TEST REPORT

Reference No.	:	WTD24D01021765W001
FCC ID	:	2BE2A-S03
Applicant.....	:	YOUNGY HEALTH CO.,LTD.
Address.....	:	No.34 Hehuan Road, High-Tech Development Zone, Hefei, Anhui, China
Manufacturer	:	YOUNGY HEALTH CO.,LTD.
Address.....	:	No.34 Hehuan Road, High-Tech Development Zone, Hefei, Anhui, China
Product.....	:	sauna controller with bluetooth connection
Model(s).	:	S03
Standards.....	:	FCC 47CFR Part 15.247
Date of Receipt sample	:	2024-01-29
Date of Test	:	2024-01-29 to 2024-02-19
Date of Issue.....	:	2024-02-20
Test Result.....	:	**Pass**

Remarks:
The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

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3 Revision History

Test Report No.	Date of Receipt Sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTD24D01021765W001	2024-01-29	2024-01-29 to 2024-02-19	2024-02-20	Original	-	Valid

4 General Information

4.1 General Description of E.U.T.

Product:	sauna controller with bluetooth connection
Model(s):	S03
Bluetooth Version:	V5.0
Hardware Version:	SWV1.0
Software Version:	SWV1.0

4.2 Details of E.U.T.

Operation Frequency:	2402~2480MHz
Max. RF output power:	2.17dBm
Type of Modulation:	GFSK, π/4DQPSK
Antenna installation:	PCB printed antenna
Antenna Gain:	-0.58dBi

Note:
#: The antenna gain is provided by the applicant, and the applicant should be responsible for its authenticity, WALTEK lab has not verified the authenticity of its information.

Ratings:	AC 100V-240V 50-60Hz 30A

4.3 Channel List

Normal

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	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	-	-

4.4 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests; the worst data were recorded and reported.

Test mode	Low channel	Middle channel	High channel
Transmitting	2402MHz	2441MHz	2480MHz

4.5 Test Facility

The test facility has a test site registered with the following organizations:

ISED CAB identifier: CN0013. Test Firm Registration No.: 7760A.

Waltek Testing Group Co., Ltd. Has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration number 7760A, October 15, 2016.

FCC Designation No.: CN1201. Test Firm Registration No.: 523476.

Waltek Testing Group Co., Ltd. EMC Laboratory `has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration number 523476, September 10, 2019.

5 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions	15.205(a) 15.209 15.247(d)	PASS
Conducted Spurious emissions	15.247(d)	PASS
Band edge	15.247(d) 15.205(a)	PASS
Conducted Emission	15.207	PASS
20 dB Bandwidth and 99% 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	Complies
Maximum Permissible Exposure (Exposure of Humans to RF Fields)	1.1307(b)(1)	PASS

6 Equipment Used during Test

6.1 Equipments List

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date	Calibration Due Date
Conducted Emissions 1#						
1	EMI Test Receiver	R&S	ESCI	100947	2023-07-27	2024-07-26
2	LISN	R&S	ENV216	100115	2023-07-27	2024-07-26
3	Cable	Top	TYPE16(3.5M)	-	2023-07-27	2024-07-26
3m Semi-anechoic Chamber for Radiation Emissions 1#						
1	Spectrum Analyzer	R&S	FSP30	100091	2023-04-24	2024-04-23
2	Amplifier	Agilent	8447D	2944A10178	2023-07-27	2024-07-26
3	Tri-log Broadband Antenna	SCHWARZBECK	VULB9163	336	2023-08-07	2024-08-06
4	Coaxial Cable	Top	TYPE16(13M)	-	2023-04-24	2024-04-23
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120D	667	2024-01-23	2025-01-22
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	2023-07-27	2024-07-26
7	Broadband Preamplifier	COMPLIANCE	PAP-1G18	2004	2023-08-08	2024-08-07
8	Coaxial Cable	Top	ZT26-NJ-NJ-8M/FA	-	2024-01-23	2025-01-22
9	Microwave Amplifier	SCHWARZBECK	BBV 9721	100472	2023-07-27	2024-07-26
10	Coaxial Cable	Top	ZT40-2.92J-2.92J-2.0M	17100919	2023-04-24	2024-04-23
3m Semi-anechoic Chamber for Radiation Emissions 2#						
1	Test Receiver	R&S	ESCI	101296	2023-04-24	2024-04-23
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2023-11-04	2024-11-03
3	Active Loop Antenna	Com-Power	AL-130R	10160007	2023-05-07	2024-05-06
4	Amplifier	ANRITSU	MH648A	M43381	2023-04-24	2024-04-23
5	Cable	HUBER+SUHNER	CBL2	525178	2023-04-24	2024-04-23
RF Conducting						
1	Spectrum Analyzer	R&S	FSP40	100501	2023-07-27	2024-07-26
2	Spectrum Analyzer	Agilent	N9020A	MY49100060	2023-07-27	2024-07-26

Test Software:

Test Item	Software name	Software version
Conduction disturbance Radiated Emission(3m)	EZ-EMC	EZ-EMC(RA-03A1-1)

6.2 Measurement Uncertainty

Parameter	Uncertainty
Conducted Emission	± 3.64 dB(AC mains 150KHz~30MHz)
Radiated Spurious Emissions	± 5.08 dB (Bilog antenna 30M~1000MHz)
	± 4.99 dB (Horn antenna 1000M~25000MHz)
Radio Frequency	± 1 x 10^{-7}Hz
RF Power	± 0.42 dB
Dwell time	1.0%
Conducted Spurious Emissions	± 2.76 dB (9kHz~26500MHz)
Confidence interval：95%. Confidence factor:k=2	

7 Conducted Emission

Test Requirement: FCC 47CFR Part 15 Section 15.207

Test Method: ANSI C63.10:2013

Test Result: PASS

Frequency Range: 150kHz to 30MHz

Limit:

Frequency (MHz)	Limit (dBμV)	
	Quasi-pea	Average
0.15 to 0.5	66 to 56*	56 to 46
0.5 to 5	56	46
5to 30	60	50

7.1 E.U.T. Operation

Operating Environment:

Temperature: 23.2 °C

Humidity: 53.2 % RH

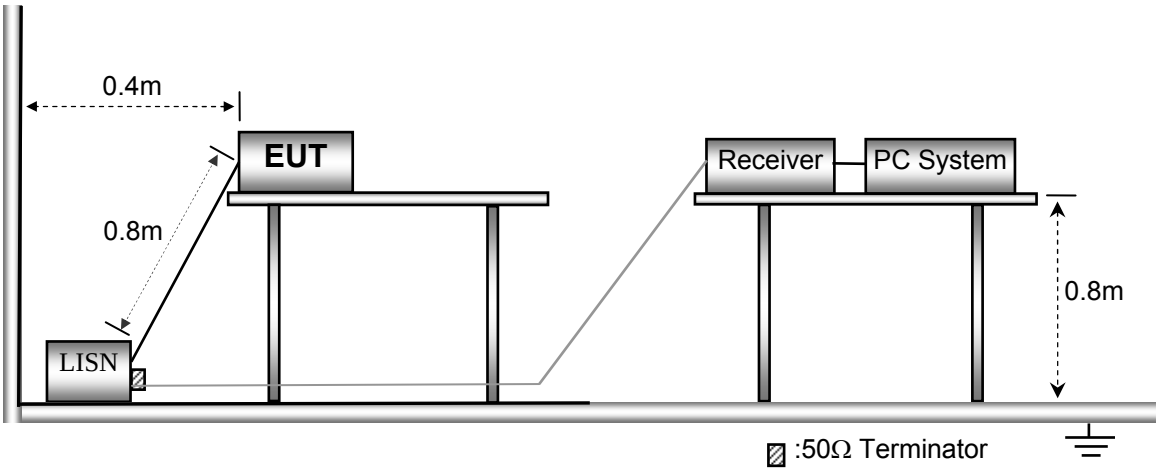
Atmospheric Pressure: 101.5kPa

EUT Operation:

The test was performed in Transmitting mode, the worst test data were shown in the report.

7.2 EUT Setup

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



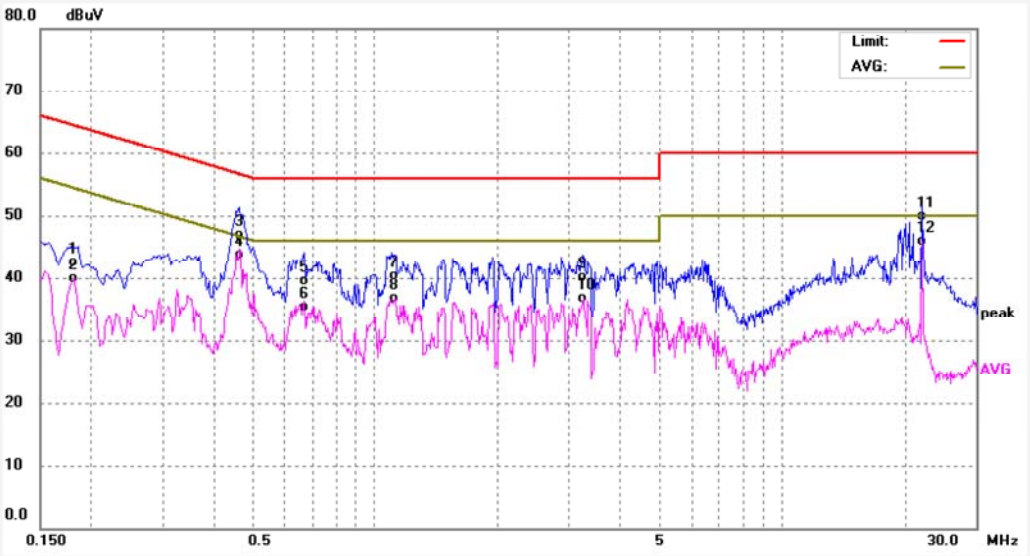
7.3 Measurement Description

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.

7.4 Conducted Emission Test Result

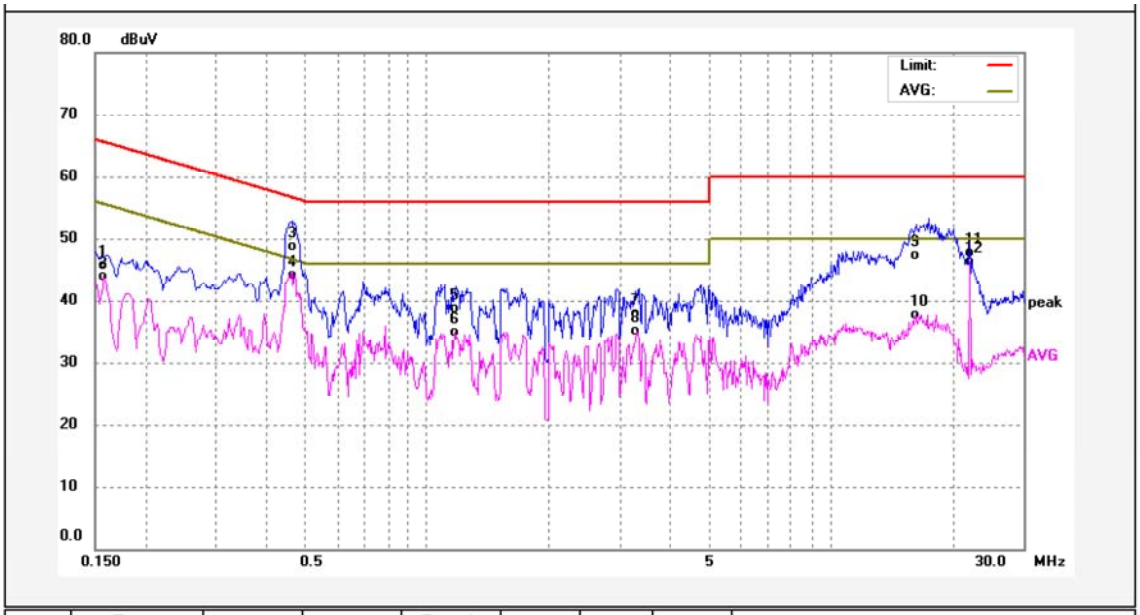
Remark: only the worst data (GFSK modulation Low channel mode) were reported

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1819	32.30	10.30	42.60	64.39	-21.79	QP	
2	0.1819	29.59	10.30	39.89	54.39	-14.50	AVG	
3	0.4660	36.47	10.51	46.98	56.58	-9.60	QP	
4	0.4660	33.27	10.51	43.78	46.58	-2.80	AVG	
5	0.6700	28.88	10.57	39.45	56.00	-16.55	QP	
6	0.6700	24.80	10.57	35.37	46.00	-10.63	AVG	
7	1.1180	29.62	10.74	40.36	56.00	-15.64	QP	
8	1.1180	25.99	10.74	36.73	46.00	-9.27	AVG	
9	3.2580	29.17	10.84	40.01	56.00	-15.99	QP	
10	3.2580	25.78	10.84	36.62	46.00	-9.38	AVG	
11	22.1097	38.85	11.01	49.86	60.00	-10.14	QP	
12	22.1097	34.99	11.01	46.00	50.00	-4.00	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1580	35.55	10.08	45.63	65.56	-19.93	QP	
2	0.1580	33.73	10.08	43.81	55.56	-11.75	AVG	
3	0.4620	38.25	10.51	48.76	56.66	-7.90	QP	
4	0.4620	33.58	10.51	44.09	46.66	-2.57	AVG	
5	1.1697	28.17	10.52	38.69	56.00	-17.31	QP	
6	1.1697	24.36	10.52	34.88	46.00	-11.12	AVG	
7	3.3060	27.01	10.88	37.89	56.00	-18.11	QP	
8	3.3060	24.31	10.88	35.19	46.00	-10.81	AVG	
9	16.1496	36.39	10.83	47.22	60.00	-12.78	QP	
10	16.1496	26.93	10.83	37.76	50.00	-12.24	AVG	
11	22.1097	36.85	10.80	47.65	60.00	-12.35	QP	
12	22.1097	35.50	10.80	46.30	50.00	-3.70	AVG	

8 Radiated Spurious Emissions

Test Requirement: FCC 47CFR Part 15 Section 15.205 &15.209 & 15.247

Test Method: ANSI C63.10: 2013

Test Result: PASS

Measurement Distance: 3m

Limit:

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	$20\log^{(500)}$

8.1 EUT Operation

Operating Environment **:**

Temperature: 23.1 °C

Humidity: 54.3% RH

Atmospheric Pressure: 101.2kPa

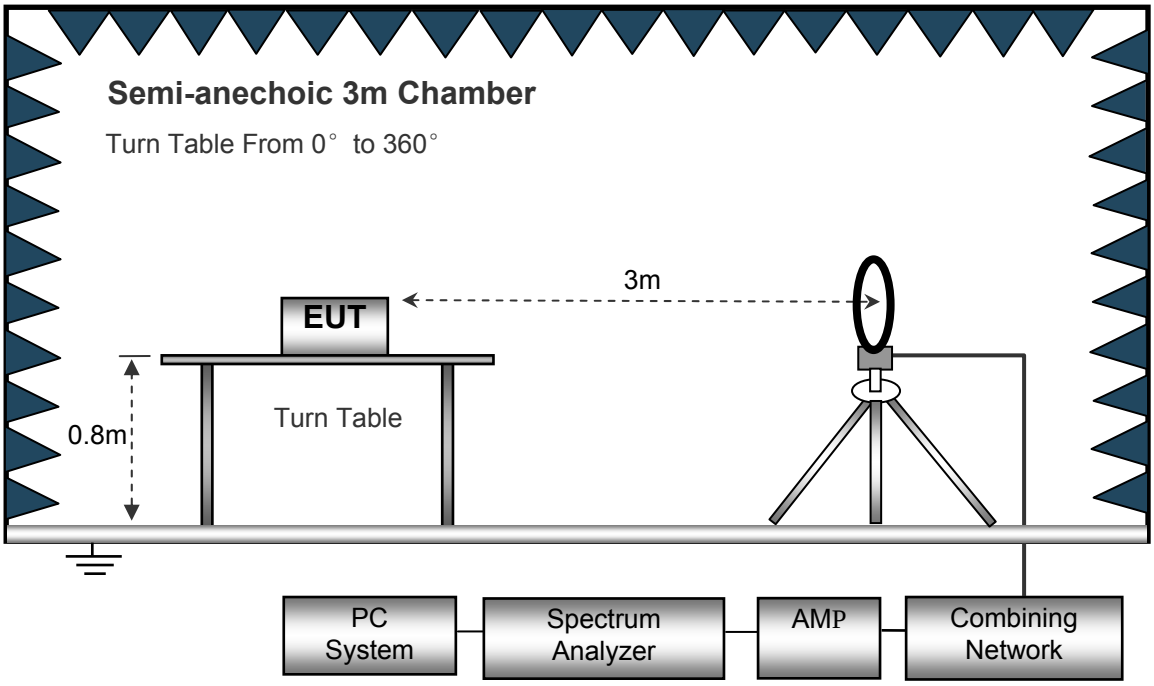
EUT Operation :

The test was performed in Transmitting mode, the worst test data were shown in the report.

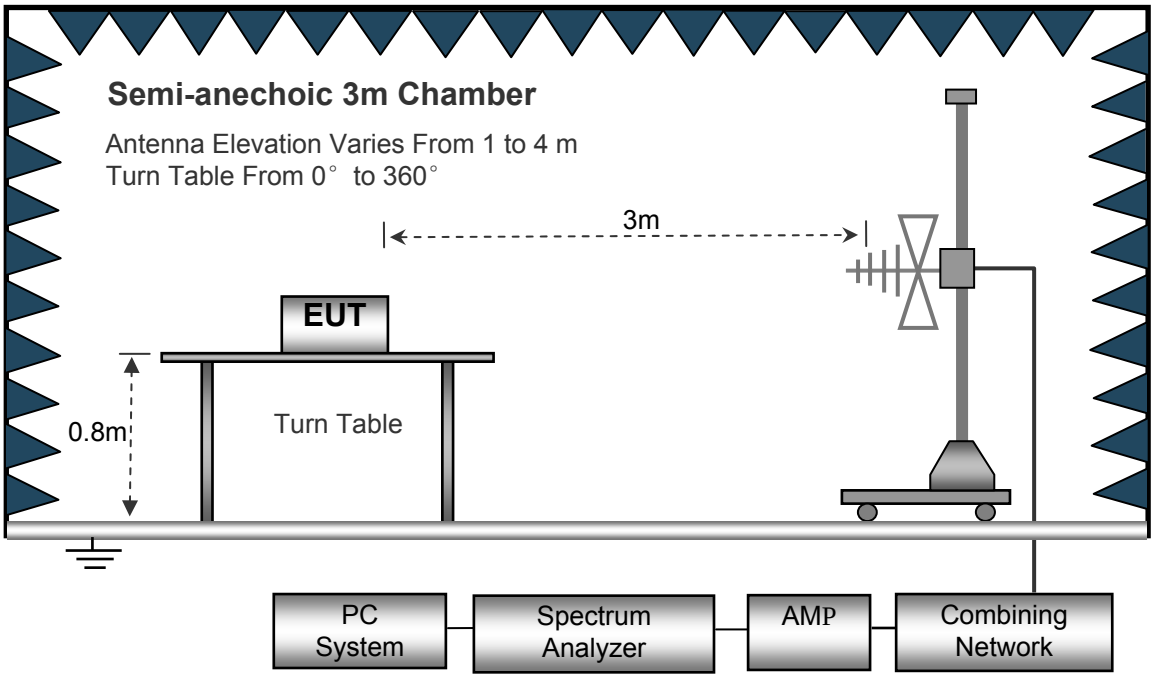
8.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10: 2013.

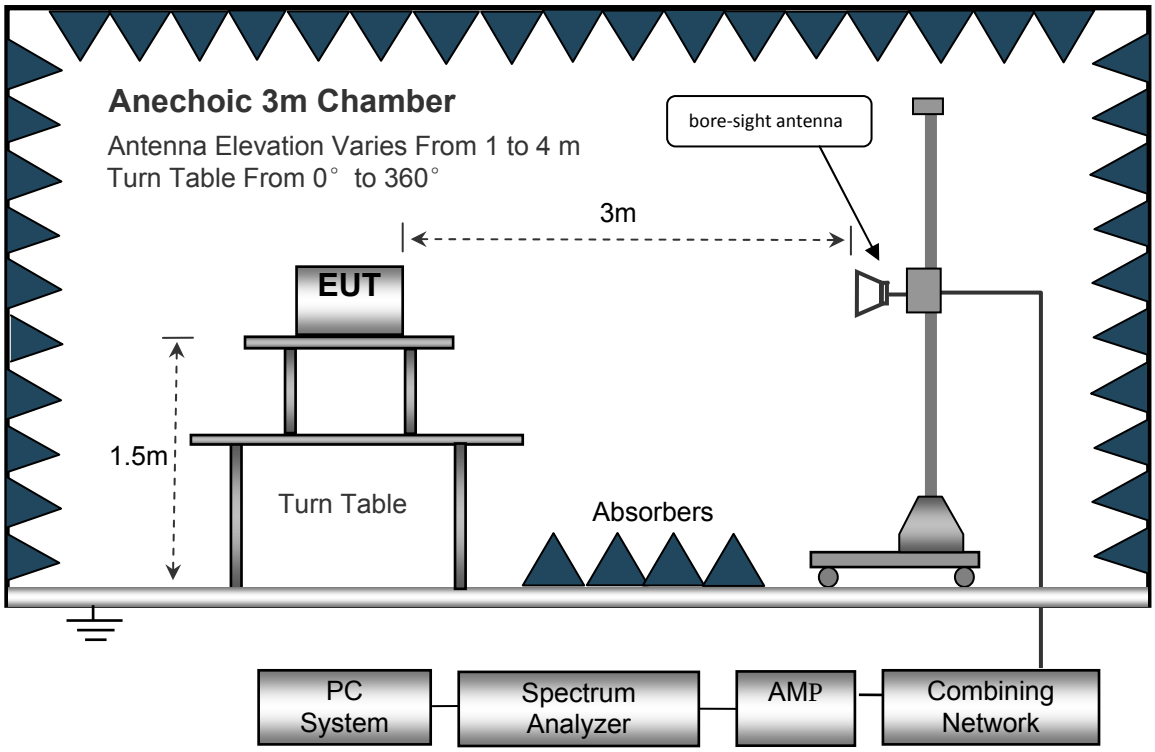
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



8.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed ..... Auto
IF Bandwidth..... 10kHz
Video Bandwidth..... 10kHz

Resolution Bandwidth..... 10kHz

30MHz ~ 1GHz

Sweep Speed ..... Auto
Detector ..... PK
Resolution Bandwidth..... 100kHz
Video Bandwidth..... 300kHz

Above 1GHz

Sweep Speed ..... Auto
Detector ..... PK
Resolution Bandwidth..... 1MHz
Video Bandwidth..... 3MHz
Detector ..... Ave.
Resolution Bandwidth..... 1MHz
Video Bandwidth..... 10Hz

8.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane for below 1GHz and 1.5m for above 1GHz.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
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 Z position. So the data shown was the Z position only.

