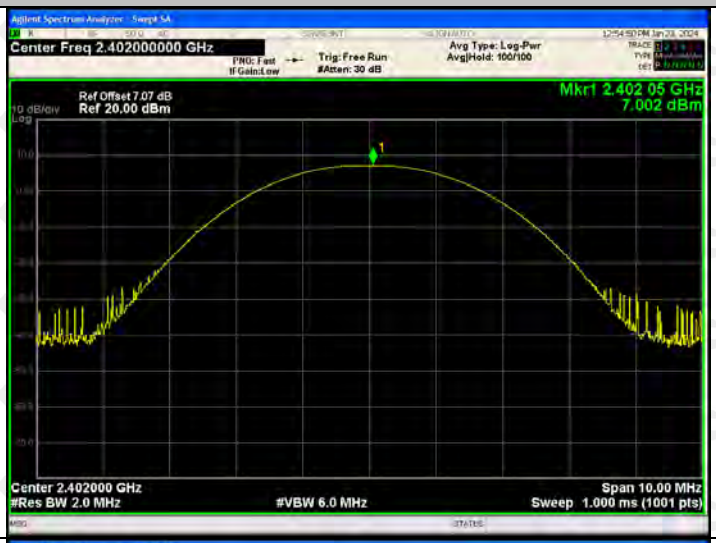
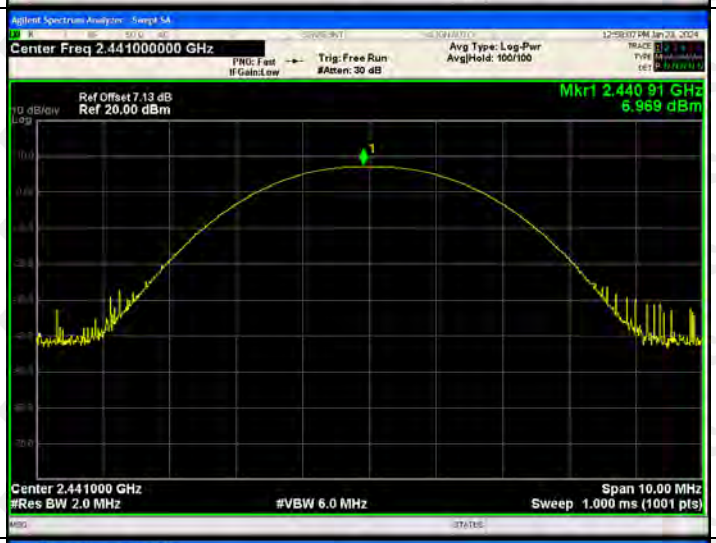
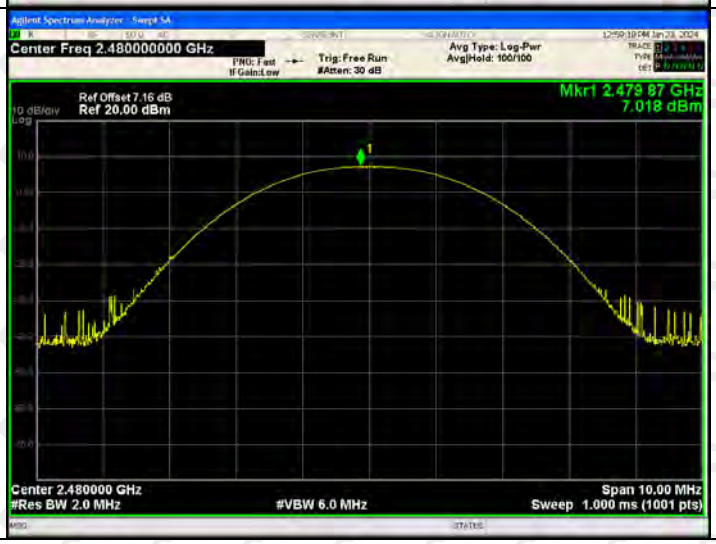
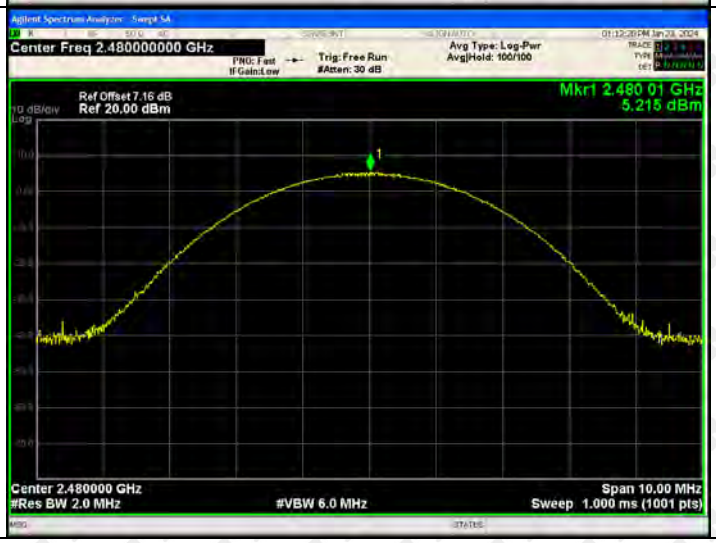
8DPSK/LCH			
8DPSK /MCH			
8DPSK /HCH			

QW850-1 module:

Test Graph:

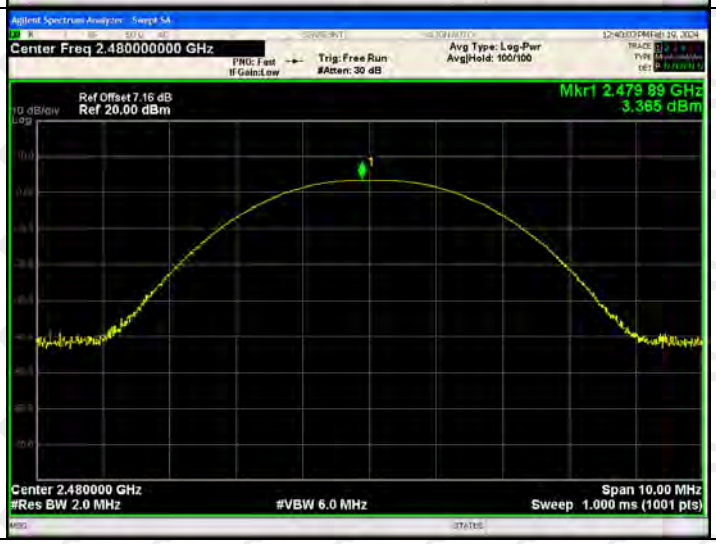
Graphs			
GFSK/LCH			
GFSK/MCH			
GFSK/HCH			

π/4DQPSK/LCH			
π/4DQPSK/MCH			
π/4DQPSK/HCH			

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

QW850-2 module:

Test Graph:

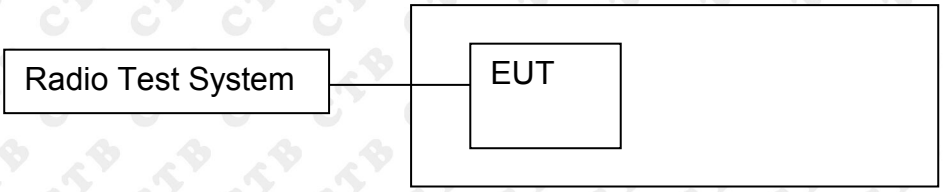
Graphs			
GFSK/LCH			
GFSK/MCH			
GFSK/HCH			

π/4DQPSK/LCH			
π/4DQPSK/MCH			
π/4DQPSK/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) ≥ 3 x 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

BW121 module:

Test Mode	Frequency	20dB Bandwidth (MHz)	Result
GFSK	Low channel	0.987	**PASS**
	Mid channel	1.051	**PASS**
	High channel	0.824	**PASS**
π/4DQPSK	Low channel	1.153	**PASS**
	Mid channel	1.247	**PASS**
	High channel	1.18	**PASS**
8DPSK	Low channel	1.238	**PASS**
	Mid channel	1.245	**PASS**
	High channel	1.252	**PASS**

QW850-1 module:

Test Mode	Frequency	20dB Bandwidth (MHz)	Result
GFSK	Low channel	0.945	**PASS**
	Mid channel	0.921	**PASS**
	High channel	0.93	**PASS**
π/4DQPSK	Low channel	1.273	**PASS**
	Mid channel	1.344	**PASS**
	High channel	1.339	**PASS**
8DPSK	Low channel	1.301	**PASS**
	Mid channel	1.298	**PASS**
	High channel	1.351	**PASS**

QW850-2 module:

Test Mode	Frequency	20dB Bandwidth (MHz)	Result
GFSK	Low channel	0.858	**PASS**
	Mid channel	0.865	**PASS**
	High channel	0.905	**PASS**
π/4DQPSK	Low channel	1.279	**PASS**
	Mid channel	1.333	**PASS**
	High channel	1.327	**PASS**
8DPSK	Low channel	1.351	**PASS**
	Mid channel	1.298	**PASS**
	High channel	1.33	**PASS**

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

BW121 module:
Test Graph:

GFSK Low channel			
GFSK Mid channel			
GFSK High channel			

π/4-DQPSK Low channel			
π/4-DQPSK Mid channel			
π/4-DQPSK High channel			

8DPSK Low channel			
8DPSK Mid channel			
8DPSK High channel			

QW850-1 module:
Test Graph:

GFSK Low channel		
GFSK Mid channel		
GFSK High channel		

π/4-DQPSK Low channel			
π/4-DQPSK Mid channel			
π/4-DQPSK High channel			

8DPSK Low channel			
8DPSK Mid channel			
8DPSK High channel			

QW850-2 module:
Test Graph:

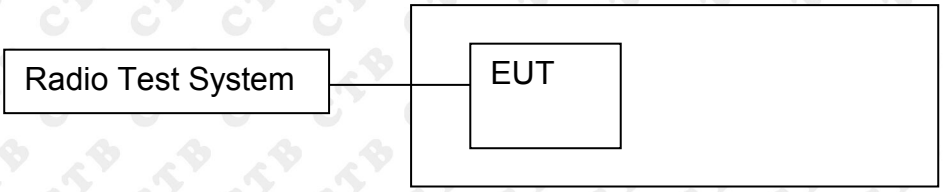
GFSK Low channel		
GFSK Mid channel		
GFSK High channel		

