





## 3.3. Band Edge Emissions

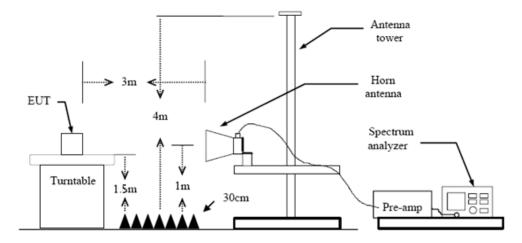
Limit

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

Restricted Frequency Band	(dBuV/m	n)(at 3m)
(MHz)	Peak	Average
2310 ~2390	74	54
2483.5 ~2500	74	54

Conducted band edge limit: The highest point of the operating frequency waveform down 20dB

#### **Test Configuration**



## **Test Procedure**

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

#### **Test Mode**

Please refer to the clause 2.3.



#### (1) Radiation Test

Ant. I	Pol.			Hori	zoni	al												
est	Mod	e:		GFS	SK N	1ode	24	02MF	Ηz									
110.0	dBuV/	m																1
		_						_					_				Λ	
																	$\Lambda^{-}$	
												FCC Pa	t15 Clas	s C 3M A	bove-	1G Peak	$\square$	
																	$\vdash \setminus$	
60		_										FCC	Part15 C	lass C 3	1 Abo	ve-1G AV	+	
															Ť	1		
															3		\	
F	-														Ť			
		_																
10.0																		
2307	7.000 2	317.00	23	27.00	233	7.00	234	7.00	2357.	00	236	7.00 2	377.00	2387	.00		2407.00	MHz
No	).	Frec (N	juen 1Hz)			acto B/m			adin BuV)			vel JV/m)		imit uV/m		largin (dB)	Detec	tor
1		239	0.0	00	3	1.1	0	21	.59	Τ	52	.69	7	4.00	-	21.31	pea	ak
2		239	0.0	00	3	1.1	0	9	.28	╈	40	.38	5	4.00	-	13.62	AV	G



nt. Po	nt. Pol. est Mode:	Verti	cal					
est Mo	ode:	GFS	K Mode 24	02MHz				
110.0 dE	luV/m							
								^
								$\Lambda \rightarrow$
					FCC Part1	5 Class C 3M Abov	e-1G Peak	
60								
					FCC Pa	art15 Class C 3M At	ove-16 AV	
						×		
10.0								
	0 2317.00	2327.00	2337.00 234	47.00 2357.00	2367.00 23	77.00 2387.00	24	107.00 MHz
No.	Frequ (Mł	Hz)	Factor (dB/m)	Reading (dBuV)	· · · ·	Limit (dBuV/m)	· /	Detector
1	2390	0.000	31.10	19.59	50.69	74.00	-23.31	peak
2	2390	000.0	31.10	8.38	39.48	54.00	-14.52	AVG



	GFSK	Mode	2480 I	MHz					
						ECC Part	15 Class C 2M /	boye 16 Peak	
						rccrait	TJ Class C JM P	DOVE-TO LEAK	
						FCC F	art15 Class C 3	Above-1G AV	
5.00 249	5.00 3	2505.00	2515.00	2525.0	0 253	5.00 2	545.00 255	5.00	2575.00 MI
requent (MHz)							Limit (dBuV/m	Margin ) (dB)	Detecto
2483.50	00	31.50	) :	22.85	54	4.35	74.00	-19.65	peak
2483.50		31.50	) ·	13.81	4	5.31	54.00	-8.69	AVG
	requen (MHz)	requency	Frequency Facto (MHz) (dB/m	Frequency Factor Ro (MHz) (dB/m) (d	Frequency Factor Reading (MHz) (dB/m) (dBuV)	Frequency Factor Reading Le (MHz) (dB/m) (dBuV) (dBu	5.00 2495.00 2505.00 2515.00 2525.00 2535.00 2 Frequency Factor (dB/m) (dBuV) (dBuV/m)	FCC Part 15 Class C 3 FCC Part 15 Class C 3 5.00 2495.00 2505.00 2515.00 2525.00 2535.00 2545.00 2555 Frequency Factor Reading Level Limit (MHz) (dB/m) (dBuV) (dBuV/m) (dBuV/m)	Frequency Factor Reading Level Limit Margin (MHz) (dB/m) (dBuV) (dBuV/m) (dBuV/m) (dB)



Ant. Po		Vert	ical										
Test Mo	de:	GFS	SK M	ode 24	80 MI	Ηz							
110.0 dB	i∀/m												
60 10.0 2475.000	2485.00 2	495.00	2505	.00 25	15.00	2525.00	2535	FCC F	115 Class C 3M Part 15 Class C 3 545.00 25		IG AV	2575.00 MH	z
										_			_
No.	Frequer (MHz			actor 3/m)		ding SuV)		vel V/m)	Limit (dBuV/n	Mar n) (dl		Detector	r
1	2483.5	00	31	1.50	22	.47	53	.97	74.00	-20	.03	peak	Ι
2	2483.5	00	31	1.50	10	.91	42	.41	54.00	-11	.59	AVG	Ι
Remark		Anton			dD (mail)		о Го-	tor (dF					
	(dB/m) =			•	ав/m)	+Cabl	e rac	tor (ae	s)-Pre-am	ipiitier I	acto	J.	

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Ant. Pol.		Hori	zontal									
Test Mod	de:	π/4-	DQPSI	< Mo	de 24	02MH	z					
110.0 dBuV	7m											
												$\Lambda$
						_		FCC Part	15 Class C 3	M Abo	ve-1G Peak	$\mathbb{A}$
60											/	
		_				_		FCC P	art15 Class	C 3M A	pove-16 AV	-+
											2	
											*	
						_				_		
						_						_
10.0												
2307.000	2317.00 23	27.00	2337.00	234	7.00	2357.00	2367	.00 23	377.00	2387.00	) 2	2407.00 MHz
	Freque	201	Fac	tor	Pee	ding		vel	Lim		Morgin	
No.	Frequei (MHz		(dB/		dB				(dBuV		Margin (dB)	Detector
1	2390.0	,	31.		20	,		.03	74.0		-21.97	peak
2	2390.0		31.		9.			.49	54.0		-13.51	AVG
-	2000.0		01.		0.		10	.10	01.0		10.01	
Remarks	: (dB/m) = /	Anton	na Eac	tor /		LCabl		tor (de	2) Dro c	mol	ifior Eact	or
	value = L				uD/III) <sup>.</sup>	-Cabl			5)-116-5	inpi	mer Fact	UI

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Ant.	Pol.	1		V	ertic	cal														
Test	Mod	de:		π	/4-C	DQP	SK	Мо	de 24	402N	ЛH	z								
110.0	dBu	uV/m									_									
													F	CC Parl	t15 Clas	is C 3M	Abov	ve-16 Peak		
60														FCC F	Part15 C	lass C	зм А	bove-1G A	1	
															<u></u>	~	; ;	×	/	
10.0	07.000	2317.	00	2327	.00	233	7.00	23	47.00	235	7.00	23	67.00	1 2	377.00	23	37.00		240	7.00 MHz
No		Fre	que	nc	y	Fa	acto	r	Rea	adin	g	L	eve	əl	L	imit		Margi	n r	Detector
			MH:				B/m			Bu∨		-		/m)	-	uV/r		(dB)		
1			90.				3.10			9.60			1.5			4.00		-32.5	_	peak
2		23	90.	000	)	-8	3.10	)	37	7.52		2	9.4	2	5	4.00	)	-24.5	8	AVG
Rema 1.Fac			n) =	Ant	tenr	na F	acto	or (d	B/m	)+Ca	able	e Fa	cto	r (dE	8)-Pre	e-am	plif	ier Fac	tor	

