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Harmonized European Standard (Telecommunications series)

**Broadband Radio Access Networks (BRAN);
5 GHz high performance RLAN;
Harmonized EN covering essential requirements
of article 3.2 of the R&TTE Directive**

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Foreword

This Harmonized European Standard (Telecommunications series) has been produced by ETSI Technical Committee Broadband Radio Access Networks (BRAN).

The present document has been produced by ETSI in response to a mandate from the European Commission issued under Council Directive 98/34/EC (as amended) laying down a procedure for the provision of information in the field of technical standards and regulations.

The present document is intended to become a Harmonized Standard, the reference of which will be published in the Official Journal of the European Communities referencing the Directive 1999/5/EC [1] of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity ("the R&TTE Directive").

National transposition dates	
Date of adoption of this EN:	29 June 2007
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Introduction

The present document is part of a set of standards developed by ETSI and is designed to fit in a modular structure to cover all radio and telecommunications terminal equipment within the scope of the R&TTE Directive. The modular structure is shown in EG 201 399 [7].

1 Scope

The present document applies to 5 GHz high performance RLAN equipment which is used in wireless local area networks. Such networks provide high speed data communications in between devices connected to the wireless infrastructure. The present document also applies to ad-hoc networking where these devices communicate directly with each other, without the use of a wireless infrastructure. The equipment uses a medium access protocol designed to facilitate spectrum sharing with other devices in the wireless network.

5 GHz high performance RLAN equipment covered by the present document is operated in accordance with the ECC Decision (04)08 [5] and the Commission Decision 2005/513/EC [6]. The equipment is intended to operate in the frequency ranges 5 150 MHz to 5 350 MHz and 5 470 MHz to 5 725 MHz.

The present document is intended to cover the provisions of article 3.2 of R&TTE Directive [1], which states that: "…radio equipment shall be so constructed that it effectively uses the spectrum allocated to terrestrial/space radio communications and orbital resources so as to avoid harmful interference".

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

[1] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).

[2] ETSI TR 100 028-1 V1.4.1 (2001-12): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1".

[3] ETSI TR 100 028-2 V1.4.1 (2001-12): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2".

[4] CISPR 16-1-1 (2006-11) Ed. 2.1 Consolidated Edition: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus".

[5] CEPT ECC/DEC(04)08: "ECC Decision of 12 November 2004 on the harmonised use of the 5 GHz frequency bands for the implementation of Wireless Access Systems including Radio Local Area Networks (WAS/RLANs)".

[6] Commission Decision 2005/513/EC of 11 July 2005 on the harmonised use of radio spectrum in the 5 GHz frequency band for the implementation of wireless access systems including radio local area networks (WAS/RLANs).

[7] ETSI EG 201 399 V2.1.1 (2005-12): "Electromagnetic compatibility and Radio spectrum Matters (ERM); A guide to the production of candidate Harmonized Standards for application under the R&TTE Directive".

[8] IEEE 802.11a-1999 [ISO/IEC 8802-11:1999/Amd 1:2000(E)] (Supplement to IEEE Std 802.11, 1999 Edition): "Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: High-speed Physical Layer in the 5 GHz Band".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in the R&TTE Directive [1] and the following apply:

5 GHz RLAN bands: total frequency range that consists of 2 sub-bands:

- 5 150 MHz to 5 350 MHz; and
- 5 470 MHz to 5 725 MHz.

ad-hoc mode: operating mode in which an RLAN device establishes a temporary wireless connection with other RLAN devices without a controlling network infrastructure

antenna array: two or more antennas connected to a single device and operating simultaneously

Available Channel: channel identified as available for use as an *Operating Channel* without having to perform a *Channel Availability Check* first

beam forming gain: additional (antenna) gain realized by using beam forming techniques in smart antenna systems

NOTE: Beam forming gain as used in the present document, does not include the gain of the antenna assembly.

burst: period during which radio waves are intentionally transmitted, preceded and succeeded by periods during which no intentional transmission is made

channel: amount of spectrum used by a single RLAN device operating on one of the declared centre frequencies

channel plan: the combination of the centre frequencies and for each of the centre frequencies, the declared nominal bandwidth(s)

combined equipment: any combination of non-radio equipment that requires a plug-in radio device to offer full functionality

dedicated antenna: antenna external to the equipment, using an antenna connector with a cable or a wave-guide and which has been designed or developed for one or more specific types of equipment

NOTE: It is the combination of dedicated antenna and radio equipment that is expected to be compliant with the regulations.

environmental profile: range of environmental conditions under which equipment within the scope of the present document is required to comply with the provisions of the present document

host equipment: any equipment which has complete user functionality when not connected to the radio equipment part and to which the radio equipment part provides additional functionality and to which connection is necessary for the radio equipment part to offer functionality

integral antenna: antenna designed as a fixed part of the equipment, without the use of an external connector and as such which can not be disconnected from the equipment by a user with the intent to connect another antenna

NOTE: An integral antenna may be fitted internally or externally. In the case where the antenna is external, a non-detachable cable or wave-guide can be used.

master mode: mode which relates to the DFS functionality where the RLAN device uses a Radar Interference Detection function and controls the transmissions of RLAN devices operating in slave mode

NOTE: In this mode it is able to select a channel and initiate a network by sending enabling signals to other RLAN devices. 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.

multi-radio equipment: radio, host or combined equipment using more than one radio transceiver

Operating Channel: *Available Channel* on which the RLAN has started transmissions

NOTE: An *Operating Channel* becomes again an *Available Channel* if the RLAN stopped all transmissions on that channel and no radar signal was detected by the *In-Service Monitoring*.

plug-in radio device: radio equipment module intended to be used with or within host, combined or multi-radio equipment, using their control functions and power supply

receive chain: receiver circuit with an associated antenna

NOTE: Two or more receive chains are combined in a smart antenna system.

simulated radar burst: series of periodic radio wave pulses for test purposes

slave mode: mode which relates to the DFS functionality where the transmissions of the RLAN are under control of a RLAN device operating in master mode

NOTE: An RLAN device in slave mode may use a Radar Interference Detection function.

smart antenna systems: equipment that combines multiple transmit and/or receive chains with a signal processing function to increase the throughput and/or to optimize its radiation and/or reception capabilities

NOTE: E.g. techniques such as spatial multiplexing, beam forming, cyclic delay diversity, MIMO, etc.

stand-alone radio equipment: equipment that is intended primarily as communications equipment and that is normally used on a stand-alone basis

transmit chain: transmitter circuit with an associated antenna

NOTE: Two or more transmit chains are combined in a smart antenna system.

Transmit Power Control (TPC): technique in which the transmitter output power is controlled resulting in reduced interference to other systems

Unavailable Channel: channel which can not be considered by the RLAN device for a certain period of time *(Non-Occupancy Period)* after a radar signal was detected on that channel

Usable Channel: any channel from the declared channel plan, which can be considered by the RLAN for possible use, unless it is precluded by either:

1) the intended outdoor usage of the RLAN; or

2) previous detection of a radar on the channel (*Unavailable 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.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

A	Measured power output
B	Radar burst period
Ch_f	Channel free from radars
Ch_r	Channel occupied by a radar
D	Measured power density
E	Field strength
E_o	Reference field strength
f_c	Carrier frequency
G	Antenna gain
L	Radar burst length
n	Number of channels
P_H	Calculated EIRP at highest power level
P_L	Calculated EIRP at lowest power level
PD	Calculated power density
P_d	Detection Probability
R	Distance
R_o	Reference distance
S0	Signal power
T0	Time instant
T1	Time instant
T2	Time instant
T3	Time instant
W	Radar pulse width
x	Observed duty cycle
Y	Beam forming (antenna) gain

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

CSD	Cyclic Shift Diversity
CISPR	International Special Committee on Radio Interference (Comité International Spécial des Perturbations Radioélectriques)
dB/div	dB per division
DFS	Dynamic Frequency Selection
EIRP	Equivalent Isotropically Radiated Power
EMC	Electro-Magnetic Compatibility
ERP	Effective Radiated Power
HT20	High Throughput in a 20 MHz channel
HT40	High Throughput in a 40 MHz channel
IEEE	Institute of Electrical and Electronic Engineers
MCS	Modulation Coding Scheme
PPB	Pulses Per Burst
ppm	parts per million
PRF	Pulse Repetition Frequency
PSD	Power Spectral Density
R&TTE	Radio and Telecommunications Terminal Equipment
RF	Radio Frequency
RLAN	Radio Local Area Network
TPC	Transmit Power Control
Tx	Transmit, Transmitter
UUT	Unit Under Test

4 Technical requirements specifications

4.1 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be stated by the manufacturer.

The equipment shall comply in any of the operating modes with all the technical requirements of the present document at all times when operating within the boundary limits of the stated operational environmental profile.

4.2 Centre frequencies

4.2.1 Definition

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

4.2.2 Limits

The actual centre frequency for any given channel declared by the manufacturer shall be maintained within the range $f_c \pm 20$ ppm.

4.2.3 Conformance

Conformance tests as defined in clause 5.3.2 shall be carried out.

4.3 Nominal Channel Bandwidth and Occupied Channel Bandwidth

4.3.1 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 frequency bandwidth of the signal power at the -6 dBc points when measured with a 100 kHz resolution bandwidth.

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

4.3.2 Limits

The nominal bandwidth shall be in the range from 10 MHz to 40 MHz.

The occupied channel bandwidth shall be between 80 % and 100 % of the declared nominal channel bandwidth. In case of smart antenna systems (devices with multiple transmit chains) each of the transmit chains shall meet this requirement.

NOTE: The limit for occupied bandwidth is not applicable for devices with a nominal bandwidth of 40 MHz when temporarily operating in a mode in which they transmit only in the upper or lower 20 MHz part of a 40 MHz channel. (e.g. to transmit a packet in the upper or lower 20 MHz part of a 40 MHz channel).

4.3.3 Conformance

Conformance tests as defined in clause 5.3.3 shall be carried out to determine the occupied channel bandwidth.

4.4 RF output power, Transmit Power Control (TPC) and power density

4.4.1 Definitions

4.4.1.1 RF output power

The RF output power is the mean equivalent isotropically radiated power (EIRP) during a transmission burst.

4.4.1.2 Transmit Power Control (TPC)

Transmit Power Control (TPC) is a mechanism to be used by the UUT to ensure a mitigation factor of at least 3 dB on the aggregate power from a large number of devices. This requires the UUT to have a TPC range from which the lowest value is at least 6 dB below the values for mean EIRP given in table 1.

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

4.4.1.3 Power density

The power density is the mean Equivalent Isotropically Radiated Power (EIRP) density during a transmission burst.

4.4.2 Limits

The limits below are applicable to the system as a whole and in any possible configuration. This includes smart antenna systems (devices with multiple transmit chains).

4.4.2.1 RF output power and power density at the highest power level

For devices with TPC, the RF output power and the power density when configured to operate at the highest stated power level of the TPC range shall not exceed the levels given in table 1.

For devices without TPC, the limits in table 1 shall be reduced by 3 dB, except when operating on channels whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz.

Table 1: Mean EIRP limits for RF output power and power density at the highest power level

Frequency range	Mean EIRP limit	Mean EIRP density limit
5 150 MHz to 5 350 MHz	23 dBm	10 dBm/MHz
5 470 MHz to 5 725 MHz	30 dBm (see note)	17 dBm/MHz (see note)
NOTE: For Slave devices without a Radar Interference Detection function the mean EIRP shall be less than 23 dBm and the mean EIRP density shall be less than 10 dBm/MHz.		

4.4.2.2 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 2.

Table 2: Mean EIRP limits for RF output power at the lowest power level of the TPC range

Frequency range	Mean EIRP
5 250 MHz to 5 350 MHz	17 dBm
5 470 MHz to 5 725 MHz	24 dBm (see note)
NOTE: For Slave devices without a Radar Interference Detection function the mean EIRP shall be less than 17 dBm.	

The limits in table 2 do not apply for devices without TPC or when operating on channels whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz.

4.4.3 Conformance

Conformance tests as defined in clause 5.3.4 shall be carried out.

4.5 Transmitter unwanted emissions

4.5.1 Transmitter unwanted emissions outside the 5 GHz RLAN bands

4.5.1.1 Definition

These are radio frequency emissions outside the 5 GHz RLAN bands.

4.5.1.2 Limits

The level of unwanted emission shall not exceed the limits given in table 3.

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

Frequency range	Maximum power, ERP	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87,5 MHz	-36 dBm	100 kHz
87,5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 862 MHz	-54 dBm	100 kHz
862 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 5,15 GHz	-30 dBm	1 MHz
5,35 GHz to 5,47 GHz	-30 dBm	1 MHz
5,725 GHz to 26 GHz	-30 dBm	1 MHz

4.5.1.3 Conformance

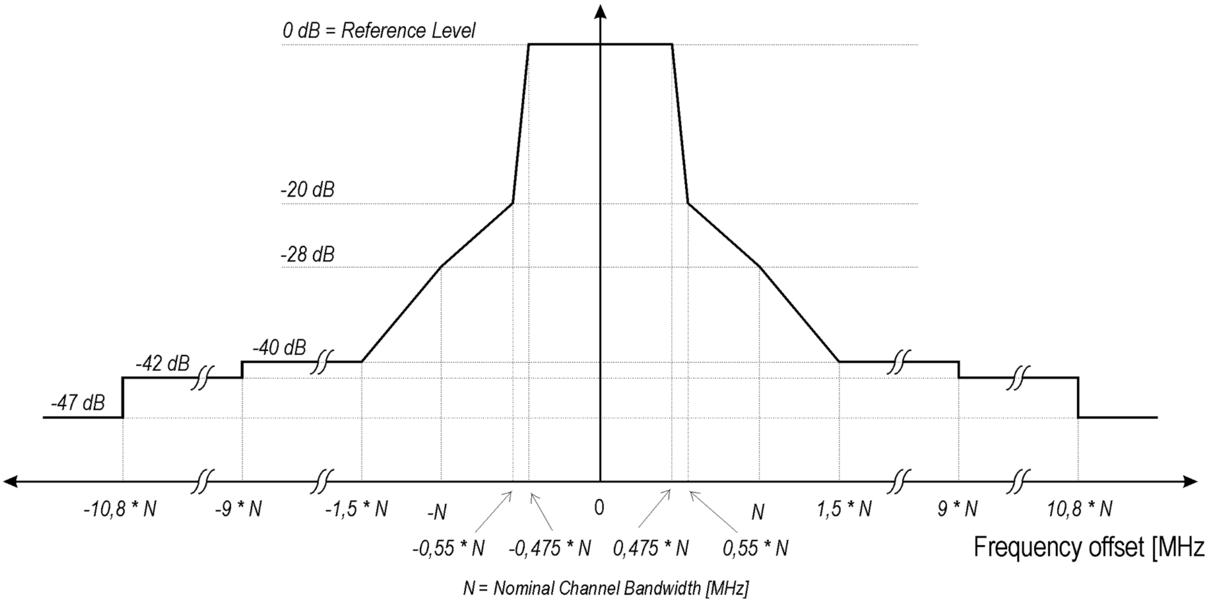
Conformance tests as defined in clause 5.3.5 shall be carried out.