π/4-DQPSK Low channel			
π/4-DQPSK Mid channel			
π/4-DQPSK High channel			

8DPSK Low channel			
8DPSK Mid channel			
8DPSK High channel			

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

BW121 module:

Mode	Channel.	Carrier Frequency Separation [MHz]	Limit(2/3 of the 20dB bandwidth MHz)	Verdict
GFSK	LCH	0.992	0.658	PASS
GFSK	MCH	0.998	0.701	PASS
GFSK	HCH	1.004	0.549	PASS
π/4DQPSK	LCH	1.006	0.769	PASS
π/4DQPSK	MCH	1.008	0.831	PASS
π/4DQPSK	HCH	0.994	0.787	PASS
8DPSK	LCH	1.004	0.825	PASS
8DPSK	MCH	0.996	0.830	PASS
8DPSK	HCH	1.006	0.835	PASS

QW850-1 module:

Mode	Channel.	Carrier Frequency Separation [MHz]	Limit(2/3 of the 20dB bandwidth MHz)	Verdict
GFSK	LCH	0.998	0.630	PASS
GFSK	MCH	1.002	0.614	PASS
GFSK	HCH	0.992	0.620	PASS
π/4DQPSK	LCH	1.002	0.849	PASS
π/4DQPSK	MCH	1.004	0.896	PASS
π/4DQPSK	HCH	1.004	0.893	PASS
8DPSK	LCH	1.006	0.867	PASS
8DPSK	MCH	1.008	0.865	PASS
8DPSK	HCH	1.006	0.901	PASS

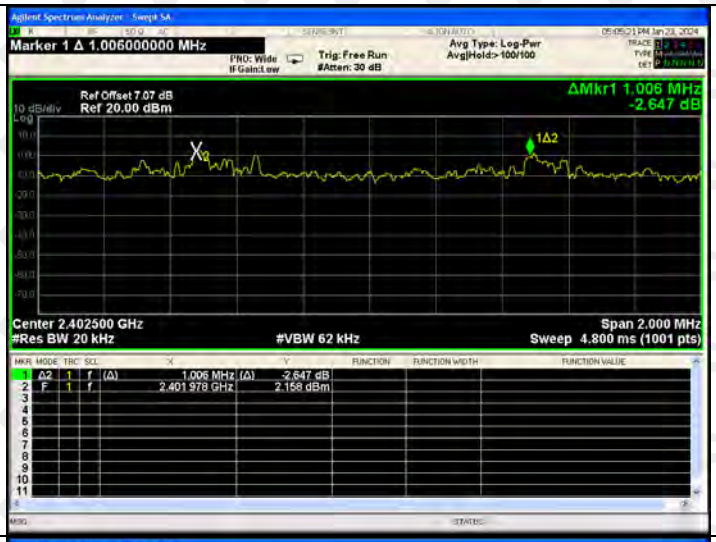
QW850-2 module:

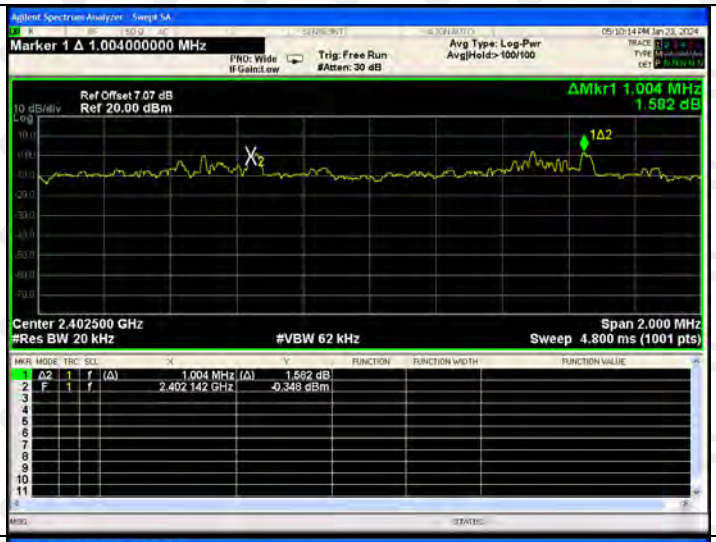
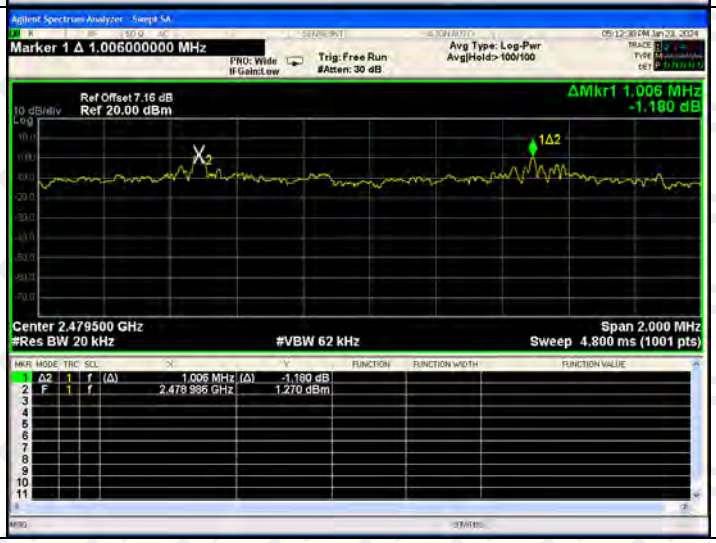
Mode	Channel.	Carrier Frequency Separation [MHz]	Limit(2/3 of the 20dB bandwidth MHz)	Verdict
GFSK	LCH	1.000	0.572	PASS
GFSK	MCH	1.004	0.577	PASS
GFSK	HCH	0.996	0.603	PASS
π/4DQPSK	LCH	0.996	0.853	PASS
π/4DQPSK	MCH	1.000	0.889	PASS
π/4DQPSK	HCH	0.998	0.885	PASS
8DPSK	LCH	0.998	0.901	PASS
8DPSK	MCH	1.004	0.865	PASS
8DPSK	HCH	0.994	0.887	PASS

BW121 module:

Test Graph

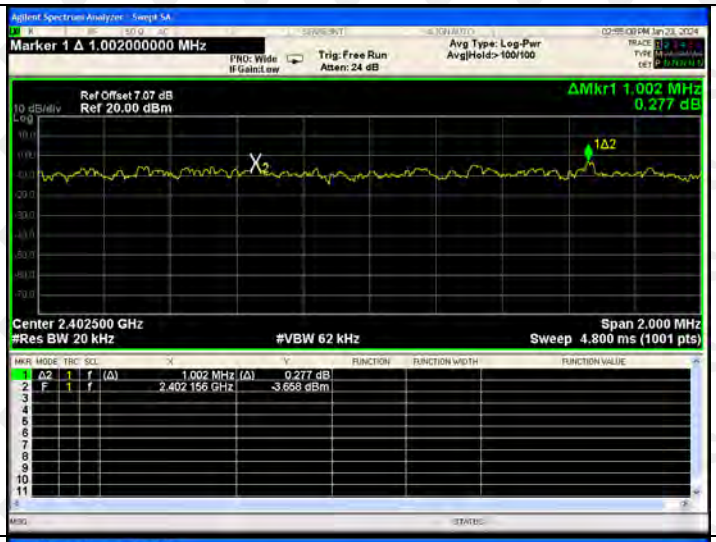
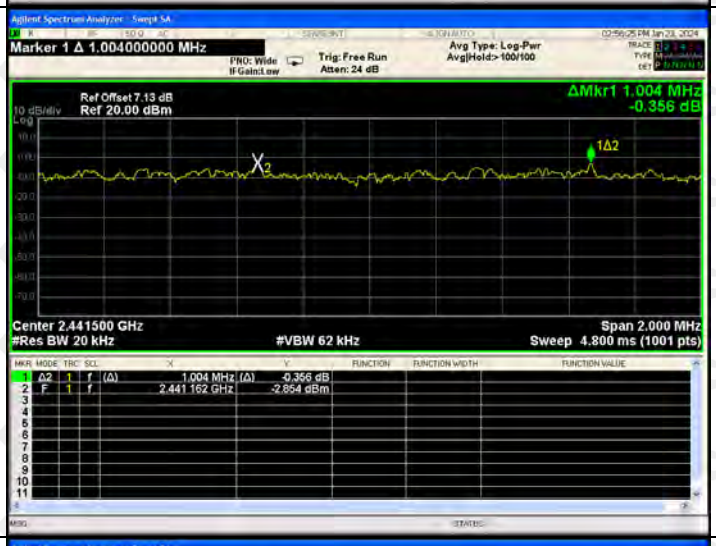
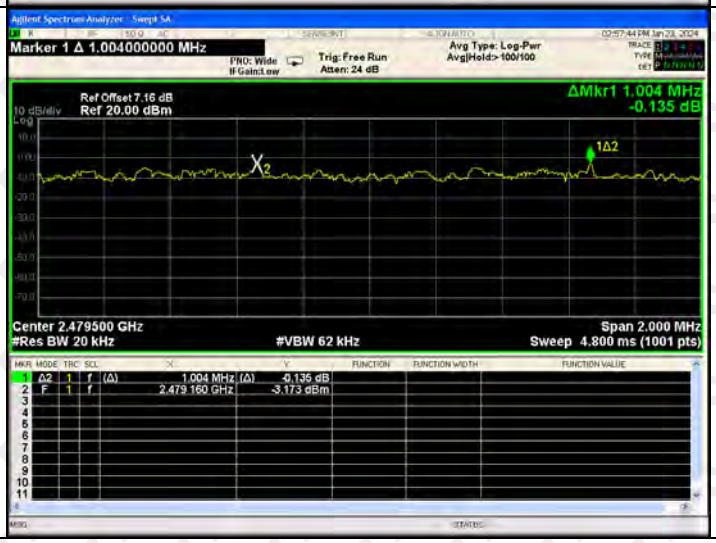
Graphs			
GFSK/LCH			
GFSK/MCH			
GFSK/HCH			

