TEST REPORT

Product Name:	TWS Earphone
Trademark:	N/A
Model Number:	UTW-1003P
Prepared For:	
Address:	
Manufacturer:	
Address:	
Prepared By:	Shenzhen CTB Testing Technology Co., Ltd.
Address:	Floor 1&2, Building A, No. 26 of Xinhe Road, Xinqiao Street, Baoan District, Shenzhen China
Sample Received Date:	Aug. 30, 2019
Sample tested Date:	Aug. 30, 2019 to Sep. 2, 2019
Issue Date:	Sep. 2, 2019
Report No.:	CTB190902037RFX
Test Standards	ETSI EN 300 328 V2.2.2 (2019-07)
Test Results	PASS
Remark:	This is Bluetooth radio test report.

Compiled by:	Reviewed by:	Approved by:
Victory	Rita Xiao	Sherwin Qian
Victory	Rita Xiao	Sherwin Qian/ Director

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TABLE OF CONTENT

(Note: N/A means not applicable)

1. VERSION

Report No.	Issue Date	Description	Approved
CTB190902037RFX	Sep. 2, 2019	Original	Valid

2. TEST SUMMARY

The Product has been tested according to the following specifications:

Standard	EN 300 328 V2.2.2		
Test Item	**Test Requirement**	**Test Method**	**Results**
Transmitter Parameters			
RF Output Power	Clause 4.3.1.2	Clause 5.4.2	PASS
Power Spectral Density	Clause 4.3.2.3	Clause 5.4.3	N/A[1]
Duty cycle, Tx-Sequence, Tx-gap	Clause 4.3.1.3	Clause 5.4.2	N/A[2]
Accumulated Transmit time, Frequency Occupation & Hopping Sequence	Clause 4.3.1.4	Clause 5.4.4	PASS
Hopping Frequency Separation	Clause 4.3.1.5	Clause 5.4.5	PASS
Medium Utilization	Clause 4.3.1.6	Clause 5.4.2	N/A[2]
Adaptivity	Clause 4.3.1.7	Clause 5.4.6	N/A[3]
Occupied Channel Bandwidth	Clause 4.3.1.8	Clause 5.4.7	PASS
Transmitter unwanted emissions in the OOB domain	Clause 4.3.1.9	Clause 5.4.8	PASS
Transmitter unwanted emissions in the spurious domain	Clause 4.3.1.10	Clause 5.4.9	PASS
Receiver Parameters			
Receiver spurious emissions	Clause 4.3.1.11	Clause 5.4.10	PASS
Receiver Blocking	Clause 4.3.1.12	Clause 5.4.11	PASS
Geo-location capability	Clause 4.3.1.13	Clause 5.4.12	N/A[4]

Remark:
N/A[1]: Only for equipment using wide band modulations other than FHSS
N/A[2]: Only for non-Adaptive equipment.
N/A[3]:The maximum ouput power of EUT less than 10dBm, so not applicable
N/A[4]: Only for equipment with geo-location capability
Tx: In this whole report Tx (or tx) means Transmitter.
Rx: In this whole report Rx (or rx) means Receiver.
RF: In this whole report RF means Radiated Frequency.
CH:In this whole report CH means channel.

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3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

No.	Item	Uncertainty
1	Occupancy bandwidth	U=±54.3Hz
2	Adjacent channel power	U=±1.3dB
3	Conducted Adjacent channel power	U=±1.38dB
4	Conducted output power Above 1G	U=±1.0dB
5	Conducted output power below 1G	U=±0.9dB
6	Power Spectral Density , Conduction	U=±1.0dB
7	Conduction spurious emissions	U=±2.8dB
8	Out of band emission	U=±54Hz
9	3m camber Radiated spurious emission(30MHz-1GHz)	U=±4.3dB
10	3m chamber Radiated spurious emission(1GHz-18GHz)	U=±4.5dB
11	humidity uncertainty	U=±5.3%
12	Temperature uncertainty	U=±0.59℃
13	Supply voltages	U=±3%
14	Time	U=±5%

4. PRODUCT INFORMATION AND TEST SETUP

4.1 Product Information

Model(s):	UTW-1003P
Model Description:	N/A
Bluetooth Version:	Bluetooth 5.0
Hardware Version:	V1.0
Software Version:	V1.0
Operation Frequency:	Bluetooth: 2402-2480MHz
Max. RF output power:	Bluetooth: 6.09dBm
Type of Modulation:	Bluetooth: GFSK, π/4 DQPSK, 8DPSK
Antenna installation:	Bluetooth: Internal antenna
Antenna Gain:	Bluetooth: 1dBi
Ratings:	Battery DC 3.7V 35mAh DC 5V, 0.5A, charging from adapter

4.2 Test Setup Configuration

See test photographs attached in EUT TEST SETUP PHOTOGRAPHS for the actual connections between Product and support equipment.

4.3 Support Equipment

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
1	Laptop	DELL	Inspiron5570	JR4G1A00DPC	AE
2	AC Adaptor	DELL	HA45NM140	CN-00285K-CH200-88V-	AE
3	Adapter	Green cheung	LX05A	Input:100-240V, 50/60Hz, 1.5A	AE

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

4.4 Channel List

CH	Frequency (MHz)	CH	Frequency (MHz)	CH	Frequency (MHz)	CH	Frequency (MHz)
0	2402	1	2403	2	2404	3	2405
4	2406	5	2407	6	2408	7	2409
8	2410	9	2411	10	2412	11	2413
12	2414	13	2415	14	2416	15	2417
16	2418	17	2419	18	2420	19	2421
20	2422	21	2423	22	2424	23	2425
24	2426	25	2427	26	2428	27	2429
28	2430	29	2431	30	2432	31	2433
32	2434	33	2435	34	2436	35	2437
36	2438	37	2439	38	2440	39	2441
40	2442	41	2443	42	2444	43	2445
44	2446	45	2447	46	2448	47	2449
48	2450	49	2451	50	2452	51	2453
52	2454	53	2455	54	2456	55	2457
56	2458	57	2459	58	2460	59	2461
60	2462	61	2463	62	2464	63	2465
64	2466	65	2467	66	2468	67	2469
68	2470	69	2471	70	2472	71	2473
72	2474	73	2475	74	2476	75	2477
76	2478	77	2479	78	2480	79	/

4.5 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by
performing full tests, the worst data were recorded and reported.

Test mode	Low channel	Middle channel	High channel
Transmitting (GFSK/Π/4DQPSK/8DPSK)	2402MHz	2441MHz	2480MHz
Receiving (GFSK/Π/4DQPSK/8DPSK)	2402MHz	2441MHz	2480MHz

4.6 Test Environment

Humidity(%):	55
Atmospheric Pressure(kPa):	101.1
Normal Voltage(DC):	3.7
Normal Temperature(℃)	25
Low Temperature(℃)	0
High Temperature(℃)	40

5. TEST FACILITY AND TEST INSTRUMENT USED

5.1 Test Facility

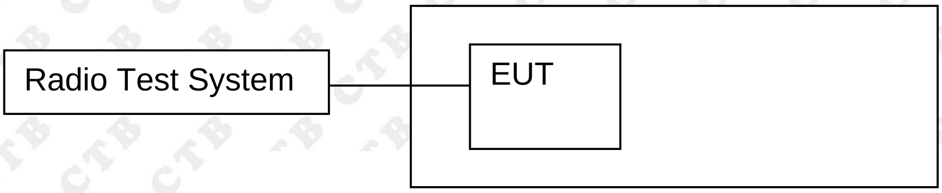
All measurement facilities used to collect the measurement data are located at Floor 1&2, Building A, No. 26 of Xinhe Road, Xinqiao Street, Baoan District, Shenzhen China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-1 other equivalent standards.

