RADIO TEST REPORT

For

Shenzhen Wesion Technology Co., Ltd.

Single Board Computer

Test Model: VIM2 Max

Additional Model No.: VIM2 Pro, VIM2 Basic

Prepared for	:	Shenzhen Wesion Technology Co., Ltd.
Address	:	Room 511, A Building, Mingyou Purchasing Center, Baoyuan Road, Xixiang Street, Bao'an District, Shenzhen, China. 518102
Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
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Date of receipt of test sample	:	September 22, 2017
Number of tested samples	:	1
Serial number	:	Prototype
Date of Test	:	September 22, 2017~December 05, 2017
Date of Report	:	December 05, 2017

RADIO TEST REPORT

ETSI EN 301 893 V2.1.1 (2017-05)

5 GHz RLAN; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

Report Reference No.	**: LCS170922077AE5**
Date of Issue	: December 05, 2017
Testing Laboratory Name	**: Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address	: 1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Testing Location/ Procedure	: Full application of Harmonised standards ■ Partial application of Harmonised standards ☐ Other standard testing method ☐
Applicant's Name.......................	**: Shenzhen Wesion Technology Co., Ltd.**
Address	: Room 511, A Building, Mingyou Purchasing Center, Baoyuan Road, Xixiang Street, Bao'an District, Shenzhen, China. 518102
Test Specification	
Standard	: ETSI EN 301 893 V2.1.1 (2017-05)
Test Report Form No.	: LCSEMC-1.0
TRF Originator.............................	: Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF	: Dated 2011-03

Test Item Description.	**: Single Board Computer**
Trade Mark..................................	: Khadas
Test Model	: VIM2 Max
Ratings	: Input: 5V⎓ 2000mA Output: USB1: 5V⎓ 900mA USB2: 5V⎓ 500mA
Result	**: Positive**

Compiled by:	**Supervised by:**	**Approved by:**
Raing Ye/ Administrators	Dick Su/ Technique principal	Gavin Liang/ Manager

RADIO -- TEST REPORT

Test Report No. : LCS170922077AE5	December 05, 2017 Date of issue

Test Model..............................	:	VIM2 Max
EUT...	:	Single Board Computer
Applicant...............................	**:**	**Shenzhen Wesion Technology Co., Ltd.**
Address..................................	:	Room 511, A Building, Mingyou Purchasing Center, Baoyuan Road, Xixiang Street, Bao’an District, Shenzhen, China. 518102
Telephone...............................	:	
Fax...	:	
Manufacturer........................	**:**	**Shenzhen Wesion Technology Co., Ltd.**
Address..................................	:	Room 511, A Building, Mingyou Purchasing Center, Baoyuan Road, Xixiang Street, Bao’an District, Shenzhen, China. 518102
Telephone...............................	:	
Fax...	:	
Factory...................................	**:**	**Shenzhen Wesion Technology Co., Ltd.**
Address..................................	:	Room 511, A Building, Mingyou Purchasing Center, Baoyuan Road, Xixiang Street, Bao’an District, Shenzhen, China. 518102
Telephone...............................	:	
Fax...	:	

Test Result	**Positive**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revision History

Revision	Issue Date	Revisions	Revised By
00	December 05, 2017	Initial Issue	Gavin Liang

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Test Report Description Page

1. GENERAL INFORMATION

1.1. Product Description for Equipment Under Test (EUT)

EUT	: Single Board Computer
Test Model	: VIM2 Max
Additional Model No.	: VIM2 Pro, VIM2 Basic
Model Declaration	: PCB board, structure and internal of these model(s) are the same, So no additional models were tested.
Power Supply	: Input: 5V⎓ 2000mA Output: USB1: 5V⎓ 900mA USB2: 5V⎓ 500mA
Hardware Version	: V12
Software Version	: Android 7.1
Bluetooth	
Frequency Range	: 2.402-2.480GHz
Channel Number	: 79 channels for Bluetooth V4.2 (DSS) 40 channels for Bluetooth V4.2 (DTS)
Channel Spacing	: 1MHz for Bluetooth V4.2 (DSS) 2MHz for Bluetooth V4.2 (DTS)
Modulation Type	: GFSK, π /4-DQPSK, 8-DPSK for Bluetooth V4.2 (DSS) GFSK for Bluetooth V4.2 (DTS)
Bluetooth Version	: V4.2
Antenna Description	: PCB Antenna, 2.5dBi (Max.)
2.4G WLAN	
Frequency Range	: 2.412-2.472GHz
Channel Number	: 13 Channels for WIFI 20MHz Bandwidth(802.11b/g/n-HT20) 11 Channels for WIFI 40MHz Bandwidth(802.11n-HT40)
Channel Spacing	: 5MHz
Modulation Type	: IEEE 802.11b: DSSS(CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n: OFDM (64QAM, 16QAM,QPSK,BPSK)
Antenna Description	: PCB Antenna, 2.5dBi (Max.)
WIFI(5.2G Band)	
Frequency Range	: 5180-5240MHz / 5260-5320MHz / 5500-5720MHz
Channel Number	: 4 Channels for 20MHz bandwidth(5180-5240MHz) 4 Channels for 20MHz bandwidth(5260-5320MHz) 12 Channels for 20MHz bandwidth(5500-5720MHz) 2 channels for 40MHz bandwidth(5190~5230MHz) 2 channels for 40MHz bandwidth(5270~5310MHz) 6 Channels for 40MHz bandwidth(5510-5710MHz) 1 channels for 80MHz bandwidth(5210MHz) 1 channels for 80MHz bandwidth(5290MHz) 3 Channels for 80MHz bandwidth(5530-5690MHz)
Modulation Type	: 802.11a/n/ac: OFDM
Antenna Description	: PCB Antenna, 2.5dBi (Max.)
SRD(5.8G Band)	
Frequency Range	: 5745-5825MHz
Channel Number	: 5 Channels for 20MHz bandwidth(5725-5825MHz) 2 channels for 40MHz bandwidth(5755~5795MHz) 1 channels for 80MHz bandwidth(5775MHz)

Modulation Type : 802.11a/n/ac: OFDM
Antenna Description : PCB Antenna, 2.5dBi (Max.)

1.2. Objective

This Type approval report is prepared on behalf of **Shenzhen Wesion Technology Co., Ltd.** in accordance with ETSI EN 301 893 V2.1.1 (2017-05): 5 GHz RLAN; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

The objective is to determine compliance with ETSI EN 301 893 V2.1.1 (2017-05).

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

No Related Submittals.

1.4. Test Methodology

All measurements contained in this report were conducted with ETSI EN 301 893 V2.1.1 (2017-05).

1.5. Description of Test Facility

FCC Registration Number. is 254912.
Industry Canada Registration Number. is 9642A-1.
ESMD Registration Number. is ARCB0108.
UL Registration Number. is 100571-492.
TUV SUD Registration Number. is SCN1081.
TUV RH Registration Number. is UA 50296516-001.
NVLAP Registration Code is 600167-0.

1.6. Support equipment List

Manufacturer	Description	Model	Serial Number	Certificate
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1.7. External I/O

I/O Port Description	Quantity	Cable
LAN Port	1	N/A
USB Port	2	N/A
Type-C Sort	1	0.8m, shielded
HDMI Slot	1	1.0m, shielded
Audio Output Port	1	1.0m, shielded
TF Card Slot	1	N/A

1.8. Measurement Uncertainty

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

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

1.9. Test Environment

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	25
Humidity (%RH)	25-75	50
Barometric pressure (mbar)	860-1060	950-1000

1.10. Description Of Test Modes

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

Test Mode
Mode 1: Transmit by 802.11a
Mode 2: Transmit by 802.11n(20MHz)
Mode 3: Transmit by 802.11n(40MHz)
Mode 4: Transmit by 802.11ac(80MHz)
Mode 5: Receive by 802.11a
Mode 6: Receive by 802.11n(20MHz)
Mode 7: Receive by 802.11n(40MHz)
Mode 8: Receive by 802.11ac(80MHz)

Note:

(1) For portable device, radiated spurious emission was verified over X, Y, Z Axis, and shown the worst case on this report.

(2) Regard to the frequency band operation for systems using Wide Band modulation: the lowest, middle, highest frequency channel for conducted test, and the lowest, highest frequency channel for radiation spurious test.

(3) The extreme test condition for voltage and temperature were declared by the manufacturer.

2. SYSTEM TEST CONFIGURATION

2.1. Justification

The system was configured for testing in engineering mode.

2.2. EUT Exercise Software

N/A.

2.3. Special Accessories

N/A.

2.4. Block Diagram/Schematics

Please refer to the related document.

2.5. Equipment Modifications

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

2.6. Configuration of Test Setup

Please refer to the test setup photo.

3. SUMMARY OF TEST RESULT

☒ No deviations from the test standards

☐ Deviations from the test standards as below description:

Performed Test Item	Normative References	Test Performed	Deviation
Centre Frequencies	ETSI EN 300 893 V2.1.1 (2017-05)	Yes	No
Nominal Channel Bandwidth and Occupied Channel Bandwidth	ETSI EN 300 893 V2.1.1 (2017-05)	Yes	No
RF Output Power	ETSI EN 300 893 V2.1.1 (2017-05)	Yes	No
Transmit Power Control (TPC)	ETSI EN 300 893 V2.1.1 (2017-05)	N/A	N/A
Power Density	ETSI EN 300 893 V2.1.1 (2017-05)	Yes	No
Transmitter unwanted emissions outside the 5 GHz RLAN bands	ETSI EN 300 893 V2.1.1 (2017-05)	Yes	No
Transmitter unwanted emissions within the 5 GHz RLAN bands	ETSI EN 300 893 V2.1.1 (2017-05)	Yes	No
Receiver spurious emissions	ETSI EN 300 893 V2.1.1 (2017-05)	Yes	No
Dynamic Frequency Selection (DFS)	ETSI EN 300 893 V2.1.1 (2017-05)	N/A	N/A
Adaptivity (Channel Access Mechanism)	ETSI EN 300 893 V2.1.1 (2017-05)	Yes	No
Receiver Blocking	ETSI EN 300 893 V2.1.1 (2017-05)	Yes	No
User Access Restrictions	ETSI EN 300 893 V2.1.1 (2017-05)	Yes	No
Geo-location capability	ETSI EN 300 893 V2.1.1 (2017-05)	N/A	N/A

Note:
1. The EUT can operate in an adaptive mode, and can’t operate in a non-adaptive mode which is stated by the supplier.
2. The EUT is equipment which using wide band modulations other than FHSS. It is an adaptive equipment which can’t operate in non-adaptive mode.
3. N/A: the test item not required for channels whose nominal bandwidth falls completely within the band 5150 MHz to 5250 MHz.

4. CENTRE FREQUENCIES

4.1. Limit

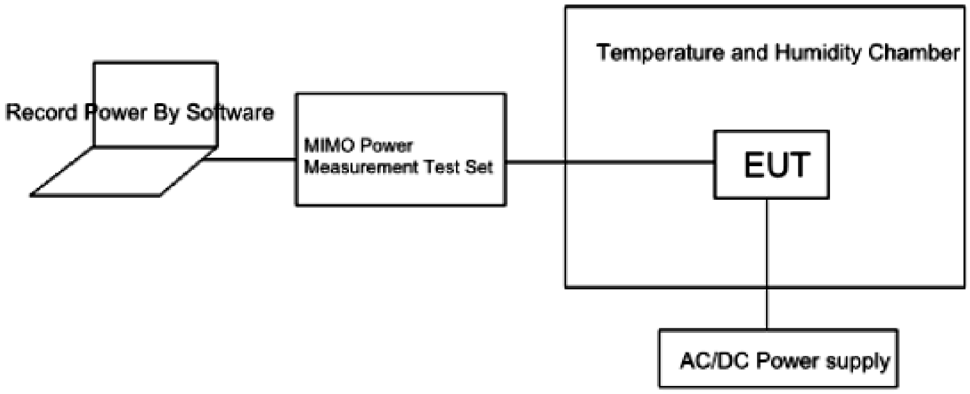
The centre frequency is the centre of the channel declared by the manufacturer as part of the declared channel plan(s).

