SLOVENSKI STANDARD
SIST EN 301 391 V1.1.1:2003

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Elektromagnetna združljivost in zadeve v zvezi z radijskim spektrom (ERM) ï Podatkovne komunikacije, ki uporabljajo naprave kratkega dosega ï Dostopovni protokol, pravila zasedenosti in ustrezne tehniļne znaļilnosti za prenos podatkov

ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); Data communications using short range devices; Access protocol, occupation rules and corresponding technical characteristics for the transmission of data

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Electromagnetic compatibility and Radio spectrum Matters (ERM); Data communications using short range devices; Access protocol, occupation rules and corresponding technical characteristics for the transmission of data

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Foreword

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

Annex A is normative and provides additional information concerning measurements.

National transposition dates	
Date of adoption of this EN:	31 December 1999
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Introduction

The present document specifies an access protocol intended to be used in equipment employing short range (radio) devices for the cordless transfer of small data packets.

It is intended that the implementation of this protocol is sufficiently simple to suit the low costs necessary for some products.

The present document relies on all equipment on a shared channel using this protocol.

The protocol allows efficient channel sharing in high data traffic situations, and has been devised to provide an equitable share between all users of the channel. The present document only applies to applications that require infrequent bursts of small data packets for the purpose of control and limited data transfer i.e. not continuous unbroken data transmission.

This protocol relies on there being a limited radiated power and therefore a limited range, thus restricting the overlap of local users (cell size) to a level where the protocol can cope by time sharing between them.

Data collision is minimized in this protocol by using carrier sense multiple access (CSMA) which requires that the radio channel is silent before starting any transmission.

Arbitration between competing users is achieved by using a pseudo random length delay period before transmitting. A mechanism for prioritizing messages, based on message length, is also provided as part of the arbitration process.

1 Scope

The present document covers a radio channel access protocol and provides all the parameters that are essential for its use.

The present document has been designed to be used with Short Range Devices sharing a common, single frequency, radio channel and transmitting small (short duration) data packets. Standards EN 300 220-1 [1], EN 300 330 [2] and I-ETS 300 440 [3] provide technical characteristics for short range device equipment. These products will be co-existing on the same radio spectrum.

The present document specifies the access protocol and the occupation rules for data communications on a radio channel shared by different users. The present document does not specify or impose any restriction on the bit rate, data format or modulation scheme.

This access protocol is not intended for applications requiring continuous (unbroken) data transmission.

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, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, 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] EN 300 220-1 (V1.2): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short range devices; Technical characteristics and test methods for radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW; Part 1: Parameters intended for regulatory purposes".

[2] EN 300 330: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Technical characteristics and test methods for radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz".

[3] I-ETS 300 440: "Radio Equipment and Systems (RES); Short Range Devices (SRDs); Technical characteristics and test methods for radio equipment to be used in the 1 GHz to 25 GHz frequency range".

[4] ETS 300 113: "Radio Equipment and Systems (RES); Land mobile service; Technical characteristics and test conditions for radio equipment intended for the transmission of data (and speech) and having an antenna connector".

[5] ETR 273-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement of radiated methods of measurement (using test sites) and evaluation of the corresponding measurement uncertainties; Part 2: Anechoic chamber".

[6] ETR 273-3: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement of radiated methods of measurement (using test sites) and evaluation of the corresponding measurement uncertainties; Part 3: Anechoic chamber with a ground plane".

[7] ETR 273-4: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement of radiated methods of measurement (using test sites) and evaluation of the corresponding measurement uncertainties; Part 4: Open area test site".

[8] CEPT/ERC Recommendation 70-03: "Relating to the use of Short Range Devices (SRD)". Including Appendices and Annexes.

[9] IEC Publication 60489-3: "Methods of measurement for radio equipment used in the mobile services. Part 3: Receivers for A3E or F3E emissions".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

attack time: time taken between establishing that the channel can be accessed to the actual instant of access. The detailed definition is given in subclause 7.7

observation time: definition is given in subclause 6.5

bit: binary digit

data packet: smallest quantity of data sent over the radio channel in one access period. A number of useful bits are always sent together with corresponding redundancy bits in any given packet. An acknowledge reply, if used, is also included in the packet

message: user data to be transferred in one or more packets in a session

message length: time taken to transmit a message; the sum of the carrier on time of all the data packets used and the carrier off (silence) times of all the data packets used

reply: transmission by a device in answer to the "initiating transmitter". This reply can be an acknowledge ("ACK") or a negative acknowledge ("NACK") and/or a longer packet of useful / requested information

reply carrier delay: time period between end of a transmission and start of an acknowledge / reply

silence: condition of no detected carrier energy in the radio channel in question

transmission (physical): one packet transmitted between carrier on and final carrier off of a particular transmitter

3.2 Symbols

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

dB	decibel
dBm	dB relative to 1 mW
dBµV	dB relative to 1 µV
Tx	transmitter (radio)

3.3 Abbreviations

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

ACK	ACKnowledge
ASK	Amplitude Shift Keying
CSMA	Carrier Sense Multiple Access
EUT	Equipment Under Test
f_c	carrier frequency (band centre)
FSK	Frequency Shift Keying
NACK	Negative ACKnowledge
OATS	Open Area Test Site
P_c	Steady state transmit power
P_{mean}	Mean level of transmit power
P_{off}	carrier off power level
$P_{r\ acc}$	minimum receiver sensitivity needed to check that a channel is free
$P_{r\ check}$	received carrier power level, generated by a checking transmitter
PSK	Phase Shift Keying
QAM	Quadrature Amplitude Modulation
RF	Radio Frequency
t_c	reply carrier delay time
t_f	fixed part of observation time
t_o	observation time
t_p	priority part of observation time
t_r	pseudo random part of observation time

4 General

4.1 Applications using this protocol

This access protocol applies to a wide variety of applications operating at various data rates in both domestic and industrial fields. To accommodate this situation, four priority levels are included which correspond to different data packet lengths. This, for example, improves the chance of access for a simple control function (requiring a fast response time) in favour of a function transferring a large amount of data (less critical of response time).

