REPORT No. : SZ18010062W07

TEST REPORT

MANUFACTURER	**:**	Shenzhen Chainway Information Technology Co.,Ltd.
PRODUCT NAME	**:**	Mobile Data Terminal
MODEL NAME	**:**	C72
BRAND NAME	**:**	CHAINWAY
STANDARD(S)	**:**	ETSI EN 300 328 V2.1.1 (2016-11)
TEST DATE	**:**	2018-01-14 to 2018-01-18
ISSUE DATE	**:**	2018-02-02

Tested by: Tu Ya'nan

Tu Yanan (Test Engineer)

Approved by: Andy Yeh

Andy Yeh (Technical Director)

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DIRECTORY

Change History		
Issue	**Date**	**Reason for change**
1.0	2018-02-02	First edition

1. Technical Information

Note: Provide by manufacturer.

1.1. Manufacturer and Factory Information

Manufacturer:	Shenzhen Chainway Information Technology Co.,Ltd.
Manufacturer Address:	9/F, Building 2, Daqian Industrial Park, Longchang Rd., District 67, Bao'an, Shenzhen
Factory:	Shenzhen Chainway Information Technology Co.,Ltd.
Factory Address:	9/F, Building 2, Daqian Industrial Park, Longchang Rd., District 67, Bao'an, Shenzhen

1.2. Equipment Under Test (EUT) Description

Product Name:	Mobile Data Terminal	
Serial No:	(N/A, marked #1 by test site)	
Hardware Version:	C70SE_MB_V11	
Software Version:	C72E_MT6735_V1.1_EU_GITfcd74c4_20180115	
Equipment type:	Bluetooth 4.1(BR+EDR)	
Modulation Technology:	FHSS	
Modulation Type:	GFSK, π/4-DQPSK, 8-DPSK	
Operating Frequency Range:	2.402GHz - 2.480GHz	
Channel Number:	Refer 1.3	
Maximum e.r.i.p:	6.16dBm	
Adaptive Mode:	Adaptive/non-adaptive equipment:	Adaptive Equipment without the possibility to switch to a non-adaptive mode
	LBT Base DAA:	Yes
	Non-LBT Base DAA:	No
	Number of transmit chain:	1
	Number of receive chain:	1
Antenna Gain:	Antenna Type:	PIFA Antenna
	Antenna Gain:	0.49 dBi
Power Supply:	Battery/AC Adaptor	
Operating voltage:	Normal(NV):	3.8V
Operating temperature:	Normal(NT):	25°C
	Lowest(LT):	-20°C
	Highest(HT):	50°C

Note 1: This test report is updated from report (Report No.: SZ17080130W06), based on the similarity between before, the software version was changed and added an external accessory with RFID function. The changes only affect the test results of transmitter unwanted emissions in the spurious domain and receiver spurious emissions.

Note 2: The EUT is contains Bluetooth Module operating at 2.4GHz ISM band; only the Bluetooth classic was covered in this report. For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

1.3. The channel number and frequency of EUT

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
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		

Note 1: The Lowest Channel 0, Middle 39 and Highest 78 were selected for test in the report.

1.4. Setting of test system

Setting	Value
Test Mode:	GFSK, π/4-DQPSK, 8-DPSK
EUT frequency configurable:	Yes
Test channel-Low:	2402MHz
Test channel-Middle:	2441MHz
Test channel-High:	2480MHz
Adaptive:	Yes
With TPC function:	No
Number of the antenna:	1
Number of transmission chains:	1
Beam forming:	No
Maximum beam forming gain:	N/A
Antenna gain:	0.49 dBi

1.5. Test Standards and Results

The EUT has been tested according to ETSI EN 300 328 V2.1.1 (2016-11).

ETSI EN 300 328 V2.1.1 (2016-11)	Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

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Test items and the results are as bellow:

EN Reference		EN 300 328 V2.1.1 (2016-11)	Test Engineer	Result
№	Sub clause	Test Items		
1	4.3.1.2	RF Output Power	Li Jingzong	**PASS** Note2
2	4.3.1.4	Accumulated Transmit Time, Frequency Occupation & Hopping Sequence	Li Jingzong	**PASS** Note2
3	4.3.1.5	Hopping Frequency Separation	Li Jingzong	**PASS** Note2
4	4.3.1.7	Adaptively	N/A	**N/A** Note1
5	4.3.1.8	Occupied Channel Bandwidth	Li Jingzong	**PASS** Note2
6	4.3.1.9	Transmitter unwanted emissions in the OOB domain	Li Jingzong	**PASS** Note2
7	4.3.1.10	Transmitter unwanted emissions in the spurious domain	Li Jingzong Wang Dalong	**PASS**
8	4.3.1.11	Receiver spurious emissions	Li Jingzong Wang Dalong	**PASS**
9	4.3.1.12	Receiver Blocking	Li Jingzong	**PASS** Note2
10	4.3.1.13	Geo-location capability	Li Jingzong	**PASS** Note2
Note1: This requirement does not apply for equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p. Note2: The test results of these test items in this report refer to the test report (Report No.: SZ17080130W07).				

1.6. EUT Setup and Operating Conditions

The EUT is activated and controlled by the System Simulator and software. The EUT is powered by a battery.

1.7. Environmental Conditions

Ambient temperature: +15~+35°C
Relative humidity: 20~75%
Atmosphere pressure: 86-106kPa

2. Transmitter Parameters

2.1. EN 300 328 §4.3.1.2 Maximum transmit power

2.1.1. Definition

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

2.1.2. Limits

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 m). 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.

2.1.3. Test condition

See clause 5.1 for the environmental test conditions. Apart from the RF output power, these measurements need only to be performed at normal environmental conditions. The measurements for RF output power shall be performed at both normal environmental conditions and at the extremes of the operating temperature range.
In the case of equipment intended for use with an integral antenna and where no antenna connectors are provided, a test fixture as described in clause B.4 may be used to perform relative measurements at the extremes of the operating temperature range.
The equipment shall be operated under its worst case configuration (for example modulation, bandwidth, data rate.power) with regards to the requirement being tested. Measurement of multiple data sets may be required.
For equipment using FHSS modulation, the measurements shall be performed during normal operation (hopping) and the equipment is assumed to have no blacklisted frequencies (operating on all hopping positions).
For equipment using wide band modulations other than FHSS, the measurement shall be performed at the lowest, the middle, and the highest channel on which the equipment can operate. These frequencies shall be recorded.

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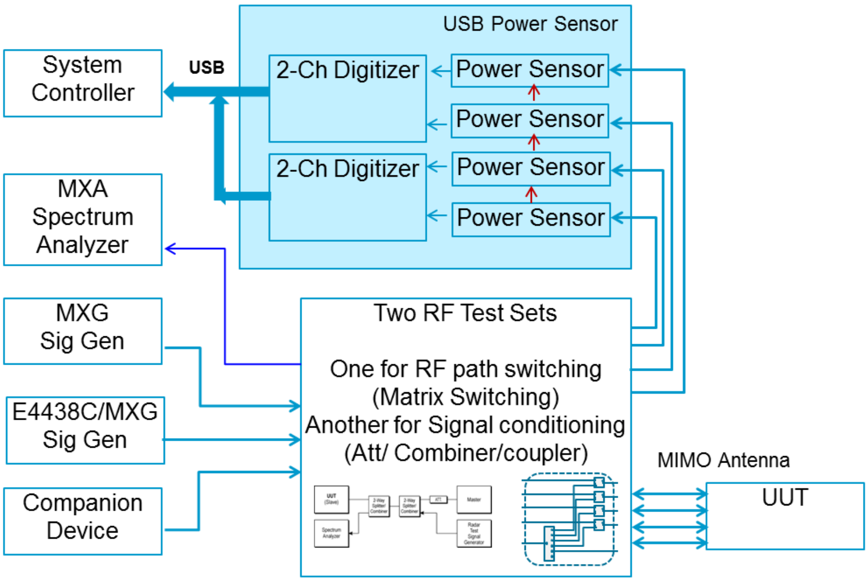
2.1.4. Test procedures



Step 1:

• Use a fast power sensor suitable for 2,4 GHz and capable of minimum 1 MS/s.

• Use the following settings:

- Sample speed 1 MS/s or faster.
- The samples shall represent the RMS power of the signal.
- Measurement duration: For non-adaptive equipment: equal to the observation period defined in clause 4.3.1.3.2 or clause 4.3.2.4.2. For adaptive equipment, the measurement duration shall be long enough to ensure a minimum number of bursts (at least 10) is captured.

For adaptive equipment, to increase the measurement accuracy, a higher number of bursts may be used.

Step 2:

• For conducted measurements on devices with one transmit chain:

- Connect the power sensor to the transmit port, sample the transmit signal and store the raw data.

Use these stored samples in all following steps.

• For conducted measurements on devices with multiple transmit chains:

- Connect one power sensor to each transmit port for a synchronous measurement on all transmit ports.
- Trigger the power sensors so that they start sampling at the same time. Make sure the time difference between the samples of all sensors is less than 500 ns.
- For each individual sampling point (time domain), sum the coincident power samples of all ports and store them. Use these summed samples as the new stored data set.

Step 3:

• Find the start and stop times of each burst in the stored measurement samples.

The start and stop times are defined as the points where the power is at least 30 dB below the highest value of the stored samples in step 2.

In case of insufficient dynamic range, the value of 30 dB may need to be reduced appropriately.

Step 4:

• Between the start and stop times of each individual burst calculate the RMS power over the burst using the formula below. The start and stop points shall be included. Save these P_{burst} values, as well as the start and stop times for each burst..

$$P_{burst} = \frac{1}{K}\sum_{n=1}^{k} P_{sample}(n)$$

with k being the total number of samples and n the actual sample number.

Step 5:

• The highest of all P_{burst} values (value A in dBm) will be used for maximum e.i.r.p. calculations.

Step 6:

• Add the (stated) antenna assembly gain G in dBi of the individual antenna.

• If applicable, add the additional beamforming gain Y in dB.

• If more than one antenna assembly is intended for this power setting, the maximum overall antenna gain (G or G + Y) shall be used.

• The RF Output Power (P) shall be calculated using the formula below:

P = A + G + Y

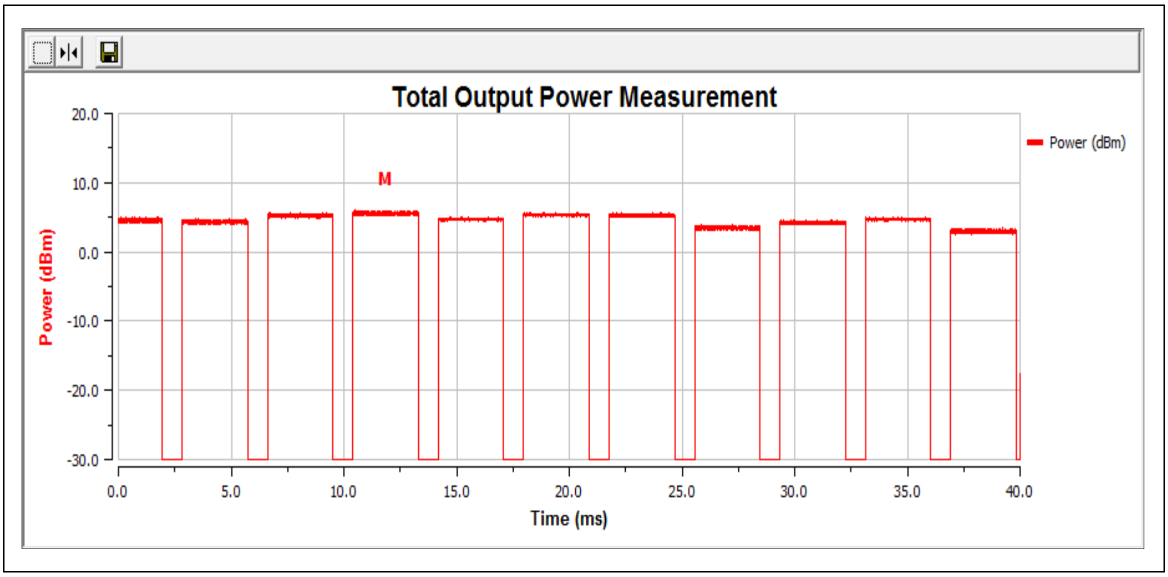
• This value, which shall comply with the limit given in clause 4.3.1.2.3 or clause 4.3.2.2.3, shall be recorded in the test report.

2.1.5. Result

2.1.5.1 GFSK Mode:

Test Conditions		EIRP (dBm)	Result
		Hopping Mode	
NT	NV	6.16	**PASS**
LT	NV	6.15	**PASS**
HT	NV	6.13	**PASS**

Test Plot

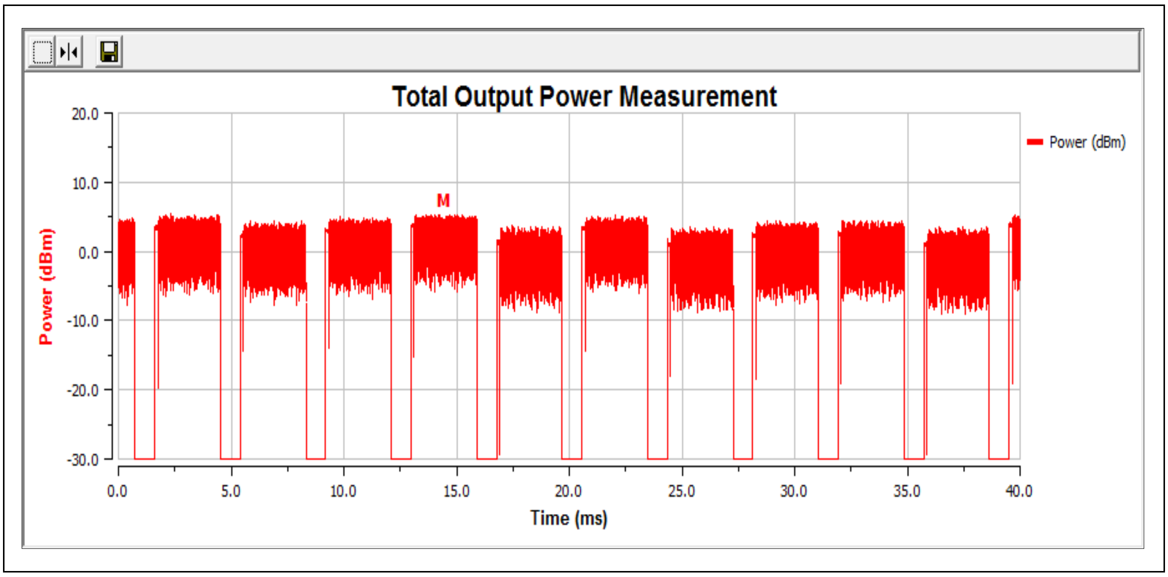


(GFSK Hopping Mode)

2.1.5.2 π/4-DQPSK Mode:

Test Conditions		EIRP (dBm) Hopping Mode	Result
NT	NV	2.87	**PASS**
LT	NV	2.89	**PASS**
HT	NV	2.85	**PASS**

Test Plot

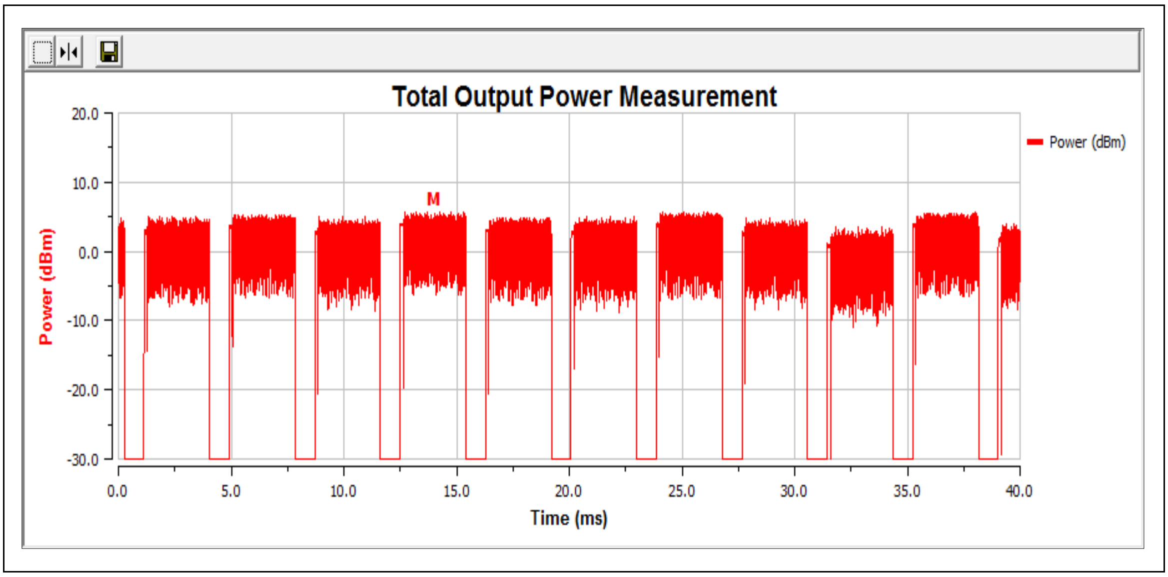


(π/4-DQPSK Hopping Mode)

2.1.5.3 8-DPSK Mode:

Test Conditions		EIRP (dBm) Hopping Mode	Result
NT	NV	3.01	**PASS**
LT	NV	3.09	**PASS**
HT	NV	2.96	**PASS**

Test Plot



(8-DPSK Hopping Mode)

Notes:

(1) Conducted measurement method was used.

(2) The path loss as the factor is calibrated to correct the reading.

2.2. EN 300 328 §4.3.1.4 Accumulated Transmit Time, Frequency Occupation and Hopping Sequence

2.2.1. Definition

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. The equipment may be transmitting, receiving or stay idle during the Dwell Time spent on that hopping frequency.

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

2.2.2. Limit

2.2.2.1 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.

2.2.2.2 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 15 or the result of 15 MHz divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.

2.2.2.3 Other Requirements

For non-Adaptive Frequency Hopping equipment, from the N hopping frequencies defined in clause 4.3.1.4.3.1 above, the equipment shall transmit on at least one hopping frequency while other hopping frequencies are blacklisted.
For equipment that blacklists one or more hopping frequencies, these blacklisted frequencies are considered as active transmitting for the calculation of the MU factor of the equipment. See also clause 5.4.2.2.1.3 step 4, first bullet item and clause 5.4.2.2.1.4 step 3, first bullet item,second paragraph.
For Adaptive Frequency Hopping equipment, from the N hopping frequencies defined in clause 4.3.1.4.3.2 above, the equipment shall consider at least one hopping frequency for its transmissions. Providing that there is no interference present on this 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 non-Adaptive Frequency Hopping equipment, when not transmitting on a hopping frequency, the equipment has to occupy that frequency for the duration of the typical dwell time (see also definition for blacklisted frequency in clause 3.1).
For Adaptive Frequency Hopping equipment using LBT based DAA, if a signal is detected during the CCA, the equipment may jump immediately to the next frequency in the hopping sequence (see clause 4.3.1.7.2.2 point 2) provided the limit for maximum dwell is respected.

2.2.3. Test condition

See clause 5.1 for the environmental test conditions. These measurements shall only be performed at normal test conditions.
The equipment shall be configured to operate at its maximum Dwell Time and maximum Duty Cycle.
The measurement shall be performed on a minimum of two (active) hopping frequencies chosen arbitrary from the actual hopping sequence. The results as well as the frequencies on which the test was performed shall be recorded in the test report.

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2.2.4. Test procedures

The test procedure shall be as follows:

Step 1:

• The output of the transmitter shall be connected to a spectrum analyzer or equivalent.

• The analyser shall be set as follows:

- Centre Frequency: Equal to the hopping frequency being investigated
- Frequency Span: 0 Hz
- RBW: ~ 50 % of the Occupied Channel Bandwidth
- VBW: ⩾ RBW
- Detector Mode: 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: 30 000
- Trace mode: Clear / Write
- Trigger: Free Run

Step 2:

• Save the trace data to a file for further analysis by a computing device using an appropriate software application or program.

Step 3:

• Identify the data points related to the frequency being investigated by applying a threshold.

The data points resulting from transmissions on the hopping frequency being investigated are assumed to have much higher levels compared to data points resulting from transmissions on adjacent hopping frequencies. If a clear determination between these transmissions is not possible, the RBW in step 1 shall be further reduced. In addition, a channel filter may be used.

• Count the number of data points identified as resulting from transmissions on the frequency being investigated and multiply this number by the time difference between two consecutive data points.

Step 4:

• The result in step 3 is the Accumulated Transmit Time which shall comply with the limit provided in clause 4.3.1.4.3.1 or clause 4.3.1.4.3.2 and which shall be recorded in the test report.

Step 5:

This step is only applicable for equipment implementing Option 1 in clause 4.3.1.4.3.1 or Option 1 in clause 4.3.1.4.3.2 for complying with the Frequency Occupation requirement and the manufacturer decides to demonstrate compliance with this requirement via measurement.

• Make the following changes on the analyser and repeat step 2 and step 3.

Sweep time: 4 × Dwell Time × Actual number of hopping frequencies in use

The hopping frequencies occupied by the equipment without having transmissions during the dwell time (blacklisted frequencies) should be taken into account in the actual number of hopping frequencies in use. If this number cannot be determined (number of blacklisted frequencies unknown) it shall be assumed that the equipment uses the maximum possible number of hopping frequencies.

• The result shall be compared to the limit for the Frequency Occupation defined in clause 4.3.1.4.3.1,Option 1 or clause 4.3.1.4.3.2,Option 1.The result of this comparison shall be recorded in the test report.

Step 6:

• Make the following changes on the analyser:

- Start Frequency: 2 400 MHz
- Stop Frequency: 2 483,5 MHz
- RBW: ~ 50 % of the Occupied Channel Bandwidth (single hopping frequency)
- VBW: ≥ RBW
- Detector Mode: RMS
- Sweep time: 1 s; this setting may result in long measuring times. To avoid such long measuring times, an FFT analyser may be used
- Trace Mode: Max Hold
- Trigger: Free Run

• Wait for the trace to stabilize. Identify the number of hopping frequencies used by the hopping sequence.

• The result shall be compared to the limit (value N) defined in clause 4.3.1.4.3.1 or clause 4.3.1.4.3.2. This value shall be recorded in the test report.

For equipment with blacklisted frequencies, it might not be possible to verify the number of hopping frequencies in use. However, they shall comply with the requirement for Accumulated Transmit Time and Frequency Occupation assuming the minimum number of hopping frequencies (N) defined in clause 4.3.1.4.3.1 or clause 4.3.1.4.3.2 is used.

Step 7:

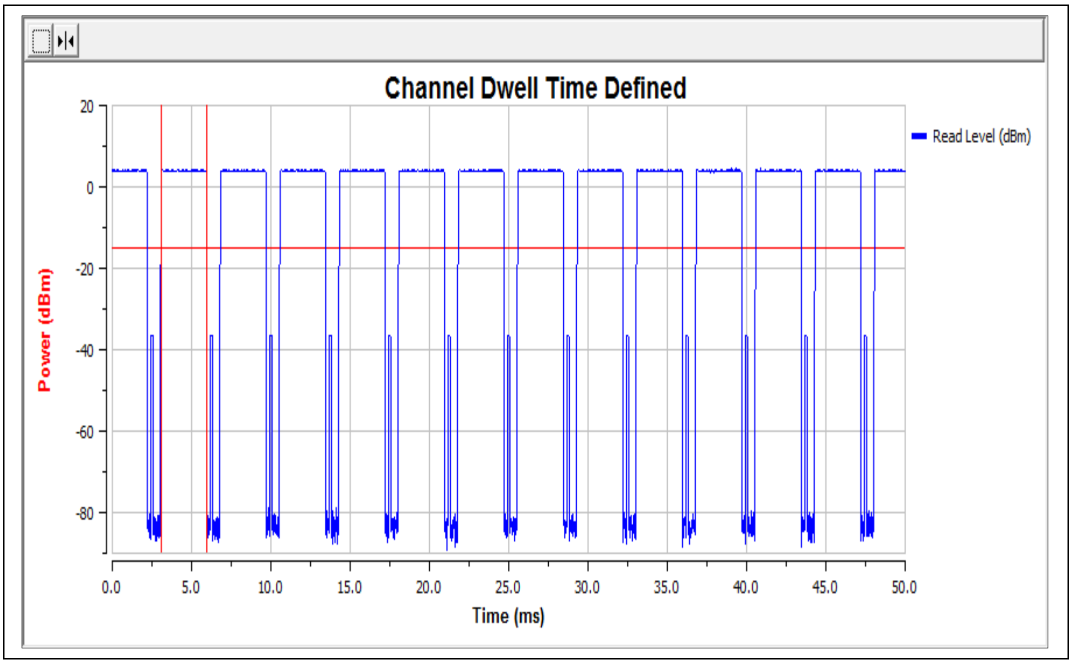
• For adaptive frequency hopping equipment, it shall be verified whether the equipment uses 70 % of the band specified in table 1.This verification can be done using the lowest and highest -20 dB points from the total spectrum envelope obtained in step 6.The result shall be recorded in the test report.

