TEST REPORT

Report No.: SHATBL2407020W06

Applicant	:	Shanghai AllyNav Technology Co.,Ltd.
Product Name	:	Orchard Sparying Robot
Brand Name	:	N/A
Model Name	:	Aries300N
FCC ID	:	2AT4H-ARIES300N
Test Standard	:	47 CFR 15.247
Date of Test	:	2024.08.20-2024.08.28

Report Prepared by : Emily

(Emily)

Report Approved by : Guozheng Li

(Guozheng Li)

Authorized Signatory : Terry Yang

(Terry Yang)

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REVISION HISTORY

Rev.	Issue Date	Revisions	Revised by
00	2024.12.10	Initial Release	Guozheng Li

DECLARATION OF REPORT

1. The device has been tested by ATBL, and the test results show that the equipment under test (EUT) is in compliance with the requirements of 47 CFR 15.247. And it is applicable only to the tested sample identified in the report.

2. This report shall not be reproduced except in full, without the written approval of ATBL, this document only be altered or revised by ATBL, personal only, and shall be noted in the revision of the document.

3. The general information of EUT in this report is provided by the customer or manufacture, ATBL is only responsible for the test data but not for the information provided by the customer or manufacture.

4. The results in this report is only apply to the sample as tested under conditions. The customer or manufacturer is responsible for ensuring that the additional production units of this model have the same electrical and mechanical components.

5. In this report, '☐' indicates that EUT does not support content after '☐', and '☑' indicates that it supports content after '☑'

SUMMARY OF TEST RESULT

Report Section	Standard Section	Test Item	Judgment	Remark
3.1	47 CFR 15.247(b)(1)	Maximum Peak Conducted Output Power	PASS	--
3.2	47 CFR 15.247(a)(1)(iii)	Number of Hopping Frequencies	PASS	--
3.3	47 CFR 15.247(a)(1)(iii)	Duty Cycle and Dwell Time	PASS	--
3.4	47 CFR 15.247(a)(1)	20dB Bandwidth	Report only	--
3.5	47 CFR 15.247(a)(1)	Carrier Frequency Separation	PASS	--
3.6	47 CFR 15.247(d)	Conducted Band Edge	PASS	--
3.7	47 CFR 15.247(d)	Conducted Spurious Emission	PASS	--
3.8	47 CFR 15.247(d)/15.209(a)/15.205(a)	Radiated Spurious Emission and Restricted Band	PASS	Note(1)
3.9	47 CFR 15.207(a)	AC Power-Line Conducted Emission	N/A	--
3.10	47 CFR 15.203	Antenna Requirements	PASS	--

Note:

(1)The data content is provided by Industrial Internet Innovation Center (Shanghai) Co.,Ltd.(A2LA number: #3682.01)

1. GENERAL DESCRIPTION

1.1. Applicant

Name : Shanghai AllyNav Technology Co.,Ltd.

Address : Room 201, Buliding 1,No 215, Gaoguang RD,Qingpu District,Shanghai, China

1.2. Manufacturer

Name : Shanghai AllyNav Technology Co.,Ltd.

Address : Room 201, Buliding 1,No 215, Gaoguang RD,Qingpu District,Shanghai, China

1.3. Factory

Name : Shanghai AllyNav Technology Co.,Ltd.

Address : Room 201, Buliding 1,No 215, Gaoguang RD,Qingpu District,Shanghai, China

1.4. General Information of EUT

General Information	
Equipment Name	Orchard Sparying Robot
Brand Name	N/A
Model Name	Aries300N
Series Model	Aries300N-1
Model Difference	The model is changed according to the difference of overseas customers, and its composition and key parts are exactly the same
Sample No	202400515007001
Power Input	DC 48V
Adapter	N/A
Battery	Model: Lead acid battery Brand:TianNeng Capacity: 10-19AH
Hardware version	Aries300N-1
Software version	1.2.2.25RC
Connecting I/O Port(s)	Refer to the remark below.

Remark:

The above information of EUT was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.5. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature	Normal Temperature(TN):	25°C
	High Temperature(TH):	60°C
	Low Temperature(TL):	-20°C
Voltage	Normal Voltage(VN):	48V
	High Voltage(VH):	52.8V
	Low Voltage(VL):	45.6V
Other	Relative Humidity	52 %
	Air Pressure	101 kPa

1.6. Equipment Specification

Equipment Specification		
Frequency Range	2402 MHz - 2480 MHz	
Number of Channels	79	
Carrier Frequency of Each Channel	2402 + n*1 MHz; n = 0 ~ 78	
Maximum Output Power To Antenna	☑Bluetooth BR(1Mbps):	10.62dBm (0.0115W)
	☑Bluetooth EDR(2Mbps):	10.53dBm (0.0113W)
	☑Bluetooth EDR(3Mbps):	10.55dBm (0.0114W)
Type of Modulation	☑Bluetooth BR(1Mbps):	GFSK
	☑Bluetooth EDR(2Mbps):	π/4-DQPSK
	☑Bluetooth EDR(3Mbps):	8-DPSK
Antenna Type	PCB antenna	
Antenna Gain	2.7 dBi	

1.7. Modification of EUT

No modifications are made to the EUT during all test items.

1.8. Laboratory Information

Company Name	:	Shanghai ATBL Technology Co., Ltd.
Address	:	5F., Unit 1, No.8, Free Trade One Life Science and Sci-Tech Industrial Park, No.160, Basheng Road, Pudong New District, Shanghai, China
Telephone	:	+86(0)21-51298625

1.9. Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

47 CFR Part 15 Subpart C §15.247

FCC KDB 558074 D01 15.247 Meas Guidance v05r02

ANSI C63.10-2013

Remark:

All test items were verified and recorded according to the standards and without any deviation during the test.

2. TEST CONFIGURATION OF EUT

2.1. Carrier Frequency Channel

Frequency Band	Channel	Frequency MHz	Channel	Frequency MHz	Channel	Frequency MHz
2400 - 2483.5 MHz	**00**	**2402**	27	2429	54	2456
	01	2403	28	2430	55	2457
	02	2404	29	2431	56	2458
	03	2405	30	2432	57	2459
	04	2406	31	2433	58	2460
	05	2407	32	2434	59	2461
	06	2408	33	2435	60	2462
	07	2409	34	2436	61	2463
	08	2410	35	2437	62	2464
	09	2411	36	2438	63	2465
	10	2412	37	2439	64	2466
	11	2413	38	2440	65	2467
	12	2414	**39**	**2441**	66	2468
	13	2415	40	2442	67	2469
	14	2416	41	2443	68	2470
	15	2417	42	2444	69	2471
	16	2418	43	2445	70	2472
	17	2419	44	2446	71	2473
	18	2420	45	2447	72	2474
	19	2421	46	2448	73	2475
	20	2422	47	2449	74	2476
	21	2423	48	2450	75	2477
	22	2424	49	2451	76	2478
	23	2425	50	2452	77	2479
	24	2426	51	2453	**78**	**2480**
	25	2427	52	2454	--	--
	26	2428	53	2455	--	--

Remark:

Low Channel: **CH00_2402 MHz**; Middle Channel: **CH39_2441 MHz**; High Channel: **CH78_2480 MHz**.

2.2. Test Modes

The table below is showing all test modes to demonstrate in compliance with the standard.

Summary Table of Test Modes			
Test Item	Data Rate / Modulation		
	Bluetooth BR(1Mbps) GFSK	Bluetooth EDR(2Mbps) π/4-DQPSK	Bluetooth EDR(3Mbps) 8-DPSK
For Conducted and Radiated Test	Mode 1: CH00_2402 MHz	Mode 2: CH00_2402 MHz	Mode 3: CH00_2402 MHz
	Mode 4: CH39_2441 MHz	Mode 5: CH39_2441 MHz	Mode 6: CH39_2441 MHz
	Mode 7: CH78_2480 MHz	Mode 8: CH78_2480 MHz	Mode 9: CH78_2480 MHz
	Mode 10: Hopping	Mode 11: Hopping	Mode 12: Hopping
For AC Power-line Conducted Emission	Mode 13: Keep Bluetooth link under the maximum output power		

2.3. Block Diagram of Test System

2.3.1. For Radiated Spurious Emission

2.3.2. For Conducted Test

2.4. Description of Support Units

NO.	Unit	Brand	Model	Description
1	Notebook	Lenovo	Air 14	/
2	USB Line	ZL	24AWG	/

2.5. Test Software and Power Level

During the test, the channel and power control software provided by the customer is used to control the operation channel and output power level.

2.6. EUT Operating Conditions

For AC power-line conducted emission, the EUT was connected under the large package sizes transmission.

For radiated spurious emission and conducted test, the engineering test program was provided and make the EUT to continuous transmit/receive.

