



TEST REPORT

Product Name: Baby Car & Home Monitor
FCC ID: 2BGR9-BCM02
Trademark: bonoch
Model Number: BCM02, BCM02RX, BCM02A, BCM02B, BCM02C, BCM02D, BCM02E
Prepared For: Shenzhen Velocity Technology Innovations Co., Ltd.
Address: Room 301, Building C, Phase 2, Galaxy WORLD, Minle Community, Minzhi Subdistrict, Longhua District, Shenzhen, China
Manufacturer: Shenzhen Velocity Technology Innovations Co., Ltd.
Address: Room 301, Building C, Phase 2, Galaxy WORLD, Minle Community, Minzhi Subdistrict, Longhua District, Shenzhen, China
Prepared By: Shenzhen CTB Testing Technology Co., Ltd.
Address: 1&2/F., Building A, No.26, Xinhe Road, Xinqiao, Xinqiao Street, Bao'an District, Shenzhen, Guangdong, China
Sample Received Date: Nov. 14, 2024
Sample tested Date: Nov. 14, 2024 to Nov. 28, 2024
Issue Date: Nov. 28, 2024
Report No.: CTB241125001RF
Test Standards: FCC CFR Title 47 Part 15 Subpart C Section 15.247
ANSI C63.10:2013
Test Results: PASS
Remark: This is 2.4GHz radio test report.

Compiled by:

Zhou kui

Zhou Kui

Reviewed by:

Arron Liu

Arron Liu

Approved by:

Bin 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. Without written approval of Shenzhen CTB Testing Technology Co., Ltd. this report can't be reproduced except in full. The tested sample(s) and the sample information are provided by the client. "*" indicates the testing items were fulfilled by subcontracted lab. "#" indicates the items are not in CNAS accreditation scope.

TABLE OF CONTENT

Test Report Declaration	Page
1. VERSION	4
2. TEST SUMMARY	5
3. MEASUREMENT UNCERTAINTY	6
4. PRODUCT INFORMATION AND TEST SETUP	7
4.1 Product Information	7
4.2 Test Setup Configuration	7
4.3 Support Equipment	7
4.4 Channel List	8
4.5 Test Mode	8
4.6 Test Environment	8
5. TEST FACILITY AND TEST INSTRUMENT USED	9
5.1 Test Facility	9
5.2 Test Instrument Used	9
6. AC POWER LINE CONDUCTED EMISSION	12
6.1 Block Diagram Of Test Setup	12
6.2 Limit	12
6.3 Test procedure	12
6.4 Test Result	14
7. RADIATED SPURIOUS EMISSION	16
7.1 Block Diagram Of Test Setup	16
7.2 Limit	16
7.3 Test procedure	17
7.4 Test Result	18
8. BAND EDGE AND RF CONDUCTED SPURIOUS EMISSIONS	27
8.1 Block Diagram Of Test Setup	27
8.2 Limit	27
8.3 Test procedure	27
8.4 Test Result	28
9. CONDUCTED PEAK OUTPUT POWER	31
9.1 Block Diagram Of Test Setup	31
9.2 Limit	31
9.3 Test procedure	31
9.4 Test Result	31
10. 20DB OCCUPIED BANDWIDTH	33
10.1 Block Diagram Of Test Setup	33
10.2 Limit	33
10.3 Test procedure	33
10.4 Test Result	33
11. CARRIER FREQUENCIES SEPARATION	35
11.1 Block Diagram Of Test Setup	35
11.2 Limit	35
11.3 Test procedure	35
11.4 Test Result	35
12. HOPPING CHANNEL NUMBER	37
12.1 Block Diagram Of Test Setup	37
12.2 Limit	37
12.3 Test procedure	37
12.4 Test Result	37
13. DWELL TIME	39
13.1 Block Diagram Of Test Setup	39

13.2	Limit	39
13.3	Test procedure	39
13.4	Test Result	39
14.	PSEUDORANDOM FREQUENCY	42
14.1	Limit	42
14.2	Test procedure	42
14.3	Test Result	42
15.	ANTENNA REQUIREMENT	43
16.	EUT TEST SETUP PHOTOGRAPHS	44

(Note: N/A means not applicable)



1. VERSION

Report No.	Issue Date	Description	Approved
CTB241125001RF	Nov. 28, 2024	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(a)&TCB Exclusion List (7 July 2002)	ANSI C63.10-2013	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 C63.10-2013.

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(9KHz-30MHz)	4.8dB
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°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(s):	BCM02, BCM02RX, BCM02A, BCM02B, BCM02C, BCM02D, BCM02E
Model Description:	All the model are the same circuit and RF module, only the name and appearance colors are different. Test sample model: BCM02
Hardware Version:	V3.1
Software Version:	v2.6
Operation Frequency:	2410-2477MHz
Max. RF output power:	20.565dBm
Type of Modulation:	GFSK
Antenna installation:	FPC antenna
Antenna Gain:	1.9dBi
Ratings:	Input: 110Vac/220Vac 50hz/60hz, 0.45A(Max) Output: 5Vdc, 2A

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. 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)
CH1	2410MHz	CH7	2431MHz	CH13	2452MHz	CH19	2473MHz
CH2	2413.5MHz	CH8	2434.5MHz	CH14	2455.5MHz	CH20	2477MHz
CH3	2417MHz	CH9	2438MHz	CH15	2459MHz		
CH4	2420.5MHz	CH10	2441.5MHz	CH16	2462.5MHz		
CH5	2424MHz	CH11	2445MHz	CH17	2466MHz		
CH6	2427.5MHz	CH12	2448.5MHz	CH18	2469.5MHz		

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)	2410MHz	2441.5MHz	2477MHz
Receiving (GFSK)	2410MHz	2441.5MHz	2477MHz

4.6 Test Environment

Humidity(%):	54
Atmospheric Pressure(kPa):	101
Normal Voltage(AC):	120V
Normal Temperature(°C)	23
Low Temperature(°C)	0
High Temperature(°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, Xinhua 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.

5.2 Test Instrument Used

No.	Equipment	Manufacturer	Type No.	Serial No.	Firmware Version	Calibrated until
1	Spectrum Analyzer	Agilent	N9020A	MY52090073	A.14.16	2025/6/28
2	Power Sensor	Agilent	U2021XA	MY56120032	/	2025/6/28
3	Power Sensor	Agilent	U2021XA	MY56120034	/	2025/6/28
4	Communication test set	R&S	CMW500	108058	V3.5.80	2025/6/28
5	Spectrum Analyzer	KEYSIGHT	N9020A	MY51289897	A.14.16	2025/6/28
6	Signal Generator	Agilent	N5181A	MY50140365	A.01.60	2025/6/28
7	Vector signal generator	Agilent	N5182A	MY47420195	A.01.87	2025/6/28
8	Communication test set	Agilent	E5515C	MY50102567	B.19.07 (E1962B)	2025/6/28
9	2.4 GHz Filter	Shenxiang	MSF2400-24 83.5MS-1154	20181015001	/	2025/6/30
10	5 GHz Filter	Shenxiang	MSF5150-58 50MS-1155	20181015001	/	2025/6/30
11	Filter	Xingbo	XBLBQ-DZA 120	190821-1-1	/	2025/6/30
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	/	2025/6/28
14	Temperature humidity chamber	Hongjing	TH-80CH	DG-15174	/	2025/6/28
15	234G Automatic test software	Microwave	MTS8200	Ver. 2.0.0.0	/	/
16	966 chamber	C.R.T.	966	/	/	2027/6/21
17	Receiver	R&S	ESPI	100362	RF_ATTEN_7 (104489/003)	2025/6/28
18	Amplifier	HP	8447E	2945A02747	/	2025/6/28
19	Amplifier	Agilent	8449B	3008A01838	/	2025/6/28
20	TRILOG Broadband Antenna	Schwarzbeck	VULB 9168	00869	/	2025/6/28
21	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA9120D	01911	/	2025/6/28

22	EMI test software	Fala	EZ-EMC	FA-03A2 RE	/	/
23	Loop Antenna	Schwarzbeck	FMZB 1519B	1519B-224	/	2025/6/28
24	loop antenna	ZHINAN	ZN30900A	GTS534	/	/
25	40G Horn antenna	A/H/System	SAS-574	588	/	2025/6/28
26	Amplifier	AEROFLEX	Aeroflex	097	/	2025/6/28
27	Power Metter	KEYSIGHT	N1912AP	N/A	A.05.00	2025/6/28

