REPORT No. : SZ18010062W09

TEST REPORT

MANUFACTURER	**:**	Shenzhen Chainway Information Technology Co.,Ltd.
PRODUCT NAME	**:**	Mobile Data Terminal
MODEL NAME	**:**	C72
BRAND NAME	**:**	CHAINWAY
STANDARD(S)	**:**	ETSI EN 301 893 V2.1.1 (2017-05)
TEST DATE	**:**	2018-01-14 to 2018-01-18
ISSUE DATE	**:**	2018-02-02

Tested by: Tu Yanan (Test Engineer)

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Change History		
Issue	**Date**	**Reason for change**
1.0	2018-02-02	First edition

1. Technical Information

Note: Provide by manufacturer.

1.1. Manufacturer and Factory Information

Manufacturer:	Shenzhen Chainway Information Technology Co.,Ltd.
Manufacturer Address:	9/F, Building 2, Daqian Industrial Park, Longchang Rd., District 67, Bao'an, Shenzhen
Factory:	Shenzhen Chainway Information Technology Co.,Ltd.
Factory Address:	9/F, Building 2, Daqian Industrial Park, Longchang Rd., District 67, Bao'an, Shenzhen

1.2. Equipment Under Test (EUT) Description

Product Name:	Mobile Data Terminal	
Serial No:	(N/A, marked #1 by test site)	
Hardware Version:	C70SE_MB_V11	
Software Version:	C72E_MT6735_V1.1_EU_GITfcd74c4_20180115	
Modulation Type:	OFDM	
Wireless Technology:	802.11a, 802.11n(HT20), 802.11n(HT40)	
Operating Frequency Range:	5150MHz to 5250MHz; 5250MHz-5350MHz; 5470MHz-5725MHz	
Transmit Operating Modes:	Single Antenna Equipment(only 1 antenna)	
Antenna Type:	PIFA Antenna	
Antenna Gain:	0.49 dBi	
TPC feature:	No	
Maximum EIRP:	5150MHz to 5250MHz:	14.69dBm
	5250MHz to 5350MHz	12.82dBm
	5470MHz to 5725MHz	13.08dBm
Operating voltage:	Normal:	3.8 V
Operating temperature:	Normal:	25°C
	Lowest:	-20°C
	Highest:	50°C

Note 1: This test report is updated from report (Report No.: SZ17080130W09), based on the similarity between before, the software version was changed and added an external accessory with RFID function. The changes only affect the test results of Transmitter

unwanted emissions outside the 5 GHz RLAN bands and receiver spurious emissions.

Note 2: The EUT supports 802.11a, 802.11b, 802.11g, 802.11n; the 802.11a, 802.11n was tested in this report.

Note 3: The EUT doesn't support hotspot.

Note 4: Please refer to ANNEX A for the photographs of the EUT. For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacture.

1.3. The channel number and frequency of the EUT

Nominal Channel Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	**36**	**5180**	108	5540
	40	5200	112	5560
	44	5220	116	5580
	48	5240	120	5600
	52	5260	124	5620
	56	5280	128	5640
	60	5300	132	5660
	64	**5320**	136	5680
	100	**5500**	140	5700
	105	5520	**144**	**5720**
40MHz	**38**	**5190**	110	5550
	46	5230	118	5590
	54	5270	126	5630
	62	**5310**	134	5670
	102	**5510**	**142**	**5710**

Note 1: The Channel (36), Channel (64), Channel (100) and Channel (144) were selected test for HT20;

Note 2: The Channel (38), Channel (62), Channel (102) and Channel (142) were selected test for HT40;

1.4. Test Standards and Results

The EUT has been tested according to ETSI EN 301 893 V2.1.1 (2017-05)

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

Test items and the results are as bellow:

EN Reference		EN 301 893	Test Engineer	Result
№	**Sub clause**	**Description**		
1	4.2.1	Centre frequencies	Tu Yanan	**PASS** Note2
2	4.2.2	Nominal, and occupied, channel bandwidth	Tu Yanan	**PASS** Note2
3	4.2.3	RF output power	Tu Yanan	**PASS** Note2
4	4.2.3	Transmit Power Control (TPC)	N/A	**N/A** Note1
5	4.2.3	Power Density	Tu Yanan	**PASS**
6	4.2.4.1	Transmitter unwanted emissions outside the 5 GHz RLAN bands	Peng Shiqing	**PASS**
7	4.2.4.2	Transmitter unwanted emissions within the 5 GHz RLAN bands	Tu Yanan	**PASS** Note2
8	4.2.5	Receiver spurious emissions	Peng Shiqing	**PASS**
9	4.2.7	Adaptivity	Tu Yanan	**PASS** Note2
10	4.2.6	DFS	Tu Yanan	**PASS** Note2
11	4.2.8	Receiver Blocking	Tu Yanan	**PASS** Note2
12	4.2.9	User Access Restrictions	Tu Yanan	**PASS** Note2
13	4.2.10	Geo-location capability	Tu Yanan	**PASS** Note2

Note1: The EUT without TPC function.
Note2: The test results of these test items in this report refer to the test report (Report No.: SZ17080130W09).

1.5. EUT Setup and Operating Conditions

The EUT is activated and controlled by the System Simulator and software. The EUT is powered by a battery.

1.6. Environmental Conditions

Ambient temperature: +15~+35°C
Relative humidity: 20~75%
Atmosphere pressure: 86-106kPa

2. Transmitter Parameters

2.1. EN 301 893 §4.2.1 Centre frequencies

2.1.1. General

RLAN equipment typically operates on one or more fixed frequencies. The equipment is allowed to change its normal operating frequency when interference is detected, or to prevent causing interference to other equipment or for frequency planning purposes.

2.1.2. Definition

The Nominal Centre Frequency is the centre of the Operating Channel.

2.1.3. Limits:

The Nominal Centre Frequencies (fc) for a Nominal Channel Bandwidth of 20 MHz are defined by equation (1). See also figure 3.

$$f_{cn} = 5\,160 + (g \times 20)\ \text{MHz, where } 0 \leqslant g \leqslant 9 \text{ or } 16 \leqslant g \leqslant 27 \qquad (1)$$

A maximum offset of the Nominal Centre Frequency of ± 200 kHz is permitted. Where the manufacturer decides to make use of this frequency offset, the manufacturer shall declare the actual centre frequencies used by the equipment. See clause 5.4.1, item a).

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

Equipment may have simultaneous transmissions on more than one Operating Channel with a Nominal Channel Bandwidth of 20 MHz.

2.1.4. Conformance

Conformance tests as defined in clause 5.4.2 shall be carried out.

2.1.5. Test Conditions

These measurements shall be performed under both normal and extreme test conditions (see clause 5.1.3).

The channels on which the conformance requirements in clause 4.2.1 shall be verified are defined in clause 5.3.2.

The UUT shall be configured to operate at a normal RF Output Power level. In addition, the UUT shall be configured to operate on a single channel.

For a UUT with antenna connector(s) and using dedicated external antenna(s), or for a UUT with integral antenna(s) but with a temporary antenna connector(s) provided, conducted measurements shall be used.

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.

For a UUT with integral antenna(s) and without a temporary antenna connector(s), radiated measurements shall be used.

2.1.6. Test Methods

2.1.6.1 Conducted measurement

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.

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 f1.

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 f2.

The centre frequency is calculated as (f1 + f2) / 2.

Radiated measurement

The test set up as described in annex B shall be used with a spectrum analyser attached to the test antenna.

The test procedure is as described under clause 5.4.2.2.1.

2.1.7. Result

2.1.7.1 802.11a Mode

Test Conditions		Centre frequency			
		Frequency (MHz)	Measurement Centre frequency(MHz)	△F (ppm)	Limit (ppm)
NV	NT	5180.0000	5180.0500	9.65	±20
	LT	5180.0000	5180.0515	9.94	±20
	HT	5180.0000	5180.0496	9.58	±20
Test Result		**PASS**			

Test Conditions		Centre frequency			
		Frequency (MHz)	Measurement Centre frequency(MHz)	△F (ppm)	Limit (ppm)
NV	NT	5500.0000	5500.0300	5.45	20
	LT	5500.0000	5500.0321	5.84	20
	HT	5500.0000	5500.0312	5.67	20
Test Result		**PASS**			

Notes: (1) Conducted measurement method was used.

(2) The path loss as the factor is calibrated to correct the reading.

2.2. EN 301 893 §4.2.2 –Nominal, and occupied, channel bandwidth

2.2.1. Definition

The Nominal Channel Bandwidth is the widest band of frequencies, inclusive of guard bands, assigned to a single channel.
The Occupied Channel Bandwidth is the bandwidth containing 99 % of the power of the signal.
When equipment has simultaneous transmissions in adjacent channels, these transmissions may be considered as one signal with an actual Nominal Channel Bandwidth of "n" times the individual Nominal Channel Bandwidth where "n" is the number of adjacent channels. When equipment has simultaneous transmissions in non-adjacent channels, each power envelope shall be considered separately.

2.2.2. Limit

The Nominal Channel Bandwidth for a single Operating Channel shall be 20 MHz.
Alternatively, equipment may implement a lower Nominal Channel Bandwidth with a minimum of 5 MHz, providing they still comply with the Nominal Centre Frequencies defined in clause 4.2.1 (20 MHz raster).
The Occupied Channel Bandwidth shall be between 80 % and 100 % of the Nominal Channel Bandwidth. In case of smart antenna systems (devices with multiple transmit chains) each of the transmit chains shall meet this requirement.The Occupied Channel Bandwidth might change with time/payload.
During a Channel Occupancy Time (COT), equipment may operate temporarily with an Occupied Channel Bandwidth of less than 80 % of its Nominal Channel Bandwidth with a minimum of 2 MHz.

2.2.3. Conformance

Conformance tests as defined in clause 5.4.3 shall be carried out to determine the Occupied Channel Bandwidth.

2.2.4. Test Conditions

The conformance requirements in clause 4.2.2 shall be verified only under normal operating conditions, and on those channels and channel bandwidths defined in clause 5.3.2.
The measurements shall be performed using normal operation of the equipment with the test signal applied (see clause 5.3.1.1).
The UUT shall be configured to operate at a typical RF power output level used for normal

operation.
When equipment has simultaneous transmissions in adjacent channels, these transmissions may be considered as one signal with an actual Nominal Channel Bandwidth of "n" times the individual Nominal Channel Bandwidth where "n" is the number of adjacent channels. When equipment has simultaneous transmissions in non-adjacent channels, each power envelope shall be considered separately.
For a UUT with antenna connector(s) and using dedicated external antenna(s), or for a UUT with integral antenna(s) but with a temporary antenna connector(s) provided, conducted measurements shall be used.
In case of conducted measurements on smart antenna systems (devices with multiple transmit chains) measurements need only to be performed on one of the active transmit chains (antenna outputs).
For a UUT with integral antenna(s) and without a temporary antenna connector(s), radiated measurements shall be used.

2.2.5. Test Method

2.2.5.1 Conducted measurement

The measurement procedure shall be as follows:

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.

2.2.5.2 Radiated measurement

The test set up as described in annex B and the applicable measurement procedures described in annex C shall be used.

The test procedure is as described under clause 5.4.3.2.1.

2.2.6. Result

2.2.6.1 802.11 a Mode

Occupied Bandwidth					
Frequency (MHz)	Occupied Bandwidth (MHz)	Limit (MHz)	Declared Bandwidth (MHz)	Bandwidth (%)	Limit (%)
5180	16.404	16~20	20	82.02	80~100
5500	16.476	16~20	20	82.38	80~100
Test Result	**PASS**				

Notes: (1) Conducted measurement method was used.

(2) The Occupied Channel Bandwidth method shall be measured using the §5.3.3.

(3) The path loss as the factor is calibrated to correct the reading.

2.2.6.2 802.11 n (HT40) Mode

Occupied Bandwidth					
Frequency (MHz)	Occupied Bandwidth (MHz)	Limit (MHz)	Declared Bandwidth (MHz)	Bandwidth (%)	Limit (%)
5190	36.096	32~40	40	90.24	80~100
5510	36.198	32~40	40	90.49	80~100
Test Result	**PASS**				

Notes: (1) Conducted measurement method was used.

(2) The Occupied Channel Bandwidth method shall be measured using the §5.3.3.

(3) The path loss as the factor is calibrated to correct the reading.

2.3. EN 301 893 §4.2.3 – RF output power, TPC range and power Density

2.3.1. Definitions

2.3.1.1 RF output power

The RF Output Power is the mean equivalent isotropically radiated power (e.i.r.p.) during a transmission burst.

2.3.1.2 Transmit Power Control (TPC)

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 2 for devices with TPC.

2.3.1.3 Power Density

The Power Density is the mean equivalent isotropically radiated power (e.i.r.p.) density during a transmission burst.

2.3.2. Limits

2.3.2.1 General

The limits below are applicable to the system as a whole and in any possible configuration. This means that the antenna gain of the integral or dedicated antenna has to be taken into account as well as the additional (beamforming) gain in case of smart antenna systems (devices with multiple transmit chains).

In case of multiple (adjacent or non-adjacent) channels within the same sub-band, the total RF Output Power of all channels in that sub-band shall not exceed the limits defined in table 2 and table 3.

In case of multiple, non-adjacent channels operating in separate sub-bands, the total RF Output Power in each of the sub-bands shall not exceed the limits defined in table 2 and table 3.

2.3.2.2 Limits for RF output power and power density at the highest power level

TPC is not required for channels whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz.

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 2.

Devices are allowed to operate without TPC. See table 2 for the applicable limits that shall apply in this case.

Table 2: 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
5150-5350	23	20/23[note1]	10	7/10[note2]
5470-5725	30[note3]	27[note3]	17[note3]	14[not3]

Note 1: The applicable limit is 20dBm, 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 23dBm.

Note 2: The applicable limit is 7dBm/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 10dBm/MHz.

Note 3: Slave devices without a Radar Interference Detection function shall comply with the limits for the frequency range 5 250MHz to 5 350MHz.

2.3.2.3 Limit for RF output power at the lowest power level of the TPC range

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 3. For devices without TPC, the limits in table 3 do not apply.

Table 3: Mean e.i.r.p. limits for RF Output Power at the lowest power level of the TPC range

Frequency range(MHz)	Mean E.I.R.P (dBm)
5150-5350	17
5470-5725	24[note 1]

Note 1: Slave devices without a Radar Interference Detection function shall comply with the limits for the band 5 250 MHz to 5 350 MHz.

2.3.3. Conformance

Conformance tests as defined in clause 5.4.4 shall be carried out.

2.3.4. Test Conditions

The conformance requirements in clause 4.2.3 shall be verified on those channels and channel bandwidths defined in clause 5.3.2.

The measurements described in the present clause may need to be repeated to cover:

- each of the TPC ranges (or transmitter output power levels for equipment without TPC) and corresponding antenna assemblies declared by the manufacturer (see clause 5.4.1, item e), item f) and item g));

- each of the transmit operating modes declared by the manufacturer (see clause 5.3.3.2 and clause 5.4.1,item c)).

The measurements shall be performed with test signal specified in clause 5.3.1.1 applied. Alternatively, if special test functions are available, the equipment may also be configured in a continuous transmit mode or with a constant duty cycle (e.g. frame based systems) which is at least 10 %.

For a UUT with antenna connector(s) and using dedicated external antenna(s), or for a UUT with integral antenna(s) but with a temporary antenna connector(s) provided, conducted measurements shall be used in conjunction with the stated antenna assembly gain(s).

In the case of equipment intended for use with an integral antenna and where no external (temporary) antenna connectors are provided, a test fixture as described in clause B.4 may be used to perform relative measurements at the extremes of the operating temperature range.

2.3.5. Test Method

2.3.5.1 Conducted measurement

RF output power at the highest power - PH

Additional test conditions

These measurements shall be performed under both normal and extreme test conditions (see clause 5.1.3).

The UUT shall be configured to operate at:

- the highest stated transmitter output power level of the TPC range; or
- the maximum stated transmitter output power level in case the equipment has no TPC feature.

Option 1: For equipment with continuous transmission capability or for equipment operating (or with the capability to operate) with a constant duty cycle (e.g. Frame Based equipment)

This option is for equipment that operates only in one sub-band or that is capable for operation in two sub-bands simultaneously but, for the purpose of the testing, the equipment can be configured to:

- operate in a continuous transmit mode or with a constant duty cycle (x), and
- operate only in one sub-band.

Step 1:

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

- The output power of the transmitter shall be coupled to a matched diode detector or equivalent thereof. The output of the diode detector shall be connected to the vertical channel of an oscilloscope.
- The combination of the diode detector and the oscilloscope shall be capable of faithfully reproducing the duty cycle of the transmitter output signal.

• The observed duty cycle of the transmitter (Tx on / (Tx on + Tx off)) shall be noted as x ($0 < x \leq 1$), and recorded in the test report.

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 PH (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.

$PH = A + G + Y + 10 \times \log(1 / x)$ (dBm) (5)

• This value PH shall be compared to the applicable limit contained in table 2 of clause 4.2.3.2.2.

Option 2: For equipment without continuous transmission capability and operating (or with the capability to operate) in only one sub-band

This option is for equipment that is either:

• equipment capable of operation in both sub-bands, but not simultaneously; or

• equipment capable of operation in both sub-bands simultaneously but which, for the purpose of the testing, can be configured to transmit only in one sub-band.

Equipment having simultaneous transmissions in both sub-bands and which cannot be configured to transmit only in one sub-band, shall be tested using option 3 given in clause 5.4.4.2.1.1.4.

• The test procedure shall be as follows:

Step 1:

• Sample the transmit signal from the device using a fast power sensor suitable for 6 GHz. Save the raw samples.

The samples shall represent the RMS power of the signal.

• Settings:

- Sample speed: ⩾ 106 Samples/s.
- Measurement duration: Sufficient to capture a minimum of 10 transmitter bursts (see clause 5.3.1.1).

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 a power sensor to each transmit port for a synchronous measurement on all transmit ports.
- Trigger the power sensors so that they start sampling at the same time. Make sure the time difference between the samples of all sensors is less than 500 ns.
- For each individual sampling point (time domain), sum the coincident power samples of all ports and store them. Use these summed samples in the 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 30 dB may need to be reduced appropriately.

Step 4:

•Between the start and stop times of each individual burst, calculate the RMS (mean) power over the burst (P_{burst}) using the formula below:

$$P_{burst} = \frac{1}{k}\sum_{n=1}^{k} P_{sample}(n) \qquad (6)$$

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

•The highest of all P_{burst} values is the value A in dBm.

Step 5:

•The RF output power (e.i.r.p) at the highest power level PH shall be calculated from the above measured power output A (in dBm), the stated antenna assembly gain G in dBi and if applicable the beamforming gain Y in dB,according to the formula below. 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:

$$P_H = A + G + Y \text{ (dBm)} \qquad (7)$$

•This value P_H shall be compared to the applicable limit contained in table 2 of clause 4.2.3.2.2 and shall be recorded in the report.

Option 3: For equipment without continuous transmission capability and having simultaneous transmissions in both sub-bands

•This option is for equipment having simultaneous transmissions in both sub-bands but which cannot be configured to transmit only in one sub-band.

•This procedure first measures the peak power in each sub-band separately, then measures the Peak to Mean Power ratio for the overall transmission and uses this to calculate the RF Output Power (e.i.r.p.) in each sub-band separately using the measured values for peak power.

•The test procedure shall be as follows:

Step 1: **Measuring the Total Peak Power within the lower sub-band.**

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

- Start Frequency: 5 100 MHz

- Stop Frequency: 5 400 MHz
- RBW: 1 MHz
- VBW: 3 MHz
- Detector Mode: Peak
- Trace Mode: Max Hold
- Sweep Time: Auto

•Ensure that the noise floor of the spectrum analyser is at least 30 dB to 40 dB below the peak of the power envelope. If this is not possible (e.g. radiated measurements) reduce the bandwidth of the channel power function to a value which is still slightly above the Nominal Channel Bandwidth (e.g. +10 %) to avoid the noise floor influencing the measurement result.

•When the trace is complete, use the "Channel Power" function to measure the total peak power of the transmissions within the band 5 150 MHz to 5 350 MHz.

•For conducted measurements on devices with multiple transmit chains, the procedure above shall be repeated for each of the active transmit chains. The results shall be summed to provide the total peak power of the transmissions within the band 5 150 MHz to 5 350 MHz.

Step 2: **Measuring the Total Peak Power within the upper sub-band.**

•Change the Start Frequency to 5 420 MHz and the Stop Frequency to 5 775 MHz.

•Ensure that the noise floor of the spectrum analyser is at least 30 dB to 40 dB below the peak of the power envelope. If this is not possible (e.g. radiated measurements) reduce the bandwidth of the channel power function to a value which is still slightly above the Nominal Channel Bandwidth (e.g. +10 %) to avoid the noise floor influencing the measurement result.

•When the trace is complete, use the "Channel Power" function to measure the total peak power of all transmissions with the band 5 470 MHz to 5 725 MHz.

•For conducted measurements on devices with multiple transmit chains, the procedure above shall be repeated for each of the active transmit chains. The results shall be summed to provide the total peak power of the transmissions within the band 5 470 MHz to 5 725 MHz.

Step 3: **Calculating the Total Peak Power.**

•Calculate the total peak power by adding the measured value for the band 5 150 MHz to 5 350 MHz in step 1 to the value measured for the band 5 470 MHz to 5 725 MHz in step 2.

•Modern spectrum analysers may be able to measure the peak power in both sub-bands in one measurement in which case step 1 and step 2 can be combined.

Step 4: **Measuring Total Mean Output Power.**

•Sample the transmit signal from the device using a fast power sensor suitable for 6 GHz. Save the raw samples.The samples shall represent the RMS power of the signal.

•Settings:

- Sample speed: $\geqslant 10^6$ Samples/s.
- Measurement duration: Sufficient to capture a minimum of 10 transmitter bursts (see clause 5.3.1.1).

•For conducted measurements on devices with one transmit chain:

- Connect the power sensor to the transmit port, sample the transmit signal and store the raw data. Use these stored samples in all following steps.

• For conducted measurements on devices with multiple transmit chains:
  - Connect one power sensor to each transmit port for a synchronous measurement on all transmit ports.
  - Trigger the power sensors so that they start sampling at the same time. Make sure the time difference between the samples of all sensors is less than 500 ns.
  - For each individual sampling point (time domain), sum the coincident power samples of all ports and store them. Use these summed samples in all following steps.

• 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 case of insufficient dynamic range, the value of 30 dB may need to be reduced appropriately.

• Between the start and stop times of each individual burst, calculate the RMS (mean) power over the burst (P_{burst}) using the formula below:

$$P_{burst} = \frac{1}{k}\sum_{n=1}^{k} P_{sample}(n) \qquad (8)$$

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

• The highest of all P_{burst} values is the Total Mean Output Power and this value will be used for further calculations.

Step 5: **Calculating the Peak to Mean Power Ratio.**

• Using the value for Total Peak Power calculated in step 3 and the highest value for Total Mean Output Power measured in step 4, calculate the Peak to Average Power ratio in dB.

Step 6: **Calculating the RF Output Power (e.i.r.p.) for each sub-band.**

• The RF output power (e.i.r.p.) at the highest power level P_H shall be calculated for each of the sub-bands from the Peak to Mean Power Ratio obtained in step 5 and the measured values for Peak Power in each of the sub-bands (see step 1 and step 2). These values (values A in dBm) will be used for maximum e.i.r.p. calculations:
  - Add the (stated) antenna assembly gain G in dBi of the individual antenna element.
  - 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:

• For each sub-band, P_H (e.i.r.p.) shall be calculated using the formula below:

$$P_H = A + G + Y \text{ (dBm)} \qquad (9)$$

• These values for P_H shall be compared to the applicable limits contained in table 2 of clause 4.2.3.2.2 and shall be recorded in the report.

2.3.5.1.1 RF output power at the lowest power level of the TPC range - P_L

2.3.5.1.2.1 Additional test conditions

This test is only required for equipment with a TPC feature.

These measurements shall be performed under both normal and extreme test conditions (see clause 5.1.3).

The UUT shall be configured to operate at the lowest stated transmitter output power level of the TPC range.

For equipment with continuous transmission capability or for equipment operating (or with the capability to operate) with a constant duty cycle (e.g. Frame Based equipment)

This option is for equipment that operates only in one sub-band or that is capable for operation in two sub-bands simultaneously but, for the purpose of the testing, the equipment can be configured to:

- operate in a continuous transmit mode or with a constant duty cycle (x), and
- operate only in one sub-band.

Step 1 and Step 2:

- See step 1 and step 2 in clause 5.4.4.2.1.1.2.

The duty cycle measurement done in step 1 of clause 5.4.4.2.1.1.2 may not need to be repeated.

Step 3:

- The RF output power at the lowest power level PL (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:

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

- This value PL shall be compared to the applicable limit contained in table 3 of clause 4.2.3.2.3.

Option 2: For equipment without continuous transmission capability
and operating (or with the capability to operate) in only one sub-band

This option is for equipment that is either:

- equipment capable of operation in both sub-bands, but not simultaneously; or
- equipment capable of operation in both sub-bands simultaneously but which, for the purpose of the testing, can be configured to transmit only in one sub-band.

Equipment having simultaneous transmissions in both sub-bands and which cannot be configured to transmit only in one sub-band, shall be tested using option 3 given in clause 5.4.4.2.1.1.4.

The test procedure shall be as follows:

Step 1 to Step 4:

- See step 1 to step 4 in clause 5.4.4.2.1.1.3.

Step 5:

- The RF output power (e.i.r.p.) at the lowest power level P_L shall be calculated from the above measured power output A (in dBm), the stated 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 TPC range, the gain of the antenna assembly with the highest gain shall be used:

$$P_L = A + G + Y \text{ (dBm)} \qquad (11)$$

- This value P_L shall be compared to the applicable limit contained in table 3 of clause 4.2.3.2.3 and shall be recorded in the report.

Option 3: For equipment without continuous transmission capability and having simultaneous transmissions in both sub-bands

This option is for equipment having simultaneous transmissions in both sub-bands but which cannot be configured to transmit only in one sub-band.

This procedure first measures the peak power in each sub-band separately, then measures the Peak to Mean Power ratio for the overall transmission and uses this to calculate the RF Output Power (e.i.r.p.) in each sub-band separately using the measured values for peak power.

The test procedure shall be as follows:

Step 1: **Measuring the Total Peak Power within the lower sub-band.**

- Connect the UUT to the spectrum analyser and use the following settings:
  - Start Frequency: 5 100 MHz
  - Stop Frequency: 5 400 MHz
  - RBW: 1 MHz
  - VBW: 3 MHz
  - Detector Mode: Peak
  - Trace Mode: Max Hold
  - Sweep Time: Auto
- Ensure that the noise floor of the spectrum analyser is at least 30 dB to 40 dB below the peak of the power envelope. If this is not possible (e.g. radiated measurements) reduce the bandwidth of the channel power function to a value which is still slightly above the Nominal Channel Bandwidth (e.g. +10 %) to avoid the noise floor influencing the measurement result.
- When the trace is complete, use the "Channel Power" function to measure the total peak power of the transmissions within the band 5 150 MHz to 5 350 MHz.
- For conducted measurements on devices with multiple transmit chains, the procedure above shall be repeated for each of the active transmit chains. The results shall be summed to provide the total peak power of the transmissions within the band 5 150 MHz to 5 350 MHz.

Step 2: **Measuring the Total Peak Power within the upper sub-band.**

- Change the Start Frequency to 5 420 MHz and the Stop Frequency to 5 775 MHz.
- Ensure that the noise floor of the spectrum analyser is at least 30 dB to 40 dB below the peak of the power envelope. If this is not possible (e.g. radiated measurements) reduce the bandwidth of the channel power function to a value which is still slightly above the Nominal Channel Bandwidth (e.g. +10 %) to avoid the noise floor influencing the measurement result.
- When the trace is complete, use the "Channel Power" function to measure the total peak power of all transmissions with the band 5 470 MHz to 5 725 MHz.
- For conducted measurements on devices with multiple transmit chains, the procedure above shall be repeated for each of the active transmit chains. The results shall be summed to provide the

total peak power of the transmissions within the band 5 470 MHz to 5 725 MHz.

Step 3: **Calculating the Total Peak Power.**

- Calculate the total peak power by adding the measured value for the band 5 150 MHz to 5 350 MHz in step 1 to the value measured for the band 5 470 MHz to 5 725 MHz in step 2.
- Modern spectrum analysers may be able to measure the peak power in both sub-bands in one measurement in which case step 1 and step 2 can be combined.

Step 4: **Measuring Total Mean Output Power.**

- Sample the transmit signal from the device using a fast power sensor suitable for 6 GHz. Save the raw samples.The samples shall represent the RMS power of the signal.
- Settings:
  - Sample speed: $\geqslant 10^6$ Samples/s.
  - Measurement duration: Sufficient to capture a minimum of 10 transmitter bursts (see clause 5.3.1.1).
- For conducted measurements on devices with one transmit chain:
  - Connect the power sensor to the transmit port, sample the transmit signal and store the raw data. Use these stored samples in all following steps.
- For conducted measurements on devices with multiple transmit chains:
  - Connect one power sensor to each transmit port for a synchronous measurement on all transmit ports.
  - Trigger the power sensors so that they start sampling at the same time. Make sure the time difference between the samples of all sensors is less than 500 ns.
  - For each individual sampling point (time domain), sum the coincident power samples of all ports and store them. Use these summed samples in all following steps.
- 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 case of insufficient dynamic range, the value of 30 dB may need to be reduced appropriately.
- Between the start and stop times of each individual burst, calculate the RMS (mean) power over the burst (P_{burst}) using the formula below:

$$P_{burst} = \frac{1}{k}\sum_{n=1}^{k} P_{sample}(n) \qquad (12)$$

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

- The highest of all P_{burst} values is the Total Mean Output Power and this value will be used for further calculations.

Step 5: **Calculating the Peak to Mean Power Ratio.**

- Using the value for Total Peak Power calculated in step 3 and the highest value for Total Mean Output Power measured in step 4, calculate the Peak to Average Power ratio in dB.

Step 6: **Calculating the RF Output Power (e.i.r.p.) for each sub-band.**

- The RF output power (e.i.r.p.) at the highest power level P_L shall be calculated for each of the sub-bands from the Peak to Mean Power Ratio obtained in step 5 and the measured values for Peak Power in each of the sub-bands (see step 1 and step 2). These values (values A in dBm) will be used for maximum e.i.r.p. calculations:

- Add the (stated) antenna assembly gain G in dBi of the individual antenna element.
- 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:

•For each sub-band, P_L (e.i.r.p.) shall be calculated using the formula below:

$$P_L = A + G + Y \text{ (dBm)} \qquad (13)$$

• These values for P_L shall be compared to the applicable limits contained in table 2 of clause 4.2.3.2.2 and shall be recorded in the report.

Power Density

Additional test conditions

These measurements shall only be performed at normal test conditions (see clause 5.1.2).

The UUT shall be configured to operate at the lowest Nominal Channel Bandwidth with:

•the highest stated transmitter output power level of its TPC range; or

•the maximum stated transmitter output power level in case the equipment has no TPC feature.

For equipment with continuous transmission capability or for equipment operating (or with the capability to operate) with a constant duty cycle (e.g. Frame Based equipment)

This option is for equipment that can be configured to operate in a continuous transmit mode or with a constant duty cycle (x).

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: 1 MHz
- VBW: 3 MHz
- 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: 3 MHz
- RBW: 1 MHz
- VBW: 3 MHz
- 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 (see clause 5.4.4.2.1.1.2, step 1), 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:

$$PD = D + G + Y + 10 \times \log (1 / x) \text{ (dBm / MHz)} \qquad (14)$$

Option 2: For equipment without continuous transmission capability and without the capability to transmit with a constant duty cycle

This method can be used if the equipment has non-continuous transmissions and cannot be configured to transmit continuously or with a constant duty cycle.

For devices having simultaneous transmissions in both sub-bands, the Power Density in each of the sub-bands shall be measured separately and compared with the applicable limits contained in table 2 of clause 4.2.3.2.2.

