Operation Mode: TX CH High (2480MHz)

Horizontal (Worst case):

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	52.86	-5.81	47.05	74	26.95	peak
2483.50	/	-5.81	/	54	/	AVG
2500.00	52.35	-6.06	46.29	74	27.71	peak
2500.00	/	-6.06	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Limit - Level.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	56.24	-5.81	50.43	74	23.57	peak
2483.50	/	-5.81	/	54	/	AVG
2500.00	54.53	-6.06	48.47	74	25.53	peak
2500.00	/	-6.06	/	54	/	AVG
Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Limit - Level.						
Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.						

Remark:
1. If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.
2. In restricted bands of operation, the spurious emissions below the permissible value more than 20dB.
3. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

3.3. Maximum Peak Conducted Output Power

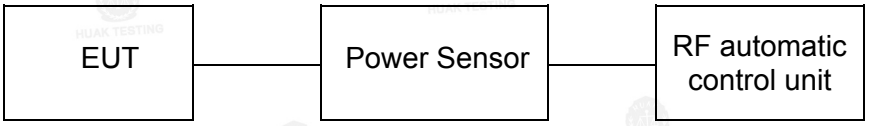
Limit

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 125mW. 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 hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power sensor.

Test Configuration



Test Results

Type	Channel	Maximum Peak Conducted Output Power (dBm)	Limit (dBm)	Result
GFSK	00	-2.10	21.00	Pass
	39	-0.84		
	78	-0.18		
π/4DQPSK	00	-1.40	21.00	Pass
	39	-0.30		
	78	0.26		

Note: The test results including the cable loss.

3.4. 20dB Bandwidth

Limit

For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwidth.

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 30 KHz RBW and 100 KHz VBW.

The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:

RBW=1% to 5% of the OBW
VBW=approximately 3 X RBW
Detector=Peak
Trace Mode: Max Hold

Use the 99% power bandwidth function of the instrument to measure the Occupied Bandwidth and recoded.

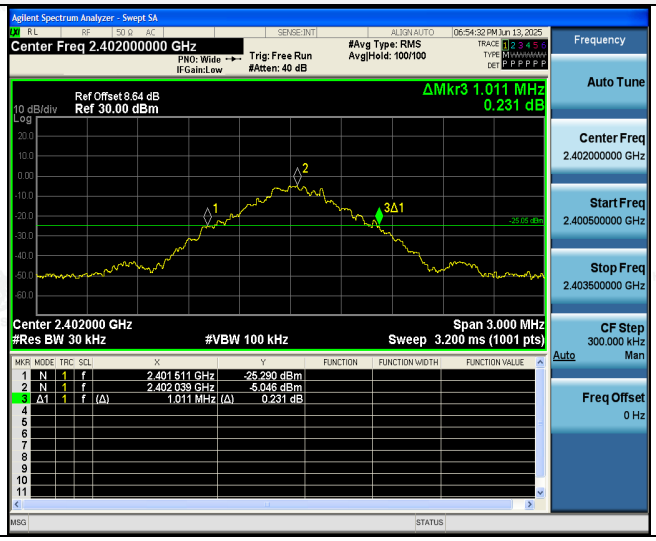
Test Configuration

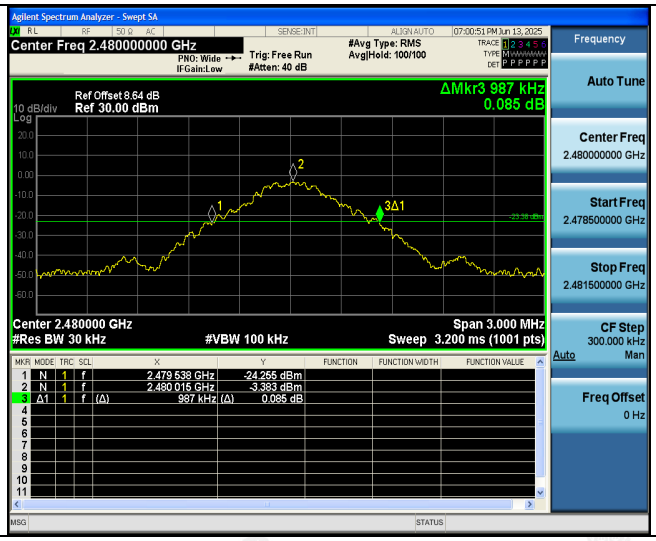
Test Results

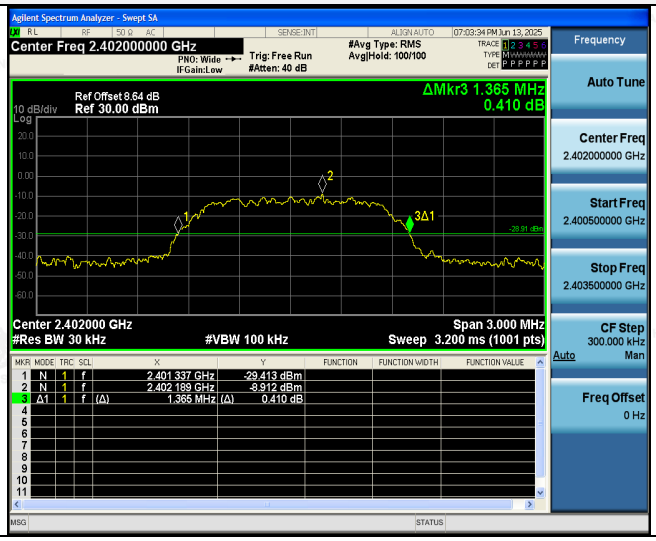
Modulation	Channel	20dB Bandwidth (MHz)	Result
GFSK	CH00	1.011	Pass
	CH39	0.993	
	CH78	0.987	
π/4DQPSK	CH00	1.365	
	CH39	1.299	
	CH78	1.323	

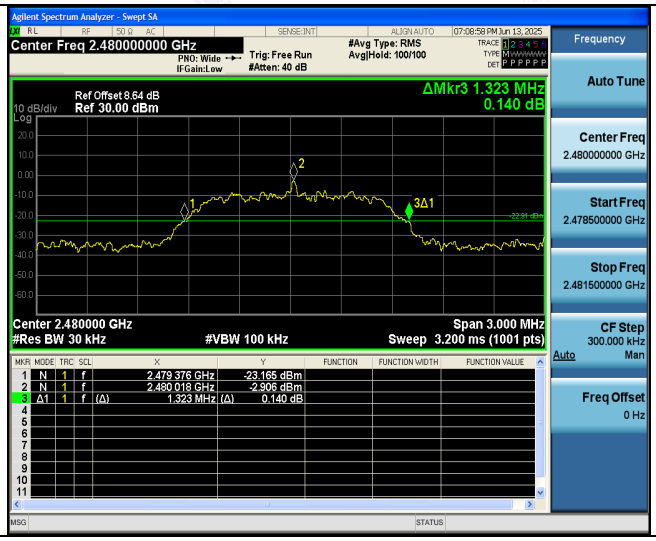
Test plot as follows:

20dB Bandwidth

GFSK Modulation

CH00

CH39

CH78

π/4DQPSK Modulation

CH00

CH39

CH78

3.5. Frequency Separation

Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25 KHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 30 KHz RBW and 100 KHz VBW.

