



TEST REPORT

Test item description: PROJECTOR
FCC ID: 2BFIZ-X4AR
Trademark(s): N/A
Model/Type reference: X4AR, X4 Ultra, X4 Pro Max, X4 Max, X4AI, X4 Plus, M5AR, M5, M5PR0, HT1, HT2, HT3, HT4, HT5, HT6, HT7, HT8, HT9, SKW2603, SDT2603, CW2603, QV2000, WV2000, TP400 NTV, TP400 GTV, X4AR, TP400, X4ER, PL800, PL900, X4
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Sample Received Date: Jun. 08, 2026
Sample tested Date: Jun. 08, 2026 to Jun. 29, 2026
Issue Date: Jun. 29, 2026
Report No.: CTB26060806402RF02
Test Standards: FCC CFR Title 47 Part 15 Subpart C Section 15.247
ANSI C63.10:2020
Test Results: PASS
Remark: This is Bluetooth radio test report.
Compiled by: Reviewed by: Approved by:

Kai Chen

Kai Chen

Martin Feng

Martin FengBin Mei / Director

Note: If there is any objection to the inspection results in this report, please submit a written report to the company within 15 days from the date of receiving the report. The test report is effective only with both signature and specialized stamp. This result(s) shown in this report refer only to the sample(s) tested. The tested sample(s) and the sample information are provided by the applicant. The authenticity, accuracy, and completeness of the provided information are the sole responsibility of the applicant. Without written approval of Shenzhen CTB Testing Technology Co., Ltd. this report can't be reproduced except in full. The result decision rules of our laboratory are based solely on the direct comparison between the actual measured values of test results and the standard limits, without considering the measurement uncertainty. "★" indicates the testing items were fulfilled by subcontracted lab. "—" indicates the items are not in CNAS accreditation scope.

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(Note: N/A means not applicable)

**1. VERSION**

Report No.	Issue Date	Description	Approved
CTB26060806402RF02	Jun. 29, 2026	Original	Valid

2. TEST SUMMARY

The Product has been tested according to the following specifications:

Test Item	Test Requirement	Test method	Result
AC Power Line Conducted Emission	47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2020	PASS
Radiated Spurious emissions	47 CFR Part 15 Subpart C Section 15.205/15.209	ANSI C63.10-2020	PASS
Band edge and RF Conducted Spurious Emissions	47 CFR Part 15 Subpart C Section 15.247(d)/15.205(a)	ANSI C63.10-2020	PASS
Conducted Peak Output Power	47 CFR Part 15 Subpart C Section 15.247 (b)(1)	ANSI C63.10-2020	PASS
20dB Occupied Bandwidth	47 CFR Part 15 Subpart C Section 15.247 (a)(1)	ANSI C63.10-2020	PASS
Carrier Frequencies Separation	47 CFR Part 15 Subpart C Section 15.247 (a)(1)	ANSI C63.10-2020	PASS
Hopping Channel Number	47 CFR Part 15 Subpart C Section 15.247 (b)	ANSI C63.10-2020	PASS
Dwell Time	47 CFR Part 15 Subpart C Section 15.247 (a)(1)	ANSI C63.10-2020	PASS
Pseudorandom Frequency Hopping Sequence	47 CFR Part 15 Subpart C Section 15.247(a)&TCB Exclusion List (7 July 2002)	ANSI C63.10-2020	PASS
Antenna Requirement	47 CFR Part 15 Subpart C Section 15.203/15.247 (b)	/	PASS
RF Exposure Evaluation	47 CFR Part 15 Subpart C Section 15.247 (i)/1.1310/2.1093	KDB447498D01v06	PASS

Remark:

Test according to ANSI C63.10-2020.

3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Item	Uncertainty
Occupancy bandwidth	54.3kHz
Conducted output power above 1G	0.9dB
Conducted output power below 1G	0.9dB
Power Spectral Density , Conduction	0.9dB
Conduction spurious emissions	2.0dB
Out of band emission	2.0dB
3m chamber Radiated spurious emission(9kHz-30MHz)	4.8dB
3m chamber Radiated spurious emission(30MHz-1GHz)	4.6dB
3m chamber Radiated spurious emission(1GHz-18GHz)	5.1dB
3m chamber Radiated spurious emission(18GHz-40GHz)	3.4dB
Humidity uncertainty	5.5%
Temperature uncertainty	0.63°C
Frequency	1×10 ⁻⁷
Conducted Emission(150kHz-30MHz)	3.2 dB
Radiated Emission(30MHz ~ 1000MHz)	4.8 dB
Radiated Emission(1GHz ~6GHz)	4.9 dB

4. PRODUCT INFORMATION AND TEST SETUP

4.1 Product Information

Model/Type reference:	X4AR, X4 Ultra, X4 Pro Max, X4 Max, X4AI, X4 Plus, M5AR, M5, M5PR0, HT1, HT2, HT3, HT4, HT5, HT6, HT7, HT8, HT9, SKW2603, SDT2603, CW2603, QV2000, WV2000, TP400 NTV, TP400 GTV, X4AR, TP400, X4ER, PL800, PL900, X4
Model Description:	All the model are the same circuit and RF module, only the name, appearance and colors are different. Test sample model: X4AR
Bluetooth Version:	Bluetooth 5.0
Hardware Version:	V1.0
Software Version:	V1.0
Operation Frequency:	Bluetooth: 2402-2480MHz
Max. RF output power:	Bluetooth: 3.77dBm
Type of Modulation:	Bluetooth: GFSK, $\pi/4$ DQPSK, 8DPSK
Antenna installation:	Bluetooth: FPC antenna
Antenna Gain:	Bluetooth: 3.98dBi
Ratings:	AC 100-240V 1.5A 50/60HZ

4.2 Test Setup Configuration

See test photographs attached in EUT TEST SETUP PHOTOGRAPHS for the actual connections between Product and support equipment.

4.3 Support Equipment

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
1.	Laptop	DELL	Vostro 5490	N/A	AE

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

4.4 Channel List

CH	Frequency (MHz)	CH	Frequency (MHz)	CH	Frequency (MHz)	CH	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	79	/

4.5 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 (GFSK, $\pi/4$ DQPSK, 8DPSK)	2402MHz	2441MHz	2480MHz
Receiving (GFSK, $\pi/4$ DQPSK, 8DPSK)	2402MHz	2441MHz	2480MHz

4.6 Test Environment

Humidity(%):	54
Atmospheric Pressure(kPa):	101
Normal Voltage(AC):	120V
Normal Temperature($^{\circ}$ C)	23
Low Temperature($^{\circ}$ C)	0
High Temperature($^{\circ}$ C)	40

5. TEST FACILITY AND TEST INSTRUMENT USED

5.1 Test Facility

All measurement facilities used to collect the measurement data are located at 1&2F., Building A, No. 26, Xinhe Road, Xinqiao, Xinqiao Street, Bao'an District, Shenzhen, Guangdong, China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-1 other equivalent standards.

FCC Test Firm Registration Number: CN1276

5.2 Test Instrument Used

No.	Equipment	Manufacturer	Type No.	Serial No.	Firmware Version	Calibrated Date	Calibrated until
1	Spectrum Analyzer	Agilent	N9020A	MY52090073	A.14.16	2026/5/14	2027/5/13
2	Power Sensor	Agilent	U2021XA	MY56120032	/	2026/5/14	2027/5/13
3	Power Sensor	Agilent	U2021XA	MY56120034	/	2026/5/14	2027/5/13
4	Communication test set	R&S	CMW500	108058	V3.5.80	2026/5/14	2027/5/13
5	Spectrum Analyzer	KEYSIGHT	N9020A	MY51289897	A.14.16	2026/5/14	2027/5/13
6	Signal Generator	Agilent	N5181A	MY50140365	A.01.60	2026/5/14	2027/5/13
7	Vector signal generator	Agilent	N5182A	MY47420195	A.01.87	2026/5/14	2027/5/13
8	Communication test set	Agilent	E5515C	MY50102567	B.19.07 (E1962B)	2026/5/14	2027/5/13
9	2.4 GHz Filter	Shenxiang	MSF2400-2483. 5MS-1154	20181015001	/	2026/5/16	2027/5/15
10	5 GHz Filter	Shenxiang	MSF5150-5850 MS-1155	20181015001	/	2026/5/16	2027/5/15
11	Filter	Xingbo	XBLBQ-DZA120	190821-1-1	/	2026/5/16	2027/5/15
12	BT&WI-FI Automatic test software	Microwave	MTS8310	Ver. 2.0.0.0	/	/	/
13	Rohde & Schwarz SFU Broadcast Test System	R&S	SFU	101017	/	2025/10/20	2026/10/19
14	Temperature humidity chamber	Hongjing	TH-80CH	DG-15174	/	2025/7/13	2026/7/12
15	234G Automatic test software	Microwave	MTS8200	Ver. 2.0.0.0	/	/	/
16	966 chamber	C.R.T.	966	/	/	2024/6/23	2027/6/22

17	Receiver	R&S	ESPI	100362	RF_ATTEN_7 (104489/003)	2026/5/15	2027/5/14
18	Amplifier	HP	8447E	2945A02747	/	2026/5/15	2027/5/14
19	Amplifier	Agilent	8449B	3008A01838	/	2026/5/14	2027/5/13
20	TRILOG Broadband Antenna	Schwarzbeck	VULB 9168	00869	/	2026/5/17	2027/5/16
21	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA9120D	01911	/	2026/5/15	2027/5/14
22	EMI test software	Fala	EZ-EMC	FA-03A2 RE	/	/	/
23	Loop Antenna	Schwarzbeck	FMZB 1519B	1519B-224	/	2026/5/17	2027/5/16
24	loop antenna	ZHINAN	ZN30900A	GTS534	/	/	/
25	40G Horn antenna	A/H/System	SAS-574	588	/	2026/6/1	2027/5/31
26	Amplifier	AEROFLEX	Aeroflex	097	/	2026/6/1	2027/5/31
27	Power Meter	KEYSIGHT	N1912AP	N/A	A.05.00	2026/6/1	2027/5/31

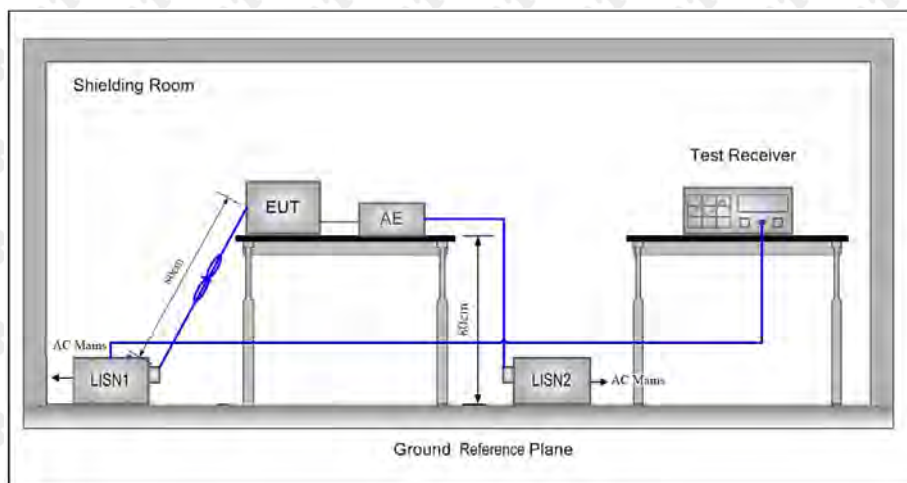
Continuous disturbance							
No.	Equipment	Manufacturer	Model No.	Serial No.	Firmware version	Calibrated Date	Calibrated until
1	843 Shield Room	C/ R/ T	843	/	/	2024/6/22	2027/6/21
2	LISN	ROHDE&SCHWARZ	ESH3-Z5	831551852	/	2026/5/14	2027/5/13
3	EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI	100428	V4.42.SP3	2026/5/15	2027/5/14
4	Coaxial cable	ZDECL	Z302S	18091904	/	2026/5/14	2027/5/13
5	ISN	Schwarzbeck	NTFM8158	183	/	2026/5/18	2027/5/17
6	Voltage sensor	Schwarzbeck	TK 9420	01189	/	2026/5/16	2027/5/15
7	EZ-EMC	Frad	EMC-con3A1.1	/	/	/	/
8	Current Probe	FCC	F-52B	199453	/	2026/5/22	2027/5/21
9	Communication test set	R&S	CMW500	108058	B.19.07 (E1962B)	2026/5/14	2027/5/13
10	Communication test set	Agilent	E5515C	MY50102567	V3.5.80	2026/5/14	2027/5/13

Radiated emission(No.2 Chamber)							
No.	Equipment	Manufacturer	Model No.	Serial No.	Firmware version	Calibrated Date	Calibrated until
1	966 Chamber	C/ R/ T	966	/	/	2024/6/8	2027/6/7
2	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA 9120 D	01911	/	2026/5/15	2027/5/14

3	Broadband Antenna	Schwarzbeck	VULB 9168	1471	/	2025/9/19	2026/9/18
4	Amplifier	Agilent	8449B	3008A01838	/	2026/5/14	2027/5/13
5	Preamplifier	Schwarzbeck	BBV 9743 B	00500	/	2026/5/15	2027/5/14
6	EMI TEST RECEIVER	R&S	ESCI7	100861	/	2025/9/19	2026/9/18
7	Spectrum Analyzer	KEYSIGHT	N9020A	MY51289897	A.14.16	2026/5/14	2027/5/13
8	EMI test software	Farad	EZ-EMC	/	Ver. FARAD-3A1+	/	/
9	Coaxial cable	Rosenberg	8m	/	/	2026/5/16	2027/5/15
10	Coaxial cable	Times	2m	/	/	2026/5/16	2027/5/15
11	Coaxial cable	Times	2m	/	/	2026/5/16	2027/5/15
12	Coaxial cable	Times	1m	/	/	2026/5/16	2027/5/15
13	loop antenna	Schwarzbeck	FMZB 1519B	1519B-224	/	2026/5/17	2027/5/16
14	Communication test set	R&S	CMW500	108058	B.19.07 (E1962B)	2026/5/14	2027/5/13
15	Communication test set	Agilent	E5515C	MY50102567	V3.5.80	2026/5/14	2027/5/13

6. AC POWER LINE CONDUCTED EMISSION

6.1 Block Diagram Of Test Setup



6.2 Limit

Table 4 – AC power-line conducted emissions limits

Frequency (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 ^{Note 1}	56 to 46 ^{Note 1}
0.5 - 5	56	46
5 - 30	60	50

Note 1: The level decreases linearly with the logarithm of the frequency.

* Decreasing linearly with the logarithm of the frequency

6.3 Test procedure

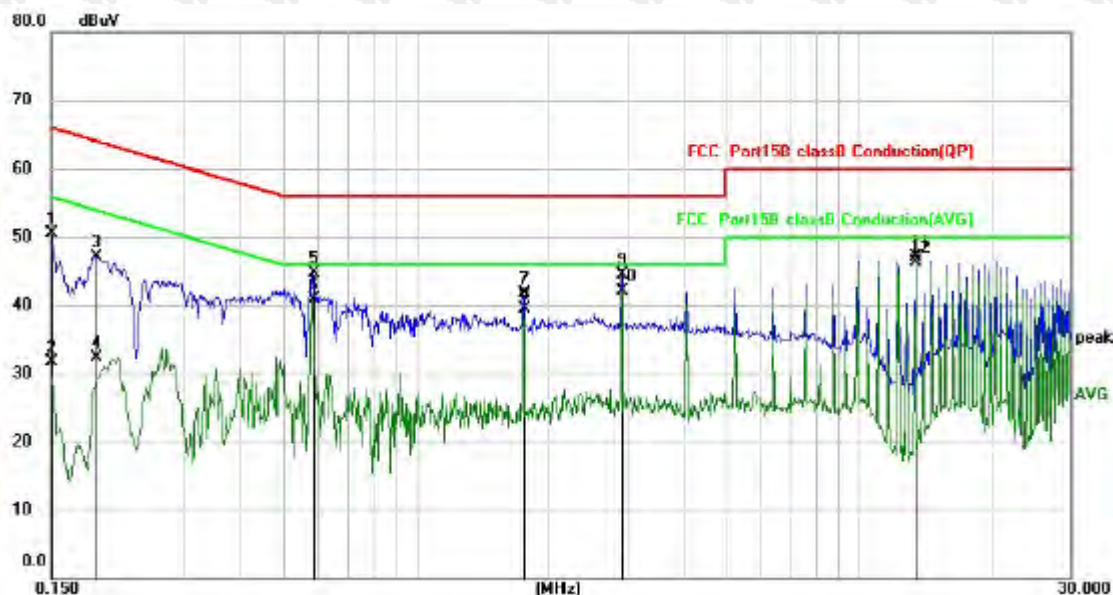
- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a $50\Omega/50\mu\text{H} + 5\Omega$ linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
- 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
- 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0,4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane.

This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.

- 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10:2020 on conducted measurement.
- 6) All modes were tested at AC 120V and 240V, only the worst result of AC 120V 60Hz was reported.
- 7) If a EUT received DC power from the USB Port of Notebook PC, the PC's adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.

