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ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); Wideband  
 Transmission systems; data transmission equipment operating in the 2,4 GHz ISM band  
 and using spread spectrum modulation techniques; Part 1: Technical characteristics and  
 test conditions

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# ETSI EN 300 328-1 V1.2.2 (2000-07)

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*European Standard (Telecommunications series)*

**Electromagnetic compatibility  
and Radio spectrum Matters (ERM);  
Wideband Transmission systems; data transmission  
equipment operating in the 2,4 GHz ISM band  
and using spread spectrum modulation techniques;  
Part 1: Technical characteristics and test conditions**

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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 is part 1 of a multi-part EN covering the Electromagnetic compatibility and Radio Spectrum Matters (ERM); Wideband Transmission systems; data transmission equipment operating in the 2,4 GHz ISM band and using spread spectrum modulation techniques, as identified below:

**Part 1: "Technical characteristics and test conditions";**

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

Annex A provides additional requirements concerning radiated measurements.

Annex B contains normative specifications for the adjustment of the measurement equipment and of the equipment to be measured in order to achieve correct results.

Annex C provides a Bibliography.

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Date of withdrawal of any conflicting National Standard (dow):	30 April 2001

## Introduction

Wideband radio data transmission systems are rapidly being introduced into a variety of commercial and industrial applications and the technology employed by these systems is still developing.

The present document may be used by accredited test laboratories for the assessment of the performance of the equipment. The performance of the equipment submitted for type testing should be representative for 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 type testing purposes (clause 4), testing conditions (clause 6) and methods of measurement (clause 7).

The present document assumes that:

- the type test measurements performed in an accredited test laboratory in one CEPT country would be accepted by the Type Approval Authority in another country provided that the national regulatory requirements are met (see CEPT Recommendation T/R 71-03 [3]);
- if equipment available on the market is required to be checked it would be tested in accordance with the methods of measurement specified in the present document.

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# 1 Scope

The present document covers equipment referred to in CEPT Recommendation T/R 10-01 [1]. The present document covers the minimum technical characteristics for radio data transmission equipment having the following technical parameters:

- wideband radio modulation techniques;
- aggregate bit rates in excess of 250 kbits/s;
- operation in the 2,4 to 2,483 5 GHz Industrial, Scientific and Medical (ISM) band;
- effective radiated power of up to -10 dBW (100 mW);
- power density of up to -10 dBW (100 mW) per 100 kHz for frequency hopping modulation;
- power density of up to -20 dBW (10 mW) per 1 MHz for other forms of spread spectrum modulation.

The present document only addresses the transceivers, transmitters and receivers of equipment offered for testing.

The equipment offered for testing may be used in fixed, mobile or portable applications, e.g.:

- stand-alone radio equipment with or without their own control provisions;
- plug-in radio devices intended for use with or within a variety of host systems, e.g. personal computers, hand-held terminals, etc.

The equipment may be fitted with integral antennae and/or antenna connectors.

CEPT Recommendation T/R 10-01 [1] defines the total power and power density limits for systems using spread spectrum modulation together with a minimum aggregate bit rate of 250 kbits/s. The Recommendation does not address the details of these modulation techniques. Therefore, the present document does not cover the design or operation of the equipment being tested but describes a common set of measurements to be applied to various types of such equipment, including those employing Frequency Hopping Spread Spectrum (FHSS) modulation and Direct Sequence Spread Spectrum (DSSS) modulation.

CEPT Recommendation T/R 10-01 [1] specifies that spread spectrum modulation be used and it gives power density values for FHSS and DSSS modulation. The present document specifies the minimum technical parameters of FHSS modulation such that it can be clearly differentiated from other types of modulation, including DSSS modulation.

CEPT Recommendation T/R 01-04 [2] defines limits of spurious emissions for a variety of radio equipment; these limits are used in the present document as appropriate.

The present document describes measurements for operating frequency range(s), effective radiated power and power density as well as spurious emissions for transmitters and receivers.

The measurement methods have been adapted from ETR 027 [4] where possible.

The present document specifies test site characteristics, test conditions, equipment calibration and methods of measurement.

The present document is a general standard which may be superseded by specific standards covering specific applications.

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



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## 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] CEPT Recommendation T/R 10-01: "Wide Band Data Transmission Systems Using Spread-Spectrum Technology in the 2,5 GHz Band".
- [2] CEPT Recommendation T/R 01-04: "Use of Low Power Devices (LPD) Using Integral Antennas and Operating in Harmonized Frequency Bands".
- [3] CEPT Recommendation T/R 71-03: "Procedures for Type Testing and Approval for Radio Equipment Intended for Non-Public Systems".
- [4] ETSI ETR 027: "Radio Equipment and Systems (RES); Methods of measurement for private mobile radio equipment".
- [5] ETSI ETR 028: "Radio Equipment and Systems (RES); Uncertainties in the measurement of mobile radio equipment characteristics".

