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European Standard (Telecommunications series)

Transmission and Multiplexing (TM); Digital Radio Relay Systems (DRRS); Plesiochronous Digital Hierarchy (PDH); Low and medium capacity and STM-0 DRRS operating in the frequency bands in the range 3 GHz to 11 GHz

Reference

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Keywords

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Contents

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Transmission and Multiplexing (TM), and is now submitted for the Public Enquiry phase of the ETSI standards Two-step Approval Procedure.

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

1 Scope

The present document specifies the minimum performance parameters for low and medium capacity terrestrial fixed service digital radiocommunications equipment operating in the frequency bands between around 3 GHz and 11 GHz but nevertheless such system should provide the efficient use of the spectrum under any conditions.

The present document covers equipment intended to be used at nominal data rates for PDH systems between 2 Mbit/s and 2 × 34 Mbit/s and for SDH systems transmitting STM-0 signals with a VC3 payload capacity.

Consideration has to be given to special requirements of the local and access network especially different network structures with high density nodes.

The systems considered are envisaged to operate in these networks having regard for existing hop lengths which mainly depend on the intended frequency band, the performance objectives set by relevant ITU-R Recommendations or national network operators requirements and existing propagation characteristics. The hop lengths are considered to be up to about 100 km in the frequency band 3 GHz and 60 km in the frequency band 11 GHz taking into account diversity techniques.

Typical applications include:

a) point-to-point links in local, regional and national networks;

b) mobile base station connections;

c) business networks connections;

d) customer access links.

The parameters to be specified fall into two categories:

a) Those that are required to provide compatibility between RF channels from different sources of equipment on the same route, connected either to:

   - separate antennas, or to;

   - separate polarization of the same antenna.

b) Parameters defining the transmission quality of the proposed system.

The standardization deals with RF and baseband characteristics relevant to low and medium capacity PDH and STM-0 SDH transmission. Spurious emissions and EMC requirements are also included in the present document. Antenna/feeder system requirements are covered in ETS300 833 [1].

As the maximum transmission rate in a given bandwidth depends on systems spectral efficiency, different Classes are defined:

Class 1:	Equipment based on performances of a typical 4-states modulation scheme
Class 2:	Equipment based on performances of a typical 16-states modulation scheme
Class 3:	Equipment based on performances of a typical 32 or 64-states modulation scheme

Safety aspects are outside the mandate of ETSI and they will not be considered in the present document.

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, subsequent revisions do apply.
- A non-specific reference to an ETS should also be taken to refer to later versions published as an EN with the same number.

[1] ETS 300 833: "Transmission and Multiplexing (TM); Digital Radio Relay Systems (DRRS); Antennas used in point-to-point DRRS operating in the frequency band 3 to 60 GHz".

[2] ERC/REC 14-03 E: "Harmonized radio frequency channel arrangements for low and medium capacity systems in the band 3400 MHz to 3600 MHz".

[3] ERC/REC 12-08: "Harmonized Radio Frequency Channel Arrangements and Block Allocations for Medium and High Capacity Systems in the band 3600 MHz to 4200 MHz".

[4] ITU-R Recommendation F.383: "Radio-frequency channel arrangements for high capacity radio relay systems operating in the lower 6 GHz band".

[5] ITU-R Recommendation F.384: "Radio-frequency channel arrangements for medium and high capacity analogue or digital radio-relay systems operating in the upper 6 GHz band".

[6] ITU-R Recommendation F.385: "Radio-frequency channel arrangements for radio-relay systems operating in the 7 GHz band".

[7] ITU-R Recommendation F.386: "Radio-frequency channel arrangements for medium and high capacity analogue or digital radio-relay systems operating in the 8 GHz band".

[8] ITU-R Recommendation F.746: "Radio-frequency channel arrangements for radio-relay systems".

[9] ITU-R Recommendation F.747: "Radio-frequency channel arrangements for radio-relay systems operating in the 10 GHz band".

[10] ERC/REC 12-05: "Harmonized radio frequency channel arrangements for digital terrestrial fixed systems operating in the band 10,0 - 10,68 GHz".

[11] ITU-R Recommendation F.635: "Radio-frequency channel arrangements based on a homogeneous pattern for radio-relay systems operating in the 4 GHz band".

[12] ITU-R Recommendation F.382: "Radio-frequency channel arrangements for radio-relay systems operating in the 2 and 4 GHz bands".

[13] ITU-R Recommendation F.1092: "Error performance objectives for constant bit rate digital path at or above the primary rate carried by digital radio-relay systems which may form part of the international portion of a 27 500 km hypothetical reference path".

[14] ITU-R Recommendation F.1189: "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".

[15] ITU-R Recommendation F.557: "Availability objective for radio-relay systems over a hypothetical reference circuit and a hypothetical reference digital path".

[16] ITU-T Recommendation G.826: "Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate".

[17] ITU-T Recommendation G.827: "Availability parameters and objectives for path elements of international constant bit-rate digital paths at or above the primary rate".

[18] ITU-R Recommendation F.752: "Diversity techniques for radio-relay systems".

[19] ITU-R Recommendation F.1093: "Effects of multipath propagation on the design and operation of line-of-sight digital radio-relay systems".

[20] ITU-R Recommendation F.1101: "Characteristics of digital radio-relay systems below about 17 GHz".

[21] ETS 300 019, Parts 1 and 2: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-2: Classification of environmental conditions; Transportation".

[22] ETS 300 132: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment".

[23] ETS 300 385: "Radio Equipment and Systems (RES); ElectroMagnetic Compatibility (EMC) standard for digital fixed radio links and ancillary equipment with data rates at around 2 Mbit/s and above".

[24] ITU-T Recommendation G.773: "Protocol suites for Q-interfaces for management of transmission systems".

[25] IEC 60154: "Flanges for Waveguides".

[26] ITU-T Recommendation G.703: "Physical / electrical characteristics of hierarchical digital interfaces".

[27] ITU-T Recommendation G.704: "Synchronous frame structures used at 1544, 6312, 2048, 8488 and 44 736 kbit/s hierarchical levels".

[28] ITU-T Recommendation I.412: "ISDN user-network interfaces - Interface structures and access capabilities".

[29] ETS 300 233: "Integrated Services Digital Network (ISDN); Access digital section for ISDN primary rate".

[30] ITU-T Recommendation G.707: "Network node interface for the synchronous digital hierarchy (SDH)".

[31] ITU-T Recommendation G.781: "Structure of Recommendations on equipment for the synchronous digital hierarchy".

[32] ITU-T Recommendation G.782: "Types and general characteristics of SDH equipment".

[33] ITU-T Recommendation G.783: "Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks".

[34] ITU-T Recommendation G.784: "Synchronous digital hierarchy (SDH) management".

[35] ITU-T Recommendation G.957: "Optical interfaces for equipments and systems relating to the synchronous digital hierarchy".

[36] ITU-R Recommendation F.750: "Architectures and functional aspects of radio-relay systems for SDH-based networks."

[37] ITU-R Recommendation SM.329: "Spurious emissions".

[38] ITU-R Recommendation F.1191: "Bandwidths and unwanted emissions of digital radio-relay systems"

[39] ETS 300 119: "Equipment Engineering (EE); European telecommunication standard for equipment practice".

[40] TR 101 035: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH) aspects regarding Digital Radio Relay Systems (DRRS)".

[41] TR 101 036-1: "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".

3 Symbols and abbreviations

3.1 Symbols

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

dB decibel
dBm decibel relative to 1 mW
Hz hertz
GHz gigahertz
kbit/s kilobits per second
kHz kilohertz
km kilometer
Mbit/s megabits per second
MHz megahertz
ns nanosecond
ppm part per million

3.2 Abbreviations

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

ACDP Adjacent Channel Dual Polarized
ATPC Automatic Transmit Power Control
BBER Background Bit Error Rate
BER Bit Error Ratio
C/I Carrier to Interference ratio
CMI Coded Marked Inverted
CS Channel Spacing
CW Continuous Wave
EMC ElectroMagnetic Compatibility
ERC European Radio Committee
Fc Cut-off Frequency
Fs Symbol Rate
IF Intermediate Frequency
ISDN Integrated Services Digital Network
LO Local Oscillator
NFD Net Filter Discrimination
PDH Plesiochronous Digital Hierarchy
PSTN Public Switched Telecommunication Network
RF Radio Frequency

RSL	Receive Signal Level
Rx	Receiver
SDH	Synchronous Digital Hierarchy
SOH	Section OverHead
STM	Synchronous Transfer Module
TMN	Telecommunications Management Network
Tx	Transmitter
VC	Virtual Container
W/U	Wanted to Unwanted ratio
XPD	Cross Polar Discrimination

4 General Characteristics

4.1 Frequency bands and channel arrangements

4.1.1 Channel plan

The equipment should operate on one or more of the frequency ranges defined below.

The frequency ranges are:

- 3,410 GHz to 3,600 GHz;
- 3,600 GHz to 4,200 GHz;
- 5,925 GHz to 6,425 GHz;
- 6,425 GHz to 7,100 GHz;
- 7,110 GHz to 7,900 GHz;
- 7,725 GHz to 8,500 GHz;
- 10,000 GHz to 10,680 GHz.

