

GFSK	and the second sec	Agilent Spectrum Analyzer - Occupied BW				
Low channel		07 R RF 50 R AC Center Freq 2.402000000 GHz	SENSE:INT ALIGNAUTO Center Freq: 2.40200000 GHz Trig: Free Run Avg Hold: 100/100	05:51:16 PMNov 20, 2023 Radio Std: None		
	27 AV	#IFGain:Low	#Atten: 30 dB	Radio Device: BTS Mkr3 2.402493 GHz	2	
	C' C' C	Ref Offset 6.71 dB 10 dB/div Ref 26.71 dBm Log		-22.577 dBm		
	40 40	16.7	1		-0-	
	S . S	3.29	2 milmin 2		S.Y	
	\circ \circ \circ	-233				
	\$	43.3		2 mm		
	6 6 6			man		
		Center 2.402 GHz #Res BW 30 kHz	#VBW 100 kHz	Span 3 MHz Sweep 3.2 ms		
	A A	Occupied Bandwidth	Total Power 8.01 dBm	Gweep 5.2 ma	C.Y	
	C' C' C	818.48 kHz				
	\$ \$	Transmit Freq Error 54.937 kHz				
	S	x dB Bandwidth 875.8 kHz	x dB -20.00 dB		5	
0.501		мва	STATUS			2
GFSK Mid channel	6 6 6	Agilent Spectrum Analyzer - Occupied BW R RF 50 Q AC Center Freq 2.441000000 GHz	SENSE:INT ALIGNAUTO Center Freg: 2.441000000 GHz	05:52:44 PMNov 20, 2023 Radio Std: None	× .	
wid channel	4 4	#IFGain:Low	Trig: Free Run Avg Hold: 100/100 #Atten: 30 dB	Radio Device: BTS	-	
	S . S .	Ref Offset 6.72 dB		Mkr3 2.441491 GHz -23.302 dBm	ST	
		16.7				
	\$	-3.28	min			
	6 6 6	-133 -233	2 mm 13			
		-33.3 -43.3				
	K K	C C C C C C C C C C C C C C C C C C C		M. Jumm	C.Y	
	C' C' C	Center 2.441 GHz		Span 3 MHz	1	
	\$ \$	#Res BW 30 kHz Cccupied Bandwidth	#VBW 100 kHz Total Power 7.09 dBm	Sweep 3.2 ms	.9	
	8 8 6	797.50 kHz				
		Transmit Freq Error 50.312 kHz				
	RY RY	x dB Bandwidth 880.7 kHz	x dB -20.00 dB		~~~	
	C' C' (
		MSG	STATUS			
GFSK High channel	ST ST	Aglient Spectrum Analyzer - Occupied BW DR R BF 50 Q AC Center Freq 2.480000000 GHz	SENSE:INT ALIGNAUTO Center Freq: 2.480000000 GHz	05:53:38 PMNov 20, 2023 Radio Std: None	S.	
nigh channel		#IFGain:Low	Trig: Free Run Avg Hold: 100/100	Radio Device: BTS		
g		Ref Offset 6.73 dB 10 dB/dly Ref 26.73 dBm		Mkr3 2.480516 GHz -25.498 dBm		
	2 x x x	10 dB/div Ref 26.73 dBm		-25.498 dBm		
55 ° 55 °	65 × 65 × 6	10 dB/div Ref 26.73 dBm		-25.498 dBm		
5 × 5 ×		10 dB/div Ref 26.73 dBm	m	-25.498 dBm	-	
CAB CAB	578 578 (578 578 (10 dB/div Ref 26.73 dBm 167 673 3.27 113 -233	2 m 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	-25.498 dBm	5.4	
		10 dB/div Ref 26.73 dBm 107 107 107 107 107 107 107 107		-23.499 dism	C B	
		10 dB/div Ref 26,73 dBm 167 177 3,27 133 433 433 433 433 433 433 433		-23.498 dBm	4	
		167 107 673 327 123 333 433 433	Arrive As a start of the start	Van James	1 B	
		Log 673 3.7 4.3 4.3 4.3 4.3 4.3 4.3 Center 2.48 GHz #Res BW 30 kHz	#VBW 100 kHz		5 B	
		167 107 673 327 123 333 433 433	#VBW 100 kHz Total Power 5.55 dBm	Van James	2.4 2.4 2.4	
		Log Image: Constraint of the second sec	#VBW 100 kHz Total Power 5.55 dBm OBW Power 99.00 %	Van James	5 P 5 P 5 P	
		Leg 67 37 37 37 37 37 37 37 37 37 3	#VBW 100 kHz Total Power 5.55 dBm OBW Power 99.00 %	Van James	2 4 2 4 2 4 2 4	