The test procedure shall be as follows:

Step 1:

- Connect the UUT to the spectrum analyser and use the following settings:
  - Start Frequency: lower band edge of applicable sub-band (e.g. 5 150 MHz or 5 470 MHz)
  - Stop Frequency: upper band edge of applicable sub-band (e.g. 5 350 MHz or 5 725 MHz)
  - RBW: 10 kHz
  - VBW: 30 kHz
  - Sweep Points: > 20 000 (for 5 150 MHz to 5 350 MHz)
    > 25 500 (for 5 470 MHz to 5 725 MHz)

    For spectrum analysers not supporting this number of sweep points, the frequency band may be segmented.
  - Detector: RMS
  - Trace Mode: Max Hold

- Sweep time: 30 s

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

Step 2:

• For conducted measurements on smart antenna systems using either operating mode 2 or operating mode 3 (see clause 5.3.3.2), repeat the measurement for each of the transmit ports. For each sampling point (frequency domain), add up the coincident power values (in mW) for the different transmit chains and use this as the new data set.

Step 3:

•Add up the values of power for all the samples in the file using the formula below:

$$P_{sum} = \sum_{n=1}^{k} P_{sample}(n) \qquad (15)$$

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.) (P_H) measured in clause 5.4.4.2.1.1 for this sub-band. The following formulas can be used:

$$C_{Corr} = P_{Sum} - P_{He.i.r.p} \qquad (16)$$

$$P_{Samplecorr}(n) = P_{sample}(n) - C_{Corr} \qquad (17)$$

with 'n' being the actual sample number

Step 5:

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

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 sample #101).

Step 7:

• Repeat step 6 until the end of the data set and save the radiated power density values for each of the 1 MHz segments.

•From all the saved results, the highest value is the maximum Power Density (e.i.r.p.) for the UUT. This value,which shall comply with the limit contained in table 2 of clause 4.2.3.2.2, shall be recorded in the test report.

2.3.5.2 Radiated measurement

When performing radiated measurements on a UUT with a directional antenna (including smart antenna systems and systems capable of beamforming), the UUT shall be configured/positioned for maximum e.i.r.p. in the horizontal plane.This configuration/position shall be recorded for future use (see clause 5.2.4).

A test site as described in annex B and using the applicable measurement procedures as described in annex C shall be used.

The test procedure is further as described under clause 5.4.4.2.1. However, the following shall be taken into account when performing radiated measurements.

For measuring Output Power:

- When using Option 1 as in clause 5.4.4.2.1.1.2 and clause 5.4.4.2.1.2.2, the values G and Y used in step 3 shall be ignored.
- When using Option 2 as in clause 5.4.4.2.1.1.3 and clause 5.4.4.2.1.2.3, the values G and Y used in step 5 shall be ignored.
- When using Option 3 as in clause 5.4.4.2.1.1.4 and clause 5.4.4.2.1.2.4, the values G and Y used in step 6 shall be ignored.

For measuring Power Density:

- When using Option 1 as in clause 5.4.4.2.1.3.2, the values G and Y used in step 5 shall be ignored.

For measuring the RF output power at the highest and lowest power level, it is likely that a radiated measurement would be performed using a spectrum analyser or measurement receiver, rather than a wide band power sensor. If this is the case and if the resolution bandwidth capability of the measurement device is narrower than the Occupied Channel Bandwidth of the UUT signal measured, then the method of measurement shall be documented in the test report.

2.3.6. Result for output power

2.3.6.1 802.11 a Mode output power

Test Conditions		EIRP (dBm)				Result
		Transmitter Power Level; Limit=20/23[Note1]dBm		Transmitter Power Level; Limit=27dBm		
		Ch36, 5180MHz	CH64, 5320MHz	CH100, 5500MHz	CH144, 5720MHz	
NV	NT	12.88	10.55	10.41	11.45	PASS
	LT	12.87	10.57	10.44	11.47	PASS
	HT	12.83	10.50	10.39	11.40	PASS

2.3.6.2 802.11 n (HT40) mode output power

Test Conditions		EIRP (dBm)				Result
		Transmitter Power Level; Limit=20/23[Note1]dBm		Transmitter Power Level; Limit=20dBm		
		CH38, 5190MHz	CH62, 5310MHz	CH102, 5510MHz	CH142, 5710MHz	
NV	NT	14.69	12.80	12.03	13.06	**PASS**
	LT	14.67	12.82	12.07	13.08	**PASS**
	HT	14.65	12.73	12.01	13.04	**PASS**

Note 1: The applicable limit is 20dBm, 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 23dBm.
Note 2: Conducted measurement method was used.
Note 3: The path loss as the factor is calibrated to correct the reading.
Note 4: This device without TPC function.

2.3.7. Result for Power Density

Test Mode	Frequency (MHz)	Power Density (dBm/MHz)	Limit (dBm/MHz)	Test Result
a Mode	5180	4.31	10	**PASS**
	5320	1.59	7	**PASS**
	5500	0.73	10	**PASS**
	5720	0.97	10	**PASS**

Note 1: Conducted measurement method was used.
Note 2: The path loss as the factor is calibrated to correct the reading.
Note 3: This device without TPC function.

2.4. EN 301 893 §4.2.4.1 - Transmitter unwanted emissions outside the 5 GHz RLAN bands

2.4.1. Definition

Transmitter unwanted emissions outside the 5 GHz RLAN bands are radio frequency emissions outside the 5 GHz RLAN bands defined in clause 3.1.

2.4.2. Limit

The level of transmitter unwanted emissions outside the 5 GHz RLAN bands shall not exceed the limits given in table 4.
In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted) and to the emissions radiated by the cabinet. In case of integral antenna equipment (without temporary antenna connectors), these limits apply to emissions radiated by the equipment.

Table 4: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 26 GHz	-30 dBm	1 MHz

2.4.3. Conformance

Conformance tests as defined in clause 5.4.5 shall be carried out.

2.4.4. Test Conditions

The conformance requirements in clause 4.2.4.1 shall be verified only under normal operating conditions, and when operating on those channels defined in clause 5.3.2.
The equipment shall be configured to operate under its worst case situation with respect to

unwanted emissions outside the 5 GHz RLAN bands.

If possible, the UUT shall be set to continuous transmit (duty cycle = 1) for the duration of this test. If continuous transmit is not possible, the UUT should be configured to operate at its maximum duty cycle.

The level of transmitter unwanted emissions shall be measured as, either:

a) their power in a specified load (conducted emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment (cabinet radiation); or

b) their effective radiated power when radiated by cabinet and antenna in case of integral antenna equipment with no temporary antenna connectors.

2.4.5. Test Method

2.4.5.1 Conducted measurement

Pre-scan

The UUT shall be connected to a spectrum analyser capable of RF power measurements.

This pre-scan test procedure 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 clause 4.2.4.1.2, table 4.

Step 2:

• The unwanted emissions over the range 30 MHz to 1 000 MHz shall be identified.

• Spectrum analyser settings:

- Resolution bandwidth: 100 kHz
- Video bandwidth: 300 kHz
- Detector mode: Peak
- Trace Mode: Max Hold
- Sweep Points: ≥ 9 700

  For spectrum analysers not supporting this number of sweep points, the frequency band may be segmented. For spectrum analysers capable of supporting twice this number of sweep points, the frequency adjustment in clause 5.4.5.2.1.2 (step 1, last bullet) may be omitted.
- 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.

EXAMPLE 1: For non-continuous transmissions, if the UUT is using a test sequence as described in clause 5.3.1.1 with a transmitter on + off time of 2 ms, then the sweep time has to be greater than 4 ms per 100 kHz.

• Allow the trace to stabilize. Any emissions identified that have a margin of less than 6 dB with respect to the limits given in clause 4.2.4.1.2, table 4 shall be individually measured using the procedure in clause 5.4.5.2.1.2 and compared to the limits given in clause 4.2.4.1.2, table 4.

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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: ⩾ 25 000

For spectrum analysers not supporting this number of sweep points, the frequency band may be segmented. For spectrum analysers capable of supporting twice this number of sweep points, the frequency adjustment in clause 5.4.5.2.1.2 (step 1, last bullet) may be omitted.

- 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.

EXAMPLE 2: For non-continuous transmissions, if the UUT is using a test sequence as described in clause 5.3.1.1 with a transmitter on + off time of 2 ms, then the sweep time has to be greater than 4 ms per 1 MHz.

• Allow the trace to stabilize. Any emissions identified that have a margin of less than 6 dB with respect to the limits given in clause 4.2.4.1.2, table 4 shall be individually measured using the procedure in clause 5.4.5.2.1.2 and compared to the limits given in clause 4.2.4.1.2, table 4.

Measurement of the emissions identified during the pre-scan

The limits for transmitter unwanted emissions in clause 4.2.4.1 refer to average power levels.

The steps below shall be used to accurately measure the individual unwanted emissions identified during the pre-scan measurements above.

Continuous transmit signals:

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 clause 4.2.4.1.2, table 4.

Non-continuous transmit signals:

For non-continuous transmit signals, the measurement shall be made only over the "on" part of the burst.

Step 1:

• The level of the emissions shall be measured in the time domain, using the following spectrum analyser settings:

- Centre Frequency: Frequency of emission identified during the pre-scan
- RBW: 100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
- VBW: 300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
- Frequency Span: 0 Hz
- Sweep mode: Single Sweep

- Sweep Time: Suitable to capture one transmission burst. Additional measurements may be needed to identify the length of the transmission burst. In case of continuous signals, the Sweep Time shall be set to 30 ms
- Sweep points: Sweeptime [μs] / 1 μs with a maximum of 30 000
- Trigger: Video (burst signals) or Manual (continuous signals)
- Detector: RMS
- Trace Mode: Clear/Write

• Adjust the centre frequency (fine tune) to capture the highest level of one burst of the emission to be measured.
This fine tuning can be omitted for spectrum analysers capable of supporting twice this number of sweep points required in step 2 and step 3 from the pre-scan procedure in clause 5.4.5.2.1.1.

Step 2:

• Adjust the trigger level to select the transmissions with the highest power level.

• 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. If the spurious emission to be measured is a continuous signal, the measurement window shall be set to match the start and stop times of the sweep.

• Select RMS power to be measured within the selected window and note the result which is the RMS power of this particular spurious emission. Compare this value with the applicable limit provided by clause 4.2.4.1.2,table 4.

Repeat this procedure for every emission identified during the pre-scan. The values and corresponding frequencies shall be recorded.

In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), the measurements shall be repeated for each of the active transmit chains. Comparison with the applicable limits shall be done using either of the options given below:

• Option 1: the results for each of the transmit chains for the corresponding 1 MHz segments shall be added and compared with the limits provided by table 4 in clause 4.2.4.1.2.

• Option 2: the results for each of the transmit chains shall be individually compared with the limits provided by table 4 in clause 4.2.4.1.2 after these limits have been reduced by 10 × log10 (Tch) (number of active transmit chains).

2.4.5.2 Radiated measurement

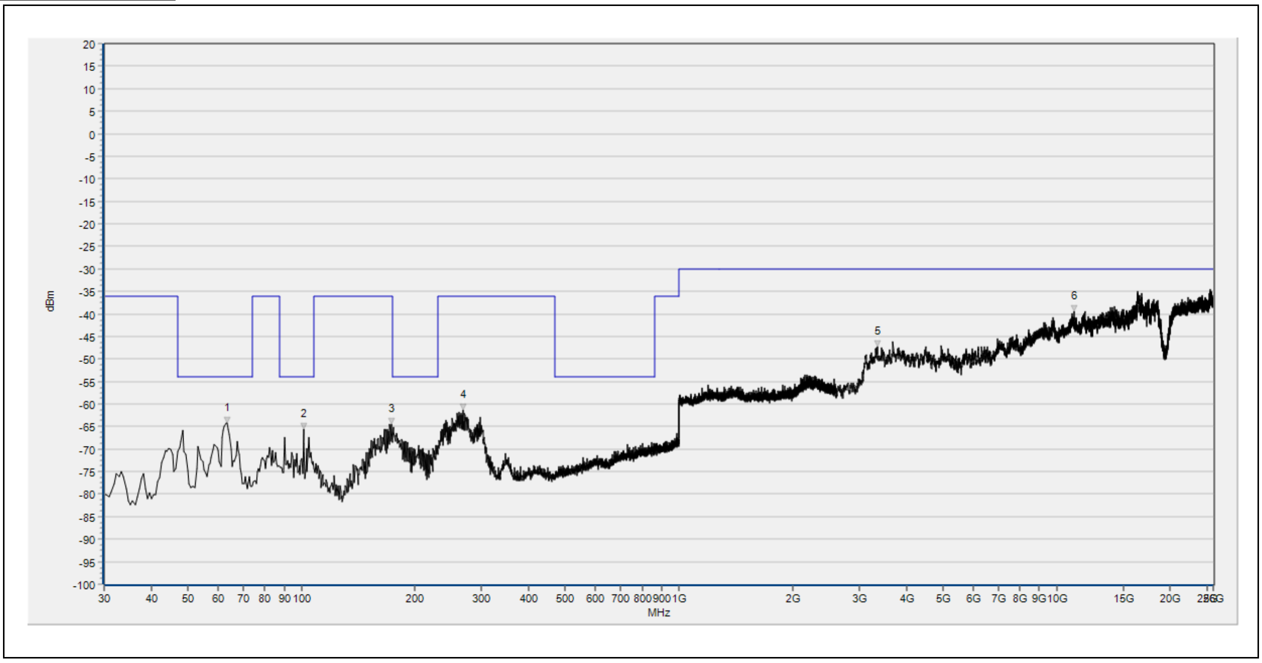
The test set up as described in annex B shall be used with a spectrum analyser attached to the test antenna.

The test procedure is as described under clause 5.4.5.2.1.

2.4.6. Results (Radiated Method):

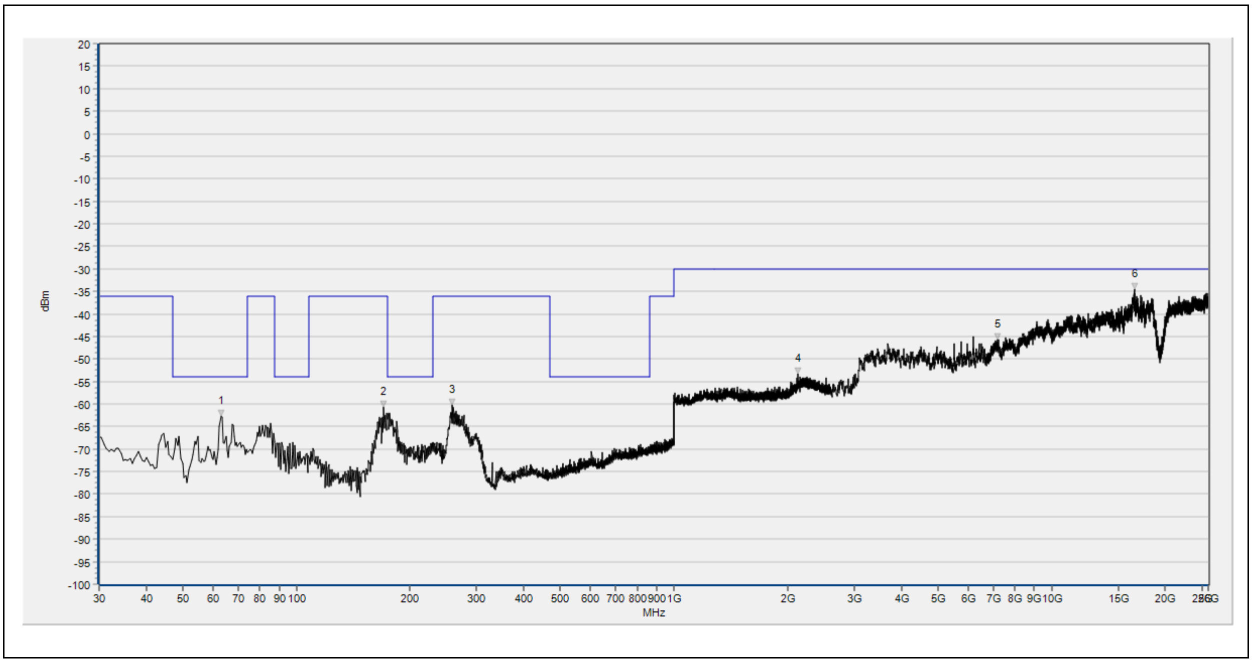
2.4.6.1 802.11 a Mode

Channel = 36



(30MHz to 26GHz, Antenna Horizontal, channel 36)

Test frequency range 30MHz to 26 GHz	Channel =36				
	Transmitter with modulation Mode at 5180MHz				
	Frequency (MHz)	**Peak (dBm)**	**Limit(PK)**	**Antenna**	**Verdict**
	63.532	-64.31	-54.00	Horizontal	PASS
	101.088	-65.51	-54.00	Horizontal	PASS
	172.786	-64.56	-36.00	Horizontal	PASS
	267.409	-61.26	-36.00	Horizontal	PASS
	3348.950	-47.25	-30.00	Horizontal	PASS
	11128.666	-39.50	-30.00	Horizontal	PASS



(30MHz to 26GHz, Antenna Vertical, channel 36)

Test frequency range 30MHz to 26 GHz	Channel = 36				
	Transmitter with modulation Mode at 5180MHz				
	Frequency(MHz)	**Peak (dBm)**	**Limit(PK)**	**Antenna**	**Verdict**
	63.044	-62.70	-54.00	Vertical	PASS
	170.348	-60.63	-36.00	Vertical	PASS
	258.629	-60.29	-36.00	Vertical	PASS
	2129.977	-53.34	-30.00	Vertical	PASS
	7191.998	-45.76	-30.00	Vertical	PASS
	16549.190	-34.62	-30.00	Vertical	PASS

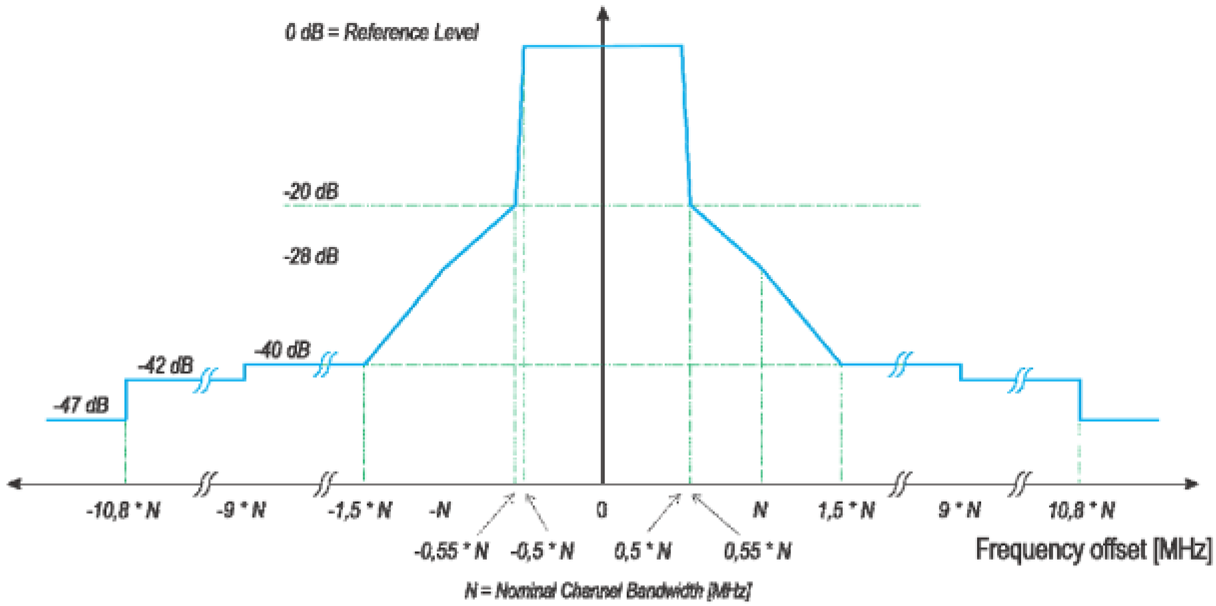
2.5. EN 301 893 §4.2.4.2 - Transmitter unwanted emissions within the 5 GHz RLAN bands

2.5.1. Definition

Transmitter unwanted emissions within the 5 GHz RLAN bands are radio frequency emissions within the 5 GHz RLAN bands defined in clause 3.1.

2.5.2. Limit

Figure 1:Transmit spectral power mask



The average level of transmitter unwanted emissions within the 5 GHz RLAN bands shall not exceed the limits of the mask provided in figure 1 or an absolute level of –30 dBm with a 1 MHz measurement bandwidth, whichever is greater.The limits in figure 1 are relative to the maximum spectral power density of the transmitted signal and apply with a reference bandwidth of 1 MHz. The mask is only applicable within the band of operation. Beyond the band edges the requirements of clause 4.2.4.1 apply.

In case of smart antenna systems (devices with multiple transmit chains) each of the transmit chains shall meet the limits provided in figure 1.

For transmitter unwanted emissions within the 5 GHz RLAN bands, simultaneous transmissions in adjacent channels may be considered as one signal with an actual Nominal Channel Bandwidth of "n" times the individual Nominal Channel Bandwidth where "n" is the number of adjacent channels used simultaneously.

For simultaneous transmissions in multiple non-adjacent channels, the overall transmit spectral power mask is constructed in the following manner. First, a mask as provided in figure 1 is applied to each of the channels. Then, for each frequency point, the greatest value from the spectral masks of all the channels assessed shall be taken as the overall spectral mask requirement at that frequency.

2.5.3. Conformance

Conformance tests as defined in clause 5.4.6 shall be carried out.

2.5.4. Test conditions

The conformance requirements in clause 4.2.4.2 shall be verified only under normal operating conditions, and when operating on those channels and channel bandwidths defined in clause 5.3.2.
The equipment shall be configured to operate under its worst case situation with respect to unwanted emissions within the 5 GHz RLAN bands.
For UUT without an integral antenna and for a UUT with an integral antenna but with a temporary antenna connector(s), conducted measurements shall be performed. Alternatively, if UUT has an integral antenna(s), but no temporary antenna connector(s), radiated measurements can be used.
In case of conducted measurements on smart antenna systems (devices with multiple transmit chains) operating in a mode with more than one transmit chain being active simultaneously, measurements shall only be performed on one of the transmit chains (antenna outputs).

2.5.5. Test method

2.5.5.1 Conducted measurement

Option 1: For equipment with continuous transmission capability

The UUT shall be configured for continuous transmit mode (duty cycle equal to 100 %). If this is not possible, then option 2 shall be used.

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 5 150 MHz to 5 350 MHz and 5 470 MHz to 5 725 MHz. No other parameter of the spectrum analyser should be changed.
- Compare the relative power envelope of the UUT with the limits defined in clause 4.2.4.2.2.

Option 2: For equipment without continuous transmission capability

This method shall be used if the UUT is not capable of operating in a continuous transmit mode (duty cycle less than 100 %). In addition, this option can also be used as an alternative to option 1 for systems operating in a continuous transmit mode.

Step 1: Determination of the reference average power level.

- Spectrum analyser settings:
  - Resolution bandwidth: 1 MHz
  - Video bandwidth: 30 kHz
  - Detector mode: RMS
  - Trace Mode: Max Hold
  - Sweep time: ≥ 1 min
  - 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 5 150 MHz to 5 350 MHz and 5 470 MHz to 5 725 MHz. No other parameter of the spectrum analyser should be changed.
- Compare the relative power envelope of the UUT with the limits defined in clause 4.2.4.2.2.

2.5.5.2 Radiated measurement

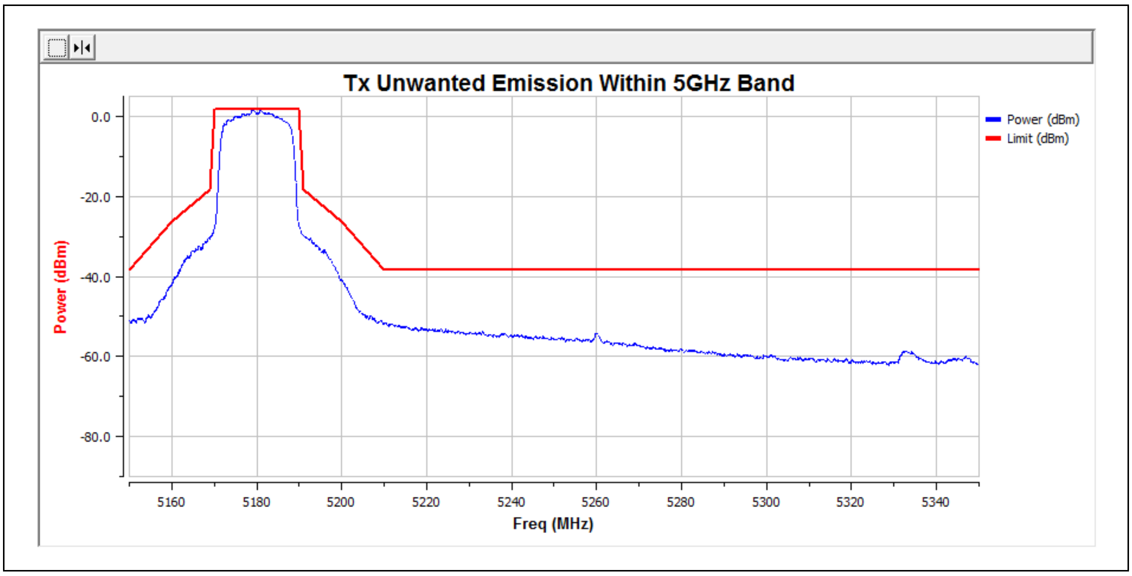
The test set up as described in annex B shall be used with a spectrum analyser attached to the test antenna.

The test procedure is as described under clause 5.4.6.2.1.

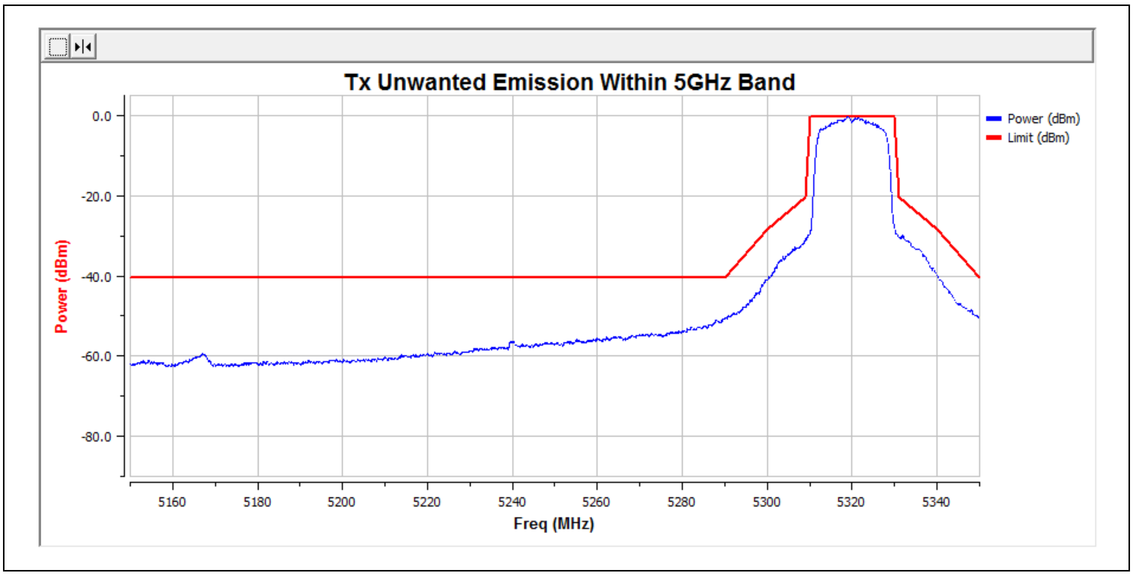
2.5.6. Results (Conducted Method):