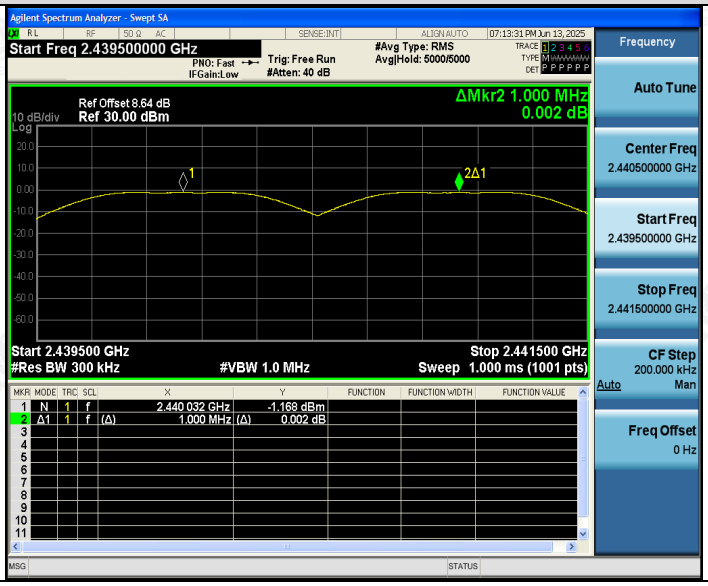
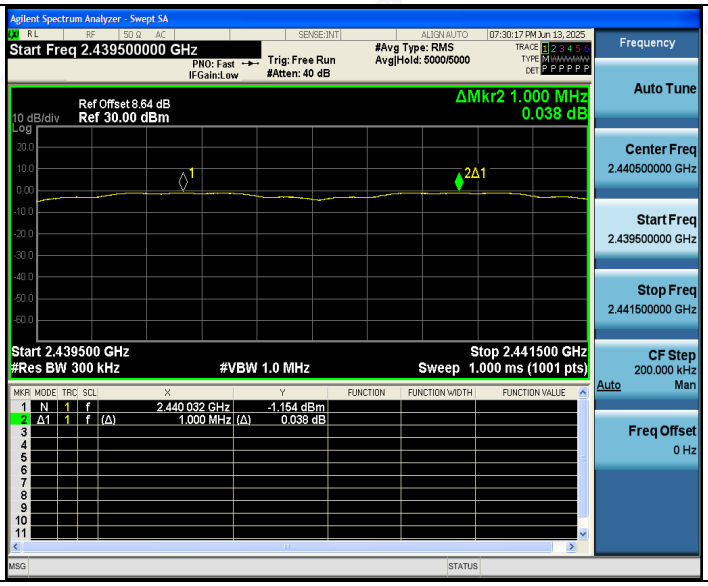
Test Configuration

Test Results

Modulation	Channel	Channel Separation (MHz)	Limit(MHz)	Result
GFSK	CH39	1.000	0.674	Pass
	CH40			
π/4DQPSK	CH39	1.000	0.910	Pass
	CH40			

Note: We have tested all mode at high, middle and low channel, and recorded worst case at middle

Test plot as follows:

Frequency Separation

GFSK

π/4DQPSK

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

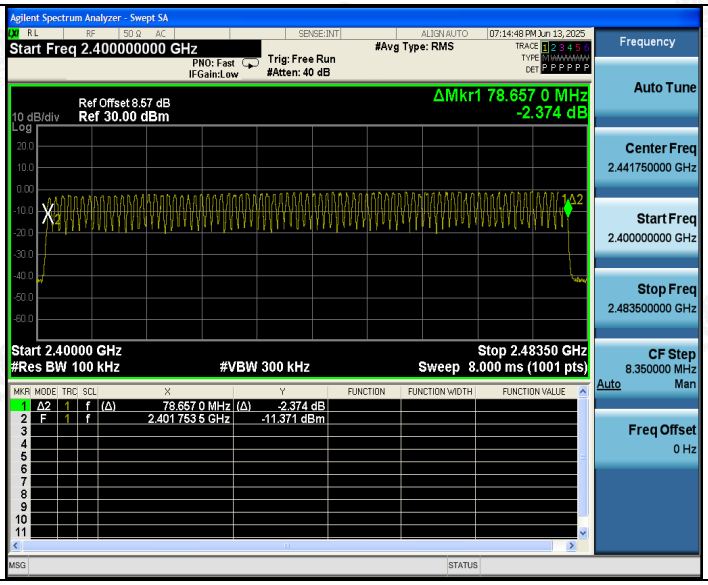
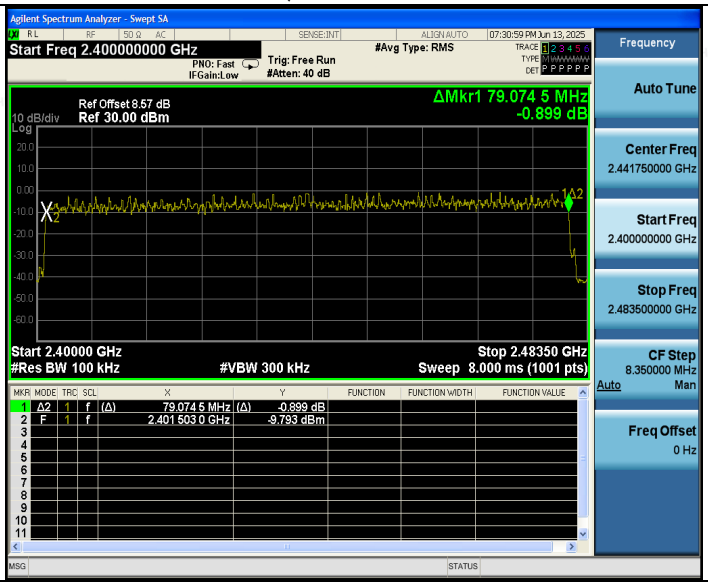
The transmitter output was connected to the spectrum analyzer through an attenuator. Set spectrum analyzer start 2400MHz to 2483.5MHz.

Test Configuration

Test Results

Modulation	Number of Hopping Channel	Limit	Result
GFSK	79	≥15	Pass
π/4DQPSK	79		

Test plot as follows:

GFSK Modulation

π/4DQPSK Modulation


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

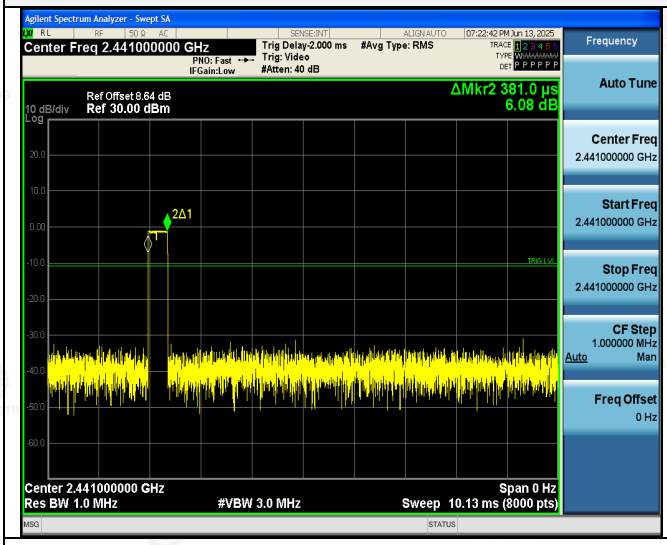
Modulation	Packet	Pulse time (ms)	Number of transmission in 31.6s (79 Hopping*0.4)= Burst Count	Dwell time (second)	Limit (second)	Result
GFSK	DH1	0.381	30 (pulses)*10=300	0.114	0.40	PASS
	DH3	1.638	15 (pulses)*10=150	0.246		
	DH5	2.885	12 (pulses)*10=120	0.346		
π/4DQPSK	2-DH1	0.391	31 (pulses)*10=310	0.121	0.40	PASS
	2-DH3	1.643	18 (pulses)*10=180	0.296		
	2-DH5	2.891	11 (pulses)*10=110	0.318		

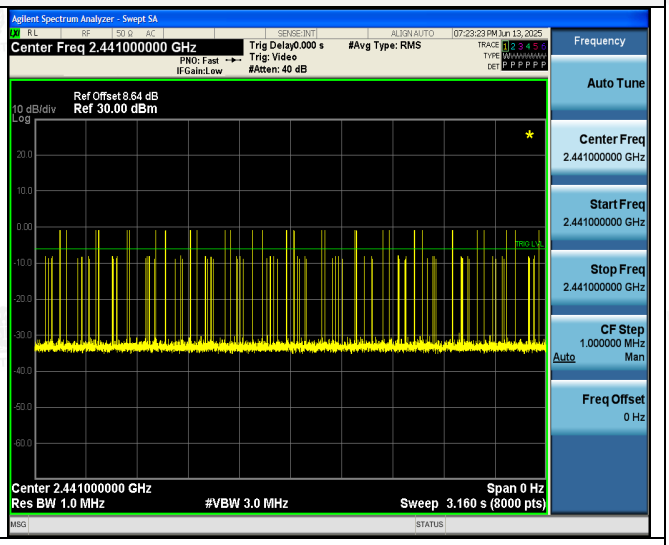
Note:

1. We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.
2. Dwell time =[Pulse time (ms) /1000] x Burst Count

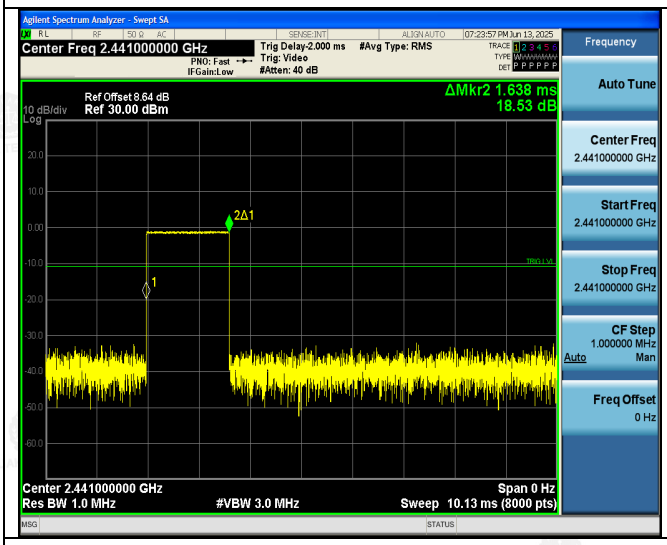
Test plot as follows:

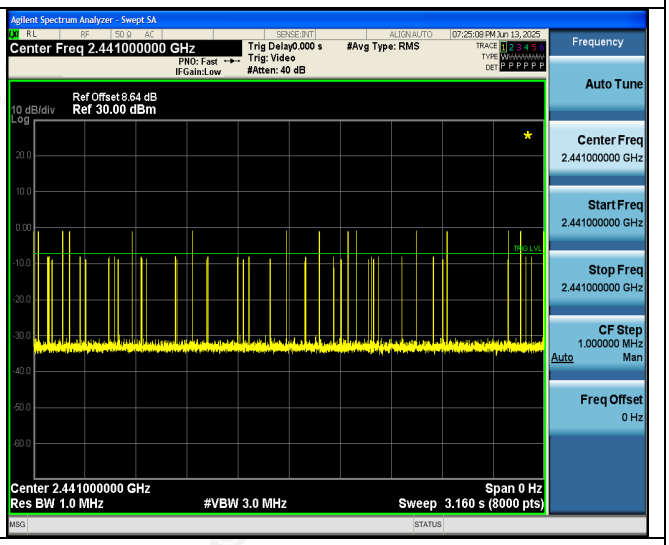
GFSK Modulation



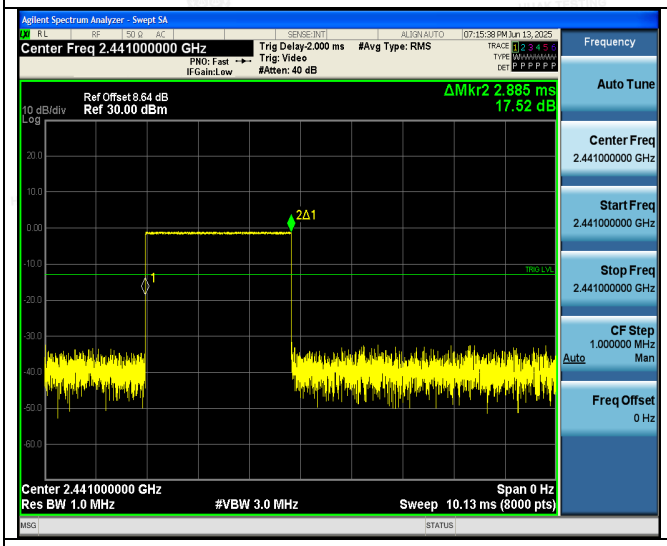


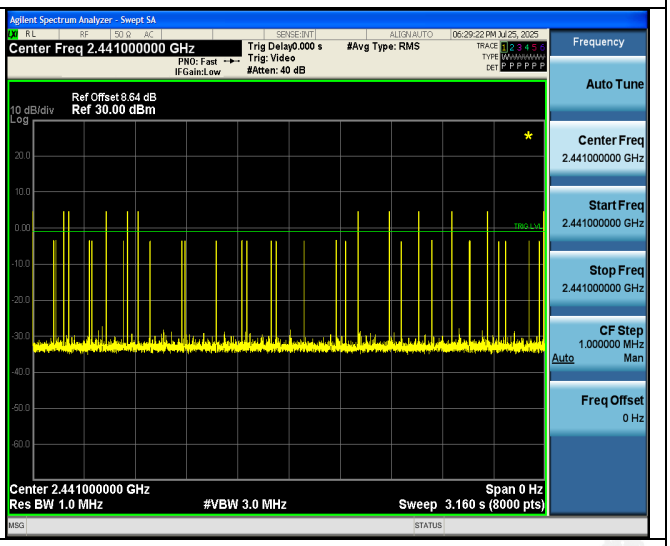
DH1





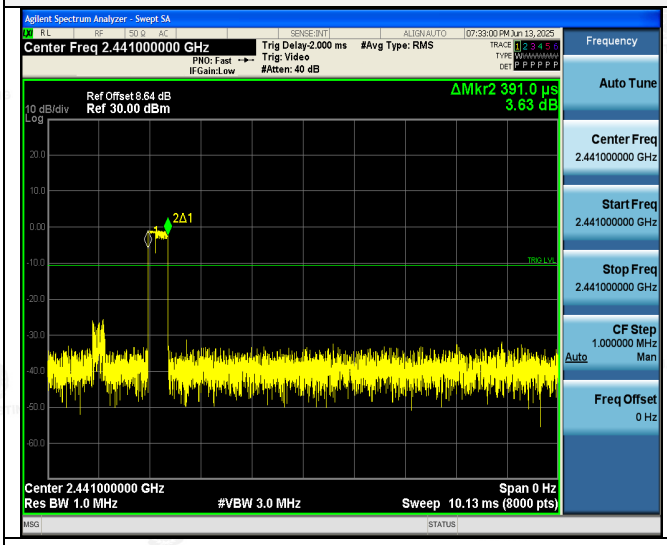
DH3

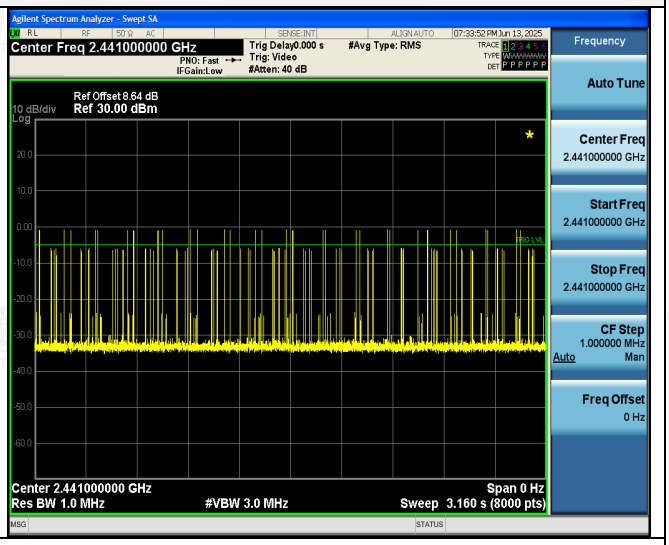




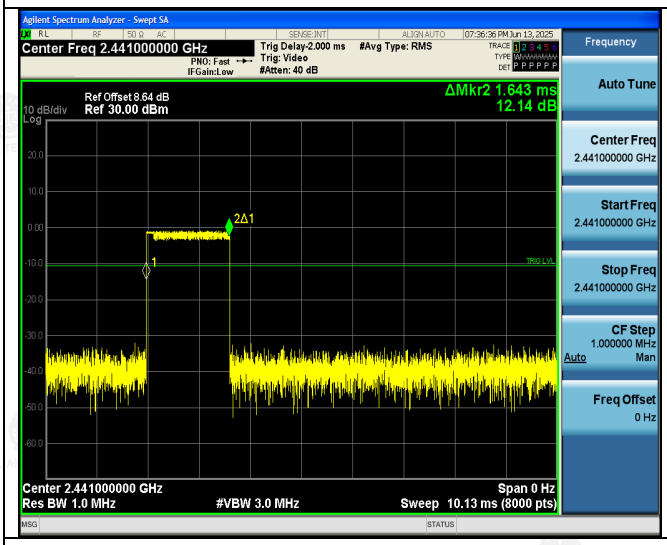
DH5

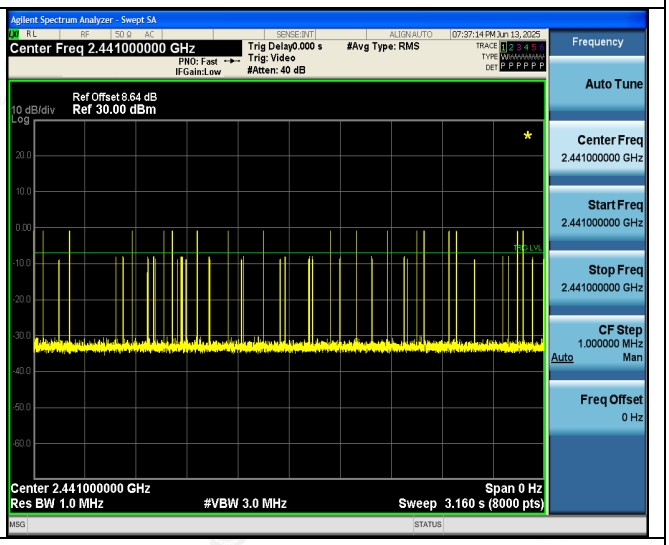
π/4DQPSK Modulation



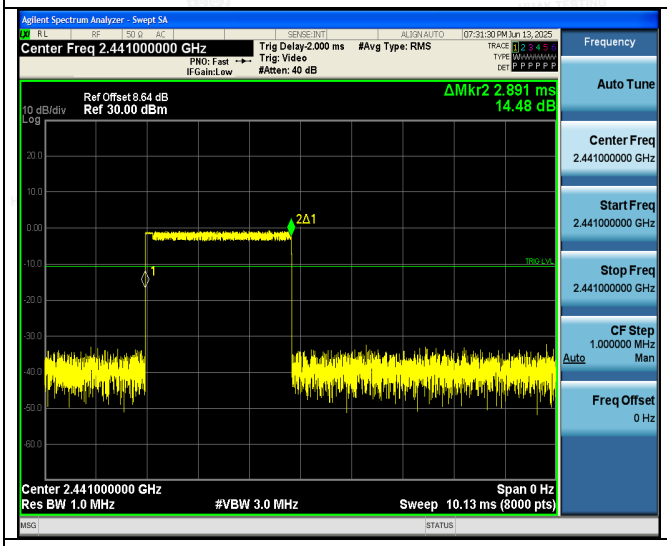


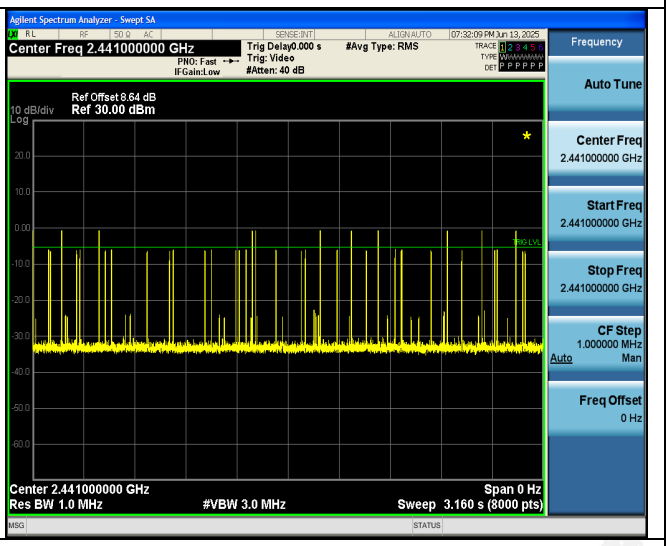
2-DH1





2-DH3





2-DH5

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.

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

Test Results

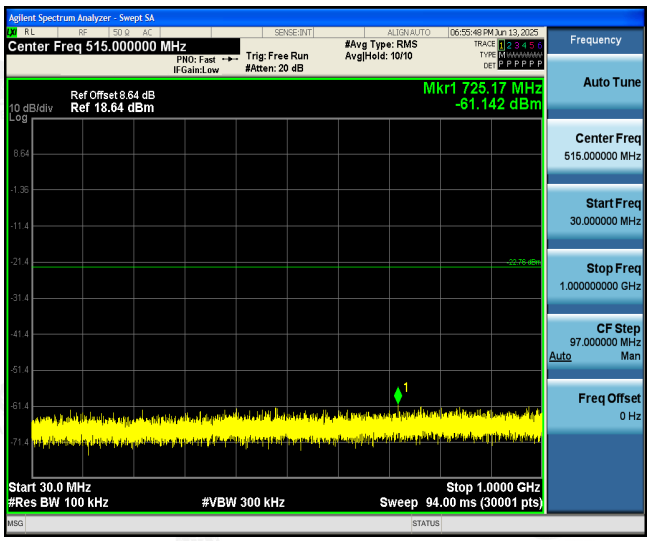
Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandage measurement data.
We measured all conditions (DH1, DH3, DH5) and recorded worst case at DH5 and 2DH5

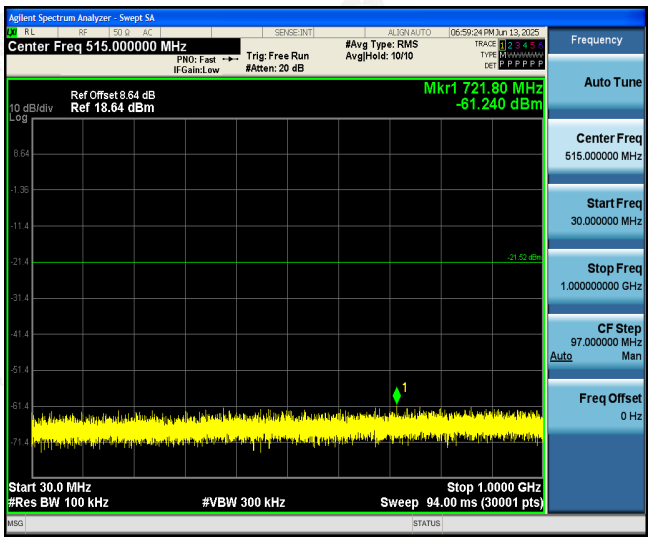
Test plot as follows:

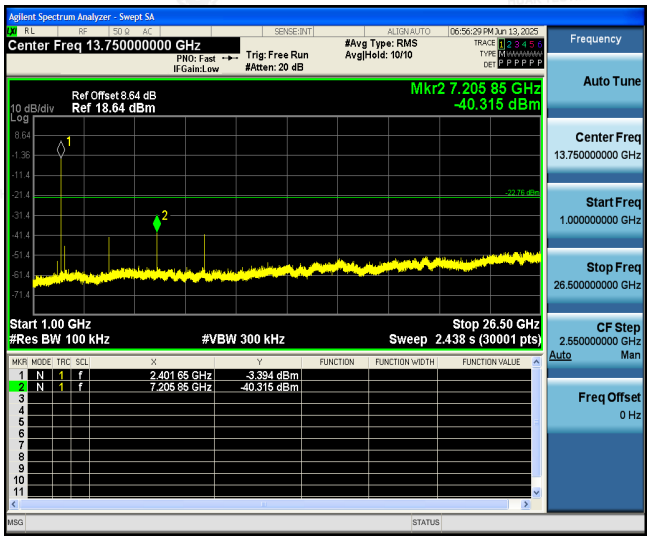
GFSK

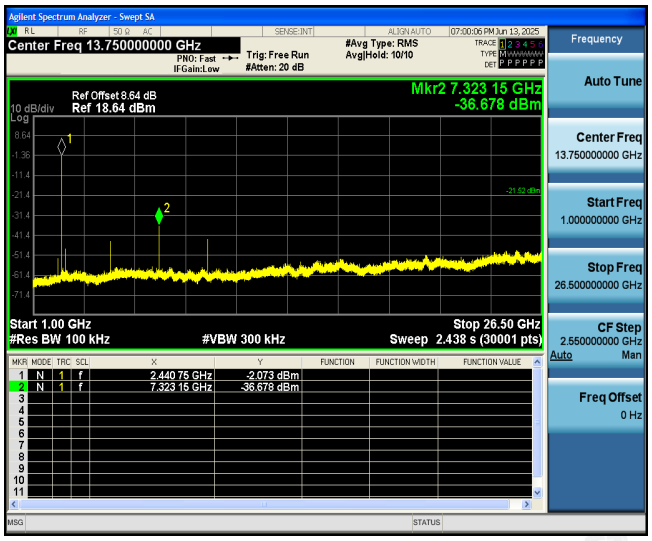
CH00

CH39

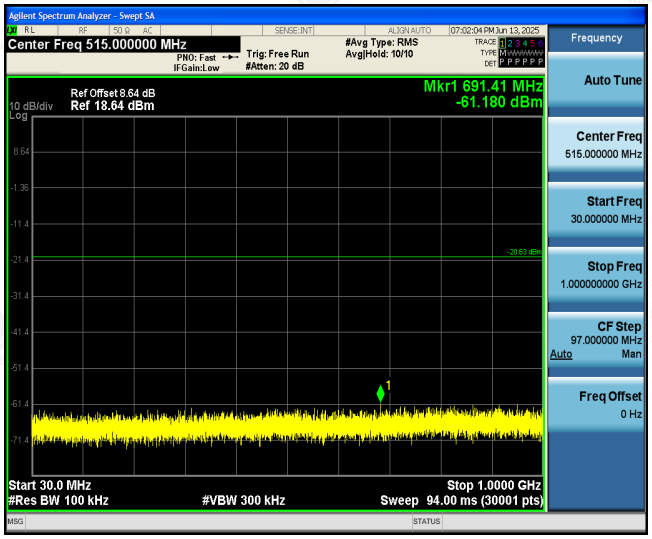


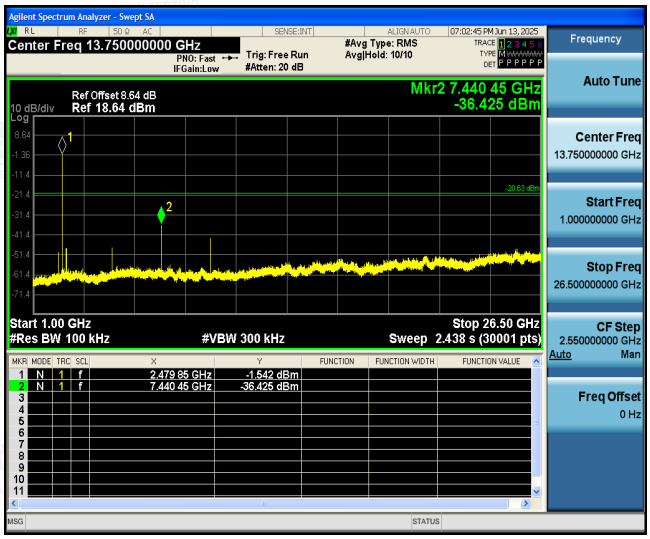


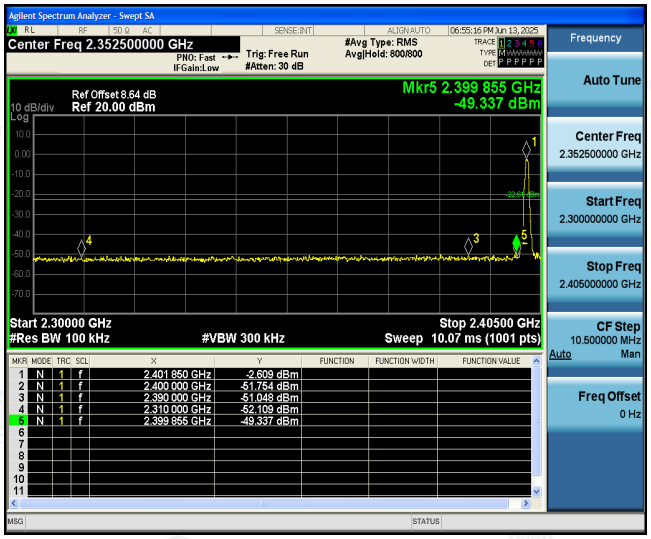




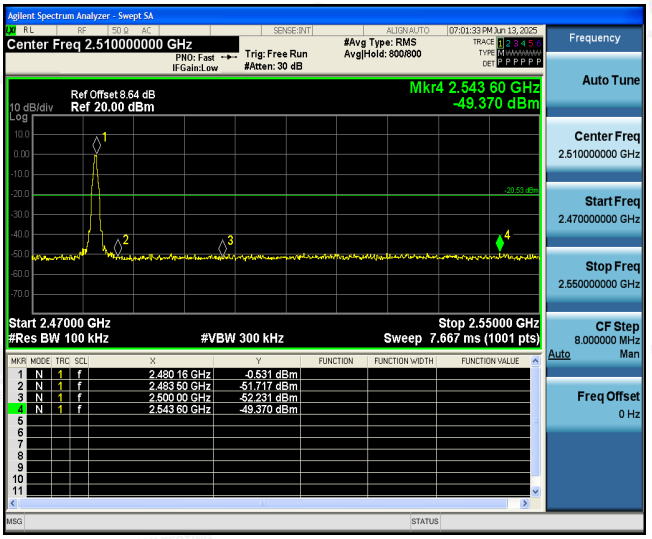
CH78



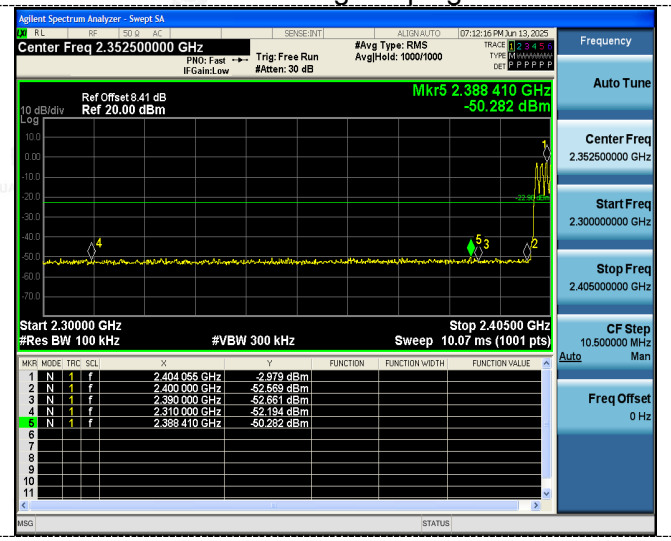




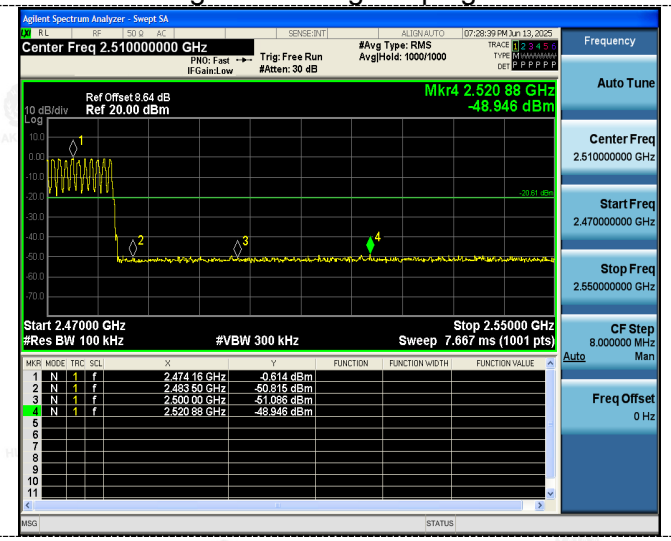
Left Band edge hoping off



Right Band edge hoping off



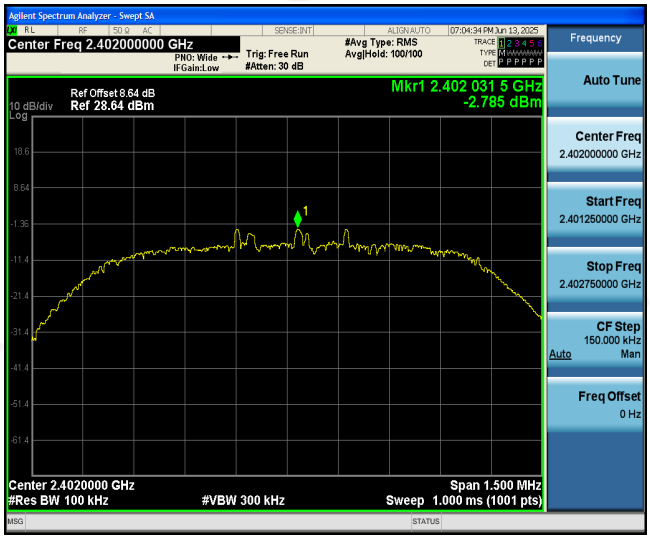
Left Band edge hoping on



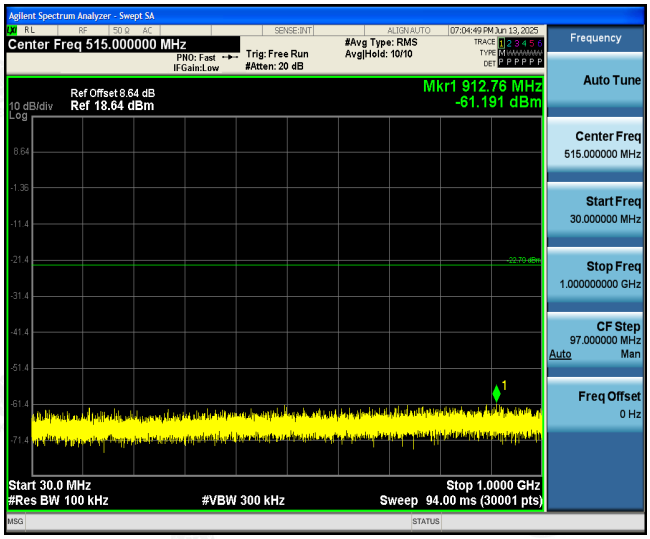
Right Band edge hoping on

