



RADIO TEST REPORT

For

Meteca SA

MBC-WB

Model Number : MBC-WB01

Prepared for : Meteca SA

Via alla Torre 2, 6850 Mendrisio ,Switzerland

Prepared By : Shenzhen STL Testing Technology Co., Ltd.

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TEST REPORT DECLARATION

Applicant	Meteca SA
Address	Via alla Torre 2, 6850 Mendrisio ,Switzerland
Manufacturer	Meteca SA
Address	Via alla Torre 2, 6850 Mendrisio ,Switzerland
EUT Description	MBC-WB
Model Number	MBC-WB01

Test Standards:

ETSI EN 300 328 V2.2.0 (2017-11)

The EUT described above is tested by Shenzhen STL Testing Technology Co., Ltd. EMC Laboratory to determine the maximum emissions from the EUT and ensure the EUT to be compliance with the immunity requirements of the EUT. Shenzhen STL Testing Technology Co., Ltd. Laboratory is assumed full responsibility for the accuracy of the test results. Also, this report shows that the EUT technically complies with the 2014/53/EU directive and its amendment requirements.

The test report is valid for above tested sample only and shall not be reproduced in part without written approval of the laboratory.

Date of Test:

Mar.28-Apr.28 .2019

Prepared by:

Eris

Project Engineer

Reviewed by:

Lewis

Project Engineer

Approved by:



Technical Director

1. TEST STANDARDS

The tests were performed according to following standards:

Draft ETSI EN 300 328 V2.2.0 (2017-11) –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



2. SUMMARY

2.1. General Remarks

Date of receipt of test sample	:	2019/03/28
Testing commenced on	:	2019/04/08
Testing concluded on	:	2019/04/28

2.2. Product Description

Name of EUT	MBC-WB
Model(s) Number	MBC-WB01
List Models	MBC-WB01-0001
Difference description	All model's the function, software and electric circuit are the same, only with a product color and model named different. Test sample model: MBC-WB01.
Hardware version	V2.0
Software version	V2.0
Antenna Type	PCB Antenna

2.3. Equipment Under Test

Power supply system utilised

Power supply voltage	:	<input type="radio"/> 230V/ 50 Hz	<input type="radio"/> 120V/60Hz
		<input type="radio"/> 12 V DC	<input type="radio"/> 24 V DC
		<input checked="" type="radio"/> Other (specified in blank below)	

DC 3.3V From Adapter

Description of the test mode

Bluetooth 4.2 used 40 channels and channel separation was 2MHz.

Channel	Frequency(MHz)	Channel	Frequency(MHz)
00	2402	20	2442
01	2404	21	2444
02	2406	22	2446
03	2408	23	2448
04	2410	24	2450
05	2412	25	2452
06	2414	26	2454
07	2416	27	2456
08	2418	28	2458
09	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	2440	39	2480

Type	Test Frequency					
	Lowest		Middle		Highest	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
BLE	00	2402	19	2440	39	2480

2.4. Description of the Equipment under Test (EUT)

Reference documents:	Bluetooth® Core Specification
Special test descriptions:	None
Configuration descriptions:	TX tests: were performed with x-DH5 packets and static PRBS pattern payload. RX/Standby tests: BT test mode enabled, scan enabled, TX Idle
Test mode:	<input type="checkbox"/> Bluetooth Test mode loop back enabled (EUT is controlled over CBT/CMU) <input checked="" type="checkbox"/> Special software is used. EUT is transmitting pseudo random data by itself
Bluetooth capabilities:	standard 40 channels channel separation 2 MHz used freq. range 2402-2480 MHz Modulation types: GFSK Bandwidth appr. 2MHz for single

2.5. EUT Classification:

Type of equipment:	<input checked="" type="checkbox"/>	stand alone equipment
	<input type="checkbox"/>	plug in radio equipment
	<input type="checkbox"/>	combined equipment
Modulation types:	<input checked="" type="checkbox"/>	Wide Band Modulation (None Hopping – e.g. DSSS, OFDM)
	<input type="checkbox"/>	Frequency Hopping Spread Spectrum (FHSS)
Adaptive equipment:	<input checked="" type="checkbox"/>	Yes, LBT-based
	<input type="checkbox"/>	Yes, non-LBT-based
	<input type="checkbox"/>	Yes (but can be disabled)

Antennas and transmit operating modes:	<input type="checkbox"/>	No
	<input type="checkbox"/>	COT value
	<input checked="" type="checkbox"/>	CCA value(18μs)
	<input type="checkbox"/>	Operating mode 1 (single antenna) Equipment with 1 antenna, Equipment with 2 diversity antennas operating in switched diversity mode by which at any moment in time only 1 antenna is used, Smart antenna system with 2 or more transmit/receive chains, but operating in a mode where only 1 transmit/receive chain is used)
	<input checked="" type="checkbox"/>	Operating mode 2 (multiple antennas, no beamforming) Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously but without beamforming.
	<input type="checkbox"/>	Operating mode 3 (multiple antennas, with beamforming) Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously with beamforming. In addition to the antenna assembly gain (G), the beamforming gain (Y) may have to be taken into account when performing the measurements.

2.6. EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

● - supplied by the manufacturer

○ - supplied by the lab

○	Power Cable	Length (m) :	/
		Shield :	/
		Detachable :	/

● Adapter information
N/A

2.7. Modifications

No modifications were implemented to meet testing criteria.

3. TEST ENVIRONMENT

3.1. Address of the test laboratory

1F, B2 Building, Junfeng Zhongcheng Zhizao Innovation Park,
Heping Community, Fuhai Street, Bao'an District, Shenzhen, China

3.2. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Normal Temperature: 15°C~35°C
High Temperature: 40°C
Low Temperature: -10°C
Normal Voltage: DC 3.3V
High Voltage: DC 3.6V
Low Voltage: DC 3.0V
Relative Humidity: 55 %
Air Pressure: 989 hPa

3.3. Test Description

3.4.1 Main Terms

Verdict	Verdict of each test cases.
Test Case	Test cases identification number and description in ETSI specification.

3.4.2 Terms used in Condition column

NTC Normal voltage, Normal Temperature
HTHV High voltage, High Temperature
LTHV High voltage, Low Temperature
HTLV Low voltage, High Temperature
LTLV Low voltage, Low Temperature

3.4.3 Terms used in Verdict column

Pass	This test cases has been tested, and EUT is conformant to the applied standards in the given frequency band.
Fail	This test cases has been tested, but EUT is not conformant to the applied standards in the given frequency band.
N/A	This test case is either not required/not applicable in the specified band or is not applicable according to the specific PICS/PIXIT for the EUT.
Inc	Test case result is ambiguous in the given frequency band.
Decl	Declaration is received from the client to demonstrate the conformity to the relevant specification in the given frequency band.
BR	This test cases is not tested in the given frequency band, but this testcases was tested with pass result for the initial model in the given frequency band.

3.4.4 Summary of measurement results



No deviations from the technical specifications were ascertained



There were deviations from the technical specifications ascertained

Test Specification Clause	Test Case	Test Condition	Mode	Pass	Fail	N/A	NP	Remark
5.4.2	RF output power	NTC	GFSK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		LT		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		HT		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5.4.2	Duty Cycle, Tx-sequence, Tx-gap	NTC	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
5.4.4	Dwell time, min Freq. Occupation and Hopping sequence	NTC	GFSK	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
5.4.5	Hopping Separation	NTC	GFSK	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
5.4.2	Medium Utilisation	NTC	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
5.4.3	Power Spectral Density	NTC	GFSK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5.4.6	Adaptivity, Short Control Signalling Transmissions	NTC	GFSK	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
5.4.7	Occupied Channel Bandwidth	NTC	GFSK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5.4.8	Transmitter unwanted emissions in the out-of-band domain	NTC	GFSK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		LT		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		HT		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
5.4.9	Transmitter unwanted emissions in the spurious domain (conducted & radiated)	NTC	GFSK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5.4.10	Receiver spurious emissions (conducted & radiated)	NTC	GFSK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5.4.11	Receiver Blocking	NTC	----	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Remark: The measurement uncertainty is not included in the test result.

