Microtest
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Test Report

Report No.: MTi220613003-01E1

Date of issue: 2022-06-27

Applicant:

Product: RGB Bluetooth speaker

Model(s): P329.42,

Shenzhen Microtest Co., Ltd.
http://www.mtitest.com

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Instructions

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2. The test results in this test report are only responsible for the samples submitted

3. This test report is invalid without the seal and signature of the laboratory.

4. This test report is invalid if transferred, altered, or tampered with in any form without authorization.

5. Any objection to this test report shall be submitted to the laboratory within 15 days from the date of receipt of the report.

Contents

Test Result Certification	
Applicant:	
Address:	
Manufacturer:	
Address:	
Product description	
Product name:	RGB Bluetooth speaker
Trademark:	N/A
Model name:	P329.42
Serial Model:	EBS-211056
Standards:	ETSI EN 300 328 V2.2.2 (2019-07)
Date of Test	
Date of test:	2022-06-17 ~ 2022-06-27
Test result:	Pass

Test Engineer : David. Lee

(David Lee)

Reviewed By: : Leon chen

(Leon Chen)

Approved By: : Tom Xue

(Tom Xue)

1 General Description

1.1 Description of EUT

Product name:	RGB Bluetooth speaker
Model name:	P329.42
Series Model:	
Model difference:	All the models are the same circuit and module, except the model name.
Accessories:	Cable: USB-A to Micro Cable 50cm
Electrical rating:	Input: DC 5V/1A
Hardware version:	HF-9552-65E-NTC-V1
Software version:	AC696N-SDK-V1.3.0
Battery:	DC 3.7V 1200mAh
RF specification	
Bluetooth version:	V5.2
Operating frequency range:	2402MHz - 2480MHz
Channel number:	79 channels
Modulation type:	GFSK, π/4-DQPSK
Antenna designation:	PCB antenna, antenna Gain: 0.6 dBi

1.2 Description of test modes

1.2.1 Operation channel list

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461	-	-

1.2.2 Test frequency channel

Chanel	Frequency
Lowest (CH0)	2402MHz
Middle (CH39)	2441MHz
Highest (CH78)	2480MHz

Note: The test software has been used to control EUT for working in engineering mode, that enables selectable channel, and capable of continuous transmitting and constant receiving mode.

1.3 Environmental conditions for testing

For normal test conditions:

Temperature:	15ºC~35ºC
Humidity:	20 % RH ~ 75 % RH
Atmospheric pressure:	98 kPa~101 kPa

For extreme test conditions

Test Conditions	Normal	N.V.L.T.	N.V.H.T.
Temperature (℃)	25	-20	50
Power supply	DC 3.7V from battery		
Note1: The extremes of the operating temperature ranges are declared by the manufacture. **Note2:** N.V.L.T. is the abbreviation of normal voltage lowest temperature; N.V.H.T. is the abbreviation of normal voltage highest temperature.			

1.4 Description of support units

Support equipment list			
Description	Model	Serial No.	Manufacturer
/	/	/	/

1.5 Measurement uncertainty

Parameter	Measurement uncertainty
Occupied channel bandwidth	±3 %
RF output power, conducted	±1 dB
Power Spectral Density, conducted	±1 dB
Unwanted Emissions, conducted	±1 dB
All emissions, radiated	±4.7 dB
Temperature	±1 °C
Supply voltages	±1 %
Time	±1 %

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

2 Summary of Test Result

No.	Description of Test	Reference clause No.	Result
1	RF Output Power	4.3.1.2	Pass
2	Accumulated Transmit time, Frequency Occupation & Hopping Sequence	4.3.1.4	Pass
3	Hopping Frequency Separation	4.3.1.5	Pass
4	Adaptivity	4.3.1.7	N/A
5	Occupied Channel Bandwidth	4.3.1.8	Pass
6	Transmitter unwanted emissions in the OOB domain	4.3.1.9	Pass
7	Transmitter unwanted emissions in the spurious domain	4.3.1.10	Pass
8	Receiver spurious emissions	4.3.1.11	Pass
9	Receiver Blocking	4.3.1.12	Pass
10	Geo-location capability	4.3.1.13	N/A

Note: N/A means not applicable.

3 Test Facilities and Accreditations

3.1 Test laboratory

Test laboratory:	Shenzhen Microtest Co., Ltd.
Test site location:	101, No. 7, Zone 2, Xinxing Industrial Park, Fuhai Avenue, Xinhe Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Telephone:	(86-755)88850135
Fax:	(86-755)88850136
CNAS Registration No.:	CNAS L5868

4 List of Test Equipment

No.	Equipment	Manufacturer	Model	Serial No.	Cal. date	Cal. Due
MTI-E043	EMI test receiver	R&S	ESCI7	101166	2022/05/05	2023/05/04
MTI-E044	Broadband antenna	Schwarzbeck	VULB9163	9163-1338	2021/05/30	2023/05/29
MTI-E045	Horn antenna	Schwarzbeck	BBHA9120D	9120D-2278	2021/05/30	2023/05/29
MTI-E047	Pre-amplifier	Hewlett-Packard	8447F	3113A06184	2022/05/05	2023/05/04
MTI-E048	Pre-amplifier	Agilent	8449B	3008A01120	2022/05/05	2023/05/04
MTi-E120	Broadband antenna	Schwarzbeck	VULB9163	9163-1419	2021/05/30	2023/05/29
MTi-E121	Pre-amplifier	Hewlett-Packard	8447D	2944A09365	2022/04/15	2023/04/14
MTi-E123	Pre-amplifier	Agilent	8449B	3008A04723	2022/05/05	2023/05/04
MTi-E057	Wideband Radio Communication Tester	R&S	CMW500	149155	2022/05/05	2023/05/04
MTi-E058	ESG Series Analog Signal Generator	Agilent	E4421B	GB40051240	2022/05/05	2023/05/04
MTi-E062	PXA Signal Analyzer	Agilent	N9030A	MY51350296	2022/05/05	2023/05/04
MTi-E065	DC Power Supply	Agilent	E3632A	MY40027695	2022/05/05	2023/05/04
MTi-E066	MXA Signal Analyzer	Agilent	N9020A	MY50143483	2022/05/05	2023/05/04
MTi-E067	RF Control Unit	Tonscend	JS0806-1	19D8060152	2022/05/05	2023/05/04
MTi-E068	RF Control Unit	Tonscend	JS0806-2	19D8060153	2022/05/05	2023/05/04
MTi-E069	Band Reject Filter Group	Tonscend	JS0806-F	19D8060160	2022/05/05	2023/05/04
MTi-E071	ESG Vector Signal Generator	Agilent	N5182A	MY50143762	2022/05/05	2023/05/04
MTI-E014S	RF Test System	Tonscend	TS®JS1120 V2.6.88.0330	/	/	/

5 Test Result

5.1 RF output power

5.1.1 Description

The RF output power is defined as the mean equivalent isotopically radiated power (e.i.r.p.) of the equipment during a transmission burst.

5.1.2 Limits

The RF output power for FHSS equipment shall be equal to or less than 20 dBm.
This limit shall apply for any combination of power level and intended antenna assembly.

5.1.3 Test method

See clause 5.4.2 of EN 300 328.

5.1.4 Test result

Test modes	Test conditions	RF output power (e.i.r.p.) (dBm)		
		Lowest channel	Middle channel	Highest channel
GFSK (DH5)	Normal	-0.95	-0.96	-0.95
	N.V.L.T.	-0.98	-1.00	-1.00
	N.V.H.T.	-1.02	-1.01	-1.02
π/4-DQPSK (2DH5)	Normal	-2.33	-2.29	-2.29
	N.V.L.T.	-2.35	-2.33	-2.34
	N.V.H.T.	-2.39	-2.34	-2.39
Limit (dBm)		**20**		

Notes:

RF output power (dBm) = the highest of P_{burst} (dBm) + antenna gain (dBi).
The offset of cable loss and antenna gain has been in compensation during the testing.

5.2 Accumulated Transmit time, Frequency Occupation & Hopping Sequence

5.2.1 Description

The Accumulated Transmit Time is the total of the transmitter 'on'-times, during an observation period, on a particular hopping frequency.

The Frequency Occupation is the number of times that each hopping frequency is occupied within a given period. A hopping frequency is considered to be occupied when the equipment selects that frequency from the Hopping Sequence. FHSS equipment may be transmitting, receiving or stay idle during the dwell time spent on that hopping frequency.

The Hopping Sequence of a FHSS equipment is the pattern of the hopping frequencies used by the equipment.

5.2.2 Limits

Adaptive FHSS equipment shall be capable of operating over a minimum of 70 % of the band specified in table 1.

The Accumulated Transmit Time on any hopping frequency shall not be greater than 400 ms within any observation period of 400 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.

In order for the FHSS equipment to comply with the Frequency Occupation requirement, it shall meet either of the following two options:
Option 1: Each hopping frequency of the Hopping Sequence shall be occupied at least once within a period not exceeding four times the product of the dwell time and the number of hopping frequencies in use.
Option 2: The occupation probability for each frequency shall be between ((1 / U) × 25 %) and 77 % where U is the number of hopping frequencies in use.

The Hopping Sequence(s) shall contain at least N hopping frequencies at all times, where N is either 15 or the result of 15 MHz divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.

NOTE: See also clause 4.3.1.5.3.2 for the Hopping Frequency Separation applicable to adaptive FHSS equipment.

For Adaptive FHSS equipment, from the N hopping frequencies defined above, the equipment shall consider at least one hopping frequency for its transmissions. Providing that there is no interference present on this hopping frequency with a level above the detection threshold defined in clause 4.3.1.7.2.2, point 5 or clause 4.3.1.7.3.2, point 5, then the equipment shall have transmissions on this hopping frequency. For Adaptive FHSS equipment using LBT, if a signal is detected during the CCA, the equipment may jump immediately to the next hopping frequency in the Hopping Sequence (see clause 4.3.1.7.2.2, point 2) provided the limit for Accumulated Transmit Time on the new hopping frequency is respected.

5.2.3 Test method

See clause 5.4.4 of EN 300 328.

