

## RADIO TEST REPORT

For

Shenzhen Wesion Technology Co., Ltd

Edge

Test Model: Edge Max

Additional Model No.: please refer to page 7

Prepared for	:	Shenzhen Wesion Technology Co., Ltd
Address	:	A#511, Mingyou Purchasing Center, Baoyuan Rd., Xixiang St., Bao' an Dis., Shenzhen, China.
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Date of receipt of test sample	:	June 20, 2019
Number of tested samples	:	1
Serial number	:	Prototype
Date of Test	:	June 22, 2019 ~ September 11, 2019
Date of Report	:	September 21, 2019



**RADIO TEST REPORT****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

**Report Reference No. .... : LCS190618055AEB**

**Date of Issue ..... : September 21, 2019**

**Testing Laboratory Name ..... : Shenzhen LCS Compliance Testing Laboratory Ltd.**

**Address ..... : 101, 601, Xingyuan Industrial Park, Gushu Community, Xixiang Street, Bao' an District, Shenzhen, Guangdong, China**

**Testing Location/ Procedure ..... : Full application of Harmonised standards ☒**  
 Partial application of Harmonised standards ☐  
 Other standard testing method ☐

**Applicant's Name..... : Shenzhen Wesion Technology Co., Ltd**

**Address ..... : A#511, Mingyou Purchasing Center, Baoyuan Rd., Xixiang St., Bao' an Dis., Shenzhen, China.**

**Test Specification**

**Standard ..... : ETSI EN 300 328 V2.1.1 (2016-11)**

**Test Report Form No. .... : LCSEMC-1.0**

**TRF Originator..... : Shenzhen LCS Compliance Testing Laboratory Ltd.**

**Master TRF ..... : Dated 2017-06**

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**Test Item Description. .... : Edge**

**Trade Mark..... : Khadas**

**Test Model ..... : Edge Max**

**Ratings ..... : Input:100-240V, 0.7A**  
 Output:5V-3A, 9V-2.67A, 12V-2A

**Result ..... : Positive**

**Compiled by:**

Jayden Zhuo

**Supervised by:**

Aking Jin

**Approved by:**



Jayden Zhuo / Administrators

Aking Jin/ Technique principal

Gavin Liang/ Manager

**RADIO -- TEST REPORT****Test Report No. : LCS190618055AEB**September 21, 2019  
Date of issue

Test Model..... : Edge Max

EUT..... : Edge

**Applicant..... : Shenzhen Wesion Technology Co., Ltd**Address..... : A#511, Mingyou Purchasing Center, Baoyuan Rd., Xixiang St.,  
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Telephone..... : /

Fax..... : /

**Test Result****Positive**

The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

## Revision History

Revision	Issue Date	Revisions	Revised By
000	September 21, 2019	Initial Issue	Gavin Liang

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# 1. GENERAL INFORMATION

## 1.1. Product Description for Equipment Under Test (EUT)

EUT	: Edge
Test Model	: Edge Max
List Model No.	Edge Pro, Edge Basic
Model Declaration	PCB board, structure and internal of these model(s) are the same, So no additional models were tested. Input:100-240V, 0.7A
Power Supply	: Output:5V-3A, 9V-2.67A, 12V-2A
Hardware Version	: V14
Software Version	: Android 7.1
Bluetooth	:
Frequency Range	: 2402MHz ~ 2480MHz
Channel Number	: 79 channels for Bluetooth 5.0 (DSS) 40 channels for Bluetooth 5.0 (DTS) 40 channels for Bluetooth 5.0 (DTS)
Channel Spacing	: 1MHz for Bluetooth 5.0 (DSS) 2MHz for Bluetooth 5.0 (DTS) 2MHz for Bluetooth 5.0 (DTS)
Modulation Type	: GFSK, $\pi/4$ -DQPSK, 8-DPSK for Bluetooth 5.0 (DSS) GFSK for Bluetooth 5.0 (DTS) GFSK for Bluetooth 5.0 (DTS)
Bluetooth Version	: V5.0
Antenna Description	: PCB Antenna, 3.7dB (Max.)
WIFI(2.4G Band)	:
Frequency Range	: 2.412-2.472GHz
Channel Number	: 13 Channels for WIFI 20MHz Bandwidth(802.11b/g/n-HT20)
Channel Spacing	: 5MHz
Modulation Type	: IEEE 802.11b: DSSS(CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n: OFDM (64QAM, 16QAM,QPSK,BPSK)
Antenna Description	: PCB Antenna, 3.7dBi (Max.)
WIFI(5.2G Band)	:
Frequency Range	: 5180MHz-5240MHz
Channel Number	: 4 Channels for 20MHz bandwidth(5180-5240MHz) 2 channels for 40MHz bandwidth(5190~5230MHz) 1 channels for 80MHz bandwidth(5210MHz)
Modulation Type	: 802.11a/n/ac: OFDM
Antenna Description	: PCB Antenna, 3.38dBi (Max.)
SRD(5.8G Band)	:
Frequency Range	: 5745MHz-5825MHz
Channel Number	: 5 channels for 20MHz bandwidth(5745-5825MHz) 2 channels for 40MHz bandwidth(5755~5795MHz) 1 channels for 80MHz bandwidth(5775MHz)
Modulation Type	: 802.11a/n/ac: OFDM
Antenna Description	: PCB Antenna, 3.38dBi (Max.)

## 1.2. Objective

This Type approval report is prepared on behalf of **Shenzhen Wesion Technology Co., Ltd** in accordance with 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.

The objective is to determine compliance with ETSI EN 300 328 V2.1.1 (2016-11).

## 1.3. Related Submittal(s)/Grant(s)

No Related Submittals.

## 1.4. Test Methodology

All measurements contained in this report were conducted with ETSI EN 300 328 V2.1.1 (2016-11).

## 1.5. Description of Test Facility

FCC Registration Number is 254912.

Industry Canada Registration Number is 9642A-1.

EMSD Registration Number is ARCB0108.

UL Registration Number is 100571-492.

TUV SUD Registration Number is SCN1081.

TUV RH Registration Number is UA 50296516-001.

NVLAP Accreditation Code is 600167-0.

FCC Designation Number is CN5024.

CAB identifier: CN0071.

