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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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European Standard (Telecommunications series)

**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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Contents

Intellectual Property Rights.....	6
Foreword	6
1 Scope.....	7
2 References.....	8
3 Symbols and abbreviations	10
3.1 Symbols	10
3.2 Abbreviations.....	10
4 General characteristics.....	11
4.1 Frequency bands and channel arrangements	11
4.1.1 Channel arrangements	11
4.1.2 Co-polar channel spacing for systems operating, on different antennas, on the same route.....	11
4.2 Compatibility requirements between systems	12
4.3 Performance and availability requirements.....	12
4.4 Environmental conditions	12
4.4.1 Equipment within weather protected locations (indoor locations)	12
4.4.2 Equipment for non-weather protected locations (outdoor locations).....	13
4.5 Power supply.....	13
4.6 Electromagnetic compatibility	13
4.7 System block diagram.....	13
4.8 Telecommunications Management Network (TMN) interface	14
4.9 Branching/feeder/antenna characteristics.....	14
4.9.1 Antenna radiation patterns.....	14
4.9.2 Antenna cross-Polar Discrimination (XPD).....	14
4.9.3 Antenna Inter-Port Isolation (IPI)	14
4.9.4 Waveguide flanges (or other connectors).....	14
4.9.5 Return loss.....	14
5 Parameters for digital systems	14
5.1 Transmission capacity.....	14
5.2 Baseband parameters	15
5.2.1 Plesiochronous interfaces.....	15
5.2.2 ISDN interface (primary rate)	15
5.2.3 SDH baseband interface.....	15
5.3 Transmitter characteristics.....	15
5.3.1 Transmitter power range	15
5.3.2 Transmit power and frequency control.....	16
5.3.2.1 Automatic Transmit Power Control (ATPC).....	16
5.3.2.2 Remote Transmit Power Control (RTPC).....	16
5.3.2.3 Remote Frequency Control (RFC).....	16
5.3.3 Transmitter output power tolerance.....	16
5.3.4 Transmit Local Oscillator (LO) frequency arrangements.....	16
5.3.5 RF spectrum mask	17
5.3.6 Spectral lines at the symbol rate.....	18
5.3.7 Spurious emissions	18
5.3.7.1 Spurious emissions - external	18
5.3.7.1.1 Within the relevant channel spacing	19
5.3.7.1.2 Outside the band of the relevant channel spacing	19
5.3.7.2 Spurious emissions - internal	19
5.3.8 Radio frequency tolerance.....	19
5.4 Receiver characteristics	20
5.4.1 Input level range.....	20
5.4.2 Receiver local oscillator frequency arrangements	20
5.4.3 Spurious emissions	20
5.4.3.1 Spurious emissions - external	20

5.4.3.2	Spurious emissions - internal	20
5.5	System performance without diversity	20
5.5.1	BER as a function of Receiver input Signal Level (RSL)	20
5.5.2	Equipment Background BER	21
5.5.3	Interference sensitivity	22
5.5.3.1	Co-channel interference sensitivity	22
5.5.3.2	Adjacent channel Interference	22
5.5.3.3	CW Spurious Interference	23
5.5.3.4	Front-end non-linearity requirements (two-tone CW spurious interference)	23
5.5.4	Distortion sensitivity	24
5.6	System characteristics with diversity	24
6	Parameters for wideband analogue systems.....	24
6.1	Transmit/receive capacity	24
6.2	Applications	24
6.3	Baseband parameters	24
6.3.1	Video interfaces	24
6.3.2	Audio interfaces (if applicable)	24
6.3.3	Digital interfaces (if applicable)	25
6.3.4	IF interfaces (if applicable)	25
6.3.5	Baseband performance	25
6.4	Transmitter characteristics	25
6.4.1	Transmitter power range	25
6.4.2	Transmitter output power tolerance.....	25
6.4.3	Radiated spectrum	26
6.4.3.1	Spectrum mask.....	26
6.4.3.2	Frequency deviation.....	27
6.4.4	Spurious emissions	28
6.4.5	Radio frequency tolerance.....	28
6.5	Receiver characteristics	28
6.5.1	Input level range.....	28
6.5.2	Spurious emissions.....	28
6.5.3	Noise figure.....	28
6.6	System performance.....	29
6.6.1	Receiver threshold.....	29
6.6.2	Interference sensitivity	29
Annex A (informative): Additional information		30
A.1	Radio frequency channel arrangement.....	30
A.2	Antenna characteristics	31
A.2.1	Antenna radiation patterns	31
A.2.2	Antenna cross-Polar Discrimination (XPD).....	33
A.2.3	Antenna Inter-Port Isolation (IPI).....	33
A.2.4	Feeder/antenna return loss	33

