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Harmonized European Standard

**White Space Devices (WSD);
Wireless Access Systems operating in the 470 MHz to 790 MHz
TV broadcast band;
Harmonized EN covering the essential requirements
of article 3.2 of the R&TTE Directive**

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Foreword

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

The present document has been produced by ETSI in response to mandates M/284 and M/512 issued from the European Commission under Directive 98/34/EC [i.1] as amended by Directive 98/48/EC [i.2].

The title and reference to the present document are intended to be included in the publication in the Official Journal of the European Union of titles and references of Harmonized Standard under the Directive 1999/5/EC [i.3].

See article 5.1 of Directive 1999/5/EC [i.3] for information on presumption of conformity and Harmonized Standards or parts thereof the references of which have been published in the Official Journal of the European Union.

The requirements relevant to Directive 1999/5/EC [i.3] are summarized in annex A.

National transposition dates	
Date of adoption of this EN:	21 April 2014
Date of latest announcement of this EN (doa):	31 July 2014
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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 [i.3]. The modular structure is shown in EG 201 399 [i.4].

The methods and principles used in the present document for the operation of TV White Space devices in the band 470 MHz to 790 MHz are taken from the ECC Report 186 [i.5], which explains the regulatory principles under which it is envisaged such devices will be permitted to operate in Europe. This approach is also explained in further detail in Chapter 9 of "Dynamic White Space Spectrum Access" [i.11].

A requirement to facilitate coexistence between TVWSDs is not considered essential with respect to compliance with Article 3.2 of Directive 1999/5/EC [i.3] and therefore is not included in the current version of the present document. This may change in the future, resulting in the inclusion of mitigation techniques in a revision of the present document, to improve the coexistence among TVWSDs, if considered essential in order to comply with Article 3.2 of Directive 1999/5/EC [i.3].

1 Scope

The present document applies to TV white space devices (TVWSDs) controlled by a TV white space database (TVWSDB) and which operate in the TV broadcast band 470 MHz to 790 MHz.

The present document applies to the following radio equipment types:

1) Master TV white space device (TVWSD)

2) Slave TV white space device (TVWSD)

The present document applies to TVWSDs with integral, dedicated or external antennas, where TVWSDs using external antennas are intended only for fixed use. The present document is intended to cover the provisions of Directive 1999/5/EC [i.3] (R&TTE Directive), Article 3.2, 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".

In addition to the present document, other ENs that specify technical requirements in respect of essential requirements under other parts of article 3 of the R&TTE Directive may apply to equipment within the scope of the present document.

NOTE: A list of such ENs is included on the web site http://www.newapproach.org.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) 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.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] NIMA Technical Report TR8350.2 (1984, including amendment 1 of 03 January 2000 and amendment 2 of 23 June 2004): "Department of Defense World Geodetic System 1984. Its Definition and Relationships with Local Geodetic Systems".

NOTE: Available at http://earth-info.nga.mil/GandG/publications/tr8350.2/wgs84fin.pdf.

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

[4] IETF RFC 4122 (05-2007): "A Universally Unique IDentifier (UUID) URN Namespace".

NOTE: Available at http://www.ietf.org/rfc/rfc4122.txt.

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1]   Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations and of rules on Information Society services.

[i.2]   Directive 98/48/EC of the European Parliament and of the Council of 20 July 1998 amending Directive 98/34/EC laying down a procedure for the provision of information in the field of technical standards and regulations.

[i.3]   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).

[i.4]   ETSI EG 201 399: "Electromagnetic compatibility and Radio spectrum Matters (ERM); A guide to the production of Harmonized Standards for application under the R&TTE Directive".

[i.5]   ECC Report 186: "Technical and operational requirements for the operation of white space devices under geo-location approach", January 2013.

[i.6]   ETSI TR 102 273-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties; Part 2: Anechoic chamber".

[i.7]   ETSI TR 102 273-3: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties; Part 3: Anechoic chamber with a ground plane".

[i.8]   ETSI TR 102 273-4: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties; Part 4: Open area test site".

[i.9]   ETSI TR 103 231: "White Space Devices (WSD); Wireless Access Systems operating in the 470 MHz to 790 MHz TV broadcast band; Information on weblistings of TV White Space Databases (TVWSDBs)".

[i.10]   ECC Report 159: "Technical and operational requirements for the possible operation of cognitive radio systems in the "white spaces" of the frequency band 470-790 MHz", January 2011.

[i.11]   Dynamic White Space Spectrum Access; By William Webb and contributors.

NOTE: Available at http://www.webbsearch.co.uk/publications/.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in ECC Report 159 [i.10] and the following apply:

Adjacent Channel Leakage Ratio (ACLR): ratio of the in-band transmit power measured in an 8 MHz TV channel, to the out-of-band emission measured in 100 kHz in an adjacent TV channel

altitude: height above the reference level defined by WGS84

association: process whereby a slave TVWSD provides its device parameters to a master TVWSD and initially identifies itself to its serving master TVWSD

Authentication: ability to verify the identity of a server, and that a message was truly sent by the asserted sender

channel usage parameters: parameters sent by a TVWSD to inform the TVWSDB of the actual radio resources that will be used by both the master and the slave TVWSDs

dedicated antenna: removable antenna supplied and assessed with the radio equipment, designed as an indispensable part of the equipment

device emission class: classification declared by the manufacturer that identifies the level of ACLR for the device

device parameters: parameters that specify the technical characteristics of an individual TVWSD, and its location

Digital Terrestrial Television (DTT): platform for the delivery of digital TV content via terrestrial broadcasting

DTT channel: 8 MHz channel in accordance with the European harmonized DTT channel raster

external antenna: removable antenna which is designed for use with a broad range of radio equipment and has not be designed for use with a specific product

> NOTE: An external antenna is not assessed together with the equipment against the requirements of the present document.

generic operational parameters: transmission parameters communicated by a master TVWSD to any slave TVWSD within the coverage area of that master TVWSD to allow the slave TVWSD to operate as required

geographic validity: geographic area within which the operational parameters for a geo-located TVWSD are valid

geo-location capability: capability of a TVWSD to determine and report the latitude, longitude and altitude coordinates of its antenna

geo-location uncertainty: 3D position error defined by the difference in metres between the point reported by the TVWSD device to the TVWSDB and the actual position of the TVWSD antenna

horizontal geo-location capability: capability of a TVWSD to determine and report the latitude and longitude coordinates of its antenna

in-block emissions: intended emissions that fall within a single or multiple DTT channel(s)

integral antenna: antenna designed as a fixed part of the equipment, without the use of an external connector, which cannot 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 can be used.

Integrity: capability to protect messages against accidental or malicious changes during transit

master operational parameters: transmission parameters communicated from a TVWSDB to a master TVWSD to allow the master TVWSD to operate as required

master TVWSD: geo-located TVWSD that is able to communicate directly with a TVWSDB and with TVWSDs

out-of-block emissions: unwanted emissions that fall within the 470 MHz to 790 MHz band

regulatory domains: geographical area where a set of regulatory rules applies

> NOTE: This is normally a country.

reverse intermodulation attenuation: measure of the capability of the transmitter to inhibit the generation of intermodulation signals in its non-linear components caused by the presence of the transmitter wanted signal and an unwanted signal reaching the transmitter via the antenna

reverse intermodulation attenuation improvement: measure of the improvement in reverse intermodulation attenuation beyond the minimum value required, as a function of in-block transmitter power

slave operational parameters: transmission parameters communicated from a TVWSDB via a master TVWSD to enable a slave TVWSD to operate as required

slave TVWSD: TVWSD that is only able to communicate with other TVWSDs, when under the control of a master TVWSD

sleep mode: mode of operation for which the TVWSD is inactive but is not powered-down

specific operation parameters: transmission parameters communicated from a TVWSDB to a specific TVWSD (master or slave), taking account of the device parameters of that specific TVWSD

test equipment: equipment that provides the means to operate and control a UUT for the purposes of testing against the requirements contained in the present document

test master TVWSD: test equipment that emulates the functionalities of a master TVWSD for the purposes of testing a slave TVWSD against the requirements contained in the present document

test slave TVWSD: test equipment that emulates the functionalities of a slave TVWSD for the purposes of testing a master TVWSD against the requirements contained in the present document

test white space database: test equipment that emulates the functionalities of a TVWSDB for the purposes of testing a TVWSD against the requirements contained in the present document

time validity: period of time when a set of operational parameters is valid, determined by the $T_{ValStart}$ and T_{ValEnd} parameters contained in the said operational parameter set

TV white spaces: frequencies within the 470 MHz to 790 MHz band which have been identified by a TVWSDB for use by a TVWSD

TV White Space Database (TVWSDB): database system approved by the relevant national regulatory authority which can communicate with TVWSDs and provide information on TV white space availability

TV White Space Device (TVWSD): TVWSD controlled by a TVWSDB and which operates in TV white spaces

UHF TV band: 470 MHz to 790 MHz band

NOTE: This corresponds to DTT channels 21 to 60.

vertical geo-location capability: capability of a TVWSD to determine and report the altitude of its antenna

weblisting: publically available Internet listing of approved TVWSDB(s) relevant to a regulatory domain, and which is hosted by, or on behalf of the national regulatory authority for that regulatory domain

3.2 Symbols

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

A_{ch}	Number of active transmit chains
dB	decibel
dBc	decibel relative to carrier
dBm	decibel relative to 1 milliwatt
f	Frequency of measurement
f_c	Centre frequency of the assigned channel
$f_{l,i}$	Frequency at the lower edge of the ith channel
$f_{u,i}$	Frequency at the upper edge of the ith channel
f_{un}	Centre frequency of the unwanted signal
f_w	Centre frequency of the wanted signal
$P_{0,i}$	Maximum mean EIRP in a given (i^{th})100 kHz channel
$P_{1,i}$	Maximum mean EIRP in a given (i^{th}) 8 MHz channel
P_{IB}	Measured in block EIRP spectral density over 8 MHz
P_{IBk}	An intermediate (k^{th}) value of P_{IB}
P_{IBMax}	Maximum value of P_{IB}
PIM3	Power of the third order intermodulation product at frequency ($2 \times f_w - f_{un}$), measured in a 100 kHz bandwidth
P_{OOB}	Mean out of block EIRP spectral density
$p_{0,i}$	In-block EIRP spectral density (dBm/100 kHz) which a TVWSD intends to use within each DTT channel
$p_{1,i}$	In-block EIRP which a TVWSD intends to use within each (8 MHz) DTT channel
RIM3	third order reverse intermodulation attenuation
ΔRIM3	Improvement in the third order reverse intermodulation attenuation (RIM3)

T_{Dur} Time duration of the operational parameters
T_{ValEnd} Absolute time of the end of the period of validity of the operational parameters
$T_{ValStart}$ Absolute time of the start of the period of validity of the operational parameters

3.3   Abbreviations

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

AC   Alternating Current
ACLR   Adjacent Channel Leakage Ratio
BW   Bandwidth
DC   Direct Current
DHCP   Dynamic Host Configuration Protocol
DNS   Domain Name System
DTT   Digital Terrestrial Television
EIRP   Equivalent Isotropically Radiated Power
FAR   Fully Anechoic Room
GHz   GigaHertz
GNSS   Global Navigation Satellite System
IEEE   Institute of Electrical and Electronics Engineers
IETF   Internet Engineering Task Force
IP   Internet Protocol
LPDA   Logarithmic Periodic Dipole Antenna
MAC   Media Access Control
MHz   MegaHertz
OATS   Open Area Test Site
OUI   Organizationally Unique Identifier
R&TTE   Radio equipment and Telecommunications Terminal Equipment
RBW   Resolution Bandwidth
RF   Radio Frequency
RMS   Root Mean Square
SAR   Semi Anechoic Room
TE   Test Equipment
TV   Television
TVWSD   TV White Space Device
TVWSDB   TV White Space Database
UE   User Equipment
UHF   Ultra High Frequency
UUID   Universally Unique Identifier
UUT   Unit Under Test
VSWR   Voltage Standing Wave Ratio

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 declared by the supplier. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the declared normal and extreme operating conditions.

4.2   Conformance requirements

To meet the essential requirements under article 3.2 of the R&TTE Directive [i.3] the essential parameters have been identified. Table A.1 provides a cross reference between these essential parameters and the corresponding technical requirements for equipment within the scope of the present document. To fulfil an essential parameter the compliance with all the corresponding technical requirements in table A.1 shall be verified.

Where the technical requirements in the present document do not contain values for the operating limits, these values will be supplied individually by the TVWSDB according to national regulations.

4.2.1 Equipment types

For the purpose of the present document, two equipment types have been defined.

NOTE: It is envisaged that a TVWSD which is not fixed, will operate with an integral or dedicated antenna.

4.2.1.1 Equipment Type A

A Type A TVWSD is a device that is intended for fixed use only. This type of equipment can have integral, dedicated or external antennas.

4.2.1.2 Equipment Type B

A Type B TVWSD is a device that is not intended for fixed use and which has an integral antenna or a dedicated antenna.

The equipment and the antenna shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

In the case of dedicated antennas, the manufacturer has to specify the antennas that have been assessed together with the equipment against the requirements of the present document. That information shall be included in the user documentation. The use of other antennas is prohibited.

4.2.2 Nominal Channel Bandwidth and Total Nominal Channel Bandwidth

4.2.2.1 Definition

A Nominal Channel is defined as one or more contiguous DTT channels that are used by a TVWSD for its wanted transmissions.

The Nominal Channel Bandwidth is the bandwidth of a Nominal Channel. The Nominal Channel Bandwidth is a multiple of 8 MHz.

The Total Nominal Channel Bandwidth is the sum of all of the Nominal Channel Bandwidths used simultaneously by a TVWSD.

NOTE: A TVWSD may operate in a single DTT channel, or it may operate simultaneously in a group of contiguous DTT channels, multiple non-contiguous DTT channels, or a mixture of contiguous and non-contiguous DTT channels. See the examples in annex E.

4.2.2.2 Requirements

The lower and upper edge frequencies of a nominal channel shall coincide with the European harmonized DTT channel raster shown in figure 1.

DTT channel raster (MHz)	470 to 478	478 to 486	486 to 494	...	766 to 774	774 to 782	782 to 790

DTT channel numbers	21	22	23	...	58	59	60

Figure 1: European harmonized DTT channel raster

The Nominal Channel Bandwidth used by a TVWSD shall not exceed the Maximum Nominal Channel Bandwidth specified by the TVWSDB (see clause 4.2.6.2.1.2).

The Total Nominal Channel Bandwidth used by a TVWSD shall not exceed the Maximum Total Nominal Channel Bandwidth specified by the TVWSDB (see clause 4.2.6.2.1.2).

4.2.2.3   Conformance

Conformance tests as defined in clause 5.3.3 shall be carried out.

4.2.3   RF power and RF power spectral density

4.2.3.1   Definitions

4.2.3.1.1   RF power

The RF power is the mean Equivalent Isotropically Radiated Power (EIRP) averaged over the time period of a transmission burst.

4.2.3.1.2   RF power spectral density

The RF power spectral density is the mean Equivalent Isotropically Radiated Power (EIRP) over a bandwidth of 100 kHz or 8 MHz within a Nominal Channel (in-block) and averaged over the time period of a transmission burst.

4.2.3.2   Limits

The RF power and RF power spectral density radiated from a TVWSD shall not exceed the levels stated below irrespective of the number of transmit antennas:

- The RF power within DTT channel i shall not exceed the level $P_{1,i}$ dBm as specified by the TVWSDB for that channel.

- In the case of simultaneous operation in multiple DTT channels, the TVWSDB may direct a device to restrict its maximum total RF power as to min $\{P_{1,i}\}$ dBm, where $P_{1,i}$ is the RF power level specified by the TVWSD for DTT channel i. This restriction is communicated to the device by means of the simultaneous channel operation restriction parameter (see table 4). The RF power spectral density in any 100 kHz bandwidth within DTT channel i shall not exceed the level $P_{0,i}$ dBm as specified by the TVWSDB for that channel.

4.2.3.3   Conformance

Conformance tests as defined in clauses 5.3.2 and 5.3.3 shall be carried out.

4.2.4   Transmitter unwanted emissions

4.2.4.1   Transmitter unwanted emissions outside the 470 MHz to 790 MHz band

4.2.4.1.1   Definition

These are unwanted emissions from a TVWSD outside the 470 MHz to 790 MHz band when the TVWSD is in the transmit mode.

4.2.4.1.2   Limits

The level of these unwanted emissions shall not exceed the limits given in table 1. These limits apply to the overall emissions of a TVWSD and in any possible configuration.

NOTE: In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted) and to the emissions radiated by the cabinet. In case of integral antenna equipment (without temporary antenna connectors), these limits apply to emissions radiated by the equipment.

Table 1: Transmitter unwanted emission limits outside the 470 MHz to 790 MHz bands

Frequency Range	Maximum power	Measurement 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
790 MHz to 862 MHz	-54 dBm	100 kHz
862 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 4 GHz	-30 dBm	1 MHz

4.2.4.1.3   Conformance

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

4.2.4.2   Transmitter unwanted emissions within the 470 MHz to 790 MHz band

4.2.4.2.1   Definition

These are unwanted emissions from a TVWSD outside the nominal channels (out-of-block) within the 470 MHz to 790 MHz band when the TVWSD is in the transmit mode.

4.2.4.2.2   Limits

The out-of-block EIRP spectral density, P_{OOB}, of a TVWSD shall satisfy the following limit:

$$P_{OOB} \text{ (dBm / (100 kHz))} \leq \max\{\ P_{IB} \text{ (dBm / (8 MHz))} - ACLR \text{ (dB)}, -84 \text{ (dBm / (100 kHz))}\ \}$$

where P_{IB} is the measured in-block EIRP spectral density over 8 MHz, and ACLR is the adjacent channel leakage ratio outlined in the table 2 for different Device Emission Classes.

