RADIO TEST REPORT

for

Dongguan Meiloon Acoustic Equipments Co., Ltd.

Integrated Music System

Model Number: R410

Prepared for	:	Dongguan Meiloon Acoustic Equipments Co., Ltd.
Address	:	80, Yuanlin Road Fenghuanggang Ind, Estate, Tangxia Town, 523727 Dongguan City, Guangdong Province, PEOPLE'S REPUBLIC OF CHINA.
Prepared by	:	Keyway Testing Technology (Guangdong) Co., Ltd.
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Report No.	: TR23040454-E-000
Date of Test	: Aug.10 ~ Sep. 28, 2023
Date of Report	: Oct. 10, 2023

Keyway Testing Technology (Guangdong) Co., Ltd.

Applicant: **Address:**	Dongguan Meiloon Acoustic Equipments Co., Ltd. 80, Yuanlin Road Fenghuanggang Ind, Estate, Tangxia Town, 523727 Dongguan City, Guangdong Province, PEOPLE'S REPUBLIC OF CHINA.		
Manufacturer: **Address:**	Ruark Audio Limited 59 Tailors Court,Temple Farm Industrial Estate, Southend on Sea, Essex, SS2 5TH, United Kingdom		
E.U.T:	Integrated Music System		
Model Number:	R410		
Trade Name:	ruark audio	**Sample Number:**	230811003
Date of Receipt:	Aug. 10, 2023	**Date of Test:**	Aug.10 ~ Sep. 28, 2023
Test Specification:	ETSI EN 300 328 V2.2.2 (2019-07)		
Test Result:	The equipment under test was found to be compliance with the requirements of the standards applied. **Issue Date: Oct. 10, 2023**		

Tested by:	Reviewed by:	Approved by:
Jacob Ouyang / Engineer	Billy Zeng / Supervisor	Andy Gao / Manager

Other Aspects:

None.

Abbreviations: OK/P=passed fail/F=failed n.a/N=not applicable E.U.T=equipment under tested

This test report is based on a single evaluation of one sample of above mentioned products. It is not permitted to be duplicated in extracts without written approval of Keyway Testing Technology (Guangdong) Co., Ltd.

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1. Summary Of Test Results

1.1. Test procedures according to the technical standards:

The following essential requirements and test specifications are relevant to the presumption of conformity under Article 3.2 of the RED Directive; Test results included in this report is only for the Bluetooth EDR part.			
No	Test Parameter	Clause No	Results
Transmitter Parameters			
1	RF output power	4.3.1.2	PASS
2	Duty Cycle, Tx-sequence, Tx-gap	4.3.1.3	N/A
4	Accumulated Transmit Time, Frequency Occupation and Hopping Sequence	4.3.1.4	PASS
5	Hopping Frequency Separation	4.3.1.5	PASS
6	Medium Utilisation (MU) factor	4.3.1.6	N/A
7	Adaptivity (Adaptive Frequency Hopping)	4.3.1.7	N/A
8	Occupied Channel Bandwidth	4.3.1.8	PASS
9	Transmitter unwanted emissions in the out-of-band domain	4.3.1.9	PASS
10	Transmitter unwanted emissions in the spurious domain	4.3.1.10	PASS
Receiver Parameters			
11	Receiver spurious emissions	4.3.1.11	PASS
12	Receiver Blocking	4.3.1.12	PASS
13	Geo-location capability	4.3.1.13	N/A
Note: N/A is an abbreviation for Not Applicable and means this test item is not applicable for this device according to the technology characteristic of device.			

1.2. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

● **CNAS —Registration No.: CNAS L5783**

Keyway Testing Technology (Guangdong) Co., Ltd., EMC Laboratory has been registered and fuly described in a report filed with the Certificated by CNAS China.

Registration No.: CNAS L5783.

Date of registration: August 8, 2012

● **Industry Canada (IC)**

The 3m Semi-anechoic chamber of Keyway Testing Technology (Guangdong) Co., Ltd. has been Registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 9868A -1.

1.3. Measurement Uncertainty

Measurement Uncertainty for a Level of Confidence of 95 %, U=2xUc(y)

RF frequency	1 x 10^{-7}
RF power, conducted	± 1.0 dB
Conducted emission of receivers	± 1 dB
Radiated emission of transmitter	± 6 dB
Radiated emission of receiver	± 6 dB
Temperature	±1 degree
Humidity	± 5 %

General Information

1.4. General Description Of EUT

Product Name:	Integrated Music System
Test Model No.:	R410
Series Model No.:	N/A
Model difference:	N/A
Operation Frequency:	BT: 2402~2480MHz
Channel Numbers:	79 Channels for BR+EDR
Channel Separation:	1MHz for BR+EDR
Modulation Technology:	GFSK, Pi/4 QPSK, 8DPSK for BR+EDR
Antenna Type:	Internal PCB Antenna
Antenna Gain:	0dBi
Power Input:	AC100V-240V 50/60Hz

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.
2.

Channel List					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	27	2429	54	2456
01	2403	28	2430	55	2457
02	2404	29	2431	56	2458
03	2405	30	2432	57	2459
04	2406	31	2433	58	2460
05	2407	32	2434	59	2461
06	2408	33	2435	60	2462
07	2409	34	2436	61	2463
08	2410	35	2437	62	2464
09	2411	36	2438	63	2465
10	2412	37	2439	64	2466
11	2413	38	2440	65	2467
12	2414	39	2441	66	2468
13	2415	40	2442	67	2469
14	2416	41	2443	68	2470
15	2417	42	2444	69	2471
16	2418	43	2445	70	2472
17	2419	44	2446	71	2473
18	2420	45	2447	72	2474
19	2421	46	2448	73	2475
20	2422	47	2449	74	2476
21	2423	48	2450	75	2477
22	2424	49	2451	76	2478
23	2425	50	2452	77	2479
24	2426	51	2453	78	2480
25	2427	52	2454		
26	2428	53	2455		

3. Annex E

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: 15

The Dwell Time: 309.23ms maximum

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: ..... μs

□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.):6.70dBm

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)
  GFSK
- Hopping Frequency Separation (only for FHSS equipment)
  GFSK
- Medium Utilisation

.....

- Adaptivity & Receiver Blocking

.....

- Occupied Channel Bandwidth
  GFSK
- Transmitter unwanted emissions in the OOB domain
  GFSK
- 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: 2402 MHz to 2480 MHz
- 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: 1.148MHz
Occupied Channel Bandwidth 2:
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 normal and the extreme operating conditions that apply to the equipment:

Normal operating conditions (if applicable):
Operating temperature: 25 ° C
Other (please specify if applicable): ……
Extreme operating conditions:
Operating temperature range: Minimum: 0° C Maximum : 45° C
Other (please specify if applicable): …… Minimum: …… Maximum :……
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

■Internal PCB Antenna
Antenna Gain: 0dBi
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).

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: AC 230V/50Hz
□DC State DC voltage:

In case of DC, indicate the type of power source
■Internal Power Supply
□External Power Supply or AC/DC adapter
□Battery:
□Other: .....

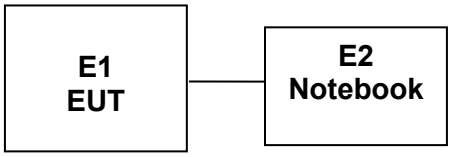
o) Describe the test modes available which can facilitate testing:
The EUT can be into the Engineer mode for testing.

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

1.5. Description Of Test Conditions

(1) EUT was tested in normal configuration (Please See following Block diagram)

1. Block diagram of EUT configuration



1.6. Test Conditions and Channel

	Normal Test Conditions	Extreme Test Conditions
Temperature	15°C - 35°C	0°C ~ 45°C Note: (1)
Relative Humidity	20% - 75%	N/A
Supply Voltage	AC 230V/50Hz	N/A

Test Channel	EUT Channel	Test Frequency (MHz)
lowest	CH00	2402
middle	CH39	2441
highest	CH78	2480

Note:

(1)Where tests at extreme temperatures are required, measurements shall be made over the extremes of the operating temperature range as declared by the manufacturer.
The HT 45°C and LT 0°C was declared by manufacturer, The EUT couldn't be operate normally with higher or lower temperature.

(2) The measurements are performed at the highest, middle, lowest available channels.

(3) The measurements are performed at worst mode for 1Mbps and 3Mbps.

1.7. Description Of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
E-1	Integrated Music System	ruark audio	R410	N/A	EUT
E-2	Notebook	Lenovo	300-15SK	GB14477457	AE

Item	Shielded Type	Ferrite Core	Length	Note

Note:

(1) The support equipment was authorized by Declaration of Confirmation.

(2) For detachable type I/O cable should be specified the length in m in『Length』column.

1.8. Equipments List for All Test Items

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
MXG Signal Analyzer	Keysight	N9020A	MY56070279	Apr 10,23	Apr 09,24
MIMO4TX-1	Keysight	MIMO4TX	TW5451101,TW5451102,TW5451103,TW5451104	Apr 11,22	Apr 10,24
MXG Vector Signal Generator	Agilent	N5182A	MY50143410	Apr 10,23	Apr 09,24
MXG Analog Signal Generator	Agilent	N5181B	MY53050432	Apr 10,23	Apr 09,24
Comprehensive tester	R&S	CMW500	106288	Apr 11,22	Apr 10,24
EMI Test Receiver	Rohde&Schwarz	ESCI	101156	Apr 12,22	Apr 11,24
TRILOG Broadband Antenna	Schwarzbeck	VULB 9168	00829	Apr 12,22	Apr 11,24
3m Semi-anechoic Chamber	ETS-LINDGREN	966	170326	Apr 11,22	Apr 10,24
RF Cable	Junkosha	MWX322-2m	1305G007	Apr 11,22	Apr 10,24
RF Cable	Junkosha	MWX322-8m	1305G008	Apr 11,22	Apr 10,24
MULTI-DEVICE Controller	ETS-LINDGREN	2090	126913	N/A	N/A
Antenna Holder	ETS-LINDGREN	2070B	00109601	N/A	N/A
EMI Test Receiver	Rohde&Schwarz	ESCI	101156	Apr 11,22	Apr 10,23
Horn Antenna	DAZE	ZN30701	11003	Apr 11,22	Apr 10,24
Spectrum Analyzer	Keysight	N9020A	MY56070279	Apr 11,22	Apr 10,24
3m anechoic Chamber	ETS-LINDGREN	966	170326	Apr 12,22	Apr 11,24
Signal Amplifier	ZHINAN	ZN3380C	11001	Apr 10,23	Apr 09,24
RF Cable	Junkosha	MWX322-1m	1305G006	Apr 11,22	Apr 10,24
RF Cable	Junkosha	MWX322-2m	1305G007	Apr 11,22	Apr 10,24
RF Cable	Junkosha	MWX322-8m	1305G008	Apr 11,22	Apr 10,24
MULTI-DEVICE Controller	ETS-LINDGREN	2090	126913	N/A	N/A
Antenna Holder	ETS-LINDGREN	2070B	00109601	N/A	N/A

2. RF Output Power

2.1. Limit

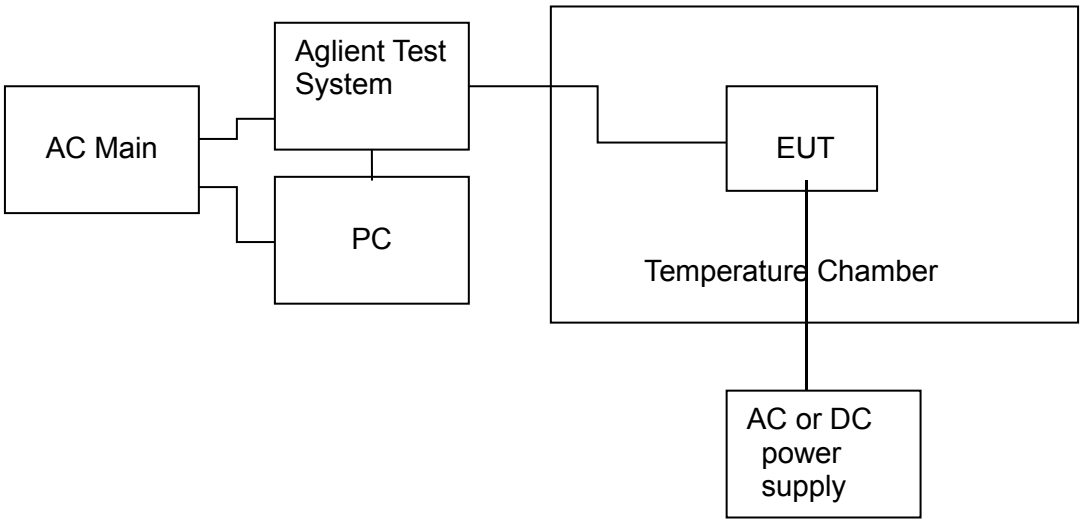
The maximum RF output power for adaptive Frequency Hopping equipment shall be equal to or less than 20 dBm.

The maximum RF output power for non-adaptive Frequency Hopping equipment shall be declared by the manufacturer. See clause 5.4.1). The maximum RF output power for this equipment shall be equal to or less than the value declared by the manufacturer. This declared value shall be equal to or less than 20 dBm.

This limit shall apply for any combination of power level and intended antenna assembly.

Limit
≤20dBm

2.2. Test Setup



2.3. Test Procedure

Refer to ETSI EN 300 328 V2.2.2 Clause 5.4.2
The conformance tests for this requirement are defined in clause 5.4.2 and specifically in clause 5.4.2.2.1.2.

2.4. Test Result

Temperature:	25°C	Relative Humidity:	60 %
Pressure:	1012 hPa	Test Voltage:	AC 230V/50Hz

Test Mode: GFSK					
TEST CONDITIONS			Total e.i.r.p (dBm)		
			CH00	CH39	CH78
Normal voltage	T nom (°C)	25.00	5.57	6.17	6.70
	T min (°C)	0.00	5.39	6.02	6.57
	T max (°C)	45.00	5.12	5.89	6.38
Max RF Power			**6.70**		
Limits			20dBm		
Result			**Complies**		

Test Mode: Pi/4 QPSK					
TEST CONDITIONS			Total e.i.r.p (dBm)		
			CH00	CH39	CH78
Normal voltage	T nom (°C)	25.00	4.80	5.56	6.30
	T min (°C)	0.00	4.63	5.41	6.18
	T max (°C)	45.00	4.51	5.23	6.07
Max RF Power			**6.30**		
Limits			20dBm		
Result			**Complies**		

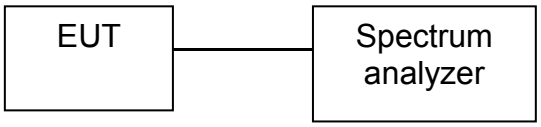
Test Mode: 8DPSK					
TEST CONDITIONS			Total e.i.r.p (dBm)		
			CH00	CH39	CH78
Normal voltage	T nom (°C)	25.00	4.67	5.50	5.98
	T min (°C)	0.00	4.41	5.39	5.71
	T max (°C)	45.00	4.23	5.16	5.58
Max RF Power			**5.98**		
Limits			20dBm		
Result			**Complies**		

3. Duty Cycle, Tx-sequence, Tx-gap

3.1. Limit

For non-adaptive FHSS equipment, the Duty Cycle shall be equal to or less than the maximum value declared by the manufacturer. In addition, the maximum Tx-sequence time shall be 5 ms while the minimum Tx-gap time shall be 5 ms.