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Test Mode:	_/4						
	π/4·	DQPSK Mo	de 2480MH	Z			
110.0 dBuV/m							
60					115 Class C 3M Abo Part15 Class C 3M A		
10.0							
2475.000 248	5.00 2495.00	2505.00 25	15.00 2525.00	2535.00 2	545.00 2555.00	) :	2575.00 MHz
NO.	requency (MHz)	Factor (dB/m)	Reading (dBuV)	· · · ·	(dBuV/m)	Margin (dB)	Detector
1 2	2483.500	31.50	31.54	63.04	74.00	-10.96	peak
2 2	2483.500	31.50	20.75	52.25	54.00	-1.75	AVG

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1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor 2.Margin value = Level -Limit value



Ant. Po	J.	Verti	cal					
Test Mo	ode:	π/4-I	DQPSK Mo	de 2480MH	z			
110.0 d	BuV/m							
$\square$					FCC Pa	rt15 Class C 3M Ab	ove-1G Peak	
60	1							
-	_ <b>_</b>				FCC	Part15 Class C 3M	Above-1G AV	
	Ń							
10.0								
2476.0	00 2486.00	2496.00	2506.00 2	516.00 2526.00	2536.00	2546.00 2556.	DO	2576.00 MH
	Frequ	ency	Factor	Reading	Level	Limit	Margin	
No.	(MF	łz)	(dB/m)	(dBuV)	(dBuV/m)		(dB)	Detector
1	2483	.500	31.50	28.57	60.07	74.00	-13.93	peak
2	2483	.500	31.50	19.34	50.84	54.00	-3.16	AVG

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor 2.Margin value = Level -Limit value



Ant.	Pol.		Hori	zonta	al								
Test	Mode:		8-DF	PSK I	Mode	24021	ИНz						
110.0	dBu∀/m												
						_							$\wedge$
						_			FCC Par	t15 Class I	C 3M Ab	ove-1G Peak	A
													$\square$
60													
									FCC	Part15 Cla		Above-1G AV	
						_						Ĭ	
┝					<u></u>					~		\$	
10.0													
	8.000 231	8.00	2328.00	2338	.00 23	348.00	2358.00	) 2368	.00 2	2378.00	2388.	00	2408.00 MH
No	5. F	reque (MH:			actor 3/m)		ading 3uV)	Lev		Lin (dBu\		Margin (dB)	Detector
1		2390.	,		1.10		).19	51.	,	(uBu 74.		-22.71	pook
	_			-				-	-				peak
2		2390.	000	3	1.10	9	.74	40.	84	54.	00	-13.16	AVG
	arks:												



Ant. Po	ol.	Verti	cal						
est M	ode:	8-DF	PSK Mode 2	2402MHz					
110.0 dB	uV/m								
								Δ	
					FCC Par	t15 Class C 3M Ab	ove-16 Peak	$-\Lambda$	
60								$( \land )$	
					FCC	Part15 Class C 3M	Above-1G AV		
		_					Ť I	$\leftarrow$	
						<u>~</u>	2		
10.0 2307.00	0 2317.00 2	327.00	2337.00 23	47.00 2357.00	2367.00 2	377.00 2387.0	00	2407.00 MI	Hz
No.	Freque (MHz		Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	r
1	2390.0		31.10	20.68	51.78	74.00	-22.22	peak	_
2	2390.0	000	31.10	8.83	39.93	54.00	-14.07	AVG	_
Remarl								L	
			na Factor ( Limit value	dB/m)+Cabl	e Factor (dE	3)-Pre-ampl	ifier Fact	or	



nt. Po	I.	Hori	zontal								
est Mo	ode:	8-DF	PSK Mod	le 248	80MHz						
10.0 dBu	uV/m										
$\square$							FCC	Part1	15 Class C 3M At	ove-1G Peak	
	1 X										
60	1						F	CC Pa	art15 Class C 3M	Above-1G AV	
	×.										
0.0											
2476.000	2486.00	2496.00	2506.00	2516.00	) 2526	.00	2536.00	25	46.00 2556.	00 2	2576.00 MHz
No.		uency Hz)	Facto		Readin (dBuV		Level		Limit (dBuV/m	Margin ) (dB)	Detector
1		, 3.500	31.50	_	33.59	<u> </u>	65.09	- 1	74.00	-8.91	peak
2		3.500	31.50	-	20.63	_	52.13	_	54.00	-1.87	AVG

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor 2.Margin value = Level -Limit value

CTC Laboratories, Inc. 1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China Tel.: (86)755-27521059 百里国家认证认可监督管理委员会 Greatiation Administration of the People's Republic of China : <u>yz.cnca.cn</u>

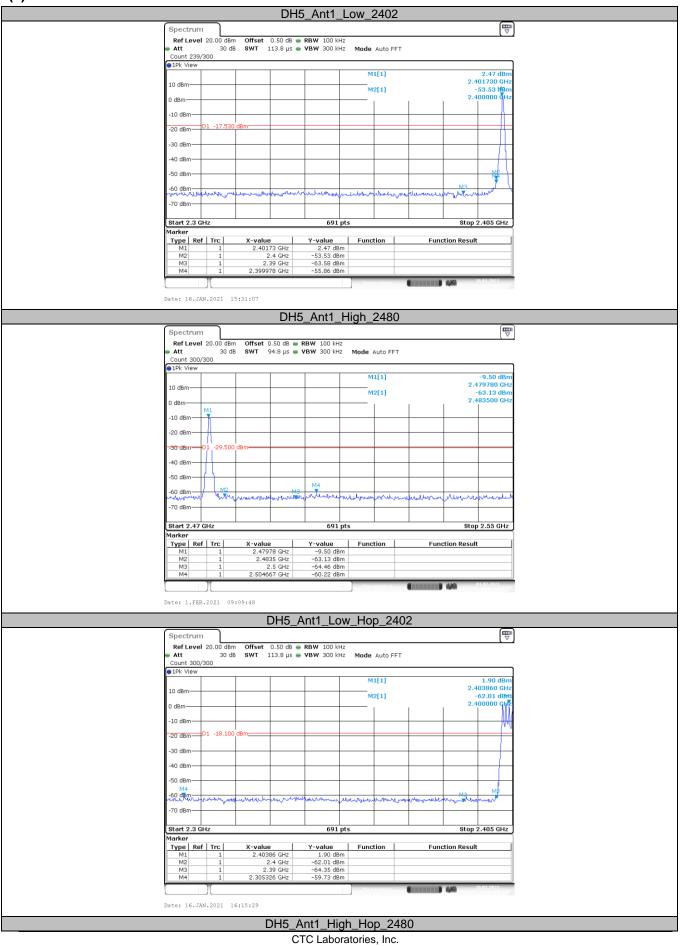


	ol.	Verti						
lest N		8-DF	PSK Mode 2	2480MHz				
110.0	lBu¥/m							
	<u>^</u>							
	1							
					FCC Par	t15 Class C 3M Abo	we-1G Peak	
	1							
60	Î				FCC F	Part15 Class C 3M /	Above-1G AV	
	Ť							
1								
10.0	00 2486.00	2496.00	2506.00 25	16.00 2526.00	2536.00 2	546.00 2556.0		2576.00 MHz
	Frequ	Jency	Factor	Reading	Level	Limit	Margin	
No.	(MI		(dB/m)	(dBuV)	(dBuV/m)		(dB)	Detector
1	2483	3.500	31.50	29.16	60.66	74.00	-13.34	peak
2	2483	3.500	31.50	19.55	51.05	54.00	-2.95	AVG