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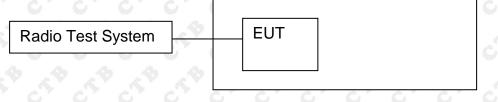
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11. CARRIERFREQUENCIES SEPARATION

11.1 Block Diagram Of Test Setup



11.2 Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz 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 0.125W.

11.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port

to the spectrum.

2. Set the spectrum analyzer: RBW = 100kHz. VBW = 300kHz , Span = 2MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

11.4 Test Result

Ria	ht	ear:	
1 119		our.	

Mode	Channel.	Carrier Frequency Separation [MHz]	Limit(2/3 of the 20dB bandwidth MHz)	Verdict	
GFSK	LCH	0.998	0.584	PASS	
GFSK	MCH	1.002	0.587	PASS	
GFSK	НСН	1.008	0.615	PASS	
π/4DQPSK	LCH	1.008	0.859	PASS	
π/4DQPSK	MCH	0.994	0.859	PASS	
π/4DQPSK	НСН	1.006	0.858	PASS	

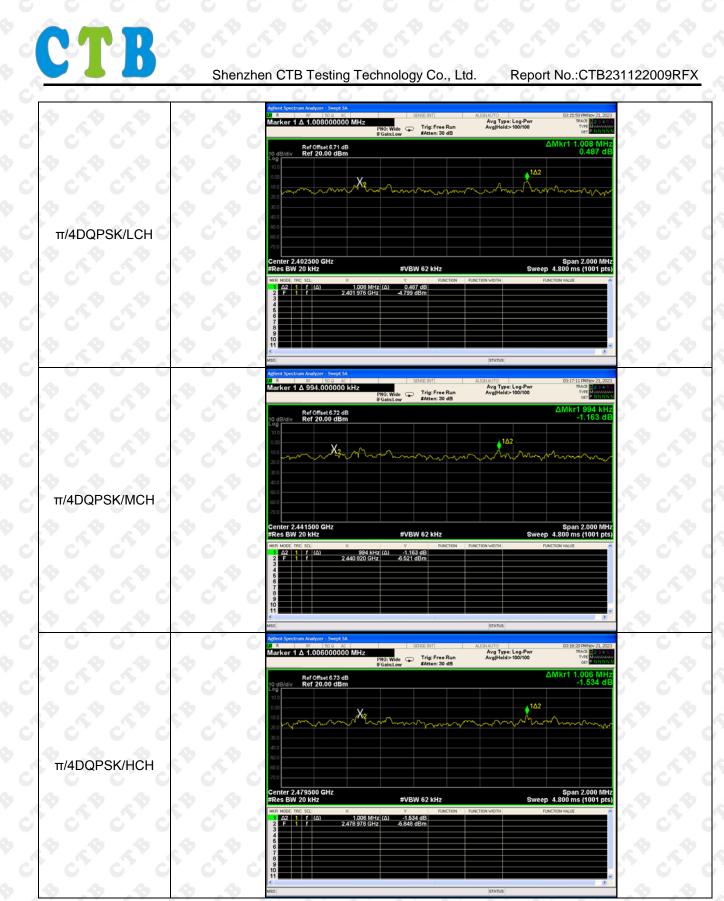
Left ear:

Mode	Channel.	Carrier Frequency Separation [MHz]	Limit(2/3 of the 20dB bandwidth MHz)	Verdict
GFSK	LCH	0.994	0.577	PASS
GFSK	MCH	1.004	0.571	PASS
GFSK	НСН	<u> </u>	0.582	PASS
π/4DQPSK	LCH	1.004	0.855	PASS
π/4DQPSK	MCH	0.996	0.874	PASS
π/4DQPSK	НСН	1.002	0.881	PASS