2.7. Equipment List

2.7.1. For Conducted Test

Equipment Name	Manufacturer	Model	Serial No.	Calibration Until	Calibration DUE Until	Cal. Interval
Power meter	Anritsu	ML2496A	1935001	2024.07.18	2025.07.17	1 year
Power sensor	Anritsu	MA2411B	1911006	2024.07.18	2025.07.17	1 year
Power sensor	Keysight	U2021XA	MY59120004	2024.07.18	2025.07.17	1 year
Adjustable Attenuator	Agilent	8494B	MY42144015	2024.07.18	2025.07.17	1 year
Adjustable Attenuator	Agilent	8496B	MY42143776	2024.07.18	2025.07.17	1 year
Environmental Test Chamber	KSON	THS-B6C-150	9159K	2024.03.28	2025.03.27	1 year
Signal analyzer	Keysight	N9020A	MY50510136	2024.07.18	2025.07.17	1 year
Vector signal generator	Keysight	N5182B	MY57300196	2024.07.18	2025.07.17	1 year
Vector signal generator	Agilent	N5182A	MY50143555	2024.07.18	2025.07.17	1 year
Analog signal generator	Keysight	N5173B	MY60403026	2024.07.18	2025.07.17	1 year
Wideband radio communication tester	R&S	CMW500	101331	2024.07.18	2025.07.17	1 year
Spectrum analyzer	R&S	FSV40-N	101761	2024.07.18	2025.07.17	1 year
Switch Box	N/A	RFSW3003328	RFSW201019	N/A	N/A	1 year
Thermometer	DeLi	N/A	N/A	2024.07.18	2025.07.17	1 year
Test Software	FALA	LZ-RF	N/A	N/A	N/A	1 year
Test Software	Cesheng	WCS-WCN	N/A	N/A	N/A	N/A

2.7.2. For Radiated Spurious Emission

Equipment Name	Manufacturer	Model	Serial No.	Calibration Until	Calibration DUE Until	Cal. Interval
Universal Radio Communication Tester	R&S	CMW500	104178	2024.10.09	2025.10.08	1 year
Test Receiver	R&S	ESR7	102399	2024.06.07	2025.06.06	1 year
Test Receiver	R&S	FSW43	101943	2024.08.21	2025.08.20	1 year
Loop Antenna	COM-POWER	AL-130R	121083	2024.08.31	2025.08.30	1 year
Trilog Antenna	Schwarzbeck	VULB9162	00426	2024.08.02	2025.08.01	1 year
Double Ridged Guide Antenna	ETS	ETS-3117	00135885	2024.03.26	2025.03.25	1 year
Horn Antenna	R&S	QMS-00880	24715	2024.08.03	2025.08.02	1 year
EMI Test Software	R&S	EMC32 V10.60.20	N/A	N/A	N/A	N/A
Antenna Tower	Top Precision	TPMDC-LF	N/A	N/A	N/A	N/A
Antenna Tower	Top Precision	TPMDC-HF	N/A	N/A	N/A	N/A

2.8. Measurement Uncertainty

The reported uncertainty of measurement y±U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of *k*=2, providing a level of confidence of approximately 95 %.

No.	Item	Uncertainty
1	Conducted Output Power	1.266dB
2	Power spectral density	1.282dB
3	Conducted Frequency Stability	10.14Hz
4	Conducted spurious emissions	1.73dB
5	RF Cable Loss	1.22dB
6	Radiated Spurious Emission 9KHz-30MHz	2.35dB
7	Radiated Spurious Emission 30MHz-1GHz	3.60dB
8	Radiated Spurious Emission 1GHz-18GHz	5.40dB
9	Radiated Spurious Emission 18GHz - 40GHz	8.20dB

3. TEST RESULT

3.1. Maximum Peak Conducted Output Power

3.1.1. Limit

47 CFR 15.247(b)(1): 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.

3.1.2. Test Procedure

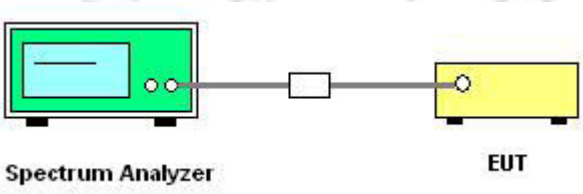
ANSI C63.10-2013 clause 7.8.5: This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

1. Use the following spectrum analyzer settings:
   ① Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
   ② RBW > 20 dB bandwidth of the emission being measured.
   ③ VBW ≥ RBW.
   ④ Sweep: Auto.
   ⑤ Detector function: Peak.
   ⑥ Trace: Max hold.
2. Allow trace to stabilize.
3. Use the marker-to-peak function to set the marker to the peak of the emission.
4. The indicated level is the peak output power, after any corrections for external attenuators and cables.
5. A plot of the test results and setup description shall be included in the test report.

Remark:

A peak responding power meter may be used, where the power meter and sensor system video bandwidth is greater than the occupied bandwidth of the unlicensed wireless device, rather than a spectrum analyzer.

3.1.3. Test Setup



3.1.4. Test Result of Maximum Peak Conducted Output Power

Please refer to the Appendix A1.

3.2. Number of Hopping Frequencies

3.2.1. Limit

47 CFR 15.247(a)(1)(iii): Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

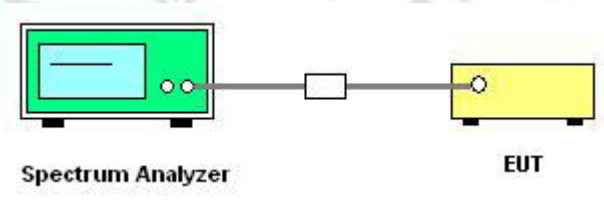
3.2.2. Test Procedure

ANSI C63.10-2013 clause 7.8.3: The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
2. RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
3. VBW ≥ RBW.
4. Sweep: Auto.
5. Detector function: Peak.
6. Trace: Max hold.
7. Allow the trace to stabilize.

It might prove necessary to break the span up into sub ranges to show clearly all of the hopping frequencies. Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels. A plot of the data shall be included in the test report.

3.2.3. Test Setup



3.2.4. Test Result of Number of Hopping Frequencies

Please refer to the Appendix A2.

3.3. Duty Cycle and Dwell Time

3.3.1. Limit

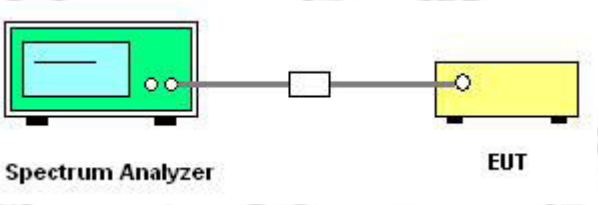
47 CFR 15.247(a)(1)(iii): The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

3.3.2. Test Procedure

ANSI C63.10-2013 clause 7.8.4: The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span: Zero span, centered on a hopping channel.
2. RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
3. Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
4. Detector function: Peak.
5. Trace: Max hold.
6. Use the marker-delta function to determine the transmit time per hop.
7. The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements.

3.3.3. Test Setup



3.3.4. Test Result of Duty Cycle and Dwell Time

Please refer to the Appendix A3.

3.4. 20dB Bandwidth

3.4.1. Limit

There is no limit requirement for 20dB Bandwidth.

3.4.2. Test Procedure

1. The testing follows *ANSI C63.10-2013 clause 6.9.2 and 6.9.3*.

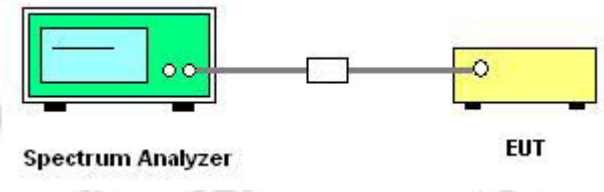
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

3. Set to the maximum power setting and enable the EUT transmit continuously.

4. Use the following spectrum analyzer settings for 20dB Bandwidth measurement. Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel; RBW ≥ 1% of the 20 dB bandwidth; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold.

5. Measure and record the results in the test report.

3.4.3. Test Setup



3.4.4. Test Result of 20dB Bandwidth

Please refer to the Appendix A4.

3.5. Carrier Frequency Separation

3.5.1. Limit

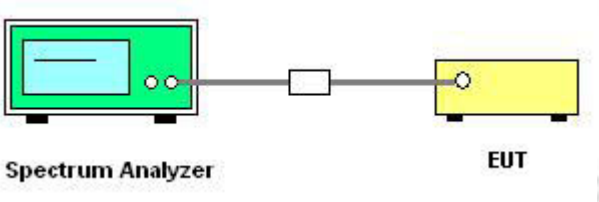
47 CFR 15.247(a)(1): Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

3.5.2. Test Procedure

ANSI C63.10-2013 clause 7.8.2: The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span: Wide enough to capture the peaks of two adjacent channels.
2. RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
3. VBW ≥ RBW.
4. Sweep: Auto.
5. Detector function: Peak.
6. Trace: Max hold.
7. Allow the trace to stabilize.
8. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. A plot of the data shall be included in the test report.

3.5.3. Test Setup



3.5.4. Test Result of Carrier Frequency Separation

Please refer to the Appendix A5.

3.6. Conducted Band Edge

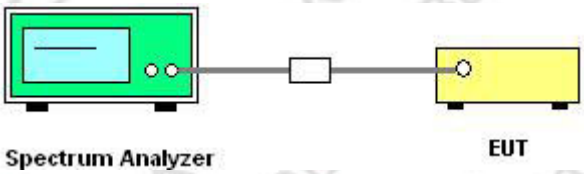
3.6.1. Limit

47 CFR 15.247(d): 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 conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

3.6.2. Test Procedure

1. The testing follows *ANSI C63.10-2013 clause 11.13*.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Conducted Band Edge measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the 100 kHz bandwidth within the band that contains the highest level of the desired power when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
4. Measure and record the results in the test report.
5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.6.3. Test Setup



3.6.4. Test Result of Conducted Band Edge

Please refer to the Appendix A6.

3.7. Conducted Spurious Emission

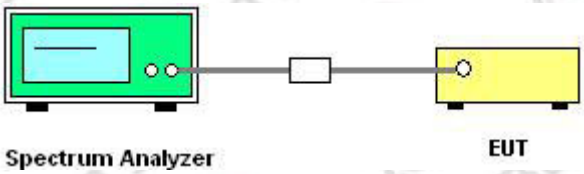
3.7.1. Limit

47 CFR 15.247(d): 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 conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

3.7.2. Test Procedure

1. The testing follows *ANSI C63.10-2013 clause 7.8.8*.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.7.3. Test Setup



3.7.4. Test Result of Conducted Spurious Emission

Please refer to the Appendix A6.

