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3.6. NUMBER OF HOPPING FREQUENCY

Limit

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. Set spectrum analyzer start 2400MHz to 2483.5MHz.

Test Configuration



<u>Test Results</u>

STIME	The still	STIM	STIM
Modulation	Number of Hopping Channel	Limit	Result
GFSK	79	TING	
π/4DQPSK	79	≥15	Pass
8DPSK	79		C HUAK IL

Test plot as follows:

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HUAK TES !!	Allert Control Andrew Sound S	GFSK Modul	ation	JAK TEST.	HUAKTE
9. V	Agilent Spectrum Analyzer - Swept S OF RL RF 500 AC Start Freq 2.400000000	GINGI-INT	Id>100/100 TVPE NUMBER OF PARTY NAME	equency	
	Ref Offset 8.64 di 10 dB/div Ref 20.00 dBm		-0.156 dB	Auto Tune	
UAKTESTING				renter Freq 750000 GHz	
0	-20.0			Start Freq 0000000 GHz	
TESTING	-60.0		2.483	Stop Freq	
es.	Start 2.40000 GHz #Res BW 100 kHz	#VBW 300 kHz	Stop 2.48350 GHz Sweep 8.000 ms (1001 pts) 8	CF Step 350000 MHz	
	ΜΚΠ ΜΟΟΕ ΤΑΓ SCL 1 Δ2 1 f (Δ) 2 F 1 f (Δ) 3	X Y FUNCTION 78,490 0 MHz (Δ) -0,156 dB 01 753 5 GHz -5,980 dBm	UNCTION WIDTH FUNCTION VALUE	Man Freq Offset	
Dia	4 6 6 7 8			0 Hz	
HUAKTESTIN	9 10 11		×	TESTIC	
	MSG	π/4DQPSK Mod	status Iulation	0	9
. a G	Agilent Spectrum Analyzer Swept S UR RL RF 50 0 AC Start Freq 2.400000000	GHz SPASEINT	ALIGNAUTO 06:50:39 PM Apr 10, 2022	equency	-1G
UAKTESTING	10 dB/div Ref Offset 9.54 di Log Ref 20.00 dBn	IFGain:Low Atten: 22 dB	DET	Auto Tune	
0		ฟระสมุทธรรรรรมการการการการการการการ	142	enter Freq 1750000 GHz	
ESTING				Start Freq	
ES HUNKTE	-40.0			Stop Freq	
				CE Step	
TNG	Start 2.40000 GHz #Res BW 100 kHz MXR MODE TRC SCL Δ2 1 f (Δ) 0.4	#VBW 300 kHz × Y FUNCTION 78,907 5 MHz (Δ) 2.098 dB 01 503 0 GHz -7.528 dBm	Auto	350000 MHz Man	
HUAKTESTING		-7,528 dbm		Freq Offset 0 Hz	
9	7 8 9 10 11				
300	€ MSG	8DPSK Modu	status	-noiG	NG
UNKTEST	Agilent Spectrum Analyzer Swept S UM RL RF 50 & A0 Start Freq 2.400000000	SENSE-INT	ALIGNAUTO 06:59:56 PM Apr 18, 2022	equency	HUAK TEST
	Ref Offset 8.64 dl	IFGain:Low Atten: 22 dB		Auto Tune	
ESTING HUNKTE	10 dB/div Ref 20.00 dBm		142	enter Freq 1750000 GHz	
950)		nadauthalaunn-nuthralauthnithaanaih-a	al a fan al an a fan fan di fan di fan an fan an a	Start Freq	
	-000 -400 -600		2.400	Stop Freq	
TESTING	40.0 70.0 Start 2.40000 GHz			0500000 GHz	
HUAK TESTING	Start 2.40000 GHz #Res BW 100 kHz Μ/Л MODE TRC SCL Δ2 1 f (Δ)	#VBW 300 kHz × Υ Function 78,991 0 MHz (Δ) -1.174 dB 01 503 0 GHz 6.388 dBm	Sweep 8.000 ms (1001 pts)	CF Step 350000 MHz Man	
	2 F 1 f 24 3 4 4 5	78.991 0 MHz (Δ) -1.174 dB 01 503 0 GHz -6.368 dBm		Freq Offset 0 Hz	
UNCESTING	67 8 9 9			TING	HUNKTESTING
N TES	NUTES II		×		

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3.7. TIME OF OCCUPANCY (DWELL TIME)

Limit

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with 1MHz RBW and 3MHz VBW, Span 0Hz.