5.2 Test Instrument Used

Item	Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
1	966 chamber	C.R.T.	966 Room	966	Oct. 17, 2018	Oct. 16, 2019
2	Receiver	R&S	ESPI	100362	Nov. 02, 2018	Nov. 01, 2019
3	Spectrum Analyzer	Aglient	N9020A	MY52090073	Nov. 02, 2018	Nov. 01, 2019
4	Amplifier	HP	8447E	2945A02747	Nov. 02, 2018	Nov. 01, 2019
5	Amplifier	Agilent	8449B	3008A01838	Nov. 02, 2018	Nov. 01, 2019
6	TRILOG Broadband Antenna	Schwarzbeck	VULB 9163	869	Nov. 03, 2018	Nov. 02, 2019
7	Horn Antenna	Schwarzbeck	BBHA9120D	1911	Nov. 03, 2018	Nov. 02, 2019
8	band rejection filter	Shenxiang	MSF2400-2483.5MS-1154	20181015001	Nov. 02, 2018	Nov. 01, 2019
9	Signal Generator	Agilent	N5181A	MY49060920	Nov. 02, 2018	Nov. 01, 2019
10	Vector signal generator	Agilent	N5182A	MY47420195	Nov. 02, 2018	Nov. 01, 2019
11	Power Sensor	Agilent	U2021XA	MY56120032	Nov. 02, 2018	Nov. 01, 2019
12	Preamplifier	Agilent	8449B	3008A01838	Nov. 02, 2018	Nov. 01, 2019
13	Software	Fala	EZ-EMC	Ver. EMC-con3A1.1	\	\
14	Software	Micowave	MTS8000	Ver. 2.0.0.0	\	\
15	D.C. Power Supply	Agilent	E3632A	MY51390395	Oct. 30, 2018	Oct. 29, 2019
16	Loop Antenna	Daze	ZN30401	17014	Nov. 10, 2018	Nov. 09, 2019
17	Receiver	R&S	ESCS30	834115/006	Nov. 02, 2018	Nov. 01, 2019

6. RF OUTPUT POWER

6.1 Block Diagram Of Test Setup



6.2 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 5.3.1 m). 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

6.3 Test procedure

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) are captured.

NOTE 1: 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 in all following steps.

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.

NOTE 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. Save these Pburst 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 Pburst 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:

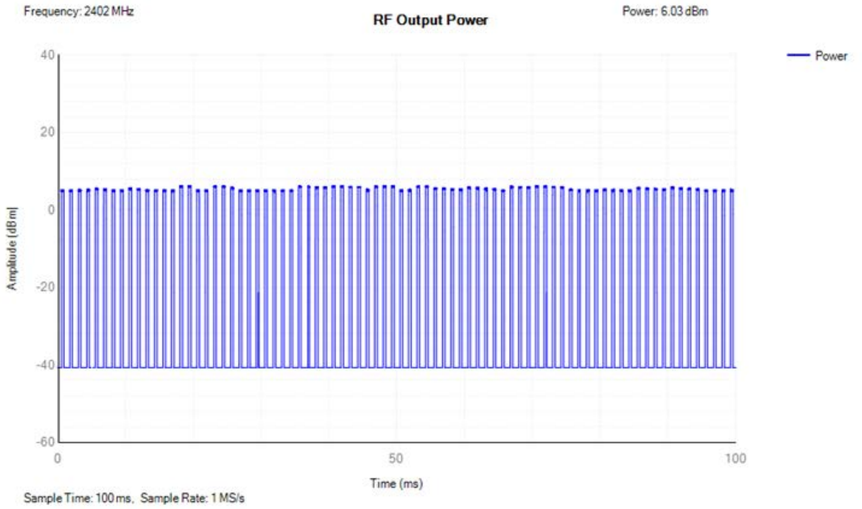
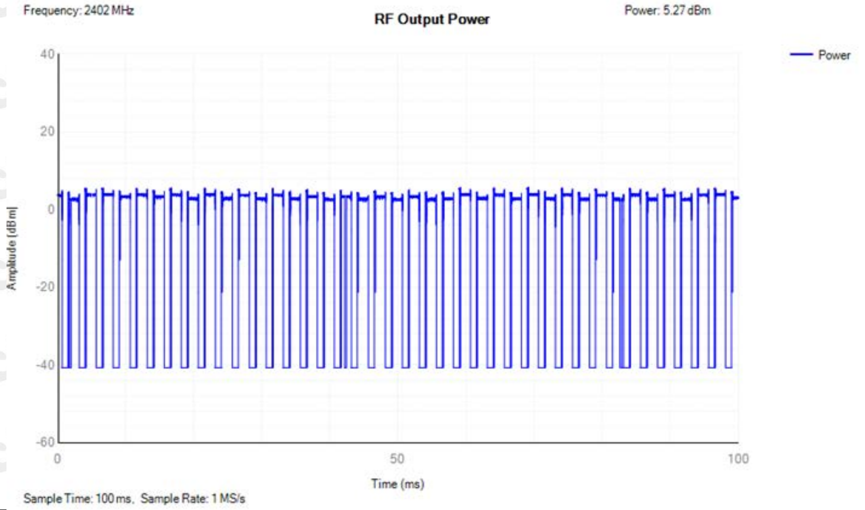
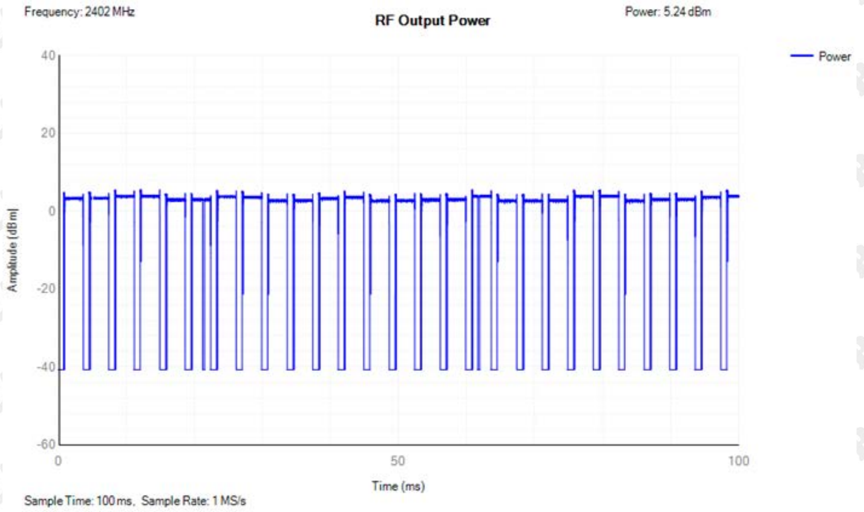
$$P = A + G + Y$$

- 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.

6.4 Test Result

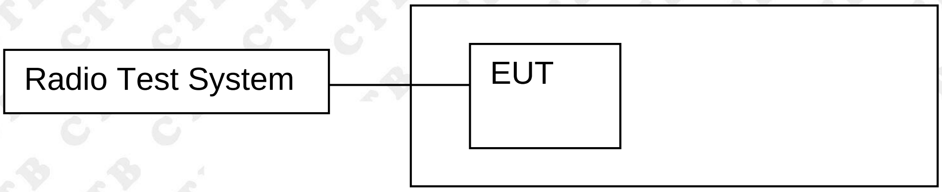
Modulation	Test conditions (Temperature)	EIRP (dBm) Hopping mode
GFSK	Normal	6.03
	Lower	6.09
	Upper	5.86
π/4DQPSK	Normal	5.27
	Lower	5.17
	Upper	4.92
8DPSK	Normal	5.24
	Lower	5.14
	Upper	4.89
Limit		≤100mW (20dBm)
Remark: P = A + G + Y,G=1dBi,x=100%		

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

GFSK	
π/4 DQPSK	
8DPSK	

7. ACCUMULATED TRANSMIT TIME, MINIMUM FREQUENCY OCCUPATION AND HOPPING SEQUENCE

7.1 Block Diagram Of Test Setup



7.2 Limit

Adaptive Frequency Hopping equipment shall be capable of operating over a minimum of 70 % of the band specified in clause 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 15 divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.

7.3 Test procedure

Step 1:

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

NOTE 1: This step is only applicable for equipment implementing Option 1 in clause 4.3.1.4.3.1 or 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 or clause 4.3.1.4.3.2. The result of this comparison shall be recorded in the test report.

Step 6:

• Make the following changes on the analyzer:

- 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

- Trace Mode: Max Hold

- Trigger: Free Run

NOTE 2: The above sweep time setting may result in long measuring times. To avoid such long measuring times, an FFT analyser could be used.

• 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 equipment, using the lowest and highest -20 dB points from the total spectrum envelope obtained in step 6, it shall be verified whether the equipment uses 70 % of the band specified in clause 1. The result shall be recorded in the test report.