The channel plan should be in accordance with the CEPT ERC or ITU-R Recommendations listed in the Table 1 below.

Table 1: Relevant CEPT ERC and ITU-R Recommendations

CEPT ERC or ITU-R Recommendation	Band	Frequency range
ERC/REC 14-03 E [2]	3,5 GHz	3,410 GHz to 3,600 GHz
ERC/REC 12-08 [3] Annex A	4 GHz	3,600 GHz to 4,200 GHz
ERC/REC 12-08 [3] Annex B Part 2	id	3,600 GHz to 3,800 GHz
ERC/REC 12-08 [3] Annex B Part 1	id	3,800 GHz to 4,200 GHz
ITU-R Recommendation F. 383 [4]	L6 GHz	5,925 GHz to 6,425 GHz
ITU-R Recommendation F.384 [5]	U6 GHz	6,425 GHz to 7,100 GHz
ITU-R Recommendation F.385 [6]	7 GHz	7,125 GHz to 7,425 GHz
id	id	7,425 GHz to 7,725 GHz
id	id	7,250 GHz to 7,550 GHz
id	id	7,550 GHz to 7,850 GHz
ITU-R Recommendation F.385 [6] Annex 1	id	7,425 GHz to 7,725 GHz
ITU-R Recommendation F.385 [6] Annex 3	id	7,110 GHz to 7,750 GHz
ITU-R Recommendation F.385 [6] Annex 4	id	7,425 GHz to 7,900 GHz
ITU-R Recommendation F.386 [7]	8 GHz	8,200 GHz to 8,500 GHz
ITU-R Recommendation F.386 [7] Annex 1	id	7,725 GHz to 8,275 GHz
ITU-R Recommendation F.386 [7] Annex 3	id	8,275 GHz to 8,500 GHz
ITU-R Recommendation F.386 [7] Annex 4 (see note)	id	7,900 GHz to 8,400 GHz
ITU-R Recommendation F.746 [8] Annex 4	10 GHz	10,300 GHz to 10,680 GHz
ITU-R Recommendation F.747 [9]	10 GHz	10,500 GHz to 10,680 GHz
ERC/REC 12-05 [10]	10 GHz	10,150 GHz to 10,300 GHz paired with 10,500 GHz to 10,650 GHz
NOTE: Annex 4 of ITU-R Recommendation F.386 [7] is currently under approval in ITU-R.		

Description of relevant characteristics is provided by Tables 2a and 2b.

Table 2a: Channel plans characteristics/PDH applications

Frequency band	Band limits	Channel spacing	Transmit/ receive spacing
ERC/REC 14-03 E [2]	3,410 GHz to 3,600 GHz	1,75/3,5/7/14MHz	100 MHz or 50 MHz
ERC/REC 12-08 [3] Annex A Part 1 Annex A Part 2 Annex B Part 1 Annex B Part 2	 3,6 GHz to 4,2 GHz based on ITU-R Rec F.635 [11] 3,6 GHz to 4,2 GHz based on ITU-R Rec F.635 [11] 3,8 GHz to 4,2 GHz based on ITU-R Rec F.382 [12] 3,6 GHz to 3,8 GHz divided into 0,25 MHz slots	 20 MHz 15/30 MHz 14,5/29 MHz 1,75/3,5/7/ 14 MHz (basic raster 0,25 MHz)	 320 MHz 320 MHz 213 MHz 100 or 50 MHz
ITU-Rec. F.383 [4]	5,925 GHz to 6,425 GHz	29,65 MHz	252,04 MHz
7 GHz ITU-Rec. F.385 [6]	7,425 GHz to 7,725 GHz 7,125 GHz to 7,425 GHz 7,250 GHz to 7,550 GHz 7,550 GHz to 7,850 GHz	7/14/28 MHz	161 MHz
ITU-Rec. F.385 [6] Annex 1	7,425 GHz to 7,725 GHz	28 MHz	154 MHz
ITU-Rec. F.385 [6] Annex 3	7,110 GHz to 7,750 MHz	28 MHz	196 MHz
ITU-Rec. F.385 [6] Annex 4	7,425 GHz to 7,900 GHz	7/14/28 MHz	245 MHz
ITU-Rec. F.386 [7]	8,200 GHz to 8,500 GHz	11,662 MHz	151,614 MHz
ITU-Rec. F.386 [7] Annex 1	7,725 GHz to 8,275 GHz	29,65 GHz	311,32 MHz
ITU-Rec. F.386[7] Annex 3	8,275 GHz to 8,500 GHz id	14/28 MHz 7/14/28 MHz	119 MHz 126 MHz
ITU-Rec. F.386[7] Annex 4	7,900 GHz to 8,400 GHz	7/14/28 MHz	266 MHz
ITU-Rec. F.747[9] ITU-Rec. F.747[9] Annex 1	10,5 GHz to 10,68 GHz	3,5/7/14 MHz (homogeneous pattern 3,5 MHz)	91 MHz
ERC/REC 12-05 [10]	10,15 GHz to 10,30 GHz paired with 10,5 GHz to 10,65 GHz	3,5/7/14/28 MHz (basic raster 0,5 MHz)	350 MHz

Table 2b: Channel plans characteristics/STM-0 applications

Frequency band	Band limits	Channel spacing	Transmit/ receive spacing
ERC/REC 14-03 E [2]	3,410 GHz to 3,600 GHz	14 MHz	100 MHz or 50 MHz
ERC/REC 12-08 [3] Annex A Part1 Annex A Part 2 Annex B Part 1 Annex B Part 2	3,6 GHz to 4,2 GHz 3,6 GHz to 4,2 GHz based on ITU-R Rec F.635 [11] 3,6 GHz to 4,2 GHz based on ITU-R Rec F.635 [11] 3,8 GHz to 4,2 GHz based on ITU-R Rec 382 [12] 3,6 GHz to 3,8 GHz divided into 0,25 MHz slots	 20 MHz 15/30 MHz 14,5/29 MHz 14 MHz (basic raster 0,25 MHz)	 320 MHz 320 MHz 213 MHz 100 MHz or 50 MHz
L6 GHz ITU-Rec. F.383 [4]	5,925 GHz to 6,425 GHz	29,65 MHz	252,04 MHz
U6 GHz ITU-Rec. F.384 [5]	6,425 GHz to 7,100 GHz	20 MHz	340 MHz
7 GHz ITU-Rec. F.385 [6]	7,125 GHz to 7,425 GHz 7,425 GHz to 7,725 GHz 7,250 GHz to 7,550 GHz 7,550 GHz to 7,850 GHz	14 MHz, 21 MHz, 28 MHz	161 MHz
7 GHz ITU-Rec. F.385 [6] Annex 1	7,425 GHz to 7,725 GHz	28 MHz	154 MHz
7 GHz ITU-Rec. F.385 [6] Annex 3	7,110 GHz to 7,780 MHz	28 MHz	196 MHz
7 GHz ITU-R F.385 [6] Annex 4	7,425 GHz to 7,900 GHz	14/28 MHz	245 MHz
8 GHz ITU-Rec. F.386 [7]	8,200 GHz to 8,500 GHz	2 × 11,662 MHz	151,614 MHz
8 GHz ITU-Rec. F.386 [7] Annex 1	7,725 GHz to 8,275 GHz	29,65 MHz	311,32 MHz
8 GHz ITU-R F.386 [7] Annex 3	8,275 GHz to 8,500 GHz id	14/28 MHz 14/21/28 MHz	119 MHz 126 MHz
8 GHz ITU-R F.386 [7] Annex 4	7,900 GHz to 8,400 GHz	14/28 MHz	266 MHz
10 GHz ERC/REC 12-05 [10]	10,15 GHz to 10,30 GHz paired with 10,5 GHz to 10,65 GHz	14/28 MHz (basic raster 0,5 MHz)	350 MHz
10 GHz ITU-Rec. F.746 [8] Annex 4	10,300 GHz to 10,680 GHz	20 MHz	

4.1.2 Channel Spacing for systems operating on the same route

Multiple channel operation via branching networks is a system consideration and is outside the scope of the present document.

The systems in the present document are designed to operate on the same route using the combinations of co-polar or cross-polar channel spacings and nominal system bit rate given in Tables 3a and 3b (for the precise payload Bit Rates see Subclause 5.1). In practice, when common antenna operation is envisaged, adjacent channels may be connected to a different polarization of the same antenna.

Table 3a: Channel spacing for particular PDH bit rates

		Co-polar spacing						Cross-polar spacing
	Nominal Payload Bit Rate Mbit/s	**2 Mbit/s**	**2 × 2 Mbit/s**	**8 Mbit/s**	**2 × 8 Mbit/s**	**34 Mbit/s**	**2 × 34 Mbit/s**	**2 × 34 Mbit/s**
Channel Spacing	Class 1	1,75 MHz	3,5 MHz	7 MHz/ 11,662 MHz	14 MHz/ 14,5 MHz/ 15 MHz	28 MHz/ 29 MHZ/ 29,65 MHz/ 30 MHz	---	---
	Class 2	----	1,75 MHz	3,5 MHz	7 MHz	14 MHz/ 14,5 MHz/ 15 MHz	28 MHz/ 29 MHz/ 29,65 MHz/ 30 MHz	---
	Class 3	----	---	---	---	---	14 MHz/ 14,5 MHz/ 15 MHz	14 MHz/ 14,5 MHz/ 15 MHz (note)

NOTE: Variations of Class 3 equipment exist designed to operate cross-polarization in adjacent channels (ACDP systems). In this case the co-polar CS would become 28 MHz, 29 MHz or 30 MHz.