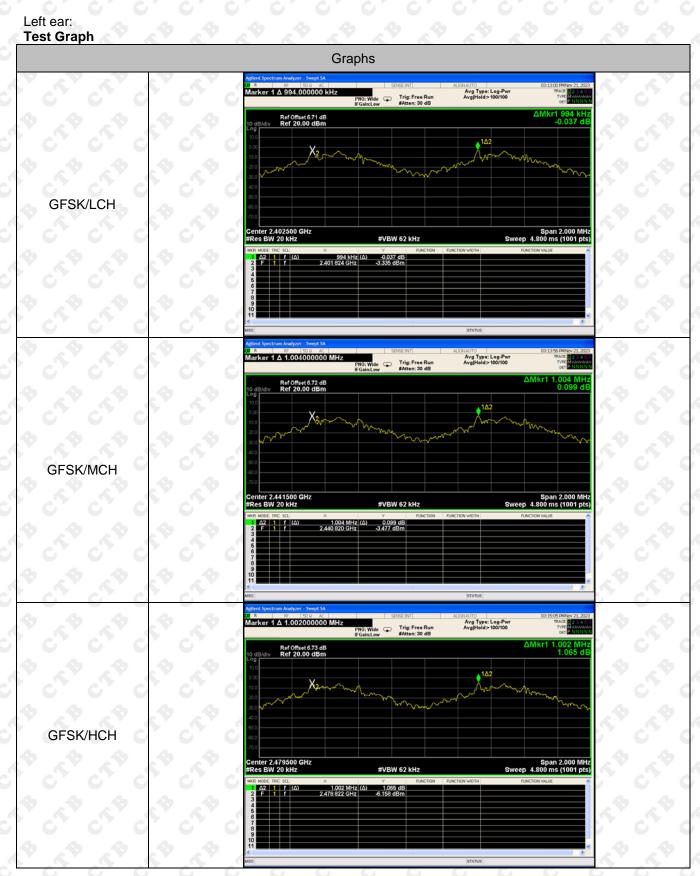


Right ear: Test Graph







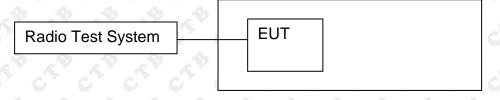






12. HOPPING CHANNEL NUMBER

12.1 Block Diagram Of Test Setup



12.2 Limit

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

12.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 100kHz. VBW = 300kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.

4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.4835GHz. Sweep=auto;

12.4 Test Result

Right ear:

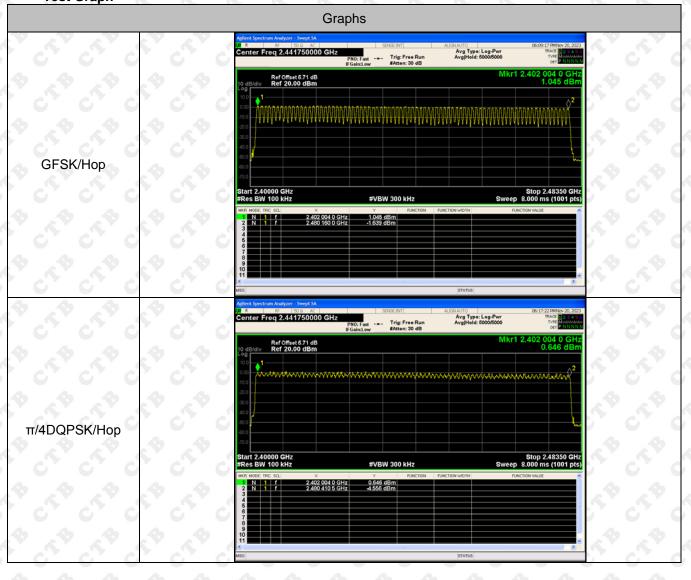
Mode	Channel.	Number of Hopping Channel	Limit	Verdict	
GFSK	Нор	79	≥15	PASS	
π/4DQPSK	Нор	79	≥15	PASS	

Left ear:

Mode Channel.		Number of Hopping Channel	Limit	Verdict	
GFSK	Нор	79	≥15	PASS	
π/4DQPSK	Нор	79	≥15	PASS	