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value



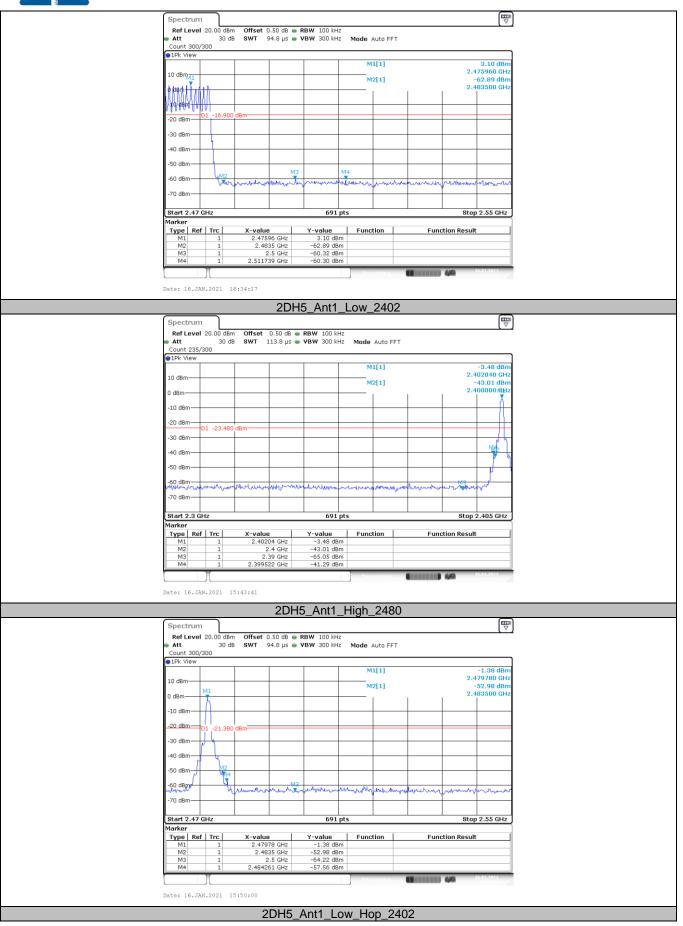
#### (2) Conducted Test



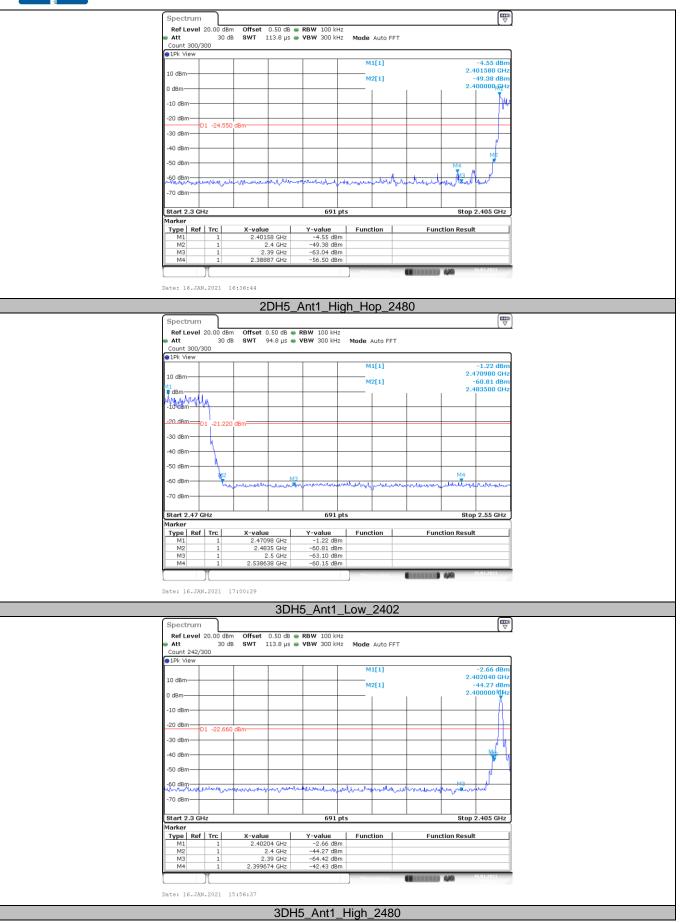


1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China Fax: (86)755-27521011 Http://www.sz-ctc.org.cn For anti-fake verification, please visit the official website of Certification and Accreditation Administration of the People's Republic of China : yz.cnca.cn



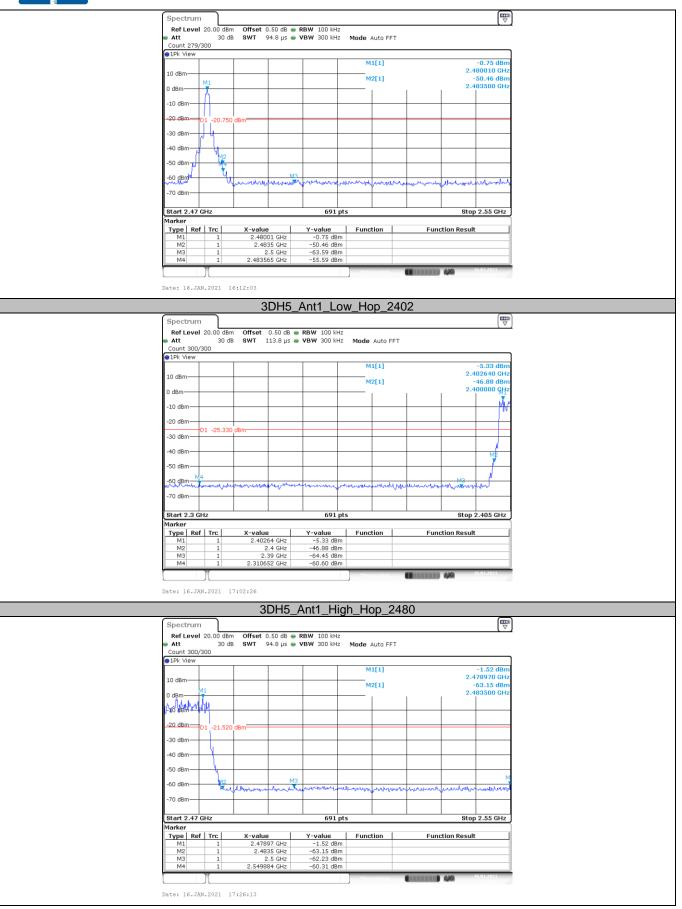














# 3.4. Occupied Channel Bandwidth and 20DB Bandwidth

### <u>Limit</u>

N/A

## Test Configuration



#### Test Procedure

- 1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- 2. OCB and 20dB Spectrum Setting:
  - (1) Set RBW =  $1\% \sim 5\%$  occupied bandwidth.
  - (2) Set the video bandwidth (VBW)  $\geq$  3 RBW.
  - (3) Detector = Peak.
  - (4) Trace mode = Max hold.
  - (5) Sweep = Auto couple.

Note: The EUT was set to continuously transmitting in each mode and low, Middle and high channel for the test.

## Test Mode

Please refer to the clause 2.3.

