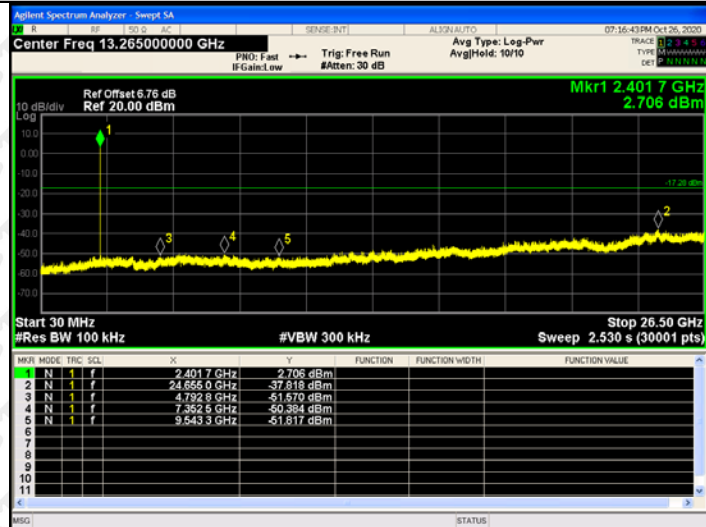
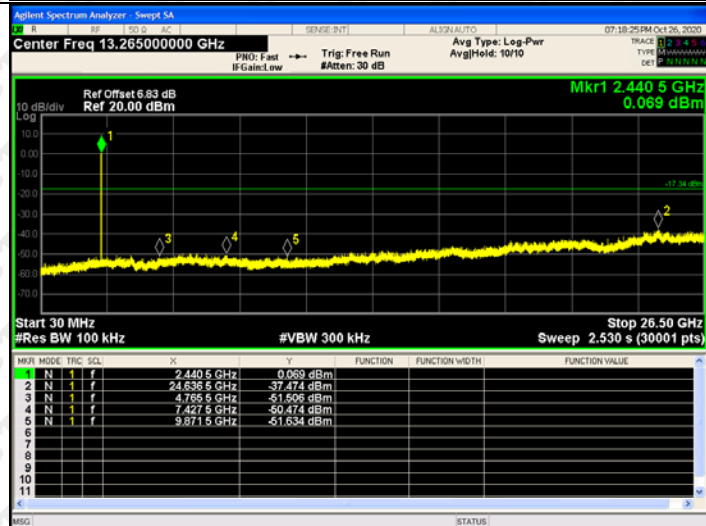


