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Primary Surveillance Radar (PSR);

Part 2: Harmonised Standard covering the Essential Requirements of Article 3.2 of Directive 2014/53/EU for Air Traffic Control (ATC) Primary Surveillance Radar Sensors operating in 2700-3100 MHz frequency band (S band)

<

**HARMONISED EUROPEAN STANDARD**

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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 standards EN Approval Procedure.

The present document has been prepared in reply to the Commission's standardisation request Commission Implementing Decision C(2015) 5376 final [i.15]to provide a 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 2 of a multi-part deliverable covering ground based ATC Primary Surveillance Radars (PSR), as identified below:

Part 1: “Harmonized Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU for Air Traffic Control (ATC) Primary Surveillance Radar sensors operating in 1215-1400 MHz frequency band (L band)”

**Part 2: "Harmonized Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU for Air Traffic Control (ATC) Primary Surveillance Radar sensors operating in 2700-3100 MHz frequency band (S band)".**

Part 3: “Harmonized Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU for Air Traffic Control (ATC) Primary Surveillance Radar sensors operating in 8500-10000 MHz frequency band (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](http://portal.etsi.org/Help/editHelp!/Howtostart/ETSIDraftingRules.aspx) (Verbal forms for the expression of provisions).

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# Scope

The present document specifies technical characteristics and methods of measurements for ground based ATC primary surveillance radars operating in the S band (2700 MHz to 3100 MHz)

NOTE: According to Article 5 of the International Radio Regulations 2016 [1] the band 2 700 MHz to 2 900 MHz is allocated to the Aeronautical Radionavigation Service on a primary basis and Radiolocation Service on a secondary basis. The band 2 900 MHz to 3 100 MHz is allocated to the Radiolocation and Radionavigation Services on a co-primary basis.

The present document covers the essential requirements of article 3.2 of Directive 2014/53/EU under the conditions identified in annex A.

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 Radio Equipment Directive [i.1] as well as essential requirements under the SES

Interoperability Regulation 552/2004 [i.7] and related implementing rules and/or essential requirements under the

EASA basic Regulation (EC) No 216/2008 [i.5] as amended by Regulation (EC) No 1108/2009 [i.6] may apply to equipment within the scope of the present document.

# References



## 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 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.

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

[1] ITU Radio Regulations (2016).

[2] ERC/Recommendation 74-01 (2011): "Unwanted emissions in the spurious domain".

[3] ECC/Recommendation (02)05 (2012): "Unwanted emissions".

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

## 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.

[i.5] REGULATION (EC) No 216/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC

[i.6] REGULATION (EC) No 1108/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 October 2009 amending Regulation (EC) No 216/2008 in the field of aerodromes, air traffic management and air navigation services and repealing Directive 2006/23/EC

[i.6] EUROCONTROL Standard Document for Radar Surveillance in En-Route and Major Terminal Areas SUR.ET1.ST01.1000-STD-01-01 Edition: 1.0 Date: March 1997.

[i.7] EC Regulation No 552/2004, the Interoperability Regulation, Article 5 and Annex III (3) as amended by EC Regulation No 1070/2009.

[i.8]

[i.8] ITU-R Recommendation SM.1541-6 (2015) "Unwanted emissions in the out-of-band domain".

[i.9] ITU-R Recommendation SM.329-12 (2012) "Unwanted emissions in the spurious domain".

[i.10] ETSI TS 103 052 (V1.1.1) (03-2011): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Radiated measurement methods and general arrangements for test sites up to 100 GHz".

[i.11] Regulation (EU) 1025/2012 of the European Parliament and of the Council of 25 October 2012 on European Standardisation, amending Council Directives 89/686EEC and 93/15/EEC and Directives 94/9/EC, 94/25/EC 95/16/EC, 97/23/EC, 98/34/EC, 2004/22/EC, 2007/23/EC, 2009/23/EC and 2009/105/EC and the European Parliaments and of the Council and repealing Council Decision 87/95/EEC and Decision No 1673/2006/EC of the European Parliament and of the Council.

[i.12] 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”.

[i.13] ETSI TR 100 028-2 (V1.4.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2".

[i.14] IEC 60 153-2 ed. 2.0 1974] (ref in 6.3.5) “Hollow metallic waveguides, Part 2: Relevant specifications for ordinary rectangular waveguides”, (Cut off frequency).

[i.15] 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.16] EUROCONTROL Specification for ATM Surveillance System Performance

* Volume 1 Edition: 1.1 Edition date: September 2015.
* Volume 2 Appendices Edition: 1.1 Edition date: September 2015.

# Definitions, symbols and abbreviations

## Definitions

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

**assigned frequency band:** frequency band within which the emission of a station is authorized; the width of the band equals the necessary bandwidth plus twice the absolute value of the frequency tolerance.

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

**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: This definition is taken from ITU Radio Regulation [1].

**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: This definition is taken from ITU Radio Regulation [1]).

NOTE 2: 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%

**peak envelope power:** 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 Regulation [1].

**pulse duration:** 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)

**transmit radar sensor:**  all the physical transmitter hardware (including embedded software) to the free space interface (i.e. physical hardware side of antenna to free space interface)

**receive radar sensor:** all the physical receiver hardware (including embedded software) from the free space interface to the physical receiver hardware (including embedded software) output.

Note: that is from the point of signal entering the radar (i.e. the antenna to free space interface) to one of the following:

1. Monosensor Plot output
2. Monosensor Track output
3. Monosensor Video output

**injection of interfering scenarios:** introduction of the interfering signal scenarios into the radar by either free space summation or by direct injection into the radar receiver chain at some point after the antenna

NOTE 1: The injection point may vary from radar to radar but it always include the signal transiting any hardware components that may contribute to signal performance degradation in the presence of interference signals as defined in Annex C