2.5.6.1 802.11 a Mode

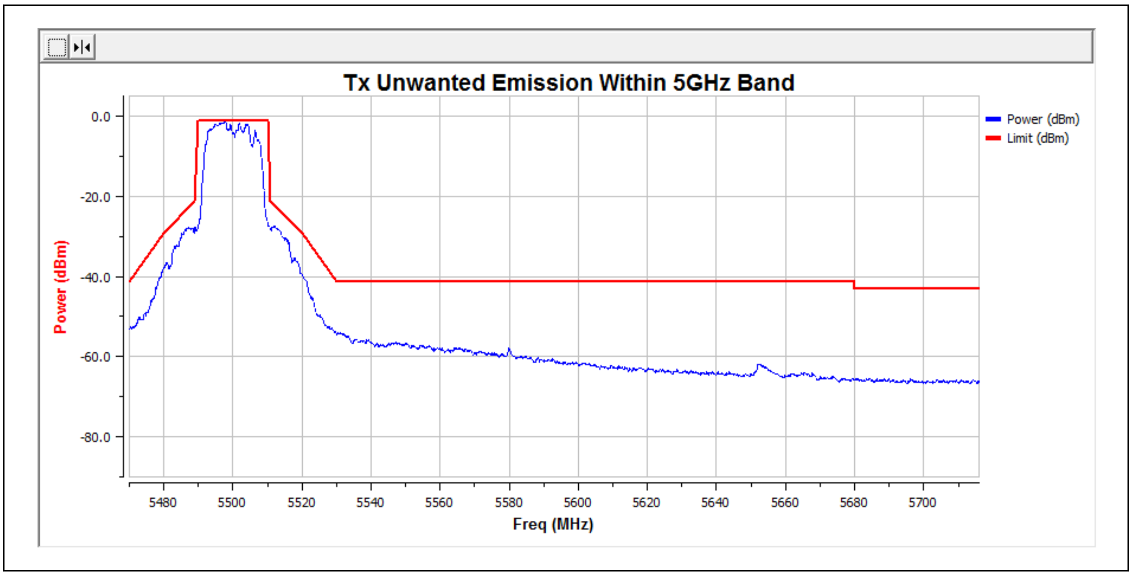
Channel - 5180MHz



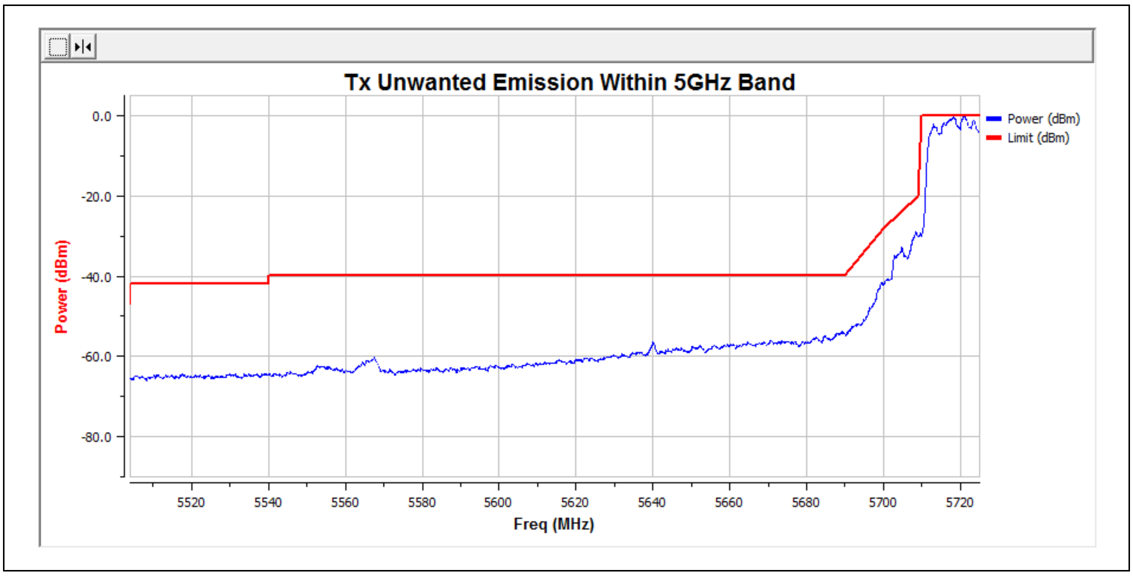
Channel - 5320MHz



Channel - 5500MHz

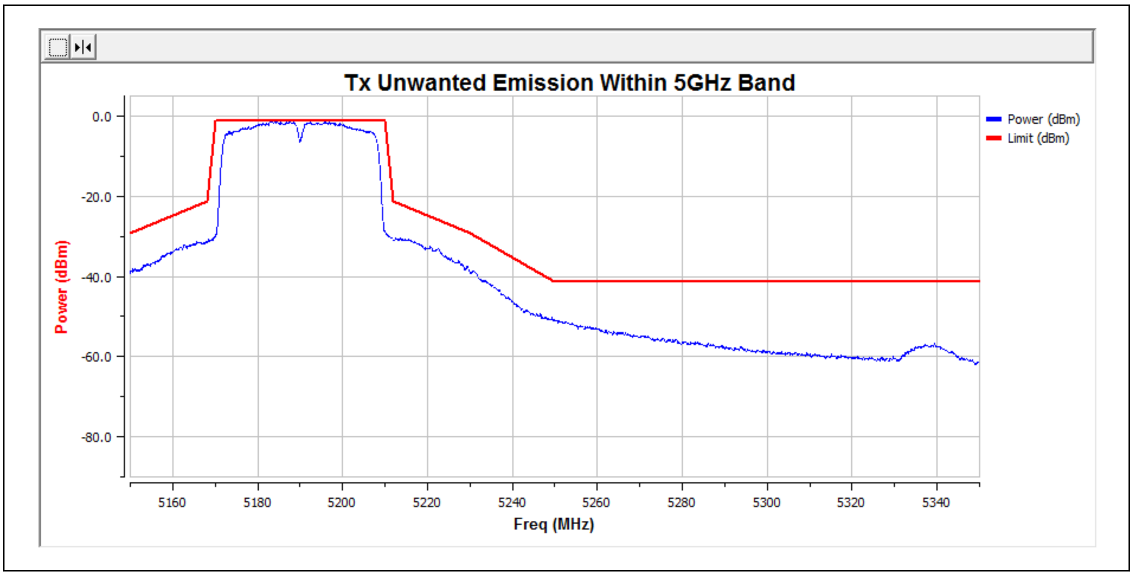


Channel - 5720MHz

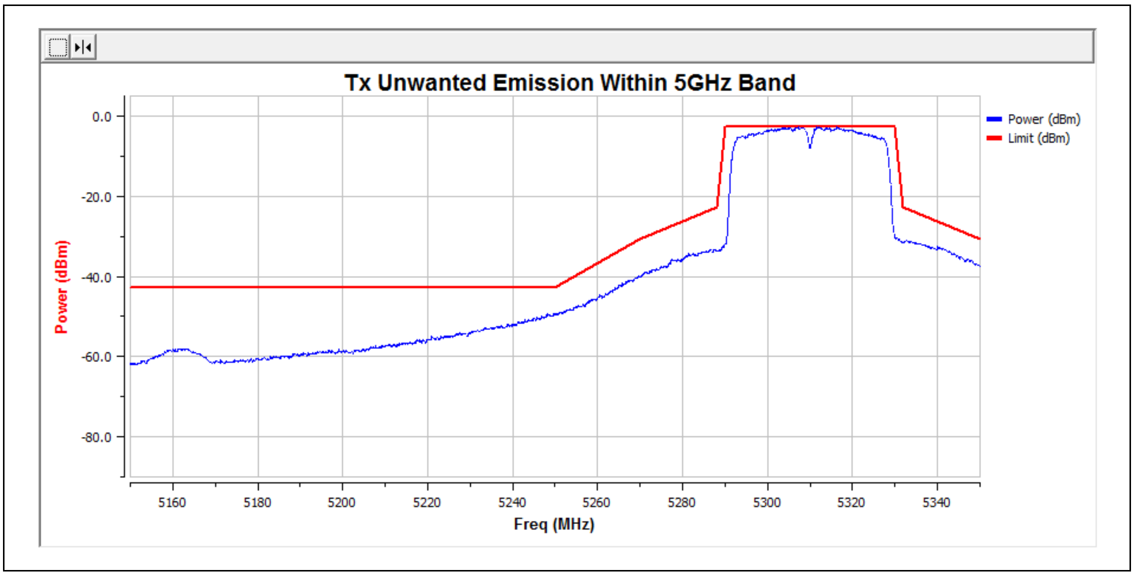


2.5.6.2 802.11 n (HT40) Mode

Channel - 5190MHz



Channel - 5310MHz



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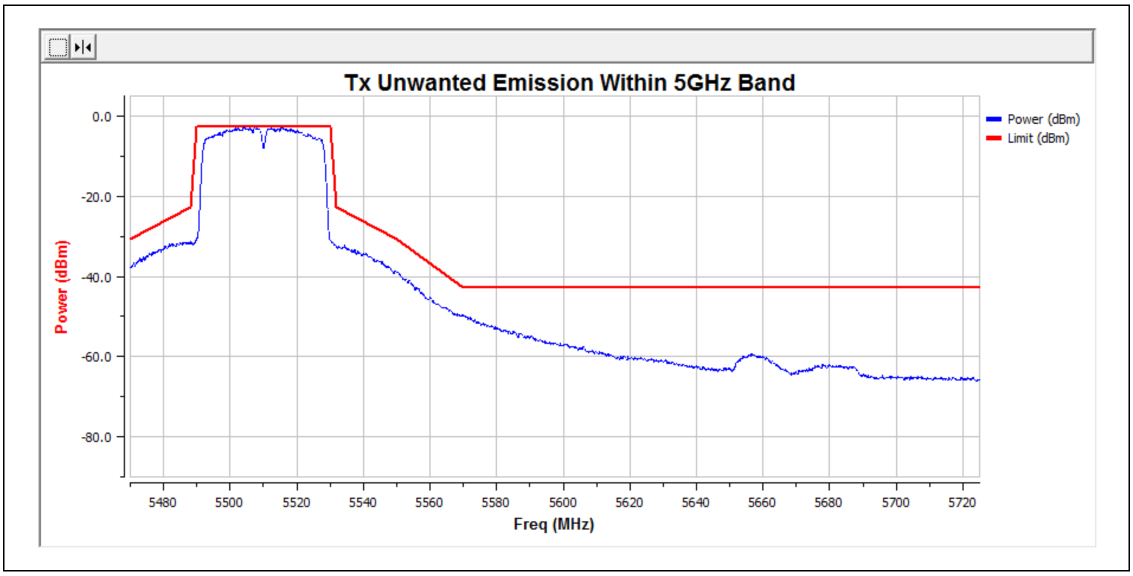
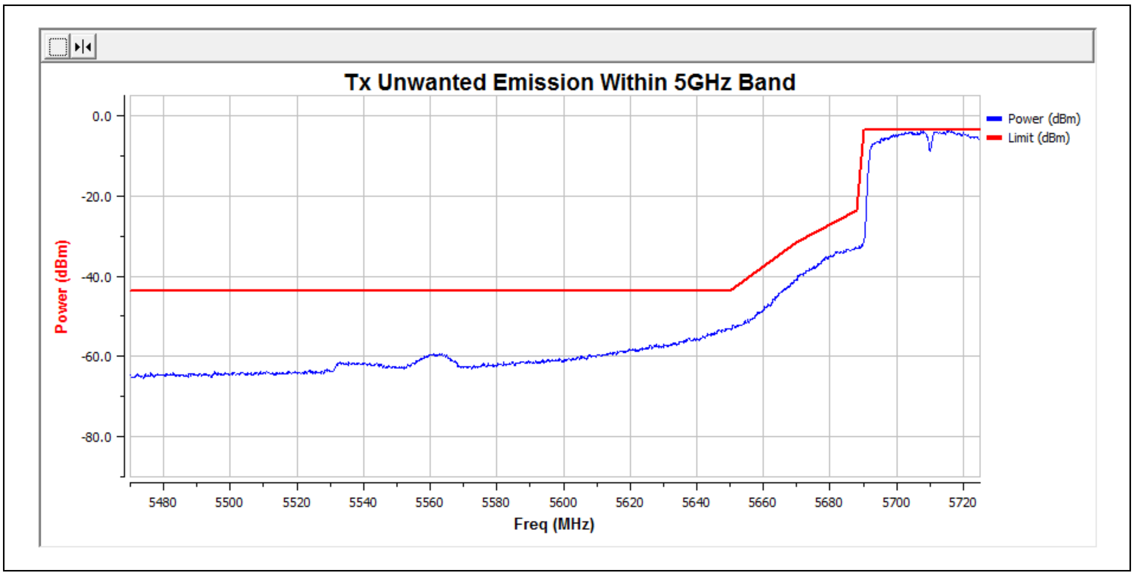
Channel - 5510MHz



Channel - 5710MHz



2.6. EN 301 893 §4.2.5- Receiver Spurious Emissions

2.6.1. Definition

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

2.6.2. Limit

The spurious emissions of the receiver shall not exceed the limits given in table 5.
In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted) and to the emissions radiated by the cabinet. In case of integral antenna equipment (without temporary antenna connectors), these limits apply to emissions radiated by the equipment.

Table 5: Spurious radiated emission limits

Frequency range (MHz)	Maximum power, E.R.P. (≤1GHz); E.I.R.P (> 1GHz)	Bandwidth
30-1380	-57 dBm	100 KHz
1380-26000	-47 dBm	1 MKHz

2.6.3. Conformance

Conformance tests as defined in clause 5.4.7 shall be carried out.

2.6.4. Test conditions

The conformance requirements in clause 4.2.5 shall be verified only under normal operating conditions, and when operating on those channels defined in clause 5.3.2.
For equipment having different operating modes (see clause 5.3.3.2) the measurements described in the present clause may not need to be repeated for all the operating modes.
The level of receiver spurious emissions shall be measured as, either:
a) their power in a specified load (conducted emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment (cabinet radiation); or
b) their effective radiated power when radiated by cabinet and antenna in case of integral antenna equipment with no temporary antenna connectors.
The test method in clause 5.4.7.2 below assumes, that for the duration of the test, the UUT is configured into a continuous receive mode, or is operated in a mode where no transmissions occur.

2.6.5. Test method

2.6.5.1 Conducted measurement

Pre-scan

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 clause 4.2.5.2, table 5.

Step 2:

• The emissions shall be measured over the range 30 MHz to 1 000 MHz.

• Spectrum analyser settings:

- Resolution bandwidth: 100 kHz
- Video bandwidth: 300 kHz
- Detector mode: Peak
- Trace Mode: Max Hold
- Sweep Points: ⩾ 9 700

For spectrum analysers not supporting this number of sweep points, the frequency band may be segmented. For spectrum analysers capable of supporting twice this number of sweep points, the frequency adjustment in clause 5.4.7.2.1.2 (step 1, last bullet) may be omitted.

- 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 clause 4.2.5.2, table 5, shall be individually measured using the procedure in clause 5.4.7.2.1.2 and compared to the limits given in clause 4.2.5.2, table 5.

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: ⩾ 25 000

For spectrum analysers not supporting this high number of sweep points, the frequency band may need to be segmented. For spectrum analysers capable of supporting twice this number of sweep points, the frequency adjustment in clause 5.4.7.2.1.2 (step 1, last bullet) may be omitted.

- 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 clause 4.2.5.2, table 5, shall be individually measured using the procedure in clause 5.4.7.2.1.2 and compared to the limits given in clause 4.2.5.2, table 5.

Measurement of the emissions identified during the pre-scan

The limits for receiver spurious emissions in clause 4.2.5 refer to average power levels.

The steps 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 (emissions < 1 GHz) / 1 MHz (emissions > 1 GHz)
  - Video Bandwidth: 300 kHz (emissions < 1 GHz) / 3 MHz (emissions > 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

• Adjust the centre frequency (fine tune) to capture the highest level of one burst of the emission to be measured.This fine tuning can be omitted for spectrum analysers capable of supporting twice this number of sweep points required in step 2 and step 3 from the pre-scan procedure in clause 5.4.7.2.1.1.

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 shall be repeated for each of the active receive chains.

• 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 clause 4.2.5.2, table 5.

2.6.5.2 Radiated measurement

The test set up as described in annex B shall be used with a spectrum analyser attached to the test antenna.

The test procedure is as described under clause 5.4.7.2.1.

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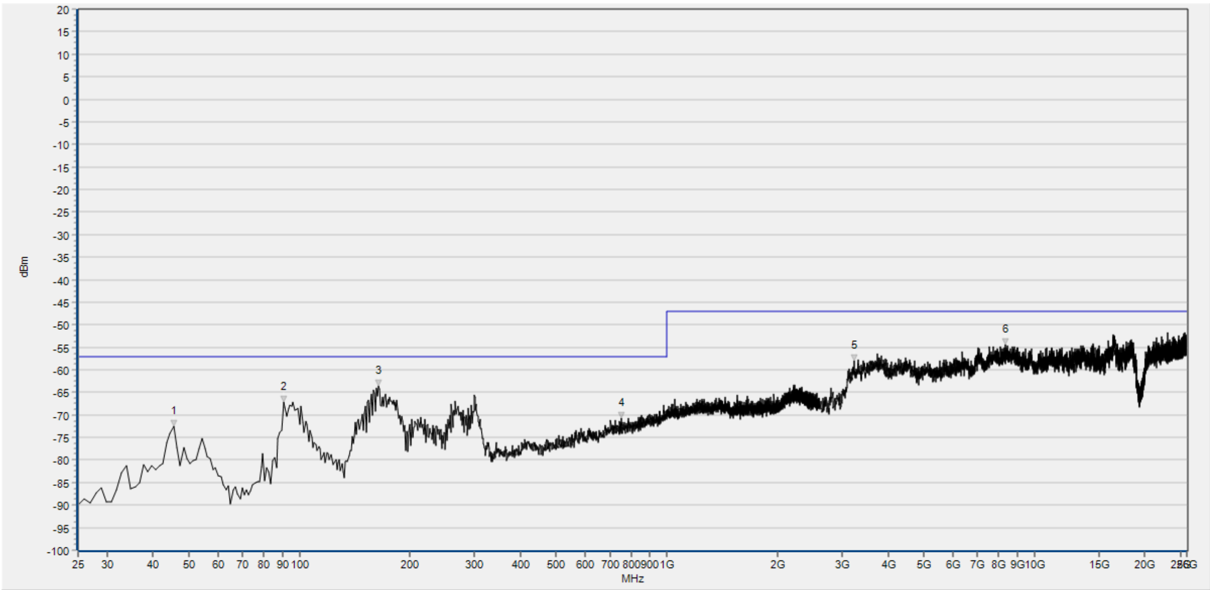
2.6.6. Results (Radiated Method):

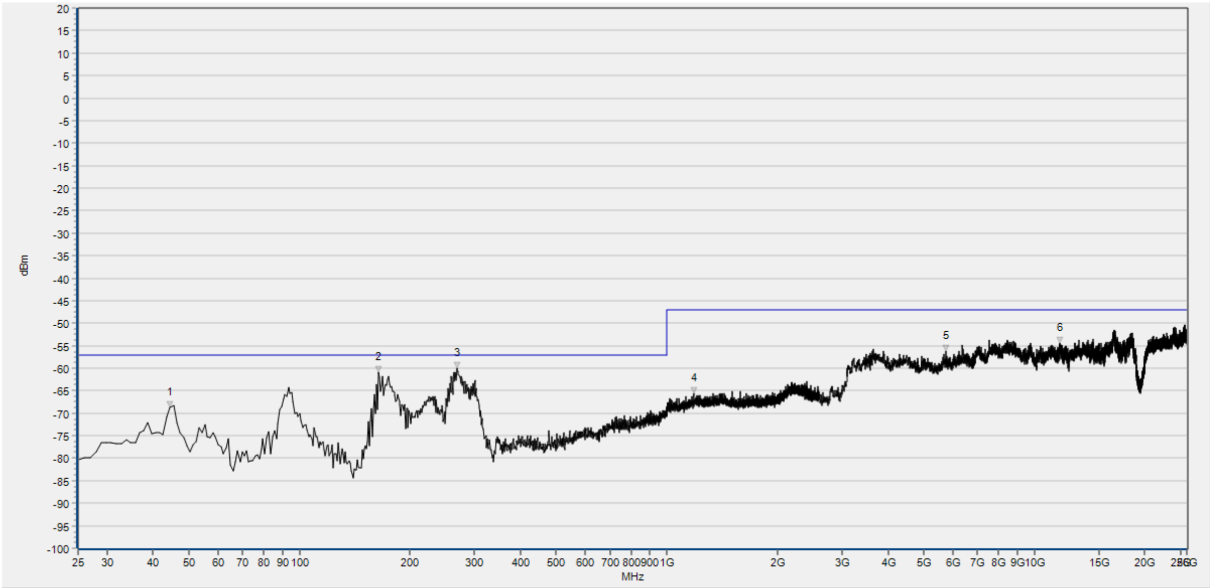
2.6.6.1 802.11 a Mode

<u>Plot for Channel = 36</u>



(30MHz to 26GHz, Antenna Horizontal, channel 36)

Test frequency range 30MHz to 26 GHz	Channel = 36				
	Receiving Mode at 5180MHz				
	Frequency (MHz)	Peak (dBm)	Limit(PK)	Antenna	Verdict
	45.495	-72.43	-57.00	Horizontal	PASS
	90.390	-67.23	-57.00	Horizontal	PASS
	164.565	-63.64	-57.00	Horizontal	PASS
	753.078	-70.80	-57.00	Horizontal	PASS
	3231.926	-57.94	-47.00	Horizontal	PASS
	8343.509	-54.32	-47.00	Horizontal	PASS



(30MHz to 26GHz, Antenna Vertical, channel 36)

Test frequency range 30MHz to 26 GHz	Channel = 36				
	Receiving Mode at 5180MHz				
	Frequency(MHz)	Peak (dBm)	Limit(PK)	Antenna	Verdict
	44.520	-68.67	-57.00	Vertical	PASS
	164.565	-60.79	-57.00	Vertical	PASS
	268.018	-60.06	-57.00	Vertical	PASS
	1181.691	-65.67	-47.00	Vertical	PASS
	5754.951	-56.14	-47.00	Vertical	PASS
	11741.868	-54.49	-47.00	Vertical	PASS

2.7. EN 301 893 §4.2.6–Dynamic Frequency Selection (DFS)

2.7.1. Introduction

2.7.1.1 General

An RLAN shall employ a Dynamic Frequency Selection (DFS) function to:

- detect interference from radar systems (radar detection) and to avoid co-channel operation with these systems;
- provide on aggregate a near-uniform loading of the spectrum (Uniform Spreading).

The DFS function as described in the present document is not tested for its ability to detect frequency hopping radar signals.

Whilst the DFS function described in this clause defines conditions under which the equipment may transmit,transmissions are allowed providing they are not prohibited by the Adaptivity requirement in clause 4.2.7.

2.7.1.2 DFS applicable frequency range

Radar detection shall be used when operating on channels whose nominal bandwidth falls partly or completely within the frequency ranges 5 250 MHz to 5 350 MHz or 5 470 MHz to 5 725 MHz. This requirement applies to all types of RLAN devices regardless of the type of communication between these devices.

Uniform Spreading is required across the frequency ranges 5 150 MHz to 5 350 MHz and 5 470 MHz to 5 725 MHz.Uniform Spreading is not applicable for equipment that only operates in the band 5 150 MHz to 5 250 MHz.

2.7.1.3 DFS operational modes

Within the context of the operation of the DFS function, an RLAN device shall operate as either a master or a slave.RLAN devices operating as a slave shall only operate in a network controlled by an RLAN device operating as a master. A device which is capable of operating as either a master or a slave shall comply with the requirements applicable to the mode in which it operates.

Some RLAN devices are capable of communicating in ad-hoc manner without being attached to a network. RLAN devices operating in this manner on channels whose nominal bandwidth falls partly or completely within the frequency ranges 5 250 MHz to 5 350 MHz or 5 470 MHz to 5 725 MHz shall employ DFS and shall be tested against the requirements applicable to a master.

Slave devices used in fixed outdoor point to point or fixed outdoor point to multipoint applications shall behave as slave with radar detection independent of their output power. See table 6.

2.7.1.4 DFS operation

The operational behaviour and individual DFS requirements that are associated with master and slave devices are as follows:

Master devices:

a) The master device shall use a Radar Interference Detection function in order to detect radar signals.

The master device may rely on another device, associated with the master, to implement the Radar Interference Detection function. In such a case, the combination shall comply with the requirements applicable to a master.

An RLAN network always has at least one RLAN device operating in master mode when operating in the bands 5 250 MHz to 5 350 MHz and 5 470 MHz to 5 725 MHz.

b) A master device shall only start operations on Available Channels. At installation (or reinstallation) of the equipment, the RLAN is assumed to have no Available Channels within the band 5 250 MHz to 5 350 MHz and/or 5 470 MHz to 5 725 MHz. In such a case, before starting operations on one or more of these channels,the master device shall perform either a Channel Availability Check or an Off-Channel CAC to ensure that there are no radars operating on any selected channel. If no radar has been detected, the channel(s) becomes an Available Channel(s) and remains as such until a radar signal is detected during the In-Service Monitoring after the channel became an Operating Channel. The Channel Availability Check or the Off-Channel CAC may be performed over a wider bandwidth such that all channels within the tested bandwidth become Available Channels.

The initial Channel Availability Check may be activated manually at installation or reinstallation of the equipment.

c) A master device may initiate a network by sending enabling signals to other RLAN (slave) devices. Once the RLAN has started operations on an Available Channel, then that channel becomes an Operating Channel.During normal operation, the master device shall monitor all Operating Channels (In-Service Monitoring) to ensure that there is no radar operating within these channel(s). If no radar was detected on an Operating Channel by the In-Service Monitoring but the RLAN stops operating on that channel, then the channel becomes again an Available Channel.

An RLAN is allowed to start transmissions on multiple (adjacent or non-adjacent) Available Channels. In this case all these channels become Operating Channels.

d) If the master device has detected a radar signal on an Operating Channel during In-Service Monitoring, the master device shall instruct all its associated slave devices to stop transmitting on this channel which becomes an Unavailable Channel. When operating on multiple (adjacent or non-adjacent) Operating Channels simultaneously, only the Operating Channel containing the frequency on which radar was detected shall become an Unavailable Channel.

e) An Unavailable Channel can become a Usable Channel again after the Non-Occupancy Period. A new Channel Availability Check or an Off-Channel CAC is required to verify there is no radar operating on this channel before it becomes an Available Channel again.

f) In all cases, if radar detection has occurred, then the channel containing the frequency on which radar was detected becomes an Unavailable Channel. Alternatively, the channel may be marked as an Unusable Channel.

Slave devices:

a) A slave device shall not transmit before receiving an appropriate enabling signal from an associated master device.

b) A slave device shall stop its transmissions on a channel whenever instructed by a master device. The slave device shall not resume any transmissions on this channel until it has received an appropriate enabling signal from an associated master device.

c) A slave device which is required to perform radar detection (see table D.2, note 2), shall stop its own transmissions on an Operating Channel if it has detected a radar on that channel. That Operating Channel becomes an Unavailable Channel for the slave device. It shall not resume any transmissions on this Unavailable Channel for a period of time equal to the Non-Occupancy Period. A Channel Availability Check or an Off-Channel CAC is required by the slave device to verify there is no radar operating on this channel before the slave may use it again.

2.7.2. DFS technical requirements specifications

2.7.2.1 Applicability

Table 6 lists the DFS related technical requirements and their applicability for every operational mode. If the RLAN device is capable of operating in more than one operational mode then every operating mode shall be assessed separately.

Table 6: Applicability of DFS requirements

Requirement	DFS Operational mode		
	Master	**Slave without radar detection (see table D.2, note 2)**	**Slave with radar detection (see table D.2, note 2)**
Channel Availability Check	Required	Not required	Required (see note 2)
Off-Channel CAC (see note 1)	Required	Not required	Required (see note 2)
In-Service Monitoring	Required	Not required	Required
Channel Shutdown	Required	Required	Required
Non-Occupancy Period	Required	Not required	Required
Uniform Spreading	Required	Not required	Not required
NOTE 1: Where implemented by the manufacturer. NOTE 2: A slave with radar detection is not required to perform a CAC or Off-Channel CAC at initial use of the channel but only after the slave has detected a radar signal on the Operating Channel by In-Service Monitoring and the Non-Occupancy Period resulting from this detection has elapsed.			

The radar detection requirements specified in clause 4.2.6.2.2 to clause 4.2.6.2.4 assume that the centre frequencies of the radar signals fall within the central 80 % of the Occupied Channel Bandwidth of the RLAN (see clause 4.2.2)

2.7.2.2 Channel Availability Check

Definition

The Channel Availability Check (CAC) is defined as a mechanism by which an RLAN device checks channels for the presence of radar signals. This mechanism is used for identifying Available

Channels.

There shall be no transmissions by the RLAN device on the channels being checked during this process.

If no radars have been detected on a channel, then that channel becomes an Available Channel.

For devices that support multiple Nominal Channel Bandwidths, the Channel Availability Check may be performed once using the widest Nominal Channel Bandwidth. All narrower channels within the tested bandwidth become Available Channels providing no radar was detected.

Limit

The Channel Availability Check shall be performed during a continuous period in time (Channel Availability Check Time) which shall not be less than the value defined in table D.1.

During the Channel Availability Check, the RLAN device shall be capable of detecting any of the radar test signals that fall within the ranges given by table D.4 with a level above the Radar Detection Threshold defined in table D.2.

The RLAN device shall comply with the minimum detection probability as defined in table D.5.

Conformance

Conformance tests for this requirement are defined in clause 5.4.8.

2.7.2.3 Off-Channel CAC (Off-Channel Channel Availability Check)

Definition

Off-Channel CAC is defined as an optional mechanism by which an RLAN device monitors channel(s), different from the Operating Channel(s), for the presence of radar signals. The Off-Channel CAC may be used in addition to the Channel Availability Check defined in clause 4.2.6.2.2, for identifying Available Channels.

Off-Channel CAC is performed by a number of non-continuous checks spread over a period in time. This period, which is required to determine the presence of radar signals, is defined as the Off-Channel CAC Time.

If no radars have been detected in a channel, then that channel becomes an Available Channel.

Limit

Where implemented, the Off-Channel CAC Time shall be declared by the manufacturer. However, the declared Off-Channel CAC Time shall be within the range specified in table D.1.

During the Off-Channel CAC, the RLAN device shall be capable of detecting any of the radar test signals that fall within the ranges given by table D.4 with a level above the Radar Detection Threshold defined in table D.2.

The RLAN device shall comply with the minimum detection probability as defined in table D.5.

Conformance

Conformance tests for this requirement are defined in clause 5.4.8.

2.7.2.4 In-Service Monitoring

Definition

The In-Service Monitoring is defined as the process by which an RLAN device monitors each Operating Channel for the presence of radar signals.

Limit

The In-Service Monitoring shall be used to monitor each Operating Channel.

The In-Service-Monitoring shall start immediately after the RLAN device has started transmissions on a channel.

During the In-Service Monitoring, the RLAN device shall be capable of detecting any of the radar test signals that fall within the ranges given by table D.4 with a level above the Radar Detection Threshold defined in table D.2.

The RLAN device shall comply with the minimum detection probability associated with a given radar test signal as defined in table D.5.

Conformance

Conformance tests for this requirement are defined in clause 5.4.8.

2.7.2.5 Channel Shutdown

Definition

The Channel Shutdown is defined as the process initiated by the RLAN device on an Operating Channel after a radar signal has been detected during the In-Service Monitoring on that channel.

The master device shall instruct all associated slave devices to stop transmitting on this channel, which they shall do within the Channel Move Time.

Slave devices with a Radar Interference Detection function, shall stop their own transmissions on an Operating Channel within the Channel Move Time upon detecting a radar signal within this channel.

The aggregate duration of all transmissions of the RLAN device on this channel during the Channel Move Time shall be limited to the Channel Closing Transmission Time. The aggregate duration of all transmissions shall not include quiet periods in between transmissions.

For equipment having simultaneous transmissions on multiple (adjacent or non-adjacent) operating channels, only the channel(s) containing the frequency on which radar was detected is subject to the Channel Shutdown requirement.The equipment is allowed to continue transmissions on other Operating Channels.

Limit

The Channel Move Time shall not exceed the limit defined in table D.1.

The Channel Closing Transmission Time shall not exceed the limit defined in table D.1.

Conformance

Conformance tests for this requirement are defined in clause 5.4.8.

2.7.2.6 Non-Occupancy Period

Definition

The Non-Occupancy Period is defined as the time during which the RLAN device shall not make any transmissions on a channel after a radar signal was detected on that channel.

For equipment having simultaneous transmissions on multiple (adjacent or non-adjacent) operating channels, only the channel(s) containing the frequency on which radar was detected is subject to the Non-Occupancy Period requirement.The equipment is allowed to continue

transmissions on other Operating Channels.
After the Non-Occupancy Period, the channel needs to be identified again as an Available Channel before the RLAN device may start transmitting again on this channel.

Limit

The Non-Occupancy Period shall not be less than the value defined in table D.1.

Conformance

Conformance tests for this requirement are defined in clause 5.4.8.

2.7.2.7 Uniform Spreading

Definition

The Uniform Spreading is a mechanism to be used by the RLAN to provide, on aggregate, a uniform loading of the spectrum across all devices. The Uniform Spreading is limited to the usable channels being declared as part of the channel plan.
The required spreading may be achieved by various means. These means include network management functions controlling large numbers of RLAN devices as well as the channel selection function in an individual RLAN device.

Limit

Each of the declared Channel Plans (see clause 3.1) shall make use of at least 60 % of the spectrum available in the applicable sub-band(s).
The Uniform Spreading is limited to the usable channels being declared as part of the channel plan.
Usable channels do not include channels which are precluded by either:

1) the intended outdoor usage of the RLAN; or
2) previous detection of a radar on the channel (Unavailable Channel or Unusable Channel); or
3) national regulations; or
4) the restriction to only operate in the band 5 150 MHz to 5 250 MHz for RLAN devices without a radar
detection capability.

Each of the Usable Channels shall be used with approximately equal probability. RLAN equipment for which the declared channel plan includes channels whose nominal bandwidth falls completely or partly within the band 5 600 MHz to 5 650 MHz may omit these channels from the list of Usable Channels at initial power up or at initial installation. Channels being used by other RLAN equipment may be omitted from the list of Usable Channels.

2.7.3. Test conditions

2.7.3.1 General

The conformance requirements in clause 4.2.6 shall be verified only under normal operating conditions.
The channels and the channel bandwidths to be used for testing are defined in clause 5.3.2.

Some of the tests may be facilitated by disabling certain operational features of the UUT for the duration of the test.
It should be noted that once a UUT is powered on, it will not start its normal operating functions immediately, as it will have to finish its power-up cycle first (Tpower_up). As such, the UUT, as well as any other device used in the set-up, may be equipped with a feature that will indicate its status during the testing, e.g. power-up mode, normal operation mode,channel check status, radar detection event, etc.
The UUT is capable of transmitting a test transmission sequence as described in clause 5.3.1.2.
The UUT shall be configured to operate at its maximum Channel Occupancy Time without the use of any pauses in between transmissions. This is defined in clause 4.2.7.3.1 for Frame Based Equipment and in clause 4.2.7.3.2 for Load Based Equipment.
The signal generator is capable of generating any of the radar test signals defined in table D.3 and table D.4.
A spectrum analyser or equivalent shall be used to measure the aggregate transmission time of the UUT.
Clause 5.4.8.1.3.1 to clause 5.4.8.1.3.3 describe the different set-ups to be used during the measurements.

