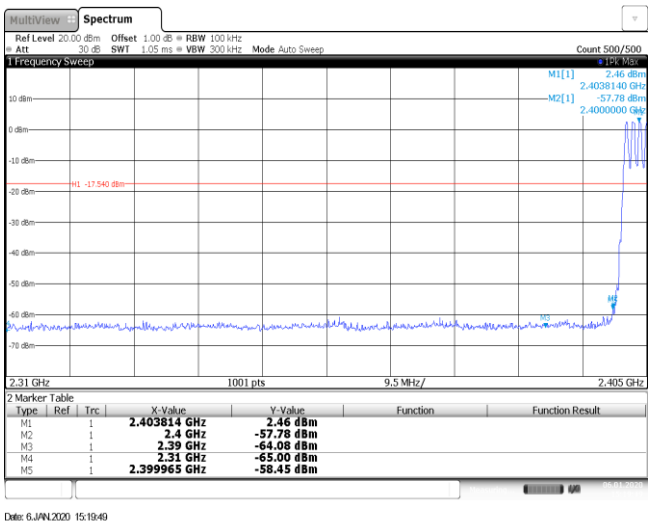
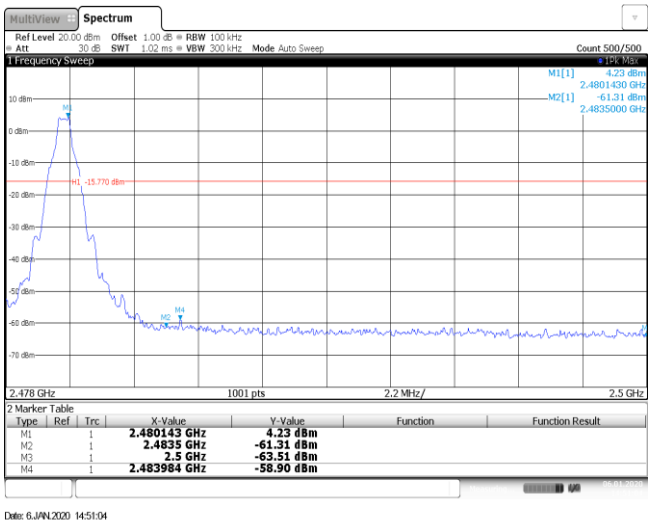
3DH3 Burst number	
3DH5 Burst width	
3DH5 Burst number	

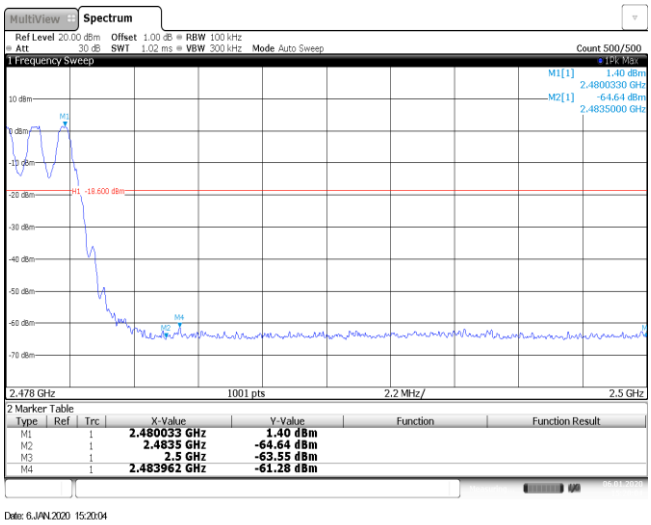
Appendix G：Duty Cycle Correction Factor (DCCF)

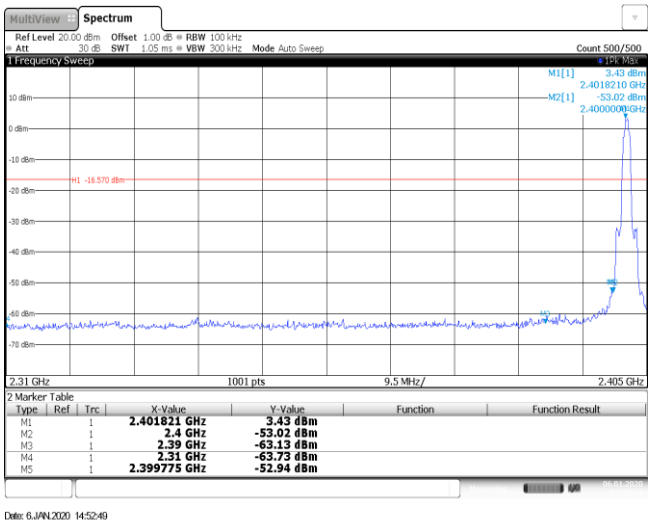
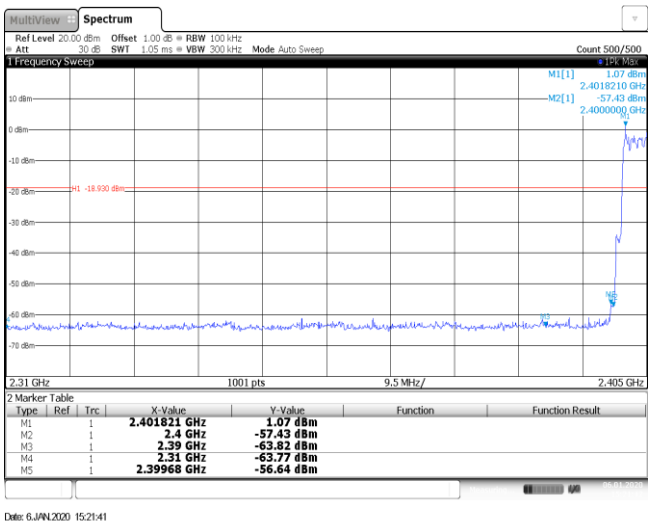
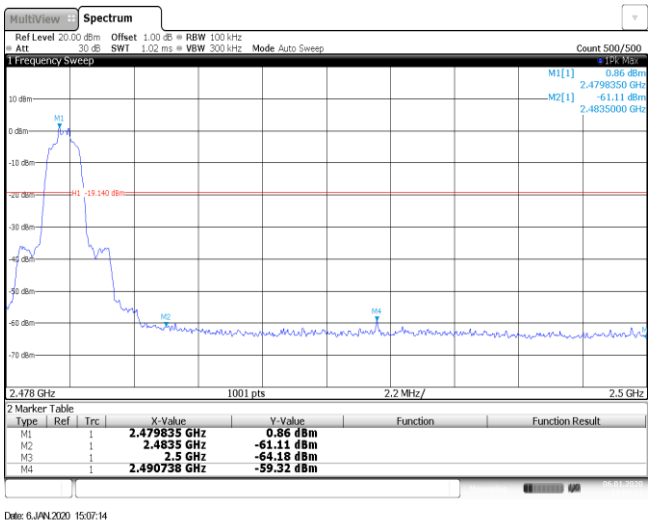
DCCF Calculate Formula					
DCCF=20 * Log(duty cycle) = 20 * Log($T_{on\ time}$ / T_{period})					
Modulation type	Test Frequency（MHz）	$T_{on\ time}$ for single burst [ms]	T_{period} [ms]	Burst Quantity	DCCF [dB]
GFSK	2441	2.87	100	2	-24.82
π/4 DQPSK	2441	2.87	100	2	-24.82
8DPSK	2441	2.88	100	2	-24.79