5.2.4 Test result

Accumulated Transmit time:

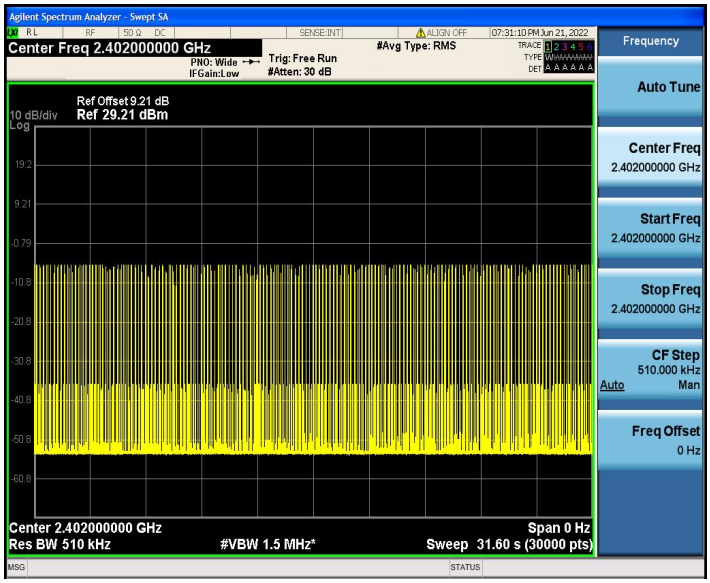
Test modes	Data Packet	Frequency (MHz)	Accumulated Transmit time (ms)	Limit (ms)
GFSK	DH1	Hop_2402	337.088	≤ 400
	DH3		255.976	
	DH5		309.7	
	DH1	Hop_2480	336.035	
	DH3		246.496	
	DH5		298.112	
π/4-DQPSK	2DH1	Hop_2402	337.088	
	2DH3		283.365	
	2DH5		291.792	
	2DH1	Hop_2480	336.035	
	2DH3		258.083	
	2DH5		304.433	

Notes:

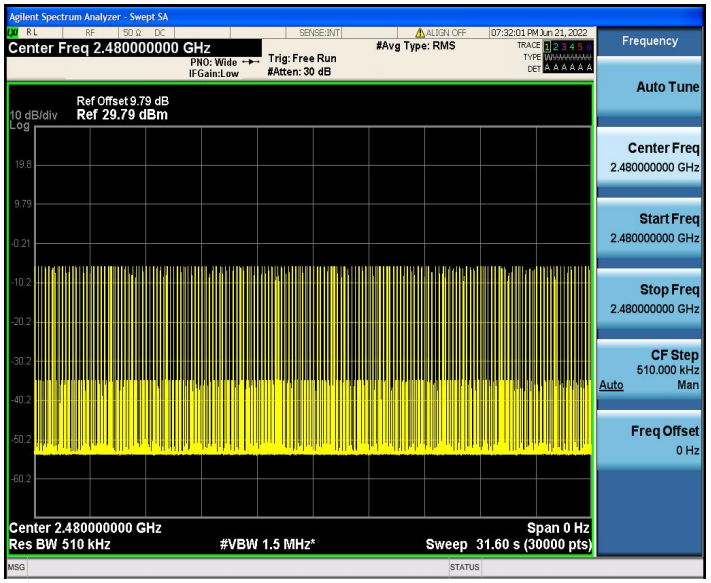
Period = 0.4 (s) * 79 (minimum number of hop channels) = 31.6 (s)