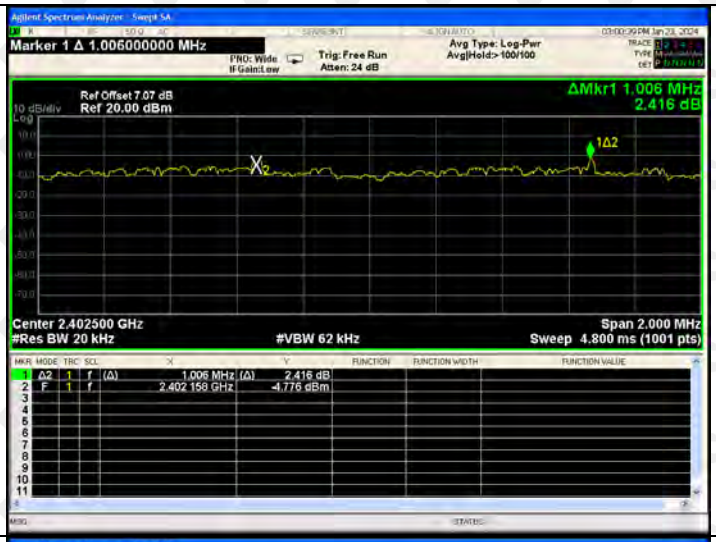
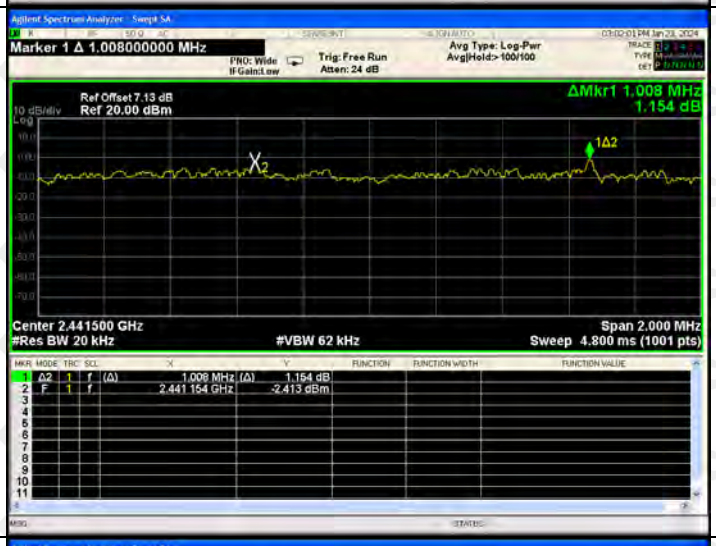
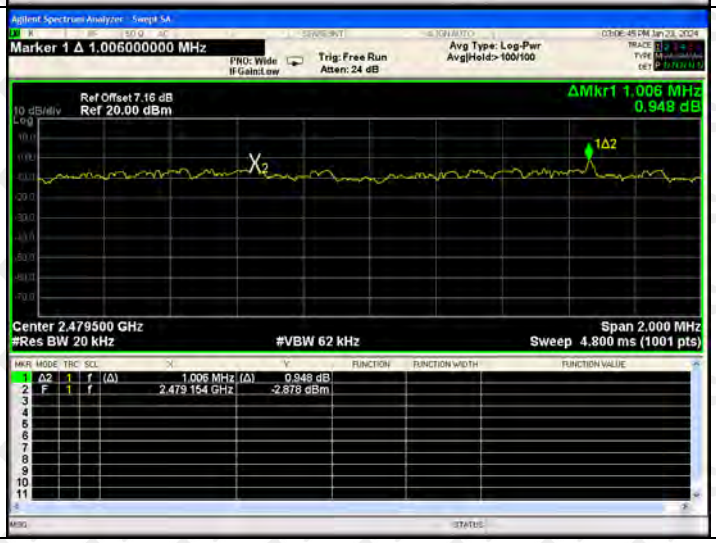
π/4DQPSK/LCH			
π/4DQPSK/MCH			
π/4DQPSK/HCH			

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

QW850-1 module:
Test Graph

Graphs			
GFSK/LCH			
GFSK/MCH			
GFSK/HCH			

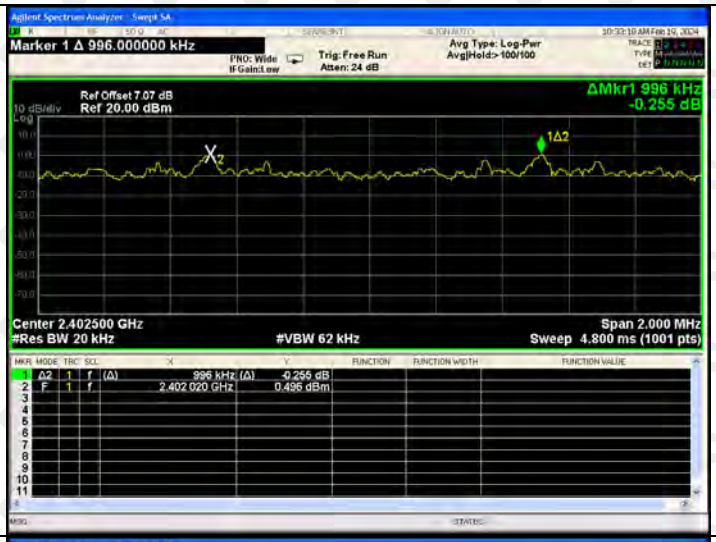
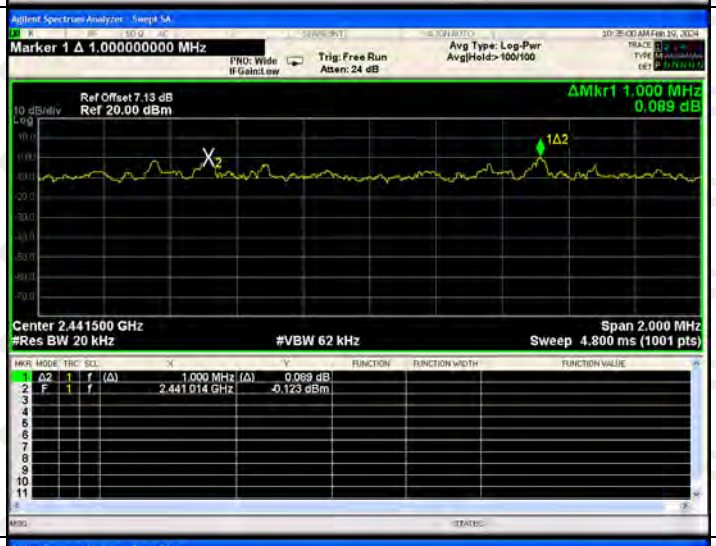
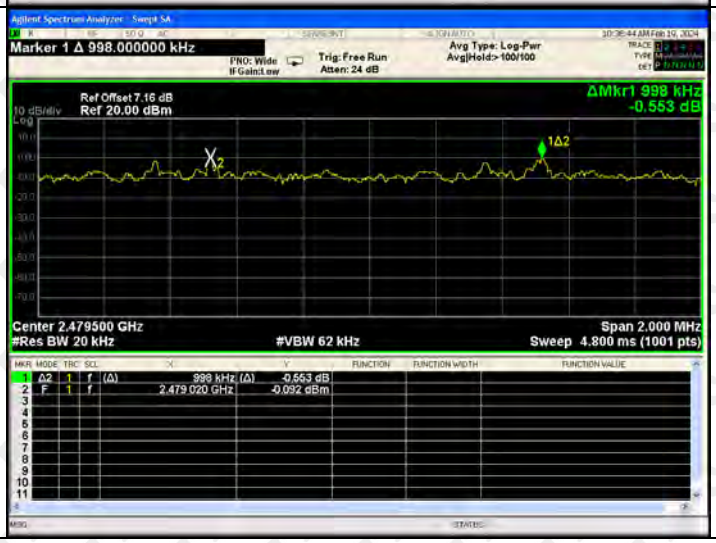
π/4DQPSK/LCH			
π/4DQPSK/MCH			
π/4DQPSK/HCH			

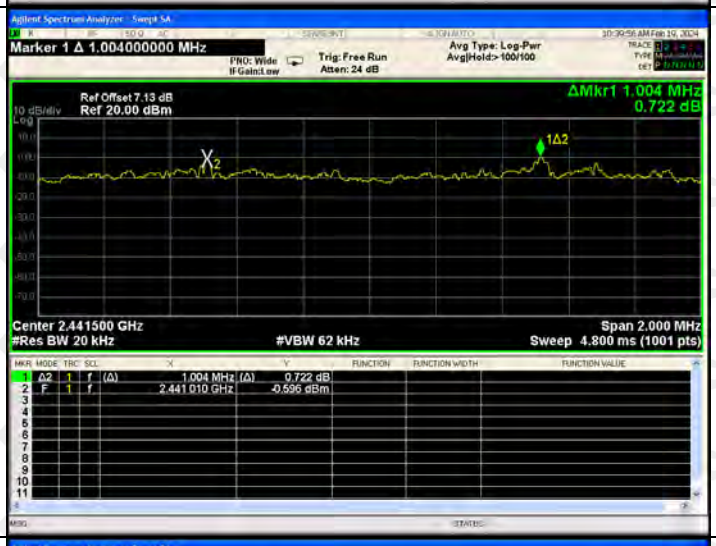
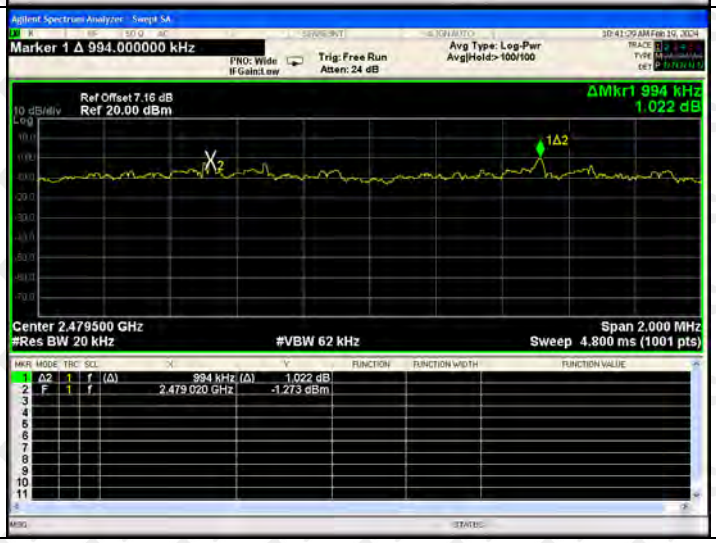
8DPSK/LCH			
8DPSK /MCH			
8DPSK /HCH			