6.4 Test Result

L: Worst case-8DPSK (Mid channel)

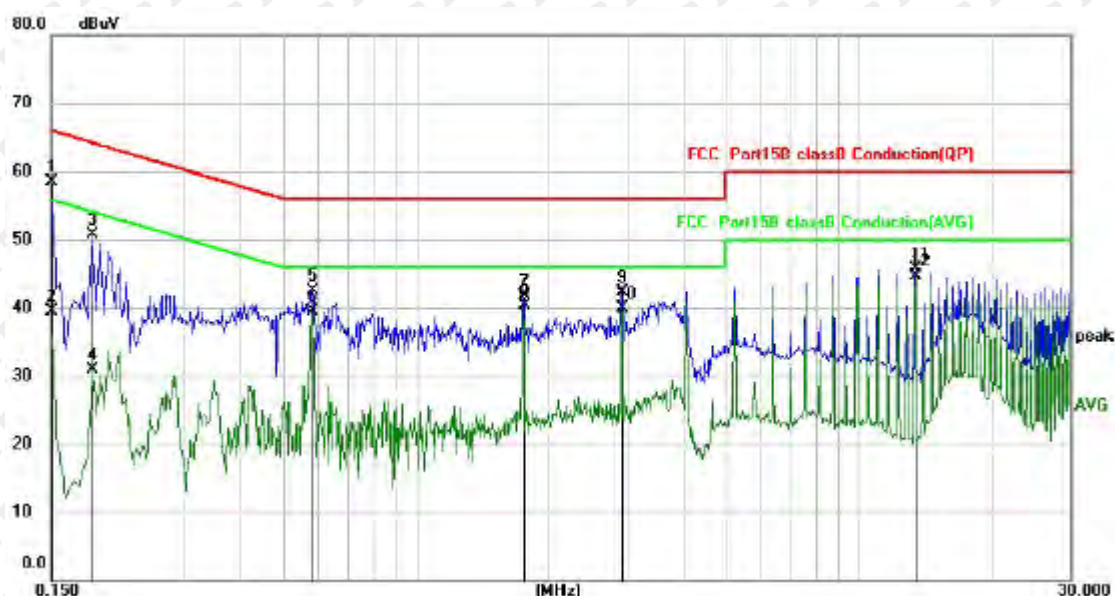


No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	
		MHz	Level	Factor	ment			Detector
			dBuV	dB	dBuV	dBuV	dB	
1		0.1500	40.45	10.07	50.52	66.00	-15.48	QP
2		0.1500	21.61	10.07	31.68	56.00	-24.32	AVG
3		0.1900	37.06	10.08	47.14	64.04	-16.90	QP
4		0.1900	22.24	10.08	32.32	54.04	-21.72	AVG
5		0.5858	34.69	10.10	44.79	56.00	-11.21	QP
6		0.5858	30.78	10.10	40.88	46.00	-5.12	AVG
7		1.7500	31.62	10.16	41.78	56.00	-14.22	QP
8		1.7500	29.40	10.16	39.56	46.00	-6.44	AVG
9		2.9180	34.27	10.20	44.47	56.00	-11.53	QP
10		2.9180	31.84	10.20	42.04	46.00	-3.96	AVG
11		13.4177	36.46	10.64	47.10	60.00	-12.90	QP
12	*	13.4177	35.74	10.64	46.38	50.00	-3.62	AVG

Remark:

Factor = Cable loss + LISN factor, Margin = Measurement – Limit

N: Worst case-8DPSK (Mid channel)



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.1500	48.53	10.07	58.60	66.00	-7.40	QP
2		0.1500	29.51	10.07	39.58	56.00	-16.42	AVG
3		0.1859	40.56	10.08	50.64	64.22	-13.58	QP
4		0.1859	20.88	10.08	30.96	54.22	-23.26	AVG
5		0.5819	32.37	10.10	42.47	56.00	-13.53	QP
6		0.5819	29.45	10.10	39.55	46.00	-6.45	AVG
7		1.7500	31.64	10.16	41.80	56.00	-14.20	QP
8		1.7500	30.17	10.16	40.33	46.00	-5.67	AVG
9		2.9140	32.07	10.20	42.27	56.00	-13.73	QP
10		2.9140	29.78	10.20	39.98	46.00	-6.02	AVG
11		13.4100	35.16	10.64	45.80	60.00	-14.20	QP
12	*	13.4100	34.06	10.64	44.70	50.00	-5.30	AVG

Remark:

Factor = Cable loss + LISN factor, Margin = Measurement – Limit

7. RADIATED SPURIOUS EMISSION

7.1 Block Diagram Of Test Setup

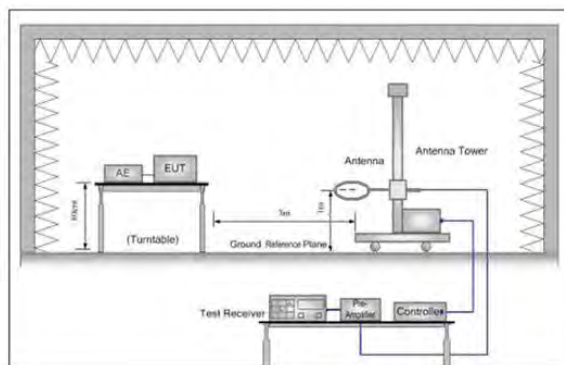


Figure 1. Below 30MHz

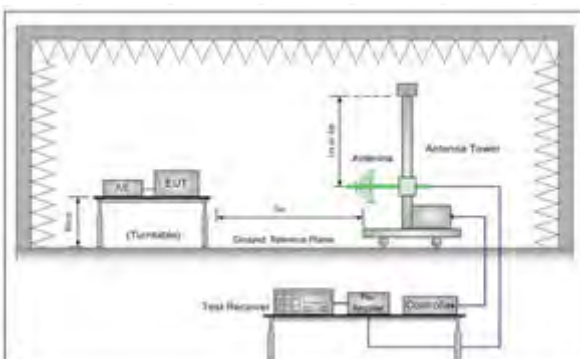


Figure 2. 30MHz to 1GHz

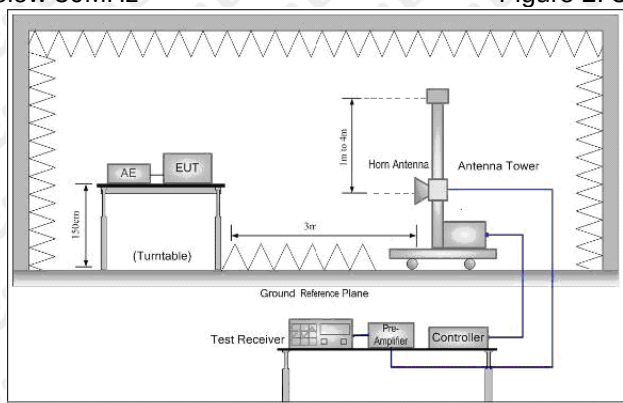


Figure 3. Above 1GHz

7.2 Limit

Spurious Emissions:

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

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

7.3 Test procedure

Below 1GHz test procedure as below:

- The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rota table table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Above 1GHz test procedure as below:

- Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 meter to 1.5 meter(Above 18GHz the distance is 1 meter and table is 1.5 meter).
- Test the EUT in the lowest channel ,the middle channel ,the Highest channel
- Repeat above procedures until all frequencies measured was complete.
- Full battery is used during test.

Receiver set:

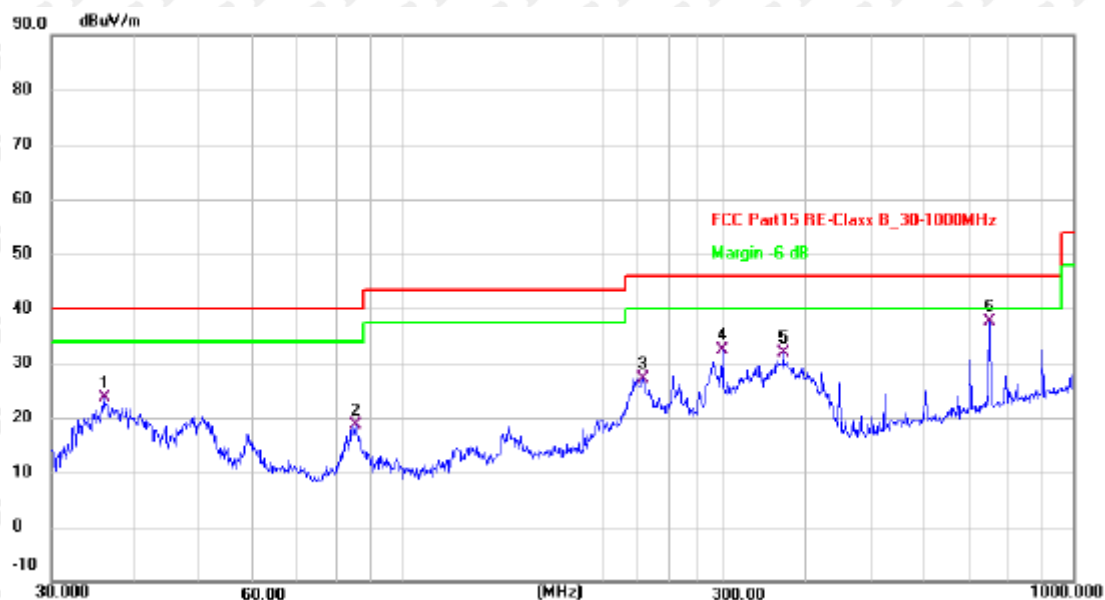
Frequency	Detector	RBW	VBW	Remark
0.009MHz-0.090MHz	Peak	10kHz	30KHz	Peak
0.009MHz-0.090MHz	Average	10kHz	30KHz	Average
0.090MHz-0.110MHz	Quasi-peak	10kHz	30KHz	Quasi-peak
0.110MHz-0.490MHz	Peak	10kHz	30KHz	Peak
0.110MHz-0.490MHz	Average	10kHz	30KHz	Average
0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak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

7.4 Test Result

Below 1GHz Test Results:

Antenna polarity: H

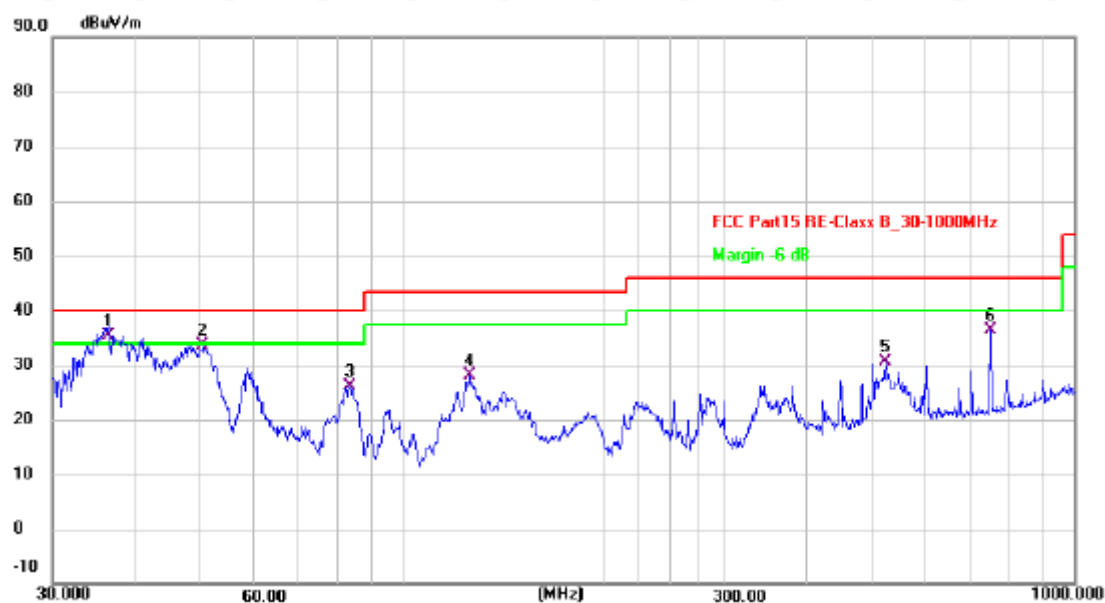
Worst case-GFSK(Mid channel)



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	36.0007	36.98	-13.35	23.63	40.00	-16.37	QP
2	85.2980	36.00	-17.30	18.70	40.00	-21.30	QP
3	228.4904	41.95	-14.75	27.20	46.00	-18.80	QP
4	300.3672	44.64	-12.14	32.50	46.00	-13.50	QP
5	369.4047	42.88	-10.88	32.00	46.00	-14.00	QP
6 *	750.1083	40.45	-2.92	37.53	46.00	-8.47	QP

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

Antenna polarity: V
Worst case-GFSK(Mid channel)



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1 *	36.3814	48.63	-13.32	35.31	40.00	-4.69	QP
2	50.4089	46.87	-13.19	33.68	40.00	-6.32	QP
3	83.2298	43.12	-17.11	26.01	40.00	-13.99	QP
4	125.8864	43.41	-15.40	28.01	43.50	-15.49	QP
5	522.7180	38.14	-7.41	30.73	46.00	-15.27	QP
6	750.1083	39.32	-2.92	36.40	46.00	-9.60	QP

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement— Limit

Above 1 GHz Test Results:

Antenna polarity: H

Worst case-8DPSK(Low channel)

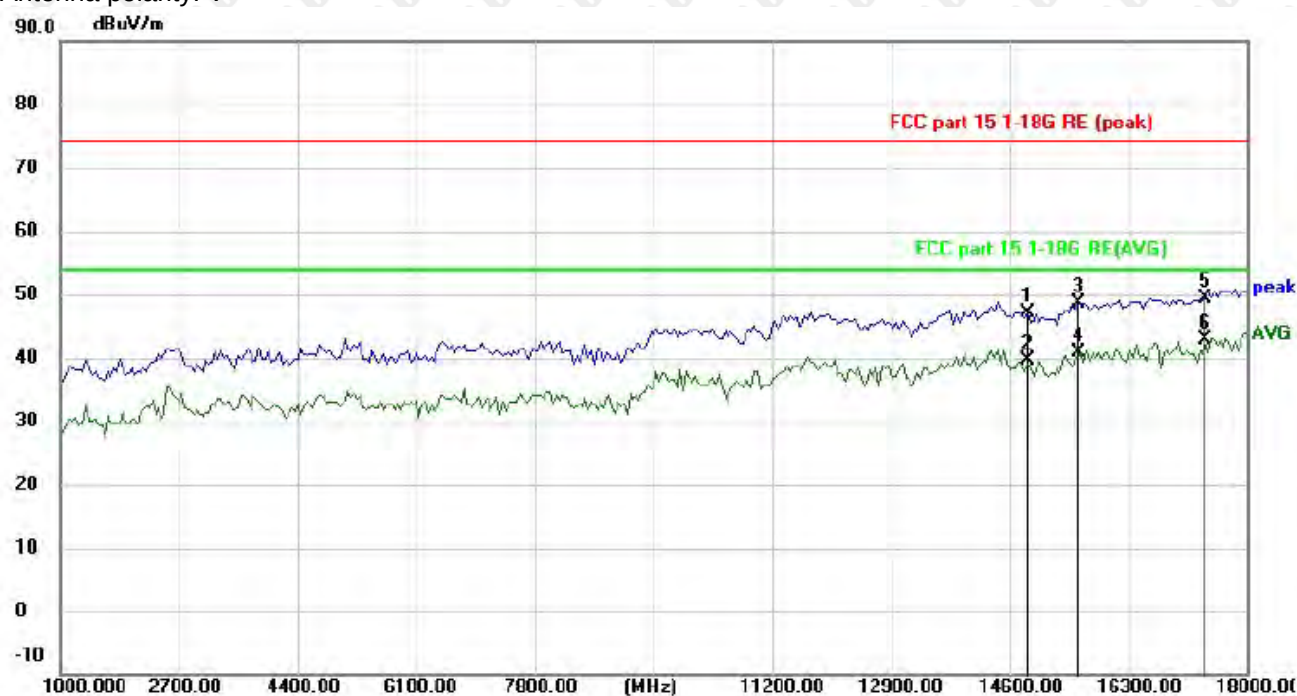
90.0 dBuV/m



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dB/m	Over dB	Detector
1		14345.000	37.03	10.57	47.60	74.00	-26.40	peak
2		14345.000	30.18	10.57	40.75	54.00	-13.25	AVG
3		16257.500	38.40	10.72	49.12	74.00	-24.88	peak
4		16257.500	30.08	10.72	40.80	54.00	-13.20	AVG
5		17277.500	35.83	15.83	51.66	74.00	-22.34	peak
6	*	17277.500	26.72	15.83	42.55	54.00	-11.45	AVG

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

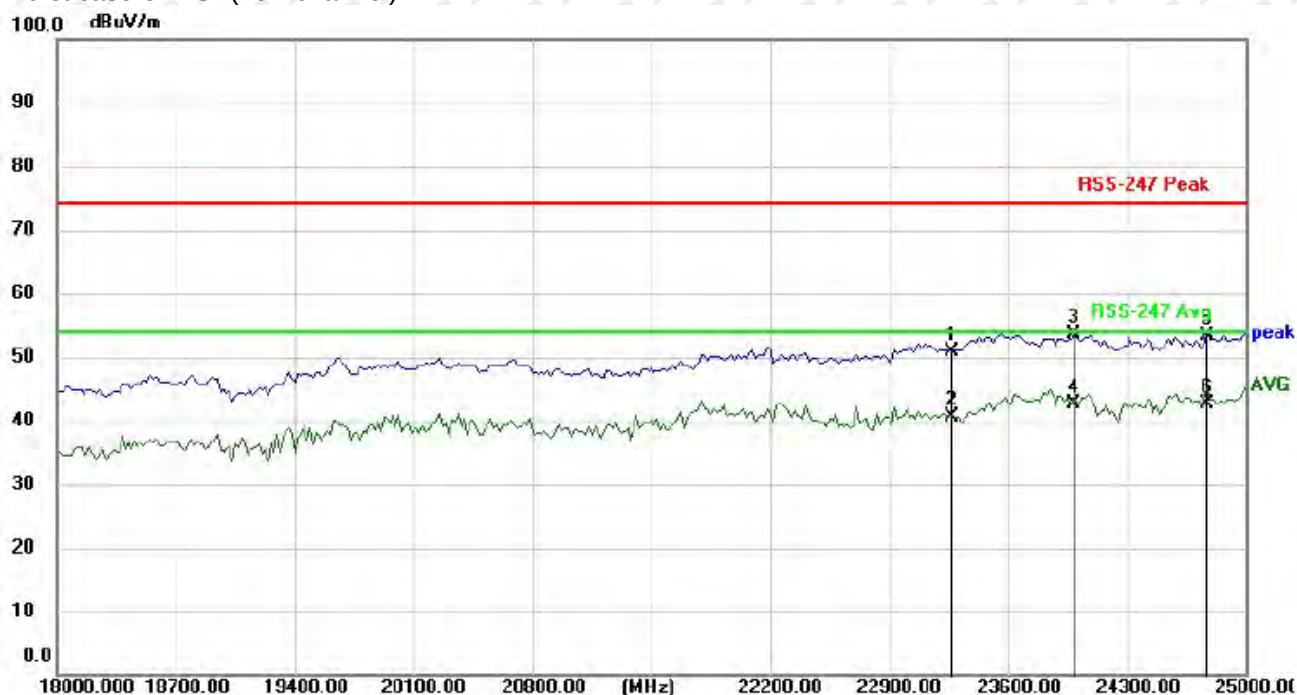
Antenna polarity: V



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dB/m	Over dB	Detector
1		14855.000	36.71	10.46	47.17	74.00	-26.83	peak
2		14855.000	29.06	10.46	39.52	54.00	-14.48	AVG
3		15577.500	38.76	9.98	48.74	74.00	-25.26	peak
4		15577.500	30.94	9.98	40.92	54.00	-13.08	AVG
5		17405.000	32.64	16.76	49.40	74.00	-24.60	peak
6	*	17405.000	26.15	16.76	42.91	54.00	-11.09	AVG

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

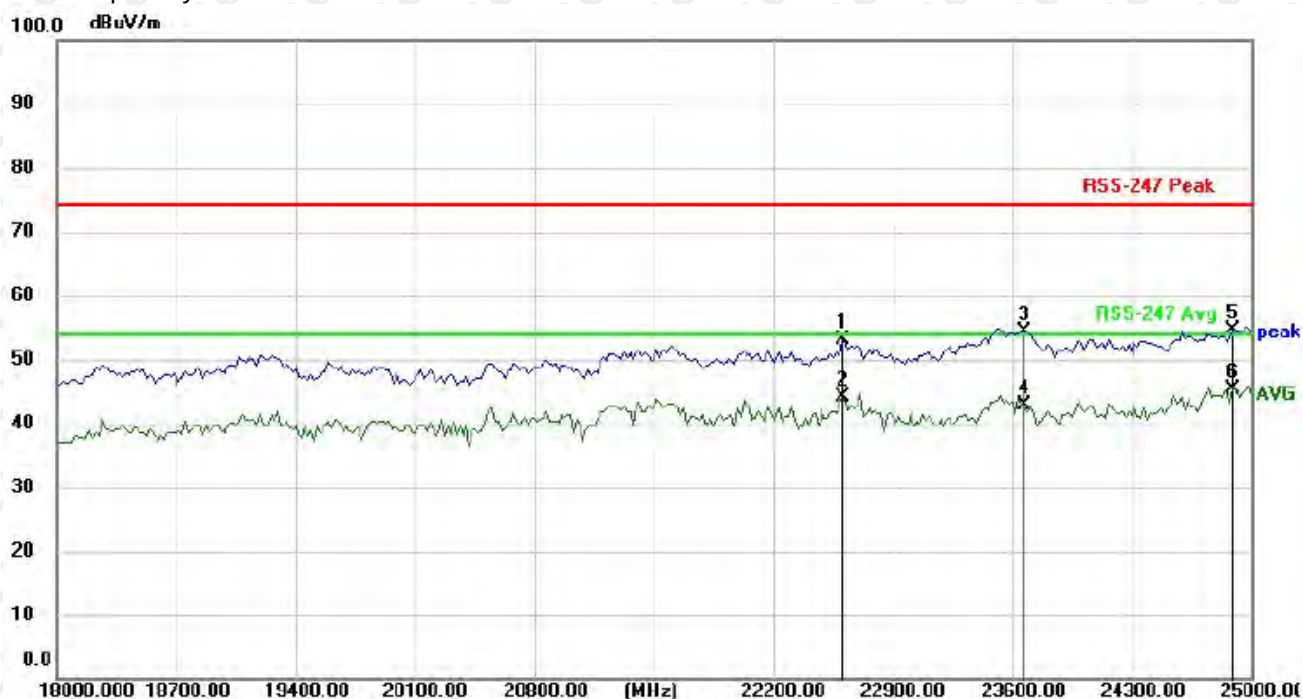
Antenna polarity: H
Worst case-8DPSK(Low channel)



