TEST REPORT

Product Name:	Dazzling projector lamp
FCC ID:	2A2P4-HR-C1
Trademark:	N/A
Model Number:	HR-C1
Prepared For:	Yunfu Hongrui Intelligent Equipment Co., Ltd.
Address:	Room 101, Ground Floor, No.15, Guanwu, Xingyun Middle Road, Yuncheng District, Yunfu City, China
Manufacturer:	Yunfu Hongrui Intelligent Equipment Co., Ltd.
Address:	Room 101, Ground Floor, No.15, Guanwu, Xingyun Middle Road, Yuncheng District, Yunfu City, China
Prepared By:	Shenzhen CTB Testing Technology Co., Ltd.
Address:	Floor 1&2, Building A, No. 26 of Xinhe Road, Xinqiao Community, Xinqiao Street, Baoan District, Shenzhen, Guangdong China
Sample Received Date:	Jul. 13, 2021
Sample tested Date:	Jul. 13, 2021 to Jul. 17, 2021
Issue Date:	Jul. 27, 2021
Report No.:	CTB210716002RFX
Test Standards	FCC Part15.247 ANSI C63.10:2013
Test Results	PASS
Remark:	This is Bluetooth radio test report.

Compiled by:	Reviewed by:	Approved by:
Arron Liu	Bin Mei	Rita Xiao
Arron Liu	Bin Mei	Rita Xiao / Director

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Test Report Declaration Page

(Note: N/A means not applicable)

1. VERSION

Report No.	Issue Date	Description	Approved
CTB210716002RFX	Jul. 27, 2021	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 C63.10-2013	PASS
Radiated Spurious emissions	47 CFR Part 15 Subpart C Section 15.205/15.209	ANSI C63.10-2013	PASS
Band edge and RF Conducted Spurious Emissions	47 CFR Part 15 Subpart C Section 15.247(d)/15.205(a)	ANSI C63.10-2013	PASS
Conducted Peak Output Power	47 CFR Part 15 Subpart C Section 15.247 (b)(1)	ANSI C63.10-2013	PASS
20dB Occupied Bandwidth	47 CFR Part 15 Subpart C Section 15.247 (a)(1)	ANSI C63.10-2013	PASS
Carrier Frequencies Separation	47 CFR Part 15 Subpart C Section 15.247 (a)(1)	ANSI C63.10-2013	PASS
Hopping Channel Number	47 CFR Part 15 Subpart C Section 15.247 (b)	ANSI C63.10-2013	PASS
Dwell Time	47 CFR Part 15 Subpart C Section 15.247 (a)(1)	ANSI C63.10-2013	PASS
Pseudorandom Frequency Hopping Sequence	47 CFR Part 15 Subpart C Section 15.247(b)(4)&TCB Exclusion List (7 July 2002)	ANSI C63.10-2013	PASS
Antenna Requirement	47 CFR Part 15 Subpart C Section 15.203/15.247 (c)	ANSI C63.10-2013	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 C63.4-2014 & ANSI C63.10-2013.

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 camber 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℃
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(s):	HR-C1
Model Description:	N/A
Bluetooth Version:	Bluetooth 5.0
Hardware Version:	V1.0
Software Version:	V1.0

Operation Frequency:	Bluetooth: 2402-2480MHz
Max. RF output power:	Bluetooth: -2.971dBm
Type of Modulation:	Bluetooth: GFSK, π/4 DQPSK, 8DPSK
Antenna installation:	Bluetooth: PCB antenna
Antenna Gain:	Bluetooth: 1dBi
Ratings:	DC 5V charging from adapter

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

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, π/4 DQPSK, 8DPSK)	2402MHz	2441MHz	2480MHz
Receiving (GFSK, π/4 DQPSK, 8DPSK)	2402MHz	2441MHz	2480MHz

4.6 Test Environment

Humidity(%):	55
Atmospheric Pressure(kPa):	101.1
Normal Voltage(DC):	3.7V
Normal Temperature(℃)	25
Low Temperature(℃)	0
High Temperature(℃)	40

5. TEST FACILITY AND TEST INSTRUMENT USED

5.1 Test Facility

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

5.2 Test Instrument Used

No.	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	Spectrum Analyzer	Agilent	N9020A	MY52090073	2021.09.27
2	Power Sensor	Agilent	U2021XA	MY56120032	2021.09.27
3	Power Sensor	Agilent	U2021XA	MY56120034	2021.09.27
4	Communication test set	R&S	CMW500	108058	2021.09.27
5	Spectrum Analyzer	R&S	FSP40	100550	2021.09.27
6	Signal Generator	Agilent	N5181A	MY49060920	2021.09.27
7	Signal Generator	Agilent	N5182A	MY47420195	2021.09.27
8	Communication test set	Agilent	E5515C	MY50102567	2021.09.27
9	band rejection filter	Shenxiang	MSF2400-2483.5MS-1154	20181015001	2021.09.27
10	band rejection filter	Shenxiang	MSF5150-5850MS-1155	20181015001	2021.09.27
11	band rejection filter	Xingbo	XBLBQ-DZA120	190821-1-1	2021.09.27
12	BT&WI-FI Automatic test software	Micowave	MTS8310	Ver. 2.0.0.0	2021.09.27
13	Rohde & Schwarz SFU Broadcast Test System	R&S	SFU	101017	2021.09.27
14	Temperature humidity chamber	Hongjing	TH-80CH	DG-15174	2021.09.27
15	234G Automatic test software	Micowave	MTS8200	Ver. 2.0.0.0	2021.09.27
16	966 chamber	C.R.T.	966 Room	966	2021.09.27
17	Receiver	R&S	ESPI	100362	2021.09.27
18	Amplifier	HP	8447E	2945A02747	2021.09.27
19	Amplifier	Agilent	8449B	3008A01838	2021.09.27
20	TRILOG Broadband	Schwarzbeck	VULB 9163	869	2021.09.27

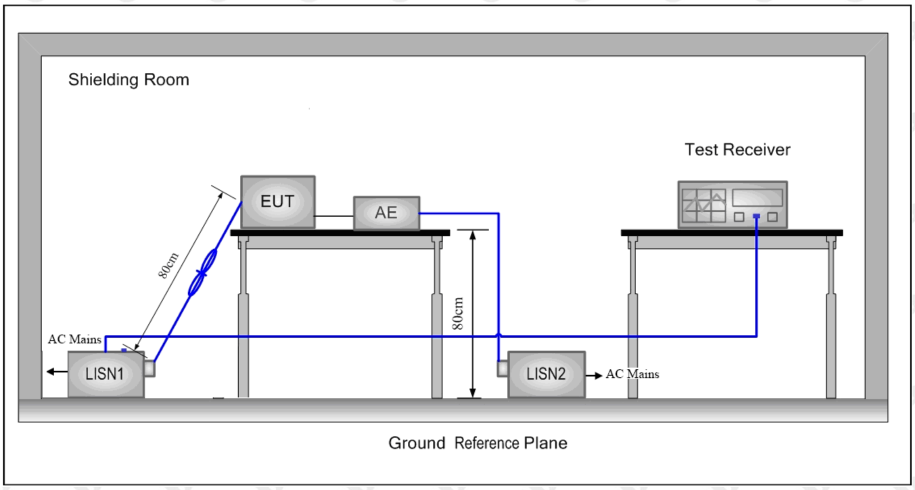
	Antenna				
21	Horn Antenna	Schwarzbeck	BBHA9120D	1911	2021.09.27
22	Software	Fala	EZ-EMC	FA-03A2 RE	2021.09.27
23	3-Loop Antenna	Daze	ZN30401	17014	2021.09.27
24	loop antenna	ZHINAN	ZN30900A	/	2021.09.27
25	Horn antenna	A/H/System	SAS-574	588	2021.09.27
26	Amplifier	AEROFLEX	/	S/N/ 097	2021.09.27

Continuous disturbance					
No.	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	AMN	ROHDE&SCHWARZ	ESH3-Z5	831551852	2021.09.27
2	Pulse limiter	ROHDE&SCHWARZ	ESH3Z2	357881052	2021.09.27
3	EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCS30	834115/006	2021.09.27
4	Coaxial cable	ZDECL	Z302S	18091904	2021.09.27
5	AAN	Schwarzbeck	NTFM8158	183	2021.09.27
6	Communication test set	Agilent	E5515C	MY50102567	2021.09.27
7	Communication test set	R&S	CMW500	108058	2021.09.27
8	EZ-EMC	Frad	EMC-con3A1.1	/	/

Radiated emission					
No.	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA 9120D	1911	2021.11.01
2	TRILOG Broadband Antenna	Schwarzbeck	VULB 9168	869	2021.11.01
3	Amplifier	Agilent	8449B	3008A01838	2021.09.27
4	Amplifier	HP	8447E	2945A02747	2021.09.27
5	EMI TEST RECEIVER	ROHDE&SCHWARZ	ESPI7	100362	2021.09.27
6	Coaxial cable	ETS	RFC-SNS-100-NMS-80 NI	/	2021.09.27
7	Coaxial cable	ETS	RFC-SNS-100-NMS-20 NI	/	2021.09.27
8	Coaxial cable	ETS	RFC-SNS-100-SMS-20 NI	/	2021.09.27
9	Coaxial cable	ETS	RFC-NNS-100-NMS-300 NI	/	2021.09.27
10	Communication test set	Agilent	E5515C	MY50102567	2021.09.27
11	Communication test set	R&S	CMW500	108058	2021.09.27
12	EZ-EMC	Frad	EMC-con3A1.1	/	/

6. AC POWER LINE CONDUCTED EMISSION

6.1 Block Diagram Of Test Setup



6.2 Limit

Frequency (MHz)	Maximum RF Line Voltage (dBμV)			
	CLASS A		CLASS B	
	Q.P.	Ave.	Q.P.	Ave.
0.15 - 0.50	79	66	66-56*	56-46*
0.50 - 5.00	73	60	56	46
5.00 - 30.0	73	60	60	50

* 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 50Ω/50μH + 5Ω 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.

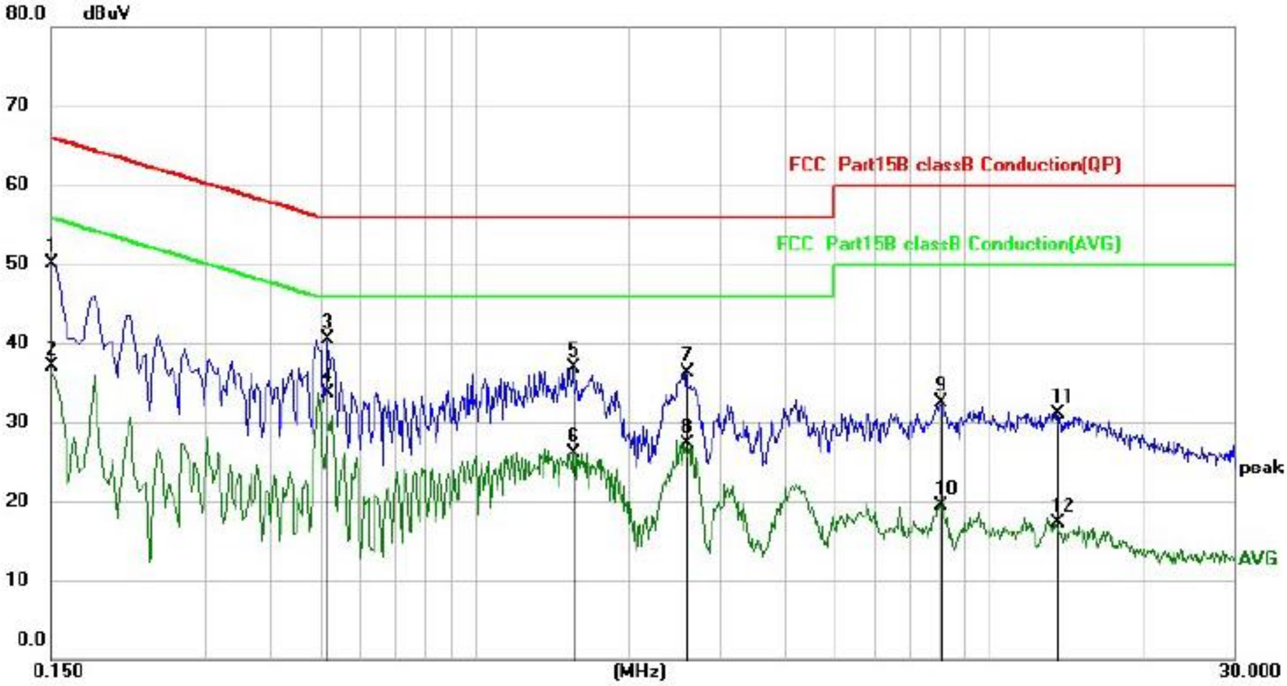
5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

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:

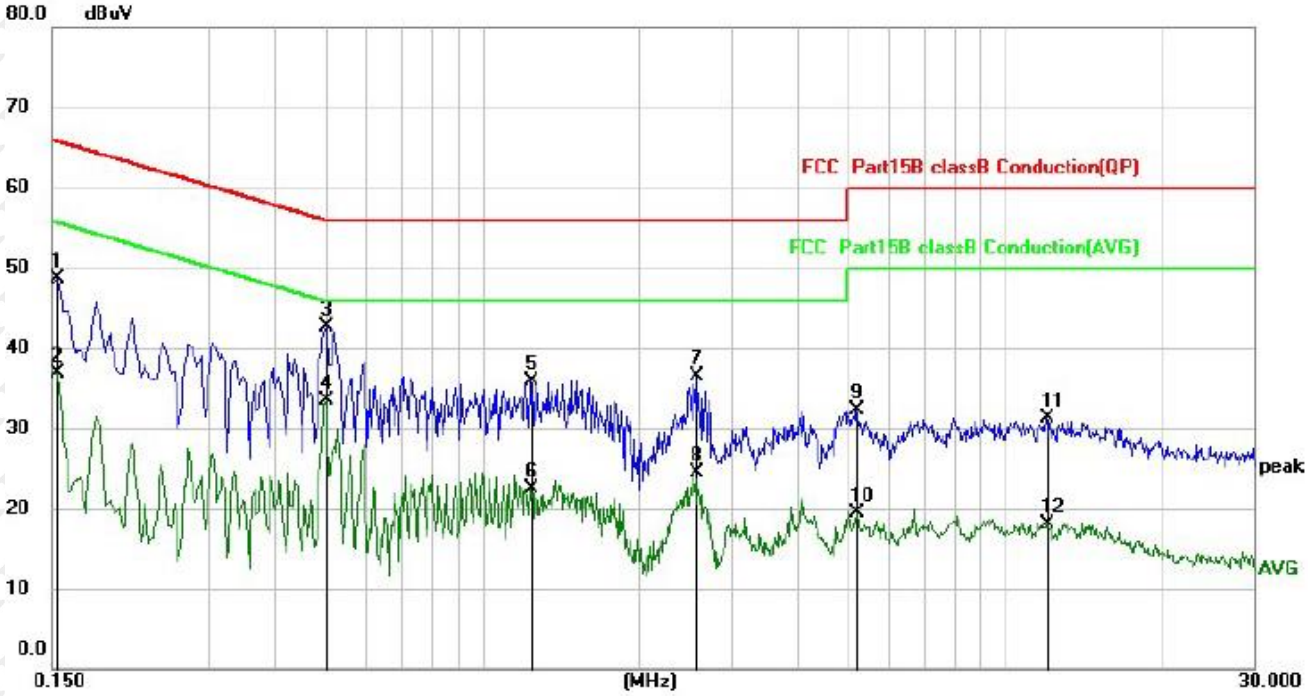


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.1500	40.05	9.96	50.01	66.00	-15.99	QP
2		0.1500	27.06	9.96	37.02	56.00	-18.98	AVG
3		0.5180	30.61	9.96	40.57	56.00	-15.43	QP
4	*	0.5180	23.70	9.96	33.66	46.00	-12.34	AVG
5		1.5580	26.85	9.99	36.84	56.00	-19.16	QP
6		1.5580	16.18	9.99	26.17	46.00	-19.83	AVG
7		2.5900	26.22	10.04	36.26	56.00	-19.74	QP
8		2.5900	17.29	10.04	27.33	46.00	-18.67	AVG
9		8.0900	22.03	10.56	32.59	60.00	-27.41	QP
10		8.0900	8.92	10.56	19.48	50.00	-30.52	AVG
11		13.5740	20.19	10.92	31.11	60.00	-28.89	QP
12		13.5740	6.41	10.92	17.33	50.00	-32.67	AVG

Remark:

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

N:



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.1539	38.69	9.96	48.65	65.79	-17.14	QP
2		0.1539	26.86	9.96	36.82	55.79	-18.97	AVG
3		0.5020	32.75	9.96	42.71	56.00	-13.29	QP
4	*	0.5020	23.54	9.96	33.50	46.00	-12.50	AVG
5		1.2420	25.96	9.97	35.93	56.00	-20.07	QP
6		1.2420	12.59	9.97	22.56	46.00	-23.44	AVG
7		2.5740	26.49	10.04	36.53	56.00	-19.47	QP
8		2.5740	14.39	10.04	24.43	46.00	-21.57	AVG
9		5.2060	22.02	10.20	32.22	60.00	-27.78	QP
10		5.2060	9.33	10.20	19.53	50.00	-30.47	AVG
11		12.0500	20.42	10.87	31.29	60.00	-28.71	QP
12		12.0500	7.24	10.87	18.11	50.00	-31.89	AVG