2.2.5. Result

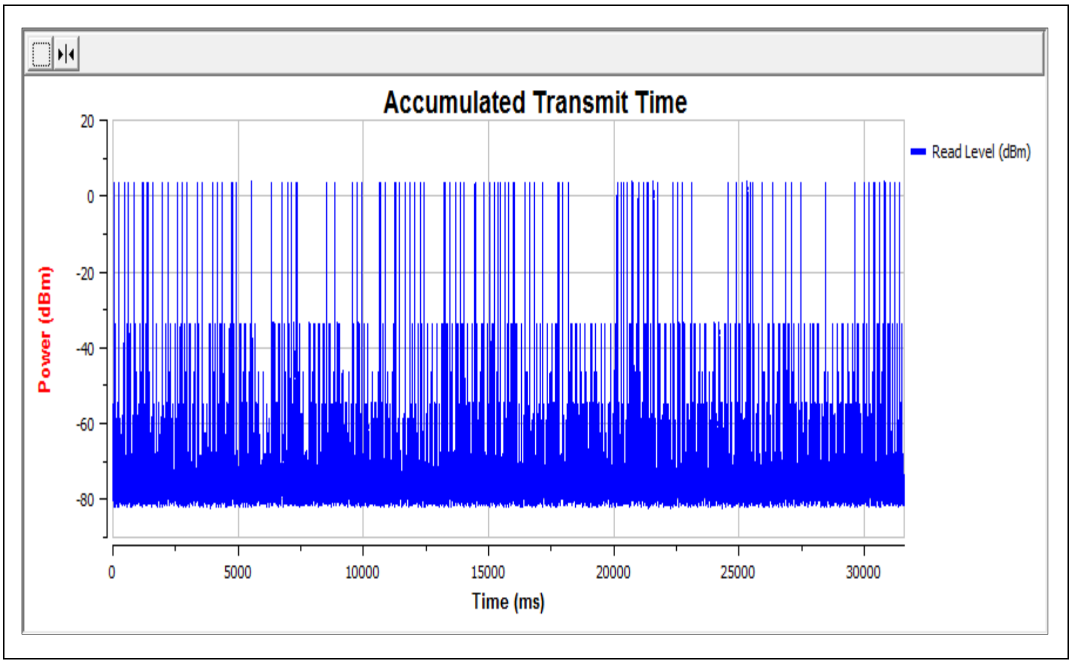
Note: The maximum Dwell Time and maximum Duty Cycle of the package type is DH5(GFSK), 2-DH5(π/4-DQPSK) and 3-DH5(8-DPSK).So only have DH5, 2-DH5, 3-DH5 test result in this report.

2.2.5.1 GFSK

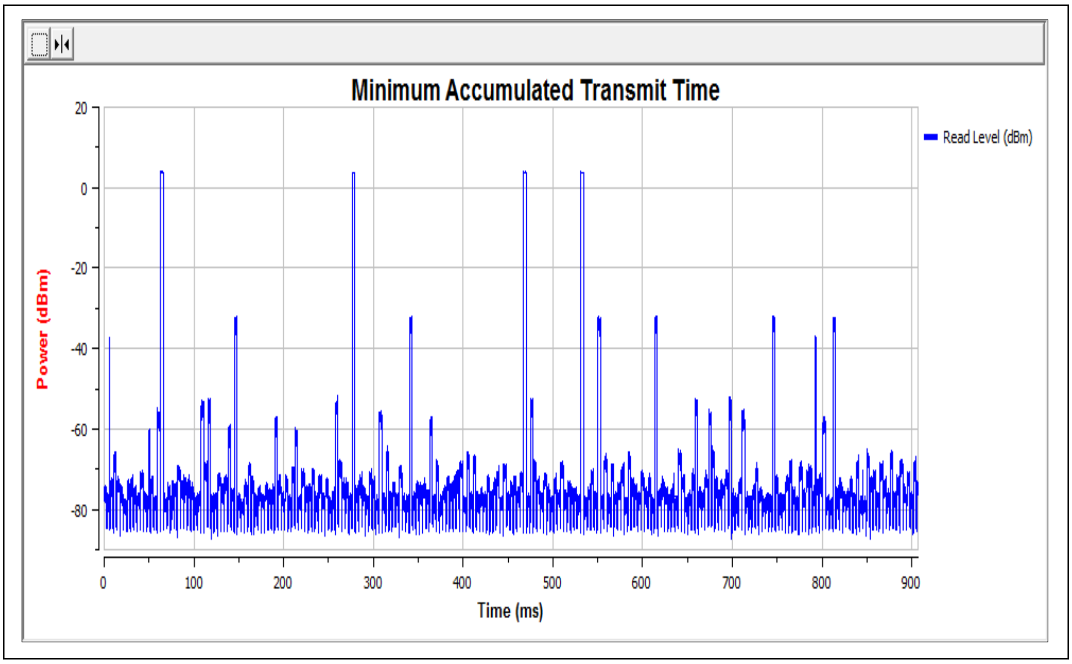
Length of Transmission Time (ms)	Dwell Time (ms)	Limit (ms)	Minimum Frequency Occupation	Limit (ms)	Result
2.87	315.70	≤400	4	1≤Minimum Frequency Occupation≤4	**PASS**



(GFSK: Length of Transmission Time)



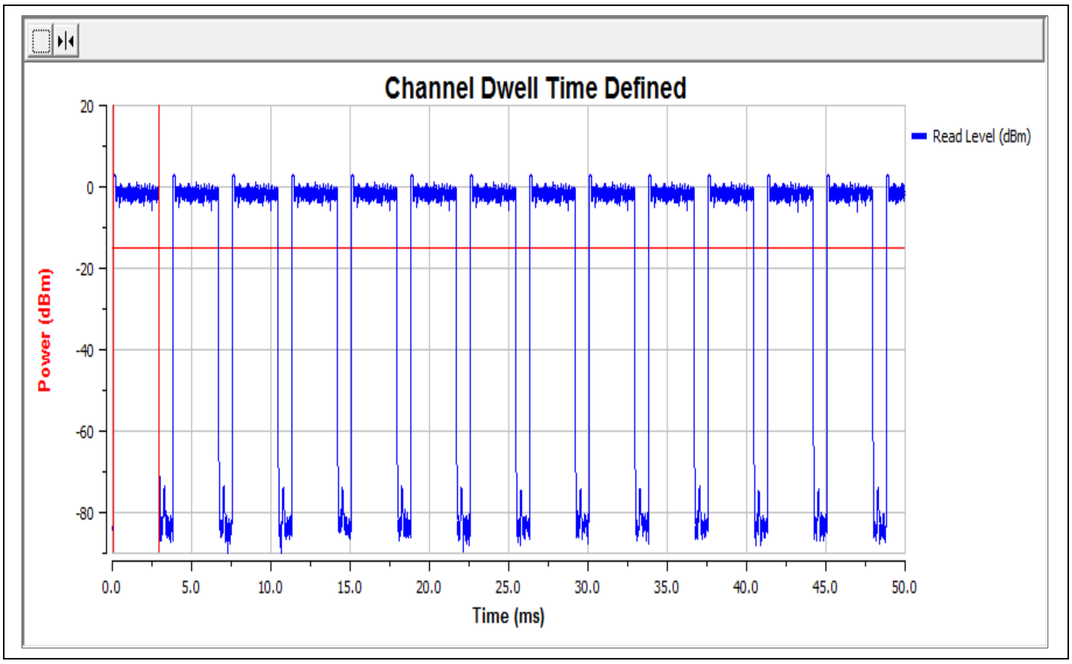
(GFSK: Dwell Time)



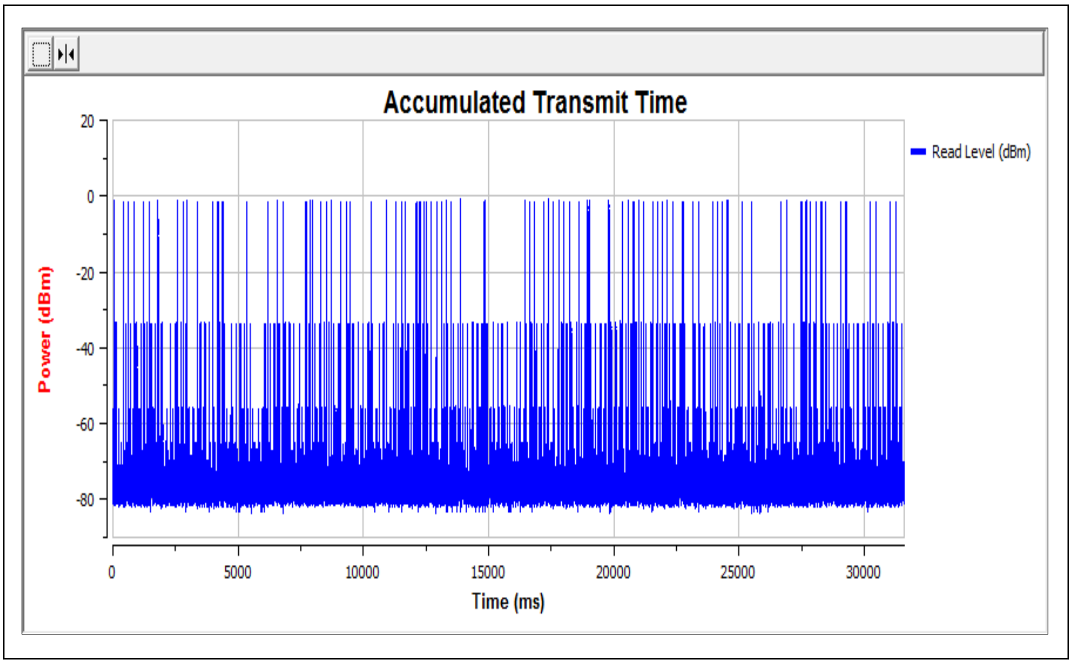
(GFSK: Minimum Frequency Occupation)

2.2.5.2 π/4-DQPSK

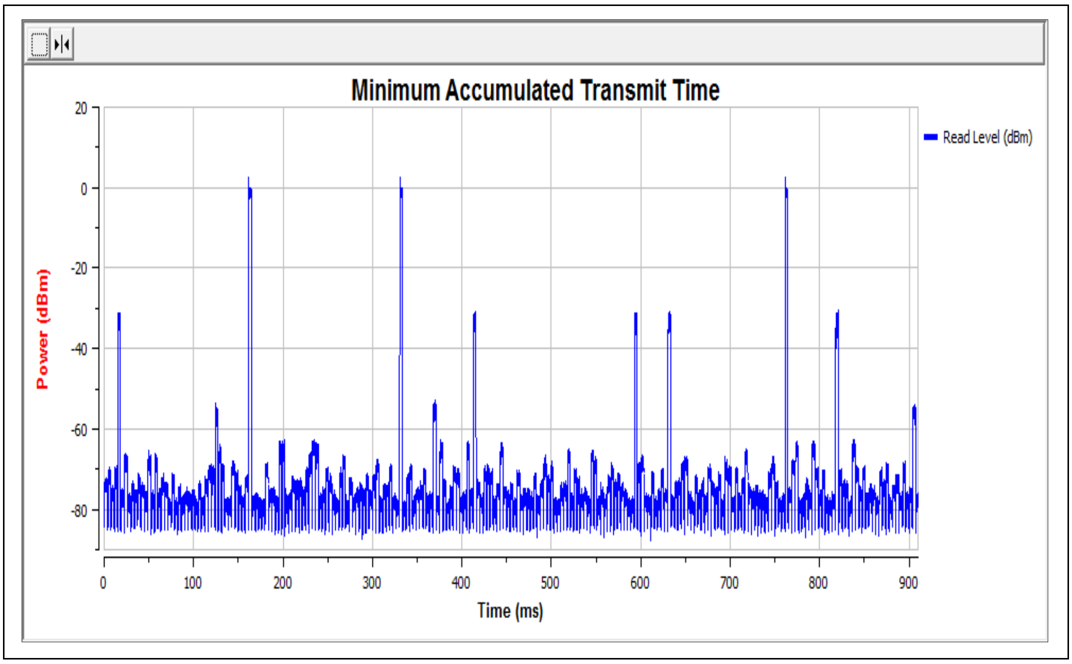
Length of Transmission Time (ms)	Dwell Time (ms)	Limit (ms)	Minimum Frequency Occupation	Limit (ms)	Result
2.88	316.80	≤400	3	1≤Minimum Frequency Occupation≤4	**PASS**



(π/4-DQPSK: Length of Transmission Time)



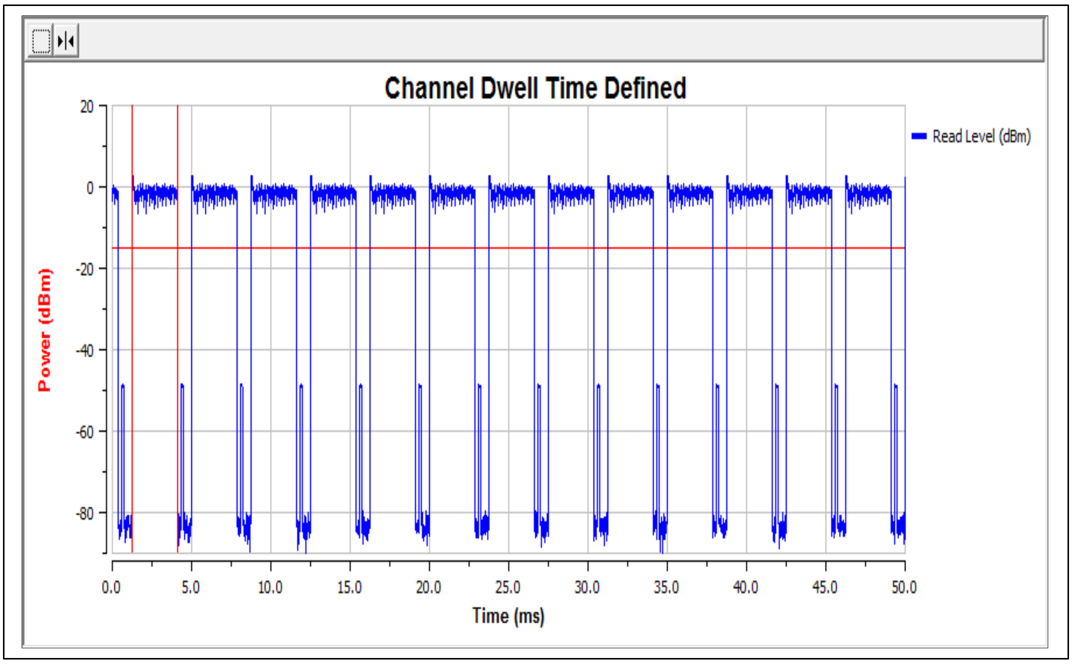
(π/4-DQPSK: Dwell Time)



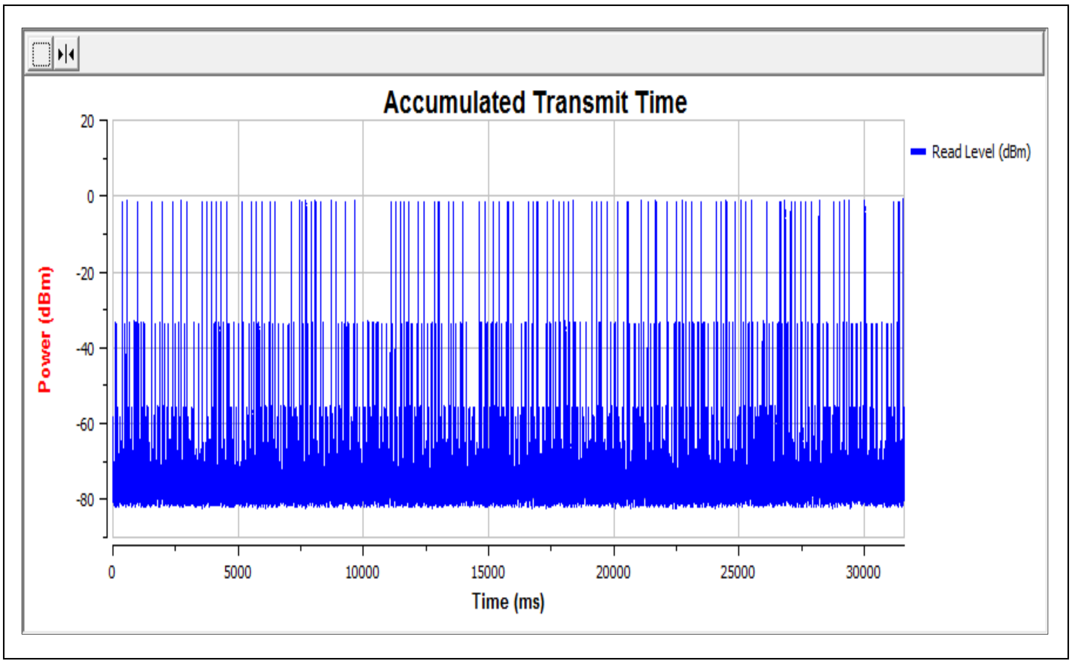
(π/4-DQPSK: Minimum Frequency Occupation)

2.2.5.3 8-DPSK

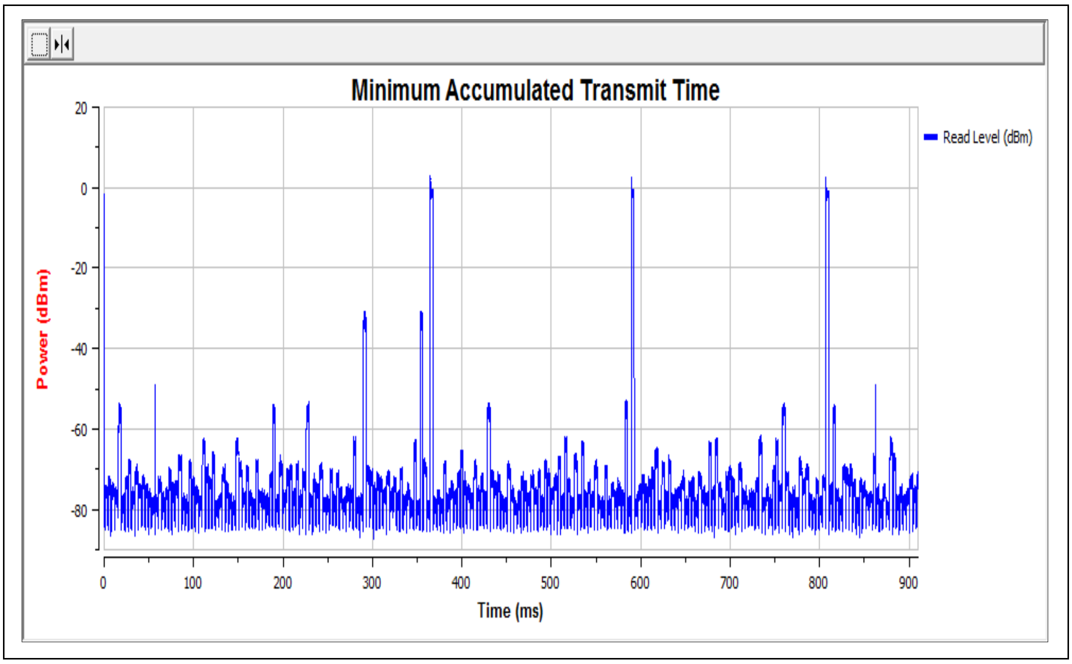
Length of Transmission Time (ms)	Dwell Time (ms)	Limit (ms)	Minimum Frequency Occupation	Limit (ms)	Result
2.88	305.28	≤400	4	1≤Minimum Frequency Occupation≤4	**PASS**



(8-DPSK: Length of Transmission Time)



(8-DPSK: Dwell Time)

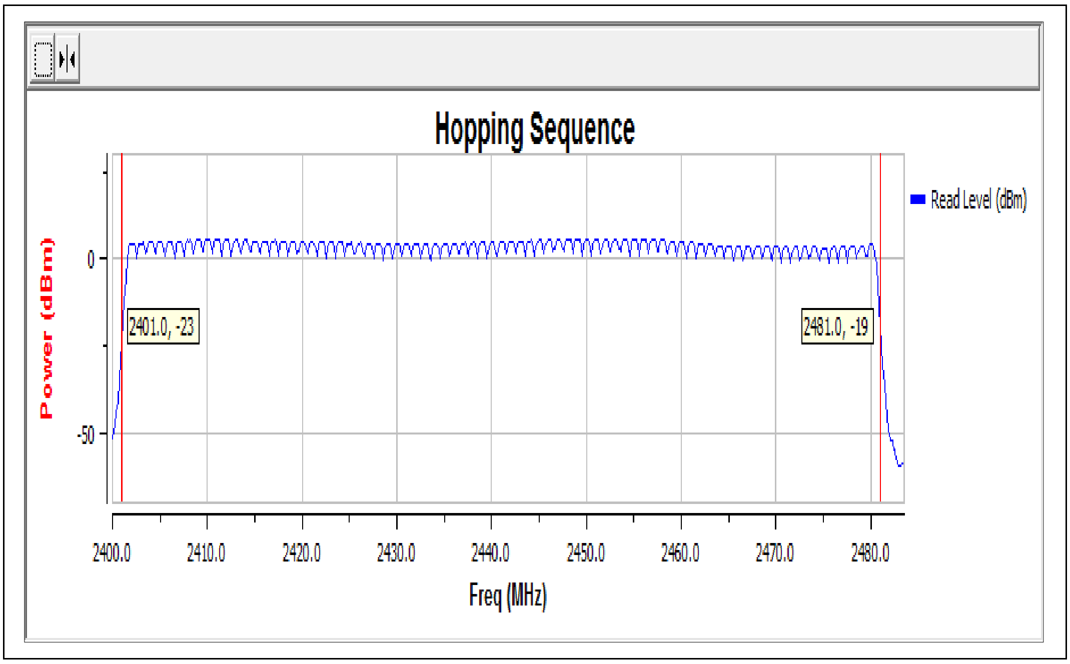


(8-DPSK: Minimum Frequency Occupation)

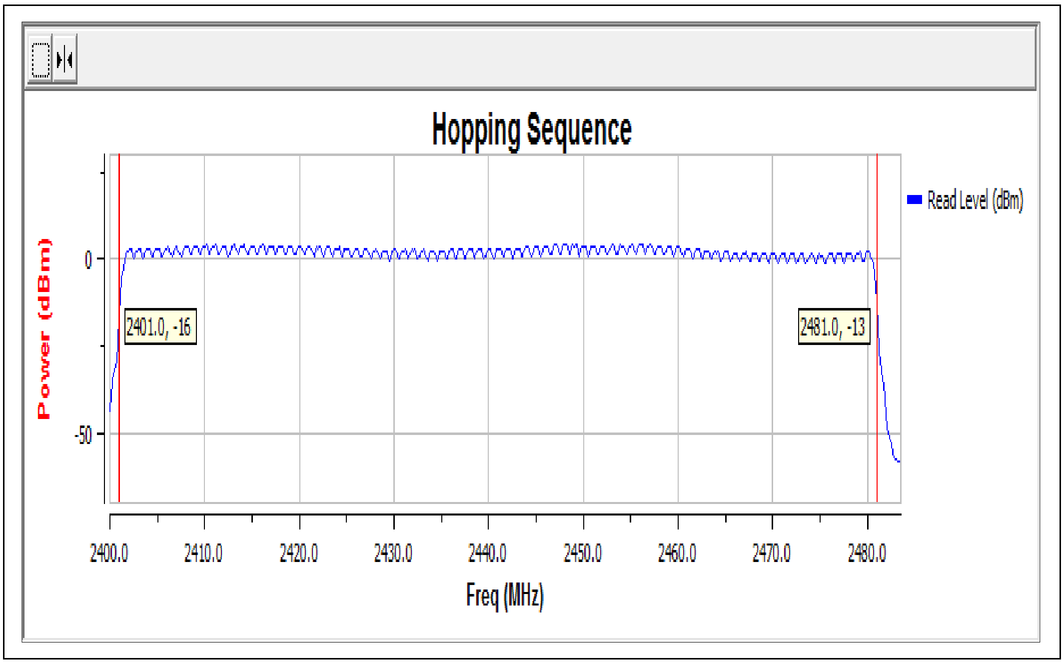
2.2.5.4 Hopping Sequence

Mode	Hopping Sequence Bandwidth(MHz)	Number of Hopping Frequency	Refer to Plot	Limit	Result
GFSK	79.60	79	Plot A4	Hopping Frequency≥15 Operation Frequency Bandwidth ≥58.45MHz	**PASS**
π/4-DQPSK	80.02	79	Plot A5		**PASS**
8-DPSK	80.02	79	Plot A6		**PASS**

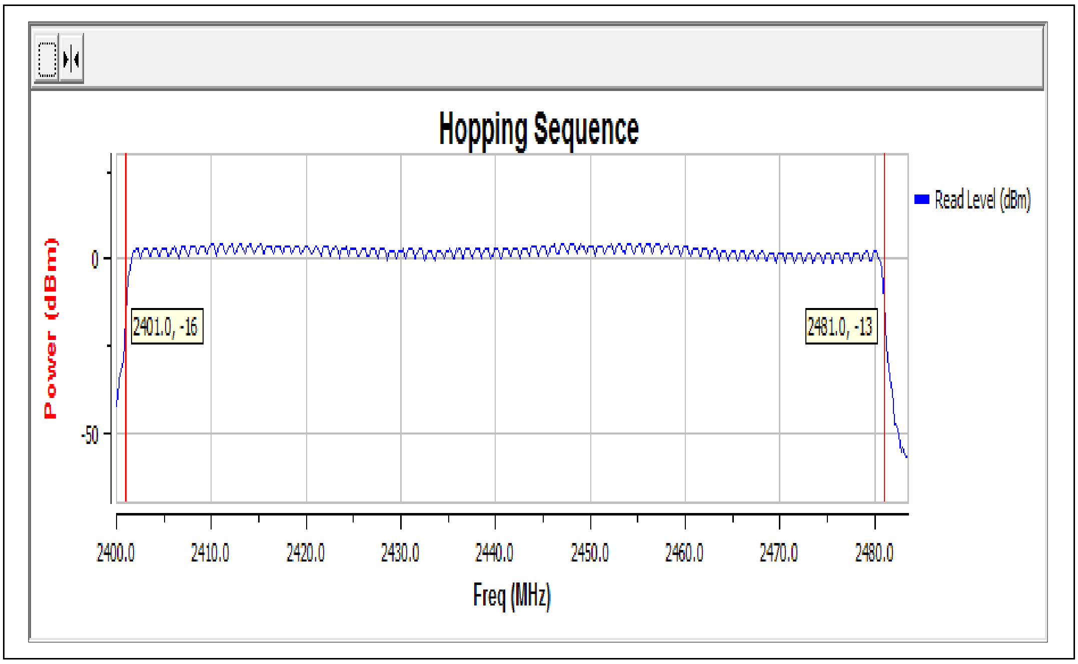
Test Plot:



(Plot A4: GFSK Hopping Sequence)



(Plot A5: π/4-DQPSK Hopping Sequence)



(Plot A6: 8-DPSK Hopping Sequence)

2.3. EN 300 328 §4.3.1.5 Hopping Frequency Separation

2.3.1. Definition

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

2.3.2. Limits

2.3.2.1 Non-adaptive frequency hopping systems

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..