Continuous disturbance

No.	Equipment	Manufacturer	Model No.	Serial No.	Firmware version	Calibrated until
1	843 Shield Room	C/ R/ T	843	/	/	2027/6/21
2	AMN	ROHDE&SCHWARZ	ESH3-Z5	831551852	/	2025/6/30
3	Pulse limiter	ROHDE&SCHWARZ	ESH3Z2	357881052	/	2025/6/28
4	EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI	100428	V4.42.SP3	2025/6/30
5	Coaxial cable	ZDECL	Z302S	18091904	/	2025/6/30
6	ISN	Schwarzbeck	NTFM8158	183	/	2025/6/30
7	Voltage sensor	Schwarzbeck	TK 9420	01189	/	2024/11/16
8	EZ-EMC	Frad	EMC-con3A1.1	/	/	/
9	Current Probe	FCC	F-52B	199453	/	2025/5/27
10	Communication test set	R&S	CMW500	108058	B.19.07 (E1962B)	2025/6/28
11	Communication test set	Agilent	E5515C	MY50102567	V3.5.80	2025/6/28

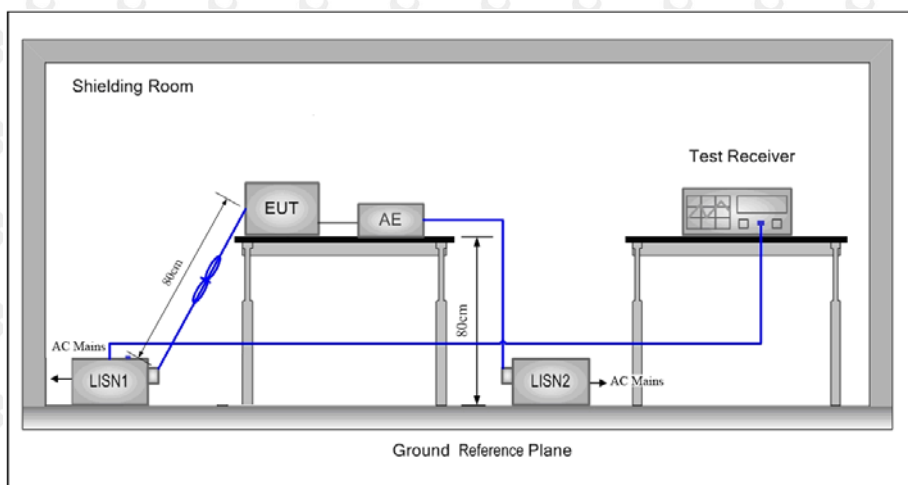
Radiated emission(No.2 Chamber)

No.	Equipment	Manufacturer	Model No.	Serial No.	Firmware version	Calibrated until
1	966 Chamber	C/ R/ T	966	/	/	2026/11/14
2	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA 9120 D	01911	/	2026/7/07
3	Broadband Antenna	Schwarzbeck	VULB 9168	1471	/	2025/7/06
4	Amplifier	Agilent	8449B	3008A01838	/	2025/6/30
5	Preamplifier	Schwarzbeck	BBV 9743 B	00500	/	2025/5/23
6	EMI TEST RECEIVER	R&S	ESCI7	100861	/	2024/11/27
7	Spectrum Analyzer	KEYSIGHT	N9020A	MY51289897	A.14.16	2025/6/28
8	EMI test software	Farad	EZ-EMC	/	Ver. FARAD-3A1+	/
9	Coaxial cable	Rosenberg	8m	/	/	2024/11/27
10	Coaxial cable	Times	2m	/	/	2024/11/27
11	Coaxial cable	Times	2m	/	/	2024/11/27

12	Coaxial cable	Times	1m	/	/	2024/11/27
13	loop antenna	Schwarzbeck	FMZB 1519B	1519B-224	/	2025/6/29
14	Communication test set	R&S	CMW500	108058	B.19.07 (E1962B)	2025/6/28
15	Communication test set	Agilent	E5515C	MY50102567	V3.5.80	2025/6/28

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

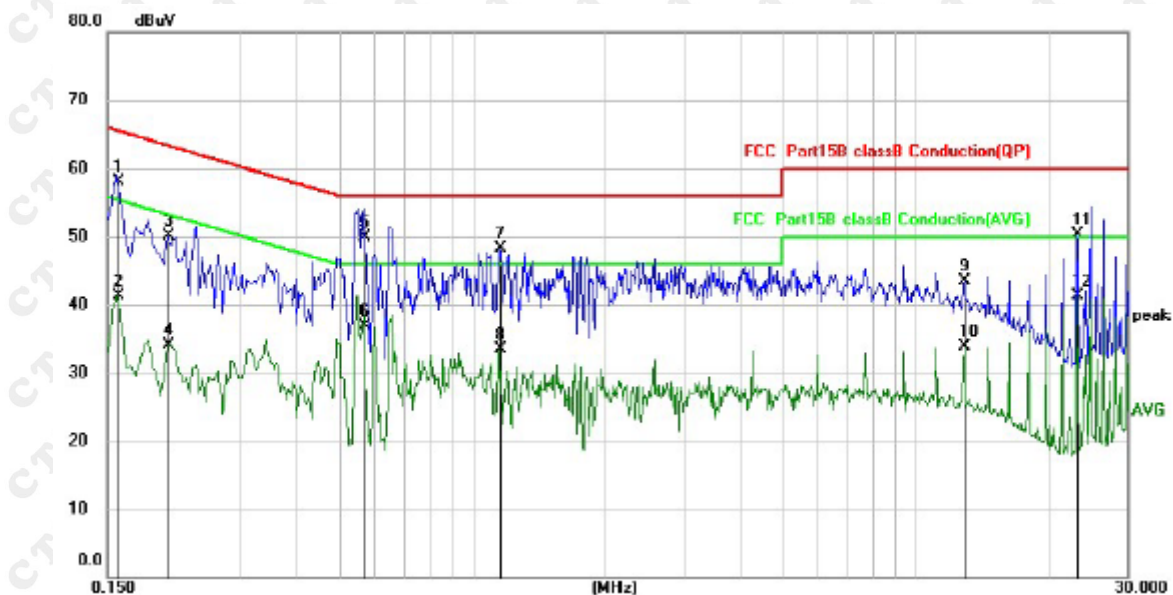
6.3 Test procedure

- 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 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: Worst case-GFSK(low channel)

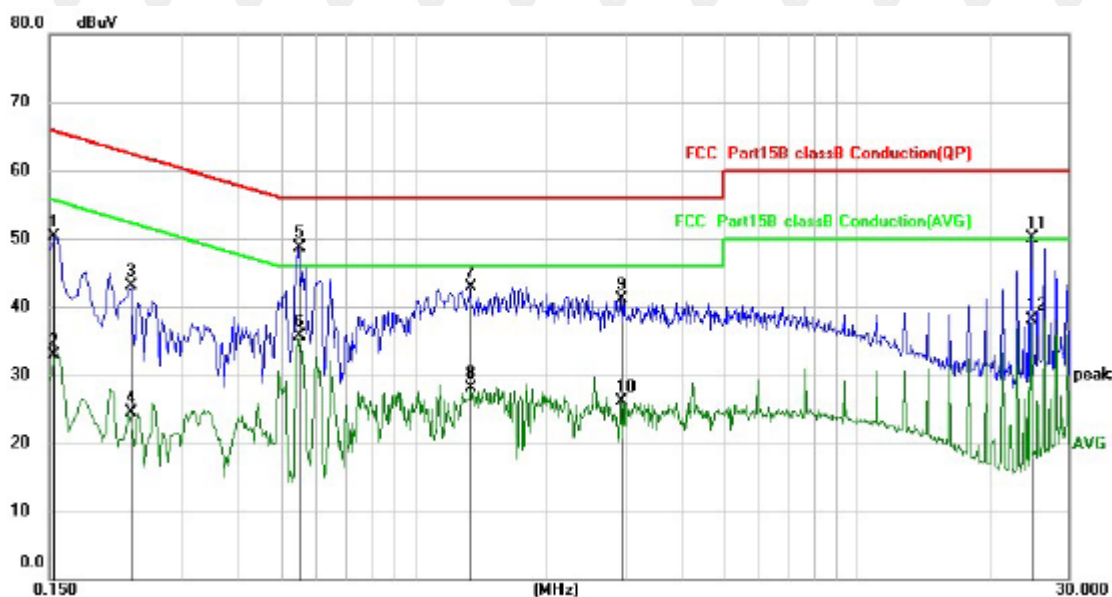


No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	
		MHz	Level	Factor	ment			Detector
			dBuV	dB	dBuV	dBuV	dB	
1		0.1582	47.22	10.86	58.08	65.56	-7.48	QP
2		0.1582	30.42	10.86	41.28	55.56	-14.28	AVG
3		0.2060	39.45	10.71	50.16	63.37	-13.21	QP
4		0.2060	23.37	10.71	34.08	53.37	-19.29	AVG
5	*	0.5700	39.36	10.58	49.94	56.00	-6.06	QP
6		0.5700	26.38	10.58	36.96	46.00	-9.04	AVG
7		1.1539	37.28	11.05	48.33	56.00	-7.67	QP
8		1.1539	22.55	11.05	33.60	46.00	-12.40	AVG
9		12.8540	30.21	13.30	43.51	60.00	-16.49	QP
10		12.8540	20.55	13.30	33.85	50.00	-16.15	AVG
11		23.1220	36.36	13.86	50.22	60.00	-9.78	QP
12		23.1220	27.38	13.86	41.24	50.00	-8.76	AVG

