Draft ETSI EN 303 364-1-1 V1.0.0 (2025-03)

Primary Surveillance Radar (PSR);
Harmonised Standard for access to radio spectrum;
Part 1: Air Traffic Control (ATC) PSR sensors operating in the frequency band 1 215 MHz to 1 400 MHz (L band);
Sub-part 1: radar systems using reflector antennas

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Foreword

This draft Harmonised 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 Standardisation Request deliverable Approval Procedure (SRdAP).

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The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.2] 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.

The present document is part 1, sub-part 1, of a multi-part deliverable covering Primary Surveillance Radar (PSR), as identified below:

Part 1: "Air Traffic Control (ATC) PSR sensors operating in the frequency band 1 215 MHz to 1 400 MHz (L band)";

Sub-part 1: "radar systems using reflector antennas";

Sub-part 2: "radar systems using phased array antennas".

Part 2: "Air Traffic Control (ATC) PSR sensors operating in the frequency band 2 700 MHz to 3 100 MHz (S band)";

Part 3: "Air Traffic Control (ATC) PSR sensors operating in the frequency band 8 500 MHz to 10 000 MHz (X band)".

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**", "**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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1 Scope

The present document specifies technical characteristics and methods of measurements for ground based monostatic ATC solid state primary surveillance radars that are intended to work with a waveguide-based rotating passive antenna and have the following characteristics:

- operation in the 1 215 MHz to 1 400 MHz frequency range;
- transmitter output peak power up to 100 kW;
- the transceiver output uses an RF circulator;
- a piece of waveguide of at least 66 cm is integral to the transceiver.

NOTE 1: Phased array ATC primary surveillance radars are not covered by the present document.

NOTE 2: 66 cm equals 2 times the cut-off wavelength of a WR650/WG6/R14 waveguide which is typically used in the 1 215 MHz to 1 400 MHz frequency range.

NOTE 3: 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 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 in the ETSI docbox.

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 300 019-1-3 (V2.4.1) (04-2014): "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weather protected locations".

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.

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 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.

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[i.2] 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.3] ITU Radio Regulations (2024).

[i.4] Recommendation ITU-R SM.1541-7 (09/2024): "Unwanted emissions in the out-of-band domain".

[i.5] ETSI EG 203 336 (V1.2.1): "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.6] IEC 60153-2 (2016): "Hollow metallic waveguides - Part 2: Relevant specifications for ordinary rectangular waveguides".

[i.7] Recommendation ITU-R SM.331-4 (07/78): "Noise and sensitivity of receivers".

[i.8] Recommendation ITU-R SM.332-4 (07/78): "Selectivity of receivers".

[i.9] ECC Recommendation (02)05 (October 2012): "Unwanted emissions".

[i.10] ERC Recommendation 74-01 (May 2022): "Unwanted emissions in the spurious domain".

[i.11] Recommendation ITU-R M.1177-4 (04/2011): "Techniques for measurement of unwanted emissions of radar systems".

3 Definition of terms, symbols and abbreviations

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3.1 Terms

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

active state: state which produces the authorized emission

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allocated frequency band: frequency range that regionally or nationally is allocated to one or more radio services on a primary or secondary basis

chirp bandwidth: total frequency shift during the pulse generation of an FM/chirped radar

EXAMPLE: If the Frequency Modulation is from 1 250 MHz to 1 280 MHz, the chirp bandwidth is 30 MHz.

declared frequency band: band or bands within which the equipment under test is declared to operate

NOTE: The declared frequency band for a given region or country is always contained within the allocated frequency band.

dummy load: device connected to a waveguide or coaxial cable and matched to their impedance (typically 50 Ω) to absorb the RF energy propagating inside

Equipment Under Test (EUT): device that is the subject of the specific test investigation being described

idle/stand-by state: state where the transmitter is available for traffic, but is not in the active state

matched filter: receiver filter that matches the transmitted radar waveform, i.e. this is the filter that maximizes the signal-to-noise ratio of the received pulse

necessary bandwidth: width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions for a given class of emission

NOTE 1: This definition is taken from ITU Radio Regulation [i.3].

NOTE 2: For Primary radars the necessary bandwidth B_N is considered to be B_{-20} (20 dB bandwidth) as defined in Recommendation ITU-R SM.1541-7 [i.4].

occupied bandwidth: width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage β/2 of the total mean power of a given emission

NOTE 1: Unless otherwise specified in an ITU-R Recommendation for the appropriate class of emission, the value of β/2 should be taken as 0,5 %.