The actual centre frequency for any given channel declared by the manufacturer shall be maintained within the range fc ±20 ppm.

In case of conducted measurements on smart antenna systems (devices with multiple transmit chains) the measurements shall be performed on only one of the active transmit chains.

4.2. Test Setup

These measurements shall be performed under both normal and extreme test conditions.
For Conducted Measurement



4.3. Test Procedure

Refer to ETSI EN 301 908 V2.1.1 (2017-05) Clause 5.4.2

Conducted measurement:

1) Equipment operating without modulation

• This test method requires that the UUT can be operated in an unmodulated test mode.

• The UUT shall be connected to a suitable frequency measuring device (e.g. a frequency counter or a spectrum analyser) and operated in an unmodulated mode.

• The result shall be recorded.

2) Equipment operating with modulation

• This method is an alternative to the above method in case the UUT cannot be operated in an un-modulated mode.

• The UUT shall be connected to spectrum analyser.

• Max Hold shall be selected and the centre frequency adjusted to that of the UUT.

• The peak value of the power envelope shall be measured and noted. The span shall be reduced and the marker moved in a positive frequency increment until the upper, (relative to the centre frequency), -10 dBc point is reached. This value shall be noted as f_H.

• The marker shall then be moved in a negative frequency increment until the lower, (relative to the centre frequency), -10 dBc point is reached. This value shall be noted as f_L.

• The centre frequency is calculated as $(f_H + f_L) / 2$.

4.4. Test Result

Pass

Test Conditions		Reference Frequency: 5180 MHz 802.11a (TX0)				
Temperature (℃)	Voltage (V_{DC})	F_L (MHz)	F_H (MHz)	$(F_H+F_L)/2$ (MHz)	Frequency Deviation (ppm)	Limit (ppm)
-20℃	DC 4.5V	5163.82	5196.14	5179.98	-4.00	±20
	DC 5V	5163.85	5196.14	5180.00	-0.45	
	DC 5.5V	5163.89	5196.14	5180.02	3.06	
25℃	DC 4.5V	5163.83	5196.11	5179.97	-5.14	
	DC 5V	5163.87	5196.17	5180.02	3.78	
	DC 5.5V	5163.82	5196.13	5179.97	-5.21	
45℃	DC 4.5V	5163.82	5196.20	5180.01	1.49	
	DC 5V	5163.83	5196.19	5180.01	1.46	
	DC 5.5V	5163.87	5196.18	5180.03	5.39	

Test Conditions		Reference Frequency: 5180 MHz 802.11n(20MHz) (TX0)				
Temperature (℃)	Voltage (V_{DC})	F_L (MHz)	F_H (MHz)	$(F_H+F_L)/2$ (MHz)	Frequency Deviation (ppm)	Limit (ppm)
-20℃	DC 4.5V	5172.83	5187.16	5179.99	-1.06	±20
	DC 5V	5172.85	5187.19	5180.02	4.58	
	DC 5.5V	5172.81	5187.15	5179.98	-4.17	
25℃	DC 4.5V	5172.82	5187.15	5179.98	-3.73	
	DC 5V	5172.84	5187.10	5179.97	-5.11	
	DC 5.5V	5172.80	5187.10	5179.95	-8.89	
45℃	DC 4.5V	5172.90	5187.18	5180.04	7.84	
	DC 5V	5172.81	5187.14	5179.97	-4.85	
	DC 5.5V	5172.81	5187.19	5180.00	-0.34	

Test Conditions		Reference Frequency: 5190 MHz 802.11n(40MHz) (TX0)				
Temperature (℃)	Voltage (V_{DC})	F_L (MHz)	F_H (MHz)	$(F_H+F_L)/2$ (MHz)	Frequency Deviation (ppm)	Limit (ppm)
-20℃	DC 4.5V	5173.89	5206.16	5190.03	5.25	±20
	DC 5V	5173.87	5206.12	5189.99	-0.97	
	DC 5.5V	5173.85	5206.11	5189.98	-3.39	
25℃	DC 4.5V	5173.86	5206.10	5189.98	-4.24	
	DC 5V	5173.82	5206.12	5189.97	-5.91	
	DC 5.5V	5173.87	5206.17	5190.02	4.42	
45℃	DC 4.5V	5173.87	5206.19	5190.03	5.35	
	DC 5V	5173.83	5206.14	5189.99	-2.65	
	DC 5.5V	5173.83	5206.20	5190.01	2.45	

Test Conditions		Reference Frequency: 5210 MHz 802.11ac(80MHz) (TX0)				
Temperature (℃)	Voltage (V_{DC})	F_L (MHz)	F_H (MHz)	$(F_H+F_L)/2$ (MHz)	Frequency Deviation (ppm)	Limit (ppm)
-20℃	DC 4.5V	5180.81	5239.11	5209.96	-7.49	±20
	DC 5V	5180.86	5239.14	5210.00	0.40	
	DC 5.5V	5180.88	5239.15	5210.02	3.44	
25℃	DC 4.5V	5180.87	5239.13	5210.00	0.06	
	DC 5V	5180.89	5239.12	5210.00	0.69	
	DC 5.5V	5180.89	5239.15	5210.02	3.48	
45℃	DC 4.5V	5180.86	5239.19	5210.03	4.89	
	DC 5V	5180.87	5239.13	5210.00	0.13	
	DC 5.5V	5180.90	5239.19	5210.04	7.94	

Test Conditions		Reference Frequency: 5180 MHz 802.11a (TX1)				
Temperature (℃)	Voltage (V_{DC})	F_L (MHz)	F_H (MHz)	$(F_H+F_L)/2$ (MHz)	Frequency Deviation (ppm)	Limit (ppm)
-20℃	DC 4.5V	5163.87	5196.17	5180.02	4.43	±20
	DC 5V	5163.89	5196.10	5180.00	-0.65	
	DC 5.5V	5163.87	5196.12	5180.00	-0.82	
25℃	DC 4.5V	5163.81	5196.15	5179.98	-4.22	
	DC 5V	5163.85	5196.15	5180.00	0.00	
	DC 5.5V	5163.86	5196.14	5180.00	-0.01	
45℃	DC 4.5V	5163.80	5196.14	5179.97	-6.03	
	DC 5V	5163.83	5196.11	5179.97	-6.13	
	DC 5.5V	5163.86	5196.12	5179.99	-1.94	

Test Conditions		Reference Frequency: 5180 MHz 802.11n(20MHz) (TX1)				
Temperature (℃)	Voltage (V_{DC})	F_L (MHz)	F_H (MHz)	$(F_H+F_L)/2$ (MHz)	Frequency Deviation (ppm)	Limit (ppm)
-20℃	DC 4.5V	5172.86	5187.14	5180.00	-0.31	±20
	DC 5V	5172.89	5187.14	5180.01	2.18	
	DC 5.5V	5172.81	5187.13	5179.97	-5.71	
25℃	DC 4.5V	5172.84	5187.13	5179.99	-2.78	
	DC 5V	5172.82	5187.10	5179.96	-7.56	
	DC 5.5V	5172.89	5187.16	5180.02	4.78	
45℃	DC 4.5V	5172.80	5187.14	5179.97	-5.32	
	DC 5V	5172.84	5187.13	5179.99	-2.61	
	DC 5.5V	5172.82	5187.12	5179.97	-5.82	

Test Conditions		Reference Frequency: 5190 MHz 802.11n(40MHz) (TX1)				
Temperature (℃)	Voltage (V_{DC})	F_L (MHz)	F_H (MHz)	$(F_H+F_L)/2$ (MHz)	Frequency Deviation (ppm)	Limit (ppm)
-20℃	DC 4.5V	5173.81	5206.11	5189.96	-6.97	±20
	DC 5V	5173.87	5206.10	5189.99	-2.36	
	DC 5.5V	5173.85	5206.16	5190.00	0.80	
25℃	DC 4.5V	5173.80	5206.20	5190.00	0.36	
	DC 5V	5173.85	5206.16	5190.00	0.78	
	DC 5.5V	5173.87	5206.13	5190.00	0.08	
45℃	DC 4.5V	5173.86	5206.18	5190.02	4.44	
	DC 5V	5173.87	5206.14	5190.00	0.44	
	DC 5.5V	5173.86	5206.10	5189.98	-3.93	

Test Conditions		Reference Frequency: 5210 MHz 802.11ac(80MHz) (TX1)				
Temperature (℃)	Voltage (V_{DC})	F_L (MHz)	F_H (MHz)	$(F_H+F_L)/2$ (MHz)	Frequency Deviation (ppm)	Limit (ppm)
-20℃	DC 4.5V	5180.90	5239.15	5210.02	4.16	±20
	DC 5V	5180.81	5239.14	5209.98	-4.53	
	DC 5.5V	5180.86	5239.17	5210.01	2.16	
25℃	DC 4.5V	5180.85	5239.16	5210.00	0.67	
	DC 5V	5180.84	5239.16	5210.00	0.10	
	DC 5.5V	5180.83	5239.15	5209.99	-2.64	
45℃	DC 4.5V	5180.87	5239.14	5210.00	0.45	
	DC 5V	5180.86	5239.13	5210.00	-0.77	
	DC 5.5V	5180.90	5239.16	5210.03	5.51	

5. NOMINAL CHANNEL BANDWIDTH AND OCCUPIED CHANNEL BANDWIDTH

5.1. Limit

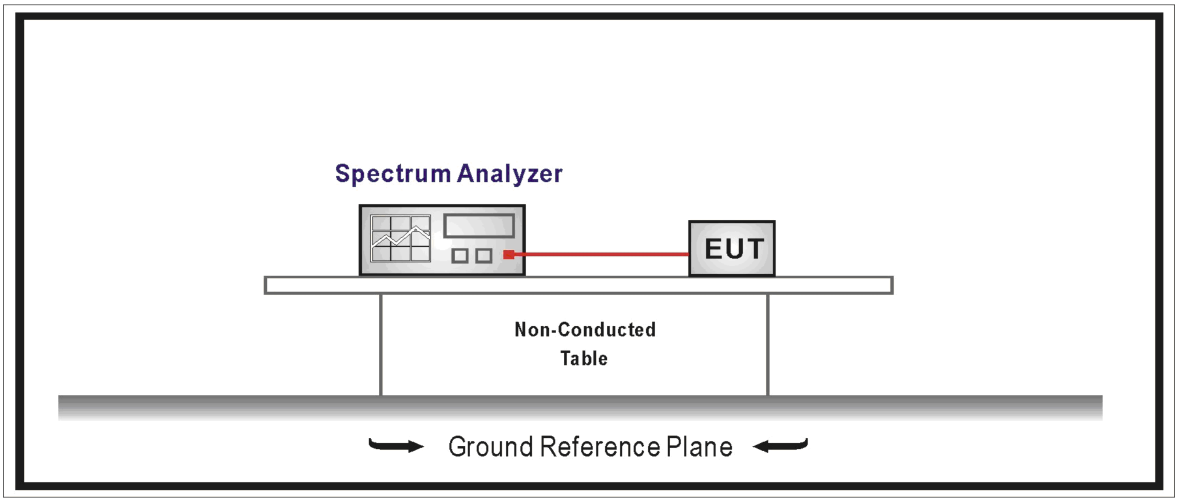
The Nominal Channel Bandwidth is the widest band of frequencies, inclusive of guard bands, assigned to a single channel.
The Nominal Channel Bandwidth shall be at least 5 MHz at all times.

The Occupied Channel Bandwidth is the bandwidth containing 99 % of the power of the signal.
The Occupied Channel Bandwidth shall be between 80 % and 100 % of the declared Nominal Channel Bandwidth. In case of smart antenna systems (devices with multiple transmit chains) each of the transmit chains shall meet this requirement.

During an established communication, the device is allowed to operate temporarily with an Occupied Channel Bandwidth below 80 % of its Nominal Channel Bandwidth with a minimum of 4 MHz.

5.2. Test Setup

The conformance requirements shall be verified only under normal operating conditions.