A.3	Automatic Transmit Power Control (ATPC)	33
A.4	Co-channel and adjacent channel interference	34
Annex B (normative):	EN 300 198, Transmission and Multiplexing (TM); Parameters for radio relay systems for the transmission of digital signals and analogue video signals operating at 23 GHz	36
Annex C (normative):	ERC Decision on the adoption of approval regulations for equipment to be used for radio relay systems operating in the fixed service for the transmission of digital signals and analogue video signals operating between 21,2 GHz and 23,6 GHz based on the European Standard (Telecommunications series) EN 300 198 V1.2.2	37
Annex D (informative):	Bibliography.....	51
History		52

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Foreword

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

The present document, together with ETS 300 385 is intended to become a Harmonized Standard, the reference of which is intended to be published in the Official Journal of the European Communities, referencing Council Directive 89/336/EEC (EMC Directive).

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

In addition to a complete revision in certain areas, this present document (equivalent to edition 2 of ETS 300 198) incorporates, where necessary, changes made in Amendment 1 (1997).

Amendment 1 was produced by the Radio Equipment and Systems (RES) Technical Committee and consists of:

- annex B; the technical specifications relevant to the EMC Directive;
- annex C; the ERC Decision ERC/DEC/(98)09 which references the technical specifications in the present document for inclusion in national approval regulations.

National transposition dates

Date of adoption of this EN:	5 December 1997
Date of latest announcement of this EN (doa):	31 May 1998
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	30 November 1998
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1 Scope

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

- Electromagnetic Compatibility (EMC) standardization (i.e. ETS 300 385 [11] and ETS 300 339 [10] where applicable);
- emissions and immunity at antenna port standardization activity (under study in TM4), new revised ITU-R Recommendation SM.329-7 [20] and the forthcoming CEPT Recommendation on spurious emissions;
- conformance test standardization activity of test methods and test reports (i.e. EN 301 126-1 [2]).

The present document does not cover aspects related to test procedures and test conditions which are in the scope of EN 301 126-1 [2].

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). Typical applications include:

- a) customer connections;
- b) Integrated Services Digital Network (ISDN) extension;
- c) mobile base station connections.

Digital systems considered in the present document will be able to meet the performance objectives of the ITU-R national portion of the reference path, i.e. ITU-R Recommendation F.1189 [17], and the performance objectives detailed in ITU-T Recommendation G.826 [29].

Analogue systems are intended to be used in local television (TV) point-to-point contribution and point-to-multipoint distribution.

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, sub-STM-1 and STM-1 Synchronous Digital Hierarchy (SDH) transmission systems. Antenna/feeder system requirements are covered in ETS 300 833 [3].

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 performances based on typically 4-states modulation scheme (e.g. 4-FSK, 4 - QAM (Quadrature Amplitude Modulation), or equivalent); |
| Class 3: | equipment performances based on typically 16-states modulation scheme (e.g. 16-QAM, or equivalent). |

Some equipment types may benefit from some performance improvement due to the technology gap; for this reason two grades of system performance, grade A and grade B are provided.

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

2 References

References may be made to:

- a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or
- b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or
- c) all versions subsequent to and including the identified version (identified by "onwards" following the version identity); or
- d) publications without mention of a specific version, in which case 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.

In the case of undated references, the time frame of application and new certification procedures for new releases of these normative references next to the date of the first public enquiry of the present document or to the first certification of the equipment shall be agreed between the supplier and the regulatory authority. These new certification procedures will cover in any case only the parameters subject to changes from the on going release during the previous certification.