## Symbols

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

*B-40*-40 dB bandwidth

*BC* Chirp bandwidth

*BN* Necessary bandwidth

*Bres* 3 dB resolution bandwidth of transceiver

dB/dec dB per decade

*dBpp* dB with respect to peak power

*I/N* Interference to Noise ratio

*k*  Boltzmann's constant

*NFsys* Noise Figure of the system

*PD* Probability of detection

*PEP* Peak Envelope Power

*Pfa* Probability of false alarm

*Pt* Pulse power of transmission

*S/N* Signal to Noise ratio

*t* Time

*TC* Chirp length in sec

*tp* Pulse duration

*tr* Pulse rise time

*T0*  Temperature in Kelvin

*λ* Wavelength

## Abbreviations

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

AC Alternating Current

CW Continuous Wave

DPSK Differential Phase Shift Keying

EIRP Effective isotropically radiated power

ESASSP EUROCONTROL Specification for ATM Surveillance System Performance

EUT Equipment Under Test

FFM Far Field Monitor

FM-CW Frequency Modulated Continuous Wave

MHz Megahertz

ICAO International Civil Aviation Organization

IRS Interfering radio signal

ITU International Telecommunication Union

LNA Low Noise Amplifier

MDL Minimum Decode Level

MTL Minimum Triggering Level

OoB Out-of-Band

PEP Peak Envelope Power

ppm parts per million

RED Radio Equipment Directive

RF Radio Frequency

SNR Signal to Noise Ratio

PSR Primary Surveillance Radar

**SUGGESTED STRUCTURE OF THE DOCUMENT**

**4 Technical Requirement specifications**

***Here you specify all the technical requirement relevant to this HS***

**5 General conditions of measurement**

***Here you can specify everything you need for the measurements, including the test conditions, power sources, RF connections and what have you***

**6 Radio Tests**

***Here you specify, for each identified technical requirement, the radio test***

**7 Testing for compliance with technical requirement**

***Here you specify only the Maximum measurement uncertainty and you point to clause 5 for the “Environmental conditions for testing”***

# Technical requirements specifications

## 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 manufacturer, but as a minimum, shall be as specified in the test conditions contained in the present document.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.

## Conformance requirements

### Transmitter requirements

#### Frequency tolerance

##### Definition

The frequency tolerance is the difference between the measured carrier frequency and its nominal value.

##### Limit

For all radar types covered by the present document the measured B-40 bandwidth of the signal shall be contained completely within the frequency ranges 2 700 MHz to 3 100 MHz in all operating modes.

The maximum permissible absolute value of frequency deviation shall be of 1250 ppm as specified in Appendix 2 of the ITU Radio Regulations [1].

##### Conformance

The conformance tests are specified in clause 5.2.1.1.3

#### Out-Of-Band emissions

##### Definition

An important parameter to determine the Out-of-Band (OoB) emissions mask of the radar is the -40 dB bandwidth.

Annex 8 of Recommendation ITU‑R SM.1541‑6 [i.8] specifies the 40 dB bandwidth specified for various types of waveforms (e.g. pulsed radar signals).

With the following assumptions which apply to most Primary Surveillance Radars, these specifications can be further simplified:

* the radar is operating in the band 2 700 MHz to 3 100 MHz;
* the pulse rise time *tr* is greater than 0,0094∙*t*, where *t* is the pulse duration.

With the aforementioned assumptions the -40 dB bandwidth (*B-40*) for primary non-FM pulse radars is determined as follows:

 (1)

Where:

*t* is the pulse duration.

*tr* is the rise time in the case of a trapezoidal pulse.

NOTE: For non-FM pulse PSR radars, typical values of a pulse duration of *t* = 1µs and a rise time of *tr =* 200 ns the formula above yields a ‑40 dB bandwidth value of 17 MHz.

For pulse FM radar two formulas are specified in ITU‑R SM.1541‑6 [i.8] for the B-40 bandwidth:

(2)

Where:

B-40 is the -40 dB bandwidth in Hz;

BC is the bandwidth of the frequency deviation (total frequency shift during the pulse generation);

BS is the maximum range over which the carrier frequency will be shifted, BS equals zero for non-frequency

hopping cases. It is zero in case of a single carrier frequency;

τ is the pulse length including rise & fall times;

tr is the risetime in seconds;

tf is the falltime in seconds.

NOTE: For detailed definitions of parameters, refer to equations (40) to (43), in clause3.1 of ITU-R SM.1541-6 [i.8].

 (3)

Where K = 7.6 and A = 0,065

(2) is applicable if:

 and if 

In all other cases (3) is applicable.

According to ITU-R SM.1541-6 [i.8], annex 8, clause3.1, for FM-pulse radars with frequency hopping, the value of Bs needs to be added to the value of B-40 (equation (2) or equation (3)).

NOTE: For FM pulse PSR radars, typical values for a pulse duration of *t* = 100µs and a rise time of *tr =* 200 ns the formulas above yield a ‑40 dB bandwidth value of ≈ 10 MHz depending on the modulation bandwidth.

According to ITU-R SM.1541-6 [i.8], annex 8, clause5, for primary radar stations, the boundary between the Out of Band and Spurious domains is defined as at the frequency where the Out of Band domain emission limits defined herein are equal to the spurious limit defined in Table II of RR Appendix 3.

For radars with multiple pulse waveforms, the *B-40* bandwidth should be calculated for each individual pulse type and the maximum *B-40* bandwidth obtained shall be used to establish the shape of the emission mask.

For radars with multiple carriers, the OoB domain should start at the edges of the total assigned bandwidth. This

means that the effective B-40 is from the lower end of the calculated B-40 of the lowest radar frequency to the high end

of the B-40 for the highest radar frequency.

For radars with an asymmetrical spectrum , the B-40 dB bandwidth can be offset from the frequency of maximum emission level, but the necessary bandwidth, *B*N and preferably the overall occupied bandwidth should be contained completely within the allocated band as stipulated in section 4 of Annex 8 of Recommendation ITU‑R SM.1541‑6 [i.8].

The application of this rule is illustrated in figure 1.

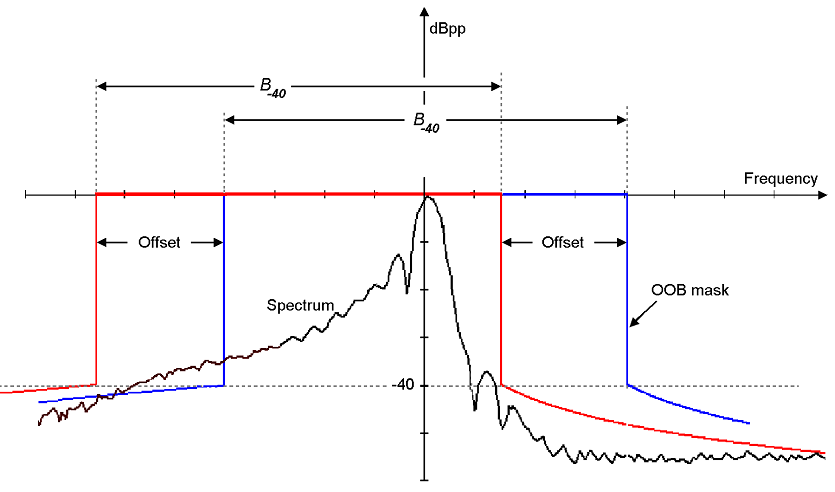


Figure 1: Application of the offset-rule for the Out-of-Band emission limit mask

##### Limits

The Out-of-Band emission limits are defined based on the -40 dB bandwidth (B-40). The Out of Band mask rolls off at 30 dB per decade, from the B-40 bandwidth to the level specified for spurious emissions.