QW850-2 module:

Test Graph

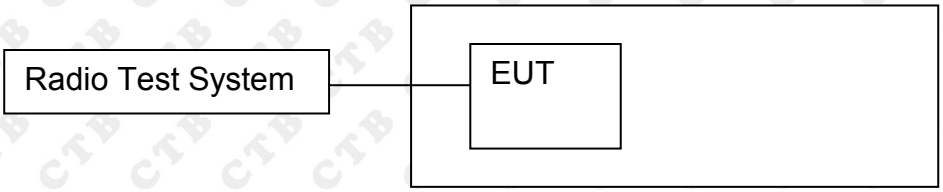
Graphs			
GFSK/LCH			
GFSK/MCH			
GFSK/HCH			

π/4DQPSK/LCH			
π/4DQPSK/MCH			
π/4DQPSK/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

BW121 module:

Mode	Channel.	Number of Hopping Channel	Limit	Verdict
GFSK	Hop	79	≥15	PASS
π/4DQPSK	Hop	79	≥15	PASS
8DPSK	Hop	79	≥15	PASS

QW850-1 module:

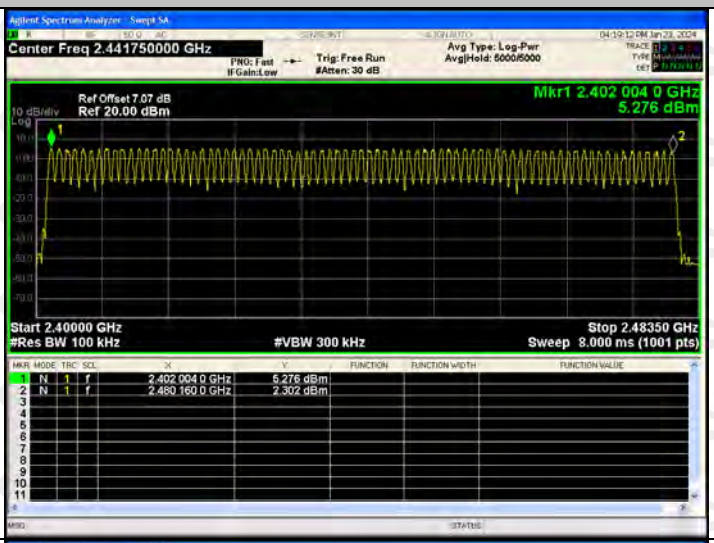
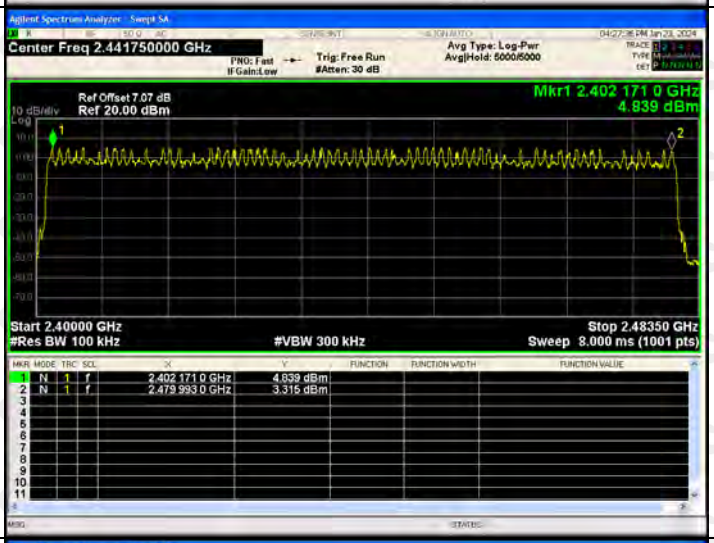
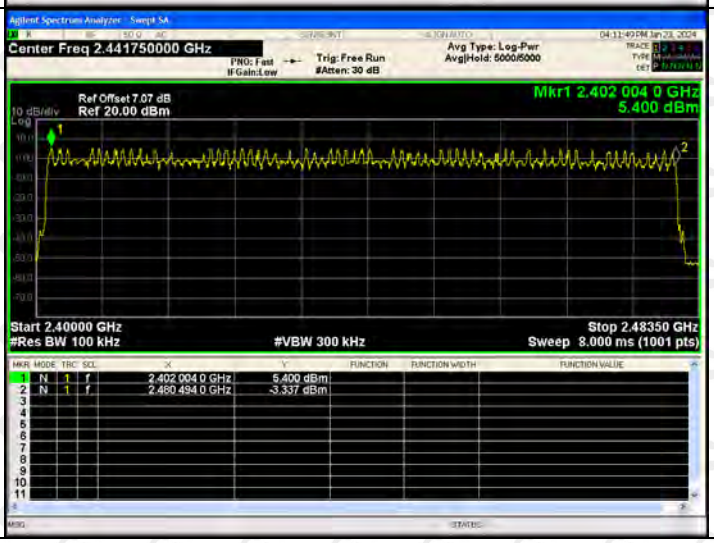
Mode	Channel.	Number of Hopping Channel	Limit	Verdict
GFSK	Hop	79	≥15	PASS
π/4DQPSK	Hop	79	≥15	PASS
8DPSK	Hop	79	≥15	PASS

QW850-2 module:

Mode	Channel.	Number of Hopping Channel	Limit	Verdict
GFSK	Hop	79	≥15	PASS
π/4DQPSK	Hop	79	≥15	PASS
8DPSK	Hop	79	≥15	PASS

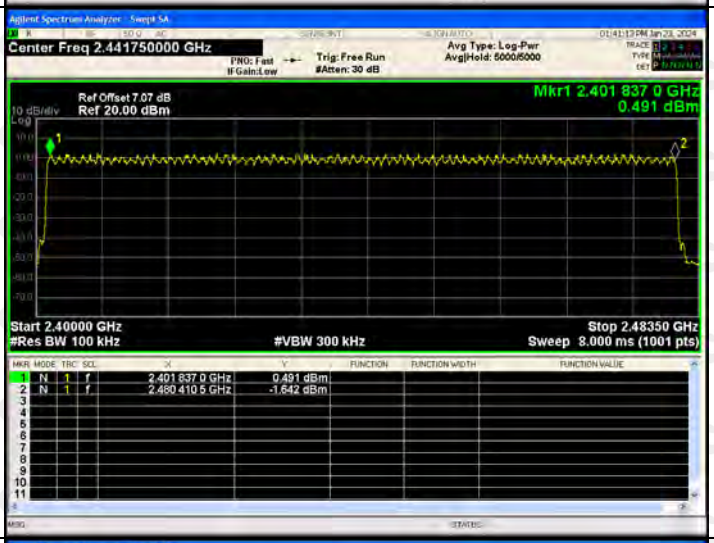
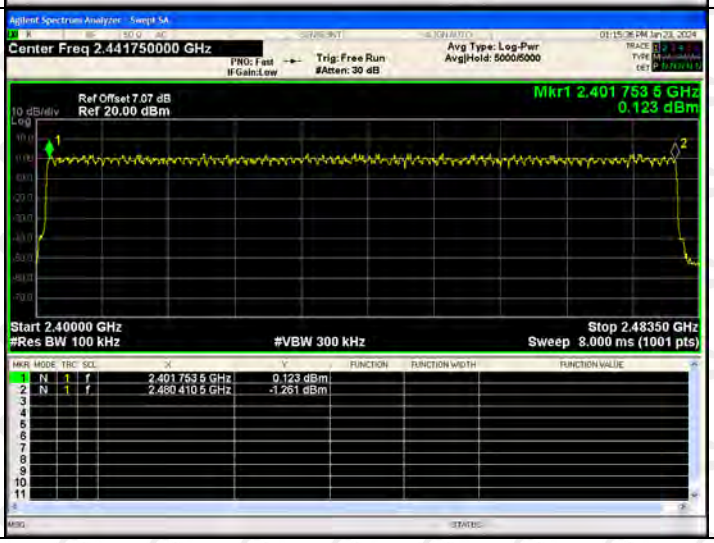
BW121 module:

Test Graph

Graphs			
GFSK/Hop			
π/4DQPSK/Hop			
8DPSK/Hop			

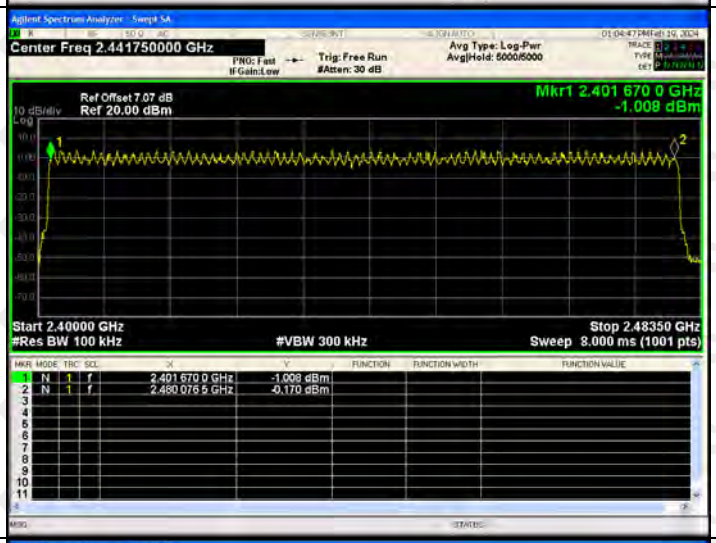
QW850-1 module:

Test Graph

Graphs			
GFSK/Hop			
π/4DQPSK/Hop			
8DPSK/Hop			

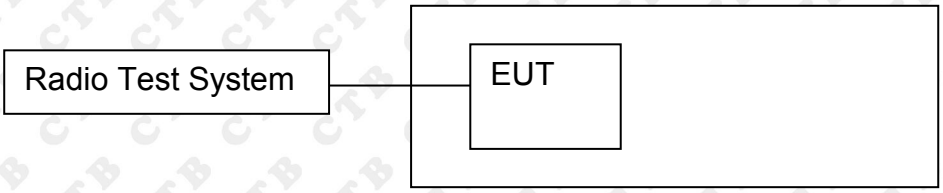
QW850-2 module:

Test Graph

Graphs			
GFSK/Hop			
π/4DQPSK/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

BW121 module:
Worst case-GFSK:

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	0.394	126.08	400	PASS
	DH3	LCH	1.647	263.52	400	PASS
	DH3	MCH	1.647	263.52	400	PASS
	DH3	HCH	1.654	264.64	400	PASS
	DH5	LCH	2.901	309.44	400	PASS
	DH5	MCH	2.899	309.227	400	PASS
	DH5	HCH	2.899	309.227	400	PASS

QW850-1 module:
Worst case-GFSK:

Mode	Packet	Channel	Pulse Time (ms)	Total Dwell Time (ms)	Limit (ms)	Verdict
GFSK	DH1	LCH	0.382	122.24	400	PASS
	DH1	MCH	0.382	122.24	400	PASS
	DH1	HCH	0.382	122.24	400	PASS
	DH3	LCH	1.631	260.96	400	PASS
	DH3	MCH	1.632	261.12	400	PASS
	DH3	HCH	1.637	261.92	400	PASS
	DH5	LCH	2.887	307.947	400	PASS
	DH5	MCH	2.886	307.84	400	PASS
	DH5	HCH	2.886	307.84	400	PASS

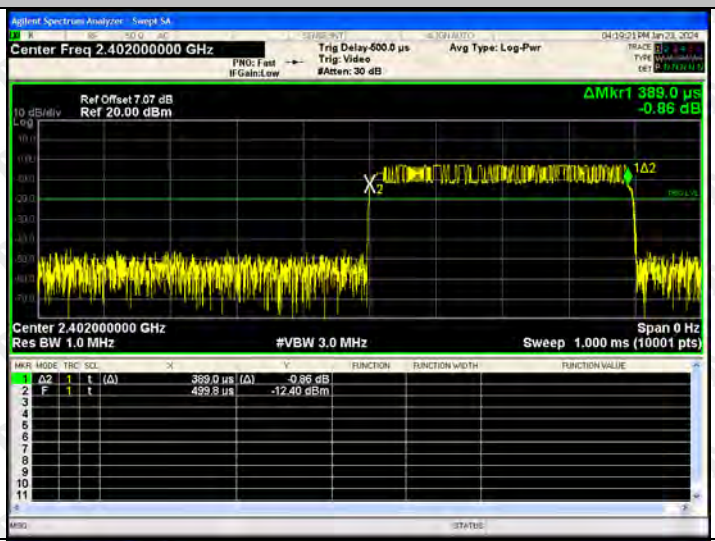
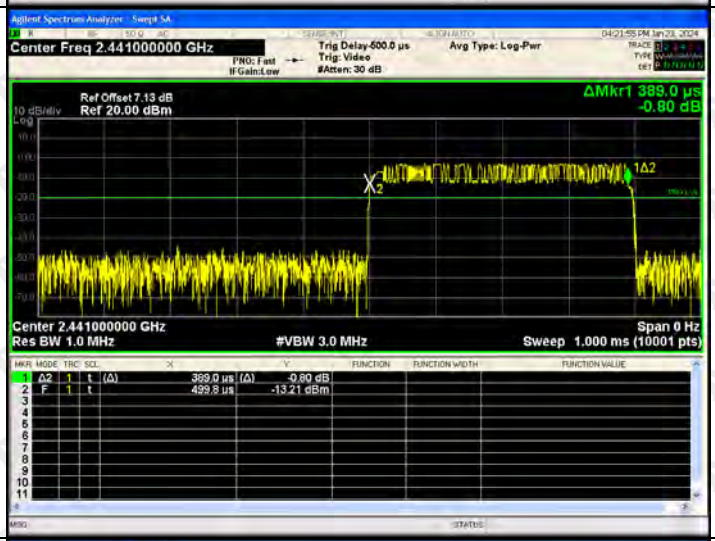
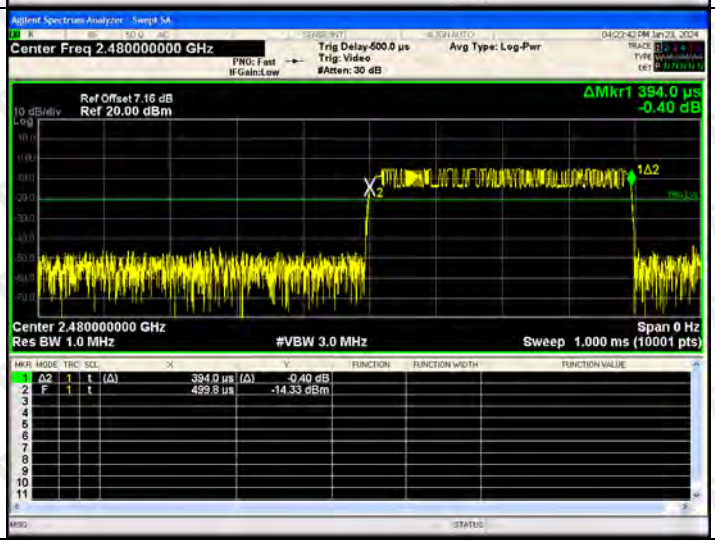
QW850-2 module:
Worst case-GFSK:

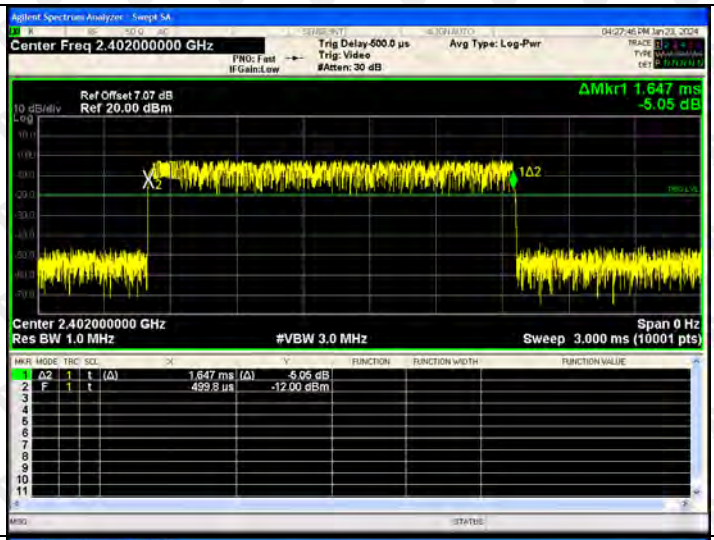
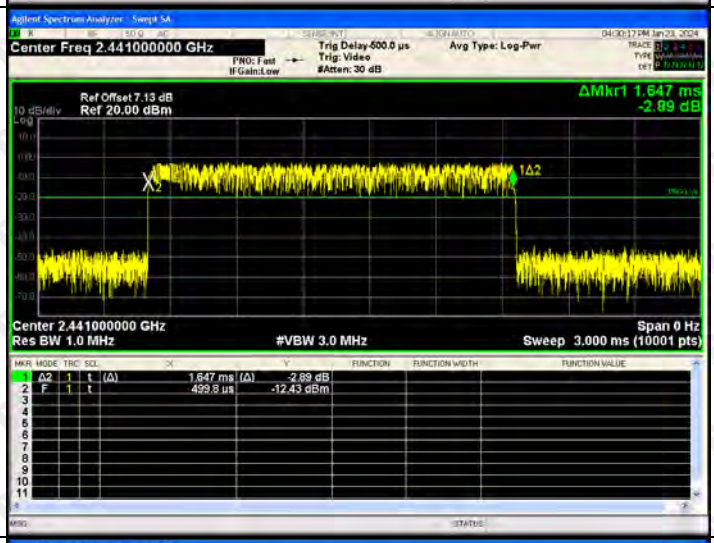
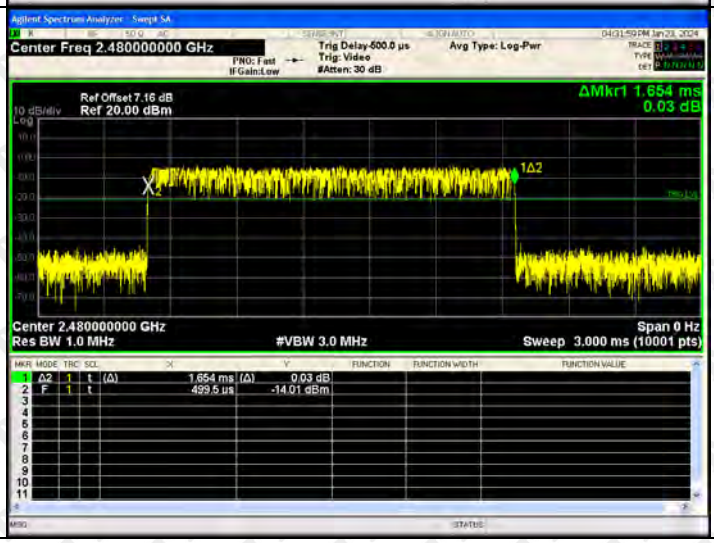
Mode	Packet	Channel	Pulse Time (ms)	Total Dwell Time (ms)	Limit (ms)	Verdict
GFSK	DH1	LCH	0.382	122.24	400	PASS
	DH1	MCH	0.382	122.24	400	PASS
	DH1	HCH	0.382	122.24	400	PASS
	DH3	LCH	1.631	260.96	400	PASS
	DH3	MCH	1.632	261.12	400	PASS
	DH3	HCH	1.637	261.92	400	PASS
	DH5	LCH	2.887	307.947	400	PASS
	DH5	MCH	2.886	307.84	400	PASS
	DH5	HCH	2.886	307.84	400	PASS

