GTS Global United Technology Services Co., Ltd.

Report No.: GTS201709000079E02

SPECTRUM REPORT (WIFI)

Applicant:	Dragino Technology Co., Limited
Address of Applicant:	Room 1101, City Invest Commercial Center, No.546 QingLinRoad LongCheng Street, LongGang District , Shenzhen 518116,China
Manufacturer/Factory:	Dragino Technology Co., Limited
Address of Manufacturer/Factory:	Room 1101, City Invest Commercial Center, No.546 QingLinRoad LongCheng Street, LongGang District , Shenzhen 518116,China

Equipment Under Test (EUT)

Product Name:	Wireless IoT Module
Model No.:	DUO-1G-32, DUO-2G-32
Applicable standards:	ETSI EN 300 328 V2.1.1 (2016-11)
Date of sample receipt:	September 13, 2017
Date of Test:	September 14-30, 2017
Date of report issue:	September 30, 2017
Test Result :	PASS *

* In the configuration tested, the EUT detailed in this report complied with the standards specified above.

The CE mark as shown below can be used, under the responsibility of the manufacturer, after completion of an EC Declaration of Conformity and compliance with all relevant EC Directives. The protection requirements with respect to electromagnetic compatibility contained in Directive 2014/53/EU are considered.

Robinson Lo
Laboratory Manager

This results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

2 Version

Version No.	Date	Description
00	*September 30, 2017*	*Original*

Prepared By:	Bill. Yuan	***Date:***	*September 30, 2017*
	Project Engineer		
Check By:	Andy. Wu	***Date:***	*September 30, 2017*
	Reviewer		

3 Contents

4 Test Summary

Radio Spectrum Matter (RSM) Part of Tx					
Test	**Test Requirement**	**Test method**	**Limit/Severity**	**Uncertainty**	**Result**
RF Output Power	Clause 4.3.2.2	Clause 5.4.2.2	20dBm	±1.5dB	PASS
Power Spectral Density	Clause 4.3.2.3	Clause 5.4.3.2	10dBm/MHz	±3dB	PASS
Duty Cycle, Tx-sequence, Tx-gap	Clause 4.3.2.4	Clause 5.4.2.2.1.3	Clause 4.3.2.4.3	±5 %	N/A
Medium Utilisation (MU) factor	Clause 4.3.2.5	Clause 5.4.2.2.1.4	≤ 10%	±5 %	N/A
Adaptivity	Clause 4.3.2.6	Clause 5.4.6.2	Clause 4.3.2.6.2.2 & Clause 4.3.2.6.3.2 & Clause 4.3.2.6.4.2	--	PASS
Occupied Channel Bandwidth	Clause 4.3.2.7	Clause 5.4.7.2	Clause 4.3.2.7.3	±5 %	PASS
Transmitter unwanted emissions in the OOB domain	Clause 4.3.2.8	Clause 5.4.8.2	Clause 4.3.2.8.3	±3dB	PASS
Transmitter unwanted emissions in the spurious domain	Clause 4.3.2.9	Clause 5.4.9.2	Clause 4.3.2.9.3	±6dB	PASS
Radio Spectrum Matter (RSM) Part of Rx					
Receiver spurious emissions	Clause 4.3.2.10	Clause 5.4.10.2	Clause 4.3.2.10.3	±6dB	PASS
Receiver Blocking	Clause 4.3.2.11	Clause 5.4.11.2	Clause 4.3.2.11.4	--	PASS
Geo-location capability	Clause 4.3.2.12	--	--	--	N/A

Remark:

Tx: In this whole report Tx (or tx) means Transmitter.

Rx: In this whole report Rx (or rx) means Receiver.

Temperature (Uncertainty): ±1°C   Humidity(Uncertainty): ±5%

Uncertainty: ± 3%(for DC and low frequency voltages)

5 General Information

5.1 General Description of EUT

Product Name:	Wireless IoT Module
Model No.:	DUO-1G-32, DUO-2G-32
Test Model:	DUO-2G-32
Remark:	All above models are identical in the same PCB layout, interior structure and electrical circuits. The differences are the capacity of the DDR.
Operation Frequency:	2412MHz~2472MHz(802.11b/802.11g/802.11n(H20))
Channel numbers:	13 for 802.11b/802.11g/802.11n(HT20)
Channel separation:	5MHz
Modulation Technology: (IEEE 802.11b)	Direct Sequence Spread Spectrum(DSSS)
Modulation Technology: (IEEE 802.11g/802.11n)	Orthogonal Frequency Division Multiplexing(OFDM)
Antenna Type:	Integral antenna
Antenna gain:	Ant 1:2.0dBi Ant 2:2.0dBi
Power Supply:	DC 12V 1A(Supplied by the AC adapter)

WIFI Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2412MHz	5	2432MHz	9	2452MHz	13	2472MHz
2	2417MHz	6	2437MHz	10	2457MHz		
3	2422MHz	7	2442MHz	11	2462MHz		
4	2427MHz	8	2447MHz	12	2467MHz		

The EUT operation in above frequency list, and used test software to control the EUT for staying in continuous transmitting and receiving mode. So test frequency is below:

Test channel	**Frequency (MHz)**
	802.11b/802.11g/802.11n(HT20)
Lowest channel	2412MHz
Middle channel	2442MHz
Highest channel	2472MHz

5.2 Test mode

Transmitting mode	Keep the EUT in continuously transmitting mode.
Receiving mode	Keep the EUT in receiving mode.

We have verified the construction and function in typical operation. All the test modes were carried out with the EUT in transmitting operation, which was shown in this test report and defined as follows:

Per-scan all kind of data rate in lowest channel, and found the follow list which it was worst case.

Mode	*802.11b*	*802.11g*	*802.11n(HT20)*
Data rate	*1Mbps*	*6Mbps*	*6.5Mbps*

5.3 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

● FCC —Registration No.: 600491

Global United Technology Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fuly described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in files. Registration 600491, June 22, 2016.

● Industry Canada (IC) —Registration No.: 9079A-2

The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. Has been Registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 9079A-2, August 15, 2016.

5.4 Test Location

All tests were performed at:

Global United Technology Services Co., Ltd.
Address: No. 301-309, 3/F., Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China 518102
Tel: 0755-27798480
Fax: 0755-27798960

5.5 Description of Support Units

The EUT has been tested as an independent unit.

5.6 Deviation from Standards

None.

5.7 Abnormalities from Standard Conditions

None.

5.8 Other Information Requested by the Customer

None.

6 Test Instruments List

Radiated Emission:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	3m Semi- Anechoic Chamber	ZhongYu Electron	9.0(L)*6.0(W)* 6.0(H)	GTS250	July. 03 2015	July. 02 2020
2	Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	GTS251	N/A	N/A
3	ESU EMI Test Receiver	R&S	ESU26	GTS203	June. 29 2017	June. 28 2018
4	BiConiLog Antenna	SCHWARZBECK	VULB9163	GTS214	June. 29 2017	June. 28 2018
5	Double-ridged horn antenna	SCHWARZBECK	9120D	GTS208	June. 29 2017	June. 28 2018
6	Horn Antenna	ETS-LINDGREN	3160-09	GTS218	June. 29 2017	June. 28 2018
7	RF Amplifier	HP	8347A	GTS204	June. 29 2017	June. 28 2018
8	RF Amplifier	HP	8349B	GTS206	June. 29 2017	June. 28 2018
9	Broadband Preamplifier	SCHWARZBECK	BBV9718	GTS535	June. 29 2017	June. 28 2018
10	PSA Series Spectrum Analyzer	Agilent	E4440A	GTS536	June. 29 2017	June. 28 2018
11	Universal Radio Communication tester	ROHDE&SCHWARZ	CMU 200	GTS538	June. 29 2017	June. 28 2018
12	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
13	Coaxial cable	GTS	N/A	GTS210	N/A	N/A
14	Coaxial Cable	GTS	N/A	GTS211	N/A	N/A
15	Thermo meter	N/A	N/A	GTS256	June. 29 2017	June. 28 2018

Conducted:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	MXA Signal Analyzer	Agilent	N9020A	MY51110321	June. 01 2017	June. 01 2018
2	MXG vector Signal Generator	Agilent	N5182A	MY47070255	June. 01 2017	June. 01 2018
3	ESG Analog Signal Generator	Agilent	E4428C	MY47381216	June. 01 2017	June. 01 2018
4	USB RF Power Sensor	DARE	RPR3006W	16I00054SNO18	June. 01 2017	June. 01 2018
5	USB RF Power Sensor	DARE	RPR3006W	16I00054SNO19	June. 01 2017	June. 01 2018
6	RF Switch Box	Shongyi	RFSW3003328	RFSW170511	June. 01 2017	June. 01 2018
7	Programmable Constant Temp & Humi Test Chamber	WEWON	WHTH-150L-40-880	WH20170602001	June. 01 2017	June. 01 2018

7 Radio Technical Specification in ETSI EN 300 328

7.1 Test Environment and Mode

Test mode:	
Transmitting mode:	Keep the EUT in transmitting mode with modulation.
Receiving mode	Keep the EUT in receiving mode.

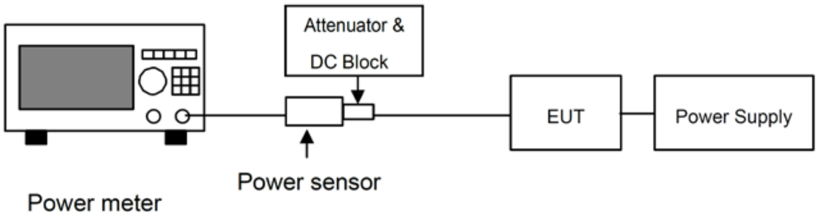
Operating Environment:

Item	**Normal condition**	**Extreme condition**	
		NVHT	**NVLT**
Temperature	+25ºC	+40ºC	0ºC
Humidity	20%-95%		
Atmospheric Pressure:	1008 mbar		

Setting	Value
Modulation	Other
Adaptive	Yes
Antenna Gain 1	2dBi
Nominal Channel Bandwidth	20MHz/40MHz
DUT Frequency not configurable	No
Frequency Low	2412MHz
Frequency Mid	2442MHz
Frequency High	2472MHz

