FCC Part 15C TEST REPORT

FCC ID: 2AI4G-AU-AMP

Product	:	**Amplifier**
Model Name	:	**VAU-AMP, AAU-AMP, ZAU-AMP-R# (where "Z" can be any alphanumeric character or blank for commercial purpose; "-R#" can be any alphanumeric character or blank for internal code.)**
Brand	:	
Report No.	:	**NCT25017680**

repared for

LLW Enterprise LLC

15486 N Nebraska Ave, Lutz, Florida, United States, 33549

Prepared by

Shenzhen NCT Testing Technology Co., Ltd.

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1 TEST RESULT CERTIFICATION

Applicant's name	:	LLW Enterprise LLC
Address	:	15486 N Nebraska Ave, Lutz, Florida, United States, 33549
Manufacture's name	:	AstroSound Audio Co., Ltd.
Address	:	3F, No.6 Building, No.501 Hongye Road Xiuzhou District, Jiaxing City Zhejiang Province China 314031
Product name	:	Amplifier
Model name	:	VAU-AMP
Additional model	:	AAU-AMP, ZAU-AMP-R# (where "Z" can be any alphanumeric character or blank for commercial purpose; "-R#" can be any alphanumeric character or blank for internal code.)
Standards	:	FCC CFR47 Part 15 Section 15.247
Test procedure	:	ANSI C63.10:2013
Test Date	:	Apr. 11 ~ Apr. 23, 2025
Date of Issue	:	Apr. 24, 2025
Test Result	:	Pass

This device described above has been tested by NCT, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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Test Engineer:

Hugh Zhang

Hugh Zhang / Engineer

Technical Manager:

Henry Wang

Henry Wang / Manager

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2 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions and Restricted Bandedge	15.205(a) 15.209 15.247(d)	PASS
Conducted Unwanted emissions and Band edge	15.247(d) 15.205(a)	PASS
Conduct Emission	15.207	PASS
20dB Bandwidth & 99% OCB	15.247(a)(1)	PASS
Maximum Peak Output Power	15.247(b)(1)	PASS
Frequency Separation	15.247(a)(1)	PASS
Number of Hopping Frequency	15.247(a)(1)(iii)	PASS
Dwell time	15.247(a)(1)(iii)	PASS
Antenna Requirement	15.203	PASS

Remark:

1. “N/A” denotes test is not applicable in this Test Report.

3 TEST FACILITY

Site Description

EMC Lab. : Accredited by CNAS, 2022-09-27

The certificate is valid until 2028.01.07

The Laboratory has been assessed and proved to be in compliance with CNAS-CL01:2006 (identical to ISO/IEC 17025:2017)

The Certificate Registration Number is L8251

Designation Number: CN1347

Test Firm Registration Number: 894804

Accredited by A2LA, June 14, 2023

The Certificate Registration Number is 6837.01

Accredited by Industry Canada, November 09, 2018

The Conformity Assessment Body Identifier is CN0150

Company Number: 30806

Name of Firm : Shenzhen NCT Testing Technology Co., Ltd.

Site Location : A101&2F B2, Fuqiao 6th Area, Xintian Community, Fuhai Street, Baoan District, Shenzhen, People's Republic of China

4 General Information

4.1 General Description of E.U.T.

Product Name	:	Amplifier
Model Name	:	VAU-AMP
Sample ID	:	250416096
Sample(s) Status:	:	Engineer sample
Additional model	:	AAU-AMP, ZAU-AMP-R# (where “Z” can be any alphanumeric character or blank for commercial purpose; “-R#” can be any alphanumeric character or blank for internal code.)
Model difference	:	Except for the different model names, everything else is the same.
Operating frequency	:	2402-2480MHz
Numbers of Channel	:	79 channels
Antenna Type	:	External antenna
Antenna Gain	:	2.5dBi max
Type of Modulation	:	GFSK, Π/4-DQPSK, 8DPSK
Power supply	:	AC 100-240V, 50/60Hz
Hardware Version	:	N/A
Software Version	:	N/A
Remark：the Antenna gain is provided by customer from Antenna spec. and the laboratory will not be responsible for the accumulated calculation results which covers the information provided by the applicant.		

4.2 Channel List

The EUT has been tested under its typical operating condition. Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting. Only the worst case data were reported.

The EUT has been associated with peripherals pursuant to ANSI C63.10-2013 and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation (9 KHz to the 10th harmonics of the highest fundamental frequency or to 40 GHz, whichever is lower).

The EUT has been tested under TX operating condition.

This EUT is a FHSS system, were conducted to determine the final configuration from all possible combinations. We use software control the EUT, Let EUT hopping on and transmit with highest power, all the modes GFSK, Π/4-DQPSK, 8DPSK have been tested. 79 Channels are provided by EUT. The 3 channels of lower, medium and higher were chosen for test.

Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	1	2403	2	2404	3	2405
4	2406	5	2407	6	2408	7	2409
8	2410	9	2411	10	2412	11	2413
12	2414	13	2415	14	2416	15	2417
16	2418	17	2419	18	2420	19	2421
20	2422	21	2423	22	2424	23	2425
24	2426	25	2427	26	2428	27	2429
28	2430	29	2431	30	2432	31	2433
32	2434	33	2435	34	2436	35	2437
36	2438	37	2439	38	2440	39	2441
40	2442	41	2443	42	2444	43	2445
44	2446	45	2447	46	2448	47	2449
48	2450	49	2451	50	2452	51	2453
52	2454	53	2455	54	2456	55	2457
56	2458	57	2459	58	2460	59	2461
60	2462	61	2463	62	2464	63	2465
64	2466	65	2467	66	2468	67	2469
68	2470	69	2471	70	2472	71	2473
72	2474	73	2475	74	2476	75	2477
76	2478	77	2479	78	2480	-	-

Channel	Frequency(MHz)
0	2402
39	2441
78	2480

4.3 Test Setup Configuration

Conducted Emission

AC Line ——— EUT

Radiated Emission

AC Line ——— EUT

Conducted Spurious

AC Line ——— EUT

4.4 Test Mode

Transmitting mode	Keep the EUT in continuously transmitting mode.
Remark: During the test, the test voltage was tuned from 85% to 115% of the nominal rated supply voltage, and found that the worst case was under the nominal rated supply condition. So the report just shows that condition's data.	

Test Software	bt_tool_v1.1.2
Power level setup	≤10dBm

5 Equipment During Test

5.1 Equipments List

Conducted emission Test Equipment

Name	Model No.	Serial No.	Manufacturer	Date of Cal.	Due Date
944 Shielded Room	944 Room	/	EMToni	2022/5/31	2025/5/30
EMI Test Receiver	ESPI	101604	Rohde & Schwarz	2024/6/17	2025/6/16
LISN	ENV 216	102796	Rohde & Schwarz	2024/6/17	2025/6/16
LISN	VN1-13S	004023	CRANAGE	2024/6/17	2025/6/16
Cable	RG223-1500MM	NA	RG	2024/6/17	2025/6/16

Radiated emission & Radio Frequency Test Equipment

Name	Model No.	Serial No.	Manufacturer	Date of Cal.	Due Date
966 Shielded Room	966 Room	/	EMToni	2022/5/31	2025/5/30
EMI Test Receiver	ESCI	101178	Rohde & Schwarz	2024/6/17	2025/6/16
Spectrum Analyze （10Hz-26.5GHz）	N9020A	MY50510202	Agilent	2024/6/17	2025/6/16
Amplifi （30MHz-1GHz）	BBV 9743 B	00374	SCHNWARZBECK	2024/6/17	2025/6/16
Bilog Antenna （30MHz-1GHz）	VULB9162	00473	SCHNWARZBECK	2025/3/18	2027/3/17
Horn antenna （1GHz-18GHz）	BBHA 9120 D	02622	SCHNWARZBECK	2025/3/18	2027/3/17
Pream plifier （1GHz-18GHz）	BBV 9718D	00042	SCHNWARZBECK	2024/6/17	2025/6/16
Spectrum Analyze （1GHz-40GHz）	FSV 40	100952	Rohde & Schwarz	2024/6/17	2025/6/16
Pream plifier （15GHz-40GHz）	BBV 9718D	0024	SCHNWARZBECK	2024/6/17	2025/6/16
Broadband Antenna （15GHz-40GHz）	SAS-574	588	A.H.System	2025/3/18	2027/3/17
Loop Antenna (9KHz-30MHz)	FMZB1519B	014	SCHNWARZBECK	2024/6/20	2025/6/19