2.7.3.2 Selection of radar test signals

The radar test signals to be used during the DFS testing are defined in table D.3 and table D.4.
For each of the variable radar test signals in table D.4, an arbitrary combination of Pulse Width, Pulse Repetition Frequency and if applicable the number of different PRFs, shall be chosen from the ranges given in table D.4 and recorded in the test report.
The radar test signals given in table D.4 simulate real radar systems. They take into account the combined effect of antenna rotation speed, antenna beam width and pulse repetition frequency for a particular type of radar. The given values for Pulses Per Burst (PPB) represent the number of pulses for a given PRF, seen at the RLAN device for each scan of the radar.
PPB = [{antenna beamwidth (deg)} × {pulse repetition rate (PPS)}] / [{scan rate (deg/s)}] (18)
Table D.5 provides for each radar test signal the required detection probability (Pd). Pd represents a minimum level of detection performance under defined conditions. Therefore Pd does not represent the overall detection probability for any particular radar under real life conditions.
The pulse widths given in the table D.3 and table D.4 shall have an accuracy of ±5 %.
The tests related to the Channel Availability Check, In-Service Monitoring, Channel Shut Down and Non-Occupancy Period (see clause 5.4.8.2.1.2, clause 5.4.8.2.1.3, clause 5.4.8.2.1.5 and clause 5.4.8.2.1.6) are performed with a single burst radar test signal while the tests related to the Off-Channel CAC (see clause 5.4.8.2.1.4) are performed with a repetitive burst radar test signal (see note 4 in table D.4).

Set-up A

Set-up A is a set-up whereby the UUT is an RLAN device operating in master mode. Radar test signals are injected into the UUT. This set-up also contains an RLAN device operating in slave mode which is associated with the UUT.

Figure 5 shows an example for Set-up A. The set-up used shall be documented in the test report.

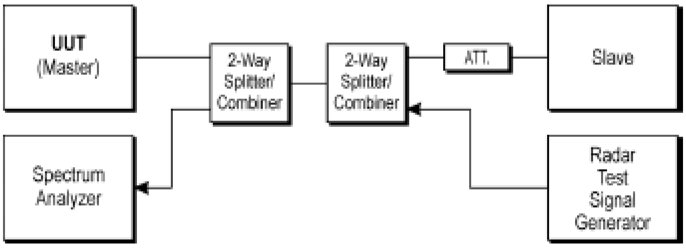


Figure 5: Set-up A

Set-up B

Set-up B is a set-up whereby the UUT is an RLAN device operating in slave mode, with or without Radar Interference Detection function. This set-up also contains an RLAN device operating in master mode. The radar test signals are injected into the master device. The UUT (slave device) is associated with the master device.

Figure 6 shows an example for Set-up B. The set-up used shall be documented in the test report.

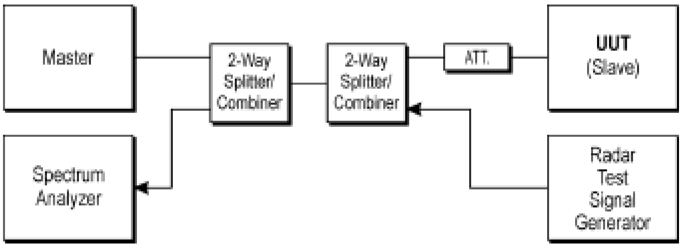


Figure 6: Set-up B

Set-up C

The UUT is an RLAN device operating in slave mode with Radar Interference Detection function. Radar test signals are injected into the slave device. This set-up also contains an RLAN device operating in master mode. The UUT (slave device) is associated with the master device.

Figure 7 shows an example for Set-up C. The set-up used shall be documented in the test report.

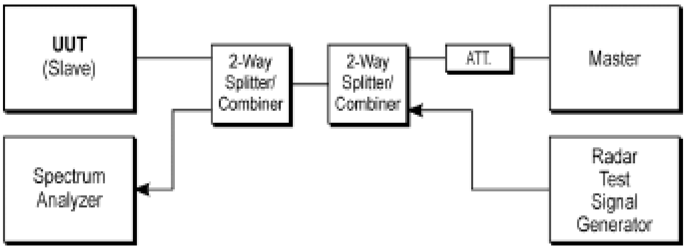


Figure 7: Set-up C

2.7.4. Test method

2.7.4.1 Conducted measurement

Additional test conditions

For a UUT with antenna connector(s) and using dedicated external antenna(s), or for a UUT with integral antenna(s) but with a temporary antenna connector(s) provided, conducted measurements shall be used.

When performing DFS testing on smart antenna systems, a power splitter/combiner shall be used to combine all the receive chains (antenna inputs) into a single test point. The insertion loss of the splitter/combiner shall be taken into account.

The UUT shall be configured to operate at the highest transmitter output power setting.

If the UUT has a Radar Interference Detection function, the output power of the signal generator producing the radar test signals, as selected using clause 5.4.8.1.2, shall (unless otherwise specified) provide a received signal power at the antenna connector of the UUT with a level equal to applicable Radar Detection Threshold level defined in table D.2.Parameter G [dBi] in table D.2 corresponds to the gain of the antenna assembly stated by the manufacturer. If more than one antenna assembly is intended for this power setting, the gain of the antenna assembly with the lowest gain shall be used.

Beamforming gain Y of smart antenna systems, operating in a mode where beamforming is active, is ignored in order to test the worst case.

The centre frequencies of the radar test signals used in the test procedures below shall fall within the central 80 % of the Occupied Channel Bandwidth of the RLAN channel under test.

Channel Availability Check

Additional Test Conditions

The clauses below define the procedure to verify the Channel Availability Check and the Channel Availability Check Time ($T_{ch\_avail\_check}$) on the selected channel Ch_r by ensuring that the UUT is capable of detecting radar pulses at the beginning and at the end of the Channel Availability Check Time. This is illustrated in figure 8. There shall be no transmissions by the UUT on Ch_r during this time.

A test channel shall be identified in accordance with clause 5.3.2. This channel is designated as Ch_r (see clause 3.2). For the purpose of the test, the UUT shall be configured to ensure that the Channel Availability Check is performed on Ch_r.

Tests with a radar burst at the beginning of the Channel Availability Check Time

The steps below define the procedure to verify the radar detection capability on the selected channel Ch_r when a radar burst occurs at the beginning of the Channel Availability Check Time:

a) The signal generator and UUT are connected using Set-up A as described in clause 5.4.8.1.3.1. The power of the UUT is switched off.

b) The UUT is powered on at T0. T1 denotes the instant when the UUT has completed its power-up sequence (T_{power_up}) and is ready to start the radar detection. The Channel Availability Check is expected to commence on Ch_r at instant T1 and is expected to end no sooner than T1 + $T_{ch\_avail\_check}$ unless the radar test signal is detected sooner.

Additional verification may be needed to define T1 in case it is not exactly known or indicated by the UUT.

c) A single radar burst is generated on Ch_r using the reference test signal defined in table D.3 at a level of up to 10 dB above the level defined in clause 5.4.8.2.1.1. This single-burst radar test signal shall commence within 2 s after time T1.

d) It shall be recorded if the radar test signal was detected.

e) A timing trace or description of the observed timing and behaviour of the UUT shall be recorded.

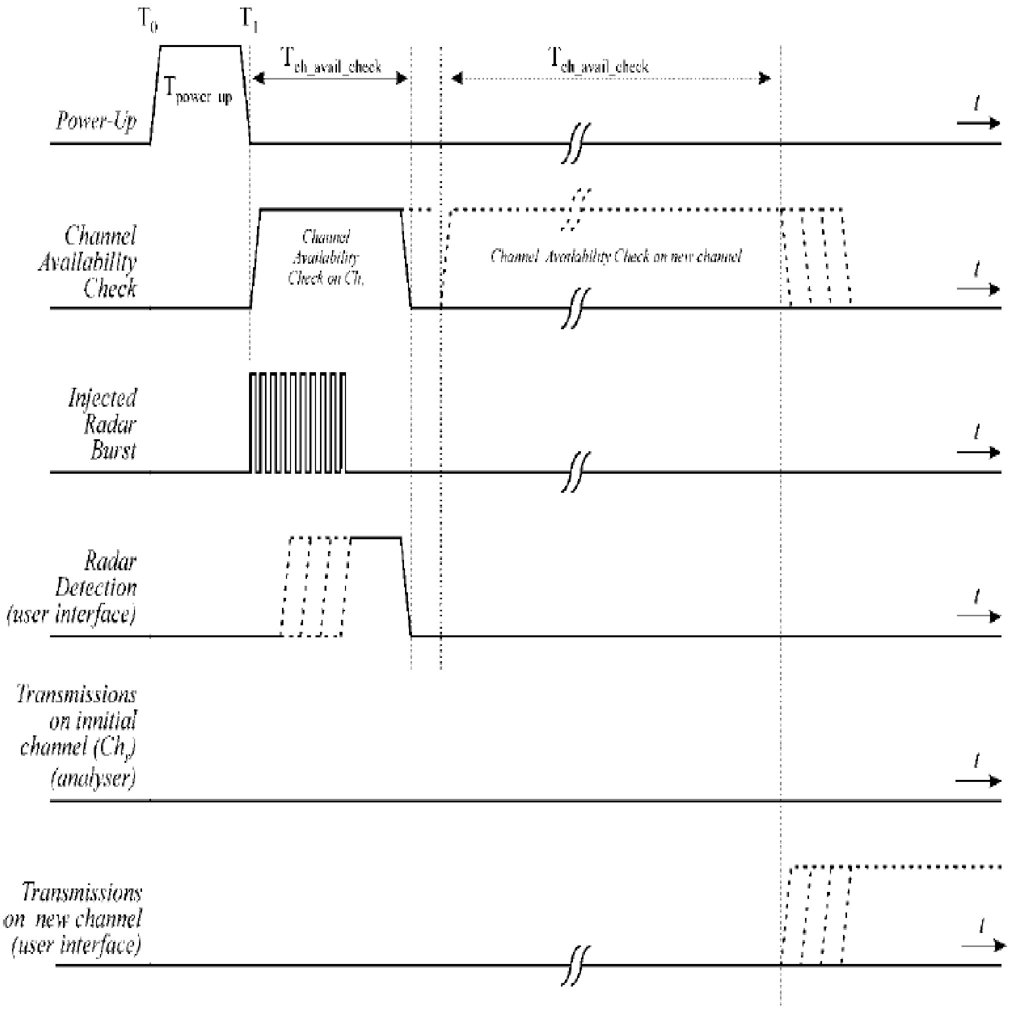


Figure 8: Example of timing for radar testing at the beginning of the Channel Availability Check Time

Tests with radar burst at the end of the Channel Availability Check Time

The steps below define the procedure to verify the radar detection capability on the selected channel Ch_r when a radar burst occurs at the end of the Channel Availability Check Time (see note). This is illustrated in figure 9.

NOTE: The applicable Channel Availability Check Times are given by table D.1.

a) The signal generator and UUT are connected using Set-up A described in clause 5.4.8.1.3.1. The power of the UUT is switched off.

b) The UUT is powered up at T0. T1 denotes the instant when the UUT has completed its power-up sequence (T_{power_up}) and is ready to start the radar detection. The Channel Availability Check is expected to commence on Ch_r at instant T1 and is expected to end no sooner than T1 + $T_{ch\_avail\_check}$ unless the radar test signal is detected sooner.

Additional verification may be needed to define T1 in case it is not exactly known or indicated by the UUT.

c) A single radar burst is generated on Ch_r using the reference test signal defined in table D.3 at a level of up to 10 dB above the level defined in clause 5.4.8.2.1.1. This single-burst radar test signal shall commence towards the end of the minimum required Channel Availability Check Time but not before time T1 + $T_{ch\_avail\_check}$ - 2 s.

d) It shall be recorded if the radar test signal was detected.

e) A timing trace or description of the observed timing and behaviour of the UUT shall be recorded.

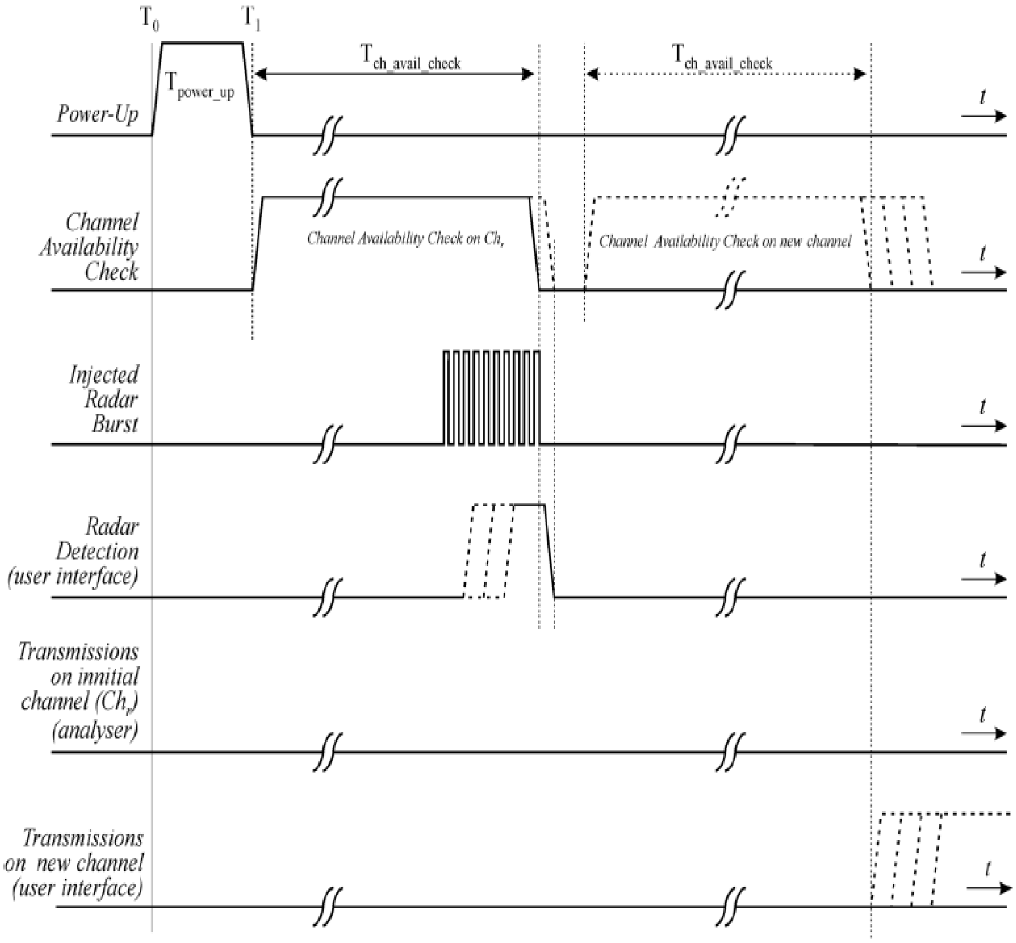


Figure 9: Example of timing for radar testing towards the end of the Channel Availability Check Time

Radar Detection Threshold (during the Channel Availability Check)

The different steps below define the procedure to verify the Radar Detection Threshold during the Channel Availability Check Time for channels outside the 5 600 MHz to 5 650 MHz band. This is illustrated in figure 10.

a) The signal generator and UUT are connected using Set-up A described in clause 5.4.8.1.3.1. The power of the UUT is switched off.

b) The UUT is powered on at T0. T1 denotes the instant when the UUT has completed its power-up sequence (Tpower_up) and is ready to start the radar detection. The Channel Availability Check on Chr is expected to commence at instant T1 and is expected to end no sooner than T1 + Tch_avail_check unless the radar test signal is detected sooner.

Additional verification may be needed to define T1 in case it is not exactly known or indicated by the UUT.

c) A single burst radar test signal is generated on Chr using any of the radar test signals defined in table D.4 at a level defined in clause 5.4.8.2.1.1. This single-burst radar test signal may commence at any time within the applicable Channel Availability Check Time.

For the purpose of reducing test time, it is recommended that the single-burst radar test signal starts approximately 10 s after T1.

d) It shall be recorded if the radar test signal was detected.

e) Step c) to step d) shall be performed 20 times and each time a unique radar test signal shall be generated from options provided in table D.4. When selecting these 20 unique radar test signals, the radar test signals #1 to #6 from table D.4 shall be included as well as variations of pulse width, pulse repetition frequency and number of different PRFs (if applicable) within the ranges given. The radar test signals used shall be recorded in the report. The radar test signal shall be detected at least 12 times out of the 20 trials in order to comply with the detection probability specified for this frequency range in table D.5.

Where the declared channel plan includes channels whose nominal bandwidth falls completely or partly within the 5 600 MHz to 5 650 MHz band, additional testing as described in the steps below shall be performed on a channel within this band.

f) A single burst radar test signal is generated on Chr using any of the radar test signals defined in table D.4 (except signals #3 and #4) at a level of 10 dB above the level defined in clause 5.4.8.2.1.1. This single burst radar test signal may commence at any time within the applicable Channel Availability Check Time.

For the purpose of reducing test time, it is recommended that the single burst radar test signal starts approximately 10 s after T1.

g) Step f) shall be performed 20 times, each time a different radar test signal shall be generated from options provided in table D.4 (except signals #3 and #4). The radar test signals used shall be recorded in the report.The radar test signal shall be detected during each of these tests and this shall be recorded.

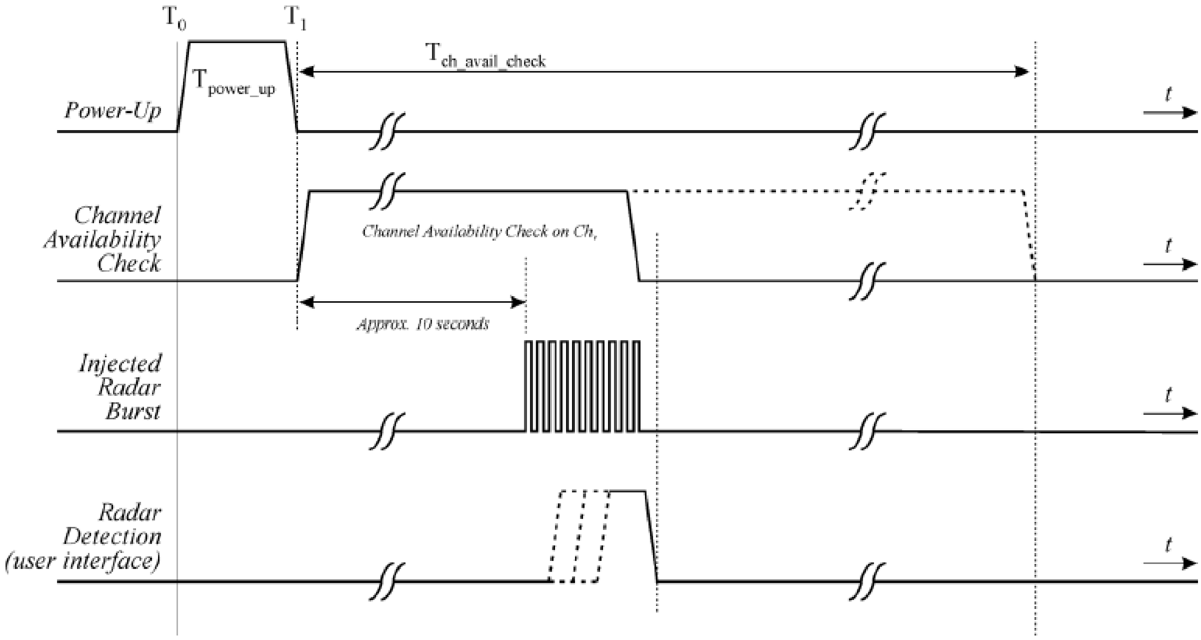


Figure 10: Example of timing for radar testing during the Channel Availability Check

Off-Channel CAC

Additional Test Conditions

The channel, on which the Off-Channel CAC test will be performed, shall be selected in accordance with clause 5.3.2.This channel is designated as Ch_r.

For the purpose of the test, the UUT shall be configured to select the Operating Channel(s) different from Ch_r. There shall be no transmissions by the UUT on Ch_r during the Off-Channel CAC Time.

Radar Detection Threshold (during Off-Channel CAC)

The different steps below define the procedure to verify the Radar Detection Threshold during the Off-Channel CAC.

Where the declared channel plan includes channels whose nominal bandwidth falls completely or partly within the 5 600 MHz to 5 650 MHz band, the test shall be performed on one of these channels in addition to a channel outside this band. See clause 5.3.2.

a) The signal generator, the UUT (master device) and a slave device associated with the UUT, are connected using Set-up A described in clause 5.4.8.1.3.1.

b) The UUT shall transmit a test transmission sequence in accordance with clause 5.3.1.2 on (all) the Operating Channel(s).

c) A multi burst radar test signal is generated on Ch_r using any of the radar test signals defined in table D.4 at a level defined in clause 5.4.8.2.1.1. The radar test signal used shall be recorded in the report. This multi burst radar test signal shall commence at T3 and shall continue for the total duration of the Off-Channel CAC Time ($T_{Off\text{-}Channel\_CAC}$) as declared by the manufacturer in accordance with table D.1. For channels within the 5 600 MHz to 5 650 MHz band test signals #3 and #4 shall not be used and the Burst Interval Time (BIT) during the test shall be varied between 8 min and 10 min. For channels outside this band, the Burst Interval Time (BIT) during the test shall be varied between 45 s and 60 s.

d) The UUT shall detect the radar test signal before the end of the Off-Channel CAC Time and this shall be recorded.

For the purpose of reducing test time, the test may be terminated immediately once the UUT has reported detection of the radar test signal.

Detection Probability (Pd)

This test may be facilitated by disabling the Channel Shutdown feature for the duration of the test.

For channels outside the 5 600 MHz to 5 650 MHz band, the test in clause 5.4.8.2.1.4.2 is sufficient to demonstrate that the UUT meets the Detection Probability (Pd) defined in table D.5.

Where the declared channel plan includes channels whose nominal bandwidth falls completely or partly within the 5 600 MHz to 5 650 MHz band, the procedure in the steps below has to be performed on one of these channels. See clause 5.3.2.

a) A multi burst radar test signal is generated on Ch_r using any of the radar test signals defined in table D.4 (except signals #3 and #4) at a level of 10 dB above the level defined in clause 5.4.8.2.1.1. The radar test signal used shall be recorded in the report. This multi burst radar test signal shall commence at T3 and shall continue for the total duration of the Off-Channel CAC Time ($T_{Off\text{-}Channel\_CAC}$) as declared by the manufacturer in accordance with table D.1. The Burst Interval Time (BIT) during the test shall be varied between 8 minutes and 10 minutes.

b) It shall be recorded how many bursts have been detected by the UUT at the end of the Off-Channel CAC Time.The minimum number of bursts that the UUT shall detect in order to comply with the detection probability defined for this frequency range in table D.5 is given by table 12.

Table 12: Minimum number of burst detections for channels within the 5 600 MHz to 5 650 MHz band

Off-Channel CAC Time (Minutes)	Number of Bursts generated assuming a BIT of 10 minutes	Minimum Number of burst detections
60	6	5
90	9	6
160	16	7
320	32	8
1 440	144	9

For the purpose of reducing test time, the test may be terminated immediately the UUT has reported the minimum number of burst detections required.

Figure 11 provides an example of the timing of a UUT when radar signals are detected during the Off-Channel CAC testing.

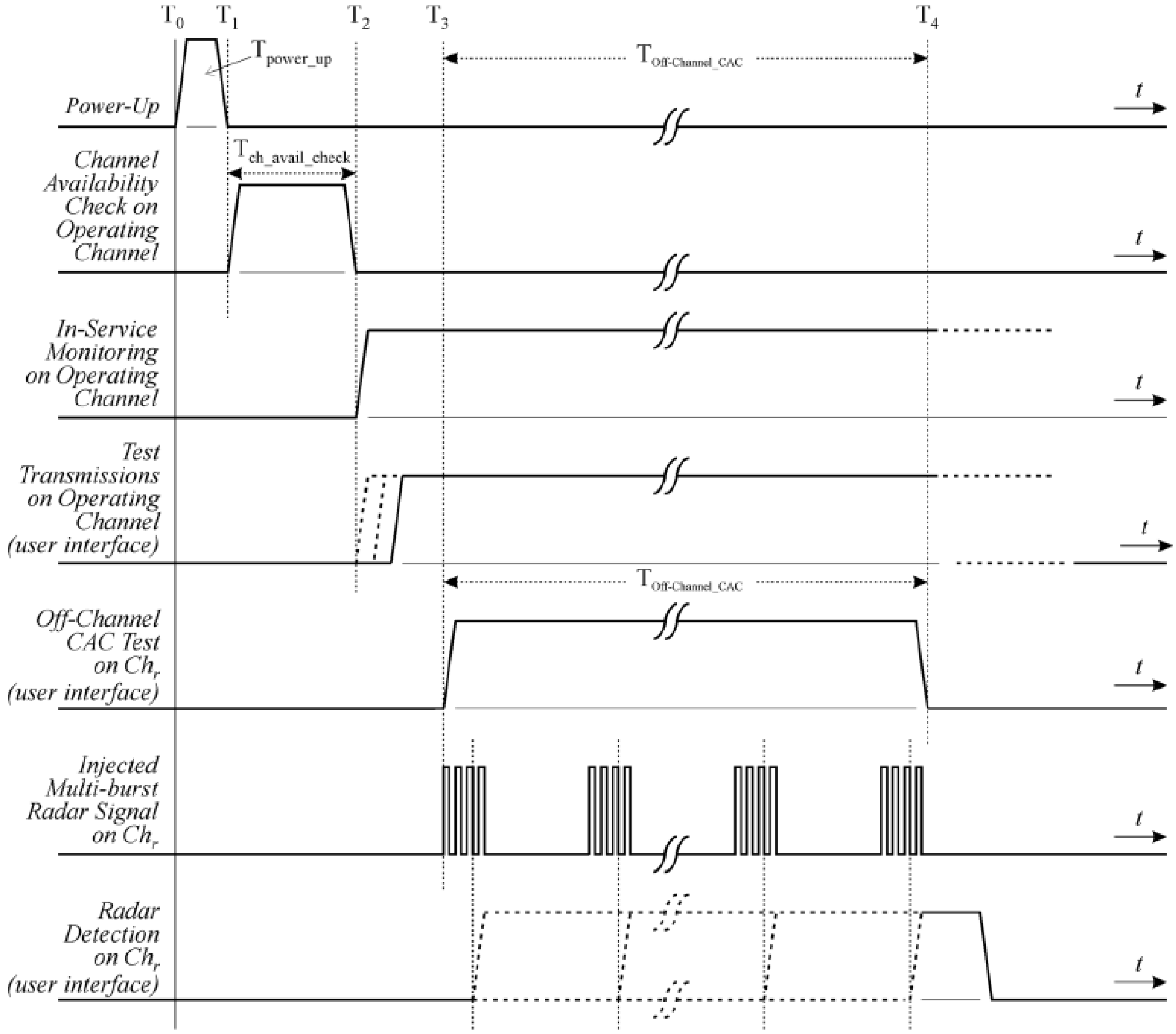


Figure 11: Example of timing for radar testing during the Off-Channel CAC

In-Service Monitoring

The steps below define the procedure to verify the In-Service Monitoring and the Radar Detection Threshold during the In-Service Monitoring.

The channel, on which the In-Service Monitoring test will be performed, shall be selected in accordance with clause 5.3.2. This channel, designated as Chr, is an Operating Channel.

a) When the UUT is a master device, a slave device will be used that associates with the UUT. The signal generator and the UUT are connected using Set-up A described in clause 5.4.8.1.3.1.

When the UUT is a slave device with a Radar Interference Detection function, the UUT shall associate with a master device. The signal generator and the UUT are connected using Set-up C described in clause 5.4.8.1.3.3.

b) The UUT shall transmit a test transmission sequence in accordance with clause 5.3.1.2 on the selected channel Chr. While the testing is performed on Chr, the equipment is allowed to have simultaneous transmissions on other adjacent or non-adjacent operating channels.

c) At a certain time T0, a single burst radar test signal is generated on Chr using radar test signal #1 defined in table D.4 and at a level defined in clause 5.4.8.2.1.1. T1 denotes the end of the radar burst.

d) It shall be recorded if the radar test signal was detected.

e) Step b) to step d) shall be performed 20 times, each time a random value shall be chosen for pulse width and pulse repetition frequency from the corresponding ranges provided in table D.4. For radar test signal #5 and radar test signal #6 provided in table D.4 the number of PRF values shall vary between 2 or 3. The radar test signal shall be detected at least 12 times out of the 20 trials in order to comply with the detection probability specified in table D.5.

f) Step b) to step e) shall be repeated for each of the radar test signals defined in table D.4 and as described in clause 5.4.8.1.2.

Figure 12 provides an example of the timing of a UUT when radar signals are detected during the In-Service Monitoring.

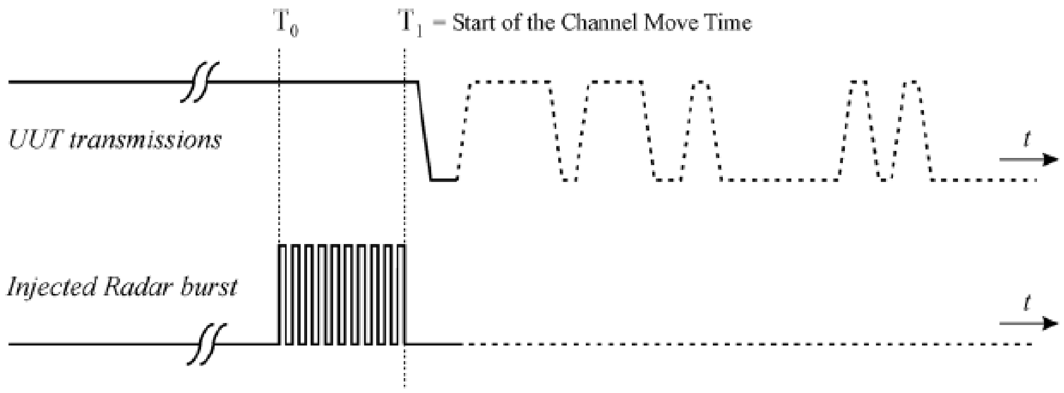


Figure 12: Example of timing for radar testing during In-Service Monitoring

Channel Shutdown and Non-Occupancy period

The steps below define the procedure to verify the Channel Shutdown process and to determine the Channel Closing Transmission Time, the Channel Move Time and the Non-Occupancy Period. This is illustrated in figure 13.

The channel, on which these tests will be performed, shall be selected in accordance with clause 5.3.2. This channel,designated as Ch_r, is an Operating Channel.

a) When the UUT is a master device, a slave device will be used that associates with the UUT. The signal generator and the UUT shall be connected using Set-up A described in clause 5.4.8.1.3.1.

When the UUT is a slave device (with or without a Radar Interference Detection function), the UUT shall associate with a master device. The signal generator and the UUT shall be connected using Set-up B described in clause 5.4.8.1.3.2.

In both cases, it is assumed that the channel selection mechanism for the Uniform Spreading requirement is disabled in the master.

b) The UUT shall transmit a test transmission sequence in accordance with clause 5.3.1.2 on the selected channel Chr. While the testing is performed on Ch_r, the equipment is allowed to have simultaneous transmissions on other adjacent or non-adjacent operating channels.

c) At a certain time T0, a single burst test signal is generated on Ch_r using the reference DFS test signal defined in table D.3 and at a level of up to 10 dB above the level defined in clause 5.4.8.2.1.1 on the selected channel.T1 denotes the end of the radar burst.

d) The transmissions of the UUT following instant T1 on the selected channel Ch_r shall be observed for a period greater than or equal to the Channel Move Time defined in table D.1. The aggregate duration (Channel Closing Transmission Time) of all transmissions from the UUT on Ch_r during the Channel Move Time shall be compared to the limit defined in table D.1. For equipment capable of having simultaneous transmissions on multiple (adjacent or non-adjacent) operating channels, the equipment is allowed to continue transmissions on other Operating Channels (different from Ch_r).

The aggregate duration of all transmissions of the UUT does not include quiet periods in between transmissions of the UUT.

e) T2 denotes the instant when the UUT has ceased all transmissions on the channel Chr. The time difference between T1 and T2 shall be measured. This value (Channel Move Time) shall be noted and compared with the limit defined in table D.1.

f) Following instant T2, the selected channel Ch_r shall be observed for a period equal to the Non-Occupancy Period (T3-T2) to verify that the UUT does not resume any transmissions on this channel.

g) When the UUT is a slave device with a Radar Interference Detection function step b) to step f) shall be repeated with the generator connected to the UUT using Set-up C as described in clause 5.4.8.1.3.3. See also note 2 in table D.2.