7.2 Transmitter Requirement

7.2.1 RF Output Power

Test Requirement:	ETSI EN 300 328 clause 4.3.2.2
Test Method:	ETSI EN 300 328 clause 5.4.2.2.1.2
Limit:	20dBm
Test setup:	
Test procedure:	**Step 1:** Use a fast power sensor suitable for 2,4 GHz and capable of 1 MS/s. Use the following settings: - Sample speed 1 MS/s or faster. - The samples must represent the power of the signal. - Measurement duration: For non-adaptive equipment: equal to the observation period defined in clauses 4.3.1.3.2 or 4.3.2.4.2. For adaptive equipment, the measurement duration shall be long enough to ensure a minimum number of bursts (at least 10) are captured. For adaptive equipment, to increase the measurement accuracy, a higher number of bursts may be used. **Step 2:** For conducted measurements on devices with one transmit chain: -Connect the power sensor to the transmit port, sample the transmit signal and store the raw data.Use these stored samples in all following steps. For conducted measurements on devices with multiple transmit chains: -Connect one power sensor to each transmit port for a synchronous measurement on all transmit ports. -Trigger the power sensors so that they start sampling at the same time. Make sure the time difference between the samples of all sensors is less than 500ns. -For each individual smpling point(time domain), sum the coincident power samples of all ports and store them. Use these summed samples in all following steps. **Step 3:** Find the start and stop times of each burst in the stored measurement samples. The start and stop times are defined as the points where the power is at least 30 dB below the highest value of the stored samples in step 2. In case of insufficient dynamic range,the value of 30dB may need to be

	reduced appropriately. **Step 4:** Between the start and stop times of each individual burst calculate the RMS power over the burst using the formula below. Save these P_{burst} values, as well as the start and stop times for each burst. $$P_{burst} = \frac{1}{k}\sum_{n=1}^{k} P_{sample}(n)$$ With "k" being the total number of samples and "n" the actual sample number **Step 5:** The highest of all P_{burst} values (value "A" in dBm) will be used for maximum e.i.r.p. calculations. **Step 6:** Add the (stated) antenna assembly gain "G" in dBi of the individual antenna. If applicable, add the additional beamforming gain "Y" in dB. If more than one antenna assembly is intended for this power setting, the maximum overall antenna gain (G or G + Y) shall be used. The RF Output Power (P) shall be calculated using the formula below: P = A + G + Y **Step 7:** This value, which shall comply with the limit given in clause 4.3.1.2.3 or clause 4.3.2.2.3, shall be recorded in the test report.
Measurement Record:	Uncertainty: ± 1.5dB
Test Instruments:	See section 6.0
Test mode:	Transmitting mode

Measurement Data

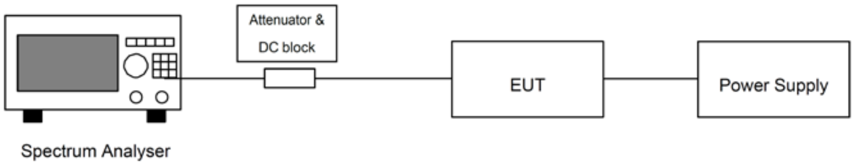
802.11b mode						
Test conditions	**Channel**	**Burst RMS power (dBm)**	**Antenna Gain(dBi)**	**Calculated Power (dBm)**	**Limit (dBm)**	**Result**
Normal	Lowest	13.40	2.00	15.40	20	Pass
	Middle	13.00	2.00	15.00		
	Highest	13.40	2.00	15.40		
NVHT	Lowest	13.28	2.00	15.28		
	Middle	12.93	2.00	14.93		
	Highest	13.23	2.00	15.23		
NVLT	Lowest	13.38	2.00	15.38		
	Middle	12.95	2.00	14.95		
	Highest	13.33	2.00	15.33		

802.11g mode						
Test conditions	**Channel**	**Burst RMS power (dBm)**	**Antenna Gain(dBi)**	**Calculated Power (dBm)**	**Limit (dBm)**	**Result**
Normal	Lowest	11.20	2.00	13.20	20	Pass
	Middle	10.70	2.00	12.70		
	Highest	11.40	2.00	13.40		
NVHT	Lowest	11.18	2.00	13.18		
	Middle	10.56	2.00	12.56		
	Highest	11.28	2.00	13.28		
NVLT	Lowest	11.17	2.00	13.17		
	Middle	10.59	2.00	12.59		
	Highest	11.35	2.00	13.35		

802.11n(HT20) mode						
Test conditions	**Channel**	**Burst RMS power (dBm)**	**Antenna Gain(dBi)**	**Calculated Power (dBm)**	**Limit (dBm)**	**Result**
Normal	Lowest	11.80	2.00	13.80	20	Pass
	Middle	11.20	2.00	13.20		
	Highest	11.50	2.00	13.50		
NVHT	Lowest	10.37	2.00	12.37		
	Middle	10.57	2.00	12.57		
	Highest	10.76	2.00	12.76		
NVLT	Lowest	10.42	2.00	12.42		
	Middle	10.65	2.00	12.65		
	Highest	10.84	2.00	12.84		

Remark:1>. Volt= Voltage, Temp= Temperature
2>. Antenna Gain=2dBi

7.2.2 Power Spectral Density

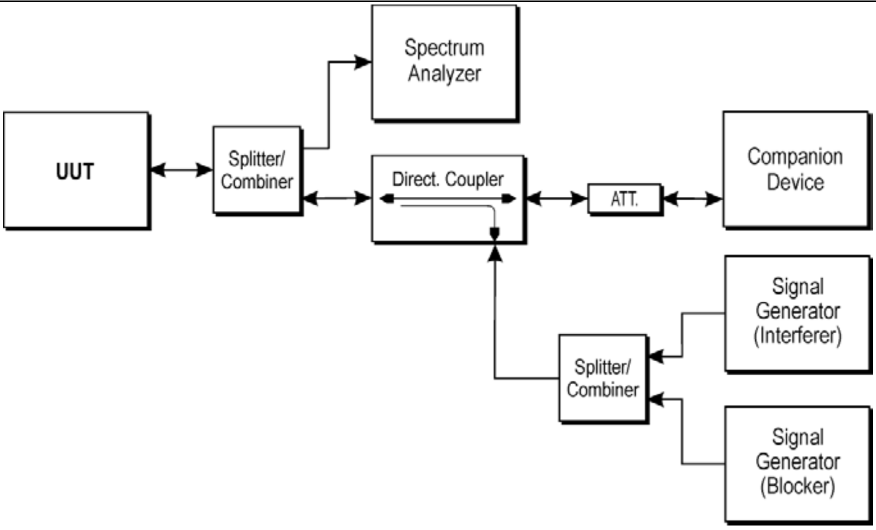
Test Requirement:	ETSI EN 300 328 clause 4.3.2.3
Test Method:	ETSI EN 300 328 clause 5.4.3.2.1
Limit:	10dBm/MHz
Test setup:	
Test procedure:	**Step 1:** Connect the UUT to the spectrum analyser and use the following settings: Start Frequency: 2400 MHz Stop Frequency: 2483.5 MHz Resolution BW: 10 kHz Video BW: 30 kHz Sweep Points: > 8350 For spectrum analysers not supporting this number of sweep points, the frequency band may be segmented. Detector: RMS Trace Mode: Max Hold Sweep time: 10s; 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 stabilize. Save the (trace data) set to a file. **Step 2:** For conducted measurements on smart antenna systems using either operating mode 2 or 3 (see clause 5.3.2.2), 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 5.4.2 and save the

	corrected data. The following formulas can be used: $$C_{Corr} = P_{Sum} - P_{e.i.r.p.}$$ $$P_{Samplecorr}(n) = P_{Sample}(n) \text{ - } C_{Corr}$$ With"n" being the actual sample number **Step 5:** Starting from the first sample $P_{samplecorr(n)}$ (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 #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 one 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.
Measurement Record:	Uncertainty: ±3dB
Test Instruments:	See section 6.0
Test mode:	Transmitting mode

Measurement Data

802.11b mode			
Channel	Power Spectral Density (dBm/MHz)	Limit (dBm/MHz)	Result
CH 1	-8.64	10.00	Pass
CH 7	-8.27		
CH 13	-8.19		
802.11g mode			
Channel	Power Spectral Density (dBm/MHz)	Limit (dBm/MHz)	Result
CH 1	-10.60	10.00	Pass
CH 7	-10.26		
CH 13	-10.23		
802.11n-HT20 mode			
Channel	Power Spectral Density (dBm/MHz)	Limit (dBm/MHz)	Result
CH 1	-10.68	10.00	Pass
CH 7	-10.48		
CH 13	-10.19		

7.2.3 Adaptivity

Test Requirement:	ETSI EN 300 328 clause 4.3.2.6
Test Method:	ETSI EN 300 328 clause 5.3.7.2.1
Limit:	Clause 4.3.2.6.2.2 & Clause 4.3.2.6.3.2 & Clause 4.3.2.6.4.2
Test setup:	
Test procedure:	**1. Adaptive Frequency Hopping equipment using DAA** The different steps 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 may connect to a companion device during the test. The interference signal generator, the blocking 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 blocking signal generators do not generate any signals at this point in time. The spectrum analyser is used to monitor the transmissions of the UUT in response to the interfering and the blocking 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 analyzer shall be set as follows: RBW: use next available RBW setting below the measured Occupied Channel Bandwidth Filter type: Channel Filter VBW: ≥ RBW Detector Mode: RMS

	Centre Frequency: Equal to the hopping frequency to be tested Span: 0Hz 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 to resulting in a minimum transmitter activity ratio(TxOn+TxOff)) of 0.3.Where this is not possible, the UUT shall be configured to the maximum payload possible. Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that, for equipment with a dwell time greater than the maximum allowable Channel Occupancy Time, the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in clauses 4.3.1.7.2.2 and 4.3.1.7.3.2. **Step 3: Adding the interference signal** An interference signal as defined in clause B.6 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 clauses 4.3.1.7.2.2 or 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 clauses 4.3.1.7.2.2 or clause 4.3.1.7.3.2 As stated in clause 4.3.1.7.3.2, the Channel Occupancy Time for non-LBT based frequency hopping systems 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 will 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 60s or more. 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 frequecy 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 blocking signals are present, the monitoring time may need to be 60s 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 signal 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 point 2. **Step 7:** The steps 2 to 6 shall be repeated for each of the hopping frequencies to be tested.