4.5.2 Transmitter unwanted emissions within the 5 GHz RLAN bands

4.5.2.1 Definition

These are radio frequency emissions within the 5 GHz RLAN bands.

4.5.2.2 Limits



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

Figure 1: Transmit spectral power mask

The average level of transmitter unwanted emissions within the 5 GHz RLAN bands shall not exceed the limit of the mask provided in figure 1 or the limit for unwanted emissions provided in table 3, whichever is the higher.

NOTE: The mask is only applicable within the band of operation. Beyond the band edges the requirements of clause 4.5.1 apply.

In case of smart antenna systems (devices with multiple transmit chains) each of the transmit chains shall meet this requirement.

4.5.2.3 Conformance

Conformance tests as defined in clause 5.3.6 shall be carried out.

4.6 Receiver spurious emissions

4.6.1 Definition

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

4.6.2 Limits

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

Table 4: Spurious radiated emission limits

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

4.6.3 Conformance

Conformance tests as defined in clause 5.3.7 shall be carried out.

4.7 Dynamic Frequency Selection (DFS)

4.7.1 Introduction

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

- detect interference from other systems and to avoid co-channel operation with these systems, notably radar systems (radar detection);
- provide on aggregate a uniform loading of the spectrum across all devices.

Radar detection is required 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 and to any type of communication between these devices.

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

4.7.1.1 DFS operational modes

Within the context of the operation of the DFS function, an RLAN device shall operate in either master mode or slave mode. RLAN devices operating in slave mode (slave device) shall only operate in a network controlled by a RLAN device operating in master mode (master device).

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

4.7.1.2 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.

b) Before initiating a network on a channel, which has not been identified as an *Available Channel*, the master device shall perform a *Channel Availability Check* to ensure that there is no radar operating on the channel.

c) During normal operation, the master device shall monitor the O*perating Channel (In-Service Monitoring)* to ensure that there is no radar operating on the channel.

d) If the master device has detected a radar signal during *In-Service Monitoring*, the *Operating Channel* is made unavailable. The master device shall instruct all its associated slave devices to stop transmitting on this (to become unavailable) channel.

e) The master device shall not resume any transmissions on this *Unavailable Channel* during a period of time after a radar signal was detected. This period is referred as the *Non-Occupancy Period.*

Slave devices:

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

g) A slave device shall stop all its transmissions whenever instructed by a master device to which it is associated. The device shall not resume any transmissions until it has again received an appropriate enabling signal from a master device.

h) A slave device which is required to perform radar detection (see table D.3), shall stop its own transmissions if it has detected a radar. The *Operating Channel* is made unavailable 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.*

See table 5 in clause 4.7.2 for the applicability of DFS requirements for each of the above mentioned operational modes.

The master device may implement the Radar Interference Detection function referred to under a) using another device associated with the master. In such a case, the combination shall be tested against the requirements applicable to the master.

The maximum power level of a slave device will define whether or not the device needs to have a Radar Interference Detection function. (see table D.3)

4.7.2 DFS technical requirements specifications

Table 5 lists the DFS related technical requirements and their applicability for each of the operational modes described in clause 4.7.1. If the RLAN device is capable of operating in more than one operational mode described in clause 4.7.1 then each operating mode shall be assessed separately.

Table 5: Applicability of DFS requirements

Requirement	DFS Operational mode		
	Master	**Slave without radar detection** (see table D.3)	**Slave with radar detection** (see table D.3)
Channel Availability Check	✓	Not required	Not required
In-Service Monitoring	✓	Not required	✓
Channel Shutdown	✓	✓	✓
Non-Occupancy Period	✓	Not required	✓
Uniform Spreading	✓	Not required	Not required

4.7.2.1 Channel Availability Check

4.7.2.1.1 Definition

The *Channel Availability Check* is defined as the mechanism by which an RLAN device checks a channel for the presence of radar signals.

There shall be no transmissions by the device within the channel being checked during this process.

If no radars have been detected, the channel becomes an *Available Channel* valid for a period of time.

The RLAN shall only start transmissions on *Available Channels*.

At power-up, the RLAN is assumed to have no *Available Channels*.

4.7.2.1.2 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 shall be capable of detecting any of the radar signals that fall within the range given by table D.4 with a level above the *Interference Detection Threshold* defined in tables D.2 and D.3.

The detection probability for a given radar signal shall be greater than the value defined in table D.4.

Available channels remain valid for a maximum period of 24 hours.

4.7.2.1.3 Conformance

Conformance tests for this requirement are defined in clause 5.3.8.

4.7.2.2 In-Service Monitoring

4.7.2.2.1 Definition

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

4.7.2.2.2 Limit

The *In-Service Monitoring* shall be used to continuously monitor an *Operating Channel*.

The *In-Service-Monitoring* shall start immediately after the RLAN has started transmissions on an *Operating Channel*.

During the *In-Service Monitoring*, the RLAN shall be capable of detecting any of the radar signals that fall within the range given by table D.4 with a level above the *Interference Detection Threshold* defined in tables D.2 and D.3.

The detection probability for a given radar signal shall be greater than the value defined in table D.4.

4.7.2.2.3 Conformance

Conformance tests for this requirement are defined in clause 5.3.8.

4.7.2.3 Channel Shutdown

4.7.2.3.1 Definition

The *Channel Shutdown* is defined as the process initiated by the RLAN device immediately after a radar signal has been detected on an *Operating 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 within the *Channel Move Time*.

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.

4.7.2.3.2 Limit

The *Channel Shutdown* process shall start immediately after a radar signal has been detected.

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.

4.7.2.3.3 Conformance

Conformance tests for this requirement are defined in clause 5.3.8.

4.7.2.4 Non-Occupancy Period

4.7.2.4.1 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 by either the *Channel Availability Check* or the *In-Service Monitoring*.

NOTE: A new *Channel Availability Check* is required before the channel can be identified again as an *Available Channel*.

4.7.2.4.2 Limit

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

4.7.2.4.3 Conformance

Conformance tests for this requirement are defined in clause 5.3.8.

4.7.2.5 Uniform Spreading

4.7.2.5.1 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.

This requires that a RLAN device shall select a channel out of the list of *Usable Channels* so that the probability of selecting a given channel shall be the same for all channels.

When implementing a frequency re-use plan across a planned network, the selection of the *Operating Channel* may be under control of the network.

4.7.2.5.2 Limit

Each of the declared channel plans (combination of centre frequencies and declared nominal bandwidths) shall make use of at least 80 % of the spectrum available in the applicable sub-band(s).

The probability of selecting each of the *Usable Channels* shall be within 10 % of the theoretical probability. For "n" *Usable Channels*, the theoretical probability is 1/n.

4.8 Medium Access Protocol

4.8.1 Definition

A medium access protocol is a mechanism designed to facilitate spectrum sharing with other devices in the wireless network.

4.8.2 Requirement

A medium access protocol shall be implemented by the equipment and shall be active under all circumstances.

4.9 User Access Restrictions

4.9.1 Definition

User Access Restrictions are restraints implemented in the RLAN to restrict access for the user to certain hardware and/or software settings of the equipment.

4.9.2 Requirement

DFS controls (hardware or software) related to radar detection shall not be accessible to the user so that the DFS requirements described in clauses 4.7.2.1 to 4.7.2.4 can neither be disabled nor altered.

5 Testing for compliance with technical requirements

5.1 Conditions for testing

5.1.1 Normal and extreme test conditions

Unless otherwise stated in the test procedures for essential radio test suites (see clause 5.3), the tests defined in the present document shall be carried out at representative points within the boundary limits of the declared operational environmental profile (see clause 5.3.1 k)).

Where technical performance varies subject to environmental conditions, tests shall be carried out under a sufficient variety of environmental conditions (within the boundary limits of the declared operational environmental profile) to give confidence of compliance for the affected technical requirements.

5.1.2 Test sequences and traffic load

5.1.2.1 General test transmission sequences

Except for the DFS tests or if mentioned otherwise, all the tests in the present document shall be performed by using a test transmission sequence that shall consist of regularly transmitted packets with an interval of e.g. 2 ms. The test transmissions shall be fixed in length in a sequence and shall exceed the transmitter minimum activity ratio of 10 %. The minimum duration of the sequence shall be adequate for the test purposes.

The general structure of the test transmission sequence is shown in figure 2.

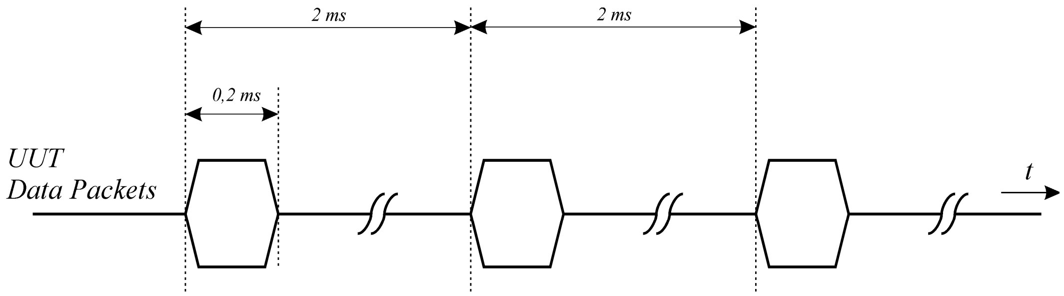


Figure 2: General structure of the test transmission sequences

5.1.2.2 Test transmission sequences for DFS tests

The DFS tests in the present document shall be performed by using a test transmission sequence that shall consist of packet transmissions that together exceed the transmitter minimum activity ratio of 30 % measured over an interval of 100 ms. The duration of the sequence shall be adequate for the DFS test purposes.

5.1.3 Test frequencies

Table 6 contains the test frequencies to be used for testing.

Table 6: Test frequencies

Test	**Clause**	**Test frequencies (MHz)**		
		Lower sub-band (5 150 MHz to 5 350 MHz)		**Higher sub-band 5 470 MHz to 5 725 MHz**
		5 150 MHz to 5 250 MHz	**5 250 MHz to 5 350 MHz**	
Centre frequencies	5.3.2	F1	F2	F3, F4
Occupied Channel Bandwidth	5.3.3	F1 (note 1)	F2 (note 1)	F3, F4 (note 1)
Power, power density	5.3.4	F1 (note 1)	F2 (note 1)	F3, F4 (note 1)
Transmitter unwanted emissions	5.3.5 and 5.3.6	F1 (note 1)	F2 (note 1)	F3, F4 (note 1)
Receiver spurious emissions	5.3.7	F1 (note 2)	F2 (note 2)	F3, F4 (note 2)
Transmit Power Control (TPC)	5.3.4	n.a. (note 3)	F2 (note 2)	F3, F4 (note 2)
Dynamic Frequency Selection (DFS)	5.3.8	n.a. (note 4)	F5	F6

F1, F3 The centre frequency of the lowest declared channel for every declared nominal bandwidth within this band.
F2, F4: The centre frequency of the highest declared channel for every declared nominal bandwidth within this band.
F5, F6: The centre frequency of one channel out of the declared channels for this frequency range. If more than one nominal bandwidth has been declared, the widest shall be used.
NOTE 1: Testing shall be repeated for each declared nominal bandwidth.
NOTE 2: In case of more than 1 channel plan has been declared, testing should be performed only according to one of the declared channel plans.
NOTE 3: TPC is not required for channels whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz. If that is not the case, TPC shall be tested at the centre frequencies of one of those relevant channels.
NOTE 4: Testing not required, unless the combination of a centre frequency and a corresponding nominal bandwidth results in operation in 5 250 MHz to 5 350 MHz.

5.1.4 Antennas

5.1.4.1 Integrated and dedicated antennas

The equipment can have either integral antennas or dedicated antennas. Dedicated antennas, further referred to as *dedicated external antennas*, are antennas that are physically external to the equipment and are assessed in combination with the equipment against the requirements in the present document.

NOTE: It should be noted that assessment does not necessarily lead to testing.

An antenna assembly referred to in the present document is understood as the combination of the antenna (integral or dedicated), its coaxial cable and if applicable, its antenna connector and associated switching components. The gain of an antenna assembly (G) in dBi, does not include the additional gain that may result out of beam forming.

Smart antenna systems may use beam forming techniques which may result in additional (antenna) gain. This beam forming gain (Y) is specified in dB. Beam forming gain does not include the gain of the antenna assembly (G).