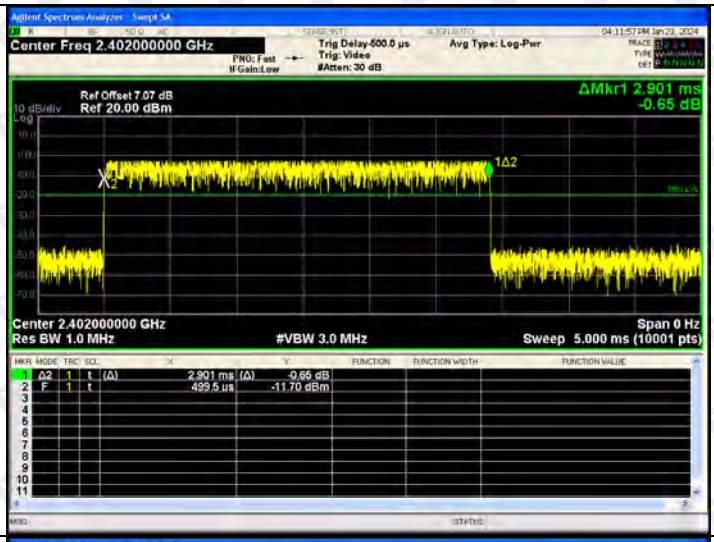
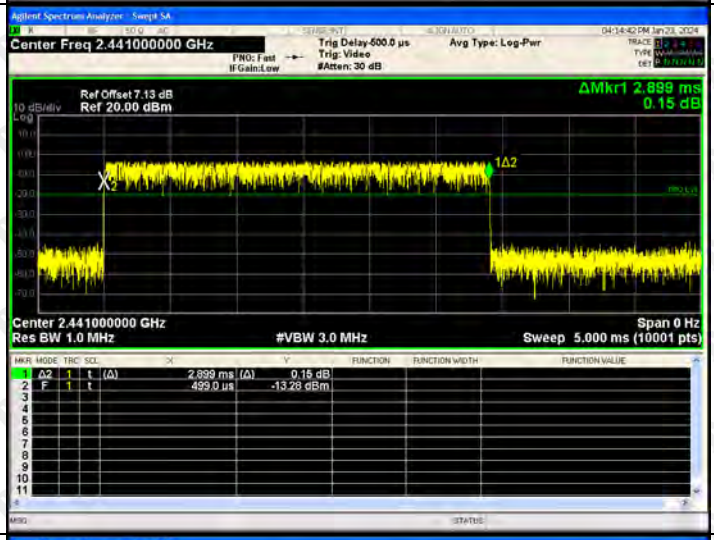
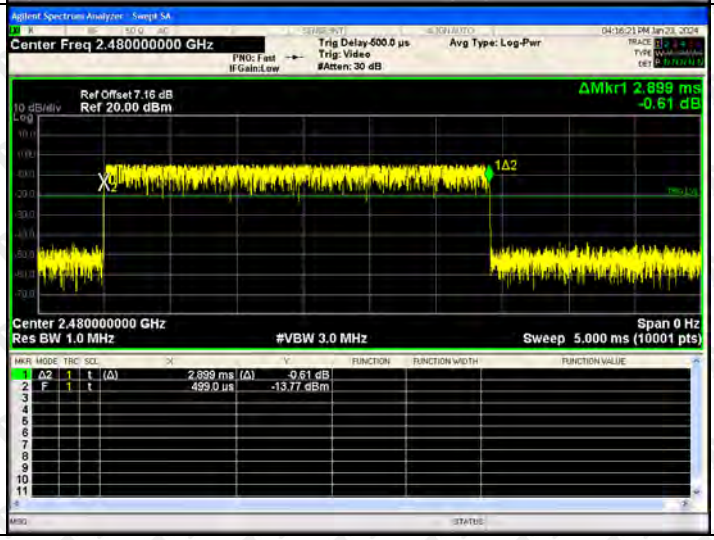
Remark: DH5 Packet permit maximum 1600 / 79 / 6 hops per second in each channel (5 time slots RX, 1 time slot TX).
DH3 Packet permit maximum 1600 / 79 / 4 hops per second in each channel (3 time slots RX, 1 time slot TX).
DH1 Packet permit maximum 1600 / 79 /2 hops per second in each channel (1 time 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.

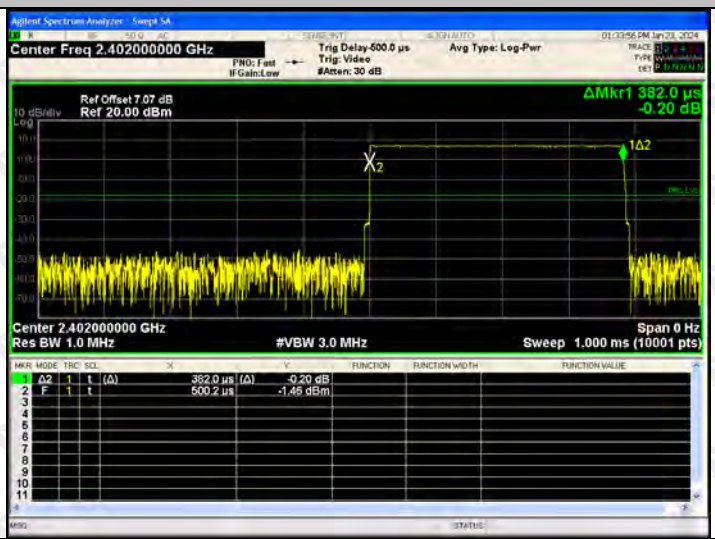
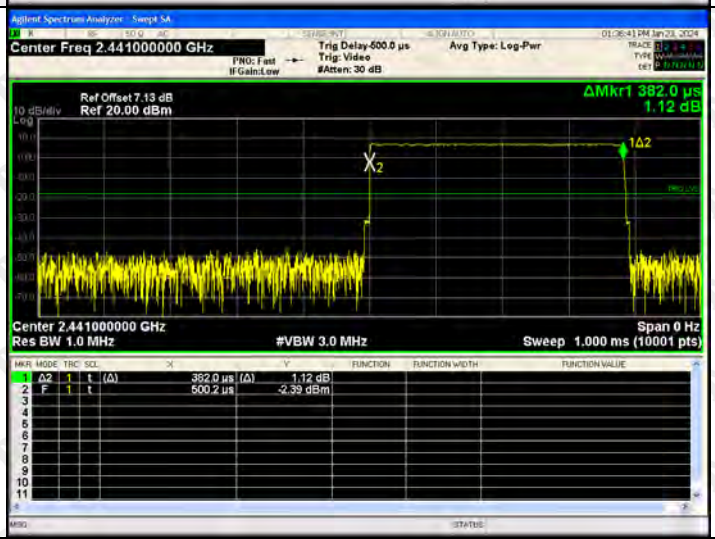
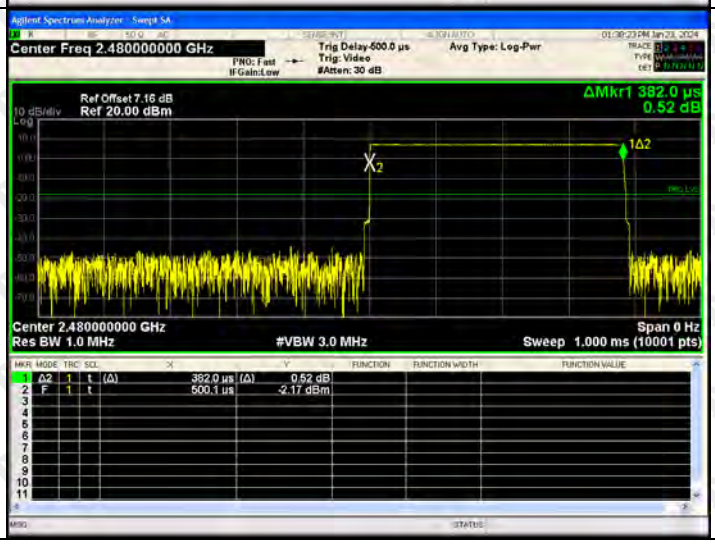
BW121 module:
Test Graph

