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Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 2-1: System-dependent requirements for digital systems operating in frequency bands where frequency co-ordination is applied

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European Standard (Telecommunications series)

**Fixed Radio Systems;
Characteristics and requirements for
point-to-point equipment and antennas;
Part 2-1: System-dependent requirements
for digital systems operating in frequency bands
where frequency co-ordination is applied**

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Foreword

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

The present document is part 2-1 of a multi-part deliverable covering the Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas, as identified below:

Part 1: "Overview and system-independent common characteristics";

Part 2-1: "System-dependent requirements for digital systems operating in frequency bands where frequency co-ordination is applied";

Part 2-2 "Harmonized EN covering essential requirements of Article 3.2 of R&TTE Directive for digital systems operating in frequency bands where frequency co-ordination is applied";

Part 3: "Harmonized EN covering essential requirements of Article 3.2 of R&TTE Directive for equipment operating in frequency bands where no frequency co-ordination is applied";

Part 4-1: "System-dependent requirements for antennas";

Part 4-2: "Harmonized EN covering essential requirements of Article 3.2 of R&TTE Directive for antennas".

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Introduction

The introduction of EN 302 217-1 applies.

1 Scope

The present document summarizes all system-dependent requirements for Point-to-Point (P-P) equipment in applications deployed in bands where frequency co-ordination is generally applied. These requirements are introduced in two different clauses sub-sets:

- **Main requirements** are requirements that are also related to the "essential requirements" under article 3.2 of the R&TTE Directive [1] and further detailed in EN 302 217-2-2 [16].
- **Complementary requirements** are requirements that are not related to essential requirements under article 3.2 of the R&TTE Directive [1]. Nevertheless they are considered having been commonly agreed for proper system operation and deployment when specific deployment conditions or compatibility requirements are present. Compliance to all or some of these requirements is made on a voluntary basis.

Description and limits for parameters relevant to essential requirements under article 3.2 of R&TTE Directive [1] are given in EN 302 217-2-2 [16].

For other system-dependent parameters where standardization is required but that do not affect the R&TTE Directive "essential requirements" mentioned above, description and limits are detailed in the present document in the annexes A to G, subdivided by frequency band or specific applications.

The present document deals with Radio Frequency (RF) and base-band equipment characteristics; antenna system requirements are covered in EN 302 217-4-1 (see bibliography) and EN 302 217-4-2 (see bibliography).

The present document does not cover test procedures and test conditions which are set out in EN 301 126-1 [14].

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

- Class 1: equipment spectral efficiency based on typical 2-states modulation scheme (e.g. 2-FSK, 2-PSK or equivalent);
- Class 2: equipment spectral efficiency based on typical 4-states modulation scheme (e.g. 4-FSK, 4-QAM, or equivalent);
- Class 3: equipment spectral efficiency based on typical 8-states modulation scheme (e.g. 8-PSK, or equivalent);

NOTE: It is also noted that, in this class, for design commonality with other efficiency classes, the 16 QAM format is popular).

- Class 4: equipment spectral efficiency based on typical 16-states or 32-states modulation scheme (e.g. 16-QAM or 32-QAM, or equivalent);
- Class 5A: equipment spectral efficiency based on typical 64-states or 128-states modulation scheme (e.g. 64-QAM or 128-QAM, or equivalent), for cross-polar adjacent channel (ACAP) operation;
- Class 5B: equipment spectral efficiency based on typical 64-states or 128-states modulation scheme (e.g. 64-QAM or 128-QAM, or equivalent), for co-polar adjacent channel (ACCP) and frequency reuse through CCDP operation;
- Class 6A: equipment spectral efficiency based on typical 256-states or 512-states modulation scheme (e.g. 256-QAM or 512-QAM, or equivalent), for cross-polar adjacent channel (ACAP) operation;
- Class 6B: equipment spectral efficiency based on typical 256-states or 512-states modulation scheme (e.g. 256-QAM or 512-QAM, or equivalent), for co-polar adjacent channel (ACCP) and frequency reuse through CCDP operation.