Amplifier (9KHz-30MHz)	CVP 9222 C	00109	CHNWARZBECK	2024/6/18	2025/6/17
MXG Signal Analyzer	N9020A	MY50510202	Agilent	2024/6/17	2025/6/16
MXG Vector Signal Generator	N5182A	MY50140020	Agilent	2024/6/17	2025/6/16
MXG Analog Signal Generator	N5181A	MY47420919	Agilent	2024/6/17	2025/6/16
Power Sensor	TR1029-2	512364	Techoy	2024/6/17	2025/6/16
RF Swith	TR1029-1	512364	Techoy	2024/6/17	2025/6/16
Cable	DA800-4000MM	NA	DA	2024/6/17	2025/6/16
Cable	DA800-11000MM	NA	DA	2024/6/17	2025/6/16

Other

Item	Name	Manufacturer	Model	Software version
1	EMC Conduction Test System	AUDIX	e3	6.120718
2	EMC radiation test system	AUDIX	e3	6.120718
3	RF test system	TACHOY	RFTest	V1.0.0
4	RF communication test system	TACHOY	RFTest	V1.0.0

5.2 Measurement Uncertainty

Parameter	Uncertainty
RF output power, conducted	±1.0dB
Power Spectral Density, conducted	±2.2dB
Radio Frequency	± 1 x 10^{-6}
Bandwidth	± 1.5 x 10^{-6}
Time	±2%
Duty Cycle	±2%
Temperature	±1°C
Humidity	±5%
DC and low frequency voltages	±3%
Conducted Emissions (150kHz~30MHz)	±3.64dB
Radiated Emission(30MHz~1GHz)	±5.03dB
Radiated Emission(1GHz~25GHz)	±4.74dB

5.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
E-1	Amplifier	VOLT AMP	VAU-AMP	N/A	EUT
E-2	Notebook	Lenovo	LN-A0403A3C	36001672	AE

Note:

(1) The support equipment was authorized by Declaration of Confirmation.

(2) For detachable type I/O cable should be specified the length in cm in『Length』column.

6 Conducted Emission

Test Requirement:	:	FCC CFR 47 Part 15 Section 15.207
Test Method:	:	ANSI C63.10:2013
Test Result:	:	PASS
Frequency Range:	:	150kHz to 30MHz
Class/Severity:	:	Class B
Detector:	:	Peak for pre-scan (9kHz Resolution Bandwidth)

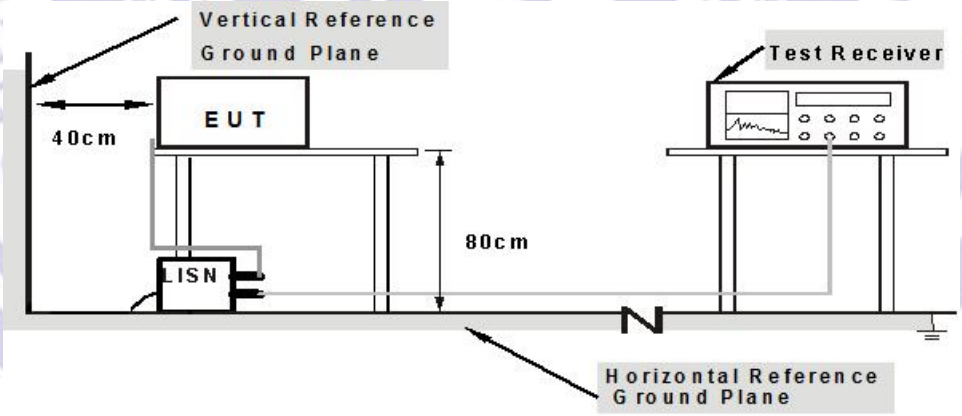
6.1 E.U.T. Operation

Operating Environment **:**

Temperature:	:	23.5°C
Humidity:	:	54 % RH
Atmospheric Pressure:	:	101.50 kPa
Test Voltage	:	AC 120V/60Hz

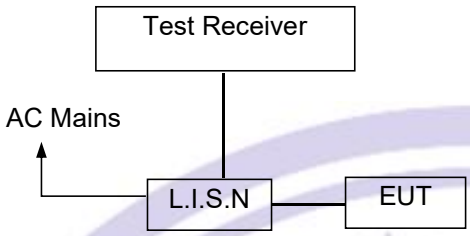
6.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10: 2013



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80
from other units and other metal planes

6.3 Test SET-UP (Block Diagram of Configuration)



6.4 Measurement Procedure:

1. The EUT was placed on a table, which is 0.1m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured was complete.

6.5 Conducted Emission Limit

Conducted Emission

Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note:

1. The lower limit shall apply at the transition frequencies
2.The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

6.6 Measurement Description

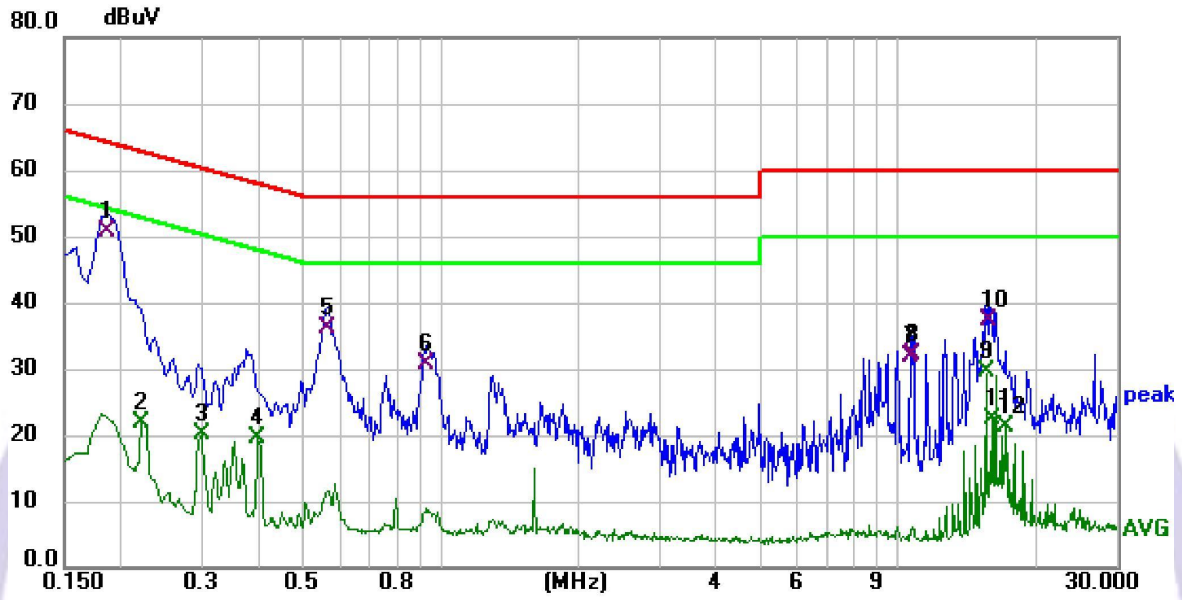
The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

6.7 Conducted Emission Test Result

Pass

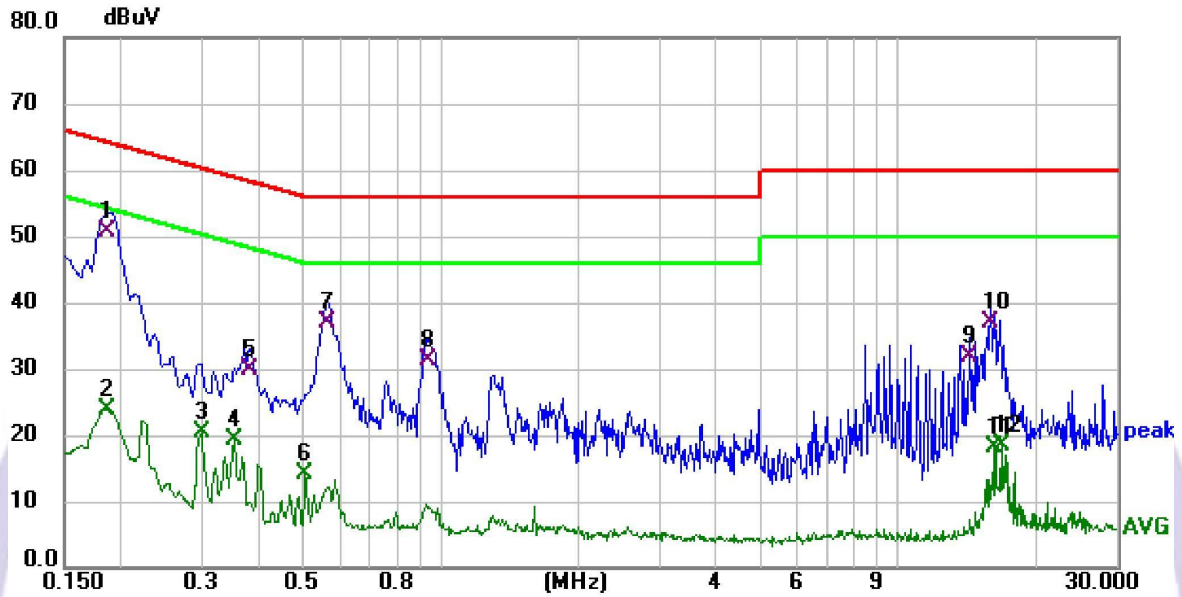
Conducted emission at both 120V & 240V is assessed, and emission at 120V represents the worst case. All the modulation modes were tested the data of the worst mode (GFSK) are recorded in the following pages and the others modulation methods do not exceed the limits.