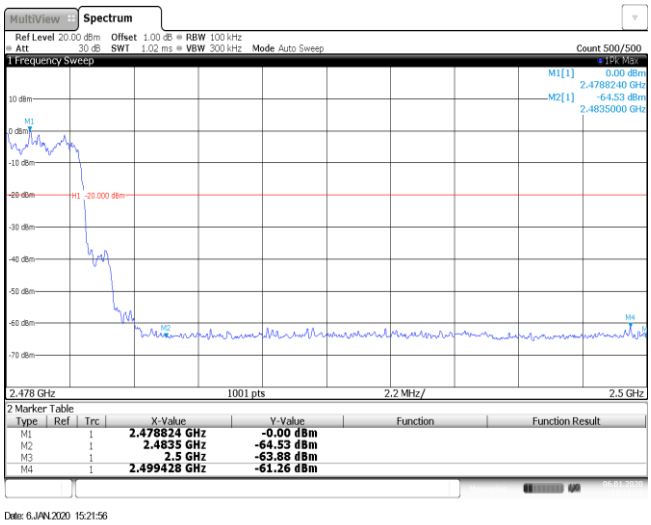
GFSK	
	
$T_{on\ time}$ for single burst	Burst Quantity
π /4 DQPSK	
	
$T_{on\ time}$ for single burst	Burst Quantity
8DPSK	
	
$T_{on\ time}$ for single burst	Burst Quantity

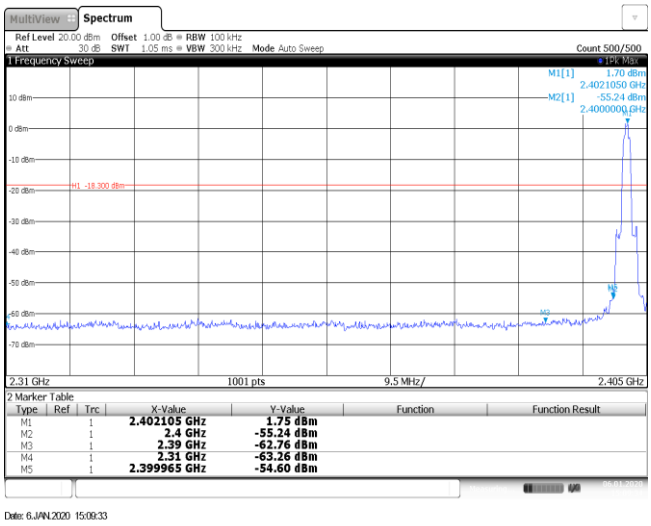
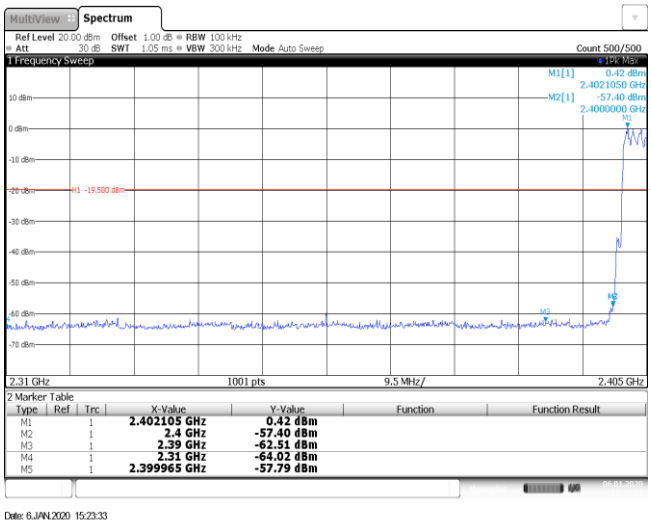
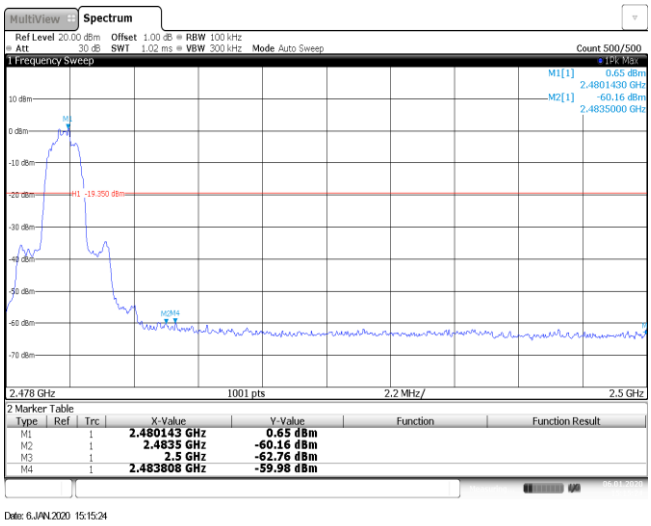
Appendix H：Band edge and Spurious Emissions (conducted)