5.3. Test Procedure

Refer to ETSI EN 301 893 V2.1.1 (2017-05) Clause 5.4.3

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 Bandwidth: 100 kHz
• Video Bandwidth: 300 kHz
• Frequency Span: 2 × Nominal Bandwidth (e.g. 40 MHz for a 20 MHz channel)

• Sweep time: > 1 s; for larger Nominal Bandwidths, the sweep time may be increased until a value where the sweep time has no impact on the RMS value of the signal
• Detector Mode: RMS
• Trace Mode: Max Hold

Step 2:

Wait for the trace to stabilize.

Step 3:

• 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.
• Use the 99 % bandwidth function of the spectrum analyser to measure the Occupied Channel Bandwidth of the UUT. This value shall be recorded.

The measurement described in step 1 to step 3 above shall be repeated in case of simultaneous transmissions in non-adjacent channels.

5.4. Test Result

Pass

UUT Mode (Chain 0)	Nominal Bandwidth (MHz)	Nominal Bandwidth Limit (MHz)	Measurement Occupied Channel Bandwidth (MHz)		Occupied Channel Bandwidth Limit (MHz)
			TX0	TX1	
802.11a	20	5≤BW	16.38	16.35	16≤BW≤20
802.11n(20MHz)	20	5≤BW	17.58	17.51	16≤BW≤20
802.11n(40MHz)	40	5≤BW	35.93	35.87	32≤BW≤40
802.11ac(80MHz)	80	5≤BW	75.54	75.50	64≤BW≤80

6. RF OUTPUT POWER, TRANSMIT POWER CONTROL (TPC) AND POWER DENSITY

6.1. Limit

The RF Output Power is the mean equivalent isotropically radiated power (e.i.r.p.) during a transmission burst.
Transmit Power Control (TPC) is a mechanism to be used by the RLAN device to ensure a mitigation factor of at least 3 dB on the aggregate power from a large number of devices. This requires the RLAN device to have a TPC range from which the lowest value is at least 6 dB below the values for mean e.i.r.p. given in table 1 for devices with TPC.
TPC is not required for channels whose nominal bandwidth falls completely within the band 5150 MHz to 5250 MHz.
The Power Density is the mean equivalent isotropically radiated power (e.i.r.p.) density during a transmission burst.

For devices with TPC, the RF output power and the power density when configured to operate at the highest stated power level of the TPC range shall not exceed the levels given in table 1.
Devices are allowed to operate without TPC. See table 1 for the applicable limits in this case.

Table 1: Mean e.i.r.p. limits for RF output power and power density at the highest power level

Frequency range [MHz]	Mean e.i.r.p. limit [dBm]		Mean e.i.r.p. density limit [dBm/MHz]	
	with TPC	without TPC	with TPC	without TPC
5 150 to 5 350	23	20/23 (see note 1)	10	7/10 (see note 2)
5 470 to 5 725	30 (see note 3)	27 (see note 3)	17 (see note 3)	14 (see note 3)

NOTE 1: The applicable limit is 20 dBm, except for transmissions whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz, in which case the applicable limit is 23 dBm.
NOTE 2: The applicable limit is 7 dBm/MHz, except for transmissions whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz, in which case the applicable limit is 10 dBm/MHz.
NOTE 3: Slave devices without a Radar Interference Detection function shall comply with the limits for the band 5 250 MHz to 5 350 MHz.

For devices using TPC, the RF output power during a transmission burst when configured to operate at the lowest stated power level of the TPC range shall not exceed the levels given in table 2. For devices without TPC, the limits in table 2 do not apply.

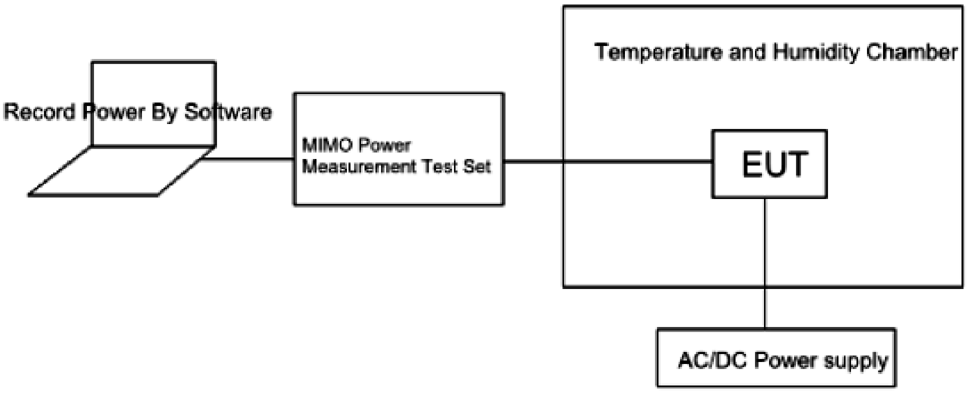
Table 2: Mean e.i.r.p. limits for RF output power at the lowest power level of the TPC range

Frequency range	Mean e.i.r.p. [dBm]
5 250 MHz to 5 350 MHz	17
5 470 MHz to 5 725 MHz	24 (see note)

NOTE: Slave devices without a Radar Interference Detection function shall comply with the limits for the band 5 250 MHz to 5 350 MHz.

6.2. Test Setup

For Conducted Measurement



6.3. Test Procedure

Refer to ETSI EN 301 893 V2.1.1 (2017-05) Clause 5.4.4

Conducted measurement:

1) Measurement For RF Output Power

The measurement shall be performed under both normal and extreme test conditions.

Step 1:

• The equipment is configured into a continuous transmit mode (x = 1), proceed immediately with step 2.

Step 2:

• The RF output power shall be determined using a wideband RF power meter with a thermocouple detector or an equivalent thereof and with an integration period that exceeds the repetition period of the transmitter by a factor 5 or more. The observed value shall be noted as A (in dBm).

• In case of conducted measurements on smart antenna systems operating in a mode with multiple transmit chains active simultaneously, the output power of each transmit chain shall be measured separately to calculate the total power (value A in dBm) for the UUT.

Step 3:

• The RF output power at the highest power level P_H (e.i.r.p.) shall be calculated from the above measured power output A (in dBm), the observed duty cycle x, the stated antenna gain G in dBi and if applicable the beamforming gain Y in dB, according to the formula below. This value shall be recorded in the test report. If more than one antenna assembly is intended for this power setting or TPC range, the gain of the antenna assembly with the highest gain shall be used.

$$P_H = A + G + Y + 10 \times \log (1 / x) \text{ (dBm)}.$$

2) Measurement For Power Density

The measurement shall only be performed at normal test conditions.

Step 1:

- Connect the UUT to the spectrum analyser and use the following settings:
- Centre Frequency: The centre frequency of the channel under test
- RBW: 1MHz
- VBW: 3MHz
- Frequency Span: 2 × Nominal Bandwidth (e.g. 40 MHz for a 20 MHz channel)
- Detector Mode: Peak
- Trace Mode: Max Hold

Step 2:

- When the trace is complete, find the peak value of the power envelope and record the frequency.

Step 3:

- Make the following changes to the settings of the spectrum analyser:
- Centre Frequency: Equal to the frequency recorded in step 2
- Frequency Span: 3MHz
- RBW: 1MHz
- VBW: 3MHz
- Sweep Time: 1 minute
- Detector Mode: RMS
- Trace Mode: Max Hold

Step 4:

- When the trace is complete, the trace shall be captured using the "Hold" or "View" option on the spectrum analyser.
- Find the peak value of the trace and place the analyser marker on this peak. This level is recorded as the highest mean power (power density) D in a 1 MHz band.
- Alternatively, where a spectrum analyser is equipped with a function to measure spectral power density, this function may be used to display the power density D in dBm / MHz.
- In case of conducted measurements on smart antenna systems operating in a mode with multiple transmit chains active simultaneously, the power density of each transmit chain shall be measured separately to calculate the total power density (value D in dBm / MHz) for the UUT.

Step 5:

- The maximum spectral power density e.i.r.p. is calculated from the above measured power density D, the observed duty cycle x, the applicable antenna assembly gain G in dBi and if applicable the beamforming gain Y in dB, according to the formula below. This value shall be recorded in the test report. If more than one antenna assembly is intended for this power setting, the gain of the antenna assembly with the highest gain shall be used.

$$PD = D + G + Y + 10 \times \log (1 / x) \text{ (dBm / MHz)}$$

6.4. Test Result

Pass

Test Conditions		The Lowest Declared Channel: 5180MHz 802.11a		
Temperature (℃)	Voltage (V_{DC})	RF Output Power EIRP (dBm)		Limit (dBm)
		TX0	TX1	
-20℃	DC 4.5V	15.73	15.69	23
	DC 5V	15.72	15.62	
	DC 5.5V	15.14	15.18	
25℃	DC 4.5V	15.21	15.32	
	DC 5V	15.28	15.34	
	DC 5.5V	15.65	15.64	
45℃	DC 4.5V	15.64	15.59	
	DC 5V	15.25	15.22	
	DC 5.5V	15.81	15.83	

Test Conditions		The Lowest Declared Channel: 5180MHz 802.11n(20MHz)			
Temperature (℃)	Voltage (V_{DC})	RF Output Power EIRP (dBm)			Limit (dBm)
		TX0	TX1	TX0+TX1	
-20℃	DC 4.5V	15.20	15.24	18.23	23
	DC 5V	15.54	15.53	18.54	
	DC 5.5V	15.01	15.03	18.03	
25℃	DC 4.5V	15.59	15.63	18.62	
	DC 5V	15.71	15.69	18.71	
	DC 5.5V	15.44	15.45	18.46	
45℃	DC 4.5V	15.42	15.58	18.51	
	DC 5V	14.89	14.77	17.84	
	DC 5.5V	15.33	15.26	18.31	

Test Conditions		The Lowest Declared Channel: 5190MHz 802.11n(40MHz)			
Temperature (℃)	Voltage (V_{DC})	RF Output Power EIRP (dBm)			Limit (dBm)
		TX0	TX1	TX0+TX1	
-20℃	DC 4.5V	14.72	14.65	17.70	23
	DC 5V	14.64	14.60	17.63	
	DC 5.5V	14.90	14.89	17.91	
25℃	DC 4.5V	14.24	14.18	17.22	
	DC 5V	14.71	14.59	17.66	
	DC 5.5V	14.87	14.87	17.88	
45℃	DC 4.5V	14.79	14.82	17.82	
	DC 5V	14.22	14.18	17.21	
	DC 5.5V	14.11	14.26	17.19	

Test Conditions		The Lowest Declared Channel: 5210MHz 802.11ac(80MHz)			
Temperature (℃)	Voltage (V_{DC})	RF Output Power EIRP (dBm)			Limit (dBm)
		TX0	TX1	TX0+TX1	
-20℃	DC 4.5V	14.56	14.67	17.62	23
	DC 5V	14.37	14.33	17.36	
	DC 5.5V	15.08	15.10	18.10	
25℃	DC 4.5V	15.32	15.38	18.36	
	DC 5V	14.81	14.66	17.75	
	DC 5.5V	15.16	15.30	18.24	
45℃	DC 4.5V	15.23	15.31	18.28	
	DC 5V	14.52	14.54	17.54	
	DC 5.5V	14.58	14.55	17.58	

Test Conditions	The Lowest Declared Channel: 5180MHz 802.11a		
	Power Density (dBm/MHz)		Limit (dBm/MHz)
	TX0	TX1	
Normal	4.66	4.71	10

Test Conditions	The Lowest Declared Channel: 5180MHz 802.11n(20MHz)			
	Power Density (dBm/MHz)			Limit (dBm/MHz)
	TX0	TX1	TX0+TX1	
Normal	4.45	4.55	7.51	10

Test Conditions	The Lowest Declared Channel: 5190MHz 802.11n(40MHz)			
	Power Density (dBm/MHz)			Limit (dBm/MHz)
	TX0	TX1	TX0+TX1	
Normal	3.78	3.85	6.82	10

Test Conditions	The Lowest Declared Channel: 5210MHz 802.11ac(80MHz)			
	Power Density (dBm/MHz)			Limit (dBm/MHz)
	TX0	TX1	TX0+TX1	
Normal	2.42	2.38	5.41	10

7. TRANSMITTER UNWANTED EMISSIONS OUTSIDE THE 5 GHZ RLAN BANDS

7.1. Limit

Transmitter unwanted emissions outside the 5 GHz RLAN bands are radio frequency emissions outside the 5 GHz RLAN bands(total frequency range that consists of the 5150 MHz to 5350 MHz and the 5470 MHz to 5725 MHz sub-bands).

