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Short Range Devices (SRD);
Ground- and Wall- Probing Radio determination (GPR/WPR) devices;
Harmonised Standard for access to radio spectrum

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Foreword

This Harmonised European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.5] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.1].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

National transposition dates	
Date of adoption of this EN:	9 June 2020
Date of latest announcement of this EN (doa):	30 September 2020
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 March 2021
Date of withdrawal of any conflicting National Standard (dow):	31 March 2022

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**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).

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Introduction

GPR and WPR radars are imaging systems designed to operate while in contact with, or in close proximity to the ground or the wall, and their emissions are directed into the ground or wall (e.g. measured by a proximity sensor or imposed by the mechanical design).

The GPR/WPR applications in the present document are not intended for communications purposes, and the intended signal is not radiated into free space. The emissions into the air resulting from the operation of GPR/WPR imaging systems are defined as those emissions radiated in all directions above the ground from the GPR/WPR equipment, including direct emissions from the housing/structure of the equipment and emissions reflected or passing through the media under inspection (referred in ECC/DEC/(06)08 [i.2] and in the present document as "undesired emissions"); they are therefore dependent on the operational conditions and are meaningful only if the GPR/WPR are coupled with the material being investigated. Figure 1 shows the scenario to be considered for the emissions radiated into the air by GPR/WPR.

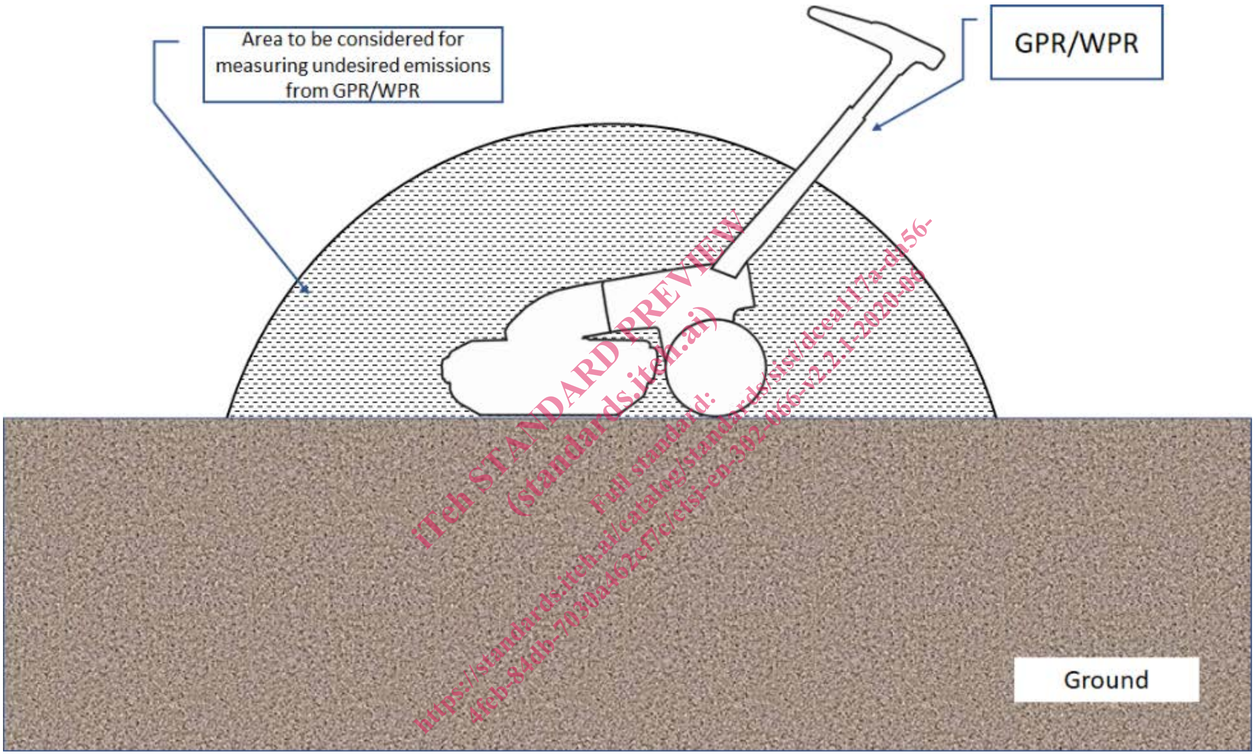

Figure 1: Hatched area around the GPR/WPR shows the emissions to be considered in this clause

1 Scope

The present document specifies the requirements for Ground- and Wall- Probing Radar imaging systems applications. Ground Probing Radars (GPR) and Wall Probing Radars (WPR) are used in survey and detection applications.These do not include radars operated from aircraft or spacecraft.

The present document applies to:

1) Ground Probing Radars (GPR) operating in the frequency range 30 MHz to 12,4 GHz radiating directly downwards into the ground.