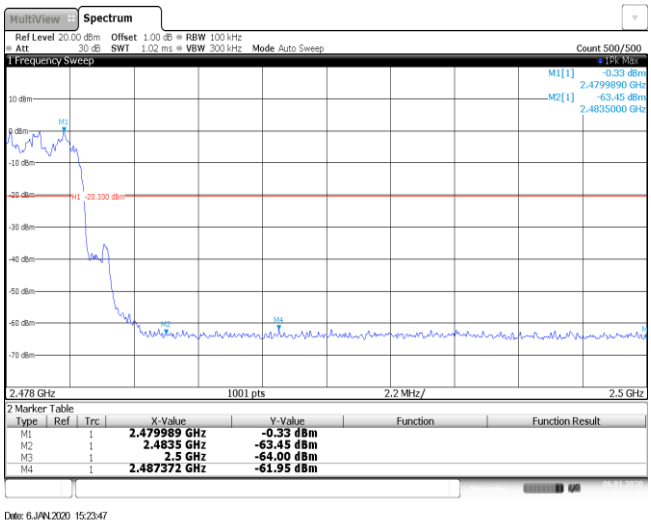
Test Item:	Band edge	Modulation type:	GFSK
CH00 No hopping mode			
CH00 Hopping mode			
CH78 No hopping mode			

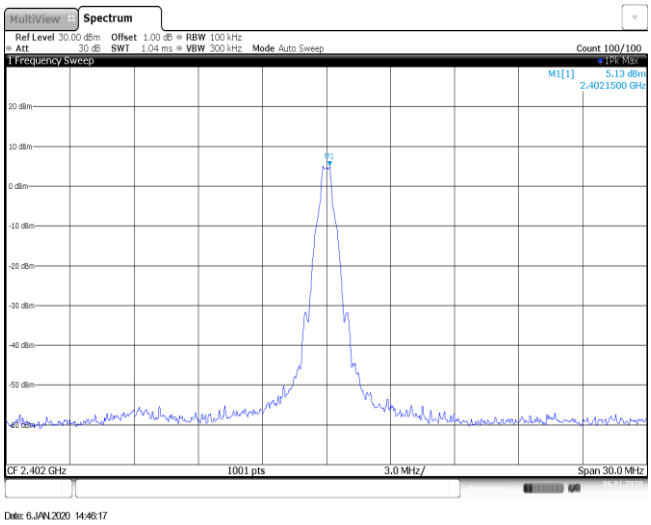
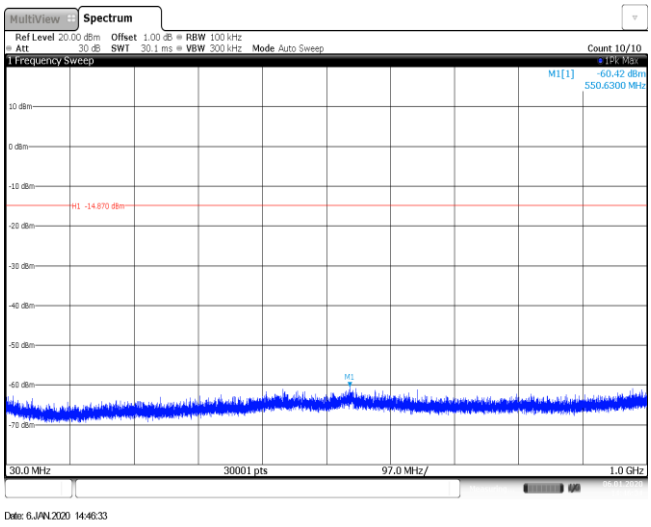
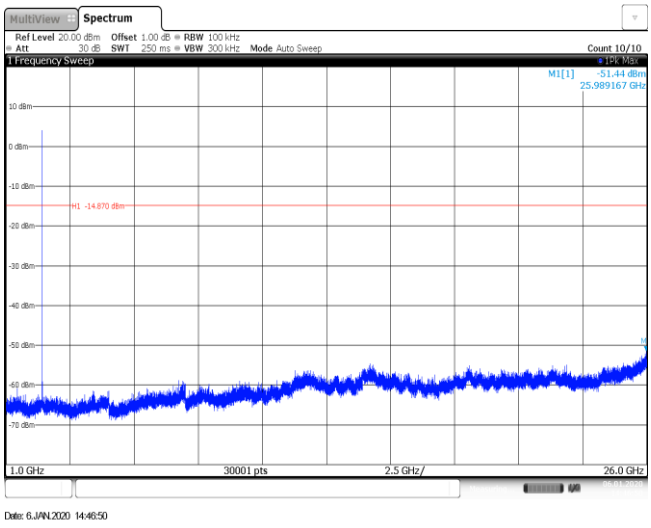
CH78 Hopping mode	