※※※※※END OF APPENDIX A※※※※※

3.8. Radiated Spurious Emission and Restricted Band

3.8.1. Limit

47 CFR 15.247(d): 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 conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

47 CFR 15.205(a): Only spurious emissions are permitted in any of the frequency bands listed below:

Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
0.090-0.110	12.29-12.293	149.9-150.05	1660-1710	8.025-8.5
0.495-0.505	12.51975-12.52025	156.52475-156.52525	1718.8-1722.2	9.0-9.2
2.1735-2.1905	12.57675-12.57725	156.7-156.9	2200-2300	9.3-9.5
4.125-4.128	13.36-13.41	162.0125-167.17	2310-2390	10.6-12.7
4.17725-4.17775	16.42-16.423	167.72-173.2	2483.5-2500	13.25-13.4
4.20725-4.20775	16.69475-16.69525	240-285	2690-2900	14.47-14.5
6.215-6.218	16.80425-16.80475	322-335.4	3260-3267	15.35-16.2
6.26775-6.26825	25.5-25.67	399.9-410	3332-3339	17.7-21.4
6.31175-6.31225	37.5-38.25	608-614	3345.8-3358	22.01-23.12
8.291-8.294	73-74.6	960-1240	3600-4400	23.6-24.0
8.362-8.366	74.8-75.2	1300-1427	4500-5150	31.2-31.8
8.37625-8.38675	108-121.94	1435-1626.5	5350-5460	36.43-36.5
8.41425-8.41475	123-138	1645.5-1646.5	7250-7750	Above 38.6

47 CFR 15.209(a): The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

3.8.2. Test Procedure

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.

2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.

3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.

4. Set to the maximum power setting and enable the EUT transmit continuously.

5. Use the following spectrum analyzer settings:

① Span shall wide enough to fully capture the emission being measured;

② Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak;

③ For average measurement: use duty cycle correction factor method per 15.35(c).

Duty cycle = On time/100 milliseconds

On time = N1*L1+N2*L2+...+Nn-1*LNn-1+Nn*Ln

Where N1 is number of type 1 pulses, L1 is length of type 1 pulses, etc.

Average Emission Level = Peak Emission Level + 20*log(Duty cycle)

6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Pre-amp Factor = Level

7. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.

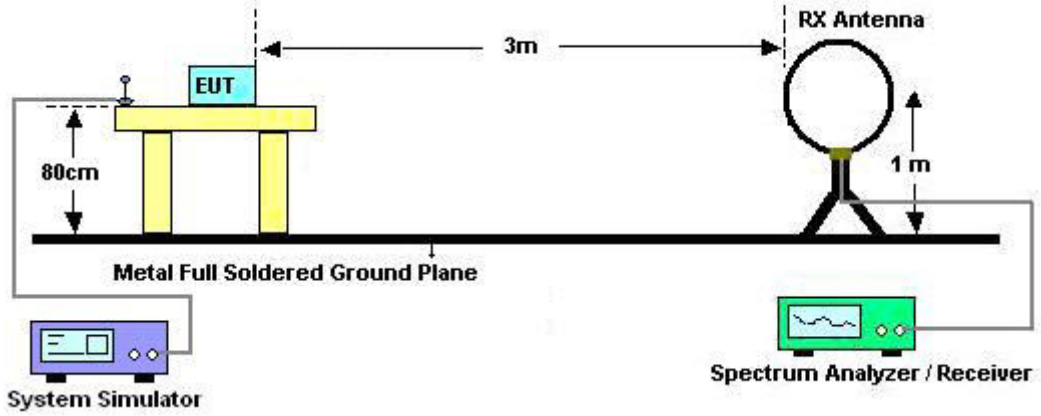
8. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Remark:

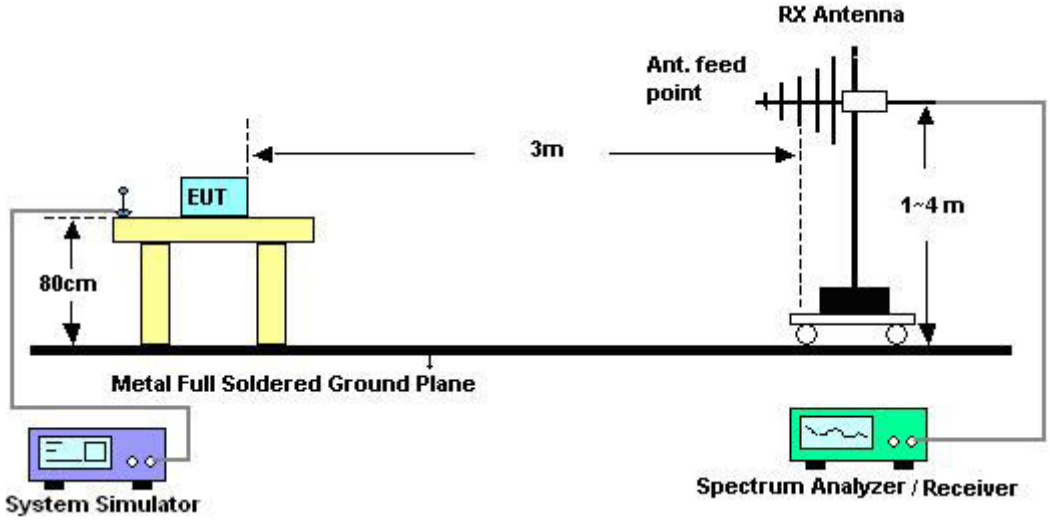
The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.70dB) derived from 20log (dwell time/100ms). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

3.8.3. Test Setup

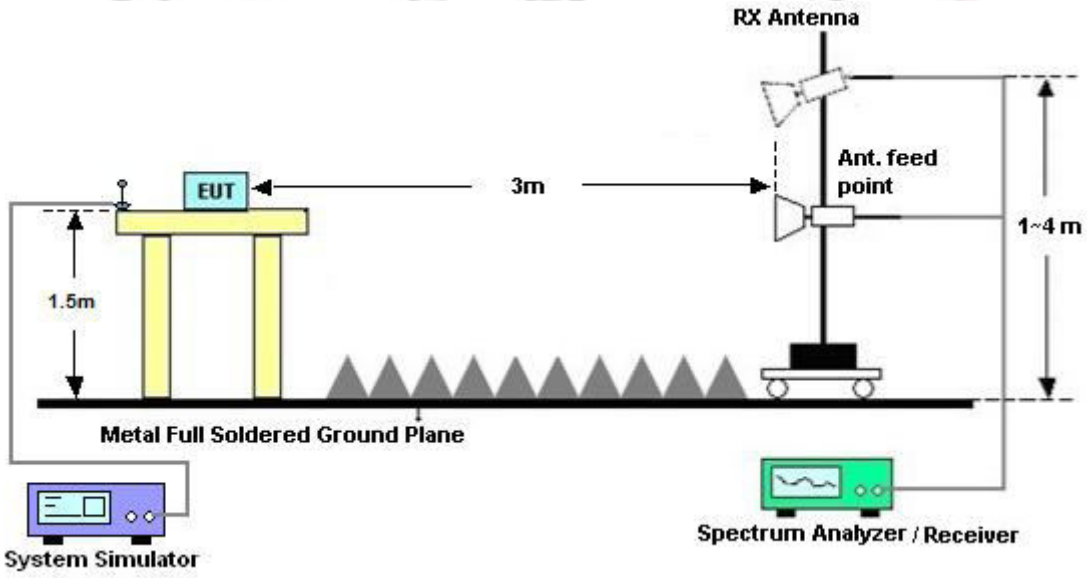
3.8.3.1. For radiated emissions below 30MHz



3.8.3.2. For radiated emissions from 30MHz to 1GHz



3.8.3.3. For radiated emissions above 1GHz



3.8.4. Test Result of Radiated Spurious Emission

Please refer to the Appendix B.

3.8.5. Test Result of Restricted Band

Please refer to the Appendix B.

3.9. AC Power-Line Conducted Emission

3.9.1. Limit

47 CFR 15.207(a): For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table:

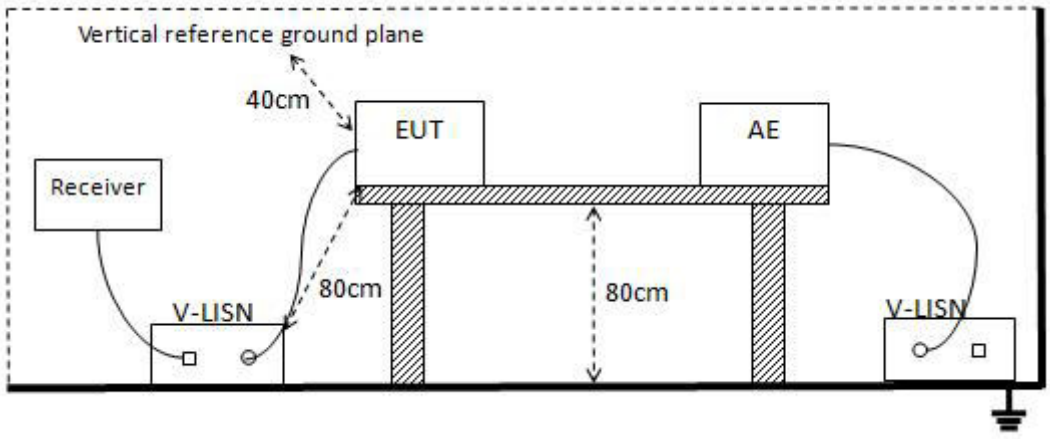
Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

3.9.2. Test Procedure

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9 kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.9.3. Test Setup



3.9.4. Test Result of AC Power-Line Conducted Emission

Please refer to the Appendix B.