	2. Non-LBT based adaptive equipment using modulations other than FHSS The different steps below define the procedure to verify the efficiency of the non-LBT based DAA adaptive mechanism of equipment using wide band modulations other than FHSS. 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 uwanted 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 generator do not generate any signals at this point in time. The spectrum analyser is used to monitor the transmissions of the UUT in response to the interfering and the unwanted signals. Adjust the received signal level (wanted signal from the companion device) at the UUT to the value defined in table table 9 (clause 4.3.2.6.2.2). Testing of Unidirectional equipment does not require a link to be established with a companion device. The analyzer shall be set as follows: RBW: ≥ Occupied Channel Bandwidth (if the analyser does not support this setting, the highest available setting s hall be used) VBW: 3 × RBW (if the analyser does not support this setting, the highest available setting shall be used) Detector Mode: RMS Centre Frequency: Equal to the hopping frequency to be tested Span: 0Hz Sweep time: > Channel Occupancy Time of the UUT 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+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 5.3.7.2.1.4, it shall be verified that the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in clause 4.3.2.6.2.2. **Step 3: Adding the interference signal** An interference signal as defined in clause B.6 is injected centred on the current operating channel of the UUT. The Power Spectral Density level(at the input of the UUT) of this interference signal shall be equal to the detection threshold defined in clauses 4.3.2.6.2.2 step 5). **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 operating channel with the interfering signal

	injected. This may require the spectrum analyser sweep to be triggered bythe 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 current operating channel being tested. The UUT is assumed to stop transmissions within a period equal to the maximum Channel Occupancy Time defined in clause 4.3.2.6.2.2 step 4. ii) Apart from Short Control Signalling Transmissions (see iii) below), there shall be no subsequent transmissions on this operating channel for a (silent) period defined in clause 4.3.2.6.2.2 step 2. After that, the UUT may have normal transmissions again for the duration of a single Channel Occupancy Time period. Because the interference signal is still present, another silent period as defined in clause 4.3.2.6.2.2 step 2 needs to be included. This sequence is repeated as long as the interfering signal is present. 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. iii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while the interference signal is present. These transmissions shall comply with the limits defined in clause 4.3.2.6.4.2. 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 9 of clause 4.3.2.6.2.2. The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected operating channel. 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 current operating channel as long as both the interference and blocking signals remain present. To verify that the UUT is not resuming normal transmissions as long as the interference and blocking signals are present, the monitoring time may need to be 60 s or more. ii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while the interference and unwanted signals are present. These transmissions shall comply with the limits defined in clause 4.3.2.6.4.2. 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 start transmissions again on this channel however, it shall be verified that this shall only be done after the period defined in clause 4.3.2.6.2.2 step 2. **Step 7:**

	The steps 2 to 6 shall be repeated for each of the frequencies to be tested. **3. LBT based adaptive equipment using modulations other than FHSS** Step 1 to step 7 below define the procedure to verify the efficiency of the LBT based adaptive mechanism of equipment using wide band modulations other than FHSS. This method can be applied on Load Based Equipment and Frame Based Equipment. **Step 1:** The UUT may 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 generator do not generate any signals at this point in time. The spectrum analyser is used to monitor the transmissions of the UUT in response to the interfering and the unwanted signals. Adjust the received signal level (wanted signal from the companion device) at the UUT to the value defined in table 10 (clause 4.3.2.6.3.2.2) for Frame Based Equipment or in table 11 (clause 4.3.2.6.3.2.3) for Load Based Equipment. Testing of Unidirectional equipment does not require a link to be established with a companion device. The analyzer shall be set as follows: RBW: ≥ Occupied Channel Bandwidth (if the analyser does not support this setting, the highest available setting shall be used) VBW: 3 × RBW (if the analyser does not support this setting, the highest available setting shall be used) Detector Mode: RMS Centre Frequency: Equal to the centre frequency of the operating channel Span: 0Hz Sweep time: > maximum Channel Occupancy Time 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. For Frame Based Equipment, using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in clause 4.3.2.6.3.2.2 step 3). When measuring the Idle Period of the UUT, it shall not include the transmission time of the companion device. For Load Based equipment, using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in

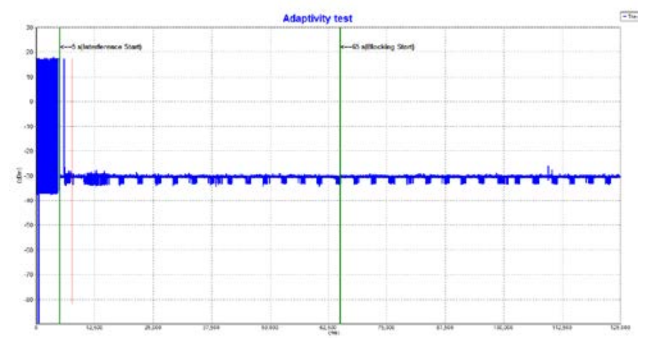
	clause 4.3.2.6.3.2.3, step 2 and step 3. When measuring the Idle Period of the UUT, it shall not include the transmission time of the companion device For the purpose of testing Load Based Equipment referred to in the first paragraph of clause 4.3.2.6.3.2.3 (IEEE 802.11™ [i.3] or IEEE 802.15.4™ [i.4] equipment), the limits to be applied for the minimum Idle Period and the maximum Channel Occupancy Time are the same as defined for other types of Load Based Equipment (see clause 4.3.2.6.3.2.3 step 2) and step 3). The Idle Period is considered to be equal to the CCA or Extended CCA time defined in clause 4.3.2.6.3.2.3 step 1) and step 2). **Step 3: Adding the interference signal** An interference signal as defined in clause B.7 is injected on the current operating channel of the UUT. 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 4.3.2.6.3.2.2 step 5) (frame based equipment) or clause 4.3.2.6.3.2.3 step 5) (load based equipment). **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 operating channel 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 current operating channel. The UUT is assumed to stop transmissions within a period equal to the maximum Channel Occupancy Time defined in clause 4.3.2.6.3.2.2 (frame based equipment) or clause 4.3.2.6.3.2.3 (load based equipment). ii) Apart from Short Control Signalling Transmissions, there shall be no subsequent transmissions while the interfering signal is present. 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. iii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while the interfering signal is present. These transmissions shall comply with the limits defined in clause 4.3.2.6.4.2. 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 6 of clause 4.3.2.11.3. The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected operating channel. This may require the spectrum analyser sweep to be triggered by the start of the unwanted signal. Using the procedure defined in clause 5.3.7.2.1.4, it shall be verified that: i) The UUT shall not resume normal transmissions on the current operating channel as long as both the interference and unwanted

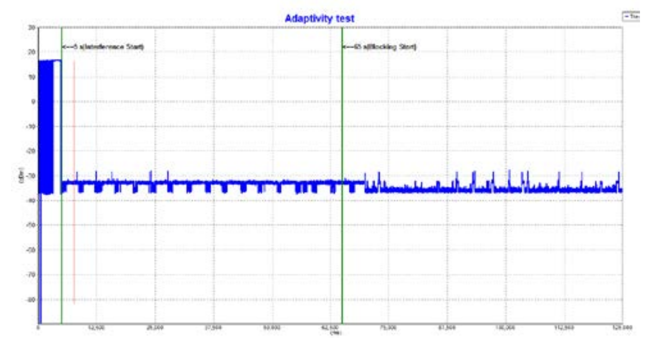
	signals remain present. To verify that the UUT is not resuming normal transmissions as long as the interference and unwanted signals are present, the monitoring time may need to be 60 s or more. ii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while the interfering and unwanted signals are present. These transmissions shall comply with the limits defined in clause 4.3.2.6.4.2. 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 start transmissions again on this channel however this is not a requirement and therefore does not require testing. **Step 7:** The steps 2 to 6 shall be repeated for each of the frequencies to be tested. **4. Generic test procedure for measuring channel/frequency usage** This is a generic test method to evaluate transmissions on the operating (hopping) frequency being investigated. This test is performed as part of the procedures described in clause 5.4.6.2.1.2 to clause 5.4.6.2.1.4. The test procedure shall be as follows: **Step 1:** The analyzer shall be set as follows: Centre Frequency: Equal to the hopping frequency or centre frequency of the channel beinginvestigated Frequency Span: 0Hz RBW: ~ 50 % of the Occupied Channel Bandwidth (if the analyser does not support this setting, the highest available setting shall be used) VBW: ≥ RBW (if the analyser does not support this setting, the highest available setting shall be used) Detector Mode: RMS Sweep time: > the Channel Occupancy Time. It shall be noted that if the Channel Occupancy Time is non-contiguous (for non-LBT based Frequency Hopping Systems), the sweep time shall be sufficient to cover the period over which the Channel Occupancy Time is spread out Number of sweep points: The time resolution has to be sufficient to meet the maximum measurement uncertainty of 5 % for the period to be measured. In most cases, the Idle Period is the shortest period to be measured and thereby defining the time resolution. If the Channel Occupancy Time is non-contiguous (non-LBT based Frequency Hopping Systems), there is no Idle Period to be measured and therefore the

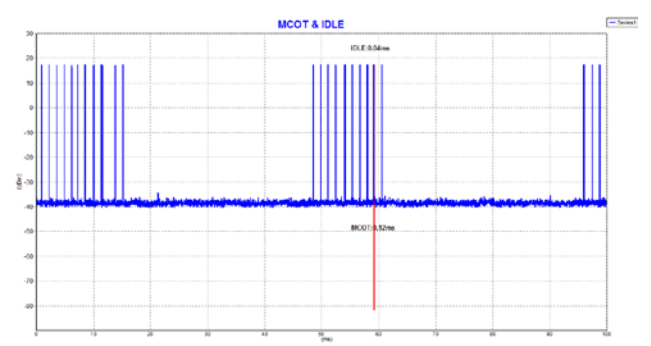
	time resolution can be increased (e.g. to 5 % of the dwell time) to cover the period over which the Channel Occupancy Time is spread out, without resulting in too high a number of sweep points for the analyzer. EXAMPLE 1: For a Channel Occupancy Time of 60 ms, the minimum Idle Period is 3 ms, hence the minimum time resolution should be < 150 µs. EXAMPLE 2: For a Channel Occupancy Time of 2 ms, the minimum Idle Period is 100 µs, hence the minimum time resolution should be < 5 µs. EXAMPLE 3: In case of a system using the non-contiguous Channel Occupancy Time approach (40 ms) and using 79 hopping frequencies with a dwell time of 3,75 ms, the total period over which the Channel Occupancy Time is spread out is 3,2 s. With a time resolution 0,1875 ms (5 % of the dwell time), the minimum number of sweep points is ~ 17 000. Trace mode: Clear / Write Trigger: Video In case of Frequency Hopping Equipment, 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. **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:** Indentify the data points related to the frequency being investigated by applying a threshold. Count the number of consecutive data points identified as resulting from a single transmission on the frequency being investigated and multiply this number by the time difference between two consecutive data points. Repeat this for all the transmissions within the measurement window. For measuring idle or silent periods, count the number of consecutive data points identified as resulting from a single transmitter off period on the frequency being investigated and multiply this number by the time difference between two consecutive data points.Repeat this for all the transmitter off periods within the measurement window.
Measurement Record:	Uncertainty: N/A
Test Instruments:	See section 6.0
Test mode:	Normal link mode
Test Result:	Pass