Test Configuration



Test Results

Modulation	Packet	Pulse time (ms)	Dwell time (second)	Limit (second)	Result	
TESTING	DH1	0.38	0.122	TESTING		
GFSK	DH3	1.64	0.262	0.40	PASS	
	DH5	2.89	0.308	-mus Of		
π/4DQPSK	2-DH1	0.39	0.125	~	PASS	
	2-DH3	1.64	0.262	0.40		
	2-DH5	2.89	0.308	O HU D.		
	3-DH1	0.39	0.125			
8DPSK	3-DH3	1.64	0.262	0.40	PASS	
	3-DH5	2.89	0.308	O HUM	O HOL	

Note:

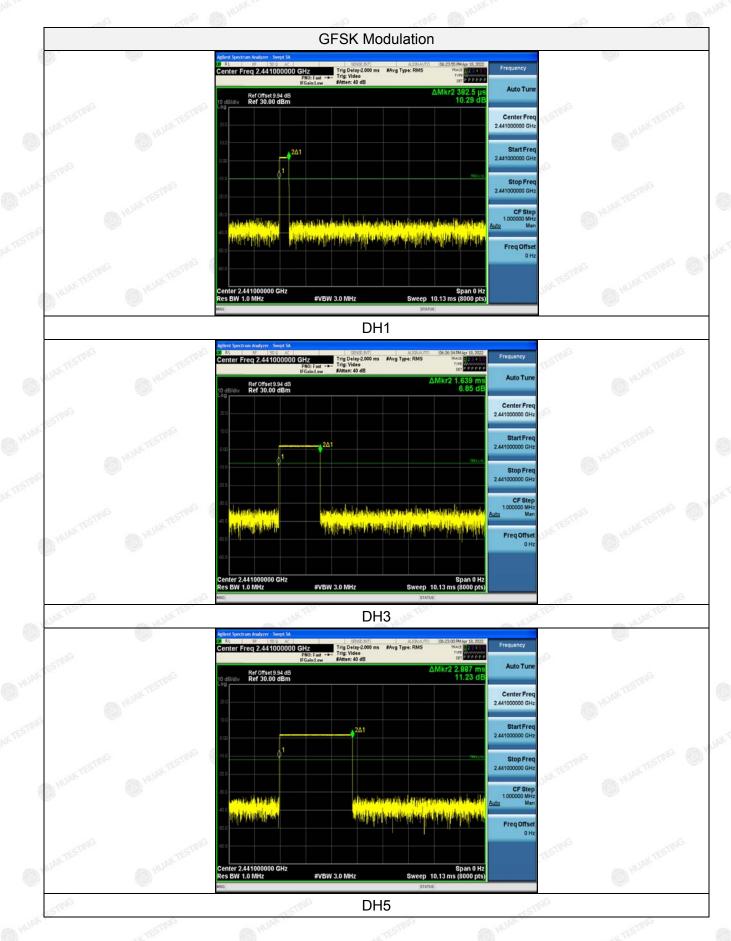
- 1. We have tested all mode at high, middle and low channel, and recoreded worst case at middle channel.
- Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second for DH1, 2-DH1, 3-DH1
 Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second for DH3, 2-DH3, 3-DH3
 Dwell time=Pulse time (ms) × (1600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

Test plot as follows:

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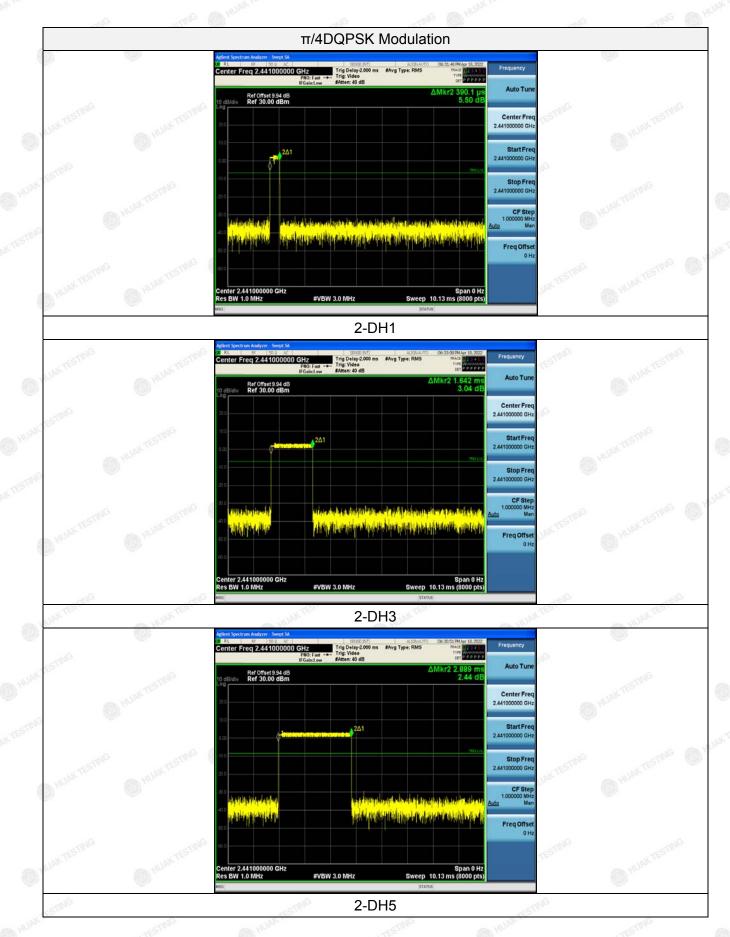
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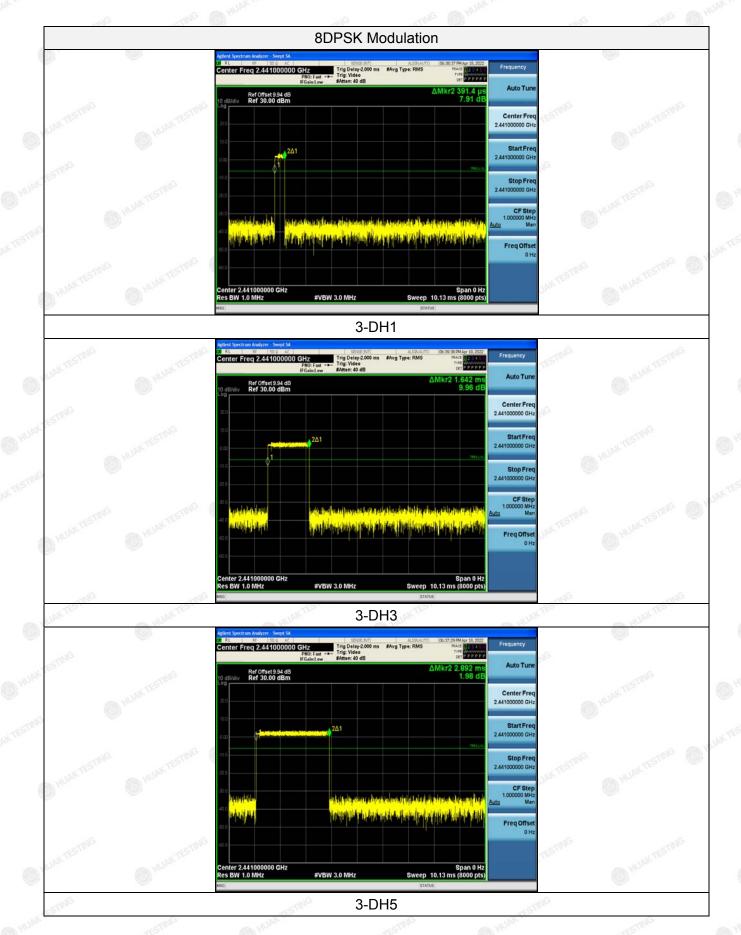


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3.8. OUT-OF-BAND EMISSIONS

Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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 con-ducted or a radiated measurement, pro-vided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter com-plies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Test Procedure

Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector, and max hold. Measurements utilizing these setting are made of the in-band reference level, band edge and out-of-band emissions.

