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Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices; Wireless alarms with low duty cycle; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive

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Contents

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Foreword

This draft Harmonized European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the combined Public Enquiry and Vote phase of the ETSI standards EN Approval Procedure.

The present document has been produced by ETSI in response to mandate M/284 issued from the European Commission under Directive 98/34/EC [i.9] as amended by Directive 98/48/EC [i.6].

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.2].

The requirements relevant to Directive 1999/5/EC [i.2] are summarized in annex A.

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	18 months after doa

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**may not**", "**need**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

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.2]. The modular structure is shown in ETSI EG 201 399 [i.1].

The present document is intended to be applicable to Short Range equipment used in applications for which a high overall reliability of operation may be required.

It is recognized that the radio communications link alone does not determine the overall operation of a system, but that a functioning radio communications link is an essential foundation upon which a system may be built.

The present document sets out various means and features by which the performance of a radio communications link may be improved. These include:

1) Spectrum Access Rules - with the aim of reducing the probability of collisions between transmissions from different equipment.

2) Receiver Parameters - with the aim of reducing the probability of interference from equipment on other frequencies.

3) Bi-Directional Communications - with the aim of reducing the time and number of transmissions required to achieve a given level of confidence in successful communication.

4) Frequency Agility - with the aim of enabling the equipment to change its operating frequency to avoid certain types of interference.

Clauses 1 and 3 provide a general description on the types of equipment covered by the present document and the definitions and abbreviations used.

Clause 4 specifies technical requirements to be met by all equipment.

Clause 5 specifies technical requirements for receivers in equipment with uni-directional communications.

Clause 6 specifies technical requirements for equipment with bi-directional communications.

Clause 7 specifies technical requirements for equipment with bi-directional communications and frequency agility.

Clause 8 specifies the methods for testing for compliance with the technical requirements.

Annex A summarizes the requirements relevant to Directive 1999/5/EC [i.2].

1 Scope

The present document applies to wireless alarms equipment using low duty cycle, as described in clause 4 and in ETSI TS 103 060 [i.7], as a means of enhancing reliability of radio communications.

The present document also applies to any wireless alarm that meets the usage restrictions for the frequency concerned.

SRD alarms and social alarms are also covered in the scope of alternative standards, e.g. ETSI EN 300 220-2 [i.8].

These equipment types may operate in the frequency bands given in table 1a.

Table 1a: Frequency bands designated to wireless alarms by EU Commission Decision 2013/752/EU [i.3]

	Frequency band	Category of short-range devices	Other usage restrictions
Transmit and Receive	868,600 MHz to 868,700 MHz	Low duty cycle/high reliability devices	This set of usage conditions is only available to alarm systems.
Transmit and Receive	869,200 MHz to 869,250 MHz	Low duty cycle/high reliability devices	This set of usage conditions is only available to social alarm devices.
Transmit and Receive	869,250 MHz to 869,300 MHz	Low duty cycle/high reliability devices	This set of usage conditions is only available to alarm systems.
Transmit and Receive	869,300 MHz to 869,400 MHz	Low duty cycle/high reliability devices	This set of usage conditions is only available to alarm systems.
Transmit and Receive	869,650 MHz to 869,700 MHz	Low duty cycle/high reliability devices	This set of usage conditions is only available to alarm systems.

These equipment types are also capable of operating in all or part of the frequency bands given in table 1b.

Table 1b: Non specific SRD frequency bands also available to wireless alarms within 25 MHz to 1 000 MHz

	Frequency bands
Transmit and Receive	169,400 MHz to 169,8125 MHz
Transmit and Receive	863,000 MHz to 876,000 MHz
Transmit and Receive	915,000 MHz to 921,000 MHz

NOTE 1: The non specific frequency bands in table 1b are primarily intended for all SRD types; therefore the same level of reliability as when operating on frequencies in table 1a may not be achieved.

The present document is intended to cover the provisions of Directive 1999/5/EC (R&TTE Directive) [i.2], 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 2: 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] Recommendation ITU-T O.153 (1992): "Basic parameters for the measurement of error performance at bit rates below the primary rate".

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

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

[i.2] 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.3] Commission Decision 2013/752/EU on harmonization of the radio spectrum for use by short-range devices.

[i.4] CISPR 16 (2006) (parts 1-1, 1-4 and 1-5): "Specification for radio disturbance and immunity measuring apparatus and methods; Part 1: Radio disturbance and immunity measuring apparatus".

[i.5] ETSI TR 102 273 (all parts) (V1.2.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties".

[i.6] 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.7] ETSI TS 103 060: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Method for a harmonized definition of Duty Cycle Template (DCT) transmission as a passive mitigation technique used by short range devices and related conformance test methods".

[i.8] ETSI EN 300 220-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW; Part 2: Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive".

[i.9] Directive 98/34/EC of the European Parliament and the Council of 22 June 1998, laying down a procedure for the provision of information in the field of technical standards and regulations.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

adjacent channel: frequency band, of width channel spacing, on either side of the operating channel

alternate adjacent channels: those two channels offset from the operating channel by double the channel bandwidth

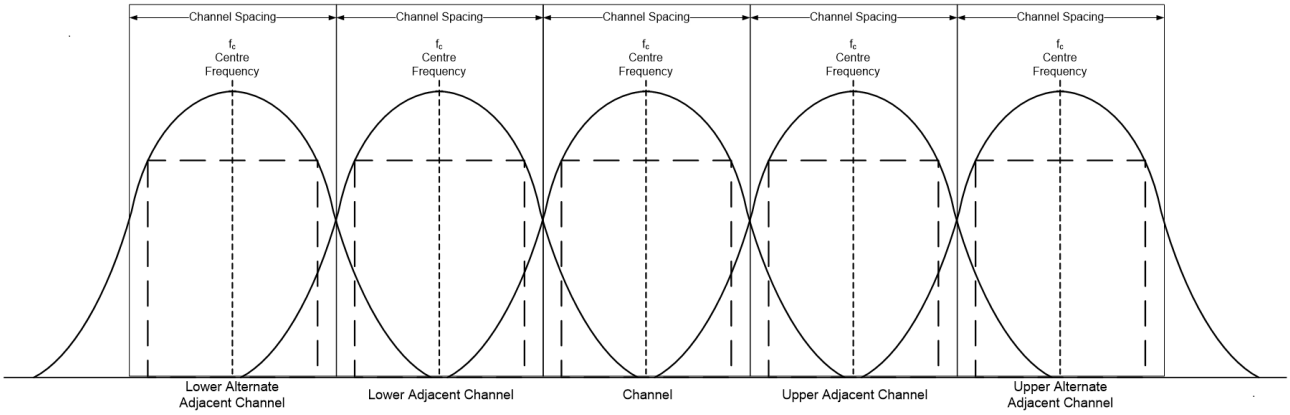


Figure 1: Adjacent and alternate adjacent channel definitions

assigned frequency band: frequency band or sub-band within which the device is authorized to operate and to perform the intended function of the equipment

centre frequency: nominal centre frequency of a transmission

channel: frequency band, of width channel spacing, the centre of which defines the nominal centre frequency for a given transmission

channel spacing: separation, in hertz, between adjacent nominal centre frequencies

channelized equipment: equipment to be used at a frequency where the channel spacing is defined by regulation

conducted measurements: measurements which are made using a direct 50 Ω connection to the equipment under test

continuous transmission: modulated transmission without interruption for the period of the test

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

disregard time (T_{dis}): See annex F.

duty cycle: See annex F.

extreme (voltage/temperature) test conditions: See clause 8.3.9.

frequency adaptivity: capability of equipment to avoid using permitted operating channels that it has determined are temporarily or permanently unsuitable for its use

frequency agility: capability of equipment to dynamically change operating channel

integral antenna: permanent fixed antenna, which may be built-in, designed as an indispensable part of the equipment

low duty cycle/high reliability: category of device used in Commission Decision 2013/752/EU [i.3]

NOTE: Note (15) in the Commission Decision states: *The low duty cycle/high reliability device category covers radio devices that rely on low overall spectrum utilisation and low duty cycle spectrum access rules to ensure highly reliable spectrum access and transmissions in shared bands. Typical uses include alarm systems that use radio communication for indicating an alert condition at a distant location and social alarms systems that allow reliable communication for a person in distress.*

maximum transmission duration (T_{On-Max}): See annex F.

minimum inter-transmission interval ($T_{Off-Min}$): See annex F.

Message Initiator (MI): part which generates a message of import to be transferred to another part, such as a Message Responder

NOTE: Applies to equipment with bi-directional communication. For instance, the MI may be the sensor or trigger in an alarm system.

Message Responder (MR): part which receives a message of import from another part, such as a Message Initiator

NOTE: Applies to equipment with bi-directional communication. For instance, the MR may be the base station or control panel in an alarm system.

normal (voltage/temperature) test conditions: See clause 8.3.9.

operating channel: channel in which transmissions from the device occur

operating frequency: centre frequency

operational frequency band: frequency band or sub-band within which the device is authorized to operate and to perform the intended function of the equipment

provider: manufacturer, or his authorized representative or the person responsible for placing the equipment on the market

radiated measurements: measurements which involve the absolute measurement of a radiated field

signal threshold ($P_{Threshold}$): See annex F.

spurious emissions: emissions on a frequency or frequencies which are outside the occupied bandwidth and the level of which may be reduced without affecting the corresponding transmission of information

NOTE: Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

Transmission: See annex F.

wanted channel: channel to which a receiver is tuned

wanted performance criterion: See clause 8.3.11.

3.2 Symbols

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

dB	decibel
dBm	power expressed relative to 1 mW
E	Electric field strength
mW	milliWatt
nW	nanoWatt
µW	microwatt
W	Watt
λ	wavelength

3.3 Abbreviations

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

ACK	Acknowledgement
ARQ	Automatic Repeat Request
B	Channel width declared by the provider
BER	Bit Error Ratio
BW	BandWidth
CEPT	Commission Européenne des Postes et Télécommunications
CISPR	International Special Committee on Radio Interference
DC	Duty Cycle
e.r.p.	effective radiated power
EC	European Commission
EMC	ElectroMagnetic Compatibility
ER-GSM	Extended GSM Rail
ERP	Effective Radiated Power
EU	European Union
EUT	Equipment Under Test
FAR	Fully Anechoic Room
FEC	Forward Error Correction
IF	Intermediate Frequency
ITU-R	International Telecommunication Union - Radiocommunication
ITU-T	International Telecommunication Union - Telecommunication Standardization Sector
LPDA	Logarithmic Periodic Dipole Antenna
MI	Message Initiator
MR	Message Responder
OATS	Open Area Test Site
PER	Packet Error Ratio
R&TTE	Radio and Telecommunications Terminal Equipment
RBW	Resolution BandWidth
RBWREF	Reference RBW
RF	Radio Frequency
RMS	Root Mean Square
Rx	Receiver
SAR	Semi-Anechoic Room
SRD	Short Range Device
TR	Technical Report
Tx	Transmitter
VBW	Video Bandwidth
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 operational environmental profile.

4.2 Conformance requirements

The present document applies to equipment operating in frequency bands that may be Channelized or Unchannelized. A Channelized frequency band is one which is divided by regulation into channels with spacing of 25 kHz or less. All other bands are considered as Unchannelized, although restrictions on signal bandwidth may still apply.

Technical requirements for equipment operating in Channelized bands are specified in clause 4.2.1.

Technical requirements for equipment operating in Unchannelized bands are specified in clause 4.2.2.

Technical requirements common to all equipment are specified in clause 4.2.3.

NOTE 1: Equipment compliant with the Channelized technical requirements may, in some cases, also be compliant with the Unchannelized technical requirements, but the reverse is not necessarily so.

NOTE 2: Some frequency bands are available as either Channelized or Unchannelized. They are listed in both clauses 4.2.1 and 4.2.2 in order to provide options for compliance declaration and/or testing.

NOTE 3: An equipment may be compliant with the Channelized technical requirements in one phase of its operation and with the Unchannelized technical requirements in another phase.

4.2.1 Technical requirements for operation on Channelized frequencies

4.2.1.1 Applicability

This clause applies to all types of equipment operating on Channelized frequencies.

Table 2: Technical Requirements for Channelized Frequencies

Band no.	Frequency Band	Maximum radiated power, e.r.p.	Channel spacing	Usage restrictions
E4	169,5875 MHz to 169,8125 MHz	10 mW	12,5 kHz	
2	868,600 MHz to 868,700 MHz	10 mW	25 kHz	This set of usage conditions is only available to alarm systems
3	869,200 MHz to 869,250 MHz	10 mW	25 kHz	This set of usage conditions is only available to social alarm systems
4	869,250 MHz to 869,300 MHz	10 mW	25 kHz	This set of usage conditions is only available to alarm systems
5	869,300 MHz to 869,400 MHz	10 mW	25 kHz	This set of usage conditions is only available to alarm systems
6	869,650 MHz to 869,700 MHz	25 mW	25 kHz	This set of usage conditions is only available to alarm systems

4.2.1.2 Operating Frequency and Channel

4.2.1.2.1 Description

The nominal operating frequency is the centre of a channel of width B.

4.2.1.2.2 Limits

The channel widths, B, shall be equal to the Channel Spacing listed in table 2. The channels shall lie on a raster formed by the Channel Spacing and the edges of the bands.

4.2.1.2.3 Conformance

There is no conformance test specified for this requirement.

The provider shall declare the operating frequency.

NOTE: More than one operating frequency on one or more channels may be declared.

4.2.1.3 Effective Radiated Power

This requirement applies to all types of equipment operating on Channelized frequencies.

4.2.1.3.1 Description

The effective radiated power (e.r.p) is the power radiated in the direction of the maximum field strength under specified conditions of measurements for any condition of modulation. For equipment with a permanent or temporary antenna connection it may be taken as the power delivered from that connector.

If the equipment is designed to operate with different carrier powers, the rated power for each level or range of levels shall be declared by the provider.

4.2.1.3.2 Limits

The effective radiated power shall not be greater than the value shown in table 2.

4.2.1.3.3 Conformance

The conformance tests for this requirement are specified in clauses 8.4.2 and 8.4.3.

4.2.1.4 Duty Cycle and short term behaviour

4.2.1.4.1 Description

The present document applies to equipment operating with low duty cycle and transmissions of limited duration. Equipment may be triggered manually, by internal timing or by external stimulus. Depending on the method of triggering the timing may be predictable or random.

NOTE: The Duty Cycle, Observation Period, Max Ton, Min Toff and Observation Bandwidth are defined in annex F.

4.2.1.4.2 Limits

Table 3: Duty Cycle and Transmission Timings for Channelized Frequencies

Band no.	Duty Cycle			Short term behaviour		
	Frequency Band	Duty cycle	Observation Period	Max Ton	Min Toff	Observation BW
		DC	T_{obs}	T_{on_max}	T_{off_min}	F_{dc}
E4	169,5875 MHz to 169,8125 MHz	0,1 %	1 hr	200 ms	200 ms	100 kHz
2	868,600 MHz to 868,700 MHz	1 %	1 hr	200 ms	200 ms	100 kHz
3	869,200 MHz to 869,250 MHz	0,1 %	1 hr	200 ms	200 ms	50 kHz
4	869,250 MHz to 869,300 MHz	0,1 %	1 hr	200 ms	200 ms	50 kHz
5	869,300 MHz to 869,400 MHz	1 %	1 hr	200 ms	200 ms	100 kHz
6	869,650 MHz to 869,700 MHz	10 %	1 hr	200 ms	200 ms	50 kHz

An equipment may operate on only one channel at a time in each of the bands in table 3.

An equipment may operate sequentially in more than one of the bands in table 3.

4.2.1.4.3 Conformance

The provider shall produce an assessment of the Duty Cycle for a representative period of T_{obs}. The representative period shall be the most active one in normal use of the device. Thus the Duty Cycle shall be assessed on the basis of the traffic in the "rush hour" rather than the average over a day or a week.

Procedures such as test and development of equipment and setup and configuration during installation are not considered part of normal operation.

The conformance tests for other parts of this requirement are specified in clause 8.4.9.

4.2.1.5 Adjacent Channel Power

4.2.1.5.1 Description

Adjacent channel power is power incidental to proper operation of a transmitter falling into the neighbouring channels.

The adjacent channels and alternate adjacent channels are defined in clause 3.

NOTE: If the frequency error measurements in clause 4.2.3.2 cannot be performed, an alternative is to perform the adjacent channel power measurements in this clause under extreme test conditions.

4.2.1.5.2 Limits

The power in the adjacent channels shall not exceed the maximum values given in table 4.

Table 4: Adjacent channel power limits applicable to Channelized systems

		Adjacent Channel	Alternate Adjacent Channel
Channel spacing < 20 kHz	Normal test conditions	1 µW	1 µW
	Extreme test conditions	3,2 µW	1 µW
Channel spacing ≥ 20 kHz	Normal test conditions	200 nW	100 nW
	Extreme test conditions	640 nW	200 nW

4.2.1.5.3 Conformance

The conformance tests for this requirement are specified in clause 8.4.5.

