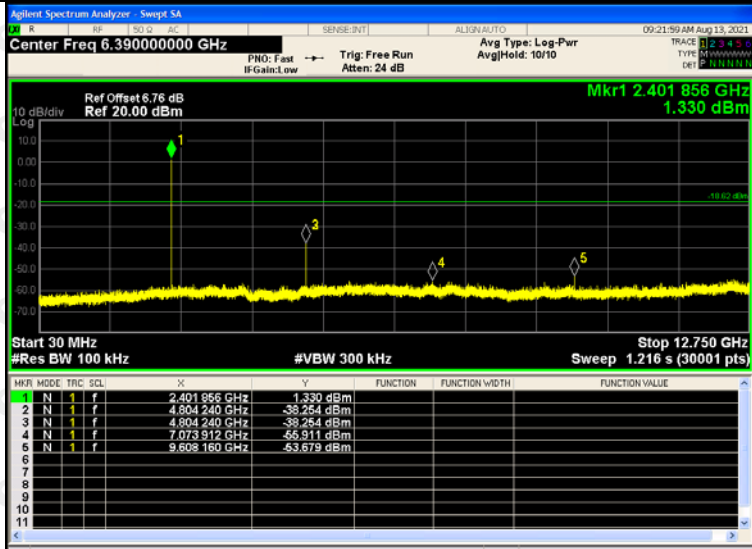
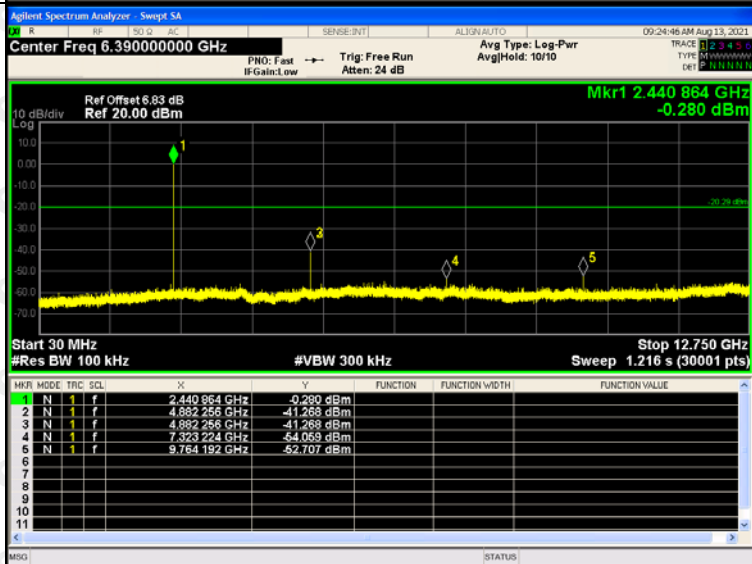