Channel:	Middle	Phase :	L



No.		Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	*	0.186	40.55	10.05	50.60	64.21	-13.61	QP	P
2		0.222	12.02	9.95	21.97	52.74	-30.77	AVG	P
3		0.298	10.24	9.95	20.19	50.30	-30.11	AVG	P
4		0.398	9.68	9.95	19.63	47.90	-28.27	AVG	P
5		0.564	26.04	10.12	36.16	56.00	-19.84	QP	P
6		0.933	20.38	10.29	30.67	56.00	-25.33	QP	P
7		10.650	20.92	10.94	31.86	60.00	-28.14	QP	P
8		10.775	21.19	10.94	32.13	60.00	-27.87	QP	P
9		15.575	18.51	10.92	29.43	50.00	-20.57	AVG	P
10		15.825	26.24	10.92	37.16	60.00	-22.84	QP	P
11		15.975	11.57	10.93	22.50	50.00	-27.50	AVG	P
12		17.175	10.35	10.99	21.34	50.00	-28.66	AVG	P

Channel:	Middle	Phase :	N



No.		Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	*	0.186	40.53	10.05	50.58	64.21	-13.63	QP	P
2		0.186	13.83	10.05	23.88	54.21	-30.33	AVG	P
3		0.298	10.39	9.98	20.37	50.30	-29.93	AVG	P
4		0.352	9.25	10.02	19.27	48.92	-29.65	AVG	P
5		0.380	19.91	10.05	29.96	58.28	-28.32	QP	P
6		0.505	4.14	10.14	14.28	46.00	-31.72	AVG	P
7		0.564	26.93	10.17	37.10	56.00	-18.90	QP	P
8		0.938	21.07	10.32	31.39	56.00	-24.61	QP	P
9		14.375	20.84	10.93	31.77	60.00	-28.23	QP	P
10		15.950	26.05	10.95	37.00	60.00	-23.00	QP	P
11		16.300	7.18	10.96	18.14	50.00	-31.86	AVG	P
12		16.775	7.38	10.96	18.34	50.00	-31.66	AVG	P

Notes:
1.An initial pre-scan was performed on the line and neutral lines with peak detector.
2.Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3.Mesurement Level = Reading level + Correct Factor

7 Radiated Spurious Emissions

Test Requirement : FCC CFR47 Part 15 Section 15.209 & 15.247

Test Method : ANSI C63.10:2013

Test Result : PASS

Measurement Distance : 3m

Limit : See the follow table

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))} + 80$
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))} + 40$
1.705 ~ 30	30	30	100 * 30	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

7.1 EUT Operation

Operating Environment :

Temperature : 26.0 °C

Humidity : 54.0% RH

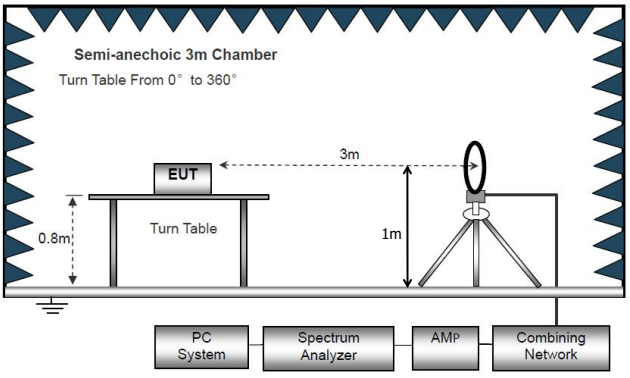
Atmospheric Pressure : 101.50kPa

Test Voltage : AC 120V60Hz

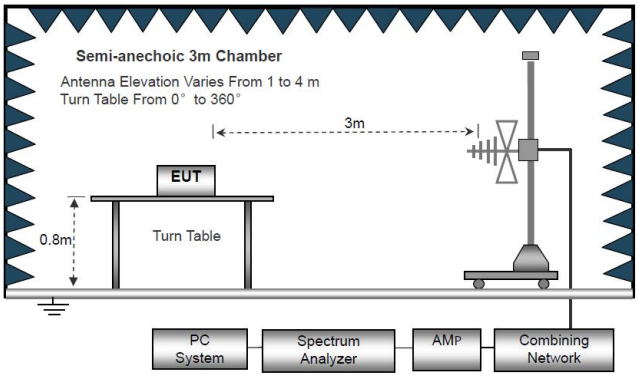
7.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site

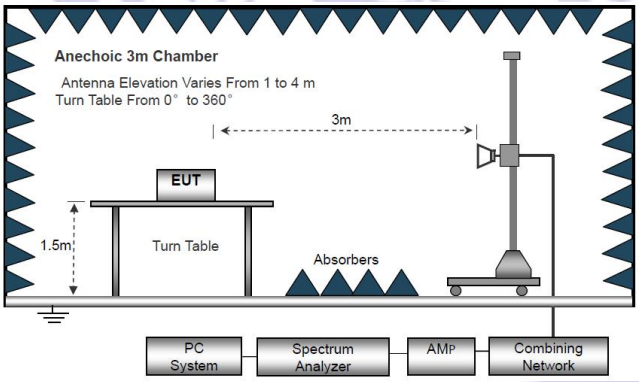
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz.



7.3 Spectrum Analyzer Setup

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / *10Hz* for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

7.4 Test Procedure

1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10-2013.

2. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane.

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

4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (From 1m to 4m) and turntable (from 0 degree to 360 degree) 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.

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

6. Final measurement (Above 1GHz): The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1MHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 degree to 360 degree in order to have the antenna inside the cone of radiation.

7. Test Procedure of measurement (For Above 1GHz):

1) Monitor the frequency range at horizontal polarization and move the antenna over all sides of the EUT(if necessary move the EUT to another orthogonal axis).

2) Change the antenna polarization and repeat 1) with vertical polarization.

3) Make a hardcopy of the spectrum.

4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.

5) Change the analyser mode to Clear/ Write and found the cone of emission.

6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3m and the antenna will be still inside the cone of emission.

7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarization and azimuth and the peak and average detector, which causes the maximum emission.

8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.

8. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.

7.5 Summary of Test Results

Test Frequency: 9KHz-30MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level (dBuV/m)	Limit 3m (dBuV/m)	Over (dB)
--	--	--	--	>20

Note:

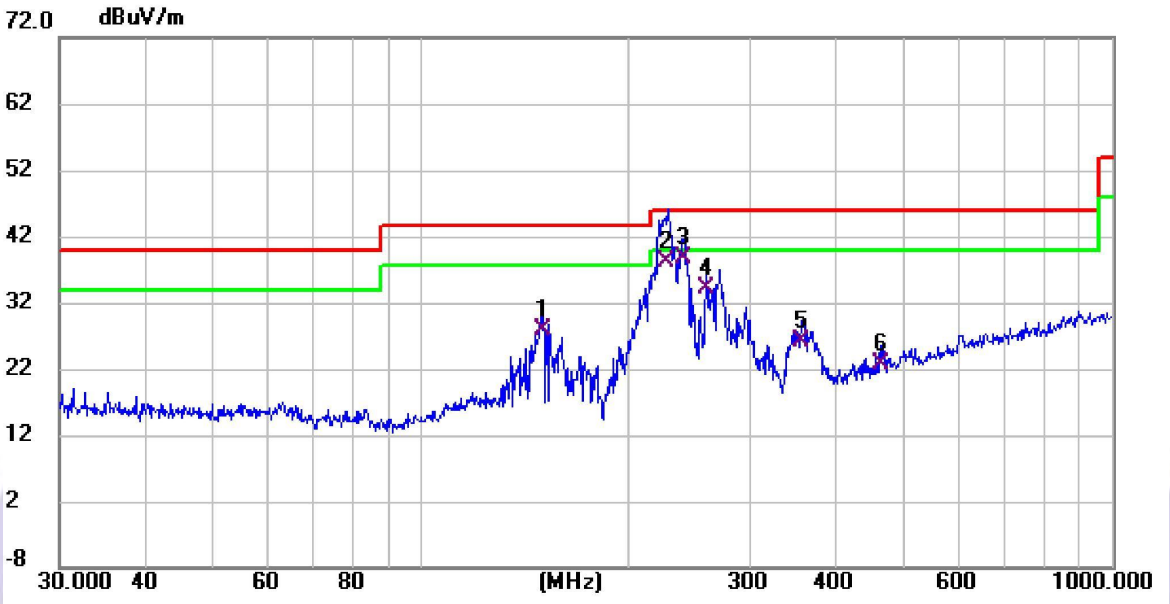
The amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

Distance extrapolation factor =40log(Specific distance/ test distance)(dB);
Limit line=Specific limits(dBuV) + distance extrapolation factor.

Test Frequency: 30MHz ~ 1GHz

Please refer to the following test plots,Low Channel (2402MHz) Worst case GFSK for record:

Test plot for Horizontal



No.		Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F
1		150.011	14.57	13.33	27.90	43.50	-15.60	QP	200	294	P
2		227.235	26.71	11.44	38.15	46.00	-7.85	QP	200	87	P
3	*	239.987	26.49	12.17	38.66	46.00	-7.34	QP	200	148	P
4		259.234	21.55	12.50	34.05	46.00	-11.95	QP	200	80	P
5		354.183	11.15	15.01	26.16	46.00	-19.84	QP	200	271	P
6		462.346	5.28	17.38	22.66	46.00	-23.34	QP	200	25	P

Remark:

Emission Level=Reading+Factor

Factor=Cable Loss+ANT Factor-Preamp Factor

Test plot for Vertical

No.		Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F
1		36.127	10.41	12.83	23.24	40.00	-16.76	QP	100	221	P
2		81.497	1.51	16.28	17.79	40.00	-22.21	QP	100	355	P
3		160.909	23.43	13.47	36.90	43.50	-6.60	QP	100	129	P
4	*	225.369	30.49	11.34	41.83	46.00	-4.17	QP	100	121	P
5	!	237.477	29.22	12.03	41.25	46.00	-4.75	QP	100	135	P
6		259.234	23.74	12.50	36.24	46.00	-9.76	QP	100	58	P
7		350.477	16.76	14.92	31.68	46.00	-14.32	QP	100	159	P

Remark:

Emission Level=Reading+Factor

Factor=Cable Loss+ANT Factor-Preamp Factor

Test Frequency 1GHz-25GHz

Bluetooth (GFSK, Pi/4-DQPSK, 8DPSK)mode have been tested, and the worst result(GFSK) was report as below

GFSK

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre-amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
Low Channel:2402MHz									
V	4804	48.36	34.12	5.03	32.39	51.66	74	-22.34	Pk
V	4804	40.18	34.12	5.03	32.39	43.48	54	-10.52	AV
V	7206	42.41	32.54	6.29	35.86	52.02	74	-21.98	Pk
V	7206	31.94	32.54	6.29	35.86	41.55	54	-12.45	AV
V	9608	40.08	32.98	7.55	38.4	53.05	74	-20.95	Pk
V	9608	30.00	32.98	7.55	38.4	42.97	54	-11.03	AV
V	12010	37.38	32.09	8.93	39	53.22	74	-20.78	Pk
V	12010	28.29	32.09	8.93	39	44.13	54	-9.87	AV
H	4804	51.33	34.12	5.03	32.39	54.63	74	-19.37	Pk
H	4804	41.80	34.12	5.03	32.39	45.10	54	-8.90	AV
H	7206	43.57	32.54	6.29	35.86	53.18	74	-20.82	Pk
H	7206	33.07	32.54	6.29	35.86	42.68	54	-11.32	AV
H	9608	39.64	32.98	7.55	38.4	52.61	74	-21.39	Pk
H	9608	30.52	32.98	7.55	38.4	43.49	54	-10.51	AV
H	12010	40.01	32.09	8.93	39	55.85	74	-18.15	Pk
H	12010	30.69	32.09	8.93	39	46.53	54	-7.47	AV

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre-amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
Middle Channel:2441MHz									
V	4882	51.06	34.07	5.09	32.59	54.67	74	-19.33	Pk
V	4882	40.64	34.07	5.09	32.59	44.25	54	-9.75	AV
V	7323	43.06	32.63	6.34	35.96	52.73	74	-21.27	Pk
V	7323	32.52	32.63	6.34	35.96	42.19	54	-11.81	AV
V	9764	41.60	32.92	7.59	38.4	54.67	74	-19.33	Pk
V	9764	32.01	32.92	7.59	38.4	45.08	54	-8.92	AV
V	12205	39.56	31.96	8.88	39.04	55.52	74	-18.48	Pk
V	12205	29.42	31.96	8.88	39.04	45.38	54	-8.62	AV
H	4882	51.38	34.07	5.09	32.59	54.99	74	-19.01	Pk
H	4882	41.18	34.07	5.09	32.59	44.79	54	-9.21	AV
H	7323	42.40	32.63	6.34	35.96	52.07	74	-21.93	Pk
H	7323	34.03	32.63	6.34	35.96	43.70	54	-10.30	AV
H	9764	41.58	32.92	7.59	38.4	54.65	74	-19.35	Pk
H	9764	31.80	32.92	7.59	38.4	44.87	54	-9.13	AV
H	12205	39.42	31.96	8.88	39.04	55.38	74	-18.62	Pk
H	12205	29.13	31.96	8.88	39.04	45.09	54	-8.91	AV

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre-amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
High Channel:2480MHz									
V	4960	50.89	34.02	5.15	32.8	54.82	74	-19.18	Pk
V	4960	41.14	34.02	5.15	32.8	45.07	54	-8.93	AV
V	7440	42.58	32.71	6.4	36.05	52.32	74	-21.68	Pk
V	7440	31.78	32.71	6.4	36.05	41.52	54	-12.48	AV
V	9920	42.71	32.86	7.62	38.4	55.87	74	-18.13	Pk
V	9920	30.83	32.86	7.62	38.4	43.99	54	-10.01	AV
V	12400	40.02	31.82	8.84	39.08	56.12	74	-17.88	Pk
V	12400	29.32	31.82	8.84	39.08	45.42	54	-8.58	AV
H	4960	50.16	34.02	5.15	32.8	54.09	74	-19.91	Pk
H	4960	40.75	34.02	5.15	32.8	44.68	54	-9.32	AV
H	7440	43.90	32.71	6.4	36.05	53.64	74	-20.36	Pk
H	7440	34.75	32.71	6.4	36.05	44.49	54	-9.51	AV
H	9920	40.52	32.86	7.62	38.4	53.68	74	-20.32	Pk
H	9920	31.28	32.86	7.62	38.4	44.44	54	-9.56	AV
H	12400	39.08	31.82	8.84	39.08	55.18	74	-18.82	Pk
H	12400	29.66	31.82	8.84	39.08	45.76	54	-8.24	AV

Note: 1. The testing has been conformed to 10*2480MHz=24800MHz.