- [1] CEPT Recommendation T/R 13-02: "Preferred channel arrangements for fixed services in the range 22,0 GHz - 29,5 GHz".
- [2] EN 301 126-1 : "Transmission and Multiplexing (TM); Conformance testing for Digital Radio Relay Systems (DRRS); Part 1: Point-to-point equipment parameters".
- [3] 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".
- [4] ITU-R Recommendation F.637: "Radio-frequency channel arrangements for analogue and digital radio relay systems in the 21,2 to 23,6 GHz frequency band".
- [5] ETS 300 645: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH) radio relay equipment; Information model for use on Q-interfaces".
- [6] ETS 300 019: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".
- [7] ETS 300 132-1: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 1: Operated by alternating current (ac)".
- [8] ETS 300 132-2: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)".
- [9] ETS 300 233: "Integrated Services Digital Network (ISDN); Access digital section for ISDN primary rate".
- [10] ETS 300 339: "Radio Equipment and Systems (RES); General Electro-Magnetic Compatibility (EMC) for radio equipment".
- [11] 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".
- [12] ETS 300 635: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH); Radio specific functional blocks for transmission of Mx STM-N".
- [13] ETS 300 785: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH); SDH radio specific functional blocks for transmission of Mx sub-STM-1".

- [14] ITU-R Recommendation F.750: "Architectures and functional aspects of radio-relay systems for SDH-based networks".
- [15] ITU-R Recommendation F.751: "Transmission characteristics and performance requirements of radio-relay systems for SDH-based networks".
- [16] ITU-R Recommendation F.1102: "Characteristics of radio-relay systems operating in frequency bands above about 17 GHz".
- [17] 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".
- [18] ITU-R Recommendation F.1191: "Bandwidths and unwanted emissions of digital radio-relay systems".
- [19] ITU-R Recommendation P.530-6: "Propagation data and prediction methods required for the design of terrestrial line-of-sight systems".
- [20] ITU-R Recommendation SM.329-7: "Spurious emissions".
- [21] ITU-T Recommendation G.703 (1991): "Physical/electrical characteristics of hierarchical digital interfaces".
- [22] ITU-T Recommendation G.704 (1995): "Synchronous frame structures used at 1 544, 6 312, 2 048, 8 488 and 44 736 kbit/s hierarchical levels".
- [23] ITU-T Recommendation G.707 (1996): "Network node interface for the synchronous digital hierarchy (SDH)".
- [24] ITU-T Recommendation G.773 (1993): "Protocol suites for Q-interfaces for management of transmission systems".
- [25] ITU-T Recommendation G.781 (1994): "Structure of Recommendations on equipment for the synchronous digital hierarchy (SDH)".
- [26] ITU-T Recommendation G.782 (1994): "Types and general characteristics of synchronous digital hierarchy (SDH) equipment".
- [27] ITU-T Recommendation G.783 (1994): "Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks".
- [28] ITU-T Recommendation G.784 (1994): "Synchronous digital hierarchy (SDH) management".
- [29] ITU-T Recommendation G.826 (1993): "Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate".
- [30] ITU-T Recommendation G.861 (1996): "Principles and guidelines for the integration of satellite and radio systems in SDH transport networks".
- [31] ITU-T Recommendation G.957 (1995): "Optical interfaces for equipments and systems relating to the synchronous digital hierarchy".
- [32] ITU-T Recommendation I.412 (1988): "ISDN user-network interfaces - Interface structures and access capabilities".
- [33] ITU-T Recommendation O.151 (1992): "Error performance measuring equipment operating at the primary rate and above".
- [34] ITU-T Recommendation O.181 (1996): "Equipment to assess error performance on STM-N interfaces".
- [35] TR 101 036-01 V1.1.2: "Transmission and Multiplexing (TM); Generic wordings for standards on Digital Radio Relay System (DRRS) characteristics; Part 1: General aspects and point-to-point equipment parameters".

- [36] ITU-R Recommendation F.403: "Intermediate frequency characteristics for the interconnection of analogue radio-relay systems".
- [37] ITU-R Recommendation F.746: "Radio-frequency channel arrangements for radio-relays systems".