3.2. Test Setup



3.3. Test Procedure

Refer to ETSI EN 300 328 V2.2.2 Clause 5.4.2
The conformance tests for this requirement are defined in clause 5.4.2 and specifically in clause 5.4.2.2.1.3.

3.4. Test Result

Not applicable
Note: The EUT belong to adaptive frequency hopping equipment and can not operate in a non-adaptive mode, the maximum ouput power of EUT less than 10dBm e.i.r.p. , so not applicable.

4. Accumulated Transmit Time, Frequency Occupation and Hopping Sequence

4.1. Limit

For Non-adaptive frequency hopping systems

The Accumulated Transmit Time on any hopping frequency shall not be greater than 15 ms within any observation period of 15 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.

In order for the 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 where N is either 5 or the result of 15 MHz divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater. According to clause 4.3.1.5.3.1 the minimum Hopping Frequency Separation for non-adaptive equipment is equal to the Occupied Channel Bandwidth with a minimum of 100 kHz.

For Adaptive frequency hopping systems

Adaptive Frequency Hopping 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.

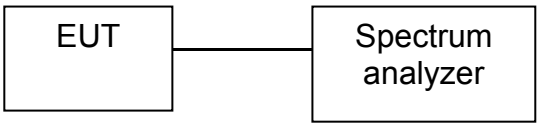
In order for the equipment to comply with the Frequency Occupation requirement, it shall meet either of the following two options:

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.

4.2. Test Setup



4.3. Test Procedure

Refer to ETSI EN 300 328 V2.2.2 Clause 5.4.4.
The conformance tests for this requirement are defined in clause 5.4.4 and specifically in clause 5.4.4.2.1.

Connect the UUT to the spectrum analyzer and use the following settings:

Centre Frequency :	Equal to the hopping frequency being investigated
Frequency Span :	0 Hz
RBW :	~ 50 % of the Occupied Channel Bandwidth
VBW :	≥ RBW
Detector :	RMS
Sweep Time :	Equal to the applicable observation period (see clause 4.3.1.4.3.1 or clause 4.3.1.4.3.2)
Number of sweep points :	30000
Trace Mode :	Clear / Write
Trigger :	Free Run

4.4. Test Result

Accumulated Transmit Time

Modulation	Packet Type	Channel	Dwell Time (ms)	Number of data points	Acc. Dwell Time (ms)	Limit (ms)	Result
GFSK	DH5	0	2.88	107	308.16	400	PASS
		39	2.88	107	308.16		PASS
		78	2.88	107	308.16		PASS
π/4DQPSK	2-DH5	0	2.89	107	309.23		PASS
		39	2.88	106	305.28		PASS
		78	2.89	107	309.23		PASS
8DPSK	3-DH5	0	2.89	106	306.34		PASS
		39	2.89	107	309.23		PASS
		78	2.89	107	309.23		PASS

Note:
Test Period: 400ms * Minimum number of hopping frequencies (N)
Accumulated Transmit Time = Time slot length (Dwell Time) * Number of data points within a test period

Frequency Occupation

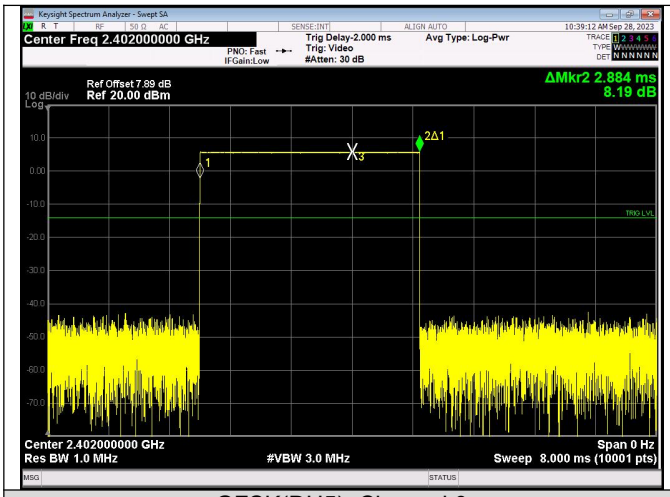
Modulation	Packet Type	Channel	Result [Num.]	Limit [Num.]	Result
GFSK	DH5	0	3	1	True
		39	3	1	True
		78	3	1	True
π/4DQPSK	2-DH5	0	3	1	True
		39	3	1	True
		78	3	1	True
8DPSK	3-DH5	0	3	1	True
		39	3	1	True
		78	3	1	True

Hopping Sequence

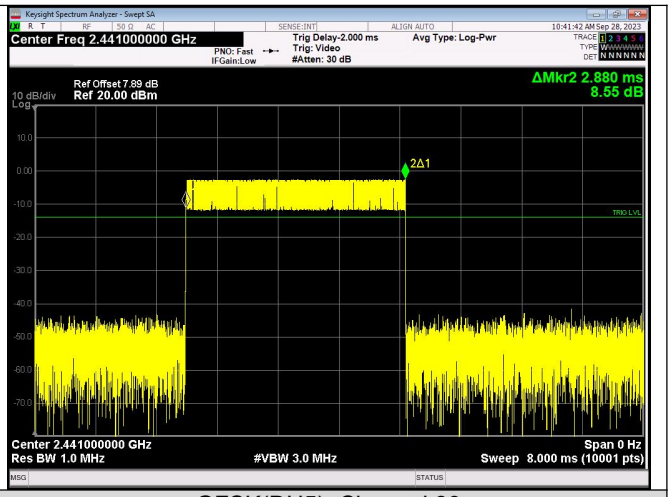
Modulation	Frequency Band	Number of Hopping Frequencies (N)	Limit	-20dB Points Occupied Bandwidth	Limit	Result
GFSK	2400 MHz to 2483.5 MHz	79	15	79.68	58.45MHz = 70% * 83.5MHz	PASS
		79		79.77		PASS
		79		79.73		PASS
π/4DQPSK		79		80.2		PASS
		79		80.23		PASS
		79		80.06		PASS
8DPSK		79		80.27		PASS
		79		80.27		PASS
		79		80.26		PASS

Test Graphs

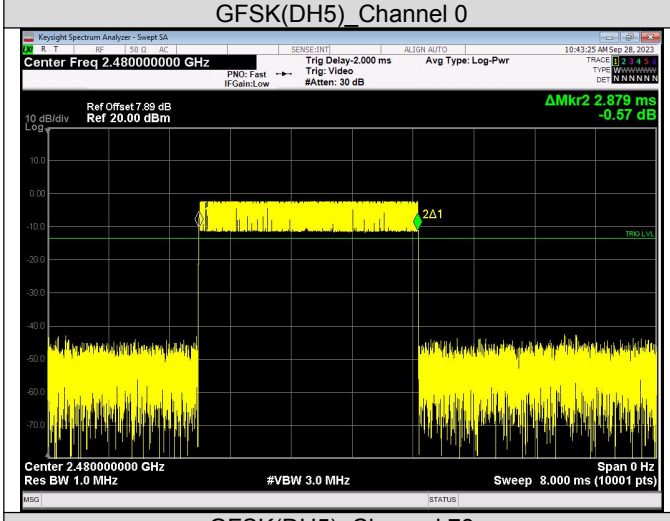
Dwell Time



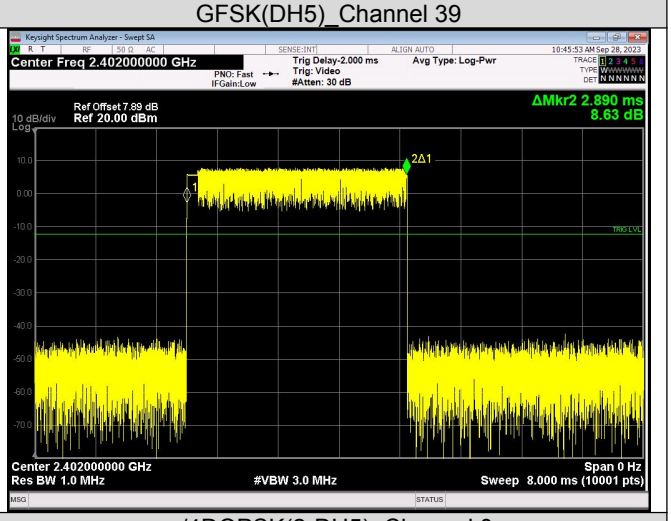
GFSK(DH5)_Channel 0



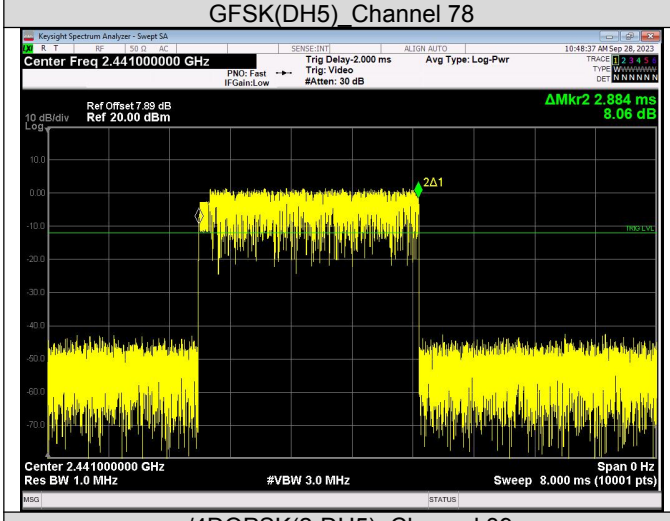
GFSK(DH5)_Channel 39



GFSK(DH5)_Channel 78



π/4DQPSK(2-DH5)_Channel 0



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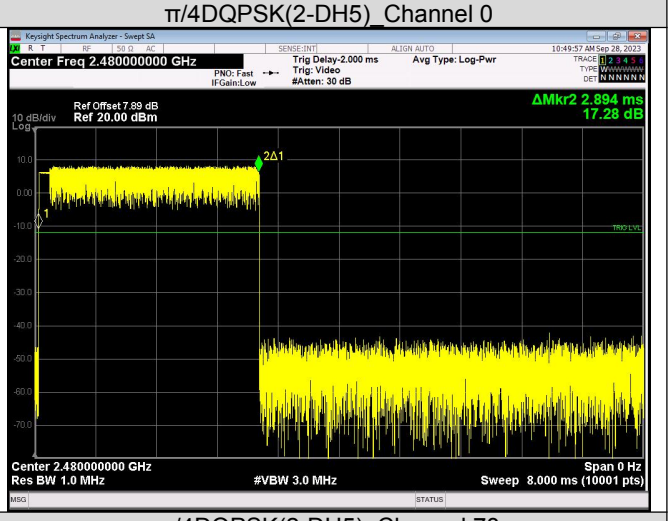
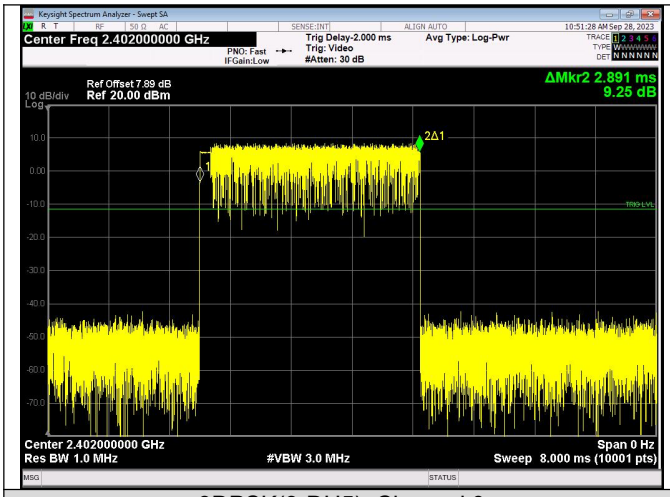
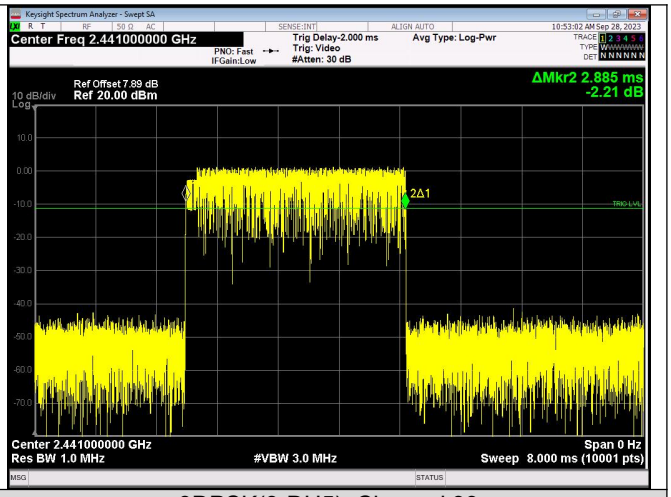