2.3.2.2 Adaptive frequency hopping systems

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..

2.3.3. Test condition

See clause 5.1 for the environmental test conditions. These measurements shall only be performed at normal test conditions.

The measurement shall be performed on two adjacent hopping frequencies. The frequencies on which the test was performed shall be recorded.

2.3.4. Test procedures

Option 1

The test procedure shall be as follows:

Step 1:

• The output of the transmitter shall be connected to a spectrum analyser or equivalent.

• The analyser shall be set as follows:

- 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
- Detector Mode: Max Peak
- Trace Mode: Max Hold
- Sweep time: Auto

Step 2:

• Wait for the trace to stabilize.

• Use the marker function of the analyser to define the frequencies corresponding to the lower -20 dBr point and the upper -20 dBr point for both hopping frequencies F1 and F2. This will result in $F1_L$ and $F1_H$ for hopping frequency F1 and in $F2_L$ and $F2_H$ for hopping frequency F2. These values shall be recorded in the report.

Step 3:

• Calculate the centre frequencies $F1_C$ and $F2_C$ for both hopping frequencies using the formulas below. These values shall be recorded in the report.

$$\mathrm{F1_C} = \frac{\mathrm{F1_L} + \mathrm{F1_H}}{2} \quad \mathrm{F2_C} = \frac{\mathrm{F2_L} + \mathrm{F2_H}}{2}$$

• Calculate the Hopping Frequency Separation (F_{HS}) using the formula below. This value shall be recorded in the report.

$$\mathrm{F_{HS}} = \mathrm{F2_C} - \mathrm{F1_C}$$

• Compare the measured Hopping Frequency Separation with the limit defined in clause 4.3.1.5.3. In addition, for non-Adaptive Frequency Hopping equipment, the Hopping Frequency Separation shall be equal to or greater than the Occupied Channel Bandwidth as defined in clause 4.3.1.8 or:

$$\mathrm{F_{HS}} \geq \text{Occupied Channel Bandwidth}$$

• See figure 4:

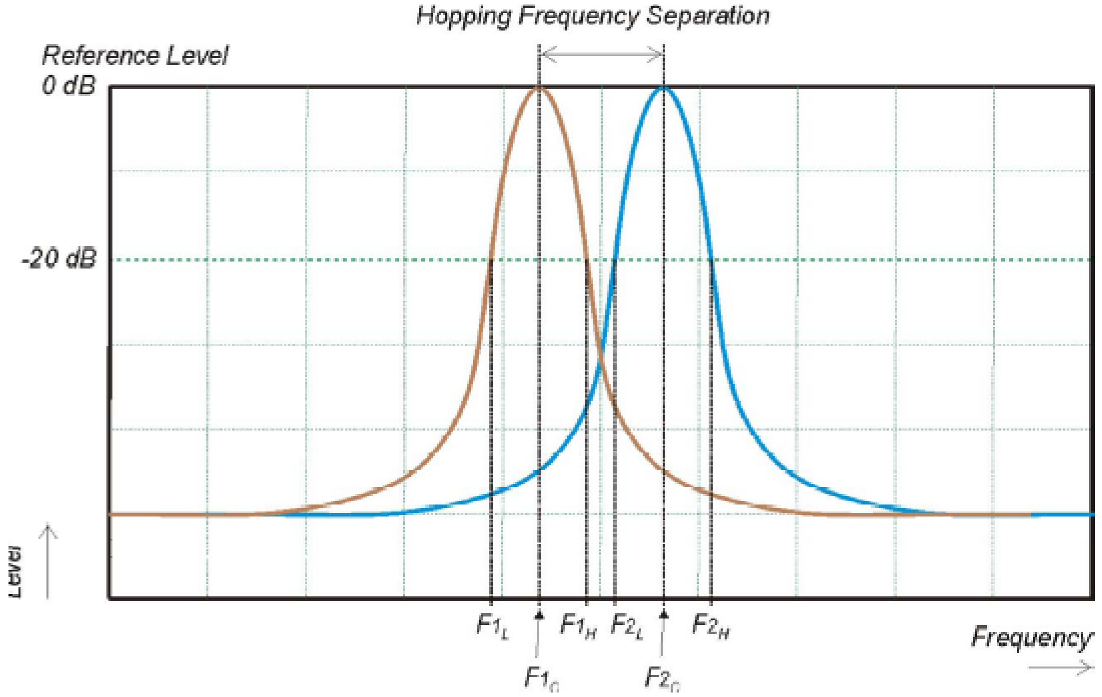


Figure 4: Hopping Frequency Separation

For adaptive equipment, in case of overlapping channels which prevents the definition of the -20 dBr reference points $F1_H$ and $F2_L$, a higher reference level (e.g. -10 dBr or - 6 dBr) may be chosen to define the reference points $F1_L$;$F1_H$; $F2_L$ and $F2_H$.

Alternatively, special test software may be used to:

• force the UUT to hop or transmit on a single Hopping Frequency by which the -20 dBr reference points can be measured separately for the two adjacent Hopping Frequencies; and/or

• force the UUT to operate without modulation by which the centre frequencies $F1_C$ and $F2_C$ can be measured directly.

The method used to measure the Hopping Frequency Separation shall be documented in the test report.

Option 2

The test procedure shall be as follows:

Step 1:

• The output of the transmitter shall be connected to a spectrum analyser or equivalent.

• The analyser shall be set as follows:

- 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
- Detector Mode: Max Peak
- Trace Mode: Max Hold

- Sweep time: Auto

Step 2:

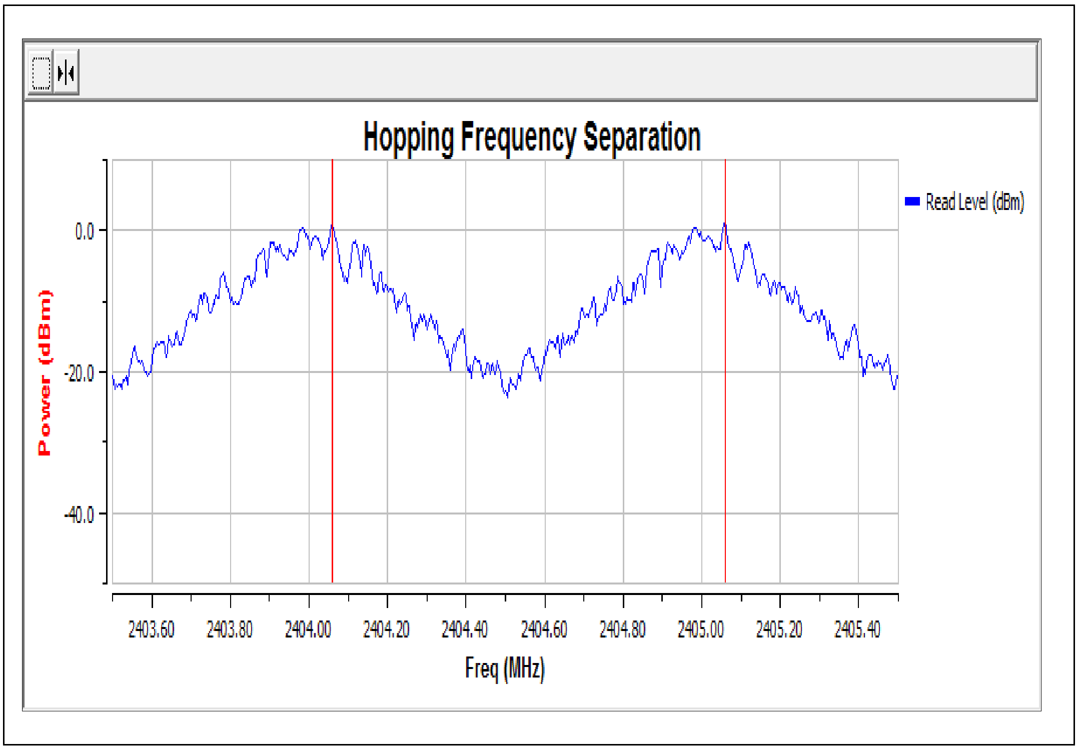
• Wait for the trace to stabilize.

• Use the marker-delta function to determine the Hopping Frequency Separation between the centers of the two adjacent hopping frequencies (e.g. by indentifying peaks or notches at the centre of the power envelope for the two adjacent signals). This value shall be compared with the limits defined in clause 4.3.1.5.3 and shall be recorded in the test report.

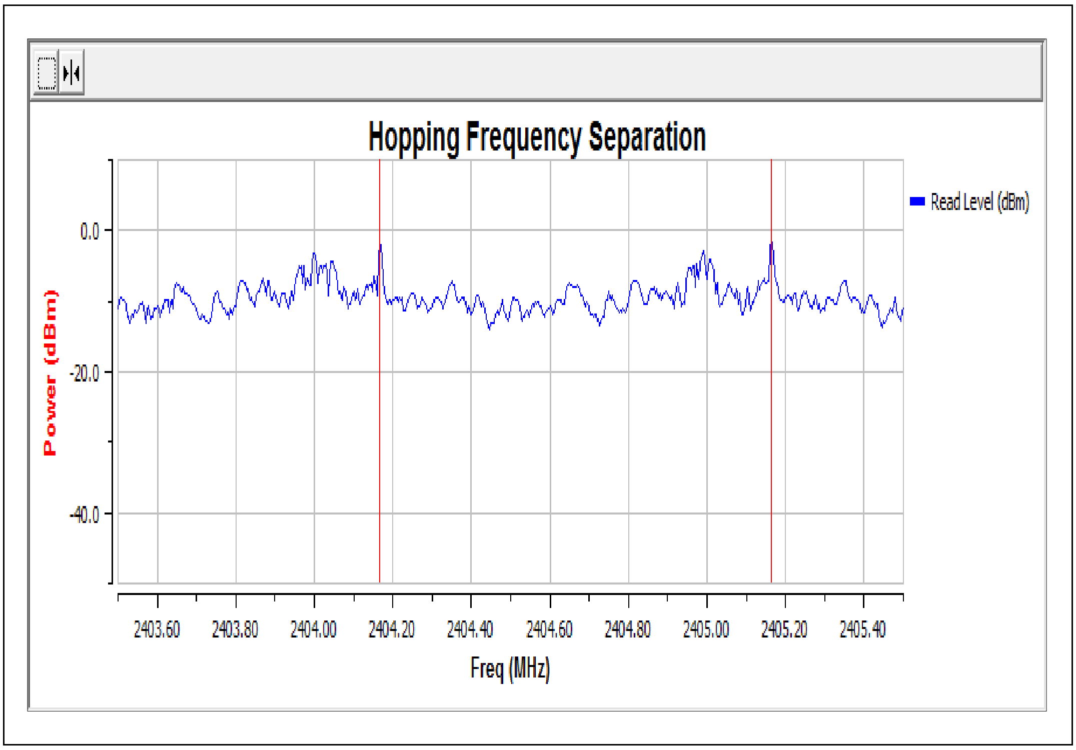
2.3.5. Result

Test Mode	Test data of the Frequencies separation (MHz)	Limit of the Frequencies separation (MHz)	Test plot	Result
GFSK	1.00	≥ 0.1	Plot A7	**PASS**
π/4-DQPSK	1.00	≥0.1	Plot A8	**PASS**
8-DPSK	1.00	≥0.1	Plot A9	**PASS**

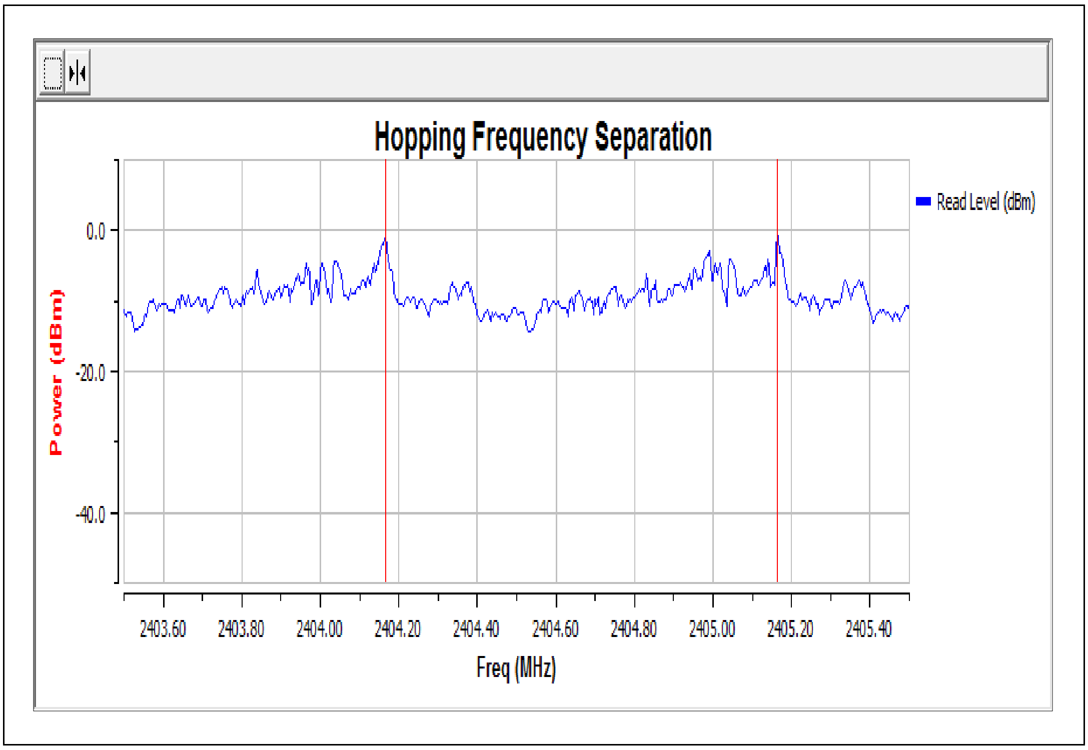
Test Plot:



(Plot A7: Carrier Frequency Separation)



(Plot A8: Carrier Frequency Separation)



(Plot A9: Carrier Frequency Separation)

2.4. EN 300 328 §4.3.1.7 Adaptively

2.4.1. Definition

2.4.1.1 Adaptive Frequency Hopping using LBT based DAA

Adaptive Frequency Hopping using LBT based DAA is a mechanism by which a given hopping frequency is made 'unavailable' because an interfering signal was detected before any transmission on that frequency. This mechanism shall operate as intended in the presence of an unwanted signal on frequencies other than those of the operating band.

2.4.1.2 Adaptive Frequency Hopping using other forms of DAA (non-LBT based)

Adaptive Frequency Hopping using other forms of DAA is a mechanism different from LBT, by which a given hopping frequency is made 'unavailable' because an interfering signal was reported after transmissions on that frequency. This mechanism shall operate as intended in the presence of an unwanted signal on frequencies other than those of the operating band.

2.4.2. Limit

2.4.2.1 Adaptive Frequency Hopping using LBT based DAA

Adaptive Frequency Hopping equipment using LBT based DAA 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 frequency hopping 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 Signaling 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 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:

$$\mathrm{TL} = -70\mathrm{dBm/MHz} + 10 \times \log_{10}(100\mathrm{mW/Pout}) \qquad (\mathrm{Pout\ in\ mW\ e.i.r.p})$$

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 signal frequency(MHz)	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 value which can be used in most cases is -50 dBm/MHz. NOTE 3: The level specified is the level in front of the UUT antenna. In case of conducted measurements, this level has to be corrected by the actual antenna assembly gain.		

2.4.2.2 Adaptive Frequency Hopping using other forms of DAA (non-LBT based)

Adaptive Frequency Hopping equipment using non-LBT based DAA, shall comply with the following minimum set of requirements:

1) During normal operation, the equipment shall evaluate the presence of a signal for each of its hopping frequencies. 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'.

2) The hopping frequency shall remain unavailable for a minimum time equal to 1 second or 5 times the actual number of hopping frequencies in the current (adapted) channel map used by the equipment, multiplied with the Channel Occupancy Time whichever is the greater . There shall be no transmissions during this period on this hopping frequency. After this, the hopping frequency may be considered again as an 'available' frequency.

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 shall be less than 40 ms. For equipment using a dwell time > 40 ms that wants to have other transmissions during the same hop (dwell time) an Idle Period (no transmissions) of minimum 5 % of the Channel Occupancy Period with a minimum of 100 µs shall be implemented.

After the Idle Period has expired, the procedure as in step 1) needs to 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 9 transmission sequences of 40 ms each, separated with an Idle Period of 3 ms.

For non-LBT based frequency hopping equipment with a dwell time < 40 ms, the maximum Channel Occupancy Time may be non-contiguous, i.e. spread over a number of hopping sequences (equal to 40 ms divided by the dwell time [ms]).

4) 'Unavailable' channels may be removed from or may remain in the hopping sequence, but in any case:

• apart from the Short Control Signaling 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 below 20 dBm e.i.r.p., the detection threshold level may be relaxed to:

$$\mathrm{TL} = -70\mathrm{dBm/MHz} + 10 \times \log_{10}(100\mathrm{mW/Pout}) \qquad (\mathrm{Pout\ in\ mW\ e.i.r.p})$$

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 3.

Table 3:Unwanted Signal parameters		
Wanted signal mean power from companion device	**Unwanted signal frequency(MHz)**	**Unwanted CW signal power(dBm)**
-30	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 thelowest 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: The level specified is the level in front of the UUT antenna. In case of conducted measurements, this level has to be corrected by the actual antenna assembly gain.		

2.4.2.3 Short Control Signaling Transmissions

Short Control Signaling Transmissions are transmissions used by Adaptive Frequency Hopping equipment to send control signals (e.g. ACK/NACK signals, etc.) without sensing the frequency for the presence of other signals.

Adaptive equipment may or may not have Short Control Signaling Transmissions.

If implemented, Short Control Signaling Transmissions shall have a maximum TxOn / (TxOn + TxOff) ratio of 10 % within any observation period of 50 ms or within an observation period equal to the dwell time, whichever is less.

2.4.3. Test condition

See clause 5.1 for the environmental test conditions. These measurements shall only be performed at normal test conditions.

When supported by the operating frequency range of the equipment, this test shall be performed on two operating (hopping) frequencies randomly selected from the operating frequencies used by the equipment. The first (lower) frequency shall be randomly selected within the range 2 400 MHz to 2 442 MHz while the second (higher) frequency shall be randomly selected within the range 2 442 MHz to 2 483,5 MHz. The equipment shall be in a normal operating (hopping) mode.

For equipment which can operate in an adaptive and a non-adaptive mode, it shall be verified that prior to the test, the equipment is operating in the adaptive mode.

The equipment shall be configured in a mode that results in the longest Channel Occupancy Time.

2.4.4. Test procedures (Conducted measurements)

Figure 5 describes an example of the test set-up.

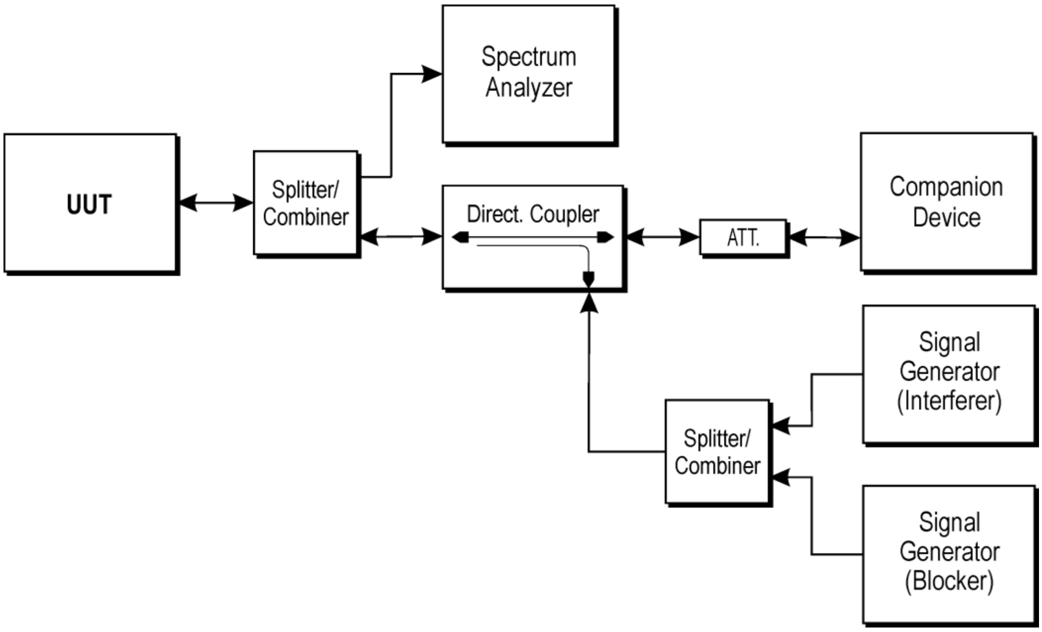


Figure 5: Test Set-up for verifying the adaptivity of an equipment

2.4.4.1 Adaptive Frequency Hopping equipment using DAA

Step 1 to step 7 below define the procedure to verify the efficiency of the DAA based adaptive mechanisms for frequency hopping equipment. These mechanisms are described in clause 4.3.1.7.

For systems using multiple receive chains only one chain (antenna port) need to be tested. All other receiver inputs shall be terminated.