The above classes are indicative only and do not imply any constraint to the actual modulation format, provided that all the requirements in the relevant parts of this EN 302 217 series are met.

In some cases, where within the same spectral efficiency class there are different applications, (e.g. for multi-channel trunk or single channel operation), that justify different radio frequency parameters, two different equipment "types" (e.g. type 1 and 2) are provided.

Guidance on the definition of radio parameters relevant to the essential requirements under article 3.2 of R&TTE Directive [1] for DFRS may be found in TR 101 506 (see bibliography).

Technical background for most of the parameters and requirements referred to in this EN 302 217 series may be found in TR 101 036-1 (see bibliography).

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.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

- [1] 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 (R&TTE Directive).
- [2] CENELEC EN 122150: "Sectional Specification: Radio frequency coaxial connectors - Series EIA flange".
- [3] ERC/DEC(00)07: "ERC Decision of 19 October 2000 on the shared use of the band 17.7 - 19.7 GHz by the fixed service and Earth stations of the fixed-satellite service (space to Earth)".
- [4] ETSI EN 300 019-1-0: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-0: Classification of environmental conditions; Introduction".
- [5] ETSI EN 300 019-1-1: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-1: Classification of environmental conditions; Storage".
- [6] ETSI EN 300 019-1-2: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-2: Classification of environmental conditions; Transportation".
- [7] ETSI EN 300 019-1-3: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weatherprotected locations".
- [8] ETSI EN 300 019-1-4: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-4: Classification of environmental conditions; Stationary use at non-weatherprotected locations".
- [9] ETSI EN 300 019-2-0: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-0: Specification of environmental tests; Introduction".
- [10] ETSI EN 300 019-2-1: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-1: Specification of environmental tests; Storage".

- [11] ETSI EN 300 019-2-2: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-2: Specification of environmental tests; Transportation".
- [12] ETSI EN 300 019-2-3: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-3: Specification of environmental tests; Stationary use at weatherprotected locations".
- [13] ETSI EN 300 019-2-4: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-4: Specification of environmental tests; Stationary use at non-weatherprotected locations".
- [14] ETSI EN 301 126-1: "Fixed Radio Systems; Conformance testing; Part 1: Point-to-Point equipment - Definitions, general requirements and test procedures".
- [15] ETSI EN 302 217-1: "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 1: Overview and system-independent common characteristics".
- [16] ETSI EN 302 217-2-2: "Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 2-2: Harmonized EN covering essential requirements of Article 3.2 of R&TTE Directive for digital systems operating in frequency bands where frequency co-ordination is applied".
- [17] IEC 60153-2: "Hollow metallic waveguides. Part 2: Relevant specifications for ordinary rectangular waveguides".
- [18] IEC 60154-2: "Flanges for waveguides. Part 2: Relevant specifications for flanges for ordinary rectangular waveguides".
- [19] IEC 60169: "Radio-frequency connectors. Part 1: General requirements and measuring methods".
- [20] IEC 60339 (all parts): "General purpose rigid coaxial transmission lines and their associated flange connectors".
- [21] IEC 60835-2-4: "Methods of measurement for equipment used in digital microwave radio transmission systems - Part 2: Measurements on terrestrial radio-relay systems - Section 4: Transmitter/receiver including modulator/demodulator".
- [22] IEC 60835-2-8: "Methods of measurement for equipment used in digital microwave radio transmission systems - Part 2: Measurements on terrestrial radio-relay systems - Section 8: Adaptive equalizer".
- [23] IEEE 802.3-2002: "IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications".
- [24] IEEE 1802.3-2001: "IEEE Conformance Test Methodology for IEEE Standards for Local and Metropolitan Area Networks-Specific Requirements-Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications".
- [25] ITU-T Recommendation G.708: "Sub STM-0 network node interface for the synchronous digital hierarchy (SDH)".
- [26] ITU-T Recommendation O.151: "Error performance measuring equipment operating at the primary rate and above".
- [27] ITU-T Recommendation O.181: "Equipment to assess error performance on STM-N interfaces".
- [28] ITU-T Recommendation O.191: "Equipment to measure the cell transfer performance of ATM connections".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in EN 302 217-1 [15] apply.

