ETSI EN 300328 RADIO TEST REPORT

On Behalf of

WIRELESS SPEAKER SUNGLASSES

Model No.: P326.981

Prepared for	:	
Address	:	

Prepared By	:	Shenzhen Alpha Product Testing Co., Ltd.
Address	:	Building i, No.2, Lixin Road, Fuyong Street, Bao'an District, 518103, Shenzhen, Guangdong, China

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Description Page

TEST REPORT DECLARATION

Applicant	:	
Address	:	
Manufacturer	:	
Address	:	
EUT Description	:	WIRELESS SPEAKER SUNGLASSES
	(A) Model No.	: P326.981
	(B) Trademark	: N/A

Measurement Standard Used:

ETSI EN 300 328 V2.1.1

The device described above is tested by Shenzhen Alpha Product Testing Co., Ltd. The measurement results are contained in this test report and Shenzhen Alpha Product Testing Co., Ltd. is assumed full of responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT (Equipment Under Test) is technically compliant with the EN 300 328 requirements.

This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Shenzhen Alpha Product Testing Co., Ltd.

Tested by (name + signature).....	Reak Yang Project Engineer	
Approved by (name + signature).....	Simple Guan Project Manager	
Date of issue.....	December 11, 2017	

Revision History

Revision	Issue Date	Revisions	Revised By
00	December 11, 2017	Initial released Issue	Simple Guan

1. General Information

1.1. Description of Device (EUT)

EUT Name	:	WIRELESS SPEAKER SUNGLASSES
Trademark	:	N/A
Model No.	:	P326.981
DIFF.	:	N/A
Power supply	:	DC 3.7V from battery or DC 5V from USB for charge.
Radio Technology	:	Bluetooth 4.2
Operation frequency	:	2402MHz-2480MHz
Modulation	:	GFSK, π/4 DQPSK, 8 - DPSK
Antenna Type	:	PCB Antenna, Maximum Gain is 1.5dBi
Software version	:	0.1.0
Hardware version	:	HC-X13 V2
Intend use environment	:	Residential, commercial and light industrial environment

a) The type of modulation used by the equipment:

■FHSS

□other forms of modulation

b) In case of FHSS modulation:

•In case of non-Adaptive Frequency Hopping equipment:

The number of Hopping Frequencies:

•In case of Adaptive Frequency Hopping Equipment:

The maximum number of Hopping Frequencies: 79

The minimum number of Hopping Frequencies: 79

The Dwell Time: 320.42ms maximum

The Minimum Channel Occupation Time: 1281.68ms maximum

c) Adaptive / non-adaptive equipment:

□non-adaptive Equipment

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

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

d) In case of adaptive equipment:

The Channel Occupancy Time implemented by the equipment: 1216.4ms

□The equipment has implemented an LBT based DAA mechanism

•In case of equipment using modulation different from FHSS:

□The equipment is Frame Based equipment

□The equipment is Load Based equipment

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

The CCA time implemented by the equipment: ..... µs

The value q as referred to in clause 4.3.2.5.2.2.2 .....

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

□The equipment can operate in more than one adaptive mode

e) In case of non-adaptive Equipment:

The maximum RF Output Power (e.i.r.p.): 5.00dBm

The maximum (corresponding) Duty Cycle: ……. %

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

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

•RF Output Power

GFSK

•Power Spectral Density

.....

•Duty cycle, Tx-Sequence, Tx-gap

.....

•Dwell time, Minimum Frequency Occupation & Hopping Sequence (only for FHSS equipment)

GFSK

•Hopping Frequency Separation (only for FHSS equipment)

GFSK

•Medium Utilisation

.....

•Adaptivity & Receiver Blocking

.....

•Occupied Channel Bandwidth

GFSK

•Transmitter unwanted emissions in the OOB domain

GFSK

•Transmitter unwanted emissions in the spurious domain

GFSK

•Receiver spurious emissions

GFSK

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

■Operating mode 1: Single Antenna Equipment

■Equipment with only 1 antenna

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

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

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

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

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

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

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

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

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

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

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

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

h) In case of Smart Antenna Systems:

•The number of Receive chains: .....

•The number of Transmit chains: .....

□symmetrical power distribution

□asymmetrical power distribution

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

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

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

• Operating Frequency Range 1: 2402 MHz to 2480 MHz

• Operating Frequency Range 2: ..... MHz to ..... MHz

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

j) Occupied Channel Bandwidth(s):

. Occupied Channel Bandwidth 1: 0.9906MHz

. Occupied Channel Bandwidth 2:

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

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

■Stand-alone

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

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

Other .....

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

Operating temperature range:-20° C to 55° C

Operating voltage range: 3.4V to 4.2V □AC ■DC

Details provided are for the: ■stand-alone equipment

□combined (or host) equipment

□test jig

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

• Antenna Type

■PCB Antenna

Antenna Gain: 1.5dBi

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

□Temporary RF connector provided

□No temporary RF connector provided

□Dedicated Antennas (equipment with antenna connector)

□Single power level with corresponding antenna(s)

□Multiple power settings and corresponding antenna(s)

Number of different Power Levels: .....

Power Level 1: ..... dBm

Power Level 2: ..... dBm

Power Level 3: ..... dBm

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

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

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

Details provided are for the: ■stand-alone equipment

□combined (or host) equipment

□test jig

Supply Voltage □AC mains State AC voltage ……. V

■ DC State DC voltage :3.7V

In case of DC, indicate the type of power source

□Internal Power Supply

□External Power Supply or AC/DC adapter

■Battery: 3.7V

□Other: .....

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

The EUT can be into the Engineer mode for testing.

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

Bluetooth

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

Not apply

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

Not apply

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):

The minimum performance criterion shall be a PER less than or equal to 10 %.

The intended use of the equipment should be in the normal operation without lost the communication link or no unintentionally operation occurs.

1.2. Categorization

☐ Receiver category 1

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

■ Receiver category 2

Non-adaptive equipment with a Medium Utilization (MU) factor greater than 1 % and less than or equal to 10 % or adaptive equipment with a maximum RF output power of Bm e.i.r.p. shall be considered as receiver category 2 equipment.

☐ Receiver category 3

Non-adaptive equipment with a maximum Medium Utilization (MU) factor of 1 % or adaptive equipment with a maximum RF output power of 0 dBm e.i.r.p. shall be considered as receiver category 3 equipment.

1.3. Accessories of Device (EUT)

N/A

1.4. Ancillary Equipment Details

N/A

1.5. Test Lab Information

Shenzhen Alpha Product Testing Co., Ltd
Building i, No.2, Lixin Road, Fuyong Street, Bao'an District, 518103,
Shenzhen, Guangdong, China

2. Summary of Measurement

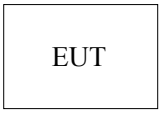
2.1. Test Standard Description

ETSI EN 300 328 V2.1.1: 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

2.2. Summary of Test Result

The following essential requirements and test specifications are relevant to the presumption of conformity under ETSI EN 300 328 V2.1.1			
No	Test Parameter	Clause No	Results
Transmitter Parameters			
1	RF output power	4.3.2.2	PASS
2	Power Spectral Density	4.3.2.3	N/A
3	Duty Cycle, Tx-sequence, Tx-gap	4.3.2.4	N/A
4	Dwell time, Minimum Frequency Occupation & Hopping Sequence	4.3.1.4	PASS
5	Hopping Frequency Separation	4.3.1.5	PASS
6	Medium Utilisation (MU) factor	4.3.2.5	N/A
7	Adaptivity (adaptive equipment using modulations other than FHSS)	4.3.2.6	N/A
8	Occupied Channel Bandwidth	4.3.2.7	PASS
9	Transmitter unwanted emissions in the out-of-band domain	4.3.2.8	PASS
10	Transmitter unwanted emissions in the spurious domain	4.3.2.9	PASS
Receiver Parameters			
11	Receiver spurious emissions	4.3.2.10	PASS
12	Receiver Blocking	4.3.2.11	PASS
13	Geo-location capability	4.3.2.12	N/A
Note: N/A is an abbreviation for Not Applicable and means this test item is not applicable for this device according to the technology characteristic of device.			

2.3. Block Diagram of Configuration for Test



2.4. Test Mode

The special RF test software was used to control EUT work in Continuous Bluetooth TX mode, and select test channel, wireless mode.

Tested mode, channel, and data rate information			
Mode	data rate (Mpbs)	Channel	Frequency (MHz)
BDR:GFSK	1	Low :CH0	2402
	1	Middle: CH39	2441
	1	High: CH78	2480
EDR:8-DPSK	3	Low :CH0	2402
	3	Middle: CH39	2441
	3	High: CH78	2480

2.5. Test Conditions

	Normal Conditions	Extreme Conditions
Temperature range	15-35℃	-20℃ and 55℃
Humidity range	20-75%	20-75%
Pressure range	86-106kPa	86-106kPa
Power supply	DC 3.7V from battery	3.4V and 4.2V (declared by the manufacturer.)
Note 1: The test procedure described in clause 5.1 of EN300 328 was used for extreme test procedure. 2: The Extreme Temperature and Extreme Voltages declared by the manufacturer.		