2) Wall Probing Radars (WPR) operating in the frequency range 30 MHz to 12,4 GHz radiating directly into a "wall". The "wall" is a building material structure, the side of a bridge, the wall of a mine or another physical structure that absorbs a significant part of the signal transmitted by the radar.

These equipment can either:

1) be fitted with integral antennas and without antenna connector; or

2) use different imaging heads (antennas) with an antenna connector, to allow operation at different operating bandwidths frequencies.

NOTE 1: Equipment covered by the present document operates in accordance with ECC/DEC(06)08 [i.2].

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

Table 1: Permitted ranges of operation

Permitted range of operation	
Transmit	30 MHz to 12,4 GHz
Receive	30 MHz to 12,4 GHz
NOTE 1: Limits in table 2, clause 4.3.4 are to be met. NOTE 2: The frequency usage conditions for GPR/WPR are not fully harmonised in the EU and CEPT. Some National Regulatory Authorities (NRAs) may not have a general frequency allocation for GPR/WPT and may have established individual licensing requirements (e.g. registration of the user). Annex 2 of ECC/DEC/(06)08 [i.2] gives some guidance to administrations.	

NOTE 2: The relationship between the present document and essential requirements of article 3.2 of Directive 2014/53/EU [i.1] is given in annex A.

2 References

2.1 Normative references

References are specific, identified by date of publication and/or edition number or version number. Only the cited version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://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.

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

[1] ETSI EN 303 883 (V1.1.1) (09-2016): "Short Range Devices (SRD) using Ultra Wide Band (UWB); Measurement Techniques".

[2] ETSI TS 103 361 (V1.1.1) (03-2016): "Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Receiver technical requirements, parameters and measurement procedures to fulfil the requirements of the Directive 2014/53/EU".

[3] CENELEC EN 55016-1-1 (March 2010 + A1 October 2010 + A2 September 2014): "Specification for radio disturbance and immunity measuring apparatus and methods; Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus".

2.2 Informative 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.

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

[i.1] Directive 2014/53/EU of the European Parliament and of the council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC.

[i.2] ECC/DEC/(06)08: "ECC Decision of 1 December 2006 on the conditions for use of the radio spectrum by Ground- and Wall- Probing Radar (GPR/WPR) imaging systems".

[i.3] ETSI TS 103 051 (V1.1.1) (08-2011): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Expanded measurement uncertainty for the measurement of radiated electromagnetic fields".

[i.4] Void.

[i.5] Commission Implementing Decision C(2015) 5376 final of 4.8.2015 on a standardisation request to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53/EU of the European Parliament and of the Council.

[i.6] ETSI EG 203 336 (V1.1.1) (08-2015): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Guide for the selection of technical parameters for the production of Harmonised Standards covering article 3.1(b) and article 3.2 of Directive 2014/53/EU".

[i.7] Recommendation ITU-R SM.1755: "Characteristics of ultra-wideband technology".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI EN 303 883 [1] and the following apply:

footsize: outside dimension of the DUT in the horizontal plane

large GPR/WPR: GPR/WPR with the largest dimension in the horizontal plane 1 metre or more

Pulse Repetition Frequency (PRF): inverse of the Pulse Repetition Interval (PRI), averaged over a sufficiently long time to cover all PRI variations

Pulse Repetition Interval (PRI): time between the rising edges of the transmitted (pulsed) output power

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

small GPR/WPR: GPR/WPR with all dimensions in the horizontal plane below 1 metre

time window: length of time that the GPR/WPR receiver is activated to collect reflections from a single transmitted signal

undesired emissions: emissions radiated in all directions above the ground from the GPR/WPR equipment, including direct emissions from the housing/structure of the equipment and emissions reflected or passing through the media under inspection (see ETSI EG 203 336 [i.6])

user manual: end user documentation to be included with the device

3.2 Symbols

For the purposes of the present document, the symbols given in ETSI EN 303 883 [1] and the following apply:

dB	DeciBel
dBi	Gain in decibels relative to an isotropic antenna
D1	Difference between M and N
D2	Difference between M and I
E	Electrical field strength
f_C	Frequency at which the emission is the peak power at maximum
I	Signal recorded by the receiver in presence of the interferer
λ	Wavelength
M	Maximum signal for the receiver in the linear region of operation
N	Receiver noise level

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI EN 303 883 [1] and the following apply:

CEPT	European Conference of Postal and Telecommunications administrations
DT	DwellTime
DUT	Device Under Test
GPR	Ground Probing Radar, Ground Penetrating Radar
RNSS	Radio Navigation Satellite Service
RX	Receiver
SA	Spectrum Analyser
ST	ScanTime
TX	Transmitter
WPR	Wall Probing Radar

4 Technical requirements specifications

4.1 Environmental conditions

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be declared by the manufacturer. The equipment shall comply with all the technical requirements of the present document which are identified as applicable in annex A at all times when operating within the boundary limits of the declared operational environmental profile.

