Industrial Internet Innovation Center (Shanghai) Co.,Ltd.

FCC/IC BT TEST REPORT

PRODUCT	POS System
BRAND	SUNMI
MODEL	L1584,L1585,L1586,L1591, L1592, L1593,L3571,L3572,L3573
APPLICANT	Shanghai Sunmi Technology Co.,Ltd.
FCC ID	2AH25D2S2ND
IC	22621-D2S2ND
ISSUE DATE	January 06, 2023
STANDARD(S)	FCC Part15, RSS-247 Issue 2, RSS-Gen Issue 5

Prepared by: ***Tao Lingyan***	**Reviewed by:** ***Yang Fan***	**Approved by:** ***Zhang Min***
Signature	***Signature***	***Signature***

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1. Summary of Test Report

1.1 Test Standard(s)

No.	Test Standard(s)	Title	Version
1	FCC Part15	FCC CFR 47, Part 15, Subpart C: 15.205 Restricted bands of operation; 15.209 Radiated emission limits, general requirements; 15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz.	2020
2	RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices	2017
3	RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus	2021

1.2 Reference Documents

No.	Title	Title	Version
1	ANSI C63.10	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices	2013
2	KDB 558074	Guidance for Performing Compliance Measurements on Frequency Hopping Spread Spectrum systems (DSS) Operating Under §15.247	2019

1.3 Summary of Test Results

Measurement Items	Sub-clause of Part15C	Sub-clause of IC	Verdict
Maximum Peak Output Power	15.247(b)	RSS-247 5.4	Pass
20dB Occupied Bandwidth	15.247(a)	RSS-247 5.1	Pass
99% Occupied Bandwidth	15.247(a)	RSS-Gen 6.7	Pass
Band Edges Compliance	15.247 (d)	RSS-247 5.5	Pass
Time Of Occupancy (Dwell Time)	15.247(a)	RSS-247 5.1	Pass
Carrier Frequency Separation	15.247(a)	RSS-247 5.1	Pass
Number Of Hopping Channels	15.247(a)	RSS-247 5.1	Pass
Transmitter Spurious Emission-Conducted	15.247(d)	RSS-247 5.5	Pass
Transmitter Spurious Emission-Radiated	15.247,15.209,15.205	RSS-Gen 8.9,8.10	Pass
AC Powerline Conducted Emission	15.207	RSS-Gen 8.8	Pass
NOTE： The L1584,L1585,L1586,L1591, L1592, L1593,L3571,L3572,L3573 manufactured by Shanghai Sunmi Technology Co.,Ltd. is a new products for testing.			

Industrial Internet Innovation Center (Shanghai) Co., Ltd. only performed test cases which identified with Pass/Fail/Inc result in section 1.3. Industrial Internet Innovation Center (Shanghai) Co., Ltd. has verified that the compliance of the tested device specified in section 4 of this test report is successfully evaluated according to the procedure and test methods as defined in type certification requirement listed in section 1 of this test report.

a. All the test data for each data were verified, but only the worst case was reported.

b. The DC and low frequency voltages' measurement uncertainty is ±2%.

1.4 Data Provided by Applicant

No.	Item(s)	Data
1	Antenna gain of EUT	1.58 dBi
Note: The data of 1.4 is provided by the customer may affect the validity of the test results in this report, and the impact and consequences of this shall be undertaken by the customer.		

2. General Information of The Laboratory

2.1 Testing Laboratory

Lab Name	Industrial Internet Innovation Center (Shanghai) Co.,Ltd.
Address	Building 4，No. 766，Jingang Road，Pudong，Shanghai，China
Telephone	021-68866880
FCC Registration No.	958356
FCC Designation No.	CN1177

2.2 Laboratory Environmental Requirements

Temperature	15℃~35℃
Relative Humidity	25%RH~75%RH
Atmospheric Pressure	101kPa

2.3 Project Information

Project Manager	Gao Hongning
Test Date	June 8, 2022 to August 2, 2022

3. General Information of The Customer

3.1 Applicant

Company	Shanghai Sunmi Technology Co.,Ltd.
Address	Room 505,No.388,Song Hu Road,Yang Pu District,Shanghai,China
Telephone	+86 18501703215

3.2 Manufacturer

Company	Shanghai Sunmi Technology Co.,Ltd.
Address	Room 505,No.388,Song Hu Road,Yang Pu District,Shanghai,China

4. General Information of The Product

4.1 Product Description for Equipment under Test

Product Name	POS System
Model name	L1584,L1585,L1586,L1591, L1592, L1593,L3571,L3572,L3573
Date of Receipt	N01: May 29,2022 N06: June 09,2022
EUT ID*	N01/N06
SN/IMEI	DD23D05N40036/ DD19D25U40089
Supported Radio Technology and Bands	BT 4.2 BR/ EDR, BLE WLAN 802.11 b,g,n WLAN 802.11 a,n,ac
Hardware Version	RK3568_MB_V2.0
Software Version	3.0.0
FCC ID	2AH25D2S2ND
IC	22621-D2S2ND
NOTE：EUT ID is the internal identification code of the laboratory.	

4.2 Internal Identification of AE used during the test

AE ID*	Description	Model	SN/Remark
AE1	RF Cable	N/A	N/A

4.3 Additional Information

Bluetooth Frequency	2402MHz-2480MHz
Bluetooth Channel	Ch0-78
Bluetooth Modulation	GFSK; π/4 DQPSK; 8DPSK

5. Test Configuration Information

5.1 Laboratory Environmental Conditions

5.1.1 Permanent Facilities

Relative Humidity	Min. = 45 %, Max. = 55 %		
Atmospheric Pressure	101kPa		
Temperature	Normal	Minimum	Maximum
	25℃	-10℃	55℃
Working Voltage of EUT	Normal	Minimum	Maximum
	24V	22.8V	25.2V

5.2 Test Equipments Utilized

5.2.1 Conducted Test System

No.	Name	Model	S/N	Manufacturer	Cal. Date	Cal. Interval
1	Programmable Power Supply	Keithley 2303	4039070	Starpoint	May 10, 2021	1.5years
2	Vector Signal Generator	SMBV100A	257904	R&S	February 21, 2022	1 year
3	Temperature box	B-TF-107C	BTF107C-201804107	Boyi	May 10, 2021	1.5 years
4	Spectrum Analyzer	FSQ40	200063	R&S	November 02, 2021	1 year
5	USB Wideband Power Senser	U2021XA	MY56410009	KEYSGHT	February 21, 2022	1 year
6	Simultaneous Sampling DQA	U2531A	TW56183514	Agilent	March 02, 2022	1 year
7	Vector Signal Generator	SMU200A	104684	R&S	May 10, 2021	1.5 years
8	Wireless communication comprehensive tester	CMW270	100919	R&S	May 10, 2021	1.5 years
9	Eagle Test Software	Eagle V3.3	N/A	ECIT	N/A	N/A
10	Talent Microwave Band Rejection Filter	Filter	191016001	N/A	N/A	N/A

5.2.2 Radiated Emission Test System

No.	Name	Model	S/N	Manufacturer	Cal. Date	Cal. Interval
1	EMI Test Receiver	ESU40	100307	R&S	February 23, 2022	1 Year
2	Trilog Antenna	VULB9163	VULB9163-515	Schwarzbeck	March 11,2022	1 Year
3	Double Ridged Guide Antenna	ETS-3117	00135890	ETS	March. 09,2022	2 Years
4	Universal Radio Communication tester	CMU200	123123	R&S	August 23,2021	1Year
5	Universal Radio Communication tester	CMW500	104178	R&S	August 23,2021	1Year
6	EMI Test Software	EMC32 V9.15.00	N/A	R&S	N/A	N/A
7	2-Line V-Network	ENV216	101380	R&S	February 21, 2022	1 Year

5.2.3 Test Environment

Shielding Room1 (6.0 meters×3.0 meters×2.7 meters) did not exceed following limits along the conducted RF performance testing:

Temperature	Min. = 15 ℃, Max. = 35 ℃
Relative humidity	Min. = 20 %, Max. = 75 %
Shielding effectiveness	> 100 dB
Ground system resistance	< 0.5 Ω
Temperature	Min. = 15 ℃, Max. = 35 ℃

Control room did not exceed following limits along the EMC testing:

Temperature	Min. = 15 ℃, Max. = 35 ℃
Relative humidity	Min. =30 %, Max. = 60 %
Shielding effectiveness	> 100 dB
Electrical insulation	> 10 kΩ
Ground system resistance	< 0.5 Ω

Fully-anechoic chamber1 (9.8 meters×6.7 meters×6.7 meters) did not exceed following limits along the EMC testing:

Temperature	Min. = 15 ℃, Max. = 35 ℃
Relative humidity	Min. = 25 %, Max. = 75 %
Shielding effectiveness	> 100 dB
Electrical insulation	> 10 kΩ

Ground system resistance	< 0.5 Ω
VSWR	Between 0 and 6 dB, from 1GHz to 18GHz
Site Attenuation Deviation	Between -4 and 4 dB,30MHz to 1GHz

5.3 Measurement Uncertainty

Measurement Items	Range	Confidence Level	Calculated Uncertainty
Peak Output Power-Conducted	2402MHz-2480MHz	95%	0.544dB
Frequency Band Edges-Conducted	2402MHz-2480MHz	95%	0.544dB
Conducted Emission	30MHz-2GHz	95%	0.90dB
Conducted Emission	2GHz-3.6GHz	95%	0.88dB
Conducted Emission	3.6GHz-8GHz	95%	0.96dB
Conducted Emission	8GHz-20GHz	95%	0.94dB
Conducted Emission	20GHz-22GHz	95%	0.88dB
Conducted Emission	22GHz-26GHz	95%	0.86dB
Transmitter Spurious Emission-Radiated	9KHz-30MHz	95%	5.66dB
Transmitter Spurious Emission-Radiated	30MHz-1000MHz	95%	4.98dB
Transmitter Spurious Emission-Radiated	1000MHz -18000MHz	95%	5.06dB
Transmitter Spurious Emission-Radiated	18000MHz -40000MHz	95%	5.20dB
Dwell Time	2402MHz-2480MHz	95%	0.218ms
20dB Bandwidth	2402MHz-2480MHz	95%	62.04Hz
AC Power line Conducted Emission	0.15MHz-30MHz	95%	3.66 dB

6. Test Results

6.1 Peak Output Power-Conducted

6.1.1 Measurement Limit

Standard	Limit (dBm)	EIRP Limit (dBm)
FCC 47 Part 15.247(b)(3)	<30	<36
RSS-247 5.4(d)	<30	<36

6.1.2 Test Condition

Hopping Mode	RBW	VBW	Span	Sweeptime
Hopping OFF	3MHz	10MHz	9MHz	Auto

6.1.3 Test Procedure

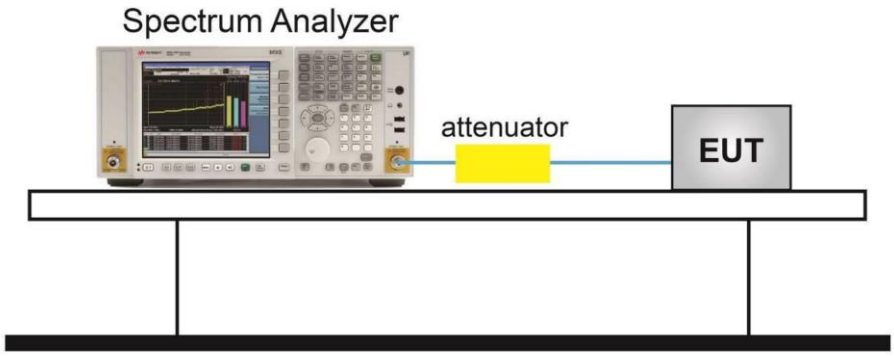
The measurement is according to ANSI C63.10 clause 7.8.5.

1. The output power of EUT was connected to the spectrum analyzer and CMW270 by cable and divide. The path loss was compensated to the results for each measurement.