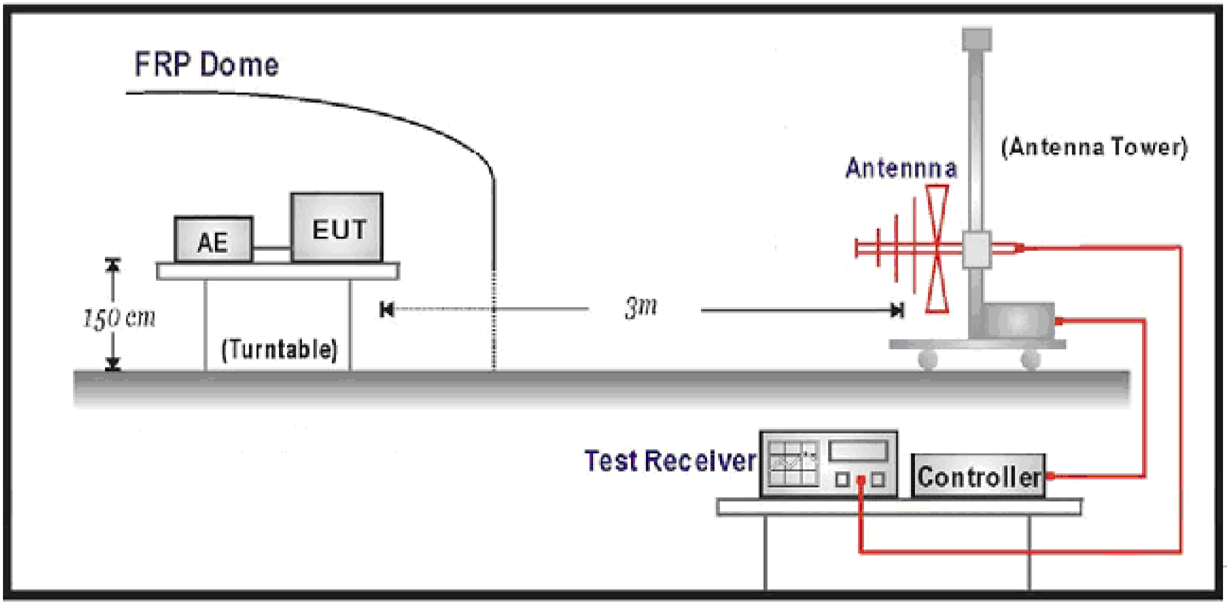
The level of transmitter unwanted emissions outside the 5 GHz RLAN bands shall not exceed the limits given in table 3.

Table 3: Transmitter unwanted emission limits outside the 5 GHz RLAN bands

Frequency range	Maximum power	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 5,15 GHz	-30 dBm	1 MHz
5,35 GHz to 5,47 GHz	-30 dBm	1 MHz
5,725 GHz to 26 GHz	-30 dBm	1 MHz

11.2. Test Setup

For Radiated Measurement



7.3. Test Procedure

Refer to ETSI EN 301 893 V2.1.1 (2017-05) Clause 5.4.5
The conformance requirements shall be verified only under normal operating conditions.

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 table 3.

Step 2:

The unwanted emissions over the range 30 MHz to 1000 MHz shall be identified.
Spectrum analyser settings:

- Resolution bandwidth: 100 kHz
- Video bandwidth: 300 kHz
- Detector mode: Peak
- Trace Mode: Max Hold
- Sweep Points: ≥ 9700

NOTE: 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.
- Allow the trace to stabilize. Any emissions identified that have a margin of less than 6 dB with respect to the limits given in table 3 shall be individually measured and compared to the limits given in table 3.

Step 3:

The unwanted emissions over the range 1 GHz to 26 GHz shall be identified.
Spectrum analyser settings:

- Resolution bandwidth: 1 MHz
- Video bandwidth: 3 MHz
- Detector mode: Peak
- Trace Mode: Max Hold
- Sweep Points: ≥ 25000

NOTE: For spectrum analysers not supporting this number of sweep points, the frequency band may 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.
- Allow the trace to stabilize. Any emissions identified that have a margin of less than 6 dB with respect to the limits given in table 3 shall be individually measured and compared to the limits given in table 3.

Note: For continuous transmit signals, a simple measurement using the RMS detector of the spectrum analyser is permitted. The measured values shall be recorded and compared with the limits in table 3.

7.4. Test Result

The Worst Test Result For 802.11a (The Worst Case: TX0)					
Frequency (MHz)	Polarization (H/V)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector
Channel 36 (5180MHz)					
54.96	H	-84.88	-54.00	-30.88	PK
63.53	V	-74.47	-54.00	-20.47	PK
805.66	H	-77.91	-54.00	-23.91	PK
920.27	V	-76.48	-36.00	-40.48	PK
3190.07	H	-50.41	-30.00	-20.41	PK
3184.65	V	-61.89	-30.00	-31.89	PK
10360.07	H	-55.58	-30.00	-25.58	PK
10360.07	V	-52.26	-30.00	-22.26	PK

The Worst Test Result For 802.11n(20MHz) (The Worst Case: TX0+TX1)					
Frequency (MHz)	Polarization (H/V)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector
Channel 36 (5180MHz)					
54.95	H	-83.54	-54.00	-29.54	PK
63.14	V	-75.61	-54.00	-21.61	PK
806.28	H	-77.05	-54.00	-23.05	PK
922.25	V	-75.76	-36.00	-39.76	PK
3203.80	H	-50.54	-30.00	-20.54	PK
3175.22	V	-62.12	-30.00	-32.12	PK
10360.06	H	-54.11	-30.00	-24.11	PK
10360.08	V	-52.45	-30.00	-22.45	PK

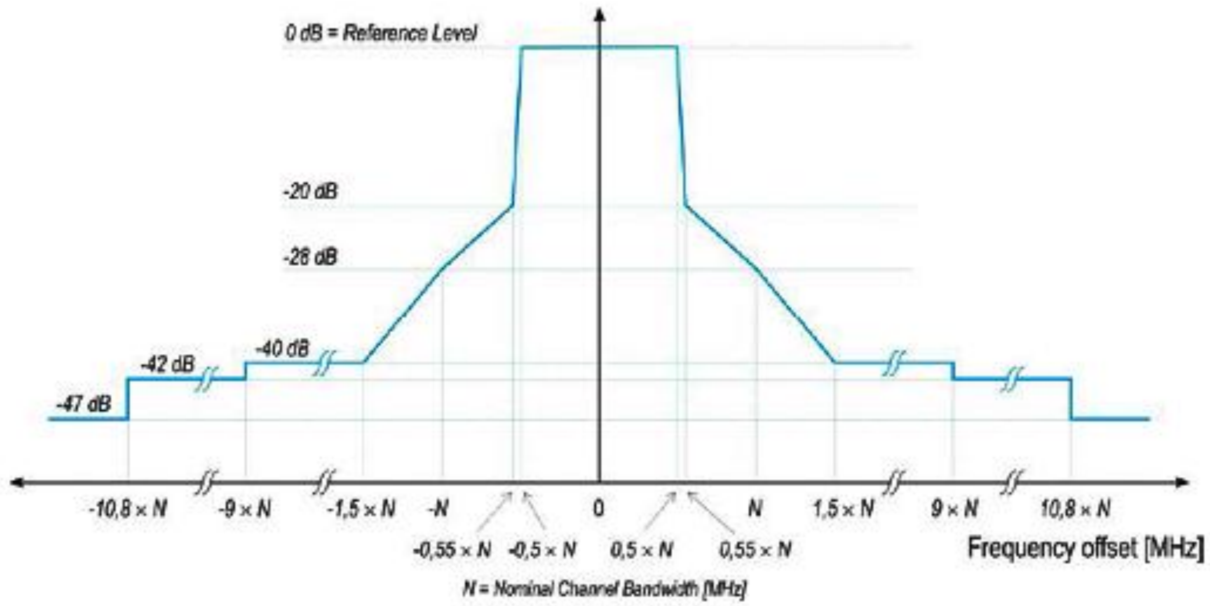
The Worst Test Result For 802.11n(40MHz) (The Worst Case: TX0+TX1)					
Frequency (MHz)	Polarization (H/V)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector
Channel 38 (5190MHz)					
54.48	H	-84.76	-54.00	-30.76	PK
62.80	V	-74.50	-54.00	-20.50	PK
805.99	H	-77.28	-54.00	-23.28	PK
920.16	V	-76.50	-36.00	-40.50	PK
3191.14	H	-50.76	-30.00	-20.76	PK
3202.66	V	-62.11	-30.00	-32.11	PK
10380.05	H	-54.96	-30.00	-24.96	PK
10380.01	V	-51.89	-30.00	-21.89	PK

The Worst Test Result For 802.11ac(80MHz) (The Worst Case: TX0+TX1)					
Frequency (MHz)	Polarization (H/V)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector
Channel 42 (5210MHz)					
55.44	H	-83.01	-54.00	-29.01	PK
62.64	V	-75.97	-54.00	-21.97	PK
805.75	H	-76.91	-54.00	-22.91	PK
921.30	V	-75.47	-36.00	-39.47	PK
3183.37	H	-49.90	-30.00	-19.90	PK
3172.26	V	-62.20	-30.00	-32.20	PK
10360.05	H	-54.30	-30.00	-24.30	PK
10360.05	V	-52.89	-30.00	-22.89	PK

8. TRANSMITTER UNWANTED EMISSIONS WITHIN THE 5 GHZ RLAN BANDS

8.1. Limit

Transmitter unwanted emissions within the 5 GHz RLAN bands are radio frequency emissions within the 5 GHz RLAN bands (total frequency range that consists of the 5150 MHz to 5350 MHz and the 5470 MHz to 5725 MHz sub-bands).



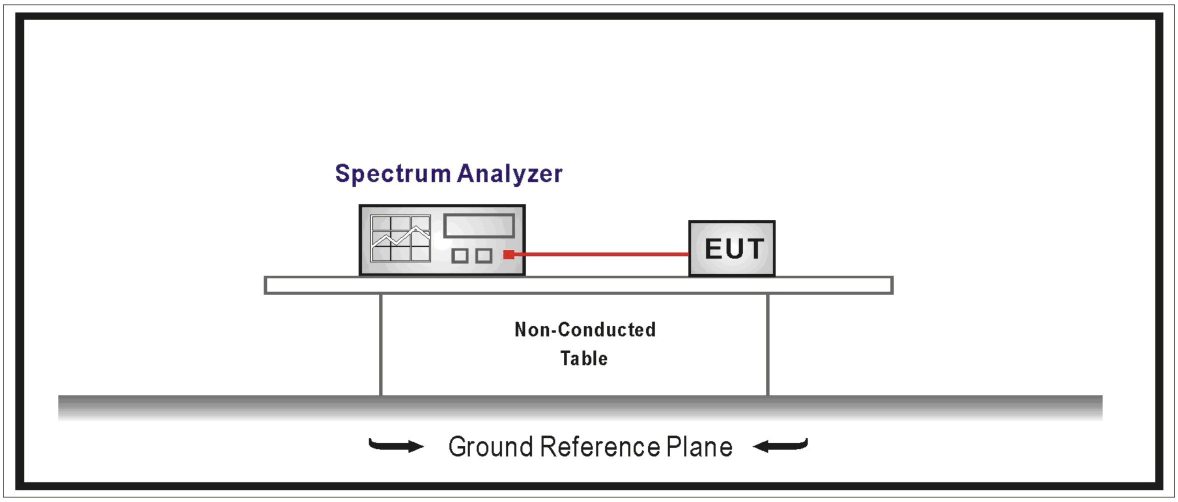
NOTE: dBc is the spectral density relative to the maximum spectral power density of the transmitted signal.