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dB/m	Over dB	Detector
1		23267.500	60.14	-9.16	50.98	74.00	-23.02	peak
2		23267.500	49.69	-9.16	40.53	54.00	-13.47	AVG
3		23985.000	61.61	-8.08	53.53	74.00	-20.47	peak
4		23985.000	50.68	-8.08	42.60	54.00	-11.40	AVG
5		24772.500	60.39	-6.89	53.50	74.00	-20.50	peak
6	*	24772.500	49.59	-6.89	42.70	54.00	-11.30	AVG

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

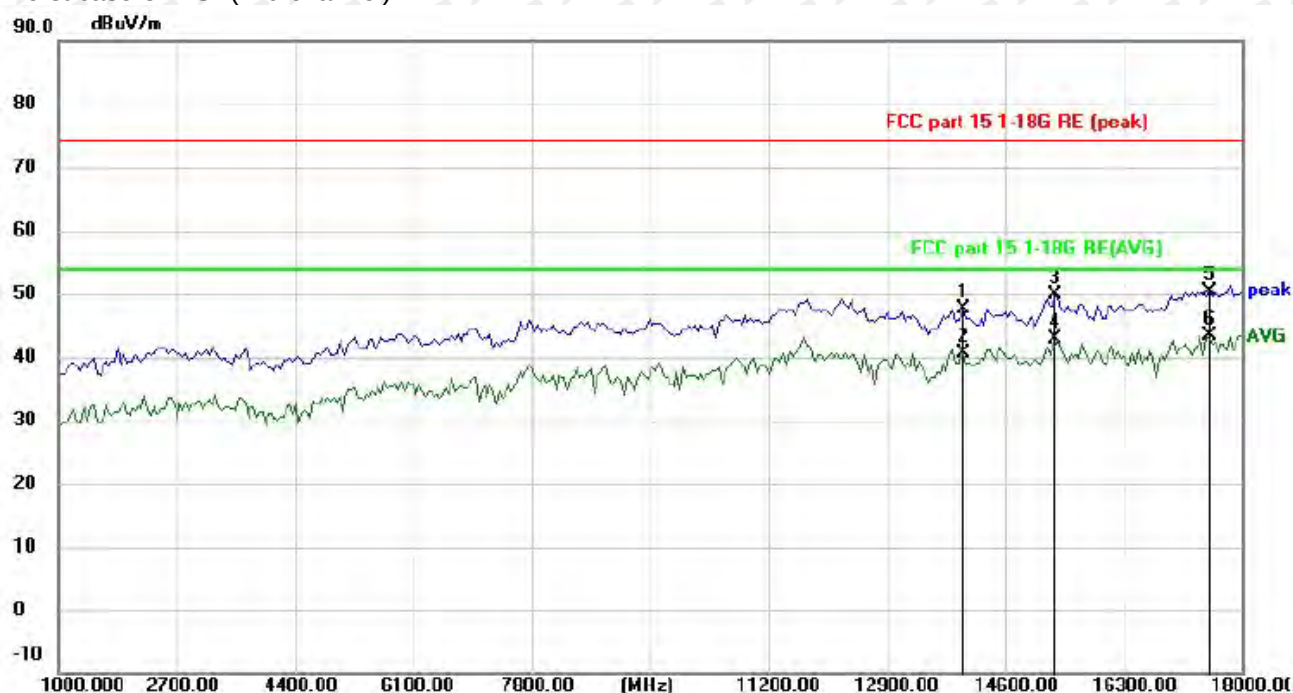
Antenna polarity: V



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector
		MHz	dBuV	dB	dBuV/m	dB/m	dB	
1		22602.500	62.74	-9.73	53.01	74.00	-20.99	peak
2		22602.500	53.79	-9.73	44.06	54.00	-9.94	AVG
3		23670.000	63.00	-8.55	54.45	74.00	-19.55	peak
4		23670.000	51.36	-8.55	42.81	54.00	-11.19	AVG
5		24895.000	61.38	-6.70	54.68	74.00	-19.32	peak
6	*	24895.000	52.01	-6.70	45.31	54.00	-8.69	AVG

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

Antenna polarity: H
Worst case-8DPSK(Mid channel)



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1		14005.000	37.00	10.65	47.65	74.00	-26.35	peak
2		14005.000	30.04	10.65	40.69	54.00	-13.31	AVG
3		15322.500	39.63	10.18	49.81	74.00	-24.19	peak
4		15322.500	32.82	10.18	43.00	54.00	-11.00	AVG
5		17532.500	32.77	17.69	50.46	74.00	-23.54	peak
6	*	17532.500	25.72	17.69	43.41	54.00	-10.59	AVG

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

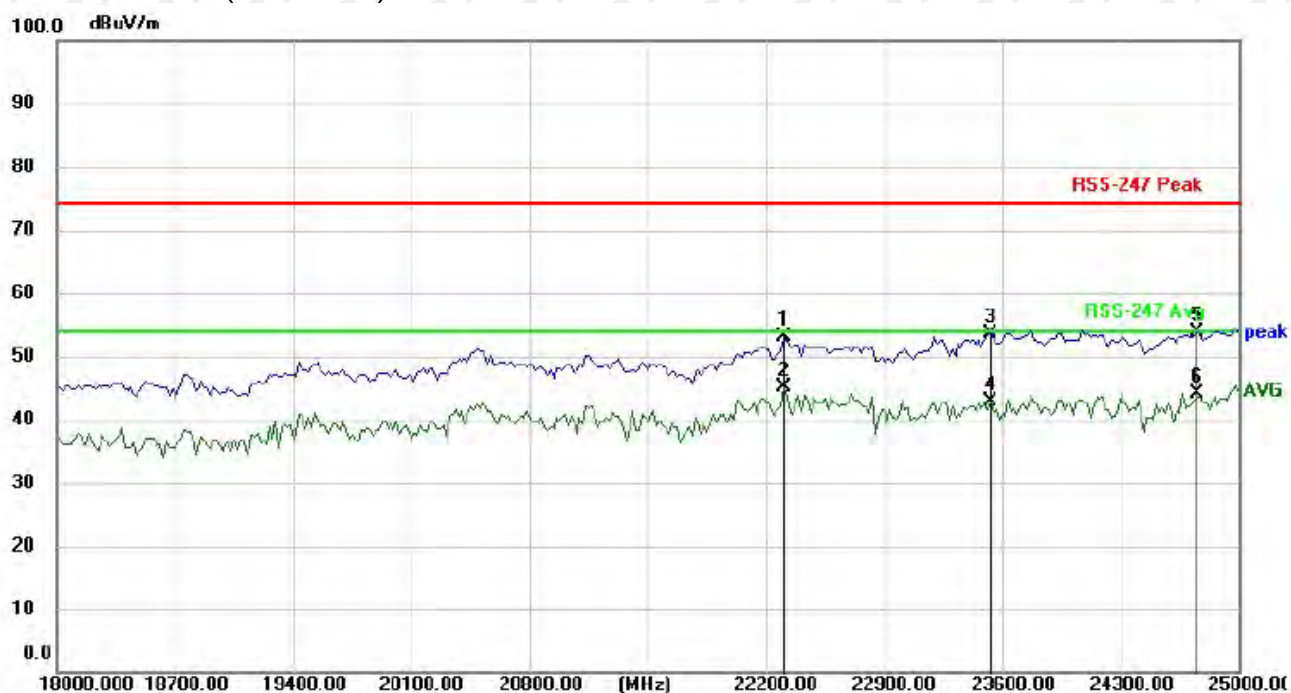
Antenna polarity: V



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1		17447.500	35.61	17.07	52.68	74.00	-21.32	peak
2		14812.500	38.40	10.47	48.87	74.00	-25.13	peak
3		11157.500	40.66	5.07	45.73	74.00	-28.27	peak
4		11157.500	31.27	5.07	36.34	54.00	-17.66	AVG
5		14812.500	31.63	10.47	42.10	54.00	-11.90	AVG
6	*	17447.500	25.82	17.07	42.89	54.00	-11.11	AVG

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

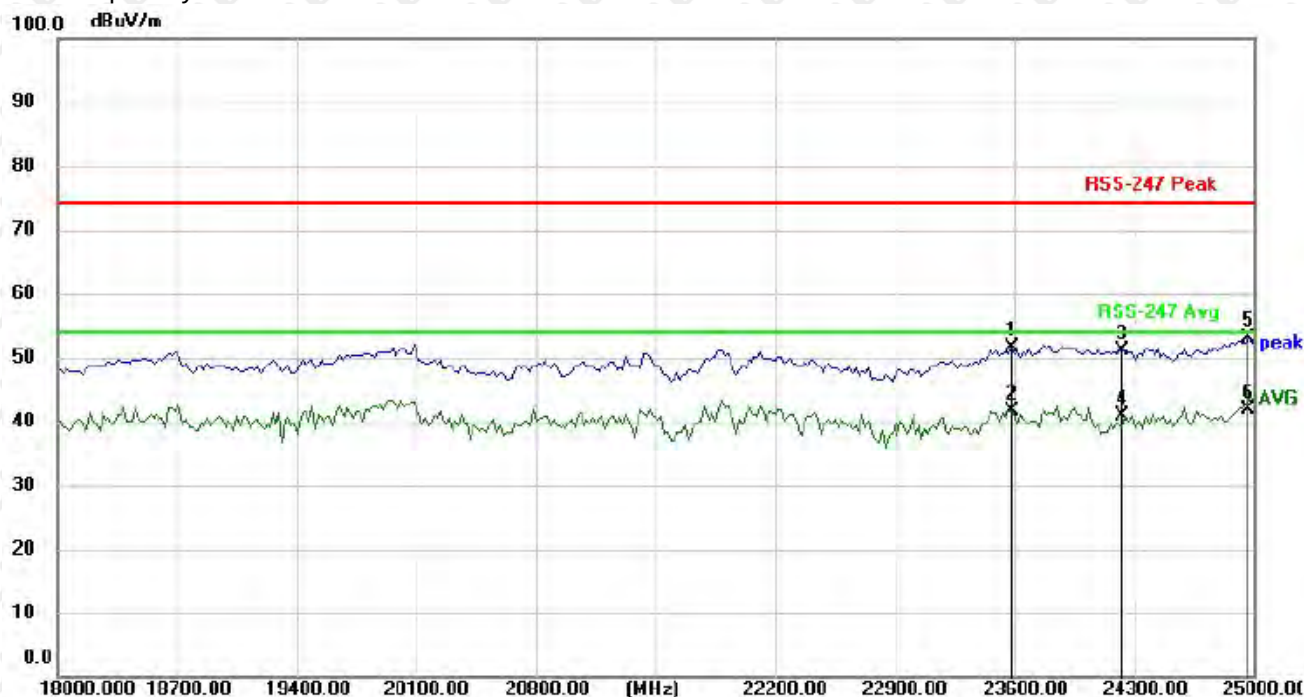
Antenna polarity: H
Worst case-8DPSK(Mid channel)



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1		22305.000	63.03	-9.85	53.18	74.00	-20.82	peak
2	*	22305.000	54.87	-9.85	45.02	54.00	-8.98	AVG
3		23530.000	62.44	-8.77	53.67	74.00	-20.33	peak
4		23530.000	51.62	-8.77	42.85	54.00	-11.15	AVG
5		24755.000	60.68	-6.91	53.77	74.00	-20.23	peak
6		24755.000	51.06	-6.91	44.15	54.00	-9.85	AVG

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

Antenna polarity: V



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dB/m	Over dB	Detector
1		23582.500	60.43	-8.69	51.74	74.00	-22.26	peak
2		23582.500	50.42	-8.69	41.73	54.00	-12.27	AVG
3		24230.000	58.96	-7.71	51.25	74.00	-22.75	peak
4		24230.000	48.60	-7.71	40.89	54.00	-13.11	AVG
5		24965.000	59.71	-6.59	53.12	74.00	-20.88	peak
6	*	24965.000	48.38	-6.59	41.79	54.00	-12.21	AVG

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

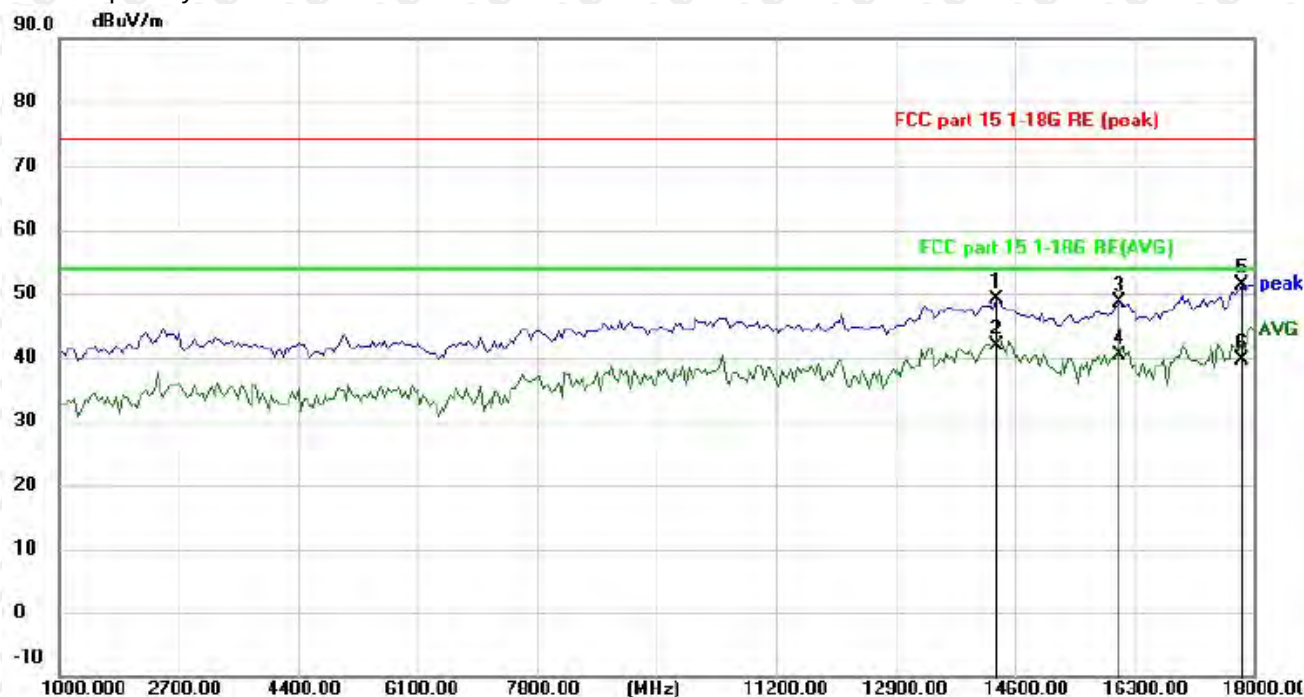
Antenna polarity: H
Worst case-8DPSK(High channel)



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dB/m	Over dB	Detector
1		17745.000	32.24	19.25	51.49	74.00	-22.51	peak
2		16087.500	41.08	10.01	51.09	74.00	-22.91	peak
3		13622.500	39.58	10.02	49.60	74.00	-24.40	peak
4		13622.500	32.63	10.02	42.65	54.00	-11.35	AVG
5		16087.500	34.48	10.01	44.49	54.00	-9.51	AVG
6	*	17745.000	25.30	19.25	44.55	54.00	-9.45	AVG

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

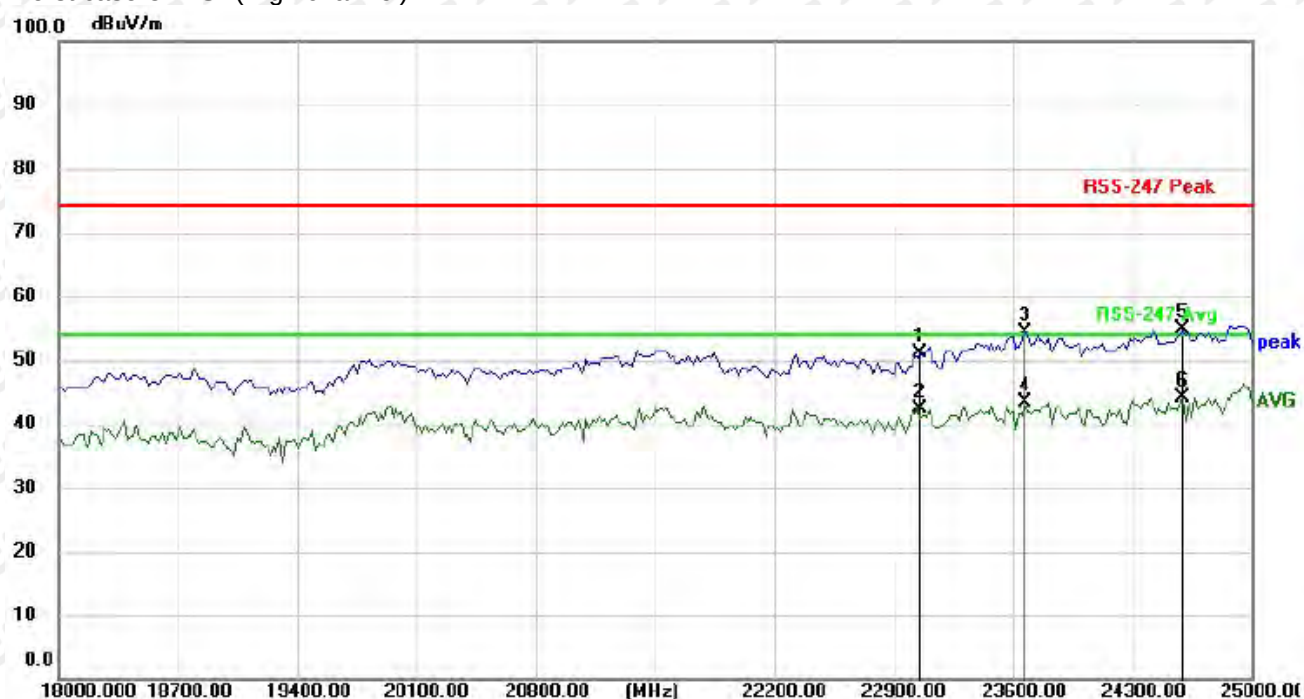
Antenna polarity: V



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dB/m	Over dB	Detector
1		14345.000	38.53	10.57	49.10	74.00	-24.90	peak
2	*	14345.000	31.34	10.57	41.91	54.00	-12.09	AVG
3		16087.500	38.58	10.01	48.59	74.00	-25.41	peak
4		16087.500	30.44	10.01	40.45	54.00	-13.55	AVG
5		17830.000	31.53	19.87	51.40	74.00	-22.60	peak
6		17830.000	19.66	19.87	39.53	54.00	-14.47	AVG

