



EUROPEAN
TELECOMMUNICATION
STANDARD

ETS 300 418

November 1995

Source: ETSI TC-BTC

Reference: DE/BTC-02021

ICS: 33.040.30

Key words: ONP, leased line, D2048U, D2048S, network interface

**Business TeleCommunications (BTC);
2 048 kbit/s digital unstructured and structured leased lines
(2048U and D2048S);
Network interface presentation**

ETSI

European Telecommunications Standards Institute

ETSI Secretariat

Postal address: F-06921 Sophia Antipolis CEDEX - FRANCE

Office address: 650 Route des Lucioles - Sophia Antipolis - Valbonne - FRANCE

X.400: c=fr, a=atlas, p=etsi, s=secretariat - **Internet:** secretariat@etsi.fr

Tel.: +33 92 94 42 00 - Fax: +33 93 65 47 16

Copyright Notification: No part may be reproduced except as authorized by written permission. The copyright and the foregoing restriction extend to reproduction in all media.

© European Telecommunications Standards Institute 1995. All rights reserved.

Contents

Foreword	5
Introduction	5
1 Scope	7
2 Normative references	7
3 Definitions and abbreviations	8
3.1 Definitions	8
3.2 Abbreviations	8
4 Requirements	9
4.1 Physical characteristics	9
4.1.1 Hardwired connection	9
4.1.2 Socket specification	9
4.1.3 Shield connection point	10
4.2 Electrical characteristics	10
4.2.1 Output port	10
4.2.1.1 Signal coding	10
4.2.1.2 Waveform shape	10
4.2.1.3 Output timing under failure conditions	11
4.2.1.4 Impedance towards ground	12
4.2.1.5 Output return loss	12
4.2.1.6 Output signal balance	12
4.2.1.7 Output timing and jitter	12
4.2.2 Input port	12
4.2.2.1 Signal coding	12
4.2.2.2 Input return loss	12
4.2.2.3 Input loss tolerance	12
4.2.2.4 Immunity against reflections	13
4.2.2.5 Tolerable longitudinal voltages	13
4.2.2.6 Impedance towards ground	13
4.2.2.7 Input timing and jitter tolerance	13
4.3 Safety	13
4.3.1 General requirements	13
4.3.2 Touch current	14
4.4 Overvoltage protection	14
4.4.1 Surge simulation, common mode	14
4.4.2 Surge simulation, transverse mode between transmit and receive pairs	14
4.4.3 Mains simulation, common mode	14
4.4.4 Mains simulation, transverse mode	14
4.4.5 Impulse transfer from mains, common mode	15
4.4.6 Impulse transfer from mains, transverse mode	15
4.4.7 Conversion of common mode to transverse mode	15
4.4.8 Impulse transfer from auxiliary interface	15
4.5 ElectroMagnetic Compatibility (EMC)	15
Annex A (normative): Test methods	16
A.1 General	16
A.1.1 Additional information to support the test	16
A.1.2 Equipment connection	16

A.2	Test methods.....	16
A.2.1	Signal coding at output port.....	16
A.2.2	Waveform shape at output port.....	17
A.2.3	Return loss at input port.....	18
A.2.4	Input loss tolerance and immunity against reflections.....	19
A.2.5	Tolerable longitudinal voltage and HDB3 input coding.....	20
A.2.6	Impedance towards ground.....	21
A.2.7	Output timing under failure conditions.....	22
Annex B (normative):	Definition of HDB3 code.....	23
B.1	General.....	23
B.2	Definition.....	23
Annex C (informative):	Bibliography.....	24
History.....		25

Foreword

This European Telecommunication Standard (ETS) has been produced by the Business Telecommunications (BTC) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This ETS resulted from a mandate from the Commission of the European Community (CEC) to provide harmonized standards for the support of the Directive on Open Network Provision (ONP) of leased lines (92/44/EEC).

In the case of the unstructured leased line, this ETS is intended to supersede ETS 300 246.

There are four other standards directly related to this ETS:

- ETS 300 247: "Open Network Provision (ONP) technical requirements; 2 048 kbit/s digital unstructured leased line (D2048U); Connection characteristics";
- ETS 300 248: "Open Network Provision (ONP) technical requirements; 2 048 kbit/s digital unstructured leased line (D2048U); Terminal equipment interface";
- ETS 300 419: "Business Telecommunications (BTC); 2 048 kbit/s digital structured leased line (D2048S); Connection characteristics";
- ETS 300 420: "Business Telecommunications (BTC); 2 048 kbit/s digital structured leased line (D2048S); Terminal equipment interface".

This ETS is based on information from ITU-T Recommendations and ETSI publications and the relevant documents are quoted where appropriate.

Transposition dates	
Date of adoption of this ETS	17 November 1995
Date of latest announcement of this ETS (doa):	28 February 1996
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	31 August 1996
Date of withdrawal of any conflicting National Standard (dow):	31 August 1996

Introduction

The Council Directive on the application of ONP to leased lines (92/44/EEC) concerns the harmonization of conditions for open and efficient access to, and use of, the leased lines provided over public telecommunications networks, and the availability throughout the European Union (EU) of a minimum set of leased lines with harmonized technical characteristics.

The consequence of the Directive is that telecommunications organizations within the EU shall make available a set of leased lines between points in these countries with specified connection characteristics and specified interfaces. Under the Second Phase Directive (91/263/EEC), terminal equipment for connection to these leased lines will be required to fulfil certain essential requirements.

ETS 300 166 and CCITT Recommendation G.703 are used as the basis for the network interface presentation requirements.

Blank page

1 Scope

This ETS specifies the technical requirements and test principles for the network interface presentations of ONP 2 048 kbit/s digital leased lines using 120 Ω interfaces. This includes:

- the 2 048 kbit/s digital unstructured leased line; and
- the 2 048 kbit/s digital structured leased line with an information transfer rate of 1 984 kbit/s without restriction on binary content.

A connection is presented via interfaces at Network Termination Points (NTP). This ETS defines the network interface as presented by the leased line provider and should be used in conjunction with the appropriate companion standard, ETS 300 247 or ETS 300 419, specifying the connection characteristics between the NTPs of the leased line. This ETS and the appropriate connection characteristics standard together describe the technical characteristics of the leased line.

This ETS is applicable to leased lines, including part time leased lines, for which the establishment or release do not require any protocol exchange or other intervention at the NTP.