3.10. Antenna Requirement

3.10.1. Standard Requirement

According to *47 CFR 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.

3.10.2. EUT Antenna

The antenna used for the EUT is PCB antenna, which meets the antenna requirements.

4. TEST SETUP PHOTOGRAPHS

Please refer to the Appendix C.

5. EXTERNAL AND INTERNAL PHOTOS OF THE EUT

Please refer to the Appendix D.

※※※※※END OF THE REPORT※※※※※

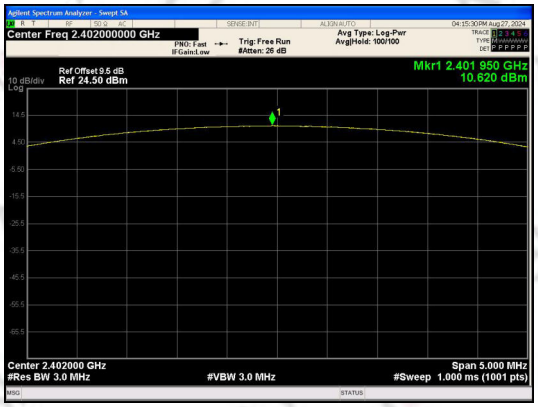
Appendix A _ Conducted Test Data

Appendix A1.Conducted Output Power

Test Result

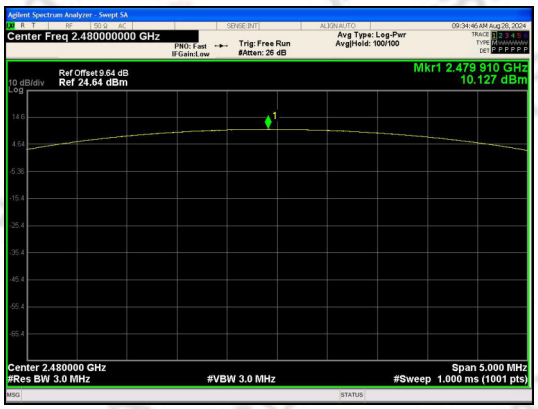
Modulation	Packet Type	Channel	Peak Output Power (dBm)	Peak Output Power (mW)	Max. Avg. Power (dBm)	Limit (dBm)	Result
GFSK	DH5	0	10.620	11.535	None	⩽30	PASS
		39	9.859	9.681	None		PASS
		78	10.127	10.297	None		PASS
π/4DQPSK	2-DH1	0	10.528	11.293	None	⩽20.97	PASS
		39	9.555	9.026	None		PASS
		78	9.631	9.185	None		PASS
8DPSK	3-DH1	0	10.554	11.361	None		PASS
		39	9.615	9.152	None		PASS
		78	9.702	9.337	None		PASS

Test Graphs

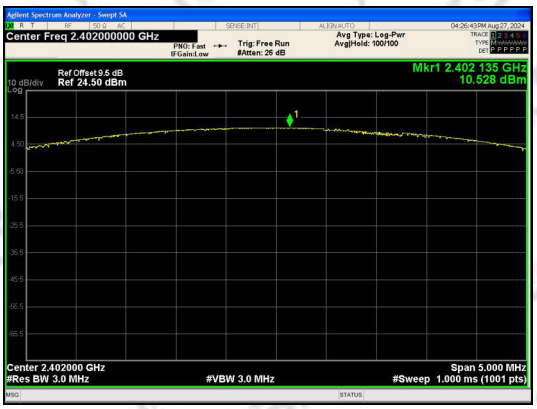


Peak Output Power
GFSK_Channel 0

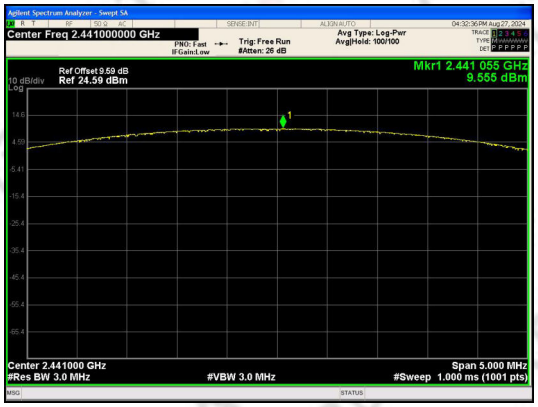
Peak Output Power
GFSK_Channel 39



Peak Output Power
GFSK_Channel 78

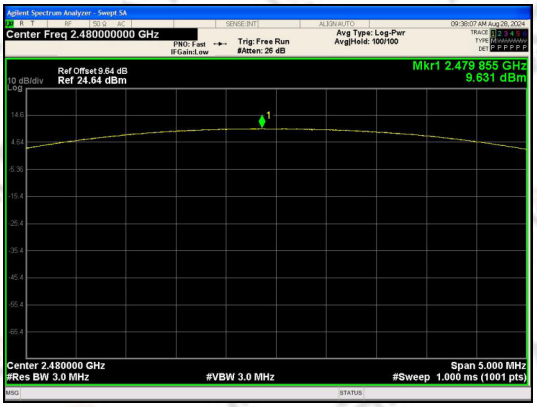


Peak Output Power
π/4DQPSK_Channel 0



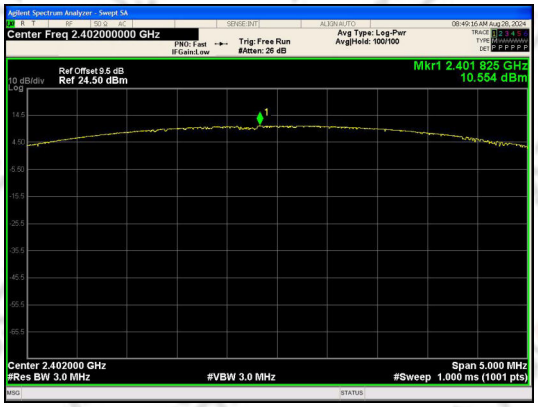
Peak Output Power

π/4DQPSK_Channel 39



Peak Output Power

π/4DQPSK_Channel 78

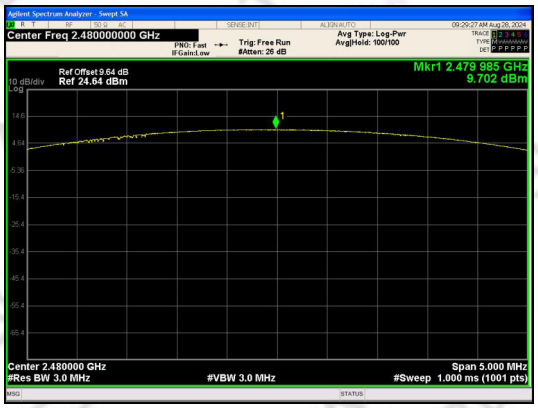


Peak Output Power

8DPSK_Channel 0

Peak Output Power

8DPSK_Channel 39



Peak Output Power

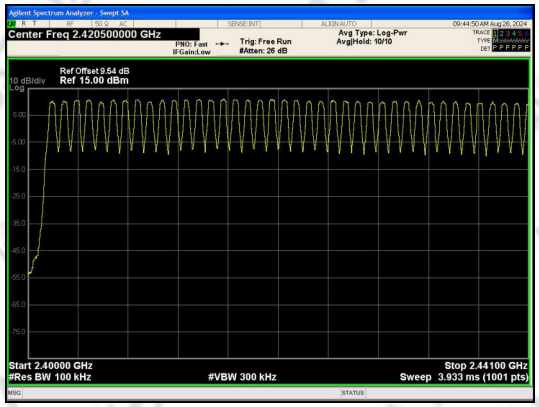
8DPSK_Channel 78

Appendix A2. Number of Hopping Frequencies

Test Result

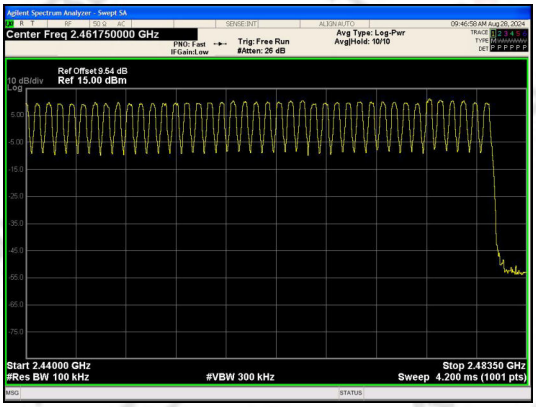
Modulation	Packet	Number of Hopping Channel	Limit	Result
GFSK	DH5	79	15	PASS
GFSK	DH5	79	15	PASS
GFSK	DH5	79	15	PASS
π/4DQPSK	2-DH1	79	15	PASS
π/4DQPSK	2-DH1	79	15	PASS
π/4DQPSK	2-DH1	79	15	PASS
8DPSK	3-DH1	79	15	PASS
8DPSK	3-DH1	79	15	PASS
8DPSK	3-DH1	79	15	PASS