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

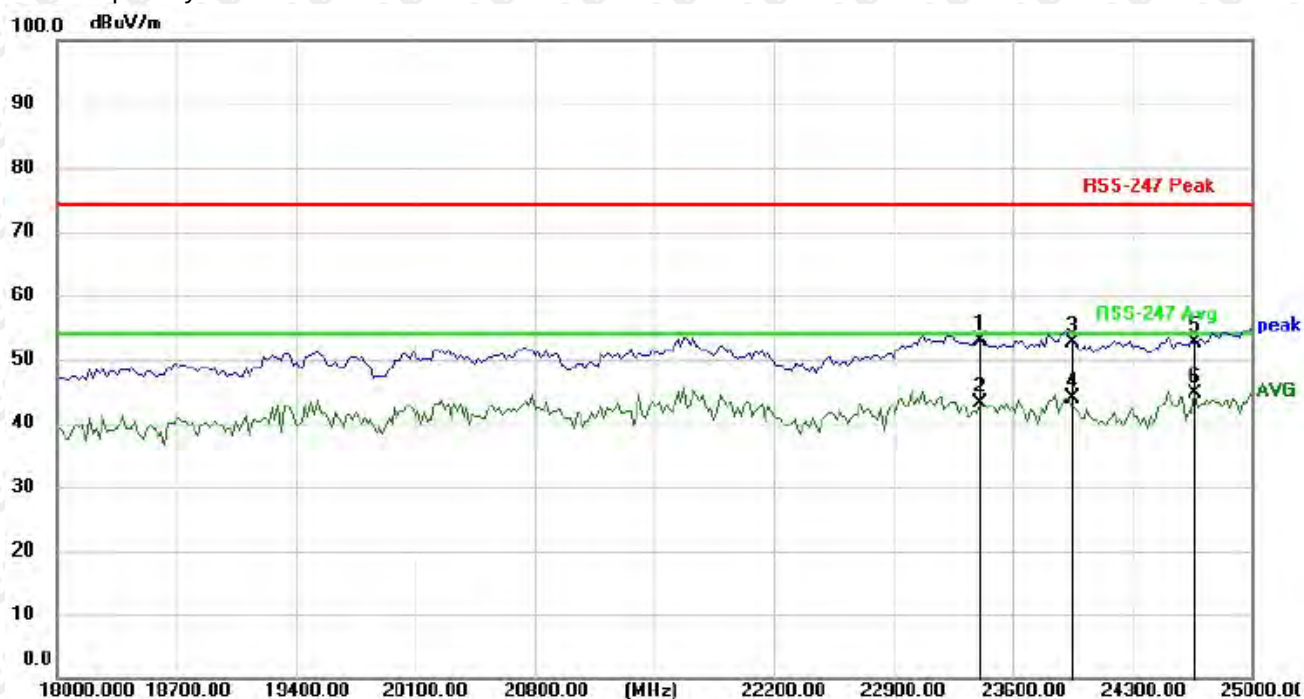
Antenna polarity: H
Worst case-8DPSK(High channel)



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1		23057.500	60.58	-9.47	51.11	74.00	-22.89	peak
2		23057.500	51.73	-9.47	42.26	54.00	-11.74	AVG
3		23670.000	63.00	-8.55	54.45	74.00	-19.55	peak
4		23670.000	51.86	-8.55	43.31	54.00	-10.69	AVG
5		24597.500	61.93	-7.15	54.78	74.00	-19.22	peak
6	*	24597.500	51.30	-7.15	44.15	54.00	-9.85	AVG

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

Antenna polarity: V



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1		23407.500	61.72	-8.95	52.77	74.00	-21.23	peak
2		23407.500	52.20	-8.95	43.25	54.00	-10.75	AVG
3		23950.000	60.79	-8.13	52.66	74.00	-21.34	peak
4		23950.000	52.10	-8.13	43.97	54.00	-10.03	AVG
5		24667.500	59.79	-7.05	52.74	74.00	-21.26	peak
6	*	24667.500	51.70	-7.05	44.65	54.00	-9.35	AVG

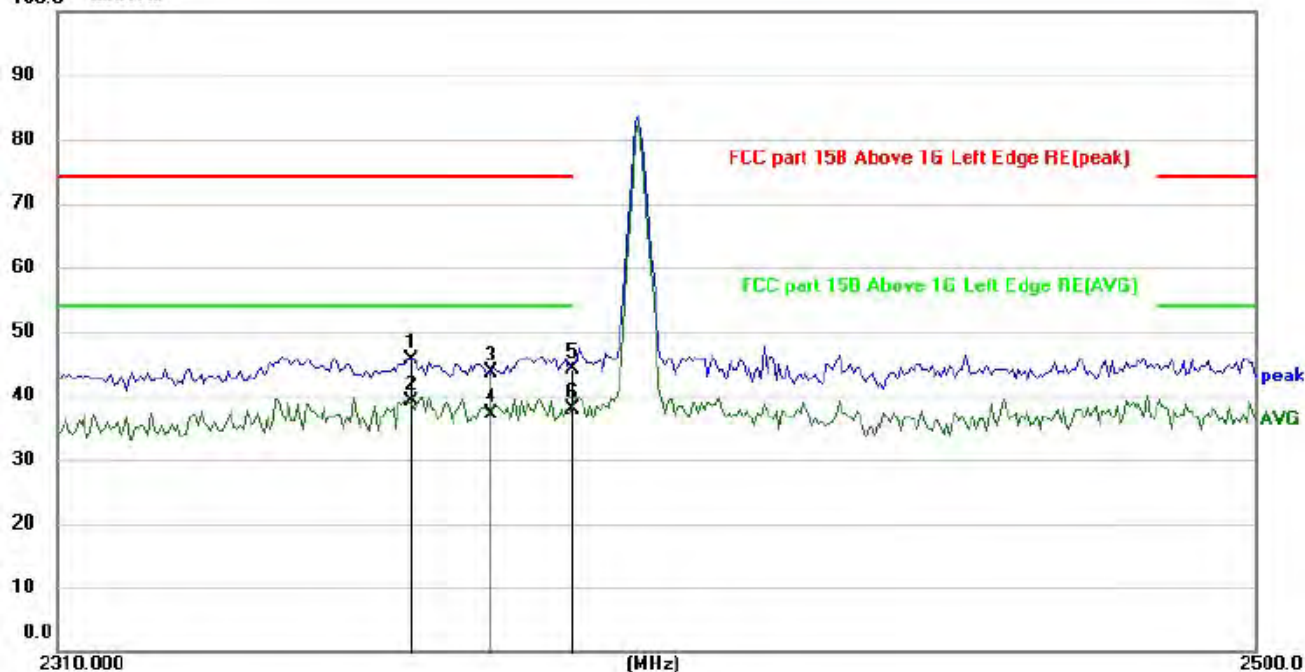
Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

Restricted bands around fundamental frequency (Radiated)

Antenna polarity: H

Worst case-8DPSK(Low channel)

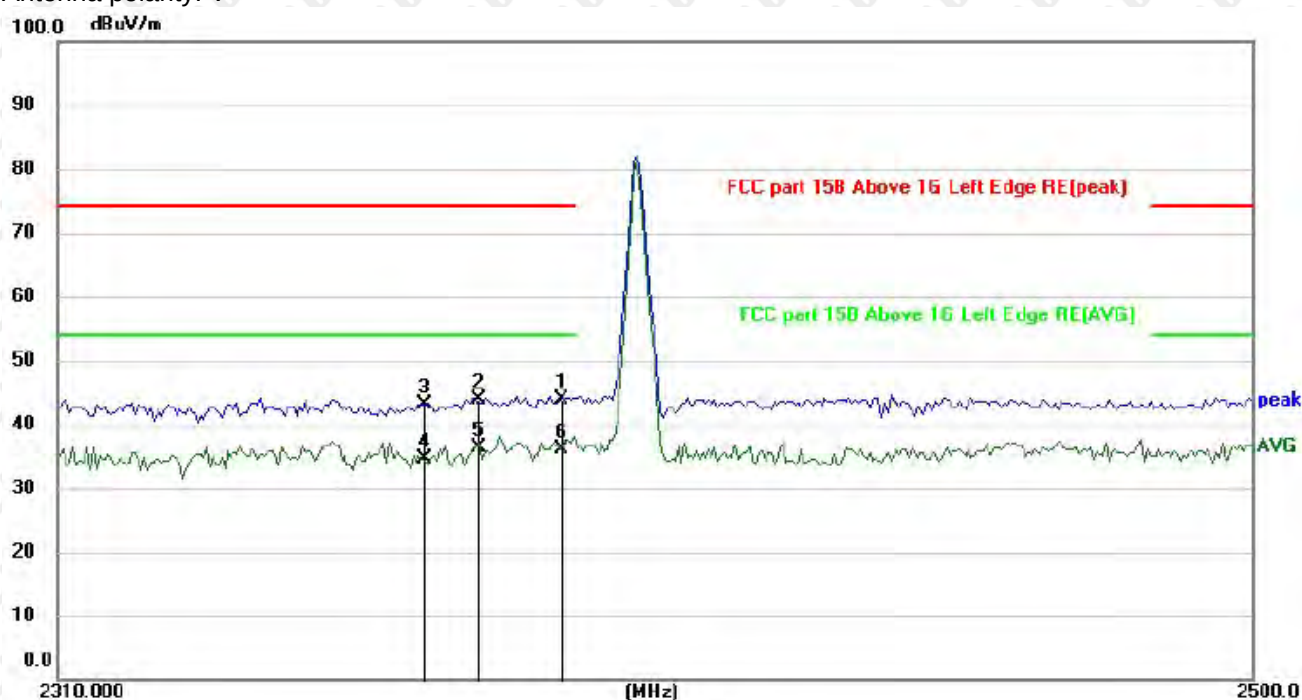
100.0 dBuV/m



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dB/m	Over dB	Detector
1		2364.030	65.42	-19.82	45.60	74.00	-28.40	peak
2	*	2364.030	58.88	-19.82	39.06	54.00	-14.94	AVG
3		2377.146	63.35	-19.75	43.60	74.00	-30.40	peak
4		2377.146	56.95	-19.75	37.20	54.00	-16.80	AVG
5		2389.391	63.87	-19.68	44.19	74.00	-29.81	peak
6		2389.391	57.54	-19.68	37.86	54.00	-16.14	AVG

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

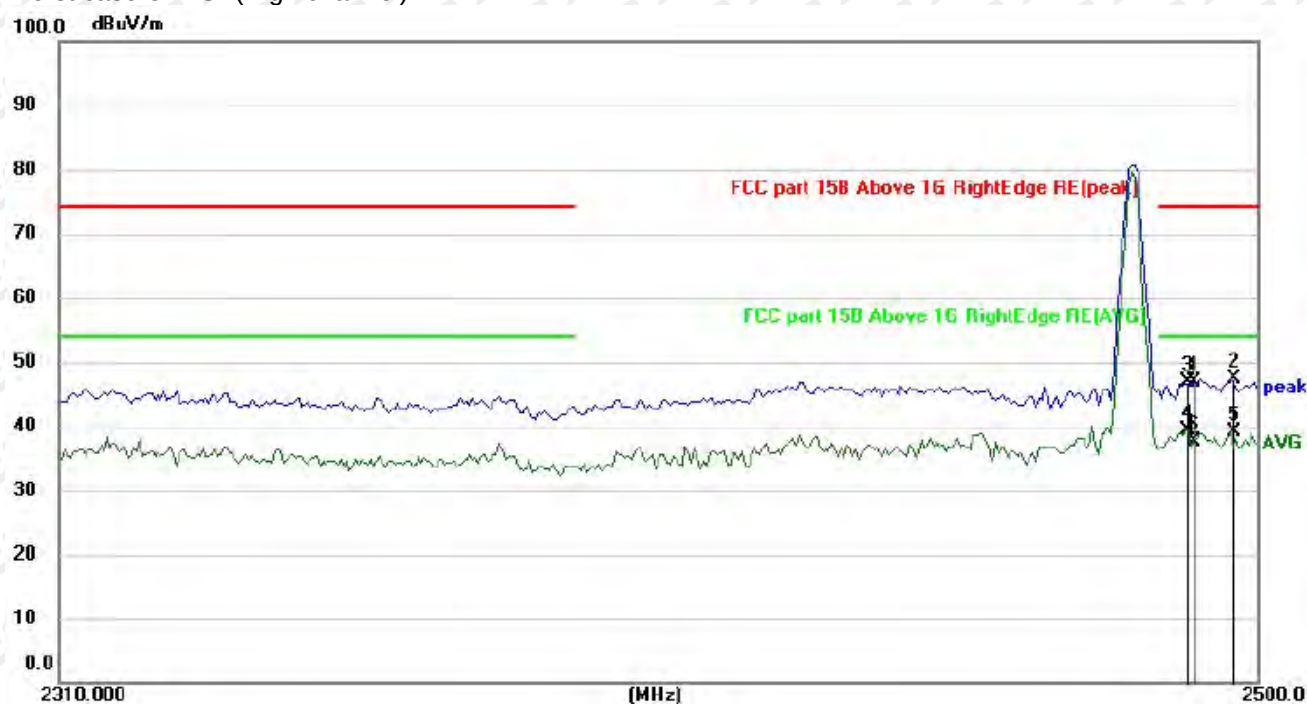
Antenna polarity: V



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1		2387.975	63.55	-19.69	43.86	74.00	-30.14	peak
2		2374.799	63.54	-19.76	43.78	74.00	-30.22	peak
3		2366.834	62.87	-19.81	43.06	74.00	-30.94	peak
4		2366.834	54.36	-19.81	34.55	54.00	-19.45	AVG
5	*	2374.799	56.18	-19.76	36.42	54.00	-17.58	AVG
6		2387.975	55.74	-19.69	36.05	54.00	-17.95	AVG

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

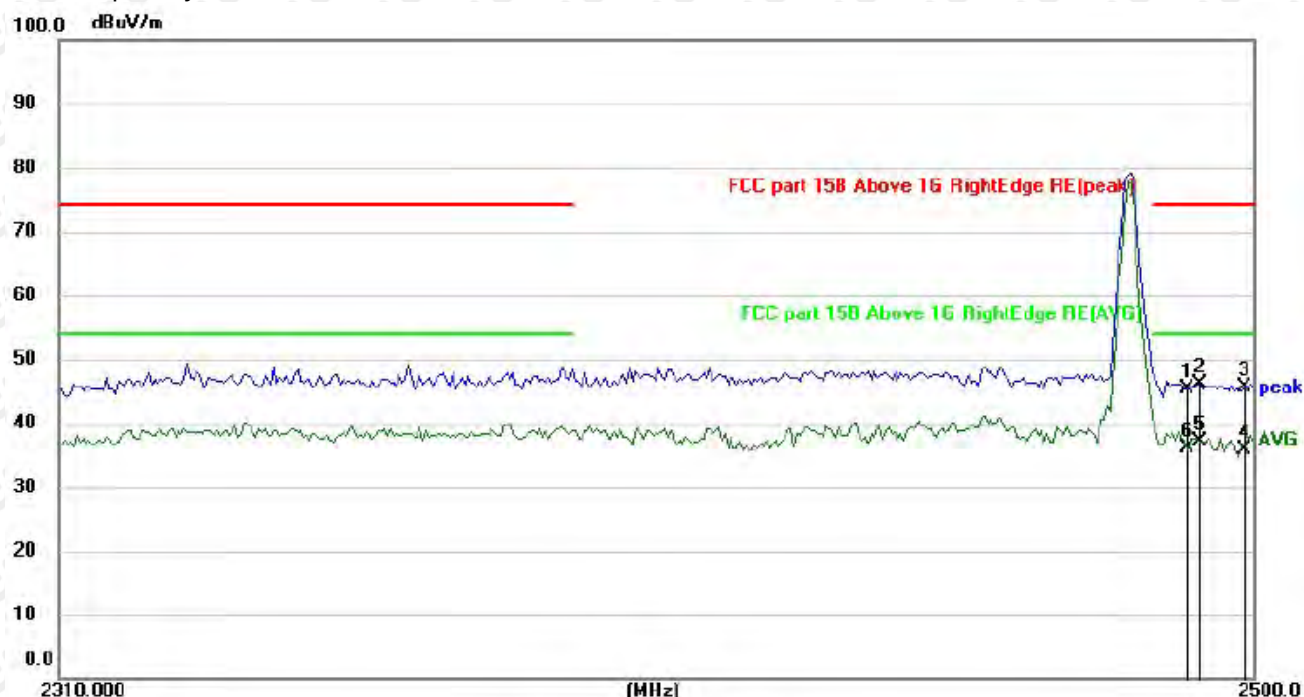
Antenna polarity: H
Worst case-8DPSK(High channel)



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dB/m	Over dB	Detector
1		2489.647	66.03	-19.12	46.91	74.00	-27.09	peak
2		2495.558	66.38	-19.08	47.30	74.00	-26.70	peak
3		2488.663	66.06	-19.12	46.94	74.00	-27.06	peak
4	*	2488.663	58.42	-19.12	39.30	54.00	-14.70	AVG
5		2495.558	58.28	-19.08	39.20	54.00	-14.80	AVG
6		2489.647	56.68	-19.12	37.56	54.00	-16.44	AVG

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

Antenna polarity: V



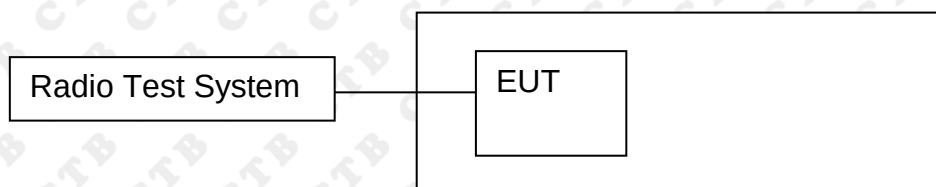
No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1		2489.155	64.44	-19.12	45.32	74.00	-28.68	peak
2		2491.123	65.19	-19.11	46.08	74.00	-27.92	peak
3		2498.518	64.78	-19.07	45.71	74.00	-28.29	peak
4		2498.518	55.06	-19.07	35.99	54.00	-18.01	AVG
5	*	2491.123	56.34	-19.11	37.23	54.00	-16.77	AVG
6		2489.155	55.35	-19.12	36.23	54.00	-17.77	AVG

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement- Limit

Note: All modes of GFSK, $\pi/4$ DQPSK, 8DPSK were test at Low, High channel, Hopping and No Hoppingwas tested and passed, the worst result of 8DPSK No Hopping was reported.

8. BAND EDGE AND RF CONDUCTED SPURIOUS EMISSIONS

8.1 Block Diagram Of Test Setup



8.2 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 §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)).