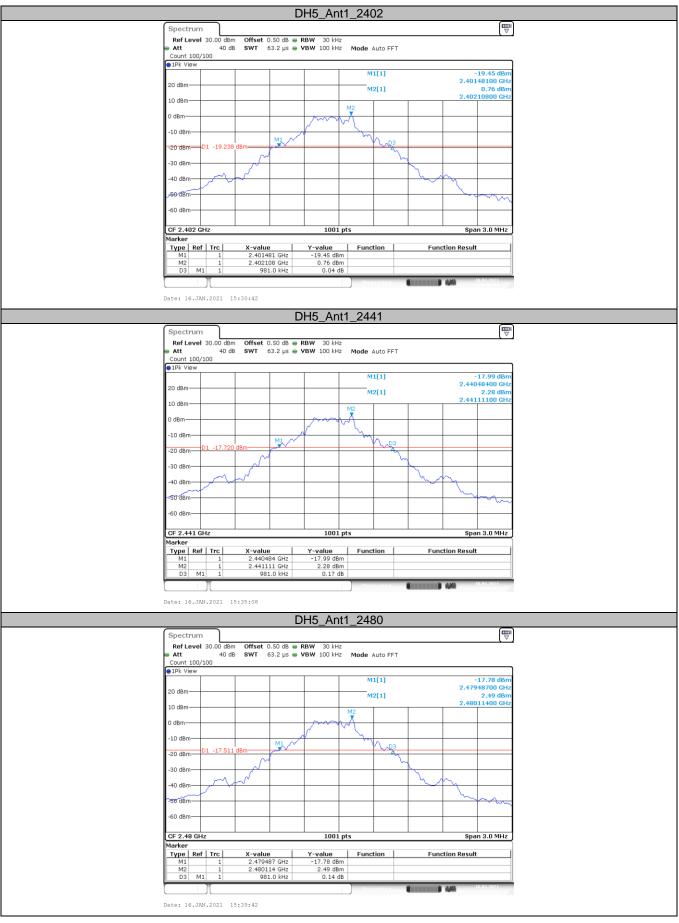
#### Test Results

中国国家认证

Modulation type	Channel	99% Bandwidth (MHz)	20dB Bandwidth (MHz)	20dB Bandwidth *2/3 (MHz)
	00	0.896	0.981	0.654
GFSK	39	0.899	0.981	0.654
	78	0.899	0.981	0.654
	00	1.232	1.356	0.904
π/4-DQPSK	39	1.220	1.356	0.904
	78	1.223	1.356	0.904
	00	1.211	1.308	0.872
8-DPSK	39	1.214	1.311	0.874
	78	1.214	1.338	0.892