Each out-of-block EIRP spectral density is examined in relation to P_{IB} in the nearest (in frequency) DTT channel used by the TVWSD. Where there are two nearest (in frequency) DTT channels used, the one with the lower P_{IB} shall be considered.

The manufacturer shall declare which Device Emission Class from table 2 that the TVWSD complies with.

Table 2: Adjacent Channel Leakage Ratios (ACLR) for different Device Emission Classes

Where P_{OOB} falls within the nth adjacent DTT channel (based on 8 MHz wide channels)	ACLR (dB)				
	Class 1	Class 2	Class 3	Class 4	Class 5
n = ±1	74	74	64	54	43
n = ±2	79	74	74	64	53
n ≥ +3 or n ≤ -3	84	74	84	74	64

4.2.4.2.3   Conformance

Conformance tests as defined in clause 5.3.3 shall be carried out.

4.2.5   Transmitter Reverse Intermodulation Attenuation

4.2.5.1   Definition

The transmitter reverse intermodulation attenuation is a measure of the capability of the transmitter to inhibit the generation of intermodulation signals in its non-linear components caused by the presence of the transmitter wanted signal and an unwanted signal (e.g. from another TVWSD) reaching the transmitter via the antenna.

4.2.5.2   Limits

The level of the wanted signal shall be the maximum power that the device can support (P_{IBMax} (dBm)).

In the presence of an unwanted signal as described below:

a)   The level of the unwanted signal shall be 40 dB below P_{IBMax} (dBm).

b)   The unwanted signal shall be a continuous wave.

c)   The centre frequency of the unwanted signal (f_{un}) shall be offset at $\pm$ 8 MHz from the wanted signal centre frequency (f_w).

d)   Unwanted signals which are partially or completely outside the band 470 MHz to 790 MHz are excluded.

The third-order reverse intermodulation attenuation (RIM3) is defined (in decibels) as
$RIM3(P_{IB}) = (2 \times P_{IB}) + P_u - PIM3(P_{IB})$ where:

- P_{IB} = Mean in block power (dBm).

- P_{IBMax} = Maximum in block power (dBm) that the device can support.

- P_u = Power of the unwanted signal (dBm) which should be set to 40 dB below the maximum power that the device can support (P_{IBMax} (dBm)).

- PIM3 = Power (dBm) of the third order intermodulation product at frequency ($2 \times f_w - f_{un}$), measured in a 100 kHz bandwidth.

The device shall have a reverse intermodulation attenuation (RIM3) greater than 45 dB.

4.2.5.3   Conformance

Conformance tests as defined in clause 5.3.5 shall be performed.

4.2.6   Control and monitoring

The control and monitoring requirements:

- prevent a master TVWSD from transmitting in the absence of communications with an approved TVWSDB;

- prevent a slave TVWSD from transmitting in the absence of communications with a master TVWSD;

- require a master TVWSD or a slave TVWSD to transmit in accordance with instructions and parameters provided by approved TVWSDBs;

- prevent a master TVWSD from getting parameters from an TVWSDB that is not approved by the relevant national authority.

NOTE: The protocol used for data transfer between slave TVWSDs, master TVWSDs and TVWSDB are outside the scope of the present document.

4.2.6.1   TVWSDB identification

4.2.6.1.1   Definition

This is the process by which the master TVWSD identifies the weblisting of approved TVWSDB(s), and only contacts a TVWSDB which is in that weblisting.

4.2.6.1.2   Applicability

These requirements apply to a Master TVWSD only.

4.2.6.1.3   Requirements

At start up and before initiating any transmissions within the 470 MHz to 790 MHz band the master TVWSD shall identify and consult the weblisting. The master TVWSD shall not transmit within the 470 MHz to 790 MHz band if it cannot consult the weblisting.

The master TVWSD shall also reconsult this weblisting after no more than N minutes. The value N will be specified in the same weblisting as the approved TVWSDBs.

A master TVWSD shall not request operational parameters from (i.e. query) a TVWSDB that is not on the weblisting that corresponds to its geographical location.

NOTE: A non-exhaustive list of these weblistings is given in TR 103 231 [i.9].

If the weblisting is not accessible after the time specified by N has expired, the TVWSD shall:

a)   continue to use the weblisting that it already holds; and

b)   try to reconsult the weblisting at least as frequently as once every two hours thereafter but not more frequently than once per hour until such time as when the weblisting can be accessed.

4.2.6.1.4   Conformance

Conformance tests as defined in clause 5.3.11.1 shall be carried out.

4.2.6.2   Data exchange and compliance with parameters

This clause specifies requirements for the information that TVWSDs shall communicate and about their behaviour with regards to the information.

4.2.6.2.1   Definitions

This clause defines three sets of parameters: the Device Parameters, the Operational Parameters and the Channel Usage parameters as well as the information elements within each set. Specific protocol implementations may use different names for the parameter sets or for the individual information elements.

4.2.6.2.1.1   Device Parameters

These are the device parameters for either the master TVWSD or the slave TVWSD. The device parameters of a master TVWSD are communicated from the master TVWSD to the TVWSDB. The device parameters of a slave TVWSD are communicated from the slave TVWSD to the serving master TVWSD, which will then communicate these to the TVWSDB.

Table 3: Device Parameters

Parameter Name	Description
Antenna location	Latitude and longitude coordinates and altitude, e.g. in WGS84 format [1].
Antenna location uncertainty	Latitude, longitude, and altitude uncertainties specified as $\pm\Delta x$, $\pm\Delta y$ and $\pm\Delta z$ metres respectively, corresponding to a 95 % confidence level.
Device type	Type A or Type B.
Device category	Master or slave.
Unique device identifier - Manufacturer identifier	A set of characters representing the IEEE Organizationally Unique Identifier (OUI) of the manufacturer, or the Universally Unique Identifier (UUID).
Unique device identifier - Model identifier	A set of characters representing the manufacturer's model number or some identifier to identify the product family.
Unique device identifier - Serial number	A set of characters representing an identifier unique to this device for this manufacturer.
Technology identifier	A set of characters representing that allows to uniquely identify the technology. This may include: • name of the organization responsible for the technology specifications; • specification number, version and issue date.
Device Emission class	Class 1, Class 2, Class 3, Class 4 or Class 5. The device emission class number reported by the TVWSD to the TVWSDB is the Class with which the device complies with as specified in table 2.
Spectral mask improvement	Improvement, $\Delta ACLR(n_{IB}, n_{OOB}) \geq 0$ dB, in adjacent channel leakage ratio, as a function of the out-of-block DTT channel index, n_{OOB} (21 to 60), and the nearest in-block DTT channel index, n_{IB} (21 to 60). The improvement is in relation to the ACLR of the device emission class (see table 2) reported by the TVWSD. Where $\Delta ACLR$ is not reported for a certain (n_{IB}, n_{OOB}) combination, the TVWSDB will assume that $\Delta ACLR = 0$ dB. Note that the ACLRs cannot be smaller than the values specified for the most relaxed device emission class.
Reverse intermodulation attenuation improvement	The reverse intermodulation attenuation improvement $\Delta RIM3(P_{IBk}) \geq 0$ dB, as well as P_{IBk} where: $\Delta RIM3(P_{IBk}) = RIM3(P_{IBk}) - 45$ dB And for k different in-block power levels, P_{IBk} is a specific (k^{th}) in-block power level.
NOTE 1: The Unique device identifier is formed of three elements: the manufacturer identifier, the model identifier, and the serial number. NOTE 2: The IEEE Organizationally Unique Identifier (OUI) is a 24 bit number which has been assigned by the IEEE and which uniquely identifies a particular equipment vendor or manufacturer. Since the OUI is an essential element of all Ethernet Media Access Control (MAC) addresses, it is anticipated that all TVWSD vendors already have, or will need to obtain an OUI, for the purpose of assigning MAC addresses. NOTE 3: It is permitted to use an IETF UUID, as defined in RFC 4122 [4] in lieu of the IEEE OUI.	

4.2.6.2.1.2   Operational Parameters

The operational parameters are used by any TVWSD in order to configure its transmissions within the 470 MHz to 790 MHz band. All operational parameters are generated by the TVWSDB and communicated to the master TVWSD. Operational parameters for slave TVWSDs from the TVWSDB are communicated via the serving master TVWSD. The operational parameters may be communicated to the slave TVWSD by the master TVWSD as either as a single set of parameters or a series of sets of parameters.

Specific operational parameters are operational parameters that a TVWSDB calculates using the device parameters of a specific TVWSD as input. A TVWSDB will only provide specific operational parameters for a TVWSD if it has received the device parameters of that TVWSD.

Generic operational parameters are the operational parameters that any slave TVWSD in the coverage area of a serving master TVWSD can use. A TVWSDB will provide generic operational parameters to a master TVWSD, and the master will broadcast these parameters for all slave TVWSDs in its coverage area. The TVWSDB will calculate generic operational parameters using, as input, the device parameters of the master TVWSD and a set of assumptions about the slave TVWSDs.

   NOTE: The algorithms to calculate operational parameters and the assumptions for these calculations are outside the scope of the present document.

Table 4: Operational parameters

Parameters	Description
Lists of DTT channel edge frequency pairs	This is the list of frequency blocks where the TVWSD is allowed to transmit. The ith lower channel edge frequency, $f_{L,i}$ will be specified as $(470 + 8k_i)$ MHz, with the corresponding i^{th} upper channel edge frequency, $f_{U,i}$ specified as $(470 + 8k_i + 8)$ MHz, where $0 \le k_i \le 39$
Maximum in-block RF EIRP spectral density for each DTT channel edge frequency pair	$P_{0,\,i}$ (dBm / (0,1 MHz)) over the frequency interval $f_{L,i}$ to $f_{U,i}$
Maximum in-block RF EIRP for each DTT channel edge frequency pair	$P_{1,\,i}$ (dBm) over the frequency interval $f_{L,i}$ to $f_{U,i}$
Maximum nominal channel bandwidth	Maximum contiguous bandwidth (in Hz) allowed
Maximum total bandwidth	Maximum total bandwidth (in Hz) allowed, which may or may not be contiguous
Time validity start ($T_{ValStart}$)	Time when the operational parameters start being valid
Time validity end (T_{ValEnd})	Time when the operational parameters stop being valid. Alternatively, for slave TVWSDs, the serving master may indicate time validity by a permitted duration of operation, specified as T_{Dur} seconds instead of the pair $T_{ValStart}$ and T_{ValEnd}
Location validity (L_{Val})	Radius (in metres) of the circle centred on the reported location of the TVWSD, outside of which the operational parameters are not valid
Simultaneous channel operation power restriction (see note 2)	Can take values of 0 or 1. A value of 1 indicates the device that the power restriction in clause 4.2.3.2 applies, a value of 0 indicates that the power restriction does not apply. The default value is 0
Update timer (T_{Update})	This timer indicates how often (in seconds) the master TVWSD shall check with the TVWSDB that the operational parameters are still valid
NOTE 1: The TVWSDB specifies the maximum permitted in-block EIRP spectral density, P_0 (dBm in 0,1 MHz), and the maximum permitted RF EIRP, P_1 (dBm), that the TVWSD can use in each DTT channel.	
NOTE 2: If the simultaneous channel operation power restriction parameter is not provided, the device shall use the default value of 0.	

4.2.6.2.1.3   Channel Usage Parameters

The Channel Usage Parameters describe the radio resources (frequencies and powers) that a TVWSD intends to use. These radio resources may be the full set or a subset of the resources indicated by the TVWSDB in the Operational Parameters.

The Channel usage parameters are communicated from a master TVWSD to the TVWSDB, or from a slave TVWSD to its serving master TVWSD which it will forward to the TVWSDB.

Table 5: Channel usage parameters

Parameters	Description
List of lower and upper DTT channel edge frequencies within which a TVWSD intends to transmit	The ith lower and upper edges shall be specified as: $f_{L,i} = (470 + 8k_i)$ MHz, and $f_{U,i} = (470 + 8k_i + 8)$ MHz, where $0 \le k_i \le 39$.
In-block EIRP spectral density which a TVWSD intends to use within each DTT channel	Specified as $p_{0,\,i}$ (dBm / 0,1 MHz) over the frequency interval $f_{L,i}$ to $f_{U,i}$.
In-block EIRP which a TVWSD intends to use within each DTT channel	Specified as $p_{1,\,i}$ (dBm) over the frequency interval $f_{L,i}$ to $f_{U,i}$.

The operational parameter $P_{0,\,i}$ is the peak EIRP value in dBm that shall not be exceeded in *any* 100 kHz bandwidth within channel *i*.

The channel usage parameter $p_{0,i}$ is the peak EIRP value in dBm that the TVWSD shall not exceed in *any* 100 kHz bandwidth within channel *i*.

4.2.6.2.2   Transmission in compliance with parameters

4.2.6.2.2.1   Definitions

Operational parameters

A TVWSD is considered to be transmitting in accordance with a set of operational parameters if:

- The TVWSD only transmits in DTT channels that are in the list of available channels provided by the relevant TVWSDB.

- The TVWSD RF EIRP in each DTT channel does not exceed the maximum specified by the relevant TVWSDB.

- The TVWSD RF EIRP spectral density in each DTT channel does not exceed the maximum EIRP spectral density specified by the relevant TVWSDB.

- The Nominal Channel Bandwidth of each TVWSD nominal channel does not exceed the Maximum Nominal Channel Bandwidth specified by the relevant TVWSDB.

- The Total Nominal Channel Bandwidth used by the TVWSD does not exceed the Maximum Total Nominal Channel Bandwidth specified by the relevant TVWSDB.

- The TVWSD transmission time is between the time validity start ($T_{ValStart}$) and the time validity end (T_{ValEnd}) specified by the relevant TVWSDB.

- The estimated TVWSD location is less than L_{Val} away from the location reported to the TVWSDB at the time the operational parameters were obtained from the relevant TVWSDB.

Channel usage parameters

A TVWSD is considered to be transmitting in accordance with the set of channel usage parameters if:

- The TVWSD only transmits in DTT channels that are in the list of channels described by the said channel usage parameters.

- The RF EIRP in each DTT channel does not exceed the intended level declared in the channel usage parameters.

- The RF EIRP spectral density in each DTT channel does not exceed the intended level declared in the channel usage parameters.

4.2.6.2.2.2   Requirements

A master TVWSD shall not start transmissions in the UHF TV band unless it has received operational parameters from a TVWSDB.

A slave TVWSD shall not start transmissions in the UHF TV band unless it has received operational parameters, either generic or specific, from a master TVWSD.

A master TVWSD shall, at any point in time, only transmit in accordance with operational parameters that it has received from a TVWSDB.

A slave TVWSD shall, at any point in time, only transmit in accordance with specific or generic operational parameters received from a master TVWSD.

A master TVWSD shall, at any point in time, only transmit in accordance with the channel usage parameters that it has communicated to a TVWSDB.

If a slave TVWSD's usage parameters have been communicated to the TVWSDB, then the slave TVWSD shall transmit in accordance with the said channel usage parameters.

> NOTE: Communication between two slave devices is permitted providing that each of the slave TVWSDs is operating in accordance with the operational parameters given by its serving master TVWSD.

4.2.6.2.3   Reporting of device parameters

This requirement applies to:

- A master TVWSD that requires operational parameters.

- A slave TVWSD that requires specific operational parameters, or that intends to use the generic operational parameters broadcasted by a master TVWSD.

4.2.6.2.3.1   Definitions

The reporting of device parameters is understood as the communication from the TVWSD to the TVWSDB containing one or more of the parameters in table 3.

4.2.6.2.3.2   Requirements

A master TVWSD that requires operational parameters from a TVWSDB shall first accurately report its own device parameters to the TVWSDB. Apart from the location, these device parameters shall be declared by the manufacturer (see clause 5.3.1).

A slave TVWSD that requires specific operational parameters shall accurately report its own device parameters to the serving master TVWSD.

A slave TVWSD that intends to use the generic operational parameters broadcasted by a master shall accurately report its unique device identifier to the serving master. The slave TVWSD may also report its other device parameters.

If any of the parameters shown in table 3 cannot be reported to the TVWSDB then the device shall indicate that the parameter is not available.

4.2.6.2.4   Reporting of channel usage parameters

4.2.6.2.4.1   Definition

The reporting of channel usage parameters is understood as the communication from the TVWSD to the TVWSDB containing the parameters in table 5.

4.2.6.2.4.2   Requirements

A master TVWSD shall communicate its channel usage parameters to the TVWSDB prior to transmission.

A slave TVWSD shall communicate its channel usage parameters to its serving master TVWSDB, unless the slave TVWSD channel usage parameters have been chosen by the master TVWSD.

If a device frequency hops among DTT channels, then the channel usage parameters shall include the full list of DTT channels it intends to hop into, as well as the in-block EIRP and the EIRP spectral density it intends to use in each channel.

4.2.6.2.5   Functionality of a master TVWSD to support slave TVWSDs

A slave TVWSD receives operational parameters through a master TVWSD, and not directly from a TVWSDB. The requirements in this section relate to:

- the communication of the information that the master TVWSD receives from a TVWSDB and that is intended for one or all the associated slave TVWSDs; and

- the communication of the information that the master TVWSD receives from any associated slave TVWSD that is intended for the TVWSDB.

A master TVWSD may be able to broadcast generic operational parameters, which can be used by slave TVWSDs in the master's coverage area.

A master TVWSD may be able to support provision of specific operational parameters to slave TVWSDs in its coverage area.

