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Fixed Radio Systems; Point-to-point equipment; Parameters for radio systems for the transmission of digital signals operating at 23 GHz

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European Standard (Telecommunications series)

**Fixed Radio Systems;
Point-to-point equipment;
Parameters for radio systems for the transmission
of digital signals operating at 23 GHz**

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Contents

| | |
|--|----|
| Intellectual Property Rights | 5 |
| Foreword..... | 5 |
| 1 Scope..... | 6 |
| 2 References..... | 7 |
| 3 Symbols and abbreviations..... | 9 |
| 3.1 Symbols..... | 9 |
| 3.2 Abbreviations..... | 9 |
| 4 General characteristics | 10 |
| 4.1 Frequency bands and channel arrangements..... | 10 |
| 4.1.1 Channel arrangements..... | 10 |
| 4.1.2 Channel spacing for systems operating on the same route | 10 |
| 4.2 Compatibility requirements between systems | 11 |
| 4.3 Performance and availability requirements..... | 11 |
| 4.4 Environmental conditions | 11 |
| 4.4.1 Equipment within weather protected locations (indoor locations)..... | 11 |
| 4.4.2 Equipment for non-weather protected locations (outdoor locations)..... | 11 |
| 4.5 Power supply..... | 11 |
| 4.6 Electromagnetic compatibility | 11 |
| 4.7 System block diagram..... | 12 |
| 4.8 Telecommunications Management Network (TMN) interface..... | 12 |
| 4.9 Branching/feeder/antenna characteristics..... | 12 |
| 4.9.1 Antenna radiation patterns..... | 12 |
| 4.9.2 Antenna cross-Polar Discrimination (XPD)..... | 12 |
| 4.9.3 Antenna Inter-Port Isolation (IPI)..... | 12 |
| 4.9.4 Waveguide flanges (or other connectors)..... | 12 |
| 4.9.5 Return loss..... | 13 |
| 5 System Parameters..... | 13 |
| 5.1 Transmission capacity | 13 |
| 5.2 Baseband parameters | 13 |
| 5.2.1 Plesiochronous interfaces | 13 |
| 5.2.2 SDH baseband interface..... | 13 |
| 5.3 Transmitter characteristics..... | 14 |
| 5.3.1 Transmitter power range | 14 |
| 5.3.2 Transmit power and frequency control..... | 14 |
| 5.3.2.1 Automatic Transmit Power Control (ATPC)..... | 14 |
| 5.3.2.2 Remote Transmit Power Control (RTPC)..... | 14 |
| 5.3.2.3 Remote Frequency Control (RFC)..... | 15 |
| 5.3.3 Transmitter output power tolerance | 15 |
| 5.3.4 Transmit Local Oscillator (LO) frequency arrangements..... | 15 |
| 5.3.5 RF spectrum mask..... | 15 |
| 5.3.6 Spectral lines at the symbol rate | 18 |
| 5.3.7 Spurious emissions..... | 18 |
| 5.3.7.1 Spurious emissions - external..... | 18 |
| 5.3.7.2 Spurious emissions - internal | 19 |
| 5.3.8 Radio frequency tolerance..... | 19 |
| 5.4 Receiver characteristics | 19 |
| 5.4.1 Input level range | 19 |
| 5.4.2 Receiver local oscillator frequency arrangements..... | 19 |
| 5.4.3 Spurious emissions..... | 19 |
| 5.4.3.1 Spurious emissions - internal | 19 |
| 5.5 System performance without diversity | 19 |
| 5.5.1 BER as a function of Receiver input Signal Level (RSL) | 20 |
| 5.5.2 Equipment Residual BER..... | 20 |

| | | |
|---|---|-----------|
| 5.5.3 | Interference sensitivity | 20 |
| 5.5.3.1 | Co-channel interference sensitivity..... | 21 |
| 5.5.3.2 | Adjacent channel Interference..... | 21 |
| 5.5.3.3 | CW Spurious Interference..... | 22 |
| 5.5.3.4 | Front-end non-linearity requirements (two-tone CW spurious interference)..... | 22 |
| 5.5.4 | Distortion sensitivity | 23 |
| 5.6 | System characteristics with diversity..... | 23 |
| Annex A (informative): Additional information | | 24 |
| A.1 | Radio frequency channel arrangement..... | 24 |
| A.2 | Feeder/antenna return loss..... | 24 |
| A.3 | Automatic Transmit Power Control (ATPC) | 25 |
| A.4 | RBER..... | 25 |
| A.5 | Co-channel and adjacent channel interference | 26 |
| Annex B (normative): Void | | 30 |
| Annex C (normative): System type codes for regulatory procedures | | 31 |
| Annex D (normative): Output Power Tolerance and RBER..... | | 32 |
| History | | 33 |

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Transmission and Multiplexing (TM).