3.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to ETSI TR 100 028-1 [1], ETSI TS 103 051 [2] and ETSI TS 103 052 [3] and shall correspond to an expansion factor (coverage factor) $k = 1,96$ or $k = 2$ (which provide confidence levels of respectively 95 % and 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)), and is documented in the quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device

No.	Item	Uncertainty
1	Occupied Channel Bandwidth	$\pm 3.6\text{dB}$
2	RF power, conducted	$\pm 0.16\text{dB}$
3	Power Spectral Density, conducted	$\pm 1.3\text{dB}$
4	Unwanted Emissions, conducted	$\pm 1.3\text{dB}$
5	All emissions, radiated	$\pm 4.7\text{dB}$
6	Temperature	$\pm 0.5^\circ\text{C}$
7	Humidity	$\pm 2\%$
8	DC and low frequency voltages	$\pm 1.5\%$
9	Time	$\pm 1.0\%$
10	Duty Cycle	$\pm 3.0\%$

3.5. Equipment Used during the Test

RF output power & PSD & OOB & OBW & Hoping & Duty Cycle, Tx-sequence, Tx-gap & Adaptively&Blocking						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
1	Spectrum analyzer	Agilent	N9020A	HKE-048	2018/12/27	2019/12/26
2	Signal generator	Agilent	83630A	HKE-028	2018/12/27	2019/12/26
3	Signal generator	Agilent	N5182A	HKE-029	2018/12/27	2019/12/26
4	RF automatic control unit	Tonscend	JS0806-2	HKE-060	2018/12/27	2019/12/26
5	Power meter	Agilent	E4419B	HKE-085	2018/12/27	2019/12/26

Transmitter spurious emissions & Receiver spurious emissions						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
1	Broadband antenna	Schwarzbeck	VULB 9163	HKE-012	2018/12/27	2019/12/26
2	Horn antenna	Schwarzbeck	9120D	HKE-013	2018/12/27	2019/12/26
3	Receiver	R&S	ESCI 7	HKE-010	2018/12/27	2019/12/26
4	Position controller	Taiwan MF	MF7802	HKE-011	2018/12/27	2019/12/26
5	Preamplifier	EMCI	EMC05184 5SE	HKE-015	2018/12/27	2019/12/26
6	Preamplifier	Agilent	83051A	HKE-016	2018/12/27	2019/12/26
7	High pass filter unit	Tonscend	JS0806-F	HKE-055	2018/12/27	2019/12/26
8	Spectrum analyzer	Agilent	N9020A	HKE-048	2018/12/27	2019/12/26

The calibration interval is 1 year.

4. TEST CONDITIONS AND RESULTS

4.1. ETSI EN 300 328 REQUIREMENTS

4.1.1. RF Output Power

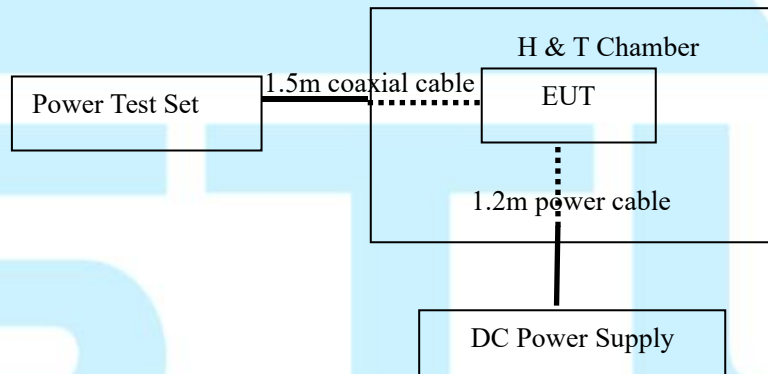
LIMIT

ETSI EN 300 328 (V2.2.0) §4.3.2.2.2,

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.

TEST CONFIGURATION



TEST PROCEDURE

According to Draft ETSI EN 300 328 V2.2.0 (2017-11) §5.4.2.2.1.1, conducted method.

EUT DESCRIPTION:

Mode:	BT Test mode
Test Channel	Channel 00(2402MHz),Channel 19(2440MHz),Channel 39(2480MHz)
Packet Type:	Longest supported
Modulation:	GFSK

MEASUREMENT DESCRIPTION

Instrument:	Power Meter measuring burst Power(EMS) of a least 10 packets	
Performed:	<input checked="" type="checkbox"/>	Conducted
	<input type="checkbox"/>	Radiated (only if no conducted sample is provided)

TEST RESULTS

Test environmental		Maximum conducted Burst Power in 15 measured Bursts (RMS) [dBm]		
Test Mode	Test Condition	Antenna Measured Power (dBm)	EIRP(dBm)	Limit(dBm)
00	NTC	1.85	1.85	20
	LT/NV	0.74	0.74	20
	HT/NV	1.64	1.64	20
19	NTC	0.28	0.28	20
	LT/NV	0.41	0.41	20
	HT/NV	0.27	0.27	20
39	NTC	0.53	0.53	20
	LT/NV	0.83	0.83	20
	HT/NV	0.15	0.15	20
Result		Pass		

Note :Cable loss and antenna gain was combined in the calculated result.

4.1.2. Duty Cycle, TX-sequence, TX-gap

LIMIT

Draft ETSI EN 300 328 V2.2.0 (2017-11) Sub-clause 4.3.1.3

The Duty Cycle shall be equal to or less than the maximum value declared by the supplier.

The maximum Tx-sequence Time and the minimum Tx-gap Time shall be according to the formula below:

$$\text{Maximum Tx-Sequence Time} = \text{Minimum Tx-gap Time} = M$$

where M is in the range of 3,5 ms to 10 ms.

Duty Cycle is defined as the ratio of the total transmitter 'on'-time to a 1 second observation period.

Tx-sequence is defined as a period in time during which a single or multiple transmissions may occur and which shall be followed by a Tx-gap.

Tx-gap is defined as a period in time during which no transmissions occur.

NOTE: The maximum Duty Cycle at which the equipment can operate, is declared by the supplier.

These requirements apply to non-adaptive equipment or to adaptive equipment when operating in a non-adaptive mode. The equipment is using wide band modulations other than FHSS.

These requirements do not apply for equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p.

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 they do not have to comply with the requirements for Duty Cycle, Tx-sequence and Tx-gap.

TEST PROCEDURE

Please refer to ETSI EN 300 328 (V2.2.0) Sub-clause 5.4.2.2.1.3

For equipment using FHSS modulation, the measurements shall be performed during normal operation (hopping) and the equipment is assumed to have no blacklisted frequencies (operating on all hopping positions). These requirements apply to non-adaptive frequency hopping equipment or to adaptive frequency hopping equipment operating in a non-adaptive mode, and only to be performed at normal environmental conditions, shall be as follows:

Step 1:

- Use the same stored measurement samples from the procedure described in clause 5.4.2.2.1.2.
- 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 case of insufficient dynamic range, the value of 30 dB may need to be reduced appropriately.

Step 2:

- Between the saved start and stop times of each individual burst, calculate the TxOn time. Save these TxOn values.

Step 3:

- Duty Cycle (DC) is the sum of all TxOn times between the end of the first gap (which is the start of the first burst within the observation period) and the start of the last burst (within this observation period) divided by the observation period. The observation period is defined in clause 4.3.1.3.2 or clause 4.3.2.4.2.

Step 4:

- For equipment using blacklisting, the TxOn time measured for a single (and active) hopping frequency shall be multiplied by the number of blacklisted frequencies. This value shall be added to the sum calculated in step 3 above. If the number of blacklisted frequencies cannot be determined, the minimum number of hopping frequencies (N) as defined in clause 4.3.1.4.3 shall be assumed.
- The calculated value for Duty Cycle (DC) shall be recorded in the test report. This value shall be equal to or less than the maximum value declared by the manufacturer.

Step 5:

- Use the same stored measurement samples from the procedure described in clause 5.4.2.2.1.2.
- Identify any TxOff time that is equal to or greater than the minimum Tx-gap time as defined in clause 4.3.1.3.3 or clause 4.3.2.4.3. These are the potential valid gap times to be further considered in this procedure.
- Starting from the second identified gap, calculate the time from the start of this gap to the end of the preceding gap. This time is the Tx-sequence time for this transmission. Repeat this procedure until the last identified gap within the observation period is reached.
- A combination of consecutive Tx-sequence times and Tx-gap times followed by a Tx-gap time, which is at least as long as the duration of this combination, may be considered as a single Tx-sequence time and in which case it

shall comply with the limits defined in clause 4.3.1.3.3 or clause 4.3.2.4.3.

- It shall be noted in the test report whether the UUT complies with the limits for the maximum Tx-sequence time and minimum Tx-gap time as defined in clause 4.3.1.3.3 or clause 4.3.2.4.3.

EUT DESCRIPTION:

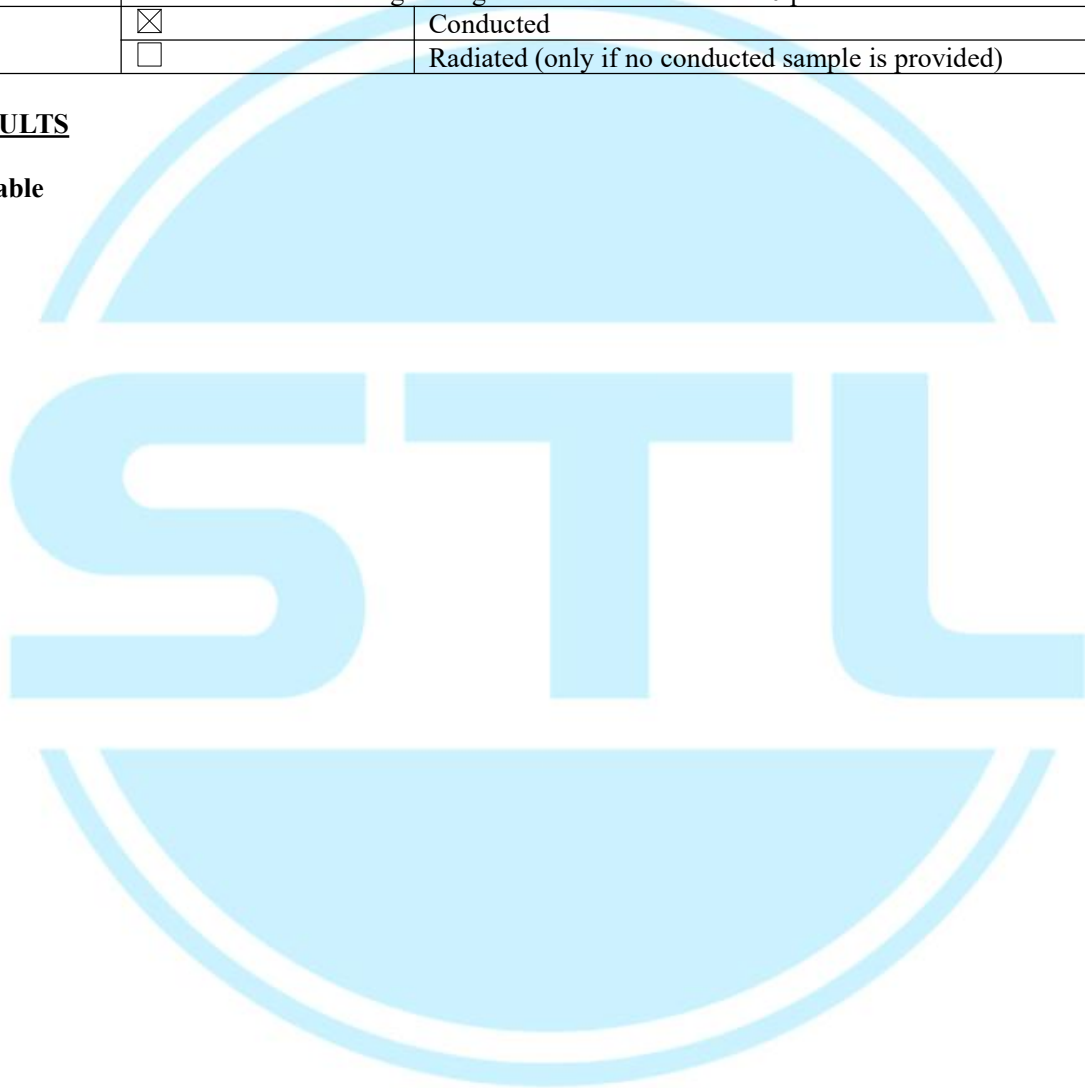
Mode:	BT Testmode
Test Channel	Channel 00(2402MHz),Channel 19(2440MHz),Channel 39(2480MHz)
Modulation:	GFSK

MEASUREMENT DESCRIPTION

Instrument:	Power Meter measuring average burst Power of a least 10 packets	
Performed:	<input checked="" type="checkbox"/>	Conducted
	<input type="checkbox"/>	Radiated (only if no conducted sample is provided)

TEST RESULTS

Not Applicable



4.1.3. Medium Utilisation (MU) factor

LIMIT

Draft ETSI EN 300 328 V2.2.0 (2017-11) Sub-clause 4.3.2.5.3

For non-adaptive equipment using wide band modulations other than FHSS, the maximum Medium Utilization factor shall be 10 %.

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 10 dBm e.i.r.p. or for equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p.

TEST PROCEDURE

Please refer to Draft ETSI EN 300 328 V2.2.0 (2017-11) Sub-clause 5.4.2.2.1.4

Step 1:

- Use the same stored measurement samples from the procedure described in clause 5.4.2.2.1.2.

Step 2:

- For each burst calculate the product of (Pburst / 100 mW) and the TxOn time. Pburst is expressed in mW. TxOn time is expressed in ms.

Step 3:

- Medium Utilization is the sum of all these products divided by the observation period (expressed in ms) which is defined in clause 4.3.1.3.2 or clause 4.3.2.4.2. This value, which shall comply with the limit given in clause 4.3.1.6.3 or clause 4.3.2.5.3, shall be recorded in the test report.

If operation without blacklisted frequencies is not possible, the power of the bursts on blacklisted hopping frequencies (for the calculation of the Medium Utilization) is assumed to be equal to the average value of the RMS power of the bursts on all active hopping frequencies.

EUT DESCRIPTION:

Mode:	BT Test mode
Test Channel	Channel 00(2402MHz),Channel 19(2440MHz),Channel 39(2480MHz)
Modulation:	GFSK

MEASUREMENT DESCRIPTION

Instrument:	Power Meter measuring average burst Power of a least 10 packets	
Performed:	<input checked="" type="checkbox"/>	Conducted
	<input type="checkbox"/>	Radiated (only if no conducted sample is provided)

TEST RESULTS

Not Applicable according to Draft ETSI EN 300 328 V2.2.0 (2017-11) Sub-clause 4.3.2.5.1

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 10 dBm e.i.r.p. or for equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p..

4.1.4. Power Spectral Density

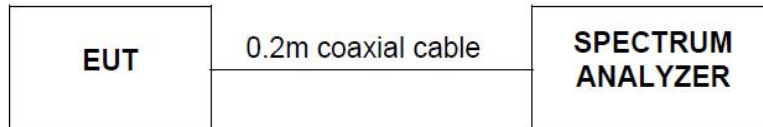
LIMIT

According to Draft ETSI EN 300 328 V2.2.0 (2017-11) §4.3.2.3.3,

For equipment using wide band modulations other than FHSS, the maximum Power Spectral Density is limited to 10dBm/MHz.

These measurements shall only be performed at normal test conditions.

TEST CONFIGURATION



TEST PROCEDURE

According to Draft ETSI EN 300 328 V2.2.0 (2017-11) §5.4.3.2.1, conducted method.

The test procedure shall be as follows:

Step 1:

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

- Start Frequency: 2 400 MHz
- Stop Frequency: 2 483.5 MHz
- Resolution BW: 10 kHz
- Video BW: 30 kHz
- Sweep Points: > 8 350

NOTE: For spectrum analyzers not supporting this number of sweep points, the frequency band may be segmented.

- Detector: RMS
- Trace Mode: Max Hold
- Sweep time: 10 s; the sweep time may be increased further until a value where the sweep time has no impact on the RMS value of the signal

For non-continuous signals, wait for the trace to be completed. Save the (trace) data set to a file.

Step 2:

For conducted measurements on smart antenna systems using either operating mode 2 or operating mode 3 (see clause 5.1.3.2), repeat the measurement for each of the transmit ports. For each sampling point (frequency domain), add up the coincident power values (in mW) for the different transmit chains and use this as the new data set.

Step 3:

Add up the values for power for all the samples in the file using the formula below.

$$P_{Sum} = \sum_{n=1}^k P_{sample}(n)$$

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

Step 4:

Normalize the individual values for power (in dBm) so that the sum is equal to the RF Output Power (e.i.r.p.) measured in clause 5.3.2 and save the corrected data. The following formulas can be used:

$$C_{Corr} = P_{Sum} - P_{e.i.r.p.}$$

$$P_{Samplecorr}(n) = P_{Sample}(n) - C_{Corr}$$

with 'n' being the actual sample number

Step 5:

Starting from the first sample PSamplecorr(n) (lowest frequency), add up the power (in mW) of the following samples representing a 1 MHz segment and record the results for power and position (i.e. sample #1 to sample #100). This is the Power Spectral Density (e.i.r.p.) for the first 1 MHz segment which shall be recorded.

**Step 6:**

Shift the start point of the samples added up in step 5 by 1 sample and repeat the procedure in step 5 (i.e. sample #2 to #101).

Step 7:

Repeat step 6 until the end of the data set and record the Power Spectral Density values for each of the 1 MHz segments. From all the recorded results, the highest value is the maximum Power Spectral Density for the UUT. This value, which shall comply with the limit given in clause 4.3.2.3.3, shall be recorded in the test report.

EUT DESCRIPTION:

ME ASU	Mode:	BT Test mode
	Test Channel	Channel 00(2402MHz),Channel 19(2440MHz),Channel 39(2480MHz)
	Modulation:	GFSK

REMENT DESCRIPTION

Instrument:	Spectrum Analyzer	
Detector:	RMS	
Sweep time:	10S	
Video bandwidth:	30KHz	
Resolution bandwidth:	10KHz	
Span:	83.5MHz	
Frequency range	2400-2483.5MHz	
Sweep Points	15000	
Performed:	<input checked="" type="checkbox"/>	Conducted
	<input type="checkbox"/>	Radiated (only if no conducted sample is provided)

TEST RESULTS

The Maximum Power Spectral Density				
Test Channel Number	Test Condition	Measured Power Density (dBm/MHz)	EIRP Density (dBm/MHz)	Limit(dBm/MHz)
00	NTC	0.28	0.28	10
19	NTC	-0.42	-0.42	10
39	NTC	-0.41	-0.41	10
Result		PASS		

Adaptivity (Adaptive equipment using modulations other than FHSS)

LIMIT

Requirement	Type	
	Adaptive Frequency Hopping using LBT based DAA	Adaptive Frequency Hopping using other forms of DAA (non-LBT based)
Minimum Clear Channel Assessment (CCA) Time	At least of Max(18 us, 0.2% of COT) (Note 1)	N/A
Maximum Channel Occupancy (COT) Time	2.0ms _{note4} to 60ms/Dwell time (Note 3)	40 ms
Minimum Idle Period	5% of COT and should longer then 100us	At least 5% of COT and 100 μ s
Extended CCA check	(CCA, 5% of COT)	N/A
Short Control Signaling Transmissions	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 less. (Note 2)	
Note 1: The CCA time used by the equipment shall be declared by the supplier. Note 2: Adaptive equipment may or may not have Short Control Signaling Transmissions. Note 3: For LBT based adaptive frequency hopping equipment with a dwell time < 60 ms, the maximum Channel Occupancy Time is limited by the dwell time. Note 4: according to 4.3.1.7.2.2 3) of ETSI EN 300 328 V2.2.0, the 5% of COT should longer then 100us, so the minimum COT should longer then 2.0ms.		