2. Enable EUT transmitter maximum power continuously.

3. Measure the conducted output power and record the results it

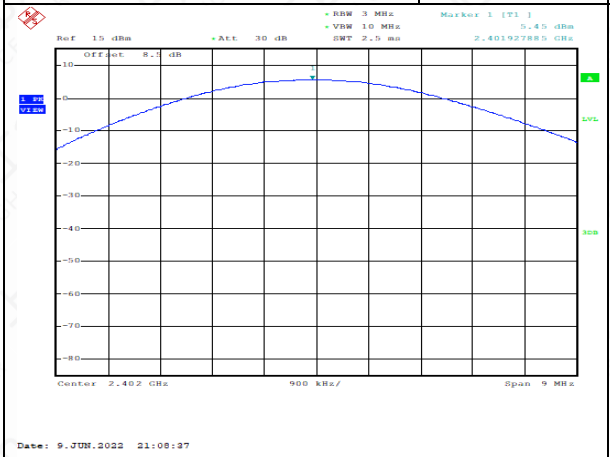
6.1.4 Test setup

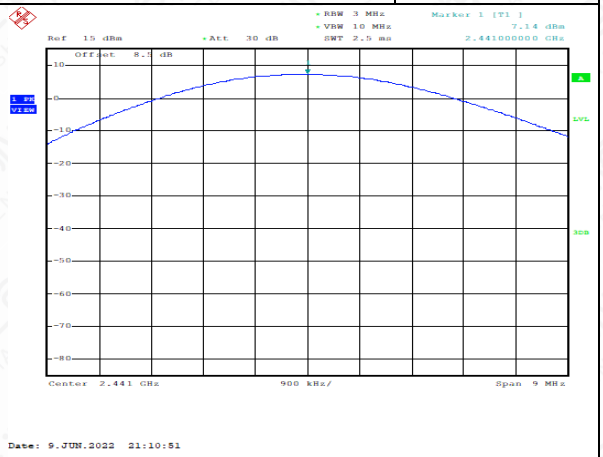


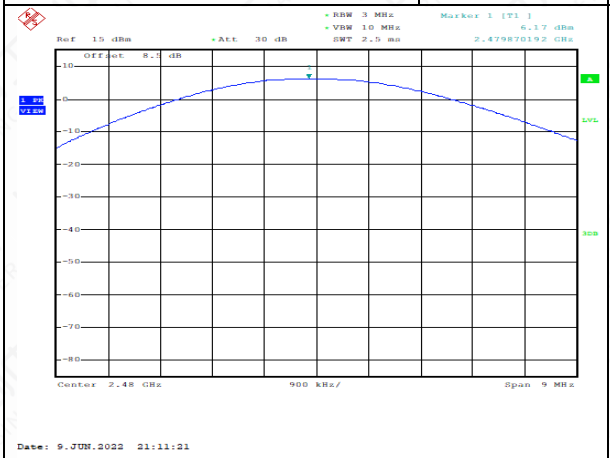
Measurement Results

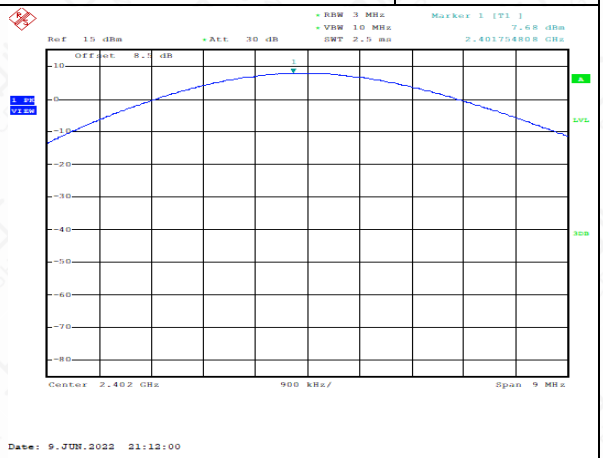
Note: Bold font is the maximum Value

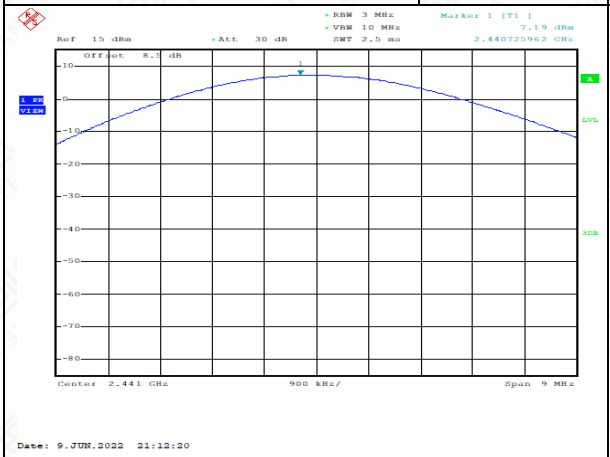
Peak Conducted Output Power GFSK, CH0 (dBm)	5.45
Peak Conducted Output Power GFSK, CH39 (dBm)	7.14
Peak Conducted Output Power GFSK, CH78 (dBm)	6.17
Peak Conducted Output Power π/4 DQPSK, CH0 (dBm)	7.68
Peak Conducted Output Power π/4 DQPSK, CH39 (dBm)	7.19
Peak Conducted Output Power π/4 DQPSK, CH78 (dBm)	8.50

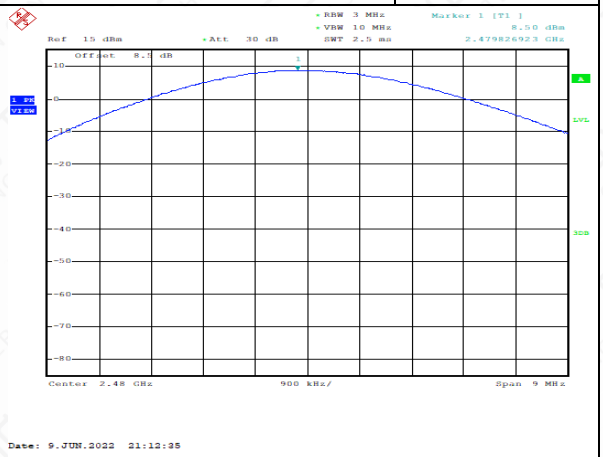


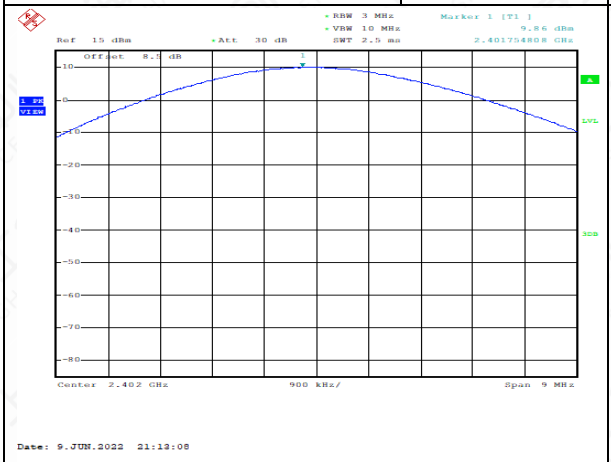
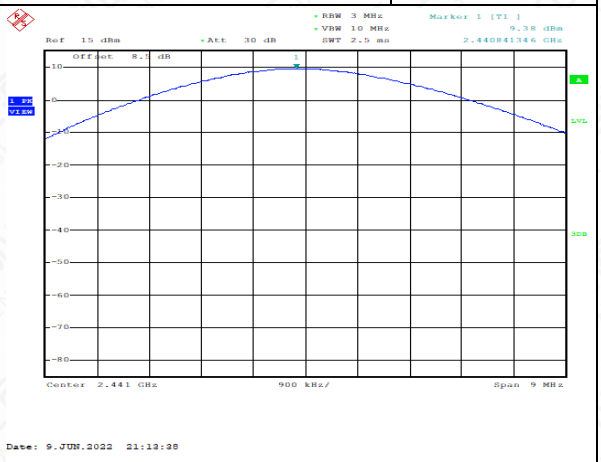
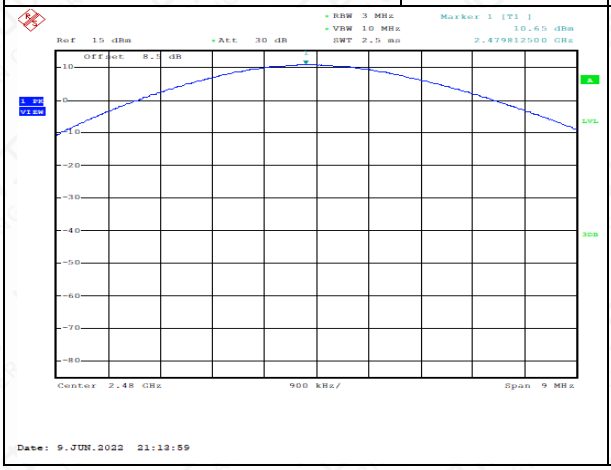










Peak Conducted Output Power 8DPSK, CH0 (dBm)	9.86	Peak Conducted Output Power 8DPSK, CH39 (dBm)	9.38
			
Peak Conducted Output Power 8DPSK, CH78 (dBm)	10.65	/	/
		/	

Modulation type	Channel	EIRP
GFSK DH5	Ch 0	7.03
	Ch 19	8.72
	Ch 39	7.75
π /4 DQPSK	Ch 0	9.26
	Ch 19	8.77
	Ch 39	10.08
8DPSK	Ch 0	11.44
	Ch 19	10.96
	Ch 39	12.23

Note: Test of default power settings for EUT devices.

Using the ADB platform software set by default by the customer.

6.2 Frequency Band Edges-Conducted

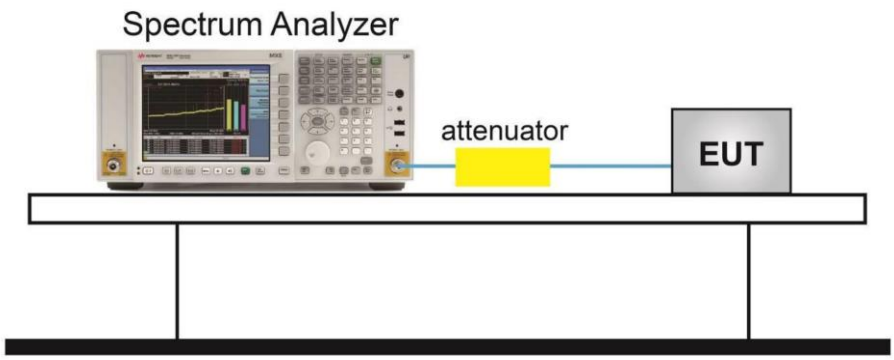
6.2.1 Measurement Limit

Standard	Limit(dBc)
FCC 47 CFR Part 15.247(d)	>20
RSS-247 5.5	>20

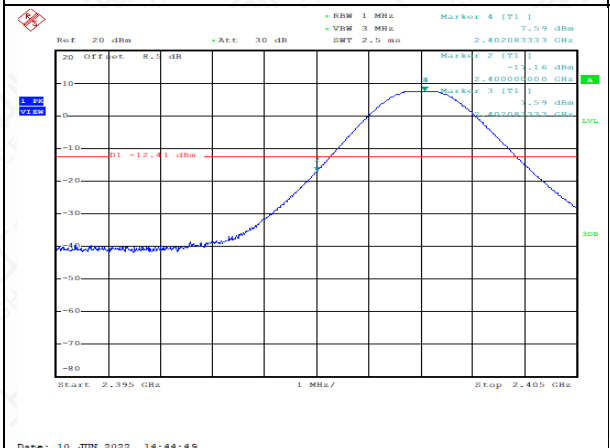
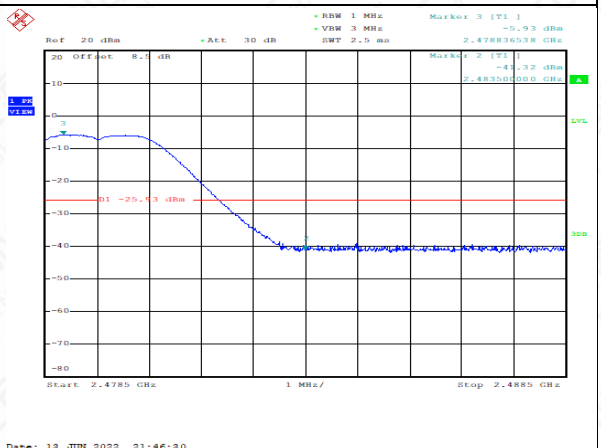
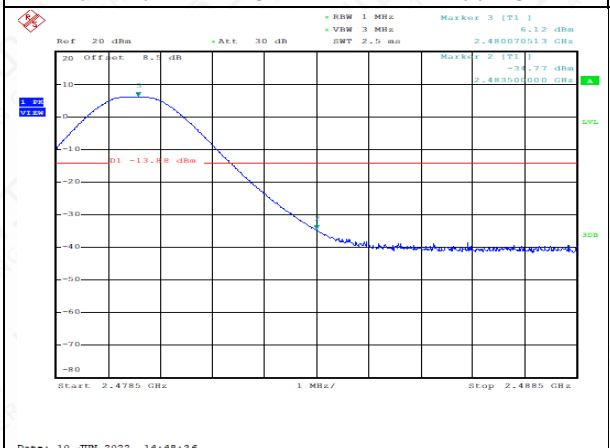
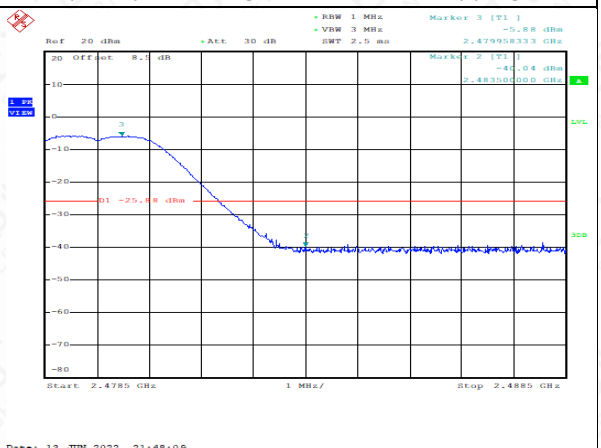
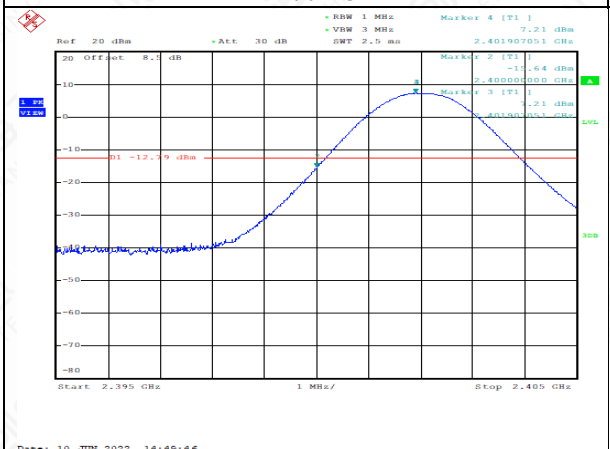
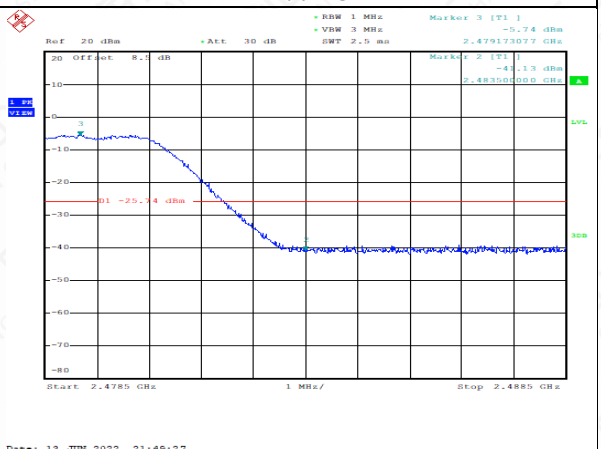
6.2.2 Test procedures