8.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – Limit

8.6 Summary of Test Results

Test Frequency: 9KHz~30MHz

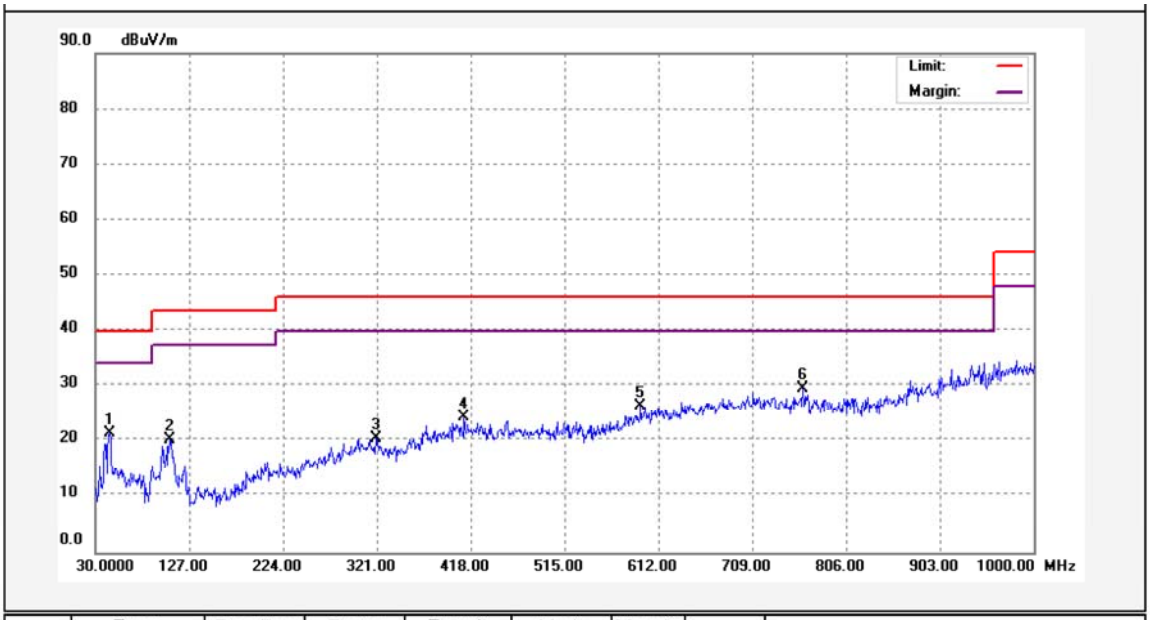
The measurements were more than 20 dB below the limit and not reported.

Frequency: 2402 MHz

Mode: DH5

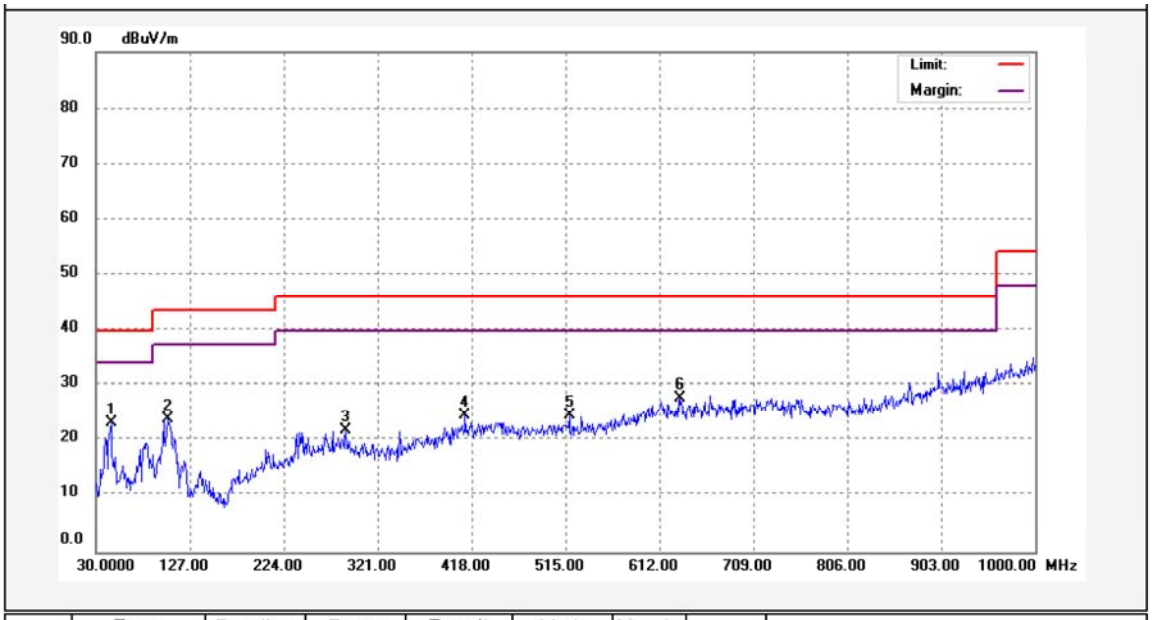
Frequency Range: 30MHz ~ 1000MHz

Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	44.5500	35.54	-14.03	21.51	40.00	-18.49	peak	
2	106.6300	34.15	-13.78	20.37	43.50	-23.13	peak	
3	320.0298	28.50	-7.98	20.52	46.00	-25.48	peak	
4	411.2100	31.39	-6.97	24.42	46.00	-21.58	peak	
5	593.5700	28.97	-2.53	26.44	46.00	-19.56	peak	
6	761.3800	30.02	-0.48	29.54	46.00	-16.46	peak	

Antenna Polarization: Vertical



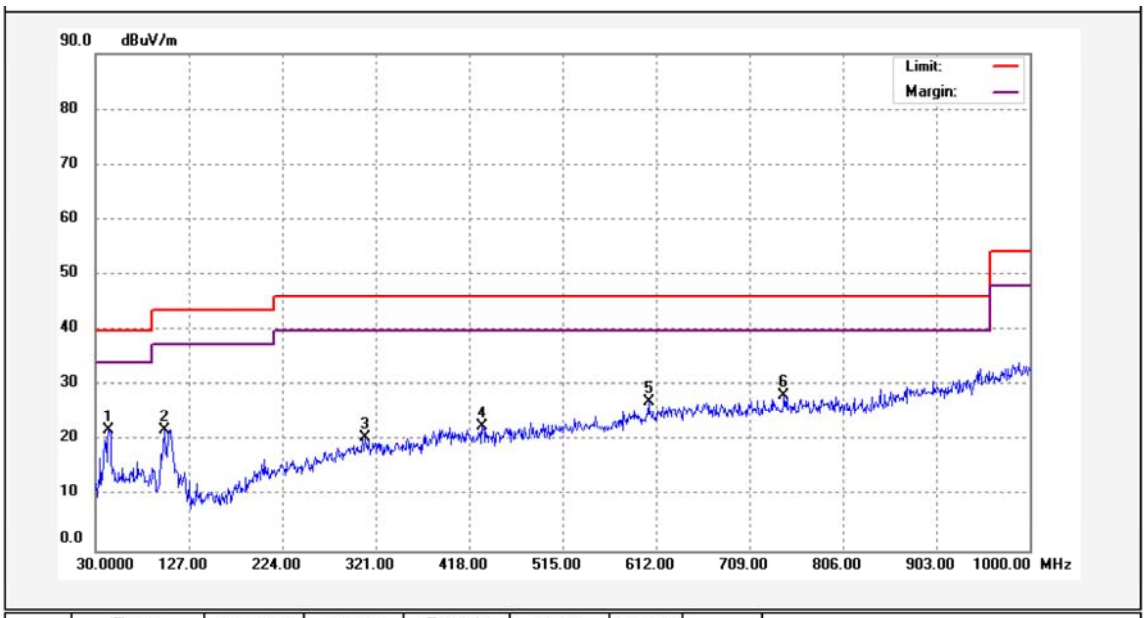
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	45.5200	37.19	-13.97	23.22	40.00	-16.78	peak	
2	104.6898	37.67	-13.66	24.01	43.50	-19.49	peak	
3	288.0200	30.86	-8.84	22.02	46.00	-23.98	peak	
4	411.2100	31.50	-6.97	24.53	46.00	-21.47	peak	
5	518.8800	30.34	-5.62	24.72	46.00	-21.28	peak	
6	633.3400	29.49	-1.67	27.82	46.00	-18.18	peak	

Frequency: 2402 MHz

Mode: 2DH5

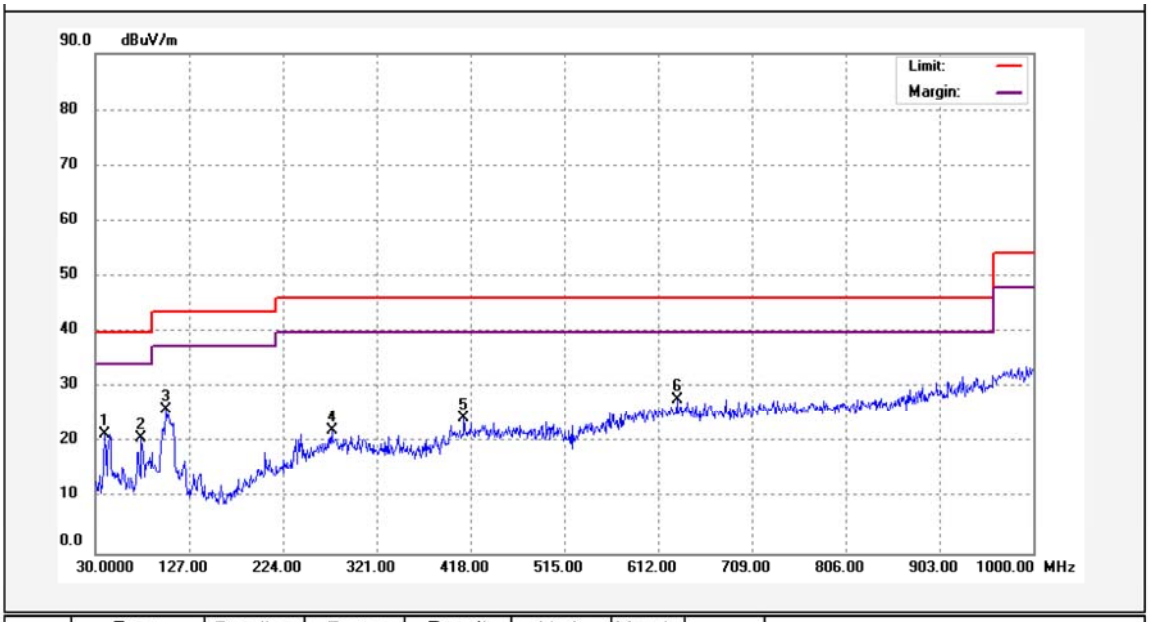
Frequency Range: 30MHz ~ 1000MHz

Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	43.5800	36.02	-14.12	21.90	40.00	-18.10	peak	
2	101.7800	35.51	-13.60	21.91	43.50	-21.59	peak	
3	309.3599	28.53	-8.04	20.49	46.00	-25.51	peak	
4	431.5800	29.31	-6.72	22.59	46.00	-23.41	peak	
5	604.2400	29.06	-2.04	27.02	46.00	-18.98	peak	
6	744.8900	28.67	-0.52	28.15	46.00	-17.85	peak	

Antenna Polarization: Vertical



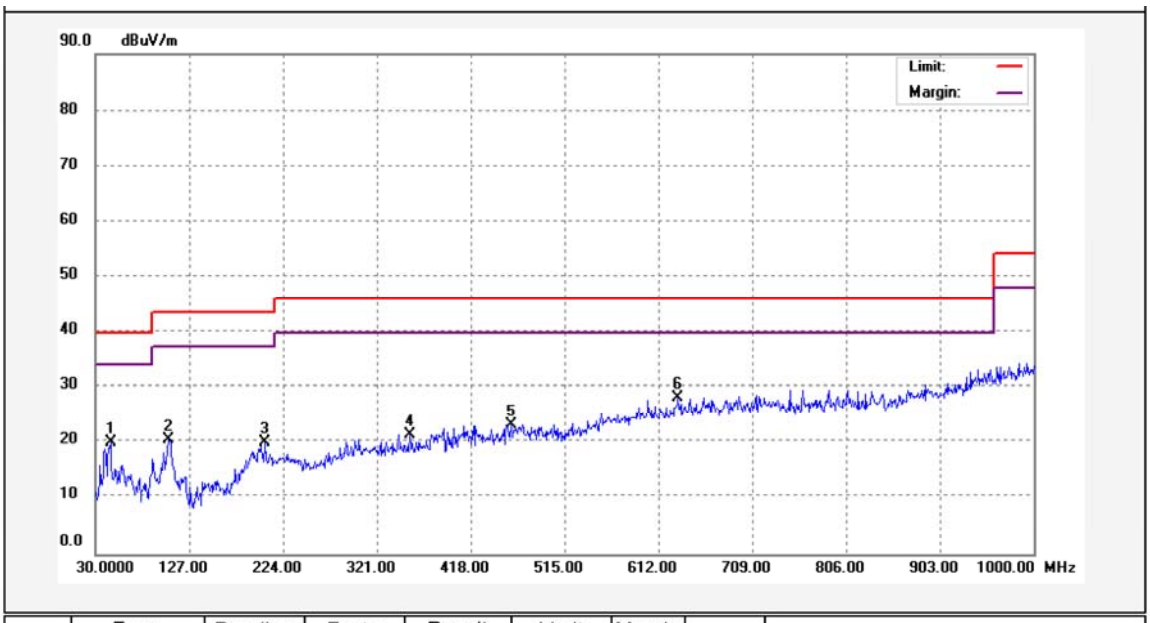
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	39.7000	36.00	-14.50	21.50	40.00	-18.50	peak	
2	77.5300	37.82	-16.96	20.86	40.00	-19.14	peak	
3	102.7500	39.67	-13.61	26.06	43.50	-17.44	peak	
4	274.4400	31.91	-9.68	22.23	46.00	-23.77	peak	
5	411.2100	31.44	-6.97	24.47	46.00	-21.53	peak	
6	631.4000	29.38	-1.69	27.69	46.00	-18.31	peak	

Frequency: 2441 MHz

Mode: DH5

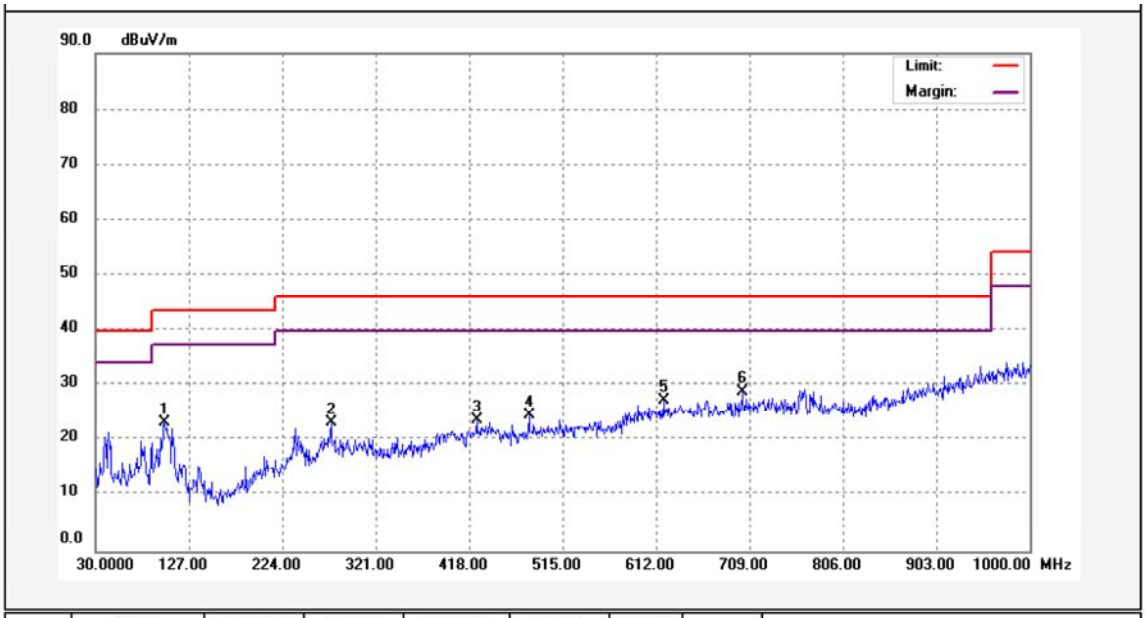
Frequency Range: 30MHz ~ 1000MHz

Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	45.5200	34.06	-13.97	20.09	40.00	-19.91	peak	
2	105.6598	34.40	-13.71	20.69	43.50	-22.81	peak	
3	205.5697	32.44	-12.25	20.19	43.50	-23.31	peak	
4	354.9500	29.30	-7.73	21.57	46.00	-24.43	peak	
5	459.7100	29.72	-6.36	23.36	46.00	-22.64	peak	
6	632.3700	29.97	-1.68	28.29	46.00	-17.71	peak	

Antenna Polarization: Vertical



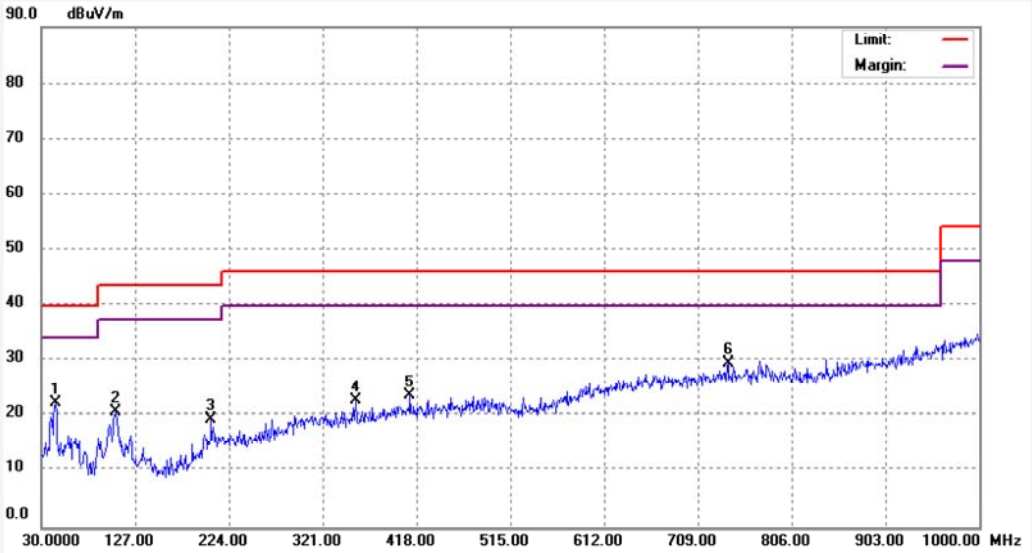
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	101.7800	36.92	-13.60	23.32	43.50	-20.18	peak	
2	274.4400	32.86	-9.68	23.18	46.00	-22.82	peak	
3	425.7600	30.52	-6.78	23.74	46.00	-22.26	peak	
4	480.0800	30.70	-6.08	24.62	46.00	-21.38	peak	
5	619.7600	29.19	-1.84	27.35	46.00	-18.65	peak	
6	701.2400	29.76	-0.87	28.89	46.00	-17.11	peak	