Figure 1: Transmit spectral power mask

The average level of transmitter unwanted emissions within the 5 GHz RLAN bands shall not exceed the limit of the mask provided in figure 1 or the limit for unwanted emissions provided in table 3, whichever is the higher.
The mask is only applicable within the band of operation.
In case of smart antenna systems (devices with multiple transmit chains) each of the transmit chains shall meet this requirement.

8.2. Test Setup

For Conducted Measurement



8.3. Test Procedure

Refer to ETSI EN 301 893 V2.1.1 (2017-05) Clause 5.4.6
The conformance requirements shall be verified only under normal operating conditions.
The UUT shall be configured for continuous transmit mode (duty cycle equal to 100 %).

Step 1: Determination of the reference average power level.

• Spectrum analyser settings:
- Resolution bandwidth: 1 MHz
- Video bandwidth: 30 KHz
- Detector Mode: Peak
- Trace Mode: Video Average
- Sweep Time: Coupled
- Centre Frequency: Centre frequency of the channel being tested
- Span: 2 × Nominal Channel Bandwidth
- Use the marker to find the highest average power level of the power envelope of the UUT. This level shall be used as the reference level for the relative measurements.

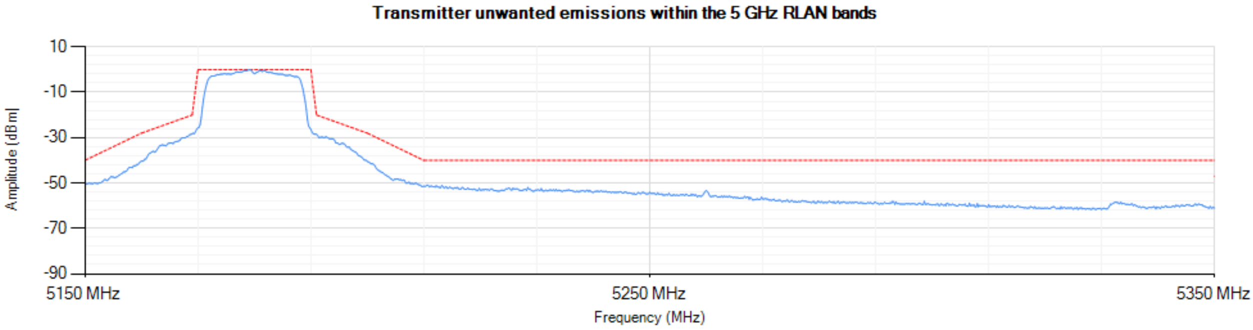
Step 2: Determination of the relative average power levels.

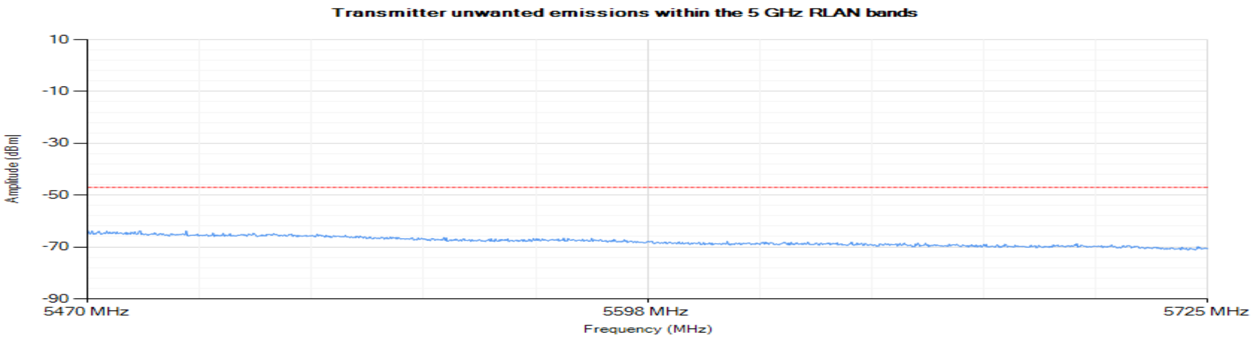
• Adjust the frequency range of the spectrum analyser to allow the measurement to be performed within the sub-bands 5150 MHz to 5350 MHz and 5470 MHz to 5725 MHz. No other parameter of the spectrum analyser should be changed.
• Compare the relative power envelope of the UUT with the limits

8.4. Test Result

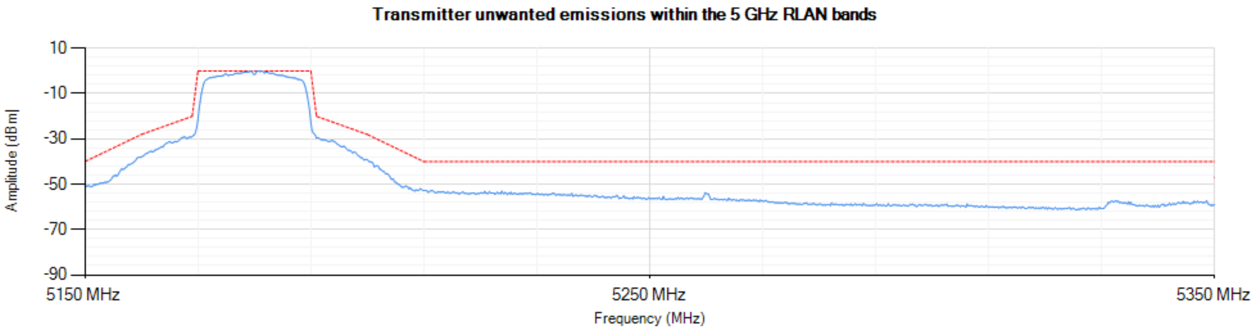
Pass

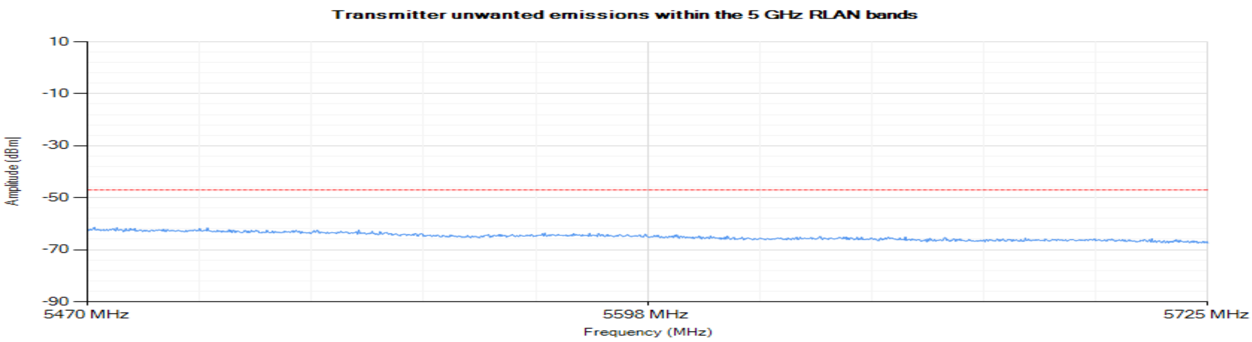
802.11a (Channel 36: 5180MHz) (The Worst Case: TX0)



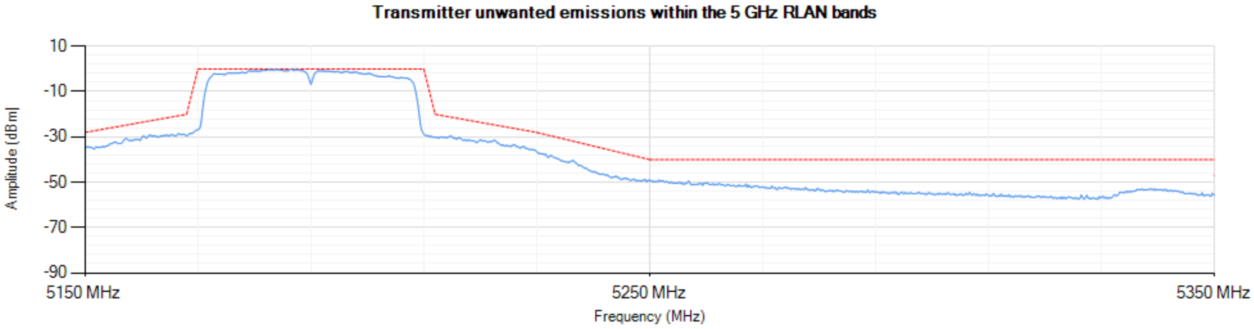


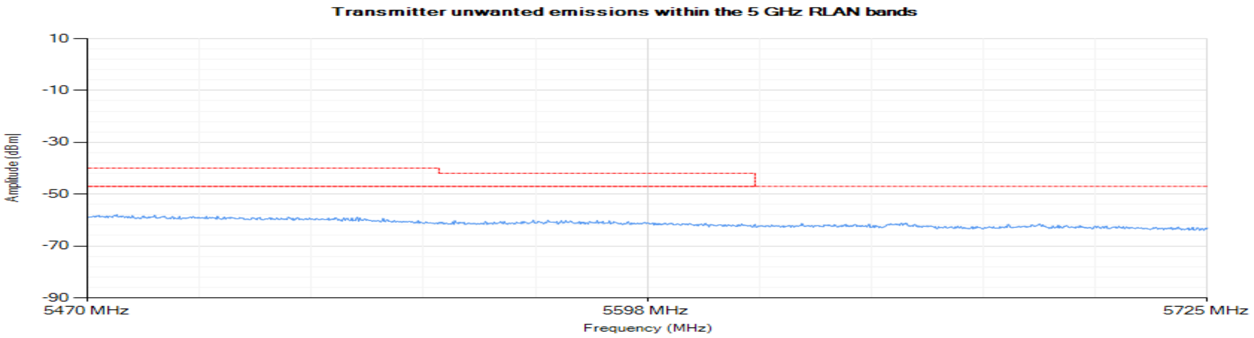
802.11n(20MHz) (Channel 36: 5180MHz) (The Worst Case: TX0)



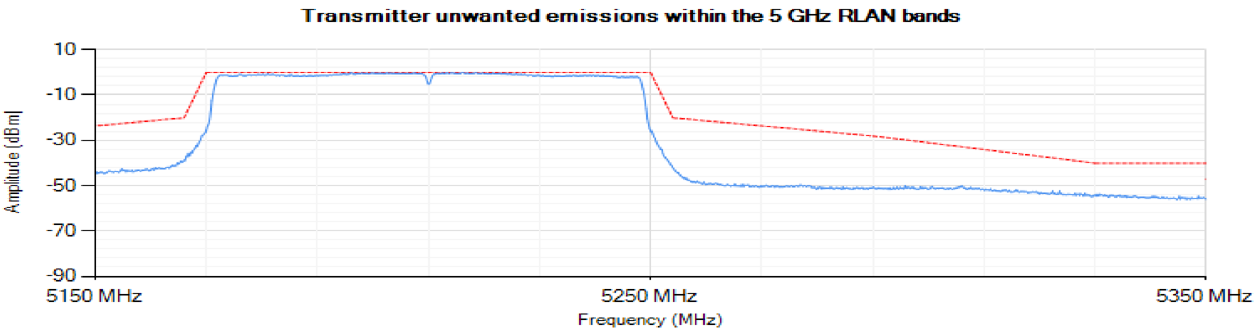


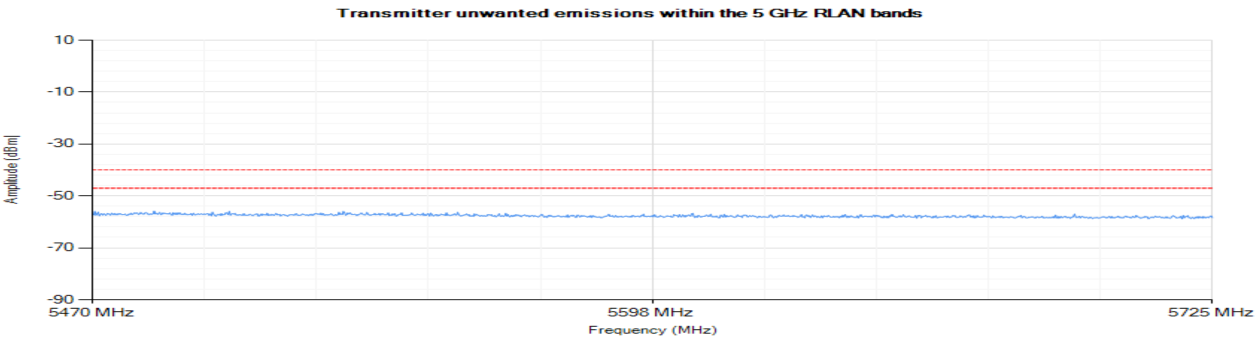
802.11n(40MHz) (Channel 38: 5190MHz) (The Worst Case: TX0)





802.11ac(80MHz) (Channel 42: 5210MHz)





9. RECEIVER SPURIOUS EMISSIONS

9.1. Limit

Receiver spurious emissions are emissions at any frequency when the equipment is in receive mode.