Remark:

Factor = Cable loss + LISN factor, Margin = Measurement – Limit
Measurement=Reading level+correct facto

N: Worst case-GFSK(low channel)



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector
1		0.1539	39.46	10.88	50.34	65.79	-15.45	QP
2		0.1539	21.97	10.88	32.85	55.79	-22.94	AVG
3		0.2300	32.32	10.69	43.01	62.45	-19.44	QP
4		0.2300	13.91	10.69	24.60	52.45	-27.85	AVG
5	*	0.5500	38.22	10.56	48.78	56.00	-7.22	QP
6		0.5500	25.24	10.56	35.80	46.00	-10.20	AVG
7		1.3420	31.69	11.17	42.86	56.00	-13.14	QP
8		1.3420	16.90	11.17	28.07	46.00	-17.93	AVG
9		2.9340	29.28	11.79	41.07	56.00	-14.93	QP
10		2.9340	14.32	11.79	26.11	46.00	-19.89	AVG
11		24.7420	36.03	14.00	50.03	60.00	-9.97	QP
12		24.7420	24.17	14.00	38.17	50.00	-11.83	AVG

Remark:

Factor = Cable loss + LISN factor, Margin = Measurement – Limit
Measurement=Reading level+correct facto

7. RADIATED SPURIOUS EMISSION

7.1 Block Diagram Of Test Setup

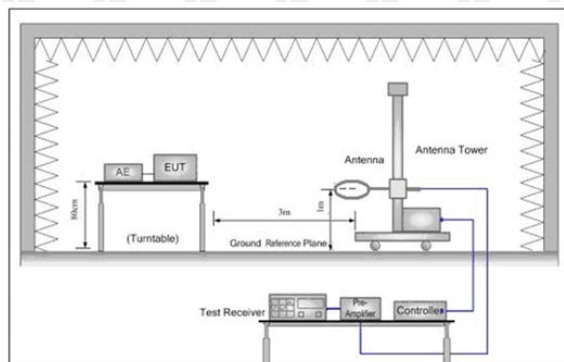


Figure 1. Below 30MHz

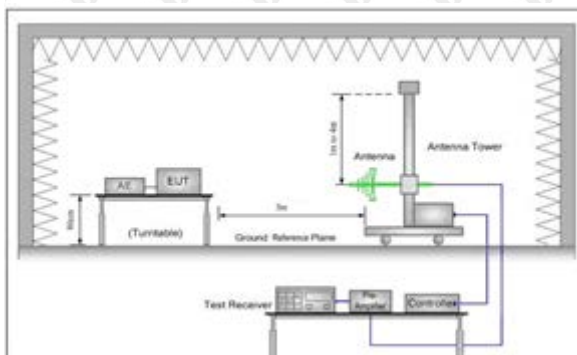


Figure 2. 30MHz to 1GHz

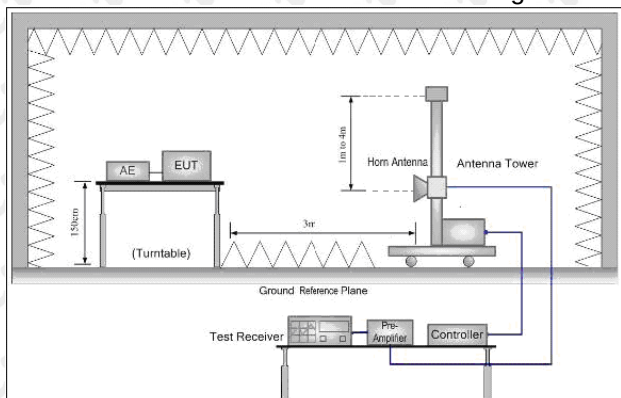


Figure 3. Above 1GHz

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:

- 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:

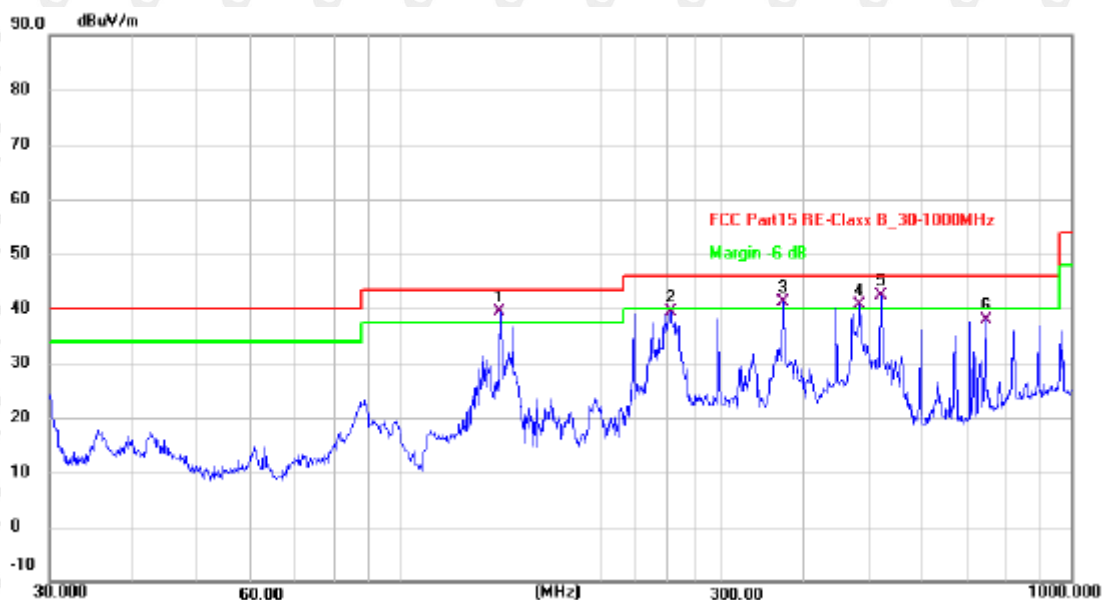
Frequency	Detector	RBW	VBW	Remark
0.009MHz-0.090MHz	Peak	10kHz	30KHz	Peak
0.009MHz-0.090MHz	Average	10kHz	30KHz	Average
0.090MHz-0.110MHz	Quasi-peak	10kHz	30KHz	Quasi-peak
0.110MHz-0.490MHz	Peak	10kHz	30KHz	Peak
0.110MHz-0.490MHz	Average	10kHz	30KHz	Average
0.490MHz -30MHz	Quasi-peak	10kHz	30KHz	Quasi-peak
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

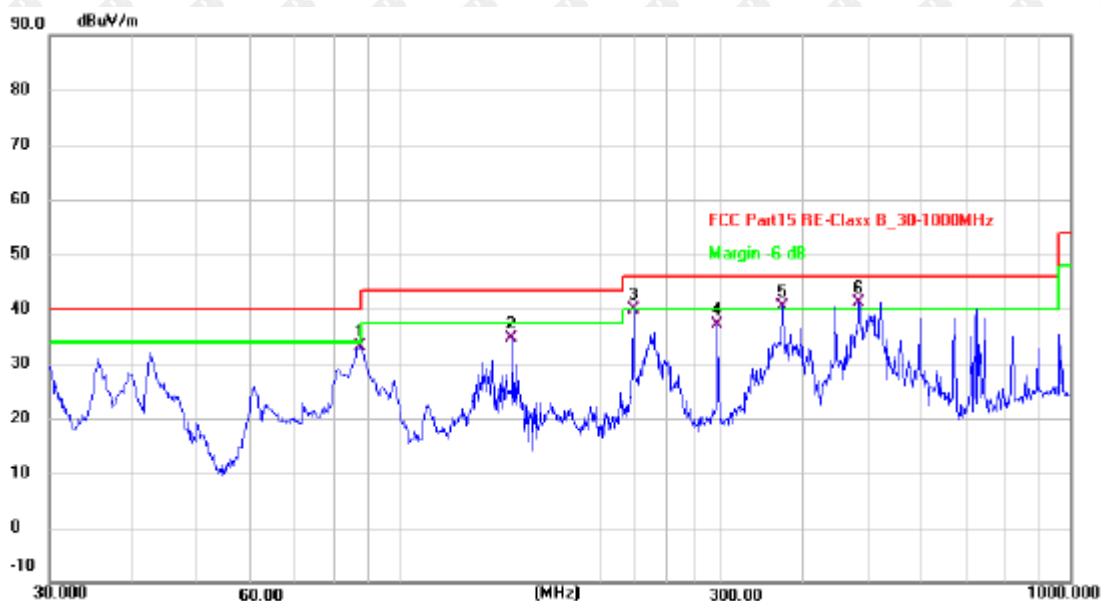
Worst case-GFSK(low channel)