RF Conducted Spurious Emissions Graphs

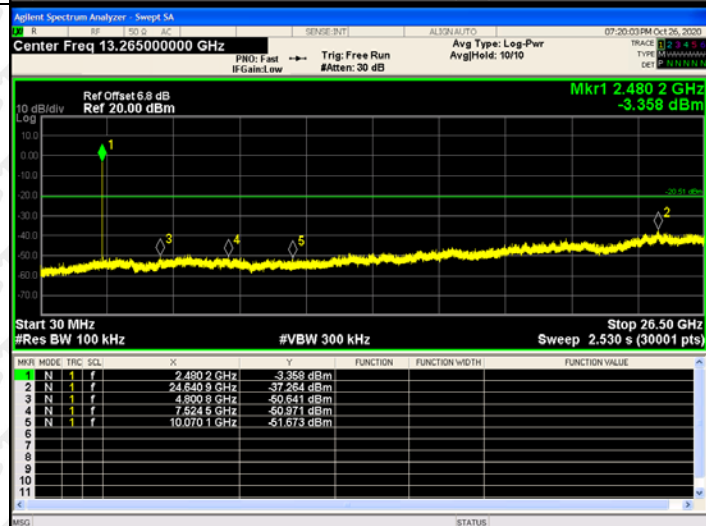
GFSK/LCH

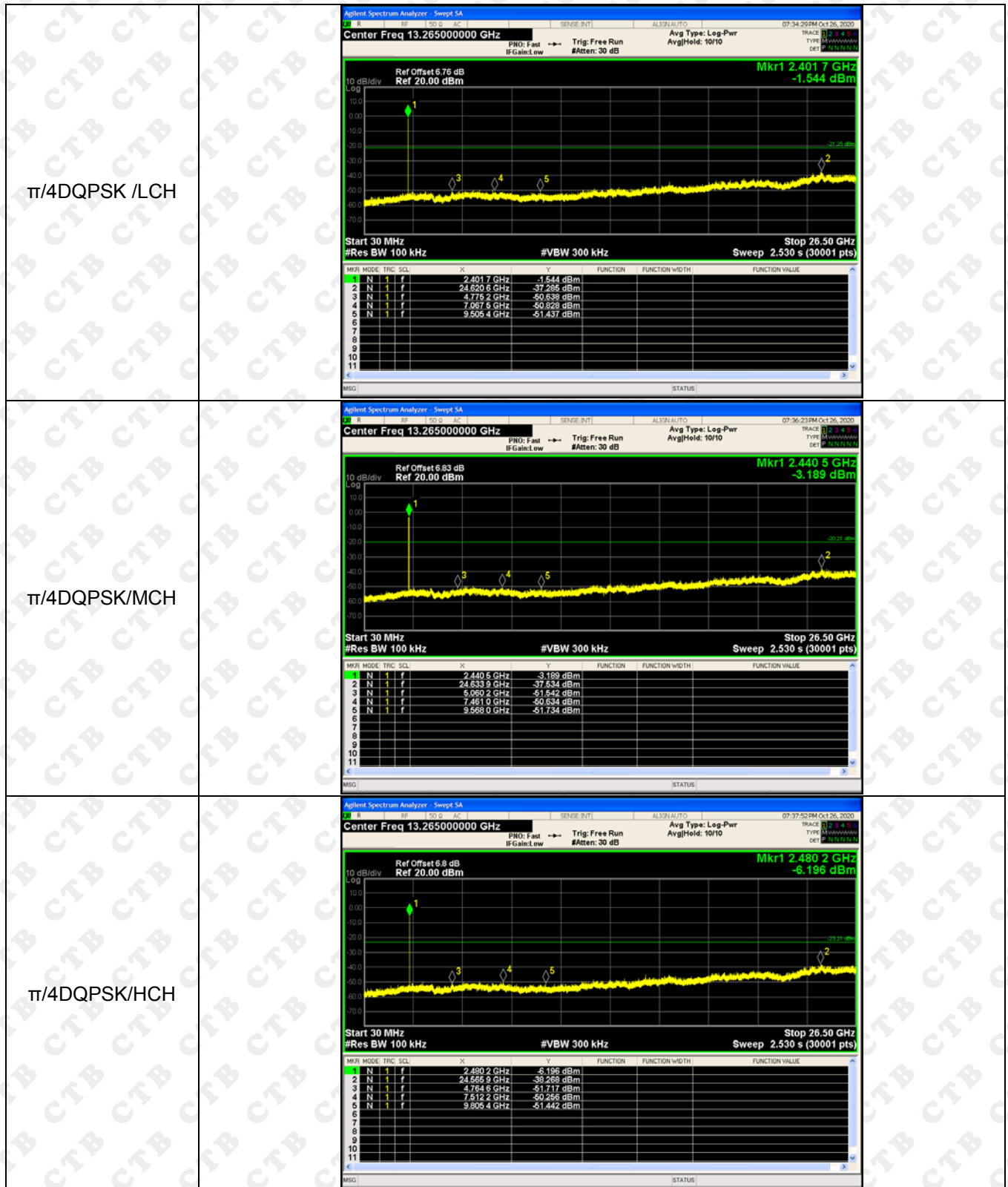


GFSK/MCH

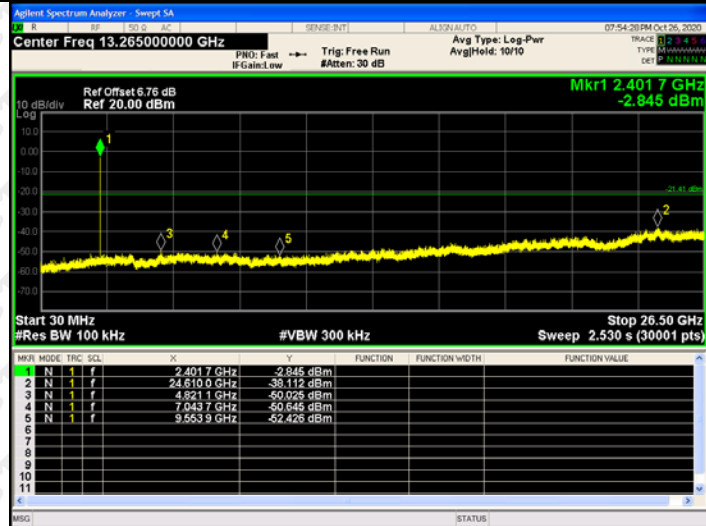


GFSK/HCH

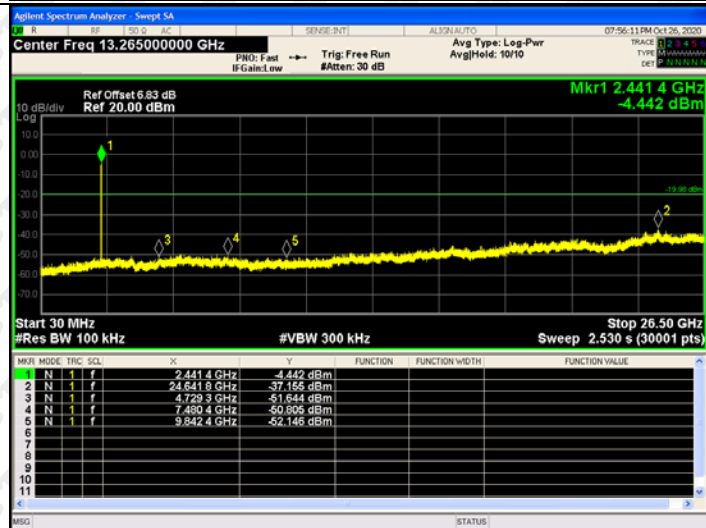




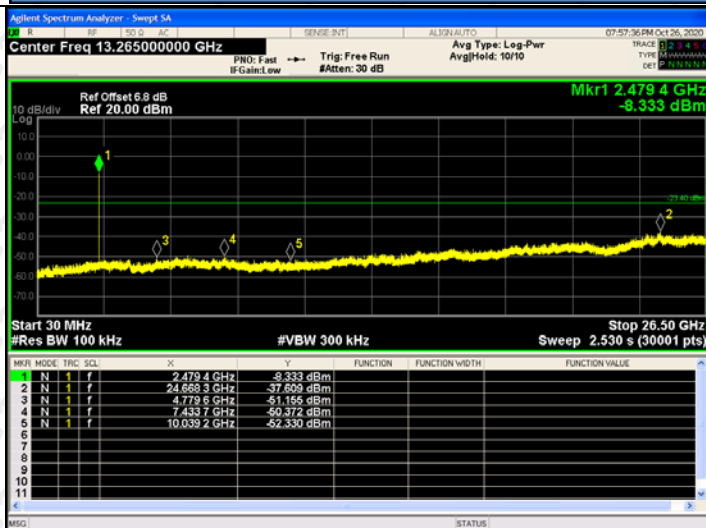
8DPSK/LCH



8DPSK/MCH

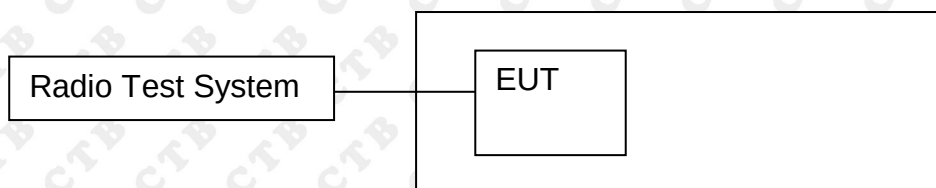


8DPSK/HCH



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.