2. All other emissions more than 30dB below the limit.

3. Factor = Antenna Factor + Cable Loss – Pre-amplifier.
Emission Level = Reading + Factor
Margin=Emission Level-Limit

Spurious Emission in Restricted Band 2310-2390MHz and 2483.5-2500MHz

Bluetooth (GFSK, Pi/4-DQPSK, 8DPSK)mode have been tested, and the worst result(GFSK) was report as below

	Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre-amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB/m)	Emission level (dBuV/m)	Limit (dBuV/m)	Detector Type	Result
GFSK	Low Channel: 2402MHz									
	H	2390	56.63	35.17	3.48	27.49	52.43	74	PK	PASS
	H	2390	46.12	35.17	3.48	27.49	41.92	54	AV	PASS
	H	2400	57.26	35.16	3.49	27.52	53.11	74	PK	PASS
	H	2400	46.44	35.16	3.49	27.52	42.29	54	AV	PASS
	V	2390	56.04	35.17	3.48	27.49	51.84	74	PK	PASS
	V	2390	47.73	35.17	3.48	27.49	43.53	54	AV	PASS
	V	2400	57.38	35.16	3.49	27.52	53.23	74	PK	PASS
	V	2400	47.06	35.16	3.49	27.52	42.91	54	AV	PASS
	High Channel: 2480MHz									
	H	2483.5	55.60	35.11	3.56	27.75	51.80	74	PK	PASS
	H	2483.5	46.36	35.11	3.56	27.75	42.56	54	AV	PASS
	H	2485.5	56.69	35.1	3.57	27.8	52.96	74	PK	PASS
	H	2485.5	46.58	35.1	3.57	27.8	42.85	54	AV	PASS
	V	2483.5	55.30	35.11	3.56	27.75	51.50	74	PK	PASS
	V	2483.5	55.59	35.11	3.56	27.75	51.79	54	AV	PASS
	V	2485.5	56.99	35.1	3.57	27.8	53.26	74	PK	PASS
	V	2485.5	46.53	35.1	3.57	27.8	42.80	54	AV	PASS

Remark:

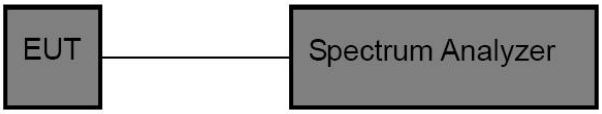
1. Emission Level = Meter Reading + Antenna Factor + Cable Loss – Pre-amplifier, Margin= Emission Level - Limit

8 Maximum Peak Output Power Test

8.1 Test Standard and Limit

Test Standard	FCC Part15 C Section 15.247 (b)(1)
Test Limit	For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts. For FHSS operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W.

8.2 Test Setup



8.3 Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above,

2. Spectrum Setting:

   RBW > the 20 dB bandwidth of the emission being measured

   Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

   VBW ≥ RBW

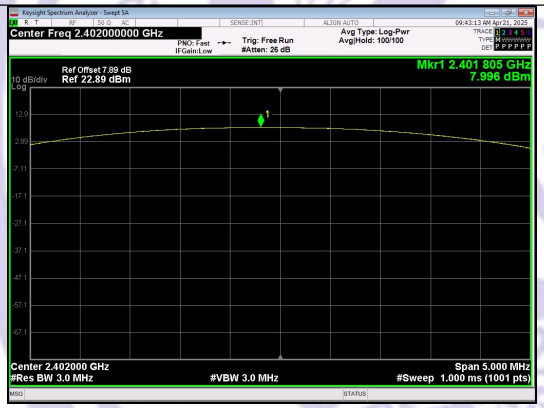
   Sweep = auto

   Detector function = peak

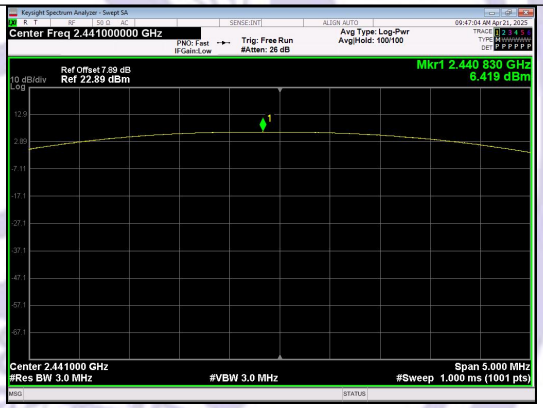
   Trace = max hold

8.4 Test Data

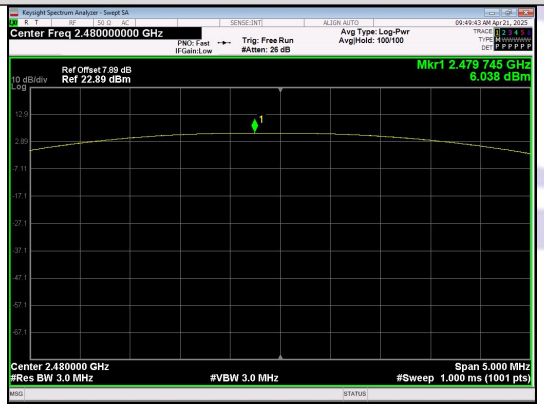
Modulation	Packet Type	Channel	Peak Output Power (dBm)	Peak Output Power (mW)	Max. Avg. Power (dBm)	Limit (dBm)	Result
GFSK	DH5	0	8.00	6.30	None	30	PASS
		39	6.42	4.38	None		PASS
		78	6.04	4.02	None		PASS
π/4DQPSK	2-DH5	0	8.83	7.63	None	20.97	PASS
		39	7.64	5.81	None		PASS
		78	7.49	5.61	None		PASS
8DPSK	3-DH5	0	8.91	7.79	None		PASS
		39	7.89	6.15	None		PASS
		78	7.79	6.01	None		PASS