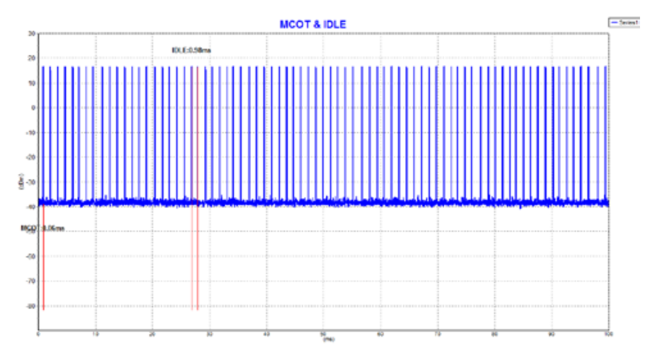
Test plots are below:

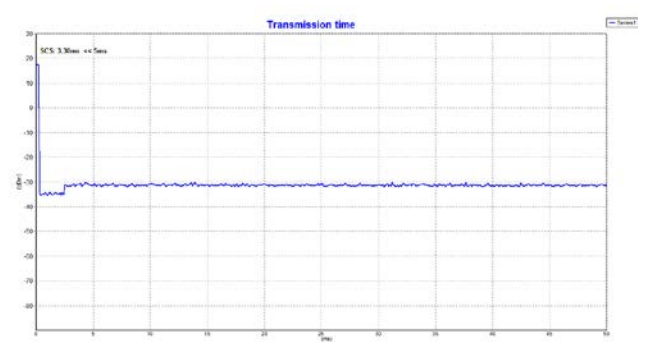
802.11b mode lowest channel		**802.11b mode highest channel**	
AWGN Interference Level (dBm)	-67.25	AWGN Interference Level (dBm)	-67.49
Unwanted CW Signal Level (dBm)	-35	Unwanted CW Signal Level (dBm)	-35
AWGN Interference Start Time (s)	5.00	AWGN Interference Start Time (ms)	5.00
Unwanted CW Signal Start Time (ms)	65.00	Unwanted CW Signal Start Time (ms)	65.00
Max COT (ms)	0.12	Max COT (ms)	0.06
CCA Time (ms)	0.04	CCA Time (ms)	0.98
Short Control Signalling(ms)	3.3	Short Control Signalling(ms)	0.00

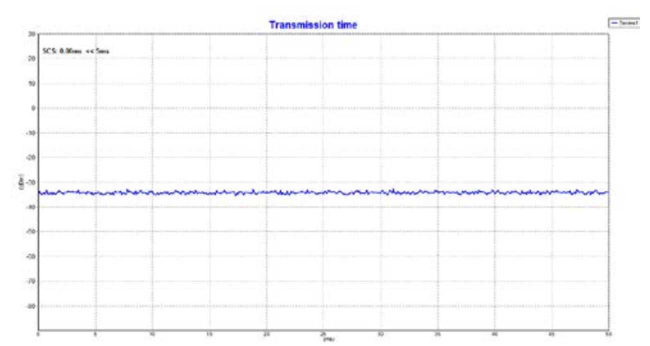


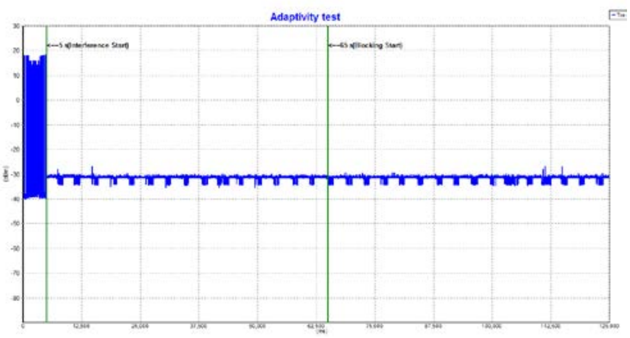
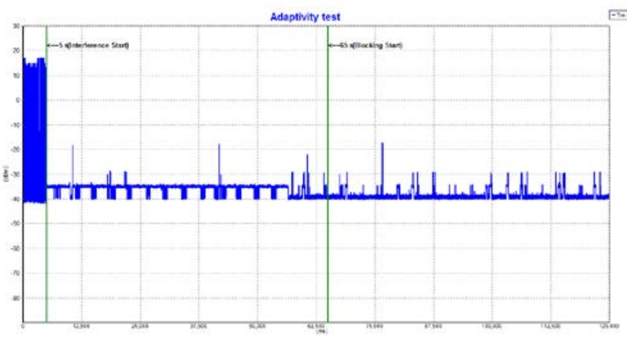
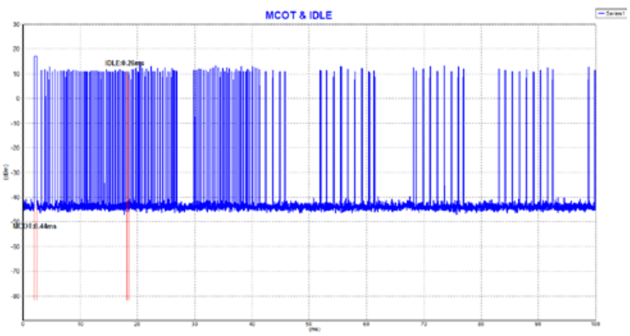
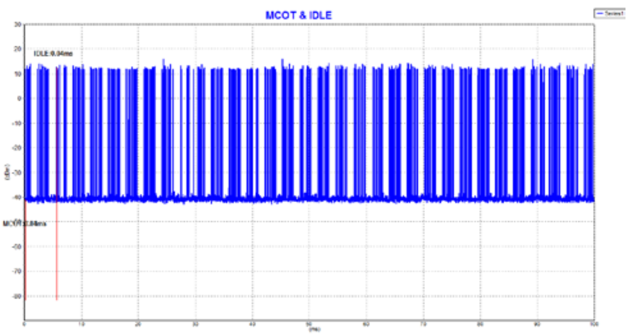
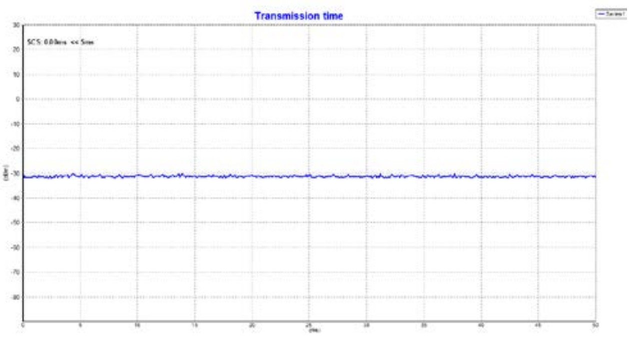
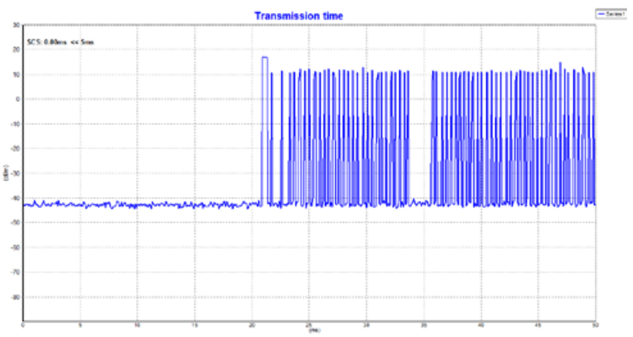


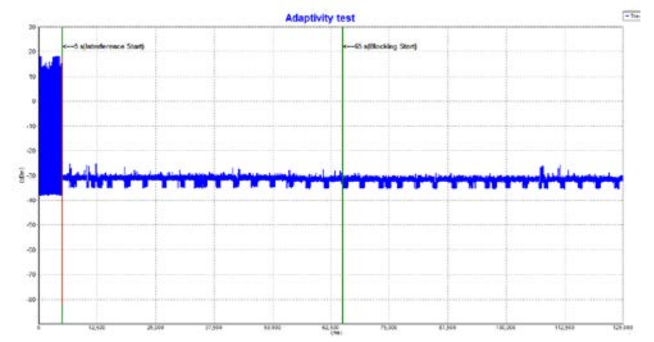
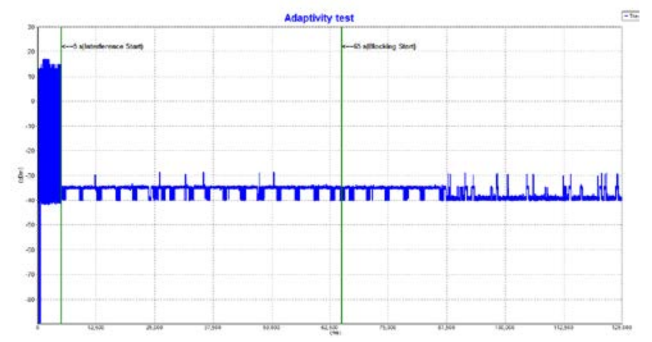
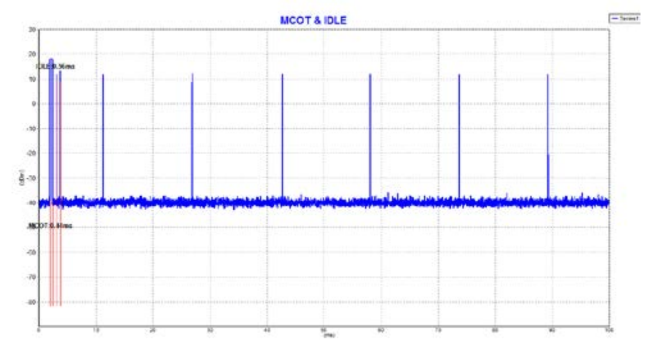
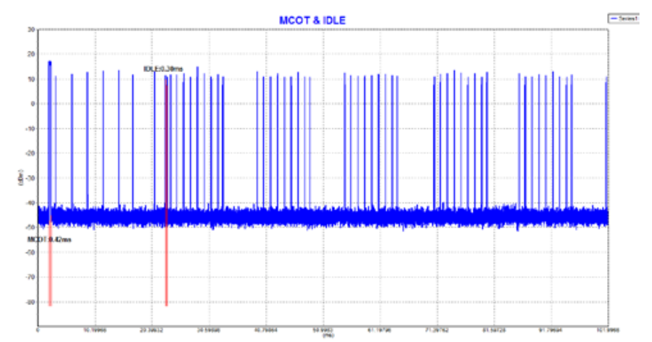
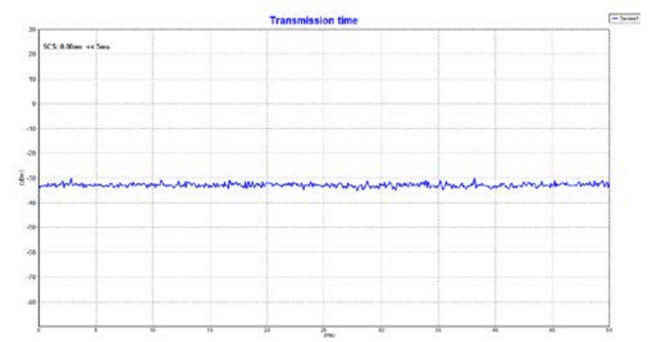
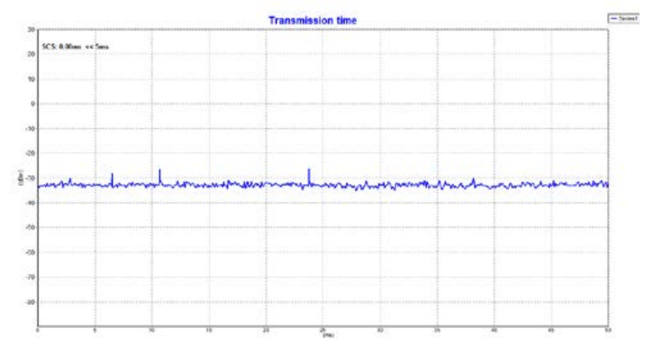