Table 3b: Channel spacing for STM-0bit rate

	Nominal Payload bit rate (Mbit/s)	**51 Mbit/s**				
Channel Spacing	Class 2	---	20 MHz	21 MHz	2 × 11,662 MHz	28 MHz/ 29 MHz/ 29,65 MHz/ 30 MHz
	Class 3	14 MHz/ 14,5 MHz/ 15 MHz	---	---	---	---

4.2 Compatibility requirements between systems

There should be no requirement to operate transmitting equipment from one manufacturer with receiving equipment from another.

Different manufacturer equipment may be used on different polarization of the same antenna but there should be no requirement to multiplex different manufacturer equipment on the same polarization of the same antenna.

4.3 Performance and availability requirements

Equipment should be designed in order to meet network performance and availability requirements foreseen by ITU-R Recommendations, F.1092 [13], F. 1189 [15] and F.557 [15] following the criteria defined in ITU-T Recommendations G.826 [16] and G.827 [17] for international or national portion of the digital path.

The implication of the link design on the performance is recognized and the general design criteria reported in ITU-R Recommendations F.752 [18], F.1093 [19], F.1101 [20], F.1092 [13] and F.1189 [14] are to be applied.

4.4 Environmental conditions

Both indoor and partially outdoor installations are considered.

The equipment should be required to meet the environmental conditions set out in ETS 300 019 [21] which defines weather protected and non-weather protected locations, classes and test severity.

The manufacturer should state which class the equipment is designed to withstand.

4.4.1 Equipment within weather protected locations (indoor locations)

Equipment intended for operation within temperature controlled locations or partially temperature controlled locations should meet the requirements of ETS 300 019 [21] classes 3.1 and 3.2 respectively.

Optionally, the more stringent requirements of ETS 300 019 [21] classes 3.3 (Non-temperature controlled locations), 3.4 (Sites with heat trap) and 3.5 (Sheltered locations) may be applied.

4.4.2 Equipment for non-weather protected locations (outdoor locations)

Equipment intended for operation within non-weather protected locations should meet the requirements of ETS 300 019 [21], class 4.1 or 4.1E.

Class 4.1 applies to many European countries and class 4.1E applies to all European countries.

4.5 Power supply

The power supply interface should be in accordance with the characteristics of one or more of the secondary voltages foreseen in Part 1 and Part 2 of ETS 300 132 [22].

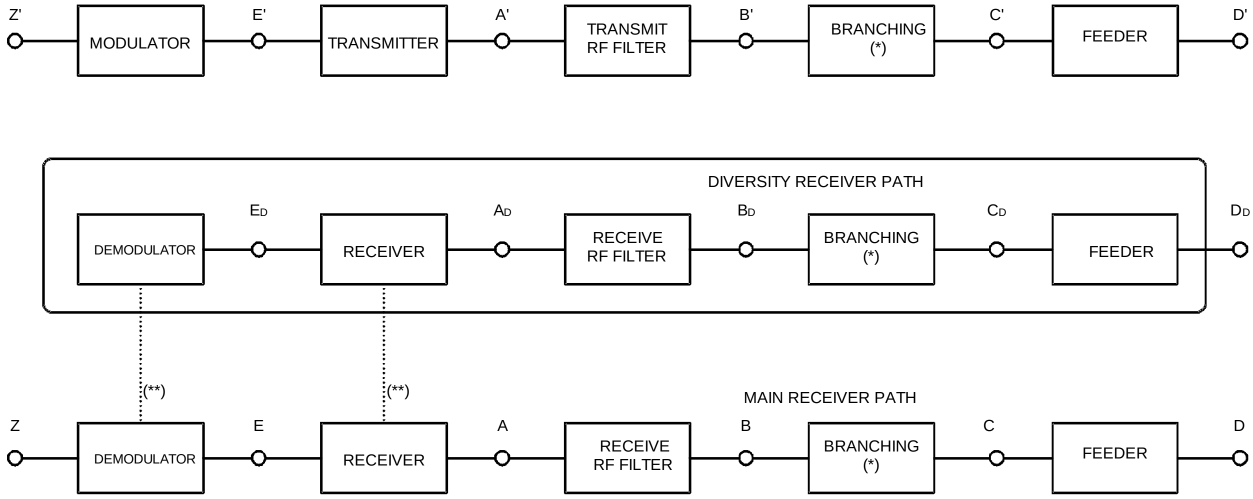
NOTE: Some applications may require secondary voltages that are not covered by ETS 300 132 [22].

For DC systems, the positive pole of the voltage supply should be earthed at the source.

4.6 ElectroMagnetic compatibility

Equipment should operate under the conditions specified in ETS 300 385 [23].

4.7 System block diagram



(*) NO FILTERING INCLUDED
(**) ALTERNATIVE CONNECTION AT RF, IF OR BASEBAND
NOTE 1: For the purpose of defining the measurement points, the branching network does not include a hybrid.
NOTE 2: The points shown above are reference points only; points C and C', D and D' in general coincide.
NOTE 3: Points B and C, B' and C' may coincide when simple duplexer is used.
NOTE 4: Diversity is an optional feature.

Figure 1: System Block Diagram

4.8 TMN interface

TMN interface, if any, should be in accordance with ITU-T Recommendation G.773 [24].

NOTE: The standardization of TMN interface functionalities is under responsibility and development in ETSI TC TMN (formerly in TM2), and will be applicable to the radio relay systems considered in the present document.

4.9 Mechanical requirements

See Annex A.5.

4.10 Feeder and antenna requirements

4.10.1 Antenna radiation pattern

See Annex A.1.

4.10.2 Antenna cross-polar discrimination

See Annex A.1.

4.10.3 Waveguide flanges

If a waveguide flange is used at point C/C', the following type should all be used in accordance with IEC 60154 [25].

Table 4: RF Waveguide Interfaces

Frequency band	Waveguide flange
3,5 GHz	UDR/UBR/PBR/CBR 32
4 GHz	UDR/UBR/PBR/CBR 40
U6 GHz	UDR/UBR/PBR/CBR 70
7 GHz	UDR/PDR/CDR 70 or 84 UBR/PBR/CBR 70 or 84
8 GHz	UDR/PDR/CDR 84 UBR/PBR/CBR 84
10,5 GHz	UDR/PDR/CDR 100 UBR/PBR/CBR 100 UDR/PDR/CDR/120 UBR/PBR/CBR 120

4.10.4 Return loss

The minimum return loss of the branching system should be 20 dB for Class 3 systems, 15 dB for Class 2 systems and 12 dB for Class 1 systems. The measurement should be referred to point C/C' towards the radio equipment and across a frequency band greater than or equal to 0,7 times the maximum aggregate symbol rate.

When antenna is an integral part of the system there should be no requirement.

NOTE: For indoor systems, a feeder + antenna return loss equal or better than 20 dB is assumed. If this performance is not achieved, values better than the above return loss figures may be required.

For feeder/antenna RL information, see Annex A.1.

5 Parameters for digital systems

5.1 Transmission Capacity

For sake of simplicity in the present document the considered nominal 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 and 51 Mbit/s (STM-0), these capacities will appear in Tables 3a, 3b, 8, 10a, 10b, 11 and in the titles of Figures 2a to 2e.

However, the actual payload Bit Rate(s) considered should be 2,048 Mbit/s, 8,448 Mbit/s, 34,368 Mbit/s and STM-0 or any combinations of n × 2,048 Mbit/s (e.g. with n in the range 1 to 32) and n × 8,448 Mbit/s (e.g. with n in the range 1 to 8).

Moreover medium capacity systems sometimes offer the option for one additional 2,048 Mbit/s way-side traffic built in the radio frame complementary overhead; if this additional capacity will have the same transmission quality and equivalent TMN functionality of the standard payload rate, it should be considered among payload (e.g. resulting, in 34 Mbit/s and STM-0 systems, in a transmission capacity of 17 Mbit or 22 × 2,048 Mbit/s respectively).

For example the relevant requirements, for the following n × 2,048 Mbit/s, can be found:

for 4 × 2 Mbit/s in the rows related to 8 Mbit/s;

for 8 × 2 Mbit/s (9 × 2 Mbit/s if applicable) in the rows related to 2 × 8 Mbit/s;

for 16 × 2 Mbit/s (17 × 2 Mbit/s if applicable) in the rows related to 34 Mbit/s;

for 21 × 2 Mbit/s (22 × 2 Mbit/s if applicable) in the rows related to 51 Mbit/s.