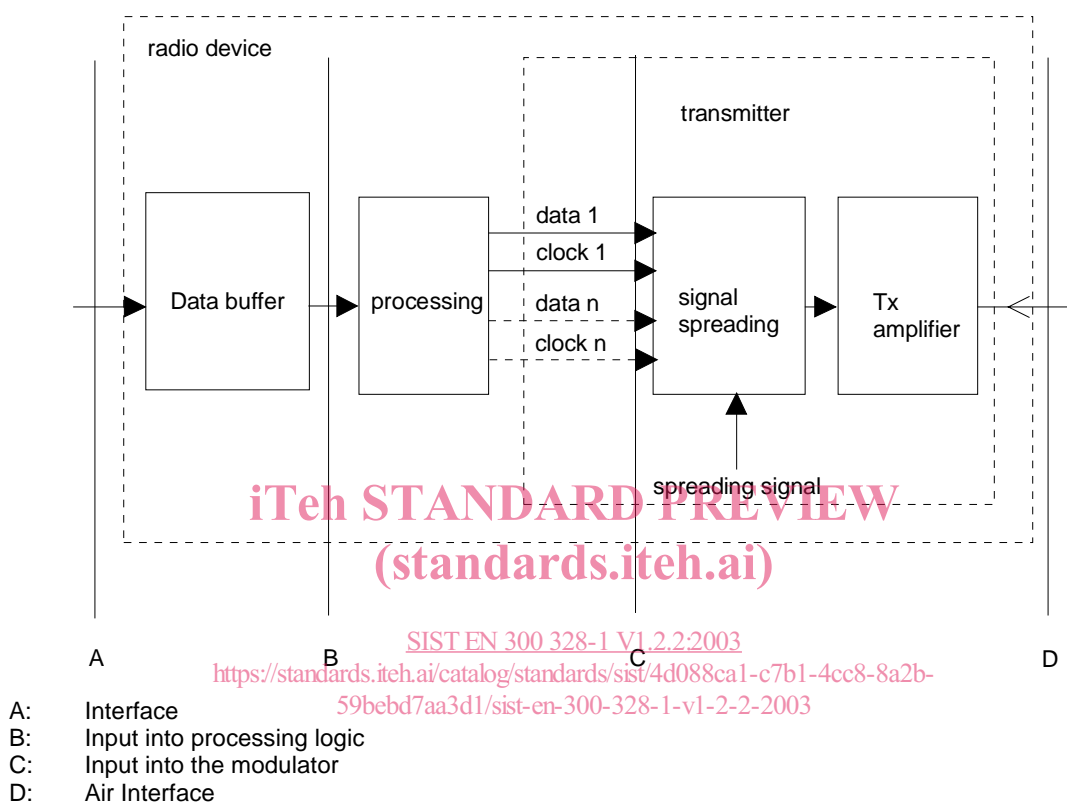
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## 3 Definitions and abbreviations

### 3.1 Definitions

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

**aggregate bit rate:** bit rate at the air interface (see point D in figure 1) including protocol overhead where applicable and excluding the effects of signal spreading.



**Figure 1: Parameters related to the aggregate bit rate**

**chip:** unit of modulation used in direct sequence spread spectrum modulation.

**chip rate:** number of chips per second.

**chip sequence:** sequence of chips with defined length and defined chip polarities.

**direct sequence spread spectrum modulation:** form of modulation where a combination of data to be transmitted and a known code sequence (chip sequence) is used to directly modulate a carrier, e.g. by phase shift keying. The transmitted bandwidth is determined by the chip rate and the modulation scheme.

**fixed station:** equipment intended for use in a fixed location and fitted with one or more antennae. The equipment may be fitted with either antenna socket(s) or integral antenna(e) or both.

**frequency hopping spread spectrum modulation:** spread spectrum technique in which the transmitter signal occupies a number of frequencies in time, each for some period of time, referred to as the dwell time. Transmitter and receiver follow the same frequency hop pattern. The frequency range is determined by the lowest and highest hop positions and the bandwidth per hop position (see subclause 5.2.3).

**frequency range:** range of operating frequencies over which the equipment can be adjusted.

**hand-portable station:** equipment normally used on a stand-alone basis and to be carried by a person or held in the hand. The equipment may be fitted with one or more antennae. The equipment may be fitted with either antenna socket(s) or integral antenna(e) or both.

**host:** host equipment is any equipment which has complete user functionality when not connected to the radio equipment part and to which the radio equipment part provides additional functionality and to which connection is necessary for the radio equipment part to offer functionality.