For multi-frequency and active array radars spurious emission limits shall be 43+ 10log (PEP) or 60 dBpp (whichever is less stringent) as specified in Table 5.1 of ECC Recommendation 74-01 [2] and table 1 below.

NOTE: Frequency diversity is regarded as multi-frequency (i.e. multiple carriers).

For all other radar systems spurious emission limits shall be ‑30 dBm or 100 dBpp (whichever is less stringent) as specified in Table 5.1 of ECC Recommendation 74-01 [2] and table 2 below.

Table 1: Limits for OoB emissions for multiple frequency and active arrays

|  |  |  |
| --- | --- | --- |
| Frequency offset  relative to B-40 | Limit  dBpp | Slope  dB/decade |
| 0,5 to 2.3 | -40 to 43 + 10\*log(PEP) / -60 (see note 1) | -30 |
| NOTE1: from -40 to 43 + 10\*log(PEP) or -60 dBpp whichever is less stringent | | |

Table 2 - Limits for OoB emissions for all other radar systems

|  |  |  |
| --- | --- | --- |
| Frequency offset  relative to B-40 | Limit  dBpp | Slope  dB/decade |
| 0,5 to 5 | -40 to -70 | -30 |
| 5 to 15,8 | -70 to -100 / -30 dBm (See note 1) | -60 |
| NOTE 1: from -70 to -100 or -30 dBm whichever is less stringent | | |

The unwanted emission mask is shown in figure 2.



Figure 2: unwanted emission mask

##### Conformance

The conformance tests are specified in clause 5.3.1.3.

PLEASE NOTE ETSI [TS 103 052](http://www.etsi.org/deliver/etsi_ts/103000_103099/103052/01.01.01_60/ts_103052v010101p.pdf) for Radiated measurement methods and general arrangements for test sites. It is, for instance, referred to in the HS related to navigation radars for the test site for radiate demission measurements.

#### Spurious emissions

##### Definition

Spurious emissions are defined as the entity of all emissions in the frequency range of the cut‑off frequency 2,08 GHz of the waveguide section to 15.5 GHz, but outside the OoB-boundaries.

NOTE: The lower limit of this frequency range of 2.08 GHz is obtained as cut-off frequency of the combination of WR-284/R32 Waveguide as defined in IEC 60153-2 [i.14.]. The upper limit corresponds to the upper limit stated in ERC/Recommendation 74-01 [i.2] (5th harmonic).

They include:

* harmonic emissions (whole multiples of the operating frequency);
* parasitic emissions (independent, accidentally);
* intermodulation (between oscillator- and operation frequency or between oscillator and harmonics);
* emissions caused by frequency conversions.

The boundaries between OoB domain and the spurious domain are where the OoB limit mask specified in ECC/Recommendation (02)05 [3] reaches the spurious emission limit of -100 dBpp according to ERC/Recommendation 74‑01 [2]. This is illustrated in figure 3.



Figure 3: Definition of OoB and spurious emission domains  
(Not to scale)

##### Limits

For primary surveillance radar systems, the spurious emissions limits are related to the PEP. The limits shall be as specified in Table 3. These limits are taken from ERC/Recommendation 74-01 [2] Annex 5.

Table 3 - Limits for spurious emissions

|  |  |
| --- | --- |
| Radar type | Spurious emission limits |
| Multi-frequency and active array | 43 + 10\*log(PEP) or 60 dB (see note 1) |
| Other types of fixed stations | -100 dB or -30 dBm (see note 1) |
| NOTE 1: whichever is less stringent  NOTE 2: PEP is measured in Watts. | |

##### Conformance

The conformance tests are specified in clause 5.4.1.4.

### Receiver requirements

#### General

The Primary Surveillance Radar design may have one or more receivers fed from antenna elements such as receiver horn(s) (see Figure 2) or phased array receive antennas elements (see Figure 5).

The radar sensor receiver is defined as the receiving part of the radar sensor system that includes the ASTERIX outputs 1, 2 or 3 to the later processing or display system.

The radar sensor receiver itself may consist of smaller receiver elements (from two receivers up to the designed value greater than two) that when combined and the data processed, generates the final ASTERIX outputs (1, 2 and 3).

The design of ATC primary radar systems can be varied and the ability of the radar to operate in the presence of other signals is a function of the Radio Frequency performance and the digital processing algorithms applied in the radar and the characteristics of the other signals.

The method is based the measurement of designated radar parameters with and without the presence of a set of RF scenarios that comprehensively tests the performance of the radar receiver system.

The scenario consists of the simultaneous injection of test frequencies that exercise a range of receiver parameters as indicated below:

1. Receiver sensitivity
2. Receiver co-channel rejection
3. Adjacent channel selectivity
4. Adjacent band selectivity
5. Intermodulation susceptibility
6. Blocking
7. Dynamic range
8. Reciprocal mixing

The conformance in this EN includes a requirement is the ability to provide evidence of ‘a known and stated level of performance’ both with and without a series of test scenarios that will exercise the effects 1 to 8 above simultaneously.

The scenarios are designed to test various aspect of the radar system receiver design and combined with suitable metrics allow all the effects on the radar to be examined.

There are some metrics that ATC radar should meet which are in general the **radar related** ESASSP[[1]](#footnote-1) requirements that set performance parameters to be measured and met.

This then results in further radar related requirement (as previously indicated in publications such as the Primary Surveillance Radar requirement[[2]](#footnote-2) (SUR.ET1.ST01.1000-STD-01-01) such as probability of detection (Pd) and especially False Alarm Rate(FAR).

The final test for a radar is in the operation in real life with clutter which is a matter for the end customer environment and contractual terms, however this EN focuses on the transmitter and receiver aspects, independent of ‘specific real life’ RF environmental factors (unless appropriate for measurement environment adopted).