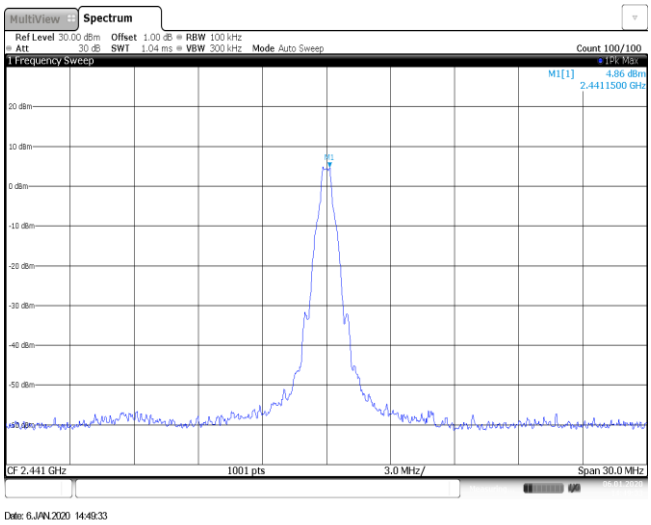
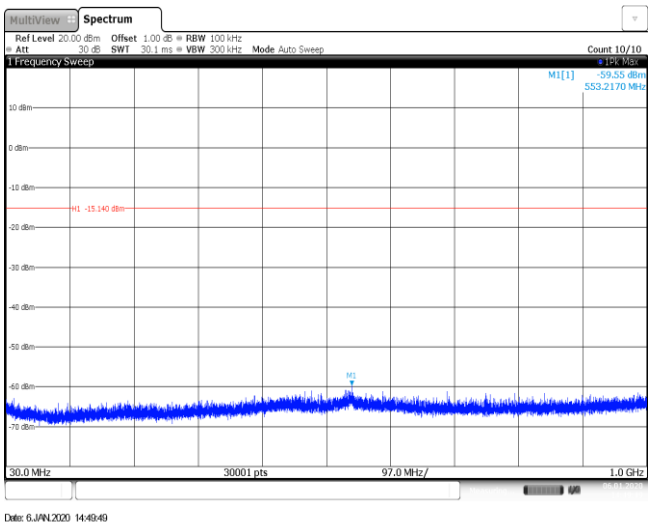
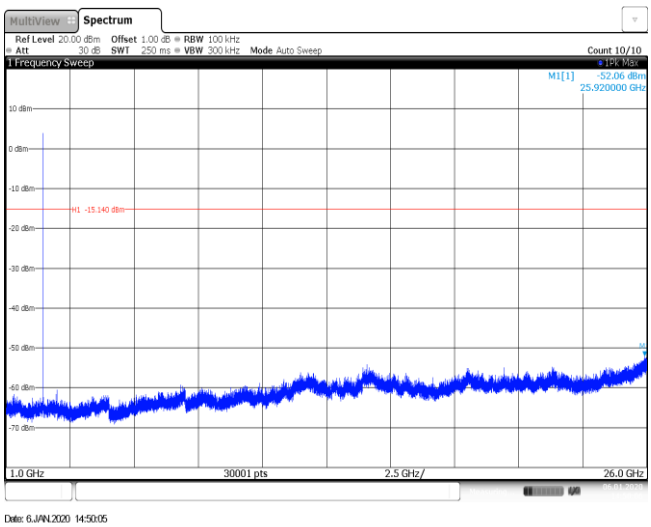
Test Item:	Band edge	Modulation type:	π/4DQPSK
CH00 No hopping mode			
CH00 Hopping mode			
CH78 No hopping mode			

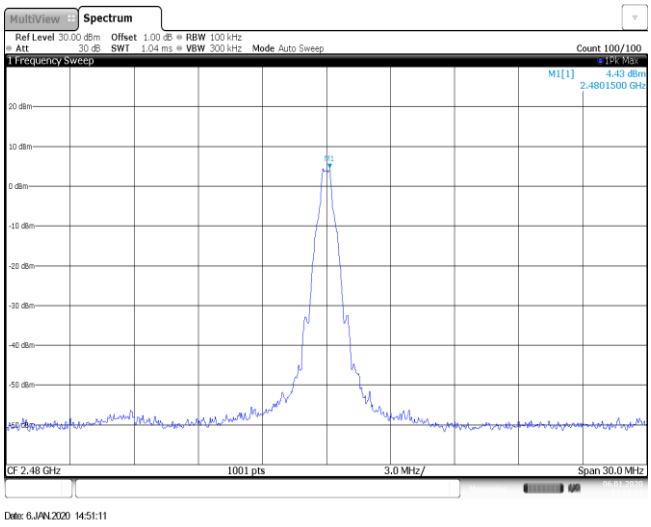
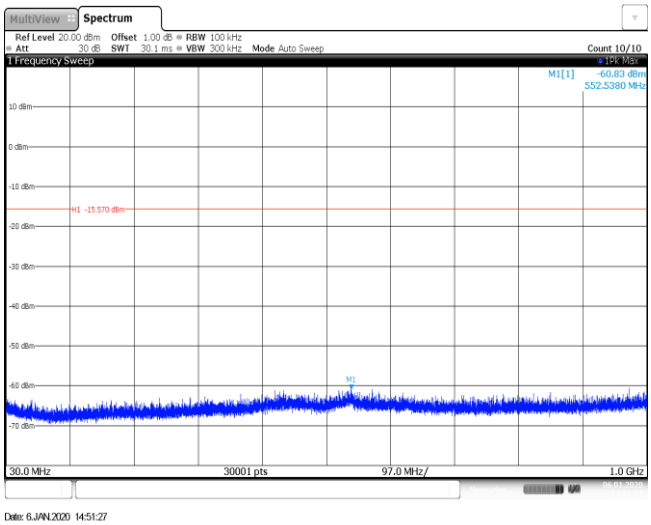
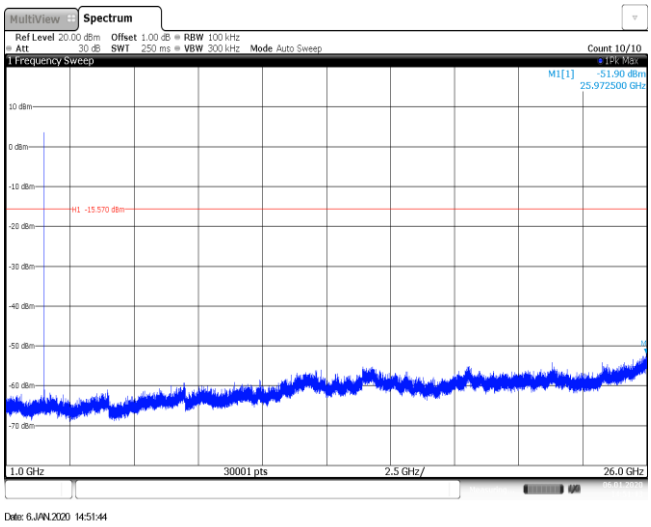
CH78 Hopping mode	