Right ear: Test Graph

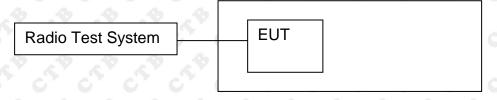




		G	raphs					
ి లో లో లో ల	5 × 5 × 0	Aglent Spectrum Analyzer - Swept SA J. R. Barling - 55 (500 - Act) Center Freq 2.441750000 GF	carcard	ALIGNAUTO Avg Type: Log-Pwr Avg[Hold: 5000/5000	03:41:23 PMNov 21, 2023 TRACE 12 2 4 4 5 TVM M	S.V.	cr ^r	6
	SP CLP	Comparison of the sector	<u> </u>		2.402 004 0 GHz -0.658 dBm			5
* 5 [*] 5 [*] 6	58 558				LAAAAAAAAAAA			5
GFSK/Hop	58 558	400 300 Start 2.40000 GHz #Res BW 100 kHz	#VBW 300 kHz	Sweep	Stop 2.48350 GHz 8.000 ms (1001 pts)			5
	2 B C 2 B	MRR MODE TRC SL X 1 N 1 f 2402004 2 N 1 f 2.479993 4 5 6 7	Y FUNCTION F 0 GHz -0,659 dBm 0 GHz -2,544 dBm	UNCTION WIDTH FUNC	TION VALUE			Ś
^b c ¹ ^b c ¹ ^b c	5 8 c 5 8	8 10 11 <		STATUS	2	50	C'TB	Ś
	58 558	Aglient Spectrum Analyzer - Swept SA D R BF 500 AC Center Freq 2.441750000 G	PNO: Fast Trig: Free Run IFGain:Low #Atten: 30 dB	ALIGNAUTO Avg Type: Log-Pwr Avg Held: 5000/5000	03:49:04 PMNov 21, 2023 TRACE 22 4 5 TVRE PUNNIN Det PUNNIN 2.401 670 0 GHZ			c'
	rt crt	10 dB/dlv Ref 20.00 dBm	uuluununun		2.401 670 0 GHz -5.437 dBm			5
π/4DQPSK/Hop	r o cro	400						Ś
	2 8 c 2 8	Start 2.40000 GHz #Res BW 100 kHz MKR MODE TRC SCL X		Sweep :	Stop 2.48350 GHz 8.000 ms (1001 pts)			5
	50 50	1 N 1 f 2401670 2 N 1 f 2.480243 3 1 f 2.480243 5 6 6 7	0 GHz 5,437 dBm 5 GHz -7.016 dBm					5
	A .A	8 10 11		STATUS	×			K



- 13. DWELL TIME
- 13.1 Block Diagram Of Test Setup



13.2 Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

13.3 Test procedure

Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
 Set spectrum analyzer span = 0. Centred on a hopping channel;

3. Set RBW = 1MHz and VBW = 3MHz.Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.

4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).



13.4 Test Result

Right ear: Worst case-GFSK:

Mode	Packet	Channel	Pulse Time (ms)	Total Dwell Time (ms)	Limit (ms)	Verdict
	DH1	LCH	0.376	120.32	400	PASS
	DH1	MCH	0.376	120.32	<u> </u>	PASS
	DH1	HCH	0.376	120.32	400	PASS
	DH3	LCH	1.638	262.08	400	PASS
GFSK	DH3	MCH	1.638	262.08	400	PASS
	DH3	HCH	1.638	262.08	400	PASS
	DH5	LCH	2.88	307.2	400	PASS
	DH5 MCH		2.881	307.307	400	PASS
	DH5	HCH	2.88	307.2	400	PASS

Left ear:

Worst case-GFSK:

Mode	Packet	Channel	Pulse Time (ms)	Total Dwell Time (ms)	Limit (ms)	Verdict	
	DH1	LCH	0.383	122.56	400	PASS	
	DH1	MCH	0.383	122.56	400	PASS	
	DH1	HCH	0.383	122.56	400	PASS	
	DH3	LCH	1.644	263.04	400	PASS	
GFSK	DH3	MCH	1.644	263.04	400	PASS	
	DH3	HCH	1.644	263.04	400	PASS	
	DH5	LCH	2.887	307.947	400	PASS	
	DH5	MCH	2.888	308.053	400	PASS	
	DH5	HCH	2.887	307.947	400	PASS	

Remark: DH5 Packet permit maximum 1600 / 79 / 6 hops per second in each channel (5 time slots RX, 1 time slot TX).