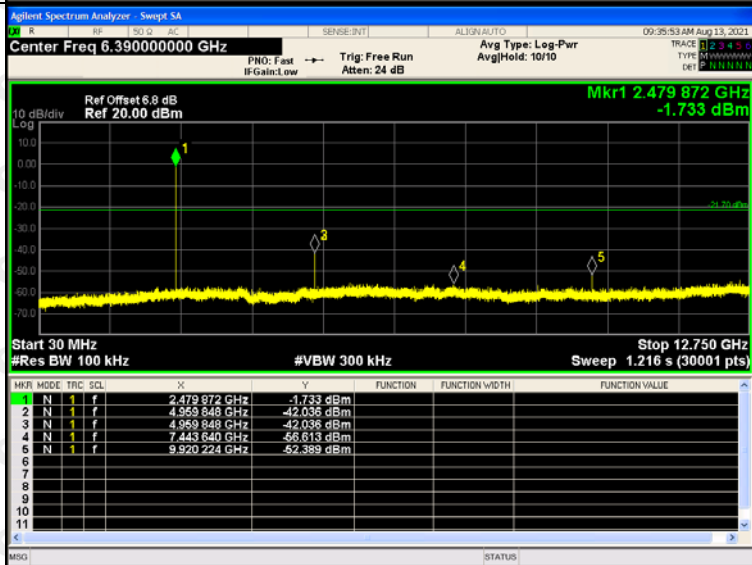
8DPSK /LCH



8DPSK /MCH

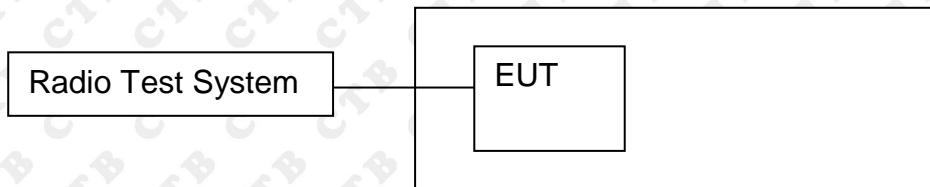


8DPSK /HCH



9. COUDUCTED PEAK OUTPUT POWER

9.1 Block Diagram Of Test Setup



9.2 Limit

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

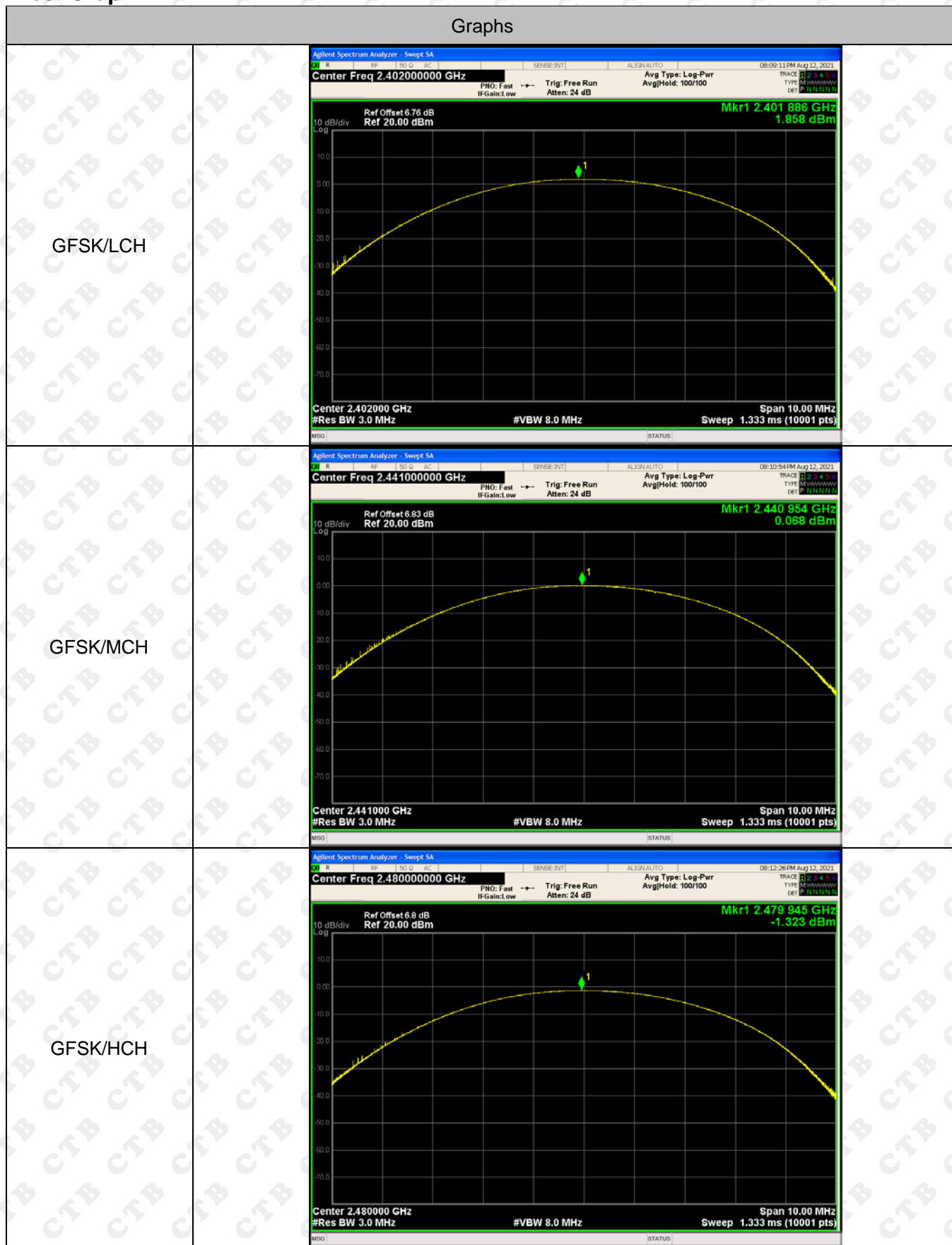
9.3 Test procedure

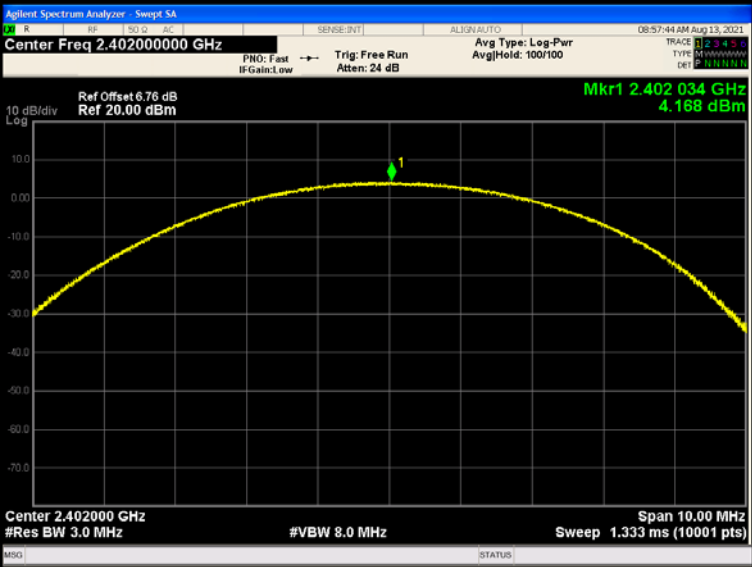
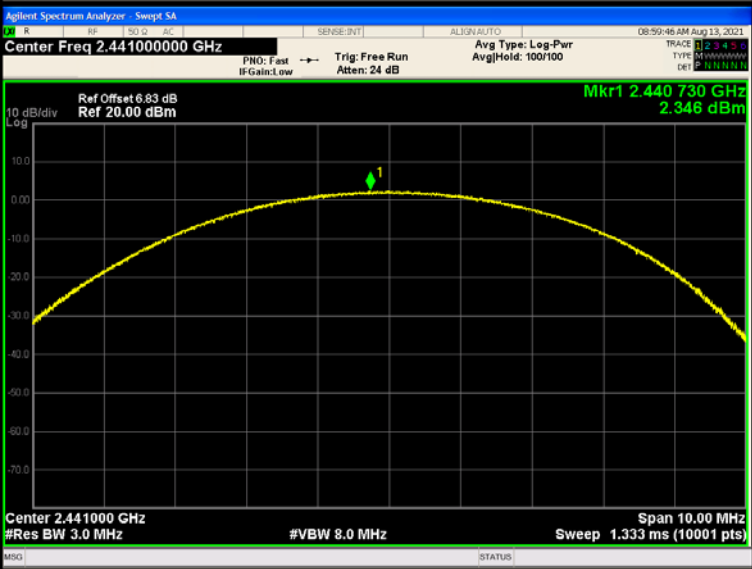
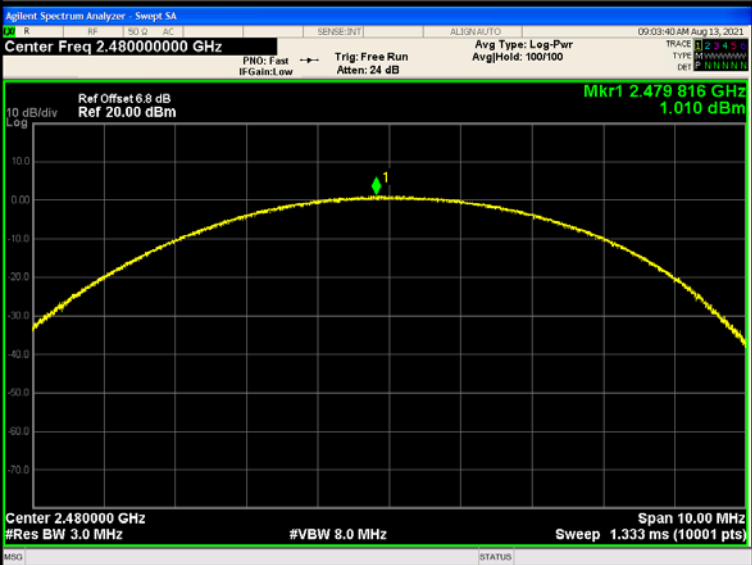
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3MHz. VBW = 8MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, middle and highest channel individually. Record the max value.