The protocol may be used with the following types of communication:

- point-to-point (source to destination);
- point-to-multi-point (source to group);
- multi-point-to-point (polling).

4.2 Conformity to the present document

Conformity to the requirements of the present document is based upon both declarations and measurements.

4.2.1 Declaration of conformity

Those parameters covered by manufacturers declaration are given in clause 6 of the present document.

A signed declaration shall be provided as confirmation that the equipment meets the requirements of this access protocol. This declaration may be submitted by the manufacturer, or his representative, together with the application form for tests.

In the case where the controlling software for the equipment (or modules thereof) has not been designed by the manufacturer of the radio equipment, the responsible party for engineering such software shall also provide a signed declaration of conformity.

4.2.2 Measurements to be performed

These measurements shall be performed for all parts of the equipment included in the system, designed to use this protocol. Clause 7 of the present document gives the methods of measurements and limits for these parameters.

The manufacturer shall provide any necessary test points and/or test fixtures, dedicated test equipment (if needed) and/or test modes for the purpose of testing and making measurements.

The following measurements and tests shall be performed, in an accredited test laboratory:

- channel access duration;
- reply carrier delay;
- anti blocking;
- carrier sense threshold;
- carrier sense delay;
- observation time;
- channel accessing carrier attack time.

4.2.3 Interpretation of the measurement results

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

a) the measured value related to the corresponding limit shall be used to decide whether the equipment under test meets the requirements of the present document or not;

b) the actual measurement uncertainty of the test laboratory carrying out the measurement, for each particular measurement, shall be included in the test report;

c) the values of the actual measurement uncertainty shall be, for each measurement, equal to or lower than the figures given in clause 9, absolute measurement uncertainties.

5 Technical characteristics of the equipment

This protocol is intended to be used by short range devices fulfilling the requirements of EN 300 220-1 [1], EN 300 330 [2] and I-ETS 300 440 [3] as applicable. The use of short range devices (SRD) is also covered in CEPT/ERC Recommendation 70-03 [8].

It is recommended that the spread of the minimum reception sensitivity between all manufactured devices in a system be kept as small as possible. This is in the interests of minimizing data clashes between competing systems.

6 Description of the access protocol

All devices fulfilling the present standard shall use this protocol each time they access the RF channel and the RF channel is to be used only by such devices.

6.1 Channel access duration

The total time during which the channel may be occupied for each access (channel access duration) shall not exceed **the duration given in subclause 7.1.3**. This includes the duration of any acknowledgement or reply from a responding device.

Provided that both the maximum duration of channel occupation (channel access duration) and the reply carrier delay limits are fulfilled, the channel may be occupied by a sequence of any number of transmissions (involving, possibly, replies from one or more transmitters).

If, therefore, a replying device, or devices are required to return data (e.g. for handshake purposes), then the time taken to do this shall be included in the channel access duration.

Transfer of large quantities of data shall be achieved by dividing it up into suitably small packets to satisfy this protocol.

6.2 Principles

For the purpose of channel access, the equipment determines whether or not the channel is free and has been free for the observation time *to* by means of carrier sensing in the channel.

The observation time (see subclause 6.5) consists of a fixed part, a priority part and a pseudo-random additional part. When the channel appears to have been continuously free by the end of the observation time, the transmitter may be initiated and shall be powered up within the specified time (the accessing carrier attack time delay, see subclause 7.7).

The priority part has been included in the observation time for the purpose of giving priority to shorter messages in order to improve their response time chances.

The total duration of the RF carrier emission (access time) is limited (see subclauses 6.1 and 7.1).

The overall duty cycle limitation is given in subclause 6.7.

The number of transmission retries (intended to overcome transmission collisions and corruption) should be limited to a maximum of 5.

6.3 Procedure

In order to gain access to the radio channel the equipment shall determine whether or not the channel is, and has been, free during the observation time t_o by means of carrier sensing (see subclause 6.4). If the channel appears to be free throughout the observation time and there is information to be sent, the transmission shall then be initiated and RF carrier radiation commenced within the specified time (carrier attack time; see subclause 7.7.1 for definition). Once the channel has been seized it may be occupied for up to the maximum time allowed for a single channel occupancy (see subclauses 6.1 and 7.1).

At the end of a transmission, another observation time may start immediately, unless the duty cycle limit has been reached (subclause 6.7).

If a re-transmission is required (due, for example, to a "collision"), this same process shall be repeated and, once again, the channel shall be detected as being free during the observation time prior to repeating the attempt to transmit.

To ensure that no other user can access the channel during a half duplex access, a maximum Reply carrier delay tc has been defined (see subclause 7.2).

6.4 Carrier sensing

Carrier sensing, or more appropriately channel energy sensing, is the detection of whether the RF level in the receive channel exceeds a given threshold or not.

The carrier sense shall be able to detect RF signals with different types of modulation (e.g. FSK, ASK, PSK, QAM etc.).

The channel shall be regarded as in use during the observation time (see subclause 6.5) if the level of the RF signal on the channel exceeds the threshold given in subclause 7.4.3.

Carrier sensing shall take place throughout the observation time either continuously or at regular intervals not exceeding **250 µs** and the carrier sense delay shall not exceed the limit given in subclause 7.5.3.