8.3 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:

Below 30MHz:

RBW = 100kHz, VBW = 300kHz, Sweep = auto
 Detector function = peak, Trace = max hold

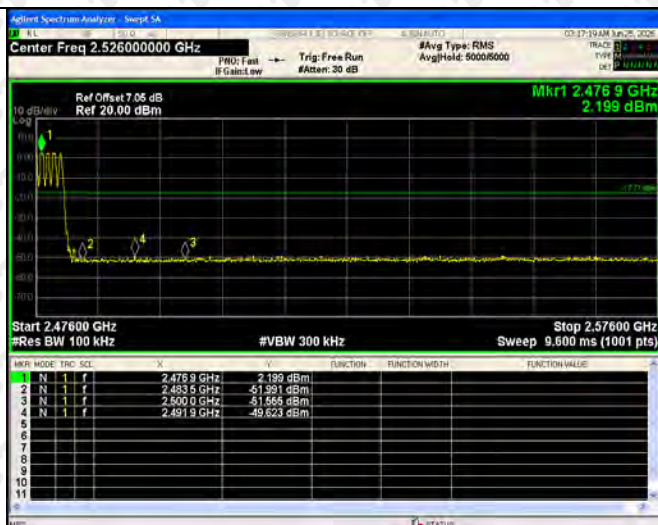
Above 30MHz:

RBW = 100kHz, VBW = 300kHz, Sweep = auto
 Detector function = peak, Trace = max hold

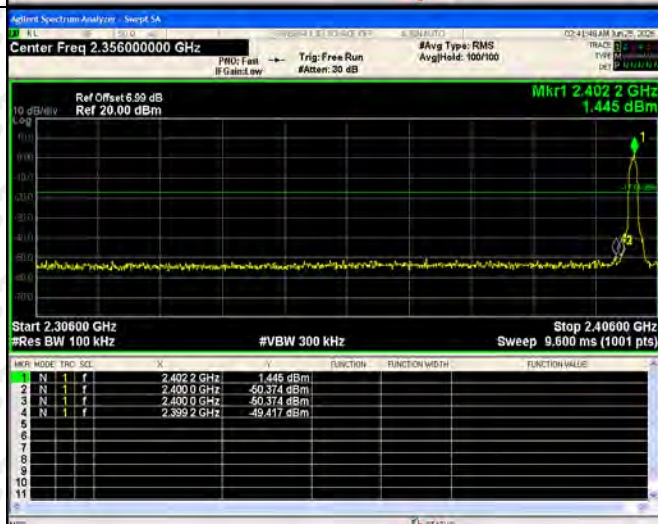
8.4 Test Result



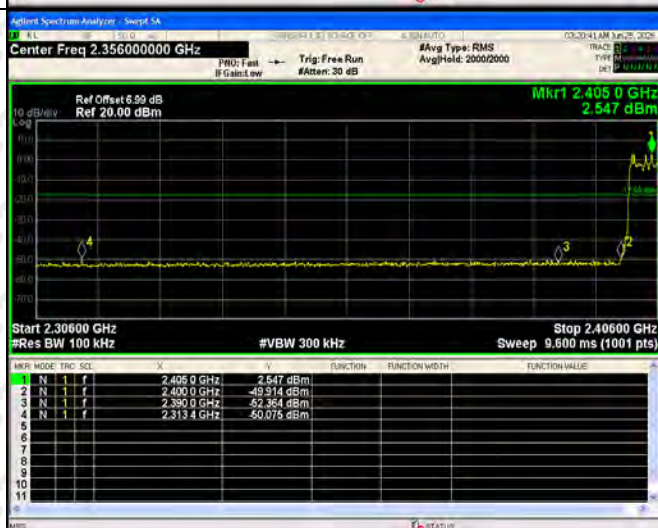
GFSK/HCH/
Hop

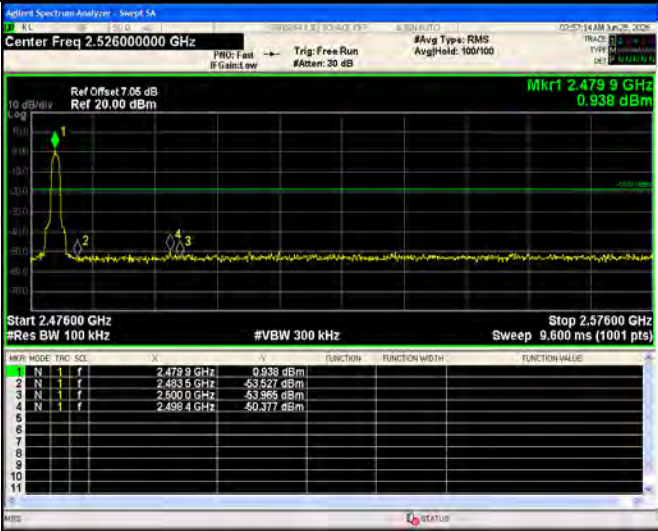
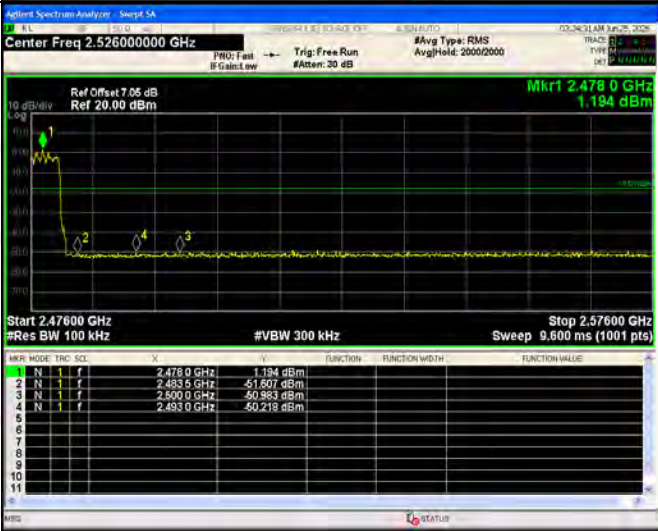
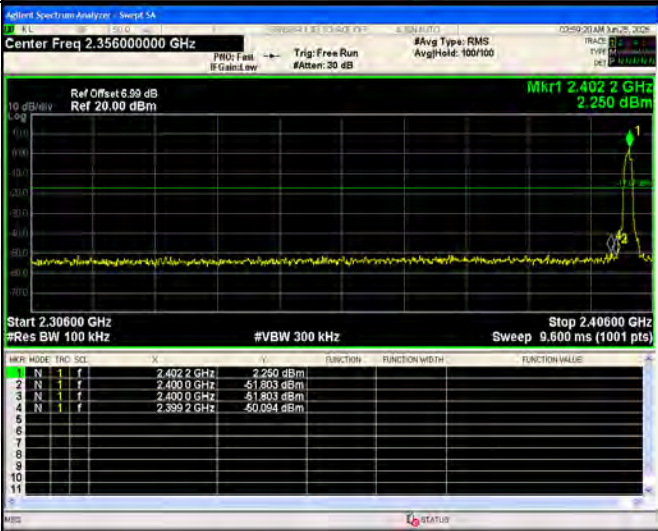


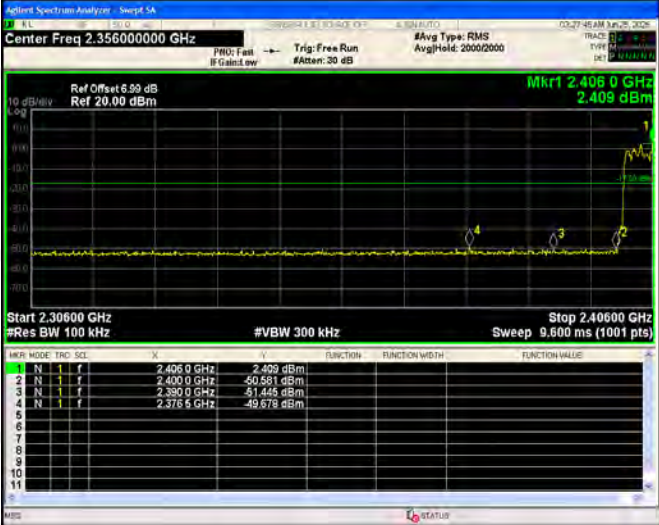
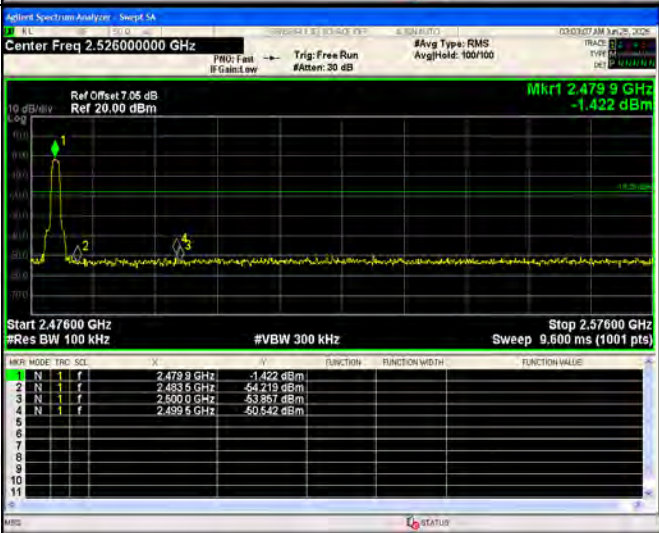
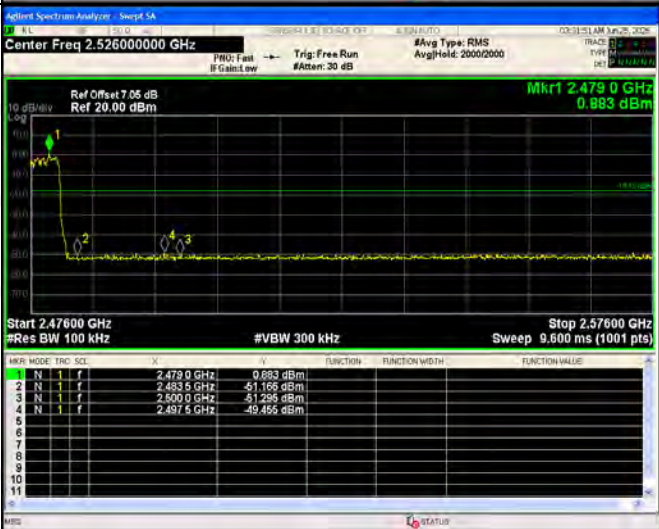
π /4DQPSK/LCH/
No Hop



π /4DQPSK/LCH/
Hop

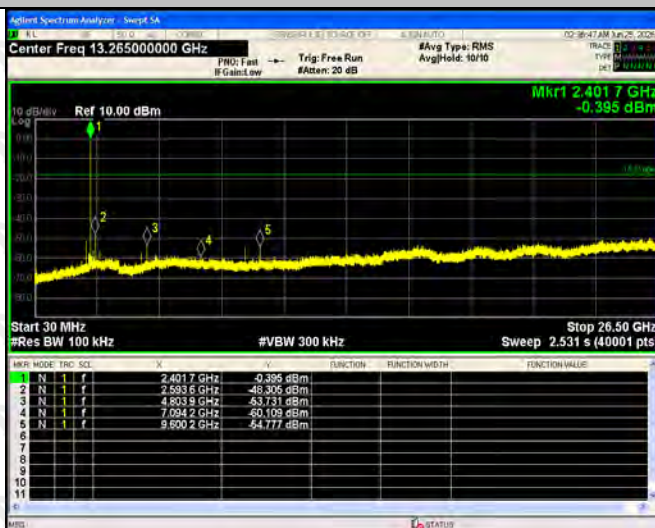


$\pi/4$DQPSK/HCH/ No Hop	
$\pi/4$DQPSK/HCH/ Hop	
8DPSK/LCH/No Hop	

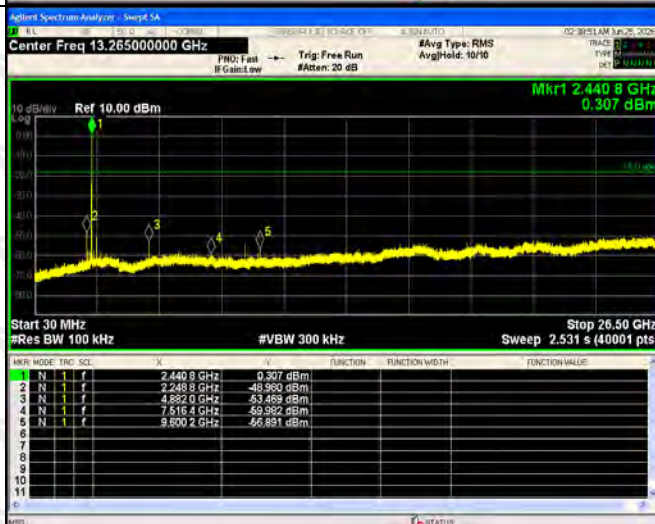
8DPSK /LCH/Hop	
8DPSK /HCH/No Hop	
8DPSK /HCH/Hop	

RF Conducted Spurious Emissions Graphs

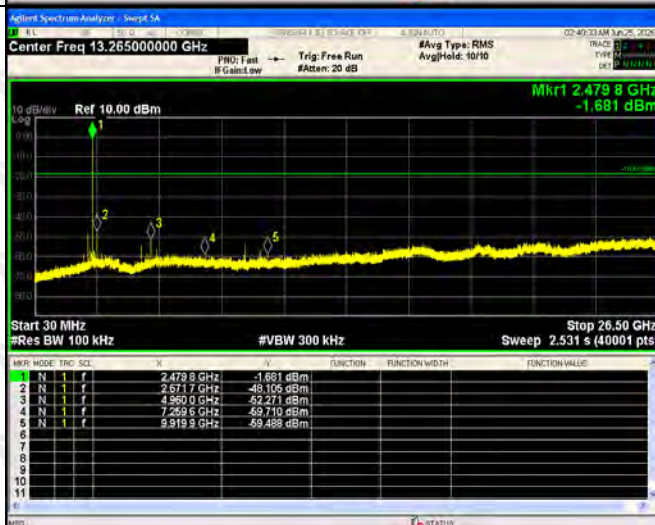
GFSK/LCH

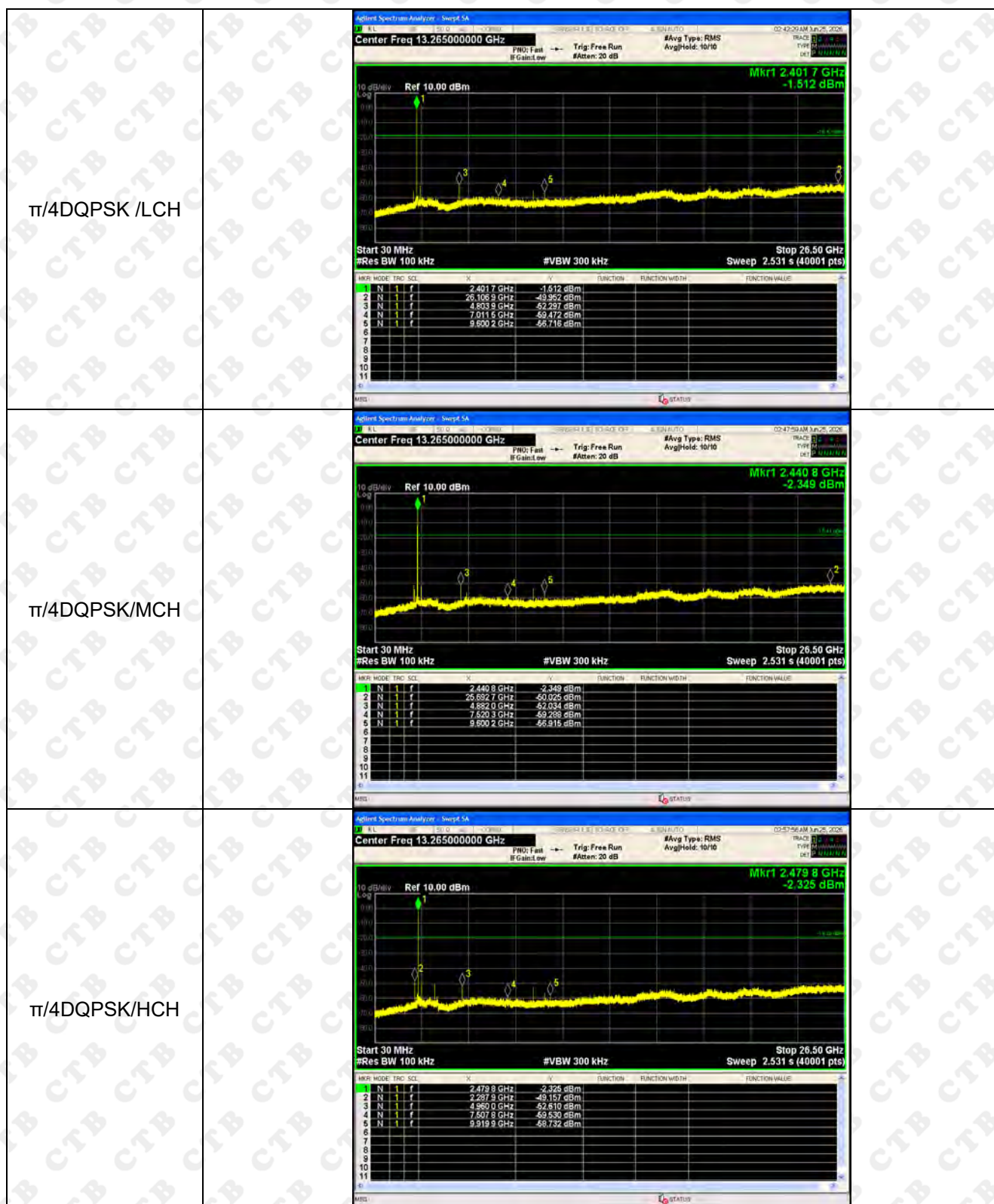


GFSK/MCH

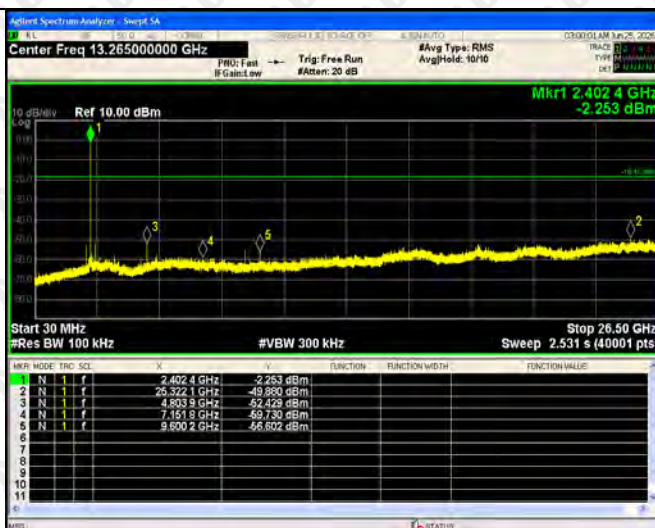


GFSK/HCH

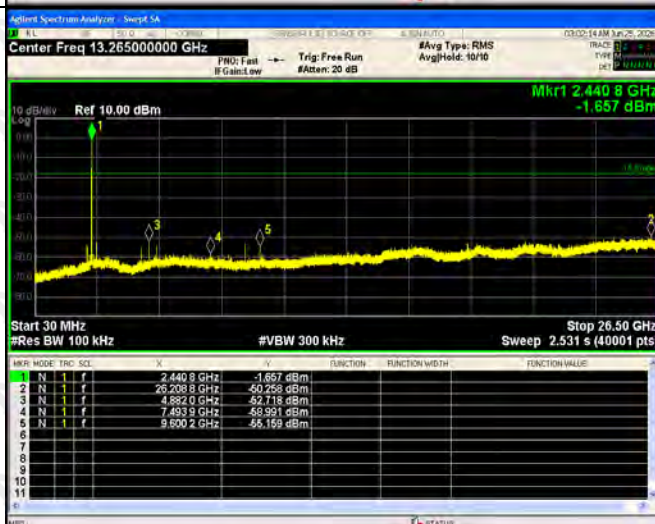




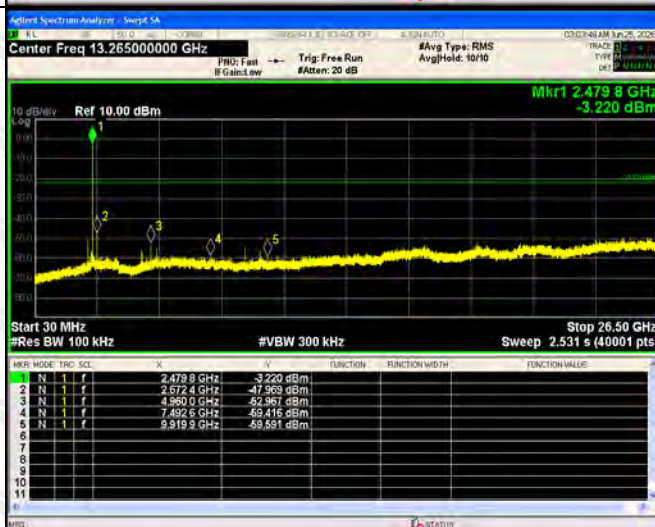
8DPSK /LCH



8DPSK /MCH

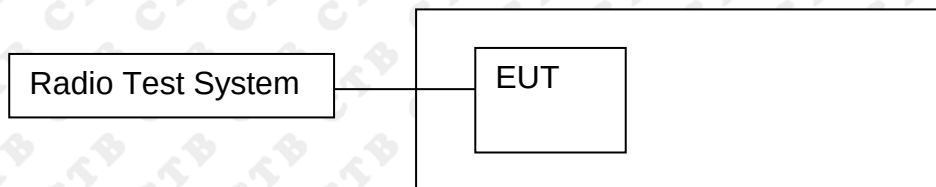


8DPSK /HCH



9. CONDUCTED PEAK OUTPUT POWER

9.1 Block Diagram Of Test Setup



9.2 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.