The ESASSP requirements are broader than pure radar requirements but the parameters identified as those suitable for ATC radar assessment are as follows:

1. EUROCONTROL SPECIFICATION FOR ATM SURVEILLANCE SYSTEM PERFORMANCE (VOLUME 1). MARCH 2012. EUROCONTROL-SPEC-0147. ISBN 978-2-87497-022-1.
2. EUROCONTROL Specification for ATM Surveillance System Performance (Volume 2 Appendices) Edition Number : 1.1 Date : 02/09/2015

In addition the following provides specific radar performance requirements:

* Eurocontrol Standard Document for Radar Surveillance in En-Route Airspace and Major Terminal Areas SUR.ET1.ST01.1000-STD-01-01 Edition : 1.0 Date : March 1997

To test the acceptability of the radar receiver (i.e. the immunity to RF interference) then there may be two general approaches:

1. The injection of interfering scenarios and by RF /IF measurement (e.g. S/N) combined with technical analysis to produce an evidence based compliance with requirements based on the immunity to the scenarios
2. The injection of interfering scenarios and simulated targets and assessing the radar performance in the presence of the interference via plot and track analysis

Wideband Gaussian noise is used to allow a consistent interfering signal statistic to be defined.

The scenarios shall be as diagrammatically represented in **Annex C (normative): Definition of receiver test measurement scenarios.**

Scenario 1 (Figure 6) is the adjacent band scenario where two blocks of Gaussian interferers are defined as occupying two frequency bands with set power levels at the antenna face. The interference is both below and above the radar band under consideration.

The polarisation of the free space summation shall be assumed to be co-linear with the radar polarisation if the radar operates in a linear polarisation and it should be arbitrary polarisation if the radar is required to operate in circular polarisation at all times in operational use.

As the interfering signal is to be injected after the antenna but before the first component of significance (typically the LNA), then justification and equivalence of the injected signal to the specified free space signal level shall be justified.

#### Receiver sensitivity

##### Definition

This sensitivity refers to the ability to detect wanted signals against unwanted signals noises in the radar bandwidth.

Receiver sensitivity may vary however the requirement is based upon the need for the SUR.ET1.ST01.1000-STD-01-01 requirements[[3]](#footnote-3) to be met with the presence of other interfering sources (in-band or out of band).

##### Limits

Figures 7 and Figure 8 provide the scenarios for noise in the radar band in and not in the radar bandwidth (necessary band width)

Wideband Gaussian noise of two instantaneous bandwidths;

1. 10MHz BW swept from ARF(1) to ARF(2) and
2. 200MHz (x2) instantaneous bandwidth ARF(1) to ARF(2) in two blocks

to be considered, the value (c) is approximately -130 dBm/MHz/m2

##### Conformance

The conformance tests are specified in clause X4.

#### Receiver dynamic range

##### Definition

##### Limits

The receiver dynamic range above the sensitivity level shall be sufficient to operate over the minimum to maximum range requirement for the specified interference signal. This dynamic range shall be measured for all radar

The conformance tests are specified in clause X4, X5 and X6

#### Receiver bandwidth

##### Definition

The receiver bandwidth is the difference between the upper and lower cut-off frequencies sufficient for the PSR receiver to meet the sensitivity requirements and to accommodate the frequency tolerance of the transmitter.

##### Limits

The PSR shall incorporate a receiver (or receivers) with a bandwidth, contained within the frequency band 2.7 MHz to 3.1 GHz that is sufficient to meet the sensitivity requirements and accommodates the frequency tolerance of the transmitter

##### Conformance

The conformance tests are specified in clause X4

#### Receiver selectivity

##### Definition

The receiver selectivity defines the capability of the receiver to detect and decode desired signal in the presence of other

unwanted interfering signals.

##### Limits

The following requirement shall apply to a PSR Conformance

##### Conformance

The conformance tests are specified in clause X4, X5 and X6.

#### Receiver unwanted emissions in the spurious domain

##### Definition

The receiver may be active during the interval between transmission periods in the case of ‘monostatic transmit / receive operation and during any operation shall meet the limits

##### Limits

Below are the unwanted emission limits as defined in 74/01 and 02/05.

##### Conformance

The conformance tests are specified in clause X7.

# Testing for compliance with technical requirements

## General conditions for testing

For the purpose of the compliance tests described in the present document, the radar under test shall be set up in a realistic operation mode. This means that the transceiver shall be operating and set-up with parameters which produce the worst-case spectrum (e.g. shortest pulse length, highest peak frequency deviation). Furthermore, the radar has to be supplied with the necessary signals (e.g. antenna azimuth encoder signal, safety loop signals) to simulate normal operation. In the test report the mode of operation applied for the tests shall be documented.

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

## Environmental conditions for testing

### Test Conditions

Tests defined in the present document shall be carried out at representative points within the boundary limits of the declared operational environmental profile which, as a minimum, shall be that specified in the test conditions contained in the present document (see clause 5.2.2 and 5.2.3).

As technical performance varies subject to environmental conditions, tests shall be carried out under a sufficient variety of environmental conditions as specified in the present document to give confidence of compliance for the affected technical requirements.

### Normal temperature and humidity

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

1. temperature: +15 oC to +35 oC;
2. relative humidity: 20 % to 75 %.

Actual values shall be stated in the test report.

### Normal test power supply

The test voltage for equipment to be connected to an AC supply shall be the nominal mains voltage declared by the manufacturer -10 % to +10 %. For the purpose of the present document, the nominal voltage shall be the declared voltage or each of the declared voltages for which the equipment is indicated as having been designed. The frequency of the test voltage shall be 50 Hz ± 1 Hz.

## Interpretation of the measurement results

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

* the measured value related to the corresponding limit will be used to decide whether an equipment meets the requirements of the present document;
* the value of the measurement uncertainty for the measurement of each parameter shall be included in the test report;
* the recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures in Table 3.

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 characterising the actual measurement uncertainties are normal (Gaussian)). Principles for the calculation of measurement uncertainty are contained in TR 100 028 [i.11], in particular in annex D of the TR 100 028-2 [i.12].

Table 3 is based on such expansion factors.

Table 3: Maximum measurement uncertainty

|  |  |
| --- | --- |
| Parameter | Uncertainty |
| Transmitter measurements | |
| frequency tolerance | ±1∙10-7 |
| Transmitter power | ±0.75 dB |
| Out-of-Band emissions | ± 4 dB |
| Spurious emissions | ± 4 dB |
| **Receiver measurements** | |
| Receiver Selectivity | ± 4 dB |

## Radio Test suites

### Transmission test measurements

#### Frequency tolerance

Set up transmitter port measurement.