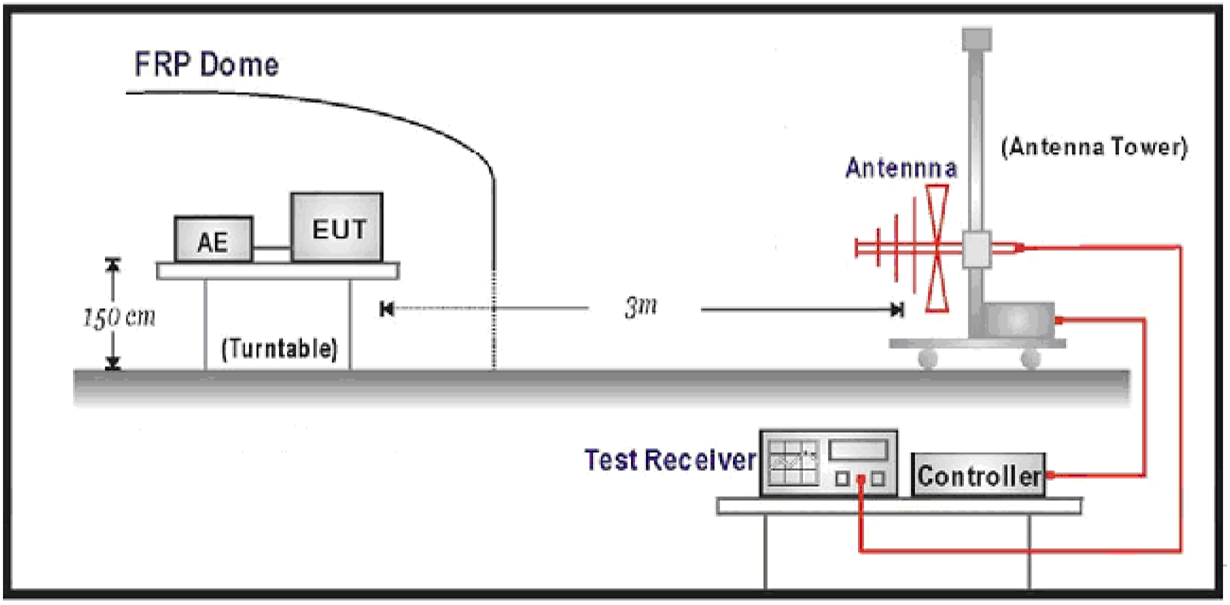
The spurious emissions of the receiver shall not exceed the limits given in table 4.

Table 4: Spurious radiated emission limits

Frequency range	Maximum power	Measurement bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 26 GHz	-47 dBm	1 MHz

9.2. Test Setup

For Radiated Measurement



9.3. Test Procedure

Refer to ETSI EN 301 893 V2.1.1 (2017-05) Clause 5.4.7

The conformance requirements shall be verified only under normal operating conditions.

The test procedure below shall be used to identify potential receiver spurious 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 table 4.

Step 2:

The emissions shall be measured over the range 30 MHz to 1000 MHz.

Spectrum analyser settings:

- Resolution bandwidth: 100 kHz
- Video bandwidth: 300 kHz
- Detector mode: Peak
- Trace Mode: Max Hold
- Sweep Points: ≥ 9700

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

- Sweep time: Auto
- Wait for the trace to stabilize. Any emissions identified that have a margin of less than 6 dB with respect to the limits given in table 4 shall be individually measured and compared to the limits given in table 4.

Step 3:

The emissions shall now be measured over the range 1 GHz to 26 GHz.

Spectrum analyser settings:

- Resolution bandwidth: 1 MHz
- Video bandwidth: 3 MHz
- Detector mode: Peak
- Trace Mode: Max Hold
- Sweep Points: ≥ 25000

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

- Sweep time: Auto
- Wait for the trace to stabilize. Any emissions identified that have a margin of less than 6 dB with respect to the limits given in table 4 shall be individually measured and compared to the limits given in table 4.

9.4. Test Result

The Worst Test Result For 802.11a (The Worst Case: TX0)					
Frequency (MHz)	Polarization (H/V)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector
Channel 36 (5180MHz)					
55.40	H	-83.73	-57.00	-26.73	PK
62.39	V	-75.62	-57.00	-18.62	PK
804.98	H	-76.30	-57.00	-19.30	PK
921.62	V	-75.88	-57.00	-18.88	PK
1242.31	H	-65.18	-47.00	-18.18	PK
1312.38	V	-65.02	-47.00	-18.02	PK
6270.03	H	-59.59	-47.00	-12.59	PK
6367.02	V	-61.91	-47.00	-14.91	PK

The Worst Test Result For 802.11n(20MHz) (The Worst Case: TX0+TX1)					
Frequency (MHz)	Polarization (H/V)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector
Channel 36 (5180MHz)					
55.49	H	-83.76	-57.00	-26.76	PK
62.47	V	-75.87	-57.00	-18.87	PK
807.00	H	-76.23	-57.00	-19.23	PK
920.54	V	-75.27	-57.00	-18.27	PK
1324.81	H	-64.78	-47.00	-17.78	PK
1359.19	V	-65.33	-47.00	-18.33	PK
6270.07	H	-59.76	-47.00	-12.76	PK
6367.10	V	-61.67	-47.00	-14.67	PK

The Worst Test Result For 802.11n(40MHz) (The Worst Case: TX0+TX1)					
Frequency (MHz)	Polarization (H/V)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector
Channel 38 (5190MHz)					
54.56	H	-83.97	-57.00	-26.97	PK
62.32	V	-75.57	-57.00	-18.57	PK
806.76	H	-76.30	-57.00	-19.30	PK
920.28	V	-75.51	-57.00	-18.51	PK
1324.90	H	-65.20	-47.00	-18.20	PK
1359.18	V	-65.39	-47.00	-18.39	PK
6270.01	H	-59.93	-47.00	-12.93	PK
6367.04	V	-61.12	-47.00	-14.12	PK

The Worst Test Result For 802.11ac(80MHz) (The Worst Case: TX0+TX1)					
Frequency (MHz)	Polarization (H/V)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector
Channel 38 (5190MHz)					
55.22	H	-83.39	-57.00	-26.39	PK
63.22	V	-75.34	-57.00	-18.34	PK
806.84	H	-75.83	-57.00	-18.83	PK
920.69	V	-75.58	-57.00	-18.58	PK
1324.86	H	-65.01	-47.00	-18.01	PK
1359.11	V	-65.82	-47.00	-18.82	PK
6270.08	H	-60.08	-47.00	-13.08	PK
6367.02	V	-61.04	-47.00	-14.04	PK

10. ADAPTIVITY (CHANNEL ACCESS MECHANISM)

10.1. Limit

Adaptivity is an automatic channel access mechanism by which a device avoids transmissions in a channel in the presence of transmissions from other RLAN devices in that channel.

The present document defines two types of adaptive equipment:
• Frame Based Equipment;
• Load Based Equipment.

Whilst the mechanisms described in this clause define conditions under which the equipment may transmit, transmissions are only allowed providing they are not prohibited by any of the DFS requirements.

Frame Based Equipment:
Frame Based Equipment shall comply with the following requirements:
1) Before starting transmissions on an Operating Channel, the equipment shall perform a Clear Channel Assessment (CCA) check using "energy detect". The equipment shall observe the Operating Channel(s) for the duration of the CCA observation time which shall be not less than 20 μs. The Operating Channel shall be considered occupied if the energy level in the channel exceeds the threshold corresponding to the power level given in point 5) below. If the equipment finds the Operating Channel(s) to be clear, it may transmit immediately. See figure 2 below.
2) If the equipment finds an Operating Channel occupied, it shall not transmit on that channel during the next Fixed Frame Period.
The equipment is allowed to continue Short Control Signalling Transmissions on this channel providing it complies with the requirements in clause 4.8.3.3 of ETSI EN 301 893 V1.8.1(2015-03).
For equipment having simultaneous transmissions on multiple (adjacent or non-adjacent) Operating Channels, the equipment is allowed to continue transmissions on other Operating Channels providing the CCA check did not detect any signals on those channels.
3) The total time during which an equipment has transmissions on a given channel without re-evaluating the availability of that channel, is defined as the Channel Occupancy Time.
The Channel Occupancy Time shall be in the range 1 ms to 10 ms and the minimum Idle Period shall be at least 5 % of the Channel Occupancy Time used by the equipment for the current Fixed Frame Period. Towards the end of the Idle Period, the equipment shall perform a new CCA as described in point 1) above.
4) The equipment, upon correct reception of a packet which was intended for this equipment, can skip CCA and immediately (see note) proceed with the transmission of management and control frames (e.g. ACK and Block ACK frames). A consecutive sequence of such transmissions by the equipment, without it performing a new CCA, shall not exceed the Maximum Channel Occupancy Time as defined in point 3) above.
NOTE: For the purpose of multi-cast, the ACK transmissions (associated with the same data packet) of the individual devices are allowed to take place in a sequence.

5) For transmit power levels of 23 dBm e.i.r.p. or above, the CCA threshold level (TL), at the input to the receiver, shall be a minimum of -73 dBm/MHz assuming a 0 dBi receive antenna.
For transmit power levels below 23 dBm e.i.r.p., the CCA threshold level (TL), at the input of the receiver, shall be proportional to the maximum transmit power (P_H) according to the formula which assumes a 0 dBi receive antenna and P_H to be specified in dBm e.i.r.p.

$$TL = -73 \text{ dBm / MHz} + (23 \text{ dBm} - P_H) / (1 \text{ MHz})$$

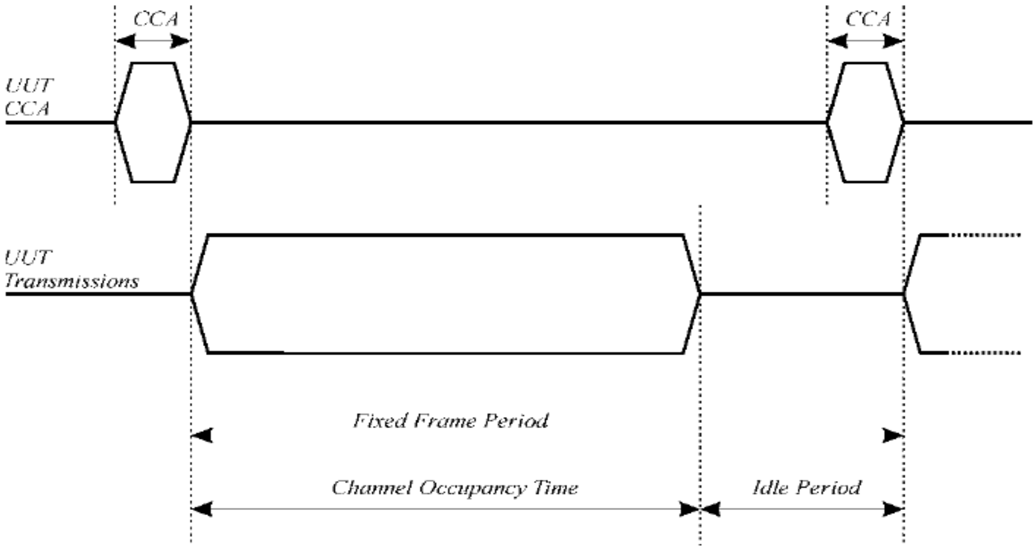


Figure 2: Example of timing for Frame Based Equipment

Load Based Equipment:
Load based Equipment may implement an LBT based spectrum sharing mechanism based on the Clear Channel Assessment (CCA) mode using "energy detect".
Load Based Equipment not using any of the mechanisms referenced above shall comply with the minimum set of requirements contained in either option A or option B below. When selecting option B, the value of q shall be declared by the manufacturer.