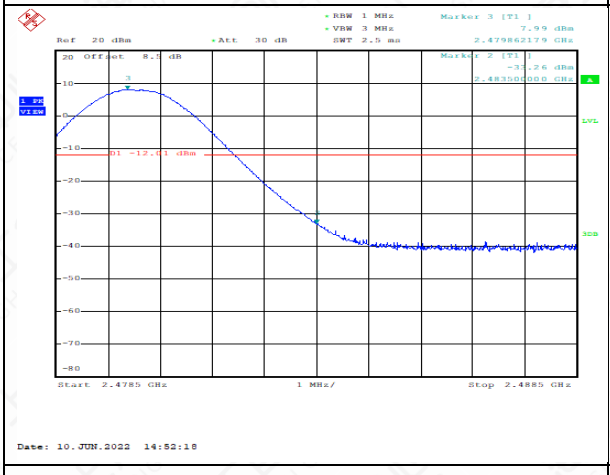
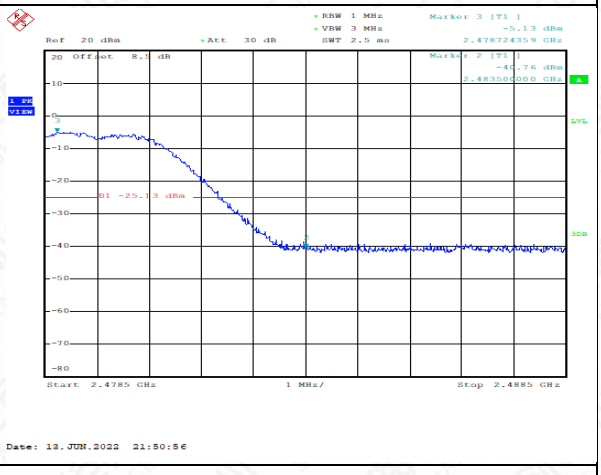
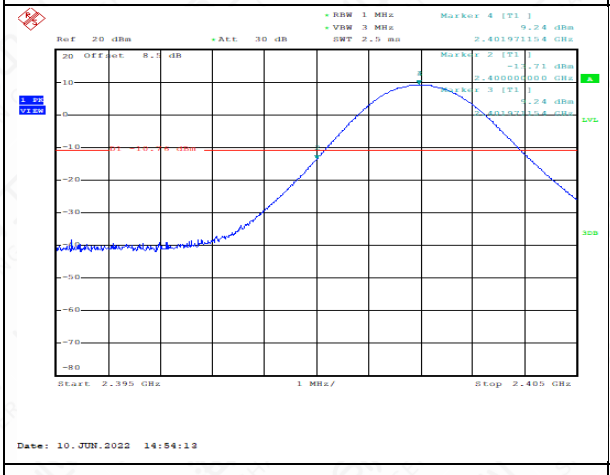
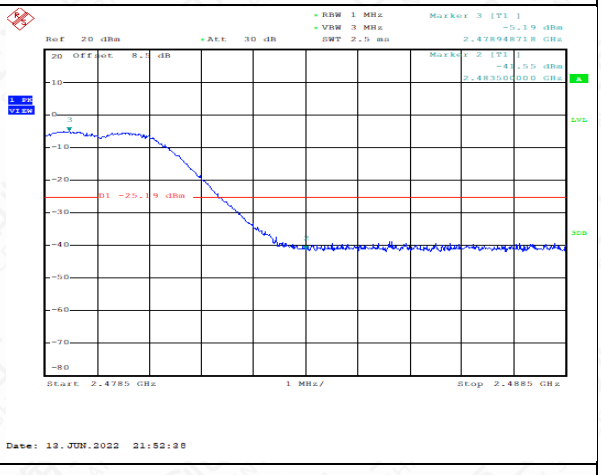
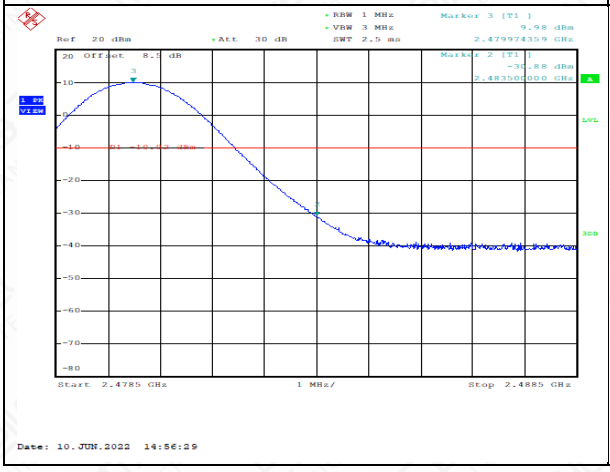
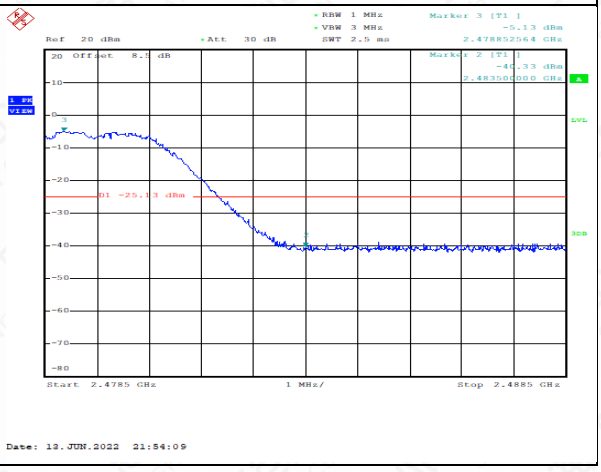
The measurement is according to ANSI C63.10 clause 7.8.6.

1. Connect the EUT to spectrum analyzer.
2. Set RBW=100KHz, VBW=300KHz, span more than 1.5 times channel bandwidth (2MHz).
3. Detector =peak, sweep time=auto couple, trace mode=max hold.Allow sweep to continue until the trace stabilizes.
4. Test setup



Measurement Result

Frequency Band Edge: GFSK, Ch0, Hopping OFF	Frequency Band Edge: GFSK, Ch0, Hopping ON
	
Frequency Band Edge: GFSK,Ch78, Hopping OFF	Frequency Band Edge: GFSK, Ch78, Hopping ON
	
Frequency Band Edge: π/4 DQPSK, Ch0, Hopping OFF	Frequency Band Edge: π/4 DQPSK, Ch0, Hopping ON
	

Frequency Band Edge: π/4 DQPSK, Ch78, Hopping OFF	Frequency Band Edge: π/4 DQPSK, Ch78, Hopping ON
	
Frequency Band Edge: 8DPSK,Ch0, Hopping OFF	Frequency Band Edge: 8DPSK, Ch0, Hopping ON
	
Frequency Band Edge:8DPSK, Ch78, Hopping OFF	Frequency Band Edge: 8DPSK, Ch78, Hopping ON
	

6.3 Conducted Emission

6.3.1 Measurement Limt

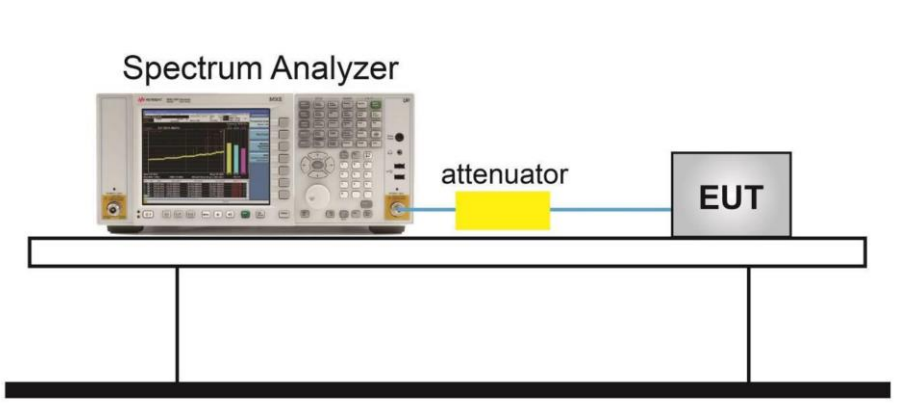
Standard	Limit
FCC 47 CFR Part15.247 (d)	20dB below peak output power in 100KHz bandwidth
RSS-247 5.5	20dB below peak output power in 100KHz bandwidth

6.3.2 Test procedures

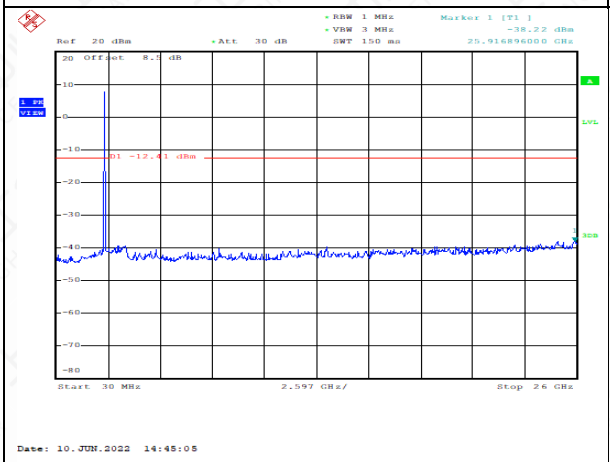
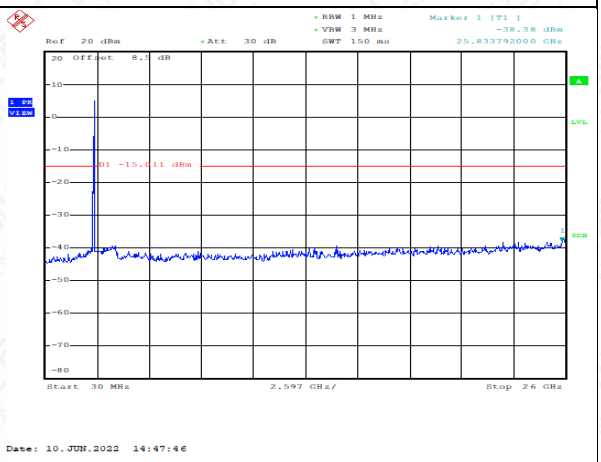
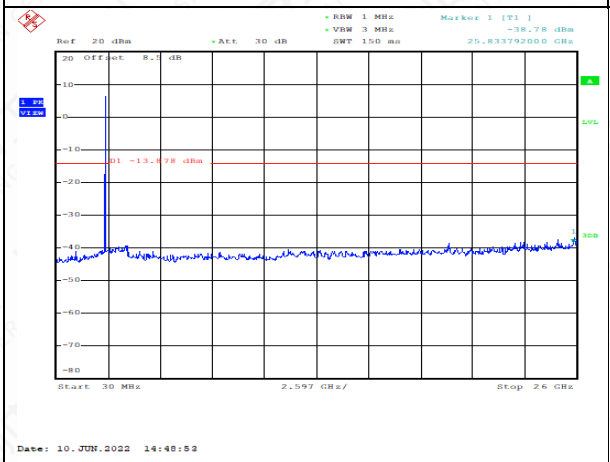
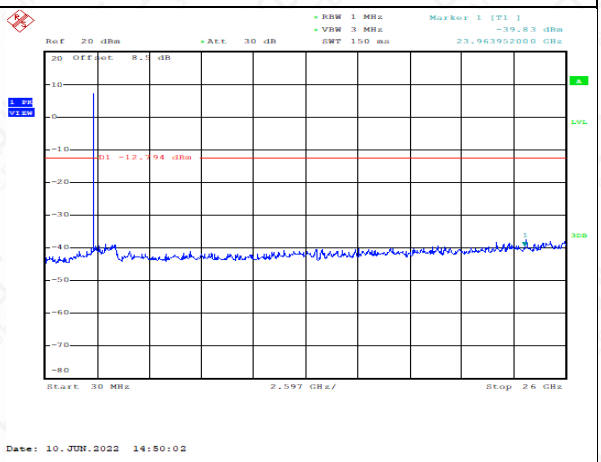
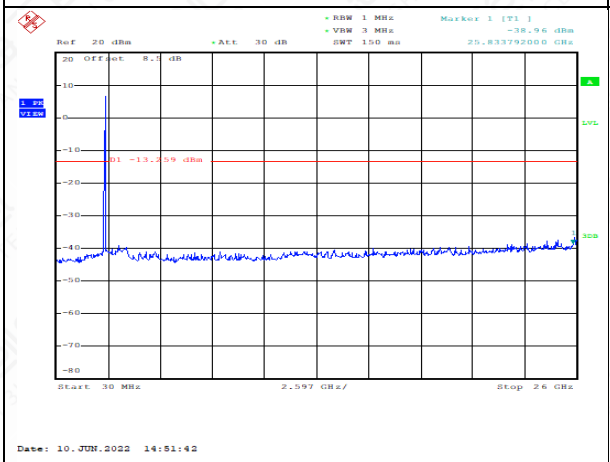
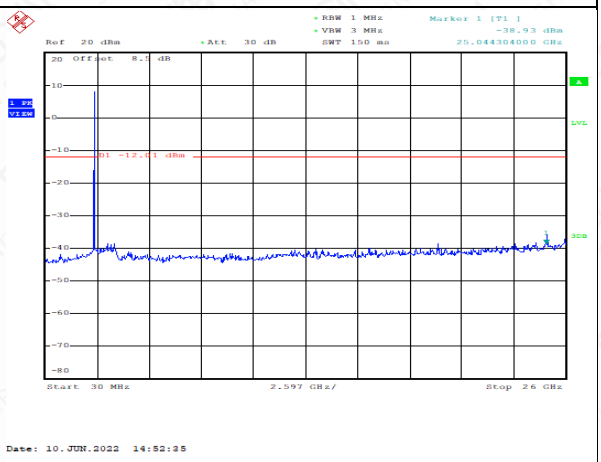
The measurement is according to ANSI C63.10 clause 7.8.8.

