



SLOVENSKI STANDARD

SIST EN 300 761:2001

01-februar-2001

Elektromagnetna združljivost (EMC) in zadeve v zvezi z radijskim spektrom (ERM) - Avtomatska identifikacija vozil za železnico (AVI)

ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); Automatic Vehicle
Identification (AVI) for railways

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Ta slovenski standard je istoveten z: ^{SIST EN 300 761:2001} **EN 300 761 Version 1.1.1**
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ICS:

33.060.99	Druga oprema za radijske komunikacije	Other equipment for radiocommunications
33.100.01	Elektromagnetna združljivost na splošno	Electromagnetic compatibility in general
45.020	Železniška tehnika na splošno	Railway engineering in general

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EN 300 761 V1.1.1 (1998-01)

European Standard (Telecommunications series)

Electromagnetic compatibility and Radio spectrum Matters (ERM); Automatic Vehicle Identification (AVI) for railways

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European Telecommunications Standards Institute

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Foreword

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

The present document has been produced by ETSI in response to a mandate from the European Commission issued under Council Directive 83/189/EEC (as amended) laying down a procedure for the provision of information in the field of technical standards and regulations.

The present document, together with ETS 300 683, is intended to become a Harmonized Standard, the reference of which will be published in the Official Journal of the European Communities referencing the Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility ("the EMC Directive") (89/336/EEC as amended).

Technical specifications relevant to the EMC Directive are given in annex D.

Every EN prepared by ETSI is a voluntary standard. The present document contains text concerning type approval of the equipment to which it relates. This text should be considered as guidance and does not make the present document mandatory.

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National transposition dates

Date of adoption of this EN:	2 January 1998
Date of latest announcement of this EN (doa):	30 April 1998
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 October 1998
Date of withdrawal of any conflicting National Standard (dow):	31 October 1998

Introduction

The present document was drafted on the assumption that type test measurements, performed in an accredited test laboratory, will be accepted by the various national regulatory authorities in order to grant type approval, provided the national regulatory requirements are met. This is in compliance with CEPT/ERC Recommendation 70-03 [1] and CEPT/ERC Recommendation 01-06 [5].

The present document specifies the requirements for a dedicated 2,45 GHz short range microwave link intended for a European wide data communication system for Railway applications, Automatic Vehicle Identification (AVI).

The in-track base station (interrogator) transmit and receive modulations are a combination of Amplitude Shift Keying (ASK) and Frequency Shift Keying (FSK) respectively.

The present document supports the necessary transmitter and receiver data rates between 192 kbit/s and 384 kbit/s according to the type of transaction.

The system comprises five channels with dynamic channel allocation, within an 8 MHz bandwidth.

The maximum radiated equivalent isotropically radiated power (e.i.r.p) at each carrier frequency is 500 mW (+27 dBm).

In order to permit the greatest freedom of design of equipment, whilst protecting other radio services from interference, a balance is required between the permitted range of frequencies on which the equipment may be used, and its frequency stability and modulation characteristics. The present document specifies the operational frequencies and system bandwidths; these parameters are covered by CEPT/ERC Recommendation 70-03, annex 4 [1].

Clauses 1 and 3 give a general description of the types of equipment covered by the present document and the definitions and abbreviations used. Clause 4 gives general requirement in order that type tests may be carried out and any markings on the equipment to be provided by the manufacturer.

Clauses 5 and 6 specify the test conditions.

Clauses 7 and 8 specify the limits of the parameters which are required to be tested. These limits have been chosen to minimize harmful interference to and from other equipment and services. These clauses also specify how the equipment is to be tested and the conditions which are applied.

Clause 9 specifies the limits of the parameters which are required to be tested for transponders. Details on the test methods for the transponders are also specified.

Clause 10 specifies the maximum measurement uncertainty values.

Annex A provides normative specifications concerning test sites for radiated measurements.

Annex B provides normative descriptions of measurement methods for radiated measurements.

Annex C provides normative descriptions of alternative measurement methods for receivers.

Annex D provides normative technical parameters relevant to the EMC Directive

1 Scope

The present document applies to 2,45 GHz Short Range Devices (SRDs) for use in Railway AVI which fulfil the Union Internationale des Chemins de fer (UIC) specifications (annex E) and are interoperable with the current UIC system except for the interrogator (Track Units (TU)) bandwidth. The Interrogator bandwidth is limited to 8 MHz shared within five channels:

- with a Radio Frequency (RF) output connection and specified antenna or with an integral antenna;
- for data transmission only;
- operating on radio frequencies in the 2,446 GHz to 2,454 GHz Industrial, Scientific and Medical (ISM) band, with power levels up to 500 mW e.i.r.p as defined in the CEPT/ERC Recommendation T/R 70-03 [1].