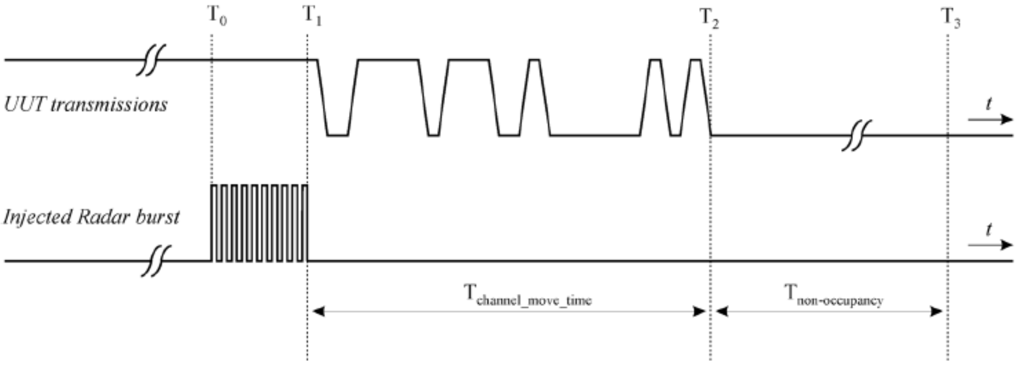


Figure 13: Channel Closing Transmission Time, Channel Move Time and Non-Occupancy Period

2.7.4.2 Radiated measurement

For a UUT with integral antenna(s) and without temporary antenna connector(s), radiated measurements shall be used.

If the UUT has a Radar Interference Detection function, the output power of the signal generator shall (unless otherwise specified) provide a signal power at the antenna of the UUT with a level equal to Radar Detection Threshold level defined in table D.2.

When performing radiated DFS testing on a UUT with a directional antenna (including smart antenna systems and systems capable of beamforming), the wanted communications link (between the UUT and the associated device) and the DFS radar test signals shall be aligned to the direction corresponding to the UUT's maximum antenna gain.

The test set up as described in annex B and applicable measurement procedures as described in annex C shall be used to test the different DFS features of the UUT. The test procedure is further as described under clause 5.4.8.2.1.

2.7.5. DFS information of EUT

DFS operating frequency band	5250MHz~5350MHz; 5470MHz~5725MHz;
DFS operating mode	Slave mode without Radar Interference Detection function.

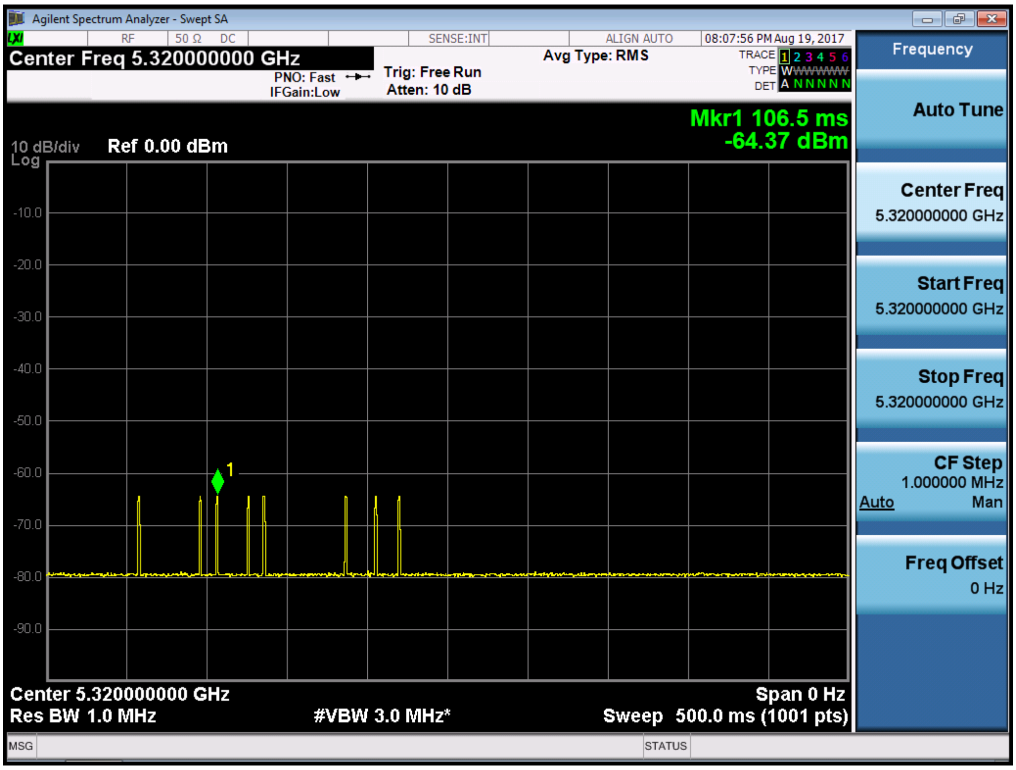
2.7.6. Test Result

The EUT operating in slave mode without Radar Interference Detection function

Test case	**Result**
Channel Availability Check	Not required
Off-Channel CAC	Not required
In-Service Monitoring	Not required
Channel Shutdown	**Pass**
Non-Occupancy Period	Not required
Uniform Spreading	Not required

2.7.6.1 Interference threshold values

The radar burst single level to the AP receiver connect is -64dBm with the 0dBi receive antenna gain.

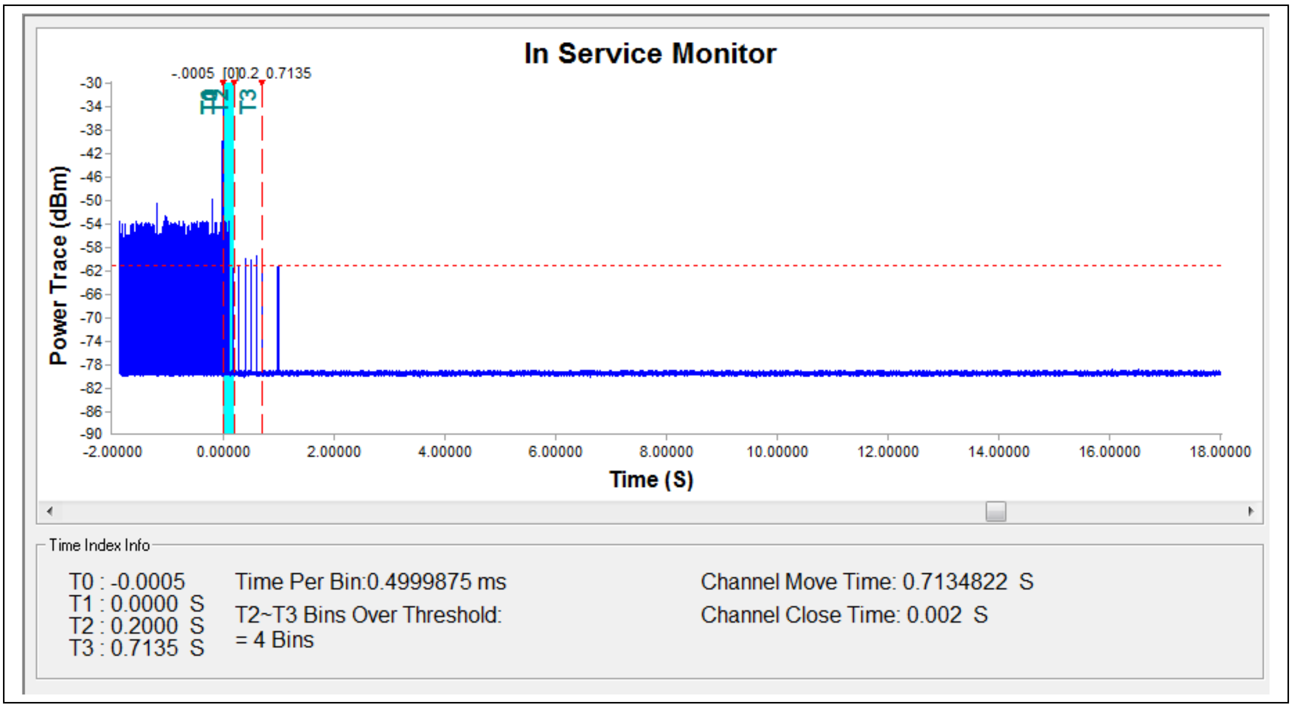


Reference radar single

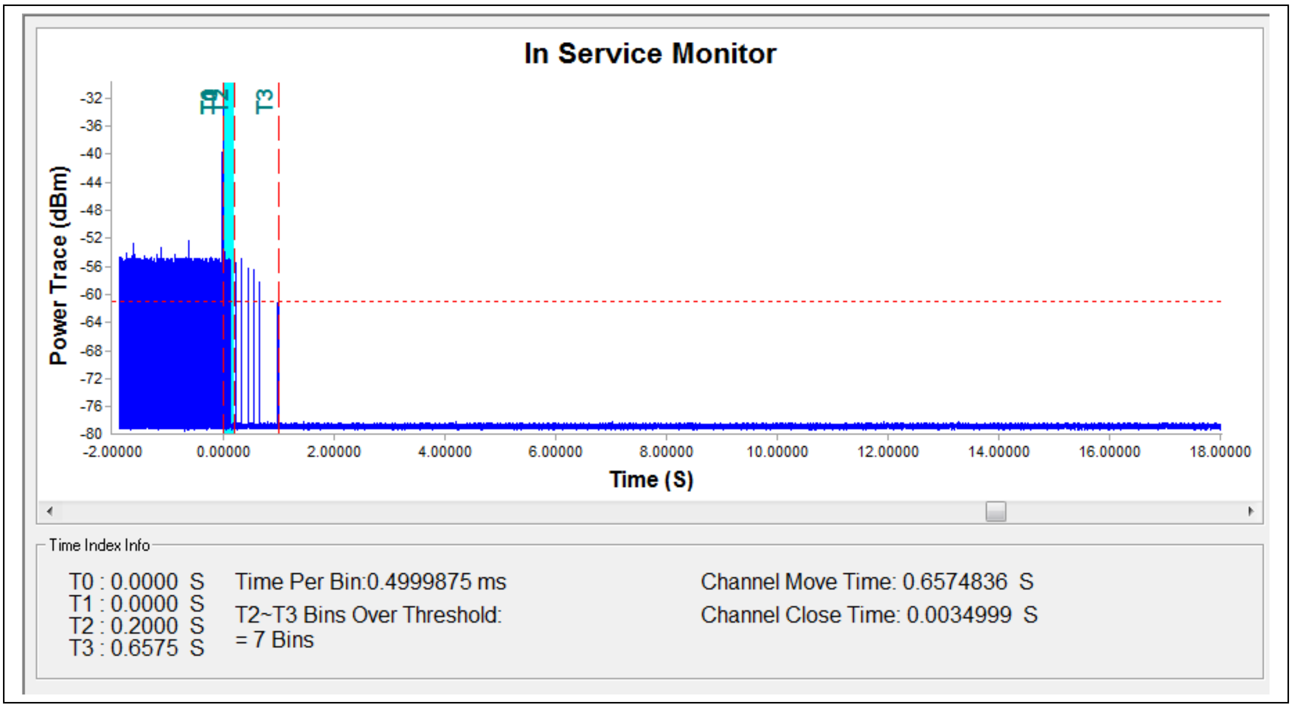
2.7.6.2 Test Plots

Note: T0 denotes the start time of the Radar single transmitted,T1 denotes the end time of the Radar single transmit ted. T2 denotes the data transmission time of 200ms from T1. T3 denotes the end of the Channel Move Time, the time of T3 from T1 is less than 12s.

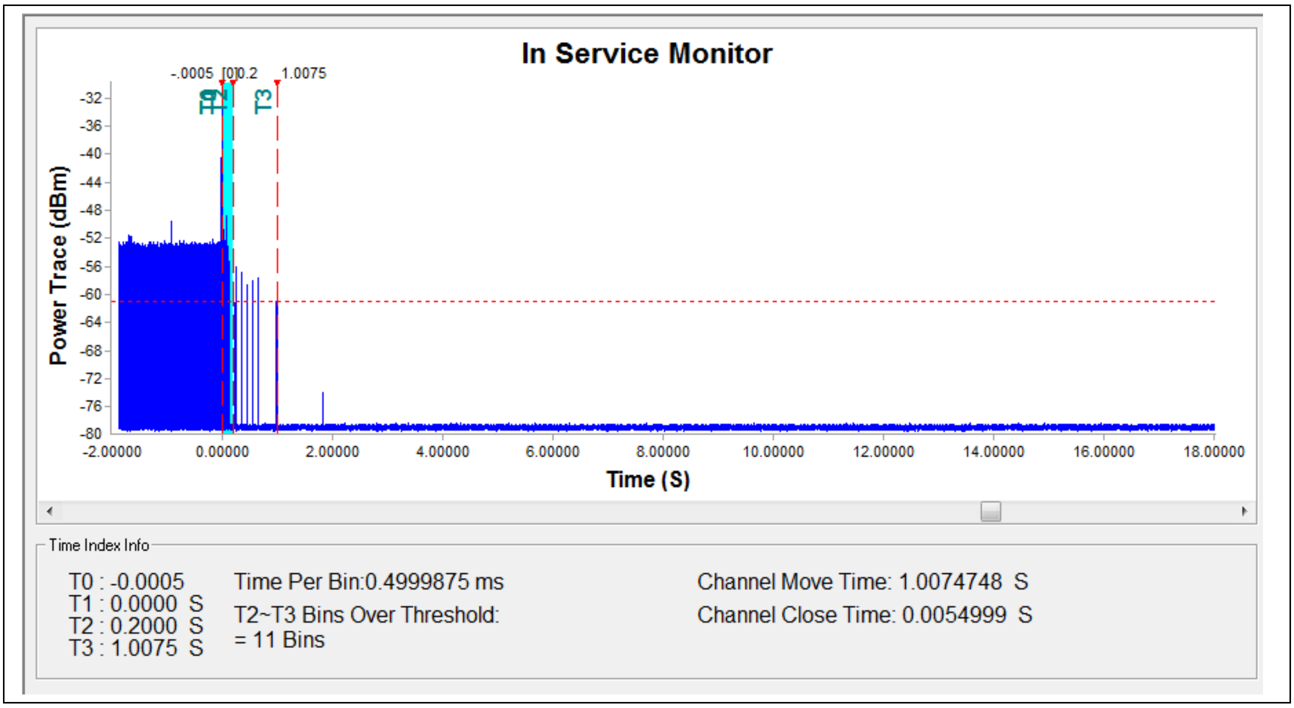
802.11 a Mode 5320MHz



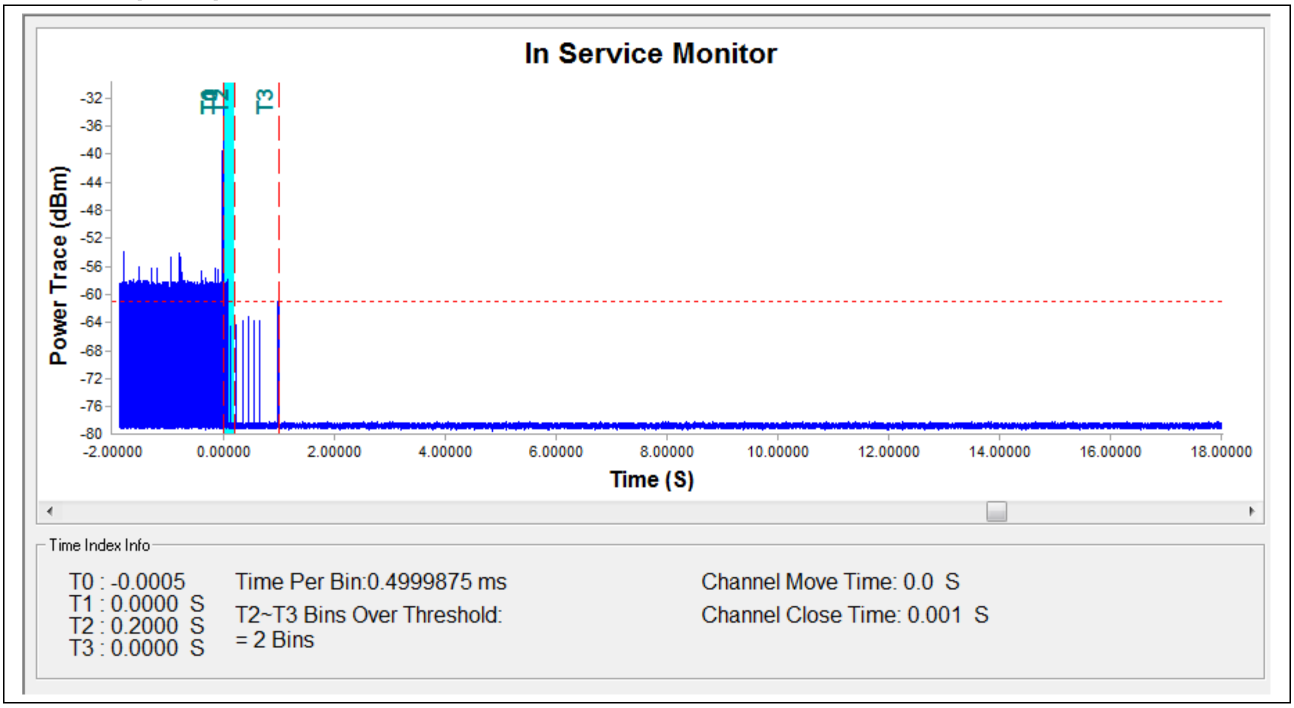
802.11 a Mode 5500MHz



802.11 n (HT40) 5270MHz



802.11 n (HT40) 5550MHz



2.8. EN 301 893 §4.2.7 – Adaptivity (Channel Access Mechanism)

2.8.1. Applicability

The present requirement applies to all equipment within the scope of the present document.
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 in clause 4.2.6.

2.8.2. Definition

Adaptivity (Channel Access Mechanism) is an automatic mechanism by which a device limits its transmissions and gains access to an Operating Channel.
Adaptivity is not intended to be used as an alternative to DFS to detect radar transmissions, but to detect transmissions from other RLAN devices operating in the band. DFS requirements are covered by clause 4.2.6.

2.8.3. Requirements and limits

2.8.3.1 Frame Based Equipment (FBE)

Introduction

Frame Based Equipment shall implement a Listen Before Talk (LBT) based Channel Access Mechanism to detect the presence of other RLAN transmissions on an Operating Channel.
Frame Based Equipment is equipment where the transmit/receive structure has a periodic timing with a periodicity equal to the Fixed Frame Period. A single Observation Slot as defined in clause 3.1 and as referenced by the procedure in clause 4.2.7.3.1.4 shall have a duration of not less than 9 μs.

Device Types (Adaptivity)

A device that initiates a sequence of one or more transmissions is denoted as the Initiating Device. Otherwise, the device is denoted as a Responding Device. Frame Based Equipment may be an Initiating Device, a Responding Device,or both.
The Initiating Device shall implement a Channel Access Mechanism as further described in clause 4.2.7.3.1.4.
A Responding Device shall implement a Channel Access Mechanism as further described in clause 4.2.7.3.1.5.

Multi-channel Operation

Frame Based Equipment being capable of simultaneous transmissions in adjacent or non-adjacent Operating Channels (see clause 4.2.1) may use any combination/grouping of 20 MHz Operating Channels out of the list of channels (Nominal Centre Frequencies) provided in clause 4.2.1, if it satisfies the channel access requirements (Channel Access Mechanism) for an Initiating Device as described in clause 4.2.7.3.1.4 on each such 20 MHz Operating Channel.

Initiating Device Channel Access Mechanism

The Initiating Device (Frame Based Equipment) shall implement a Channel Access Mechanism that complies with the following requirements:

1) The Fixed Frame Periods supported by the equipment shall be declared by the manufacturer. See clause 5.4.1,item q). This shall be within the range of 1 ms to 10 ms. Transmissions can start only at the beginning of a Fixed Frame Period. See figure 2 below. An equipment may change its Fixed Frame Period but it shall not do more than once every 200 ms.

2) Immediately before starting transmissions on an Operating Channel at the start of a Fixed Frame Period, the Initiating Device shall perform a Clear Channel Assessment (CCA) check during a single Observation Slot.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 6) below. If the Initiating Device finds the Operating Channel(s) to be clear, it may transmit immediately. See figure 2.

If the Initiating Device finds an Operating Channel occupied, then there shall be no transmissions on that channel during the next Fixed Frame Period. The Frame Based Equipment is allowed to continue Short Control Signalling Transmissions on this channel providing it complies with the requirements given in clause 4.2.7.3.3.

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.

The total time during which Frame Based Equipment can have transmissions on a given channel without re-evaluating the availability of that channel, is defined as the Channel Occupancy Time (COT).

The equipment can have multiple transmissions within a Channel Occupancy Time without performing an additional CCA on this Operating Channel providing the gap between such transmissions does not exceed 16 μs.

If the gap exceeds 16 μs, the equipment may continue transmissions provided that an additional CCA detects no RLAN transmissions with a level above the threshold defined in point 6). The additional CCA shall be performed within the gap and within the observation slot immediately before transmission. All gaps are counted as part of the Channel Occupancy Time.

3) An Initiating Device is allowed to grant an authorization to one or more associated Responding

Devices to transmit on the current Operating Channel within the current Channel Occupancy Time. A Responding Device that receives such a grant shall follow the procedure described in clause 4.2.7.3.1.5.

4) The Channel Occupancy Time shall not be greater than 95 % of the Fixed Frame Period defined in point 1)and shall be followed by an Idle Period until the start of the next Fixed Frame Period such that the Idle Period is at least 5 % of the Channel Occupancy Time, with a minimum of 100 μs.

5) The equipment, upon correct reception of a packet which was intended for this equipment, can skip CCA and immediately 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 4) above.

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.

6) The CCA Threshold Level (TL), at the input of the receiver, shall be proportional to the maximum transmit power (PH) according to the formula which assumes a 0 dBi receive antenna and PH to be specified in dBm e.i.r.p.

TL = Min (-75 dBm/MHz, Max (-85 dBm/MHz, -85 dBm/MHz + (23 dBm - P_H))) (2)

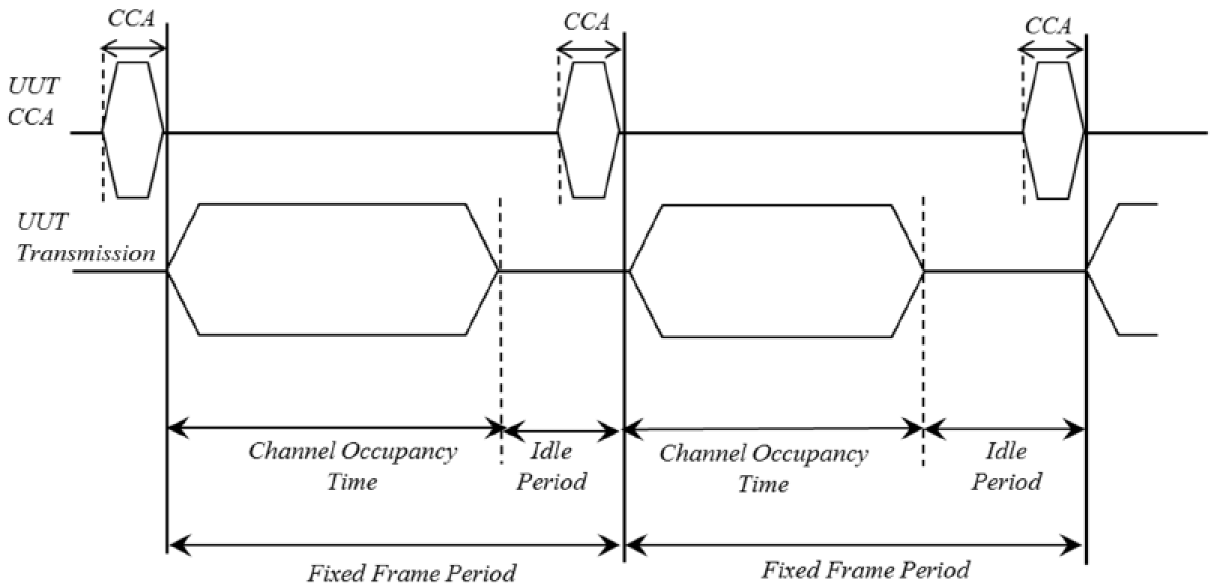


Figure 2: Example of timing for Frame Based Equipment

Responding Device Channel Access Mechanism

Clause 4.2.7.3.1.4, point 3) describes the possibility whereby an Initiating Device grants an authorization to one or more associated Responding Devices to transmit on the current Operating Channel within the current Fixed Frame Period. A Responding Device that receives such a grant shall follow the procedure described in step 1) to step 3):

1) A Responding Device that received a transmission grant from an associated Initiating Device

may proceed with transmissions on the current Operating Channel:

a) The Responding Device may proceed with such transmissions without performing a Clear Channel Assessment (CCA) if these transmissions are initiated at most 16 μs after the last transmission by the Initiating Device that issued the grant.

b) The Responding Device that does not proceed with such transmissions within 16 μs after the last transmission from the Initiating Device that issued the grant, shall perform a Clear Channel Assessment (CCA) on the Operating Channel during a single observation slot within a 25 μs period ending immediately before the granted transmission time. If energy was detected with a level above the CCA Threshold Level defined in clause 4.2.7.3.1.4, point 6), the Responding Device shall proceed with step 3).Otherwise, the Responding Device shall proceed with step 2).

2) The Responding Device may perform transmissions on the current Operating Channel for the remaining Channel Occupancy Time of the current Fixed Frame Period. The Responding Device may have multiple transmissions on this Operating Channel provided that the gap in between such transmissions does not exceed 16 μs. When the transmissions by the Responding Device are completed the Responding Device shall proceed with step 3).

3) The transmission grant for the Responding Device is withdrawn.

2.8.3.2 Load Based Equipment (LBE)

Introduction

Load based Equipment shall implement a Listen Before Talk (LBT) based Channel Access Mechanism to detect the presence of other RLAN transmissions on an Operating Channel.

Device Types (Adaptivity)

With regard to Adaptivity for Load Based Equipment, a device that initiates a sequence of one or more transmissions is denoted as the Initiating Device. Otherwise, the device is denoted as a Responding Device. Load Based Equipment may be an Initiating Device, a Responding Device, or both.

The Initiating Device shall implement a Channel Access Mechanism with prioritized, truncated exponential back off mechanism as further described in clause 4.2.7.3.2.6.

A Responding Device shall implement a Channel Access Mechanism as further described in clause 4.2.7.3.2.7.

Each transmission belongs to a single Channel Occupancy Time (COT). A Channel Occupancy Time (COT) consists of one or more transmissions of an Initiating Device and zero or more transmissions of one or more Responding Devices.

An equipment that controls (non-DFS related) operating parameters of one or more other equipment is denoted as a Supervising Device. Otherwise, the equipment is denoted as a Supervised Device. The roles of a Supervising Device and Supervised Device has only to be seen in relation to Adaptivity and are different from the roles of a Master device and a Slave Device in the context of DFS as defined in clause 4.2.6.

Multi-channel Operation

Load Based Equipment being capable of simultaneous transmissions in adjacent or non-adjacent Operating Channels (see clause 4.2.1) shall implement either option 1 or option 2 below:

Option 1: Load Based Equipment may use any combination/grouping of 20 MHz Operating Channels out of the list of channels (Nominal Centre Frequencies) provided in clause 4.2.1, if it satisfies the channel access requirements (Channel Access Mechanism) for an Initiating Device as described in clause 4.2.7.3.2.6 on each such 20 MHz Operating Channel.

Option 2: Figure 3 defines bonded 40 MHz, 80 MHz or 160 MHz channels (see also clause 4.2.1.3 for the channel number). Load Based Equipment that uses a combination/grouping of 20 MHz Operating Channels that is a subset of bonded 40 MHz, 80 MHz or 160 MHz channels, may transmit on any of the 20 MHz Operating Channels, if:

- The equipment satisfies the channel access requirements (Channel Access Mechanism) for an Initiating Device as defined in clause 4.2.7.3.2.6 on one of the 20 MHz Operating Channels (Primary Operating Channel), and
- The equipment performs a Clear Channel Assessment (CCA) of at least 25 μs immediately before the intended transmissions on each of the other Operating Channels on which transmissions are intended, and no energy was detected with a level above the Energy Detect Threshold defined in clause 4.2.7.3.2.5.

The choice of the Primary Operating Channel shall follow one of the following procedures:

- The Primary Operating Channel is chosen uniformly randomly whenever the contention window (CW), corresponding to a completed transmission on the current Primary Operating Channel is set to its minimum value (CWmin). For this procedure, a contention window (CW) is maintained for each Priority Class (see clause 4.2.7.3.2.4) within each 20 MHz Operating Channel within the bonded channel.
- The Primary Operating Channel is arbitrarily determined and not changed more than once per second.

The bonded 40 MHz, 80 MHz or 160 MHz channel that the combination/grouping of 20 MHz operating channels is a subset of shall not be changed more than once per second.

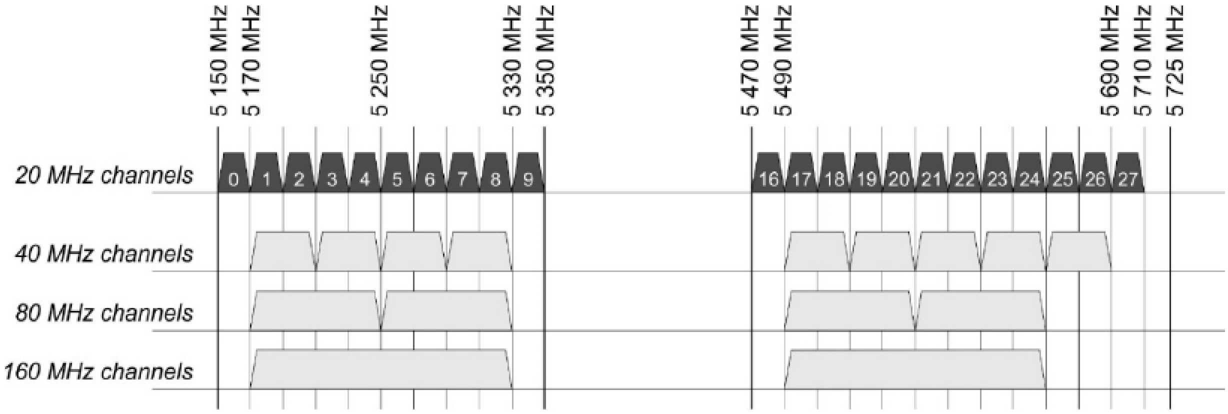


Figure 3: Channel Bonding for option 2

Priority Classes

Table 7 and table 8 each contain four different sets of Channel Access parameters for Supervised Devices and Supervising Devices respectively, resulting in different Priority Classes and different maximum Channel Occupancy Times. These parameters are used by the Channel Access Mechanism for the Initiating Device described in clause 4.2.7.3.2.6 to gain access to an Operating Channel.

If a Channel Occupancy consists of more than one transmission the transmissions may be separated by gaps. The Channel Occupancy Time is the total duration of all transmissions and all gaps of 25 μs duration or less within a Channel Occupancy and shall not exceed the maximum Channel Occupancy Time in table 7 and table 8. The duration from the start of the first transmission within a Channel Occupancy until the end of the last transmission in that same Channel Occupancy shall not exceed 20 ms.

The Initiating Device may have data to be transmitted in different Priority Classes and therefore the Channel Access Mechanism is allowed to operate different Channel Access Engines as described in clause 4.2.7.3.2.6 simultaneously (one for each implemented Priority Class).