4.2.6.2.5.1   Definitions

A subset of an initial set of operational parameters is defined as a set of operational parameters such that:

- It contains all or some of the DTT channels in the initial set.

- The maximum in-block RF EIRP spectral density in each DTT does not exceed the corresponding value in the initial set.

- The maximum in-block RF EIRP in each DTT channel does not exceed the corresponding value in the initial set.

- The maximum nominal channel bandwidth does not exceed the corresponding value in the initial set.

- The maximum total bandwidth does not exceed the corresponding value in the initial set.

- The time validity is equal to, or contained within, the time validity in the initial set.

- The location validity is equal or smaller than the location validity in the initial set.

4.2.6.2.5.2   Requirements

A master TVWSD that supports broadcast of generic operational parameters shall:

- report its device parameters to the TVWSDB in order to obtain said generic operational parameters;

- broadcast generic operational parameters that are equal to, or a subset of, those received from the TVWSDB;

- report to the TVWSDB its own Unique ID together with the device parameters of the slave TVWSD(s) which transmit using the generic operational parameters.

    NOTE: Some slave TVWSDs may only report their Unique Device Identifier.

A master TVWSD that supports provision of specific operational parameters to the slave TVWSDs in its coverage area shall:

- provide to the TVWSDB the device parameters of the slave TVWSDs for which it is requesting specific operational parameters;

- provide to each slave TVWSD specific operational parameters that are equal to, or a subset of, those received from the TVWSDB for that slave TVWSD.

A master TVWSD shall accurately communicate to the TVWSDB its own Unique ID together with the channel usage parameters that it may receive from its served slave TVWSDs.

4.2.6.2.6   Conformance

Conformance with the requirements in clause 4.2.6.2.2 to clause 4.2.6.2.5 shall be tested according to clause 5.3.11.2.

4.2.6.3   Master TVWSD update

4.2.6.3.1   Definition

The master TVWSD update is the process by which a TVWSDB informs a master TVWSD that its operational parameters, and those of the slave TVWSDs attached to it, are still valid or are no longer valid. The update can be initiated by either the master TVWSD or the TVWSDB.

4.2.6.3.2   Requirements

A master TVWSD shall support TVWSD update function.

A master TVWSD shall cease transmission, and shall instruct the slaves attached to it to cease transmission, if it receives update from the TVWSDB that the operational parameters are no longer valid.

A master TVWSD shall cease transmission, and shall instruct the slaves attached to it to cease transmission, if it fails to connect with the TVWSDB for a period which exceeds T_{Update}. The parameter T_{Update} is itself one of the operational parameters (see clause 4.2.6.2.1.2).

A master TVWSD shall update every T_{Update}.

A master TVWSD shall support a T_{Update} value of 60 seconds or higher.

A TVWSD is allowed to enter a sleep mode, i.e. inactive but not powered down. A master device that is in sleep mode, does not need to be reachable by the TVWSDB, and does not need to contact the TVWSDB, while it remains in sleep mode.

A master TVWSD which has been in sleep mode for longer than T_{Update} and wants to restart transmissions shall not transmit according operational parameters obtained before going into sleep mode until it has been updated by the TVWSDB that the operational parameters are still valid.

4.2.6.3.3 Conformance

Conformance with the requirements in clause 4.2.6.3.3 shall be tested according to clauses 5.3.6 and 5.3.7.

4.2.6.4 Slave TVWSD update

4.2.6.4.1 Definition

The slave TVWSD update is the process by which a master TVWSD informs a slave TVWSD that its operational parameters are still valid or are no longer valid.

4.2.6.4.2 Requirements

A slave TVWSD shall support TVWSD update function.

A slave TVWSD shall cease transmission when the master informs the slave TVWSD that its operational parameters are no longer valid.

A slave shall cease transmission within five seconds of discovering that it can no longer receive updates from its serving master TVWSD.

A TVWSD is allowed to enter a sleep mode, i.e. inactive but not powered down. A slave device that is in sleep mode, does not need to be reachable by the master device, and does not need to contact the master device, while it remains in sleep mode.

A slave TVWSD which has been in sleep mode for more than five seconds and wants to restart transmissions shall re-confirm its operational parameters with the serving master TVWSD before continuing transmissions.

4.2.6.4.3 Conformance

Conformance tests as defined in clauses 5.3.8 and 5.3.9 shall be carried out.

4.2.7 Receiver spurious emissions

4.2.7.1 Definition

These are unwanted RF emissions from a TVWSD at any frequency when the equipment is in receive mode.

4.2.7.2 Limits

The level of the receiver spurious emissions from a TVWSD shall not exceed the limits given in table 6.

NOTE: In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted) and to the emissions radiated by the cabinet. In case of integral antenna equipment (without temporary antenna connectors), these limits apply to emissions radiated by the equipment.

Table 6: Receiver spurious emission limits

Frequency range	Measurement bandwidth	Maximum power
30 MHz to 1 GHz	100 kHz	-57 dBm
1 GHz to 4 GHz	1 MHz	-47 dBm

4.2.7.3   Conformance

Conformance tests as defined in clause 5.3.10 shall be carried out.

4.2.8   Geo-Location capability

4.2.8.1   Definition

Geo-location capability is the capability of a TVWSD to determine and report the latitude and longitude (i.e. horizontal geo-location capability) and altitude (i.e. vertical geo-location capability) coordinates of its antenna.

4.2.8.2   Applicability

A master TVWSD shall have a horizontal geo-location capability.

A slave TVWSD may have a horizontal geo-location capability.

A TVWSD with a horizontal geo-location capability may also have a vertical geo-location capability.

4.2.8.3   Requirements

A TVWSD which has geo-location capability and is able to determine its location shall:

1)   report the geo-location coordinates of its transmit antenna(s), as part of its device parameters; and

2)   report its geo-location uncertainty (in metres), with a confidence level of 95 %, as part of its device parameters.

A Type B TVWSD that has geo-location capability shall confirm its location at least every 60 seconds except while in sleep mode.

A Type B TVWSD that has geo-location capability, has been in sleep mode, and wants to restart transmissions shall confirm its location before transmitting.

A TVWSD, whose location is more than L_{Val} away from the location reported to the TVWSDB, shall not transmit according to the operational parameters for the reported location.

NOTE: L_{Val} is part of the set of operational parameters, and it is recognized that there is a permitted geo-location uncertainty.

A TVWSD which had previously reported a location to the TVWSDB but it is no longer able to determine its location shall stop transmitting in accordance with the existing operational parameters.

A TVWSD which does not have horizontal geo-location capability, or does have horizontal geo-location capability but is not currently able to determine its location, shall indicate to the TVWSDB that horizontal geo-location is not available.

A TVWSD which does not have vertical geo-location capability, or does have vertical geo-location capability but is not currently able to determine its location, shall indicate to the TVWSDB that vertical geo-location is not available.

4.2.8.4   Conformance

Conformance tests as defined in clause 5.3.12 shall be carried out.

4.2.9　Software, Firmware and User Access Restrictions

4.2.9.1　Definition

Software, Firmware and User Access Restrictions are those measures which are intended to prevent changes which could adversely impact the compliance of the TVWSD with the requirements in the present document.

4.2.9.2　Requirement

The equipment shall not allow the user to have access to hardware or software settings that relate to the exchange of the parameters given in tables 4, 5 and 6, communicated between a TVWSD and a TVWSDB.

The equipment shall not allow the user to have access to hardware or software settings that relate to the TVWSDB identification (see clause 4.2.6.1).

The equipment shall not allow the user to have access to any hardware or software settings that adversely impact the compliance of the TVWSD with the requirements in the present document.

The equipment shall not accept the installation of software which can change the compliance of that equipment with the requirements in the present document.

Manufacturers who provide their software or firmware as open source code shall prevent modified software from having any impact on the compliance of the equipment with the requirements in the present document.

The configuration of equipment, and as such also the compliance with the requirements in the present document, shall not be made dependent of the correct selection by the user of the appropriate country of operation, or any other setting to be input by the end user.

4.2.9.3　Conformance

The manufacturer shall declare the measures it has taken to comply with the requirements given in clause 4.2.9.2 (see list of declared parameters in clause 5.3.1).

4.2.10　Security

4.2.10.1　Definition

Security is defined as the measures in order to support the concepts of Authentication and Integrity.

4.2.10.2　Requirements

Authentication

A master TVWSD shall authenticate the web server providing the weblisting using a widely accepted Internet authentication mechanism. A master TVWSD shall not use a weblisting from a web server that has not been authenticated.

A master TVWSD shall authenticate the TVWSDB using a widely accepted Internet authentication mechanism.

A master TVWSD shall not communicate its device or channel usage parameters, or the device or channel usage parameters of a slave TVWSD, to a TVWSDB that has not been authenticated.

A master TVWSD shall not use operational parameters obtained from a TVWSDB that has not been authenticated. A master TVWSD shall not provide generic or specific operational parameters to a slave TVWSD from a TVWSDB that has not been authenticated.

Integrity

A master TVWSD shall communicate with the TVWSDB using a protocol that includes functionality to avoid tampering with the exchange of parameters in transit.

A master TVWSD and a slave TVWSD shall communicate using a protocol that includes functionality to avoid corruption of the parameters in transit.

4.2.10.3   Conformance

The manufacturer shall declare the measures it has taken to comply with the security requirements given in clause 4.2.10.2 (see clause 5.3.1).

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5   Testing for compliance with technical requirements

The testing of device compliance with the technical specifications of clause 4 is described in this clause.

A TVWSD supplied by a manufacturer for testing is referred to as a unit under test (UUT).

The tests contained in this clause require an appropriate test TVWSDB. In addition the manufacturer shall provide the means to operate and control the UUT during the tests, including the ability to configure a UUT via the test TVWSDB (by specifying appropriate operational parameters).

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 (clause 5.3), the tests defined in the present document shall be carried out at representative points within the boundary limits of the declared normal and extreme test conditions (see clause 5.3.1 s)).

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 normal and extreme test conditions) to give confidence of compliance for the affected technical requirements.

5.1.2   Antennas

Equipment using integral antennas may be provided with temporary connectors for purposes of testing.

An antenna assembly referred to in the present document is understood as the combination of the antenna, 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 from beamforming.

Multiple antenna systems may use beamforming techniques which may result in additional (antenna) gain. This beamforming gain (Y) is specified in dB. Beamforming gain does not include the gain of the antenna assembly (G), or the gain resulting from adding the transmit powers from the antennas.

For a UUT with antenna connector(s) provided, conducted measurements shall be performed.

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

When performing radiated measurements, the UUT shall be configured and antenna(s) positioned (including smart antenna systems and systems capable of beamforming) for maximum EIRP towards the measuring antenna.

For radiated measurement, the relevant test procedure with the test set up as described in annex B and the applicable measurement procedures as described in annex C shall be used.

5.1.3 Transmit operating modes

Operating mode 1 (single antenna)

The equipment uses only one 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 two or more diversity antennas, but where at any moment in time only one antenna is used for transmission.

- Equipment with two or more antennas, but operating in a mode where only one antenna is used.

Operating mode 2 (multiple antennas, no beamforming)

The equipment that operates in this mode transmits simultaneously from multiple antennas but without beamforming.

Operating mode 3 (multiple antennas, with beamforming)

The equipment that operates in this mode transmits simultaneously from multiple antennas with beamforming.

In addition to the antenna assembly gain, G, the beamforming gain, Y, shall have to be taken into account when performing the measurements described in the present document.

5.1.4 Requirements for the test modulation

The modulation/multiple-access scheme used by the UUT for the purposes of testing shall be representative of normal use of the equipment. Where the equipment is not capable of continuous RF transmission, the test modulation/multiple-access scheme shall be such that transmissions occur regularly in time.

If the equipment uses multiple modulation methods with different RF characteristics, the modulation that produces the worst measured values (values which comply with the limits by the smallest margin) for each essential test shall be used, and this modulation shall be declared along with the rationale for why this modulation produces worse values than other modulation methods used by the equipment.

5.1.5 Communication between test TVWSDB, master and slave UUT

For the purpose of the tests defined in the essential test suites, a master UUT shall be connected to an appropriate test set-up (which incorporates a test TVWSDB) using a non-radio link. The TE shall be configured to allow a master UUT or master test TVWSD to readily identify (or otherwise consult) its test TVWSDB upon connection.

The master UUT shall be configured to operate with an appropriate TE (test TVWSDB).

The communication protocol between the slave TVWSD and the master TVWSD will be defined by the radio technology specifications of the TVWSDs being tested.

The above are illustrated in figure 2.
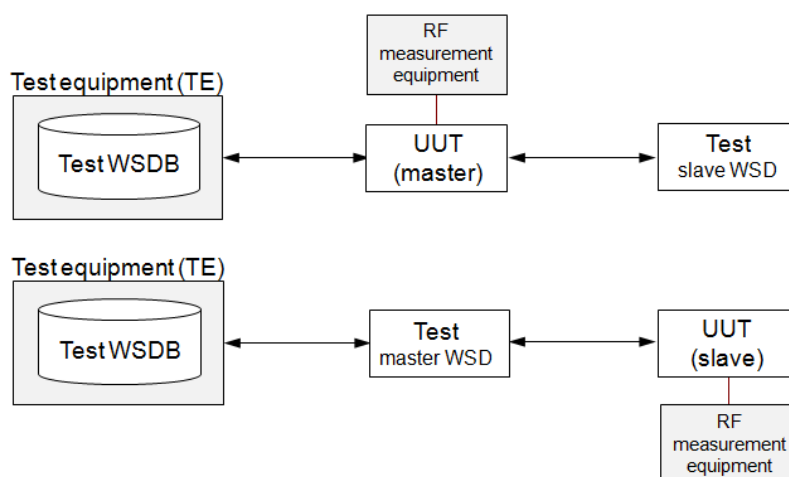
Figure 2: Test set up

5.1.6   Operational Parameter set

The operational parameters shall be set as follows:

- The permitted channel edge frequencies correspond to those of one or more DTT channels that fall within the operating frequency range declared by the manufacturer.

- The values for the maximum permitted mean in-block EIRP spectral densities (in 100 kHz and 8 MHz) within the permitted channel frequency boundaries shall be greater than the maximum mean in-block EIRP spectral densities that the manufacturer has declared by the manufacturer for the device.

- The values for the Maximum nominal channel bandwidth and maximum total bandwidth are equal to those declared by the manufacturer.

- A time validity of 60 minutes and a location validity of 50 metres.

- A T_{Update} of 60 seconds.

- A simultaneous channel operation power restriction value of 0, i.e. no restriction.

5.2   Interpretation of 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	$\pm 1 \times 10^{-7}$
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	±5 %

5.3   Essential test suites

5.3.1   Product Information

The following information shall be stated by the supplier in order to carry out the test suites and/or to declare compliance to the technical requirements (i.e. technical requirements for which no conformance test is included in the present document). This information shall form an integral part of the test report. The application form contained in annex F may be used to provide this information.

a)   The unique identifier, device emission class (1, 2, 3, 4 or 5), technology identifier, type (A or B) and category (master or slave) of the UUT.

NOTE 1: The provision of the unique identifier is only required in order to enable the appropriate communication between the UUT and the TE.

b)   The operating frequency range(s) of the equipment within the 470 MHz to 790 MHz band.

c)   A declaration as to whether the UUT can support simultaneous transmissions in multiple DTT channels (contiguous and/or non-contiguous).

d)   The nominal channel bandwidth(s) supported (n × 8 MHz where n ≥ 1).

e)   The maximum *total* nominal channel bandwidth supported (m × 8 MHz where m ≥ 1).

f)   Groupings of DTT channels.

NOTE 2: If the declared nominal channel bandwidths are 8 MHz and 16 MHz, and the declared maximum total nominal channel bandwidth is 32 MHz, then the following DTT channel groupings are possible (where "-" separates non-contiguous DTT channels): 1, 1-1, 1-2, 1-1-1, 1-1-1-1, 1-1-2, 2-2.

g)   The maximum RF power spectral density (EIRP) in 100 kHz supported by the UUT.

h)   The maximum RF power (EIRP) supported by the UUT.

i)   The types of modulation and multiple access schemes employed by the UUT.

j)   The modulation and multiple access scheme used by the UUT for each of the RF tests (see clause 5.1.4).

k)   The integral or dedicated antenna design used by the equipment and measures to prevent the user from connecting a different antenna.

l)   For a TVWSD with dedicated antenna(s), the antenna gain of the antenna assembly, and any beamforming gain (beyond the summation of the emissions from each antenna) intended to be used in combination with the equipment.

m)   For a Type A TVWSD with external antenna(s), the highest value of antenna gain intended to be used with the equipment.

n)   The different transmit operating modes in which the equipment can operate (see clause 5.1.3).

o)   A declaration of whether (in the case of slave TVWSDs) the equipment has horizontal geo-location capability, and also whether (in the case of master TVWSDs and slave TVWSDs) the equipment includes vertical geo-location.

p)   For a slave UUT, the manufacturer shall declare if the UUT is capable of requesting specific operational parameters from a master TVWSD.

q)   For a slave UUT, the manufacturer shall declare whether the UUT is capable of communicating directly with another slave TVWSD. If the UUT has such a capability, the manufacturer shall also declare that the UUT will remain under the control of its serving master TVWSD when operating in this mode.

r)   With regards to user access restrictions, the manufacturer shall declare that the controls (hardware or software) related to the exchange of information between the UUT and a TVWSDB, and the controls (hardware or software) that define the operation of the UUT have been made inaccessible to the user (see clause 4.2.9).

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

t)   For each of the tests to be performed, the worst case operational mode (e.g. power settings, modulation, antennas, etc.) with respect to the test being performed.

u)   The manufacturer shall also declare the parameters described above for any test master TVWSD or test slave TVWSD which it provides for the purposes of testing the UUT.

v)   How the equipment meets the security requirements in clause 4.2.10.

w)   The regulatory domains supported by the device.