Although the measurement methods in the present document allow conducted measurements to be performed, it should be noted that the equipment together with all its intended antenna assemblies shall comply with the applicable technical requirements defined in the present document.

5.1.4.2 Transmit operating modes

5.1.4.2.1 Operating mode 1 (single antenna)

The equipment uses only 1 antenna when operating in this mode.

The following types of equipment and/or operating modes are examples covered by this category:

- Equipment with only one antenna.
- Equipment with 2 diversity antennas but at any moment in time only 1 antenna is used.
- Smart antenna system with 2 or more antennas, but operating in a mode where only 1 antenna is used.

5.1.4.2.2 Operating mode 2 (multiple antennas, no beam forming)

The equipment that can operate in this mode contains a smart antenna system using two or more transmit chains simultaneously but without beam forming.

5.1.4.2.3 Operating mode 3 (multiple antennas, with beam forming)

The equipment that can operate in this mode contains a smart antenna system using two or more transmit chains simultaneously with beam forming.

In addition to the antenna assembly gain (G), the beam forming gain (Y) may have to be taken into account when performing the measurements described in the present document.

5.1.5 Presentation of equipment

5.1.5.1 Testing of host connected equipment and plug-in radio devices

For combined equipment and for radio parts for which connection to or integration with host equipment is required to offer functionality to the radio, different alternative test approaches are permitted. Where more than one such combination is intended, testing shall not be repeated for combinations of the radio part and various host equipment where the latter are substantially similar.

Where more than one such combination is intended and the combinations are not substantially similar, one combination shall be tested against all requirements of the present document and all other combinations shall be tested separately for radiated spurious emissions only.

5.1.5.1.1 The use of a host or test jig for testing plug-in radio devices

Where the radio part is a plug-in radio device which is intended to be used within a variety of combinations, a suitable test configuration consisting of either a test jig or a typical host equipment shall be used. This shall be representative for the range of combinations in which the device may be used. The test jig shall allow the radio equipment part to be powered and stimulated as if connected to or inserted into host or combined equipment. Measurements shall be made to all requirements of the present document.

5.1.5.1.2 Testing of combinations

5.1.5.1.2.1 Alternative A: General approach for combinations

Combined equipment or a combination of a plug-in radio device and a specific type of host equipment may be used for testing according to the full requirements of the present document.

5.1.5.1.2.2 Alternative B: For host equipment with a plug-in radio device

A combination of a plug-in radio device and a specific type of host equipment may be used for testing according to the full requirements of the present document.

For radiated spurious emission tests the most appropriate standard shall be applied to the host equipment. The plug-in radio device shall meet the radiated spurious emissions requirements as described in the present document.

5.1.5.1.2.3 Alternative C: For combined equipment with a plug-in radio device

Combined equipment may be used for testing according to the full requirements of the present document.

For radiated spurious emissions the requirements of the most appropriate harmonized EMC standard shall be applied to the non-radio equipment. The plug-in radio device shall meet the radiated spurious emissions requirements as described in the present document.

In the case where the plug-in radio device is totally integrated and cannot operate independently, radiated spurious emissions for the combination shall be tested using the most appropriate harmonized standard with the radio part in receive and/or standby mode. If the frequency range is less then the one defined in the present document, additional measurements according to the requirements in the present document shall be performed to cover the remaining parts of the frequency range. With the radio in transmit mode, the radiated spurious emissions requirements of the present document shall be applied.

5.1.5.1.2.4 Alternative D: For equipment with multiple radios

Multi-radio equipment, where at least one of the radio parts is within the scope of the present document, may be used for testing according to the full requirements of the present document. Additional requirements and limits for multi-radio equipment are set out in the relevant harmonized radio product standards applicable to the other radio parts.

When measuring spurious emissions in the receive and/or standby mode, it is essential that none of the transmitters within the combined equipment are transmitting.

5.1.5.1.2.4.1 The spurious emissions from each radio can be identified

Where the spurious emissions from each radio can be identified, then the spurious emissions from each radio are assessed to the relevant harmonized radio standard.

5.1.5.1.2.4.2 The spurious emissions from each radio cannot be identified

Where the spurious emissions from each radio cannot be identified, then the combined equipment is assessed to the spurious emission requirements contained in all of the relevant harmonized radio standards applicable to the radios contained within the combined product.

Where the applicable harmonized radio standards contain different limits and measuring conditions, then the combined product is assessed to the harmonized radio standard that specifies the least stringent limits for the common part of the frequency measurement ranges. To assess the remaining parts of the frequency measurement ranges the limits from the relevant harmonized radio standard should be used.

5.2 Interpretation of the measurement results

The interpretation of the results recorded in a test report for the measurements described in the present document shall be as follows:

- The measured value related to the corresponding limit will be used to decide whether an equipment meets the requirements of the present document.
- The value of the measurement uncertainty for the measurement of each parameter shall be included in the test report.
- The recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures in table 7.
- The shared risk approach shall be applied for the interpreting of all measurement results.

For the test methods to determine RF power levels, according to the present document, the measurement uncertainty figures shall be calculated in accordance with TR 100 028-1 [2] and TR 100 028-2 [3] and shall correspond to an expansion factor (coverage factor) k = 1,96 or k = 2 (which provide confidence levels of respectively 95 % and 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

Table 7 is based on such expansion factors.

Table 7: Maximum measurement uncertainty

Parameter	Uncertainty
RF frequency	$\pm 1 \times 10^{-5}$
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 %

5.3 Essential radio test suites

5.3.1 Product information

The following information shall be stated by the manufacturer in order to carry out the test suites and/or to declare compliance to technical requirements (e.g. technical requirements for which no conformance test is included in the present document):

a) The channel plan(s), being the centre frequencies and associated nominal channel bandwidth(s).

b) The different transmit operating modes in which the equipment can operate (see clause 5.1.4.2).

c) For each of the modes declared under b) the following shall be provided:

- the number of transmit chains;
- if more than 1 transmit chain is active, whether the power is distributed equally or not;
- the number of receive chains;
- whether or not antenna beam forming is implemented, and if so the maximum beam forming gain (Y) for this transmit operating mode.

d) Whether or not the device has a TPC feature containing one or more TPC ranges.

NOTE: The equipment can have more than one TPC range to accommodate different antennas and/or the different applicable power limits.

e) For devices with a TPC feature, for each TPC range:

- The lowest and highest transmitter output power level (or lowest and highest EIRP level in case of integrated antenna equipment).

NOTE 1: In case of smart antenna systems with different transmit operating modes (see clause 5.1.4.2) the transmitter power levels may differ depending on the transmitter operating mode.

- ▪ The intended antenna assembly(ies), their corresponding gain(s) (G), the resulting EIRP values (taking also into account the beam forming gain (Y) if applicable) and the corresponding DFS threshold level(s).
- ▪ The applicable operating frequency range(s).

f) For devices operating in a mode without a TPC feature:

- The maximum transmitter output power level (or maximum EIRP level in case of integrated antenna equipment).

NOTE 2: In case of smart antenna systems with different transmitter operating modes (see clause 5.1.4) the transmitter output power levels may differ depending on the operating mode.

- The intended antenna assembly(ies), their corresponding gain(s) (G), the resulting EIRP values (taking also into account the beam forming gain (Y) if applicable) and the corresponding DFS threshold level(s).
- The applicable operating frequency range(s).

NOTE 3: The manufacturer may decide to declare that his equipment can operate with and without a TPC feature in which case he may provide details in response to both clause e) and f).

g) With regard to DFS, the DFS operational modes in which the equipment can operate (master, slave with radar detection, slave without radar detection).

h) With regard to DFS, to confirm that the DFS controls (hardware or software) related to radar detection have been made inaccessible to the user (see clause 4.9).

i) Whether or not the device can operate in ad-hoc mode, and if so, the operating frequency range when operating in ad-hoc mode.

j) The operating frequency range(s) of the equipment.

k) The normal and the extreme operating conditions (e.g. voltage and temperature) that apply to the equipment.

l) The test sequence(s) used by the UUT.

m) Type of Equipment, for example: stand-alone equipment, plug-in radio device, combined equipment, etc..

n) The medium access protocol implemented by the UUT.

5.3.2 Carrier frequencies

5.3.2.1 Test conditions

These measurements shall be performed under both normal and extreme test conditions (see clause 5.1.1).

The frequencies at which the conformance requirements in clause 4.2 shall be verified are defined in clause 5.1.3.

The measurements described in the present clause may need to be repeated to cover each of the channel plans declared by the manufacturer (see clause 5.3.1.a)).

The UUT shall be configured to operate at a normal RF power output level.

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.

5.3.2.2 Test methods

5.3.2.2.1 Conducted measurement

5.3.2.2.1.1 Equipment operating without modulation

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

The UUT shall be connected to a frequency counter and operated in an unmodulated mode. The result shall be recorded.

5.3.2.2.1.2 Equipment operating with modulation

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

The UUT shall be connected to spectrum analyser.

The settings of the spectrum analyser shall be adjusted to optimize the instruments frequency accuracy.

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.

5.3.2.2.2 Radiated measurement

The test set up as described in annex B shall be used with a spectrum analyser of sufficient accuracy attached to the test antenna (see clause 5.2).

The test procedure is as described under clause 5.3.2.2.1.

5.3.3 Occupied Channel Bandwidth

5.3.3.1 Test conditions

The conformance requirements in clause 4.3 shall be verified only under normal operating conditions, and at those carrier centre frequencies defined in clause 5.1.3.

The measurements described in the present clause may need to be repeated to cover each of the channel plans declared by the manufacturer (see clause 5.3.1.a)).

The measurements shall be performed using normal operation of the equipment with the test signal applied (see clause 5.1.2.1).

The UUT shall be configured to operate at a normal RF power output level.

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.

5.3.3.2 Test method

5.3.3.2.1 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 BW: 100 kHz
- Video BW: 100 kHz

- Frequency Span: 2 x 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, capture the trace, for example using the 'View' option on the spectrum analyser.

Find the peak value of the trace and place the analyser marker on this peak.

Step 3:

Use a second marker of the spectrum analyser and find the frequency below the operating frequency at which the level is 6 dB below the level of the 1st marker. This frequency shall be recorded as f_L.

Step 4:

Use a third marker of the spectrum analyser and find the frequency above the operating frequency at which the level is 6 dB below the level of the 1st marker. This frequency shall be recorded as f_H.

Step 5:

The difference between the frequencies measured (f_H - f_L) is the Occupied Channel Bandwidth which shall be recorded.

5.3.3.2.2 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 5.3.3.2.1.

5.3.4 RF output power, Transmit Power Control (TPC) and power density

5.3.4.1 Test conditions

The conformance requirements in clause 4.4 shall be verified at those carrier centre frequencies defined in clause 5.1.3.

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 clauses 5.3.1.e and 5.3.1.f);
- each of the transmit operating modes declared by the manufacturer (see clauses 5.3.1.b and 5.1.4.2).

The measurements shall be performed using normal operation of the equipment with test signal applied (see clause 5.1.2.1).

NOTE: Special test functions may be needed in the UUT to make this test possible.

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).

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

5.3.4.2 Test method

5.3.4.2.1 Conducted measurement

5.3.4.2.1.1 RF output power at the highest power level

These measurements shall be performed under both normal and extreme test conditions (see clause 5.1.1).

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 not TPC feature.

Step 1:

a) Using suitable attenuators, 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.

b) The combination of the diode detector and the oscilloscope shall be capable of faithfully reproducing the duty cycle of the transmitter output signal.

c) 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. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal to or greater than 0,1 (see clause 5.1.2.1).

Step 2:

a) The RF output power of the transmitter when operating at the highest power level shall be determined using a wideband calibrated RF power meter with a matched 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.

b) The EIRP 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 beam forming gain "Y" in dB, according to the formula in c). If more then 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.

c) $P_H = A + G + Y + 10 \log (1/x)$ (dBm).

d) P_H shall be recorded in the test report.

5.3.4.2.1.2 RF output power at the lowest power level of the TPC range

These measurements shall be performed under both normal and extreme test conditions (see clause 5.1.1).

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

Step 1:

a) Using suitable attenuators, 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.

b) The combination of the diode detector and the oscilloscope shall be capable of faithfully reproducing the duty cycle of the transmitter output signal.

c) 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. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal to or greater than 0,1 (see clause 5.1.2.1).

Step 2:

a) The RF output power of the transmitter when operating at the lowest power level of the TPC range shall be determined using a wideband calibrated RF power meter with a matched 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.

b) The EIRP 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 beam forming gain "Y" in dB, according to the formula in c). If more then one antenna assembly is intended for this TPC range, the gain of the antenna assembly with the highest gain shall be used.

c) $P_L = A + G + Y + 10 \log (1/x)$ (dBm).

d) P_L shall be recorded in the test report.

5.3.4.2.1.3 Power density

These measurements shall only be performed at normal test conditions (see clause 5.1.1).

The UUT shall be operated as described in clause 5.3.4.2.1.1. Furthermore, for the purpose of this test, the minimum transmitter on-time should be 10 µs.

The transmitter shall be connected to the measuring equipment via a suitable attenuator and the power density as defined in clause 4.4.1 shall be measured and recorded.

The power density shall be determined using a spectrum analyser of adequate bandwidth in combination with an RF power meter.

Connect an RF power meter to the narrow IF output of the spectrum analyser and correct its reading using a known reference source, e.g. a signal generator.

NOTE: The IF output of the spectrum analyser may be 20 dB or more below the input level of the spectrum analyser. Unless the power meter has adequate sensitivity, a wideband amplifier may be required.

Different options for measuring the power density are offered within the present document. The method used shall be documented in the test report.

The power density to be measured is the highest mean power level found in any 1 MHz band.

