FCC TEST REPORT

FCC ID: 2BGP2-J80

Product	:	**Wireless Microphone**
Model Name	:	**J80, J81, J82, J85, J86, J88, J60, J61, J62, J65, J66, J68, J13, H61, H62, H63, H65, H66, H68, K1, K2, K3, K15, K6, K63, K10, K61**
Brand	:	**/**
Report No.	:	**NCT24021447E**

Prepared for

Lieno (Shenzhen) Technology Co., LTD

Room 401, Unit 1, No. 92-1, Xiangyin Road, Nanlian Community, Longgang Street, Longgang District, Shenzhen

Prepared by

Shenzhen NCT Testing Technology Co., Ltd.

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

TEL: 400-8868-419

FAX: 86-755-27790922

1 TEST RESULT CERTIFICATION

Applicant's name	:	Lieno (Shenzhen) Technology Co., LTD
Address	:	Room 401, Unit 1, No. 92-1, Xiangyin Road, Nanlian Community, Longgang Street, Longgang District, Shenzhen
Manufacture's name	:	Lieno (Shenzhen) Technology Co., LTD
Address	:	Room 401, Unit 1, No. 92-1, Xiangyin Road, Nanlian Community, Longgang Street, Longgang District, Shenzhen
Product name	:	Wireless Microphone
Model name	:	J80, J81, J82, J85, J86, J88, J60, J61, J62, J65, J66, J68, J13, H61, H62, H63, H65, H66, H68, K1, K2, K3, K15, K6, K63, K10, K61
Standards	:	FCC CFR47 Part 15 Section 15.247
Test procedure	:	ANSI C63.10:2013
Test Date	:	May 20, 2024- May 30, 2024
Date of Issue	:	May 30, 2024
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: / Engineer

Technical Manager: Henry Wang / Manager

Contents

Page

2 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions	15.205(a) 15.209 15.247(d)	PASS
Band edge	15.247(d) 15.205(a)	PASS
Conduct Emission	15.207	PASS
20dB Bandwidth	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	:	Wireless Microphone
Model Name	:	J80
Sample ID	:	NCT24021447A-001
Sample(s) Status:	:	Engineer sample
Additional model	:	J81, J82, J85, J86, J88, J60, J61, J62, J65, J66, J68, J13, H61, H62, H63, H65, H66, H68, K1, K2, K3, K15, K6, K63, K10, K61
Difference	:	All the same except the model number
Operating frequency	:	2402-2480MHz
Numbers of Channel	:	79 channels
Antenna Type	:	Chip Antenna
Antenna Gain	:	1.75dBi
Type of Modulation	:	GFSK, Π/4-DQPSK
Power supply	:	DC 3.7V from Battery or DC 5V from adapter input AC 120V/60Hz
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-DQPSKhave been tested. 79 Channels are provided by EUT. The 3 channels of lower, medium and higher were chosen for test.

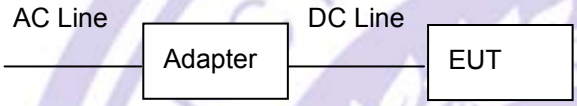
Channel List:

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	J80	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



Radiated Emission(30MHz-1GHz)

Radiated Emission(above 1GHz)

Conducted Spurious

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.	

Lowest Frequency		Middle Frequency		Highest Frequency	
Channel	Frequency(MHz)	Channel	Frequency(MHz)	Channel	Frequency(MHz)
0	2402	39	2441	78	2480

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	2023/6/21	2024/6/20
LISN	ENV 216	102796	Rohde & Schwarz	2023/6/21	2024/6/20
LISN	VN1-13S	004023	CRANAGE	2023/6/21	2024/6/20
Cable	RG223-1500MM	NA	RG	2023/6/21	2024/6/20

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	2023/6/21	2024/6/20
Amplifi （30MHz-1GHz）	BBV 9743 B	00374	SCHNWARZBECK	2023/6/21	2024/6/20
Bilog Antenna （30MHz-1GHz）	VULB9162	00473	SCHNWARZBECK	2023/3/19	2025/3/18
Horn antenna （1GHz-18GHz）	BBHA 9120 D	02622	SCHNWARZBECK	2023/3/19	2025/3/18
Pream plifier （1GHz-18GHz）	BBV 9718D	0024	SCHNWARZBECK	2023/6/21	2024/6/20
Spectrum Analyze （10Hz-40GHz）	FSV 40	100952	Rohde & Schwarz	2023/6/21	2024/6/20
Pream plifier （18GHz-40GHz）	BBV 9721	0056	SCHNWARZBECK	2023/6/21	2024/6/20
Double Ridge Guide Horn Antenna （18GHz-40GHz）	SAS-574	588	A.H.System	2023/3/19	2025/3/18
Loop Antenna (9KHz-30MHz)	FMZB 1513-60	00115	SCHNWARZBECK	2023/6/21	2024/6/20
Amplifier (9KHz-30MHz)	BBV 9745	00109	CHNWARZBECK	2023/6/21	2024/6/20

MXG Signal Analyzer	N9020A	MY50510202	Agilent	2023/6/21	2024/6/20
MXG Vector Signal Generator	N5182A	MY50140020	Agilent	2023/6/21	2024/6/20
MXG Analog Signal Generator	N5181A	MY47420919	Agilent	2023/6/21	2024/6/20
Power Sensor	TR1029-2	512364	Techoy	2023/6/21	2024/6/20
RF Swith	TR1029-1	512364	Techoy	2023/6/21	2024/6/20
Cable	DA800-4000MM	NA	DA	2023/6/21	2024/6/20
Cable	DA800-11000MM	NA	DA	2023/6/21	2024/6/20

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(9KHz~30MHz)	±4.51dB
Radiated Emission(30MHz~1GHz)	±5.03dB
Radiated Emission(1GHz~25GHz)	±4.74dB
Radiated Emission(25GHz~40GHz)	±3.38dB
Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%	

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	Wireless Microphone	N/A	J80	N/A	EUT
E-2	Adapter	anju	A18A-050100U-US2	AJ-230600002514	Auxiliary

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: : 23.2°C

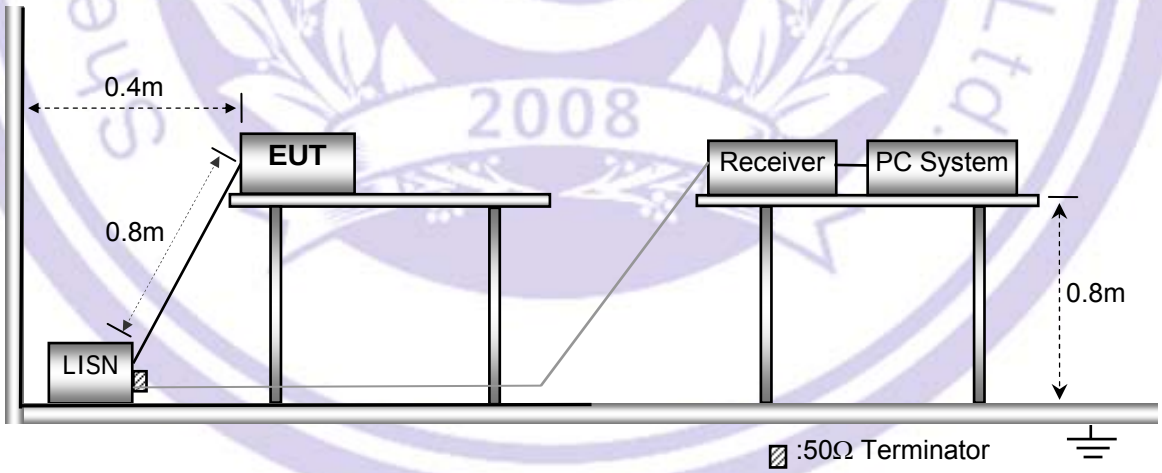
Humidity: : 51 % RH

Atmospheric Pressure: : 101.12 kPa

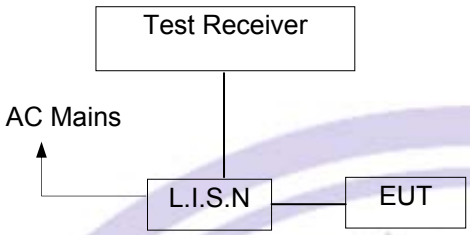
Test Voltage : AC 120V/60Hz

6.2 EUT Setup

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



6.3 Test SET-UP (Block Diagram of Configuration)



6.4 Measurement Procedure:

1. The EUT was placed on a table, which is 0.8m 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

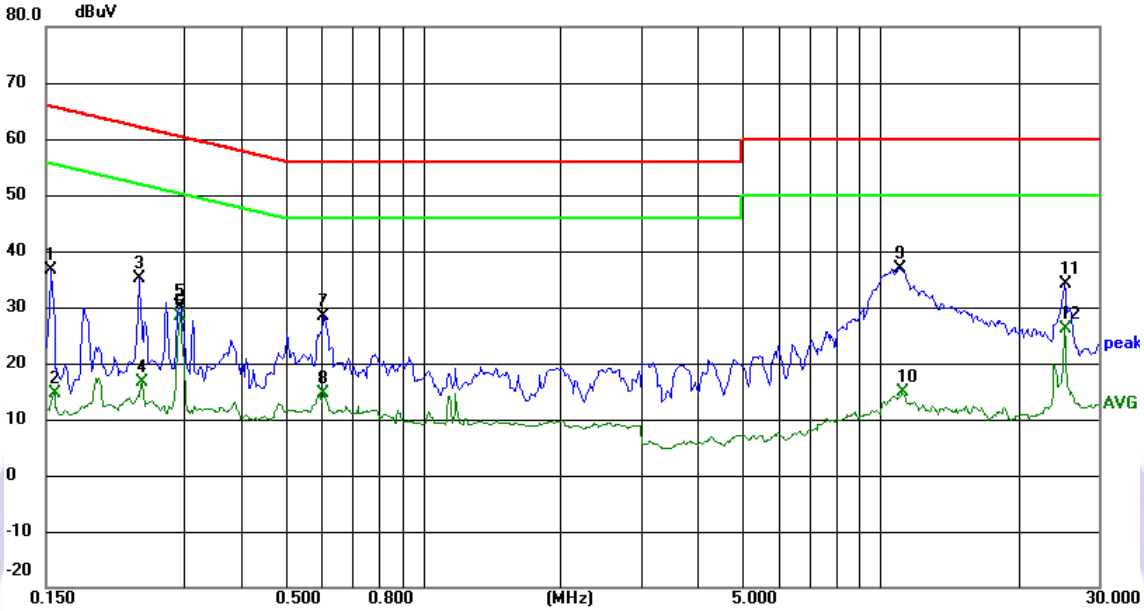
The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

6.7 Conducted Emission Test Result

Pass

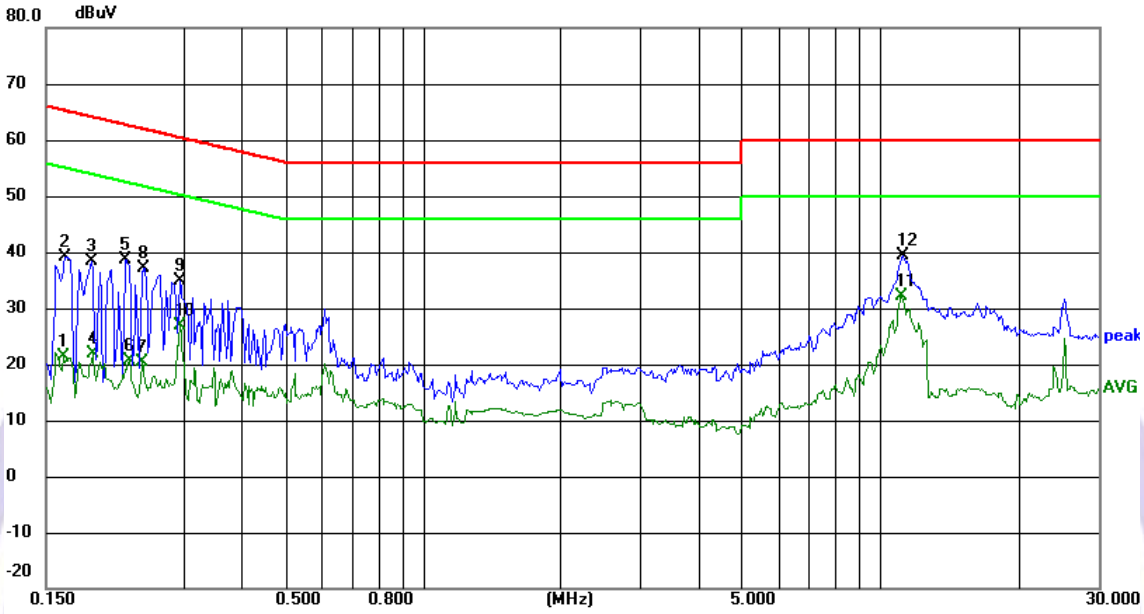
Conducted emission at both 120V & 240V is assessed, and emission at 120V represents the worst case. All the modulation modes were tested the data of the worst mode (Π/4-DQPSK) are recorded in the following pages and the others modulation methods do not exceed the limits.