Accumulated Transmit time - GFSK

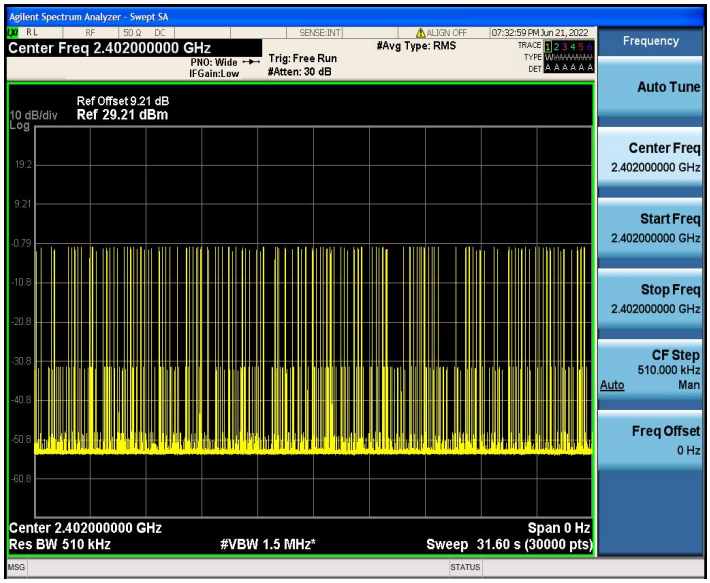
GFSK-DH1: 2402 MHz



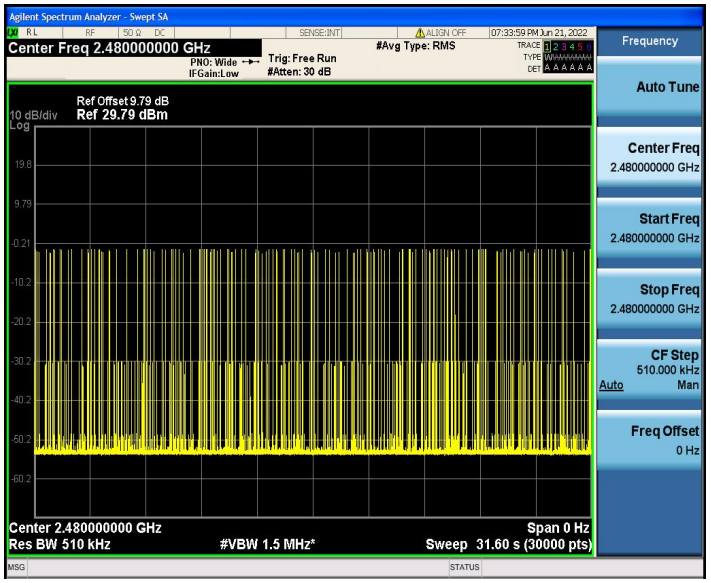
GFSK-DH1: 2480 MHz



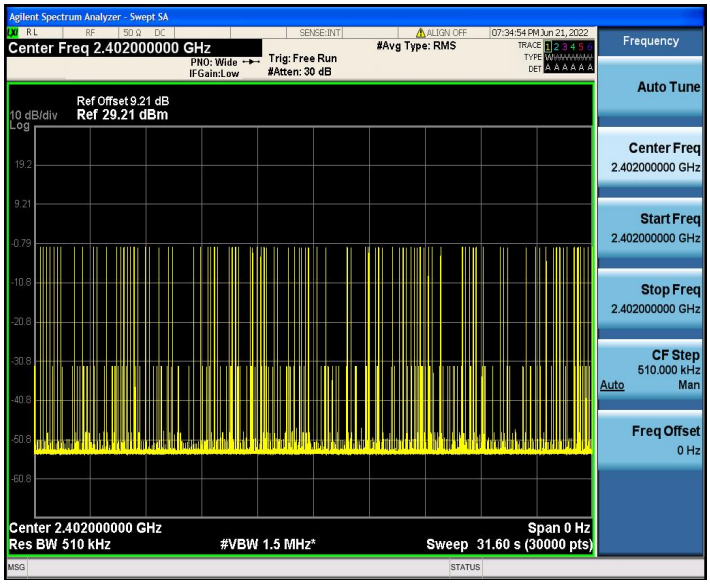
GFSK-DH3: 2402 MHz



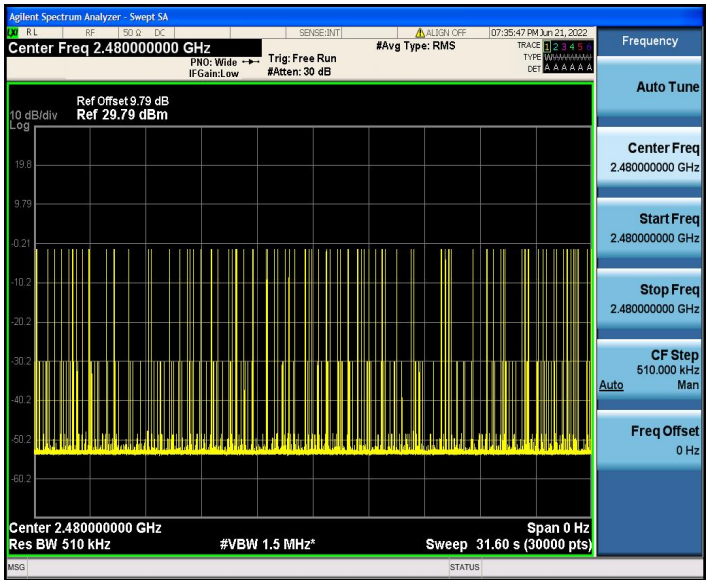
GFSK-DH3: 2480 MHz



GFSK-DH5: 2402 MHz

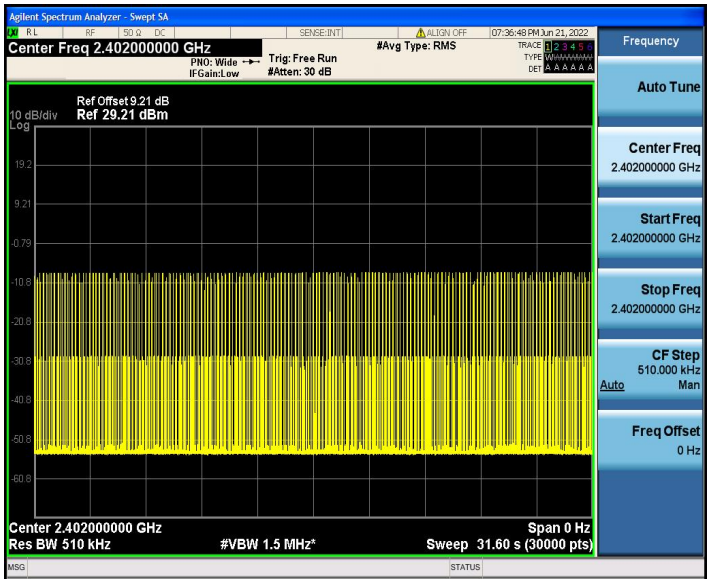


GFSK-DH5: 2480 MHz

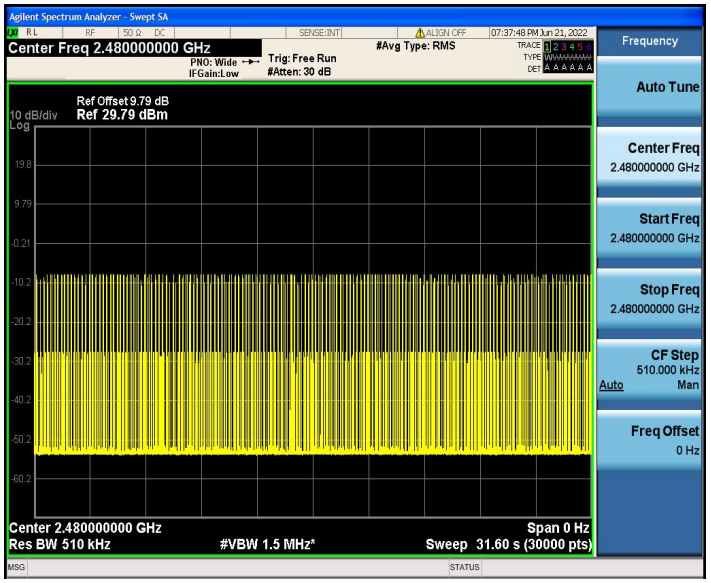


Accumulated Transmit time - π/4 DQPSK

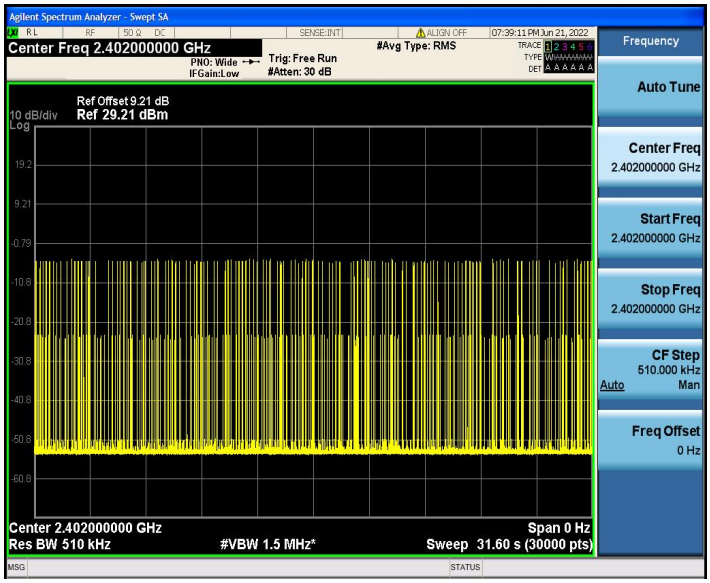
π/4 DQPSK-2DH1: 2402 MHz



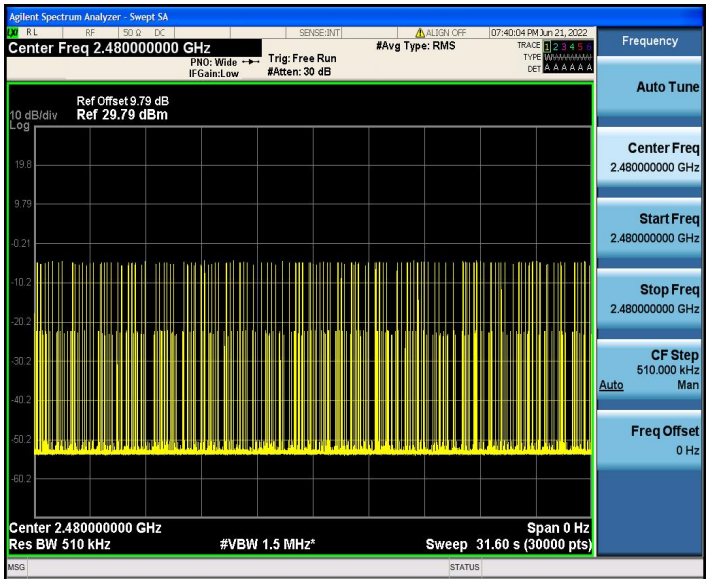
π/4 DQPSK-2DH1: 2480 MHz



π/4 DQPSK-2DH3: 2402 MHz

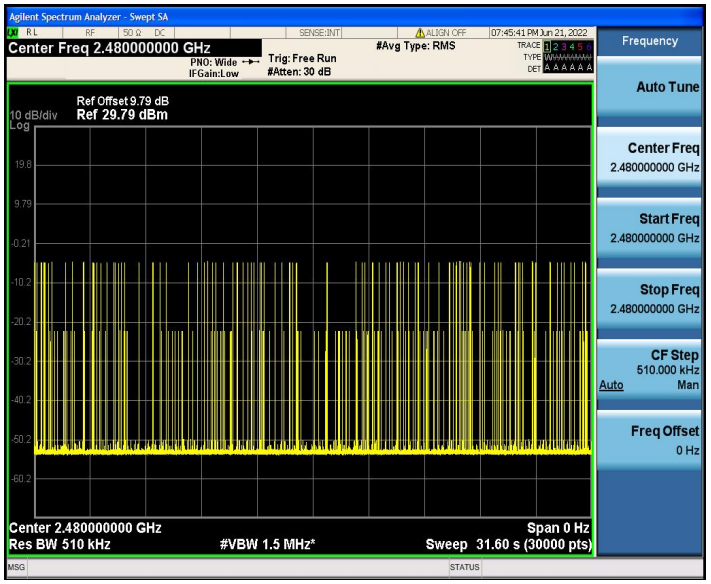


π/4 DQPSK-2DH3: 2480 MHz



π/4 DQPSK-2DH5: 2402 MHz

π/4 DQPSK-2DH5: 2480 MHz

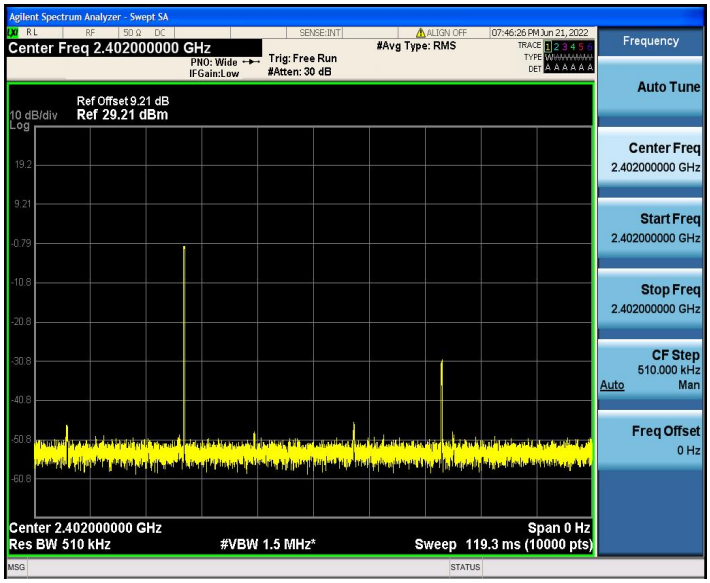


Frequency Occupation:

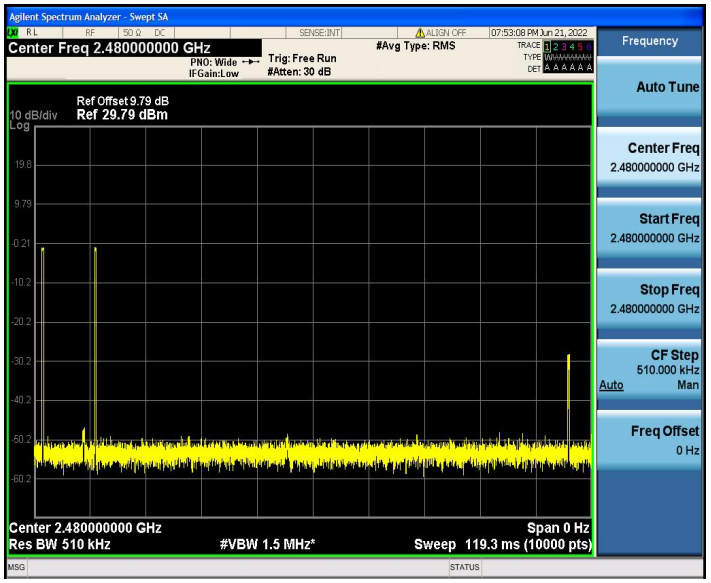
Test modes	Data Packet	Frequency (MHz)	Number of hopping	Limit (Number)
GFSK	DH1	Hop_2402	1	≥ 1
	DH3		2	
	DH5		2	
	DH1	Hop_2480	2	
	DH3		1	
	DH5		5	
π/4 DQPSK	2DH1	Hop_2402	2	
	2DH3		2	
	2DH5		3	
	2DH1	Hop_2480	1	
	2DH3		3	
	2DH5		5	