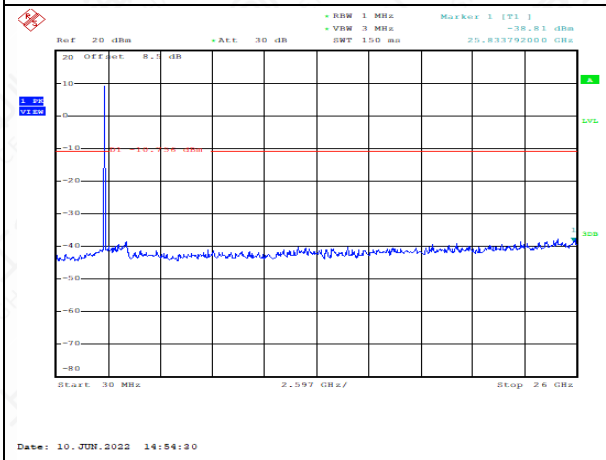
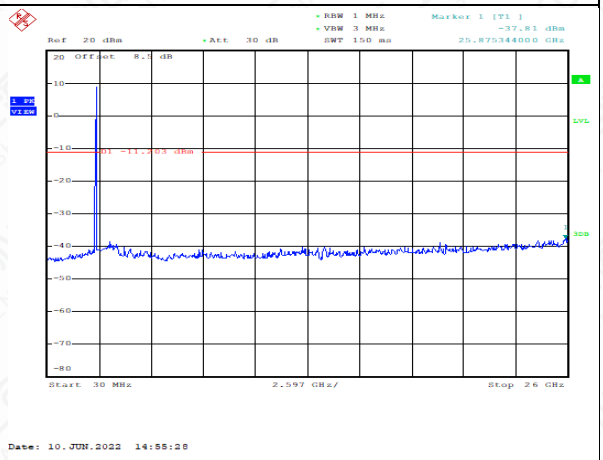
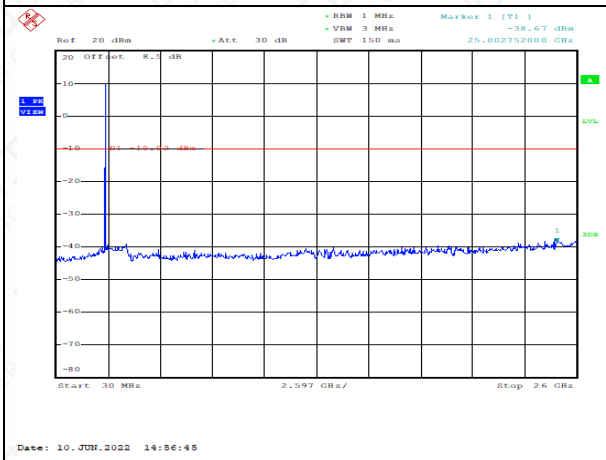
1. Connect the EUT to spectrum analyzer.
2. Set RBW=100KHz, VBW=300KHz.
3. Detector =peak, sweep time=auto couple, trace mode=max hold

6.3.3 Test Setup



Measurement Results

Conducted spurious emission: GFSK, Ch0, 30MHz~26GHz	Conducted spurious emission: GFSK, Ch39, 30MHz~26GHz
	
Conducted spurious emission: GFSK, Ch78, 30MHz~26GHz	Conducted spurious emission: π/4 DQPSK, Ch0, 30MHz~26GHz
	
Conducted spurious emission: π/4 DQPSK, Ch39, 30MHz~26GHz	Conducted spurious emission: π/4 DQPSK, Ch78, 30MHz~26GHz
	

Conducted spurious emission: 8DPSK, Ch0, 30MHz~26GHz	Conducted spurious emission: 8DPSK, Ch39, 30MHz~26GHz
	
Conducted spurious emission: 8DPSK, Ch78, 30MHz~26GHz	/
	/

6.4 Radiated Emission

6.4.1 Measurement Limit

Standard	Limit
FCC 47 CFR Part 15.247, 15.205, 15.209	20dB below peak output power
RSS-Gen 8.9,8.10	20dB below peak output power

In addition, radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see 15.205(c)).

Limit in restricted band

Frequency of emission (MHz)	Field strength (uV/m)	Field strength (dBuV/m)
30~88	100	40
88~216	150	43.5
216~960	200	46
Above 960	500	54

6.4.2 Test Method

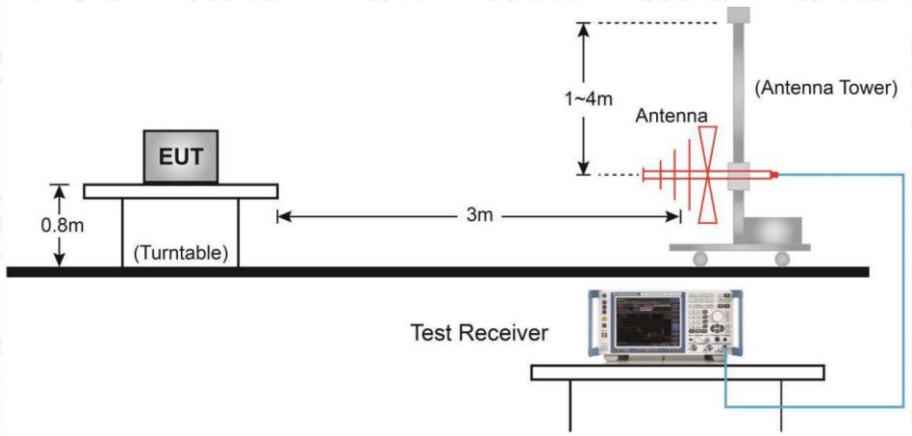
Portable, small, lightweight, or modular devices that may be handheld, worn on the body, or placed on a table during operation shall be positioned on a non-conducting platform, the top of which is 80 cm above the reference ground plane. The preferred area occupied by the EUT arrangement is 1 m by 1.5 m, For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. but it may be larger or smaller to accommodate various sized EUTs. For testing purposes, ceiling- and wall-mounted devices also shall be positioned on a tabletop (see also ANSI C63.10-2013 section 6.3.4 and 6.3.5). In making any tests involving handheld, body-worn, or ceiling-mounted equipment, it is essential to recognize that the measured levels may be dependent on the orientation (attitude) of the three orthogonal axes of the EUT. Thus, exploratory tests as specified in 8.3.1 shall be carried out for various axes orientations to determine the attitude having maximum or near-maximum emission level.

The EUT was placed on a non-conductive table. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and the EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. This maximization process was repeated with the EUT positioned in each of its three orthogonal orientations.

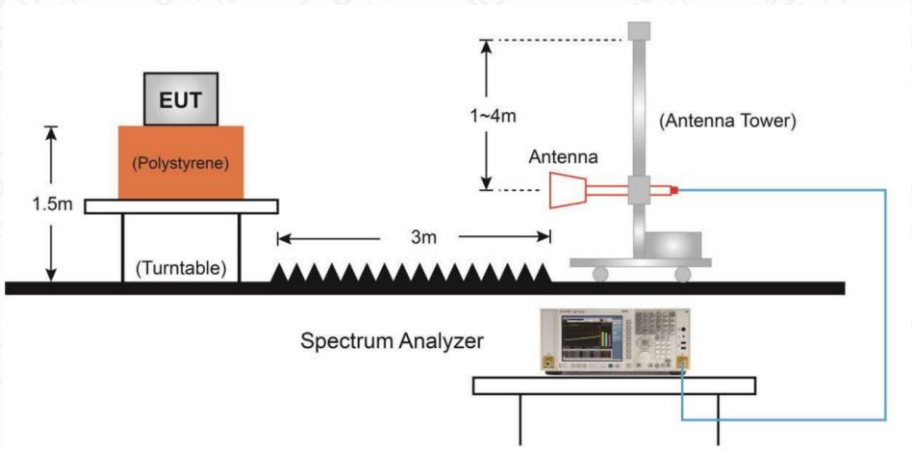
Frequency of emission	RBW/VBW	Sweep Time (s)
30~1000	100KHz/300KHz	5
1000~4000	1MHz/3MHz	15
4000~18000	1MHz/3MHz	40
18000~26500	1MHz/3MHz	20

6.4.3 Test Setup

Below 1GHz Test Setup



Above 1GHz Test Setup



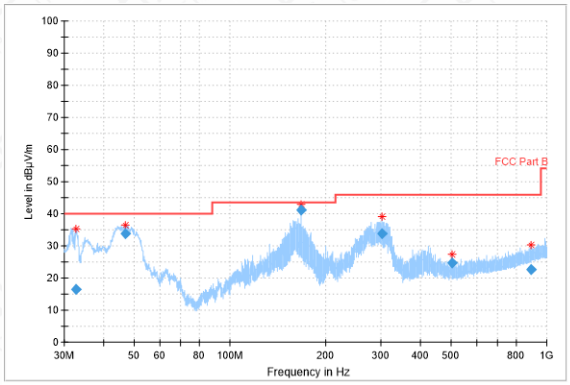
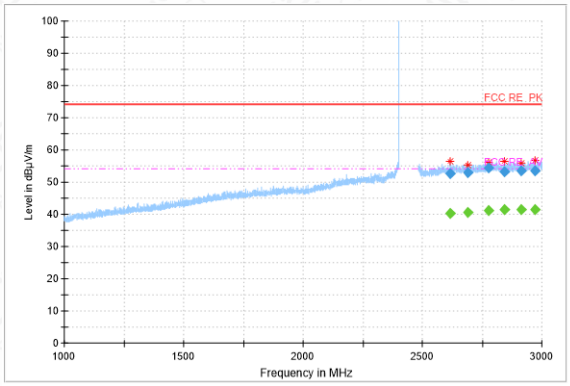
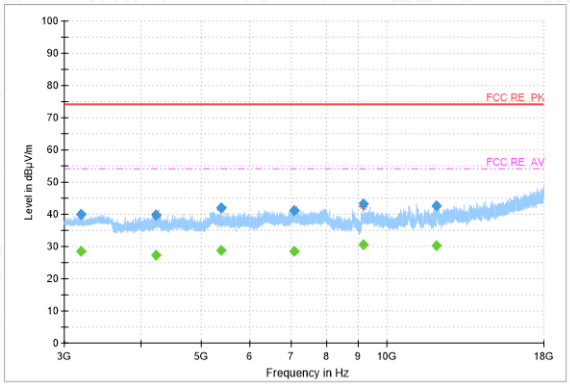
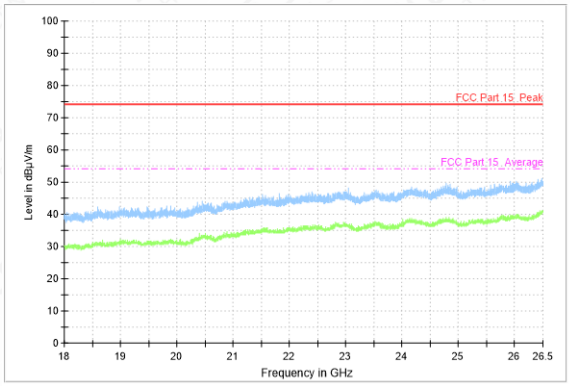
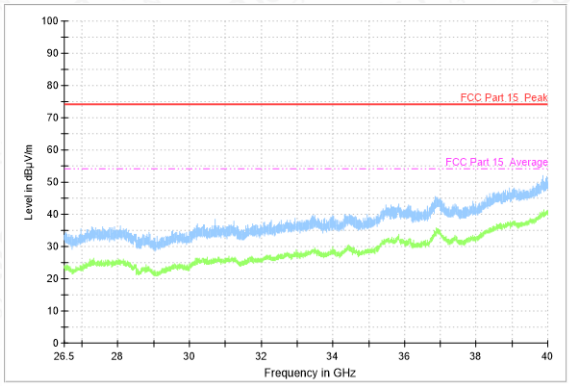
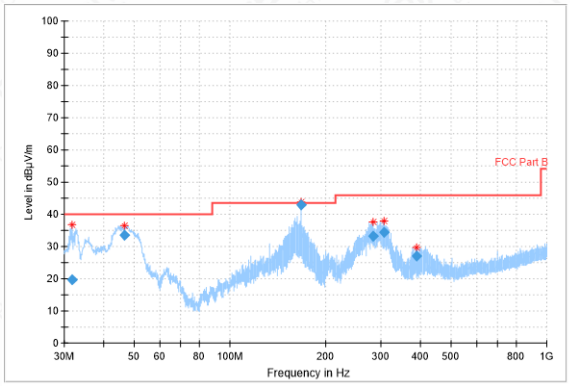
Measurement Results