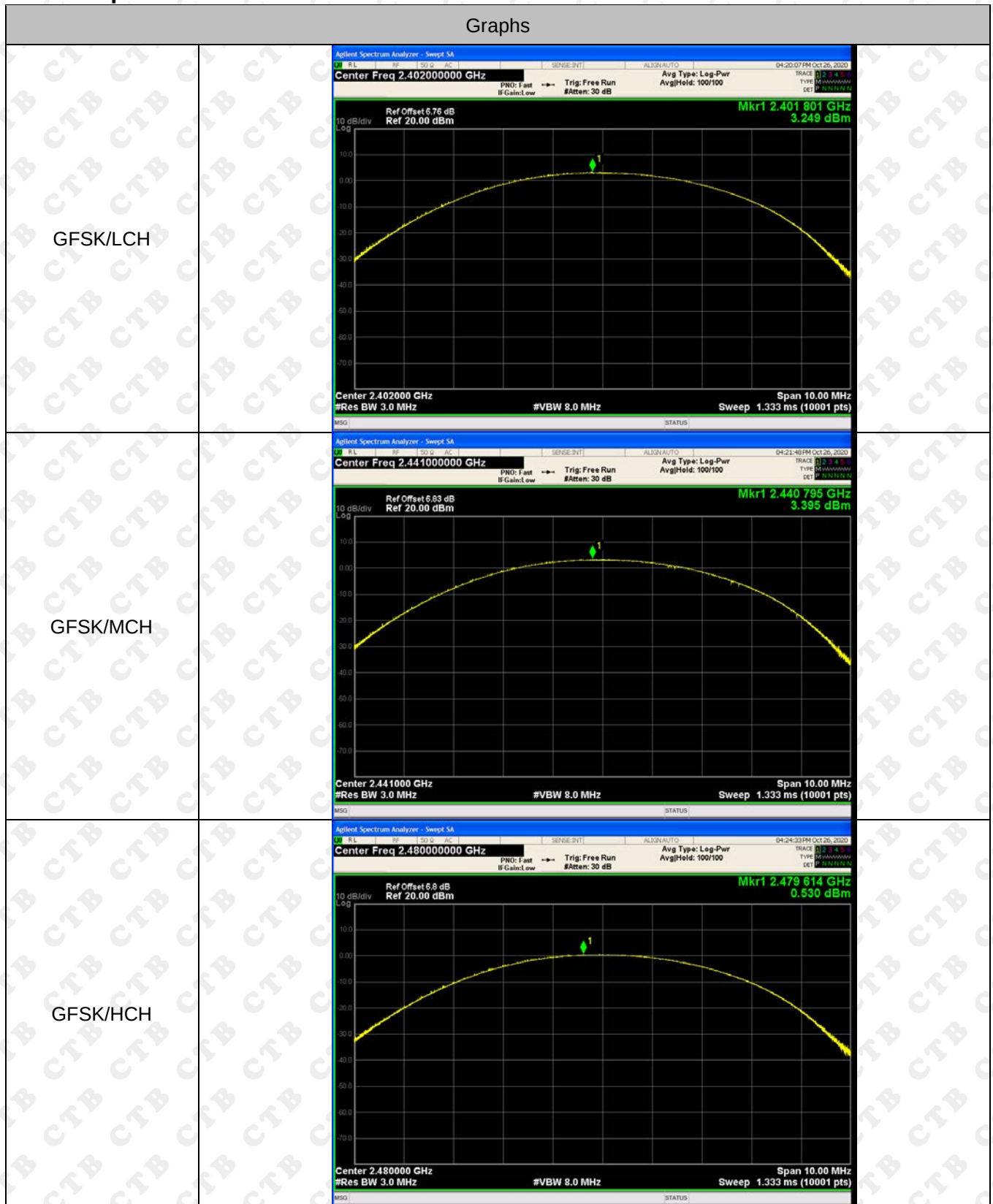
9.3 Test procedure

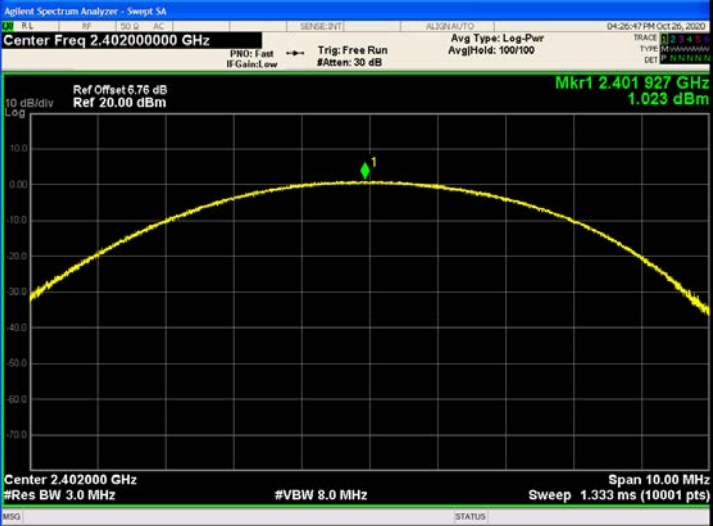
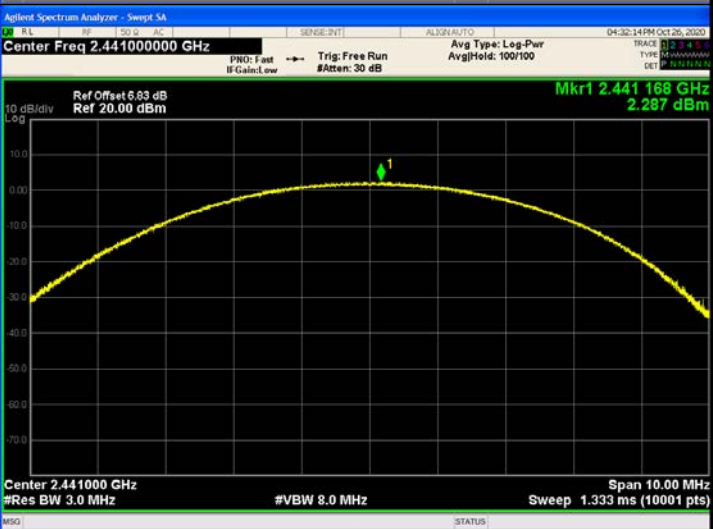
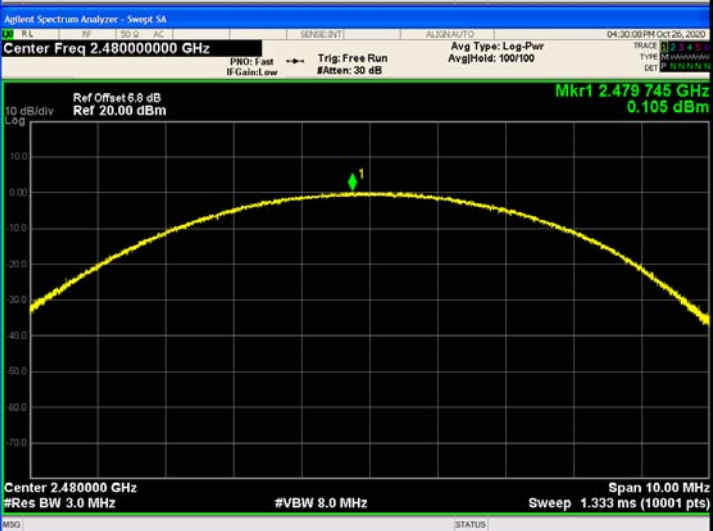
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3MHz. VBW = 8MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, middle and highest channel individually. Record the max value.

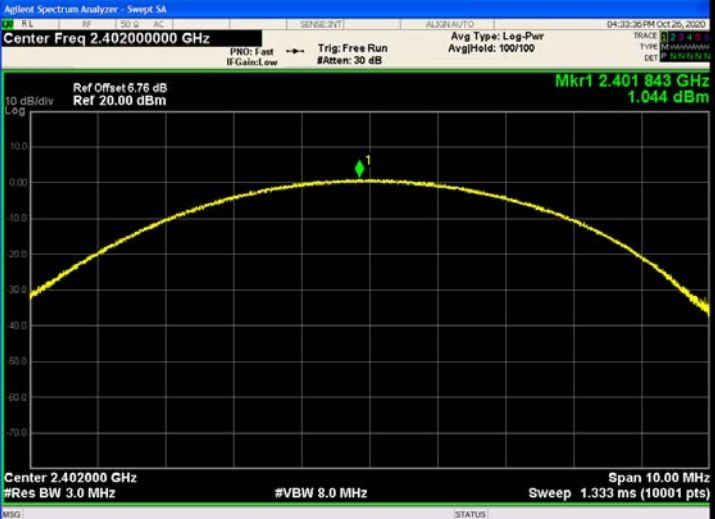
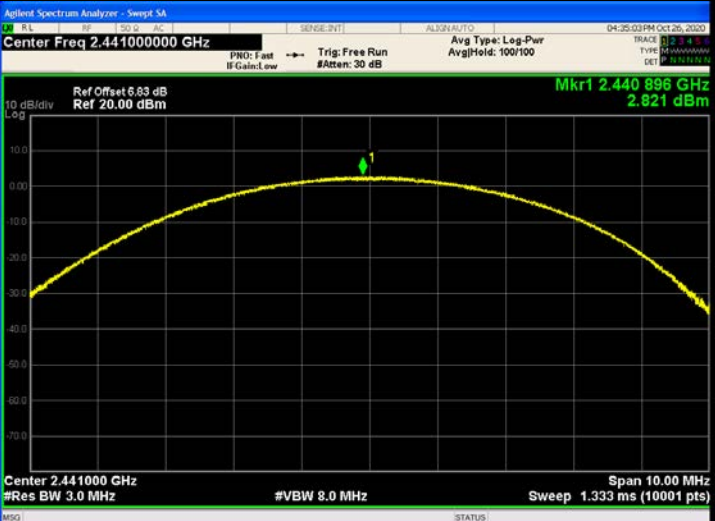
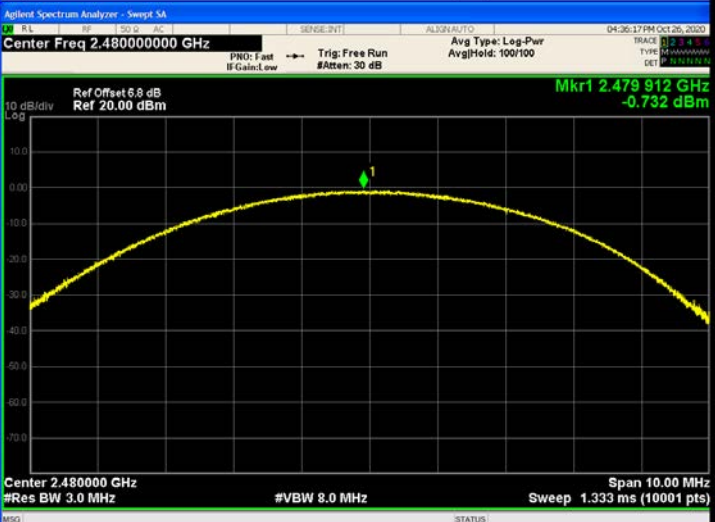
9.4 Test Result

Mode	Channel.	Maximum Peak Output Power [dBm]	Verdict
EDR mode (GFSK)	LCH	3.249	PASS
	MCH	3.395	PASS
	HCH	0.53	PASS
EDR mode ($\pi/4$ DQPSK)	LCH	1.023	PASS
	MCH	2.287	PASS
	HCH	0.105	PASS
EDR mode (8DPSK)	LCH	1.044	PASS
	MCH	2.821	PASS
	HCH	-0.732	PASS

Test Graph:



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

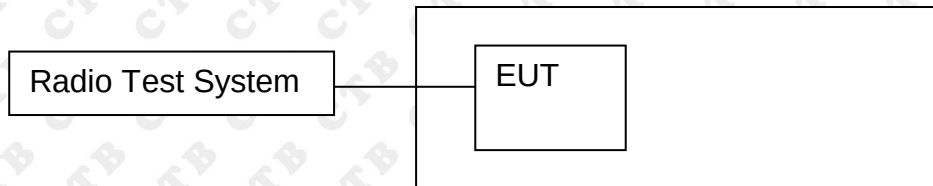
8DPSK/LCH	
8DPSK/MCH	
8DPSK/HCH	

10. 20DB OCCUPIED BANDWIDTH

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.