4.2.2 Technical requirements for operation on Unchannelized frequencies

4.2.2.1 Applicability

This clause applies to all types of equipment operating on Unchannelized frequencies.

Table 5: Technical Requirements for Unchannelized Frequencies

Band no.	Frequency Band	Maximum radiated power, e.r.p.	Max Channel Spacing	Other usage restrictions	Notes
E2	169,400 MHz to 169,475 MHz	500 mW	50 kHz		2
E4	169,5875 MHz to 169,8125 MHz	10 mW	100 kHz		
2	868,600 MHz to 868,700 MHz	10 mW	100 kHz	This set of usage conditions is only available to alarm systems	
7	875,800 MHz to 876,000 MHz	25 mW	100 kHz		
8	915,000 MHz to 915,200 MHz	25 mW	100 kHz		
9	920,800 MHz to 921,000 MHz	25 mW	100 kHz		
G	863,000 MHz to 870,000 MHz	25 mW	200 kHz		1, 2
G5	870,000 MHz to 876,000 MHz	25 mW	200 kHz		1, 2
G8	915,000 MHz to 921,00 MHz	25 mW	200 kHz		1, 3
NOTE 1: Excluding frequencies in bands 2, 7, 8, 9 in this table and bands 3, 4, 5 and 6 in table 2. NOTE 2: This band is also used by other SRD equipment types at powers up to 500 mW erp. NOTE 3: This band is also used by other SRD equipment types at powers up to 2 W erp.					

4.2.2.2 Operating Frequency

4.2.2.2.1 Description

The nominal operating frequency is the centre of a channel of width B.

4.2.2.2.2 Limits

B shall be either 12,5 kHz or a multiple of 25 kHz up to the maximum value of Channel Spacing specified in table 5. The same value of B shall be used for transmitter and receiver measurements.

The channels chosen shall lie on a 25 kHz raster aligned with the edge of the assigned bands. Channels wider than 25 kHz shall be formed by combining 25 kHz segments.

4.2.2.2.3 Conformance

There is no conformance test specified for this requirement.

The provider shall declare the operating frequency.

NOTE: More than one operating frequency on one or more channels may be declared.

4.2.2.3 Effective Radiated Power

4.2.2.3.1 Description

The effective radiated power is the power radiated in the direction of the maximum field strength under specified conditions of measurements for any condition of modulation. For equipment with a permanent or temporary antenna connection it may be taken as the power delivered from that connector.

If the equipment is designed to operate with different carrier powers, the rated power for each level or range of levels shall be declared by the provider.

4.2.2.3.2 Limits

The effective radiated power shall not be greater than the value shown in table 5.

4.2.2.3.3 Conformance

The conformance tests for this requirement are specified in clauses 8.4.2 and 8.4.3.

4.2.2.4 Duty Cycle and short term behaviour

4.2.2.4.1 Description

The present document applies to equipment operating with low duty cycle and transmissions of limited duration. Equipment may be triggered manually, by internal timing or by external stimulus. Depending on the method of triggering, the timing may be predictable or random.

NOTE: The Duty Cycle, Observation Period, Max T_{on}, Min T_{off} and Observation Bandwidth are defined in annex F.

4.2.2.4.2 Limits

The requirements for Duty Cycle and transmission timings are specified in table 6.

Table 6: Duty Cycle and Transmission Timings for Unchannelized Frequencies

Band no.	Duty Cycle			Short term behaviour			Notes
	Frequency Band	Duty cycle	Observation Period	Max T_{on}	Min T_{off}	Observation BW	
		DC	T_{obs}	T_{on_max}	T_{off_min}	F_{dc}	
E2	169,400 MHz to 169,475 MHz	1 %	1 hr	200 ms	200 ms	75 kHz	
E4	169,5875 MHz to 169,8125 MHz	0,1 %	1 hr	200 ms	200 ms	75 kHz	
2	868,600 MHz to 868,700 MHz	1 %	1 hr	200 ms	200 ms	100 kHz	
G5a	870,000 MHz to 875,600 MHz	1 %	1 hr	400 ms	400 ms	200 kHz	2
G5b	875,600 MHz to 875,800 MHz	1 %	1 hr	200 ms	200 ms	200 kHz	2
G5c	875,800 MHz to 876,000 MHz	0,1 %	1 hr	200 ms	200 ms	200 kHz	2
G8a	915,000 MHz to 915,200 MHz	0,1 %	1 hr	200 ms	200 ms	200 kHz	
G8b	915,200 MHz to 920,800 MHz	1 %	1 hr	200 ms	200 ms	200 kHz	
G8c	920,800 MHz to 921,000 MHz	0,1 %	1 hr	200 ms	200 ms	200 kHz	
G	863,000 MHz to 870,000 MHz	0,1 %	1 hr	n/a	n/a	n/a	1

Band no.	Duty Cycle			Short term behaviour			Notes
	Frequency Band	Duty cycle	Observation Period	Max T_{on}	Min T_{off}	Observation BW	
		DC	T_{obs}	T_{on_max}	T_{off_min}	F_{dc}	
NOTE 1: Excluding frequencies in band 2 in this table, and bands 3, 4, 5 and 6 in table 2. NOTE 2: For ER-GSM protection (873 MHz to 876 MHz, where applicable), the duty cycle is limited to ≤ 0,01 % and a maximum single transmitter on time of 5 ms/1 s.							

An equipment may operate on only one channel at a time in each of the bands in table 6.

An equipment may operate sequentially in more than one of the bands in table 6.

4.2.2.4.3 Conformance

The provider shall produce an assessment of the Duty Cycle for a representative period of T_{obs}. The representative period shall be the most active one in normal use of the device. Thus the Duty Cycle shall be assessed on the basis of the traffic in the "rush hour" rather than the average over a day or a week.

Procedures such as test and development of equipment and setup and configuration during installation are not considered part of normal operation.

The conformance tests for other parts of this requirement are specified in clause 8.4.9.

4.2.2.5 Adjacent Channel Power

4.2.2.5.1 Description

Adjacent channel power is power incidental to proper operation of a transmitter falling into the neighbouring channels.

The adjacent channels and alternate adjacent channels are defined in clause 3.

This requirement applies to all types of equipment operating on Unchannelized frequencies.

NOTE: If the frequency error measurements in clause 4.2.3.2 cannot be performed, an alternative is to perform the adjacent channel power measurements in this clause under extreme test conditions.

4.2.2.5.2 Limits for channel width B ≤ 25 kHz

Where the declared channel width B is less than or equal to 25 kHz, the power in the adjacent channels shall not exceed the values given in table 7.

Table 7: Adjacent channel power limits applicable to Unchannelized systems with B ≤ 25 kHz

Channel Width	Conditions	Adjacent Channel	Alternate Adjacent Channel
B < 20 kHz	Normal test conditions	1 μW	1 μW
	Extreme test conditions	3,2 μW	1 μW
B ≥ 20 kHz	Normal test conditions	200 nW	100 nW
	Extreme test conditions	640 nW	200 nW

4.2.2.5.3 Limits for channel width B > 25 kHz

Where the declared channel width B is more than 25 kHz, the power measured at any frequency in the adjacent channels shall not exceed the values given in table 8.

Table 8: Adjacent channel power limits applicable to Unchannelized systems with B > 25 kHz

	Adjacent Channel Freq Range	Alternate Adjacent Channel Freq Range
Reference Bandwidth (RBW)	1 kHz	1 kHz
Normal test conditions	250 nW	250 nW
Extreme test conditions	250 nW	250 nW

4.2.2.5.4 Conformance

The conformance tests for this requirement are specified in clauses 8.4.5 and 8.4.6.

4.2.3 Technical requirements for all equipment

4.2.3.1 Applicability

These requirements apply to all equipment, unless otherwise stated.

4.2.3.2 Transmitter Frequency Error

4.2.3.2.1 Description and Applicability

Frequency error is the difference, under normal and extreme conditions, between the measured unmodulated carrier frequency and the nominal operating frequency.

Frequency error is normally measured with an unmodulated carrier. If the equipment is not capable of producing an unmodulated carrier, then this requirement does not apply. Instead the adjacent channel power (see clause 4.2.1.5 for Channelized equipment or clause 4.2.2.5 for Unchannelized equipment) requirements shall be met under extreme test conditions.

4.2.3.2.2 Limits

The frequency error shall not exceed:

- ±10 % of the Channel Spacing, or, in the case of Unchannelized Bands, the channel width B declared by the provider;

  and not exceeding

- ±12 ppm of the nominal frequency.

4.2.3.2.3 Conformance

The conformance tests for this requirement are specified in clause 8.4.1.

4.2.3.3 Transmitter Transient Power

4.2.3.3.1 Description

Transmitter transient power is power falling into frequencies other than the operating channel as a result of the transmitter being switched on and off.

4.2.3.3.2 Limits

The limits in table 9 apply when the transmitter is being switched on and off repeatedly.

Table 9: Transmitter Transient Power limits

	Adjacent Channel Freq Range	Extended frequency range
Offset from edge of operating channel	**0 < δf ≤ B**	**B < δf ≤ 500 kHz**
Reference Bandwidth (RBW)	1 kHz	1 kHz
Video Bandwidth (VBW)	10 kHz	10 kHz
Detector mode	Max hold	Max hold
Limit	[10 μW]	2 μW

4.2.3.3.3 Conformance

The conformance tests for this requirement are specified in clause 8.4.4.

4.2.3.4 Spurious Emissions

4.2.3.4.1 Description

Spurious emissions are unwanted emissions in the spurious domain radiated by the equipment or its antenna.

For transmitters, the spurious domain is all frequencies apart from the channel on which the transmitter is intended to operate and its adjacent and alternate adjacent channels.

For receivers, the spurious domain is all frequencies.

4.2.3.4.2 Limits

The power of any unwanted emission in the spurious domain shall not exceed the values given in table 10.

Table 10: Spurious domain emission limits

Frequency / State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
Transmitting	4 nW	250 nW	1 μW
Standby	2 nW	2 nW	20 nW
Receiving	2 nW	2 nW	20 nW

4.2.3.4.3 Conformance

The conformance tests for this requirement are specified in clause 8.4.7.

4.2.3.5 Frequency Stability under Low Voltage Conditions

4.2.3.5.1 Description and Applicability

This requirement applies only to transmitters in battery operated equipment.

The frequency stability under low voltage condition is the ability of the equipment to maintain its operating frequency when the battery voltage falls below the lower extreme voltage level.

4.2.3.5.2 Limits

The equipment shall either:

a) remain on the declared channel, within the limits stated in clause 4.2.3.1; or

b) reduce its effective radiated power below the spurious emission limits; or

c) shut down.

As the voltage falls below the providers declared operating voltage.

4.2.3.5.3 Conformance

The conformance tests for this requirement are specified in clause 8.4.8.

4.2.4 Receiver Parameters

Table 11: Summary of minimum receiver parameters for all systems

Requirement	Test Conditions	Limits
Adjacent Channel Selectivity	Wanted signal 3 dB above minimum	30 dB
Blocking at ±2 MHz	Wanted signal 3 dB above minimum	35 dB
Blocking at ±10 MHz	Wanted signal 3 dB above minimum	60 dB

4.2.4.1 Applicability

This requirement applies to all receiving equipment combined with or intended to be used in conjunction with transmitters conforming to the present document.

4.2.4.2 Adjacent Channel Selectivity

4.2.4.2.1 Description

The adjacent channel selectivity is a measure of the capability of the receiver to operate satisfactorily in the presence of an unwanted signal, which differs in frequency from the wanted signal by an amount equal to the channel separation for which the equipment is intended.

4.2.4.2.2 Limits

The adjacent channel selectivity shall be equal to or greater than the limit in table 11.

4.2.4.2.3 Conformance

The conformance tests for this requirement are specified in clause 8.5.1.

4.2.4.3 Blocking

4.2.4.3.1 Description

Blocking is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted input signal at any frequencies other than those of the spurious responses or the adjacent channels or bands.

4.2.4.3.2 Limits

The blocking levels at the specified frequency offsets shall be equal to or greater than the limits in table 11.

4.2.4.3.3 Conformance

The conformance tests for this requirement are specified in clause 8.5.3.

5 Technical Requirements for Uni-Directional Communication

5.1 Mode B Applicability and Conformance Requirements

This clause applies to:

- Social Alarms using uni-directional communication.
- Any other equipment at the discretion of the provider.

NOTE 1: This clause forms an alternative technical solution known as Mode B.

For Mode B, equipment shall meet the requirements of clause 4, plus the additional requirements of clause 5.2.

NOTE 2: For some parameters, conformance with clause 5.2 will demonstrate conformance with clause 4.2.

5.2 Additional Conformance requirements

5.2.1 Void

5.2.2 Void

5.2.3 Transmitter Parameters

No additional requirements.

5.2.4 Receiver Parameters

Table 12: Summary of minimum receiver parameters for uni-directional systems

Requirement	Test Conditions	Limits
Adjacent Channel Selectivity (B ≤ 25 kHz)	Wanted signal 3 dB above sensitivity	54 dB - A (Note 1)
Adjacent Channel Selectivity (B > 25 kHz)	Wanted signal 3 dB above sensitivity	60 dB - A (Note 1)
Adjacent channel saturation	Wanted signal 43 dB above sensitivity	47 dB
Blocking at ±2 MHz	Wanted signal 3 dB above sensitivity	84 dB - A (Note 1)
Blocking at ±10 MHz	Wanted signal 3 dB above sensitivity	84 dB - A (Note 1)
Spurious response rejection	Wanted signal 3 dB above sensitivity	60 dB (Note 2)
NOTE 1: A = 10 log (B / 25 kHz), where B is the channel width. NOTE 2: For spurious response tests separated from the wanted signal by less than 0,1 % of the centre frequency, the limits are relaxed by 25 dB.		

5.2.4.1 Applicability

This requirement applies to all receiving equipment combined with or intending to be used in conjunction with transmitters conforming to the present document.

5.2.4.2 Adjacent Channel Selectivity

5.2.4.2.1 Description

The adjacent channel selectivity is a measure of the capability of the receiver to operate satisfactorily in the presence of an unwanted signal, which differs in frequency from the wanted signal by an amount equal to the channel separation for which the equipment is intended.

5.2.4.2.2 Limits

The adjacent channel selectivity shall be equal to or greater than the limit in table 12.

5.2.4.2.3 Conformance

The conformance tests for this requirement are specified in clause 8.5.1.

5.2.4.3 Blocking

5.2.4.3.1 Description

Blocking is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted input signal at any frequencies other than those of the spurious responses or the adjacent channels or bands.

5.2.4.3.2 Limits

The blocking levels at the specified frequency offsets shall be equal to or greater than the limits in table 12.

5.2.4.3.3 Conformance

The conformance tests for this requirement are specified in clause 8.5.3.

5.2.4.4 Adjacent Channel Saturation

5.2.4.4.1 Description

The receiver saturation is a measure of the capability of the receiver to operate as intended in the presence of a strong signal in the wanted channel together with a strong signal in the adjacent channel, which differs in frequency from the wanted signal by an amount equal to the channel separation.

5.2.4.4.2 Limits

The adjacent channel saturation shall be equal to or greater than the limit in table 12.

5.2.4.4.3 Conformance

The conformance tests for this requirement are specified in clause 8.5.2.

5.2.4.5 Spurious Response Rejection

5.2.4.5.1 Description

The spurious response rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal at any other frequency, at which a response is obtained.

5.2.4.5.2 Limits

The spurious response rejection of the equipment shall be equal to or greater than the limit in table 12.

5.2.4.5.3 Conformance

The conformance tests for this requirement are specified in clause 8.5.4.

6 Bi-Directional Communication - Single Frequency

6.1 Mode C1 Applicability and Conformance Requirements

This clause applies to:

- Social Alarms using bi-directional communication on a single frequency.
- Any other equipment at the discretion of the provider.

NOTE 1: This clause forms an alternative technical solution known as Mode C1.

For Mode C1, equipment shall meet the requirements of clause 4, plus the additional requirements of clause 6.2.

NOTE 2: For some parameters, conformance with clause 6.2 will demonstrate conformance with clause 4.2.

For the purposes of this section, the EUT will consist of two or more parts. The provider shall identify one part as the Message Initiator (MI) and one part as the Message Responder (MR). If only one part is being tested the other part may be replaced by a simulator if necessary.

6.2 Additional Conformance requirements

6.2.1 Bi-directional Communication

6.2.1.1 Applicability

This requirement applies to each of the MI and the MR when working in conjunction.

6.2.1.2 Acknowledgement

6.2.1.2.1 Description

An acknowledgement (ACK) is a short message sent in the return direction to signal that a forward going message has been received successfully.

6.2.1.2.2 Limits

The EUT shall be able to demonstrate an acknowledgment (ACK) of message transfer.

6.2.1.2.3 Conformance

The conformance tests for this requirement are specified in clause 8.6.1.