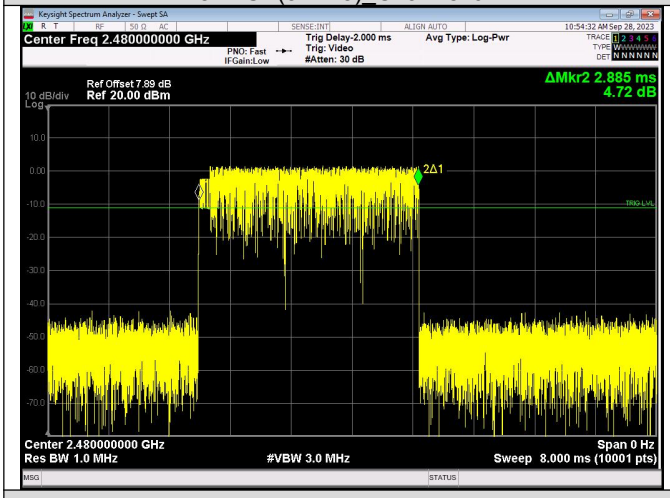
π/4DQPSK(2-DH5)_Channel 78



8DPSK(3-DH5)_Channel 0



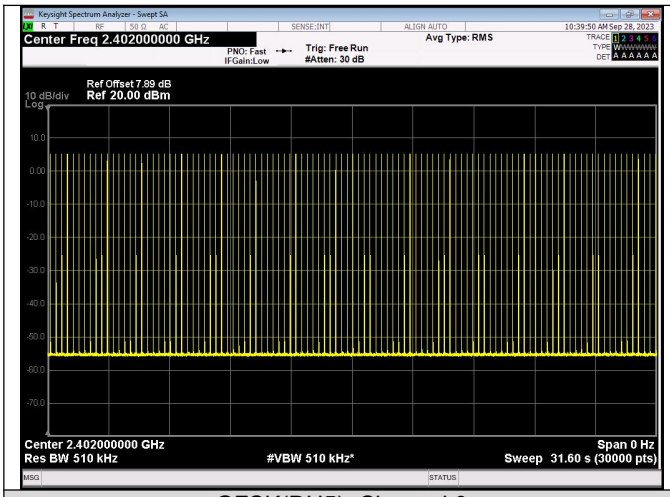
8DPSK(3-DH5)_Channel 39



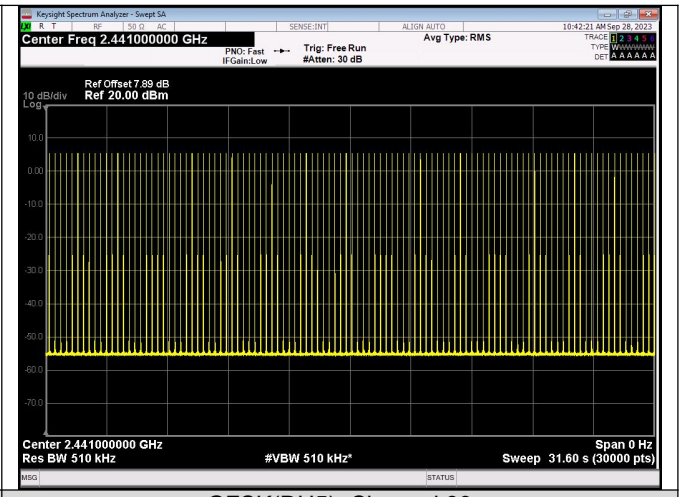
8DPSK(3-DH5)_Channel 78

Void

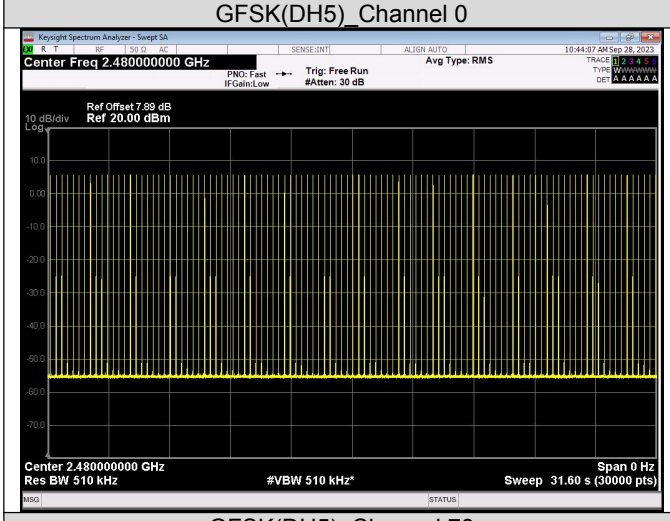
Accumulated Transmit Time



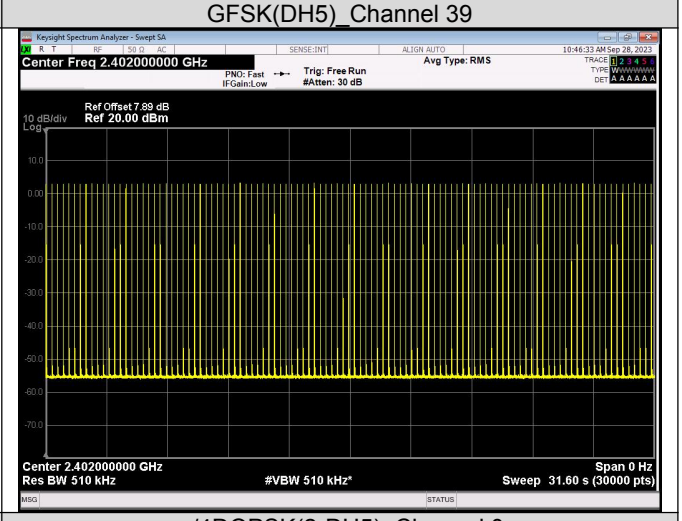
GFSK(DH5)_Channel 0



GFSK(DH5)_Channel 39



GFSK(DH5)_Channel 78



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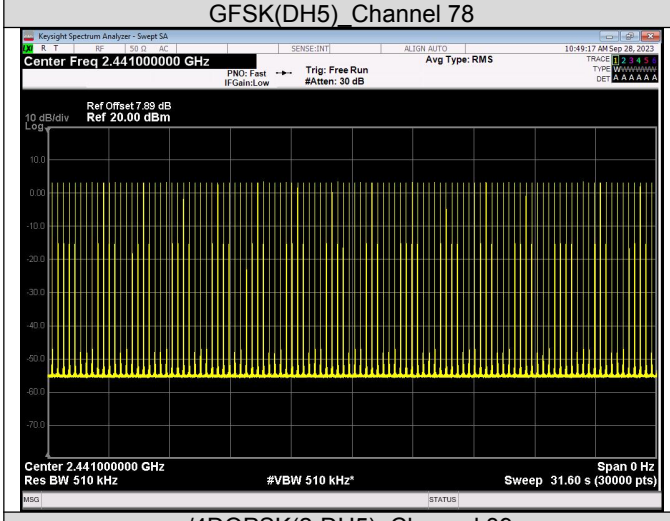
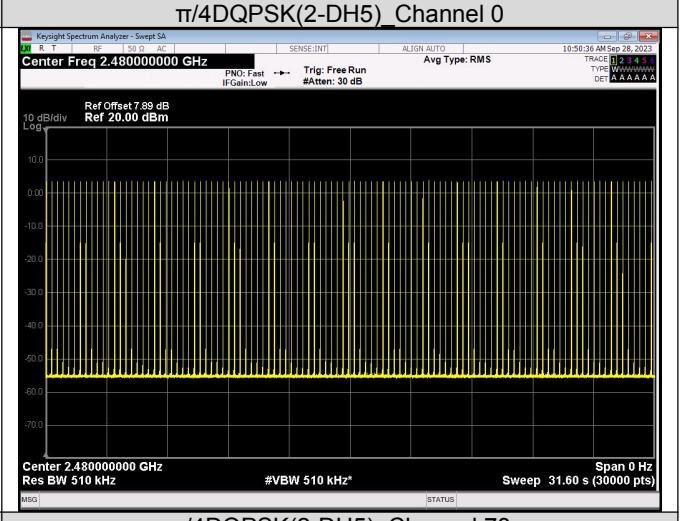
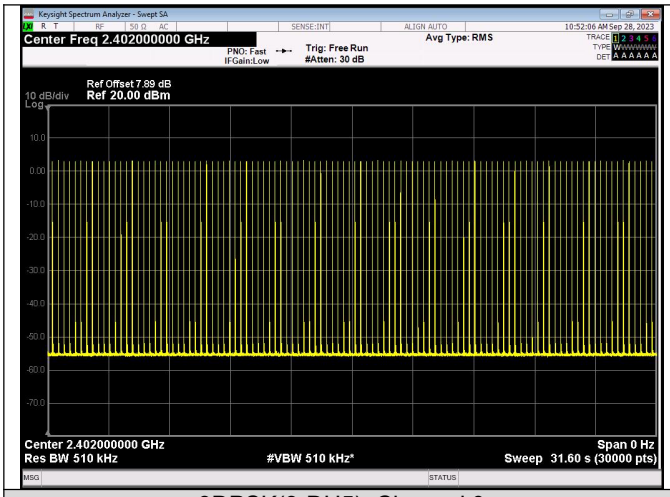