7.4 Test Result

Accumulated Transmit Time

Channel	Modulation	Accumulated Transmit Time (ms)	Limit (ms)	Result
LCH	GFSK	119.36	400	Pass
	π/4DQPSK	261.28	400	Pass
	8DPSK	310.824	400	Pass
HCH	GFSK	119.36	400	Pass
	π/4DQPSK	269.445	400	Pass
	8DPSK	282.534	400	Pass

Minimum Frequency Occupation

Channel	Modulation	Occupied period	Limit	Result
LCH	GFSK	1	4≥X≥1	Pass
	π/4DQPSK	1		Pass
	8DPSK	1		Pass
HCH	GFSK	1		Pass
	π/4DQPSK	1		Pass
	8DPSK	1		Pass

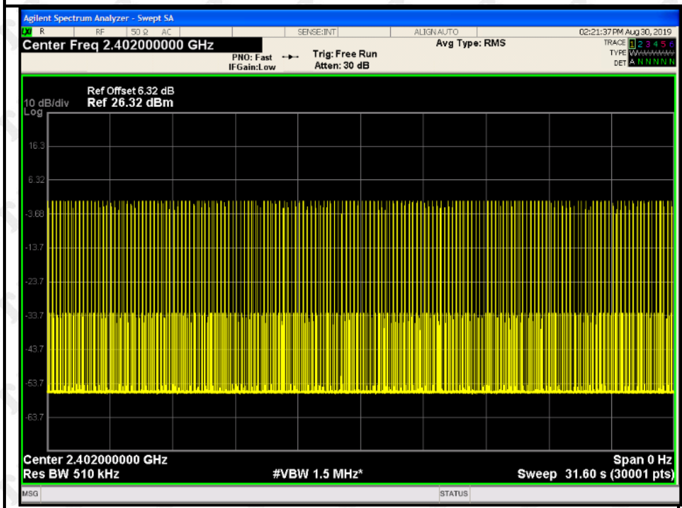
Hopping Sequence

Modulation	One pulse time (ms)	Number of Hopping Channel	Limit	-20 dB Bandwidth (%)	Limit	Result
GFSK	0.373	79	≥15	94.91	70 % of the band 2400MHz-2483.5MHz	Pass
π/4DQPSK	1.633	79		95.38		
8DPSK	2.878	79		94.84		

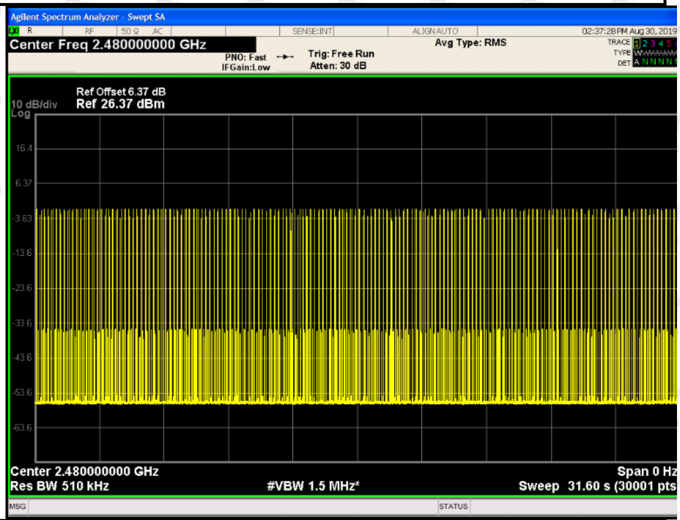
Test Graphs

Accumulated Transmit Time

GFSK

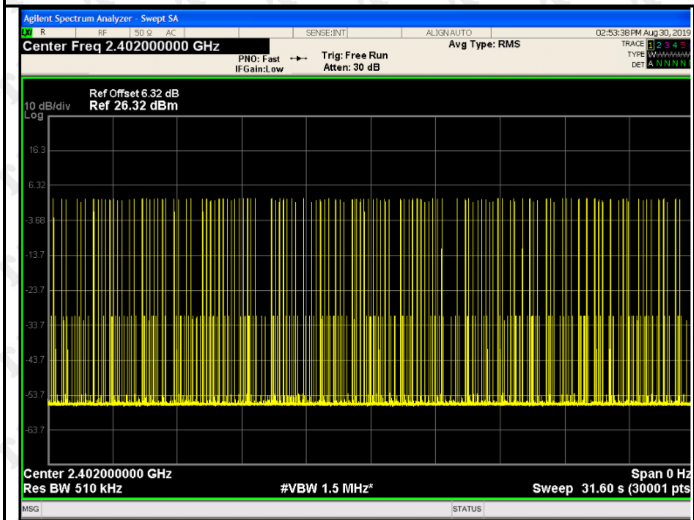


CH00



CH78

π/4DQPSK



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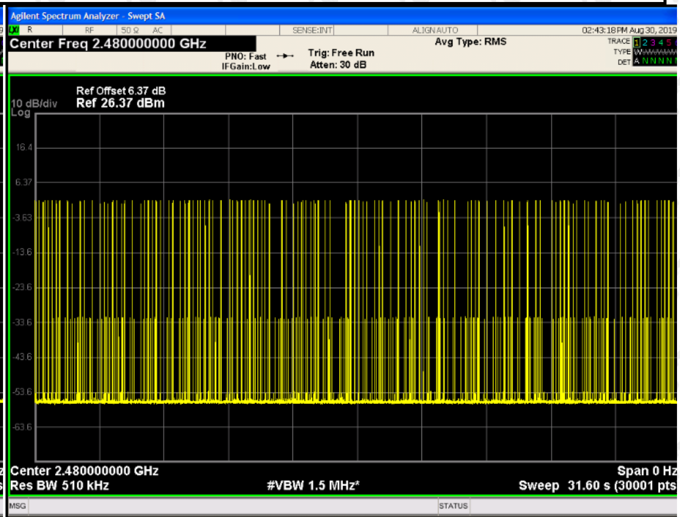
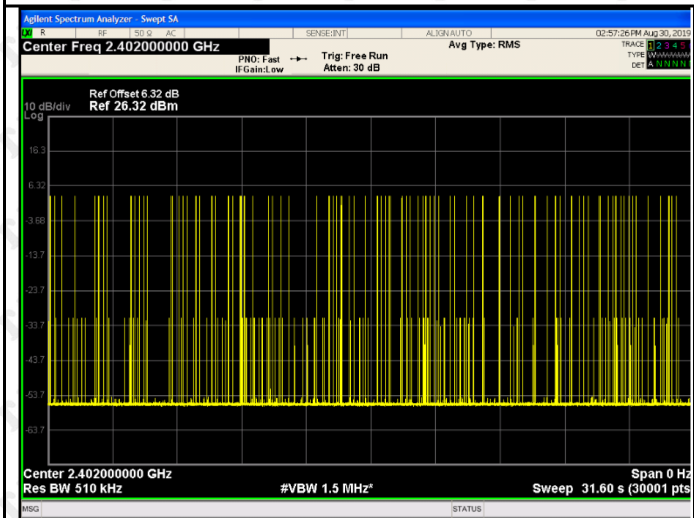