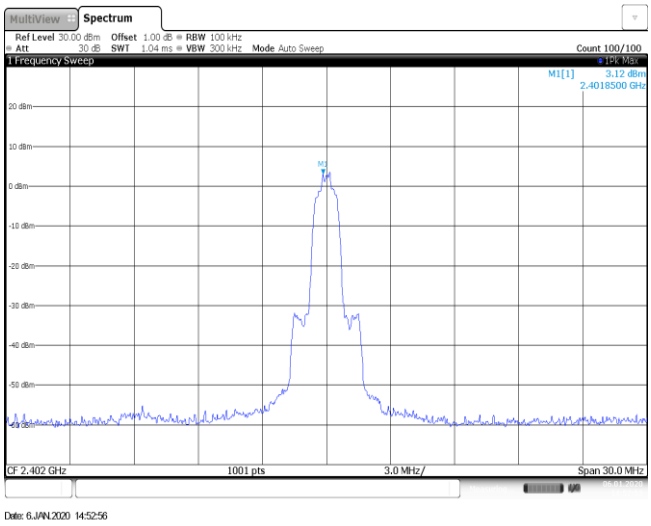
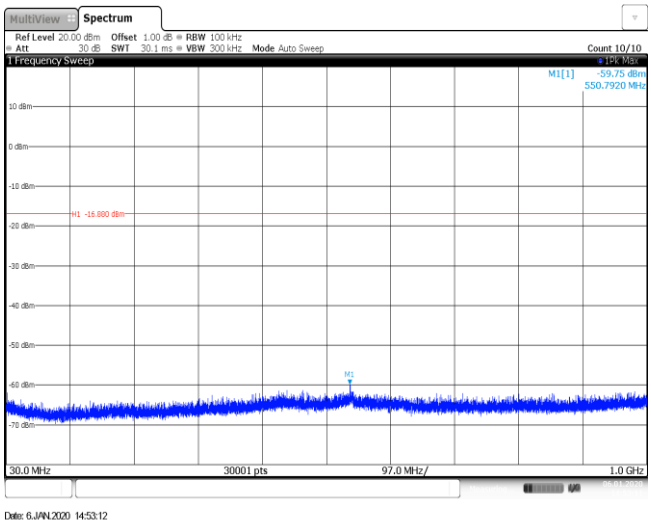
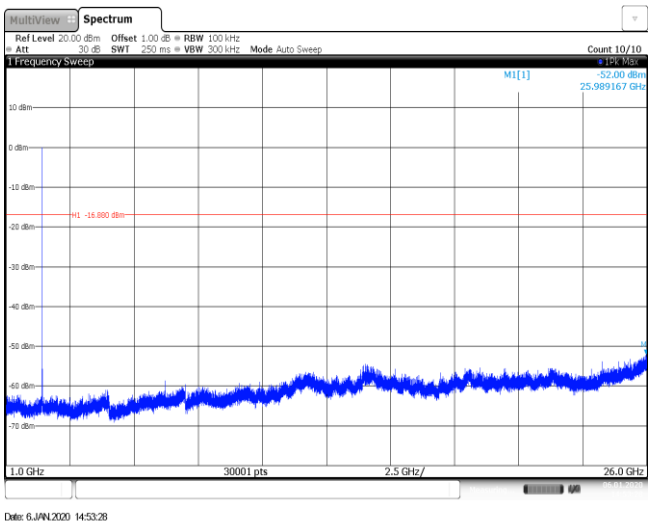
Test Item:	Band edge	Modulation type:	8DPSK
CH00 No hopping mode			
CH00 Hopping mode			
CH78 No hopping mode			