## 1.6. Support Equipment List

Manufacturer	Description	Model	Serial Number	Certificate
--	--	--	--	CE

## 1.7. External I/O

I/O Port Description	Quantity	Cable
DC IN Port	1	N/A
HDMI Port	1	N/A
Micro USB Port	1	N/A
USB Port	2	N/A

### 1.8. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

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

### 1.9. Test Environment

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	24.8
Humidity (%RH)	25-75	54.3
Barometric pressure (mbar)	860-1060	950-1000

### 1.10. Description Of Test Modes

LCS has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode
Mode 1: Transmit by DH1
Mode 2: Transmit by 2DH1
Mode 3: Transmit by 3DH1
Mode 4: Receive by DH1
Mode 5: Receive by 2DH1
Mode 6: Receive by 3DH1

Note:

- (1) For portable device, radiated spurious emission was verified over X, Y, Z Axis, and shown the worst case on this report.
- (2) Regard to the frequency band operation for systems using Wide Band modulation: the lowest, middle, highest frequency channel for conducted test, and the lowest, highest frequency channel for radiation spurious test.
- (3) The extreme test condition for voltage and temperature were declared by the manufacturer.

## **2. SYSTEM TEST CONFIGURATION**

### **2.1. Justification**

The system was configured for testing in engineering mode.

### **2.2. EUT Exercise Software**

N/A.

### **2.3. Special Accessories**

N/A.

### **2.4. Block Diagram/Schematics**

Please refer to the related document.

### **2.5. Equipment Modifications**

Shenzhen LCS Compliance Testing Laboratory Ltd. has not done any modification on the EUT.

### **2.6. Configuration of Test Setup**

Please refer to the test setup photo.

### 3. SUMMARY OF TEST RESULT

☒ No deviations from the test standards

☐ Deviations from the test standards as below description:

Technical requirements for the equipment using wide band modulations other than FHSS:

Performed Test Item	Normative References	Test Performed	Deviation
RF Output Power & Receiver Category	ETSI EN 300 328 V2.1.1 (2016-11)	Yes	No
Power Spectral Density	ETSI EN 300 328 V2.1.1 (2016-11)	Yes	No
Duty cycle, Tx-Sequence, Tx-gap	ETSI EN 300 328 V2.1.1 (2016-11)	N/A	N/A
Medium Utilisation (MU) factor	ETSI EN 300 328 V2.1.1 (2016-11)	N/A	N/A
Adaptivity	ETSI EN 300 328 V2.1.1 (2016-11)	Yes	No
Occupied Channel Bandwidth	ETSI EN 300 328 V2.1.1 (2016-11)	Yes	No
Transmitter unwanted emissions in the out-of-band domain	ETSI EN 300 328 V2.1.1 (2016-11)	Yes	No
Transmitter unwanted emissions in the spurious domain	ETSI EN 300 328 V2.1.1 (2016-11)	Yes	No
Receiver Spurious Emissions	ETSI EN 300 328 V2.1.1 (2016-11)	Yes	No
Receiver Blocking	ETSI EN 300 328 V2.1.1 (2016-11)	Yes	No

Note:

1. The EUT can operate in an adaptive mode, and can't operate in a non-adaptive mode which is stated by the supplier.
2. The EUT is equipment which using wide band modulations other than FHSS. It is an adaptive equipment which can't operate in non-adaptive mode.

## 4. RF OUTPUT POWER

### 4.1. Limit

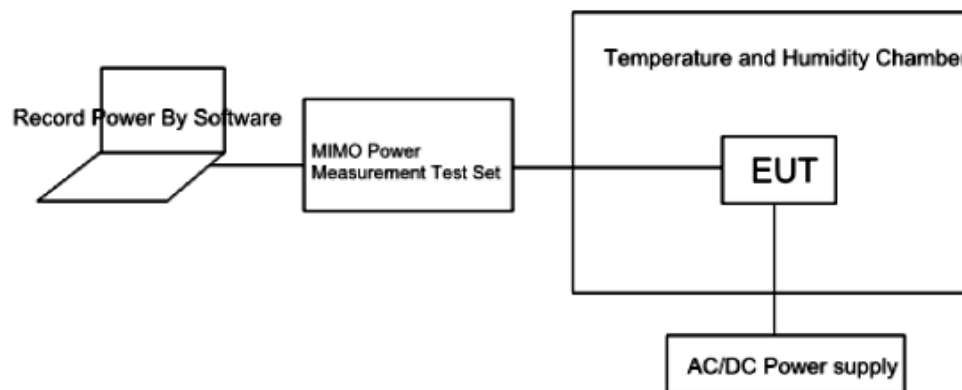
For adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be 20 dBm.

The maximum RF output power for non-adaptive equipment shall be declared by the supplier and shall not exceed 20 dBm. 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.

### 4.2. Test Setup

For Conducted Measurement



### 4.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.2

**Step 1:**

- The fast power sensor use the following setting: Sample speed 1 MS/s.

**Step 2:**

- 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.

**Step 3:**

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

**Step 4:**

- Between the start and stop times of each individual burst calculate the RMS power over the burst. Save these Pburst values, as well as the start and stop times for each burst.

**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.

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

$$P = A + G + Y$$

#### 4.4. Test Result

Please refer to the Appendix for BT RF Test Data

#### 4.5. Receiver Category

**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 10 dBm 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.

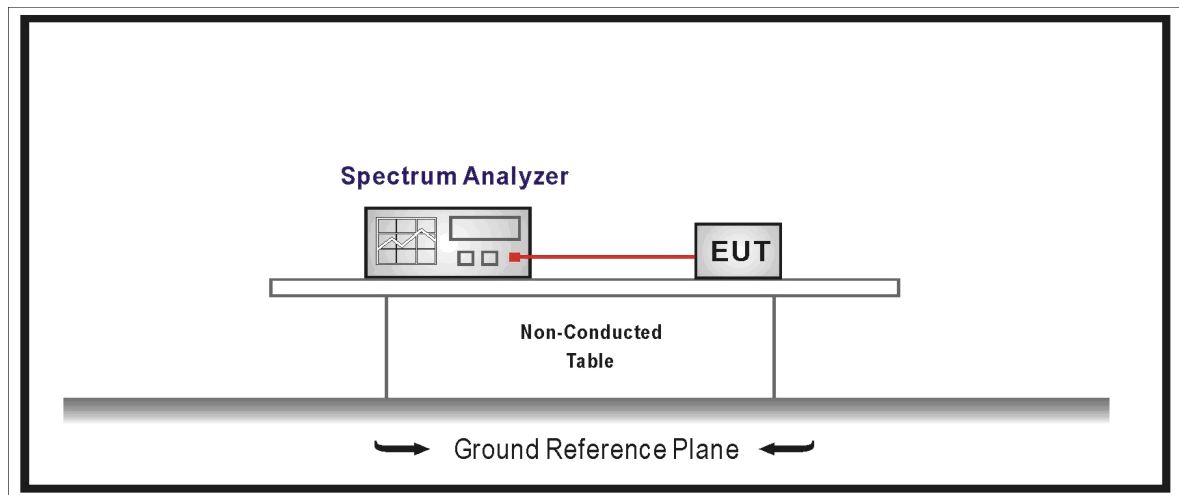
As this an adaptivity device with a maximum power of -0.86dBm, **it belongs to receiver category 2.**