Remark:

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

7. RADIATED SPURIOUS EMISSION

7.1 Block Diagram Of Test Setup

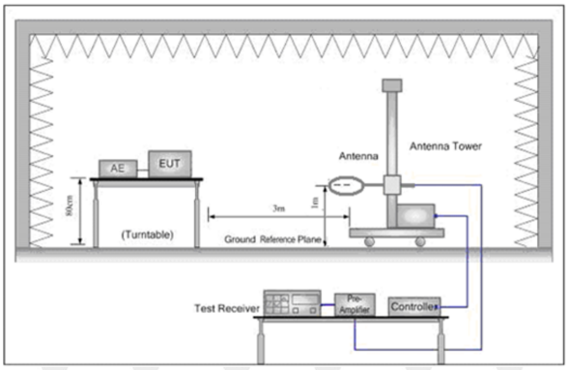


Figure 1. Below 30MHz

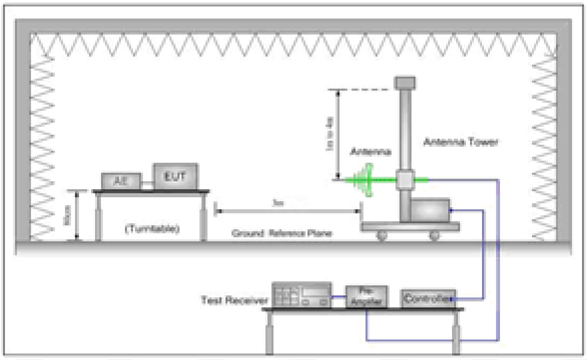


Figure 2. 30MHz to 1GHz

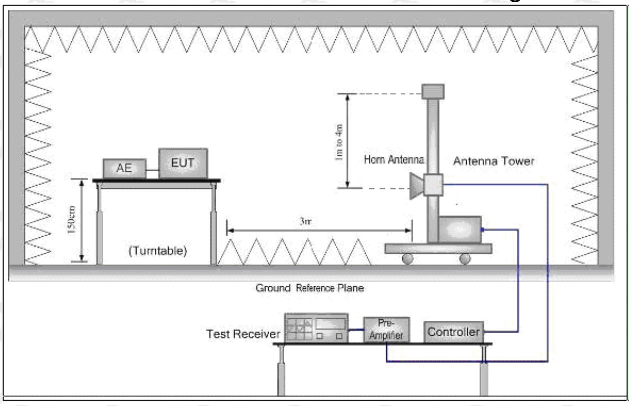


Figure 3. Above 1GHz

7.2 Limit

Spurious Emissions:

Frequency	Field strength (microvolt/meter)	Limit (dBµV/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:

a.The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.

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

c.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.

d.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.

e.The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f.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:

g.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).

h.Test the EUT in the lowest channel ,the middle channel ,the Highest channel

j.Repeat above procedures until all frequencies measured was complete.

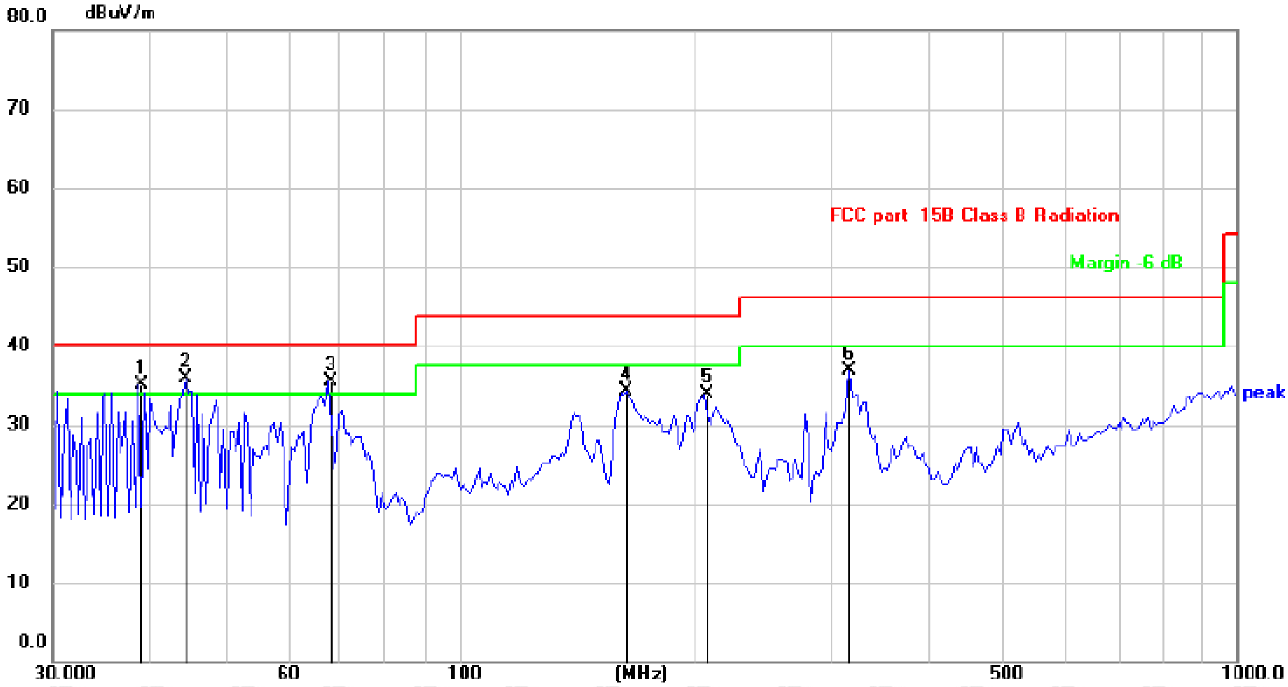
j. Full battery is usedduring test

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

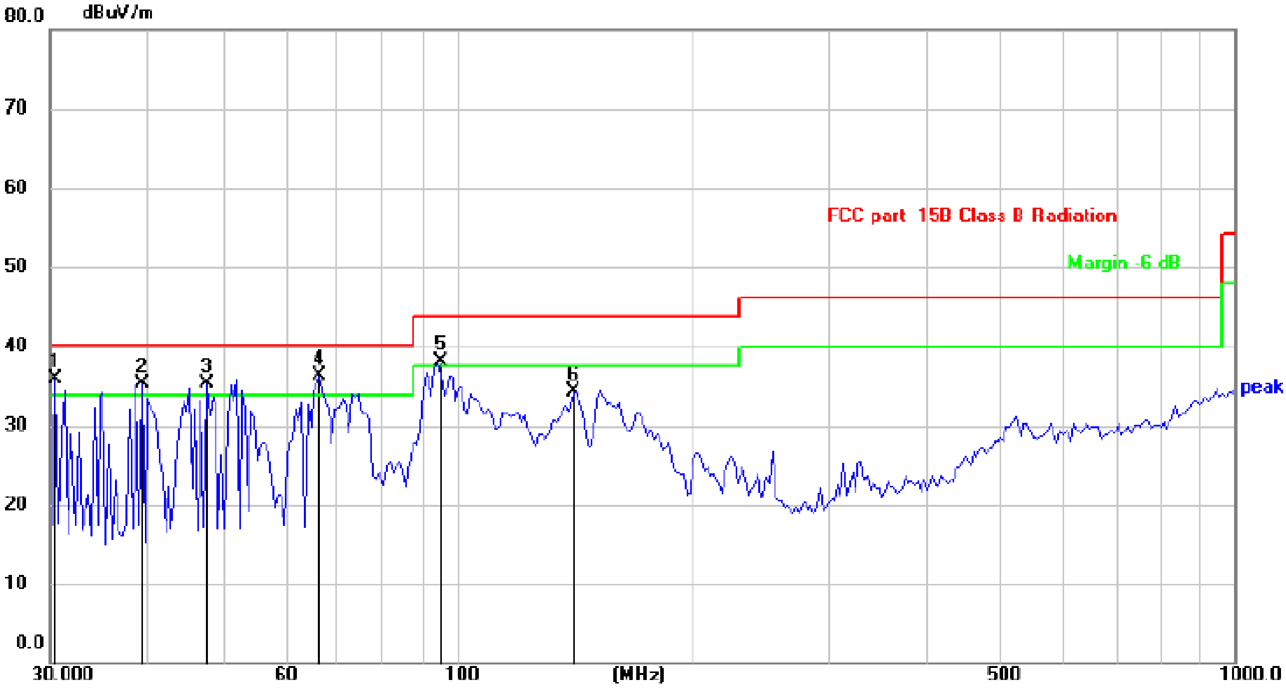
Below 1GHz Test Results:
Antenna polarity: H



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	!	38.6839	42.10	-6.91	35.19	40.00	-4.81	QP
2	*	44.5087	42.78	-6.91	35.87	40.00	-4.13	QP
3	!	67.7939	44.83	-9.30	35.53	40.00	-4.47	QP
4		164.3301	41.53	-7.13	34.40	43.50	-9.10	QP
5		206.3976	43.90	-9.95	33.95	43.50	-9.55	QP
6		317.1445	43.25	-6.40	36.85	46.00	-9.15	QP

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

Antenna polarity: V



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	!	30.5305	44.19	-8.27	35.92	40.00	-4.08	QP
2	!	39.3680	42.08	-6.84	35.24	40.00	-4.76	QP
3	!	47.7421	42.37	-7.00	35.37	40.00	-4.63	QP
4	*	66.6156	45.48	-9.10	36.38	40.00	-3.62	QP
5	!	94.5941	48.98	-10.82	38.16	43.50	-5.34	QP
6		141.5776	41.59	-7.28	34.31	43.50	-9.19	QP

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

Above 1 GHz Test Results:

CH Low (2402MHz)
Horizontal:

Frequency (MHz)	Reading Result (dBµV)	Factor (dB)	Emission Level (dBµV/m)	Limits (dBµV/m)	Margin (dB)	Detector Type
4804	58.50	-3.65	54.85	74.00	-19.15	peak
4804	48.97	-3.65	45.32	54.00	-8.68	AVG
7206	60.66	-0.95	59.71	74.00	-14.29	peak
7206	41.98	-0.95	41.03	54.00	-12.97	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Emission level = Reading Result + Factor, Margin = Emission level - Limits						

Vertical:

Frequency (MHz)	Reading Result (dBµV)	Factor (dB)	Emission Level (dBµV/m)	Limits (dBµV/m)	Margin (dB)	Detector Type
4804	59.30	-3.65	55.65	74.00	-18.35	peak
4804	50.92	-3.65	47.27	54.00	-6.73	AVG
7206	59.73	-0.95	58.78	74.00	-15.22	peak
7206	41.10	-0.95	40.15	54.00	-13.85	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Emission level = Reading Result + Factor, Margin = Emission level - Limits						

CH Middle (2441MHz)

Horizontal:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4882.00	58.11	-3.54	54.57	74.00	-19.43	peak
4882.00	47.10	-3.54	43.56	54.00	-10.44	AVG
7323.00	57.64	-0.81	56.83	74.00	-17.17	peak
7323.00	44.11	-0.81	43.30	54.00	-10.70	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Emission level = Reading Result + Factor, Margin = Emission level - Limits						

Vertical:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4882.00	56.90	-3.54	53.36	74.00	-20.64	peak
4882.00	48.34	-3.54	44.80	54.00	-9.20	AVG
7323.00	56.37	-0.81	55.56	74.00	-18.44	peak
7323.00	43.81	-0.81	43.00	54.00	-11.00	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Emission level = Reading Result + Factor, Margin = Emission level - Limits						

CH High (2480MHz)
Horizontal:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	
4960	56.95	-3.43	53.52	74.00	-20.48	peak
4960	48.09	-3.44	44.65	54.00	-9.35	AVG
7440	59.85	-0.77	59.08	74.00	-14.92	peak
7440	40.32	-0.77	39.55	54.00	-14.45	AVG

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Emission level = Reading Result + Factor, Margin = Emission level - Limits

Vertical:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	
4960	58.53	-3.43	55.10	74.00	-18.90	peak
4960	49.35	-3.44	45.91	54.00	-8.09	AVG
7440	60.29	-0.77	59.52	74.00	-14.48	peak
7440	42.34	-0.77	41.57	54.00	-12.43	AVG

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Emission level = Reading Result + Factor, Margin = Emission level - Limits

Remark:
(1) Measuring frequencies from 1 GHz to the 25 GHz。
(2). All modes of GFSK, π/4 DQPSK， 8DPSK were test at Low, Middle, and High channel, only the worst result of GFSK DH5 Low Channel was reported for below 1GHz test.
(3). For BT above 1GHz test all modes of GFSK, π/4 DQPSK， 8DPSK were test at Low, Middle, and High channel, only the worst result of GFSK DH5 was reported.
(4). By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that “Z axis” position was the worst, and test data recorded in this report.
(5). Radiated emission test from 9kHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9kHz to 30MHz and not recorded in this report.

Restricted bands around fundamental frequency (Radiated)

hopping
Operation Mode: TX CH Low (2402MHz)
Horizontal (Worst case)

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	
2310.00	56.56	-5.81	50.75	74.00	-23.25	peak
2310.00	/	-5.81	/	54.00	/	AVG
2390.00	56.55	-5.84	50.71	74.00	-23.29	peak
2390.00	/	-5.84	/	54.00	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	
2310.00	56.92	-5.81	51.11	74.00	-22.89	peak
2310.00	/	-5.81	/	54.00	/	AVG
2390.00	56.07	-5.84	50.23	74.00	-23.77	peak
2390.00	/	-5.84	/	54.00	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Operation Mode: TX CH High (2480MHz)
Horizontal (Worst case)

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.50	54.67	-5.81	48.86	74.00	-25.14	peak
2483.50	/	-5.81	/	54.00	/	AVG
2500.00	54.72	-6.06	48.66	74.00	-25.34	peak
2500.00	/	-6.06	/	54.00	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.50	57.54	-5.81	51.73	74.00	-22.27	peak
2483.50	/	-5.81	/	54.00	/	AVG
2500.00	55.36	-6.06	49.30	74.00	-24.70	peak
2500.00	/	-6.06	/	54.00	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						
Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.						

NO hopping

Operation Mode: TX CH Low (2402MHz)
Horizontal (Worst case)

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310.00	56.79	-5.81	50.98	74.00	-23.02	peak
2310.00	/	-5.81	/	54.00	/	AVG
2390.00	53.49	-5.84	47.65	74.00	-26.35	peak
2390.00	/	-5.84	/	54.00	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310.00	56.44	-5.81	50.63	74.00	-23.37	peak
2310.00	/	-5.81	/	54.00	/	AVG
2390.00	54.41	-5.84	48.57	74.00	-25.43	peak
2390.00	/	-5.84	/	54.00	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Operation Mode: TX CH High (2480MHz)
Horizontal (Worst case)

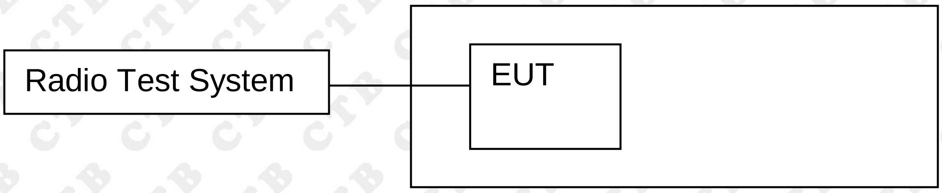
Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	57.39	-5.81	51.58	74.00	-22.42	peak
2483.50	/	-5.81	/	54.00	/	AVG
2500.00	55.56	-6.06	49.50	74.00	-24.50	peak
2500.00	/	-6.06	/	54.00	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	56.07	-5.81	50.26	74.00	-23.74	peak
2483.50	/	-5.81	/	54.00	/	AVG
2500.00	55.34	-6.06	49.28	74.00	-24.72	peak
2500.00	/	-6.06	/	54.00	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						
Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.						

8. BAND EDGE AND RF COUNDUCTED 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

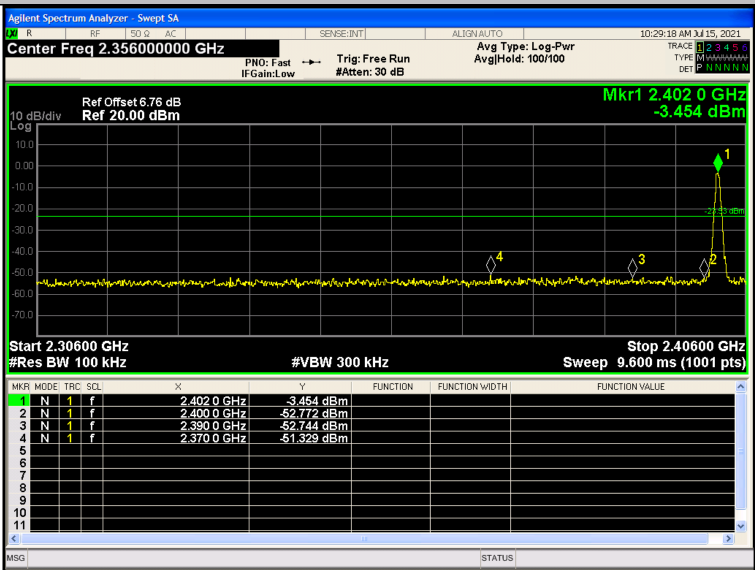
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer:
Blow 30MHz:
RBW = 100kHz, VBW = 300kHz, Sweep = auto
Detector function = peak, Trace = max hold
Above 30MHz:
RBW = 100KHz, VBW = 300KHz, Sweep = auto
Detector function = peak, Trace = max hold

Test from 30MHz to 25GHz,only worse case 30MHz to 12.75GHz is reported ,no emission found above 12.75GHz .

