



**SLOVENSKI STANDARD**  
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**01-december-2003**

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ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); Short Range Devices (SRD); Automatic Vehicle Identification (AVI) for railways operating in the 2,45 GHz frequency range; Part 1: Technical characteristics and methods of measurement

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# ETSI EN 300 761-1 V1.2.1 (2001-06)

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*European Standard (Telecommunications series)*

**Electromagnetic compatibility  
and Radio spectrum Matters (ERM);  
Short Range Devices (SRD);  
Automatic Vehicle Identification (AVI) for railways  
operating in the 2,45 GHz frequency range;  
Part 1: Technical characteristics and  
methods of measurement**

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## Foreword

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

For non EU countries the present document may be used for regulatory (Type approval or conformity to the R&TTE Directive) purposes.

The present document is part 1 of a multi-part deliverable covering the Short Range Devices (SRD); Automatic Vehicle Identification (AVI) for railways operating in the 2,45 GHz frequency range, as identified below:

**Part 1: "Technical characteristics and methods of measurement";**

Part 2: "Harmonized standard covering essential requirements under article 3.2 of the R&TTE Directive".

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 spectrum utilization parameters which are required to be measured. These are maximum limits which have been chosen to minimize harmful interference to other equipment or services. The clauses provide details on how the equipment should be tested and the conditions which should be 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 gives maximum measurement uncertainty values.

Annex A provides normative specifications concerning radiated measurements.

Annex B provides normative description of measurement methods.

Annex C provides normative description of an alternative measurement method for receivers.

### National transposition dates

Date of adoption of this EN:	15 June 2001
Date of latest announcement of this EN (doa):	30 September 2001
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 March 2002
Date of withdrawal of any conflicting National Standard (dow):	31 March 2002

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## 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 or conformity to the R&TTE Directive, provided the national regulatory requirements are met. This is in compliance with CEPT/ERC Recommendation 70-03 [1] and CEPT/ERC Recommendation 01-06 (see Bibliography).

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 annex 4 of CEPT/ERC Recommendation 70-03 [1].

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# 1 Scope

The present document applies to a dedicated 2,45 GHz Short Range Device (SRD) microwave link intended for a European wide data communication system for Railway applications, Automatic Vehicle Identification (AVI), which fulfil the relevant Union Internationale des Chemins de fer (UIC) specifications (see Bibliography) and are interoperable with the current UIC system except for the interrogator (Track Units (TU)) bandwidth.

The present document contains the technical characteristics for radio equipment and is referenced by CEPT/ERC Recommendation T/R 70-03 [1].

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.

The present document 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 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.

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

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.

---

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

- [1] CEPT/ERC Recommendation 70-03 (2001): "Relating to the use of Short Range Devices (SRD)".
- [2] CISPR 16-1: "Specification for radio disturbance and immunity measuring apparatus and methods; Part 1: Radio disturbance and immunity measuring apparatus".
- [3] ITU-T Recommendation O.153: "Basic parameters for the measurement of error performance at bit rates below the primary rate".

- [4] ETSI ETR 028: "Radio Equipment and Systems (RES); Uncertainties in the measurement of mobile radio equipment characteristics".
- [5] IEC 60721-3-4 (1995): "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 4: Stationary use at non-weatherprotected locations".
- [6] ITU-T Recommendation O.41: "Psophometer for use on telephone-type circuits"

## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

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

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

**integral antenna:** permanent fixed antenna, which may be built-in, designed as an indispensable part of the equipment

**conducted measurements:** measurements which are made using a direct connection to the equipment under test

**identification system:** equipment consisting of a transmitter(s), receiver(s) (or a combination of the two) and an antenna(s) to identify objects by means of a transponder

**interrogator:** equipment intended for use in a fixed location (Fixed Station (FS))

**manufacturer:** manufacturer means the manufacturer or his official representative

**operating frequency range:** 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:** device normally fixed in a vehicle which responds to an interrogating signal

### 3.2 Symbols

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

$\lambda$	wavelength
E	field strength
$E_0$	reference field strength (see annex B)
$f_0$	frequency of operation
R	distance (see annex B)
$R_0$	reference distance (see annex B)

### 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
dBi	gain relative to an isotropic antenna
dBm	dB relative to 1 mW
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
Rx	Receiver
SRD	Short Range Device
TU	Track Unit
Tx	Transmitter
UIC	Union Internationale des Chemins de fer (International Union of Railways)
VSWR	Voltage Standing Wave Ratio

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## 4 General requirements

### 4.1 General requirements

#### 4.1.1 Equipment classification

The product covered by the present document has its specific set of minimum performance criteria. This classification is based upon the impact on persons and required railway functionality in case the equipment does not operate above the specified minimum performance level.