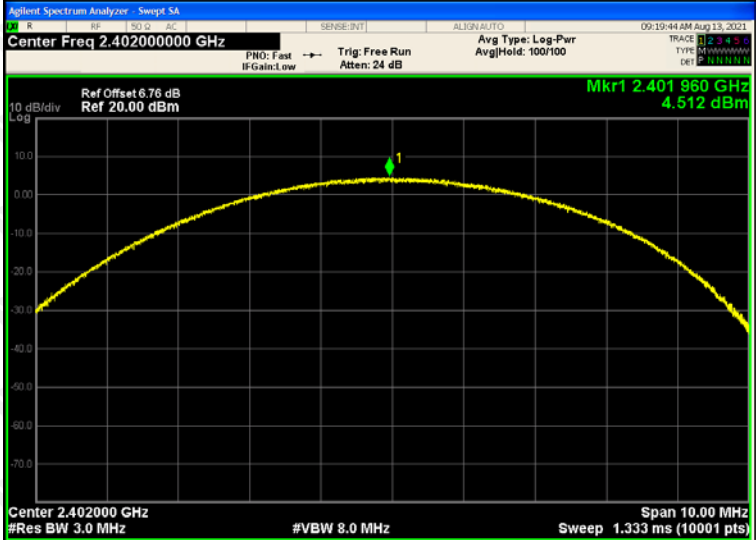
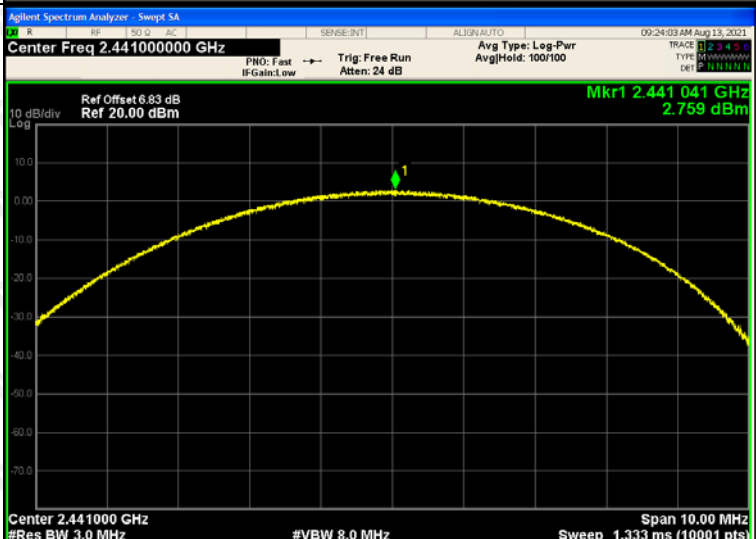
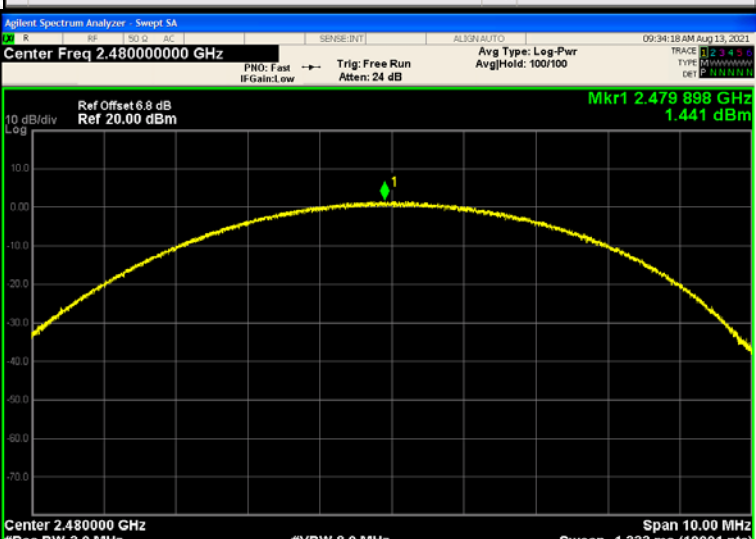
9.4 Test Result

Mode	Channel.	Maximum Peak Output Power [dBm]	Verdict
EDR mode (GFSK)	LCH	1.858	PASS
	MCH	0.068	PASS
	HCH	-1.323	PASS
EDR mode ($\pi/4$ DQPSK)	LCH	4.168	PASS
	MCH	2.346	PASS
	HCH	1.01	PASS
EDR mode (8DPSK)	LCH	4.512	PASS
	MCH	2.759	PASS
	HCH	1.441	PASS

Test Graph:

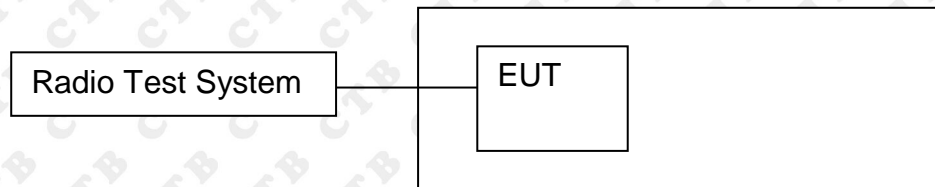


$\pi/4$ DQPSK/LCH	
$/4$ DQPSK/MCH	
$\pi/4$ DQPSK/HCH	

8DPSK/LCH	
8DPSK /MCH	
8DPSK /HCH	

10. 20DB OCCUPIED BANDWIDTH

10.1 Block Diagram Of Test Setup



10.2 Limit

Alternatively, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125mw.

10.3 Test procedure

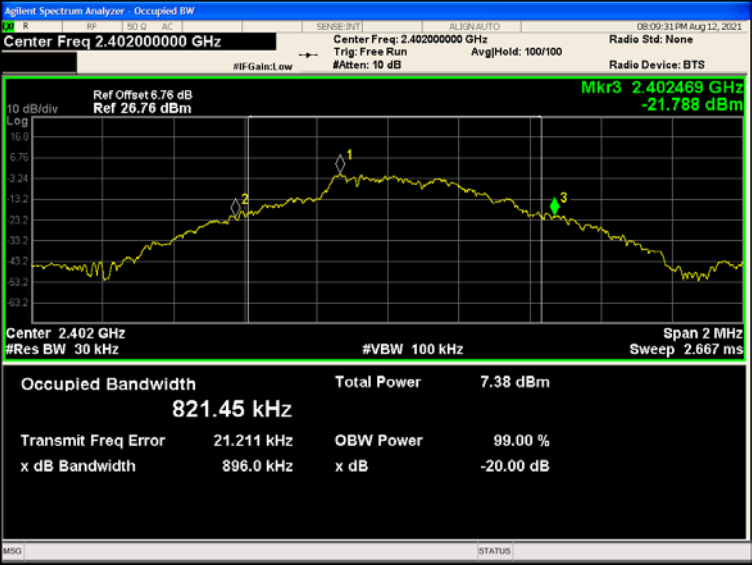
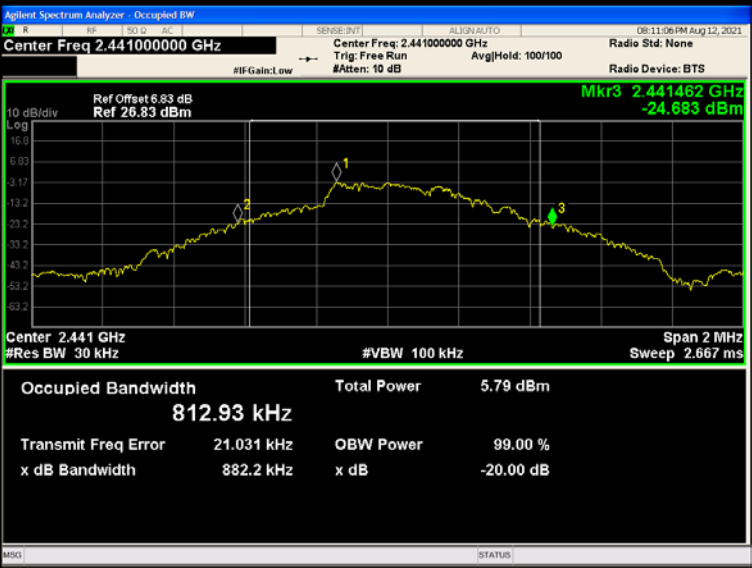