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1 !	141.3296	53.48	-14.19	39.29	43.50	-4.21	QP
2	252.9481	55.67	-16.25	39.42	46.00	-6.58	QP
3 !	372.0045	54.02	-12.80	41.22	46.00	-4.78	QP
4 !	483.9094	50.28	-9.77	40.51	46.00	-5.49	QP
5 *	520.8881	51.10	-8.69	42.41	46.00	-3.59	QP
6	744.8660	42.01	-4.21	37.80	46.00	-8.20	QP

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

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



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	87.1116	51.59	-18.43	33.16	40.00	-6.84	QP
2	146.8876	48.21	-13.51	34.70	43.50	-8.80	QP
3	222.9502	56.68	-16.75	39.93	46.00	-6.07	QP
4	297.2240	50.97	-13.92	37.05	46.00	-8.95	QP
5 !	372.0045	53.08	-12.80	40.28	46.00	-5.72	QP
6 *	483.9094	50.98	-9.77	41.21	46.00	-4.79	QP

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

Above 1 GHz Test Results:

CH Low (2410MHz)

Horizontal:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4820	58.22	-3.65	54.57	74.00	-19.43	peak
4820	49.09	-3.65	45.44	54.00	-8.56	AVG
7230	60.26	-0.95	59.31	74.00	-14.69	peak
7230	42.53	-0.95	41.58	54.00	-12.42	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)	
4820	58.88	-3.65	55.23	74.00	-18.77	peak
4820	48.25	-3.65	44.60	54.00	-9.40	AVG
7230	59.97	-0.95	59.02	74.00	-14.98	peak
7230	40.03	-0.95	39.08	54.00	-14.92	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Emission level = Reading Result + Factor, Margin = Emission level - Limits						

CH Middle (2441.5MHz)

Horizontal:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4883.00	57.74	-3.54	54.20	74.00	-19.80	peak
4883.00	48.62	-3.54	45.08	54.00	-8.92	AVG
7324.50	56.76	-0.81	55.95	74.00	-18.05	peak
7324.50	42.14	-0.81	41.33	54.00	-12.67	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)	
4883.00	58.00	-3.54	54.46	74.00	-19.54	peak
4883.00	49.47	-3.54	45.93	54.00	-8.07	AVG
7324.50	58.02	-0.81	57.21	74.00	-16.79	peak
7324.50	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						

CH High (2477MHz)

Horizontal:

Frequency	Reading Result	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4954	57.15	-3.43	53.72	74.00	-20.28	peak
4954	50.02	-3.44	46.58	54.00	-7.42	AVG
7431	61.31	-0.77	60.54	74.00	-13.46	peak
7431	41.60	-0.77	40.83	54.00	-13.17	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)	
4954	58.83	-3.43	55.40	74.00	-18.60	peak
4954	48.29	-3.44	44.85	54.00	-9.15	AVG
7431	59.94	-0.77	59.17	74.00	-14.83	peak
7431	41.84	-0.77	41.07	54.00	-12.93	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Emission level = Reading Result + Factor, Margin = Emission level - Limits						

The test range is 9K ~10 times the main wave, and other spurious below the limit of 20dB will not be reflected in the report

Restricted bands around fundamental frequency (Radiated)

hopping

Operation Mode: TX CH Low (2410MHz)

Horizontal (Worst case-GFSK)

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2310.00	58.30	-5.81	52.49	74.00	-21.51	peak
2310.00	/	-5.81	/	54.00	/	AVG
2390.00	54.64	-5.84	48.80	74.00	-25.20	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	57.16	-5.81	51.35	74.00	-22.65	peak
2310.00	/	-5.81	/	54.00	/	AVG
2390.00	56.35	-5.84	50.51	74.00	-23.49	peak
2390.00	/	-5.84	/	54.00	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

When the peak value is smaller than the AVG limit, AVG is not reflected.

Operation Mode: TX CH High (2477MHz)
Horizontal (Worst case-GFSK)

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	55.80	-5.81	49.99	74.00	-24.01	peak
2483.50	/	-5.81	/	54.00	/	AVG
2500.00	54.92	-6.06	48.86	74.00	-25.14	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	56.83	-5.81	51.02	74.00	-22.98	peak
2483.50	/	-5.81	/	54.00	/	AVG
2500.00	54.66	-6.06	48.60	74.00	-25.40	peak
2500.00	/	-6.06	/	54.00	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

When the peak value is smaller than the AVG limit, AVG is not reflected.

NO hopping

Operation Mode: TX CH Low (2410MHz)
Horizontal (Worst case-GFSK)

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2310.00	55.92	-5.81	50.11	74.00	-23.89	peak
2310.00	/	-5.81	/	54.00	/	AVG
2390.00	54.30	-5.84	48.46	74.00	-25.54	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	54.89	-5.81	49.08	74.00	-24.92	peak
2310.00	/	-5.81	/	54.00	/	AVG
2390.00	53.63	-5.84	47.79	74.00	-26.21	peak
2390.00	/	-5.84	/	54.00	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

When the peak value is smaller than the AVG limit, AVG is not reflected.

Operation Mode: TX CH High (2477MHz)
Horizontal (Worst case-GFSK)

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	56.87	-5.81	51.06	74.00	-22.94	peak
2483.50	/	-5.81	/	54.00	/	AVG
2500.00	54.61	-6.06	48.55	74.00	-25.45	peak
2500.00	/	-6.06	/	54.00	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

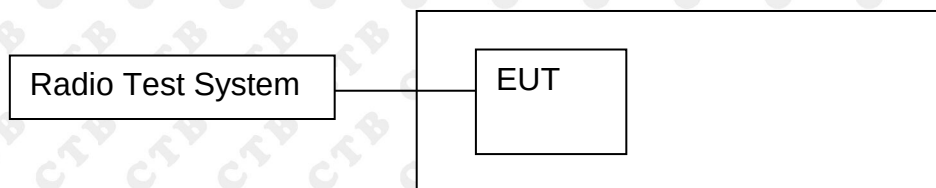
Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	55.23	-5.81	49.42	74.00	-24.58	peak
2483.50	/	-5.81	/	54.00	/	AVG
2500.00	55.06	-6.06	49.00	74.00	-25.00	peak
2500.00	/	-6.06	/	54.00	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

When the peak value is smaller than the AVG limit, AVG is not reflected.