Frequency Occupation - GFSK

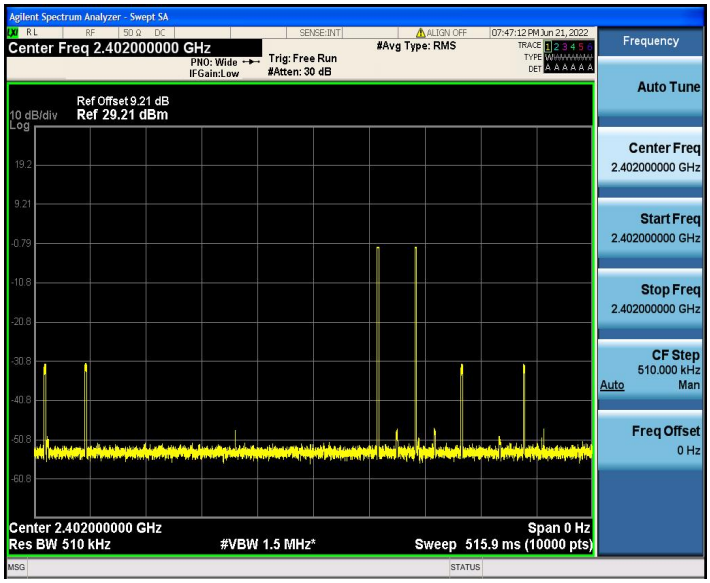
GFSK-DH1: 2402 MHz



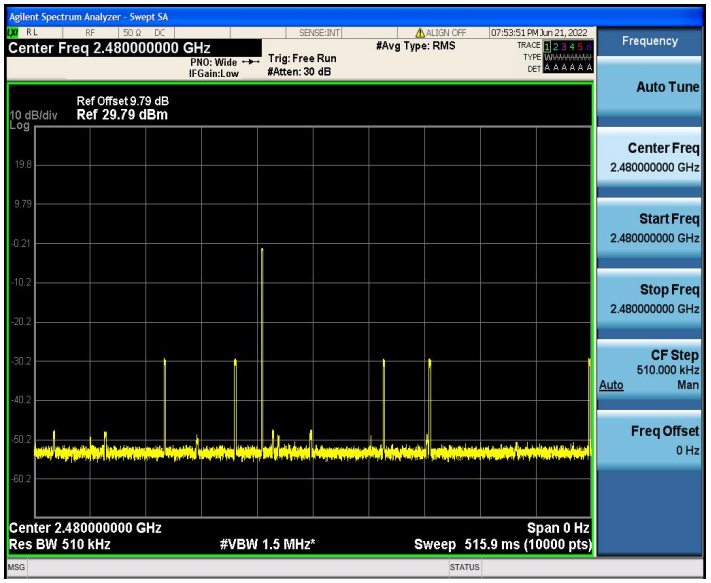
GFSK-DH1: 2480 MHz



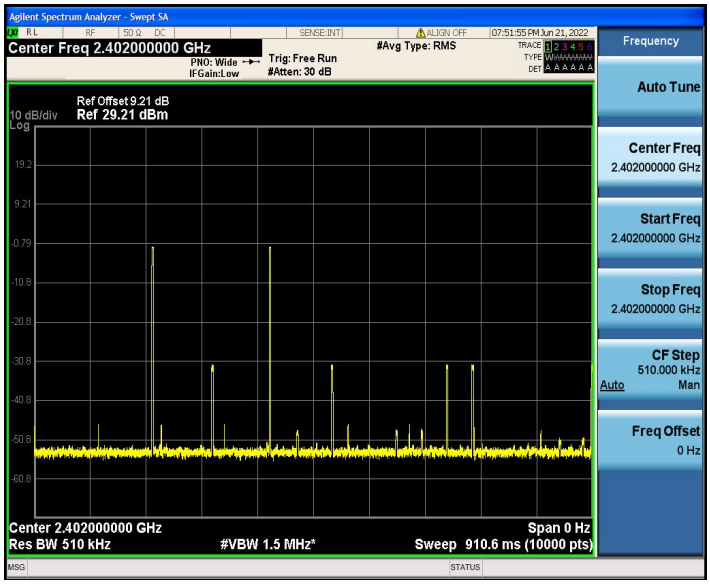
GFSK-DH3: 2402 MHz



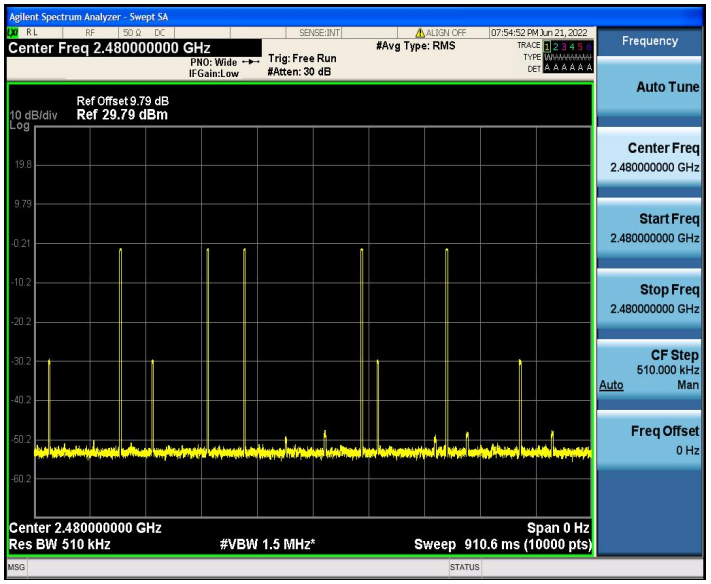
GFSK-DH3: 2480 MHz



GFSK-DH5: 2402 MHz

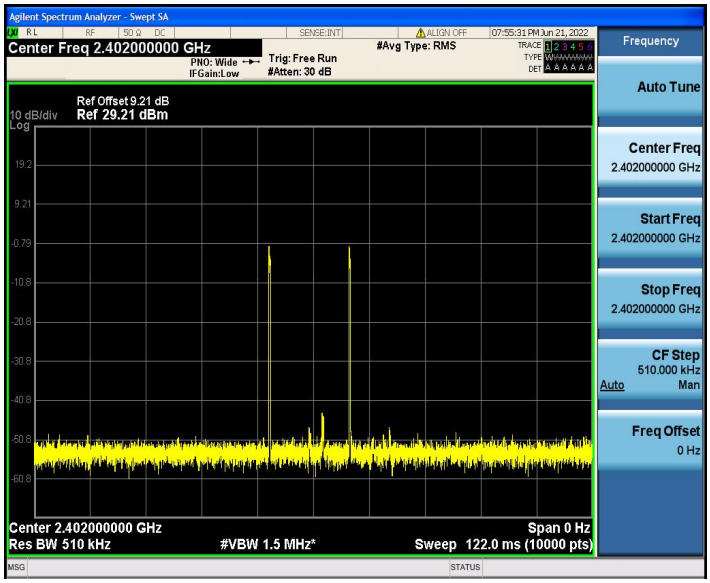


GFSK-DH5: 2480 MHz

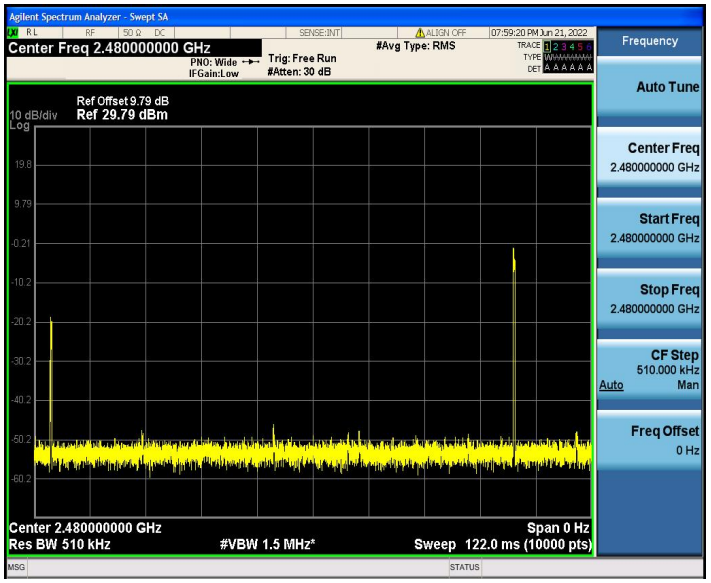


Frequency Occupation - π/4 DQPSK

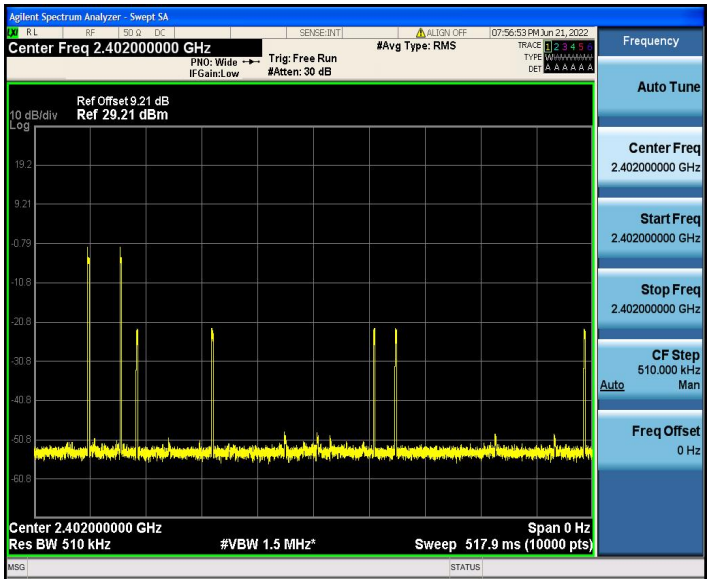
π/4 DQPSK-2DH1: 2402 MHz



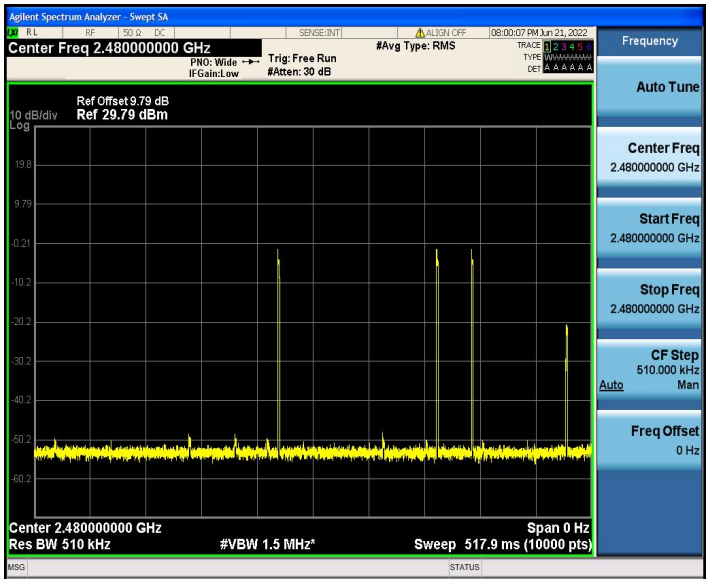
π/4 DQPSK-2DH1: 2480 MHz



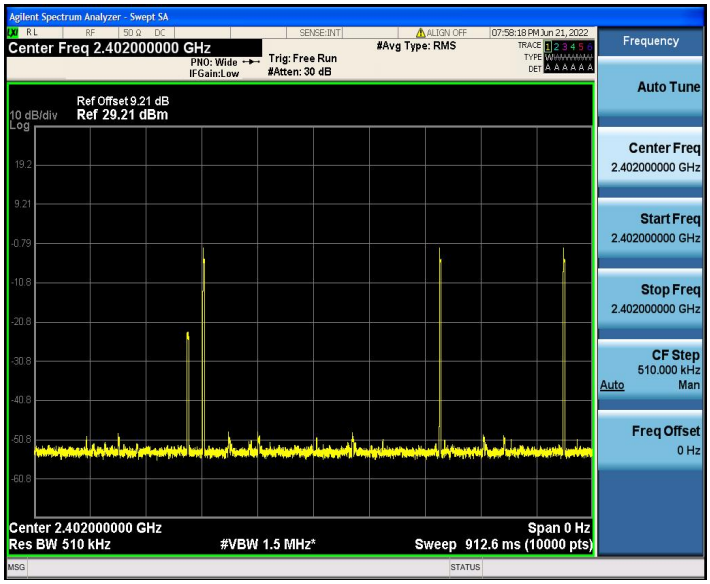
π/4 DQPSK-2DH3: 2402 MHz



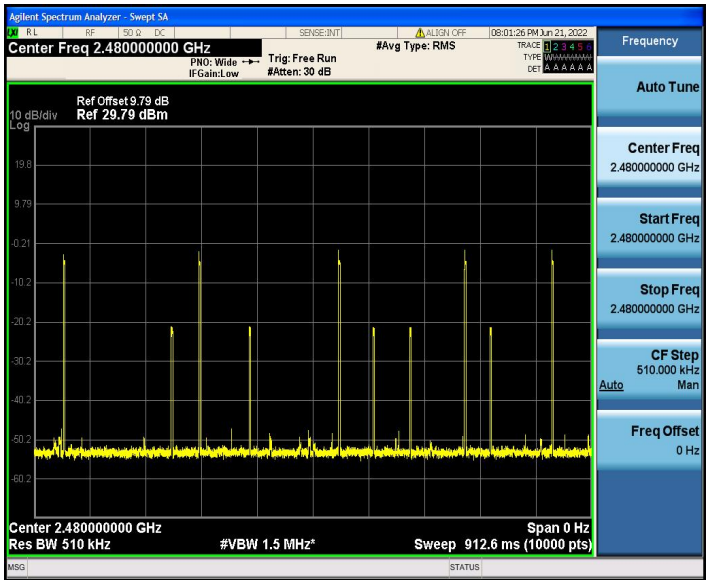
π/4 DQPSK-2DH3: 2480 MHz



π/4 DQPSK-2DH5: 2402 MHz



π/4 DQPSK-2DH5: 2480 MHz



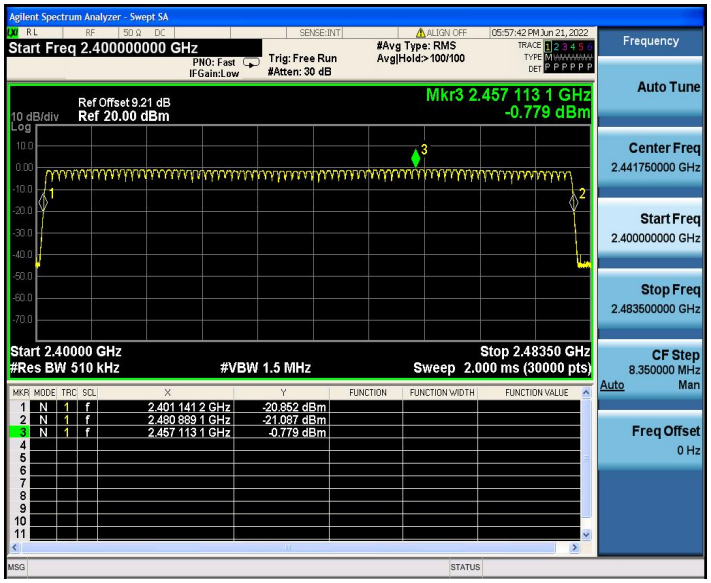
Hopping Sequence:

Test modes	Hopping number	Limit	Hopping Sequence (%)	Limit (%)
GFSK-DH5	79	>=15	95.51	>=70
π/4-DQPSK-2DH5	79	>=15	95.95	>=70

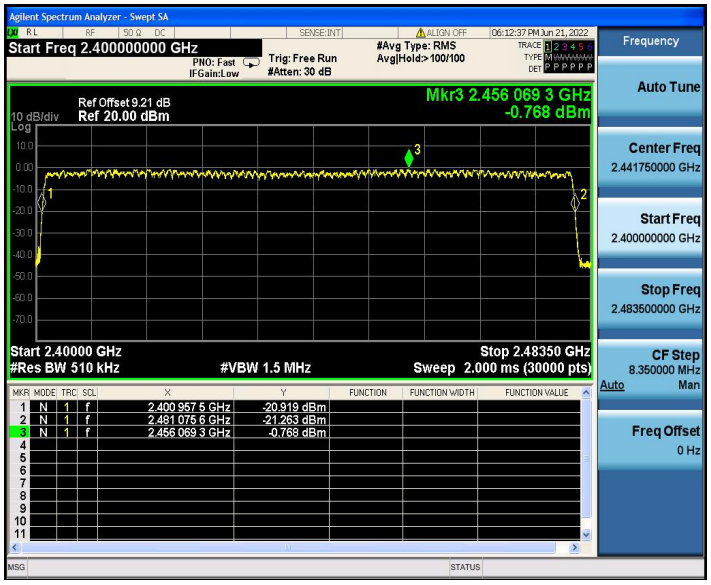
Note: Hopping sequence = (20 dB BW / 83.5) * 100%

Hopping Sequence

GFSK-DH5



π/4-DQPSK-2DH5



5.3 Hopping Frequency Separation

5.3.1 Description

The Hopping Frequency Separation is the frequency separation between two adjacent hopping frequencies.

5.3.2 Limits

For adaptive FHSS equipment, the minimum Hopping Frequency Separation shall be 100 kHz.

5.3.3 Test method

See clause 5.4.5 of EN 300 328.

5.3.4 Test Result

Test modes	Test Channel	Hopping frequency separation (MHz)	Limit (MHz)	Result
GFSK-DH5	Hop-Low	1	>=0.1	Pass
	Hop-Mid	0.998		Pass
	Hop-High	0.998		Pass
π/4-DQPSK-2DH5	Hop-Low	0.998		Pass
	Hop-Mid	1		Pass
	Hop-High	1.002		Pass

Hopping Frequency Separation – GFSK mode

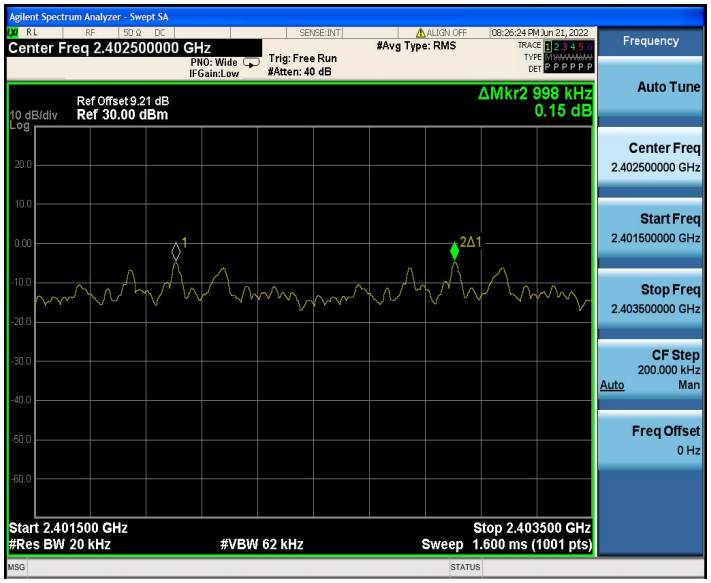
Low channel

Middle channel

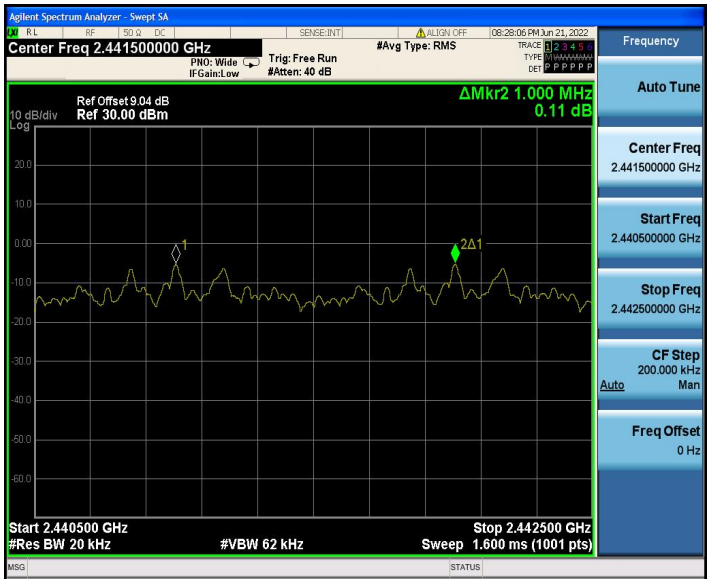
High channel

Hopping Frequency Separation – π/4-DQPSK mode

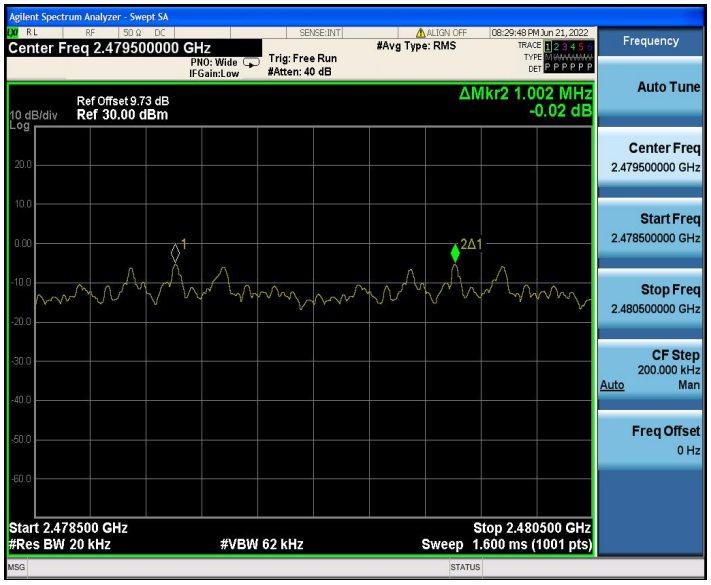
Low channel



Middle channel



High channel



5.4 Adaptivity

5.4.1 Definition

Adaptive mode of LBT based Detect and Avoid is a mechanism by which equipment using wide band modulations other than FHSS, avoids transmissions in a channel in the presence of other transmissions in that channel.

5.4.2 Limits

Minimum set of requirements:

LBT based Detect and Avoid mechanism: Load Based Equipment.

1) Before a transmission or a burst of transmissions, the equipment shall perform a Clear Channel Assessment (CCA) check using energy detect. The equipment shall observe the operating channel for the duration of the CCA observation time which shall be not less than 18µs. The channel shall be considered occupied if the energy level in the channel exceeds the threshold given in step 5) below. If the equipment finds the channel to be clear, it may transmit immediately

2) If the equipment finds the channel occupied, it shall not transmit on this channel (see note 2). The equipment shall perform an Extended CCA check in which the channel is observed for a random duration in the range between 18µs and at least 160µs. If the extended CCA check has determined the channel to be no longer occupied, the equipment may resume transmissions on this channel. If the Extended CCA time has determined the channel still to be occupied, it shall perform new Extended CCA checks until the channel is no longer occupied.

Note 1: The Idle Period in between transmissions is considered to be the CCA or the Extended CCA check as there are no transmissions during this period.
Note 2: The equipment is allowed to switch to a non-adaptive mode and to continue transmissions on this channel providing it complies with the requirements applicable to non-adaptive systems. Alternatively, the equipment is also allowed to continue transmissions on this channel providing it complies with the requirements.

3) The total time that an equipment makes use of a RF channel is defined as the Channel Occupancy Time. This Channel Occupancy Time shall be less than 13ms, after which the device shall perform a new CCA as described in step 1) above.

4) The equipment, upon correct reception of a packet which was intended for this equipment can skip CCA and immediately (see note 3) proceed with the transmission of management and control frames (e.g. ACK and Block ACK frames are allowed but data frames are not allowed). A consecutive sequence of transmissions by the equipment without a new CCA shall not exceed the maximum channel occupancy time as defined in step 3) above.

Note 3: For the purpose of multi-cast, the ACK transmissions (associated with the same data packet) of the individual devices are allowed to take place in a sequence.

5) The energy detection threshold for the CCA shall be proportional to the transmit power of the transmitter: for a 20 dBm e.i.r.p. transmitter the CCA threshold level (TL) shall be equal or less than -70 dBm/MHz at the input to the receiver (assuming a 0 dBi receive antenna). For power levels below 20 dBm e.i.r.p., the CCA threshold level may be relaxed to TL = -70 dBm/MHz + (20 dBm - Pout e.i.r.p.)/1 MHz (Pout in dBm).

Short Control Signalling Transmissions:

If implemented, Short Control Signalling Transmissions of adaptive equipment using wide band modulations other than FHSS shall have a maximum duty cycle of 10% within an observation period of 50ms.

5.4.3 Test method

See clause 5.4.6 of EN 300 328.

5.4.4 Test result

Note: Not applicable. this requirement does not apply for FHSS equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for FHSS equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p.

5.5 Occupied Channel Bandwidth

5.5.1 Definition

The Occupied Channel Bandwidth is the bandwidth that contains 99 % of the power of the signal when considering a single hopping frequency.

5.5.2 Limits

The Occupied Channel Bandwidth for each hopping frequency shall be within the band given in table 1.