[Set radar to lowest frequency, measure: set radar to middle frequency, measure: set radar to highest frequency, measured with Spectrum analyser with resolution of ± 1 KHz, calibrated accuracy of ± 1 KHz]

Set radar to lowest frequency measure frequency with spectrum analyser with resolution of greater than the maximum frequency error. Measure frequency

Set radar to highest frequency measure frequency with spectrum analyser with resolution of greater than the maximum frequency error. Measure frequency

Set radar to lowest frequency measure frequency with spectrum analyser with resolution of greater than the maximum frequency error. Measure frequency, calculate error.

Set radar to highest frequency measure frequency with spectrum analyser with resolution of greater than the maximum frequency error. Measure frequency, calculate error.

#### Transmitter power

Measure RF losses via signal injection from transmitter output port to antenna input [ref. 1177 contains measurement technique]

Set up transmitter port measurement.

Set radar to lowest frequency, measure: measure peak power with spectrum analyser with resolution of greater than the *B-40* bandwidth MHz.

set radar to highest frequency, measure: measure peak power with spectrum analyser with resolution of greater than the *B-40* bandwidth MHz.

#### Out-of-Band-emissions This is 1177 or a SA + Filter (notch) calibrated

The so-called indirect method as described in ITU‑R Recommendation M.1177-4 clause xxx shall be applied for the measurement of unwanted emissions of radar systems.

At first the transmitter output spectrum is measured with removed antenna at the output port of the transmitter as illustrated in Figure B.1.

NOTE 1: To obtain a sufficient dynamic range the radar signal needs to be suppressed by an additional notch-filter.

For multi-frequency and active array radars the Out-of-Band power emission shall be measured in the frequency bands given in table 6.

For all other radar systems the Out-of-Band power emission shall be measured in the frequency bands given in table 7.

The results obtained shall be compared to the limits in clause 4.2.1.2.2 and depicted in Figure 4in order to prove compliance with the requirement.

Table 6: Out-of-Band emissions boundaries for multiple frequency and active arrays

|  |  |
| --- | --- |
| Lower OoB boundary | Upper OoB boundary |
| Carrier frequency -2,3 *B-40* | Carrier frequency + 2,3 *B-40* |
| NOTE 1: the values are taken from ECC Recommendation (02)05  NOTE 2: measurements below the waveguide cut-off frequency are not necessary | |

Table 7: Out-of-Band emissions boundaries for all other radar systems

|  |  |
| --- | --- |
| Lower OoB boundary | Upper OoB boundary |
| Carrier frequency -15,8 *B-40* | Carrier frequency + 15,8 *B-40* |
| NOTE 1: the values are taken from ECC Recommendation (02)05  NOTE 2: measurements below the waveguide cut-off frequency are not necessary | |

#### Spurious emissions This is 1177 or a SA + Filter (notch) calibrated

The so-called indirect method as described in ITU‑R Recommendation M.1177-4 clause xxx shall be applied for the measurement of unwanted emissions of radar systems.

To perform the measurement the radar and the measuring equipment shall be installed as displayed in Figure B.1.

The spurious power emission shall be measured in frequency ranges outside the Out-of-Band emissions boundaries.

If required to reach a dynamic amplitude measuring range of 110 dB minimum, a Low Noise Amplifier (LNA), and a notch filter for the operating frequency should be used.

The results obtained shall be compared to the limits in clause XXX in order to prove compliance with the requirement.

Table : Spurious emissions measurement bands (S-band radar)

|  |  |
| --- | --- |
| Lower measurement band | Upper measurement band |
| From 2.08 GHz  to the lower OoB boundary | From the upper OoB boundary  to 15,5 GHz |
| NOTE 1: the lower limit correspond to the cut-off frequency of the waveguide  NOTE 2: the upper limit is taken from ECC Recommendation (74) 01 with transmitter frequency set to 3,1 GHz | |

### Receiver test measurements

#### General

See Annex C at the moment

#### Receiver sensitivity

##### By scenario measurementsReceiver dynamic range

##### By scenario measurementsBandwidth

According to spectrum analyser

#### Receiver selectivity

By scenario measurements

#### Receiver immunity to interference

As per scenarios measurement

#### Receiver unwanted emissions in the spurious domain

As per Transmitter unwanted emissions

# Annex A (informative): Relationship between the present document and the essential requirements of Directive 2014/53/EU

The present document has been prepared by ETSI in response to mandate M/xxx from the European Commission to provide a means of conforming to the essential requirements of 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 radio Equipment Directive.

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.

NOTE 1: General guidance for RF measurements can be found in ETSI TS 103 052 (V1.1.1) (03-2011): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Radiated measurement methods and general arrangements for test sites up to 100 GHz".