6.2.2 Void

6.2.3 Transmitter Parameters

6.2.3.1 Duty Cycle and short term behaviour

For the purposes of assessing Ton and Toff times, ACKs from a MR, up to 20 ms maximum duration, may be considered part of the MI transmissions.

If this option is chosen, the combination of the forward transmission (MI to MR), the changeover time and the ACK (MR to MI) shall fit within the Ton _max limits.

The MR and MI transmissions shall still meet the overall duty cycle limits.

6.2.4 Receiver Parameters

Table 13: Summary of minimum receiver parameters for bi-directional systems

Requirement	Test Conditions	Limits
Adjacent Channel Selectivity	Wanted signal 3 dB above sensitivity	42 dB
Adjacent channel saturation	Wanted signal 43 dB above sensitivity	30 dB
Blocking at ±1 MHz	Wanted signal 3 dB above sensitivity	60 dB - A (Note 1)
Blocking at ± 2 MHz	Wanted signal 3 dB above sensitivity	70 dB - A (Note 1)
Blocking at ±5 MHz	Wanted signal 3 dB above sensitivity	70 dB - A (Note 1)
Blocking at ±10 MHz	Wanted signal 3 dB above sensitivity	80 dB - A (Note 1)
Behaviour at high wanted signal level	Wanted signal only	100 μW
Spurious response rejection	Wanted signal 3 dB above sensitivity	50 dB (Note 2)
NOTE 1: A = 10 log (B / 25 kHz), where B is the channel width. NOTE 2: For spurious response tests separated from the wanted signal by less than 0,1 % of the centre frequency, the limits are relaxed by 25 dB.		

6.2.4.1 Applicability

These requirements apply to all receiving equipment that is part of a MR.

6.2.4.2 Adjacent Channel Selectivity

6.2.4.2.1 Description

The adjacent channel selectivity is a measure of the capability of the receiver to operate satisfactorily in the presence of an unwanted signal, which differs in frequency from the wanted signal by an amount equal to the channel separation for which the equipment is intended.

6.2.4.2.2 Limits

The adjacent channel selectivity shall be equal to or greater than the limit in table 13.

6.2.4.2.3 Conformance

The conformance tests for this requirement are specified in clause 8.5.1.

6.2.4.3 Blocking

6.2.4.3.1 Description

Blocking is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted input signal at any frequencies other than those of the spurious responses or the adjacent channels or bands.

6.2.4.3.2 Limits

The blocking levels at the specified frequency offsets shall be equal to or greater than the limits in table 13.

6.2.4.3.3 Conformance

The conformance tests for this requirement are specified in clause 8.5.3.

6.2.4.4 Adjacent Channel Saturation

6.2.4.4.1 Description

The receiver saturation is a measure of the capability of the receiver to operate as intended in the presence of a strong signal in the wanted channel together with a strong signal in the adjacent channel, which differs in frequency from the wanted signal by an amount equal to the channel separation.

6.2.4.4.2 Limits

The adjacent channel saturation shall be equal to or greater than the limit in table 13.

6.2.4.4.3 Conformance

The conformance tests for this requirement are specified in clause 8.5.2.

6.2.4.5 Spurious Response Rejection

6.2.4.5.1 Description

The spurious response rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal at any other frequency, at which a response is obtained.

6.2.4.5.2 Limits

The spurious response rejection of the equipment shall be equal to or greater than the limit in table 13.

6.2.4.5.3 Conformance

The conformance tests for this requirement are specified in clause 8.5.4.

6.2.4.6 Behaviour at high wanted signal level

6.2.4.6.1 Description

The behaviour at high wanted signal level is a measure of the capability of the receiver to operate as intended in the presence of a strong signal in the wanted channel.

6.2.4.6.2 Limits

The BER or PER under the specified conditions shall be equal to or better than the limit in table 13.

6.2.4.6.3 Conformance

The conformance tests for this requirement are specified in clause 8.5.6.

7 Bi-Directional Communication with Frequency Agility

7.1 Mode CN Applicability and Conformance Requirements

This clause applies to:

- Social Alarms using bi-directional communication on more than one frequency.
- Any other equipment at the discretion of the provider.

NOTE 1: This clause forms an alternative technical solution known as Mode CN.

For Mode CN, equipment shall meet the requirements of clause 4, plus the additional requirements of clause 7.2.

NOTE 2: For some parameters, conformance with clause 7.2 will demonstrate conformance with clause 4.2.

For the purposes of this section, the EUT will consist of two or more parts. The provider shall identify one part as the Message Initiator (MI) and one part as the Message Responder (MR). If only one part is being tested the other part may be replaced by a simulator if necessary.

7.2 Additional Conformance requirements

7.2.1 Bi-directional Communication

7.2.1.1 Applicability

This requirement applies to each of the MI and the MR when working in conjunction.

7.2.1.2 Acknowledgement

7.2.1.2.1 Description

An acknowledgement (ACK) is a short message sent in the return direction to signal that a forward going message has been received successfully.

7.2.1.2.2 Limits

The EUT shall be able to demonstrate an acknowledgment (ACK) of message transfer.

7.2.1.2.3 Conformance

The conformance tests for this requirement are specified in clause 8.6.1.

7.2.2 Frequency Agility

7.2.2.1 Applicability

This requirement applies to the two parts of the system operating in conjunction.

7.2.2.2 Ability to change communication frequency

7.2.2.2.1 Description

Frequency agility is the ability of the two parts of the system to co-ordinate a change of operating frequency.

7.2.2.2.2 Limits

The system shall demonstrate the ability to change frequency and maintain or re-establish communication within 5 seconds.

7.2.2.2.3 Conformance

The conformance tests for this requirement are specified in clause 8.6.2.

7.2.3 Transmitter Parameters

7.2.3.1 Duty Cycle and short term behaviour

For the purposes of assessing Ton and Toff times, ACKs from a MR, up to 20 ms maximum duration, may be considered part of the MI transmissions.

If this option is chosen, the combination of the forward transmission (MI to MR), the changeover time and the ACK (MR to MI) shall fit within the Ton _max limits.

The MR and MI transmissions shall still meet the overall duty cycle limits.

7.2.4 Receiver Parameters

Table 14: Summary of minimum receiver parameters for bi-directional systems with frequency agility

Requirement	Test Conditions	Limits
Adjacent Channel Selectivity	Wanted signal 3 dB above sensitivity	35 dB
Adjacent channel saturation	Wanted signal 43 dB above sensitivity	30 dB
Blocking at ±1 MHz	Wanted signal 3 dB above sensitivity	60 dB - A (Note 1)
Blocking at ±2 MHz	Wanted signal 3 dB above sensitivity	70 dB - A (Note 1)
Blocking at ±5 MHz	Wanted signal 3 dB above sensitivity	70 dB - A (Note 1)
Blocking at ±10 MHz	Wanted signal 3 dB above sensitivity	80 dB - A (Note 1)
Behaviour at high wanted signal level	Wanted signal only	100 μW
Spurious response rejection	Wanted signal 3 dB above sensitivity	50 dB
NOTE 1: A = 10 log (B / 25 kHz), where B is the channel width. NOTE 2: For spurious response tests separated from the wanted signal by less than 0,1 % of the centre frequency, the limits are relaxed by 25 dB.		

7.2.4.1 Applicability

These requirements apply to all receiving equipment that is part of a MR.

7.2.4.2 Adjacent Channel Selectivity

7.2.4.2.1 Description

The adjacent channel selectivity is a measure of the capability of the receiver to operate satisfactorily in the presence of an unwanted signal, which differs in frequency from the wanted signal by an amount equal to the channel separation for which the equipment is intended.

7.2.4.2.2 Limits

The adjacent channel selectivity shall be equal to or greater than the limit in table 14.

7.2.4.2.3 Conformance

The conformance tests for this requirement are specified in clause 8.5.1.

7.2.4.3 Blocking

7.2.4.3.1 Description

Blocking is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted input signal at any frequencies other than those of the spurious responses or the adjacent channels or bands.

7.2.4.3.2 Limits

The blocking levels at the specified frequency offsets shall be equal to or greater than the limits in table 14.

7.2.4.3.3 Conformance

The conformance tests for this requirement are specified in clause 8.5.3.

7.2.4.4 Adjacent Channel Saturation

7.2.4.4.1 Description

The receiver saturation is a measure of the capability of the receiver to operate as intended in the presence of a strong signal in the wanted channel together with a strong signal in the adjacent channel, which differs in frequency from the wanted signal by an amount equal to the channel separation.

7.2.4.4.2 Limits

The adjacent channel saturation shall be equal to or greater than the limit in table 14.

7.2.4.4.3 Conformance

The conformance tests for this requirement are specified in clause 8.5.2.

7.2.4.5 Spurious Response Rejection

7.2.4.5.1 Description

The spurious response rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal at any other frequency, at which a response is obtained.

7.2.4.5.2 Limits

The spurious response rejection of the equipment shall be equal to or greater than the limit in table 14.

7.2.4.5.3 Conformance

The conformance tests for this requirement are specified in clause 8.5.4.

7.2.4.6 Behaviour at high wanted signal level

7.2.4.6.1 Description

The behaviour at high wanted signal level is a measure of the capability of the receiver to operate as intended in the presence of a strong signal in the wanted channel.

7.2.4.6.2 Limits

The BER or PER under the specified conditions shall be equal to or better than the limit in table 14.

7.2.4.6.3 Conformance

The conformance tests for this requirement are specified in clause 8.5.6.

8 Testing for compliance with technical requirements

8.1 Environmental conditions for testing

Tests defined in the present document shall be carried out at representative points within the boundary limits of the declared operational environmental profile.

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

8.2 Interpretation of the measurement results

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

- the measured value related to the corresponding limit shall be used to decide whether an EUT meets the requirements of the present document;
- the value of the measurement uncertainty for the measurement of each parameter shall be separately included in the test report;
- the value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures in table 15.

Table 15: Measurement uncertainty

Radio frequency	$\pm 1 \times 10^{-7}$
RF power, conducted	±1,5 dB
Adjacent channel power	±3 dB
Conducted spurious emission of transmitter, valid up to 6 GHz	±3 dB
Conducted emission of receivers	±3 dB
Radiated emission of transmitter, valid up to 6 GHz	±6 dB
Radiated emission of receiver, valid up to 6 GHz	±6 dB
RF level uncertainty for a given BER	±1,5 dB
Temperature	±1 °C
Humidity	±10 %

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated 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)). Principles for the calculation of measurement uncertainty are contained in ETSI TR 100 028 [2], in particular in annex D of the ETSI TR 100 028-2.

Table 15 is based on such expansion factors.

8.3 Test and General Conditions

8.3.1 Transmitter test signals

For the purposes of the present document a test signal is a modulated or unmodulated carrier generated by the EUT to facilitate a particular test. The EUT should be capable of generating the following test signals:

- D-M1 Unmodulated carrier (optional)
- D-M2 Continuous modulated carrier (optional)
- D-M2a Intermittent modulated carrier (required)
- D-M3 Message or Packet transmission (required for certain tests)

Test signals may be generated by applying test baseband signals to a modulation port on the device or be generated internally by the device. Operation in a test mode may involve suitable temporary internal modifications of the EUT or the use of special software. Details of the method chosen and the test signals shall be recorded in the test report.

8.3.1.1 D-M1 Unmodulated carrier

A test signal consisting of an unmodulated carrier may be used for tests such as frequency error (clause 8.4.1). If it is not possible to provide an un-modulated carrier then this shall be stated and alternative tests (e.g. adjacent channel power under extreme conditions)) conducted instead.

8.3.1.2 D-M2 Modulated carrier

Where appropriate, a test signal shall be used with the following characteristics:

- representative of normal operation;
- causes greatest occupied RF bandwidth.

The preferred data content is:

- a pseudo-random bit sequence of at least 511 bits in accordance with Recommendation ITU-T O.153 [1]. This sequence shall be continuously repeated. If such a sequence cannot be used, the actual method used shall be stated in the test report.

If it is not possible to provide a continuous modulated carrier then this shall be stated and the relevant tests may be performed in an appropriate time window using an intermittent modulated carrier.

8.3.1.3 D-M2a Intermittent Modulated carrier

The EUT shall be capable of generating a sequence of transmissions such that:

- the generated RF signal is representative of normal operation;
- the generated RF signal is the same for each transmission, apart from details of the data content;
- transmissions occur regularly in time;
- sequences of transmissions can be accurately repeated;
- the sequence timing is representative of normal operation, apart from compliance with a duty cycle limit.

8.3.1.4 D-M3 Message or packet transmission

A test signal shall be agreed between the test laboratory and the provider in case selective messages are used and are generated or decoded within the EUT.

The agreed test signal may be formatted and may contain error detection and correction components.

The test signal shall be representative of normal operation.

NOTE: Some test procedures require the disabling of error detection and correction mechanisms in the receiving EUT.

8.3.1.5 Recommended Test Signals

For each test performed, the test signal used shall be recorded in the test report. Recommended test signals for each test are shown in table 16.

Table 16: Recommended test signals

Requirement	Clause	Test Signal
Frequency error	8.4.1	D-M1
Effective radiated power	8.4.2 8.4.3	D-M2, D-M2a, D-M3
Transient power	8.4.4	D-M2a
Adjacent Channel Power	8.4.5 8.4.6	D-M2, D-M2a
Tx spurious emissions	8.4.7	D-M2, D-M2a, D-M3
Frequency stability under low voltage	8.4.8	D-M1, D-M2, D-M2a, D-M3
Duty cycle	8.4.9	D-M2a, D-M3
Adjacent Channel Selectivity	8.5.1	D-M3
Receiver Saturation at adjacent channel	8.5.2	D-M3
Receiver behaviour at high wanted signal level	8.5.6	D-DM3
Blocking	8.5.3	D-M3
Spurious Response Rejection	8.5.4	D-M3
Rx spurious emissions	8.4.7	N/A

8.3.2 Testing of multi frequency or frequency agile equipment

8.3.2.1 Uniform maximum transmit power

Where an EUT uses the same power level on each operating frequency in a band, tests shall be carried out on the highest operating frequency and the lowest operating frequency in that band. unless otherwise stated.

Where appropriate tests shall also be carried out on one or more intermediate frequencies as agreed between the test laboratory and the provider.

8.3.2.2 Non-uniform maximum transmit power

Where an EUT does not use the same power level on each operating frequency in a band, specific test procedures are required for certain tests. Where the operating frequency does not materially impact the testing of the requirement, the highest and lowest operating frequencies on which the EUT operates at its highest power level shall be used in place of the highest and lowest operating frequencies declared by the provider.

Where the operating frequency does materially impact the testing of the requirement, the tests shall be performed on the highest and lowest operating frequencies declared by the provider. The tests shall then be repeated for each next highest and lowest operating frequency on which a greater power level is used until operating frequencies on which the highest power level is used have been tested.

The result of the test shall be recorded as the worst case of the sets of frequencies tested for the specific test suite.

The test suites where these specific procedures apply are shown in table 17.

Table 17: Specific test procedures

Clause	Requirement	Specific Test Procedures
8.4.1	Frequency error	No
8.4.2, 8.4.3	Effective radiated power	Yes
8.4.4	Transient power	No
8.4.5, 8.4.6	Adjacent channel power	No
8.4.7	Unwanted emissions in the spurious domain	Yes
8.4.8	Frequency stability under low voltage conditions	No
8.4.9	Duty cycle	No

8.3.3 Dummy load

Where applicable, tests shall be carried out using an artificial antenna or dummy load which shall be a substantially non-reactive non-radiating load connected to the EUT antenna connector and providing a coupling port for connection to test equipment. The Voltage Standing Wave Ratio (VSWR) at the 50 Ω connector or the provider's specified test fixture shall not be greater than 1,5:1 over the frequency range of the measurement.

8.3.4 EUT without an external RF connector

This clause applies to EUT with an integral antenna or with an antenna connection other than a conventional 50 Ω coaxial connector.

Where applicable, conducted measurements may be made on such EUT by:

- access to an internal connector,
- fitting of a temporary connector,
- use of a test fixture.

8.3.4.1 EUT with an internal connector

Where the EUT has an internal conventional 50 Ω coaxial connector between the antenna and the circuitry, this may be utilized to perform conducted measurements. The means to access the connector shall be stated with the aid of a diagram by the provider. The fact that use has been made of the internal antenna connection, to facilitate measurements shall be recorded in the test report.

8.3.4.2 EUT with a temporary antenna connector

One set of EUT, with the normal antenna connected, may be tested to enable radiated measurements to be made. The provider shall attend the test laboratory at the conclusion of the radiated measurements, to disconnect the antenna and fit the temporary connector. The testing laboratory staff shall not connect or disconnect any temporary antenna connector.

Alternatively, two sets of EUT may be submitted to the test laboratory, one fitted with a temporary antenna connector with the antenna disconnected and another EUT with the antenna connected. Each EUT shall be used for the appropriate tests. There shall be a declaration that the two sets of EUT are identical in all aspects except for the antenna connector.