## 5. DUTY CYCLE, TX-SEQUENCE, TX-GAP

### 5.1. Limit

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

### 5.2. Test Setup



### 5.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.2

### 5.4. Test Result

Please refer to the Appendix for BT RF Test Data

## 6. ACCUMULATED TRANSMIT TIME, FREQUENCY OCCUPATION AND HOPPING SEQUENCE

### 6.1. Limit

#### **For non-adaptive frequency hopping systems**

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

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

**Option 1:** Each hopping frequency of the hopping sequence shall be occupied at least once within a period not exceeding four times the product of the dwell time and the number of hopping frequencies in use.

**Option 2:** The occupation probability for each frequency shall be between  $((1 / U) \times 25 \%)$  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 15 or 15 divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.

#### **For adaptive frequency hopping systems**

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

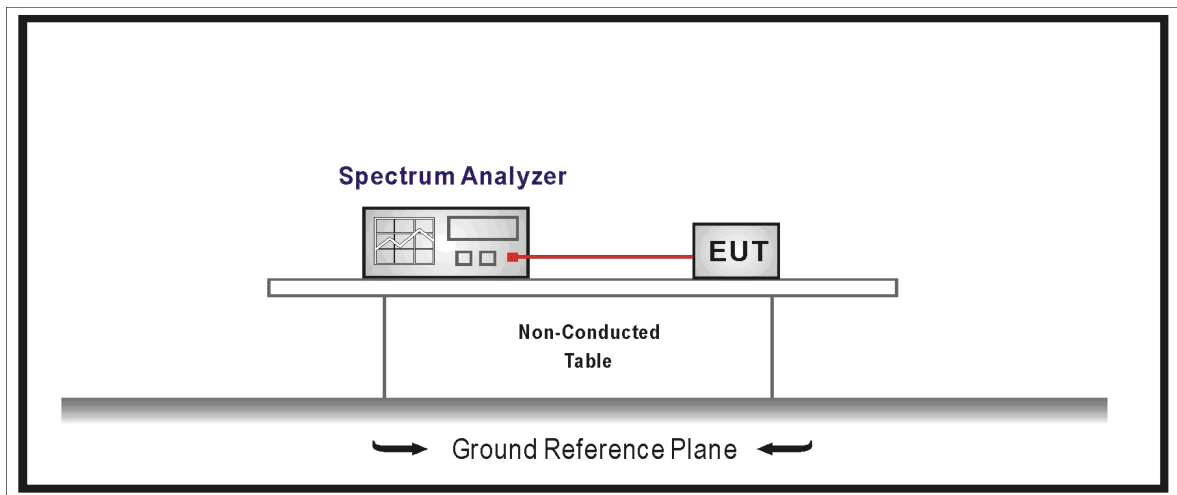
In order for the equipment to comply with the Frequency Occupation requirement, it shall meet either of the following two options:

**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  $((1 / U) \times 25 \%)$  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.

## 6.2. Test Setup



## 6.3. Test Procedure

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

### 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 (we set RBW=510KHz)
  - VBW:  $\geq$  RBW (we set RBW=1500KHz)
  - Detector Mode: RMS
  - Sweep time: Equal to the applicable observation period ( we set  $400\text{ms} \times 79 = 31600\text{ms}$ )
  - 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:**

- Make the following changes on the analyzer and repeat steps 2 and 3.

Sweep time:  $4 \times \text{Dwell Time} \times \text{Actual number of hopping frequencies in use}$

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 hop) (we set RBW=510KHz)

- VBW:  $\geq$  RBW (we set RBW=1500KHz)

- Detector Mode: RMS

- Sweep time: 1s

- 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 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.

**6.4. Test Result**

**Please refer to the Appendix for BT RF Test Data**

## 7. HOPPING FREQUENCY SEPARATION

### 7.1. Limit

#### For non-adaptive equipment

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

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

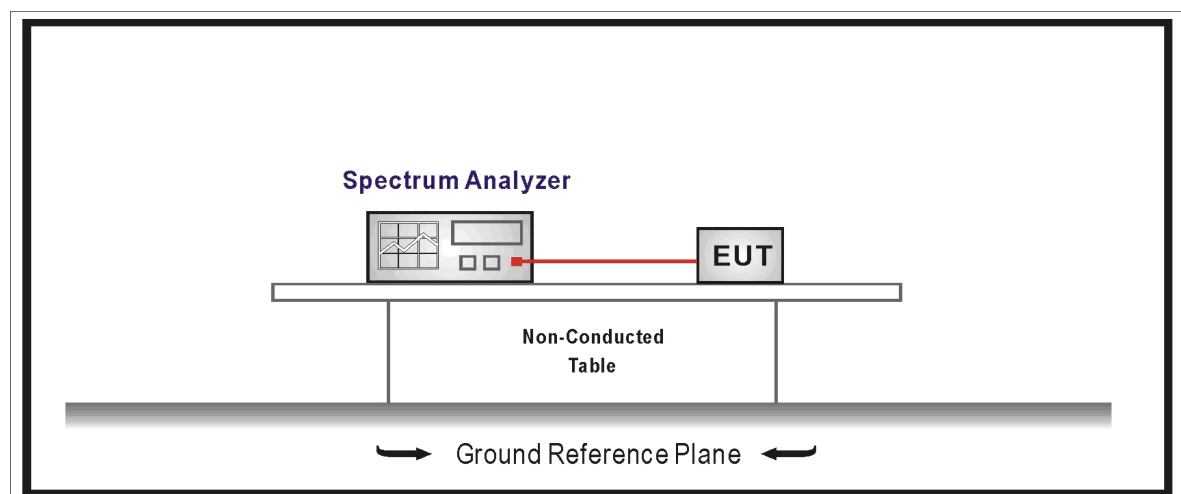
#### For adaptive equipment

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

Adaptive Frequency Hopping equipment, which for one or more hopping frequencies, has switched to a non-adaptive mode because interference was detected on all these hopping positions with a level above the threshold level defined in clause 4.3.1.7.2.2 or clause 4.3.1.7.3.2, is allowed to continue to operate with a minimum Hopping Frequency Separation of 100 kHz on these hopping frequencies as long as the interference is present on these 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 in clause 4.3.1.5.3.1 for these hopping frequencies as well as with all other requirements applicable to non-adaptive frequency hopping equipment.

