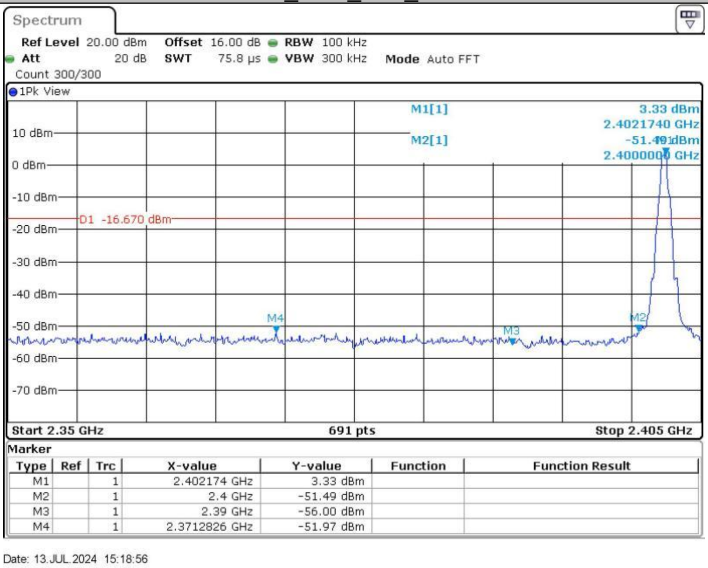
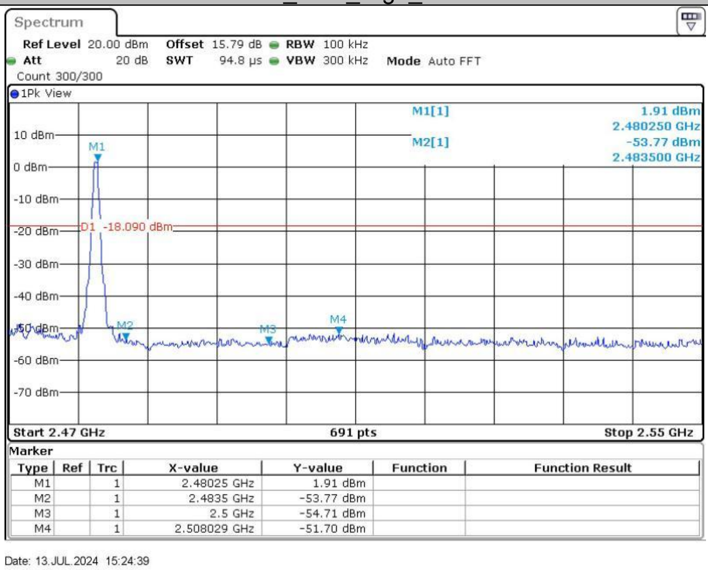
Test plot as follows:

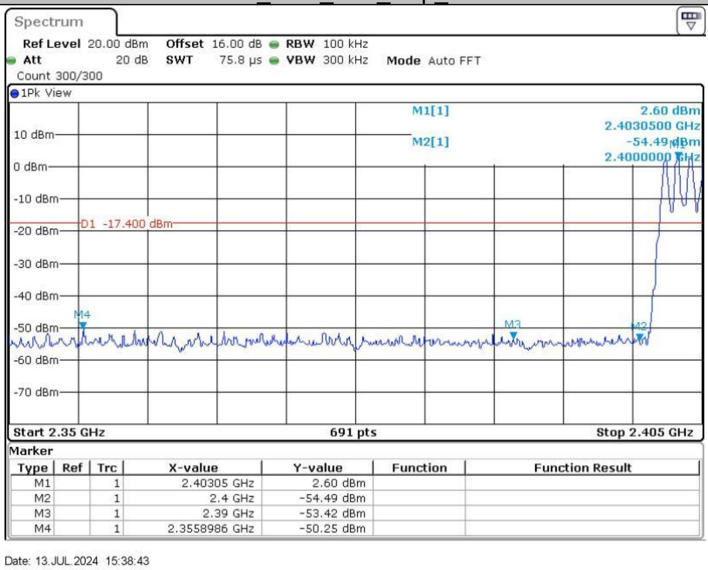
DH5_Ant1_Low_2402



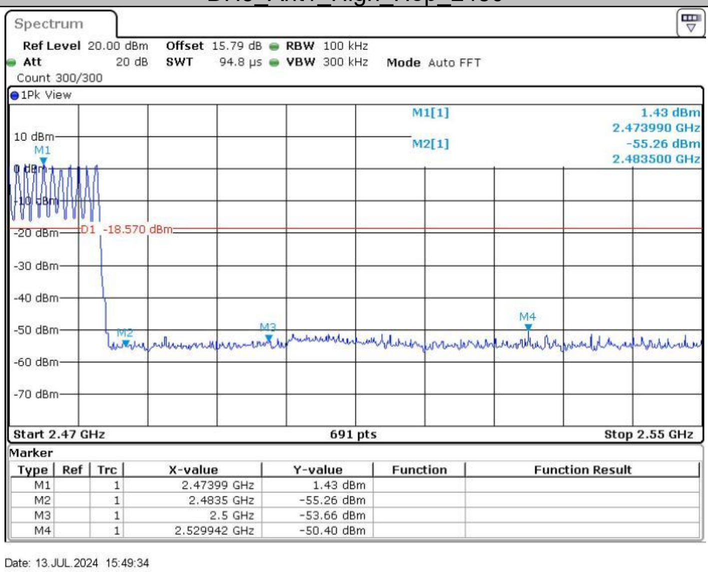
DH5_Ant1_High_2480



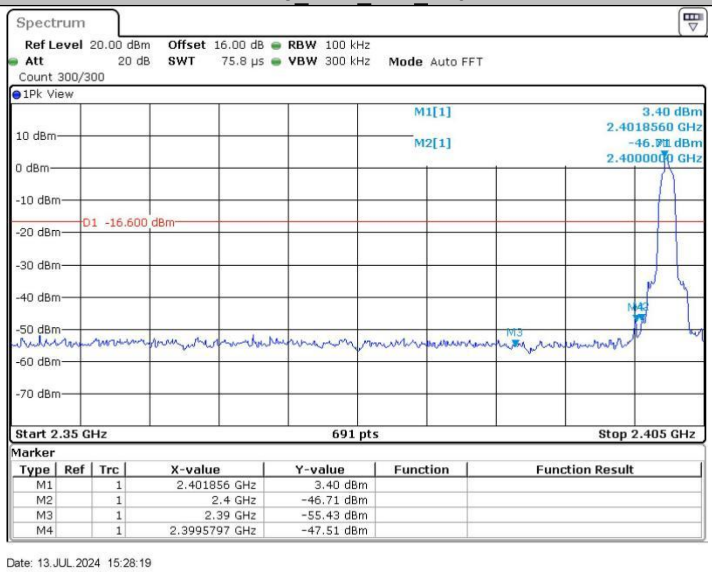
DH5_Ant1_Low_Hop_2402



DH5_Ant1_High_Hop_2480

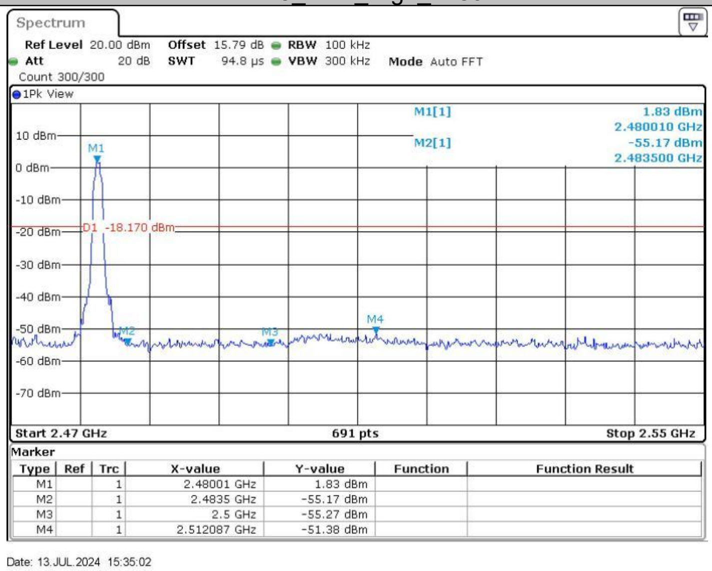


2DH5_Ant1_Low_2402



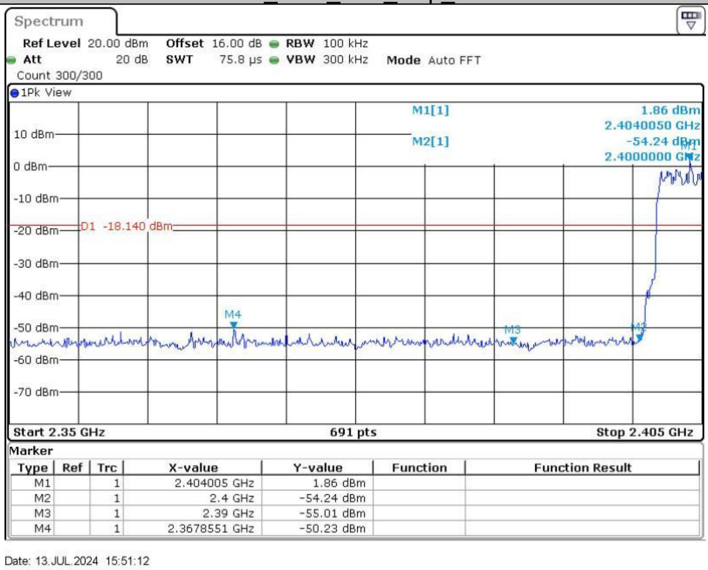
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.401856 GHz	3.40 dBm		
M2		1	2.4 GHz	-46.71 dBm		
M3		1	2.39 GHz	-55.43 dBm		
M4		1	2.3995797 GHz	-47.51 dBm		

2DH5_Ant1_High_2480

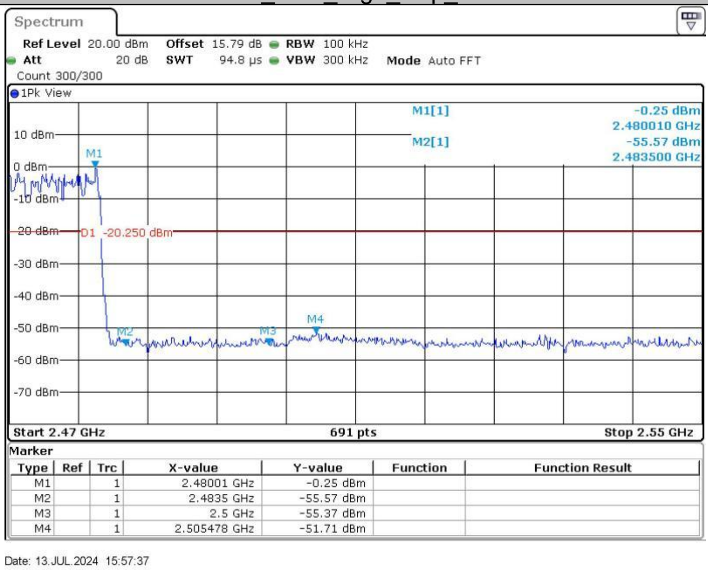


Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.48001 GHz	1.83 dBm		
M2		1	2.4835 GHz	-55.17 dBm		
M3		1	2.5 GHz	-55.27 dBm		
M4		1	2.512087 GHz	-51.38 dBm		