5.3.2   RF output power

5.3.2.1   Test conditions

See clause 5.1 for the test conditions. The measurements for RF output power shall be performed at both normal environmental conditions and at the extremes of the operating temperature range.

In the case of equipment intended for use with an integral antenna and where no external (temporary) antenna connectors are provided, a test fixture as described in clause B.3 may be used to perform relative measurements at the extremes of the operating temperature range.

The equipment shall be operated under its worst case configuration (for example modulation, bandwidth, data rate, power) with regards to RF output power. Measurement of multiple data sets may be required.

5.3.2.2   Test method

5.3.2.2.1   Conducted measurements

In case of conducted measurements the transmitter shall be connected to the measuring equipment by a suitable method. The RF power as defined in clause 4.2.3 shall be measured and recorded.

The test procedure shall be as follows:

Step 1:

- Use a fast power sensor suitable for a minimum of 1 GHz and suitable for measurements at 1 MS/s or faster.

- Use the following settings:

  - Sample speed 1 MS/s or faster.

  - The samples shall represent the power of the signal.

  - Measurement duration: sufficient to capture a minimum of 10 bursts.

NOTE 1: The above sampling speed assumes the minimum transmission time is at least 20 µs; otherwise the sampling speed needs to be adjusted accordingly.

Step 2:

- For conducted measurements on devices with one transmit chain:

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

- For conducted measurements on devices with multiple transmit chains:

  - Connect one power sensor to each transmit port for a synchronous measurement on all transmit ports.

  - Trigger the power sensors so that they start sampling at the same time. Make sure the time difference between the samples of all sensors is less than 500 ns.

  - For each individual sampling point (time domain), sum the coincident power samples of all ports and store them. Use these summed samples in all following steps.

Step 3:

- Find the start and stop times of each burst in the stored measurement samples.

  The start and stop times are defined as the points where the power is at least 30 dB below the highest value of the stored samples in step 2.

  NOTE 2: In case of insufficient dynamic range, the value of 30 dB may need to be reduced appropriately.

Step 4:

- Between the start and stop times of each individual burst calculate the RMS power averaged over the burst using the formula below. Save these P_{burst} values, as well as the start and stop times for each burst.

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

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

Step 5:

- The highest of all P_{burst} values (value "A" in dBm) will be used for maximum EIRP calculations.

Step 6:

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

- If applicable, add the additional beamforming gain "Y" in dB.

- If more than one antenna assembly is intended for this power setting, the maximum overall antenna gain (G or G + Y) shall be used.

- The RF Output Power (P) shall be calculated using the formula below:

$$P = A + G + Y$$

- This value, which shall comply with the limit given in clause 4.2.3.2, shall be recorded in the test report.

5.3.2.2.2   Radiated measurements

This method shall only be used for integral antenna equipment which does not have a temporary antenna connector(s) provided.

When performing radiated measurements, the UUT shall be configured and antenna(s) positioned (including smart antenna systems and systems capable of beamforming) for maximum EIRP towards the measuring antenna.

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

Taking into account the calibration factor from the measurement site, the test procedure is further as described under clause 5.3.2.2.1.

5.3.3 Power Spectral Density and Transmitter unwanted emissions within the 470 MHz to 790 MHz band

5.3.3.1 Test conditions

See clause 5.1 for the test conditions. These measurements shall be performed at normal test conditions.

The UUT shall be configured to transmit under normal operating conditions which result in the lowest adjacent frequency leakage ratios inside the 470 MHz to 790 MHz band.

The UUT shall be configured to the worst case operational mode for this requirement.

5.3.3.2 Test method

5.3.3.2.1 Conducted measurement

The transmitter shall be connected to a spectrum analyser and the power spectral density as defined in clause 4.2.3 shall be measured and recorded.

For a UUT that can at most transmit in a single DTT channel, the test TVWSDB shall be configured as follows:

- Set the permitted lower channel edge frequency and upper channel edge frequency so that they coincide with the lowest DTT channel in the operating frequency range declared by the manufacturer.

- Set the maximum permitted in-block RF power spectral density (in 100 kHz) to the maximum in-block RF power spectral density (in 100 kHz) declared by manufacturer.

- Set the maximum permitted in-block RF power (in 8 MHz) to the UUT maximum in-block RF power (in 8 MHz) declared by manufacturer.

When the tests have been performed, they should then be repeated with the equipment set to the middle and highest DTT channels in the operating frequency range declared by the manufacturer.

For a UUT that can also transmit simultaneously in a group of contiguous DTT channels, the test shall be repeated with the test TVWSDB configured as follows:

- Set the permitted lower and upper channel edge frequencies so that they coincide with those of a group of contiguous DTT channels that fall at the middle of the operating frequency range declared by the manufacturer.

- Set the maximum nominal channel bandwidth in accordance with the highest value declared by the manufacturer.

- Set the maximum permitted in-block RF power spectral density (in 100 kHz) for each DTT channel to the maximum in-block RF power spectral density (in 100 kHz) declared by the manufacturer.

- Set the maximum permitted in-block RF power spectral density (in 8 MHz) for each DTT channel to the UUT maximum in-block RF power spectral density (in 8 MHz) declared by manufacturer.

For a UUT that can also transmit simultaneously in multiple non-contiguous (or a mixture of contiguous and non-contiguous) DTT channels, the test shall be repeated with the test TVWSDB configured as follows:

- Set the permitted lower and upper channel edge frequencies so that they correspond to multiple non-contiguous (or a mixture of contiguous and non-contiguous) DTT channels that fall within the operating frequency range declared by the manufacturer.

- Set the maximum total nominal channel bandwidth in accordance with the maximum total nominal channel bandwidth declared by the manufacturer.

- Set the maximum permitted in-block RF power spectral density (in 100 kHz) for each DTT channel to the maximum in-block RF power spectral density (in 100 kHz) declared by the manufacturer.

- Set the maximum permitted in-block RF power spectral density (in 8 MHz) for each DTT channel to the UUT maximum in-block RF power spectral density (in 8 MHz) declared by manufacturer.

The tests shall be repeated for a selection of the declared grouping of DTT channels.

The test procedure shall be as follows:

Step 1:

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

- Start Frequency: 470 + RBW / 2 MHz

- Stop Frequency: 790 - RBW / 2 MHz

- Resolution BW (RBW):   10 kHz

- Video BW: 30 kHz

- Sweep Points/"Samples":   Frequency span / RBW

  For spectrum analysers not supporting this number of sweep points, the frequency band shall be segmented. But the Start / Stop Frequency for any segment shall always coincide with a DTT channel edge, taking into account the RBW.

- Detector: RMS

- Trace Mode: Max Hold

- Sweep time: 1 ms per sample point

For non-continuous signals, wait for the trace to be stabilized.

Save the data (trace data) set to a file.

Step 2:

For conducted measurements on smart antenna systems using either operating mode 2 or operating mode 3 (see clause 5.1.3), repeat the measurement for each of the transmit ports. For each sampling point (frequency domain), add up the coincident (power) values for the different transmit chains and use this as the new data set.

Step 3:

Add up the values (in the linear domain) for power for all the Sweep Points (P_{sample}) in the file using the formula below:

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

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

Step 4:

Normalize the individual values for power so that the sum is equal to the RF Output Power (EIRP) measured in clause 5.3.2.

Step 5:

Consider the samples in the first DTT channel.

Step 6:

Starting from the first sample in the file (lowest frequency), add up the power of the first 10 samples representing a 10 kHz segment and record the results for power and position (i.e. sample number 1 to sample number 10). This is the Power Spectral Density (EIRP) for the first 100 kHz segment within the DTT channel being considered, which shall be recorded.

Step 7:

Within the current DTT channel, shift the start point of the samples added up in step 6 by one sample and repeat the procedure in step 6 (i.e. sample number 2 to sample number 11).

Step 8:

Repeat step 7 until the end of the data set for the DTT channel being considered, and record the power spectral density values for each of the 100 kHz segments within this DTT channel.

Step 9:

Compare the power spectral density measured for each of the 100 kHz segment with the limit (in-band power spectral density (clause 4.2.3), or unwanted emission (clause 4.2.4.2), as appropriate) that applies for this DTT channel.

If the device is reporting a spectral mask improvement, check that the power spectral density of the segment being considered is below $P_{OOB} - \Delta ACLR(n_{IB}, n_{OOB})$. P_{OOB} is the out of block emission for the device emission class being declared, and $\Delta ACLR(n_{IB}, n_{OOB})$ is the value obtained by the test database for the corresponding in block channel (n_{IB}) and the out of block section being considered.

Step 10:

Repeat step 6 to step 9 for the samples in each subsequent DTT channel.

Step 11:

For DTT channels in which the UUT has wanted emissions, add up the power for the corresponding 800 samples (10 kHz segments) that fall within this DTT channel. This is the total power within this 8 MHz channel. This value shall be compared to the limit that applies for this DTT channel.

5.3.3.2.2   Radiated measurement

This method shall only be used for integral antenna equipment which does not have a temporary antenna connector(s) provided.

When performing radiated measurements, the UUT shall be configured and antenna(s) positioned (including smart antenna systems and systems capable of beamforming) for maximum EIRP towards the measuring antenna.

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

Taking into account the calibration factor from the measurement site, the test procedure is further as described under clause 5.3.3.2.1.

5.3.4   Transmitter unwanted emissions outside the 470 MHz to 790 MHz bands

The objective of these tests is to ensure that the UUT unwanted emissions outside the 470 MHz to 790 MHz band comply with the requirements set out in clause 4.2.4.1.

5.3.4.1   Test conditions

See clause 5.1 for the test conditions. These measurements shall be performed at normal test conditions.

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

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

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

The UUT shall be configured to the worst case operational mode for this requirement.

For a UUT which is capable of transmitting simultaneously in multiple DTT channels, the UUT shall be configured to transmit in one group of contiguous DTT channels, with equal power in each DTT channel, and at the maximum total nominal channel bandwidth declared by the manufacturer.

The UUT shall be configured such that the occupied nominal channels are tested at the upper and lower ends of the operating frequency range declared by the manufacturer.

5.3.4.2   Test method

5.3.4.2.1   Conducted measurements

The UUT shall be connected to a spectrum analyser.

a)   Frequency scan

The frequency scan test procedure shall be used to identify potential transmitter unwanted emissions of the UUT.

Step 1:

The sensitivity of the measurement set-up shall be such that the noise floor is at least 12 dB below the limits given in table 1.

Step 2:

The emissions shall be measured over the range 30 MHz to 1 000 MHz (but excluding the 470 MHz to 790 MHz band) with the following spectrum analyser settings:

Parameter	Value
Resolution Bandwidth:	100 kHz
Video Bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold
Sweep points:	≥ 9 700
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.

Any emissions identified during the above sweeps which fall above the applicable limit, or within the 6 dB range below the applicable limit given in table 1 shall be individually measured using the *measurement of identified emissions* procedure below.

Step 3:

The emissions shall now be measured over the range 1 GHz to 4 GHz with the following spectrum analyser settings:

Parameter	Value
Resolution Bandwidth:	1 MHz
Video Bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold
Sweep points:	≥ 3 000
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.

Any emissions identified during the above sweeps which fall above the applicable limit, or within the 6 dB range below the applicable limit given in table 1 shall be individually measured using the *measurement of identified emissions* procedure below.

Step 4:

In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), the step 2 and step 3 need to be repeated for each of the active transmit chains (A_{ch}).

The limits used to identify emissions during this frequency scan need to be reduced by $10 \times \log_{10}(A_{ch})$; where A_{ch} is the number of active transmit chains.

b)   Measurement of the emissions identified during the frequency scan

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

Step 1:

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

Parameter	Value
Centre Frequency:	Frequency of emission identified during the frequency scan
Resolution Bandwidth:	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
Video Bandwidth:	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Frequency Span:	Wide enough to capture each individual emission identified during the frequency scan
Sweep Mode:	Continuous
Sweep Time:	Auto
Trigger:	Free run
Detector:	RMS
Trace Mode:	Max Hold

Step 2:

In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), the step 1 needs to be repeated for each of the active transmit chains (A_{ch}).

The trace data for each transmit chain has to be recorded.

Sum the power in each of the traces for each individual frequency bin.

Step 3:

Use the marker function to find the highest peak within the measurement trace and record its value and its frequency.

Step 4:

The measured values shall be compared to the limits defined in table 1.

Repeat the above procedures for every emission identified during the frequency scan.

5.3.4.2.2 Radiated measurements

For radiated measurement, the above test procedure with the test set up as described in annex B shall be used.

5.3.5 Transmitter Intermodulation

The objective of this test is to verify whether the UUT complies with the requirements and limits in clause 4.2.5.2.

5.3.5.1 Measurement Arrangement
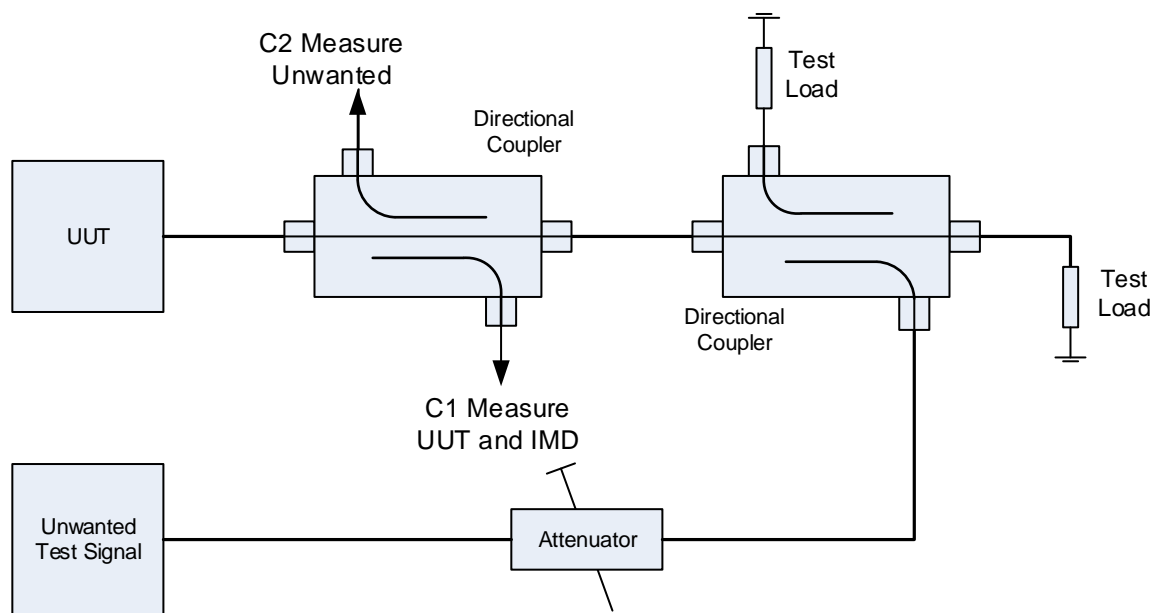
Figure 3: Transmitter Intermodulation Test Set-Up

The test set-up is shown in figure 3.

5.3.5.2 Test Method

Step 1: Configure the UUT to operate on the centre channel of the range declared by the manufacturer, and to operate at the maximum RF output power level (P_{IBMax}).

Step 2: Connect the power meter to the port C1 of the directional coupler. Measure the output power of the UUT taking account of the coupling loss of the coupler.

Step 3: Connect the power meter to port C2 of the directional coupler. Switch on and configure the signal generator to produce the unwanted test signal as defined in clause 4.2.5.2.

Step 4: Connect the spectrum analyser to port C1 of the directional coupler and measure the level of the third-order product which is at the frequency $2 \times f_w - f_{un}$. This should be measured in a 100 kHz bandwidth. Confirm that the UUT complies with the requirements contained in clause 4.2.5.2.

If the device supports the reporting of the intermodulation improvement ($\Delta RIM3(P_{IBk})$) the following additional steps need to be performed.

Step 5: Decrease the power P_{IBk-1} to next power down ($P_{IBk-1} < P_{IBk}$) and measure the third intermodulation product as described in step 4. Calculate $\Delta RIM3(P_{IBk})$ and check that is it higher or equal to the value reported to the test database.

Step 6: Repeat step 5 for decreasing values of k until the last supported power is used (P_{IB1}).

5.3.6 Master TVWSD update

This test verifies that a master TVWSD complies with the requirements in clause 4.2.6.3.

5.3.6.1 Test conditions

For the purposes of carrying out this test, the master device shall be set to a test mode that bypasses the authentication of the weblisting server and of the controlling TVWSDB.

The UUT shall be configured to:

1) identify the test TVWSDB in the TE, obtain operational parameters from the TVWSDB for itself and operate according to those parameters;

2) if the UUT supports broadcasting generic operational parameters, consult the test TVWSDB to obtain generic operational parameters;

3) if the UUT supports provision of specific operational parameters to slave TVWSDs, process the request for specific operational parameters from the test slave.

If the UUT does not support sleep mode, the test TVWSDB shall be configured to (CONFIGURATION1):

1) allow the UUT to identify the test TVWSDB in the TE;

2) emulate the normal operations of a TVWSDB in terms of its data exchange with a master device;

3) provide the operational parameters described in the operational parameter set (see clause 5.1.6) when:

    a) the UUT requests operational parameters for itself;

    b) the UUT requests generic operational parameters; and

    c) the UUT requests specific operational parameters for the test slave;

4) 60 seconds after of providing operational parameters to the master TVWSD, update the master TVWSD that the operational parameters are still valid;

5) 120 seconds after providing operational parameters to the master TVWSD, update the master TVWSD that its operational parameters and those of slave TVWSDs attached to it are no longer valid.