8.3.4.3 Use of a Test Fixture

A test fixture is a structure for coupling the integral antenna of the EUT to a 50 Ω RF terminal at all frequencies for which measurements need to be performed.

A test fixture may only be used for relative measurements.

For further information on the test fixture, see annex C.

8.3.5 Conducted and radiated measurements

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

Where a test method is given using a conducted connection, an equivalent radiated measurement may generally be used instead. Exceptions are testing at extreme temperature conditions and certain receiver or immunity measurements. For certain measurements, an equivalent test using a test fixture may be used instead. In such cases, appropriate procedures to establish reference levels shall be used and recorded.

Where a test method specifies a radiated measurement, it is not generally possible to substitute a conducted or a test fixture measurement. A preliminary conducted or test fixture measurement is permissible, for instance to identify at which frequencies a radiated measurement is needed. The results of a preliminary conducted or test fixture measurement may also be used to show that a radiated measurement is not required, for instance if it is clear that spurious emissions are significantly below the specified limits.

For guidance on radiation test sites, see annex B. Detailed descriptions of radiated measurement arrangements and procedures are included in this annex.

Table 18 gives guidance as to which measurements may be performed using conducted or test fixture connections.

Table 18: Measurement Options

Clause	Description	Conducted with connector on EUT	Test Fixture	Radiated
8.4.2 8.4.3	ERP	Y		Y
8.4.9	Transmission Timings	Y	Y	Y
8.4.5 8.4.6	Adjacent Channel Power	Y	Y	Y
8.4.1	Transmitter Frequency Error	Y	Y	
8.4.4	Transient Power	Y	Y	Y
8.4.7	Unwanted Emissions in the Spurious Domain			Y
8.4.8	Frequency Stability under Low Voltage Conditions	Y	Y	Y
8.5.1	Adjacent Channel Selectivity	Y	Y	
8.5.2	Receiver saturation at adjacent channel	Y	Y	
8.5.3	Blocking	Y	Y	
8.5.4	Spurious response rejection	Y	Y	
8.5.6	Behaviour at high wanted signal level	Y	Y	
8.6.1	Acknowledgement	Y	Y	Y
8.6.2	Ability to change communication frequency	Y	Y	Y

8.3.6 Void

8.3.7 Measuring receiver

The term "measuring receiver" refers to a frequency-selective voltmeter or a spectrum analyser. An RMS detector is used if not defined otherwise for a specific measurement.

The bandwidth of the measuring receiver shall, where possible, be as given in table 19. In order to obtain the required sensitivity, a narrower measurement bandwidth may be necessary, and in such cases, this shall be stated in the test report form.

Table 19: Reference bandwidth for the measurement receiver

Frequency range: (f)	Measuring receiver bandwidth (RBW_{REF})
f < 150 kHz	200 Hz or 300 Hz
150 kHz ≤ f < 25 MHz	9 kHz or 10 kHz
25 MHz ≤ f ≤ 1 000 MHz	100 kHz or 120 kHz
f > 1 000 MHz	1 MHz
NOTE: The frequency ranges and corresponding RBW_{REF} values are derived from CISPR 16 [i.4].	

In the case of a narrower measurement bandwidth being used, the result shall be integrated over RBW_{REF}.

8.3.8 General methods of measurement

8.3.8.1 Transmitters

Where the transmitter is designed with an adjustable carrier power, then all transmitter parameters shall be measured using the highest power level, as declared by the provider. The EUT shall then be set to the lowest carrier power setting, as declared by the provider, and the measurements for spurious emissions shall be repeated.

When performing transmitter tests on EUT designed for intermittent operation it may be necessary to exceed the duty cycle associated with normal operation. Where this is the case, care should be taken to avoid effects such as heating having an adverse effect on the EUT and the parameters being measured. The maximum transmit-on time and duty cycle for test purposes shall be stated by the provider, where applicable.

8.3.8.2 Receivers

If the receiver is equipped with a mute, squelch or battery-saving circuit, this circuit shall be made inoperative for the duration of the tests.

8.3.8.3 Receiver two signal measurements

Certain receiver tests require the application of two signals simultaneously. The general arrangement is shown in figure 2.

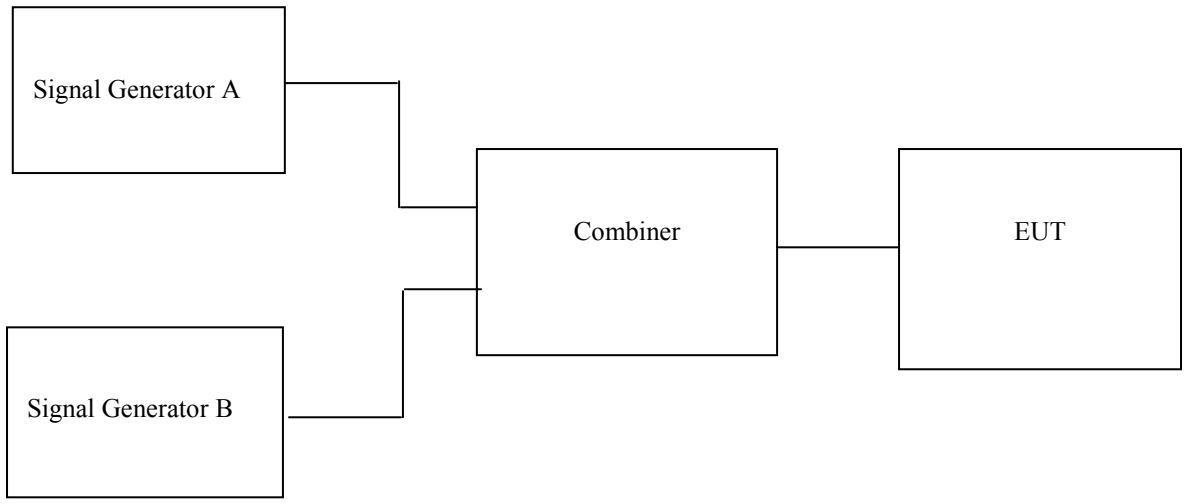


Figure 2: Receiver conducted measurement general arrangement

The combiner or combining network shall:

- contain only passive linear circuitry,
- provide adequate isolation to avoid interactions between the two signal generators,
- be so constructed that the relative levels of the two signals at the EUT input may be determined to the required accuracy, see clause 8.2.

For radiated measurement signal generators A and B together with a combiner shall be placed outside the anechoic chamber and a Tx test antenna shall be placed with the EUT's antenna polarization. The EUT shall be placed at the location of the turntable at the orientation of the most sensitive position.

Signal generator A is used to generate the wanted signal which is representative of normal operation. If it is not feasible to generate the required signal with a conventional signal generator then alternative means may be used, e.g. a representative transmitter supplied by the provider, provided that:

- it is verified that the signal meets the requirements applying to transmitters in the present document,
- the signal level can be established to the required accuracy, see clause 8.2.

8.3.8.4 Signal Generators and Signal Sources

Care should be taken that the performance of signal generators and signal sources is adequate for the tests undertaken. This is particularly important in respect of the phase noise.

8.3.9 Normal and extreme test conditions

8.3.9.1 General

Unless otherwise stated, the tests defined in the present document shall be carried out at representative points within the boundary limits of the declared operational environmental profile (see clause 4.1).

8.3.9.2 Normal test conditions

8.3.9.2.1 Normal temperature and humidity

The normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges:

- temperature: +15 °C to +35 °C;

- relative humidity: 20 % to 75 %.

The actual values during the tests shall be recorded.

8.3.9.2.2 Normal power source

The normal test voltage for the EUT shall be the nominal voltage for which the EUT was designed.

8.3.9.3 Extreme test conditions

8.3.9.3.1 Extreme temperatures

For tests at extreme temperatures, measurements shall be made over the extremes of the operating temperature range as declared by the manufacturer.

8.3.9.3.2 Extreme power source voltages

For tests at extreme voltages, measurements shall be made over the extremes of the power source voltage range as declared by the manufacturer.

When the EUT is designed for operation as part of and powered by another system or piece of equipment, then the limit values of the host equipment or combined equipment as stated by the manufacturer shall apply to the combination to be tested.

8.3.10 Presentation of equipment for testing purposes

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

Table 20: Declarations to be made by the Provider

Parameter	Notes	Requirement reference	Test reference
Operating Frequency	One or more operating frequencies	4.2.1.1 or 4.2.2.1	
Channel Width, B	For each operating frequencies in unchannelized bands	4.2.2.1	
Duty Cycle (operational)	An assessment of maximum DC in normal use	4.2.1.3 or 4.2.2.3	
Disregard Time	Maximum duration of an inter-emission gap in a transmission		7.1.8.2
Normal operating voltage			8.3.9
Minimum operating voltage	Applies to battery operated EUT	4.2.3.4	
Mode B or C operation	Whether compliance with Mode B or C1 or CN is claimed	5 or 6 or 7	
Environmental Profile		4.1	8.1 8.3.9
Test modes	Transmitter test signals the EUT is capable of		8.3.1
Antenna type and connection	Whether the EUT has a 50 Ohm antenna port or an integral or dedicated antenna		8.3.3 8.3.4
Antenna gain	Gain in dB, relative to a dipole, where the antenna is not provided as part of the EUT		8.3.4

Parameter	Notes	Requirement reference	Test reference
Declaration of conformity of test sample	Where EUT is provided with a temporary antenna connection		8.3.4.2
Maximum Duty Cycle (testing)	The maximum permitted DC of the EUT when undergoing testing		8.3.8

8.3.11 Wanted performance criteria

8.3.11.1 Receiver response

For the purpose of the performance tests involving a receiver, the wanted performance criterion is that the receiver shall produce an appropriate output as indicated below:

- after demodulation, a data signal with a bit error ratio of 10^{-3} without correction; or
- after demodulation, a message acceptance ratio of 90 %;
- an appropriate false alarm rate or sensing criteria as declared by the provider.

Where the indicated performance cannot be achieved, the performance criterion used to determine the performance of the receiver shall be declared and published by the provider.

The receiver measurements should be conducted with any Forward Error Correction (FEC) or Automatic Repeat reQuest (ARQ) function disabled. If it is not practical to disable such error correction, a suitable note shall be made in the test report, together with any alternative test method used.

8.3.11.2 Receiver sensitivity reference

Where the wanted performance criteria is used to establish the receiver sensitivity as a reference level for other measurements, the value used for the sensitivity shall not be lower than (i.e. more sensitive than) the limits in table 21.

Table 21: Maximum Receiver Sensitivity Reference

Channel Width	dBm	Watts
25 kHz	-107 dBm	20 fW
Other channel width B (kHz)	$S_P = 10\log\frac{B}{25} - 107 \quad dBm$	$S_P = \frac{B}{25}.20 \quad fW$

8.4 Essential radio test suites - Transmitters and Emissions

8.4.1 Frequency error

8.4.1.1 Description

Frequency error is the difference, under normal and extreme conditions, between the measured unmodulated carrier frequency and the nominal frequency as stated by the provider.

Frequency error is normally measured with an unmodulated carrier. If the EUT is not capable of producing an unmodulated carrier, then an alternative requirement is generally specified.

8.4.1.2 Test conditions

1) The measurements shall be performed under normal and extreme test conditions with the worst case combination of extreme temperature and extreme supply voltage applied simultaneous.

2) The measurement shall be performed on the lowest and the highest frequency declared by the provider. Additional frequencies may be tested.

8.4.1.3 Method of measurement

The preferred method of measurement is conducted (see clause 8.3.5).

8.4.1.4 Measurement procedure

The carrier frequency shall be measured in the absence of modulation. The difference from the declared operating frequency shall be noted.

The measurement shall be repeated at a range of temperatures spanning the extreme temperature conditions.

At each temperature, the frequency difference shall be measured at extreme voltage conditions.

The maximum frequency difference shall be noted.

8.4.2 Effective Radiated Power (conducted measurement)

8.4.2.1 Description

This is the average power delivered to the artificial antenna (see clause 8.3.3) adjusted for the antenna gain.

This method applies only to EUT with a permanent external antenna connector. For all other EUT the method in clause 8.4.3 applies.

8.4.2.2 Test conditions

1) The measurements shall be performed under normal and extreme test conditions with the worst case combination of extreme temperature and extreme supply voltage applied simultaneously.

2) The measurement shall be performed on the lowest and the highest frequency declared by the provider. Additional frequencies may be tested.

3) If the EUT is designed to operate with different power levels, the rated power for each level or range of levels shall be declared by the provider. These measurements shall be performed at the highest power level at which the transmitter is intended to operate.

4) In the case of non constant envelope modulation, the D-M1 test signal shall not be used.

8.4.2.3 Method of measurement

This test procedure applies only to conducted measurements (see clause 8.3.5).

8.4.2.4 Measurement procedure

The transmitter shall be connected to a dummy load (see clause 8.3.3) and the power delivered shall be measured.

In the case of non constant envelope modulation, the average power shall be measured.

The maximum gain of the antenna to be used together with the EUT shall be declared by the provider and this shall be recorded in the test report.

The radiated power (erp) limit applies to the maximum measured conducted power value adjusted by the antenna gain (relative to a dipole).

8.4.3 Effective radiated power (radiated measurement)

8.4.3.1 Description

The effective radiated power is the power radiated in the direction of the maximum field strength under specified conditions of measurements for any condition of modulation.

This measurement method applies to EUT other than those measured using clause 8.4.2.

8.4.3.2 Test conditions

1) The measurements shall be performed under normal temperature conditions and extreme voltage conditions.

2) The measurement shall be performed on the lowest and the highest frequency declared by the provider. Additional frequencies may be tested.

3) These measurements shall be performed at the highest power level at which the transmitter is intended to operate.

4) In the case of non constant envelope modulation, the D-M1 test signal shall not be used.

8.4.3.3 Method of measurement

This test procedure applies only to radiated measurements (see clause 8.3.5).

8.4.3.4 Measurement procedure

A suitable test site shall be selected from those described in clause B.1 and the radiated power established using the procedures described in clause B.6.

In the case of non constant envelope modulation, the average power shall be measured.

8.4.4 Transient power

8.4.4.1 Description

Transient power is the power falling into adjacent spectrum due to the transmitter switching on and off or changing frequency channel during normal operation.

8.4.4.2 Test conditions

1) The measurements shall be performed under normal and extreme test conditions with the worst case combination of extreme temperature and extreme supply voltage applied simultaneously.

2) The measurement shall be performed on the lowest and the highest frequency declared by the provider. Additional frequencies may be tested.

3) These measurements shall be performed at the highest power level at which the transmitter is intended to operate.

8.4.4.3 Method of measurement

Guidance on methods of coupling the signal between the EUT and the test equipment is given in clause 8.3.5.

8.4.4.4 Measurement procedure

The test set up is similar to that used for Adjacent Channel Power (B > 25 kHz), clause 8.4.6, except that a different transmitter test signal may be used.

For each measurement the EUT shall make sufficient on and off switches for the max hold trace to stabilize.

The maximum value within the specified frequency range shall be noted and this shall be used to calculate the absolute level of RF power.

8.4.5 Adjacent channel power (B ≤ 25 kHz)

8.4.5.1 Description

The adjacent channel power is the amount of the modulated RF signal power which falls within a given adjacent channel, clause 3.1 definitions.

This power is the sum of the mean power produced by the modulation, hum and noise of the transmitter.

This measurement applies to EUT operating in channels of width 25 kHz or less or in unchannelized bands where the provider has declared a channel width, B, of 25 kHz or less.

8.4.5.2 Test conditions

1) The measurements shall be performed under normal test conditions. When it is not possible to perform the measurement of frequency error in the absence of modulation, this measurement shall be repeated under extreme test conditions with the worst case combination of extreme temperature and extreme supply voltage applied simultaneously.

2) The measurement shall be performed on the lowest and the highest frequency declared by the provider. Additional frequencies may be tested.

3) These measurements shall be performed at the highest power level at which the transmitter is intended to operate

8.4.5.3 Method of measurement

Guidance on methods of coupling the signal between the EUT and the test equipment is given in clause 8.3.5.

8.4.5.4 Measurement procedure

Averaging measurements with 100 samples are possible for constant and non-constant envelope modulated EUT.

The measurement arrangement is shown in figure 3.