Channel:	Middle	Phase :	L



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.1539	26.95	9.78	36.73	65.79	-29.06	peak	P
2	0.1564	4.93	9.78	14.71	55.65	-40.94	AVG	P
3	0.2396	25.32	9.75	35.07	62.11	-27.04	peak	P
4	0.2436	6.90	9.75	16.65	51.97	-35.32	AVG	P
5	0.2943	20.30	9.76	30.06	60.40	-30.34	peak	P
6 *	0.2943	18.59	9.76	28.35	50.40	-22.05	AVG	P
7	0.6060	18.57	9.78	28.35	56.00	-27.65	peak	P
8	0.6060	4.74	9.78	14.52	46.00	-31.48	AVG	P
9	11.0418	26.76	10.21	36.97	60.00	-23.03	peak	P
10	11.1586	4.56	10.21	14.77	50.00	-35.23	AVG	P
11	25.2259	23.22	11.00	34.22	60.00	-25.78	peak	P
12	25.2259	15.24	11.00	26.24	50.00	-23.76	AVG	P

Channel:	Middle	Phase :	N



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.1632	11.65	9.78	21.43	55.30	-33.87	AVG	P
2	0.1655	29.43	9.77	39.20	65.18	-25.98	peak	P
3	0.1890	28.63	9.76	38.39	64.08	-25.69	peak	P
4	0.1892	12.15	9.76	21.91	54.07	-32.16	AVG	P
5	0.2240	28.88	9.75	38.63	62.67	-24.04	peak	P
6	0.2280	10.84	9.75	20.59	52.52	-31.93	AVG	P
7	0.2436	10.57	9.75	20.32	51.97	-31.65	AVG	P
8	0.2454	27.41	9.75	37.16	61.91	-24.75	peak	P
9	0.2943	25.08	9.76	34.84	60.40	-25.56	peak	P
10	0.2943	17.15	9.76	26.91	50.40	-23.49	AVG	P
11 *	11.1385	22.00	10.21	32.21	50.00	-17.79	AVG	P
12	11.1975	29.07	10.21	39.28	60.00	-20.72	peak	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 : 24.5 °C

Humidity : 55.5% RH

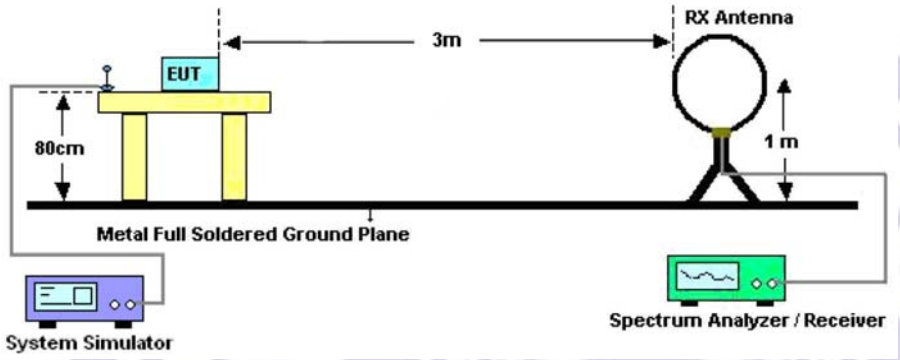
Atmospheric Pressure : 101.3kPa

Test Voltage : AC 120V60Hz

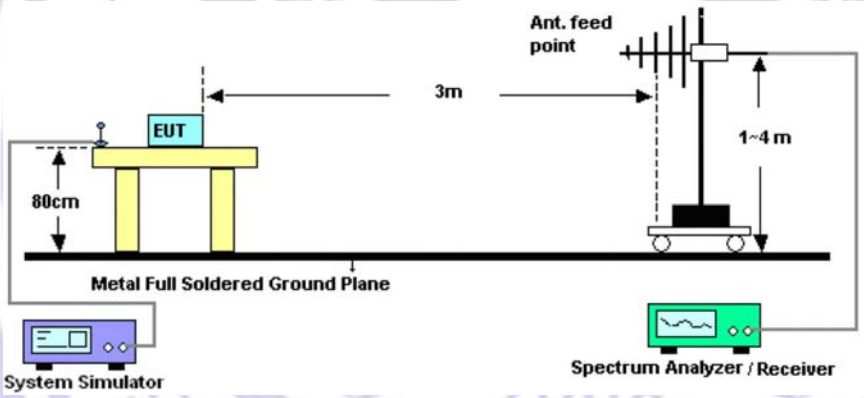
7.2 Test Setup

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

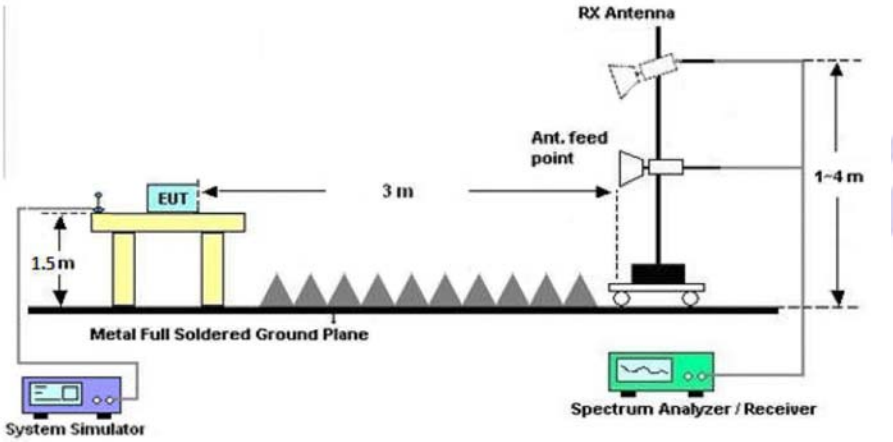
The test setup for emission measurement below 30MHz.



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.

7. 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:

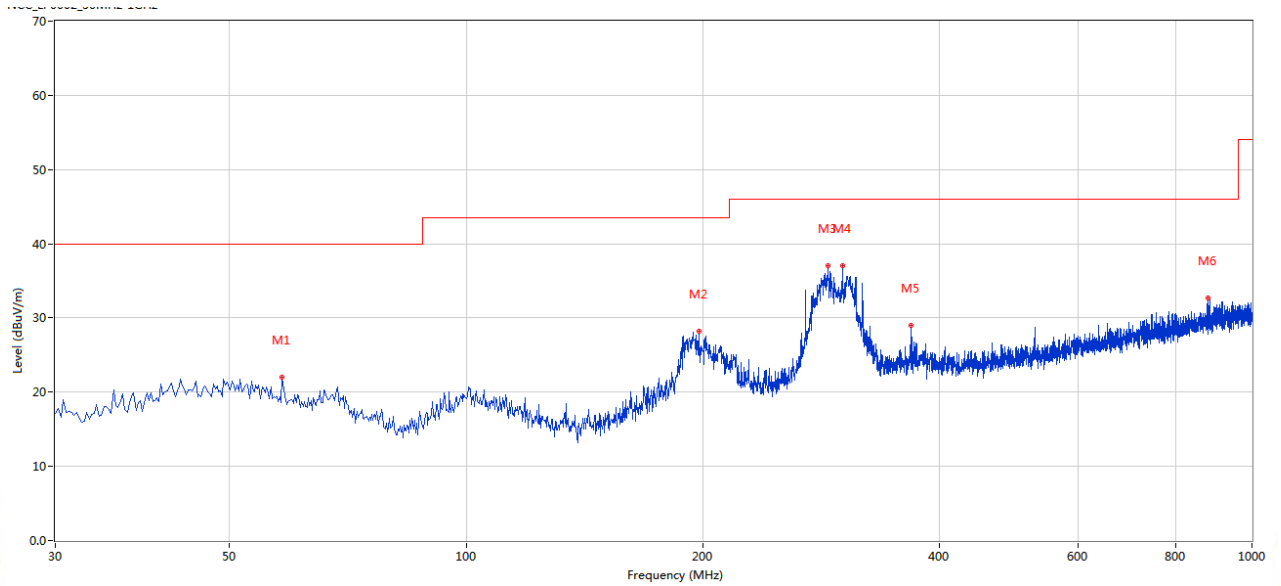
The amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

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 Π/4-DQPSK for record:

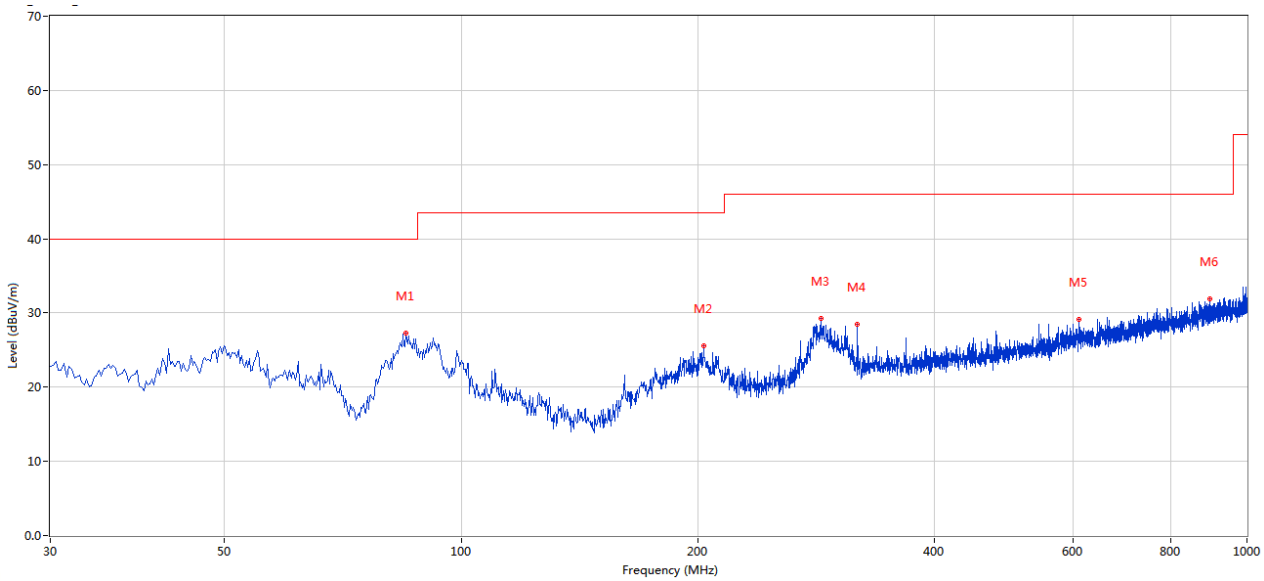
Test plot for Horizontal



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	ANT	Verdict
1	58.365	22.00	-12.73	40.0	18.00	Peak	Horizontal	Pass
2	198.010	28.21	-13.49	43.5	15.29	Peak	Horizontal	Pass
3	288.683	37.09	-11.25	46.0	8.91	Peak	Horizontal	Pass
4	301.047	37.04	-11.01	46.0	8.96	Peak	Horizontal	Pass
5	368.445	28.98	-9.50	46.0	17.02	Peak	Horizontal	Pass
6	879.265	32.64	-1.96	46.0	13.36	Peak	Horizontal	Pass

Remark:Emission Level=Reading+Cable Loss+ANT Factor-AMP Factor

Test plot for Vertical



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	ANT	Verdict
1	85.034	27.26	-16.52	40.0	12.74	Peak	Vertical	Pass
2	203.587	25.62	-13.48	43.5	17.88	Peak	Vertical	Pass
3	287.228	29.23	-11.29	46.0	16.77	Peak	Vertical	Pass
4	319.473	28.48	-10.62	46.0	17.52	Peak	Vertical	Pass
5	611.370	29.09	-5.12	46.0	16.91	Peak	Vertical	Pass
6	897.691	31.89	-1.76	46.0	14.11	Peak	Vertical	Pass

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Test Frequency 1GHz-25GHz

Π/4-DQPSK

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	4804.00	52.26	34.12	5.03	32.39	55.56	74.00	-18.44	Pk
V	4804.00	40.04	34.12	5.03	32.39	43.34	54.00	-10.66	AV
V	7206.00	45.25	32.54	6.29	35.86	54.86	74.00	-19.14	Pk
V	7206.00	35.52	32.54	6.29	35.86	45.13	54.00	-8.87	AV
V	9608.00	40.61	32.98	7.55	38.40	53.58	74.00	-20.42	Pk
V	9608.00	31.06	32.98	7.55	38.40	44.03	54.00	-9.97	AV
V	12010.00	40.83	32.09	8.93	39.00	56.67	74.00	-17.33	Pk
V	12010.00	25.86	32.09	8.93	39.00	41.7	54.00	-12.3	AV
H	4804.00	50.62	34.12	5.03	32.39	53.92	74.00	-20.08	Pk
H	4804.00	37.75	34.12	5.03	32.39	41.05	54.00	-12.95	AV
H	7206.00	46.16	32.54	6.29	35.86	55.77	74.00	-18.23	Pk
H	7206.00	33.73	32.54	6.29	35.86	43.34	54.00	-10.66	AV
H	9608.00	46.06	32.98	7.55	38.40	59.03	74.00	-14.97	Pk
H	9608.00	31.44	32.98	7.55	38.40	44.41	54.00	-9.59	AV
H	12010.00	36.67	32.09	8.93	39.00	52.51	74.00	-21.49	Pk
H	12010.00	27.87	32.09	8.93	39.00	43.71	54.00	-10.29	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	4882.00	50.68	34.07	5.09	32.59	54.29	74.00	-19.71	Pk
V	4882.00	38.13	34.07	5.09	32.59	41.74	54.00	-12.26	AV
V	7323.00	43.33	32.63	6.34	35.96	53	74.00	-21	Pk
V	7323.00	33.72	32.63	6.34	35.96	43.39	54.00	-10.61	AV
V	9764.00	41.16	32.92	7.59	38.40	54.23	74.00	-19.77	Pk
V	9764.00	28.44	32.92	7.59	38.40	41.51	54.00	-12.49	AV
V	12205.00	40.44	31.96	8.88	39.04	56.4	74.00	-17.6	Pk
V	12205.00	27.51	31.96	8.88	39.04	43.47	54.00	-10.53	AV
H	4882.00	49.50	34.07	5.09	32.59	53.11	74.00	-20.89	Pk
H	4882.00	37.59	34.07	5.09	32.59	41.2	54.00	-12.8	AV
H	7323.00	46.13	32.63	6.34	35.96	55.8	74.00	-18.2	Pk
H	7323.00	31.93	32.63	6.34	35.96	41.6	54.00	-12.4	AV
H	9764.00	42.26	32.92	7.59	38.40	55.33	74.00	-18.67	Pk
H	9764.00	27.81	32.92	7.59	38.40	40.88	54.00	-13.12	AV
H	12205.00	39.39	31.96	8.88	39.04	55.35	74.00	-18.65	Pk
H	12205.00	27.02	31.96	8.88	39.04	42.98	54.00	-11.02	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	4960.00	50.54	34.02	5.15	32.8	54.47	74.00	-19.53	Pk
V	4960.00	38.99	34.02	5.15	32.8	42.92	54.00	-11.08	AV
V	7440.00	46.07	32.71	6.4	36.05	55.81	74.00	-18.19	Pk
V	7440.00	32.44	32.71	6.4	36.05	42.18	54.00	-11.82	AV
V	9920.00	40.72	32.86	7.62	38.4	53.88	74.00	-20.12	Pk
V	9920.00	30.82	32.86	7.62	38.4	43.98	54.00	-10.02	AV
V	12400.00	40.95	31.82	8.84	39.08	57.05	74.00	-16.95	Pk
V	12400.00	28.39	31.82	8.84	39.08	44.49	54.00	-9.51	AV
H	4960.00	48.85	34.02	5.15	32.8	52.78	74.00	-21.22	Pk
H	4960.00	38.06	34.02	5.15	32.8	41.99	54.00	-12.01	AV
H	7440.00	43.91	32.71	6.4	36.05	53.65	74.00	-20.35	Pk
H	7440.00	34.20	32.71	6.4	36.05	43.94	54.00	-10.06	AV
H	9920.00	44.05	32.86	7.62	38.4	57.21	74.00	-16.79	Pk
H	9920.00	30.51	32.86	7.62	38.4	43.67	54.00	-10.33	AV
H	12400.00	41.14	31.82	8.84	39.08	57.24	74.00	-16.76	Pk
H	12400.00	27.06	31.82	8.84	39.08	43.16	54.00	-10.84	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

