
Nadzor zračnega prometa - Sistemi za širokopasovno multilateracijo (WAM), ki delujejo v območju 1030 MHz in 1090 MHz - Harmonizirani standard za dostop do radijskega spektra

Air Traffic Control Surveillance - Wide Area Multilateration (WAM) systems operating at 1 030 MHz and 1 090 MHz - Harmonised Standard for access to radio spectrum

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**Air Traffic Control Surveillance;
Wide Area Multilateration (WAM) systems operating
at 1 030 MHz and 1 090 MHz;
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.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.

National transposition dates	
Date of adoption of this EN:	20 January 2026
Date of latest announcement of this EN (doa):	30 April 2026
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 October 2026
Date of withdrawal of any conflicting National Standard (dow):	31 October 2027

Modal verbs terminology

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Introduction

Wide Area Multilateration (WAM) Systems provide cooperative surveillance service for all types of airspace covering 1 030 MHz / 1 090 MHz transponder equipped aircraft in flight. WAM systems typically extend over a larger region with multiple ground stations that are equipped with a receive function, an interrogation function, or both. A central processor coordinates and schedules interrogation activity and performs position calculation. WAM systems provide their RF interface via non-rotating omni-directional or sectorial antennas. Multiple transmitters are simultaneously operated both for redundancy and to cover disjunctive parts of the designated coverage volume. Interrogations serve to perform range measurements supporting position calculation as well as for soliciting the downlink of aircraft derived data.

An additional function is used for built-in end-to-end integrity testing of the WAM system. This test transmission function provides 1 090 MHz Mode S signals at regular intervals for the WAM receivers to receive and process.

The test transmission function may also be used to establish a precise common time base throughout the entire WAM system, in a similar way as this is done for airport Multilateration systems (MLAT). This function is then referred to as "reference transmission".

The 1 090 MHz test/reference transmission function may be integrated with the interrogation function, i.e. as a 1 030/1 090 MHz transmit function in some ground stations or implemented as a separate test transmitter or transponder. As the WAM system elements (ground stations) can be distributed across a larger region, there can be multiple test transmission sources distributed throughout the system.

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1 Scope

The present document specifies technical characteristics and methods of measurements for the following equipment used in ground-based ATC Surveillance for civil air navigation:

- Wide Area Multilateration (WAM) systems with Mode S capabilities which may include Mode A/C, transmitting at 1 030 MHz and at 1 090 MHz, and receiving at 1 090 MHz, used for air traffic control with or without 1 090 MHz phase overlay.

The system operates in the frequencies as indicated in Table 1 below.

Table 1: WAM service frequencies

Signals	Service frequencies
Interrogation Transmission	1 030 MHz
Reference/Test Transmission	1 090 MHz
Receive	1 090 MHz

Antennas for this equipment are passive.

Remote Field Monitors (RFM) as described in ETSI EN 303 363-2 [i.6] as well as Vehicle transmitters as described in ETSI EN 303 213-5-2 [i.7] are not covered in the present document.

NOTE: 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.

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

- [1] [ICAO Annex 10, Volume IV](#): "Aeronautical Telecommunications - Surveillance Radar and Collision Avoidance Systems", 5th edition, July 2014, including amendments up to amendment 91.
- [2] [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 weatherprotected locations". .
- [3] [ETSI EN 300 019-1-4 \(V2.2.1\) \(04-2014\)](#): "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-4: Classification of environmental conditions; Stationary use at non-weatherprotected locations".

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- [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] [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] ETSI EG 203 336 (V1.2.1) (05-2020): "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.4] [ERC/Recommendation 74-01 \(May 2022\)](#): "Unwanted emissions in the spurious domain".
- [i.5] ITU-R Radio Regulations (2024).
- [i.6] ETSI EN 303 363-2 (V1.1.1) (10-2023): "Air Traffic Control Surveillance Radar Sensors; Secondary Surveillance Radar (SSR); Harmonised Standard for access to radio spectrum; Part 2: Far Field Monitor (FFM)".
- [i.7] ETSI EN 303 213-5-2 (V1.1.1) (04-2022): "Advanced Surface Movement Guidance and Control System (A-SMGCS); Part 5: Harmonised Standard for access to radio spectrum for Multilateration (MLAT) equipment; Sub-part 2: Reference and Vehicle Transmitters".
- [i.8] EUROCAE ED-102B (2020) + Change 1 (2022): "MOPS for 1090 MHz Extended Squitter ADS-B and TIS-B".
- [i.9] EUROCAE ED-142 (2010): "Technical Specification for Wide Area Multilateration (WAM) Systems".

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

conducted measurements: measurements which are made using a wired connection to the EUT

duty cycle: ratio, expressed as a percentage, of the cumulative duration of transmissions within an observation interval and the interval itself, as measured in an observation bandwidth

equipment under test: system of constituents for qualification under the present document

ground station: remote ground based multilateration equipment intended for use as a component in a multilateration system

NOTE: Multilateration equipment can include receiver, interrogator and/or transponder components. It can be fixed or mobile, or even space-based.

integral antenna: antenna which is integrated into a piece of equipment without the use of an external connector, and which is considered to be part of the equipment itself

interrogator: aeronautical station equipment including at least one transmitter designed to produce aeronautical mobile service signals at 1 030 MHz

mode A: interrogation triggering a Mode A reply allowing the identification of aircraft

NOTE: For any Mode S-based system including WAM systems, a Mode A interrogation consists of P1, P3 and P4 pulses transmitted on the sum port of the WAM interrogator. In some cases, an ACAS Whisper-Shout technique is applied and then an S1 pulse is used to suppress unwanted replies. Details are defined in ICAO Annex 10, Volume IV [1].

mode C: interrogation triggering a Mode C reply containing encoded pressure-altitude information

NOTE: For any Mode S-based system including WAM systems, a Mode C interrogation consists of P1, P3 and P4 pulses transmitted on the sum port of the WAM interrogator. In some cases, an ACAS Whisper-Shout technique is applied and then an S1 pulse is used to suppress unwanted replies. Details are defined in ICAO Annex 10, Volume IV [1].

mode S: interrogation triggering a Mode S reply allowing the addressing of individual aircraft and the retrieving of information with higher integrity

NOTE 1: A Mode S interrogation consists of P1, P2 and P6 pulses.