This ETS covers the physical, mechanical and electrical characteristics of the network interface and specifies the conformance tests for equipment of the kind that provides the interface presentation. Some of the tests described in this ETS are not designed to be applied to the interface of an installed leased line; such tests may be applied to equipment of the kind used to provide the interface. This ETS does not include details concerning the implementation of the tests nor does it include information on any regulations concerning testing. There is no requirement for each leased line to be tested in accordance with this ETS before it is brought into, or returned into, service.

2 Normative references

This ETS incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to, or revisions of any of these publications apply to this ETS only when incorporated into it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- [1] CCITT Recommendation G.703 (1991): "Physical/electrical characteristics of hierarchical digital interfaces".
- [2] CCITT Recommendation O.151 (1992): "Error performance measuring equipment for digital systems at the primary rate and above".
- [3] EN 60950 (1992): "Safety of information technology equipment including electrical business equipment".
- [4] ETS 300 046-4 (1992): "Integrated Services Digital Network (ISDN); Primary rate access - safety and protection Part 4: Interface I_b - safety".
- [5] ETS 300 046-5 (1992): "Integrated Services Digital Network (ISDN); Primary rate access - safety and protection Part 5: Interface I_b - protection".

NOTE: This ETS also contains a number of informative references which have been included to indicate the sources from which various material has been derived, hence they do not have an associated normative reference number. Details of these publications are given in annex C. In some cases the same publication may have been referenced in both a normative and an informative manner.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETS, the following definitions apply:

leased lines: The telecommunications facilities provided by a public telecommunications network that provide defined transmission characteristics between NTPs and that do not include switching functions that the user can control, (e.g. on-demand switching).

Network Termination Point (NTP): All physical connections and their technical access specifications which form part of the public telecommunications network and are necessary for access to and efficient communication through that public network.

PRBS(2¹⁵-1): A Pseudo Random Bit Sequence (PRBS) (as defined in subclause 2.1 of CCITT Recommendation O.151 [2]).

Safety Extra-Low Voltage (SELV) circuit: A secondary circuit which is so designed and protected that under normal and single fault conditions, the voltage between any two accessible parts and, for class 1 equipment, between any accessible part and the equipment protective earthing terminal does not exceed a safe value (subclause 1.2.8.5 of EN 60950 [3]).

terminal equipment: Equipment intended to be connected to the public telecommunications network, i.e.:

- to be connected directly to the termination of a public telecommunication network; or
- to interwork with a public telecommunications network being connected directly or indirectly to the termination of a public telecommunications network,

in order to send, process, or receive information.

3.2 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

AIS	Alarm Indication Signal
AMI	Alternate Mark Inversion
CRC-4	Cyclic Redundancy Check-4 bit
D2048S	2 048 kbit/s digital structured leased line
D2048U	2 048 kbit/s digital unstructured leased line
dc	direct current
EMC	ElectroMagnetic Compatibility
HDB3	High Density Bipolar code of order 3 (see annex B)
ISDN	Integrated Services Digital Network
NTP	Network Termination Point
ONP	Open Network Provision
ppm	parts per million
PRBS	Pseudo Random Bit Sequence
rms	root mean square
RX	RX is a signal input (at either the leased line interface or the test equipment, see figure 1)
SELV	Safety Extra-Low Voltage
TX	TX is a signal output (at either the leased line interface or the test equipment, see figure 1)

4 Requirements

These requirements define the network interface presentation for:

- the 2 048 kbit/s digital unstructured leased line (D2048U) which provides a bidirectional point-to-point digital connection with a usable bit rate of 2 048 kbit/s where timing is not provided from the network. The provision of circuit timing is the responsibility of the user. No structuring of the data is provided, or shall be required, by the network and any structuring is the responsibility of the user; and
- the 2 048 kbit/s digital structured leased line (D2048S) which provides a bidirectional point-to-point digital connection with an information transfer rate of 1 984 kbit/s without restriction on binary content. The frame structure in the 2 048 kbit/s bit stream is defined in ETS 300 419. Any structuring of the data within the transparent 1 984 kbit/s part of the frame is the responsibility of the user.

NOTE 1: The network interface is not designed for power feeding.

NOTE 2: If equipment providing the interface requires a mains supply, the leased line provider should bring this to the attention of the user so that the user can provide mains supply back-up facilities, if required.

4.1 Physical characteristics

The connection arrangements provided by the leased line interface shall be suitable for hardwired connection (see subclause 4.1.1); however, with the agreement of the user, an alternative means of connection, using a socket, may be provided (see subclause 4.1.2).

The transmit pair is the output from the network interface. The receive pair is the input to the network interface, as shown in figure 1. Where the terms "output" and "input" are used without qualification in this ETS, they refer to the network interface.

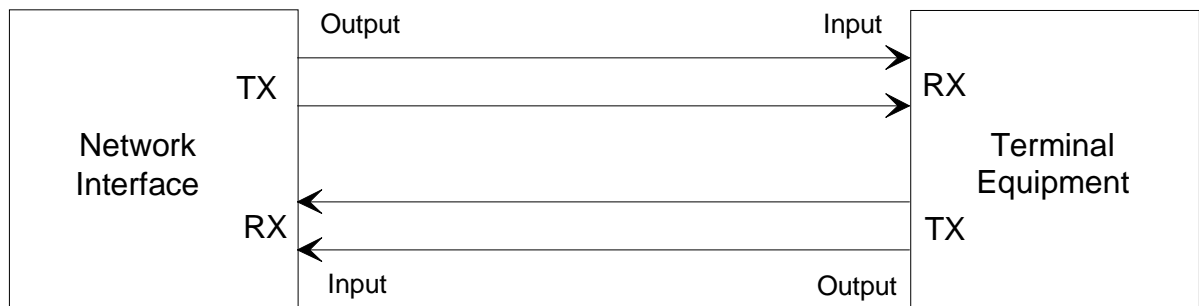


Figure 1

The use on the terminal equipment side of the interface of shielded cables may be necessary to meet radiation and immunity requirements defined in ElectroMagnetic Compatibility (EMC) standards. Therefore the NTP is required to provide a point for connection of the shield (see subclause 4.1.3).

4.1.1 Hardwired connection

Requirement: Where the leased line is being presented as a hardwired connection, the leased line interface shall provide a means of terminating wire with solid conductors having diameters in the range 0,4 mm to 0,6 mm. The leased line provider shall provide information on the configuration of the means of connection.