Wanted signal mean power from companion device:

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

Unwanted Signal parameters

Wanted signal mean power from companion device	Maximum transmit power (PH) EIRP mW	Threshold Level (TL)
sufficient to maintain the link (see note 2)	2 395 or 2 488,5 (see note 1)	-35 (see note 3)

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

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

NOTE 3: The level specified is the level in front of the UUT antenna. In case of conducted measurements, this level has to be corrected by the actual antenna assembly gain.

TEST CONFIGURATION

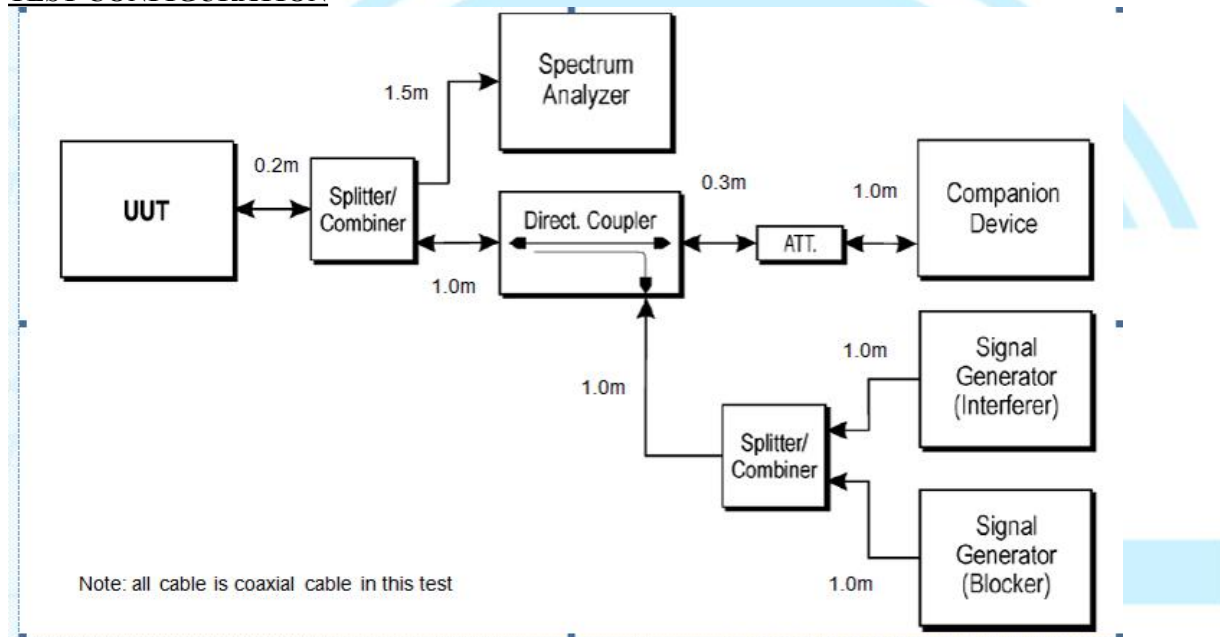


Figure 5: Test set-up for verifying the adaptivity of an equipment

MEASUREMENT DESCRIPTION

According to Draft ETSI EN 300 328 V2.2.0 (2017-11) §5.4.6.2.1.2, Conducted measurements

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

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

Step 1:

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

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

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

- The analyser shall be set as follows:

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

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

Step 2:

- Configure the UUT for normal transmissions with a sufficiently high payload resulting in a minimum transmitter activity ratio ($TxOn / (TxOn + TxOff)$) of 0,3. Where this is not possible, the UUT shall be configured to the maximum payload possible.
- Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that, for equipment with a dwell time greater than the maximum allowable Channel Occupancy Time, the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in clause 4.3.1.7.2.2 or clause 4.3.1.7.3.2. When measuring the Idle Period of the UUT, it shall not include the transmission time of the companion device.

Step 3: Adding the interference signal

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

Step 4: Verification of reaction to the interference signal

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

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

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

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

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

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

In case of overlapping channels, transmissions in adjacent channels may generate transmission bursts on the channel being investigated; however, they have a lower amplitude as on-channel transmissions. Care should be taken to only evaluate the on-channel transmissions. The Time Domain Power Option of the analyser may be used to measure the RMS power of the individual bursts to distinguish on-channel transmissions from transmissions on adjacent channels. In some cases, the RBW may need to be reduced. To verify that the UUT is not resuming normal transmissions as long as the interference signal is present, the monitoring time may need to be 60 s or more. If transmissions are detected during this period, the settings of the analyser may need to be adjusted to allow an accurate assessment to verify the transmissions comply with the limits for Short Control Signalling Transmissions.

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

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

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

Step 5: Adding the unwanted signal

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

step 6.

- The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected hopping frequency. This may require the spectrum analyser sweep to be triggered by the start of the unwanted signal.
- Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that:

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

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

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

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

Step 6: Removing the interference and unwanted signal

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

Step 7:

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

**MEASUREMENT DESCRIPTION**

Instrument:	Spectrum Analyzer	
Detector:	RMS	
Sweep time:	> Channel Occupancy Time	
Video bandwidth:	≥ RBW	
Resolution bandwidth:	≥ Occupied Channel Bandwidth	
Span:	0 Hz	
Center:	Equal to the hopping freq. to be tested	
Trace:	clear/write video triggered	
Performed:	<input checked="" type="checkbox"/>	Conducted
	<input type="checkbox"/>	Radiated (only if no conducted sample is provided)
	<input type="checkbox"/>	Short Control Signalling Transmissions available

TEST RESULTS

This requirement do not apply for equipment with a maximum declared RF Output power level of less than 10 dBme.i.r.p. or for equipment when operating in a mode where the RF Output power is less than 10 dBme.i.r.p. So This requirement do not apply for EUT

4.1.5. Occupied Channel Bandwidth

LIMIT

According to Draft ETSI EN 300 328 V2.2.0 (2017-11) 4.3.1.8.3

The Occupied Channel Bandwidth for each hopping frequency shall fall completely within the band given in clause 1. For non-adaptive Frequency Hopping equipment with e.i.r.p greater than 10 dBm, the Occupied Channel Bandwidth for every occupied hopping frequency shall be equal to or less than the Nominal Channel Bandwidth declared by the supplier. See clause 5.3.1 j). This declared value shall not be greater than 5 MHz.

TEST PROCEDURE

Please refer to ETSI EN 300 328 (V2.2.0) Sub-clause 5.3.8.2.1

According to Draft ETSI EN 300 328 V2.2.0 (2017-11) §5.3.8.2.1 Conducted measurement

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: $3 \times \text{RBW}$
- Frequency Span for frequency hopping equipment: Lowest frequency separation that is used within the hopping sequence
- Frequency Span for other types of equipment: $2 \times \text{Nominal Channel Bandwidth}$ (e.g. 40 MHz for a 20 MHz channel)
- 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.

EUT DESCRIPTION:

Mode:	BT Testmode
Hopping:	Off
Packet Type:	Longest supported
Modulation:	GFSK

MEASUREMENT DESCRIPTION

Instrument:	Spectrum Analyzer	
Detector:	RMS	
Sweep time:	auto	
Video bandwidth:	100KHz	
Resolution bandwidth:	30KHz	
Span:	100KHz	
Center:	Transmit channel	
Trace:	Max hold	
Performed:	<input checked="" type="checkbox"/>	Conducted
	<input type="checkbox"/>	Radiated (only if no conducted sample is provided)

TEST RESULTS**Test Data**

Test Condition	Test Mode	Test Channel	Ant	OBW [MHz]	FL OBW [MHz]	FH OBW [MHz]	Verdict
TNVN	BLE	2402	Ant1	1.041	2401.315	---	PASS
TNVN	BLE	2480	Ant1	1.055	---	2480.483	PASS



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

LIMIT

Draft ETSI EN 300 328 V2.2.0 (2017-11) Sub-clause 4.3.1.9.3

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.