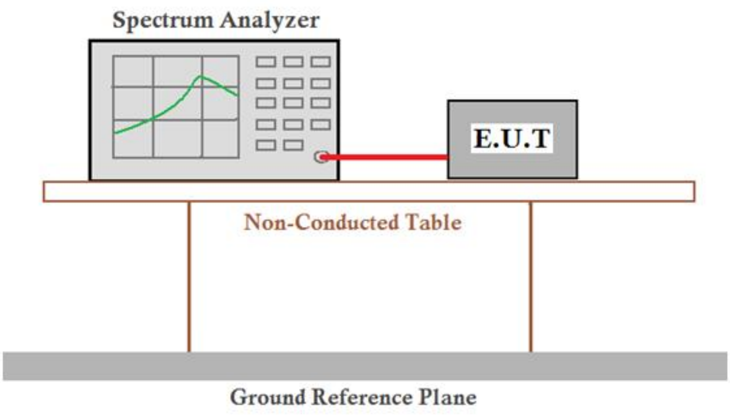
2DH5_Ant1_Low_Hop_2402

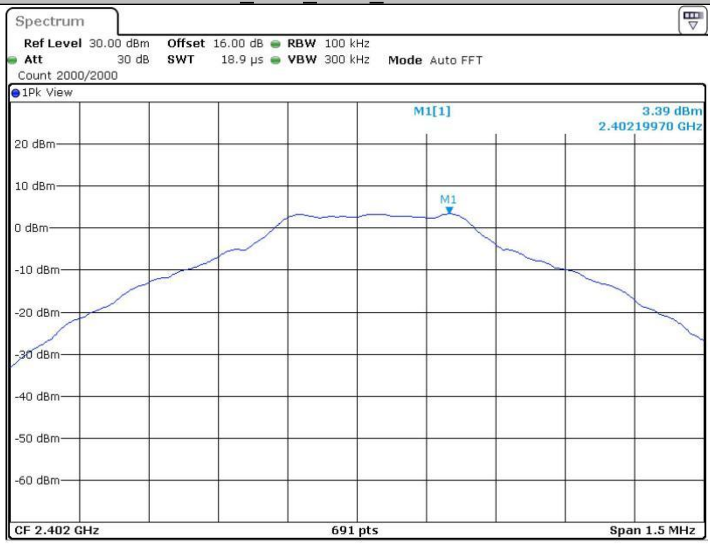
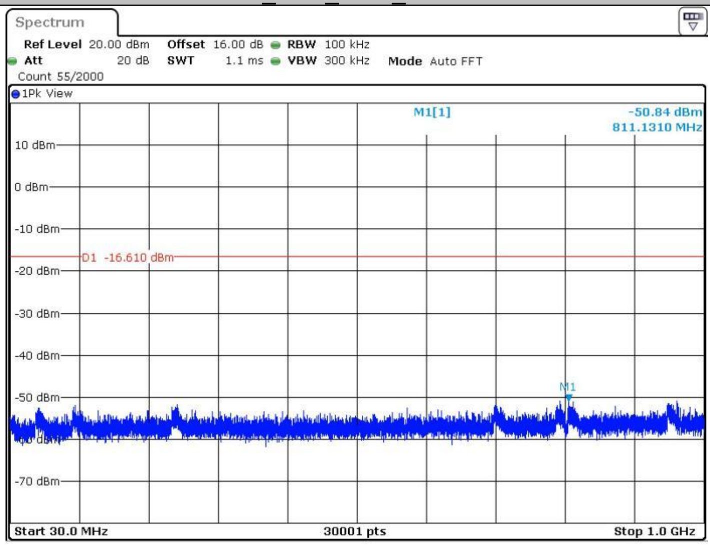


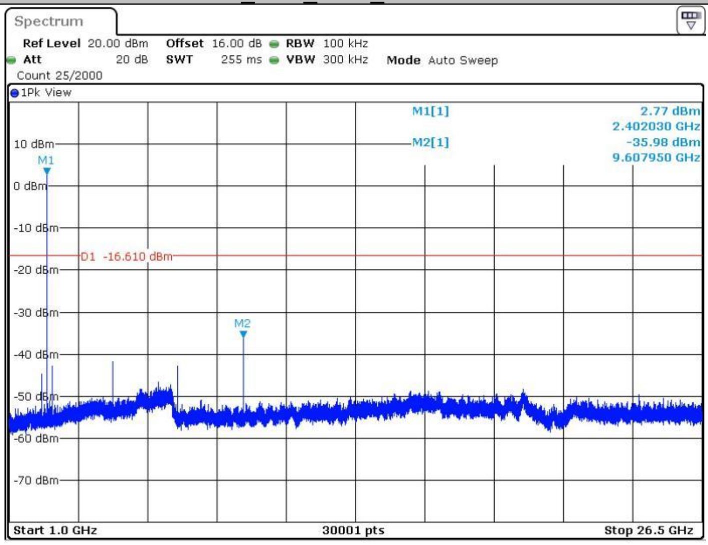
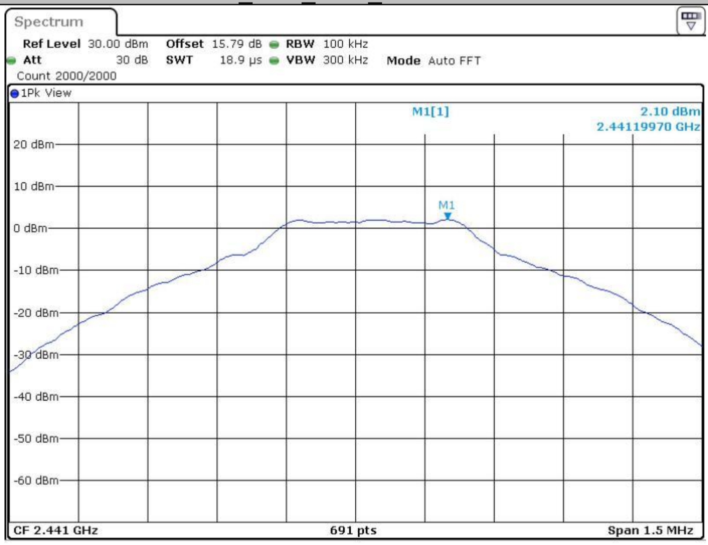
2DH5_Ant1_High_Hop_2480

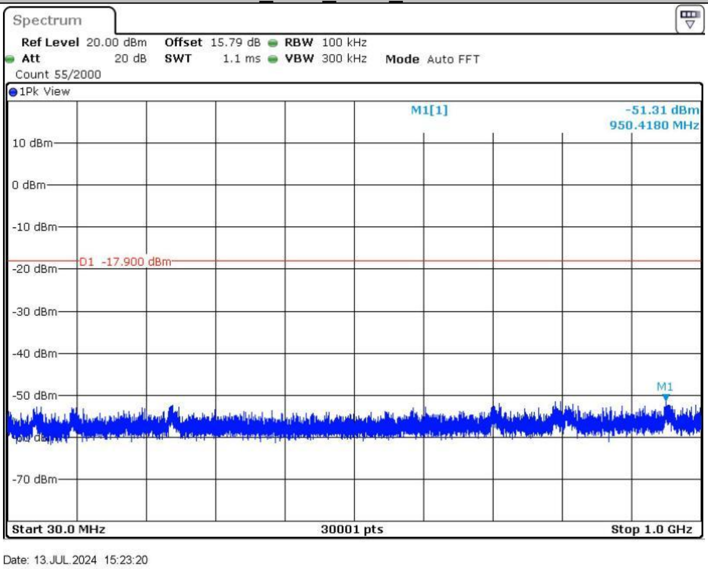
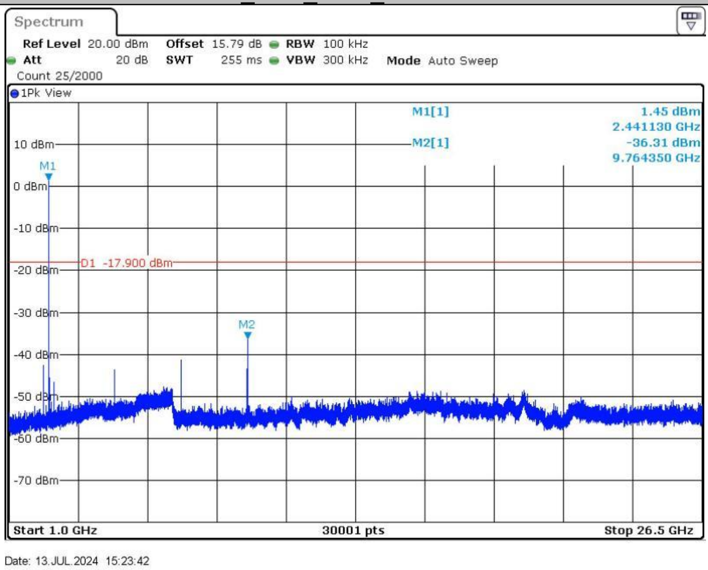