Test Configuration



<u>Test Results</u>

Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandage measurement data.

We measured all conditions (DH1, DH3, DH5) and recorded worst case at DH5, 2DH5 and 3DH5.

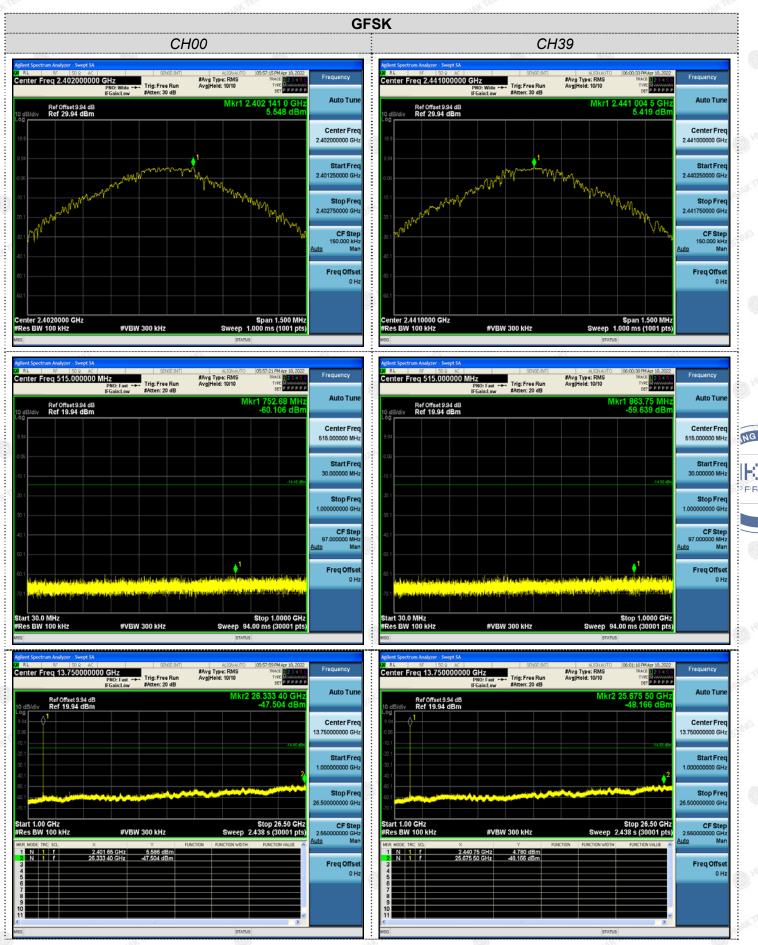
Test plot as follows:

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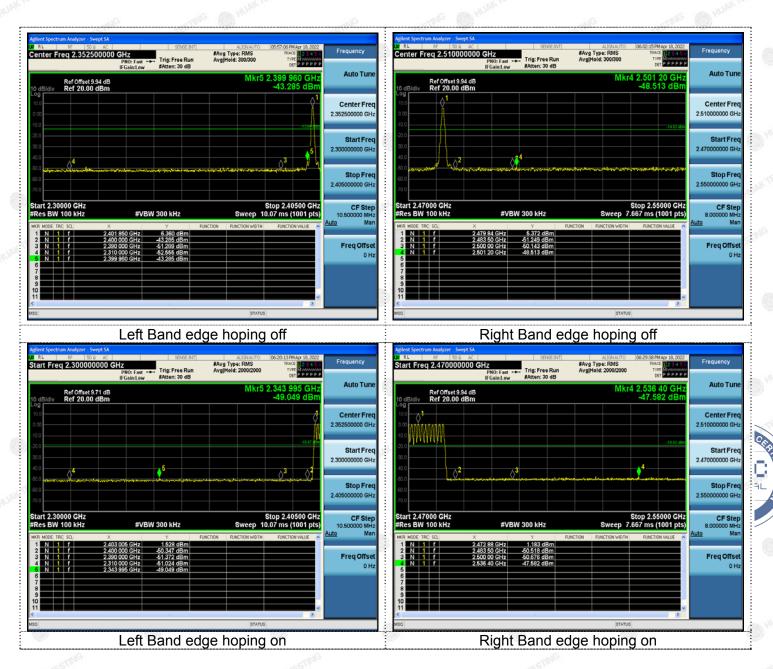