NOTE: Within the 2 400 MHz to 2 483,5 MHz band, the Out-of-band emissions are fulfilled by compliance with the Occupied Channel Bandwidth requirement in clause 4.3.1.8

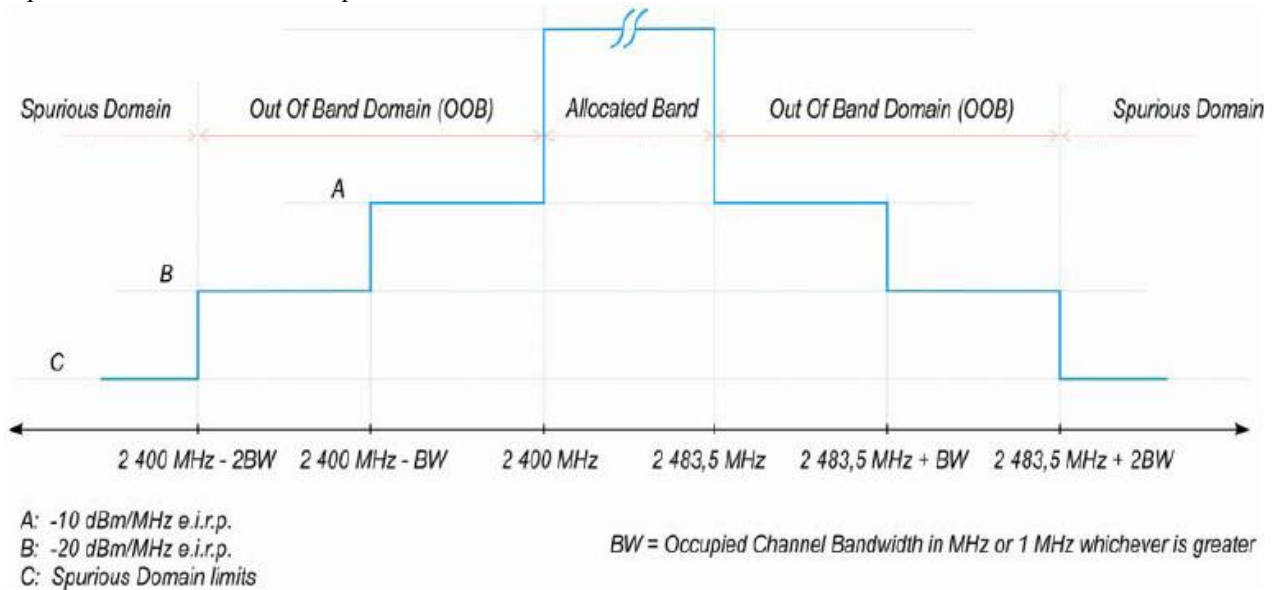


Figure 1: Transmit mask

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

These measurements shall only be performed at normal test conditions.

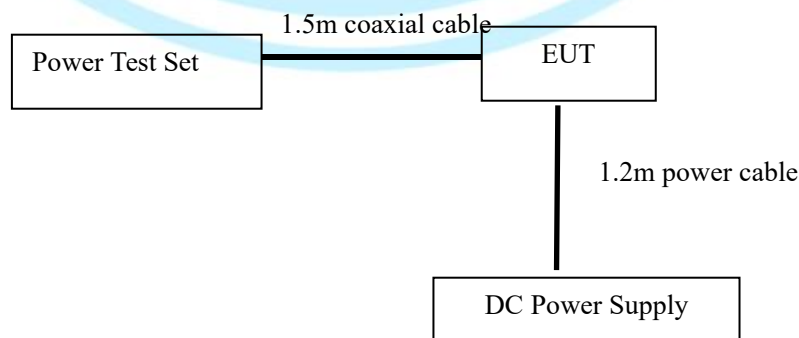
For systems using FHSS modulation, the measurements shall be performed during normal operation (hopping).

For systems using wide band modulations other than FHSS, the measurement shall be performed at the lowest and the highest channel on which the equipment can operate. These operating channels shall be recorded.

The equipment shall be configured to operate under its worst case situation with respect to output power.

If the equipment can operate with different Occupied Channel Bandwidths (e.g. 20 MHz and 40 MHz), than each channel bandwidth shall be tested separately.

TEST CONFIGURATION



TEST PROCEDURE

According to Draft ETSI EN 300 328 V2.2.0 (2017-11) §5.4.8.2.1, conducted method.

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

- Centre Frequency: evaluated frequency
- 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 μ 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 - BW + 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: A_{ch} refers to the number of active transmit chains.

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

EUT DESCRIPTION:

Mode:	BT Testmode
Hopping:	On
Packet Type:	Longest supported
Modulation:	GFSK
Assumed antenna gain:	0 dBi

MEASUREMENT DESCRIPTION

Instrument:	Spectrum Analyzer	
Detector:	RMS	
Sweep time:	depending on packet length	
Video bandwidth:	3MHz	
Resolution bandwidth:	1MHz	
Span:	0Hz	
Center:	fc (see result table)	
Trigger Mode:	Video trigger	
Sweep points:	Sweep Time [s] / (1 μ s) or 5 000 whichever is greater	
Performed:	<input checked="" type="checkbox"/>	Conducted
	<input type="checkbox"/>	Radiated (only if no conducted sample is provided)

TEST RESULTS

Test Condition	Test Mode	Test Channel	Ant	Freq [MHz]	Result [dBm]	Limit [dBm]	Verdict
TNVN	BLE	2402	Ant1	2398.423	-50.21	≤ -20	PASS
TNVN	BLE	2402	Ant1	2398.462	-53.08	≤ -20	PASS
TNVN	BLE	2402	Ant1	2399.462	-48.05	≤ -10	PASS
TNVN	BLE	2402	Ant1	2399.500	-51.71	≤ -10	PASS
TNVN	BLE	2402	Ant1	2484.000	-70.69	≤ -10	PASS
TNVN	BLE	2402	Ant1	2484.039	-73.19	≤ -10	PASS
TNVN	BLE	2402	Ant1	2485.039	-73.51	≤ -20	PASS
TNVN	BLE	2402	Ant1	2485.077	-70.91	≤ -20	PASS
TNVN	BLE	2480	Ant1	2398.390	-70.94	≤ -20	PASS
TNVN	BLE	2480	Ant1	2398.445	-70.79	≤ -20	PASS
TNVN	BLE	2480	Ant1	2399.445	-71.48	≤ -10	PASS
TNVN	BLE	2480	Ant1	2399.500	-72.07	≤ -10	PASS
TNVN	BLE	2480	Ant1	2484.000	-53.36	≤ -10	PASS
TNVN	BLE	2480	Ant1	2484.055	-55.18	≤ -10	PASS



TNVN	BLE	2480	Ant1	2485.055	-57.26	<=-20	PASS
TNVN	BLE	2480	Ant1	2485.110	-58.5	<=-20	PASS



4.1.7. Transmitter unwanted emissions in the spurious domain

Limit

According to ETSI ETSI EN 300 328 V2.2.0(2017-11) §4.3.1.10.3

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table 4.

Table 1: Transmitter limits for spurious emissions

Frequency Range	Maximum power e.r.p.(≤ 1 GHz) e.i.r.p.(> 1 GHz)	Limit when Standby
30 MHz to 47 MHz	-36 dBm	100 KHz
47 MHz to 74 MHz	-54 dBm	100 KHz
74MHz 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

These measurements shall only be performed at normal test conditions.

The level of spurious emissions shall be measured as, either:

- their power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment (cabinet radiation); or
- their effective radiated power when radiated by cabinet and antenna in case of Integral antenna equipment with no antenna connectors.

For equipment using FHSS modulation, the measurements may be performed when normal hopping is disabled. In this case measurements need to be performed when operating at the lowest and the highest hopping frequency. When this is not possible, the measurement shall be performed during normal operation (hopping).

For systems using wide band modulations other than FHSS, the measurement shall be performed at the lowest and the highest channel on which the equipment can operate. These frequencies shall be recorded.

The equipment shall be configured to operate under its worst case situation with respect to output power.