5.9 Spurious RF Conducted Emissions

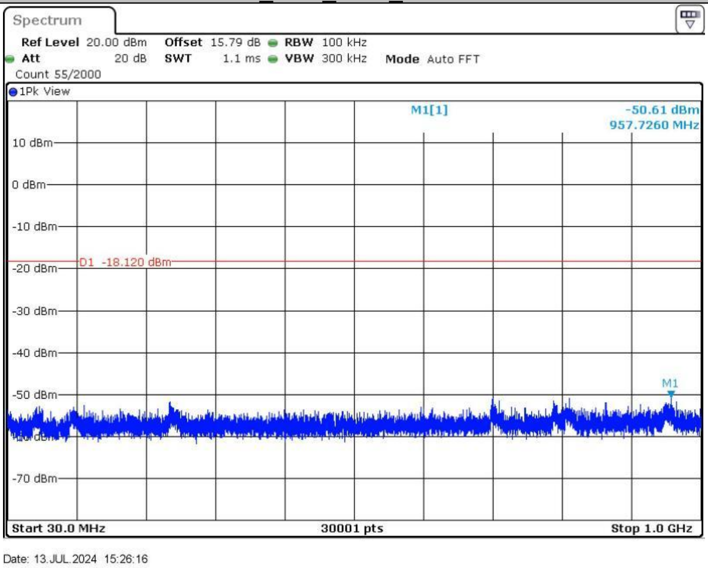
Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10:2013
Test Setup:	 *Remark: Offset=cable loss+ attenuation factor.*
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is 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 conducted or a radiated measurement.
Exploratory Test Mode:	Non-hopping transmitting with all kind of modulation and all kind of data type
Final Test Mode:	Through Pre-scan, find the DH5 of data type is the worst case of GFSK modulation type, 2-DH5 of data type is the worst case of π/4DQPSK modulation type, 3-DH5 of data type is the worst case of 8DPSK modulation type.
Test Results:	Pass

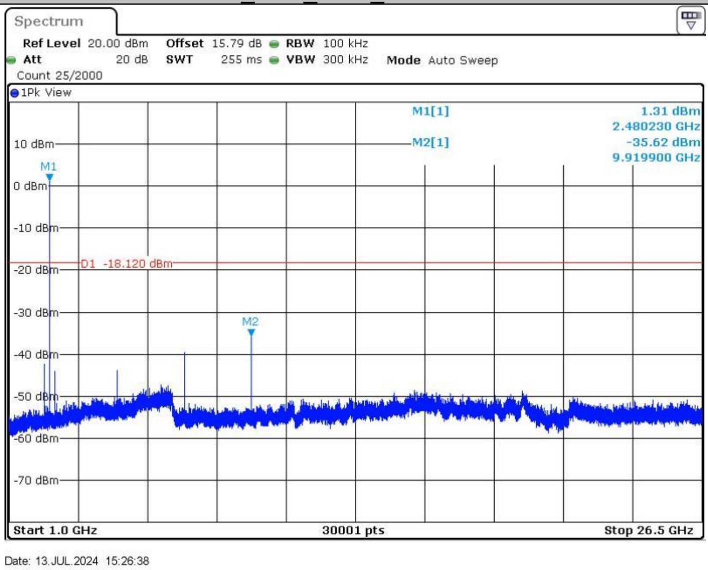
DH5_Ant1_2402_0~Reference
 Date: 13.JUL.2024 15:20:36
DH5_Ant1_2402_30~1000
 Date: 13.JUL.2024 15:20:43

DH5_Ant1_2402_1000~26500
 Date: 13.JUL.2024 15:21:05
DH5_Ant1_2441_0~Reference
 Date: 13.JUL.2024 15:23:13