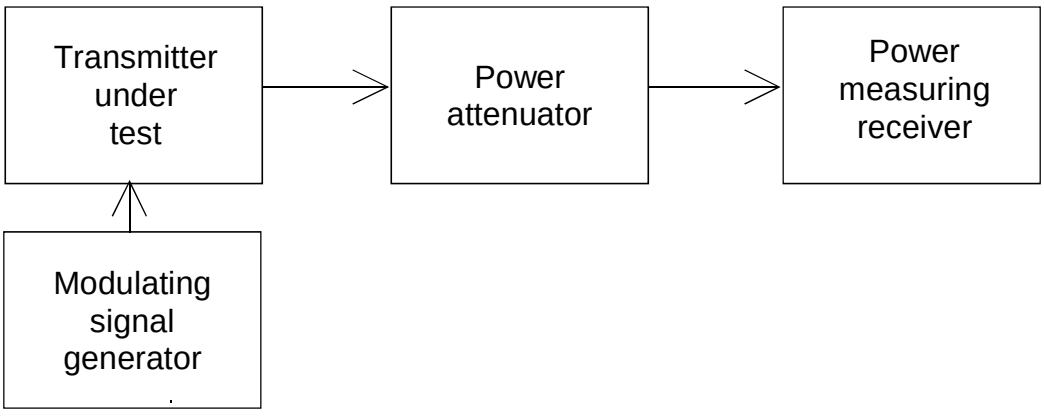


Figure 3: Measurement arrangement

The adjacent channel powers shall be measured, as follows, with a power measuring receiver which conforms to annex D (referred to in this clause as the "receiver").

The centre frequency of the "receiver" shall be set to each of the upper and lower adjacent and alternate adjacent channels. Upper and lower measurements may require different configurations of the "receiver" to respect the requirements for filter shape close to carrier and distant from carrier.

The reference level for the "receiver" may be established in either of two ways:

a) by substitution of the EUT with a signal generator;

b) by a relative method. The "receiver" is set to the operating frequency of the transmitter and the attenuator adjusted to give the same meter reading as obtained in the adjacent channel measurement. The adjacent channel power is then found from the transmitter power corrected by the change in attenuator setting.

8.4.6 Adjacent Channel Power (B > 25 kHz)

8.4.6.1 Description

The adjacent channel power is the amount of the modulated RF signal power which falls within a given adjacent channel, clause 3.1 definitions.

This power is the sum of the mean power produced by the modulation, hum and noise of the transmitter.

This measurement applies to EUT operating in channels of width greater than 25 kHz or in unchannelized bands where the provider has declared a channel width, B, of more than 25 kHz.

8.4.6.2 Test conditions

1) The measurements shall be performed under normal test conditions. When it is not possible to perform the measurement of frequency error in the absence of modulation, this measurement shall be repeated under extreme test conditions with the worst case combination of extreme temperature and extreme supply voltage applied simultaneously.

2) The measurement shall be performed on the lowest and the highest frequency declared by the provider. Additional frequencies may be tested.

3) These measurements shall be performed at the highest power level at which the transmitter is intended to operate.

8.4.6.3 Method of measurement

Guidance on methods of coupling the signal between the EUT and the test equipment is given in clause 8.3.5.

8.4.6.4 Measurement procedure

The modulation used shall be recorded in the test report.

The output of the EUT shall be connected to a spectrum analyser or equivalent measuring equipment.

The video bandwidth should be a factor of 3 or more greater than the resolution bandwidth. For each adjacent channel measurement the spectrum analyser resolution bandwidth shall be changed to the specified value.

The spectrum analyser scan shall include the specified adjacent or alternate adjacent channel frequency range.

The spectrum analyser should be set to:

- Detector function: peak.
- Trace: max hold.

The maximum value within the specified adjacent or alternate adjacent channel frequency range shall be noted and this shall be used to calculate the absolute level of RF power.

8.4.7 Unwanted emissions in the spurious domain

8.4.7.1 Description

Spurious emissions are unwanted emissions in the spurious domain.

8.4.7.2 Test conditions

1) The measurements shall be performed under normal test conditions.

2) The measurement shall be performed on the lowest and the highest frequency declared by the provider. Additional frequencies may be tested.

3) For transmitters, the measurement shall be performed with the EUT operating at its maximum operating power level, as declared by the provider, and also with the EUT in powered-on stand-by mode.

8.4.7.3 Method of measurement

For EUT without an external conventional 50 Ω coaxial antenna connector, the spurious emissions levels shall be established by the radiated measurement procedure in clause 8.7.4.2.

For all other EUT the spurious emissions levels shall be established as both:

i) the conducted measurement procedure in clause 8.7.4.1; and

ii) the radiated measurement procedure in clause 8.7.4.2, with the antenna port terminated in a dummy load.

8.4.7.4 Measurement procedure

8.4.7.4.1 Conducted measurement

The antenna port of the EUT shall be connected to the dummy load and the output of the dummy load connected to the measuring receiver.

The measuring receiver shall be tuned over the frequency range shown in table 22.

Table 22: Conducted Spurious Radiations Measurement Frequency Range

Operating Mode	Frequency Range	RBW_{REF} (see note 2)
Transmit mode	9 kHz ≤ f < 150 kHz	1 kHz
	150 kHz ≤ f < 30 MHz	10 kHz
	30 MHz ≤ f < f_c - m	100 kHz
	f_c - m ≤ f < f_c - n	10 kHz
	f_c - n ≤ f < f_c - p	1 kHz
	f_c + p < f ≤ f_c + n	1 kHz
	f_c + n < f ≤ f_c + m	10 kHz
	f_c + m < f ≤ 1 GHz	100 kHz
	1 GHz < f ≤ 6 GHz	1 MHz
Receive mode Transmitter standby mode All other modes	9 kHz ≤ f < 150 kHz	1 kHz
	150 kHz ≤ f < 30 MHz	10 kHz
	30 MHz ≤ 1 GHz	100 kHz
	1 GHz < f ≤ 6 GHz	1 MHz
NOTE 1: f is the measurement frequency. f_c is the operating frequency. m is the larger of 10 x B or 500 kHz. n is the larger of 4 x B or 100 kHz. p is 2,5 x B. NOTE 2: See clause 8.3.7 if the value of RBW used for measurement is different from RBW_{REF}.		

At each frequency at which a spurious component is detected, the spurious emission power level shall be noted as the average power level delivered into the dummy load.

8.4.7.4.2 Radiated measurement

A suitable test site shall be selected from those described in clause B.1.

The measuring receiver shall be tuned over the frequency range shown in table 23.

Table 23: Radiated Spurious Radiations Measurement Frequency Range

Operating Mode	Frequency Range	RBW_{REF} (see note 2)
Transmit mode	25 MHz ≤ f < f_C - m	100 kHz
	f_C - m ≤ f < f_C - n	10 kHz
	f_C - n ≤ f < f_C - p	1 kHz
	f_C + p < f ≤ f_C + n	1 kHz
	f_C + n < f ≤ f_C + m	10 kHz
	f_C + m < f ≤ 1 GHz	100 kHz
	1 GHz < f ≤ 6 GHz	1 MHz
Receive mode Transmitter standby mode All other modes	25 MHz ≤ 1 GHz	100 kHz
	1 GHz < f ≤ 6 GHz	1 MHz
NOTE 1: f is the measurement frequency. f_C is the operating frequency. m is the larger of 10 x B or 500 kHz. n is the larger of 4 x B or 100 kHz. p is 2,5 x B. NOTE 2: See clause 8.3.7 if the value of RBW used for measurement is different from RBW_{REF}.		

At each frequency at which a spurious component is detected, the spurious emission power level shall be established using the procedures described in clause B.6.

8.4.8 Frequency stability under low voltage conditions

8.4.8.1 Description

The frequency stability under low voltage condition is the ability of the EUT to remain on channel, for channelized EUT, or within the assigned operating frequency band, for non-channelized EUT, when the battery voltage falls below the lower extreme voltage level.

This test is for battery operated EUT and for EUT with a standby battery.

8.4.8.2 Test Conditions

1) The measurements shall be performed under normal test conditions.

2) The measurements shall be performed on the highest and lowest frequencies declared by the provider.

8.4.8.3 Method of measurement

Guidance on methods of coupling the signal between the EUT and the test equipment is given in clause 8.3.5.

8.4.8.4 Measurement procedure

Step 1:

Operation of the EUT shall be started, on the highest operating frequency as declared by the provider, with the appropriate test signal and with the EUT operating at nominal operating voltage.

The centre frequency of the transmitted signal shall be measured and noted.

Step 2:

The operating voltage shall be reduced by an appropriate step.

The centre frequency of the transmitted signal shall be measured and noted.

Step 3:

Step 2 shall be repeated until either the EUT ceases to operate or the voltage reaches zero.

Step 4:

Operation of the EUT shall be restarted, on the lowest operating frequency as declared by the provider, with the appropriate test signal and with the EUT operating at nominal operating voltage.

The centre frequency of the transmitted signal shall be measured and noted.

Step 5:

Step 2 and step 3 shall be repeated.

8.4.9 Duty Cycle and short term behaviour

8.4.9.1 Description

The timing parameters of a transmitter are expressed with respect to two different observation intervals, overall duty cycle and short term.

Related definitions may be found in annex F.

Overall duty cycle

The aggregate duty cycle describes the behaviour of transmissions within the observation frequency band over the observation period.

Unless otherwise stated the observation bandwidth shall be the operating frequency band.

The overall duty cycle shall be declared by the provider.

Short term behaviour

The short term behaviour describes the behaviour of transmissions within an observation band of specified bandwidth over a short observation interval.

Each transmission consists of an RF emission, or sequence of RF emissions separated by intervals < T_{dis}. The EUT shall wait a minimum period before beginning a subsequent transmission.

Where the specified observation bandwidth is the same as the channel spacing, the observation band shall be aligned with the channel.

Where the specified observation bandwidth is larger than the channel spacing but less than the width of the operating frequency band, the provider shall divide the operating frequency band into a contiguous set of observation bands. The upper and lower observation bands may be narrower than the observation bandwidth.

8.4.9.2 Test conditions

1) The measurements shall be performed under normal test conditions.

2) The measurement shall be performed on a frequency declared by the provider. The frequency shall correspond to a channel centre frequency consistent with the highest and lowest frequencies and channel spacing declared by the provider.

3) The EUT shall be configured to transmit its maximum length transmissions.

8.4.9.3 Method of measurement

Guidance on methods of coupling the signal between the EUT and the test equipment is given in clause 8.3.5.

8.4.1.4 Measurement procedure

This test is performed using a fast power sensing equipment suitable for measurements in the operating frequency band. The test equipment shall be capable of not less than 1 Msamples/second to provide 1 μ second resolution.

Table 24: Power Sensor Settings for short term behaviour measurement

Setting	Value	Notes
Sample rate	≥ 1 M samples/second	Sampling rate for at least 1 µsecond resolution
Trigger		Trigger setting to capture leading edge of first transmission
$P_{Threshold}$		Signal threshold
NOTE: The trigger setting shall be determined by the test laboratory. The threshold power level shall be agreed between the test laboratory and the provider.		

The power sensing equipment shall be configured according to the settings in table 24.

The EUT shall be connected to the power sensor and its levels adjusted according to the power envelope of the EUT transmissions.

Step 1:

The EUT shall be set to operate for not less than 10 transmissions.

The sampled power readings shall be saved.

NOTE 1: For low activity EUT it may be agreed with the test laboratory that a smaller number of transmissions may be accepted.

Step 2:

Using suitable analysis software the start time and stop time of each sequence of samples above $P_{Threshold}$ shall be obtained.

Between the saved start and stop times of each individual burst, the T_{On} time shall be calculated. These T_{On} values shall be saved.

Between the saved stop and start times of two subsequent bursts, the T_{Off} time shall be calculated. These T_{Off} values shall be saved.

NOTE 2: For low activity EUT, a note should be made if only a single transmission occurred.

Step 3:

Within the calculated T_{Off} times, any interval less than T_{dis} shall be discarded. The lowest value of T_{Off} shall be noted.

The transmission duration is the time between two consecutive T_{Off} intervals. The highest value calculated for transmission duration shall be noted.

NOTE 3: If only a single transmission occurred the duration is calculated from the samples directly and the T_{off} time is the duration from the end of the transmission to the end of the sampling interval.

8.5 Essential radio test suites - Receivers

8.5.1 Adjacent channel selectivity

8.5.1.1 Description

The adjacent channel selectivity is a measure of the capability of the receiver to operate satisfactorily in the presence of an unwanted signal, which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the EUT is intended.

8.5.1.2 Test Conditions

1) The measurements shall be performed under normal test conditions.

2) The measurements shall be performed on the highest and lowest frequencies declared by the provider.

8.5.1.3 Method of measurement

The preferred method of measurement is conducted (see clause 8.3.5).

8.5.1.4 Measurement procedure

Two signal generators A and B shall be connected to the receiver via a combining network to the receiver antenna connector, see clause 8.3.8.3.

Signal generator A shall be at the nominal frequency of the receiver, and configured to generate the wanted signal.

Signal generator B shall be unmodulated and shall be adjusted to the adjacent channel center frequency immediately above the wanted channel.

Initially signal generator B shall be switched off. Signal generator A shall be set to the minimum level which gives the wanted performance criterion or the reference level in clause 8.3.11.2, whichever is the higher. This level is the sensitivity. The output level of generator A shall then be set to the sensitivity plus the specified amount.

Signal generator B is then switched on and the signal amplitude is adjusted to the minimum level at which the wanted performance criterion is not achieved.

Adjacent channel selectivity is the difference between signal generator B and signal generator A levels at the EUT.

The measurements shall be repeated with signal generator B adjusted to the adjacent channel centre frequency immediately below the wanted channel.

8.5.2 Receiver saturation at adjacent channel

8.5.2.1 Description

The receiver saturation is a measure of the capability of the receiver to operate as intended in the presence of a strong signal in the wanted channel together with a strong signal in the adjacent channel.

8.5.2.2 Test Conditions

1) The measurements shall be performed under normal test conditions.

2) The measurements shall be performed on the highest and lowest frequencies declared by the provider.

8.5.2.3 Method of measurement

The preferred method of measurement is conducted (see clause 8.3.5).

8.5.2.4 Measurement procedure

The method of measurements is identical to that for Adjacent Channel Selectivity, clause 8.5.1 except of the use of a wanted signal (generator A) at a higher level.

8.5.3 Blocking

8.5.3.1 Description

Blocking is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted input signal at any frequencies other than those of the spurious responses or the adjacent channels or bands.

8.5.3.2 Test Conditions

1) The measurements shall be performed under normal test conditions.

2) The measurements shall be performed on the highest and lowest frequencies declared by the provider.

8.5.3.3 Method of measurement

The preferred method of measurement is conducted (see clause 8.3.5).

8.5.3.4 Measurement procedure

Two signal generators A and B shall be connected to the receiver via a combining network to the receiver antenna connector, see clause 8.3.8.3.

Signal generator A shall be at the nominal frequency of the receiver, and configured to generate the wanted signal.

Signal generator B shall be unmodulated. Measurements shall be carried out at frequencies of the unwanted signal at approximately the specified offsets, avoiding those frequencies at which spurious responses occur.

Initially signal generator B shall be switched off. Signal generator A shall be set to the minimum level which gives the wanted performance criterion or the reference level in clause 8.3.11.2, whichever is the higher. This is the sensitivity. The output level of generator A shall then be increased by the specified amount.

Signal generator B is then switched on and the signal amplitude is adjusted to the minimum level at which the wanted performance criterion is not achieved.

Blocking is the difference between signal generator B and signal generator A levels at the EUT.

8.5.4 Spurious response rejection

8.5.4.1 Description

The spurious response rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal at any other frequency, at which a response is obtained.

8.5.4.2 Test Conditions

1) The measurements shall be performed under normal test conditions.

2) The measurements shall be performed on the highest and lowest frequencies declared by the provider.

8.5.4.3 Method of measurement

The preferred method of measurement is conducted (see clause 8.3.5).

8.5.4.4 Measurement procedure

To determine the frequencies at which spurious responses can occur the following calculations shall be made:

- Calculation of the "limited frequency range":

  a) the limited frequency range is defined as the frequency of the local oscillator signal (f_{LO}) applied to the first mixer of the receiver plus or minus the Intermediate Frequency (IF) or where more than 1 IF is involved, at the image frequency of the first and subsequent frequency conversions;

  b) at frequency separation corresponding to half of the first IF from the wanted receive frequency.

For the calculations a) and b) above, the manufacturer shall state the frequency of the receiver, the frequency of the local oscillator signal (f_{LO}) applied to the 1st mixer of the receiver, the intermediate frequencies (f_{I1}, f_{I2}, etc.).

Two signal generators A and B shall be connected to the receiver via a combining network to the receiver antenna connector, see clause 8.3.8.3.

Signal generator A shall be at the nominal frequency of the receiver and configured to generate the wanted signal.

Signal generator B shall be unmodulated and shall be adjusted to the test frequency as determined above.

Initially signal generator B shall be switched off. Signal generator A shall be set to the minimum level which gives the wanted performance criterion or the reference level in clause 8.3.11.2, whichever is the higher. This level is the sensitivity. The output level of generator A shall then be set to the sensitivity plus the specified amount.

Signal generator B is then switched on and the signal amplitude is adjusted to the minimum level at which the wanted performance criterion is not achieved.

The spurious response rejection is the difference between signal generator B and signal generator A levels at the EUT.