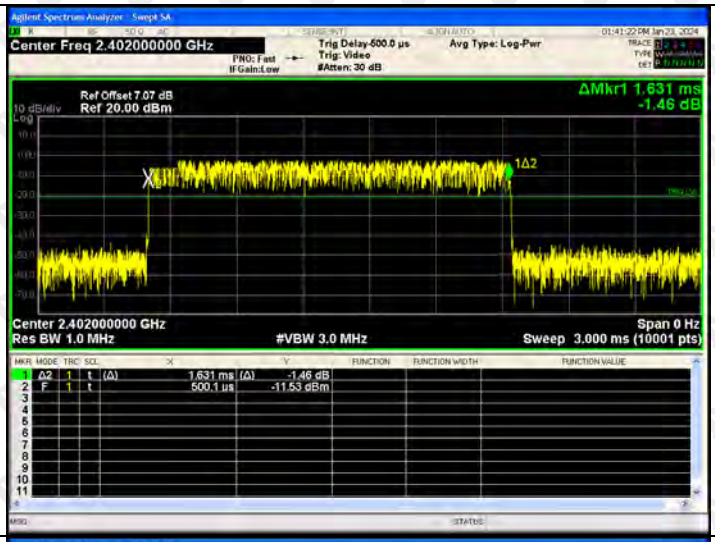
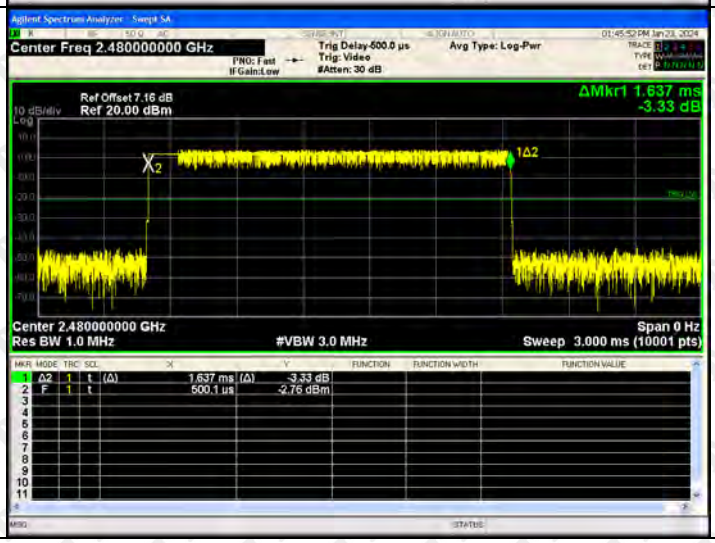
Graphs		
GFSK_DH1/LCH		
GFSK_DH1/MCH		
GFSK_DH1/HCH		

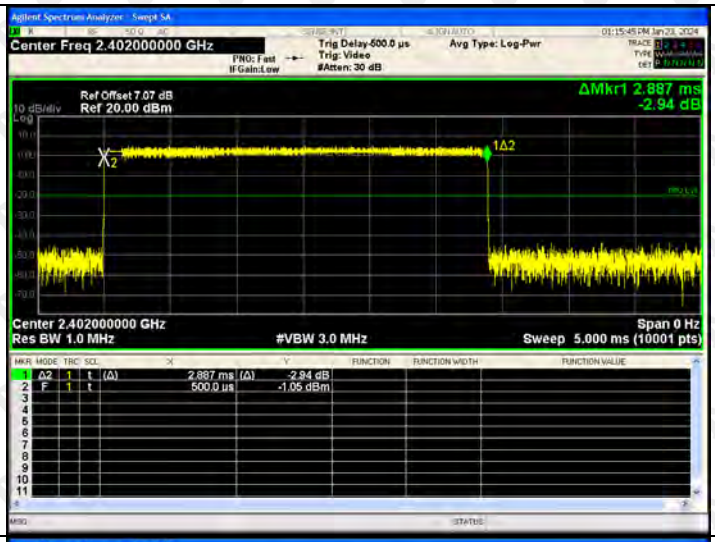
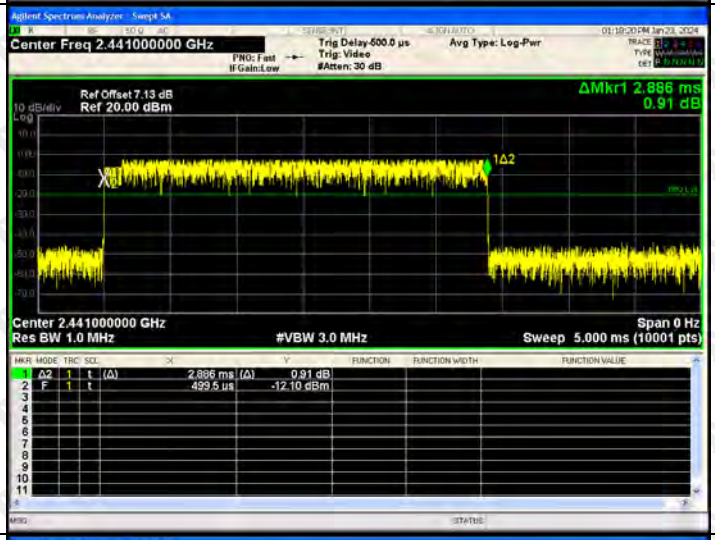
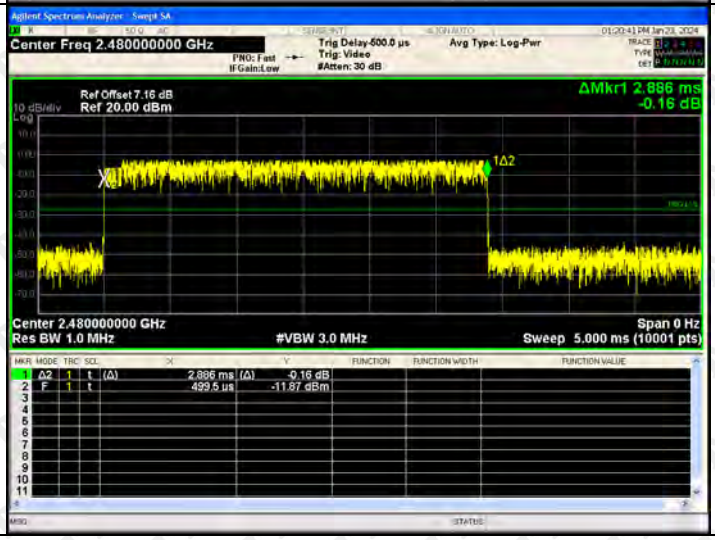
GFSK_DH3/LCH		
GFSK_DH3/MCH		
GFSK_DH3/HCH		

GFSK_DH5/LCH		
GFSK_DH5/MCH		
GFSK_DH5/HCH		

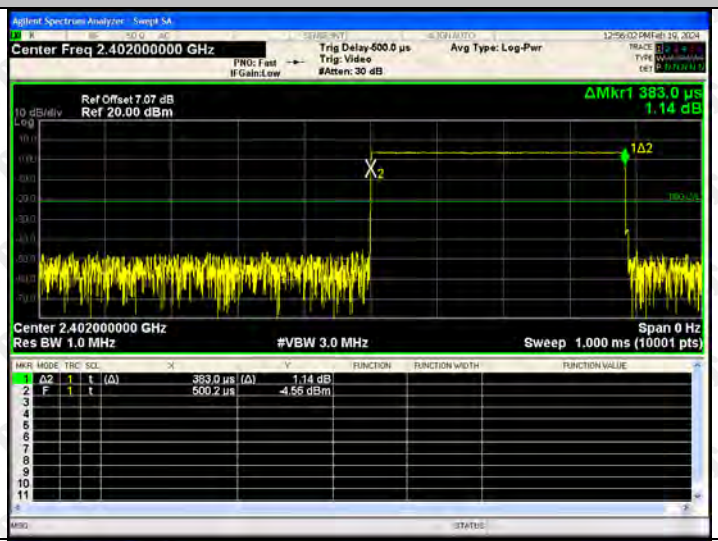
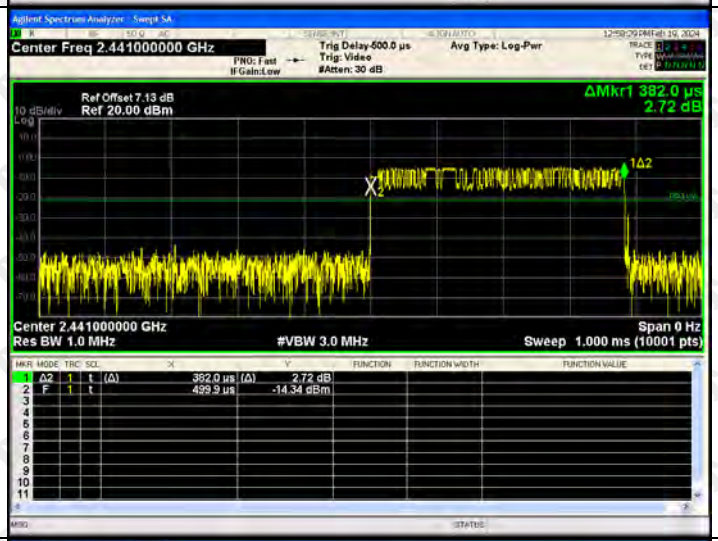
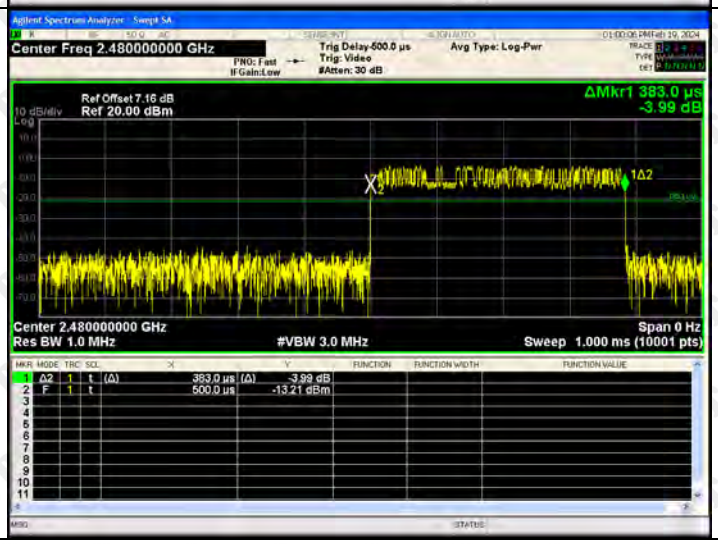
QW850-1 module:
Test Graph