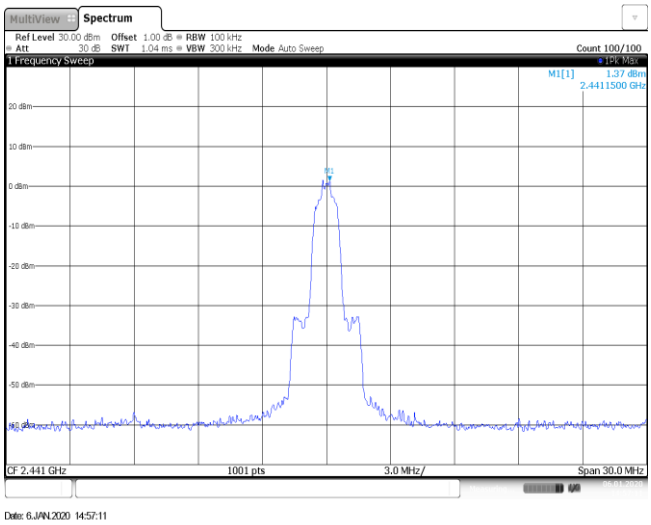
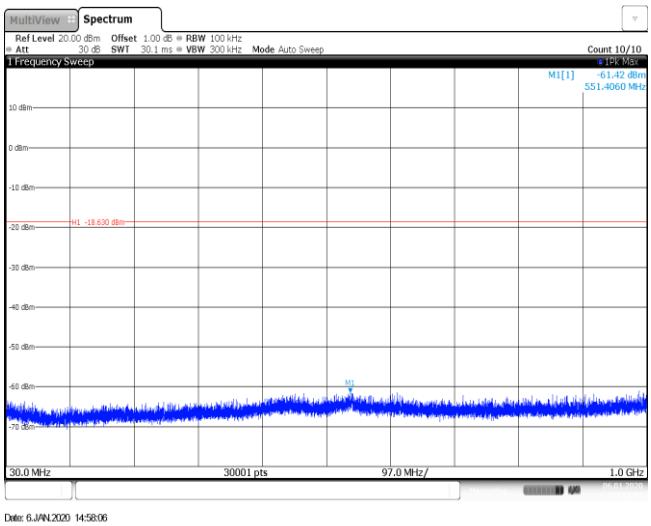
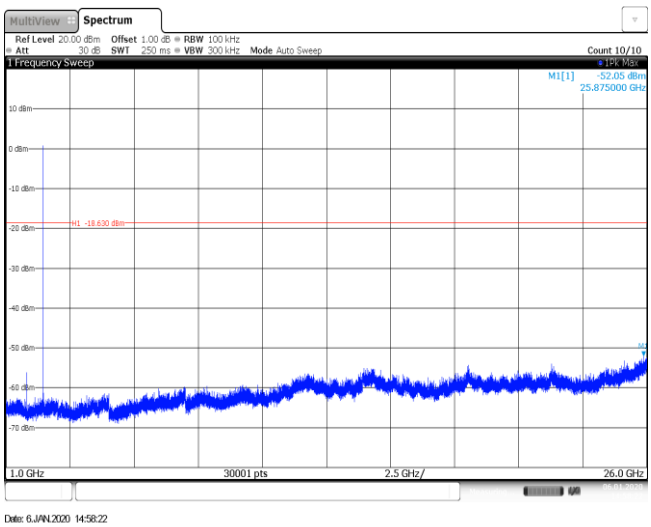
CH78 Hoppig mode	

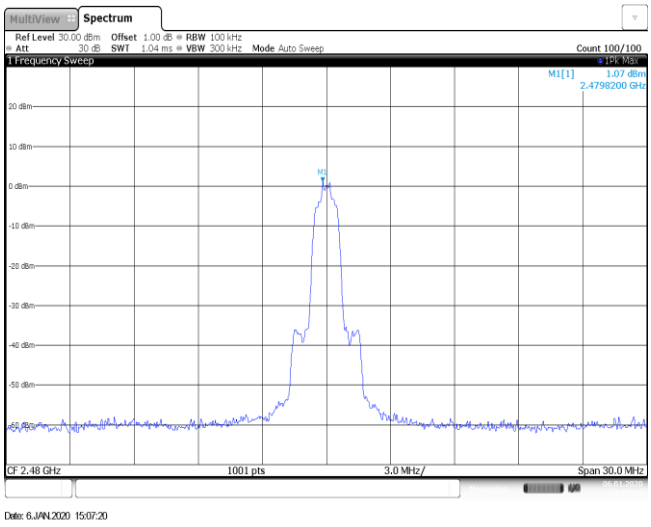
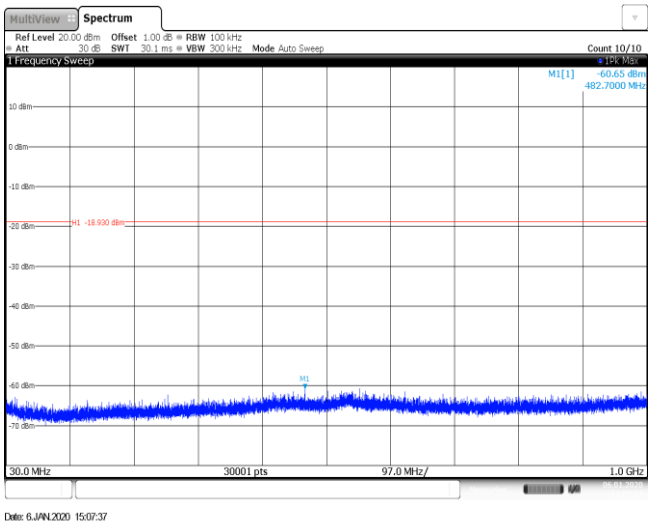
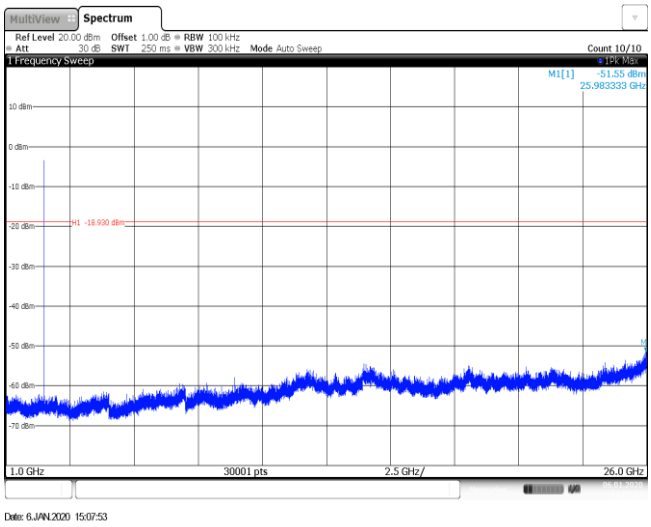
Test Item:	Spurious Emission	Modulation type:	GFSK
CH00 Reference level	
CH00 30MHz~1000MHz	
CH00 1GHz~26GHz	