5.2 Baseband Parameters

5.2.1 Plesiochronous interfaces

Plesiochronous interfaces at 2 Mbit/s, 8 Mbit/s and 34 Mbit/s should comply with ITU-T Recommendation G.703 [26]. Parameters for service channels and wayside traffic channels are outside the scope of the present document.

5.2.2 ISDN interface (primary rate)

The transmission of 2 Mbit/s signals using the structure and functions of ISDN primary multiplex signals is to be in accordance with ITU-T Recommendations G.703 [26], G.704 [27], I.412 [28] and ETS 300 233 [29].

5.2.3 SDH baseband interface

The SDH baseband interfaces are in accordance with ITU-T Recommendations G.703 [26], G.707 [30], G.781 [31], G.782 [32], G.783 [33], G.784 [34] and G.957 [35] (with possible simplifications under study in ETSI TM3 and TM4) and ITU-R Recommendation F.750 [36].

Two STM-1 interfaces should be possible:

- CMI electrical (ITU-T Recommendation G.703 [26]);
- Optical (ITU-T Recommendation G.957 [35]).

The use of reserved bytes contained in the SOH, and their termination should be in accordance with ITU-R Recommendation F.750 [36]. Further details on the possible use of the SOH bytes reserved for future international standardization are given in TR 101 035 [40].

5.3 Transmitter Characteristics

The specified transmitter characteristics should be met with the appropriate baseband signals applied at reference points Z' of Figure 1.

5.3.1 Transmitter Power Range

The maximum value of output power at reference point B' (for equipment with multichannel branching system) or C' (for equipment with simple duplexer) of the system block diagram (Figure 1) should not exceed +40 dBm under any conditions. If for proper operation of the system, a lower transmitter output power is required, then an internal or external means of adjustment should be provided.

The maximum nominal value should be declared by the manufacturer.

5.3.2 Automatic Transmit Power Control

ATPC is an optional feature.

If implemented, the ATPC range should not be less than 10 dB.

NOTE : For hop lengths of more than about 35 km an ATPC device with a range of more than 20 dB may be required for use on the same polarization on different antennas on the same route.

Equipment with ATPC will be subject to Manufacturer declaration of ATPC range and related tolerances.

Testing should be carried out with output power level corresponding to:

- ATPC set manually to a fixed value for system performance (see Subclauses 5.5 and 5.6);
- ATPC set at maximum provided power for Tx performance (see Subclause 5.3).

Further information on ATPC is given in Annex A.2.

5.3.3 Transmitter output power tolerance

The tolerance of the nominal output power should be within:

- nominal output power ± 2 dB for systems operating within non-weather protected locations;
- nominal output power ± 1 dB for systems operating within weather protected locations.

5.3.4 Tx local oscillator frequency arrangements

There should be no requirement on LO frequency arrangement.

5.3.5 RF spectrum mask

The spectrum masks are shown in Figures 2a to 2e.

The 0 dB level shown on the spectrum masks relates to the spectral power density of the actual centre frequency disregarding residual carrier.

The masks do not include frequency tolerance.

In some particular circumstances as mentioned in the clause A.3, tighter requirements are required.

The spectrum analyser settings for measuring the RF spectrum mask detailed in Figures 2a to 2e are shown in the Table 5 below.

Table 5 shows the recommended spectrum analyser settings for measurement on a band ≤ 10 Fs across centre frequency, for wider band measurement an IF bandwidth of 1 MHz and a Video bandwidth of 10 kHz may be used.

Table 5: Spectrum Analyser Settings for RF Power Spectrum Measurement

Parameter	**Setting**				
Channel Spacing	1,75 MHz	3,5 MHz	7 MHz 11,662 MHz	14 MHz 14,5 MHz 15 MHz	≥20 MHz
RF Centre Frequency	**Spectrum Centre**				
Amplitude Scale	10 dB/div	10 dB/div	10 dB/div	10 dB/div	10 dB/div
IF Bandwidth	30 kHz	30 kHz	30 kHz	100 kHz	100 kHz
Sweep Width	10 MHz	20 MHz	50 MHz	100 MHz	200 MHz
Scan Time	Automatic				
Video Bandwidth Filter	300 Hz	300 Hz	300 Hz	300 Hz	300 Hz

5.3.6 Spectral lines at the symbol rate

The power level (Reference point B') of spectral lines at a distance from the channel frequency equal to the symbol rate should not be more than -30 dBm or should fall within the relevant RF Spectrum mask defined in Subclause 5.3.5, whichever is less stringent requirement.

Other unwanted emissions at distance from transmitter centre frequency equal to multiples of the symbol rate should fall within the spectrum mask provided by Subclause 5.3.5.

5.3.7 Spurious emissions

It is necessary to define spurious emissions from transmitters for two reasons:

a) to limit interference into systems operating wholly externally to the system (external emissions) which limits are referred by ITU-R Recommendations SM.329 [37] and F.1191 [38];

b) to limit local interference within the system where transmitters and receivers are directly connected via the filter and branching systems (internal emissions).

This leads to two sets of spurious emission limits where the specific limits given for 'internal' interference are required to be no greater than the 'external' level limits at reference point C'.

5.3.7.1 Spurious emissions - external

According to ITU-R Recommendation SM.329 [37], the specific application to fixed service provided by ITU-R Recommendation F.1191 [38] the external spurious emissions are defined as emissions at frequencies which are removed from the nominal carrier frequency more than ± 250 % of the relevant CS.

The frequency range where limits of spurious emissions are defined is from 9 kHz to 110 GHz or the second harmonic if higher. However, for practical measurements, spurious emissions up to the fifth harmonic of the fundamental frequency should be measured, provided that this does not exceed 26 GHz. For those systems with a fundamental frequency above 13 GHz, spurious emissions up to only the second harmonic should be measured.

NOTE: When waveguide is used between reference points A' and C', which length is higher than twice the free space wavelength of Fc, the lower limit of measurement will be increased to 0,7 Fc and to 0,9 Fc when the length is higher than four times the same wavelength.

The levels of spurious emissions should be expressed in terms of the mean power, supplied by the transmitter to the antenna feeder line at the frequencies of the spurious emission concerned, within a defined reference bandwidth. Consequently "noise-like" emissions are intended not to exceed the limits in any elementary reference bandwidth.

The limit values measured at reference point C' are:

5.3.7.1.1 Within ±250 % of the relevant channel spacing

The emission includes in this range only fundamental and out of band emissions which should be in accordance with the spectrum mask and the limits required by Subclause 5.3.5 and Subclause 5.3.6.

5.3.7.1.2 Outside the band ±250 % of the relevant CS

NOTE 1: When waveguide is used between reference point A and C, which length is higher than twice the free space wavelength of Fc, the lower limit of measurement will be increased to 0,7 Fc and to 0,9 Fc when the length is higher than four times the same wavelength.

Emissions falling from 9 kHz to 21,2 GHz:

- -50 dBm in any 1 kHz reference bandwidth:

  from 9 kHz to 150 kHz

- -50 dBm in any 10 kHz reference bandwidth:

  from 150 kHz to 30 MHz

- -50 dBm in any 100 kHz reference bandwidth:

  from 30 MHz to 1 GHz

- -50 dBm in any 1 MHz reference bandwidth:

  from 1 GHz to 21,2 GHz excluding the frequency ranges for the CS reported below:

  - for 1 MHz ≤ CS < 5,6 MHz in the range from ± 250 % of CS to ± 14 MHz,

    the limit is defined in any 1 kHz reference bandwidth;

  - for 1 MHz ≤ CS < 5,6 MHz in the range from ± 14 MHz to ± 28 MHz,

    and

  - for 5,6 MHz ≤ CS < 10 MHz in the range from ± 250 % of channel spacing to ± 28 MHz,

    and

  - for 10 MHz ≤ CS < 19,6 MHz in the range from ± 250 % of channel spacing to ± 49 MHz,

    the limit is defined in any 10 kHz reference bandwidth;

  - for 1 MHz ≤ CS < 10 MHz in the range from ± 28 MHz to ± 70 MHz,

    and

  - for 10 MHz ≤ CS < 19,6 MHz in the range from ± 49 MHz to ± 70 MHz,

    and

  - for 19,6 MHz ≤ CS < 22,4 MHz in the range from ± 250 % of channel spacing to ± 70 MHz,

    the limit is defined in any 100 kHz reference bandwidth.

NOTE 2: In case where the actual absolute power density relative to the spectrum mask at the ±250 % boundary, when evaluated in one or more of the smallest resolution bandwidths, is lower than the spurious emission limit itself, the corresponding steps of the spurious emissions staircase are no longer applicable. The first applicable spurious emission reference bandwidth step, which corresponds to a power density equal or lower than that evaluated with the RF spectrum mask in the same reference bandwidth, should be extended back to the 250 % boundary.

Emissions falling from 21,2 GHz to 110 GHz:

- -30 dBm in any 1 MHz band.

5.3.7.2 Spurious emissions - internal

Being the requirement to multiplex equipment from different manufacturers on different polarization of the same antenna, the levels of the spurious emissions from the transmitter, referenced to reference point C' are specified in Table 6.

The required level will be the total average level integrated over the bandwidth of the emission under consideration.