8. BAND EDGE AND RF CONDUCTED SPURIOUS EMISSIONS

8.1 Block Diagram Of Test Setup



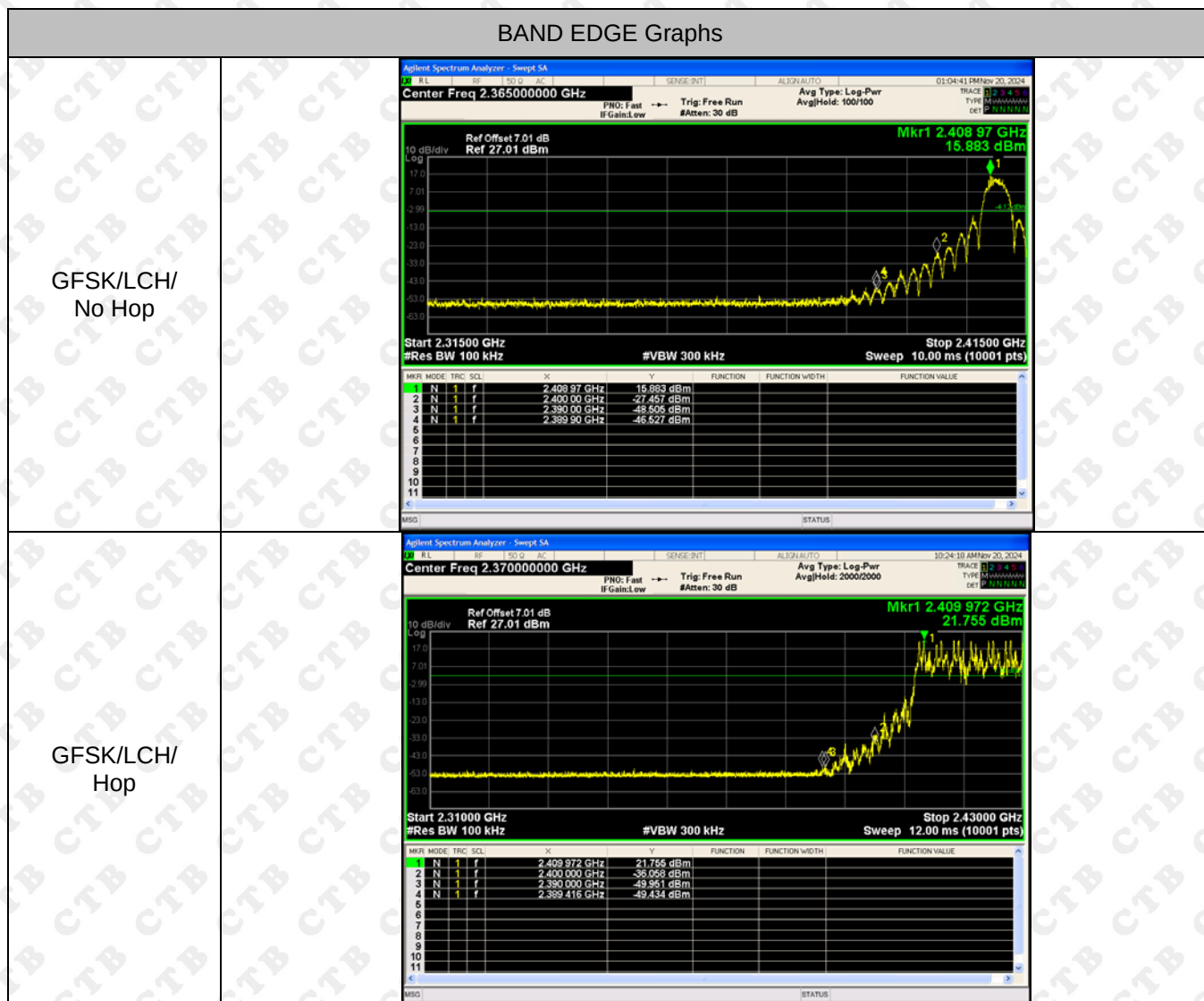
8.2 Limit

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)).

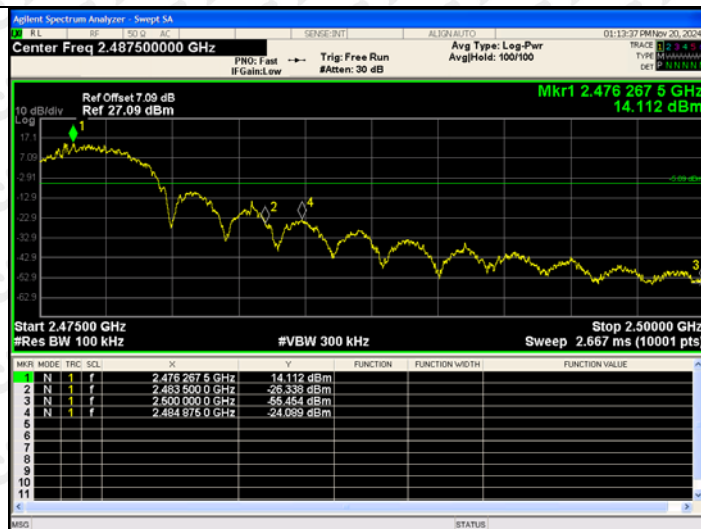
8.3 Test procedure

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

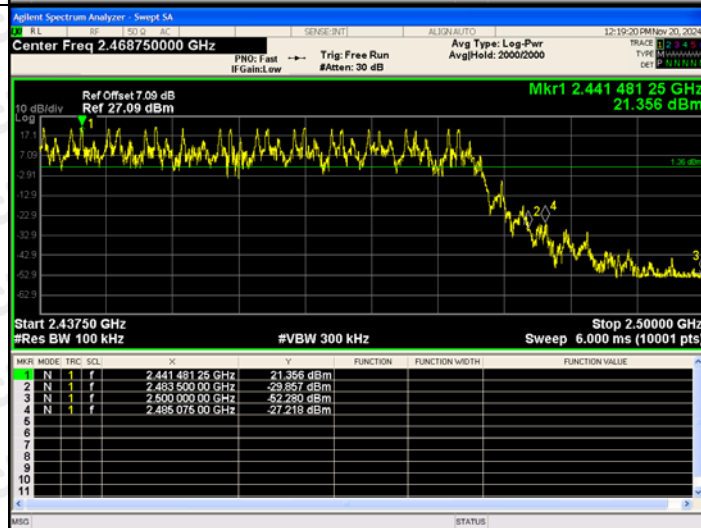
8.4 Test Result



GFSK/HCH/
No Hop

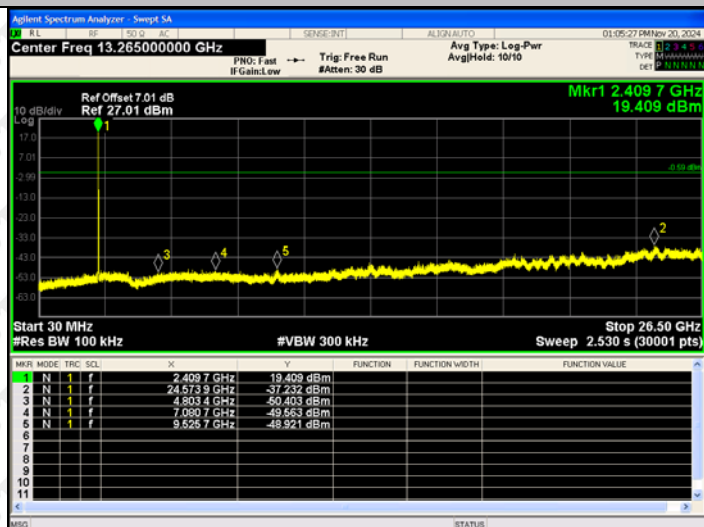


GFSK/HCH/
Hop

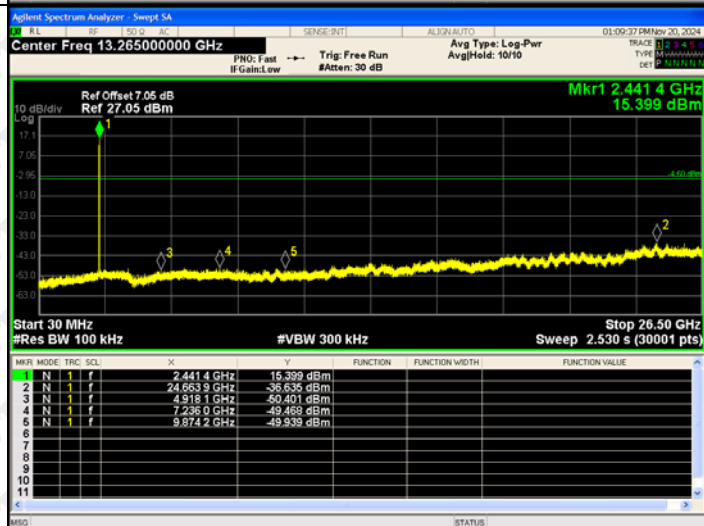


RF Conducted Spurious Emissions Graphs

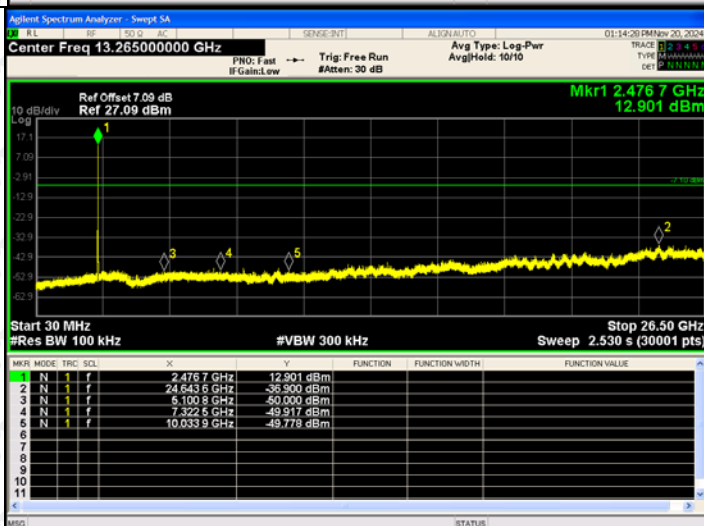
GFSK/LCH



GFSK/MCH

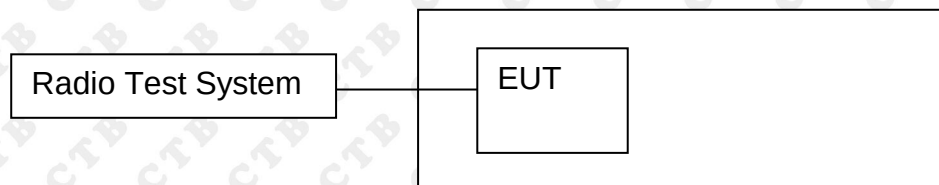


GFSK/HCH



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.