4. All the modes have tested and recorded the worst mode(Π/4-DQPSK) in the report

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

	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	2390.00	59.69	35.17	3.48	27.49	55.49	74.00	PK	PASS
	H	2390.00	51.83	35.17	3.48	27.49	47.63	54.00	AV	PASS
	H	2400.00	61.62	35.16	3.49	27.52	57.47	74.00	PK	PASS
	H	2400.00	51.35	35.16	3.49	27.52	47.2	54.00	AV	PASS
	V	2390.00	58.93	35.17	3.48	27.49	54.73	74.00	PK	PASS
	V	2390.00	52.21	35.17	3.48	27.49	48.01	54.00	AV	PASS
	V	2400.00	61.25	35.16	3.49	27.52	57.1	74.00	PK	PASS
	V	2400.00	51.47	35.16	3.49	27.52	47.32	54.00	AV	PASS
	High Channel: 2480MHz									
	H	2483.50	58.54	35.11	3.56	27.75	54.74	74.00	PK	PASS
	H	2483.50	51.63	35.11	3.56	27.75	47.83	54.00	AV	PASS
	H	2500.00	59.79	35.10	3.57	27.80	56.06	74.00	PK	PASS
	H	2500.00	49.93	35.10	3.57	27.80	46.2	54.00	AV	PASS
	V	2483.50	58.63	35.11	3.56	27.75	54.83	74.00	PK	PASS
	V	2483.50	49.58	35.11	3.56	27.75	45.78	54.00	AV	PASS
	V	2500.00	58.90	35.10	3.57	27.80	55.17	74.00	PK	PASS
	V	2500.00	49.99	35.10	3.57	27.80	46.26	54.00	AV	PASS
π/4-DQPSK	Low Channel: 2402MHz									
	H	2390.00	59.92	35.17	3.48	27.49	55.72	74.00	PK	PASS
	H	2390.00	50.67	35.17	3.48	27.49	46.47	54.00	AV	PASS
	H	2400.00	60.65	35.16	3.49	27.52	56.5	74.00	PK	PASS

	H	2400.00	51.10	35.16	3.49	27.52	46.95	54.00	AV	PASS
	V	2390.00	59.09	35.17	3.48	27.49	54.89	74.00	PK	PASS
	V	2390.00	49.44	35.17	3.48	27.49	45.24	54.00	AV	PASS
	V	2400.00	59.90	35.16	3.49	27.52	55.75	74.00	PK	PASS
	V	2400.00	49.83	35.16	3.49	27.52	45.68	54.00	AV	PASS
	High Channel: 2480MHz									
	H	2483.50	58.74	35.11	3.56	27.75	54.94	74.00	PK	PASS
	H	2483.50	50.77	35.11	3.56	27.75	46.97	54.00	AV	PASS
	H	2500.00	60.76	35.10	3.57	27.80	57.03	74.00	PK	PASS
	H	2500.00	50.41	35.10	3.57	27.80	46.68	54.00	AV	PASS
	V	2483.50	59.85	35.11	3.56	27.75	56.05	74.00	PK	PASS
	V	2483.50	51.08	35.11	3.56	27.75	47.28	54.00	AV	PASS
	V	2500.00	59.31	35.10	3.57	27.80	55.58	74.00	PK	PASS
	V	2500.00	50.37	35.10	3.57	27.80	46.64	54.00	AV	PASS

Remark:

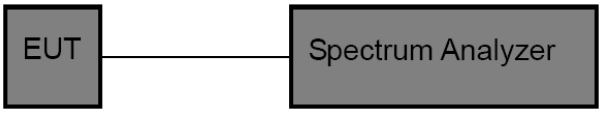
1. Emission Level = Meter Reading + Antenna Factor + Cable Loss – Pre-amplifier, Margin= Emission Level - Limit

8 Maximum Peak Output Power Test

8.1 Test Standard and Limit

Test Standard	FCC Part15 C Section 15.247 (b)(3)
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.

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

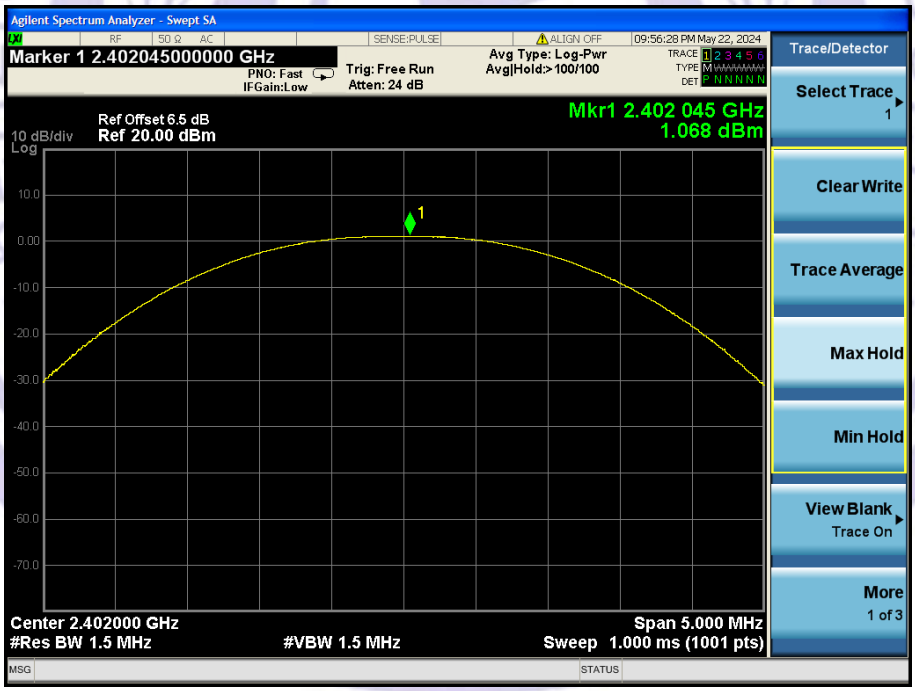
   Trace = max hold

8.4 Test Data

Mode	Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
GFSK	Lowest	1.068	30.00	Pass
	Middle	0.698		
	Highest	0.575		
π/4-DQPSK	Lowest	1.428	20.97	Pass
	Middle	1.031		
	Highest	0.886		

Test plots

GFSK Low Channel



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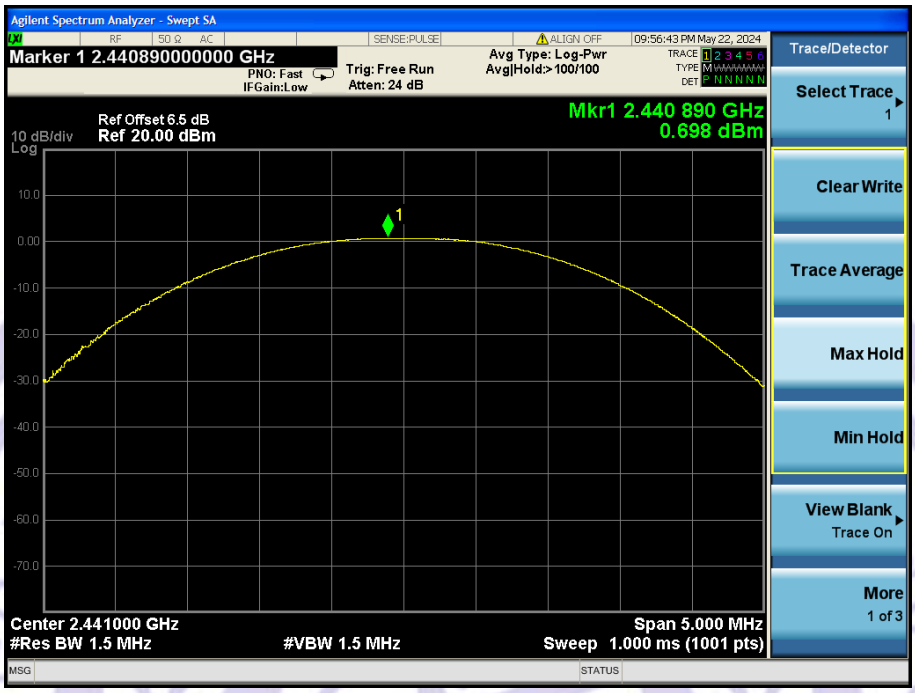
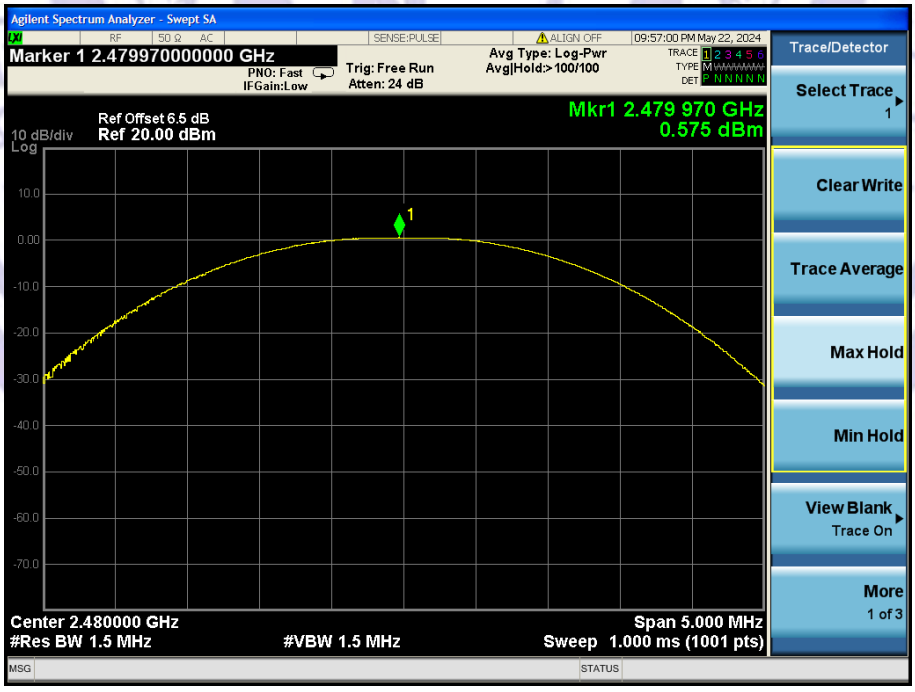
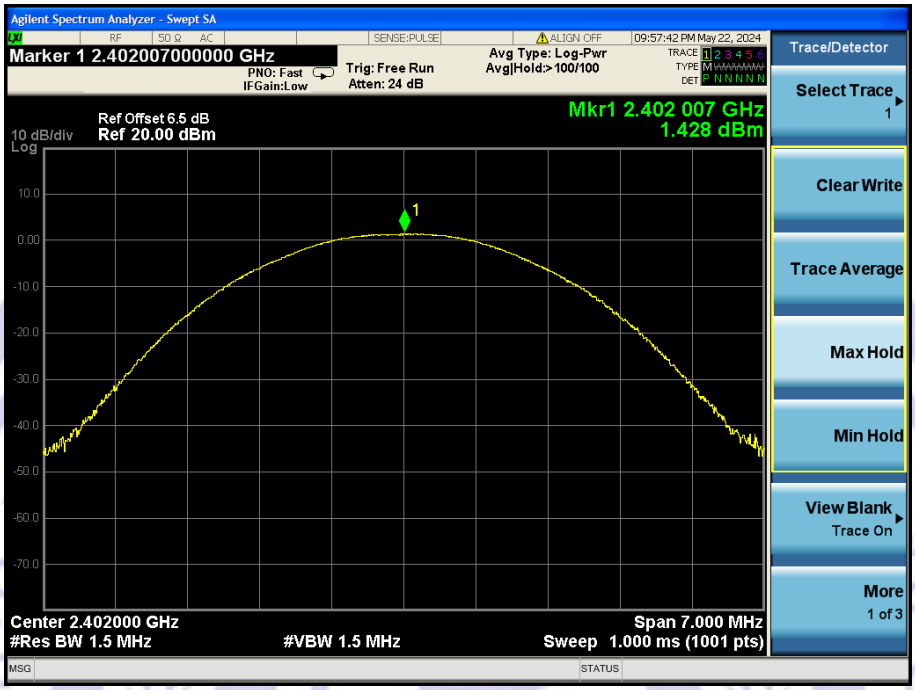
GFSK Middle Channel



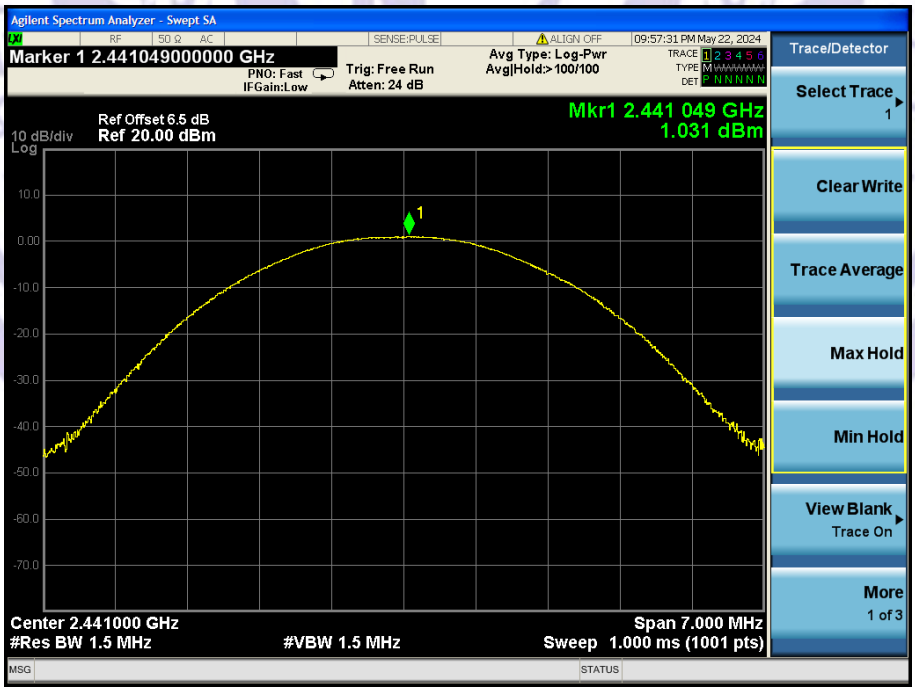
GFSK High Channel



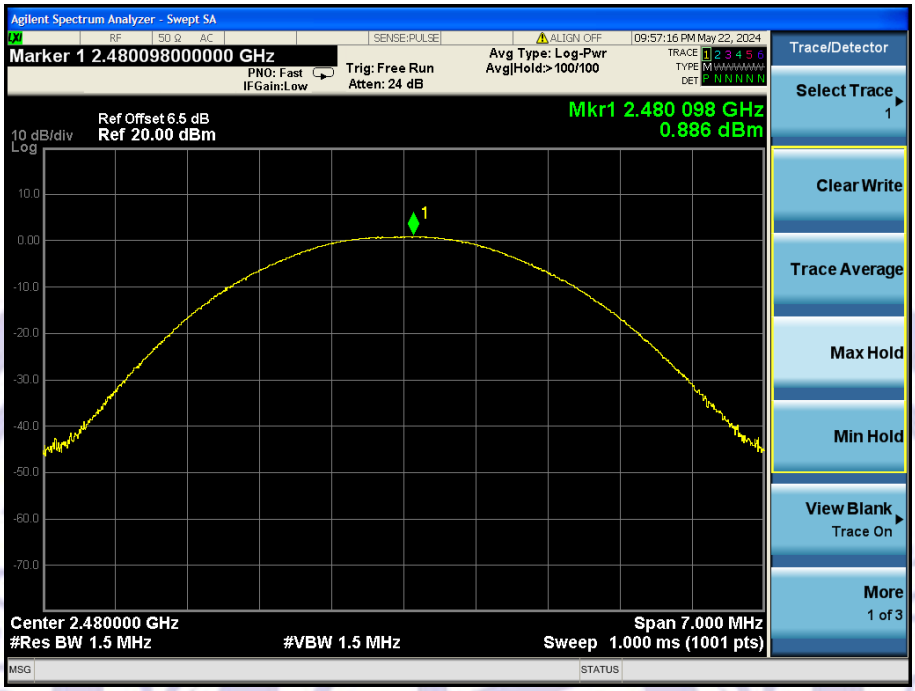
π/4-DQPSK Low Channel



π/4-DQPSK Middle Channel



π/4-DQPSK High Channel

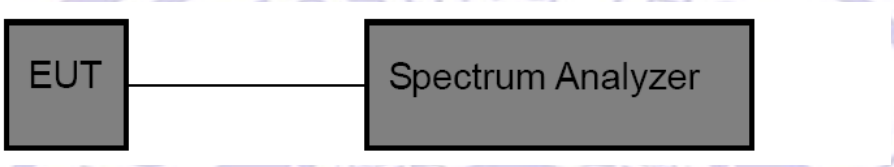


9 20DB Occupy Bandwidth Test

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:

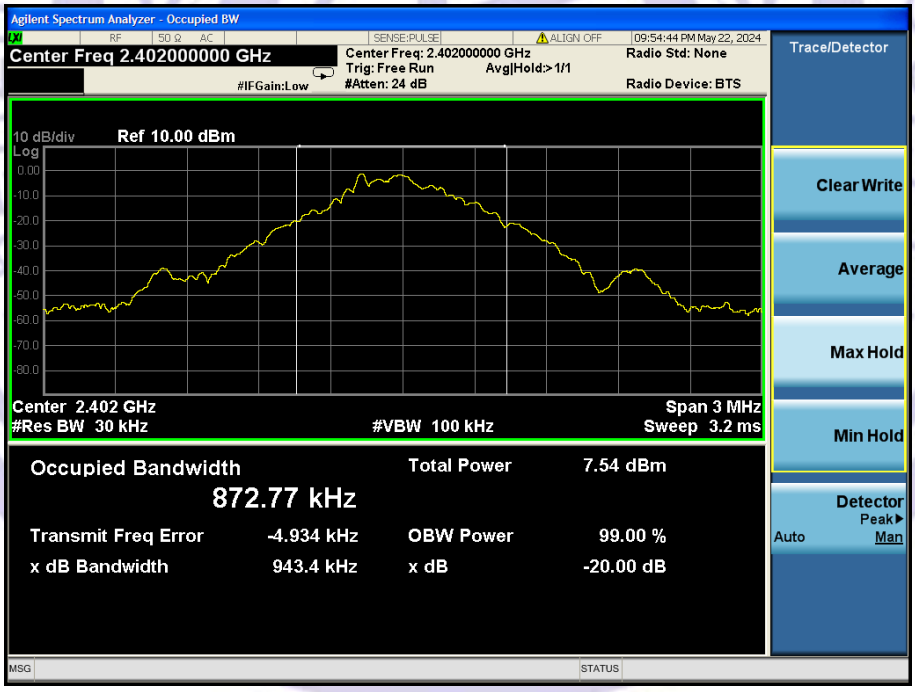
1. Span= approximately 2 to 3 times the 20dB bandwidth, centered on a hopping channel.
2. Set the RBW = 30 kHz.
3. Set the VBW = 100 kHz.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

9.4 Test Data

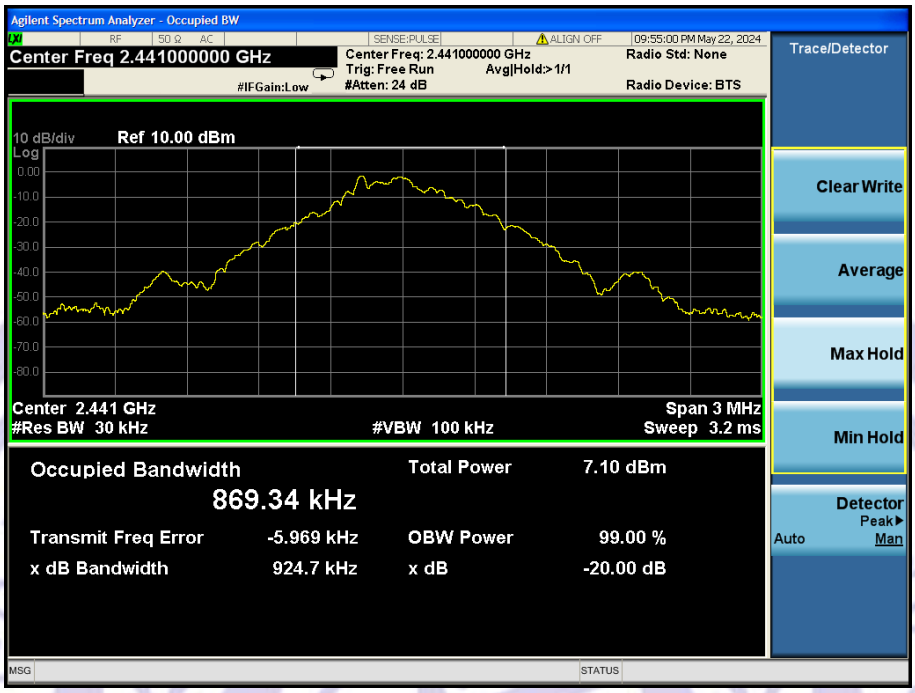
Mode	Test channel	20dB Emission Bandwidth (MHz)	Result
GFSK	Lowest	0.943	Pass
	Middle	0.925	
	Highest	0.936	
π/4-DQPSK	Lowest	1.230	Pass
	Middle	1.231	
	Highest	1.229	

Test plots

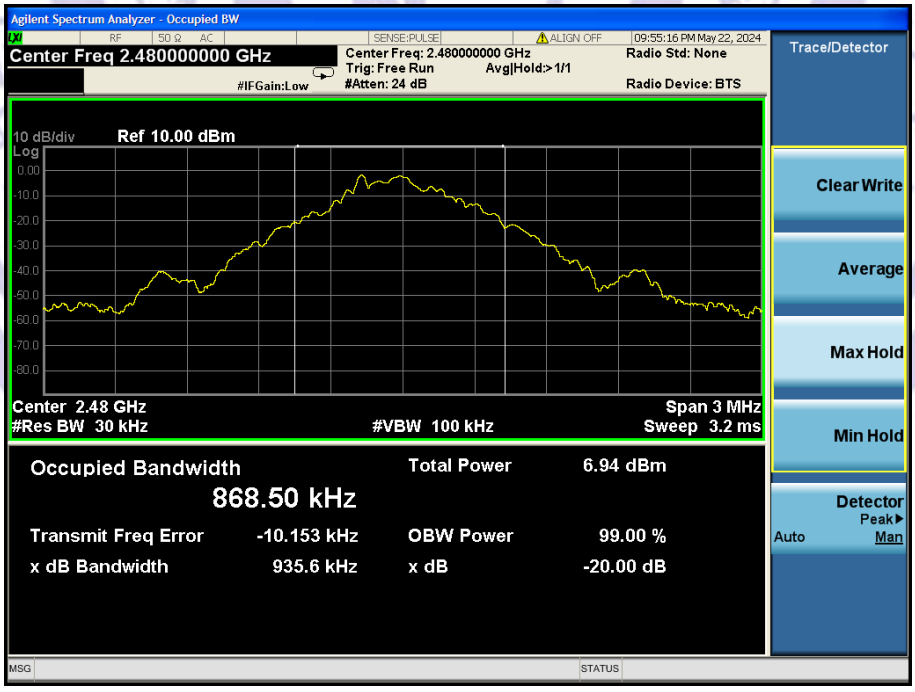
GFSK Low Channel



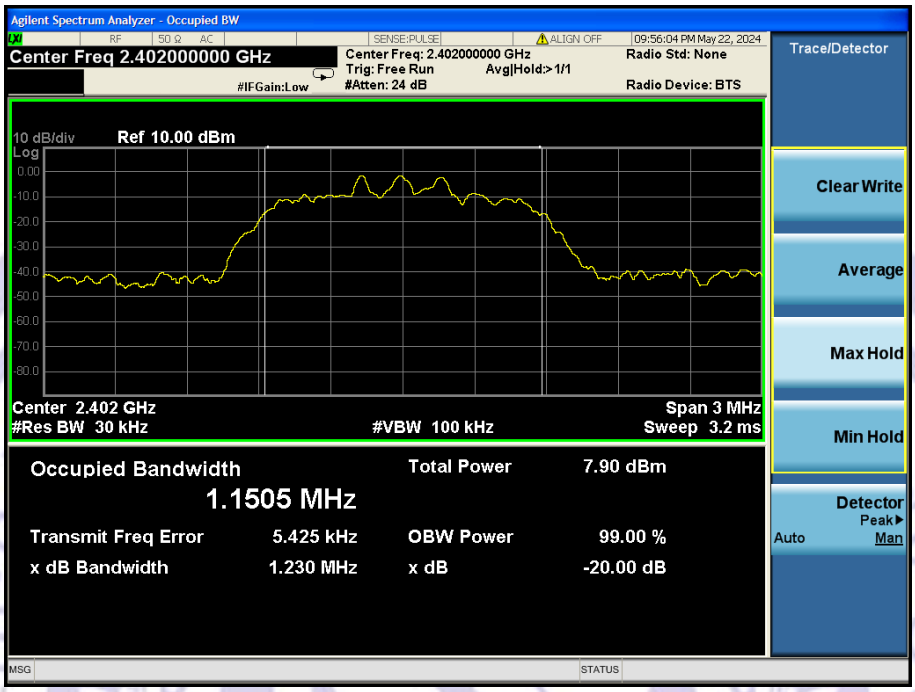
GFSK Middle Channel



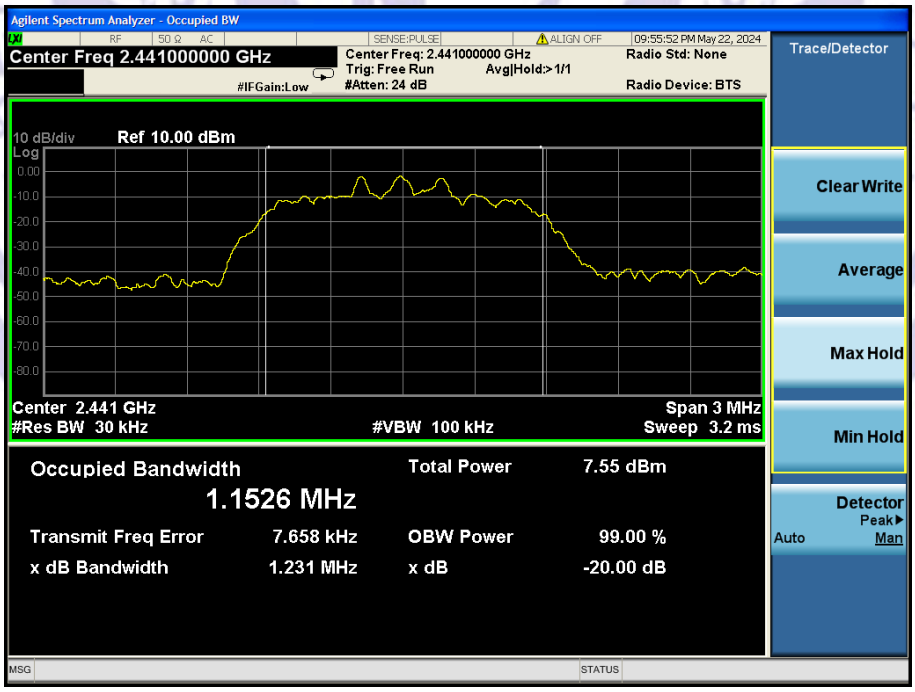
GFSK High Channel



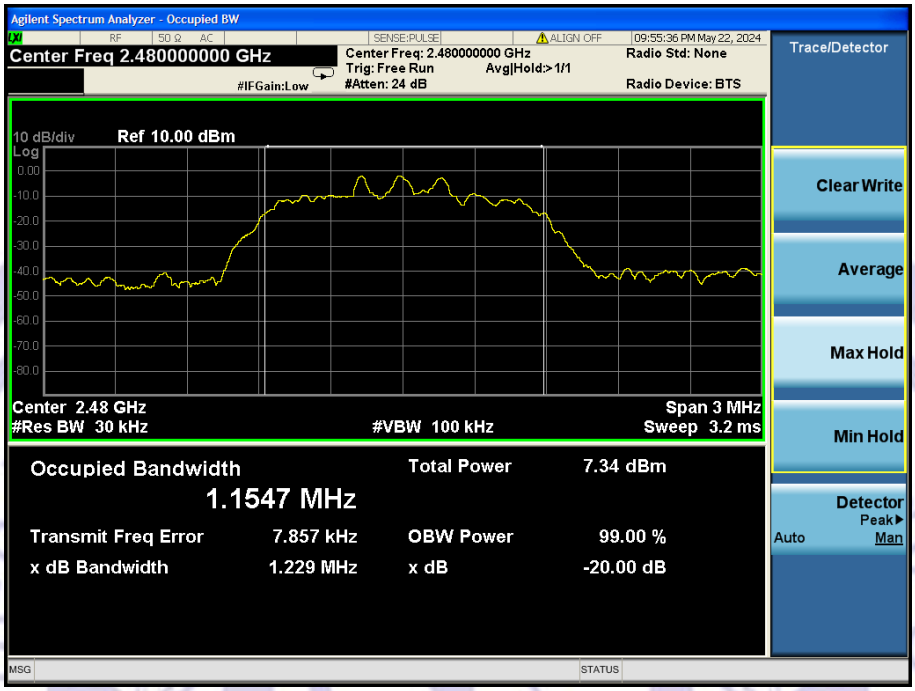
π/4-DQPSK Low Channel



π/4-DQPSK Middle Channel



π/4-DQPSK High Channel



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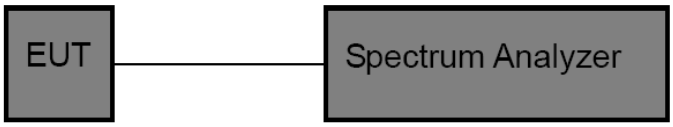
10 Carrier Frequency Separation Test