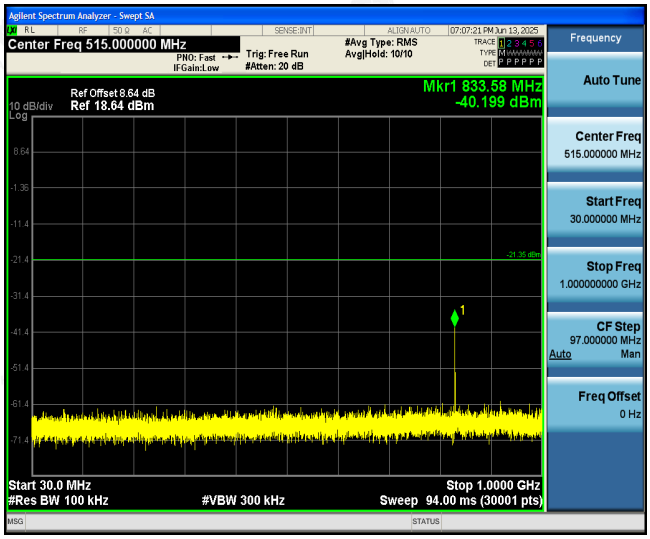
π/4DQPSK

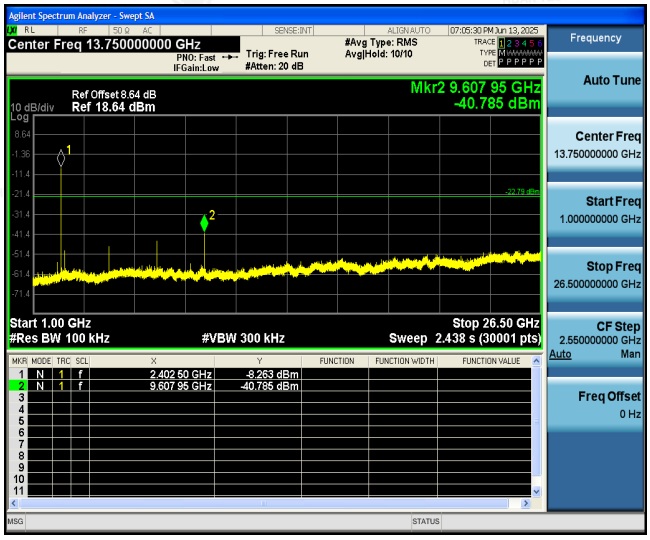
CH00

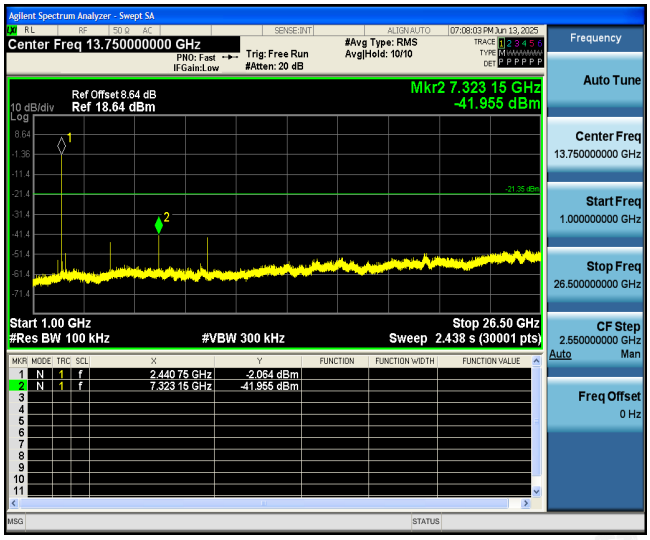


CH39

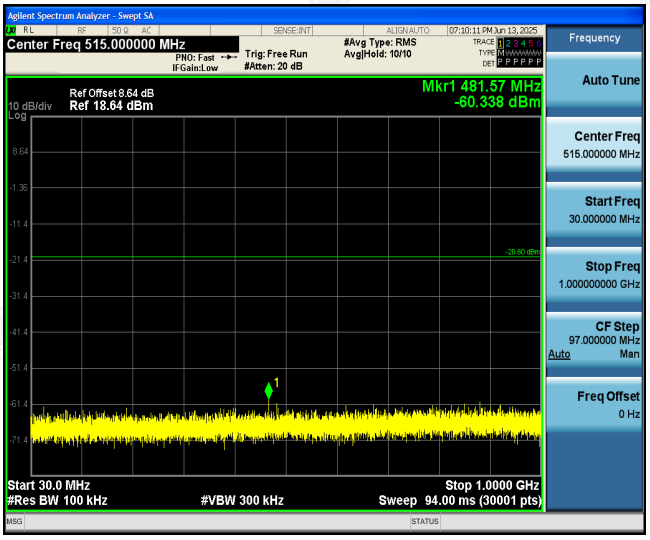


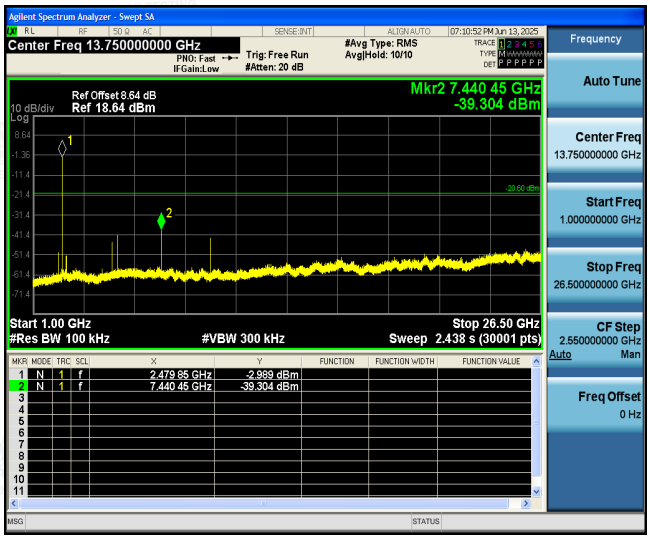


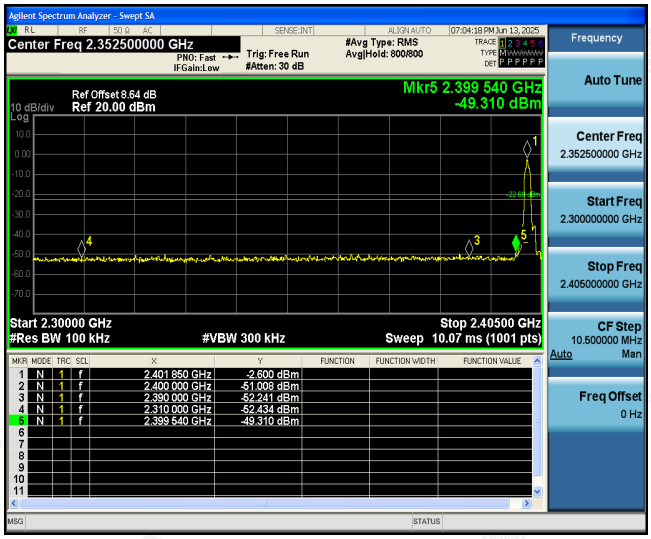




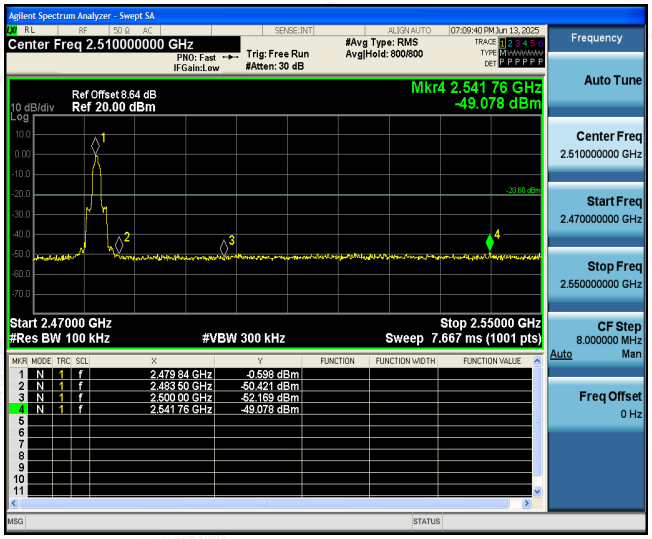
CH78



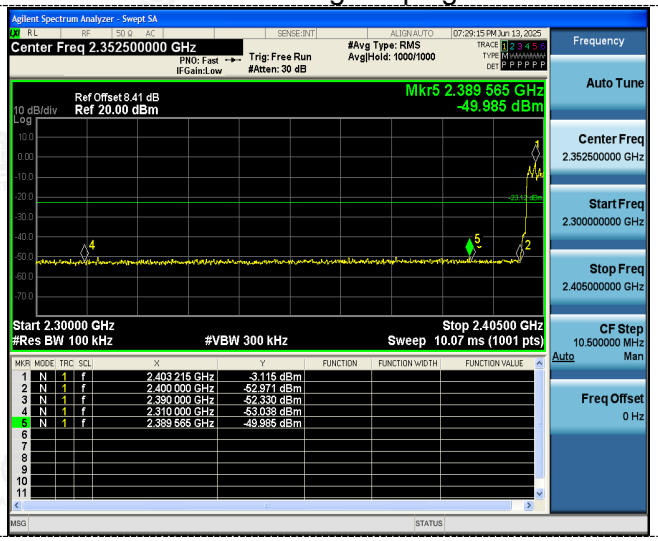




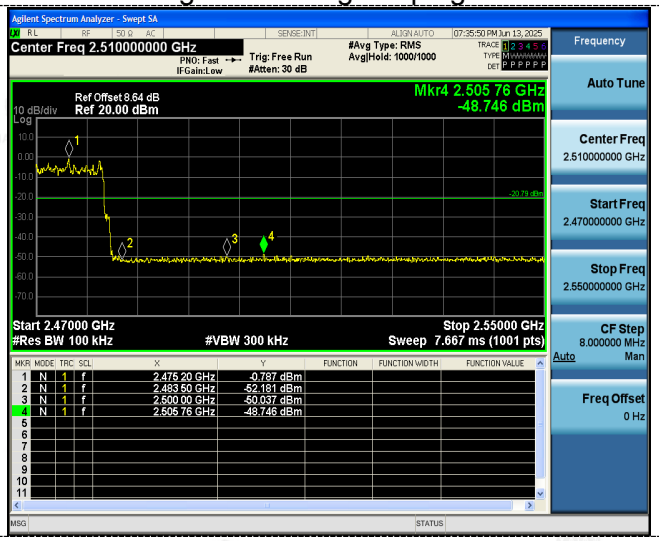
Left Band edge hoping off



Right Band edge hoping off



Left Band edge hoping on



Right Band edge hoping on

3.9. Pseudorandom Frequency Hopping Sequence