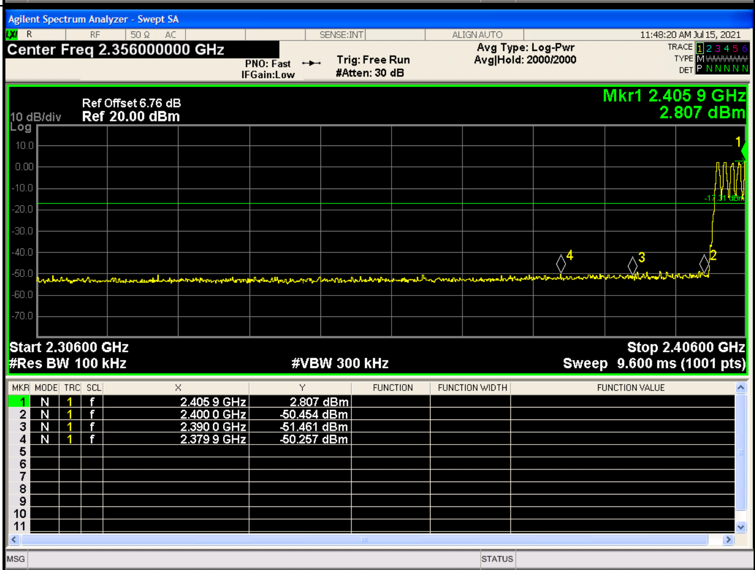
8.4 Test Result

BAND EDGE Graphs

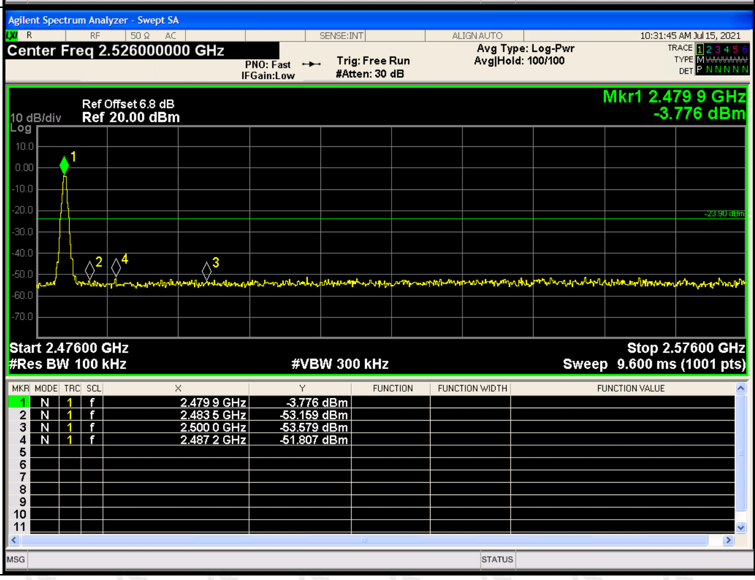
GFSK/LCH/ No Hop

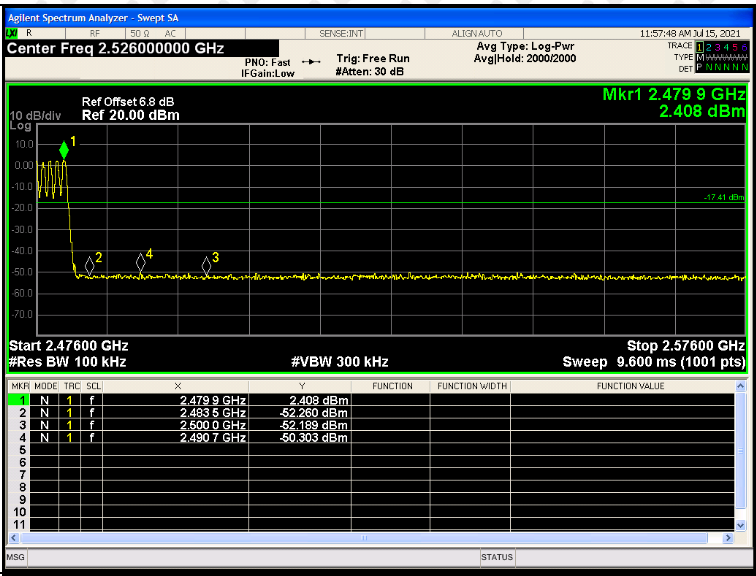
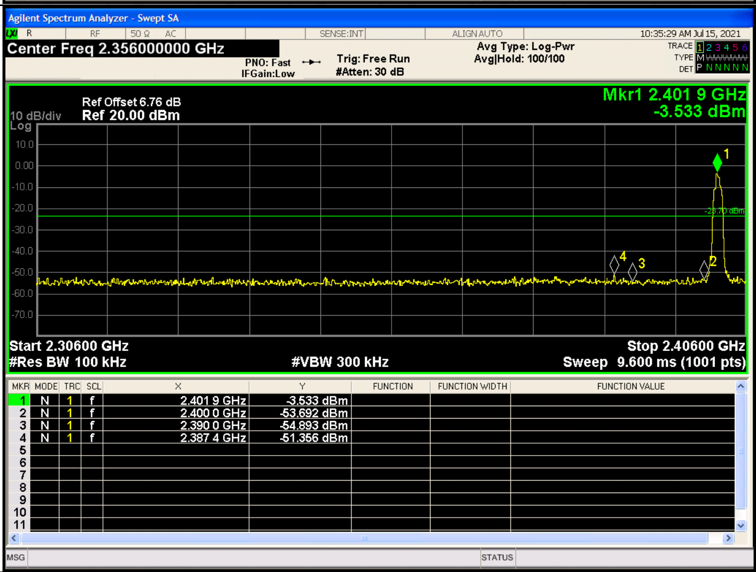
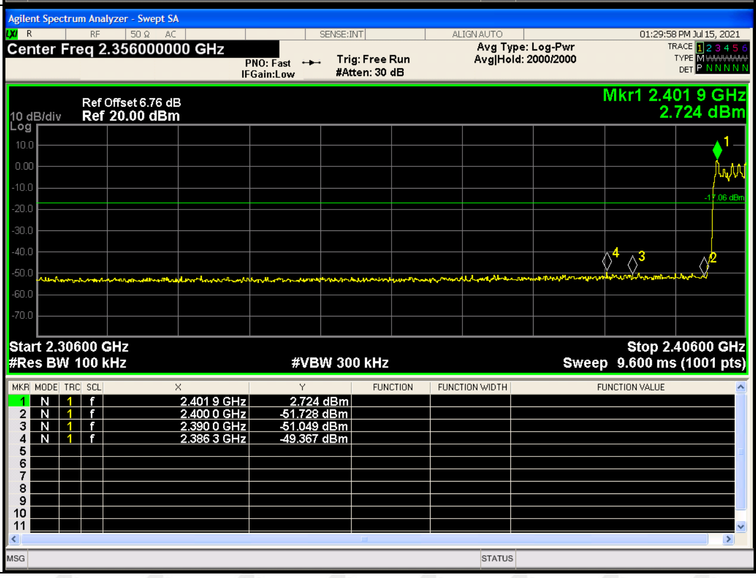


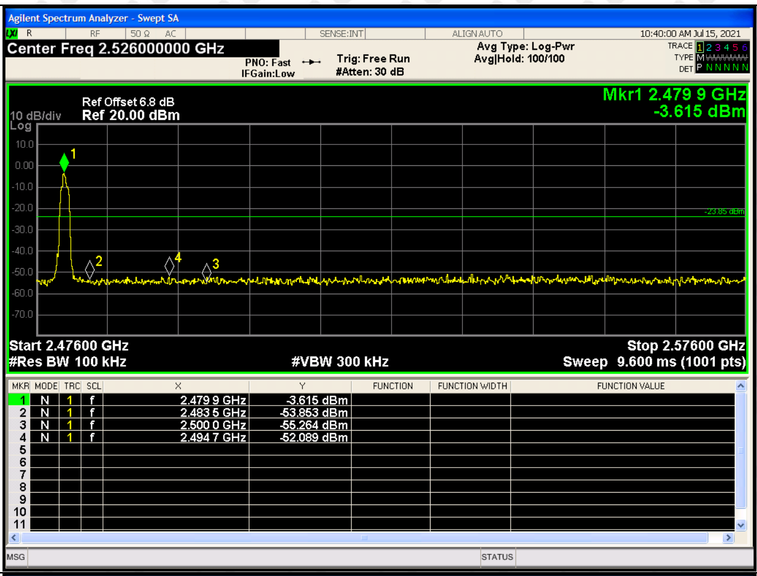
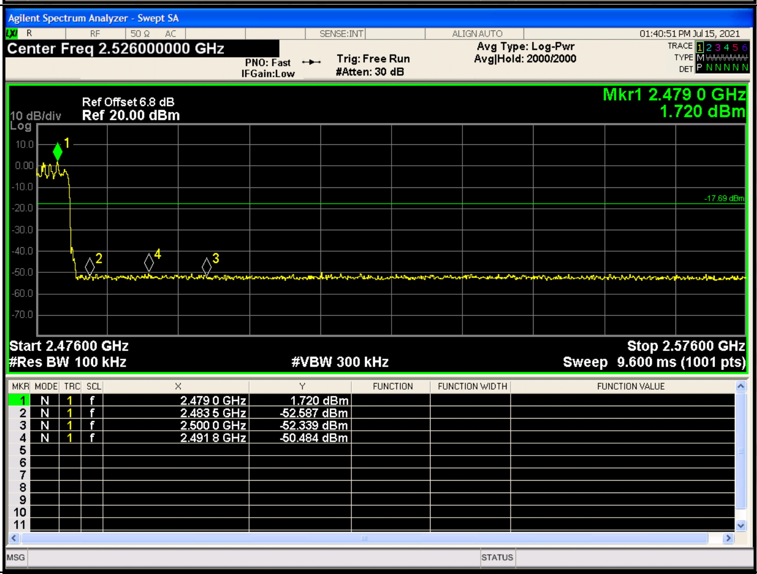
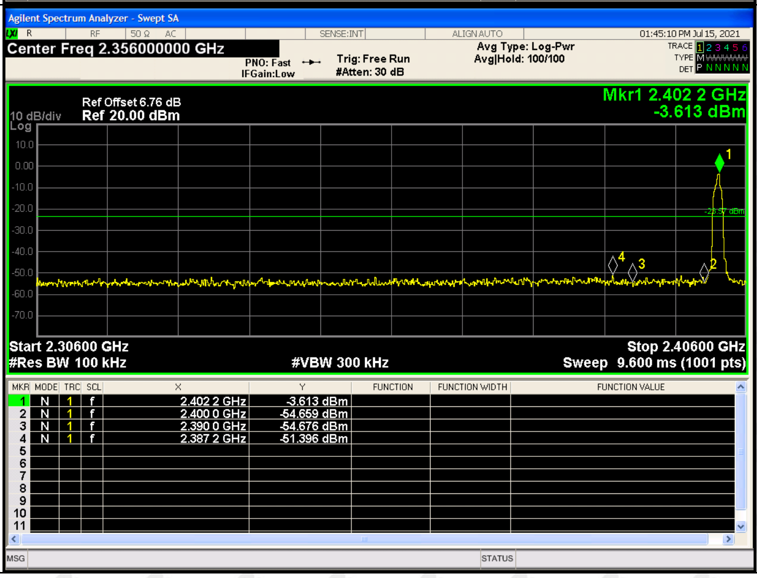
GFSK/LCH/ Hop