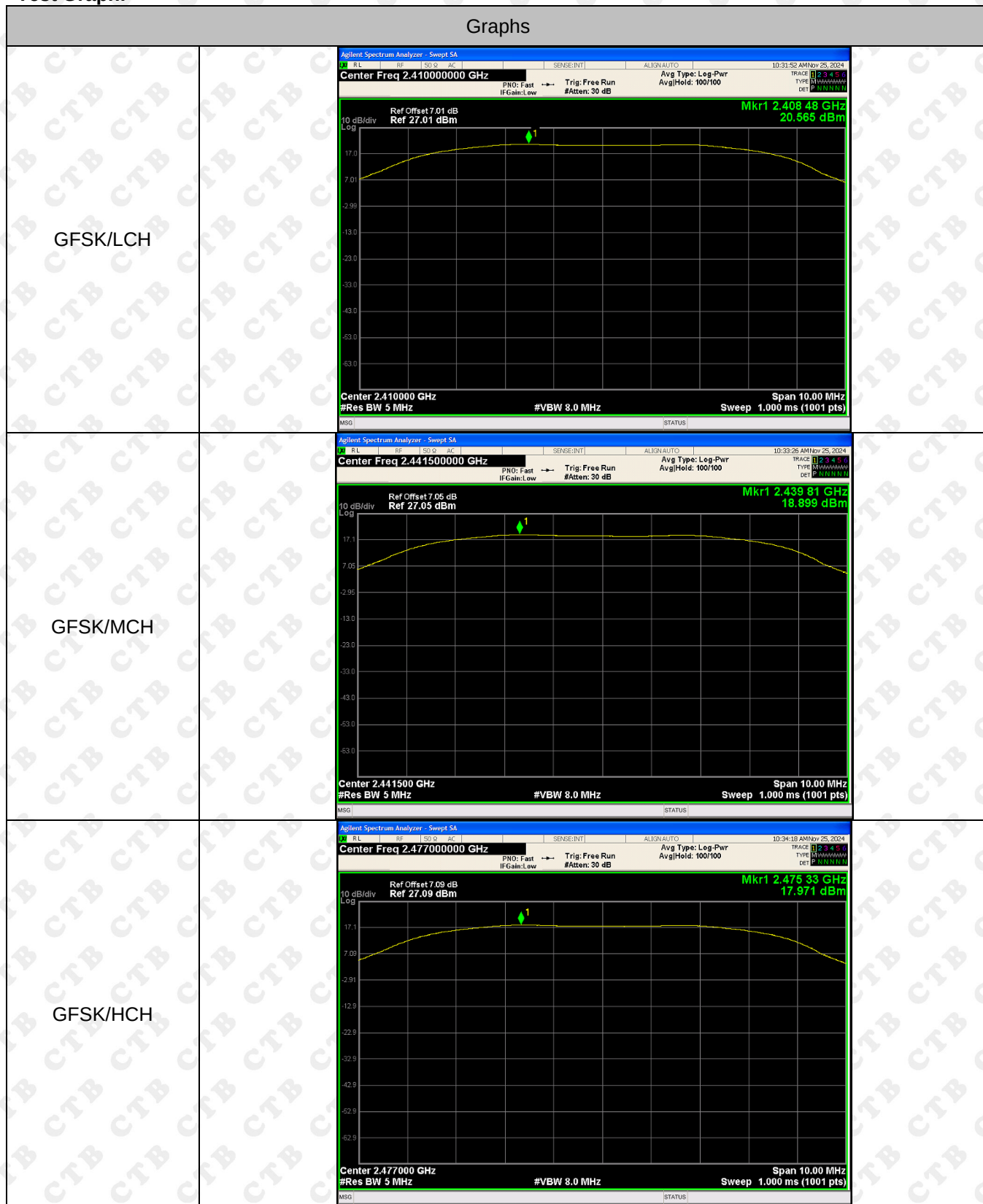
9.3 Test procedure

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 = 5MHz. 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

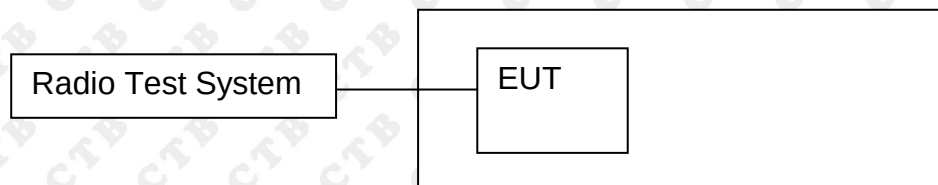
Mode	Channel.	Maximum Peak Output Power [dBm]	Limit [dBm]	Verdict
2.4GHz (GFSK)	LCH	20.565	20.97	PASS
	MCH	18.899	20.97	PASS
	HCH	17.971	20.97	PASS

Test Graph:



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

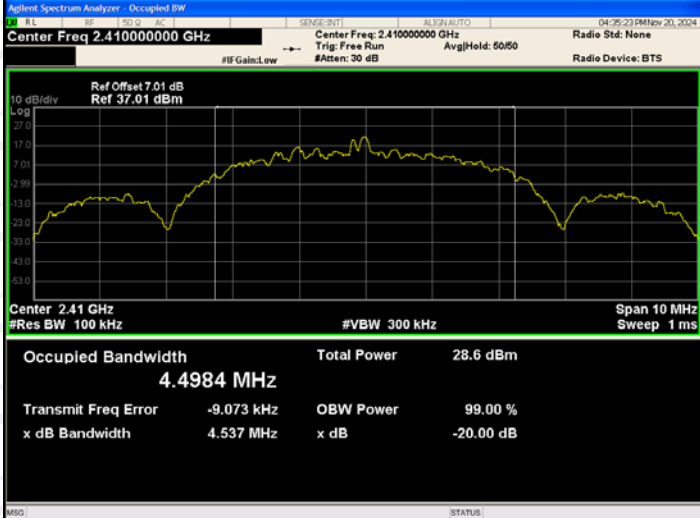
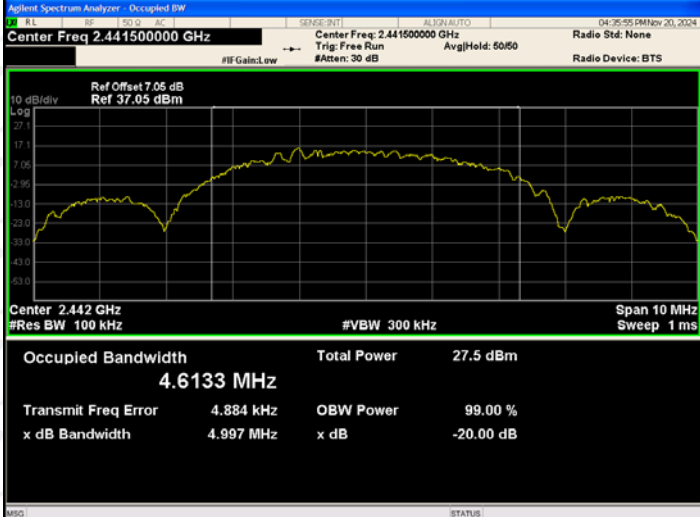
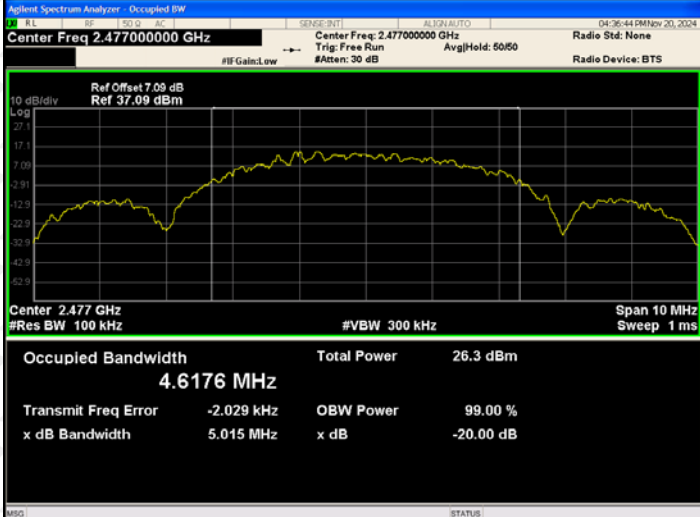
1. Rem1. Set RBW = 30 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 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	4.537	PASS
	Mid channel	4.997	PASS
	High channel	5.015	PASS

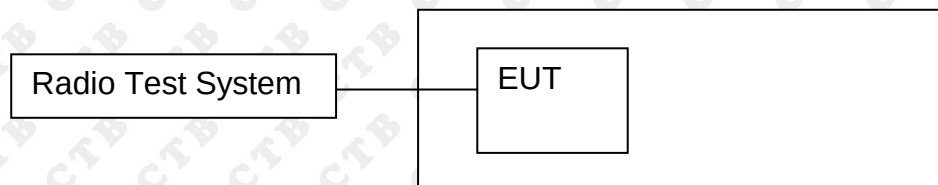
Note: All modes of operation were Pre-scan and the worst-case emissions are reported.