The present document specifies the minimum performance parameters for radio equipment operating in the frequency ranges as detailed in subclause 4.1.1.

The former title of the present document was "Transmission and Multiplexing (TM); Digital Radio Relay Systems (DRRS); Parameters for DRRS for the transmission of digital signals and analogue video signals operating at 23 GHz".

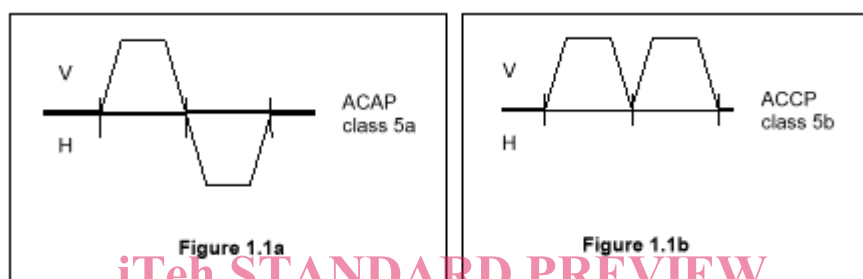
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1 Scope

The present document specifies the minimum performance parameters for terrestrial digital fixed service radio communications equipments operating in the 23 GHz frequency band and contains a complete revision in the areas of:

- additional systems with higher spectrum efficiency in the new class 4 systems;
- introduction of unique system type codes for regulatory reference to the various system types detailed in the present document, refer to new annex C and related categories of equipment classes of spectral efficiency;
- change of spectrum mask and adjacent channel selectivity of STM-0 systems in 28 MHz channel spacing to align to EN 300 639 [33];
- introduction of new spectrum efficiency class 5 for STM-1 capacity for 28 MHz Adjacent Channel Alternate-Polarization (ACAP as class 5a) and Adjacent Channel Co-Polarization (ACCP as class 5b), see examples of the spectrum usage in figures 1.1a and 1.1b;



NOTE: In a previous version of the present document there was provision for:

- parameters for wideband analogue systems;
- further options for digital radio systems (there referred as Grade A systems);
- specific antenna radiation patterns (now superseded by EN 300 833 [3]).

These options are not reprinted in this version as they are considered to be no longer of interest for ETSI members. However, for regulatory purposes, they may still be referenced from the previous version.

Digital systems are intended to be used for point-to-point connections in local and regional networks at data rates between 2 Mbit/s and Synchronous Transport Module, level 1 (STM-1).

The parameters to be specified fall into two categories:

- a) those that are required to provide compatibility between channels from different sources of equipment on the same route, connected either:
 - to separate antennas; or
 - to separate polarizations of the same antenna.
- b) parameters defining the transmission quality of the proposed system.

The present document deals with Radio Frequency (RF) and baseband characteristics relevant to low, medium and high capacity Plesiochronous Digital Hierarchy (PDH) transmission systems, STM-0 and STM-1 Synchronous Digital Hierarchy (SDH) transmission systems. Antenna/feeder system requirements are covered in EN 300 833 [3].

The present document does not contain aspects related to test procedures and test conditions however they are to be found in EN 301 126-1 [2].

As the maximum transmission rate in a given bandwidth depends on system spectral efficiency, different equipment classes are defined:

- class 1: equipment performance based on typically 2-states modulation scheme (e.g. 2-FSK (Frequency-Shift Keying), Gaussian Minimum Shift Keying (GMSK) with discriminator detection, or equivalent);
- class 2: equipment spectral efficiency based on typically 4-states modulation scheme (e.g. 4-FSK, 4-QAM, or equivalent);
- class 3: equipment spectral efficiency based on typically 8-states modulation scheme (e.g. 8 PSK, or equivalent);
- class 4: equipment spectral efficiency based on typically 16 or 32-states modulation scheme (e.g. 16-QAM, 32-QAM, or equivalent);
- class 5: equipment spectral efficiency based on typically 64-states or 128-states modulation scheme (e.g. 64-QAM, 128-QAM, or equivalent).

The above classes are indicative only and do not imply any constraint to the actual modulation format, provided that all the requirements in the present document are met.

Safety aspects will not be considered in the present document. However compliance to EN 60950 [34] will be required to comply with 1999/5/EC [35] Directive (R&TTE).