Test Graphs



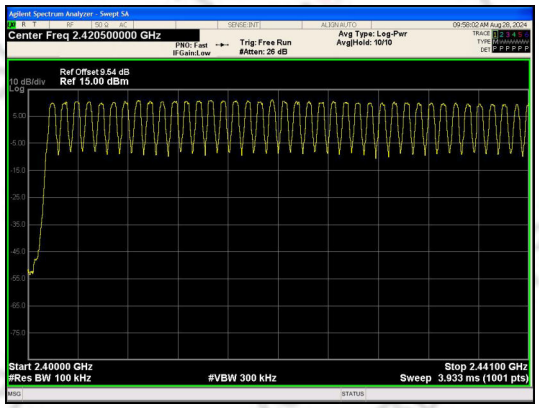
Low End Spectrum Channel Hopping Plot

GFSK



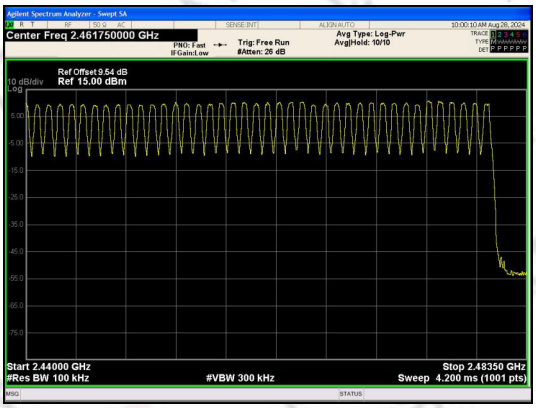
High End Spectrum Channel Hopping Plot

GFSK



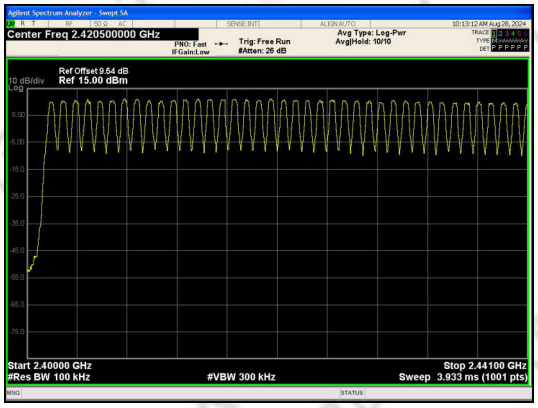
Low End Spectrum Channel Hopping Plot

GFSK



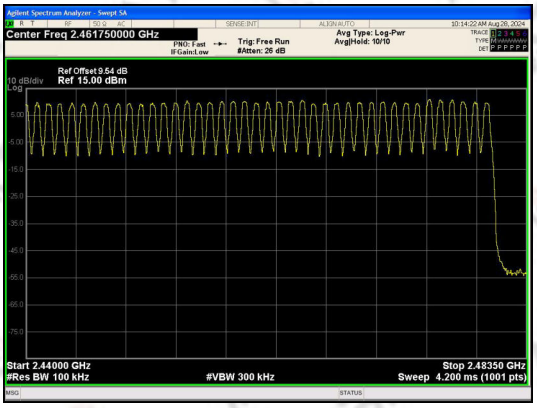
High End Spectrum Channel Hopping Plot

GFSK



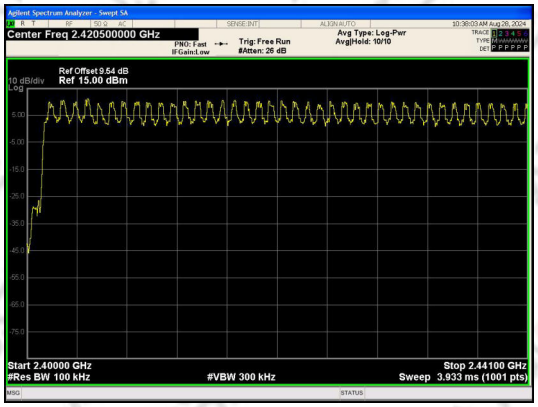
Low End Spectrum Channel Hopping Plot

GFSK



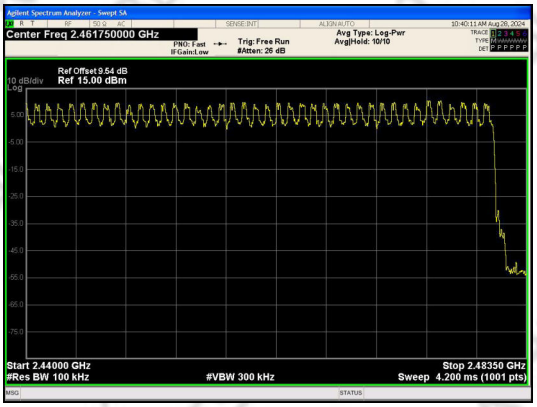
High End Spectrum Channel Hopping Plot

GFSK



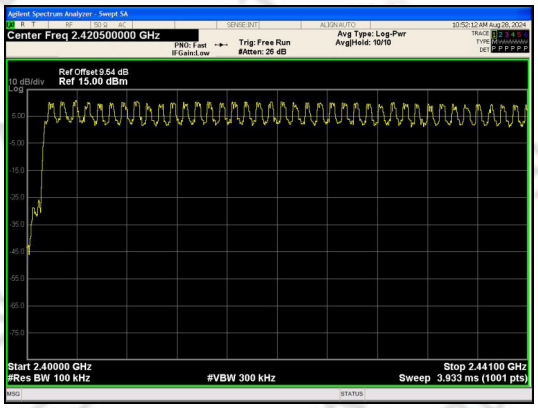
Low End Spectrum Channel Hopping Plot

π/4DQPSK



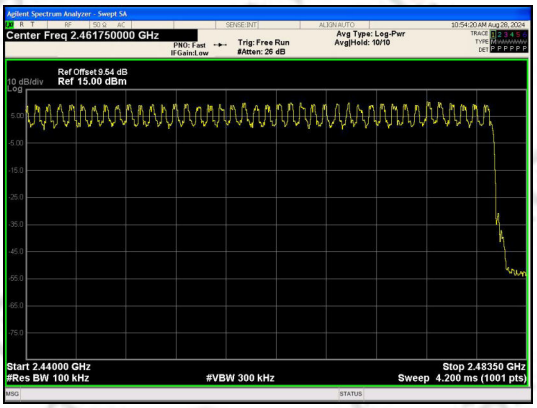
High End Spectrum Channel Hopping Plot

π/4DQPSK



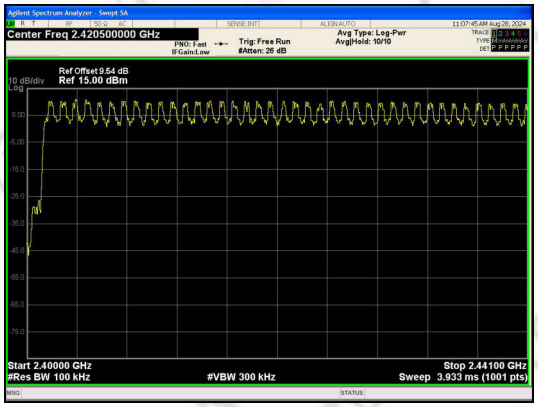
Low End Spectrum Channel Hopping Plot

π/4DQPSK



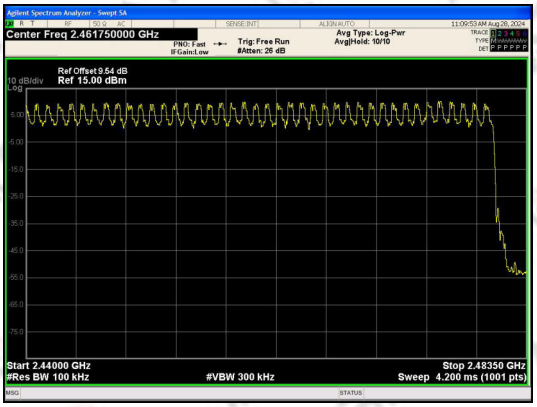
High End Spectrum Channel Hopping Plot

π/4DQPSK



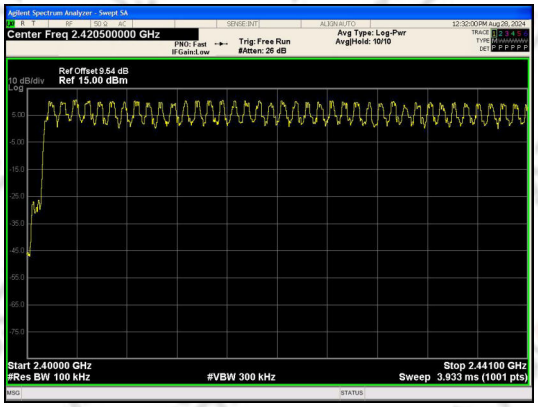
Low End Spectrum Channel Hopping Plot

π/4DQPSK