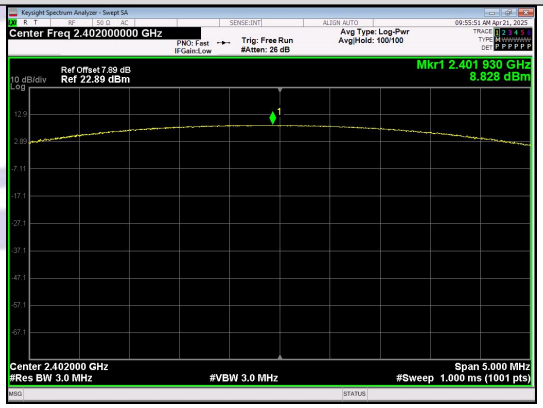


Peak Output Power
GFSK_Channel 0

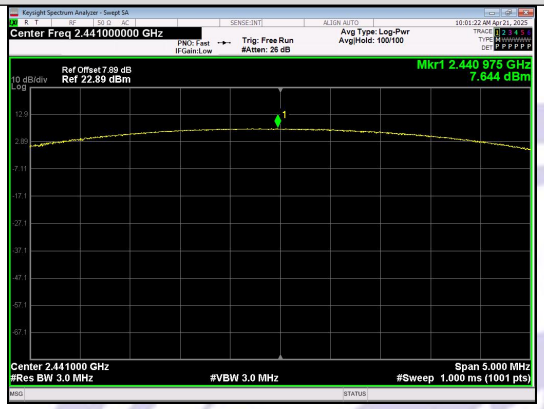


Peak Output Power
GFSK_Channel 39

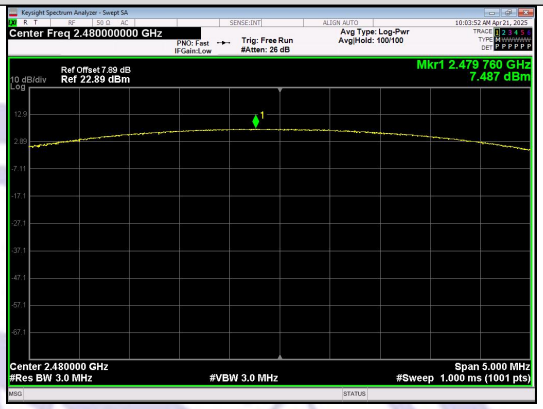




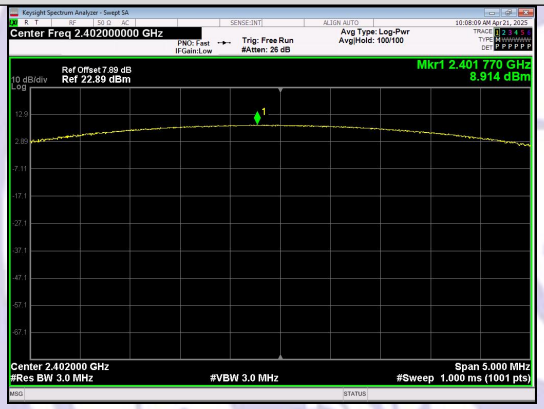
Peak Output Power
GFSK_Channel 78



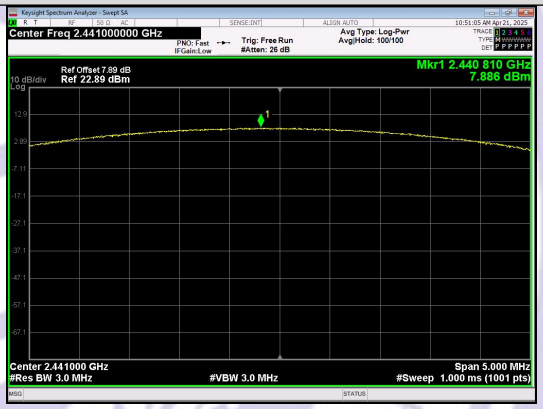
Peak Output Power
π/4DQPSK_Channel 0



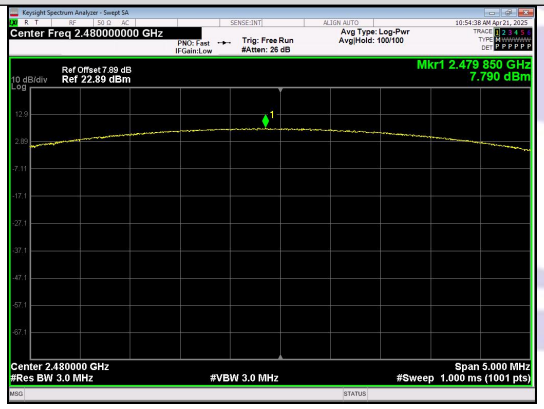
Peak Output Power
π/4DQPSK_Channel 39



Peak Output Power
π/4DQPSK_Channel 78



Peak Output Power
8DPSK_Channel 0



Peak Output Power
8DPSK_Channel 39

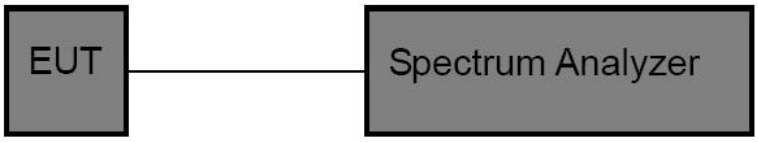
Peak Output Power
8DPSK_Channel 78

9 20DB Occupy Bandwidth & 99% OCB Test

9.1 Test Standard

Test Standard	FCC Part15 C Section 15.247 (a)(1)

9.2 Test Setup



9.3 Test Procedure

Using the following spectrum analyzer settings:

20dB Occupy Bandwidth:

1. Span= approximately 2 to 3 times the 20dB bandwidth, centered on a hopping channel.
2. Set the RBW = 30 kHz.
3. Set the VBW = 91 kHz.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

99% OCB:

1. Span= approximately 2 to 3 times the 20dB bandwidth, centered on a hopping channel.
2. Set the RBW = 20 kHz.
3. Set the VBW = 62 kHz.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

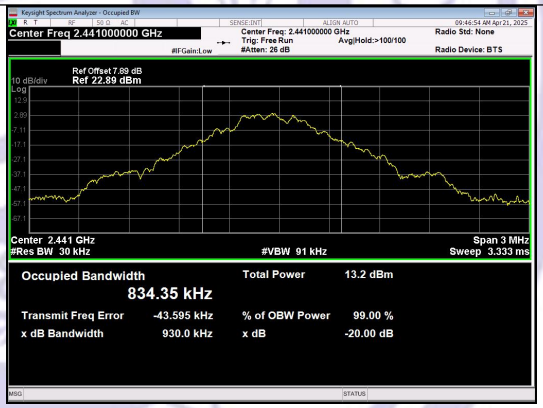
9.4 Test Data

Mode	Test channel	20dB Emission Bandwidth (MHz)	99% Bandwidth (MHz)	Result
GFSK	Lowest	0.9287	0.83949	Pass
	Middle	0.9300	0.84139	
	Highest	0.9309	0.82336	
π/4-DQPSK	Lowest	1.302	1.1830	Pass
	Middle	1.292	1.1631	
	Highest	1.300	1.1626	
8-DPSK	Lowest	1.244	1.1732	Pass
	Middle	1.239	1.1623	
	Highest	1.237	1.1550	

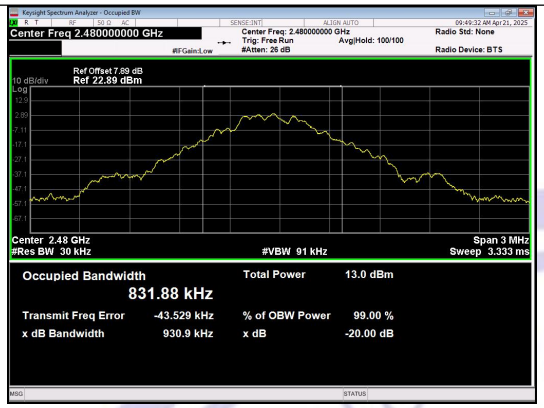
Test plots

20dB Occupy Bandwidth:

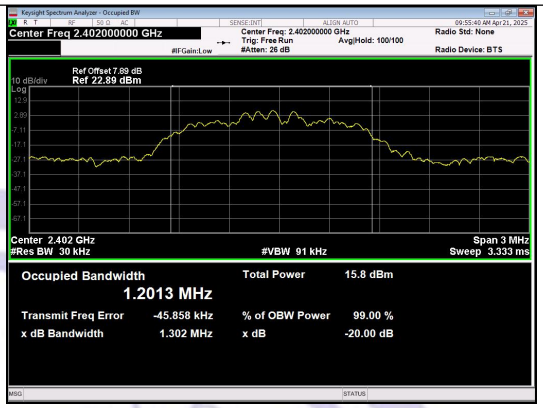
GFSK_DH1_Channel 0



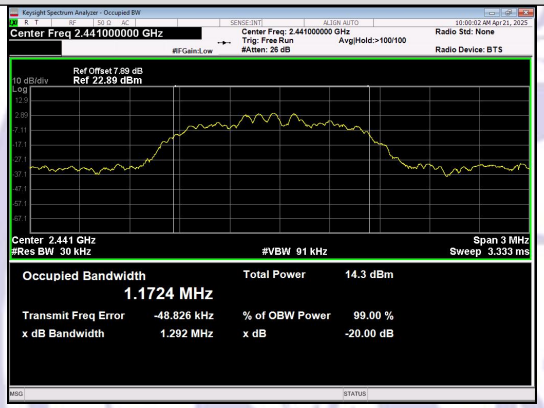
GFSK_DH1_Channel 39



GFSK_DH1_Channel 78



π/4DQPSK_2-DH1_Channel 0



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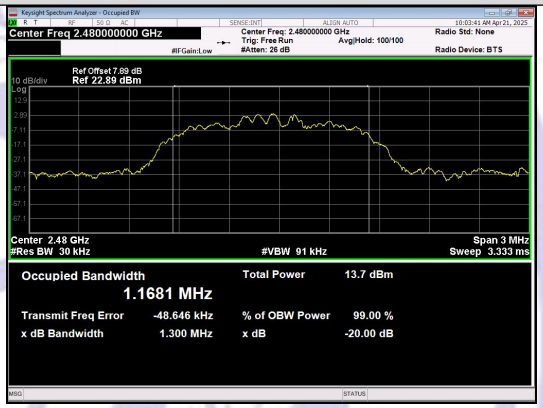

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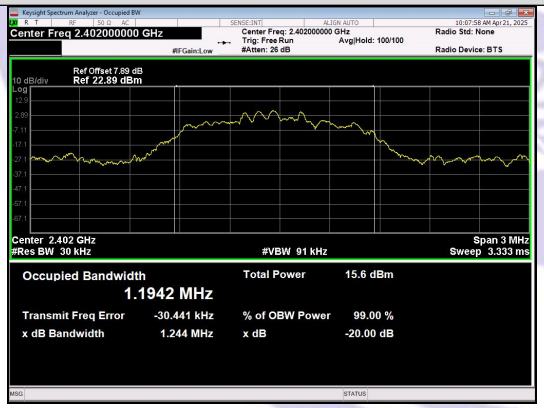
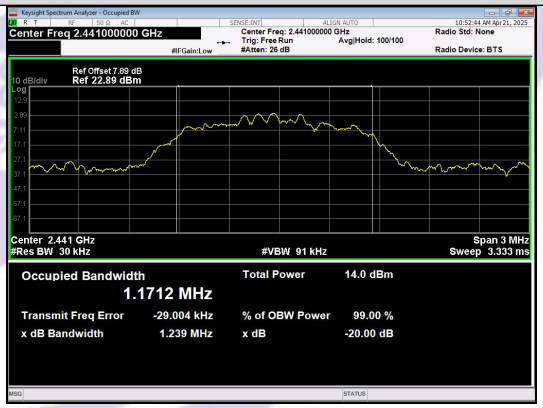
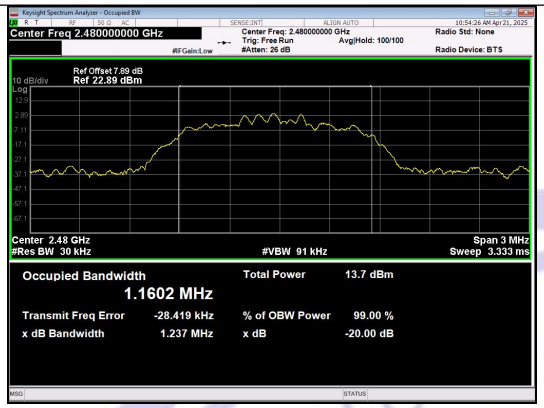