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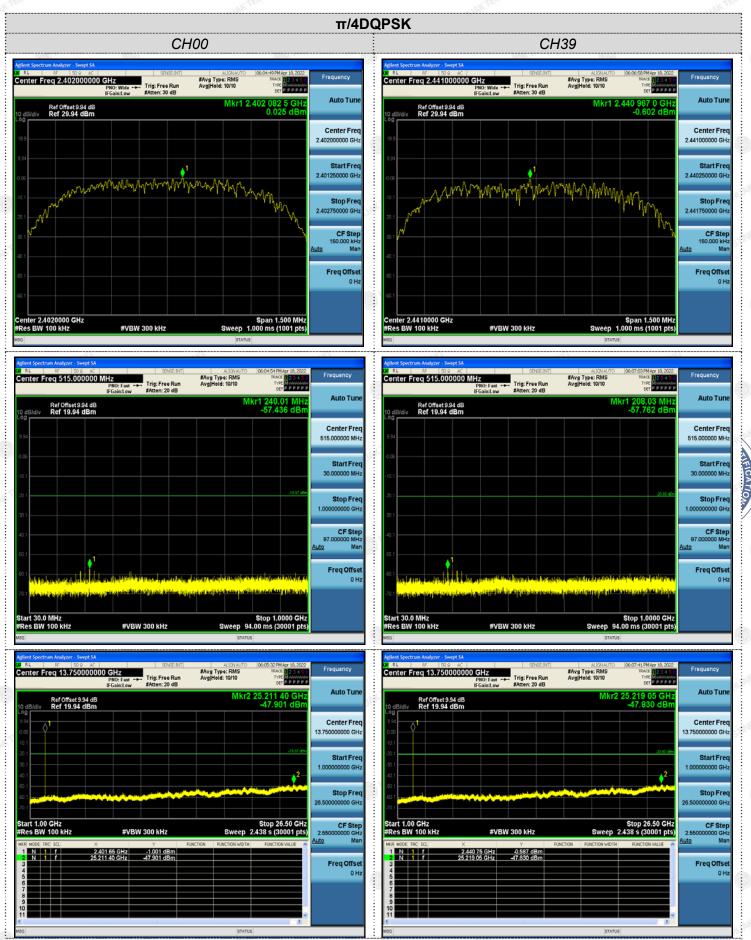