• **Option A**

1) Before a transmission or a burst of transmissions on an Operating Channel, the equipment shall perform a Clear Channel Assessment (CCA) check using "energy detect". The equipment shall observe the Operating Channel(s) for the duration of the CCA observation time which shall be not less than 20 μs. The Operating Channel shall be considered occupied if the energy level in the channel exceeds the threshold corresponding to the power level given in point 5) below. If the equipment finds the channel to be clear, it may transmit immediately (see point 3) below).
2) If the equipment finds an Operating Channel occupied, it shall not transmit in that channel (see paragraphs below). The equipment shall perform an Extended CCA check in which the Operating Channel is observed for the duration of an observation period of q Observation Slots. An Observation Slot is either an Unoccupied Idle Slot of 18 μs (ECCA slot time) or a Busy Slot. A Busy Slot is the total time the Operating Channel was found occupied in between two unoccupied ECCA slots and which shall be considered as a single Observation Slot. The initial value of q is 16 and shall be doubled for every new Extended CCA check that has to be performed because the previous one failed to find N unoccupied ECCA slots. Once q has reached a value of 1024 and the Extended CCA check still failed to find N unoccupied ECCA slots, the value of q may be reset to the initial value of 16 for the start of the next Extended CCA check. The value of N shall be randomly selected in the range 1 to q every time an

Extended CCA is required.
If an Extended CCA check has found N unoccupied ECCA slots, the equipment may resume transmissions on this channel and the value of q shall be reset to its initial value.
The equipment is allowed to continue Short Control Signalling Transmissions on this channel providing it complies with the requirements in clause 4.8.3.3 of ETSI EN 301 893 V1.8.1(2015-03).
For equipment having simultaneous transmissions on multiple (adjacent or non-adjacent) operating channels, the equipment is allowed to continue transmissions on other Operating Channels providing the CCA check did not detect any signals on those channels.
NOTE: The total Idle Period is equal to the total of any CCA (initial or extended) checks which have been performed since the last transmission.
3) The total time that an equipment makes use of an Operating Channel is the Maximum Channel Occupancy Time which shall be less than 10 ms, after which the device shall perform a new Extended CCA as described in point 2) above.
4) The equipment, upon correct reception of a packet which was intended for this equipment, can skip CCA and immediately (see note 2) proceed with the transmission of management and control frames (e.g. ACK and Block ACK frames). A consecutive sequence of transmissions by the equipment, without it performing a new CCA, shall not exceed the Maximum Channel Occupancy Time as defined in point 3) above.
NOTE: For the purpose of multi-cast, the ACK transmissions (associated with the same data packet) of the individual devices are allowed to take place in a sequence.
5) For transmit power levels of 23 dBm e.i.r.p. or above, the CCA threshold level (TL), at the input to the receiver, shall be -73 dBm/MHz assuming a 0 dBi receive antenna.
For transmit power levels below 23 dBm e.i.r.p., the CCA threshold level (TL), at the input of the receiver, shall be proportional to the maximum transmit power (P_H) according to the formula which assumes a 0 dBi receive antenna and P_H to be specified in dBm e.i.r.p.

$$TL = -73\ dBm / MHz + (23\ dBm - P_H) / (1\ MHz)$$

• **Option B**

1) Before a transmission or a burst of transmissions on an Operating Channel, the equipment shall perform a Clear Channel Assessment (CCA) check using "energy detect". The equipment shall observe the Operating Channel(s) for the duration of the CCA observation time which shall be not less than 20 μs. The CCA observation time used by the equipment shall be declared by the manufacturer. The Operating Channel shall be considered occupied if the energy level in the channel exceeds the threshold corresponding to the power level given in point 5) below. If the equipment finds the channel to be clear, it may transmit immediately (see point 3) below).
2) If the equipment finds an Operating Channel occupied, it shall not transmit in that channel. The equipment shall perform an Extended CCA check in which the Operating Channel is observed for the duration (observation period) of a random factor N multiplied by the CCA observation time. N defines the number of unoccupied idle slots resulting in a total Idle Period that needs to be observed before initiation of the transmission. The value of N shall be randomly selected in the range 1 to q every time an Extended CCA is required and the value stored in a counter. The value of q is selected by the manufacturer in the range 4 to 32. This selected value shall be declared by the manufacturer (see clause 5.3.1 q)). The counter is decremented every time a CCA slot is considered to be "unoccupied". When the counter reaches zero, the equipment may transmit.
The equipment is allowed to continue Short Control Signalling Transmissions on this channel providing it complies with the requirements in clause 4.8.3.3 of ETSI EN 301 893 V1.8.1(2015-03).

For equipment having simultaneous transmissions on multiple (adjacent or non-adjacent) operating channels, the equipment is allowed to continue transmissions on other Operating Channels providing the CCA check did not detect any signals on those channels.

3) The total time that an equipment makes use of an Operating Channel is the Maximum Channel Occupancy Time which shall be less than (13 / 32) × q ms, with q as defined in point 2) above, after which the device shall perform the Extended CCA described in point 2) above.

4) The equipment, upon correct reception of a packet which was intended for this equipment, can skip CCA and immediately (see note 3) proceed with the transmission of management and control frames (e.g. ACK and Block ACK frames). A consecutive sequence of transmissions by the equipment, without it performing a new CCA, shall not exceed the Maximum Channel Occupancy Time as defined in point 3) above.

NOTE: For the purpose of multi-cast, the ACK transmissions (associated with the same data packet) of the individual devices are allowed to take place in a sequence.

5) For transmit power levels of 23 dBm e.i.r.p. or above, the CCA threshold level (TL), at the input to the receiver, shall be -73 dBm/MHz assuming a 0 dBi receive antenna.

For transmit power levels below 23 dBm e.i.r.p., the CCA threshold level (TL), at the input of the receiver, shall be proportional to the maximum transmit power (P_H) according to the formula which assumes a 0 dBi receive antenna and P_H to be specified in dBm e.i.r.p.

$$TL = -73\ dBm / MHz + (23\ dBm - P_H) / (1\ MHz)$$

Short Control Signalling Transmissions:

Short Control Signalling Transmissions are transmissions used by Adaptive equipment to send management and control frames (e.g. ACK/NACK signals) without sensing the channel for the presence of other signals.

NOTE: It is not required for adaptive equipment to implement Short Control Signalling Transmissions.

If implemented, Short Control Signalling Transmissions of Adaptive equipment shall have a maximum duty cycle of 5 % within an observation period of 50 ms.

10.2. Test Setup

Conducted measurements

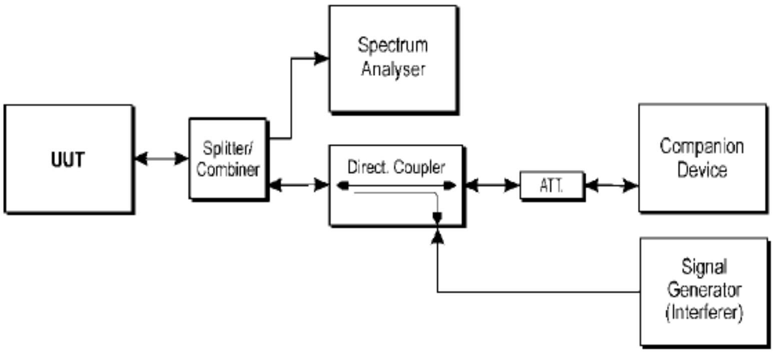


Figure 13: Example Test Set-up for verifying the adaptivity of an equipment

10.3. Test Procedure

Refer to ETSI EN 301 893 V2.1.1 (2017-05) Clause 5.4.9
These measurements shall only be performed at normal test conditions.
The different steps below define the procedure to verify the efficiency of the adaptivity mechanism of the equipment.

Step 1:

• The UUT shall connect to a companion device during the test. The signal generator, spectrum analyser, UUT and the companion device are connected using a Set-up equivalent to the example given by figure 13 although the signal generator does 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 interference signal.
• The received signal level (wanted signal from the companion device) at the UUT shall be sufficient to maintain a reliable link for the duration of the test. A typical value for the received signal level which can be used in most cases is -50 dBm/MHz.
• The analyser shall be set as follows:
RBW: ≥ Occupied Channel Bandwidth (if the analyser does not support this setting, the highest available setting shall be used. We set RBW=8MHz)
VBW: 3 ×RBW (if the analyser does not support this setting, the highest available setting shall be used. We set VBW=50MHz)
Detector mode: RMS
Centre Frequency: Equal to the centre frequency of the operating channel
Span: 0 Hz
Sweep time: > Channel Occupancy Time
Trace Mode: Clear/Write
Trigger Mode: Video or External

Step 2:

• Configure the UUT for normal transmissions with a payload resulting in a minimum transmitter activity ratio of 30 %. Where this is not possible, the UUT shall be configured to the maximum payload possible.
• Verified that the UUT complies with the maximum Channel Occupancy Time and the (minimum) Idle Period for Load Based Equipment.
• Adding the interference signal and verified of reaction to the interference signal.
• Record the data.

10.4. Test Result

According to Table 11 in clause 5.3.2 of ETSI EN 301 893 V2.1.1(2017-05), for adaptivity, testing shall be performed using the highest nominal channel bandwidth. So this test item is only performed on 802.11ac(80MHz; Channel 42: 5210MHz)

The Worst Test Mode (TX0)	802.11ac(80MHz; Channel 42: 5210MHz)
AWGN Interference Level (dBm)	-65.32
Interference Start Time (ms)	100
Stop time after interfering signal(ms)	100
Suggest q Level	4
Max. COT (ms)	4.43
Pulse width (ms)	0
Duty Cycle (%)	0

The Worst Test Mode (TX0)	802.11ac(80MHz; Channel 42: 5210MHz)
OFDM Interference Level (dBm)	-65.32
Interference Start Time (ms)	100
Stop time after interfering signal(ms)	100
Suggest q Level	4
Max. COT (ms)	6.37
Pulse width (ms)	0
Duty Cycle (%)	0

The Worst Test Mode (TX0)	802.11ac(80MHz; Channel 42: 5210MHz)
LTE Interference Level (dBm)	-65.32
Interference Start Time (ms)	100
Stop time after interfering signal(ms)	100
Suggest q Level	4
Max. COT (ms)	5.53
Pulse width (ms)	0
Duty Cycle (%)	0

11. RECEIVER BLOCKING

11.1. Limit

The minimum performance criterion shall be a PER of 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.

While maintaining the minimum performance criteria as defined in clause 4.2.8.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined in table 7.

Table 7: Receiver Blocking parameters

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)		Type of blocking signal
		Master or Slave with radar detection (see table D.2, note 2)	Slave without radar detection (see table D.2, note 2)	
Pmin + 6 dB	5 100	-53	-59	Continuous Wave
Pmin + 6 dB	4 900 5 000 5 975	-47	-53	Continuous Wave
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined clause 4.2.8.3 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 same levels should be used at the antenna connector irrespective of antenna gain.				