### 7.2. Test Setup



### 7.3. Test Procedure

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

The analyzer was setting as follow:

- 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 (we set RBW=20KHz)
- VBW:  $3 \times \text{RBW}$  (we set VBW=60KHz)
- Detector Mode: RMS
- Trace Mode: Max Hold
- Sweep time: 1s

### 7.4. Test Result

**Please refer to the Appendix for BT RF Test Data**

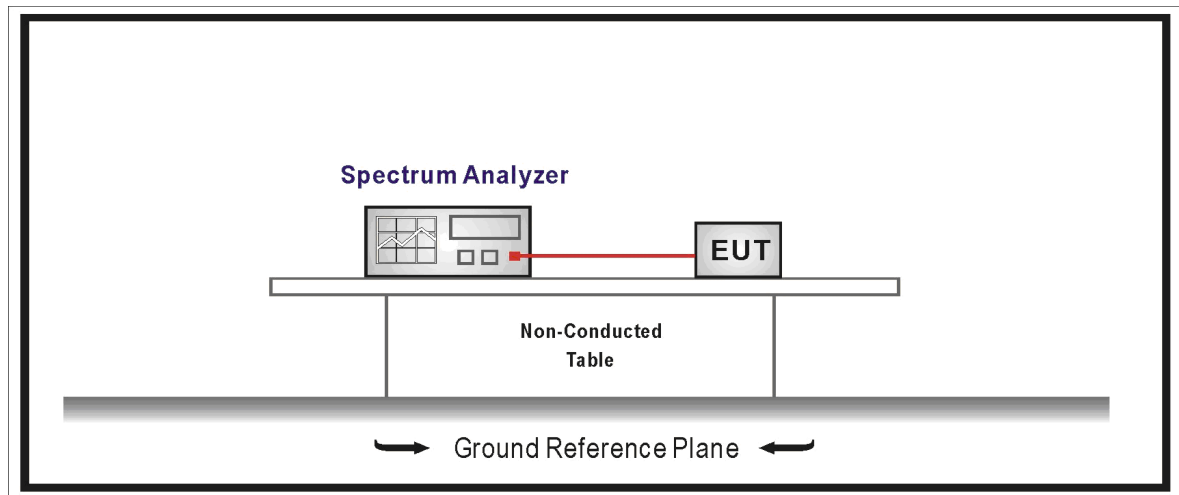
## 8. MEDIUM UTILISATION (MU) FACTOR

### 8.1. Limit

#### For non-adaptive equipment

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

### 8.2. Test Setup



### 8.3. Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.2

### 8.4. Test Result

This requirement does not apply to adaptive equipment unless operating in a non-adaptive mode.

In addition, this requirement does not apply for equipment with a maximum declared RF Output power level of less than 10dBm E.I.R.P. or for equipment when operating in a mode where the RF Output power is less than 10dBm E.I.R.P.

No applicable.

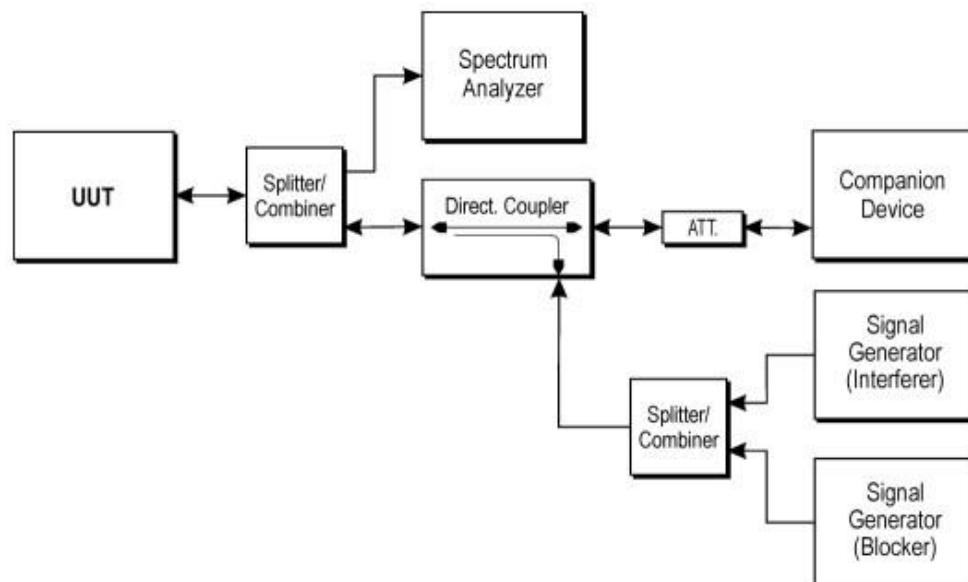
## 9. ADAPTIVITY (ADAPTIVE FREQUENCY HOPPING)

### 9.1. Limit

Adaptivity Limit	
<input type="checkbox"/> LBT based Detect and Avoid	<p>--- The CCA observation time shall be not less than 0,2 % of the Channel Occupancy Time with a minimum of 18 <math>\mu</math>s;</p> <p>--- COT <math>\leq</math> 60 ms;</p> <p>--- Idle Period = 5% of COT with a minimum of 100 <math>\mu</math>s;</p> <p>--- Detection threshold level = <math>-70 \text{ dBm/MHz} + (20 \text{ dBm} - P_{\text{out e.i.r.p}})/1 \text{ MHz}</math> (<math>P_{\text{out}}</math> in dBm)</p>
<input checked="" type="checkbox"/> Non-LBT based Detect and Avoid	<p>--- The 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 longest.</p> <p>--- COT <math>\leq</math> 40 ms;</p> <p>--- For equipment using a dwell time <math>&gt; 40</math> ms that want 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 <math>\mu</math>s shall be implemented.</p> <p>--- Detection threshold level = <math>-70 \text{ dBm/MHz} + (20 \text{ dBm} - P_{\text{out e.i.r.p}})/1 \text{ MHz}</math> (<math>P_{\text{out}}</math> in dBm)</p>
<input type="checkbox"/> Short Control Signalling Transmissions:	<p>--- Short Control Signalling 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 the shorter.</p>

### 9.2. Test Setup

Conducted measurements



### 9.3. Test Procedure

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

### 9.4. Test Result

This requirement does not apply to non-adaptive equipment or adaptive equipment operating in a non-adaptive mode providing the equipment complies with the requirements and/or restrictions applicable to non-adaptive equipment.