GFSK/HCH/ No Hop



GFSK/HCH/ Hop		
π/4DQPSK/LCH/ No Hop		
π/4DQPSK/LCH/ Hop		

π/4DQPSK/HCH/ No Hop		
8DPSK/HCH/Hop		
8DPSK/LCH/No Hop		

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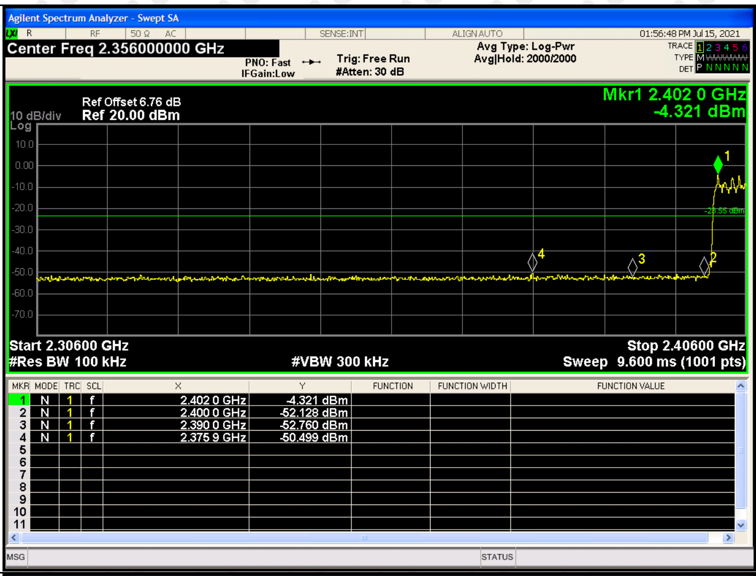
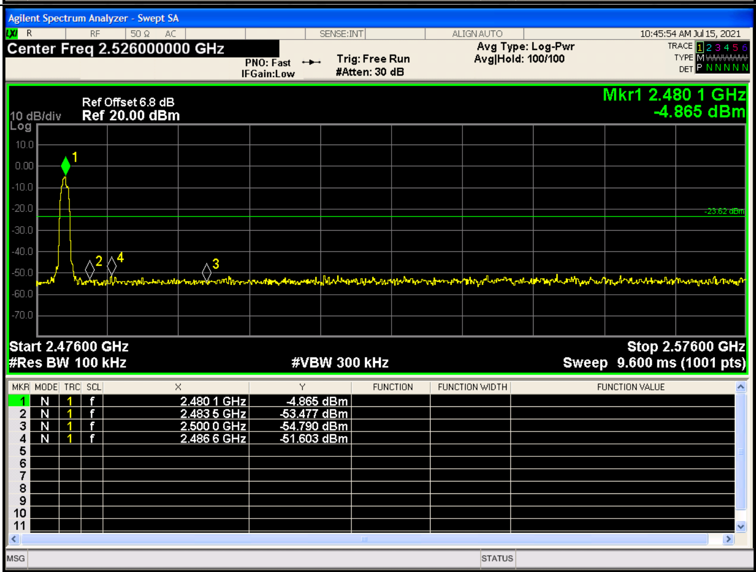
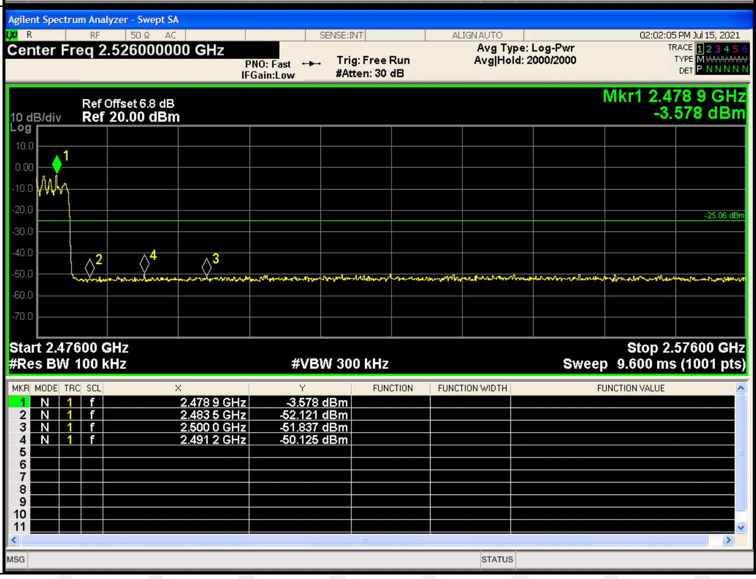
<tr><td>8DPSK/LCH/Hop</td><td></td><td></td></tr>
<tr><td>8DPSK/HCH/No Hop</td><td></td><td></td></tr>
<tr><td>8DPSK/HCH/Hop</td><td></td><td></td></tr>
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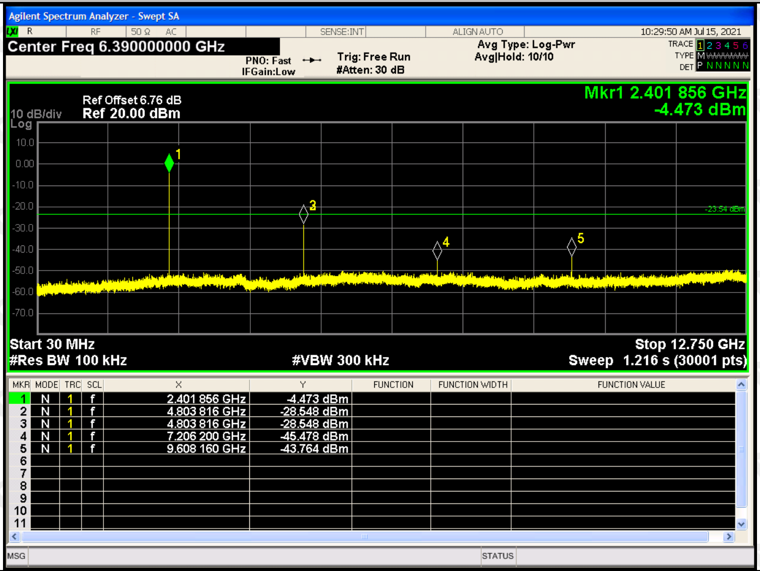
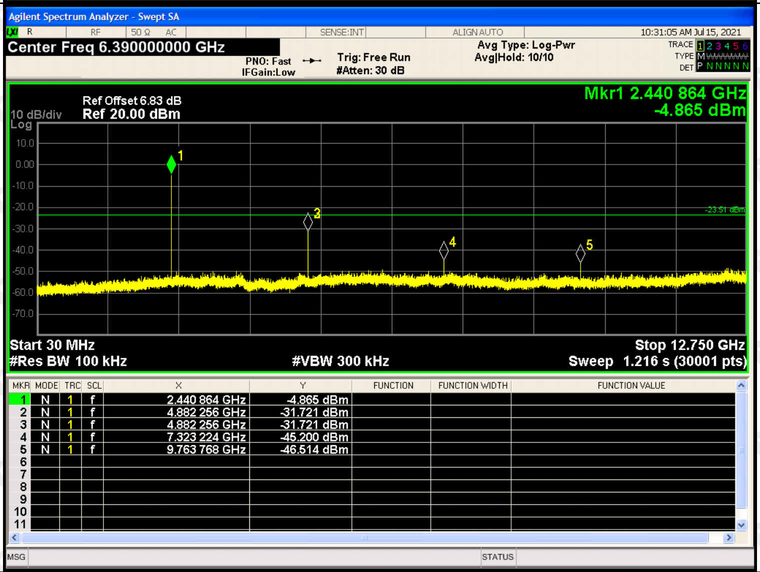
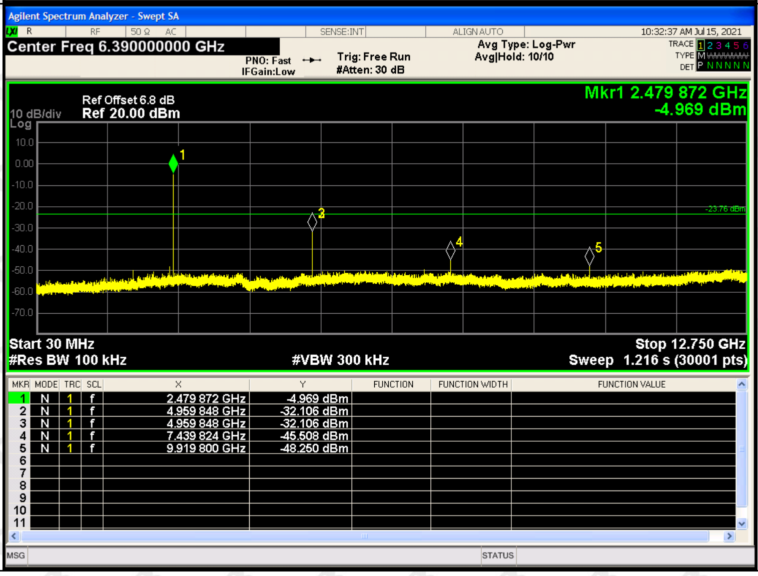
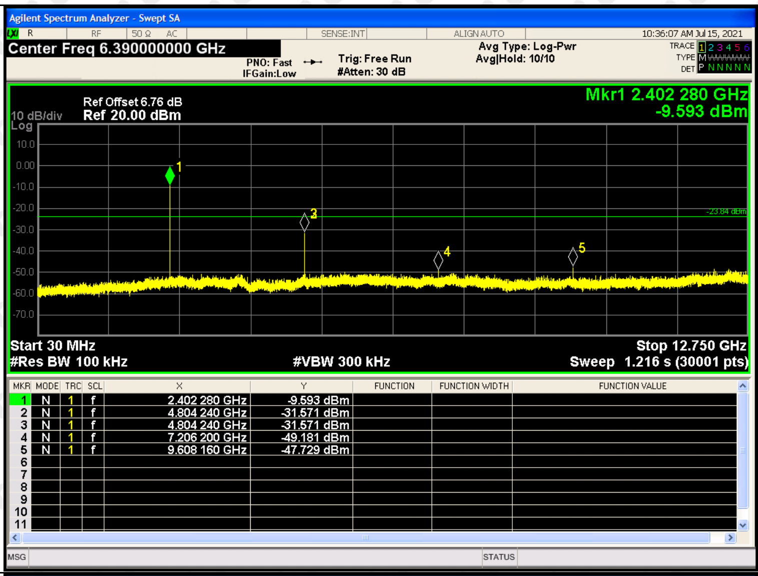
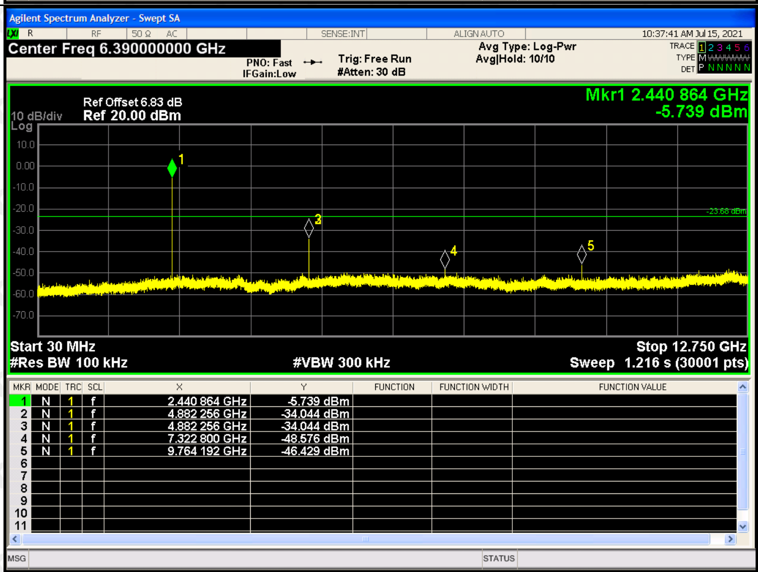
RF Conducted Spurious Emissions Graphs

GFSK/LCH		
GFSK/MCH		
GFSK/HCH		

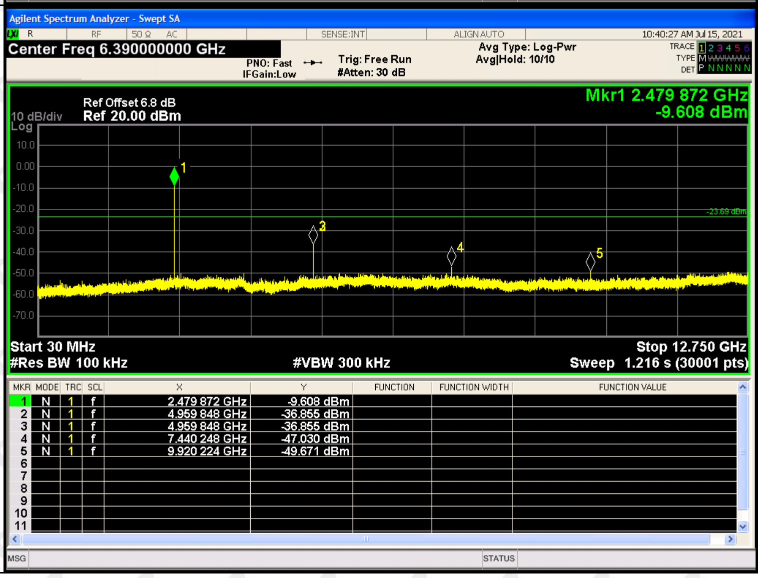
π/4DQPSK /LCH



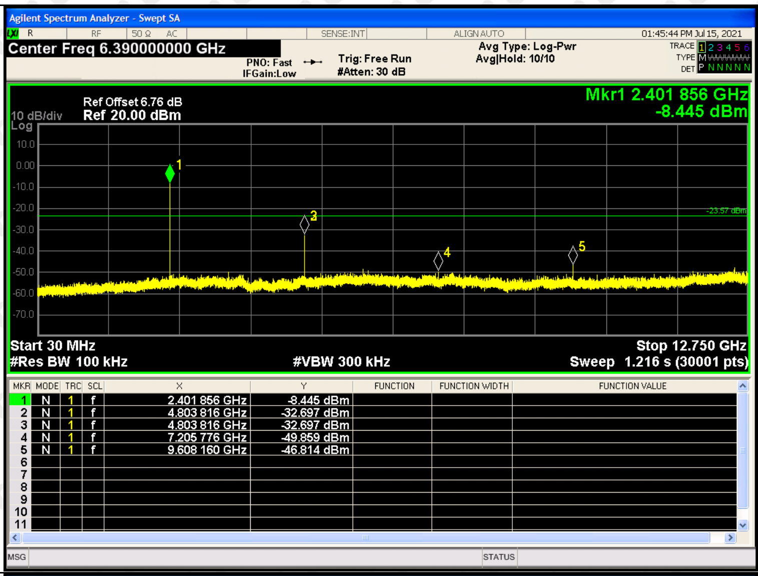
π/4DQPSK/MCH



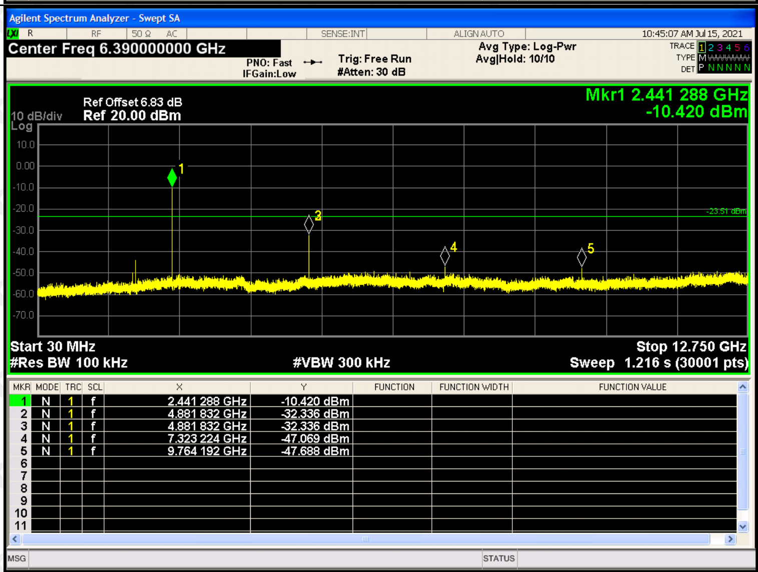
π/4DQPSK/HCH



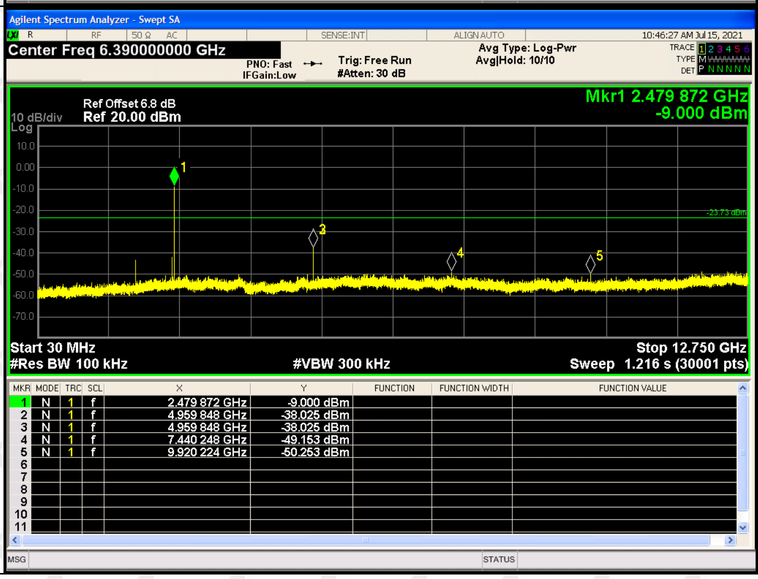
8DPSK /LCH



8DPSK/MCH

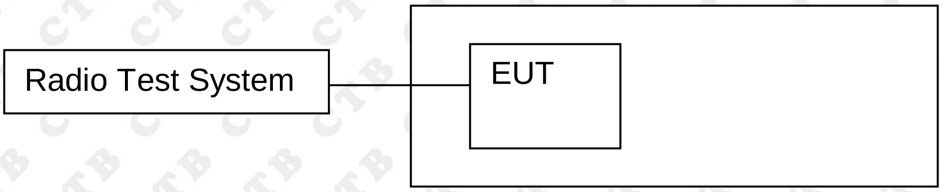


8DPSK/HCH



9. COUDUCTED 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 = 3MHz. VBW = 8MHz. 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]	Verdict
EDR mode (GFSK)	LCH	-3.052	PASS
	MCH	-3.024	PASS
	HCH	-3.267	PASS
EDR mode (π/4DQPSK)	LCH	-3.186	PASS
	MCH	-3.11	PASS
	HCH	-3.232	PASS
EDR mode (8DPSK)	LCH	-3.123	PASS
	MCH	-2.971	PASS
	HCH	-3.057	PASS

Test Graph:

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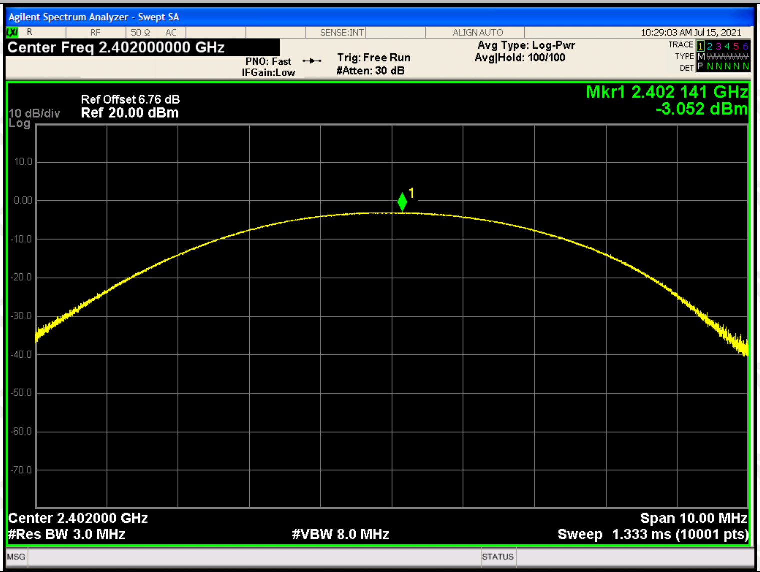
<tr><td>GFSK/LCH</td><td></td><td>
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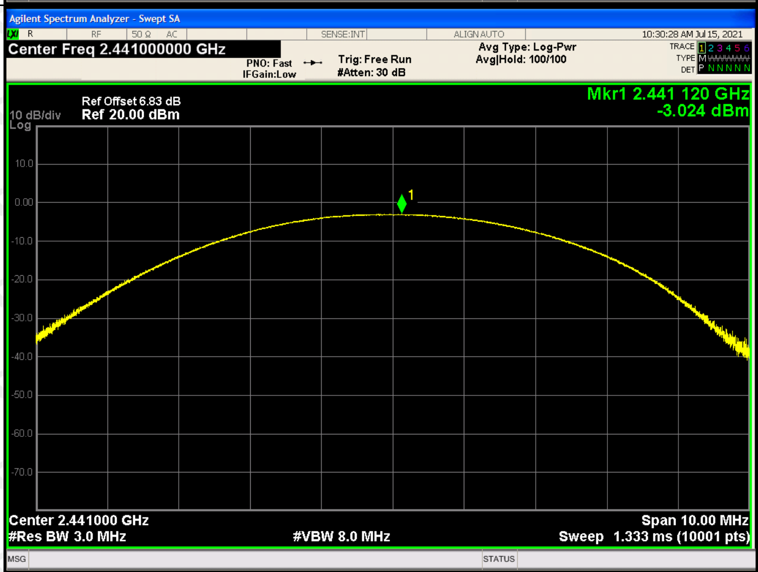
<tr><td>GFSK/MCH</td><td></td><td>
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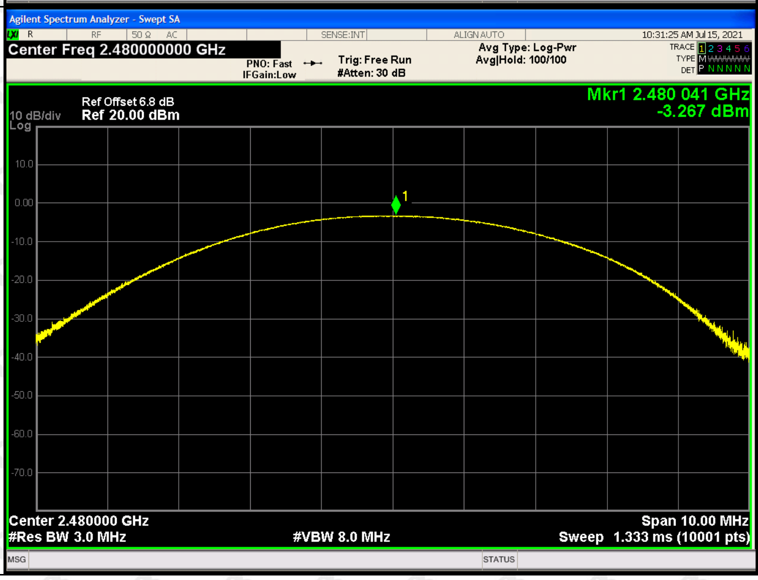
<tr><td>GFSK/HCH</td><td></td><td>
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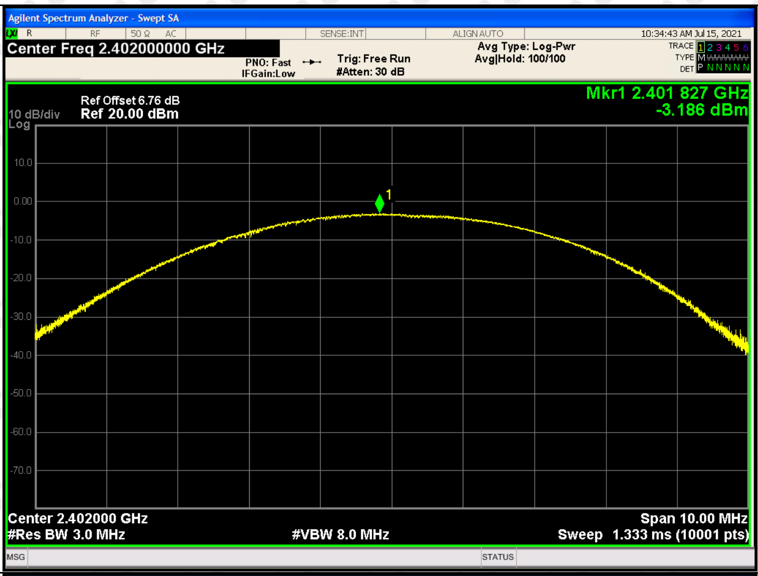
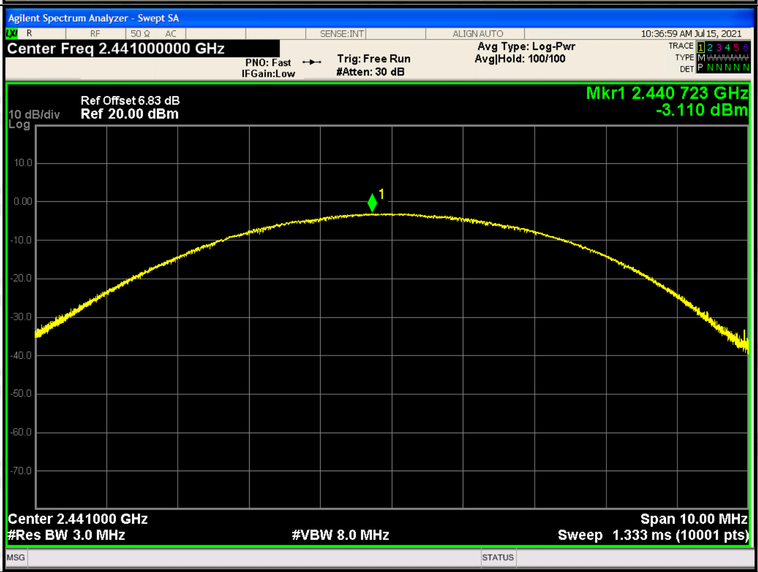
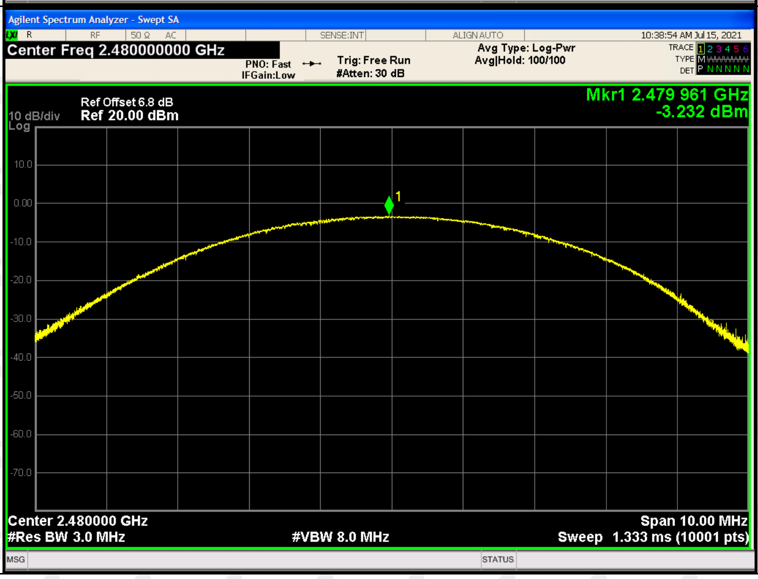
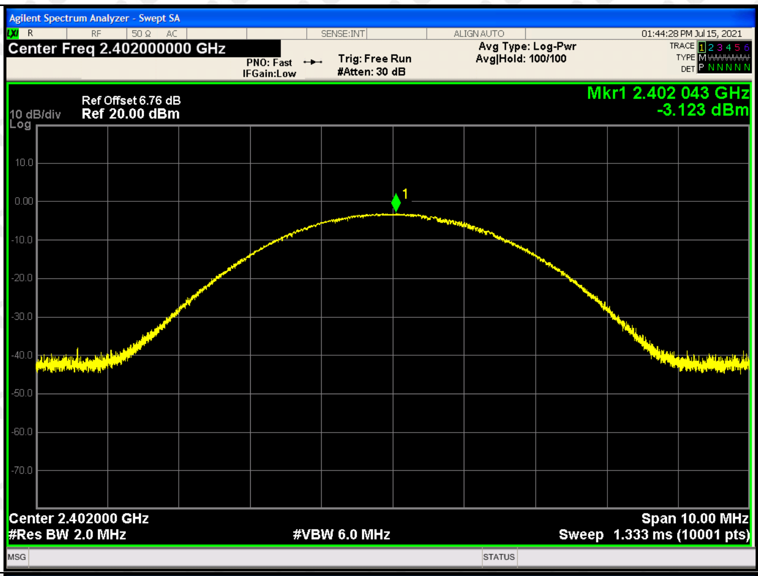
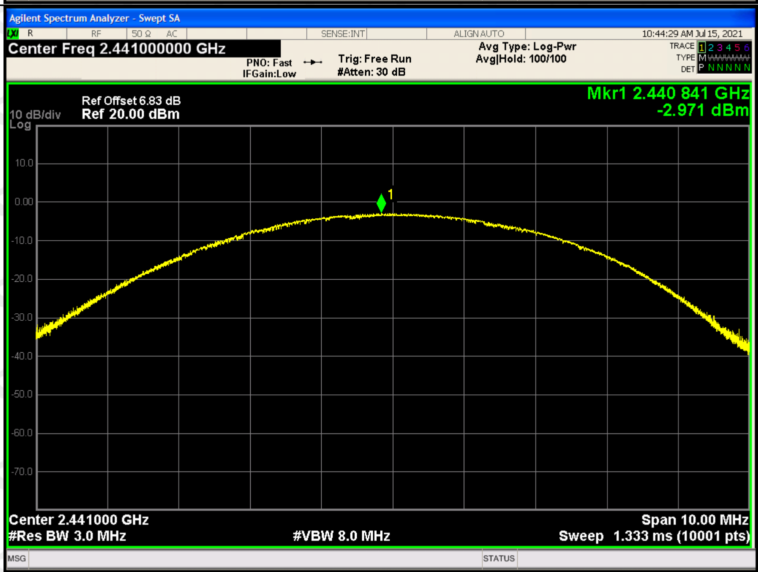
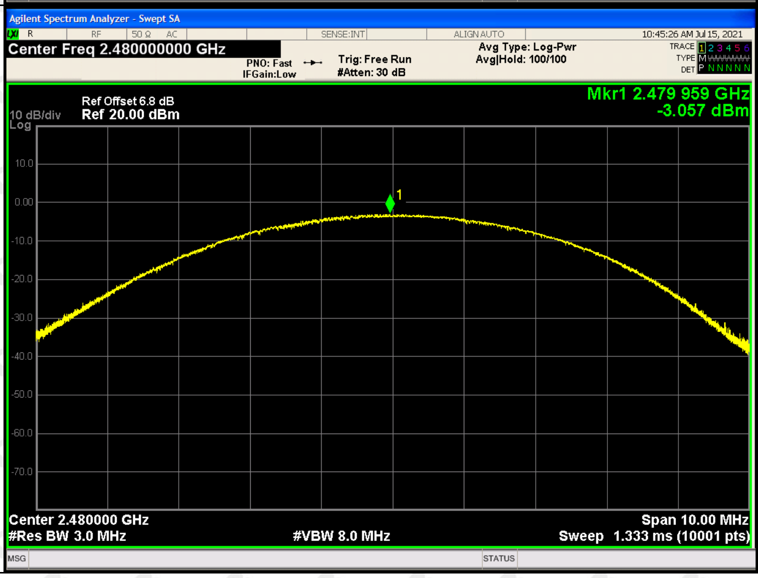
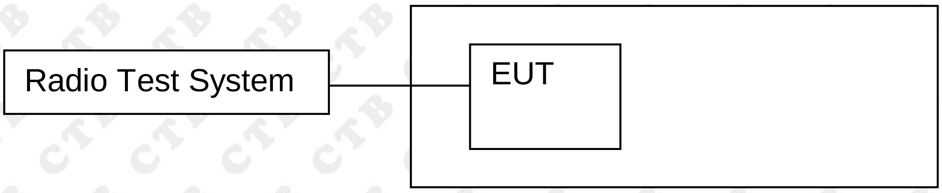
π/4DQPSK/LCH			
π/4DQPSK/MCH			
π/4DQPSK/HCH			

8DPSK/LCH		
8DPSK//MCH		
8DPSK/HCH		

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 125nw.

10.3 Test procedure

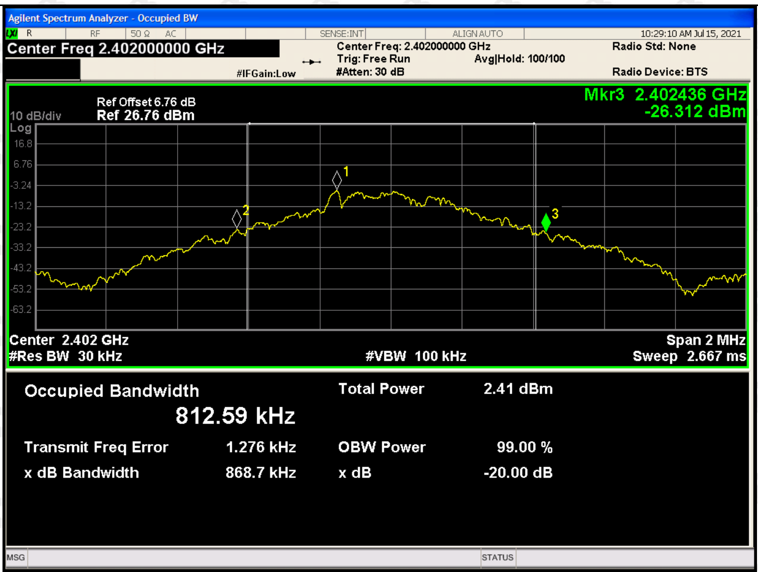
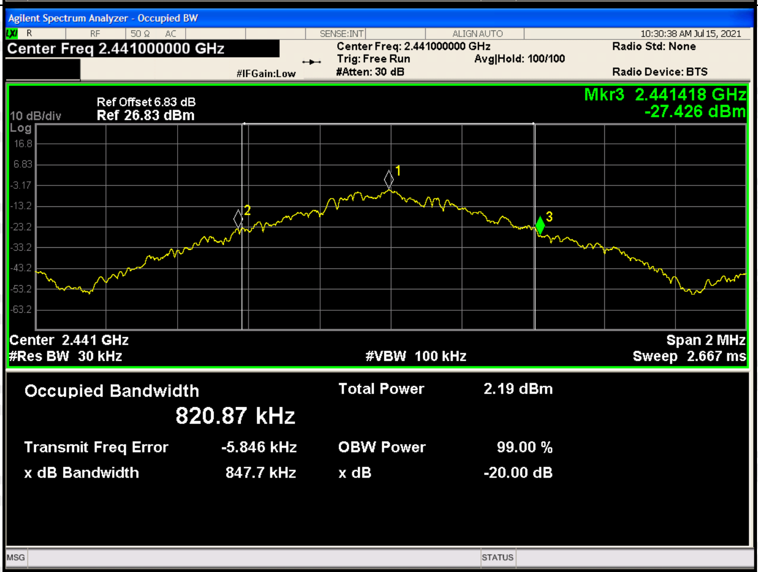
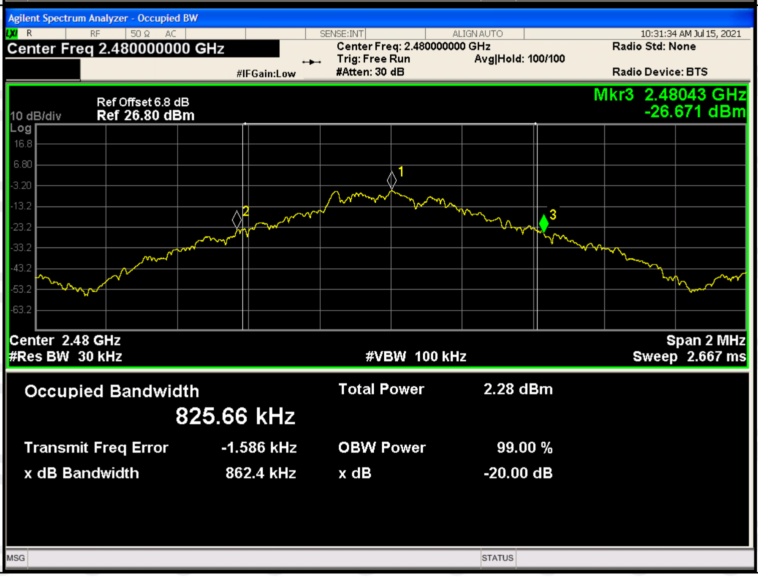
1. Rem1. Set RBW = 30 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude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

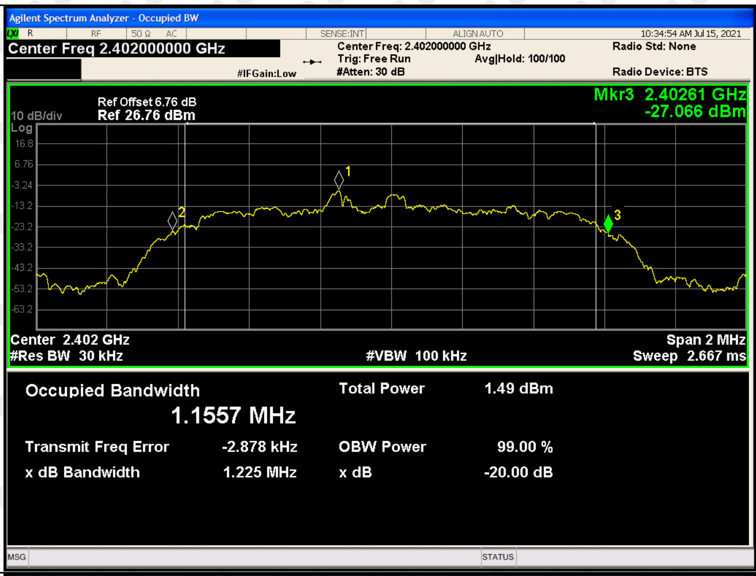
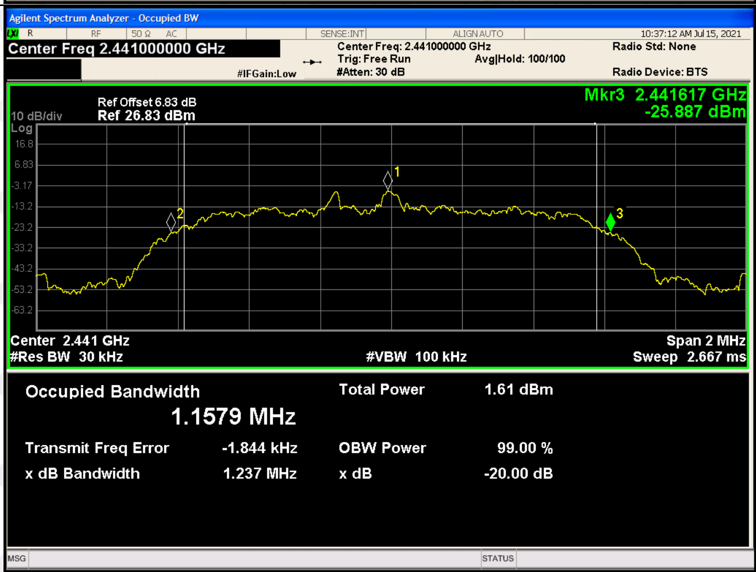
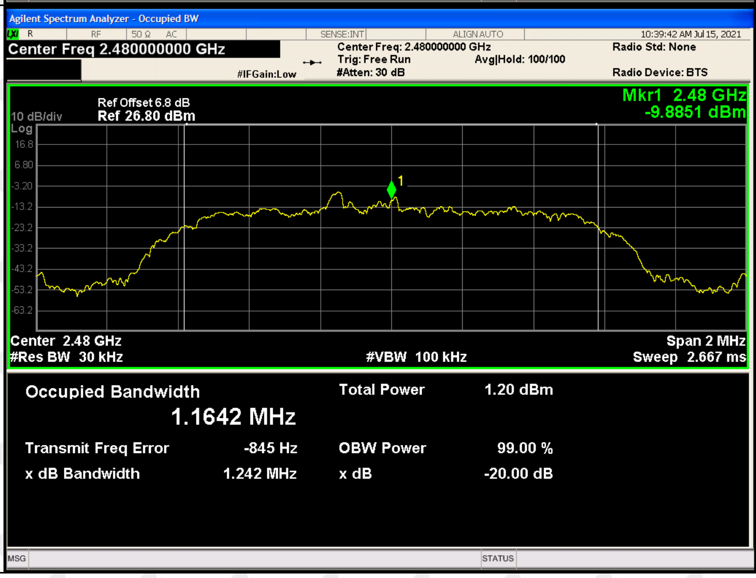
10.4 Test Result