CH78

8DPSK



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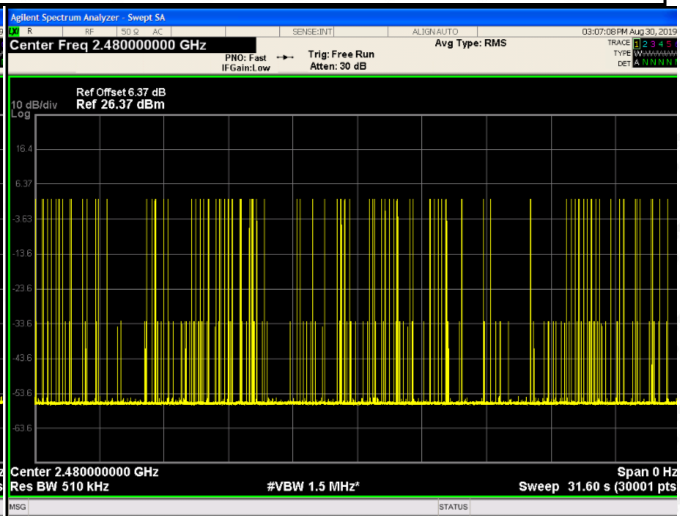
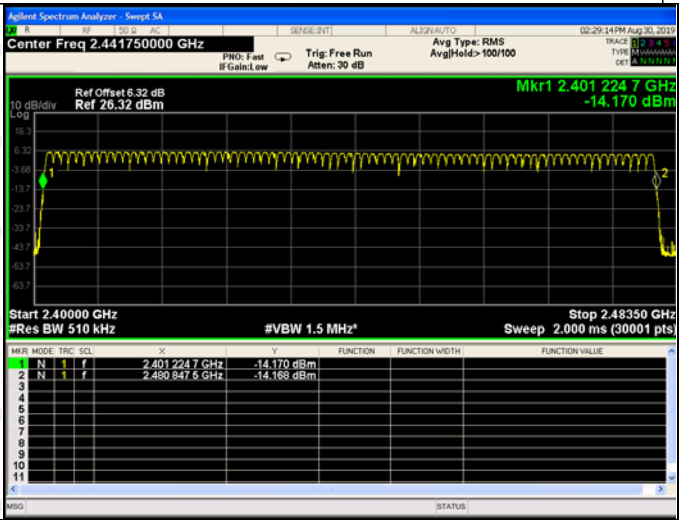
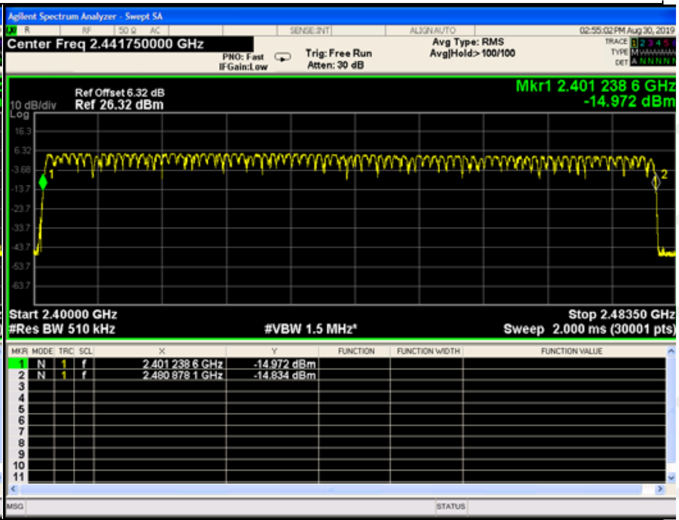
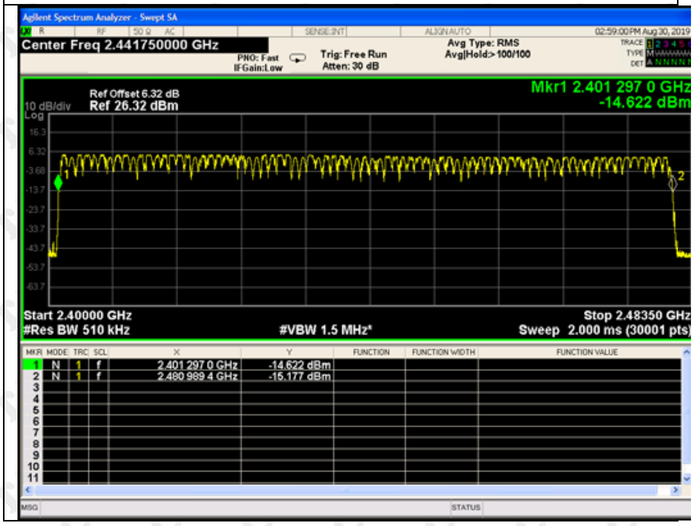


CH78

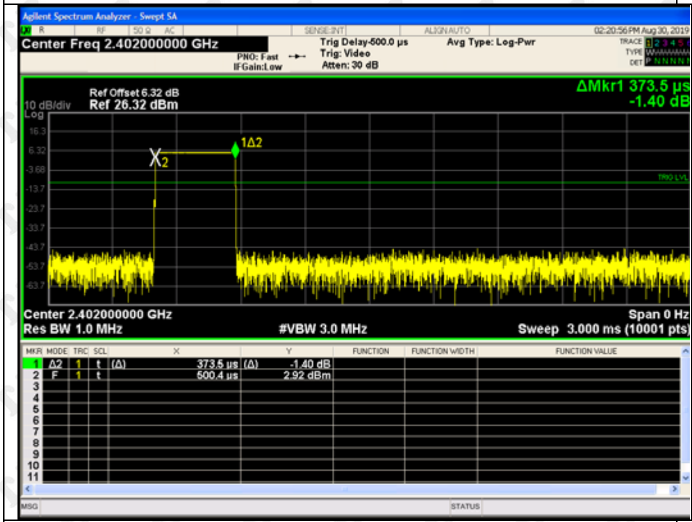
Hopping Sequence

GFSK	π/4DQPSK
	

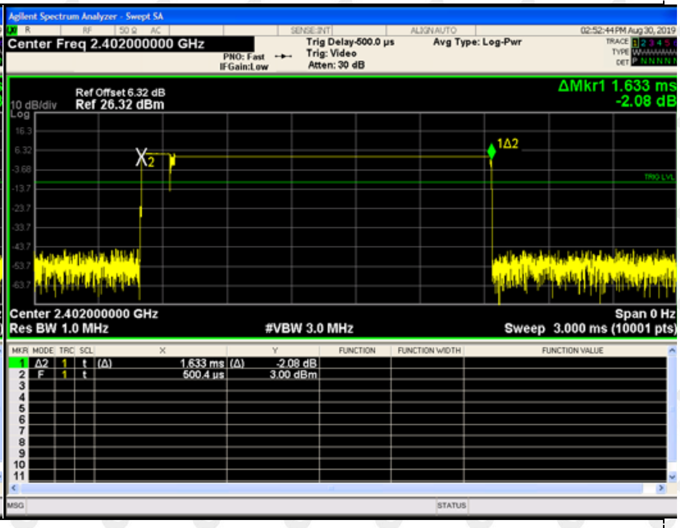
8DPSK	
	

One pulse time

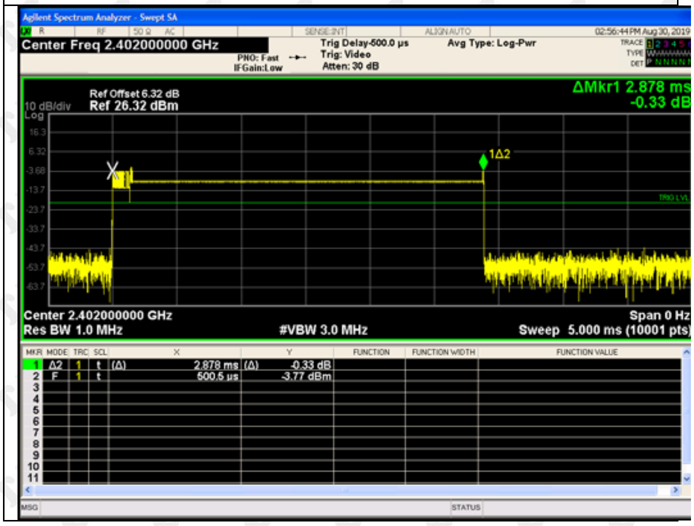
GFSK



π/4DQPSK

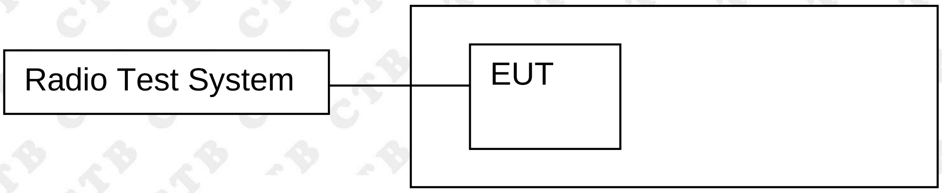


8DPSK



8. HOPPING FREQUENCY SEPARATION

8.1 Block Diagram Of Test Setup



8.2 Limit

For Non-adaptive frequency hopping systems
The minimum Hopping Frequency Separation shall be equal to Occupied Channel Bandwidth (see clause 5.3.1.5.3) 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.

8.3 Test procedure

The Hopping Frequency Separation as defined in clause 4.3.1.5 shall be measured and recorded using any of the following options. The selected option shall be stated in the test report.

Option 1

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: RMS
- Trace Mode: Max Hold
- Sweep time: 1 s

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

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

formulas below. These values shall be recorded in the report.

• Calculate the -20 dBr channel bandwidth (BW_{CHAN}) using the formula below. This value shall be recorded in the report.

$$BW_{CHAN} = F1_H - F1_L$$

• Calculate the Hopping Frequency Separation (FHS) using the formula below. This value shall be recorded in the report.