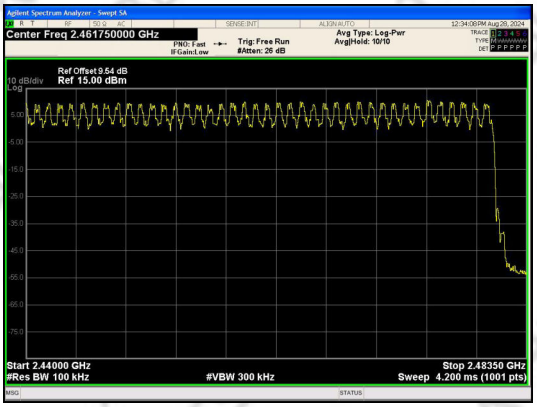
High End Spectrum Channel Hopping Plot

π/4DQPSK



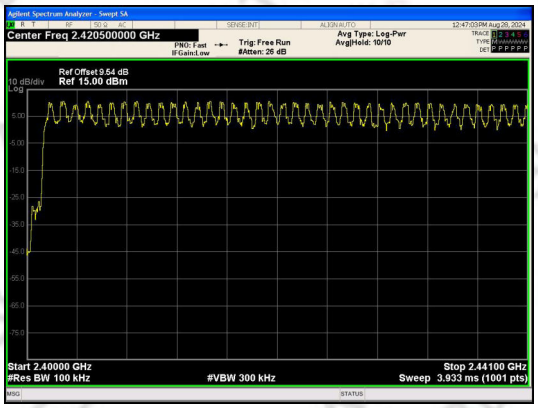
Low End Spectrum Channel Hopping Plot

8DPSK



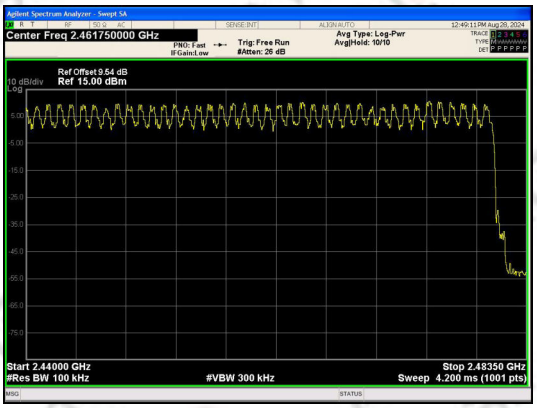
High End Spectrum Channel Hopping Plot

8DPSK



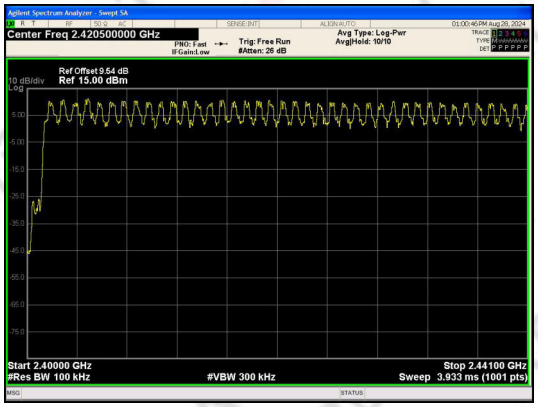
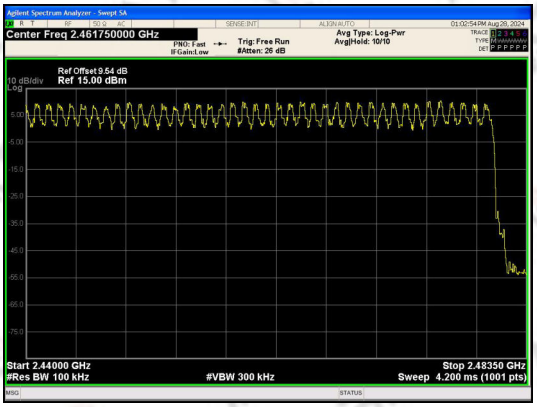
Low End Spectrum Channel Hopping Plot

8DPSK



High End Spectrum Channel Hopping Plot

8DPSK

	
Low End Spectrum Channel Hopping Plot 8DPSK	High End Spectrum Channel Hopping Plot 8DPSK

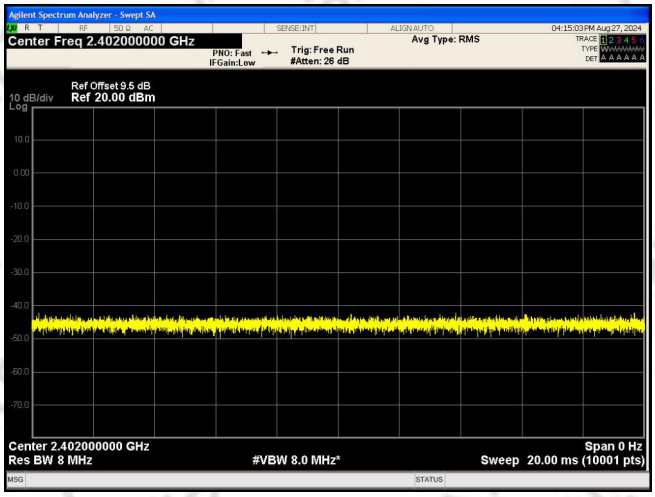
Appendix A3. Duty Cycle and Dwell Time

Duty Cycle

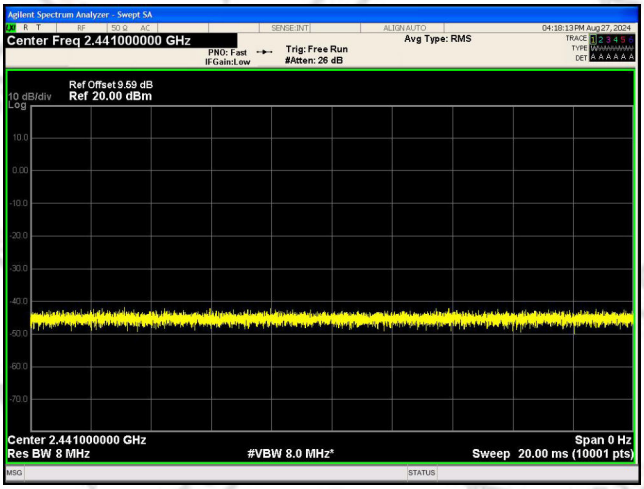
Test Result

Modulation	Packets	Channel	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle (linear)	Duty Cycle Factor (dB)
GFSK	DH5	0	20.000	20.000	100	1	0.0
		39	20.000	20.000	100	1	0.0
		78	20.000	20.000	100	1	0.0
π/4DQPSK	2-DH1	0	6.000	6.000	100	1	0.0
8DPSK	3-DH1		6.000	6.000	100	1	0.0
		78	2.881	3.749	76.85	0.7685	1.1436