Frequency: 2441 MHz

Mode: 2DH5

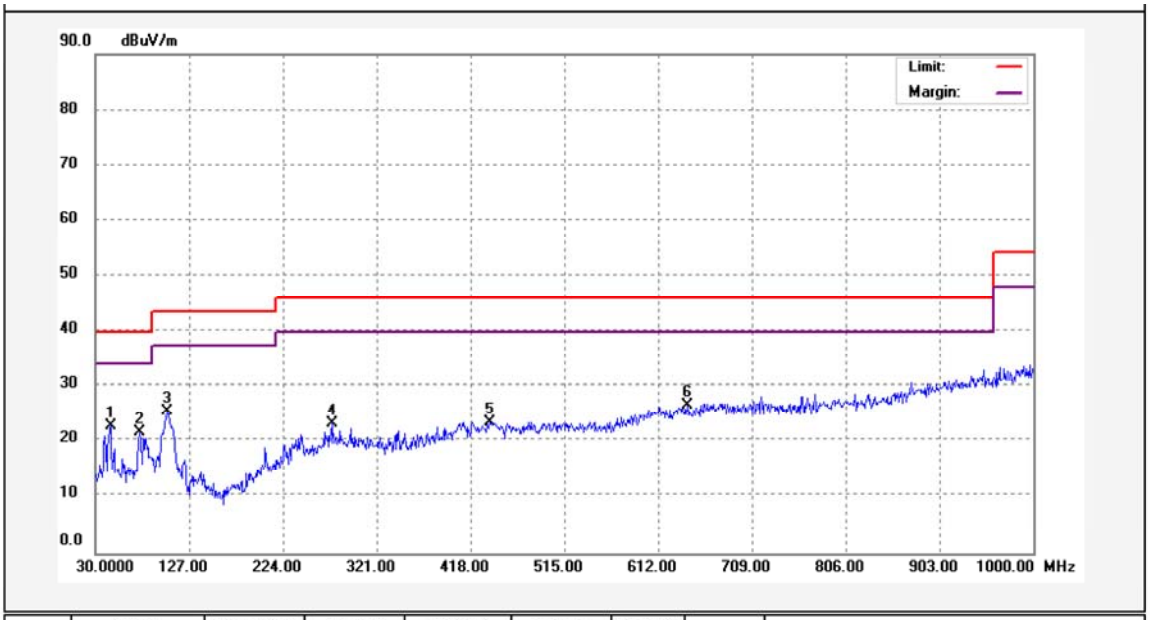
Frequency Range: 30MHz ~ 1000MHz

Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	44.5500	36.38	-14.03	22.35	40.00	-17.65	peak	
2	106.6300	34.61	-13.78	20.83	43.50	-22.67	peak	
3	205.5697	31.67	-12.25	19.42	43.50	-24.08	peak	
4	354.9500	30.49	-7.73	22.76	46.00	-23.24	peak	
5	411.2100	30.73	-6.97	23.76	46.00	-22.24	peak	
6	740.0398	30.07	-0.56	29.51	46.00	-16.49	peak	

Antenna Polarization: Vertical



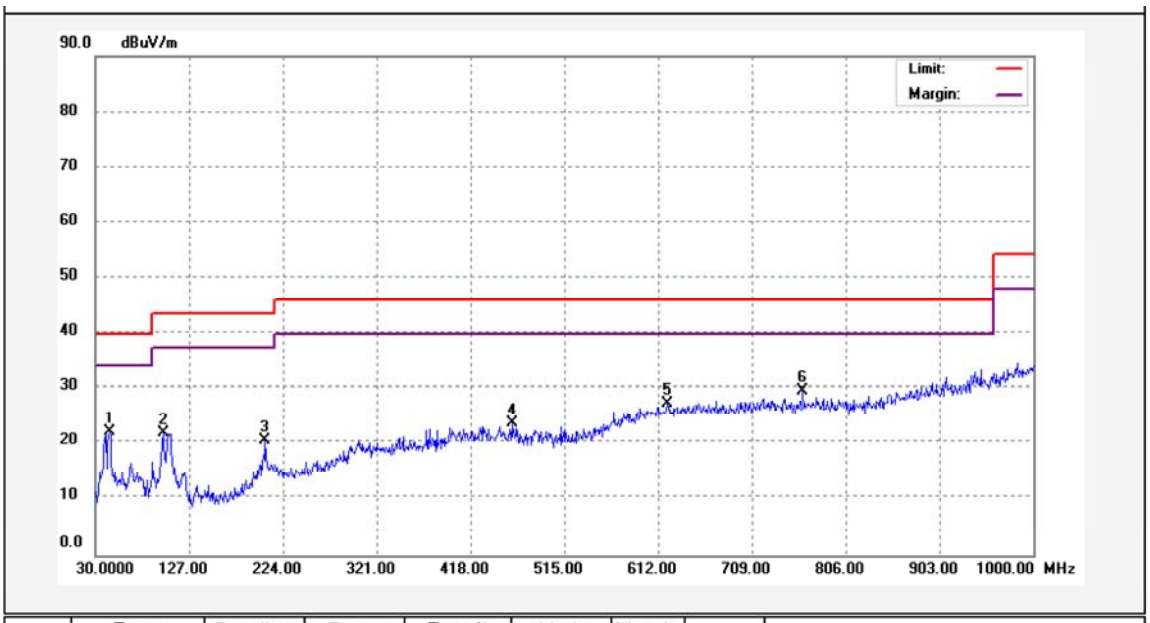
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	45.5200	36.88	-13.97	22.91	40.00	-17.09	peak	
2	75.5899	38.43	-16.72	21.71	40.00	-18.29	peak	
3	103.7198	39.11	-13.63	25.48	43.50	-18.02	peak	
4	274.4400	33.03	-9.68	23.35	46.00	-22.65	peak	
5	437.4000	30.26	-6.65	23.61	46.00	-22.39	peak	
6	642.0700	28.18	-1.55	26.63	46.00	-19.37	peak	

Frequency: 2480 MHz

Mode: DH5

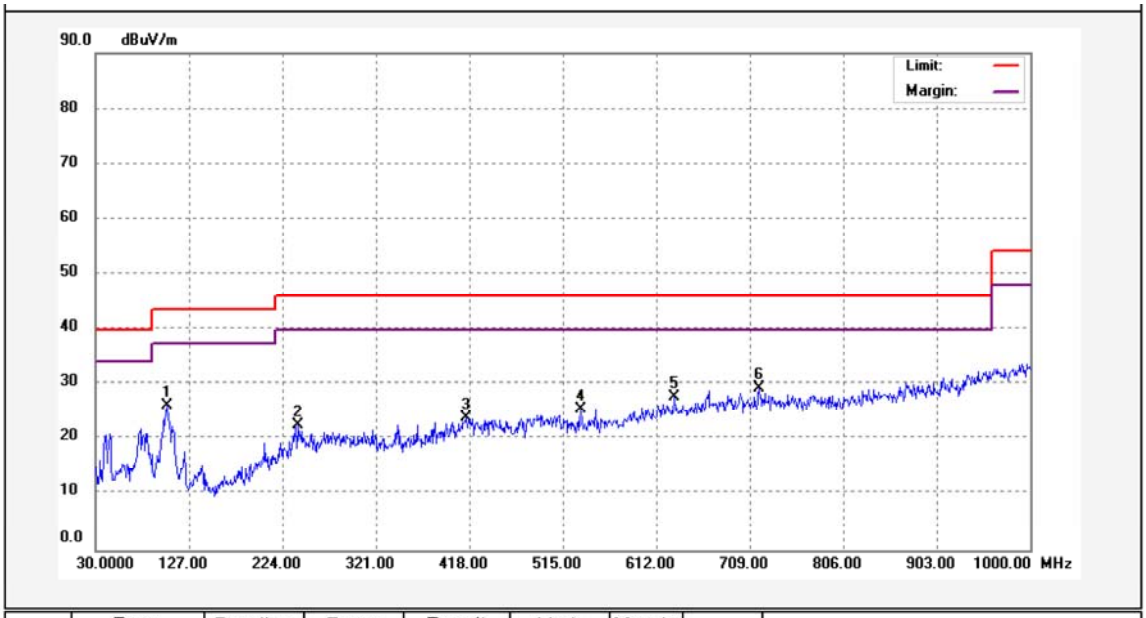
Frequency Range: 30MHz ~ 1000MHz

Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	44.5500	36.15	-14.03	22.12	40.00	-17.88	peak	
2	99.8399	35.55	-13.58	21.97	43.50	-21.53	peak	
3	205.5697	32.83	-12.25	20.58	43.50	-22.92	peak	
4	460.6800	30.01	-6.35	23.66	46.00	-22.34	peak	
5	621.7000	29.10	-1.81	27.29	46.00	-18.71	peak	
6	761.3800	30.01	-0.48	29.53	46.00	-16.47	peak	

Antenna Polarization: Vertical



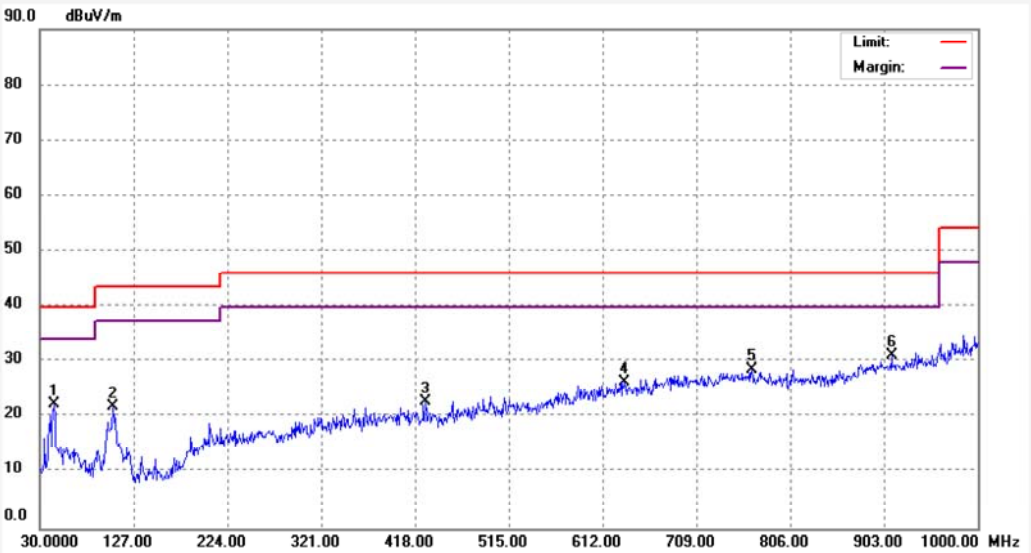
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	104.6898	39.78	-13.66	26.12	43.50	-17.38	peak	
2	239.5200	34.05	-11.45	22.60	46.00	-23.40	peak	
3	415.0900	30.85	-6.92	23.93	46.00	-22.07	peak	
4	533.4298	31.16	-5.51	25.65	46.00	-20.35	peak	
5	630.4298	29.42	-1.71	27.71	46.00	-18.29	peak	
6	718.7000	30.11	-0.73	29.38	46.00	-16.62	peak	

Frequency: 2480 MHz

Mode: 2DH5

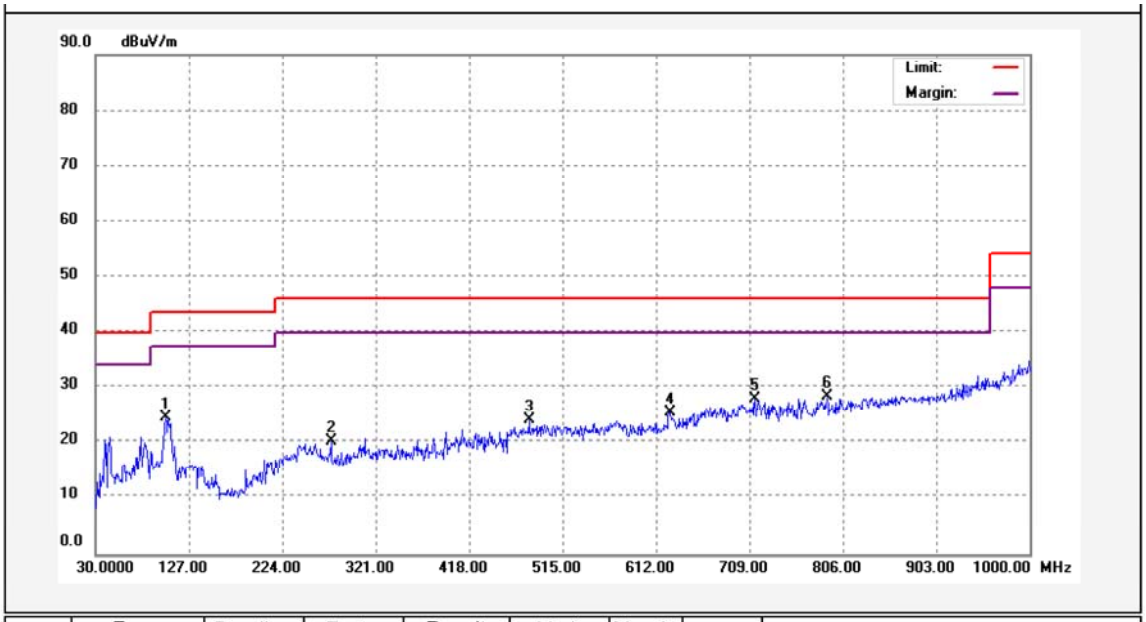
Frequency Range: 30MHz ~ 1000MHz

Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	44.5500	36.32	-14.03	22.29	40.00	-17.71	peak	
2	105.6598	35.75	-13.71	22.04	43.50	-21.46	peak	
3	428.6700	29.64	-6.75	22.89	46.00	-23.11	peak	
4	634.3096	28.16	-1.65	26.51	46.00	-19.49	peak	
5	766.2300	29.20	-0.49	28.71	46.00	-17.29	peak	
6	910.7600	28.14	3.02	31.16	46.00	-14.84	peak	

Antenna Polarization: Vertical



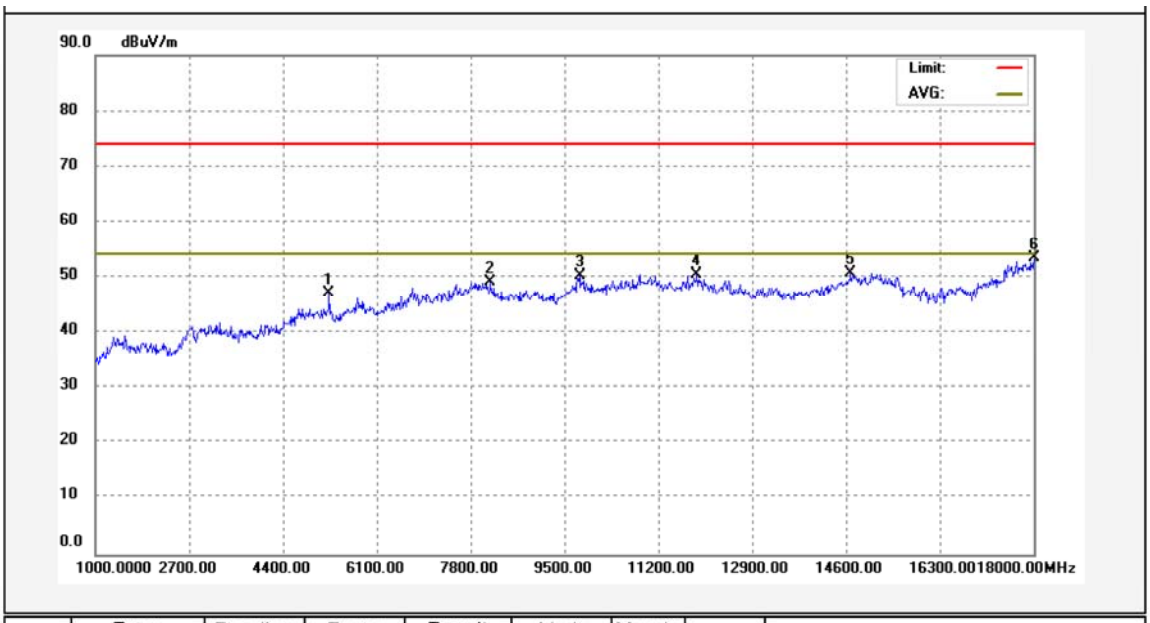
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	102.7500	38.30	-13.61	24.69	43.50	-18.81	peak	
2	274.4400	30.08	-9.68	20.40	46.00	-25.60	peak	
3	480.0800	30.24	-6.08	24.16	46.00	-21.84	peak	
4	626.5498	27.36	-1.75	25.61	46.00	-20.39	peak	
5	714.8200	28.72	-0.76	27.96	46.00	-18.04	peak	
6	789.5100	28.89	-0.49	28.40	46.00	-17.60	peak	

Frequency: 2402 MHz

Mode: DH5

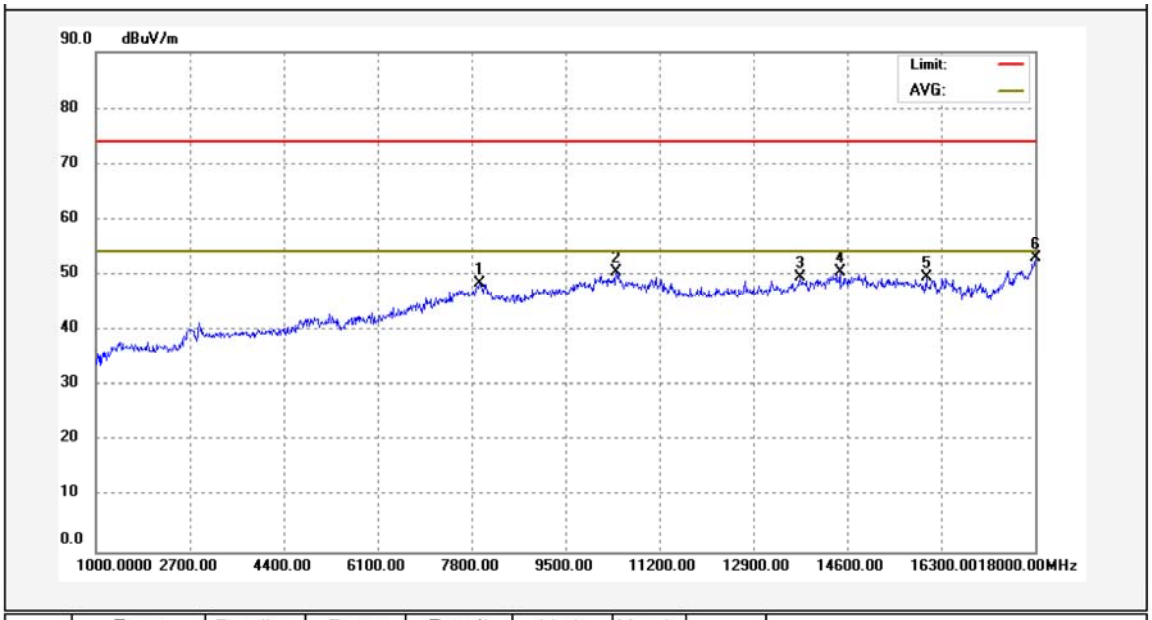
Frequency Range: 1GHz ~ 18GHz

Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	5233.000	50.75	-3.66	47.09	74.00	-26.91	peak	
2	8157.000	46.36	2.85	49.21	74.00	-24.79	peak	
3	9772.000	46.01	4.18	50.19	74.00	-23.81	peak	
4	11897.000	44.65	5.87	50.52	74.00	-23.48	peak	
5	14685.000	42.22	8.58	50.80	74.00	-23.20	peak	
6	18000.000	35.56	17.87	53.43	74.00	-20.57	peak	

Antenna Polarization: Vertical



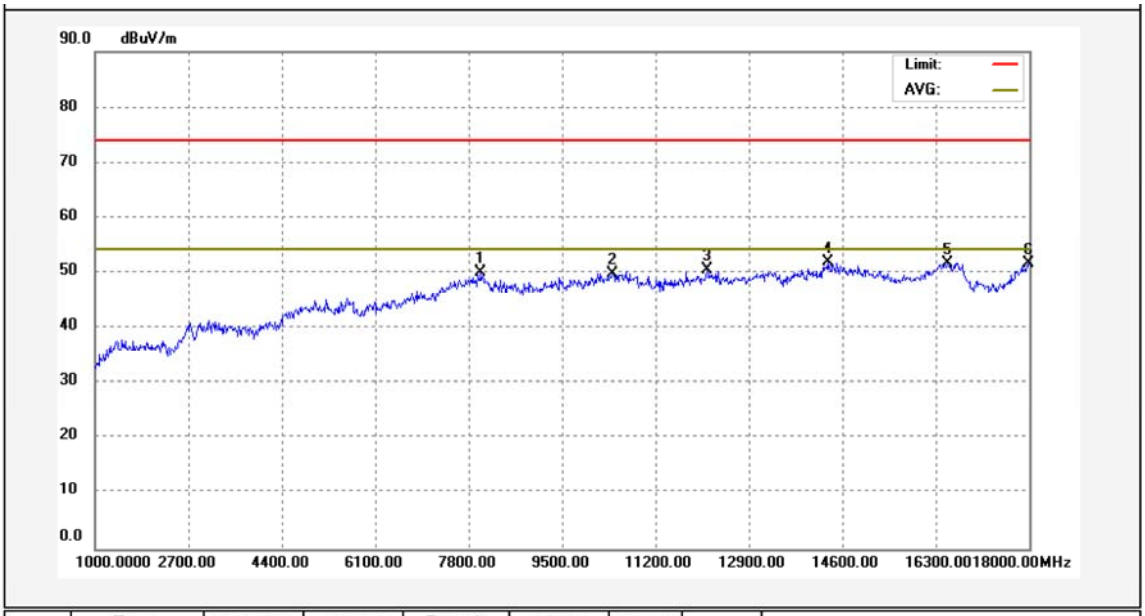
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	7936.000	45.53	2.85	48.38	74.00	-25.62	peak	
2	10418.000	45.12	5.48	50.60	74.00	-23.40	peak	
3	13750.000	41.25	8.46	49.71	74.00	-24.29	peak	
4	14464.000	41.93	8.57	50.50	74.00	-23.50	peak	
5	16028.000	41.05	8.52	49.57	74.00	-24.43	peak	
6	18000.000	35.03	17.87	52.90	74.00	-21.10	peak	