10.1 Test Standard and Limit

Test Standard	FCC Part15 C Section 15.247 (a)(1)
Test Limit	>25KHz or >two-thirds of the 20 dB bandwidth

10.2 Test Setup



10.3 Test Procedure

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

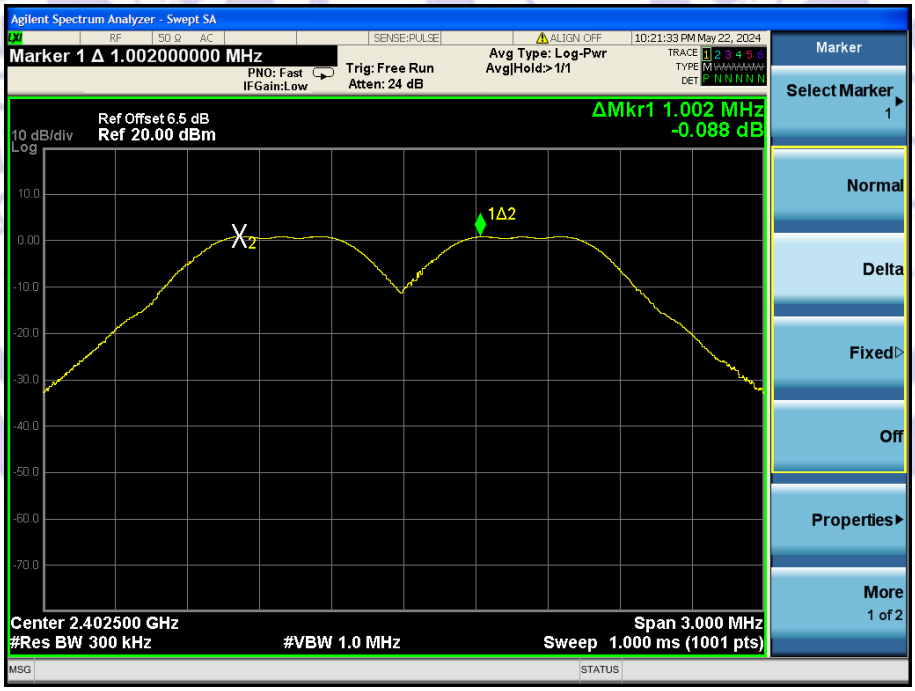
1. Span= Wide enough to capture the peaks of two adjacent channels
2. Set the RBW = 300 kHz.
3. Set the VBW = 1 MHz.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

10.4 Test Data

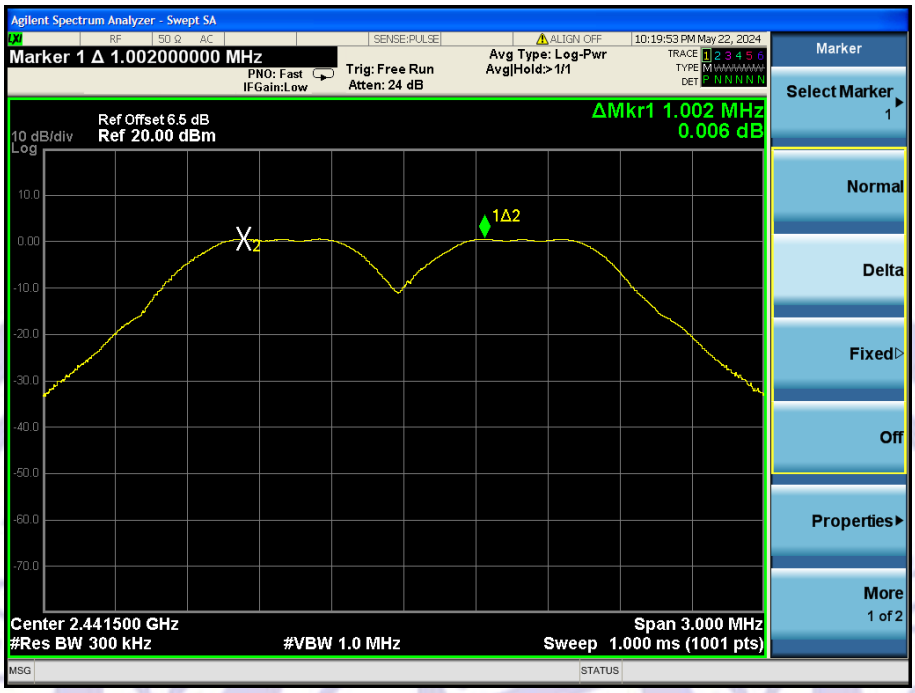
Mode	Test channel	Frequencies Separation (MHz)	Limit (kHz)	Result
GFSK	Low	1002.0	25KHz or 2/3*20dB bandwidth	Pass
	Middle	1002.0		Pass
	High	1002.0		Pass
π/4-DQPSK	Low	1002.0	25KHz or 2/3*20dB bandwidth	Pass
	Middle	1002.0		Pass
	High	1002.0		Pass

Test plots

GFSK Low Channel



GFSK Middle Channel



GFSK High Channel

π/4-DQPSK Low Channel

π/4-DQPSK Middle Channel

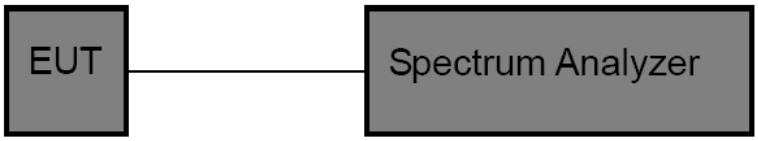
π/4-DQPSK High Channel

11 Number of Hopping Channel Test

11.1 Test Standard and Limit

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

11.2 Test Setup



11.3 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 = 300kHz.
3. Set the VBW = 1MHz.
4. Sweep time = auto couple.
5. Detector function = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.

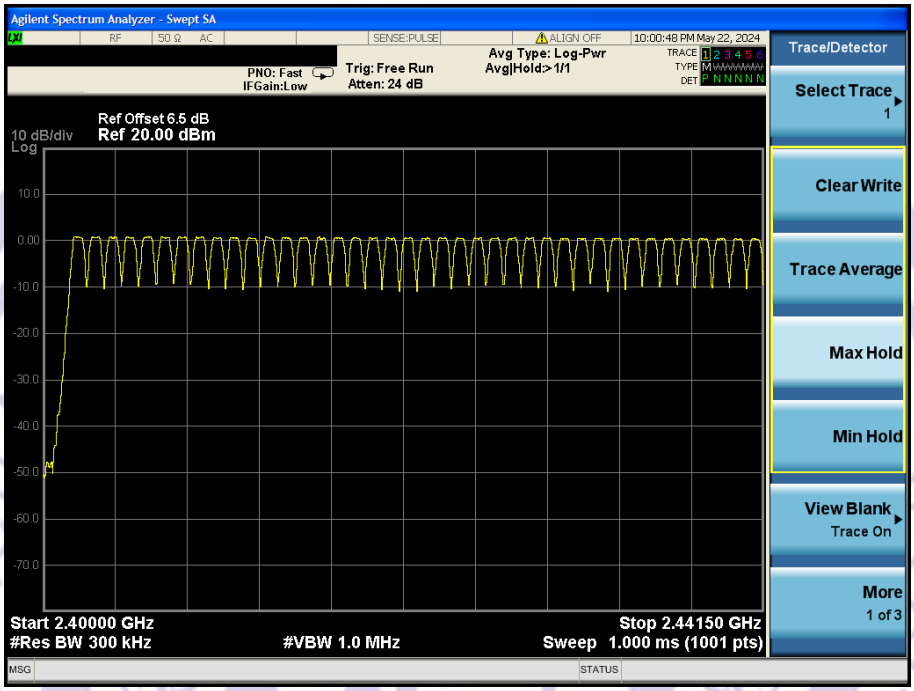
11.4 Test Data

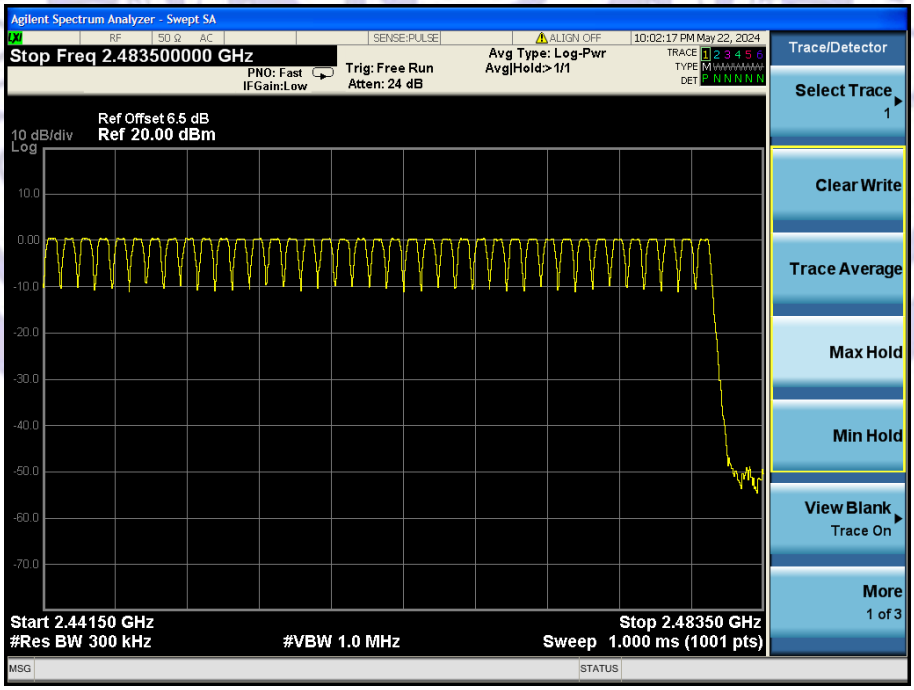
Mode	Hopping channel numbers	Limit	Result
GFSK	79	≥15	Pass
π/4-DQPSK	79		Pass

Test Plots:

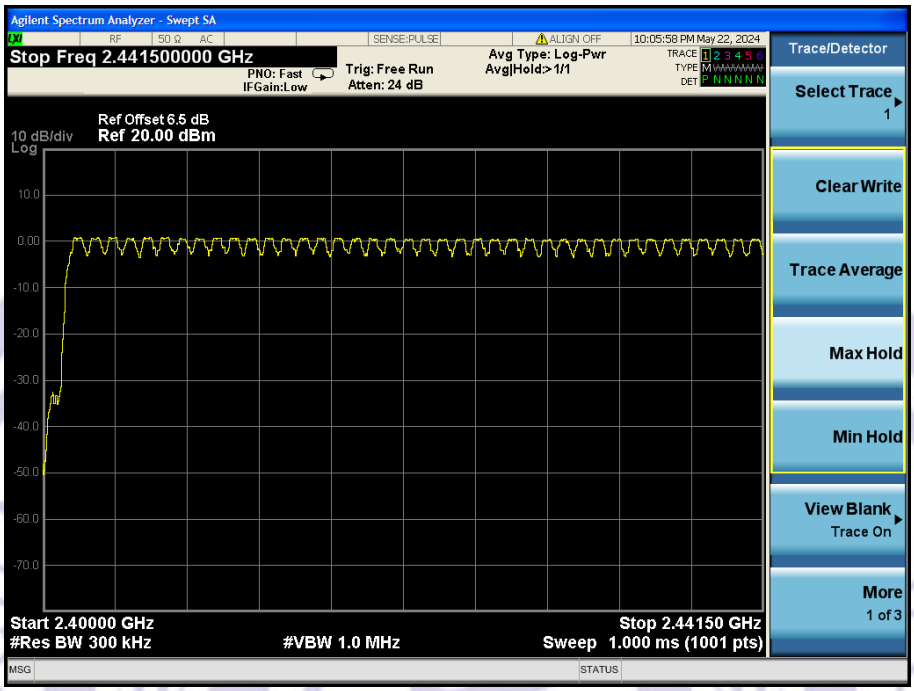
79 Channels in total

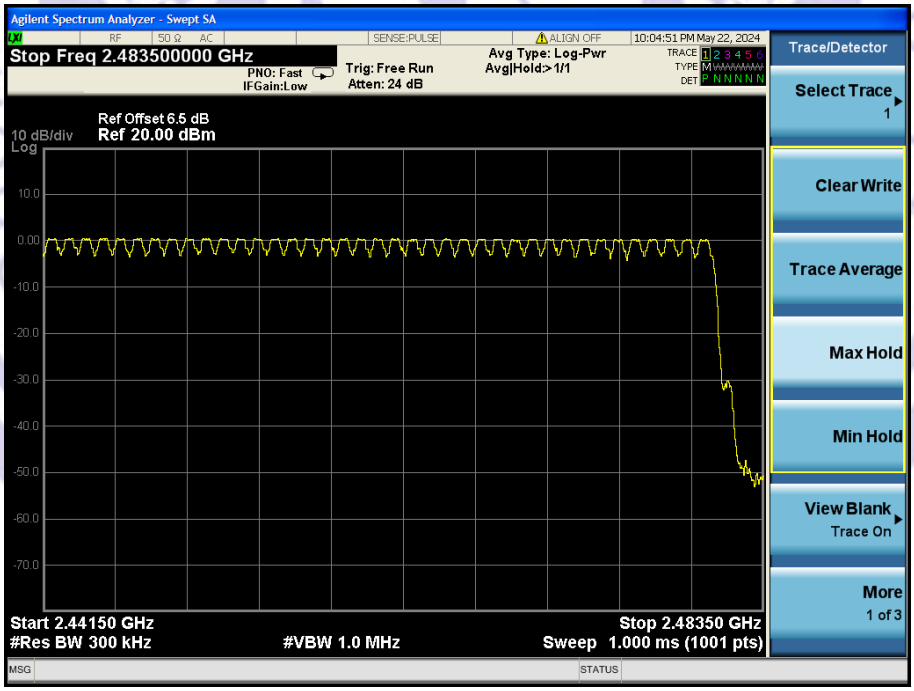
GFSK





π/4-DQPSK


Agilent Spectrum Analyzer - Swept SA
Stop Freq 2.441500000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 24 dB
Avg Type: Log-Pwr
Avg|Hold:>1/1
10:05:58 PM May 22, 2024
Ref Offset 6.5 dB
10 dB/div
Log
Ref 20.00 dBm
Start 2.40000 GHz
#Res BW 300 kHz
#VBW 1.0 MHz
Stop 2.44150 GHz
Sweep 1.000 ms (1001 pts)
Trace/Detector
Select Trace 1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank Trace On
More 1 of 3