In addition, this requirement does not apply for equipment with a maximum declared RF Output power level of less than 10dBm E.I.R.P. or for equipment when operating in a mode where the RF Output power is less than 10dBm E.I.R.P.

No applicable.

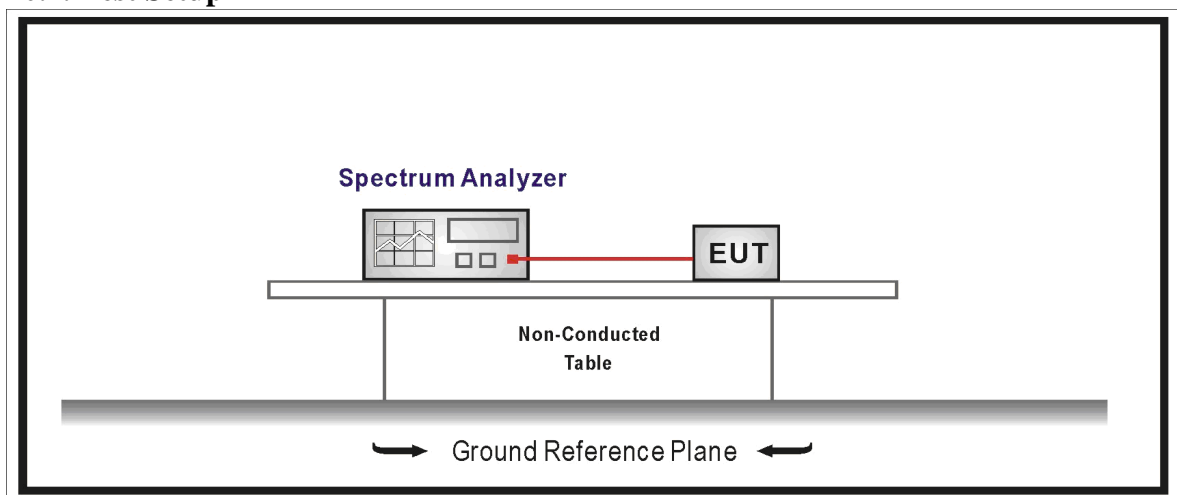
## 10. OCCUPIED CHANNEL BANDWIDTH

### 10.1. Limit

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

For non-adaptive Frequency Hopping equipment with E.I.R.P greater than 10dBm, the Occupied Channel Bandwidth for every occupied hopping frequency shall be equal to or less than the value declared by the supplier. This declared value shall not be greater than 5 MHz.

### 10.2. Test Setup



### 10.3. Test Procedure

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

#### 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:  $\sim 1\%$  of the span without going below  $1\%$  (We set RBW=20KHz)
- Video BW:  $3 \times \text{RBW}$  (We set VBW=60KHz)
- Frequency Span:  $2 \times \text{Occupied Channel Bandwidth}$  (We set Span=2MHz)
- Detector Mode: RMS
- Trace Mode: Max Hold

#### Step 2:

Wait until the trace is completed. 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.

### 10.4. Test Result

**Please refer to the Appendix for BT RF Test Data**

## 11. TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

### 11.1. Limit

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

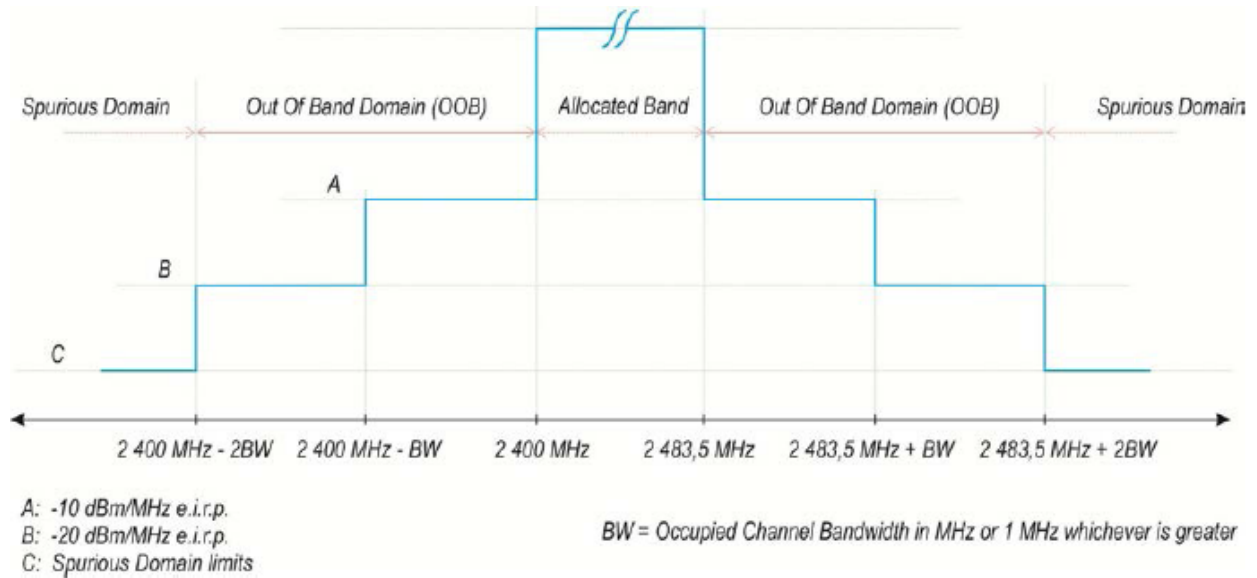
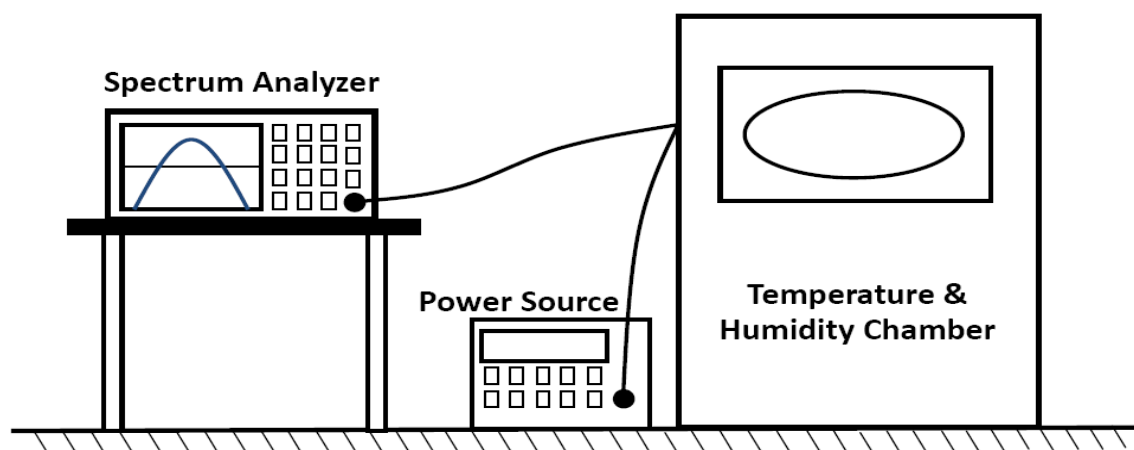