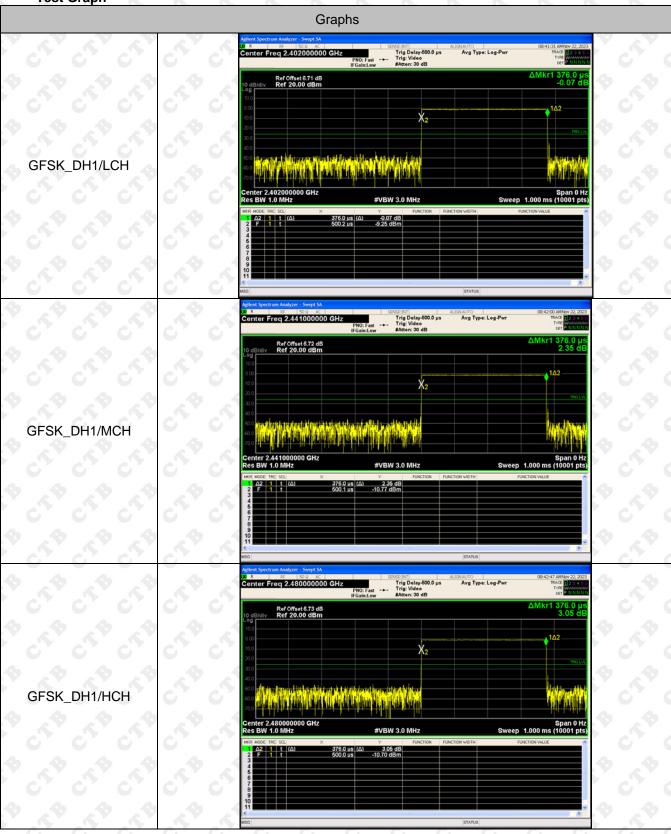
DH3 Packet permit maximum 1600 / 79 / 4 hops per second in each channel (3 time slots RX, 1 time slot TX).

DH1 Packet permit maximum 1600 / 79 /2 hops per second in each channel (1 time slot RX, 1 time slot TX). So, the Dwell Time can be calculated as follows:

DH5:1600/79/6*0.4*79*(MkrDelta)/1000 DH3:1600/79/4*0.4*79*(MkrDelta)/1000 DH1:1600/79/2*0.4*79*(MkrDelta)/1000 Remark: Mkr Delta is once pulse time.



Right ear: Test Graph





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	Graphs
دی ^{می} کی ^{مر} کبی دیری مرکبی دیری مرکبی مرکبی	Agent of Spectrum Analyzer - Swept SA All/Autro OD-41:30 PM/orv 21, 2023 Center Freq 2.402000000 GHz IF GainLew Trig Delay-500.0 µs Avg Type: Log-Pwr TriAct Play-500.0 µs Ref Offset 871 dB Anten: 30 dB CMMkr1 383.0 µs -12.45 dB 0.9 dB/dly Ref Offset 871 dB -12.45 dB -12.45 dB 0.00 V V V -12.45 dB 0.00 V V -10.00 Jb -10.00 Jb
GFSK_DH1/LCH	Center 2.402000000 GHz Span 0 Hz Res BW 1.0 MHz #VBW 3.0 MHz Sweep 1.000 ns (10001 pts) WR MODE TRC SCI X Y Parcton Parcton wolth Parcton value 1 d/2 1 1 1 (d) 383.0 µs (d) 12.45 dB 12.45 dB 10.41 dBm 1
GFSK_DH1/MCH	Address Security Address Security Address Security Address Security Address Security Address Security Center Freq 2.441000000 GHz IFG elist security Trig Delay Security Avg Type: Leg Pwr Proc Freq 2.441000000 GHz IFG elist security Trig Delay Security Avg Type: Leg Pwr Proc Freq 2.441000000 GHz IFG elist security Avg Type: Leg Pwr Trince Purchase Proc Freq 2.441000000 GHz Proc Freq 2.441000000 GHz IFG elist security Avg Type: Leg Pwr Trince Purchase Proc Freq 2.441000000 GHz Proc Freq 2.441000000 GHz IFG elist security Avg Type: Leg Pwr Trince Purchase Proc Freq 2.441000000 GHz Proc Freq 2.441000000 GHz IFG elist security Trince Purchase Proc Freq 2.441000000 GHz Trince Purchase Proc Freq 2.44000 Just security Proc Freq 2.441000000 GHz IFG elist security Trince Purchase Proc Freq 2.4400 Just security Trince Purchase Proc Freq 2.4400 Just security Trince Purchase Purchase Proc Freq 2.4400 Just security Proc Freq 2.4400 Just security Trince Purchase Purchase Purchase Purchase Purchase Purchase Trince Purchase Purc
	Center 2.441000000 GHz Span 0 Hz Res BW 1.0 MHz #VBW 3.0 MHz Sweep 1.000 ms (10001 pts) WR MOST X Panction Ranction worth A2 1 L A383.0 µs A33.3 dBm A3 F 1 L A393.0 µs A33.3 dBm A3 F 1 L A393.0 µs A33.3 dBm A3 F 1 L A393.0 µs A33.3 dBm M35 Mas Section Ranction worth Ranction worth M35 B B Control worth Ranction worth M35 B Control worth Ranction worth Ranction worth M35 B Control
GFSK_DH1/HCH	Center 2.480000000 GHz Res BW 1.0 MHz TV 102 TV 102
	2 F 1 t 600.2 µs -12.02 dBm 3 4 4 -