3 Symbols and abbreviations

3.1 Symbols

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

Ω	Ohm
dB	decibel
dB _i	decibel relative to isotropic radiator
dB _m	decibel relative to 1 mW
dB _{q0ps}	decibel quasi-peak weighted relative to test tone reference level
dB _u	decibel relative to 1 microVolt
dBW	decibel relative to 1 W
GHz	GigaHertz
kHz	kiloHertz
Mbit/s	Mega-bits per second
MHz	MegaHertz
mW	milliWatt
ns	nanosecond
ppm	parts per million

3.2 Abbreviations (standards.iteh.ai)

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

ac	alternating current
ATPC	Automatic Transmit Power Control
AU	Administrative Unit
BB	Base Band
BBER	Background BER
BER	Bit Error Ratio
BWe	evaluation BandWidth (resolution bandwidth in which spectrum components are measured)
C/I	Carrier to Interference ratio
CEPT	Conférence des Administrations Européennes des Postes et Télécommunications
CMI	Coded Mark Inversion
CW	Continuous Wave
dc	direct current
DRRS	Digital Radio Relay Systems
EIRP	Equivalent Isotropically Radiated Power
EMC	ElectroMagnetic Compatibility
ERC	European Radiocommunications Committee
FSK	Frequency-Shift Keying (modulation)
GMSK	Gaussian Minimum Shift Keying (modulation)
IEC	International Electrotechnical Committee
IF	Intermediate Frequency
IPI	Inter-Port Isolation
ISDN	Integrated Services Digital Network
ITU-R	International Telecommunication Union-Radiocommunications standardization sector
ITU-T	International Telecommunication Union-Telecommunications standardization sector
LO	Local Oscillator
PAL	Phase Alternate Line
PDH	Plesiochronous Digital Hierarchy
PRBS	Pseudo Random Binary Sequence
QAM	Quadrature Amplitude Modulation

RES	Radio Equipment and Systems (ETSI Technical Committee)
RF	Radio Frequency
RFC	Remote Frequency Control
RL	Return Loss
RSL	Receive Signal Level
RTPC	Remote Transmit Power Control
SDH	Synchronous Digital Hierarchy
SOH	Section OverHead
STM-N	Synchronous Transport Module, level N
sub-STM-1	medium capacity SDH radio transport module (51,840 Mbit/s AU-3 equivalent, also referred as STM-0 by ITU-T Recommendation G.861 [30])
sub-sub-STM-1	low capacity SDH radio transport module (n times VC-12 or VC2 equivalent)
TM	ETSI TC-Transmission and Multiplexing
TMN	Telecommunications Management Network
TV	TeleVision
VC-n	Virtual Container n
WG	Working Group
XPD	cross-Polar Discrimination
YS	defined by ITU-R Recommendation F.746 as “the radio-frequency separation between the centre frequencies of the go and return radio-frequency channels which are nearest to each other”.

4 General characteristics

4.1 Frequency bands and channel arrangements

4.1.1 Channel arrangements

The equipment shall operate on one or more of the channels as defined below:

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]. The channel plan is given in figure A.1.

NOTE: In a transition period for the adoption of CEPT Recommendation T/R 13-02 [1], different channel plans, derived by ITU-R Recommendation F.637 [4], may be required on national basis.

The separation band shall be 400 MHz.

The innermost channels spacing (YS as defined by ITU-R Recommendation F.746 [37]) shall range from 423,5 MHz to 560 MHz for 3,5 MHz to 112 MHz channel spacing respectively.

The transmitter receiver duplex frequency separation shall be 1 008 MHz.

4.1.2 Co-polar channel spacing for systems operating, on different antennas, on the same route

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

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 1 equipments	3,5/7	7	14		56		
	Class 2 equipments	3,5	3,5	7	14	28	56	112
	Class 3 equipments			3,5	7	14	14/28	56

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 may be used where appropriate (e.g. three or four times VC12 into an 8 Mbit/s channel spacing).

Video base-band for analogue systems and their relevant co-polar channel spacing are reported in table 2.

Table 2: Analogue systems channel spacings for various video base-band

Video Base-band [MHz]	< 3,5	< 6	< 10	< 14
Channel Spacings [MHz]	28	56	56	56

4.2 Compatibility requirements between systems

The compatibility requirements between systems are as follows:

- there shall be no requirement to operate transmitting equipment from one manufacturer with receiving equipment from another;
- there shall not be a requirement to multiplex different manufacturers equipment on the same polarization of the same antenna;
- there may be a requirement to multiplex different manufacturers equipment on different polarization of the same antenna. This will not apply to systems with integral antenna;
- depending on the application, it shall be possible to operate the system in vertical and/or horizontal polarization, if required by the channel arrangement.