Test Applicable

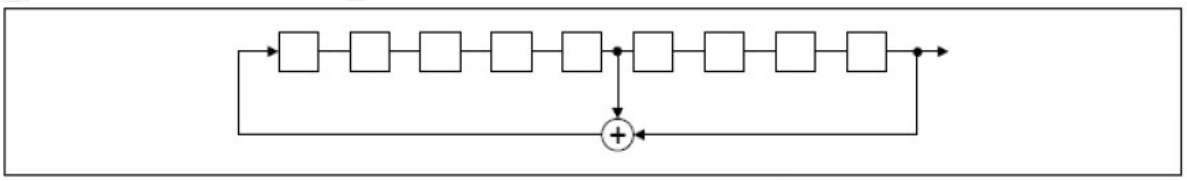
For 47 CFR Part 15C section 15.247 (a) (1):

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

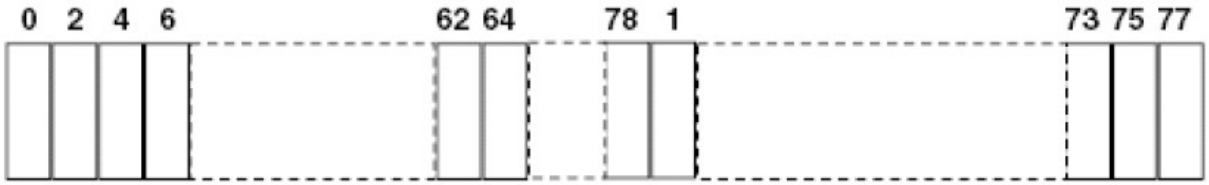
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones, for example: 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

An example of pseudorandom frequency hopping sequence as follows:



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.

3.10. Antenna Requirement

Standard Applicable

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.