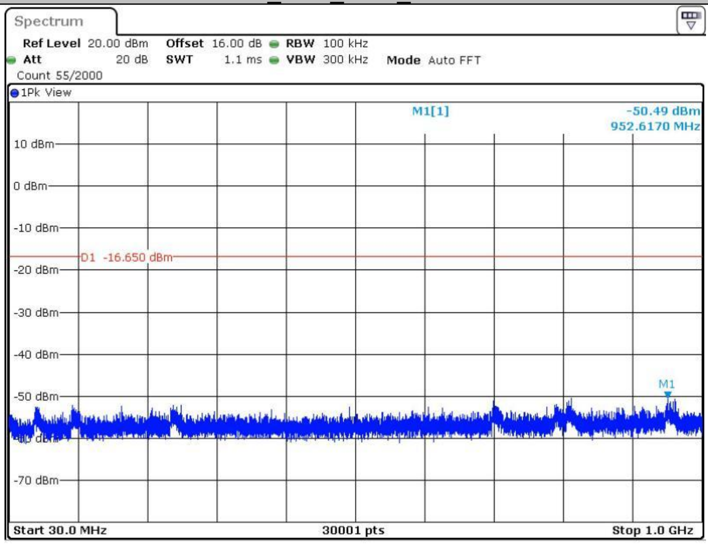
DH5_Ant1_2441_30~1000

DH5_Ant1_2441_1000~26500


DH5_Ant1_2480_0~Reference

DH5_Ant1_2480_30~1000


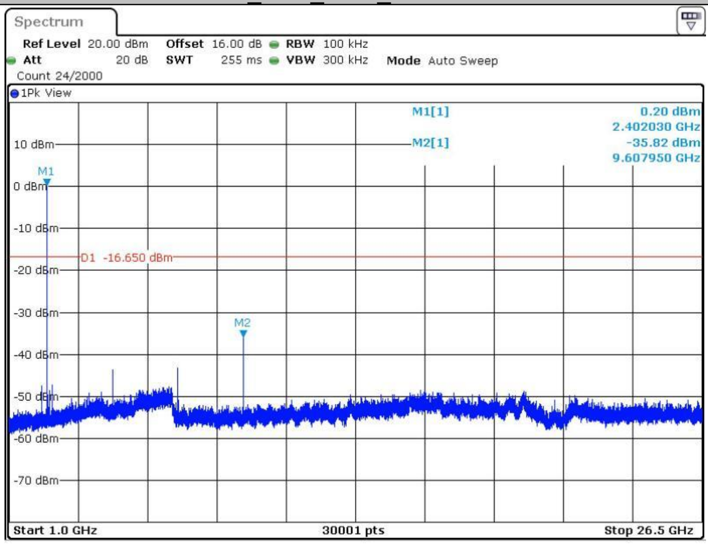
DH5_Ant1_2480_1000~26500

2DH5_Ant1_2402_0~Reference


2DH5_Ant1_2402_30~1000



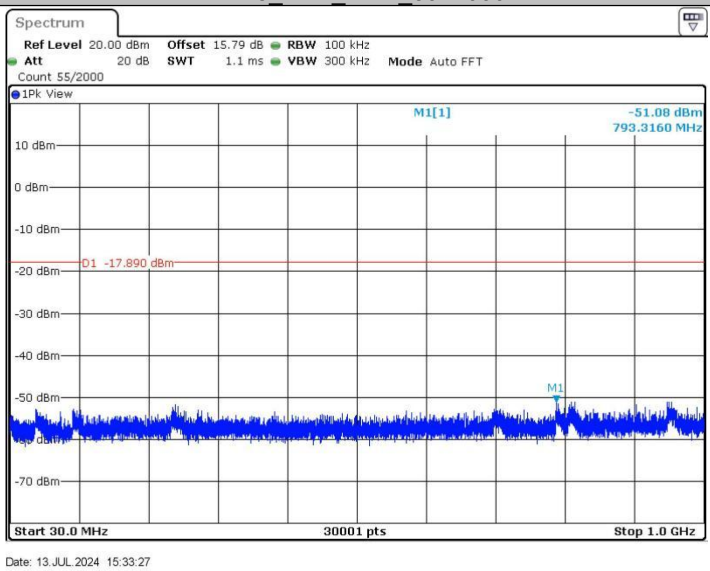
Date: 13.JUL.2024 15:30:05

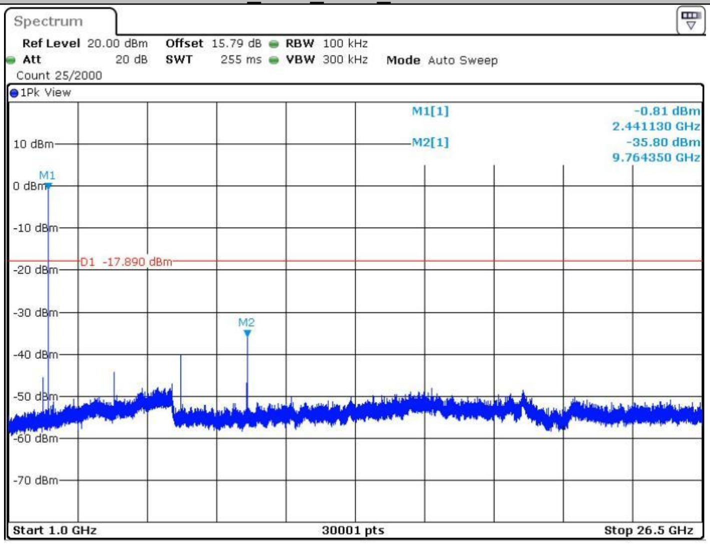
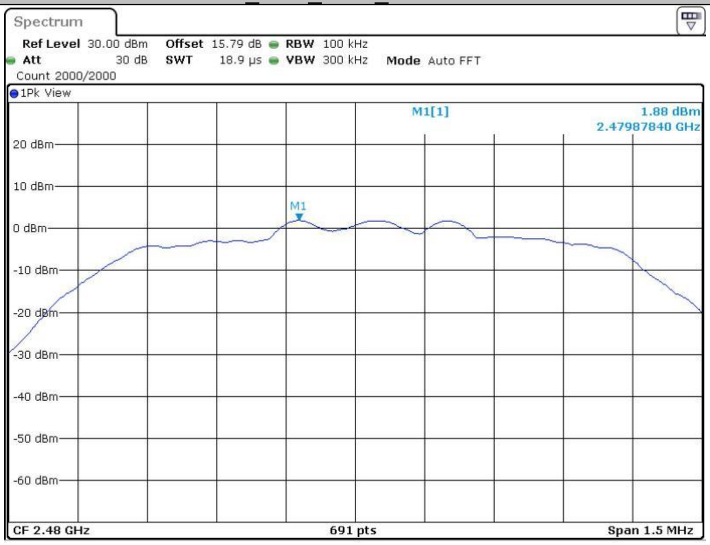
2DH5_Ant1_2402_1000~26500

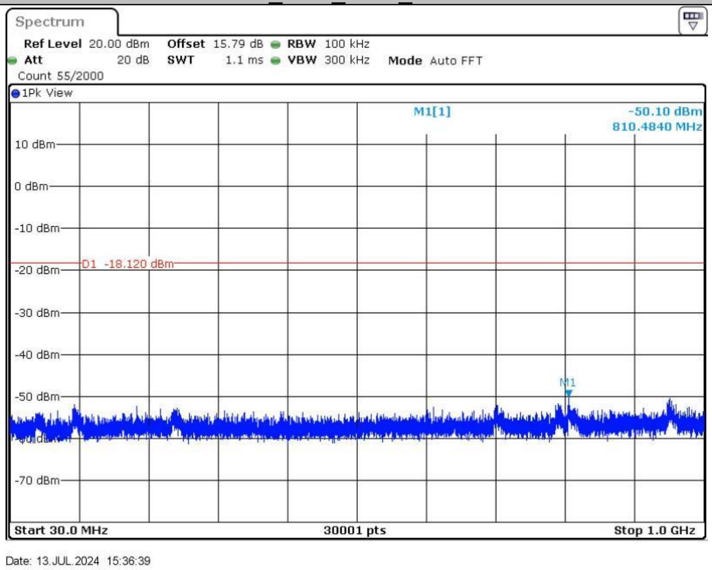
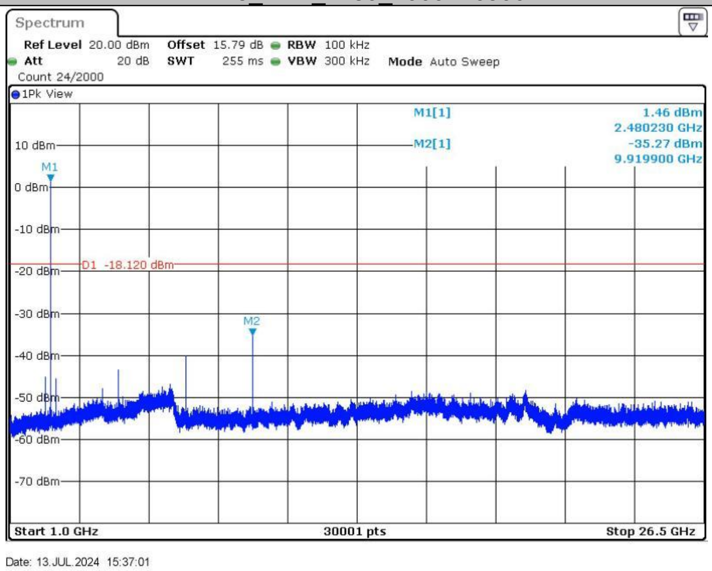