2.6. Measurement Uncertainty (95% confidence levels, k=2)

Item	MU	Remark
Uncertainty for Conducted Emission Test	2.74dB	
Uncertainty for Radiation Emission test in 3m chamber (30MHz to 1GHz)	3.77dB	Polarize: V
	3.80dB	Polarize: H
Uncertainty for Radiation Emission test in 3m chamber (1GHz to 25GHz)	4.16dB	Polarize: H
	4.13dB	Polarize: V
Uncertainty for radio frequency	5.4×10^{-8}	
Uncertainty for conducted RF Power	0.37dB	

2.7. Test Equipment

Equipment	Manufacturer	Model No.	Serial No.	Last cal.	Cal. Due day
Bilog Antenna	SCHWARZBECK	VULB 9168	9168-4 38	2016.09.30	2018.09.29
Test Receiver	ROHDE&SCHWARZ	ESCI	101165	2017.09.22	2018.09.21
Spectrum analyzer	Agilent	E4407B	MY49510055	2017.09.23	2018.09.22
Horn Antenna	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D(1201)	2016.09.30	2018.09.29
Filter	KANGMAI	ZLPF-LDC-1000- 1959	1209002075	2017.09.22	2018.09.21
Filter	WAINWRIGHT	WHKX2.80/18G- 12SS	SN1	2017.09.22	2018.09.21
RF Cable	Resenberger	Cable 4	N/A	2017.09.22	2018.09.21
CMU200	ROHDE&SCHWARZ	CMU200	116785	2017.09.22	2018.09.21
Signal Analyzer	Agilent	N9020A	MY499100060	2017.09.23	2018.09.22
vector Signal Generator	Agilent	N5182A	MY49060042	2017.09.22	2018.09.21
vector Signal Generator	Agilent	E4438C	US44271917	2017.09.28	2018.09.27
Amplifier	HP	HP8347A	2834A00455	2017.09.23	2018.09.22
Amplifier	Teseq	LNA6901	72718	2017.09.23	2018.09.22
Amplifier	Agilent	8449B	3008A02664	2017.09.23	2018.09.22
Filter	WAINWRIGHT	WHKX1.0G/15G- 10SS	SN40	2017.09.22	2018.09.21
Test Receiver	ROHDE&SCHWARZ	ESR	1316.3003K03-102082-Wa	2017.09.23	2018.09.22
Bilog Antenna	SCHWARZBECK	VULB 9168	9168-438	2016.09.30	2018.09.29
9*6*6 anechoic chamber	CHENYU	9*6*6	N/A	2016.07.21	2020.07.20
RF Cable	Resenberger	Cable 1	N/A	2017.09.22	2018.09.21

RF Cable	Resenberger	Cable 2	N/A	2017.09.22	2018.09.21
RF Cable	Resenberger	Cable 3	N/A	2017.09.28	2018.09.27
Power Sensor	Power Radio	RPR3006W	15100041SNO91	2017.09.23	2018.09.22
Power Sensor	Power Radio	RPR3006W	15100041SNO92	2017.09.23	2018.09.22
CMW500	ROHDE&SCHWARZ	CMW500	1201.0002K50-117239-sM	2017.09.22	2018.09.21
Loop Antenna	SCHWARZBECK	FMZB 1519B	00005	2016.09.29	2018.09.28
Audio Analyzer	ROHDE&SCHWARZ	UPL	100689	2017.06.15	2018.06.15
Attenuator	HP	8494B	DC-18G	2017.10.22	2018.10.23
Attenuator	HP	8496B	DC-18G	2017.10.22	2018.10.23
Temperature& Humidity test chamber	GZGONGWEN	GDS-250	080821	2017.10.22	2018.10.23
20dB Attenuator	ICPROBING	IATS1	82347	2017.09.22	2018.09.21
L.I.S.N.#1	Schwarzbeck	NSLK8126	8126466	2017.09.22	2018.09.21
L.I.S.N.#2	ROHDE&SCHWARZ	ENV216	101043	2017.09.22	2018.09.21

3. RF Output Power

3.1. Limit

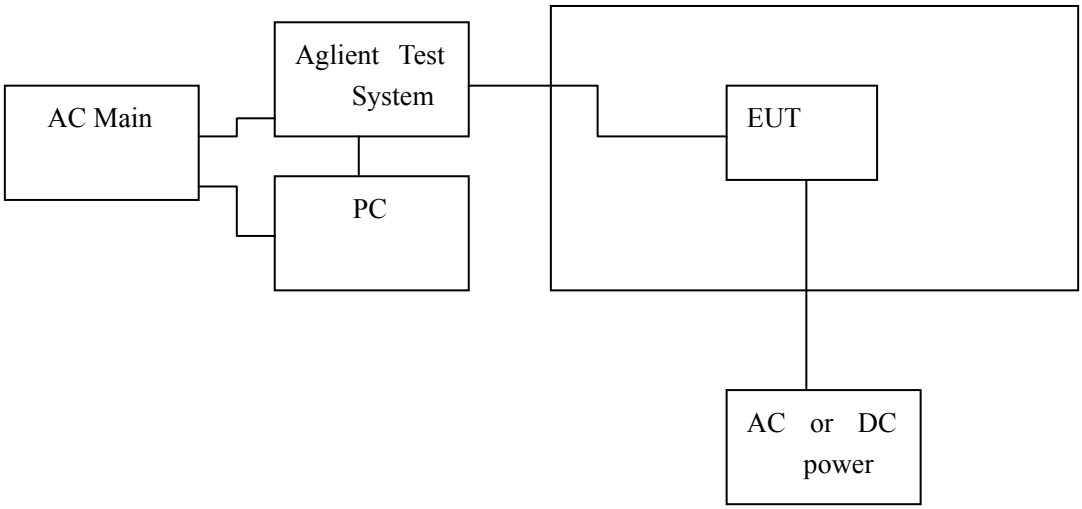
For adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be 20 dBm.

The maximum RF output power for non-adaptive equipment shall be declared by the supplier and shall not exceed 20 dBm. See clause 5.4.1. For non-adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be equal to or less than the value declared by the supplier.

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

Limit
20dBm

3.2. Test Setup



3.3. Test Procedure

Refer to ETSI EN 300 328 2.1.1 (2016-11) Clause 5.4.2.

3.4. Test Result

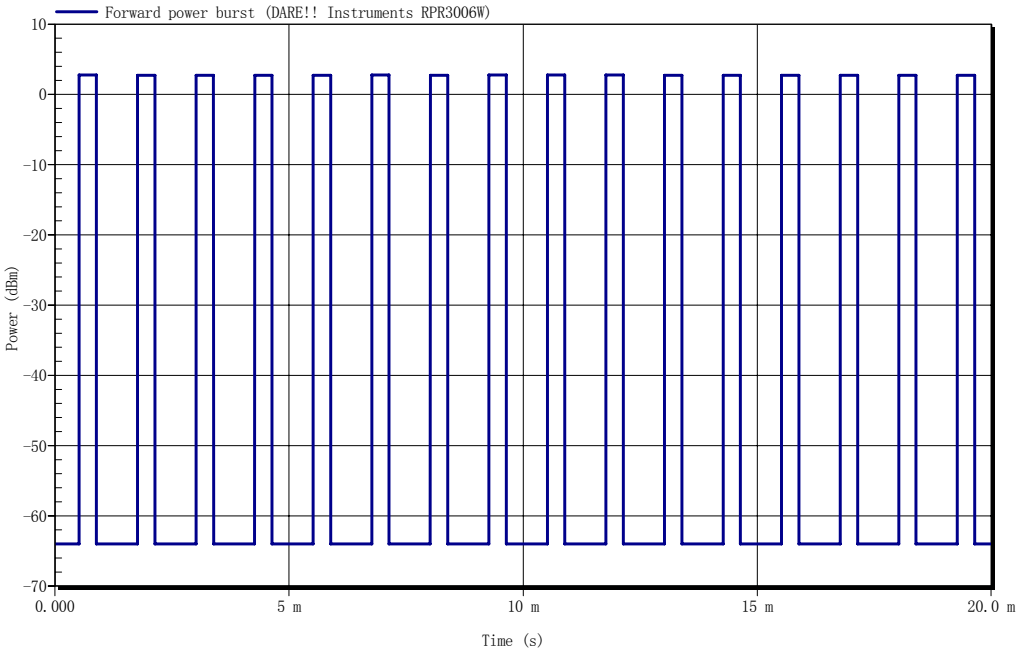
Test site: RF site				
Cable loss: 0.6dB			Antenna Gain: 1.5dBi	
Sample speed	Sample speed 1 MS/s for power sensor			
Number of Burst	At least 10			
Mode	Condition	CH	Result	Limit
			Total e.i.r.p（dBm）	e.i.r.p (dBm)
GFSK	Normal 25℃/3.7V	CH0	4.30	＜20
		CH39	5.00	＜20
		CH78	4.50	＜20
	-20℃/3.4V	CH0	4.79	＜20
		CH39	4.22	＜20
		CH78	4.01	＜20
	-20℃/4.2V	CH0	4.74	＜20
		CH39	4.21	＜20
		CH78	4.19	＜20
	55℃/3.4V	CH0	4.79	＜20
		CH39	4.21	＜20
		CH78	4.03	＜20
	55℃/4.2V	CH0	4.73	＜20
		CH39	4.21	＜20
		CH78	4.79	＜20
Conclusion: PASS				

Test site: RF site				
Cable loss: 0.6dB			Antenna Gain: 1.5dBi	
Sample speed	Sample speed 1 MS/s for power sensor			
Number of Burst	At least 10			
Mode	Condition	CH	Result	Limit
			Total e.i.r.p（dBm）	e.i.r.p (dBm)
π/4 DQPSK	Normal 25℃/3.7V	CH0	1.80	＜20
		CH39	2.70	＜20
		CH78	1.90	＜20
	-20℃/3.4V	CH0	1.69	＜20
		CH39	2.45	＜20
		CH78	1.75	＜20
	-20℃/4.2V	CH0	1.62	＜20
		CH39	2.50	＜20
		CH78	1.76	＜20
	55℃/3.4V	CH0	1.65	＜20
		CH39	2.43	＜20
		CH78	1.78	＜20
	55℃/4.2V	CH0	1.63	＜20
		CH39	2.57	＜20
		CH78	1.75	＜20
Conclusion: PASS				