3.2 Symbols

For the purposes of the present document, the symbols given in EN 302 217-1 [15] apply.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in EN 302 217-1 [15] apply.

4 General characteristics

For commonality of purpose, systems are sub-divided into families by frequency range of operation; one normative annex is assigned to each family of equipment. There are six families of annexes, referenced from A to F, which may be found in both in the present document and EN 302 217-2-2 [16]:

- A Frequency bands from 1,4 GHz to 2,7 GHz.
- B Frequency bands from 3 GHz to 11 GHz (Channel separation up to 30 MHz).
- C Frequency bands from 3 GHz to 11 GHz (Channel separation 40 MHz).
- D Frequency bands 13 GHz, 15 GHz and 18 GHz.
- E Frequency bands from 23 GHz to 55 GHz.
- F Transmission of packet data and combinations of other signals in bands from 3 GHz to 55 GHz.

4.1 Frequency bands and channel arrangements

Frequency bands and channel arrangements, which are relevant for equipment covered by the present document, are defined by ITU-R Recommendations and/or CEPT Recommendations and are referenced in the first table of each annex A through E (i.e. tables A.1 through E.1) of EN 302 217-2-2 [16].

ITU-R Recommendations or CEPT/ECC (Note) recommended frequency channel arrangements, known at the date of publication of this EN 302 217 series, are set out for reference only. In general, the channel arrangement is relevant neither to article 3.2 of the R&TTE Directive [1] nor for other requirements in the present document; only the frequency band, actual channel separation and, in some cases innermost channels separation are relevant for defining the set of parameters and test suites relevant to each system.

NOTE: CEPT Recommendations were published until 2002 as CEPT/ERC Recommendations; consequently to the restructuring of ERC under new ECC organization, new and revised Recommendations might formally change their reference as ECC Recommendations, without changing their technical content and applicability.

Other national or future ITU-R Recommendations or CEPT/ECC Recommendations, set around the same or close to the frequency range of present ITU-R Recommendations or CEPT/ECC Recommendations, are considered applicable to systems assessed against this EN 302 217 series, provided that they use the same channel separation.

Specification and tests of wide radio-frequency band covering units and multirate equipment are placed in normative annex G of EN 302 217-2-2 [16]. Whenever applicable, it is also valid for assessing parameters specified in the present document.

4.2 Special compatibility requirements between systems

There shall be no requirement to operate transmitting equipment from one supplier with receiving equipment from another and, depending on the deployment conditions, it shall be possible to operate the system in vertical and/or horizontal polarization, if required by the channel arrangement.

To be compatible with certain constraints given by existing installations and/or deployments already made with systems from other supplier or for different FS applications, new systems on the same path may be subject to additional requirements, other than those derived for a single supplier or same application environment.

NOTE: This does not imply that when a single supplier is involved there are no similar requirements; however, they do not need standardization because many other technical and cost-effective solutions might be flexibly adopted under suppliers' own responsibility only.

For the purposes of this EN 302 217 series the following set of compatibility requirements between systems has been defined:

- a) There may be a requirement to multiplex different suppliers' equipment on the same polarization of the same antenna. This will not apply to systems with an integral antenna.
- b) There may be a requirement to multiplex different suppliers' equipment on different polarizations of the same antenna. This will not apply to systems with an integral antenna.
- c) "There may be a requirement to coexist with analogue systems on adjacent cross-polarized channels on the same route.

4.3 Transmission capacity and spectral efficiency

The payload bit rates considered in this EN 302 217 series are commonly tailored to typical PDH and SDH baseband interfaces: 2,048 Mbit/s, $2 \times 2,048$ Mbit/s, 8,448 Mbit/s, $2 \times 8,448$ Mbit/s, 34,368 Mbit/s, $2 \times 34,368$ Mbit/s, 51,840 Mbit/s (STM-0), $2 \times 51,840$ Mbit/s ($2 \times$ STM-0), 155,520 Mbit/s (STM-1), $N \times 155,520$ Mbit/s ($N \times$ STM-1), STM-N. Only systems in annex A, due to the smaller channel separation provided, are (exceptionally) labelled with typical capacity rate without specific reference to PDH/SDH rates. In the following text these capacities will be simply referred to as 2 Mbit/s, 2×2 Mbit/s, 8 Mbit/s, 2×8 Mbit/s, 34 Mbit/s, 2×34 Mbit/s, STM-0, $2 \times$ STM-0, STM-1, $N \times$ STM-1 and STM-N.