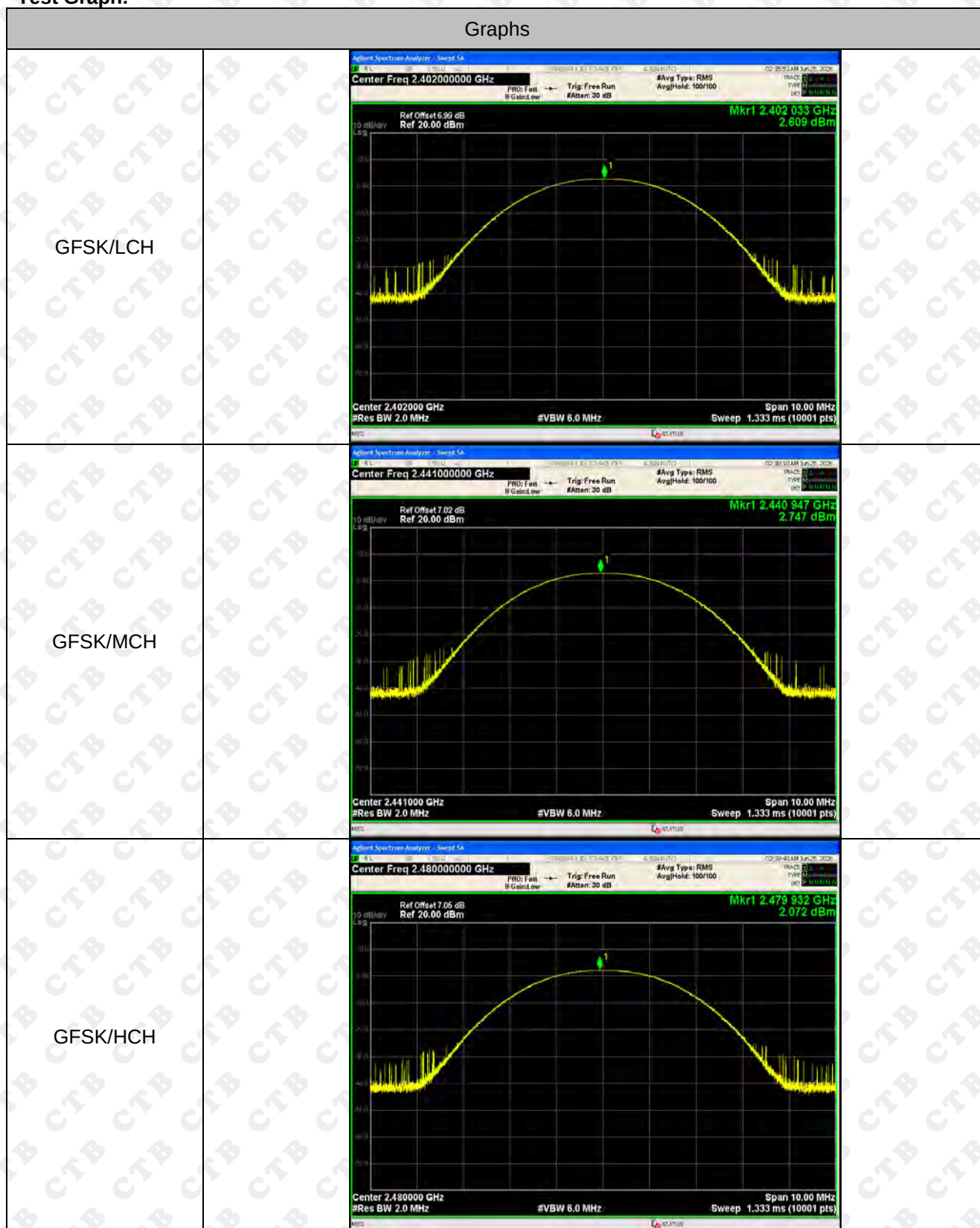
9.3 Test procedure

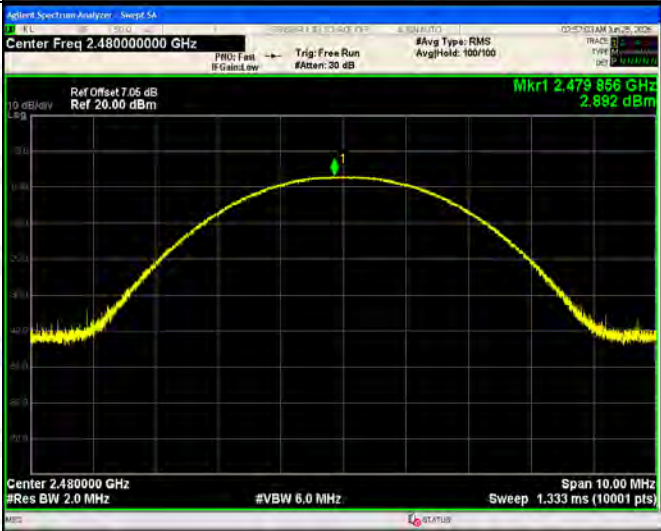
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 2MHz. VBW = 6MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, middle and highest channel individually. Record the max value.

9.4 Test Result

Mode	Channel.	Maximum Peak Output Power [dBm]	Limit [dBm]	Verdict
GFSK	LCH	2.61	20.97	PASS
	MCH	2.75	20.97	PASS
	HCH	2.07	20.97	PASS
$\pi/4$ DQPSK	LCH	3.39	20.97	PASS
	MCH	3.48	20.97	PASS
	HCH	2.89	20.97	PASS
8DPSK	LCH	3.54	20.97	PASS
	MCH	3.77	20.97	PASS
	HCH	3.17	20.97	PASS

Test Graph:

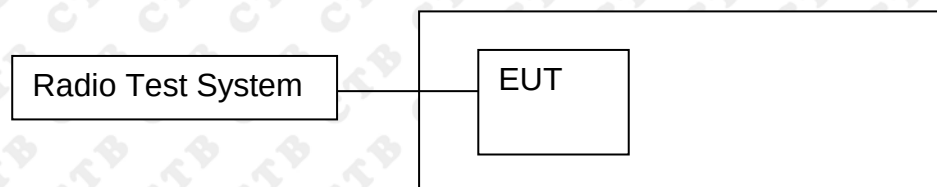


$\pi/4$DQPSK/LCH	 Agilent Spectrum Analyzer - Sweep 5A Center Freq 2.40200000 GHz Ref Offset 6.99 dB Ref 20.00 dBm Mkr1 2.401949 GHz 3.390 dBm Center 2.402000 GHz #Res BW 2.0 MHz #VBW 5.0 MHz Span 10.00 MHz Sweep 1.333 ms (10001 pts)
$\pi/4$DQPSK/MCH	 Agilent Spectrum Analyzer - Sweep 5A Center Freq 2.44100000 GHz Ref Offset 7.02 dB Ref 20.00 dBm Mkr1 2.440904 GHz 3.482 dBm Center 2.441000 GHz #Res BW 2.0 MHz #VBW 5.0 MHz Span 10.00 MHz Sweep 1.333 ms (10001 pts)
$\pi/4$DQPSK/HCH	 Agilent Spectrum Analyzer - Sweep 5A Center Freq 2.48000000 GHz Ref Offset 7.05 dB Ref 20.00 dBm Mkr1 2.479856 GHz 2.882 dBm Center 2.480000 GHz #Res BW 2.0 MHz #VBW 5.0 MHz Span 10.00 MHz Sweep 1.333 ms (10001 pts)

8DPSK/LCH	 Agilent Spectrum Analyzer - Sweep 5A Center Freq 2.40200000 GHz Ref Offset 6.99 dB Ref 20.00 dBm Mkr1 2.401929 GHz 3.541 dBm Center 2.402000 GHz #Res BW 2.0 MHz #VBW 6.0 MHz Span 10.00 MHz Sweep 1.333 ms (10001 pts)
8DPSK /MCH	 Agilent Spectrum Analyzer - Sweep 5A Center Freq 2.44100000 GHz Ref Offset 7.02 dB Ref 20.00 dBm Mkr1 2.440990 GHz 3.765 dBm Center 2.441000 GHz #Res BW 2.0 MHz #VBW 6.0 MHz Span 10.00 MHz Sweep 1.333 ms (10001 pts)
8DPSK /HCH	 Agilent Spectrum Analyzer - Sweep 5A Center Freq 2.48000000 GHz Ref Offset 7.05 dB Ref 20.00 dBm Mkr1 2.480039 GHz 3.170 dBm Center 2.480000 GHz #Res BW 2.0 MHz #VBW 6.0 MHz Span 10.00 MHz Sweep 1.333 ms (10001 pts)

10. 20DB OCCUPIED BANDWIDTH

10.1 Block Diagram Of Test Setup



10.2 Limit

Alternatively, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125mw.

10.3 Test procedure

1. Rem1. Set RBW = 30 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

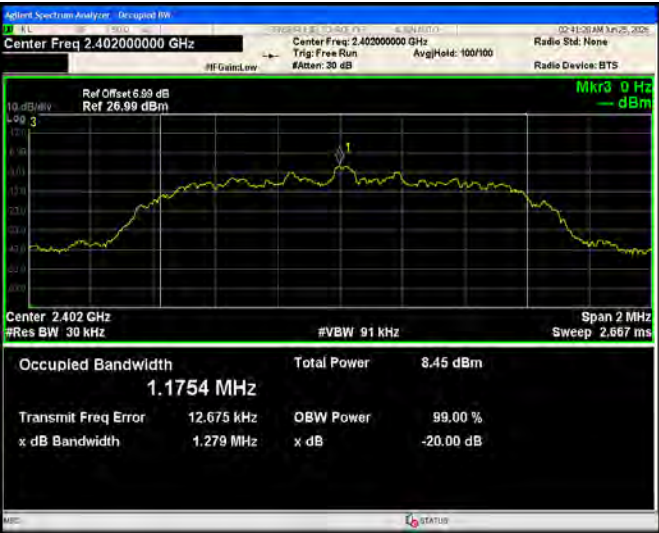
10.4 Test Result

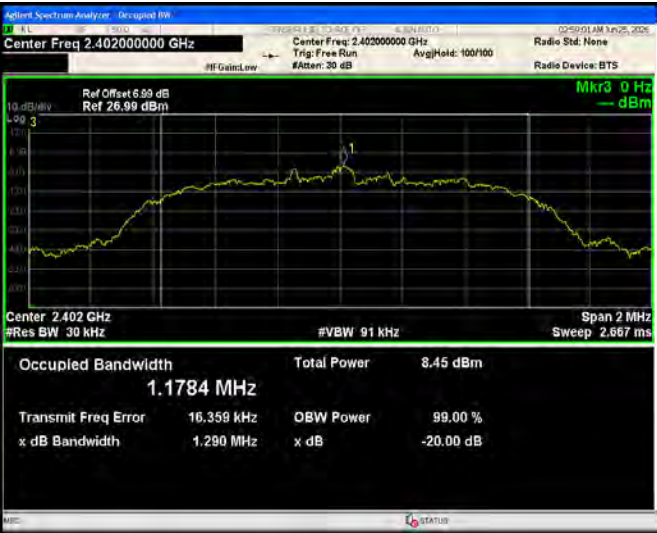
Test Mode	Frequency	20dB Bandwidth (MHz)	Result
GFSK	Low channel	0.875	PASS
	Mid channel	0.871	PASS
	High channel	0.873	PASS
$\pi/4$ DQPSK	Low channel	1.279	PASS
	Mid channel	1.277	PASS
	High channel	1.276	PASS
8DPSK	Low channel	1.290	PASS
	Mid channel	1.280	PASS
	High channel	1.306	PASS

Note: All modes of operation were Pre-scan and the worst-case emissions are reported.

Test Graph:

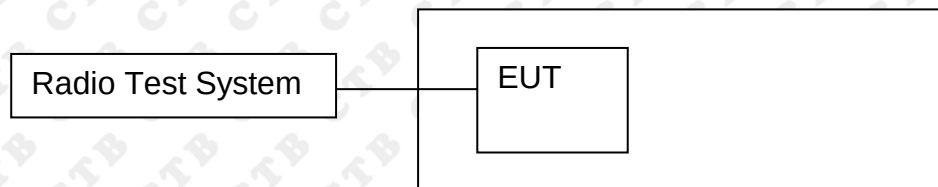
GFSK Low channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq 2.40200000 GHz Ref Offset 6.99 dB Ref 26.99 dBm Center 2.402 GHz #Res BW 30 kHz Occupied Bandwidth 834.34 kHz Total Power 8.41 dBm Transmit Freq Error 12.825 kHz OBW Power 99.00 % x dB Bandwidth 874.5 kHz x dB -20.00 dB
GFSK Mid channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq 2.44100000 GHz Ref Offset 7.02 dB Ref 27.02 dBm Center 2.441 GHz #Res BW 30 kHz Occupied Bandwidth 828.57 kHz Total Power 8.79 dBm Transmit Freq Error 10.682 kHz OBW Power 99.00 % x dB Bandwidth 870.8 kHz x dB -20.00 dB
GFSK High channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq 2.48000000 GHz Ref Offset 7.05 dB Ref 27.05 dBm Center 2.48 GHz #Res BW 30 kHz Occupied Bandwidth 850.06 kHz Total Power 7.87 dBm Transmit Freq Error 12.614 kHz OBW Power 99.00 % x dB Bandwidth 873.2 kHz x dB -20.00 dB

$\pi/4$-DQPSK Low channel	
$\pi/4$-DQPSK Mid channel	
$\pi/4$-DQPSK High channel	

8DPSK Low channel	 Center Freq: 2.402000000 GHz Res BW: 30 kHz Span: 2 MHz Occupied Bandwidth: 1.1784 MHz Total Power: 8.45 dBm
8DPSK Mid channel	 Center Freq: 2.441000000 GHz Res BW: 30 kHz Span: 2 MHz Occupied Bandwidth: 1.1875 MHz Total Power: 8.66 dBm
8DPSK High channel	 Center Freq: 2.480000000 GHz Res BW: 30 kHz Span: 2 MHz Occupied Bandwidth: 1.2043 MHz Total Power: 7.96 dBm

11. CARRIER FREQUENCIES SEPARATION

11.1 Block Diagram Of Test Setup



11.2 Limit

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 an output power no greater than 0.125W.

11.3 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 = 20kHz. VBW = 60kHz , Span = 2MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
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.

11.4 Test Result

Mode	Channel.	Carrier Frequency Separation [MHz]	Limit(2/3 of the 20dB bandwidth MHz)	Verdict
GFSK	LCH	1.000	0.583	PASS
GFSK	MCH	1.002	0.581	PASS
GFSK	HCH	1.000	0.582	PASS
$\pi/4$ DQPSK	LCH	1.000	0.853	PASS
$\pi/4$ DQPSK	MCH	1.004	0.851	PASS
$\pi/4$ DQPSK	HCH	1.004	0.851	PASS
8DPSK	LCH	1.004	0.860	PASS
8DPSK	MCH	1.004	0.853	PASS
8DPSK	HCH	0.998	0.871	PASS

Graphs

Agilent Spectrum Analyzer - Sweep 3A

1.5856841 GHz 10.0 dB

Marker 1 Δ 1.000000000 MHz

PNP: Wide IF Gain: 0.0

Trig: Free Run #Atten: 30 dB

Avg Type: Log-Pwr Avg/Hold: >100/100

CP-12-158 04 Jun 2010 10:00:00

TRACE 1A2

TYPE 1A2

DET 0.000000

Ref Offset 6.99 dB

Ref 20.00 dBm

ΔMkr1 1.000 MHz

0.000 dB

10 dBm

0.00

10.00

0.00

20.00

30.00

40.00

50.00

60.00

70.00

Center 2.402500 GHz

#Res BW 20 kHz

#VBW 62 kHz

Span 2.000 MHz

Sweep 4.800 ms (1001 pts)

MNR	MODE	TRG	SCN	X	Y	FUNCTION	WIDTH	VALUE
1	Δ2	1	f	(Δ)	1.000 MHz (Δ)	0.000 dB		
2	F	1	f		2.401854 GHz	1.359 dBm		
3								
4								
5								
6								
7								
8								
9								
10								
11								

The screenshot displays a Rohde & Schwarz Spectrum Analyzer interface. The main display shows a frequency spectrum with a peak at 1.002 MHz. The interface includes various control panels and a data table at the bottom.

Top Panel:

- Left: **Marker 1 Δ 1.002000000 MHz**
- Center: **1.002000000 MHz**
- Right: **Avg Type: Log-Per**, **Avg/Hold: >100/100**

Left Panel:

- Ref Offset 7.02 dB**
- Ref 20.00 dBm**

Right Panel:

- ΔMkr1 1.002 MHz**
- 0.084 dB**

Main Display:

- Y-axis: **10 dBmV**
- X-axis: **Center 2.441500 GHz**, **#Res BW 20 kHz**, **#VBW 62 kHz**, **Sweep 4.800 ms (1001 pts)**

Bottom Panel:

MNR	MODE	TRC	SL	F	F	FUNCTION	WIDTH	FUNCTION VALUE
1	Δ2	1	f	(Δ)	1.002 MHz (Δ)	-0.084 dB		
2	F	1	f		2.440 854 GHz	1.683 dBm		
3								
4								
5								
6								
7								
8								
9								
10								
11								