Test Mode	Frequency	20dB Bandwidth (MHz)	Result
GFSK	Low channel	0.869	PASS
	Mid channel	0.848	PASS
	High channel	0.862	PASS
π/4DQPSK	Low channel	1.225	PASS
	Mid channel	1.237	PASS
	High channel	1.242	PASS
8DPSK	Low channel	1.242	PASS
	Mid channel	1.238	PASS
	High channel	1.246	PASS

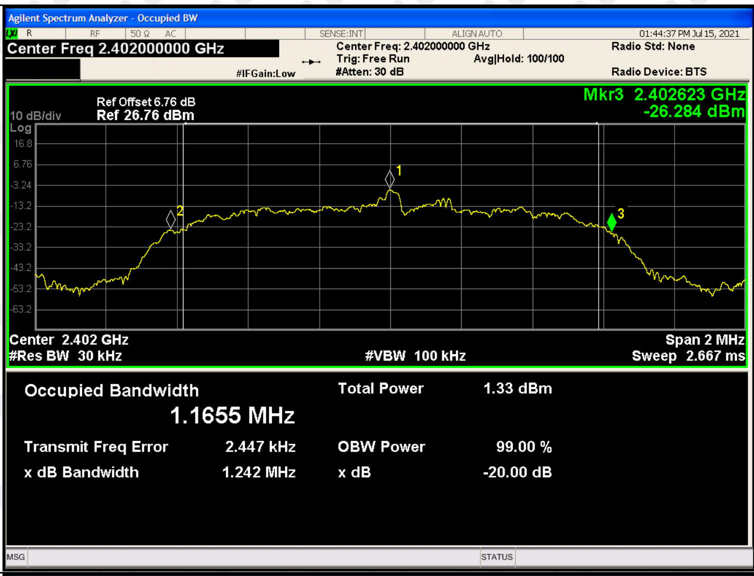
Note: All modes of operation were Pre-scan and the worst-case emissions are reported.

Test Graph:

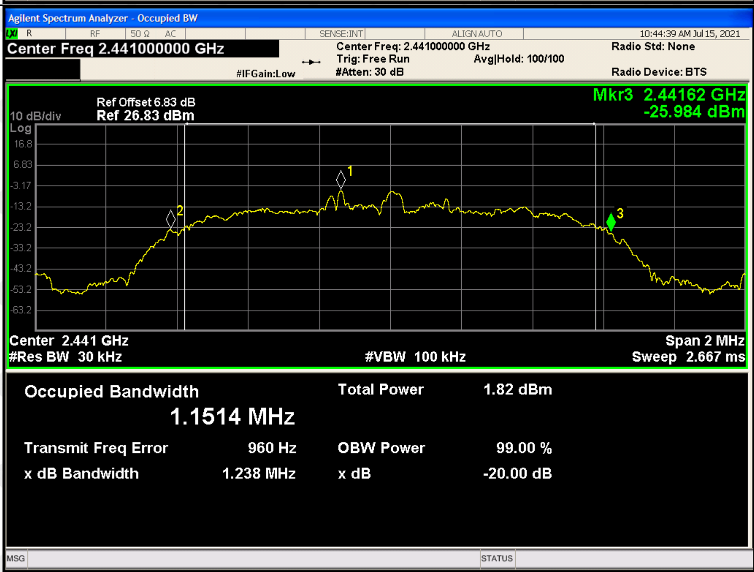
GFSK Low channel		
GFSK Mid channel		
GFSK High channel		

π/4-DQPSK Low channel		
π/4-DQPSK Mid channel		
π/4-DQPSK High channel		

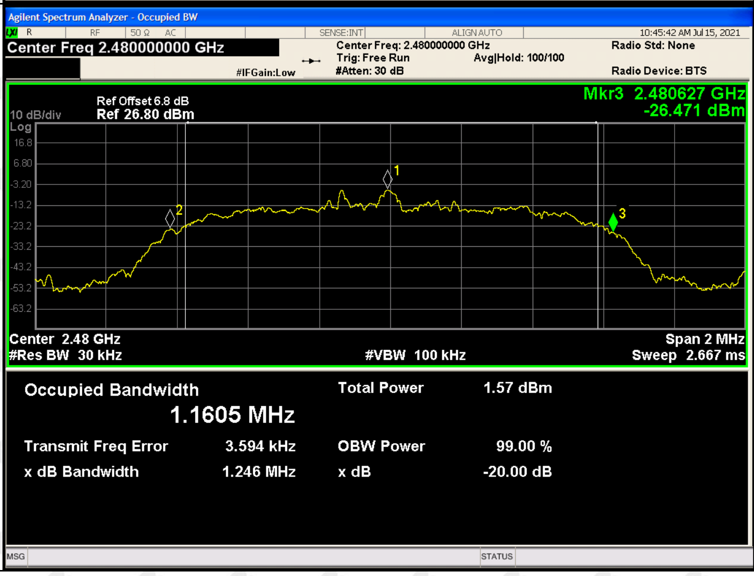
8DPSK Low channel



8DPSK Mid channel

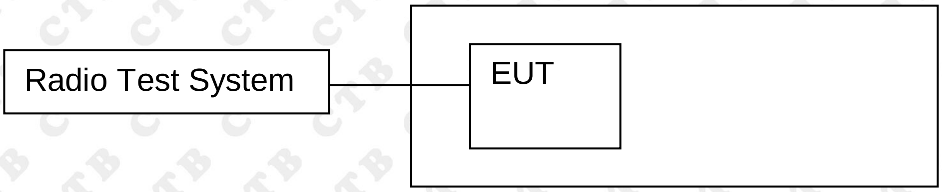


8DPSK High channel



11. CARRIERFREQUENCIES 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.

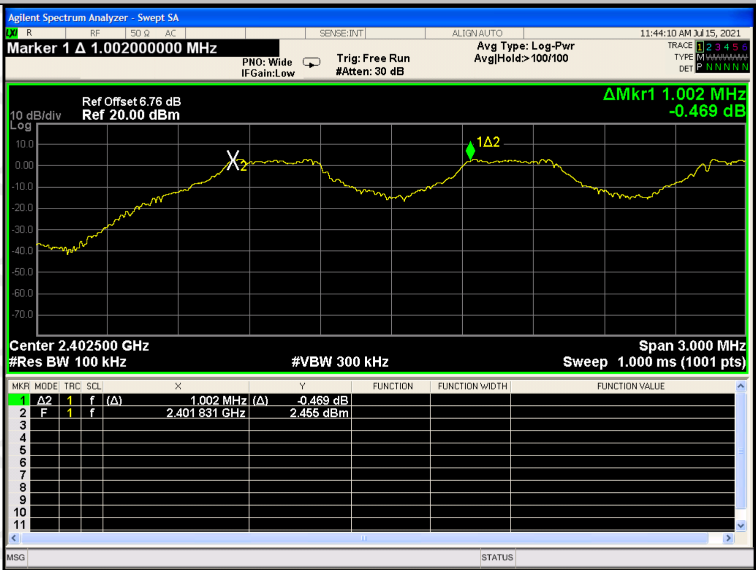
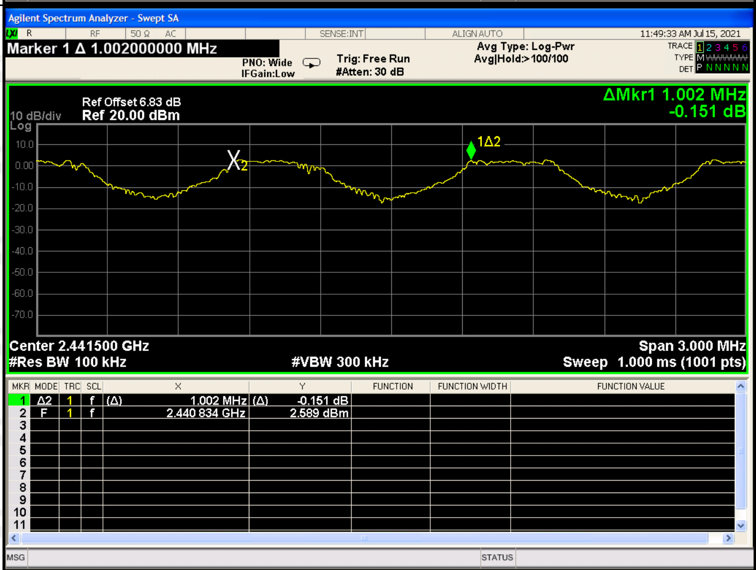
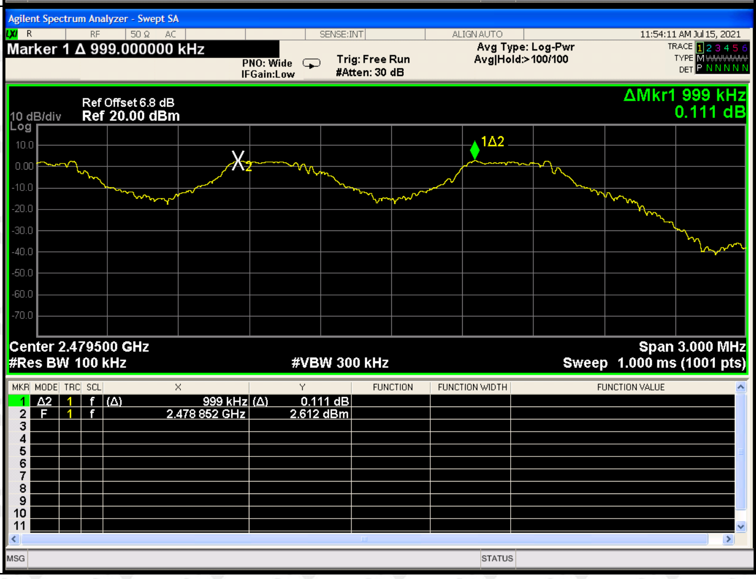
11.3 Test procedure

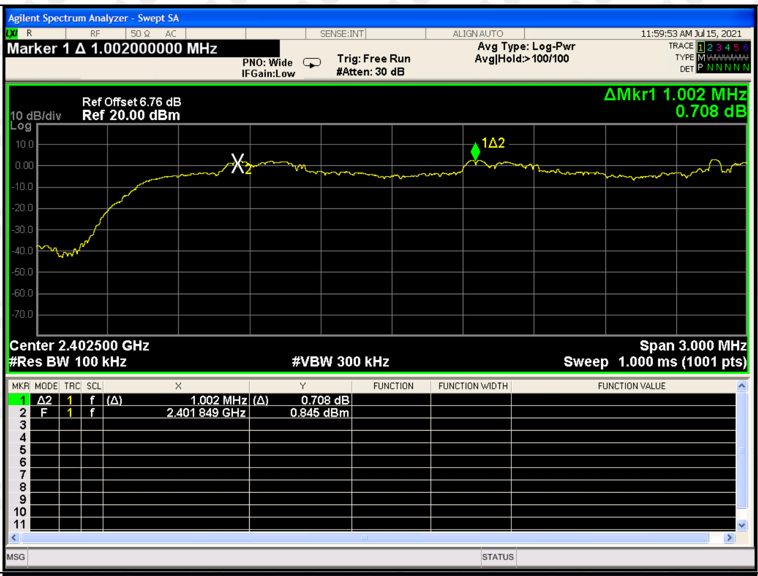
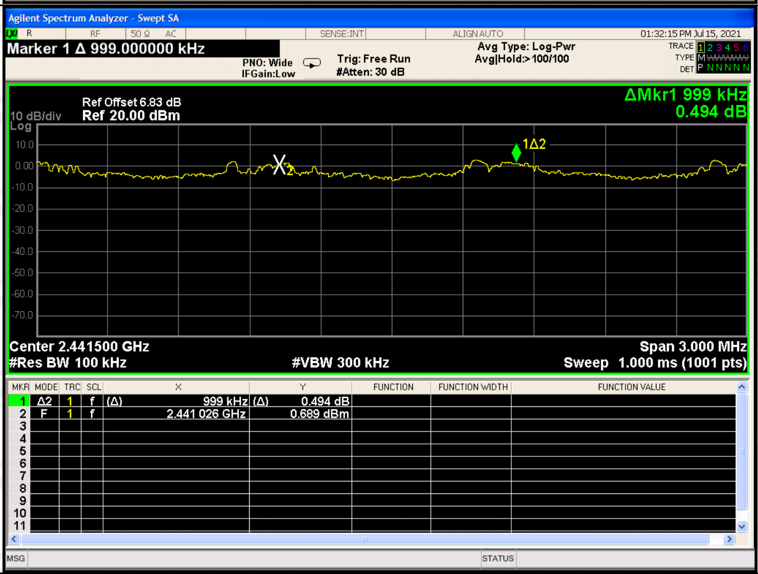
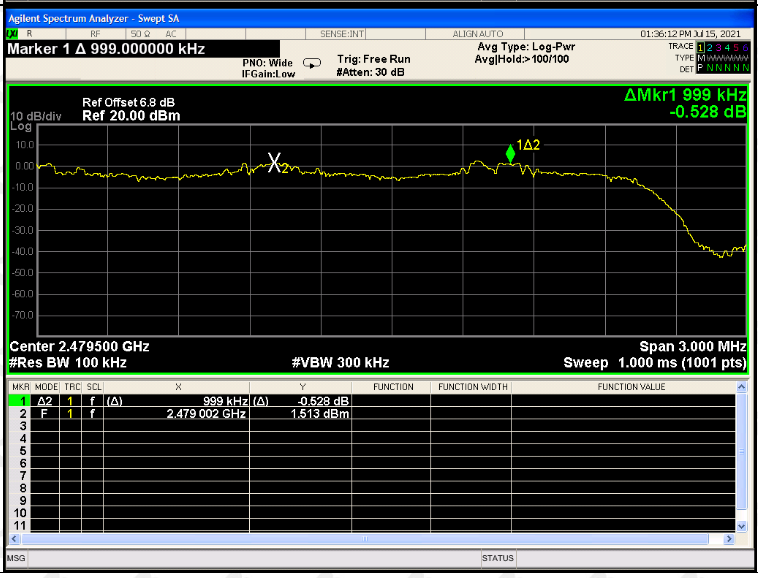
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 30kHz. VBW = 100kHz , Span = 3.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to 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.