Option 1: Using a spectrum analyser with an average detector and/or PSD measurement feature

Step 1:

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

- Centre Frequency: The centre frequency of the channel under test
- Resolution BW: 1 MHz
- Video BW: 1 MHz
- Frequency Span: 2 x 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
- Resolution BW: 1 MHz
- Video BW: 1 MHz
- Sweep Time: 1 minute
- Detector Mode: Average
- Trace Mode: Max Hold

NOTE: The detector mode "Average" is often referred to as "RMS Average" but do not use Video Average.

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 EIRP is calculated from the above measured power density (D), the observed duty cycle x (see clause 5.3.4.2.1.1 step 1), the applicable antenna assembly gain "G" in dBi and if applicable the beam forming 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.

- $PD = D + G + Y + 10 \log (1/x)$;
- PD shall be recorded in the test report.

Option 2: Using a spectrum analyser with an IF output port

Step 1:

Use the following settings for the spectrum analyser:

- Centre Frequency: The centre frequency of the channel under test
- Resolution BW: 1 MHz
- Video BW: 1 MHz
- Frequency Span: 2 x Nominal Bandwidth (e.g. 40 MHz for a 20 MHz channel)
- Detector Mode: Peak
- Trace Mode: Max Hold

Step 2:

Connect the UUT to the spectrum analyser and switch on the UUT.

Step 3:

Adjust the Reference Level of the Spectrum Analyser so that the peak of the power envelope is between the Reference Level and the Reference Level - 10 dB with the amplitude scale set to 10 dB/div.

Step 4:

When the trace is complete, find the peak value of the power envelope using a marker.

The centre frequency of the spectrum analyser shall be set to the marker frequency. The span shall be further reduced to 1 MHz and the frequency of the highest power output shall be found. The frequency and level shall be recorded.

Step 5:

Change the settings of the spectrum analyser as follows:

- Centre Frequency: Equal to the frequency recorded in step 4
- Resolution BW: 1 MHz
- Video BW: 1 MHz
- Detector Mode: Peak
- Trace Mode: Max Hold
- Averaging: off
- Span: zero Hz

Step 6:

Connect a Power Meter to the "Narrow I.F." output port of the Spectrum Analyser.

NOTE: The IF output of the spectrum analyser may be 20 dB or more below the input level of the spectrum analyser. Unless the power meter has adequate sensitivity, a wideband amplifier may be required.

Fine tune the Centre Frequency of the spectrum analyser for the highest indication on the power meter.

The level measured by the power meter shall be recorded as level "A".

It is important not to change any of the spectrum analyser settings beyond this stage.

Step 7:

Switch off the UUT and disconnect it from the spectrum analyser.

Connect an RF signal generator to the Spectrum Analyser and adjust the level and frequency of the signal generator to the values recorded in Step 4.

NOTE: It is advisable to use the same cable which was connected before to the UUT.

Fine tune the frequency of the generator for the highest indication on the power meter. This to ensure that the frequency of the signal generator is identical to the centre frequency of the analyser.

Adjust the level of the generator to get the same indication on the power meter as the level "A" noted in step 6.

The level of the signal generator is now equal to the measured power density (D). Depending on the accuracy of the level indication on the signal generator, a power meter may be used to accurately measure the current power (density) level (D) of the generator.

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.

The mean power density EIRP is calculated from the above measured power density (D), the observed duty cycle x (see clause 5.3.4.2.1.1, step 1), the applicable antenna assembly gain "G" in dBi and if applicable the beam forming gain "Y" in dB, according to the formula below. If more then 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:

- PD = D + G + Y + 10 log (1/x);
- PD shall be recorded in the test report.

The procedure in option 1 or option 2 shall be repeated for each of the frequencies identified in clause 5.1.3.

Where the spectrum analyser bandwidth is non-Gaussian, a suitable correction factor shall be determined and applied.

5.3.4.2.2 Radiated measurement

When performing radiated measurements on a UUT with a directional antenna (including smart antenna systems and systems capable of beam forming), the UUT shall be configured/positioned for maximum EIRP in the horizontal plane.

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 5.3.4.2.1.

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 bandwidth of the UUT signal measured, then the method of measurement shall be documented in the test report.

5.3.5 Transmitter unwanted emissions outside the 5 GHz RLAN bands

5.3.5.1 Test conditions

The conformance requirements in clause 4.5.1 shall be verified only under normal operating conditions, and at those carrier centre frequencies defined in clause 5.1.3.

For equipment having different transmit operating modes (see clause 5.1.4.2) the measurements described in the present clause may not need to be repeated for all the operating modes.

The UUT shall be configured to operate at the highest stated power level.

For UUT without an integral antenna and for a UUT with an integral antenna but with a temporary antenna connector(s), one of the following options shall be used:

- The level of unwanted emissions shall be measured as their power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment with the antenna connector(s) terminated by a specified load (cabinet radiation).
- The level of unwanted emissions shall be measured as their effective radiated power when radiated by cabinet and antenna.

When performing the conducted spurious emissions testing on smart antenna systems (devices with multiple transmit chains) a power splitter/combiner shall be used to combine all the transmit chains (antenna outputs) into a single test point. The insertion loss of the power splitter/combiner shall be taken into account.

NOTE: Special care should be taken with selecting the power splitter/combiner, i.e. it should be capable to handle the output power of the UUT and it should have sufficient isolation between the ports to avoid intermodulation products being produced in the UUT.

In the case where the UUT has an integral antenna, but no option for temporary antenna connector(s), only radiated measurements shall be used.

5.3.5.2 Test method

5.3.5.2.1 Conducted measurement

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

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.

5.3.5.2.1.1 Pre-scan

The test procedure below shall be used to identify potential unwanted emissions of the UUT.

Step 1:

The sensitivity of the spectrum analyser should be such that the noise floor is at least 6 dB below the limits given in clause 4.5.1.2, table 3.

Step 2:

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

Spectrum analyser settings:

- Resolution bandwidth: 100 kHz
- Video bandwidth: 100 kHz
- Detector mode: Peak
- Trace Mode: Max Hold
- 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.

NOTE 1: E.g. for non continuous transmissions, if the UUT is using a test sequence as described in clause 5.1.2.1 (transmitter on + off time of 2 ms), then the sweep time has to be greater than 4 ms per 100 kHz. In this case, a full sweep from 30 MHz to 1000 MHz would result in a sweep time of at least 39 s.

Any emissions identified during the sweeps above and that fall within the 6 dB range below the applicable limit, shall be individually measured using the procedure in clause 5.3.5.2.1.2 and compared to the limits given in clause 4.5.1.2, table 3.

Step 3:

The emissions shall now be measured over the ranges:

- 1 GHz to 5,15 GHz
- 5,35 GHz to 5,47 GHz
- 5,725 GHz to 26 GHz

Spectrum analyser settings:

- Resolution bandwidth: 1 MHz
- Video bandwidth: 1 MHz
- Detector mode: Peak
- Trace Mode: Max Hold

- 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.

NOTE 2: E.g. for non continuous transmissions, if the UUT is using a test sequence as described in clause 5.1.2.1 (transmitter on + off time of 2 ms), then the sweep time has to be greater than 4 ms per 1 MHz. In this case, a full sweep of 1 GHz would result in a sweep time of at least 4 s.

Any emissions identified during the sweeps above that fall within the 6 dB range below the applicable limit, shall be individually measured using the procedure in clause 5.3.5.2.1.2 and compared to the limits given in clause 4.5.1.2, table 3.

5.3.5.2.1.2 Measurement of the emissions identified during the pre-scan

The limits for unwanted emissions in clause 4.5.1 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 Video Average detector of the spectrum analyser is permitted. The measured values shall be recorded and compared with the limits in clause 4.5.1.

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
- Resolution Bandwidth: 100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
- Video Bandwidth: 100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
- Frequency Span: 0 Hz
- Sweep Time: Suitable to capture one transmission burst
- Trigger: Video Trigger
- Detector: Peak
- Trace Mode: Clear Write

Adjust the centre frequency (fine tune) to capture the highest level of one burst of the emission to be measured.

Step 2:

Change the following setting on the spectrum analyser:

- Detector Video Average, minimum of 100 sweeps.

The measured value is the average power of this emission during the on-time of the burst. The value shall be recorded and compared with the limit in clause 4.5.1.

5.3.5.2.2 Radiated measurement

The test set up as described in annex B shall be used with a spectrum analyser of sufficient accuracy attached to the test antenna (see clause 5.2).

The test procedure is as described under clause 5.3.5.2.1.

5.3.6 Transmitter unwanted emissions within the 5 GHz RLAN bands

5.3.6.1 Test conditions

The conformance requirements in clause 4.5.2 shall be verified only under normal operating conditions, and at those carrier centre frequencies defined in clause 5.1.3.

For equipment having different transmit operating modes (see clause 5.1.4.2) the measurements described in the present clause may not need to be repeated for all the operating modes.

The UUT shall be configured to operate at the highest stated conducted RF power level or highest EIRP level in case of integral antenna equipment.

For UUT without an integral antenna and for a UUT with an integral antenna but with a temporary antenna connector(s), one of the following options shall be used:

- the level of unwanted emissions shall be calculated from their measured power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment with the antenna connector(s) terminated by a specified load (cabinet radiation); or
- the level of unwanted emissions shall be measured as their effective radiated power when radiated by cabinet and antenna.

In case of conducted measurements on smart antenna systems (devices with multiple transmit chains) operating in a mode with more than 1 transmit chain active simultaneously, measurements need only to be performed on one of the transmit chains (antenna outputs).

In the case where the UUT has an integral antenna, but no temporary antenna connector(s), only radiated measurements shall be used.

5.3.6.2 Test method

5.3.6.2.1 Conducted measurement

5.3.6.2.1.1 Option 1: Using a spectrum analyser video averaging mode

The UUT shall be configured for continuous transmit mode (duty cycle equal to 100 %). If this is not possible, than 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 times the 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 spectrum mask given in clause 4.5.2.

5.3.6.2.1.2 Option 2: Using a spectrum analyser average detector

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: Average (see note)
- Trace Mode: Max Hold
- Sweep time: ≥ 1 minute
- Centre Frequency: Centre frequency of the channel being tested.
- Span: 2 times the Nominal Channel Bandwidth.

NOTE: The spectrum analyser Average Detector shall be used. Do not use Video Average.

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 spectrum mask given in clause 4.5.2.

5.3.6.2.2 Radiated measurement

The test set up as described in annex B shall be used with a spectrum analyser of sufficient accuracy attached to the test antenna (see clause 5.2).

The test procedure is as described under clause 5.3.6.2.1.

5.3.7 Receiver spurious emissions

5.3.7.1 Test conditions

The conformance requirements in clause 4.6 shall be verified only under normal operating conditions, and at those carrier centre frequencies defined in clause 5.1.3.

For equipment having different operating modes (see clause 5.1.4.2) the measurements described in the present clause may not need to be repeated for all the operating modes.

For UUT without an integral antenna and for a UUT with an integral antenna but with a temporary antenna connector(s), one of the following options shall be used:

- the level of unwanted emissions shall be measured as their power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the equipment with the antenna connector(s) terminated by a specified load (cabinet radiation); or
- the level of unwanted emissions shall be measured as their effective radiated power when radiated by cabinet and antenna.

When performing the conducted spurious emissions testing on smart antenna systems (devices with multiple receive chains) 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.

In the case where the UUT has an integral antenna, but no option for temporary antenna connector(s), only radiated measurements shall be used.

5.3.7.2 Test method

5.3.7.2.1 Conducted measurement

The test method 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.

5.3.7.2.1.1 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 6 dB below the limits given in clause 4.6.2, table 4.

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: 100 kHz
- Detector mode: Peak
- Trace Mode: Max Hold

Any emissions identified that fall within the 6 dB range below the applicable limit, shall be individually measured using the procedure in clause 5.3.7.2.1.2 and compared to the limits given in clause 4.6.2, table 4.

Step 3:

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

Spectrum analyser settings:

- Resolution bandwidth: 1 MHz
- Video bandwidth: 1 MHz
- Detector mode: Peak
- Trace mode: Max Hold

Any emissions identified that fall within the 6 dB range below the applicable limit, shall be individually measured using the procedure in clause 5.3.7.2.1.2 and compared to the limits given in clause 4.6.2, table 4.

5.3.7.2.1.2 Measurement of the emissions identified during the pre-scan

The limits for receiver spurious emissions in clause 4.6 refer to average power levels.

A simple measurement using the Video Average detector of the spectrum analyser is permitted. The measured values shall be recorded and compared with the limits in clause 4.6.

5.3.7.2.2 Radiated measurement

The test set up as described in annex B shall be used with a spectrum analyser of sufficient accuracy attached to the test antenna (see clause 5.2).

The test procedure is as described under clause 5.3.7.2.1.

5.3.8 Dynamic Frequency Selection (DFS)

5.3.8.1 Test conditions

The conformance requirements in clause 4.7 shall be verified only under normal operating conditions and at those carrier centre frequencies defined in clause 5.1.3.

The tests in the present clause need only to be performed at one of the declared channel bandwidths.

Some of the tests may be facilitated by disabling the *Non-Occupancy Period* as well as the channel selection mechanism for the *Uniform Spreading* requirement.

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 (T_{power_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.

5.3.8.1.1 Selection of radar test signals

The radar test signals to be used during the DFS testing are defined in table D.4.

For each of the variable radar test signals, an arbitrary combination of Pulse Width and Pulse Repetition Frequency shall be chosen from the options given in the table D.4 and recorded in the test report.

5.3.8.1.2 Test set-ups

For the purposes of the test, the UUT as well as other RLAN devices used in the set-up may be equipped with a specific user interface to allow monitoring of the behaviour of the different devices of the set-up during the tests.

The UUT is capable of transmitting a test transmission sequence as described in clause 5.1.2.2. The signal generator is capable of generating any of the radar test signals defined in table D.4.