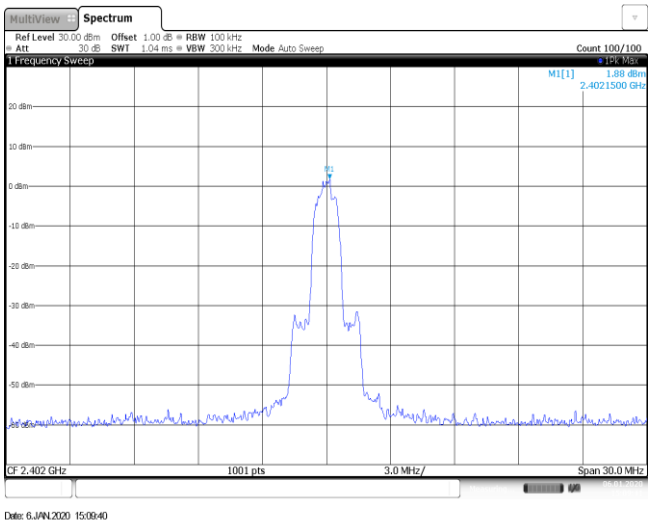
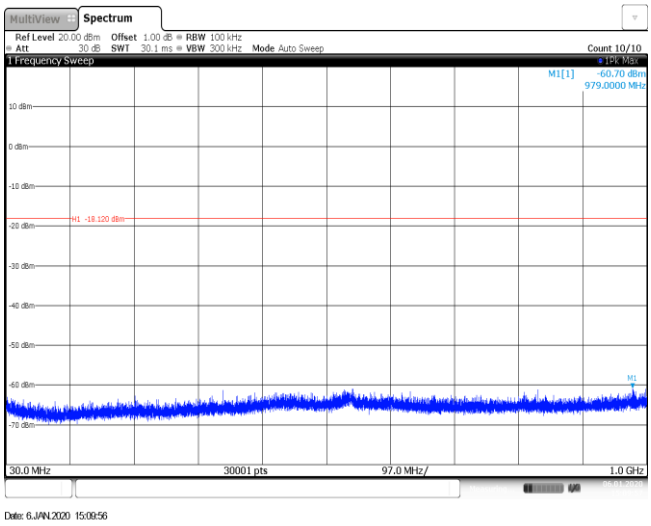
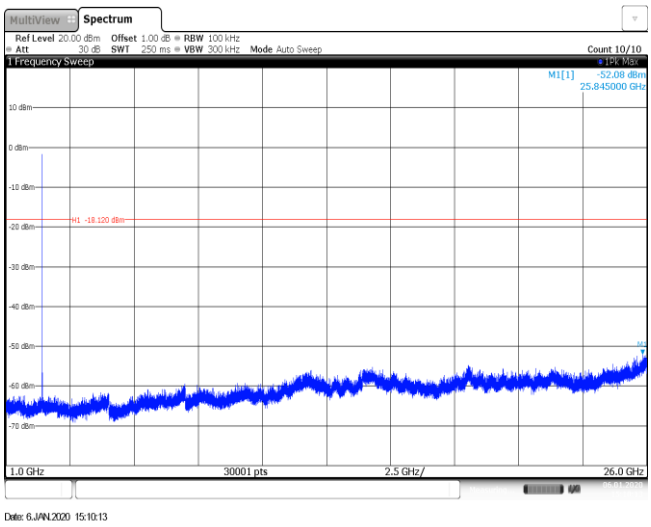
CH39 Reference level	
CH39 30MHz~1000MHz	
CH39 1GHz~26GHz	

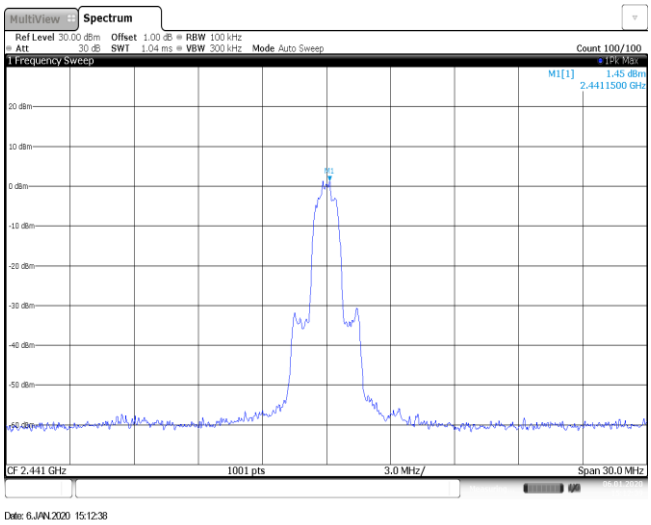
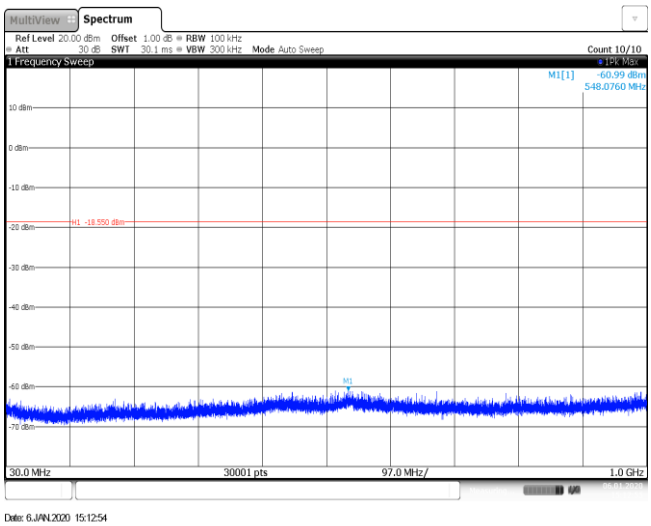
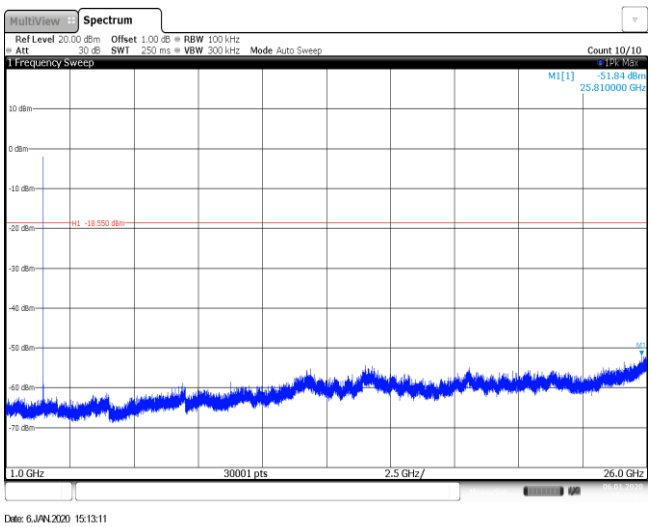
CH78 Reference level	
CH78 30MHz~1000MHz	
CH78 1GHz~26GHz	