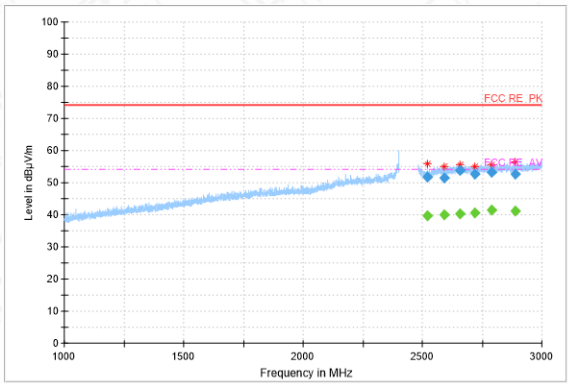
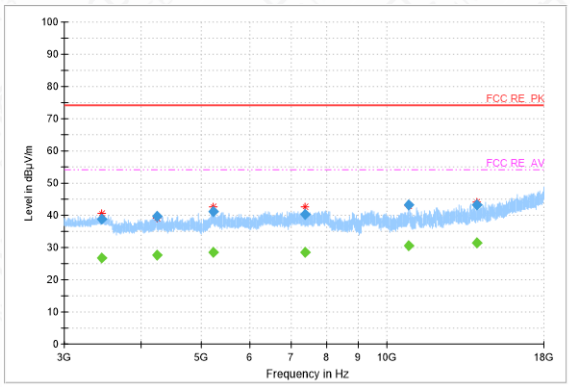
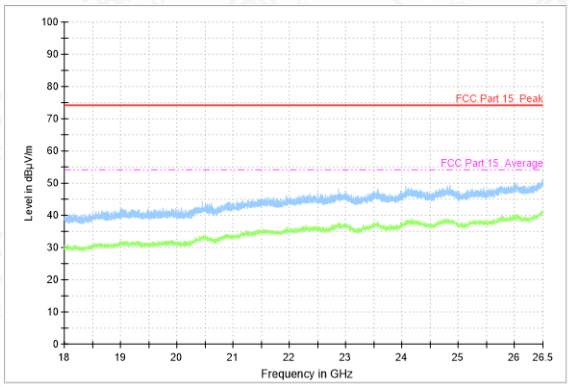
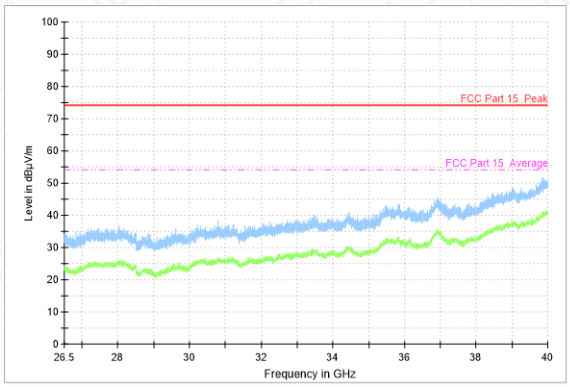
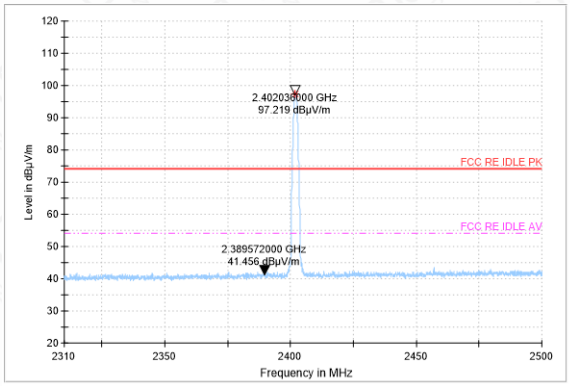
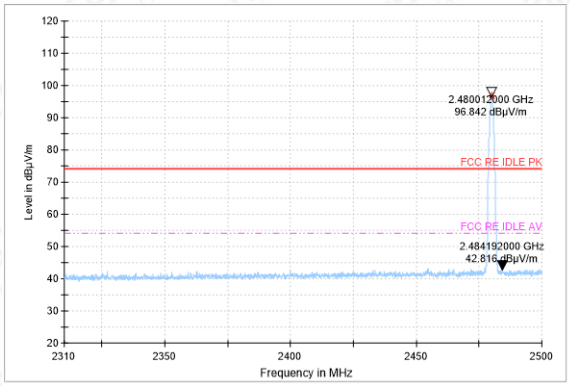
A “reference path loss” is established and ARpi is the attenuation of “reference path loss”, and including the gain of receive antenna, the gain of the preamplifier, the cable loss.

The measurement results are obtained as described below:

A_{Rpi} = Cable loss + Antenna Factor-Preamplifier gain

Result=P_{Mea} + A_{Rpi}

Radiated emission: 8DPSK, Ch0, 30MHz~1GHz	Radiated emission: 8DPSK, Ch0, 1GHz~3GHz
	
Radiated emission: 8DPSK, Ch0, 3GHz~18GHz	**Radiated emission: 8DPSK, Ch0, 18GHz~26.5GHz**
	
Radiated emission: 8DPSK, Ch0, 26.5GHz~40GHz	**Radiated emission: 8DPSK, Ch78, 30MHz~1GHz**
	

Radiated emission: 8DPSK, Ch78, 1GHz~3GHz	Radiated emission: 8DPSK, Ch78, 3GHz~18GHz
	
Radiated emission: 8DPSK, Ch78, 18GHz~26.5GHz	**Radiated emission: 8DPSK, Ch78, 26.5GHz~40GHz**
	
Bandedge (Low): 8DPSK, low channel	**Bandedge (High): 8DPSK, high channel**
	

8DPSK Ch0 30M-1G

Frequency (MHz)	Result (dBµV/m)	ARpl (dB)	PMea (dBµV/m)	Polarity
32.6	16.55	-14.2	30.75	H
46.9	33.74	-12.2	45.94	V
168.0	41.29	-15.3	56.59	H
302.7	33.83	-10.8	44.63	H

504.0	24.62	-6.2	30.82	V
890.5	22.68	-0.2	22.88	H

8DPSK Ch0 1G-3G

Frequency (MHz)	Result (dBµV/m)	ARpl (dB)	PMea (dBµV/m)	Polarity
2616.6	52.74	15.6	37.14	H
2690.1	52.98	15.9	37.08	V
2778.1	54.34	16.4	37.94	H
2843.3	53.27	16.6	36.67	V
2912.0	53.39	16.8	36.59	H
2969.6	53.52	17	36.52	H
2616.6	52.74	15.6	37.14	H

8DPSK Ch0 1G-3G (Average)

Frequency (MHz)	Result (dBµV/m)	ARpl (dB)	PMea (dBµV/m)	Polarity
2778.1	41.21	16.4	24.81	H

8DPSK Ch0 3G-18G

Frequency (MHz)	Result (dBµV/m)	ARpl (dB)	PMea (dBµV/m)	Polarity
3192.1	40.08	-7.5	47.58	V
4230.3	39.57	-5.5	45.07	H
5383.9	42.16	-3.3	45.46	H
7089.8	41.03	-2.3	43.33	H
9183.1	43.14	-0.3	43.44	H
12057.0	42.64	2	40.64	H

8DPSK Ch78 30M-1G

Frequency (MHz)	Result (dBµV/m)	ARpl (dB)	PMea (dBµV/m)	Polarity
31.8	19.74	-14.3	34.04	V
46.4	33.64	-12.2	45.84	V
168.0	42.82	-15.3	58.12	H
283.5	33.36	-10.9	44.26	H
307.1	34.44	-10.6	45.04	H
389.1	27.04	-8.4	35.44	H

8DPSK Ch78 1G-3G

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
2520.4	51.69	14.6	37.09	V
2591.4	51.55	15.4	36.15	V
2657.1	53.88	15.9	37.98	H
2717.1	52.65	16	36.65	H
2790.8	53.09	16.5	36.59	V
2889.3	52.68	16.7	35.98	H

8DPSK Ch78 3G-18G

Frequency (MHz)	Result (dBμV/m)	ARpl (dB)	PMea (dBμV/m)	Polarity
3445.6	38.82	-6.7	45.52	V
4248.0	39.68	-5.4	45.08	H
5232.8	41.13	-1.4	42.53	V
7363.0	40.38	-2.2	42.58	H
10859.8	43.25	1.1	42.15	H
14001.2	43.32	4.7	38.62	H

Note: We test all modes of the EUT, select the worst case in the report, the EUT N06 is the worst case.

6.5 Time Of Occupancy (Dwell Time)

6.5.1 Measurement Limit

Standard	Limit(ms)
FCC 47 Part 15.247 (a) (1) (iii)	<400
RSS-247 5.5	<400

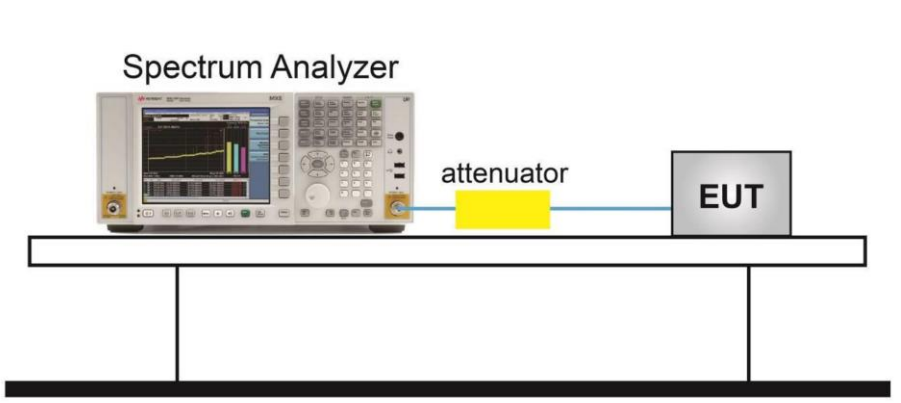
6.5.2 Test procedures

The measurement is according to ANSI C63.10 clause 7.8.4

1. Connect the EUT through cable and divide with CMW270 and spectrum analyzer.
2. Enable the EUT transmit maximum power.
3. Set the spectrum analyzer as step 4 to step 8.
4. Span: Zero span, centered on a hopping channel.
5. RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
6. Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to showtwo successive hops on a channel.
7. Detector function: Peak.
8. Trace: Max hold.
9. Use the marker-delta function, and record it.

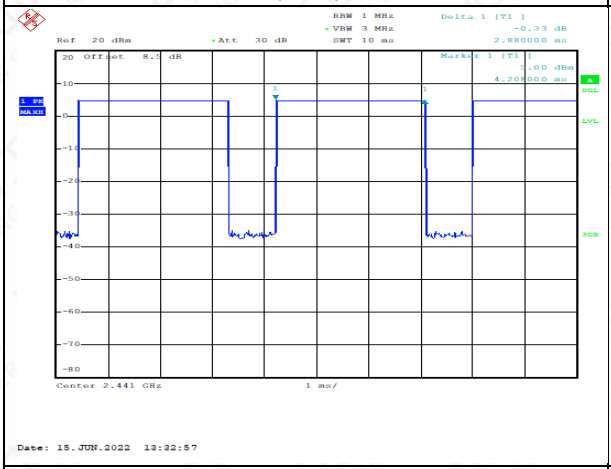
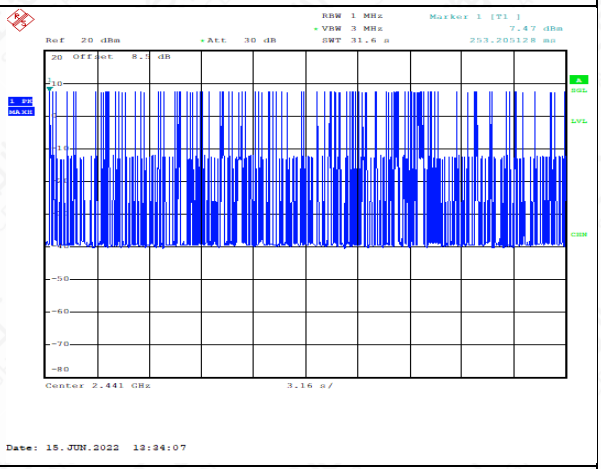
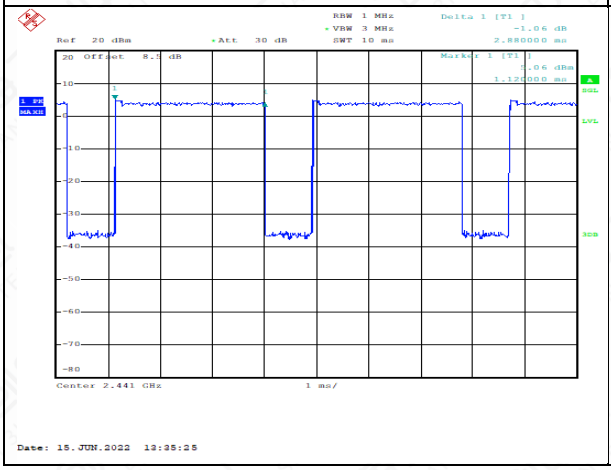
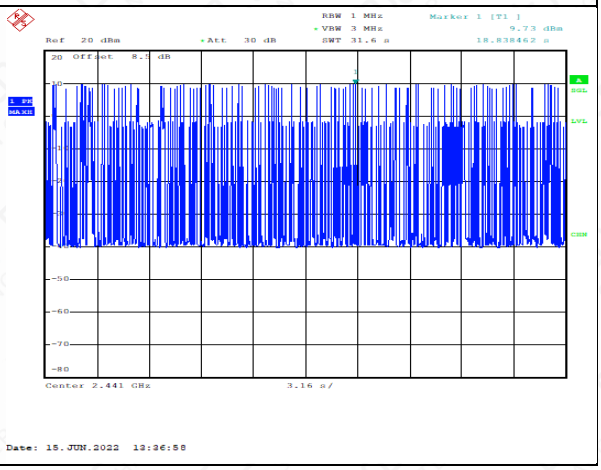
Note： For AFH mode, Test Period = 0.4 (second/ channel) x 20 Channel = 8 sec,
For FHSS mode, Test Period = 0.4 (second/ channel) x 79 Channel = 31.6 sec,
So the Time of Occupancy (Dwell Time) of AFH mode= Time of Occupancy (Dwell Time) of FHSS mode / 79 Channel x 20 Channel.