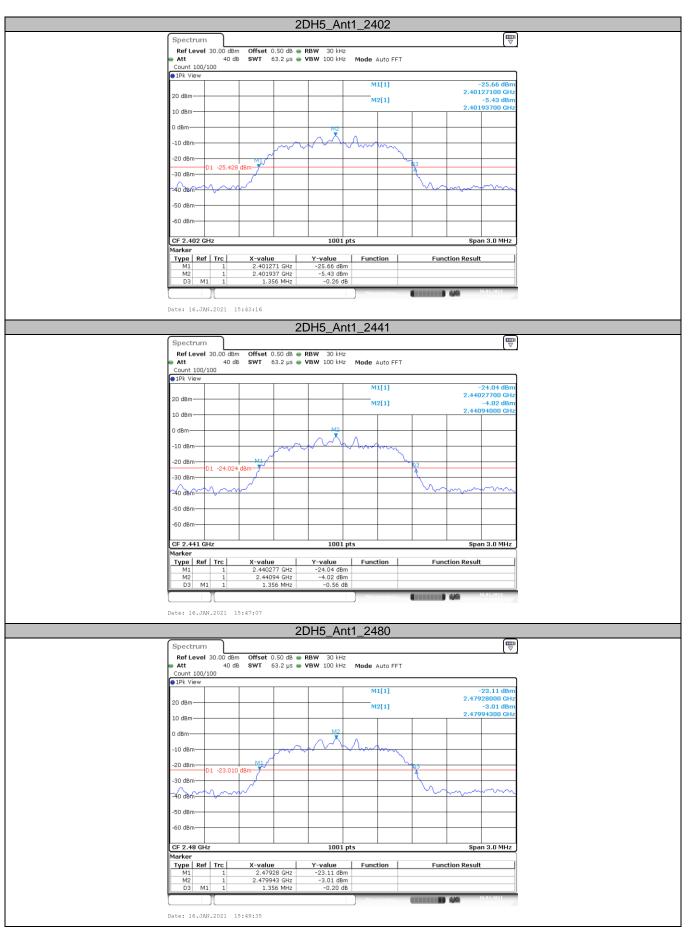


#### 20dB Bandwidth



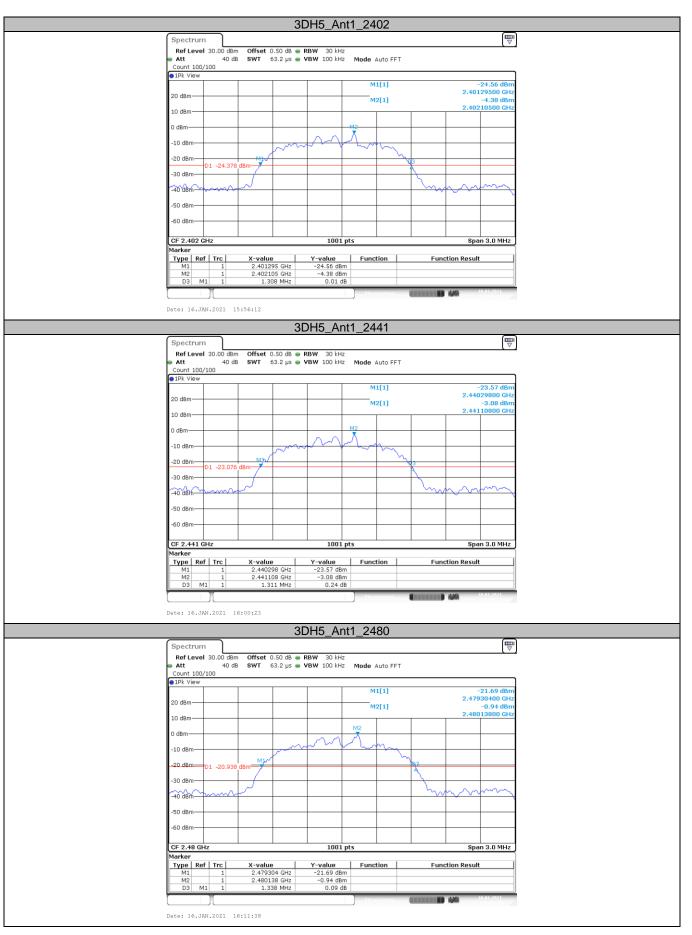






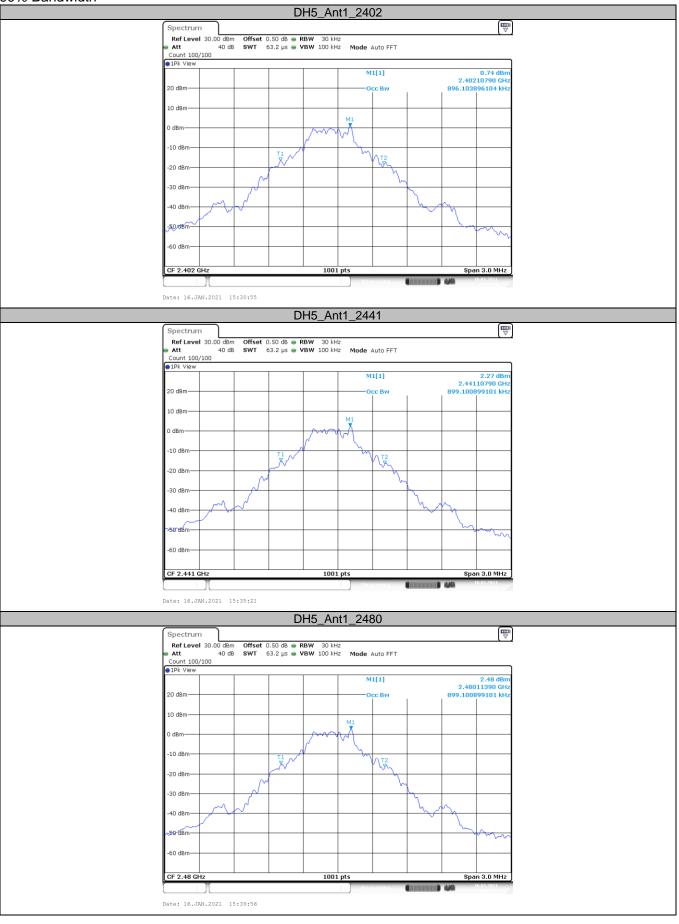


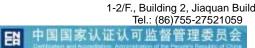




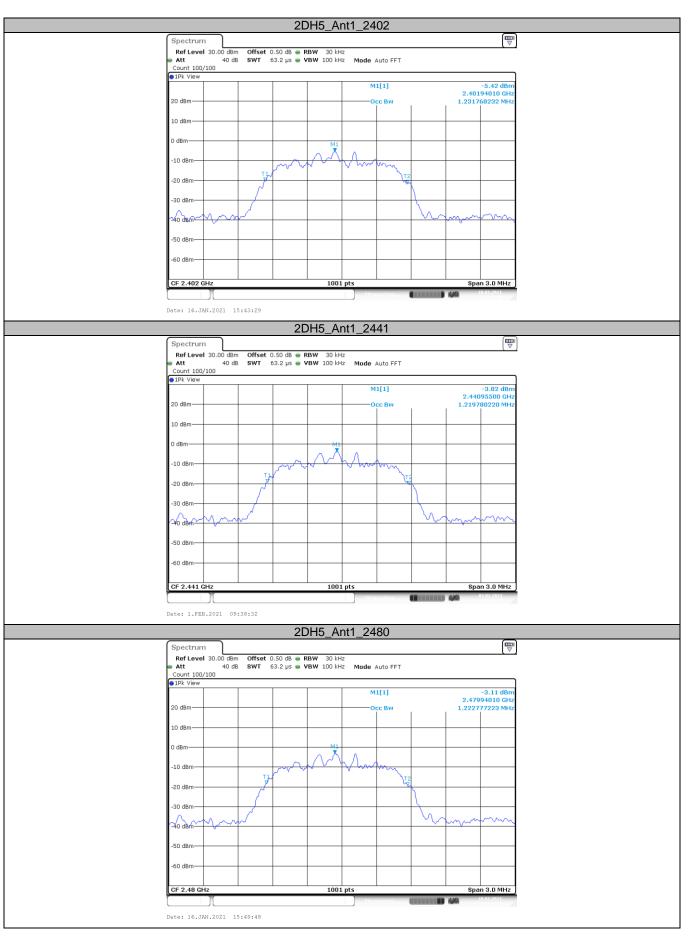


#### 99% Bandwidth

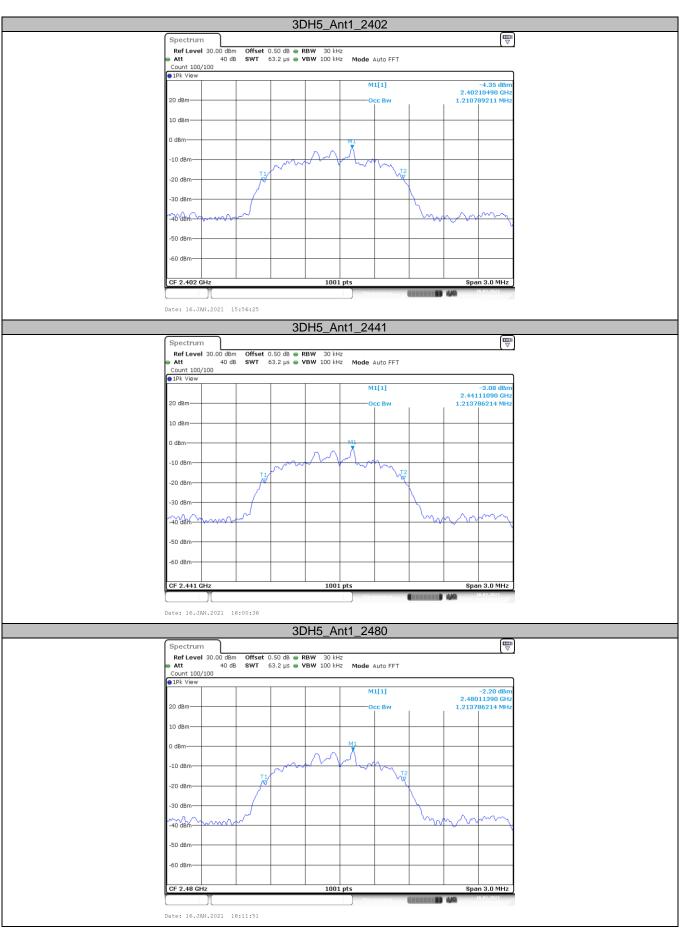














## 3.5. Channel Separation

<u>Limit</u>

## FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(1)/ RSS-247 5.1 b :

Test Item	Limit	Frequency Range(MHz)
Channel Separation	>25KHz or >two-thirds of the 20 dB bandwidth Which is greater	2400~2483.5

## Test Configuration



#### Test Procedure

- 3. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- 4. Spectrum Setting:
  - (1) Set RBW = 100 kHz.
  - (2) Set the video bandwidth (VBW)  $\geq$  3 RBW.
  - (3) Detector = Peak.
  - (4) Trace mode = Max hold.
  - (5) Sweep = Auto couple.

#### Test Mode

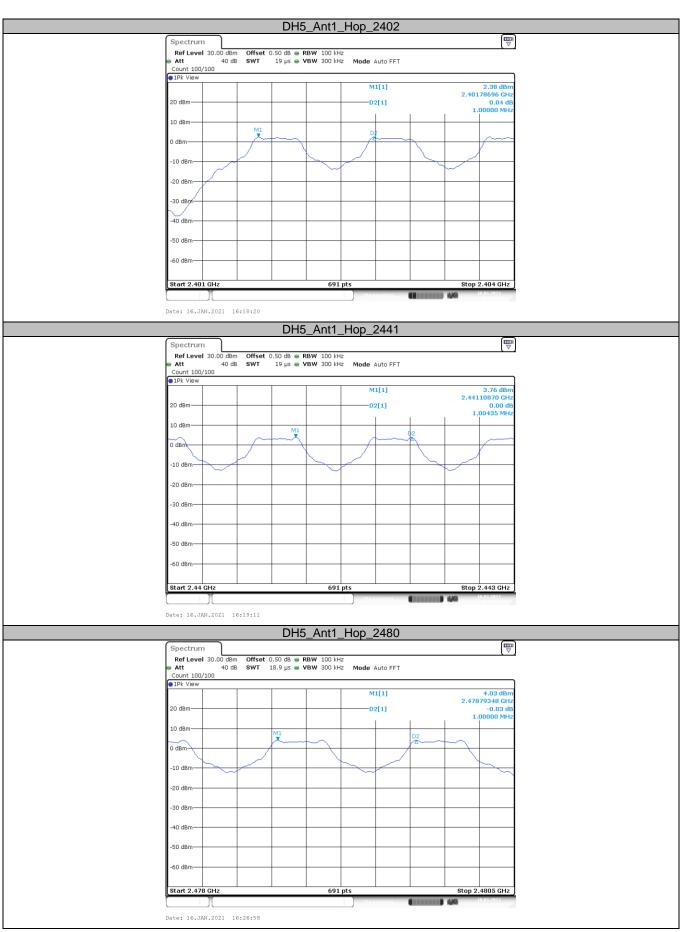
Please refer to the clause 2.3.