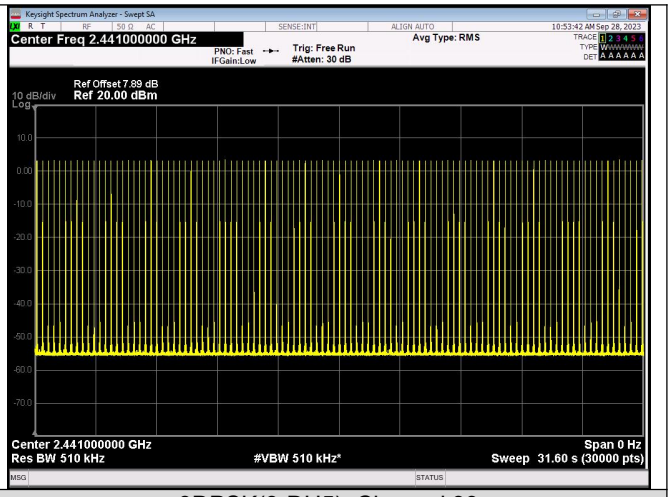
π/4DQPSK(2-DH5)_Channel 39



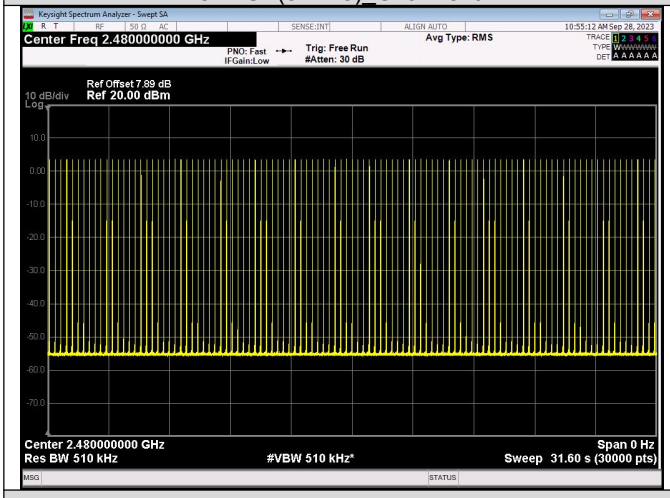
π/4DQPSK(2-DH5)_Channel 78



8DPSK(3-DH5)_Channel 0



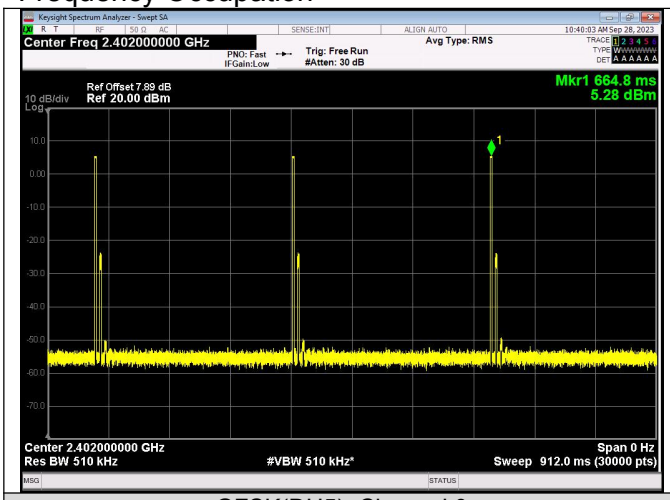
8DPSK(3-DH5)_Channel 39



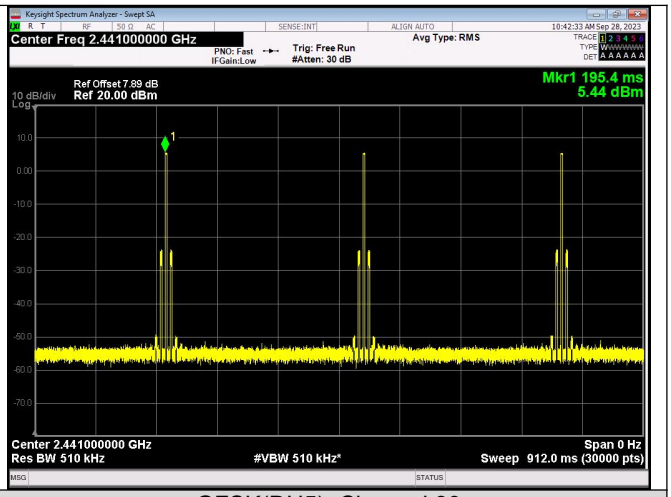
8DPSK(3-DH5)_Channel 78

Void

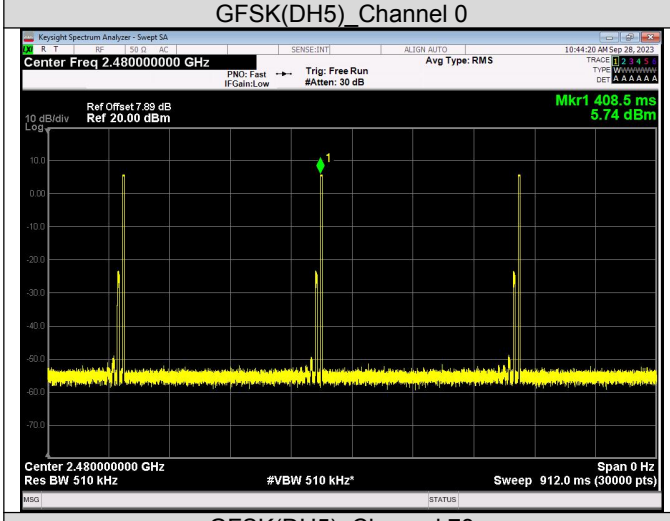
Frequency Occupation



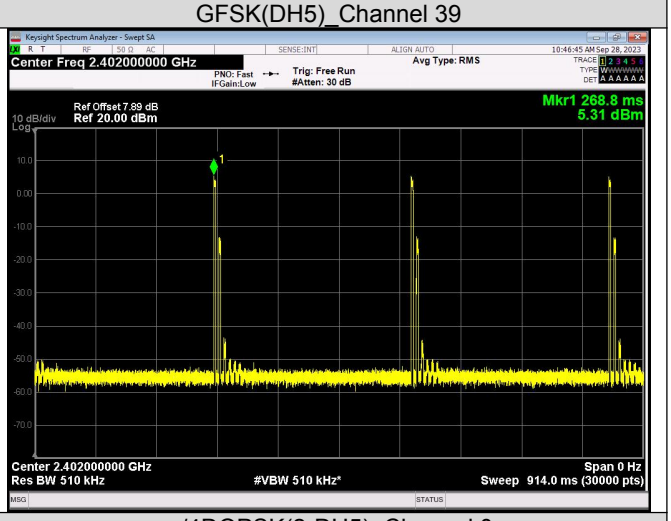
GFSK(DH5)_Channel 0



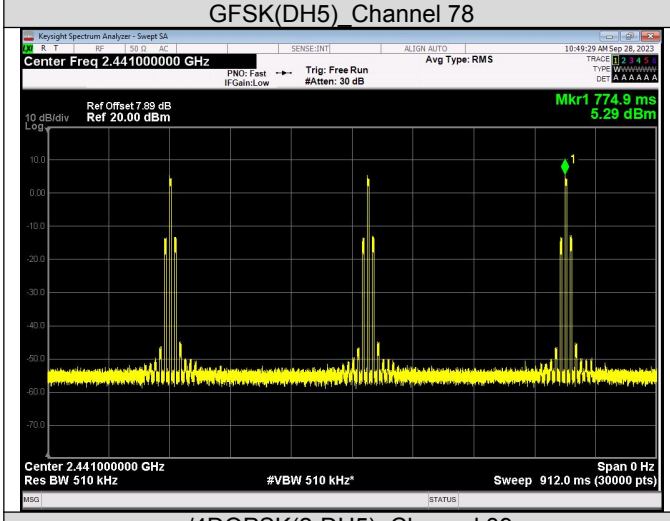
GFSK(DH5)_Channel 39



GFSK(DH5)_Channel 78



π/4DQPSK(2-DH5)_Channel 0



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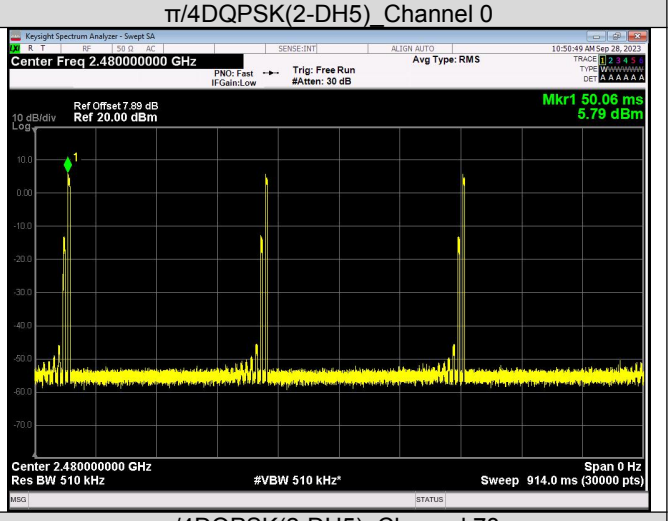
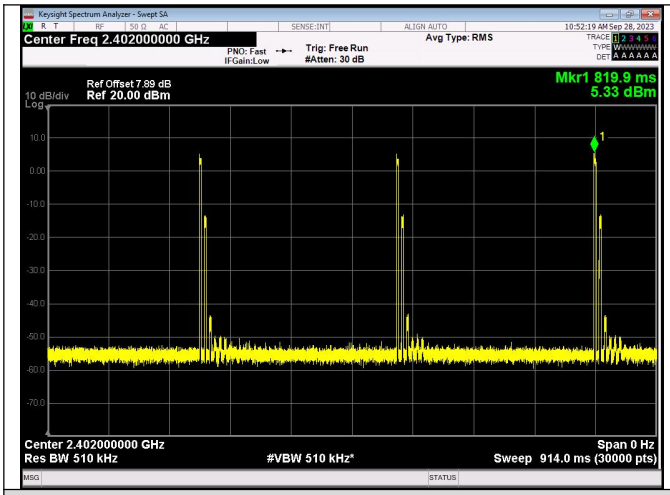
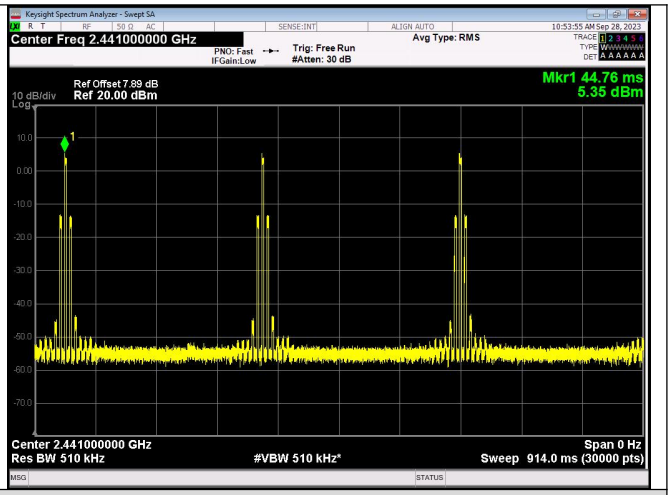


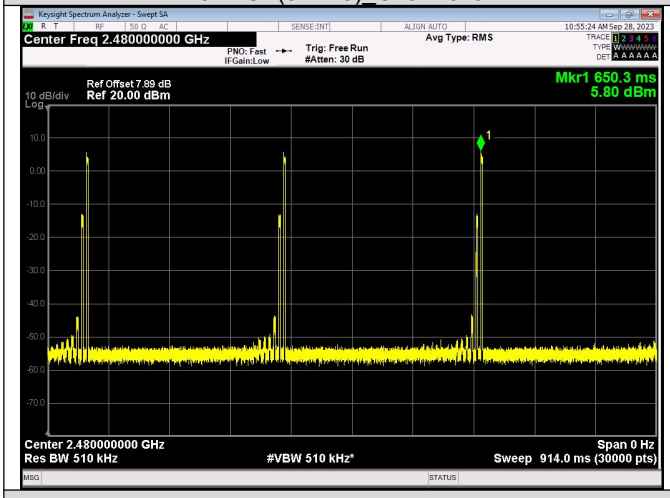
π/4DQPSK(2-DH5)_Channel 78



8DPSK(3-DH5)_Channel 0



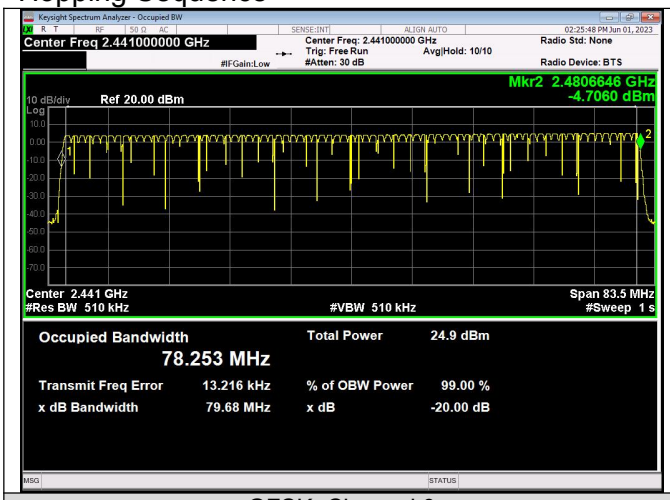
8DPSK(3-DH5)_Channel 39



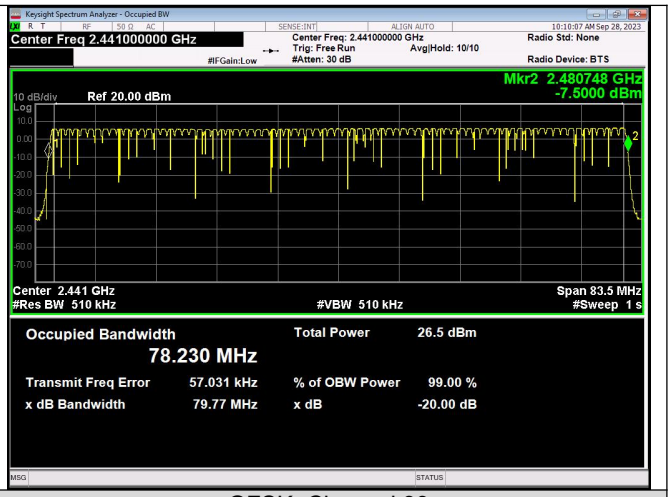
8DPSK(3-DH5)_Channel 78

Void

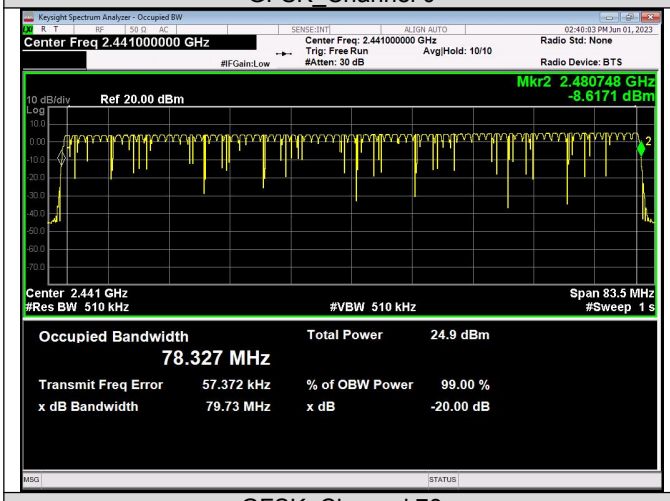
Hopping Sequence



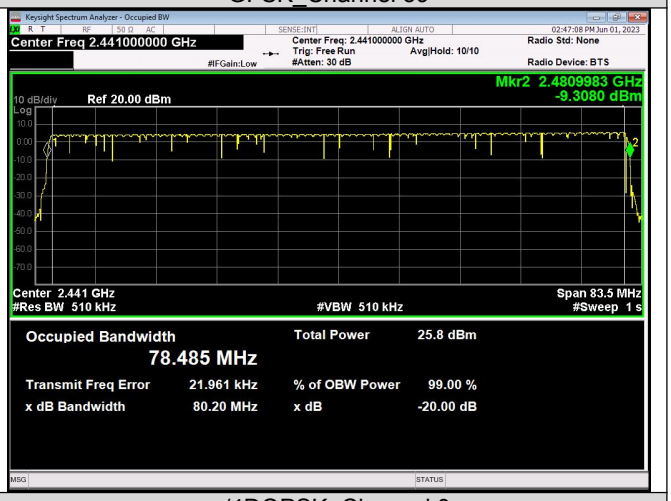
GFSK_Channel 0



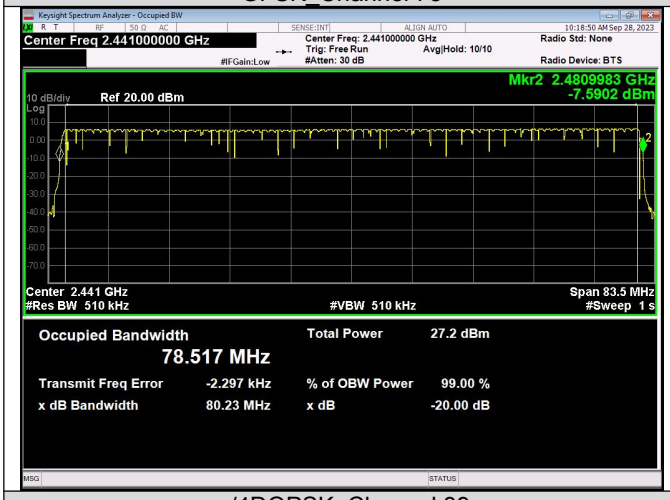
GFSK_Channel 39



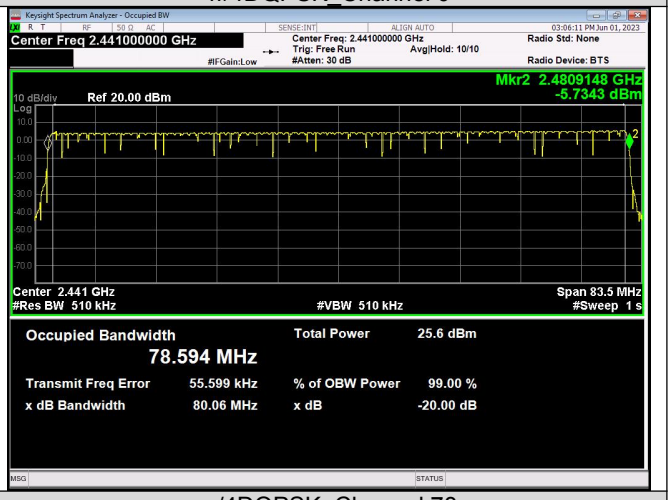
GFSK_Channel 78



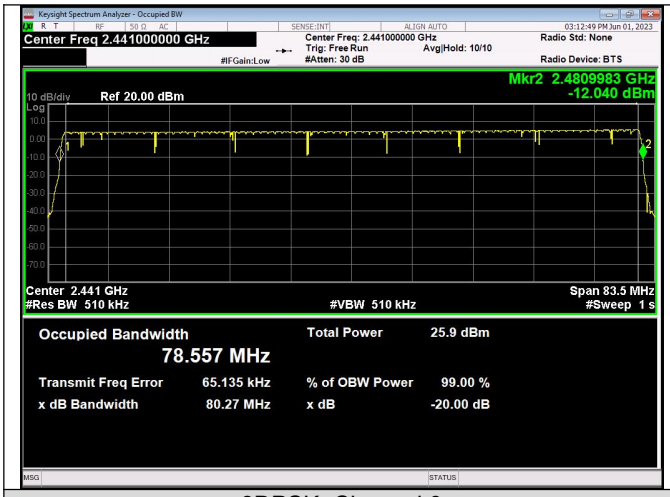
π/4DQPSK_Channel 0



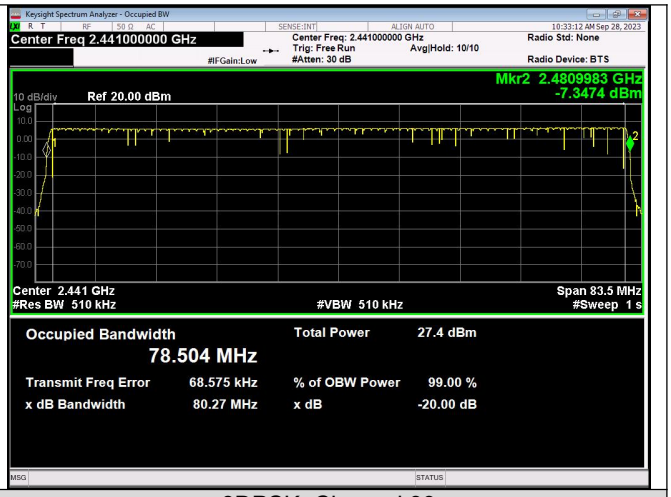
π/4DQPSK_Channel 39



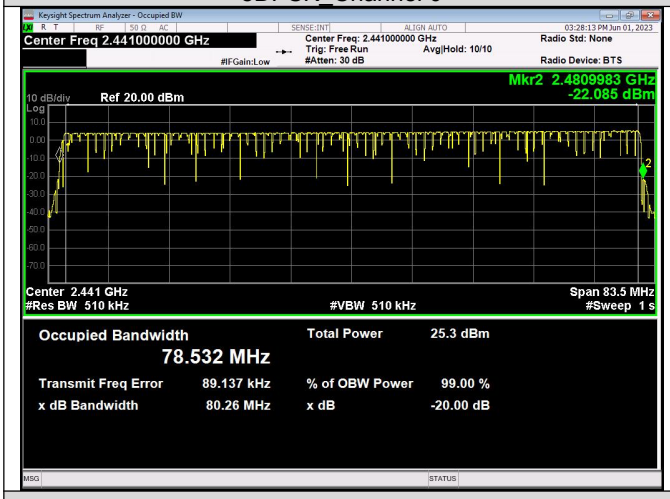
π/4DQPSK_Channel 78



8DPSK_Channel 0



8DPSK_Channel 39



8DPSK_Channel 78

Void

5. Hopping Frequency Separation

5.1. Limit

For Non-adaptive frequency hopping equipment

For non-adaptive Frequency Hopping equipment, the Hopping Frequency Separation shall be equal to or greater than the Occupied Channel Bandwidth (see clause 4.3.1.8), with a minimum separation of 100 kHz.

For equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for non-adaptive Frequency Hopping equipment operating in a mode where the RF Output power is less than 10 dBm e.i.r.p. only the minimum Hopping Frequency Separation of 100 kHz applies.

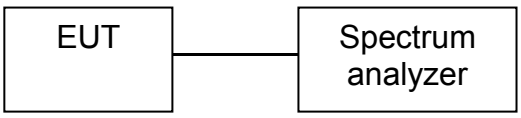
For Adaptive frequency hopping equipment

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

Adaptive Frequency Hopping equipment that switched to a non-adaptive mode for one or more hopping frequencies because interference was detected on these hopping frequencies with a level above the threshold level defined in clause 4.3.1.7.2.2, point 5 or clause 4.3.1.7.3.2, point 5, is allowed to continue to operate with a minimum Hopping Frequency Separation of 100 kHz as long as the interference remains present on these hopping frequencies. The equipment shall continue to operate in an adaptive mode on other hopping frequencies.

Adaptive Frequency Hopping equipment which decided to operate in a non-adaptive mode on one or more hopping frequencies without the presence of interference, shall comply with the limit for Hopping Frequency Separation for non-adaptive equipment defined in clause 4.3.1.5.3.1 (first paragraph) for these hopping frequencies as well as with all other requirements applicable to non-adaptive frequency hopping equipment.