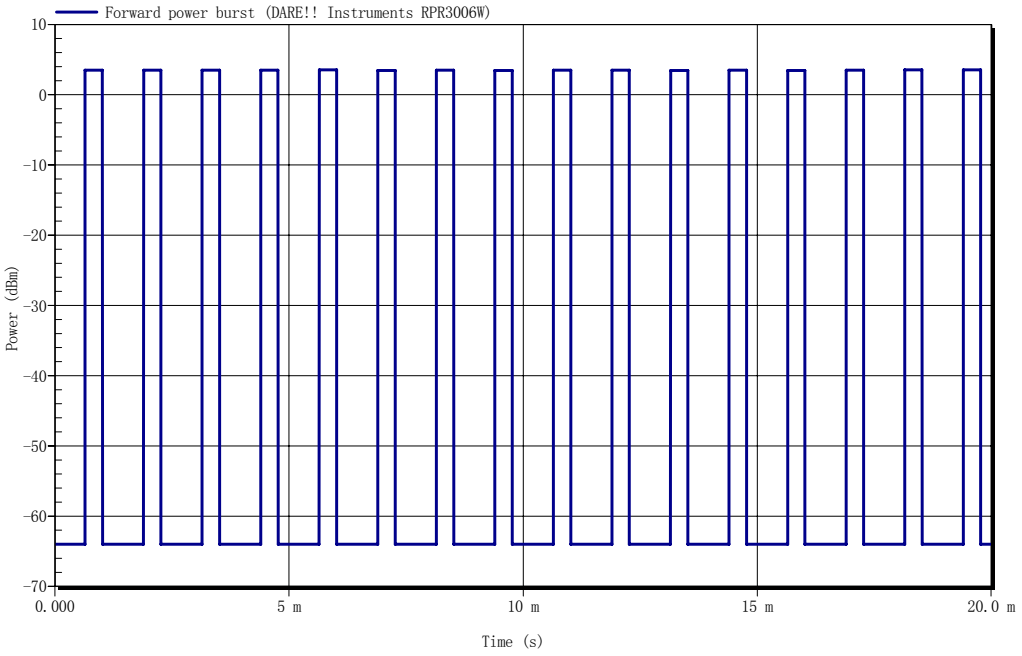
Test site: RF site				
Cable loss: 0.6dB			Antenna Gain: 1.5dBi	
Sample speed	Sample speed 3 MS/s for power sensor			
Number of Burst	At least 10			
Mode	Condition	CH	Result	Limit
			Total e.i.r.p（dBm）	e.i.r.p (dBm)
8-DPSK	Normal 25℃/3.7V	CH0	1.80	＜20
		CH39	2.60	＜20
		CH78	1.90	＜20
	-20℃/3.4V	CH0	1.64	＜20
		CH39	2.39	＜20
		CH78	1.79	＜20
	-20℃/4.2V	CH0	1.68	＜20
		CH39	2.41	＜20
		CH78	1.73	＜20
	55℃/3.4V	CH0	1.68	＜20
		CH39	2.47	＜20
		CH78	1.76	＜20
	55℃/4.2V	CH0	1.62	＜20
		CH39	2.39	＜20
		CH78	1.76	＜20
Conclusion: PASS				

Remark: This Report only show the test plots of the worst case.

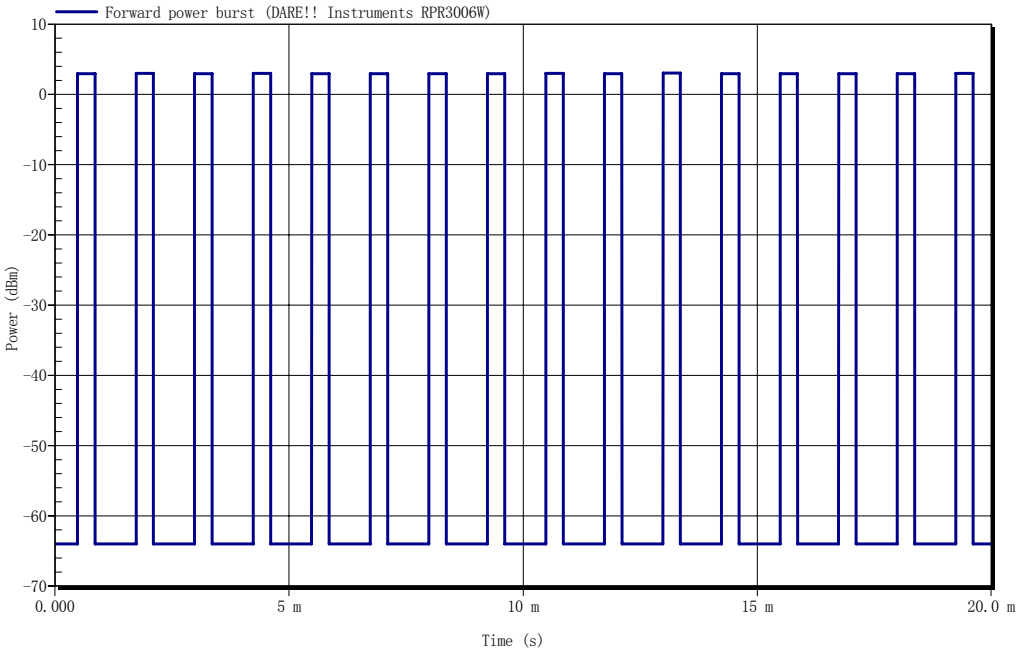
Channel	Voltage	Conducted Power (dBm)	EIRP (dBm)
GFSK CH Low-2402	Normal	2.80	4.30



Channel	Voltage	Conducted Power (dBm)	EIRP (dBm)
GFSK CH Mid-2441	Normal	3.50	5.00



Channel	Voltage	Conducted Power (dBm)	EIRP (dBm)
GFSK CH High-2480	Normal	3.00	4.50



4. Dwell Time, Minimum Frequency Occupation and Hopping Sequence

4.1. Limit

For Adaptive frequency hopping systems

Adaptive Frequency Hopping systems shall be capable of operating over a minimum of 70 % of the band specified in clause 1.

The maximum accumulated dwell time on any hopping frequency shall be 400 ms within any period of 400 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.

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

The Minimum Frequency Occupation Time shall be equal to one dwell time within a period not exceeding four times the product of the dwell time per hop and the number of hopping frequencies in use.

For Non-adaptive frequency hopping systems

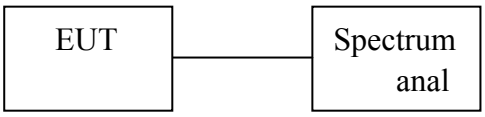
The accumulated Dwell Time on any hopping frequency shall not be greater than 15 ms within any period of 15 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.

Non-adaptive medical devices requiring reverse compatibility with other medical devices placed on the market when earlier versions of the present document were harmonised, are allowed to have an operating mode in which the maximum dwell time is 400 ms.

The hopping sequence(s) shall contain at least N hopping frequencies where N is 15 or 15 divided by the minimum

Hopping Frequency Separation in MHz, whichever is the greater. The Minimum Frequency Occupation Time shall be equal to one dwell time within a period not exceeding four times the product of the dwell time per hop and the number of hopping frequencies in use.

4.2. Test Setup



4.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.4

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

Centre Frequency	Equal to the hopping frequency being investigated
Frequency Span	2 × Occupied Channel Bandwidth (e.g. 2 MHz for a 1 MHz channel)
RBW	~ 50 % of the Occupied Channel Bandwidth (510KHz)
VBW	≥ RBW (510KHz)
Detector	RMS
sweep points	30 000
Trace	Clear / Write
Trigger	Free Run

4.4. Test Result

Hopping channel

Mode	Number of hopping channel	Limit	Conclusion
GFSK	79	>15	PASS
8-DPSK	79	>15	PASS

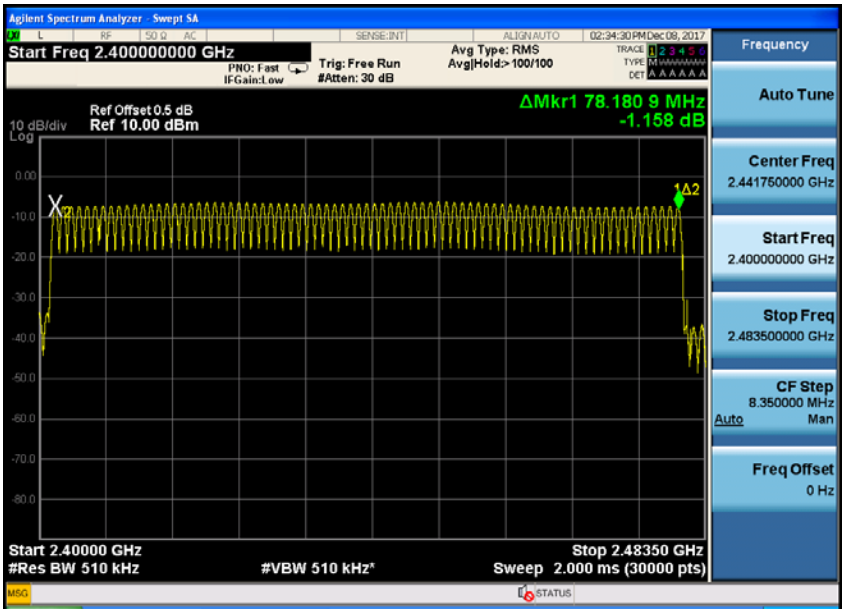
Operating hopping Bandwidth:

Mode	Bandwidth (MHz)	Limit(MHz)	Conclusion
GFSK	78.18	>58.45	PASS
8-DPSK	78.19	>58.45	PASS

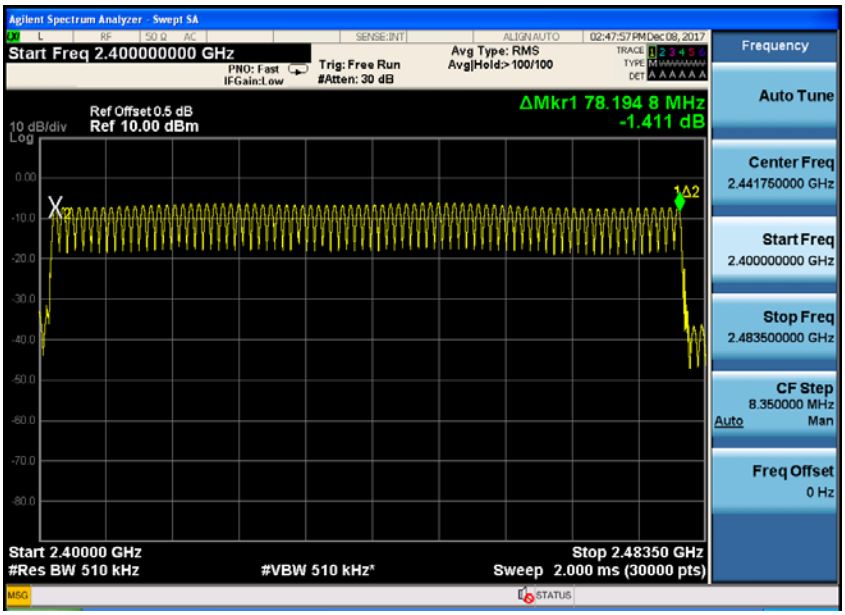
Hopping sequence

Mode	Hopping Sequence(%)	Limit	Conclusion
GFSK	95.45	>70%	PASS
8-DPSK	95.45	>70%	PASS
Note: 1. For adaptive systems, using the lowest and highest -20 dB points from the total spectrum envelope, it shall be verified whether the system uses 70 % of the band specified. 2. Hopping Sequence(%) = (20dB BW/83.5)*100			

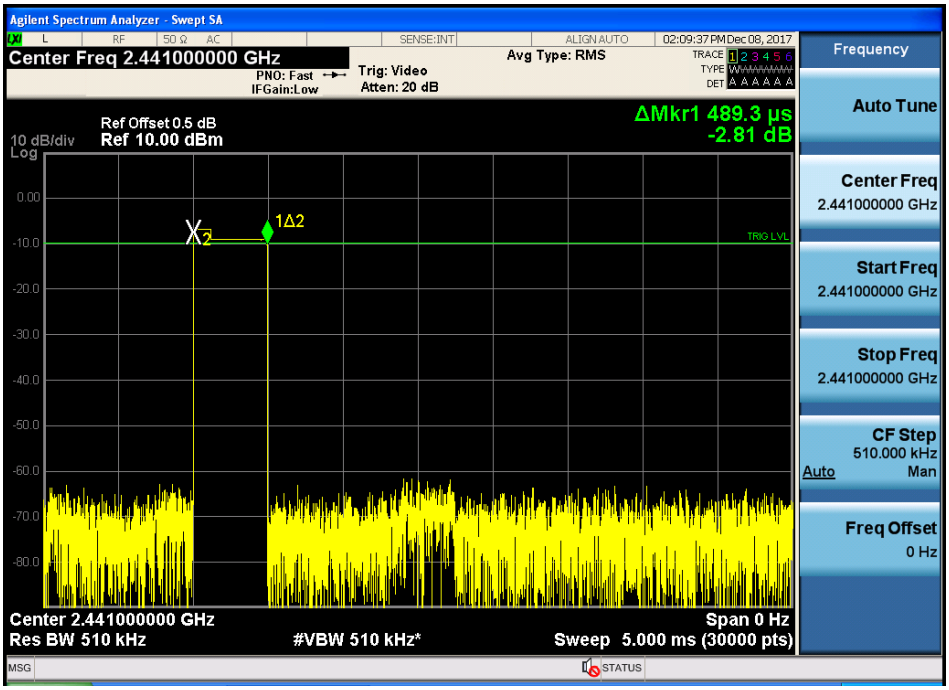
Hopping Number for GFSK	79



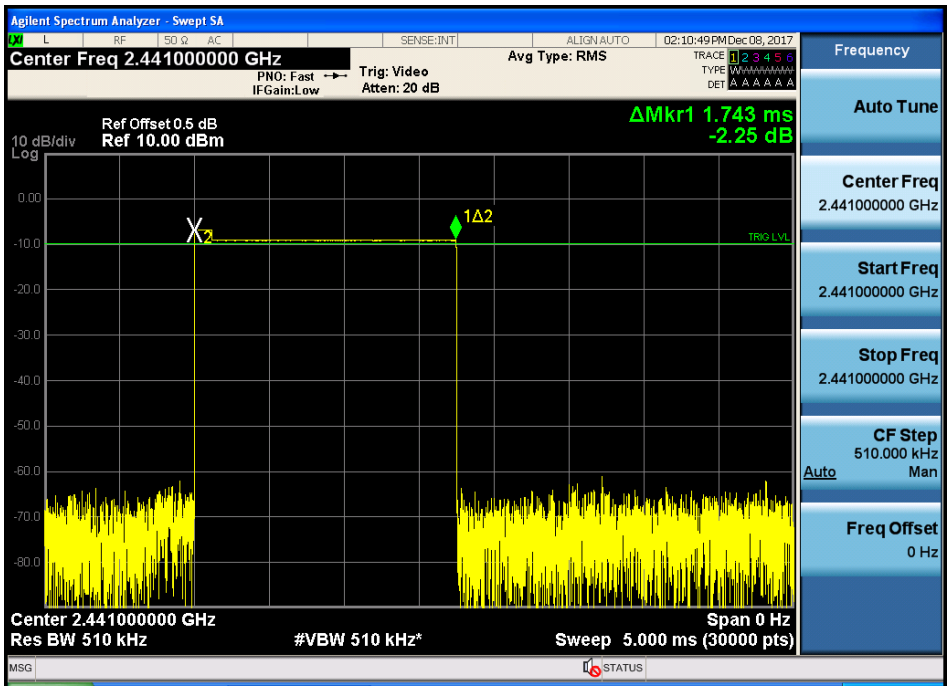
Hopping Number for 8-DPSK	79



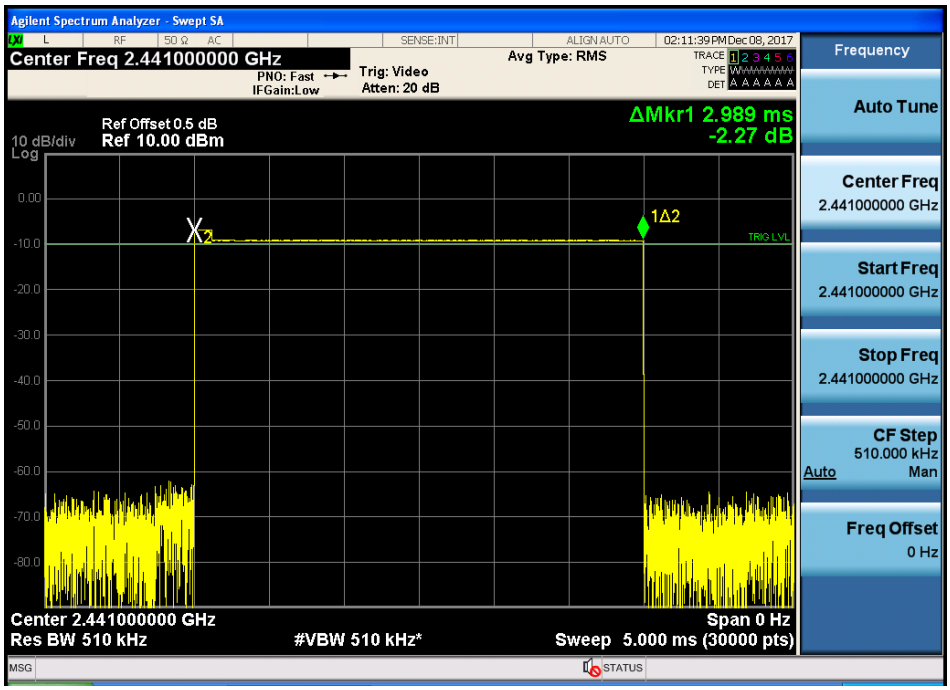
GFSK(1M) DH1:CH Mid-2441:	
Pulse Time (ms)	0.489
Dwell Time (ms)	156.48
Minimum Frequency Occupation (ms)	625.92