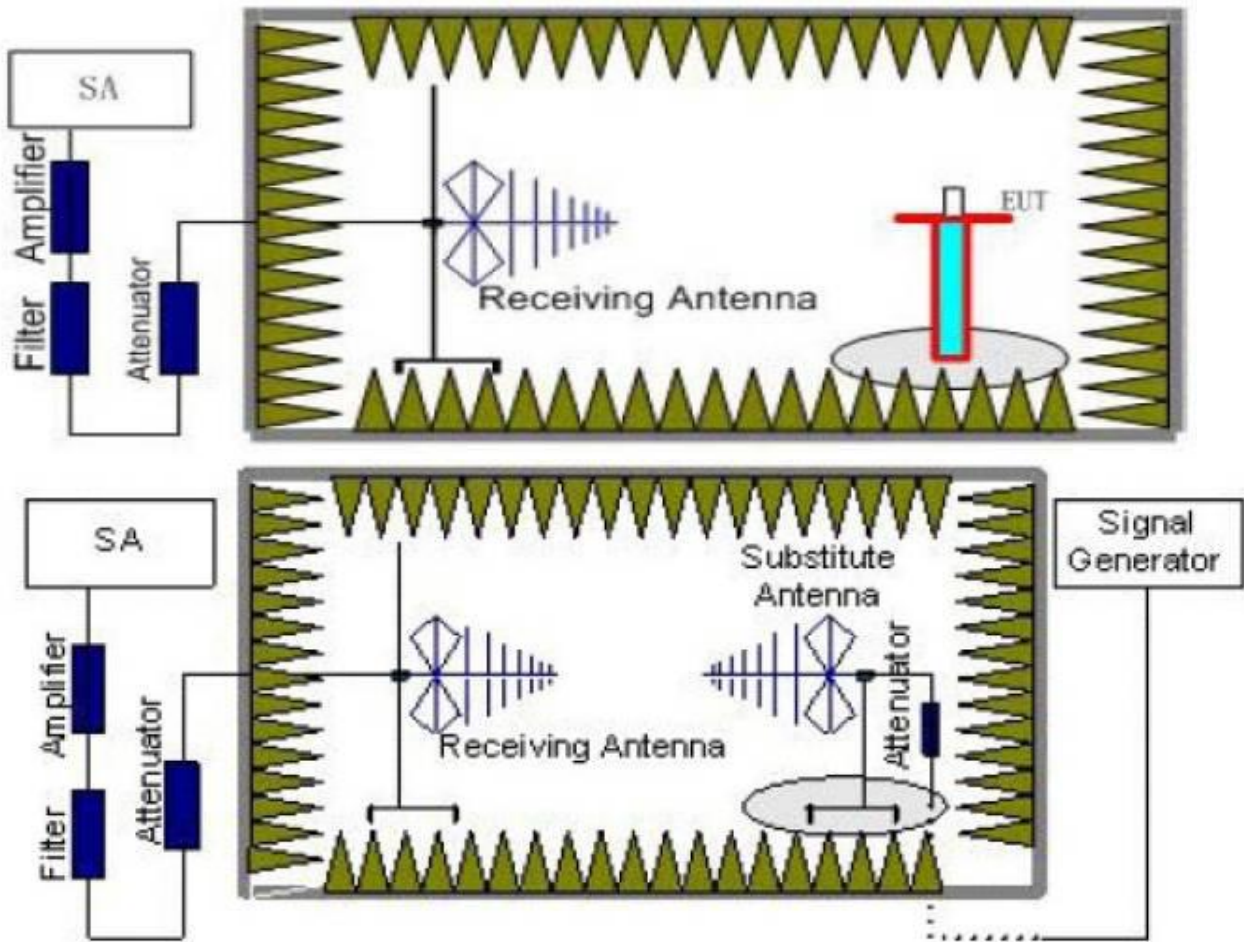
If the equipment can operate with different Nominal Channel Bandwidths (e.g. 20 MHz and 40 MHz), then the equipment shall be configured to operate under its worst case situation with respect to spurious emissions.

Test Procedure

According to Draft ETSI EN 300 328 V2.2.0 (2017-11) §5.4.9.2.2, Radiated measurement.

Test Configuration

Effective Radiated Power measurement (30 MHz to 12.75 GHz)



Test Results

Remark: We test all modulation type, and recorded the worst case mode for BT test.

Fre. (MHz)	ANT. Pol.	Result (dBm)	Limit	Margin	Conclusion
Below 1GHz:					
163.61	V	-64.83	-54	10.83	PASS
543.75	H	-64.91	-54	10.91	PASS
Above 1GHz:					
Test Mode: Low Channel					
4804	H	-42.25	-30	12.25	PASS
4804	V	-39.87	-30	9.87	PASS
7206	H	-41.77	-30	11.77	PASS
7206	V	-41.95	-30	11.95	PASS
9608	H	-46.16	-30	16.16	PASS
9608	V	-39.71	-30	9.71	PASS
Test Mode: High Channel					
4960	H	-41.71	-30	11.71	PASS
4960	V	-40.28	-30	10.28	PASS
7440	H	-39.74	-30	9.74	PASS
7440	V	-43.16	-30	13.16	PASS
9920	H	-43.02	-30	13.02	PASS
9920	V	-40.81	-30	10.81	PASS
Note: 1. Cable loss and antenna gain was combined in the calculated result. 2. No record for margin above 20dB.					

4.1.8. Receiver spurious emissions

LIMIT

According to Draft ETSI EN 300 328 V2.2.0 (2017-11) §4.3.2.11.3

The spurious emissions of the receiver shall not exceed the values given in table 5.

Table 2: spurious emission limits for receivers

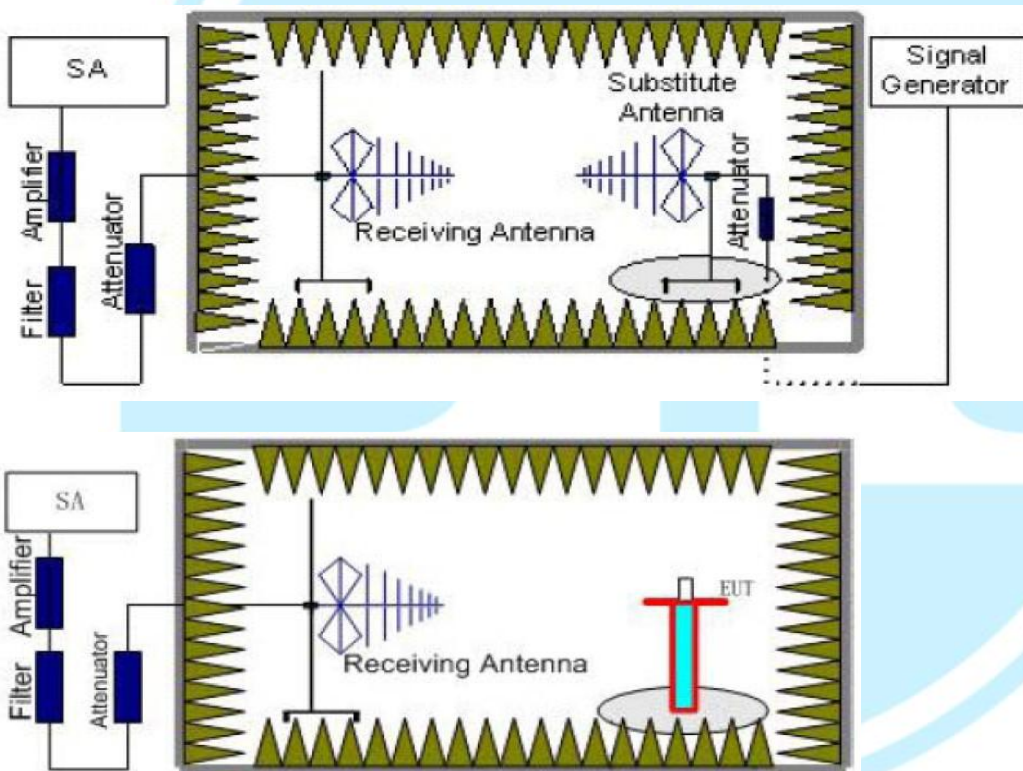
Frequency	Maximum power, e.r.p.	Measurement bandwidth
30 MHz to 1 GHz	-57 dBm	100 KHz
30 MHz to 12.75 GHz	-47 dBm	1 MHz

Test Procedure

The same as clause 4.1.8

Test Configuration

Effective Radiated Power measurement (30 MHz to 12.75 GHz)



The level of spurious emissions shall be measured as, either:

- their power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment (cabinet radiation); or
- their effective radiated power when radiated by cabinet and antenna in case of Integral antenna equipment without temporary antenna connectors.

Testing shall be performed when the equipment is in a receive-only mode.

For equipment using wide band modulations other than FHSS, the measurement shall be performed at the lowest and the highest channel on which the equipment can operate. These frequencies shall be recorded.

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

Test Results

Remark: We test all modulation type, and recorded the worst case mode for wifi test.

Fre. (MHz)	ANT. Pol.	ERP (dBm)	Limit	Margin	Conclusion
Below 1GHz:					
158.56	V	-67.34	-57	10.34	PASS
474.61	H	-67.25	-57	10.25	PASS
Above 1GHz:					
Test Mode: Lowest frequency					
1283.69	H	-58.93	-47	11.93	PASS
1283.69	V	-56.84	-47	9.84	PASS
2073.61	H	-59.24	-47	12.24	PASS
2073.61	V	-62.26	-47	15.26	PASS
Test Mode: Highest frequency					
1429.72	H	-53.19	-47	6.19	PASS
1429.72	V	-55.43	-47	8.43	PASS
2473.95	H	-56.34	-47	9.34	PASS
2473.95	V	-52.87	-47	5.87	PASS
Note:					
1. Cable loss and antenna gain was combined in the calculated result.					
2. No record for margin above 20dB.					

4.1.9. Receiver Blocking

LIMIT

According to Draft ETSI EN 300 328 V2.2.0 (2017-11) §4.3.2.11.4

While maintaining the minimum performance criteria as defined in clause 4.3.2.11.3, 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 14, table 15 or table 16.

The minimum performance criterion shall be a PER less than or equal to 10 %. The manufacturer may declare alternative performance criteria as long as that is appropriate for the intended use of the equipment.