NOTE 2: This definition is taken from ITU Radio Regulations [i.3], chapter I, 1.153.

operating frequencies: frequencies on which the radar is tuned to operate

operating mode: predefined configuration for a given service accessible to the operator of the radar system

NOTE 1: Several operating modes may be available.

NOTE 2: Changing operating mode might affect the radio characteristics of the radar system.

Peak Envelope Power (PEP): average power supplied to the antenna transmission line by a transmitter during one radio frequency cycle at the crest of the modulation envelope taken under normal operating conditions

NOTE: This definition is taken from ITU Radio Regulations [i.3], chapter I, 1.157.

product configuration: hardware variant of the same typology of system under test (e.g. different power outputs, magnetrons)

pulse fall time: time taken for the trailing edge of the pulse to decrease from 90 % to 10 % of the maximum amplitude (voltage)

pulse length: time between the 50 % amplitude (voltage) points

pulse rise time: time taken for the leading edge of the pulse to increase from 10 % to 90 % of the maximum amplitude (voltage)

radar equipment: equipment and its associated primary navigational display intended for the navigation of aircraft in airways

receiver output: output of the digital matched filter function

system coupler: directional waveguide coupler with forward and reverse port or only a forward port

NOTE: The system coupler is inserted in the waveguide run between the circulator and the antenna but not directly located behind the antenna. Usually it is located very close behind the circulator.

unwanted emissions: consist of spurious emissions and out-of-band emissions

NOTE: This definition is taken from ITU Radio Regulation [i.3].

3.2 Symbols

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

B_{-20}	-20 dB bandwidth below PEP of the spectrum of the transmitted waveform
B_{-40}	-40 dB bandwidth below PEP of the spectrum of the transmitted waveform
B_C	Chirp bandwidth
B_m	Measurement bandwidth
B_N	Necessary bandwidth
B_{ref}	Reference bandwidth
B_{res}	3 dB resolution bandwidth of transceiver
dB/dec	dB per decade
dBm	Power ratio expressed in decibels (dB) with reference to 1 milliwatt
dBpp	Power ratio expressed in decibels (dB) with reference to peak power
f_o	Operating Frequency
f_{co}	*Cut-off* Frequency
f_{IF}	Intermediate Frequency
f_{RF}	Receiver operating Frequency
f_{image}	Image Frequency

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k	Boltzmann's constant
f_{LO}	Local Oscillator Frequency
P_{meas}	Spectrum Peak Power
Pt	Pulse power of transmission
RF	Radio Frequency
S/N	Signal-to-Noise ratio
t	Pulse length
T_C	Pulse length (of individual chirp waveforms) in seconds
tr	Pulse rise time
tf	Pulse fall time
T_0	Temperature in Kelvin
β/2	Percentage of the total mean power of a given emission
λ	Wavelength

3.3 Abbreviations

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

AC	Alternating Current
ATC	Air Traffic Control
COF	Cut-Off Frequency
CW	Continuous Wave
DC	Direct Coupling
EIA	Electronic Industries Alliance
EN	European Norm
ENR	Excess Noise Ratio
EUT	Equipment Under Test
FM	Frequency Modulation
Hz	Hertz
IEC	International Electrotechnical Commission
IF	Intermediate Frequency
IMD	InterModulation Distortion
ITU-R	International Telecommunications Union - Radiocommunications
kHz	kiloHertz
kW	kiloWatt
NA	Not Available
NF	Noise Factor
OoB	Out-of-Band
PEP	Peak Envelope Power
ppm	parts per million
PSR	Primary Surveillance Radar
RCL	Receiver Compression level
RF	Radio Frequency
SM	Spectrum Management
STD	Standard Deviation
SWT	Sweep Time

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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 in accordance with its intended use, but as a minimum, shall be that specified in the test conditions contained in the present document. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the operational environmental profile defined by its intended use.

4.2 Conformance Requirements

4.2.1 Transmitter requirements

4.2.1.1 Occupied bandwidth

4.2.1.1.1 Definition

Occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage β/2 of the total mean power of a given emission as defined in ITU Radio Regulations [i.3], chapter I, 1.153.

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4.2.1.1.2 Limits

The occupied bandwidth with β/2 = 0,5 % shall be maintained wholly within the declared frequency band.

NOTE: The value of β/2 = 0,5 % is taken from chapter I, 1.153 of the ITU Radio Regulations [i.3].

4.2.1.1.3 Conformance

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The conformance tests are specified in clause 5.2.1.1.