| Harmonised Standard ETSI EN 303 364  The following requirements are relevant to the presumption of conformity under the article 3.2 of Directive 2014/53/EU | | | | |
| --- | --- | --- | --- | --- |
| Requirement | | | Requirement Conditionality | |
| No | Description | Reference: Clause No | U/C | Condition |
| 1 | Transmitter power limits | **Fehler! Verweisquelle konnte nicht gefunden werden.** |  | The power will be set by the national regulatory body so there should be no ETSI limitation |
| 2 | Transmitter power accuracy | **Fehler! Verweisquelle konnte nicht gefunden werden.** |  | For national licencing body there is a need to have an accurate knowledge of transmitter power (± dB) |
| 3 | Spectrum mask | 4.2.1.2 |  | Towith regards to ITU, CEPT, spectrum needs mask as in xxxx |
| 4 | Transmitter frequency stability | **Fehler! Verweisquelle konnte nicht gefunden werden.** |  | Stability will be set to a standard ±1250 ppm |
| 5 | Transmitter intermodulation attenuation | **Fehler! Verweisquelle konnte nicht gefunden werden.** |  | Not applicable |
| 6 | Transmitter unwanted emissions in the spurious domain | **Fehler! Verweisquelle konnte nicht gefunden werden.** |  | To meetwith regards to ITU, CEPT, spectrum needs mask as in xxxx |
| 7 | Unwanted emissions | **Fehler! Verweisquelle konnte nicht gefunden werden.** |  | To meetwith regards to ITU, CEPT, spectrum needs mask as in xxxx |
| 8 | Unwanted emissions in the out of band domain | **Fehler! Verweisquelle konnte nicht gefunden werden.** |  | To meetwith regards to ITU, CEPT, spectrum needs mask as in xxxx |
| 9 | Unwanted emissions in the spurious domain | **Fehler! Verweisquelle konnte nicht gefunden werden.** |  | To meetwith regards to ITU, CEPT, spectrum needs mask as in xxxx |
| 10 | Transmitter time domain characteristics | [insert cross ref] |  | Not Required except as a stated modulation definition |
| 11 | Transmitter transients | [insert cross ref] |  | N/A (rise and fall time) |
| 14 | Receiver sensitivity | [insert cross ref] |  | Establishes the level of noise in the radar operational channel that the radar can still operate with (i.e. in the radar final bandwidth (can be measurement but no specific standard) |
| 15 | Receiver co-channel rejection | [insert cross ref] |  | Establishes the level of noise in the radar operational channel that the radar can still operate with (can be measurement but no specific standard) |
| 16 | Receiver Selectivity | [insert cross ref] |  | Establishes the selectivity against a set of defined wide band signals (scenarios 1,2,3) |
| 18 | Single signal selectivity | [insert cross ref] |  | Incorporated in 16 |
| 19 | Receiver adjacent signal selectivity (adjacent channel selectivity) | [insert cross ref] |  | Establishes the selectivity against a set of defined wide band signals (scenarios 1,2,3) |
| 20 | Receiver spurious response rejection | [insert cross ref] |  | Establishes the level of noise in the radar operational channel that the radar can still operate with (N/A) |
| 21 | Receiver multiple signal selectivity | [insert cross ref] |  | Establishes the selectivity against a set of defined wide band signals (scenarios 1,2,3) |
| 22 | Receiver blocking | [insert cross ref] |  | 1. Establishes the level of noise in the radar operational channel that the radar can still operate with (scenario 3) 2. Scenario 1 |
| 23 | Receiver radio-frequency intermodulation | [insert cross ref] |  | Establishes the selectivity against a set of defined wide band signals (scenarios 1,2,3) |
| 24 | Receiver adjacent signal selectivity (adjacent in radar band channel selectivity) | [insert cross ref] |  | Establishes the selectivity against a set of defined wide band signals (scenario 3) |
| 25 | Other receiver effects | [insert cross ref] |  | Establishes the selectivity against a set of defined wide band signals (scenarios 1,2,3) |
| 26 | Receiver dynamic range | [insert cross ref] |  | Establishes the selectivity against a set of defined wide band signals (scenarios 1,2,3) |
| 27 | Reciprocal mixing | [insert cross ref] |  | Establishes the selectivity against a set of defined wide band signals (scenarios 1,2,3) |
| 28 | Desensitization | [insert cross ref] |  | ??? Do we want a range where desensitization is ‘linear and a level where the desensitization is non-linear (compression point???) less than the value which still meets the OR |
| 29 | Receiver unwanted emissions in the spurious domain | [insert cross ref] |  | Defined in as per 5.3.1.5 \*Tx version). |
| 30 | Protocol elements, interference mitigation techniques and type of modulation | [insert cross ref] |  | Removed as not applicable to ATC Primary radar |
| 31 | General | [insert cross ref] |  | Removed as not applicable to ATC Primary radar |
| 32 | Transmitter Power Control (TPC) | [insert cross ref] |  | Removed as not applicable to ATC Primary radar |
| 33 | Listen Before Talk (LBT) | [insert cross ref] |  | Removed as not applicable to ATC Primary radar |
| 34 | Equipment operating under the control of a network | [insert cross ref] |  | The compliance to the EN parameters is independent of the radar control. I.e. any remote control has suitable restrictive processes to ensure safe operation |

**Key to columns:**

**Requirement:**

**No** A unique identifier for one row of the table which may be used to identify a requirement.

**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 shall 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".

Presumption of conformity stays valid only as long as a reference to the present document is maintained in the list published in the Official Journal of the European Union. Users of the present document should consult frequently the latest list published in the Official Journal of the European Union.

Other Union legislation may be applicable to the product(s) falling within the scope of the present document.

Table A.1: Correspondence between the present document and Article 3.2 of Directive 2014/53/EU

|  |  |  |
| --- | --- | --- |
| Essential Requirements of Directive | Clause(s)/sub-clause(s) of the present document | Test specification |
| Article 3.2 | Operating frequency | 5.3.1.1 |
| Transmitter power | Transmit coupler Calibrated Spectrum Analyser ± 1KHz |
| Out-of-Band emissions | In band filter Transmit coupler Calibrated Spectrum Analyser accuracy as per table xxx |
| Spurious emissions | In band filter Transmit coupler Calibrated Spectrum Analyser accuracy as per table xxx |
| 4.2.2.1 Receiver Selectivity | As per |

Alternative table....

| Requirement | | | Measurement Method | Limits |
| --- | --- | --- | --- | --- |
| No | Description | Reference: Clause No | Reference:  Clause No | Reference:  Clause No |
| 1 | Operating frequency | 4.2.1.1 | 5.3.1.1 | 4.2.1.1.2 |
| 2 | Transmitter power | 4.2.1.2 | 0 | 4.2.1.2.2 |
| 3 | Out-of-Band emissions | 4.2.1.3 | 0 | 4.2.1.3.2 |
| 4 | Spurious emissions | 4.2.1.4 | 5.2.1.5 | 4.2.1.4.2 |
| 5 | Receiver Selectivity | 4.2.2.1 | **Fehler! Verweisquelle konnte nicht gefunden werden.** | 4.2.2.1.1 |

# Annex B (normative): Transmission power and unwanted emissions of radar systems with indirect methods



Figure 1: Indirect method for radio frequency measurements with dismounted antenna

The method for measurement of the operation frequency, transmit power as well as out‑of-band and spurious emission shown in Figure B.1 shall be applied.

This is a requirement for repeatable measurement technique for the appropriate radar technology… to be filled in by supplier.

# Annex C (normative): Definition of receiver test measurement scenario

### Method 1

Figure 2 shows the version of test scenario generation where external interference signal and external target RF generation is use. There are two continuous (in frequency and time) stationary interference signals generated [S1] and [S2]. In addition a simulated radar target is generated.

The mean signal strength for both [S1] and [S2] at [A] is 5 dBm when integrated across the particular band.

The method to establish this is by direct field strength measurement or by measurement at [B] where the transition to the radar system has been achieved by antenna and feed structures.