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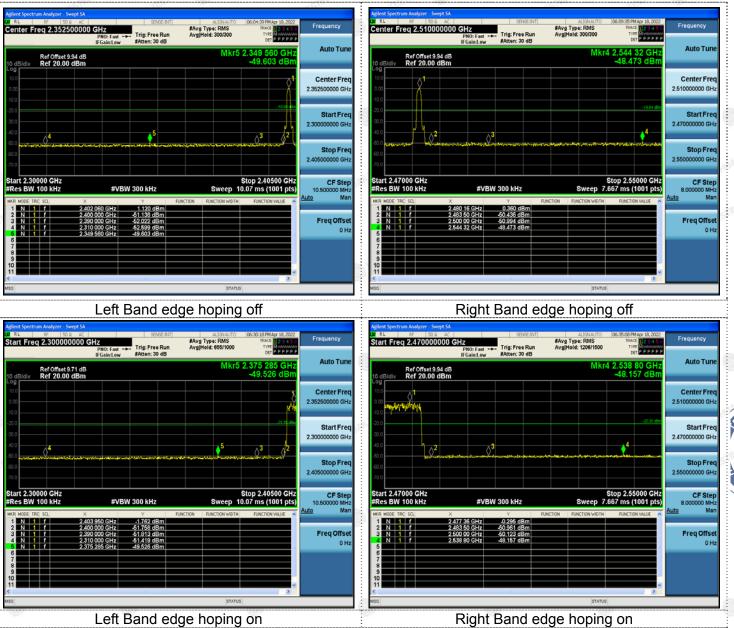
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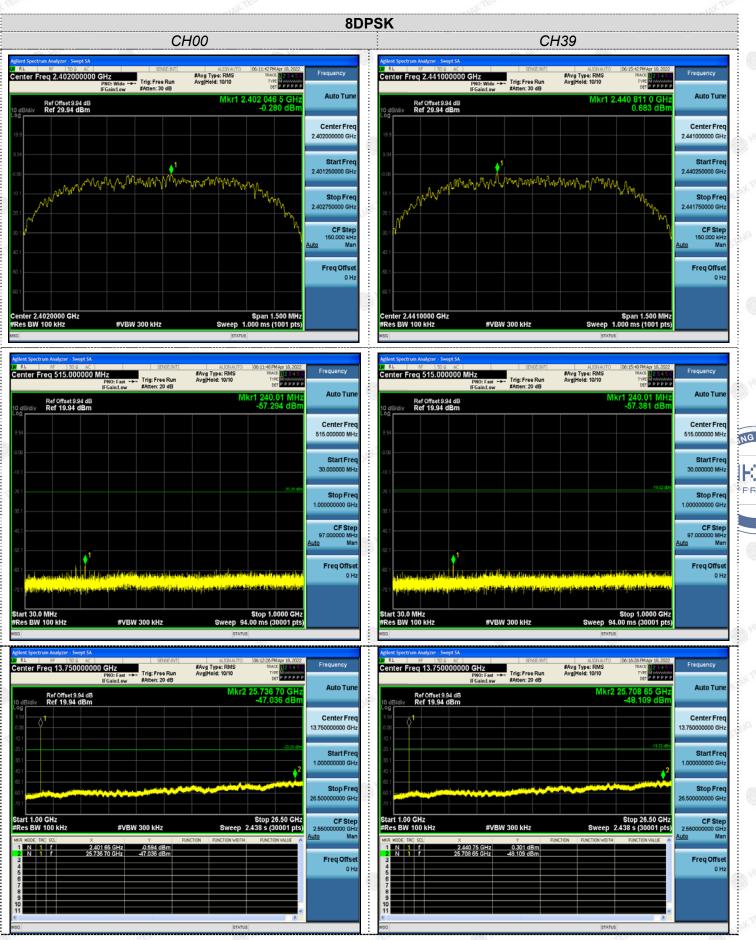
Left Band edge hoping on

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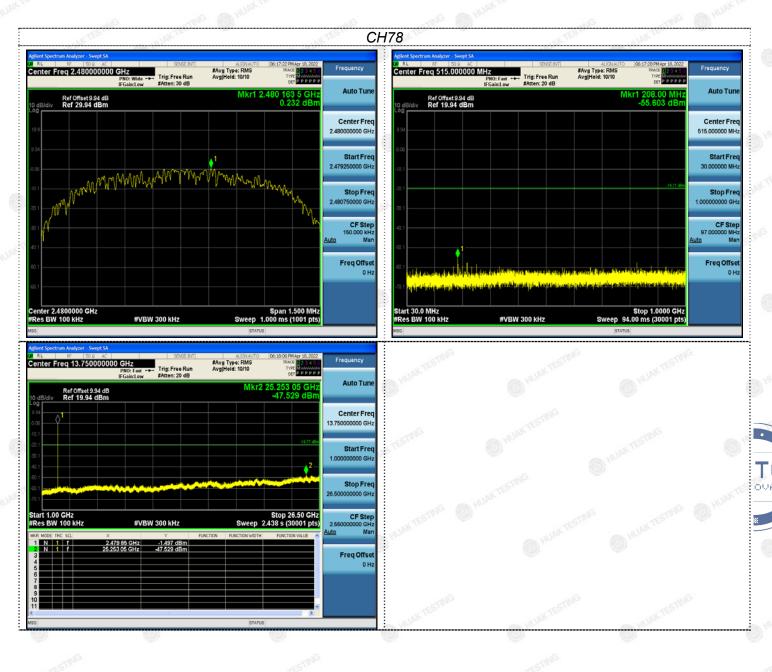