Test: There is no test. All subsequent tests are carried out via the specified connection method.

4.1.2 Socket specification

There is no constraint on the type of socket that may be used under this ETS.

NOTE: The intention is to specify the same socket as is specified for Integrated Services Digital Network (ISDN) primary rate access; however this approach is not practicable at present since connectors conforming to ISO/IEC 10173 are not available. A requirement to use the ISDN primary rate socket may be added to this ETS when such connectors are readily available.

4.1.3 Shield connection point

Requirement: The NTP shall provide a point, or points, to which the shield, or shields, of the cable on the terminal side of the interface can be connected.

NOTE: The purpose of these points is to provide a path from the shield to a common reference. The common reference point does not necessarily have to be earthed.

Test: There shall be a visual inspection that a point, or points, for connection of the shield, or shields, is provided.

4.2 Electrical characteristics

4.2.1 Output port

4.2.1.1 Signal coding

Requirement: The signal transmitted at the output port shall comply with the High Density Bipolar code of order 3 (HDB3) encoding rules (see annex B).

Test: The test shall be according to subclause A.2.1.

4.2.1.2 Waveform shape

Requirement: The pulse at the output port shall comply with the requirements given in table 1 and figure 2, based on CCITT Recommendation G.703.

Table 1: Waveform shape at output port

Pulse shape (nominally rectangular)	All marks of a valid signal shall conform with the mask (see figure 2) irrespective of the polarity. The value V corresponds to the nominal peak voltage of a mark.
Test load impedance	120 Ω non-reactive
Nominal peak voltage V of a mark	3 V
Peak voltage of a space	0 \pm 0,3 V
Nominal pulse width	244 ns
Ratio of the amplitudes of positive and negative pulses at the centre of the pulse interval	0,95 to 1,05
Ratio of the widths of positive and negative pulses at the nominal half amplitude	0,95 to 1,05

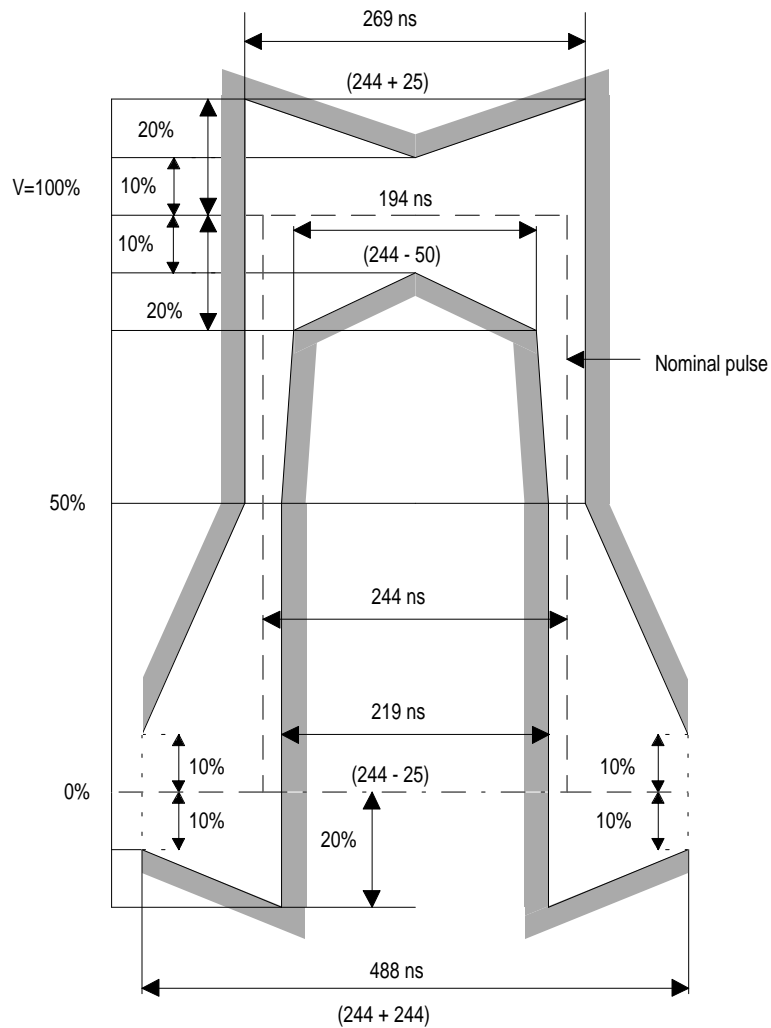


Figure 2: Pulse mask for 2 048 kbit/s pulse

Test: The test shall be according to subclause A.2.2.

4.2.1.3 Output timing under failure conditions

Requirement: When there is a failure within the network and if a signal is presented at the interface output (e.g. an Alarm Indication Signal (AIS)), the output timing shall be 2 048 kbit/s \pm 50 parts per million (ppm).

NOTE: AIS is encoded as a continuous stream of binary ONES. It is used to indicate a loss of capability in the direction from the network to the user. When an AIS signal is transmitted by the network interface, its timing may:

- not be derived from network timing in the case where the leased line should be providing network timing; or
- not be the timing provided by the user at the far end where the leased line should be carrying user timing.

Test: The test shall be according to subclause A.2.7.

4.2.1.4 Impedance towards ground

Requirement: The impedance towards ground of the output port shall be greater than 1 000 Ω for frequencies in the range 10 Hz to 1 MHz when measured with a sinusoidal test voltage of 2 V root mean square (rms). Ground (in this context) shall be the shield connection point defined in subclause 4.1.3.

NOTE: This requirement is included to allow transformerless implementations.

Test: The test shall be according to subclause A.2.6.

4.2.1.5 Output return loss

There are no requirements for output return loss under this ETS.

NOTE: A requirement for output return loss may be added to this ETS when appropriate specifications become available.

4.2.1.6 Output signal balance

There are no requirements for output signal balance under this ETS.

NOTE: The effects of the output signal imbalance are covered under the EMC Directive (89/336/EEC).

4.2.1.7 Output timing and jitter

NOTE: Output timing requirements and jitter limits for the leased line are specified in the appropriate connection standard, ETS 300 247 or ETS 300 419.

4.2.2 Input port

4.2.2.1 Signal coding

Requirement: The input port shall correctly decode HDB3 encoded signals without error in accordance with HDB3 encoding rules (see annex B).

Test: The test shall be according to subclause A.2.5.