Frequency: 2402 MHz

Mode: 2DH5

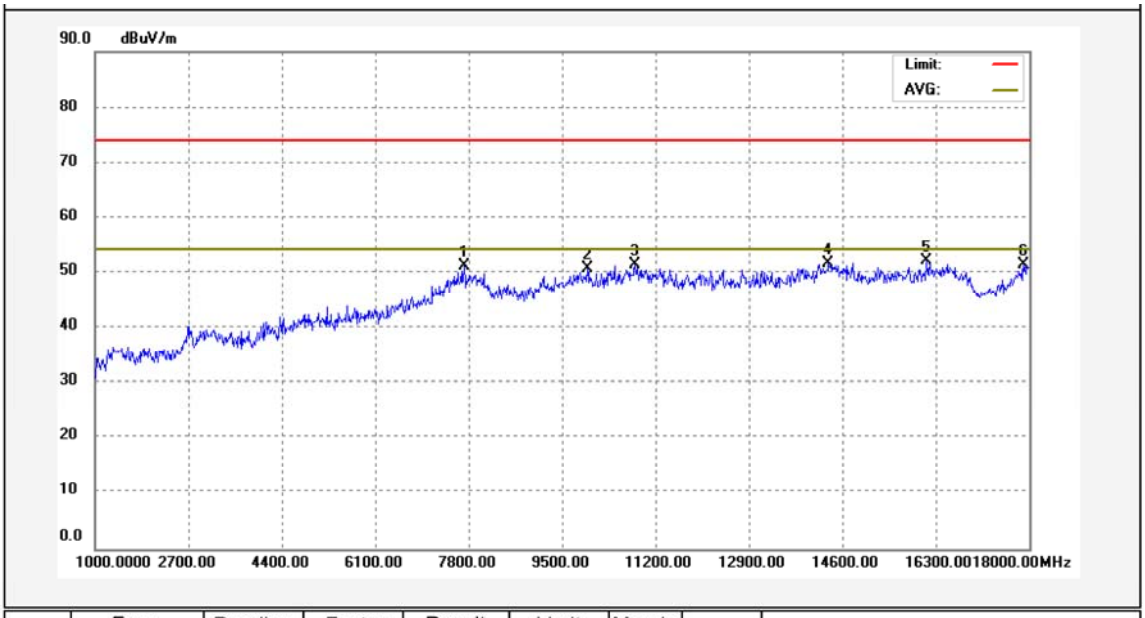
Frequency Range: 1GHz ~ 18GHz

Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	8021.000	47.06	2.93	49.99	74.00	-24.01	peak	
2	10418.000	44.46	5.48	49.94	74.00	-24.06	peak	
3	12135.000	44.74	5.85	50.59	74.00	-23.41	peak	
4	14328.000	43.21	8.59	51.80	74.00	-22.20	peak	
5	16504.000	41.31	10.42	51.73	74.00	-22.27	peak	
6	17983.000	33.91	17.77	51.68	74.00	-22.32	peak	

Antenna Polarization: Vertical



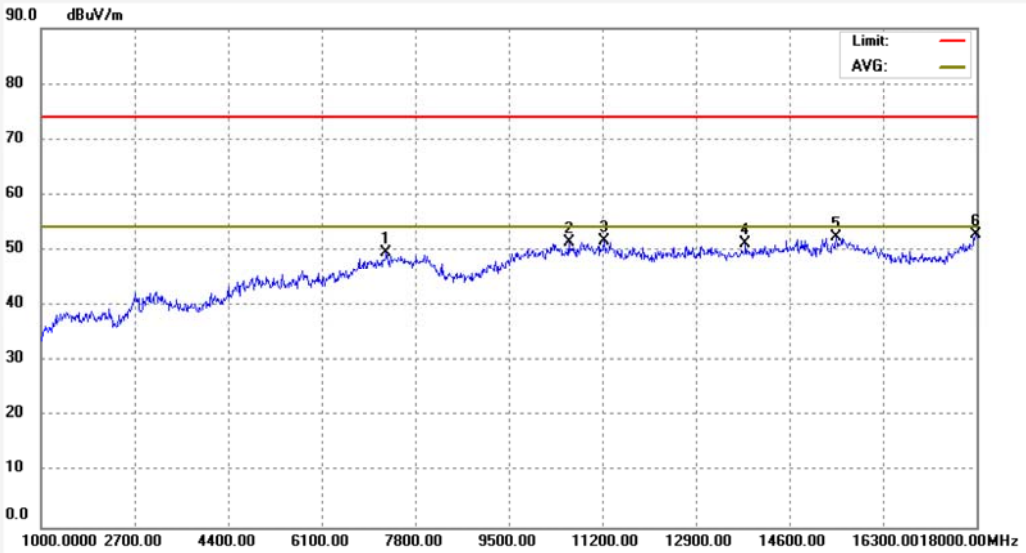
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	7715.000	48.60	2.54	51.14	74.00	-22.86	peak	
2	9959.000	46.41	4.26	50.67	74.00	-23.33	peak	
3	10826.000	45.17	6.14	51.31	74.00	-22.69	peak	
4	14345.000	43.06	8.59	51.65	74.00	-22.35	peak	
5	16130.000	43.08	8.93	52.01	74.00	-21.99	peak	
6	17898.000	34.06	17.28	51.34	74.00	-22.66	peak	

Frequency: 2441 MHz

Mode: DH5

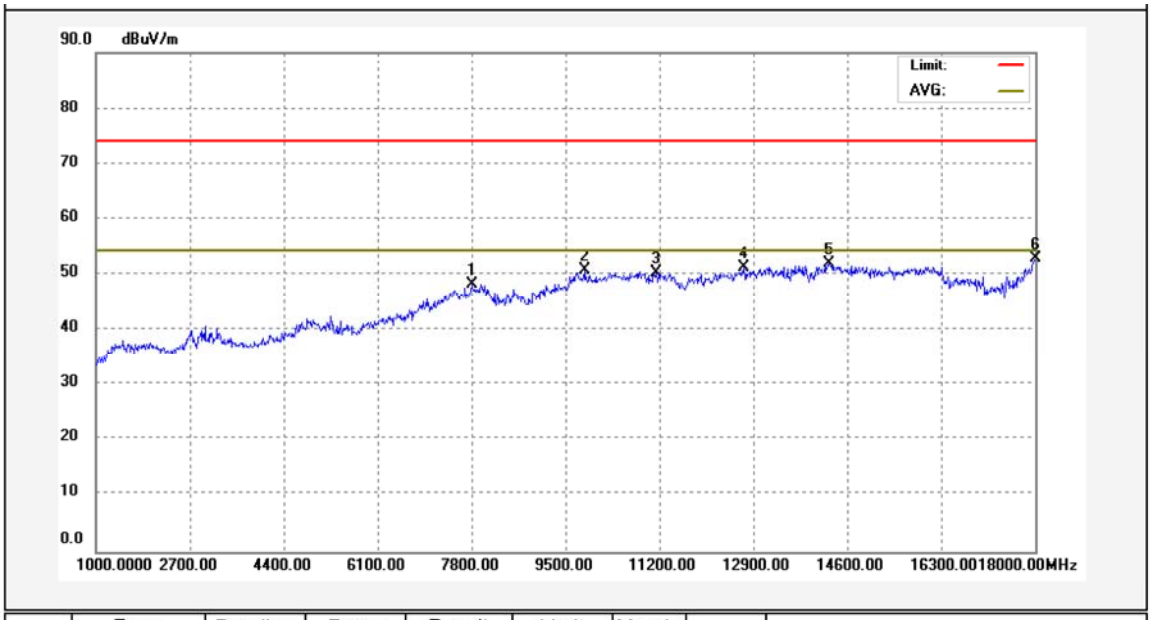
Frequency Range: 1GHz ~ 18GHz

Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	7273.000	47.82	1.85	49.67	74.00	-24.33	peak	
2	10588.000	45.49	5.83	51.32	74.00	-22.68	peak	
3	11234.000	45.34	6.31	51.65	74.00	-22.35	peak	
4	13801.000	42.77	8.50	51.27	74.00	-22.73	peak	
5	15450.000	43.94	8.46	52.40	74.00	-21.60	peak	
6	17983.000	35.08	17.77	52.85	74.00	-21.15	peak	

Antenna Polarization: Vertical



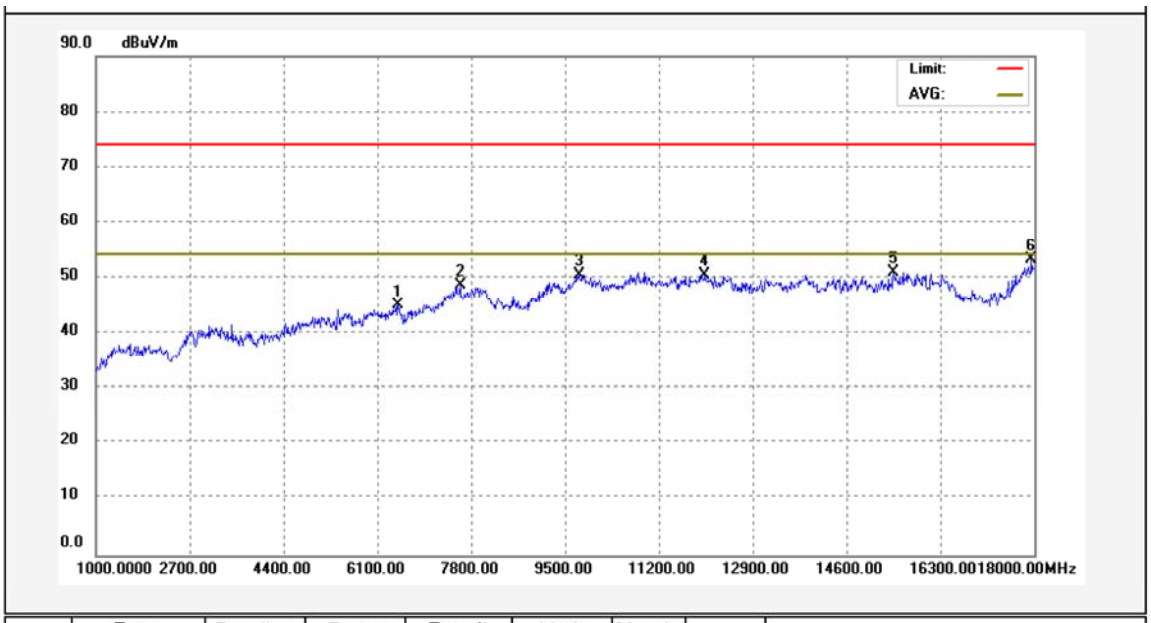
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	7800.000	45.66	2.67	48.33	74.00	-25.67	peak	
2	9840.000	46.51	4.20	50.71	74.00	-23.29	peak	
3	11149.000	43.94	6.33	50.27	74.00	-23.73	peak	
4	12730.000	44.62	6.53	51.15	74.00	-22.85	peak	
5	14260.000	43.24	8.60	51.84	74.00	-22.16	peak	
6	18000.000	34.92	17.87	52.79	74.00	-21.21	peak	

Frequency: 2441 MHz

Mode: 2DH5

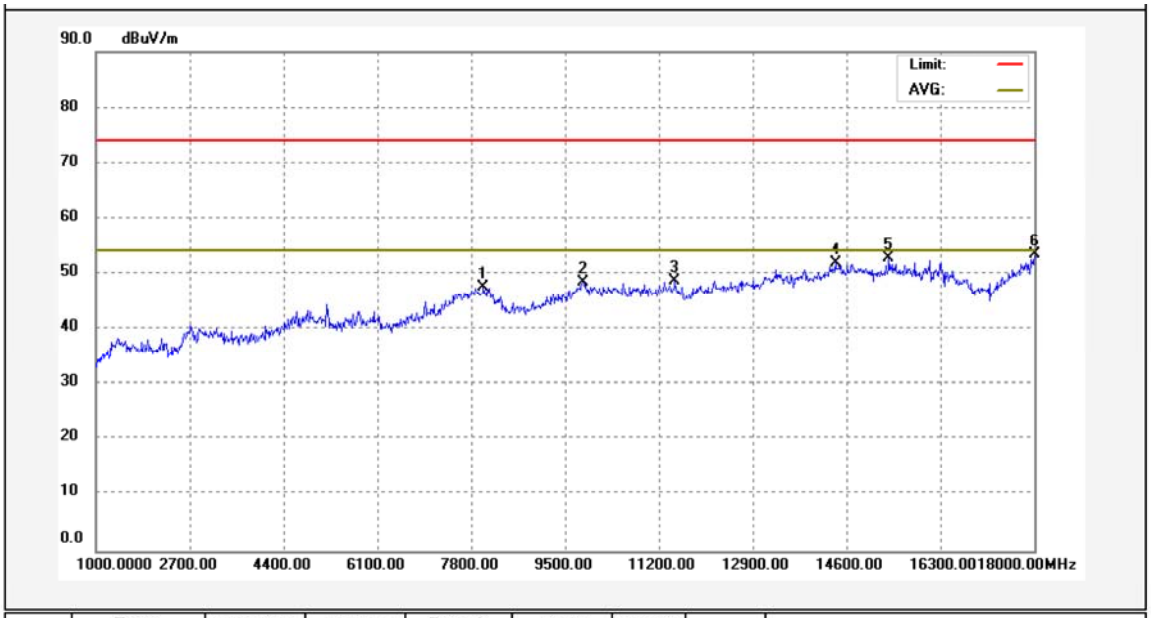
Frequency Range: 1GHz ~ 18GHz

Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	6474.000	45.71	-0.62	45.09	74.00	-28.91	peak	
2	7596.000	46.24	2.37	48.61	74.00	-25.39	peak	
3	9755.000	46.38	4.16	50.54	74.00	-23.46	peak	
4	12033.000	44.79	5.79	50.58	74.00	-23.42	peak	
5	15450.000	42.46	8.46	50.92	74.00	-23.08	peak	
6	17949.000	35.60	17.57	53.17	74.00	-20.83	peak	

Antenna Polarization: Vertical



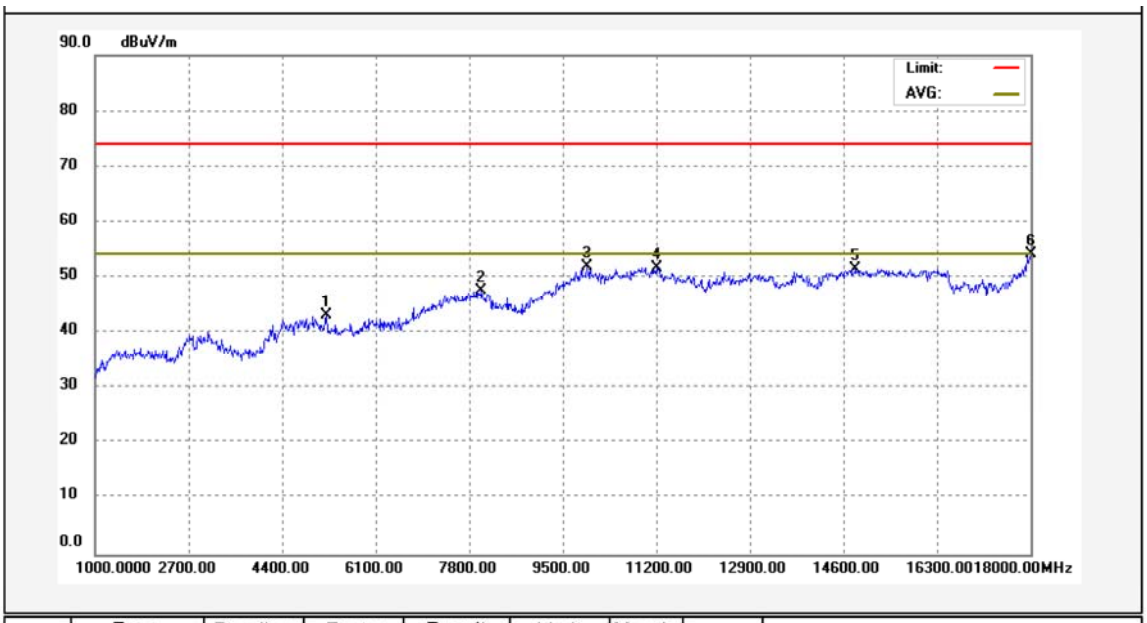
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	8021.000	44.68	2.93	47.61	74.00	-26.39	peak	
2	9823.000	44.26	4.20	48.46	74.00	-25.54	peak	
3	11489.000	42.34	6.27	48.61	74.00	-25.39	peak	
4	14396.000	43.27	8.58	51.85	74.00	-22.15	peak	
5	15365.000	44.18	8.48	52.66	74.00	-21.34	peak	
6	18000.000	35.58	17.87	53.45	74.00	-20.55	peak	

Frequency: 2480 MHz

Mode: DH5

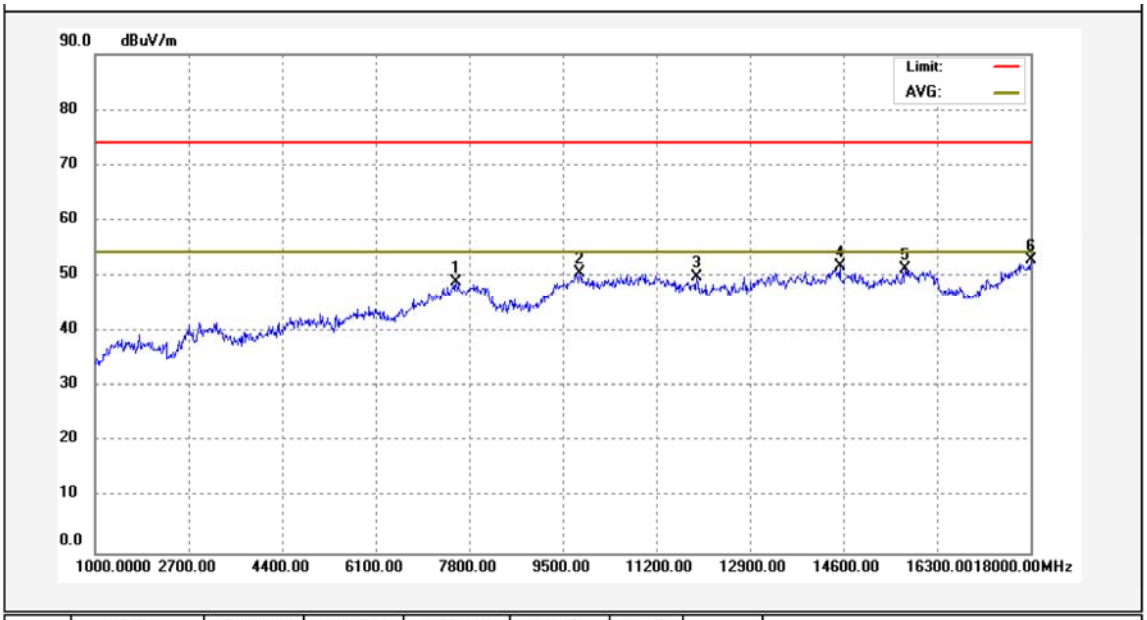
Frequency Range: 1GHz ~ 18GHz

Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	5199.000	46.70	-3.68	43.02	74.00	-30.98	peak	
2	8021.000	44.66	2.93	47.59	74.00	-26.41	peak	
3	9942.000	47.61	4.24	51.85	74.00	-22.15	peak	
4	11200.000	45.35	6.32	51.67	74.00	-22.33	peak	
5	14821.000	42.82	8.57	51.39	74.00	-22.61	peak	
6	18000.000	36.18	17.87	54.05	74.00	-19.95	peak	

Antenna Polarization: Vertical



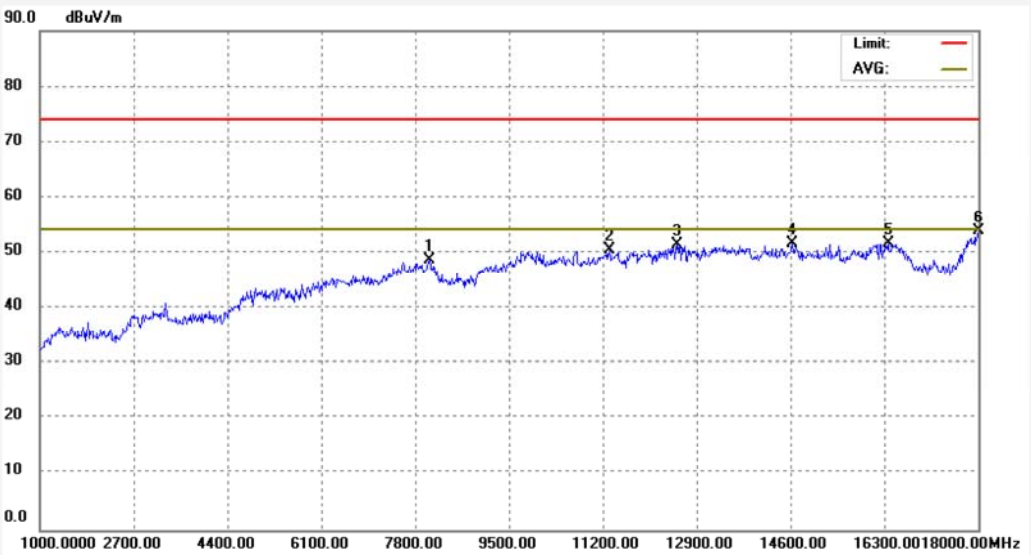
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	7562.000	46.54	2.34	48.88	74.00	-25.12	peak	
2	9806.000	46.25	4.18	50.43	74.00	-23.57	peak	
3	11931.000	44.03	5.84	49.87	74.00	-24.13	peak	
4	14532.000	43.01	8.57	51.58	74.00	-22.42	peak	
5	15722.000	42.85	8.43	51.28	74.00	-22.72	peak	
6	18000.000	34.83	17.87	52.70	74.00	-21.30	peak	