Technical background for most of the parameters and requirements referred in the present document may be found in TR 101 036-1 [30].

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2 References (standards.iteh.ai)

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

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- 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 13-02: "Preferred channel arrangements for fixed services in the range 22,0 GHz to 29,5 GHz".
 - [2] ETSI EN 301 126-1: "Fixed Radio Systems; Conformance testing; Part 1: Point-to-Point equipment - Definitions, general requirements and test procedures".
 - [3] ETSI EN 300 833: "Fixed Radio Systems; Point to Point Antennas; Antennas for point-to-point fixed radio systems operating in the frequency band 3 GHz to 60 GHz".
 - [4] ITU-R Recommendation F.637-3: "Radio-frequency channel arrangements for radio-relay systems operating in the 23 GHz band".
 - [5] ETSI EN 300 645: "Telecommunications Management Network (TMN); Synchronous Digital Hierarchy (SDH) radio relay equipment; Information model for use on Q interfaces".
 - [6] ETSI ETS 300 019 (all parts): "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".
 - [7] ETSI ETS 300 132-1: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 1: Operated by alternating current (ac) derived from direct current (dc) sources".

- [8] ETSI ETS 300 132-2: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)".
- [9] ETSI EN 301 489-4: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 4: Specific conditions for fixed radio links and ancillary equipment and services".
- [10] ETSI ETS 300 635: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH); Radio specific functional blocks for transmission of Mx STM-N".
- [11] ETSI ETS 300 785: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH); Radio specific functional blocks for transmission of M x sub-STM-1".
- [12] ITU-R Recommendation F.750-3: "Architectures and functional aspects of radio-relay systems for SDH-based networks".
- [13] ITU-R Recommendation F.751-2: "Transmission characteristics and performance requirements of radio-relay systems for SDH-based networks".
- [14] ITU-R Recommendation F.1102: "Characteristics of radio-relay systems operating in frequency bands above about 17 GHz".
- [15] ITU-R Recommendation F.1189-1: "Error performance objectives for constant bit rate digital paths at or above the primary rate carried by digital radio-relay systems which may form part or all of the national portion of a 27 500 km hypothetical reference path".
- [16] ITU-R Recommendation F.1191-1: "Bandwidths and unwanted emissions of digital radio-relay systems".
- [17] ITU-R Recommendation P.530-6: "Propagation data and prediction methods required for the design of terrestrial line-of-sight systems".
- [18] ITU-T Recommendation G.703 (1991): "Physical/electrical characteristics of hierarchical digital interfaces".
[SIST EN 300 198 V1.3.1:2005](https://standards.iteh.ai/catalog/standards/sist/aa9b3284-6cc3-4d57-ad60-0d4ecc4b4b8b/sist-en-300-198-v1-3-1-2005)
- [19] ITU-T Recommendation G.707 (1996): "Network node interface for the synchronous digital hierarchy (SDH)".
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- [20] ITU-T Recommendation G.773 (1993): "Protocol suites for Q-interfaces for management of transmission systems".
- [21] ITU-T Recommendation G.708: "Sub STM-0 network node interface for the synchronous digital hierarchy (SDH)".
- [22] IEC 60154-2: "Flanges for waveguides. Part 2: Relevant specifications for flanges for ordinary rectangular waveguides".
- [23] ITU-T Recommendation G.783 (1994): "Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks".
- [24] ITU-T Recommendation G.784 (1994): "Synchronous digital hierarchy (SDH) management".
- [25] ITU T Recommendation G.826 (1993): "Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate".
- [26] ITU-T Recommendation G.861 (1996): "Principles and guidelines for the integration of satellite and radio systems in SDH transport networks".
- [27] ITU-T Recommendation G.957 (1995): "Optical interfaces for equipments and systems relating to the synchronous digital hierarchy".
- [28] ITU-T Recommendation O.151 (1992): "Error performance measuring equipment operating at the primary rate and above".
- [29] ITU-T Recommendation O.181 (1996): "Equipment to assess error performance on STM-N interfaces".

- [30] ETSI TR 101 036-1 (V1.1): "Transmission and Multiplexing (TM); Digital Radio Relay Systems (DRRS); Generic wordings for standards on DRRS characteristics; Part 1: General aspects and point-to-point equipment parameters".
- [31] CEPT/ERC Recommendation 74-01: "Spurious Emissions".
- [32] ETSI TR 101 035 (V1.1): "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH) aspects regarding Digital Radio Relay Systems (DRRS)".
- [33] ETSI EN 300 639: "Fixed Radio Systems; Point-to-point equipment; Sub-STM-1 digital radio systems operating in the 13 GHz, 15 GHz and 18 GHz frequency bands with about 28 MHz co-polar and 14 MHz cross-polar channel spacing".
- [34] EN 60950: "Safety of information technology equipment".
- [35] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.
- [36] Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility.