Step 1:

• The UUT shall connect to a companion device during the test. The interference signal generator, the unwanted signal generator, the spectrum analyser, the UUT and the companion device are connected using a set-up equivalent to the example given by figure 5, although the interference and unwanted signal generators do not generate any signals at this point in time. The spectrum analyser is used to monitor the transmissions of both the UUT and the companion device and it should be possible to distinguish between either transmission. In addition, the spectrum analyser is used to monitor the transmissions of the UUT in response to the interfering and the unwanted signals.

• For the hopping frequency to be tested, adjust the received signal level (wanted signal from the companion device) at the UUT to the value defined in table 2 and table 3 (clause 4).

Testing of Unidirectional equipment does not require a link to be established with a companion device

• The analyser shall be set as follows:

- RBW: use next available RBW setting below the measured Occupied Channel Bandwidth
- Filter type: Channel Filter
- VBW: ≥ RBW

- Detector Mode: RMS
- Centre Frequency: Equal to the hopping frequency to be tested
- Span: 0 Hz
- Sweep time: > Channel Occupancy Time of the UUT. If the Channel Occupancy Time is non-contiguous (non-LBT based equipment), the sweep time shall be sufficient to cover the period over which the Channel Occupancy Time is spread out.
- Trace Mode: Clear/Write
- Trigger Mode: Video

Step 2:

• Configure the UUT for normal transmissions with a sufficiently high payload resulting in a minimum transmitter activity ratio (TxOn / (TxOn + TxOff)) of 0,3. Where this is not possible, the UUT shall be configured to the maximum payload possible.

• Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that, for equipment with a dwell time greater than the maximum allowable Channel Occupancy Time, the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in clauses 4.3.1.7.2.2 and 4.3.1.7.3.2.

Step 3: Adding the interference signal

An interference signal as defined in clause B.7 is injected centred on the hopping frequency being tested. The power spectral density level (at the input of the UUT) of this interference signal shall be equal to the detection threshold defined in clause 4.3.1.7.2.2 or clause 4.3.1.7.3.2.

Step 4: Verification of reaction to the interference signal

• The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected hopping frequency with the interfering signal injected. This may require the spectrum analyser sweep to be triggered by the start of the interfering signal.

• Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that:

i) The UUT shall stop transmissions on the hopping frequency being tested.

The UUT is assumed to stop transmissions on this hopping frequency within a period equal to the maximum Channel Occupancy Time defined in clause 4.3.1.7.2.2 or clause 4.3.1.7.3.2. As stated in clause 4.3.1.7.3.2, step 3, the Channel Occupancy Time for non-LBT based frequency hopping equipment may be non-contiguous.

ii) For LBT based frequency hopping equipment, apart from Short Control Signalling Transmissions (see iii) below), there shall be no subsequent transmissions on this hopping frequency, as long as the interference signal remains present.

For non-LBT based frequency hopping equipment, apart from Short Control Signalling Transmissions(see iii) below), there shall be no subsequent transmissions on this hopping frequency for a (silent) period defined in clause 4.3.1.7.3.2, step 2. After that, the UUT may have normal transmissions again for the duration of a single Channel Occupancy Time period (which may be non-contiguous). Because the interference signal is still present, another silent period as defined in clause 4.3.1.7.3.2, step 2 needs to be included. This sequence is repeated as long as the interfering signal is present.

In case of overlapping channels, transmissions in adjacent channels may generate transmission bursts on the channel being investigated; however, they have a lower amplitude as on-channel transmissions. Care should be taken to only evaluate the on-channel transmissions. The Time Domain Power Option of the analyser may be used to measure the RMS power of the individual bursts to distinguish on-channel transmissions from transmissions on adjacent channels. In some cases, the RBW may need to be reduced.

To verify that the UUT is not resuming normal transmissions as long as the interference signal is present,the monitoring time may need to be 60 s or more. If transmissions are detected during this period, the settings of the analyser may need to be adjusted to allow an accurate assessment to verify the transmissions comply with the limits for Short Control Signalling Transmissions.

iii) The UUT may continue to have Short Control Signalling Transmissions on the hopping frequency being tested while the interference signal is present. These transmissions shall comply with the limits defined in clause 4.3.1.7.4.2.

The verification of the Short Control Signalling transmissions may require the analyser settings to be changed (e.g. sweep time).

iv) Alternatively, the equipment may switch to a non-adaptive mode.

Step 5: Adding the blocking signal

• With the interfering signal present, a 100 % duty cycle CW signal is inserted as the unwanted signal. The frequency and the level are provided in table 2 of clause 4.3.1.7.2.2, step 6 or table 3 of clause 4.3.1.7.3.2,step 6.

• The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected hopping frequency. This may require the spectrum analyser sweep to be triggered by the start of the unwanted signal.

• Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that:

i) The UUT shall not resume normal transmissions on the hopping frequency being tested as long as both the interference and unwanted signals remain present.

To verify that the UUT is not resuming normal transmissions as long as the interference and unwanted signals are present, the monitoring time may need to be 60 s or more. If transmissions are detected during this period, the settings of the analyser may need to be adjusted to allow an accurate assessment to verify the transmissions comply with the limits for Short Control Signalling Transmissions.

ii) The UUT may continue to have Short Control Signalling Transmissions on the hopping frequency being tested while the interference and unwanted signals are present. These transmissions shall comply with the limits defined in clause 4.3.1.7.4.2.

The verification of the Short Control Signalling transmissions may require the analyser settings to be changed (e.g. sweep time).

Step 6: Removing the interference and blocking signal

• On removal of the interference and unwanted signal, the UUT is allowed to re-include any channel previously marked as unavailable; however, for non-LBT based equipment, it shall be verified that this shall only be done after the period defined in clause 4.3.1.7.3.2, step 2.

Step 7:

• Step 2 to step 6 shall be repeated for each of the hopping frequencies to be tested.

2.4.5. Result

This test case not applies this kind of EUT.

2.5. EN 300 328 §4.3.1.8 Occupied Channel Bandwidth

2.5.1. Definition

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

2.5.2. Limit

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

2.5.3. Test condition

See clause 5.1 for the environmental test conditions. These measurements shall only be performed at normal test conditions.
In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains) measurements need only to be performed on one of the active transmit chains (antenna outputs).
For equipment using FHSS modulation and which have overlapping channels, special software might be required to force the UUT to hop or transmit on a single Hopping Frequency.
The measurement shall be performed only on the lowest and the highest frequency within the stated frequency range.The frequencies on which the tests were performed shall be recorded.
If the equipment can operate with different Nominal Channel Bandwidths (e.g. 20 MHz and 40 MHz), then each channel bandwidth shall be tested separately.

2.5.4. Test procedures

The measurement procedure shall be as follows:
Step 1:
Connect the UUT to the spectrum analyzer and use the following settings:
• Centre Frequency: The centre frequency of the channel under test
• Resolution BW: ~ 1 % of the span without going below 1 %
• Video BW: 3 × RBW
• Frequency Span: 2 × Nominal Channel Bandwidth

• Detector Mode: RMS
• Trace Mode: Max Hold
• Sweep time: 1 s

Step 2:

Wait for the trace to stabilize.

Find the peak value of the trace and place the analyzer marker on this peak.

Step 3:

Use the 99 % bandwidth function of the spectrum analyser to measure the Occupied Channel Bandwidth of the UUT.This value shall be recorded.

Make sure that the power envelope is sufficiently above the noise floor of the analyser to avoid the noise signals left and right from the power envelope being taken into account by this measurement.

2.5.5. Result

2.5.5.1 GFSK

Channel	Frequency (MHz)	Measure Frequency (MHz)	Refer Plot	Limit (MHz)	Result
0	2402	2401.55	Plot B3	≥2400	**PASS**
78	2480	2480.45	Plot B4	≤2483.5	**PASS**

2.5.5.2 π/4-DQPSK

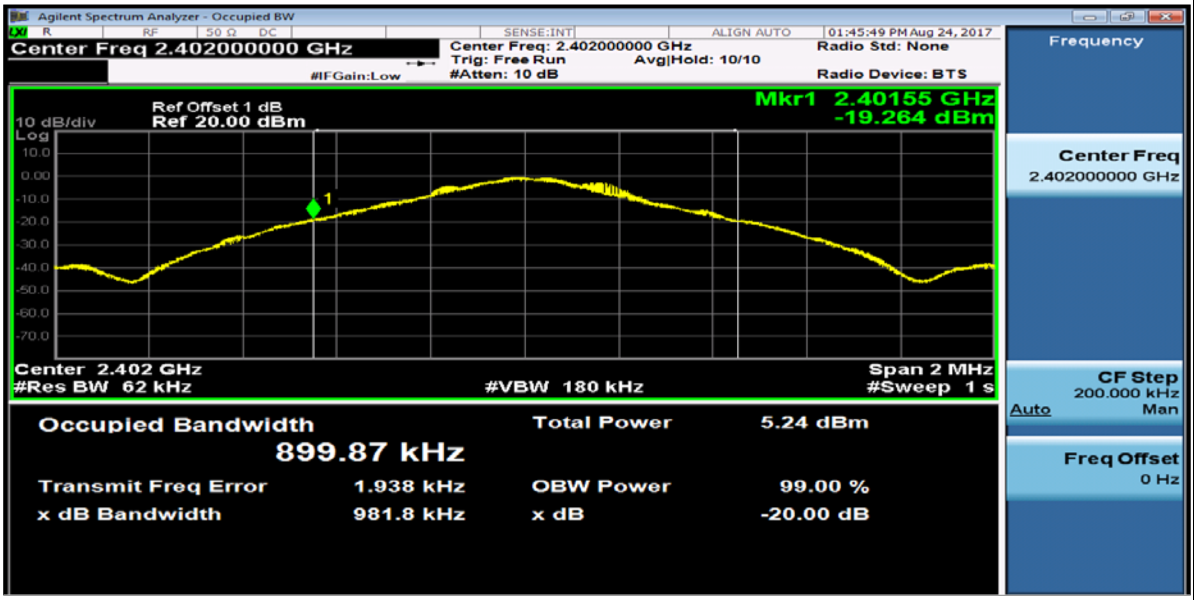
Channel	Frequency (MHz)	Measure Frequency (MHz)	Refer Plot	Limit (MHz)	Result
0	2402	2401.40	Plot C3	≥2400	**PASS**
78	2480	2480.60	Plot C4	≤2483.5	**PASS**

2.5.5.3 8-DPSK

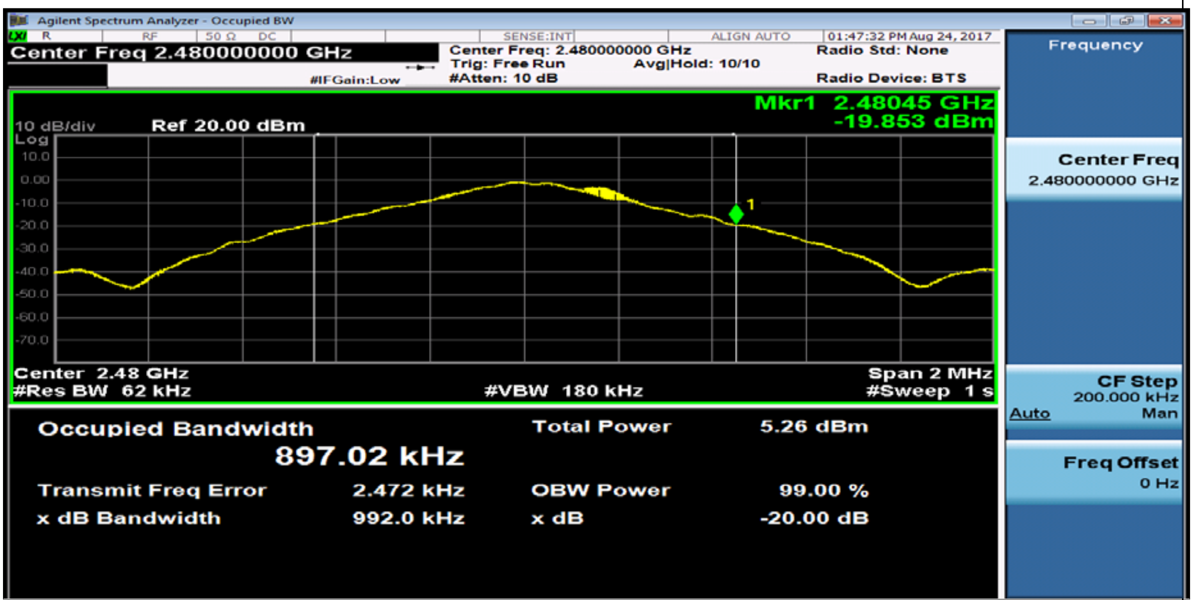
Channel	Frequency (MHz)	Measure Frequency (MHz)	Refer Plot	Limit (MHz)	Result
0	2402	2401.40	Plot D3	≥2400	**PASS**
78	2480	2480.60	Plot D4	≤2483.5	**PASS**

Test Plot:

GFSK

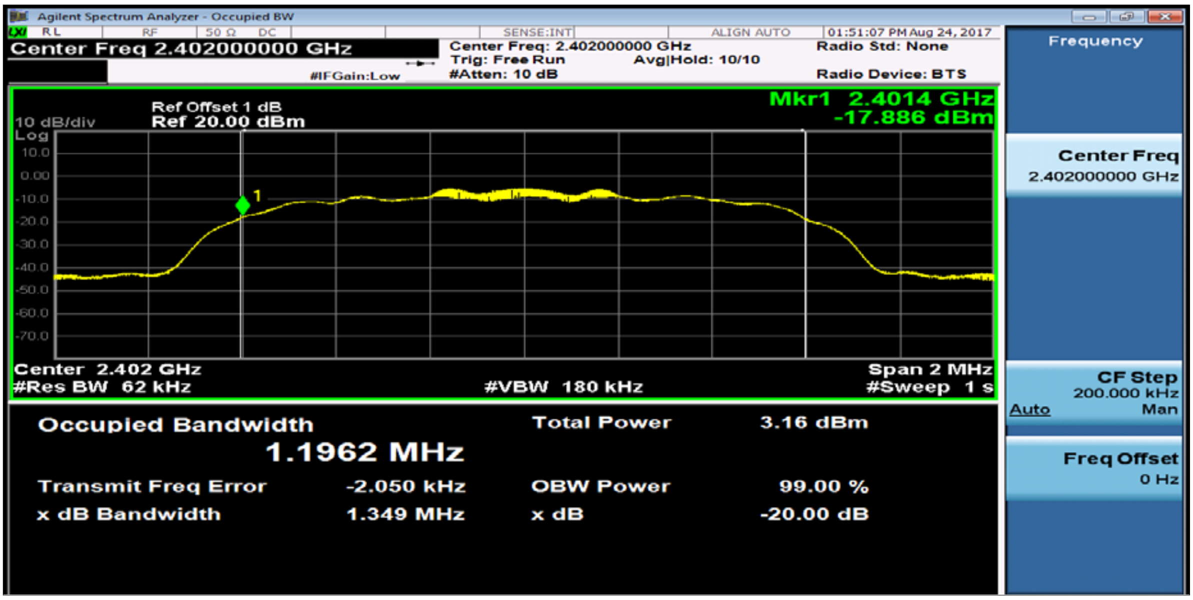


(Plot B3: Channel0 Occupied Channel Bandwidth)

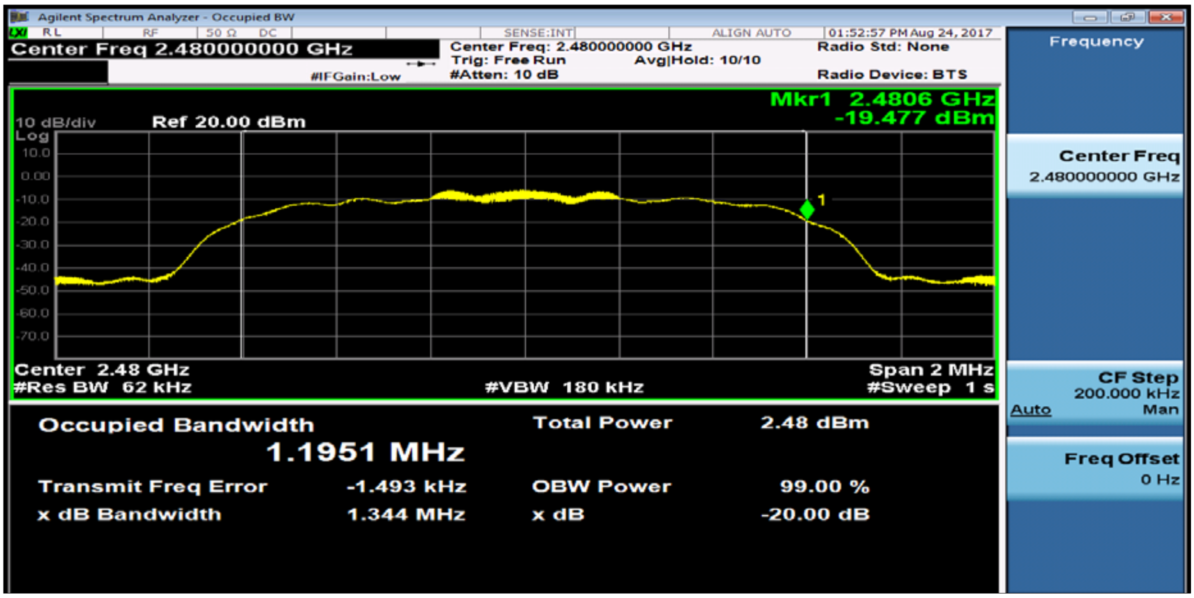


(Plot B4: Channel78 Occupied Channel Bandwidth)

π/4-DQPSK

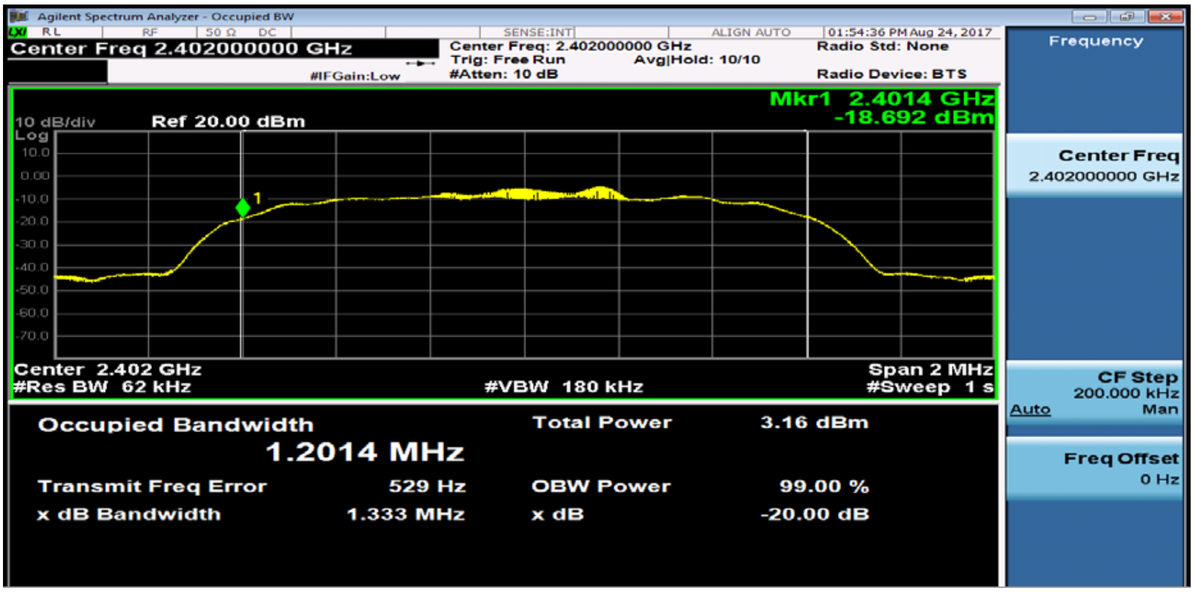


(Plot C3: Channel0 Occupied Channel Bandwidth)

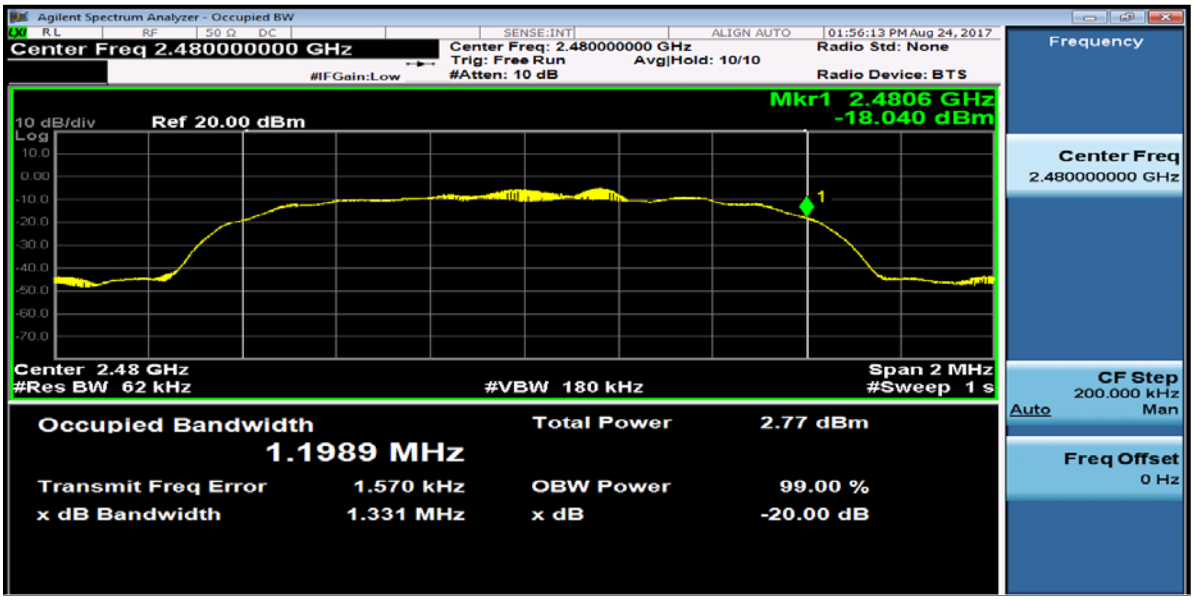


(Plot C4: Channel78 Occupied Channel Bandwidth)

8-DPSK



(Plot D3: Channel0 Occupied Channel Bandwidth)



(Plot D4: Channel78 Occupied Channel Bandwidth)

2.6. EN 300 328 §4.3.1.9 Transmitter unwanted emissions in the OOB domain

2.6.1. Definition

Transmitter unwanted emissions in the out-of-band domain are emissions when the equipment is in Transmit mode, on frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions.

2.6.2. 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.
Within the band specified in table 1, the Out-of-band emissions are fulfilled by compliance with the Occupied Channel Bandwidth requirement in clause 4.3.1.8.

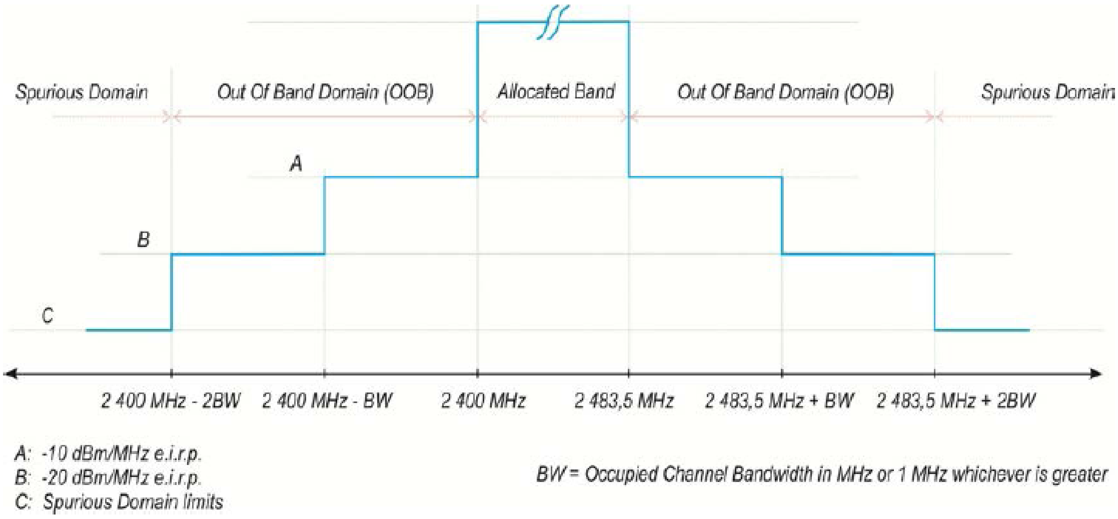


Figure 1: Transmit mask

2.6.3. Test condition

See clause 5.1 for the environmental test conditions.
These measurements shall only be performed at normal test conditions.
For equipment using FHSS modulation, the measurements shall be performed during normal operation (hopping).
For equipment using wide band modulations other than FHSS, the measurement shall be performed at the lowest and the highest channel on which the equipment can operate. These operating channels shall be recorded.