For each system the bit rates related to each class and their relevant channel separation are detailed in the second table of each annex A through E (i.e. tables A.2 through E.2) of EN 302 217-2-2 [16] of this EN 302 217 series.

Provided that they meet all requirements of the relevant annex, equivalent PDH or SDH transport rates may be used where appropriate. Such equivalent transport rates may be:

- $N \times 2$ Mbit/s or other PDH rates in place of equivalent higher PDH rates.
- 140 Mbit/s in place of STM-1 (including 4×34 Mbit/s pre-mapping into the 140 Mbit/s frame).
- Any PDH mapping into STM-0 or STM-1 frames, as defined in the basic multiplexing schemes.
- $N \times 2$ Mbit/s mapped into SDH VC12 or VC2 transport bit rates (sub-STM-0 defined, as sSTM-1k or sSTM-2n capacities, by ITU-T Recommendation G.708 [25]) in place of a PDH rate (e.g. $4 \times$ VC12/sSTM14 or $1 \times$ VC2/sSTM21 in place of 8 Mbit/s).

NOTE: In addition to this general principle, annex D (system D.2) presents specific characteristics for sub-STM-0 systems in the 18 GHz band.

- any other signal (e.g. IP frames or ATM cells, even possibly mixed with PDH capacities) mapping into PDH or SDH frames, according present or future basic ITU-T or ETSI multiplexing schemes.

The present document is also applicable to other base band interfaces (e.g. packet data interfaces or mixed interfaces) even if multiplexed (including compression algorithms if any) into proprietary frames; for such cases annex F gives the basic rules for applying the conventional PDH/SDH set of parameters to those equipment assessment.

5 Main requirements

This clause summarizes requirements related to the "essential requirements" under article 3.2 of the R&TTE Directive [1] that are further detailed in EN 302 217-2-2 [16]. However, for some requirements, besides the relevant essential limits set out in EN 302 217-2-2 [16] for the purpose of their separate publishing in the Official Journal of the European Communities (OJEC) under the R&TTE Directive [1], additional, non-essential, more stringent limits are here set out in response to specific compatibility requirements by network operators when deploying new systems on the same routes with existing systems from other suppliers.

The specified transmitter and receiver characteristics shall be met with the appropriate baseband signals applied at reference point X' and received from reference point X of figure 1 of EN 302 217-1 [15].

Table 1: Baseband test signals

Type of baseband signal interface at X/X'	Test signal to be applied according to...
PDH	PRBS ITU-T Recommendation O.151 [26]
SDH	ITU-T Recommendation O.181 [27]
ATM	ITU-T Recommendation O.191 [28]
Ethernet interface (packet data)	IEEE 802.3 [23], IEEE 1802.3 [24]
Other than the above	Relevant standards which the interface refers to

5.1 Transmitter characteristics

5.1.1 Transmitter power

The only essential requirement is the Maximum Output Power which is an essential requirement under article 3.2 of R&TTE Directive [1] and is specified in EN 302 217-2-2 [16].

For guidance, in addition to the absolute maximum transmitter power, typical values of transmitter highest power for real equipment, of feeder loss and length, and of antenna diameter and gain are provided in TR 102 243-1 (see bibliography) in order to support inter- and intra- compatibility and sharing analysis.

In some frequency bands, or parts of frequency bands, ITU-R Recommendations define specific limits in terms of output power and/or EIRP (or output power and/or EIRP density) in order to improve the compatibility with other Radio Services sharing these frequency bands with the FS.