Adequate measurement equipment, e.g. spectrum analyser, shall be used to measure the aggregate transmission time of the UUT.

Clauses 5.3.8.1.2.1 to 5.3.8.1.2.3 describe the different set-ups to be used during the measurements.

5.3.8.1.2.1 Set-up A

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

Figure 3 shows an example for *Set-up A*. The set-up used shall be documented in the test report.

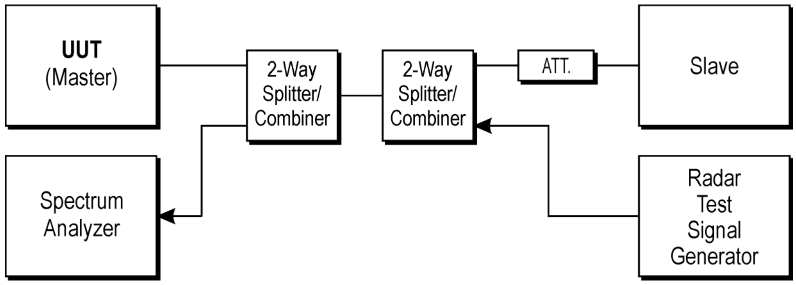


Figure 3: Set-up A

5.3.8.1.2.2 Set-up B

Set-up B is a set-up whereby the UUT is a RLAN device operating in slave mode, with or without Radar Interference Detection function. This set-up also contains a 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 4 shows an example for *Set-up B*. The set-up used shall be documented in the test report.

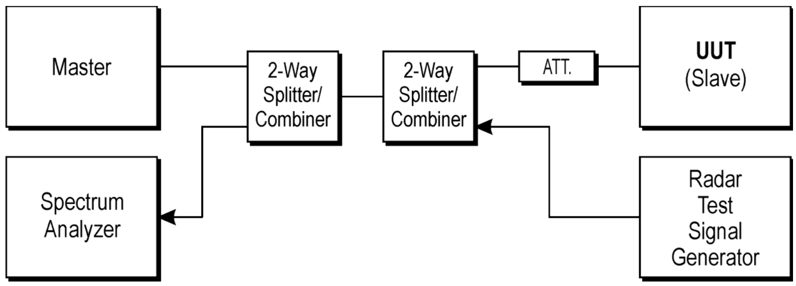


Figure 4: Set-up B

5.3.8.1.2.3 Set-up C

The UUT is a 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 a RLAN device operating in master mode. The UUT (slave device) is associated with the master device.

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

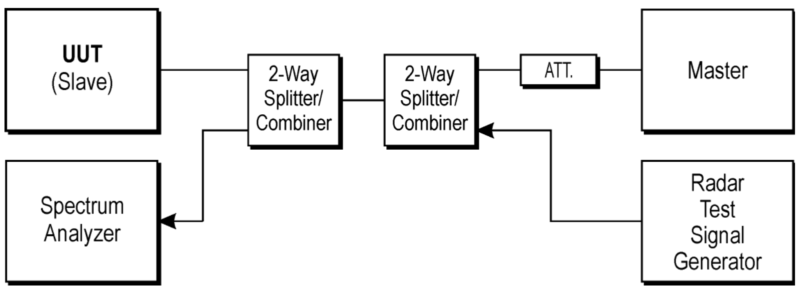


Figure 5: Set-up C

5.3.8.2 Test Method

5.3.8.2.1 Conducted measurement

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 5.3.8.1.1, shall (unless otherwise specified) provide a received signal power at the antenna connector of the UUT with a level equal to (*Interference Detection Threshold* + G), see tables D.2 and D.3. Parameter G [dBi] corresponds to the gain of the antenna assembly stated by the manufacturer. If more then one antenna assembly is intended for this power setting, the gain of the antenna assembly with the lowest gain shall be used.

NOTE: Beam forming gain (Y) of smart antenna systems, operating in a mode where beam forming is active, is ignored in order to test the worse case.

A channel shall be selected in accordance with clause 5.1.3. This channel is designated as Ch_r (channel occupied by a radar). The UUT shall be configured to select Ch_r as the first O*perating Channel*.

5.3.8.2.1.1 Channel Availability Check

The clauses below define the procedure to verify the *Channel Availability Check* and the *Channel Availability Check Time* ($T_{ch\_avail\_check}$) 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 6.

5.3.8.2.1.1.1 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 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 5.3.8.1.2.1. 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 a radar is detected sooner.

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

c) A radar burst is generated on Ch_r using radar test signal #1 defined in table D.4 at a level of 10 dB above the level defined in clause 5.3.8.2.1. This single-burst radar test signal shall commence within 2 sec 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.

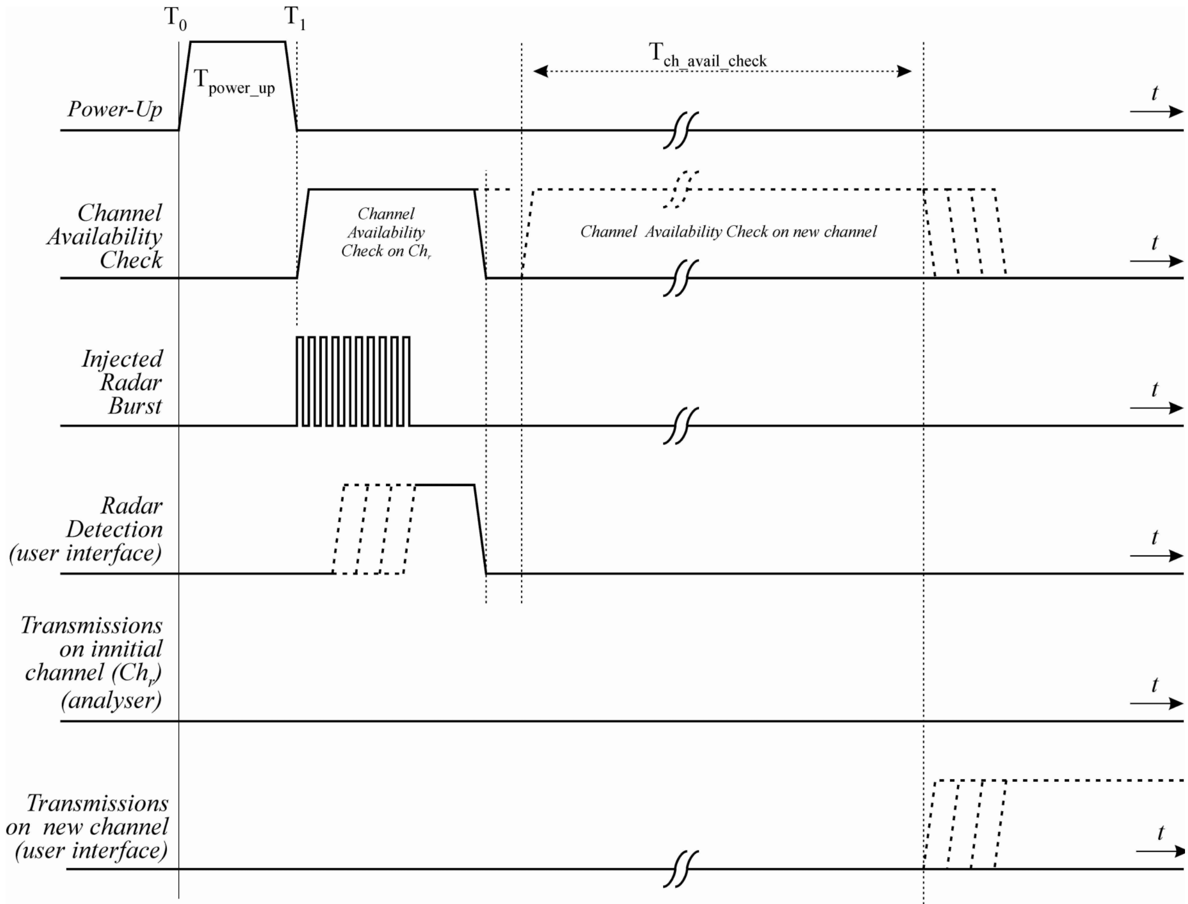


Figure 6: Example of timing for radar testing at the beginning of the Channel Availability Check Time

5.3.8.2.1.1.2 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 when a radar burst occurs at the end of the *Channel Availability Check Time*. This is illustrated in figure 7:

a) The signal generator and UUT are connected using *Set-up A* described in clause 5.3.8.1.2.1. 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 a radar is detected sooner.

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

c) A radar burst is generated on Ch_r using radar test signal #1 defined in table D.4 at a level of 10 dB above the level defined in clause 5.3.8.2.1. 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 [sec].

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.

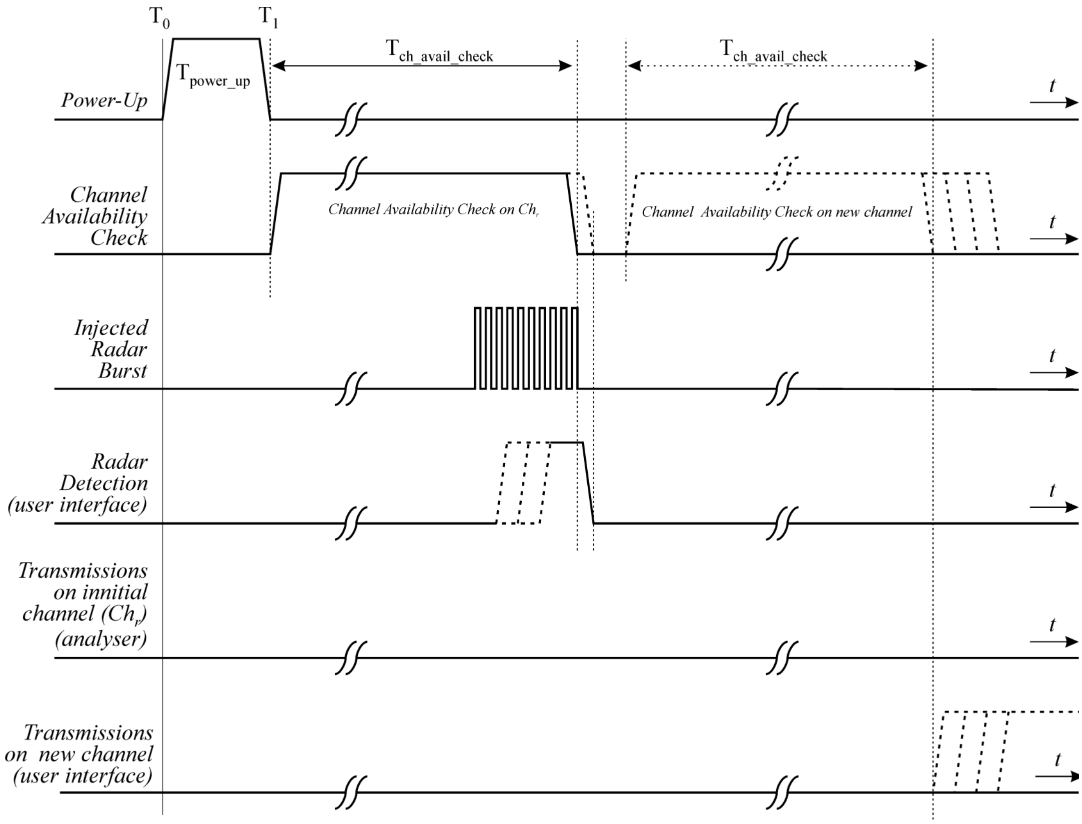


Figure 7: Example of timing for radar testing towards the end of the Channel Availability Check Time

5.3.8.2.1.2 Interference Detection Threshold (during the Channel Availability Check)

The different steps below define the procedure to verify the *Interference Detection Threshold* during the *Channel Availability Check Time*. This is illustrated in figure 8.

a) The signal generator and UUT are connected using *Set-up A* described in clause 5.3.8.1.2.1. 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 a radar is detected sooner.

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

c) A radar burst is generated on Ch_r using radar test signal #1 defined in table D.4 at a level defined in clause 5.3.8.2.1. This single-burst radar signal shall commence at approximately 10 seconds after T1.

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

e) The steps c) to d) shall be repeated at least 20 times in order to determine the detection probability for the selected radar test signal. The detection probability shall be compared with the limit specified in table D.4.

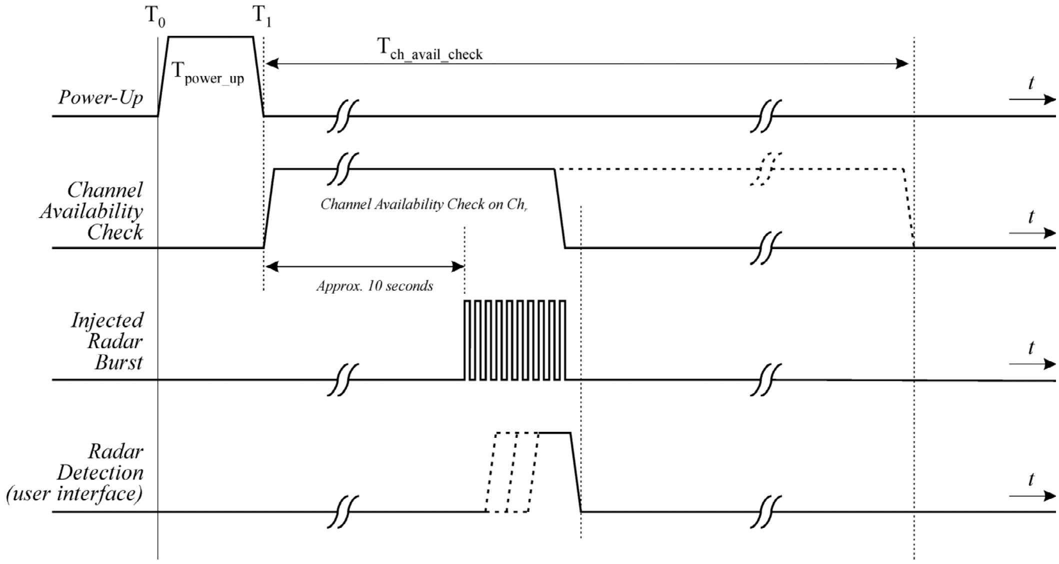


Figure 8: Example of timing for radar testing during the Channel Availability Check

5.3.8.2.1.3 In-Service Monitoring

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

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 5.3.8.1.2.1.