The equipment shall be configured to operate under its worst case situation with respect to output power. If the equipment can operate with different Nominal Channel Bandwidths(e.g. 20 MHz and 40 MHz), then each channel bandwidth shall be tested separately.

2.6.4. Test procedures

The applicable mask is defined by the measurement results from the tests performed under clause 5.4.7 (Occupied Channel Bandwidth).
The Out-of-band emissions within the different horizontal segments of the mask provided in figure 1 and figure 3 shall be measured using the procedure in step 1 to step 6 below. This method assumes the spectrum analyser is equipped with the Time Domain Power option.

Step 1:

• Connect the UUT to the spectrum analyser and use the following settings:

- Centre Frequency: 2 484 MHz
- Span: 0 Hz
- Resolution BW: 1 MHz
- Filter mode: Channel filter
- Video BW: 3 MHz
- Detector Mode: RMS
- Trace Mode: Max Hold
- Sweep Mode: Continuous
- Sweep Points: Sweep Time [s] / (1 μs) or 5 000 whichever is greater
- 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

Step 2 (segment 2 483,5 MHz to 2 483,5 MHz + BW):

• Adjust the trigger level to select the transmissions with the highest power level..

• For frequency hopping equipment operating in a normal hopping mode, the different hops will result in signal bursts with different power levels. In this case the burst with the highest power level shall be selected.

• Set a window (start and stop lines) to match with the start and end of the burst and in which the RMS power shall be measured using the Time Domain Power function.

• Select RMS power to be measured within the selected window and note the result which is the RMS power within this 1 MHz segment (2 483,5 MHz to 2 484,5 MHz). Compare this value with the applicable limit provided by the mask.

• Increase the centre frequency in steps of 1 MHz and repeat this measurement for every 1 MHz segment within the range 2 483,5 MHz to 2 483,5 MHz + BW. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + BW - 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 3 (segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW):

• Change the centre frequency of the analyser to 2 484 MHz + BW and perform the measurement for the first 1 MHz segment within range 2 483,5 MHz + BW to 2 483,5 MHz + 2BW. Increase the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + 2 BW - 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 4 (segment 2 400 MHz - BW to 2 400 MHz):

• Change the centre frequency of the analyzer to 2 399,5 MHz and perform the measurement for the first 1 MHz segment within range 2 400 MHz - BW to 2 400 MHz Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - BW + 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 5 (segment 2 400 MHz - 2BW to 2 400 MHz - BW):

• Change the centre frequency of the analyzer to 2 399,5 MHz - BW and perform the measurement for the first 1 MHz segment within range 2 400 MHz - 2BW to 2 400 MHz - BW. Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - 2BW + 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 6:

•In case of conducted measurements on equipment with a single transmit chain, the declared antenna assembly gain G in dBi shall be added to the results for each of the 1 MHz segments and compared with the limits provided by the mask given in figure 1 or figure 3. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered.

• In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), the measurements need to be repeated for each of the active transmit chains. The declared antenna assembly gain G in dBi for a single antenna shall be added to these results. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered. Comparison with the applicable limits shall be done using any of the options given below:

- Option 1: the results for each of the transmit chains for the corresponding 1 MHz segments shall be added. The additional beam forming gain "Y" in dB shall be added as well and the resulting values compared with the limits provided by the mask given in figure 1 or figure 3.

- Option 2: the limits provided by the mask given in figure 1 or figure 3 shall be reduced by $10 \times \log_{10} (A_{ch})$ and the additional beam forming gain "Y" in dB. The results for each of the transmit chains shall be individually compared with these reduced limits.

NOTE: A_{ch} refers to the number of active transmit chains.

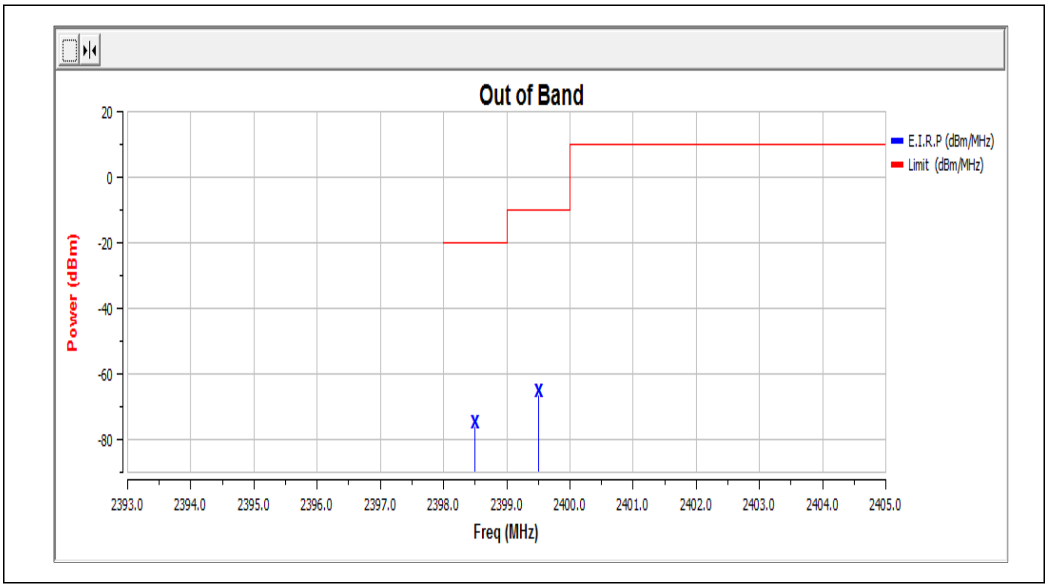
It shall be recorded whether the equipment complies with the mask provided in figure 1 or figure 3.

2.6.5. Result

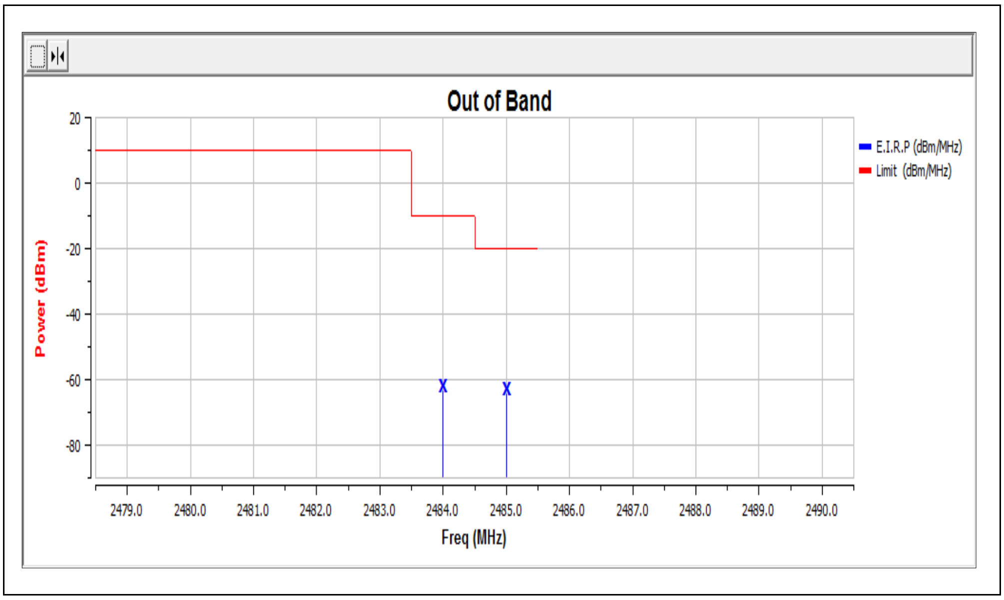
2.6.5.1 GFSK

Test Conditions		Out-of-band domain (MHz)		Out-of-band domain (MHz)	
		2400-BW to 2400	2400-2BW to 2400-BW	2483.50 to 2483.5+BW	2483.5+BW to 2483.5+2BW
NT	NV	-66.94	-76.48	-63.69	-64.73
Limit (dBm/MHz)		-10	-20	-10	-20
Result		**PASS**	**PASS**	**PASS**	**PASS**

Test Plot:



(Test Plot: Channel0 2402MHz)

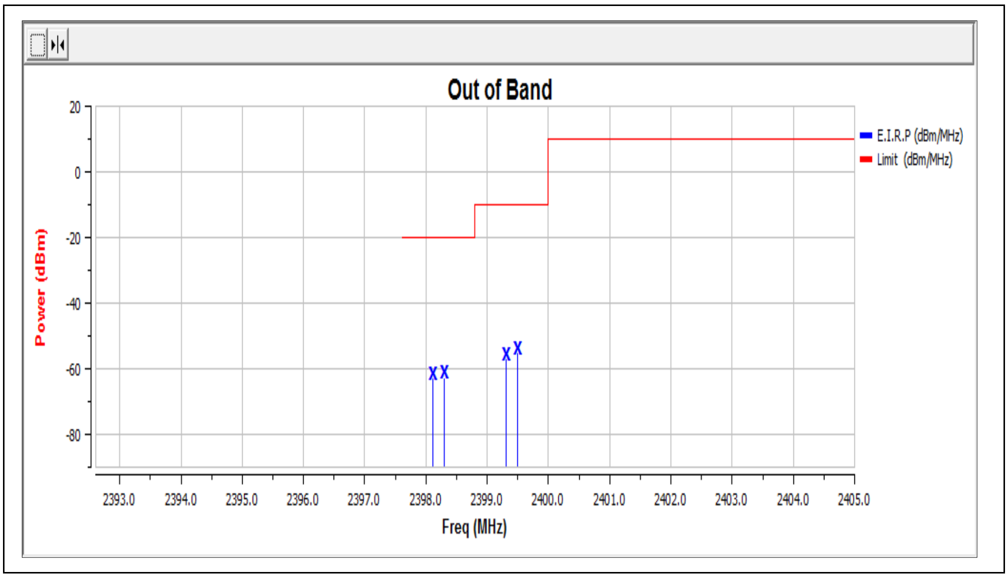


(Test Plot: Channel78 2480MHz)

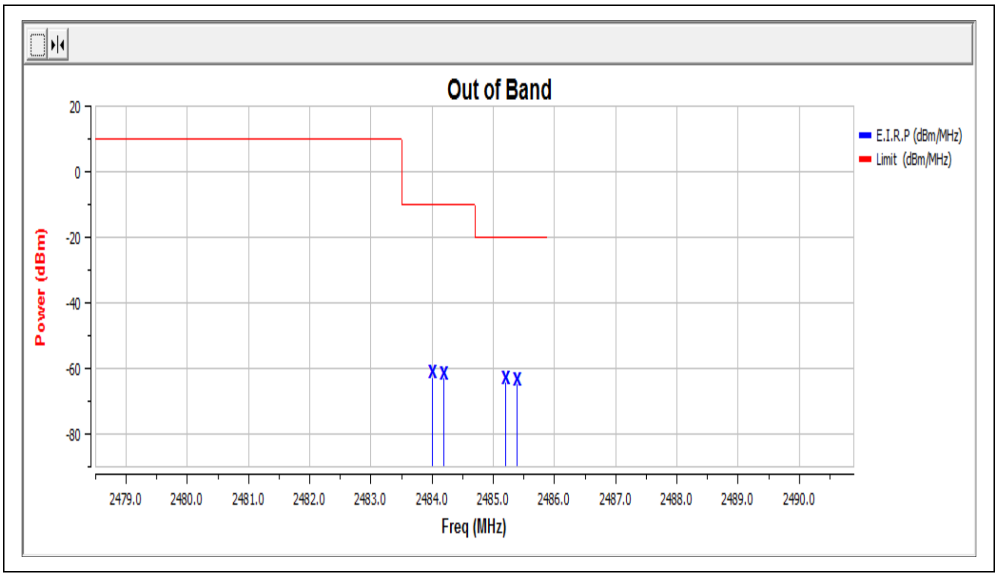
2.6.5.2 π/4-DQPSK

Test Conditions		Out-of-band domain (MHz)		Out-of-band domain (MHz)	
		2400-BW to 2400	2400-2BW to 2400-BW	2483.50 to 2483.5+BW	2483.5+BW to 2483.5+2BW
NT	NV	-55.47	-62.97	-63.11	-64.72
Limit (dBm/MHz)		-10	-20	-10	-20
Result		**PASS**	**PASS**	**PASS**	**PASS**

Test Plot:



(Test Plot: Channel0 2402MHz)

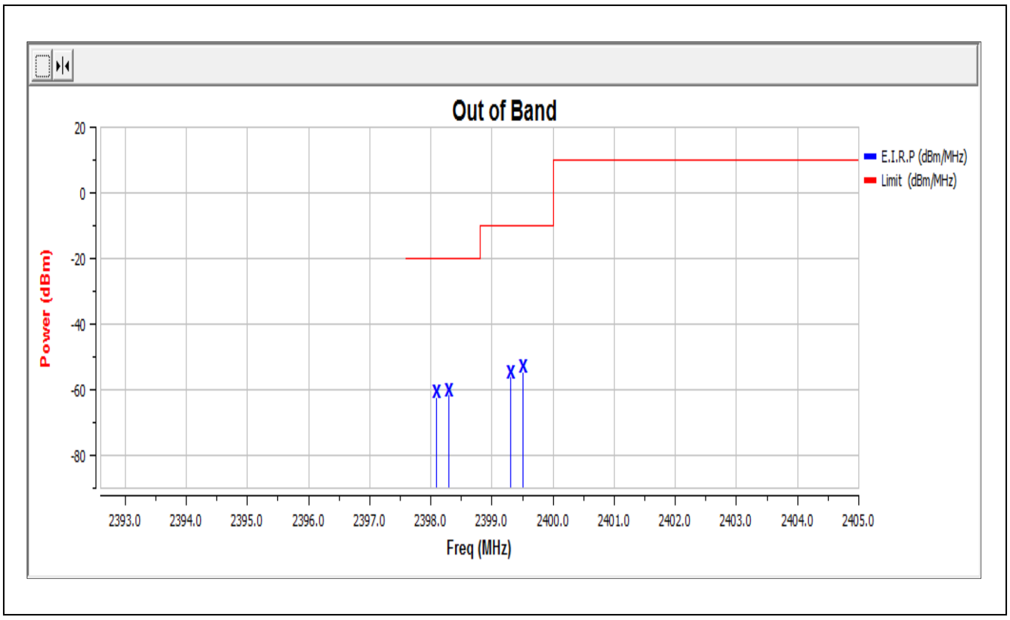


(Test Plot: Channel78 2480MHz)

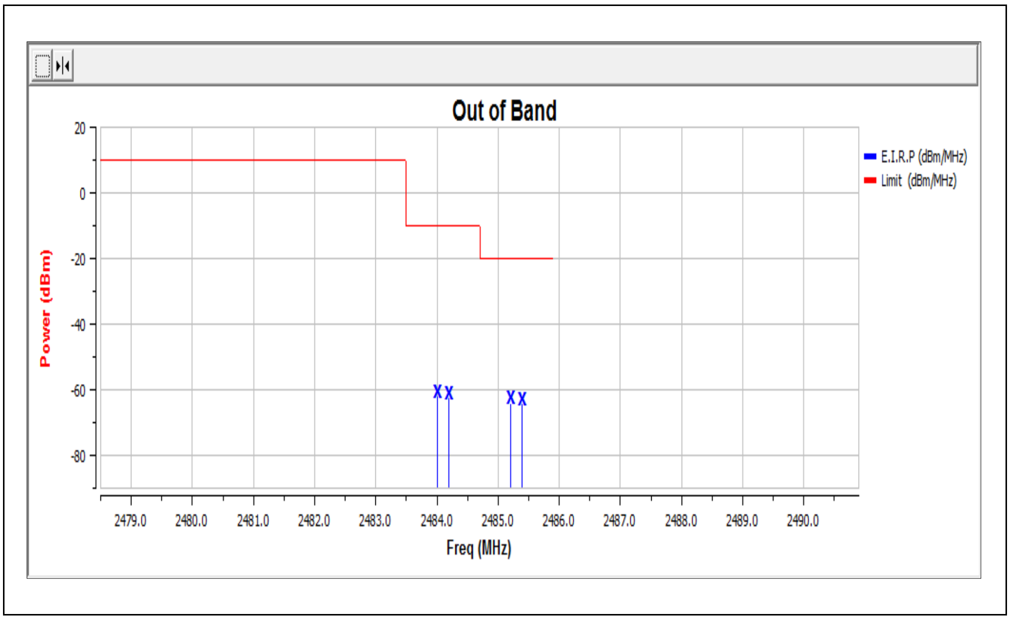
2.6.5.3 8-DPSK

Test Conditions		Out-of-band domain (MHz)		Out-of-band domain (MHz)	
		2400-BW to 2400	2400-2BW to 2400-BW	2483.50 to 2483.5+BW	2483.5+BW to 2483.5+2BW
NT	NV	-54.79	-61.98	-62.48	-64.43
Limit (dBm/MHz)		-10	-20	-10	-20
Result		**PASS**	**PASS**	**PASS**	**PASS**

Test Plot:



(Test Plot: Channel0 2402MHz)



(Test Plot: Channel78 2480MHz)

2.7. EN 300 328 §4.3.1.10 Transmitter unwanted emissions in the spurious domain

2.7.1. 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.

2.7.2. Limit

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	100kHz
47 MHz to 74 MHz	-54 dBm	100kHz
74 MHz to 87,5 MHz	-36 dBm	100kHz
87,5 MHz to 118 MHz	-54 dBm	100kHz
118 MHz to 174 MHz	-36 dBm	100kHz
174 MHz to 230 MHz	-54 dBm	100kHz
230 MHz to 470 MHz	-36 dBm	100kHz
470 MHz to 862 MHz	-54 dBm	100kHz
862 MHz to 1 GHz	-36 dBm	100kHz
1 GHz to 12,75 GHz	-30 dBm	1MHz

2.7.3. Test condition

See clause 5.1 for the test conditions. These measurements shall only be performed at normal test conditions.
The level of spurious emissions shall be measured as, either:
a) their power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment (cabinet radiation); or
b) their effective radiated power when radiated by cabinet and antenna in case of integral antenna

equipment with no temporary antenna connectors.
Testing shall be performed when the equipment is in a receive-only mode.
For equipment using wide band modulations other than FHSS, the measurement shall be performed at the lowest and the highest channel on which the equipment can operate. These frequencies shall be recorded.
For equipment using FHSS modulation, the measurements may be performed when normal hopping is disabled. In this case measurements need to be performed when operating at the lowest and the highest hopping frequency. These frequencies shall be recorded. When disabling the normal hopping is not possible, the measurement shall be performed during normal operation (hopping).

2.7.4. Test procedures

The measurement procedure shall be as follows.

2.7.4.1 Conducted measurement

Pre-scan

The procedure in step 1 to step 4 below shall be used to identify potential unwanted emissions of the UUT.

Step 1:

The sensitivity of the measurement set-up should be such that the noise floor is at least 12 dB below the limits given in table 5 or table 13.

Step 2:

The emissions over the range 30 MHz to 1 000 MHz shall be identified.
Spectrum analyser settings:
• Resolution bandwidth: 100 kHz
• Video bandwidth: 300 kHz
• Filter type: 3 dB (Gaussian)
• Detector mode: Peak
• Trace Mode: Max Hold
• Sweep Points: ⩾ 19 400
• Sweep Time: Auto
Wait for the trace to stabilize. Any emissions identified during the sweeps above and that fall within the 6 dB range below the applicable limit or above, shall be individually measured using the procedure in clause 5.4.10.2.1.3 and compared to the limits given in table 5 or table 13.

Step 3:

The emissions over the range 1 GHz to 12,75 GHz shall be identified.
Spectrum analyser settings:
• Resolution bandwidth: 1 MHz
• Video bandwidth: 3 MHz

• Filter type: 3 dB (Gaussian)
• Detector mode: Peak
• Trace Mode: Max Hold
• Sweep Points: ≥ 23 500;for spectrum analyzers not supporting this high number of sweep points, the frequency band may need to be segmented.
• Sweep time: Auto

Wait for the trace to stabilize. Any emissions identified during the sweeps above that fall within the 6 dB range below the applicable limit or above, shall be individually measured using the procedure in clause 5.4.10.2.1.3 and compared to the limits given in table 5 or table 13.

Frequency Hopping equipment may generate a block (or several blocks) of spurious emissions anywhere within the spurious domain. If this is the case, only the highest peak of each block of emissions shall be measured using the procedure in clause 5.4.10.2.1.3.

Step 4:

• In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), step 2 and step 3 need to be repeated for each of the active transmit chains (A_{ch}).The limits used to identify emissions during this pre-scan need to be reduced with 10 × log10 (A_{ch}) .

Measurement of the emissions identified during the pre-scan

The procedure in step 1 to step 4 below shall be used to accurately measure the individual unwanted emissions identified during the pre-scan measurements above. This method assumes the spectrum analyser has a Time Domain Power function.

Step 1:

The level of the emissions shall be measured using the following spectrum analyser settings:

• Measurement Mode: Time Domain Power
• Centre Frequency: Frequency of the emission identified during the pre-scan
• Resolution Bandwidth: 100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
• Video Bandwidth: 300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
• Frequency Span: Zero Span
• Sweep mode: Single Sweep
• Sweep time: 30ms
• Sweep points: ≥30 000
• Trigger: Video (burst signals) or Manual (continuous signals)
• Detector: RMS

Step 2:

Set a window where the start and stop indicators match the start and end of the burst with the highest level and record the value of the power measured within this window.If the spurious emission to be measured is a continuous transmission, the measurement window shall be set to match the start and stop times of the sweep.

Step 3:

In case of conducted measurements on smart antenna systems (equipment with multiple transmit

chains), step 2 needs to be repeated for each of the active transmit chains (A_{ch}).
Sum the measured power (within the observed window) for each of the active transmit chains.

Step 4:

The value defined in step 3 shall be compared to the limits defined in tables 5 and table 13.

2.7.4.2 Radiated measurement

The test site as described in annex B and applicable measurement procedures as described in annex C shall be used.

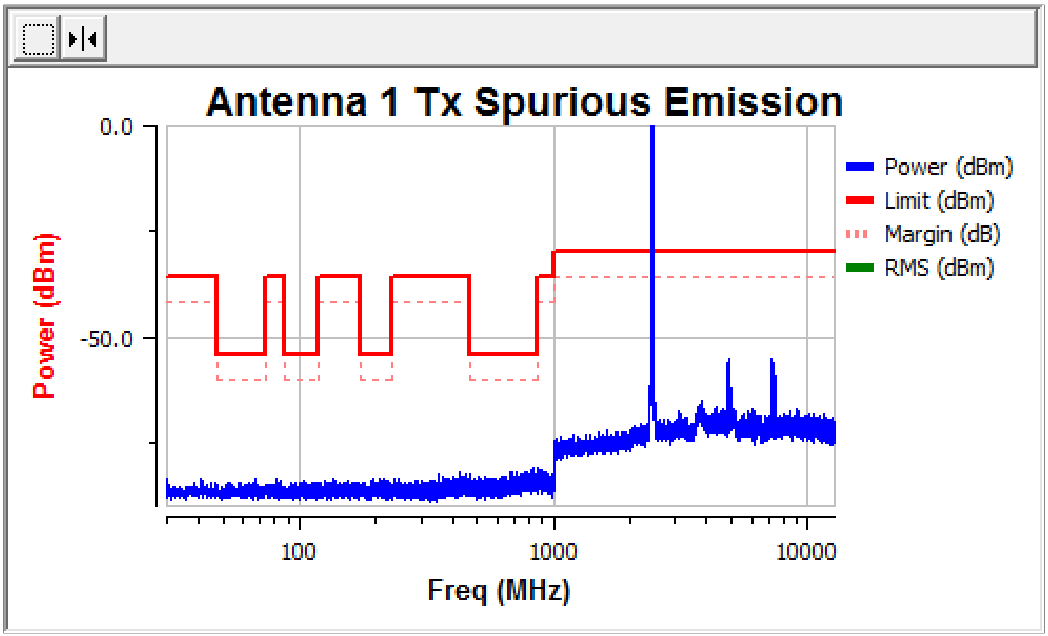
The test procedure is further as described under clause 5.4.10.2.1.