If the UUT supports sleep mode, the test TVWSDB shall be configured to (CONFIGURATION2):

1) Items 1) to 3) in CONFIGURATION1 above.

2) Update the UUT every 60 seconds to confirm that the operational parameters are still valid.

The test slave TVWSD shall be configured to use generic operational parameters - if the UUT supports this functionality - and to request generic and specific operational parameters - if the UUT supports this functionality.

5.3.6.2 Test method

The following test method applies to all master TVWSDs. The test TVWSDB shall be configured in accordance with CONFIGURATION1:

a) Switch off the UUT. Switch off the test slave TVWSD. Connect the UUT to the TE. Connect the test slave TVWSD to the UUT. Connect the UUT to a spectrum analyser.

b) Switch on the UUT. Switch on the test slave TVWSD. Confirm that the UUT consults the TE and identifies the TVWSDB.

c) Confirm that the UUT identifies the test TVWSDB, obtains operational parameters for itself and transmits in accordance with the operational parameters via the spectrum analyser.

d) Confirm that the test slave TVWSD obtains generic operational parameters and specific operational parameters - if the UUT supports the functionalities to provide these.

e) Confirm that, 60 seconds after the operational parameters for the UUT where provided, the UUT either requests an update from the test TVWSDB (pull mode) or acknowledges reception of an update from the test TVWSDB (push mode).

f) Confirm via the spectrum analyser that the UUT is still transmitting according to the operational parameters provided by the test TVWSDB.

g) Confirm that, 120 seconds after the operational parameters for the UUT were provided, the UUT either requests an update from the test TVWSDB (pull mode) or acknowledges reception of an update from the test TVWSDB (push mode).

h) Confirm via the spectrum analyser that the UUT has stopped transmitting in the 470 MHz to 790 MHz band.

i) Confirm that the UUT has communicated the test slave TVWSD to stop transmitting.

In addition, if the UUT supports sleep mode, the following test should be carried out. The test TVWSDB shall be configured in accordance with CONFIGURATION2:

a) Repeat step a) to step f) above.

b) Wait 3 minutes. Instruct the UUT to go into sleep mode for 150 seconds. Confirm, via the spectrum analyser, that the UUT stops transmissions.

c) Confirm, via the spectrum analyser, that the UUT does not transmit in the 470 MHz to 790 MHz band for at least 150 seconds.

d) Confirm that the UUT either requests an update from the test TVWSDB (pull mode) or acknowledges an update from the test TVWSDB (push mode) before starting transmissions.

e) Confirm, via the spectrum analyser, that the UUT transmits in accordance with the operational parameters provided by the test TVWSDB.

5.3.7 Lost connection between the master TVWSD and the TVWSDB

5.3.7.1 Test conditions

For the purposes of carrying out this test, the UUT shall be set to a test mode that bypasses the authentication of the weblisting server and of the controlling TVWSDB.

The UUT shall be configured to:

1) identify the test TVWSDB in the TE, obtain operational parameters from the TVWSDB for itself and operate according to those parameters;

2) if the UUT supports generic operational parameters, consult the test TVWSDB to obtain generic operational parameters;

3) if the UUT supports provision of specific operational parameters to slave TVWSDs, process the request for specific operational parameters from the test slave.

The test TVWSDB shall be configured to:

1) allow the UUT to identify the test TVWSDB in the TE;

2) emulate the normal operations of a controlling TVWSDB in terms of its data exchange with a master device;

3) provide the operational parameters described in the operational parameter set (clause 5.1.6) when:

   a) the UUT requests operational parameters for itself;

   b) the UUT requests generic operational parameters; and

   c) the UUT requests specific operational parameters for the test slave.

The test slave TVWSD shall be configured to use generic operational parameters - if the UUT supports this functionality - and to request generic and specific operational parameters - if the UUT supports this functionality.

5.3.7.2   Test method

a)   Switch off the UUT. Switch off the test slave TVWSD. Connect the UUT to the TE. Connect the test slave TVWSD to the UUT. Connect the UUT to a spectrum analyser.

b)   Switch on the UUT. Switch on the test slave TVWSD. Confirm that the UUT consults the TE and identifies the test TVWSDB.

c)   Confirm that the UUT identifies the test TVWSDB, obtains operational parameters for itself and transmits in accordance with the operational parameters via the spectrum analyser.

d)   Confirm that the test slave TVWSD obtains generic operational parameters and specific operational parameters - if the UUT supports the functionalities to provide these.

e)   Confirm that, 60 seconds after the operational parameters for the UUT where provided, the UUT either requests an update from the test TVWSDB (pull mode) or acknowledges reception of an update from the test TVWSDB (push mode).

f)   Confirm via the spectrum analyser that the UUT is still transmitting in accordance with the operational parameters provided by the test TVWSDB.

g)   Disconnect the UUT from the test TVWSDB.

h)   Confirm that, no later than 60 seconds after g), the UUT stops transmissions and commands the test slave to stop transmissions.

5.3.8   Slave TVWSD update - specific parameters invalidated

5.3.8.1   Test conditions

For the purposes of carrying out this test, the master device shall be set to a test mode that bypasses the authentication of the weblisting server and of the controlling TVWSDB.

The UUT shall be configured to:

1)   identify the test TVWSDB in the TE, obtain operational parameters from the TVWSDB for itself and operate according to those parameters;

2)   if the UUT supports broadcasting generic operational parameters, consult the test TVWSDB to obtain generic operational parameters;

3)   provision of specific operational parameters to slave TVWSDs, process the request for specific operational parameters from the test slave.

5.3.8.2   Test method

The test method below applies to the case where specific operational parameters for a slave UUT are invalidated. The test method applies to conducted measurements and the measurement procedure shall be as follows:

a)   Switch off the UUT. Connect the UUT to a test master TVWSD (which is itself connected to the test TVWSDB) and a spectrum analyser.

b)   Switch on the UUT. Confirm, via the spectrum analyser, that the UUT transmits according to either generic operational parameters or the specific operational parameters provided by the test TVWSDB.

c)   Command the test master TVWSD to update the UUT that its specific operational parameters are no longer valid.

d)   Confirm, via the spectrum analyser, that the UUT stops transmitting in accordance with the specific operational parameters provided.

NOTE: The UUT may continue transmitting according to the generic operational parameters.

If the UUT supports sleep mode, the following additional steps shall be carried out:

   e)   Repeat step a) and step b).

   f)   Wait three minutes. Instruct the UUT to go into sleep mode for 150 seconds. Confirm, via the spectrum
        analyser, that the UUT stops transmissions.

   g)   Set the master TVWSD to indicate to the UUT that the specific operational parameters are not valid.

   h)   Confirm, via the spectrum analyser, that the UUT does not transmit for at least 150 seconds.

   i)   Once the 150 seconds have elapsed, confirm, via the spectrum analyser, that the UUT does not resume
        transmission according to the specific operational parameters it had previously obtained.

5.3.9   Slave TVWSD update - loss of communication with master TVWSD

5.3.9.1   Test conditions

For the purposes of carrying out this test, the master device shall be set to a test mode that bypasses the authentication
of the weblisting server and of the controlling TVWSDB.

The UUT shall be configured to:

   1)   identify the test TVWSDB in the TE, obtain operational parameters from the TVWSDB for itself and operate
        according to those parameters;

   2)   if the UUT supports broadcasting generic operational parameters, consult the test TVWSDB to obtain generic
        operational parameters;

   3)   if the UUT supports provision of specific operational parameters to slave TVWSDs, process the request for
        specific operational parameters from the test slave.

5.3.9.2   Test method

The test method below applies to the case where a slave UUT loses communications with the master test TVWSD. The
test method applies to conducted measurements and the measurement procedure shall be as follows:

   a)   Switch off the UUT. Connect the UUT to a test master TVWSD (which is itself connected to the test
        TVWSDB) and a spectrum analyser.

   b)   Switch on the UUT. Confirm, via the spectrum analyser, that the UUT transmits according to either generic
        operational parameters or the specific operational parameters provided by the test TVWSDB.

   c)   Disconnect the master TVWSD from the UUT.

   d)   Confirm, via the spectrum analyser, that the UUT stops transmitting within five seconds.

5.3.10   Receiver spurious emission

The objective of these tests is to ensure that the UUT receiver spurious emissions comply with the specifications set out
in clause 4.2.7.

5.3.10.1   Test conditions

For the duration of the test, the UUT shall be configured to operate in a continuous receive mode, or is operated in a
mode where no transmissions occur.

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

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

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

5.3.10.2   Test method

5.3.10.2.1   Conducted measurements

The UUT shall be connected to a spectrum analyser.

The frequency scan test procedure below shall be used to identify potential receiver spurious emissions of the UUT.

a)   Frequency scan

Step 1:

The sensitivity of the measurement set-up shall be such that the noise floor is at least 12 dB below the limits given in table 6.

Step 2:

The emissions shall be measured over the range 30 MHz to 1 000 MHz, with the following spectrum analyser settings:

Parameter	Value
Resolution Bandwidth:	100 kHz
Video Bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

Any emissions identified during the above sweeps which fall above the applicable limit, or within the 6 dB range below the applicable limit given in table 6 shall be individually measured using the *measurement of identified emissions* procedure below.

Step 3:

The emissions shall now be measured over the range 1 GHz to 4 GHz with the following spectrum analyser settings:

Parameter	Value
Resolution Bandwidth:	1 MHz
Video Bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

Any emissions identified during the above sweeps which fall above the applicable limit, or within the 6 dB range below the applicable limit in table 6, shall be individually measured using the measurement of emissions identified during frequency scan procedure below.

b)   Measurement of the emissions identified during the frequency scan

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

Step 1:

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

Parameter	Value
Centre Frequency:	Frequency of emission identified during the frequency scan
Resolution Bandwidth:	100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
Video Bandwidth:	300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
Frequency Span:	Wide enough to capture each individual emission identified during the frequency scan
Sweep Mode:	Continuous
Sweep Time:	Auto
Trigger:	Free run
Detector:	RMS
Trace Mode:	Max Hold

Step 2:

In case of conducted measurements on smart antenna systems (equipment with multiple receive chains), step 1 needs to be repeated for each of the active receive chains (A_{ch}).

The trace data for each receive chain has to be recorded.

Sum the power in each of the traces for each individual frequency bin.

Step 3:

Use the marker function to find the highest peak within the measurement trace and record its value and its frequency.

Step 4:

The measured values shall be compared to the limits defined in table 6.

Repeat the above procedures for every emission identified during the frequency scan.

5.3.10.2.2 Radiated measurements

For radiated measurement, the above test procedure with the test set up as described in annex B shall be used.

5.3.11 Control and monitoring functions

5.3.11.1 TVWSDB identification

The test verifies the requirements in clause 4.2.6.1.

5.3.11.1.1 Test condition

In this test, the UUT is configured to operate normally. The data port of the UUT (i.e. the port that it uses to connect to the Internet) shall be connected to the test port of the test equipment (TE). For the purposes of this test, the TE shall provide the following IP related functions:

- Logging of all the IP traffic to and from the UUT.

- Providing Internet connection to the UUT.

- Blocking the IP traffic between the UUT and certain Internet servers.

  NOTE 1: The TE may also act as an IP DNS server and DHCP server for the UUT.

If the UUT supports GNSS location, then a GNSS signal generator shall be connected to the UUT. The GNSS generator shall be capable of producing signals corresponding to positions located in all the geographical areas covered by the regulatory domains supported by the UUT.

If the UUT does not support GNSS location, then the UUT manufacturer shall provide the means to simulate locations in all the geographical areas covered by the regulatory domains supported by the UUT.

The UE antenna connector shall be connected to a power measuring equipment with an RF bandwidth that exceeds the total operating transmit frequency range of the UUT.

NOTE 2: The master TVWSD may need, prior to consulting the weblisting, to contact an Internet location server to obtain the address of the weblisting that corresponds to its geographical location.

The test arrangement is illustrated in figure 4.
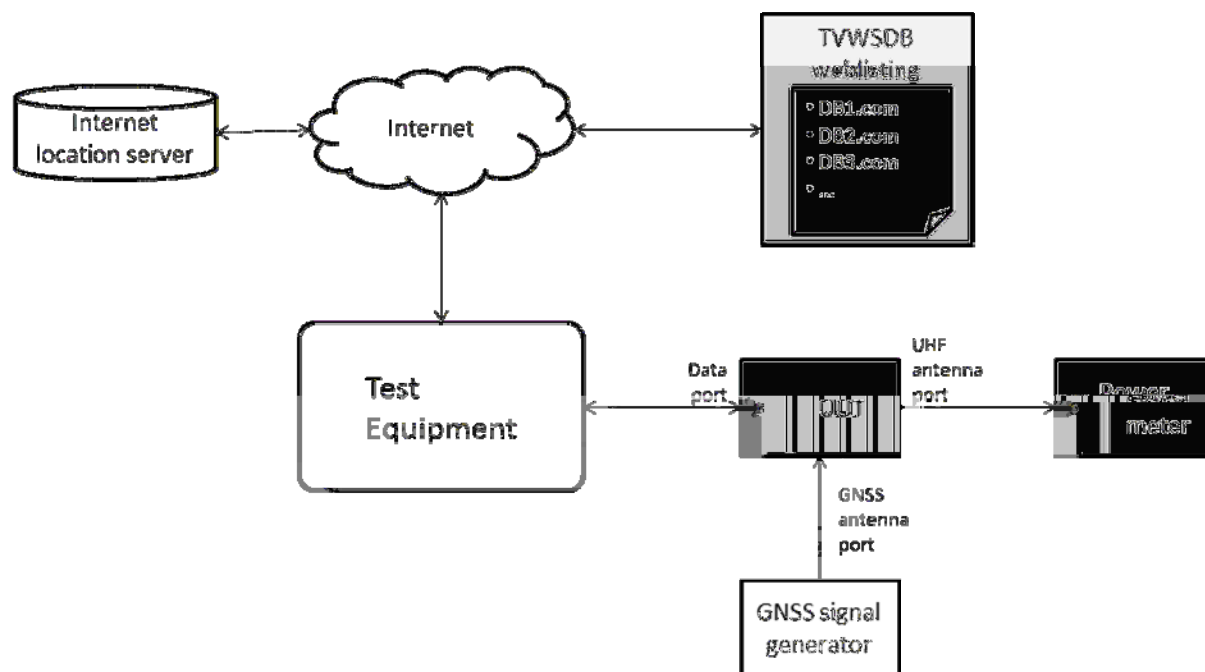
Figure 4: Test arrangement for test database identification and access

5.3.11.1.2   Test method 1

This test verifies the behaviour of the UUT when the Internet connection is not accessible at start up:

a)   The UUT shall be switched off at the start of the test. The UUT data port shall be disconnected from the TE and from any means to connect to the Internet. The power meter shall be connected to the UHF antenna port of the UUT.

b)   If the UUT is capable of geolocation, the GNSS generator shall be configured to produce the signals corresponding to a position located in a geographical area covered by any of the regulatory domains supported by the UUT.

c)   The UUT shall be switched on for a period of at least fifteen minutes.

d)   The test is passed if the reading of the power meter shows no transmissions from the UUT.

5.3.11.1.3   Test method 2

This test verifies that a master TVWSD obtains the weblisting relevant to its geographical location, and contacts one of the approved TVWSDB in the list.

The following test procedure shall be repeated for each of the regulatory domains supported by the UUT:

a)   The UUT shall be switched off at the start of the test. The UUT data port shall be connected to the data port of the TE. The power meter shall be connected to the UHF antenna port of the UUT. The TE shall be configured to log all the IP traffic from and to the UUT.

b) If the UUT is capable of geolocation, the GNSS generator shall be configured to produce the signals corresponding to a position located in the geographical area covered by the regulatory domain being tested. If the UUT does not support geolocation, the UUT shall be configured to be located in a position within the geographical area covered by the regulatory domain being tested.

c) The UUT shall be switched on.

d) Once that the power meter shows that the UUT is transmitting, the UUT can be switched off. Alternatively, if fifteen minutes have elapsed and the UUT has not started transmissions then the UUT can be switched off.

e) The test if passed if the IP traffic log captured by the TE shows that:

1) The UUT has contacted and downloaded the weblisting relevant to its regulatory domain.

2) The UUT has contacted one of the TVWSDB in the weblisting.

5.3.11.1.4   Test method 3

This test verifies that a master TVWSD does not request operational parameters from a TVWSDB that is not on the weblisting:

a) The UUT shall be switched off at the start of the test. The UUT data port shall be connected to the data port of the TE. The power meter shall be connected to the UHF antenna port of the UUT.

b) If the UUT is capable of geolocation, the GNSS generator shall be configured to produce the signals corresponding to a position located in the geographical area covered by one of the regulatory domains supported by the UUT. If the UUT does not support geolocation, the UUT shall be configured to be located in a position within the geographical area covered by one of the regulatory domains supported by the UUT.

c) The TE shall be configured to log all the IP traffic from and to the UUT and to block any traffic between the UUT and the TVWSDBs listed in the relevant weblisting.

d) The UUT shall be switched on for at least fifteen minutes.

e) The test is passed if the reading of the power meter shows no transmissions from the UUT and the IP traffic log captured by the TE shows that:

1) The UUT has contacted and downloaded the weblisting relevant to its regulatory domain.

2) The UUT has not contacted a TVWSDB that is not in the weblisting.