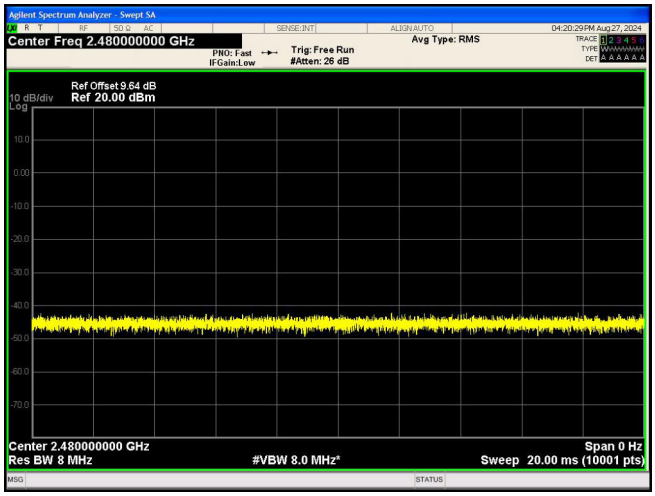
Test Graphs



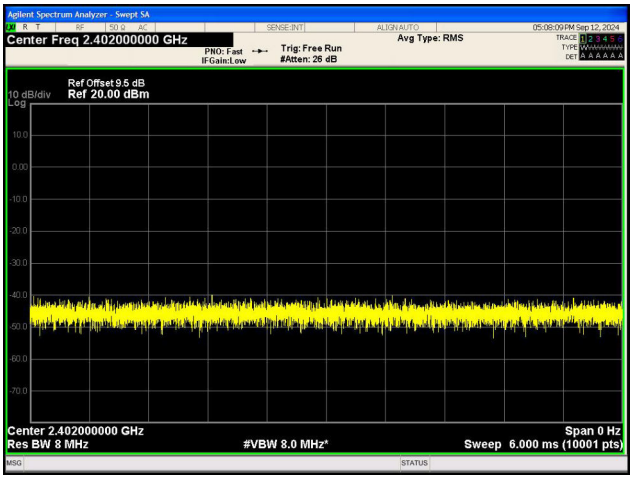
GFSK(DH5)_Channel 0



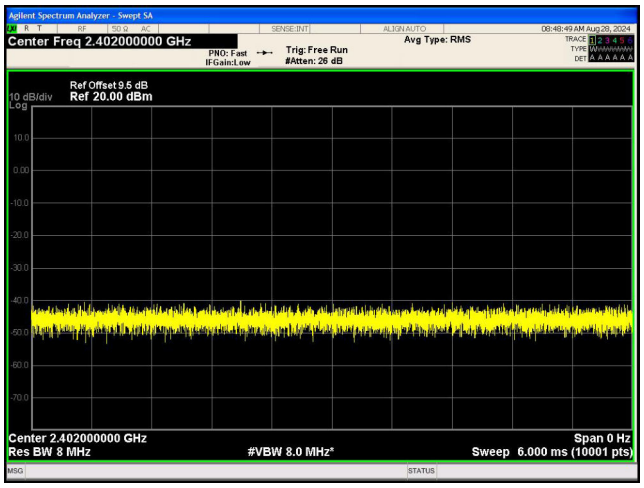
GFSK(DH5)_Channel 39



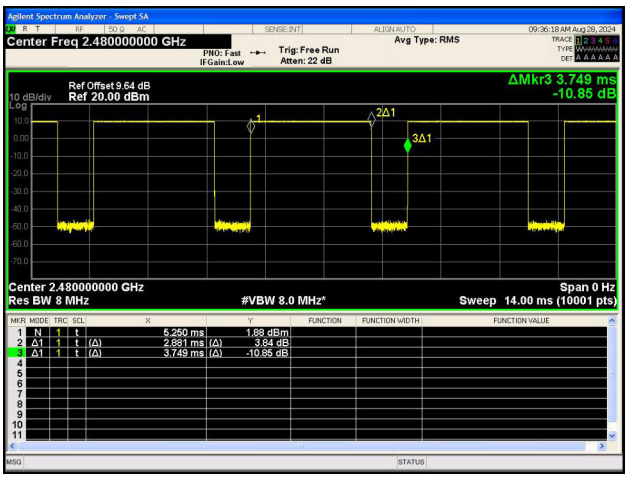
GFSK(DH5)_Channel 78



π/4DQPSK(2-DH1)_Channel 0



8DPSK(3-DH1)_Channel 0



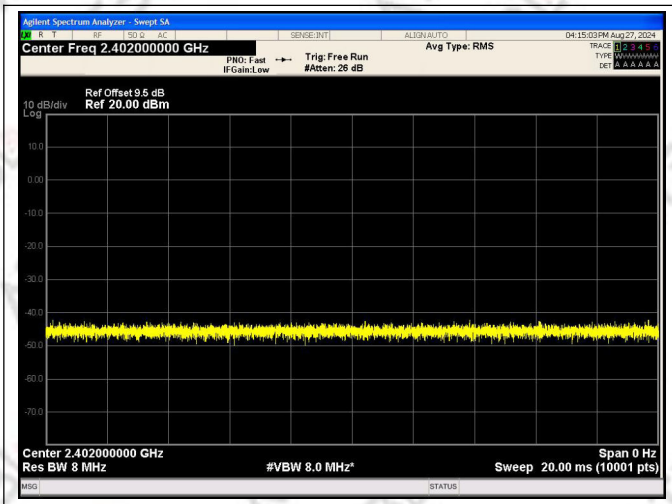
8DPSK(3-DH1)_Channel 78

Dwell Time

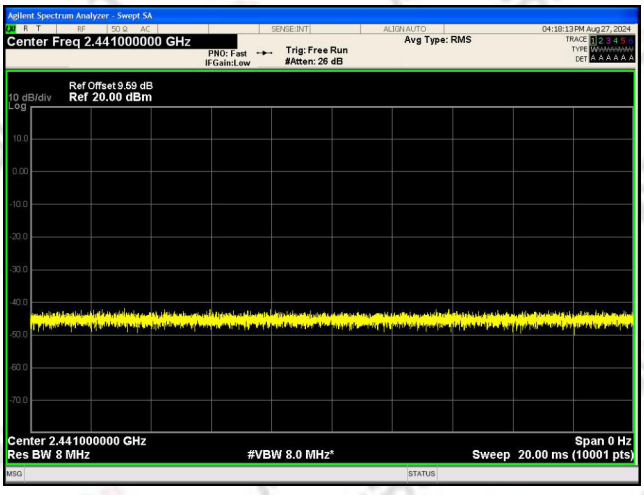
Test Result

Modulation	Packets	Channel	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle (linear)	Duty Cycle Factor (dB)
GFSK	DH5	0	20.000	20.000	100	1	0.0
		39	20.000	20.000	100	1	0.0
		78	20.000	20.000	100	1	0.0
π/4DQPSK	2-DH1	0	6.000	6.000	100	1	0.0
8DPSK	3-DH1		6.000	6.000	100	1	0.0
		78	2.881	3.749	76.85	0.7685	1.1436

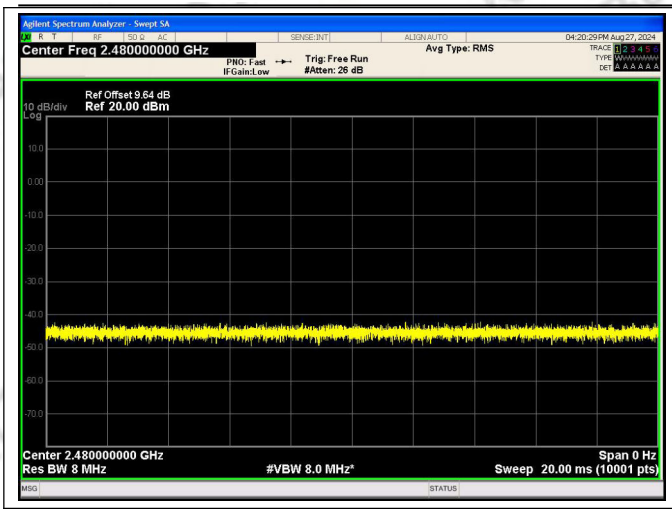
Test Graphs



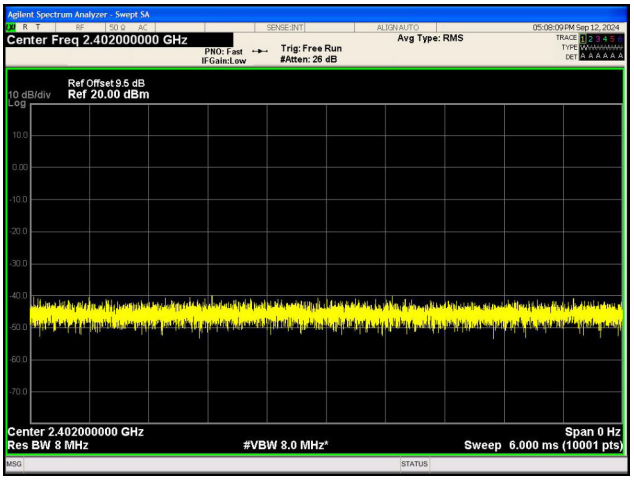
GFSK(DH5)_Channel 0



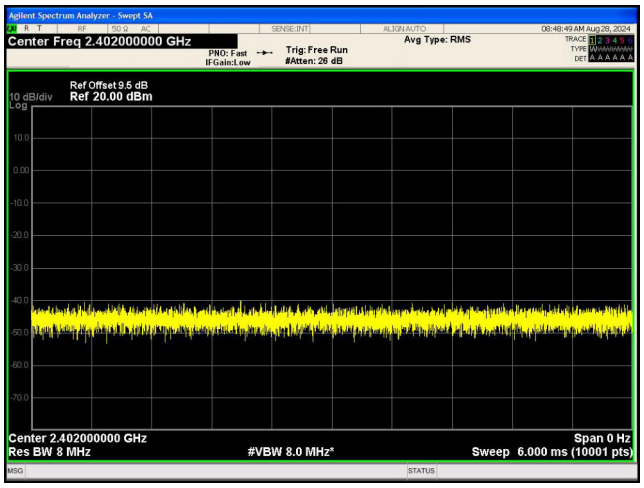
GFSK(DH5)_Channel 39



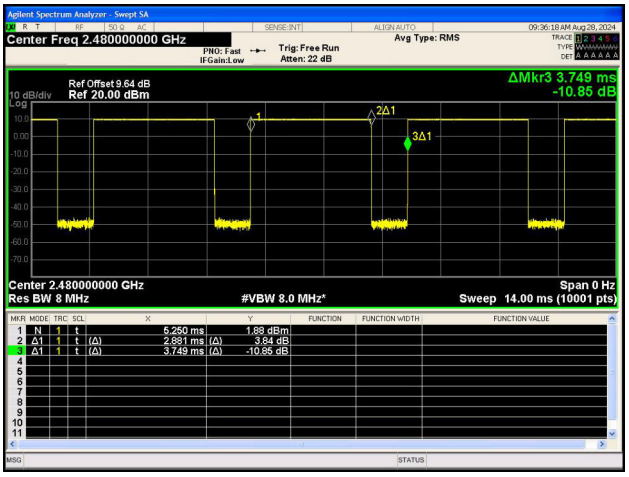
GFSK(DH5)_Channel 78



π/4DQPSK(2-DH1)_Channel 0



8DPSK(3-DH1)_Channel 0



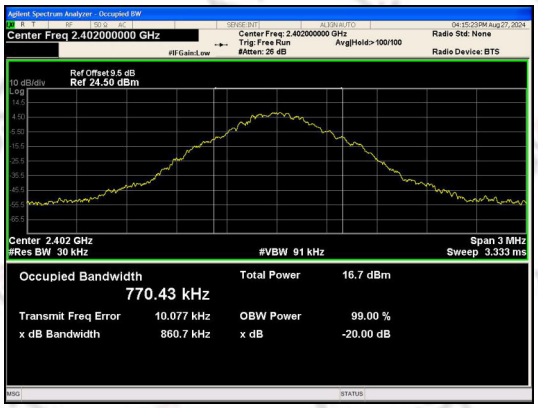
8DPSK(3-DH1)_Channel 78

Appendix A4. 20dB Bandwidth

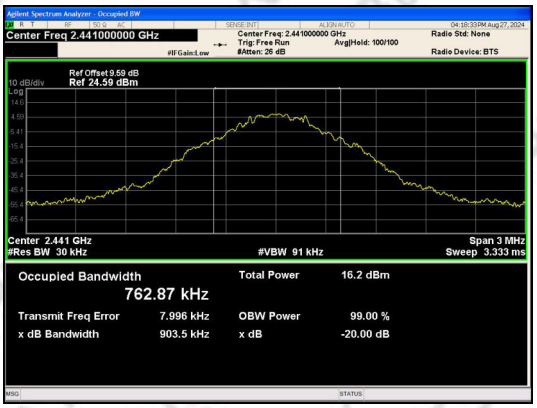
Test Result

Modulation	Channel	Center Frequency (MHz)	20 dB Bandwidth (MHz)
GFSK	0	2402 MHz	0.8607
	39	2441 MHz	0.9035
	78	2480 MHz	0.8546
π/4DQPSK	0	2402 MHz	1.238
	39	2441 MHz	1.221
	78	2480 MHz	1.237
8DPSK	0	2402 MHz	1.252
	39	2441 MHz	1.251
	78	2480 MHz	1.219