Table 7: Priority Class dependent Channel Access parameters for Supervised Devices

Class #	**p0**	**CWmin**	**CWmax**	**Maximum Channel Occupancy Time (COT)**
4	2	3	7	2ms
3	2	7	15	4ms
2	3	15	1023	6ms(see note 1)
1	7	15	1023	6ms(see note 1)

NOTE 1: The maximum Channel Occupancy Time (COT) of 6 ms may be increased to 8 ms by inserting one or more pauses. The minimum duration of a pause shall be 100 μs. The maximum duration (Channel Occupancy) before including any such pause shall be 6 ms. Pause duration is not included in the channel occupancy time. NOTE 2: The values for p0, CWmin, CWmax are minimumvalues. Greater values are allowed.

Table 8: Priority Class dependent Channel Access parameters for Supervising Devices

Class #	p0	CWmin	CWmax	Maximum Channel Occupancy Time (COT)
4	1	3	7	2ms
3	1	7	15	4ms
2	3	15	63	6ms(see note 1 and note 2)
1	7	15	1023	6ms(see note 1)
NOTE 1: The maximum Channel Occupancy Time (COT) of 6 ms may be increased to 8 ms by inserting one or more pauses. The minimum duration of a pause shall be 100 μs. The maximum duration (Channel Occupancy) before including any such pause shall be 6 ms. Pause duration is not included in the channel occupancy time. NOTE 2: The maximum Channel Occupancy Time (COT) of 6 ms may be increased to 10 ms by extending CW to CW × 2 + 1 when selecting the random number q for any backoff(s) that precede the Channel Occupancy that may exceed 6 ms or which follow the Channel Occupancy that exceeded 6 ms. The choice between preceding or following a Channel Occupancy shall remain unchanged during the operation time of the device. NOTE 3: The values for p0, CWmin, CWmax are minimumvalues. Greater values are allowed.				

Energy Detect Threshold (ED Threshold)

Equipment shall consider a channel to be occupied as long as other RLAN transmissions are detected at a level greater than the ED Threshold. The ED Threshold level is integrated over the total Nominal Channel Bandwidth of all Operating Channels used by the equipment.

The ED Threshold level depends on the type of equipment:

Option 1: For equipment that for its operation in the 5 GHz bands is conforming to IEEE 802.11™ac-2013 [10], clause 22, or to IEEE 802.11™-2012 [9], clause 18 or clause 20, or any combination of these clauses, the Energy Detect Threshold (ED Threshold) is independent of the equipment's maximum transmit power (PH). The Energy Detect Threshold (ED Threshold) shall be:

TL = -75 dBm/MHz (3)

Option 2: For equipment conforming to one or more of the clauses listed in Option 1, and to at least one other operating mode, and for equipment conforming to none of the clauses listed in Option 1, the Energy Detect Threshold (ED Threshold) shall be proportional to the equipment's maximum transmit power (PH). Assuming a 0 dBi receive antenna the Energy Detect Threshold (ED Threshold) shall be:

TL = Min (-75 dBm/MHz, Max (-85 dBm/MHz, -85 dBm/MHz + (23 dBm - PH))) (4)

Equipment shall consider a channel to be occupied as long as other RLAN transmissions are detected at a level greater than the TL.

Initiating Device Channel Access Mechanism

Before a transmission or a burst of transmissions on an Operating Channel, the Initiating Device shall operate at least one Channel Access Engine that executes the procedure described in step 1) to step 8) below. This Channel Access Engine makes use of the parameters defined in table 7 or table 8 in clause 4.2.7.3.2.4.

A single Observation Slot as defined in clause 3.1 and as referenced by the procedure in the present clause shall have a duration of not less than 9 µs.

An Initiating Device shall operate at least one and no more than four different Channel Access Engines each with a different Priority Class as defined in clause 4.2.7.3.2.4.

1) The Channel Access Engine shall set CW to CWmin.

2) The Channel Access Engine shall select a random number q from a uniform distribution over the range 0 to CW. Note 2 in table 8 defines an alternative range for q when the previous or next Channel Occupancy Time is greater than the maximum Channel Occupancy Time specified in table 8.

3) The Channel Access Engine shall initiate a Prioritization Period as described in step 3) a) to step 3) c):

a) The Channel Access Engine shall set p according to the Priority Class associated with this Channel Access Engine. See clause 4.2.7.3.2.4.

b) The Channel Access Engine shall wait for a period of 16 µs.

c) The Channel Access Engine shall perform a Clear Channel Assessment (CCA) on the Operating Channel during a single Observation Slot:

i) The Operating Channel shall be considered occupied if other transmissions within this channel are detected with a level above the ED threshold defined in clause 4.2.7.3.2.5. In this case, the Channel Access Engine shall initiate a new Prioritization Period starting with step 3) a) after the energy within the channel has dropped below the ED threshold defined in clause 4.2.7.3.2.5.

ii) In case no energy within the Operating Channel is detected with a level above the ED threshold defined in clause 4.2.7.3.2.5, p may be decremented by not more than 1. If p is equal to 0, the Channel Access Engine shall proceed with step 4), otherwise the Channel Access Engine shall proceed with step 3) c).

4) The Channel Access Engine shall perform a Backoff Procedure as described in step 4) a) to

step 4) d):

a) This step verifies if the Channel Access Engine satisfies the Post Backoff condition. If q < 0 and the Channel Access Engine is ready for a transmission, the Channel Access Engine shall set CW equal to CWmin and shall select a random number q from a uniform distribution over the range 0 to CW before proceeding with step 4) b). Note 2 in table 8 defines an alternative range for q when the previous or next Channel Occupancy Time is greater than the maximum Channel Occupancy Time specified in table 8.

b) If q < 1 the Channel Access Engine shall proceed with step 4) d). Otherwise, the Channel Access Engine may decrement the value q by not more than 1 and the Channel Access Engine shall proceed with step 4)c).

c) The Channel Access Engine shall perform a Clear Channel Assessment (CCA) on the Operating Channel during a single Observation Slot:

i) The Operating Channel shall be considered occupied if energy was detected with a level above the ED threshold defined in clause 4.2.7.3.2.5. In this case, the Channel Access Engine shall continue with step 3).

ii) If no energy was detected with a level above the ED threshold defined in clause 4.2.7.3.2.5, the Channel Access Engine shall continue with step 4) b).

d) If the Channel Access Engine is ready for a transmission the Channel Access Engine shall continue with step 5). Otherwise, the Channel Access Engine shall decrement the value q by 1 and the Channel Access Engine shall proceed with step 4) c). It should be understood that q can become negative and keep decrementing as long as the Channel Access Engine is not ready for a transmission.

5) If only one Channel Access Engine of the Initiating Device is in this stage (see note 1) the Channel Access Engine shall proceed with step 6). If the Initiating Device has a multitude of Channel Access Engines in this stage (see note 2), the Channel Access Engine with highest Priority Class in this multitude shall proceed with step 6) and all other Channel Access Engines in the current stage shall proceed with step 8).

NOTE 1: This is equivalent to the equipment having no internal collision.

NOTE 2: This is equivalent to the equipment having one or more internal collisions.

6) The Channel Access Engine may start transmissions belonging to the corresponding or higher Priority Classes, on one or more Operating Channels. If the initiating device transmits in more than one Operating Channels, it shall comply with the requirements contained in clause 4.2.7.3.2.3.

a) The Channel Access Engine can have multiple transmissions without performing an additional CCA on this Operating Channel providing the gap in between such transmissions does not exceed 16 μs.Otherwise, if this gap exceeds 16 μs and does not exceed 25 μs, the Initiating Device may continue transmissions provided that no energy was detected with a level above the ED threshold defined in clause 4.2.7.3.2.5 for a duration of one Observation Slot.

b) The Channel Access Engine may grant an authorization to transmit on the current Operating

Channel to one or more Responding Devices. If the Initiating Device issues such a transmission grant to a Responding Device, the Responding Device shall operate according to the procedure described in clause 4.2.7.3.2.7.

c) The Initiating Device may have simultaneous transmissions of Priority Classes lower than the Priority Class of the Channel Access Engine, provided that the corresponding transmission duration (Channel Occupancy Time) is not extended beyond the time that is needed for the transmission(s) corresponding to the Priority Class of the Channel Access Engine.

7) When the Channel Occupancy has completed, and it has been confirmed that at least one transmission that started at the beginning of the Channel Occupancy was successful, the Initiating Device proceeds with step 1) otherwise the Initiating Device proceeds with step 8).

8) The Initiating Device may retransmit. If the Initiating Device does not retransmit the Channel Access Engine shall discard all data packets associated with the unsuccessful Channel Occupancy and the Channel Access Engine shall proceed with step 1). Otherwise, the Channel Access Engine shall adjust CW to ((CW + 1) × m) - 1 with m ⩾ 2. If the adjusted value of CW is greater than CWmax the Channel Access Engine may set CW equal to CWmax. The Channel Access Engine shall proceed with step 2).

According to clause 4.2.7.3.2.4 where four different Priority Classes are defined, an Initiating Device shall operate only one Channel Access Engine for each Priority Class implemented.

CW may take values that are greater than the values of CW in step 1) to step 8).

Responding Device Channel Access Mechanism

Clause 4.2.7.3.2.6, step 6) b) describes the possibility whereby an Initiating Device grants an authorization to one or more associated Responding Devices to transmit on the current Operating Channel . A Responding Device that receives such a grant shall follow the procedure described in step 1) to step 3):

1) A Responding Device that received a transmission grant from an associated Initiating Device may proceed with transmissions on the current Operating Channel .

a) The Responding Device may proceed with such transmissions without performing a Clear Channel Assessment (CCA) if these transmissions are initiated at most 16 μs after the last transmission by the Initiating Device that issued the grant.

b) The Responding Device that does not proceed with such transmissions within 16 μs after the last transmission from the Initiating Device that issued the grant, shall perform a Clear Channel Assessment (CCA) on the Operating Channel during a single observation slot within a 25 μs period ending immediately before the granted transmission time. If energy was detected with a level above the ED Threshold defined in clause 4.2.7.3.2.5, the Responding Device shall proceed with step 3). Otherwise, the Responding Device shall proceed with step 2).

2) The Responding Device may perform transmissions on the current Operating Channel for the remaining Channel Occupancy Time. The Responding Device may have multiple transmissions on this Operating Channel provided that the gap in between such transmissions does not exceed 16

µs. When the transmissions by the Responding Device are completed the Responding Device shall proceed with step 3).

3) The transmission grant for the Responding Device is withdrawn.

2.8.3.3 Short Control Signalling Transmissions (FBE and LBE)

General

Frame Based Equipment and Load Based Equipment are allowed to have Short Control Signalling Transmissions on the Operating Channel providing these transmissions comply with the requirements in clause 4.2.7.3.3. It is not required for adaptive equipment to implement Short Control Signalling Transmissions.

Definition

Short Control Signalling Transmissions are transmissions used by the equipment to send management and control frames without sensing the channel for the presence of other signals.

Limits

The use of Short Control Signalling Transmissions is constrained as follows:

- within an observation period of 50 ms, the number of Short Control Signalling Transmissions by the equipment shall be equal to or less than 50; and
- the total duration of the equipment's Short Control Signalling Transmissions shall be less than 2 500 µs within said observation period.

2.8.4. Conformance

The conformance tests for this requirement are defined in clause 5.4.9.

2.8.5. Test conditions

These measurements shall only be performed at normal test conditions.

The channel to be used for testing is defined in clause 5.3.2. The device shall be configured to operate at its maximum output power level.

2.8.6. Test method for Frame Based Equipment

2.8.6.1 Additional test conditions

The manufacturer shall declare if the UUT is an Initiating Device and/or a Responding Device (see also clause 5.4.1,item q)).

The manufacturer shall declare the Fixed Frame Period(s) implemented by the Frame Based Equipment (see also clause 5.4.1, item q)).

All measurements shall have temporal resolution of less than or equal to 1 µs.

The measurement equipment shall be able to observe the UUT behaviour for a duration of at least 250 ms at the aforementioned temporal resolution. If the data is recorded in segments then the

Fixed Frame Periods shall be extracted from each data segment. The combined set of all Fixed Frame Periods shall be analysed as described in clause 5.4.9.2.2.4.

2.8.6.2 Conducted measurements

Initialisation of the test

Figure 14 shows an example of the test set-up.

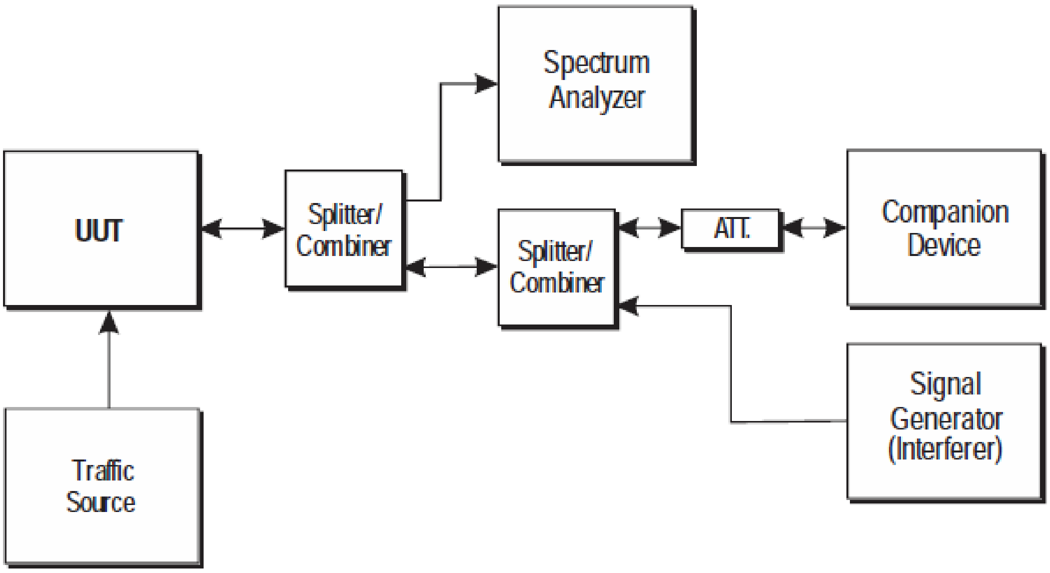


Figure 14: Example Test Set-up for verifying the adaptivity of an equipment

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, the spectrum analyser, the UUT, the traffic source and the companion device are connected using a set-up equivalent to the example given by figure 14 although the interference source is switched off at this point in time. The spectrum analyser is used to monitor the transmissions of the UUT in response to the interference signal. The traffic source might be part of the UUT itself.

•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)
- VBW: ≥ 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: 0 Hz
- Sweep time: > 2 × Channel Occupancy Time
- Trace Mode: Clear/Write
- Trigger Mode: Video or RF/IF Power

Step 2:

•Configure the traffic source so that it fills the UUT's buffers to a level causing the UUT to always have transmissions queued (buffer-ready-for-transmission condition) towards the companion device.Where this is not possible, the UUT shall be configured to occupy the Channel Occupancy Time of the Fixed Frame Period to the highest extent possible.

Procedure to verify the capability to detect other RLAN transmissions on the operating channel when operating on a single channel

Step 1: Setting up the communications link

•The UUT shall be configured to operate on a single Operating Channel.

Step 2: Adding the interference signal.

•One of the three interference signals as defined in clause B.7 is injected on the current Operating Channel of the UUT. The level (at the input of the UUT) of this interference signal shall be equal to the applicable CCA Threshold Level defined in clause 4.2.7.3.1.4.

Step 3: 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 after the interference signal was injected. This may require the spectrum analyser sweep to be triggered by the start of the interfering signal.

• Using the procedure defined in clause 5.4.9.2.3, it shall be verified that:

i) The UUT shall not have transmissions on the current Operating Channel during the Fixed Frame Period following the first Clear Channel Assessment after the interference signal was injected. The UUT is allowed to have Short Control Signalling Transmissions on the current operating channel, see ii) and iii).

ii) Apart from Short Control Signalling Transmissions there shall be no subsequent transmissions while the interfering signal is present.

iii) The Short Control Signalling Transmissions shall comply with the limits defined in clause 4.2.7.3.3. The verification of the Short Control Signalling Transmissions may require the analyser settings to be changed (e.g. sweep time).

•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, in which case a segmented measurement may need to be performed in order to achieve the required resolution.

•Once the test is completed and the interference signal is removed, the UUT may start transmissions again on this channel; however, this is not a requirement and therefore does not require testing.

Step 4:

• Step 2 and step 3 shall be repeated for each of the interference signals defined in clause B.7.

Procedure to verify the capability to detect other RLAN transmissions in case of multi-channel operation

Step 1: Setting up the communications link

•The UUT shall be configured to operate on a set of at least two and at most on six adjacent 20 MHz Operating Channels. The number of channels used for the multi-channel operation during this test shall be declared and be noted in the test report. See clause 5.4.1, item b).

•It shall be verified that the UUT started transmissions on all these channels.

Step 2: Adding the interference signal.

•One of the three interference signals as defined in clause B.7 is switched on.

•When using the interference signal specified in clause B.7.1, the centre frequency and the bandwidth of this signal shall be such that it covers all Operating Channels used for the multi-channel operation during this test.Alternatively, or when using the interference signal specified in clause B.7.2 and clause B.7.3, this test may be performed sequentially by which each of the Operating Channels is tested separately using an interference signal that only covers a single Operating Channel.

• The level (at the input of the UUT) of this interference signal shall be equal to the applicable CCA Threshold Level defined in clause 4.2.7.3.1.4.

Step 3: Verification of reaction to the interference signal.

•The spectrum analyser shall be used to monitor the transmissions of the UUT after the interference signal was injected. This may require the spectrum analyser sweep to be triggered by the start of the interfering signal.

• Using the procedure defined in clause 5.4.9.2.3, it shall be verified that:

i) The UUT shall not have transmissions on any of the Operating Channels configured in step 1 and on which the interference signal was inserted during the Fixed Frame Period following the first Clear Channel Assessment after the interference signal was detected. The UUT is allowed to have Short Control Signalling Transmissions on any of the current operating channels, see ii) and iii).

ii) Apart from Short Control Signalling Transmissions there shall be no subsequent transmissions of the UUT on any of the Operating Channels configured in step 1 and on which the interference signal was inserted, while the interfering signal is present in those channels.

iii) The Short Control Signalling Transmissions shall comply with the limits defined in clause 4.2.7.3.3.The verification of the Short Control Signalling Transmissions may require the analyser settings to be changed (e.g. sweep time).

•To verify that the UUT is not resuming normal transmissions on any of the Operating Channels configured in step 1 as long as the interference signal is present, the monitoring time may need to be 60 s or more, in which case a segmented measurement may need to be performed in order to achieve the required resolution.

•Once the test is completed and the interference signal is removed, the UUT may start transmissions again on any of the Operating Channels used for the multi-channel operation configured in step 1; however, this is not a requirement and therefore does not require testing.

Step 4:

•Step 2 and step 3 shall be repeated for each of the interference signals defined in clause B.7.

Medium Access Mechanism

The below steps define the test procedure to verify the Channel Occupancy Time and Idle Period as part of the Medium Access Mechanism.

Step 1:

•See clause 5.4.9.2.2.1, step 1.

Step 2:

•See clause 5.4.9.2.2.1, step 2.

Step 3: Recording transmissions

•Record start time and duration of every transmission on the Operating Channel and record start time and duration of every gap in between transmissions on the Operating Channel.

•Let tx denote a point in time the Operating Channel becomes occupied and let dx denote the duration the Operating Channel is subsequently occupied. Let iy denote a point in time the Operating Channel becomes unoccupied and let gy denote the duration the Operating Channel is subsequently unoccupied. Figure 15 presents an example.

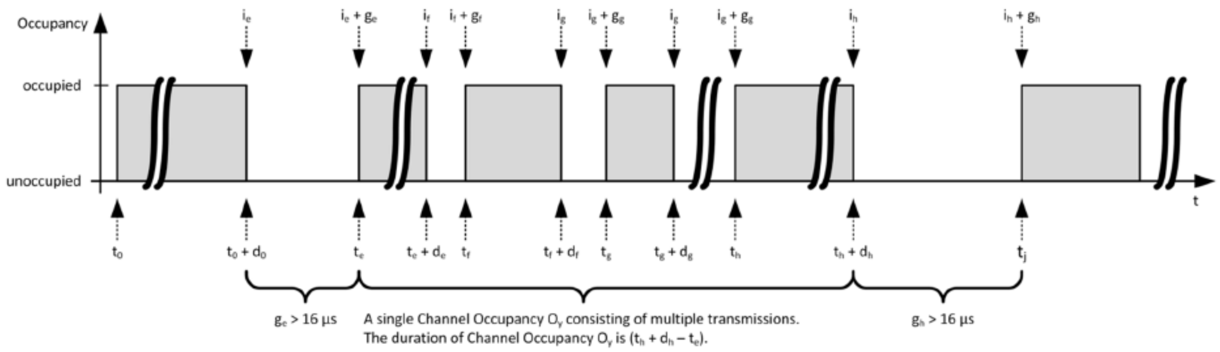


Figure 15: Example of UUT transmissions

Step 4: Measurement of Unoccupied Periods and Channel Occupancy Times

•Any Channel Occupancy Time (COT) Ox is defined as (th + dhte) with te < th if within the interval [te, th + dh] all periods gy that the Operating Channel is unoccupied have duration of less than or equal to 16 µs. As defined in clause 4.2.7.3.1.4, any Channel Occupancy Time may consist of one or more transmissions of the UUT. If the companion device acts as a responding device (see clause 4.2.7.3.1.4), any Channel Occupancy Time may consist of one or more transmissions of the UUT and zero or more transmissions of the companion device.

•Using the values recorded in step 3, the duration of any of the Channel Occupancy Times shall be determined and the duration of any of the Unoccupied Periods between such Channel Occupancy Times shall be determined. An Unoccupied Period is defined as any period gy in between transmissions that has a duration greater than 18 µs (corresponds to 16 µs gap duration plus measurement tolerance). All other gaps in between transmissions are considered as part of the Channel Occupancy Time.

Step 5: Indentification of the Fixed Frame Period

•Based on the measurement results of step 4 and the declared Fixed Frame Period(s) of UUT, identify the start point and duration of each Fixed Frame Period.

•The contiguous Unoccupied Period immediately before the start of a Fixed Frame Period is classified as Idle Period that belongs to the preceding Fixed Frame Period as defined in clause 4.2.7.3.1.4.

Step 6: Verification of Requirements

•Using the results of step 5 it shall be verified that the UUT complies with the maximum Channel Occupancy Time and the minimum Idle Period for each of the Fixed Frame Periods implemented and as defined in clause 4.2.7.3.1.4.

2.8.6.3 Generic test procedure for measuring channel/frequency usage

This is a generic test method to evaluate transmissions on the operating channel being investigated. This test is only performed as part of the procedure described in clause 5.4.9.2.2.2.

The test procedure shall be as follows:

Step 1:

•The analyser shall be set as follows:

- Centre Frequency: equal to the centre frequency of the channel being investigated
- Frequency Span: 0 Hz
- RBW: approximately 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: > 2 × the Channel Occupancy Time
- Sweep points: at least one sweep point per μs
- Trace mode: Clear/Write
- Trigger: Video or RF/IF Power

Step 2:

•Save the trace data to a file for further analysis by a computing device using an appropriate software application or program.

Step 3:

•Identify the data points related to the channel being investigated by applying a threshold.

•Count the number of consecutive data points identified as resulting from a single transmission on the channel 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 channel 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.

2.8.6.4 Radiated measurements

For a UUT with integral antenna(s) and without temporary antenna connector(s), radiated measurements shall be used.

The output power of the signal generator simulating the interference signal shall provide a signal power at the antenna of the UUT with a level equal to CCA Threshold Level (TL) defined in clause 4.2.7.3.1.4.

When performing radiated testing on a UUT with a directional antenna (including smart antenna systems and systems capable of beamforming), the wanted communications link (between the UUT and the companion device) and the interference test signals shall be aligned to the direction corresponding to the UUT's maximum antenna gain.

The test set up as described in annex B and applicable measurement procedures as described in annex C shall be used to test the adaptivity of the UUT. The test procedure is further as described under clause 5.4.9.2.2.

2.8.7. Test method for Load Based Equipment

2.8.7.1 Additional test conditions

A UUT that can operate as a Supervising and as a Supervised Device (see clause 4.2.7.3.2.2, last paragraph) shall be tested for both functionalities.

The manufacturer shall declare if the UUT is capable to make use of note 1 in table 7 or note 1 in table 8, see also clause 5.4.1, item r).

If the UUT is a Supervising Device the manufacturer shall declare if the UUT is capable to make use of note 2 in table 8 in clause 4.2.7.3.2.4, see also clause 5.4.1, item r).

The manufacturer shall declare if the UUT is an Initiating Device and/or a Responding Device, see also clause 5.4.1,item r).

The manufacturer shall declare the UUT's theoretical maximum radio performance, see also clause 5.4.1, item u).

The manufacturer shall declare all Priority Classes the UUT implements, see also clause 5.4.1, item r).

All measurements shall have temporal resolution of less than or equal to 1 μs.

The measurement equipment shall be able to observe UUT behaviour of at least 2 000 Channel Occupancy Times (COTs) at the aforementioned temporal resolution. This data may be recorded in segments. In that case, the COTs shall be extracted from each data segment. The combined set of all COTs shall be analysed as described in clause 5.4.9.3.2.4.

The Priority Class used for testing is selected as follows

- If the UUT implements Priority Class 2 (and potentially other classes), the UUT shall be tested against the requirements of Priority Class 2 as outlined in table 7 or table 8 in clause 4.2.7.3.2.4.

•If the UUT does not implement Priority Class 2 but the UUT implements Priority Class 1 (and potentially other Priority Classes), the UUT shall be tested against the requirements of Priority Class 1 as outlined in table 7 or table 8 in clause 4.2.7.3.2.4.

•If the UUT implements neither Priority Class 2 nor Priority Class 1 but the UUT implements Priority Class 3 (and optionally Priority Class 4), the UUT shall be tested against the requirements of Priority Class 3 as outlined in table 7 or table 8 in clause 4.2.7.3.2.4.

•If the UUT implements no Priority Classes other than Priority Class 4, the UUT shall be tested against the requirements of Priority Class 4 as outlined in table 7 or table 8 in clause 4.2.7.3.2.4.

2.8.7.2 Conducted measurements

Initialization of the test

Figure 16 shows an example of the test set-up.

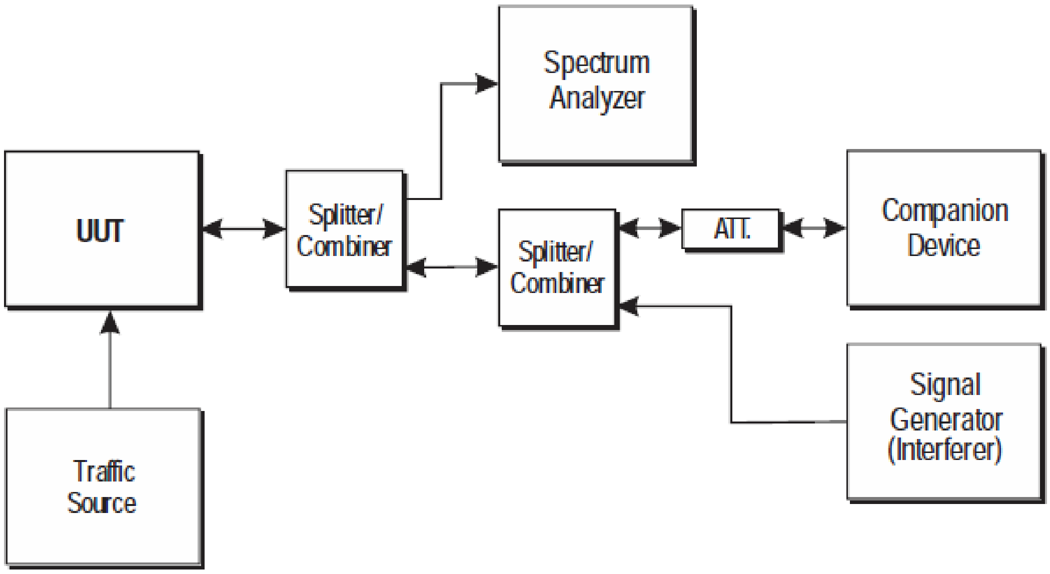


Figure 16: Example Test Set-up for verifying the adaptivity of an equipment

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, the spectrum analyser, the UUT, the traffic source and the companion device are connected using a Set-up equivalent to the example given by figure 16 although the interference source is switched off at this point in time. The spectrum analyser is used to monitor the transmissions of the UUT in response to the interference signal. The traffic source might be part of the UUT itself.

•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)
- 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: 0 Hz
- Sweep time: > 2 × Channel Occupancy Time
- Trace Mode: Clear/Write
- Trigger Mode: Video or RF/IF power

Step 2:

•Configure the traffic source so that it exceeds the UUT's theoretical radio performance. The traffic source shall fill the UUT's buffers causing the UUT to always have transmissions queued (full buffer condition) towards the companion device.

Procedure to verify the capability to detect other RLAN transmissions on the Operating Channel when operating on a single channel

Step 1: Setting up the communications link

• The UUT shall be configured to operate on a single Operating Channel.

Step 2: Adding the interference signal.

• One of the three interference signals as defined in clause B.7 is injected on the current Operating Channel of
the UUT. The level (at the input of the UUT) of this interference signal shall be equal to the applicable CCA
threshold level defined in clause 4.2.7.3.2.5.

Step 3: 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 after the interference signal was injected. This may require the spectrum analyser sweep to be triggered by the start of the interfering signal.

•Using the procedure defined in clause 5.4.9.3.3, it shall be verified that:

i) The UUT stops transmissions on the current Operating Channel.
The UUT is assumed to stop transmissions within a period equal to the maximum Channel Occupancy Time that corresponds to the Priority Class being tested (see table 7 and table 8). The UUT is allowed to have Short Control Signalling Transmissions on the current operating channel, see ii) and iii).

ii)Apart from Short Control Signalling Transmissions there shall be no subsequent transmissions while the interfering signal is present.

iii)The Short Control Signalling Transmissions shall comply with the limits defined in clause 4.2.7.3.3.The verification of the Short Control Signalling Transmissions may require the analyser settings to be changed (e.g. sweep time).

•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, in which case a segmented measurement may need to be performed in order to achieve the required resolution.

•Once the test is completed and the interference signal is removed, the UUT may start transmissions again on this channel however this is not a requirement and therefore does not require testing.

Step 4:

•Step 2 and step 3 shall be repeated for each of the interference signals defined in clause B.7.

Procedure to verify the capability to detect other RLAN transmissions in case of multi-channel operation

Equipment implementing Option 1 for multi-channel operation

Step 1: Setting up the communications link.

•The UUT shall be configured to operate on a set of at least two and at most on six adjacent 20 MHz Operating Channels. The number of channels used for the multi-channel operation during this test shall be declared and be noted in the test report, see clause 5.4.1, item b).

•It shall be verified that the UUT started transmissions on all these channels.

Step 2: Adding the interference signal.

•One of the three interference signals as defined in clause B.7 is switched on.

•When using the interference signal specified in clause B.7.1, the centre frequency and the bandwidth of this signal shall be such that it covers all Operating Channels used for the multi-channel operation during this test.Alternatively, or when using the interference signal specified in clause B.7.2 and clause B.7.3, this test may be performed sequentially by which each of the Operating Channels is tested separately using an interference signal that only covers a single Operating Channel.

•The level (at the input of the UUT) of this interference signal shall be equal to the applicable Energy Detect Threshold level defined in clause 4.2.7.3.2.5.

Step 3: Verification of reaction to the interference signal.

•The spectrum analyser shall be used to monitor the transmissions of the UUT after the interference signal was injected. This may require the spectrum analyser sweep to be triggered by the start of the interfering signal.

•Using the procedure defined in clause 5.4.9.3.3, it shall be verified that:

i) The UUT stops transmissions on any of the Operating Channels configured in step 1 and on which the interference signal was inserted.