The lower beam [L] shall use the maximum lower beam gain [Ga(1)] to establish the signal in the radar in the lower beam channel

The upper beam [H] shall use the maximum upper beam gain to establish the signal in the radar [Ga(2)].

If there are other receive beams they should be analysed is the same manner.

Each beam (either conventional or selected digitally beam formed beams) can be assessed individually

The simulated target signal [S3] should be set at a level that allows any loss in radar sensitivity to be determined (usually by setting Pd to be in the region 0.6 to 0.9 at the stated operating range of the radar and the target can be ‘flown in to closure ranges).

The measurement may be absolute performance or showing insignificant change from ‘no interference’ to ‘interference conditions’

The receiver chain shall be assessed as per below (number to be clarified on reformatting)

|  |
| --- |
|  |
| Figure 2. Free space test scenarios and free space test target generation block diagram for conventional rotation PSR (two receive beams shown) |

### Method 2

Figure 3 shows the version of test scenario generation where external interference signal is generated and internal target RF generation is use.

|  |
| --- |
|  |
| Figure 3. Free space interference scenarios and internal injected target generation diagram for conventional rotating PSR |

There are two continuous (in frequency and time) interference signals generated [S1] and [S2]. In addition a simulated radar target is generated.

The mean signal strength for both [S1] and [S2] at [A] is 5 dBm when integrated across each band.

The method to establish this is by direct field strength measurement or by measurement at [B] where the transition to the radar system has been achieved by antenna and feed structures.

The lower beam [L] shall use the maximum gain [Ga(1)] to establish the signal in the radar in the lower beam channel

The upper beam [H] shall use the horizontal gain to establish the signal in the radar [Ga(2)].

The simulated target signal [S3] shall be generated by a radar target generation by sampling the radar waveform and be capable of generating simulated target with range rate and Doppler characteristics that are appropriate for the PSR under test to be able to detect the target

The effective RCS should be set at a level that allows any loss in radar sensitivity to be determined (usually by setting Pd to be in the region 0.6 to 0.9). at the stated operating range of the radar and the target can be ‘flown in to closure ranges).

The measurement may be absolute performance or showing insignificant change from ‘no interference’ to ‘interference conditions’

Each beam (either conventional or selected digitally beam formed beams) can be assessed individually

The RF losses from [B] to [F] should be accounted for especially the additional loss due to the coupler [C] to [E] (including connector losses).

### Method 3

**Fehler! Verweisquelle konnte nicht gefunden werden.** shows the version of test scenario generation where internal interference signal is generated and internal target RF generation is use.

|  |
| --- |
|  |
| Figure 4. Injected Test signal and target generation diagram for conventional rotating PSR |

There are two continuous (in frequency and time) stationary interference signals generated [S1] and [S2]. In addition a simulated radar target is generated.

The mean signal strength for both [S1] and [S2] at [D] is the value equivalent to 5 dBm when integrated across each band as would be measured at [B].

The method to establish this is by direct field strength measurement or by measurement at [B] where the transition to the radar system has been achieved by antenna and feed structures.

The lower beam [L] shall use the maximum gain [Ga(1)] to establish the signal in the radar in the lower beam channel

The upper beam [H] shall use the Horizon/maximum gain [Ga(2)] to establish the signal in the radar.

The simulated target signal [S3] shall be generated by a radar target generation by sampling the radar waveform and be capable of generating simulated target with range rate and Doppler characteristics that are appropriate for the PSR under test to be able to detect the target

The effective RCS should be set at a level that allows any loss in radar sensitivity to be easily determined (usually by setting Pd to be in the region 0.6 to 0.9) at the stated operating range of the radar and the target can be ‘flown in to closure ranges). The FAR should be set to meet the requirements without interfering signals.

The measurement may be absolute performance or showing insignificant change from ‘no interference’ to ‘interference conditions’

The RF losses from [B] to [F] should be accounted for especially the additional loss due to the coupler [C] to [E] (including connector losses).

The signal levels [S1] and [S2] should use the following method to establish the [S1] and [S2] mean levels.

Use the nominal gains of the lower and upper beams to establish an antenna effective area ‘Aeff’ for both the lower [Aeff(1)] and upper beams [Aeff (2)] using Equation 1. The gain used shall be the maximum gain of the particular antenna beam (L or H or other if more than two beams)

…… Equation 1

This allows the interference to be calculated at [B].

The losses shall be applied so the signal levels are reduced by the losses from [B] to [F].

Receiver chain assessment (note: should be C.4)

There shall be an assessment of the critical elements of the receiver chain and any element that can cause S/N loss shall be included in any measurement (Plot or track).

### Method 4

Phased Array measurement

|  |
| --- |
|  |
| Figure 4. Phased array diagram for target insertion and processing points |

### Measurement type 1

The first type of measurement can be a RF / IF, measurement at [G] (this point must be justified by the manufacturer[[4]](#footnote-4)) where the criteria shall be that any increase in noise, i.e. loss in signal to noise is sufficiently low in the presence of the interfering scenarios, 1,2,3 such that the declared operational performance (by the manufacturer) would be maintained. There could be a loss in performance but this would have to translate into the declared operational performance still being met. THIS IS NOT AGREED - FOR DISCUSSION. ULTIMATELY THIS MAY DISAPPEAR

### Measurement type 2

A second type of measurement can be at [] (this point must be justified by the manufacturer ) where the criteria shall be that any increase in false plots [I] is within the declared false plot performance of the radar and the simulated target probability of detection is maintained to be consistent with the declared Pd detection performance specification, i.e. the radar maintains its’ declared Pd and Pfa performance in in the presence of the interfering and target scenarios, 1,2,3 such that the declared operational performance (by the manufacturer) would be maintained. There could be a loss in performance but this would have to translate into the declared operational performance still being met.

### Measurement type 3

A third type of measurement can be at [J] (this point must be justified by the manufacturer ) where the criteria shall be that any increase in false [J] tracks is within the declared false track performance of the radar and the simulated target probability of detection is maintained to be consistent with the declared track initiation and track continuity specification, i.e. the radar maintains it operational performance in in the presence of the interfering and target scenarios, 1,2,3 such that the declared operational performance (by the manufacturer) would be maintained. There could be a loss in performance but this would have to translate into the declared operational performance still being met.