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

• 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 Occupied Channel Bandwidth as defined in clause 4.3.1.8 or:

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

• See figure 4:

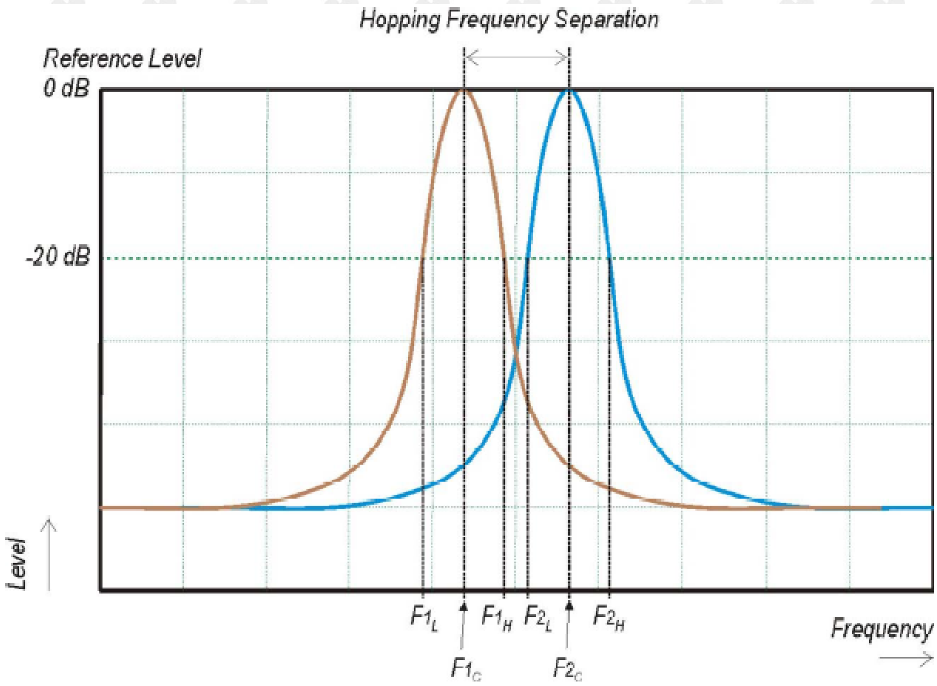


Figure 4: Hopping Frequency Separation

For adaptive equipment, in case of overlapping channels which will prevent 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 F1C and F2C can be measured directly.

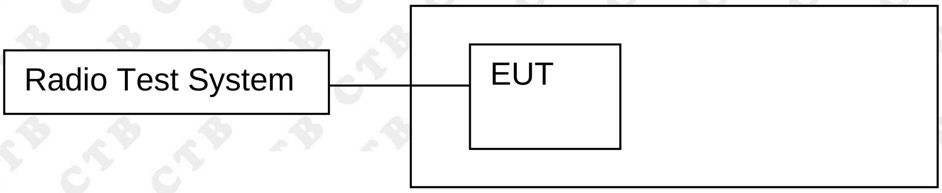
The method used to measure the Hopping Frequency Separation shall be documented in the test report.

8.4 Test Result

Mode		Measurement (MHz)	Limit (MHz)	Result
GFSK	DH1	1.0037	0.1	PASS
	DH3	1.0015	0.1	
	DH5	0.9923	0.1	

9. OCCUPIED CHANNEL BANDWIDTH

9.1 Block Diagram Of Test Setup



9.2 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.

9.3 Test procedure

Step 1:

Connect the UUT to the spectrum analyser 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 analyser 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.

NOTE: 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.

9.4 Test Result

Modulation	Frequency (MHz)	Frequency Range (MHz)		Occupied Channel (MHz)
GFSK DH1	Low	2401.595	/	0.797
	High	/	2480.392	0.803
π/4-DQPSK 2H3	Low	2401.459	/	1.061
	High	/	2480.518	1.059
8DPSK 3DH5	Low	2401.478	/	1.038
	High	/	2480.518	1.048

GFSK DH1 Low Channel

GFSK DH1 High Channel

<table>
<tr>
<td>π/4-DQPSK
2H3
Low
Channel</td>
<td></td>
<td>
</td>
<td></td>
</tr>
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<td>π/4-DQPSK
2H3
High
Channel</td>
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3DH5
Low
Channel</td>
<td></td>
<td>


</td>
</tr>
<tr>
<td>8DPSK
3DH5
High
Channel</td>
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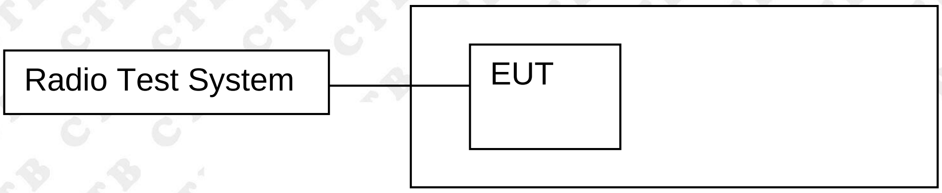
10. TRANSMITTER UNWANTED EMISSIONS IN THE OUT-OF-BAND DOMAIN

11.1 Block Diagram Of Test Setup



11.2 Limit

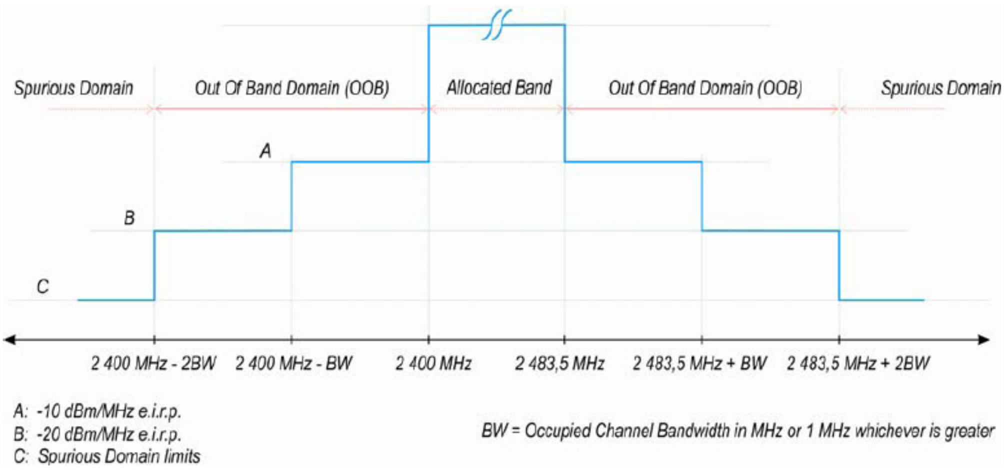


Figure 3: Transmit mask

11.3 Test procedure

The applicable mask is defined by the measurement results from the tests performed under clause 5.3.8 (Occupied Channel Bandwidth).

The test procedure is further as described under clause 5.3.9.2.1.

The Out-of-band emissions within the different horizontal segments of the mask provided in figures 1 and 3 shall be measured using the steps 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

NOTE 1: 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 analyser 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 analyser 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 beamforming 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 × log10(Ach) and the additional beamforming gain "Y" in dB. The results for each of the transmit chains shall be individually compared with these reduced limits.

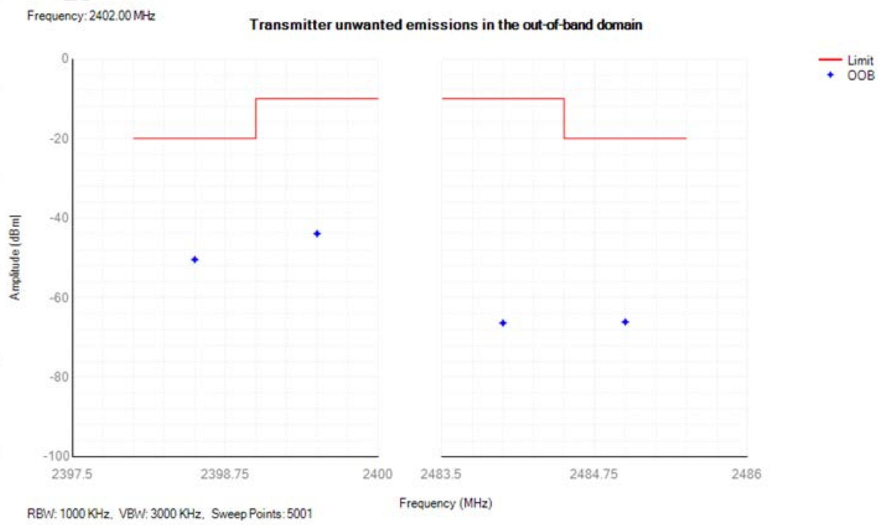
NOTE 2: Ach refers to the number of active transmit chains.