5.3.11.1.5   Test method 4

This test verifies that the master TVWSD reconsults the weblisting no later than the value of N specified in the weblisting:

a) The UUT shall be switched off at the start of the test. The UUT data port shall be connected to the data port of the TE. The power meter shall be connected to the UHF antenna port of the UUT. The TE shall be configured to log all the IP traffic from and to the UUT.

b) If the UUT is capable of geolocation, the GNSS generator shall be configured to produce the signals corresponding to a position located in the geographical area covered by one of the regulatory domains supported by the UUT. If the UUT does not support geolocation, the UUT shall be configured to be located in a position within the geographical area covered by one of the regulatory domains supported by the UUT.

c) The UUT shall be switched on.

d) The TE logs shall be checked to confirm that:

1) The UUT has contacted and downloaded the weblisting relevant to the regulatory domain.

2) The UUT has contacted one of the TVWSDB in the weblisting.

e) The TE shall keep logging the IP traffic until after N.

f) The TE logs shall be checked to confirm that The UUT has re-contacted and downloaded the weblisting again.

5.3.11.1.6   Test method 5

This test verifies the behaviour of the master TVWSD when the weblisting is not available for re-consultation:

a)   The UUT shall be switched off at the start of the test. The UUT data port shall be connected to the data port of the TE. The power meter shall be connected to the UHF antenna port of the UUT. The TE shall be configured to log all the IP traffic from and to the UUT.

b)   If the UUT is capable of geolocation, the GNSS generator shall be configured to produce the signals corresponding to a position located in the geographical area covered by one of the regulatory domains supported by the UUT. If the UUT does not support geolocation, the UUT shall be configured to be located in a position within the geographical area covered by one of the regulatory domains supported by the UUT.

c)   The UUT shall be switched on.

d)   The TE logs shall be checked to confirm that:

1)   The UUT has contacted and downloaded the weblisting relevant to the regulatory domain.

2)   The UUT has contacted one of the TVWSDB in the weblisting.

e)   The TE shall be configured to block any further traffic between the UUT and the weblisting server.

f)   The TE shall keep logging the IP traffic until after N + 2 hours.

g)   The TE logs shall be checked to confirm that:

1)   The UUT has tried to contact the weblisting server a first time before N expired.

2)   The UUT has tried to contact the weblisting server a second time no sooner than one hour but no later than two hours after the first try.

5.3.11.2   Transmission in compliance with parameters, provision of device parameters, provision of channel usage parameters and master TVWSD functionality in support of slave TVWSDs

The objective of this test is to verify that a UUT complies with the requirements in clause 4.2.6.2.

5.3.11.2.1   Test condition

If the UUT is a master TVWSD, the device shall be configured such that it first identifies and consults the test TVWSDB in the TE, and then operates normally in terms of its data exchange with a TVWSDB as emulated by the TE. In order to do this, the master TVWSD shall be configured to communicate with un-authenticated weblisting server and an un-authenticated TVWSDB.

If the UUT is a slave TVWSD, the device shall be configured such that it operates normally in terms of its data exchange with the test master TVWSD.

The test setup in figure 4 applies for this test. RF measurements should be conducted with a spectrum analyser.

The test equipment (TE) for this test shall:

•   Log all the communications to and from the master TVWSD under test, or the test master TVWSD (when the UUT is a slave TVWSD).

•   Let the master TVWSD communicate with servers on the Internet.

•   Act as a web server that replicates the website hosting the weblisting relevant to the geographical domain where the test takes place. Configure the weblisting to contain only its own test TVWSDB server.

•   Redirect the request from the master TVWSD for the weblist to its own webserver, instead of the legitimate server from the regulatory domain the where the test takes place.

•   Act as a test TVWSDB server and communicate through a protocol that is supported by the master TVWSD under test.

- Emulate the normal operations of a TVWSDB in terms of its data exchange with a master device.

- The test TVWSDB in the TE shall be configured to respond to requests from the master TVWSD under test, or from the test master TVWSD (when the UUT is a slave TVWSD), as follows:

  1) TE CONFIGURATION1:

     - not respond to the UUT requests for operational parameters.

  2) TE CONFIGURATION2:

     - provide operational parameters as described in the operational parameter set (see clause 5.1.6).

  3) TE CONFIGURATION3:

     - provide operational parameters for the master TVWSD under test as described in the operational parameter set;

     - provide broadcast generic operational parameters for slave TVWSDs served by the master TVWSD under test as described in the operational parameter set;

     - provide specific operational parameters for slave TVWSDs served by the master TVWSD under test as described in the operational parameter set.

Where the UUT is a slave TVWSD, the permitted channel edge frequencies and the maximum permitted EIRP spectral densities shall be set differently for generic operational parameters and specific operational parameters.

5.3.11.2.2   Test method 1

This test verifies that a master TVWSD does not transmit in the absence of communications with a weblisting server and a TVWSDB. This test verifies that a slave TVWSD does not transmit in the absence of a signal from a master TVWSD.

The following test method shall be applied to any TVWSD. A test slave TVWSD, a test master TVWSD and a TE are not needed for this test method:

a) Switch off the UUT. Disconnect the UUT data port (if it has one). Connect the UUT to a spectrum analyser.

b) Switch on the UUT.

c) Confirm via the spectrum analyser that the UUT does not transmit.

d) Wait 10 minutes to conclude the test.

5.3.11.2.3   Test method 2

This test verifies that a master TVWSD only transmits in accordance with operational parameters that it has received from a TVWSDB, that it reports its device parameters accurately and that it reports its channel usage parameters accurately.

The test method shall be applied in the case where the UUT is a master TVWSD. A test slave is not needed for this test method:

a) Set the TE to CONFIGURATION1.

b) Switch off the UUT. Connect the UUT to the TE. Connect the UUT to a spectrum analyser.

c) Switch on the UUT. Confirm that the UUT consults the TE and identifies the TVWSDB.

d) Confirm, via the spectrum analyser, that the UUT does not transmit in the UHF TV band.

e) Set the TE to CONFIGURATION2 and repeat step b) and step c).

f) Confirm that the UUT communicates its device parameters to the TE, and that the parameters are accurate as described in clause 4.2.6.2.3.

g) The TE then shall respond with operational parameters described in CONFIGURATION2.

h) Confirm, via the spectrum analyser, that the UUT transmits in accordance with the operational parameters.

i) If the UUT total EIRP is higher than the value specified in clause 4.2.6.2.4, confirm that the UUT has communicated channel usage parameters to the TE and that the actual transmissions are in accordance with those parameters.

j) Wait until the validity of the operational parameters expires and confirm that the UUT stops transmitting according to the operating parameters.

5.3.11.2.4 Test method 3

This test verifies the functionalities of a master TVWSD in support of slave TVWSDs.

The test method shall be applied in the case where the UUT is a master TVWSD that supports broadcast of generic operational parameters:

a) Set the TE to CONFIGURATION3.

b) Configure the test slave TVWSD to receive generic operational parameters and to communicate to the master its device parameters and channel usage parameters.

c) Switch off the UUT. Switch off the test slave TVWSD. Connect the UUT to the TE. Connect the test slave TVWSD to the UUT.

d) Switch on the UUT. Switch on the test slave TVWSD.

e) Confirm that the UUT communicates its device parameters to the TE. Confirm that the UUT requests generic operational parameters:

1) The TE then shall respond with operational parameters for the master as described in CONFIGURATION3, and with generic operational parameters for the slaves served by the master as described in CONFIGURATION3, too.

f) Confirm via the test slave TVWSD that the generic operational parameters broadcasted by the UUT are a subset of those in the operational parameter set.

g) Confirm via the TE that the UUT has reported back to the test TVWSDB the device parameters and the channel usage parameters of the test slave TVWSD.

5.3.11.2.5 Test method 4

This test verifies the functionalities of a master TVWSD in support of slave TVWSDs.

The test method shall be applied in the case where the UUT is a master TVWSD that supports provision of specific operational parameters to slave TVWSDs in its coverage area:

a) Set the TE to CONFIGURATION3.

b) Configure the test slave TVWSD to receive generic operational parameters, to request specific operational parameters (for which it shall communicate its device parameters) and to report back channel usage parameters.

c) Switch off the UUT. Switch off the test slave TVWSD. Connect the UUT to the TE. Connect the test slave TVWSD to the UUT.

d) Switch on the UUT. Switch on the test slave TVWSD:

1) The UUT, the test TVWSDB and the test slave TVWSD will communicate the UUT device parameters, the operational parameters for the UUT and the generic operational parameters. The test slave TVWSD will also send a request for specific operational parameters with its own device parameters.

e) Confirm that the UUT communicates the device parameters of the test slave TVWSD to the test TVWSDB to request specific operational parameters.

f)   Confirm via the test slave device that the specific operational parameters communicated by the UUT are a subset of those in the operational parameter set.

5.3.11.2.6   Test method 5

This test verifies the functionality of a slave TVWSD.

The test method shall be applied in the case where the UUT is a slave TVWSD that supports generic operational parameters:

a)   Set the TE to CONFIGURATION3.

b)   Switch off the test master TVWSD. Switch off the UUT. Connect the test master TVWSD to the TE. Connect the UUT to the test master TVWSD. The test master TVWSD shall be configured such that it operates normally in terms of its data exchange with a TVWSDB as emulated by the TE. Connect the UUT to a spectrum analyser.

c)   Switch on the UUT.

d)   Confirm via the test master TVWSD that the UUT communicates its unique device identifier to the test master TVWSD. The UUT may also provide the rest of device parameters.

e)   Confirm, via the spectrum analyser, that the UUT transmits in accordance with the generic operational parameters broadcasted by the test master TVWSD.

f)   If the UUT total EIRP is greater than the value specified in clause 4.2.6.2.4, confirm that the UUT communicates channel usage parameters to the test master TVWSD and that the actual transmissions are in accordance with those parameters.

g)   Wait until the time validity of the operational parameters expires and confirm that the UUT stops transmitting according to the operating parameters.

5.3.11.2.7   Test method 6

This test method verifies the functionality of a slave TVWSD.

The test method shall be applied in the case where the UUT is a slave TVWSD that supports specific operational parameters. The UUT shall be configured to request specific operational parameters after it has received generic operational parameters:

a)   Set the TE to CONFIGURATION3.

b)   Switch off the test master TVWSD. Switch off the UUT. Connect the test master TVWSD to the TE. Connect the UUT to the test master TVWSD. The test master TVWSD shall be configured such that it operates normally in terms of its data exchange with a TVWSDB as emulated by the TE. Connect the UUT to a spectrum analyser.

c)   Switch on the UUT.

d)   Confirm via the test master TVWSD that the UUT requests specific operational parameters and, if it has not done it before, communicates its device parameters to the TE:

   1)   The TE then shall respond, via the test master TVWSD, with operational parameters described in the operational parameter set.

e)   Confirm, via the spectrum analyser, that the UUT transmits in accordance with the operational parameters.

f)   If the UUT total EIRP is greater than the value specified in clause 4.2.6.2.4, confirm that the UUT has communicated channel usage parameters to the test master TVWSD and that the actual transmissions are in accordance with those parameters.

g)   Wait until the validity of the operational parameters expires and confirm that the UUT stops transmitting according to the operating parameters.
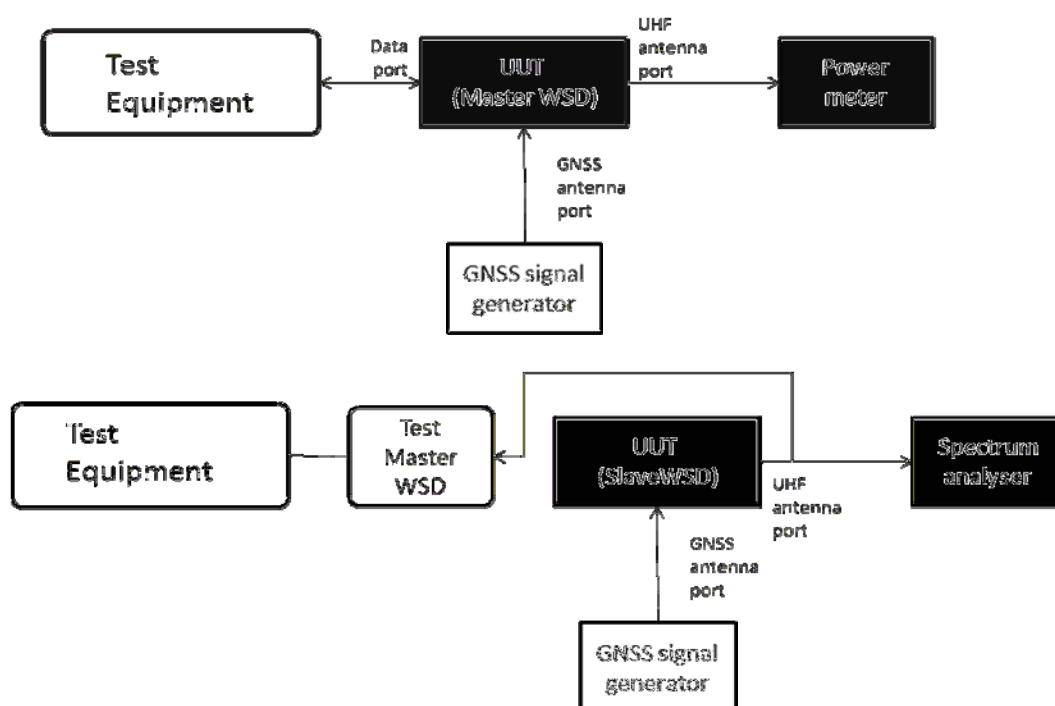
5.3.12   Geo-location capability

The objective of this test is to verify that a TVWSD will not continue to transmit with its current operational parameters after its horizontal position has changed by more than L_{val} metres with respect to its position at the time when this was last reported to the TVWSDB (see clause 4.2.8).

This test applies to all TVWSDs which have geo-location capabilities (and so can request specific operational parameters).

5.3.12.1   Test conditions

If the UUT is a master TVWSD, the device shall be configured such that it first identifies the test TVWSDB in the TE, and then operates normally in terms of its data exchange with a TVWSDB, which is emulated by the TE (see figure 5). In order to do this, the master TVWSD shall be configured to communicate with un-authenticated weblisting server and an un-authenticated TVWSDB.

If the UUT is a slave TVWSD, the UUT shall be configured such that it operates normally in terms of its data exchange with the test master TVWSD. The test master TVWSD shall be configured such that it operates normally in terms of its data exchange with a TVWSDB (see figure 5), which is emulated by the TE.

Figure 5: Test arrangement for Geo-location capability

The GNSS signal generator shall be configured to produce the signals corresponding to a position located in a geographical area covered by one of the regulatory domains supported by the UUT.

The TE shall be configured to:

- Let the master TVWSD communicate with servers on the Internet.

- Act as a web server that replicates the website hosting the weblisting relevant to the regulatory domain chosen for the simulated location of the GNSS signal generator. Configure the weblisting to contain only its own test TVWSDB server.

- Redirect the request from the master TVWSD for the weblist to its own webserver, instead of the legitimate server from the regulatory domain where the test takes place.

- Act as a test TVWSDB server and communicate through a protocol that is supported by the master TVWSD under test.

- Emulate the normal operations of a TVWSDB in terms of its data exchange with a master device.

- Provide operational parameters that are supported by the UUT, as declared by the manufacturer. A value of 50 metres shall be taken for the L_{val} parameter. If the UUT is a slave TVWSD, the TE shall provide generic operational parameters and specific operational parameters. The test master TVWSD shall provide both sets of parameters.

5.3.12.2 Test method

The following test method shall be applied to the case where the UUT is a master TVWSD:

a) Switch off the UUT. Connect the UUT to the TE. Switch on the UUT. Observe that the UUT consults the TE, communicates to the TE its device parameters including location to requests specific operational parameters and confirm that the TE responds with specific operational parameters.

b) Configure the TE to respond with a request declined to any additional request for operational parameters.

c) Change the configuration of the GNSS signal generator to simulate a location that is greater than L_{val} metres horizontally with respect to its location in step a) above.

d) Confirm, via the power meter, that the UUT stops transmitting within 60 seconds.

The following test method shall be applied to the case where the UUT is a slave TVWSD:

a) Switch off the UUT. Switch off the test master TVWSD. Connect the test master TVWSD to the TE. Connect the UUT to the master TVWSD. Switch on the master test TVWSD. Switch on the UUT. Observe that the UUT consults the test master TVWSD and the TE, requests specific operational parameters, and communicates to the TE (via the test master TVWSD) its device parameters. Confirm that the TE responds with specific operational parameters.

b) Configure the TE to respond with a request declined to any additional request for specific operational parameters.

c) Change the configuration of the GNSS signal generator to simulate a location that is greater than L_{val} metres horizontally with respect to its location in step a) above.

d) Confirm, via the spectrum analyser, that the UUT stops transmitting in accordance with the specific operational parameters provided for the initial location within 60 seconds.

NOTE: The UUT may continue transmitting according to the generic operational parameters.