2.7.5. Result

Below is the worst case situation test data:

2.7.5.1 Conducted test result

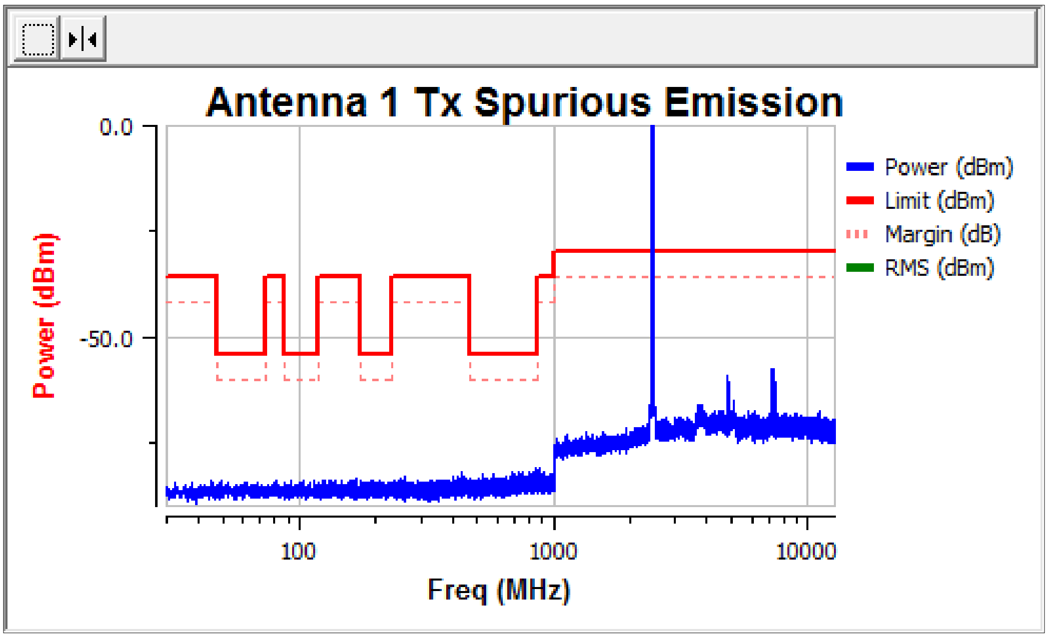
GFSK Hopping Mode



(GFSK Mode , 30MHz to 12.75GHz)

Freq (MHz)	Peak Level (dBm)	Limit (dBm)	Over Limit (dB)	Status
684.600	-81.68	-54.00	-27.68	PASS
716.400	-81.35	-54.00	-27.35	PASS
778.900	-81.36	-54.00	-27.36	PASS
829.650	-80.41	-54.00	-26.41	PASS
857.850	-80.72	-54.00	-26.72	PASS
4836.000	-55.45	-30.00	-25.45	PASS
4918.000	-54.76	-30.00	-24.76	PASS
7221.000	-54.56	-30.00	-24.56	PASS
7248.500	-55.04	-30.00	-25.04	PASS
7275.000	-55.76	-30.00	-25.76	PASS

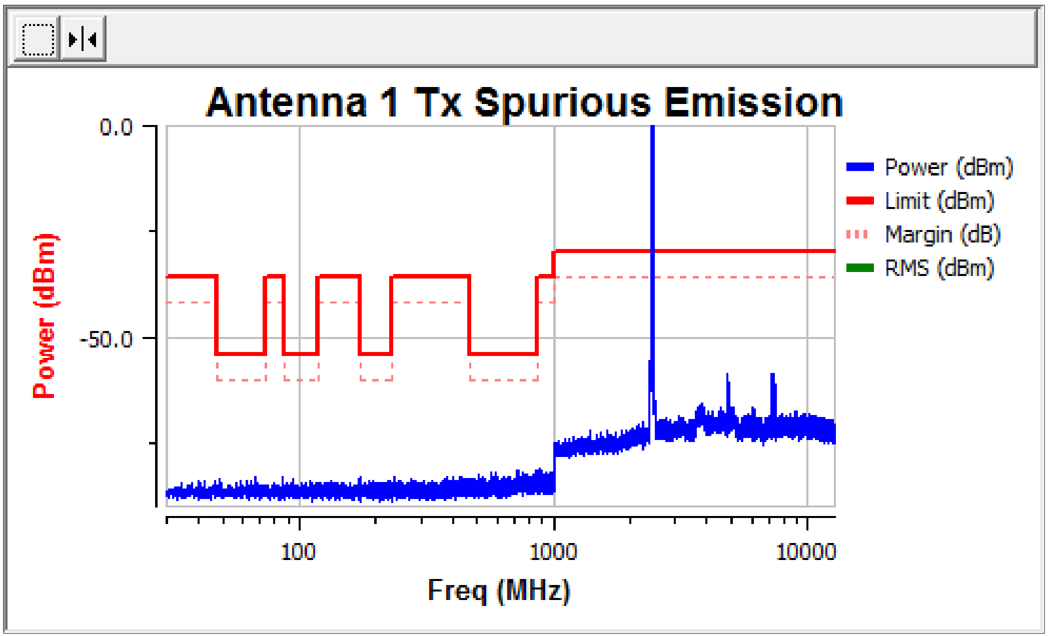
π/4-DQPSK Hopping Mode



(π/4-DQPSK Mode , 30MHz to 12.75GHz)

Freq (MHz)	Peak Level (dBm)	Limit (dBm)	Over Limit (dB)	Status
689.350	-81.62	-54.00	-27.62	PASS
725.650	-81.45	-54.00	-27.45	PASS
752.800	-81.77	-54.00	-27.77	PASS
796.750	-81.44	-54.00	-27.44	PASS
843.250	-80.74	-54.00	-26.74	PASS
4830.000	-58.89	-30.00	-28.89	PASS
7218.500	-58.73	-30.00	-28.73	PASS
7254.500	-57.40	-30.00	-27.40	PASS
7302.000	-57.34	-30.00	-27.34	PASS
7359.000	-59.06	-30.00	-29.06	PASS

8-DPSK Hopping Mode

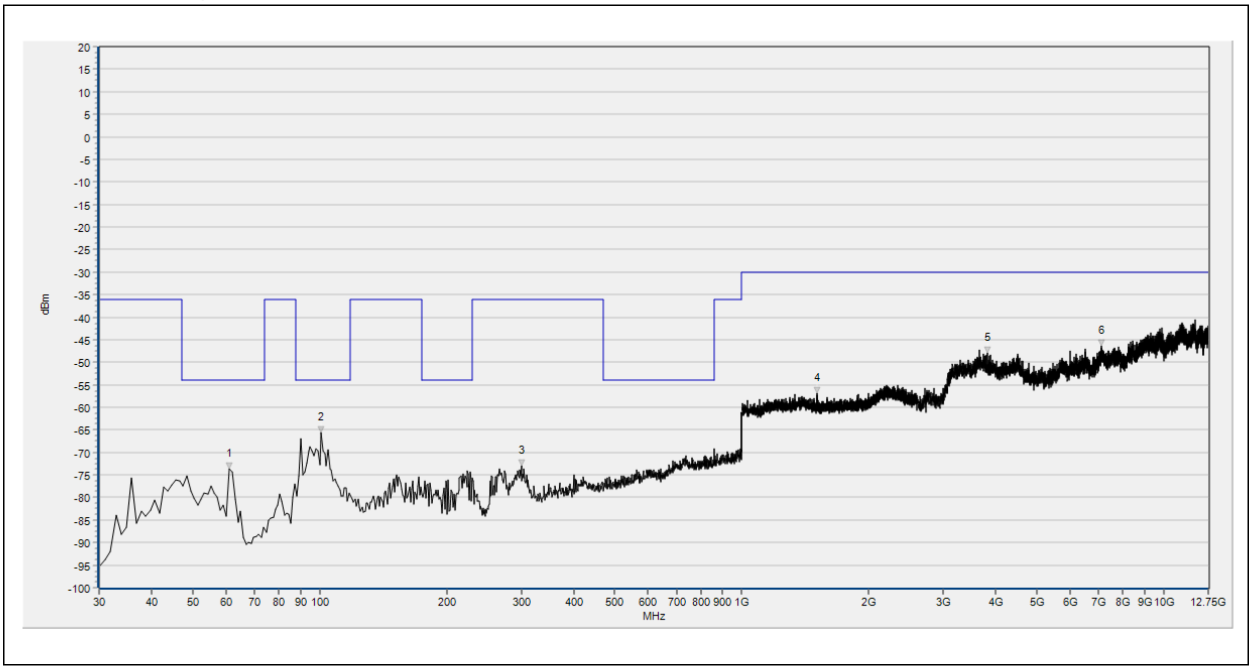


(8-DPSK Mode, 30MHz to 12.75GHz)

Freq (MHz)	Peak Level (dBm)	Limit (dBm)	Over Limit (dB)	Status
569.000	-81.78	-54.00	-27.78	PASS
594.750	-81.71	-54.00	-27.71	PASS
717.050	-81.10	-54.00	-27.10	PASS
761.750	-81.53	-54.00	-27.53	PASS
853.600	-81.26	-54.00	-27.26	PASS
2398.000	-56.86	-30.00	-26.86	PASS
4839.500	-58.35	-30.00	-28.35	PASS
7215.000	-58.02	-30.00	-28.02	PASS
7251.500	-58.40	-30.00	-28.40	PASS
7323.000	-58.21	-30.00	-28.21	PASS

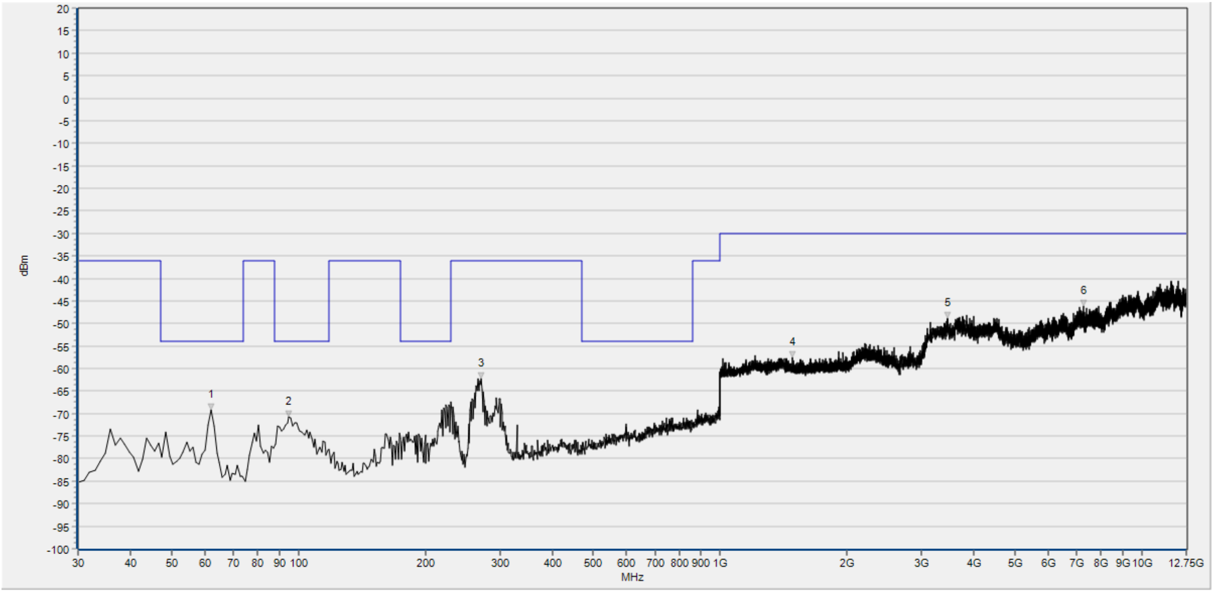
2.7.5.2 Radiated test result

GFSK Hopping Mode



(Plot A.1: 30MHz to 1GHz, Antenna Horizontal @ GFSK)

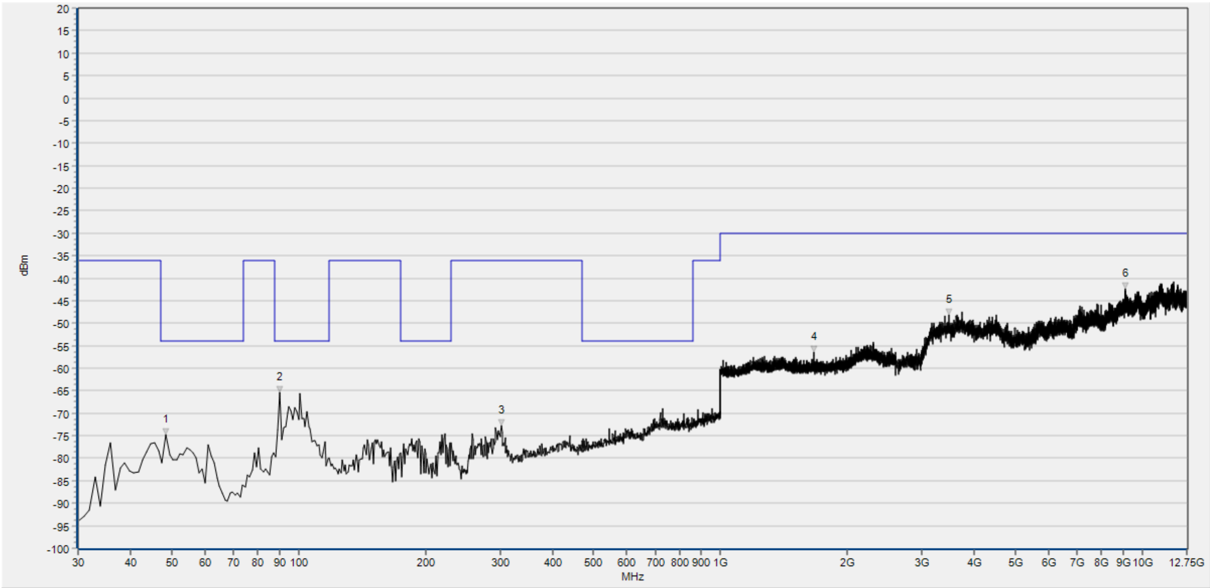
Test frequency range 30MHz to 12.75 GHz	Hopping Mode				
	Transmitter with modulation Mode at Hopping Mode				
	Frequency (MHz)	**Peak (dBm)**	**Limit(PK)**	**Antenna**	**Verdict**
	61.040	-73.66	-54.00	Horizontal	PASS
	100.812	-65.64	-54.00	Horizontal	PASS
	300.630	-72.90	-36.00	Horizontal	PASS
	1511.467	-56.82	-30.00	Horizontal	PASS
	3828.150	-47.99	-30.00	Horizontal	PASS
	7130.960	-46.43	-30.00	Horizontal	PASS



(Plot A.2: 1GHz to12.75GHz, Antenna Vertical @ GFSK)

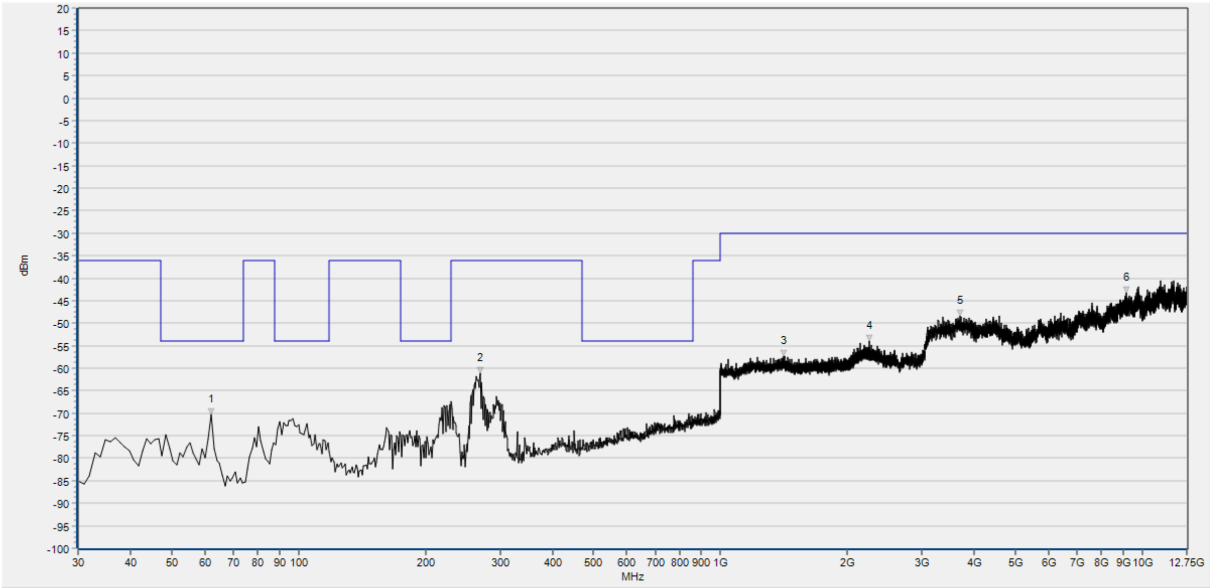
Test frequency range 30MHz to 12.75 GHz	Hopping Mode				
	Transmitter with modulation Mode at Hopping Mode				
	Frequency (MHz)	Peak (dBm)	Limit(PK)	Antenna	Verdict
	62.010	-69.26	-54.00	Vertical	PASS
	94.990	-70.71	-54.00	Vertical	PASS
	271.530	-62.28	-36.00	Vertical	PASS
	1480.533	-57.60	-30.00	Vertical	PASS
	3466.810	-48.78	-30.00	Vertical	PASS
	7254.790	-46.15	-30.00	Vertical	PASS

π/4-DQPSK Hopping Mode



(Plot B.1: 30MHz to 12.75GHz, Antenna Horizontal @π/4-DQPSK)

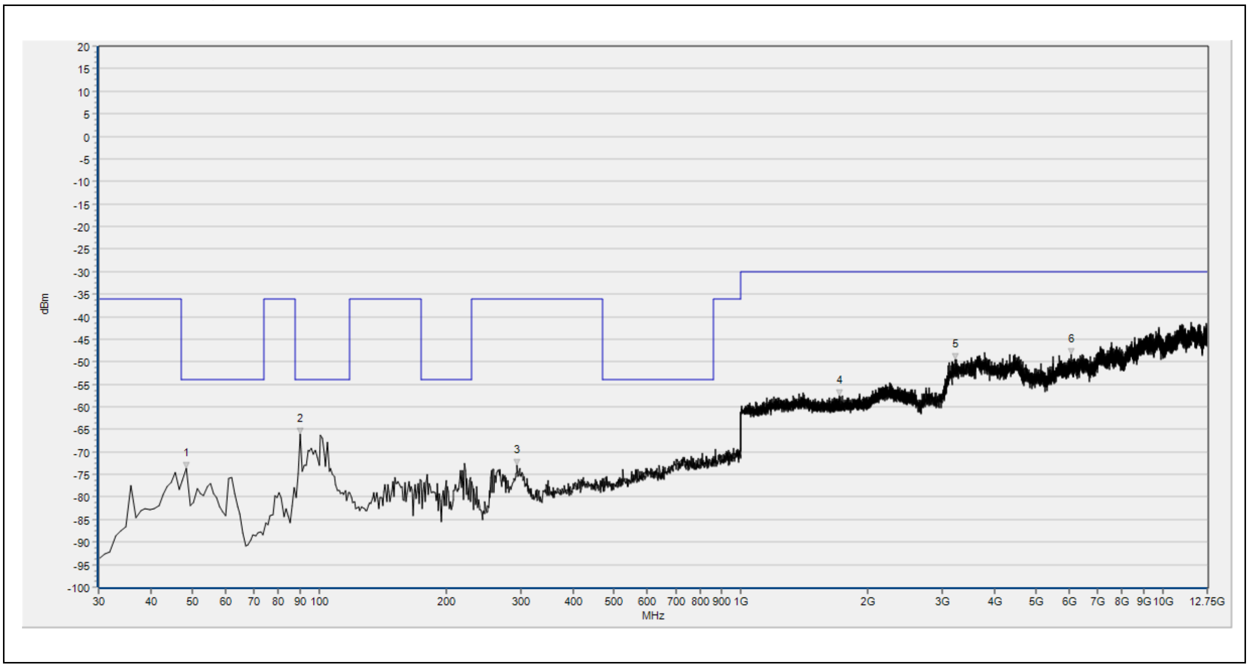
Test frequency range 30MHz to 12.75 GHz	Hopping Mode				
	Transmitter with modulation Mode at Hopping Mode				
	Frequency (MHz)	**Peak (dBm)**	**Limit(PK)**	**Antenna**	**Verdict**
	48.430	-74.74	-54.00	Horizontal	PASS
	90.140	-65.36	-54.00	Horizontal	PASS
	302.570	-72.68	-36.00	Horizontal	PASS
	1665.067	-56.37	-30.00	Horizontal	PASS
	3485.080	-48.22	-30.00	Horizontal	PASS
	9116.300	-42.40	-30.00	Horizontal	PASS



(Plot B.2: 30MHz to 12.75GHz, Antenna Vertical @π/4-DQPSK)

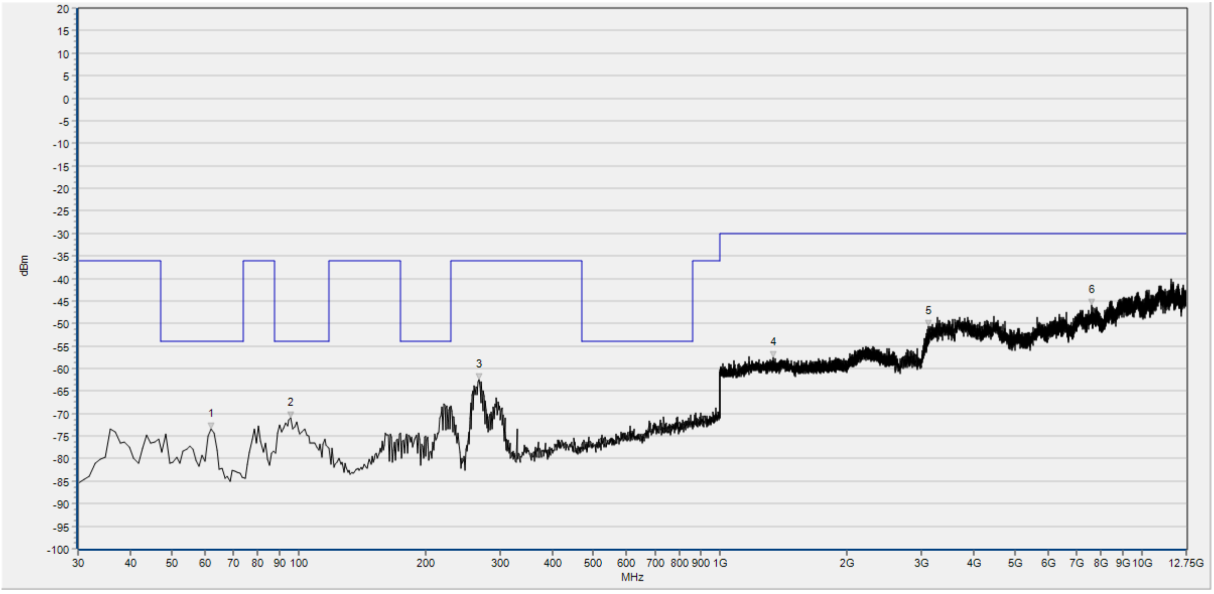
Test frequency range 30MHz to 12.75 GHz	Hopping Mode				
	Transmitter with modulation Mode at Hopping Mode				
	Frequency (MHz)	**Peak (dBm)**	**Limit(PK)**	**Antenna**	**Verdict**
	62.010	-70.27	-54.00	Vertical	PASS
	269.590	-61.07	-36.00	Vertical	PASS
	1409.067	-57.38	-30.00	Vertical	PASS
	2254.400	-54.06	-30.00	Vertical	PASS
	3698.230	-48.44	-30.00	Vertical	PASS
	9146.750	-43.24	-30.00	Vertical	PASS

8-DPSK Hopping Mode



(Plot C.1: 30MHz to 12.75GHz, Antenna Horizontal @ 8-DPSK)

Test frequency range 30MHz to 12.75 GHz	Hopping Mode				
	Transmitter with modulation Mode at Hopping Mode				
	Frequency (MHz)	**Peak (dBm)**	**Limit(PK)**	**Antenna**	**Verdict**
	48.430	-73.54	-54.00	Horizontal	PASS
	90.140	-65.94	-54.00	Horizontal	PASS
	294.810	-72.95	-36.00	Horizontal	PASS
	1707.200	-57.51	-30.00	Horizontal	PASS
	3217.120	-49.57	-30.00	Horizontal	PASS
	6053.030	-48.38	-30.00	Horizontal	PASS



(Plot C.2: 30MHz to 12.75GHz, Antenna Vertical @ 8-DPSK)

Test frequency range 30MHz to 12.75 GHz	Hopping Mode				
	Transmitter with modulation Mode at Hopping Mode				
	Frequency (MHz)	**Peak (dBm)**	**Limit(PK)**	**Antenna**	**Verdict**
	62.010	-73.45	-54.00	Vertical	PASS
	95.960	-71.00	-54.00	Vertical	PASS
	267.650	-62.50	-36.00	Vertical	PASS
	1337.600	-57.64	-30.00	Vertical	PASS
	3117.650	-50.57	-30.00	Vertical	PASS
	7595.830	-45.94	-30.00	Vertical	PASS

3. Receiver Parameters

3.1. EN 300 328 §4.3.1.11 - Receiver Spurious Emissions

3.1.1. Definition

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

3.1.2. Limit

The spurious emissions of the receiver 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 5:Spurious emission limits forreceiver		
Frequency range	**Maximum power**	**Bandwidth**
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12,75 GHz	-47 dBm	1 MHz

3.1.3. Test condition

See clause 5.1 for the environmental test conditions. These measurements shall only be performed at normal test conditions.
The level of spurious emissions shall be measured as, either:
a) their power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment (cabinet radiation); or
b) their effective radiated power when radiated by cabinet and antenna in case of integral antenna equipment with no antenna connectors.
Testing shall be performed when the equipment is in a receive-only mode.
For equipment using wide band modulations other than FHSS, the measurement shall be performed at the lowest and the highest channel on which the equipment can operate. These frequencies shall be recorded.
For equipment using FHSS modulation, the measurements may be performed when normal

hopping is disabled. In this case measurements need to be performed when operating at the lowest and the highest hopping frequency. These frequencies shall be recorded. When disabling the normal hopping is not possible, the measurement shall be performed during normal operation (hopping).