Frequency: 2480 MHz

Mode: 2DH5

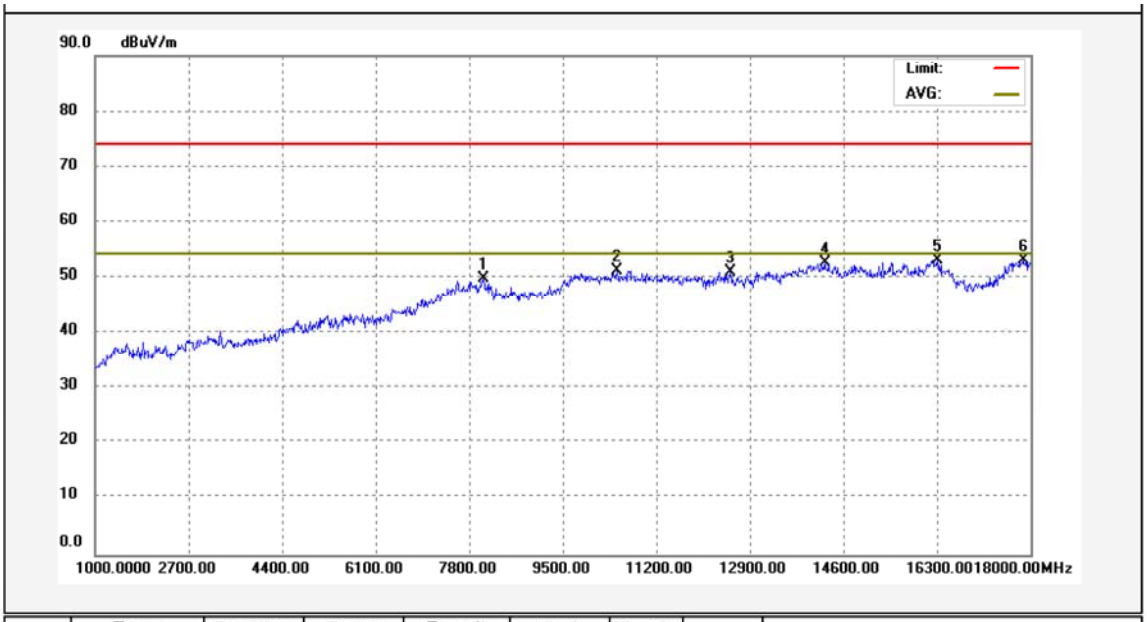
Frequency Range: 1GHz ~ 18GHz

Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	8055.000	45.85	2.90	48.75	74.00	-25.25	peak	
2	11319.000	44.13	6.30	50.43	74.00	-23.57	peak	
3	12543.000	45.38	6.13	51.51	74.00	-22.49	peak	
4	14634.000	43.10	8.58	51.68	74.00	-22.32	peak	
5	16368.000	41.74	9.88	51.62	74.00	-22.38	peak	
6	18000.000	35.96	17.87	53.83	74.00	-20.17	peak	

Antenna Polarization: Vertical



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	8055.000	46.85	2.90	49.75	74.00	-24.25	peak	
2	10486.000	45.62	5.67	51.29	74.00	-22.71	peak	
3	12543.000	44.88	6.13	51.01	74.00	-22.99	peak	
4	14260.000	44.03	8.60	52.63	74.00	-21.37	peak	
5	16300.000	43.41	9.61	53.02	74.00	-20.98	peak	
6	17864.000	35.88	17.07	52.95	74.00	-21.05	peak	

Test Frequency: 18GHz~25GHz

The measurements were more than 20 dB below the limit and not recorded

9 Conducted Spurious Emissions

Test Requirement: FCC 47CFR Part 15 Section 15.247

Test Method: ANSI C63.10: 2013

Test Result: PASS

Limit:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

9.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer:

Blow 30MHz:

RBW = 100kHz, VBW = 300kHz, Sweep = auto

Detector function = peak, Trace = max hold

Above 30MHz:

RBW = 100kHz, VBW = 300kHz, Sweep = auto

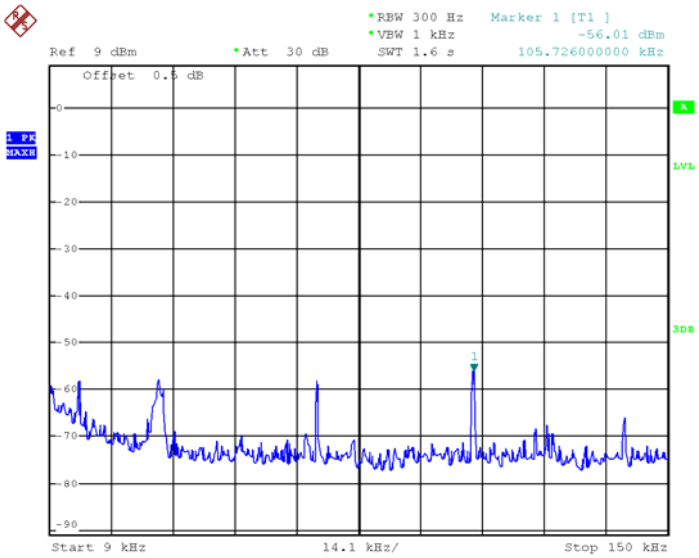
Detector function = peak, Trace = max hold