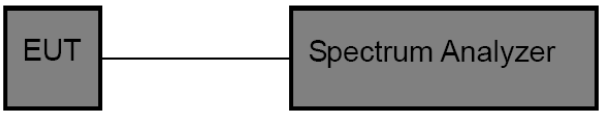

Agilent Spectrum Analyzer - Swept SA
Stop Freq 2.483500000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 24 dB
Avg Type: Log-Pwr
Avg|Hold:>1/1
10:04:51 PM May 22, 2024
Ref Offset 6.5 dB
10 dB/div
Log
Ref 20.00 dBm
Start 2.44150 GHz
#Res BW 300 kHz
#VBW 1.0 MHz
Stop 2.48350 GHz
Sweep 1.000 ms (1001 pts)
Trace/Detector
Select Trace 1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank Trace On
More 1 of 3

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 = 1 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

GFSK mode:

Frequency	Packet	Pulse time (ms)	Dwell time(ms)	Limit(ms)	Result
Hopping	DH1	0.368	118	400	Pass
Hopping	DH3	1.616	259	400	Pass
Hopping	DH5	2.860	305	400	Pass

Note:We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.
Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second for DH1, 2-DH1
Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second for DH3, 2-DH3
Dwell time=Pulse time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second for DH5, 2-DH5

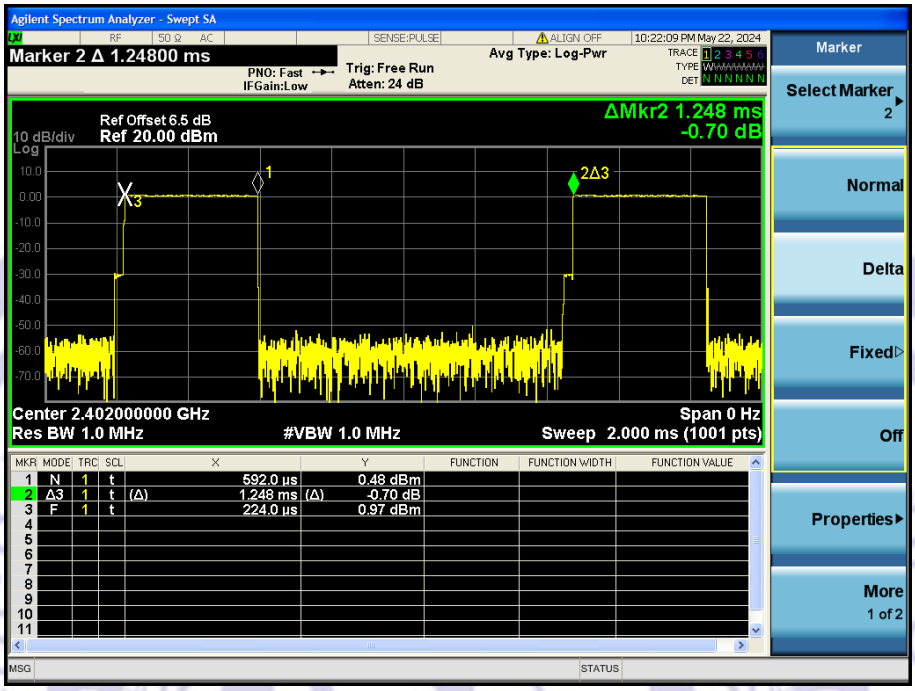
π/4-DQPSK mode:

Frequency	Packet	Pulse time (ms)	Dwell time(ms)	Limit(ms)	Result
Hopping	DH1	0.378	121	400	Pass
Hopping	DH3	1.628	260	400	Pass
Hopping	DH5	2.876	307	400	Pass

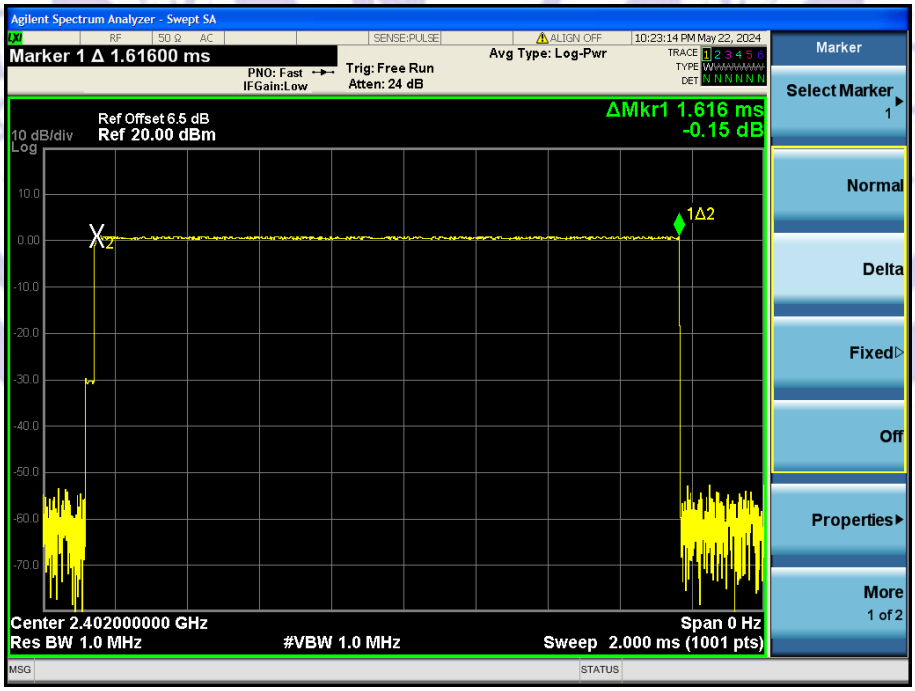
Note:We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.
Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second for DH1, 2-DH1
Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second for DH3, 2-DH3
Dwell time=Pulse time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second for DH5, 2-DH5

Test Plots

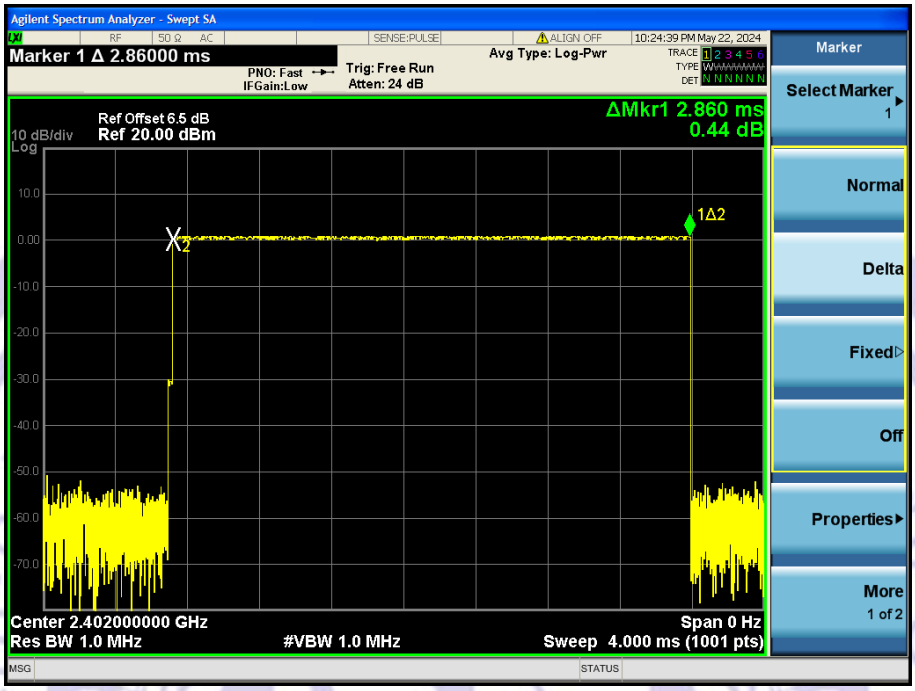
GFSK DH1 2402MHz



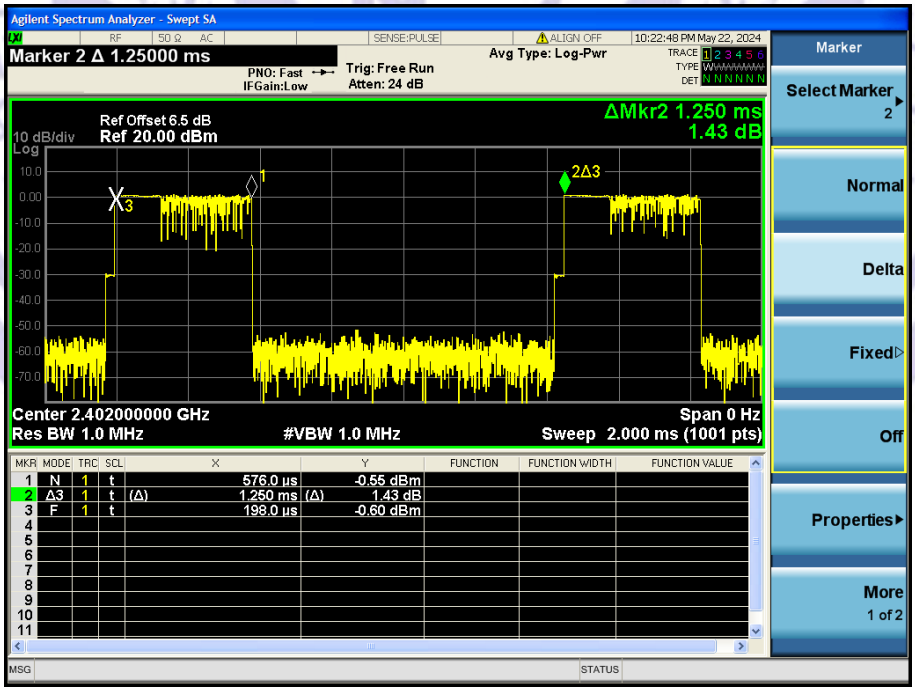
GFSK DH3 2402MHz



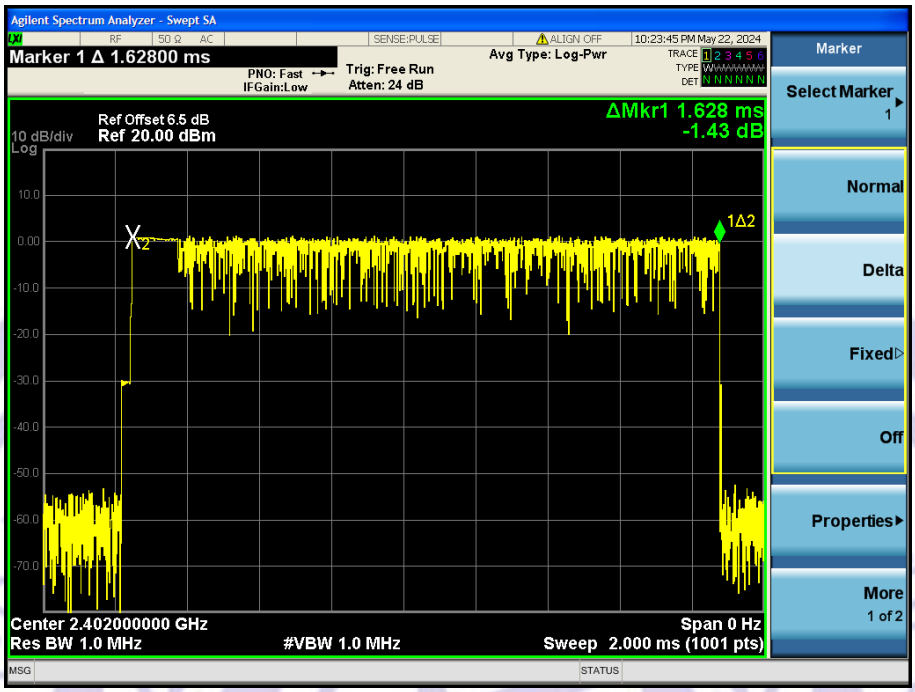
GFSK DH5 2402MHz



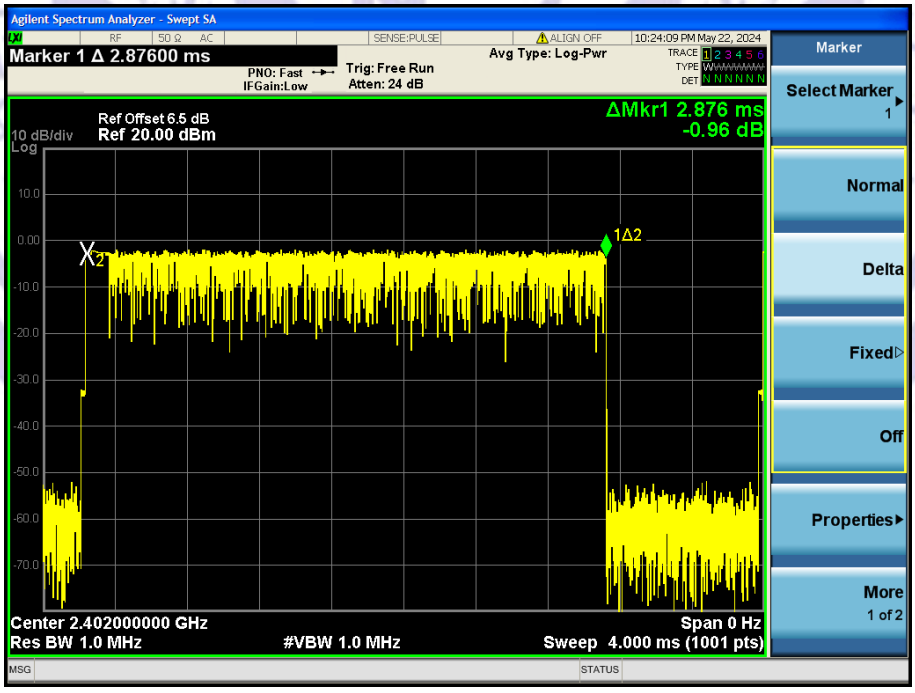
π/4-DQPSK 2DH1 2402MHz



π/4-DQPSK 2DH3 2402MHz



π/4-DQPSK 2DH5 2402MHz

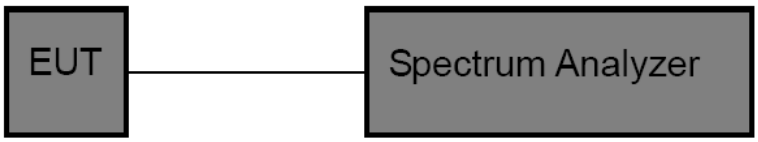


13 100kHz Bandwidth of Frequency Band Edge Requirement

13.1 Test Standard and Limit

Test Standard	FCC Part15 C Section 15.247 (d)
Test Limit	in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in 15.209(a).