3.1.4. Test procedures

3.1.4.1 Conducted measurement

Pre-scan

The procedure in step 1 to step 4 below shall be used to identify potential unwanted emissions of the UUT.

Step 1:

The sensitivity of the spectrum analyser should be such that the noise floor is at least 12 dB below the limits given in table 5 or table 13.

Step 2:

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

Spectrum analyzer settings:

• Resolution bandwidth: 100 kHz
• Video bandwidth: 300 kHz
• Filter type: 3 dB (Gaussian)
• Detector mode: Peak
• Trace Mode: Max Hold
• Sweep Points: ⩾19 400;
• Sweep time: Auto

Wait for the trace to stabilize. Any emissions identified during the sweeps above and that fall within the 6 dB range below the applicable limit or above, shall be individually measured using the procedure in clause 5.4.10.2.1.3 and compared to the limits given in table 5 or table 13.

Step 3:

The emissions over the range 1 GHz to 12,75 GHz shall be identified.

Spectrum analyzer settings:

• Resolution bandwidth: 1 MHz
• Video bandwidth: 3 MHz
• Filter type: 3 dB (Gaussian)
• Detector mode: Peak
• Trace Mode: Max Hold
• Sweep Points: ⩾23 500; for spectrum analysers not supporting this high number of sweep points,the frequency band may be segmented
• Sweep time: Auto

Wait for the trace to stabilize. Any emissions identified during the sweeps above that fall within the

6 dB range below the applicable limit or above, shall be individually measured using the procedure in clause 5.4.10.2.1.3 and compared to the limits given in table 5 or table 13.

Frequency Hopping equipment may generate a block (or several blocks) of spurious emissions anywhere within the spurious domain. If this is the case, only the highest peak of each block of emissions shall be measured using the procedure in clause 5.4.10.2.1.3.

Step 4:

• In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), step 2 and step 3 need to be repeated for each of the active receive chains (A_{ch})The limits used to identify emissions during this pre-scan need to be reduced by $10 \times \log_{10} (A_{ch})$.

Measurement of the emissions identified during the pre-scan

The procedure in step 1 to step 4 below shall be used to accurately measure the individual unwanted emissions identified during the pre-scan measurements above. This method assumes the spectrum analyser has a Time Domain Power function..

Step 1:

The level of the emissions shall be measured using the following spectrum analyser settings:

• Measurement Mode: Time Domain Power
• Centre Frequency: Frequency of the emission identified during the pre-scan
• Resolution Bandwidth: 100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
• Video Bandwidth: 300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
• Frequency Span: Zero Span
• Sweep mode: Single Sweep
• Sweep time: 30ms
• Sweep points: ⩾ 30 000
• Trigger: Video (for burst signals) or Manual (for continuous signals)
• Detector: RMS

Step 2:

Set a window where the start and stop indicators match the start and end of the burst with the highest level and record the value of the power measured within this window.If the spurious emission to be measured is a continuous transmission, the measurement window shall be set to the start and stop times of the sweep.

Step 3:

In case of conducted measurements on smart antenna systems (equipment with multiple receive chains), step 2 needs to be repeated for each of the active receive chains (A_{ch}).

Sum the measured power (within the observed window) for each of the active receive chains

Step 4:

The value defined in step 3 shall be compared to the limits defined in tables 5 and table 13.

3.1.4.2 Radiated measurement

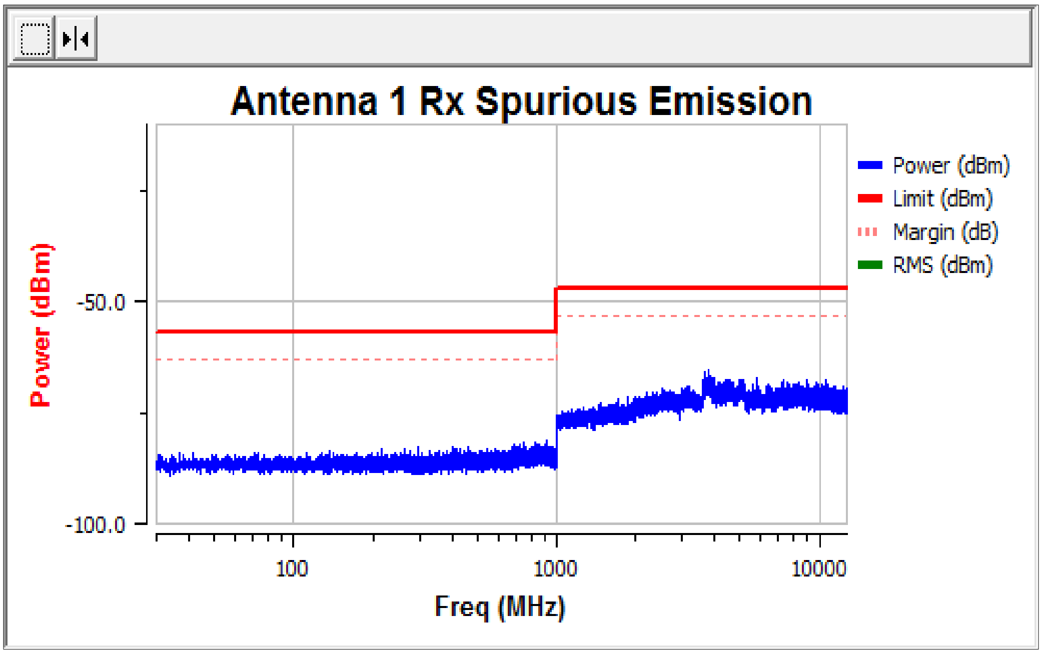
The test site as described in annex B and applicable measurement procedures as described in annex C shall be used.The test procedure is further as described under clause 5.4.10.2.1.

3.1.5. Results:

Below is the worst case situation test data:

3.1.5.1 Conducted test result

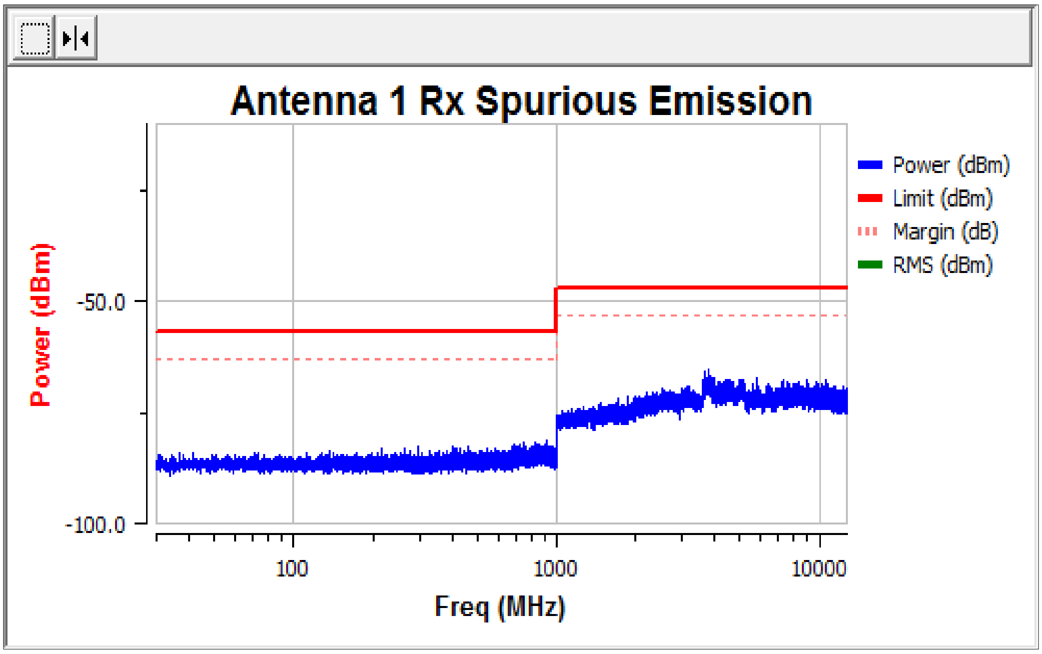
GFSK Hopping Mode



(GFSK Mode , 30MHz to 12.75GHz)

Freq (MHz)	Peak Level (dBm)	Limit (dBm)	Over Limit (dB)	Status
720.600	-80.96	-57.00	-23.96	PASS
788.100	-81.75	-57.00	-24.75	PASS
826.150	-81.40	-57.00	-24.40	PASS
886.600	-81.21	-57.00	-24.21	PASS
915.250	-81.10	-57.00	-24.10	PASS
1763.500	-57.16	-47.00	-10.16	PASS
3671.500	-66.74	-47.00	-19.74	PASS
3730.500	-66.14	-47.00	-19.14	PASS
3805.500	-64.78	-47.00	-17.78	PASS
3870.500	-66.47	-47.00	-19.47	PASS

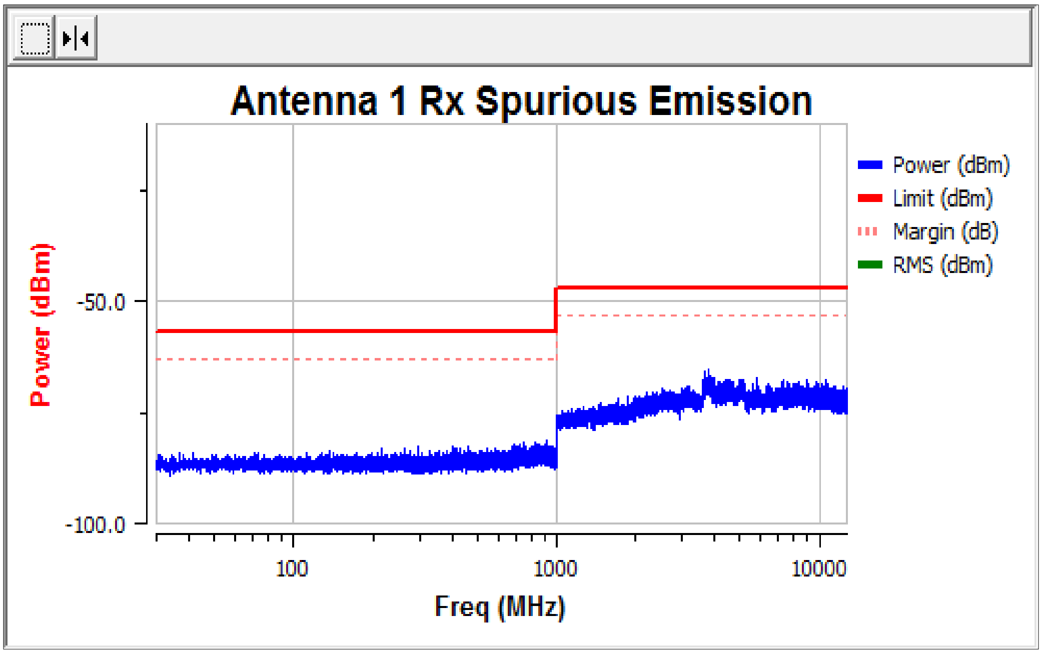
π/4-DQPSK Hopping Mode



(π/4-DQPSK Mode , 30MHz to 12.75GHz)

Freq (MHz)	Peak Level (dBm)	Limit (dBm)	Over Limit (dB)	Status
743.300	-81.23	-57.00	-24.23	PASS
831.800	-81.73	-57.00	-24.73	PASS
888.850	-81.34	-57.00	-24.34	PASS
916.550	-81.24	-57.00	-24.24	PASS
978.550	-81.82	-57.00	-24.82	PASS
3693.000	-66.32	-47.00	-19.32	PASS
3718.500	-65.51	-47.00	-18.51	PASS
3831.000	-65.80	-47.00	-18.80	PASS
3854.500	-65.98	-47.00	-18.98	PASS
4939.000	-66.09	-47.00	-19.09	PASS

8-DPSK Hopping Mode

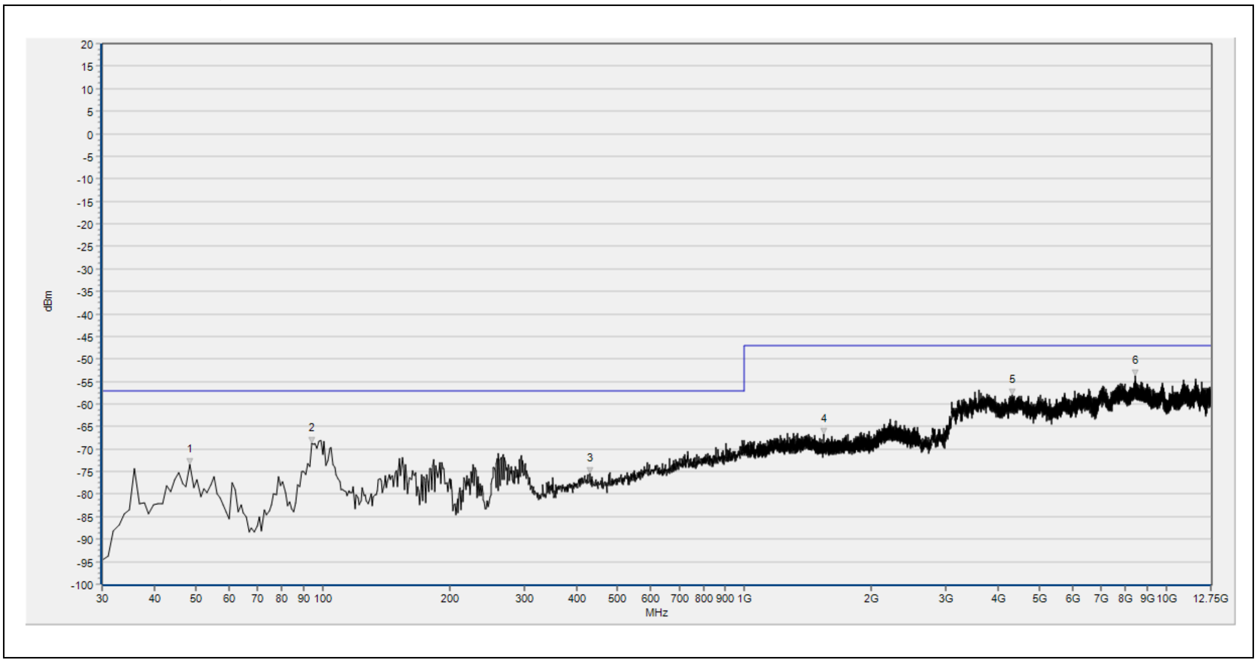


(8-DPSK Mode , 30MHz to 12.75GHz)

Freq (MHz)	Peak Level (dBm)	Limit (dBm)	Over Limit (dB)	Status
720.950	-81.56	-57.00	-24.56	PASS
748.950	-81.48	-57.00	-24.48	PASS
825.200	-81.32	-57.00	-24.32	PASS
903.800	-81.64	-57.00	-24.64	PASS
923.900	-80.99	-57.00	-23.99	PASS
3693.000	-66.01	-47.00	-19.01	PASS
3810.000	-65.01	-47.00	-18.01	PASS
3831.000	-66.54	-47.00	-19.54	PASS
3912.000	-66.49	-47.00	-19.49	PASS
5798.500	-66.57	-47.00	-19.57	PASS

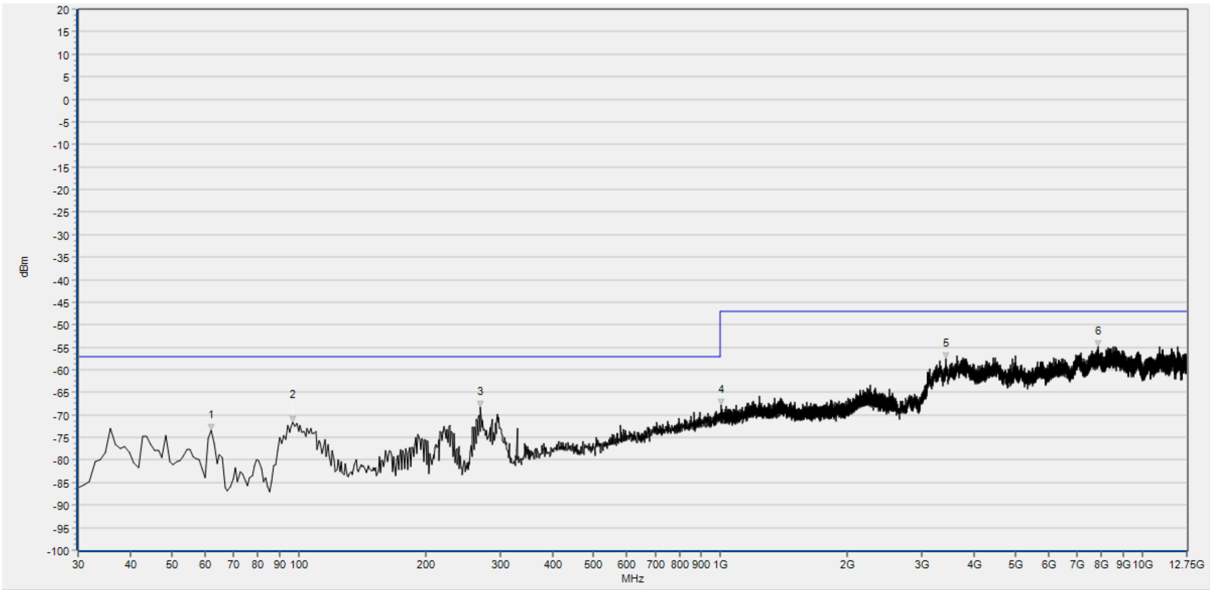
3.1.5.2 Radiated test result

GFSK Hopping Mode



(Plot A.1: 30MHz to 12.75GHz, Antenna Horizontal @ GFSK)

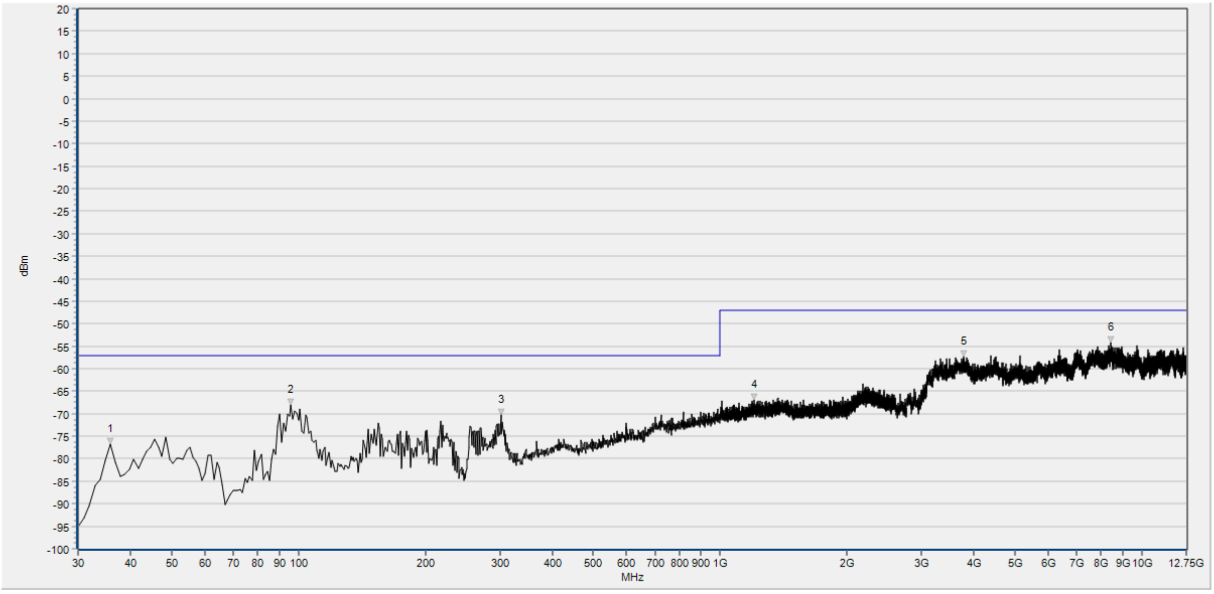
Test frequency range 30MHz to 12.75 GHz	Hopping Mode				
	Receiver with modulation Mode at Hopping Mode				
	Frequency (MHz)	**Peak (dBm)**	**Limit(PK)**	**Antenna**	**Verdict**
	48.448	-73.49	-57.00	Horizontal	PASS
	94.084	-68.64	-57.00	Horizontal	PASS
	430.040	-75.52	-57.00	Horizontal	PASS
	1542.400	-66.61	-47.00	Horizontal	PASS
	4305.200	-57.93	-47.00	Horizontal	PASS
	8460.610	-53.64	-47.00	Horizontal	PASS



(Plot A.2: 30MHz to 12.75GHz, Antenna Vertical @ GFSK)

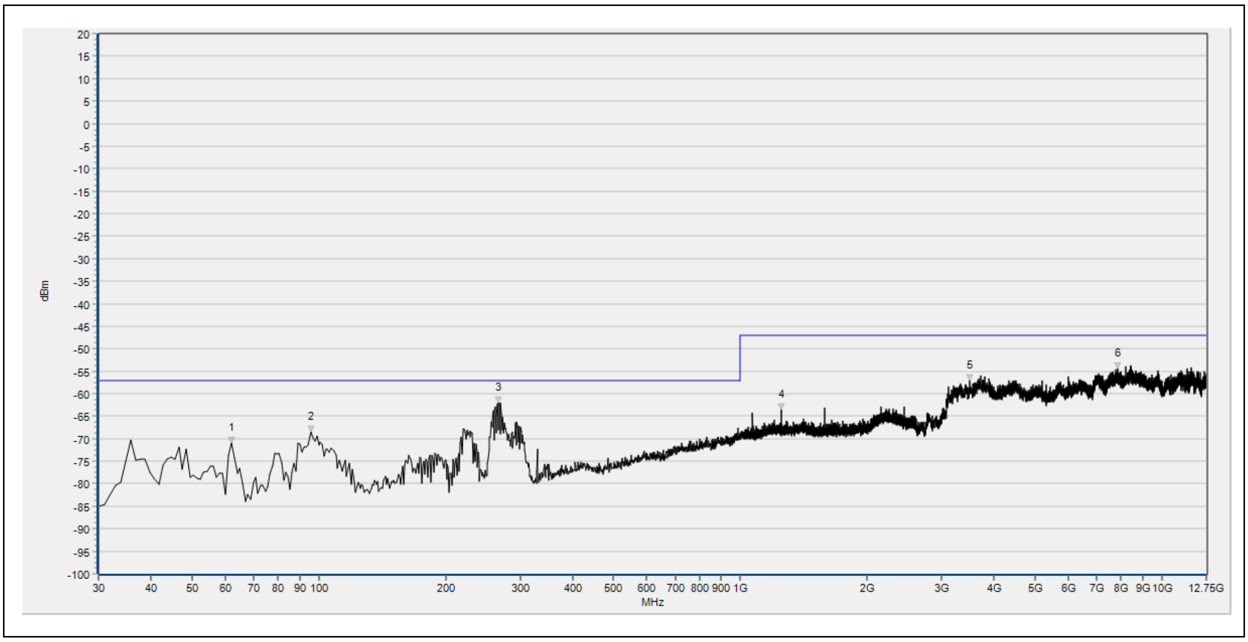
Test frequency range 30MHz to 12.75 GHz	Hopping Mode				
	Receiver with modulation Mode at Hopping Mode				
	Frequency (MHz)	**Peak (dBm)**	**Limit(PK)**	**Antenna**	**Verdict**
	62.042	-73.47	-57.00	Vertical	PASS
	96.997	-71.73	-57.00	Vertical	PASS
	269.830	-68.19	-57.00	Vertical	PASS
	1003.200	-67.86	-47.00	Vertical	PASS
	3422.150	-57.57	-47.00	Vertical	PASS
	7847.550	-54.86	-47.00	Vertical	PASS