1. Rem1. Set RBW = 30 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times \text{RBW}$.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

10.4 Test Result

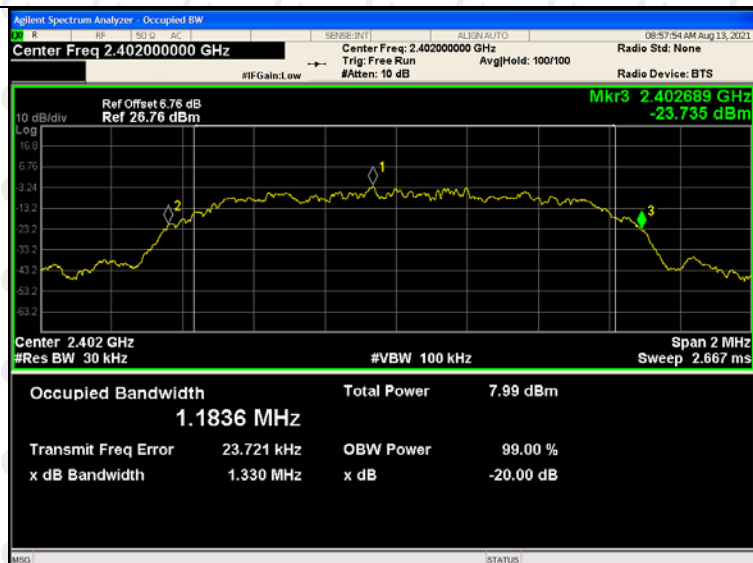
Test Mode	Frequency	20dB Bandwidth (MHz)	Result
GFSK	Low channel	0.896	PASS
	Mid channel	0.882	PASS
	High channel	0.872	PASS
$\pi/4$ DQPSK	Low channel	1.33	PASS
	Mid channel	1.325	PASS
	High channel	1.279	PASS
8DPSK	Low channel	1.249	PASS
	Mid channel	1.249	PASS
	High channel	1.252	PASS

Note: All modes of operation were Pre-scan and the worst-case emissions are reported.

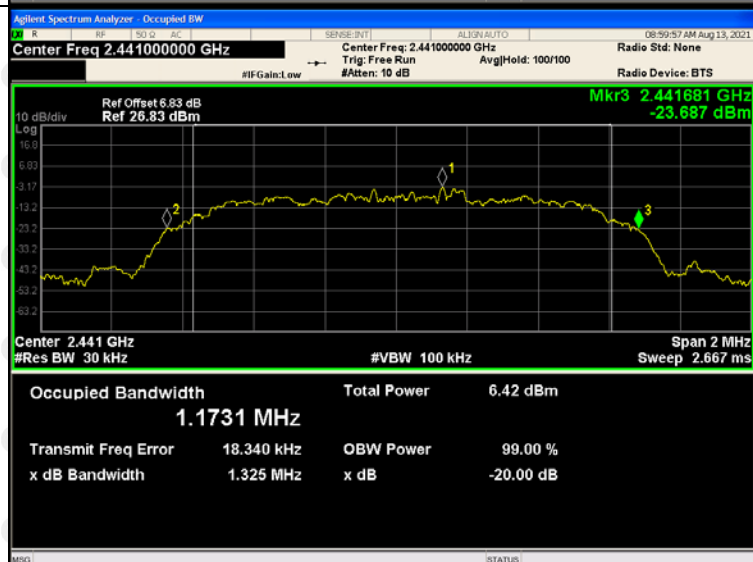
Test Graph:

<p>GFSK Low channel</p>	
<p>GFSK Mid channel</p>	
<p>GFSK High channel</p>	

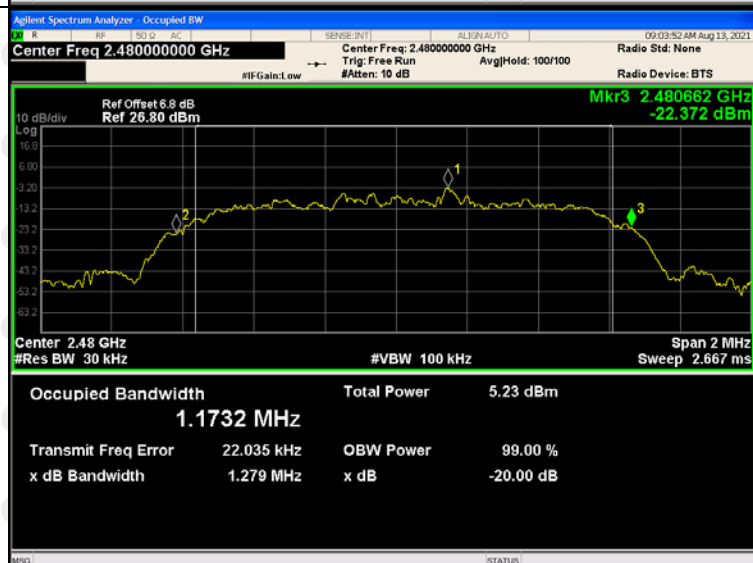
$\pi/4$ -DQPSK
Low channel

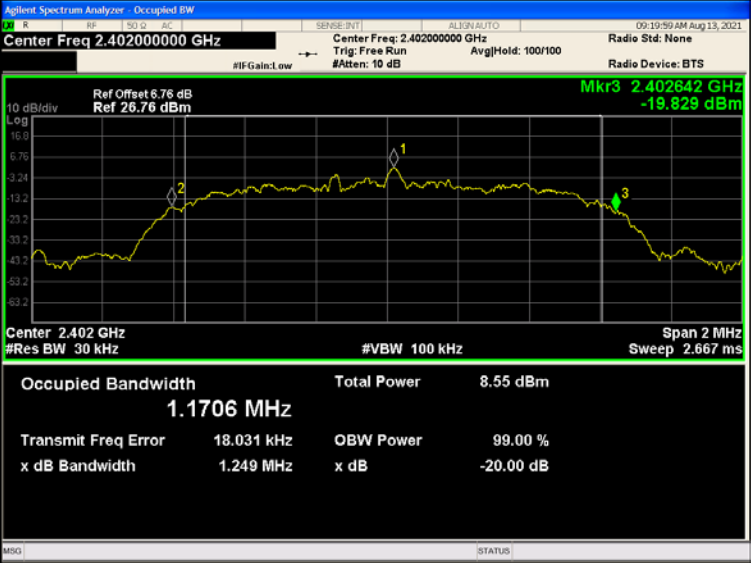
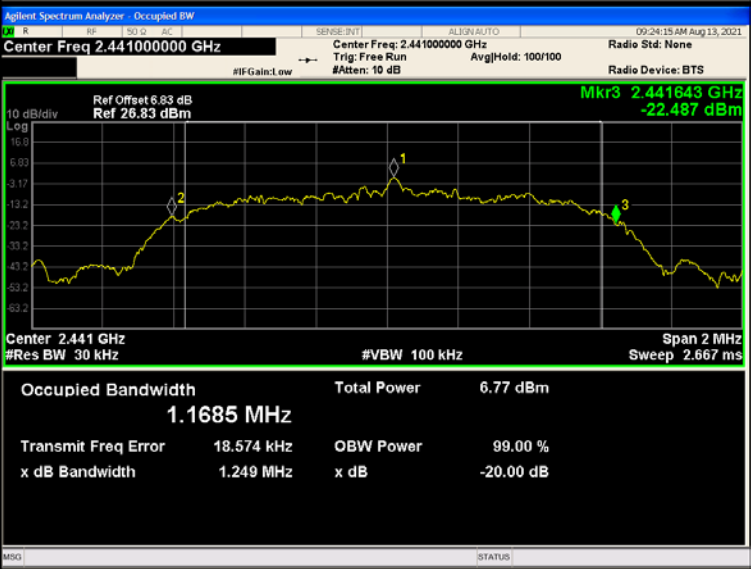
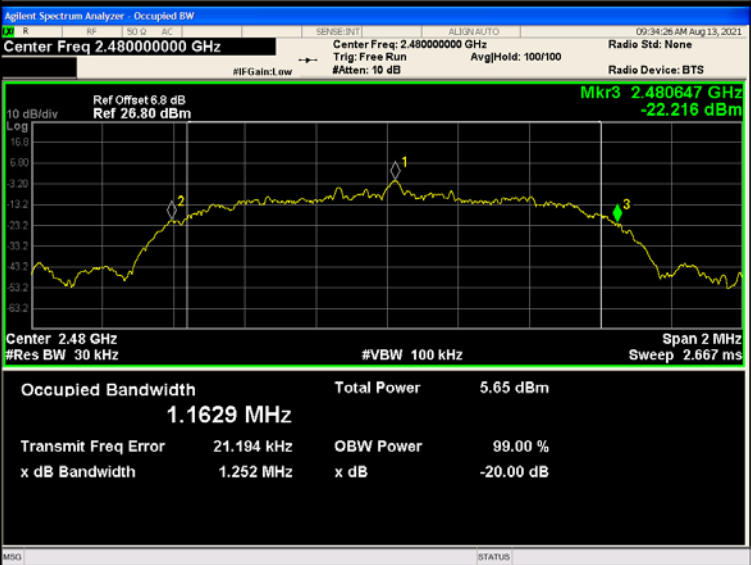


$\pi/4$ -DQPSK
Mid channel



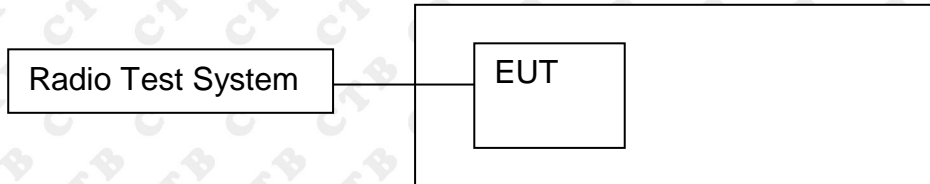
$\pi/4$ -DQPSK
High channel



<p>8DPSK Low channel</p>	 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq 2.40200000 GHz</p> <p>Ref Offset 6.76 dB Ref 26.76 dBm</p> <p>Mkr3 2.402642 GHz -19.829 dBm</p> <p>Center 2.402 GHz #Res BW 30 kHz</p> <p>Span 2 MHz Sweep 2.667 ms</p> <p>Occupied Bandwidth 1.1706 MHz</p> <p>Total Power 8.55 dBm</p> <p>Transmit Freq Error 18.031 kHz</p> <p>OBW Power 99.00 %</p> <p>x dB Bandwidth 1.249 MHz</p> <p>x dB -20.00 dB</p>
<p>8DPSK Mid channel</p>	 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq 2.44100000 GHz</p> <p>Ref Offset 6.83 dB Ref 26.83 dBm</p> <p>Mkr3 2.441643 GHz -22.487 dBm</p> <p>Center 2.441 GHz #Res BW 30 kHz</p> <p>Span 2 MHz Sweep 2.667 ms</p> <p>Occupied Bandwidth 1.1685 MHz</p> <p>Total Power 6.77 dBm</p> <p>Transmit Freq Error 18.574 kHz</p> <p>OBW Power 99.00 %</p> <p>x dB Bandwidth 1.249 MHz</p> <p>x dB -20.00 dB</p>
<p>8DPSK High channel</p>	 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq 2.48000000 GHz</p> <p>Ref Offset 6.8 dB Ref 26.80 dBm</p> <p>Mkr3 2.480647 GHz -22.216 dBm</p> <p>Center 2.48 GHz #Res BW 30 kHz</p> <p>Span 2 MHz Sweep 2.667 ms</p> <p>Occupied Bandwidth 1.1629 MHz</p> <p>Total Power 5.65 dBm</p> <p>Transmit Freq Error 21.194 kHz</p> <p>OBW Power 99.00 %</p> <p>x dB Bandwidth 1.252 MHz</p> <p>x dB -20.00 dB</p>

11. CARRIER FREQUENCIES 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 = 30kHz. VBW = 100kHz , Span = 3.0MHz. 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

Mode	Channel.	Carrier Frequency Separation [MHz]	Verdict
GFSK	LCH	0.999	PASS
GFSK	MCH	1.002	PASS
GFSK	HCH	0.999	PASS
$\pi/4$ DQPSK	LCH	1.002	PASS
$\pi/4$ DQPSK	MCH	0.999	PASS
$\pi/4$ DQPSK	HCH	0.999	PASS
8DPSK	LCH	1.002	PASS
8DPSK	MCH	0.999	PASS
8DPSK	HCH	1.002	PASS

Test Graph

Graphs

GFSK/LCH



GFSK/MCH



GFSK/HCH



$\pi/4$ DQPSK/LCH

 $\pi/4$ DQPSK/MCH

 $\pi/4$ DQPSK/HCH

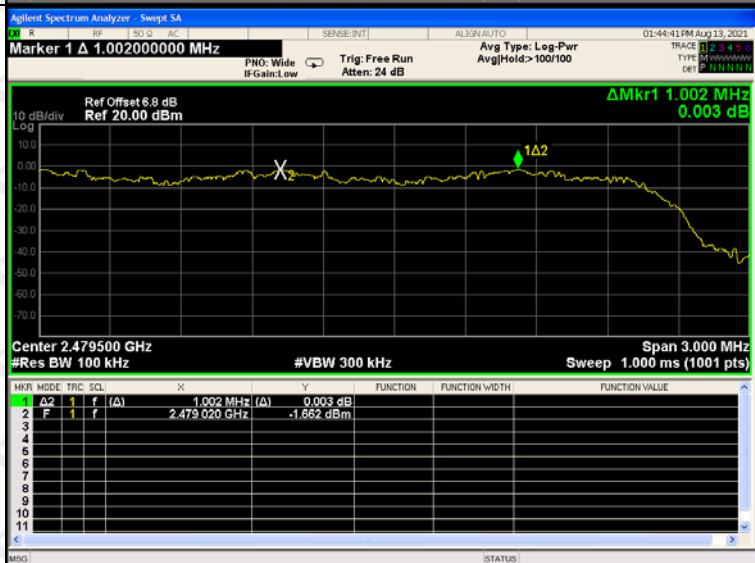

8DPSK/LCH



8DPSK /MCH

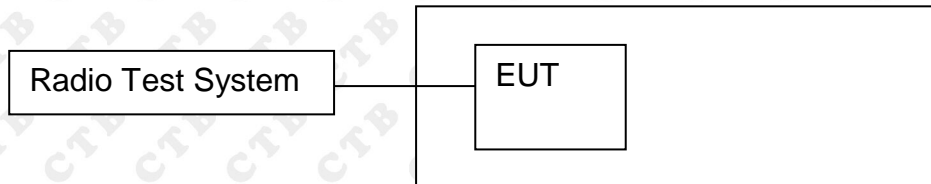


8DPSK /HCH



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;