9.2 Test Result

9kHz – 150kHz

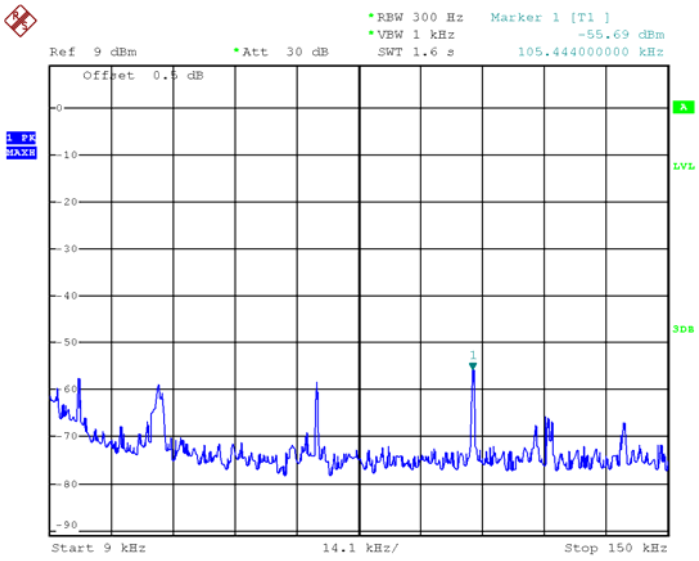
GFSK

Low Channel



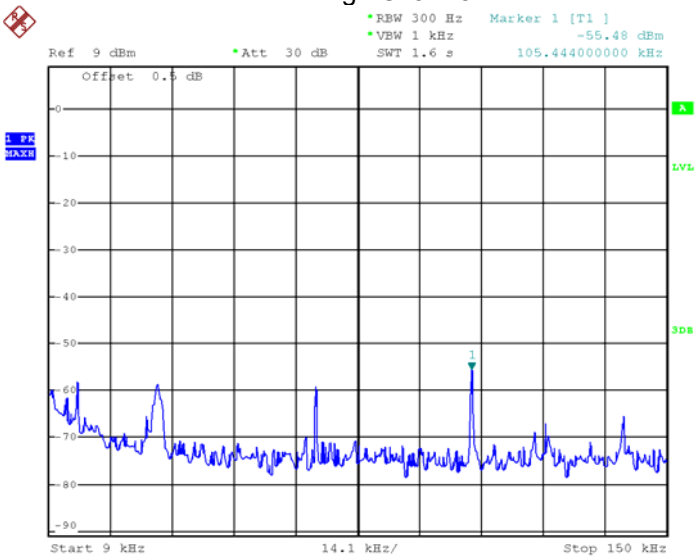
Date: 30.JAN.2024 13:35:54

Middle Channel



Date: 30.JAN.2024 13:38:06

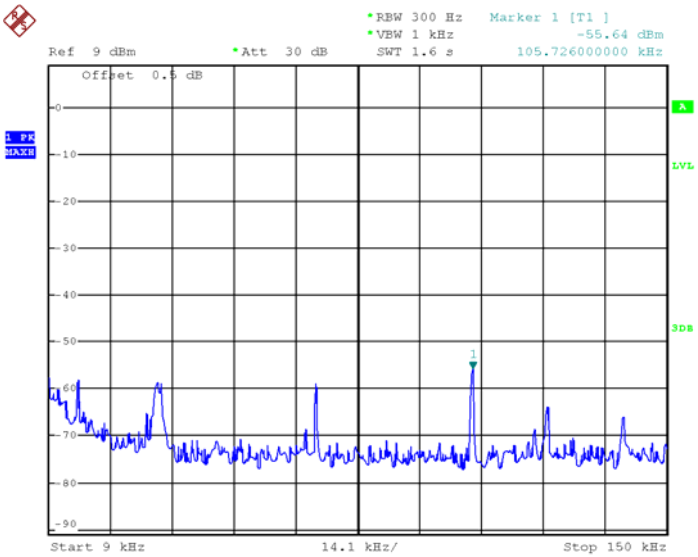
High Channel



Date: 30.JAN.2024 13:40:38

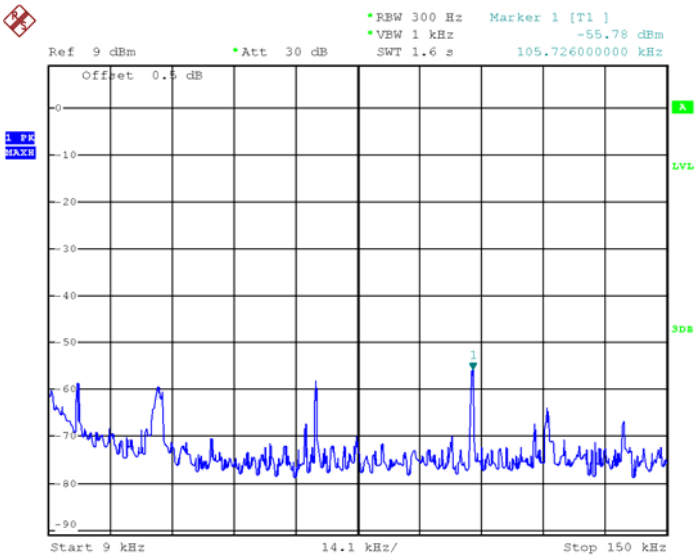
π/4DQPSK

Low Channel



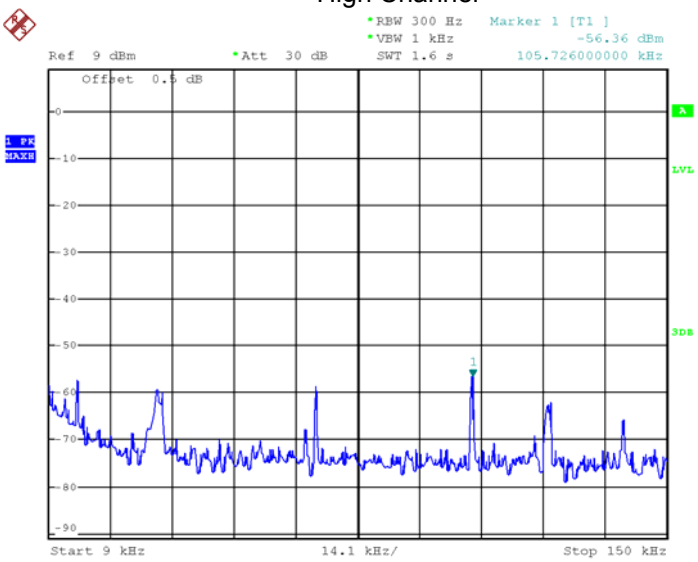
Date: 30.JAN.2024 13:42:54

Middle Channel



Date: 30.JAN.2024 13:45:41

High Channel

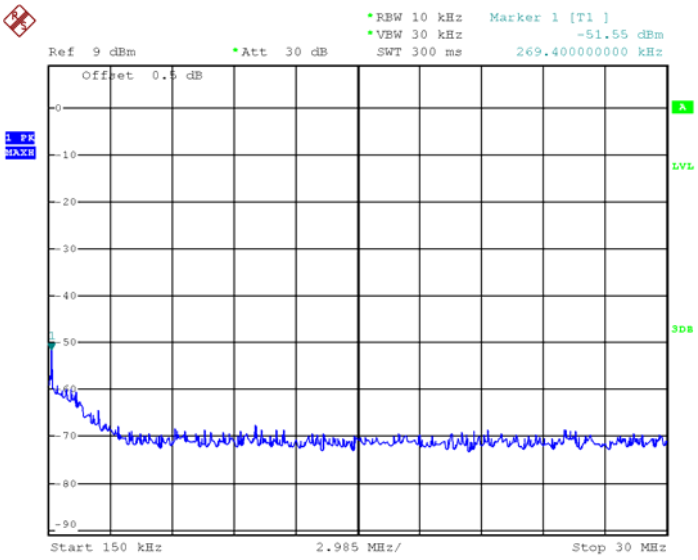


Date: 30.JAN.2024 13:47:33

150kHz – 30MHz

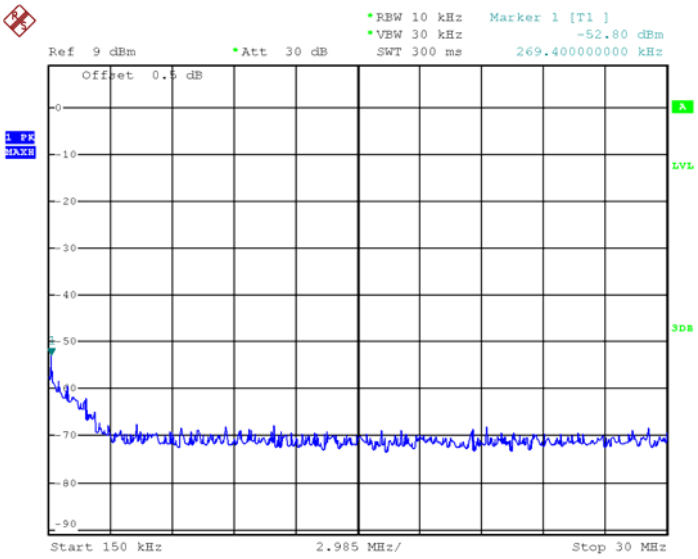
GFSK

Low Channel



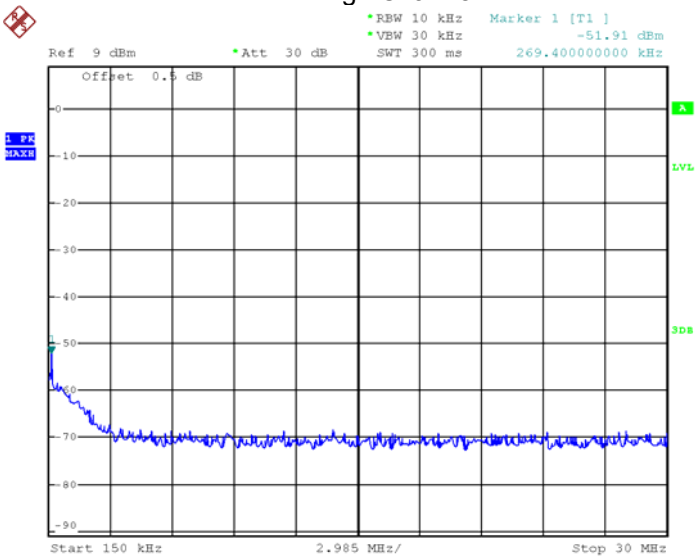
Date: 30.JAN.2024 13:36:14

Middle Channel



Date: 30.JAN.2024 13:38:26

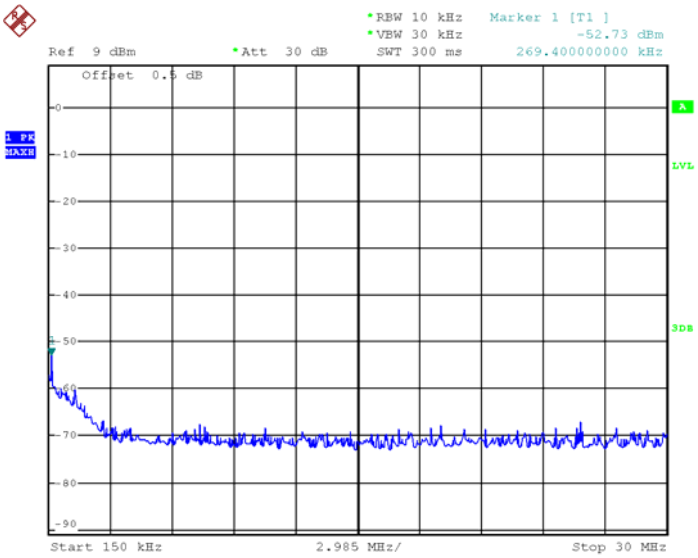
High Channel



Date: 30.JAN.2024 13:41:03

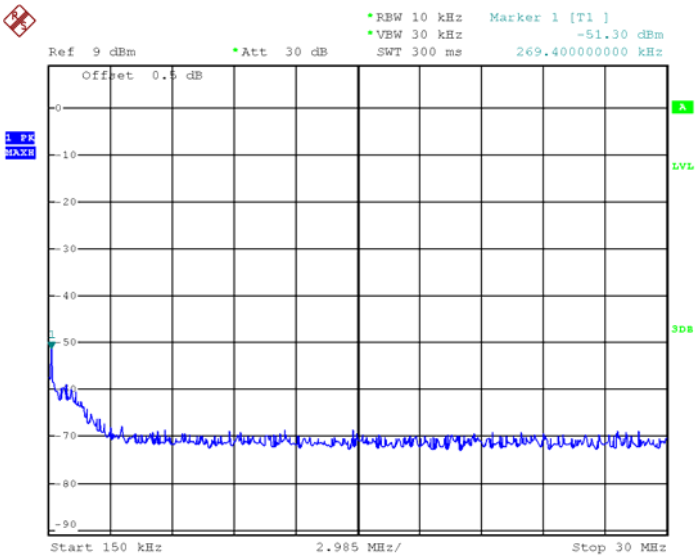
π/4DQPSK

Low Channel



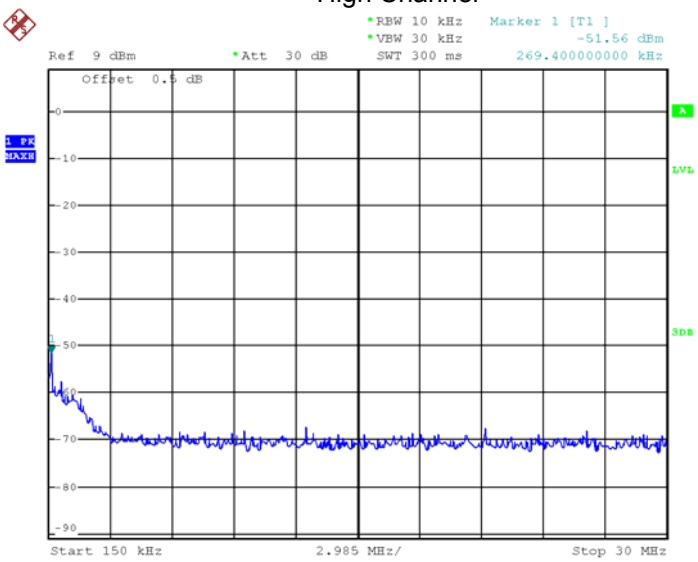
Date: 30.JAN.2024 13:43:19

Middle Channel



Date: 30.JAN.2024 13:45:59

High Channel

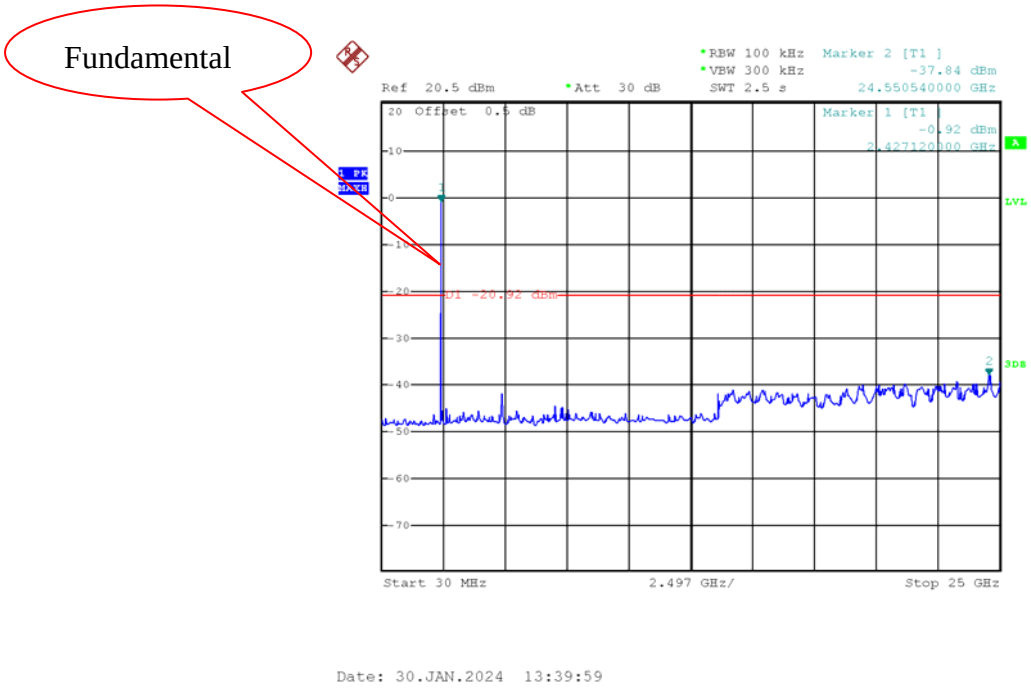


Date: 30.JAN.2024 13:47:59

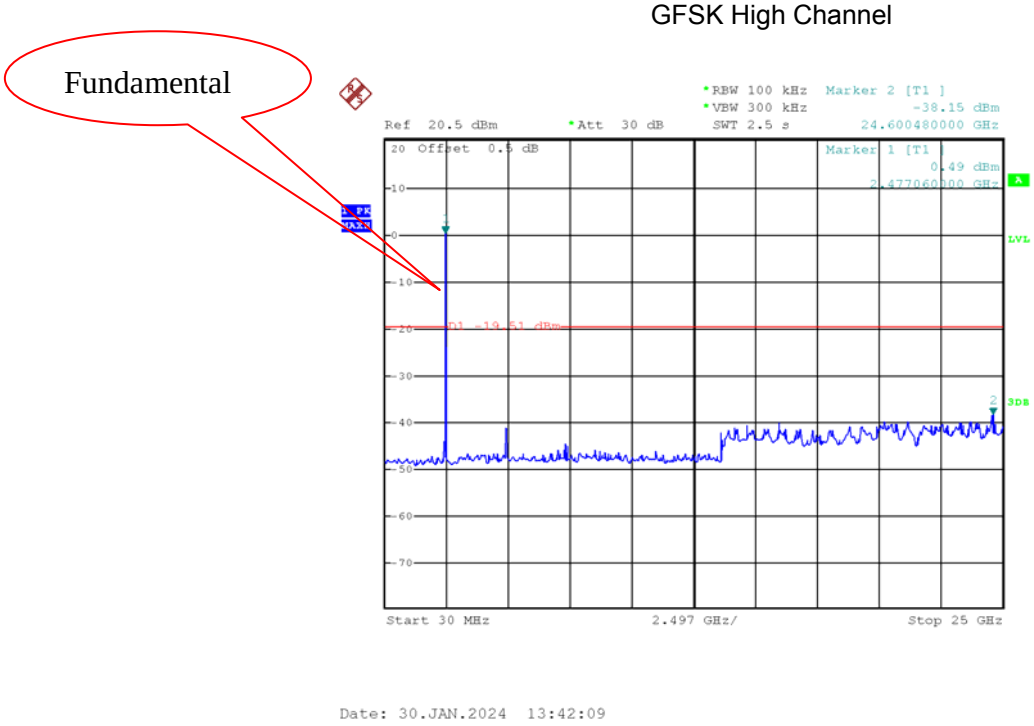
30MHz – 25GHz

GFSK Low Channel

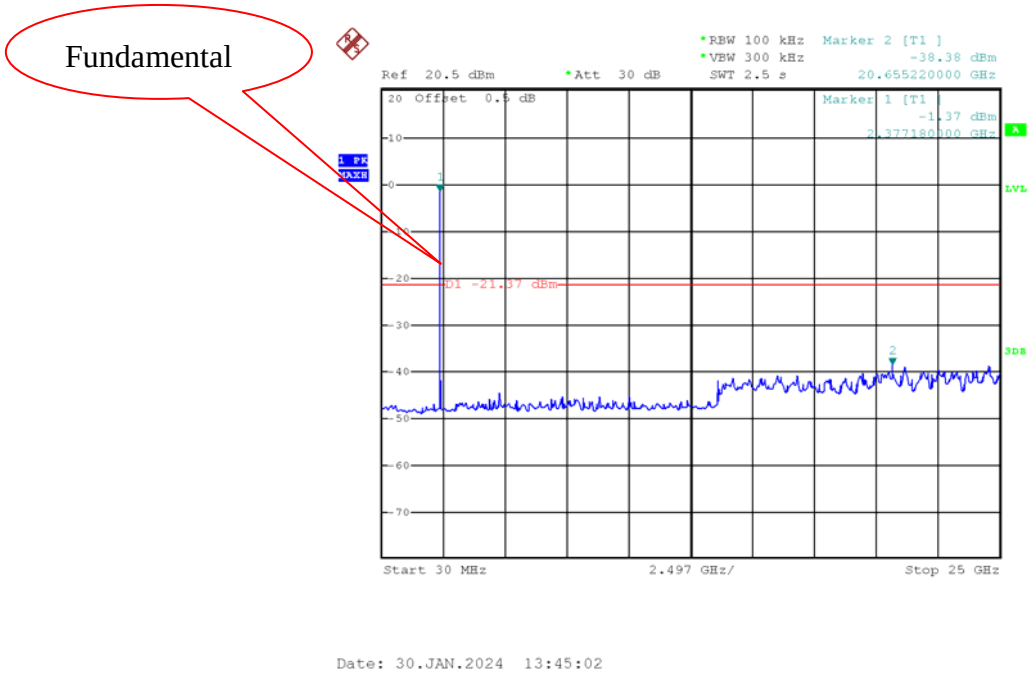
GFSK Middle Channel



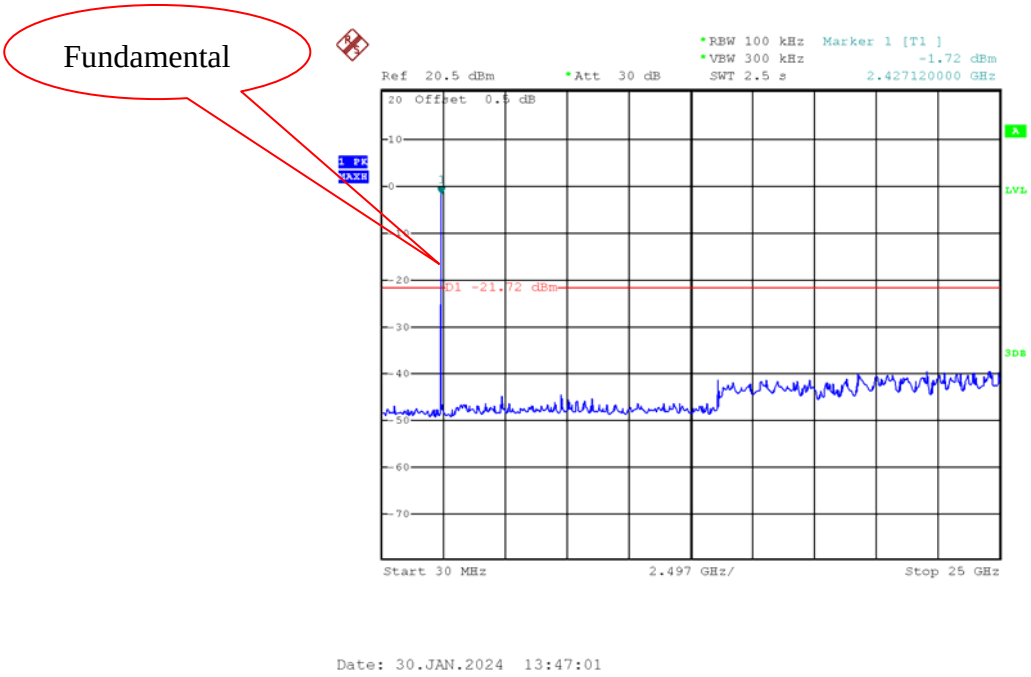
GFSK High Channel



π/4DQPSK Low Channel



π/4DQPSK Middle Channel



π/4DQPSK High Channel

10 Band Edge Measurement

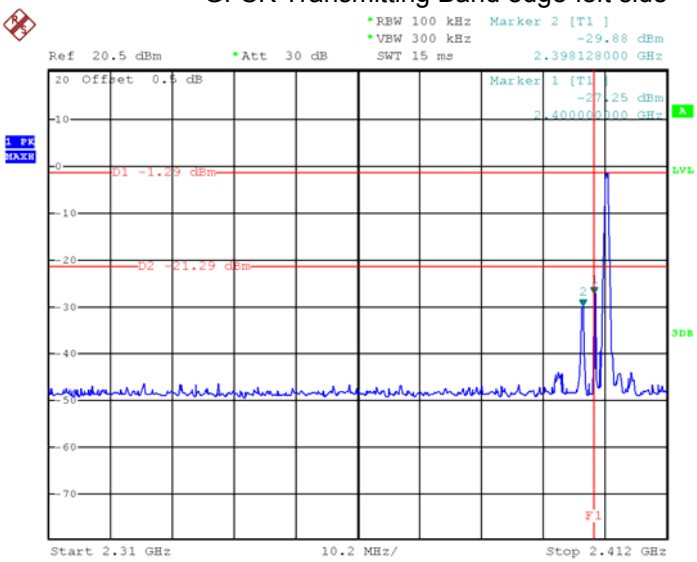
Test Requirement:	Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).
Test Method:	ANSI C63.10: 2013
Test Limit:	Regulation 15.247 (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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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) (see §15.205(c)).
Test Mode:	Transmitting

10.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto
   Detector function = peak, Trace = max hold

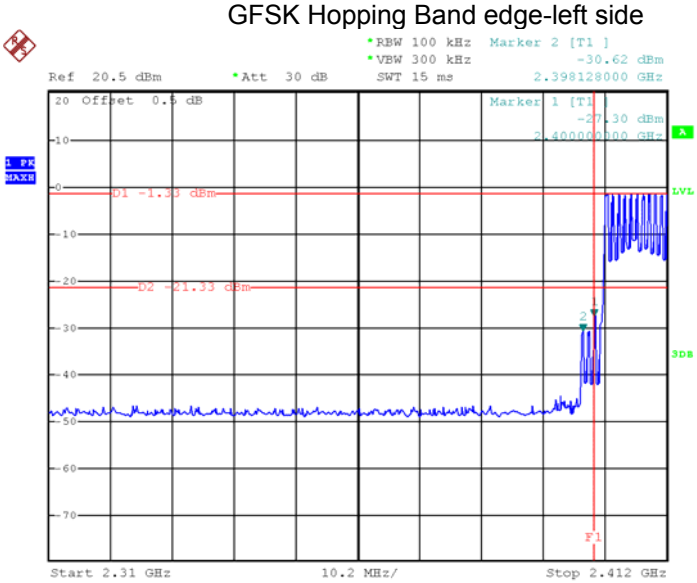
10.2 Test Result

GFSK Transmitting Band edge-left side



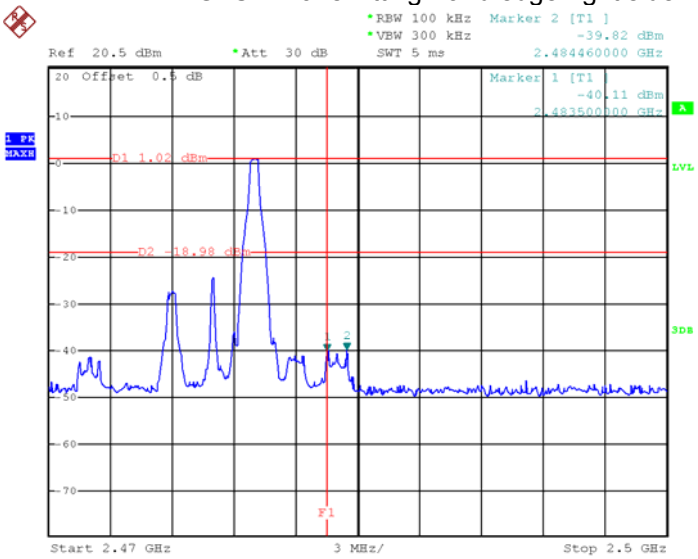
Date: 30.JAN.2024 13:20:11

GFSK Hopping Band edge-left side



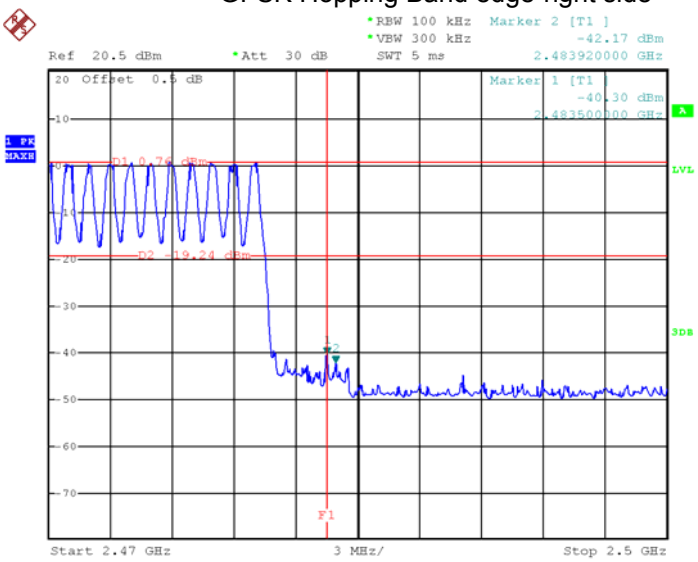
Date: 30.JAN.2024 13:19:02

GFSK Transmitting Band edge-right side



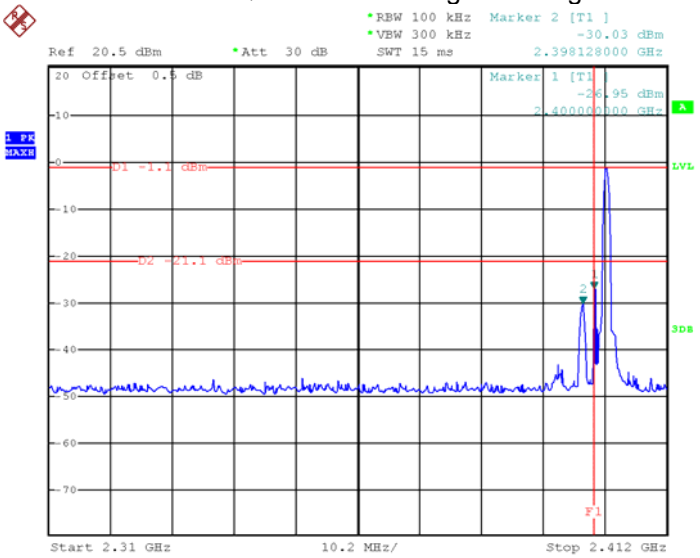
Date: 30.JAN.2024 13:22:17

GFSK Hopping Band edge-right side



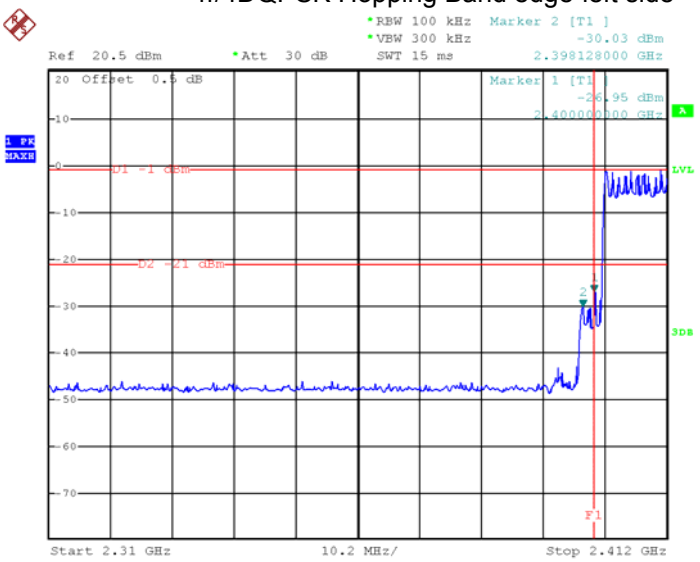
Date: 30.JAN.2024 13:23:18

π/4DQPSK Transmitting Band edge-left side



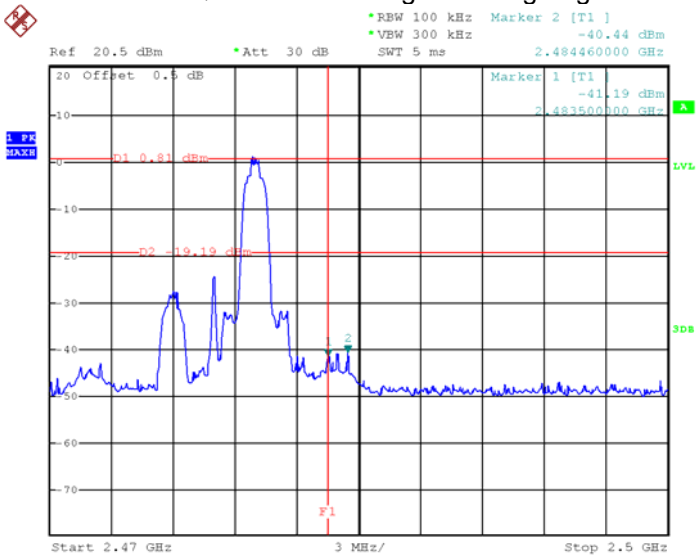
Date: 30.JAN.2024 13:24:37

π/4DQPSK Hopping Band edge-left side



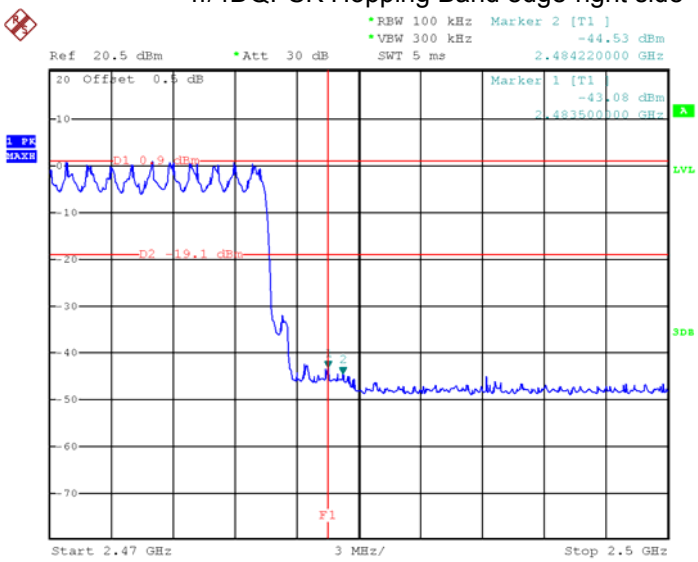
Date: 30.JAN.2024 13:29:15

π/4DQPSK Transmitting Band edge-right side



Date: 30.JAN.2024 13:31:37

π/4DQPSK Hopping Band edge-right side



Date: 30.JAN.2024 13:34:45

11 20 dB Bandwidth and 99% Bandwidth Measurement

Test Requirement: FCC 47CFR Part 15 Section 15.247

Test Method: ANSI C63.10: 2013

Test Mode: Test in fixing operating frequency at low, Middle, high channel.

11.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 30kHz, VBW = 100kHz

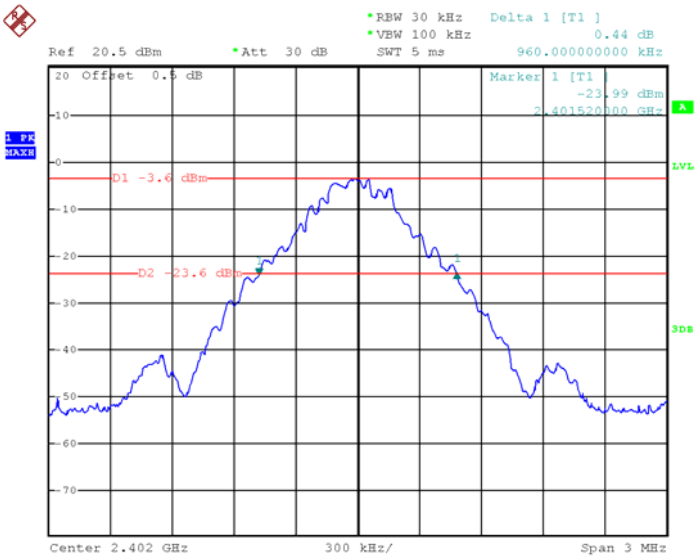
11.2 Test Result

Modulation	Test Channel	20 dB Bandwidth MHz	99% Bandwidth MHz
GFSK	Low	0.960	0.858
GFSK	Middle	0.960	0.858
GFSK	High	0.948	0.858
π/4DQPSK	Low	1.308	1.182
π/4DQPSK	Middle	1.314	1.188
π/4DQPSK	High	1.308	1.194