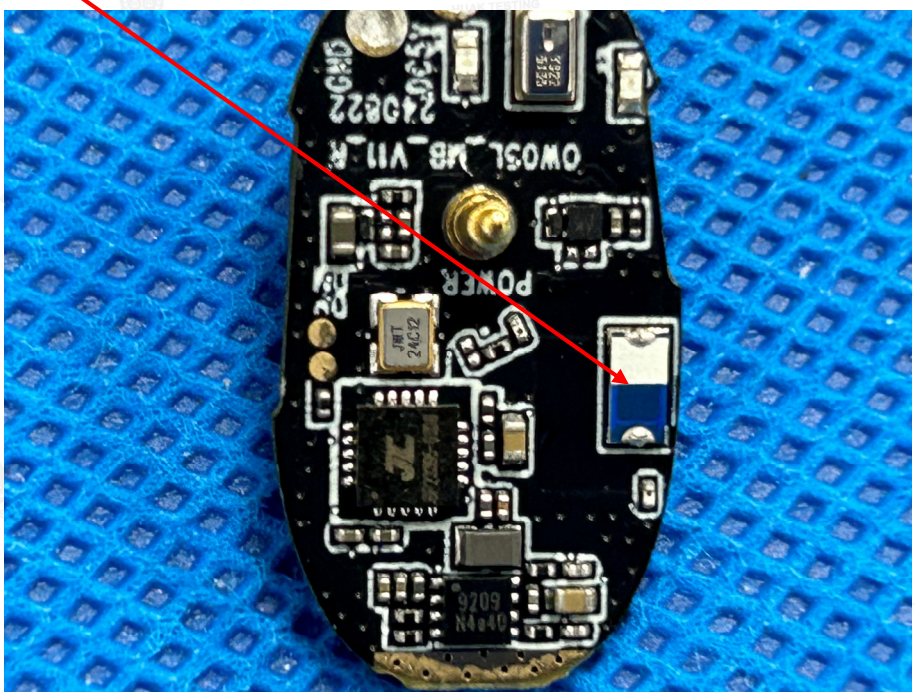
Refer to Statement below for Compliance

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

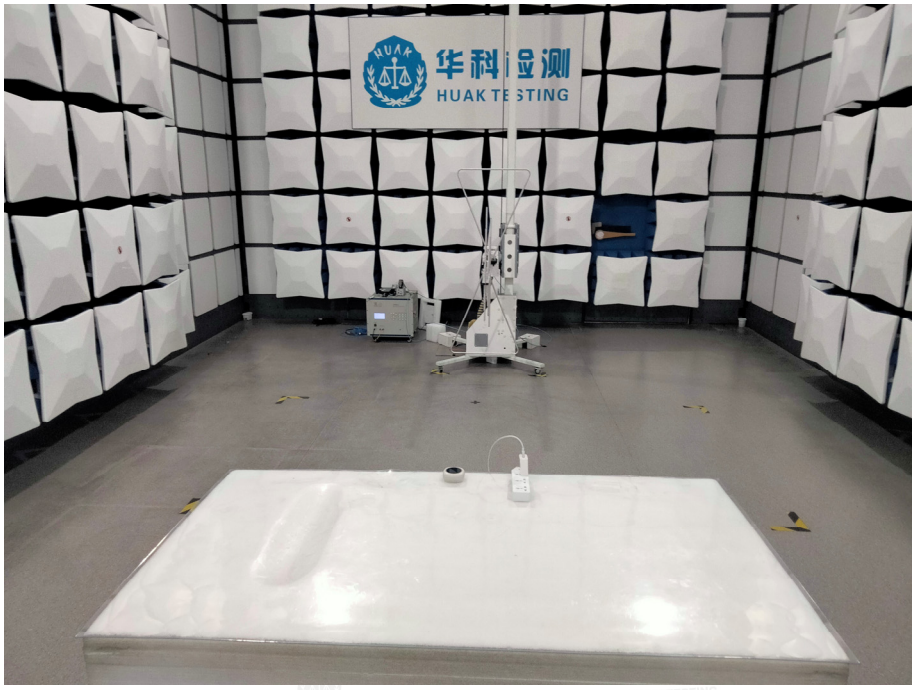
The antenna used in this product is a Ceramic Antenna, is a permanently attached antenna on the PCB. It conforms to the standard requirements. The directional gains of antenna used for transmitting is 1.75dBi.

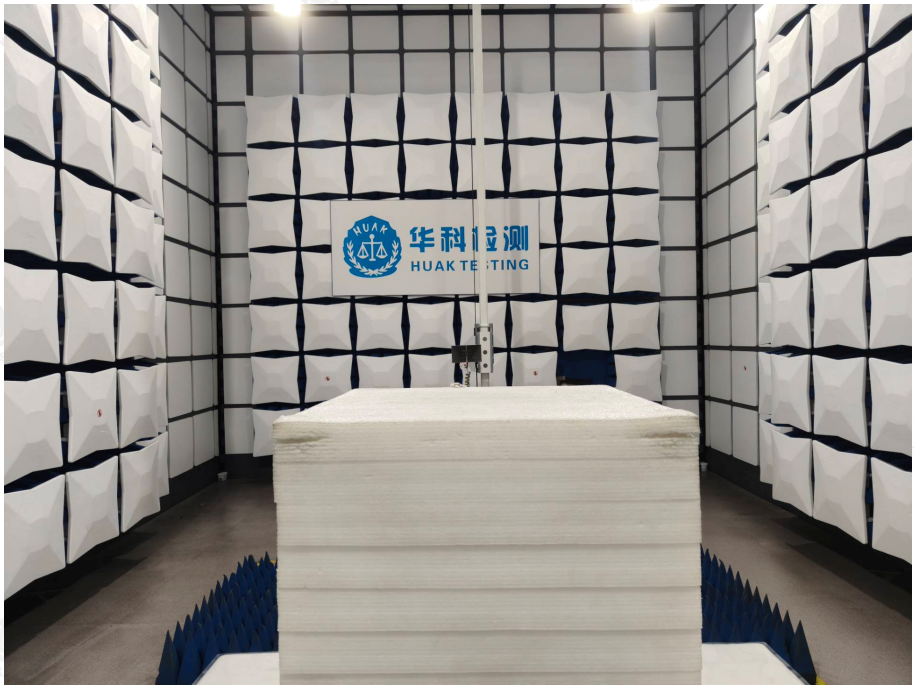
Antenna



4. Test Setup Photos of the EUT

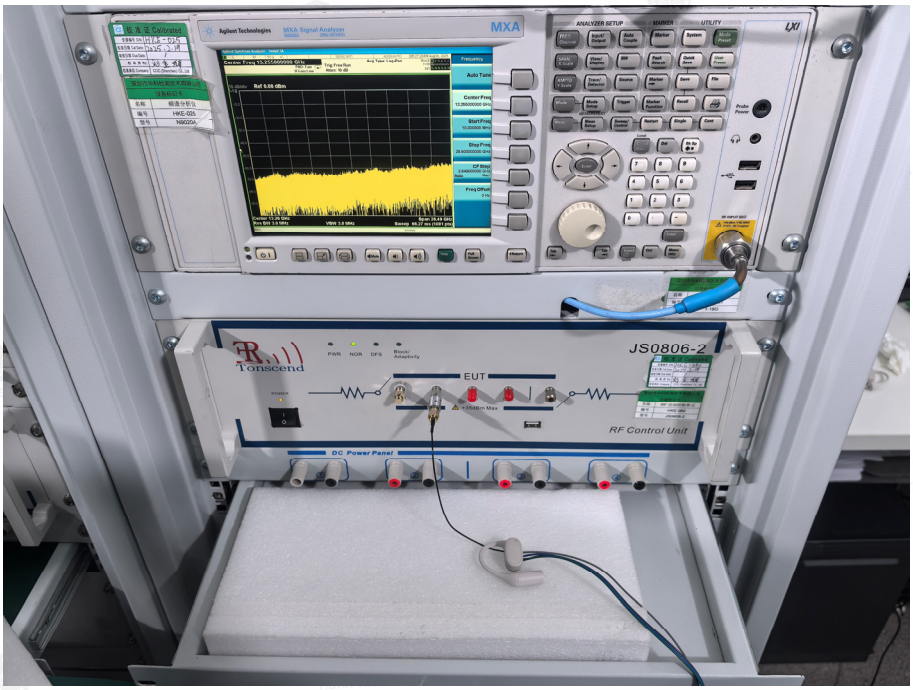
Radiated Emission





AC Conducted Emission

RF Conducted Emission



5. Photos of the EUT

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

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