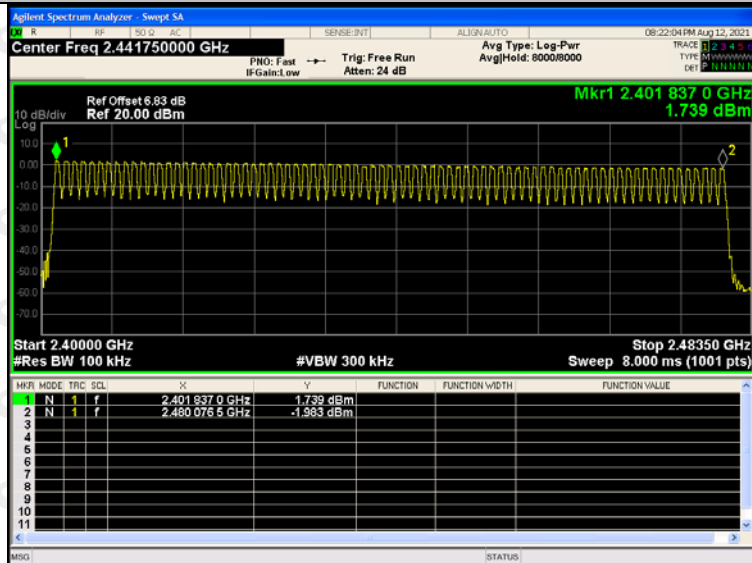
12.4 Test Result

Mode	Channel.	Number of Hopping Channel	Verdict
GFSK	Hop	79	PASS
$\pi/4$ DQPSK	Hop	79	PASS
8DPSK	Hop	79	PASS

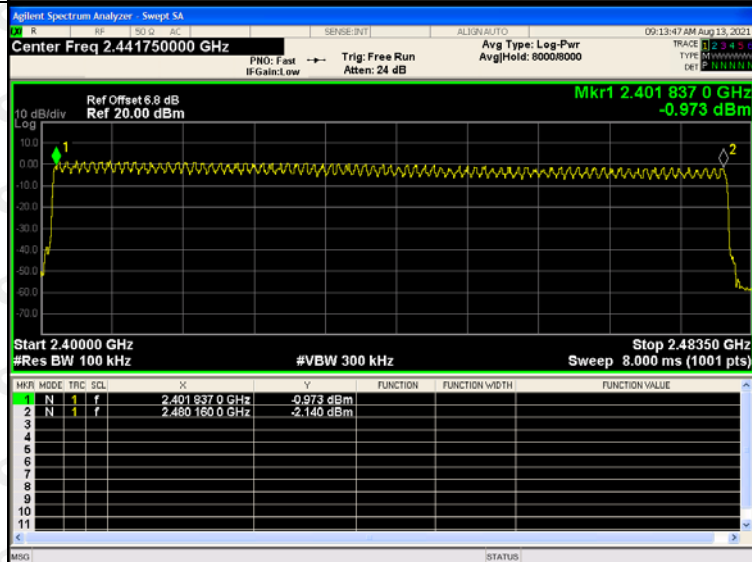
Test Graph

Graphs

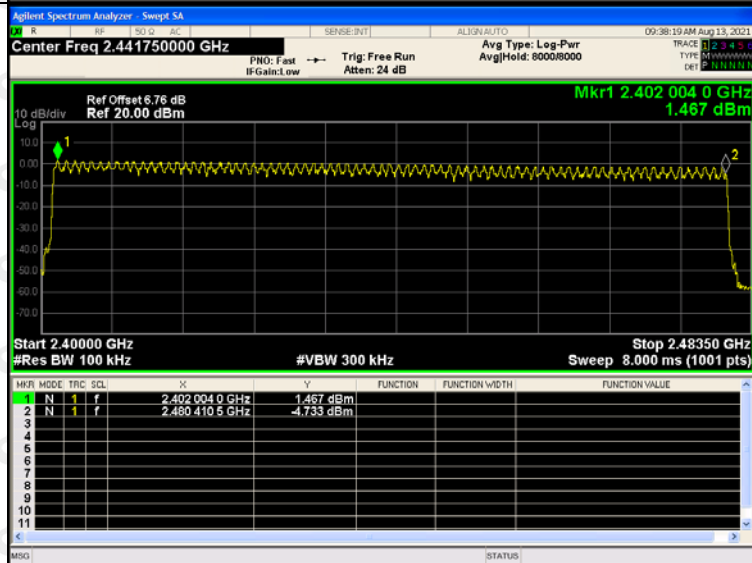
GFSK/Hop



$\pi/4$ DQPSK/Hop

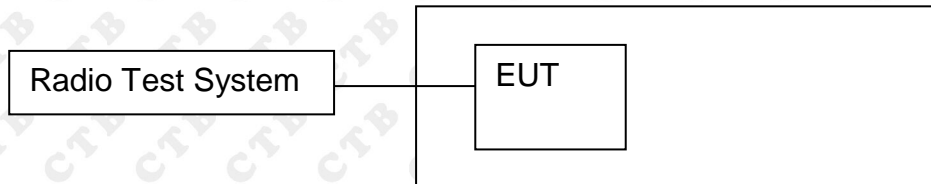


8DPSK/Hop



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

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. 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

Mode	Packet	Channel	Pulse Time (ms)	Total Dwell Time (ms)	Limit (ms)	Verdict
GFSK	DH1	LCH	0.389	124.48	400	PASS
	DH1	MCH	0.389	124.48	400	PASS
	DH1	HCH	0.389	124.48	400	PASS
	DH3	LCH	1.649	263.84	400	PASS
	DH3	MCH	1.65	264	400	PASS
	DH3	HCH	1.65	264	400	PASS
	DH5	LCH	2.9	309.333	400	PASS
	DH5	MCH	2.901	309.44	400	PASS
	DH5	HCH	2.901	309.44	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:

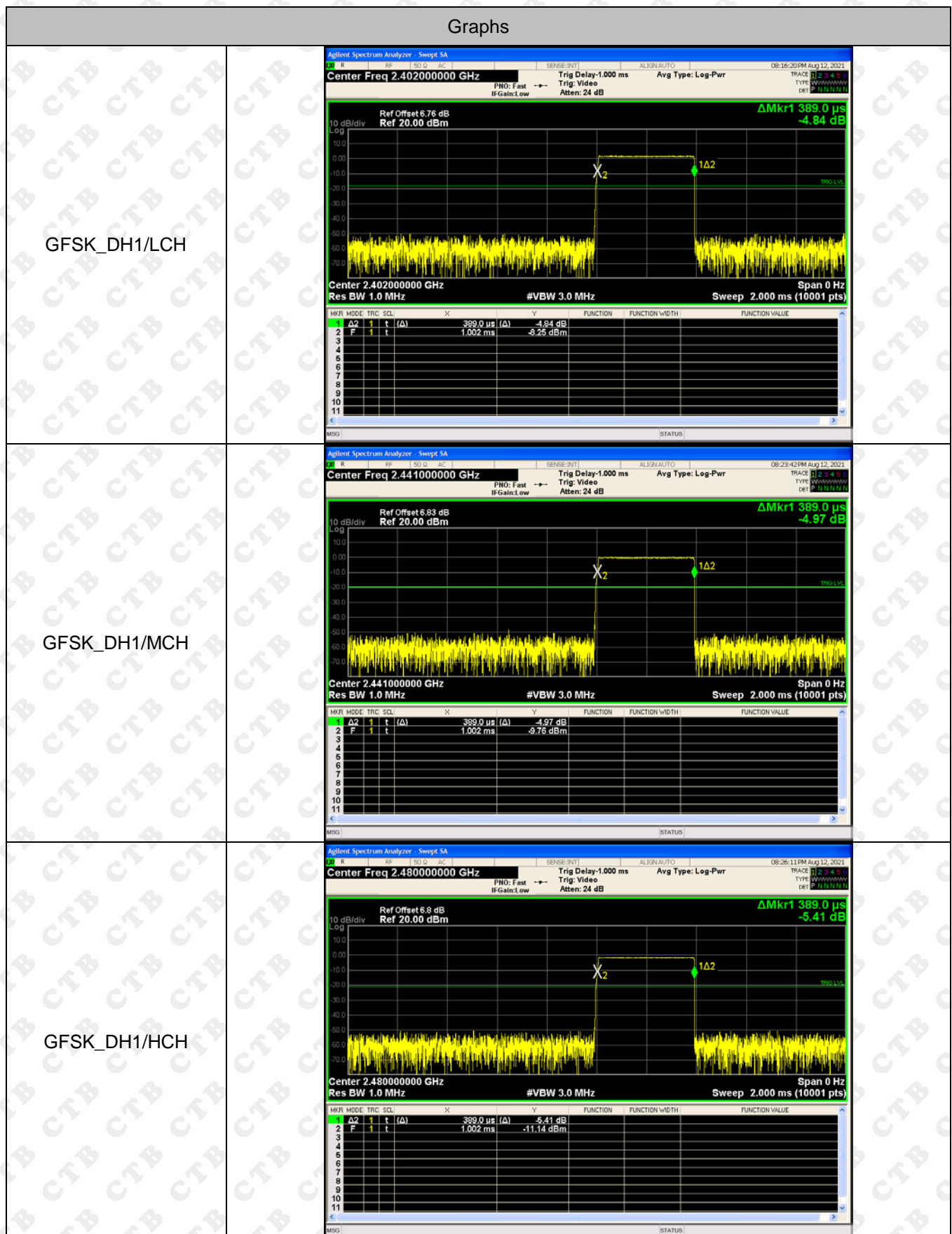
DH5: $1600/79/6*0.4*79*(MkrDelta)/1000$

DH3: $1600/79/4*0.4*79*(MkrDelta)/1000$

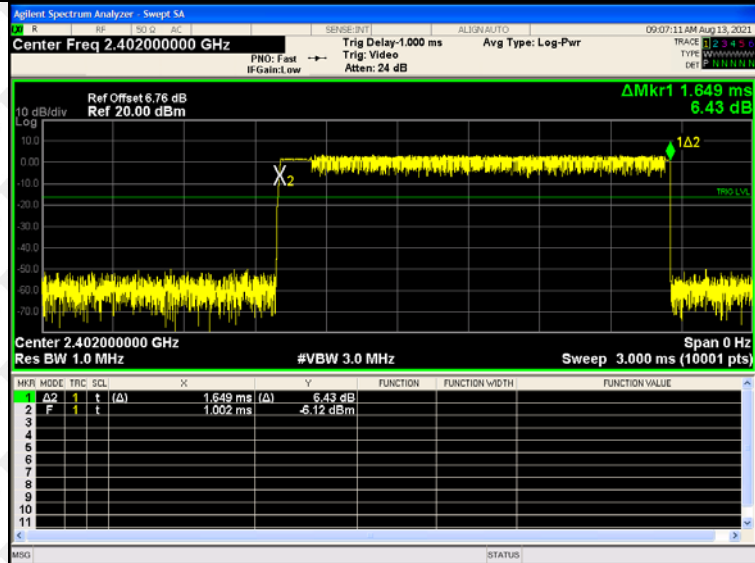
DH1: $1600/79/2*0.4*79*(MkrDelta)/1000$

Remark: Mkr Delta is once pulse time.