An additional capability for output power level adjustment may be required, for regulatory purposes, in the interface regulations according to article 4.1 of the R&TTE Directive [1], in which case the range of adjustment, either by fixed or automatic attenuators, should be in increments of 5 dB or less.

In particular, for the band 18 GHz, the FS shall, where practical, implement the appropriate mitigation techniques as required in ERC/DEC(00)07 [3]. See informative annex H.

5.1.2 Transmitter power and frequency control

5.1.2.1 Transmitter power control (ATPC and RTPC)

5.1.2.1.1 Automatic Transmitter Power Control (ATPC)

This functionality is relevant to essential requirements under article 3.2 of R&TTE Directive [1] and is specified in EN 302 217-2-2 [16].

Besides those essential requirements specified in EN 302 217-2-2 [16], ATPC may be requested as mandatory functionality in the licensing conditions for the following purposes:

- to enhance network density (see note 1);
- as a mitigation factor for sharing with other Services due to CEPT Decisions (see notes 2 and 3).

Administrations should explicitly state whether ATPC is used as a regulatory measure for either frequency coordination or as a mitigation technique to protect other services in its radio regulation interface for notification according to article 4.1 of the R&TTE Directive [1].

NOTE 1: In this particular case, as an additional, but non-essential to article 3.2, requirement, it may be specified that transmitter output power meet the spectrum mask limits set out in clause 4.2 of EN 302 217-2-2 [16] throughout the ATPC range.

NOTE 2: The first example is in the 18 GHz band, where since there is sharing between FS and FSS, ATPC will become a mandatory feature for all new equipment to be deployed after the date referred by ERC/DEC (00)07 [3], however, the actual usage of ATPC will be required only where practical and depending on local sharing conditions with satellite services and local deployment conditions in existing networks. The ATPC range is not subject to standardization.

NOTE 3: When used as mitigation factor ATPC should not be, in principle, used to enhance network density.

5.1.2.1.2 Remote Transmitter Power Control (RTPC)

This parameter is relevant to essential requirements under article 3.2 of R&TTE Directive [1] and is specified in EN 302 217-2-2 [16].

5.1.2.2 Remote Frequency Control (RFC)

This parameter is relevant to essential requirements under article 3.2 of R&TTE Directive [1] and is specified in EN 302 217-2-2 [16].

5.1.3 Transmitter output power tolerance

The only essential requirement is the power tolerance around the nominal output power together with the associated temperature range, declared by the supplier, which is considered essential under article 3.2 of R&TTE Directive [1]. For relevant limits see EN 302 217-2-2 [16].

An additional ETSI voluntary requirement may be required where more stringent limits apply according to the specific environmental condition for which the equipment is designed. In this case, when specified, the tolerance of the nominal output power shall be within the limits specified for:

- Systems operating within classes of weather protected locations defined in EN 300 019-1-0 [4] to EN 300 019-2-4 [13];
nominal output power, when specified, within $\pm A$ dB; the value for A is system dependent and is given in the relevant annex(es).
- Systems operating within non-weather protected locations classes 4.1 and 4.1E and within classes 3.3, 3.4 and 3.5 weather protected locations defined in EN 300 019-1-0 [4] to EN 300 019-1-4 [8];
nominal output power within $\pm B$ dB; the value for B is system dependent and is given in the relevant annex(es).

In any case, the less stringent tolerance ($\pm B$ dB or the only one when a single tolerance exists), when applied to the operational environmental profile declared by the supplier (i.e. not necessarily an ETSI standardized one), is considered essential to article 3.2 and contained in EN 302 217-2-2 [16]. Only voluntary and more stringent tolerances are specified in the present document.

5.1.4 Radio Frequency (RF) spectrum mask

The radio frequency spectrum density mask is relevant to essential requirements under article 3.2 of R&TTE [1], the limits for the essential portion of RF spectrum density masks are found in EN 302 217-2-2 [16].

Additional non-essential requirements for spectrum density masks may have to be met in cases where there is a requirement for internal system dependent reasons only. Where more stringent RF spectrum masks are required, they may be found in the relevant annex(es) of the present document.