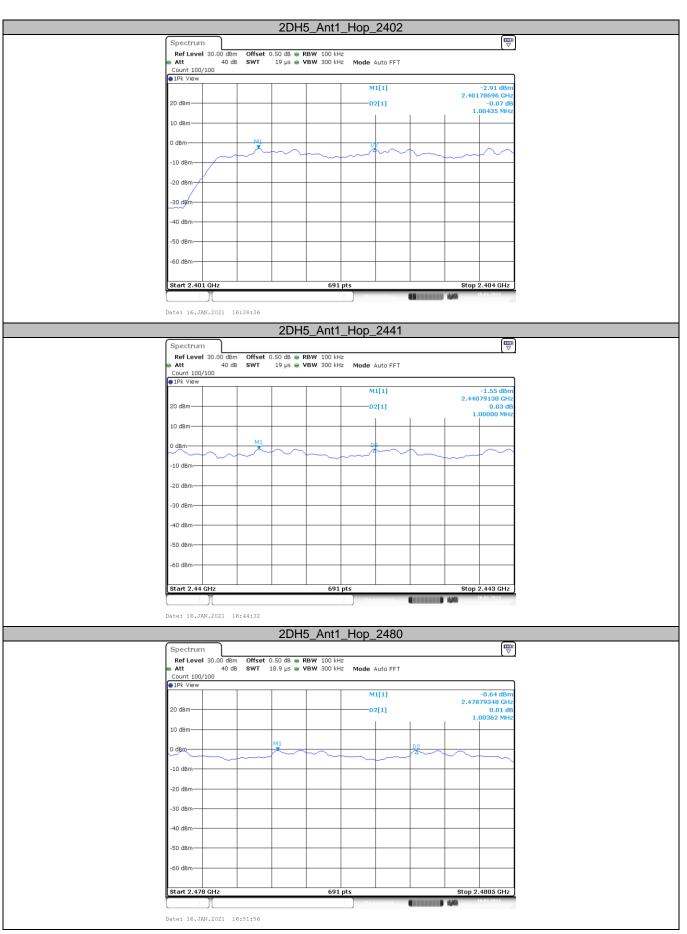
Test	<u>Results</u>	

Modulation type	Channel	Carrier Frequencies Separation (MHz)	Limit (kHz)	Result
	00	1.000	652.00	
GFSK	39	1.004	652.00	Pass
	78	1.000	654.00	
	00	1.004	906.00	
π/4-DQPSK	39	1.000	908.00	Pass
	78	1.004	908.00	
	00	1.004	878.00	
8-DPSK	39	1.043	884.00	Pass
	78	1.004	880.00	

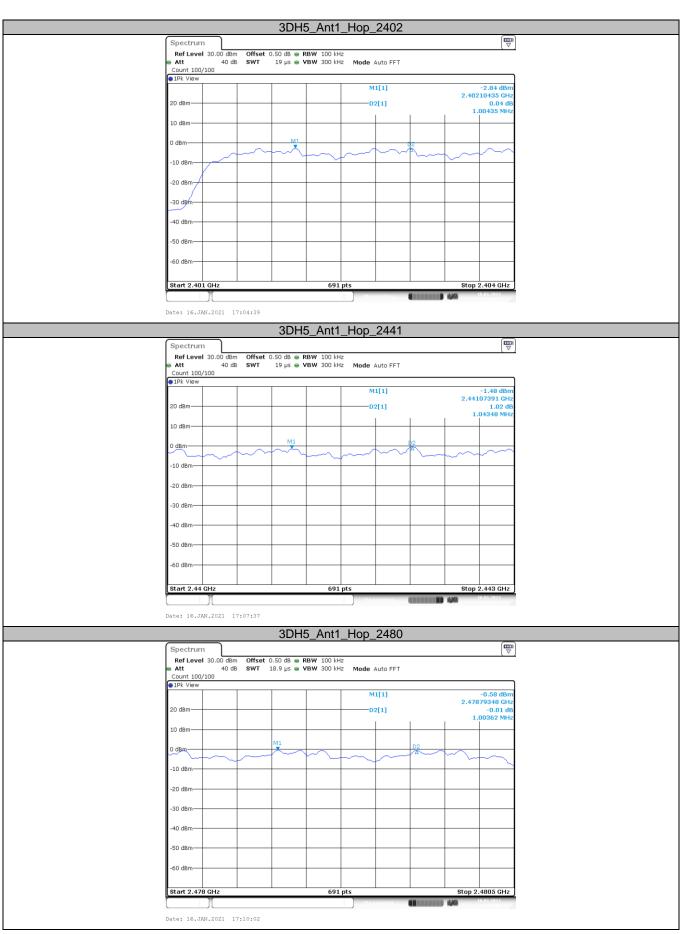














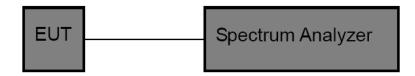
## 3.6. Number of Hopping Channel

## <u>Limit</u>

### FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(iii)/ RSS-247 5.1 d:

Section	Test Item	Limit	
15.247 (a)(iii)/ RSS-247 5.1 d:	Number of Hopping Channel	>15	

### Test Configuration



#### Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.

- 2. Spectrum Setting:
  - (1) Peak Detector: RBW=100 kHz, VBW ≥ RBW, Sweep time= Auto.

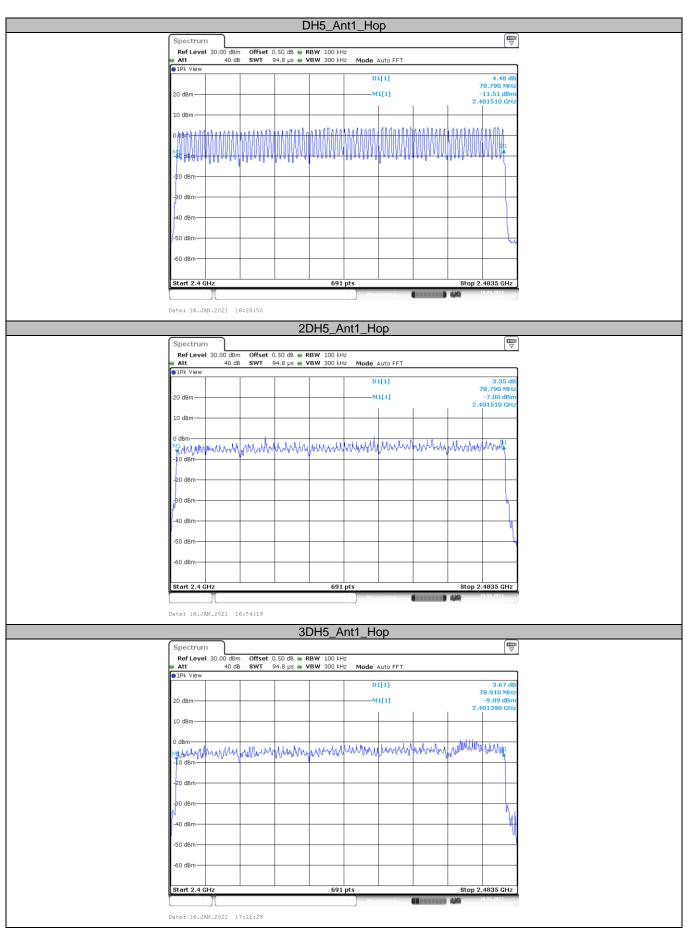
#### Test Mode

Please refer to the clause 2.3.

#### Test Result

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





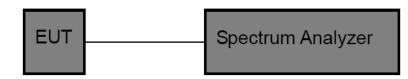


## 3.7. Dwell Time

#### <u>Limit</u>

Section	Test Item	Limit	
15.247(a)(iii)/ RSS-247 5.1 d	Average Time of Occupancy	0.4 sec	

## Test Configuration



#### Test Procedure

- 1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- 2. Spectrum Setting:
  - (1) Spectrum Setting: RBW=1MHz, VBW≥RBW.
  - (2) Use video trigger with the trigger level set to enable triggering only on full pulses.
  - (3) Sweep Time is more than once pulse time.
  - (4) Set the center frequency on any frequency would be measure and set the frequency span to

zero.