5.2. Test Setup



5.3. Test Procedure

Refer to ETSI EN 300 328 V2.2.2 Clause 5.4.5.

The conformance tests for this requirement are defined in clause 5.4.5 and specifically in clause 5.4.5.2.1.

Connect the UUT to the spectrum analyzer and use the following settings:

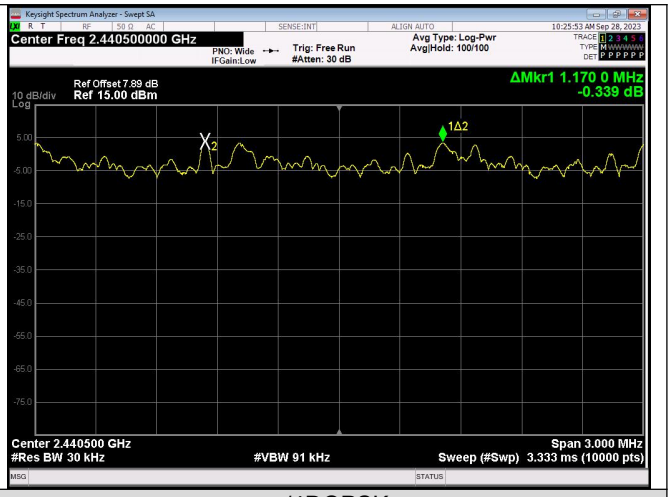
Centre Frequency	Centre of the two adjacent hopping frequencies
Frequency Span	Sufficient to see the complete power envelope of both hopping frequencies
RBW	1 % of the Span
VBW	3 × RBW (100KHz)
Detector	Max Peak
Trace	Max hold
Sweep time	Auto

5.4. Test Result

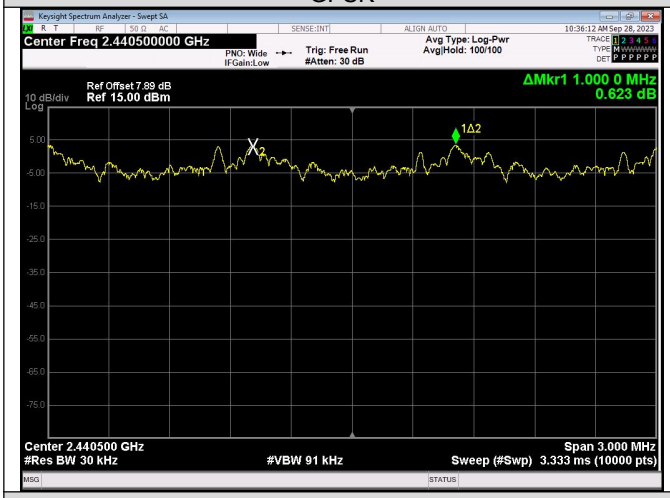
Modulation	Packet	Test Frequency (MHz)	Adjacent Frequency (MHz)	Channel Separation(MHz)	Limit (MHz)	Result
GFSK	DH1	2440	2441	1.0	≥ 0.1	PASS
π/4DQPSK	2-DH1	2440	2441	1.0	≥ 0.1	PASS
8DPSK	3-DH1	2440	2441	1.0	≥ 0.1	PASS

Test Graphs

GFSK



π/4DQPSK



8DPSK

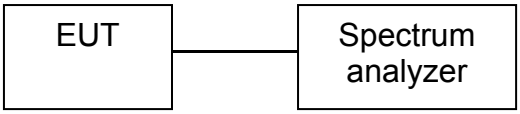
Void

6. Medium Utilization (MU) factor

6.1. Limit

The maximum Medium Utilization factor for non-adaptive Frequency Hopping equipment shall be 10 %.

6.2. Test Setup



6.3. Test Procedure

Refer to ETSI EN 300 328 V2.2.2 Clause 5.4.2
The conformance tests for this requirement are defined in clause 5.4.2 and specifically in clause 5.4.2.2.1.4.

6.4. Test Result

Not applicable
Note: The EUT belong to adaptive frequency hopping equipment and can not operate in a non-adaptive mode, the maximum ouput power of EUT less than 10dBm e.i.r.p. , so not applicable.

7. Adaptivity

7.1. Limit

Adaptive FHSS equipment using LBT shall comply with the following minimum set of requirements:

1) At the start of every dwell time, before transmission on a hopping frequency, the equipment shall perform a Clear Channel Assessment (CCA) check using energy detect. The CCA observation time shall be not less than 0,2 % of the Channel Occupancy Time with a minimum of 18 µs. If the equipment finds the hopping frequency to be clear, it may transmit immediately.

2) If it is determined that a signal is present with a level above the detection threshold defined in step 5 the hopping frequency shall be marked as 'unavailable'. Then the equipment may jump to the next frequency in the hopping scheme even before the end of the dwell time, but in that case the 'unavailable' channel cannot be considered as being 'occupied' and shall be disregarded with respect to the requirement of the minimum number of hopping frequencies as defined in clause 4.3.1.4.3.2. Alternatively, the equipment can remain on the frequency during the remainder of the dwell time. However, if the equipment remains on the frequency with the intention to transmit, it shall perform an Extended CCA check in which the (unavailable) channel is observed for a random duration between the value defined for the CCA observation time in step 1 and 5 % of the Channel Occupancy Time defined in step 3. If the Extended CCA check has determined the frequency to be no longer occupied, the hopping frequency becomes available again. 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.

3) The total time during which an equipment has transmissions on a given hopping frequency without re-evaluating the availability of that frequency is defined as the Channel Occupancy Time. The Channel Occupancy Time for a given hopping frequency, which starts immediately after a successful CCA, shall be less than 60 ms followed by an Idle Period of minimum 5 % of the Channel Occupancy Time with a minimum of 100 µs. After the Idle Period has expired, the procedure as in step 1 shall be repeated before having new transmissions on this hopping frequency during the same dwell time.

EXAMPLE: An equipment with a dwell time of 400 ms can have 6 transmission sequences of 60 ms each, separated with an Idle Period of 3 ms. Each transmission sequence was preceded with a successful CCA check of 120 µs.

For LBT based adaptive FHSS equipment with a dwell time < 60 ms, the maximum Channel Occupancy Time is limited by the dwell time.

4) 'Unavailable' channels may be removed from or may remain in the Hopping Sequence, but in any case: - apart from Short Control Signalling Transmissions referred to in clause 4.3.1.7.4, there shall be no transmissions on 'unavailable' channels; - a minimum of N hopping frequencies as defined in clause 4.3.1.4.3.2 shall always be maintained.

5) The detection threshold shall be proportional to the transmit power of the transmitter: for a 20 dBm e.i.r.p. transmitter the detection threshold level (TL) shall be equal to or less than -70 dBm/MHz at the input to the receiver assuming a 0 dBi (receive) antenna assembly. This threshold level (TL) may be corrected for the (receive) antenna assembly gain (G); however, beamforming gain (Y) shall not be taken into account. For power levels less than 20 dBm e.i.r.p., the detection threshold level may be relaxed to:

$$TL = -70 \text{ dBm/MHz} + 10 \times \log10 (100 \text{ mW} / P_{out}) \qquad (P_{out} \text{ in mW e.i.r.p.})$$

6) The equipment shall comply with the requirements defined in step 1 to step 4 of the present clause in the presence of an unwanted CW signal as defined in table 2.

Table 2: Unwanted Signal parameters

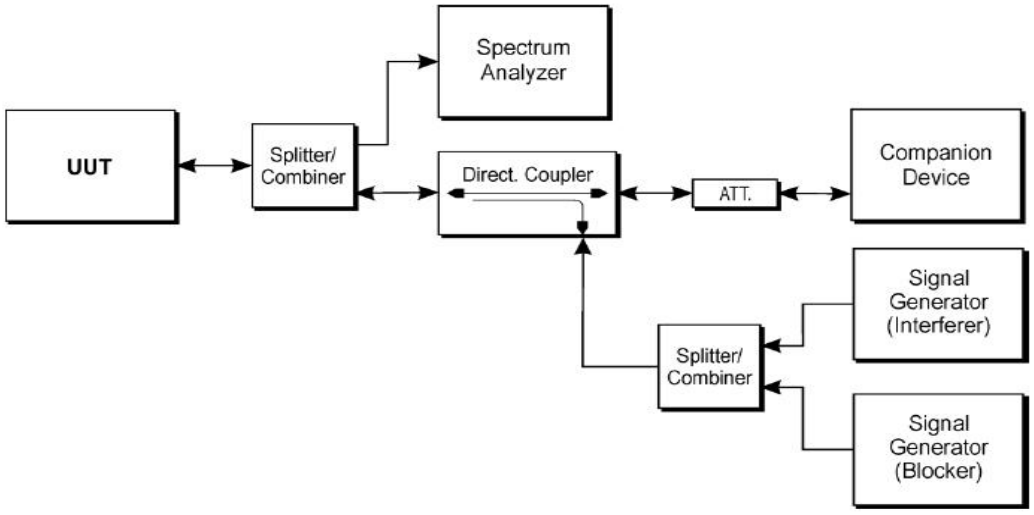
Wanted signal mean power from companion device		Unwanted CW signal power (dBm)
sufficient to maintain the link (see note 2)	2 395 or 2 488,5 (see note 1)	-35 (see note 3)

NOTE 1: The highest frequency shall be used for testing operating channels within the range 2 400 MHz to 2 442 MHz, while the lowest frequency shall be used for testing operating channels within the range 2 442 MHz to 2 483,5 MHz. See clause 5.4.6.1.

NOTE 2: A typical conducted value which can be used in most cases is -50 dBm/MHz.

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.

7.2. Test Setup



7.3. Test Procedure

Refer to ETSI EN 300 328 V2.2.2 Clause 5.4.6.

7.4. Test Result

Not applicable

Note:The maximum ouput power of EUT less than 10dBm e.i.r.p. , so not applicable.

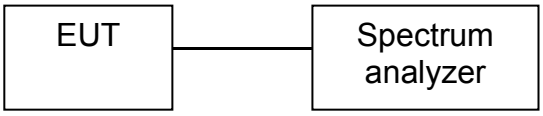
8. Occupied Channel Bandwidth

8.1. Limit

The Occupied Channel Bandwidth for each hopping frequency shall fall completely within the band between 2.4GHz to 2.4835GHz.

For non-adaptive Frequency Hopping equipment with e.i.r.p. greater than 10 dBm, the Occupied Channel Bandwidth for every occupied hopping frequency shall be equal to or less than the Nominal Channel Bandwidth declared by the manufacturer. See clause 5.4.1 j). This declared value shall not be greater than 5 MHz.

8.2. Test Setup



8.3. Test Procedure

Refer to ETSI EN 300 328 V2.2.2 Clause 5.4.7.

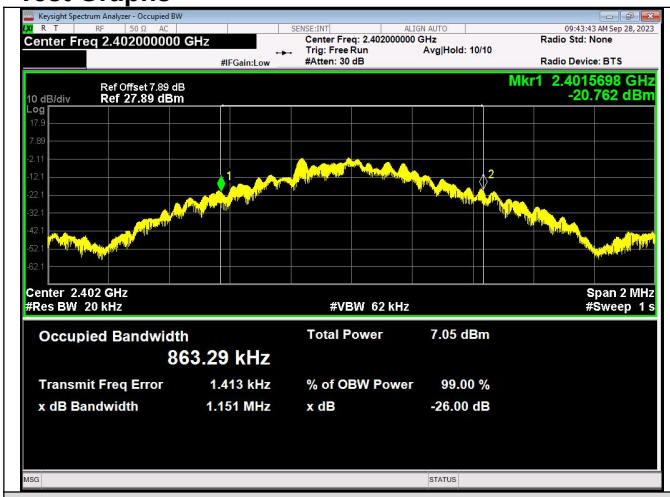
Connect the UUT to the spectrum analyzer and use the following settings:

Centre Frequency:	The centre frequency of the channel under test
Frequency Span:	2 × Nominal Channel Bandwidth
RBW:	~ 1 % of the span without going below 1 %
VBW:	3 × RBW
Detector Mode:	RMS
Trace Mode:	Max hold
Sweep time:	1 s

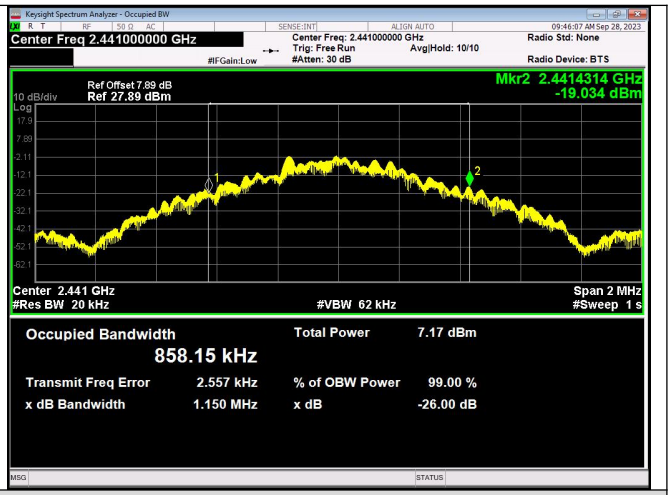
8.4. Test Result

Mode	Channel	Frequency (MHz)	Occupied Bandwidth (MHz)	FL (MHz)	FH (MHz)	Limit	Result
GFSK_DH1	0	2402	0.86330	2401.5698	2402.433	2400 MHz to 2483.5 MHz	PASS
	39	2441	0.85820	2440.5734	2441.4314		PASS
	78	2480	0.85940	2479.5732	2480.4326		PASS
π/4DQPSK_2-DH1	0	2402	1.1712	2401.402	2402.5732		PASS
	39	2441	1.1721	2440.401	2441.573		PASS
	78	2480	1.1718	2479.4018	2480.5736		PASS
8DPSK_3-DH1	0	2402	1.1663	2401.4298	2402.5958		PASS
	39	2441	1.1685	2440.4284	2441.5968		PASS
	78	2480	1.1652	2479.4308	2480.5958		PASS