10.1 Block Diagram Of Test Setup



10.3 Test procedure

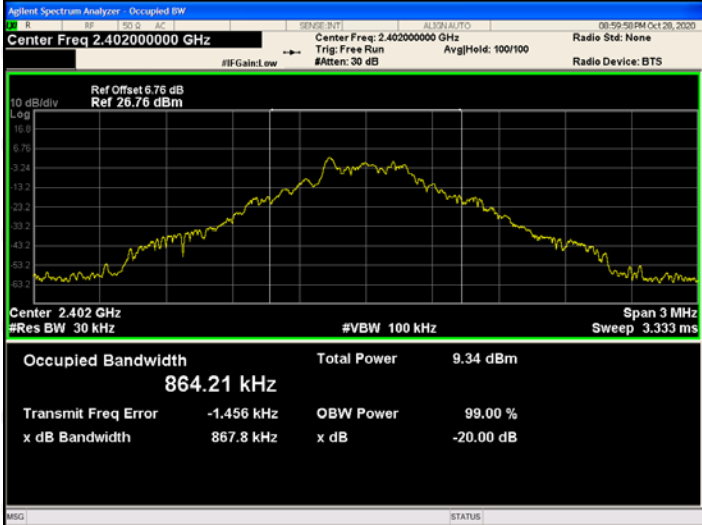
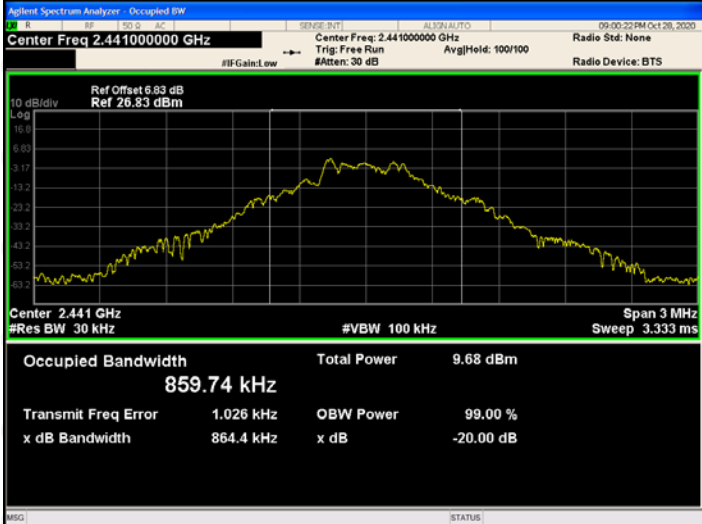
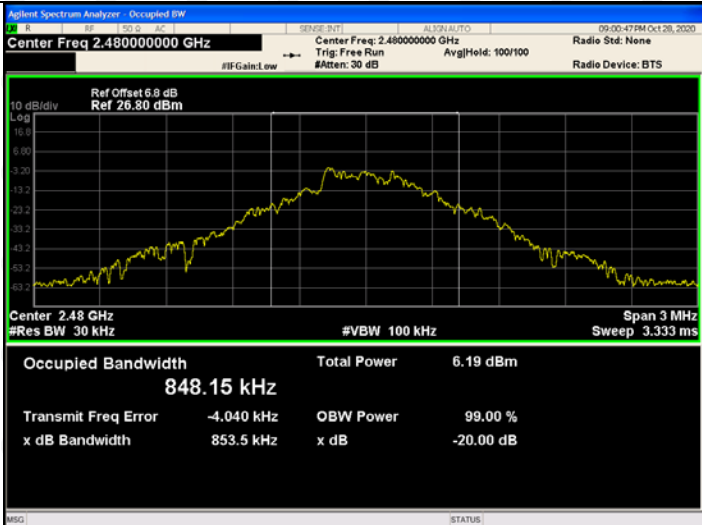
1. Rem1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

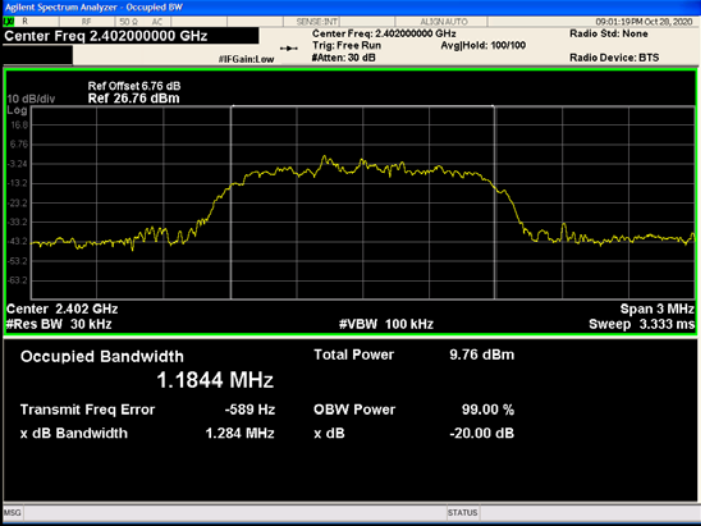
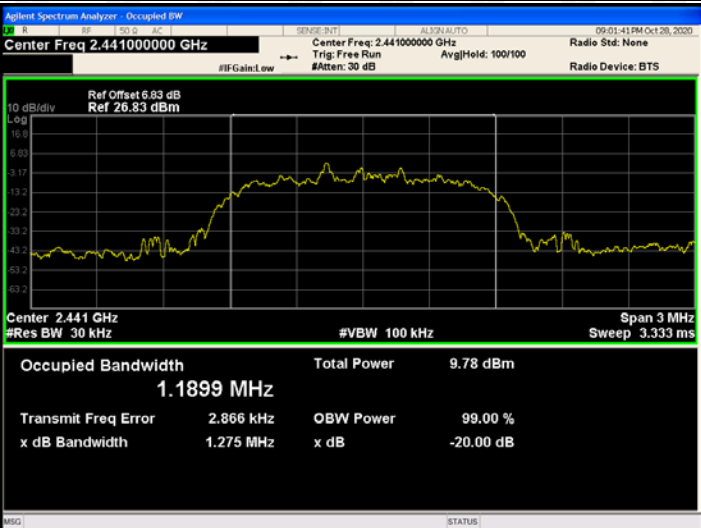
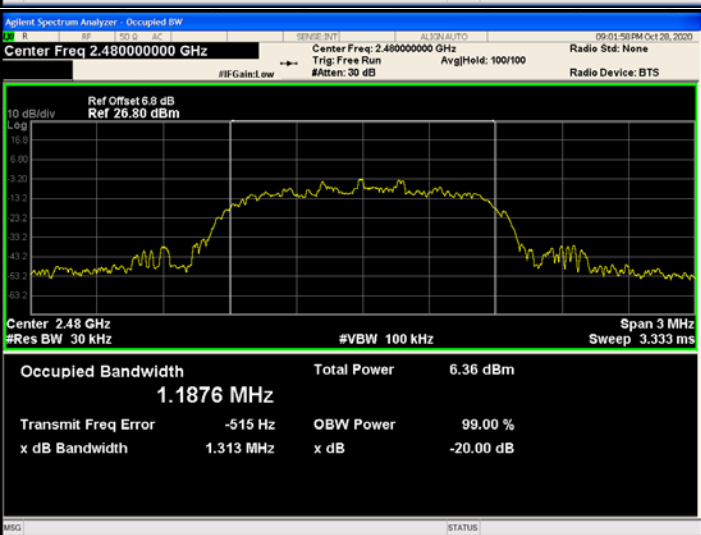
10.4 Test Result