Coupler specification insertion

|  |
| --- |
|  |
| Figure 5. Injected test scenarios and injected target generation diagram for phased array receive antenna |

|  |
| --- |
|  |
| Figure 6. Possible external interference signal scenario generation |

|  |
| --- |
|  |
| Figure 7. Scenario 1 - Adjacent band test signals (i.e. interference out of allocated radar band) |







|  |  |  |
| --- | --- | --- |
| **Parameter** | **Scenario** | **Characturistics** |
| (a) | 1 | The signal in (a) shall be based on a field strength and a statistical signal type. Gaussian voltage assumption  IntF(1) = 2.57 GHz  IntF(2) = 2.69 GHz  Total Field Strength at [A] (integrated power (mean) over entire band (2.570 GHz to 2.69 GHz) = 5 dBm/m2  Amplitude statistics = I,Q Gaussian |
| (b) | 1 | The signal in (b) shall be based on a field strength and a statistical signal type.  IntF(3) = 3.41 GHz  IntF(4) = 3.6 GHz  Total Field Strength at [A] (integrated power (mean) over entire band (3.41 GHz to 3.6 GHz)) = 5 dBm/m2  Amplitude statistics = I,Q Gaussian |
| (c) | 1 | The signal in (c) shall be based on a field strength and a statistical signal type  ARF(1) = 2.7 GHz  ARF(2) = 3.1 GHz  Field Strength equivelent power at [A] = -130 dBm/MHz/m2 at appropriate frequencies across 400 MHz band (2.7 GHz to 3.1 GHz)  Amplitude statistics = I,Q Gaussian |
| Table 5: All scenario –Field strength equivelent power at [A] definitions of all values TBD | | |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **2570 – 2690 MHz Interfering signal** | **2700 - 2900** **MHz Interfering signal** | **3410 - 3600** **Interfering signal** |
| **Variable (a)** | **Variable (c), (d) and (e)** | **Variable (b)** |
| **Power flux density threshold for Signals in the 2570-2690 MHz band (dBm/m2) [1,2,3]** | **Noise spectral power flux density threshold at 2720 MHz to 3100 MHz (dBm/MHz/m2) [1,2]** | **Power flux density threshold for Signals in the 3410-3600 MHz band  (dBm/m2) [1,2,3]** |
| Interference Scenarios | 5 | -131 | 5 |
|  |  |  |  |
| Note **[1]**: The protection thresholds are defined at the peak of the radar beam.  Note **[2]**: The protection thresholds are defined during the ‘on’ period of the transmit signal.  Note **[3]**: the value is for the full band transmission signal | | | |
| Table 6: Scenario - parameters (a), (b), (c), (d) and (e) (TBA) | | | |

# Annex D (normative): Definition of test measurement methodologies

### D1. Transmitter Function

See individual clauses

### D2. Receiver Function

The test methodology will be based on the use of the test scenarios 1, 2 and 3 with signal levels defined in dBm/MHz/m2 or dBm/m2 for all the interference scenario signals at the antenna.

The method of injection may be by free space summation before the antenna [A] or the injection of the signal behind the antenna point [C / D] but before the critical components and calculated by measured RF losses in the radar and assuming the horizontal gain of the antenna to derive the effective aperture ( radar measurements and a technical file shall justify the values used.

Polarisation shall be taken into account by assuming any incident signal on the radar will be assumed co-linear in the case of linear polarised radar and arbitrary when circular polarisation is used.

# Annex E (informative): Bibliography

|  |  |
| --- | --- |
| Draft new Recommendation ITU-R P.[BLM] | ‘Method for point-to-area predictions for terrestrial services in the frequency range 30 to 3 000 MHz’ (Doc. 3/BL/26) |
| Rec. ITU-R P. 452-10 | ‘Prediction procedure for the evaluation of microwave interference between stations on the surface of the Earth at frequencies above 0.7 GHz |
| SE 21 ECC Report 174 | Compatibility between the mobile service in the band 2500-2690 MHz and the radiodetermination service in the band 2700-2900 MHz March 2012 |
| ~~CEPT ERC Rec. 74-01~~ | ~~CEPT ERC Rec. 74-01~~ |
| ITU-R SM.1539 | Variation of the boundary between the out-of-band and spurious domains required for the application of Recommendations ITU-R SM.1541 and ITU-R SM.329 |
| ITU-R M.1460 | Technical and operational characteristics and protection criteria of radiodetermination and meteorological radars in the 2900 – 3100 MHz band |
| Rec. ITU-R M.1461 | ‘Procedures for determining the potential for interference between radars operating in the Radiodetermination Service and systems in other Services’ |
| ITU-R M.1463 | Characteristics and protection criteria for radars operating in the radiodetermination service in the frequency band 1215 – 1400 MHz |
| ITU-R M.1464 | ‘Characteristics of and protection criteria for radionavigation and meteorological radars operating in the frequency band 2700-2900 MHz’ |
| ITU-R M.1465 | Characteristics and protection criteria for radars operating in the radiodetermination service in the frequency band 3100 – 3700 MHz |
| ETSI EG 201 399 | "Electromagnetic compatibility and Radio spectrum Matters (ERM); A guide to the production of candidate Harmonized Standards for application under the RE Directive". |
| CISPR 16-1-1:2015 | "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus". |
| Table 7: Bibliography | |

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# History

|  |  |  |
| --- | --- | --- |
| **Document history** | | |
| V1.1.1 | December 2015 | Public Enquiry PE XXXX: yyyy-mm-dd to yyyy-mm-dd |
| V1.1.1 |  | Vote V XXXX: yyyy-mm-dd to yyyy-mm-dd |
| V1.1.1 |  | Publication |
| V1.2.1 |  | EN Approval Procedure AP XXXX: yyyy-mm-dd to yyyy-mm-dd |
| V1.3.1 |  | Pre-Processing done before TB approval e-mail: <mailto:edithelp@etsi.org> |
| V1.3.2 |  | Clean-up done by ***editHelp!*** e-mail: <mailto:edithelp@etsi.org> |

1. **Radar related** ESASSP requirement can be Pd for sure and then track range and angular accuracy. The false alarm rate (against Gaussian interference) should be as determined in the Non-cooperative Surveillance requirements false alarm rate in the following document [↑](#footnote-ref-1)
2. Eurocontrol Standard Document for Radar Surveillance in En-Route and Major Terminal Areas SUR.ET1.ST01.1000-STD-01-01 Edition : 1.0 Date: March 1997 [↑](#footnote-ref-2)
3. [↑](#footnote-ref-3)
4. The technical file must show there will be no further degradation in radar performance caused by subsequent processing [G] to [I] to [J] [↑](#footnote-ref-4)