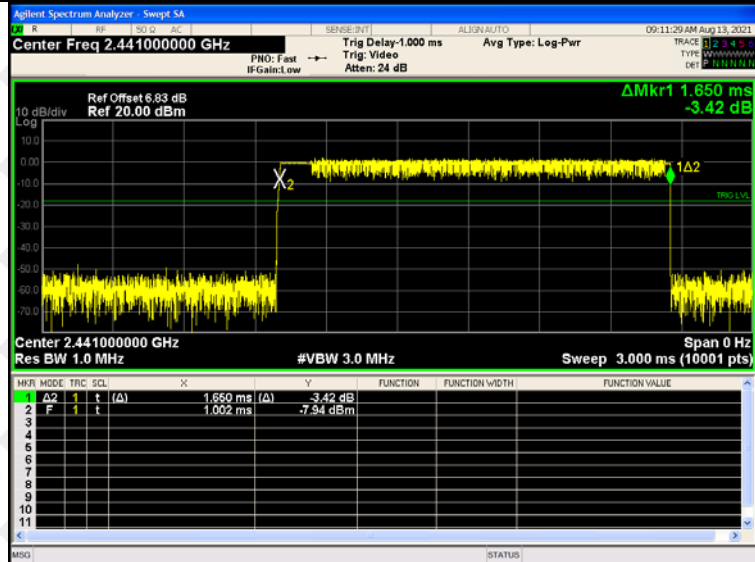
Test Graph



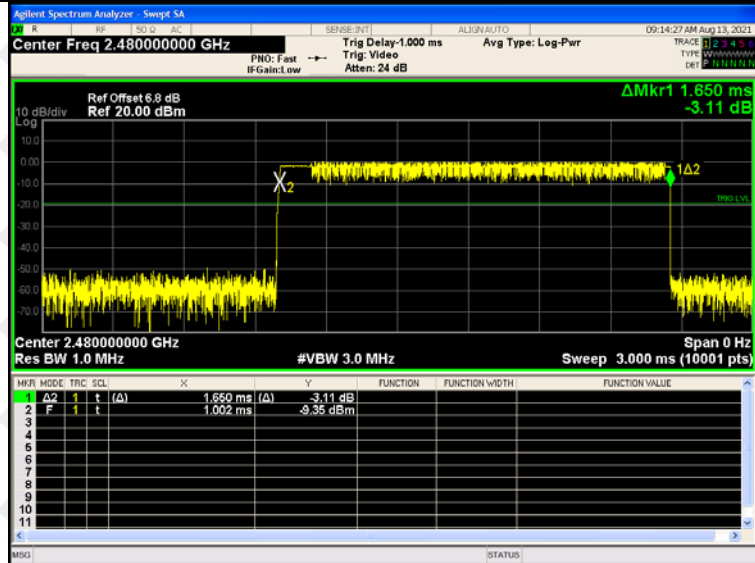
GFSK_DH3/LCH



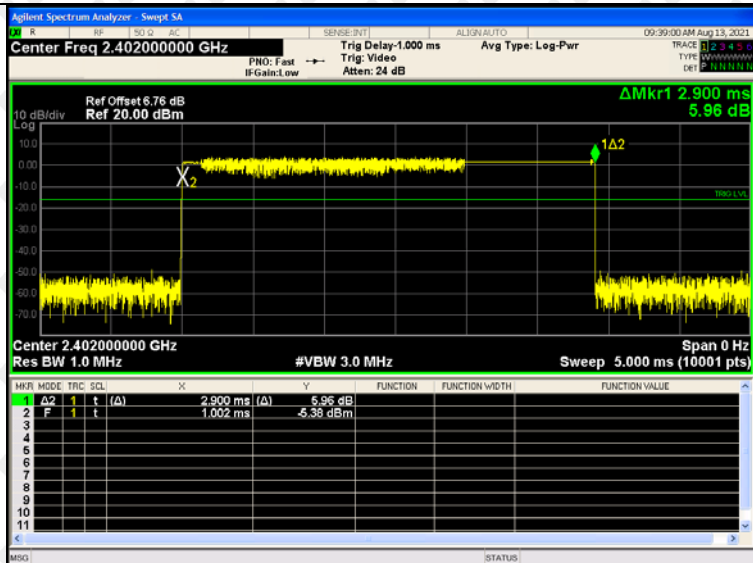
GFSK_DH3/MCH



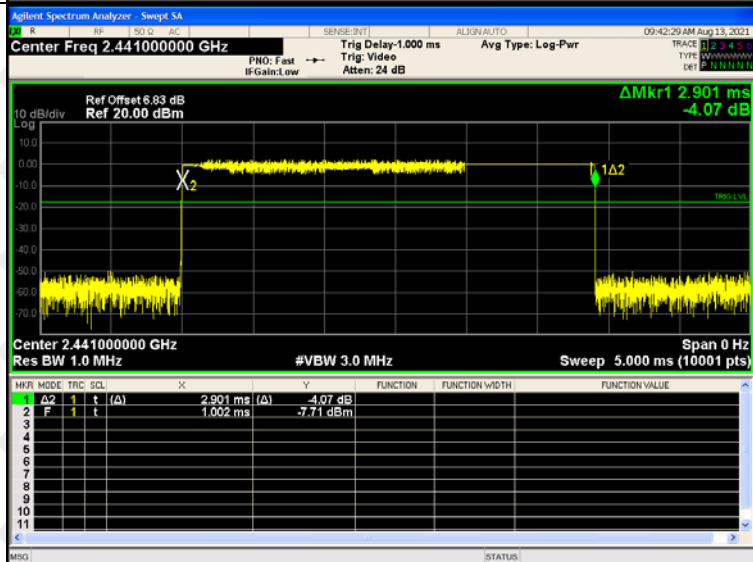
GFSK_DH3/HCH



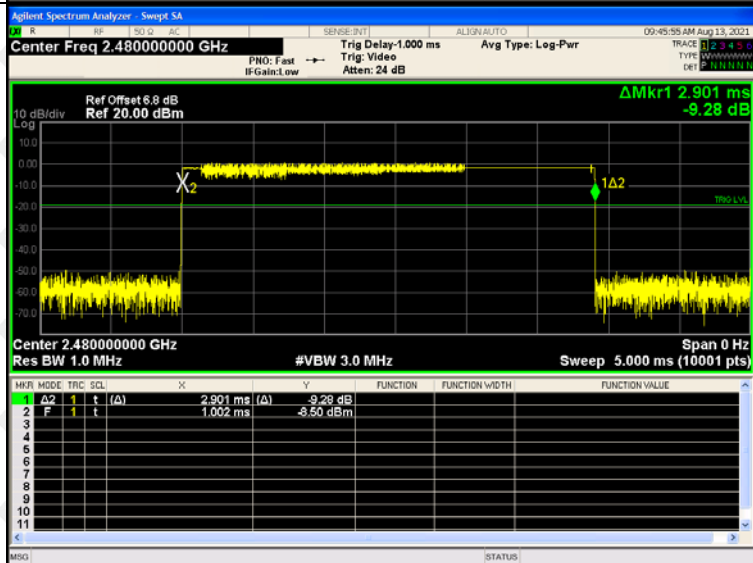
GFSK_DH5/LCH



GFSK_DH5/MCH



GFSK_DH5/HCH



14. PSEUDORANDOM FREQUENCY

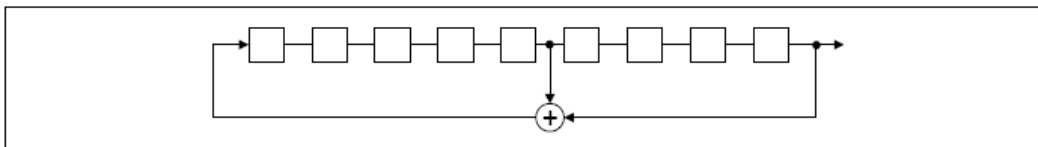
14.1 Limit

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.

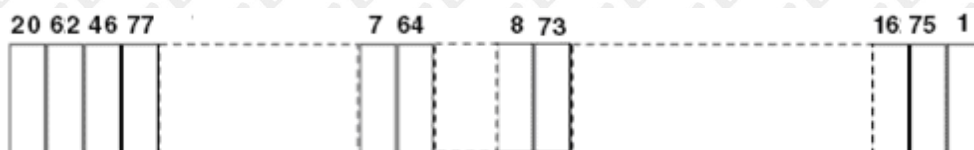
14.2 Test procedure

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: $2^9 - 1 = 511$ bits
- Longest sequence of zeros: 8 (non-inverted signal)



An example of Pseudorandom Frequency Hopping Sequence as follow:



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 Ceramic Antenna. The best case gain of the antenna is 1dBi.

16. EUT PHOTOGRAPHS

EUT Photo 1



EUT Photo 2



17. EUT TEST SETUP PHOTOGRAPHS

Radiated Emission

Below 1G



Above 1G



Conducted emissions



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