- (5) Measure the maximum time duration of one single pulse.
- (6) Set the EUT for packet transmitting.

#### Test Mode

Please refer to the clause 2.3.

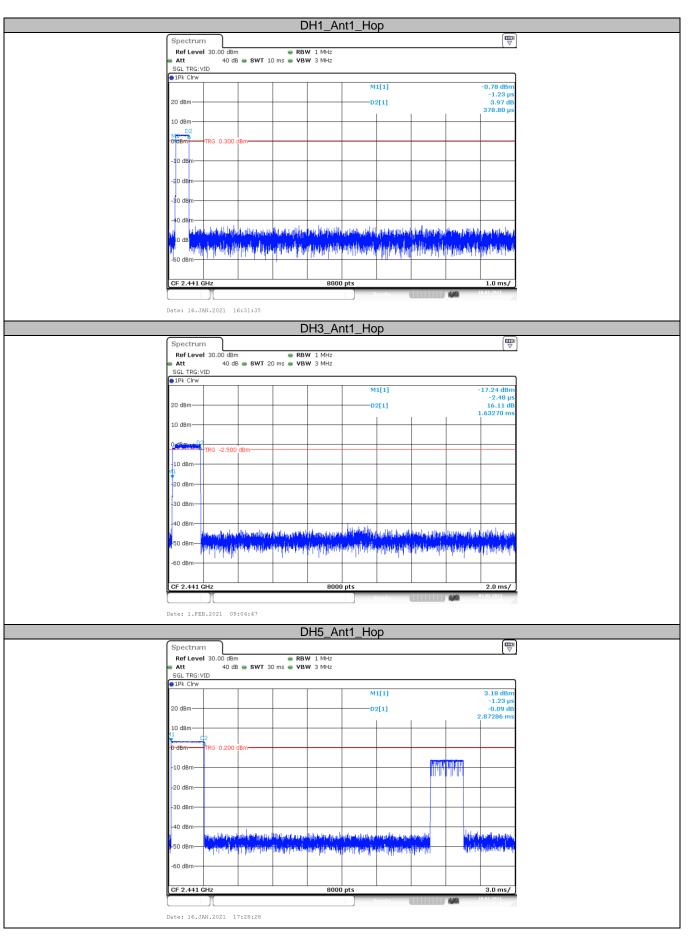


#### Test Result

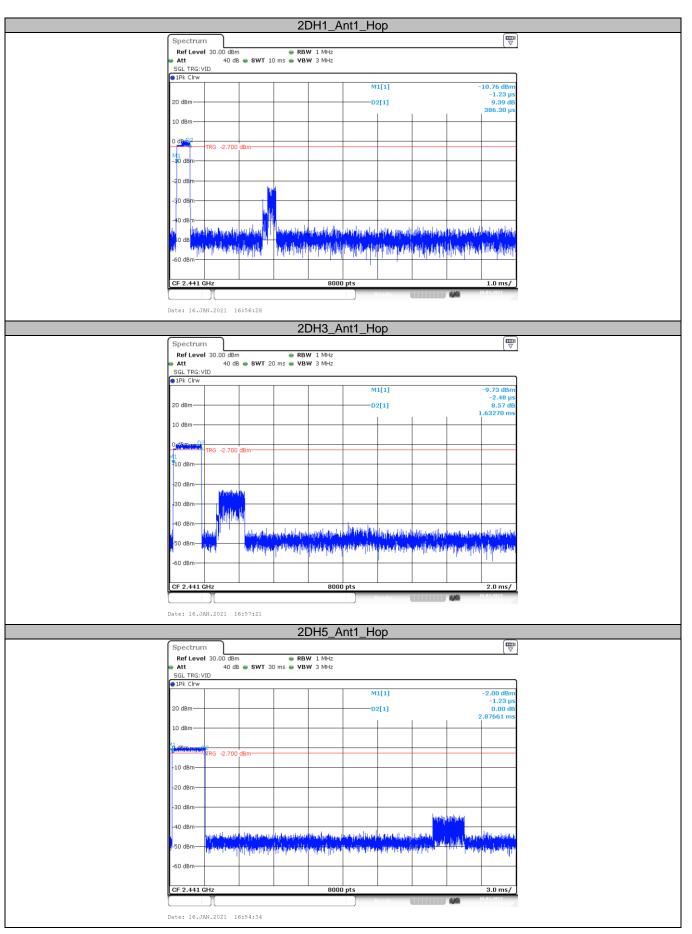
Modulation type	Channel	Channel (MHz)	Pulse Time (ms)	Total of Dwell (ms)	Period Time (ms)	Limit (Second)	Result
	DH1	2441	0.38	121.6	31.60		
GFSK	DH3	2441	1.63	260.8	31.60	≤ 0.40	Pass
	DH5	2441	2.87	306.1	31.60		
	2DH1	2441	0.39	124.8	31.60		
π/4-DQPSK	2DH3	2441	1.63	160.8	31.60	≤ 0.40	Pass
	2DH5	2441	2.88	307.2	31.60		
	3DH1	2441	0.39	124.8	31.60		
8-DPSK	3DH3	2441	1.63	160.8	31.60	≤ 0.40	Pass
	3DH5	2441	2.88	307.2	31.60		

Note: 1DH1/2DH1/3DH1Total of Dwell= Pulse Time\*(1600/2)\*31.6/79 1DH3/2DH3/3DH3 Total of Dwell= Pulse Time\*(1600/4)\*31.6/79 1DH5/2DH5/3DH5 Total of Dwell= Pulse Time\*(1600/6)\*31.6/79

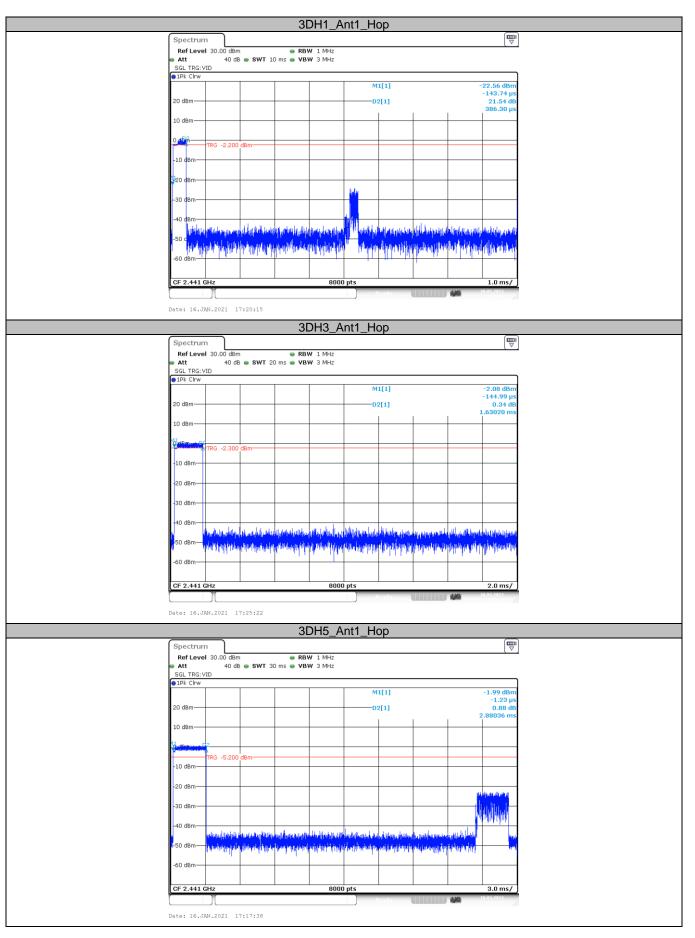














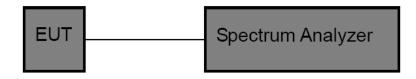
## 3.8. Peak Output Power

## Limit

## FCC CFR Title 47 Part 15 Subpart C Section 15.247 (b)(1) / RSS-247 5.4 b:

Test Item	Limit	Frequency Range(MHz)
Peak Output Power	Hopping Channels>75 Power<1W(30dBm) Other <125mW(21dBm)	2400~2483.5

#### **Test Configuration**



#### **Test Procedure**

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.