11.2. Test Setup

Conducted measurements

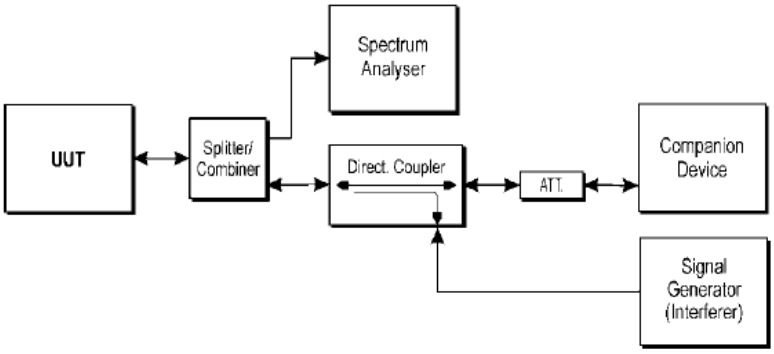


Figure 13: Example Test Set-up for verifying the adaptivity of an equipment

11.3. Test Procedure

Step 1:

- The UUT shall be set to the first operating frequency to be tested (see clause 5.3.2).

Step 2:

- The blocking signal generator is set to the first frequency as defined in table 7.

Step 3:

- With the blocking signal generator switched off a communication link is set up between the UUT and the associated companion device using the test setup shown in figure 14. 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 4.2.8.3 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 6 dB resulting in a new level (Pmin + 6 dB) of the wanted signal at the UUT receiver input.

Step 4:

- The level of the blocking signal at the UUT input is set to the level provided in table 7. It shall be verified and recorded in the test report that the performance criteria as specified in clause 4.2.8.3 are met.
- If the performance criteria as specified in clause 4.2.8.3 are met, the level of the blocking signal at the UUT may be further increased (e.g. in steps of 1 dB) until the level whereby the performance criteria as specified in clause 4.2.8.3 are no longer met. The highest level at which the performance criteria are met is recorded in the test report.

Step 5:

- Repeat step 4 for each remaining combination of frequency and level as specified in table 7.

Step 6:

- Repeat step 2 to step 5 with the UUT operating at the other operating frequencies at which the blocking test has to be performed. See clause 5.3.2.

11.4. Test Result

Product	:	Single Board Computer
Test Item	:	Receiver Blocking
Test Mode	:	Receiving (Worst Case: 802.11a, TX0)
Test Environment	:	25℃ 43.5%RH

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm)		Type of blocking signal	PER(%)		Test Result
		Test Value	Limit		Test Value	Limit	
Pmin + 6 dB	5100	-30	≥-53	CW	8.81	10	Pass
Pmin + 6 dB	4900	-20	≥-47	CW	6.74	10	Pass
	5000	-20	≥-47	CW	8.11	10	Pass
	5975	-22	≥-47	CW	7.80	10	Pass

11.5. List Of Measuring Equipment

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	X-series USB Peak and Average Power Sensor Aglient	Agilent	U2021XA	MY54080022	2017-10-26	2018-10-25
2	4 CH. Simultaneous Sampling 14 Bits 2MS/s	Agilent	U2531A	MY54080016	2017-10-26	2018-10-25
3	Test Software	Ascentest	AT890-SW	20160630	N/A	N/A
4	RF Control Unit	Ascentest	AT890-RFB	N/A	2017-06-17	2018-06-16
5	ESA-E SERIES SPECTRUM ANALYZER	Agilent	E4407B	MY41440754	2017-11-17	2017-11-16
6	MXA Signal Analyzer	Agilent	N9020A	MY49100040	2017-06-17	2018-06-16
7	SPECTRUM ANALYZER	R&S	FSP	100503	2017-06-17	2018-06-16
8	MXG Vector Signal Generator	Agilent	N5182A	MY47071151	2017-11-17	2017-11-16
9	ESG VECTOR SIGNAL	Agilent	E4438C	MY42081396	2017-11-17	2017-11-16
10	PSG Analog Signal Generator	Agilent	E8257D	MY4520521	2017-11-17	2017-11-16
11	Universal Radio Communication Tester	R&S	CMU 200	105788	2017-06-17	2018-06-16
12	WIDEBAND RADIO COMMUNICATION TESTER	R&S	CMW 500	103818	2017-06-17	2018-06-16
13	RF Control Unit	Tonscend	JS0806-1	N/A	2017-06-17	2018-06-16
14	DC Power Supply	Agilent	E3642A	N/A	2017-11-17	2017-11-16
15	LTE Test Software	Tonscend	JS1120-1	N/A	N/A	N/A
16	Temperature & Humidity Chamber	GUANGZHOU GOGNWEN	GDS-100	70932	2017-10-11	2018-10-10
17	DC Source	CHROMA	62012P-80-60	34782951	2017-10-11	2018-10-10
18	RF Filter	Micro-Tronics	BRC50718	S/N-017	2017-06-17	2018-06-16
19	RF Filter	Micro-Tronics	BRC50719	S/N-011	2017-06-17	2018-06-16
20	RF Filter	Micro-Tronics	BRC50720	S/N-011	2017-06-17	2018-06-16
21	RF Filter	Micro-Tronics	BRC50721	S/N-013	2017-06-17	2018-06-16
22	RF Filter	Micro-Tronics	BRM50702	S/N-195	2017-06-17	2018-06-16
23	Splitter/Combiner	Micro-Tronics	PS2-15	CB11-20	2017-06-17	2018-06-16
24	Splitter/Combiner	Micro-Tronics	CB11-20	N/A	2017-06-17	2018-06-16
25	Attenuator	Micro-Tronics	PAS-8-10	S/N23466	2017-06-17	2018-06-16
26	Exposure Level Tester	Narda	ELT-400	N-0713	2017-04-03	2018-04-02
27	B-Field Probe	Narda	ELT-400	M-1154	2017-04-11	2018-04-10
28	3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	2017-06-17	2018-06-16
29	Positioning Controller	MF	MF-7082	/	2017-06-17	2018-06-16
30	EMI Test Software	AUDIX	E3	N/A	2017-06-17	2018-06-16
31	EMI Test Receiver	R&S	ESR 7	101181	2017-06-17	2018-06-16
32	AMPLIFIER	QuieTek	QTK-A2525G	CHM10809065	2017-11-17	2017-11-16
33	Active Loop Antenna	SCHWARZBECK	FMZB 1519B	00005	2017-06-23	2018-06-22
34	By-log Antenna	SCHWARZBECK	VULB9163	9163-470	2017-05-02	2018-05-01
35	Horn Antenna	EMCO	3115	6741	2017-06-23	2018-06-22
36	RF Cable-R03m	Jye Bao	RG142	CB021	2017-06-17	2018-06-16
37	RF Cable-HIGH	SUHNER	SUCOFLEX 106	03CH03-HY	2017-06-17	2018-06-16
Note: All equipment is calibrated through GUANGZHOU LISAI CALIBRATION AND TEST CO.,LTD.						

12. PHOTOGRAPHS OF TEST SETUP

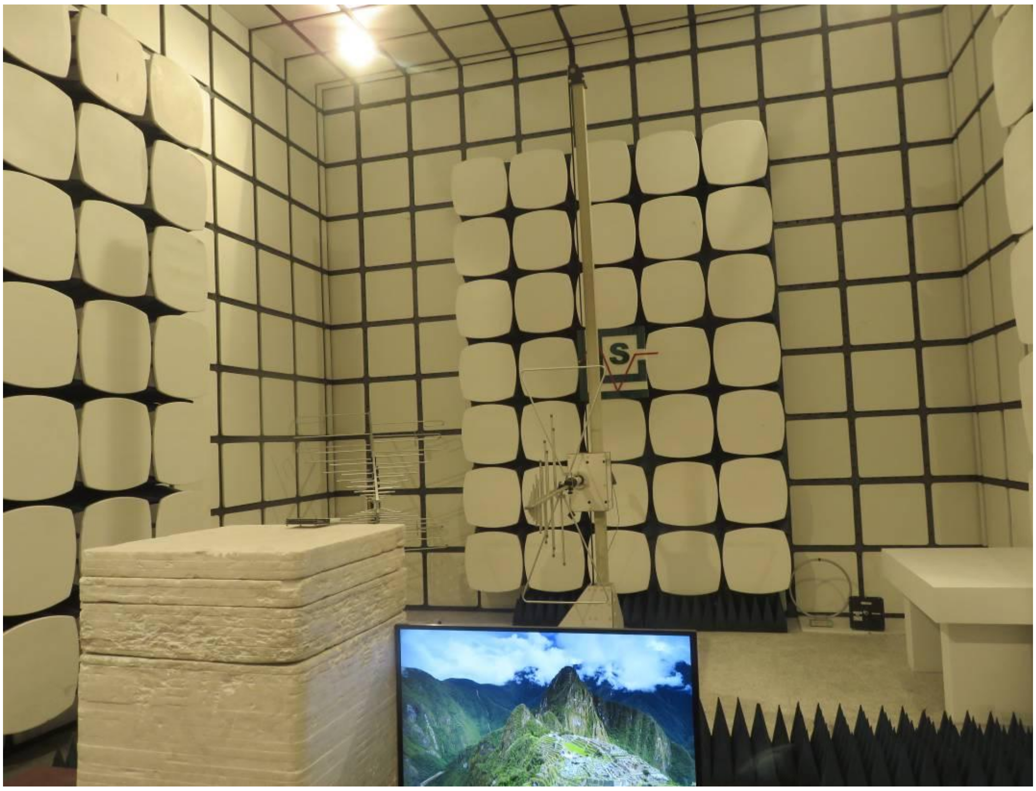


Fig. 1

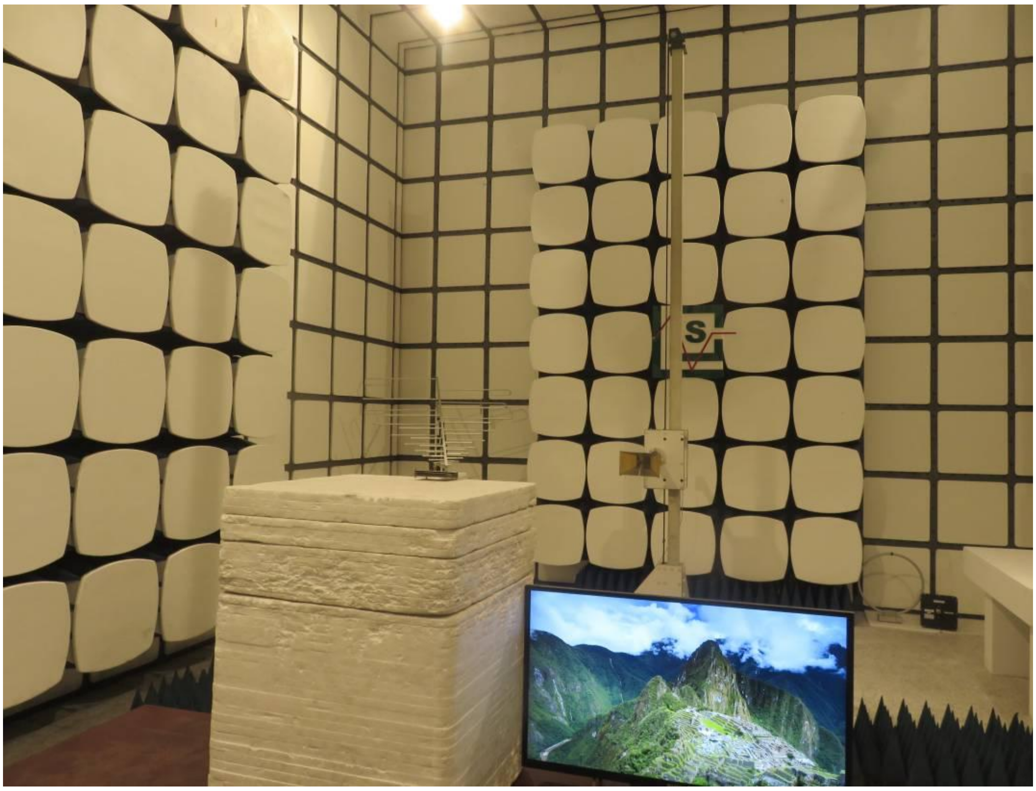


Fig. 2

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