Figure 1: Transmit mask

### 11.2. Test Setup

For Conducted Measurement



### 11.3. Test Procedure

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

#### 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: Clear / Write
- Sweep Mode: Continuous
- Sweep Points: Sweep Time [s] / (1  $\mu$ s) 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.

#### 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 - 2BW + 0,5 MHz.

**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.

**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 figures 1 or 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 figures 1 or 3.
  - Option 2: the limits provided by the mask given in figures 1 or 3 shall be reduced by  $10 \times \log_{10}(A_{ch})$  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:  $A_{ch}$  refers to the number of active transmit chains.

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

**11.4. Test Result**

**Please refer to the Appendix for BT RF Test Data**

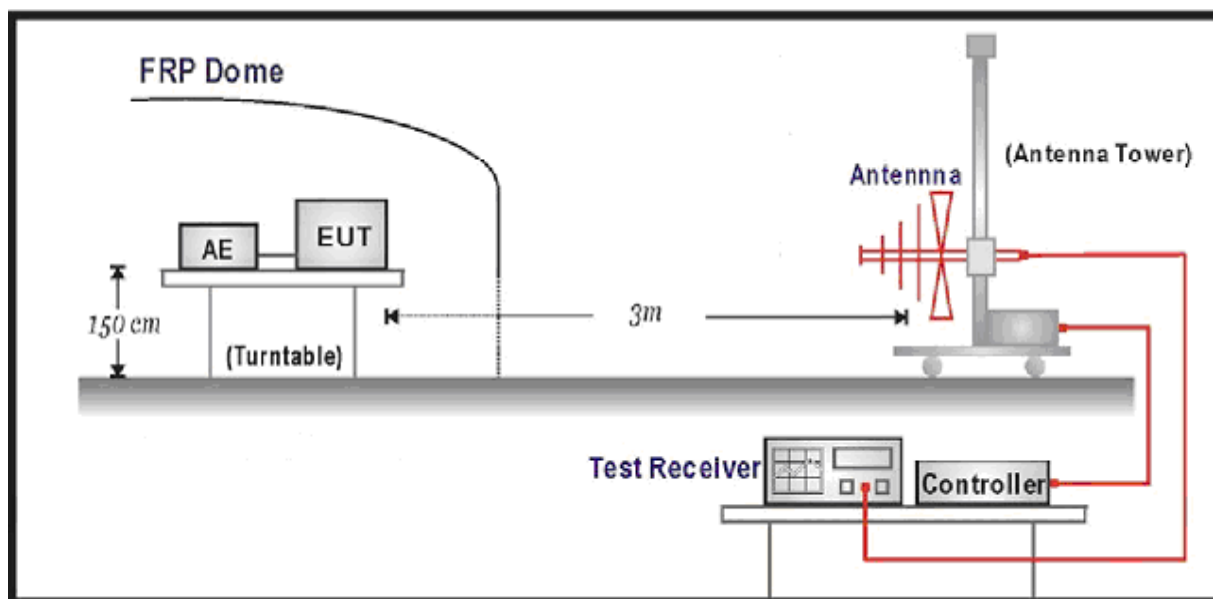
## 12. TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

### 12.1. Limit

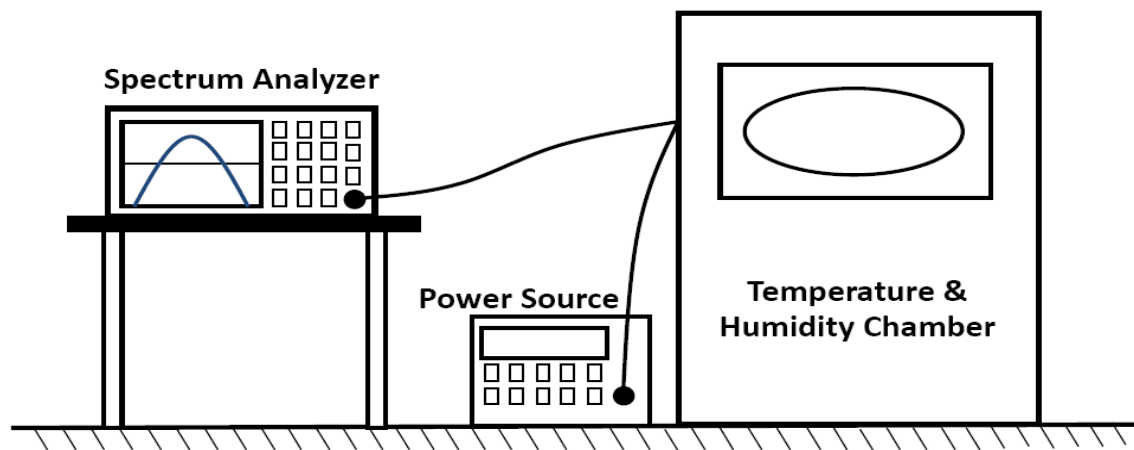
Transmitter Limits for Spurious Emissions		
Frequency Range	Maximum power E.R.P. ( $\leq 1\text{GHz}$ ) E.I.R.P. ( $> 1\text{GHz}$ )	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87,5 MHz	-36 dBm	100 kHz
87,5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 862 MHz	-54 dBm	100 kHz
862 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz

### 12.2. Test Setup

For Radiated Measurement



For Conducted Measurement



### 12.3. Test Procedure

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

#### 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 tables 1 or 4.

#### 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
- Detector mode: Peak
- Trace Mode: Max Hold
- Sweep Points:  $\geq 19400$

NOTE 1: For spectrum analysers not supporting this high number of sweep points, the frequency band may need to be segmented.