Test Graphs

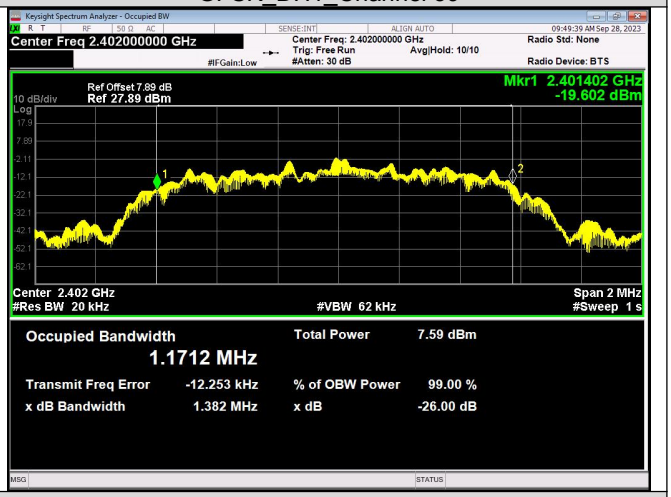


GFSK_DH1_Channel 0

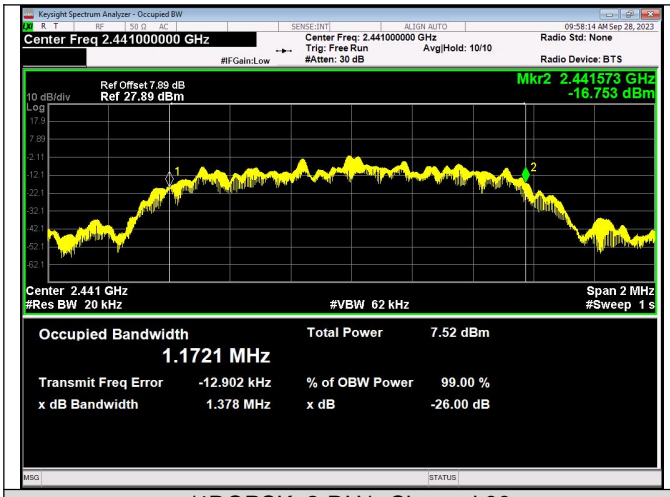


GFSK_DH1_Channel 39

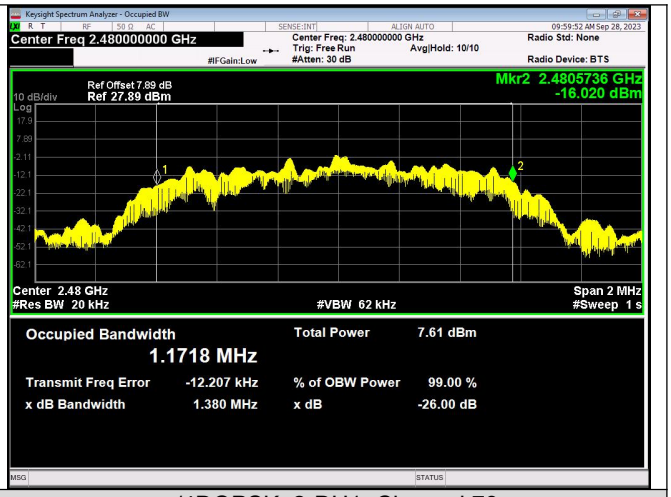
GFSK_DH1_Channel 78



π/4DQPSK_2-DH1_Channel 0

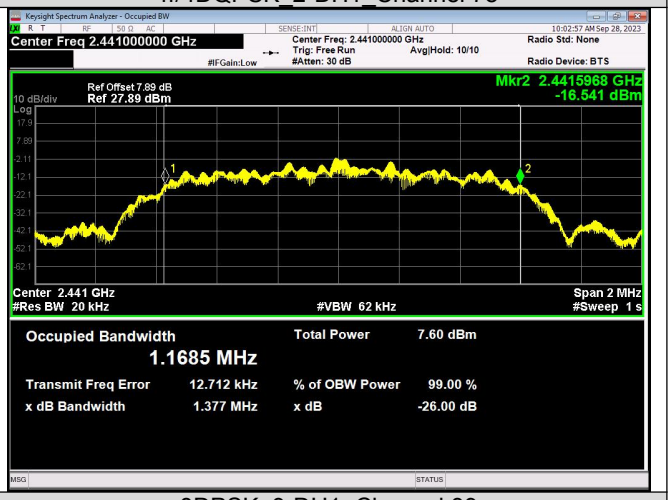


π/4DQPSK_2-DH1_Channel 39

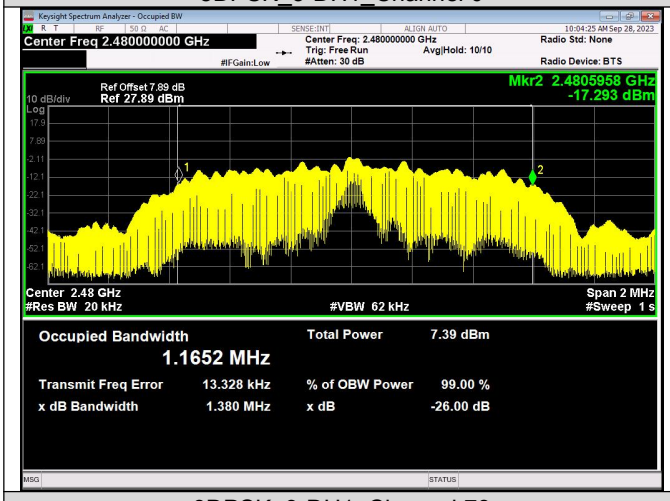


π/4DQPSK_2-DH1_Channel 78

8DPSK_3-DH1_Channel 0



8DPSK_3-DH1_Channel 39



8DPSK_3-DH1_Channel 78

Void

9. Transmitter unwanted emissions in the out-of-band domain

9.1. Limit

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

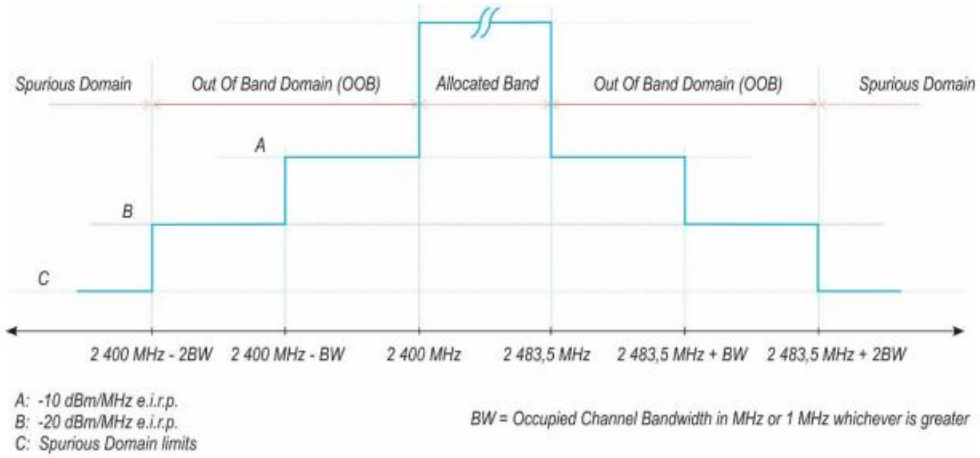


Figure 1: Transmit mask

9.2. Test Setup

The measurements were performed at normal environmental conditions. The measurement was performed at the lowest and the highest channel on which the equipment can operate.
The equipment was configured to operate under its worst case situation with respect to output power.
In case of conducted measurements the transmitter shall be connected to the measuring equipment via a suitable attenuator. The frequency has to be recorded for the right and left end above threshold of highest and lowest channel respectively.

9.3. Test Procedure

Refer to ETSI EN 300 328 V2.2.2 Clause 5.4.8.

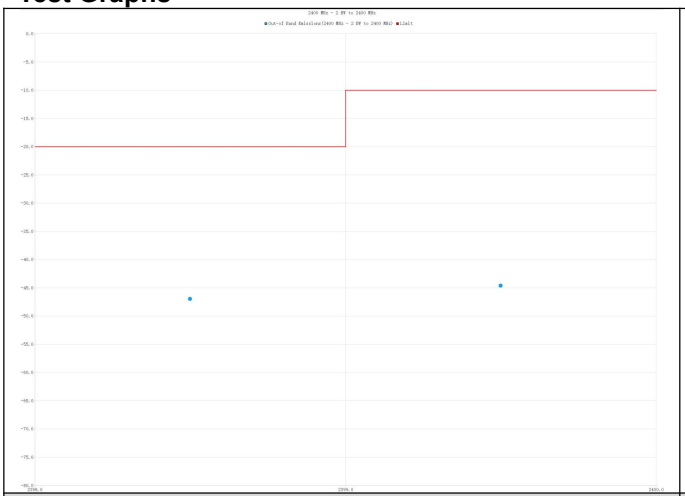
Connect the UUT to the spectrum analyzer and use the following settings:

Centre Frequency:	2484 MHz
Span	0Hz
RBW/ VBW	1MHz/3MHz
Filter Mode	Channel filter
Sweep Mode	Continuous
Sweep Points	Sweep Time [s] / (1 µs) or 5 000 whichever is greater
Detector	RMS
Trace Mode	Max Hold
Trigger Mode	Video trigger; in case video triggering is not possible, an external trigger source may be used
Sweep Time:	> 120 % of the duration of the longest burst detected during the measurement of the RF Output Power

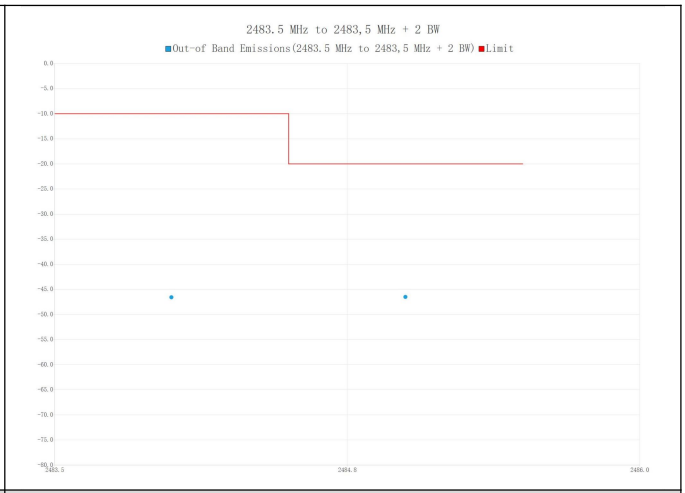
9.4. Test Result

Mode	Channel	Test Freq. (MHz)	OOB Emission (dBm)	Segments	Limit (dBm)	Margin (dB)	Result
GFSK_DH1	Hopping	2399.5	-44.653	2 400 MHz - BW to 2 400 MHz	-10	-34.65	PASS
		2398.5	-46.998	2 400 MHz - 2 BW to 2 400 MHz - BW	-20	-27.0	PASS
		2484	-46.63	2 483,5 MHz to 2 483,5 MHz + BW	-10	-36.63	PASS
		2485	-46.56	2 483,5 MHz + BW to 2 483,5 MHz + 2 BW	-20	-26.56	PASS
π/4DQPSK_2-DH1		2399.5	-35.639	2 400 MHz - BW to 2 400 MHz	-10	-25.64	PASS
		2398.5	-42.81	2 400 MHz - 2 BW to 2 400 MHz - BW	-20	-22.81	PASS
		2484	-44.564	2 483,5 MHz to 2 483,5 MHz + BW	-10	-34.56	PASS
		2485	-44.713	2 483,5 MHz + BW to 2 483,5 MHz + 2 BW	-20	-24.71	PASS
8DPSK_3-DH1		2399.5	-35.847	2 400 MHz - BW to 2 400 MHz	-10	-25.85	PASS
		2398.5	-42.329	2 400 MHz - 2 BW to 2 400 MHz - BW	-20	-22.33	PASS
		2484	-42.659	2 483,5 MHz to 2 483,5 MHz + BW	-10	-32.66	PASS
		2485	-42.491	2 483,5 MHz + BW to 2 483,5 MHz + 2 BW	-20	-22.49	PASS

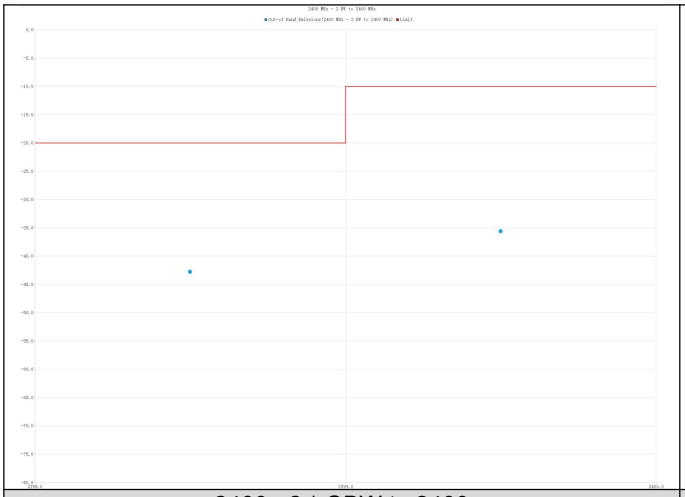
Test Graphs



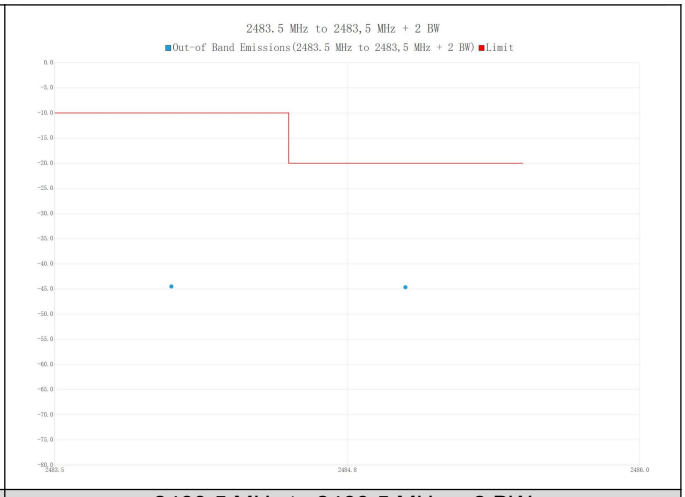
2400 - 2 * OBW to 2400
GFSK_DH1



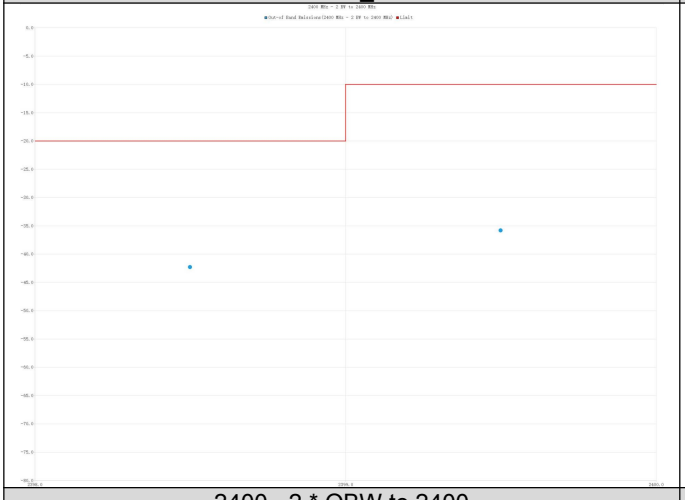
2483.5 MHz to 2483,5 MHz + 2 BW
GFSK_DH1



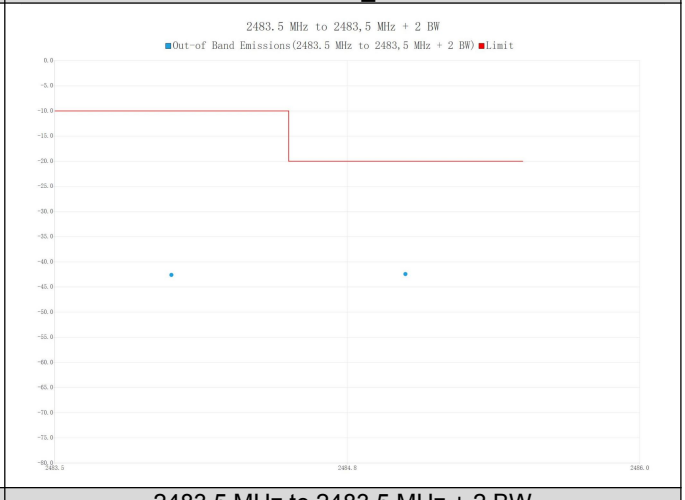
2400 - 2 * OBW to 2400
π/4DQPSK_2-DH1



2483.5 MHz to 2483,5 MHz + 2 BW
π/4DQPSK_2-DH1



2400 - 2 * OBW to 2400
8DPSK_3-DH1



2483.5 MHz to 2483,5 MHz + 2 BW
8DPSK_3-DH1

10. Transmitter unwanted emissions in the spurious domain

10.1. Applied Procedures / Limit

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

10.2. Measuring Instruments and Setting

The following table is the setting of the Spectrum Analyzer.