Table 14: Receiver Blocking parameters for Receiver Category 1 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 4)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 5)	Type of blocking signal
$(-139 \text{ dBm} + 10 \times \log_{10}(\text{OCBW}))$ or -68 dBm whichever is less (see note 2)	2 380 2 503,5	-34	CW
$(-139 \text{ dBm} + 10 \times \log_{10}(\text{OCBW}))$ or -74 dBm whichever is less (see note 3)	2 300		
	2 330		
	2 360		
	2 523,5		
	2 553,5		
	2 583,5		
	2 613,5		
	2 643,5		
	2 673,5		
<p>NOTE 1: OCBW is in Hz.</p> <p>NOTE 2: As an alternative the test may be performed using a wanted signal equal to $P_{\min} + 26 \text{ dB}$ where 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.</p> <p>NOTE 3: As an alternative the test may be performed using a wanted signal equal to $P_{\min} + 20 \text{ dB}$ where 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.</p> <p>NOTE 4: In case of radiated measurements, this wanted signal level is the level in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2. In the case of conducted measurements this wanted signal level is the level applied at the antenna connector.</p> <p>NOTE 5: In case of radiated measurements, the blocking levels specified are levels in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2. In the case of conducted measurements this blocking level is the level applied at the antenna connector. Alternatively, in case the actual antenna performance at the blocking frequencies has been declared (see clause 5.4.1 m) ii)), the difference between the in-band antenna gain and the actual antenna gain at each of the blocking frequencies shall be taken into account.</p>			

Table 15: Receiver Blocking parameters receiver Category 2 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 4)	Type of blocking signal
$(-139 \text{ dBm} + 10 \times \log_{10}(\text{OCBW}) + 10)$ or $(-74 \text{ dBm} + 10)$ whichever is less (see note 2)	2 380 2 503,5 2 300 2 583,5	-34	CW
<p>NOTE 1: OCBW is in Hz.</p> <p>NOTE 2: As an alternative the test may be performed using a wanted signal equal to $P_{\min} + 26 \text{ dB}$ where 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.</p> <p>NOTE 3: In case of radiated measurements, this wanted signal level is the level in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2. In the case of conducted measurements this wanted signal level is the level applied at the antenna connector.</p> <p>NOTE 4: In case of radiated measurements, the blocking levels specified are levels in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2. In the case of conducted measurements this blocking level is the level applied at the antenna connector. Alternatively, in case the actual antenna performance at the blocking frequencies has been declared (see clause 5.4.1 m ii)), the difference between the in-band antenna gain and the actual antenna gain at each of the blocking frequencies shall be taken into account.</p>			

Table 16: Receiver Blocking parameters receiver Category 3 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 4)	Type of blocking signal
$(-139 \text{ dBm} + 10 \times \log_{10}(\text{OCBW}) + 20)$ or $(-74 \text{ dBm} + 20)$ whichever is less (see note 2)	2 380 2 503,5 2 300 2 583,5	-34	CW
<p>NOTE 1: OCBW is in Hz.</p> <p>NOTE 2: As an alternative the test may be performed using a wanted signal equal to $P_{\min} + 30 \text{ dB}$ where 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.</p> <p>NOTE 3: In case of radiated measurements, this wanted signal level is the level in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2. In the case of conducted measurements this wanted signal level is the level applied at the antenna connector.</p> <p>NOTE 4: In case of radiated measurements, the blocking levels specified are levels in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2. In the case of conducted measurements this blocking level is the level applied at the antenna connector. Alternatively, in case the actual antenna performance at the blocking frequencies has been declared (see clause 5.4.1 m ii)), the difference between the in-band antenna gain and the actual antenna gain at each of the blocking frequencies shall be taken into account.</p>			

According to Draft ETSI EN 300 328 V2.2.0 (2017-11) § 4.2.3 Receiver categories

4.2.3.2.1 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.

4.2.3.2.2 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.

4.2.3.2.3 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.

These measurements shall only be performed at normal test conditions.

For non-frequency hopping equipment, having more than one operating channel, the equipment shall be tested operating at both the lowest and highest operating channels. Equipment which can change their operating channel automatically (adaptive channel allocation), and where this function cannot be disabled, shall be tested as a frequency hopping equipment.

If the equipment can be configured to operate with different Nominal Channel Bandwidths (e.g. 20 MHz and 40 MHz) and different data rates, then the combination of the smallest channel bandwidth and the lowest data rate for this channel bandwidth which still allows the equipment to operate as intended shall be used. This mode of operation shall be aligned with the performance criteria defined in clause 4.3.1.12.3 or clause 4.3.2.11.3 as declared by the manufacturer (see clause 5.4.1 t)) and shall be described in the test report.

It shall be verified that this performance criteria as declared by the manufacturer is achieved.

TEST CONFIGURATION

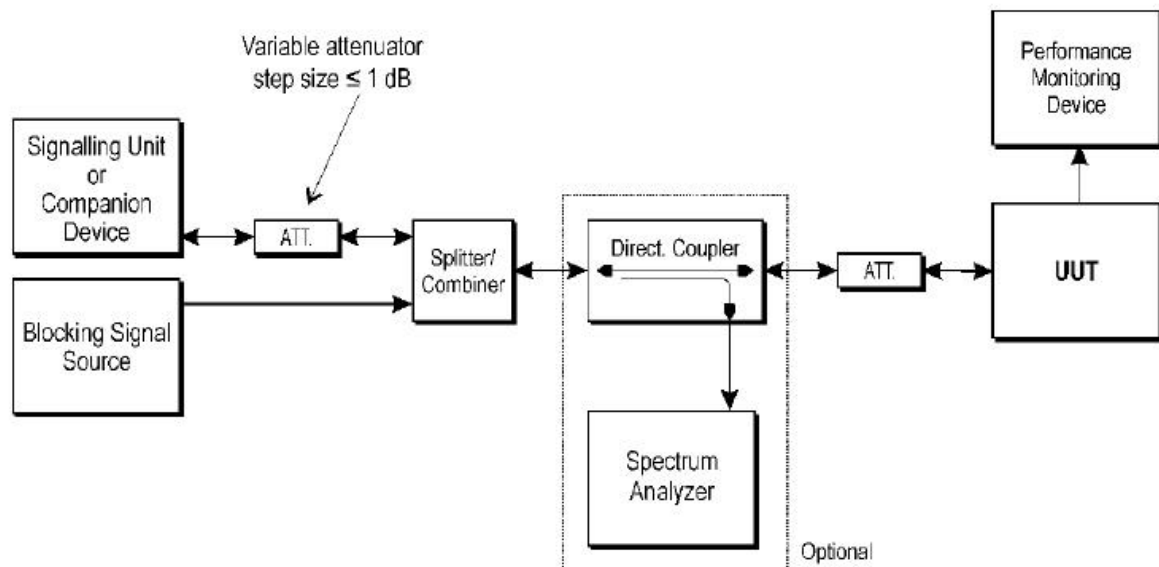


Figure 6: Test Set-up for receiver blocking

MEASUREMENT DESCRIPTION

According to Draft ETSI EN 300 328 V2.2.0 (2017-11) §5.4.11.2.1, Conducted measurements

Step 1:

- For non-FHSS equipment, the UUT shall be set to the lowest operating channel on which the blocking test has to be performed (see clause 5.4.11.1).

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.

- Unless the option provided in note 2 of the applicable table referred to in clause 5.4.11.2.1 is used, the level of the wanted signal shall be set to the value provided in the table corresponding to the receiver category and type of equipment. The test procedure defined in clause 5.4.2, and more in particular clause 5.4.2.2.1.2, can be used to measure the (conducted) level of the wanted signal however no correction shall be made for antenna gain of the companion device (step 6 in clause 5.4.2.2.1.2 shall be ignored). This level may be measured directly at the output of the companion device and a correction is made for the coupling loss into the UUT.
- When the option provided in note 2 of the applicable table referred to in clause 5.4.11.2.1 is used, the attenuation of the variable attenuator shall be increased in 1 dB steps to a value at which the minimum performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still met. The resulting level for the wanted signal at the input of the UUT is P_{min} . This signal level (P_{min}) is increased by the value provided in note 2 of the applicable 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. Where the manufacturer has declared the actual antenna gain for each of the applicable blocking frequencies (see clause 5.4.1 m) ii)) this blocking level shall be adjusted for the difference between the in-band antenna assembly gain (G) and the actual antenna gain for the blocking frequency being tested. See also note 5 in table 6, note 4 in table 7 and note 4 in table 8 or note 5 in table 14, note 4 in table 15 and note 4 in table 16. Where the actual antenna gains at the blocking frequencies have not been declared, then the antenna gain at the blocking frequencies shall be assumed identical to the in-band antenna gain.

If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is met then proceed to step 6.

Step 5:

If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is not met, step 3 and step 4 shall be repeated after that the frequency of the blocking signal set in step 2 has been increased with a value equal to the occupied channel bandwidth except:

- For the blocking frequency 2 380 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be increased by 3 dB.
- For the blocking frequency 2 503,5 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be decreased by 3 dB.

If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is not met, step 3 and step 4 shall be repeated after that the frequency of the blocking signal set in step 2 has been decreased with a value equal to the occupied channel bandwidth except:

- For the blocking frequency 2 380 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be decreased by 3 dB.
- For the blocking frequency 2 503,5 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be increased by 3 dB.

If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still not met, the UUT fails to comply with the Receiver Blocking requirement and step 6 and step 7 are no longer required.

It shall be recorded in the test report whether the shift of blocking frequencies as described in the present step was used.

Step 6:

Repeat step 4 and step 5 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 7:

For non-FHSS equipment, repeat step 2 to step 6 with the UUT operating at the highest operating channel on which the blocking test has to be performed (see clause 5.4.11.1).

Step 8:

It shall be assessed and recorded in the test report whether the UUT complies with the Receiver Blocking requirement.