Date: 13.JUL.2024 15:30:27

2DH5_Ant1_2441_0~Reference

2DH5_Ant1_2441_30~1000


2DH5_Ant1_2441_1000~26500
 Date: 13.JUL.2024 15:33:49
2DH5_Ant1_2480_0~Reference
 Date: 13.JUL.2024 15:36:33

2DH5_Ant1_2480_30~1000

2DH5_Ant1_2480_1000~26500


Remark:

Pre test 9kHz to 25GHz, find the highest point when testing, so only the worst data were shown in the test report. Per FCC Part 15.33 (a) and 15.31 (o) ,The amplitude of spurious emissions from intentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

5.10 Other requirements Frequency Hopping Spread Spectrum System

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1), (h) requirement:

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.

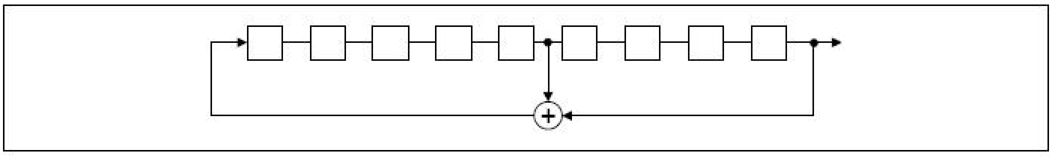
Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

Compliance for section 15.247(a)(1)

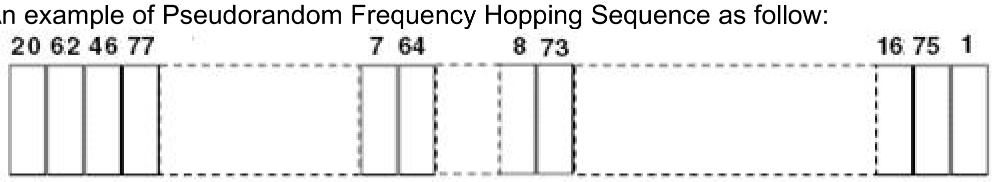
According to Bluetooth Core Specification, the pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive 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)



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.

According to Bluetooth Core Specification, Bluetooth receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any Bluetooth transmitters and shift frequencies in synchronization with the transmitted signals.

Compliance for section 15.247(g)

According to Bluetooth Core Specification, the Bluetooth system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

Compliance for section 15.247(h)
According to Bluetooth Core specification, the Bluetooth system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels. According to the Bluetooth Core specification, the Bluetooth system is designed not have the ability to coordinated with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.

5.11 Radiated Spurious Emission & Restricted bands

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205
Test Method:	ANSI C63.10: 2013
Test Site:	Measurement Distance: 3m (Semi-Anechoic Chamber)

Receiver Setup:

Frequency	Detector	RBW	VBW	Remark
0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
30MHz-1GHz	Peak	120 kHz	300kHz	Peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

Limit:

Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
1.705MHz-30MHz	30	-	-	30
30MHz-88MHz	100	40.0	Quasi-peak	3
88MHz-216MHz	150	43.5	Quasi-peak	3
216MHz-960MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3
Above 1GHz	500	54.0	Average	3

Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

Test Setup:	