- Sweep time: For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 100 kHz frequency step, the measurement time is greater than two transmissions of the UUT. For Frequency Hopping equipment operating in a normal operating (hopping not disabled) mode, the sweep time shall be further increased to capture multiple transmissions on the same hopping frequency in different hopping sequences. Allow 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 5.3.10.2.1.3 and compared to the limits given in tables 1 or 4.

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

- Sweep Points:  $\geq 23500$

NOTE 2: For spectrum analysers not supporting this high number of sweep points, the frequency band may need to be segmented.

- Sweep time: For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 1 MHz frequency step, the measurement time is greater than two transmissions of the UUT.

#### **12.4. Test Result**

**Please refer to the Appendix for BT RF Test Data**

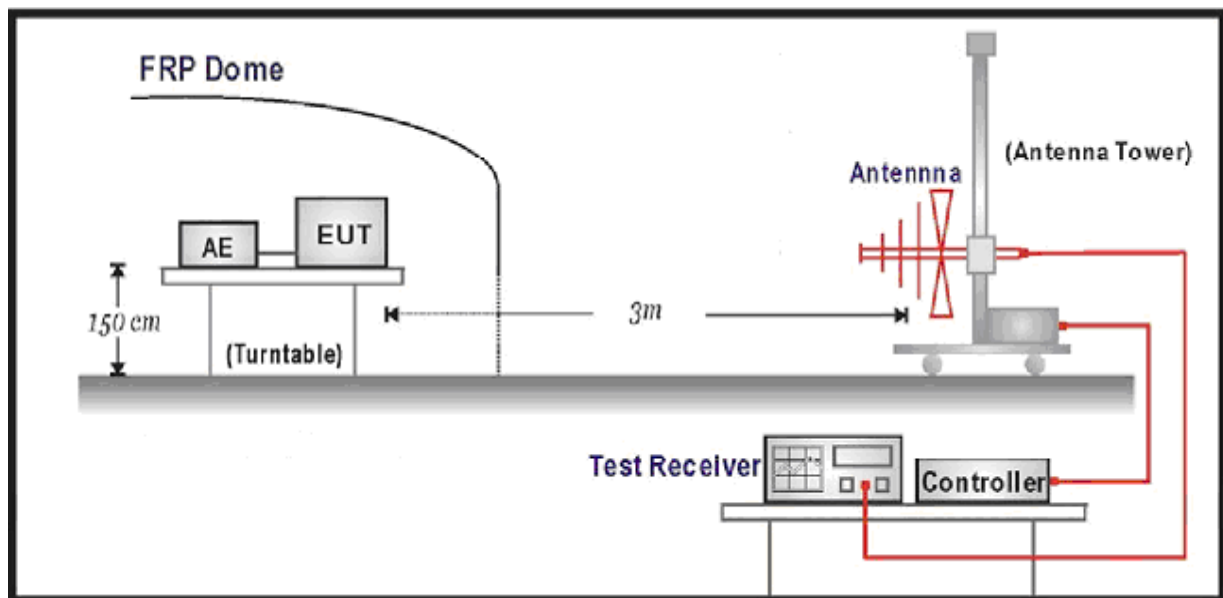
## 13. RECEIVER SPURIOUS EMISSIONS

### 13.1. Limit

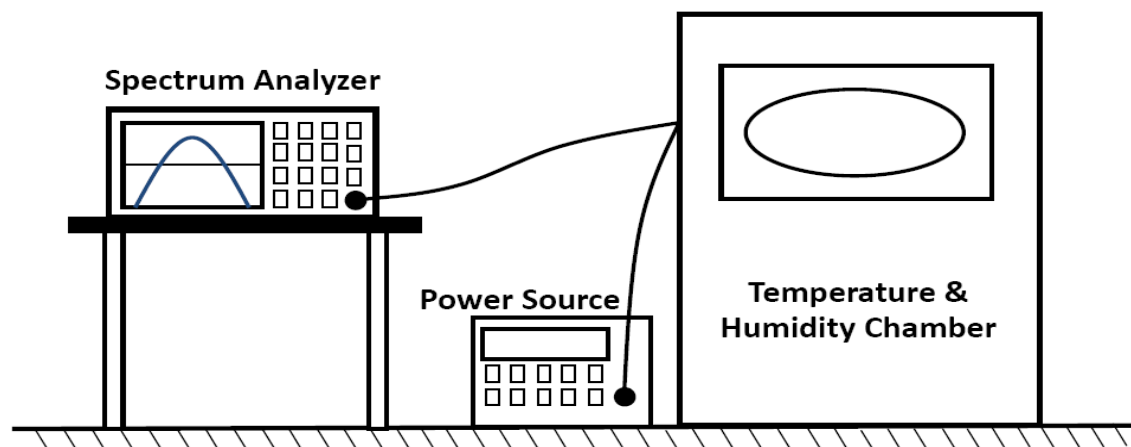
Spurious emissions limits for receivers		
Frequency Range	Maximum power E.R.P. ( $\leq 1\text{GHz}$ ) E.I.R.P. ( $> 1\text{GHz}$ )	Measurement bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12.75 GHz	-47 dBm	1 MHz

### 13.2. Test Setup

For Radiated Measurement



For Conducted Measurement



### 13.3. Test Procedure

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

#### 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 tables 2 or 5.

#### 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
- Detector mode: Peak
- Trace Mode: Max Hold
- Sweep Points:  $\geq 19400$
- Sweep time: Auto

Allow 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 5.3.11.2.1.3 and compared to the limits given in tables 2 or 5.

#### 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
- Detector mode: Peak
- Trace Mode: Max Hold
- Sweep Points:  $\geq 23500$
- Sweep time: Auto

Allow 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 5.3.11.2.1.3 and compared to the limits given in tables 2 or 5. 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 5.3.11.2.1.3.