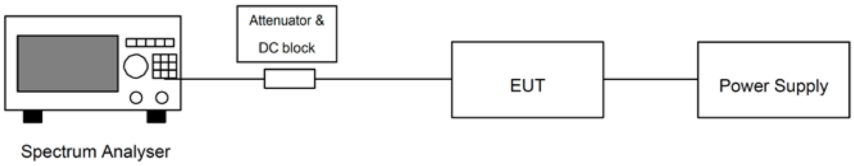
802.11g mode lowest channel		**802.11g mode highest channel**	
AWGN Interference Level (dBm)	-63.55	AWGN Interference Level (dBm)	-63.21
Unwanted CW Signal Level (dBm)	-35	Unwanted CW Signal Level (dBm)	-35
AWGN Interference Start Time (s)	5.00	AWGN Interference Start Time (s)	5.00
Unwanted CW Signal Start Time (s)	65.00	Unwanted CW Signal Start Time (s)	65.00
Max COT (ms)	0.44	Max COT (ms)	0.04
CCA Time (ms)	0.26	CCA Time (ms)	0.04
Short Control Signalling(ms)	0.00	Short Control Signalling(ms)	0.00
			
			
			

802.11n(HT20) mode lowest channel		802.11n(HT20) mode highest channel	
AWGN Interference Level (dBm)	-62.44	AWGN Interference Level (dBm)	-62.86
Unwanted CW Signal Level (dBm)	-35	Unwanted CW Signal Level (dBm)	-35
AWGN Interference Start Time (s)	5.00	AWGN Interference Start Time (s)	5.00
Unwanted CW Signal Start Time (s)	65.00	Unwanted CW Signal Start Time (s)	65.00
Max COT (ms)	0.44	Max COT (ms)	0.42
CCA Time (ms)	0.56	CCA Time (ms)	0.30
Short Control Signalling(ms)	0.00	Short Control Signalling(ms)	0.00
			
			
			

Note:

During the test, the signal observed on the channel being investigated is the Short Control Signalling Transmissions.

7.2.4 Occupied Channel Bandwidth

Test Requirement:	ETSI EN 300 328 clause 4.3.2.7
Limit:	The Occupied Channel Bandwidth for each hopping frequency shall fall completely within the band 2400MHz ~ 2483.5MHz. In addition, for non-adaptive equipment using wide band modulations other than FHSS and with e.i.r.p. greater than10 dBm, the occupied channel bandwidth shall be less than 20 MHz.
Test setup:	
Test Precedure:	**Step 1:** Connect the UUT to the spectrum analyser and use the following settings: Centre Frequency: The centre frequency of the channel under test Resolution BW: ~ 1 % of the span without going below 1 % Video BW: 3 × RBW Frequency Span 2 × Nominal Channel Bandwidth Detector Mode: RMS Trace mode: Max Hold Sweep time: 1 s **Step 2:** Wait for the trace to stabilize. Find the peak value of the trace and place the analyser marker on this peak. **Step 3:** Use the 99 % bandwidth function of the spectrum analyser to measure the Occupied Channel Bandwidth of the UUT. This value shall be recorded. 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.
Test Instruments:	See section 6.0
Test mode:	Transmitting mode

Measurement Data:

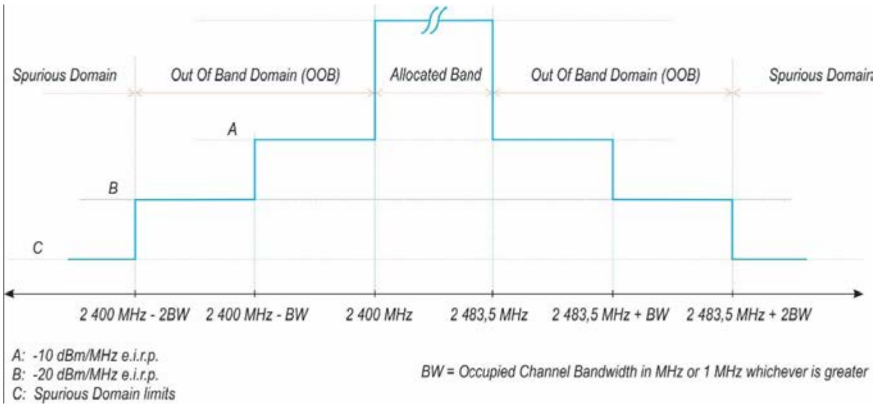
802.11b					
Test Channel	**99% Bandwidth (MHz)**	**Declared Bandwidth (MHz)**	**F_L/F_H (MHz)**	**Limit**	**Result**
Lowest	16.070	20	2405.76	2400MHz ~ 2483.5MHz	Pass
Highest	15.500	20	2478.32		Pass
802.11g					
Test Channel	**99% Bandwidth (MHz)**	**Declared Bandwidth (MHz)**	**F_L/F_H (MHz)**	**Limit**	**Result**
Lowest	17.145	20	2403.52	2400MHz ~ 2483.5MHz	Pass
Highest	17.034	20	2480.52		Pass
802.11n(H20)					
Test Channel	**99% Bandwidth (MHz)**	**Declared Bandwidth (MHz)**	**F_L/F_H (MHz)**	**Limit**	**Result**
Lowest	17.988	20	2403.16	2400MHz ~ 2483.5MHz	Pass
Highest	17.931	20	2480.96		Pass

7.2.5 Transmitter unwanted emissions in the OOB domain

<table>
<tr><td>Test Requirement:</td><td>ETSI EN 300 328 clause 4.3.2.8</td></tr>
<tr><td>Test Method:</td><td>ETSI EN 300 328 clause 5.4.8.2</td></tr>
<tr><td>Limit:</td><td>

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

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



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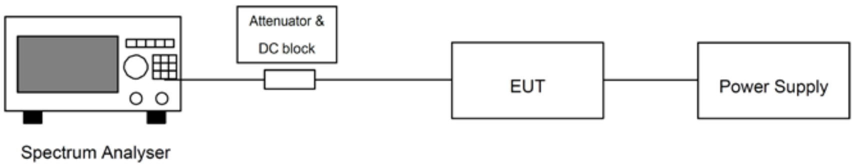
<tr><td>Test setup:</td><td>



</td></tr>
<tr><td>Test procedure:</td><td>

The applicable mask is defined by the measurement results from the tests performed under clause 5.4.7 (Occupied Channel Bandwidth).

The Out-of-band emissions within the different horizontal segments of the mask provided in figures 1 and 3 shall be measured using the step 1 to step 6 below. This method assumes the spectrum analyser is equipped with the Time Domain Power option.

Step 1:

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

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

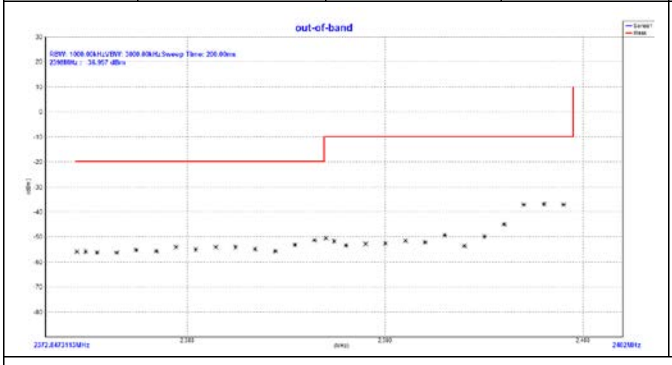
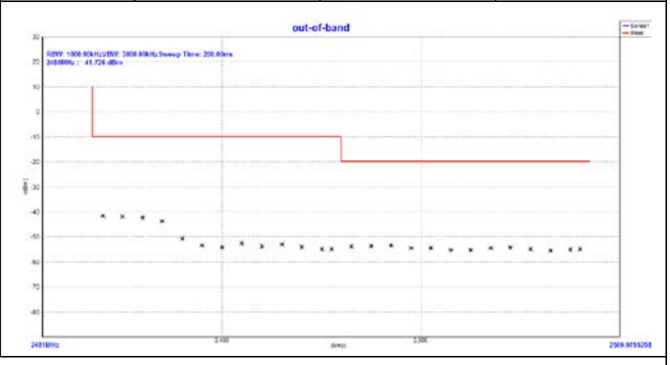
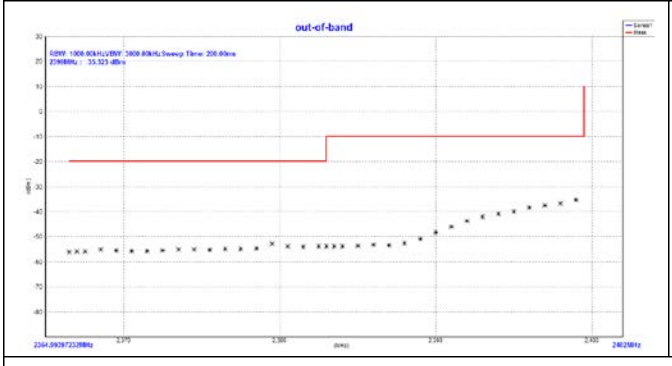
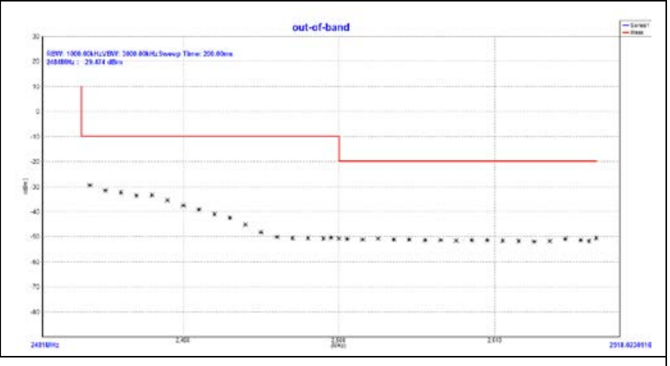
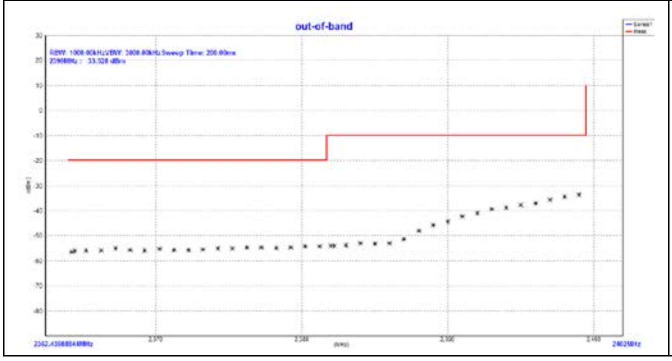
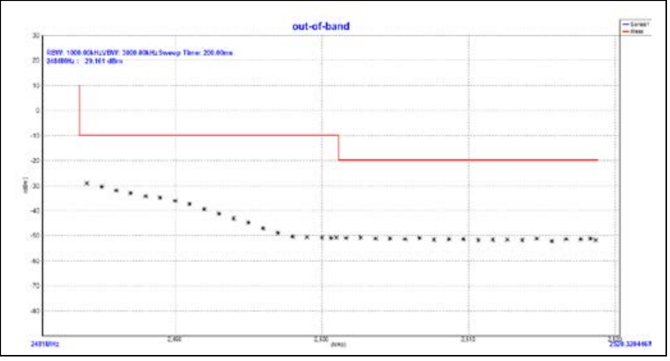
</td></tr>
</table>