Table 6: Internal levels for the transmitter spurious consideration

Spurious Emission Frequency Relative to Channel Assigned Frequency	Specification Limit	Controlling Factor for requirement application
The average level of all spurious signals both discrete CW and noise-like (including LO, ± IF, ± 2 × IF), evaluated as total signal level	≤ -70 dBm	If spurious signal's frequency falls within receiver half band, for digital systems without branching network (i.e. with duplexer)
	≤ -50 dBm	If spurious signal's frequency falls within transmitter half band
Other spurious evaluated as in Subclause 5.3.7.1	as required by Subclause 5.3.7.1	

5.3.8 Radio frequency tolerance

Maximum radio frequency tolerance should not exceed ± 15 ppm for equipment operating with channel spacing lower than 14 MHz and ± 30 ppm for equipment operating with channel spacing greater than or equal to 14 MHz. These limits include both short-term factors (environmental effects) and long-term ageing effects.

In the type test the manufacturer should state the guaranteed short-term part and the expected ageing part.

5.4 Receiver Characteristics

5.4.1 Input Level Range

The input level range for a BER < 10^{-3} should extend from the upper limit of -20 dBm to the limit specified for

BER = 10^{3} in Subclause 5.5.1.

When ATPC is used, the maximum input level for BER @ 10^{-3} may be relaxed to -26 dBm.

These limits apply without interference and are referenced to point B of Figure 1.

5.4.2 Rx local oscillator frequency arrangements

There should be no requirement on LO frequency arrangement.

5.4.3 Spurious emissions

The frequency range in which the spurious emission specifications apply is 9 kHz to 110 GHz, however for conformance test measurement will be limited to the 2nd harmonic frequency.

NOTE: When waveguide is used between ref. point A and C, which length is higher than twice the free space wavelength of Fc, the lower limit of measurement will be increased to 0,7 Fc and to 0,9 Fc when the length is higher than four times the same wavelength.

5.4.3.1 Spurious emissions - external

Spurious emissions should not exceed the following levels at reference point C:

Emissions falling from 9 kHz to 21,2 GHz:

- -50 dBm in any 1 kHz reference bandwidth from 9 kHz to 150 kHz;
- -50 dBm in any 10 kHz reference bandwidth from 150 kHz to 30 MHz;
- -50 dBm in any 100 kHz reference bandwidth from 30 MHz to 1 GHz;
- -50 dBm in any 1 MHz reference bandwidth from 1 GHz to 21,2 GHz.

Emissions falling from 21,2 GHz to 110 GHz:

- -30 dBm in any 1 MHz reference bandwidth.

5.4.3.2 Spurious emissions - internal

Spurious emissions which fall within receivers half band should be < -90 dBm, referenced to reference point C, for digital systems without branching networks (i.e. with duplexer).

The required level will be the total average level integrated over the bandwidth of the emission under consideration.

5.4.4 Receiver image rejection

If applicable, the receiver image(s) rejection should be as listed in Table 7.

Table 7: Receiver image rejection

Class of equipment	Class 1	Class 2	Class 3
a) If image frequency falls within receiver half band	> 75 dB	> 80 dB	> 90 dB
b) If image frequency falls within transmitter half band	> 85 dB	> 85 dB	> 85 dB

5.5 System Performance without diversity

All parameters are referred to reference point B or C of Figure 1.

5.5.1 BER as a function of receiver input signal level RSL

Receiver BER thresholds (dBm) referred to reference point C (for systems with simple duplexer) or B (for system with multi-channel branching system) of the System Block Diagram (Figure 1) for BER of 10^{-3}, 10^{-6} and 10^{-8} should be equal to or lower than those stated in Table 8 below (These levels do not include any hybrid loss).

Table 8: BER performance thresholds for 3 GHz to 7,5 GHz systems

		RSL@ BER→	RSL@10^{-3} (dBm)	RSL@10^{-6} (dBm)	RSL@10^{-8} (dBm)
Class of equipment ↓	**Nominal Bit-rate (Mbit/s) ↓**	**Channel spacing (MHz) ↓**			
Class 1	2	1,75	-90	-87	
	2 × 2	3,5	-87	-84	
	8	7/11,662	-85	-82	
	2 × 8	14/14,5/15	-82	-79	
	34	28/29/29,65/30	-79	-76	
Class 2	2 × 2	1,75	-87	-84	-82
	8	3,5	-84	-81	-79
	2 × 8	7/11,662	-81	-78	-76
	34	14/14,5/15	-78	-75	-73
	51	20 to 30	-78	-75	-73
	2 × 34	28/29/29,65/30	-75	-72	-70
Class 3	2 × 34	14/14,5/15 (note 2)	-72,5	-69,5	-67,5
	51	14/14,5/15	-76	-73	-71

NOTE 1: For 8 GHz to 11 GHz systems allowance for relaxation of the figures by 1 dB.
NOTE 2: Variations of Class 3 equipment exist designed to operate cross polarization in adjacent channels (ACDP systems). In this case the co-polar channel spacing would become 28 MHz, 29 MHz or 30 MHz.

5.5.2 Equipment Maximum Allowed Number of Errors

The equipment maximum allowed number of errors level under simulated operating conditions without interference is measured with a signal level at reference point B (or C) which is 10 dB above the level which gives BER = 10^{-6} (as specified in Subclause 5.5.1). All measurements will be made at the payload bit rate defined in Subclause 4.1.

Measurement period and maximum number of errors allowed are given in Table 9 below.

Table 9: Maximum allowed number of bit errors

Bit-rate	Minimum Recording Time	Maximum allowed Number of Bit Errors
2 Mbit/s	16 hours	12
8 Mbit/s	4 hours	12
34 Mbit/s	10 hours	12
51 Mbit/s	24 hours	10

NOTE: As the measurement is made on the tributaries, the clause relative to the 2 Mbit/s is also applicable to n×2 Mbit/s systems, the clause relative to the 8 Mbit/s to the n×8 Mbit/s systems, and the clause relative to the 34 Mbit/s to the 2×34 Mbit/s systems.

5.5.3 Interference Sensitivity

All receive signal levels and C/I measurements are referred to reference point B (for system with multi-channel branching system) or C (for systems with simple duplexer) of the RF Block Diagram (Figure 1).

5.5.3.1 Co-channel external interference sensitivity

The limits of the co-channel interference sensitivity should be as given in Table 10a. below, giving maximum C/I values for 1 dB and 3 dB degradation of the 10^{-6} BER limit specified in Subclause 5.5.1.

Table 10a: Co-channel external Interference Sensitivity

		RSL @BER degradation	RSL @10^{-6} 1 dB	RSL @10^{-6} 3 dB
Spectrum Efficiency Class ↓	**Nominal Bit Rate (Mbit/s)** ↓	**Channel spacing (MHz)** ↓	**Maximum C/I value (dB)**	**Maximum C/I value (dB)**
Class 1	2	1,75	23	19
	2×2	3,5	23	19
	8	7/11,662	23	19
	2×8	14/14,5/15	23	19
	34	28/29/29,65/30	23	19
Class 2	2×2	1,75	30	26,5
	8	3,5	30	26,5
	2×8	7/11,662	30	26,5
	34	14/14,5/15	30	26,5
	51	20 to 30	30	26,5
	2×34	28/29/29,65/30	30	26,5
Class 3	2×34	14/14,5/15 (note)	33	29
	51	14/14,5/15	33	29
NOTE: Variations of Class 3 equipment exist designed to operate cross polarization in adjacent channels (ACDP systems). In this case the co-polar channel spacing would become 28, 29 or 30 MHz.				

5.5.3.2 Adjacent Channel interference sensitivity

The limits of the adjacent channel interference sensitivity should be as given in Table 10b. below for like modulated signals spaced of 1 channel spacing, giving maximum C/I values for 1 dB and 3 dB degradation of the 10-6 BER limits specified in Subclause 5.5.1.

Table 10b: 1st Adjacent Channel Interference Sensitivity

		RSL @BER degradation	RSL @10^{-6} 1 dB	RSL @10^{-6} 3 dB
Spectrum Efficiency Class ↓	**Nominal Bit Rate (Mbit/s) ↓**	**Channel spacing (MHz) ↓**	**Maximum C/I value (dB)**	**Maximum C/I value (dB)**
Class 1	2	1,75	0	-4
	2×2	3,5	0	-4
	8	7	0	-4
	8	11,662	-10	-14
	2×8	14/14,5/15	0	-4
	34	28/29/29,65/30	0	-4
Class 2	2×2	1,75	-3	-7
	8	3,5	-3	-7
	2×8	7	-3	-7
	2×8	11,662	-10	-14
	34	14/14,5/15	-3	-7
	51	20 to 30	-8	-12
	2×34	28/29/29,65/30	-3	-7
Class 3	2×34 (note)	14/14,5/15	-2	-6
	51	14/14,5/15	-5	-9

NOTE: For the capacity 2×34 Mbit/s ACDP systems may be implemented, in which case the co-polar channel spacing would be effectively 28, 29 or 30 MHz. In this case the requirement for adjacent channel interference sensitivity would be given in Table 10c

Table 10c: Adjacent channel interference sensitivity (2×34 Mbit/s ACDP systems)

		RSL@BER degradation	RSL@10^{-6} 1 dB	RSL@10^{-6} 3 dB
Spectrum efficiency class	**Nominal Bit rate (Mbit/s)**	**Channel Spacing (MHz)**	**Maximum C/I value (dB)**	**Maximum C/I value (dB)**
Class 3	2×34 Mbit/s	28/29/30	-27	-31
		14/14,5/15	18	14

5.5.3.3 CW interference

For a receiver operating at the 10^{-6} BER threshold given in Table 8, the introduction of a CW interferer at a certain level specified below, with respect to the wanted signal and at any frequency in the range 9 kHz to the 3rd harmonic of the receiver operating frequency, excluding frequencies either side of the wanted centre frequency of the RF channel by up to 250 % the channel spacing, should not result in a BER greater than 10^{-5}.