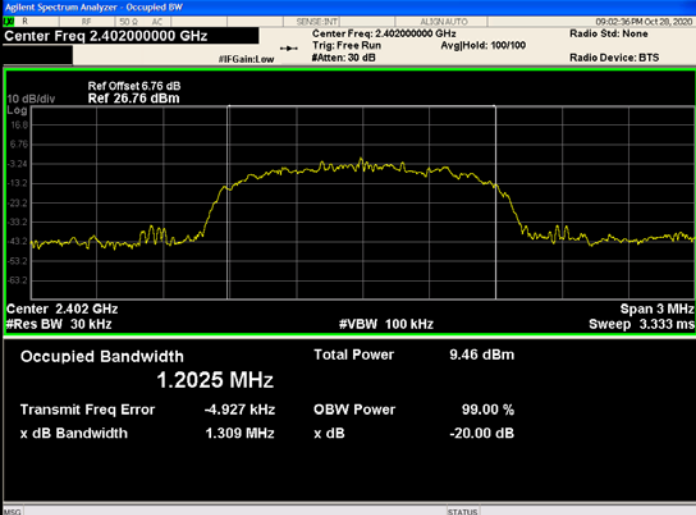
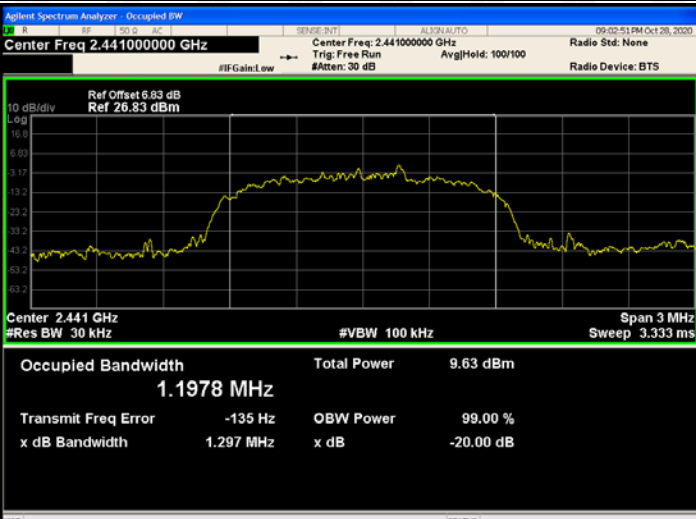
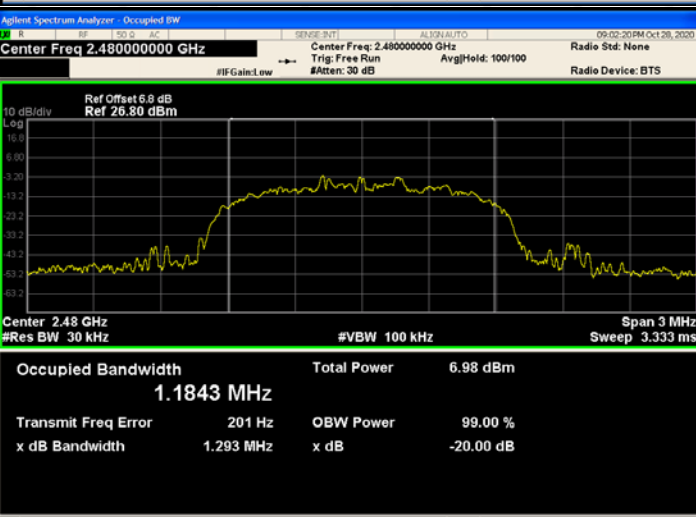
Test Mode	Frequency	20dB Bandwidth (MHz)	Result
GFSK	Low channel	0.8678	PASS
	Mid channel	0.8644	PASS
	High channel	0.8535	PASS
$\pi/4$ DQPSK	Low channel	1.284	PASS
	Mid channel	1.275	PASS
	High channel	1.313	PASS
8DPSK	Low channel	1.309	PASS
	Mid channel	1.297	PASS
	High channel	1.293	PASS

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

Test Graph:

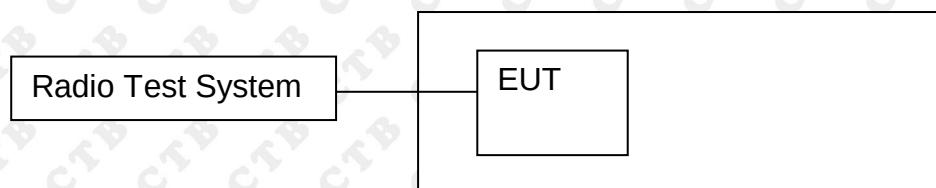
GFSK Low channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq 2.402000000 GHz Ref Offset 6.76 dB Ref 26.76 dBm Center 2.402 GHz #Res BW 30 kHz Occupied Bandwidth 864.21 kHz Total Power 9.34 dBm Transmit Freq Error -1.456 kHz OBW Power 99.00 % x dB Bandwidth 867.8 kHz x dB -20.00 dB
GFSK Mid channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq 2.441000000 GHz Ref Offset 6.83 dB Ref 26.83 dBm Center 2.441 GHz #Res BW 30 kHz Occupied Bandwidth 859.74 kHz Total Power 9.68 dBm Transmit Freq Error 1.026 kHz OBW Power 99.00 % x dB Bandwidth 864.4 kHz x dB -20.00 dB
GFSK High channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq 2.480000000 GHz Ref Offset 6.8 dB Ref 26.80 dBm Center 2.48 GHz #Res BW 30 kHz Occupied Bandwidth 848.15 kHz Total Power 6.19 dBm Transmit Freq Error -4.040 kHz OBW Power 99.00 % x dB Bandwidth 853.5 kHz x dB -20.00 dB

$\pi/4$-DQPSK Low channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq: 2.402000000 GHz Ref Offset: 6.75 dB Ref: 26.76 dBm Center 2.402 GHz #Res BW 30 kHz Occupied Bandwidth 1.1844 MHz Total Power 9.76 dBm Transmit Freq Error -589 Hz OBW Power 99.00 % x dB Bandwidth 1.284 MHz x dB -20.00 dB
$\pi/4$-DQPSK Mid channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq: 2.441000000 GHz Ref Offset: 6.83 dB Ref: 26.83 dBm Center 2.441 GHz #Res BW 30 kHz Occupied Bandwidth 1.1899 MHz Total Power 9.78 dBm Transmit Freq Error 2.866 kHz OBW Power 99.00 % x dB Bandwidth 1.275 MHz x dB -20.00 dB
$\pi/4$-DQPSK High channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq: 2.480000000 GHz Ref Offset: 6.8 dB Ref: 26.80 dBm Center 2.48 GHz #Res BW 30 kHz Occupied Bandwidth 1.1876 MHz Total Power 6.36 dBm Transmit Freq Error -515 Hz OBW Power 99.00 % x dB Bandwidth 1.313 MHz x dB -20.00 dB

8DPSK Low channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq: 2.402000000 GHz Ref Offset: 6.75 dB Ref: 26.76 dBm Center 2.402 GHz #Res BW 30 kHz Occupied Bandwidth 1.2025 MHz Total Power 9.46 dBm Transmit Freq Error -4.927 kHz OBW Power 99.00 % x dB Bandwidth 1.309 MHz x dB -20.00 dB
8DPSK Mid channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq: 2.441000000 GHz Ref Offset: 6.83 dB Ref: 26.83 dBm Center 2.441 GHz #Res BW 30 kHz Occupied Bandwidth 1.1978 MHz Total Power 9.63 dBm Transmit Freq Error -135 Hz OBW Power 99.00 % x dB Bandwidth 1.297 MHz x dB -20.00 dB
8DPSK High channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq: 2.480000000 GHz Ref Offset: 6.8 dB Ref: 26.80 dBm Center 2.48 GHz #Res BW 30 kHz Occupied Bandwidth 1.1843 MHz Total Power 6.98 dBm Transmit Freq Error 201 Hz OBW Power 99.00 % x dB Bandwidth 1.293 MHz x dB -20.00 dB