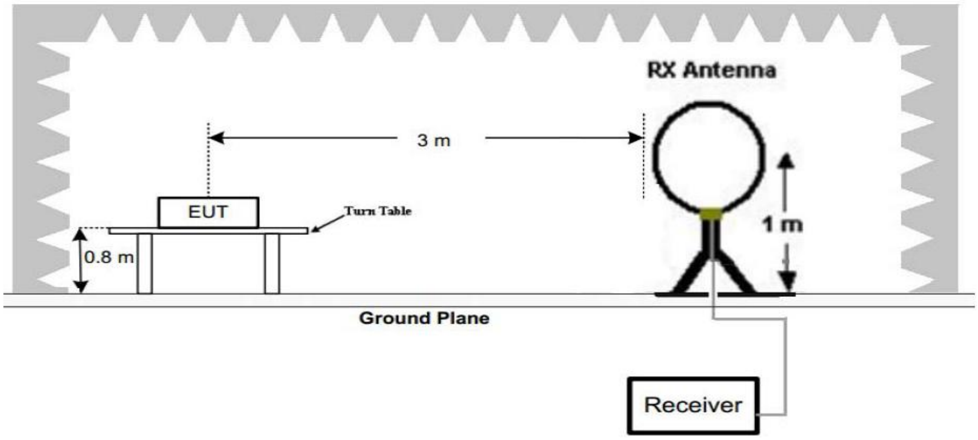


Figure 1. Below 30MHz

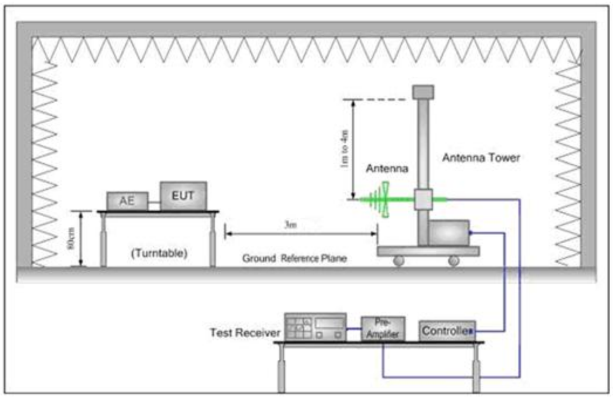


Figure 2. 30MHz to 1GHz

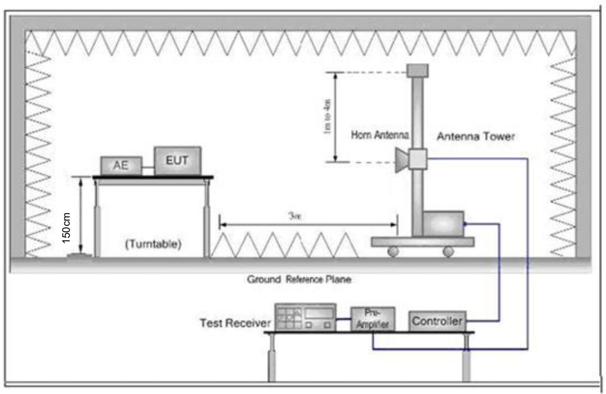


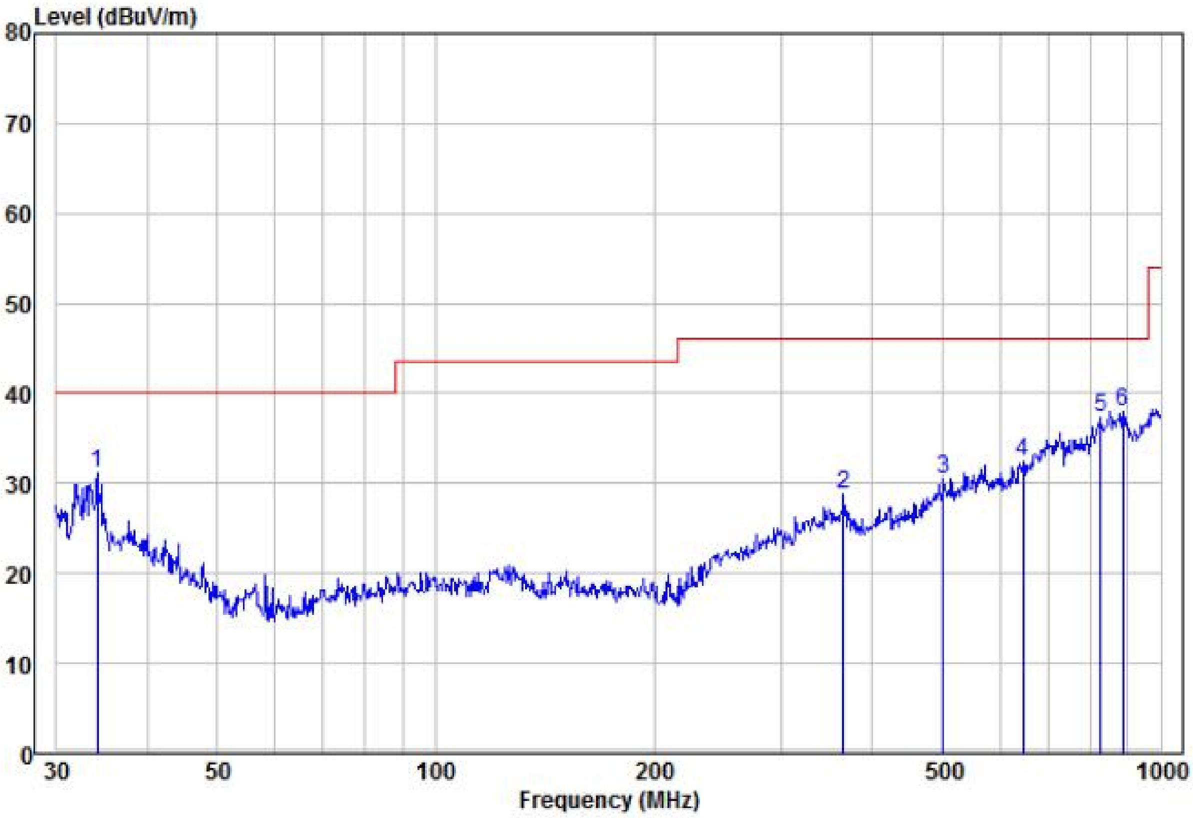
Figure 3. Above 1 GHz

Test Procedure:	
	a. 1) Below 1G: The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2) Above 1G: The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. Note: For the radiated emission test above 1GHz: Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

	d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. g. Test the EUT in the lowest channel (2402MHz),the middle channel (2441MHz),the Highest channel (2480MHz) h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case. i. Repeat above procedures until all frequencies measured was complete.
Exploratory Test Mode:	Non-hopping transmitting mode with all kind of modulation and all kind of data type Transmitting mode
Final Test Mode:	Only the worst case is recorded in the report.
Test Results:	Pass

5.11.1 Radiated Emission below 1GHz

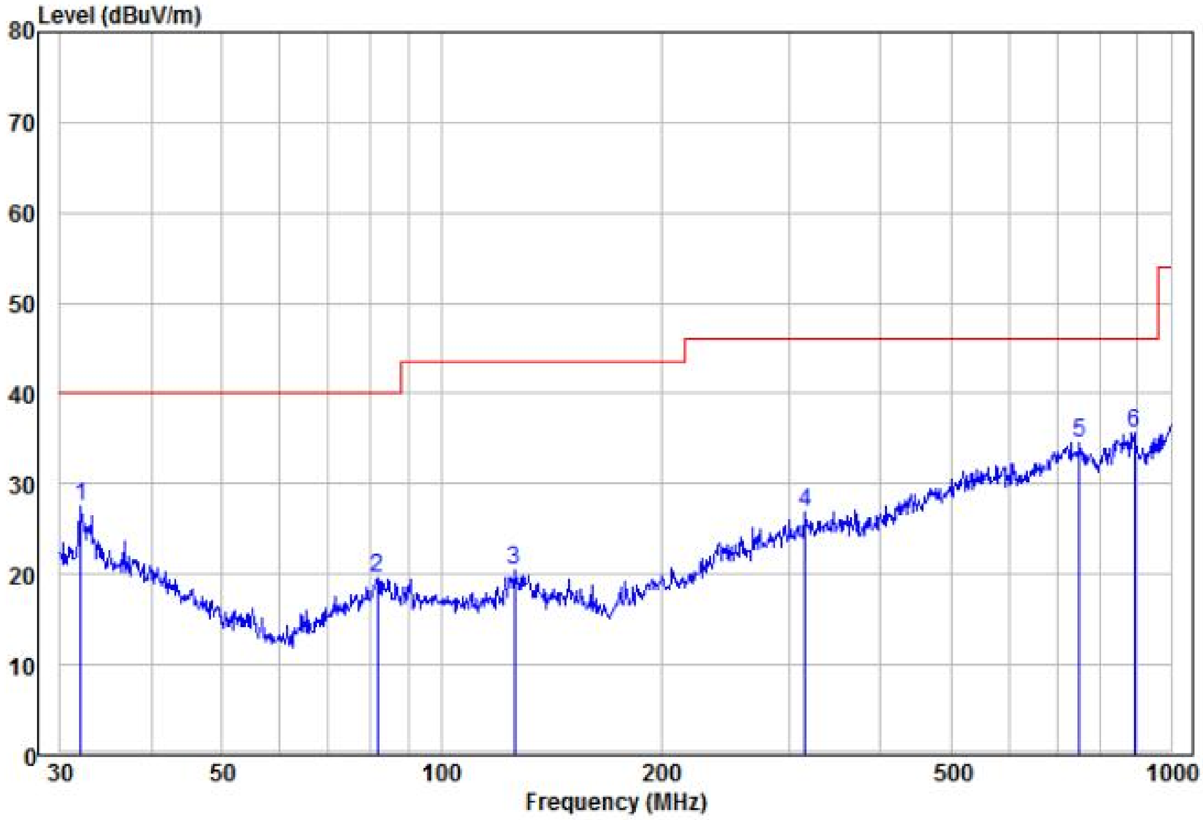
30MHz~1GHz		
Test mode:	Transmitting	Vertical