The level of the CW interferer should be:

- for a channel spacing lower than or equal to 14 MHz:

  +20 dB at any frequency either side of the wanted centre frequency of the RF channel from twice up to 500 % the channel spacing;

  +30 dB outside 500 % the channel spacing.

- for a channel spacing greater than 14 MHz:

  +30 dB.

NOTE: When waveguide is used between reference point A and C, which length is higher than twice the free space wavelength of the Fc, the lower limit of measurement will be increased to 0,7 Fc and to 0,9 Fc when the length is higher than 4 times the same wavelength.

This test is designed to identify specific frequencies at which the receiver may have a spurious response, e.g. image frequency, harmonics of the receive filter, etc. The actual test range should be adjusted accordingly. The test is not intended to imply a relaxed specification at all out of band frequencies elsewhere specified in the present document.

5.5.3.4 Front-end non-linearity requirements (Two-tone CW Spurious interference)

For a receiver operating at the RSL specified in Subclause 5.5.1 for 10^{-6} BER threshold, the introduction of two equal CW interferers each with a level of +19 dB, with respect to the wanted signal and located at the 2nd and 4th adjacent channels in the receive halfband, should not result in a BER greater than 10^{-5}.

NOTE: The requirement is consistent with the foreseen NFD at far distance.

5.5.4 Distortion sensitivity

The parameters for distortion sensitivity signatures are given in Table 12 for medium capacity (i.e. 34 Mbit/s, 2×34 Mbit/s and 51 Mbit/s) systems.

For a delay of 6,3 ns and BER of 10^{-3} and 10^{-6} the width and the depth in signature should not exceed the values of the Table 11.

These limits are valid for both minimum and non-minimum phase cases.

The limits specified for BER = 10^{-3} should also be verified by the loss of synchronization and re-acquisition signatures.

Table 11: Signature width and depth

Spectrum efficiency class	Nominal Bit rate (Mbit/s)	Channel spacing (MHz)	BER@10^{-3} Signature width	BER@10^{-3} Signature depth	BER@10^{-6} Signature width	BER@10^{-6} Signature depth
Class 1	34 Mbit/s	28/29/29,65/30 MHz	± 15 MHz	14 dB	± 17 MHz	11 dB
Class 2	34 Mbit/s	14 14,5/15 MHz	± 9 MHz	17 dB	± 11 MHz	14 dB
	51 Mbit/s	20 to 30 MHz	± 11 MHz	17 dB	± 13 MHz	14 dB
	2×34 Mbit/s	28/29/29,65/30 MHz	± 18 MHz	17 dB	± 20 MHz	14 dB
Class 3	2×34 Mbit/s	14/14,5/15MHz (co-polar or cross-polar (see note 2)	± 8 MHz	20 dB	± 9 MHz	17 dB
	51 Mbit/s	14/14,5/15 MHz	± 9 MHz	17 dB	± 11 MHz	15 dB

NOTE 1: All signature widths are relative to the assigned channel centre frequency.
NOTE 2: Variations of Class 3 equipment exist designed to operate cross polarization in adjacent channels (ACDP systems). In this case the co-polar channel spacing would become 28 MHz, 29 MHz or 30 MHz.

5.6 System characteristics with diversity

5.6.1 Differential Delay compensation

For further study.

5.6.2 BER performance

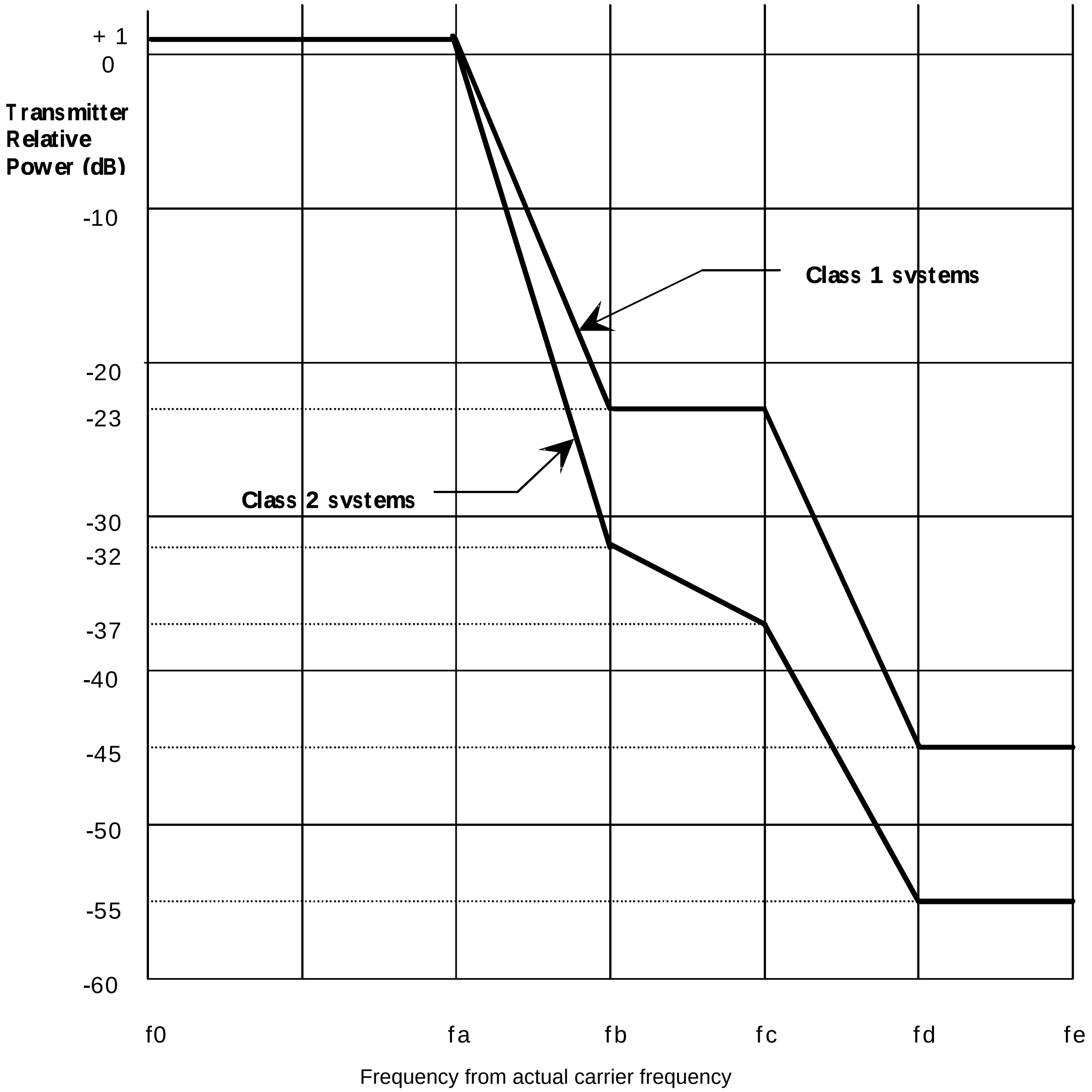
For further study.

5.6.3 Interference sensitivity

For further study.