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 5.3.8.1.2.3.

b) The UUT shall transmit a test transmission sequence in accordance with clause 5.1.2.2 on the selected channel Ch_r.

c) At a certain time T0, a radar burst is generated on Ch_r using radar test signal #1 defined in table D.4 and at a level defined in clause 5.3.8.2.1. T1 denotes the end of the radar burst.

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

e) The steps b) to d) shall be repeated at least 20 times in order to determine the detection probability for the selected radar test signal. The detection probability shall be compared with the limit specified in table D.4.

f) The steps b) to e) shall be repeated for each of the radar test signals defined in table D.4 and as described in clause 5.3.8.1.1.

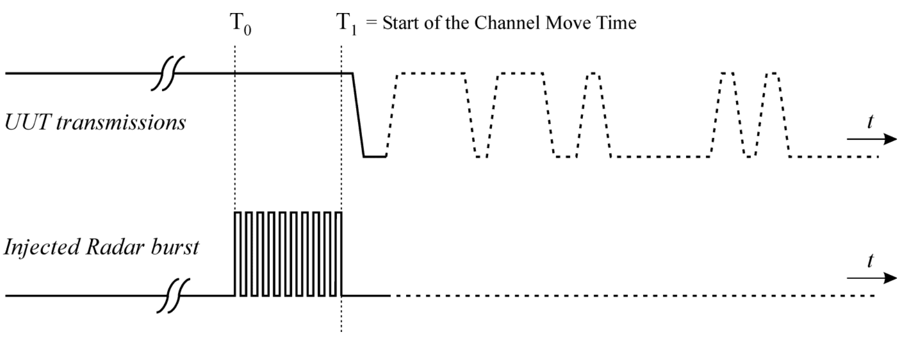


Figure 9: Example of timing for radar testing during In-Service Monitoring

5.3.8.2.1.4 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 10.

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 5.3.8.1.2.1.

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 5.3.8.1.2.2.

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 5.1.2.2 on the selected channel Ch_r.

c) At a certain time T0, a radar burst is generated on Ch_r using radar test signal #1 defined in table D.4 and at a level of 10 dB above the level defined in clause 5.3.8.2.1 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 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 during the *Channel Move Time* shall be compared to the limit defined in table D.1.

NOTE: 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. 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 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 the steps b) to f) shall be repeated with the generator connected to the UUT using *Set-up C* as described in clause 5.3.8.1.2.3. See also table D.3.

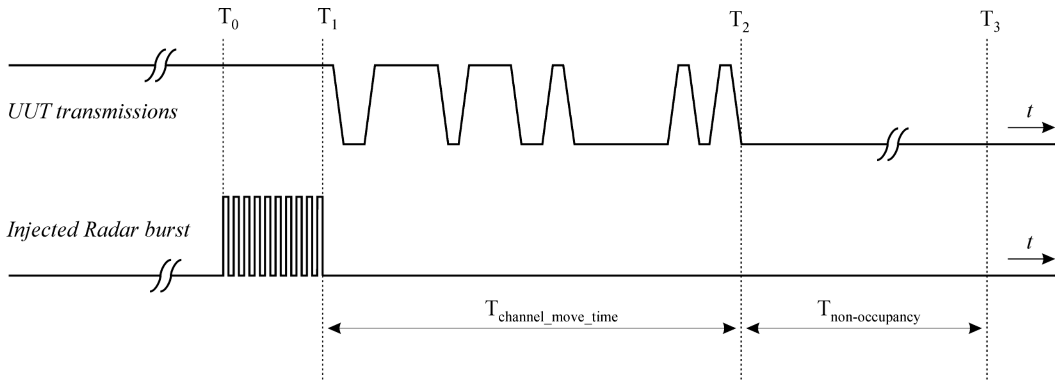


Figure 10: Channel Closing Transmission Time, Channel Move Time and Non-Occupancy Period

5.3.8.2.2 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 *Interference Detection Threshold* (table D.2, table D.3).

When performing radiated DFS testing on a UUT with a directional antenna (including smart antenna systems and systems capable of beam forming), 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 5.3.8.2.1.

Annex A (normative): HS Requirements and conformance Test specifications Table (HS-RTT)

The HS Requirements and conformance Test specifications Table (HS-RTT) in table A.1 serves a number of purposes, as follows:

- it provides a statement of all the essential requirements in words and by cross reference to a specific clause in the present document or to a specific clause in a specific referenced document;
- it provides a statement of all the test procedures corresponding to those essential requirements by cross reference to (a) specific clause(s) in the present document or to (a) specific clause(s) in (a) specific referenced document(s);
- it qualifies each requirement to be either:
    - unconditional: meaning that the requirement applies in all circumstances; or
    - conditional: meaning that the requirement is dependent on the manufacturer having chosen to support optional functionality defined within the schedule.
- in the case of Conditional requirements, it associates the requirement with the particular optional service or functionality;
- it qualifies each test procedure to be either:
    - essential: meaning that it is included with the Essential Radio Test Suite and therefore the requirement shall be demonstrated to be met in accordance with the referenced procedures;
    - other: meaning that the test procedure is illustrative but other means of demonstrating compliance with the requirement are permitted.

Table A.1: HS Requirements and conformance Test specifications Table (HS-RTT)

Harmonized Standard EN 301 893 The following essential requirements and test specifications are relevant to the presumption of conformity under Article 3.2 of the R&TTE Directive						
Essential Requirement			**Requirement Conditionality**		**Test Specification**	
No	**Description**	**Reference: Clause No**	**U/C**	**Condition**	**E/O**	**Reference: Clause No**
1	Carrier frequencies	4.2	U		E	5.3.2
2	Nominal, and occupied, channel bandwidth	4.3	U		E	5.3.3
3	RF output power	4.4	U		E	5.3.4
	Transmit Power Control (TPC)	4.4	C	Note 1	E	5.3.4
	Power Density	4.4	U		E	5.3.4
4	Transmitter unwanted emissions outside the 5 GHz RLAN bands	4.5.1	U		E	5.3.5
5	Transmitter unwanted emissions within the 5 GHz RLAN bands	4.5.2	U		E	5.3.6
6	Receiver spurious emissions	4.6	U		E	5.3.7
7	DFS: Channel Availability Check	4.7.2.1	C	Notes 2 and 3	E	5.3.8.2.1.1 and 5.3.8.2.1.2
8	DFS: In service Monitoring	4.7.2.2	C	Notes 2 and 3	E	5.3.8.2.1.3
9	DFS: Channel shutdown	4.7.2.3	C	Note 2	E	5.3.8.2.1.4
10	DFS: Non-occupancy period	4.7.2.4	C	Notes 2 and 3	E	5.3.8.2.1.4
11	DFS: Uniform spreading	4.7.2.5	C	Note 3	X	

Harmonized Standard EN 301 893 The following essential requirements and test specifications are relevant to the presumption of conformity under Article 3.2 of the R&TTE Directive						
Essential Requirement			**Requirement Conditionality**		**Test Specification**	
No	**Description**	**Reference: Clause No**	**U/C**	**Condition**	**E/O**	**Reference: Clause No**
12	Medium Access Protocol	4.8	U		X	
13	User Access Restrictions	4.9	U		X	
NOTE 1: Transmit Power Control (TPC) is not required for channels whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz. TPC is also not required for devices that operate at a maximum mean EIRP of 3 dB below the limits defined in table 1. NOTE 2: DFS is not required for channels whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz. NOTE 3: Channel Availability Check, In service Monitoring, Non-Occupancy Period and Uniform Spreading are not required for Slave devices with a maximum transmit power less than 200 mW EIRP.						

Key to columns:

Essential Requirement:

No A unique identifier for one row of the table which may be used to identify a requirement or its test specification.

Description A textual reference to the requirement.

Clause Number Identification of clause(s) defining the requirement in the present document unless another document is referenced explicitly.

Requirement Conditionality:

U/C Indicates whether the requirement is to be *unconditionally* applicable (U) or is *conditional* upon the manufacturers claimed functionality of the equipment (C).

Condition Explains the conditions when the requirement shall or shall not be applicable for a technical requirement which is classified "conditional".

Test Specification:

E/O Indicates whether the test specification forms part of the Essential Radio Test Suite (E) or whether it is one of the Other Test Suite (O).

NOTE: All tests whether "E" or "O" are relevant to the requirements. Rows designated "E" collectively make up the Essential Radio Test Suite; those designated "O" make up the Other Test Suite; for those designated "X" there is no test specified corresponding to the requirement. All tests classified "E" shall be performed as specified with satisfactory outcomes as a necessary condition for a presumption of conformity. Requirements associated with tests classified "O" or "X" must be complied with as a necessary condition for presumption of conformity, although conformance with the requirement may be claimed by an equivalent test or by manufacturer's assertion supported by appropriate entries in the technical construction file.

Clause Number Identification of clause(s) defining the test specification in the present document unless another document is referenced explicitly Where no test is specified (that is, where the previous field is "X") this field remains blank.

Annex B (normative): Test sites and arrangements for radiated measurements

B.1 Test sites

B.1.1 Open air test sites

The term "open air" should be understood from an electromagnetic point of view. Such a test site may be really in open air or alternatively with walls and ceiling transparent to the radio waves at the frequencies considered.

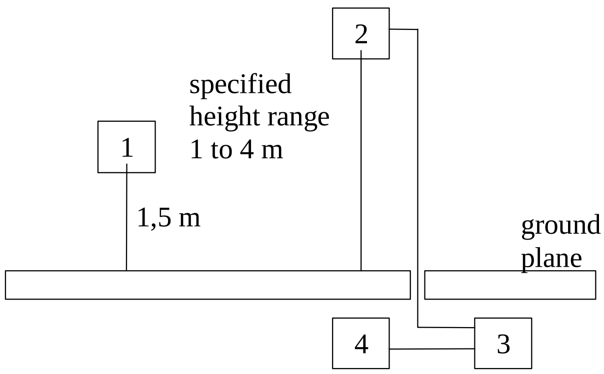
An open air test site may be used to perform the measurements using the radiated measurement methods described in clause 5. Absolute or relative measurements may be performed on transmitters or on receivers; absolute measurements of field strength require a calibration of the test site. Above 1 GHz, measurements should be done in anechoic conditions. This may be met by semi anechoic sites provided reflections are avoided.

For measurements at frequencies below 1 GHz, a measurement distance appropriate to the frequency shall be used. For frequencies above 1 GHz, any suitable measuring distance may be used. The equipment size (excluding the antenna) shall be less than 20 % of the measuring distance. The height of the equipment or of the substitution antenna shall be 1,5 m; the height of the test antenna (transmit or receive) shall vary between 1 m and 4 m.

Sufficient precautions shall be taken to ensure that reflections from extraneous objects adjacent to the site do not degrade the measurement results, in particular:

- No extraneous conducting objects having any dimension in excess of a quarter wavelength of the highest frequency tested shall be in the immediate vicinity of the site according to CISPR 16-1-1 [4].
- All cables shall be as short as possible; as much of the cables as possible shall be on the ground plane or preferably below; and the low impedance cables shall be screened.

The general measurement arrangement is shown in figure B.1.



1: Equipment under test.
2: Test antenna.
3: High pass filter (as required).
4: Spectrum analyser or measuring receiver.

Figure B.1: Measuring arrangement

B.1.2 Anechoic chamber

B.1.2.1 General

An anechoic chamber is a well shielded chamber covered inside with radio frequency absorbing material and simulating a free space environment. It is an alternative site on which to perform the measurements using the radiated measurement methods described in clause 5.7. Absolute or relative measurements may be performed on transmitters or on receivers. Absolute measurements of field strength require a calibration of the anechoic chamber. The test antenna, equipment under test and substitution antenna are used in a way similar to that at the open air test site, but are all located at the same fixed height above the floor.

B.1.2.2 Description

An anechoic chamber should meet the requirements for shielding loss and wall return loss as shown in figure B.2. Figure B.3 shows an example of the construction of an anechoic chamber having a base area of 5 m by 10 m and a height of 5 m. The ceiling and walls are coated with pyramidically formed absorbers approximately 1 m high. The base is covered with special absorbers which form the floor. The available internal dimensions of the chamber are 3 m × 8 m × 3 m, so that a maximum measuring distance of 5 m in the middle axis of this chamber is available. The floor absorbers reject floor reflections so that the antenna height need not be changed. Anechoic chambers of other dimensions may be used.

B.1.2.3 Influence of parasitic reflections

For free-space propagation in the far field, the relationship of the field strength E and the distance R is given by $E = E_o \times (R_o/R)$, where E_o is the reference field strength and R_o is the reference distance. This relationship allows relative measurements to be made as all constants are eliminated within the ratio and neither cable attenuation nor antenna mismatch or antenna dimensions are of importance.

If the logarithm of the foregoing equation is used, the deviation from the ideal curve may be easily seen because the ideal correlation of field strength and distance appears as a straight line. The deviations occurring in practice are then clearly visible. This indirect method shows quickly and easily any disturbances due to reflections and is far less difficult than the direct measurement of reflection attenuation.

With an anechoic chamber of the dimensions given above at low frequencies below 100 MHz there are no far field conditions, but the wall reflections are stronger, so that careful calibration is necessary. In the medium frequency range from 100 MHz to 1 GHz the dependence of the field strength to the distance meets the expectations very well. Above 1 GHz, because more reflections will occur, the dependence of the field strength to the distance will not correlate so closely.