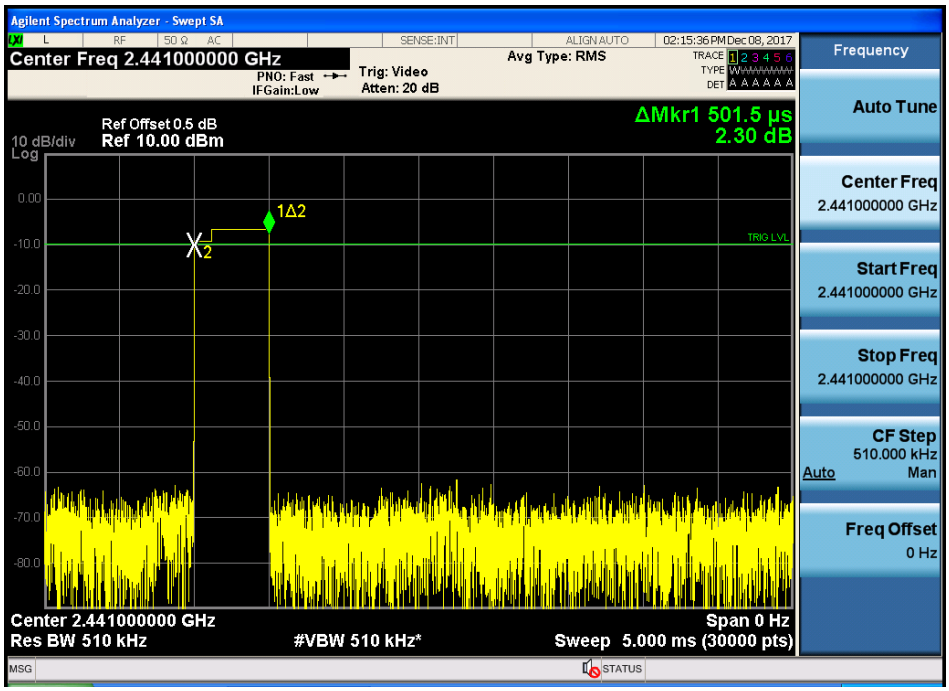
GFSK(1M) DH3:CH Mid-2441:	
Pulse Time (ms)	1.743
Dwell Time (ms)	278.88
Minimum Frequency Occupation (ms)	1115.52



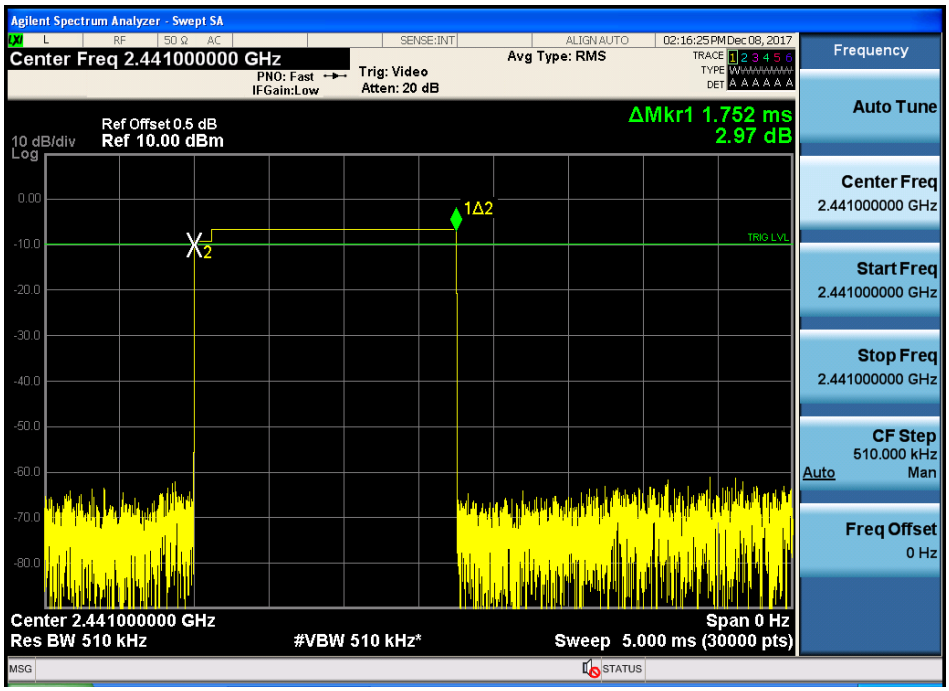
GFSK(1M) DH5:CH Mid-2441:	
Pulse Time (ms)	2.989
Dwell Time (ms)	318.93
Minimum Frequency Occupation (ms)	1275.72



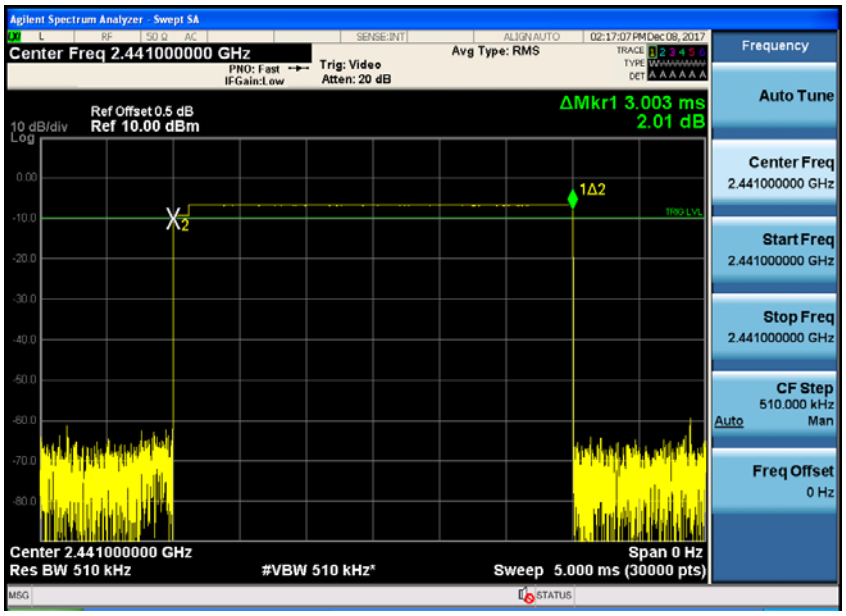
8DPSK(3M) DH1:CH Mid-2441:	
Pulse Time (ms)	0.502
Dwell Time (ms)	160.64
Minimum Frequency Occupation (ms)	642.56



8DPSK(3M) DH3:CH Mid-2441:	
Pulse Time (ms)	1.752
Dwell Time (ms)	280.32
Minimum Frequency Occupation (ms)	1121.28



8DPSK(3M) DH5:CH Mid-2441:	
Pulse Time (ms)	3.003
Dwell Time (ms)	320.42
Minimum Frequency Occupation (ms)	1281.68

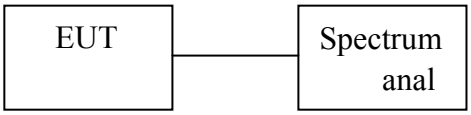


5. Hopping Frequency Separation

5.1. Limit

For Non-adaptive frequency hopping systems
The minimum Hopping Frequency Separation shall be equal to Occupied Channel Bandwidth (see clause 4.3.1.8) of a single hop, with a minimum separation of 100 kHz.
For Adaptive frequency hopping systems
The minimum Hopping Frequency Separation shall be 100 kHz.

5.2. Test Setup



5.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.5

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

Centre Frequency	Centre of the two adjacent hopping frequencies
Frequency Span	Sufficient to see the complete power envelope of both hopping frequencies
RBW	1 % of the Span
VBW	3 × RBW (20KHz)
Detector	Max Peak
Trace	Max hold
Sweep time	Auto

5.4. Test Result

Mode	Result (MHz)	Limit (MHz)	Conclusion
GFSK	1.000	＞0.1	PASS
8-DPSK	1.000	＞0.1	PASS

GFSK

Hopping Frequency Separation (MHz)	1.000

8-DPSK

Hopping Frequency Separation (MHz)	1.000

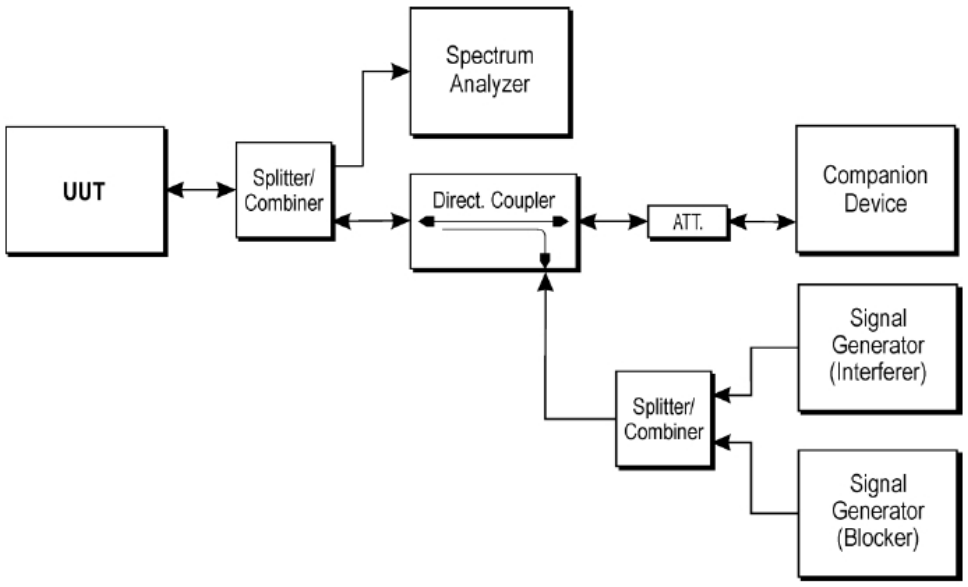
6. Adaptivity

6.1. Limit

The frequency range of the equipment is determined by the lowest and highest

Non-LBT based Detect and Avoid: 1 The frequency shall remain unavailable for a minimum time equal to 1 second after which the channel maybe considered again as an 'available' channel; 2 COT ≤ 40 ms; 3 Idle Period = 5% of COT; 4 Detection threshold level = -70dBm/MHz + 20 – Pout E.I.R.P (Pout in dBm);
LBT based Detect and Avoid (Frame Based Equipment): 1 Minimum Clear Channel Assessment (CCA) time = 20 us; 2 CCA observation time declared by the supplier; 3 COT = 1~10 ms; 4 Idle Period = 5% of COT; 5 Detection threshold level = -70dBm/MHz + 20 – Pout E.I.R.P (Pout in dBm);
LBT based Detect and Avoid (Load Based Equipment): 1 Minimum Clear Channel Assessment (CCA) time = 20 us; 2 CCA declared by the manufacturer; 3 COT ≤ (13 / 32) * q ms; q = [4~32]; 1.625ms~13ms; 4 Detection threshold level = -73dBm/MHz + 20 – Pout E.I.R.P (dBm);
Short Control Signalling Transmissions: Short Control Signalling Transmissions shall have a maximum duty cycle of 10% within an observation period of 50ms.