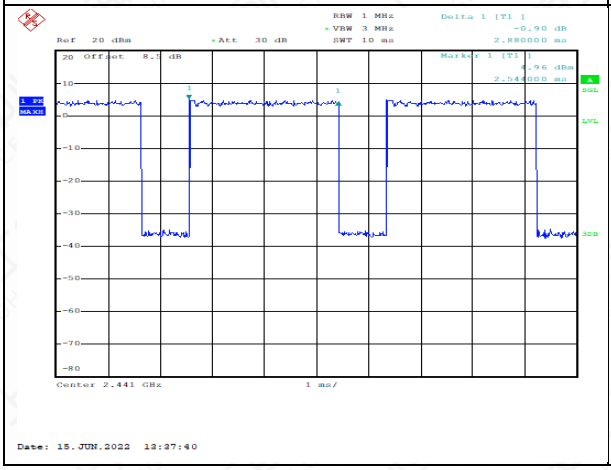
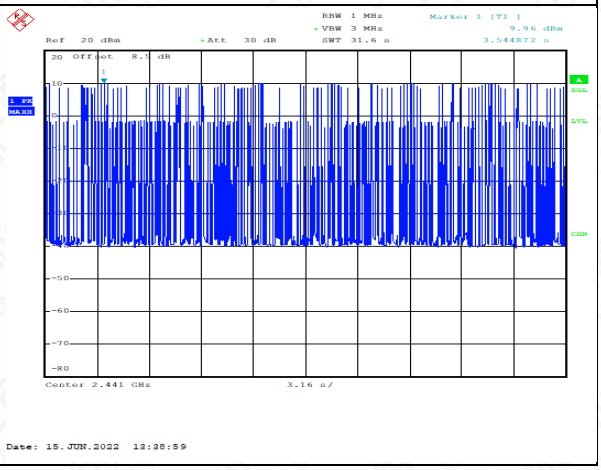
6.5.3 Test Setup



Modulation type	Frequency (MHz)	Time slot length (ms)	Hop Number	Dwell Time (ms)	Limit (ms)	Conclusion
GFSK DH5	2402-2480	2.88	89	264.96	400	P
π/4 DQPSK 2DH5	2402-2480	2.88	65	276.48	400	P
8DPSK 3DH5	2402-2480	2.88	69	276.48	400	P
Note: Dwell time = time slot length * hop rate						

Measurement Result

For GFSK, Ch39,Packet DH5 Time of occupancy (Dwell Time)	For GFSK, Ch39,Packet DH5 Number of Transmissions Measurement
	
For π/4 DQPSK, Ch39,Packet 2DH5 Time of occupancy (Dwell Time)	For π/4 DQPSK, Ch39,Packet 2DH5 Number of Transmissions Measurement
	

For 8DPSK, Ch39,Packet 3DH5 Time of occupancy (Dwell Time)	For 8DPSK, Ch39,Packet 3DH5 Number of Transmissions Measurement
	

6.6 20dB Bandwidth

6.6.1 Measurement Limit

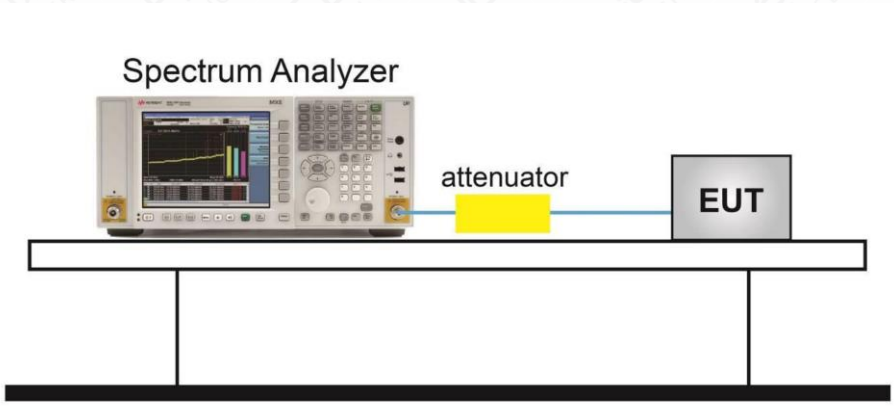
Standard	Limit
FCC 47 Part 15.247(d)	20dB below peak output power in 100KHz bandwidth
RSS-247 5.5	20dB below peak output power in 100KHz bandwidth

6.6.2 Test procedures

The measurement is according to ANSI C63.10 clause 7.8.7

1. Connect the EUT through cable and divide with CMW270 and spectrum analyzer.
2. Enable the EUT transmit maximum power.
3. Set the spectrum analyzer as step 4 to step 7.
4. Span: two or five times of OBW
5. RBW= 1% to 5% of the OBW; VBW is approximately three times of RBW; Max Hold.
6. Select the max peak, and N DB DOWN=20dB.
7. Record the results.

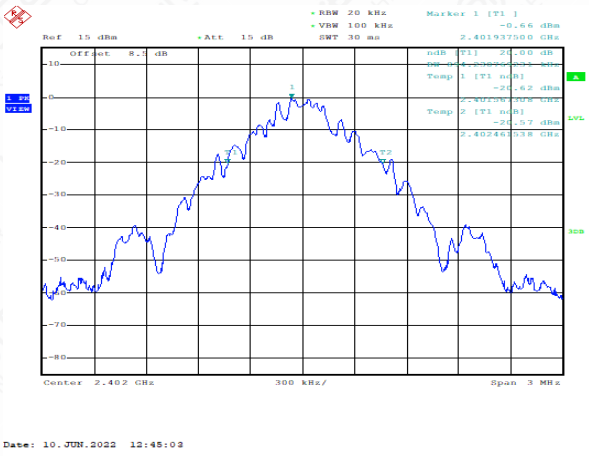
6.6.3 Test Setup



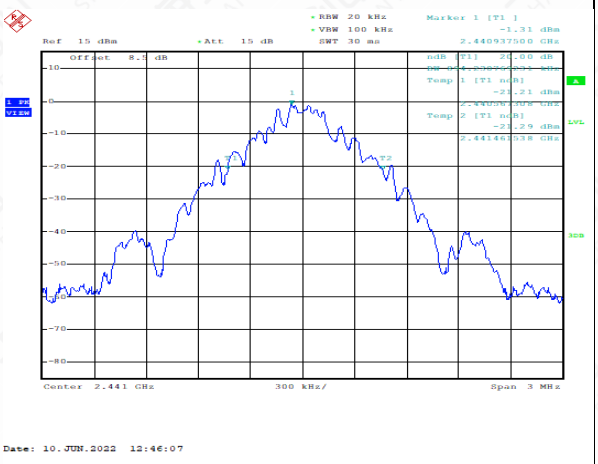
Measurement Result

Modulation type	Frequency (MHz)	20dB Bandwidth (MHz)
GFSK DH5	2402	0.894
	2441	0.894
	2480	0.894
π/4 DQPSK 2DH5	2402	1.322
	2441	1.317
	2480	1.322
8DPSK 3DH5	2402	1.284
	2441	1.279
	2480	1.279

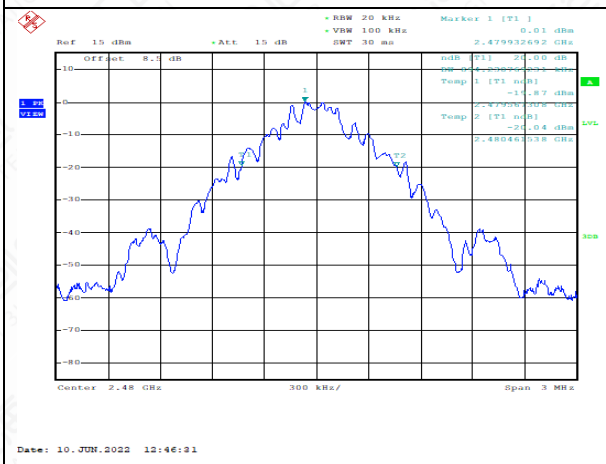
20dB Bandwidth: GFSK, Ch0



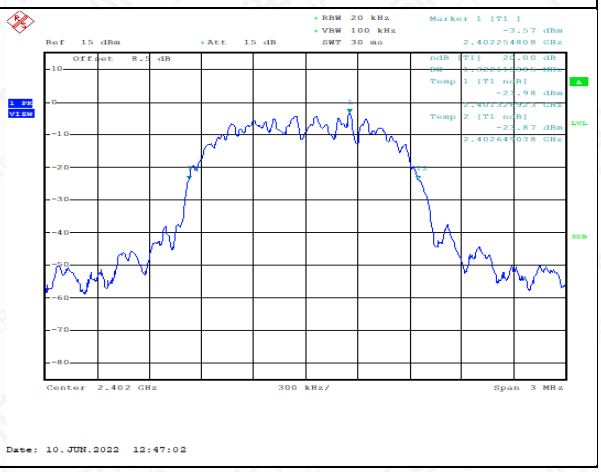
20dB Bandwidth: GFSK, Ch39

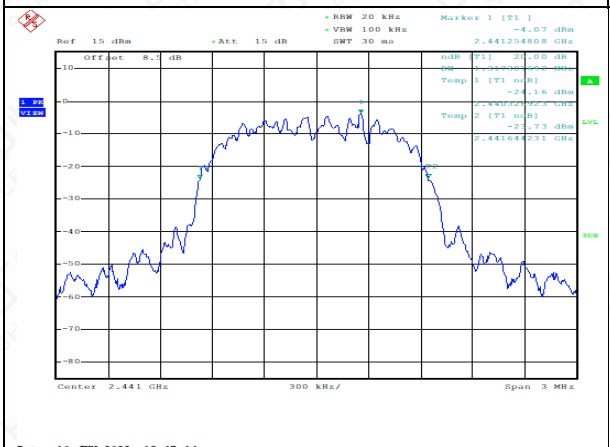
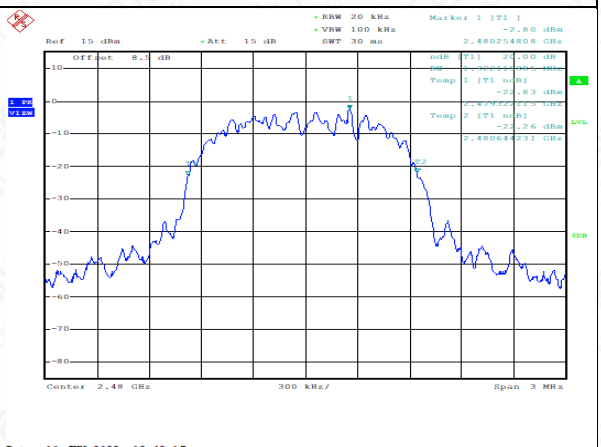
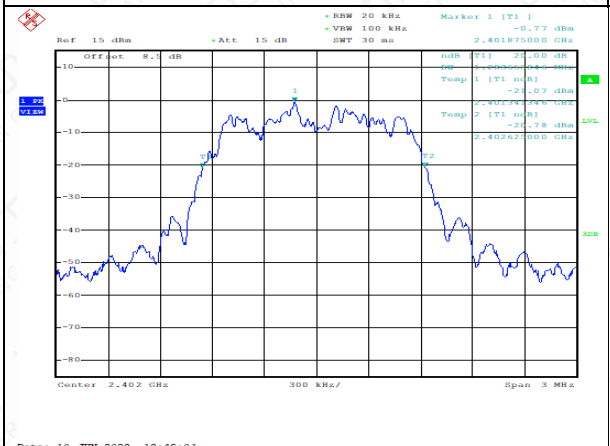
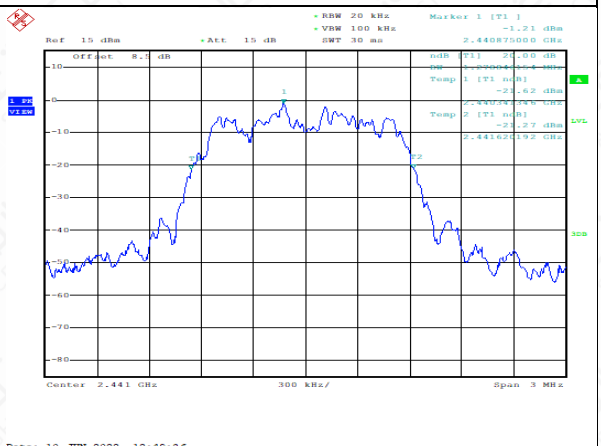
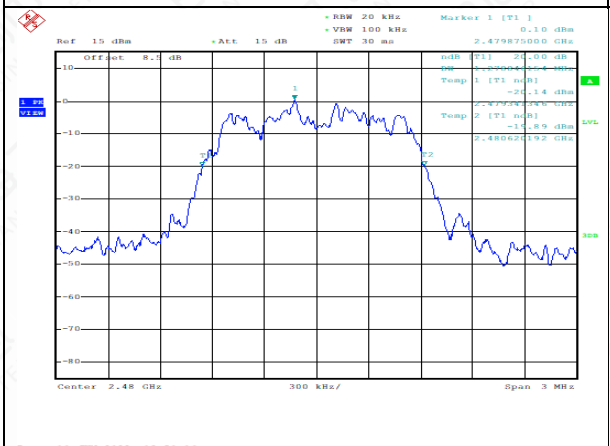