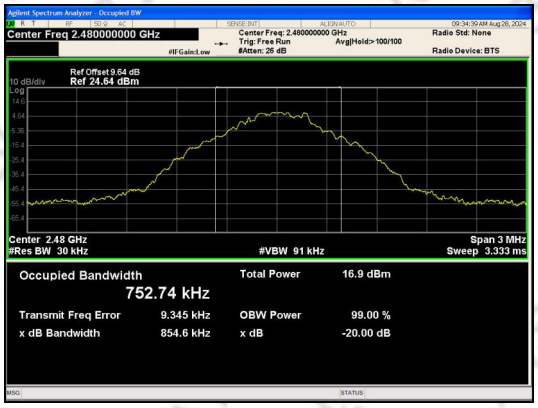
Test Graphs



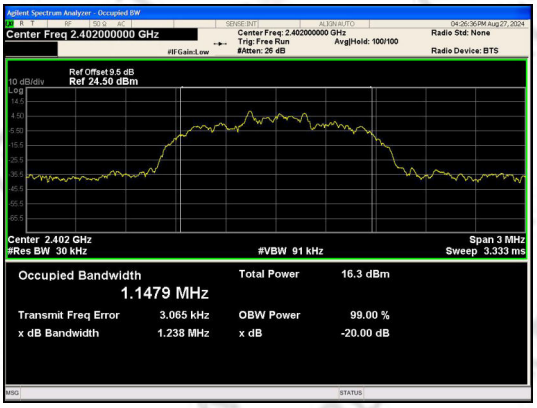
GFSK_DH5_Channel 0



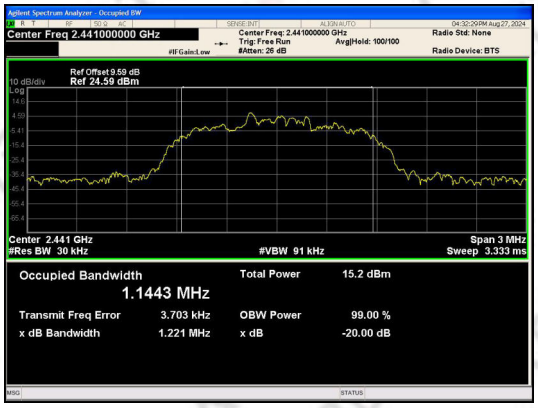
GFSK_DH5_Channel 39



GFSK_DH5_Channel 78



π/4DQPSK_2-DH1_Channel 0



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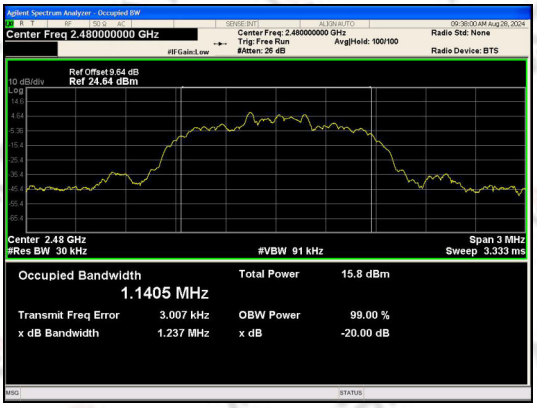
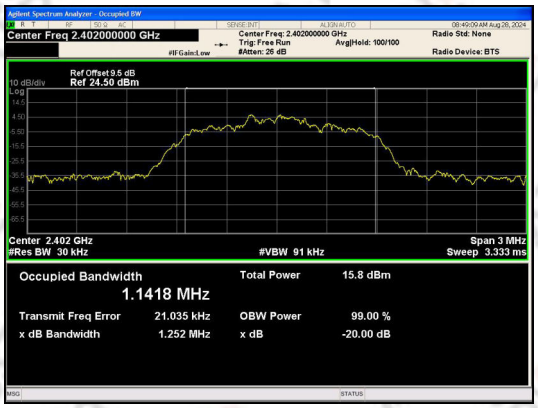
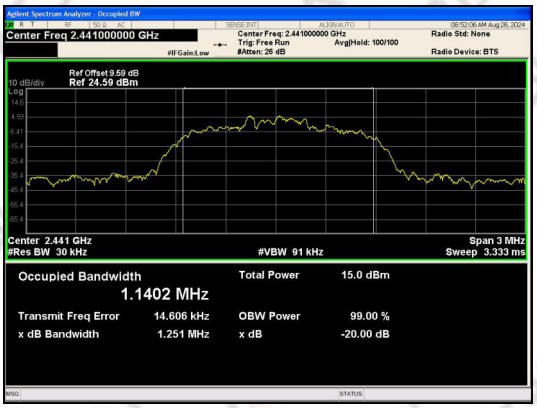


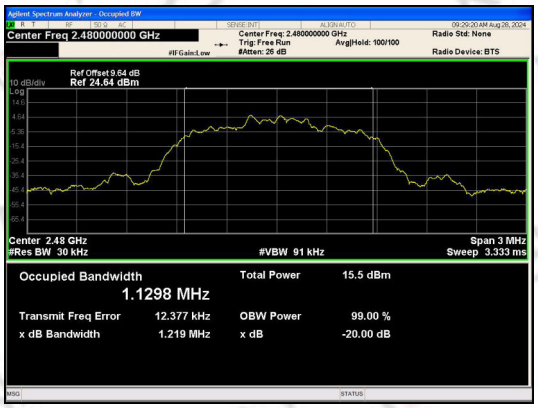
π/4DQPSK_2-DH1_Channel 78



8DPSK_3-DH1_Channel 0



8DPSK_3-DH1_Channel 39



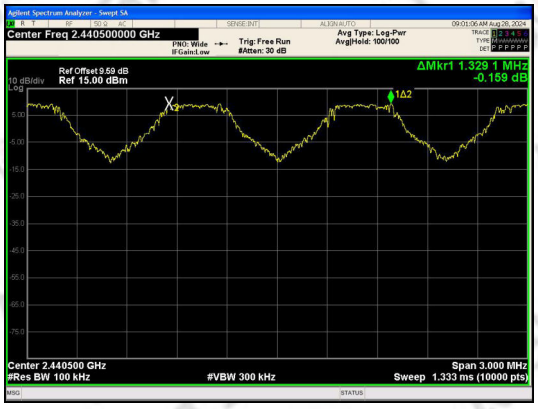
8DPSK_3-DH1_Channel 78

Appendix A5. Carrier Frequency Separation

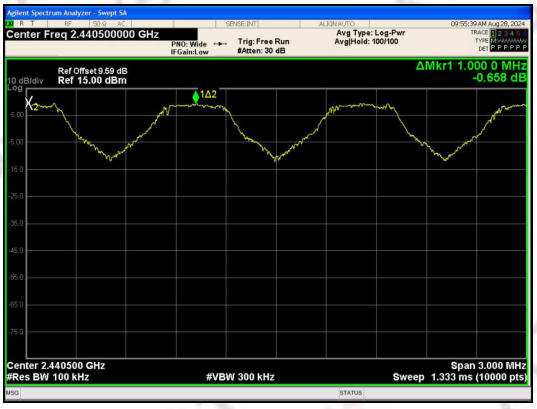
Test Result

Modulation	Packet	Left Center frequency (MHz)	Right Center frequency (MHz)	Hopping Frequency Separation (MHz)	Limit (MHz)	Result
GFSK	DH5	2439.8515	2441.1806	1.3291	0.574	PASS
GFSK	DH5	2440.0228	2441.003	1	0.602	PASS
GFSK	DH5	2439.9997	2441.0294	1.0297	0.57	PASS
π/4DQPSK	2-DH1	2439.8473	2440.8452	0.9979	0.825	PASS
π/4DQPSK	2-DH1	2439.8518	2440.8497	0.9979	0.814	PASS
π/4DQPSK	2-DH1	2439.8503	2440.8557	1.0054	0.825	PASS
8DPSK	3-DH1	2439.8491	2440.8569	1.0078	0.835	PASS
8DPSK	3-DH1	2439.8581	2440.8449	0.9868	0.834	PASS
8DPSK	3-DH1	2439.8455	2440.8401	0.9946	0.813	PASS

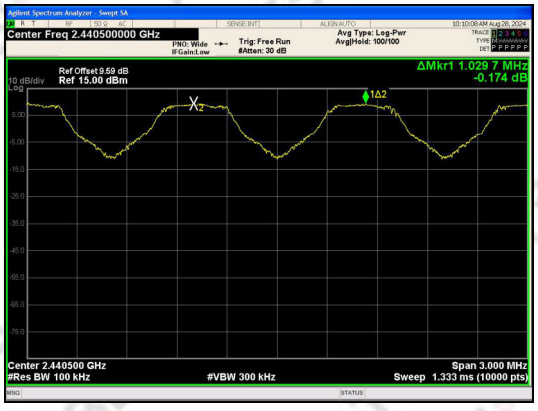
Test Graphs



GFSK



GFSK



GFSK

π/4DQPSK