Table 1: Service frequency bands

/	Service frequency bands
Transmit	2400 MHz to 2483.5 MHz
Receive	2400 MHz to 2483.5 MHz

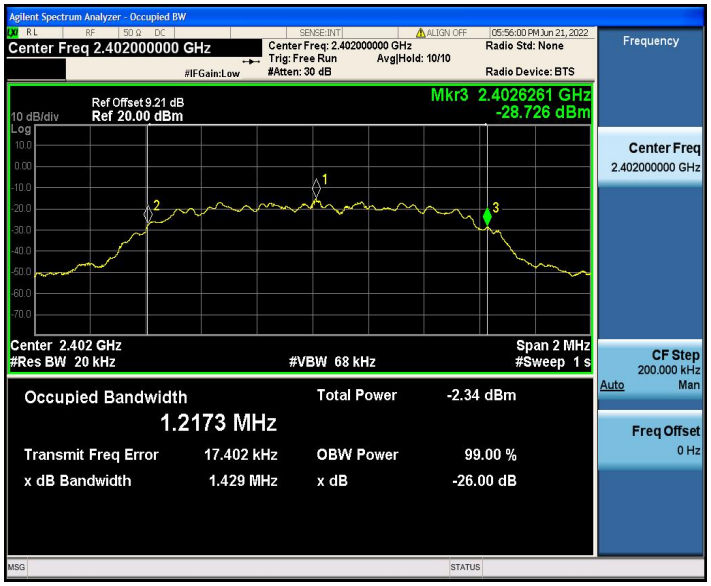
5.5.3 Test method

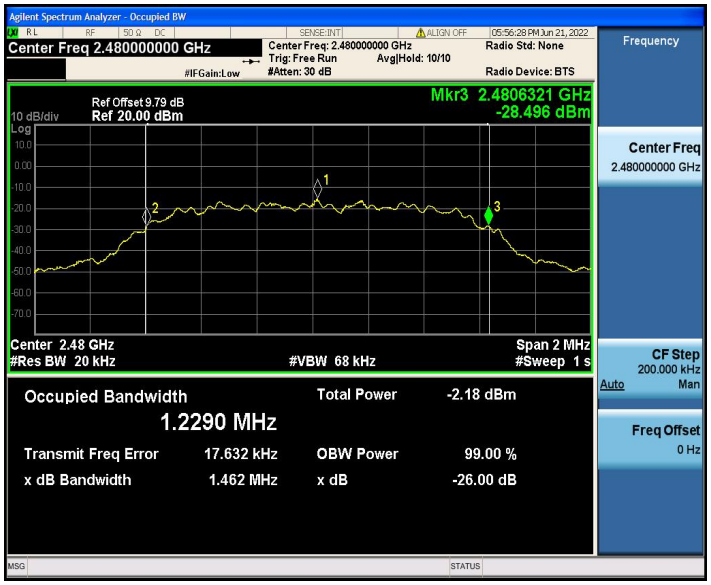
See clause 5.4.7 of EN 300 328.

5.5.4 Test result

Test Mode	Frequency (MHz)	Occupied Channel Bandwidth (MHz)	Lower Band Edge (MHz)	Upper Band Edge (MHz)	Limit (MHz)
GFSK DH5	2402	0.94442	2401.5380	2402.4824	2400~2483.5
	2480	0.97343	2479.5232	2480.4966	

Test Mode	Frequency (MHz)	Occupied Channel Bandwidth (MHz)	Lower Band Edge (MHz)	Upper Band Edge (MHz)	Limit (MHz)
π/4-DQPSK 2DH5	2402	1.2173	2401.4088	2402.6261	2400~2483.5
	2480	1.2290	2479.4031	2480.6321	





5.6 Transmitter unwanted emissions in OOB domain

5.6.1 Definition

Transmitter unwanted emissions in the out-of-band domain are emissions when the equipment is in Transmit mode, on frequencies immediately outside the allocated band, but excluding unwanted emissions in the spurious domain.

5.6.2 Limits

The transmitter unwanted emissions in the out-of-band domain shall not exceed the values provided by the mask in figure 1.

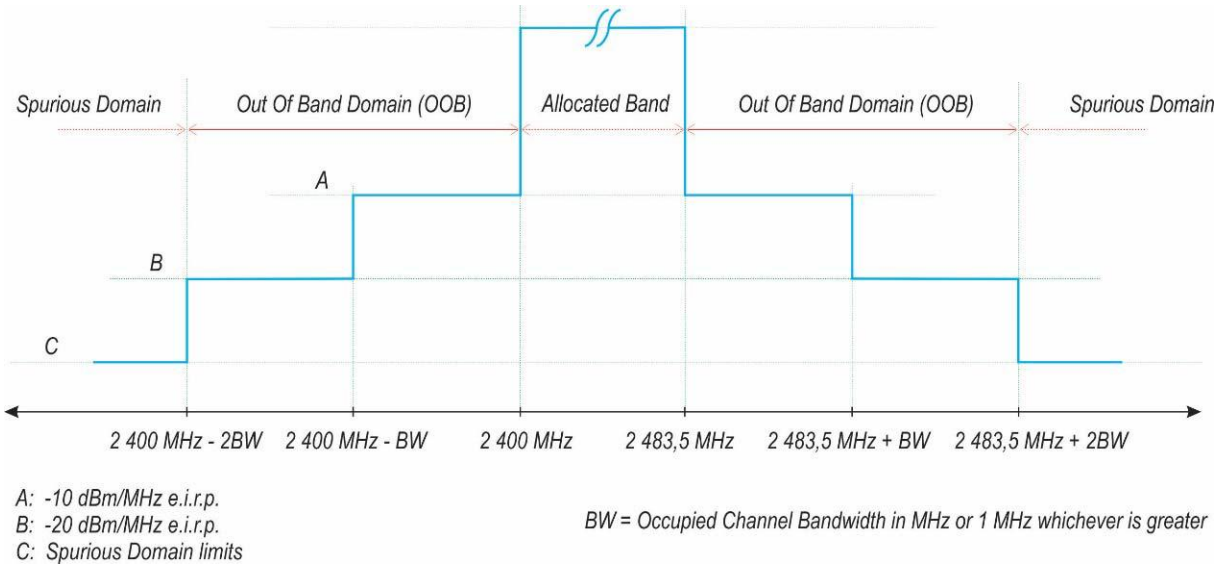


Figure 1: Transmit mask

5.6.3 Test method

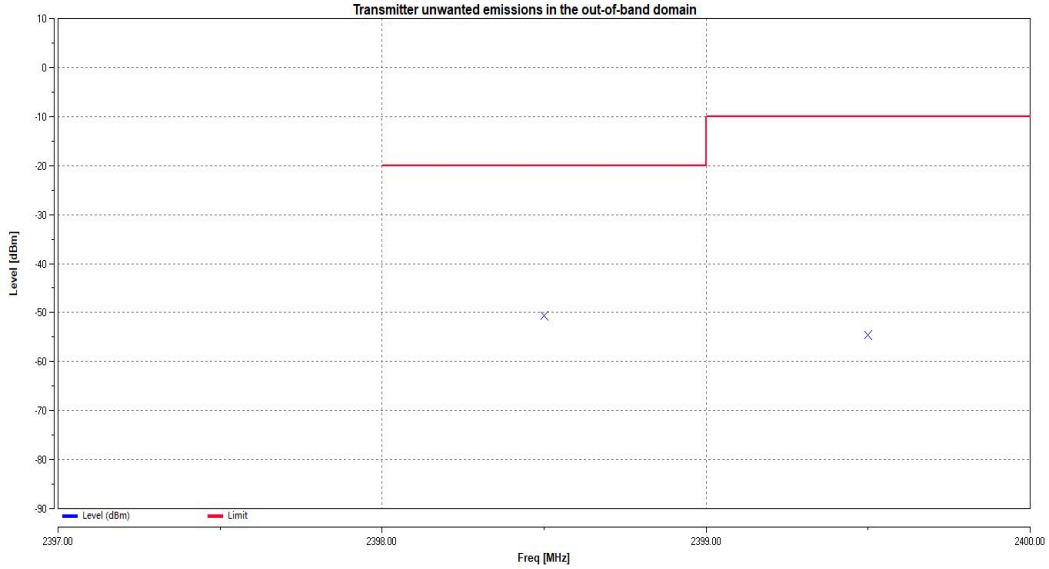
See clause 5.4.8 of EN 300 328.

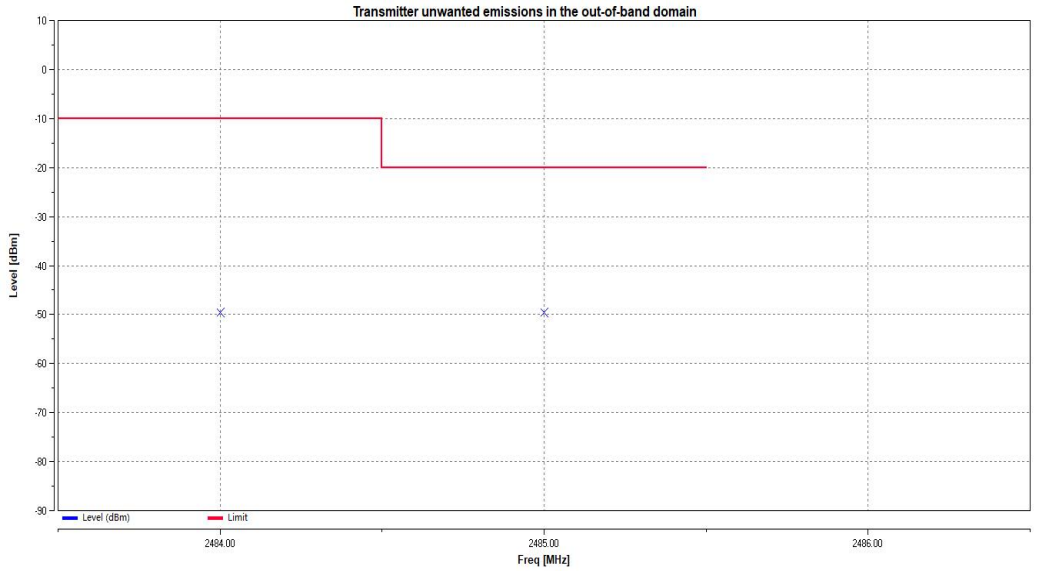
5.6.4 Test result

TestMode	Antenna	Channel	Freq. [MHz]	Level[dBm]	Limit[dBm]	Verdict
DH5	Ant1	Hop	2398.5	-50.69	-20.00	PASS
			2399.5	-54.64	-10.00	PASS
			2484	-49.59	-10.00	PASS
			2485	-49.63	-20.00	PASS
2DH5	Ant1	Hop	2398.042	-48.92	-20.00	PASS
			2398.271	-48.04	-20.00	PASS
			2399.271	-53.24	-10.00	PASS
			2399.5	-46.67	-10.00	PASS
			2484	-48.97	-10.00	PASS
			2484.229	-50.03	-10.00	PASS
			2485.229	-47.52	-20.00	PASS
			2485.458	-46.69	-20.00	PASS