B.1.2.4 Calibration and mode of use

The calibration and mode of use is the same as for an open air test site, the only difference being that the test antenna does not need to be raised and lowered whilst searching for a maximum, which simplifies the method of measurement.

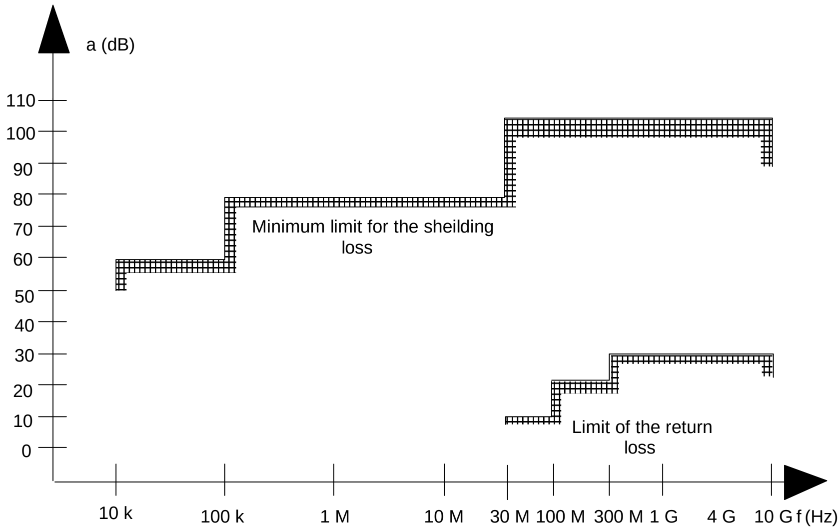


Figure B.2: Specification for shielding and reflections

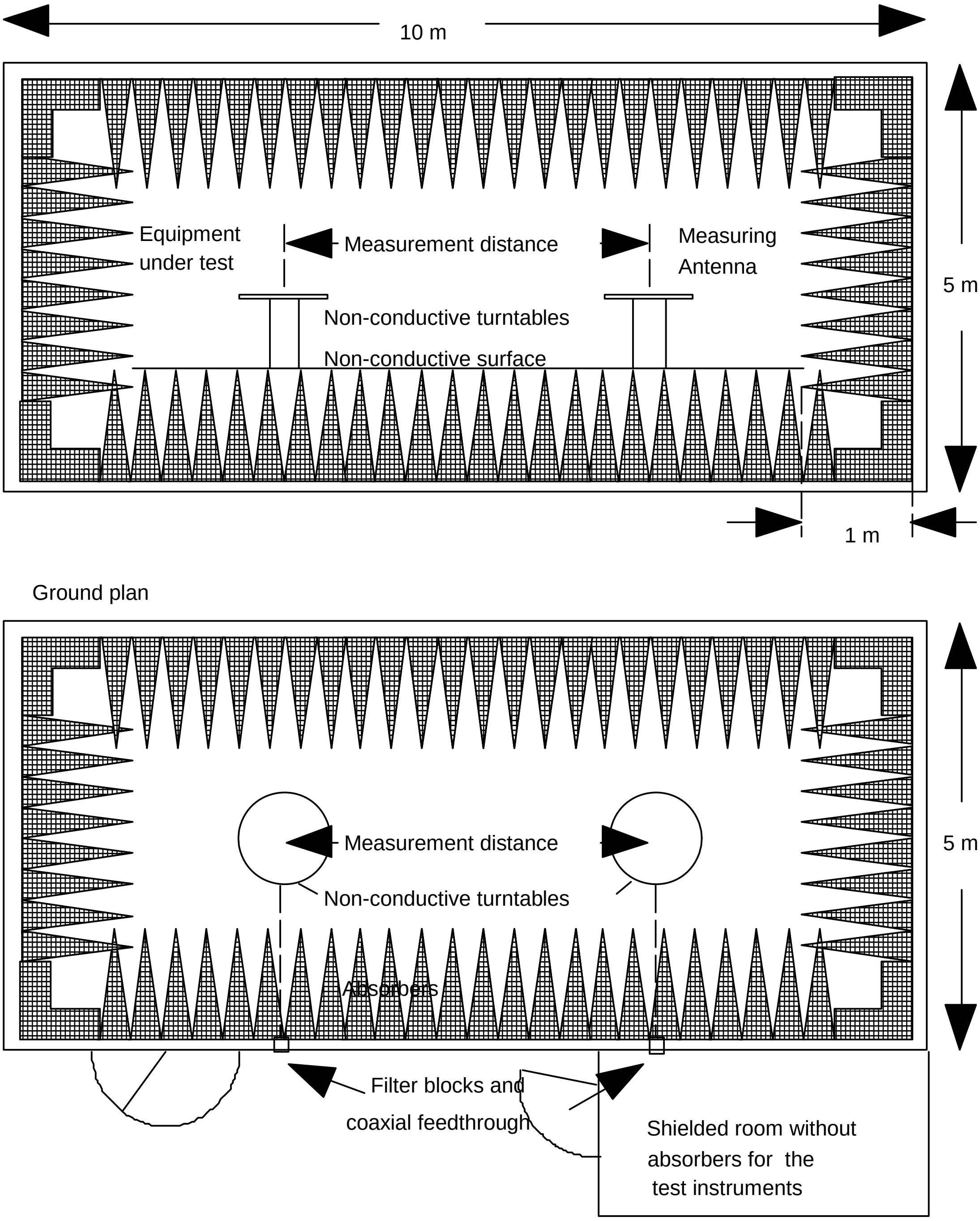


Figure B.3: Anechoic shielded chamber for simulated free space measurements

B.2 Test antenna

When the test site is used for radiation measurements the test antenna shall be used to detect the field from both the test sample and the substitution antenna. When the test site is used for the measurement of receiver characteristics the antenna shall be used as a transmitting antenna. This antenna shall be mounted on a support capable of allowing the antenna to be used in either horizontal or vertical polarization and for the height of its centre above the ground to be varied over the specified range. Preferably test antennas with pronounced directivity should be used. The size of the test antenna along the measurement axis shall not exceed 20 % of the measuring distance.

B.3 Substitution antenna

The substitution antenna shall be used to replace the UUT in substitution measurements. For measurements below 1 GHz the substitution antenna shall be a half wavelength dipole resonant at the frequency under consideration, or a shortened dipole, calibrated to the half wavelength dipole. For measurements between 1 GHz and 4 GHz either a half wavelength dipole or a horn radiator may be used. For measurements above 4 GHz a horn radiator shall be used. The centre of this antenna shall coincide with the reference point of the test sample it has replaced. This reference point shall be the volume centre of the sample when its antenna is mounted inside the cabinet, or the point where an outside antenna is connected to the cabinet.

The distance between the lower extremity of the dipole and the ground shall be at least 30 cm.

NOTE: The gain of a horn antenna is generally expressed relative to an isotropic radiator.

Annex C (normative): General description of measurement

This annex gives the general methods of measurements for RF signals using the test sites and arrangements described in annex B.

C.1 Conducted measurements

Conducted measurements may be applied to equipment provided with an antenna connector(s) e.g. by means of a spectrum analyser.

C.2 Radiated measurements

Radiated measurements shall be performed with the aid of a test antenna and measurement instruments as described in annex B. The test antenna and measurement instrument shall be calibrated according to the procedure defined in this annex. The equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted power level. This position shall be recorded in the measurement report. The frequency range shall be measured in this position.

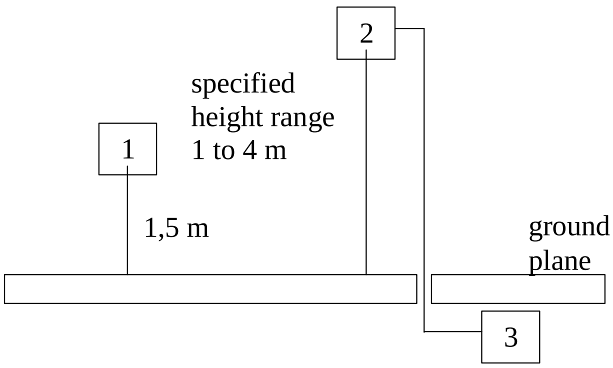
Radiated measurements should be performed in an anechoic chamber. For other test sites corrections may be needed (see annex B). The following test procedure applies:

a) A test site which fulfils the requirements of the specified frequency range of this measurement shall be used. The test antenna shall be oriented initially for vertical polarization unless otherwise stated and the transmitter under test shall be placed on the support in its standard position (clause B.1.1) and switched on.

b) For average power measurements a non-selective voltmeter or wideband spectrum analyser shall be used. For other measurements a spectrum analyser or selective voltmeter shall be used and tuned to the measurement frequency.

In either case a) or b), the test antenna shall be raised or lowered, if necessary, through the specified height range until the maximum signal level is detected on the spectrum analyser or selective voltmeter.

The test antenna need not be raised or lowered if the measurement is carried out on a test site according to clause B.1.2.



1: Equipment under test.
2: Test antenna.
3: Spectrum analyser or measuring receiver.

Figure C.1: Measurement arrangement 1

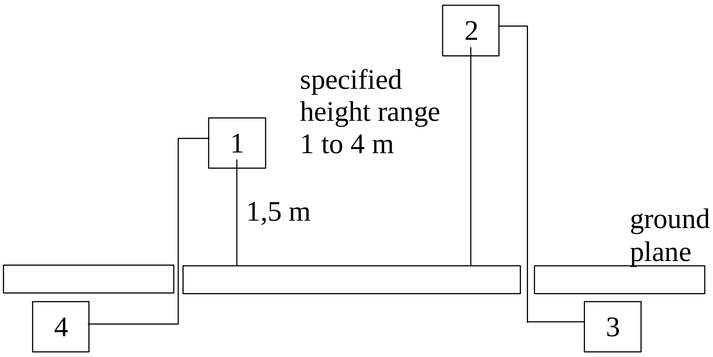
- The transmitter shall be rotated through 360° about a vertical axis until a higher maximum signal is received.
- The test antenna shall be raised or lowered again, if necessary, through the specified height range until a maximum is obtained. This level shall be recorded.

NOTE: This maximum may be a lower value than the value obtainable at heights outside the specified limits.

The test antenna need not be raised or lowered if the measurement is carried out on a test site according to clause B.1.2. This measurement shall be repeated for horizontal polarization. The result of the measurement is the higher power obtained from the two measurements with the indication of the corresponding polarization.

C.3 Substitution measurement

The actual signal generated by the measured equipment may be determined by means of a substitution measurement in which a known signal source replaces the device to be measured, see figure C.2. This method of measurement should be used in an anechoic chamber. For other test sites corrections may be needed, see annex B.



1: Substitution antenna.
2: Test antenna.
3: Spectrum analyser or selective voltmeter.
4: Signal generator.

Figure C.2: Measurement arrangement 2

Using measurement arrangement 2, figure C.2, the substitution antenna shall replace the transmitter antenna in the same position and in vertical polarization. The frequency of the signal generator shall be adjusted to the measurement frequency. The test antenna shall be raised or lowered, if necessary, to ensure that the maximum signal is still received. The input signal to the substitution antenna shall be adjusted in level until an equal or a known related level to that detected from the transmitter is obtained in the test receiver.

The test antenna need not be raised or lowered if the measurement is carried out on a test site according to clause B.1.2.

The radiated power is equal to the power supplied by the signal generator, increased by the known relationship if necessary and after corrections due to the gain of the substitution antenna and the cable loss between the signal generator and the substitution antenna.

This measurement shall be repeated with horizontal polarization. The result of the measurement is the higher power obtained from the two measurements with the indication of the corresponding polarization.

Annex D (normative): DFS parameters

Table D.1: DFS requirement values

Parameter	Value
Channel Availability Check Time	60 s
Channel Move Time	10 s
Channel Closing Transmission Time	260 ms
Non-Occupancy Period	30 min

Table D.2: Interference threshold values, master

Maximum transmit power (EIRP)	Value (see note)
≥ 200 mW	-64 dBm
< 200 mW	-62 dBm
NOTE: This is the level at the input of the receiver assuming a 0 dBi receive antenna.	

Table D.3: Interference threshold values, slave

Maximum transmit power (EIRP)	Value (see note)
≥ 200 mW	-64 dBm
< 200 mW	N/A
NOTE: This is the level at the input of the receiver assuming a 0 dBi receive antenna.	

Table D.4: Parameters of DFS test signals

Radar test signal	Pulse width W [µs] (see note 5)	Pulse repetition frequency PRF [pps]	Pulses per burst [PPB] (see note 1)	Detection probability with 30 % channel load
1 - Fixed	1	750	15	P_d > 60 %
2 - Variable	1, 2, 5	200, 300, 500, 800, 1 000	10	P_d > 60 %
3 - Variable	10, 15	200, 300, 500, 800, 1 000	15	P_d > 60 %
4 - Variable	1, 2, 5, 10, 15	1 200, 1 500, 1 600	15	P_d > 60 %
5 - Variable	1, 2, 5, 10, 15	2 300, 3 000, 3 500, 4 000	25	P_d > 60 %
6 - Variable modulated (see note 6)	20, 30	2 000, 3 000, 4 000	20	P_d > 60 %

NOTE 1: This represents the number of pulses seen at the RLAN per radar scan:
N = [{antenna beamwidth (deg)} × {pulse repetition rate (pps)}] / [{scan rate (deg/s)}].