The emissions over the range 30 MHz to 1 000 MHz shall be identified.

Spectrum Analyzer	Setting
Start Frequency	30 MHz
Stop Frequency	1000 MHz
Detector Mode	Peak
Trace Mode	Max Hold
Filter type	3 dB (Gaussian)
RBW / VBW	100 kHz / 300 kHz
Sweep Points	≥ 19 400

The emissions over the range 1 GHz to 12.75 GHz shall be identified.

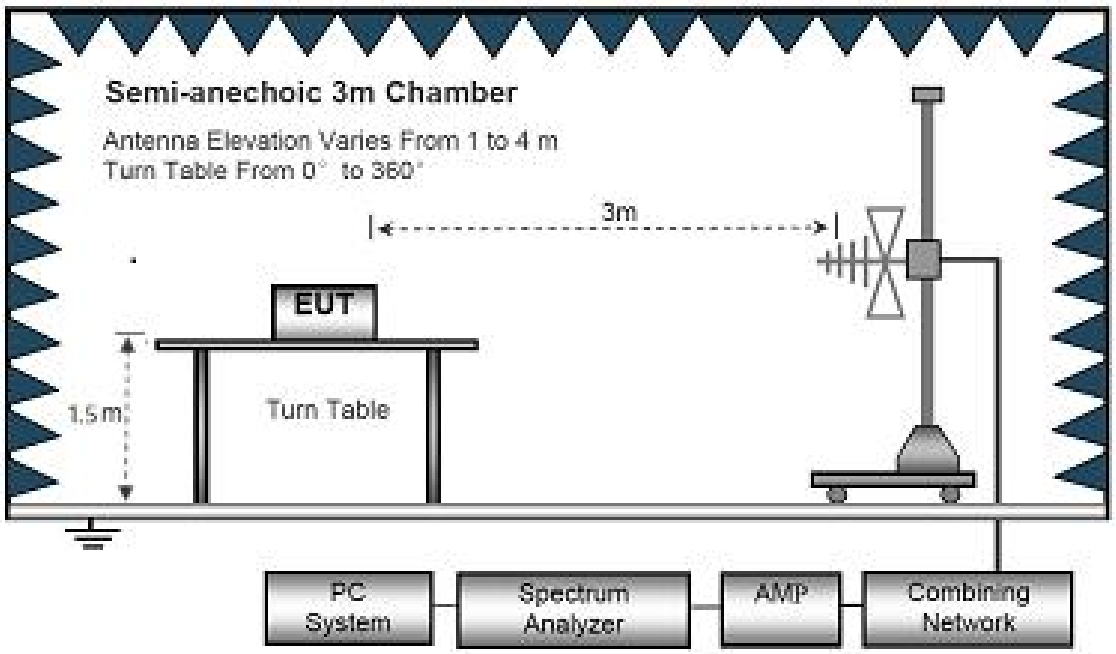
Spectrum Analyzer	Setting
Start Frequency	1 GHz
Stop Frequency	12.75 GHz
Detector Mode	Peak
Trace Mode	Max Hold
Filter type	3 dB (Gaussian)
RBW / VBW	1 MHz / 3 MHz
Sweep Points	≥ 23 500

10.3. Test Procedures

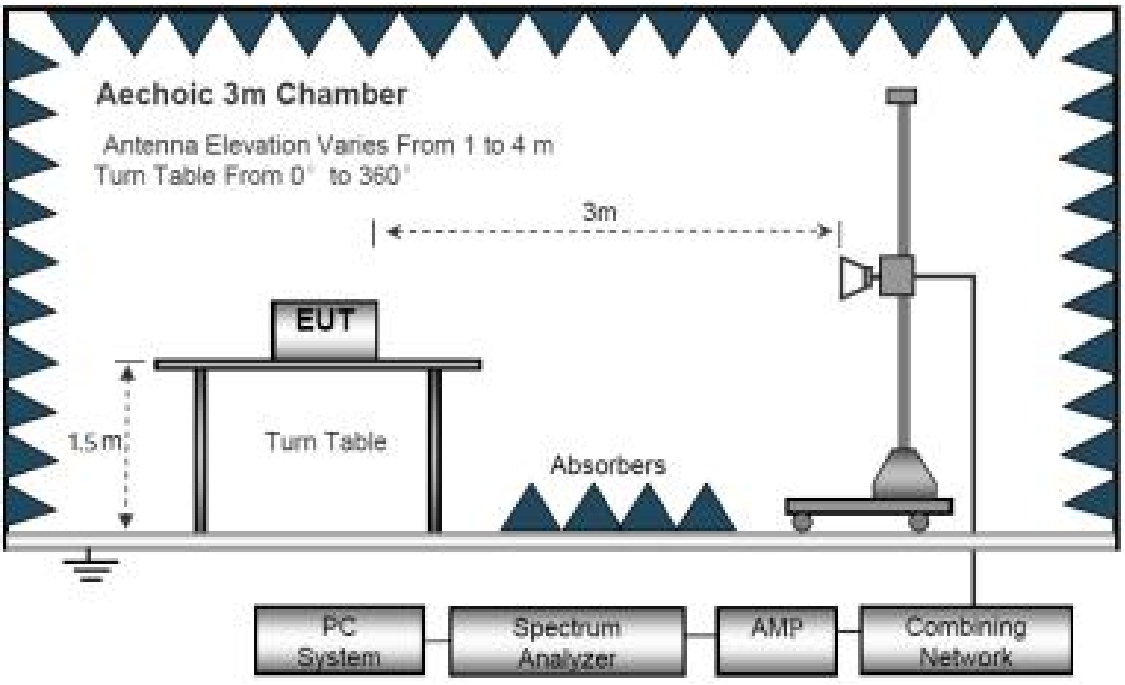
Refer to EN 300 328 V2.2.2 Clause 5.4.9.

10.4. Test Setup

Below 1GHz



Above 1GHz



11.5. Test Results

The worst test mode is GFSK, and the test data are record as below:

Below 1GHz

Test Mode: GFSK-CH00			
Temperature:	25°C	Relative Humidity:	60 %
Pressure:	1012 hPa	Test Voltage:	AC 230V/50Hz

Frequency (MHz)	Reading (dBm)	Correct Factor(dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark	Polarization
130.2106	-57.63	11.51	-46.12	-36	-10.12	peak	Horizontal
241.0326	-58.41	13.21	-45.20	-36	-9.20	peak	Horizontal
385.0126	-59.16	13.38	-45.78	-36	-9.78	peak	Horizontal
518.4025	-77.84	14.55	-63.29	-54	-9.29	peak	Horizontal
590.2031	-78.13	15.09	-63.04	-54	-9.04	peak	Horizontal
681.0253	-79.46	16.57	-62.89	-54	-8.89	peak	Horizontal
89.6532	-73.51	10.36	-63.15	-54	-9.15	peak	Vertical
268.3411	-58.62	13.11	-45.51	-36	-9.51	peak	Vertical
435.2102	-58.39	13.23	-45.16	-36	-9.16	peak	Vertical
523.1026	-77.41	14.32	-63.09	-54	-9.09	peak	Vertical
623.2501	-77.63	14.98	-62.65	-54	-8.65	peak	Vertical
671.2451	-78.01	16.45	-61.56	-54	-7.56	peak	Vertical

Test Mode: GFSK-CH78			
Temperature:	25°C	Relative Humidity:	60 %
Pressure:	1012 hPa	Test Voltage:	AC 230V/50Hz

Frequency (MHz)	Reading (dBm)	Correct Factor(dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark	Polarization
123.0514	-56.39	11.51	-44.88	-36	-8.88	peak	Horizontal
249.6352	-58.23	13.20	-45.03	-36	-9.03	peak	Horizontal
368.2101	-57.43	13.37	-44.06	-36	-8.06	peak	Horizontal
530.0214	-77.63	14.52	-63.11	-54	-9.11	peak	Horizontal
628.4153	-77.41	15.06	-62.35	-54	-8.35	peak	Horizontal
683.0214	-78.53	16.59	-61.94	-54	-7.94	peak	Horizontal
98.5012	-72.56	10.38	-62.18	-54	-8.18	peak	Vertical
263.2014	-57.83	13.15	-44.68	-36	-8.68	peak	Vertical
421.0236	-58.44	13.31	-45.13	-36	-9.13	peak	Vertical
541.0236	-76.36	14.29	-62.07	-54	-8.07	peak	Vertical
633.2014	-77.94	14.88	-63.06	-54	-9.06	peak	Vertical
679.5416	-78.19	16.34	-61.85	-54	-7.85	peak	Vertical

Note:
1. The emission behaviour belongs to narrowband spurious emission.
2. Calculation of result is: Result (dBm)= Reading (dBm)+ Correct Factor (dB)
3. GFSK mode is the worst mode and its data have been recorded in this report.

Above 1GHz

Test Mode: GFSK-CH00			
Temperature:	25°C	Relative Humidity:	60 %
Pressure:	1012 hPa	Test Voltage:	AC 230V/50Hz

Frequency (MHz)	Reading (dBm)	Correct Factor(dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark	Polarization
4804.211	-57.63	17.99	-39.64	-30	-9.64	peak	Horizontal
6342.012	-58.43	19.99	-38.44	-30	-8.44	peak	Horizontal
7816.023	-59.63	20.58	-39.05	-30	-9.05	peak	Horizontal
9153.201	-62.15	24.35	-37.8	-30	-7.8	peak	Horizontal
10523.269	-65.37	27.66	-37.71	-30	-7.71	peak	Horizontal
11023.514	-69.87	32.09	-37.78	-30	-7.78	peak	Horizontal
4804.263	-57.16	17.99	-39.17	-30	-9.17	peak	Vertical
6485.326	-58.33	19.99	-38.34	-30	-8.34	peak	Vertical
7233.514	-59.61	20.58	-39.03	-30	-9.03	peak	Vertical
9016.543	-62.53	24.35	-38.18	-30	-8.18	peak	Vertical
10256.346	-66.83	27.66	-39.17	-30	-9.17	peak	Vertical
11035.264	-70.52	32.09	-38.43	-30	-8.43	peak	Vertical

Test Mode: GFSK-CH78			
Temperature:	25°C	Relative Humidity:	60 %
Pressure:	1012 hPa	Test Voltage:	AC 230V/50Hz

Frequency (MHz)	Reading (dBm)	Correct Factor(dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark	Polarization
4960.325	-57.63	18.55	-39.08	-30	-9.08	peak	Horizontal
6235.104	-58.61	20.39	-38.22	-30	-8.22	peak	Horizontal
7316.025	-60.23	21.66	-38.57	-30	-8.57	peak	Horizontal
8635.241	-62.85	24.56	-38.29	-30	-8.29	peak	Horizontal
9152.016	-66.49	28.38	-38.11	-30	-8.11	peak	Horizontal
11423.516	-70.32	32.63	-37.69	-30	-7.69	peak	Horizontal
4960.023	-58.63	18.55	-40.08	-30	-10.08	peak	Vertical
6158.234	-59.71	20.39	-39.32	-30	-9.32	peak	Vertical
7263.014	-59.33	21.66	-37.67	-30	-7.67	peak	Vertical
9025.316	-62.51	24.56	-37.95	-30	-7.95	peak	Vertical
9532.546	-66.30	28.38	-37.92	-30	-7.92	peak	Vertical
110243.653	-70.85	32.63	-38.22	-30	-8.22	peak	Vertical

Note:
1. The emission behaviour belongs to narrowband spurious emission.
2. Calculation of result is: Result (dBm)= Reading (dBm)+ Correct Factor (dB)
3. GFSK mode is the worst mode and its data have been recorded in this report.

11. Receiver spurious emissions

11.1. Applied Procedures / Limit

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

Clause	Frequency range	Maximum power	Bandwidth
4.3.1.11.3	30MHz-1GHz	-57dBm	100kHz
	1GHz -12.75GHz	-47dBm	1MHz

11.2. Measuring Instruments and Setting

The following table is the setting of the Spectrum Analyzer.

The emissions over the range 30 MHz to 1 000 MHz shall be identified.

Spectrum Analyzer	Setting
Start Frequency	30 MHz
Stop Frequency	1000 MHz
Detector Mode	Peak
Trace Mode	Max Hold
Filter type	3 dB (Gaussian)
RBW / VBW	100 kHz / 300 kHz
Sweep Points	≥ 19 400

The emissions over the range 1 GHz to 12.75 GHz shall be identified.