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
1	34.16	16.01	15.20	31.21	40.00	-8.79	Peak	VERTICAL
2	365.54	11.76	17.00	28.76	46.00	-17.24	Peak	VERTICAL
3	501.18	10.18	20.31	30.49	46.00	-15.51	Peak	VERTICAL
4	645.12	10.57	21.82	32.39	46.00	-13.61	Peak	VERTICAL
5	827.49	11.01	26.31	37.32	46.00	-8.68	Peak	VERTICAL
6 pp	887.61	11.32	26.73	38.05	46.00	-7.95	Peak	VERTICAL

Remark:
The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Factor= Antenna Factor + Cable Factor – Preamplifier Factor,
Level = Read Level + Factor,
Over Limit=Level-Limit Line.

Test mode:	Transmitting	Horizontal



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
1	32.07	11.92	15.65	27.57	40.00	-12.43	Peak	HORIZONTAL
2	81.78	8.86	10.77	19.63	40.00	-20.37	Peak	HORIZONTAL
3	125.89	8.83	11.69	20.52	43.50	-22.98	Peak	HORIZONTAL
4	315.48	11.09	15.72	26.81	46.00	-19.19	Peak	HORIZONTAL
5	750.11	10.40	24.17	34.57	46.00	-11.43	Peak	HORIZONTAL
6 pp	890.73	8.81	26.73	35.54	46.00	-10.46	Peak	HORIZONTAL

Remark:
The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Factor= Antenna Factor + Cable Factor – Preamplifier Factor,
Level = Read Level + Factor,
Over Limit=Level-Limit Line.

5.11.2 Transmitter Emission above 1GHz

Worse case mode:		GFSK(DH5)		Test channel:		Lowest	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
2390	54.05	-9.2	44.85	74	-29.15	**Peak**	**H**
2400	56.58	-9.39	47.19	74	-26.81	Peak	H
4804	51.87	-4.33	47.54	74	-26.46	Peak	H
7206	49.16	1.01	50.17	74	-23.83	Peak	H
2390	53.51	-9.2	44.31	74	-29.69	**Peak**	**V**
2400	56.82	-9.39	47.43	74	-26.57	Peak	V
4804	52.85	-4.33	48.52	74	-25.48	Peak	V
7206	49.95	1.01	50.96	74	-23.04	Peak	V

Worse case mode:		GFSK(DH5)		Test channel:		Middle	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
4882	53.21	-4.11	49.10	74	-24.90	peak	H
7323	49.29	1.51	50.80	74	-23.20	peak	H
4882	52.24	-4.11	48.13	74	-25.87	peak	V
7323	48.42	1.51	49.93	74	-24.07	peak	V

Worse case mode:		GFSK(DH5)		Test channel:		Highest	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
2483.5	54.92	-9.29	45.63	74	-28.37	**Peak**	**H**
4960	50.92	-4.04	46.88	74	-27.12	Peak	H
7440	49.10	1.57	50.67	74	-23.33	Peak	H
2483.5	54.81	-9.29	45.52	74	-28.48	**Peak**	**V**
4960	51.09	-4.04	47.05	74	-26.95	Peak	V
7440	51.01	1.57	52.58	74	-21.42	Peak	V

Worse case mode:		π /4DQPSK (2DH5)		Test channel:		Lowest	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)		H/V
2390	55.54	-9.2	46.34	74	-27.66	**Peak**	**H**
2400	55.80	-9.39	46.41	74	-27.59	Peak	H
4804	52.07	-4.33	47.74	74	-26.26	Peak	H
7206	49.52	1.01	50.53	74	-23.47	Peak	H
2390	55.64	-9.2	46.44	74	-27.56	**Peak**	**V**
2400	54.31	-9.39	44.92	74	-29.08	Peak	V
4804	55.23	-4.33	50.90	74	-23.10	Peak	V
7206	48.95	1.01	49.96	74	-24.04	Peak	V

Worse case mode:		π /4DQPSK (2DH5)		Test channel:		Middle	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)		H/V
4882	50.90	-4.11	46.79	74	-27.21	peak	H
7323	48.54	1.51	50.05	74	-23.95	peak	H
4882	54.16	-4.11	50.05	74	-23.95	peak	V
7323	48.27	1.51	49.78	74	-24.22	peak	V

Worse case mode:		π /4DQPSK (2DH5)		Test channel:		Highest	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)		H/V
2483.5	57.04	-9.29	47.75	74	-26.25	**Peak**	**H**
4960	52.79	-4.04	48.75	74	-25.25	Peak	H
7440	49.67	1.57	51.24	74	-22.76	Peak	H
2483.5	55.01	-9.29	45.72	74	-28.28	**Peak**	**V**
4960	50.93	-4.04	46.89	74	-27.11	Peak	V
7440	49.08	1.57	50.65	74	-23.35	Peak	V

Remark:

1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
   Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor
2) Scan from 9kHz to 25GHz, the disturbance above 10GHz and below 30MHz was very low. As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. So, only the peak measurements were shown in the report.

6 Photographs - EUT Test Setup

6.1 Radiated Emission

9KHz~30MHz:

30MHz~1GHz:

Above 1GHz:

6.2 Conducted Emission

7 Photographs - EUT Constructional Details

Refer to Photographs - EUT Constructional Details OF EUT for CQASZ20240701325E-01.

*** END OF REPORT ***