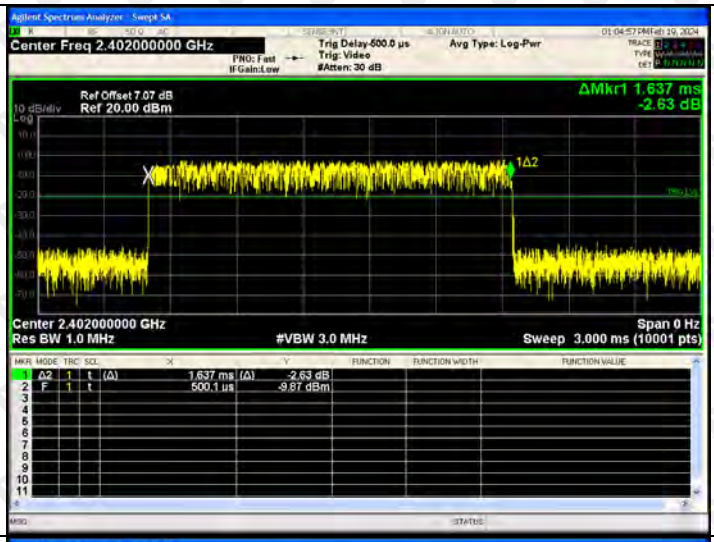
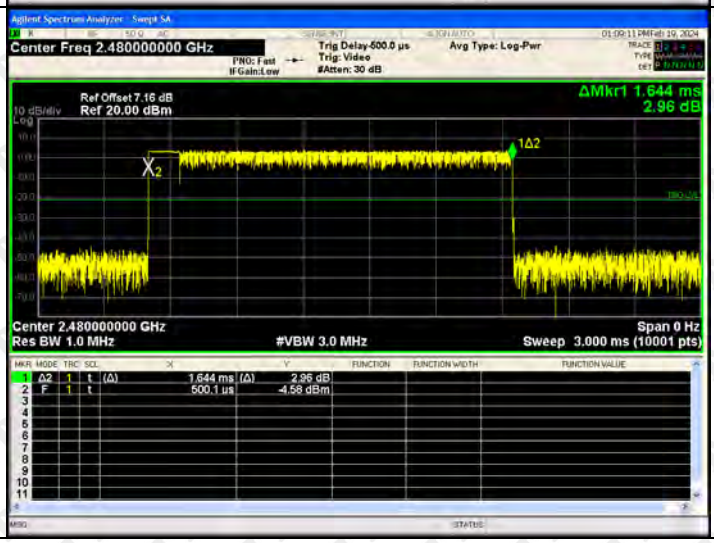
Graphs		
GFSK_DH1/LCH		
GFSK_DH1/MCH		
GFSK_DH1/HCH		

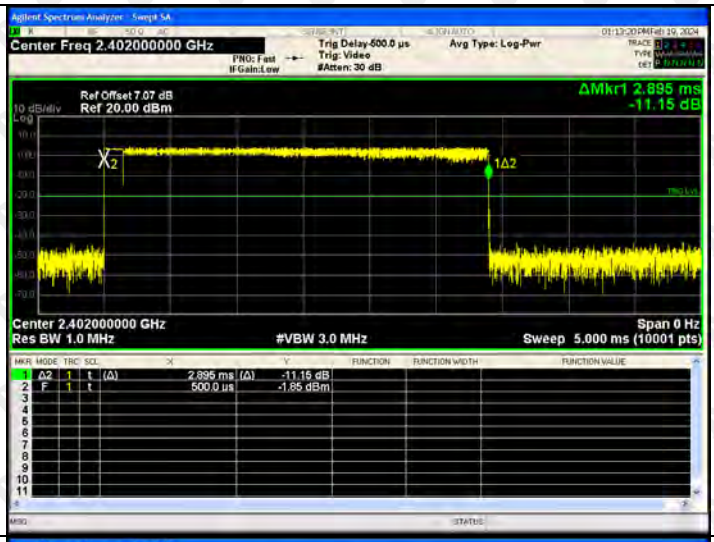
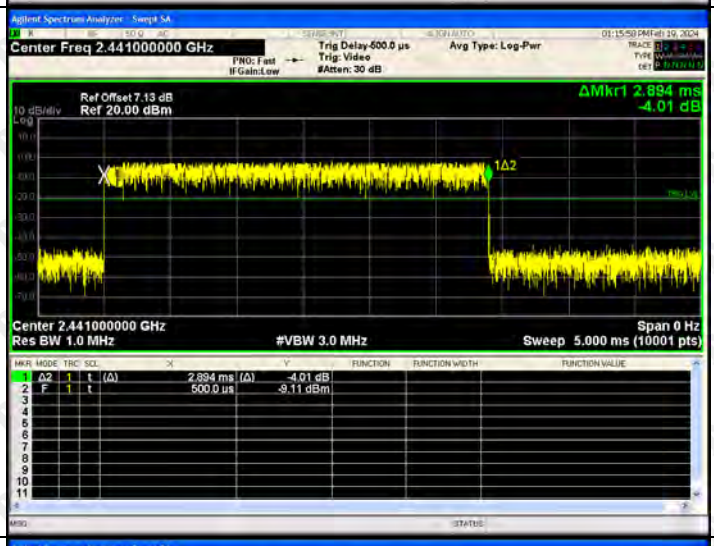
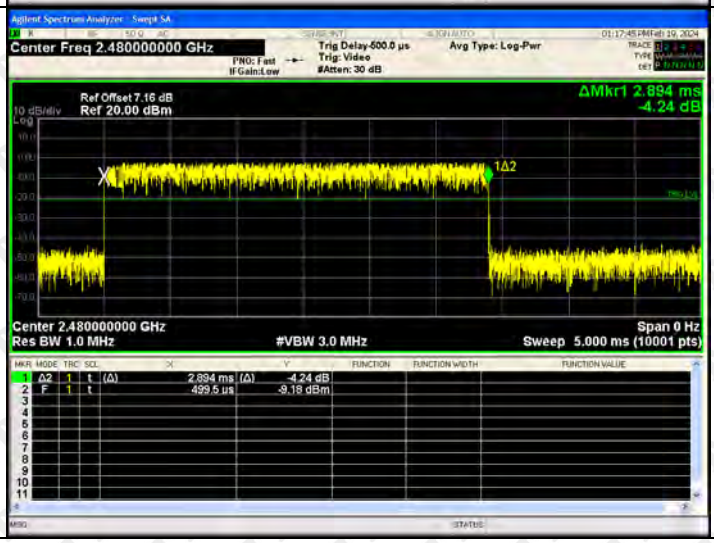
GFSK_DH3/LCH		
GFSK_DH3/MCH		
GFSK_DH3/HCH		

GFSK_DH5/LCH		
GFSK_DH5/MCH		
GFSK_DH5/HCH		

QW850-2 module:
Test Graph

Graphs		
GFSK_DH1/LCH		
GFSK_DH1/MCH		
GFSK_DH1/HCH		

GFSK_DH3/LCH		
GFSK_DH3/MCH		
GFSK_DH3/HCH		

GFSK_DH5/LCH		
GFSK_DH5/MCH		
GFSK_DH5/HCH		

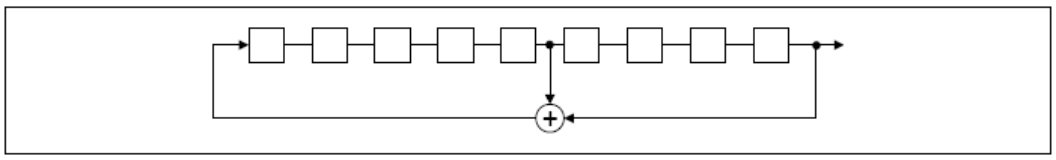
14. PSEUDORANDOM FREQUENCY

14.1 Limit

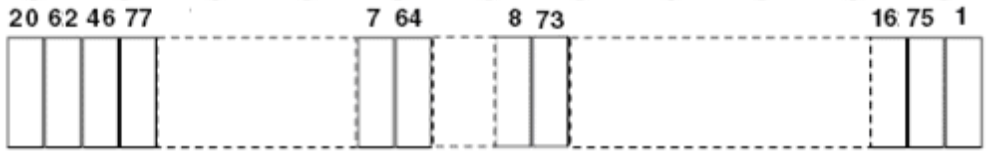
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.
Alternatively. Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that 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: 29 -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.

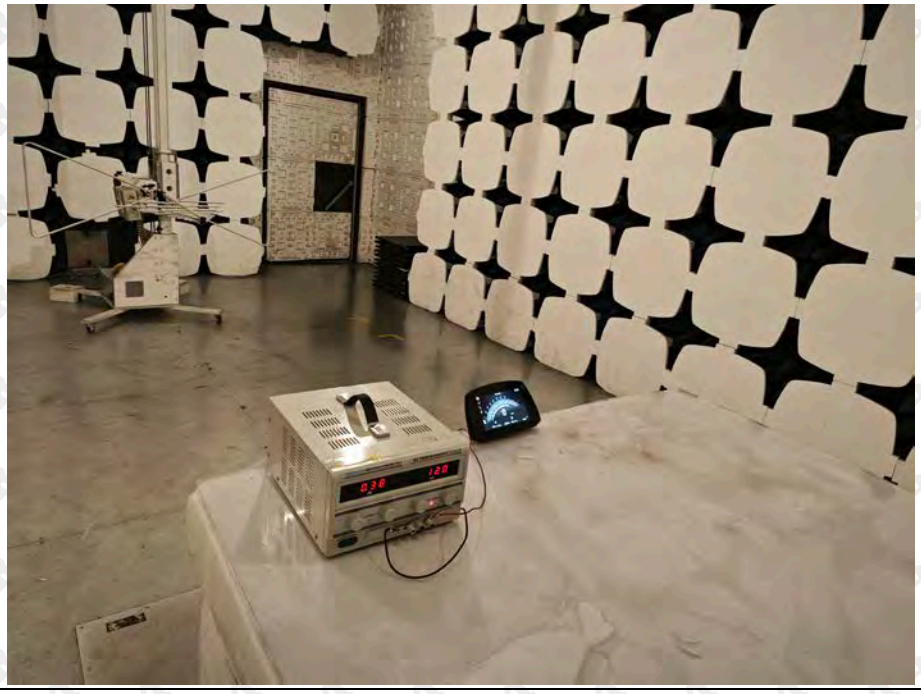
EUT Antenna:

The antenna is Internal antenna. The best case gain of the antenna is BW121 module: 1.95dBi, QW850-1 module: 4.98dBi, QW850-2 module: 3.45dBi

16. EUT TEST SETUP PHOTOGRAPHS

Radiated Emission

Below 1G



Above 1G

※※※※※ END OF REPORT ※※※※※