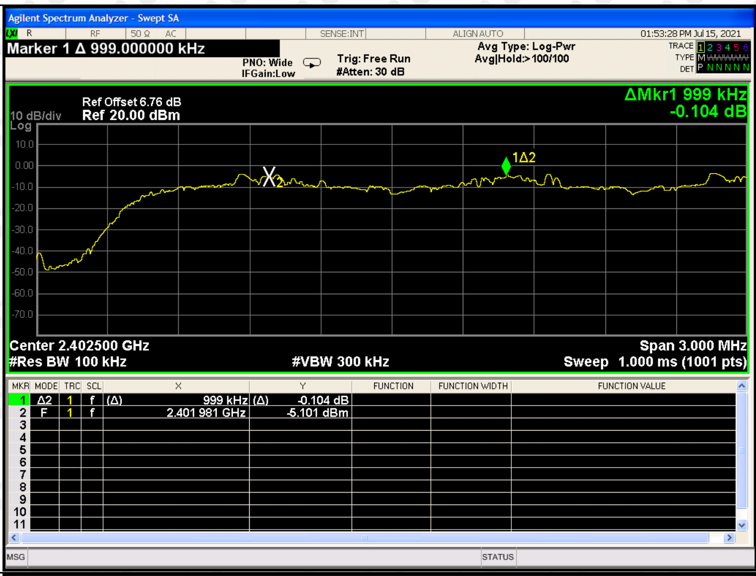
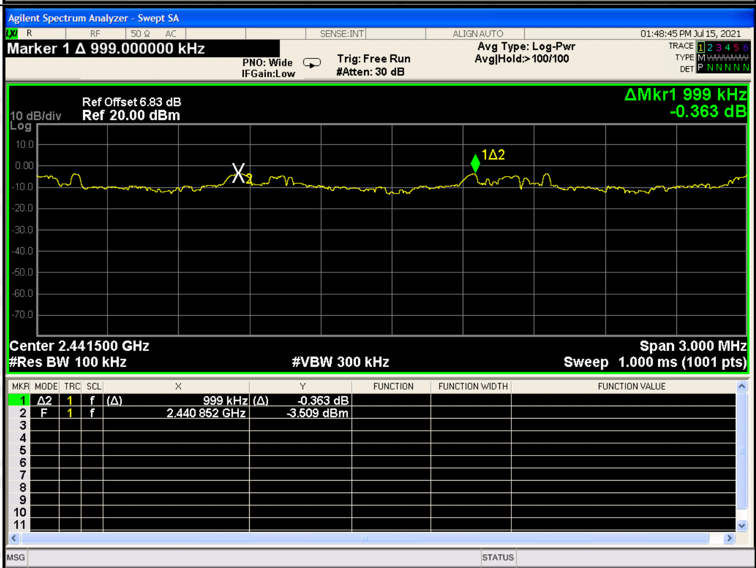
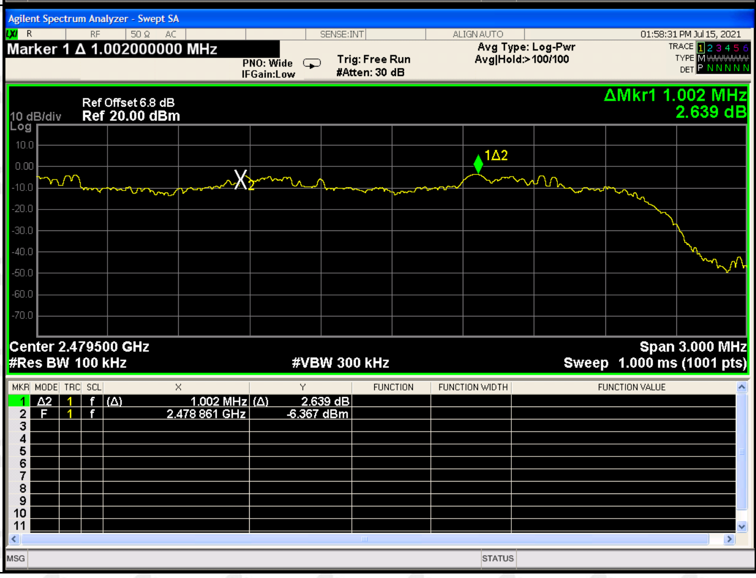
11.4 Test Result

Mode	Channel.	Carrier Frequency Separation [MHz]	Verdict
GFSK	LCH	1.002	PASS
GFSK	MCH	1.002	PASS
GFSK	HCH	0.999	PASS
π/4DQPSK	LCH	1.002	PASS
π/4DQPSK	MCH	0.999	PASS
π/4DQPSK	HCH	0.999	PASS
8DPSK	LCH	0.999	PASS
8DPSK	MCH	0.999	PASS
8DPSK	HCH	1.002	PASS

Test Graph

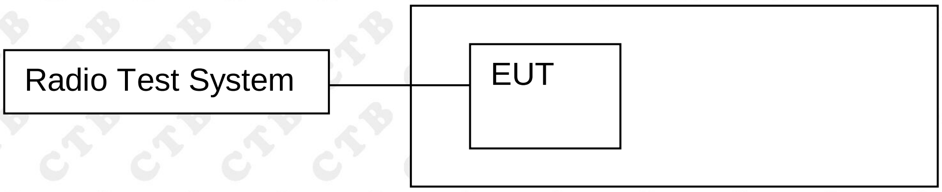
Graphs		
GFSK/LCH		
GFSK/MCH		
GFSK/HCH		

π/4DQPSK/LCH		
π/4DQPSK/MCH		
π/4DQPSK/HCH		

8DPSK/LCH		
8DPSK/MCH		
8DPSK/HCH		

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.

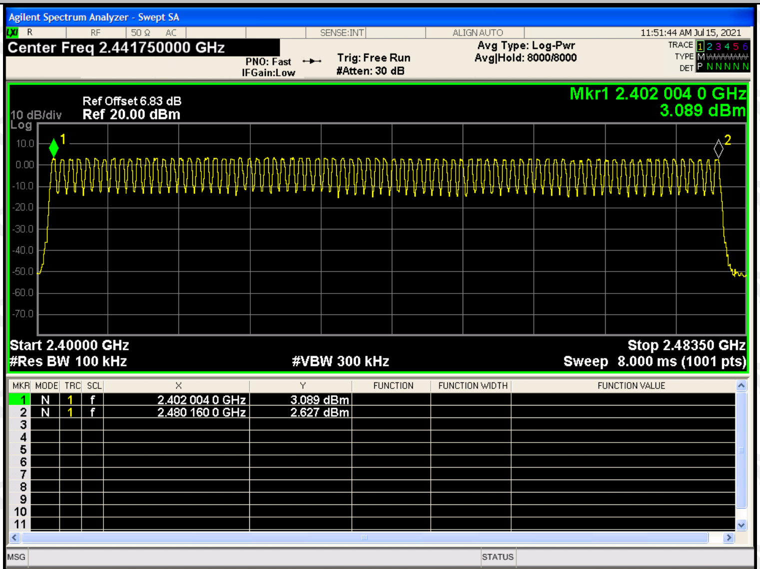
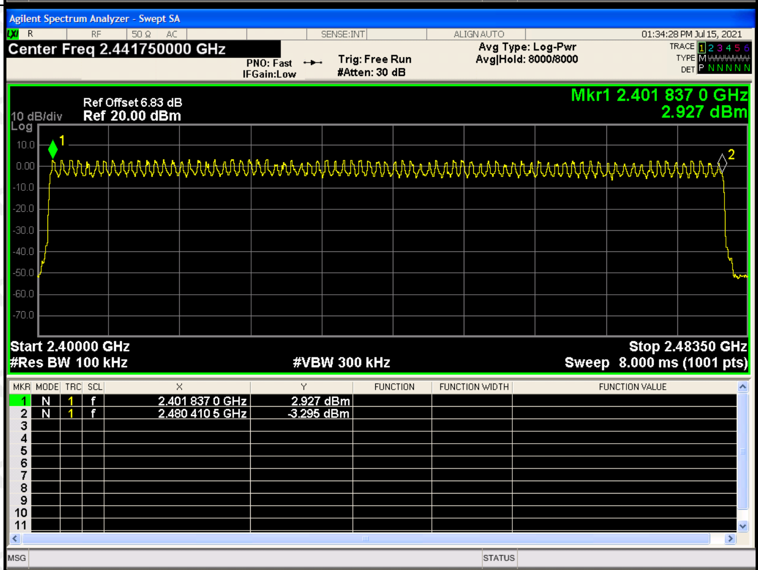
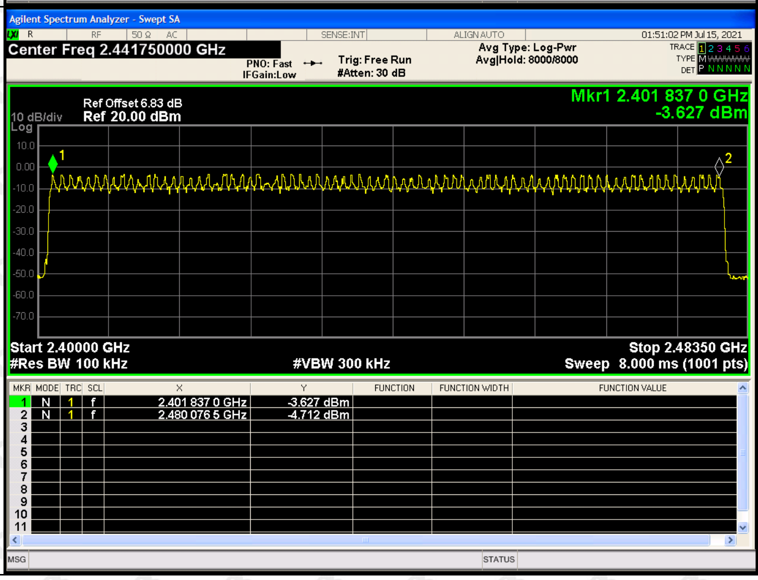
12.3 Test procedure

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

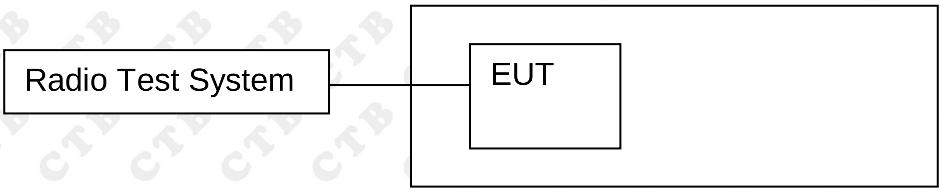
Mode	Channel.	Number of Hopping Channel	Verdict
GFSK	Hop	79	PASS
π/4DQPSK	Hop	79	PASS
8DPSK	Hop	79	PASS

Test Graph

Graphs		
GFSK/Hop		
π/4DQPSK/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

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).

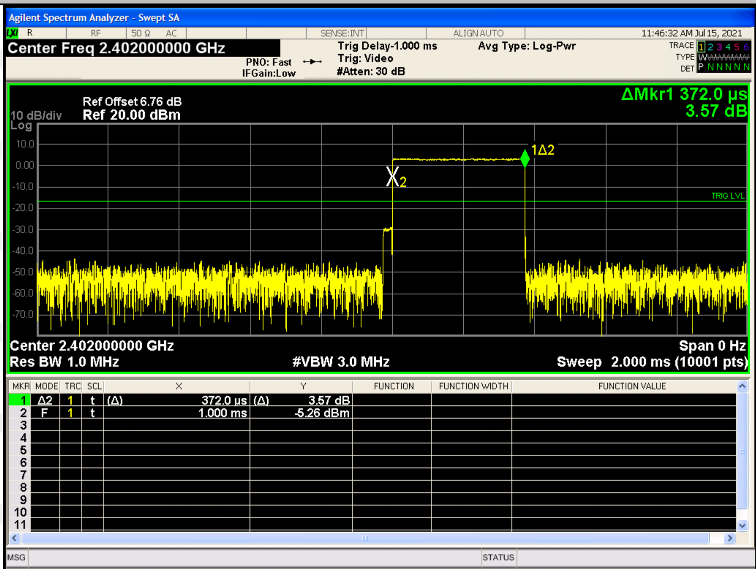
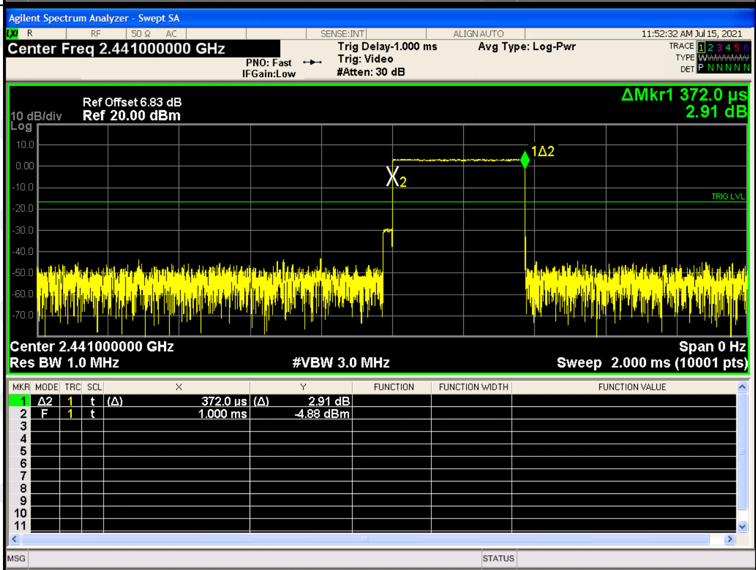
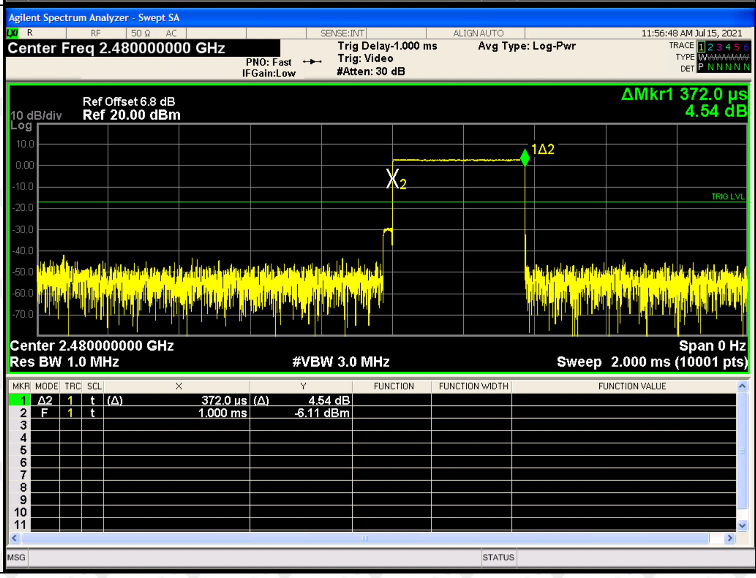
13.4 Test Result

Mode	Packet	Channel	Pulse Time (ms)	Total Dwell Time (ms)	Limit (ms)	Verdict
GFSK	DH1	LCH	0.372	119.04	400	PASS
	DH1	MCH	0.372	119.04	400	PASS
	DH1	HCH	0.372	119.04	400	PASS
	DH3	LCH	1.632	261.12	400	PASS
	DH3	MCH	1.632	261.12	400	PASS
	DH3	HCH	1.633	261.28	400	PASS
	DH5	LCH	2.882	307.413	400	PASS
	DH5	MCH	2.882	307.413	400	PASS
	DH5	HCH	2.882	307.413	400	PASS

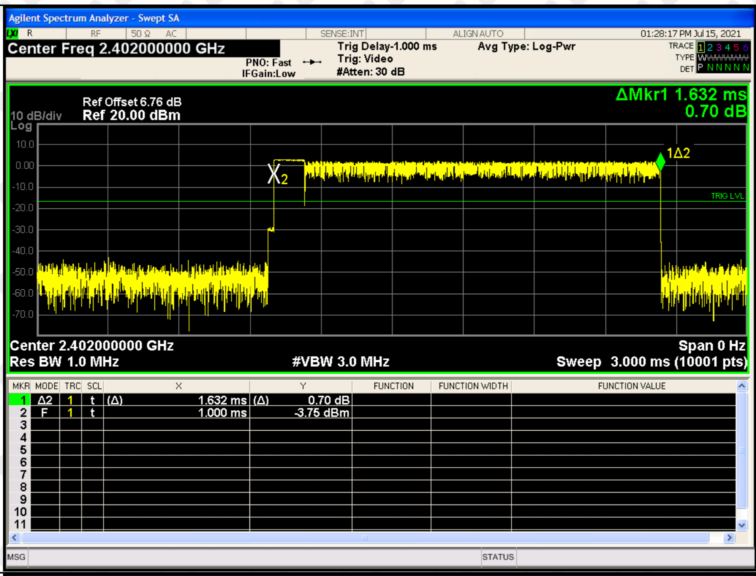
Remark: DH5 Packet permit maximum 1600 / 79 / 6 hops per second in each channel (5 time slots RX, 1 time slot TX).
DH3 Packet permit maximum 1600 / 79 / 4 hops per second in each channel (3 time slots RX, 1 time slot TX).
DH1 Packet permit maximum 1600 / 79 /2 hops per second in each channel (1 time slot RX, 1 time slot TX). So, the Dwell Time can be calculated as follows:

DH5:1600/79/6*0.4*79* MkrDelta ms
DH3:1600/79/4*0.4*79* MkrDelta ms
DH1:1600/79/2*0.4*79* MkrDelta ms
Remark: Mkr Delta is once pulse time.