Agilent Spectrum Analyzer - Setup SA

Marker 1 Δ 1.000000000 MHz

PRO: Wide If Gain: Low

Trig: Free Run #Atten: 30 dB

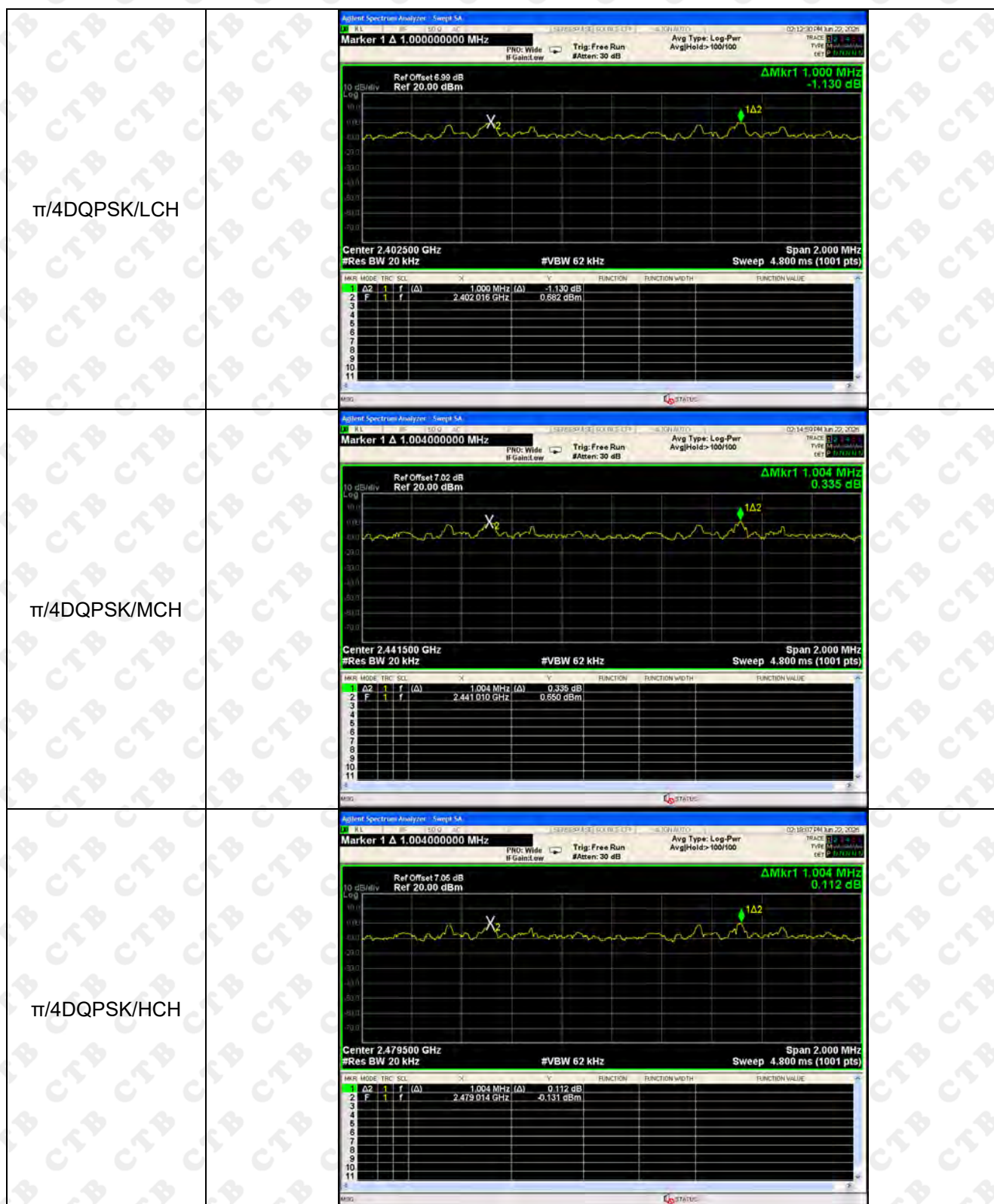
Avg Type: Log-Pwr Avg/Hold: >100/100

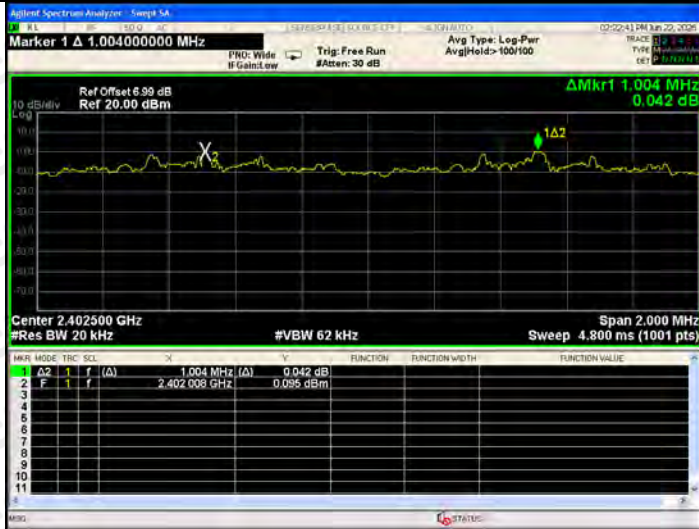
Ref Offset: 7.95 dB Ref: 20.00 dBm

Δ Mkr1 1.000 MHz 0.204 dB

Center 2.479500 GHz #Res BW 20 kHz #VBW 62 kHz Span 2.000 MHz Sweep 4.800 ms (1001 pts)

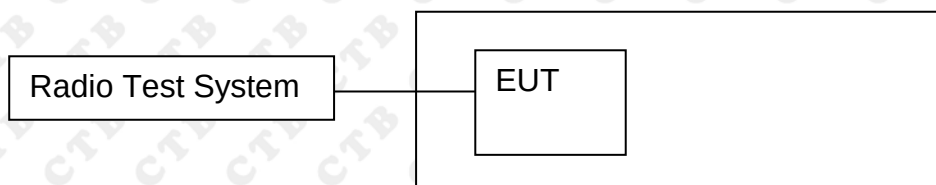
MNR	MODE	TRF	SC	F	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	Δ 2	1	f	(Δ)	1.000 MHz (Δ)	0.204 dB	
2	F	1	f		2.478 656 GHz	1.054 dBm	
3							
4							
5							
6							
7							
8							
9							
10							
11							



8DPSK/LCH	 <table><thead><tr><th>MARK</th><th>MODE</th><th>TRC</th><th>SCL</th><th>F</th><th>F (Δ)</th><th>ΔF</th><th>ΔF (Δ)</th><th>Y</th><th>FUNCTION</th><th>FUNCTION WIDTH</th><th>FUNCTION VALUE</th></tr></thead><tbody><tr><td>1</td><td>Δ2</td><td>1</td><td>f</td><td>(Δ)</td><td>1.004 MHz</td><td>(Δ)</td><td>0.042 dB</td><td></td><td></td><td></td><td></td></tr><tr><td>2</td><td>F</td><td>1</td><td>f</td><td></td><td>2.402 008 GHz</td><td></td><td>0.035 dBm</td><td></td><td></td><td></td><td></td></tr></tbody></table>	MARK	MODE	TRC	SCL	F	F (Δ)	ΔF	ΔF (Δ)	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	Δ2	1	f	(Δ)	1.004 MHz	(Δ)	0.042 dB					2	F	1	f		2.402 008 GHz		0.035 dBm				
MARK	MODE	TRC	SCL	F	F (Δ)	ΔF	ΔF (Δ)	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE																										
1	Δ2	1	f	(Δ)	1.004 MHz	(Δ)	0.042 dB																														
2	F	1	f		2.402 008 GHz		0.035 dBm																														
8DPSK /MCH	 <table><thead><tr><th>MARK</th><th>MODE</th><th>TRC</th><th>SCL</th><th>F</th><th>F (Δ)</th><th>ΔF</th><th>ΔF (Δ)</th><th>Y</th><th>FUNCTION</th><th>FUNCTION WIDTH</th><th>FUNCTION VALUE</th></tr></thead><tbody><tr><td>1</td><td>Δ2</td><td>1</td><td>f</td><td>(Δ)</td><td>1.004 MHz</td><td>(Δ)</td><td>-0.172 dB</td><td></td><td></td><td></td><td></td></tr><tr><td>2</td><td>F</td><td>1</td><td>f</td><td></td><td>2.441 014 GHz</td><td></td><td>0.350 dBm</td><td></td><td></td><td></td><td></td></tr></tbody></table>	MARK	MODE	TRC	SCL	F	F (Δ)	ΔF	ΔF (Δ)	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	Δ2	1	f	(Δ)	1.004 MHz	(Δ)	-0.172 dB					2	F	1	f		2.441 014 GHz		0.350 dBm				
MARK	MODE	TRC	SCL	F	F (Δ)	ΔF	ΔF (Δ)	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE																										
1	Δ2	1	f	(Δ)	1.004 MHz	(Δ)	-0.172 dB																														
2	F	1	f		2.441 014 GHz		0.350 dBm																														
8DPSK /HCH	 <table><thead><tr><th>MARK</th><th>MODE</th><th>TRC</th><th>SCL</th><th>F</th><th>F (Δ)</th><th>ΔF</th><th>ΔF (Δ)</th><th>Y</th><th>FUNCTION</th><th>FUNCTION WIDTH</th><th>FUNCTION VALUE</th></tr></thead><tbody><tr><td>1</td><td>Δ2</td><td>1</td><td>f</td><td>(Δ)</td><td>998 kHz</td><td>(Δ)</td><td>-0.078 dB</td><td></td><td></td><td></td><td></td></tr><tr><td>2</td><td>F</td><td>1</td><td>f</td><td></td><td>2.479 514 GHz</td><td></td><td>0.187 dBm</td><td></td><td></td><td></td><td></td></tr></tbody></table>	MARK	MODE	TRC	SCL	F	F (Δ)	ΔF	ΔF (Δ)	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	1	Δ2	1	f	(Δ)	998 kHz	(Δ)	-0.078 dB					2	F	1	f		2.479 514 GHz		0.187 dBm				
MARK	MODE	TRC	SCL	F	F (Δ)	ΔF	ΔF (Δ)	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE																										
1	Δ2	1	f	(Δ)	998 kHz	(Δ)	-0.078 dB																														
2	F	1	f		2.479 514 GHz		0.187 dBm																														

12. HOPPING CHANNEL NUMBER

12.1 Block Diagram Of Test Setup



12.2 Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

12.3 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.
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;

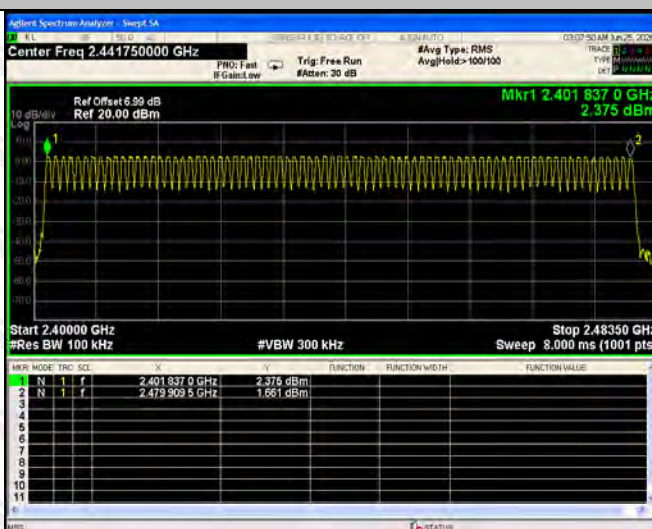
12.4 Test Result

Mode	Channel.	Number of Hopping Channel	Limit	Verdict
GFSK	Hop	79	≥ 15	PASS
$\pi/4$ DQPSK	Hop	79	≥ 15	PASS
8DPSK	Hop	79	≥ 15	PASS

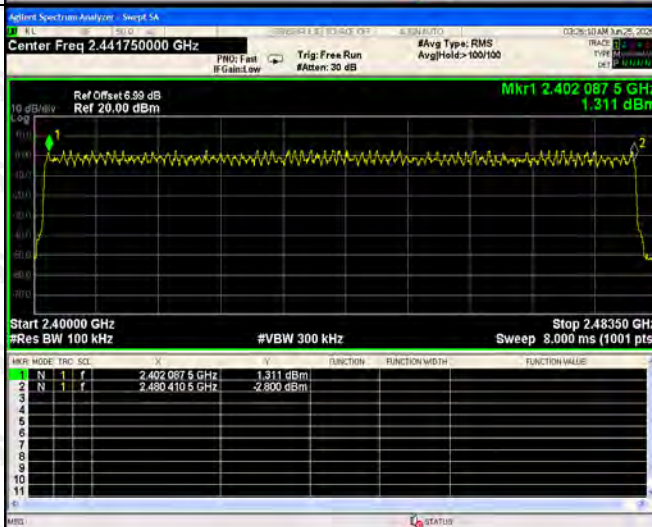
Test Graph

Graphs

GFSK/Hop

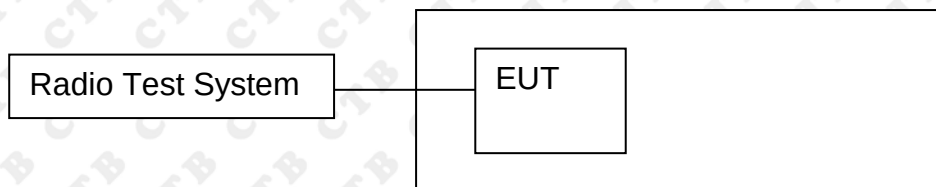

 $\pi/4$ DQPSK/Hop


8DPSK/Hop



13. DWELL TIME

13.1 Block Diagram Of Test Setup



13.2 Limit

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.

13.3 Test procedure

According to ANSI C63.10-2020 sub-clause 7.8.4

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

- Span: Zero span, centered on a hopping channel.
- RBW shall be $\leq$ channel spacing and where possible RBW should be set $\geq 1/T$, where T is the expected dwell time per channel.
- Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
- Detector function: Peak.
- Trace: Max hold.
- Trace: Clear-write, single sweep.
- Place markers at the start of the first transmission on the channel and at the end of the last transmission. The dwell time per hop is the time between these two markers.

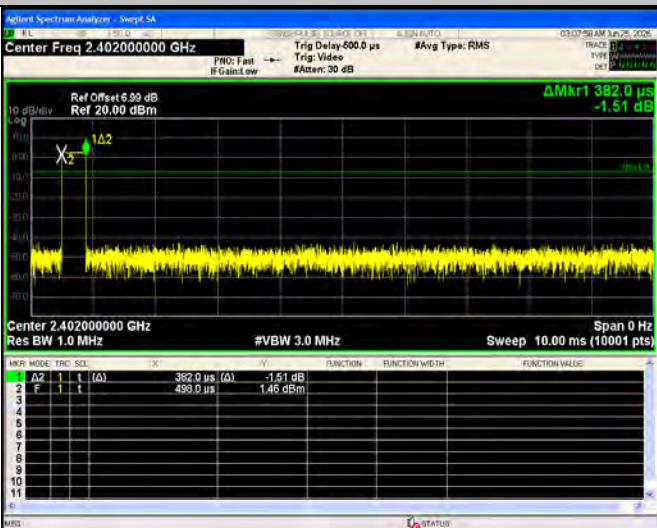
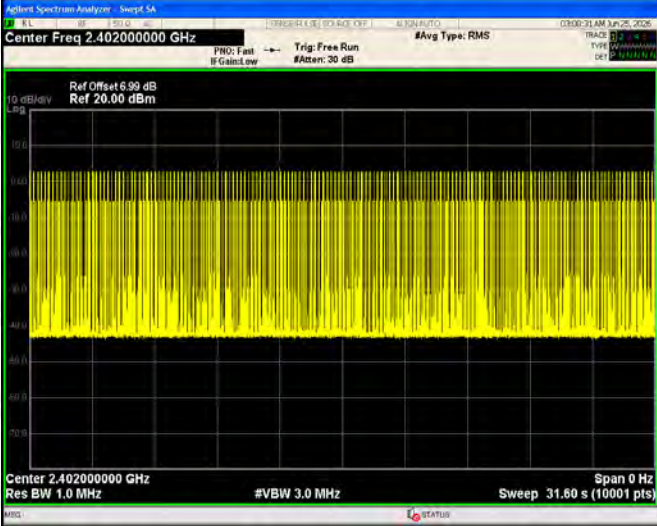
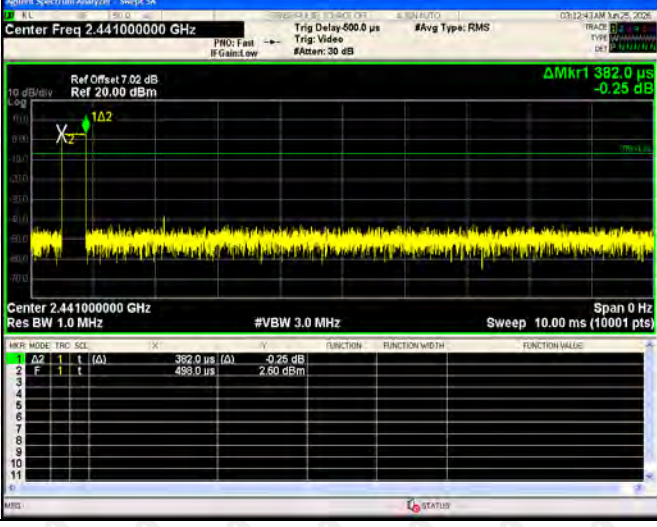
13.4 Test Result

Packet	Channel	Pulse Time (ms)	Burst Count (Num)	Total Dwell Time (ms)	Limit (ms)	Verdict
DH1	LCH	0.382	317	121.094	400	PASS
DH1	MCH	0.382	318	121.476	400	PASS
DH1	HCH	0.382	318	121.476	400	PASS
2DH3	LCH	1.643	150	246.45	400	PASS
2DH3	MCH	1.643	168	276.024	400	PASS
2DH3	HCH	1.644	157	258.108	400	PASS
3DH5	LCH	2.893	105	303.765	400	PASS
3DH5	MCH	2.893	101	292.193	400	PASS
3DH5	HCH	2.894	99	286.506	400	PASS

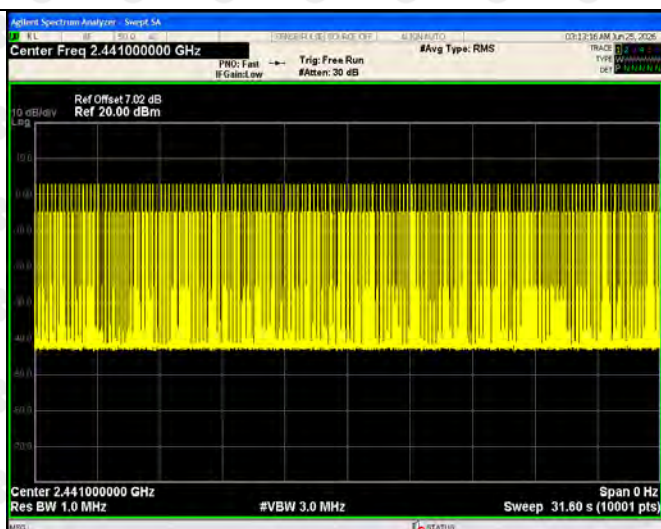
Remark: Dwell time = Pulse time * Total Hops

Remark: Mkr Delta is once pulse time.