8.5.5 Void

8.5.6 Behaviour at high wanted signal level

8.5.6.1 Description

The behaviour at high wanted signal level is a measure of the capability of the receiver to operate as intended in the presence of a strong signal in the wanted channel.

8.5.6.2 Test Conditions

1) The measurements shall be performed under normal test conditions.

2) The measurements shall be performed on the highest and lowest frequencies declared by the provider.

8.5.6.3 Method of measurement

The preferred method of measurement is conducted (see clause 8.3.5).

8.5.6.4 Measurement procedure

The sensitivity may be established by the procedure in clause 8.5.1.4, clause 8.5.3.4 or clause 8.5.4.4.

A test signal shall be connected to the EUT at an initial level approximately 10 dB above the sensitivity. It shall be verified that the wanted performance criteria is achieved. If necessary the signal level may be adjusted.

The signal level shall be increased until either the wanted performance criterion is no longer met, or the specified test limit is reached.

The signal level into the EUT shall be noted.

8.6 Radio test suites - Transceivers

8.6.1 Acknowledgement

8.6.1.1 Description

An acknowledgement is the transmission and reception of a short message in the return direction so that the sending device knows the forward message has been successfully received.

8.6.1.2 Test Conditions

1) The measurements shall be performed under normal test conditions.

2) The measurements shall be performed on the highest and lowest frequencies declared by the provider.

3) FEC, ARQ and similar facilities shall be enabled.

8.6.1.3 Method of measurement

Guidance on methods of coupling the signal between the EUT and the test equipment is given in clause 8.3.5.

8.6.1.4 Measurement procedure

The Message Initiator (MI) and the Message Receiver (MR) shall be configured so that a transmission from the MI reaches the MR at between 10 dB and 20 dB higher level than the sensitivity of the MR. The coupling mechanism shall be entirely passive so that the reciprocal path loss is the same.

NOTE: The sensitivity may established by the procedure in clause 8.5.1.4, clause 8.5.3.4 or clause 8.5.4.4.

The MI shall have a means of indicating reception of an ACK for each individual forward message.

The MI shall be made to send a series of at least 10 messages to the MR at intervals specified by the provider. The indication of ACK reception shall be noted for each message.

Either the MR shall be disabled or the coupling between the MI and the MR shall be reduced by more than 40 dB. The MI shall be made to send the same series of messages. Indication of an ACK for any message will constitute a failure of this test.

8.6.2 Frequency Agility

8.6.2.1 Description

Frequency agility is the ability of the two parts of the system to co-ordinate a change of operating frequency.

8.6.2.2 Test Conditions

1) The measurements shall be performed under normal test conditions.

2) The measurements shall be performed on the highest and lowest frequencies declared by the provider.

3) FEC, ARQ and similar facilities may be enabled.

8.6.2.3 Method of measurement

Guidance on methods of coupling the signal between the EUT and the test equipment is given in clause 8.3.5.

8.6.2.4 Measurement procedure

The Message Initiator (MI) and the Message Receiver (MR) shall be configured so that a transmission from the MI reaches the MR at between 10 and 20 dB higher level than the sensitivity of the MR. The coupling mechanism shall be entirely passive so that the reciprocal path loss is the same.

NOTE: The sensitivity may established by the procedure in clause 8.5.1.4, clause 8.5.3.4 or clause 8.5.4.4.

The MI shall have a means of indicating reception of an ACK.

Step 1:

The MI shall be made to send a series of at least 10 messages to the MR at intervals specified by the provider. For each message the reception of an ACK is required.

The operating frequency of the MI shall be noted.

Step 2:

An interfering unmodulated signal shall be introduced on the operating frequency that at the antenna or antenna connector of the MR is 10 dB higher in level than the signal from the MI.

Step 3:

The MI shall be made to send a message to the MR. An indication of an ACK shall be made within the specified time.

The operating frequency of the MI shall be checked and is required to be different from the original operating frequency.

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 dependent on the manufacturer having chosen to support optional functionality defined within the schedule.
- in the case of Conditional requirements, it associates the technical 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 ETSI EN 303 131 The following requirements and test specifications are relevant to the presumption of conformity under the article 3.2 of the R&TTE Directive [i.2]						
Requirement			**Requirement Conditionality**		**Test Specification**	
No	**Description**	**Reference: Clause No**	**U/C**	**Condition**	**E/O**	**Reference: Clause No**
1	Operating Frequency	4.2.1.2 or 4.2.2.2	U		X	
2	Effective Radiated Power	4.2.1.3 or 4.2.2.3	U		E	8.4.2 or 8.4.3
3	Duty Cycle	4.2.1.4 or 4.2.2.4	U		X	
4	Transmission Timings	4.2.1.4 or 4.2.2.4	U		E	8.4.9
5	Adjacent Channel Power	4.2.1.5 or 4.2.2.5	U		E	8.4.5 or 8.4.6
6	Adjacent Channel Power at extreme test conditions	4.2.1.5 or 4.2.2.5	C	For equipment not capable of generating an unmodulated carrier	E	8.4.5 or 8.4.6
7	Transmitter Frequency Error	4.3.3.2	C	For equipment capable of generating an unmodulated carrier	E	8.4.1
8	Transient Power	4.2.3.3	U		E	8.4.4
9	Unwanted Emissions in the Spurious Domain	4.2.3.4	U		E	8.4.7
10	Frequency Stability under Low Voltage Conditions	4.2.3.5	U		E	8.4.8

Harmonized Standard ETSI EN 303 131 The following requirements and test specifications are relevant to the presumption of conformity under the article 3.2 of the R&TTE Directive [i.2]						
Requirement			**Requirement Conditionality**		**Test Specification**	
No	**Description**	**Reference: Clause No**	**U/C**	**Condition**	**E/O**	**Reference: Clause No**
11	Adjacent Channel Selectivity	4.2.4.2 or 5.2.4.2 or 6.2.4.2 or 7.2.4.2	U		E	8.5.1
12	Blocking	4.2.4.3 or 5.2.4.3 or 6.2.4.3 or 7.2.4.3	U		E	8.5.3
13	Adjacent Channel Saturation	5.2.4.4 or 6.2.4.4 or 7.2.4.4	C	Applies to Mode B or Mode C equipment	E	8.5.2
14	Spurious Response Rejection	5.2.4.5 or 6.2.4.5 or 7.2.4.5	C	Applies to Mode B or Mode C equipment	E	8.5.4
15	Behaviour at high wanted signal level	6.2.4.6 or 7.2.4.6	C	Applies to Mode C equipment	E	8.5.6
16	Acknowledgement	6.2.1.2 or 7.2.1.2	C	Applies to Mode C equipment	O	8.6.1
17	Ability to change communication frequency	7.2.2.2	C	Applies to Mode CN equipment	O	8.6.2

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 whether "E" or "O" are relevant to the requirements. Rows designated "E" collectively make up the Essential Radio Test Suite; those designated "O" make up the Other Test Suite; for those designated "X" there is no test specified corresponding to the requirement. 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 "O" or "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, 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);

These 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.

Where absolute measurements are to be carried out, the chamber should be verified. A detailed verification procedure is described in clause 6 of ETSI TR 102 273-4 [i.5] for the OATS, in clause 6 of ETSI TR 102 273-3 [i.5] for the SAR, and in clause 6 of ETSI TR 102 273-2 [i.5] for the FAR.

Information for calculating the measurement uncertainty of measurements on one of these test sites can be found in ETSI TR 100 028-1 [2] and ETSI TR 100 028-2 [2], ETSI TR 102 273-2 [i.5], ETSI TR 102 273-3 [i.5] and ETSI TR 102 273-4 [i.5].

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.

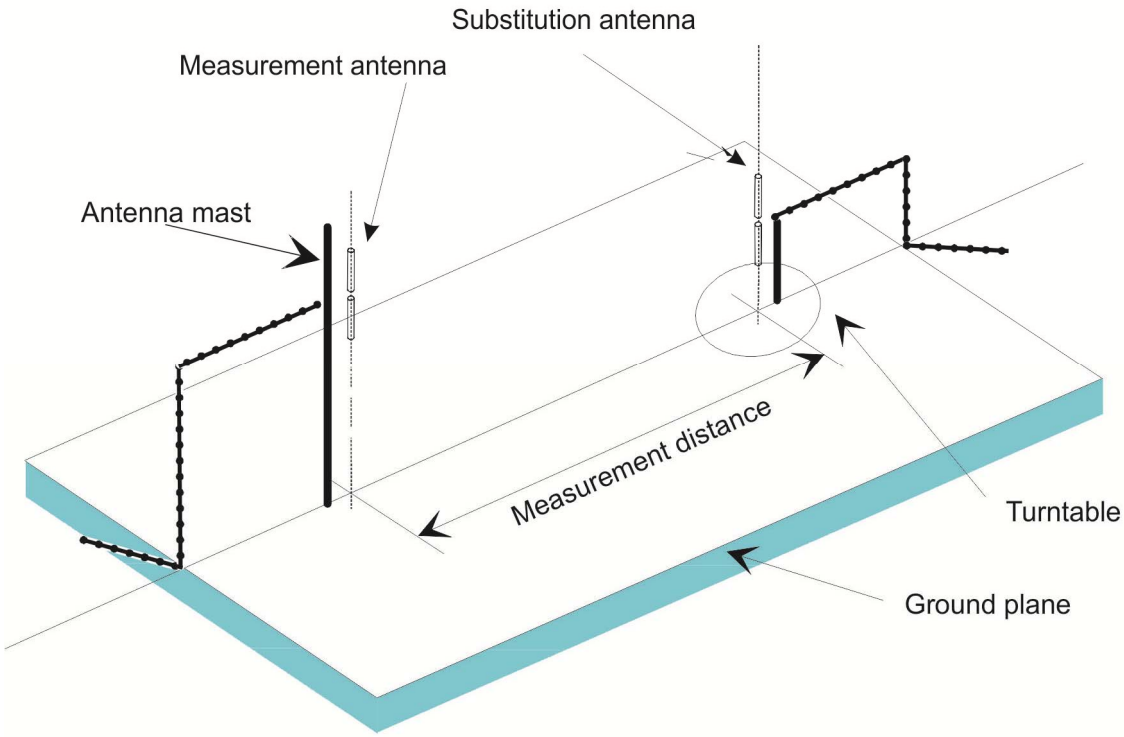


Figure B.1: A typical Open Area Test Site

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 EUT) 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 EUT 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 (EUT) 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 ETSI TR 102 273-4 [i.5].

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.

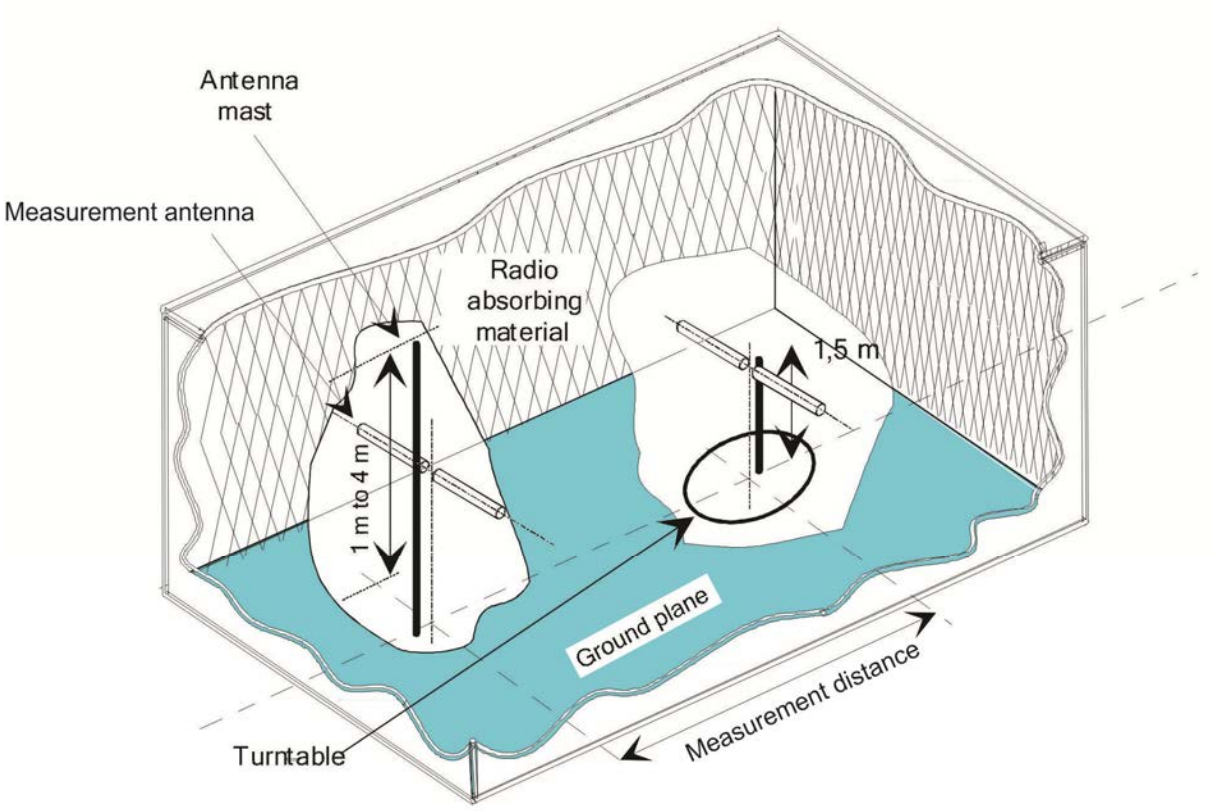


Figure B.2: A typical Semi Anechoic Room

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 EUT) 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 EUT 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 (EUT) 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 ETSI TR 102 273-3 [i.5].

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.

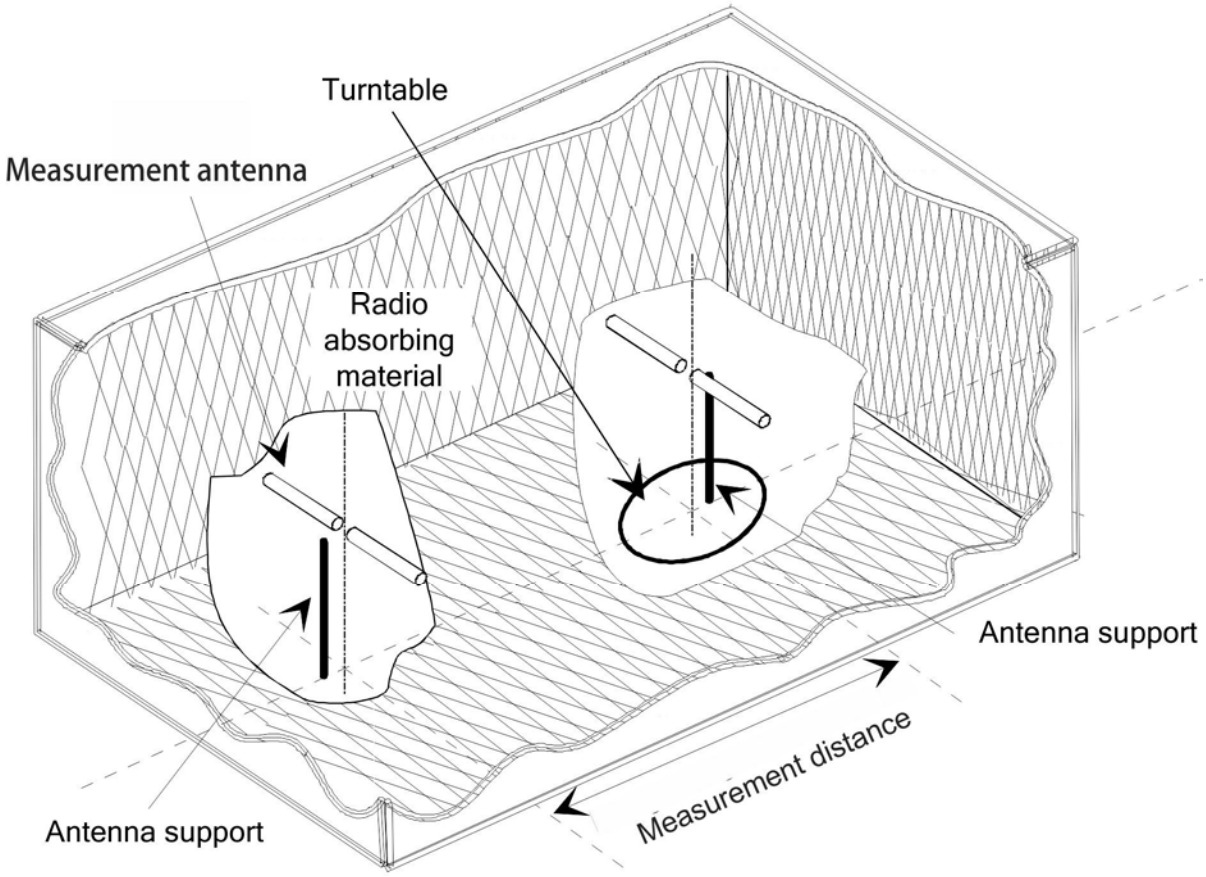


Figure B.3: A typical Fully Anechoic Room

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 EUT 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 ETSI TR 102 273-2 [i.5].