2. Spectrum Setting:

> Peak Detector: RBW=1 MHz, VBW=3 MHz for bandwidth less than 1MHz. RBW=3 MHz, VBW=3 MHz for bandwidth more than 1MHz.

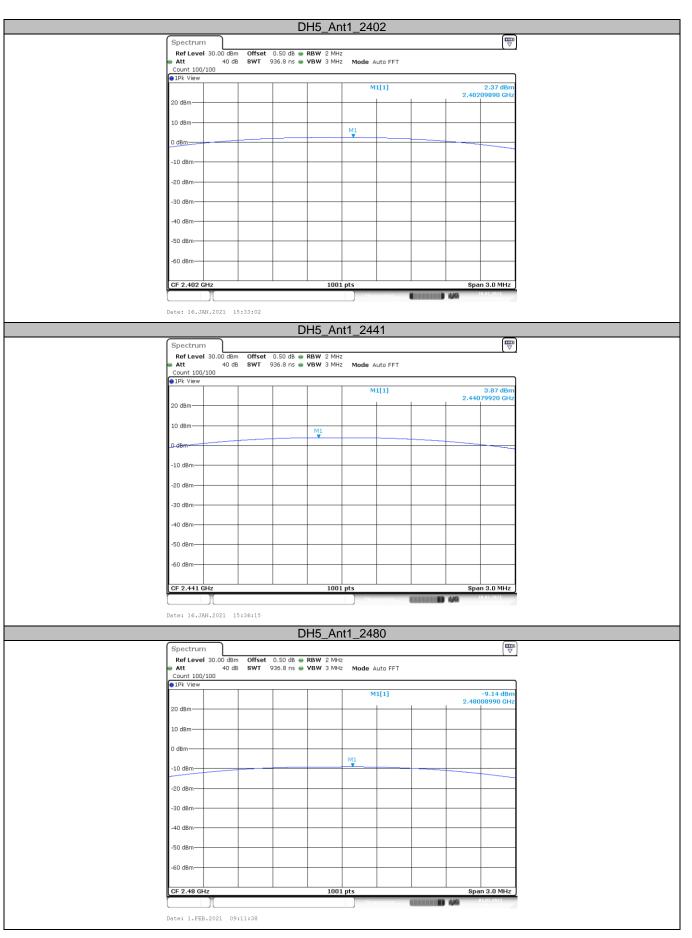
#### **Test Mode**

Please refer to the clause 2.3.

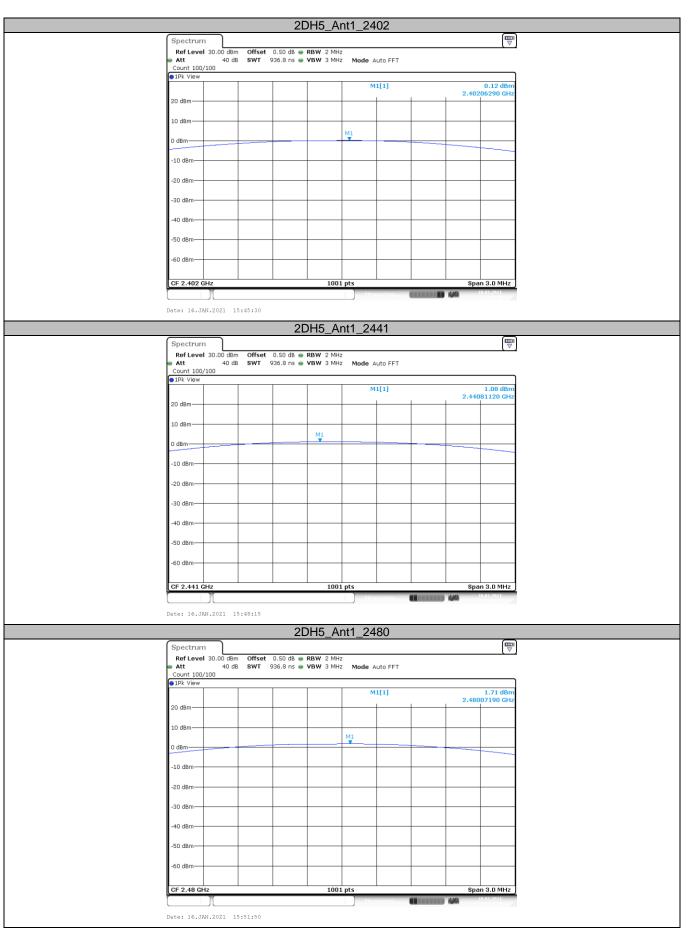
#### **Test Result**

Modulation type	Modulation type Channel Output power (dBm)		Limit (dBm)	Result	
	00	2.37			
GFSK	39	3.87	≤ 30.00	Pass	
	78	-9.14			
	00	0.12			
π/4-DQPSK	39	1.08	≤ 21.00	Pass	
	78	1.71			
	00	0.4			
8-DPSK	39	1.57	≤ 21.00	Pass	
	78	2.17			

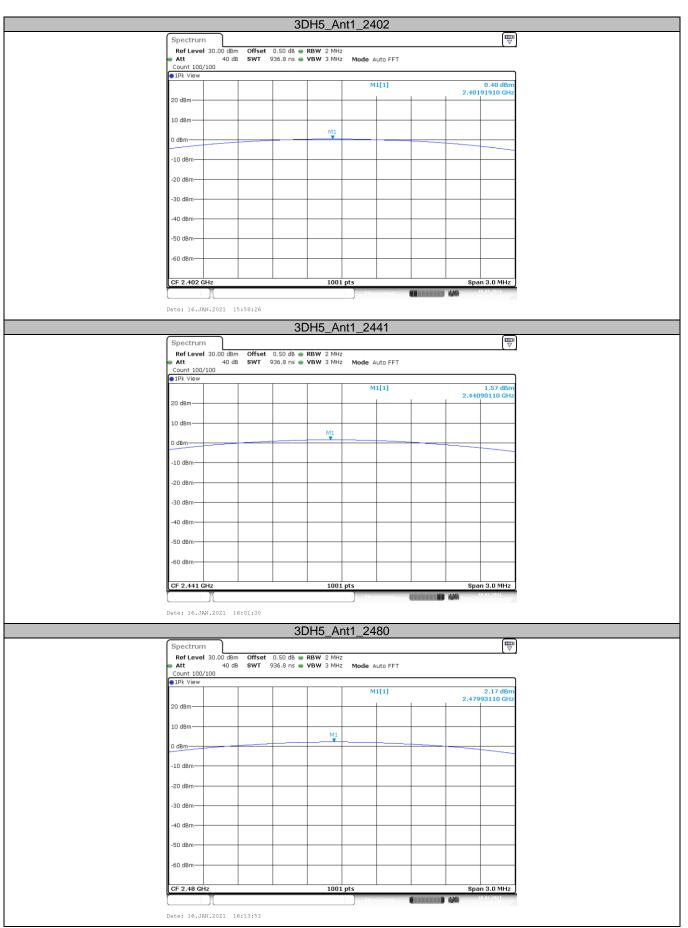














## 3.9. Antenna requirement

## **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 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 6dBi 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 6dBi.

#### Test Result

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