#### 4.1.2 General performance criteria

For the purpose of the receiver performance tests, the receiver will produce an appropriate output under normal conditions as indicated below. Where the indicated performance cannot be achieved, the manufacturer shall declare and publish the performance criteria used to determine the performance of the receiver:

- a SND/ND ratio of 20 dB, measured at the receiver output through a telephone psophometric weighting network as described in ITU-T Recommendation O.41 [6]; or
- after demodulation, a data signal with a bit error ratio of  $10^{-2}$ ; or
- after demodulation, a message acceptance ratio of 80 %.

### 4.2 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.

Where appropriate the manufacturer should chose appropriate frequencies in consultation with the Administration(s) from whom type approval or conformity to the R&TTE Directive is sought.

If an equipment is designed to operate with different carrier powers, measurements of each transmitter parameter shall be performed at the highest power level at which the transmitter is intended to operate.

Additionally, technical documentation and operating manuals, sufficient to allow testing to be performed, shall be supplied.

A test fixture for equipment with an integral antenna may be supplied by the manufacturer (see clause 6.6).

To simplify and harmonize the testing procedures between the different testing laboratories, measurements shall be performed, according to the present document, on samples of equipment defined in clauses 4.2.1 to 4.2.3.2.

These clauses 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 frequencies.

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.

#### 4.2.1 Choice of model for testing

The manufacturer shall provide one or more samples of the equipment, as appropriate for testing.

Stand alone equipment shall be offered by the manufacturer complete with any ancillary equipment needed for testing.

If an equipment has several optional features, considered not to affect the RF parameters then the tests need only to be performed on the equipment configured with that combination of features considered to be the most complex, as proposed by the manufacturer and agreed by the test laboratory.

Where practicable, equipment offered for testing shall provide a 50  $\Omega$  connector for conducted RF power measurements.

In the case of integral antenna equipment, if the equipment does not have a internal permanent 50  $\Omega$  connector then it is permissible to supply a second sample of the equipment with a temporary antenna connector fitted to facilitate testing, see clause 4.2.3.

#### 4.2.2 Testing of equipment with alternative power levels

If a family of equipment has alternative output power levels provided by the use of separate power modules or add on stages, or additionally has alternative frequency coverage, then all these shall be declared by the manufacturer. Each module or add on stage shall be tested in combination with the equipment. The necessary samples and tests can be proposed by the manufacturer and/or the test laboratory and shall be agreed with the Administration(s), based on the requirements of clause 4.2. As a minimum, measurements of the radiated power (eirp) and spurious emissions shall be performed for each combination and shall be stated in the test report.

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#### 4.2.3 Testing of equipment that does not have an external 50 Ohm RF connector (integral antenna equipment)

##### 4.2.3.1 Equipment with an internal permanent or temporary antenna connector

The means to access and/or implement the internal permanent or temporary antenna connector shall be stated by the manufacturer with the aid of a diagram. The fact that use has been made of the internal antenna connection, or of a temporary connection, to facilitate measurements shall be recorded in the test report.

##### 4.2.3.2 Equipment with a temporary antenna connector

The manufacturer, may submit one set of equipment with the normal antenna connected, to enable radiated measurements to be made. The manufacturer shall attend the test laboratory at the conclusion of the radiated measurements, to disconnect the antenna and fit the temporary connector. The testing laboratory staff shall not connect or disconnect any temporary antenna connector.

Alternatively, the manufacturer may submit two sets of equipment to the test laboratory, one fitted with a temporary antenna connector with the antenna disconnected and another equipment with the antenna connected. Each equipment shall be used for the appropriate tests. The manufacturer shall declare that the two sets of equipment are identical in all aspects except for the antenna connector.

## 4.3 Mechanical and electrical design

### 4.3.1 General

The equipment submitted by the manufacturer, 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.

Transmitters and receivers may be individual or combination units.

### 4.3.2 Controls

Those controls which, if maladjusted, might increase the interfering potentialities of the equipment shall not be easily accessible to the user.

### 4.3.3 Transmitter shut-off facility

If the transmitter is equipped with an automatic transmitter shut-off facility, it should be made inoperative for the duration of the test.

### 4.3.4 Receiver mute or squelch

If the receiver is equipped with a mute, squelch or battery-saving circuit, this circuit shall be made inoperative for the duration of the tests.

### 4.3.5 Marking (equipment identification)

The equipment shall be marked in a visible place. This marking shall be legible and durable. Where this is not possible due to physical constraints, the marking shall be included in the users manual.

[SIST EN 300 761-1 V1.2.1:2003](https://standards.iteh.ai/catalog/standards/sist/d250349d-5a67-4453-825c-1950f17350d3/sist-en-300-761-1-v1-2-1-2003)

#### 4.3.5.1 Equipment identification

The marking shall include as a minimum:

- the name of the manufacturer or his trade mark;
- the type designation.

#### 4.3.5.2 Regulatory marking

The equipment shall be marked, where applicable, in accordance with CEPT/ERC Recommendation 70-03 [1]. Where this is not applicable the equipment shall be marked in accordance with the National Regulatory requirements.

## 4.4 Interpretation of the measurement results

The interpretation of the results recorded on the appropriate test report 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.