4.2.2.2 Input return loss

Requirement: The input return loss with respect to 120 Ω at the interface shall be greater than or equal to the values given in table 2, which is taken from subclause 6.3.3 of CCITT Recommendation G.703.

Table 2: Input port minimum return loss

Frequency range		Return loss
51 kHz	to 102 kHz	12 dB
102 kHz	to 2 048 kHz	18 dB
2 048 kHz	to 3 072 kHz	14 dB

Test: The test shall be according to subclause A.2.3.

4.2.2.3 Input loss tolerance

Requirement: The input port shall correctly decode without errors a 2 048 kbit/s signal as defined in subclauses 4.2.1.1 and 4.2.1.2 above but modified by a cable or artificial cable with the following characteristics:

- attenuation that follows a \sqrt{f} law with values throughout the range 0 to 6 dB at 1 024 kHz; and

- characteristic impedance of 120 Ω with a tolerance of $\pm 20\%$ in the frequency range from 200 kHz up to, but not including, 1 MHz, and $\pm 10\%$ at 1 MHz.

Test: The test shall be according to subclause A.2.4.

4.2.2.4 Immunity against reflections

Requirement: When a signal comprising a combination of a normal signal and an interfering signal is applied to the input port, via an artificial cable with a loss in the range 0 dB to 6 dB at 1 MHz, no errors shall result due to the interfering signal.

The normal signal shall be a signal encoded according to HDB3, shaped according to the mask of figure 2 and with a binary content in accordance with a PRBS($2^{15}-1$).

The interfering signal shall be the same as the normal signal except that the level shall be attenuated by 18 dB, the bit rate shall be within 2 048 kbit/s ± 50 ppm and the timing shall not be synchronized to the normal signal.

Test: The test shall be according to subclause A.2.4.

4.2.2.5 Tolerable longitudinal voltages

Requirement: The receiver shall operate without errors with any input signal in the presence of a longitudinal voltage of magnitude 2 V rms over the frequency range 10 Hz to 30 MHz.

NOTE: This requirement is included to allow transformerless implementations.

Test: The test shall be according to subclause A.2.5.

4.2.2.6 Impedance towards ground

Requirement: The impedance towards ground of the input port shall be greater than 1 000 Ω for frequencies in the range 10 Hz to 1 MHz when measured with a sinusoidal test voltage of 2 V rms. Ground (in this context) shall be the shield connection point defined in subclause 4.1.3.

NOTE: This requirement is included to allow transformerless implementations.

Test: The test shall be according to subclause A.2.6.

4.2.2.7 Input timing and jitter tolerance

NOTE: Input timing and jitter tolerance of the leased line are specified in the appropriate connection standard, ETS 300 247 or ETS 300 419.

4.3 Safety

The tests associated with the requirements in this subclause are not suitable for use on installed leased lines. Such tests may be applied to equipment of the kind used to provide the interface.

4.3.1 General requirements

Requirement: The leased line interface shall comply with the requirements for accessible parts of a Safety Extra-Low Voltage (SELV) circuit.

NOTE: Designers should take into account the minimum impedance towards ground specified in this ETS.

Test: The test shall be conducted according to EN 60950 [3].

4.3.2 Touch current

This requirement recognizes the fact that the equipment providing the NTP may have a mains electricity supply interface. If the equipment providing the NTP does not have a mains supply, this requirement is not applicable.

For the purpose of the following requirement, the term referred to as I_b in ETS 300 046-4 [4] shall be deemed to be the point of test referred to in subclause A.1.2.

Requirement: The touch current measured across the leased line interface shall not exceed 0,25 mA.

Test: The test shall be according to subclause 5.3 of ETS 300 046-4 [4].

4.4 Overvoltage protection

Overvoltage protection shall be tested in accordance with the methods described in ETS 300 046-5 [5] as detailed below. The tests associated with these requirements are not suitable for use on installed leased lines. The compliance criteria for the overvoltage protection tests of subclauses 4.4.1 to 4.4.7 shall be:

The leased line interface shall operate properly within the limits of this specification after the test without:

- the need for resetting the fault protection facilities; or
- the need to change any hardware component; or
- reloading of data other than data of a type declared in the operating instructions to be unprotected data.

For the purpose of the following subclauses on protection, the term referred to as I_b in ETS 300 046-5 [5] shall be deemed to be the point of test referred to in subclause A.1.2.

4.4.1 Surge simulation, common mode

Requirement: The interface presentation shall meet the compliance criteria after 10 common mode surges of 1 kV (1,2/50 μ s) on the leased line interface.

Test: The test shall be according to subclause 5.5.1 of ETS 300 046-5 [5].

4.4.2 Surge simulation, transverse mode between transmit and receive pairs

Requirement: The interface presentation shall meet the compliance criteria after 10 transverse mode surges of 250 V (1,2/50 μ s) on the leased line interface between the transmit and receive pairs.

Test: The test shall be according to subclause 5.5.2 of ETS 300 046-5 [5].

4.4.3 Mains simulation, common mode

Requirement: If the interface presentation is supplied from the mains, the interface presentation shall meet the compliance criteria after 10 common mode surges of 2,5 kV (10/700 μ s).

Test: The test shall be according to subclause 5.6.1 of ETS 300 046-5 [5].

4.4.4 Mains simulation, transverse mode

Requirement: If the interface presentation is supplied from the mains, the interface presentation shall meet the compliance criteria after 10 transverse mode surges of 2,5 kV (10/700 μ s).

Test: The test shall be according to subclause 5.6.2 of ETS 300 046-5 [5].

4.4.5 Impulse transfer from mains, common mode

Requirement: If the interface presentation is supplied from the mains, it shall transfer less than 1 kV common mode voltage and less than 250 V transverse voltage to the leased line interface when a common mode surge of either polarity and of 2,5 kV (10/700 μ s) is applied to the mains supply port.

Test: The test shall be according to subclause 5.7.1 of ETS 300 046-5 [5].

4.4.6 Impulse transfer from mains, transverse mode

Requirement: If the interface presentation is supplied from the mains, it shall transfer less than 1 kV common mode voltage and less than 250 V transverse voltage to the leased line interface when a transverse mode surge of either polarity and of 2,5 kV (10/700 μ s) is applied to the mains supply port.

Test: The test shall be according to subclause 5.7.1 of ETS 300 046-5 [5].

4.4.7 Conversion of common mode to transverse mode

Requirement: The transverse mode voltage shall not be more than 250 V peak when 2 common mode surges of 1 kV (1,2/50 μ s) (one of each polarity) are applied to the leased line interface.