Test Graph:

GFSK Low channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq 2.41000000 GHz Ref Offset 7.01 dB Ref 37.01 dBm Center 2.41 GHz #Res BW 100 kHz Occupied Bandwidth 4.4984 MHz Total Power 28.6 dBm Transmit Freq Error -9.073 kHz x dB Bandwidth 4.537 MHz OBW Power 99.00 % x dB -20.00 dB
GFSK Mid channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq 2.44150000 GHz Ref Offset 7.05 dB Ref 37.05 dBm Center 2.442 GHz #Res BW 100 kHz Occupied Bandwidth 4.6133 MHz Total Power 27.5 dBm Transmit Freq Error 4.884 kHz x dB Bandwidth 4.997 MHz OBW Power 99.00 % x dB -20.00 dB
GFSK High channel	 Agilent Spectrum Analyzer - Occupied BW Center Freq 2.47700000 GHz Ref Offset 7.09 dB Ref 37.09 dBm Center 2.477 GHz #Res BW 100 kHz Occupied Bandwidth 4.6176 MHz Total Power 26.3 dBm Transmit Freq Error -2.029 kHz x dB Bandwidth 5.015 MHz OBW Power 99.00 % x dB -20.00 dB

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.

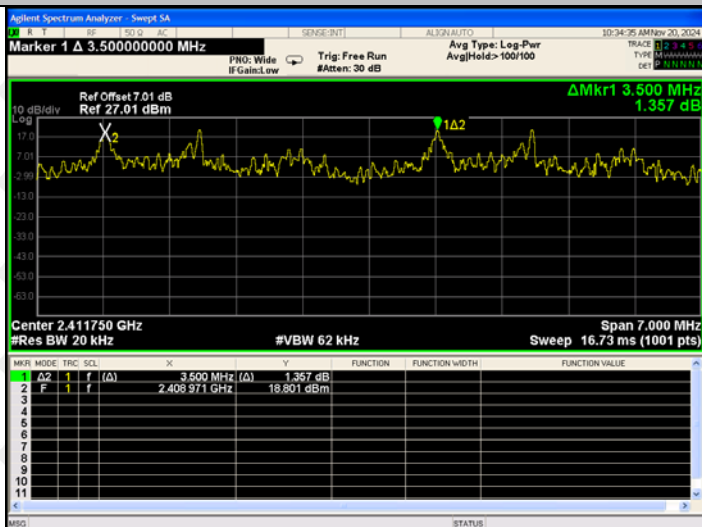
11.4 Test Result

Mode	Channel.	Carrier Frequency Separation [MHz]	Limit(2/3 of the 20dB bandwidth MHz)	Verdict
GFSK	LCH	3.500	3.025	PASS
GFSK	MCH	3.500	3.331	PASS
GFSK	HCH	4.004	3.343	PASS

Test Graph

Graphs

GFSK/LCH



GFSK/MCH

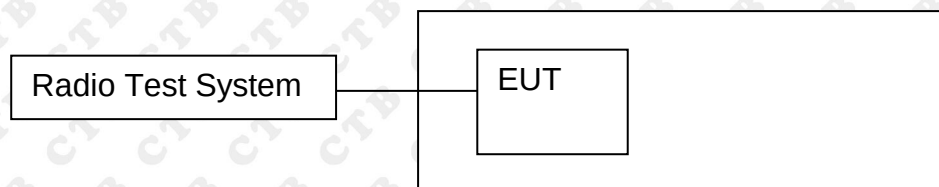


GFSK/HCH



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;

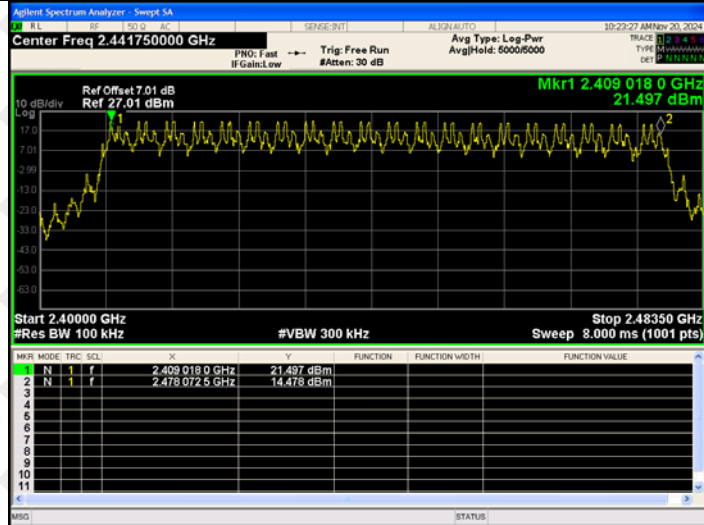
12.4 Test Result

Mode	Channel.	Number of Hopping Channel	Limit	Verdict
GFSK	Hop	20	≥ 15	PASS

Test Graph

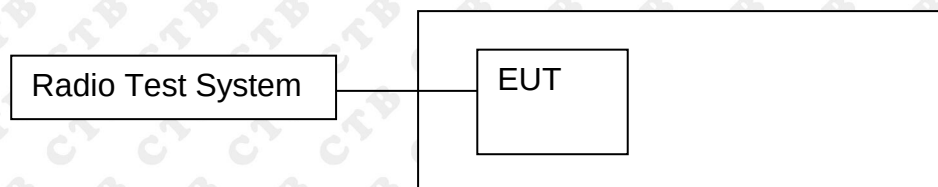
Graphs

GFSK/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

Worst case-GFSK:

Mode	Channel	Pulse Time (ms)	Total Dwell Time (ms)	Limit (ms)	Verdict
GFSK	LCH	0.383	130.986	400	PASS
	MCH	0.383	130.986	400	PASS
	HCH	0.384	131.328	400	PASS