3 Symbols and abbreviations

3.1 Symbols

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

| | |
|----------|--------------------------|
| Ω | Ohm |
| dB | decibel |
| dBm | decibel relative to 1 mW |
| GHz | GigaHertz |
| kHz | kiloHertz |
| Mbit/s | Megabits per second |
| MHz | MegaHertz |
| mW | milliWatt |
| ns | nanosecond |
| ppm | parts per million |

3.2 Abbreviations

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

| | |
|------|---|
| ac | alternating current |
| ACAP | Adjacent Channel Alternate Polarization |
| ACCP | Adjacent Channel Co-Polarization |
| ATPC | Automatic Transmit Power Control |
| AU | Administrative Unit |
| BB | Base Band |
| BBER | Background Block Error Rate |
| BER | Bit Error Rate |
| C/I | Carrier to Interference ratio |
| CMI | Coded Mark Inversion |
| CW | Continuous Wave |
| dc | direct current |
| DRRS | Digital Radio Relay Systems |
| EIRP | Equivalent Isotropically Radiated Power |
| EMC | ElectroMagnetic Compatibility |
| ESR | Errored Second Ratio |
| FSK | Frequency-Shift Keying (modulation) |

| | |
|-----------|---|
| IF | Intermediate Frequency |
| IPI | Inter-Port Isolation |
| LO | Local Oscillator |
| PDH | Plesiochronous Digital Hierarchy |
| PRBS | Pseudo Random Binary Sequence |
| QAM | Quadrature Amplitude Modulation |
| RBER | Residual BER |
| RF | Radio Frequency |
| RFC | Remote Frequency Control |
| RSL | Receive Signal Level |
| RTPC | Remote Transmit Power Control |
| SDH | Synchronous Digital Hierarchy |
| SOH | Section OverHead |
| STM-0 | medium capacity SDH radio transport module (51,840 Mbit/s AU-3 equivalent, also referred as STM-0 by ITU-T Recommendation G.861 [26]) |
| STM-N | Synchronous Transport Module, level N |
| sub-STM-0 | low capacity SDH radio transport module (n times VC-12 or VC2 equivalent) |
| TMN | Telecommunications Management Network |
| XPD | cross-Polar Discrimination |

4 General characteristics

4.1 Frequency bands and channel arrangements

4.1.1 Channel arrangements

The frequency range shall be 22 GHz to 22,6 GHz paired with 23 GHz to 23,6 GHz. The channel arrangements shall be in accordance with CEPT Recommendation T/R 13-02 [1].

For reader convenience, the basic parameters of the CEPT Recommendation are shown in annex A.

4.1.2 Channel spacing for systems operating on the same route

System bit rates and their relevant channel spacing in the present document are reported in table 1 (for the precise payload bit rates, see subclause 5.1).

NOTE: According to systems characteristics the equipment can be connected either to separate antennas or on a separate polarization to the same antenna.

Table 1: Digital systems channel spacings for various bit rates

| | Payload Bit Rate [Mbit/s]⇒ | 2 | 2 × 2 | 8 | 2 × 8 | 34 | 51 | 140 and 155 |
|------------------------|----------------------------|-----|-------|-----|-------|----|-------|-------------|
| Channel Spacings [MHz] | Class 2 equipments | 3,5 | 3,5 | 7 | 14 | 28 | 56 | |
| | Class 4 equipments | | | 3,5 | 7 | 14 | 14/28 | 56 |
| | Class 5 equipments | | | | | | | 28 |

NOTE: $n \times 2$ Mbit/s and $n \times 34$ Mbit/s bit rates may be used where appropriate.
 $n \times 2$ Mbit/s mapped into SDH VC12 transport bit rates (sub-STM-0 defined by ITU-T Recommendation G.708 [21]) may be used where appropriate (e.g. three or four times VC12 into an 8 Mbit/s channel spacing).
 The class 2, 2Mbit/s in 3.5MHz and the class 4 in 28MHz reflects equipment more typical to a class 1 (2Mbit/s) and class 3 (STM-0) system and as a result the adjacent channel interference parameters are more stringent.

For regulatory purposes in national procedures for licensing radio equipment according to the present document, the above system types shall be identified by the "system type codes" reported in annex C.