NOTE 2: The addressing method consists of a unique 24 bit Mode-S address for each individual aircraft transponder.

multilateration: surveillance technique which provides position derived from the Secondary Surveillance Radar (SSR) transponder signals (replies or squitters) primarily using Time Difference Of Arrival (TDOA) techniques

NOTE: Additional information, including identification, can be extracted from the received signals.

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

operating channel: frequency range in which the transmission from the equipment occurs, or in which the equipment is intended to receive transmissions

operating frequency: centre of the operating channel

operational: characteristic of a fielded system

NOTE: A given piece of equipment can operate using different transmission rates and power levels, in which case it is configurable.

probability of detection: ratio of received and successfully decoded RF messages

receiver: equipment which includes the capability to convert RF signals into binary content

reference sensitivity: minimum level of the wanted signal that can be received with a Pd of at least 90 %

resolution bandwidth: bandwidth that is used for spectral measurements

sensor: aeronautical station equipment including at least one receiver designed to receive aeronautical mobile service signals at 1 090 MHz

spurious domain: frequency range beyond the out-of-band domain in which spurious emissions generally predominate

NOTE: This definition is taken from ITU Radio Regulation [1.5].

squitter: broadcast of aircraft-tracking data that is transmitted periodically by a Mode S transponder without interrogation from controller's radar

transmission: radio emission consisting of one uplink or downlink message

transmitter: equipment which includes the capability to convert binary content into RF signals

transponder: aeronautical station equipment including at least one transmitter designed to produce aeronautical mobile radionavigation service signals at 1 090 MHz and zero or more receivers designed to receive aeronautical mobile radionavigation service signals at 1 030 MHz

unwanted signal: any signal other than the wanted signal or as described in a specific test case

wanted signal: in-band signal modulated

NOTE: According to the present document.

3.2 Symbols

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

dB	decibel
dBm	dB with respect to 1 mW
$dBpep$	dB with respect to peak envelope power
f_{c1030}	1 030 MHz carrier frequency
f_{c1090}	1 090 MHz carrier frequency
Pd	Probability of detection
Pd_{1090}	Probability of detection at 1 090 MHz
Pd_{offset}	Probability of detection at a frequency offset from 1 090 MHz
Ω	Ohm

3.3 Abbreviations

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

AC	Alternating Current
ADS-B	Automatic Dependant Surveillance Broadcast
CRC	Cyclic Redundancy Check
CW	Continuous Wave
DME	Distance Measuring Equipment
EUT	Equipment Under Test
ICAO	International Civil Aviation Organization
ITU	International Telecommunication Union
MLAT	MultiLATeration
OoB	Out-of-Band
PEP	Peak Envelope Power
RBW	Reference BandWidth
RF	Radio Frequency
RFM	Remote Field Monitor
SSR	Secondary Surveillance Radar
VBW	Video BandWidth
WAM	Wide Area Multilateration

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 Applicability

4.2.1.1 Equipment with and without integral antenna

A 50 Ω antenna connection point shall be provided for test purposes. For equipment with integral antenna, this connection point shall correspond to the input of the integral antenna.

4.2.1.2 Equipment with multiple functions

Any ground station which includes a transmission function shall comply with the requirements in clause 4.2.2.

Any ground station which includes the receiver function shall comply with the requirements in clause 4.2.3.

4.2.2 Transmitter requirements

4.2.2.1 Operating frequency and frequency error

4.2.2.1.1 Definition

The operating frequency is the nominal value of the carrier frequency.

Interrogations are defined as transmissions sent over the 1 030 MHz carrier frequency.

Reference/Test transmissions are defined as transmissions sent over the 1 090 MHz carrier frequency.

The frequency error is the difference between the actual carrier frequency and its nominal value of either 1 030 MHz or 1 090 MHz.

4.2.2.1.2 Limits

If the equipment contains a 1 030 MHz interrogation function, the nominal value of carrier frequency of the interrogations shall be 1 030 MHz. The absolute value of the frequency error shall not exceed 0,01 MHz.

NOTE 1: The interrogation limits are specified in ICAO Annex 10, Volume IV [1], clause 3.1.2.1.1 and are stricter than the requirement defined in the ITU Radio Regulations [i.5], Appendix 2.

If the equipment contains a 1 090 MHz reference/test transmission function, the nominal value of carrier frequency of the control transmissions shall be 1 090 MHz. The absolute value of the frequency error shall not exceed 0,05 MHz.

NOTE 2: For a 1 090 MHz transmission of 100 W or less, Appendix 2 of the ITU Radio Regulations [i.5] specifies a tolerance of 100 ppm for fixed stations, which agrees with the reference/test transmission limits specified in ICAO Annex 10 Volume IV [1], clause 3.1.2.2.1. For a transmission exceeding 100 W, Appendix 2 of the ITU Radio Regulations [i.5] specifies a tighter tolerance of 50 ppm.

NOTE 3: These limits are stricter than the requirement defined in Appendix 2 of the ITU Radio Regulations [i.5].

4.2.2.1.3 Conformance

The conformance tests are defined in clause 5.3.1.

4.2.2.2 Spectrum mask

4.2.2.2.1 Definition

A spectrum mask is a set of limit lines applied to a plot of a transmitter spectrum.