**integral antenna:** antenna designed to be connected to the equipment without the use of a standard connector and considered to be part of the equipment. An integral antenna may be fitted internally or externally to the equipment.

**manufacturer:** for the purposes of the present document "manufacturer" is understood to refer to the manufacturer or applicant of equipment offered for testing.

**mobile station:** equipment normally used in a vehicle or as a transportable station. The equipment may be fitted with one or more antennae. The equipment may be fitted with either antenna socket(s) or integral antenna(e) or both.

**operating frequency:** nominal frequency at which the equipment can be operated; this is also referred to as the operating centre frequency. Equipment may be adjustable for operation at more than one operating frequency.

**plug-in radio device:** equipment intended to be used with or within variety of host systems, using their control functions and power supply.

**power envelope:** frequency/power contour within which the useful RF power is generated.

**spread spectrum modulation:** modulation technique in which the energy of a transmitted signal is spread throughout a relatively large portion of the frequency spectrum.

**stand-alone radio equipment:** equipment that is intended primarily as communications equipment and that is normally used on a stand-alone basis.

## 3.2 Abbreviations

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

dBm	dB relative to 1 milliwatt power
dBW	dB relative to 1 watt power
DSSS	Direct Sequence Spread Spectrum
e.i.r.p.	equivalent isotropically radiated power
FHSS	Frequency Hopping Spread Spectrum
ISM	Industrial, Scientific and Medical
RF	Radio Frequency
Tx	Transmitter

## 4 General

### 4.1 Manufacturer declarations

The manufacturer shall declare the following specific characteristics of the equipment:

- the aggregate bit rate (see subclause 3.1 for the definition);
- the type of modulation used: FHSS modulation, DSSS modulation or any other type of spread spectrum modulation (see subclause 5.1);
- where FHSS modulation is used: the number of hopping channels, the dwell time per channel and the maximum time between two instances of use of the same channel; these values shall fall within the specifications given in subclause 5.1.1;
- the operating frequency range(s) of the equipment and, where applicable, band(s) of operation (see subclause 5.2.3);

- e) the type of the equipment, for example: stand-alone equipment or plug-in radio devices (see also subclause 3.1). In case of combined equipment using a plug-in radio device, and more than one combination is intended, each combination should be declared as well (see also subclause 6.5.1);
- f) the extreme operating conditions that apply to the equipment offered for testing;
- g) where the radio equipment is capable of different transmitter power settings, the manufacturer shall declare the intended combination(s) of the radio equipment power settings and one or more antenna assemblies. For each combination, the gain of the antenna assembly i.e. the transfer function between the conducted RF power and e.i.r.p., shall be declared;
- h) the nominal voltages of the stand-alone radio equipment or the nominal voltages of the host equipment in case of plug-in devices.

Where the manufacturer offers different combinations of equipment and antennae, the antennae appropriate for a given combination shall be referenced either on the equipment and on the antennae and/or in the user documentation.

## 4.2 Presentation of equipment for type testing

### 4.2.1 Choice of model

The manufacturer shall offer one or more production models or equivalent preliminary models, as appropriate, for type testing. If type approval is given on the basis of tests on (a) preliminary model(s), then the corresponding production models shall be identical to the tested models in all respects relevant for the purposes of the present document, to the preliminary model(s) tested.

Software fitted to production models shall be substantially the same as that used during type testing.

Due to the low levels of RF signal and the wideband modulations used in this type of equipment, radiated RF power measurements are imprecise. Conducted measurements are much more precise; in combination with the declared antenna assembly gain(s) adequate assurance of the RF characteristics can be achieved. Therefore, equipment offered for testing shall preferably provide a suitable connector for conducted RF power measurements. Where this is not possible, the manufacturer shall provide a documented test fixture that converts the radiated signal into a conducted signal into a suitable termination. Alternatively, radiated measurements shall be performed.

### 4.2.2 Presentation

Stand-alone equipment shall be offered complete with any ancillary equipment needed for testing. The manufacturer shall declare, the range of operating conditions and power requirements as applicable in order to establish the appropriate test conditions.

Plug-in radio devices may be offered for testing together with a suitable test jig and/or host equipment intended for normal use (see subclause 6.5). The manufacturer shall declare the range of operating conditions and power requirements that are applicable in order to establish the appropriate test conditions.

Where a manufacturer declares multiple combinations of radio equipment and antennae, the configuration to be used for testing shall be chosen as follows except where specified otherwise:

- for each combination, determine the highest user selectable power level and the antenna assembly with the highest gain;
- from the resulting combinations, choose the one with the highest e.i.r.p.

### 4.2.3 Choice of operating frequencies

Where equipment can be adjusted to or operated at different operating frequencies, a minimum of two operating frequencies shall be chosen such that the lower and higher limits of the operating range(s) of the equipment are covered (see subclause 5.2.3).