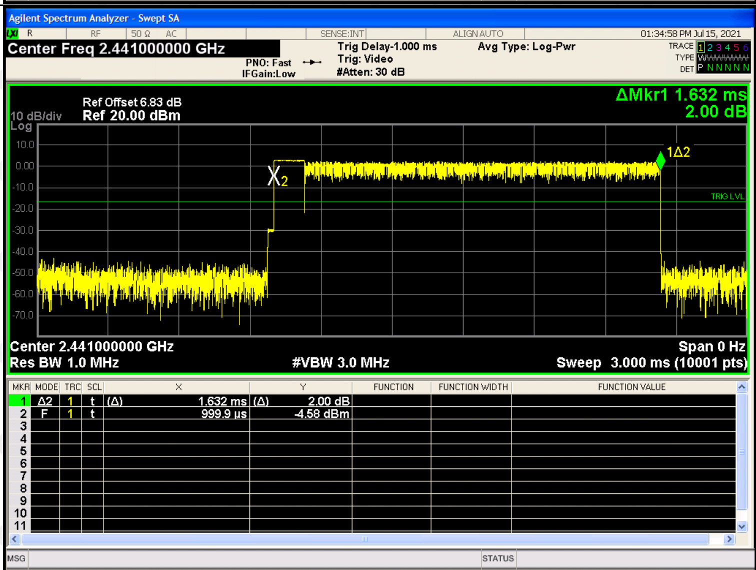
Test Graph

Graphs		
GFSK_DH1/LCH		
GFSK_DH1/MCH		
GFSK_DH1/HCH		

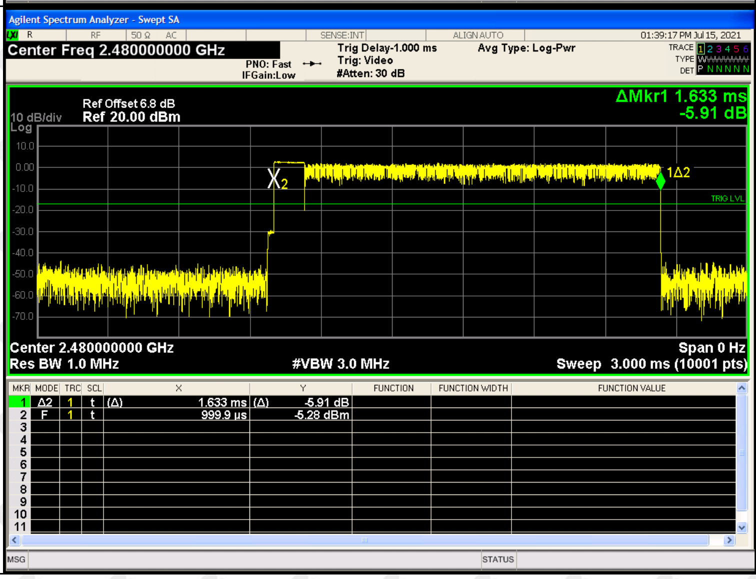
GFSK_DH3/LCH

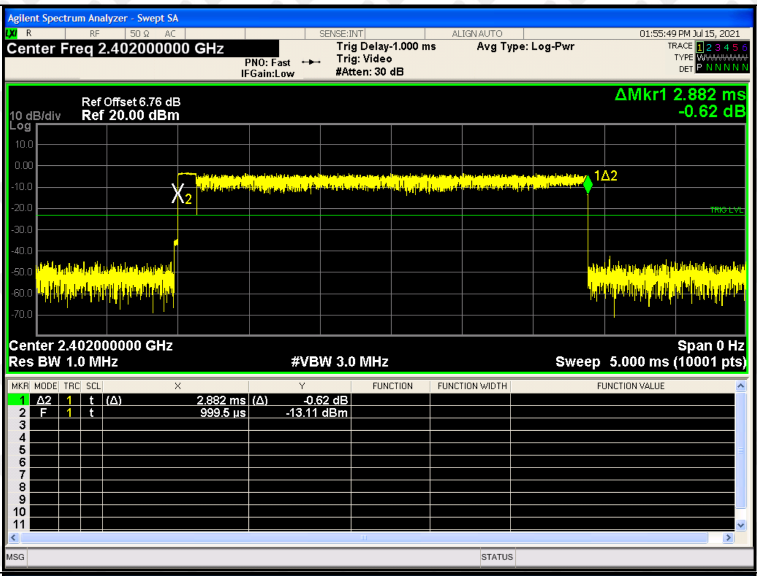
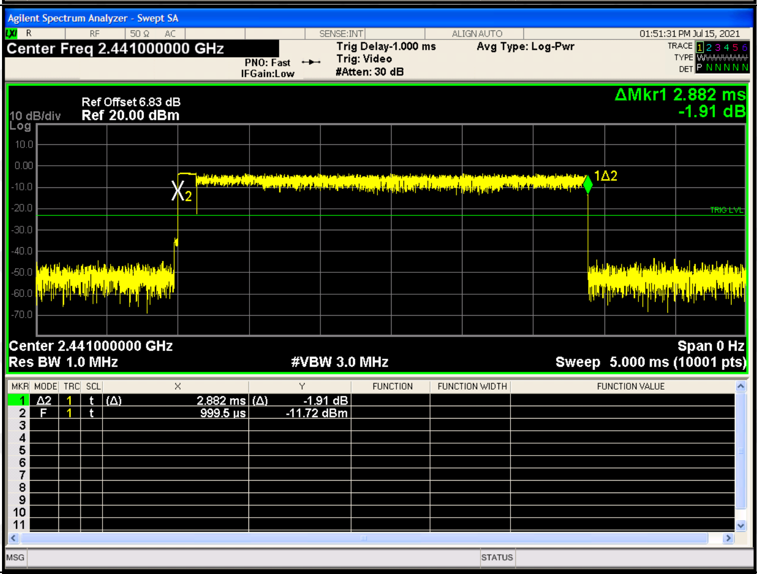
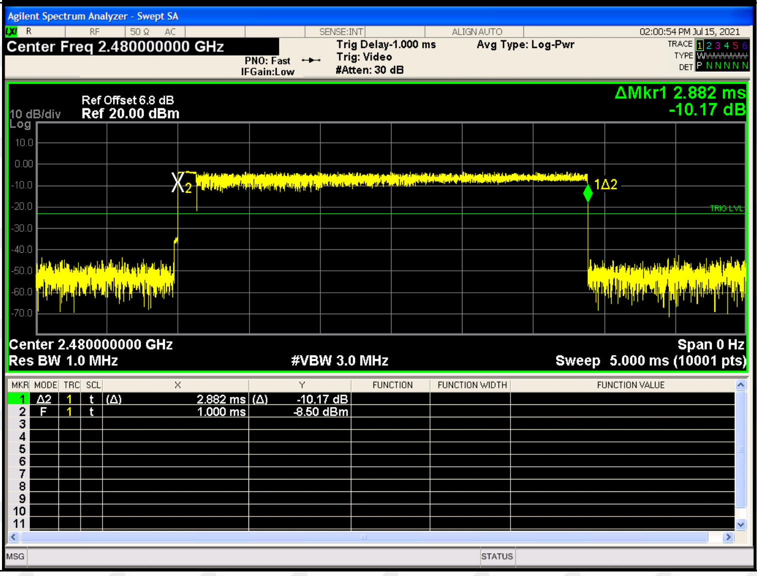


GFSK_DH3/MCH



GFSK_DH3/HCH



GFSK_DH5/LCH		
GFSK_DH5/MCH		
GFSK_DH5/HCH		

14. PSEUDORANDOM FREQUENCY

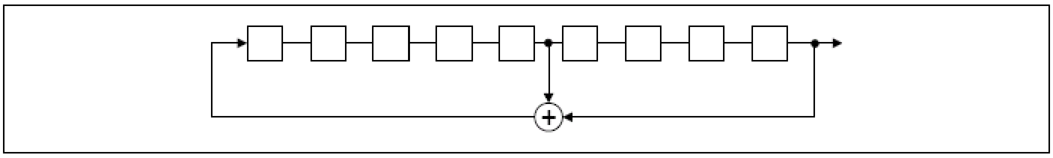
14.1 Limit

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.

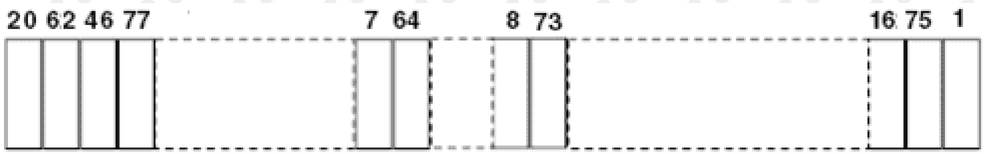
14.2 Test procedure

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: 29 -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

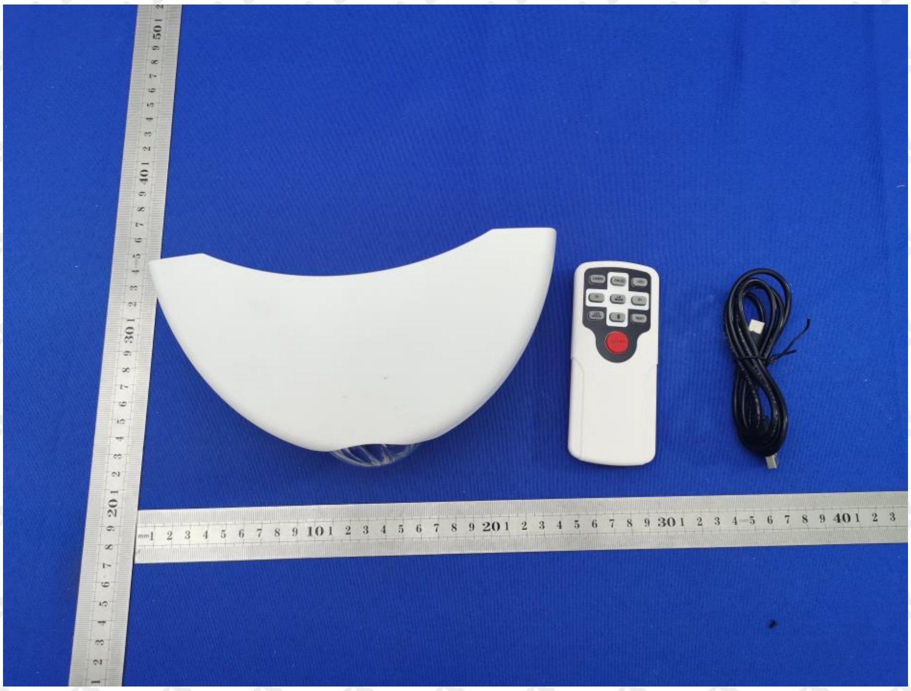
15.203 requirement:
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer 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:

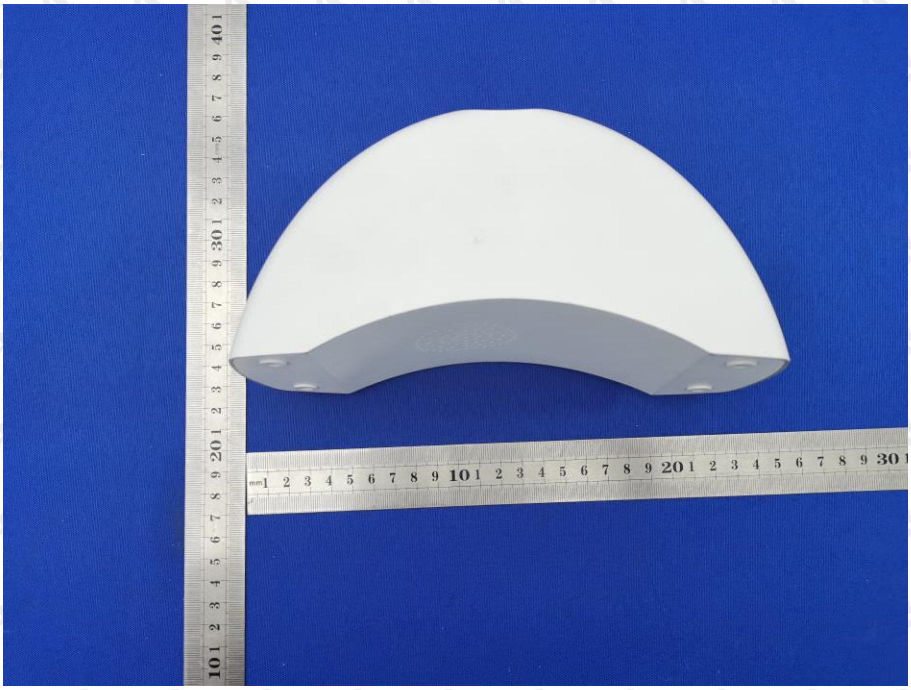
The antenna is PCB antenna. The best case gain of the antenna is 1dBi.

16. EUT PHOTOGRAPHS

EUT Photo 1



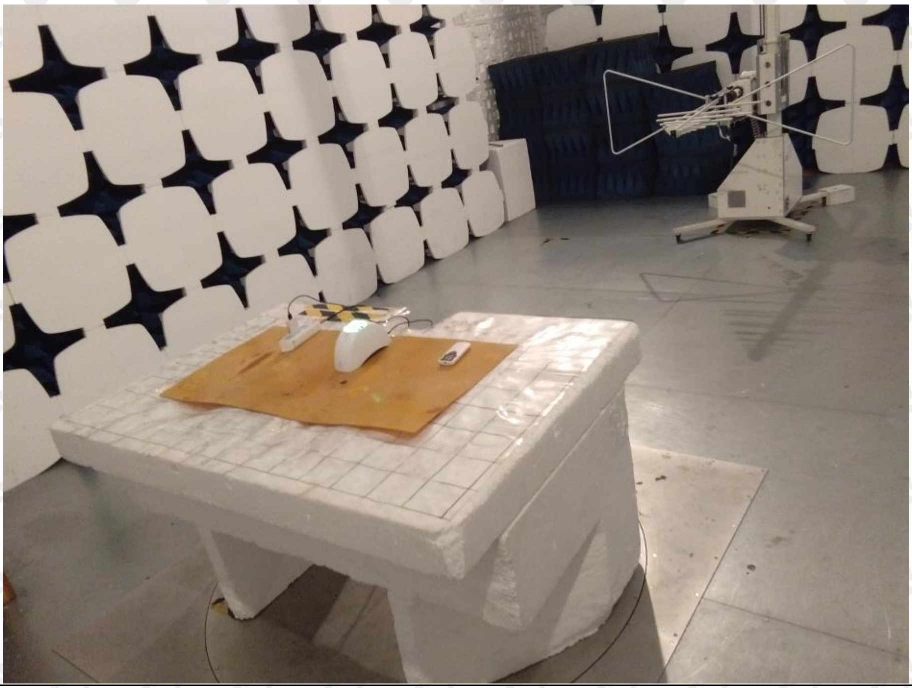
EUT Photo 2



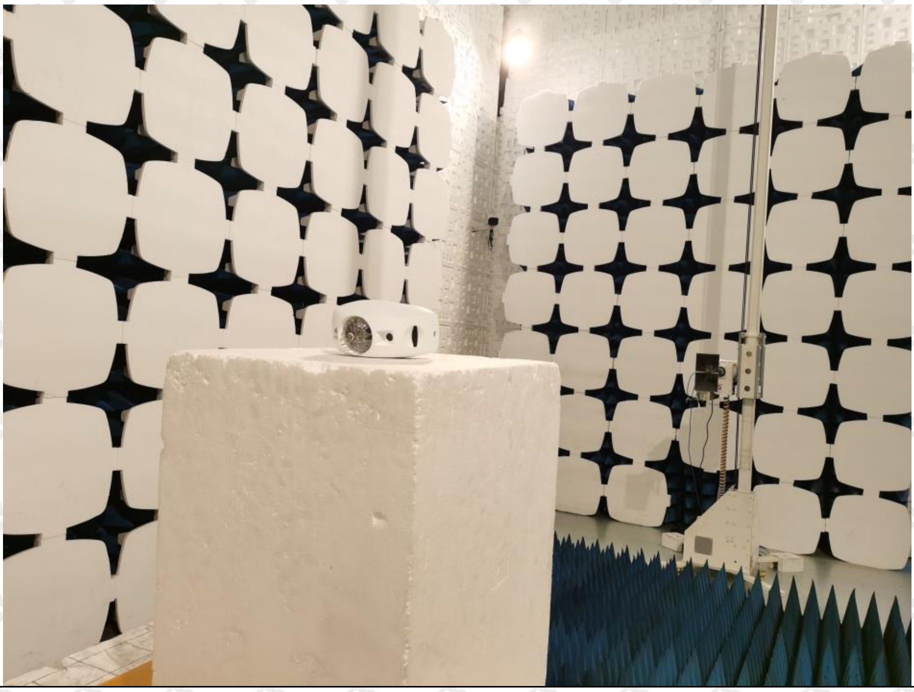
17. EUT TEST SETUP PHOTOGRAPHS

Radiated Emission

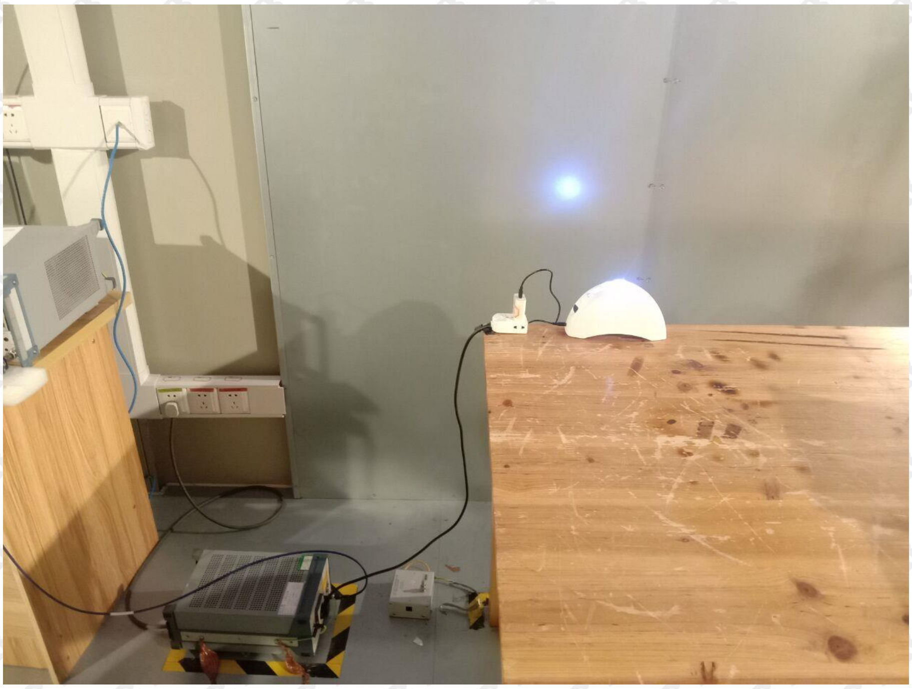
Below 1G



Above 1G



Conducted emissions



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