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	1.002	PASS
GFSK	MCH	1.002	PASS
GFSK	HCH	1.002	PASS
$\pi/4$ DQPSK	LCH	0.996	PASS
$\pi/4$ DQPSK	MCH	1.002	PASS
$\pi/4$ DQPSK	HCH	1.005	PASS
8DPSK	LCH	0.996	PASS
8DPSK	MCH	1.002	PASS
8DPSK	HCH	1.005	PASS

Test Graph

Graphs

GFSK/LCH

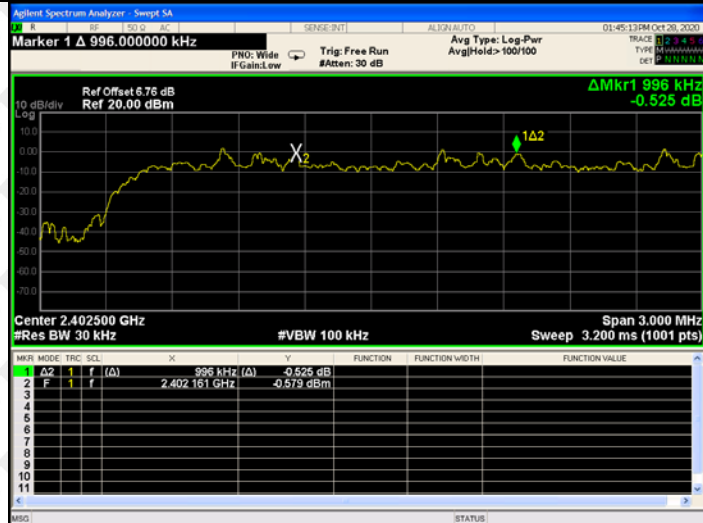
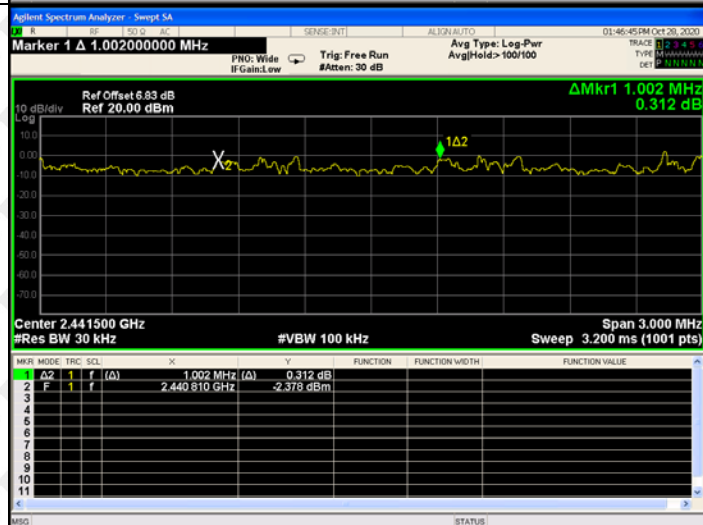


GFSK/MCH

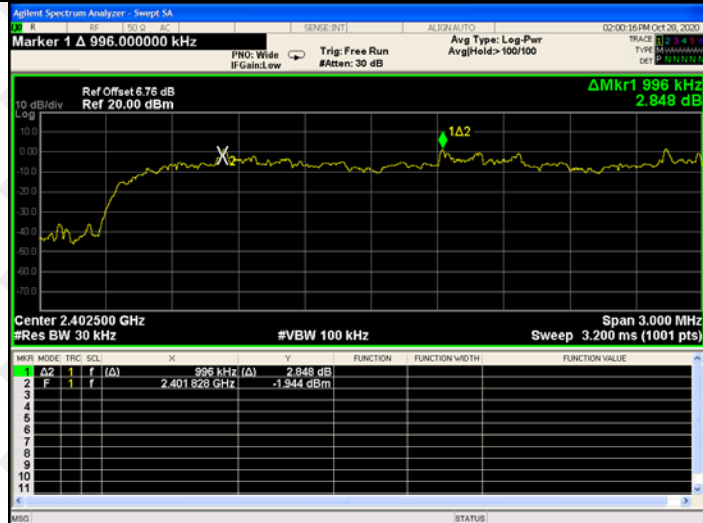


GFSK/HCH

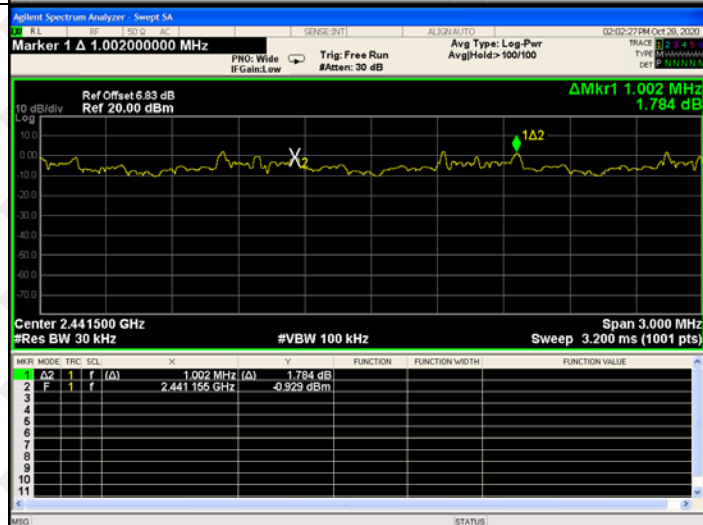


$\pi/4$ DQPSK/LCH

 $\pi/4$ DQPSK/MCH

 $\pi/4$ DQPSK/HCH


8DPSK/LCH



8DPSK/MCH

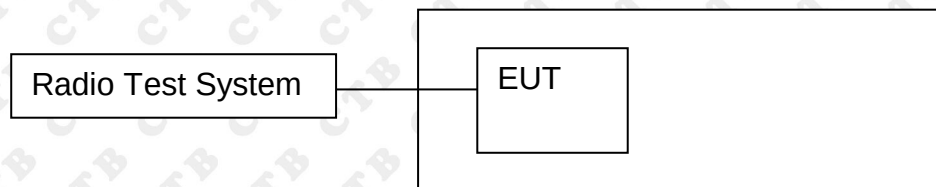


8DPSK/HCH



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;