20dB Bandwidth: GFSK, Ch78



20dB Bandwidth: π/4 DQPSK, Ch0



20dB Bandwidth: π/4 DQPSK, Ch39	20dB Bandwidth: π/4 DQPSK, Ch78
	
20dB Bandwidth: 8DPSK, Ch0	20dB Bandwidth: 8DPSK, Ch39
	
20dB Bandwidth: 8DPSK, Ch78	/
	/

6.7 99% Occupied Bandwidth

6.7.1 Measurement Limit

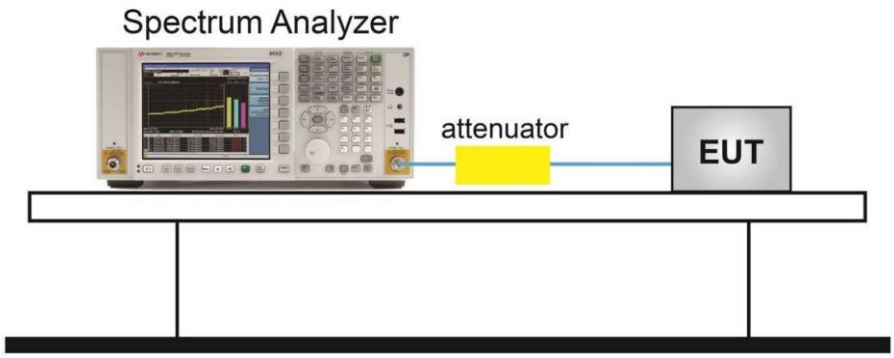
Standard	Limit
15.247(a)	N/A
RSS-Gen 6.7	N/A

6.7.2 Test procedures

The measurement is according to ANSI C63.10 clause 6.9.3.

1. The output power of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Enable EUT transmitter maximum power continuously.
3. Set RBW shall be in the range of 1% to 5% of the OBW.
4. Set the VBW ≥ [3 × RBW].
5. Detector = peak.
6. Trace mode = max hold.
7. Sweep = auto couple.
8. Allow the trace to stabilize.
9. The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

6.7.3 Test setup

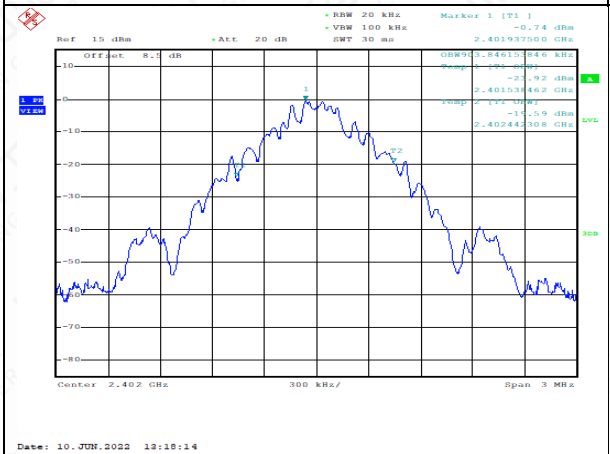
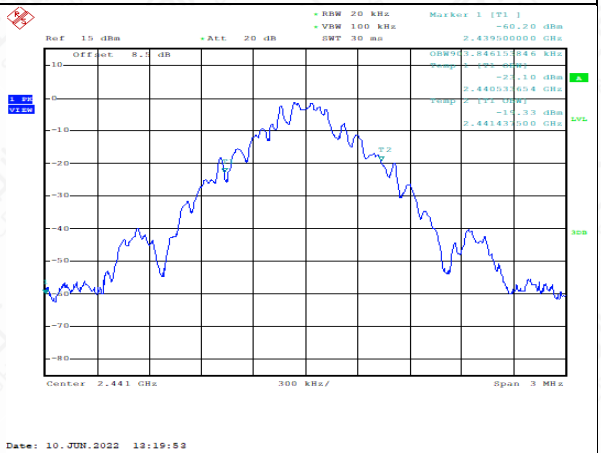
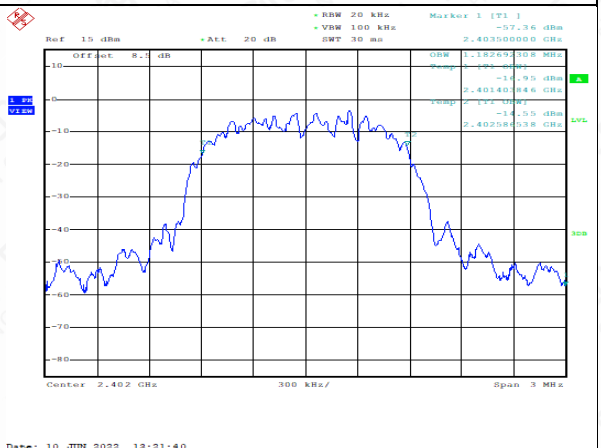


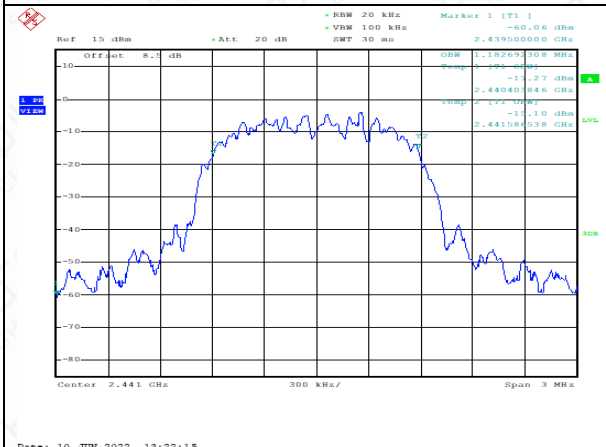
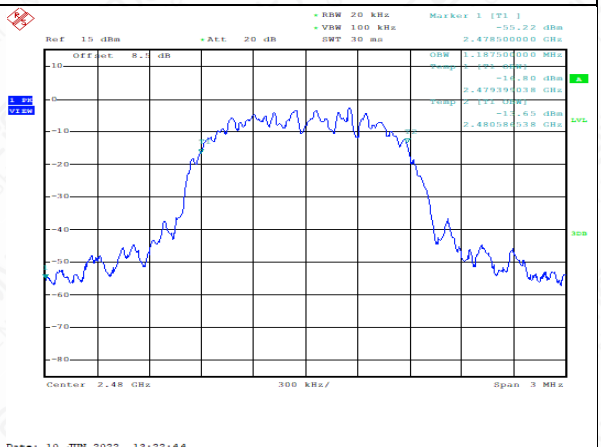
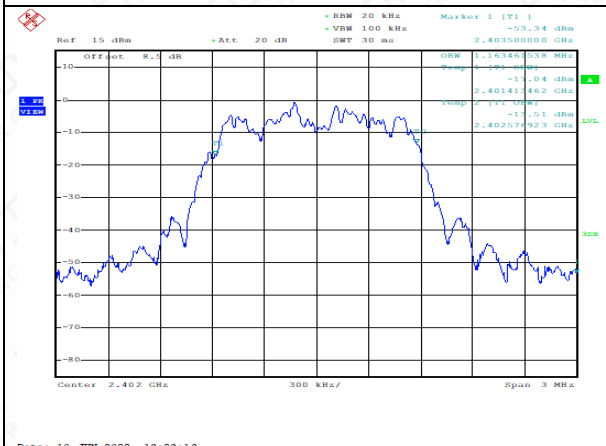
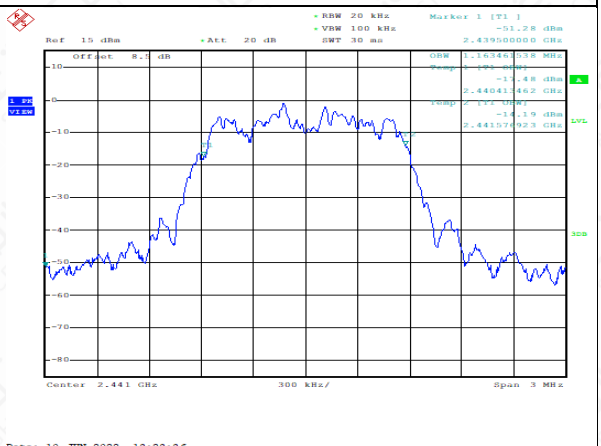
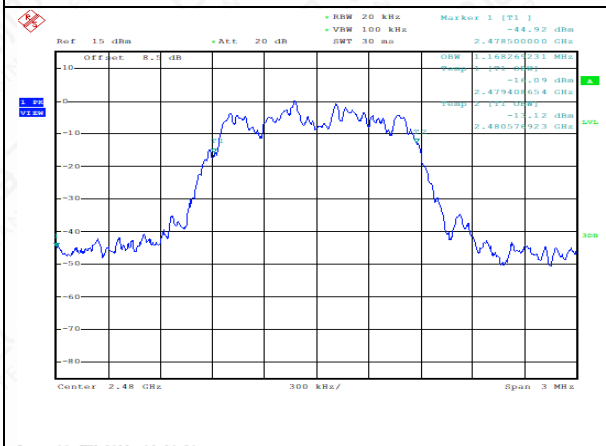
Measurement Result

Modulation type	Channel	99% Bandwidth (MHz)
GFSK DH5	2402	0.904

	2441	0.904
	2480	0.904
π/4 DQPSK 2DH5	2402	1.183
	2441	1.183
	2480	1.188
8DPSK 3DH5	2402	1.163
	2441	1.163
	2480	1.168

Test graphs as below

99% Bandwidth: GFSK, Ch0	99% Bandwidth: GFSK, Ch39
	
99% Bandwidth: GFSK, Ch78	99% Bandwidth: DQPSK, Ch0
	

99% Bandwidth: DQPSK, Ch39	99% Bandwidth: DQPSK, Ch78
	
99% Bandwidth: 8DPSK, Ch0	99% Bandwidth: 8DPSK, Ch39
	
99% Bandwidth: 8DPSK, Ch78	/
	/

6.8 Carrier Frequency Separation

6.8.1 Measurement Limit

Standard	Limit(KHz)
FCC 47 Part 15.247 (a) (1)	Over 25KHz or (2/3)*20dB bandwidth
RSS-247 5.1	Over 25KHz or (2/3)*20dB bandwidth

6.8.2 Test procedures

The measurement is according to ANSI C63.10 clause 11.13.2

1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.

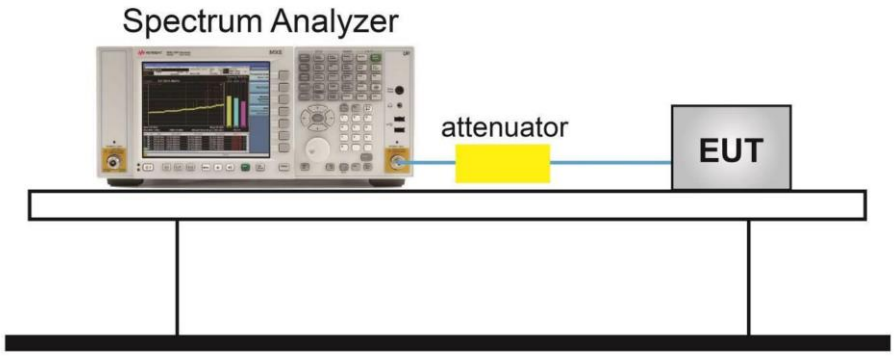
2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

3) Attenuation: Auto (at least 10 dB preferred).

4) Sweep time: Coupled.