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

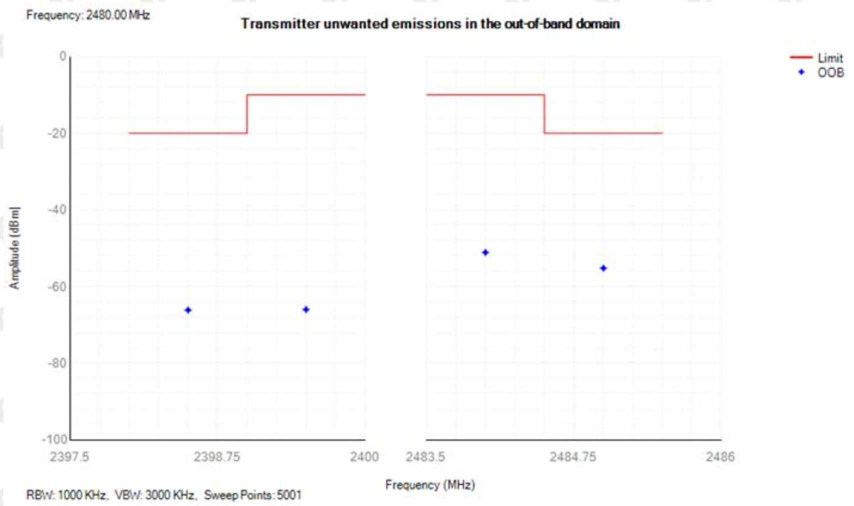
11.4 Test Result

Modulation : GFSK (the worst data)

Low Channel				
Test Freq (MHz)	**Antenna**	**Freq(MHz)**	**Level**	**Limit**
2402	Antenna 1	2399.5	-43.93	-10
2402	Antenna 1	2398.5	-50.45	-20



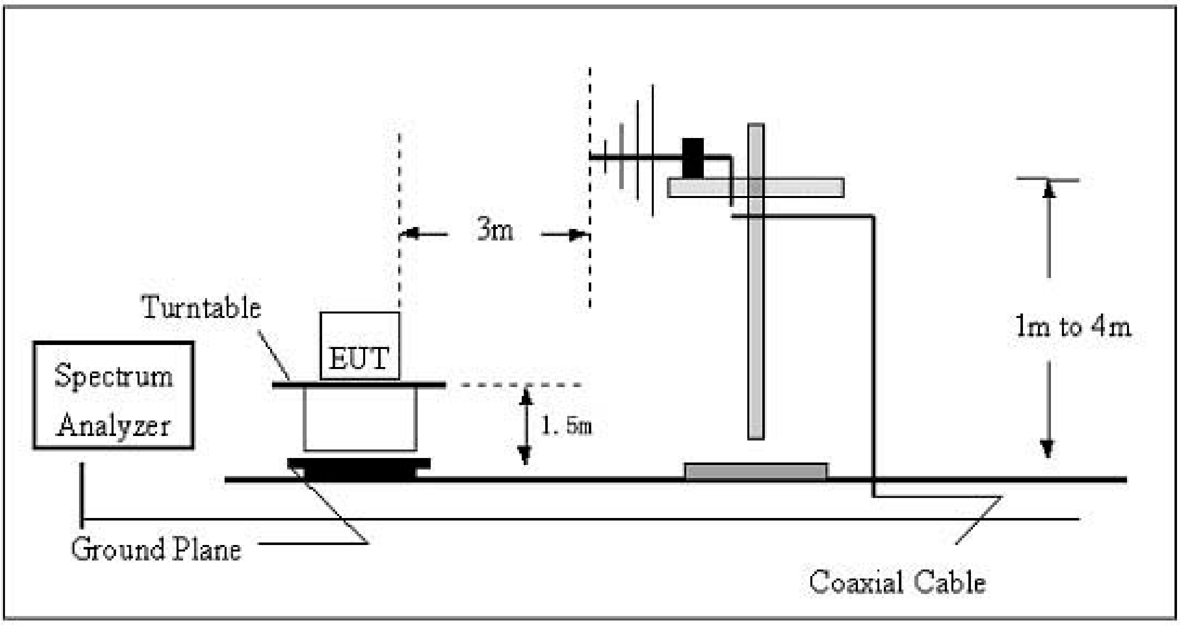
High Channel				
Test Freq (MHz)	**Antenna**	**Freq(MHz)**	**Level**	**Limit**
2480	Antenna 1	2484	-51.07	-10
2480	Antenna 1	2485	-55.16	-20



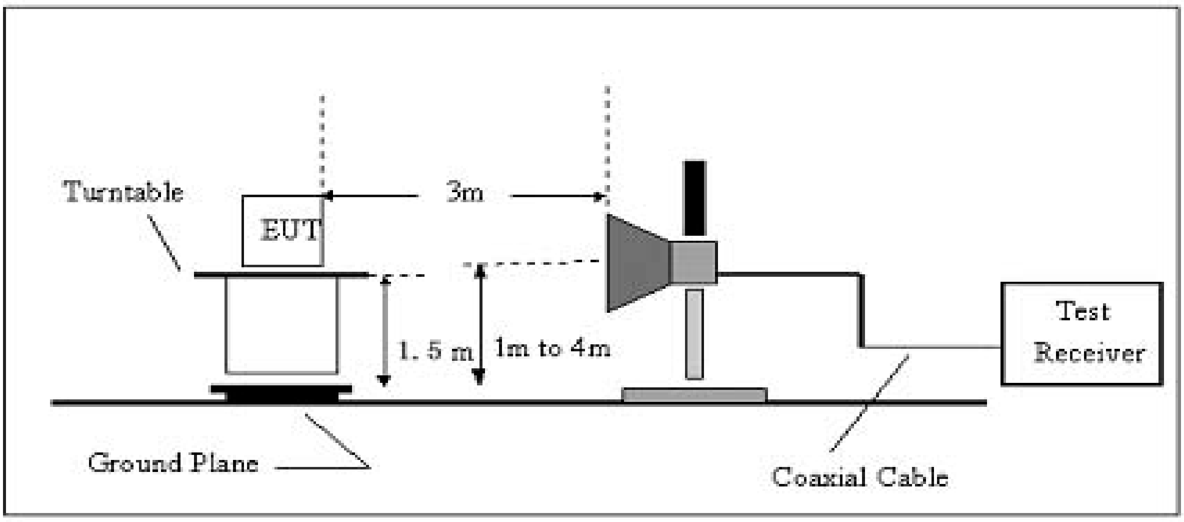
11. TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

12.1 Block Diagram Of Test Setup

(A) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(B) Radiated Emission Test Set-Up Frequency Above 1 GHz



12.2 Limits

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

12.3 Test Procedure

30MHz ~ 1GHz:

a. The Product was placed on the nonconductive turntable 1.5m above the ground in a full anechoic chamber.

b. Set the spectrum analyzer/receiver in Peak detector, Max Hold mode, and 120 kHz RBW. Record the maximum field strength of all the pre-scan process in the full band when the antenna is varied between 1~4 m in both horizontal and vertical, and the turntable is rotated from 0 to 360 degrees.

c. For each frequency whose maximum record was higher or close to limit, measure its QP value: vary the antenna's height and rotate the turntable from 0 to 360 degrees to find the height and degree where Product radiated the maximum emission, then set the test frequency analyzer/receiver to QP Detector and specified bandwidth with Maximum Hold Mode, and record the maximum value.

Above 1GHz:

a. The Product was placed on the non-conductive turntable 1.5 m above the ground in a full anechoic chamber..

b. Set the spectrum analyzer/receiver in Peak detector, Max Hold mode, and 1MHz RBW. Record the maximum field strength of all the pre-scan process in the full band when the antenna is varied in both horizontal and vertical, and the turntable is rotated from 0 to 360 degrees.

c. For each frequency whose maximum record was higher or close to limit, measure its AV value: rotate the turntable from 0 to 360 degrees to find the degree where Product radiated the maximum emission, then set the test frequency analyzer/receiver to AV value and specified bandwidth with Maximum Hold Mode, and record the maximum value.