5.6.4 Distortion sensitivity

For further study.



f0 = Actual Transmitter Carrier Frequency

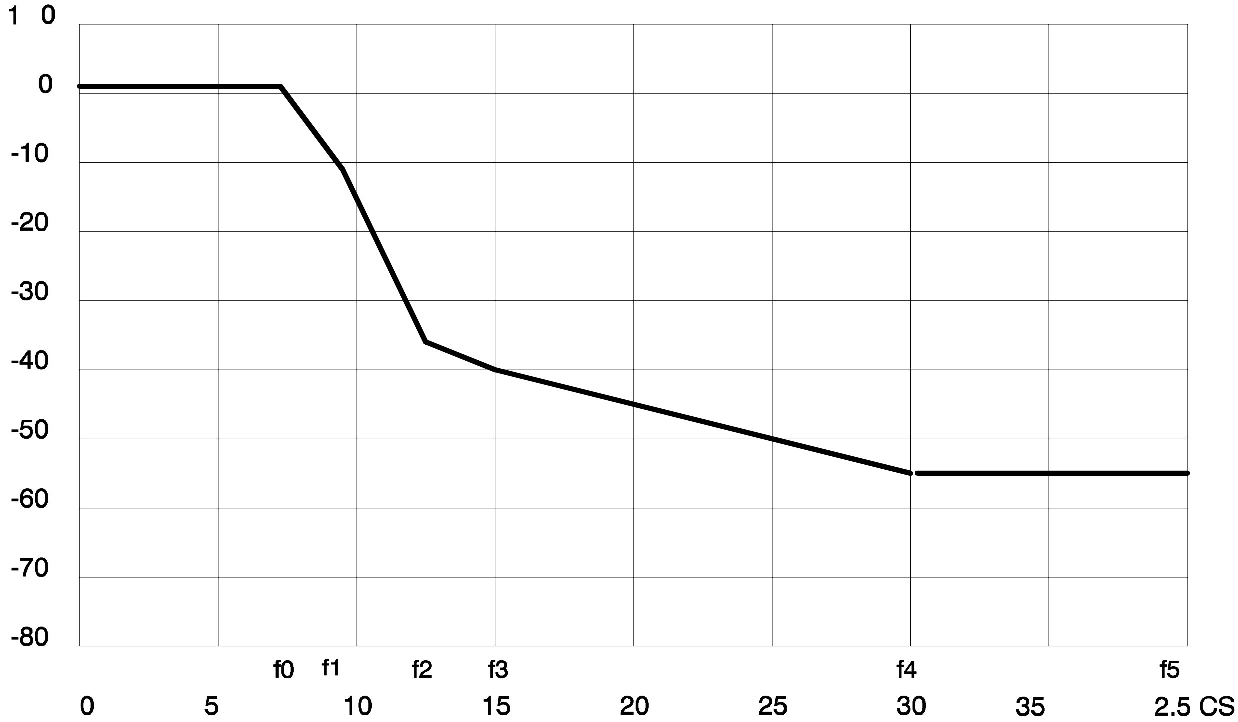
NOTE: These masks refer to actual centre frequency and do not include an allowance for frequency stability including ageing.

Figure 2a: Limits of spectral power density for 2 to 34 Mbit/s Class 1 or 2×2 to 2×34 Mbit/s Class 2 system

Reference frequencies fa to fe are reported in Table 12 below for the considered channel spacing:

Table 12: Reference frequencies

Nominal Bit rate (Mbit/s)	Channel spacing	fa	fb	fc	fd	fe
		Class 1 systems				
2	1,75 MHz	0,7 MHz	1,4 MHz	1,75 MHz	3,5 MHz	4,375 MHz
2×2	3,5 MHz	1,4 MHz	2,8 MHz	3,5 MHz	7,0 MHz	8,75 MHz
8	7/11,662 MHz	2,7 MHz	5,6 MHz	6,5 MHz	13 MHz	17,5 MHz
2×8	14/14,5/15 MHz	5,4 MHz	11,2 MHz	13 MHz	26 MHz	35 MHz
34	28/29/29,65/ 30 MHz	11,0 MHz	19 MHz	25 MHz	45,0 MHz	70 MHz
		Class 2 systems				
2×2	1,75 MHz	0,7 MHz	1,4 MHz	1,75 MHz	3,5 MHz	4,375 MHz
8	3,5 MHz	1,4 MHz	2,8 MHz	3,5 MHz	7,0 MHz	8,75 MHz
2×8	7/11,662 MHz	2,8 MHz	5,6 MHz	7 MHz	14,0 MHz	17,5 MHz
34	14/14,5/15 MHz	5,6 MHz	11,2 MHz	14 MHz	28,0 MHz	35 MHz
2×34	28/29/29,65/ 30 MHz	11,2 MHz	22,4 MHz	28 MHz	56 MHz	70 MHz



Frequency offset from the actual centre frequency (MHz)

Table of corner points

Frequency (MHz)		**Attenuation (dB)**
f0	7,5 MHz	-1
f1	9,5 MHz	+10
f2	12,5 MHz	+35
f3	15 MHz	+40
f4	30 MHz	+55
f5	2,5×CS	+55

NOTE: The masks of Figures 2b to 2e refer to actual centre frequency and do not include an allowance for frequency stability including ageing.

Figure 2b: Limits of spectral power density for 51 Mbit/s Class 2 systems (with Channel Spacing 20/21/2×11,662 MHz)

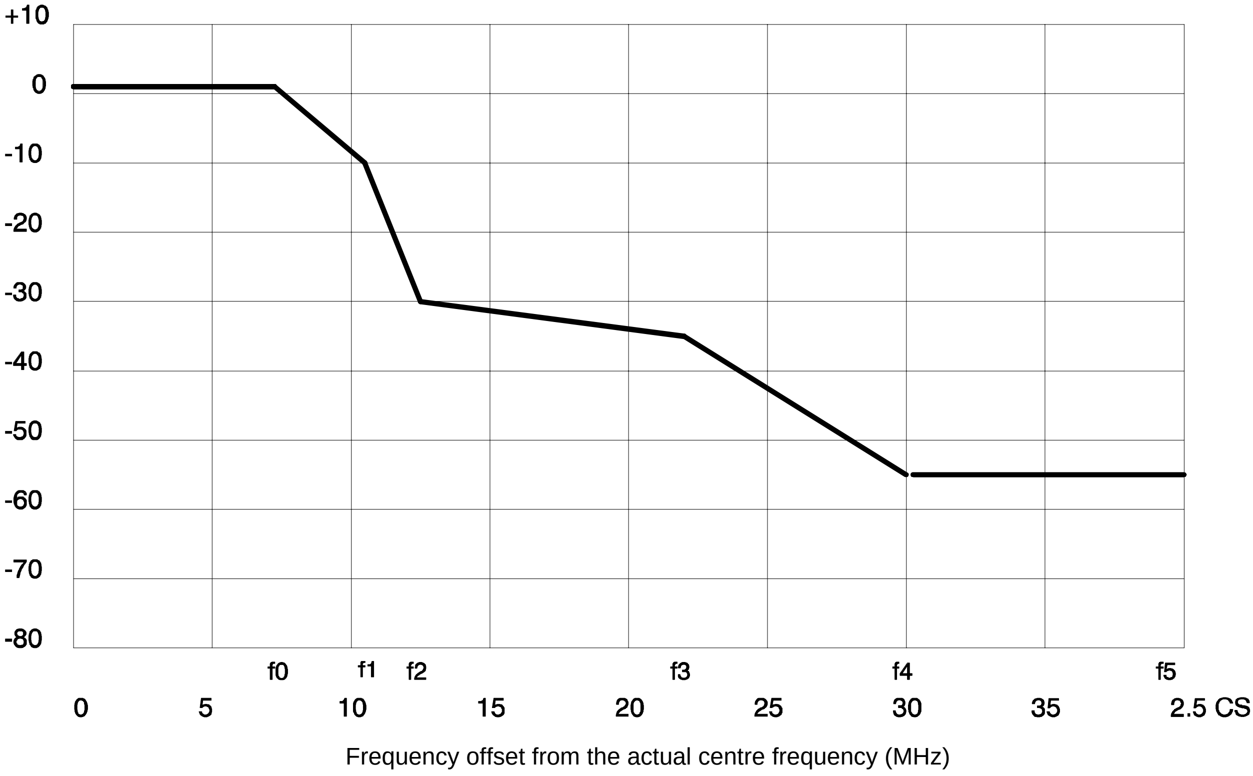


Table of corner points

Frequency (MHz)		Attenuation (dB)
f0	7,5 MHz	-1
f1	10,5 MHz	+10
f2	12,5 MHz	+30
f3	22 MHz	+35
f4	30 MHz	+55
f5	2,5×CS	+55

Figure 2c: Limits of spectral power density for 51 Mbit/s Class 2 systems (with CS 28/29,65/30 MHz)