Test: The test shall be according to subclause 5.7.3 of ETS 300 046-5 [5].

4.4.8 Impulse transfer from auxiliary interface

For the purpose of this requirement, any interfaces on the equipment providing the leased line interface, except the leased line interface under test and the mains input themselves, shall be regarded as auxiliary interfaces.

There are no requirements on impulse transfer from auxiliary interfaces.

NOTE: Impulses may appear at the leased line interface due to impulse transfer from the network. This should normally be limited to less than 1 kV common mode voltage and 250 V transverse voltage. No requirements have been included within this ETS due to the variety of auxiliary interfaces that may occur and the different protection strategies adopted by network operators.

4.5 ElectroMagnetic Compatibility (EMC)

There are no EMC requirements under this ETS.

NOTE 1: EMC requirements are imposed under the EMC Directive (89/336/EEC). Requirements for conducted emissions and immunity to continuous conducted signals may be added to this ETS when appropriate specifications become available if these requirements are not imposed under the EMC Directive.

NOTE 2: It is recommended that the interface requirements should be met when the electromagnetic environment in which the equipment providing the NTP is placed does not exceed the limits defined in EN 50082-1.

Annex A (normative): Test methods

A.1 General

This annex describes the test principles to determine the compliance of a leased line interface against the requirements of this ETS. There is no requirement for each leased line to be tested in accordance with this ETS before it is brought into, or returned into, service. The tests in subclauses A.2.1, A.2.4, A.2.5 and A.2.7 are not designed for use on installed leased lines. Such tests may be applied to equipment of the kind used to provide the interface.

It is outside the scope of this ETS to identify the specific details of the implementation of the tests.

Details of test equipment accuracy and the specification tolerance of the test devices are not included in all cases. Where such details are provided they shall be complied with, but the way they are expressed shall not constrain the method of implementing the test.

NOTE: Attention is drawn to the issue of measurement uncertainty which may be addressed in future documents. Not all the required test results make allowance for spurious events during testing (e.g. errors due to EMC effects), which may make it necessary to repeat a test.

The test configurations given do not imply a specific realization of the test equipment or test arrangement, or the use of specific test devices. However any test configuration used shall provide those test conditions specified under "interface state", "stimulus" and "monitor" for each individual test.

The test equipment shall be a device, or group of devices, that is capable of generating a stimulus signal conforming to this ETS and capable of monitoring the signal received from the network interface.

A.1.1 Additional information to support the test

The following facilities shall be provided:

- a) an ability to configure the interface such that it provides a transparent loopback of the input to the output; and
- b) an ability to transmit a given bit pattern, e.g. PRBS($2^{15}-1$).

Where a) or b) cannot be provided, an alternative means of performing the test may be used.

NOTE: Where the leased line uses the E-bits to indicate errored sub-multiframes (see ETS 300 419), this may be used as an alternative to a transparent loopback in order to determine if data at the input has been correctly received.

A.1.2 Equipment connection

Testing shall be performed at the point of connection in accordance with subclause 4.1, as this is the point at which compliance with this ETS is required.

A.2 Test methods

One test may cover more than one requirement. The scope of each test is defined under the heading "purpose".

A.2.1 Signal coding at output port

Purpose: To verify that the signal coding at the leased line output port complies with the HDB3 coding rules as required by subclause 4.2.1.1.

Test configuration: Figure A.1.

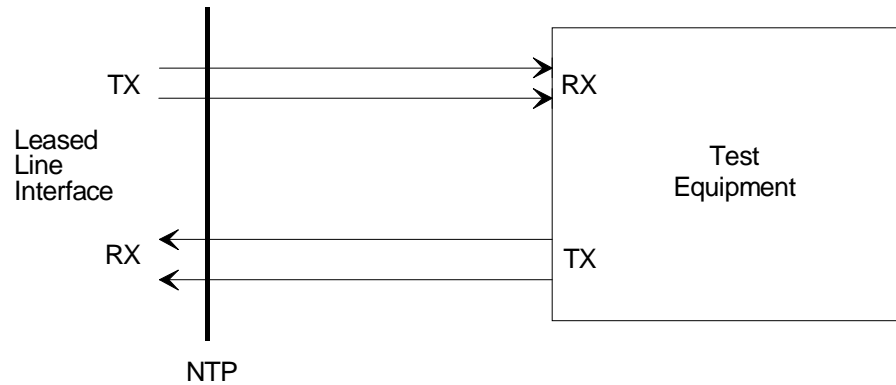


Figure A.1: Signal coding at output port

Interface state: Powered.

Stimulus: The leased line interface shall transmit a bit stream including the sequences <0000><even number of binary ONES><0000> and <0000><odd number of binary ONES><0000> which shall be encoded into HDB3; where 0 = space and 1 = mark input to the HDB3 encoder (see note).

Monitor: The output bit stream for a test period of sufficient time to allow transmission of 100 occurrences of the above patterns plus the latency period of the error detection mechanism.

Results: There shall be no errors in the HDB3 encoding.

NOTE: A pseudo random bit sequence, e.g. PRBS($2^{15}-1$), will be acceptable if the bit patterns of the above subclause are included in the bit stream. For equipment which can generate a framed signal in accordance with CCITT Recommendation G.704, the PRBS may be transmitted in bits 9 to 256 of the frame. For equipment which cannot generate such a framed signal, the PRBS should be transmitted in the whole bit stream.

A.2.2 Waveform shape at output port

Purpose: To verify conformance of the output waveform shape with the requirements of subclause 4.2.1.2.

Test configuration: Figure A.2.