12.4 Test Results

Modulation : GFSK (the worst data)
Below 1GHz

Freq (MHz)	Rd_level (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Over (dB)	detector	Height	Degree	Antenna polarization
Low Channel									
45.193	-55.41	-12.11	-67.52	-36.00	-31.52	peak	169	1.1	H
67.029	-54.81	-12.50	-67.32	-54.00	-13.32	peak	30	1.3	H
104.361	-55.81	-11.73	-67.55	-54.00	-13.55	peak	271	1.8	H
219.004	-53.31	-11.28	-64.58	-54.00	-10.58	peak	282	1.1	H
325.612	-53.28	-9.73	-63.01	-36.00	-27.01	peak	112	1.7	H
871.915	-52.10	-0.61	-52.71	-36.00	-16.71	peak	354	1.7	H
46.828	-55.11	-12.18	-67.28	-36.00	-31.28	peak	156	1.7	V
100.882	-55.08	-12.39	-67.48	-54.00	-13.48	peak	291	1.1	V
182.284	-55.47	-12.36	-67.83	-54.00	-13.83	peak	20	1.2	V
218.536	-53.47	-11.20	-64.67	-54.00	-10.67	peak	260	1.7	V
328.499	-53.38	-9.80	-63.18	-36.00	-27.18	peak	272	1.5	V
870.081	-52.12	-0.35	-52.47	-36.00	-16.47	peak	288	1.1	V
High Channel									
44.677	-54.90	-11.82	-66.73	-36.00	-30.73	peak	165	1.5	H
66.305	-55.18	-12.27	-67.45	-54.00	-13.45	peak	28	1.2	H
105.600	-55.61	-12.56	-68.16	-54.00	-14.16	peak	274	1.6	H
219.029	-53.11	-11.18	-64.29	-54.00	-10.29	peak	279	1.4	H
327.012	-53.32	-9.43	-62.75	-36.00	-26.75	peak	112	1.7	H
871.487	-52.45	-0.53	-52.99	-36.00	-16.99	peak	356	1.8	H
46.640	-54.72	-12.59	-67.32	-36.00	-31.32	peak	157	1.9	V
100.446	-54.98	-11.79	-66.77	-54.00	-12.77	peak	289	1.2	V
184.442	-56.16	-11.82	-67.99	-54.00	-13.99	peak	20	1.1	V
219.488	-53.60	-10.40	-64.00	-54.00	-10.00	peak	269	1.2	V
325.894	-53.33	-10.05	-63.38	-36.00	-27.38	peak	270	1.1	V
870.621	-52.14	-0.16	-52.31	-36.00	-16.31	peak	289	1.3	V

Remark:
Absolute Level = Receiver Reading + Factor
Factor = Antenna Factor + Cable Loss – Pre-amplifier

Above 1GHz

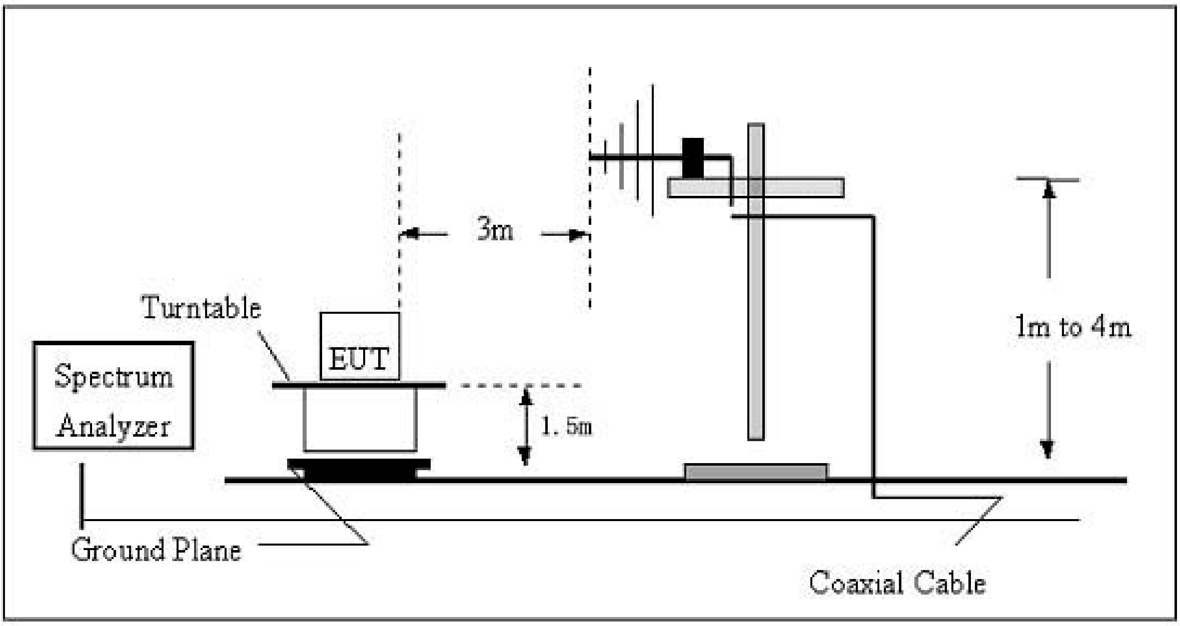
Freq (MHz)	Rd_level (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Over (dB)	detector	Height	Degree	Antenna polarization
Low Channel									
4804	-54.98	8.41	-46.57	-30.00	-16.57	peak	60	1.2	H
7206	-52.91	12.55	-40.36	-30.00	-10.36	peak	89	1.7	H
4804	-54.32	8.41	-45.91	-30.00	-15.91	peak	84	1.8	V
7206	-52.29	12.55	-39.74	-30.00	-9.74	peak	311	1.8	V
High Channel									
4960	-55.08	8.51	-46.57	-30.00	-16.57	peak	17	1.5	H
7440	-52.37	12.69	-39.68	-30.00	-9.68	peak	137	1.0	H
4960	-54.78	8.51	-46.27	-30.00	-16.27	peak	4	1.9	V
7440	-52.02	12.69	-39.33	-30.00	-9.33	peak	268	1.1	V

Remark:
Absolute Level = Receiver Reading + Factor
Factor = Antenna Factor + Cable Loss – Pre-amplifier

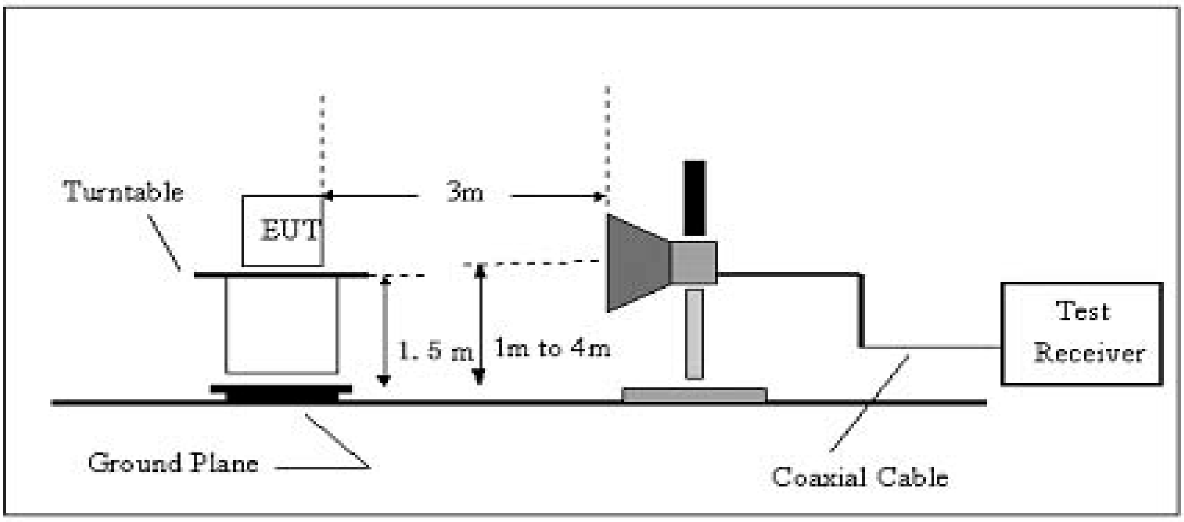
12. RECEIVER SPURIOUS EMISSIONS

13.1 Block Diagram Of Test Setup

(A) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(B) Radiated Emission Test Set-Up Frequency Above 1 GHz



13.2 Limits

Frequency(MHz)	Limit
30-1000	-57dBm
1000-12750	-47dBm

13.3 Test Procedure

30MHz ~ 1GHz:

a. The Product was placed on the nonconductive turntable 1.5m above the ground in a full anechoic chamber.

b. Set the spectrum analyzer/receiver in Peak detector, Max Hold mode, and 120 kHz RBW. Record the maximum field strength of all the pre-scan process in the full band when the antenna is varied between 1~4 m in both horizontal and vertical, and the turntable is rotated from 0 to 360 degrees.

c. For each frequency whose maximum record was higher or close to limit, measure its QP value: vary the antenna's height and rotate the turntable from 0 to 360 degrees to find the height and degree where Product radiated the maximum emission, then set the test frequency analyzer/receiver to QP Detector and specified bandwidth with Maximum Hold Mode, and record the maximum value.