#### Step 4:

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

### 13.4. Test Result

**Please refer to the Appendix for BT RF Test Data**

## 14. RECEIVER BLOCKING

### 14.1. Limit

Adaptive Frequency Hopping equipment shall comply with the requirements defined in clause 4.3.1.12.4

**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
$P_{\min} + 6 \text{ dB}$	2 380 2 503,5	-53	CW
$P_{\min} + 6 \text{ dB}$	2 300 2 330 2 360	-47	CW
$P_{\min} + 6 \text{ dB}$	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**

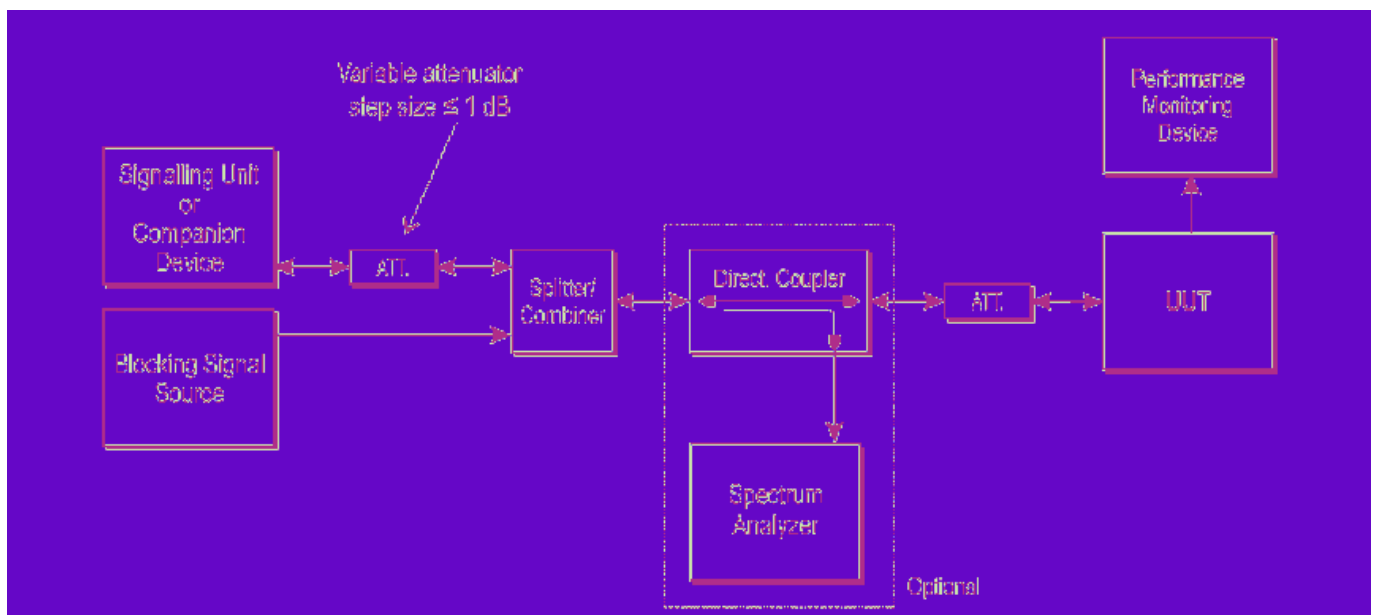
Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
$P_{\min} + 6 \text{ dB}$	2 380 2 503,5	-57	CW
$P_{\min} + 6 \text{ dB}$	2 300 2 583,5	-47	CW
NOTE 1: $P_{\min}$ is the minimum level of the wanted signal (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
$P_{\min} + 12 \text{ dB}$	2 380 2 503,5	-57	CW
$P_{\min} + 12 \text{ dB}$	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.			

## 14.2. Test Setup

Conducted measurements



## 14.3. Test Procedure

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 (Pmin) 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.

#### **14.4. Test Result**

**Please refer to the Appendix for BT RF Test Data**

## 15. LIST OF MEASURING EQUIPMENT

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	X-series USB Peak and Average Power Sensor Agilent	Agilent	U2021XA	MY54080022	2018-10-25	2019-10-24
2	4 CH. Simultaneous Sampling 14 Bits 2MS/s	Agilent	U2531A	MY54080016	2018-10-25	2019-10-24
3	Test Software	Ascentest	AT890-SW	20160630	N/A	N/A
4	RF Control Unit	Ascentest	AT890-RFB	N/A	2019-06-11	2020-06-10
5	MXA Signal Analyzer	Agilent	N9020A	MY49061051	2019-06-11	2020-06-10
6	DC Power Supply	Agilent	E3642A	N/A	2018-11-15	2019-11-14
7	MXG Vector Signal Generator	Agilent	N5182A	MY47071151	2019-06-11	2020-06-10
8	ESG Vector Signal Generator	Agilent	E4438C	MY49072627	2019-06-11	2020-06-10
9	PSG Analog Signal Generator	Agilent	E8257D	MY4520521	2019-06-11	2020-06-10
10	Temperature & Humidity Chamber	GUANGZHOU GOGNWN	GDS-100	70932	2018-10-10	2019-10-09
11	EMI Test Software	AUDIX	E3	/	N/A	N/A
12	3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	2019-06-12	2020-06-11
13	Positioning Controller	MF	MF-7082	/	2019-06-12	2020-06-11
14	Active Loop Antenna	SCHWARZBEC K	FMZB 1519B	00005	2019-07-25	2020-07-24
15	By-log Antenna	SCHWARZBEC K	VULB9163	9163-470	2019-07-25	2020-07-24
16	Horn Antenna	SCHWARZBEC K	BBHA 9120D	9120D-1925	2019-07-01	2020-06-30
17	Broadband Horn Antenna	SCHWARZBEC K	BBHA 9170	791	2018-09-20	2019-09-19
18	Broadband Preamplifier	SCHWARZBEC K	BBV 9719	9719-025	2018-09-20	2019-09-19
19	EMI Test Receiver	R&S	ESR 7	101181	2019-06-12	2020-06-11
20	RS SPECTRUM ANALYZER	R&S	FSP40	100503	2018-11-15	2019-11-14
21	AMPLIFIER	QuieTek	QTK	CHM/0809065	2018-11-15	2019-11-14
22	RF Cable-R03m	Jye Bao	RG142	CB021	2019-06-12	2020-06-11
23	RF Cable-HIGH	SUHNER	SUCOFLEX 106	03CH03-HY	2019-06-12	2020-06-11
24	WIDEBAND RADIO COMMUNICATION TESTER	R&S	CMW 500	103818	2019-06-11	2020-06-10
25	6dB Attenuator	/	100W/6dB	1172040	2019-06-11	2020-06-10
26	3dB Attenuator	/	2N-3dB	/	2019-06-11	2020-06-10

Note: All equipment is calibrated through CHINA CEPREI LABORATORY and GUANGZHOU LISAI CALIBRATION AND TEST CO., LTD.

## **16. PHOTOGRAPHS OF TEST SETUP**

Please refer to separated files Appendix A for Photographs of Test Setup.

## **17. EUT EXTERIOR AND INTERIOR PHOTOGRAPHS**

Please refer to separated files Appendix B for Photographs of The EUT.

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