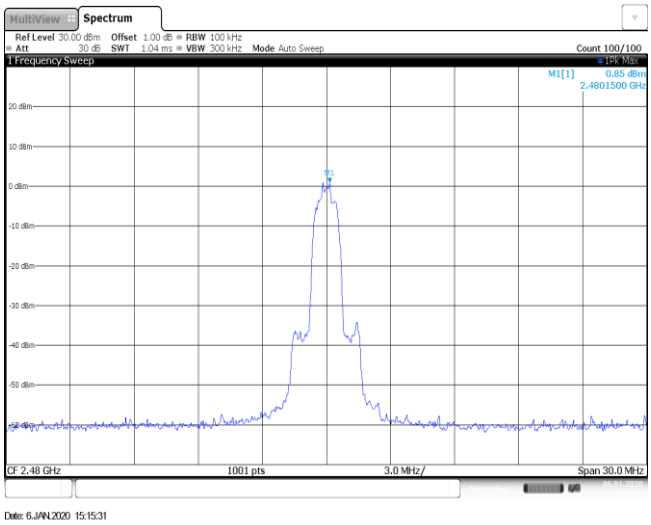
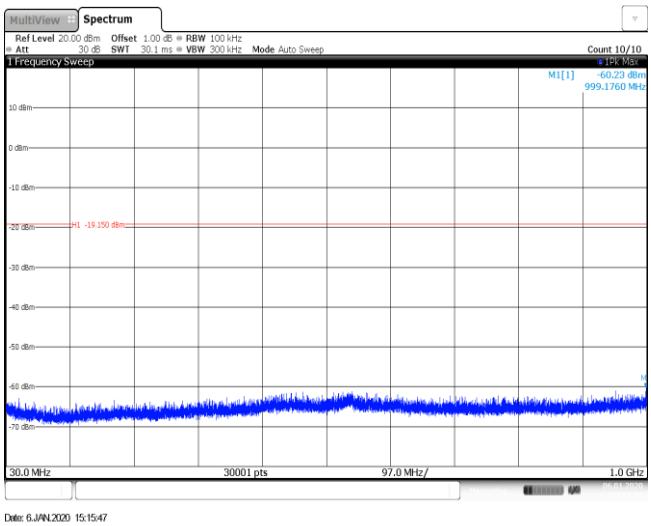
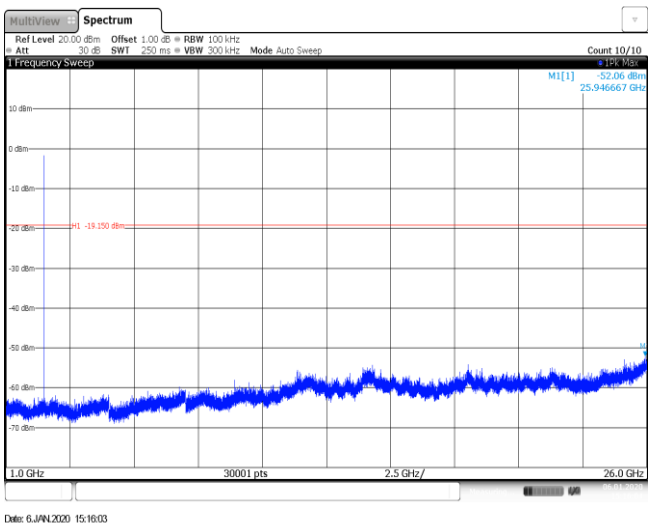
Test Item:	Spurious Emission	Modulation type:	π/4DQPSK
CH00 Reference level			
CH00 30MHz~1000MHz			
CH00 1GHz~26GHz			

CH39 Reference level	
CH39 30MHz~1000MHz	
CH39 1GHz~26GHz	

CH78 Reference level	
CH78 30MHz~1000MHz	
CH78 1GHz~26GHz	

Test Item:	Spurious Emission	Modulation type:	8DPSK
CH00 Reference level			
CH00 30MHz~1000MHz			
CH00 1GHz~26GHz			

CH39 Reference level	
CH39 30MHz~1000MHz	
CH39 1GHz~26GHz	

CH78 Reference level	
CH78 30MHz~1000MHz	
CH78 1GHz~26GHz	

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