4.2 General

UWB devices in the scope of the present document can operate in a broad permitted range of frequencies from 30 MHz to 12,4 GHz, as defined in table 1.

In order to clearly identify the required limits and thus measurement procedures it is essential to define the operating bandwidth of the UWB equipment under test, The operating bandwidth of the UWB equipment under test shall be the -10 dB bandwidth of the intended UWB signal under normal operational conditions as defined in clause 4.3.1.

A single UWB device can have more than one operating bandwidth. All UWB related emissions shall be measured in the identified operating bandwidth of the UWB device under test. The required mitigation techniques are only valid in the operating bandwidth.

The RX conformance test considers the dynamic range and the resilience of the receiver against interference signals in the operating bandwidth and on some clearly identified frequencies inside and outside the operating bandwidth(s), see clause 4.4.4.

Test site and general arrangements for compliance measurements are defined in clauses 6.1.1 and 6.1.2.

4.3 Transmitter Conformance Requirements

4.3.1 Operating Bandwidth

4.3.1.1 Applicability

This requirement shall apply to all kind of GPR/WPR.

4.3.1.2 Definition

The operating bandwidth(s) of GPR/WPR is/are the -10 dB bandwidth(s) of the undesired emissions radiated into the air by the equipment.

NOTE: This definition is in accordance with the -10 dB bandwidth as defined in Annex 1 of Recommendation ITU-R SM.1755 [i.7].

4.3.1.3 Limits

Any operating bandwidth of all the DUT shall lie within the permitted frequency range of operation of the device (see table 1) and shall be > 50 MHz.

4.3.1.4 Conformance

The conformance test suite for operating bandwidth shall be as defined in clause 6.2.2.

4.3.2 Maximum value of mean power spectral density

There is no regulatory limit for the UWB maximum mean power spectral density in the main lobe of the GPR/WPR antenna (towards ground or wall) due to the nature of the GPR/WPR applications (see scope of the present document). The relevant mean power spectral density emissions (according to ECC/DEC/(06)08 [i.2]) of the GPR/WPR device is considered in clause 4.3.4 (undesired emission limit) and annex C (calculation of the mean power density).

4.3.3 Maximum value of peak power

There is no regulatory limit for the UWB maximum peak power in the main lobe of the GPR/WPR antenna (towards ground or wall) due to the nature of the GPR/WPR applications (see scope of the present document). The relevant peak power emissions (according to ECC/DEC/(06)08 [i.2]) of the GPR/WPR device is tested under clause 4.3.4 (undesired emissions limit).

4.3.4 All undesired emissions

4.3.4.1 Applicability

This requirement shall apply to all kind of GPR/WPR.

4.3.4.2 Definition

Term "undesired emissions" see clause 3.1.

See also clause 4.3.5 for the other emissions.

4.3.4.3 Limits

The effective radiated power of any emission from GPR/WPR shall not exceed the values given in table 2.

Table 2: Power limits of radiated emissions (based on ECC/DEC/(06)08 [i.2], Annex 1)

Frequency range (MHz)	Peak power limit values for emission
30 to 230	-44,5 dBm/120 kHz (e.r.p.)
> 230 to 1 000	-37,5 dBm/120 kHz (e.r.p.)
> 1 000 to 18 000	-30 dBm/MHz (e.i.r.p.)

The maximum mean e.i.r.p. spectral density which is based on the peak values measured according to clause 6.2.5, shall be calculated as set out in annex C and shall not exceed the values in table C.1.

4.3.4.4 Conformance

The conformance test suite shall be as defined in clause 6.2.6.

4.3.5 Other Emissions

This requirement does not apply for GPR/WPR. The total undesired emissions from a GPR/WPR already include direct non UWB based (TX/RX) emissions from the housing/structure/electronics; therefore this clause does not apply because covered by the measurement of all undesired emissions in clause 4.3.4 (see ECC/DEC/(06)08 [i.2]).

4.3.6 Transmitter unwanted emissions

Transmitter unwanted emissions are specified as Out-Of-Band (OOB) and spurious emissions. For GPR/WPR these emissions are covered by the spectrum mask as defined in clause 4.3.4 and annex C and is tested under clause 4.3.4 (undesired emissions limit).

4.4 Receiver Conformance Requirements

4.4.1 General

For a detailed description for GPR/WPR receiver requirements, see annex D.

4.4.2 Receiver spurious emissions

Receiver spurious emissions are measured as part of the emissions resulting from the operation of GPR/WPR imaging systems, see clause 4.3.4.

4.4.3 Receiver dynamic range (sensitivity) for GPR/WPR

4.4.3.1 Applicability

This requirement shall apply to all kind of GPR/WPR.