8DPSK_3-DH1_Channel 0



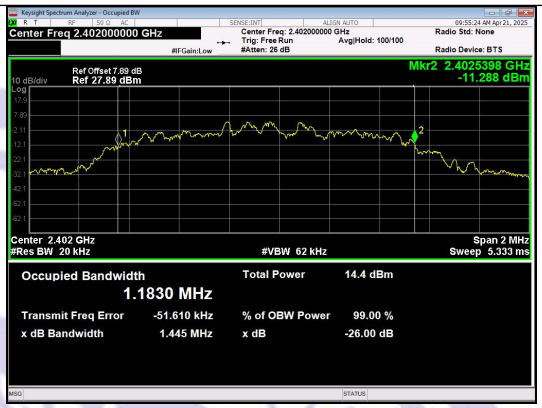
8DPSK_3-DH1_Channel 39



8DPSK_3-DH1_Channel 78

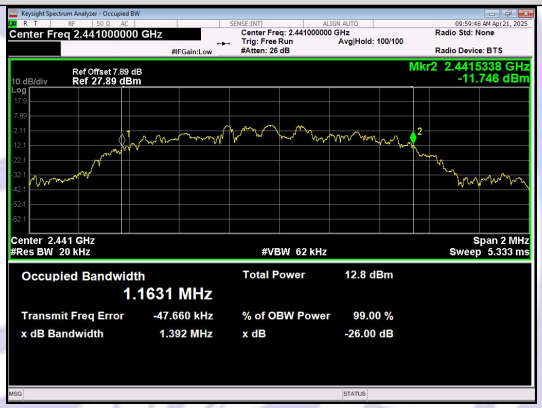
99% OCB:

GFSK_DH1_Channel 0



π/4DQPSK_2-DH1_Channel 0

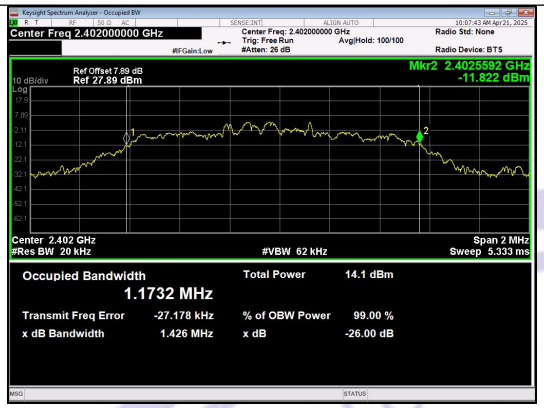
GFSK_DH1_Channel 39



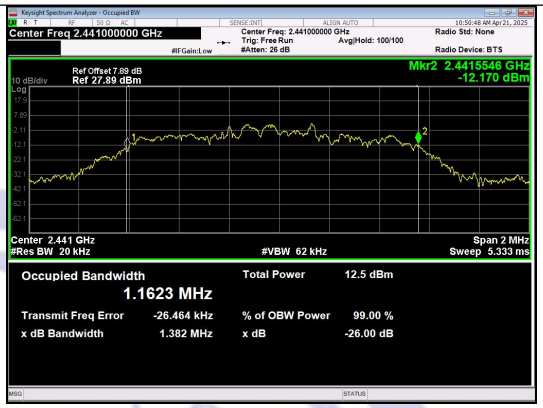
π/4DQPSK_2-DH1_Channel 39

GFSK_DH1_Channel 78

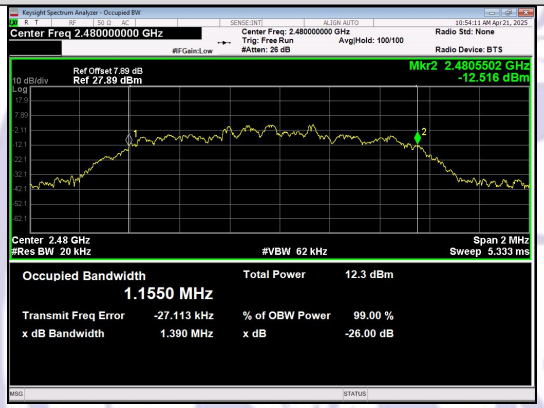
π/4DQPSK_2-DH1_Channel 78



8DPSK_3-DH1_Channel 0



8DPSK_3-DH1_Channel 39



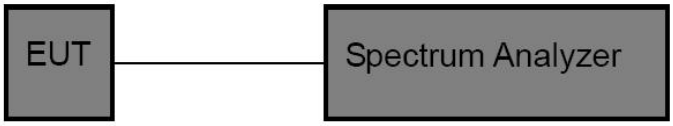
8DPSK_3-DH1_Channel 78

10 Carrier Frequency Separation Test

10.1 Test Standard and Limit

Test Standard	FCC Part15 C Section 15.247 (a)(1)
Test Limit	GFSK: 20dB bandwidth π/4-DQPSK & 8DPSK: 0.025MHz or 2/3 of the 20dB bandwidth (whichever is greater)

10.2 Test Setup



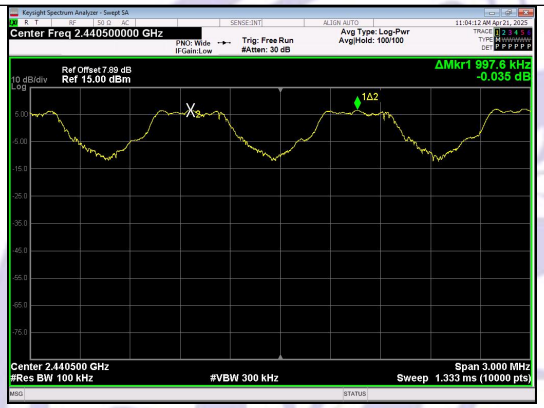
10.3 Test Procedure

The EUT must have its hopping function enabled. Using the following spectrum analyzer settings:

1. Span= Wide enough to capture the peaks of two adjacent channels
2. Set the RBW = 100 kHz.
3. Set the VBW = 300 kHz.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

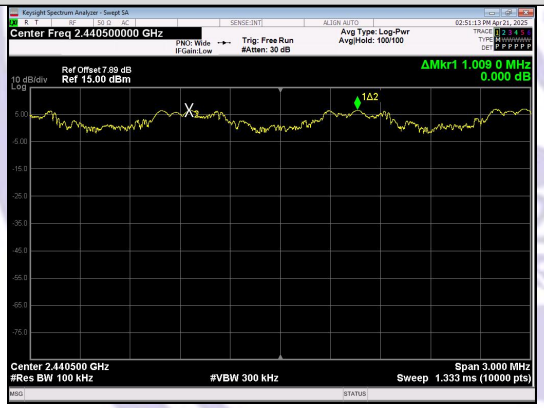
10.4 Test Data

Modulation	Separation (MHz)	Limit(MHz)	Result
GFSK	0.9976	0.621	PASS
π/4-DQPSK	1.0063	0.868	PASS
8-DPSK	1.0090	0.829	PASS



GFSK

π/4DQPSK



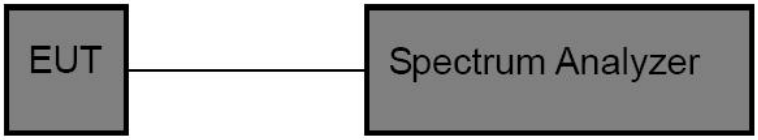
8DPSK

Number of Hopping Channel Test

10.5 Test Standard and Limit

Test Standard	FCC Part15 C Section 15.247 (a)(1)
Test Limit	≥15 channels

10.6 Test Setup



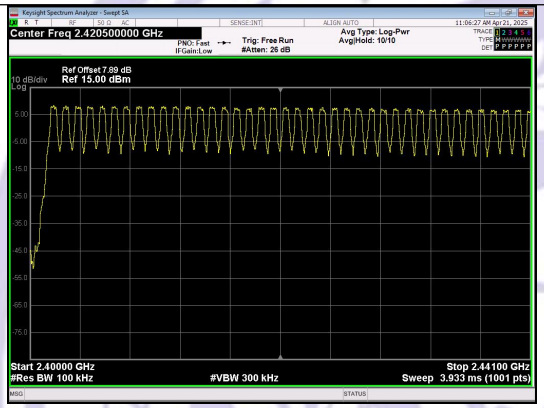
10.7 Test Procedure

The EUT must have its hopping function enabled. Using the following spectrum analyzer setting:

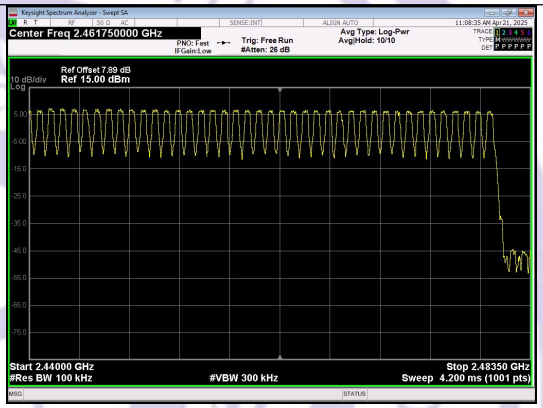
1. Span= the frequency band of operation
2. Set the RBW = 100kHz.
3. Set the VBW = 300kHz.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

10.8 Test Data

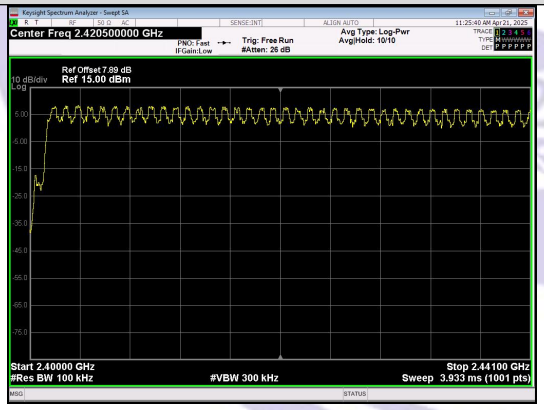
Mode	Frequency (MHz)	Packet Type	Num of Hopping Frequencies		Verdict
			ANT1	Limit	
GFSK	HOPP	DH1	79	>=15	Pass
Pi/4DQPSK	HOPP	2DH1	79	>=15	Pass
8DPSK	HOPP	3DH1	79	>=15	Pass



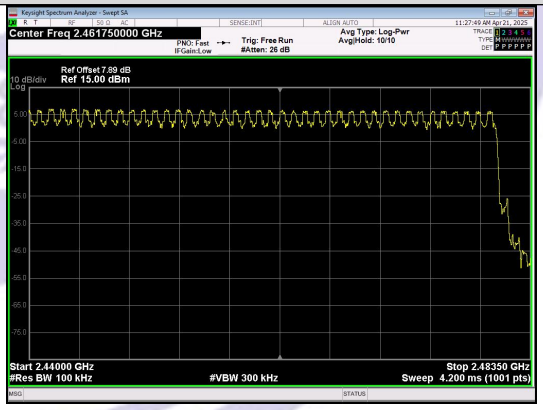
Low End Spectrum Channel Hopping Plot GFSK



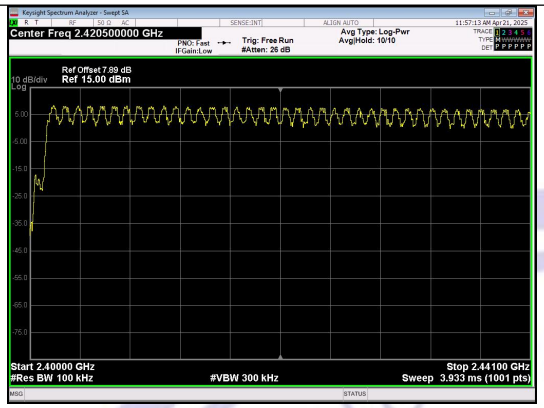
High End Spectrum Channel Hopping Plot GFSK



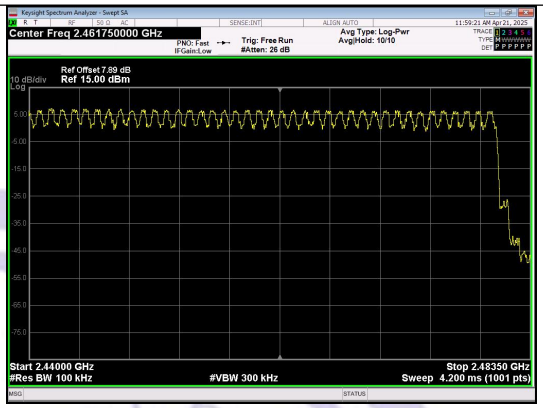
Low End Spectrum Channel Hopping Plot π/4DQPSK



High End Spectrum Channel Hopping Plot π/4DQPSK



Low End Spectrum Channel Hopping Plot
8DPSK



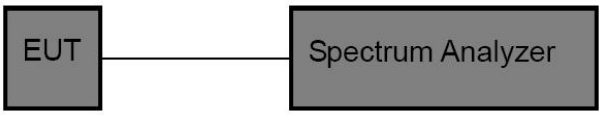
High End Spectrum Channel Hopping Plot
8DPSK

12 Dwell Time Test

12.1 Test Standard and Limit

Test Standard	FCC Part15 C Section 15.247 (a)(1)
Test Limit	0.4 sec

12.2 Test Setup



12.3 Test Procedure

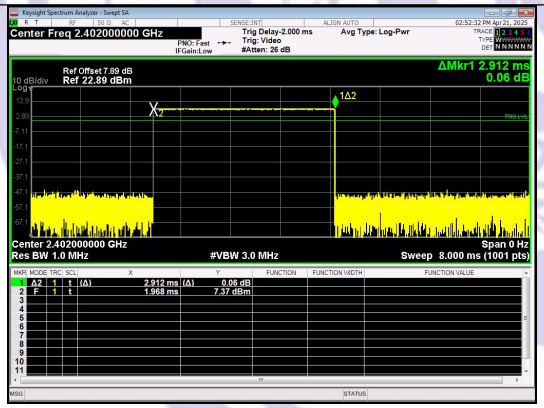
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span= zero span, centered on a hopping channel
2. Set the RBW = 1 MHz.
3. Set the VBW = 3 MHz.
4. Sweep time = as necessary to capture the entire dwell time per hopping channel.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

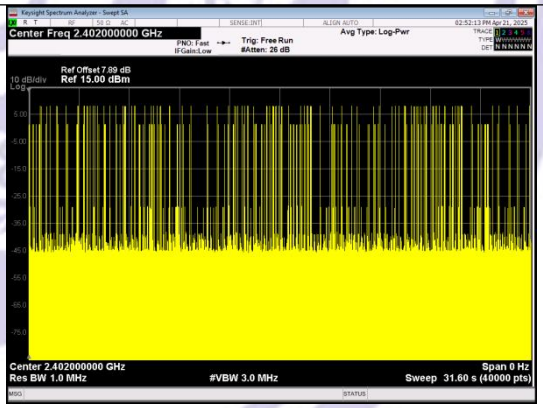
12.4 Test Data

Modulation	Packet	Channel	Pulse Width (ms)	Number of Pulses in 31.6 seconds	Dwell Time (ms)	Limit (ms)	Result
GFSK	DH5	CH0 (2402MHz)	2.912	98	285.38	< 400	PASS
	DH5	CH39 (2441MHz)	2.896	109	315.66		PASS
	DH5	CH78 (2480MHz)	2.896	95	275.12		PASS
π/4DQPSK	2-DH5	CH0 (2402MHz)	2.896	106	306.98		PASS
	2-DH5	CH39 (2441MHz)	2.896	104	301.18		PASS
	2-DH5	CH78 (2480MHz)	2.904	118	342.67		PASS
8DPSK	3-DH5	CH0 (2402MHz)	2.904	103	299.11		PASS
	3-DH5	CH39 (2441MHz)	2.912	106	308.67		PASS
	3-DH5	CH78 (2480MHz)	2.912	108	314.5		PASS

Test Plots



Pulse Width
GFSK_DH5



Number of Pulses in 31.6 seconds
GFSK_DH5