6.2. Test Setup



6.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.6.

6.4. Test Result

Not applicable

Note : The E.I.R.P. of EUT less than 10dBm, so not applicable.

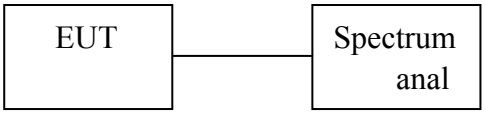
7. Occupied Channel Bandwidth

7.1. Limit

The Occupied Channel Bandwidth shall fall completely within the band given in 2.4GHz to 2.4835GHz.

In addition, for non-adaptive systems using wide band modulations other than FHSS and with e.i.r.p greater than 10 dBm, the occupied channel bandwidth shall be less than 20 MHz.

7.2. Test Setup



7.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.7.

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

Centre Frequency	The centre frequency of the channel under test
Frequency Span	2 × Nominal Channel Bandwidth (e.g. 2 MHz for a 1MHz channel)
RBW	~ 1 % of the span without going below 1 % (20KHz)
VBW	3 × RBW (62KHz)
Detector	RMS
Trace	Max hold
Sweep Time	1s

7.4. Test Result

Frequency Rang			
Test mode	CH	Result	Limit
		MHz	MHz
GFSK	CH0	2401.66	>2400.0
	CH78	2480.35	<2483.5
π /4 DQPSK	CH0	2401.51	>2400.0
	CH78	2480.50	<2483.5
8-DPSK	CH0	2401.50	>2400.0
	CH78	2480.49	<2483.5
Test Result: PASS.			

Occupied Bandwidth		
Test mode	Occupied Bandwidth (MHz)	
	Lowest frequency	Highest fequency
GFSK	0.6892	0.6903
π /4 DQPSK	0.9899	0.9885
8-DPSK	0.9906	0.9896
Test Result: PASS.		

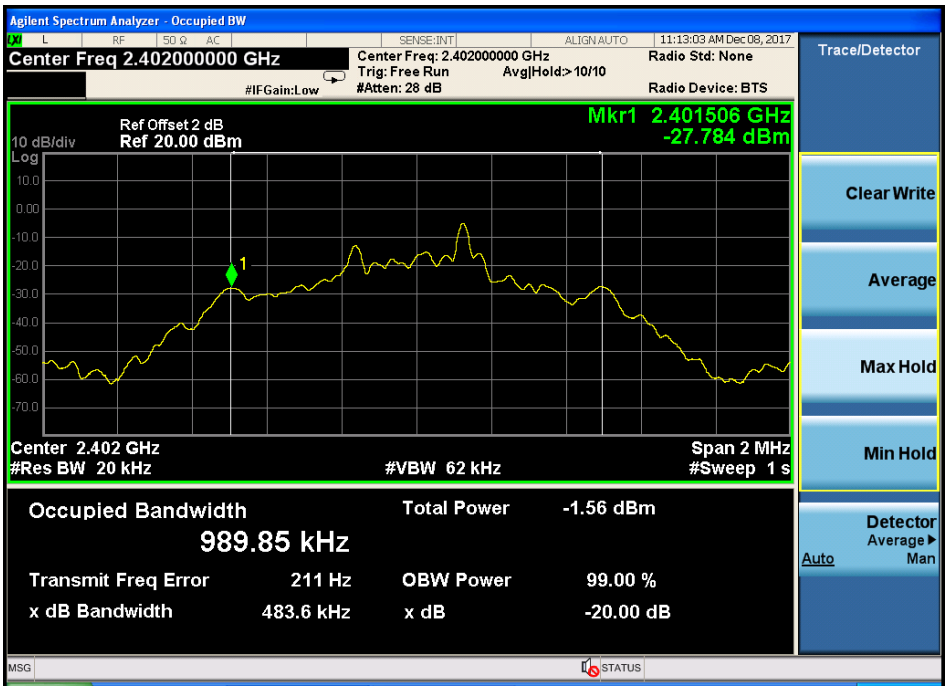
GFSK

CH Low

CH High

π /4 DQPSK

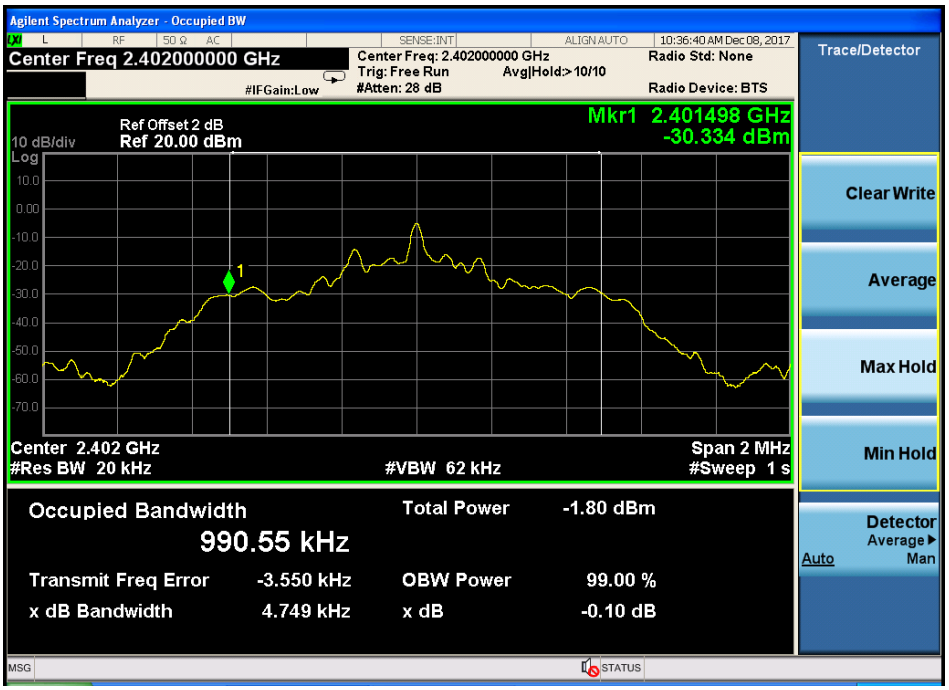
CH Low



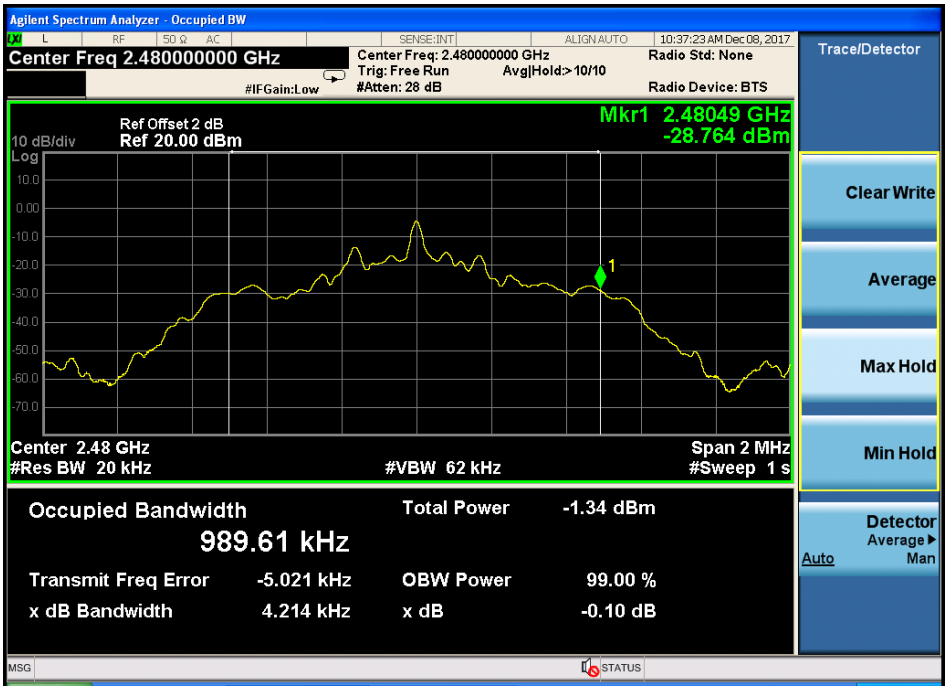
CH High

8-DPSK

Ch Low



Ch High



8. Transmitter Unwanted Emissions in the Out-of-band Domain

8.1. Limit

The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask in figure 3.