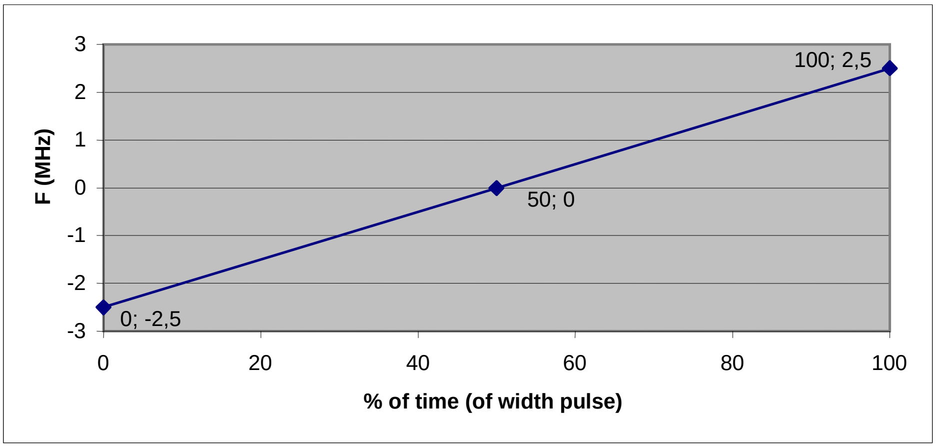
NOTE 2: The test signals above only contain a single burst of pulses. See figure D.1.

NOTE 3: The number of pulses per burst given in this table simulate real radar systems and take into account the effects of pulse repetition rate and pulse width on the detection probability for a single burst.

NOTE 4: Pd gives the probability of detection per simulated radar burst and represents a minimum level of detection performance under defined conditions - in this case a 30 % traffic load.
Therefore Pd does not represent the overall detection probability for any particular radar under real life conditions. In general 5 sequential bursts are needed to achieve a real life detection rate of better that 99 % for any radar that falls within the scope of this table.

NOTE 5: The pulse width used in these tests is assumed to be representative of real radar systems with different pulse widths and different modulations. The pulse width is assumed to have an accuracy of ±5 %.

NOTE 6: The modulation to be used for the radar test signal 6 is a chirp modulation with a ±2,5 MHz frequency deviation which is described below.



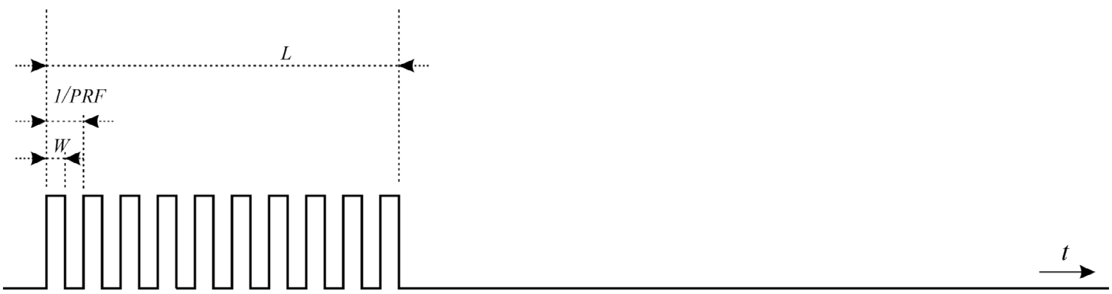


Figure D.1: General structure of a single burst DFS test transmission

Annex E (informative): Guidance for testing IEEE 802.11n Devices

E.1 Introduction

The following guidance may be used by test labs and manufacturers when evaluating compliance of IEEE 802.11n radio devices to the present document. The technology-specific information in this annex *does not* constitute additional requirements and *does not* modify the technical requirements of the present document.

In addition to the mandatory and optional modes defined in the IEEE 802.11n technology standard, Smart Antenna Systems may utilize additional modes of operation not defined in the IEEE 802.11n standard. Therefore, this annex presents a non-exhaustive list of the most commonly expected modes and operating states for IEEE 802.11n-based devices with the associated references to the appropriate categories for testing in the present document.

The guidance provided in this informative annex assumes that the product utilizes two or more transmit and receive chains.

E.2 Possible Modulations

Listed below are the most common modulation types and channel widths used by 5 GHz IEEE 802.11n devices:

- IEEE 802.11a [8] modulations using a single or multiple transmitters with or without transmit CSD.
- HT20: 20 MHz channels with one to four spatial streams (MCS 0 through MCS 76).
- HT40: 40 MHz channels with one to four spatial streams (MCS 0 through MCS 76).

NOTE: A spatial stream is a stream of bits transmitted over a separate spatial dimension. The number of spatial streams is not necessarily equivalent to the number of transmit chains.

E.2.1 Guidance for Testing

The objective is to test the equipment in configurations which result in the highest EIRP and EIRP density. These configurations are further referred to as the worst-case.

E.2.1.1 Modulation Used for Conformance Testing

One worst case modulation type for 20 MHz operation (and one worst case modulation type for 40 MHz operation, if supported) should be identified and used for conformance testing per the present document.

Where the 20 MHz and 40 MHz modes support different numbers of transmit chains and spatial streams, testing may need to be performed to identify the worst case modes.

Comparison measurements of mean RF output power (or mean EIRP) and power density (or EIRP density), across all modulations can be used to establish the worst case modulation type for 20 MHz operation (and the worse case modulation type for 40 MHz if supported):

EXAMPLE 1: If comparison measurements determine that HT20 MCS 0 (6,5 Mbit/s, one spatial stream) is worst-case, then this mode should be used for conformance testing (and not 802.11a modulations and not HT20 MCS 1 through MCS 15). One worst-case modulation for HT40 operation should be identified and used for the conformance testing.

EXAMPLE 2: However, if the product has transmit power levels different for IEEE 802.11a [8] vs. HT20 operation, then worst-case modulation type should be identified and used for testing the EIRP and EIRP density which need to be repeated for both IEEE 802.11a [8] and HT20 operation.

EIRP and EIRP density conformance tests should be repeated using the worst-case IEEE 802.11a [8] and HT20 modes, respectively. In this case three sets of EIRP and EIRP density conformance testing should be performed:

- Worst-case IEEE 802.11a [8] modulation.
- Worst-case HT20 modulation.
- Worst-case HT40 modulation.

NOTE: In some operating modes, the CSD feature may be disabled. Comparison testing between CSD enabled and CSD disabled will determine the worse-case configuration, and this configuration will then be used during the conformance testing.

E.3 Possible Operating Modes

Listed below are the most common operating states of multiple transmit/receive chains within Smart Antenna Systems:

- Beamforming feature implemented and enabled or disabled.
- All *available* transmit and receive chains enabled.
- A subset of the present transmit/receive chains temporarily disabled during normal operation (i.e. dynamically, based on link conditions or power requirements). In this case, a vendor may implement higher transmit power settings (dynamically) for the active transmit chains.
- Although not commonly expected, it is possible that a device may utilize different transmit power settings between one or more of the present transmit chains.

E.3.1 Guidance for Testing:

EIRP and EIRP density tests should be repeated using the worst-case Modulations described above and in the following operating states when supported by the device:

- Where one or more of the transmit chains is manually or automatically disabled during normal operation and different target RF output power levels are used depending on the number of active transmit chains, then EIRP and EIRP density conformance testing should be performed using each configuration:
  - For example, a device with three transmit chains may support an operating mode using three transmit chains at one power level and another operating mode in which one transmit chain is using a higher power level while the other transmit chains are disabled. EIRP and EIRP density conformance testing should be repeated (using the worst-case modulation types described above) for both of the above mentioned (three-transmit and single-transmit) operating modes.
  - For example, a device with three transmit chains which does not change its (per transmit chain) RF output power based on the number of active chains, need not undergo repeat testing for all the transmit chains.
- Where a beamforming feature is implemented, conformance testing should be performed as indicated for a device with a beamforming feature:
  - Where the beamforming feature may be disabled manually or automatically, conformance testing does not need to be repeated if the (per transmit chain) RF output power settings remain unchanged.
  - Where the beamforming feature may be disabled manually or automatically, conformance testing needs to be repeated if different (per transmit chain) RF output power settings will be used.

Annex F (informative): The EN title in the official languages

Language	EN title
Bulgarian	Широколентови мрежи с радиодостъп (BRAN). Висококачествена локална радиомрежа (RLAN) в обхвата 5 GHz. Хармонизиран европейски стандарт (EN), покриващ съществените изисквания на член 3.2 от Директивата за радиосъоръжения и крайни далекосъобщителни устройства (R&TTED)
Czech	Širokopásmové rádiové přístupové sítě (BRAN); Vysokovýkonná RLAN 5 GHz; Harmonizovaná EN pokrývající základní požadavky článku 3.2 Směrnice R&TTE
Danish	Bredbåndsradioaksessnet (BRAN); 5 GHz high-performance RLAN; Harmoniseret EN omfatter essentielle krav fra artikel 3.2 af R&TTE direktiv
Dutch	Breedband netwerken met radio toegang (BRAN). 5 GHz high performance RLAN apparatuur. Geharmoniseerde EN betreffende de wezenlijke vereisten, als aangegeven in artikel 3, lid 2, van de R&TTE Richtlijn
English	Broadband Radio Access Networks (BRAN); 5 GHz high performance RLAN; Harmonized EN covering essential requirements of article 3.2 of the R&TTE Directive
Estonian	Lairiba raadiojuurdepääsuvõrgud (BRAN); Raadiosagedusalas 5 GHz töötavate suure edastuskiirusega RLAN seadmete põhinõuded, harmoneeritud EN R&TTE direktiivi artikli 3.2 alusel
Finnish	Laajakaistaiset radioliityntäverkot (BRAN); 5 GHz korkean suoritustuskyvyn RLAN; Yhdenmukaistettu standardi (EN), joka kattaa R&TTE-direktiivin artiklan 3.2 mukaiset olennaiset vaatimukset
French	Réseaux radio fréquence large bande (BRAN); Réseaux locaux radio haute performance 5 GHz ; EN harmonisé couvrant les exigences essentielles de l'article 3.2 de la directive R&TTE
German	Breitbandige Funkzugangsnetze (BRAN); Lokale Funknetze mit hoher Leistung im 5 GHz Band; Harmonisierte Europäische Norm (EN) für die grundlegenden Anforderungen des Artikels 3.2 der Funk- und Telekommunikationsendgerätedirektive (R&TTE Direktive)
Greek	Ευρυζωνικά Δίκτυα Ραδιοεπικοινωνίας (BRAN); Υψηλης απόδοσης RLAN στους 5 GHz; Εναρμονισμένη ΕΝ που καλύπτει τις βασικές προυποθέσεις του άρθρου 3.2 της οδηγίας R&TTE
Hungarian	Széles sávú, rádiós hozzáférési hálózatok (BRAN). 5 GHz-es, kiváló minőségű RLAN. Az R&TTE-irányelv 3. cikke (2) bekezdésének alapvető követelményeit tartalmazó, harmonizált európai szabvány
Icelandic	
Italian	Reti di accesso radio a larga banda (BRAN); 5 GHz RLAN ad alte prestazioni; EN armonizzati soddisfacenti i requisiti dell'articolo 3.2 della Direttiva R&TTE
Latvian	Platjoslas radiopiekļuves tīkli (BRAN) - 5 GHz augstas veiktspējas vietējais radiopiekļuves tīkls (RLAN) - Harmonizēts Eiropas standarts (EN), kas atbilst R&TTE direktīvas 3.2.punkta būtiskajām prasībām
Lithuanian	Plačiajuostės radijo ryšio prieigos tinklai. 5 GHz dažnio aukštos kokybės vietinis radijo ryšio tinklas. Darnusis Europos standartas, apimantis esminius 1999/5/EC* direktyvos 3.2 straipsnio reikalavimus
Maltese	Netwerks għal Aċċess għal Frekwenza Wiesgħa Radjofonika (BRAN); 5 GHz kapaċità għolja RLAN; EN armonizzat li jkopri rekwiżiti essenzjali ta" artiklu 3.2 tad-Direttiva R&TTE
Norwegian	Bredb†nds radioaksessnett (BRAN);5 GHz h›yhastighets RLAN; Harmonisert EN som dekker de grunnleggende krav i R&TTE-direktivets artikkel 3.2
Polish	Sieci szerokopasmowego dostępu radiowego (BRAN) - Sieci RLAN wysokiej jakości, zakresu 5 GHz - Zharmonizowana EN zapewniająca spełnienie zasadniczych wymagań artykułu 3.2 dyrektywy R&TTE
Portuguese	Redes de Acesso Rádio em Banda Larga (BRAN); RLAN de alto desempenho na faixa dos 5 GHz; EN harmonizada cobrindo os requisitos essenciais no âmbito do Artigo 3.2 da Directiva R&TTE
Romanian	
Slovak	Širokopásmové rádiové prístupové siete (BRAN). Vysokovýkonná RLAN v pásme 5 GHz. Harmonizovaná EN vzťahujúca sa na základné požiadavky podľa článku 3.2 smernice R&TTE
Slovenian	Širokopasovna radijska dostopovna omrežja (BRAN) - Zelo zmogljivo radijsko lokalno omrežje (RLAN) na 5 GHz - Harmonizirani EN, ki zajema bistvene zahteve člena 3.2 direktive R&TTE
Spanish	Redes de acceso por radio de banda ancha (BRAN); RLAN de alto rendimiento en la banda de 5 GHz; Estandard ETSI cubriendo los aspectos esenciales del articulo 3.2 de la Directiva R&TTE
Swedish	Bredbandsradio-accessnät (BRAN); 5 GHz hög kapacitet RLAN; Harmoniserad EN omfattande väsentliga krav enligt artikel 3.2 i R&TTE-direktivet

Annex G (informative): Bibliography

ITU-R Recommendation M.1652: "Dynamic frequency selection (DFS) in wireless access systems including radio local area networks for the purpose of protecting the radiodetermination service in the 5 GHz band".

IEEE P802.11n: "Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Enhancements for Higher Throughput".

History

Document history		
V1.2.3	August 2003	Publication
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