It covers the minimum characteristics considered necessary in order to make the best use of the available frequencies. It does not necessarily include all the characteristics which may be required by a user, nor does it necessarily represent the optimum performance achievable.

The present document is based upon CEPT Recommendations T/R 70-03 [1]. It is a product standard covering various Railway applications where the data transmission of the system will be active only during the presence of the train.

The present document covers fixed installed interrogators (TUs) and transponders (mobile stations). For certain measurements the transponders are measured together with the whole interrogating system.

The present document includes specifications for methods of measurement for equipment fitted with antenna sockets and/or integral antennae.

Additional standards or specifications may be required for equipment such as that intended for connection to the Public Switched Telephone Network (PSTN) or other systems.

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2 Normative references

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References may be made to:

- a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or
- b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or
- c) all versions subsequent to and including the identified version (identified by "onwards" following the version identity); or
- d) publications without mention of a specific version, in which case the latest version applies.

A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

- | | |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [1] | draft CEPT/ERC Recommendation 70-03 (1997): "Relating to the use of Short Range Devices (SRD)". |
| [2] | IEC 721-3-4 (1995): "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 4: Stationary use at non-weatherprotected locations". |
| [3] | CISPR 16-1: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus". |
| [4] | EN 55022: "Limits and methods of measurements of radio disturbance characteristics of information technology equipment". |

- [5] CEPT/ERC Recommendation 01-06: "Procedures for type testing and approval for radio equipment intended for non-public systems".
- [6] ETR 028: "Radio Equipment and Systems (RES); Uncertainties in the measurement of mobile radio equipment characteristics".
- [7] ITU-T Recommendation O.153 (1992): "Basic parameters for the measurement of error performance at bit rates below the primary rate".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

assigned frequency band: The frequency band within which the device is authorized to operate.

integral antenna: An antenna, with or without a connector, designed as an indispensable part of the equipment.

interrogator: Equipment intended for use in a fixed location (Fixed Station (FS)).

operating frequency range: The range of operating frequencies over which the equipment can be adjusted through switching, tuning or reprogramming.

portable equipment: Equipment intended to be carried, attached or implanted.

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

transponder: A device normally fixed in a vehicle which responds to an interrogating signal.

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3.2 Symbols

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

λ	Wavelength
dB _i	Gain relative to an isotropic antenna
dB _m	dB relative to 1 mW
E	Field strength
E _o	Reference field strength, (see annex B)
f ₀	frequency of operation
R	Distance, (see annex B)
R _o	Reference distance, (see annex B)
Rx	Receiver
Tx	Transmitter

3.3 Abbreviations

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

AB	Allocated Band
ASK	Amplitude Shift Keying
AVI	Automatic Vehicle Identification
CG	Conversion Gain
e.i.r.p	equivalent isotropically radiated power
FS	Fixed Station
FSK	Frequency Shift Keying
IF	Intermediate Frequency
ISM	Industrial, Scientific and Medical

ITE	Information Technology Equipment
LLC	Layer Level Control
MAC	Medium Access Control
OEM	Original Equipment Manufacturer
ppm	parts per million (10^{-6})
PSTN	Public Switched Telephone Network
RF	Radio Frequency
SRD	Short Range Device
TU	Track Unit
UIC	Union Internationale des Chemins de fer (International Union of Railways)
VSWR	Voltage Standing Wave Ratio

4 General

4.1 Presentation of equipment for testing purposes

Each equipment submitted for testing shall fulfil the requirements of the present document on all frequencies over which it is intended to operate.

The performance of the equipment submitted for testing shall be representative of the performance of the corresponding production model. In order to avoid any ambiguity in that assessment, the present document contains instructions for the presentation of equipment for testing purposes (this subclause), conditions of testing (see clause 5) and measurement methods (see clauses 7, 8 and 9).

The applicant shall complete the appropriate application form when submitting equipment for testing. Additionally, technical documentation and operating manuals shall also be supplied.

Stand alone equipment shall be offered by the applicant complete with any ancillary equipment needed for testing. The applicant shall declare the frequency range(s), the range of operation conditions and power requirements, as applicable, in order to establish the appropriate test conditions.

Test fixtures may be supplied by the applicant (see subclause 6.7).

Original Equipment Manufacturer's (OEM) plug-in cards or units may be offered for testing together with a suitable test fixture. Alternatively, complete AVI equipment may be supplied by the manufacturer to facilitate the tests (see subclause 6.8.2).

To simplify and harmonize the testing procedures between the different test laboratories, measurements shall be performed, according to the present document, on samples of equipment defined in subclauses 4.2.1 and 4.2.2. These subclauses are intended to give confidence that the requirements set out in the present document have been met without the necessity of performing measurements on all channel frequencies.