TEST RESULTS

Channel 00@Result

Wanted signal mean power form companion device(dBm)	Blocking signal frequency(MHz)	Blocking signal power(dBm)	PER (%)	Limit (%)	Result
-72	2380	-34	0.00	10	Pass
-72	2503.5	-34	0.00	10	Pass
-72	2300	-34	0.00	10	Pass
-72	2583.5	-34	0.00	10	Pass
P_{min} = -81 dBm					

Channel 39@Result

Wanted signal mean power form companion device(dBm)	Blocking signal frequency(MHz)	Blocking signal power(dBm)	PER (%)	Limit (%)	Result
-72	2380	-34	0.00	10	Pass
-72	2503.5	-34	0.00	10	Pass
-72	2300	-34	0.00	10	Pass
-72	2583.5	-34	0.00	10	Pass
P_{min} = -81 dBm					

Note: P_{min} = Conducted Power(generated by SG) + Antenna gain.

4.1.10. Geo-location capability

Definition& Requirements

ETSI EN 300 328 (V2.2.0) Sub-clause 4.3.2.12.2 &4.3.2.12.3

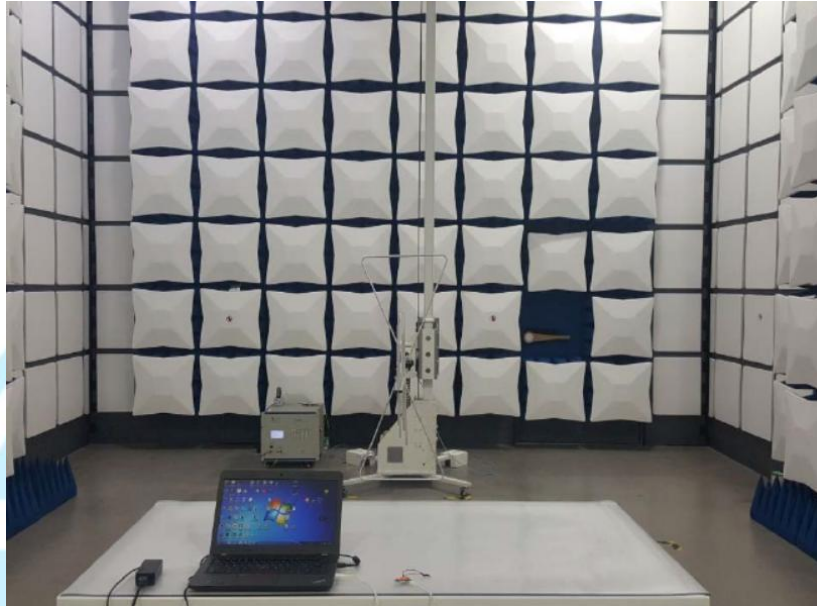
Geo-location capability is a feature of the equipment to determine its geographical location with the purpose to configure itself according to the regulatory requirements applicable at the geographical location where it operates. The geo-location capability may be present in the equipment or in an external 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

RESULTS

This equipment does not support Geo-location.



5. Test Setup Photos of the EUT



6. External and Internal Photos of the EUT

Figure 1

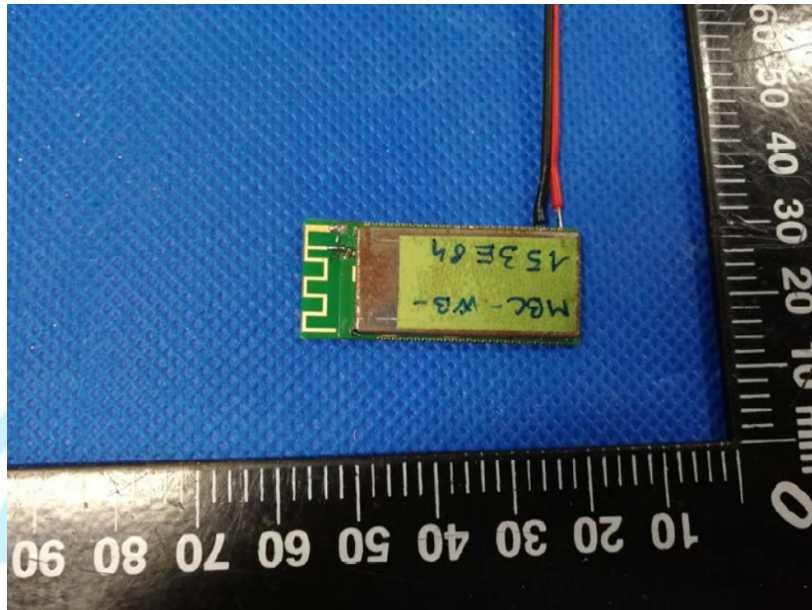


Figure 2

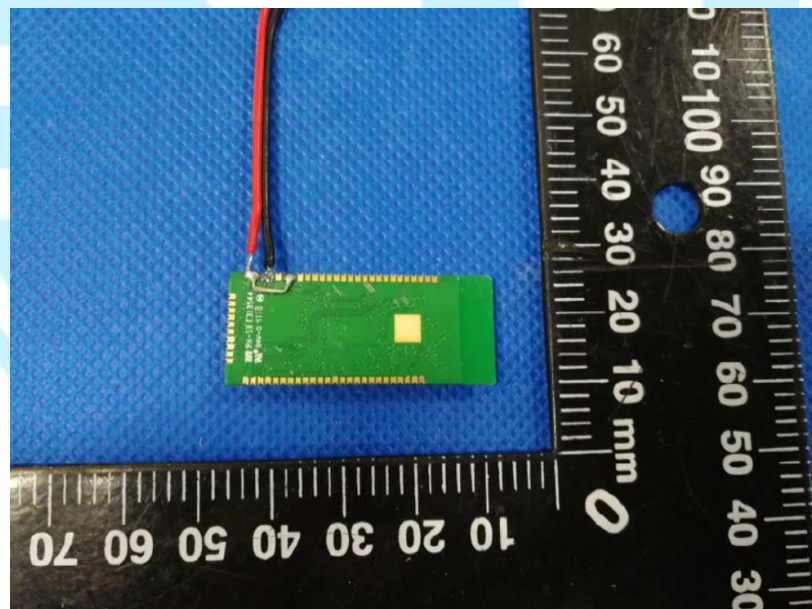


Figure 3

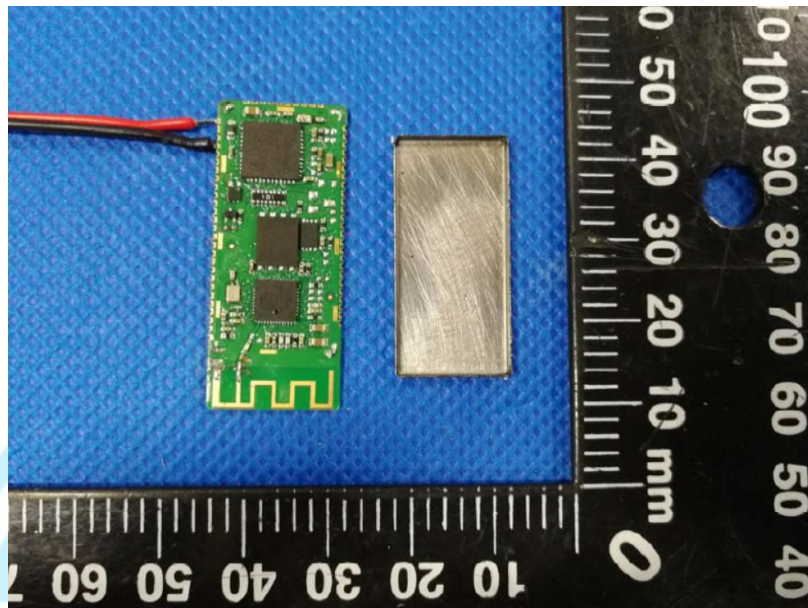
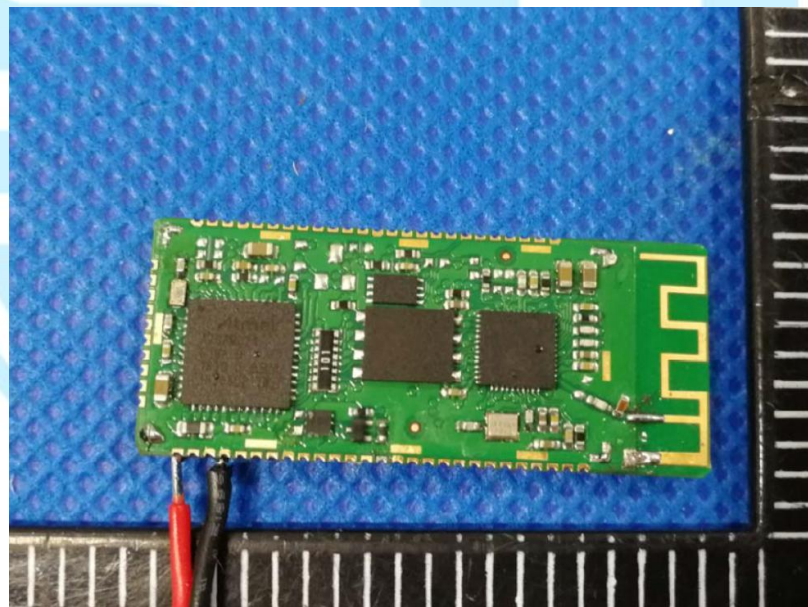


Figure 4



End of the Report