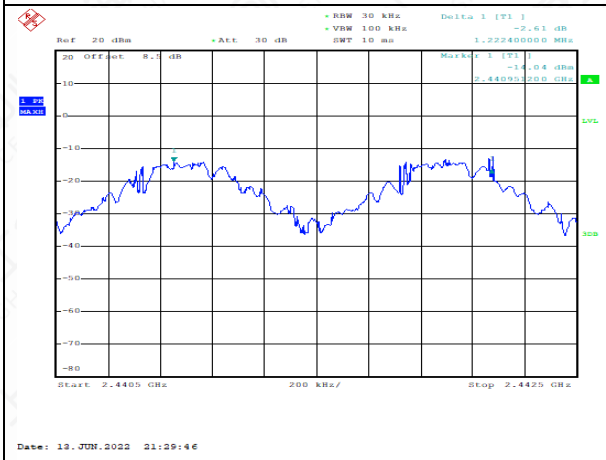
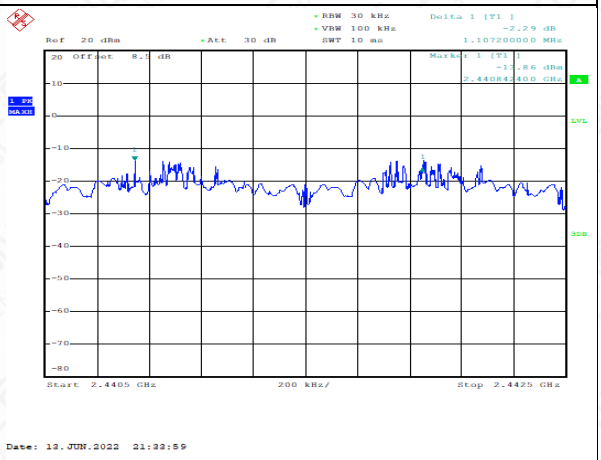
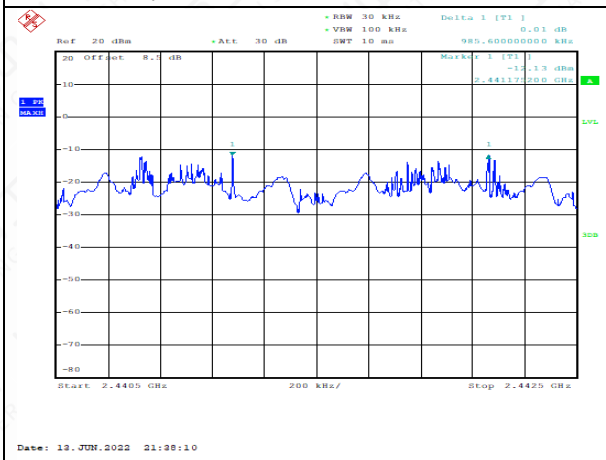
5) Resolution bandwidth: 100 kHz.6) Video bandwidth: 300 kHz.7) Detector: Peak.8) Trace: Max hold.

6.8.3 Test Setup



Measurement Result

Modulation type	Frequency (MHz)	Carrier separation measurement (KHz)
GFSK DH5	2441	1222.4
π/4 DQPSK 2DH5	2441	1107.2
8DPSK 3DH5	2441	985.6

Carrier separation measurement: GFSK, Ch39	Carrier separation measurement: π/4 DQPSK, Ch39
	
Carrier separation measurement: 8DPSK, Ch39	/
	/

6.9 Number Of Hopping Channels

6.9.1 Measurement Limit

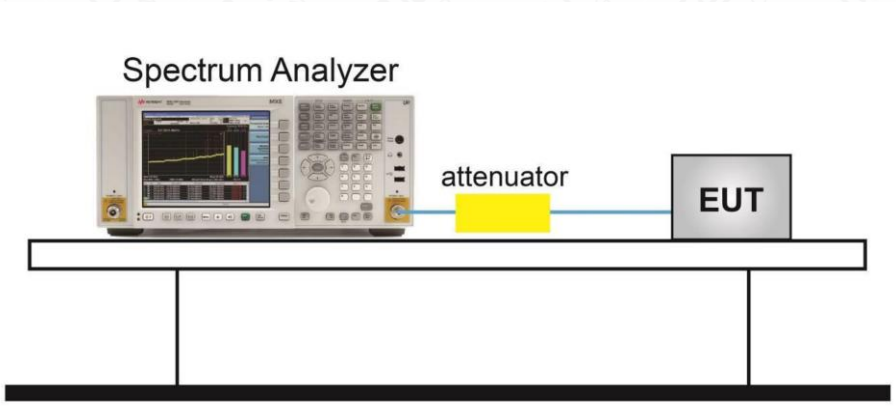
Standard	Limit
FCC 47 CFR Part 15.247 (a)(1)(iii)	At least 15 non-overlapping channels
RSS-247 5.1	At least 15 non-overlapping channels

6.9.2 Test procedure

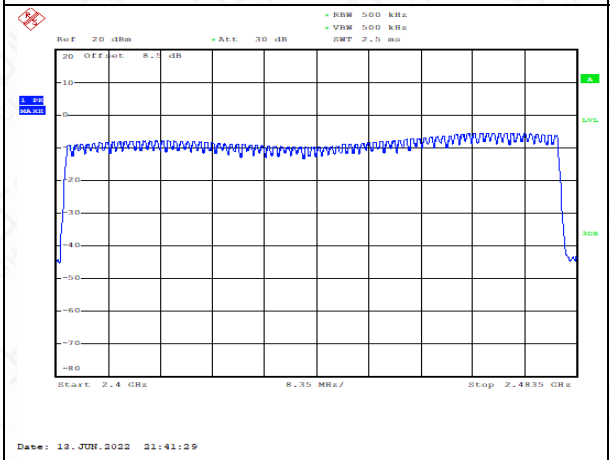
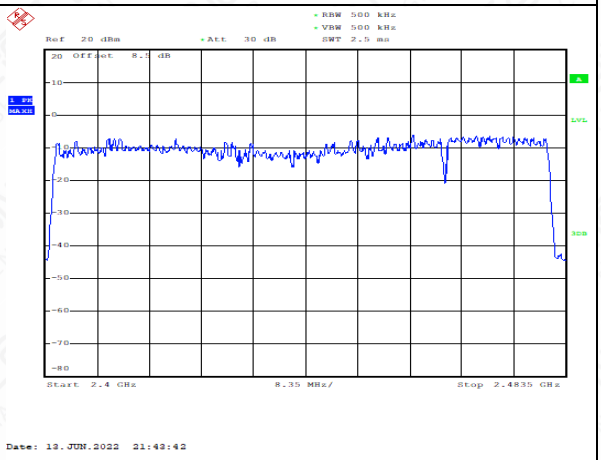
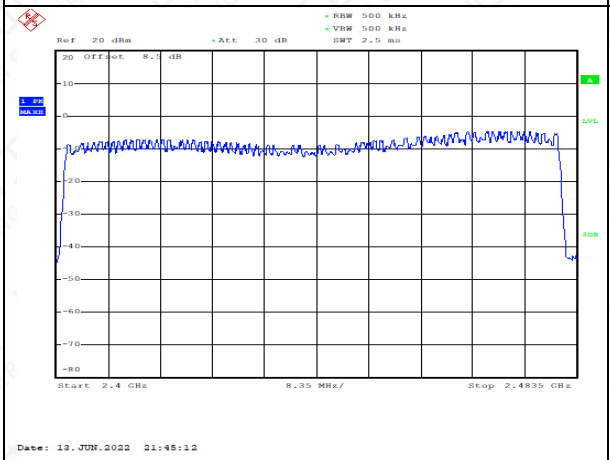
The measurement is according to ANSI C63.10 clause 7.8.3.

1. Connect the EUT through cable and divide with CMW270 and spectrum analyzer.
2. Enable the EUT transmit in hopping mode.
3. Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
4. RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
5. VBW ≥ RBW.
6. Sweep: Auto.
7. Detector function: Peak.
8. Trace: Max hold.
9. Allow the trace to stabilize.
10. Record the test results.

6.9.3 Test Setup



Measurement Result

Number of hopping frequency GFSK Ch0~78:79	Number of hopping frequency π/4 DQPSK Ch0~78:79
	
Number of hopping frequency 8DPSK Ch0~78:79	
	

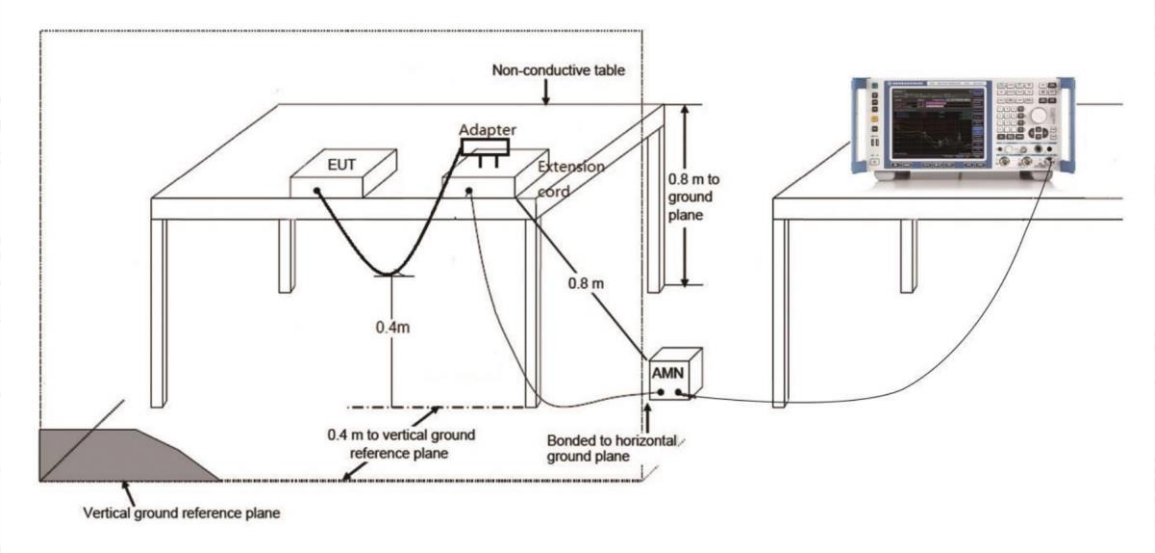
6.10 AC Powerline Conducted Emission

6.10.1 Method of Measurement: ANSI C63.10-2013-clause 6.2

1. The one EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is selected for the final measurement, while applying the appropriate modulating signal to the EUT.
2. If the EUT is relocated from an exploratory test site to a final test site, the highest emissions shall be remaximized at the final test location before final ac power-line conducted emission measurements are performed.
3. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) is then performed for the full frequency range for which the EUT is being tested for compliance without further variation of the EUT arrangement, cable positions, or EUT mode of operation.
4. If the EUT is comprised of equipment units that have their own separate ac power connections, e.g., floor-standing equipment with independent power cords for each shelf that are able to connect directly to the ac power network, each current-carrying conductor of one unit is measured while the other units are connected to a second (or more) LISN(s). All units shall be separately measured. If a power strip is provided by the manufacturer, to supply all of the units making up the EUT, only the conductors in the power cord of the power strip shall be measured.

If the EUT uses a detachable antenna, these measurements shall be made with a suitable dummy load connected to the antenna output terminals; otherwise, the tests shall be made with the antenna connected and, if adjustable, fully extended. When measuring the ac conducted emissions from a device that operates between 150 kHz and 30 MHz a non-detachable antenna may be replaced with a dummy load for the measurements within the fundamental emission band of the transmitter, but only for those measurements.36 Record the six highest EUT emissions relative to the limit of each of the current-carrying conductors of the power cords of the equipment that comprises the EUT over the frequency range specified by the procuring or regulatory agency. Diagram or photograph the test setup that was used. See Clause 8 for full reporting requirements.

6.10.2 Test Setup

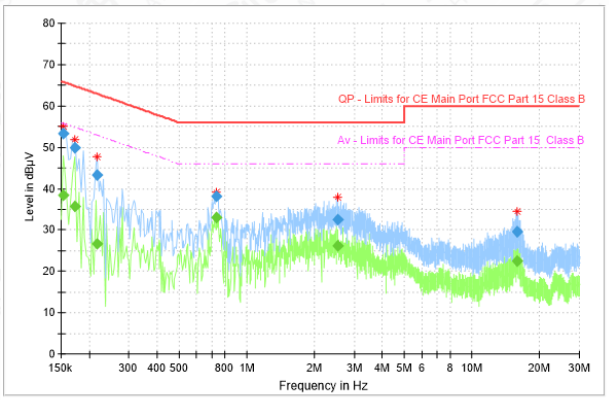


6.10.3 Test Condition

Voltage（V）	Frequency（Hz）
120	60

Measurement Result and limit
(Quasi-peak-average Limit)

Frequency range (MHz)	Quasi-peak Limit (dBμV)	Average Limit (dBμV)	Conclusion
0.15 to 0.5	66 to 56	56 to 46	P
0.5 to 5	56	46	
5 to 30	60	50	
NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.			

CA01	/
	/

CA01

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.153731	---	38.53	55.80	17.27	15000.0	9.000	L1	ON	9.6
0.153731	53.43	---	65.80	12.37	15000.0	9.000	L1	ON	9.6
0.172388	---	35.61	54.85	19.24	15000.0	9.000	L1	ON	9.6
0.172388	49.95	---	64.85	14.90	15000.0	9.000	L1	ON	9.6
0.217163	---	26.74	52.93	26.18	15000.0	9.000	L1	ON	9.6
0.217163	43.30	---	62.93	19.62	15000.0	9.000	L1	ON	9.6
0.732075	---	33.09	46.00	12.91	15000.0	9.000	L1	ON	9.6
0.732075	38.26	---	56.00	17.74	15000.0	9.000	L1	ON	9.6
2.538000	---	26.07	46.00	19.93	15000.0	9.000	L1	ON	9.7
2.538000	32.64	---	56.00	23.36	15000.0	9.000	L1	ON	9.7
15.828713	---	22.50	50.00	27.50	15000.0	9.000	L1	ON	10.1
15.828713	29.53	---	60.00	30.47	15000.0	9.000	L1	ON	10.1

Annex A: Revised History

Version	Revised Content
V00	Initial
V01	Update the equipemnts list; Add the update the test equipment; Add the EIRP test result and EIRP limit; Add the radiation spurious above 18GHz result

Annex B: Accreditation Certificate

Accredited Laboratory

A2LA has accredited

INDUSTRIAL INTERNET INNOVATION CENTER (SHANGHAI) CO., LTD.

Shanghai, People's Republic of China

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 12th day of April 2021.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3682.01
Valid to February 28, 2023

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

END OF REPORT