The UUT is assumed to stop transmissions on any of the Operating Channels used for the multi-channel operation (see step 1) during this test, and on which the interference signal was inserted, within a period equal to the maximum Channel Occupancy Time that corresponds to the Priority Class being tested (see table 7 and table 8). The UUT is allowed to have Short Control Signalling Transmissions on any of the Operating Channels configured in step 1, see also ii) and iii) below.

ii) Apart from Short Control Signalling Transmissions there shall be no subsequent transmissions of the UUT on the Operating Channels while the interfering signal is present in those channels.

iii) The Short Control Signalling Transmissions shall comply with the limits defined in clause 4.2.7.3.3.

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

•To verify that the UUT is not resuming normal transmissions in an Operating Channel as long as the interference signal is present in that channel, the monitoring time may need to be 60 s or more, in which case a segmented measurement may need to be performed in order to achieve the required resolution.

•Once the test is completed and the interference signal is removed, the UUT may start transmissions again on any of the Operating Channels used for the multi-channel operation configured in step 1; however, this is not a requirement and, therefore, does not require testing.

Step 4:

•Step 2 and step 3 shall be repeated for each of the interference signals defined in clause B.7.

Equipment implementing Option 2 for multi-channel operation

Step 1: Setting up the communications link.

•The UUT shall be configured to operate on a bonded 40 MHz channel. One of the two adjacent 20 MHz channels within this bonded channel is configured as the Primary Operating Channel (see clause 4.2.7.3.2.3,Option 2).

• It shall be verified that the UUT started transmissions within the bonded 40 MHz channel.

Step 2: Adding the interference signal.

•One of the three interference signals as defined in clause B.7 is switched on.

•The centre frequency and the bandwidth of the interference signal shall be as such that it covers only the adjacent (non-Primary) Operating Channel, it shall not cover the Primary Operating Channel. See clause B.7.

•The level (at the input of the UUT) of this interference signal shall be equal to the applicable Energy Detect Threshold level defined in clause 4.2.7.3.2.5.

Step 3: Verification of reaction to the interference signal.

•The spectrum analyser shall be used to monitor the transmissions of the UUT after the interference signal was injected. This may require the spectrum analyser sweep to be triggered by the start of the interfering signal.

•Using the procedure defined in clause 5.4.9.3.3, it shall be verified that:

i)The UUT stops transmissions on the adjacent (non-Primary) Operating Channel.

The UUT is assumed to stop transmissions on the adjacent (non-Primary) Operating Channel within a period equal to the maximum Channel Occupancy Time that corresponds to the Priority Class being tested (see table 7 and table 8). The UUT is allowed to have Short Control Signalling Transmissions on the adjacent (non-Primary) Operating Channel, see ii) and iii).

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ii)Apart from Short Control Signalling Transmissions there shall be no subsequent transmissions on the adjacent (non-Primary) Operating Channel while the interfering signal is present.

iii)The Short Control Signalling Transmissions shall comply with the limits defined in clause 4.2.7.3.3.

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

•To verify that the UUT is not resuming normal transmissions on the adjacent (non-Primary) Operating Channel as long as the interference signal is present, the monitoring time may need to be 60 s or more, in which case a segmented measurement may need to be performed in order to achieve the required resolution.

•Once the test is completed and the interference signal is removed, the UUT may start transmissions again on the adjacent (non-Primary) Operating Channel, however, this is not a requirement and, therefore, does not require testing.

Step 4:

•Step 2 and step 3 shall be repeated for each of the interference signals defined in clause B.7.

Medium Access Mechanism

Option A: Procedure to verify the Medium Access Mechanism

The below steps define the test procedure to verify the Medium Access Mechanism implemented by the UUT.

Step 1:

• See clause 5.4.9.3.2.1, step 1).

Step 2:

•See clause 5.4.9.3.2.1, step 2).

•If the UUT is making use of note 1 in table 8 in clause 4.2.7.3.2.4 the following additionally applies:

- Configure a second traffic source so that it exceeds the companion device's theoretical radio performance. The second traffic source shall fill the companion device's buffers causing the companion device to always have transmissions queued (full buffer condition) towards the UUT.
- In this test, the Supervising device shall issue one or more grants with each Channel Occupancy Time (COT). Per Channel Occupancy Time (COT) one and not more than one grant shall foresee inserting a single pause of at least 100 μs, see clause 4.2.7.3.2.4, table 8, note 1.

Step 3: Recording transmissions.

•Record start time and duration of every transmission (energy) on the Operating Channel and record start time and duration of every idle period on the Operating Channel.

•Let tx denote a point in time the Operating Channel becomes occupied and let dx denote the duration the Operating Channel is subsequently occupied. Let iy denote a point in time the Operating Channel becomes unoccupied and let gy denote the duration the Operating Channel is subsequently unoccupied. Figure 17 presents an example.

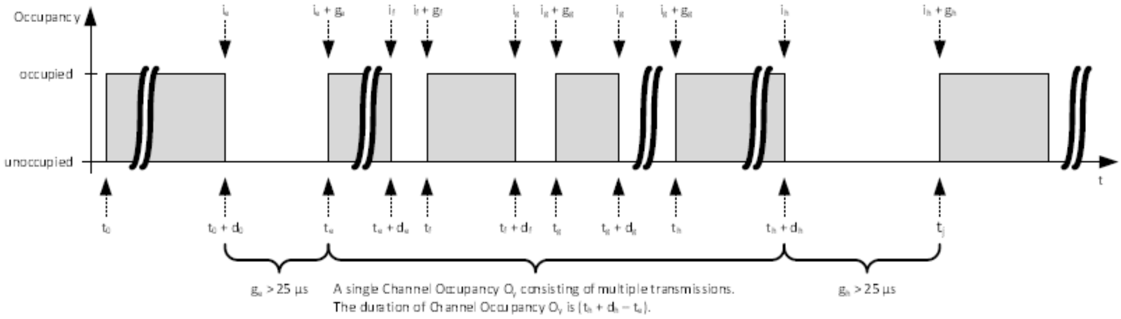

Figure 17: Example of UUT transmissions

Step 4: Measurement of Idle Periods and Channel Occupancy Times.

•Any Channel Occupancy Time (COT) Ox is defined as (th + dh− te) with te < th if within the interval [te, th + dh] all periods gy that the Operating Channel is unoccupied have duration of less than or equal to 25 μs. As defined in clause 4.2.7.3.2.2, any Channel Occupancy Time may consist of one or more transmissions of the UUT and zero or more transmissions of the companion device.

•Using the values recorded in step 3, the duration of any of the Channel Occupancy Times shall be determined and the duration of any of the Idle Periods between such Channel Occupancy Times shall be determined. An Idle Period is defined as any period gy that has a duration greater than 27 μs.The definition for the Idle Period is adjusted from 25 μs defined in clause 4.2.7.3.2.6 step 6 to 27 μs to account for measurement inaccuracies.

Step 5: Classification of Idle Periods.

•Let $k \in N_0$

•Assign all Idle Periods to one of k + 1 different bins. The value of k depends on the Priority Class used for the test. A bin is denoted as B_n with $0 \leqslant n \leqslant k$.

- If the Priority Class used for the test is 1, then k= 16 and the bins are denoted $B_0 \ldots B_{16}$.
- If the Priority Class used for the test is 2, the following applies:

i) If the UUT makes use of note 2 in table 8 in clause 4.2.7.3.2.4, then k= 32 and the bins are denoted $B_0 \ldots B_{32}$.

ii) If the UUT does not make use of note 2 in table 8 in clause 4.2.7.3.2.4, then k= 16 and the bins are denoted $B_0 \ldots B_{16}$.

- If the Priority Class used for the test is 3, then k= 8 and the bins are denoted $B_0 \ldots B_8$.
- If the Priority Class used for the test is 4, then k= 4 and the bins are denoted $B_0 \ldots B_4$.

•If the Priority Class used for the test is 1, bin B_n is defined as:

$$B_n = \begin{cases} [0.77[\mu s, n = 0 \\ [77 + 9 \times (n-1), 77 + 9 \times n[\mu s, 1 \leq n \leq 15 \\ [212, \infty[\mu s, n = 16 \end{cases}$$

• If the Priority Class used for the test is 2, bin Bn is defined as below:

- If the UUT is a Supervising Device making use of note 2 in table 8 in clause 4.2.7.3.2.4, bin Bn is defined as:

$$B_n = \begin{cases} [0.41[\mu s, n = 0 \\ [41 + 9 \times (n-1), 41 + 9 \times n[\mu s, 1 \leq n \leq 31 \\ [320, \infty[\mu s, n = 32 \end{cases}$$

- If the UUT is a Supervised Device or if the UUT is a Supervising Device not making use of note 2 in table 8 in clause 4.2.7.3.2.4, bin Bn is defined as:

$$B_n = \begin{cases} [0.41[\mu s, n = 0 \\ [41 + 9 \times (n-1), 41 + 9 \times n[\mu s, 1 \leq n \leq 15 \\ [176, \infty[\mu s, n = 16 \end{cases}$$

• If the Priority Class used for the test is 3, bin Bn is defined as below:

- If the UUT is a Supervised Device, bin B_n is defined as:

$$B_n = \begin{cases} [0.32[\mu s, n = 0 \\ [32 + 9 \times (n-1), 23 + 9 \times n[\mu s, 1 \leq n \leq 7 \\ [95, \infty[\mu s, n = 8 \end{cases}$$

- If the UUT is a Supervising Device, bin B_n is defined as:

$$B_n = \begin{cases} [0.23[\mu s, n = 0 \\ [23 + 9 \times (n-1), 32 + 9 \times n[\mu s, 1 \leq n \leq 7 \\ [86, \infty[\mu s, n = 8 \end{cases}$$

• If the Priority Class used for the test is 4, bin B_n is defined as below:

- If the UUT is a Supervised Device, bin B_n is defined as:

$$B_n = \begin{cases} [0.32[\mu s, n = 0 \\ [32 + 9 \times (n-1), 32 + 9 \times n[\mu s, 1 \leq n \leq 3 \\ [59, \infty[\mu s, n = 4 \end{cases}$$

- If the UUT is a Supervising Device, bin Bn is defined as:

$$B_n = \begin{cases} [0.23[\mu s, n = 0 \\ [23 + 9 \times (n-1), 23 + 9 \times n[\mu s, 1 \leq n \leq 3 \\ [50, \infty[\mu s, n = 4 \end{cases}$$

Step 6: Idle Period probability evaluation.

• Let $H(B_n)$ define the number of Idle Periods assigned to bin B_n.

• Let E define the total number of Idle Periods observed. Then E is the sum of events in all bins:

$$E = \sum_{n=0}^{k} H(B_n)$$

• Calculate the observed cumulative probabilities as follows:

- Let p(n) define the probability that idle periods of duration less than the upper limit specified for bin B_n occurred, p(n) = p (Idle Period < upper limit of bin B_n).

- Then, for each n, 0 ≤ n ≤ k, calculate p(n) as:

$$p(n) = \frac{\sum_{i=0}^{n} H(B_i)}{E}$$

• It shall be verified whether the UUT complies with the below maximum probabilities:

- If the Priority Class used for the test is 1, each cumulative probability p(n) of all Idle Periods recorded in bins [B_0 … B_n] shall not exceed the following maximum probability:

$$p(n) \le \begin{cases} 0{,}05, n = 0 \\ 0{,}12, n = 1 \\ 0{,}12 + (n-1) \times 0{,}0625, 2 \le n \le 15 \\ 1, n > 15 \end{cases}$$

- If the Priority Class used for the test is 2, each cumulative probability p(n) of all Idle Periods recorded in bins [B_0 … B_n] shall not exceed the following maximum probability.

- If the UUT makes use of note 2 in table 8 in clause 4.2.7.3.2.4:

$$p(n) \le \begin{cases} 0{,}05, n = 0 \\ 0{,}12, n = 1 \\ 0{,}12 + (n-1) \times 0{,}03125, 2 \le n \le 29 \\ 1, n > 29 \end{cases}$$

- If the UUT does not make use of note 2 in table 8 in clause 4.2.7.3.2.4:

$$p(n) \le \begin{cases} 0{,}05, n = 0 \\ 0{,}12, n = 1 \\ 0{,}12 + (n-1) \times 0{,}0625, 2 \le n \le 15 \\ 1, n > 15 \end{cases}$$

- If the UUT makes use of note 1 in table 8 in clause 4.2.7.3.2.4:

$$p(n) \le \begin{cases} 0{,}05, n = 0 \\ 0{,}09 + (n-1) \times 0{,}03125, 1 \le n \le 7 \\ 0{,}59 + (n-1) \times 0{,}03125, 8 \le n \le 14 \\ 1, n > 14 \end{cases}$$

- If the Priority Class used for the test is 3, each cumulative probability p(n) of all Idle Periods recorded in bins [B_0 … B_n] shall not exceed the following maximum probability:

$$p(n) \le \begin{cases} 0{,}05, n = 0 \\ 0{,}18, n = 1 \\ 0{,}18 + (n-1) \times 0{,}125, 2 \le n \le 6 \\ 1, n > 6 \end{cases}$$

- If the Priority Class used for the test is 4, each cumulative probability p(n) of all Idle Periods recorded in bins [B_0 … B_n] shall not exceed the following maximum probability:

$$p(n) \le \begin{cases} 0{,}05, n = 0 \\ 0{,}05 + n \times 0{,}25, 1 \le n \le 3 \\ 1, n > 3 \end{cases}$$

Option B: Compliance by declaration for the Medium Access Mechanism

As an alternative to performing the procedure described in clause 5.4.9.3.2.4.1, the manufacturer is allowed to declare compliance with the requirements contained in clause 4.2.7.3.2.6 and clause 4.2.7.3.2.7, see clause 5.4.1, item r).

Maximum Channel Occupancy Time(s)

Option A: Procedure to verify the maximum Channel Occupancy Time(s)

The below steps define the test procedure to verify the maximum Channel Occupancy Time(s) implemented by the UUT.

A Channel Occupancy consists of transmissions from the UUT and may contain transmissions of the companion device.See clause 4.2.7.3.2.2, last paragraph.

The Channel Occupancy Times shall be determined using the results of step 4 in clause 5.4.9.3.2.4. These Channel Occupancy Times shall be noted in the test report.

The UUT complies with the limit for the maximum Channel Occupancy Time under the following conditions:

• If the Priority Class used for the test is 1, none of the Channel Occupancy Times shall exceed 6 ms.

• If the Priority Class used for the test is 2, none of the Channel Occupancy Times shall exceed the following limits:

- 6 ms if the UUT makes use of note 1 in table 8 in clause 4.2.7.3.2.4.
- 10 ms if the UUT makes use of note 2 in table 8 in clause 4.2.7.3.2.4.
- 6 ms if the UUT does not make use of note 2 in table 8 in clause 4.2.7.3.2.4.

• If the Priority Class used for the test is 3, none of the Channel Occupancy Times shall exceed 4 ms.

• If the Priority Class used for the test is 4, none of the Channel Occupancy Times shall exceed 2 ms.

Option B: Compliance by declaration for the maximum Channel Occupancy Time(s)

As an alternative to performing the procedure described in clause 5.4.9.3.2.5.1, the manufacturer is allowed to declare compliance with the maximum Channel Occupancy Time(s) defined in clause 4.2.7.3.2.4, see clause 5.4.1, item r).

2.8.7.3 Generic test procedure for measuring channel/frequency usage

This is a generic test method to evaluate transmissions on the Operating Channel being investigated. This test is only performed as part of the procedure described in clause 5.4.9.3.2.2, clause 5.4.9.3.2.3.1 and clause 5.4.9.3.2.3.2.

The test procedure shall be as follows:

Step 1:

• The analyser shall be set as follows:

- Centre Frequency: equal to the centre frequency of the channel being investigated
- Frequency Span: 0 Hz
- RBW: approximately 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: > 2 × the Channel Occupancy Time
- Sweep points: at least one sweep point per μs
- Trace mode: Clear/Write
- Trigger: Video or RF/IF power

Step 2:

•Save the trace data to a file for further analysis by a computing device using an appropriate software application or program.

Step 3:

•Identify the data points related to the channel being investigated by applying a threshold.

•Count the number of consecutive data points identified as resulting from a single transmission on the channel 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 channel 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.

2.8.7.4 Radiated measurements

For a UUT with integral antenna(s) and without temporary antenna connector(s), radiated measurements shall be used.

The output power of the signal generator simulating the interference signal shall provide a signal power at the antenna of the UUT with a level equal to the applicable Energy Detect Threshold (ED Threshold) defined in clause 4.2.7.3.2.5.

When performing radiated testing on a UUT with a directional antenna (including smart antenna systems and systems capable of beamforming), the wanted communications link (between the UUT and the companion device) and the interference test signals shall be aligned to the direction corresponding to the UUT's maximum antenna gain.

The test set up as described in annex B and applicable measurement procedures as described in annex C shall be used to test the adaptivity of the UUT. The test procedure is further as described under clause 5.4.9.3.2.

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2.8.8. Test result

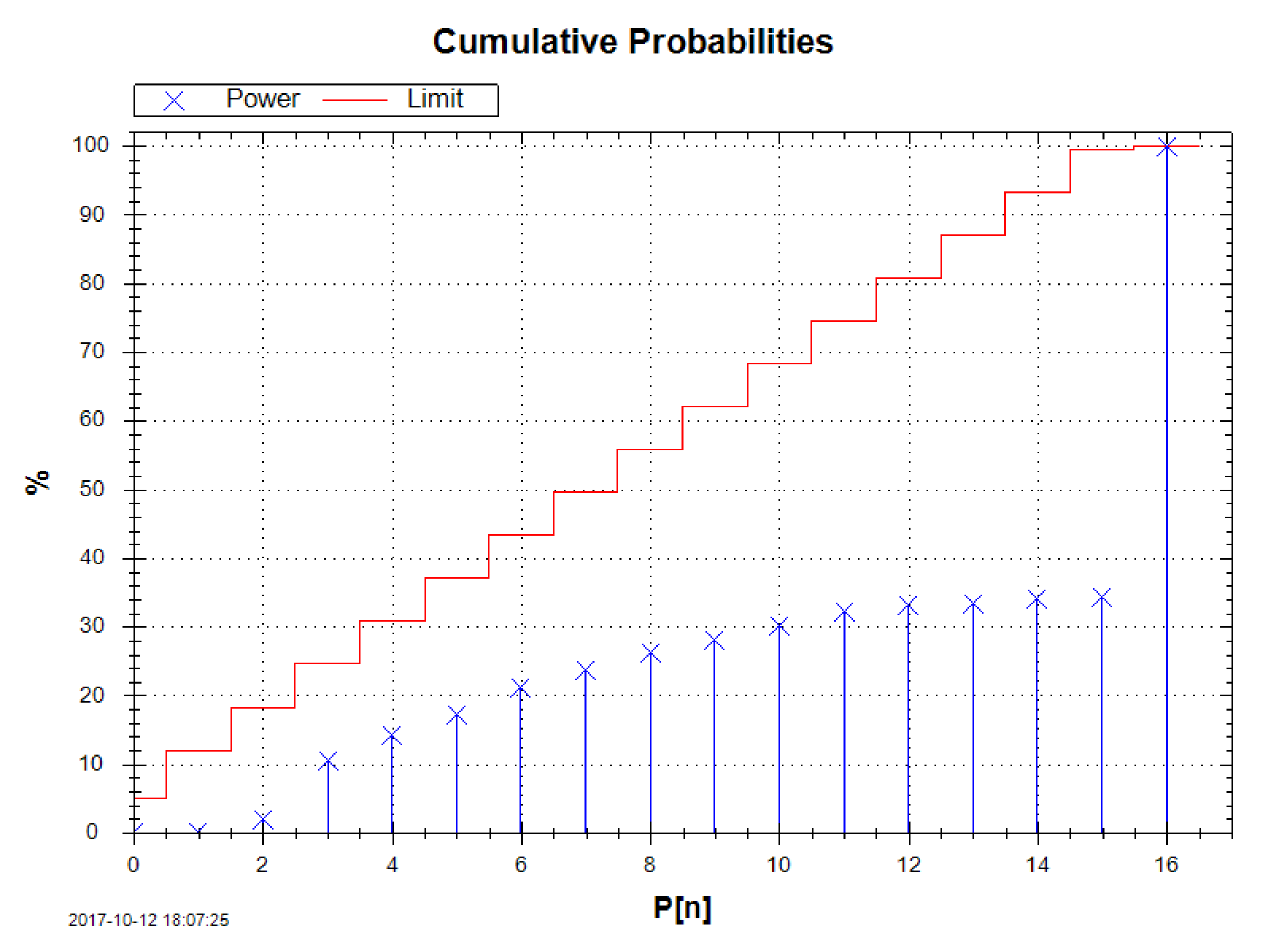
802.11a Mode

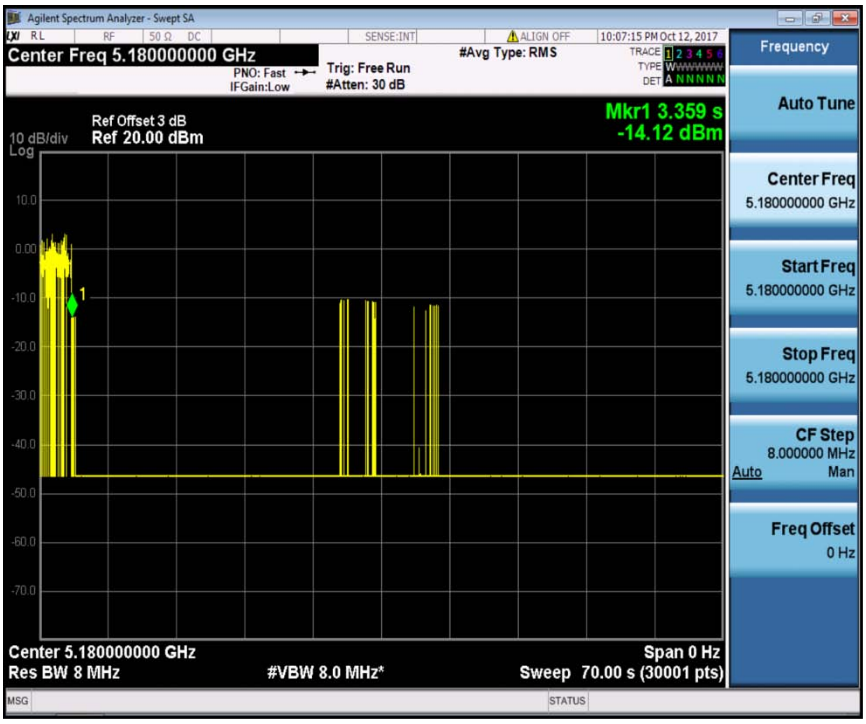
Mode	Channel	Max COT (ms)	Limit （ms）	Idle Period （us）	Limit （us）	Result
802.11a	5180MHz	5.25	6	37	＞27	PASS

Mode:	Channel:	Bn:	H(Bn):	Pn:	Probabilities (%):	Limite(%):	Result:
802.11a	5180MHz	B[0]	1	P[0]	0.2	5	Passed
802.11a	5180MHz	B[1]	0	P[1]	0.2	12	Passed
802.11a	5180MHz	B[2]	9	P[2]	1.96	18.25	Passed
802.11a	5180MHz	B[3]	44	P[3]	10.61	24.5	Passed
802.11a	5180MHz	B[4]	18	P[4]	14.15	30.75	Passed
802.11a	5180MHz	B[5]	16	P[5]	17.29	37	Passed
802.11a	5180MHz	B[6]	20	P[6]	21.22	43.25	Passed
802.11a	5180MHz	B[7]	13	P[7]	23.77	49.5	Passed
802.11a	5180MHz	B[8]	12	P[8]	26.13	55.75	Passed
802.11a	5180MHz	B[9]	10	P[9]	28.09	62	Passed
802.11a	5180MHz	B[10]	10	P[10]	30.06	68.25	Passed
802.11a	5180MHz	B[11]	11	P[11]	32.22	74.5	Passed
802.11a	5180MHz	B[12]	5	P[12]	33.20	80.75	Passed
802.11a	5180MHz	B[13]	1	P[13]	33.40	87	Passed
802.11a	5180MHz	B[14]	4	P[14]	34.18	93.25	Passed
802.11a	5180MHz	B[15]	1	P[15]	34.38	99.5	Passed
802.11a	5180MHz	B[16]	334	P[16]	100	100	Passed

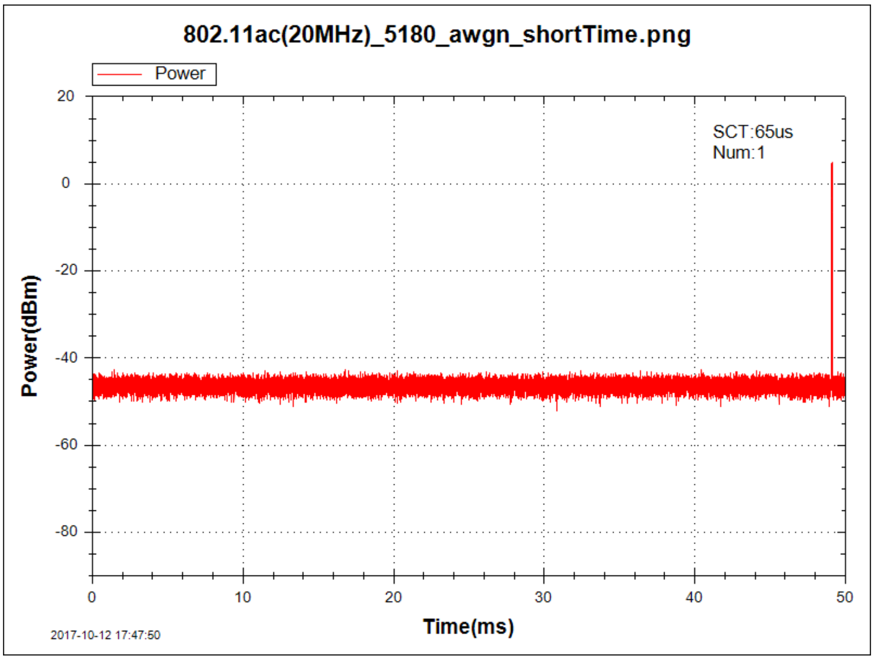
Mode	Channel	Interferer Signal Type	Threshold Level	Short Control Signal (us)	Limit (us)	Result
802.11a	5180MHz	AWGN	-75dBm/MHz	65	2500	PASS
802.11a	5180MHz	LTE	-75dBm/MHz	0	2500	PASS
802.11a	5180MHz	OFDM	-75dBm/MHz	0	2500	PASS

Test Plot:

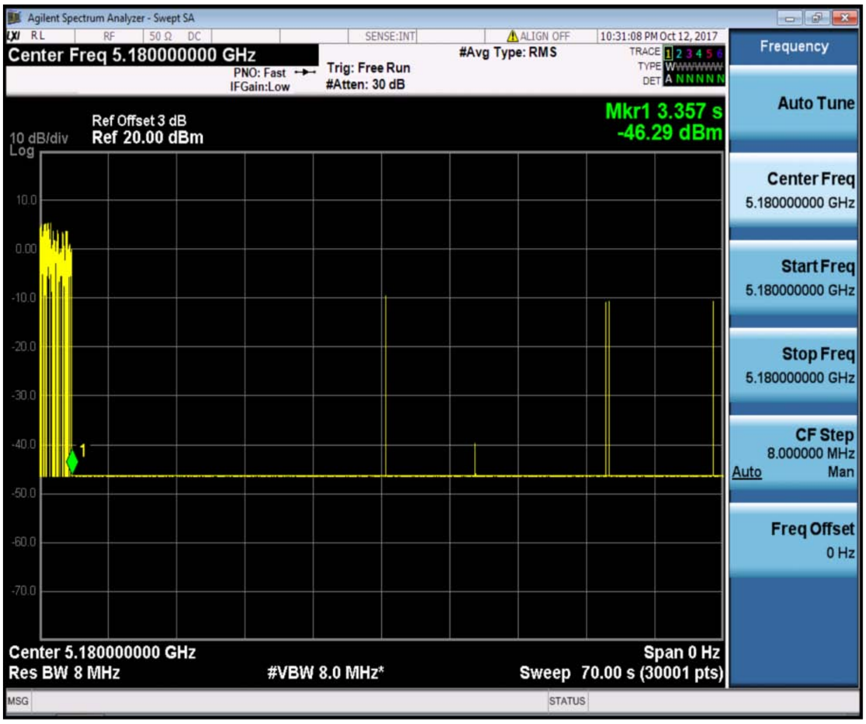

Cumulative Probabilities
Power
Limit
100
90
80
70
60
50
40
30
20
10
0
%
0
2
4
6
8
10
12
14
16
P[n]
2017-10-12 18:07:25



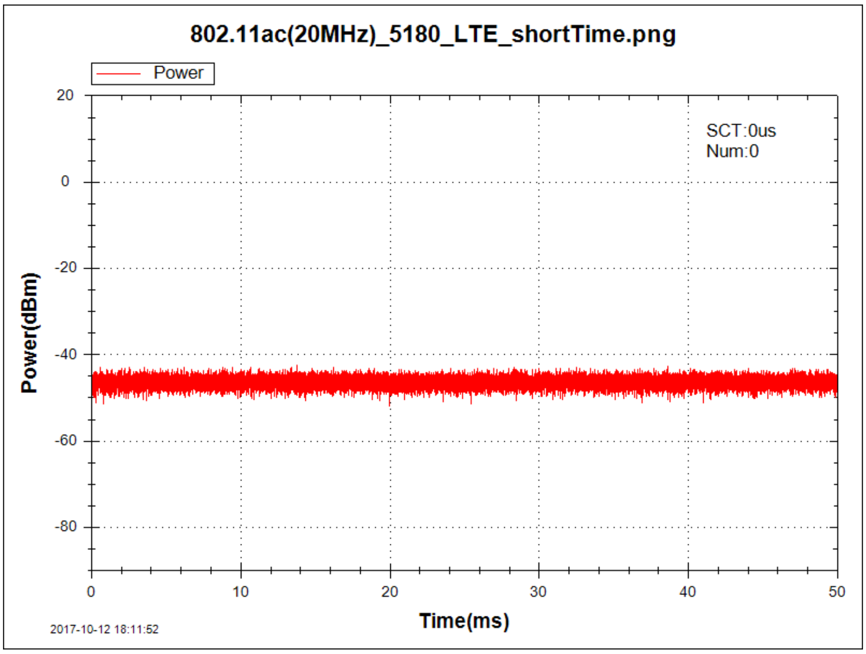
AWGN Interference



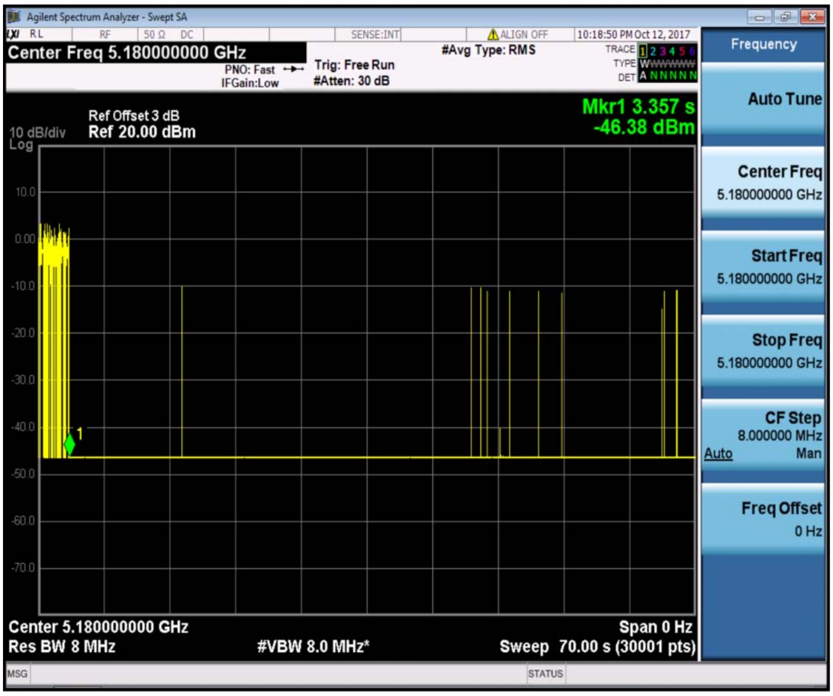
Short control signal in 50ms



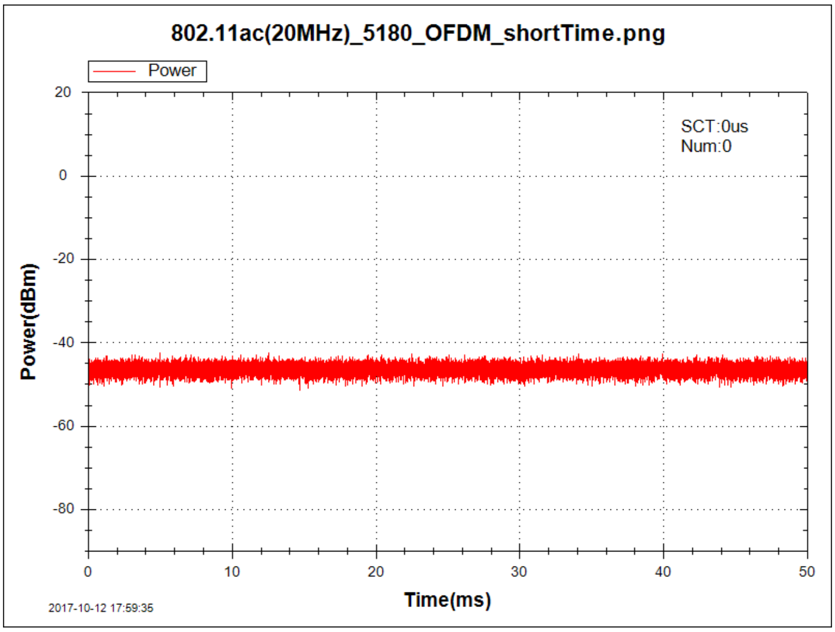
LTE Interference



Short control signal in 50ms



OFDM Interference



Short control signal in 50ms

2.9. EN 301 893 §4.2.8- Receiver Blocking

2.9.1. Applicability

The present requirement applies to all equipment within the scope of the present document.