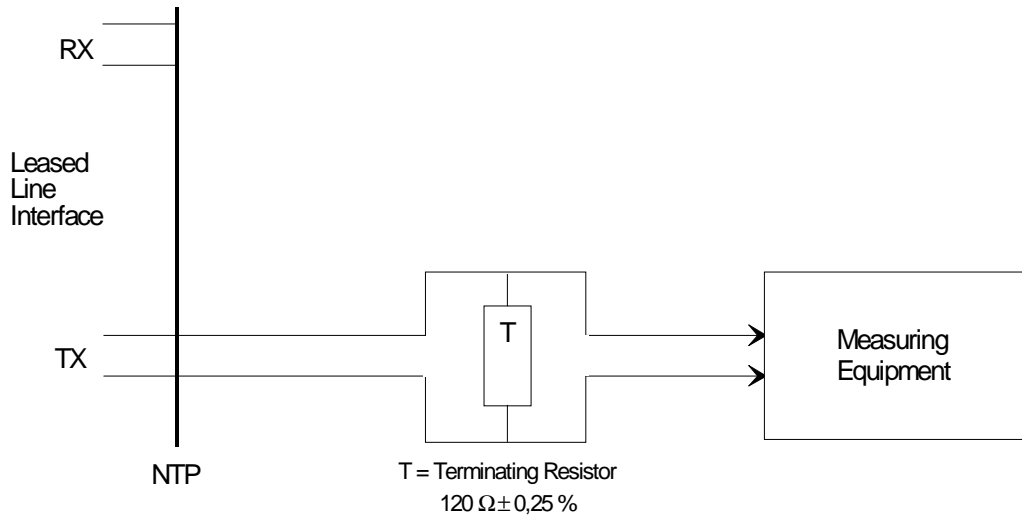


Figure A.2: Waveform shape at output port

Interface state: Powered.

Stimulus: Undefined.

Monitor: Marks and spaces transmitted from the NTP, measuring the amplitude and shape of positive and negative pulses (measured at the centre of the pulse interval) and the time duration of positive and negative pulses (measured at the nominal half of the pulse amplitude, i.e. 1,5 V).

The overall measurement accuracy shall be better than 90 mV. All the measurements shall be performed using measuring equipment capable of recording direct current (dc). A bandwidth of 200 MHz or greater shall be used to ensure the capture of over or undershoot of the pulse.

Results: Both positive and negative pulses shall be within the mask of figure 2, where $V = 100\%$ shall be 3 V.

The bit interval corresponding to a space shall not present voltages higher than $\pm 0,3$ V.

The ratio between the amplitude of positive and negative pulses shall be in the range from 0,95 to 1,05.

The ratio between the pulse widths of positive and negative pulses shall be in the range from 0,95 to 1,05.

A.2.3 Return loss at input port

Purpose: To verify the return loss of the input port of the leased line interface complies with the requirements of subclause 4.2.2.2.

Test configuration: Figure A.3.

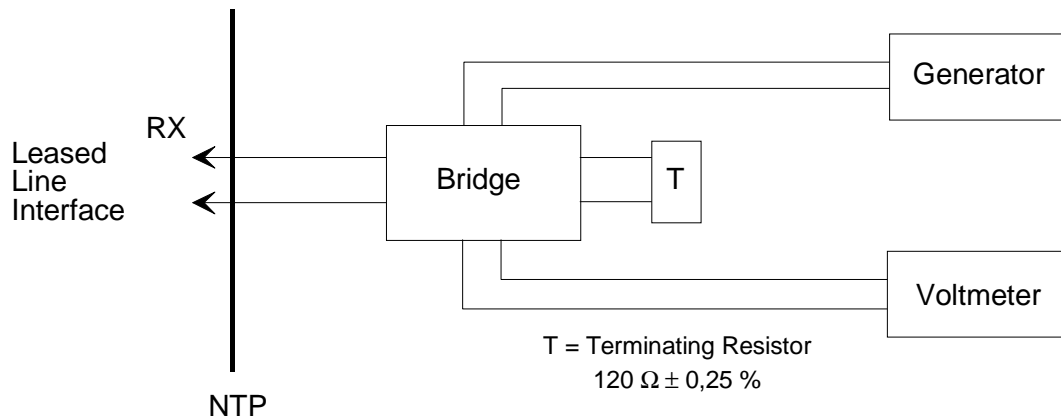


Figure A.3: Return loss at input port

Interface state: Powered.

Stimulus: Sinusoidal signal of 3 V peak at the input to the network interface with a frequency variable between 51 kHz and 3 072 kHz.

Monitor: Voltage measured across the bridge, representing a terminating resistor of 120 Ω, using a selective voltmeter with a bandwidth of less than 1 kHz.

Results: The measured return loss shall be greater than or equal to the values specified in subclause 4.2.2.2.

NOTE: The characteristics of the generator and of the voltmeter may be different depending on the implementation of the bridge however the total error of the test set-up should be less than 0,5 dB in the range between 10 dB and 20 dB. When connected to a 120 Ω ± 0,25 % resistor the measured return loss of the bridge should be 20 dB higher than the limits specified for the interface.

A.2.4 Input loss tolerance and immunity against reflections

Purpose: To verify the input port immunity against an interfering signal combined with the input signal, as specified in subclause 4.2.2.4, both without cable (i.e. 0 dB attenuation loss) and with a cable attenuation of 6 dB as specified in subclause 4.2.2.3.

Test configuration: Figure A.4.

The interfering signal shall be combined with the main signal in a combining network of impedance 120 Ω, with zero dB loss in the main path and an attenuation in the interference path of 18 dB.

The cable simulator shall have an attenuation of 6 dB measured at 1 024 kHz and an attenuation characteristic that follows a \sqrt{f} law over the frequency range 100 kHz to 10 MHz.

The conformance of the interface shall be verified in the following test conditions:

- without cable simulator and without interfering signal; and
- with cable simulator and without interfering signal; and
- without cable simulator and with interfering signal; and

- with cable simulator and with interfering signal.

The test shall be repeated with the wires at the network interface input (RX) reversed.

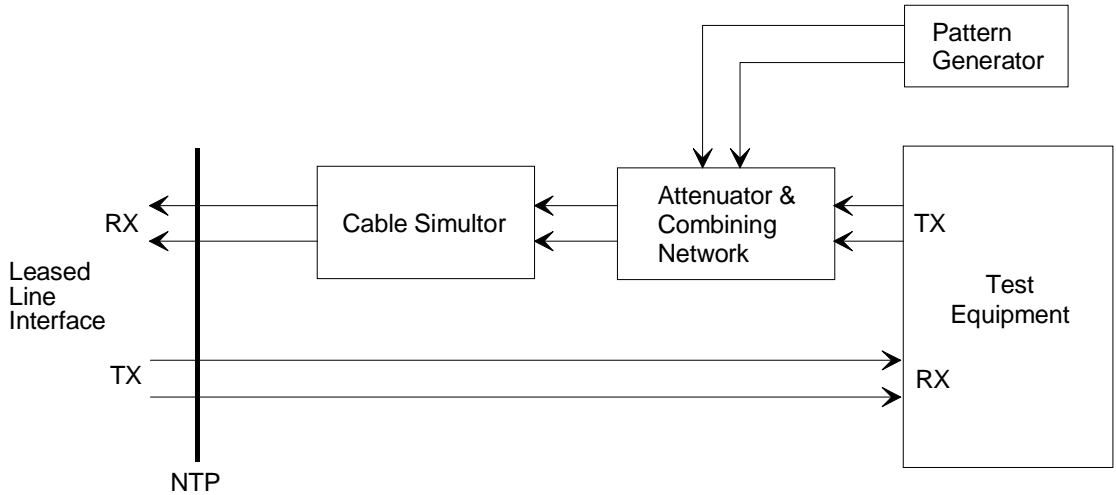


Figure A.4: Immunity against reflections

Interface state: Powered, with received data looped back to the output port.