Transmitter unwanted emissions in the OOB domain

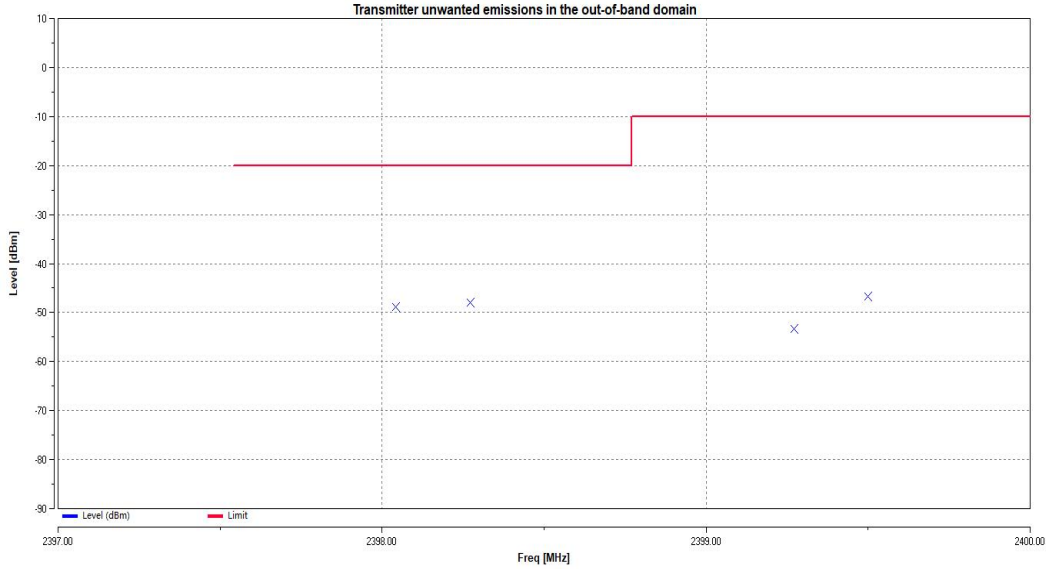
GFSK mode

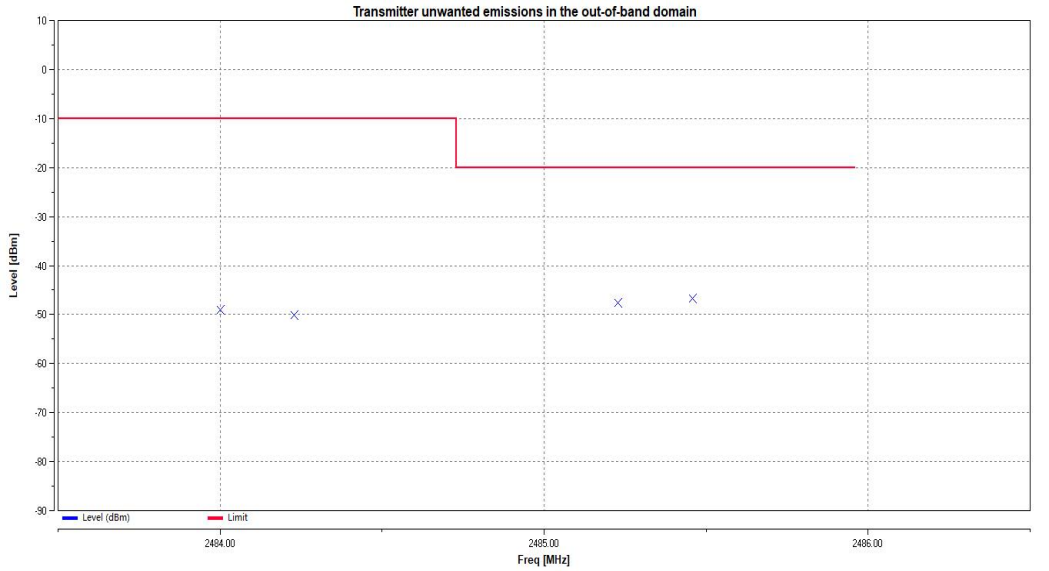




Transmitter unwanted emissions in the OOB domain

π/4-DQPSK mode





5.7 Transmitter unwanted emissions in the spurious domain

5.7.1 Definition

Transmitter unwanted emissions in the spurious domain are emissions outside the allocated band and outside the out-of-band domain as indicated in figure 1 when the equipment is in Transmit mode.

5.7.2 Limits

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table 4.

In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.

Table 4: Transmitter limits for spurious emissions

Frequency range	Maximum power	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87.5 MHz	-36 dBm	100 kHz
87.5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 694 MHz	-54 dBm	100 kHz
694 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12.75 GHz	-30 dBm	1 MHz

5.7.3 Test method

See clause 5.4.9 of EN 300 328.

5.7.4 Test result

Note: All mode of GFSK, π/4-DQPSK modulation have been tested, and only show the data of worst mode: GFSK (DH5) - TX.

Power supply:	DC 3.7V	Test site:	RE chamber 2
Environment conditions:	26°, 54% RH	Tested by:	Letter
Test mode:	GFSK -DH5 (TX)		

Polar (H/V)	Frequency (MHz)	Reading Level (dBm) m	Factor (dB)	Emission Level (dBm)	Limits (dBm)	Margin (dB)	Detector Type
operation frequency: 2402 MHz							
V	45.7548	-55.69	-9.34	-65.03	-36.00	-29.03	QP
V	60.0953	-64.48	-9.48	-73.96	-54.00	-19.96	QP
H	45.7949	-62.70	-5.72	-68.42	-36.00	-32.42	QP
H	67.3495	-61.35	-12.43	-73.78	-54.00	-19.78	QP
V	7206.000	-74.64	23.79	-50.85	-30.00	-20.85	Peak
V	9608.000	-73.58	27.99	-45.59	-30.00	-15.59	Peak
H	7206.000	-74.54	23.66	-50.88	-30.00	-20.88	peak
H	9608.000	-71.49	27.82	-43.67	-30.00	-13.67	peak
operation frequency: 2480 MHz							
V	398.3312	-69.76	-4.44	-74.20	-36.00	-38.20	QP
V	597.4850	-74.31	-0.13	-74.44	-54.00	-20.44	QP
H	45.7346	-62.82	-5.71	-68.53	-36.00	-32.53	QP
H	67.2021	-60.98	-12.36	-73.34	-54.00	-19.34	QP
V	7440.000	-75.72	24.85	-50.87	-30.00	-20.87	peak
V	9920.000	-74.26	28.27	-45.99	-30.00	-15.99	peak
H	7440.000	-75.42	24.71	-50.71	-30.00	-20.71	peak
H	9920.000	-73.61	28.24	-45.37	-30.00	-15.37	peak

Notes:

Emission Level= Reading Level+ Factor

Margin= Emission Level - Limit

5.8 Receiver spurious emissions

5.8.1 Definition

Receiver spurious emissions are emissions at any frequency when the equipment is in receive mode.

5.8.2 Limits

The receiver spurious emissions shall not exceed the values given in table 5.

In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.

Table 4: Transmitter limits for spurious emissions

Frequency range	Maximum power	Bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12.75 GHz	-47 dBm	1 MHz

5.8.3 Test method

See clause 5.4.10 of EN 300 328.

5.8.4 Test result

Note: All mode of GFSK, π/4-DQPSK modulation have been tested, and only show the data of worst mode: GFSK(DH5) - RX.

Power supply:	DC 3.7V	Test site:	RE chamber 2
Environment conditions:	26°, 54% RH	Tested by:	Letter
Test mode:	GFSK-DH5 (RX)		

Polar (H/V)	Frequency (MHz)	Reading Level (dBm)	Factor (dB)	Emission Level (dBm)	Limits (dBm)	Margin (dB)	Detector Type
operation frequency: 2402 MHz							
V	144.0184	-61.83	-10.43	-72.26	-57.00	-15.26	QP
V	168.0449	-53.28	-10.68	-63.96	-57.00	-6.96	QP
H	144.0184	-50.65	-13.73	-64.38	-57.00	-7.38	QP
H	168.0449	-49.08	-12.85	-61.93	-57.00	-4.93	QP
V	1929.719	-79.59	11.98	-67.61	-47.00	-20.61	peak
V	2386.500	-81.16	14.03	-67.13	-47.00	-20.13	peak
H	2396.781	-81.85	14.27	-67.58	-47.00	-20.58	peak
H	2809.500	-82.05	15.37	-66.68	-47.00	-19.68	peak
operation frequency: 2480 MHz							
V	120.0133	-70.04	-7.53	-77.57	-57.00	-20.57	QP
V	168.0449	-53.77	-10.68	-64.45	-57.00	-7.45	QP
H	156.0466	-58.79	-13.41	-72.20	-57.00	-15.20	QP
H	168.0449	-53.69	-12.85	-66.54	-57.00	-9.54	QP
V	2370.344	-80.02	13.94	-66.08	-47.00	-19.08	peak
V	2874.125	-82.81	15.55	-67.26	-47.00	-20.26	peak
H	1869.500	-79.15	12.22	-66.93	-47.00	-19.93	peak
H	2924.063	-82.06	15.80	-66.26	-47.00	-19.26	peak

Notes:

Emission Level= Reading Level+ Factor

Margin= Emission Level - Limit

5.9 Receiver blocking

5.9.1 Definition

Receiver blocking is a measure of the ability of the equipment to receive a wanted signal on its operating channel without exceeding a given degradation due to the presence of an unwanted input signal (blocking signal) on frequencies other than those of the operating band and spurious responses.

5.9.2 Performance Criteria

For equipment that supports a PER or FER test to be performed, the minimum performance criterion shall be a PER or FER less than or equal to 10 %.

For equipment that does not support a PER or a FER test to be performed, the minimum performance criterion shall be no loss of the wireless transmission function needed for the intended use of the equipment.

5.9.3 Limits

While maintaining the minimum performance criteria as defined in clause 4.3.1.12.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided in table 6, table 7 or table 8.

Table 6: Receiver Blocking parameters for Receiver Category 1 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 4)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 4)	Type of blocking signal
(-133 dBm + 10 × $\log_{10}$(OCBW)) or -68 dBm whichever is less (see note 2)	2 380 2 504	-34	CW
(-139 dBm + 10 × $\log_{10}$(OCBW)) or -74 dBm whichever is less (see note 3)	2 300 2 330 2 360 2 524 2 584 2 674		

NOTE 1: OCBW is in Hz.

NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 26 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.

NOTE 3: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 20 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.

NOTE 4: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.

Table 7: Receiver Blocking parameters for Receiver Category 2 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × $\log_{10}$(OCBW) + 10 dB) or (-74 dBm + 10 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
NOTE 1: OCBW is in Hz. NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 26 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.			

Table 8: Receiver Blocking parameters receiver Category 3 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × $\log_{10}$(OCBW) + 20 dB) or (-74 dBm + 20 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
NOTE 1: OCBW is in Hz. NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative the test may be performed using a wanted signal up to P_{min} + 30 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.			

5.9.4 Test method

See clause 5.4.11 of EN 300 328.