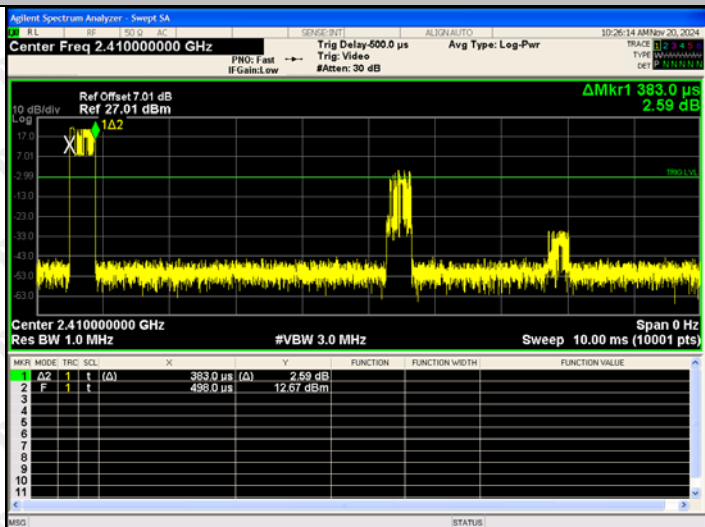
Remark: Total Dwell Time= Pulse Time*n

Sweep time=0.4*20=8s

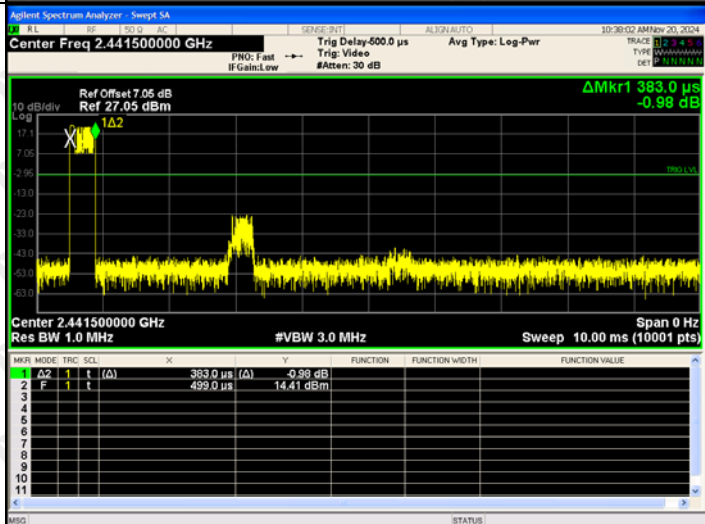
Test Graph

Graphs

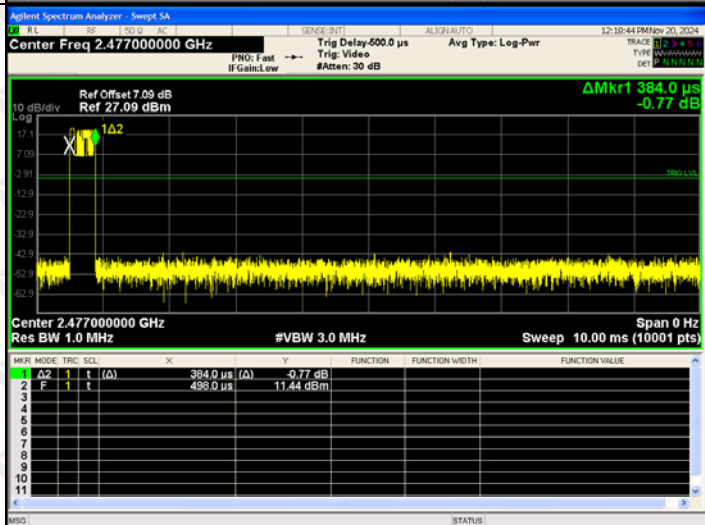
GFSK /LCH



GFSK /MCH

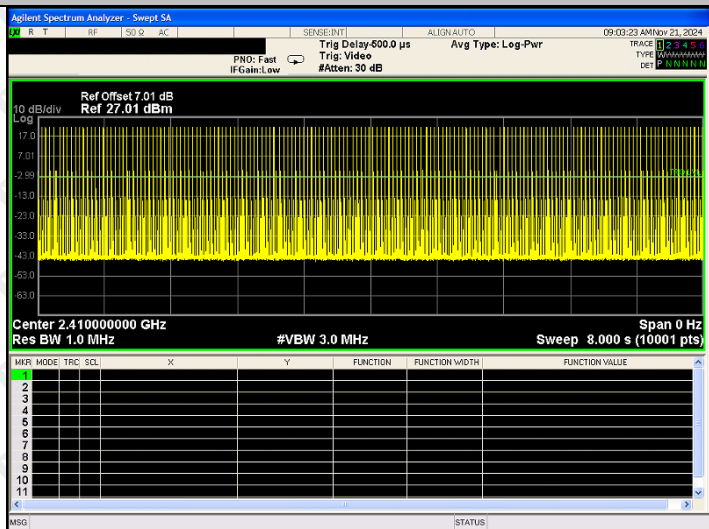


GFSK /HCH



Graphs

GFSK



14. PSEUDORANDOM FREQUENCY

14.1 Limit

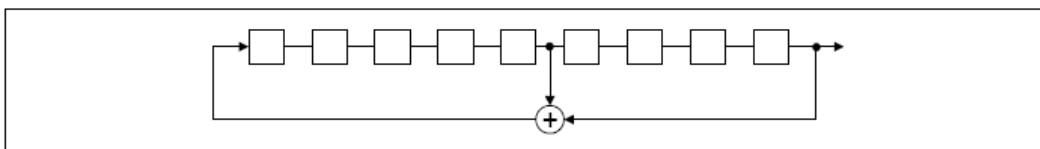
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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.

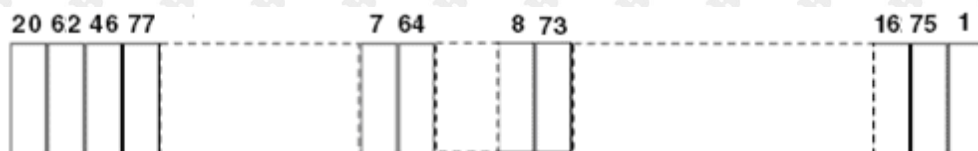
14.2 Test procedure

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.

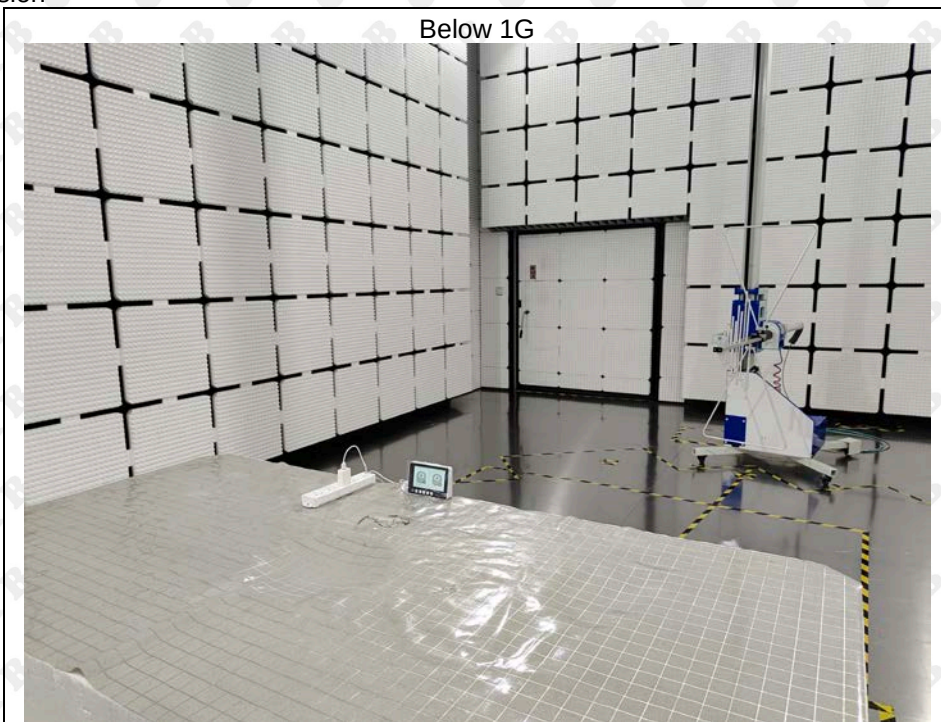
EUT Antenna:

The antenna is FPC antenna. The best case gain of the antenna is 1.9dBi.

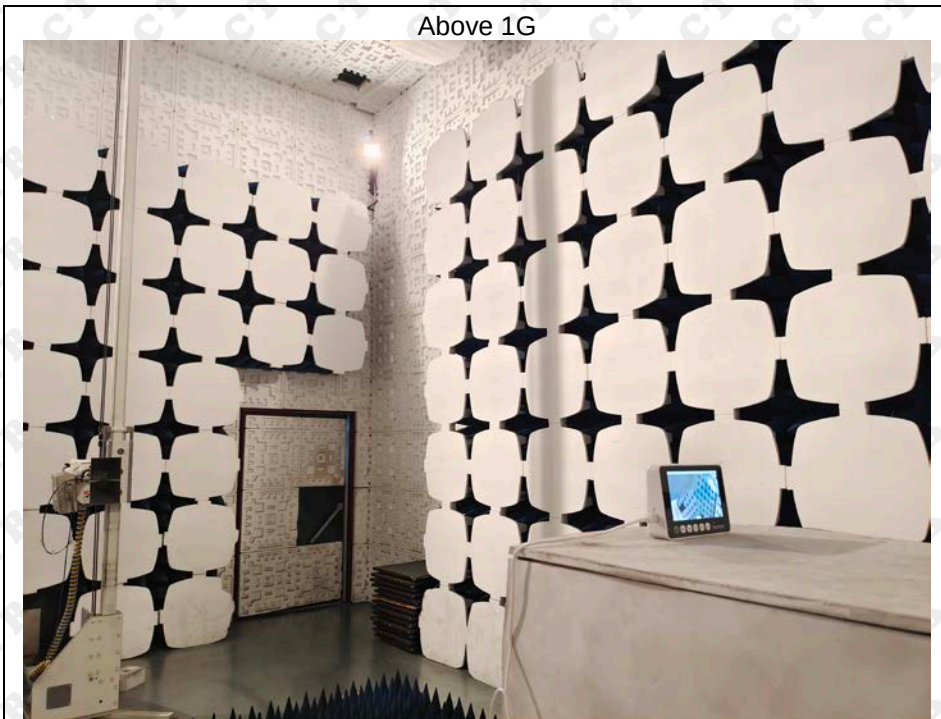
16. EUT TEST SETUP PHOTOGRAPHS

Radiated Emission

Below 1G



Above 1G



Conducted emissions



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