B.1.4 Measurement Distance

The measurement distance should be chosen in order to measure the EUT at far-field conditions. The minimum measurement distance between the equipment and the measurement antenna should be λ or $r_{m >>} \frac{D^2}{\lambda}$, whichever is the greater.

λ = wavelength in m

r_m = minimum measurement distance between EUT and measurement antenna in m

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

$\frac{D^2}{\lambda}$ = 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 EUT 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 EUT in substitution measurements.

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 EUT when its antenna is internal, or the point where an external antenna is connected to the EUT.

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 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 EUT 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.3.1 Power supplies for the battery powered EUT

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

The presence of these power cables can, however, affect the measured performance of the EUT. 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 EUT 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.3.2 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: ±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.4 Coupling of signals

B.4.1 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.4.2 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.

B.5 Void

B.6 Measurement procedures for radiated measurement

This annex gives the general procedures for radiated measurements using the test sites and arrangements described in annex B.

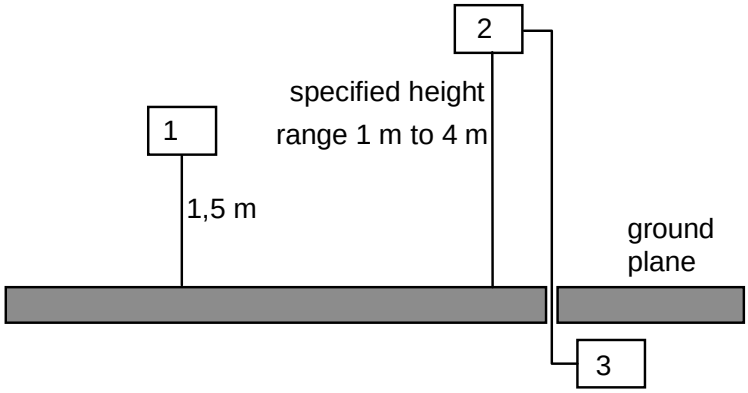
Preferably, radiated measurements shall be performed in a FAR, see clause B.6.2. Radiated measurements in an OATS or SAR are described in clause B.6.1.

B.6.1 Radiated measurements in an OATS or SAR

Radiated measurements shall be performed with the aid of a measurement antenna and a substitution antenna, in test sites described in annex B. The measurement set-up shall be calibrated according to the procedure defined in this annex. The EUT and the measurement antenna shall be oriented such as to obtain the maximum emitted power level. This position shall be recorded in the measurement report.

a) The measurement antenna (device 2 in figure B.4) shall be oriented initially for vertical polarization unless otherwise stated and the EUT (device 1 in figure B.4) shall be placed on the support in its standard position and switched on.

b) The measurement equipment (device 3 in figure B.4) shall be connected to the measurement antenna and set-up according to the specifications of the test.



1) EUT
2) Measurement antenna
3) Measurement equipment

Figure B.4: Measurement arrangement No.1

c) The EUT shall be rotated through 360° in a horizontal plane until a higher maximum signal is received.

d) The measurement antenna shall be raised or lowered again through the specified height range until a maximum is obtained. This level shall be recorded.

e) This measurement shall be repeated for horizontal polarization.

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

B.6.2 Radiated measurements in a FAR

For radiated measurements using a FAR, the procedure is identical to the one described in clause B.6.1, except that the height scan is omitted.

B.6.3 Substitution measurement

To determine the absolute measurement value a substitution measurement is performed. The following steps have to be performed:

1) Replacing the EUT with the substitution antenna that is depicted as device 1 in figure B.4. The substitution antenna will have vertical polarization.

2) Connect a signal generator to the substitution antenna, and adjust it to the measurement frequency.

3) If an OATS or a SAR is used, the measurement antenna shall be raised or lowered, to ensure that the maximum signal is received.

4) Subsequently, the power of the signal generator is adjusted until the same level is obtained again at the measurement equipment.

5) The radiated power is equal to the power supplied by the signal generator, increased the substitution antenna gain minus the cable losses (values in dB).

6) This measurement shall be repeated with horizontal polarization.

NOTE: For test sites with a fixed setup of the measurement antenna(es) and a reproducible positioning of the EUT, correction values from a verified site calibration can be used alternatively.

B.7 Guidance for testing technical requirements

This clause provides guidance on how the various technical requirements can be verified using radiated measurements.

B.7.1 Essential radio test suites and corresponding test sites

Table B.1 provides guidance on the test site to be used for each of the essential radio test suites when performing radiated measurements on integral antenna EUT.

Table B.1: Essential radio test suites and corresponding test sites

Essential radio test suite	Clause	Corresponding test site - Clause number(s)
Effective Radiated Power	8.4.2, 8.4.3	B1.1, B1.2, B1.3
Transmission timings	8.4.9	B1.1, B1.2, B1.3
Adjacent Channel Power	8.4.5, 8.4.6	B1.1, B1.2, B1.3
Transmitter Frequency Error	8.4.1	B1.1, B1.2, B1.3
Transient Power	8.4.4	B1.1, B1.2, B1.3
Unwanted emissions in the spurious domain	8.4.7, 8.5.5	B1.1, B1.2, B1.3
Frequency Stability under Low Voltage Conditions	8.4.8	B1.1, B1.2, B1.3
Adjacent Channel Selectivity	8.5.1	B1.2, B1.3
Receiver saturation at adjacent channel	8.5.2	B1.2, B1.3
Blocking	8.5.3	B1.2, B1.3
Spurious response rejection	8.5.4	B1.2, B1.3
Behaviour at high wanted signal level	8.5.6	B1.2, B1.3
Acknowledgement	8.6.1	B1.2, B1.3
Ability to change communication frequency	8.6.2	B1.2, B1.3

Annex C (normative): Test Fixture

With EUT intended for use with a small aperture integral antenna, and not equipped with a 50 Ω RF output connector, a suitable test fixture as shown in figure C.1 may be used for certain tests, see clause 8.3.5. This fixture is a radio frequency device for coupling the integral antenna to a 50 Ω RF terminal at all frequencies for which measurements need to be performed.

The test fixture shall be fully described.

In addition, the test fixture may provide:

a) a connection to an external power supply;

b) a method to provide the input to or output from the EUT. This may include coupling to or from the antenna. In case of assessment of speech EUT, an audio interface may be provided by direct connection or by an acoustic coupler or in case of non-speech EUT, the test fixture could also provide the suitable coupling means e.g. for data or video outputs.

The test fixture shall normally be supplied by the provider.

The performance characteristics of the test fixture shall be approved by the testing laboratory and shall conform to the following basic parameters:

a) the coupling loss shall not be greater than 30 dB;

b) adequate bandwidth properties;

c) a coupling loss variation over the frequency range used in the measurement which does not exceed 2 dB;

d) circuitry associated with the RF coupling shall contain no active or non-linear equipment;

e) the VSWR at the 50 Ω socket shall not be more than 1,5 over the frequency range of the measurements;

f) the coupling loss shall be independent of the position of the test fixture and be unaffected by the proximity of surrounding objects or people. The coupling loss shall be reproducible when the EUT is removed and replaced. Normally, the text fixture is in a fixed position and provides a location for the EUT;

g) the coupling loss shall remain substantially constant when the environmental conditions are varied.

The attenuation of the test fixture coupling should be such that the received signal at the measuring instrument is at least 10 dB above the measuring instrument noise floor. If the attenuation is too great it can be compensated by linear amplification outside the test-fixture.

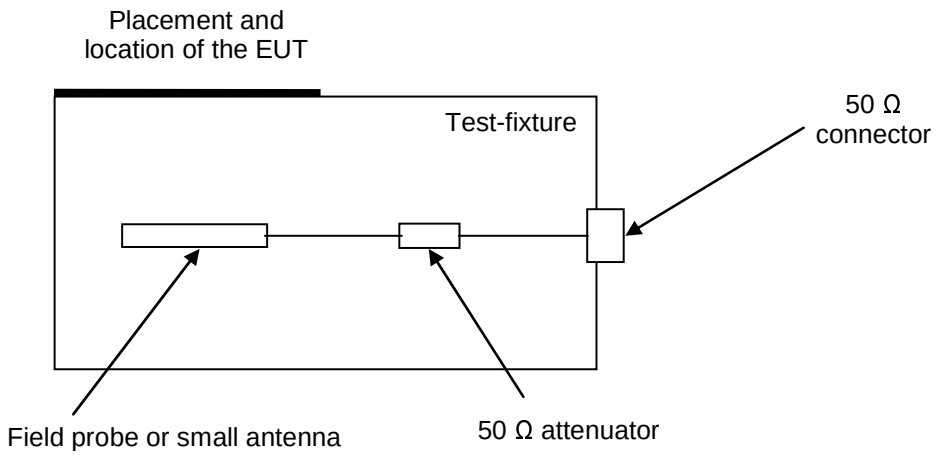


Figure C.1: Test fixture

The field probe (or small antenna) needs to be properly terminated.

The characteristics and validation shall be included in the test report.

C.1 Validation of the test-fixture in the temperature chamber

This test is only needed if test fixture measurements are performed under extreme temperature conditions.

If it is not possible to use the present method, the method used for calibrating the test fixture over the temperature range shall be agreed with the testing laboratory, and fully documented in the test report.

The test fixture is brought into a temperature chamber.

Step 1:

A transmit antenna connected to a signal generator shall be positioned from the test-fixture at a far field distance of not less than one λ at the frequency. The test fixture consists of the mechanical support for the EUT, an antenna or field probe and a 50 Ω attenuator for proper termination of the field probe. The test fixture shall be connected to a spectrum analyzer via the 50 Ω connector. A signal generator has to be set on the EUT's nominal frequency (see figure C.2). The unmodulated output power of the signal generator has to be set to a value such that a sufficiently high level can be observed with the spectrum analyzer. This determined value shall be recorded. The signal generator shall then be set to the upper and the lower band limit of the EUT's assigned frequency band. The measured values shall not deviate more than 1 dB from the value at the nominal frequency. The distance between test antenna and test fixture may be reduced to λ\2 for frequencies below 100 MHz.

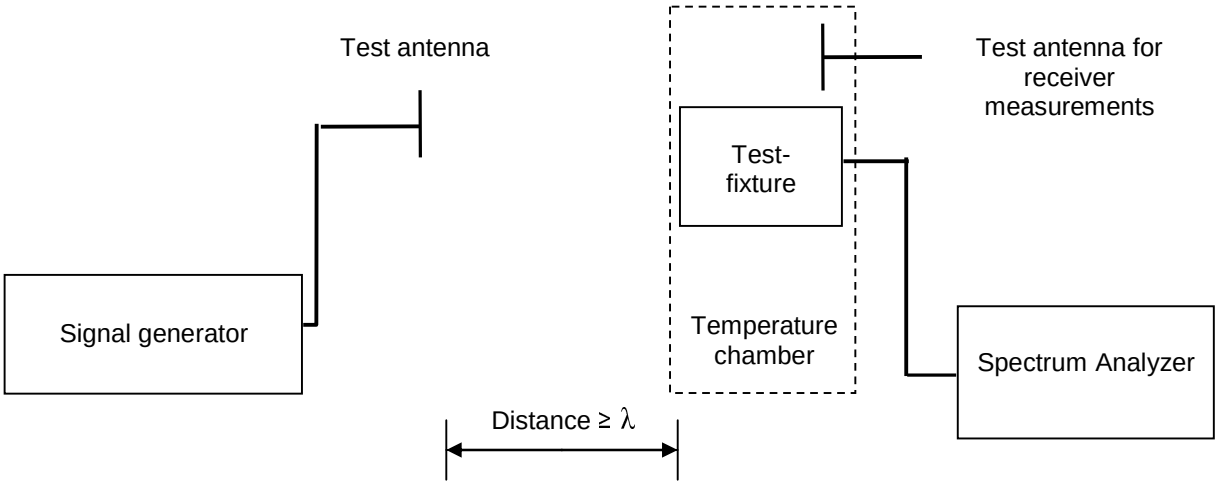


Figure C.2: Validation of test set-up without EUT

If receiver tests under extreme temperature conditions are performed, a receiver test antenna is also brought into the temperature chamber to ensure its influence in the chamber is known.

Step 2:

During validation and testing the EUT shall be fitted to the test fixture in a switched-off mode as shown in figure C.35. Step 1 shall be repeated, this time with the EUT in place. The measured values shall be compared with those from step 1 and may not vary by more than 2 dB. This shows that the EUT does not cause any significant shadowing of the radiated power.

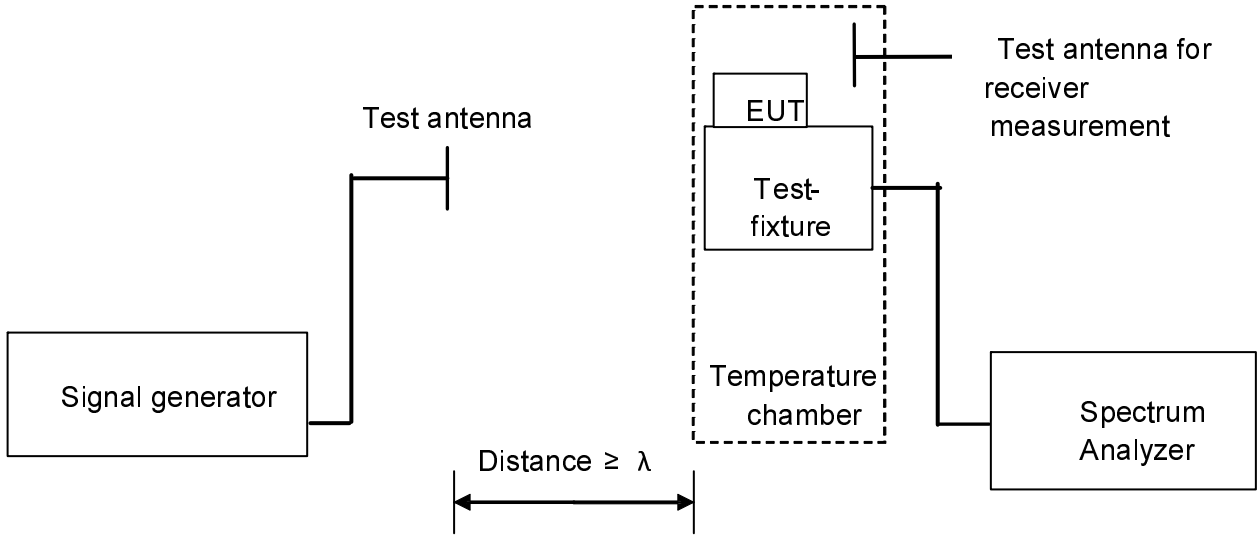


Figure C.3: Validation of test set-up with EUT in place

Step 3:

In case of a battery operated EUT that is supplied by a temporary voltage feed as well as temporary signal- and control line, a decoupling filter shall be installed directly at the EUT in order to avoid parasitic electromagnetic radiation. See figure C.4.

In this step the signal generator and the transmit antenna are removed.

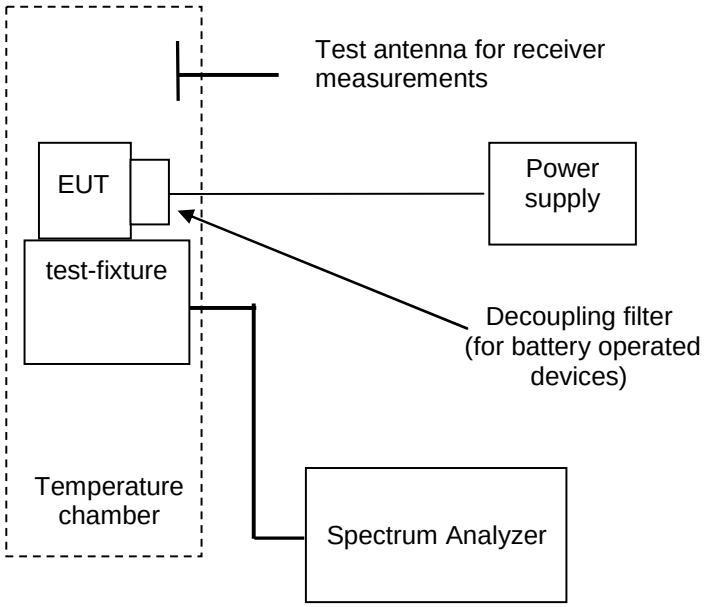


Figure C.4: Test of EUT

C.2 Mode of use

The test fixture may be used to facilitate some of the transmitter and receiver measurements in the case of EUT having an integral antenna.