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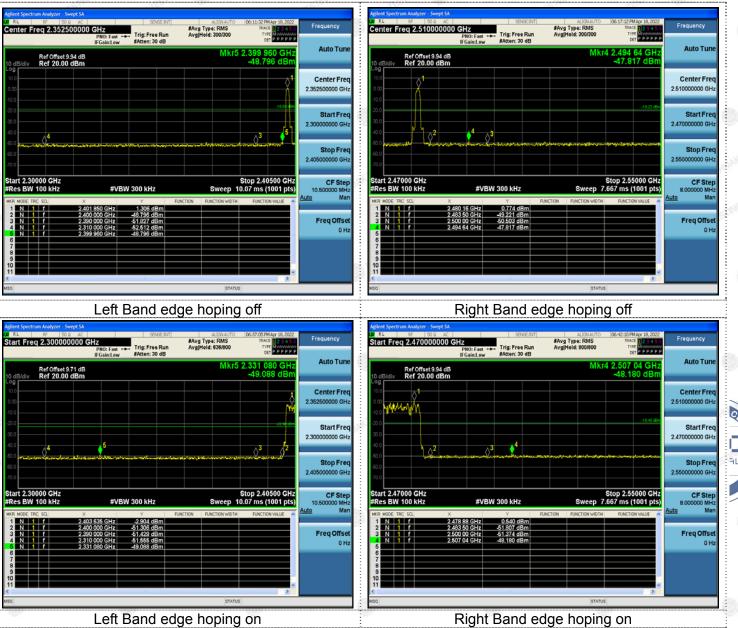
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Left Band edge hoping on

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3.9. PSEUDORANDOM FREQUENCY HOPPING SEQUENCE

TEST APPLICABLE

HUAK TESTING

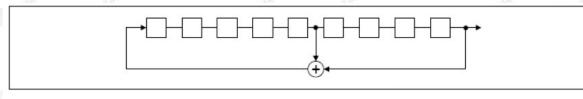
For 47 CFR Part 15C section 15.247 (a) (1):

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

EUT Pseudorandom Frequency Hopping Sequence Requirement

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 first stage. The sequence begins with the first one of 9 consecutive ones, for example: the shift register is initialized with nine ones.

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



Linear Feedback Shift Register for Generation of the PRBS sequence

0	2	4	6	62 64	78	1	73 7	5 77
								Т
				1 1				

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.

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3.10. ANTENNA REQUIREMENT

Standard Applicable

HUAK TESTING

For intentional device, according to FCC 47 CFR 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. And according to FCC 47 CFR Section 15.247, if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

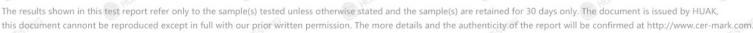
Refer to statement below for compliance.

The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

Antenna Connected Construction

The antenna used in this product is a Internal Antenna, which use a special interface and cannot easily replace. The directional gains of antenna used for transmitting is 0dBi.

ANTENNA



00 90 80 70 60 50 40 30 20 10 mm

20 40 30 50 10 100 30 80 10 60 20 40 30 50

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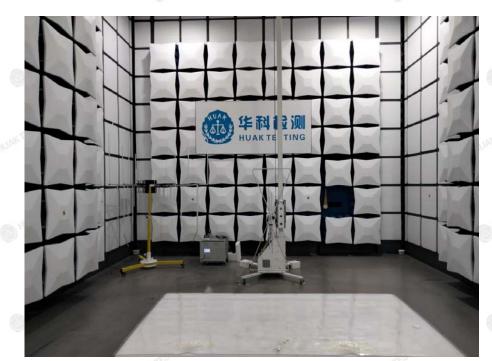


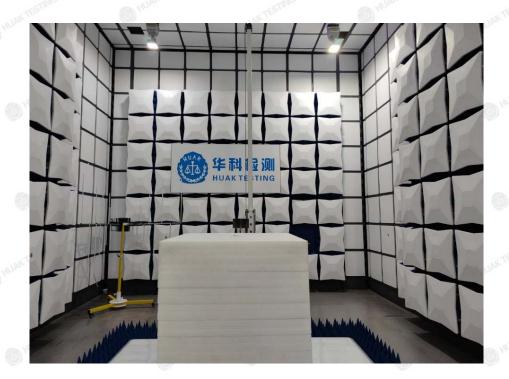
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4. TEST SETUP PHOTOS OF THE EUT

Radiated Emissions





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Conducted Emission



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5. PHOTOS OF THE EUT

Reference to the report: ANNEX A of external photos and ANNEX B of internal photos.

-----End of test report-----

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