2.9.2. Definition

Receiver blocking is a measure of the capability of the equipment to receive a wanted signal on its operating channel without exceeding a given degradation due to the presence of an unwanted input signal (blocking signal) on frequencies other than those of the operating bands provided in table 1.

2.9.3. Performance Criteria

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 (see clause 5.4.1,item t)).

2.9.4. Limits

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 9.

Table 9: 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	5100	-53	-59	Continuous Wave
Pmin + 6 dB	4900 5000 5975	-47	-53	Continuous Wave

NOTE 1: Pmin 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.

2.9.5. Conformance

The conformance tests for this requirement are defined in clause 5.4.10.

2.9.6. Test conditions

See clause 5.3 for the environmental test conditions. These measurements shall only be performed at normal test conditions.
The channels on which the conformance requirements in clause 4.2.8 shall be verified are defined in clause 5.3.2.
The UUT shall operate in its normal operational mode.
Devices which can change their operating frequency automatically (adaptive channel allocation), this function shall be disabled.
If the equipment can be configured to operate with different Nominal Channel Bandwidths (e.g. 20 MHz and 40 MHz) and different data rates, then the combination of the smallest channel bandwidth and the lowest data rate for this channel bandwidth which still allows the equipment to operate as intended shall be used. This mode of operation shall be aligned with the performance criteria defined in clause 4.2.8.3 as declared by the manufacturer (see clause 5.4.1,item t) and shall be described in the test report.
It shall be verified that this performance criteria as defined by the manufacturer is achieved during the blocking test.

2.9.7. Test Method

2.9.7.1 Conducted measurements

For systems using multiple receive chains only one chain need to be tested. All other receiver inputs shall be terminated.
Figure 18 shows the test set-up which can be used for performing the receiver blocking test.

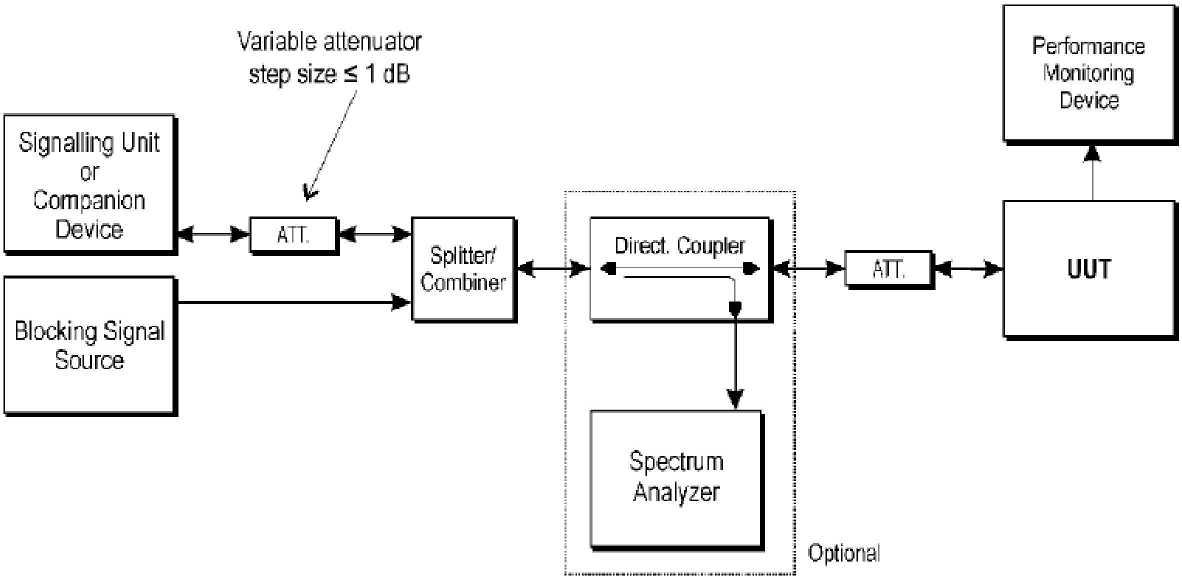


Figure 18: Test Set-up for receiver blocking

The steps below define the procedure to verify the receiver blocking requirement as described in clause 4.2.8.

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 9.

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 18. 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 Pmin.

•This signal level (Pmin) 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 9. It shall be verified and recorded in the test report that the performance criteria as specified in clause 4.2.8.3 is met.

Step 5:

•Repeat step 4 for each remaining combination of frequency and level as specified in table 9.

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.

2.9.7.2 Radiated measurements

When performing radiated measurements on equipment with dedicated antennas, measurements shall be repeated for each alternative dedicated antenna.

A test site as described in annex B and applicable measurement procedures as described in annex C shall be used.

The test procedure is further as described under clause 5.4.10.2.1.

The level of the blocking signal at the UUT referred to in step 4 is assumed to be the level in front of the UUT antenna(s). The UUT shall be positioned with its main beam pointing towards the antenna radiating the blocking signal.The position recorded in clause 5.4.4.2.2 can be used.

2.9.8. Test Result

802.11a 5180MHz:

Receiver Blocking parameters							
P_{min}=-79dBm							
Wanted signal mean power from companion device (dBm)	**Blocking signal frequency (MHz)**	**Blocking signal power (dBm)**	**Type of blocking signal**	**Send packets**	**Receiver Pack**	**PER (%)**	**Verdict**
P_{min} + 6 dB	5100	-59	CW	1000	998	0.2	PASS
P_{min} + 6 dB	4900	-53	CW	1000	997	0.3	PASS
	5000	-53	CW	1000	994	0.6	PASS
	5975	-53	CW	1000	996	0.6	PASS
NOTE 1: Pmin 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.							

802.11a 5500MHz:

Receiver Blocking parameters							
P_{min}=-76dBm							
Wanted signal mean power from companion device (dBm)	**Blocking signal frequency (MHz)**	**Blocking signal power (dBm)**	**Type of blocking signal**	**Send packets**	**Receiver Pack**	**PER (%)**	**Verdict**
P_{min} + 6 dB	5100	-59	CW	1000	994	0.6	PASS
P_{min} + 6 dB	4900	-53	CW	1000	997	0.3	PASS
	5000	-53	CW	1000	992	0.8	PASS
	5975	-53	CW	1000	992	0.8	PASS
NOTE 1: Pmin 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.							

2.10. EN 301 893 §4.2.9- User Access Restrictions

2.10.1. Definition

User Access Restrictions are constraints implemented in the RLAN device to restrict access of the user to any hardware and/or software settings of the equipment, including software replacement(s), which may impact (directly or indirectly) the compliance of the equipment with the requirements in the present document.

NOTE: The user should be understood as the end user, the operator or any person not responsible for the compliance of the equipment against the requirements in the present document.

2.10.2. Requirement

The equipment shall be so constructed that settings (hardware and/or software) related to DFS shall not be accessible to the user if changing those settings result in the equipment no longer being compliant with the DFS requirements in clause 4.2.6.

The above requirement includes the prevention of indirect access to any setting that impacts DFS. The following is a non-exhaustive list of examples of such indirect access.

EXAMPLE 1: The equipment should not allow the user to change the country of operation and/or the operating frequency band if that results in the equipment no longer being compliant with the DFS requirements.

EXAMPLE 2: The equipment should not accept software and/or firmware which results in the equipment no longer being compliant with the DFS requirements, e.g.:

- software and/or firmware provided by the manufacturer but intended for other regulatory regimes;
- modified software and/or firmware where the software and/or firmware is available as open source code;
- previous versions of the software and/or firmware (downgrade).

2.10.3. Results

Users can not modify the Pivotal system software and hardware of the EUT, meet the User Access Restrictions requirements.

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd.
FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road,
Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China
Tel: 86-755-36698555 Fax: 86-755-36698525
Http://www.morlab.cn E-mail: service@morlab.cn

2.11. EN 301 893 §4.2.10- Geo-location capability

2.11.1. Applicability

This requirement only applies to equipment with geo-location capability as defined in clause 4.2.10.2.

2.11.2. Definition

Geo-location capability is a feature of the RLAN device to determine its location at installation, at reinstallation and at each power up of the equipment, with the purpose to configure itself according to the regulatory requirements applicable at the location where it operates.
The geo-location capability may be present in the equipment or in an external device (temporary) associated with the equipment operating at the same geographic location during the initial power up of the equipment. The geographic location may also be available in equipment already installed and operating at the same geographic location.

2.11.3. Requirement

The geographic location determined by the equipment as defined in clause 4.2.10.2 shall not be accessible to the user.
If the equipment cannot determine the geographic location, it shall operate in a mode compliant with the requirements applicable in any of the geographic locations where the equipment is intended to operate.

2.11.4. Conformance

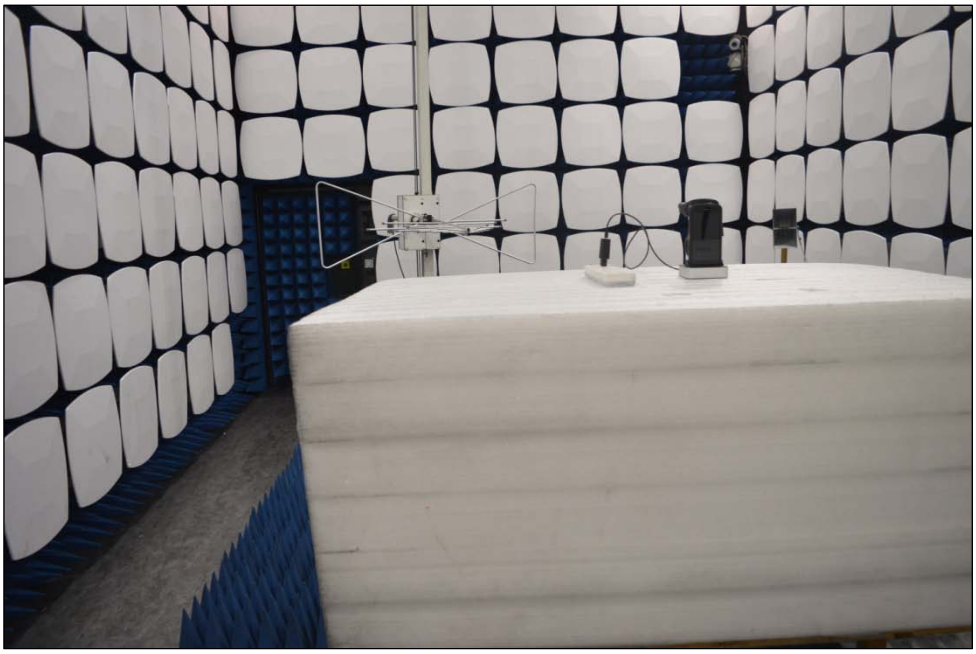
The manufacturer shall declare whether the equipment complies with the requirements contained in clause 4.2.10.3. See clause 5.4.1

2.11.5. Result

The geographical location determined by the equipment shall not be accessible to the user.

Annex A Photographs of Test Setup

1. Radiated Measurement Setup



2. Conducted Measurement Setup

Annex B Test Uncertainty

Parameter	Uncertainty
RF frequency	±1 × 10^{-5}
RF power conducted	±1.5 dB
RF power radiated	±6 dB
Spurious emissions, conducted	±3 dB
Spurious emissions, radiated	±6 dB
Humidity	±5 %
Temperature	±1 °C
Time	±10 %

Annex C Application form for testing

1. Information as required by ETSI EN 301 893 (V2.1.1), clause 5.3.1

In accordance with ETSI EN 301 893, clause 5.4.1, the following information is provided by the manufacturer.

a) The Nominal Channel Bandwidth(s):

Nominal Channel Bandwidth 1: 20MHz

Nominal Channel Bandwidth 1: 40MHz

The associated centre frequencies:

For Nominal Channel Bandwidth 1:

for the band 5 150 MHz to 5 350 MHz: 20MHz; 40MHz;

for the band 5 470 MHz to 5 725 MHz: 20MHz; 40MHz;

b) For Load Based Equipment that supports multi-channel operation:

☐The LBE equipment supports Option 1 as described in clause 4.2.7.3.2.3

☐The LBE equipment supports Option 2 as described in clause 4.2.7.3.2.3

•The (maximum) number of channels used for multi-channel operation: ......

•These channels are adjacent channels:

☐Yes ☐No

•In case of non-adjacent channels, whether or not these channels are in different sub-bands:

☐Yes ☐No

•for LBE equipment implementing option 1 (see clause 4.2.7.3.2.3), the number of channels used for multichannel operation when performing the test described in clause 5.4.9.3.2.3.1:

In case of multi-channel operation, further information defining the channels used for these simultaneous transmissions may be required.

c) The different transmit operating modes (see clause 5.1.4.2) (tick all that apply):

☑**Operating mode 1:** Single Antenna Equipment

☑a) Equipment with only 1 antenna

☐b) Equipment with diversity antennas but only 1 antenna active at any moment in time

☐c) Smart Antenna Systems with 2 or more antennas, but operating in a (legacy) mode where only 1 antenna is used.

☐**Operating mode 2:** Smart Antenna Systems - Multiple Antennas without beamforming

☐a) Single spatial stream/Standard throughput

☐b) High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1

☐c) High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2

☐**Operating mode 3:** Smart Antenna Systems - Multiple Antennas with beamforming

☐a) Single spatial stream/Standard throughput

☐b) High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1

☐c) High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2

d) In case of Smart Antenna Systems or multiple antenna systems:

• The number of Receive chains: ......

• The number of Transmit chains: ......

• Equal power distribution among the transmit chains: ☐Yes ☐No

• In case of beamforming, the maximum (additional) beamforming gain: ...... dB

NOTE: Beamforming gain does not include the basic gain of a single antenna (assembly).

e) TPC feature available:

☐ Yes

☑ No

f) For equipment with TPC range:

The lowest and highest power level (or lowest and highest e.i.r.p. level in case of integrated antenna equipment), intended antenna assemblies and corresponding operating frequency range for the TPC range (or for each of the TPC ranges if more than one is implemented).

TPC range 1: Applicable Frequency Range:

☐5150 MHz to 5350 MHz and 5 470 MHz to 5 725 MHz (Indoor)

Simultaneous transmissions in both sub-bands: ☐ Yes ☐ No

☐5470 MHz to 5725 MHz only (Outdoor only)

Indicate whether the power levels specified are Transmitter Output Power levels or e.i.r.p. levels in case of integrated antenna equipment.

Power levels are specified for: ☐ Tx out ☐ e.i.r.p

If more than one transmit chain is present (e.g. in the case of smart antenna systems), the power levels below represent the power settings per active transmit chain (and per sub-band in case of multi-channel operation).

Table G.1: Power levels for TPC range 1

	Sub-band (MHz)	Operating Mode 1 (dBm)	Operating Mode 1 (dBm)	Operating Mode 1 (dBm)
Lowest setting (P_{low})	5150 to 5350			
	5470 to 5725			
Highest setting (P_{high})	5150 to 5350			
	5470 to 5725			

Beamforming possible: ☐ Yes ☐ No

Intended Antenna Assemblies:

Table G.2: Intended Antenna Assemblies for TPC range 1

Antenna Assembly name	Antenna Gain (dBi)	Operating Mode	Sub-band (MHz)	Beam forming gain(dB)	e.i.r.p. for P_{low} (dBm)	e.i.r.p. for P_{high} (dBm)
<Antenna1>		Mode 1	5150 to 5350			
			5470 to 5725			
		Mode 2	5150 to 5350			
			5470 to 5725			

		Mode 3	5150 to 5350			
			5470 to 5725			
<Antenna2>		Mode 1	5150 to 5350			
			5470 to 5725			
		Mode 2	5150 to 5350			
			5470 to 5725			
		Mode 3	5150 to 5350			
			5470 to 5725			
<Antenna3>		Mode 1	5150 to 5350			
			5470 to 5725			
		Mode 2	5150 to 5350			
			5470 to 5725			
		Mode 3	5150 to 5350			
			5470 to 5725			

DFS Threshold level: ...... dBm ☐ at the antenna connector

☐ in front of the antenna

TPC range 2: Applicable Frequency Range:

☐5 150 MHz to 5 350 MHz and 5 470 MHz to 5 725 MHz (Indoor)

Simultaneous transmissions in both sub-bands: ☐ Yes ☐ No

☐5 470 MHz to 5 725 MHz only (Outdoor only)

Indicate whether the power levels specified are Transmitter Output Power levels or e.i.r.p. levels in case of integrated antenna equipment.

Power levels are specified for: ☐ Tx out ☐ e.i.r.p

If more than one transmit chain is present (e.g. in the case of smart antenna systems), the power levels below represent the power settings per active transmit chain (and per sub-band in case of simultaneous transmissions).

Table G.3: Power levels for TPC range 2

	Sub-band (MHz)	**Operating Mode 1 (dBm)**	**Operating Mode 1 (dBm)**	**Operating Mode 1 (dBm)**
Lowest setting (P_{low})	5150 to 5350			
	5470 to 5725			
Highest setting (P_{high})	5150 to 5350			
	5470 to 5725			

Beamforming possible: ☐ Yes ☐ No

Intended Antenna Assemblies:

Table G.4: Intended Antenna Assemblies for TPC range 2

Antenna Assembly	**Antenna Gain**	**Operating Mode**	**Sub-band (MHz)**	**Beam forming**	**e.i.r.p. for P_{low}**	**e.i.r.p. for P_{high}**

name	(dBi)			gain(dB)	(dBm)	(dBm)
<Antenna1>		Mode 1	5150 to 5350			
			5470 to 5725			
		Mode 2	5150 to 5350			
			5470 to 5725			
		Mode 3	5150 to 5350			
			5470 to 5725			
<Antenna2>		Mode 1	5150 to 5350			
			5470 to 5725			
		Mode 2	5150 to 5350			
			5470 to 5725			
		Mode 3	5150 to 5350			
			5470 to 5725			
<Antenna3>		Mode 1	5150 to 5350			
			5470 to 5725			
		Mode 2	5150 to 5350			
			5470 to 5725			
		Mode 3	5150 to 5350			
			5470 to 5725			

DFS Threshold level: ...... dBm ☐ at the antenna connector

☐ in front of the antenna

g) For equipment without a TPC range:

Power Setting 1: Applicable Frequency Range:

☑ 5 150 MHz to 5 350 MHz (Indoor)

Simultaneous transmissions in both sub-bands: ☐ Yes ☑ No

☑ 5 470 MHz to 5 725 MHz only (Outdoor only)

Indicate whether the power levels specified are Transmitter Output Power levels or e.i.r.p. levels in case of integrated antenna equipment.

Power levels are specified for: ☐ Tx out ☑ e.i.r.p.

If more than one transmit chain is present (e.g. in the case of smart antenna systems), the power levels below represent the power settings per active transmit chain (and per sub-band in case of simultaneous transmissions).

Table F.5: Maximum Transmitter Output Power for Power Setting 1

Sub-band (MHz)	Operating Mode 1 (dBm)	Operating Mode 2 (dBm)	Operating Mode 3 (dBm)
5150 to 5350			
5470 to 5725			

Beamforming possible: ☐ Yes ☐ No

Intended Antenna Assemblies:

Table G.6: Intended Antenna Assemblies for Power Setting 1

Antenna Assembly name	Antenna Gain (dBi)	Operating Mode	Sub-band (MHz)	Beam forming gain(dB)	e.i.r.p. (dBm)
<Antenna1>		Mode 1	5150 to 5350		
			5470 to 5725		
		Mode 2	5150 to 5350		
			5470 to 5725		
		Mode 3	5150 to 5350		
			5470 to 5725		
<Antenna2>		Mode 1	5150 to 5350		
			5470 to 5725		
		Mode 2	5150 to 5350		
			5470 to 5725		
		Mode 3	5150 to 5350		
			5470 to 5725		
<Antenna3>		Mode 1	5150 to 5350		
			5470 to 5725		
		Mode 2	5150 to 5350		
			5470 to 5725		
		Mode 3	5150 to 5350		
			5470 to 5725		

DFS Threshold level: ...... dBm ☐ at the antenna connector

☐ in front of the antenna

Power Setting 2: Applicable Frequency Range:

☐ 5 150 MHz to 5 350 MHz and 5 470 MHz to 5 725 MHz (Indoor)

Simultaneous transmissions in both sub-bands: ☐ Yes ☐ No

☐ 5 470 MHz to 5 725 MHz only (Outdoor only)

Indicate whether the power levels specified are Transmitter Output Power levels or e.i.r.p. levels in case of integrated antenna equipment

Power levels are specified for: ☐ Tx-out ☐ e.i.r.p.

If more than one transmit chain is present (e.g. in the case of smart antenna systems), the power levels below represent the power settings per active transmit chain (and per sub-band in case of simultaneous transmissions).

Table F.7: Maximum Transmitter Output Power for Power Setting 2

Sub-band (MHz)	Operating Mode 1 (dBm)	Operating Mode 2 (dBm)	Operating Mode 3 (dBm)
5150 to 5350			

5470 to 5725			

Beamforming possible: ☐ Yes ☐ No

Intended Antenna Assemblies:

Table G.8: Intended Antenna Assemblies for Power Setting 2

Antenna Assembly name	Antenna Gain (dBi)	Operating Mode	Sub-band (MHz)	Beam forming gain(dB)	e.i.r.p. (dBm)
<Antenna1>		Mode 1	5150 to 5350		
			5470 to 5725		
		Mode 2	5150 to 5350		
			5470 to 5725		
		Mode 3	5150 to 5350		
			5470 to 5725		
<Antenna2>		Mode 1	5150 to 5350		
			5470 to 5725		
		Mode 2	5150 to 5350		
			5470 to 5725		
		Mode 3	5150 to 5350		
			5470 to 5725		
<Antenna3>		Mode 1	5150 to 5350		
			5470 to 5725		
		Mode 2	5150 to 5350		
			5470 to 5725		
		Mode 3	5150 to 5350		
			5470 to 5725		

DFS Threshold level: ...... dBm ☐ at the antenna connector

☐ in front of the antenna

h) The DFS related operating mode(s) of the equipment:

☐ Master

☐ Slave with radar detection

☑ Slave without radar detection

If the equipment has more than one operating mode, tick all that apply.

i) User access restrictions (please check box below to confirm):

☑ the equipment is constructed to comply with the requirements contained in clause 4.2.9 in ETSI EN 301 893 V2.1.1.

j) For equipment with Off-Channel CAC functionality:

The equipment has an *"Off-Channel CAC"* function: ☐ Yes ☑ No

If yes, specify the *"Off-Channel CAC Time"*

• For channels outside the 5 600 MHz to 5 650 MHz range: .... hours
• If applicable, for channels (partially) within the 5 600 MHz to 5 650 MHz range: .... hours

k) The equipment can operate in ad-hoc mode:

☑ no ad-hoc operation
☐ ad-hoc operation in the frequency range 5 150 MHz to 5 250 MHz without DFS
☐ ad-hoc operation with DFS

If more than 1 is applicable, tick all that apply.

l) Operating Frequency Range(s):

Range 1: ☑ 5 150 MHz to 5 350 MHz
Range 2: ☑ 5 470 MHz to 5 725 MHz
Range 3: ☐ 5 150 MHz to 5 250 MHz (ad-hoc without DFS)
Range 4: ☐ other, please specify

If the equipment has more than one Operating Frequency Range, tick all that apply.

m) The extreme operating temperature and supply voltage range that apply to the equipment:

☐ -20 °C to +55 °C (Outdoor & Indoor usage)
☐ 0 °C to +35 °C (Indoor usage only)
☑ Other: -20 °C to +50 °C

The supply voltages of the stand-alone radio equipment or the supply voltages of the combined (host) equipment or test jig in case of plug-in devices:

Details provided are for the: ☑ stand-alone equipment
☐ combined (or host) equipment
☐ test jig

Supply Voltage ☐AC mains State AC voltage: Minimum: Nominal: .. Maximum: ..
☑DC State DC voltage: Minimum: 3.6V; Nominal: 3.8V; Maximum: 4.4V

In case of DC, indicate the type of power source:

☐ Internal Power Supply
☐ External Power Supply or AC/DC adapter
☑ Battery ☐ Nickel Cadmium
☐ Alkaline
☐ Nickel-Metal Hydride
☐ Lithium-Ion
☐ Lead acid (Vehicle regulated)
☐ Other

n) The test sequence/test software used (see also ETSI EN 301 893 (V2.1.1), clause 5.3.1.2):......

o) Type of Equipment:

☑ Stand-alone
☐ Combined Equipment (Equipment where the radio part is fully integrated within another type of

equipment)

☐ Plug-in radio device (Equipment intended for a variety of host systems)

☐ Other ..

p) Adaptivity (Channel Access Mechanism):

☐ Frame Based Equipment

☑ Load Based Equipment

Specify which protocol has been implemented: ☑ IEEE 802.11™ ☐ Other: ....

q) With regards to Adaptivity for Frame Based Equipment

☐The Frame Based Equipment equipment operates as an Innitiating Device

☐The Frame Based Equipment equipment operates as an Responding Device

☐The Frame Based Equipment equipment can operate as an Innitiating Device and as a Responding Device

The Frame Based Equipment has implemented the following Fixed Frame Period(s):………. ms

r) With regards to Adaptivity for Load Based Equipment

☐The Load Based Equipment equipment operates as a Supervising Device

☑The Load Based Equipment equipment operates as a Supervised Device

☐The Load Based Equipment equipment can operate as a Supervising and as a Supervised Device

☐The Load Based Equipment equipment makes use of note 1 in table 7 or note 1 in table 8 of ETSI EN 301 893 V2.1.1

☐The Load Based Equipment equipment, when operating as a Supervising Device, makes use of note 2 in table 8 of ETSI EN 301 893 V2.1.1

The Priority Classes implemented by the Load Based Equipment

•When operating as a Supervising Device

☐Priority Class 4 (Highest priority)

☐Priority Class 3

☐Priority Class 2

☐Priority Class 1 (Lowest priority)

• When operating as a Supervised Device

☐Priority Class 4 (Highest priority)

☐Priority Class 3

☐Priority Class 2

☐Priority Class 1 (Lowest priority)

☐The Load Based Equipment equipment operates as an Innitiating Device

☐The Load Based Equipment equipment operates as an Responding Device

☐The Load Based Equipment equipment can operate as an Innitiating Device and as a Responding Device

With regard to Energy Detection Threshold, the Load Based Equipment has implemented either option 1 of clause 4.2.7.3.2.5 of ETSI EN 301 893 V2.1.1 or option 2 of clause 4.2.7.3.2.5 of ETSI

EN 301 893 V2.1.1

☐Option 1

☐Option 2

Specify which protocol has been implemented: ☐ IEEE 802.11™ ☐ Other: ....

s) The equipment supports a geo-location capability as defined in clause 4.2.10 of ETSI EN 301 893 V2.1.1:

☑YES ☐NO

t) The minimum performance criteria (see ETSI EN 301 893 V2.1.1, clause 4.2.8.3) that corresponds to the intended use of the equipment.........

u) The theoretical maximum radio performance of the equipment (e.g. maximum throughput) (see ETSI EN 301 893 V2.1.1, clause 5.4.9.3.1)........

2. Additional information provided by the manufacturer

2.1 Modulation

Can the transmitter operate un-modulated? ☐ Yes ☑ No

2.2 Duty Cycle

The transmitter is intended for : ☑ Continuous duty

☐ Intermittent duty

☐ Continuous operation possible for testing purposes

2.3 About the UUT

☑ The equipment submitted are representative production models.

☐ If not, the equipment submitted are pre-production models?

☐ If pre-production equipment are submitted, the final production equipment will be identical in all respects with the equipment tested.

☐ If not, supply full details:.....

2.4 List of ancillary and/or support equipment provided by the Manufacturer

☐ Spare batteries (e.g. for portable equipment)

☑ Battery charging device

☐ External Power Supply or AC/DC adapter

☐ Test Jig or interface box

☑ RF test fixture (for equipment with integrated antennas)

☑ Host System Manufacturer: Shenzhen Chainway Information Technology Co.,Ltd.

Model #: N/A

Model name: C72

☐ Combined equipment Manufacturer: ....

Model #: ....

Model name: ....

☑ User manual

☑ Technical documentation (Handbook and circuit diagrams)

Annex D Testing Laboratory Information

1. Identification of the Responsible Testing Laboratory

Company Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Department:	Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Responsible Test Lab Manager:	Mr. Su Feng
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

3. Test Equipments Utilized

3.1 EN300328 Test system

Description	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Base Station	Anritsu	MT8852B	6K00006210	2017.05.24	2018.05.23
Temperature Chamber	CHONGQING HANBA EXPERIMENTAL EQUIPMENT CO.,LTD	HUT705P	(N/A.)	2017.05.24	2018.05.23
Power Splitter	Mini-Circuits	ZFRSC-183+	SF808201417	2017.05.24	2018.05.23
DC Power Supply	Good Will Instrument Co.,Ltd.	(N/A)	(N/A)	2017.05.24	2018.05.23
Attenuator 1	Resnet	20dB	(N/A)	2017.05.24	2018.05.23
MXG Vector Signal Generator	Angilent	N5182B	MY53050961	2017.05.24	2018.05.23
EXG Analog Signal Generator	Angilent	N5171B	MY53050558	2017.05.24	2018.05.23
EXA Signal analyzer	Angilent	N9010A	MY53470836	2017.12.02	2018.12.01
USB Power Sensor	Angilent	U2021XA	MY54210011	2017.05.24	2018.05.23

3.2 List of Software Used

Description	Manufacturer	Software Version
Test system	Tonscend	V2.6
Power Panel	Agilent	V3.8

3.3 RSE Test System

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
MXE EMI Receiver	MY54130016	N9038A	Agilent	2017.05.17	2018.05.16
Test Antenna - Bi-Log	9163-519	VULB 9163	Schwarzbeck	2017.05.14	2018.05.13
Test Antenna - Horn	01774	BBHA 9120D	Schwarzbeck	2017.09.13	2018.09.12
Anechoic Chamber	N/A	9m*6m*6m	CRT	2017.11.19	2020.11.18

END OF REPORT