Shenzhen CTB Testing Technology Co., Ltd. Report No.:CTB231122009RFX NSE:NT Trig Delay-500.0 μs Trig: Video #Atten: 30 dB Center Freq 2.402000000 GHz Avg Type: Log-Pw --Ref Offset 6.71 dB Ref 20.00 dBm indi la di mandri da di GFSK_DH5/LCH Span 0 Hz eep 5.000 ms (10001 pts) nter 2.402000 s BW 1.0 MHz 00 GH #VBW 3.0 MHz 2.887 ms (Δ) -6.07 dB 499.5 μs -15.12 dBm enter Freq 2.441000000 GHz PNO: Fast ---- Trig: Video IFGain:Low #Atten: 30 dB Avg Type: Log-Pwr Ref Offset 6.72 dB Ref 20.00 dBm X₂ GFSK_DH5/MCH 000 GHz nter 2.441000 Span 0 H Sweep 5.000 ms (10001 pts #VBW 3.0 MHz 4.71 d -10.93 dBr 2.888 ms (Δ) 499.5 μs NSE:INT Trig Delay-500.0 µs Trig: Video #Atten: 30 dB enter Freq 2.480000000 GHz Avg Type: Log-Pwr Ref Offset 6.73 dB Ref 20.00 dBm 142 Center 2.48000 Res BW 1.0 MH Span 0 H Sweep 5.000 ms (10001 pt #VBW 3.0 MHz 2.887 ms (Δ) -4.33 dB 500.0 μs -17.89 dBm

GFSK_DH5/HCH



14. PSEUDORANDOM FREQUENCY

14.1 Limit

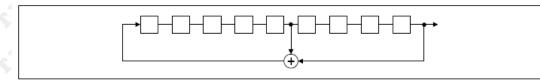
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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. The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom 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 hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

14.2 Test procedure

The pseudorandom sequence may be generated in a nine-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; i.e. 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)



An example of Pseudorandom Frequency Hopping Sequence as follow:

20 62 4	6 77		7 64	8	73			16:75	; 1	
	TT	 T	Т						\square	ľ
										2
	<u> </u>	 		JL	<u>ц</u>	(C) *	0			

Each frequency used equally on the average by each transmitter.

The system receivers have input bandwidths that match the hopping channel bandwidths of their Corresponding transmitters and shift frequencies in synchronization with the transmitted signals.



14.3 Test Result

The device does not have the ability to be coordinated with other FHSS systems in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters.



15. ANTENNA REQUIREMENT

15.203 requirement:

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. 15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

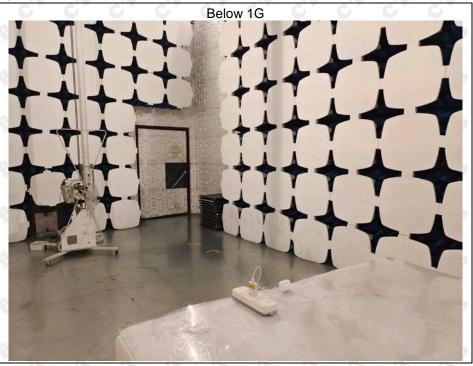
EUT Antenna:

The antenna is Chip antenna. The best case gain of the antenna is 2.67dBi.



16. EUT TEST SETUP PHOTOGRAPHS

Radiated Emission



Below 1G





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Conducted emissions



***** END OF REPORT ****