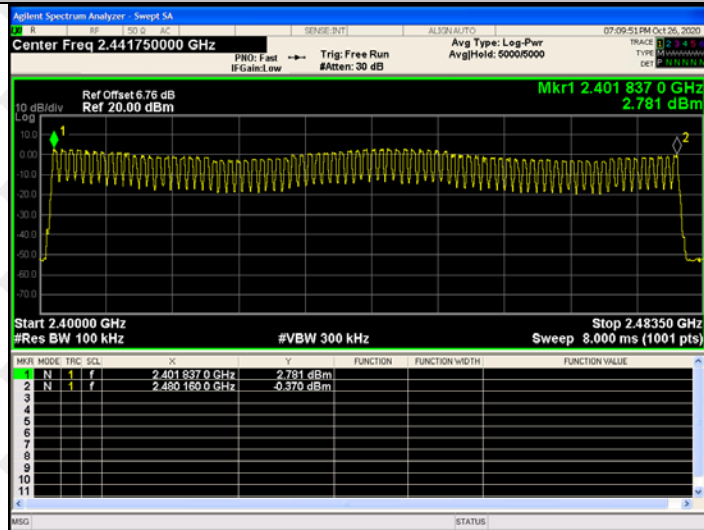
12.4 Test Result

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

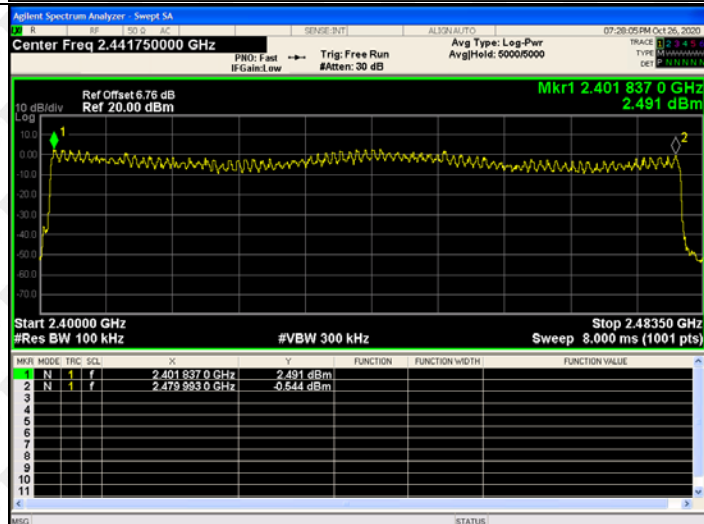
Test Graph

Graphs

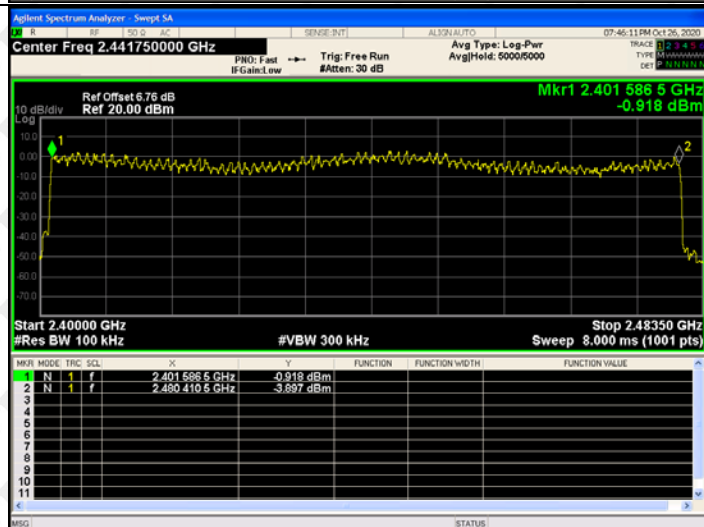
GFSK/Hop



$\pi/4$ DQPSK/Hop

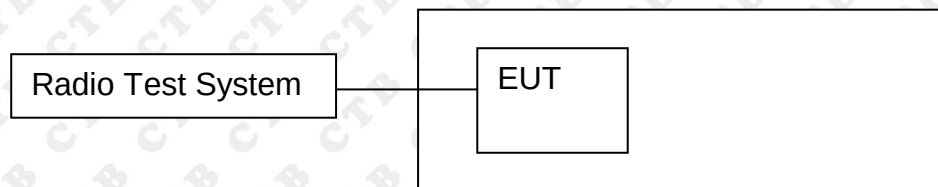


8DPSK/Hop



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	0.406	129.92	400	PASS
	DH1	MCH	0.406	129.92	400	PASS
	DH1	HCH	0.406	129.92	400	PASS
	DH3	LCH	1.651	264.16	400	PASS
	DH3	MCH	1.651	264.16	400	PASS
	DH3	HCH	1.65	264	400	PASS
	DH5	LCH	2.898	309.12	400	PASS
	DH5	MCH	2.898	309.12	400	PASS
	DH5	HCH	2.897	309.013	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:

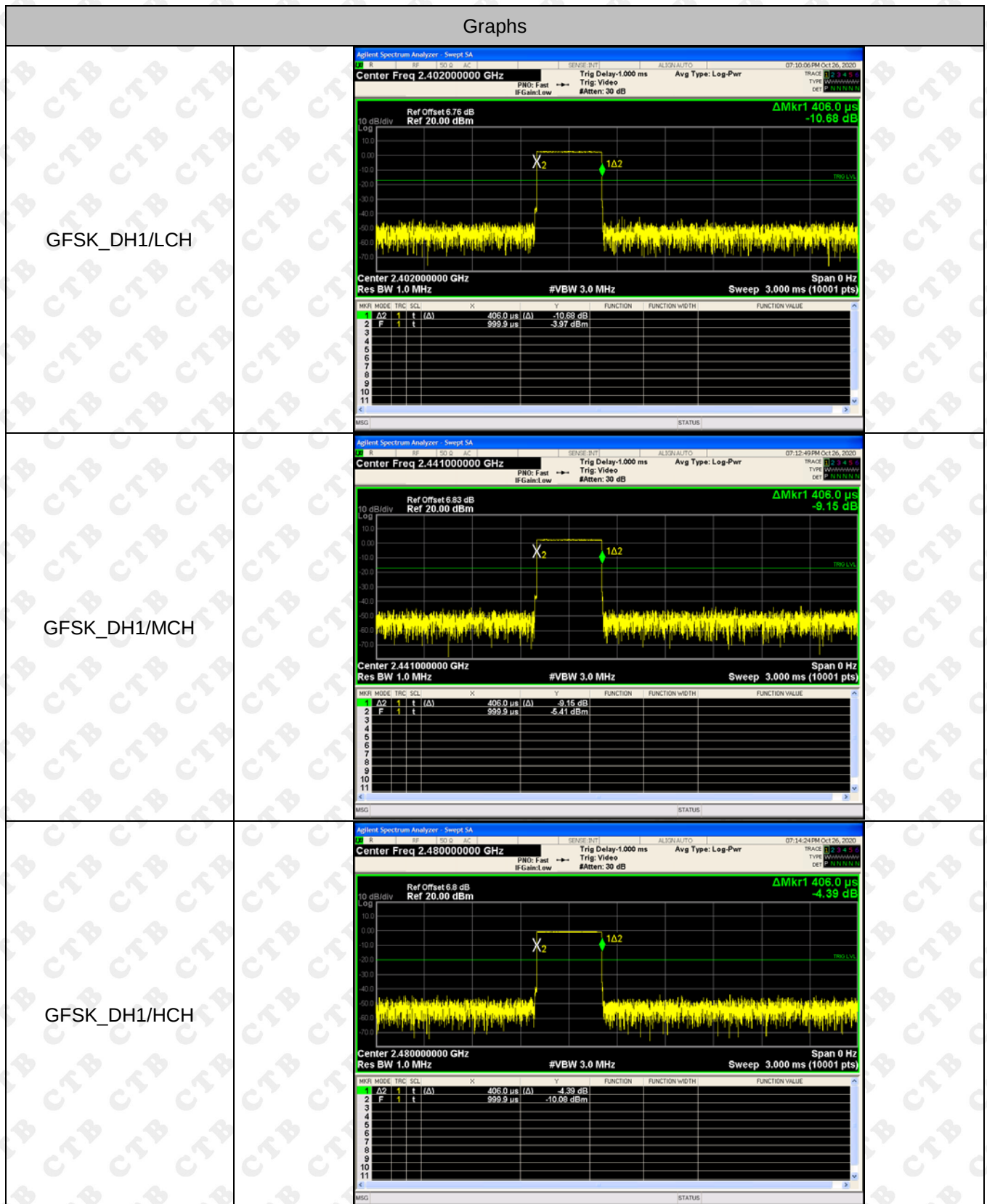
DH5: $1600/79/6*0.4*79*(MkrDelta)$

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

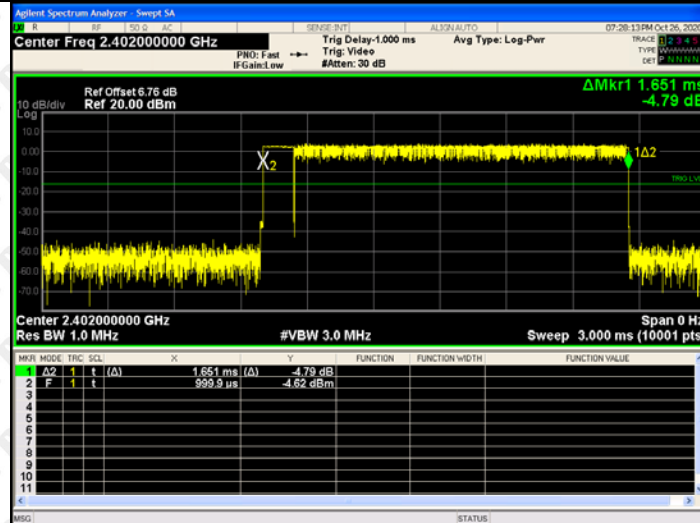
DH1: $1600/79/2*0.4*79*(MkrDelta)$

Remark: Mkr Delta is once pulse time.