4.1.1 Choice of model for testing

The applicant shall provide one or more production models of the equipment, as appropriate, for testing.

4.1.2 Choice of operating frequencies

Where equipment can be adjusted to operate at different operating frequencies other than the five standard channels, a minimum of two operating frequencies shall be chosen such that the lower and higher limits of the applicant's declared operating ranges of the equipment are covered. For equipment with RF output connection and specified antenna, the applicant shall declare the gain of the antenna assembly i.e. the transfer function between the conducted RF power and e.i.r.p shall be declared.

4.1.3 Testing of equipment without a permanent external RF port

To facilitate relative measurements, use may be made of a test fixture as described in subclause 6.7, or the equipment may be supplied with a permanent internal or temporary internal or external RF port, providing the characteristics being measured are not expected to be affected.

4.1.4 Equipment with a permanent internal RF port

The way to access a permanent internal RF port shall be stated by the applicant with aid of a diagram. The fact that use has been made of a permanent internal RF port shall be recorded in the test report.

4.1.5 Equipment with a temporary RF port

The applicant shall submit two sets of equipment to the test laboratory, one fitted with a temporary 50 Ω RF connector with the antenna disconnected and the other with the antenna connected. Each equipment shall be used for the appropriate tests. The measurements, wherever possible, should be made by use of a direct connection to the equipment under test (antenna connector or temporary 50 Ω connector) as stated in the present document, in order to ensure that the measurement uncertainties are minimized.

The way the temporary RF port is implemented shall be stated by the applicant with the aid of a diagram. The fact that use has been made of the temporary RF port to facilitate measurements shall be stated in the test report.

4.2 Mechanical and electrical design

4.2.1 General

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The equipment submitted by the applicant, or his representative, shall be designed, constructed and manufactured in accordance with good engineering practice, and with the aim of minimizing harmful interference to other equipment and services.

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Transmitters and receivers may be individual or combination units. -761-2001

4.2.2 Controls

Those controls which if maladjusted might increase the interference possibilities to and from the equipment shall only be accessible by partial or complete disassembly of the device and requiring the use of tools.

4.2.3 Test mode facility

If the unit is equipped with a data squelch or battery saving circuit or similar facility that prevents tests being made, it shall be possible to override this circuit for the duration of some tests.

4.3 Auxiliary test equipment

All necessary test signal sources and setting up information shall accompany the equipment when it is submitted for testing.

4.4 Interpretation of the measurement results

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

- the measured value related to the corresponding limit shall be used to decide whether an equipment meets the requirements of the present document;
- the measurement uncertainty value 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 of measurement uncertainty given in clause 10.

5 Test conditions, power sources and ambient temperatures

5.1 Normal and extreme test conditions

Testing shall be made under normal test conditions, and also, where stated, under extreme test conditions.

The test conditions and procedures shall be as specified in subclauses 5.2 to 5.4.

5.2 External test power source

During type tests the power source of the equipment shall be replaced by an external test power source, capable of producing normal and extreme test voltages as specified in subclauses 5.3.2 and 5.4.2. The internal impedance of the external test power source shall be low enough for its effect on the test results to be negligible.

For battery operated equipment the battery shall be removed and the external test power source shall be suitably de-coupled and applied as close to the equipment battery terminals as practicable. For radiated measurements any external power leads should be so arranged so as not to affect the measurements. If necessary, the external test power source may be replaced with the supplied or recommended internal batteries at the required voltage or a battery simulator. This shall be stated on the test report. For radiated measurements on portable equipment with an integral antenna, fully charged internal batteries should be used. The batteries used should be as supplied or recommended by the applicant.

If the equipment is powered from an external source, the test voltage shall be measured at the point of connection of the power cable to the equipment.

During tests the external test power source voltages shall be within a tolerance of ± 1 % relative to the voltage at the beginning of each test. The value of this tolerance can be critical for certain measurements. Using a smaller tolerance provides a better uncertainty value for these measurements. If internal batteries are used, at the end of each test the loaded voltage shall be within a tolerance of ± 5 % relative to the loaded voltage at the beginning of each test.

5.3 Normal test conditions

5.3.1 Normal temperature and humidity

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

- temperature $+15^{\circ}\text{C}$ to $+35^{\circ}\text{C}$;
- relative humidity 20 % to 75 %.

When it is impracticable to carry out tests under these conditions, a note to this effect, stating the ambient temperature and relative humidity during the tests, shall be added to the test report.

5.3.2 Normal test power source

5.3.2.1 Mains voltage

For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages, for which the equipment was designed.