Stimulus: The output signal of the test equipment shall be HDB3 encoded and conform to a pulse shape as defined in figure 15 of CCITT Recommendation G.703 [1], which is reproduced in figure 2 of this ETS. The binary content shall be a PRBS(2¹⁵-1). The bit rate shall be within the limits 2 048 kbit/s ± 50 ppm.

If it is necessary for the correct operation of the leased line interface, the bit stream may be synchronous to the network interface output and/or structured into frames, with the Cyclic Redundancy Check-4 bit (CRC-4), according to ETS 300 419. Within the frames not containing the frame alignment signal, bit 3 (Remote Alarm Indication (RAI)) shall be set to 0 and bits 4 to 8 (S_{a4} to S_{a8}) shall be set to 1. The binary content of the data contained in bits 9 to 256 of the frame shall be a PRBS(2¹⁵-1).

The interfering signal from the pattern generator shall:

- be HDB3 encoded and conform to a pulse shape as defined in figure 15 of CCITT Recommendation G.703 [1], which is reproduced in figure 2 of this ETS; and
- have a binary content with a PRBS(2¹⁵-1); and
- have a nominal bit rate of 2 048 kbit/s, not synchronized to the output signal of the test equipment.

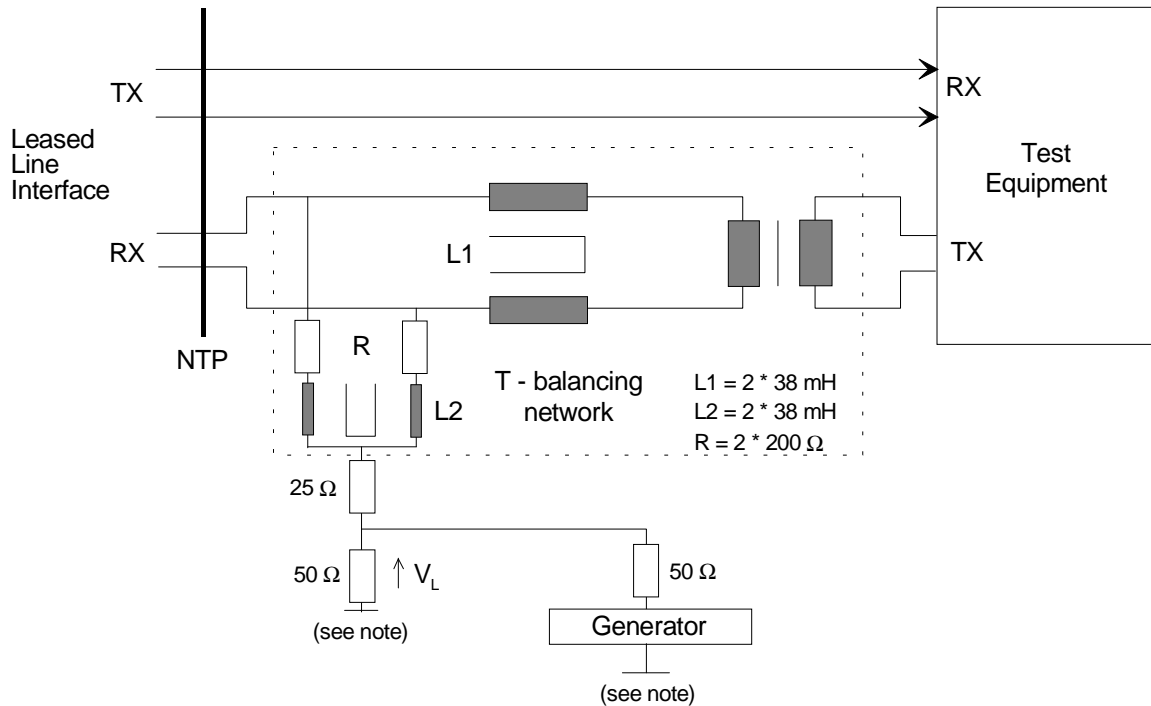
Monitor: Data at output port.

Results: There shall be no bit errors for at least one minute.

A.2.5 Tolerable longitudinal voltage and HDB3 input coding

Purpose: To verify the minimum tolerance to longitudinal voltages at the input of the leased line, as specified in subclause 4.2.2.5, and correct recognition of HDB3 code as specified in subclause 4.2.2.1.

Test configuration: Figure A.5.



NOTE: Ground (in this context) shall be the shield connection point defined in subclause 4.1.3.

Figure A.5: Tolerable longitudinal voltage and HDB3 input coding

Interface state: Powered, with received data looped back to the output port.

Stimulus: The output signal of the test equipment shall be HDB3 encoded and conform to a pulse shape as defined in figure 15 of CCITT Recommendation G.703 [1], which is reproduced in figure 2 of this ETS. The binary content shall be a PRBS(2¹⁵-1).

If it is necessary for the correct operation of the leased line interface, the bit stream may be synchronous to the network interface output and/or structured into frames, with the CRC-4, according to ETS 300 419. Within the frames not containing the frame alignment signal, bit 3 (remote alarm indication) shall be set to 0 and bits 4 to 8 (S_{a4} to S_{a8}) shall be set to 1. The binary content of the data contained in bits 9 to 256 of the frame shall be a PRBS(2¹⁵-1).

A longitudinal voltage V_L of 2 V rms, ± 20 mV with a frequency variable between 10 Hz and 30 MHz shall be applied for a minimum of 2 seconds.

Monitor: Data at the output port of the leased line.