It is used particularly for the measurement of the radiated carrier power and usable sensitivity expressed as a field strength under extreme conditions. The measurements under extreme conditions are preceded by calibrated measurements according to annex B.

Annex D (normative): Specification for measurement filter

The method of measurement of adjacent channel power refers to the use of a filter. The IF filter shall be within the limits of the selectivity characteristic of figure D.1.

An alternative measuring method shall consist in using, in place of the IF filter, a spectrum analyser with a resolution bandwidth of 100 Hz and integrating the power of all the 100 Hz sub-band measurements, over a total bandwidth of ±D2 (see table D.1).

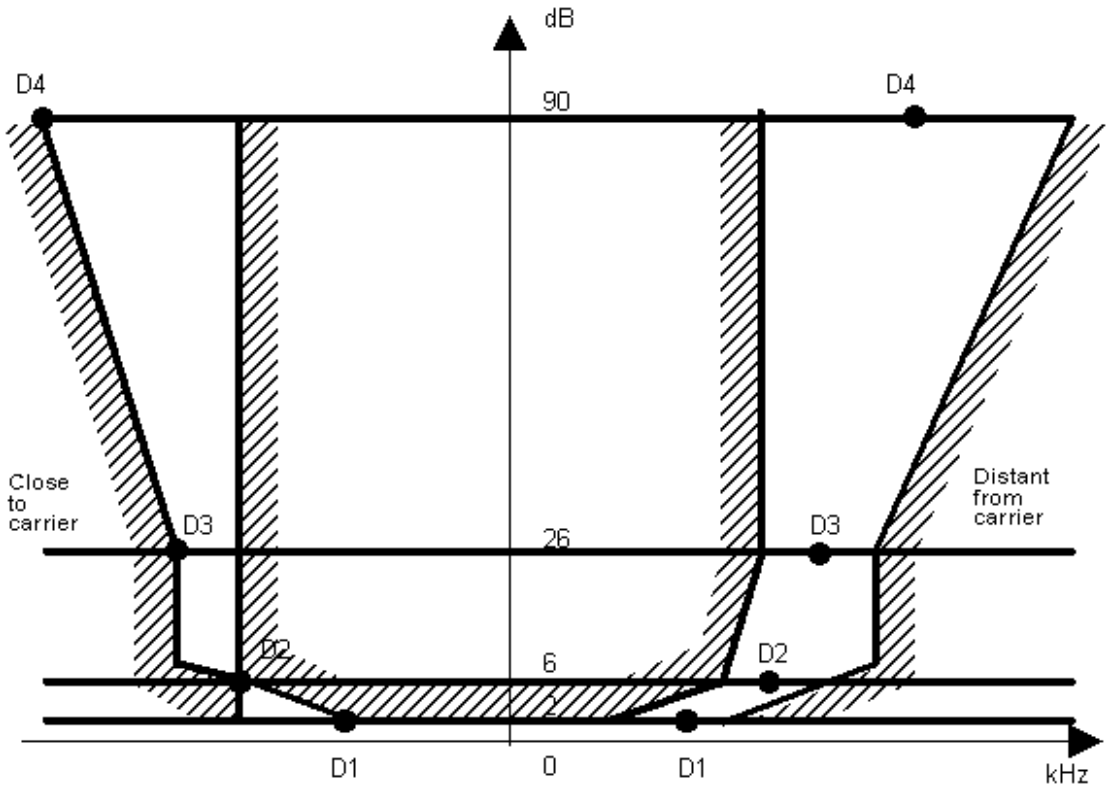


Figure D.1: IF filter

Depending on the channel separation, the selectivity characteristic shall keep the frequency separations from the nominal centre frequency of the adjacent channel as stated in table D.1.

Table D.1: Selectivity characteristics of IF filter

Channel separation (kHz)	Frequency separation of filter curve from nominal centre frequency of adjacent channel (kHz)			
	D1	D2	D3	D4
10 / 12,5	3	4,25	5,5	9,5
20	4	7,0	8,25	12,25
25	5	8,0	9,25	13,25

Depending on the channel separation, the attenuation points shall not exceed the tolerances as stated in tables D.2 and D.3.

Table D.2: Attenuation points close to carrier

Channel separation (kHz)	Tolerances range (kHz)			
	D1	D2	D3	D4
10 / 12,5	+1,35	±0,1	-1,35	-5,35
20	+3,1	±0,1	-1,35	-5,35
25	+3,1	±0,1	-1,35	-5,35

Table D.3: Attenuation points distant from the carrier

Channel separation (kHz)	Tolerance range (kHz)			
	D1	D2	D3	D4
10 / 12,5	±2,0	±2,0	±2,0	+2,0 -6,0
20	±3,0	±3,0	±3,0	+3,0 -7,0
25	±3,5	±3,5	±3,5	+3,5 -7,5

The minimum attenuation of the filter, outside the 90 dB attenuation points, shall greater than or equal to 90 dB.

Annex E (normative): Technical performance of the spectrum analyser

Methods of measurement refer to the use of a spectrum analyser. The characteristics of the spectrum analyser shall meet at least the following requirements:

- the reading accuracy of the frequency marker shall be within ±100 Hz;
- the accuracy of relative amplitude measurements shall be within ±3,5 dB.

It shall be possible to adjust the spectrum analyser to allow the separation on its screen of two equal amplitude components with a frequency difference of 100 Hz.

For statistically distributed modulations, the spectrum analyser and the integrating device (when appropriate) needs to allow determination of the power spectral density (energy per time and bandwidth), which has to be integrated over the bandwidth in question.

The spectrum analyser should have a dynamic range greater than 80 dB and the average phase noise in the adjacent and alternate channels shall be such that measurement of adjacent and alternate adjacent channel power (see clauses 8.4.5 and 8.4.6) is not limited by phase noise. In order to confirm this the selected measurement technique shall be used to measure the adjacent and alternate channel power with a unmodulated signal source with phase noise of less than -110 dBc/Hz at one channel spacing offset and -120 dBc/Hz at two channel spacing offset. The maximum adjacent channel power observed with these conditions shall not exceed -60 dBc, and the maximum alternate channel power measured with these conditions shall not exceed -70 dBc.

Annex F (normative): Duty Cycle and Timing Parameters - Definitions

F.1 Parameter Definitions

F.1.1 Transmission

A Transmission is a continuous radio emission, or sequence of emissions separated by intervals shorter than T_{dis} (see clause F.1.8.2), with a signal level greater than $P_{Threshold}$ (see clause F.1.2), within the Observation Bandwidth F_{mb} (see clause F.1.3).

F.1.2 $P_{Threshold}$

Unless otherwise defined $P_{Threshold}$ is -26 dBC.

F.1.3 Observation bandwidth (F_{dc})

F_{dc} is the bandwidth in which the energy of an equipment is considered for the purposes of assessing transmission timings.

F.1.4 Void

F.1.5 Observation Period (T_{obs})

T_{obs} is defined as a reference interval of time.

F.1.6 On-Time (T_{on})

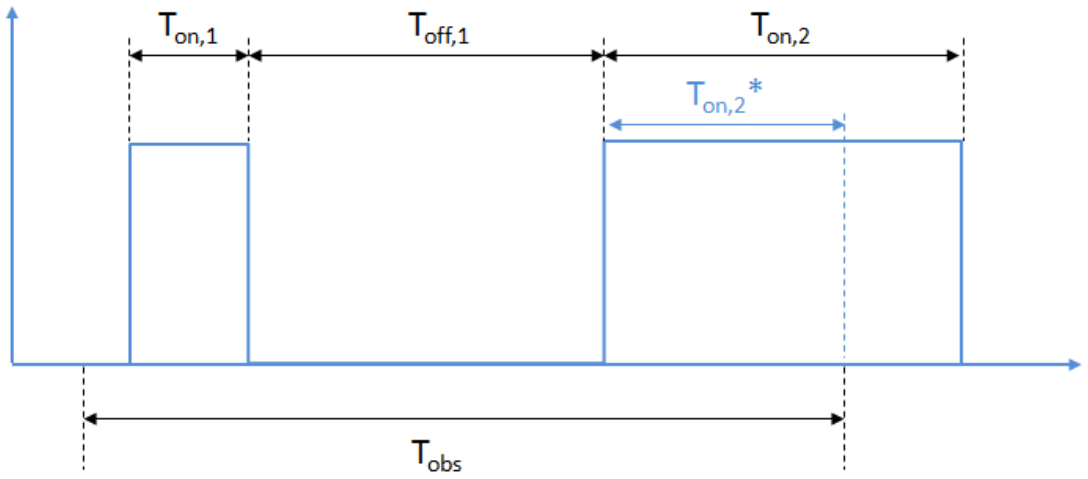
T_{on} is defined as the duration of a Transmission. This is illustrated in figure F.1.

F.1.6.1 Maximum On-Time (T_{on_max})

T_{on_max} is defined as the maximum permissible value of T_{on}.

F.1.7 Cumulative On-Time (T_{on_cum})

T_{on_cum} is defined as the sum of the individual T_{on} times, or part thereof, within $T_{obs,}$ example see figure F.1.



NOTE: In this example: $T_{on\_cum} = T_{on,1} + T_{on,2}$*.

Figure F.1: Example for Cumulative On-Time

F.1.8 Off-Time (T_{off})

T_{off} is defined as the time duration between two consecutive Transmissions (see figure F.1).

F.1.8.1 Minimum Off - Time (T_{off_min})

T_{off_min} is defined as the minimum permissible value of T_{off}.

F.1.8.2 Disregard-Time (T_{dis})

T_{dis} is defined as the time interval below which interruptions within a Transmission are considered part of T_{on}. T_{dis} is a measurement procedure parameter, it is not subject to restrictions and shall be declared by the provider (see figure F.2).

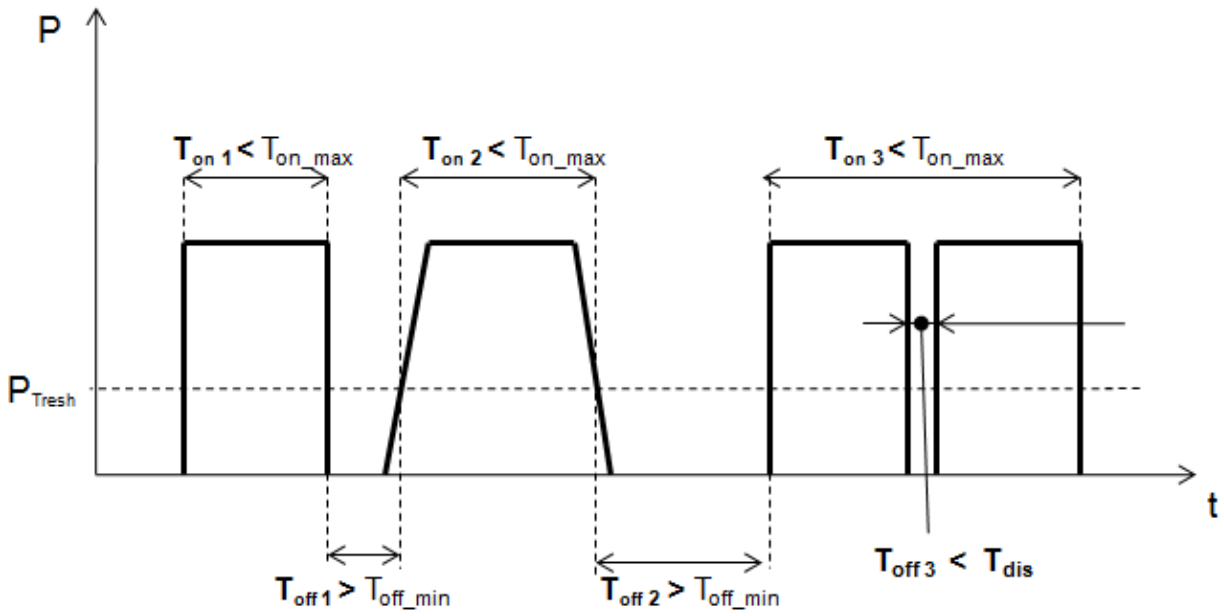


Figure F.2: Definition T_{ON} and T_{off} times

F.2 Duty Cycle Definition

DC is defined as:

$$\frac{T_{on\_cum}}{T_{obs}}$$

Respecting the constraints of T_{on_max} and T_{off_min}.

T_{obs} may take different values for specific cases.

DC may be defined for more than one value of T_{obs}.

Annex G (informative): Declarations to be made by the provider

See clause 8.3.10.

Annex H (informative): Bibliography

- ETSI EN 301 489-3: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 40 GHz".
- ANSI C63.5 (2006): "American National Standard for Calibration of Antennas Used for Radiated Emission Measurements in Electro Magnetic Interference".
- ITU-R Radio Regulations.
- ETSI TR 103 056: "Electromagnetic compatibility and Radio spectrum Matters (ERM); System Reference Document; Short Range Devices (SRD); Technical characteristics for SRD equipment for social alarm and alarm applications".
- CENELEC EN 50131-5-3: "Alarm systems - Intrusion systems. Part 5-3 Requirements for interconnections equipment using radio frequency techniques".
- CEN EN 54-25: "Fire detection and fire alarm systems - Part 25: Components using radio links".
- CEPT/ERC/REC 70-03: "Relating to the use of Short Range Devices (SRD)".
- ETSI TS 103 051 (V1.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Expanded measurement uncertainty for the measurement of radiated electromagnetic fields".
- ETSI TS 103 052 (V1.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Radiated measurement methods and general arrangements for test sites up to 100 GHz".

Annex I (informative): Change history

date	Version	Information about changes
May 2013	V0.0.1	First draft
June 2013	V0.0.1	TG28 meeting
July 2013	V0.0.1	Notes added in GoTo meetings
4 Sept 2013		Notes added in GoTo meeting.
12 Sept 2013	V0.0.3	Addition of Duty Cycle and transmission timings definitions and measurements.
23 Sept 2013	V0.0.4	Clean copy for joint ETSI/CENELEC/CEN meeting
11 Oct 2013	V0.0.5	Clauses 5, 6, 7, 8 of ETSI EN 300 220 carried in. Tables 1 to 5 aligned with new Rec 70-03 (track changes on)
26 Oct 2013	V0.0.6	All changes in V.0.0.5 accepted. Formatting and cross referencing corrected (track changes on).
1 Nov 2013	V0.0.7	All changes in V.0.0.6 accepted. Test methods in clause 8 updated. Test suite in clause 8 for Transmitters updated.
16/1/14	V0.0.8	All changes in V.0.0.7 accepted. Annexes added. Clause 8.3 updated re test modes and test fixtures.
23/1/14	V0.0.9	Minor editorials. Comments added after GoTo meeting. Track changes still on.
5/2/14	V0.1.1	Re-structuring of clauses 4, 5, 6. Track changes still on.
10/2/14	V0.1.2	All changes in V0.1.1 accepted. Annex A completed. Annex on DCT examples removed as unnecessary. 8.3.10 (provider declaration) added. Adjacent channel power reviewed.
17/2/14	V0.1.3	TOC updated. Unchannelized freqs put on 25 kHz raster. Clause 6 split to new 6 and 7. Former clause 7 moved to Annex F. Clause 8.3.5 extended. Editorial work and alignment with prEN303204.
17/2/14	V0.1.4	Clean copy of V0.1.3. Non-essential comments removed. Minor editorial corrections.
23/2/14	V0.1.5	Editorials. Alignment with pr EN303204. Addn of 8.3.1.5., 8.3.11 Test methods checked and updated.
25/2/14	V.0.1.6	Transient test method added, 8.4.4 ACk test method added, 8.6.1 Freq agility test method added 8.6. RBW spec added to spurious emission test 8.4.7.4
24/4/14	V0.1.7	All changes in V0.1.6 accepted Editorials Text moved to remove hanging paragraphs- renumbering as necessary 3.2, Symbols, 3.3 Abbreviations, updated.
26/4/14	V0.1.8	All changes in V0.1.7 accepted Restructure numbering of test methods to common format, align with 8.3.5. Tables 1, 2, 3, 4 updated and checked against Rec 70-03 and EC Decision. Short term behaviour test method updated to align with prEN303204.
11/5/14	V0.1.9	Spurious emissions test procedure updated (transmitter & receiver tests combined Editorials. Rx tests reviewed. Alternative means to Sig Gen A specified in clause 8.3.8 Annex A updated Cross references checked Some references moved to Bibliography
11/5/14	V0.2.1	All changes in V0.1.9 accepted Scope and Title altered from "Wireless Alarms" to "SRDs in the LDC/HR category" in order to a) ensure alarms can still use ETSI EN 300 220 as an alternative b) align with 5th update of EC Decision
20/5/14	V0.2.2	Revised Scope and Title at TG28#38 meeting (track changes on)
20/5/14	V0.2.3	Clean copy of V0.2.2, references to ETSI TS 103 060 and ETSI EN 300 220 added.

History

Document history			
V1.1.0	October 2014	EN Approval Procedure	AP 20150219: 2014-10-22 to 2015-02-19