4.3 Performance and availability requirements

Digital equipment shall be designed in order to meet network performance and availability requirements foreseen by ITU-T Recommendation G.826 [29], following the criteria defined in ITU-R Recommendations F.1189 [17] for the national portion of the digital connection.

The implication of the link design on the performance is recognized and the general design criteria reported in ITU-R Recommendations P.530-6 [19] and F.1102 [16] shall be applied.

4.4 Environmental conditions

The equipment shall be required to meet the environmental conditions set out in ETS 300 019 [6] which defines weather protected and non-weather protected locations, classes and test severity.

The manufacturer shall 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 shall meet the requirements of ETS 300 019 [6] classes 3.1 and 3.2 respectively.

Optionally, the more stringent requirements of ETS 300 019 [6] 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 shall meet the requirements of ETS 300 019 [6], 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 shall be in accordance with the characteristics of one or more of the secondary voltages foreseen in ETS 300 132-1 [7] and ETS 300 132-2 [8].

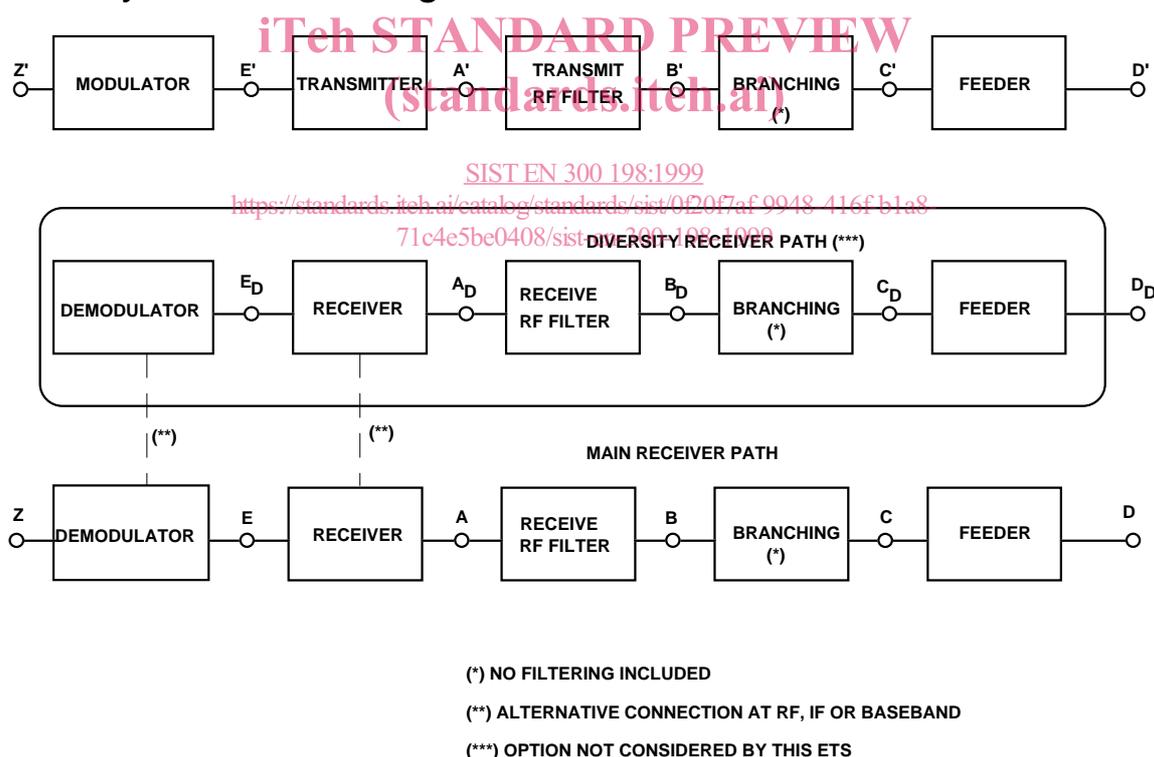
NOTE: Some applications may require secondary voltages that are not covered by ETS 300 132-1 [7] and ETS 300 132-2 [8].

4.6 Electromagnetic compatibility

Equipment with capacity of about 2 Mbit/s and above shall operate under the conditions specified in ETS 300 385 [11].

Analogue equipments shall operate under the conditions specified in ETS 300 339 [10]; performance criteria for immunity shall be specified by the supplier for the conformance test.

4.7 System block diagram



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.

Figure 1: System block diagram