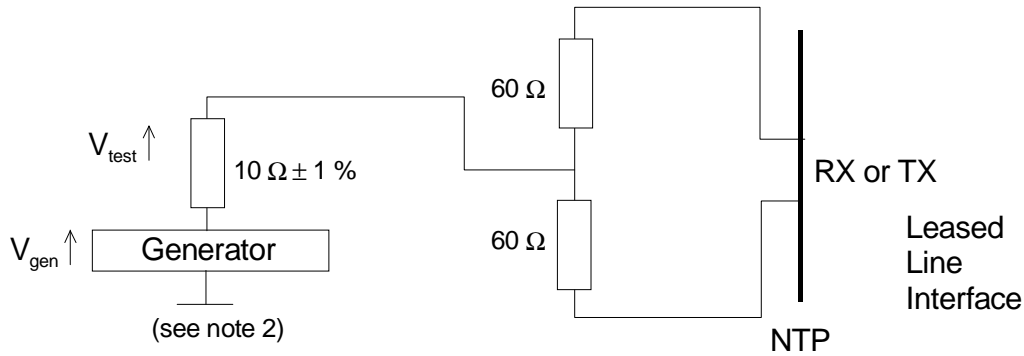
Results: There shall be no bit errors in the PRBS received from the leased line.

NOTE: The inherent longitudinal conversion loss of the T-balancing network should be greater than 30 dB.

A.2.6 Impedance towards ground

Purpose: To verify the leased line interface input and output ports impedance towards ground as specified in subclauses 4.2.1.4 and 4.2.2.6.

Test configuration: Figure A.6.



NOTE 1: The $60\ \Omega$ resistors should be within 1 % and matched to better than 0,1 %.

NOTE 2: Ground (in this context) shall be the shield connection point defined in subclause 4.1.3.

Figure A.6: Impedance towards ground

Interface state: Powered.

Stimulus: Sinusoidal test signal (V_{gen}) of 2 V rms, ± 20 mV applied over the frequency range 10 Hz to 1 MHz.

Monitor: Voltage of V_{test} .

Results: Voltage V_{test} shall be less than 19,2 mV rms.

A.2.7 Output timing under failure conditions

Purpose: To measure the output timing if an output signal is present under network failure conditions as specified in subclause 4.2.1.3.

Test Configuration: Figure A.7.

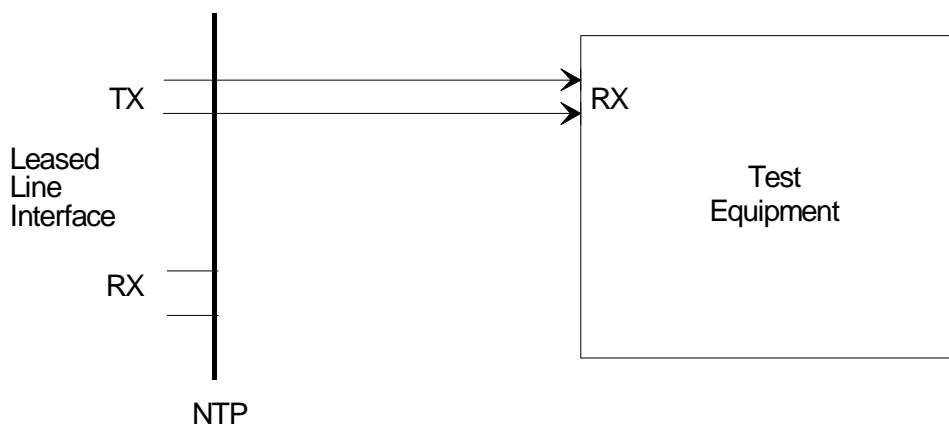


Figure A.7: Output timing under network failure conditions

Interface state: Powered.

Stimulus: The interface shall be configured to provide whatever signal is provided under network failure conditions, e.g. AIS.

Monitor: The output bit rate from the leased line interface.

Results: The output bit rate shall be within the limits of 2 048 kbit/s ± 50 ppm.

Annex B (normative): Definition of HDB3 code

B.1 General

This annex specifies the modified Alternate Mark Inversion (AMI) code HDB3. The contents of this annex are based on annex A of CCITT Recommendation G.703.

In this code, binary 1 bits are represented by alternate positive and negative pulses, and binary 0 bits by spaces. Exceptions are made when strings of successive 0 bits occur in the binary signal.

In the definition below, B represents an inserted pulse corresponding to the AMI rule, and V represents an AMI violation.

B.2 Definition

Each block of 4 successive zeros is replaced by 000V or B00V. The choice of 000V or B00V is made so that the number of B pulses between consecutive V pulses is odd. In other words, successive V pulses are of alternate polarity so that no dc component is introduced.

Annex C (informative): Bibliography

- 89/336/EEC: "Council Directive of 3 May 1989 on the approximation of the laws of Member States relating to electromagnetic compatibility".
- 91/263/EEC: "Council Directive of 29 April 1991 on the approximation of the laws of Member States concerning telecommunications terminal equipment, including the mutual recognition of their conformity".
- 92/44/EEC: "Council Directive of 5 June 1992 on the application of Open Network Provision to leased lines".
- CCITT Recommendation G.704 (1991): "Synchronous frame structures used at primary and secondary hierarchical levels".
- EN 50082-1 (1992): "Electromagnetic compatibility generic immunity standard; Generic standard class: Domestic, commercial and light industry".
- ETR 012 (1992): "Terminal Equipment (TE); Safety categories and protection levels at various interfaces for telecommunication equipment in customers premises".
- ETS 300 166 (1993): "Transmission and multiplexing; Physical and electrical characteristics of hierarchical digital interfaces for equipment using the 2 048 kbit/s-based plesiochronous or synchronous digital hierarchies".
- ETS 300 247 (1993): "Open Network Provision (ONP) technical requirements; 2 048 kbit/s digital unstructured leased line (D2048U); Connection characteristics".
- ETS 300 248 (1993): "Open Network Provision (ONP) technical requirements; 2 048 kbit/s digital unstructured leased line (D2048U); Terminal equipment interface".
- ETS 300 419: "Business TeleCommunications (BTC); 2 048 kbit/s digital structured leased line (D2048S); Connection characteristics".
- ETS 300 420: "Business TeleCommunications (BTC); 2 048 kbit/s digital structured leased line (D2048S); Terminal equipment interface".
- ISO/IEC 10173 (1991): "Information technology - Integrated Services Digital Network (ISDN) primary access connector at reference points S and T".

History

Document history	
November 1995	First Edition
February 1996	Converted into Adobe Acrobat Portable Document Format (PDF)