	Trigger Mode: Video trigger NOTE 1: In case video triggering is not possible, an external trigger source may be used. Sweep Time: >120 % of the duration of the longest burst detected during the measurement of the RF Output Power **Step 2: (segment 2 483,5 MHz to 2 483,5 MHz + BW)** Adjust the trigger level to select the transmissions with the highest power level. For frequency hopping equipment operating in a normal hopping mode, the different hops will result in signal bursts with different power levels. In this case the burst with the highest power level shall be selected. Set a window (start and stop lines) to match with the start and end of the burst and in which the RMS power shall be measured using the Time Domain Power function. Select RMS power to be measured within the selected window and note the result which is the RMS power within this 1 MHz segment (2 483,5 MHz to 2 484,5 MHz). Compare this value with the applicable limit provided by the mask. Increase the centre frequency in steps of 1 MHz and repeat this measurement for every 1 MHz segment within the range 2 483,5 MHz to 2 483,5 MHz + BW. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + BW - 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment). **Step 3: (segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW)** Change the centre frequency of the analyser to 2 484 MHz + BW and perform the measurement for the first 1 MHz segment within range 2 483,5 MHz + BW to 2 483,5 MHz + 2BW. Increase the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + 2 BW - 0,5 MHz. (which means this may partly overlap with the previous 1 MHz segment). **Step 4: (segment 2 400 MHz - BW to 2 400 MHz)** Change the centre frequency of the analyser to 2 399,5 MHz and perform the measurement for the first 1 MHz segment within range 2 400 MHz - BW to 2 400 MHz Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - BW + 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment). **Step 5: (segment 2 400 MHz - 2BW to 2 400 MHz - BW)** Change the centre frequency of the analyser to 2 399,5 MHz - BW and perform the measurement for the first 1 MHz segment within range 2 400 MHz - 2BW to 2 400 MHz - BW. Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - 2BW + 0,5 MHz. (which means this may partly overlap with the previous 1 MHz segment). **Step 6:**

	In case of conducted measurements on equipment with a single transmit chain, the declared antenna assembly gain "G" in dBi shall be added to the results for each of the 1 MHz segments and compared with the limits provided by the mask given in figures 1 or figure 3. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered. In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), the measurements need to be repeated for each of the active transmit chains. The declared antenna assembly gain "G" in dBi for a single antenna shall be added to these results. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered. Comparison with the applicable limits shall be done using any of the options given below: Option 1: the results for each of the transmit chains for the corresponding 1 MHz segments shall be added. The additional beamforming gain "Y" in dB shall be added as well and the resulting values compared with the limits provided by the mask given in figure 1 or figure 3. Option 2: the limits provided by the mask given in figure 1 or figure 3 shall be reduced by 10 x log10(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.
Measurement Record:	Uncertainty: ± 1.5dB
Test Instruments:	See section 6.0
Test mode:	Transmitting mode

Measurement Data:

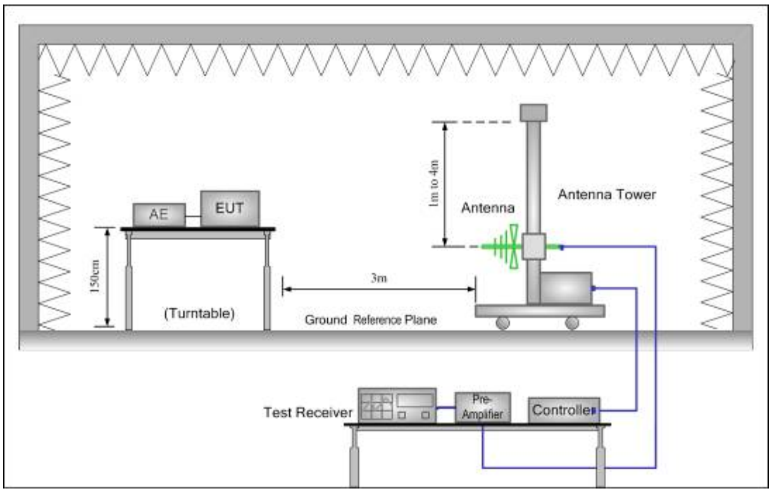
Test plots at normal condition are followed:

Test Condition:				Normal condition			
Mode:	802.11b	Channel:	Lowest	Mode:	802.11b	Channel:	Highest
							
Mode:	802.11g	Channel:	Lowest	Mode:	802.11g	Channel:	Highest
							
Mode:	802.11n(HT20)	Channel:	Lowest	Mode:	802.11n(HT20)	Channel:	Highest
							

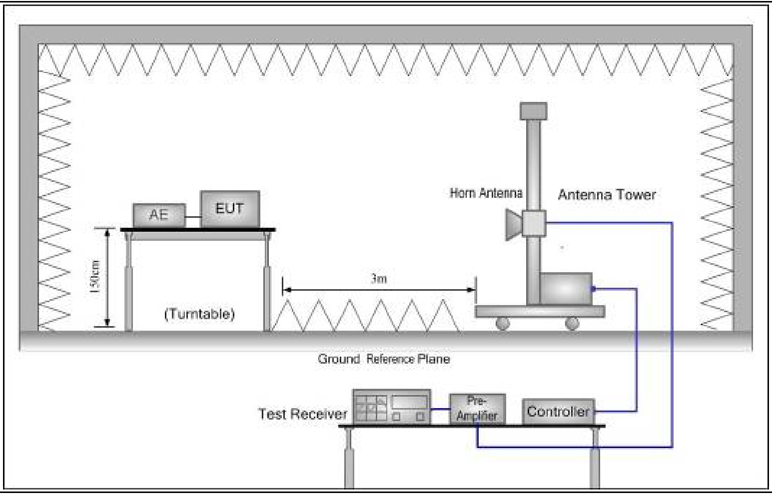
7.2.6 Transmitter unwanted emissions in the spurious domain

Test Requirement:	ETSI EN 300 328 clause 4.3.2.9
Test Method:	ETSI EN 300 328 clause 5.4.9.2
Limit:	(see table below)
Test Frequency range:	30MHz to 12.75GHz
Test setup:	Below 1GHz

Frequency Range	Maximum power e.r.p. (≤ 1 GHz) e.i.r.p. (> 1 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



Above 1GHz

	
Test procedure:	**1. Pre-scan** The test procedure below shall be used to identify potential unwanted emissions of the UUT. **Step 1:** The sensitivity of the measurement set-up should be such that the noise floor is at least 12 dB below the limits given in table 4 or table 12. **Step 2:** The emissions over the range 30 MHz to 1 000 MHz shall be identified. Spectrum analyser settings: Resolution BW: 100 kHz Video BW 300 kHz Filter type: 3 dB (Gaussian) Detector mode: Peak Trace Mode: Max Hold Sweep Points: ≥19 400 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.on any channel 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. The above sweep time setting may result in long measuring times in case of frequency hopping equipment. To avoid such long measuring times, an FFT analyser could be used. 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

	5.4.9.2.1.3 and compared to the limits given in table 4 or table 12. **Step 3:** The emissions over the range 1 GHz to 12,75 GHz shall be identified. Spectrum analyser settings: Resolution BW: 1 MHz Video BW 3 MHz Filter type: 3 dB (Gaussian) Detector mode: Peak Trace Mode: Max Hold Sweep Points: ≥ 23 500 For spectrum analysers not supporting this high number of sweep points, the frequency band may 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.on any channel 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 frequencies The above sweep time setting may result in long measuring times in case of frequency hopping equipment. To avoid such long measuring times, an FFT analyser could be used. 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 5.4.9.2.1.3 and compared to the limits given in table 4 or table 12. Frequency Hopping equipment may generate a block (or several blocks) of spurious emissions anywhere within the spurious domain. If this is the case, only the highest peak of each block of emissions shall be measured using the procedure in clause 5.4.9.2.1.3. **Step 4:** In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), the steps 2 and 3 need to be repeated for each of the active transmit chains (A_{ch}).The limits used to identify emissions during this pre-scan need to be reduced by $10 \times \log_{10}(A_{ch})$ **2. Measurement of the emissions identified during the pre-scan** The procedure in step 1 to step 4 below shall be used to accurately measure the individual unwanted emissions identified during the pre-scan measurements above. This method assumes the spectrum analyser has a Time Domain Power function. **Step 1:** The level of the emissions shall be measured using the following spectrum analyser settings:

	Measurement Mode: Time Domain Power Centre Frequency: Frequency of emission identified during the pre-scan Resolution BW: 100 kHz (< 1 GHz) / 1 MHz (> 1 GHz) Video BW 300 kHz (< 1 GHz) / 3 MHz (> 1 GHz) Frequency Span: Zero Span Sweep mode: Single Sweep Sweep time: > 120 % of the duration of the longest burst detected during the measurement of the RF Output Power Sweep points: Sweep time [μs] / (1 μs) with a maximum of 30 000 Trigger: Video (burst signals) or Manual (continuous signals) Detector: RMS **Step 2:** Set a window where the start and stop indicators match the start and end of the burst with the highest level and record the value of the power measured within this window.If the spurious emission to be measured is a continuous transmission, the measurement window shall be set to match the start and stop times of the sweep. **Step 3:** In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), step 2 needs to be repeated for each of the active transmit chains (A_{ch}). Sum the measured power (within the observed window) for each of the active transmit chains. **Step 4:** The value defined in step 3 shall be compared to the limits defined in table 4 or table 12.
Measurement Record:	Uncertainty: ± 6dB
Test Instruments:	See section 6.0
Test mode:	Transmitting mode

Measurement Data

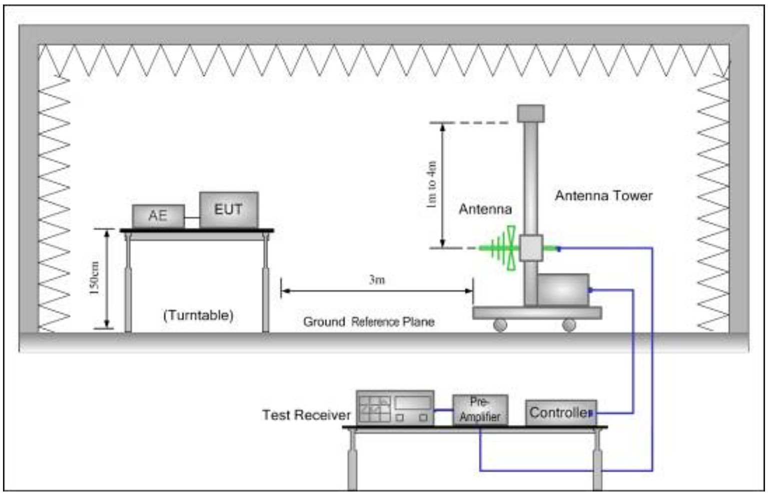
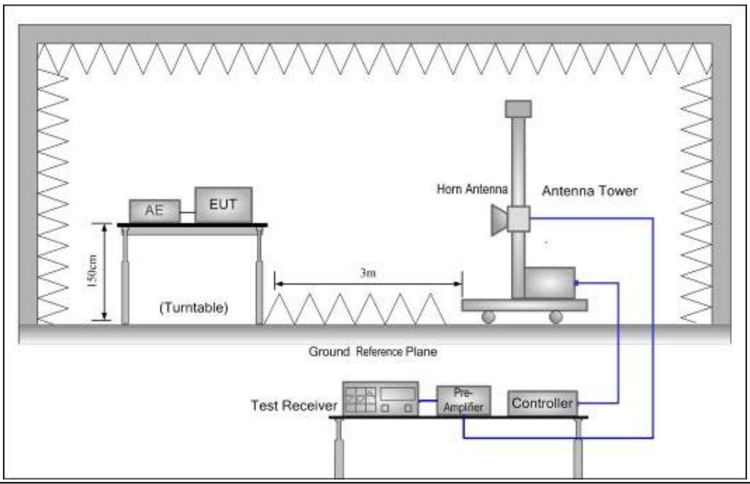
802.11b mode				
The lowest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
53.06	Vertical	-70.21	-54.00	Pass
465.60	V	-66.60	-36.00	
4824.00	V	-42.41	-30.00	
7236.00	V	-45.14	-30.00	
9648.00	V	-41.72	-30.00	
12060.00	V	-42.70	-30.00	
138.58	Horizontal	-68.99	-36.00	
653.76	H	-64.54	-54.00	
4824.00	H	-44.70	-30.00	
7236.00	H	-45.25	-30.00	
9648.00	H	-41.98	-30.00	
12060.00	H	-44.00	-30.00	
The highest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
103.14	Vertical	-71.65	-54.00	Pass
618.62	V	-62.92	-54.00	
4944.00	V	-42.92	-30.00	
7416.00	V	-44.61	-30.00	
9888.00	V	-43.40	-30.00	
12360.00	V	-42.82	-30.00	
226.38	Horizontal	-69.05	-54.00	
822.81	H	-62.03	-54.00	
4944.00	H	-44.06	-30.00	
7416.00	H	-45.03	-30.00	
9888.00	H	-43.15	-30.00	
12360.00	H	-43.45	-30.00	

802.11g mode				
The lowest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
58.76	Vertical	-71.14	-54.00	Pass
383.25	V	-67.81	-36.00	
4824.00	V	-51.89	-30.00	
7236.00	V	-45.37	-30.00	
9648.00	V	-42.15	-30.00	
12060.00	V	-44.28	-30.00	
88.51	Horizontal	-69.16	-54.00	
711.72	H	-68.46	-54.00	
4824.00	H	-50.93	-30.00	
7236.00	H	-44.79	-30.00	
9648.00	H	-42.32	-30.00	
12060.00	H	-45.04	-30.00	
The highest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
116.59	Vertical	-70.28	-54.00	Pass
973.42	V	-62.77	-36.00	
4944.00	V	-51.61	-30.00	
7416.00	V	-44.73	-30.00	
9888.00	V	-42.75	-30.00	
12360.00	V	-42.80	-30.00	
96.72	Horizontal	-69.55	-54.00	
781.71	H	-71.37	-54.00	
4944.00	H	-50.85	-30.00	
7416.00	H	-45.22	-30.00	
9888.00	H	-41.87	-30.00	
12360.00	H	-41.70	-30.00	

802.11n(HT20) mode				
The lowest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
154.76	Vertical	-69.55	-36.00	Pass
781.04	V	-63.97	-54.00	
4824.00	V	-52.29	-30.00	
7236.00	V	-44.95	-30.00	
9648.00	V	-43.25	-30.00	
12060.00	V	-43.11	-30.00	
166.21	Horizontal	-69.79	-36.00	
725.61	H	-62.02	-54.00	
4824.00	H	-52.24	-30.00	
7236.00	H	-45.86	-30.00	
9648.00	H	-43.20	-30.00	
12060.00	H	-44.64	-30.00	
The highest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
246.59	Vertical	-68.92	-36.00	Pass
915.17	V	-65.68	-36.00	
4944.00	V	-51.80	-30.00	
7416.00	V	-43.97	-30.00	
9888.00	V	-42.85	-30.00	
12360.00	V	-43.71	-30.00	
116.58	Horizontal	-71.77	-54.00	
889.37	H	-71.15	-36.00	
4944.00	H	-50.46	-30.00	
7416.00	H	-46.38	-30.00	
9888.00	H	-42.89	-30.00	
12360.00	H	-45.18	-30.00	

7.3 Receiver Requirement

7.3.1 Spurious Emissions

<table>
<tr><td>Test Requirement:</td><td>ETSI EN 300 328 clause 4.3.2.10</td></tr>
<tr><td>Test Method:</td><td>ETSI EN 300 328 clause 5.4.10.2</td></tr>
<tr><td>Limit:</td><td>
<table>
<tr><td>Frequency</td><td>Maximum power
e.r.p. (≤ 1 GHz)
e.i.r.p. (> 1 GHz)</td><td>Measurement bandwidth</td></tr>
<tr><td>30MHz to 1000 MHz</td><td>-57 dBm</td><td>100 kHz</td></tr>
<tr><td>1GHz to 12.75GHz</td><td>-47 dBm</td><td>1 MHz</td></tr>
</table>
</td></tr>
<tr><td>Test Frequency range:</td><td>30MHz to 12.75GHz</td></tr>
<tr><td>Test setup:</td><td>Below 1GHz

Above 1GHz
</td></tr>
</table>

Test procedure:	**1. Pre-scan** The procedure in step 1 to step 4 below shall be used to identify potential unwanted emissions of the UUT. **Step 1:** The sensitivity of the spectrum analyser should be such that the noise floor is at least 12 dB below the limits given in tables 5 or table13. **Step 2:** The emissions over the range 30 MHz to 1 000 MHz shall be identified. Spectrum analyser settings: Resolution BW: 100 kHz Video BW 300 kHz Filter type: 3dB (Gaussian) Detector mode: Peak Trace Mode: Max Hold Sweep Points: ≥ 19 400 Sweep time: Auto Wait for the trace to stabilize. Any emissions identified during the sweeps above and that fall within the 6 dB range below the applicable limit or above, shall be individually measured using the procedure in clause 5.4.10.2.1.3 and compared to the limits given in table 5 or table 13. **Step 3:** The emissions over the range 1 GHz to 12,75 GHz shall be identified. Spectrum analyser settings: Resolution BW: 1 MHz Video BW 3 MHz Filter type: 3 dB (Gaussian) Detector mode: Peak Trace Mode: Max Hold Sweep Points: ≥ 23500; for spectrum analysers not supporting this high number of sweep points,the frequency band may be segmented Sweep time: Auto Wait for the trace to stabilize. Any emissions identified during the sweeps above that fall within the 6 dB range below, the applicable limit or above, shall be individually measured using the procedure in clause 5.4.10.2.1.3 and compared to the limits given in table 5 or table 13. Frequency Hopping equipment may generate a block (or several blocks) of spurious emissions anywhere within the spurious domain. If this is the case, only the highest peak of each block of emissions shall be measured using the procedure in clause 5.4.10.2.1.3. **Step 4:** In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), the steps 2 and 3 need to be repeated for each of the active transmit chains (A_{ch}).The limits used to identifyemissions during this pre-scan need to be reduced with $10 \times \log_{10}(A_{ch})$

<table>
<tr><td></td><td>

2. Measurement of the emissions identified during the pre-scan

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

Step 1:

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

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

Step 2:

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

Step 3:

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

Step 4:

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

</td></tr>
<tr><td>Measurement Record:</td><td>Uncertainty: ± 6dB</td></tr>
<tr><td>Test mode:</td><td>Kept Rx in receiving mode</td></tr>
<tr><td>Test Instruments:</td><td>See section 6.0</td></tr>
</table>

Measurement Data:

802.11b mode				
The lowest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
81.42	Vertical	-71.57	2nW/ -57dBm below 1GHz, 20nW/ -47dBm above 1GHz.	Pass
693.26	V	-65.50		
4824.00	V	-64.66		
7236.00	V	-57.94		
9648.00	V	-54.47		
12060.00	V	-53.84		
196.77	Horizontal	-71.31		
424.94	H	-64.43		
4824.00	H	-61.59		
7236.00	H	-58.33		
9648.00	H	-55.52		
12060.00	H	-54.08		
The highest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
64.97	Vertical	-72.16	2nW/ -57dBm below 1GHz, 20nW/ -47dBm above 1GHz.	Pass
536.86	V	-65.31		
4944.00	V	-62.93		
7416.00	V	-58.15		
9888.00	V	-54.48		
12360.00	V	-52.93		
154.50	Horizontal	-70.17		
462.90	H	-63.81		
4944.00	H	-62.31		
7416.00	H	-55.56		
9888.00	H	-52.42		
12360.00	H	-52.18		

802.11g mode				
The lowest channel				
Frequency (MHz)	**Spurious Emission**		**Limit (dBm)**	**Test Result**
	polarization	**Level(dBm)**		
71.00	Vertical	-70.60	2nW/ -57dBm below 1GHz, 20nW/ -47dBm above 1GHz.	Pass
549.01	V	-66.53		
4944.00	V	-62.96		
7416.00	V	-58.14		
9888.00	V	-53.93		
12360.00	V	-53.18		
89.95	Horizontal	-70.23		
496.14	H	-66.36		
4944.00	H	-61.73		
7416.00	H	-55.57		
9888.00	H	-53.80		
12360.00	H	-52.62		
The highest channel				
Frequency (MHz)	**Spurious Emission**		**Limit (dBm)**	**Test Result**
	polarization	**Level(dBm)**		
110.01	Vertical	-72.01	2nW/ -57dBm below 1GHz, 20nW/ -47dBm above 1GHz.	Pass
575.88	V	-72.69		
4944.00	V	-62.31		
7416.00	V	-57.35		
9888.00	V	-53.48		
12360.00	V	-52.82		
129.47	Horizontal	-71.44		
671.33	H	-67.78		
4944.00	H	-61.62		
7416.00	H	-56.98		
9888.00	H	-54.31		
12360.00	H	-52.20		

802.11n(HT20) mode				
The lowest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
91.50	Vertical	-70.90	2nW/ -57dBm below 1GHz, 20nW/ -47dBm above 1GHz.	Pass
506.30	V	-68.99		
4824.00	V	-56.14		
7236.00	V	-60.50		
9648.00	V	-57.99		
12060.00	V	-55.57		
100.16	Horizontal	-70.99		
654.37	H	-63.52		
4824.00	H	-55.54		
7236.00	H	-61.05		
9648.00	H	-58.50		
12060.00	H	-54.69		
The highest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
207.12	Vertical	-69.41	2nW/ -57dBm below 1GHz, 20nW/ -47dBm above 1GHz.	Pass
839.56	V	-66.76		
4944.00	V	-63.46		
7416.00	V	-60.20		
9888.00	V	-56.31		
12360.00	V	-54.44		
302.48	Horizontal	-66.34		
861.75	H	-62.63		
4944.00	H	-61.28		
7416.00	H	-56.91		
9888.00	H	-54.88		
12360.00	H	-53.45		

7.3.2 Receiver Blocking

Test Requirement:	ETSI EN 300 328 clause 4.3.2.11
Test Method:	ETSI EN 300 328 clause 5.4.11.2.
Limit:	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.

Table 14: Receiver Blocking parameters for Receiver Category 1 equipment

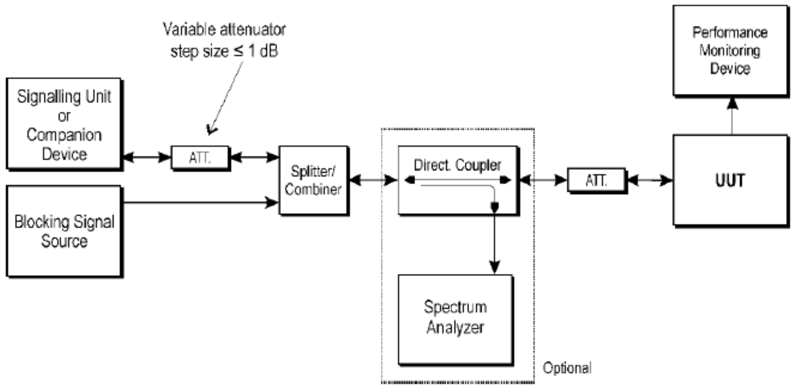
Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 6 dB	2 380 2 503,5	-53	CW
P_{min} + 6 dB	2 300 2 330 2 360	-47	CW
P_{min} + 6 dB	2 523,5 2 553,5 2 583,5 2 613,5 2 643,5 2 673,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.2.11.3 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 15: Receiver Blocking parameters receiver category 2 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 6 dB	2 380 2 503,5	-57	CW
P_{min} + 6 dB	2 300 2 583,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.2.11.3 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 16: Receiver Blocking parameters receiver category 3 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 12 dB	2 380 2 503,5	-57	CW
P_{min} + 12 dB	2 300 2 583,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.2.11.3 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.			

Test setup:	
Test procedure:	For systems using multiple receive chains only one chain (antenna port) need to be tested. All other receiver inputs shall be terminated. The procedure in step 1 to step 6 below shall be used to verify the receiver blocking requirement as described in clause 4.3.1.12 or clause 4.3.2.11. Table 6, table 7 and table 8 in clause 4.3.1.12.4 contain the applicable blocking frequencies and blocking levels for each of the receiver categories for testing Receiver Blocking on frequency hopping equipment. Table 14, table 15 and table 16 in clause 4.3.2.11.4 contain the applicable blocking frequencies and blocking levels for each of the receiver categories for testing Receiver Blocking on equipment using wide band modulations other than FHSS. **Step 1:** For non-frequency hopping equipment, the UUT shall be set to the lowest operating channel. **Step 2:** The blocking signal generator is set to the first frequency as defined in the appropriate table corresponding to the receiver category and type of equipment. **Step 3:** With the blocking signal generator switched off, a communication link is established between the UUT and the associated companion device using the test setup shown in figure 6. The attenuation of the variable attenuator shall be increased in 1 dB steps to a value at which the minimum performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still met. The resulting level for the wanted signal at the input of the UUT is Pmin. 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.

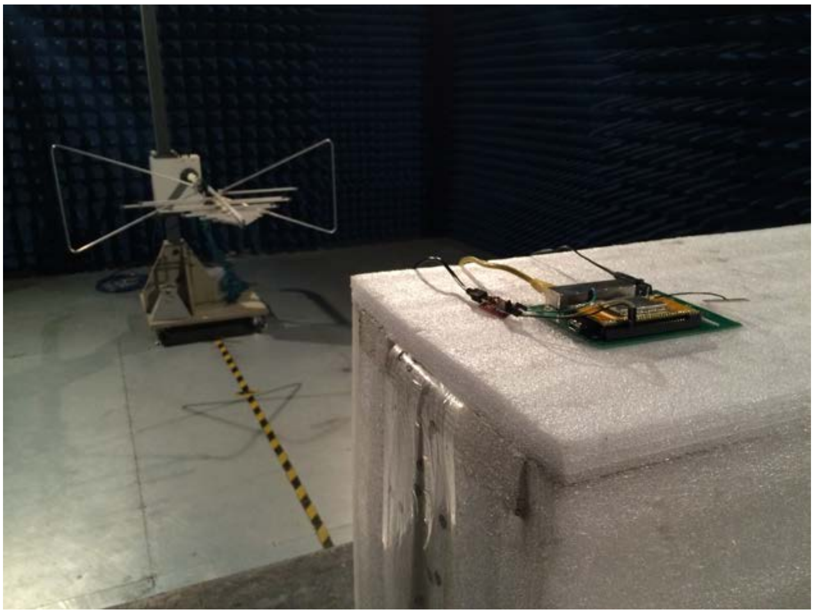
Measurement Record:	Uncertainty: N/A
Test Instruments:	See section 6.0
Test mode:	Normal link mode

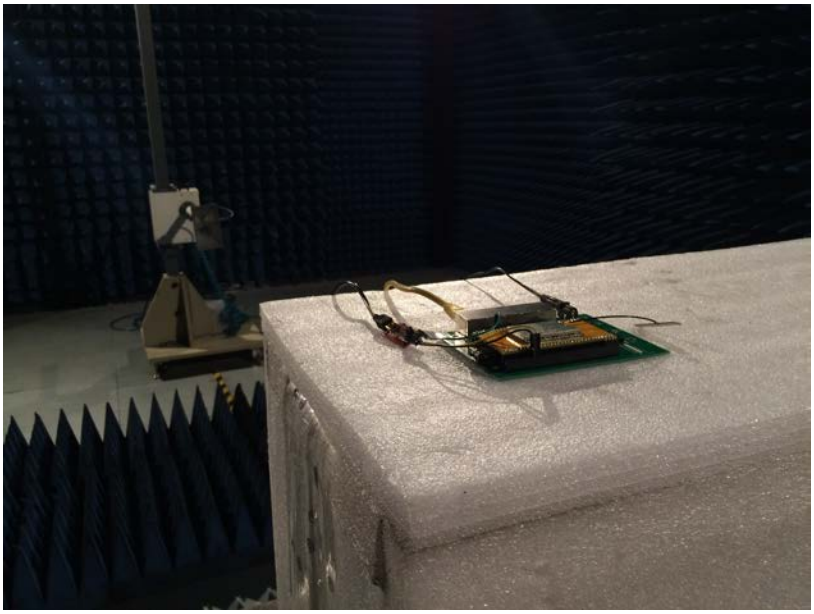
Measurement Data:

Test Channel	P_{min}(dBm)	PER(%)	Limit of PER(%)	Wanted signal mean power companion (P_{min}+6dB)	Blocking signal frequency (MHz)	Blocking signal Power (dBm)	Type of blocking signal	Result
Lowest Channel	-85.68	8.76	10	-79.68	2300.00	-47	CW	Pass
				-79.68	2330.00	-47		
				-79.68	2360.00	-47		
				-79.68	2380.00	-53		
Highest Channel	-86.07	8.59		-80.07	2503.50	-53		
				-80.07	2523.50	-47		
				-80.07	2553.50	-47		
				-80.07	2583.50	-47		
				-80.07	2613.50	-47		
				-80.07	2643.50	-47		
				-80.07	2673.50	-47		
Note: During the blocking test.The value of PER which display on the CMW 500 was no changed.Maybe the value of PER has a slight floating,but no bigger than 10%.								

Remark: According to ETSI EN 300328 V2.1.1 clause 5.4.11.1. Only the lowest data rate of 802.11b mode was tested and recorded. Because this product is an adaptive equipment and the power is greater than 10dBm e.i.r.p. .So it’s belongs to category 1 device.

8 Test setup photo





9 EUT Constructional Details

Reference to the test report No. : GTS201709000079E01

------End------