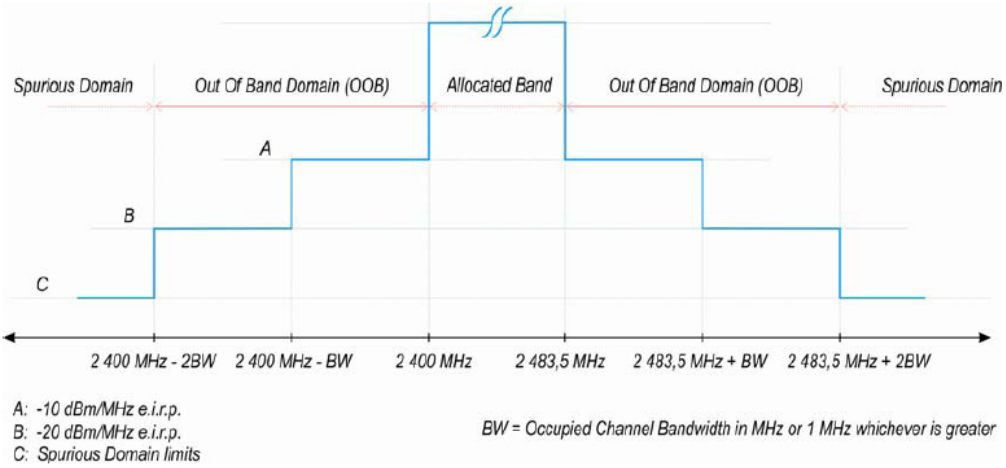
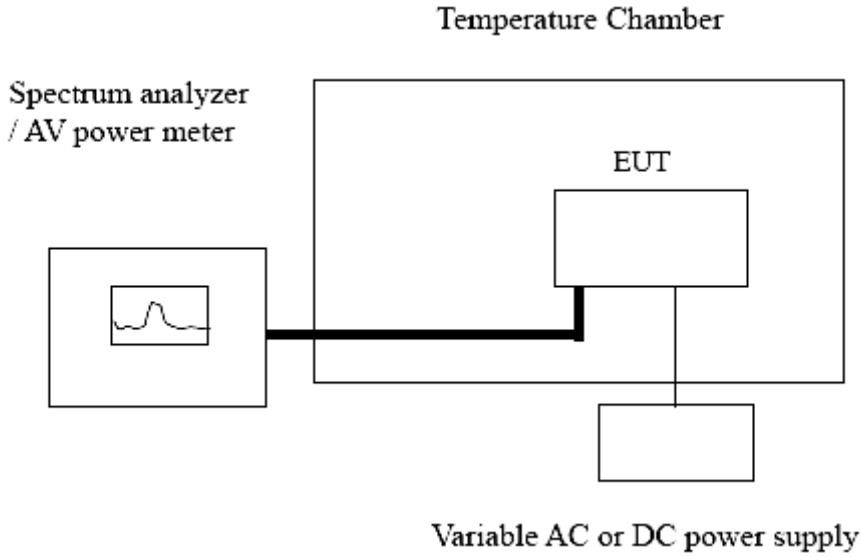


Figure 3: Transmit mask

8.2. Test Setup



8.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.8.

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

RBW/ VBW	1MHz/3MHz
Span	0Hz
Filter mode	Channel filter
Sweep mode	Continuous
Sweep Points	5000
Detector	RMS
Trace mode	Clear / Write
Trigger Mode	Video trigger

8.4. Test Result

GFSK Hopping mode :

Test Condition			Lower Band Edge		Higher Band Edge	
Test Mode	Temp	Vol tage	Segment A (dBm/MHz)	Segment B (dBm/MHz)	Segment A (dBm/MHz)	Segment B (dBm/MHz)
GFSK	Normal	Normal	-51.583	-55.947	-58.089	-58.285
Limit			＜-10	＜-20	＜-10	＜-20
Conclusion			PASS			
Remark: All modulations of EUT have been tested, but only show the test data of the worst case in this report.						

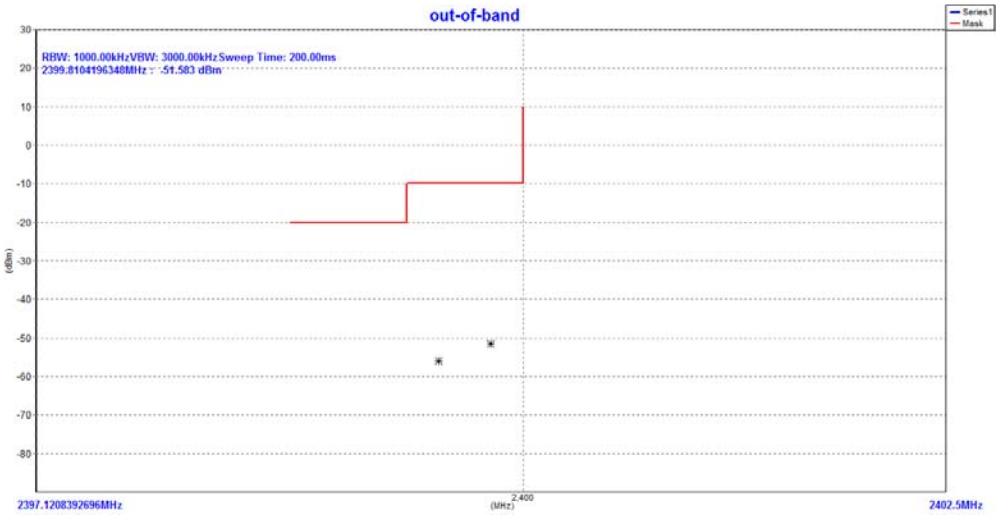
8-DPSK Hopping mode

Test Condition			Lower Band Edge		Higher Band Edge	
Test Mode	Temp	Vol tage	Segment A (dBm/MHz)	Segment B (dBm/MHz)	Segment A (dBm/MHz)	Segment B (dBm/MHz)
8-DPSK	Normal	Normal	-54.190	-59.507	-60.018	-59.964
Limit			＜-10	＜-20	＜-10	＜-20
Conclusion			PASS			
Remark: All modulations of EUT have been tested, but only show the test data of the worst case in this report.						

NTNV

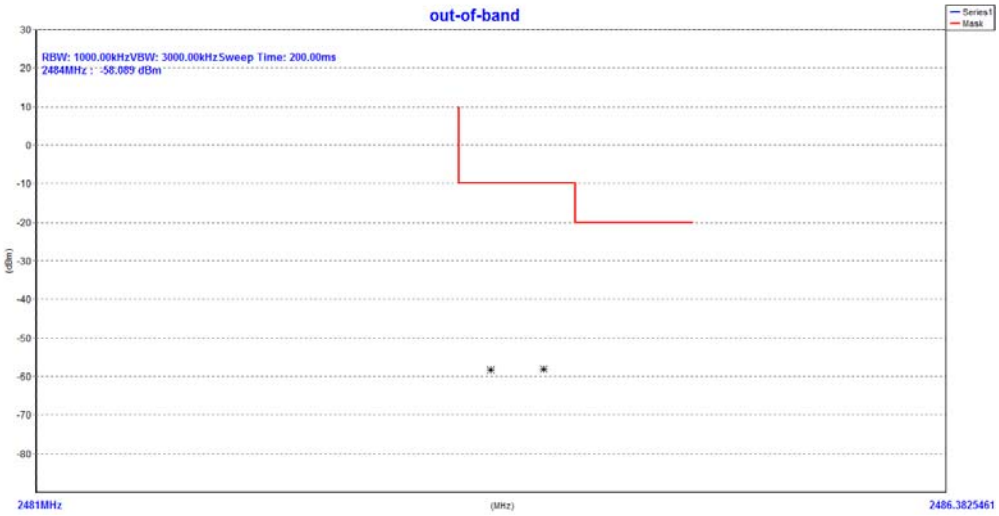
CH Low- GFSK

Channel	Antenna	Frequency	Level	Limit
CH Low-2402	Antenna 1	2399.8	-51.583	＜-10
CH Low-2402	Antenna 1	2399.5	-55.947	＜-20



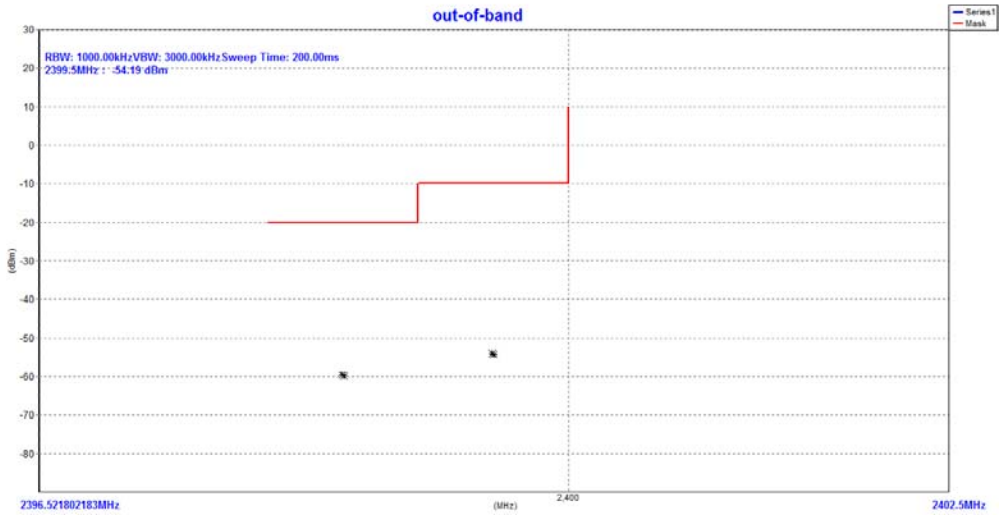
CH High- GFSK

Channel	Antenna	Frequency	Level	Limit
CH High-2480	Antenna 1	2484	-58.089	＜-10
CH High-2480	Antenna 1	2487	-58.285	＜-20