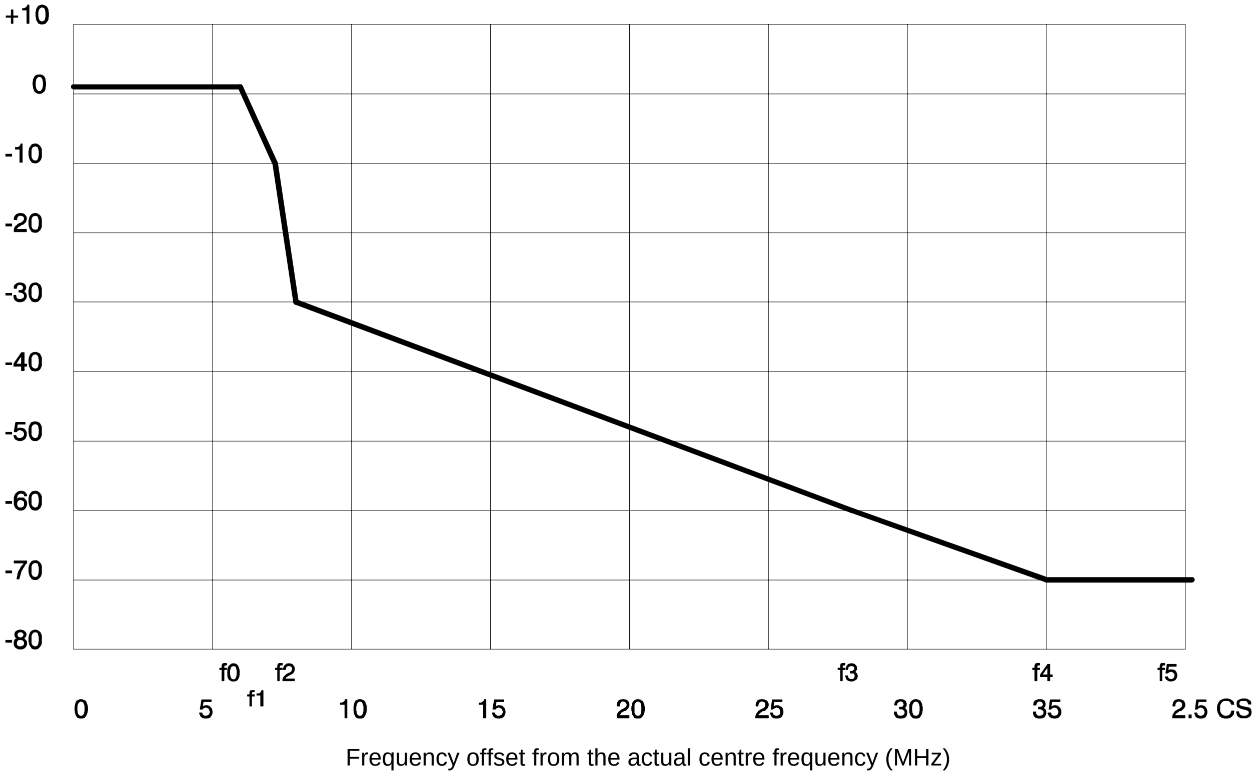
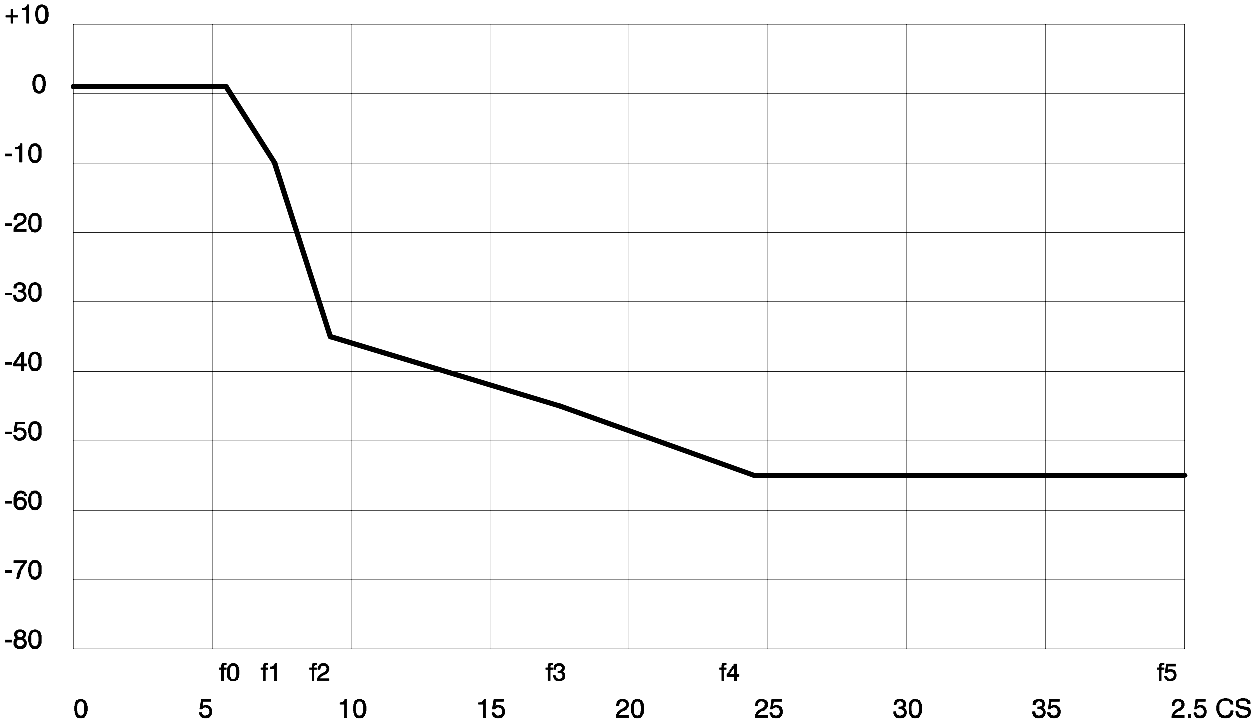


Table of corner points

Frequency (MHz)		Attenuation (dB)
f0	6 MHz	-1
f1	7 MHz	+10
f2	8 MHz	+30
f3	28 MHz	+60
f4	35 MHz	+70
f5	2,5×CS	+70

Figure 2d: Limits of spectral power density for 2×34 Mbit/s Class 3 systems (with Co-polar Channel Spacing 14/14,5/15 MHz) or 2×34 Mbit/s Class 3 ACDP systems (with Cross-polar Channel Spacing 14 /14,5/15 MHz and Co-polar Channel Spacing 28/29/30 MHz)



Frequency offset from the actual centre frequency (MHz)

Table of corner points

Frequency (MHz)		Attenuation (dB)
f0	6,0 MHz	-1
f1	7,5 MHz	+10
f2	8,5 MHz	+35
f3	17,5 MHz	+45
f4	24 MHz	+55
f5	2,5×CS	+55

NOTE: The masks of Figures 2b to 2e refer to actual centre frequency and do not include an allowance for frequency stability including ageing.

Figure 2e: Limits of spectral power density for 51 Mbit/s Class 3 system (with CS 14/14,5/15 MHz)

Annex A (informative): Additional information

A.1 Antenna requirements

NOTE: The assumptions in this Annex refer to ETS 300 833 [1].

A.1.1 Antenna radiation patterns

For equipment on which the antenna forms an integral part, the radiation pattern should be in accordance with ETS 300 833 [1]

A.1.2 Antenna cross-polar discrimination (XPD)

For equipment on which the antenna forms an integral part, the radiation pattern should be in accordance with ETS 300 833 [1].

A.1.3 Feeder/antenna return loss

The minimum return loss of the feeder/antenna system connected to indoor systems should be considered not less than 20 dB. The measurement should be referred to reference point C/C' towards the antenna.

For partially outdoor systems the antenna return loss should be considered not less than 20 dB. The measurement should be referred to reference point C/C' towards the antenna.

A.2 Automatic Transmit Power Control

Automatic Transmit Power Control (ATPC) may be useful in some circumstances, e.g:

- to reduce interference between neighbouring systems or adjacent channels of the same system;
- to improve compatibility with analogue and digital systems at nodal stations;
- to improve residual BER or BBER performance;
- to reduce upfading problems;
- to reduce transmitter power consumption;
- to reduce digital to digital and digital to analogue distant interference between hops which re-use the same frequency;
- to increase system gain during flat fading attenuation conditions.

ATPC as an optional feature is aimed at driving the Tx Power Amplifier output level from a proper minimum which facilitates the radio network planning requirements and which is used under normal propagation conditions up to a maximum value which fulfils all the specifications defined in the present document.

For planning conditions in a nodal environment a system equipped with ATPC can be considered to operate with its minimum transmitter power.

A.3 Spectrum masks

The spectrum masks given in Figure 2a to 2e are consistent with NFD figures between adjacent channels of about 24 dB for Class 1, about 28 dB for Class 2 (PDH bit rates) and about 32 dB for Class 3. For hop lengths of more than about 35 km, higher ATPC range in connection with NFD of more than 32 dB for Class 1, 38 dB for Class 2, and 44 dB for Class 3, or the use of the alternate polarization may be required for systems operating on the same route and using adjacent channels and separate antennas.

NFD can be taken as the difference between the co-channel interference (stated in the section 5.5.3.1 Table 10.a: Co-channel external interference sensitivity) and the measured value of the adjacent interference sensitivity) and the measured value of the adjacent channel interference sensitivity C/I referred to the same bit error ratio and the same modulation scheme each. This procedure is stated in the Generic Standard TR 101 036-1 [41] (Digital Radio Relay Systems Characteristics - Generic Standard Part 1: General Aspects and Point-to-Point Equipment Parameters).

A.4 Lightning protection

Lightning discharge protection may be applied at the relevant points of the indoor and outdoor equipment to safeguard against damage. Detailed requirements for lightning protection are under study.

A.5 Mechanical requirements

For outdoor installation, the outdoor unit may be separable from the antenna.

For indoor installation the equipment should conform to ETS 300 119 [39]. Other mechanical arrangement which can be made compatible with ETS 300 119 [39] should be also considered.

For maintenance purposes, the replaceable units of the equipment may be so designed that they can be easily handled by one person.

History

Document history		
V1.1.1	June 1998	Public Enquiry PE 9846: 1998-07-17 to 1998-11-13