13.2 Test Setup



13.3 Test Procedure

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

1. Set the RBW = 100kHz.

2. Set the VBW = 300kHz.

3. Sweep time = auto couple.

4. Detector function = peak.

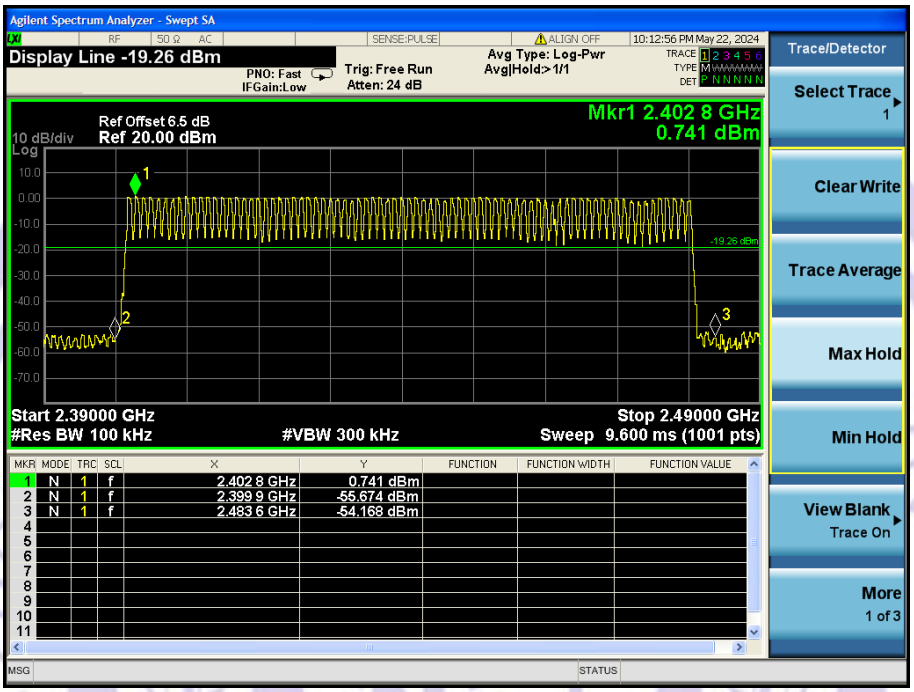
5. Trace mode = max hold.

6. Allow trace to fully stabilize.

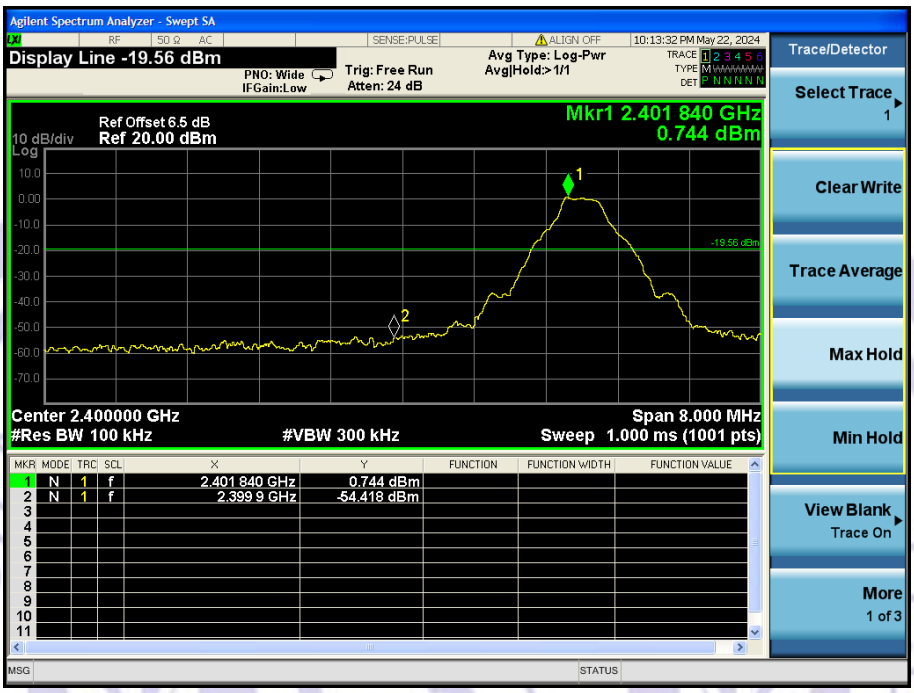
13.4 Test Data

GFSK mode:

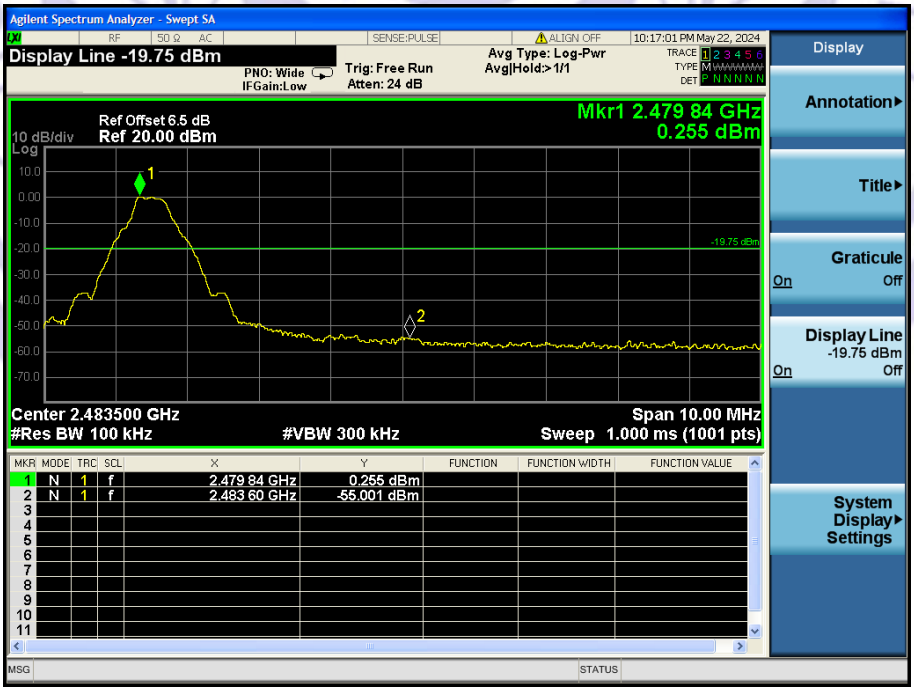
Data rate 1Mbps



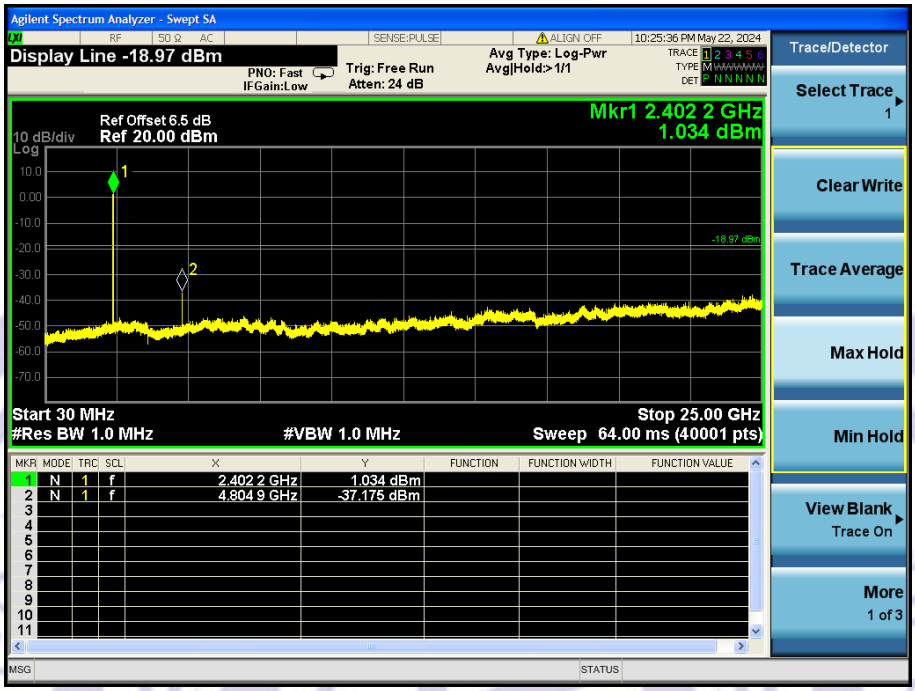
CH00 (Lower) Data rate 1Mbps



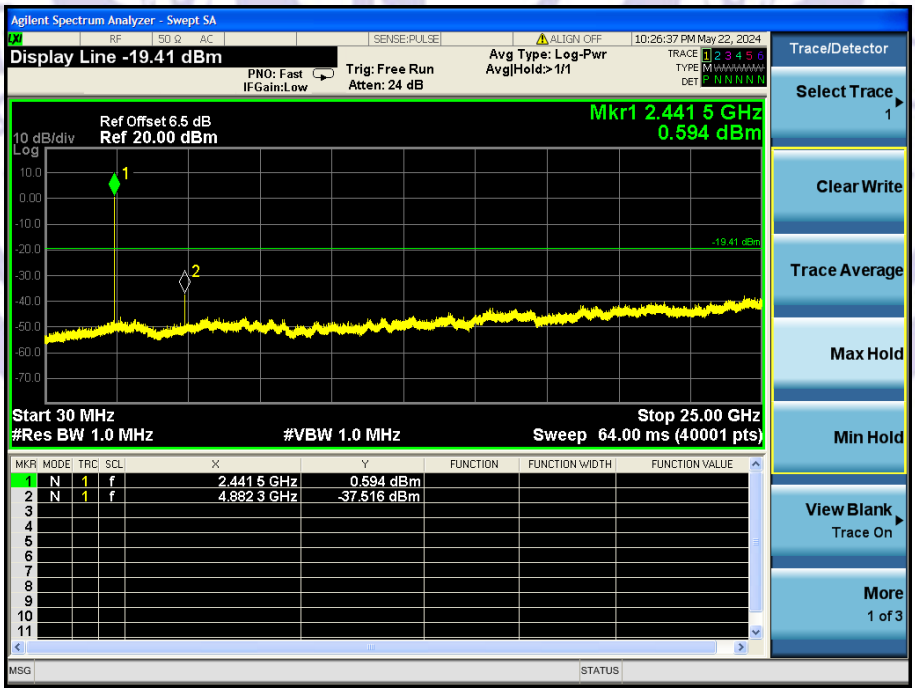
CH 78 (Upper) Data rate 1Mbps



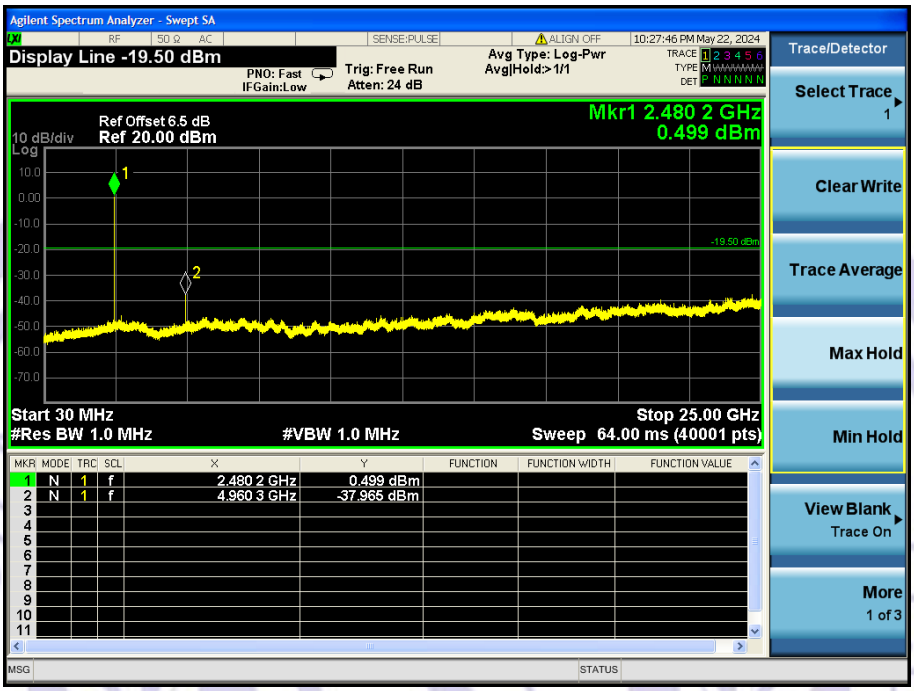
CH01


Agilent Spectrum Analyzer - Swept SA
Display Line -18.97 dBm
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 24 dB
Avg Type: Log-Pwr
Avg|Hold:>1/1
10:25:36 PM May 22, 2024
Ref Offset 6.5 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr1 2.402 2 GHz
1.034 dBm
-18.97 dBm
Start 30 MHz
#Res BW 1.0 MHz
#VBW 1.0 MHz
Stop 25.00 GHz
Sweep 64.00 ms (40001 pts)
1 N 1 f 2.402 2 GHz 1.034 dBm
2 N 1 f 4.804 9 GHz -37.175 dBm
Trace/Detector
Select Trace 1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank Trace On
More 1 of 3

CH39

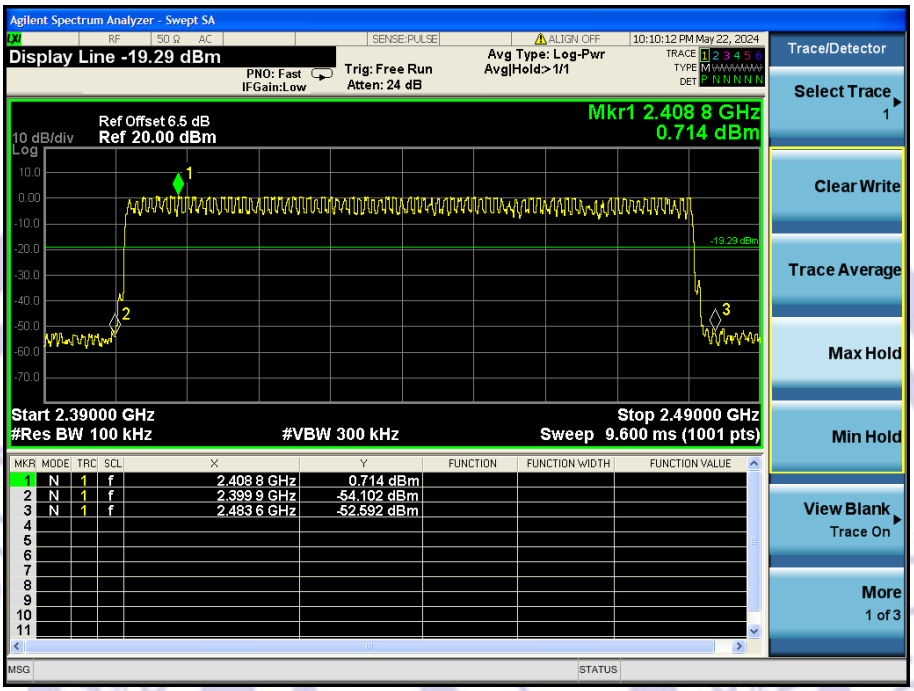

Agilent Spectrum Analyzer - Swept SA
Display Line -19.41 dBm
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 24 dB
Avg Type: Log-Pwr
Avg|Hold:>1/1
10:26:37 PM May 22, 2024
Ref Offset 6.5 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr1 2.441 5 GHz
0.594 dBm
-19.41 dBm
Start 30 MHz
#Res BW 1.0 MHz
#VBW 1.0 MHz
Stop 25.00 GHz
Sweep 64.00 ms (40001 pts)
1 N 1 f 2.441 5 GHz 0.594 dBm
2 N 1 f 4.882 3 GHz -37.516 dBm
Trace/Detector
Select Trace 1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank Trace On
More 1 of 3