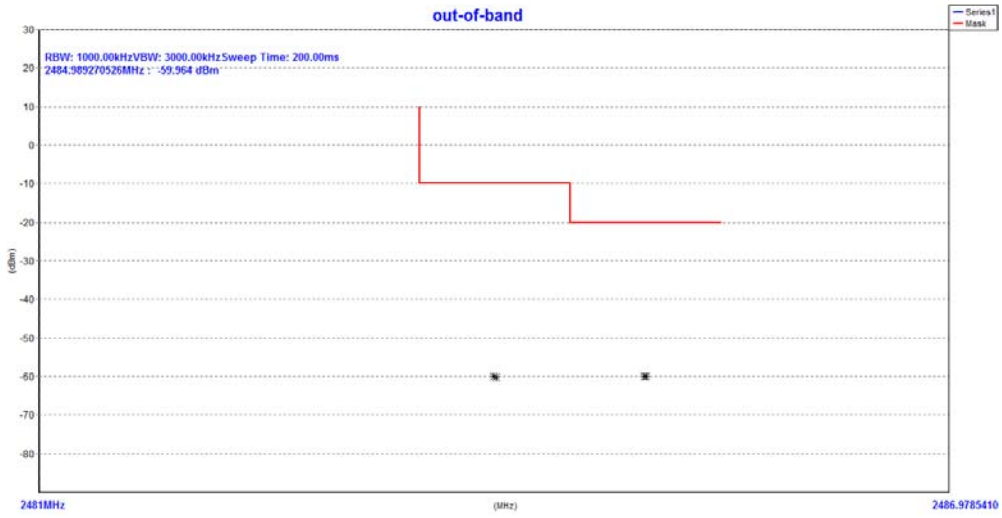
CH Low-8-DPSK

Channel	Antenna	Frequency	Level	Limit
CH Low-2402	Antenna 1	2399.5	-54.190	＜-10
CH Low-2402	Antenna 1	2398.5	-59.507	＜-20



CH High-8-DPSK

Channel	Antenna	Frequency	Level	Limit
CH High-2480	Antenna 1	2483.9893	-60.018	＜-10
CH High-2480	Antenna 1	2484.9893	-59.964	＜-20



9. Transmitter Unwanted Emissions in the Spurious Domain

9.1. Limit

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

Frequency range	Maximum power, e.r.p. (≤ 1 GHz) e.i.r.p. (> 1 GHz)	RBW/VBW
30 MHz to 47 MHz	-36 dBm	100 kHz/300KHz
47 MHz to 74 MHz	-54 dBm	100 kHz/300KHz
74 MHz to 87,5 MHz	-36 dBm	100 kHz/300KHz
87,5 MHz to 118 MHz	-54 dBm	100 kHz/300KHz
118 MHz to 174 MHz	-36 dBm	100 kHz/300KHz
174 MHz to 230 MHz	-54 dBm	100 kHz/300KHz
230 MHz to 470 MHz	-36 dBm	100 kHz/300KHz
470 MHz to 862 MHz	-54 dBm	100 kHz/300KHz
862 MHz to 1 GHz	-36 dBm	100 kHz/300KHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz/3MHz

9.2. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.9.

9.3. Test Result

Test Mode：GFSK CH1:2402MHz					
Frequency (MHz)	Antenna polarization	Result (dBm)	Limit (dBm)	Margin (dB)	Conclusion
428.6	H	-60.78	-36	-24.78	PASS
482.22	H	-61.41	-54	-7.41	PASS
646.34	H	-60.60	-54	-6.60	PASS
4804	H	-39.75	-30	-9.75	PASS
56.39	V	-62.93	-54	-8.93	PASS
597.22	V	-61.35	-54	-7.35	PASS
657.9	V	-60.09	-54	-6.09	PASS
4804	V	-42.54	-30	-12.54	PASS
Test Mode：GFSK CH79:2480MHz					
428.6	H	-55.42	-36	-19.42	PASS
574.8	H	-69.67	-54	-15.67	PASS
731.9	H	-71.56	-54	-17.56	PASS
4960	H	-43.85	-30	-13.85	PASS
488.7	V	-70.92	-54	-16.92	PASS
635.4	V	-72.56	-54	-18.56	PASS
4960	V	-43.17	-30	-13.17	PASS

Note: The test result belongs to 30MHz-12.75GHz, the other points are too low against the limit.

Test Mode：8-DPSK CH1:2402MHz					
Frequency (MHz)	Antenna polarization	Result (dBm)	Limit (dBm)	Margin (dB)	Conclusion
428.6	H	-55.14	-36	-19.14	PASS
574.8	H	-70.27	-54	-16.27	PASS
731.9	H	-69.58	-54	-15.58	PASS
4804	H	-43.12	-30	-13.12	PASS
488.7	V	-69.04	-54	-15.04	PASS
635.4	V	-70.23	-54	-16.23	PASS
657.9	V	-70.28	-54	-16.28	PASS
4804	V	-42.73	-30	-12.73	PASS
Test Mode：8-DPSK CH79:2480MHz					
428.6	H	-56.40	-36	-20.40	PASS
574.8	H	-70.13	-54	-16.13	PASS
731.9	H	-71.14	-54	-17.14	PASS
4960	H	-43.46	-30	-13.46	PASS
488.7	V	-71.45	-54	-17.45	PASS
635.4	V	-70.83	-54	-16.83	PASS
821.5	V	-68.80	-54	-14.80	PASS
4960	V	-45.88	-30	-15.88	PASS

Note: The test result belongs to 30MHz-12.75GHz, the other points are too low against the limit.

10. Receiver Spurious Emissions

10.1. Limit

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

Frequency range	Maximum power, e.r.p. (≤ 1 GHz) e.i.r.p. (> 1 GHz)	RBW/VBW
30 MHz to 1GHz	-57 dBm	100 kHz/300KHz
1 GHz to 12,75 GHz	-47 dBm	1 MHz/3MHz

10.2. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.10.

10.3. Test Result

Test Mode：GFSK CH1:2402MHz					
Frequency (MHz)	Antenna polarization	Result (dBm)	Limit (dBm)	Margin (dB)	Conclusion
428.6	H	-77.06	-57	-20.06	PASS
574.8	H	-76.11	-57	-19.11	PASS
731.9	H	-76.49	-57	-19.49	PASS
2210	H	-62.98	-47	-15.98	PASS
488.7	V	-77.99	-57	-20.99	PASS
635.4	V	-76.09	-57	-19.09	PASS
657.9	V	-78.56	-57	-21.56	PASS
2210	V	-65.01	-47	-18.01	PASS
Test Mode： GFSK CH79:2480MHz					
428.6	H	-76.99	-57	-19.99	PASS
574.8	H	-77.06	-57	-20.06	PASS
731.9	H	-75.84	-57	-18.84	PASS
2210	H	-61.44	-47	-14.44	PASS
488.7	V	-76.45	-57	-19.45	PASS
635.4	V	-77.33	-57	-20.33	PASS
657.9	V	-75.47	-57	-18.47	PASS
2210	V	-62.49	-47	-15.79	PASS
Note: All the emissions detected are belong to narrowband emissions. The test result belongs to 30MHz-12.75GHz, the other points are too low against the limit.					

11. Receiver Blocking

11.1. Limit

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

Table 6 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.			

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

Table 7: Receiver Blocking parameters receiver category 2 equipment

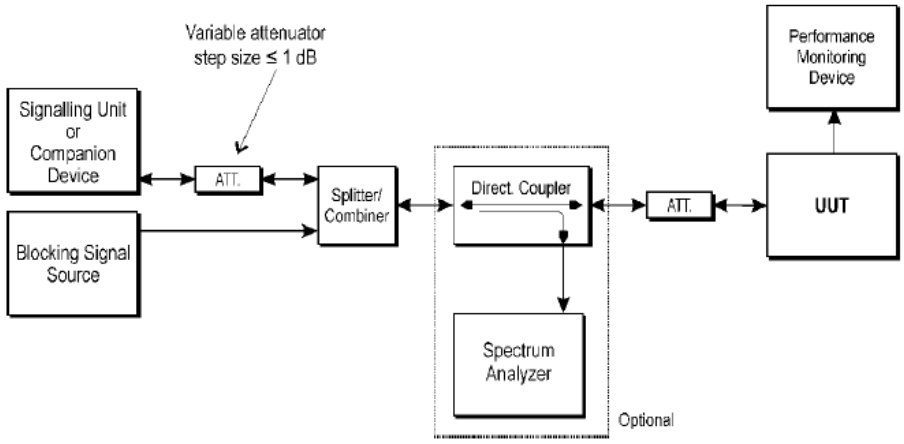
Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 6 dB	2 380 2 503,5	-57	CW
P_{min} + 6 dB	2 300 2 583,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to 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.			

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

Table 8: Receiver Blocking parameters receiver category 3 equipment

Wanted signal mean power from companion device (dBm)	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 2 583,5	-47	CW
NOTE 1: P_{min} is the minimum level of the 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.			

11.2. Test Setup



11.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.11.

11.4. Test Result

E.R.P. (dBm)	Variable attenuator vaule (dB)	Pmin (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm)	PER	PER limit
3.50	59	-55.5	2380	-57	2.4%	⩽10%
Test result: conform						
Note: 1. The equipmentbelongs to receiver gategory 2 and it shall be tested operating at hopping mode. The worst result is recorded. 2. P_{min}=E.R.P.- Variable attenuator vaule. ERP is min conducted power vaule. 3. When required blocking signals injected, communication link between the UUT and the associated companion device remains, and the performance still meet the minimum performance criterion PER≤10%.						

12. Geo-location Capability

12.1. 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.

12.2. Requirements

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

12.3. Test Result

Not apply.
This requirement only applies to equipment with geo-location capability. And this product does not have the Geo-location capability, thus, not apply to this product.

13. Photos of Test Setup

14. Photos of EUT

Please refer to report T1872164 01.

------THE END OF REPORT-------