Test plots

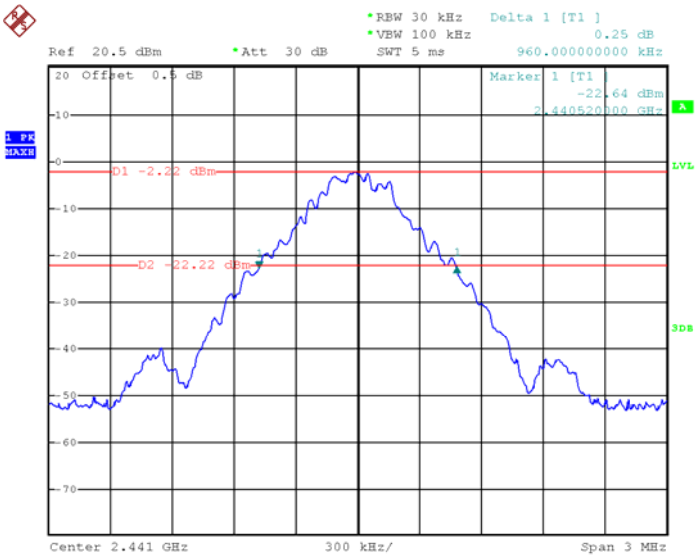
20 dB Bandwidth

GFSK Low Channel



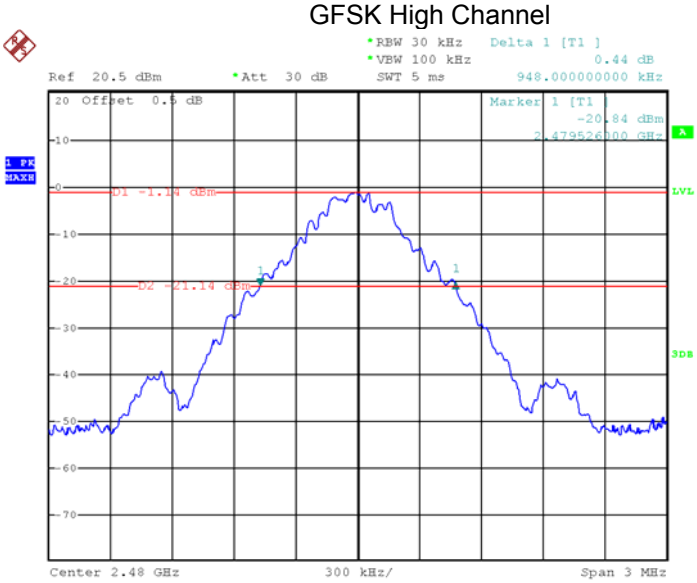
Date: 30.JAN.2024 11:14:25

GFSK Middle Channel



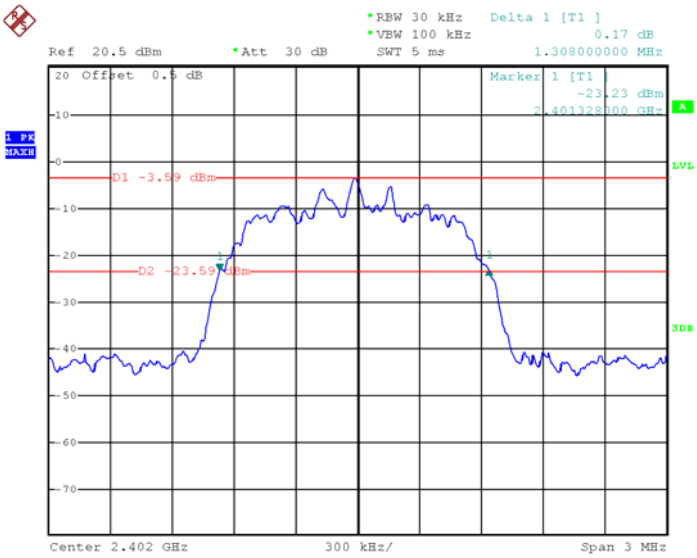
Date: 30.JAN.2024 11:15:23

GFSK High Channel



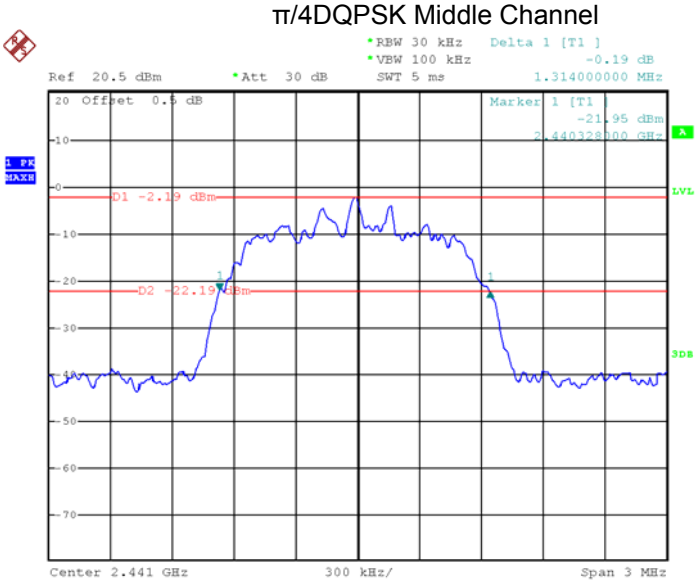
Date: 30.JAN.2024 11:16:25

π/4DQPSK Low Channel



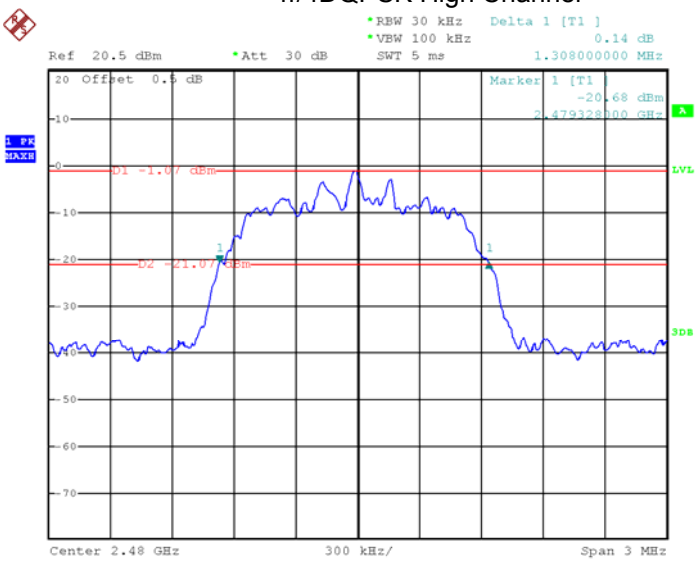
Date: 30.JAN.2024 11:13:24

π/4DQPSK Middle Channel



Date: 30.JAN.2024 11:12:22

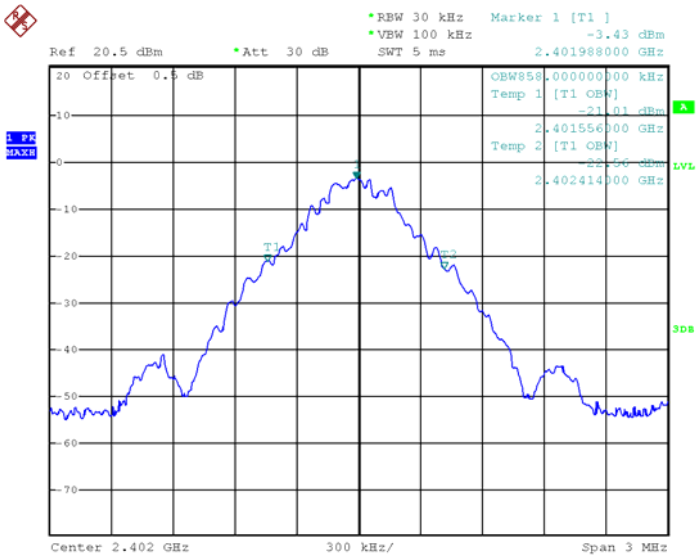
π/4DQPSK High Channel



Date: 30.JAN.2024 11:10:33

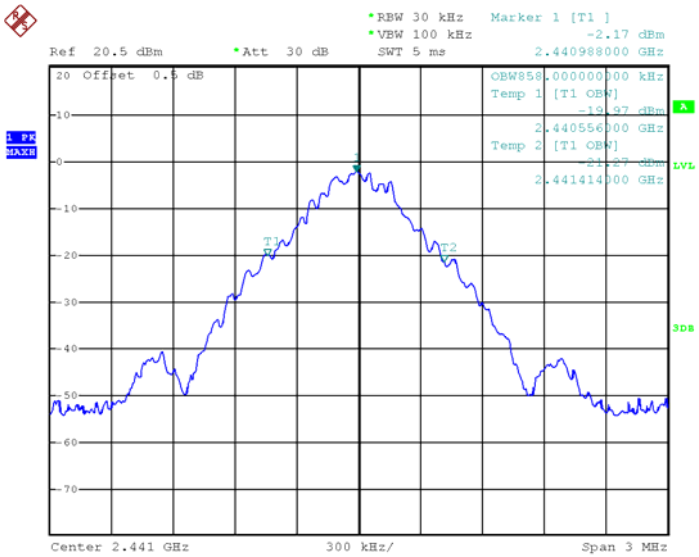
99% Bandwidth

GFSK Low Channel



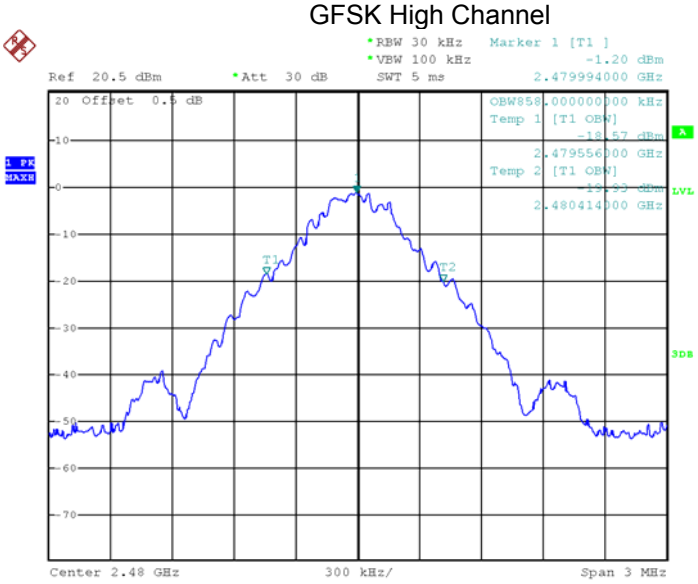
Date: 30.JAN.2024 10:57:50

GFSK Middle Channel



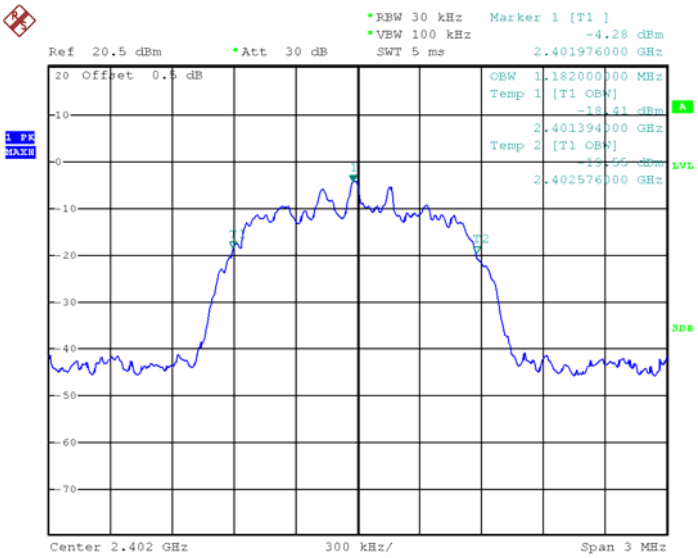
Date: 30.JAN.2024 10:58:17

GFSK High Channel



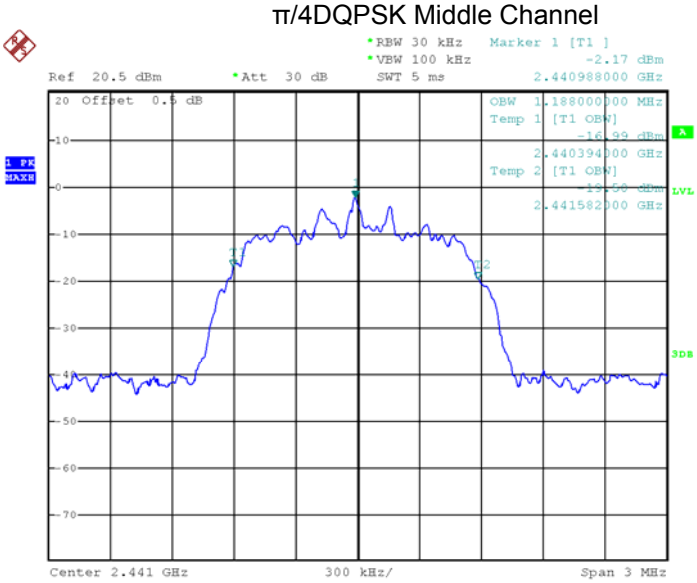
Date: 30.JAN.2024 11:06:46

π/4DQPSK Low Channel



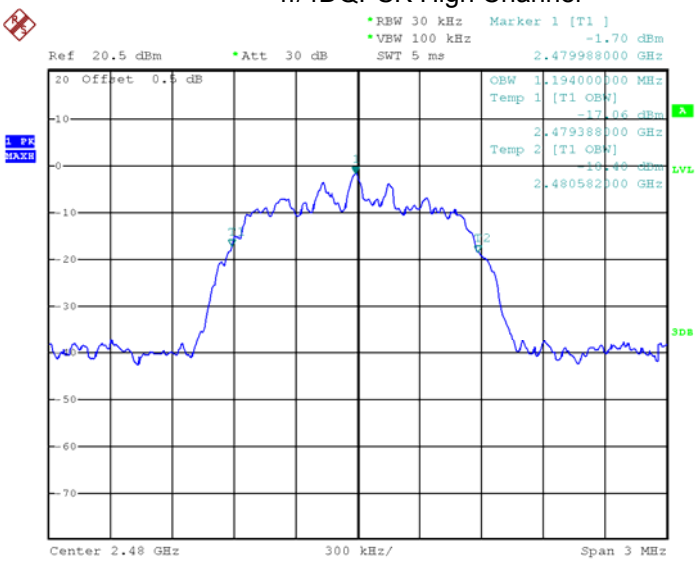
Date: 30.JAN.2024 11:07:24

π/4DQPSK Middle Channel



Date: 30.JAN.2024 11:07:56

π/4DQPSK High Channel



Date: 30.JAN.2024 11:08:19

12 Maximum Peak Output Power

Test Requirement: FCC 47CFR Part 15 Section 15.247

Test Method: ANSI C63.10: 2013

Test Limit: Regulation 15.247 (a)(1), For frequency hopping systems operating in the 2400 2483.5 MHz band by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater 0.125 watts..

Test mode: Test in fixing frequency transmitting mode.

12.1 Test Procedure

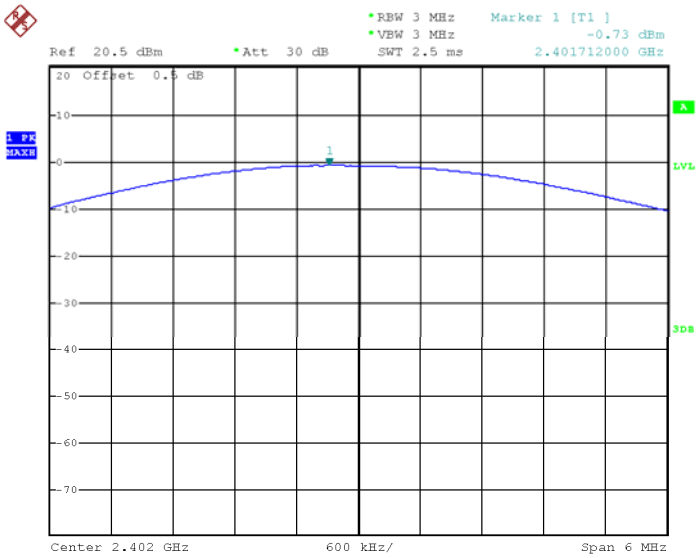
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer:
   a) Use the following spectrum analyzer settings:
      1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
      2) RBW ≥20 dB bandwidth of the emission being measured.
      3) VBW ≥ RBW.
      4) Sweep: Auto.
      5) Detector function: Peak.
      6) Trace: Max hold.
   b) Allow trace to stabilize.
   c) Use the marker-to-peak function to set the marker to the peak of the emission.
   d) The indicated level is the peak output power, after any corrections for external attenuators and cables.
   e) A plot of the test results and setup description shall be included in the test report.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

12.2 Test Result

Modulation	Test Channel	Output Power (dBm)	Limit (dBm)
GFSK	Low	-0.73	30
GFSK	Middle	0.45	30
GFSK	High	1.59	30
π/4DQPSK	Low	-0.10	21
π/4DQPSK	Middle	1.09	21
π/4DQPSK	High	**2.17**	21

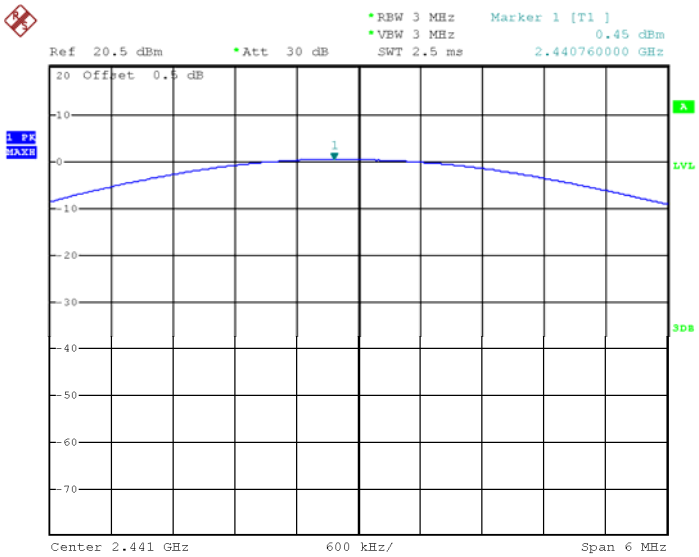
Test plots

GFSK Low Channel



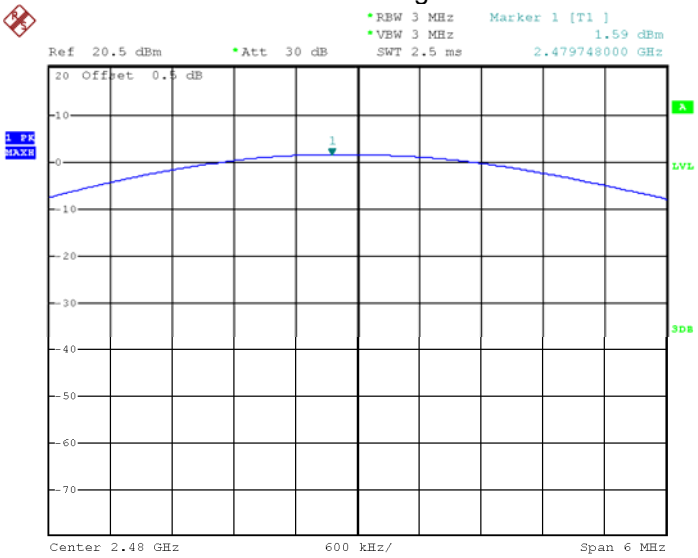
Date: 30.JAN.2024 10:55:05

GFSK Middle Channel



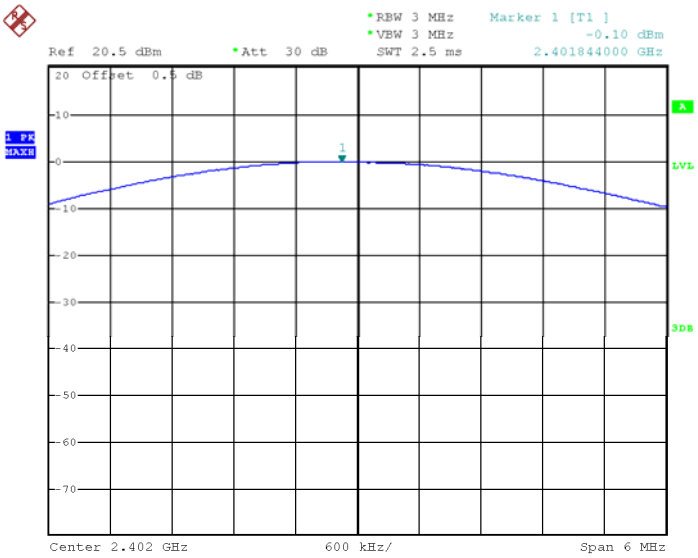
Date: 30.JAN.2024 10:55:30

GFSK High Channel



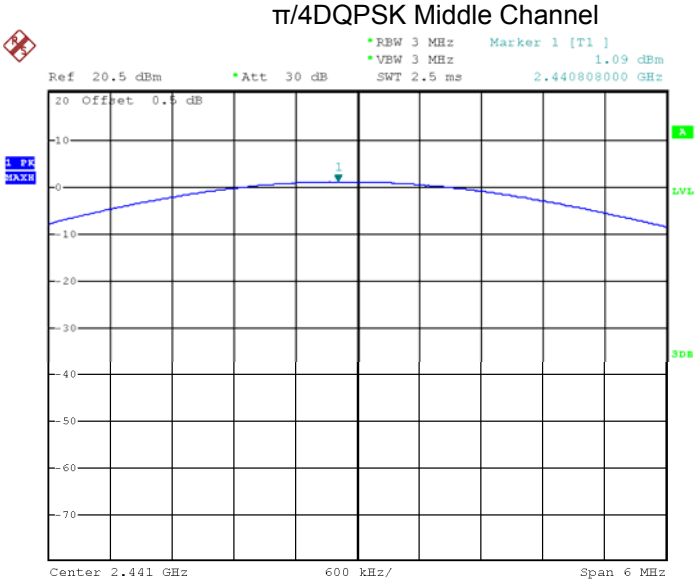
Date: 30.JAN.2024 10:55:47

π/4DQPSK Low Channel



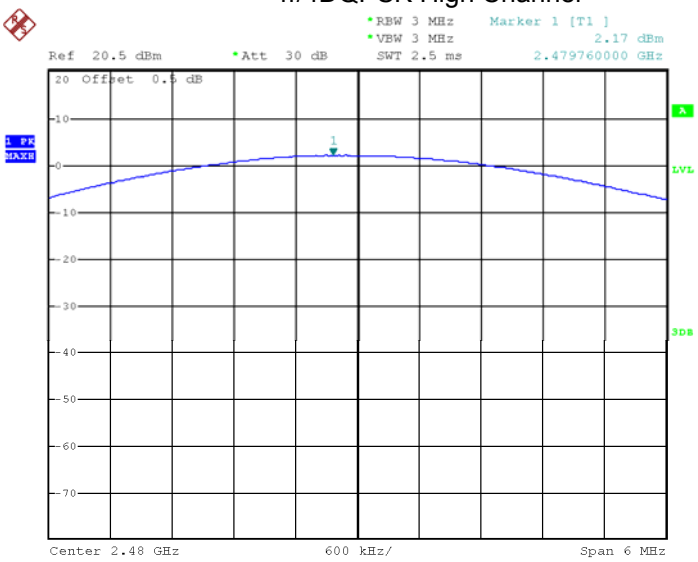
Date: 30.JAN.2024 10:56:09

π/4DQPSK Middle Channel



Date: 30.JAN.2024 10:56:33

π/4DQPSK High Channel



Date: 30.JAN.2024 10:56:55

13 Hopping Channel Separation

Test Requirement: FCC 47CFR Part 15 Section 15.247

Test Method: ANSI C63.10: 2013

Test Limit: Regulation 15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with power no greater than 0.125W.

Test Mode: Test in hopping transmitting operating mode.