π/4-DQPSK Hopping Mode



(Plot B.1: 30MHz to 12.75GHz, Antenna Horizontal @π/4-DQPSK)

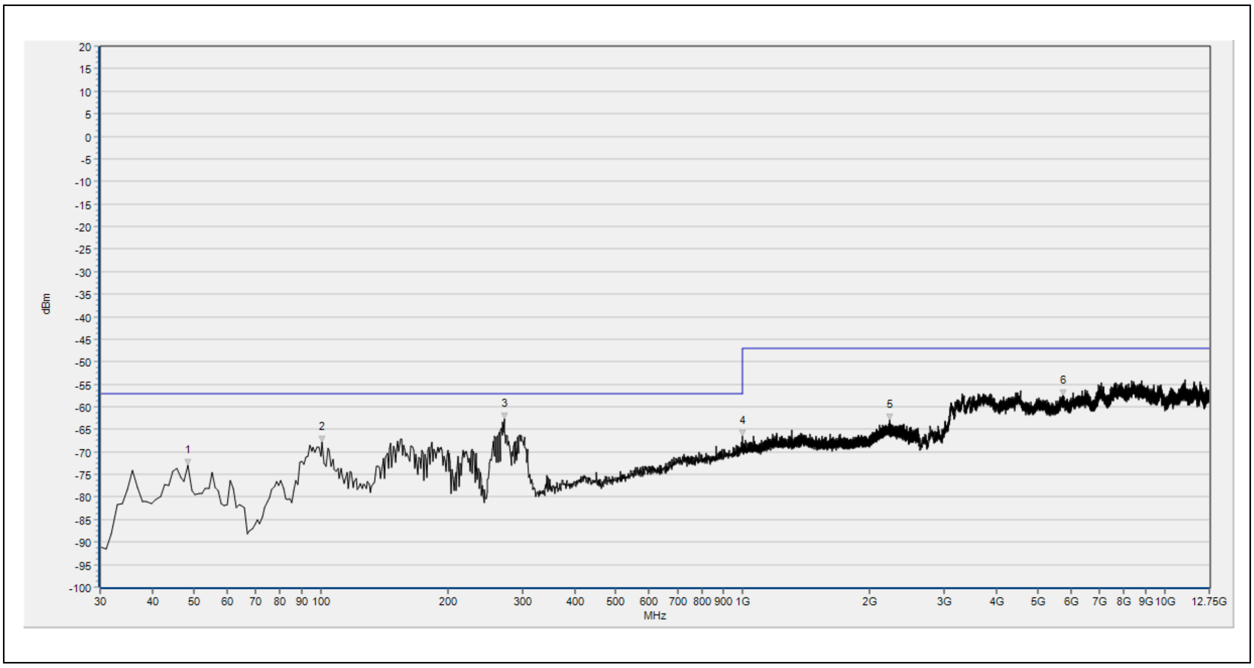
Test frequency range 30MHz to 12.75 GHz	Hopping Mode				
	Receiver with modulation Mode at Hopping Mode				
	Frequency (MHz)	**Peak (dBm)**	**Limit(PK)**	**Antenna**	**Verdict**
	35.826	-76.74	-57.00	Horizontal	PASS
	96.026	-68.04	-57.00	Horizontal	PASS
	301.872	-70.21	-57.00	Horizontal	PASS
	1205.333	-66.84	-47.00	Horizontal	PASS
	3775.370	-57.25	-47.00	Horizontal	PASS
	8458.580	-54.15	-47.00	Horizontal	PASS



(Plot B.2: 30MHz to 12.75GHz, Antenna Vertical @π/4-DQPSK)

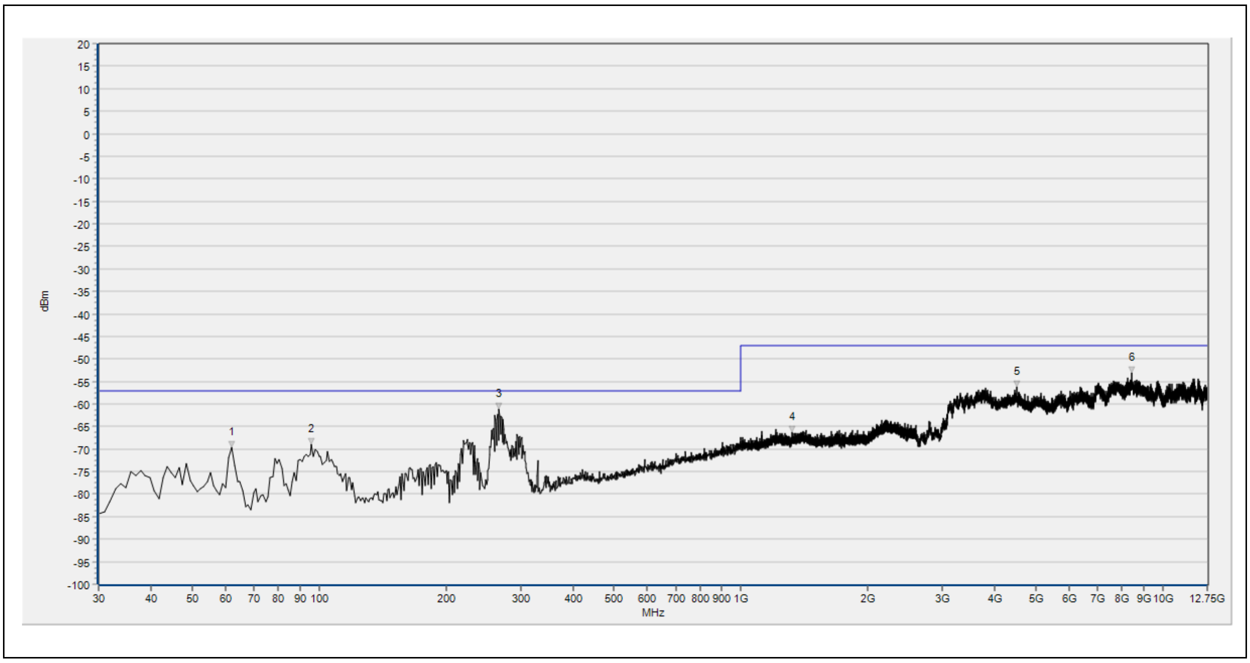
Test frequency range 30MHz to 12.75 GHz	Hopping Mode				
	Receiver with modulation Mode at Hopping Mode				
	Frequency (MHz)	**Peak (dBm)**	**Limit(PK)**	**Antenna**	**Verdict**
	62.042	-71.02	-57.00	Vertical	PASS
	96.026	-68.42	-57.00	Vertical	PASS
	266.917	-61.98	-57.00	Vertical	PASS
	1250.133	-63.53	-47.00	Vertical	PASS
	3499.290	-57.08	-47.00	Vertical	PASS
	7861.760	-54.48	-47.00	Vertical	PASS

8-DPSK Hopping Mode



(Plot C.1: 30MHz to 12.75GHz, Antenna Horizontal @ 8-DPSK)

Test frequency range 30MHz to 12.75 GHz	Hopping Mode				
	Transmitter with modulation Mode at Hopping Mode				
	Frequency (MHz)	**Peak (dBm)**	**Limit(PK)**	**Antenna**	**Verdict**
	48.448	-72.98	-57.00	Horizontal	PASS
	100.881	-67.74	-57.00	Horizontal	PASS
	271.772	-62.78	-57.00	Horizontal	PASS
	1000.000	-66.40	-57.00	Horizontal	PASS
	2232.000	-62.86	-47.00	Horizontal	PASS
	5732.290	-57.45	-47.00	Horizontal	PASS



(Plot C.2: 30MHz to 12.75GHz, Antenna Vertical @ 8-DPSK)

Test frequency range 30MHz to 12.75 GHz	Hopping Mode				
	Transmitter with modulation Mode at Hopping Mode				
	Frequency (MHz)	**Peak (dBm)**	**Limit(PK)**	**Antenna**	**Verdict**
	62.042	-69.69	-57.00	Vertical	PASS
	96.026	-68.99	-57.00	Vertical	PASS
	266.917	-61.13	-57.00	Vertical	PASS
	1319.467	-66.23	-47.00	Vertical	PASS
	4498.050	-56.29	-47.00	Vertical	PASS
	8422.040	-52.97	-47.00	Vertical	PASS

3.2. EN 300 328 §4.3.1.12 - Receiver Blocking

3.2.1. 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 in the presence of an unwanted signal (blocking signal) on frequencies other than those of the operating band provided in table 1.

3.2.2. Limits

3.2.2.1 General

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.

3.2.2.2 Receiver Category 1

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)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 6 dB	2 380 2 503,5	-53	CW
P_{min} + 6 dB	2 300 2 330 2 360	-47	CW
P_{min} + 6 dB	2 523,5 2 553,5 2 583,5 2 613,5 2 643,5 2 673,5	-47	CW

NOTE 1: P_{min} is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.

NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.

3.2.2.3 Receiver Category 2

Table 7 contains the Receiver Blocking parameters for Receiver Category 2 equipment.

Table 7: Receiver Blocking parameters for Receiver Category 2 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 6 dB	2 380 2 503,5	-57	CW
P_{min} + 6 dB	2 300 2583,5	-47	CW

NOTE 1: P_{min} is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.
NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.

3.2.2.4 Receiver Category 3

Table 8 contains the Receiver Blocking parameters for Receiver Category 3 equipment.

Table 8: Receiver Blocking parameters for Receiver Category 3 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} +12 dB	2 380 2 503,5	-57	CW
P_{min} + 12 dB	2 300 2583,5	-47	CW

NOTE 1: P_{min} is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.
NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.

3.2.3. Test condition

See clause 5.1 for the environmental test conditions. These measurements shall only be

performed at normal test conditions.
For non-frequency hopping equipment, having more than one operating channel, the equipment shall be tested operating at both the lowest and highest operating channels. Equipment which can change their operating channel automatically (adaptive channel allocation), and where this function cannot be disabled, shall be tested as a frequency hopping equipment.
If the equipment can be configured to operate with different Nominal Channel Bandwidths (e.g. 20 MHz and 40 MHz)and different data rates, then the combination of the smallest channel bandwidth and the lowest data rate for this channel bandwidth which still allows the equipment to operate as intended shall be used. This mode of operation shall be aligned with the performance criteria defined in clause 4.3.1.12.3 or clause 4.3.2.11.3 as declared by the manufacturer (see clause 5.4.1 t)) and shall be described in the test report.
It shall be verified that this performance criteria as declared by the manufacturer is achieved.

3.2.4. Test procedures (Conducted measurements)

For systems using multiple receive chains only one chain (antenna port) need to be tested. All other receiver inputs shall be terminated.
Figure 6 shows the test set-up which can be used for performing the receiver blocking test.

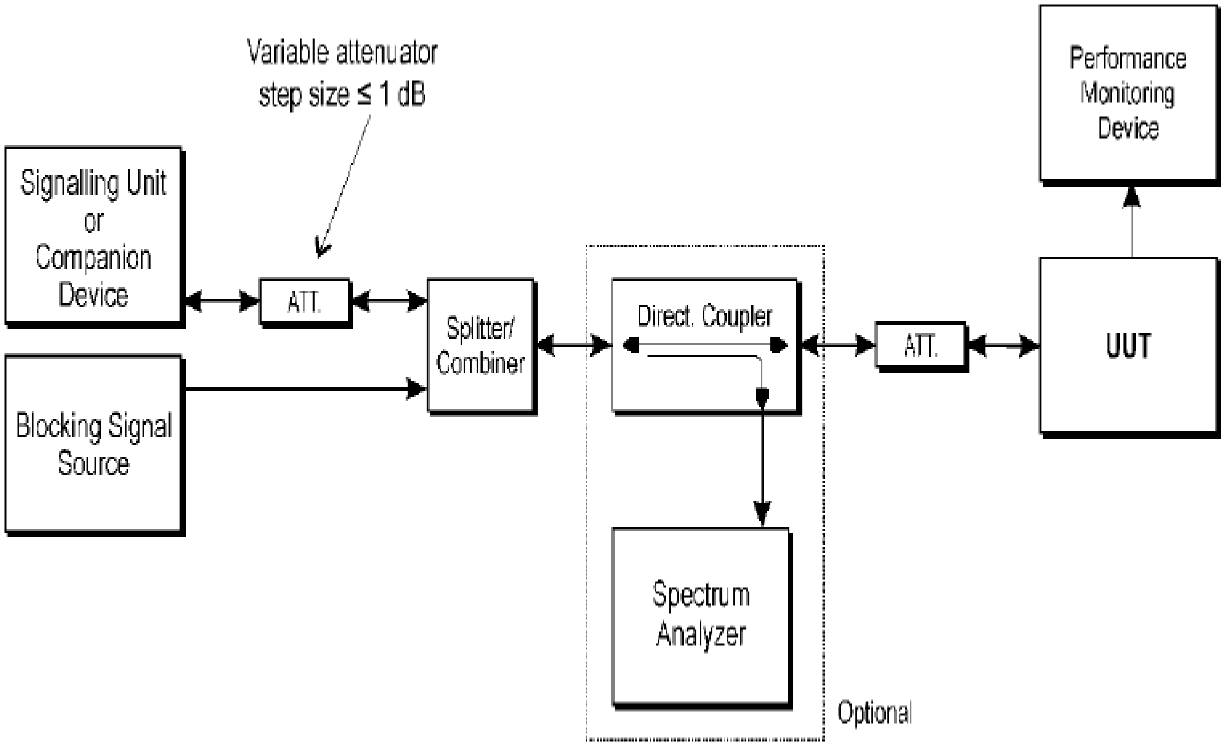


Figure 6: Test Set-up for receiver blocking

The procedure in step 1 to step 6 below shall be used to verify the receiver blocking requirement as

described in clause 4.3.1.12 or clause 4.3.2.11.
Table 6, table 7 and table 8 in clause 4.3.1.12.4 contain the applicable blocking frequencies and blocking levels for each of the receiver categories for testing Receiver Blocking on frequency hopping equipment.
Table 14, table 15 and table 16 in clause 4.3.2.11.4 contain the applicable blocking frequencies and blocking levels for each of the receiver categories for testing Receiver Blocking on equipment using wide band modulations other than FHSS.

Step 1:

•For non-frequency hopping equipment, the UUT shall be set to the lowest operating channel.

Step 2:

•The blocking signal generator is set to the first frequency as defined in the appropriate table corresponding to the receiver category and type of equipment.

Step 3:

•With the blocking signal generator switched off, a communication link is established between the UUT and the associated companion device using the test setup shown in figure 6. The attenuation of the variable attenuator shall be increased in 1 dB steps to a value at which the minimum performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still met. The resulting level for the wanted signal at the input of the UUT is P_{min}.

•This signal level (P_{min}) is increased by the value provided in the table corresponding to the receiver category and type of equipment.

Step 4:

• The blocking signal at the UUT is set to the level provided in the table corresponding to the receiver category and type of equipment. It shall be verified and recorded in the test report that the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is met.

Step 5:

• Repeat step 4 for each remaining combination of frequency and level for the blocking signal as provided in the table corresponding to the receiver category and type of equipment.

Step 6:

• For non-frequency hopping equipment, repeat step 2 to step 5 with the UUT operating at the highest operating channel.

3.2.5. Result

Note: The EUT operate in hopping mode.

Normal hopping model:

Table 7: Receiver Blocking parameters for Receiver Category 2 equipment							
P_{min}=-82dBm							
Wanted signal mean power from companion device (dBm)	**Blocking signal frequency (MHz)**	**Blocking signal power (dBm) (see note 2)**	**Type of blocking signal**	**Send pack**	**Receiver Pack**	**PER (%)**	**Verdict**
P_{min} + 6 dB	2 380	-57	CW	1000	998	0.2	PASS
	2 503,5	-57	CW	1000	999	0.1	PASS
P_{min} + 6 dB	2 300	-47	CW	1000	997	0.3	PASS
	2583,5	-47	CW	1000	1000	0	PASS
NOTE 1: P_{min} is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain..							

3.3. EN 300 328 §4.3.1.13 - Geo-location capability

3.3.1. Definition

Geo-location capability is a feature of the equipment to determine its geographical location with the purpose to configure itself according to the regulatory requirements applicable at the geographical location where it operates.

The geo-location capability may be present in the equipment or in an external device (temporary) associated with the equipment operating at the same geographical location during the initial power up of the equipment. The geographical location may also be available in equipment already installed and operating at the same geographical location.

3.3.2. Requirements

The geographical location determined by the equipment as defined in clause 3.3.1 shall not be accessible to the user.

3.3.3. Results

The geographical location determined by the equipment shall not be accessible to the user.

Annex A Photographs of Test Setup

1. Radiated Measurement Setup

2. Conducted Measurement Setup

Annex B Test Uncertainty

Parameter	Uncertainty
Occupied Channel Bandwidth	±5%
RF output power, conducted	±1,5%
Power Spectral Density, conducted	±3dB
Unwanted Emissions, conducted	±3dB
All emissions, radiated	±6dB
Temperature	±3°C
Supply voltages	±3%
Time	±5%
Duty Cycle	±5%

Annex C Information of EUT

C.1 Introduction

Notwithstanding the provisions of the copyright clause related to the text of the present document, ETSI grants that users of the present document may freely reproduce the application form pro forma in this annex so that it can be used for its intended purposes and may further publish the completed application form.

The form contained in this annex may be used by the manufacturer to comply with the requirement contained in clause 5.4.1 to provide the necessary information about the equipment to the test laboratory prior to the testing. It contains product information as well as other information which might be required to define which configurations are to be tested, which tests are to be performed as well the test conditions.

This application form should form an integral part of the test report.

C.2 Information as required by ETSI EN 300 328 V2.1.1, clause 5.4.1

In accordance with ETSI EN 300 328, clause 5.4.1, the following information is provided by the manufacturer.

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 (average) Dwell Time: 316.80ms

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 maximum Channel Occupancy Time implemented by the equipment: N/A ms

☐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: N/A μs

☑The equipment has implemented a 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.): ………. dBm

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: N/A

• Duty cycle, Tx-Sequence, Tx-gap: N/A

• Dwell time, Minimum Frequency Occupation & Hopping Sequence (only for FHSS equipment): π/4-DQPSK

•Hopping Frequency Separation (only for FHSS equipment): 8-DPSK

• Medium Utilisation: N/A

• Adaptivity & Receiver Blocking: N/A

• Occupied Channel Bandwidth: 8-DPSK

• 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 one antenna

☐Equipment with two diversity antennas but only one antenna active at any moment in time

☐Smart Antenna Systems with two or more antennas, but operating in a (legacy) mode where only one 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 Nominal Channel Bandwidth 1

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

NOTE 1: 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 Nominal Channel Bandwidth 1

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

NOTE 2: 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 (additional) beam forming gain: .... dB

NOTE: The additional 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

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

j) Nominal Channel Bandwidth(s):

• Occupied Channel Bandwidth 1: 1 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 normal and the extreme operating conditions that apply to the equipment:

Normal operating conditions (if applicable):

Operating temperature: 25 ° C

Extreme operating conditions:

Operating temperature range: Minimum: -20 ° C Maximum 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:

☑Integral Antenna (information to be provided in case of conducted measurements)

Antenna Gain: 0.49 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: N/A

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

NOTE3: 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			

NOTE4: 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			

NOTE5: 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 N/A V
☑DC State DC voltage 3.8 V

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:

Use special software to control the EUT transmit.

p) The equipment type (e.g. Bluetooth®, IEEE 802.11™ [i.3], IEEE 802.15.4™ [i.4], proprietary, etc.): Bluetooth

q) If applicable, the statistical analysis referred to in clause 5.4.1 q)

(to be provided as separate attachment)

r) If applicable, the statistical analysis referred to in clause 5.4.1 r)

(to be provided as separate attachment)

s) 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

t) Describe the minimum performance criteria that apply to the equipment (see clause 4.3.1.12.3 or clause 4.3.2.11.3):...........

C.3: Configuration for testing (see clause 5.3.2.3 of ETSI EN 300 328 V2.1.1)

From all combinations of conducted power settings and intended antenna assembly(ies) specified in clause 5.4.1 m), specify the combination resulting in the highest e.i.r.p. for the radio equipment. Unless otherwise specified in ETSI EN 300 328, this power setting is to be used for testing against the requirements of ETSI EN 300 328. In case there is more than one such conducted power setting resulting in the same (highest) e.i.r.p. level, the highest power setting is to be used for testing. See also ETSI EN 300 328, clause 5.3.2.3.

Highest overall e.i.r.p. value: 6.16 dBm	
Corresponding Antenna assembly gain: 0.49 dBi	Antenna Assembly #: N/A
Corresponding conducted power setting: N/A dBm (also the power level to be used for testing)	Listed as Power Setting #: Max Power Setting

C.4 Additional information provided by the applicant

C.4.1 Modulation

ITU Class(es) of emission: ....

Can the transmitter operate unmodulated? ☐yes ☑no

C.4.2 Duty Cycle

The transmitter is intended for: ☑ Continuous duty
☐Intermittent duty
☐Continuous operation possible for testing purposes

C.4.3 About the UUT

☑The equipment submitted are representative production models

☐If not, the equipment submitted are pre-production models?

☐If pre-production equipment are submitted, the final production equipment will be identical in all respects with the equipment tested

☐If not, supply full details.....

C.4.4 Additional items and/or supporting equipment provided

☐Spare batteries (e.g. for portable equipment)

☑Battery charging device

☐External Power Supply or AC/DC adapter

☐Test jig or interface box

☐RF test fixture (for equipment with integrated antennas)

☑Host System Manufacturer: Shenzhen Chainway Information Technology Co.,Ltd.

Model #: ....

Model name: C72

☐Combined equipment Manufacturer: ....

Model #: ....

Model name: ....

☑User Manual

☑Technical documentation (Handbook and circuit diagrams)

Annex D Testing Laboratory Information

1. Identification of the Responsible Testing Laboratory

Company Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Department:	Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Responsible Test Lab Manager:	Mr. Su Feng
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

3. Test Equipments Utilized

3.1 EN300328 Test system

Description	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Base Station	Anritsu	MT8852B	6K00006210	2017.05.24	2018.05.23
Temperature Chamber	CHONGQING HANBA EXPERIMENTAL EQUIPMENT CO.,LTD	HUT705P	(N/A.)	2017.05.24	2018.05.23
Power Splitter	Mini-Circuits	ZFRSC-183+	SF808201417	2017.05.24	2018.05.23
DC Power Supply	Good Will Instrument Co.,Ltd.	(N/A)	(N/A)	2017.05.24	2018.05.23
Attenuator 1	Resnet	20dB	(N/A)	2017.05.24	2018.05.23
MXG Vector Signal Generator	Angilent	N5182B	MY53050961	2017.05.24	2018.05.23
EXG Analog Signal Generator	Angilent	N5171B	MY53050558	2017.05.24	2018.05.23
EXA Signal analyzer	Angilent	N9010A	MY53470836	2017.12.02	2018.12.01
USB Power Sensor	Angilent	U2021XA	MY54210011	2017.05.24	2018.05.23

3.2 List of Software Used

Description	Manufacturer	Software Version
Test system	Tonscend	V2.6
Power Panel	Agilent	V3.8

3.3 RSE Test System

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
MXE EMI Receiver	MY54130016	N9038A	Agilent	2017.05.17	2018.05.16
Test Antenna - Bi-Log	9163-519	VULB 9163	Schwarzbeck	2017.05.14	2018.05.13
Test Antenna - Horn	01774	BBHA 9120D	Schwarzbeck	2017.09.13	2018.09.12
Anechoic Chamber	N/A	9m*6m*6m	CRT	2017.11.19	2020.11.18

END OF REPORT