5.9.5 Test result

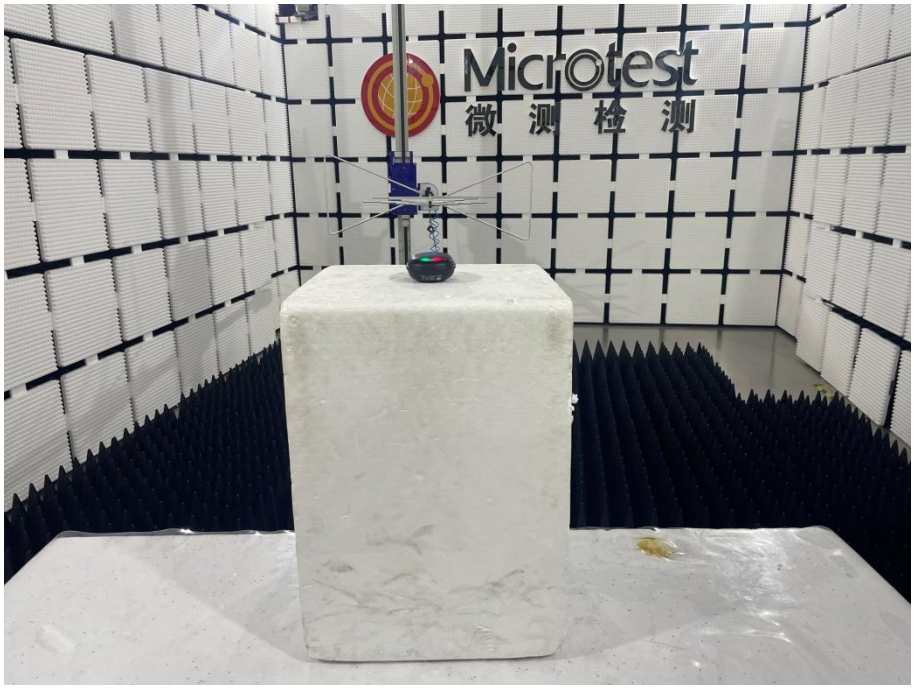
The EUT is comply with receiver category 3 equipment.

Mode	Blocking Signal Frequency (MHz)	Wanted Signal(dBm)	Blocking Signal Level (dBm)	PER (%)	PER Limit (%)
GFSK	2380	-59.2	-33.4	0.36	≤ 10
GFSK	2300	-59.2	-33.4	0.38	
GFSK	2504	-59.1	-33.4	0.36	
GFSK	2584	-59.1	-33.4	0.36	

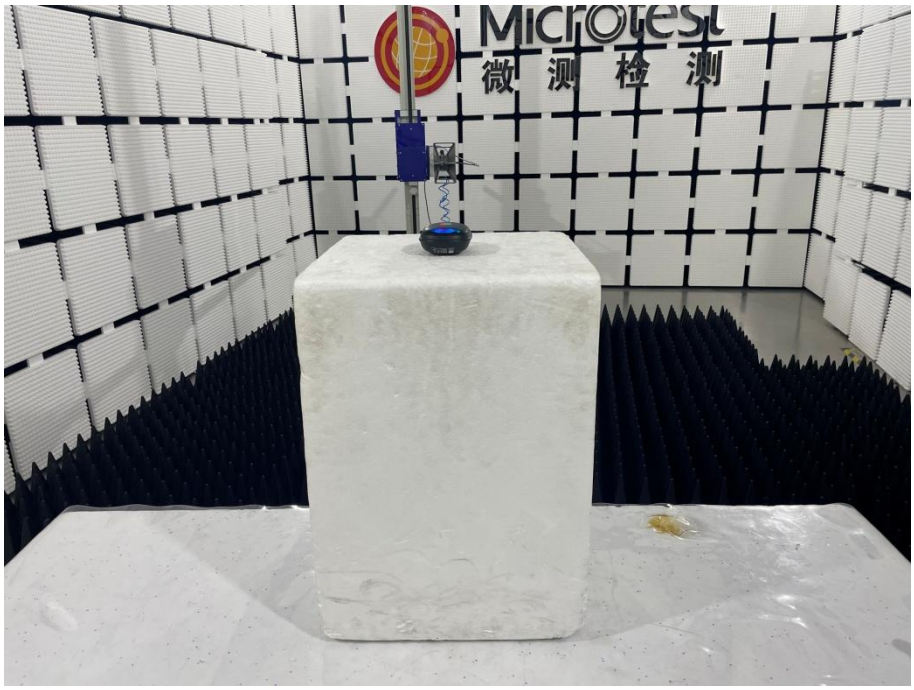
Notes:
Worst mode is GFSK, only the worst mode reported.
The antenna gain is 0.6 dBi

Photographs of the Test Setup

Radiated emissions below 1 GHz



Radiated emissions above 1 GHz



Annex A: Information for Testing

a) The type of modulation used by the equipment:

☒ FHSS

☐ Other forms of modulation

b) In case of FHSS modulation:

- In case of non-Adaptive Frequency Hopping equipment:

The number of Hopping Frequencies:

- In case of Adaptive Frequency Hopping Equipment:

The maximum number of Hopping Frequencies: 79

The minimum number of Hopping Frequencies: 79

- The Dwell Time: ms
- The Minimum Channel Occupation Time:
- The (average) Dwell Time: ms

c) **Adaptive / non-adaptive equipment:**

☐ non-adaptive Equipment

☒ adaptive Equipment without the possibility to switch to a non-adaptive mode

☐ adaptive Equipment which can also operate in a non-adaptive mode

d) **In case of adaptive equipment:**

The Channel Occupancy Time implemented by the equipment:

☐ The equipment has implemented an LBT based DAA mechanism

- In case of equipment using modulation different from FHSS:

☐ The equipment is Frame Based equipment

☐ The equipment is Load Based equipment

☐ The equipment can switch dynamically between Frame Based and Load Based equipment

The CCA time implemented by the equipment:

☐ The equipment has implemented an non-LBT based DAA mechanism

☐ The equipment can operate in more than one adaptive mode

e) In case of non-adaptive Equipment:

The maximum RF Output Power (e.i.r.p.): -0.95dBm

The maximum (corresponding) Duty Cycle: %

Equipment with dynamic behaviour, that behaviour is described here. (e.g. the different combinations of duty cycle and corresponding power levels to be declared):

f) The worst case operational mode for each of the following tests:

- RF Output Power: GFSK
- Power Spectral Density:
- Duty cycle, Tx-Sequence, Tx-gap:
- Dwell time, Minimum Frequency Occupation & Hopping Sequence (only for FHSS equipment):
- Hopping Frequency Separation (only for FHSS equipment): π/4-DQPSK
- Medium Utilisation:
- Receiver Blocking: GFSK
- Occupied Channel Bandwidth: π/4-DQPSK
- Transmitter unwanted emissions in the OOB domain: π/4-DQPSK
- Transmitter unwanted emissions in the spurious domain: GFSK
- Receiver spurious emissions: GFSK

g) The different transmit operating modes (tick all that apply):

☒ Operating mode 1: Single Antenna Equipment

☒ Equipment with only 1 antenna

☐ Equipment with 2 diversity antennas but only 1 antenna active at any moment in time

☐ Smart Antenna Systems with 2 or more antennas, but operating in a (legacy) mode where only 1 antenna is used. (e.g. IEEE 802.11™ [i.3] legacy mode in smart antenna systems)

☐ Operating mode 2: Smart Antenna Systems - Multiple Antennas without beam forming

☐ Single spatial stream / Standard throughput / (e.g. IEEE 802.11™ [i.3] legacy mode)

☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1

☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2

NOTE: Add more lines if more channel bandwidths are supported.

☐ Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming

☐ Single spatial stream / Standard throughput (e.g. IEEE 802.11™ [i.3] legacy mode)

☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1

☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2

NOTE: Add more lines if more channel bandwidths are supported.

h) **In case of Smart Antenna Systems:**

- The number of Receive chains:
- The number of Transmit chains:

☐ symmetrical power distribution

☐ asymmetrical power distribution

In case of beam forming, the maximum beam forming gain:

NOTE: Beam forming gain does not include the basic gain of a single antenna.

i) **Operating Frequency Range(s) of the equipment:**

- Operating Frequency Range 1: 2402MHz to 2480MHz
- Operating Frequency Range 2: MHz to MHz

NOTE: Add more lines if more Frequency Ranges are supported.

j) **Occupied Channel Bandwidth(s):**

- Occupied Channel Bandwidth 1: 1.2290MHz
- Occupied Channel Bandwidth 2: MHz

NOTE: Add more lines if more channel bandwidths are supported.

k) **Type of Equipment (stand-alone, combined, plug-in radio device, etc.):**

☒ Stand-alone

☐ Combined Equipment (Equipment where the radio part is fully integrated within another type of equipment)

☐ Plug-in radio device (Equipment intended for a variety of host systems)

☐ Other

l) **The extreme operating conditions that apply to the equipment:**

Operating temperature range: -20° C to 50° C

Details provided are for the: ☒ stand-alone equipment

☐ combined (or host) equipment

☐ test jig

m) **The intended combination(s) of the radio equipment power settings and one or more antenna assemblies and their corresponding e.i.r.p levels:**

- Antenna Type:

☒ PCB Antenna

Antenna Gain: 0.6 dBi

If applicable, additional beamforming gain (excluding basic antenna gain): dB

☐ Temporary RF connector provided

☐ No temporary RF connector provided

☐ Dedicated Antennas (equipment with antenna connector)

☐ Single power level with corresponding antenna(s)

☐ Multiple power settings and corresponding antenna(s)

Number of different Power Levels:

Power Level 1: dBm

Power Level 2: dBm

Power Level 3: dBm

NOTE 1: Add more lines in case the equipment has more power levels.

NOTE 2: These power levels are conducted power levels (at antenna connector).

- For each of the Power Levels, provide the intended antenna assemblies, their corresponding gains (G) and the resulting e.i.r.p. levels also taking into account the beamforming gain (Y) if applicable

Power Level 1: dBm

Number of antenna assemblies provided for this power level:

Assembly #	Gain (dBi)	e.i.r.p. (dBm)	Part number or model name
1			
2			
3			
4			

NOTE: Add more rows in case more antenna assemblies are supported for this power level.

Power Level 2: dBm

Number of antenna assemblies provided for this power level:

Assembly #	Gain (dBi)	e.i.r.p. (dBm)	Part number or model name
1			
2			
3			
4			

NOTE: Add more rows in case more antenna assemblies are supported for this power level.

Power Level 3: dBm

Number of antenna assemblies provided for this power level:

Assembly #	Gain (dBi)	e.i.r.p. (dBm)	Part number or model name
1			
2			
3			
4			

NOTE: Add more rows in case more antenna assemblies are supported for this power level.

n) **The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined (host) equipment or test jig in case of plug-in devices:**

Details provided are for the: ☒ stand-alone equipment

☐ combined (or host) equipment

☐ test jig

Supply Voltage ☐ AC mains State AC voltage /

☒ DC State DC voltage 3.7V

In case of DC, indicate the type of power source

☐ Internal Power Supply

☐ External Power Supply or AC/DC adapter

☒ Battery

☐ Other:

o) **Describe the test modes available which can facilitate testing:**

p) **The equipment type (e.g. Bluetooth®, IEEE 802.11™ [i.3], proprietary, etc.):**

Bluetooth®

q) **Geo-location capability supported by the equipment:**

☐ Yes

☐ The geographical location determined by the equipment as defined in clause 4.3.1.13.2 or clause 4.3.2.12.2 is not accessible to the user.

☒ No

Photographs of EUT

See the Appendix - EUT Photos.

----End of Report----