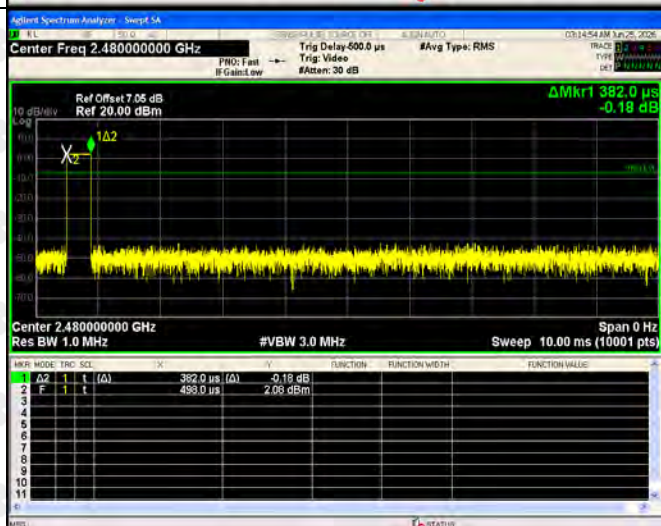
Test Graph

Graphs		
GFSK_1DH1/LCH- One Burst		
GFSK_1DH1/LCH- Accumulated		
GFSK_1DH1/MCH- One Burst		

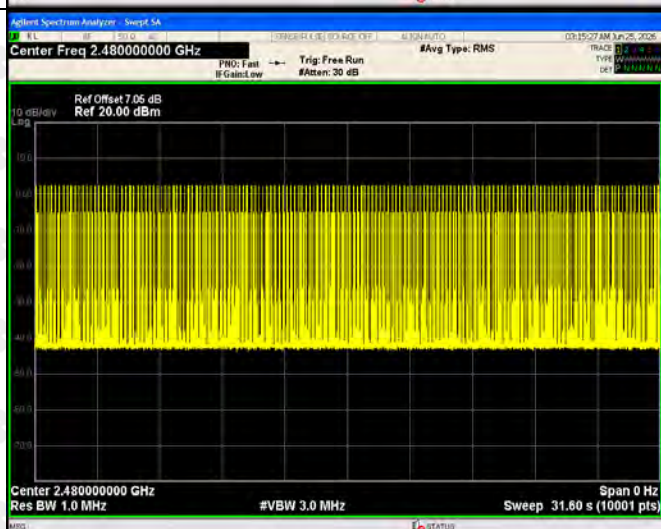
GFSK_1DH1/MCH-
Accumulated



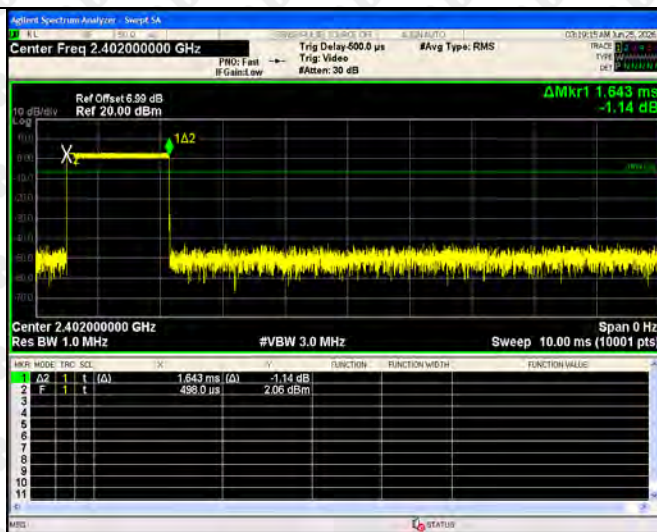
GFSK_1DH1/HCH-
One Burst



GFSK_1DH1/HCH-
Accumulated



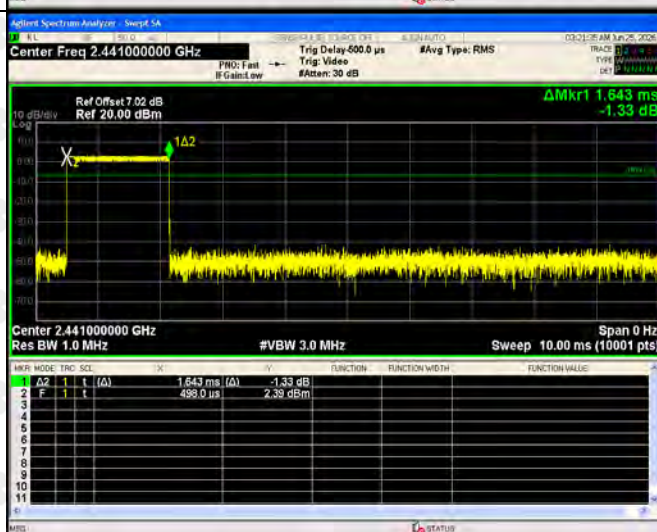
$\pi/4$ DQPSK_2DH3
/LCH- One Burst

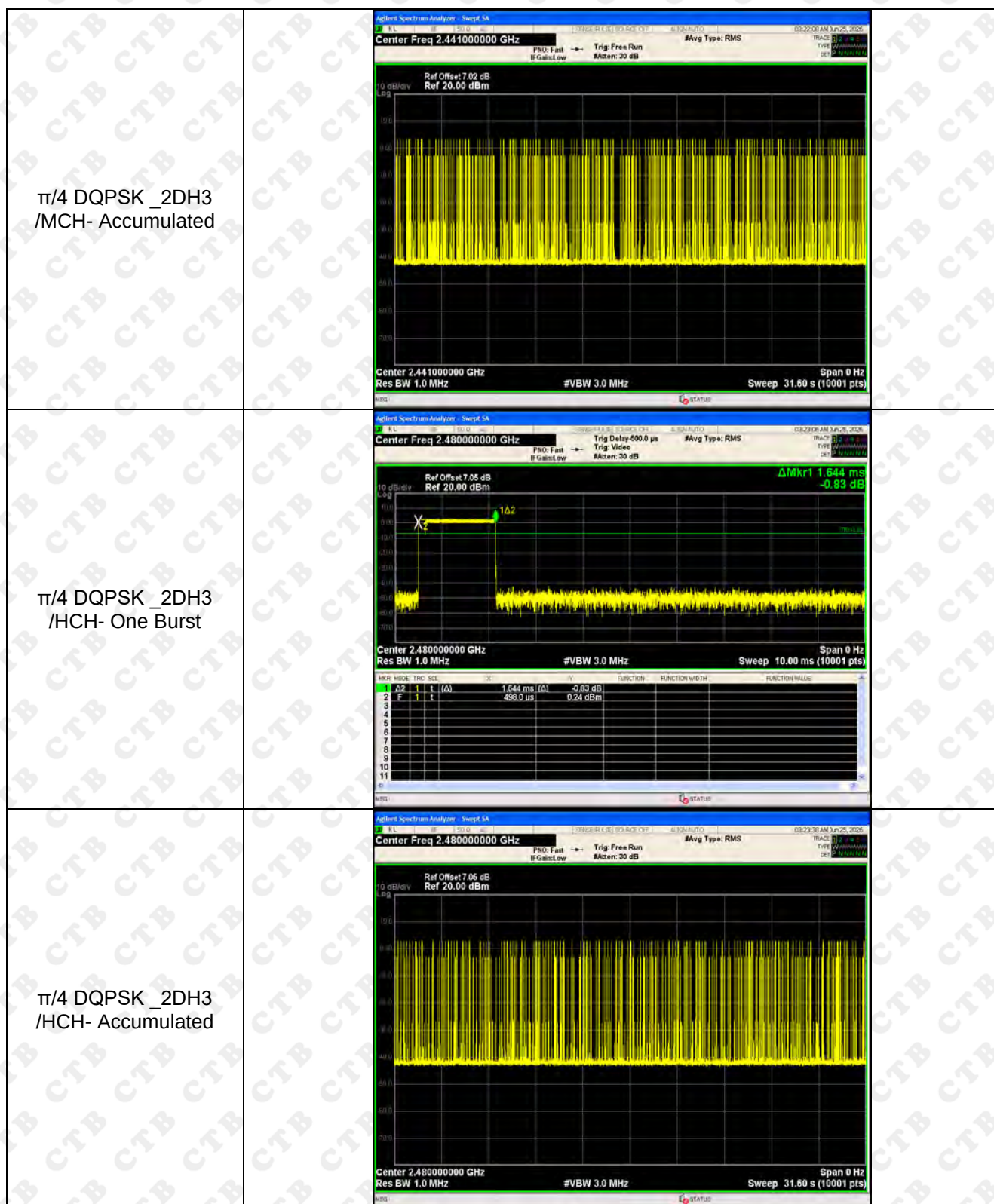


$\pi/4$ DQPSK_2DH3
/LCH- Accumulated

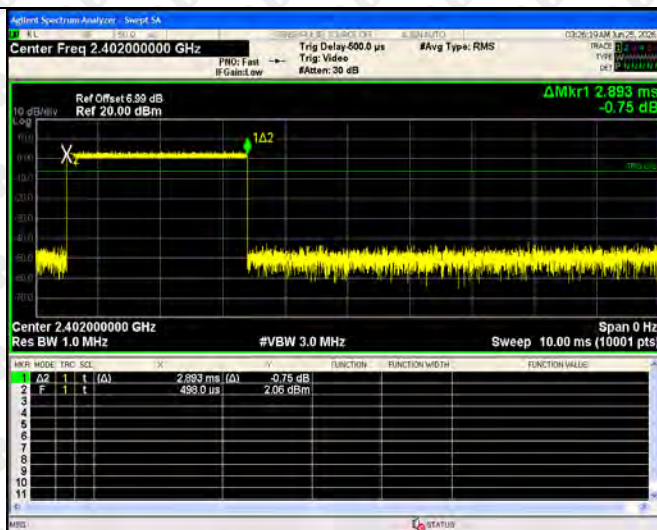


$\pi/4$ DQPSK_2DH3
/MCH- One Burst

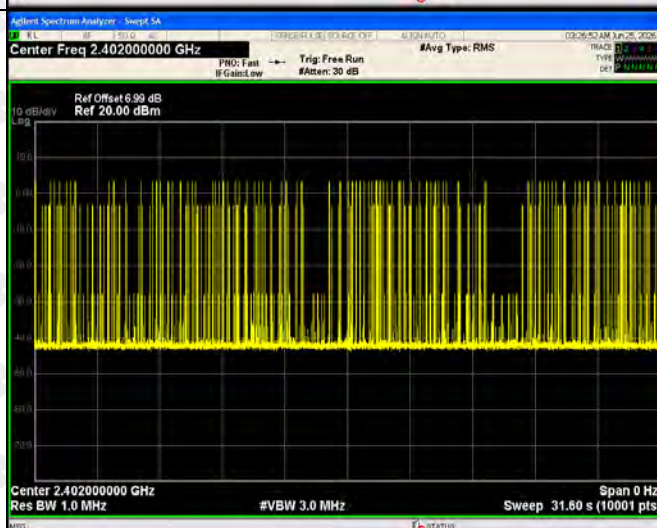




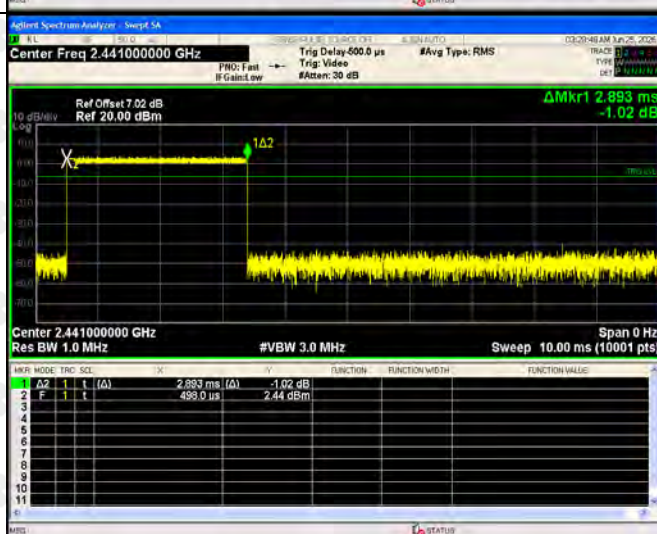
8DPSK_3DH5/LCH-
One Burst

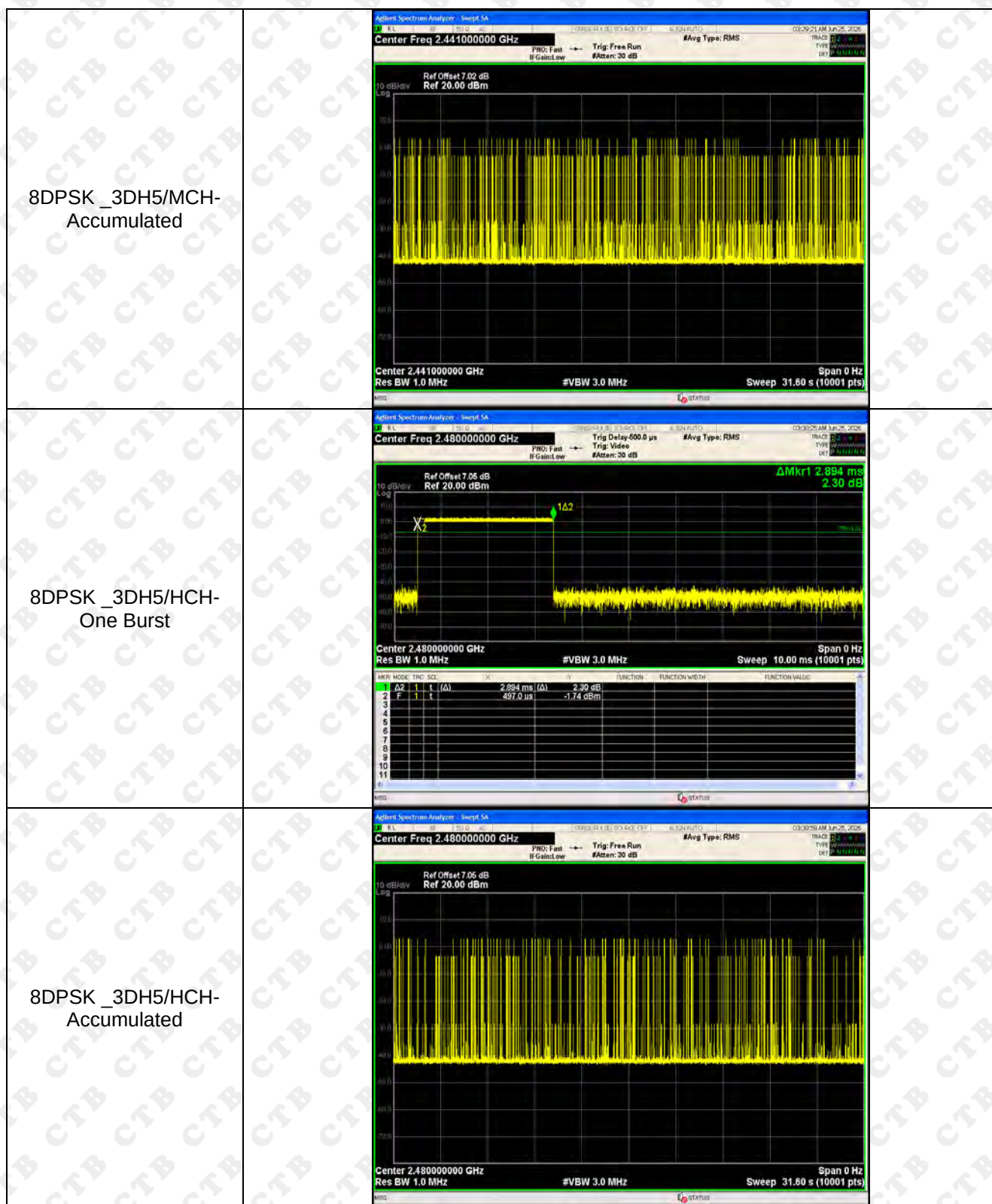


8DPSK_3DH5/LCH-
Accumulated



8DPSK_3DH5/MCH-
One Burst





14. PSEUDORANDOM FREQUENCY

14.1 Limit

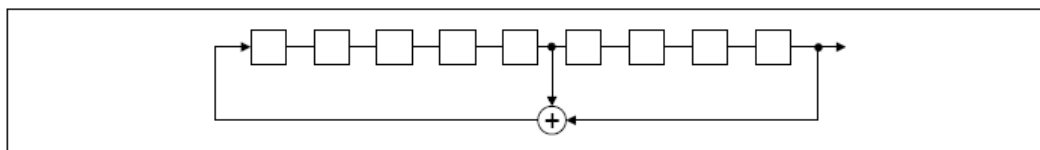
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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 an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

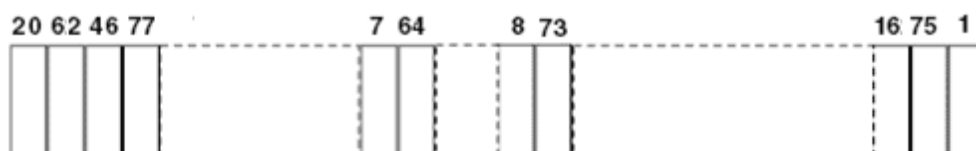
14.2 Test procedure

The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONES; i.e. the shift register is initialized with nine ones.

- Number of shift register stages: 9
- Length of pseudo-random sequence: $2^9 - 1 = 511$ bits
- Longest sequence of zeros: 8 (non-inverted signal)



An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.

The system receivers have input bandwidths that match the hopping channel bandwidths of their Corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

14.3 Test Result

The device does not have the ability to be coordinated with other FHSS systems in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

15. ANTENNA REQUIREMENT

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.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

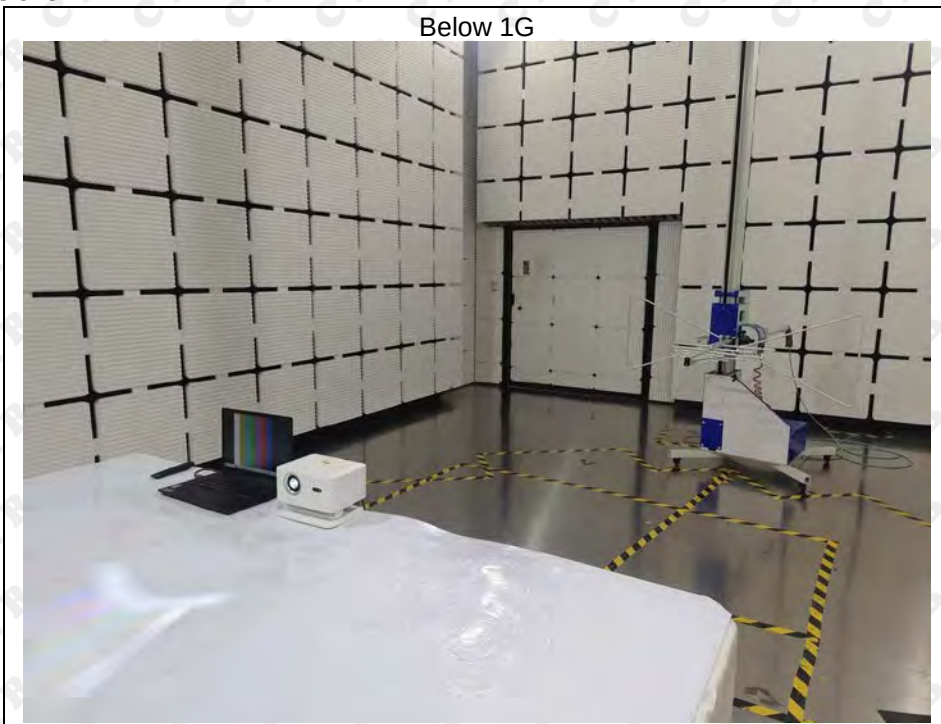
EUT Antenna:

The antenna is FPC antenna. The best case gain of the antenna is 3.98dBi.

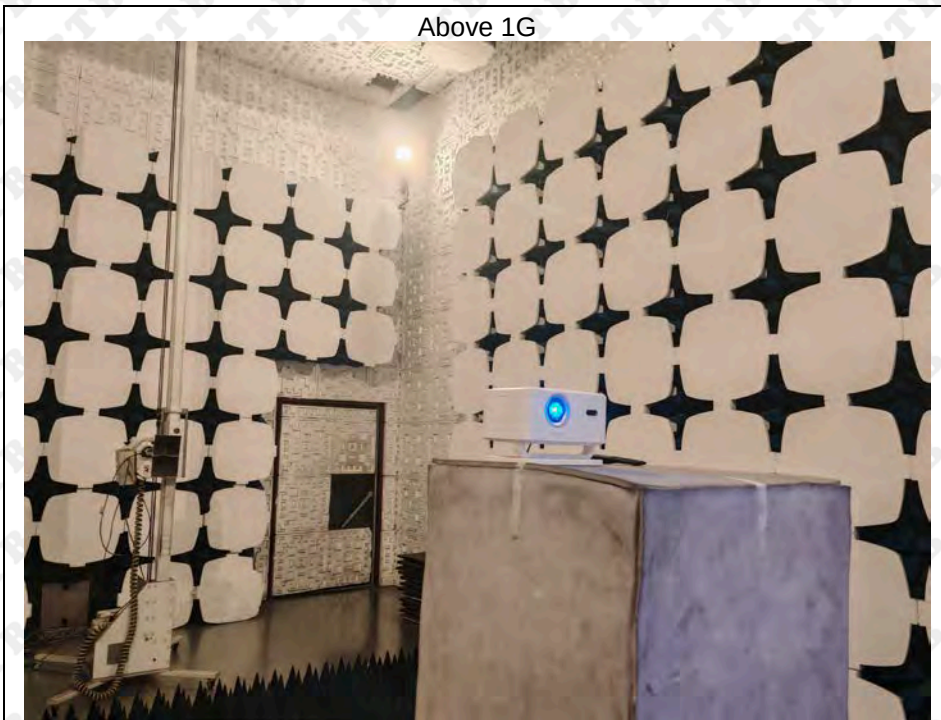
16. EUT TEST SETUP PHOTOGRAPHS

Radiated Emissions

Below 1G



Above 1G



Conducted emission



RF Conducted



***** END OF REPORT *****