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 requirements in words and 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 provides a statement of all the test procedures corresponding to those 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 dependant 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 301 598 The following requirements and test specifications are relevant to the presumption of conformity under the article 3.2 of the R&TTE Directive [i.3]						
Requirement			Requirement Conditionality		Test Specification	
No	Description	Reference: Clause No	U/C	Condition	E/O	Reference: Clause No
1	Nominal Channel Bandwidth	4.2.2	U		X	
2	Total Nominal Channel Bandwidth	4.2.2	U		X	
3	RF power	4.2.3	C	Does not apply to slave devices which are receive only in the 470 MHz to 790 MHz band	E	5.3.2
4	RF power spectral density	4.2.3	C	Does not apply to slave devices which are receive only in the 470 MHz to 790 MHz band	E	5.3.3
5	Transmitter Unwanted Emissions	4.2.4	C	Does not apply to slave devices which are receive only in the 470 MHz to 790 MHz band	E	5.3.3 & 5.3.4
6	Transmitter Reverse Intermodulation	4.2.5	C	Does not apply to slave devices which are receive only in the 470 MHz to 790 MHz band	E	5.3.5
7	TVWSDB identification	4.2.6.1	C	Only applies to master devices	E	5.3.11.1

Harmonized Standard EN 301 598						
The following requirements and test specifications are relevant to the presumption of conformity under the article 3.2 of the R&TTE Directive [i.3]						
Requirement			Requirement Conditionality		Test Specification	
No	Description	Reference: Clause No	U/C	Condition	E/O	Reference: Clause No
8	Data exchange and compliance with parameters	4.2.6.2	C	Does not apply to slave devices which are receive only in the 470 MHz to 790 MHz band. Different procedures apply for master and slave devices	E	5.3.11.2
13	Master TVWSD update	4.2.6.3	U		E	5.3.6 & 5.3.7
13bis	Slave TVWSD update	4.2.6.4	C	Does not apply to slave devices which are receive only in the 470 MHz to 790 MHz band	E	5.3.8 & 5.3.9
14	Receiver spurious emissions	4.2.7	U		E	5.3.10
15	Geo-location capability	4.2.8	C	Horizontal geo-location is mandatory for master devices. Horizontal geo-location is optional for slave devices Vertical geo-location is optional for all devices	E	5.3.12
16	Software, Firmware and User Access Restrictions	4.2.9	U		X	
18	Security requirements	4.2.10	C	Does not apply to slave devices which are receive only in the 470 MHz to 790 MHz band	X	

Key to columns:

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 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 "E" are relevant to the requirements. Rows designated "E" collectively make up the Essential Radio Test Suite; for those designated "X" there is no test specified corresponding to the requirement. The completion of all tests classified "E" as specified with satisfactory outcomes is a necessary condition for a presumption of conformity. Compliance with requirements associated with tests classified "X" is 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 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 measurement

This annex introduces three most commonly available test sites and a test fixture, to be used in the radiated measurements in accordance with the present document.

Subsequently the following items will be described:

- Open Area Test Site (OATS);

- Semi Anechoic Room (SAR);

- Fully Anechoic Room (FAR);

- Test fixture for relative measurements.

The first three are generally referred to as free field test sites. Both absolute and relative measurements can be performed on these sites. They will be described in clause B.1. Clause B.2 describes the antennas used in these test sites. The test fixture can only be used for relative measurements and will be described in clause B.3.

Where absolute measurements are to be carried out, the chamber should be verified. A detailed verification procedure is described in clause 6 of TR 102 273-4 [i.8] for the OATS, in clause 6 of TR 102 273-3 [i.7] for the SAR and in clause 6 of TR 102 273-2 [i.6] for the FAR.

Information for calculating the measurement uncertainty of measurements on one of these test sites can be found in TR 100 028-1 [2], TR 100 028-2 [3], TR 102 273-2 [i.6], TR 102 273-3 [i.7] and TR 102 273-4 [i.8].

B.1   Radiation test sites

B.1.1   Open Area Test Site (OATS)

An Open Area Test Site comprises a turntable at one end and an antenna mast of variable height at the other end above a ground plane which, in the ideal case, is perfectly conducting and of infinite extent. In practice, while good conductivity can be achieved, the ground plane size has to be limited. A typical Open Area Test Site is shown in figure B.1.
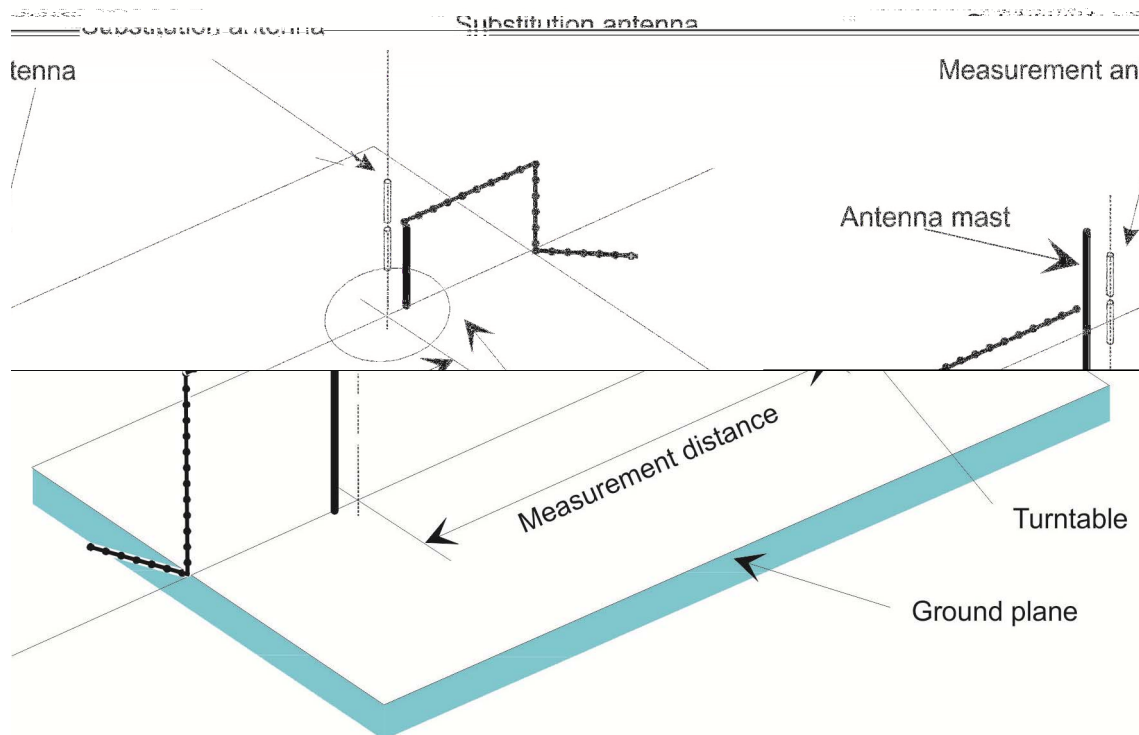
Figure B.1: A typical Open Area Test Site

The ground plane creates a wanted reflection path, such that the signal received by the receiving antenna is the sum of the signals received from the direct and reflected transmission paths. The phasing of these two signals creates a unique received level for each height of the transmitting antenna (or UUT) and the receiving antenna above the ground plane.

The antenna mast provides a variable height facility (from 1 m to 4 m) so that the position of the measurement antenna can be optimized for maximum coupled signal between antennas or between a UUT and the measurement antenna.

A turntable is capable of rotation through 360° in the horizontal plane and it is used to support the test sample (UUT) at a specified height, usually 1,5 m above the ground plane.

The measurement distance and minimum chamber dimensions can be found in clause B.1.4. The distance used in actual measurements shall be recorded with the test results.

Further information on Open Area Test Sites can be found in TR 102 273-4 [i.8].

B.1.2   Semi Anechoic Room

A Semi Anechoic Room is - or anechoic chamber with a conductive ground plane is - an enclosure, usually shielded, whose internal walls and ceiling are covered with radio absorbing material. The floor, which is metallic, is not covered by absorbing material and forms the ground plane. The chamber usually contains an antenna mast at one end and a turntable at the other end. A typical anechoic chamber with a conductive ground plane is shown in figure B.2.

This type of test chamber attempts to simulate an ideal Open Area Test Site, whose primary characteristic is a perfectly conducting ground plane of infinite extent.
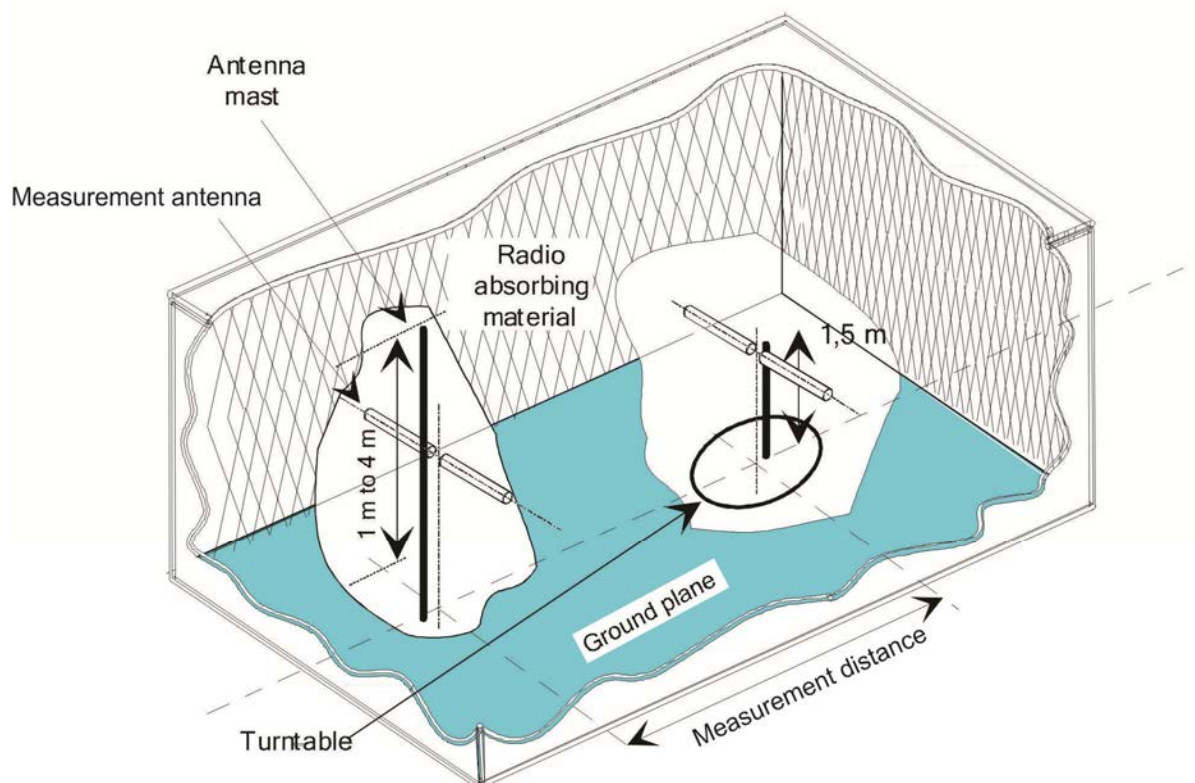
Figure B.2: A typical Semi Anechoic Room

In this facility the ground plane creates a wanted reflection path, such that the signal received by the receiving antenna is the sum of the signals received from the direct and reflected transmission paths. The phasing of these two signals creates a unique received level for each height of the transmitting antenna (or UUT) and the receiving antenna above the ground plane.

The antenna mast provides a variable height facility (from 1 m to 4 m) so that the position of the measurement antenna can be optimized for maximum coupled signal between antennas or between a UUT and the measurement antenna.

A turntable is capable of rotation through 360° in the horizontal plane and it is used to support the test sample (UUT) at a specified height, usually 1,5 m above the ground plane.

The measurement distance and minimum chamber dimensions can be found in clause B.1.4. The distance used in actual measurements shall be recorded with the test results.

Further information on Semi Anechoic Rooms can be found in TR 102 273-3 [i.7].

B.1.3   Fully Anechoic Room (FAR)

A Fully Anechoic Room is an enclosure, usually shielded, whose internal walls, floor and ceiling are covered with radio absorbing material. The chamber usually contains an antenna support at one end and a turntable at the other end. A typical Fully Anechoic Room is shown in figure B.3.

Figure B.3: A typical Fully Anechoic Room

The chamber shielding and radio absorbing material work together to provide a controlled environment for testing purposes. This type of test chamber attempts to simulate free space conditions.

The shielding provides a test space, with reduced levels of interference from ambient signals and other outside effects, whilst the radio absorbing material minimizes unwanted reflections from the walls and ceiling which can influence the measurements. The shielding should be sufficient to eliminate interference from the external environment that would mask any signals that have to be measured.

A turntable is capable of rotation through 360° in the horizontal plane and it is used to support the UUT at a suitable height (e.g. 1 m) above the ground plane.

The measurement distance and minimum chamber dimensions can be found in clause B.1.4. The distance used in actual measurements shall be recorded with the test results.

Further information on Fully Anechoic Rooms can be found in TR 102 273-2 [i.6].

B.1.4   Measurement Distance

The measurement distance should be chosen in order to measure the UUT at far-field conditions. The minimum

measurement distance between the equipment and the measurement antenna should be λ or $r_{m} \gg \dfrac{D^2}{\lambda}$, whichever is the greater.

λ =   wavelength in m

r_{m} =   minimum measurement distance between UUT and measurement antenna in m

D   =   largest dimension of physical aperture of the largest antenna in the measurement setup, in m

$\dfrac{D^2}{\lambda} = $ distance between outer boundary of radiated near field (Fresnel region) and inner boundary of the radiated far-field (Fraunhofer region) in m, also known as Rayleigh distance

For those measurements, where these conditions cannot be fulfilled and where the measurement distance would result in measurements in the near field (e.g. while measuring spurious emissions), this should be noted in the test report and the additional measurement uncertainty should be incorporated into the results.

B.2   Antennas

Antennas are needed for the radiated measurements on the three test sites described in clause B.1. Depending on its use, the antenna will be designated as "measurement antenna" or "substitution antenna".

B.2.1   Measurement antenna

In emission tests the measurement antenna is used to detect the field from the UUT in one stage of the measurement, and from the substitution antenna in the other stage. When the test site is used for the measurement of receiver characteristics, the antenna is used as the transmitting device.

The measurement antenna should be mounted on a support capable of allowing the antenna to be used in either horizontal or vertical polarization. Additionally, on an OATS or SAR, the height of the centre of the antenna above the ground should be variable over the specified range (usually 1 m to 4 m).

In the frequency band 30 MHz to 1 000 MHz, biconical or logarithmic periodic dipole antennas (LPDA) are recommended. Above 1 GHz, horn antennas or logarithmic periodic dipole antennas are recommended.

For spurious emission testing, however, a combination of biconical antennas (commonly termed "bicones") and log periodic dipole array antennas (commonly termed "log periodics") could be used to cover the entire 30 MHz to 1 000 MHz band.

The measurement antenna does not require an absolute calibration.

B.2.2   Substitution antenna

The substitution antenna shall be used to replace the equipment under test in substitution measurements.

The substitution antenna shall be suitable for the frequency range and the return loss of the antenna shall be taken into account when calculating the measurement uncertainty.

The phase centre of this antenna shall coincide with the reference point of the test sample it has replaced. Therefore antennas with a phase centre that changes as a function of frequency (such as a LPDA) are not suitable as a substitution antenna.

The reference point of the substitution antenna shall coincide with the volume centre of the UUT when its antenna is internal, or the point where an external antenna is connected to the UUT.

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

The substitution antenna shall be calibrated for the test site (OATS, SAR, FAR) in which it will be used. For below 1 GHz, the calibration is relative to a half wave dipole, while above 1 GHz, an isotropic radiator is the reference.

NOTE: Calibration figures intended for use above a reflective surface cannot be used in an anechoic chamber or vice versa.

B.3 Test fixture

B.3.1 Conducted measurements and use of test fixture

In view of the low power levels of the equipment to be tested under the present document, conducted measurements may be applied to equipment provided with a (temporary) antenna connector, e.g. by means of a spectrum analyser.

In the case of equipment intended for use with an integral antenna and no external (temporary) antenna connectors are provided, a test fixture suitable to allow relative measurements to be made on the UUT may be used at least for the measurements at the extremes of temperature.

B.3.2 Description of the test fixture

The test fixture shall provide a means of coupling to the radio frequency output(s).

The impedance of the external connection to the test fixture shall be 50 Ω at the working frequencies of the equipment.

The performance characteristics of this test fixture under normal and extreme conditions shall be such that:

a) the coupling loss shall be limited to ensure a sufficient dynamic range of the setup;

b) the variation of coupling loss with frequency shall not cause errors exceeding 2 dB in measurements using the test fixture;

c) the coupling device shall not include any non-linear elements.

B.3.3 Using the test fixture for relative measurements

The different steps below describe the principle for performing relative measurements for those requirements where testing needs to be repeated at the extremes of the temperature.

Step 1:

Perform the measurement under normal conditions on a test site for radiated measurements as described in annex B, clause B.1. This will result in an absolute value for the requirement being tested. This value shall be recorded.

Step 2:

Put the equipment with the test fixture in the temperature chamber. Perform the same measurement at normal conditions in this environment and normalize the measuring equipment to get the same reading as before in step 1.

Step 3:

Take care that the environment is time invariant (fixed coupling).

Step 4:

Change the temperature in the temperature chamber and perform the measurement again. Due to the normalization done in step 2, the result will be the value for this requirement at the extreme condition.

B.4 Guidance on the use of radiation test sites

This clause details procedures, test equipment arrangements and verification that should be carried out before any of the radiated test are undertaken. These schemes are common to all types of test sites described in clause B.1.

Where necessary, a mounting bracket of minimal size should be available for mounting the UUT on the turntable. This bracket should be made from low conductivity, low relative permittivity (i.e. $\frac{\varepsilon}{\varepsilon_0} < 1,5$) material(s) such as expanded polystyrene, balsawood, etc.

B.4.1   Power supplies for the battery powered UUT

All tests should be performed using power supplies wherever possible, including tests on UUT designed for battery-only use. For battery powered equipment, power leads should be connected to the UUT's supply terminals (and monitored with a digital voltmeter) but the battery should remain present, electrically isolated from the rest of the equipment, possibly by putting tape over its contacts.