13.1 Test Procedure

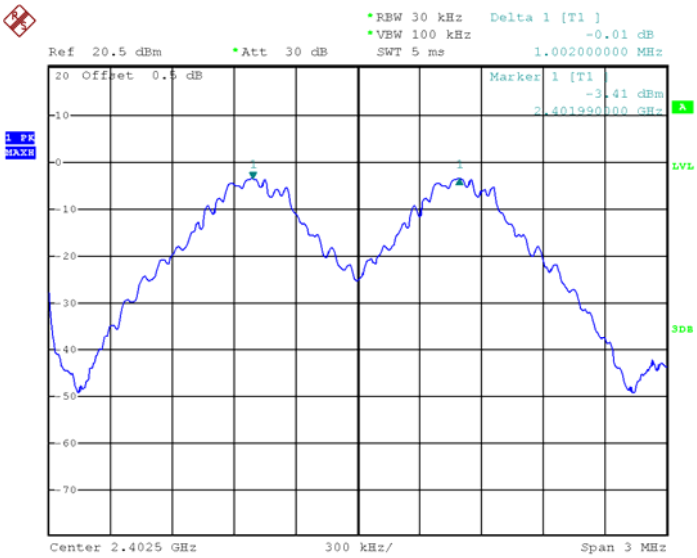
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer:
   a) Span: Wide enough to capture the peaks of two adjacent channels.
   b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
   c) Video (or average) bandwidth (VBW) ≥ RBW.
   d) Sweep: Auto.
   e) Detector function: Peak.
   f) Trace: Max hold.
   g) Allow the trace to stabilize.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

13.2 Test Result

Modulation	Test Channel	Separation (MHz)	Limit(MHz)	Result
GFSK	Low	1.002	0.640	PASS
GFSK	Middle	1.002	0.640	PASS
GFSK	High	1.002	0.632	PASS
π/4DQPSK	Low	1.002	0.872	PASS
π/4DQPSK	Middle	1.002	0.876	PASS
π/4DQPSK	High	1.002	0.872	PASS

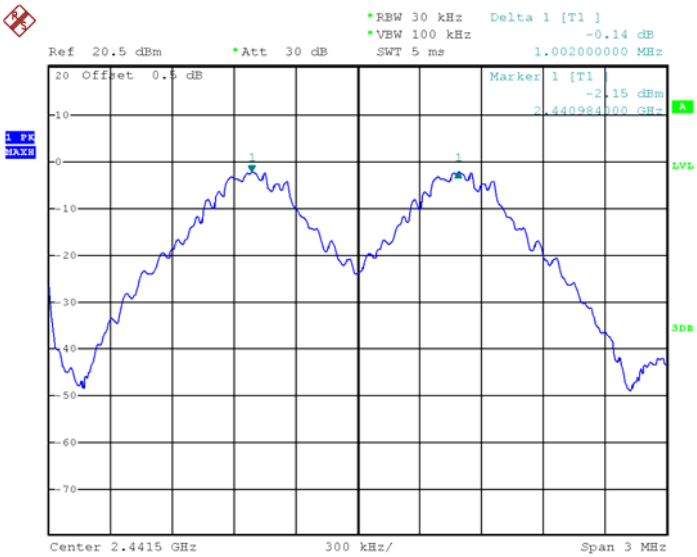
Test plots

GFSK Low Channel



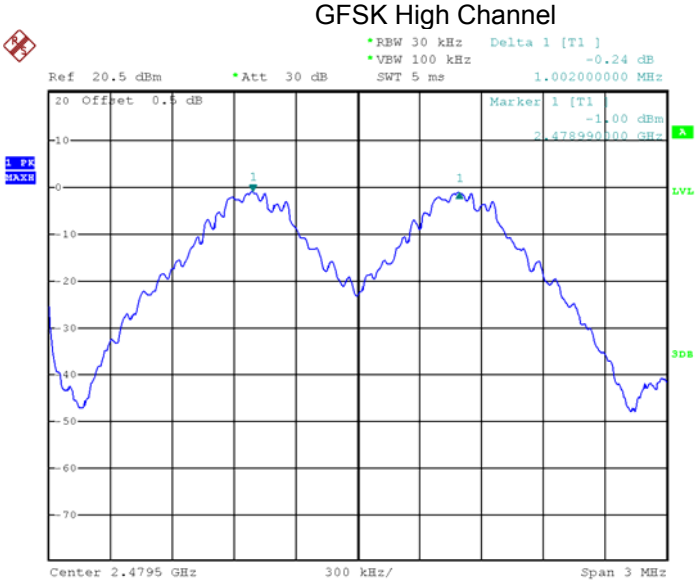
Date: 30.JAN.2024 11:22:46

GFSK Middle Channel



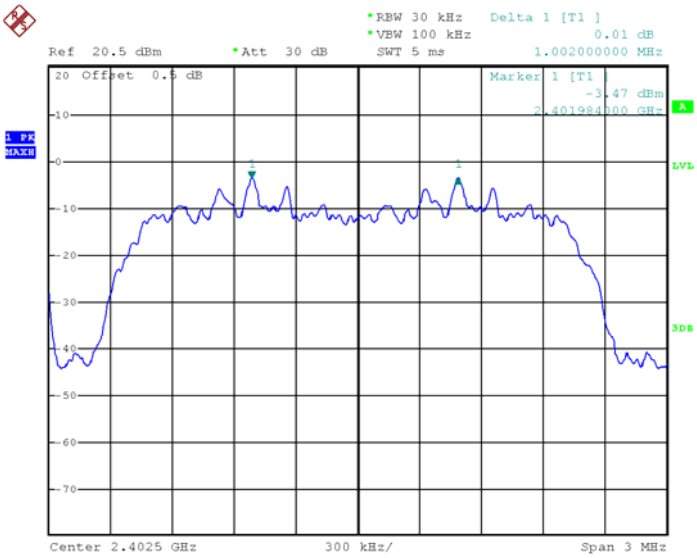
Date: 30.JAN.2024 11:24:41

GFSK High Channel



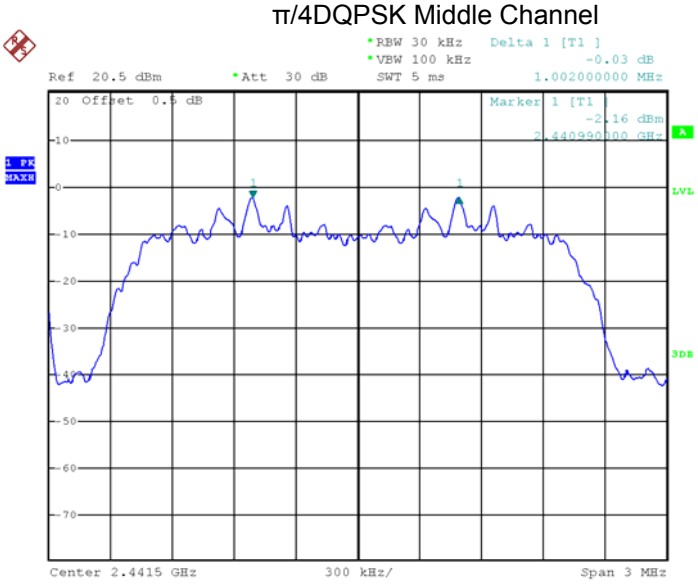
Date: 30.JAN.2024 11:26:19

π/4DQPSK Low Channel



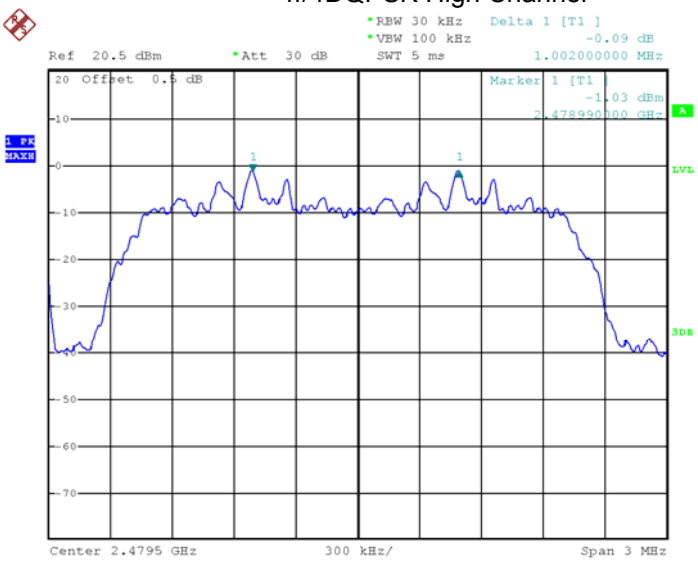
Date: 30.JAN.2024 11:27:46

π/4DQPSK Middle Channel



Date: 30.JAN.2024 11:30:22

π/4DQPSK High Channel



Date: 30.JAN.2024 11:32:12

14 Number of Hopping Frequency

Test Requirement: FCC 47CFR Part 15 Section 15.247

Test Method: ANSI C63.10: 2013

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

Test Mode: Test in hopping transmitting operating mode.

14.1 Test Procedure

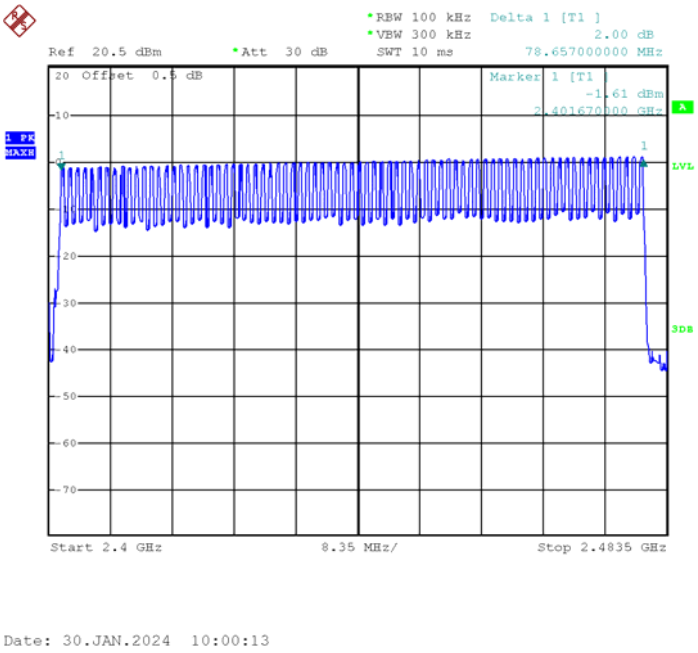
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer:
   a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
   b) 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.
   c) VBW ≥ RBW.
   d) Sweep: Auto.
   e) Detector function: Peak.
   f) Trace: Max hold.
   g) Allow the trace to stabilize..
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.4835GHz. Sweep=auto;

14.2 Test Result

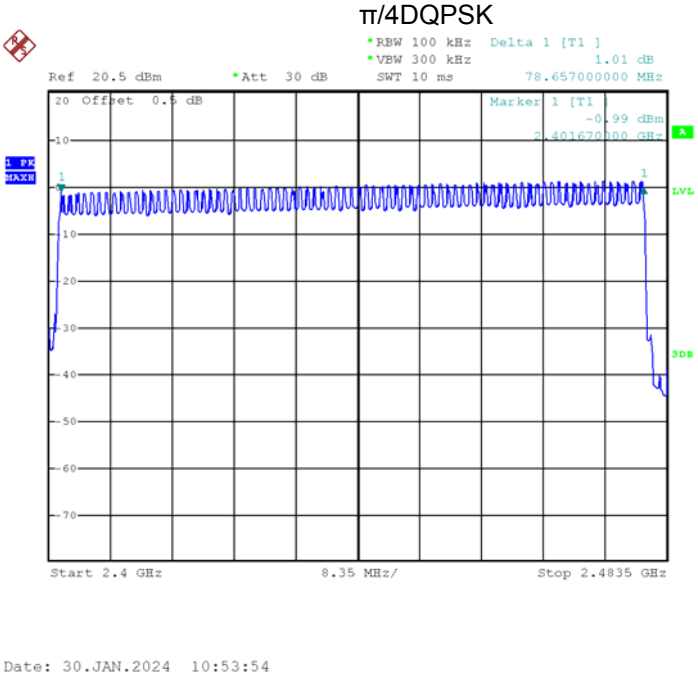
Test Plots:

79 Channels in total

GFSK



π/4DQPSK



15 Dwell Time

Test Requirement: FCC 47CFR Part 15 Section 15.247

Test Method: ANSI C63.10: 2013

Test Limit: Regulation 15.247(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Mode: Test in hopping transmitting operating mode.

15.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set spectrum analyzer span = 0. Centred on a hopping channel;
3. Set RBW = 1MHz and VBW = 3MHz.Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

15.2 Test Result

DH5 Packet permit maximum 1600 / 79 / 6 hops per second in each channel (5 time slots RX, 1 time slot TX).

DH3 Packet permit maximum 1600 / 79 / 4 hops per second in each channel (3 time slots RX, 1 time slot TX).

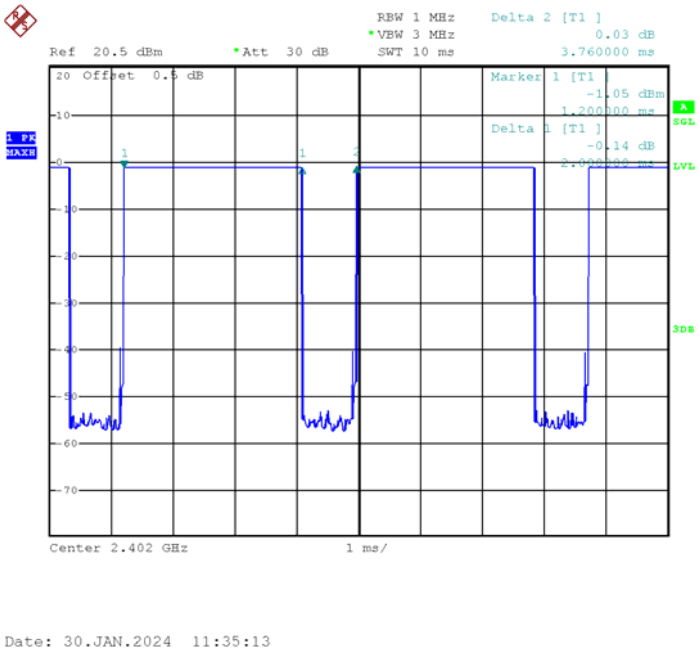
DH1 Packet permit maximum 1600 / 79 /2 hops per second in each channel (1 time slot RX, 1 time slot TX). So, the Dwell Time can be calculated as follows:

Data Packet	Dwell Time(s)
DH5	1600/79/6*0.4*79*(MkrDelta)/1000
DH3	1600/79/4*0.4*79*(MkrDelta)/1000
DH1	1600/79/2*0.4*79*(MkrDelta)/1000
Remark: Mkr Delta is once pulse time.	

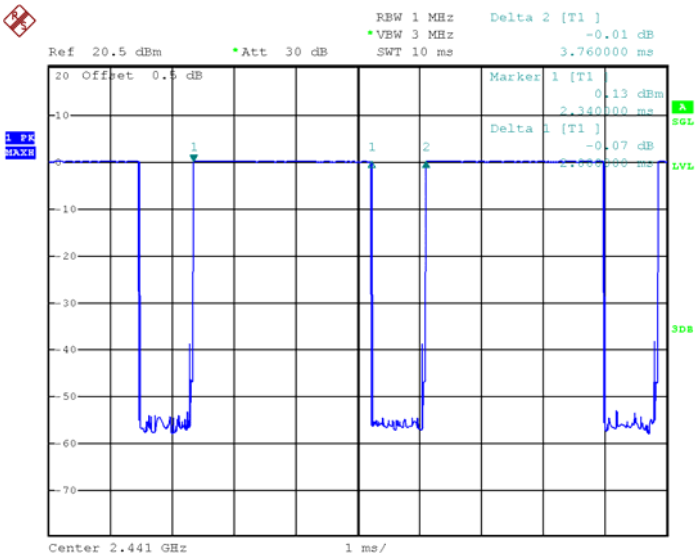
Modulation	Data Packet	Channel	pulse time(ms)	Dwell Time(s)	Limits(s)
GFSK	DH5	Low	2.880	0.307	0.4
		middle	2.880	0.307	0.4
		High	2.880	0.307	0.4
π/4DQPSK	2DH5	Low	2.900	0.309	0.4
		middle	2.900	0.309	0.4
		High	2.880	0.307	0.4

Remark: Only the worst-case mode DH5 and 2DH5 were recorded.

Test Plots
GFSK DH5 Low Channel

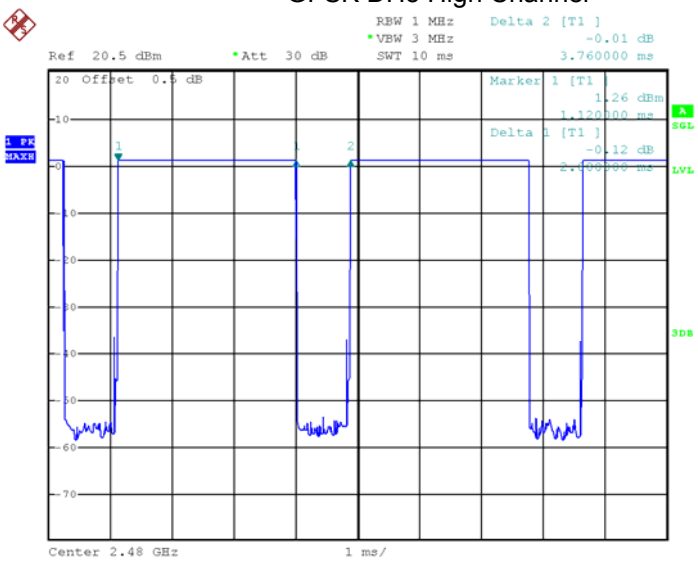


GFSK DH5 Middle Channel



Date: 30.JAN.2024 11:35:48

GFSK DH5 High Channel



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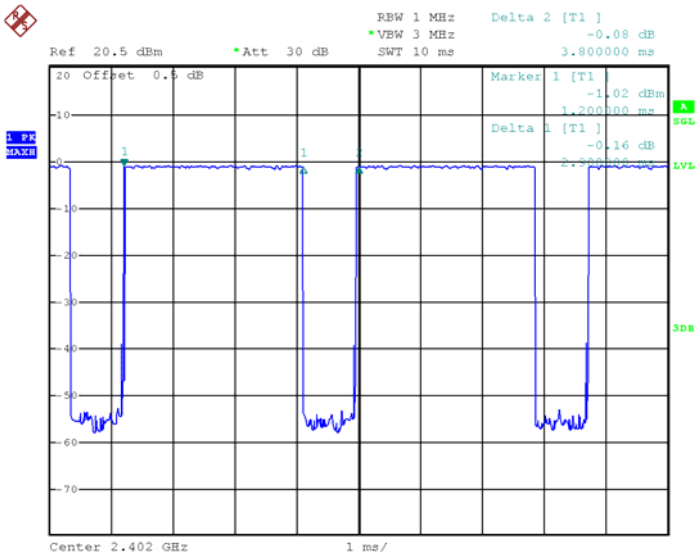
π/4DQPSK 2DH5 Low Channel



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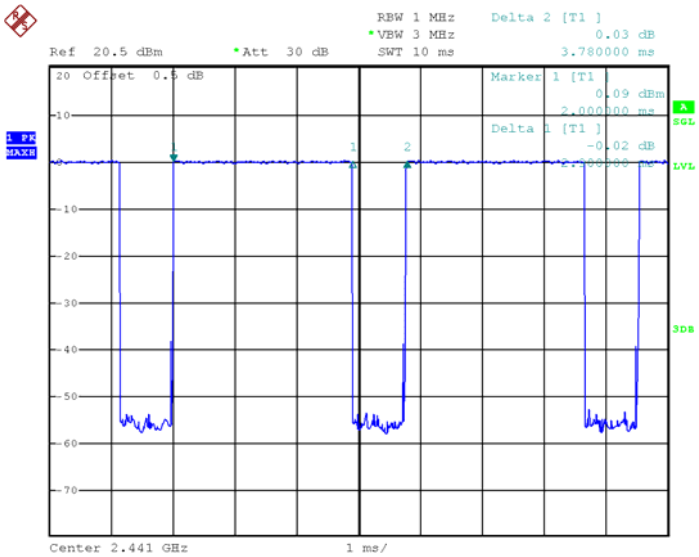
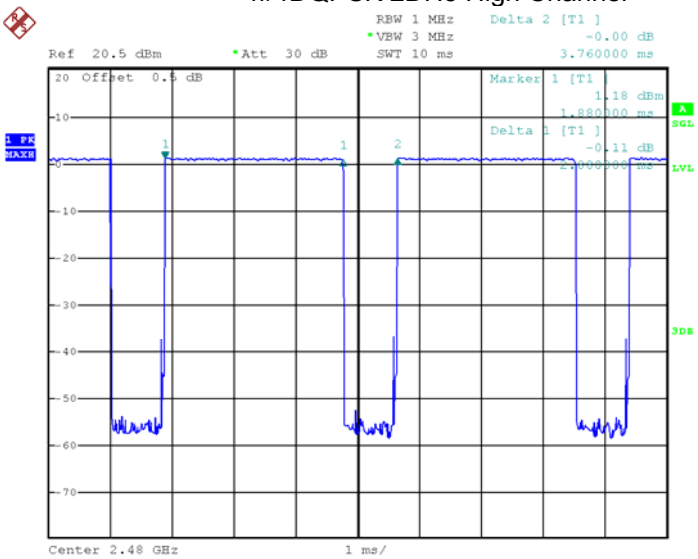
π/4DQPSK 2DH5 Middle Channel



Date: 30.JAN.2024 13:13:19

π/4DQPSK 2DH5 High Channel



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16 Antenna Requirement

According to the FCC Part 15 Paragraph 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. This product has a PCB printed antenna, fulfil the requirement of this section.

Note: Please refer to EUT photos for more details.

17 RF Exposure

Remark: refer to MPE test report: WTD24D01021765W002.

18 Photographs of test setup and EUT.

Note: Please refer to appendix: Appendix-S03-Photos.

======End of Report======