CH78

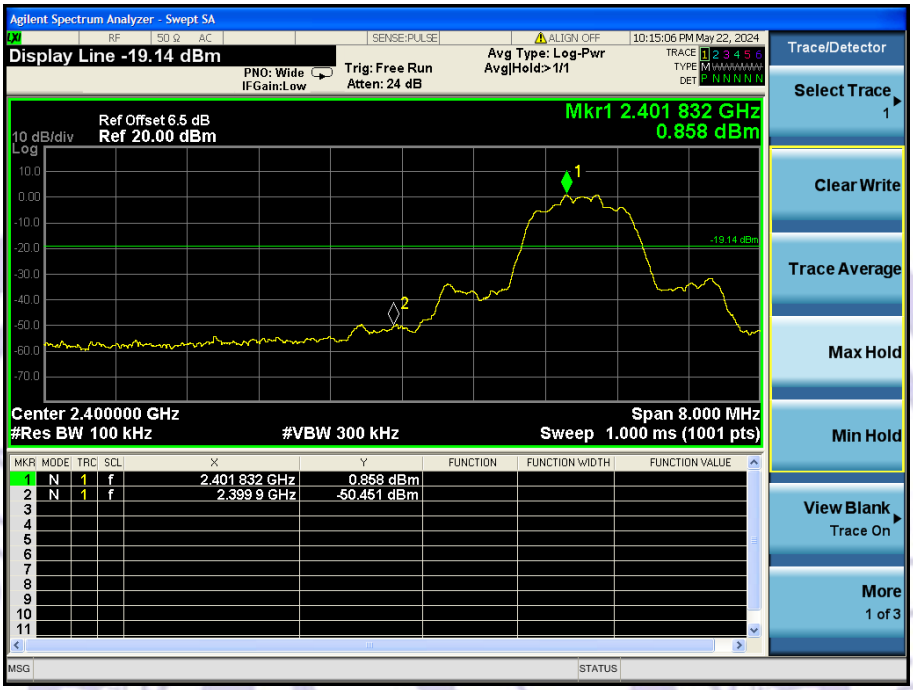

Agilent Spectrum Analyzer - Swept SA
Display Line -19.50 dBm
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 24 dB
Avg Type: Log-Pwr
Avg|Hold:>1/1
10:27:46 PM May 22, 2024
Ref Offset 6.5 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 2.480 2 GHz
0.499 dBm
-19.50 dBm
Start 30 MHz
#Res BW 1.0 MHz
#VBW 1.0 MHz
Stop 25.00 GHz
Sweep 64.00 ms (40001 pts)
1 N 1 f 2.480 2 GHz 0.499 dBm
2 N 1 f 4.960 3 GHz -37.965 dBm
Trace/Detector
Select Trace 1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank Trace On
More 1 of 3

π/4-DQPSK mode

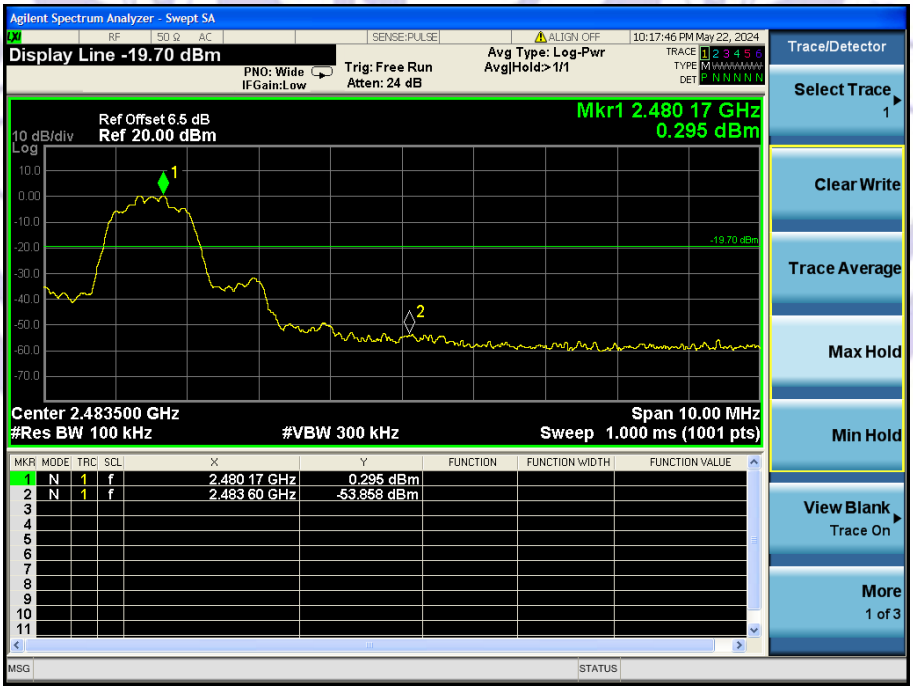
Data rate 2Mbps



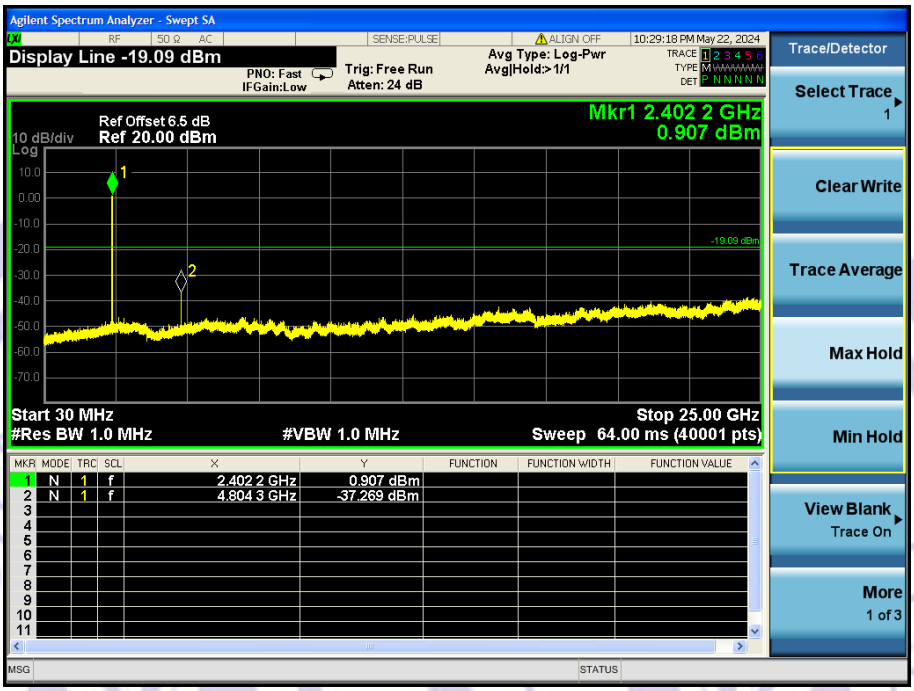
CH00 (Lower) Data rate 2Mbps



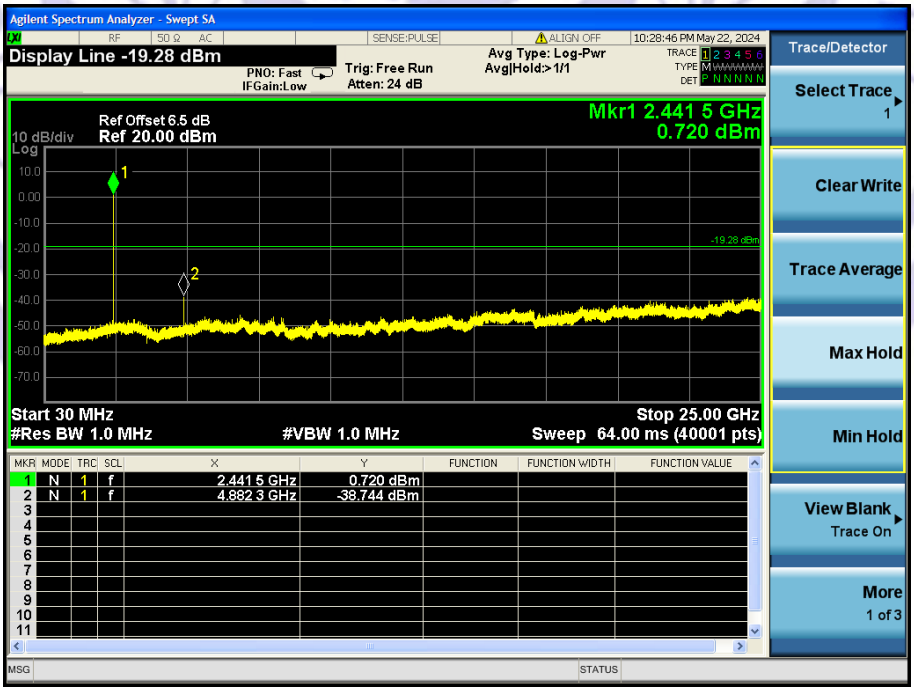
CH 78 (Upper) Data rate 2Mbps



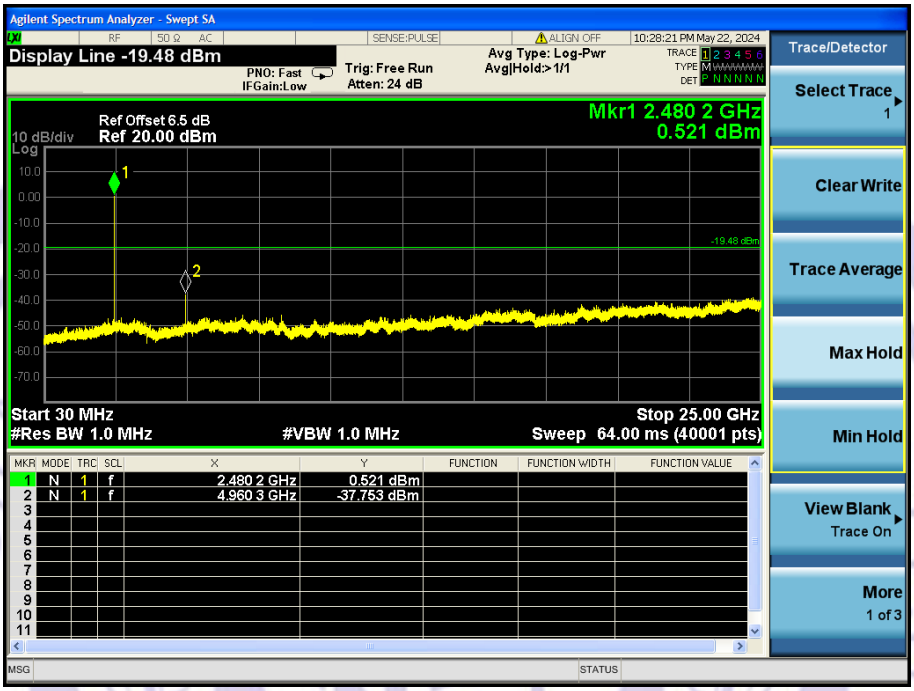
CH01


Agilent Spectrum Analyzer - Swept SA
Display Line -19.09 dBm
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 24 dB
Avg Type: Log-Pwr
Avg|Hold:>1/1
10:29:18 PM May 22, 2024
Ref Offset 6.5 dB
10 dB/div
Ref 20.00 dBm
Mkr1 2.402 2 GHz
0.907 dBm
-19.09 dBm
Start 30 MHz
#Res BW 1.0 MHz
#VBW 1.0 MHz
Stop 25.00 GHz
Sweep 64.00 ms (40001 pts)
1 N 1 f 2.402 2 GHz 0.907 dBm
2 N 1 f 4.804 3 GHz -37.269 dBm
Trace/Detector
Select Trace 1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank Trace On
More 1 of 3

CH39


Agilent Spectrum Analyzer - Swept SA
Display Line -19.28 dBm
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 24 dB
Avg Type: Log-Pwr
Avg|Hold:>1/1
10:28:46 PM May 22, 2024
Ref Offset 6.5 dB
10 dB/div
Ref 20.00 dBm
Mkr1 2.441 5 GHz
0.720 dBm
-19.28 dBm
Start 30 MHz
#Res BW 1.0 MHz
#VBW 1.0 MHz
Stop 25.00 GHz
Sweep 64.00 ms (40001 pts)
1 N 1 f 2.441 5 GHz 0.720 dBm
2 N 1 f 4.882 3 GHz -38.744 dBm
Trace/Detector
Select Trace 1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank Trace On
More 1 of 3

CH78


Agilent Spectrum Analyzer - Swept SA
Display Line -19.48 dBm
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 24 dB
Avg Type: Log-Pwr
Avg|Hold:>1/1
10:28:21 PM May 22, 2024
Ref Offset 6.5 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 2.480 2 GHz
0.521 dBm
-19.48 dBm
Start 30 MHz
#Res BW 1.0 MHz
#VBW 1.0 MHz
Stop 25.00 GHz
Sweep 64.00 ms (40001 pts)
1 N 1 f 2.480 2 GHz 0.521 dBm
2 N 1 f 4.960 3 GHz -37.753 dBm
Trace/Detector
Select Trace 1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank Trace On
More 1 of 3

14 Antenna Requirement

14.1 Test Standard and Requirement

Test Standard	FCC Part15 Section 15.203 /247(c)
Requirement	1) 15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. 2) 15.247(c) (1)(i) requirement: Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

14.2 Antenna Connected Construction

The antenna is Chip Antenna which permanently attached, and the best case gain of the antenna is 1.75dBi. It complies with the standard requirement.

15 TEST SETUP & EUT PHOTOGRAPH

Please see the attachment for details.

---------- End of Report ----------