4.2.1.2 Transmitter Peak Power

4.2.1.2.1 Definition

The transmitter peak power of a pulse radar is the peak value (PEP) of the transmitter pulse power during the transmission pulse measured at the antenna flange (output port of the transmitter).

4.2.1.2.2 Limits

The transmitter peak power shall not exceed 100 kW (i.e. 80 dBm).

4.2.1.2.3 Conformance

The conformance tests are specified in clause 5.2.1.2.

4.2.1.3 Measured B_{-40} bandwidth

4.2.1.3.1 Definition

The measured -40 dB bandwidth (B_{-40}) is the measured bandwidth of the emissions 40 dB below the measured PEP.

NOTE: Occupied bandwidth will be smaller than B_{-40} for such equipment.

4.2.1.3.2 Limits

The measured B_{-40} bandwidth shall always be contained within the declared frequency band.

4.2.1.3.3 Conformance

The conformance tests are specified in clause 5.2.1.3.

4.2.1.4 Unwanted emissions

4.2.1.4.1 General requirements

The Out-of-Band emission limits and the spurious emission limits shall be based on the calculated B_{-40} bandwidth as defined in Annex B. The OoB and Spurious domain boundaries and limits are defined in clause 4.2.1.4.2.2.

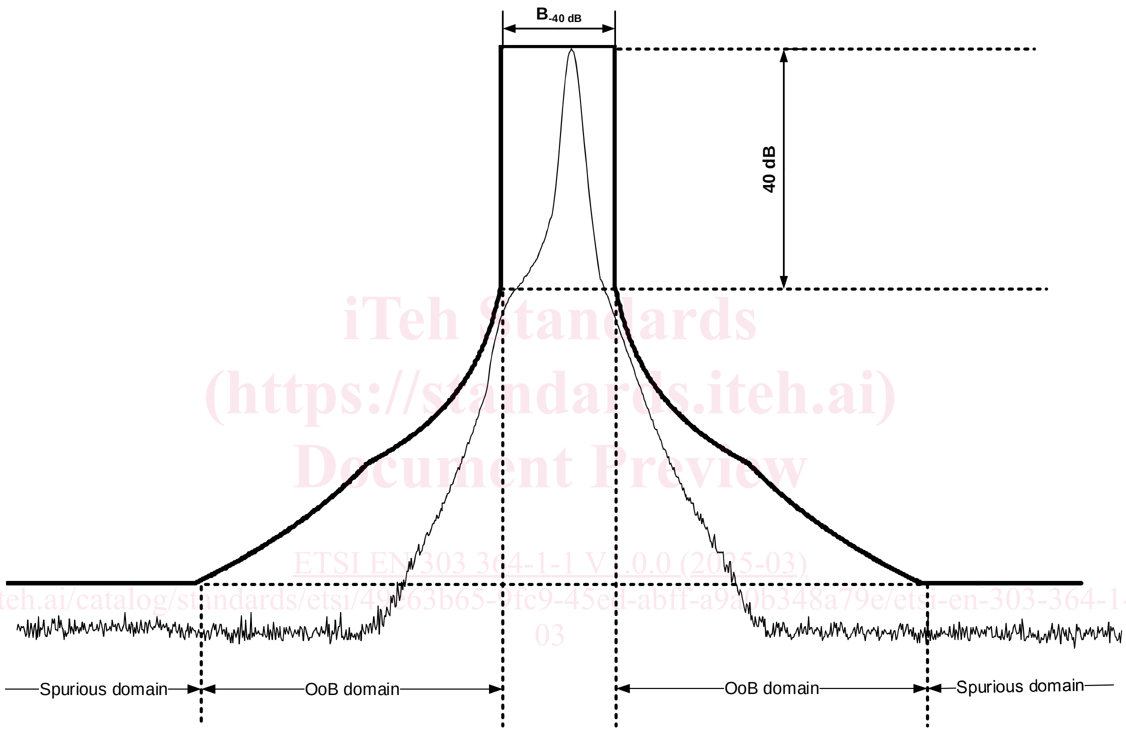

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Figure 1: Definition of OoB and spurious emission domains (case of a single operating frequency) (Not to scale)

4.2.1.4.2 Out-of-band Emissions

4.2.1.4.2.1 Definition

Out-of-Band (OoB) emissions refer to emissions in the region between the calculated B_{-40} and the spurious domain.

NOTE: The calculated B_{-40} is defined in Annex B.

4.2.1.4.2.2 Limits

For single frequency radars, the limits of emissions in the OoB domain frequency boundaries defined in Table 2, shall be as specified in Table 1.