Above 1GHz:

a. The Product was placed on the non-conductive turntable 1.5 m above the ground in a full anechoic chamber..

b. Set the spectrum analyzer/receiver in Peak detector, Max Hold mode, and 1MHz RBW. Record the maximum field strength of all the pre-scan process in the full band when the antenna is varied in both horizontal and vertical, and the turntable is rotated from 0 to 360 degrees.

c. For each frequency whose maximum record was higher or close to limit, measure its AV value: rotate the turntable from 0 to 360 degrees to find the degree where Product radiated the maximum emission, then set the test frequency analyzer/receiver to AV value and specified bandwidth with Maximum Hold Mode, and record the maximum value.

13.4 Test Results

Modulation : GFSK (the worst data)

Below 1GHz

Freq (MHz)	Rd_level (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Over (dB)	detector	Height	Degree	Antenna polarization
Low Channel									
44.470	-60.77	-12.52	-73.30	-57.00	-16.30	peak	167	1.2	H
68.691	-60.68	-12.51	-73.19	-57.00	-16.19	peak	30	1.2	H
105.981	-60.16	-12.02	-72.18	-57.00	-15.18	peak	280	1.3	H
217.846	-62.07	-10.42	-72.49	-57.00	-15.49	peak	283	1.4	H
327.829	-61.44	-9.73	-71.17	-57.00	-14.17	peak	108	1.6	H
871.851	-69.45	0.17	-69.28	-57.00	-12.28	peak	350	1.1	H
47.830	-60.54	-11.90	-72.44	-57.00	-15.44	peak	157	1.9	V
102.317	-61.43	-11.80	-73.24	-57.00	-16.24	peak	287	1.3	V
184.170	-62.57	-11.77	-74.34	-57.00	-17.34	peak	23	1.5	V
218.049	-61.26	-10.49	-71.75	-57.00	-14.75	peak	263	1.7	V
328.106	-59.25	-9.46	-68.72	-57.00	-11.72	peak	270	1.3	V
871.645	-69.73	-0.53	-70.26	-57.00	-13.26	peak	287	1.3	V
High Channel									
45.787	-60.64	-12.29	-72.92	-57.00	-15.92	peak	163	1.7	H
68.919	-60.50	-12.58	-73.08	-57.00	-16.08	peak	23	1.4	H
103.910	-60.70	-12.45	-73.15	-57.00	-16.15	peak	276	1.3	H
218.176	-62.06	-10.92	-72.98	-57.00	-15.98	peak	284	1.5	H
327.965	-61.71	-9.62	-71.32	-57.00	-14.32	peak	108	1.2	H
871.574	-69.17	0.13	-69.05	-57.00	-12.05	peak	348	1.2	H
48.077	-60.95	-12.52	-73.47	-57.00	-16.47	peak	151	1.0	V
102.096	-61.61	-12.49	-74.10	-57.00	-17.10	peak	295	1.9	V
182.098	-62.67	-12.36	-75.03	-57.00	-18.03	peak	26	1.0	V
217.131	-60.58	-10.88	-71.46	-57.00	-14.46	peak	267	1.1	V
326.853	-59.68	-10.23	-69.91	-57.00	-12.91	peak	271	1.0	V
869.520	-69.80	-0.45	-70.25	-57.00	-13.25	peak	281	1.1	V

Remark:
Absolute Level = Receiver Reading + Factor
Factor = Antenna Factor + Cable Loss – Pre-amplifier

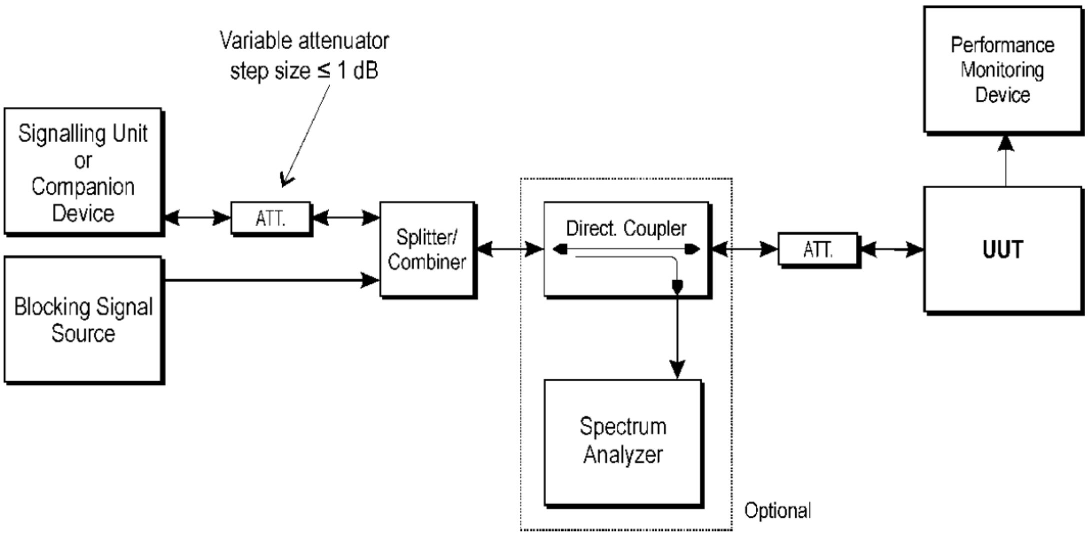
Above 1GHz

Freq (MHz)	Rd_level (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Over (dB)	detector	Height	Degree	Antenna polarization
Low Channel									
2248.44	-61.31	3.12	-58.19	-47.00	-11.19	peak	65	1.1	H
2248.76	-60.13	3.15	-56.98	-47.00	-9.98	peak	351	1.7	V
High Channel									
2443.40	-59.69	3.52	-56.17	-47.00	-9.17	peak	309	1.8	H
2443.72	-62.38	3.52	-58.86	-47.00	-11.86	peak	208	1.9	V

Remark:
Absolute Level = Receiver Reading + Factor
Factor = Antenna Factor + Cable Loss – Pre-amplifier

13. RECEIVER BLOCKING

14.1 Block Diagram Of Test Setup



14.2 Limit

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: 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: 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.			

14.3 Test procedure

Refer to ETSI EN 300 328 V2.2.2 (2019-07) Clause 5.4.11.2.

14.4 Test Result

Modulation : GFSK (the worst data)

Receiver Category 2					
GFSK Transmitting	P_{min}(dBm)	Blocking Frequency(MHz)	Blocking Power(dB)	Measured PER(%)	Limit (%)
2402	-74	2380	-57	0.40	10
2402	-74	2503.5	-57	0.48	10
2402	-74	2300	-47	0.31	10
2402	-74	2583.5	-47	0.11	10
2441	-74	2380	-57	0.26	10
2441	-74	2503.5	-57	0.31	10
2441	-74	2300	-47	0.17	10
2441	-74	2583.5	-47	0.65	10
2480	-74	2380	-57	0.57	10
2480	-74	2503.5	-57	0.53	10
2480	-74	2300	-47	0.54	10
2480	-74	2583.5	-47	0.55	10
Note:This report only shows the worst case test data.					

14. EUT PHOTOGRAPHS

Refer to Report No.CTB190902036REX for EUT external and internal photos.

15. EUT TEST SETUP PHOTOGRAPHS

Spurious emissions

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