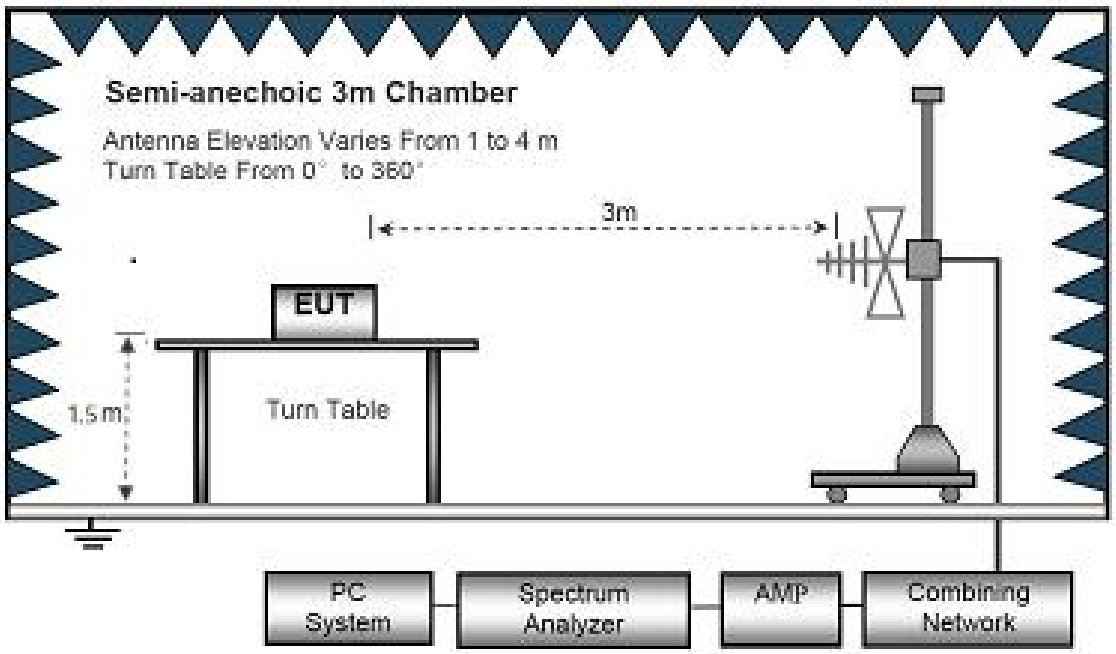
Spectrum Analyzer	Setting
Start Frequency	1 GHz
Stop Frequency	12.75 GHz
Detector Mode	Peak
Trace Mode	Max Hold
Filter type	3 dB (Gaussian)
RBW / VBW	1 MHz / 3 MHz
Sweep Points	≥ 23 500

11.3. Test Procedures

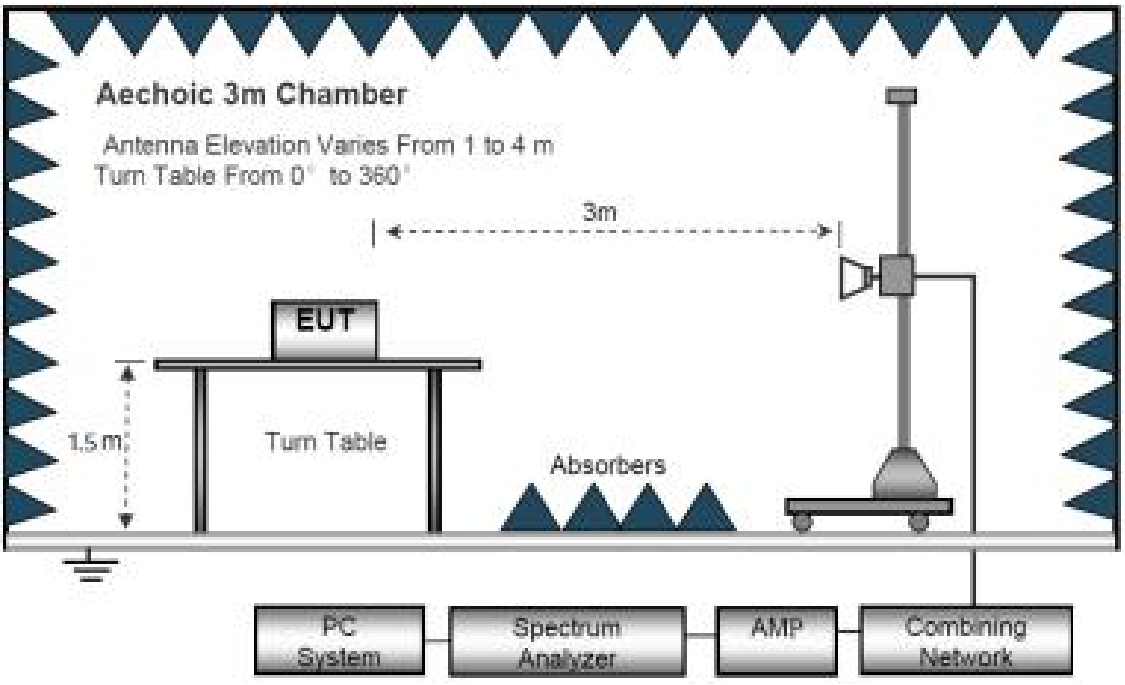
Refer to EN 300 328 V2.2.2 Clause 5.4.10.

11.4. Test Setup

Below 1GHz



Above 1GHz



12.5. Test Results

Below 1GHz

Test Mode: GFSK-CH00			
Temperature:	25°C	Relative Humidity:	60 %
Pressure:	1012 hPa	Test Voltage:	AC 230V/50Hz

Frequency (MHz)	Reading (dBm)	Correct Factor(dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark	Polarization
122.0136	-77.53	11.68	-65.85	-57	-8.85	peak	Horizontal
274.6315	-78.64	13.24	-65.4	-57	-8.4	peak	Horizontal
531.0263	-79.54	14.68	-64.86	-57	-7.86	peak	Horizontal
615.4283	-79.63	15.21	-64.42	-57	-7.42	peak	Horizontal
736.2014	-80.32	15.62	-64.7	-57	-7.7	peak	Horizontal
914.0236	-81.42	16.98	-64.44	-57	-7.44	peak	Horizontal
142.0136	-75.96	10.01	-65.95	-57	-8.95	peak	Vertical
316.0412	-78.32	13.44	-64.88	-57	-7.88	peak	Vertical
578.3602	-79.65	14.15	-65.5	-57	-8.5	peak	Vertical
621.0355	-80.23	15.08	-65.15	-57	-8.15	peak	Vertical
908.4966	-80.23	15.71	-64.52	-57	-7.52	peak	Vertical
935.2041	-80.46	16.21	-64.25	-57	-7.25	peak	Vertical

Test Mode: GFSK-CH78			
Temperature:	25°C	Relative Humidity:	60 %
Pressure:	1012 hPa	Test Voltage:	AC 230V/50Hz

Frequency (MHz)	Reading (dBm)	Correct Factor(dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark	Polarization
213.6254	-78.63	13.15	-65.48	-57	-8.48	peak	Horizontal
348.6203	-78.36	13.57	-64.79	-57	-7.79	peak	Horizontal
463.2056	-79.53	14.35	-65.18	-57	-8.18	peak	Horizontal
653.0214	-80.16	15.14	-65.02	-57	-8.02	peak	Horizontal
810.2036	-79.84	15.33	-64.51	-57	-7.51	peak	Horizontal
911.0253	-80.63	16.05	-64.58	-57	-7.58	peak	Horizontal
230.2143	-76.53	9.98	-66.55	-57	-9.55	peak	Vertical
320.3256	-77.94	13.35	-64.59	-57	-7.59	peak	Vertical
451.0236	-78.51	14.12	-64.39	-57	-7.39	peak	Vertical
556.3021	-79.64	14.52	-65.12	-57	-8.12	peak	Vertical
754.0136	-80.53	15.33	-65.2	-57	-8.2	peak	Vertical
936.5412	-80.46	16.07	-64.39	-57	-7.39	peak	Vertical

Note:
1. The emission behaviour belongs to narrowband spurious emission.
2. Calculation of result is: Result (dBm)= Reading (dBm)+ Correct Factor (dB)
3. GFSK mode is the worst mode and its data have been recorded in this report.

Above 1GHz

Test Mode: GFSK-CH00			
Temperature:	25°C	Relative Humidity:	60 %
Pressure:	1012 hPa	Test Voltage:	AC 230V/50Hz

Frequency (MHz)	Reading (dBm)	Correct Factor(dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark	Polarization
3325.106	-73.26	17.69	-55.57	-47	-8.57	peak	Horizontal
4213.051	-73.26	18.24	-55.02	-47	-8.02	peak	Horizontal
5123.016	-74.53	19.57	-54.96	-47	-7.96	peak	Horizontal
6253.014	-75.36	20.06	-55.3	-47	-8.3	peak	Horizontal
8132.041	-77.14	22.11	-55.03	-47	-8.03	peak	Horizontal
9126.305	-79.05	23.94	-55.11	-47	-8.11	peak	Horizontal
3024.163	-74.13	17.76	-56.37	-47	-9.37	peak	Vertical
463.0251	-74.1	18.07	-56.03	-47	-9.03	peak	Vertical
5210.036	-75.32	19.68	-55.64	-47	-8.64	peak	Vertical
6685.423	-75.32	19.88	-55.44	-47	-8.44	peak	Vertical
8103.246	-77.49	21.94	-55.55	-47	-8.55	peak	Vertical
9251.036	-77.94	23.24	-54.7	-47	-7.7	peak	Vertical

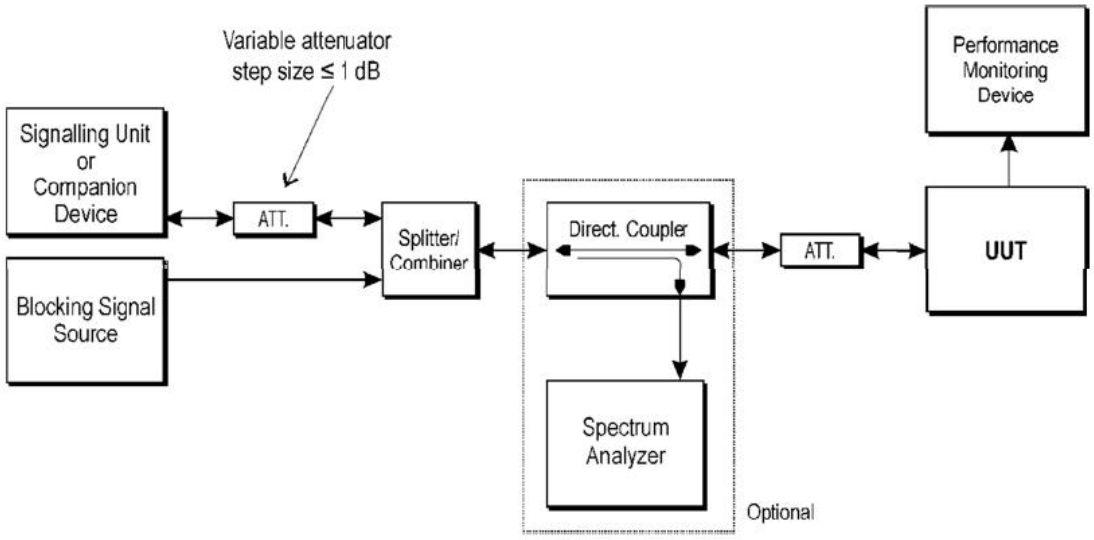
Test Mode: GFSK-CH78			
Temperature:	25°C	Relative Humidity:	60 %
Pressure:	1012 hPa	Test Voltage:	AC 230V/50Hz

Frequency (MHz)	Reading (dBm)	Correct Factor(dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark	Polarization
3102.036	-72.53	17.71	-54.82	-47	-7.82	peak	Horizontal
4293.651	-73.65	18.25	-55.4	-47	-8.4	peak	Horizontal
5315.016	-74.59	19.58	-55.01	-47	-8.01	peak	Horizontal
6142.503	-76.53	20.11	-56.42	-47	-9.42	peak	Horizontal
7143.206	-77.53	22.06	-55.47	-47	-8.47	peak	Horizontal
9158.036	-78.96	23.96	-55	-47	-8	peak	Horizontal
3256.946	-73.49	17.64	-55.85	-47	-8.85	peak	Vertical
4813.062	-74.53	18.13	-56.4	-47	-9.4	peak	Vertical
5169.023	-75.16	19.71	-55.45	-47	-8.45	peak	Vertical
6235.401	-75.36	19.95	-55.41	-47	-8.41	peak	Vertical
7143.166	-75.89	21.29	-54.6	-47	-7.6	peak	Vertical
913.0256	-78.94	23.11	-55.83	-47	-8.83	peak	Vertical

Note:
1. The emission behaviour belongs to narrowband spurious emission.
2. Calculation of result is: Result (dBm)= Reading (dBm)+ Correct Factor (dB)
3. GFSK mode is the worst mode and its data have been recorded in this report.

12. Receiver Blocking

12.1. Test Setup



12.2. Test Procedure

Refer to ETSI EN 300 328 V2.2.2 Clause 5.4.11.

12.3. Categorization

Receiver category 1
Adaptive equipment with a maximum RF output power greater than 10 dBm e.i.r.p. shall be considered as receiver category 1 equipment.

Receiver category 2
Non-adaptive equipment with a Medium Utilization (MU) factor greater than 1 % and less than or equal to 10 % (irrespective of the maximum RF output power); or quipment (adaptive or non-adaptive) with a maximum RF output power greater than 0 dBm e.i.r.p. and less than or equal to 10 dBm e.i.r.p.

Receiver category 3
Non-adaptive equipment with a maximum Medium Utilization (MU) factor of 1 % (irrespective of the maximum RF output power); or equipment (adaptive or non-adaptive) with a maximum RF output power of 0 dBm e.i.r.p.

12.4. Limit

Table 6 contains the Receiver Blocking parameters for Receiver Category 1 equipment.

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 contains the Receiver Blocking parameters for Receiver Category 2 equipment.

Table 7: Receiver Blocking parameters 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 contains the Receiver Blocking parameters for Receiver Category 3 equipment.

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.

12.5. Test Result

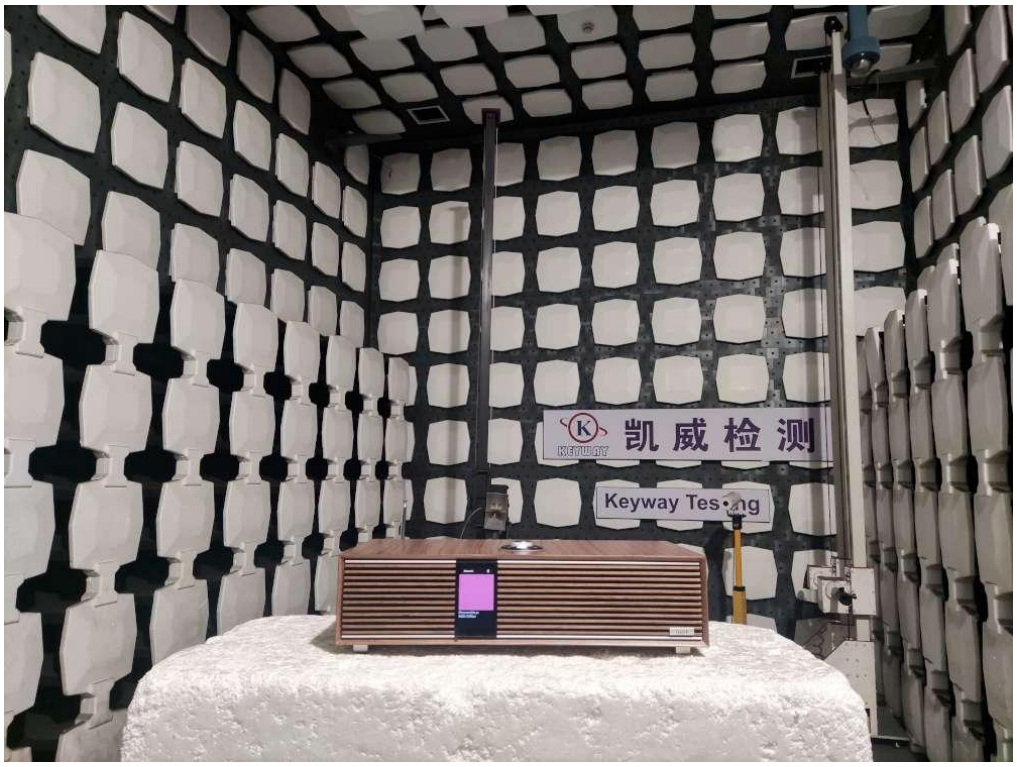
Test Mode	GFSK High Channel					
Wanted signal Mean power From companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal Power (dBm)	Type of blocking signal	PER (%)	PER (%) Limit	Result
-69.66	2380	-34	CW	0.11	≦10	Pass
	2504			0.03		
	2300			0.24		
	2584			0.16		
Test Mode	GFSK Low Channel					
Wanted signal Mean power From companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal Power (dBm)	Type of blocking signal	PER (%)	PER (%) Limit	Result
-69.64	2380	-34	CW	0.20	≦10	Pass
	2504			0.08		
	2300			0.13		
	2584			0.31		

Note: GFSK mode is the worst mode and its data have been recorded in this report.

13. Test Photograph

Spurious Emission Test

Spurious Emission Test (Horn)



14. EUT Constructional Details

Reference to the test report No. TR23040454-E-002.

*** the end of report ***