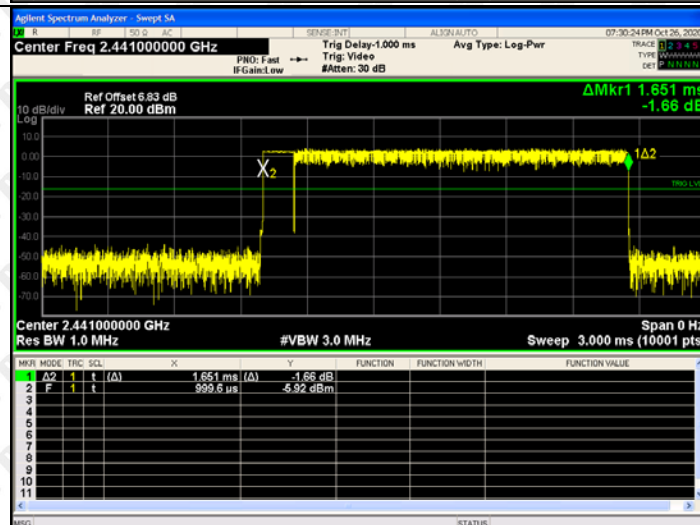
Test Graph



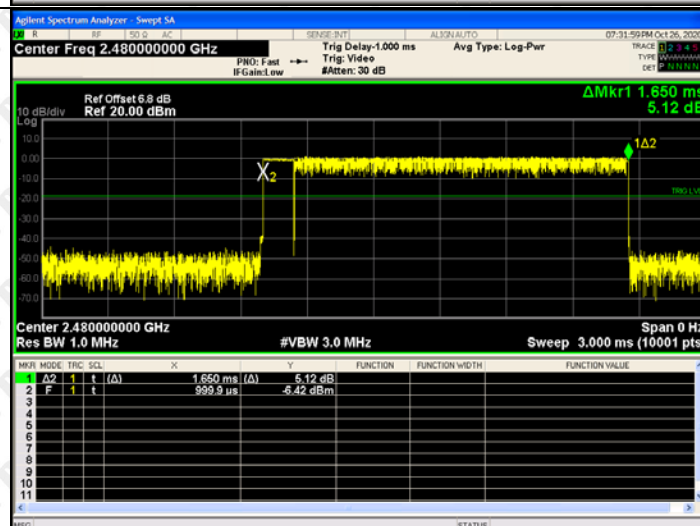
GFSK_DH3/LCH



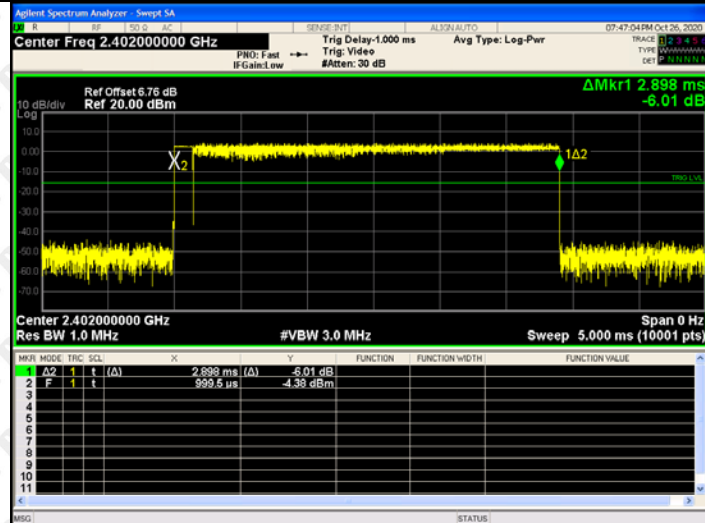
GFSK_DH3/MCH



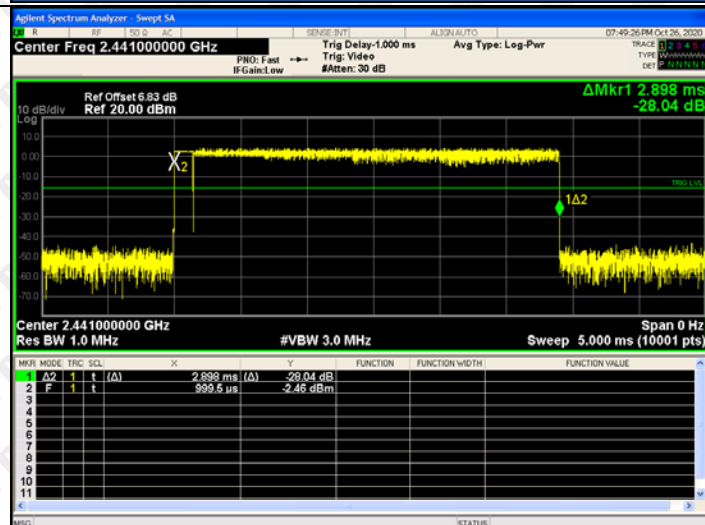
GFSK_DH3/HCH



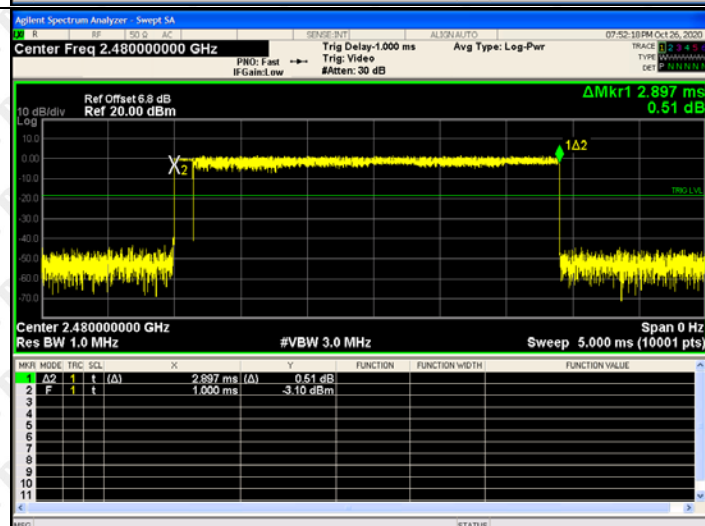
GFSK_DH5/LCH



GFSK_DH5/MCH



GFSK_DH5/HCH



14. PSEUDORANDOM FREQUENCY

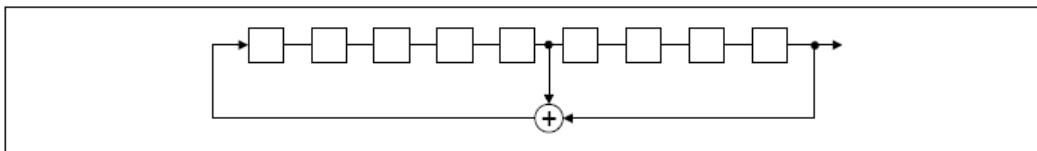
14.1 Limit

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.

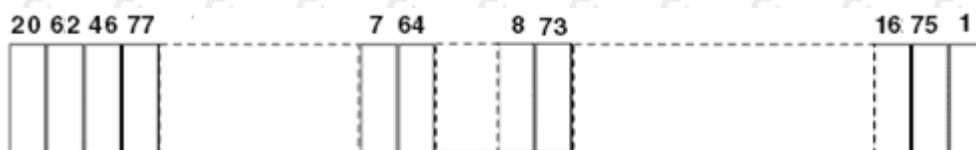
14.2 Test procedure

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 Internal antenna. The best case gain of the antenna is 1.00dBi.

ANT.

16. EUT PHOTOGRAPHS

EUT Photo 1



EUT Photo 2



17. EUT TEST SETUP PHOTOGRAPHS

Radiated Emission

Below 1G



Above 1G



CE



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