The presence of these power cables can, however, affect the measured performance of the UUT. For this reason, they should be made to be "transparent" as far as the testing is concerned. This can be achieved by routing them away from the UUT and down to the either the screen, ground plane or facility wall (as appropriate) by the shortest possible paths. Precautions should be taken to minimize pick-up on these leads (e.g. the leads could be twisted together, loaded with ferrite beads at 0,15 m spacing or otherwise loaded).

B.4.2   Site preparation

The cables to the measuring and substitution antenna should be routed horizontally away from the testing area for a minimum of 2 m (unless, in the case both types of anechoic chamber, a back wall is reached) and then allowed to drop vertically and out through either the ground plane or screen (as appropriate) to the test equipment. Precautions should be taken to minimize pick up on these leads (e.g. dressing with ferrite beads, or other loading). The cables, their routing and dressing should be identical to the verification set-up.

> NOTE: For ground reflection test sites (i.e. anechoic chambers with ground planes and Open Area Test Sites) which incorporate a cable drum with the antenna mast, the 2 m requirement may be impossible to comply with.

Calibration data for all items of test equipment should be available and valid. For test, substitution and measuring antennas, the data should include gain relative to an isotropic radiator (or antenna factor) for the frequency of test. Also, the VSWR of the substitution and measuring antennas should be known.

The calibration data on all cables and attenuators should include insertion loss and VSWR throughout the entire frequency range of the tests. All VSWR and insertion loss figures should be recorded in the log book results sheet for the specific test.

Where correction factors/tables are required, these should be immediately available.

For all items of test equipment, the maximum errors they exhibit should be known along with the distribution of the error e.g.:

- cable loss: $\pm$ 0,5 dB with a rectangular distribution;

- measuring receiver: 1,0 dB (standard deviation) signal level accuracy with a Gaussian error distribution.

At the start of measurements, system checks should be made on the items of test equipment used on the test site.

B.5   Coupling of signals

B.5.1   General

The presence of leads in the radiated field may cause a disturbance of that field and lead to additional measurement uncertainty. These disturbances can be minimized by using suitable coupling methods, offering signal isolation and minimum field disturbance (e.g. optical coupling).

B.5.2   Data Signals

Isolation can be provided by the use of optical, ultrasonic or infra-red means. Field disturbance can be minimized by using a suitable fibre optic connection. Ultrasonic or infra-red radiated connections require suitable measures for the minimization of ambient noise.

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, 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 case 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. See figure C.1.

The test antenna need not be raised or lowered if the measurement is carried out on a test site according to clause B.1.3.
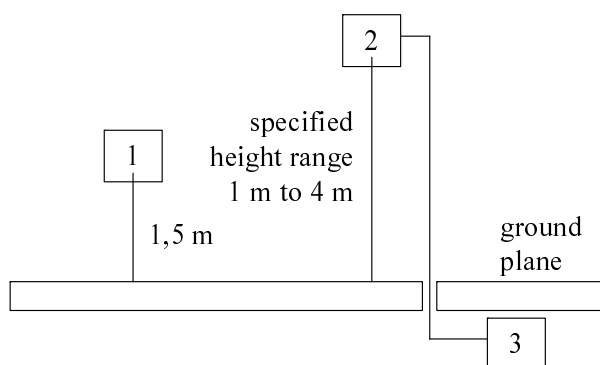
1:      Equipment under test.
2:      Test antenna.
3:      Spectrum analyser or measuring receiver.

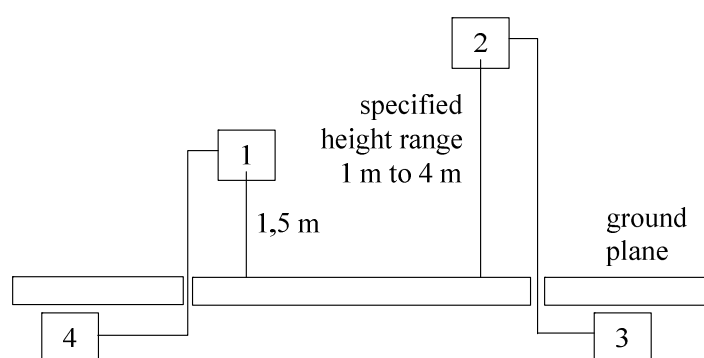**Figure C.1: Measurement arrangement 1**

- 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.1.3. 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.1.3.

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:
Void

Annex E (informative):
Nominal Channel Bandwidth and Total Bandwidth

A nominal channel is defined as one or more DTT channels that are used by a TVWSD for its wanted transmissions. The lower and upper edge frequencies of a nominal channel are specified by the TVWSDB and are expected to coincide with the European harmonized DTT channel raster shown in figure E.1.

DTT channel raster (MHz)	470 to 478	478 to 486	486 to 494	...	766 to 774	774 to 782	782 to 790

| DTT channel numbers	21	22	23	...	58	59	60

Figure E.1: TVWSDB channel edge frequencies and corresponding DTT channels

The nominal channel bandwidth is the bandwidth of a nominal channel.

The nominal channel bandwidth is the widest band of frequencies assigned to a single channel. In the case of TVWSDs a single channel will be 8 MHz or a multiple of 8 MHz, which may be contiguous or non-contiguous.

A device may transmit in a single DTT channel at any given time, or it may transmit simultaneously in a group of contiguous DTT channels, multiple non-contiguous DTT channels, or a mixture of contiguous and non-contiguous DTT channels.
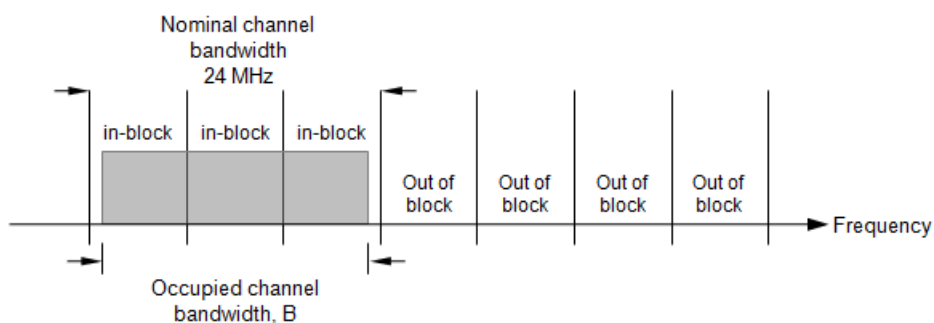
Where a TVWSD transmits in a single DTT channel, it will be considered to have a single nominal channel with a bandwidth of 8 MHz, see figure E.2.
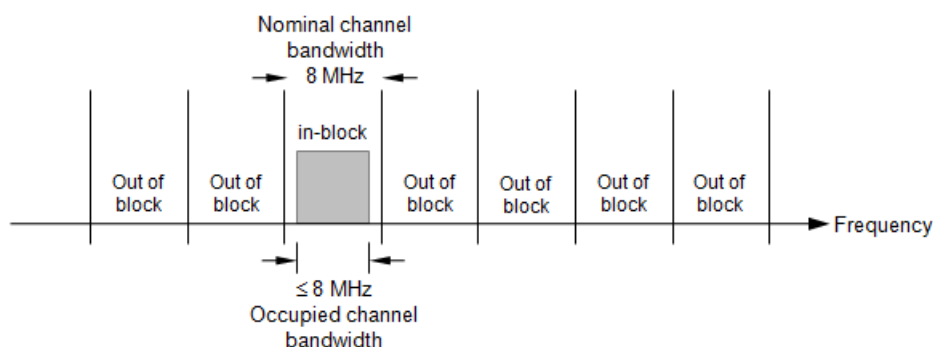
NOTE: Nominal channel bandwidth is 8 MHz.
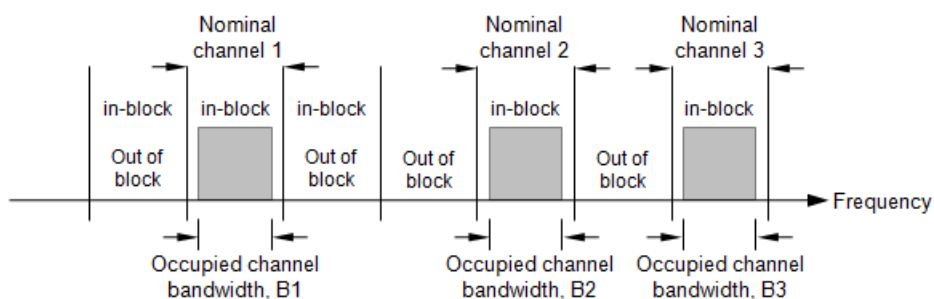
Figure E.2: Single DTT channel

Where a TVWSD transmits simultaneously in a group of contiguous DTT channels, it will be considered to have a single nominal channel with a nominal channel bandwidth which is the sum of the individual DTT channel bandwidths (i.e. a multiple of 8 MHz), see figure E.3.

NOTE: Nominal channel bandwidth is 24 MHz. The total nominal channel bandwidth is also 24 MHz.

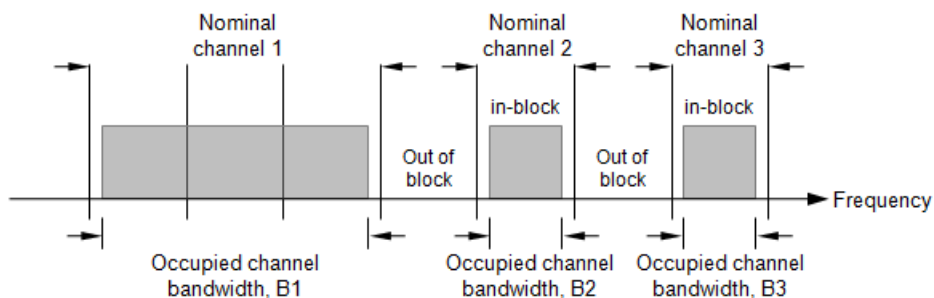**Figure E.3: Group of contiguous DTT channels**

Where a TVWSD transmits simultaneously in multiple non-contiguous DTT channels, it will be considered to have multiple nominal channels each with a nominal channel bandwidth of 8 MHz; i.e. each nominal channel will be considered separately, see figure E.4.

NOTE: Nominal channel bandwidth is 8 MHz. The total nominal channel bandwidth is 24 MHz.

Figure E.4: Multiple non-contiguous DTT channels

Where a TVWSD transmits simultaneously in a mixture of contiguous and non-contiguous DTT channels, each group of contiguous DTT channels will be considered as a single nominal channel, see figure E.5.

NOTE: Nominal channel bandwidths are 8 MHz and 24 MHz. The total nominal channel bandwidth is 40 MHz.

Figure E.5: Mixture of contiguous and non-contiguous DTT channels

In each of the above cases, the *total* nominal channel bandwidth is equal to the sum of the individual nominal channel bandwidths.

NOTE: The signal power within a nominal channel is referred to as in-block power. The signal power outside a nominal channel is referred to as out-of-block power. The *total* in-block power is the sum (in watts) of the powers in each nominal channel.

Annex F (informative):
Application form for testing

Notwithstanding the provisions of the copyright clause related to the text of the present document, ETSI grants that users of the present document may freely reproduce the application form for testing proforma in this annex so that it can be used for its intended purposes and may further publish the completed application form.

The form contained in this annex may be used by the manufacturer to comply with the requirements contained in clause 5.3.1 to provide the necessary information about the equipment to the test laboratory prior to the testing. It contains product information as well as other information which might be required to define which configurations are to be tested, which tests are to be performed as well as the test conditions.

If used, this application form should form an integral part of the test report.

F.1 Information as required by EN 301 598 V1.1.1, clause 5.3.1

In accordance with EN 301 598, clause 5.3.1, the following information is provided by the manufacturer.

a) **The unique identifier, emission class, technology identifier, type (A or B), model identifier, and category (master or slave) of the UUT**

   The unique identifier of the UUT …………

   The emission class (1, 2, 3, 4 or 5) of the UUT …………

   The technology identifier of the UUT …………

   The equipment type (A or B) of the UUT …………

   The category (master or slave) of the UUT…………

b) **The operating frequency range(s) of the equipment within the 470 MHz to 790 MHz band**

   The operating frequency range(s) of the equipment within the 470 MHz to 790 MHz band …………

c) **Whether the UUT can support simultaneous transmissions in multiple DTT channels (contiguous and/or non-contiguous)**

Can the UUT support simultaneous transmissions in multiple DTT channels (contiguous and/or non-contiguous)?
☐ Yes   ☐ No

d) **The Nominal Channel Bandwidth(s) supported**

   Nominal Channel Bandwidth 1:   ...... MHz (n × 8 MHz where n ≥ 1)

   Nominal Channel Bandwidth 2:   ...... MHz (n × 8 MHz where n ≥ 1)

   Nominal Channel Bandwidth 3:   ...... MHz (n × 8 MHz where n ≥ 1)

e) **The Maximum total Channel Bandwidth supported**

   Maximum Total Channel Bandwidth: ...... MHz (m × 8 MHz where m ≥ 1)

f) **The groupings of DTT channels supported**

   All possible groupings of DTT channels supported ……...

g) **The maximum RF power spectral density (EIRP) supported by the UUT**

   The maximum RF power spectral density supported by the UUT ………… (dBm / 100 kHz)

h)   The maximum RF power (EIRP) supported by the UUT

The maximum RF power supported by the UUT ………… (dBm)

i)   The types of modulation and multiple access schemes employed by the UUT

What types of modulation schemes are employed by the UUT? …………

What types of multiple access schemes are employed by the UUT? …………

j)   The modulation and multiple access schemes employed by the UUT for each of the RF tests

The modulation scheme to be used for testing the maximum RF power spectral density …………

The multiple access scheme to be used for testing the maximum RF power spectral density …………

The modulation scheme to be used for testing the maximum RF power …………

The multiple access scheme to be used for testing the maximum RF power …………

k)   The antenna design used by the equipment and measures to prevent the user from connecting a different antenna (tick all that apply)

Does the equipment use an integral antenna?   ☐ Yes   ☐ No

If "Yes", then what is the maximum gain of the antenna assembly ………… (dBi)

If "Yes", then what measures are applied to prevent the user from connecting a different antenna?

Does the equipment use a dedicated antenna?   ☐ Yes   ☐ No

If "Yes", then what is the maximum gain of the antenna assembly ………… (dBi)

If "Yes", then what measures are applied to prevent the user from connecting a different antenna?

Does the equipment use an external antenna?   ☐ Yes   ☐ No

For a Type A TVWSD with an external antenna(s), the antenna gain of a single antenna assembly, and (if implemented) any beamforming gain for a multiple antenna system intended to be used in combination with the equipment

What is the antenna gain of a single antenna assembly ………… (dBi)

What is the beamforming gain (beyond the summation of the emissions from each antenna) for a multiple antenna system ………… (dBi)

l)   The different transmit operating modes (see clause 5.1.2.2) (tick all that apply):

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

☐   a) Equipment with only 1 antenna

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

☐   c) Equipment with two or more antennas, but operating in a mode where only one antenna is used

☐ **Operating mode 2**: Multiple Antennas without beamforming

☐ **Operating mode 3**: Multiple Antennas with beamforming

In case of Smart Antenna Systems or multiple antenna systems

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

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

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

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

m) Declaration of geo-location capability for a master UUT

Is the UUT a master device?   ☐ Yes   ☐ No

If the UUT is a master device, does it have horizontal geo-location capability?

☐ Yes   ☐ No

If the UUT is a master device, does it have vertical geo-location capability?

☐ Yes   ☐ No

n) Declaration of geo-location capability for a slave UUT

Is the UUT a slave device?   ☐ Yes   ☐ No

If the UUT is a slave device, which of the following geo-location capabilities does it have?

☐ Horizontal geo-location capability *and* vertical geo-location capability

☐ Horizontal geo-location capability but without vertical geo-location capability

☐ No horizontal geo-location capability

o) Capability for a slave UUT to request specific operational parameters from a master TVWSD

Is the UUT a slave device?   ☐ Yes   ☐ No

If "Yes", is the UUT capable of requesting specific operational parameters from a master TVWSD?

☐ Yes   ☐ No

p) Capability for a slave UUT to communicate directly with another slave TVWSD

Is the UUT a slave device?   ☐ Yes   ☐ No

If "Yes", is the UUT capable of communicating directly with another slave TVWSD?

☐ Yes   ☐ No

If "Yes", will the UUT remain under the control of its serving master TVWSD when communicating directly with another slave TVWSD?

☐ Yes   ☐ No

q) User access restrictions

Have the controls (hardware or software) related to the exchange of information between the UUT and a TVWSDB, and the controls (hardware or software) that define the operation of the UUT been made inaccessible to the user?

☐ Yes   ☐ No

r) The extreme operating temperature and supply voltage range that apply to the equipment

☐   -20 °C to +55 °C   (Outdoor & Indoor usage)

☐   0 °C to +35 °C   (Indoor usage only)

☐   Other: ....

Supply Voltage

☐ AC mains   State AC voltage: Minimum: …   Nominal: ...   Maximum: ...

☐ DC   State DC voltage   Minimum: …   Nominal: ...   Maximum: ...

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s) **For each of the tests to be performed, the worst case operational mode (e.g. power settings, modulation, antennas, etc.) with respect to the tests being performed**

Worst case operation mode for RF output power measurements …………

Worst case operation mode for Power Spectral Density and Transmitter unwanted emissions within the 470 MHz to 790 MHz band …………

Worst case operation mode for Transmitter unwanted emissions outside the 470 MHz to 790 MHz bands …………

Annex G (informative):
Bibliography

ECC Report 159: "Technical and operational requirements for the possible operation of cognitive radio systems in the 'white spaces' of the frequency band 470-790 MHz".

ECC Report 185: "Complementary Report to ECC Report 159, Further definition of technical and operational requirements for the operation of white space devices in the band 470-790 MHz".

History

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